

**Handheld pH/ORP/Dissolved Oxygen Meter
LAQUAact-PD110**

Instruction Manual

CODE:GZ0000427800

Preface

This manual describes the operation of the Handheld pH/ORP/Dissolved Oxygen Meter LAQUAact-PD110.

Be sure to read this manual before using the product to ensure proper and safe operation of the product. Also safely store the manual so it is readily available whenever necessary.

Product specifications and appearance, as well as the contents of this manual are subject to change without notice.

■ Warranty and responsibility

HORIBA, Ltd. warrants that the Product shall be free from defects in material and workmanship and agrees to repair or replace free of charge, at option of HORIBA, Ltd., any malfunctioned or damaged Product attributable to responsibility of HORIBA, Ltd. for a period of two (2) year from the delivery unless otherwise agreed with a written agreement. In any one of the following cases, none of the warranties set forth herein shall be extended;

- Any malfunction or damage attributable to improper operation
- Any malfunction attributable to repair or modification by any person not authorized by HORIBA, Ltd.
- Any malfunction or damage attributable to the use in an environment not specified in this manual
- Any malfunction or damage attributable to violation of the instructions in this manual or operations in the manner not specified in this manual
- Any malfunction or damage attributable to any cause or causes beyond the reasonable control of HORIBA, Ltd. such as natural disasters
- Any deterioration in appearance attributable to corrosion, rust, and so on
- Replacement of consumables

HORIBA, LTD. SHALL NOT BE LIABLE FOR ANY DAMAGES RESULTING FROM ANY MALFUNCTIONS OF THE PRODUCT, ANY ERASURE OF DATA, OR ANY OTHER USES OF THE PRODUCT.

■ Trademarks

- Microsoft, Windows are registered trademarks or trademarks of Microsoft Corporation in the United States and other countries.

Other company names and brand names are either registered trademarks or trademarks of the respective companies. (R), (TM) symbols may be omitted in this manual.

Regulations

■ Conformable Directive

This equipment conforms to the following directives and standards:



| | |
|----------------|---|
| EMC: | EN61326-1 Class B, Basic electromagnetic environment |
| Safety: | EN61010-1 |
| RoHS: | EN50581 9. Monitoring and control instruments |

Warning: This product is not intended for use in industrial environments. In an industrial environment, electromagnetic environmental effects may cause the incorrect performance of the product in which case the user may be required to take adequate measures.

● Installation Environment

This product is designed for the following environment.

- Overvoltage Category II
- Pollution degree 2

● Information on disposal of electrical and electronic equipment and disposal of batteries and accumulators

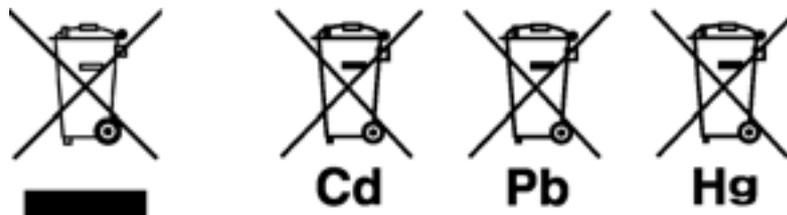
The crossed out wheeled bin symbol with underbar shown on the product or accompanying documents indicates the product requires appropriate treatment, collection and recycle for waste electrical and electronic equipment (WEEE) under the Directive 2012/19/EU, and/or waste batteries and accumulators under the Directive 2006/66/EC in the European Union.

The symbol might be put with one of the chemical symbols below. In this case, it satisfies the requirements of the Directive 2006/66/EC for the object chemical.

This product should not be disposed of as unsorted household waste.

Your correct disposal of WEEE, waste batteries and accumulators will contribute to reducing wasteful consumption of natural resources, and protecting human health and the environment from potential negative effects caused by hazardous substance in products.

Contact your supplier for information on applicable disposal methods.



● Authorised Representative in EU

HORIBA UK Limited
2 Dalston Gardens, Stanmore, Middx HA7 1BQ, UK

Regulations

■ FCC rules

Any changes or modifications not expressly approved by the party responsible for compliance shall void the user's authority to operate the equipment.

●WARNING

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

■ Korea certification

●B급 기기 (가정용 방송통신기자재)

이 기기는 가정용(B 급) 전자파적합기기로서 주로 가정에서 사용하는 것을 목적으로 하며, 모든 지역에서 사용할 수 있습니다.

■ Taiwan battery recycling mark



For your safety

■ Hazard classification and warning symbols

Warning messages are described in the following manner. Read the messages and follow the instructions carefully.

● Hazard classification



This indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This is to be limited to the most extreme situations.



This indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



This indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

● Warning symbols



Description of what should be done, or what should be followed



Description of what should never be done, or what is prohibited

For your safety

■ Safety precautions

This section provides precautions for using the product safely and correctly and to prevent injury and damage. The terms of DANGER, WARNING, and CAUTION indicate the degree of imminency and hazardous situation. Read the precautions carefully as it contains important safety messages.

● Instrument and electrode

|  WARNING | |
|--|---|
|  | Do not use an unspecified AC adapter. Otherwise, it may heat up or be ignited resulting in a fire or an accident. |
|  | Do not disassemble or modify the instrument. Otherwise, it may heat up or be ignited resulting in a fire or an accident. |

|  CAUTION | |
|--|---|
|  | Harmful chemicals The internal solution of DO electrodes is highly potassium hydroxide (KOH). If the internal solution comes in contact with the skin, wash it off immediately. If it gets into eyes, flush with plenty of water and then consult a doctor. |
|  | Harmful chemicals The internal solution of pH electrode is highly concentrated potassium chloride (3.33 mol/L KCl). If the internal solution comes in contact with the skin, wash it off immediately. If it gets into the eyes, flush with plenty of water and then consult a doctor. |
|  | Broken glass Broken glass may cause injury. The outer tube and tip of an electrode are made of glass. Handle them with care. |
|  | Do not use the RS-232C communication and the AC adapter under wet or humid conditions. Otherwise, it may cause a fire, electric shock, or breakage. |

For your safety

● Battery



WARNING



Keep batteries out of reach of children. If someone accidentally swallows a battery, consult a doctor immediately.



If alkaline fluid from a battery gets into the eyes, do not rub the eyes, rinse with clean water immediately and then consult a doctor.
Contact with alkaline fluid could cause blindness.



Do not put batteries in a fire, expose to heat, disassemble or remodel.
Doing so could cause fluid leakage, overheating or explosion.



CAUTION



Do not remove or scratch the external label of the battery.
Doing so could cause injury to hands and fingers.

■ Product handling information

● Operational precautions (instrument)

- Only use the product including accessories for their intended purpose.
- The function that measuring dissolved oxygen of the instrument is only usable for measuring under water. Do not use this function for the application except described above.
- Do not drop, crash, or give any physical impact on the instrument.
- The instrument is made of solvent-resistant materials but that does not mean it is resistant to all chemicals. Do not dip the instrument in strong acid or alkali solution, or wipe with such solution.
- If the instrument is dropped into water or gets wet, wipe it using soft cloth. Do not heat to dry it with a hair-dryer (or the like).
- The instrument has a dust-proof and waterproof structure. Waterproof performance is following specification: the instrument does not malfunction even when immersed in water of 1 m depth for 30 minutes.
This does not mean to guarantee non-destructive, trouble-free, dust-proof, and waterproof performance in all situations. If the instrument is correctly handled according to the descriptions in this manual, the instrument provides dust-proof and waterproof performance.
- When replacing the batteries with an AC adapter or a serial cable connected, the instrument does not have the dust-proof and waterproof performance. The dust-proof and waterproof performance is maintained only when the covers are attached correctly.
- After replacing the batteries with an AC adapter or a serial cable connected, make sure that the waterproof packing attached to each cover is not deformed or discolored, or has foreign matter adhering to it. If the waterproof packing is deformed, discolored or has foreign matter adhering to it, or dust could get inside, water leaks could occur that could lead to instrument malfunction.
- To disconnect an electrode, AC adapter cable or serial cable, hold the connector and pull it off. If you pull at the cable, it may cause a breakage.
- The RS-232C communication between the instrument and a personal computer (referred to as PC in the rest of this document) may fail because of environmental conditions, such as (radio/electromagnetic) noise.
- Do not replace the batteries in a dusty place or with wet hands while an AC adapter or a serial cable is connected. Dust or moisture could get inside the instrument, possibly causing instrument malfunction.
- Do not use the tip of a nail or an object with a sharp end to press the keys.

For your safety

- If the power supply is interrupted while measurement data is being saved in the instrument, the data could be corrupted.
- A Ni–MH rechargeable battery can be used in this instrument, but the battery used in the instrument cannot be charged using the AC adapter.

● Operational precautions (battery)

- Do not short circuit a battery.
- Set the + and – side of the battery correctly.
- When the battery has run out or the instrument will not be used for a long time, remove the batteries.
- Of the specified battery types, make sure to use two batteries of the same type.
- Do not use a new battery together with a used battery.
- Do not use a fully charged nickel-metal hydride battery together with a partially charged battery.
- Do not attempt to charge a non-rechargeable battery.

● Environmental conditions for use and storage

- Temperature: 0°C to 45°C
- Humidity: under 80% in relative humidity and free from condensation

Avoid the following conditions.

- Strong vibration
- Direct sunlight
- Corrosive gas environment
- Close to an air-conditioner
- Direct wind

● Transportation

When transporting the instrument, repackage it in the original package box. Otherwise, it may cause instrument breakage.

● Disposal

- Standard solution used for the calibration must be under neutralized before the disposal.
- When disposing of the product, follow the related laws and/or regulations of your country for disposal of the product.

Manual information

■ Description in this manual

Note

This interprets the necessary points for correct operation and notifies the important points for handling the product.

Reference

This indicates the part where to refer for information.

Tip

This indicates reference information.

MEMO



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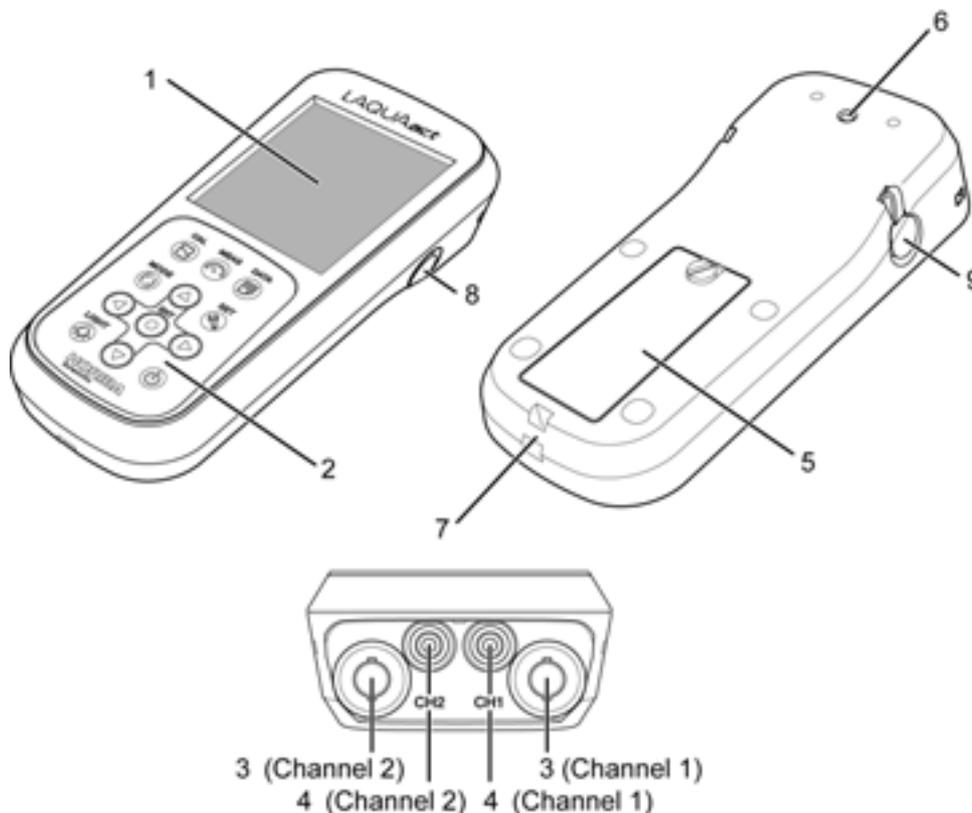
Part names and basic operation

This section describes the name of each part and the main role, function, and basic operation method of each part.

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■ Names of each part

● Instrument



| No. | Name | Function |
|-----|-----------------------------------|--|
| 1 | Display | Displays the measured value and set value and so on. |
| 2 | Operation keys | Used for instrument operation. |
| 3 | Electrode connector | Connects the BNC connector of the electrode. |
| 4 | Temperature connector (T) | Connects the temperature connector (T) of the electrode. |
| 5 | Battery cover | Set batteries inside. |
| 6 | Electrode hook attachment section | Attach the electrode hook to carry with instrument. |
| 7 | Strap attachment section | Attach a strap. |
| 8 | Serial connector | Connects the serial cable and printer cable. |
| 9 | AC adapter jack | Connects an optional AC adapter. |

- **Identification of manufacturing date**

Manufacturing date can be identified from MFG No. described in the ID label on the backside of the instrument.

Third number from the left in the MFG No. indicates manufacturing year.

Fourth alphabet from the left in the MFG No. indicates manufacturing month.

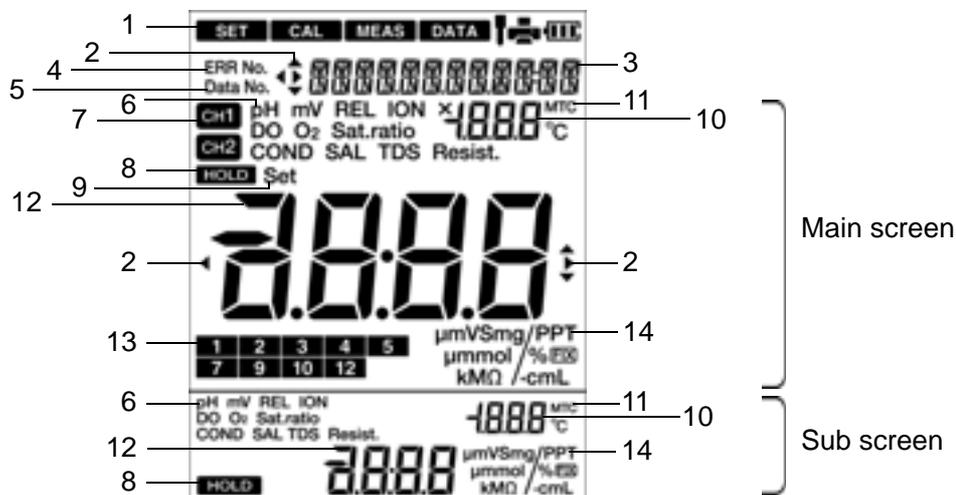
The alphabet is assigned to month according to the table below.

Ex.: ID: AA6A0000 means the device manufactured in 2016 January.

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| A | B | C | D | E | F | G | H | J | K | L | M |

● Display

Two electrodes can be connected to measure two parameters at the same time with this instrument. The display is divided into the main screen and the sub screen, and you can select the channel displayed on the main screen. The selected channel can be identified with an icon.



| No. | Name | Function |
|-----|---------------------------------------|---|
| 1 | Status icon | Displays the current operation mode, electrode status, printer or PC connection status, and remaining battery level. |
| 2 | Direction key icon | Displays the currently available direction key. |
| 3 | Date and time, set item display area | Displays the current date and time and the set items. |
| 4 | ERR No. icon | Displays an error No. |
| 5 | Data No. icon | Displays the data No. |
| 6 | Measurement parameter display area | Displays the currently set measurement parameter. This is displayed in the main screen and the sub screen, respectively. |
| 7 | Main screen channel icon | Displays the channel of the main screen. |
| 8 | HOLD icon | Lights when the measured value display is fixed. This is displayed in the main screen and the sub screen, respectively. |
| 9 | SET icon | Lights when numerical values are entered. |
| 10 | Temperature display area | Displays the measured and the set temperature. This is displayed in the main screen and the sub screen, respectively. |
| 11 | MTC icon | Lights when the temperature setting is MTC (optional temperature setting). This is displayed in the main screen and the sub screen, respectively. |
| 12 | Measured value, set item display area | Displays the measured value and the set value. This is displayed in the main screen and the sub screen, respectively. |

| No. | Name | Function |
|-----|--|---|
| 13 | Standard solution calibration history icon | When calibrating with pH standard solution, the corresponding icon lights. |
| 14 | Unit display area | Displays the unit for the measurement parameter and the display item. This is displayed in the main screen and the sub screen, respectively. |

• Battery level display



Battery level is high.



Battery level is a little lower.

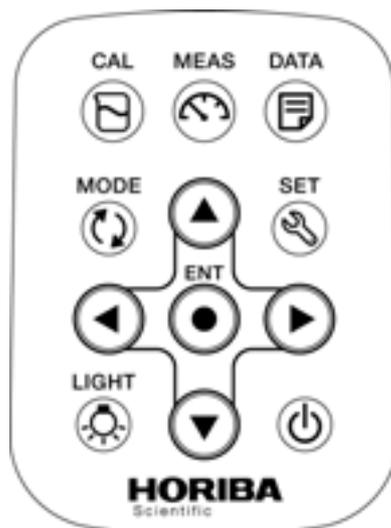


Battery level is low.
The backlight may become unavailable.



Battery has run out. Replace the batteries or use AC adapter (option).
"ERR No. 0002" is displayed and operation is disabled.

● Operation key



| Key | Name | Function |
|-----|-----------|--|
| | MEAS key | Changes the operation mode to the measurement mode during operation in a different mode. Releases the fixed measurement value mode in the auto hold mode. |
| | CAL key | Changes from the measurement mode to the calibration mode. Start calibration in the calibration mode. |
| | DATA key | Changes from the measurement mode to the data mode. |
| | SET key | Changes from the measurement mode to the setting mode. Starts repeatability inspection after calibration is complete. |
| | POWER key | Turns ON/OFF the power of instrument. |
| | MODE key | In the measurement mode, changes measurement parameters. |
| | LIGHT key | Turns on/off the backlight. |
| | ENTER key | Determines the selection or setting. Save data in the measurement mode and calibration mode. |
| | UP key | In the measurement mode, switches the display between the main screen and the sub screen. Changes the selected item. |
| | DOWN key | Changes the number of the selected digit when entering numbers. |
| | LEFT key | Changes the selected item. |
| | RIGHT key | Changes the selected digit when entering numbers. |

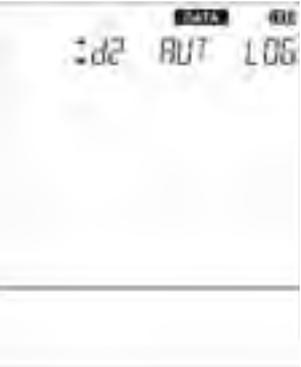
■ Basic operation

● Function layer

The function layer of the data mode and setting mode is shown as below.

"dX" and "PXX" indicates the program number which is shown in the screen of the instrument.

• Data mode

| Screen | Layer | Description |
|---|--------------|-----------------------------|
|  | d1: DATA OUT | Saved data display |
|  | d2: AUT LOG | Automatic data save setting |
|  | d3: DATA CLR | Deletion of saved data |

• **Setting mode**

<Channel 1>

| Screen | Layer | Description |
|---|---------------|--|
|  | P1: PH | pH measurement settings |
| | P11: BUF | Selection of standard solution type for calibration: USA, NIST, CUST |
| | P12: CAL DATA | Calibration data display |
| | P13: CAL ALR | Calibration alarm setting: 1 day to 400 days |
| | P14: CAL CLR | Deletion of calibration data |
|  | P2: TEMP | Temperature setting |
| | | Selection of temperature conversion or display : ATC, MTC |
|  | P3: GEN | General settings |
| | P31: MEAS | Selection of auto hold type: auto stability, auto hold |
| | P32: AUTO OFF | Automatic power off setting: 0 min to 30 min |
| | P33: RESET | Initialization of settings |
| | P34: DATE | Date and time setting |
| | P35: PRINT | Test print |

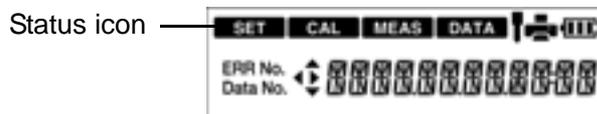
<Channel 2>

| Screen | Layer | Description |
|---|---------------|---|
|  | P1: DO | DO measurement settings |
| | P11: SAL | Salinity correction setting |
| | P12: PRES KPA | Air pressure correction setting |
| | P12: CAL DATA | Calibration data display |
| | P14: CAL CLR | Deletion of calibration data |
|  | P2: TEMP | Temperature setting |
| | | Selection of temperature conversion or display : ATC, MTC |
|  | P3: GEN | General settings |
| | P31: MEAS | Selection of auto hold type: auto stability, auto hold |
| | P32: AUTO OFF | Automatic power off setting: 0 min to 30 min |
| | P33: RESET | Initialization of settings |
| | P34: DATE | Date and time setting |
| | P35: PRINT | Test print |

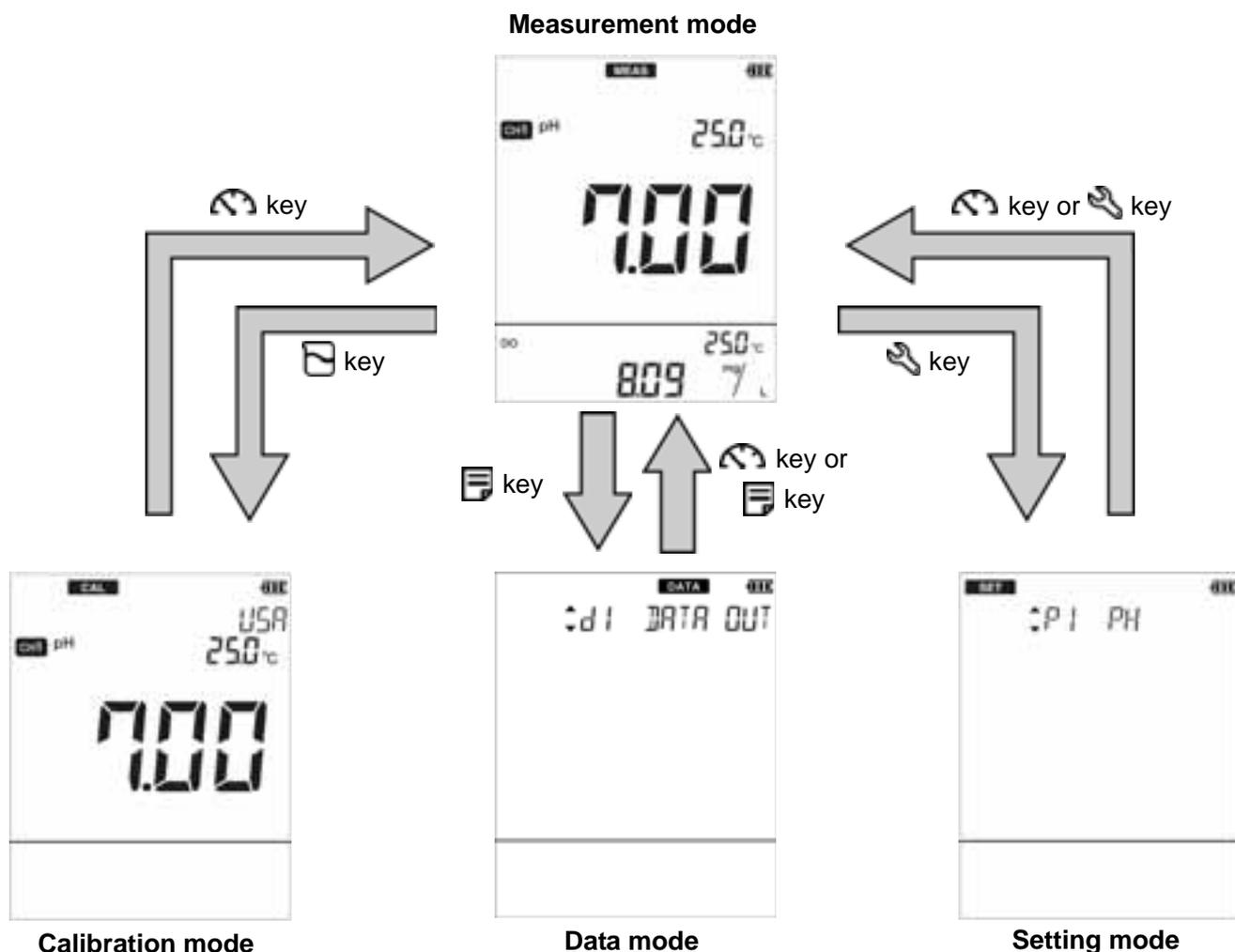
● Changing the operation mode

Change the operation mode from four available modes depending on the purpose of use. The status icon indicates the current mode.

You can change the operation mode using the corresponding key. However changing to the calibration mode, data mode, or setting mode is possible only from the measurement mode. When changing to a different mode, first change to the measurement mode and then change to the desired mode.



| Icon | Name | Function |
|-------------|------------------|---|
| MEAS | Measurement mode | Performs measurement. |
| CAL | Calibration mode | Performs calibration. |
| DATA | Data mode | Performs data settings. Displays the saved data. |
| SET | Setting mode | Performs various settings. |

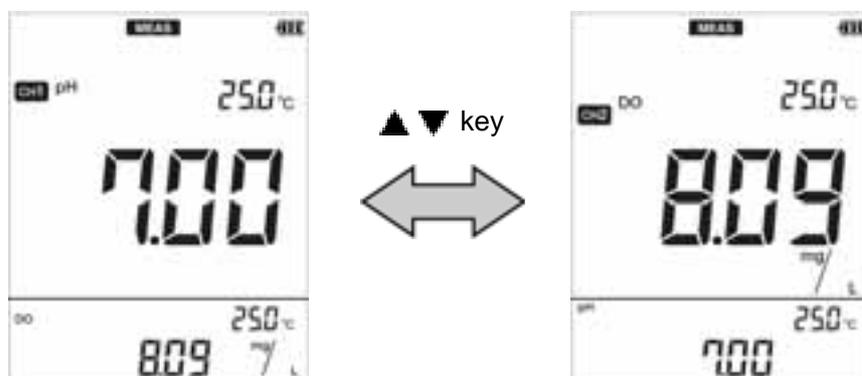


● Switching the displays

Switch the channel between the main screen and the sub screen.

In the measurement mode, pressing the ▲▼ key can switch the channels between the main screen and the sub screen.

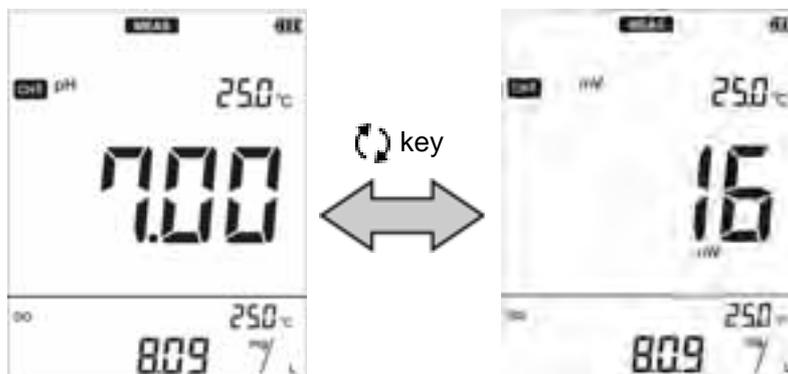
When performing calibration or setting, switch the display to show the desired channel (measurement parameter) on the main screen.



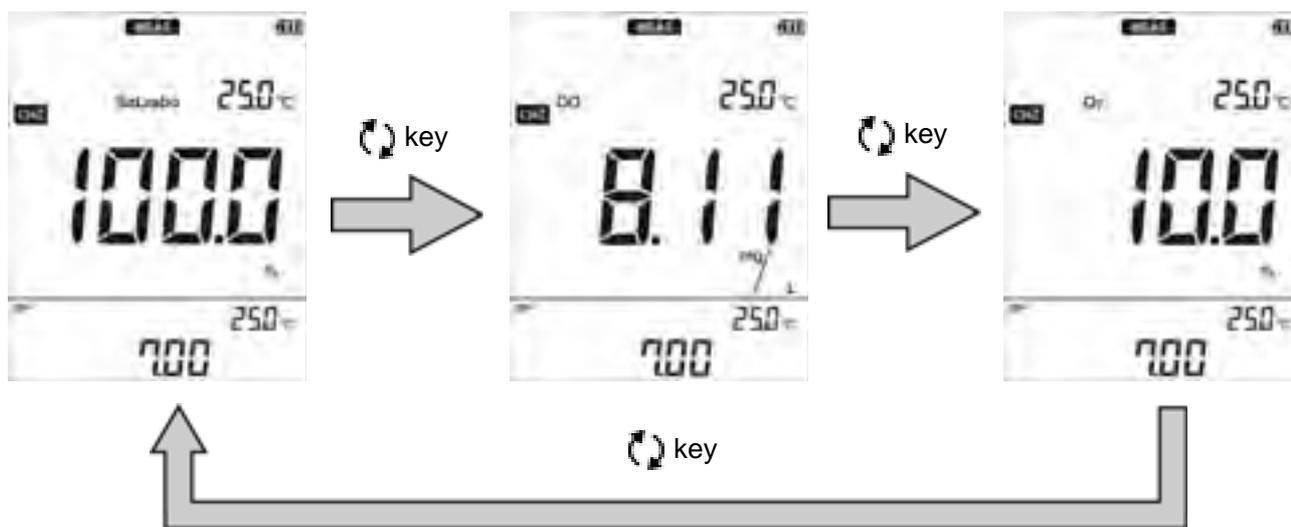
● Changing the measurement parameter

This instrument can measure multiple parameters. For measurement, an electrode corresponding to the measurement parameter is required. In the measurement mode, the measurement parameter can be changed by pressing the  key. This operation is available for the channel that is shown on the main screen.

< Channel 1 >

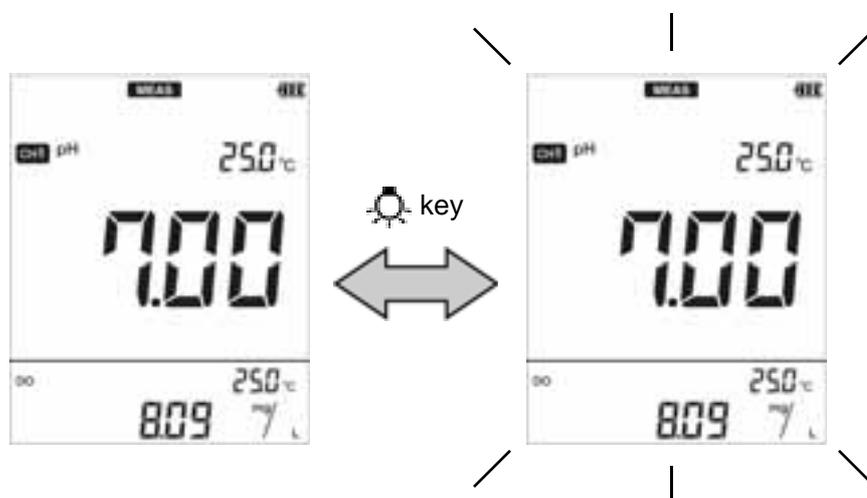


< Channel 2 >



● Using the backlight

When it is difficult to see the screen in a dark location, you can turn on the backlight by pressing the  key. If the backlight is not operated for 5 minutes, it automatically turns off. To turn it off manually, press the  key again while the backlight is on.

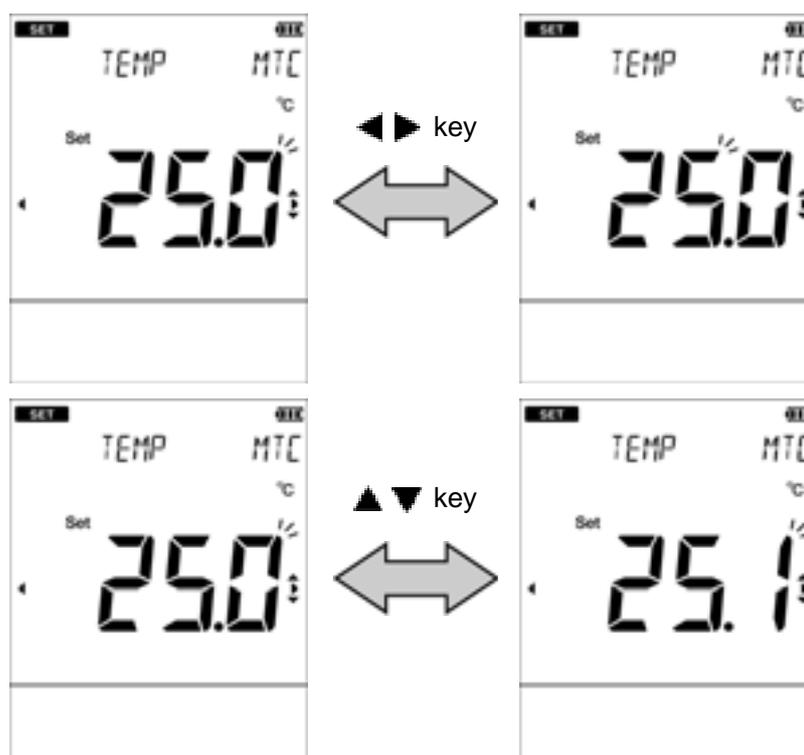


Note

- Turning on the backlight consumes energy and shortens battery life.
- The backlight becomes unavailable when the battery level becomes low.

● Entering numeric values

When entering numeric values to make various settings and set a calibration value, change the selected digit using the   keys and increment or decrement the value (0 to 9) using the   keys.

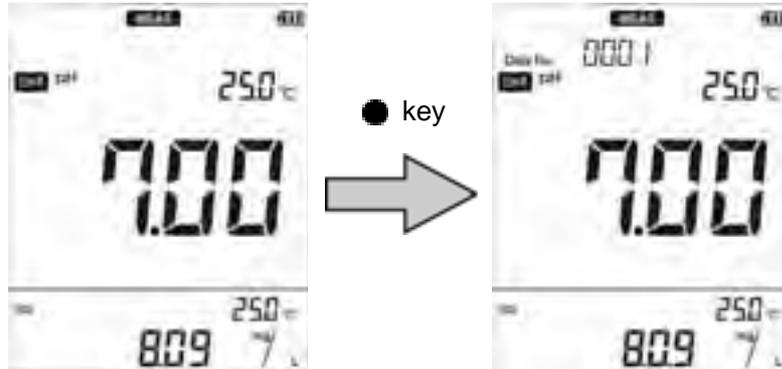


● Saving measurement data in the internal memory

Up to 1000 data items measured by the instrument can be stored in the internal memory. Saving the measurement data is possible only when the instrument is in the measurement mode.

1. Press the ● key while the data to save is displayed.

The saved data is displayed for two seconds and then the display returns to the previous screen automatically.



Note

If the data saved reaches 1000 data items, an error occurs and "ERR No. 0010" is displayed. Copy or transfer necessary data to a PC and delete the data from the memory ("Deleting all saved data" (page 54)).

Measurement

This section describes the basic method of measurement of each measurement parameters.

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■ Preparation

● Confirmation before starting measurement

- Have you prepared the appropriate electrode for the measurement parameter?
⇒ If not, purchase the appropriate electrode.

- Is the prepared electrode in good condition?
⇒ If the responsive part is stained or damaged, it may not be possible to obtain accurate values.

- Have you prepared the appropriate standard solution for the measurement parameter?
⇒ If not, prepare the standard solution by yourself or purchase it.

- Are there any items that should not be wet or stained around the instrument?
⇒ Depending on the operation during measurement, items around the instrument could get wet or stained. Secure sufficient space around the instrument and perform measurement while always paying attention to safety.

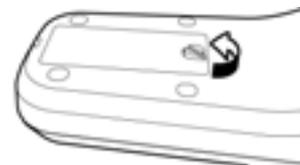
- Are there any devices that can be a source of noise?
⇒ Measured values could be affected. Do not use the instrument near such devices.
Always ground devices operated by AC power.

● Turning ON the instrument

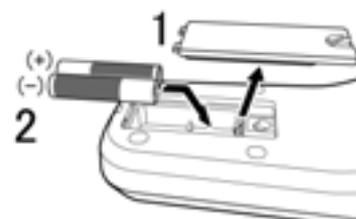
• Inserting the batteries

This instrument is operated by batteries. You can use AAA alkaline batteries or AAA Ni-MH rechargeable batteries. Perform the following procedure to insert batteries in the instrument.

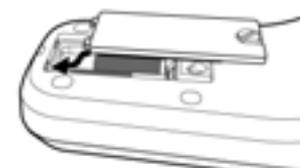
1. Turn the knob on the battery cover on the back of the instrument counterclockwise to unlock the battery cover.



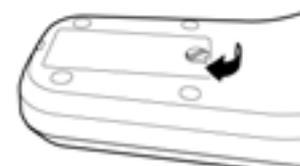
2. Remove the battery cover and set the batteries inside.



3. Put the battery cover back in.



4. Turn the knob on the battery cover on the back of the instrument clockwise to lock the battery cover.



Note

- Do not replace the batteries in a dusty place or with wet hands. Dust or moisture could get inside the instrument, possibly causing instrument malfunction.
- Do not short-circuit a battery.
- Set the + and – side of the battery correctly.
- When the battery has run out or the instrument will not be used for a long time, remove the batteries.
- Of the specified battery types, make sure to use two batteries of the same type.
- Do not use a new battery together with a used battery.
- When using the Ni-MH batteries, do not use a fully charged battery together with an insufficiently-charged battery.

• Using the AC adapter (option)

It is possible to use the AC adapter to operate the instrument.

Perform the following procedure to connect AC adapter to the instrument.

The AC adapter is an option. To purchase it, contact your dealer. (Refer to "Options" (page 100).)

1. Open the AC adapter cover of the instrument.
2. Insert the AC adapter cable by fitting with the AC adapter jack of in the instrument.
3. Insert AC adapter into the electrical socket.



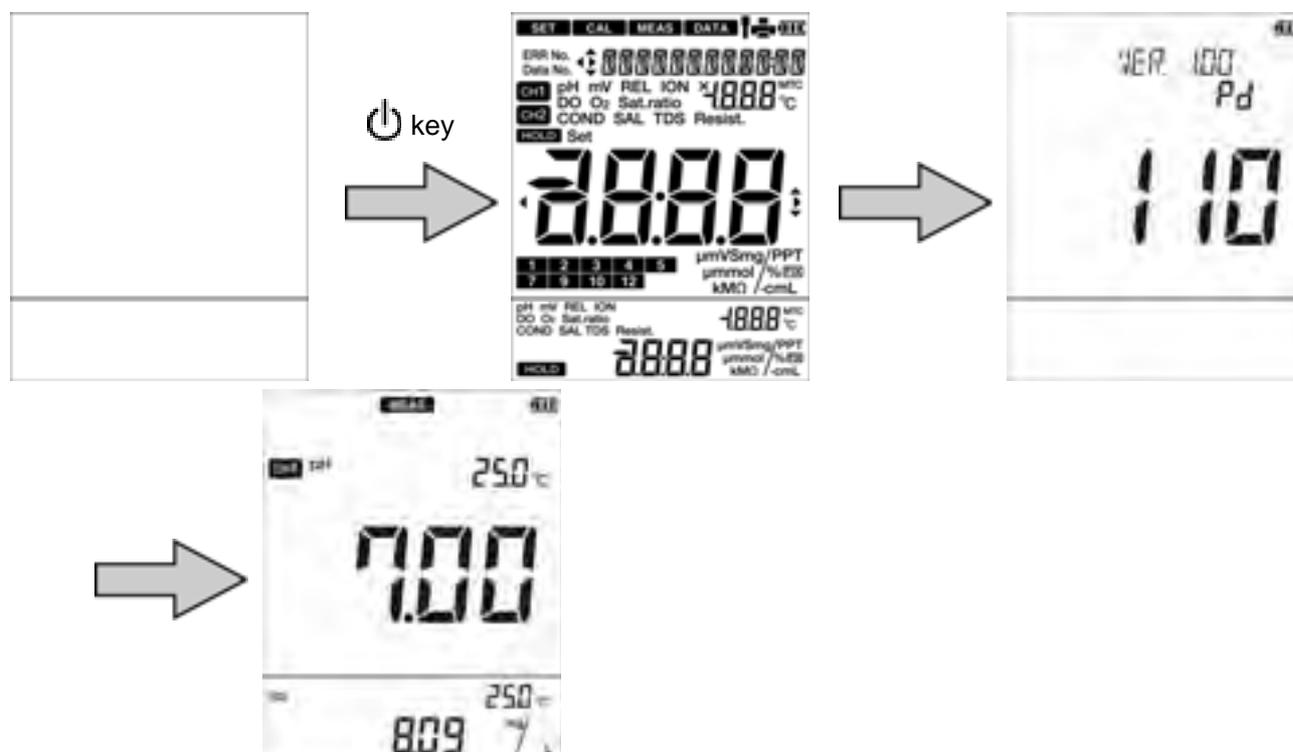
AC adapter jack

Note

- Do not insert the cable with force when the connector does not match the jack.
 - When not using the AC adapter, close the AC adapter connector cover.
 - While the AC adapter is connected, the instrument does not have the dust-proof and waterproof performance. Dust or moisture could get inside the instrument, possibly causing instrument malfunction.
-

• Pressing the POWER key

After setting the batteries or connecting the AC adapter, press the  key over one second. The LCD is fully displayed for one second, and the screen displays the version number of software and the model, and then displays the measurement mode.



Note

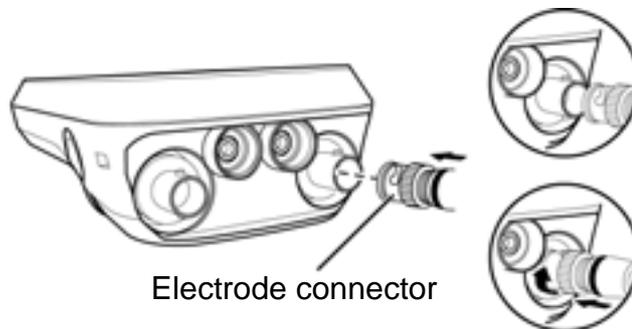
- Do not hold down the  key after the power of the instrument is turned ON.
- Do not use the tip of nail or an object with a sharp end to press keys.
- "VER" indicates the version of the software. It may be revised when the software is updated.

● Connecting an electrode

To perform measurement, you must use the appropriate electrode for measurement parameters. Recommended electrodes for each measured sample are listed in our product catalog and on our website. Refer to them when preparing electrodes. Use the following procedure to correctly connect the electrode to the instrument.

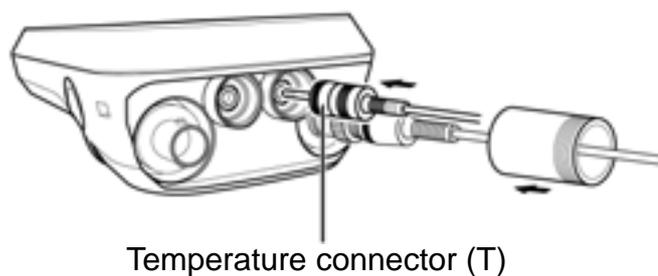
1. **Insert the electrode connector by fitting its groove with the connector pin of the instrument.**

2. **Turn the electrode connector clockwise by following the groove.**



3. **Put the connector cover on the connector.**

4. **When using a combination electrode equipped with a temperature sensor, insert the temperature connector (T) into the jack of the temperature connector (T).**



Tip

If the temperature connector (T) is unconnected or connection is wrong, temperature selected for MTC (manual temperature compensation) is displayed as the sample temperature.

Preparation for measurement is complete.

For details of the measurement operation, refer to the following pages.

■ pH measurement

You can measure the pH of the sample with a pH electrode.

Use a combination electrode incorporating a glass electrode and a reference electrode for measurement. A single glass electrode cannot be used with this instrument.

pH can be measured using channel 1 of the instrument.

● Setting the instrument

• Setting temperature compensation (default: ATC)

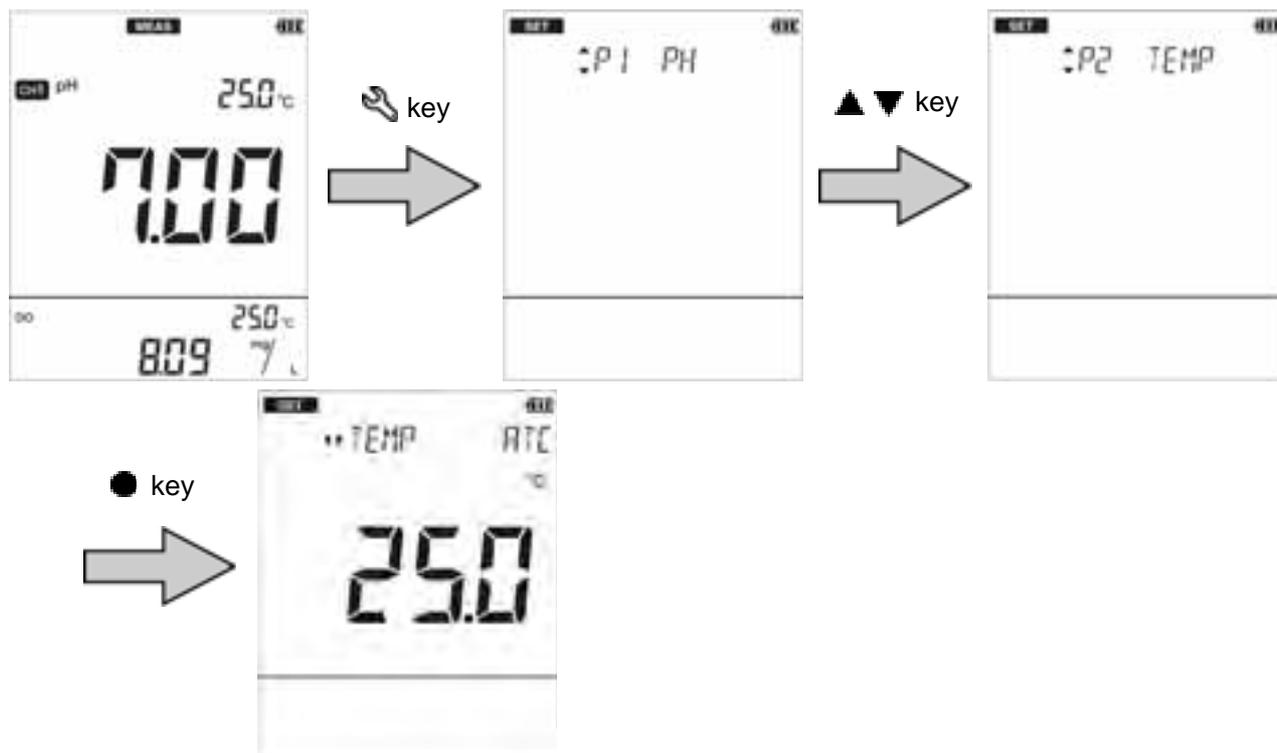
Automatic temperature compensation function can be used by using a combination electrode equipped with a temperature sensor or connecting a temperature compensation electrode. By measuring temperature during calibration of the pH standard solution and compensating for the change in pH value of the standard solution due to its temperature changes, you can perform calibration using the value matched to the standard solution temperature (only when the standard solution setting is NIST and USA). However, the function does not convert the pH value according to the temperature characteristics of each sample, and you must record the obtained value together with the sample temperature value. The variation of pH value accompanying the temperature change differs depending on the sample.

If you do not use the automatic temperature compensation function, match the temperature setting of the instrument to the temperature of the standard solution during calibration and match the sample temperature to the temperature setting of the instrument in measurement. By doing so, you can obtain the correct measurement value without being affected by sensitivity variation caused by temperature.

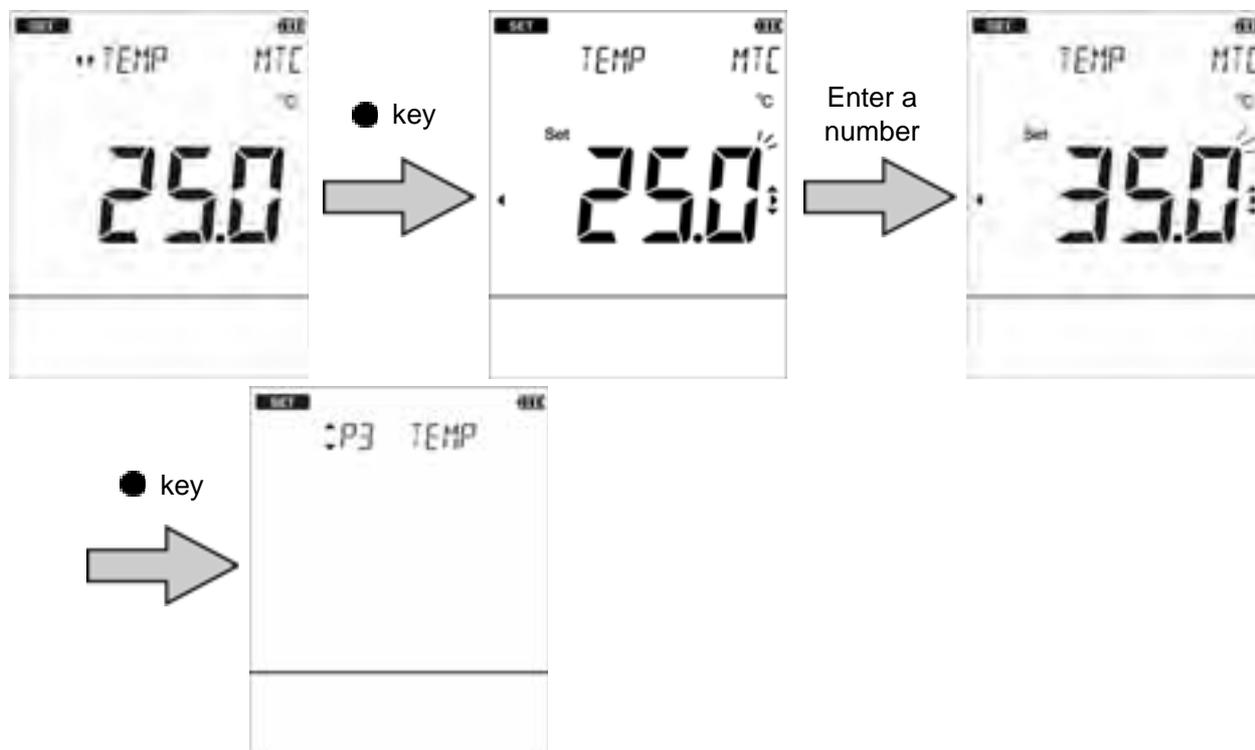
1. Press the  key to enter the setting mode.
2. Press the   keys to select "TEMP" (temperature setting) and then press the  key.

If the temperature connector (T) is connected, "ATC" (automatic temperature compensation) appears. If the temperature connector (T) is not connected, "MTC" (manual temperature compensation) appears.

In the case of "ATC", you can calibrate the temperature sensor (refer to "Calibrating temperature sensor" (page 62)).



3. In the case of "MTC", enter the temperature to be compensated for and press the ● key to confirm.

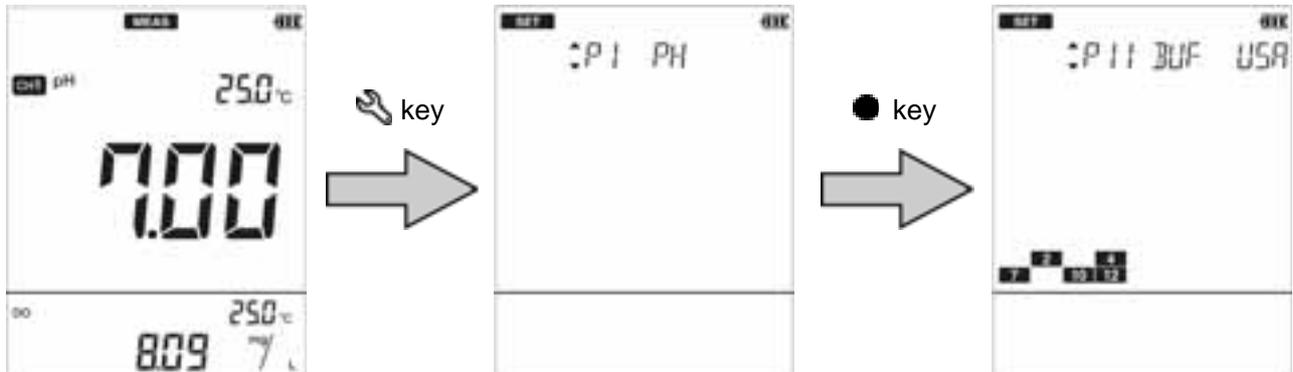


To return to the measurement mode, press the  key.

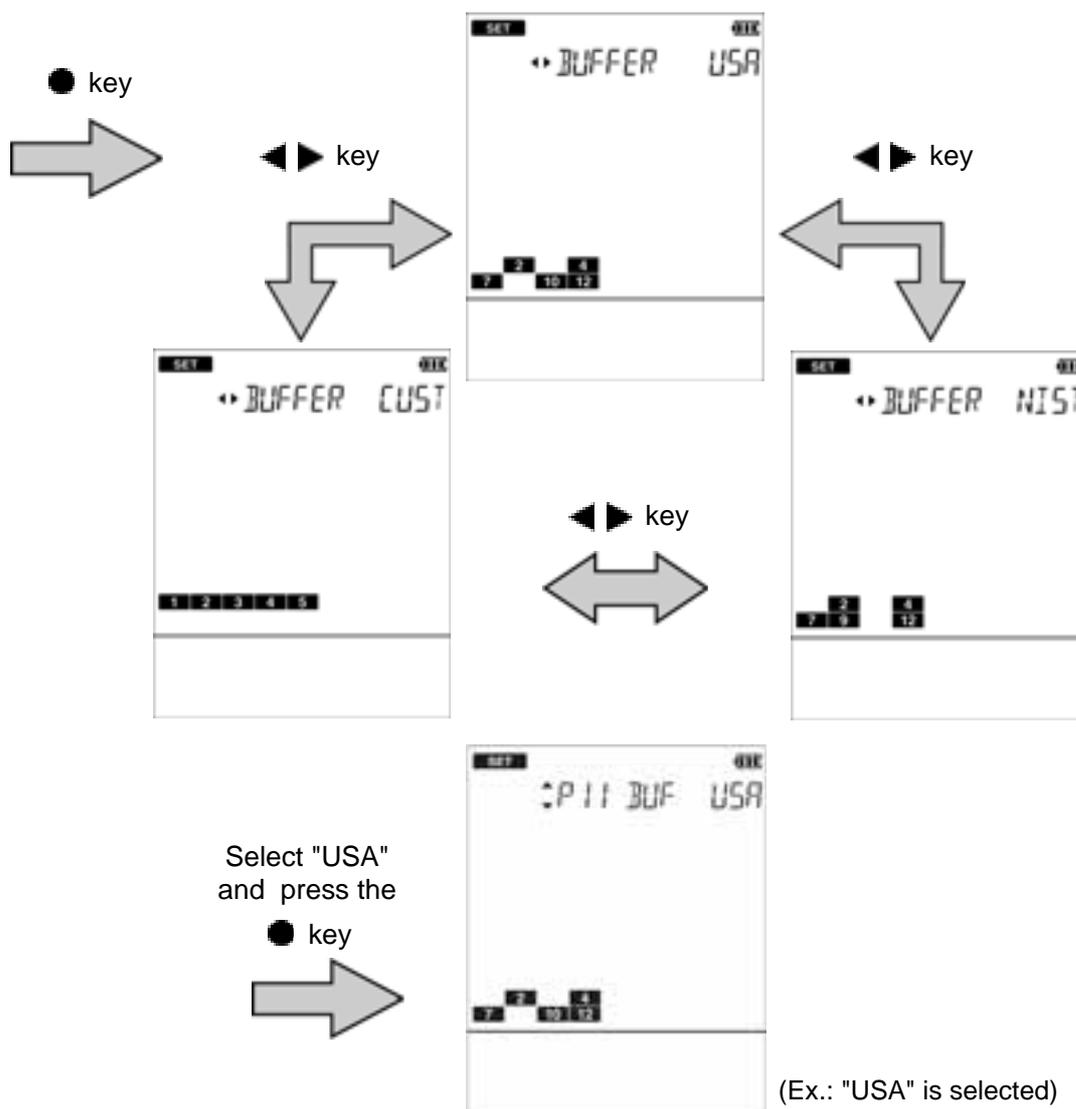
- **Setting the standard solution used for calibration (default: USA)**

Set the standard solution used for calibration. With this instrument, you can choose from 3 types, USA, NIST, and CUST (the standard solution other than USA and NIST). Set according to the standard solution to be used.

1. Press the  key to enter the setting mode.
2. Press the   keys to select "pH" (pH setting) and then press the  key.
3. Select "BUF" (pH standard solution setting) and then press the  key.



- Press the ◀▶ keys to select "USA", "NIST", or "CUST" according to the standard solution to be used and press the ● key to confirm selection.



To return to the measurement mode, press the ⏪ key.

• Standard solution type

| Standard solution type | Description | | | | |
|----------------------------------|---|------|------|-------|-------|
| USA (USA specification) | Set to use the standard solution of the USA specification. | | | | |
| | Standard solution icon | | | | |
| | 2 | 4 | 7 | 10 | 12 |
| | 1.68 | 4.01 | 7.00 | 10.01 | 12.45 |
| NIST (Japanese specification) | Set to use the standard solution of the Japanese specification. | | | | |
| | Standard solution icon | | | | |
| | 2 | 4 | 7 | 9 | 12 |
| | 1.68 | 4.01 | 6.86 | 9.18 | 12.45 |
| CUST (custom specification) | Set to use the standard solution of an optional specification. | | | | |
| | Standard solution icon 1 2 3 4 5 | | | | |

● Performing calibration

Calibration is necessary to measure pH accurately.

We recommend performing calibration once a day, before the first measurement.

According to the following procedure, perform calibration accurately.

Note

- Perform two-point calibration using pH 7 and pH 4 when you know that the sample is acidic; pH 7 and pH 9 when you know that the sample is alkaline.
- Perform three-point calibration using pH 4, pH 7, and pH 9 when the sample is unknown.
- You can confirm the current calibration data in the data mode and delete the calibration data in the setting mode. (Refer to "Displaying the latest calibration and inspection data" (page 56), "Deleting calibration data" (page 60).)

• pH standard solution setting is USA or NIST

This section describes the procedure for two-point calibration of USA, pH 4 and 7, as a general calibration example.

1. **Clean the pH electrode with pure water (or deionized water) and wipe it with filter paper or tissue paper.**



2. **Open the internal solution filler port of the pH electrode.**

If calibration is performed with the port closed, the internal solution does not flow and the measurement value is not stable. Make sure to keep the port open during calibration.



3. **Perform the 1st point calibration. Immerse at least 3 cm from the tip of the pH electrode in the pH 7 standard solution.**

In order for the internal solution to flow into the standard solution, make sure to immerse the liquid junction in the standard solution surely.



4. **Press the  key to enter the calibration mode.**

Stability judgment automatically starts and the pH icon blinks until the measured value stabilizes. When the measured value stabilizes, the pH icon changes from the blinking state to the lit state.

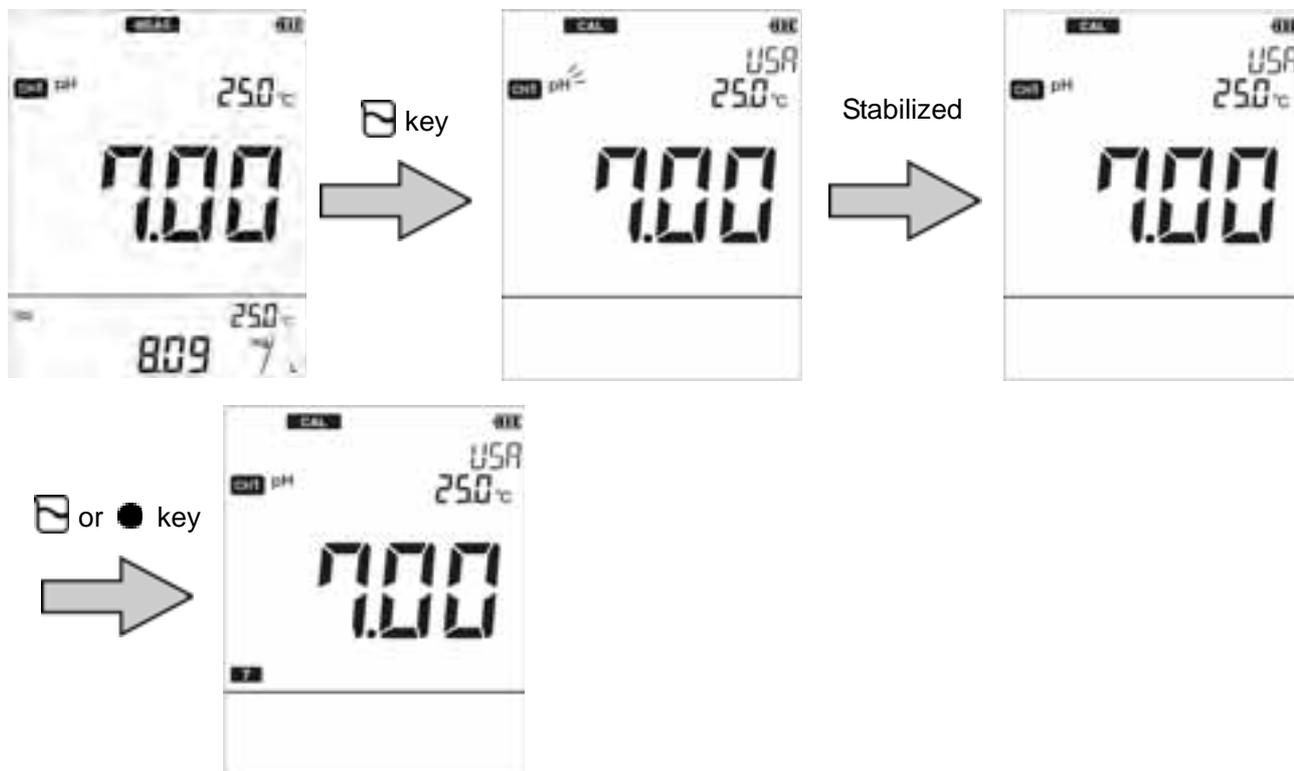
Tip

The standard solution type for the calibration is shown on the upper right screen.

5. Press the  or  key.

Calibration to the standard solution value at the measured temperature is performed. The 1st point calibration ends and "7" calibration history icon lights, indicating that pH 7 calibration is complete.

The display automatically returns to the measurement screen.



6. Perform the 2nd point calibration. As with the step 1., Clean the pH electrode and immerse it in the pH 4 standard solution. As with the step 3., immerse at least 3 cm from the tip of the pH electrode.

7. Press the  key to enter the calibration mode.

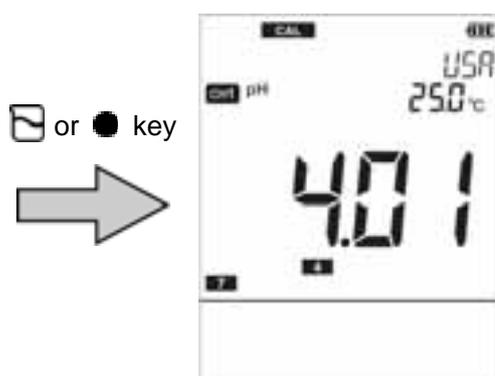
Stability judgment automatically starts and the pH icon blinks until the measured value stabilizes. When the measured value stabilizes, the pH icon changes from the blinking state to the lit state.

The current measured value display appears.

8. Then press the  or  key.

Calibration to the standard solution value at the measured temperature is performed. The 2nd point calibration ends and "4" calibration history icon lights, indicating that pH 4 calibration is complete.





Two-point calibration is complete.

When calibrating three points or more, use the same procedure to continue calibrating the 3rd and subsequent points after the 2nd point calibration. You can calibrate up to five points. Also, you can inspect repeatability using the pH 7 standard solution. About the repeatability inspection procedure, refer to "Inspecting repeatability" (page 28).

Tip

The order of calibration of the standard solution is optional.

In the above example, you can calibrate pH 4 first and then pH 7.

Note

- If calibration of any standard solution is performed again, only the value of calibrated solution is updated. If calibration is repeated, only the calibration value of used standard solution is updated. The calibration values are retained until next calibration is performed, the data is deleted or buffer setting is changed. For the procedure for deleting the calibration data, refer to "Deleting calibration data" (page 60).
- It is recommended that you should clear the previous calibration data before the calibration in order to perform more accurate calibration.

•Check of the pH electrode status

After calibration is complete, the current pH electrode status is diagnosed from the calibration result. Use this information for maintenance of the electrode.

| Display | Description | Reference |
|--|---|-----------|
| Both  and ERR No. are not displayed | Electrode sensitivity: 85% to 100% Good condition. | — |
| ERR No.0004  blinks | Asymmetry potential: less than -45 mV or excess 45 mV Maintain or replace the electrode. | P. 86 |
| ERR No.0005  blinks | Sensitivity: less than 85% or excess 105% Maintain or replace the electrode. | P. 87 |

• Inspecting repeatability

You can inspect repeatability using the pH 7 standard solution by returning to the calibration screen after calibration and ends and pressing the  key. Measure the pH 7 standard solution by using the calibrated electrode to display the absolute value of the difference between the measured value and standard solution value.

In order to inspect repeatability, you need to perform calibration of the pH 7 standard solution with either "USA" or "NIST" set as the standard solution.

1. **Clean the calibrated pH electrode with pure water (or deionized water) and wipe it with filter paper or tissue paper.**



2. **Open the internal solution filler port of the pH electrode.**

If calibration is performed with the port closed, the internal solution does not flow and the measurement value is not stable. Make sure to keep the port open during calibration.



3. **Perform the 1st point calibration. Immerse at least 3 cm from the tip of the pH electrode in the pH 7 standard solution.**

In order for the internal solution to flow into the standard solution, make sure to immerse the liquid junction in the standard solution surely.



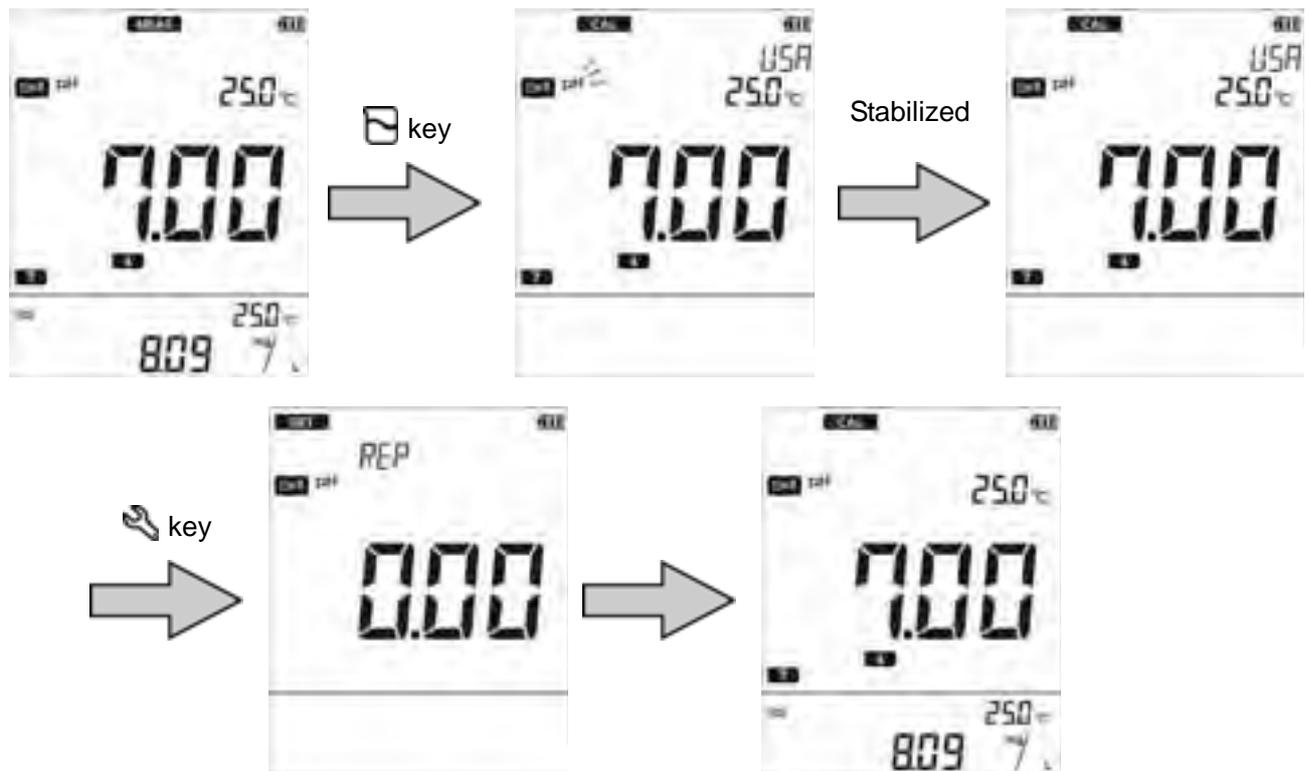
4. **Press the  key to enter the calibration mode.**

5. **Make sure that the pH icon lights while the pH electrode is immersed in the standard solution.**

Stability judgment starts and the pH icon blinks. When the value is stabilized, the pH icon changes from the blinking state to the lit state and the display is fixed to the measured value at the stable time.

6. Press the  key to start inspection.

"REP" (repeatability) is shown and display changes to the measurement mode.

**Note**

Repeatability inspection can be performed only once for one calibration.

• **pH standard solution setting is CUST**

This section describes the procedure for two-point calibration.

1. **Clean the pH electrode with pure water (or deionized water) and wipe it with filter paper or tissue paper.**



2. **Open the internal solution filler port of the pH electrode.**

If calibration is performed with the port closed, the internal solution does not flow and the measurement value is not stable. Make sure to keep the port open during calibration.



3. **Perform the 1st point calibration. Immerse at least 3 cm from the tip of the pH electrode in standard solution.**

In order for the internal solution to flow into the standard solution, make sure to immerse the liquid junction in the standard solution surely.



4. **Press the  key to enter the calibration mode.**

Stability judgment automatically starts and the pH icon blinks until the measured value stabilizes. When the measured value stabilizes, the pH icon changes from the blinking state to the lit state.

5. **Enter the standard solution value and press the  key or the  key.**

Calibration to the set standard solution value is performed. The 1st point calibration ends and "1" calibration history icon lights, indicating that 1st point calibration is complete.

The display returns to the measurement screen.



 key





6. Perform the 2nd point calibration. As with the step 1., clean the pH electrode and immerse it in the 2nd standard solution. As with the step 3., immerse at least 3 cm from the tip of the pH electrode.



7. Press the  key to enter the calibration mode. Stability judgment automatically starts and the pH icon blinks until the measured value stabilizes. When the measured value stabilizes, the pH icon changes from the blinking state to the lit state.
8. Enter the standard solution value for the second point and press the  key or the  key. Calibration to the set standard solution value is performed. The 2nd point calibration ends and "2" calibration history icon lights, indicating that the 2nd point calibration is complete.



 key





Two-point calibration is complete.

When calibrating three points or more, use the same procedure to continue calibrating the 3rd and subsequent points after the 2nd calibration. You can calibrate up to five points.

Note

- If calibration of any standard solution is performed again, only the value of calibrated solution is updated. If calibration is repeated, only the calibration value of used standard solution is updated. The calibration values are retained until next calibration is performed or the data is deleted. For the procedure for deleting the calibration data, refer to "Deleting calibration data" (page 60).
- It is recommended that you should clear the previous calibration data before the calibration in order to perform more accurate calibration.

•Check of the pH electrode status

After calibration is complete, the current pH electrode status is diagnosed from the calibration result. Refer to the following table for maintenance of the electrode.

| Display | Description | Reference |
|-------------------------------------|---|-----------|
| Both and ERR No. are not displayed | Electrode sensitivity: 85% to 100% Good condition. | — |
| ERR No.0004 blinks | Asymmetry potential: less than -45 mV or excess 45 mV Maintain or replace the electrode. | P. 86 |
| ERR No.0005 blinks | Sensitivity: less than 85% or excess 105% Maintain or replace the electrode. | P. 87 |

● Performing measurement

You can perform measurement in the measurement mode by immersing the pH electrode in the sample. You can use the automatic hold function to judge the stability of the measured value. The automatic hold function has two modes, the auto stability mode and the auto hold mode. For the instruction to set the mode, refer to "Setting the auto stability and auto hold function" (page 64).

1. **Clean the pH electrode with pure water (or deionized water) and wipe it with filter paper or tissue paper.**



2. **Open the internal solution filler port of the pH electrode.**

If calibration is performed with the port closed, the internal solution does not flow and the measurement value is not stable. Make sure to keep the port open during calibration.



3. **Immerse at least 3 cm from the tip of the pH electrode in the sample solution.**

In order for the internal solution to flow into the sample solution, make sure to immerse the liquid junction in the sample solution surely.

Stability judgment automatically starts and the pH icon blinks until the measured value stabilizes. When the measured value stabilizes, the pH icon changes from the blinking state to the lit state and the display is fixed to the stabilized measured value.

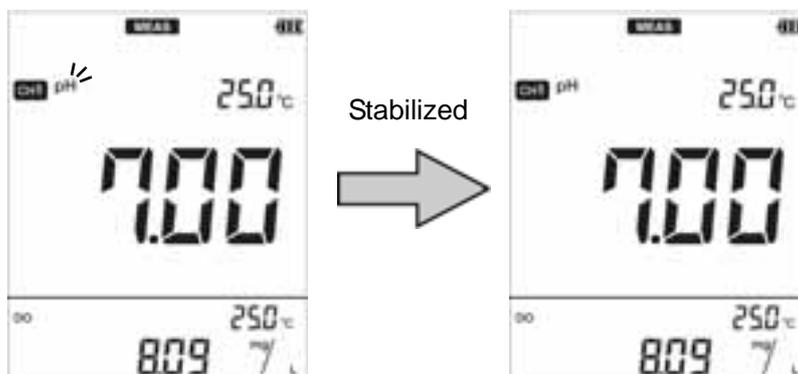


- **Auto stability mode**

If the measurement pH value does not fulfill the stability condition, the fixed value is released. When the measured value fulfill the stability condition again, the measured value is fixed.

- **Auto hold mode**

Press the  key to release the fixed measured value. When the measured value fulfill stability condition again, the measured value is fixed.



Note

- The criteria of stability judgment in the auto hold measurement are as follows.
Potential variation for 10 seconds is less than 1 mV (0.015 pH equivalent) and temperature variation is less than 2.0°C
- If the measured value is below the display range, "Ur" (under) appears. If the measured value is above the display range, "Or" (over) appears. For details on the action to take, refer to "The measured value is out of the measurement range" (page 92).

- **Saving the measured value**

To save the measurement data, press the  key in the screen that you want to save. For details, refer to "Saving measurement data in the internal memory" (page 14).

■ mV, ORP measurement

You can measure the electromotive force between the electrode and the sample by using a pH electrode. The mV value can be used to understand the status of the electrode in the mV measurement.

You can measure the ORP (oxidation-reduction potential) of the sample by using an ORP electrode in the ORP measurement.

In the measurement mode, press the  key to change the measurement parameter to "mV".

mV and ORP can be measured using channel 1 of the instrument.

● Switching between absolute value and relative value

There are two types of measurement mode for the mV and ORP measurement, the absolute value measurement and the relative value measurement.

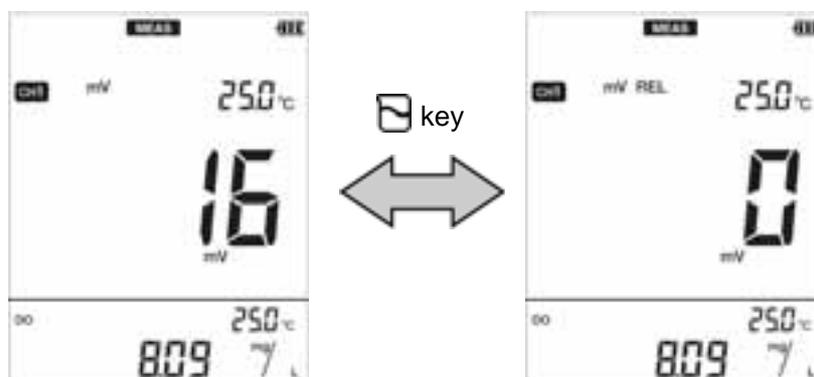
- Absolute value measurement mode

The measured value of electromotive force is displayed.

- Relative value measurement mode

The measured value of electromotive force of a sample is corrected to 0 mV and set as a relative value. When the electromotive force of another sample is measured, the difference value between the relative value and the measured value is displayed.

The default mode is the absolute value measurement mode. Pressing the  key switches to the relative value measurement mode. Pressing the  key again returns to the absolute value measurement mode.



● Performing measurement

You can perform measurement in the measurement mode by immersing the pH electrode in the sample. Also, you can use the automatic hold function to judge the stability of the measured value. The automatic hold function has two modes, the auto stability mode and the auto hold mode. For how to set the mode, refer to "Setting the auto stability and auto hold function" (page 64).

1. **Clean the electrode with pure water (or deionized water) and wipe it with filter paper or tissue paper.**



2. **Open the internal solution filler port of the electrode.**

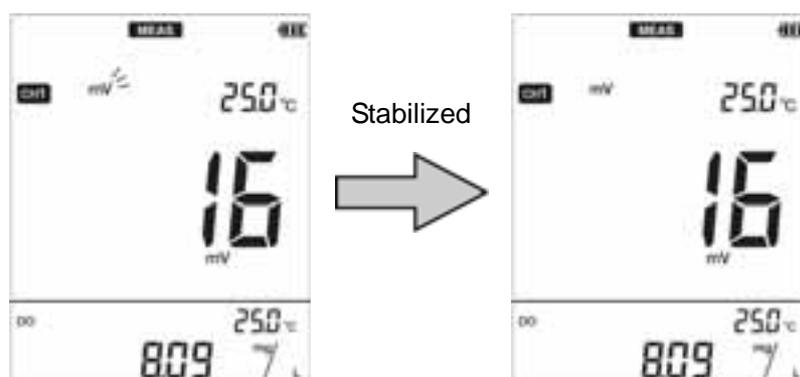
If calibration is performed with the port closed, the internal solution does not flow and the measurement value is not stable. Make sure to keep the port open during calibration.



3. **Immerse at least 3 cm from the tip of the electrode in the sample solution.**

In order for the internal solution to flow into the sample solution, make sure to immerse the liquid junction in the sample solution surely.

Stability judgment automatically starts and the mV icon blinks until the measured value stabilizes. When the measured value stabilizes, the mV icon changes from the blinking state to the lit state, and the display is fixed to the stabilized measured value.



Note

- The criteria of stability judgment in the automatic hold measurement are as follows.
Potential variation for 10 seconds is less than 1 mV and temperature variation is less than 2.0°C
 - If the measured value is below the display range, "Ur" (under) appears. If the measured value is above the display range, "Or" (over) appears. For details on the action to take, refer to "The measured value is out of the measurement range" (page 92).
 - Note that when measuring the ORP of a sample solution that has extremely low concentrations of oxidants and reductants (such as tap water, well water, or water treated with purifying equipment), there may be less responsiveness and repeatability in general.
 - If alkaline water is left, its ORP value changes considerably. Always measure alkaline ion water promptly.
-

● Saving the measured value

To save the measurement data, press the ● key in the screen that you want to save. For details, refer to "Saving measurement data in the internal memory" (page 14).

■ Dissolved oxygen measurement

You can measure the dissolved oxygen, oxygen concentration, and saturated oxygen concentration of a sample with a DO electrode. Oxygen concentration and saturated oxygen concentration are calculated from the measured value of dissolved oxygen.

Press the  key to select the measurement parameter (" Changing the measurement parameter " (page 12)).

The operation is the same for all measurement parameters.

These measurement parameters can be measured using channel 2 of the instrument.

Press the   keys to set the main screen to channel 2.

● Setting the instrument

• Setting temperature compensation

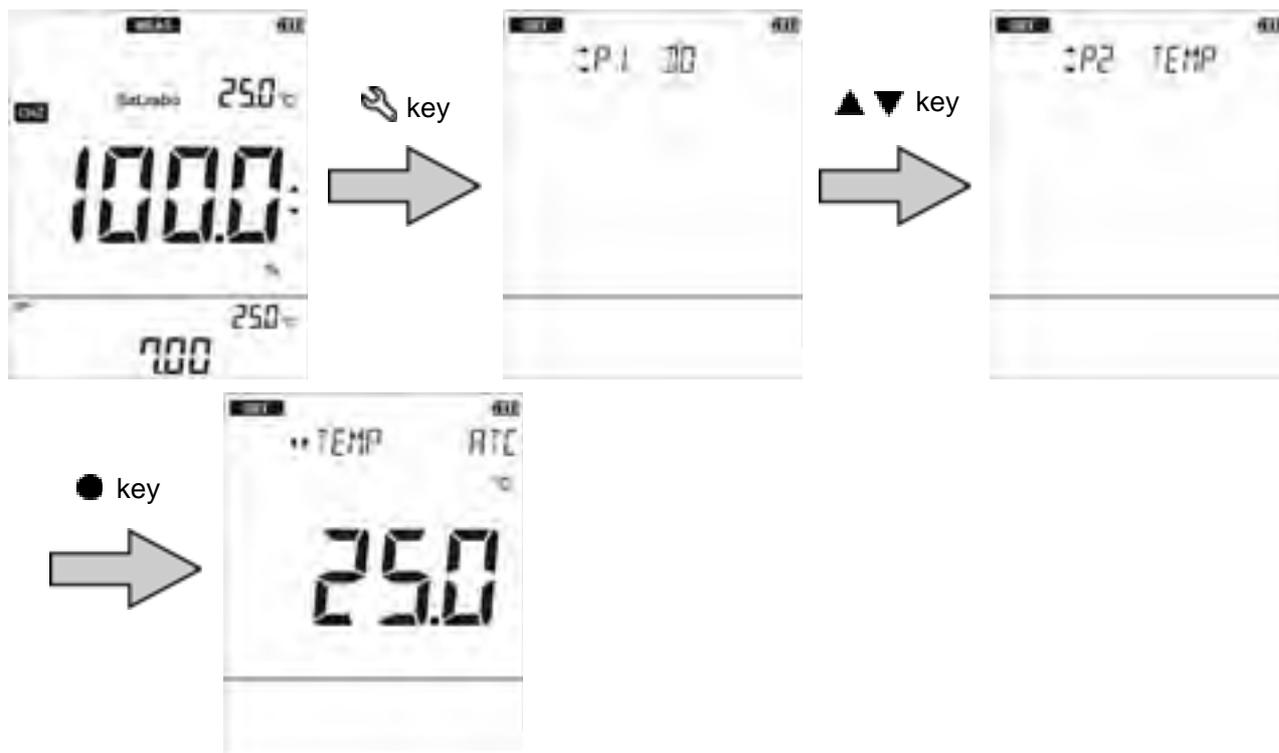
Automatic temperature compensation function can be used by using a DO electrode equipped with a temperature sensor. You can perform calibration with compensation by measuring the temperature of the standard solution (or the temperature of the air, when air calibration). You can correct the sensitivity of the calibration data according to the sample temperature with this function.

If you do not use the automatic temperature compensation function, match the temperature setting of the instrument to the temperature of the air (when air calibration is performed) or the standard solution (when standard solution calibration is performed) during calibration and match the sample temperature to the temperature setting of the instrument in measurement. By doing so, you can obtain the correct measurement value without being affected by sensitivity variation caused by temperature.

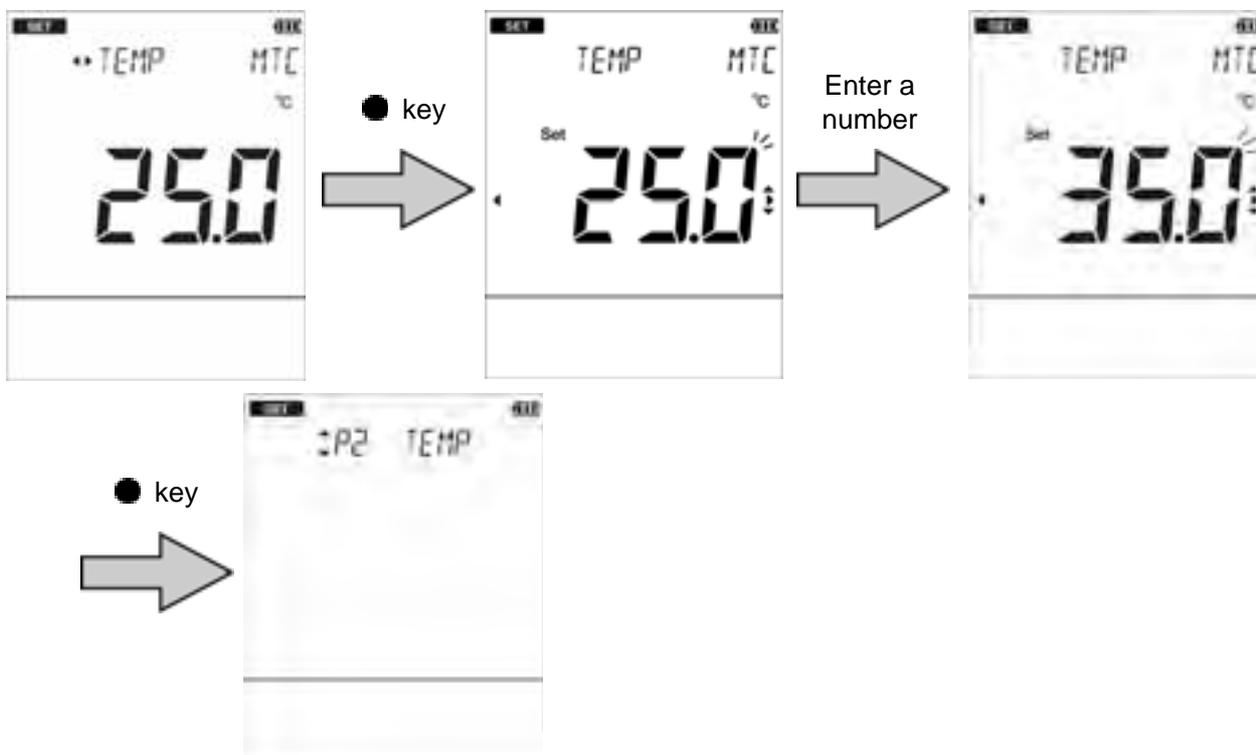
1. Press the  key to enter the setting mode.
2. Press the   keys to select "TEMP" (temperature setting) and then press the  key.

If the temperature connector (T) is connected, "ATC" (automatic temperature compensation) appears. If the temperature connector (T) is not connected, "MTC" (manual temperature compensation) appears.

In the case of "ATC", you can calibrate the temperature sensor (refer to "Calibrating temperature sensor" (page 62)).



3. In the case of "MTC", enter the temperature to be compensated for and press the ● key to confirm.



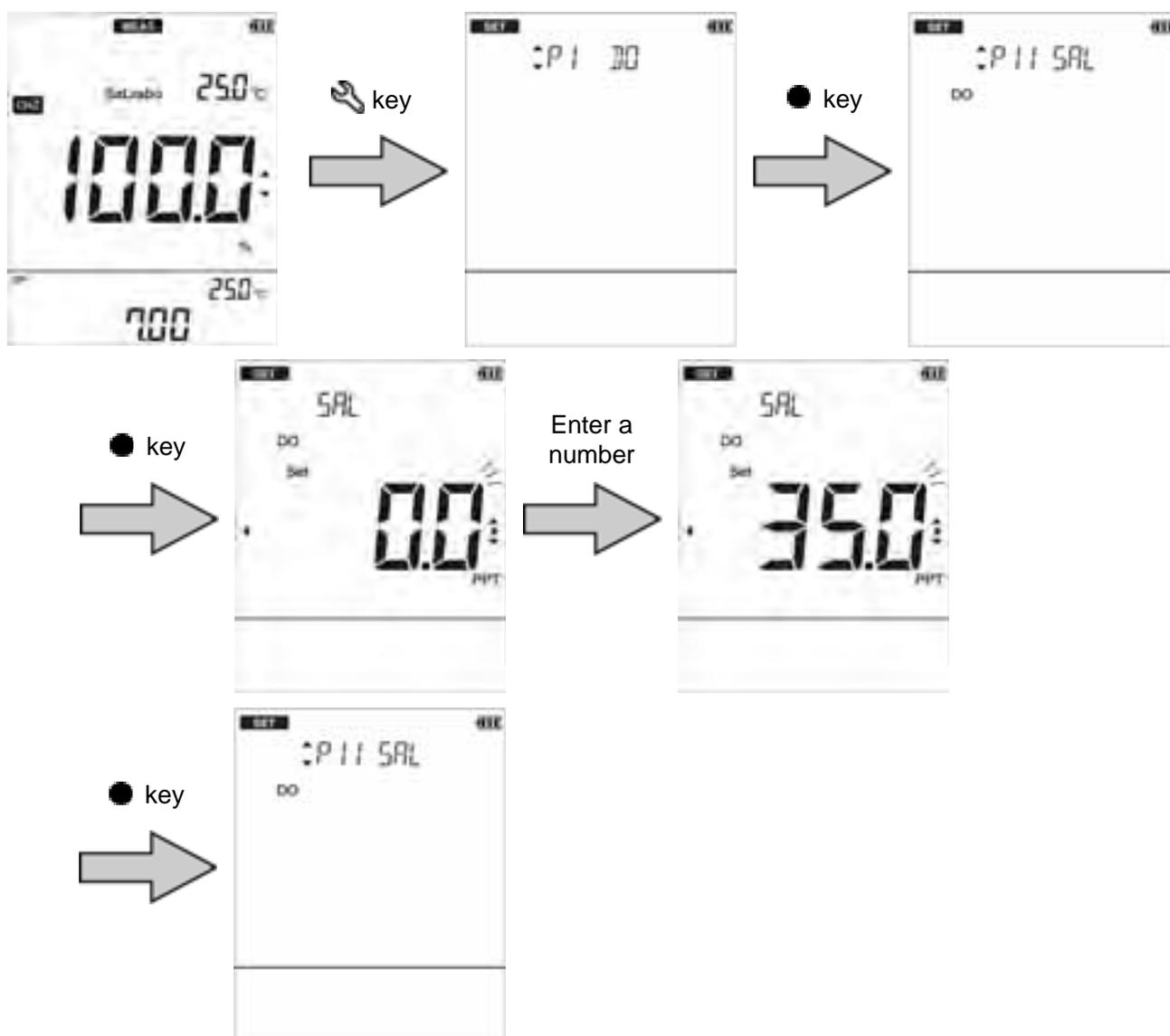
To return to the measurement mode, press the  key.

• Setting salinity correction (default: 0.0 PPT)

Because dissolved oxygen is affected by the salinity concentration, you need to correct it at measurement. Set the salinity concentration of the sample beforehand.

You can select arbitrary numeric value or sea concentration (35.0 PPT). If the measured target does not contain saline matter, set to 0.0 PPT.

1. Press the  key to change the setting mode.
2. Press the   keys to select "DO" (DO correction setting) and then press the  key.
3. Press the   keys to select "SAL" (salinity correction setting) and then press the  key.
4. Enter the salinity coefficient and press the  key.
The setting range is 0.0 PPT to 40.0 PPT.

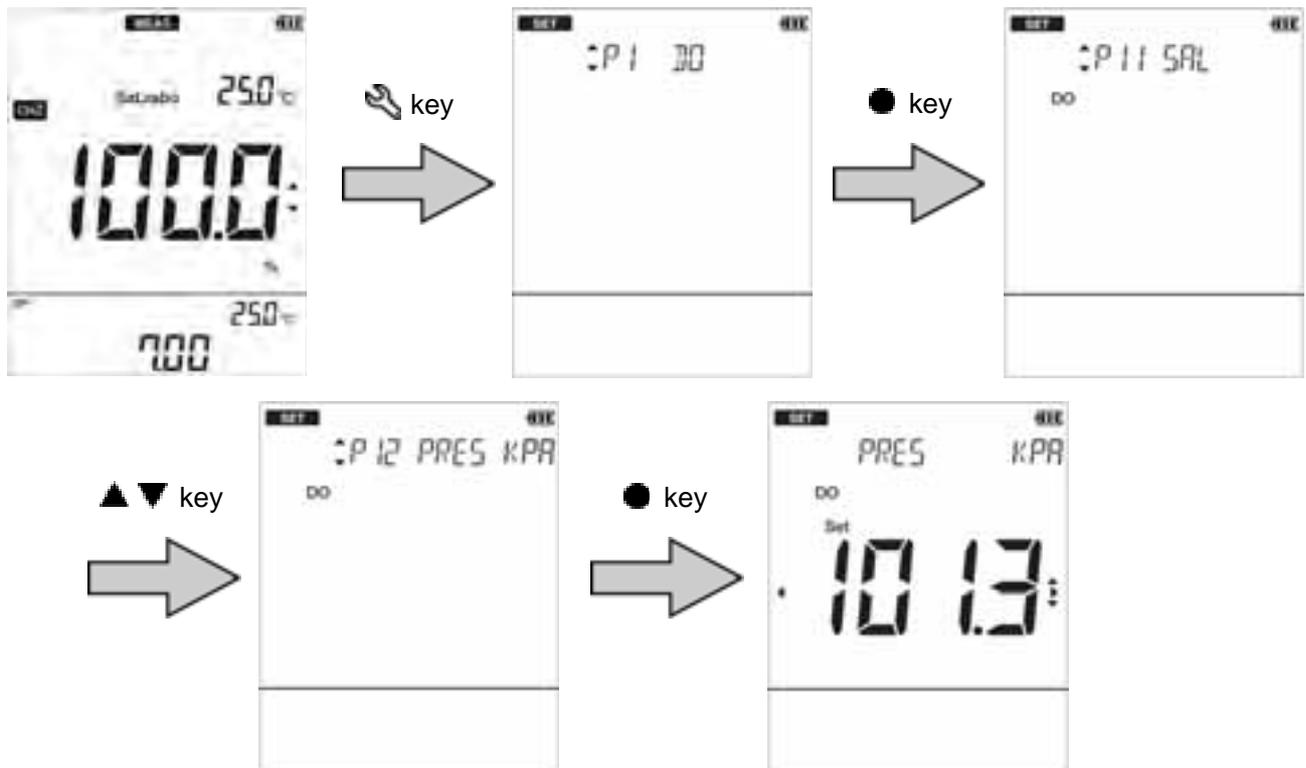


To return to the measurement mode, press the  key.

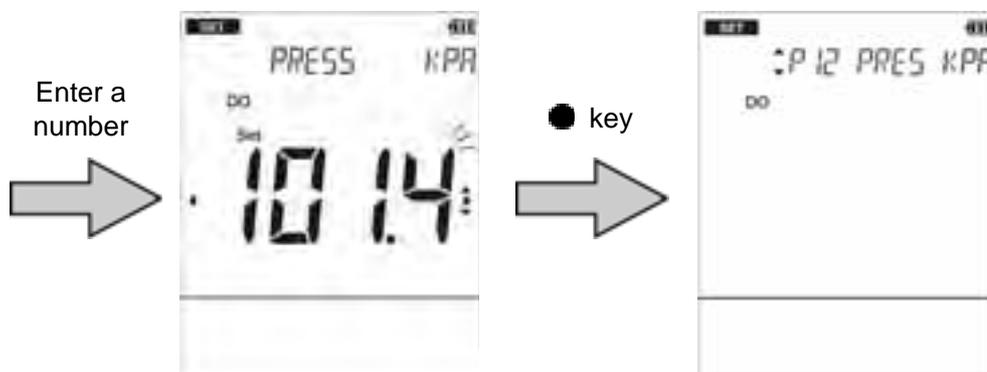
• Setting air pressure correction (default: 101.3 kPa)

Because dissolved oxygen is affected by air pressure in the location where measurement is taking place, you need to correct it at measurement. Set the air pressure of the location. At sea level, you can use the instrument with the default setting. If you are using the instrument in a high altitude area, you must set the air pressure correction.

1. Press the  key to enter the setting mode.
2. Press the   keys to select "DO" (DO collection setting) and then press the  key.
3. Press the   keys to select "PRES KPA" (air pressure collection setting) and then press the  key.



4. Enter the air pressure value of the measurement location and then press the  key.



To return to the measurement mode, press the  key.

● Performing calibration

Calibration of the DO electrode is required to measure dissolved oxygen accurately.

We recommend performing calibration once a day, before the first measurement.

According to the following procedure, perform calibration accurately.

You can use the saturated oxygen concentration mode (%) or dissolved oxygen measurement mode (mg/L) for calibration.

Note

To perform accurate calibration, set the air pressure value before calibration ("Setting air pressure correction (default: 101.3 kPa)" (page 41)).

• Calibrating in the saturated oxygen concentration mode (%)

Note

- Air calibration must be performed in clean air. If air calibration is performed in a location subject to dramatic temperature change, exposed to wind and rain, or near a heating appliance, an error may occur or the value may not be stabilized.
 - Do not hold the DO electrode with hand during calibration. DO electrode may be affected by temperature, causing an unstable value.
-

1. **Clean the membrane at the tip of the DO electrode with pure water (or deionized water) and wipe it with a soft cloth at least 10 minutes before calibration.**

Be careful not to break the membrane at the tip of the electrode.

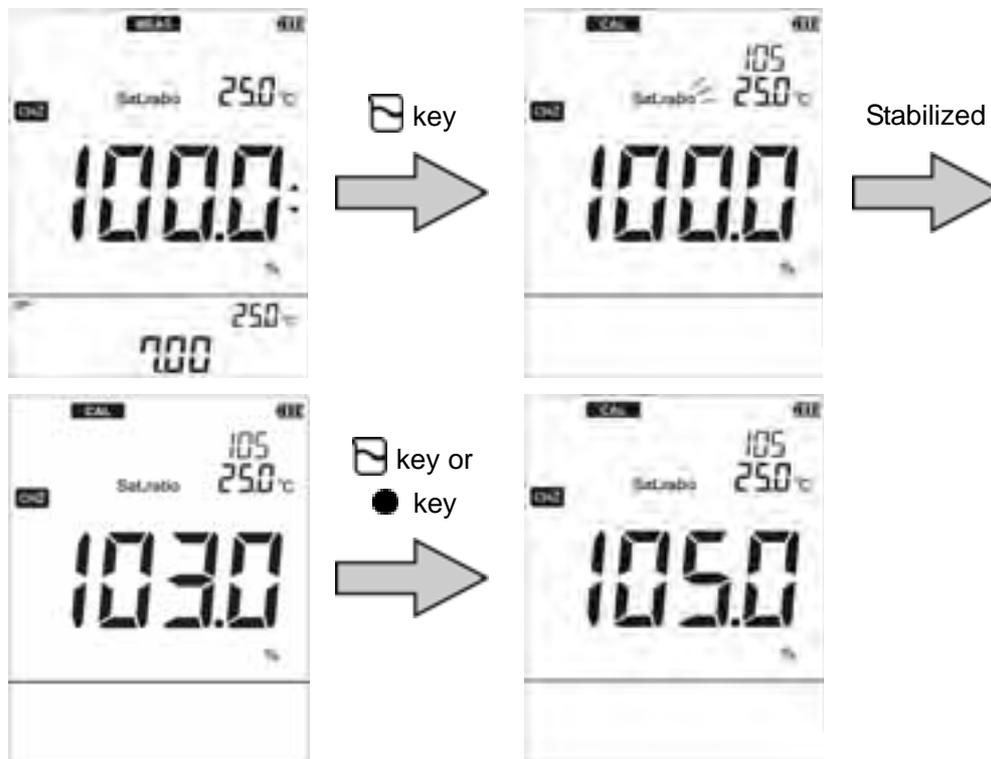
2. **Press the  key to enter the saturated oxygen concentration mode.**

3. **Hold the DO electrode still in clean air.**



4. Press the  key to enter the calibration mode.

Stability judgment starts and the sat.ratio icon blinks. When the value is stabilized, the sat.ratio icon changes from the blinking state to the lit state. When you press the  key or the  key, the calibrated value is displayed (the calibrated value differs depending on the conditions because it is affected by temperature and air pressure).



Tip

You can finish calibration by pressing the  key.

5. To perform zero calibration, immerse the same electrode in the zero standard solution.

Stability judgment starts and the sat.ratio icon blinks. When the value is stabilized, the sat.ratio icon changes from the blinking state to the lit state. When you press the  key or the  key, the calibrated value is displayed. The calibrated value is displayed and then the display returns to the measurement screen.



•Preparing the zero standard solution

Add 50 g sodium sulfite (Na_2SO_3) into 1000 mL pure water (or deionized water) and stir it until sodium sulfite completely dissolves.

• Calibrating in the dissolved oxygen measurement mode

When you perform two-point calibration in the dissolved oxygen measurement mode, calibrate in the order from a high-concentration solution to a low-concentration solution.

1. **Clean the membrane at the tip of the DO electrode with pure water (or deionized water) and wipe it with a soft cloth at least 10 minutes before calibration.**

Be careful not to break the membrane at the tip of the electrode.



2. **Prepare the standard solution to be used for calibration.**

3. **Press the  key to change to dissolved oxygen measurement mode.**

4. **Immerse at least 6 cm of the tip of the DO electrode in the calibration solution.**

In two-point calibration, immerse it in the high-concentration solution first.

In order to immerse the temperature sensor in the standard solution, make sure to immerse the electrode surely.

During measurement, use a stirrer to stir the standard solution at 1000 rpm to 1500 rpm.



Note

- If the temperature of the standard solution rises due to the use of a stirrer, use a temperature controlled bath.
 - When using an electrode "9551-20D" or "9551-100D", immerse at least 9 cm from the tip.
-

5. **Press the  key to enter the calibration mode.**

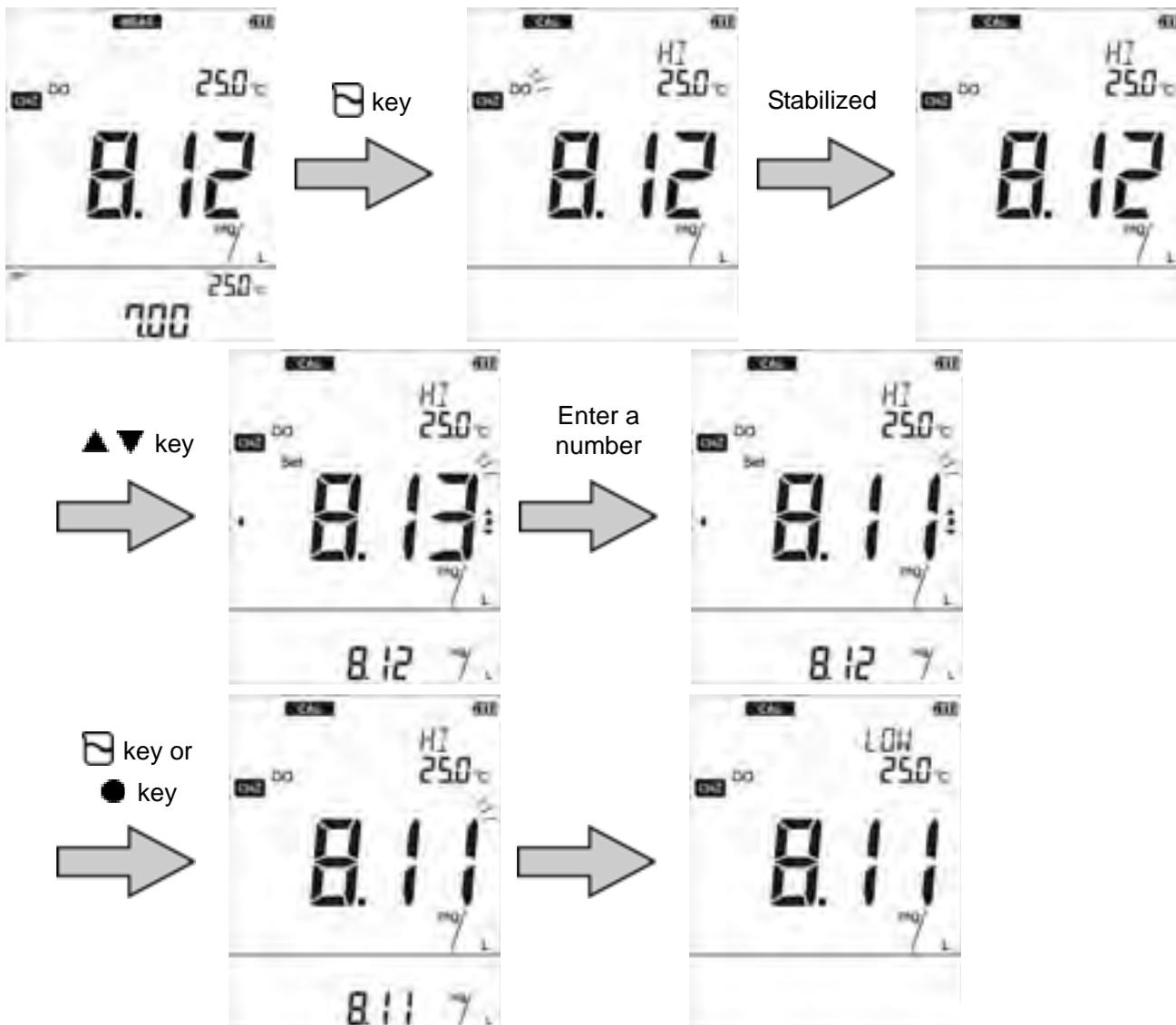
Stability judgment starts and the DO icon blinks. When the value is stabilized, the DO icon changes from the blinking state to the lit state.

The screen for entering a calibration value is displayed.

6. **Enter the DO concentration value of the solution to be used for calibration.**

7. Press the  key or the  key.

The value is set to the displayed value, and the mode is changed to Low concentration calibration.



Tip

You can finish calibration by pressing the  key.

8. To perform the 2nd point calibration, clean the DO electrode well in the same manner as the step 1. and immerse it in the second standard solution (low-concentration solution).

Note

When using an electrode "9551-20D" or "9551-100D", immerse at least 9 cm from the tip.

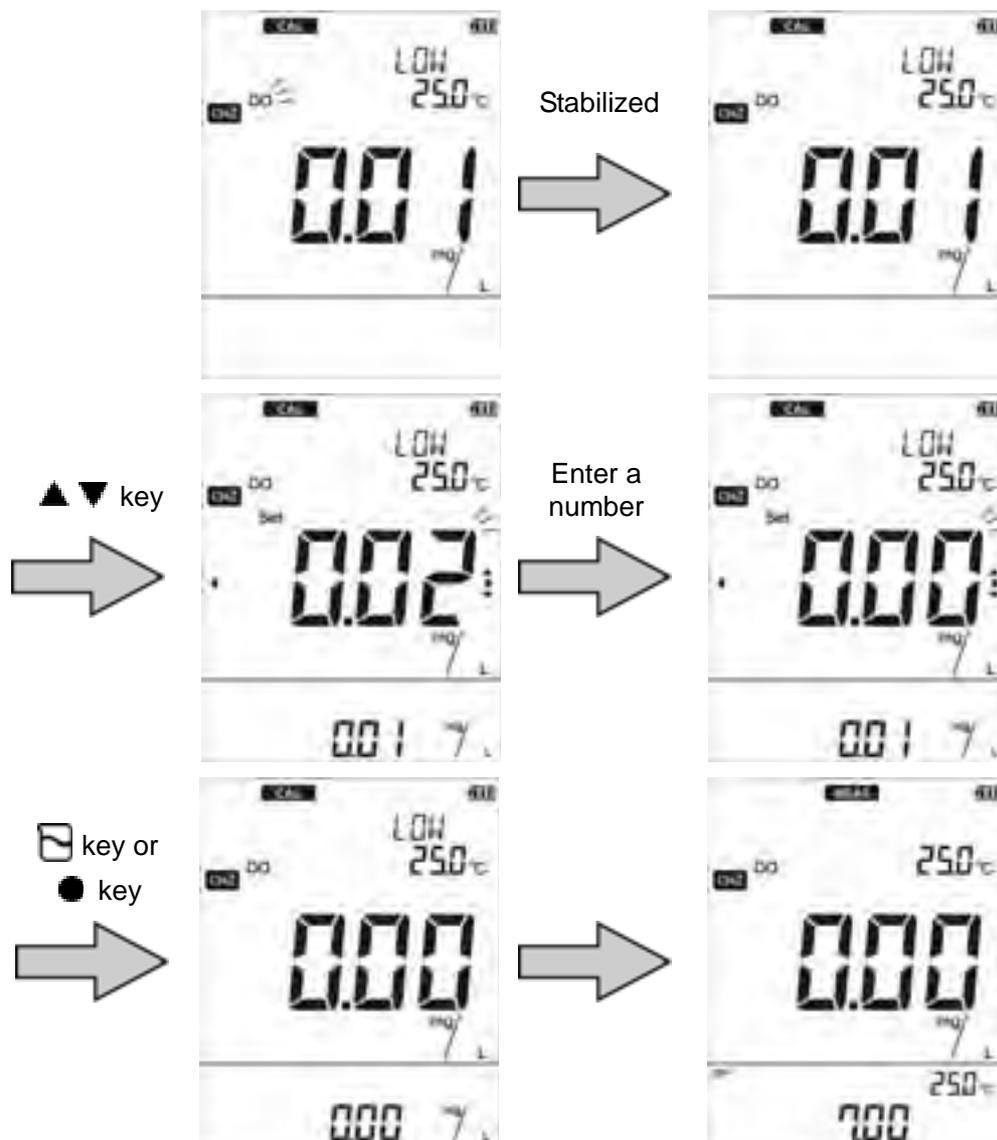
9. Immerse the DO electrode in the standard solution.

As with the step 4., immerse at least 6 cm of the tip of the DO electrode. Stability judgment starts and the DO icon blinks. When the value is stabilized, the DO icon changes from the blinking state to the lit state.

10. Press the  key to enter DO (DO concentration) value of the solution to be used for calibration.

11. Press the  key or the  key.

The value is set to the displayed value, and the display returns to the measurement mode.



Calibration using the standard solution is complete.

Note

- The zero standard solution and the span standard solution are determined automatically by the instrument.
- If calibration of any standard solution is performed again, only the value of calibrated solution is updated.

● Performing measurement

You can perform measurement in the measurement mode by immersing the DO electrode in the sample. Also, you can use the automatic hold function to judge the stability of the measured value. The automatic hold function has two modes, the auto stability mode and the auto hold mode. For the instruction to set the mode, refer to "Setting the auto stability and auto hold function" (page 64).

1. Press the  key to change the parameter to measure.
2. Clean the membrane at the tip of the DO electrode with pure water (or deionized water) and wipe it with a soft cloth at least 10 minutes before calibration.

Be careful not to break the membrane at the tip of the electrode.

3. Immerse at least 6 cm from the tip of the DO electrode in the sample solution.

In order to immerse the temperature sensor in the standard solution, make sure to immerse the electrode surely.

During measurement, use a stirrer to stir the sample solution at 1000 rpm to 1500 rpm.



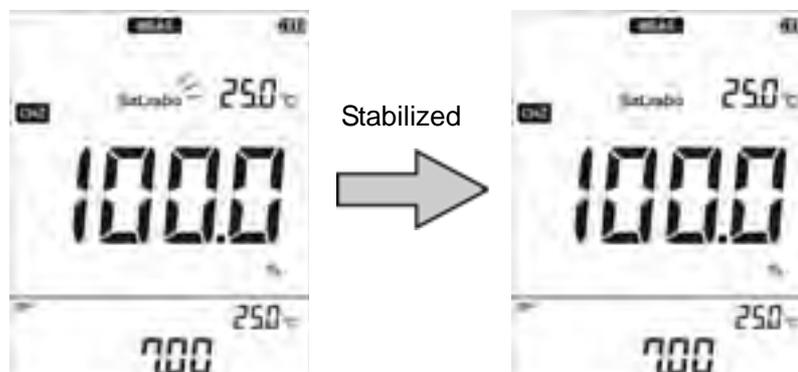
Note

When using an electrode "9551-20D" or "9551-100D", immerse at least 9 cm from the tip.

4. Immerse the DO electrode in the sample solution.

Stability judgment starts and the DO icon blinks. When the value is stabilized, the DO icon changes from the blinking state to the lit state and the display is fixed to the measured value at the stable time.

For the auto stability mode, if the measurement DO value does not meet stability condition, the fixed value is released. When the measured value meet stability condition again, the measured value is fixed. For the auto hold mode, press the  key to release fixed the measurement value. When the measured value meet stability condition again, the measured value is fixed.



Note

- The criteria of stability judgment in the automatic hold measurement are as follows.

| | |
|---------------------------------|---|
| Dissolved oxygen: | Display value change for 10 seconds is less than 0.03 mg/L and temperature change is less than 2.0°C. |
| Oxygen concentration: | Display value change for 10 seconds is less than 0.1% and temperature change is less than 2.0°C. |
| Saturated oxygen concentration: | Display value change for 10 seconds is less than 0.3% and temperature change is less than 2.0°C. |
 - "Ur" (Under) lights when the measured value is below the display range and "Or" (Over) when the measured value is above the display range. For details on how to correct them, refer to "The measured value is out of the measurement range" (page 92).
-

● Saving the measured value

To save the measurement data, press the ● key in the screen that you want to save. For details, refer to "Saving measurement data in the internal memory" (page 14).

Using various functions

This section describes functions available in this instrument.

| | |
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| ● Using the automatic data save..... | 51 |
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■ Data functions

● Displaying saved data

You can display the data saved in the internal memory.

1. Press the  key to enter the data mode.
2. Press the   keys to select "DATA OUT" (display saved data) and then press the  key.

Press the   keys to change the measurement data and press the   keys to change the display between date and data number.



● Using the automatic data save

This function saves the data in the internal memory of the instrument at the specified interval automatically.

While using this function, auto stability and hold mode are not available and the automatic power off setting is disabled.

If the batteries run out while using the automatic data save function, the data saved until just before the batteries run out. Replace the batteries and check the data.

1. Press the  key to enter the data mode.
2. Press the   keys to select "AUT LOG" (automatic data save) and then press the  key.

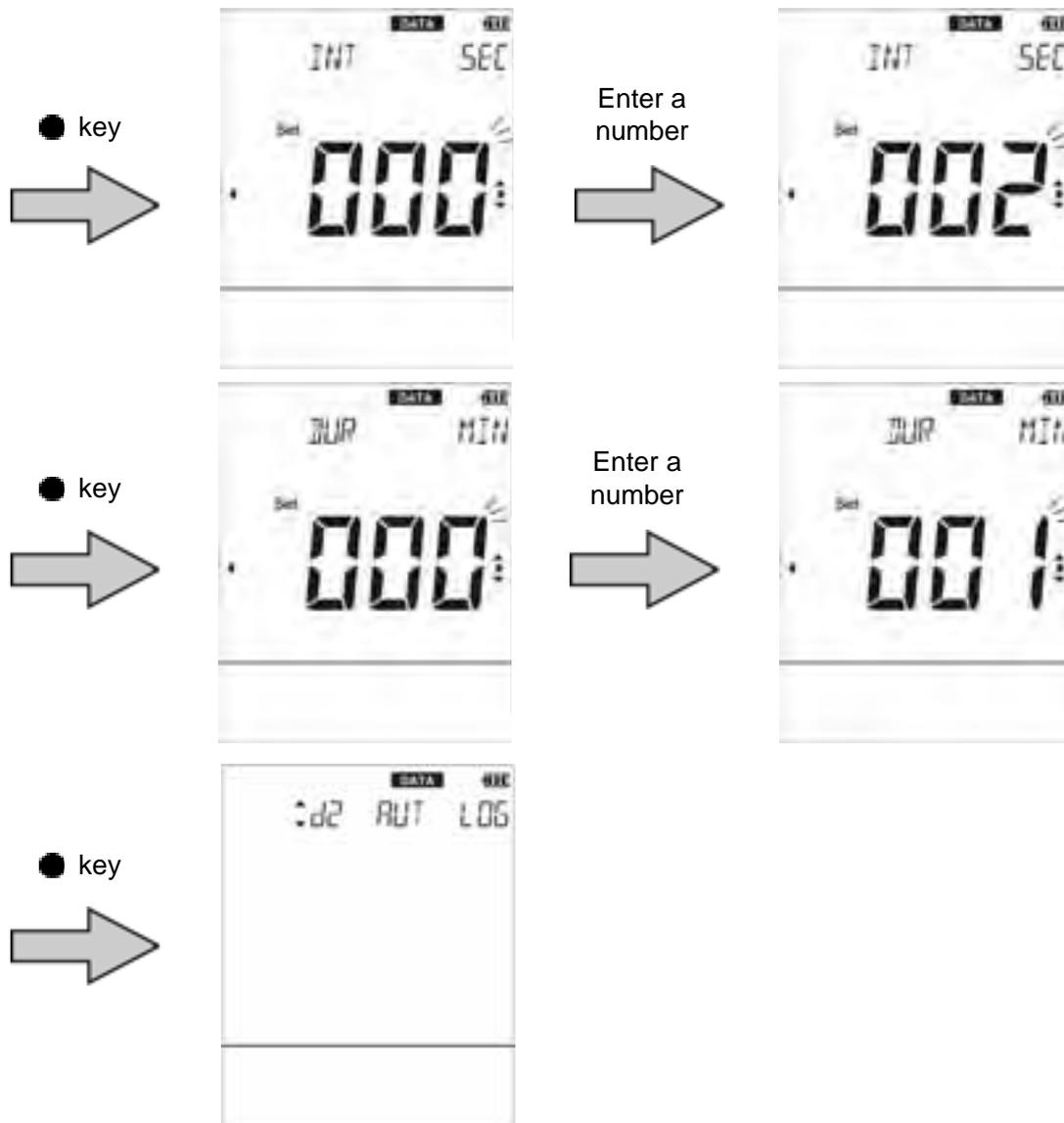


3. Enter the interval of saving in seconds and press the  key.
An interval from 0, 2 s to 3600 s can be set.
When "0" is entered, this function is set to OFF.

4. Enter the period of saving in minutes and press the  key.

A period from 0 min to 3600 min can be set.

"0" indicates no period.



5. Press the  key to enter the measurement mode.

6. Pressing the ● key starts saving the data (when the setting is "ON").

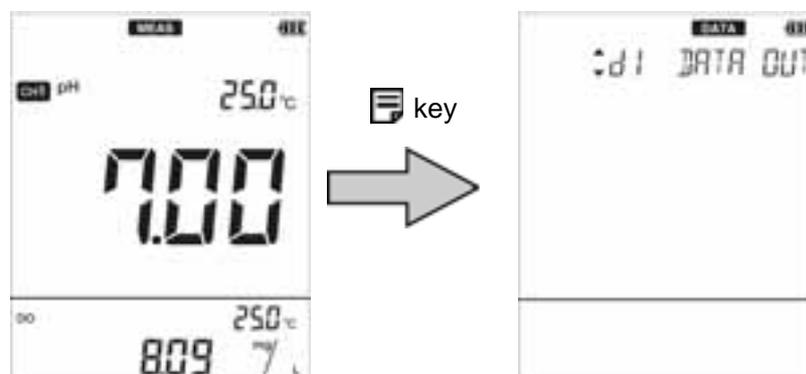
Pressing the ● key again stops the data saving process. During automatic data saving measurement, data is displayed for one second each time a measurement takes place. When more than 1000 data items are saved, "ERR No. 0010" is displayed and data saving is stopped. When you delete the data, the error is cleared (refer to "Deleting all saved data" (page 54))



● Deleting all saved data

Delete all data saved in the internal memory. Data cannot be deleted selectively. Copy or transfer the data to a PC for storage if necessary.

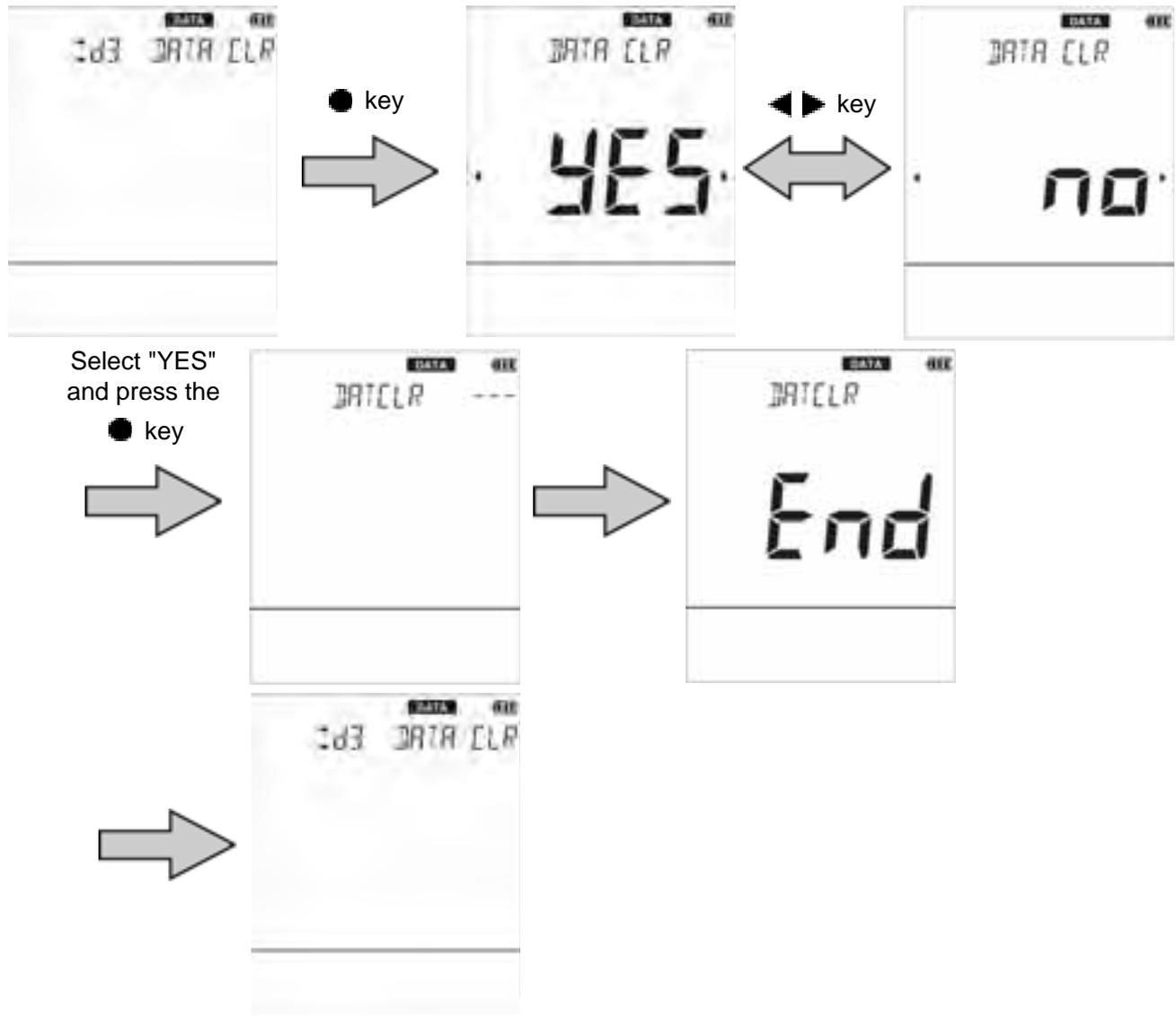
1. Press the  key to enter the data mode.



2. Press the ▲▼ keys to select "DATA CLR" (delete saved data) and then press the ● key to confirm.

3. Select "YES" to delete the saved data, or select "NO" to cancel deleting it. And then press the **●** key to confirm.

When "YES" is selected, "END" appears after deletion is complete.



To return to the measurement mode, press the **⏪** key.

■ Measurement setting

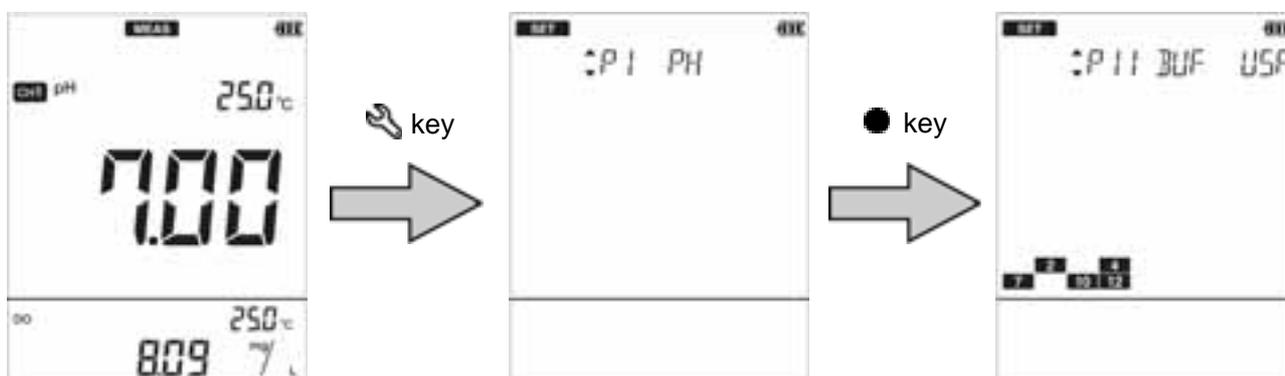
● Displaying the latest calibration and inspection data

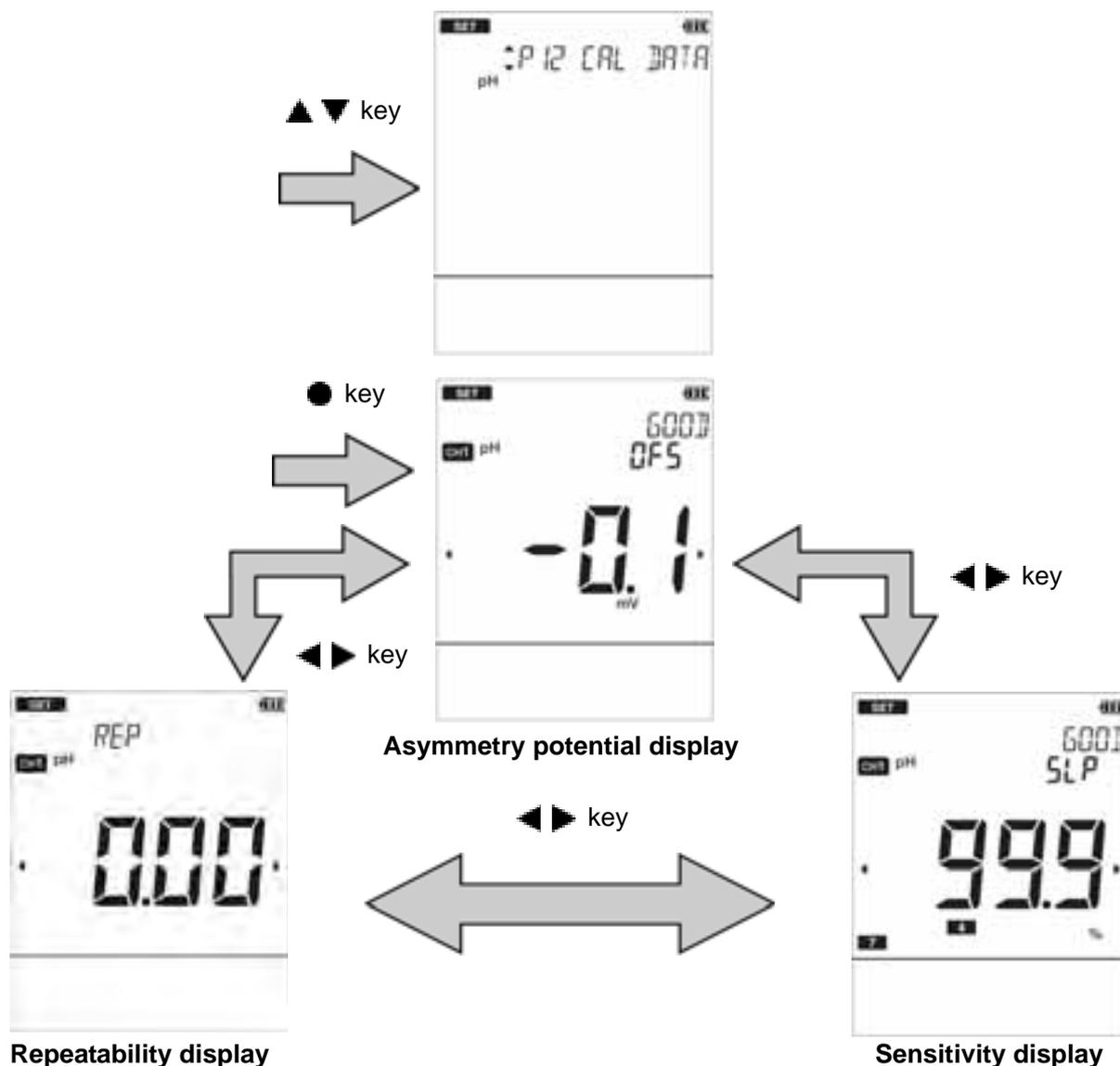
- In the case of displaying the latest pH calibration data and repeatability inspection data

You can display the latest pH calibration data and repeatability inspection data.

1. Press the  key to enter the setting mode when "pH" icon is shown on the main screen.
2. Press the ▲▼ keys to select "pH" and then press the ● key.
3. Press the ▲▼ keys to select "CAL DATA" (display calibration data) and then press the ● key.

The electrode status based on the calibration result is displayed. You can change the display item among "OFS" (asymmetry potential) to SLP (sensitivity) to REP (repeatability) by pressing the ◀▶ keys.





To return to the measurement mode, press the key and then press the key.

Tip

- The asymmetry potential can be displayed only for pH calibration data.
- When multiple point calibration (more than two points) is performed, the results of multiple point calibration are displayed.

- Electrode status based on calibration result

| Display | Description | Reference |
|---------|---|-----------|
| GOOD | Electrode sensitivity: 85% to 105% Good condition. | — |

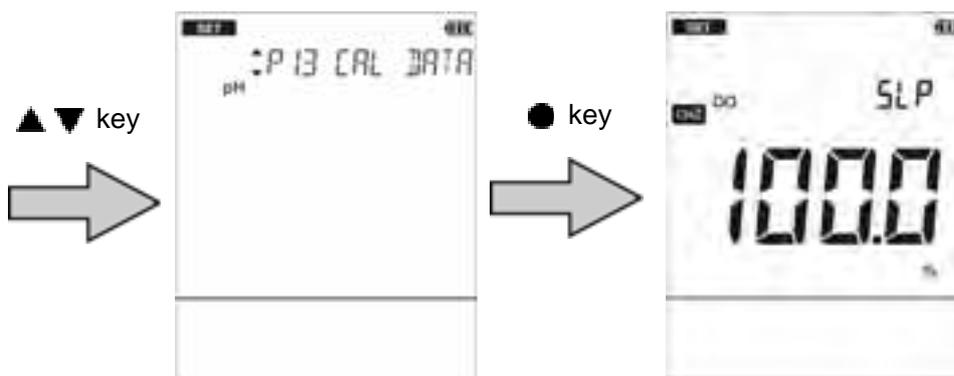
• In the case of displaying the latest DO calibration data

You can display the latest DO calibration data.

1. Press the  key to enter the setting mode when "DO" icon is shown on the main screen.
2. Press the   keys to select "DO" (DO correcting setting) and then press the  key.



3. Press the   keys to select "CAL DATA" (display calibration data) and then press the  key.
The electrode status based on the calibration result (sensitivity) is displayed.

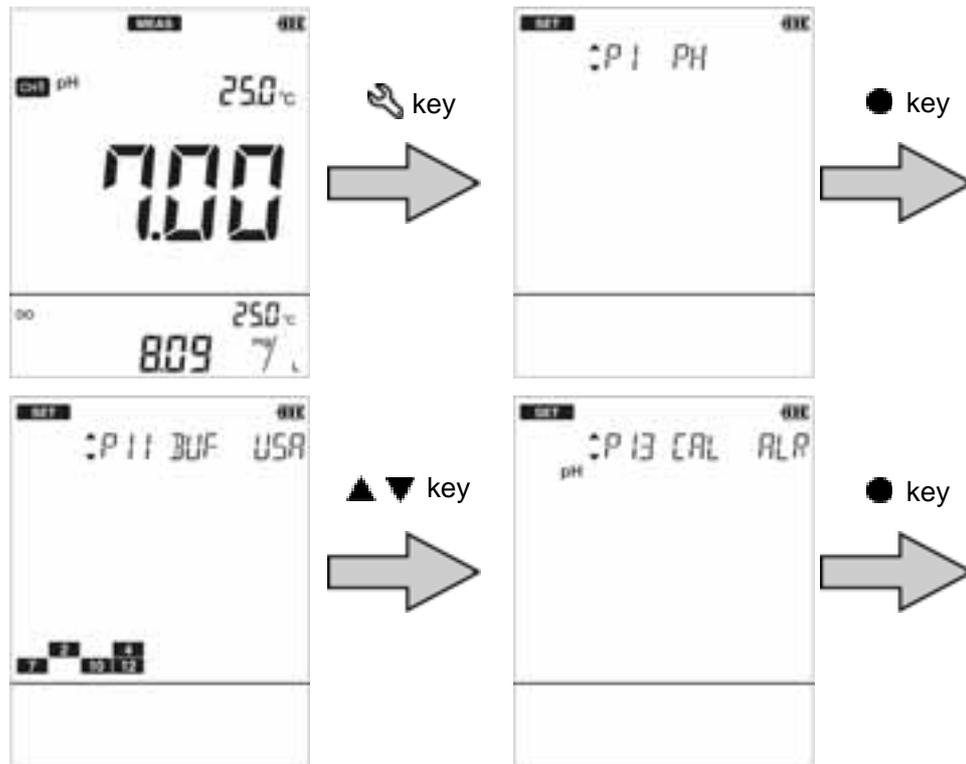


To return to the measurement mode, press the  key and then press the  key.

● Using the calibration interval alarm (default: OFF)

If calibration has not been performed for set period of time after last calibration is performed, "ERR No. 0008" is displayed to prevent forgetting to perform calibration. When the error is displayed, performing calibration clears the error.

1. Press the  key to enter the setting mode.
2. Press the   keys to select "pH" (pH setting) and then press the  key.
3. Press the   keys to select "CAL ALR" (calibration alarm setting) and then press the  key.



4. Enter the setting period of the calibration interval alarm and then press the  key.

The setting range is 1 day to 400 days.

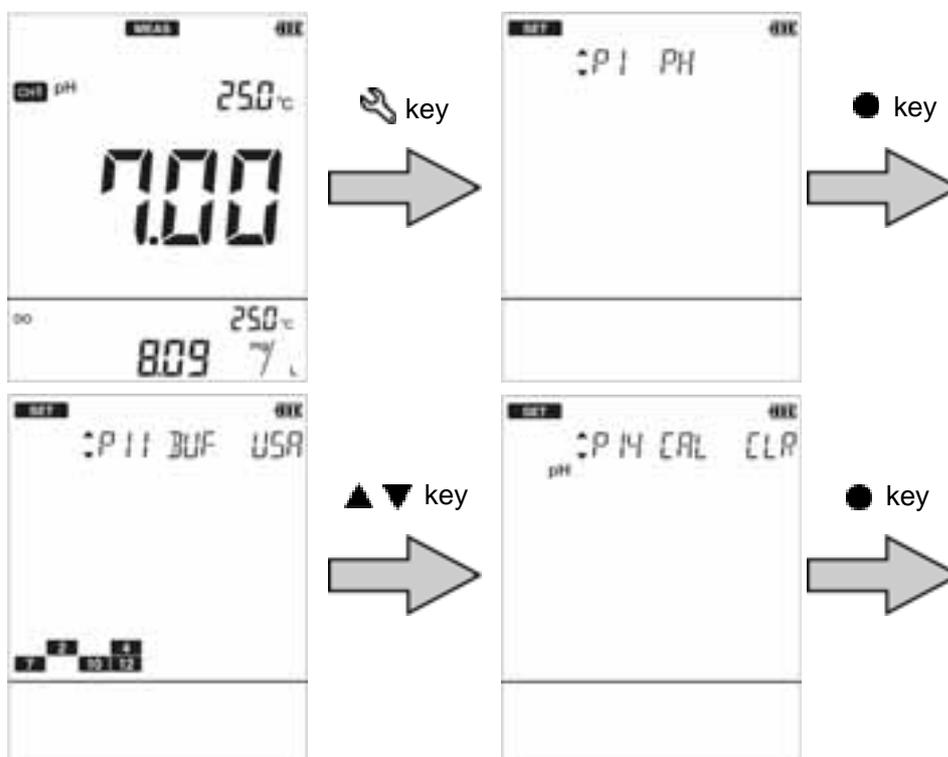


To return to the measurement mode, press the  key.

● Deleting calibration data

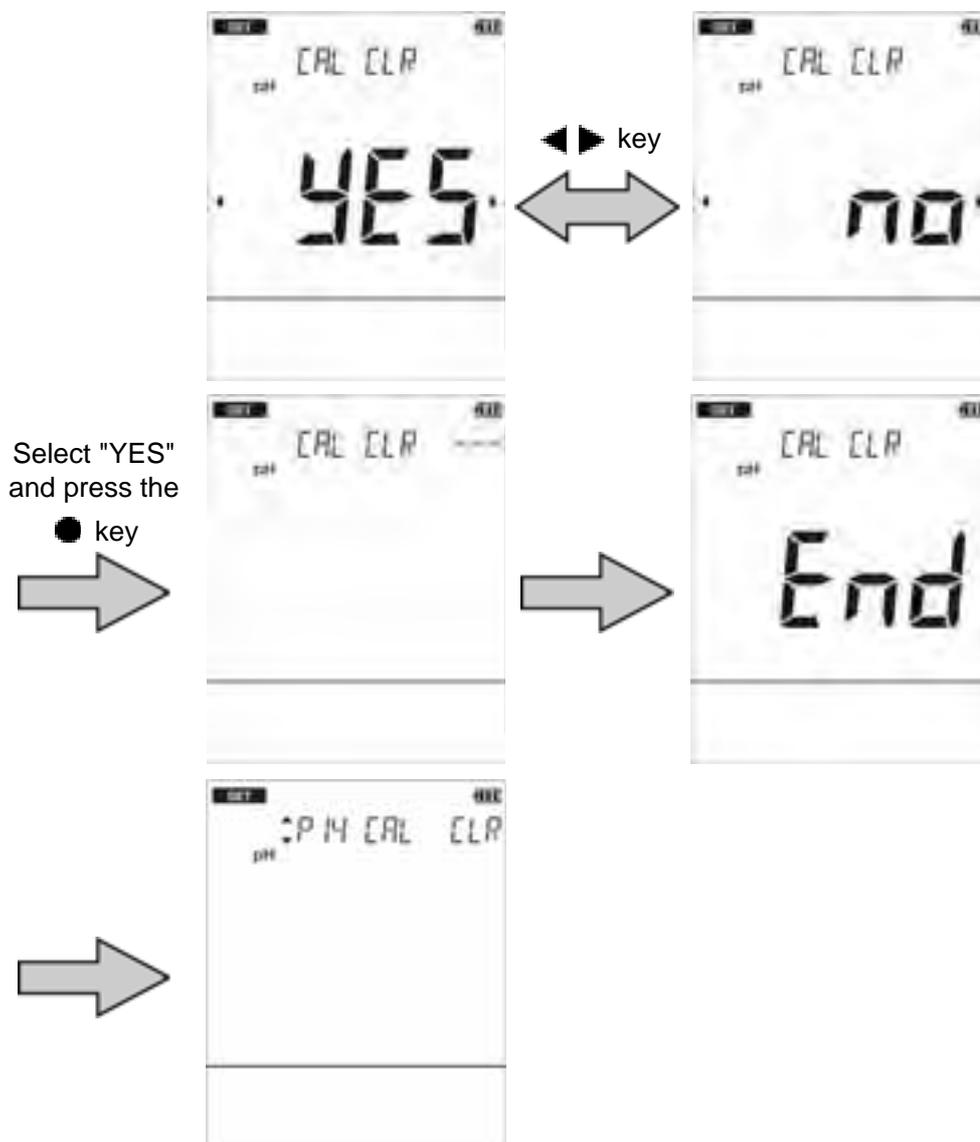
Delete the calibration data set in the instrument.

1. Press the  key to enter the setting mode.
2. Press the   keys to select the component to delete the data from "pH" or "DO" and then press the  key.
3. Press the   keys to select "CAL CLR" (delete calibration data) and then press the  key.



4. Select "YES" to delete the calibration data, or select "NO" to cancel deleting it. And then press the  key to confirm selection.

When "YES" is selected and the  key is pressed, "END" appears after deletion is complete.



To return to the measurement mode, press the  key.

Tip

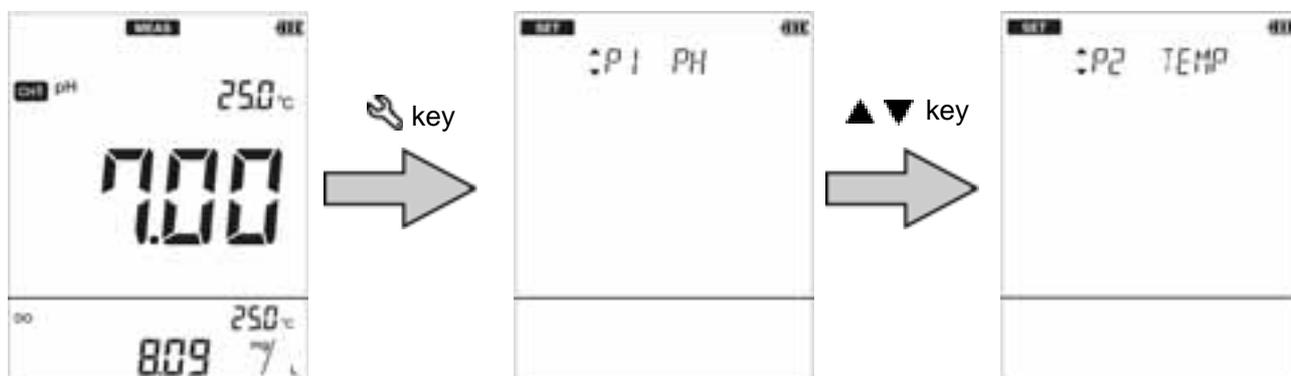
When the  key is pressed for more than three seconds in the measurement mode, "CAL CLR" screen appears, and the calibration data can be deleted.

■ Temperature settings

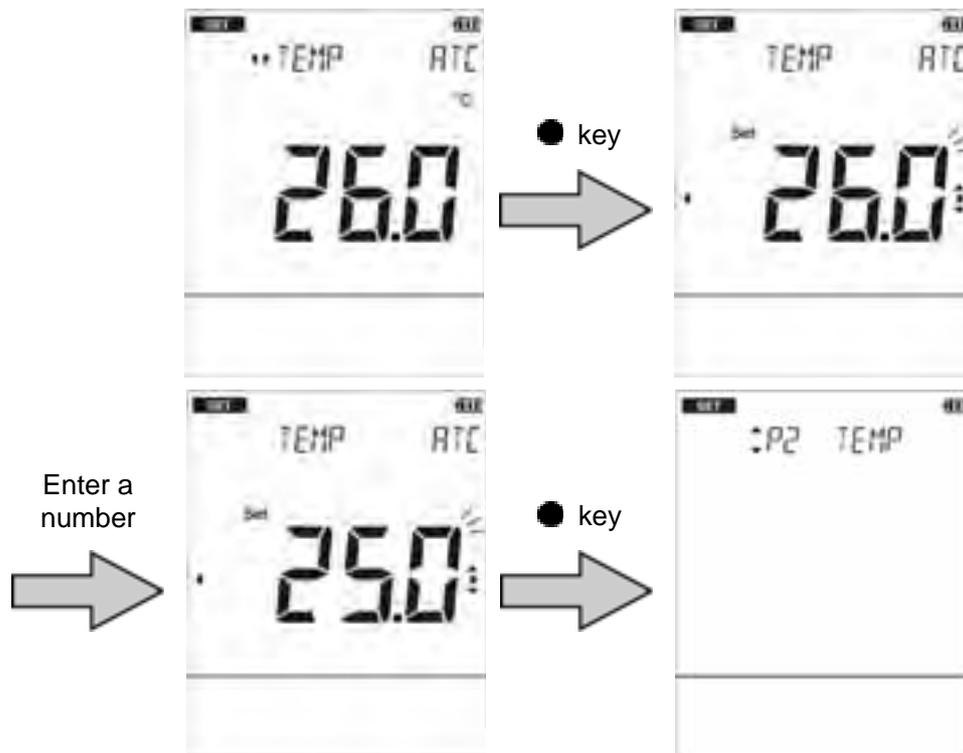
● Calibrating temperature sensor

The temperature sensor or temperature compensation electrode in the combination electrode has $\pm 1^{\circ}\text{C}$ accuracy without calibration. You can use a known temperature solution to calibrate the temperature sensor.

1. Insert the temperature connector into the jack of temperature connector (T) on the instrument.
2. Immerse the electrode into the solution until the temperature sensor is immersed.
3. Press the  key to enter the setting mode when the channel which is connected to the temperature sensor to calibrate is active.
4. Press the   keys to select "TEMP" (temperature calibration setting) and then press the  key.



5. Make sure that "ATC" is displayed, and press the  key. The temperature setting screen is displayed.
6. Enter the set temperature and press the  key to confirm. The temperature sensor is calibrated.



To return to the measurement mode, press the  key.

Note

When initializing temperature calibration data, all settings need to be initialized. Perform initialization by referring to "Resetting to factory default settings" (page 68). When initialization is performed, all saved data is deleted. Copy or transfer necessary data to a PC for storage.

■ General settings

● Setting the auto stability and auto hold function

This instrument has auto stability mode and auto hold mode.

- **Auto stability mode (displayed as AS)**

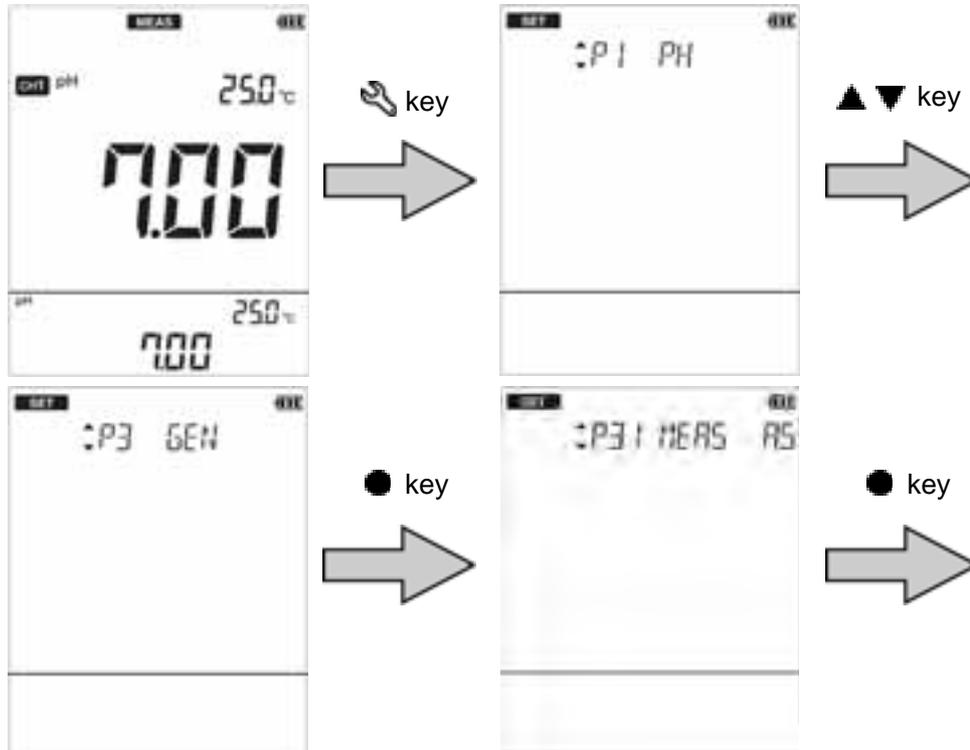
When the criterion for stability judgment is fulfilled during measurement, the component icon lights and the measured value is fixed. Once the value deviates from the stability judgment criterion, the measured value is released and displays instantaneous value.

- **Auto hold mode (displayed as AH)**

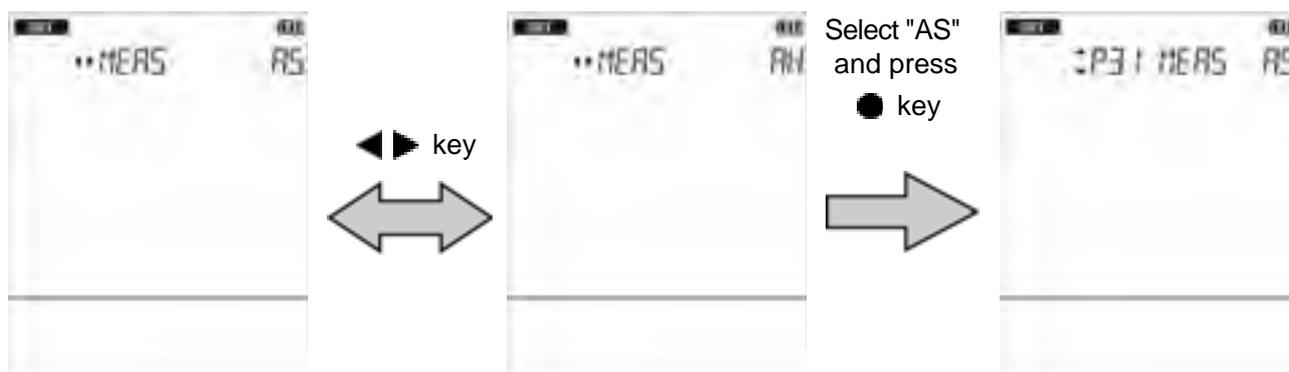
When the criterion for stability judgment is fulfilled during measurement, the component icon and the HOLD icon light and the measured value is fixed. To release the measured value, press the  key. Once a measured value is fixed, the measured value is not released automatically even when the state deviates from the stability judgment criterion.

- **Setting procedure**

1. Press the  key to enter the setting mode.
2. Press the   keys to select "GEN" (general setting) and then press the  key.
3. Press the   keys to select "MEAS" (measurement setting) and then press the  key.



4. Select "AS" to set the auto stability, or select "AH" to set the auto hold. And then press the  key to confirm selection.



To return to the measurement mode, press the  key.

Note

In the calibration mode, the auto stability mode always works.

Tip

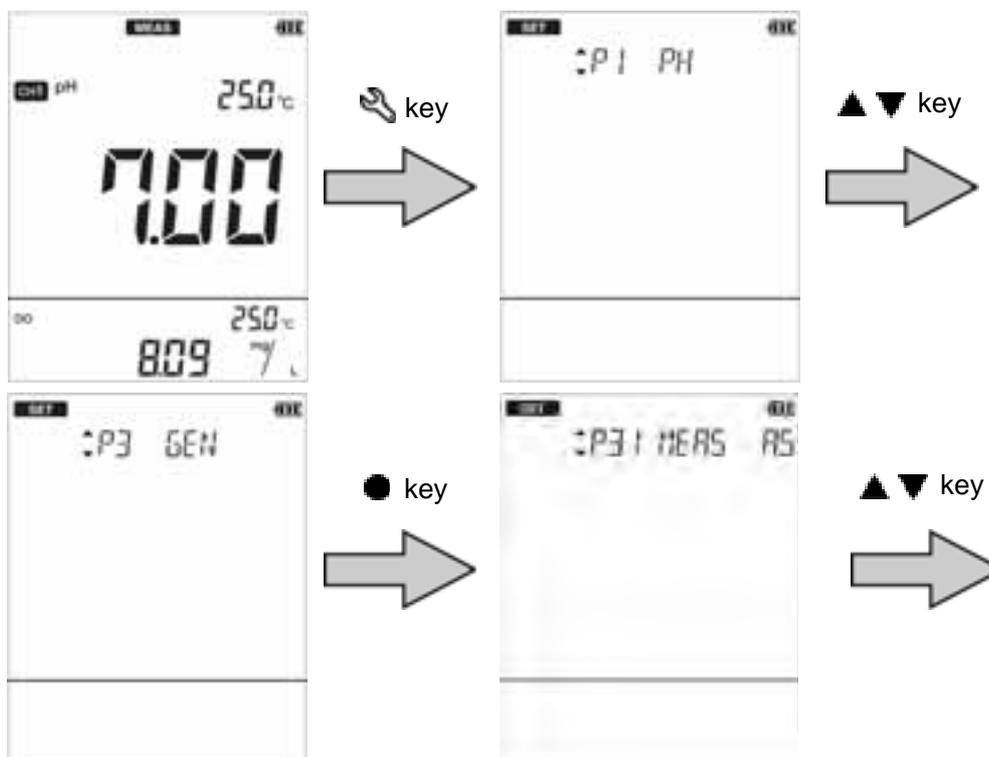
The stability judgment criteria is the same for both the auto stability mode and auto hold mode.

● Changing the automatic power off setting (default: 30 min)

You can set the instrument to automatically turn OFF when there is no key operation for a certain period of time.

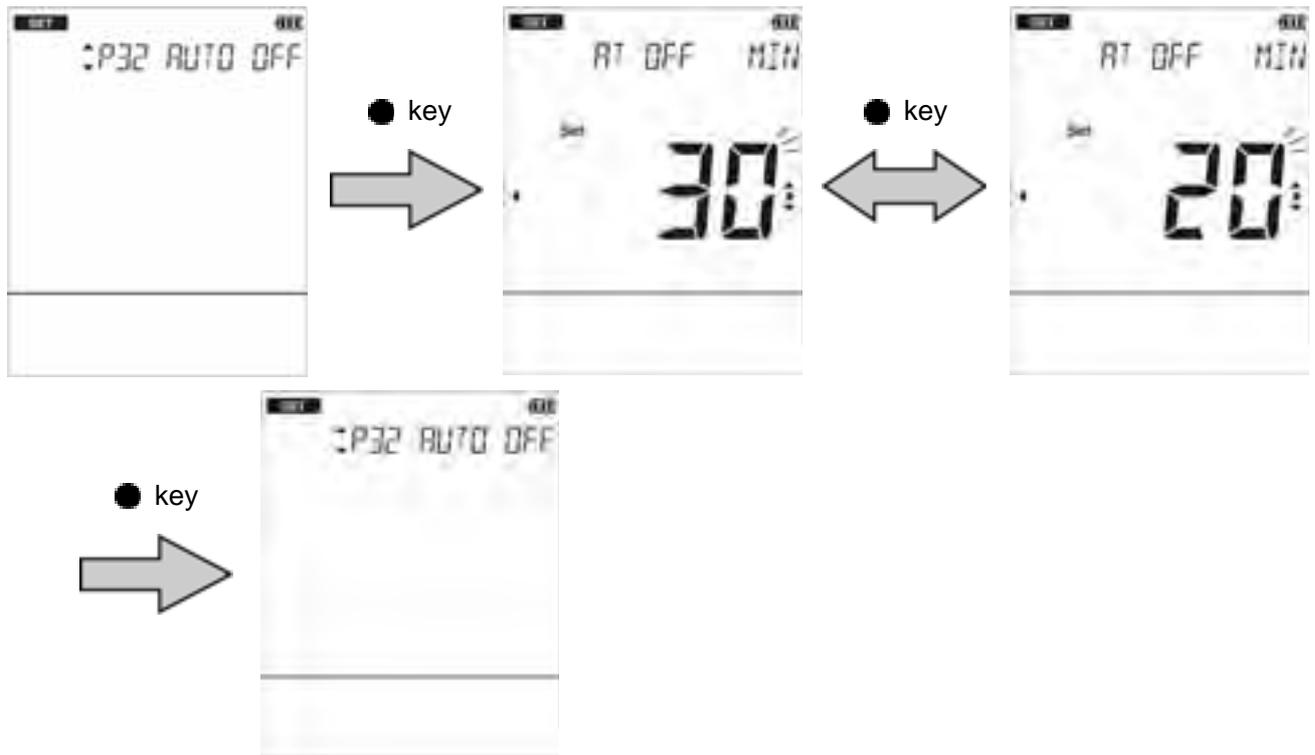
This function is disabled during automatic data memory saving or remote operation using an external device.

1. Press the  key to enter the setting mode.
2. Press the   keys to select "GEN" (general setting) and then press the  key.



3. Press the   keys to select "AUTO OFF" (automatic power off setting) and then press the  key.

4. Enter the automatic power off time and press the ● key.
The setting range is 0 min to 30 min.
"0" indicates the automatic power off is "OFF."

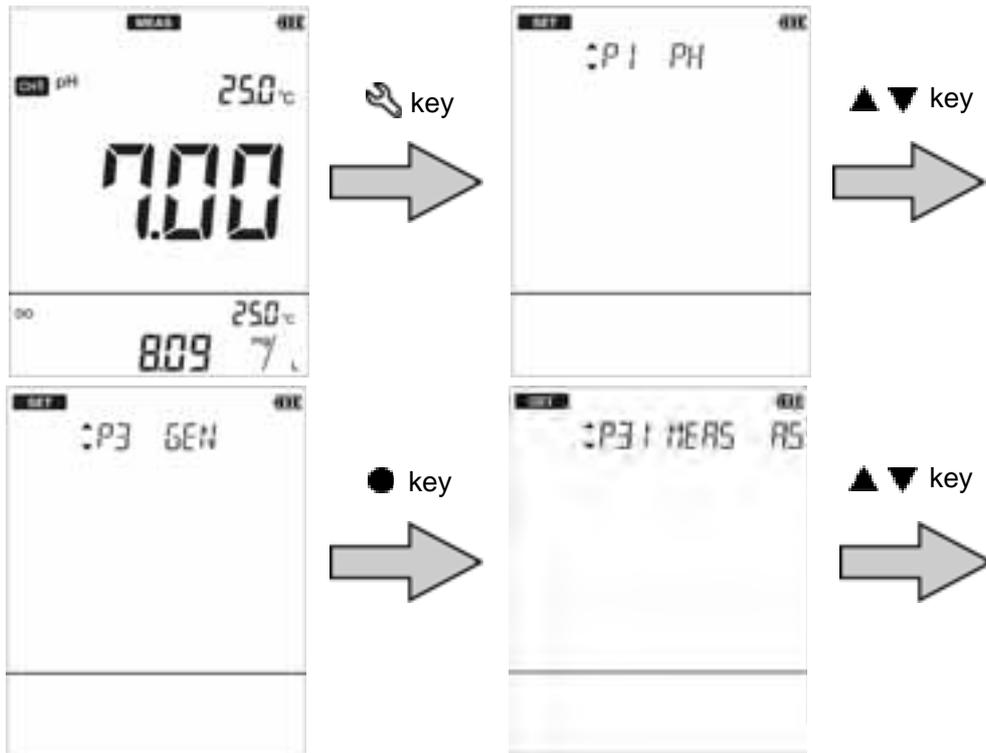


To return to the measurement mode, press the  key.

● Resetting to factory default settings

The instrument settings can be reset to the factory default settings. The calibration data is deleted but the data of date and time, and the saved data are not deleted. Make sure there will be no problems before using this function. When this function is used, the temperature calibration data is also initialized.

1. Press the  key to enter the setting mode.
2. Press the   keys to select "GEN" (general setting) and then press the  key.

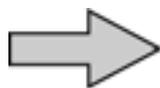
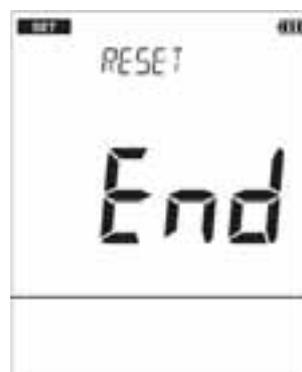
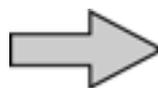
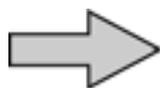


3. Press the   keys to select "RESET" (initialize) and then press the  key.

4. Select "YES" to initialize the settings to the factory default settings, or select "NO" to cancel initialization. And then press the ● key to confirm selection. When "YES" is selected, "END" appears after the settings are initialized and then the instrument is automatically power OFF.



Select "YES" and press the ● key

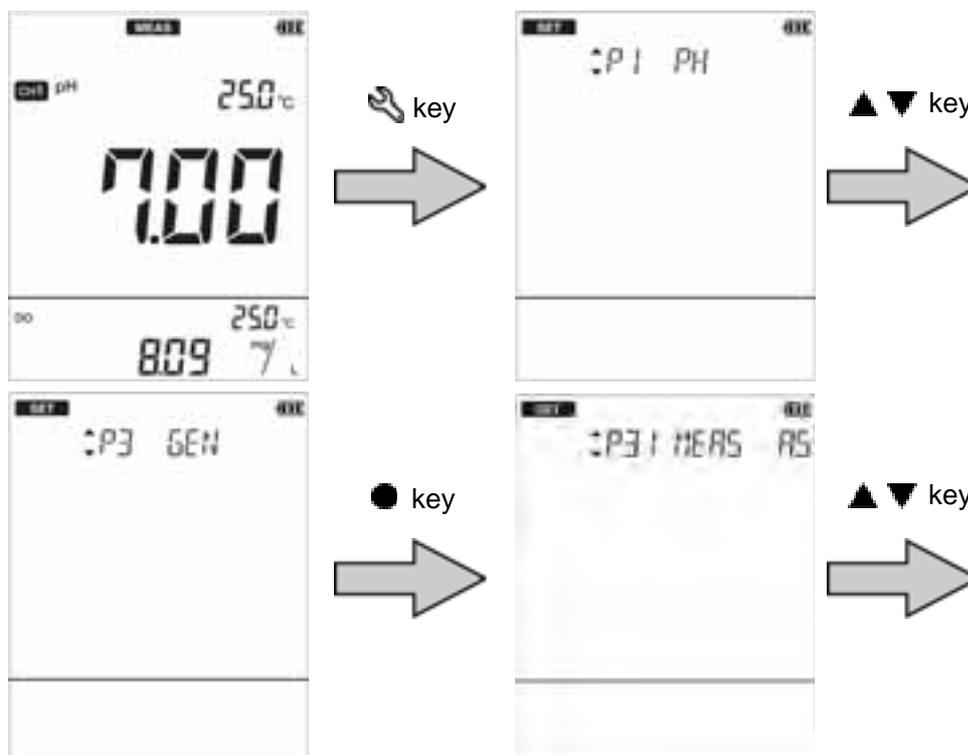


Power OFF

● Setting the date and time

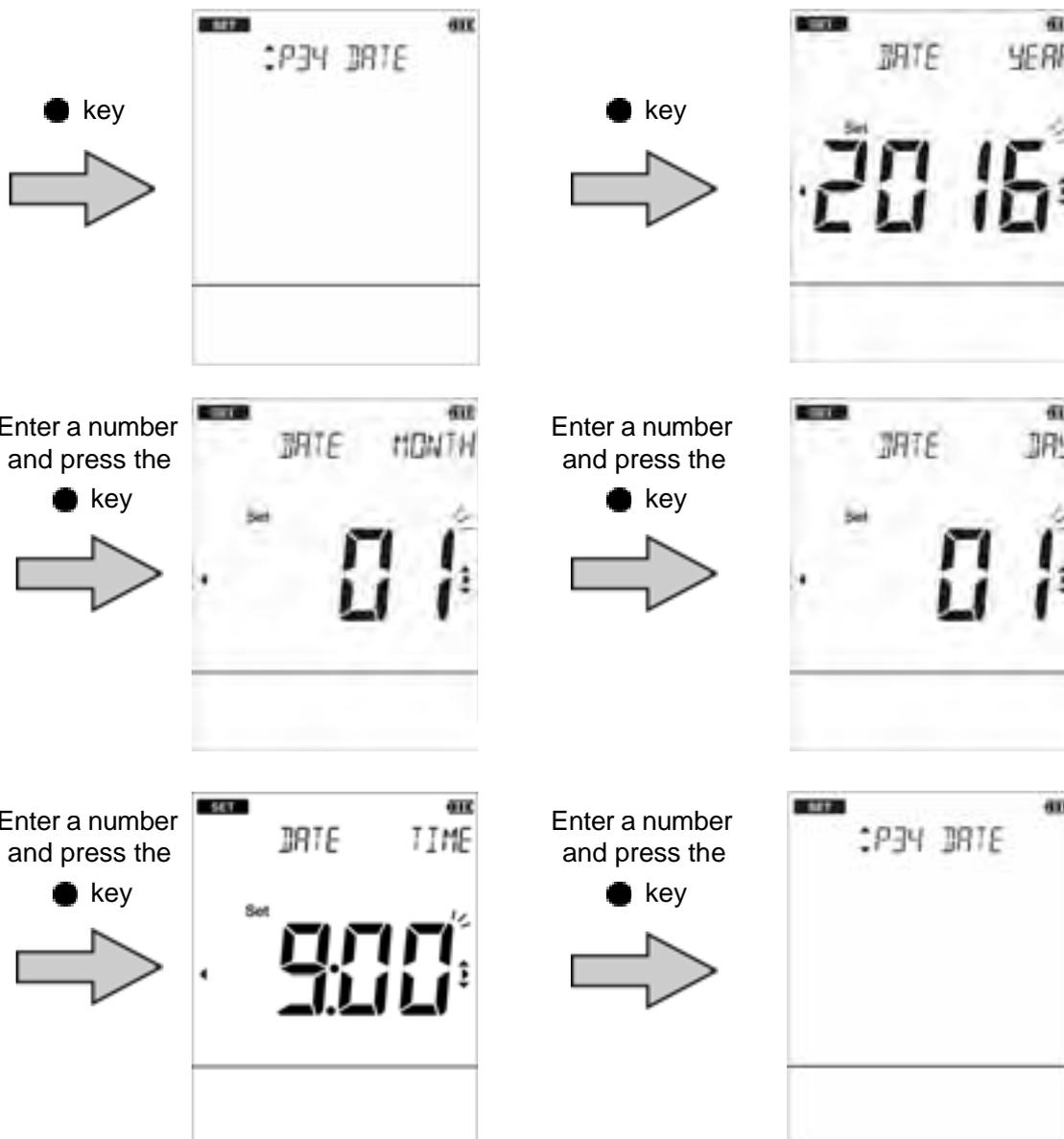
When using the instrument for the first time or after replacing the batteries, set the date and time. After setting, the date and time data is displayed correctly when saving data in the internal memory. If the setting is incorrect, the date and time of saved data becomes incorrect.

1. Press the  key to enter the setting mode.
2. Press the  keys to select "GEN" (general setting) and then press the  key.



3. Press the  keys to select "DATE" (date and time setting) and then press the  key.
4. Enter "YEAR" (current year) and press the  key.

5. In the same way, set "DATE" (month and date) and "TIME" (hour and minute), in that order.
6. Press the ● key to confirm the setting.



To return to the measurement mode, press the  key.

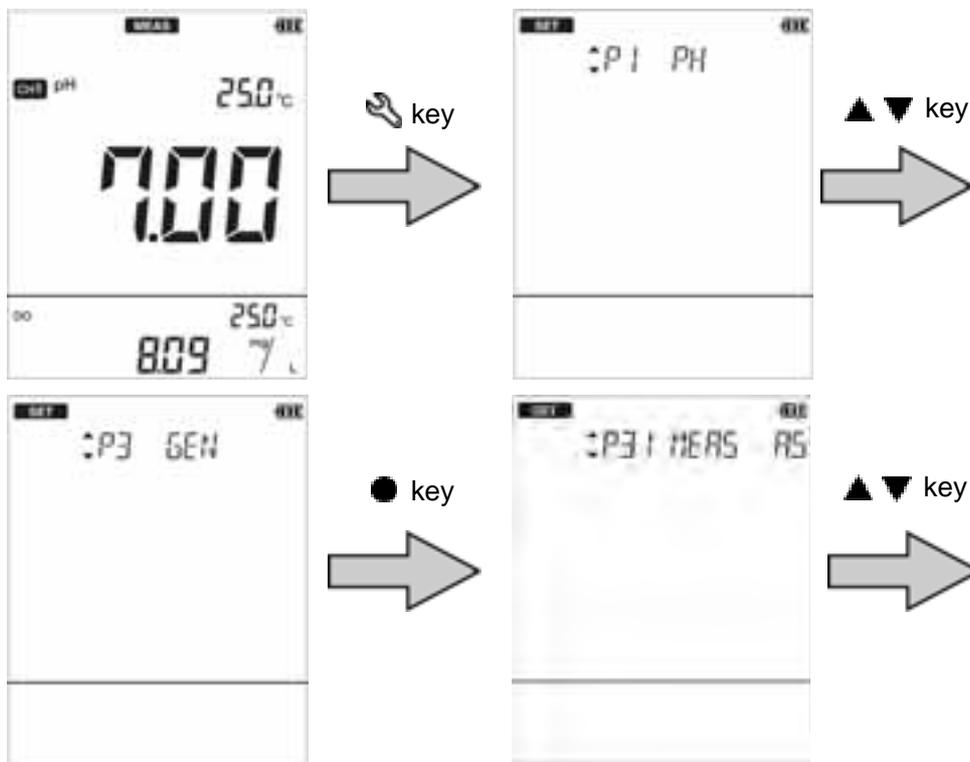
● Performing test printing of the printer unit

In order to check whether the printer unit is operating correctly or there is a printer communication problem, you can perform test printing.

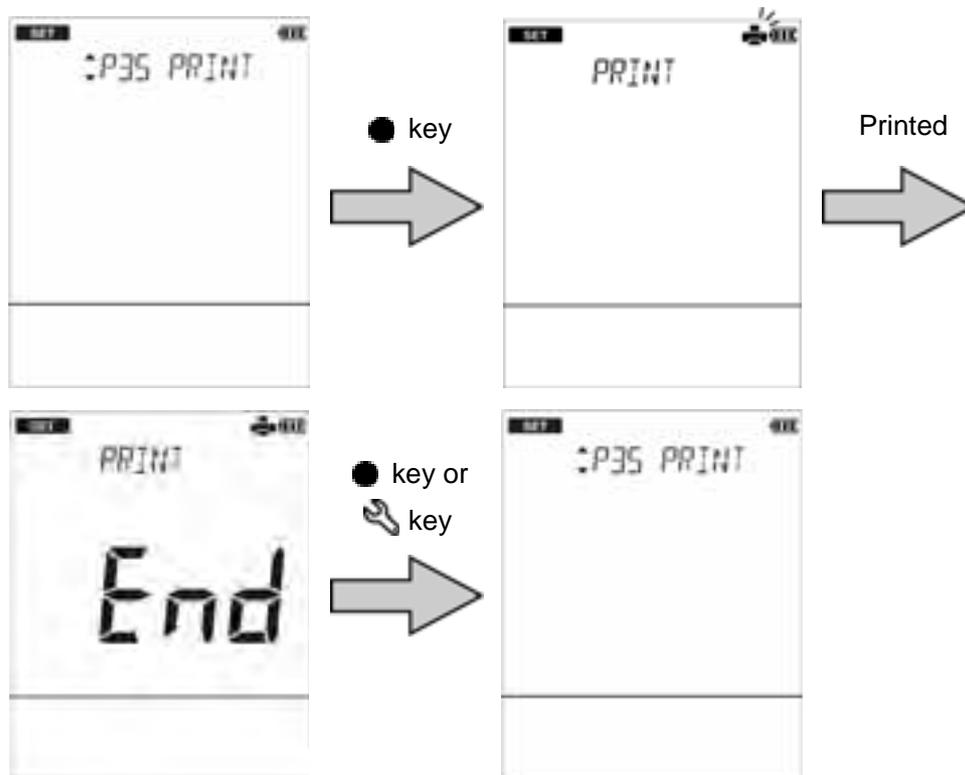
Connect the instrument and a printer correctly and perform the following procedure for test printing. As a result of test printing, if the printout is as shown below, the printer unit is operating correctly.

```
!"#$%&'()*+,-./0123
456789:;<=>?@ABCDEFGH
IJKLMNOPQRSTUVWXYZ[
¥]~_`abcdefghijklmnop
qrstuvwxyz{|}
```

1. Press the  key to enter the setting mode.
2. Press the   keys to select "GEN" (general setting) and then press the  key.



3. Press the ▲▼ keys to select "PRINT" (test print) and then press the ● key. Printing starts automatically. When printing ends, the printer icon lights and "END" appears. Press the ● key or the 🔑 key.



To return to the measurement mode, press the 🔄 key.

■ Other settings

● Printing measured values and calibration data

Print out the measured value or calibrated value displayed on the instrument, or the measurement data or the calibration data saved in the instrument. If the repeatability is inspected, the inspection data is printed out with the calibration data.

Pressing the ● key starts printing during displaying the data you want to print. Use the printer cable to connect the printer unit with the instrument beforehand. If the automatic data memory is set to "ON", you cannot print out in the measurement mode.

Reference

For details of how to display measurement data and calibration data, refer to the respective section.

"Displaying saved data" (page 50)

"Displaying the latest calibration and inspection data" (page 56)

Refer to the following table for the pH (two point calibration) and dissolved oxygen.

< The data saved in internal memory >

| Printout format | | Description |
|-----------------|------------------|---|
| Memory Num | :0001 | Data number |
| Date | : 2016/01/01 | Measurement date |
| Time | : 09:00 | Measurement time |
| Channel | : 1 | Measurement channel |
| pH | : 5.22 | Measured value and out of the measurement range or displaying range mark Over: OR Under: UR |
| Temperature | : 25.0°C MTC | Temperature value, temperature setting and out of the measurement range or displaying range mark Over: OR Under: UR |
| Inst. model | : LAQUAact-PD110 | Instrument model |
| Inst. SN | : KL1TSE10 | Instrument serial number |
| Elect. status | : GOOD | Electrode status based on calibration result |
| Memory Num | : 0001 | Data number |
| Date | : 2016/01/01 | Measurement date |
| Time | : 09:00 | Measurement time |
| Channel | : 2 | Measurement channel |
| DO | : 1.03 mg/L | Measured value |
| Temperature | : 25.0°C MTC | Temperature value and temperature setting |
| Inst. model | : LAQUAact-PD110 | Instrument model |
| Inst. SN | : KL1TSN36 | Instrument serial number |

< Calibration data (pH, inspection was performed) >

| Printout format | Description |
|------------------------------|---|
| Inst. model : LAQUAact-PD110 | Instrument model |
| Inst. SN : KL1TSN36 | Instrument serial number |
| Elect. status : GOOD | Electrode status based on calibration result |
| Offset : 0.7 mV | Asymmetry potential of calibration data |
| Sensitivity | Sensitivity of calibration data |
| pH 4.01 - 6.86 : 98.9% | |
| Repeatability : 0.01 | Repeatability of calibration data |
| Calibration data | |
| Date : 2016/01/01 | Calibration date |
| Time : 09:00 | Calibration time |
| pH 4.01 : 176.9 mV | Measurement potential |
| : 25.0°C ATC | Temperature value and temperature setting |
| pH 6.86 : 7.6 mV | Measurement potential |
| : 25.0°C ATC | Temperature value and temperature setting |
| Inspection before use | |
| pH 6.85 : 7.8 mV | Measurement potential at time of repeatability inspection |
| : 25.0°C ATC | Temperature value and temperature setting |

< Calibration data (pH, inspection was not performed) >

| Printout format | Description |
|------------------------------|--|
| Inst. model : LAQUAact-PD110 | Instrument model |
| Inst. SN : KL1TSN36 | Instrument serial number |
| Elect. status : GOOD | Electrode status based on calibration result |
| Offset : 0.7 mV | Asymmetry potential of calibration data |
| Sensitivity | Sensitivity of calibration data |
| pH 4.01 - 6.86 : 98.9% | |
| Calibration data | |
| Date : 2016/01/01 | Calibration date |
| Time : 09:00 | Calibration time |
| pH 4.01 : 176.9 mV | Measurement potential |
| : 25.0°C ATC | Temperature value and temperature setting |
| pH 6.86 : 7.6 mV | Measurement potential |
| : 25.0°C ATC | Temperature value and temperature setting |

Other settings

< Calibration data (dissolved oxygen, air calibration) >

| Printout format | Description |
|------------------------------|---|
| Inst. model : LAQUAact-PD110 | Instrument model |
| Inst. SN : KL1TSN36 | Instrument serial number |
| CAL MODE : Air | Calibration mode Air calibration: Air Standard solution calibration: Solution |
| Calibration data | |
| Date : 2016/01/01 | Calibration date |
| Time : 09:00 | Calibration time |
| CAL OK : | Calibration result |
| : 25.0°C ATC | Temperature value and temperature setting |
| SAL. Coef : 35.0 PPT | Salinity coefficient |
| Pres. Coef : 101.3 kPa | Air pressure coefficient |

< Calibration data (dissolved oxygen, standard solution calibration) >

| Printout format | Description |
|------------------------------|---|
| Inst. model : LAQUAact-PD110 | Instrument model |
| Inst. SN : KL1TSN36 | Instrument serial number |
| CAL MODE : Solution | Calibration mode Air calibration: Air Standard solution calibration: Solution |
| Calibration data | |
| Date : 2016/01/01 | Calibration date |
| Time : 09:00 | Calibration time |
| 8.11 mg/L : | SPAN calibration value |
| : 25.0°C ATC | Temperature value and temperature setting |
| SAL. Coef : 5.0 PPT | Salinity coefficient |
| Pres. Coef : 101.3 kPa | Air pressure coefficient |

● Transferring saved data to a PC

By using a serial cable to connect the instrument to a PC, you can transfer the saved data to the PC and edit it. Connect the serial connector at the instrument side to the RS-232C port on the PC.

To save and edit data, please download the software "FD-70" from our website after the registration. (The software "FD-70" will be available at the end of February 2016.)

For details of how to use the "FD-70", refer to the "FD-70" instruction manual, which you can download from our website as well.

The required PC specifications and recommended PC specifications for using the "FD-70" are shown in the following table.

| Item | Required PC specifications | Recommended PC specifications |
|----------------|--|-------------------------------|
| Memory | 32 bit: 1 GB or more 64 bit: 2 GB or more | |
| CPU | 1 GHz or more | |
| HDD free space | 5 GB or more | 10 GB or more |
| OS | Windows 7, Windows 8 (8.1), or Windows 10 | |
| Display | Super VGA (800 × 600) or more | |
| Connector | Serial connector (D-Sub 9 pin) | |

Note

- If you are not using the RS-232C communication, close the connector cover tightly.
- While using the RS-232C communication, the instrument is not dust-proof or waterproof. Do not use the RS-232C communication in a dusty place or with wet hands.

● Operating the instrument from an external device

You can remotely operate the instrument from an external device (such as PC) via the RS-232C communication. Use the serial cable to connect the serial connector on the instrument side and the serial port on the PC.

When using this function, pay attention to the following points.

- Use the optional serial cable to connect the unit to a PC.
- Make sure that the transfer formats used in the instrument and a PC are the same. When different transfer formats are used, a communication error occurs and the online mode does not start up, and as a result RS-232C communication cannot be performed. Also, when the transfer format is changed, turn OFF the power of the instrument and PC and then reboot them.

The transfer format of the instrument is as follows.

- Baud rate: 2400 bps
- Character length: 8 bits
- Parity: None
- Stop bit: 1 bit

You can download a list of communication commands from our website. In order to download the list, you need to complete user registration.

Note

- If you are not using the RS-232C communication, close the connector cover tightly.
 - While using the RS-232C communication, the instrument is not dust-proof or waterproof. Do not use the RS-232C communication in a dusty place or with wet hands.
-

Maintenance

This section describes maintenance of the instrument and the electrodes that are used with the instrument. To use them for a long period, perform the described maintenance procedures appropriately.

● Contact for maintenance

Please contact your dealer for the product maintenance.

● Maintenance and storage of the instrument

- If the instrument becomes dirty, wipe it gently with a soft dry cloth. If it is difficult to remove the dirt, wipe it gently with a cloth moistened with alcohol.
- The instrument is made of solvent resistant materials but that does not mean it is resistant to all chemicals. Do not dip the instrument in strong acid or alkali solution, or wipe it with such solution.
- Do not wipe the instrument with a polishing powder or other abrasive compound.

● Environmental conditions for storage

Temperature: 0°C to 45°C

Humidity: under 80% in relative humidity and free from condensation

Avoid the following conditions.

- Dusty place
- Strong vibration
- Direct sunlight
- Corrosive gas environment
- Close to an air-conditioner
- Direct wind

● Maintenance and storage of the pH electrode

For the detailed procedures for maintaining and storing electrodes, refer to the instruction manual for each electrode. This section describes an overview of the procedures for maintenance and storage to be performed as part of daily use.

• How to clean the electrode

When the tip of an electrode (responsive membrane and liquid junction) becomes dirty, the response speed may become slow or an error may occur in the measurement results. To avoid such error, clean the electrode. For dirt that cannot be removed by pure water (or deionized water), use the cleaning solution indicated below depending on the type of dirt. After cleaning, rinse the electrode with pure water (or deionized water).

| Type of dirt | Cleaning solution |
|---------------------|--|
| General | Diluted neutral cleaning solution |
| Oil | Alcohol, or diluted neutral cleaning solution |
| Inorganic substance | 1 mol/L HCl or electrode cleaning solution (model 220) |
| Protein | Cleaning solution including protein-removing enzyme (model 250) |
| alkali | Immerse 1 mol/L HCl or electrode cleaning solution (model 220) in 1 h to 2 h |

• Daily storage of the electrode

If the electrode becomes dry, the response will slow. Store in a moist atmosphere. Follow the steps below to properly store the electrode.

1. Clean the electrode well with pure water (or deionized water) to remove sample completely, and close the internal solution filler port.
2. Clean inside of the protective cap with pure water (or deionized water), then add enough pure water (or deionized water) to soak the sponge.
3. Attach the protective cap.

• When the electrode will not be used for a long period

To store the electrode for a long period, follow the electrode storage procedure above, and in addition, use a dropper or similar tool to replace the reference electrode internal solution (model 300) with new solution. Replace the internal solution once every three to six months.

● Maintenance and storage of the ORP electrode

For the detailed procedures for maintaining and storing electrodes, refer to the instruction manual for each electrode. This section describes an overview of the procedures for maintenance and storage to be performed as part of daily use.

• How to clean the electrode

When the tip of an electrode (responsive membrane and liquid junction) becomes dirty, the response speed may become slow or an error may occur in the measurement results. To avoid such error, clean the electrode. For dirt that cannot be removed by pure water (or deionized water), use the cleaning solution indicated below depending on the type of dirt. After cleaning, rinse the electrode with pure water (or deionized water).

| Type of dirt | Cleaning solution |
|---------------------|--|
| General | Diluted neutral cleaning solution |
| Oil | |
| Inorganic substance | Immerse dilute nitric acid (1:1 nitric acid) |

• Daily storage of the electrode

If the electrode becomes dry, the response will become slow. Store in a moist atmosphere. Follow the steps below to properly store the electrode.

1. Clean the electrode well with pure water (or deionized water) to remove sample completely, and close the internal solution filler port.
2. Clean inside of the protective cap with pure water (or deionized water), then add enough pure water (or deionized water) to soak the sponge.
3. Attach the protective cap.

• When the electrode will not be used for a long period

To store the electrode for a long period, follow the electrode storage procedure above, and in addition, use a dropper or similar tool to replace the reference electrode internal solution (model 300) with new solution. Replace the internal solution once every three to six months.

● Checking the state of the ORP electrode

ORP standard solution can be used to check the state of the ORP electrode. This solution is only used to check the state of the ORP electrode; it is not used to calibrate the instrument. The procedure for checking the electrode using HORIBA ORP standard solution powder 160-22 or 160-51 is explained below.

1. Add one bag of 160-22 or 160-51 standard solution powder to 250 mL of deionized water and mix thoroughly.

When mixing, the excess quinhydrone (a black powder) will float to the surface of the solution.

2. Immerse a washed and dried ORP electrode in the prepared standard solution and measure the mV value.

If the electrode and the instrument are working properly, numerical values within ± 15 mV of those indicated below should be obtained.

The ORP value varies by temperature. Check the appropriate ORP value for the temperature of the standard solution.

3. If the ORP value is not within ± 15 mV, replace the reference electrode internal solution.

If the surface of the metal electrode is dirty, wipe it gently with a soft material such as absorbent cotton moistened with alcohol or a neutral cleaning solution, or immerse in dilute nitric acid (1:1 nitric acid) to remove the dirt.

4. Repeat the measurement.

If the ORP value is within ± 15 mV, the electrode is normal.

If not within ± 15 mV, the electrode may have failed. Replace the electrode.

Note

- If the prepared standard solution is left out in air for one hour or more, that the ORP value might change. Do not use the ORP standard solution that was prepared more than an hour before.
- When measuring a solution that has low concentrations of oxidants and reductants after conducting an operational check using a standard substance, the measured values may not stabilize or the repeatability might be poor. If this is the case, use the ORP electrode after immersing it in the solution again and mixing it thoroughly.

• ORP value based on the temperature of ORP standard solution

| Temp. (°C) | 160-22 Phthalic-acid chloride + quinhydrone (mV) | 160-51 Neutral phosphate + quinhydrone (mV) |
|---------------|--|---|
| 5 | 274.2 | 111.9 |
| 10 | 270.9 | 106.9 |
| 15 | 266.8 | 101.0 |
| 20 | 262.5 | 95.0 |
| 25 | 257.6 | 89.0 |
| 30 | 253.5 | 82.7 |
| 35 | 248.6 | 76.2 |
| 40 | 243.6 | 69.0 |

● Maintenance and storage of the DO electrode

For the detailed procedures for maintaining and storing electrodes, refer to the instruction manual for each electrode. This section describes an overview of the procedures for maintenance and storage to be performed as part of daily use.

• How to clean the membrane of DO electrode

The membrane of DO electrode is extremely thin. Take care not to tear the membrane when cleaning. Clean the membrane with pure water (or deionized water) and wipe it with a soft cloth, taking care not to damage it.

Note

When using a neutral cleaning solution to clean the DO electrode, keep the neutral cleaning solution away from the membrane in order to prevent deterioration of the membrane.

• Daily storage of the DO electrode

Follow the steps below to store the electrode correctly.

9520-10D

1. Clean the DO electrode well with pure water (or deionized water).
2. Attach the adapter to the DO electrode.
3. Immerse the DO electrode in a conical flask containing zero standard solution (5% sodium sulfite solution).



9551-20D, 9551-100D

1. Clean the DO electrode well with tap water.
2. Keep the DO electrode immersed in tap water.

Note

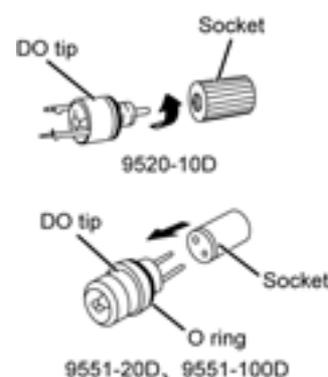
Leave the DO electrode connected to the instrument.

• When the DO electrode will not be used for a long period

Follow the steps below to store the electrode correctly.

9520-10D, 9551-20D, 9551-100D

1. Clean the DO electrode well with tap water, then dry it with cotton gauze.
2. Remove the DO tip from the DO electrode.
3. Attach the socket on the DO chip, then store it in a cool, dark location.



MEMO

How to resolve errors or troubles

This section describes the causes of typical problems and the actions to be taken, including questions frequently asked by customers. Check these before contacting us.

■ When an error message appears

If "ERR No.00XX" is displayed while you are using the instrument, check the error in the error list below, and check the cause and action to be taken.

| ERR No. | Description | Definition of error |
|---------|-------------------------------------|--|
| 0001 | Memory error | Data cannot be read from or written to the internal memory. |
| 0002 | Empty battery level | The battery level is empty. |
| 0004 | Asymmetric potential error | The asymmetric potential of the electrode is out of the range of ± 45 mV. |
| 0005 | Electrode sensitivity error | The electrode sensitivity is either 105% or more or 85% or less than the theoretical sensitivity. (pH) The electrode sensitivity is out of the setting range that allows normal measurement. (DO) |
| 0006 | Maximum calibration points exceeded | 6th point calibration is attempted. |
| 0007 | Cannot identify standard solution | The instrument cannot identify the standard solution. |
| 0008 | Calibration interval error | Exceeds the calibration interval setting. |
| 0009 | Printer error | There is a problem with the printer. |
| 0010 | Memory full | The number of the data saved has exceeded the limit of the internal memory. |

● ERR No.0001 Memory error

Data cannot be read from or written to the internal memory.

| Cause | How to solve problem |
|---|--|
| The instrument does not start properly due to noise or other at power ON. | Remove the batteries, disconnect the AC adapter, and then press the  key. |
| The defect of the internal IC | Contact your dealer for repair. |

● ERR No.0002 Empty battery level

The instrument cannot operate properly because the battery level is empty.

| Cause | How to solve problem |
|-----------------------------|---|
| The battery level is empty. | Replace the batteries or connect the AC adapter (option). |

● ERR No.0004 Asymmetric potential error

Detected that the asymmetric potential of the electrode is out of the setting range that allows proper measurement.

| Cause | How to solve problem |
|--|--|
| The electrode is dirty. | Clean the electrode. |
| The electrode is cracked. | Replace the electrode. |
| The standard solution concentration is fluctuating. | Replace the internal solution in the reference electrode. |
| The electrode is not connected correctly. | Connect the electrode correctly. |
| Electrode is not immersed enough to cover liquid junction. | The electrode must be immersed up to the liquid junction. As a guide, immerse to at least 3 cm from the tip of the electrode. |
| There is a problem with the standard solution. | Use new standard solution. |

● ERR No.0005 Electrode sensitivity error (pH)

Detected that the electrode sensitivity is out of the setting range that allows proper measurement.

| Cause | How to solve problem |
|--|---|
| The electrode is dirty | Clean the electrode. |
| The electrode is cracked | Replace the electrode. |
| Calibration was not performed correctly. | Perform the calibration correctly. |
| The electrode is not connected correctly | Connect the electrode correctly. |
| Electrode is not immersed enough to cover liquid junction. | The electrode must be immersed up to the liquid junction. As a guide, immerse to at least 3 cm from the tip of the electrode. |
| There is a problem with the standard solution. | Use new standard solution. |

● ERR No.0005 Electrode sensitivity error (DO)

Detected that the electrode sensitivity is out of the setting range that allows normal measurement.

| Cause | How to solve problem |
|--|--|
| The electrode is dirty | Clean the electrode. |
| The electrode is cracked | Replace the electrode. |
| The stirring is inappropriate. | Stir at an appropriate stirring speed (1000 to 1500 rpm). |
| The electrode is not connected correctly | Connect the electrode correctly. |
| The settings are wrong. | Set the correct salinity correction, air pressure correction, and temperature. |
| There is liquid on the DO tip membrane. (when performing air calibration) | Let the electrode sit until the liquid evaporates or remove the liquid using cotton gauze making sure not to scratch the membrane. |
| There is something wrong with the standard solution. (when conducting standard solution calibration) | Prepare new zero standard solutions. Sufficiently bubble the span standard solution with a diffuser or other tools. |

● ERR No.0006 Maximum calibration points exceeded

Attempted to perform 6th point calibration during pH calibration.

| Cause | How to solve problem |
|-------------------------------------|--------------------------------------|
| 6th point calibration is attempted. | Up to five points can be calibrated. |

● ERR No.0007 Cannot identify standard solution

Unable to automatically detect the standard solution during pH calibration.

| Cause | How to solve problem |
|---|---|
| There is a problem with the standard solution. | Use new standard solution. |
| Settings about the standard solution do not match the instrument. | Check if the instrument settings and the specifications of the standard solution are compatible. |
| The electrode is dirty. | Clean the electrode. |
| The electrode is cracked. | Replace the electrode. |
| The standard solution concentration is fluctuating. | Replace the internal solution in the reference electrode. |
| Electrode is not immersed enough to cover liquid junction. | The electrode must be immersed up to the liquid junction. As a guide, immerse to at least 3 cm from the tip of the electrode. |

● ERR No.0008 Calibration interval error

- More than the set number of days has elapsed since calibration was last performed.
- The calibration interval alarm is "ON" and calibration has not been performed.

| Cause | How to solve problem |
|--|----------------------|
| Calibration has not been performed for the set number of days of the calibration interval or longer. | Perform calibration. |
| The calibration interval alarm is "ON" and calibration has not been performed. | Perform calibration. |

● ERR No.0009 Printer error

An error occurred during printer communication.

| Cause | How to solve problem |
|--|---|
| There is a problem with the printer unit connection. | Check the printer connection, and connect the instrument and printer again. |
| The defect of the printer | Consult your dealer. |

● ERR No.0010 Memory full

Attempted to save more than the specified number of items.

| Cause | How to solve problem |
|--|---|
| Saving more than specified items of data is attempted. | The maximum number of savable items of data is 1000. Copy or transfer necessary data to a PC and delete the data from the memory ("Deleting all saved data" (page 54)). |

■ Troubleshooting

This section describes causes and actions to take for problems that customers frequently ask us.

● The indicated value fluctuates

< Problem with the electrode >

| Cause | How to solve problem |
|---|---|
| The electrode is dirty. | Clean the electrode. |
| The electrode is cracked. | Replace the electrode. |
| The wrong internal solution is being used. | Use the correct internal solution. |
| There are air bubbles on the electrode. | Shake the electrode to remove the air bubbles. |
| The level of internal solution in reference electrode is low. | Replenish the internal solution of the reference electrode until it is higher than the level of the sample. |

< Problem with the instrument >

| Cause | How to solve problem |
|---|---|
| There is a motor or other device causing electrical interference. | Measure at a place where no influence from induction is given. Ground all AC-powered equipment. |
| The electrode is not connected correctly. | Connect the electrode correctly. |

< Problem with the sample >

| Cause | How to solve problem |
|--|---|
| Electrode is not immersed enough to cover liquid junction. | The electrode must be immersed up to the liquid junction. As a guide, immerse to at least 3 cm from the tip of the electrode. |
| The stability of electrode is affected by the sample solution. | It is important to select an electrode that is appropriate for the sample. Consult your dealer. To confirm an electrode that is appropriate for the sample, check the pH electrode selection guide in our catalogue, or refer to our website. |
| The stirring is inappropriate. | Stir at an appropriate stirring speed (1000 rpm to 1500 rpm). |

● **The response is slow**

| Cause | How to solve problem |
|---|---|
| The electrode is dirty. | Clean the electrode. |
| The electrode is cracked. | Replace the electrode. |
| The wrong internal solution is being used. | Use the correct internal solution. |
| The response of electrode is affected by the sample solution. | It is important to select an electrode that is appropriate for the sample. Consult your dealer. To confirm an electrode that is appropriate for the sample, check the pH electrode selection guide in our catalogue, or refer to our website. |

● **The indicated value does not change/No response**

| Cause | How to solve problem |
|---|---|
| The electrode is cracked. | Replace the electrode. |
| The electrode is not connected correctly. | Connect the electrode correctly. |
| Keys are locked. | Turn off the power, remove the batteries, and then turn on the power again. |
| The instrument is in HOLD state. | Cancel the HOLD state. |
| Instrument defect | Consult your dealer. |

● The measured value is out of the measurement range

When the measured value is below the display range, "Ur" appears. When the measured value is over the display range, "Or" appears.

| Cause | How to solve problem |
|--|---|
| Sample is out of the measurement range. | Use a sample within the measurement range. |
| Electrode is not immersed enough to cover liquid junction. | The electrode must be immersed up to the liquid junction. As a guide, immerse to at least 3 cm from the tip of the electrode. |
| The electrode cable is broken. | Replace the electrode. |
| Calibration is not performed or performed incorrectly. | Perform calibration correctly. |
| Instrument defect | Check as explained below. |

• How to check for instrument defect

Short the metal part of the outer tube to the center pin of the electrode connector of the corresponding channel of the instrument. If "Ur" or "Or" appears in this condition, consult your dealer.



● Repeatability of the measured value is poor

| Cause | How to solve problem |
|--|---|
| Effect of the sample solution | Repeatability becomes poor when the pH of the sample changes over time. |
| The electrode is dirty. | Clean the electrode. (Electrode cleaning solution 220 or 250 is recommended.) |
| The electrode is cracked. | Replace the electrode. |
| The internal solution of the electrode runs out or contaminated. | Replace the internal solution with new one. |
| The level of internal solution in reference electrode is low. | Replenish the internal solution of the reference electrode until it is higher than the level of the sample. |

● Nothing appears when the power is turned ON

| Cause | How to solve problem |
|--------------------------------------|---|
| Power is not supplied. | Insert batteries or connect the AC adapter (option). |
| Battery polarity (+, -) is reversed. | Insert the batteries with the polarity (+, -) correctly oriented. |
| Battery life is low. | Replace the batteries or connect the AC adapter (option). |
| Instrument defect | Consult your dealer. |

● Swelling of operation key sheet

| Cause | How to solve problem |
|--|--|
| Using the instrument at high elevation or other location where the air pressure is different from sea level. | To eliminate the pressure difference between the inside and outside of the instrument, briefly open and then close the AC adapter cover. After opening, correctly close the cover to maintain dust and water proofing. |
| Instrument defect | Consult your dealer. |

● Part of the display is missing

| Cause | How to solve problem |
|-------------------|---|
| Instrument defect | Check the display in full screen state when turning ON the power of the instrument. |

MEMO

Appendix

This section describes the specifications of the instrument, default settings, measurement principles, and other technical information.

Options for the instrument are also described.

■ Main specifications

| Item | Contents |
|---|---|
| Model | LAQUAact-PD110 |
| Measurement parameters | pH, mV (ORP), dissolved oxygen, oxygen concentration, saturated oxygen concentration, temperature |
| Operating ambient temperature, humidity | 0°C to 45°C 80% or less in relative humidity (no condensation) |
| Power | AAA alkaline batteries (LR03) or AAA Ni-MH rechargeable batteries x 2 AC adapter 100 V to 240 V, 50/60 Hz, 0.37 A (option) |
| Dimensions | Approx. 67 [80] (W) x 170 (D) x 28 [42] (H) mm (The figures in square bracket are maximum thicknesses.) |
| Mass | Approx. 285 g (without batteries) |

Main specifications

· Specification of each measurement parameters

| Measurement parameter | Item | Description |
|--------------------------------|---------------------------------|--|
| pH | Measuring principle | Glass electrode |
| | Display range | pH -2.00 to pH 16.00 |
| | Measuring range | pH 0.00 to pH 14.00 |
| | Resolution | 0.01 pH |
| | Accuracy | ±0.01 pH |
| mV (ORP) | Measuring range | ±2000 mV |
| | Resolution | 1 mV |
| | Repeatability | 1 mV or 1% of the read value, whichever is greater |
| Temperature | Measuring principle | Thermistor method |
| | Display range | -30.0°C to 130.0°C |
| | Measuring range | 0.0°C to 100.0°C |
| | Resolution | 0.1°C |
| | Accuracy | 0.4°C |
| Dissolved oxygen | Measuring principle | Membrane galvanic cell |
| | Measuring range (Display range) | 0.00 mg/L to 20.00 mg/L |
| | Resolution | 0.01 mg/L |
| | Accuracy | ±0.1 mg/L |
| Oxygen concentration | Measuring principle | Conversion from dissolved oxygen value |
| | Measuring range (Display range) | 0.0% to 50.0% |
| | Resolution | 0.1% |
| Saturated oxygen concentration | Measuring principle | Conversion from dissolved oxygen value |
| | Measuring range (Display range) | 0.0% to 200.0% |
| | Resolution | 0.1% |

■ Instrument default settings

| Measurement parameter | Item | Selection item/Setting range | Default values |
|-----------------------|-------------------------------------|---------------------------------|----------------|
| Common | Auto hold | AS/AH | AS |
| | Temperature input value | 0.0°C to 100.0°C | 25.0°C |
| | Auto power off time | 0 min to 30 min ^{*1} | 30 min |
| | Auto data memory time | 0, 2 s to 3600 s ^{*2} | 0 s |
| | Auto data memory period | 0 min to 3600 min ^{*3} | 0 min |
| pH | Standard solution | USA/NIST/CUST | USA |
| | Calibration interval | 0 day to 400 days ^{*4} | 0 day |
| Dissolved oxygen | Salinity correction coefficient | 0.0 PPT to 40.0 PPT | 0.0 PPT |
| | Air pressure correction coefficient | 10.0 kPa to 199.9 kPa | 101.3 kPa |

*1: When 0 is inputted, auto power OFF is OFF.

*2: When 0 is inputted, auto data memory is OFF.

*3: When 0 is inputted, auto data memory period is OFF.

*4: When 0 is inputted, calibration alarm interval is OFF.

■ Technical note

● pH standard solutions at various temperatures

< USA >

| Temp. (°C) | pH 2 Oxalate | pH 4 Phthalate | pH 7 Neutral phosphate | pH 10 Carbonate | pH 12 Saturated calcium hydroxide solution |
|------------|--------------|----------------|------------------------|-----------------|--|
| 0 | 1.666 | 4.003 | 7.119 | 10.318 | 13.423 |
| 5 | 1.668 | 3.999 | 7.086 | 10.245 | 13.207 |
| 10 | 1.670 | 3.998 | 7.058 | 10.178 | 13.003 |
| 15 | 1.672 | 3.999 | 7.035 | 10.117 | 12.810 |
| 20 | 1.675 | 4.002 | 7.015 | 10.061 | 12.627 |
| 25 | 1.679 | 4.008 | 7.000 | 10.011 | 12.454 |
| 30 | 1.683 | 4.015 | 6.988 | 9.965 | 12.289 |
| 35 | 1.688 | 4.024 | 6.979 | 9.925 | 12.133 |
| 40 | 1.694 | 4.035 | 6.973 | 9.888 | 11.984 |
| 45 | 1.700 | 4.047 | 6.969 | 9.856 | 11.841 |

< NIST (pH 2, 4, 12 are common) >

| Temp. (°C) | pH 7 Neutral phosphate | pH 9 Borate |
|------------|------------------------|-------------|
| 0 | 6.984 | 9.464 |
| 5 | 6.951 | 9.395 |
| 10 | 6.923 | 9.332 |
| 15 | 6.900 | 9.276 |
| 20 | 6.881 | 9.225 |
| 25 | 6.865 | 9.180 |
| 30 | 6.853 | 9.139 |
| 35 | 6.844 | 9.102 |
| 40 | 6.838 | 9.068 |
| 45 | 6.834 | 9.038 |

Tip

The differences between NIST and USA standard solutions are a different pH 7 value, and the use of pH 10 standard solution instead of pH 9 standard solution in USA.

Note

Calibration is performed using Nernst's equation with the above values.

● Saturated DO levels in water at various temperatures

| Temp. (°C) | Saturated DO (mg/L) |
|------------|---------------------|------------|---------------------|------------|---------------------|------------|---------------------|
| 1 | 13.77 | 11 | 10.67 | 21 | 8.68 | 31 | 7.42 |
| 2 | 13.40 | 12 | 10.43 | 22 | 8.53 | 32 | 7.32 |
| 3 | 13.04 | 13 | 10.20 | 23 | 8.39 | 33 | 7.22 |
| 4 | 12.70 | 14 | 9.97 | 24 | 8.25 | 34 | 7.13 |
| 5 | 12.37 | 15 | 9.76 | 25 | 8.11 | 35 | 7.04 |
| 6 | 12.06 | 16 | 9.56 | 26 | 7.99 | 36 | 6.94 |
| 7 | 11.75 | 17 | 9.37 | 27 | 7.87 | 37 | 6.86 |
| 8 | 11.47 | 18 | 9.18 | 28 | 7.75 | 38 | 6.76 |
| 9 | 11.19 | 19 | 9.01 | 29 | 7.64 | 39 | 6.68 |
| 10 | 10.92 | 20 | 8.84 | 30 | 7.53 | 40 | 6.59 |

■ Options

A wide variety of electrodes and options are available for use with the instrument. You can select the optimum electrode and options for your application and objectives.

These options can be purchased from your nearest agency. Please provide the part name and part number to the representative.

With regard to electrodes, it is important to select the optimum electrode for the sample you want to measure. For details, refer to the catalogue or our website, or contact your dealer.

| Part name | | Part number | Remarks |
|---------------------|----------------------|-------------|-------------------------------|
| Plain paper printer | Printer (USA, 120 V) | 3014030146 | Printer cable sold separately |
| | Printer (EU, 230 V) | 3014030147 | |
| | Printer cable | 3014030148 | 1.5 m |
| | Roll paper | 3014030149 | 20 rolls/set |
| | Ink ribbon | 3014030150 | 5 pcs/set |
| Serial cable | | 3014030151 | 1.5 m |
| AC adapter | | 3200647413 | |

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