HORIBA

Navi@ pH

INSTRUCTION MANUAL

pH METER
F-52/F-53/F-54/F-55

HORIBA, Ltd.

Preface

Thank you for purchasing one of the F-50 Series pH meters.
This meter has a large-sized LCD display, which enables to use the varied functions by simple operations, and especially will be convenient to use in laboratory.
Carefully read this manual before using the meter.

HORIBA's Warranty and Responsibility

Your meter is covered by HORIBA's warranty for a period of one (1) year, under normal use. Although unlikely, if any trouble attributable to HORIBA should occur during this period, necessary exchange or repairs shall be conducted by HORIBA, free of charge. The warranty does not cover the following:

- Any trouble or damage attributable to actions or conditions specifically mentioned to be avoided in the operation manuals
- Any trouble or damage attributable to use of the meter in ways or for purposes other than those described in the operation manuals
- If any repairs renovations, disassembly, etc. are performed on this meter by any party other than HORIBA or a party authorized by HORIBA
- Any alteration to the external appearance of this meter attributable to scratches, dirt, etc. occurring through normal use
- Wear and tear to parts, the exchange of accessories, or the use of any parts not specified by HORIBA

HORIBA also shall not be liable for any damages resulting from any malfunctions of this product, any erasure of data, or any other uses of this product.

Unauthorized reprinting or copying of this operation manual

No unauthorized reprinting or copying of all or part of this operation manual is allowed. The utmost care has been used in the preparation of this operation manual. If, however, you have any questions or notice any errors, please contact the HORIBA customer service center printed on the back cover of this operation manual.

■ CE Marking

This product is in conformity with the following directives and standards:

Directives: The EMC Directives 89/336/EEC
The Electrical Product Safety Directive 73/23/EEC

Standards: EN61326: 1997+A1:1998
(EMISSION: Class B, IMMUNITY Category: Minimum Requirement)
EN61010-1: 2001

Installation Environment

This product is designed for the following environment.
- Pollution degree 2
- Measurement category **I**

WARNING: Do Not use the equipment for measurements within measurement categories **II** , **III** and **IV** .

■ FCC Warning

This equipment has been tested and found to comply withthe 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.

■ Type and Definition of Signal Words

For the safety use, the meter is equipped with the Warning Labels to alert every operator and user to the possible risk and danger. Before using understanding each message.

The meaning of signal words are as follows:

(WARNING) This indicates an potentially hazardous situation which, if not avoided, will result in death or serious injury.

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

■ Safety Precautions

For the safety use, be sure to read the following precautions:

⚠ WARNING:

- Do not use any unspecified AC adapters.
  Heat or fire may occur to cause fire or accidents.
- Do not disassemble or modify the meter.
  Heat or fire may occur to cause fire or accidents.

⚠ CAUTION:

- Do not use the serial communication or AC adapter in the place that may possibly contact with moisture.
  It may cause fire, electric shock, or breakage.
- Part of the electrode is made of glass; handle with care not to break it.

● Indication

⚠ WARNING

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

⚠ CAUTION

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

NOTE

This mark indicates the operation requires a special care and attention.

REF

This mark indicates to which the reader should go for reference.

HINT!

This mark indicates reference information.

■ Cautionary Items

● Precautions

- Do not give physical shock to the meter like dropping or hitting.
- Avoid water or solution from being contact with the meter body. Water or solution, if contacts with the meter, may cause the meter breakage.
- To remove the dirt on the meter, wipe it off with dry and soft cloth as silicone cloth. (Do not use water)
- Do not pour water to the electrode and/or the connector part of the meter body. Do not touch with dirty or wet hands.
- The electrode and/or the connector part of the meter body requires high insulation. Contact with water or with dirty hands may bring defective insulation, to cause indication fluctuation or erroneous measurement values. Sometimes the electrode itself may be damaged to an unrecoverable level.
- Perform the key operation by the fingers, not by the hard object like metal stick or rod.
- To disconnect the electrode cable or interface cable, pull them out with holding the connector part. Do not pull the cable part; it may cause a breakage.
- Do not use any unspecified batteries ; it may cause a breakage.

● Location of use and storage

- The place which room temperature is at 0 ℃ to 45 ℃
- The place which relative humidity is under 80% and free from condensation

Do not use or store the meter at;

- The place of much dust
- The place with strong vibration
- The place with direct sunlight
- The place with corrosive gas generation
- The place near from an air-conditioner
- The place with direct wind

● Move and Transportation of the meter

To transport the meter, use the packaging box at the delivery. Transportation by any unspecified packing methods may cause a breakage.

● Disposal

Standard solution used for the calibration must be under neutralization before the disposal. As for the disposal of the meter, treat it as an industrial waste.

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

Chapter 1 Overview

This section explains the name of each part, the connection of electrodes, the battery replacement, and the cautionary items.

1.1 Package contents

The package contents of the meter F-5X is as follows:

Product	Model			
	F-52	F-53	F-54	F-55
Main unit	○	○	○	○
Electrode stand	○	○	○	○
Button battery	Attached with the main unit			
AC Adapter	○	○	○	○
Compact flash memory card (16 MB)	–	○	○	○
Instruction Manual	○	○	○	○

NOTE

No electrode is included in the package.

1.2 Functions

1.2.1 Measurement item (depending on the model)

This is a list of measurement items. Note that they depend on the model as follows:
○ : Available ◎ : Initially set

Measurement item	F-52	F-53		F-54		F-55	
	CH1	CH1	CH2	CH1	CH2	CH1	CH2
pH	◎	◎	○	◎		◎	
ORP(mV)	○	○	○	○		○	
Ion		○	◎			○	
Conductivity					◎		◎
Salinity					○		○
Resistivity					○		○

1.2.2 Functions of each model

Item	Function	How to set	Available model	Refer to
Calendar /clock	Displays and records calibration and measurement dates	DATE AND TIME SETUP	All models	Page 138
Display Screen	Displays the measured values in a graph (Effective for confirming the stability of indication values)	SYSTEM SETUP → DISPLAY; GRAPH	All models	Page 131
	Displays the measured values by analog output (Effective for viewing the indication value moving)	SYSTEM SETUP → DISPLAY; ANALOG	All models	Page 131
	Displays the measurement items of 2CH simultaneously	SYSTEM SETUP → 2CH DISPLAY; ON	F-53,54,55	Page 133
	Sets the language in which the display is given (Japanese or English)	SYSTEM SETUP → LANGUAGE	All models	Page 137

Item	Function	How to set	Available model	Refer to
Measurement Data Memory	Changes the hold condition of the measurement data	SYSTEM SETUP → AUTO HOLD	All models	Page 134
	Identifies the sample and memorizes the data	In the Measurement screen, press F3 (DATA IN) to proceed the Sample ID setting → F4(DATA MEMORY)	All models	Page 115
	Memorizes the data continuously in a certain time span	SYSTEM SETUP → AUTO HOLD; OFF → INTERVAL MEMORY; ON In the Measurement screen press F3 (DATA IN) to proceed the Sample ID setting Press F4(DATA MEMORY) In Measurement screen press the MEAS key to start MEMORY	All models	Page 113
	Calls up the memorized data	Press F2 (DATA OUT) in the Measurement screen	All models	Page 116
	Deletes the memorized data	MAINTENANCE → CLEAR DATA MEMORY	All models	Page 142
	Copies the data to the compact flash card	COMPACT FLASH SETUP → DATA COPY SETUP	F-53,54,55	Page 144
Common operation	Mutes the operation sound	SYSTEM SETUP → SOUND; OFF	All models	Page 137
	Controls the screen brightness	MAINTENANCE → BRIGHTNESS OF DISPLAY	All models	Page 140
	Controls the screen color tone	MAINTENANCE → DISPLAY COLOR	All models	Page 140
	Turns the display of the navigation character OFF	MAINTENANCE → CHARACTER; OFF	All models	Page 140
	Sets the time until the screens (backlight OFF) go to the power saving mode	MAINTENANCE → BACK LIGHT OFF TIME Setting 0 (min) will not proceed to power saving screen	All models	Page 142
	Returns the setting to the initial value	MAINTENANCE → INITIALIZATION OF SETTINGS	All models	Page 142
	Displays temperature more accurately Adjusts the temperature indication to the standard thermometer	MAINTENANCE → TEMP CALIBRATION	All models	Page 143

Item	Function	How to set	Available model	Refer to
pH measurement setup	Changes the indicated resolution of pH	pH SETUP → DISPLAY OPTION	All models	Page 38
	Inputs the temperature of standard thermometer without temperature sensor	pH SETUP → TEMP COMPENSATION; MTC	All models	Page 39
	Performs temperature conversion of the measurement value according to the temperature characteristics of the sample	pH SETUP → TEMP COEFFICIENT; ON	All models	Page 40
	Saves the electrode model and Lot in memorizing the data	pH SETUP → ELECTRODE MODEL pH SETUP → ELECTRODE LOT	All models	Page 41 Page 42
	Sets the standard solution for the pH calibration	pH SETUP → F1 (CAL SETUP) pH CALIBRATION SETUP → BUFFER	All models	Page 44
	Sets the calibration point	pH SETUP → F1 (CAL SETUP) pH CALIBRATION SETUP → CAL POINTS	All models	Page 46
	ERR08 (Calibration Error) lights up at the set calibration interval	pH SETUP → F1 (CAL SETUP) pH CALIBRATION SETUP → CAL INTERVAL; ON	All models	Page 47
	Confirms the repeatability by the standard solution of pH 7 at the calibration before measurement. (Preliminary inspection)	pH SETUP → F1 (CAL SETUP) pH CALIBRATION SETUP → REPEATABILITY; ON	All models	Page 48
	Sets the type of periodical inspection	pH SETUP → F1 (CAL SETUP) pH CALIBRATION SETUP → SYSTEM CHECK	All models	Page 49

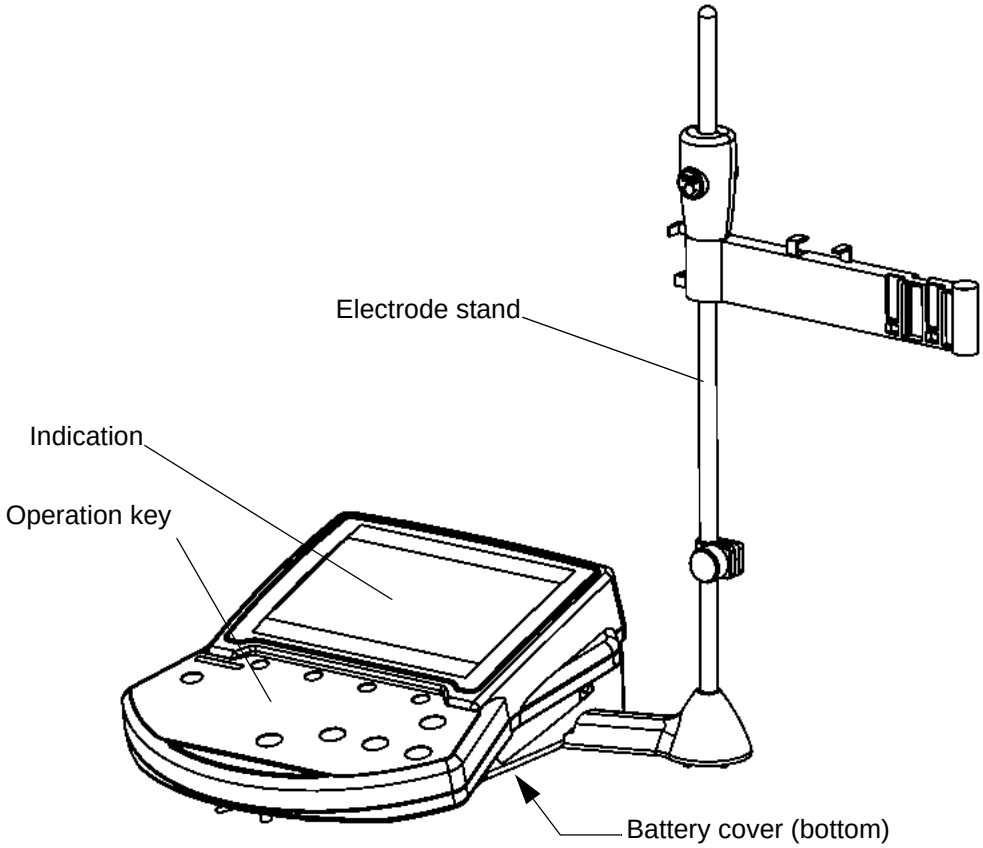
Item	Function	How to set	Available model	Refer to
ION measurement setup	Selects ion measurement method	ION SETUP → MEASUREMENT	F-53,55	Page 67
	Registers the electrode type for linearity method measurement (Memorizes the unit, calibration operations, and isothermal point by electrode model type registration by each set ion type)	ION SETUP → ELECTRODE MODEL	F-53,55	Page 84
	Saves the electrode model type and lot in memorizing each data	ION SETUP → ELECTRODE MODEL ION SETUP → ELECTRODE LOT	F-53,55	Page 84 Page 84
	Registers ion valency for linearity method measurement without registering the electrode model type	ION SETUP → ION SELECTION; MANUAL	F-53,55	Page 83
	Changes the ion measurement unit to mol/L	ION SETUP → UNIT	F-53,55	Page 83
	Inputs the temperature of standard thermometer without temperature sensor	ION SETUP → TEMP COMPENSATION; MANUAL	F-53,55	Page 82

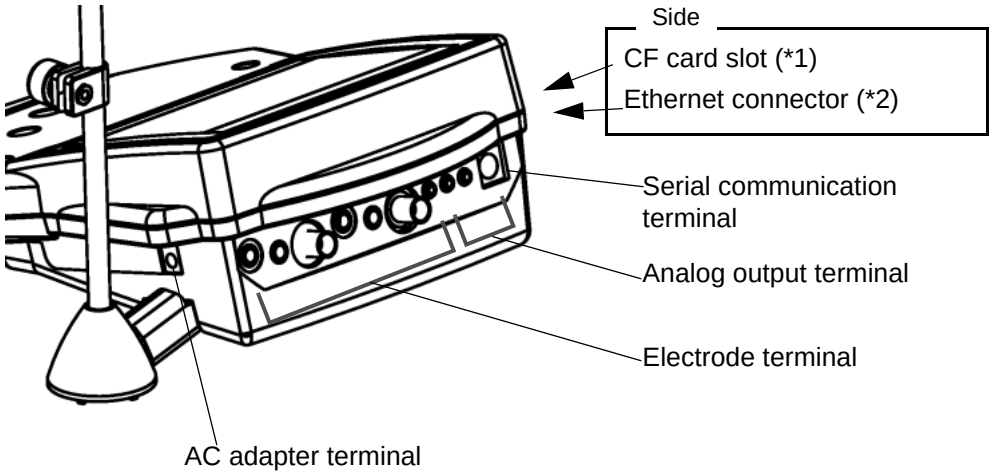
Item	Function	How to set	Available model	Refer to
COND measurement setup	Changes the unit	COND SETUP → UNIT	F-54,55	Page 94
	Inputs the temperature of standard thermometer without the temperature sensor	COND SETUP → TEMP COMPENSATION	F-54,55	Page 95
	Measures the sample with known temperature coefficient	COND SETUP → TEMP COEFFICEINT	F-54,55	Page 96
	Saves the electrode model type and lot in memorizing the data	COND SETUP → ELECTRODE MODEL COND SETUP → ELECTRODE LOT	F-54,55	Page 97 Page 98
User Control function	Starts up with the Operator name registered	SECURITY SETUP → USER MANAGEMENT; ON	All models	Page 122
	Controls the password validity	SECURITY SETUP → PASSWORD VALIDITY	All models	Page 122
	Sets the minimum character number for the password	SECURITY SETUP → PASSWORD LENGTH	All models	Page 123
	Sets limitation for the defective password input	SECURITY SETUP → PASSWORD RESTRICTION	All models	Page 123
	Sets lockout count reset	SECURITY SETUP → LOCKOUT RESET	All models	Page 124
	Changes operator registration	SECURITY SETUP → OPERATOR REGISTRATION	All models	Page 124

Item	Function	How to set	Available model	Refer to
External output	Performs printer test	(With power off, restart after the printer is connected) MAINTENANCE → PRINTER TEST	All models	Page 140
	Sets the printing data in detail	SYSTEM SETUP → PRINTER OUTPUT; EXACT	All models	Page 136
	Adjusts the analog output Outputs 2V and 0V in analog output and gives fine adjustment	MAINTENANCE → ANALOG TEST	All models	Page 141
	Sets analog output alarm	Each Measurement screen → F1(Measurement SETUP) → LIMIT; ON	All models pH: mV: ION: COND: SALINITY: RESISTIVITY:	 Page 43 Page 58 Page 86 Page 99 Page 106 Page 110
	Data output via RS-232C	After the serial cable connection, turn on the power, and either startup the PC software or send commands by the Hypertermial.	All models	Page 154
	Formats the compact flash card	COMPACT FLASH SETUP → FORMAT	F-53,54,55	Page 145
	Data write in the compact flash card	COMPACT FLASH SETUP → WRITE DATA	F-53,54,55	Page 145
	Writes personal data into the compact flash card (Password and Operator name input becomes unnecessary by the compact flash card containing personal data)	COMPACT FLASH SETUP → WRITE OPERATOR INFORMATION	F-53,54,55	Page 146
	Perform setting before the Ethernet output	NETWORK SETUP → IP ADDRESS NETWORK SETUP → GATEWAY ADDRESS NETWORK SETUP → SUBNET MASK	F-55	Page 148

1.3 Description of Each Part

Main Unit





NOTE

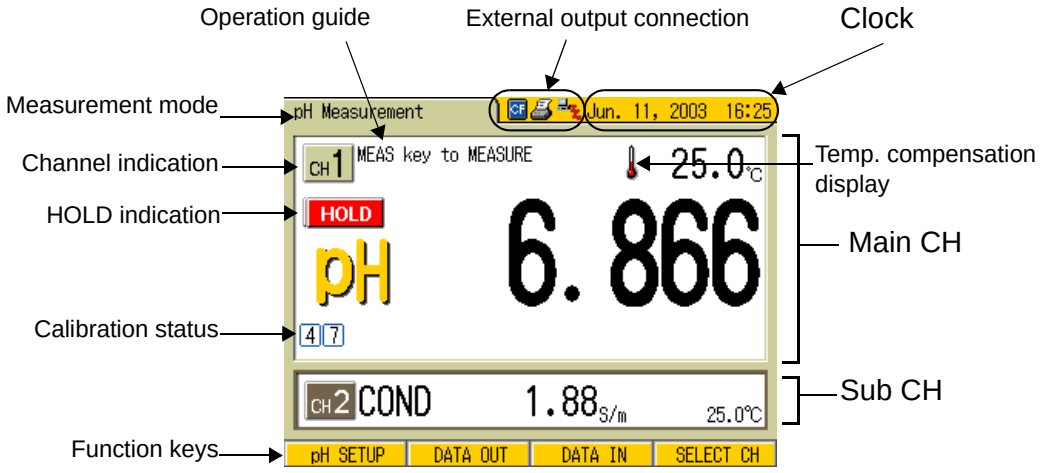
*1：For only F-53, 54, and 55
*2：For only F-55

1.4 Keys and Display

1.4.1 Control Keys

Key	Name	Description
	Function key	Allows selecting a function mode on the screen. From the left, F1, F2, F3, and F4 keys are arranged. The displayed function on each function key is available.
	ON/OFF key	Switches the operator. Turns ON or OFF the power.
	ESC key	Cancels the operation or the setting.
	MEAS key	Starts the measurement when returning to the MEASUREMENT mode.
	MODE key	Toggles the measurement modes.
	CURSOR key	Increases or decreases the numeric values. Used for the setting change.
	ENTER key	Assures the set values after the setting.
	CAL key	Starts calibration or calibration mode.
	NAVI key	Displays the operation guide (Navi).

1.4.2 MEASUREMENT screen



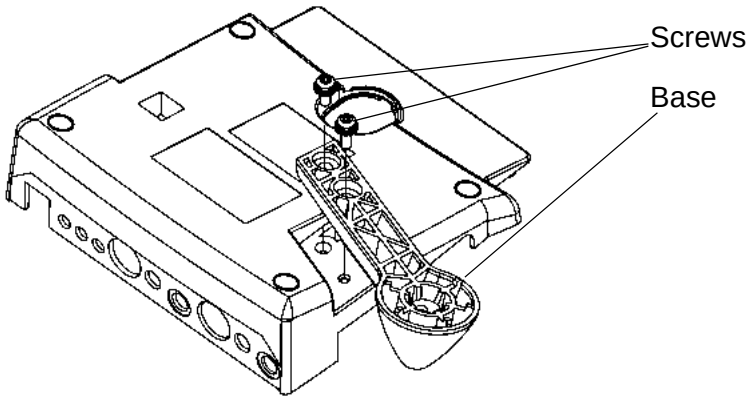
Icon displayed on the screen

Name	Indication	Description
Temperature compensation icons		At MTC Displays the values with the temperature set.
		At ATC Displays the temperature measured by the connected electrode.
HOLD icon		Without the icon: instantaneous value Blinking: in judging HOLD Lit: HOLD
External output connection icons		Compact flash Displayed when the compact flash card is connected.
		Network connection Displayed when the PC software is connected by the Ether net connection.
		Serial connection Displayed when the communication is given from PC. (When this indication is displayed, no operation is available by the meter unit. Only effective at ON/OFF.)
		Printer connection Displayed with the printer connected. (This icon is displayed with the PC connected depending on the PC.)

1.5 Assembling Electrode Stand

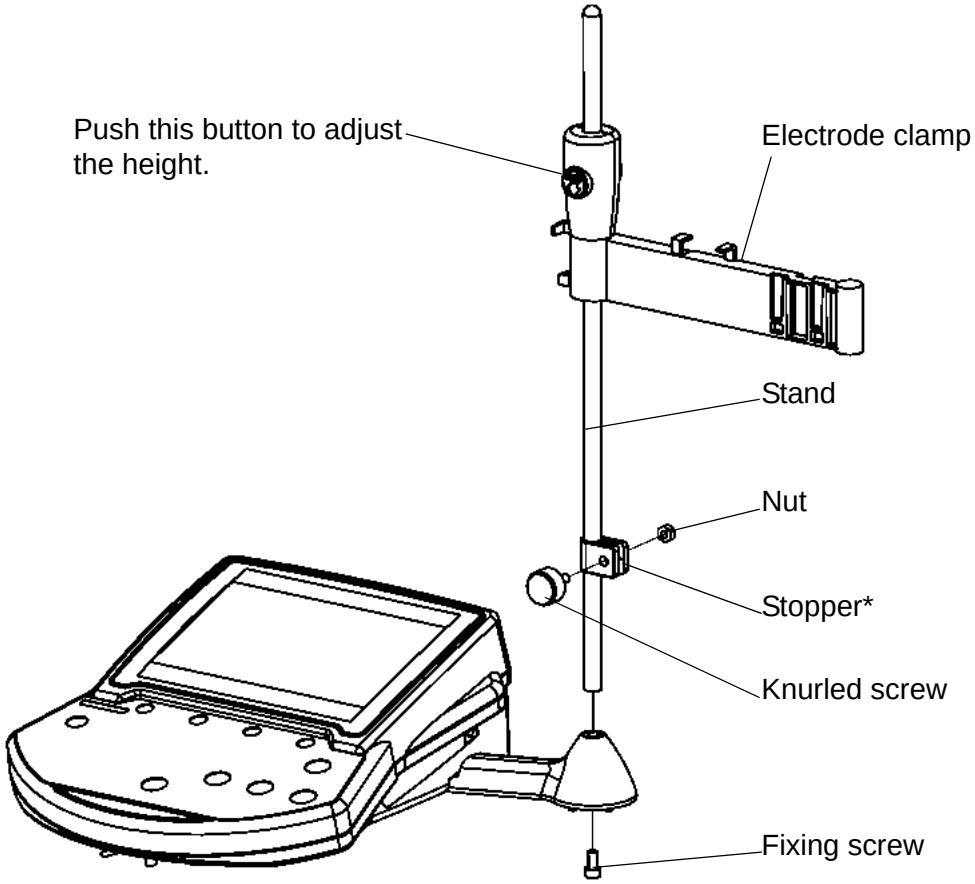
Assemble the electrode stand in the following procedure.

1. Attach the base to the bottom of the meter by 2 screws.



2. Attach the stand to the base by the fixing screw.
(At the shipment, the stand is already attached.)

3. Attach the stopper and the electrode clamp to the stand by this order.
(At the shipment, the stopper and the electrode clamp are already attached.)



NOTE

* The stopper is used to fix the electrode clamp to an optimum position at the measurement.

1.6 Connecting The Electrode and the Power Source

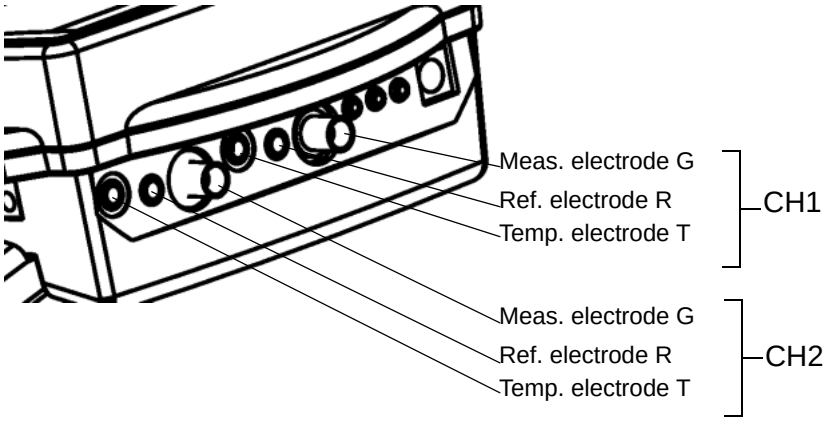
1.6.1 Connecting the Electrode

Connect the F-series pH meter and the electrode in the following procedure.

NOTE

When setting the electrode to the meter, be sure not to get any connectors wet. Do not touch the connectors with dirty hands.

The connectors to the meter depend on the electrode types as follows:



Measurement electrode G

	Measurement electrode CH1	Measurement electrode CH2
F-52	pH/ORP	—
F-53	pH/ORP/Ion	pH/ORP/Ion
F-54	pH/ORP	Conductivity
F-55	pH/ORP/Ion	Conductivity

Referential electrode R

In using the electrodes of pH, ORP, and/or of Ion for those other than the referential electrode combination type, connect the referential electrodes. Do not use this type of electrode when the electrodes of pH, ORP, and/or of Ion are not the referential electrode combination type.

Temperature connector (T)

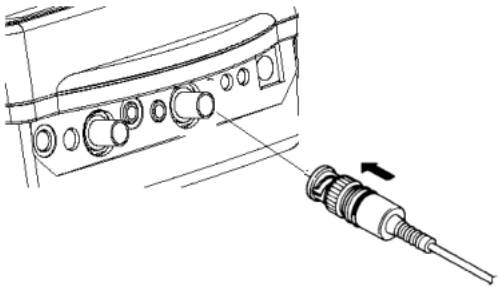
Temperature connector

Electrode connector

Connect the measurement electrode to CH1 (or CH2).
The connector cover functions to protect the connector from water to be splashed. Be sure to attach it to the connector.

1. Match the groove on the electrode connector with the pin on the counterpart located on the main unit.

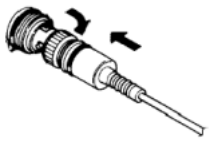
Do not push the cover to the connector forcefully when the slit does not fit to the pin.



NOTE

Do not work on the connector with dirty or wet hands.

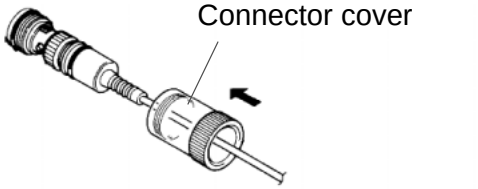
2. Hold the metal part of the electrode connector, and push it according to the slit by rotating clockwise.



NOTE

Pinched injury

3. Cover the connector with the connector cover on the straight.



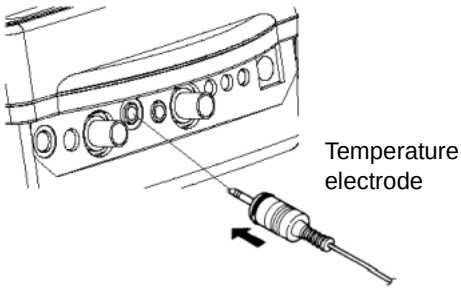
NOTE

Never rotate the connector cover. It will be blown.

Temperature connector

1. According to the connection CH of the measurement electrode, connect the temperature connector.

2. Fully insert the temperature connector into the counterpart located on the main unit.



NOTE

If measurement is performed in the automatic temperature compensation (ATC) mode without connecting the temperature connector or if the mV measurement is carried out in that state, the temperature reading will be always 25°C.

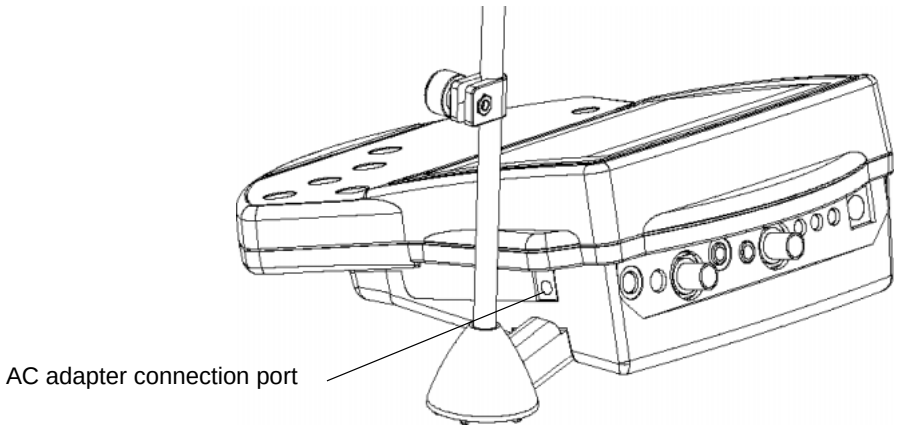
1.6.2 Connection of AC adapter

Use the exclusive AC adapter.

AC adapter specifications

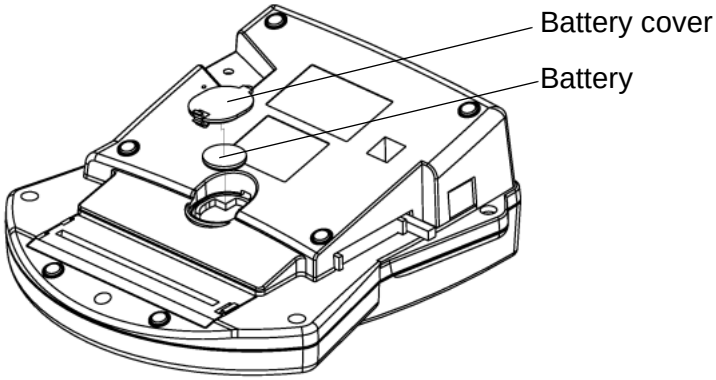
Supply voltage range	100 - 200 V AC
Frequency range	50/60 Hz
Current rating	Max 370 mA
Class2 Power supply	
Equipment protected by double insulation	
Indoor use only	
Supply voltage fluctuations allowed up to ± 10%	

1. Connect the adapter to the AC adapter connector located on the side part of the main unit.



1.6.3 Replacing the clock battery

1. Open the battery cover at the bottom of the meter, and replace the battery.



2. Adjust the clock.

NOTE

The battery life is approximately three (3) years.
The battery life depends on the using conditions.

NOTE

The built-in battery at the product shipment is the one for function check; it may have a shorter life.

1.7 Communication to Each Output

Analog output

Use the optional exclusive cable.
For connection procedure or output configuration, refer to Chapter 13 Analog Output in page 160.

Serial communication/printout

Used for PC communication and printout.
To output the data to the PC, connect the optional printer.
The exclusive serial cable and the printer cable are necessary.

NOTE

Connection should be given with the power turned off. Connection with the power on may damage the meter to cause a breakage.

Compact flash card (F-53,54,55)

For the detailed information on the compact flash card, refer to "11.5 Compact Flash Setting (F-53, 54, 55)" p.144

Ethernet output (F-55)

To disconnect the cable, hold the connector part with a screwdriver and remove the connector cap.

NOTE

Do not pull the cable forcefully.

1.8 Operation of Display Value

This meter performs measurement value operation with the digit lower than that displayed in displayed values or set values, and sometimes the following situation may occur:

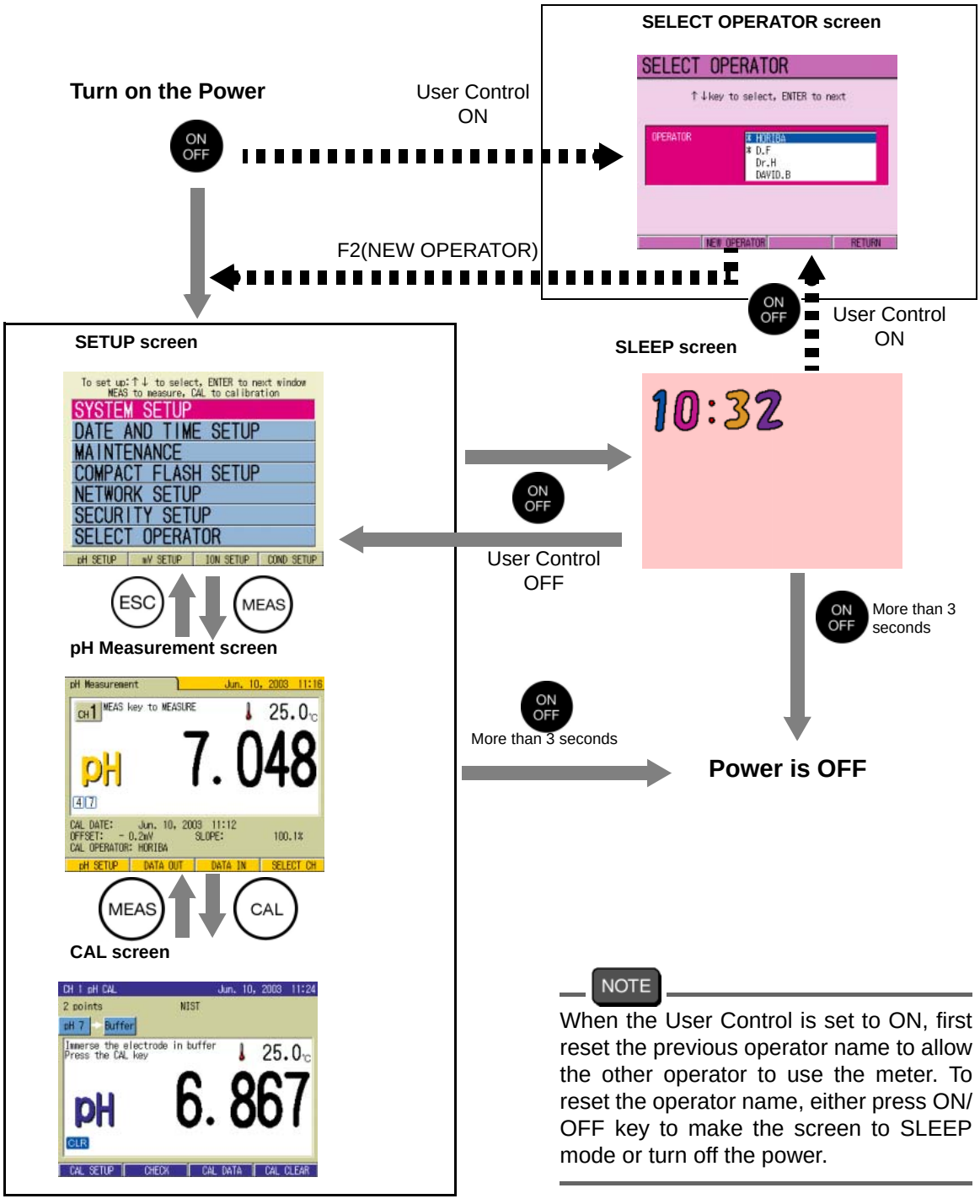
- The inspection judgment rank may differ from the actual one when the inspection result is the same with that specified in the regulation.
- A minus indication may attach to zero in the displayed value, as -0.000.
- Alarm may not be triggered even when the display value should show the alarm set value.
- The printout data may differ in 1 digit between the display value and the printout value.

1.9 Security Function

The security features of the pH meter series F aim to prevent irresponsible revision or deletion of set or measured data stored in the meter by the third person. Therefore, such setting changes as follows by the third person without authority are not available: date change, data memory deletion, or security related setting change. When the user control is set to ON, be sure not to forget the password. It is also recommended that plural Administrators are registered in case that the password carelessly lost.

Chapter 2 BASIC OPERATIONS

2.1 Measurement Flow



NOTE

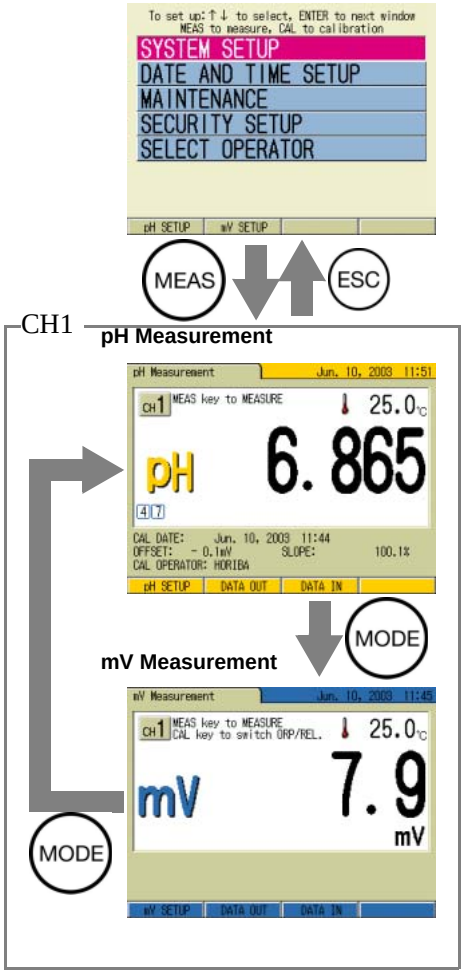
When the User Control is set to ON, first reset the previous operator name to allow the other operator to use the meter. To reset the operator name, either press ON/OFF key to make the screen to SLEEP mode or turn off the power.

2.2 Measurement Mode Transition for Each Model

Pressing the MODE key in the Measurement screen will switch the measurement item.
In this section the measurement flow for each model is explained.

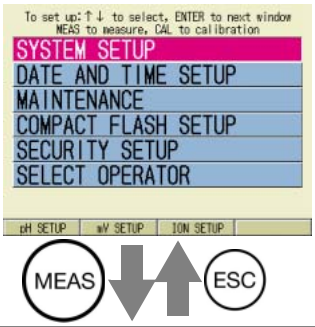
● F-52 measurement mode

SETUP screen



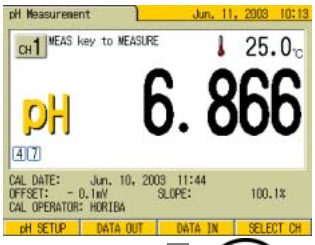
● F-53 measurement mode

SETUP screen



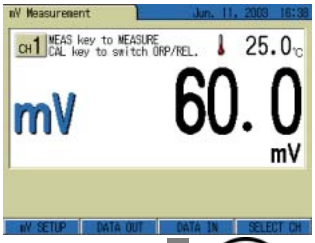
CH1

pH Measurement



MODE

mV Measurement



MODE

ION Measurement
(selecting AFTERCAL)

MODE

ION Measurement
(selecting INCREMENTAL)

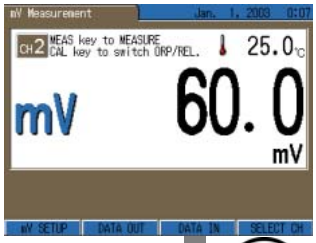
F4(SELECT CH)

CH2

pH Measurement

MODE

mV Measurement



MODE

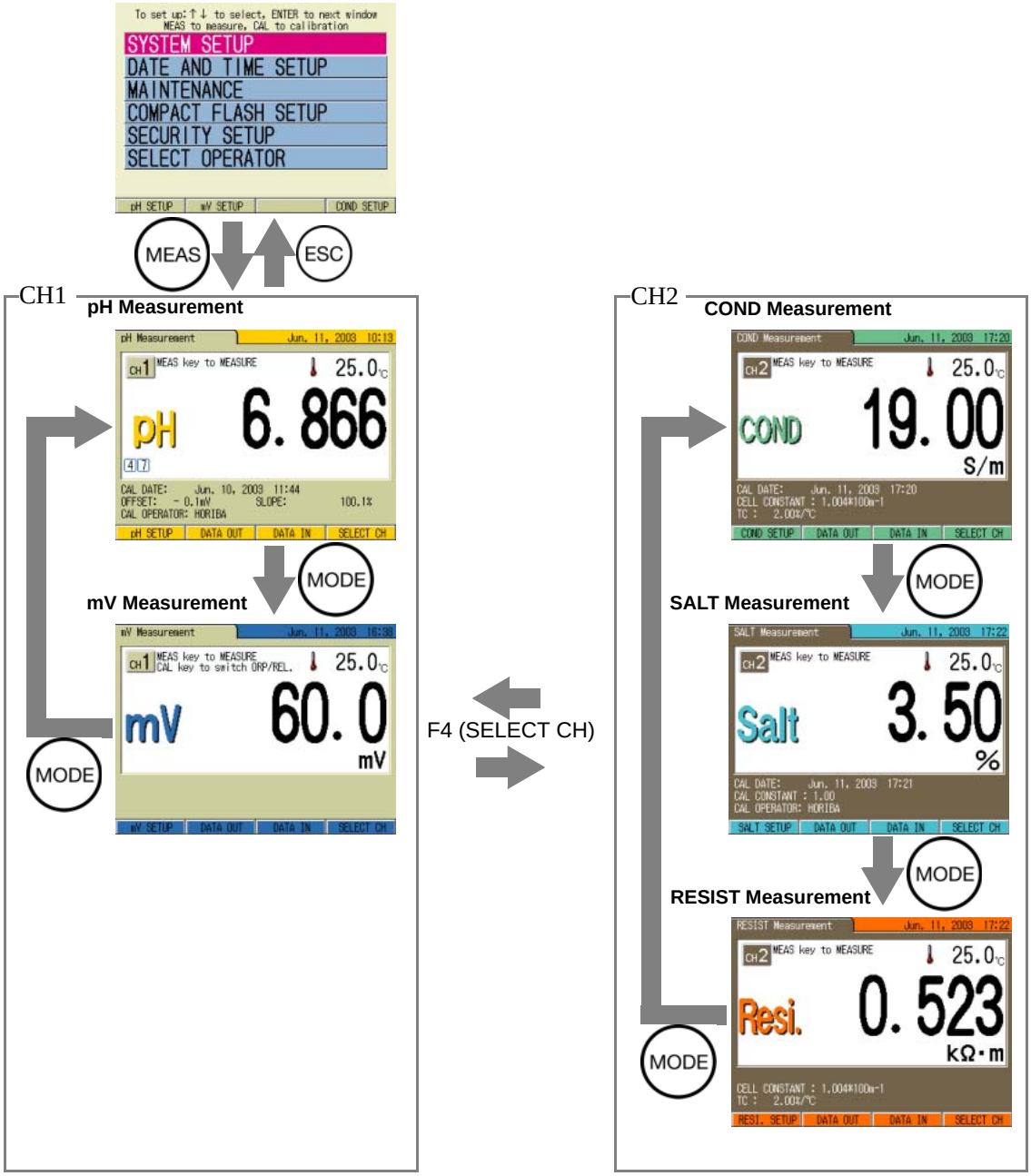
ION Measurement
(selecting AFTERCAL)

MODE

ION Measurement
(selecting INCREMENTAL)

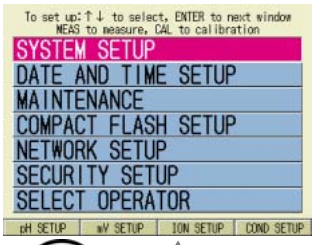
● F-54 measurement mode

SETUP screen



● F-55 measurement mode

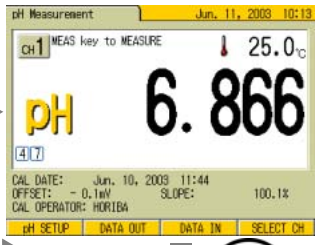
SETUP screen



MEAS / ESC

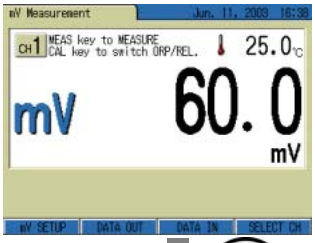
CH1

pH Measurement



MODE

mV Measurement



MODE

ION Measurement
(Selecting AFTERCAL)

MODE

ION Measurement
(Selecting INCREMENTAL)

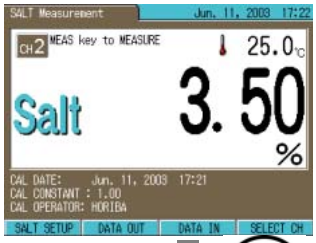
F4 (SELECT CH)

CH2

COND Measurement

MODE

SALT Measurement



MODE

RESIST Measurement

MODE

2.3 Turn on the Power

NOTE

Soon after the power OFF (approx. 4 seconds), ON/OFF key may be invalid.

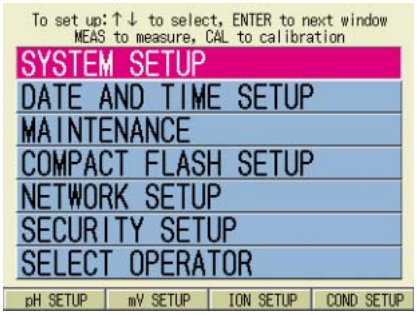
2.3.1 At User Control OFF (initial setting)

1. Press the ON/OFF key.

The startup screen appears, and then the SETUP screen appears.

NOTE

The SETUP screen depends on the model.



2.3.2 At User Control ON

When the compact flash card contains the personal data, inserting the card into the meter and starting it up allows the startup with the operator saved in the compact flash card.
(Only for F-53, F-54, and F-55.)

REF

"Chapter 10 SECURITY SETUP" page 119

1. Press ON/OFF key.

The Startup screen appears, and then the SELECT OPERATOR screen appears.

2. Press ↑ or ↓ key to select the operator.

NOTE

When the Operator is not registered, register the operator newly.

3. Press F4 (RETURN).

The INPUT PASSWORD screen appears.

Password input

4. Press ↑ , ↓ or ← , → key to select the numerical keys.

5. Press the ENTER key and input the letter one by one.

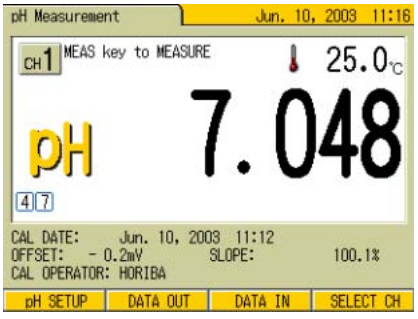
6. When all the input is completed, press F4 (RETURN).

The screen proceeds to the Measurement screen. When the Operator is registered as the Administrator, the SETUP screen appears.

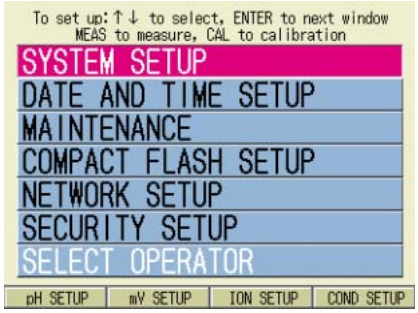
NOTE

The SETUP screen configuration depends on the model.

pH Measurement



SETUP screen



2.4 Necessary Setup for the First-time User

This meter features the clock function that allows recording the date of measurement and calibration. You need to set the clock when you use the meter for the first time or after replacing the batteries.

2.4.1 Setting the clock

Turning the power ON displays the SETUP screen.

1. Press ↑ or ↓ key to select DATE AND TIME SETUP. Press the ENTER key.

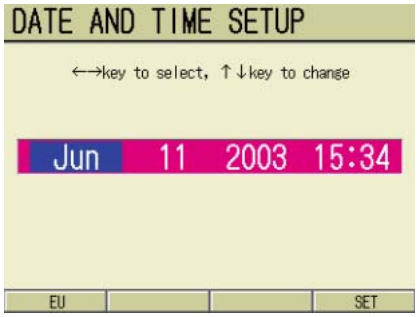
The DATE AND TIME SETUP screen appears.

2. Press ← or → key to select the set item (year, date, and time).

3. Press ↑ or ↓ key to set.

4. Press F4 (SET).

The setting is reflected, and the display returns to the SETUP screen.



NOTE

To cancel the setting, press the ESC key and return to the SETUP screen.
When the User Control is ON in the SECURITY SETUP screen, no operator other than the Administrator cannot access the clock to prevent irresponsible data revision.

2.5 Navigation Function

Pressing the NAVI key in the Measurement, CAL, or SETUP screen provides the following navigation functions.

- Operation guide display in the Measurement, CAL screens
- Operation guide display in the SETUP screen
- Pressing the NAVI key again in the NAVI screen returns to the previous screen.
- In the NAVI screen, if the screen contains the page “Detailed,” press the Detailed page mark and press the ENTER key. The display jumps to the page.
- When an error occurs, the counteraction is displayed and the error indication is deleted from the screen.

NOTE

The error indications for ERR08 (Calibration Interval Error) and ERR10 (Memory Over) are not deleted unless the cause of errors are removed. The screen only gives the counteraction display; the actual performance of the counteraction is necessary to delete the error indication.
To clear ERR08 (Calibration Interval Error), perform calibration reset or repeat the calibration again.
To clear ERR10 (Memory Over), reset the memory data.

Chapter 3 pH MEASUREMENT

3.1 Preparing Electrodes

Prepare electrodes by referring to the instruction manual.

Chemical Solution

Caution

The internal solution of the electrode contains Potassium Chloride in high concentration (3.33 mol/L KCl).
When the internal solution contacts the hands or skin, immediately wash it away with water. If the solution gets into the eyes, first wash it away with a large amount of water and immediately consult a doctor.

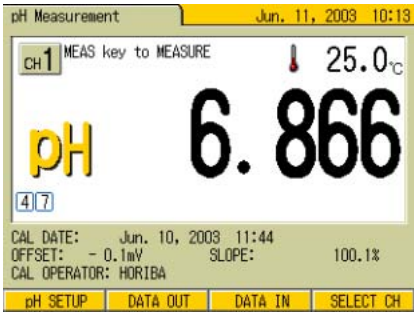
Caution

A sharp edge of broken glass may cause a cutting injury.
The support tube and the tip of the electrode are made of glass. Handle with care not to break the glass.

3.2 Open pH Measurement Screen

1. Press the MODE key in any of the Measurement screens, to go to the pH Measurement screen.

The displayed screen shows pH measurement status of instantaneous values.



3.2.1 Calibration of Standard Solution

In pH measurement, it is necessary to perform calibration once a day before the measurement. To prevent measurement error in advance, the repeatability can be confirmed with pH7 standard solution. In confirming the repeatability with standard solution, turn ON the preliminary check at Calibration Setting.

REF

"3.4.5 Preliminary check setting" page 48

There are three standard solution settings used for calibration: NIST, USA, and Custom. Under the initial setting, NIST is selected.

REF

"3.4.1 Setting standard solution" page 44

Which standard solution should be used for calibration?

- When the measurement sample is known to be acid, perform two-point calibration, pH7 and pH4. When it is known to be alkaline, perform two-point calibration, pH7 and pH9.
- When the sample pH is not known, perform three-point calibration, pH4, pH7 and pH9.
- For calibration other than that by two-point, change the calibration point setting.

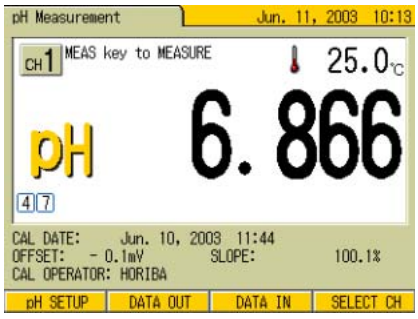
REF

"3.4.3 Calibration point setting" page 46
"3.4.2 Calibration for Custom selection" page 45

The following is a two-point calibration example using two standard solutions of pH7 and pH4.

Calibration of the 1st point

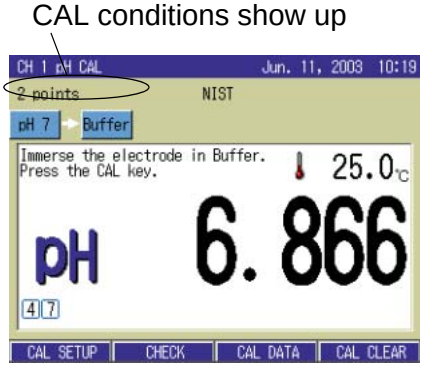
1. Press the MEAS key in the SETUP screen. The pH Measurement screen appears.



2. Press the CAL key in the pH Measurement screen.

The CAL screen appears.

CAL conditions show up



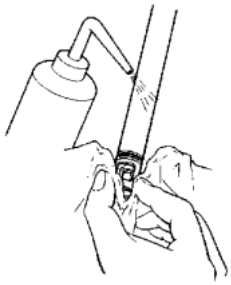
NOTE

The screen display depends on the setting condition of the standard solution.

Function key features in the CAL screen

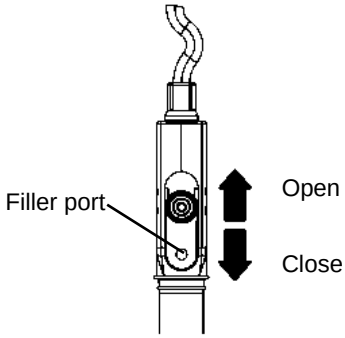
- CAL SETUP:To go to the CAL SETUP screen "3.4 Calibration Setting" page 44
- CHECK:To perform periodical check"3.4.7 Periodical check" page 50
- CAL DATA:To refer to the previous calibration status" ● Calibration data display" page 56
- CAL CLEAR: Clears the previous calibration record.

3. Wash the electrode with pure water (ion exchange water), and wipe it off by filter paper or tissue paper.



4. Open the filler port of the internal solution.

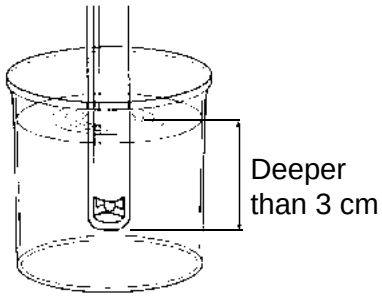
During the calibration, the filler port should be kept open.



NOTE

The fill port configuration depends on the electrode type.

5. Immerse the electrode in the beaker with standard solution of pH7.



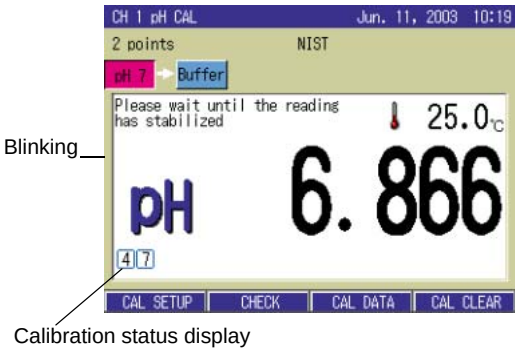
NOTE

For accurate measurement, immerse the electrode into the solution deeper than 3 cm from the tip (For details, refer to the instruction manual of the electrode.)

6. Start the calibration of the 1st point by CAL key.

The measurement value is displayed, and HOLD display starts blinking until the indication stabilizes.

When the indication value is stabilized, the calibration value is held, and the calibration status display 7 appears. This shows the calibration is completed for pH 7.



"HOLD" display blinking

To stop calibration: Press the ESC key to clear
To perform calibration: Press the ENTER key to perform

"HOLD" display lit

To display instantaneous value: Press the ESC key

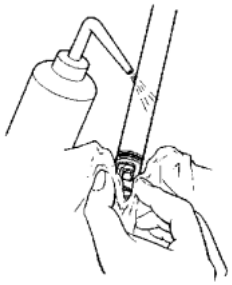
NOTE

The blinking interval of HOLD display is not always constant.

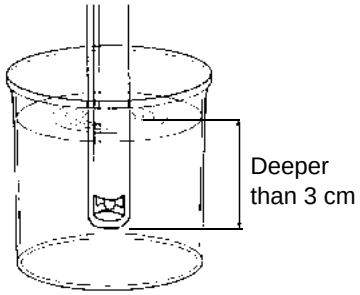
Calibration of the 2nd point

After calibration of the 1st point, perform calibration of the 2nd point similarly.

1. Wash the electrode with pure water (ion exchange water), and wipe it off either with filter paper or tissue paper.

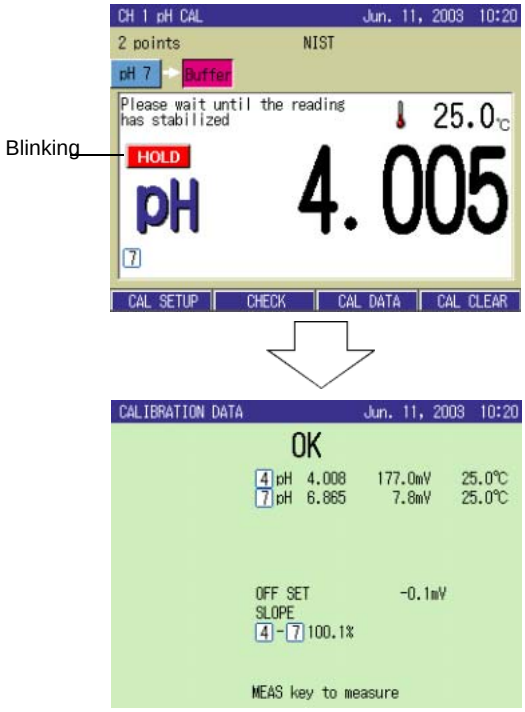


2. Immerse the electrode in the beaker with standard solution of pH4.



3. Start calibration of the 2nd point by pressing the CAL key.

When calibration of the 2nd point is complete, the calibration result is displayed on the screen.



4. Press the MEAS key.

The Measurement screen appears.

NOTE

In performing calibration of the point number more than set, press the ESC key in the result screen. Maximum five points of calibration can be performed, even though the number of set point is less than five. The screen display shows the calibration to be performed from the solution of pH7, but any standard solution can be used.

NOTE

For calibration using multiple standard solutions, continuously perform from one solution to another. Returning to the measurement mode and repeating calibration goes back to the 1st point.

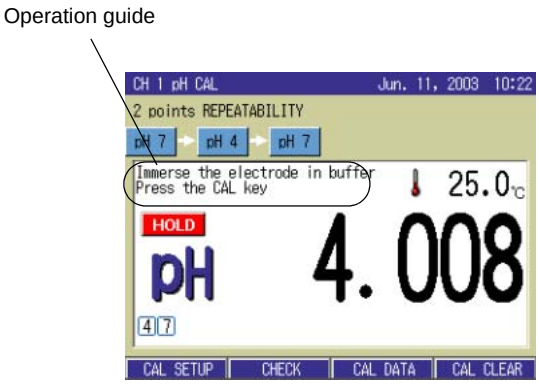
NOTE

When an error occurs in calibration, the screen displays the error. Remove the cause and repeat the calibration.
"15.2.1 Error message chart" page 200

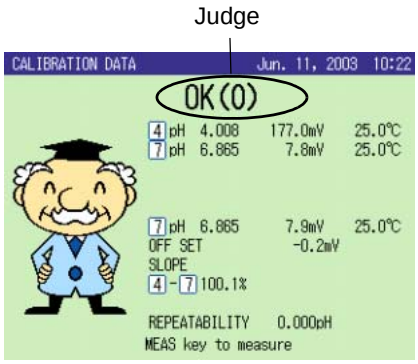
● Repeatability check

When the repeatability check is set to “ON,” the operation guide is displayed after calibration of the 2nd point is completed.

According to the displayed operation guide, confirm the repeatability.



The electrode status is displayed.



REF

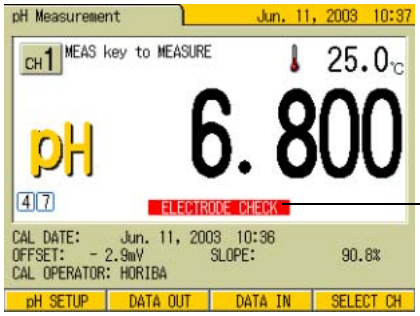
To judge the electrode status, refer to "3.4.5 Preliminary check setting" page 48

REF

For defective electrodes, perform counteraction by referring to " ● When electrodes are defective" page 52

Electrode status indication

When the electrode sensitivity is still low after calibration, or when a malfunction occurs at the preliminary check, the following display appears on the screen. When the sensitivity returns to the normal range after the repeated calibration, this status display disappears.

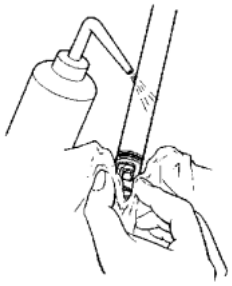


Display	Description
ELECTRODE CHECK	The electrode sensitivity has deteriorated. Wash the electrode. Electrode sensitivity: 90% to 93%
ELECTRODE STANDBY	The electrode life is coming to the end. Wash the electrode and repeat the calibration. When the display does not disappear even after the repeated calibration, exchange the electrode. Electrode sensitivity: 85 to 90%
ELECTRODE ERROR	The repeatability is over ± 0.05pH at the preliminary check. Wash the electrode.

3.2.2 Measurement

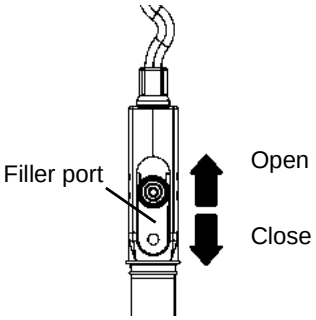
Follow the procedure below to perform pH measurement.

1. Wash the electrode with pure water (ion exchange water), and wipe it off either with filter paper or tissue paper.



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

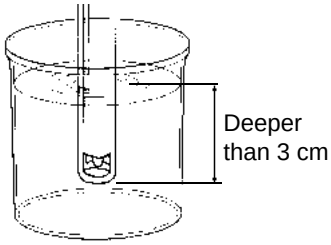
During measurement, the filler port should be kept open.



NOTE

The filler port configuration depends on the electrode type.

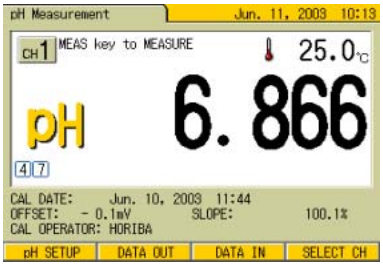
3. Immerse the electrode into the sample solution deeper than 3 cm from the tip



4. Switch the screen to the pH Measurement.

5. Press the MEAS key again.

The screen displays HOLD measurement mode. The HOLD display starts blinking until the indication stabilizes. When the indication value stabilizes, HOLD display is lit, and the indication value is held. This means the measurement is completed.



- To stop the measurement when the HOLD display is blinking, press the ESC key to return to the measurement mode of instantaneous value.
- There are several types of HOLD conditions depending on the setting configuration (Refer to Page 134).
- When the measured data is held, such as at instantaneous value measurement or at AutoHold measurement, press F3 (DATA IN) to store the data.

REF

"Chapter 9 DATA MEMORY" page 113

NOTE

Calibration of more than three points makes the electrode sensitivity different in each range. The displayed electrode sensitivity may differ from the actual sensitivity.

NOTE

pH electrodes 6367-10D, 6377-10D, 6378-10D, and 6252-10D may be affected by indication when performing 2CH simultaneous measurement in the same solution with other electrodes.

3.3 Changing the measurement setting condition

Follow the procedure below to change the pH measurement condition.
There are six items to be set:

- Resolution of pH measurement value
- Automatic Temperature Compensation(ATC) and Manual Temperature Compensation(MTC)
- Temperature conversion function
- Electrode model change
- Electrode Lot change
- Alarm setting

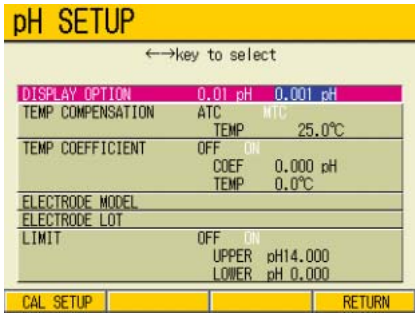
NOTE

The pH measurement setting is available for each CH on the F53 only.

Open the pH measurement SETUP screen

1. In the pH Measurement screen, press F1 (pH SETUP).

The pH SETUP screen appears.



NOTE

When no setting change is necessary, press ESC key or MEAS key to return to the pH Measurement screen.

3.3.1 Resolution of pH measurement value

Switch the resolution of pH measurement value either to 0.01 pH or 0.001 pH.

Resolution switch

1. In the pH SETUP screen, press ↑ or ↓ key to go to DISPLAY OPTION field.

2. Press ← or → key to select 0.01 pH/ 0.001 pH.

3. Press F4 (RETURN).

The setting is renewed, and the display returns to the Measurement screen.

3.3.2 Automatic Temperature Compensation (ATC) and Manual Temperature Compensation (MTC)

There are two types of temperature compensation in the pH measurement mode: Automatic Temperature Compensation (ATC) and Manual Temperature Compensation (MTC).
ATC detects the solution temperature by the sensor connected to the meter, and performs temperature compensation.
MTC measure the solution temperature beforehand, when the temperature sensor is not yet connected to the meter, and the temperature value is converted. The input temperature value is used to perform temperature compensation.

REF

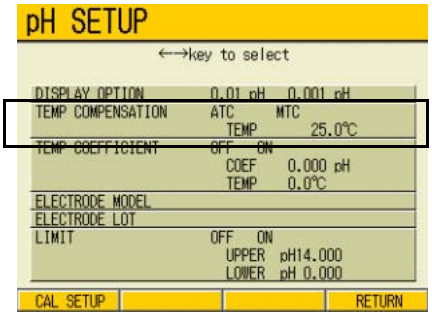
" ● Temperature compensation" page 216

Switch temperature compensation

1. In the pH SETUP screen, press ↑ or ↓ key to go to TEMP COMPENSATION field.

2. Press ← or → key to select ATC/MTC.

When “Manual” is selected, input the solution temperature.



Solution temperature input at manual temperature compensation

1. Press the ENTER key.

The cursor moves to the temperature setting field.

2. Press the ENTER key again.

The display color of the setting field changes.

3. Press either ↑ or ↓ key, and input the value.

Setting Range: : 0.0 to 100.0 ℃

4. Press the ENTER key.

The setting is determined. The display color of the setting field changes.

5. Press F4 (RETURN).

The setting is reflected, and the display returns to the Measurement screen.

3.3.3 Temperature Conversion Function

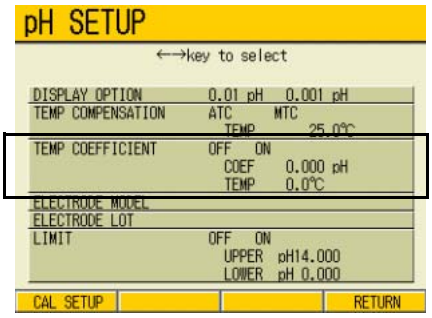
The measured pH values change according to the temperature even for the same sample. In addition, the degree of temperature change for pH values also changes according to each sample. When the temperature change degree (temperature factor) for the sample is known, the pH value can be displayed by converting it to the pH value at conversion temperature. For samples in which the temperature factor is unknown, set the temperature conversion function to OFF.

● Setting Temperature Coefficient

1. In the pH SETUP screen, press ↑ or ↓ key to go to TEMP COEFFICIENT field

2. Press ← or → key to select OFF or ON.

When ON is selected, input the temperature conversion factor.



Input temperature conversion factor

1. Press the ENTER key.

The cursor moves to the conversion factor setting part.

2. Press the ENTER key again.

The display color of the setting part changes.

3. Press ↑ or ↓ key and input the temperature conversion factor.

Setting range: -0.100 to +0.100 pH

4. Press the ENTER key.

The setting is determined. The display color of the set part changes.

5. Press ↑ or ↓ key, and move the cursor to the temperature part of the temperature conversion.

6. Press the ENTER key.

The display color of the setting part changes.

7. Press ↑ or ↓ key, and input the standard temperature value to apply conversion.

Setting range: 0.0 to 100.0 ℃

8. Press the ENTER key.

The setting is determined. The display color of the set part changes.

9. Press F4 (RETURN).

The setting is renewed, and the display returns to the Measurement screen.

REF

" ● Temperature conversion" page 217

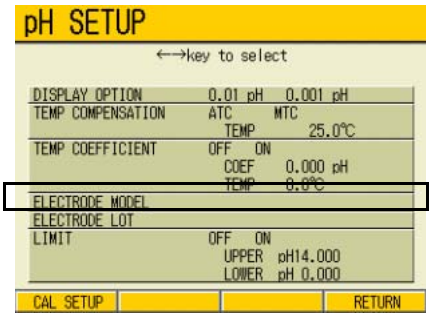
3.3.4 Electrode model change

By inputting the electrode model, the data printout (detailed) and/or data memory will contain the electrode model information.
Select the electrode model to be used in the measurement.
Maximum 9 alphabetical letters can be used to set the model name.

● Setting procedure

Model selection

1. In the pH SETUP screen, press ↑ or ↓ key and move the cursor to ELECTRODE MODEL field.



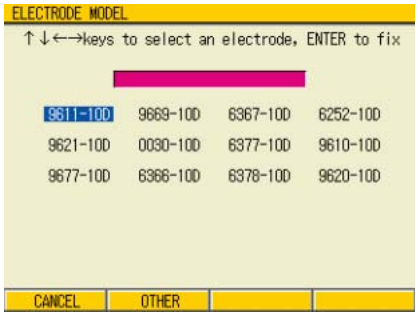
2. Press the ENTER key.

The ELECTRODE MODEL screen appears.

3. Press ↑ , ↓ and/or ← , → keys to move the cursor to the electrode model to be set.

4. Press the ENTER key.

The setting is determined.



To input model name manually:

Input the electrode model name.

1. After finishing the above step 2., press F2 (OTHER).

The input screen of the electrode model appears.

2. Press ↑ , ↓ and/or ← , → keys, input appropriate letters/numerical keys, and press ENTER key.

Maximum 9 letters can be input.

3. Determine the setting by F4 (RETURN).

4. Press F4 (RETURN).

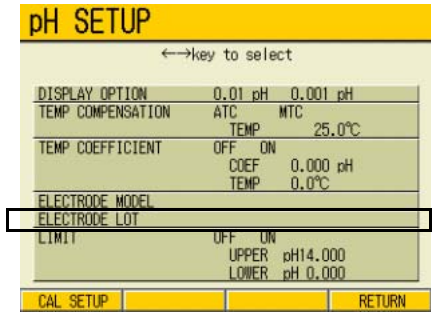
The setting is reflected, and the display returns to the Measurement screen.

3.3.5 Electrode lot change

By inputting the electrode Lot, the data printout (detailed) and/or data memory will contain the electrode Lot information.

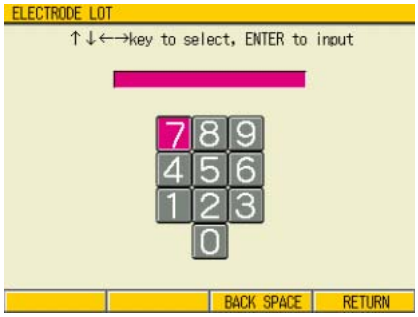
● Setting procedure

1. In the pH SETUP screen, move the cursor to the ELECTRODE LOT field by ↑ or ↓ key.



2. Press the ENTER key.

The ELECTRODE LOT screen appears.



3. Select the numerical values by ↑ , ↓ and/or ← , → keys, and press the ENTER key.

Setting range: maximum 7 digits

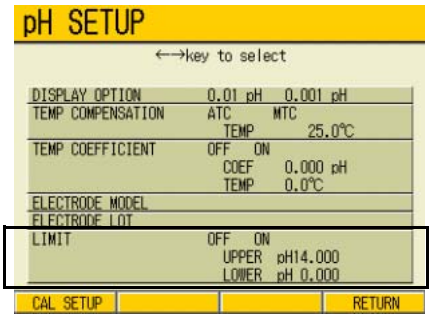
4. Press F4 (RETURN).

The display returns to the pH SETUP screen.

3.3.6 Alarm setting

Alarm setting function detects whether the measurement value exceeds upper or lower limit values, and displays it on the screen or outputs it as a signal from the external output terminal. When the measurement value exceeds the alarm range, the color of the displayed value changes in the Measurement screen.

● Setting procedure



1. In the pH SETUP screen, press ↑ or ↓ key to go to LIMIT field.

2. Press ← or → key to select OFF or ON.

In selecting ON, pressing the ENTER key moves the cursor to the upper limit value setting field. Pressing the ENTER again changes the display color of the set part, enabling to input values by ↑ or ↓ key.
Setting range: pH0.000 to 14.000

3. Press the ENTER key.

The setting is determined. The display color of the set part changes.

4. Press ↓ key to select the lower limit item.

5. Pressing the ENTER key changes the display color of the set part; press ↑ or ↓ key to input the values.

Setting range: pH0.000 to 14.000

6. Press the ENTER key.

The setting is determined. The display color of the set part changes.

7. Press F4 (RETURN).

The setting is renewed, and the display returns to the Measurement screen.

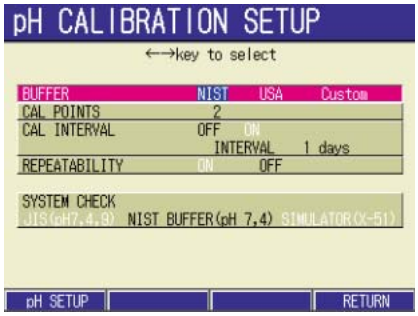
3.4 Calibration Setting

3.4.1 Setting standard solution

In the pH CALIBRATION SETUP screen, the standard solution used in the calibration can be set. There are three types of standard solutions available, NIST specification, USA specification, and Custom (exclusive use for the user).
Under the initial setting, NIST specification is selected.

1. Press F1 (CAL SETUP) in the CAL screen.

The pH CALIBRATION SETUP screen appears.



NOTE

Pressing F1 key in the pH SETUP screen also shows the pH CALIBRATION SETUP screen.

To perform calibration with the standard solution other than NIST or USA specifications, select “Custom” option.
Note that selecting “Custom”for the standard solution in the calibration setting makes the preliminary check function unavailable.

REF

" ● Repeatability check" page 35
"3.4.5 Preliminary check setting" page 48

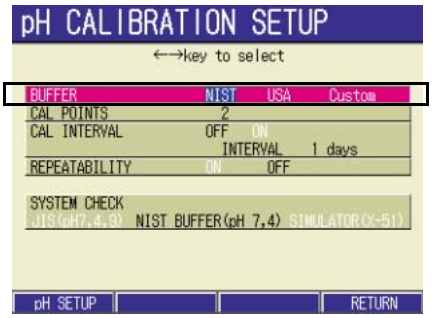
Setting procedure

1. In the pH CALIBRATION SETUP screen, press ↑ or ↓ key to go to BUFFER field.

2. Press ← or → key and select standard solution type from NIST, USA, and Custom options.

3. Press F4 (RETURN).

The setting is renewed and the display returns to the CAL screen.

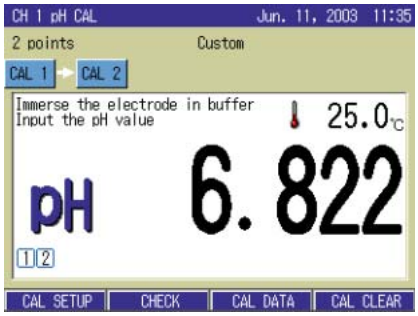


3.4.2 Calibration for Custom selection

In selecting Custom for calibration condition, a random standard solution can be used for the calibration.
By the following procedure, input the standard solution value to be used.

1. In the pH Measurement screen, press the CAL key.

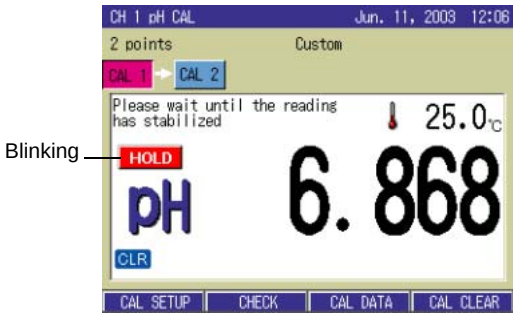
The CAL screen appears.



2. Immerse the electrode in the beaker with standard solution for the calibration.

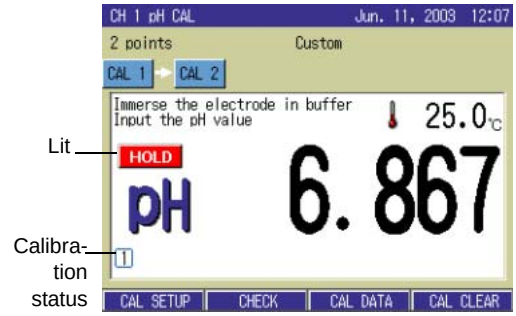
3. In calibration mode (instantaneous value), press ↑ or ↓ key, and input pH value of the standard solution.

Pressing ↑ or ↓ key stops the value fluctuation, enabling the display to be input mode.



4. Press the CAL key, and start the calibration of 1st point.

When the calibration is completed, the HOLD display is lit, displaying the calibration result of the 1st channel.



REF
"3.4.3 Calibration point setting" page 46

5. For calibration of 2nd and later points, first immerse the electrode into the standard solution as in the 1st point. Press ↑ or ↓ key, input the pH value of the standard value, and press the CAL key to start the calibration.

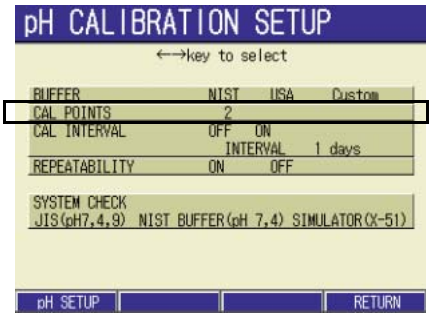
NOTE

The bottle mark shows that the calibration is completed; the number 1,2,3,4, and 5 shows the number of the calibration point.

3.4.3 Calibration point setting

Maximum 5 points of calibration is available. By setting the calibration point beforehand, the display automatically shows that the calibration of the set point is completed.

Setting procedure



1. In the pH CALIBRATION SETUP screen, press ↑ or ↓ key to go to the CAL POINTS field.

2. Press ENTER key. The display color of the set part changes. Set the calibration point by ↑ or ↓ key.

Setting range: 1 to 5 points

3. Press the ENTER key to determine the setting.

The display color of the set part changes.

4. Press the F4(RETURN) reflects the setting, and the display returns to the CAL screen.

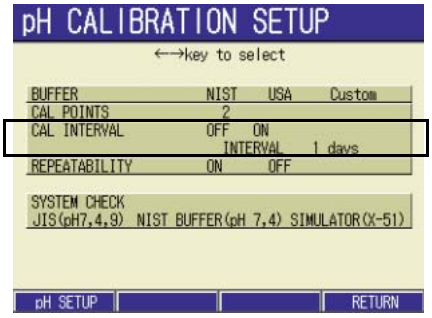
NOTE

In performing calibration of the number of points more than set, press ESC key in the result screen. This enables you to perform calibration of more than the set points. Note that there is no display on the screen to show guide message.

3.4.4 Calibration interval setting

In calibration interval setting, the number of days from the previous calibration to the next calibration can be set. By setting the calibration interval, ERR08 (calibration interval error) can be displayed on the Measurement screen when the set calibration interval comes.

Setting procedure



1. In the pH CALIBRATION SETUP screen, press ↑ or ↓ key to go to the CAL INTERVAL field

2. Press ← or → key to select ON.

3. Press the ENTER key.

The cursor moves to the interval day setting field.

4. Press the ENTER key again.

The display color of the setting part changes, and value input is available by ↑ or ↓ keys.
Setting range: 1 to 999 days

5. Press the ENTER key to determine the setting.

The display color of the setting part changes.

6. Press F4 (RETURN) key. The setting is reflected, and the display returns to the CAL screen.

When the interval setting is unnecessary:

1. Select OFF at step 1. above.

2. Press F4 (RETURN) to renew the setting. The display returns to the CAL screen.

3.4.5 Preliminary check setting

By confirming the repeatability using the standard solution of pH7 once a day at calibration, the measurement accuracy can be assured.
When calibration for the set calibration point is completed, the repeatability is automatically checked. This repeatability check confirms the deviation from the calibrated value by the standard solution of pH7.
The sequence for the two-point calibration by pH7 and pH4 is as follows:
pH7 (Calibration of 1st point) → pH4 (Calibration of 2nd point) → pH7(Repeatability check with the calibrated value by 1st point)
The result is displayed as follows:

Screen display	Repeatability
OK(0)	Within ± 0.005 pH
OK(1)	Within ± 0.02 pH
OK(2)	Within ± 0.05 pH
Error	Over ± 0.05 pH

NOTE

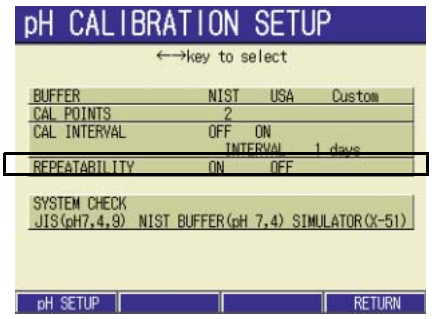
Preliminary check is only available for NIST and USA in standard solution setting.
It is not available for Custom setting.

Setting procedure

1. In the pH CALIBRATION SETUP screen, press ↑ or ↓ key to go to REPEATABILITY field.

2. Press ← or → key to select ON or OFF.

3. Press F4 (RETURN) to reflect the setting. The display returns to the CAL screen.



REF

" ● Repeatability check" page 35

3.4.6 Periodical check mode setting

Periodical check is a function to see if the meter and the electrode are maintained in good condition. The recommended check interval is once every three months.
There are three modes for the periodical check: JIS, NIST BUFFER, or SIMULATOR.

JIS mode

JIS mode is a check mode conforming to JIS(Z8802-1984).
Combination of electrode and meter can confirm which form of JIS regulation is conformed, using the standard solutions of pH7, pH4, and pH9.

NIST BUFFER mode

NIST BUFFER mode is a check mode conforming to the revised regulations by the Japanese Pharmacopoeia(JP)
After measurement by standard solutions of pH7 and pH4, the measurement of the solution of pH7 is given five times, and the repeatability is confirmed.

SIMULATOR mode

Optional pH checker (X-51) checks the meter only (electrode check is not included).

NOTE

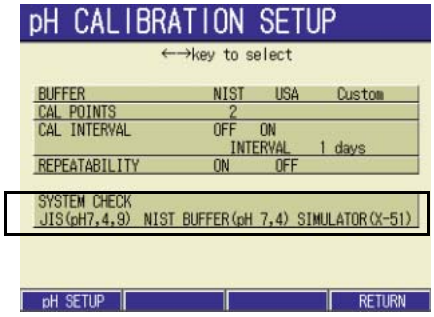
JIS and NIST BUFFER are the modes recommended by HORIBA, and not completely the same with configurations of JIS or NIST. It may not follow the possible revision or amendment given by JIS or NIST.
The calibration status displayed during check may not always show the actual checking status.

Setting procedure

1. In the pH CALIBRATION SETUP screen, press ↑ or ↓ key to go to SYSTEM CHECK field.

2. Press ← or → key, and select from JIS(pH7,4,9), NIST BUFFER (pH7, 4) or SIMULATOR (X-51).

3. Press F4 (RETURN) to reflect the setting. The display returns to the pH Measurement screen.



For F-53:

The pH calibration and check setting is available for each channel (CH).

NOTE

The checked values by the periodical check are not memorized as calibrated values.

3.4.7 Periodical check

Pressing F2 (CHECK) in the pH CALIBRATION screen displays the CHECK screen set in the pH CALIBRATION SETUP screen.

REF

"3.4.6 Periodical check mode setting" page 49

● JIS mode

According to JIS regulation, the measurement with a solution of pH9 is given three times after measurement by standard solutions of pH7 and pH4. The result is displayed on the screen.
When the periodical check mode starts, the operation guide is shown on the screen.
Perform measurement by the standard solutions in the following order.

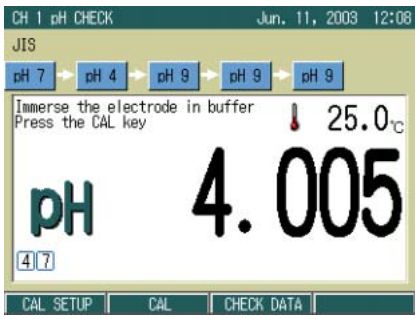
① pH6.86
② pH4.008
③ pH9.180
④ pH9.180
⑤ pH9.180

Cautionary points

- Wash the electrode with pure water before each measurement.
- Keep the temperature gap during the measurement within 0.2 ℃ .
- The measurement values during the periodical check are displayed according to those when the calibration is cleared. The result values are displayed according to those in the periodical check mode.

1. Immerse the electrode in the standard solution, and press CAL key.

The measured values are displayed.



NOTE

The displayed values can be determined by pressing the ENTER key even when HOLD indication is blinking.

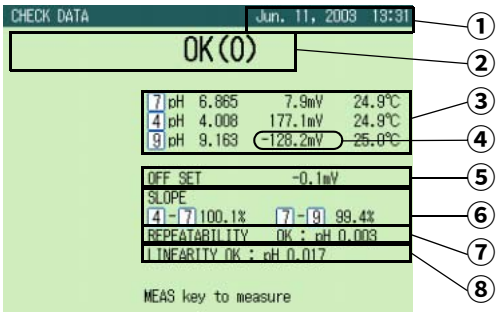
When the check is completed, the result data is displayed.

Result data output

① Date of check

② Judgment

OK:
The result data satisfies the regulation
CHECK:
The result data does not satisfy the regulation
TEMP:
The temperature gap is over 0.2 ℃



③ Calibrated value

Calibrated value for each standard solution of pH7, 4, and 9, potential, and temperature.

④ Average value for pH9

Average of the three-time measurement with standard solution of pH9

⑤ Asymmetric potential

Within regulated values ± 30 mV

⑥ Sensitivity

pH4-7(90% to 105% of regulated value)
pH7-9(90 % to 105% of regulated value)

⑦ Repeatability

OK (0)	Within ± 0.005 pH	Equivalent to 0 in JIS
OK (1)	Within ± 0.02 pH	Equivalent to I in JIS
OK (2)	Within ± 0.05 pH	Equivalent to II in JIS
CHECK	Over ± 0.05 pH	−

The repeatability shows the difference between maximum and minimum of the indication given by three times of measurements using the standard solution of pH9 (See the values ③ , ④ , and ⑤ above).

⑧ Linearity

Regulation (Within ± 0.03pH)

NOTE

This is equivalent to “0” and “I” in JIS.

The linearity shows the difference from the average values of three times using the standard solution of pH9, which is obtained by the measurement of solutions of pH7 and pH4.

For accurate measurement

The regulation equivalent to “0” in JIS is quite strict, accordingly it requires strict measurement condition to meet this regulation.
To insure accuracy in the measurement:

- Use Type 1 for the pH standard solution.
- Keep the temperature within ± 0.2 ℃ by a temperature controlled bath.
- Set the temperature in the temperature controlled bath to room temperature (25 ℃) or equivalent.
- Perform light stirring using the electrode stand and a stirrer.
- Press HOLD after the measured values completely stabilizes.
  → Pressing ESC key when the HOLD indication is lit makes the HOLD indication disappear and shows the instantaneous values. When the values are stabilized, press CAL key and start HOLD judgment.

NOTE

Typical time interval for the measurement value to become stabilized is 3 to 10 minutes while the electrode is immersed into the standard solution.

When electrodes are defective

When the above measurement does not solve the defective conditions, perform the followings:

- Clean the electrode.
- Confirm the right standard solution is used.
- Check if the electrode is deteriorated, and replace it to new one if necessary.

● NIST mode

After measurement with the standard solutions of pH7 and pH4 (or pH9), the measurement using the standard solution of pH7 is repeated five times, and the result is displayed. This check procedure conforms to the regulations by the Japanese Pharmacopoeia (JP).

1. Immerse the electrode into the standard solution, and press CAL key. The measured values are automatically read.

NOTE

When the indication value is stabilized, pressing ENTER key also determines the values.

Measure the standard solutions in the following order:
① pH6.865
② pH4.008(or pH9.180)
③ pH6.865
④ pH6.865
⑤ pH6.865
⑥ pH6.865
⑦ pH6.865

- Wash the electrode with pure water before each measurement.
- The measured values during periodical check are displayed according to the values after the calibration is cleared.

NOTE

When the calibration range error occurs either at step ① and/or ② , the screen displays the error and the check automatically stops.

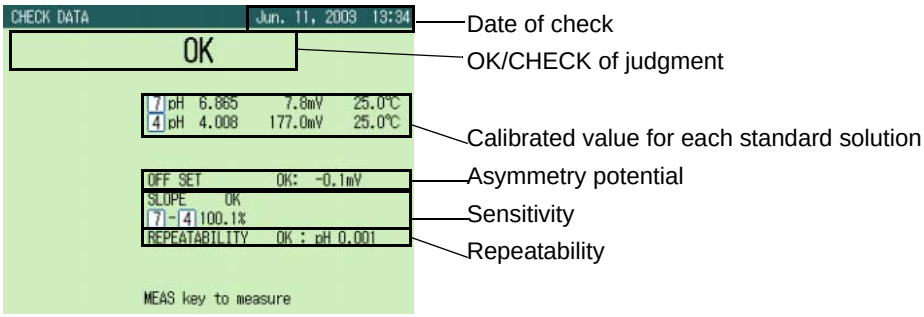
2. When the measurement is completed, data is automatically displayed.

- OK/CHECK judge
  Electrode: OK (satisfies regulation requirements)/CHECK (does not satisfy regulation requirements)
- Calibrated value for each standard solution of pH7, 4, or 9, potential, and temperature.
- Asymmetric potential (within regulated value ± 30 mV)
- Sensitivity pH4 to 7(90% to 105% of regulated value)
  pH7 to 9(90% to 105% of regulated value)
- Repeatability(within regulated value ± 0.05pH)

NOTE

The repeatability shows the difference between maximum and minimum results given by five measurements using the standard solution of pH7.

Sample printout of the result data



REF

" ● For accurate measurement" page 52
" ● When electrodes are defective" page 52

● SIMULATOR mode

Input the results given by the optional pH checker, X-51 to the meter, and perform functional check.
For detailed operation, refer to the instruction manual for the pH checker X-51.

1. Set the resolution to 0.001 pH in the pH SETUP screen.

2. Set the temperature compensation to ATC.

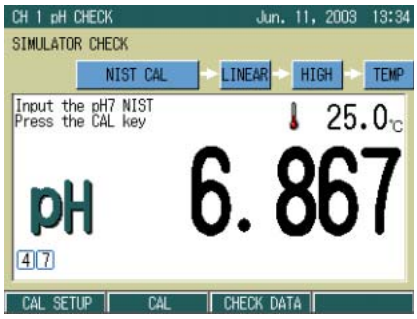
3. According to the operation guide, perform functional check as calibration by the standard solutions of pH7, pH4 in the following order.

① Calibration by standard solutions:
pH6.865
pH4.008
② Linearity check
pH0.000
pH4.000
pH7.000
pH10.000
pH14.000
③ Indication check by inputting high impedance
Input pH0.000
Input pH14.000
④ Temperature indication check
The displayed pH values at this time have nothing to do with the check result.
0.0 ℃
30.0 ℃
60.0 ℃
100.0 ℃

NOTE

When the calibration range error occurs at step ① above, the screen displays the error and the check stops.

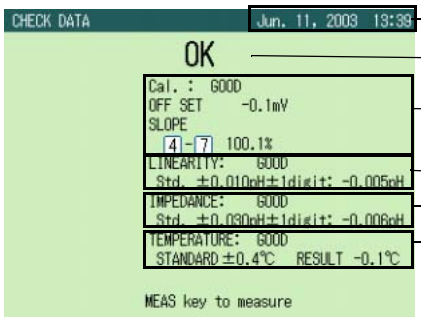
The measurement values during the periodical check are displayed after the calibration is cleared.



4. When the check is completed, the result data is automatically printed out.

- OK/CHECK — OK (satisfies the regulation)/CHECK (does not satisfy the regulation)
- Calibration
- Asymmetry potential — (Within regulated value ± 3 mV)
- Sensitivity — (99% to 101% of regulated value)
- Linearity — Indication error at each input (Regulated value ± 0.010 pH ± 1digit)
- High impedance — Indication error at each input (Regulated value ± 0.030 pH ± 1digit)
- Temperature — Indication error at each input (Regulated value ± 0.4 ℃)

Sample printout



NOTE

When the judgment of “CHECK” is displayed, check the connection and repeat the check. When the error repeatedly occurs, call customer service.

3.5 Check/Calibration Data Display

In Check/Calibration Data Display function, the latest data (for one time calibration) is displayed.
With a printer connected, “Print” is displayed at the field of F4. Pressing F4 (PRINT) prints out the displayed information.

● Check data display

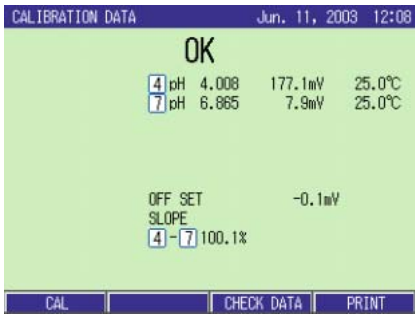
1. In the CHECK screen, press F3(CHECK DATA).

The CHECK DATA screen appears.

● Calibration data display

1. In the pH CAL screen, press F3(CAL DATA).

The CALIBRATION DATA screen appears.



Chapter 4 mV(ORP) MEASUREMENT

4.1 mV(ORP) Measurement

1. In any Measurement screen, press the MODE key to go to mV Measurement screen.

The displayed screen shows the measurement state of mV instantaneous value.

2. Pressing the MEAS key starts AutoHold measurement.

● Measurement of relative mV

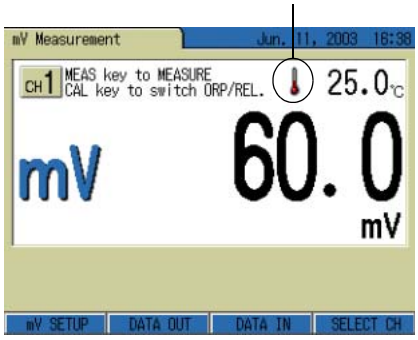
This meter features a display function of relative potential difference by shifting the measurement potential to zero. (The potential with no compensation is called as absolute mV.)

1. In measurement of mV instantaneous value, or during HOLD display is lit, press CAL key.

The displayed title of the screen changes from “mV Measurement” to “Relative mV Measurement.” The indicated value is compensated as offset potential, and the screen displays the instantaneous value of relative mV.

Display range of relative mV: ± 1999.9 mV

ATC indication

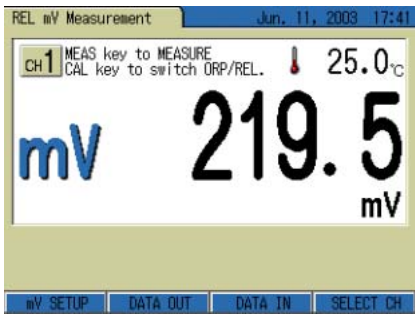


NOTE

In the relative mV measurement, the displayed values start blinking when the absolute mV at that time exceeds the measurement range (± 1999.9 mV).
The ATC display is on the screen, but this does not mean the temperature compensation is on the process. In mV (ORP) measurement there is no need of temperature compensation.

2. Press the CAL key again.

The screen display returns to that of absolute mV.



NOTE

To check ORP electrode is working well, use ORP standard solution. See (Page 220) on this concern. In mV(ORP) measurement, no MTC display is on the screen.

4.2 Functions in mV Measurement

● Alarm setting

Alarm setting function detects if the measured values are over or below the upper/lower limits, and displays them on the screen or outputs them as signals from the external output terminals.

When the measured values are out of the alarm range, the display color of the screen changes:

Setting range: -1999.9 to +1999.9 mV (for both upper and lower limits of the alarm)

Setting procedure

1. In the mV Measurement screen, press F1 (mV SETUP) to go to mV SETUP screen.

2. Press ← or → key, and select LIMIT ON.

3. Press the ENTER key.

The screen moves to the upper limit value setting field.

4. Press the ENTER key again.

The display color of the setting field changes, and the values can be input. First, the upper limit values should be under selection.

5. Press ↑ or ↓ key to input the values, and determine the setting by the ENTER key.

The display color changes.

6. Press ↓ key to select the lower limit option.

7. Press the ENTER key.

The display color of the setting field changes, and the values can be input.

8. Press ↑ or ↓ key to input the values, and determine the setting by the ENTER key.

The display color changes.

9. Reflect the setting by F4 (RETURN). The screen returns to the Measurement.

To skip alarm function

1. Select OFF in the above step 2.
2. Press F4 (RETURN) to reflect the setting. The screen returns to the Measurement.

4.3 Meter Check

There is no checking mode in mV(ORP) measurement.
For meter check, use pH checker mode.

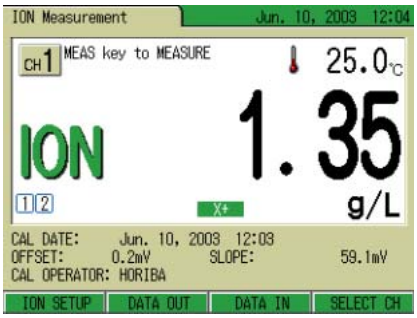
Chapter 5 Ion Measurement (F-53,55)

There are two methods to measure the ion concentration using the ion electrode; one is the calibration curve method and the other the standard addition method. The calibration curve method is used to measure the ion concentration of an unidentified solution by preparing a calibration curve which shows the relation between mV and concentration. The standard addition method is used to obtain the concentration of the target ions in the original sample by changing only that concentration and then measuring changes in the difference in electric potentials.

5.1 Open the ION Measurement Screen

1. In any Measurement screen for the corresponding CH, press the MODE key to proceed to the ION Measurement screen.

The displayed screen is the ION Measurement screen as follows:



5.2 Measurement Using a Calibration Curve

The Ion electrodes and the reference electrodes cause gap in the output according to the temperature change. Although this meter features the temperature compensation function, adjust the solution temperature of the measurement and the calibration as same as possible.

NOTE

When the Ion electrodes and the Conductivity electrodes are connected to perform 2CH simultaneous measurement for the same solution, it may take approximately 10 seconds until the indication stabilizes.

5.2.1 Calibration Using Ion Standard Solution

● CH 1 calibration

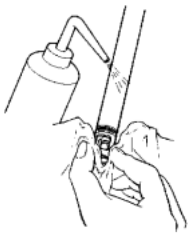
1. In any Measurement screen of the channel (CH) corresponding to the Ion measurement, press the MODE key.

ION Measurement screen appears.

2. Press the CAL key.

The ION CAL. screen appears.

3. Wash the tip of the electrode well with pure (de-ionized) water, then blot with filter or tissue paper.

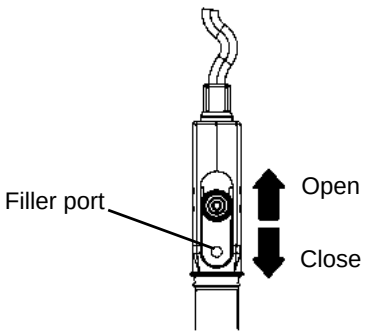


4. Open the internal solution filler port.

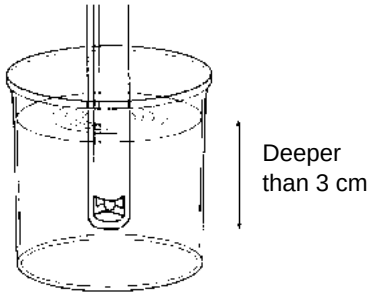
During the calibration, the filler port should be kept open.

NOTE

Filler port may differ in the structure depending on the electrode.



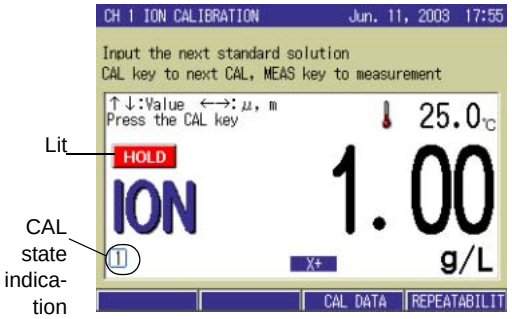
5. Immerse the electrode in the beaker with standard solution.



6. Input the values of standard solution by ↑ or ↓ key and select the auxiliary unit by ← or → key.

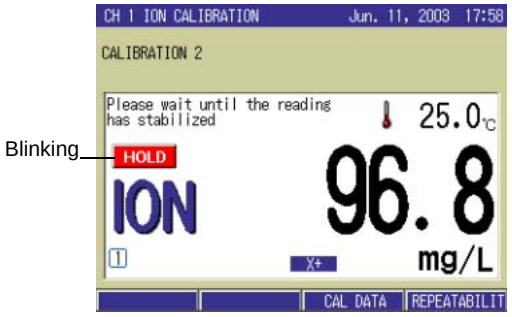
7. Press the CAL key to start the first calibration.

The measured value will be displayed. “HOLD” will flash in the display until the measured value stabilizes. When the indicated value stabilizes, “HOLD” will stop flashing and remain lit and the calibrated value will be held on the display.
The calibration status indication mark [1] showing the first point calibration appears.



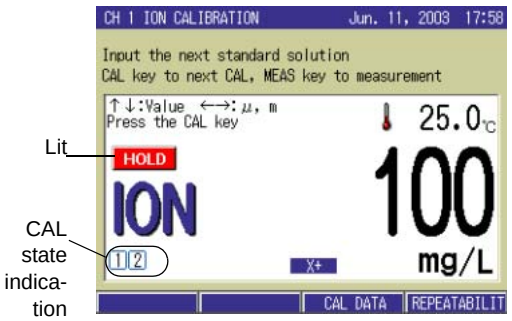
● The calibration of the second point

1. Input the value of the standard solution for the second point by ↑ or ↓ key, and select the unit by ← or → key.



2. Press the CAL key to start the second calibration.

The measured value will be displayed and “HOLD” will flash in the display until the indication stabilizes. When the indicated value stabilizes, “HOLD” will stop flashing and remain lit and the calibrated value will be held on the display.
The calibration status indication mark showing the second point calibration appears.



NOTE

During the calibration, the display range may automatically switch to change the auxiliary unit.

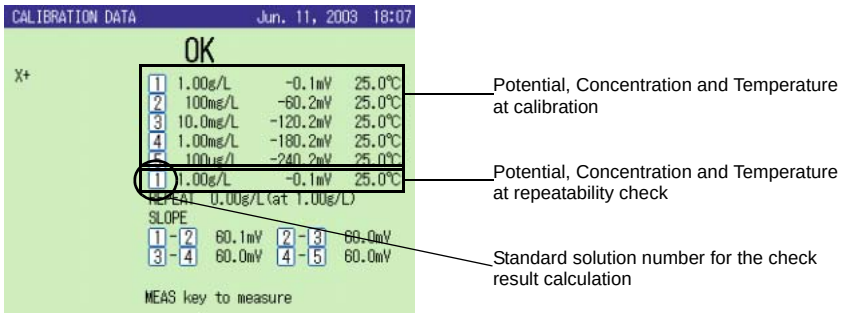
Repeatability check

To confirm the measurement accuracy in the Ion measurement, the repeatability check is available.

1. After the calibration, press F4 (REPEATABILITY) in CAL screen.

2. Immerse the electrode in the standard solution calibrated by the first point, and press the CAL key.

The difference between the calibrated value and measured value is displayed.
When the repeatability check is successfully completed, the electrode status “OK” appears on the screen.



● Function key at Ion calibration

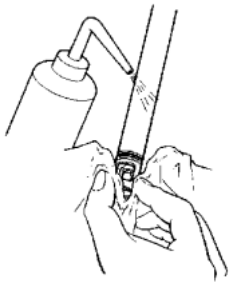
- CHECK:
  To perform periodical check, refer to " ● ION check" page 87
- CAL DATA:
  To review the former calibration status, refer to "5.5 Check Display" page 89
- CAL CLEAR:
  To clear all the calibrated values

REF

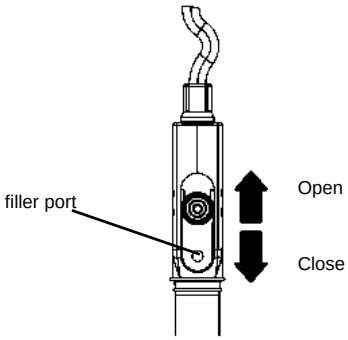
For the repeatability setup, refer to " ● Setting the Ion type" page 83

5.2.2 Ion Measuring

1. Wash the tip of the electrode with deionized water or wipe it with filter paper or tissue paper.



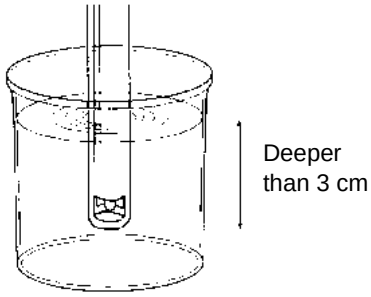
2. Open the internal solution filler port.
During the calibration, the filler port should be kept open.



NOTE

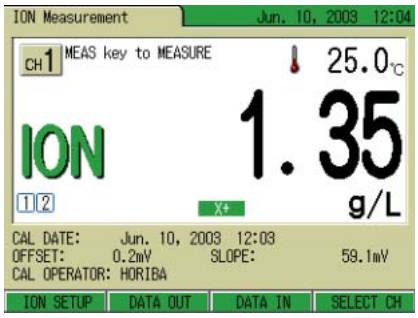
The filler port structure depends on the electrode.

3. Immerse the electrode in the sample, to at least three centimeters from the electrode tip.



4. Press the MODE key in any Measurement screen, to proceed to ION Measurement screen.

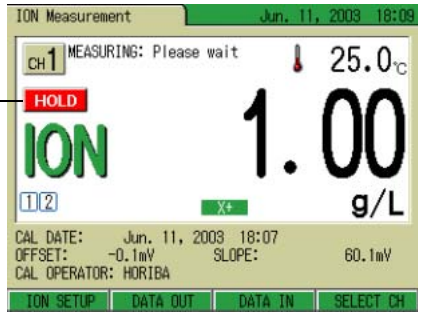
The instantaneous measurement for ION starts.



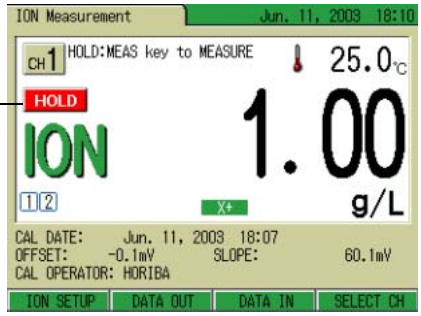
5. Press the MEAS key.

The AutoHold measurement starts. The HOLD indication starts blinking, and when the indication stabilizes the HOLD indication lights up. The indication value is held, and the measurement is completed.

Blinking



Lit



NOTE

The measured value may be in the HOLD state such as in the instantaneous measurement or the AutoHold measurement. In this case press F3 (DATA IN) memorizes the data. (Refer to "Chapter 9 DATA MEMORY" page 113)

5.3 Measurement Using Standard Addition Method

The standard addition method is classified into the known addition method, the known subtraction method, and modifications called the sample addition method and the sample subtraction method. These methods are effective when the composition varies depending on the samples and it is difficult to control conditions such as pH and ionic strength.
The F-series pH meter supports the known addition method and the sample addition method.

REF

For the known addition method, refer to JIS K0122.

● Known Addition Method and Sample Addition Method

Known addition method

For the known addition method, a small amount of standard solution for the ion species to measure is added to the sample solution to increase the amount of the target component (concentration of the ion species under measurement) by a certain amount. The sample concentration is obtained by the change in electric potential that occurs at that time.

Sample addition method

For the sample addition method, a small amount of sample is added to the standard solution for the ion species to measure to increase the amount of the target component (concentration of the ion species under measurement). The sample concentration is obtained by the change in electric potential that occurs at that time.

● Standard Addition 1 and Standard Addition 2

Standard addition 1

In the STANDARD ADDITION 1 mode, the standard solution for the ion species to measure is added once to the sample solution.

Standard addition 2

In the STANDARD ADDITION 2 mode, the standard solution for the ion species to measure is added twice to the sample solution. This mode is used to obtain the target ion concentration in the sample solution and the electric potential slope of the electrode used.

● Sample Addition 1 and Standard Addition 2

Sample addition 1

In the SAMPLE ADDITION 1 mode, the sample is added once to the standard solution for the ion species to measure.

Sample addition 2

In the SAMPLE ADDITION 2 mode, the sample is added twice to the standard solution for the ion species to measure. This mode is used to obtain the target ion concentration in the sample solution and the electric potential slope of the electrode used.

General Cautions for Standard Addition Method

In order to obtain more accurate and reliable data, pay attention to the following points:

- No ion of small coexisting tolerance limit.

REF

" Effect of coexisting substance" page 230

- No interfering ions with a high selective coefficient should coexist.
- In the STANDARD ADDITION 2 and SAMPLE ADDITION 2 mode, the target ion concentration in the sample and the electric potential slope of the ion electrode are obtained with approximation formulas. Therefore, it is not necessary to perform calibration or check the electric potential slope before measurement. However, if the linearity of the ion electrode used is low, if the electric potential slope is greatly different from the theoretical value (Nernst coefficient), or if a decrease in the concentration after addition is specified, then accurate measurement results may not be obtained.

5.3.1 Measuring Ion Concentration in Standard Addition 1 Mode

This mode is used to obtain the concentration of the ion species under measurement by adding a small amount of the target ions to the sample solution once, thus increasing the ion concentration of the target component, and then measuring the change in electric potential at that time.

Setting the measurement mode

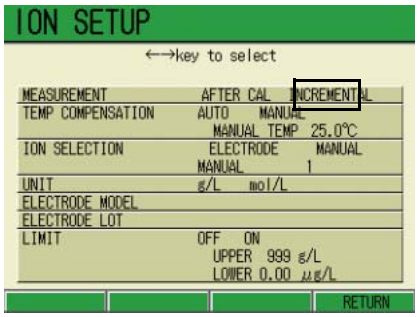
1. In ION Measurement screen, press F1 (ION SETUP).

The ION SETUP screen appears.

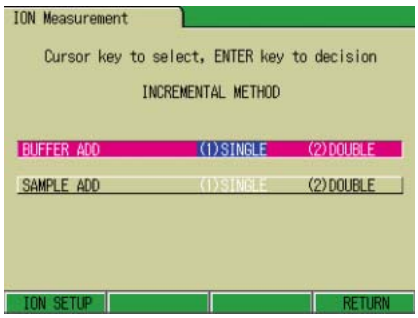
2. In the measurement item, press ← or → key, select the addition method, and then press the ENTER key.

3. Press F4 (RETURN).

The ION Measurement screen (for the Ion addition measurement) appears.



4. Press ← or → key to select (1) SINGLE of the known addition method, and press the ENTER key.

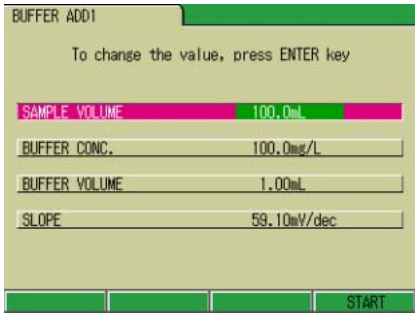


NOTE

In performing the measurement by the addition method, no setup for such parameters, as Ion type, Electrode model, Electrode lot, and/or alarms.

● Setting the Measurement condition

Input such setting items as sample volume, concentration and volume of the additive standard solution, and slope.



1. Press ↑ or ↓ key to select the option to be input.

2. Press the ENTER key.

The display color of the setting part changes.

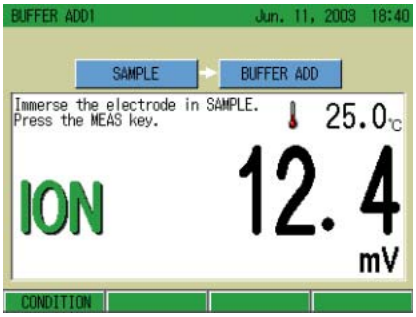
3. Press ↑ or ↓ key. After the value is determined, press the ENTER key.

Setting item and range

Sample volume:	1.0 to 19999.9 mL
Concentration of the additive standard solution:	0.1 to 19000.0 mg/L
Volume of the additive standard solution:	0.01 to 1000.00 mL
Slope:	+199.00 to -199.00 mV/dec

4. When the setting is completed, press F4 (START).

The Measurement screen appears.



For more accurate measurement

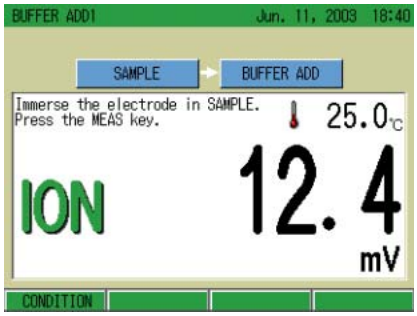
Normally, the added amount of the standard solution should be from 0.1% to 10% volume of the sample solution. It is desirable that when the standard solution is added to the sample solution, the concentration of the ion species under measurement increase by 1 to 10 times in the sample solution. It is therefore necessary to consider the concentration and added amount of the standard solution well. If the concentration of the added standard solution is too low, if the volume of the added standard volume is too larger than that of the sample, then a large error may occur in the measurement result.

NOTE

The slope depends on the Ion electrode. Input the slope of Ion electrode (potential slope) to be measured. (Refer to" ● Types and Features of Applicable Electrodes" page 235)

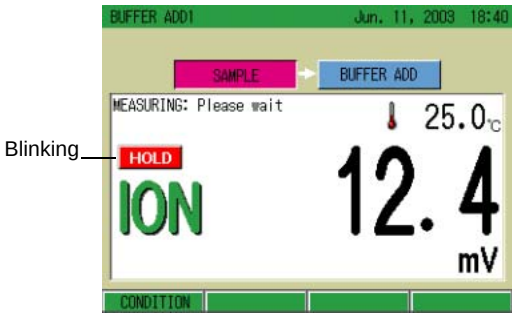
● Measuring

1. Immerse the ion electrode in sample solution.

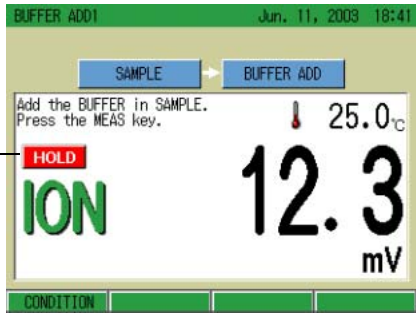


2. Press the MEAS key.

The AutoHold measurement starts.



When the indication stabilizes, the HOLD indication lights up.



NOTE

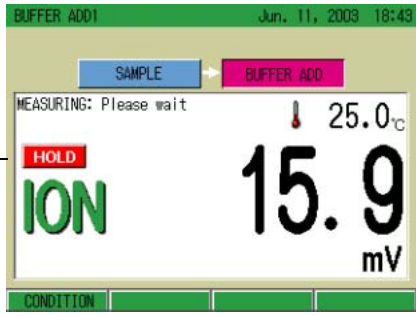
Pressing the ESC key clears the HOLD status.

3. Add the standard solution to the sample solution.

4. Press the MEAS key.

The AutoHold measurement starts.

When the indication stabilizes, the HOLD indication lights up.
After calculation, the concentration of the sample solution will display.



To measure continuously:

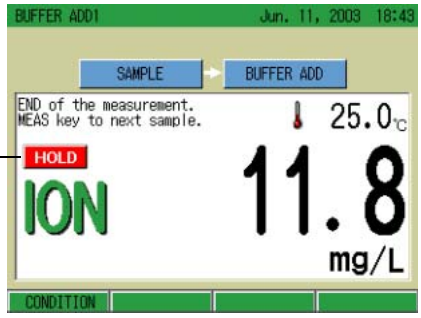
Press the MEAS key.

To change the condition:

Press F1 (CONDITION).

To switch SINGLE/DOUBLE

Press F1 (CONDITION) and press the ESC key.



5.3.2 Measuring Ion Concentration in Standard Addition 2 Mode

This mode is used to obtain the concentration of the ion species under measurement by adding a small amount of the target ions to the sample solution twice, thus increasing the ion concentration of the target component, and then measuring the change in electric potential at that time.

1. In the ION SETUP screen press ↑ or ↓ key to select MEASUREMENT.

2. Press ← or → key to select the INCREMENTAL.

3. Press F4 (RETURN).

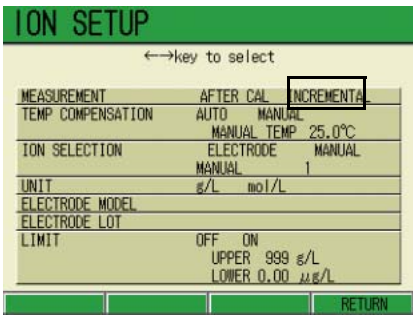
The ION Measurement screen (for the Ion addition measurement) appears.

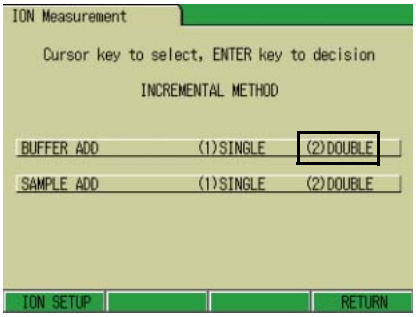
4. Press ↑ or ↓ key to select the known addition method.

5. Press ← or → key and select the (2) DOUBLE option.

6. Press F4 (RETURN).

The BUFFER ADD2 screen appears.





● Setting the Measurement condition

Input such parameters as sample volume, concentration of the additive standard solution, Volume 1 of the additive standard solution, Volume 2 of the additive standard solution, and Ion valency.

1. Press ↑ or ↓ key to select the option for the input.

2. Press the ENTER key.

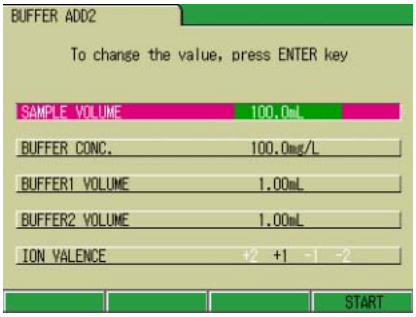
The color of the setting part changes.

3. Press ↑ or ↓ key and input the value.

4. Press the ENTER key.

The value is determined and the display color of the setting part changes.

5. When the setting is completed, press F4 (START).



Ion valency

To input the ion valency, perform the step 1 above, and instead of go to the step 2., press ← or → key to change the value.
The Ion valency depends on each ion; input the appropriate valency for the ion to be measured.

REF

" ● Types and Features of Applicable Electrodes" page 235

Setting range

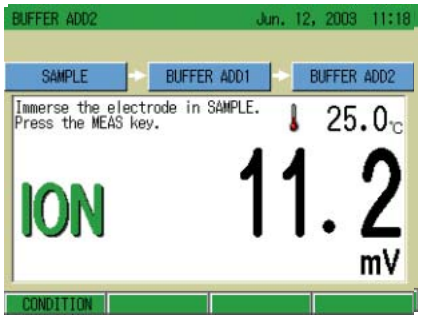
Sample volume:	1.0 to 19999.0 mL
Concentration of additive standard solution:	0.1 to 19000.0 mg/L
Volume 1, 2 of additive standard solution:	0.01 to 1000 mL
Ion valency:	+2, +1, -1, -2

For more accurate measurement:

Normally, the added amount of the standard solution should be from 0.1% to 10% volume of the sample solution. It is desirable that when the standard solution is added to the sample solution, the concentration of the ion species under measurement increase by 1 to 10 times in the sample solution. It is therefore necessary to consider the concentration and added amount of the standard solution well.If the concentration of the added standard solution is too low, if the volume of the added standard volume is too larger than that of the sample, then a large error may occur in the measurement result.

● Measurement

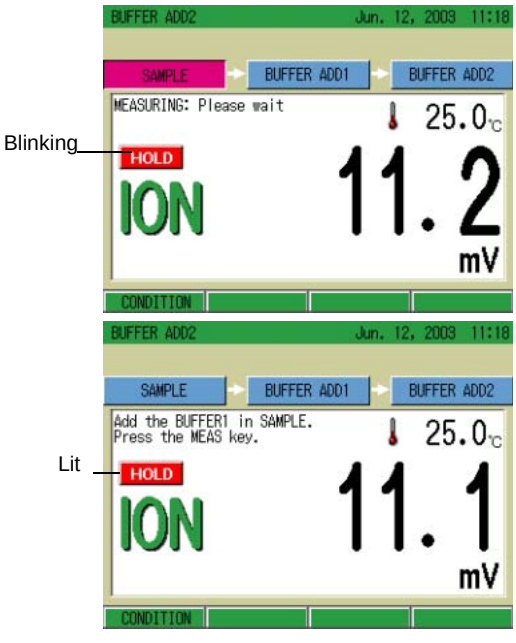
1. Immerse the ion electrode in sample solution.



2. Press the MEAS key.

The AutoHold measurement starts.

When the indication stabilizes, the HOLD indication lights up.



3. Add the standard solution 1 to the sample solution.

NOTE

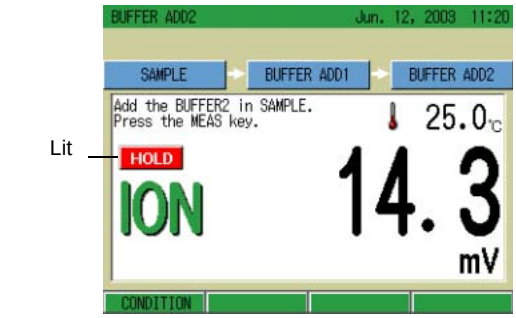
Pressing the ESC key clears the HOLD status.

4. Press the MEAS key.

The AutoHold measurement starts.

Blinking

When the indication stabilizes, the HOLD indication lights up.



Lit

5. Add the standard solution 2 to the sample solution.

NOTE

Pressing the ESC key clears the HOLD status.

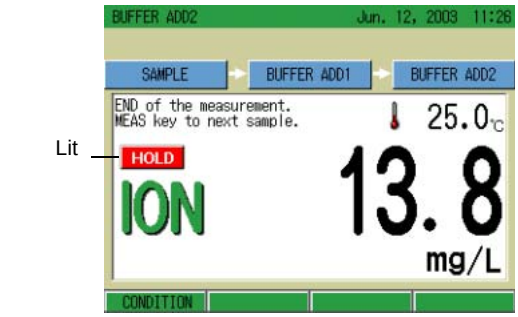
6. Press the MEAS key.

The AutoHold measurement starts.

Blinking

When the indication stabilizes, the HOLD indication lights up.After calculation, the concentration of the sample solution will display.

7. To perform measurement continuously, press F1 (CONDITION) and configure the measurement setting.



Lit

To measure continuously:

Press the MEAS key.

To change the condition:

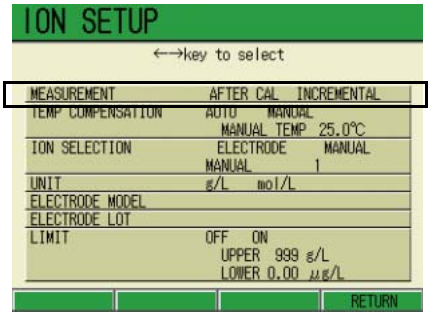
Press F1 (CONDITION).

To switch SINGLE/DOUBLE:

Press F1 (CONDITION) and press the ESC key.

5.3.3 Measuring Ion Concentration in Sample Addition 1 Mode

This mode is used to obtain the ion concentration of the target ion species by adding a small amount of the sample to the standard solution for the ion species to measure once, thus increasing the ion concentration of the target component, and then measuring the change in electric potential which occurs at that time.



1. In the ION SETUP screen, press ↑ or ↓ key and select the MEASUREMENT option.

2. Press ← or → key, select the INCREMENTAL option and press F4 (RETURN).

The ION Measurement screen appears.

3. Press ↑ or ↓ key and select the SAMPLE ADD option.

4. Press ← or → key and select (1) SINGLE.

5. Press F4 (RETURN).

The SAMPLE ADDITION 1 screen appears.

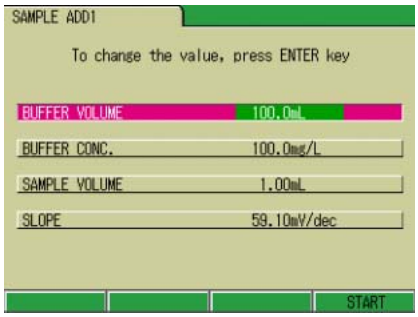
● Setting the Measurement condition

Input such setting items as sample volume, concentration and volume of the additive standard solution, and slope.

The slope depends on the Ion electrodes; input the slope of Ion electrode (potential slope) to be measured.

REF

" ● Types and Features of Applicable Electrodes" page 235



1. Press ↑ or ↓ key and select the option to be set.

2. Press the ENTER key.

The display color of the setting part changes.

3. Press ↑ or ↓ key to change the value.

4. When the value input is completed, press the ENTER key.

Setting range:

Sample volume:	1.0 to 19999.0 mL
Concentration of the additive standard solution:	0.1 to 19000 mg/L
Volume of the additive standard solution:	0.01 to 1000 mL
Slope:	+199.00 to -199.00 mV/dec

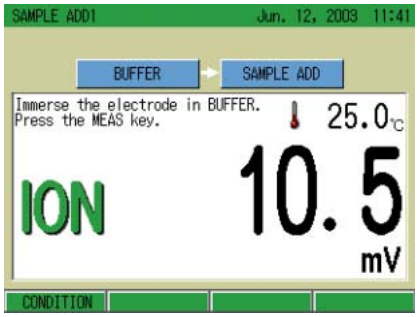
5. When the setting is completed, press F4 (START).

For more accurate measurement:

Normally, the added amount of the sample should be from 0.1% to 10% volume of the standard solution. It is desirable that when the standard buffer is added to the sample solution, the concentration of the ion species under measurement increase by 1 to 10 times in the sample solution. It is therefore necessary to consider the concentration of the standard solution and added amount of the sample well. If the concentration of the added sample is too low, if the volume of the added sample is too larger than that of the standard solution, then a large error may occur in the measurement result.

Measurement

1. Immerse the ion electrode in the standard solution.

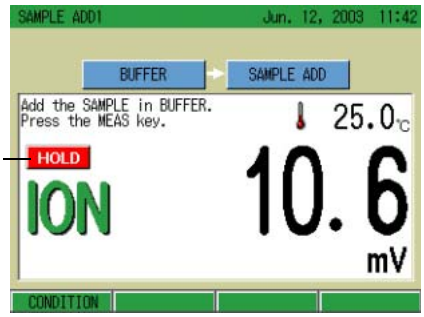


2. Press the MEAS key.

The AutoHold measurement starts.

Blinking

When the indication stabilizes, the HOLD indication lights up.



Lit

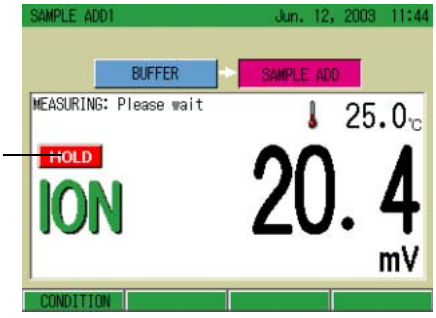
3. Add the sample to the standard solution.

NOTE

Pressing the ESC key clears the HOLD status.

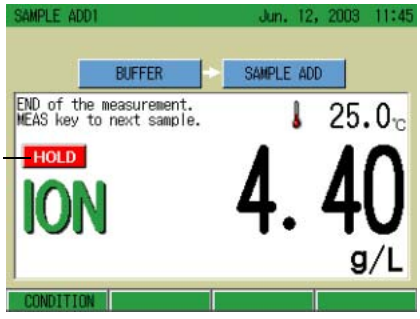
4. Press the MEAS key.

The AutoHold measurement starts.



Blinking

When the indication stabilizes, the HOLD indication lights up.
The concentration of the sample solution will display in the screen.



Lit

To measure continuously:

Press the MEAS key.

To change the condition:

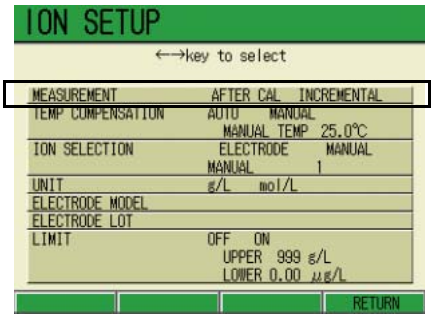
Press F1 (CONDITION).

To switch SINGLE/DOUBLE

Press F1 (CONDITION) and press the ESC key.

5.3.4 Measuring Ion Concentration in Sample Addition 2 Mode

This mode is used to obtain the concentration of the ion species under measurement by adding a small amount of sample to standard solution for the ion species to measure twice, thus increasing the ion concentration of the target component, and then measuring the change in electric potential at that time.



1. In the ION SETUP screen, press ↑ or ↓ key and select the MEASUREMENT option.

2. Press ← or → key, select the INCREMENTAL option and press F4 (RETURN).

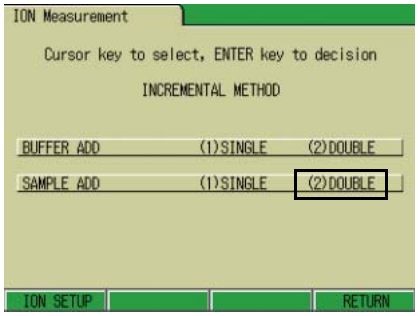
The ION Measurement screen appears.

3. Press ↑ or ↓ key and select the SAMPLE ADD option.

4. Press ← or → key and select (2) DOUBLE.

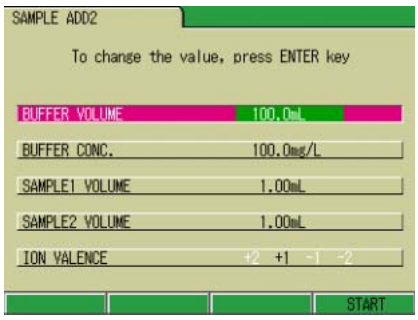
5. Press F4 (RETURN).

The SAMPLE ADDITION 2 screen appears.



● Setting the Measurement condition

Input such parameters as sample volume, concentration of the standard solution, Volume 1 of the additive standard solution, Volume 2 of the additive standard solution, and Ion valency.



1. Press ↑ or ↓ key and select the option to be input.

2. Press the ENTER key.

The display color of the setting part changes.

3. Press ↑ or ↓ key. After the value is determined, press the ENTER key.

4. Press the ENTER key.

The value is determined and the display color of the setting part changes.

5. When the setting is completed, press F4 (START).

Ion valency

To input the ion valency, perform the step 1 above, and instead of go to the step 2., press ← or → key to change the value.
The Ion valency depends on each ion; input the appropriate valency for the ion to be measured.

Setting range

Sample volume:	1.0 to 19999.0 mL
Concentration of additive standard solution:	0.1 to 19000.0 mg/L
Volume 1, 2 of additive standard solution:	0.01 to 1000 mL
Ion valency:	+2, +1, -1, -2

REF

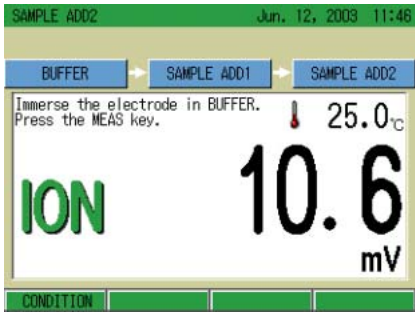
" ● Types and Features of Applicable Electrodes" page 235

For more accurate measurement:

Normally, the added amount of the sample should be from 0.1% to 10% volume of the standard solution. It is desirable that when the standard buffer is added to the sample solution, the concentration of the ion species under measurement increase by 1 to 10 times in the sample solution. It is therefore necessary to consider the concentration of the standard solution and added amount of the sample well. If the concentration of the added sample is too low, if the volume of the added sample is too larger than that of the standard solution, then a large error may occur in the measurement result.

Measuring

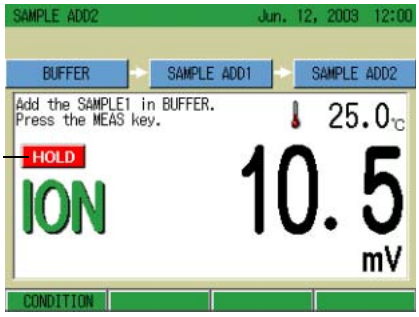
1. Immerse the ion electrode in the standard solution.



2. When the indication stabilizes, press the MEAS key.

The AutoHold measurement starts.

When the indication stabilizes, the HOLD indication lights up.



NOTE

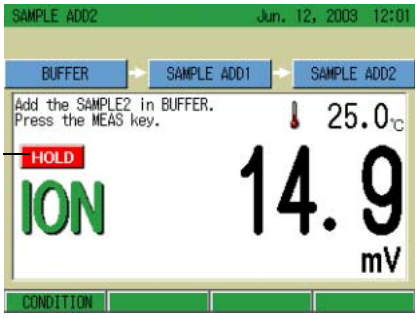
Pressing the ESC key clears the HOLD status.

3. Add the Sample 1 to the standard solution.

4. Press the MEAS key.

The AutoHold measurement starts.

When the indication stabilizes, the HOLD indication lights up.



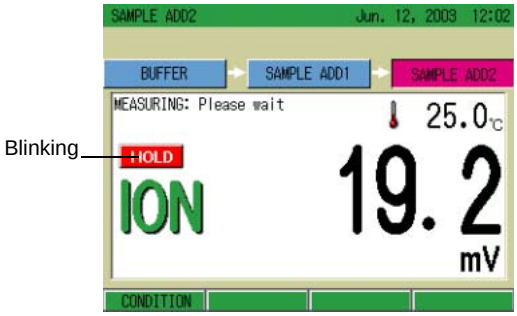
5. Add the Sample 2 to the standard solution.

NOTE

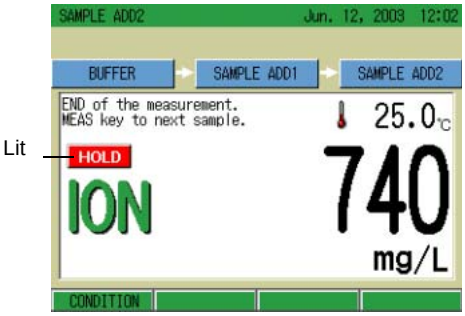
Pressing the ESC key clears the HOLD status.

6. Press the MEAS key.

The AutoHold measurement starts.



When the indication stabilizes, the HOLD indication starts blinking. When the measurement is completed, the concentration of the sample solution will display in the screen.



To continue the measurement:

Press the MEAS key.

To change the conditions:

Press F1 (CONDITION).

To switch SINGLE/DOUBLE:

Press F1 (CONDITION) and press the ESC key.

5.4 Changing Measurement SETUP Conditions

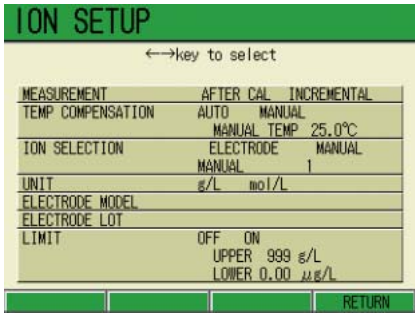
The various measurement conditions can be changed.

NOTE

For F-53 (and only for F-53), the ION SETUP is available for each CH.

1. In the ION Measurement screen, press F1 (ION SETUP).

The ION SETUP screen appears.



NOTE

When there is no need to change the conditions, press either the ESC key or the MEAS key. The screen returns to the ION Measurement screen.

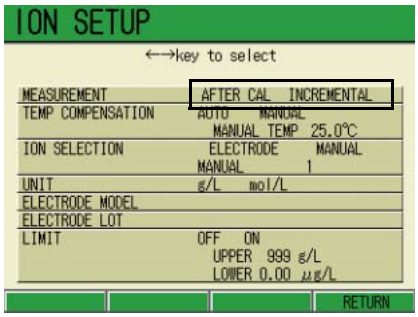
● Measurement

1. In the ION SETUP screen, press ↑ or ↓ key and select the MEASUREMENT option.

2. Press ← or → key and select either AFTER CAL or INCREMENTAL.

3. Press F4 (RETURN).

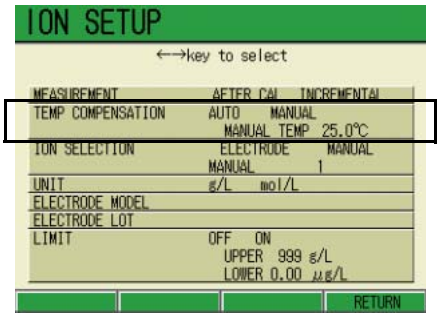
Selecting the AFTER CAL option returns to the Measurement screen. Selecting the INCREMENTAL option displays the further setting screen.



● Temperature Compensation

There are two temperature compensation methods available; one is the automatic temperature compensation (ATC) and the other the manual temperature compensation (MTC). For the ATC, the temperature of the solution is sensed by the temperature sensor built-in the electrode and then the temperature is compensated. For the MTC, when the temperature sensor is not built-in the electrode, the temperature of the solution is previously measured and its value is entered. The temperature is compensated using the entered temperature value.

1. In the ION SETUP screen, press ↑ or ↓ key and select the TEMP COMPENSATION option. Select either AUTO or MANUAL by pressing ← or → key.



Selecting AUTO:

1. Pressing F4 (RETURN).

The setting is reflected, and the display returns to the Measurement screen.

Selecting MANUAL:

1. Pressing the ENTER key moves the cursor to the TEMP COMPENSATION option.

2. Press the ENTER key again.

The display color of the setting part changes, enabling the input.

3. Press ↑ or ↓ key and input the temperature.

Setting range: 0.0 to 100.0 ℃

4. Press the ENTER key to determine the setting.

The display color of the setting part changes.

5. Press F4 (RETURN).

The setting is reflected, and the display returns to the Measurement screen.

● Setting the Ion type

The Ion type setting does not necessary for setting the Ion electrode model.
When the electrode model setting is not necessary or when the model is not freely input, the Ion valency should be input by manual operation.

1. In the ION SETUP screen, select the ION SELECTION option.

2. Press ← or → key and select MANUAL.

Selecting MANUAL:

1. Press the ENTER key.

The display color of the input part of ION SELECTION changes, enabling the input.

2. Press ↑ or ↓ key and set the Ion valency (-2, -1, 1, 2).

3. Press F4 (RETURN).

The setting is reflected, and the display returns to the Measurement screen.

● Changing the measurement unit

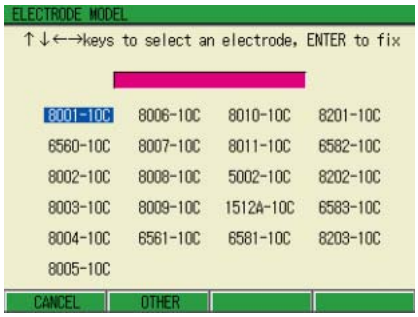
1. In the ION SETUP screen, press ↑ or ↓ key and select the UNIT option. Press ← or → key to select either g/L or mol/L.

2. Press F4 (RETURN) to reflect the setting. The display returns to the Measurement screen.

● Changing the electrode model

When the Ion model is set, the Ion type automatically changes.
For each Ion type, the unit and the calibration information is memorized.

1. In the ION SETUP screen, press the ELECTRODE MODEL option. Press the ENTER key to proceed to the ELECTRODE MODEL screen.



Selecting the electrode model

Press ↑ , ↓ or ← , → key to select the appropriate electrode model. Determine the selection by the ENTER key. The screen goes back to ION SETUP; press F4 (RETURN) to reflect the setting.

Setting the other model freely

Press F2 (OTHER) to enable the model name input by alphabetical and numerical characters.
Up to 9 characters are available.
Press F4 (RETURN) returns the screen to ION SETUP.

2. Press F4 (RETURN).

The setting is reflected, and the display returns to the Measurement screen.

NOTE

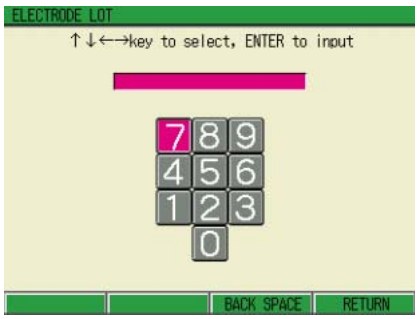
When the OTHER option is selected to input the model freely, input of the same name shown in the selection menu of ELECTRODE MODEL screen will be recognized as selecting the same electrode on the screen.

● Changing the electrode Lot

1. In the ION SETUP screen, select the ELECTRODE LOT option. Press the ENTER key, and proceed to the ELECTRODE LOT screen.

2. Select the numerical value by pressing ↑ , ↓ or ← , → key, and determine the value by the ENTER key.

Maximum character: 7 digits



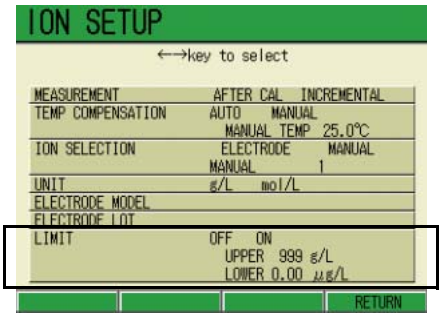
3. Press F4 (RETURN) to return to the ION SETUP screen.

4. Press F4 (RETURN) to reflect the setting and returns to the Measurement screen.

● Setting alarms

The alarm function detects the measured value out of the upper or lower limit value, and either displays them on the screen or outputs them from the external output terminals. The values out of the limit value are displayed in the different color on the screen.

1. In the ION SETUP screen, press ↑ or ↓ key to select the LIMIT option. Press ← or → key to select OFF or ON.



Selecting OFF:

1. Press F4 (RETURN).

Selecting ON:

1. Press the ENTER key.

The cursor moves to the upper limit value setting part.

2. Press the ENTER key again.

The display color of the setting part changes, enabling the input by pressing ↑ or ↓ key.
Setting range: 0.0 µg/L to 999 g/L(0.00 µmol/L to 999 mol/L)
Press ← or → key to change the auxiliary unit.

3. When the setting is completed, press the ENTER key.

The setting is determined, and the display color of the setting part changes.

4. Press the lower limit item by ↓ key.

5. Press the ENTER key.

The display color of the setting part changes, enabling the input by pressing ↑ or ↓ key.
Setting range: 0.0 µg/L to 999 g/L(0.00 µmol/L to 999 mol/L)
Press ← or → key to change the auxiliary unit.

6. Press the ENTER key to determine the setting.

The display color of the setting part changes.

7. Press F4 (RETURN).

The setting is reflected, and the display returns to the Measurement screen.

NOTE

The set value automatically selects the appropriate auxiliary unit.

● ION check

By ION check function, the output of the checker X-51 (optional) can be input to the meter, to perform the functional check of the meter.
Refer also to the instruction manual of the checker X-51 before the work.
Set the measurement unit for Ion to mol/L before starting the check work.
Set the temperature compensation to AUTO.

1. In the ION CAL screen, press F2 (CHECK).

The ION CHECK screen appears.

2. Output the sample data from the checker.

3. Press the CAL key.

When the indication stabilizes, the HOLD indication changes from the blinking state to the lit state.

4. Output the next sample data from the checker.

5. Repeat the step 3. to step 4., to confirm all the items in the following order.

Calibration by standard solution

0 mV 1.00 mol/L
120 mV 10.0 mmol/L

Linearity check

240 mV 100 μmol/L
120 mV 10.0 mmol/L
0 mV 1.00 mol/L
-120 mV 100 mol/L

Temperature check

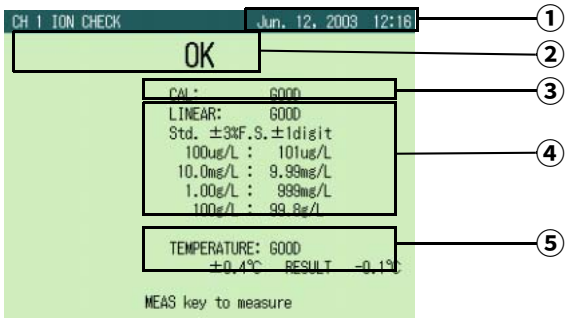
0.0 ℃
30.0 ℃
60.0 ℃
100.0 ℃

NOTE

The ion valency displayed at this time have no relation with the check.

When all the check is completed, the result is displayed.

6. When all the check is completed, the result is automatically output.



- ① Date of check completed
- ② Judgment: OK/CHECK
- ③ Calibration by standard solution
- ④Linearity check: regulated indication error by each input: ±3.0%±1digit of the full scale
- ⑤ Temperature: regulated error by each input: ± 0.4 ℃

NOTE

When the judgment of “CHECK” is displayed, assure the connection and repeat the check. When the error repeatedly occurs, ask further inspection for the meter and the checker through the sales shop you have purchased the meter.

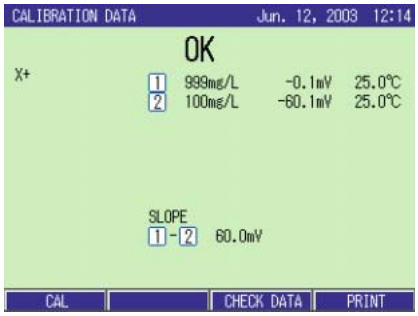
5.5 Check Display

You can display the latest check result and calibration date for ion measurement.

Ion calibration check display

1. In the CAL screen, press F3 (CAL DATA).

The CALBRATION DATA screen appears.



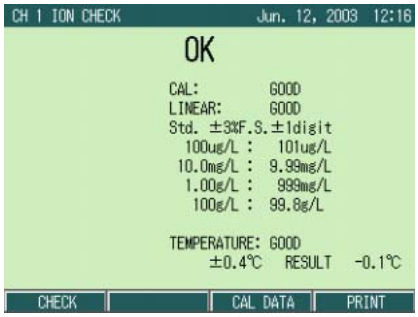
NOTE

When the printer is connected, the function display of F4 shows “PRINT.”
Pressing F4 (PRINT) prints the check data.

Check data display

1. In ION CHECK screen, press F3 (CHECK DATA).

The data is displayed.



NOTE

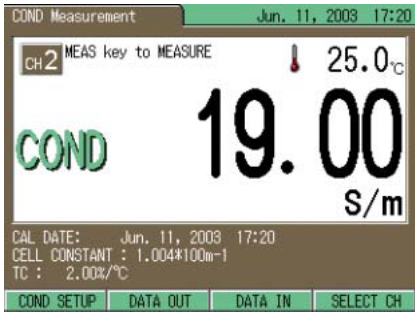
When the printer is connected, the function display of F4 shows “PRINT.”
Pressing F4 (PRINT) prints the check data.

Chapter 6 CONDUCTIVITY MEASUREMENT(F-54,55)

6.1 Open Measurement Screen for Conductivity

1. Press the MODE key in any Measurement screen, and go to COND Measurement screen.

The displayed screen shows the instantaneous measured value of conductivity.



NOTE

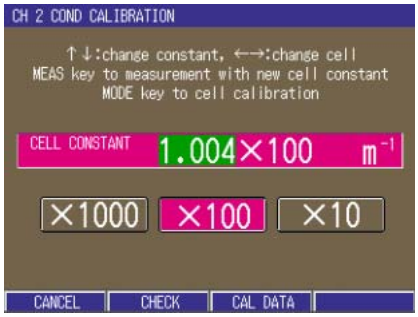
In the Measurement screens of pH, mV, or ION for F-54 and F-55, press F4 (SELECT CH) to first change the screen to CH2 pH MEASUREMENT and then proceed to the COND Measurement screen.

6.2 Cell Constant Setting

The cell constant can be input.

1. Press the CAL key in the Measurement screen.

A window appears, and the COND cell constant can be input.



2. Press ↑ or ↓ key and set the cell constant displayed on the electrode.

NOTE

The unit indication of the cell constant depends on the electrode. Convert the unit to the one for the meter before input.

100 m^{-1} = 1 cm^{-1}

1000 m^{-1} = 10 cm^{-1}

10 m^{-1} = 0.1 m^{-1}

3. Press ← or → key and set the digit.

4. Press the MEAS key.

The Measurement screen appears. The display shows the instantaneous measurement value by the set cell constant.

NOTE

To cancel, press F1 (CANCEL).

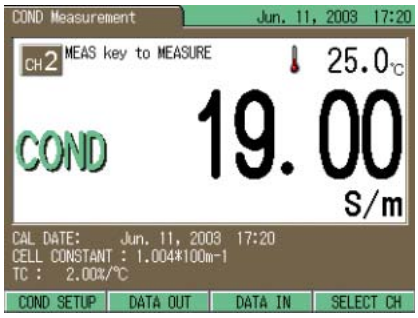
REF

"● Calibration of cell constant" page 241

6.3 Conductivity Measurement

By the step described in the previous section, pressing the MEAS key should show the instantaneous measurement value.

1. In the COND Measurement screen, press the MEAS key.



The AutoHold measurement starts.

When the indication stabilizes, the HOLD indication starts blinking, and the measurement result is displayed.

6.4 Measurement Setting Change

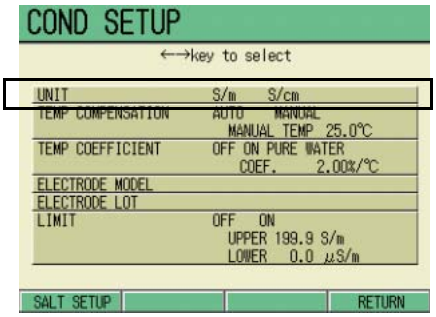
In the COND Measurement screen, press F1 (COND SETUP) to go to the COND SETUP screen.

6.4.1 Unit selection

1. In the COND SETUP screen, press ↑ or ↓ key to select the UNIT, and press ← or → key to select S/m or S/cm.

2. Press F4 (RETURN).

The setting is reflected, and the display returns to the Measurement screen.



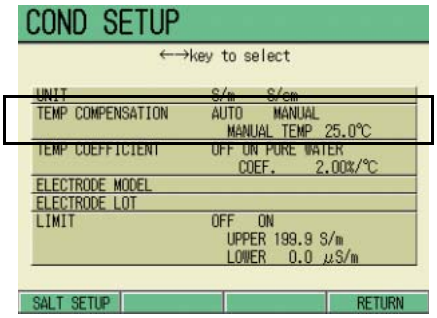
NOTE

The unit of resistivity should be determined based on the conductivity unit set in this screen.
Conductivity unit S/m
→ Resistivity unit Ω•m
Conductivity unit S/cm
→ Resistivity unit Ω•cm

6.4.2 Temperature compensation

There are two types of temperature compensation; Automatic Temperature Compensation (ATC) and Manual Temperature Compensation (MTC).
Under ATC, the temperature sensor connected to the meter detects the solution temperature. On the other hand, under MTC the operator should measure the solution temperature beforehand since the temperature sensor is not connected to the meter, and should input the temperature value to the system. The compensation uses the input temperature value.

1. In the COND SETUP screen, press ↑ or ↓ key and select the TEMP COMPENSATION option, and press ← or → key and select AUTO/MANUAL.



In selecting MANUAL

Input the temperature in the following step:

1. Press the ENTER key.

The cursor moves to the temperature setting part.

2. Press the ENTER key again.

The display color of the setting part changes, and the input is available.

3. Press ↑ or ↓ key and input the value.

Setting range: 0.0 to 100.0 ℃

4. Press the ENTER key.

The setting is determined, and the display color of the setting part changes.

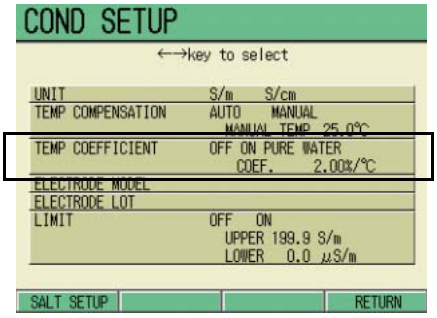
5. Press F4 (RETURN).

The setting is reflected, and the display returns to the COND Measurement screen.

6.4.3 Temperature conversion coefficient

The conductivity of the solution changes according to the solution temperature. To compare the solution conductivity, it is necessary either to perform the measurement in a certain temperature or to measure the solution by converting the temperature to the standard temperature. In the measurement of ACCURATE, the measurement solution should be kept in the standard temperature typically by a thermostatic chamber.

1. In the COND SETUP screen, press ↑ or ↓ key to select the TEMP COEFICIENT option, and press ← or → key to select OFF, ON or PURE WATER.



NOTE

In setting to PURE WATER, refer to “Pure water temperature conversion (double temperature compensation)” described in JIS K0130.

2. In selecting ON, pressing the ENTER key moves the cursor to the coefficient setting part. Pressing the ENTER key again changes the display color, enabling the value input by ↑ or ↓ key.

Setting range: 0.00 to 10.00 %/ ℃

3. Press the ENTER key.

The setting is determined, and the display color of the setting part changes.

4. Press F4 (RETURN).

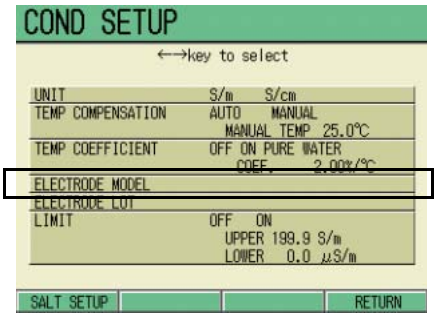
The setting is reflected, and the display returns to the Measurement screen.

REF

" ● Temperature coefficient" page 243

6.4.4 ELectrode model change

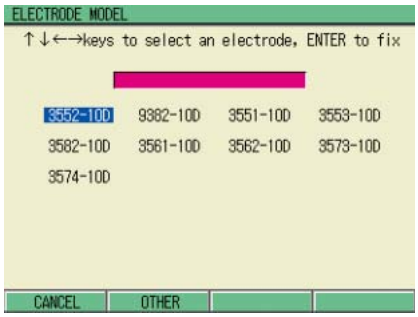
The electrode model, if input preliminarily, can be contained in the data printout (detailed) or the data memory.



1. In the COND SETUP screen, press ↑ or ↓ key and select the ELECTRODE MODEL option.

2. Press the ENTER key.

The ELECTRODE MODEL screen appears.



3. Press ↑ , ↓ or ← , → key to move the cursor to the ELETRODE MODEL option.

NOTE

Pressing F2 will switch the ELECTRODE MODEL screen with the input screen.

4. Determine the setting by the ENTER key.

5. Press F4 (RETURN).

The set value is registered.

To input the model name freely

Perform the following step instead of the step 3 above to input the model name freely.

1. Press F2 (OTHER).

The input screen of the electrode model appears.

2. Press ↑ , ↓ and/or ← , → keys, input appropriate letters/numerical keys, and press the ENTER key.

3. Determine the setting by F4 (RETURN).

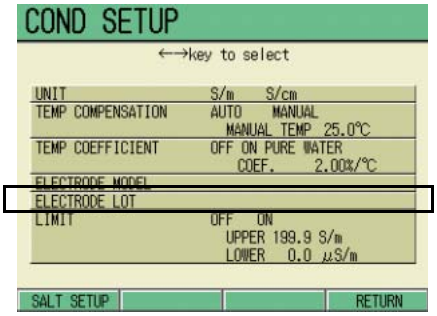
The COND SETUP screen appears.

4. Press F4 (RETURN).

The input model is registered.

6.4.5 Electrode lot change

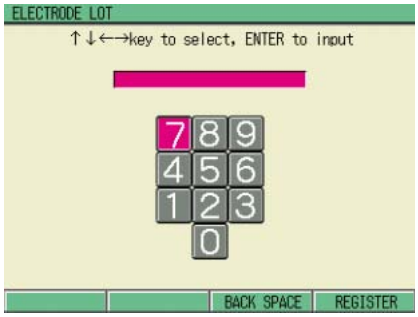
By inputting the electrode Lot, the data print-out (detailed) and/or data memory can contain the electrode Lot information.



1. In the COND SETUP screen, move the cursor to the electrode Lot. change the field by ↑ or ↓ key.

2. Press the ENTER key.

The ELECTRODE LOT screen appears.



3. Select the numerical values by ↑ , ↓ and/or ← , → keys, and press the ENTER key.

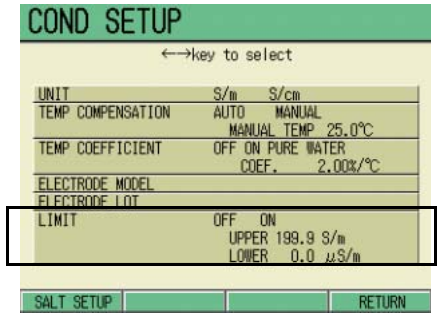
Setting range: maximum 7 digits

4. Press F4 (RETURN) to return to the COND SETUP screen.
Press F4 (RETURN) to register the set value.

6.4.6 Alarm setting

Alarm setting function detects whether the measurement value exceeds upper or lower limit values, and displays it on the screen or outputs it as a signal from the external output terminal.

When the measurement value exceeds the alarm range, the color of the displayed value changes in Measurement screen.



1. In the COND SETUP screen, press ↑ or ↓ key to select LIMIT. Press ← or → key to select OFF or ON.

When ON is selected:

1. Press the ENTER key.

The cursor moves to the upper limit value setting part.
Press the ENTER key again.
The display color of the setting part changes, enabling to input the values by pressing ↑ or ↓ key.
Setting range: 0.3 µS/m to 199.9 S/m (0.3 µS/cm to 199.9 S/cm)
Set the auxiliary unit by ← or → key.

2. Press the ENTER key.

The setting is reflected, and the display color changes.

3. Select the lower limit item by ↓ key.

4. Press the ENTER key.

The display color of the setting part changes, enabling the value input by pressing ↑ or ↓ key.
Setting range: 0.3 µS/m to 199.9 S/m (0.3 µS/cm to 199.9 S/cm)
Set the auxiliary unit by ← or → key.

NOTE

Values less than 0.2 µS/m(S/cm) can be input, but in this case alarm may not correctly triggered.

5. Press the ENTER key.

The setting is determined, and the display color of the setting part changes.

6. Press F4 (RETURN).

The setting is reflected, and the display returns to the Measurement screen.

NOTE

The set value is automatically switched to the appropriate auxiliary unit.

6.5 Periodical Check of COND

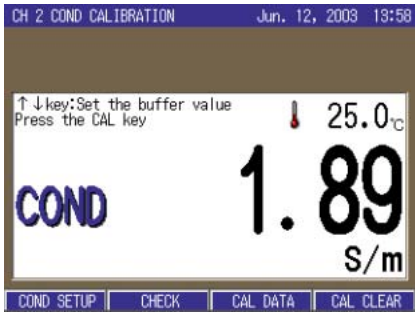
Use the optional Checker X-52 and input the value to the meter, to perform the functional check.
Refer to the Instruction Manual for the Checker X-52 before the operation.
Before starting the inspection, set the unit to S/m and the cell constant to 1.000 × 100 m^{-1}.
Also set the temperature compensation to AUTO.

1. In the COND Measurement mode, press the CAL key.

The SETUP screen for the cell constant appears.

2. Press the MODE key.

The COND CALIBRATION screen appears.



3. Press F2 (CHECK).

The periodical check mode starts. The operation guide appears on the screen.

4. The checker outputs the sample.

5. Press the CAL key.

When the indication stabilizes, the HOLD indication changes from the blinking state to the lit state.

6. The checker outputs the next sample.

7. Repeat step 5. to step 6. and confirm all the items.

The check items are the followings (totally 15):

Span check

19.00 S/m
1.900 S/m
190.0 mS/m
19.00 mS/m
1.900 mS/m

Linearity check

10.00 S/m
1.000 S/m
100.0 mS/m
10.00 mS/m
1.000 mS/m
0.000 mS/m

Temperature check

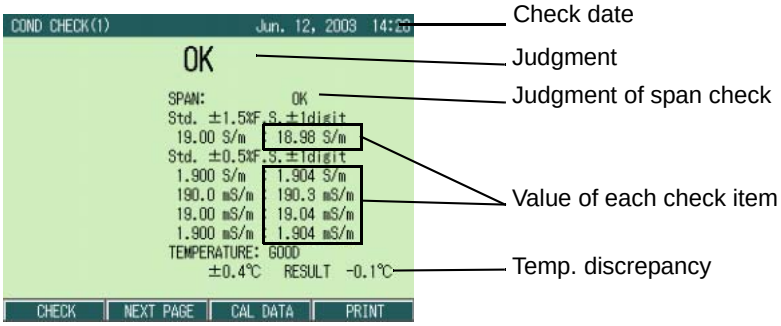
0.0 ℃
30.0 ℃
60.0 ℃
100.0 ℃

NOTE

The conductivity value displayed at the temperature check does not related with the inspection.

When all the confirmation is done, the result is displayed.

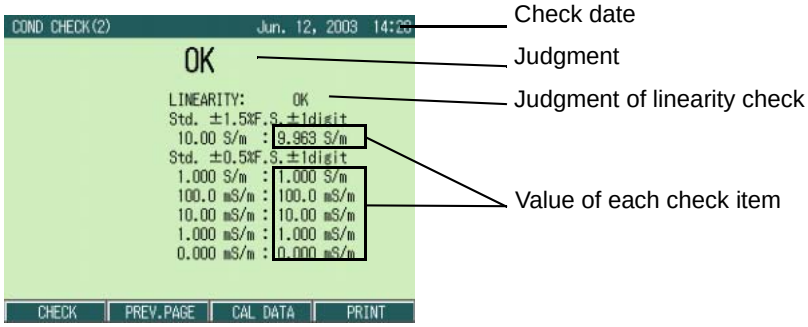
Span check result



Criteria:

± 0.5% ± 1digit of the full scale
At input of 19.00 S/m, ± 1.5% ± 1digit of the full scale

Linearity check result



Criteria:

± 0.5% ± 1digit of the full scale
At input of 10.00 S/m, ± 1.5% ± 1digit of the full scale

Temperature check result

Indication error by each input (regulated value ± 0.4 ℃).

NOTE

When the judgment of “CHECK” is displayed, assure the connection and repeat the check. When the error repeatedly occurs, ask further inspection for the meter and the checker through the sales shop you have purchased the meter.

6.6 Check/Calibration Data Display

● Check data display

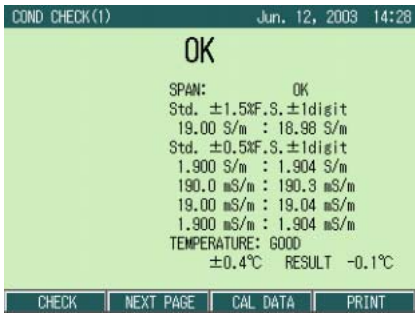
The latest check data can be displayed.

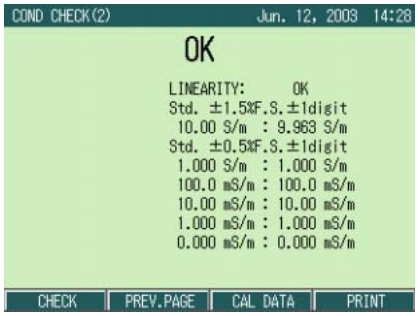
1. In the COND CHECK screen, press F3 (CHECK DATA).

The check data is displayed.

NOTE

When the printer is connected, the function display of F4 shows “PRINT.”
Pressing F4 (PRINT) prints the check data.





● Calibration data display

The latest calibration data can be displayed.

1. In the CAL screen, press F3 (CAL DATA).

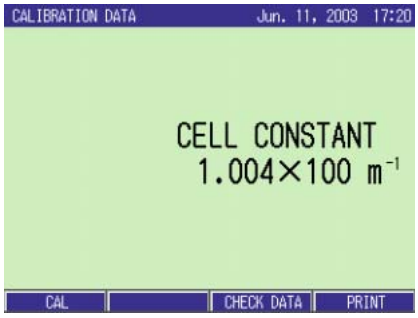
The calibration data is displayed.

NOTE

When the printer is connected, the function display of F4 shows “PRINT.”
Pressing F4 (PRINT) prints the calibration data.

NOTE

In the CAL screen, the set cell constant is displayed.
When the calibration for the cell constant is completed, the date is also displayed.
Changing the cell constant without calibration does not change the date. The date is renewed only when the calibration is performed.

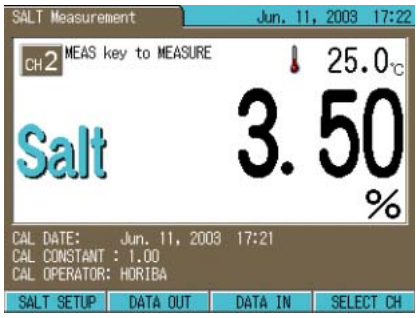


Chapter 7 SALINITY MEASUREMENT (F-54,55)

The salinity concentration is calculated from the measured value of conductivity. This is why when the cell constant is set by conductivity measurement, there is no need to input the cell constant. Cell constant needs input only when it is not set. In this case, set the cell constant by referring to "6.2 Cell Constant Setting" page 92.

7.1 Operation of Salinity Measurement

In any Measurement screen for CH2, press the MODE key to proceed to the SALT Measurement screen.The displayed screen shows the display of salinity instantaneous measurement.



NOTE

For F-54 and F-55, press F4 (SELECT CH) to select CH2.

1. Press the MEAS key.

The HOLD measurement starts.

When the indication stabilizes, the HOLD indication lights up and the measured value is displayed.

7.2 Salinity Calibration

The salinity conversion is available by conductivity, yet the calibration using the standard solution of sea water can obtain an accurate salinity concentration.

Perform the calibration in the temperature mentioned in the standard sea water as in the following step:

1. Immerse the electrode in the standard sea water.

2. In the SALT Measurement screen, press the CAL key.

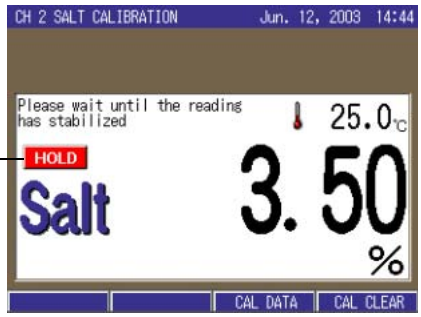
The SALT CALIBRATION screen appears.

3. Press ↑ or ↓ key to set the concentration of standard solution used for the calibration.

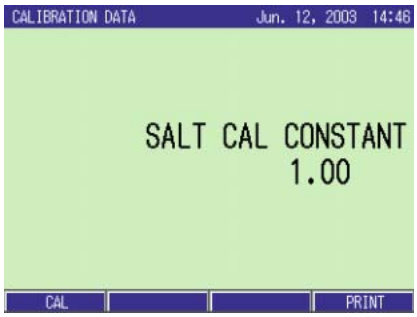
Setting range: 0.00 to 5.00%

4. Press the CAL key.

The calibration starts.



Lit



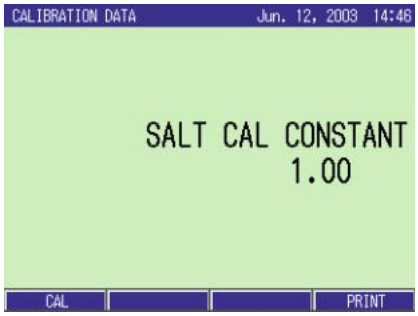
When the calibration is completed, the selected Salt Calibration Coefficient is set.

5. Press the MEAS key to return to the Measurement screen.

● Calibration data display

1. In the SALT CALIBRATION screen, press F3 (CAL DATA).

The calibration data is displayed.

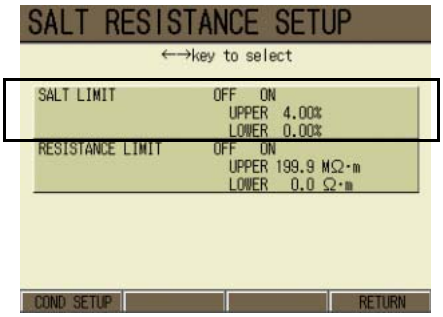


7.3 Changing the Measurement Setting Conditions

7.3.1 Opening the SALT RSISTANCE SETUP screen

1. In the SALT Measurement screen, press F1 (SALT SETUP).

The SALT RESISTANCE SETUP screen appears.



7.3.2 Setting alarms

The alarm function detects the measured value out of the upper or lower limit value, and either displays them on the screen or outputs them from the external output terminals.

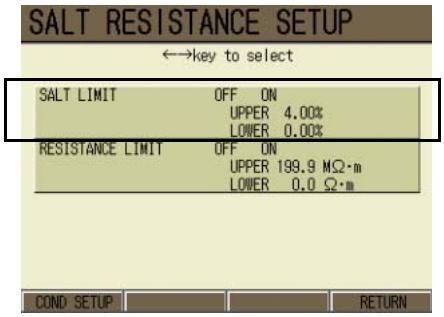
The values out of the limit value are displayed in the different color on the screen.

Set the alarm ON or OFF by the following step:

1. Press ↑ or ↓ key to select the SALT LIMIT option, and press ← or → key to select ON or OFF.

2. Press F4 (RETURN).

The setting is reflected.



Setting configuration of salt alarm

Selecting the ON option enables the alarm setting.

1. Press the ENTER key.

The cursor moves to the setting part of the upper limit value.

2. Press the ENTER key again.

The display color of the setting part changes, enabling to input the value by pressing ↑ or ↓ key.
Setting range: 0.00 to 4.00%

3. Determine the setting by the ENTER key.

The display color of the setting part changes.

4. Press ↓ key to select the lower limit option.

5. Press the ENTER key again.

The display color of the set part changes, and pressing ↑ or ↓ key enables the value input.
Setting range: 0.00 to 4.00%

6. Press the ENTER key.

The setting is determined, and the display color of the set part changes.

7. Press F4 (RETURN).

The setting is reflected, and the display returns to the Measurement screen.

7.4 Check

There is no check mode for the salinity measurement.

Check the meter by SYSTEM CHECK for COND.

Chapter 8 RESISTIVITY MEASUREMENT(F-54, 55)

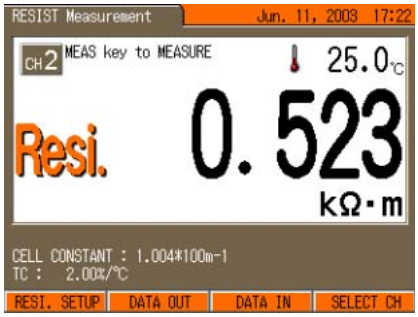
8.1 Screen Operation

The resistivity is regarded as an inverse values of conductivity, and calculated from measuring the conductivity. This is why when the cell constant is set by conductivity measurement, there is no need to input the cell constant. Cell constant needs input only when it is not set (See "6.2 Cell Constant Setting" page 92).
The unit setting of resistivity should be determined by unit setting of conductivity (See Page 94).

Conductivity unit: S/m → Resistivity unit: Ω•m
Conductivity unit: S/cm → Resistivity unit: Ω•cm

1. In any Measurement screen, press the MODE key to go to the RESIST Measurement screen.

The displayed screen should show the measured value of resistivity.

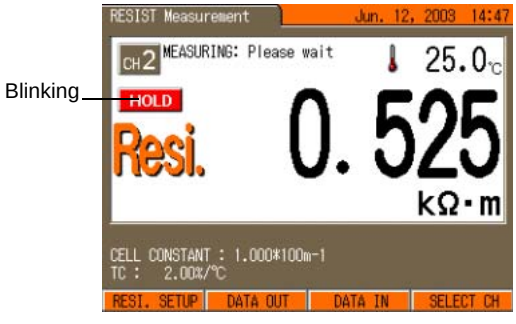


NOTE

F-54 and F-55, press F4 (SELECT CH) to select CH2.

2. Press the MEAS key.

The HOLD measurement starts.



When the indication stabilizes, the display “HOLD” lights up and the measurement result is displayed.

8.2 Setting Configuration

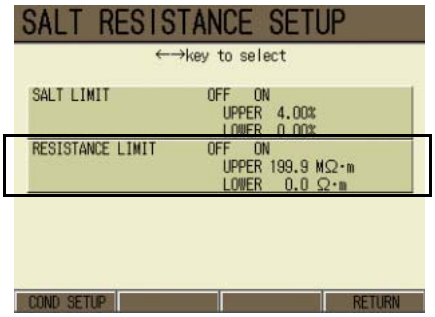
● Setting resistivity alarm

Resistivity alarm detects if the measured values are out of upper or lower limit values, and displays them on the screen or outputs them as signals from the external output terminals.

When the values are out of the set alarm range, the display color on the screen changes.

1. In the RESIST Measurement screen, press F1 (RESI. SETUP) key.

The SALT RESISTANCE SETUP screen appears.



2. In the SALT RESISTANCE SETUP screen, press ↑ or ↓ key to select the RESISTANT LIMIT option, and press ← or → key to select ON or OFF.

3. Press F4 (RETURN).

The setting is reflected, and the Measurement screen is displayed.

Setting alarm conditions

By selecting ON in the above step 2, the alarm conditions can be set.
According to the set values, the display automatically selects to appropriate unit

1. Press the ENTER key.

2. The cursor moves to the upper limit value setting field.

3. Press the ENTER key again.

The display color at the setting part changes, and the values can be input by pressing ↑ or ↓ key.
Setting range: 0.0 Ω•m to 199.9 MΩ•m
By pressing ← or → key, switch the auxiliary unit.

4. Press the ENTER key.

The setting is determined, and the display color of the set part changes.

5. Press ↓ key to go to the lower limit field.

6. Press the ENTER key again.

The display color of the set part changes, and the values can be input by pressing ↑ or ↓ key.
Setting range: 0.0 Ω•m to 199.9 MΩ•m
Switch the auxiliary unit by pressing ← or → key.

7. Press the ENTER key.

The setting is determined, and the display color of the set part changes.

8. Press F4 (RETURN).

The setting is reflected, and the display returns to the Measurement screen.

● Check mode

The resistivity does not support the check mode function.

Chapter 9 DATA MEMORY

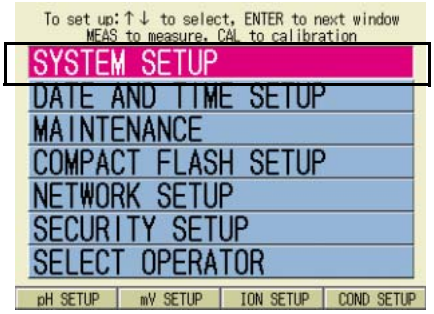
The measurement data can be stored and at the same time retrieved.
There are two ways to store data into memory: pressing “Data Memory” of the function key at any time in the Measurement mode (Manual Memory) and automatically memorizing by a certain interval (Interval Memory).

9.1 Setting Memory Type

Select either Interval memory or Manual memory.

1. Turn the power ON.

After the startup screen, the SETUP screen appears.



NOTE

Pressing ESC key in the Measurement screen also shows the SETUP screen.

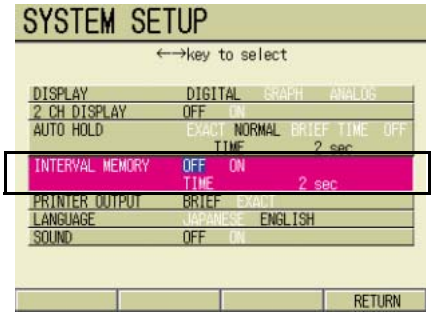
2. Pressing ↑ or ↓ key, select SYSTEM SETUP option, and press ENTER key.

The SYSTEM SETUP screen appears.

3. Pressing ↑ or ↓ key, and select INTERVAL MEMORY.

4. Press ← or → key and select ON or OFF.

When set to ON: go to " ● Interval memory" page 114.
When set to OFF: go to " ● Manual memory" page 113.



● Manual memory

1. To use Manual memory function, press ← or → key and select OFF.

2. Press F4 (RETURN).

The setting is reflected, and the display returns to the SETUP screen.

3. Press MEAS key.

The display returns to the pH Measurement screen.

● Interval memory

After step 4. on page 113, follow the steps below to set the interval time:

1. Press the ENTER key.

2. The cursor moves to the time setting field.

3. Press the ENTER key again.

The color of the set part changes; press ↑ or ↓ key to input the values.
Setting range:1 to 999 (sec)

4. Press the ENTER key.

The setting is determined, and the color of the set part changes.

5. Press the F4 (RETURN).

The setting is reflected, and the display returns to the SETUP screen.

6. Press the MEAS key.

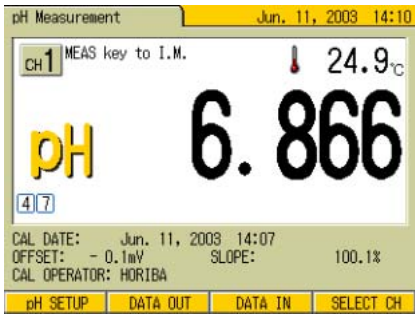
The display returns to the Measurement screen.

NOTE

In setting the Interval memory to ON, it is necessary to set the AutoHold in the Meter SETUP to OFF (Refer to Page 134)

9.2 Performing Data Memory

● For Interval memory



1. Press the MEAS key in the Measurement screen.

The Interval memory starts.
When the set time elapses, the first data is memorized.

2. Press the MEAS key.

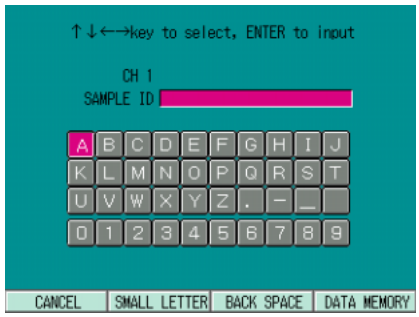
The Interval memory is canceled.

● For Manual memory

In each Measurement screen, the data can be memorized during instantaneous value display or when the AutoHold measurement is completed (while HOLD display is lit).

1. Press F3 (DATA IN).

The data at this time is memorized.
The sample ID input screen appears.



2. Press ↑ , ↓ and/or ← , → key and select the appropriate letter.

3. Press the ENTER key.

The selected letters are input.

4. Repeat step 2. to step 3., and input the sample ID.

5. When the input is completed, press F4 (DATA MEMORY).

The measurement data is memorized.

NOTE

Up to 12 digits can be input.

NOTE

When the sample ID is not necessary, press F4 (DATA MEMORY) without any input.

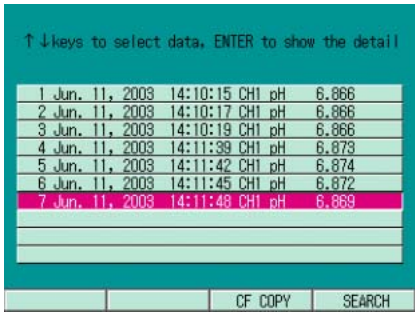
9.3 Calling up Memory Data

9.3.1 Display from memory data

The memorized data is selected and displayed on the screen.

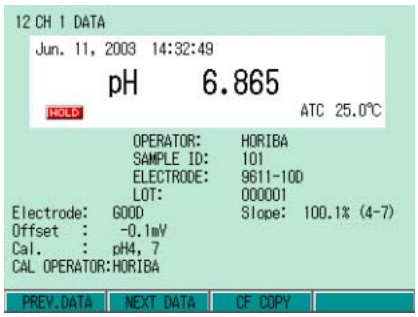
1. In the Measurement screen, press F2 (DATA OUT).

The data calling screen appears, and the list of memorized data is displayed.



2. Press ↑ or ↓ key to select the data to be called, and press the ENTER key.

The detailed data is displayed.



NOTE

In performing pH repeatability check, the electrode status displayed in the measurement data is the one judged by the preliminary inspection.

3. Press the ESC key to return to the data calling screen.

NOTE

Pressing the MEAS key goes to the Measurement screen.

● Data storage into Compact flash card (Only for F-53,54,and 55)

When the compact flash card is inserted, the CF COPY option is displayed as F3 in the data calling screen and in the detailed data screen.

Pressing F3 (CF COPY) copies the selected data onto the compact flash card.

REF

To copy all the data, refer to " WRITE DATA" page 145

9.3.2 Searching Memory data

The memorized data can be searched by such keywords as Measurement item, Operator, or Sample ID.

1. In the data calling screen, press F4(SEARCH).

The search screen appears.

2. Press ↑ or ↓ key and select the search item.

NOTE

To change the search keyword from the Operator name to Sample ID, press ENTER key.

Search by Measurement item

1. Press ← or → key and select ITEM.

2. Press F4 (SEARCH) key.

The search result is displayed.

Search by Operator name

1. Press ↑ or ↓ key and select Operator.

2. Press F4 (SEARCH).

The search result is displayed.

NOTE

Data with no operator name registration or the memory data by GUEST are out of the search range.

Search by Sample ID

1. With the search item of SAMPLE ID selected, press ENTER key.

The sample ID input screen appears.

2. Press ↑ or ↓ key, select appropriate letters (alphabetical and numerical), and press ENTER key.

The selected letters are input.

3. Repeat step 2., and input the Sample ID to be searched.

4. Press F4 (SEARCH).

The searched result is displayed.

NOTE

To delete the memorized data, perform data memory deletion by referring to " CLEAR DATA MEMORY" page 142.

Chapter 10 SECURITY SETUP

The security features of the pH meter series F aim to prevent irresponsible revision or deletion of set or measured data stored in the meter by a third person. Therefore, changes by a third person without authority are not available for date change, data memory deletion, or security related setting change.

NOTE

The meter can be used without operator registration. In that case, this section can be skipped.

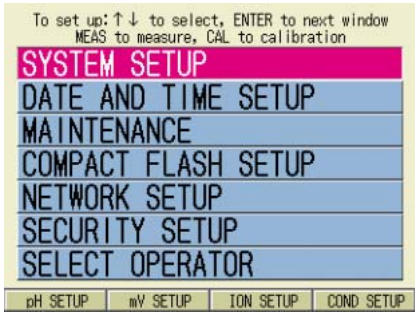
When the operator is not selected by selecting OFF in SELECT OPERATOR, the operator name "*GUEST*" is automatically selected.
There are two levels of operator: Administrator and Operator.
In user control functions, the configuration of each setting item is as follows:

Item	Administrator	Operator
Meter setting	○	○
Date/Time setting	○	-
Maintenance	○	-
Compact flash setting (Applicable only for F-53, 54, 55)	○	○
Network setting (Applicable only for F-55)	○	○
Security setting	○	-

10.1 SECURITY SETUP screen

1. Press ESC key on the Measurement screen.

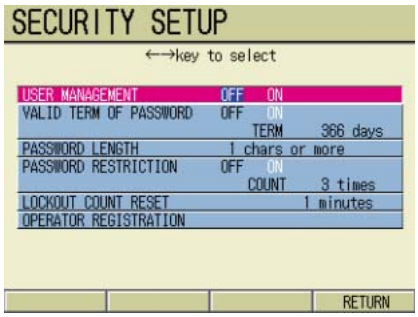
The SETUP screen appears.



2. Press ↑ or ↓ key and select the SECURITY SETUP option.

3. Press the ENTER key.

The SECURITY SETUP screen appears.



10.2 Operation in SECURITY SETUP screen

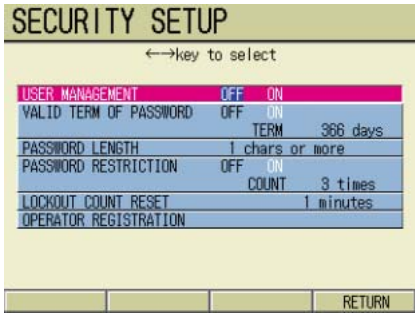
This section explains the operation procedure common to each item.
For operation of each item, refer to the specific description.

● Common operation

1. In the SETUP menu, press ↑ or ↓ key to select SECURITY SETUP.

2. Press the ENTER key.

The SECURITY SETUP screen appears.



3. Press ↑ or ↓ key to select option.

4. Set or perform each option according to each setting/performing procedure.

5. Repeat the above step 3. to step 4., and complete necessary options to set /perform.

6. When the setting is completed, press F4 (RETURN).

The setting is reflected.

NOTE

Pressing the ESC key returns to the SETUP screen.

10.3 Setting/Performing each option

10.3.1 User management

Setting the USER MANAGEMENT selection option to ON will require the Operator name in starting up the system. Also such setting configuration as date setting, security setting change, data memory deletion in maintenance setting, and/or reset operation for factory shipping will be only available to the Administrator. The User Control selection option can be set to ON only by the Administrator.

1. With setting the USER MANAGEMENT selection option ON, press ← or → key and select OFF or ON.

2. Press F4 (RETURN).

The User Control is switched to ON.
When the Operator has not been registered, the registry menu appears.
When the Operator has been registered, the SELECT OPERATOR menu appears.

NOTE

When the User Control is ON, Administrator should be careful not to forget the password. Multiple Administrators should record passwords in case the password should be lost.

10.3.2 Password validity

By switching the Password Validity setting ON, the system notices it is time to change password when the set duration is over.

NOTE

Setting the password validity requires the new password registration at 12 p.m. to be set on the next day from the set date as the starting date of computation.

1. With the PASSWORD VALIDITY option selected, press ← or → key, and select OFF or ON.

In selecting ON, set the validity.

2. With ON selected, press the ENTER key twice.

The setting can be made.

3. Press ↑ or ↓ key and input the number of days for validity.

Setting range: 1 to 999 days

4. Press the ENTER key.

The setting is determined.

NOTE

The Password validity is valid only for operators registered after the validity setting.

10.3.3 Password letter number

Minimum number of letters used for the password can be set.
This setting is valid only when the password is newly registered.

1. With the PASSWORD LENGTH option selected, press the ENTER key.
   The input is available.
2. Press ↑ or ↓ key, and input the number of letters.
   Setting range: 1 to 10
3. Press the ENTER key.
   The setting is made.

10.3.4 Password Limit

By setting the Password Limit ON, input of erroneous passwords more than the set times until the normal startup locks out the system.

To make the setting valid:

1. With the PASSWORD RESTRICTION option selected, press ← or → key, and select ON.
2. With ON selected, press the ENTER key twice.
   The setting can be made.
3. Press ↑ or ↓ key, and input the number of allowable times for an erroneous password to be input.
   Setting range: 1 to 99
4. Press the ENTER key.
   The setting is determined.

To make the setting invalid:

1. With the PASSWORD RESTRICTION option selected, press ← or → key, and select OFF.
2. Press the ENTER key.
   The setting is made.

10.3.5 Lockout count reset

The lockout count reset can set the limit time for the lockout to be reset when the erroneous passwords are input more than the times set at Password Limit.

1. With the LOCKOUT RESET option selected, press the ENTER key.

The setting is available.

2. Press ↑ or ↓ key, and input the limit time.

The setting unit is minute.
Setting range: 1 to 999 (minutes)

3. Press the ENTER key.

The setting has been made.

10.3.6 Reset the lockout

This section explains how to reset the lockout.
This operation is only available to the Administrator.

With “PASSWORD ERROR” displayed on the screen, follow the steps below.

1. Press F4 (URGENT).

The SELECT OPERATOR screen appears.
The operator registered as the Administrator is displayed.

2. Select the appropriate operator, and press F4 (RETURN).

The password input dialog appears.

3. Input the right password and press F4 (RETURN).

The lockout state is reset, and the SETUP screen appears.

10.3.7 Operator registration change

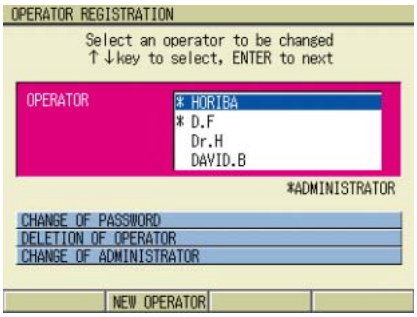
The following features are available in this function:

- Operator registration
- Password change
- Operator deletion
- Administrator registration and/or deletion

● Operator registration screen

1. Select the OPERATOR REGISTRACTION option, and press the ENTER key.

The OPERTATOR REGISTRATION menu appears.



● Operator registration

Note that this registration is for a new operator.

The operator newly registered is regarded as the Administrator.

The configuration for the Administrator and Operator can be also set after the registration.

1. In the OPERATOR REGISTRATION screen, press F2 (NEW OPERATOR).

The NEW OPERATOR screen appears.

2. Press ←, ↑ and/or ↓, → key, and select appropriate alphabetical and/or numeric letters.

3. Press ENTER key, and input the values.

4. Repeat from step 2. to step 3., and input the Operator name.

Maximum 12 letters can be input.

NOTE

Pressing F2 switches the input mode in the following order:
alphanumeric characters (uppercase) → alphanumeric characters (lowercase)

Pressing F3 deletes one letter.

5. When the input is completed, press F4 (NEXT).

The INPUT PASSWORD menu appears.

6. Press ←, ↑ or ↓, → key, and select the numeric letters.

7. Press ENTER key and input the numeric letters.

8. Repeat the above step 6. to step 7., and input the password.

9. When the input is completed, press F4 (RETURN).

   The new user is registered, and the OPERATOR REGISTRATION menu appears.

REF

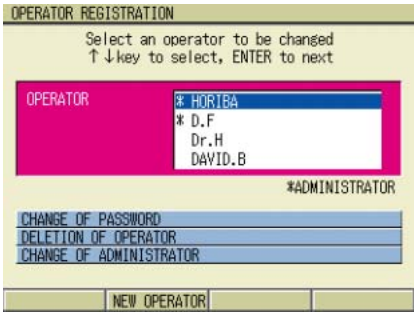
"16.6 Default settings" page 249

NOTE

An erroneous password cannot allow logon. When the password is lost, the stored data is not available.

● Changing the password

The password can be changed on the OPERATOR REGISTRATION screen.



1. Press ↑ or ↓ key, and select the operator which password is to be changed.

2. Press the ENTER key.

   Move the cursor to the CHANGE OF PASSWORD option.

3. Press the ENTER key.

   The input menu appears and requires the current registered password.

4. Press ← , ↑ and/or ↓ , → key, select the numeric letters, and press the ENTER to input the values.

5. Repeat the above step 3. to step 4. to input the password.

6. When the input is completed, press F4 (RETURN).

   The menu appears and requires new password.

7. By the same procedure above, input the new password.

8. Press F4 (REGISTER).

The password is changed, and the OPERATOR REGISTRATION screen appears.

● Operator deletion

The registered operator can be deleted on the OPERATOR REGISTRATION screen.

NOTE

Leave at least one Administrator in the system.
Deleting the Administrator with the User Control option ON will make the User Control status unable to change.

1. Press ↑ or ↓ key and select the operator to be deleted from the registration.

2. Press the ENTER key.

Move the cursor to the CHANGE OF PASSWORD option.

3. Press ↑ or ↓ key, and select the DELETION OF OPERATOR option.

4. Press the ENTER key.

The confirmation window (for the operator deletion) appears.

5. Press F4 (CONFIRM).

The operator is deleted, and the OPERATOR REGISTRATION screen is displayed.

NOTE

To cancel the operation, press F1 (CANCEL).

● Registration and deletion of Administrator

The registered Operator's authority can be switched on the OPERATOR REGISTRATION screen.

1. Press ↑ or ↓ key, and select the Operator which authority is to be changed.

2. Press the ENTER key.

Move the cursor to the CHANGE OF PASSWORD option.

3. Press ↑ or ↓ key, and select CHANGE OF ADMINISTRATOR.

4. Press the ENTER key.

The authority switches.

NOTE

The Operator registered as Administrator becomes the normal Operator, and the Operator registered as normal becomes Administrator.

NOTE

The Operator which attaches the mark "*" in front of their name is the Administrator.

Chapter 11 METER SETTING

The setting procedure described in this section is common to every measurement item. Select the item from the SETUP screen to begin.

11.1 SETUP Screen

There are two ways to open the SETUP screen:

● From the Measurement screen

1. In the Instantaneous Measurement screen, press the ESC key.

The SETUP screen appears.

● From power ON

This is effective only when the USER MANAGEMENT is OFF.

1. Turn the power ON.

The startup screen appears, and the display automatically moves to the SETUP screen.

NOTE

When the User Control is set to ON, turning the power ON moves the display to the SELECT OPERATOR screen after the startup screen appears.

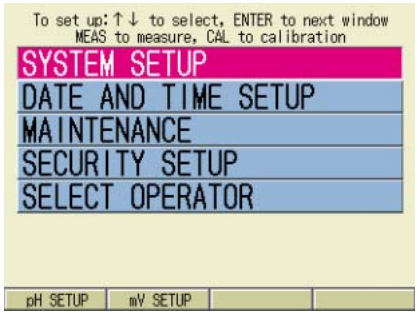
REF

"10.3.1 User management" page 122

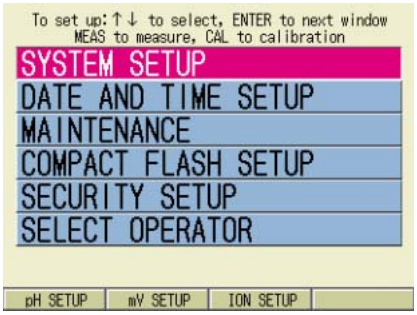
11.1.1 SETUP screen menu

The SETUP screen menu is specific on each meter model.

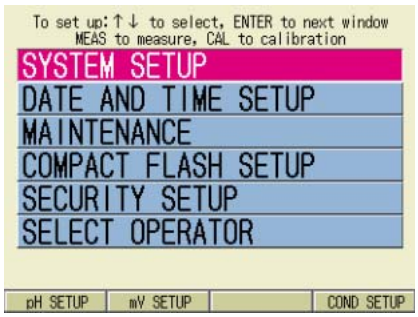
SETUP screen for F-52



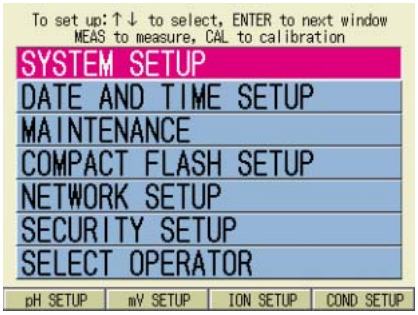
SETUP screen for F-53



SETUP screen for F-54



SETUP screen for F-55



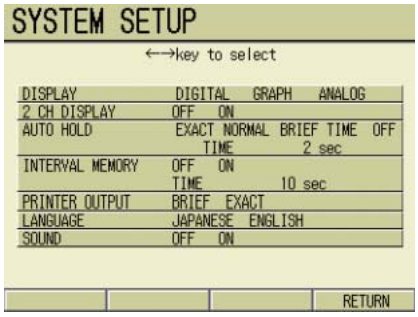
Item	Description
SYSTEM SETUP	Setting common to all the measurement items such as measurement screen display, measurement procedure, and printout.
DATE AND TIME SETUP	Setting configuration for the clock incorporated in the meter Not selectable by operators other than the Administrator when the User Control is ON
MAINTENANCE	Setting configuration for the meter functional check Not selectable by operators other than the Administrator when the User Control is ON
COMPACT FLASH SETUP	Setting configuration for the compact flash functional check and data copy
NETWORK SETUP	Setting configuration for the Ethernet
SECURITY SETUP	Setting configuration for user control Not selectable by operators other than the Administrator when the User Control is ON
SELECT OPERATOR	Setting configuration for the operator Selectable only when the User Control is OFF and the operator is not yet selected

11.2 System setup

The setting configuration for the meter setup can be stored by each operator.

1. In the SETUP screen, press ↑ or ↓ key and select SYSTEM SETUP option.

The SYSTEM SETUP screen appears.



11.2.1 Display pattern change

The display pattern of the Measurement screen can be set.

1. In the SYSTEM SETUP screen, press ↑ or ↓ key and select DISPLAY option.

2. Press ← or → key and select the display pattern (DIGITAL/GRAPH/ANALOG).

3. Press F4 (RETURN).

The setting is reflected, and the display returns to the SETUP screen.

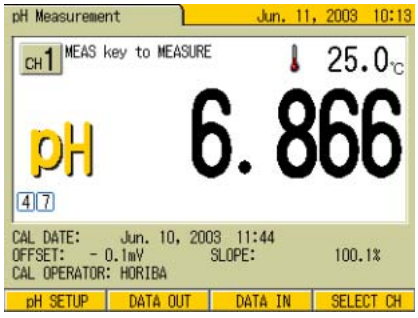
Sample display of the Measurement screen

The sample display for each screen is as follows:

"DIGITAL" display

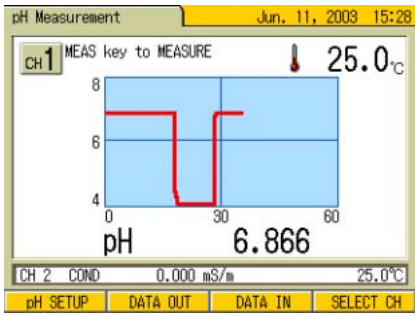
This is the standard screen display.

Screens are normally displayed in this pattern (except for the Measurement screen).



"GRAPH" display

- The display range is automatically set.
- The graph is cleared when the operations such as pressing MODE or SETUP keys are made. The horizontal axis on the graph screen is Instantaneous time (sec.).
- The data is displayed as a graph in measuring the instantaneous value or in judging AutoHold.
- Up to 180 seconds, the entire data is displayed.
  After 180 seconds, the data of the latest 180 secs is displayed (maximum up to 99999 seconds.).

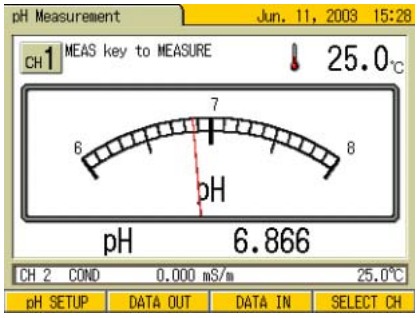


NOTE

The vertical range is set based on the maximum/minimum value from the start of measurement.

"ANALOG" display

- The display range is automatically set.



11.2.2 2CH display (F-53,54,55)

When the 2CH display is ON, two measurement data, CH1 and CH2 are displayed at the same time on the Measurement screen.

When the 2CH display is OFF, the electrode status such as calibration data is displayed on the sub screen for DIGITAL display.

1. In the SYSTEM SETUP screen, press ↑ or ↓ key and select 2CH DISPLAY option.

2. Press ← or → key and select OFF or ON.

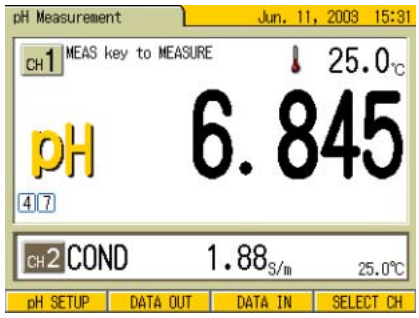
3. Press F4 (RETURN).

The setting is reflected, and the display returns to the SETUP screen.

NOTE

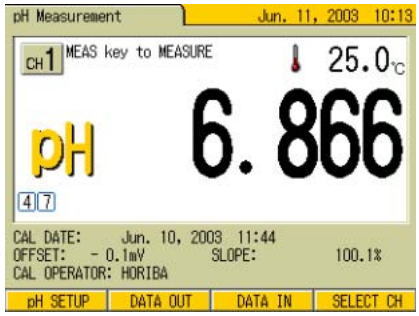
Pressing F4 (SELECT CH) in the Measurement screen will switch the channel for the main display with the lower screen.

ON: 2CH indicated



Measurement data for 2CH

OFF: 1CH indicated



Electrode status

11.2.3 AutoHold setting

AutoHold setting is the function in which the meter judges the potential stability to assure the measurement values. As the stability condition, five types of setting mode are available.

NOTE

The AutoHold condition for calibration and inspection should become Standard in regardless of the selected mode option.
Due to operation processing, the hold condition is not always given even when it seems to satisfy the stabilization criteria.

Mode	Measuring target	Criteria
EXACT	pH, mV, ION	Potential change in 10 seconds: within 0.3 mV Temperature change in 10 seconds: within 2.0 ℃
	COND	Potential change in 10 seconds: within 1digit Temperature change in 10 seconds: within 2.0 ℃
	Salinity	Potential change in 10 seconds: within 0.03% Temperature change in 10 seconds: within 2.0 ℃
NOR-MAL	pH, mV, ION	Potential change in 10 seconds: within 1 mV Temperature change in 10 seconds: within 2.0 ℃
	COND	Potential change in 10 seconds: within 3 digit Temperature change in 10 seconds: within 2.0 ℃
	Salinity	Potential change in 10 seconds: within 0.10% Temperature change in 10 seconds: within 2.0 ℃
BRIEF	pH, mV, ION	Potential change in 10 seconds: within 3 mV Temperature change in 10 seconds: within 2.0 ℃
	COND	Potential change in 10 seconds: within 5 digit Temperature change in 10 seconds: within 2.0 ℃
	Salinity	Potential change in 10 seconds: within 0.3% Temperature change in 10 seconds: within 2.0 ℃
TIME		The values are held at the set time. Setting range: 2 to 999 (sec)
OFF		The AutoHold function becomes invalid. When set to OFF, pressing MEAS key will hold the values at that time. (Manual HOLD)

NOTE

Setting to “EXACT” gives the time to HOLD longer.
The AutoHold judgment for the resistivity is calculated by the conductivity values.

Setting procedure

1. In the SYSTEM SETUP screen, select AUTOHOLD option by ↑ or ↓ key.

2. Press ← or → key and select the mode for potential stability (EXACT/NORMAL/BRIEF/TIME/OFF).

3. Press F4 (RETURN).

The setting is reflected, and the display returns to the SETUP screen.

In selecting "TIME"

When the mode option "TIME" is selected in the step 2. above, set the time until the measurement value is held by the following step:

1. Press ENTER key.

Move the cursor to the time setting field.

2. Press ENTER key again.

The display color for the set part changes, and the values can be input by ↑ or ↓ key.
Setting range: 2 to 999 (sec)

3. Press F4 (RETURN).

The setting is reflected, and the display returns to the SETUP screen.

11.2.4 Interval memory function (Setting automatic data memory)

The measured data can be stored for every set time interval.
When it is set to OFF, the data can be manually stored by selecting Data Memory of the function keys at any time. Selecting ON stores multiple data at set time intervals.

REF

"9.1 Setting Memory Type" page 113

11.2.5 Setting printout format

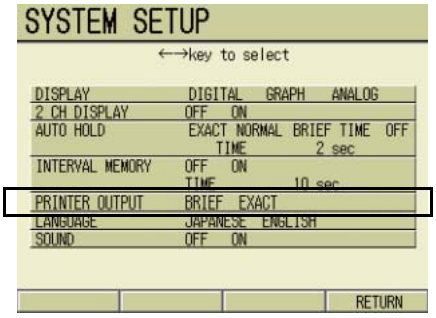
The printout format can be selected.

1. In the SYSTEM SETUP screen, press ↑ or ↓ key and select PRINTER OUTPUT option.

2. Press ← or → key and select BRIEF or EXACT.

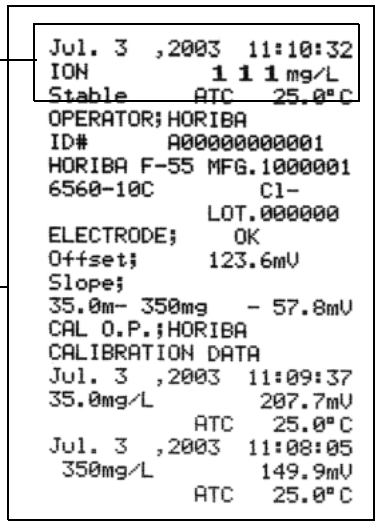
3. Press F4 (RETURN).

The setting is reflected, and the display returns to the SETUP screen.



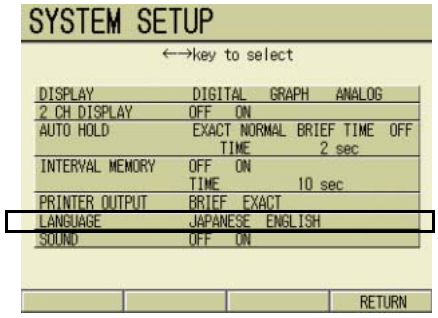
BRIEF printout

EXACT printout



11.2.6 Language selection

The language in which the display is given can be set.



1. In the SYSTEM SETUP screen, press ↑ or ↓ key and select the LANGUAGE option.

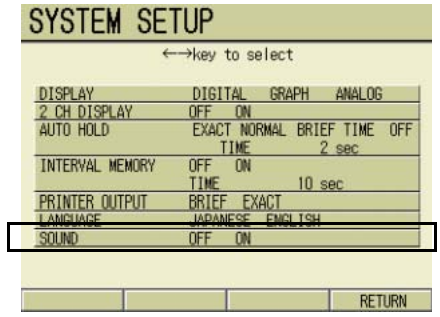
2. Press ← or → key and select either ENGLISH or JAPANESE.

3. Press F4 (RETURN).

The setting is reflected, and the display returns to the SETUP screen.

11.2.7 Sound setting

The meter electrical sound can be set to ON or OFF.



1. In the SYSTEM SETUP screen, press ↑ or ↓ key and select SOUND option.

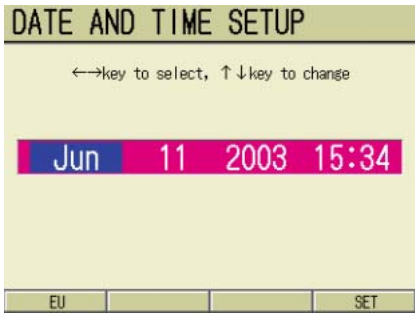
2. Press ← or → key and select either ON or OFF.

3. Press F4 (RETURN).

The setting is reflected, and the display returns to the SETUP screen.

11.3 Date setting

The time, date, and year for the clock incorporated in the system can be set.



1. In the SETUP screen, press ↑ or ↓ key and select the DATE AND TIME SETUP option.
2. Press the ENTER key.
   The DATE AND TIME SETUP screen appears.
3. Press ← or → key and select the appropriate year, date, and time.
4. Press ↑ or ↓ key and give the setting.
5. Press F4 (SET).
   The setting is reflected, and the display returns to the SETUP screen.

NOTE

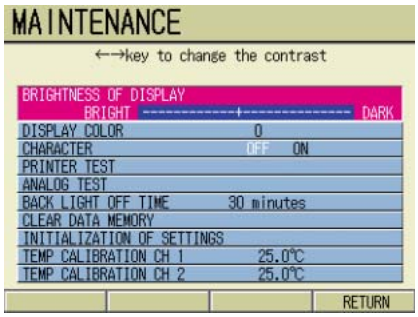
To cancel the setting, press the ESC key. The display returns to the SETUP screen.

11.4 Maintenance Setting

● Common operation

1. In the SETUP screen, press ↑ or ↓ key and select MAINTENANCE option.

2. Press the ENTER key.
The MAINTENANCE screen appears.



3. Press ↑ or ↓ key and select the option to be set or executed.

4. Set or perform the option according to each configuration.

5. Repeat step 3. and step 4. above, and complete setting and/or execution of the necessary options.

6. When all the setting/execution is completed, press F4 (RETURN).

The setting is made.

NOTE

Pressing the ESC key returns to the SETUP screen.

● Setting/Execution of each item

BRIGHTNESS OF DISPLAY

Adjust the screen brightness as follows.

1. Press ← or → key and adjust the backlight brightness.

Pressing ← key makes the screen brighter, whereas pressing → key darkens the screen.

Display color

Adjust the color tone of the screen by visually checking it on the screen.
There are totally eight (8) tones, from 0 to 7.
It is set to 0 in the initial setting.

1. Press the ENTER key.

The setting is now available.

2. Press ↑ or ↓ key, and set the color tone.

The color tone of the screen changes.

3. Press the ENTER key.

The setting is made.

Character

The navigation character can be selected to be displayed or not displayed. When set to be displayed, he appears at such operations as performing calibration and displaying calibration history, navigation, and/or clock.

1. Press ← or → key and select OFF or ON.

OFF: The character does not appear.
ON: The character appears.

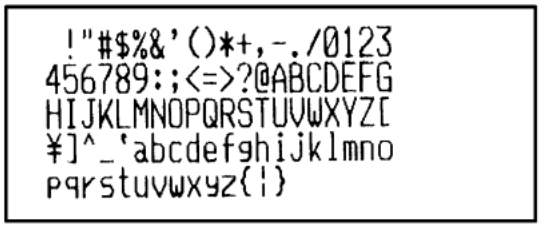
Character 

Printer test

At printer connection, the trial printout is available.

1. Press the ENTER key.

The trial printout starts.

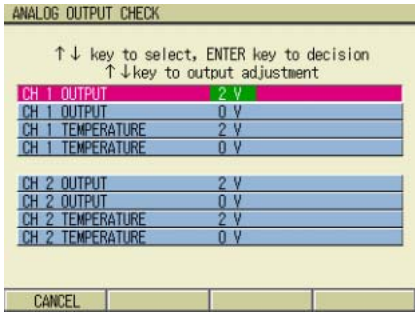


Analog test

Analog output voltage can be checked and adjusted.

1. Press the ENTER key.

The ANALOG OUTPUT CHECK screen appears.



2. Press ↑ or ↓ key and select the item, and press ENTER key to determine the selection.

3. Check the output by a voltmeter.

4. Press ↑ or ↓ key, and adjust the output voltage indicated on the voltmeter to the specified values, 0V/2V.

5. Press the ENTER key to assure the output.

6. When the confirmation and/or adjustment is completed, press F1 (CANCEL).

The display returns to the MAINTENANCE screen.

BACK LIGHT OFF TIME

The transfer time can be set. This is the time duration until the backlight is extinguished with no key operation.

1. Press the ENTER key.

The setting is now available.

2. Press ↑ or ↓ key and set the time.

Setting range: 0 to 999 (min)
Setting 0 keeps the backlight in lit state.

3. Press the ENTER key.

The setting is made.

NOTE

Pressing any key returns the display from power saving state to normal state.

CLEAR DATA MEMORY

This function deletes all the measurement results stored in the system memory.

1. Press the ENTER key.

The data memory is deleted.

NOTE

The data stored in the compact flash is not deleted.

INITIALIZATION OF SETTINGS

The set values, calibration values, and the operator information can be cleared.

1. Press the ENTER key.

The system configuration is reset to the one of factory setting, and the power is turned off.

2. Press ON or OFF button.

The power is turned on.

REF

"16.6 Default settings" page 249

Temperature sensor calibration for CH1

The indication value for the temperature sensor connected to CH1 can be adjusted.

1. Set each temperature compensation setting to “Automatic.”
2. Immerse the temperature sensor into a solution which temperature has been stabilized.
3. Read the temperature indication correctly by a thermometer.
4. Press the ENTER key.

   The setting is now ready to be made.
5. Press ↑ or ↓ key and set the value to the read temperature from the thermometer.
6. Press the ENTER key.

   The setting is made.

NOTE

When the temperature sensor is not connected, this function does not work properly.

Temperature sensor calibration for CH2 (F-53,54,55)

The indication value for the temperature sensor connected to CH2 can be adjusted.
For operation, refer to the above, “Temperature sensor calibration for CH1”.

11.5 Compact Flash Setting （F-53, 54, 55）

This section explains the compact flash operation.
The typical use of the compact flash function is as follows:

- Memory data can be read into the compact flash card. Reading this data with the exclusive software produced by HORIBA enables the data to be transferred to a PC.
- The personal information can be written into the compact flash card. Inserting the compact flash into the system and turning on the power reads the personal data into the system, and starts up the meter.

11.5.1 Cautions for operation

Cautionary items:

- The compact flash cards used in this meter should be either 8MB or 16MB.
- A micro drive with hard disk format is not available.
- Always use the products that HORIBA sells or a HORIBA specified manufacturer.
  Specified manufacturers: Hagiwara SysCom, Sun Disk

Compact flash format

- To initialize the compact flash card, use the format function of the meter. According to the capacity, the format is given in either FAT12 or FAT16.

NOTE

The compact flash cards available in this meter are MS-DOS format for MicroSoft®.

11.5.2 Attachment/Removal of compact flash card

● Attachment

1. Insert the compact flash card to the CF card slot so that the HORIBA logo comes to the top.

● Removal

1. In the COMPACT FLASH SETUP screen, press F2 (REMOVE).

2. Push the removal lever besides the CF card slot, and remove the card.

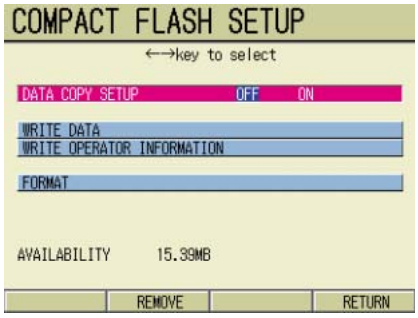
11.5.3 Compact flash operation

● Common operation

1. In the SETUP screen, select the COMPACT FLASH SETUP option by pressing ↑ or ↓ key.

2. Press the ENTER key.

The COMPACT FLASH SETUP screen appears.



3. Press ↑ or ↓ key and select the option to be set or executed.

4. Set or perform the option according to each configuration.

5. Repeat step 3. and step 4. above, and complete setting and/or execution for the necessary options.

6. Press the F4 (RETURN).

The setting is reflected, and the SETUP screen appears.

● Setting/Executing each item

DATA COPY SETUP

Setting ON will memorize the data in the compact flash card when the data is stored by manual memory.

1. Press ← or → key and select either OFF or ON.

WRITE DATA

All the data in the meter is copied to the compact flash card.

1. Press the ENTER key.

The data is stored into the compact flash card.
The data number left unwritten is indicated in the lower left of the screen.

NOTE

Turning ON and OFF during the access will write only those data recorded up to when the key is pressed.
The data having the same date and measurement items will be overwritten.

WRITE OPERATOR INFORMATION

Information such as Operator names or currently set configuration is copied onto the compact flash card.
Personal data can be written only for one person per each CF card.

1. Press the ENTER key.

Personal data such as Operator name, meter configuration items, each setup item is stored into the compact flash card.

FORMAT

The compact flash card is formatted.
Formatting will delete all the data previously stored.

1. Press ENTER key.

2. Press F4 (CONFIRM).

The formatting starts.

NOTE

Since the formatting uses a part of memory, the empty capacity displayed will be smaller than that mentioned in the compact flash card even though no data is stored.

11.5.4 Data acquisition to PC

To transfer the data from the compact flash card, the following tools are necessary:

- PC
- A compact flash card reader (those commercially available)
- Software

NOTE

The software is available by downloading from HORIBA's website after user registration.
Fill in the User Registration Card separately attached to this manual to complete the registration.

11.5.5 User control function

When individual personal data is written into the compact flash card and the cards are controlled by each person, there is no need for Operator registration.

Startup is available by the operator name registered in the compact flash card.

The compact flash card can be commonly used on multiple meters.

Startup by the compact flash card allows the following convenience:

- No password is necessary
- User Control function is available even though it is set to OFF

NOTE

The personal data, once written into the compact flash card, can read the data (operator name, meter configuration items, each setup item) at the next startup only by inserting the compact flash card.

11.6 Network Setting (F-55)

The network setting requires knowledge on network administration.When setting other than the standard configuration is necessary, or when a rooter or a hub should be used, consult with the network administrator.

Communication regulation/Transmission speed

Communication Regulation	Regulation	IEEE802.3u (100BASE-TX) IEEE802.3 (10BASE-T)
	Transmission speed	100Mbps (100BASE-TX) 10Mbps (10BASE-T)
	100BASE-TX 10BASE-T (switch)	Automatic Negotiation ※ No manual setting is available.

LAN (Ethernet) connector

RJ-45 modular connector
Use a cross cable for the Ethernet cable.

Internet address setting

This meter is conformed to the address of the Class C.

The setting range for the Internet address is:192.0.0.0 – 223.255.255.255

Item	Setting configuration (Standard setting at Factory shipping)
IP address	192.168.0.1
Gateway address	192.168.0.100
Subnet mask	255.255.255.0

NOTE

Among these addresses, the settings 192.0.0.0 - 192.0.0.255 and 223.255.255.0 – 223.255.255.255 are reserved for a specific usage as Class C regulation, and should not be used. Setting these addresses as a network address may have an adverse influence to the other network system.

Cautionary items for Internet address setting

In using IP address, a private address can be used in the environment unconnected to the external Internet (specified by RFC1918).
The environment unconnected to the external Internet means the environment in which the connection with the external network as Internet is not available using the same cable with that connected to the printer or PC.

※ What is “private address?”

When the connection is not given to the external Internet, addresses in the range below can be freely set, and these addresses are called “private address:”
192.168.0.0 — 192.168.255.255
The meter F-55 sets the standard IP address as follows: 192.168.0.1

※ What is “subnet mask?”

In TCP/IP network, computer communication with the same network is available. In this case it is necessary to distinguish the network from the host, and for this purpose the subnet mask is used. The subnet mask consists of 32 bits just as IP address, and in Class C the following address is set as standard:255.255.255.0
Normally in the setting for F-55, it is recommended to use the standard setting.

※ Gateway address

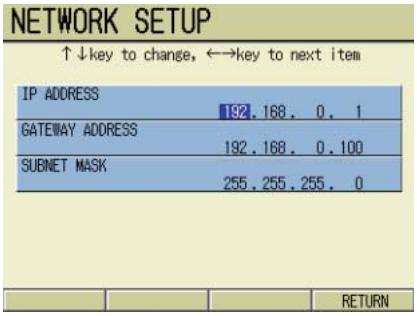
When the network configuration includes a server or rooter as gateway, the address of that server or rooter is called the gateway address.
When the PC is directly connected to an F-55 without a server or rooter connection, there is no need to change the setting. In this case follow the standard setting.

Setting procedure

1. In the SETUP screen, press ↑ or ↓ key to select NETWORK SETUP.

2. Press the ENTER key.

The NETWORK SETUP screen appears.



3. Press ← or → key and select the option to be set.

4. Press ↑ or ↓ key to set the value.

5. When the setting is completed, press F4 (RETURN).

The setting is made.

11.7 Operator Selection

When the User Control is set to OFF and when no operator is selected, this function is available.
When the User Control is set to ON, the operator can be selected only at the meter startup.

1. In the SETUP screen press ↑ or ↓ key and select the SELECT OPERATOR option.
2. Press the ENTER key.
   The SELECT OPERATOR screen appears.
3. Press ↑ or ↓ key and select the operator.
4. Press F4 (RETURN).
   The password input screen appears.
5. Press ↑ , ↓ or ← , → key to select the numerical values, and press ENTER.
6. When the password is input, press F4 (RETURN).
   The meter starts up with the selected Operator.

REF

To register the new operator, refer to" ● Operator registration" page 125

NOTE

When the screen enters into “sleep” status by pressing on ON/OFF key, the Operator selection condition is not selected.

NOTE

When no Operator is selected, the Operator name becomes “*GUEST*.”
In using the meter with * GUEST *, the setting configurations uses the settings by the previous * GUEST *.

11.8 FDA Part 11 Function (Audit Trail) (F-55)

In this meter, the electrical data control, such as audit trail or digital signature regulated and required in 21 CFR Part 11, FDA (United State Food and Drug Administration) is available.
To perform this, optional software supporting FDA 21 CFR Part 11 as well as the specific database software with the network via the Ethernet output of the F-55 is required.
For the software supporting FDA 21 CFR Part 11, ask your HORIBA representative. We will offer a quotation according to the network configuration and/or use environment.

Chapter 12 RS-232C Communication

12.1 Communication Configuration

This meter allows the RS-232C communication by connecting the serial communication terminal (refer to P.8) and PC using an exclusive communication cable. The communication is given by the following process; PC sends a command, and the meter returns a response. The below is the configuration of the RS-232C communication:

- Baud Rate: 2400 bps
- Word Length: 8 bits
- Parity: None
- Stop Bits: 1 bit
- Flow Control: None

12.2 Cautionary Items

- In connecting the meter and the PC using an exclusive communication cable, be sure to turn off the power beforehand.
- Connecting the meter and the PC with the power ON may damage the meter.
- Do not use any cable except for the exclusive one for connecting the meter and the PC.
- In performing the connection, keep away from any noise source or the equivalent such as a motor. With such sources, the commands is not correctly recognized to cause malfunction.

12.3 Connection Procedure

Confirm the followings before the connection:

- The power of the meter is turned OFF.
- The connection applies the exclusive cable

Setup the connection by the following step:

1. Connect the meter and the PC by the exclusive cable.
2. Turn the PC power ON.
3. Turn ON the power for the meter.

   To transmit the signal from the PC, prepare a terminal software as the Hyperterminal.

12.4 List of Serial Command

- Use <CR><LF> as the terminator for serial communication commands.
- All the commands except the online/offline command are valid only in the Online mode. (An error message is returned in the Offline mode.)
- the pH meter returns a response to any operation made in the following format.
  OK<CR><LF>
- If the pH meter does not accept the operation, it returns an error message in the following format.
  ER,n<CR><LF>
  n= 1: When a non-existent command is input.
  2: When a timing command is input to which the meter cannot respond.
  3: When the numerical value in the command is out of the setting range.
- When logging off the PC by pressing the ON/OFF key in the Online mode, the PC compulsorily falls into the Offline mode.
- Only the online/offline commands, interruption of potential tracing, the measurement value request command, and the data IN specification command are effective when the pH meter is performing various measurement (while HOLD lamp blinks.)
- Mode specification commands (such as CPH,CMV,CIO,CCO,COH,CSA) and measurement start command (CMS) are effective only when the main screen and the specified channel are matched.
- If the present measurement mode and the channel are not matched, an error message (incorrect operation) is responded when calibration starts.
- To return to the Measurement screen after the calibration is complete, transmit the mode specification command for the present calibration or the mode specification command that exists in the specified channel.
- When only “.”is input for the item to which a numeral with decimal point can be input, it is regarded as “0.0”.
- When calibration is in the HOLD condition, confirm that no alarm is output by performing the alarm inquiry
- When the measurement value request command is output, the data showing the HOLD condition may return from Measurement (2) to Instant value (0). In such a case, the electrode instability error (ERR 03) has occurred.
- The alarm contents cannot be cleared by the serial command. The alarm can be cleared only by checking the countermeasures, pressing the NAVI key in the Offline mode. Some alarms output during calibration may be cleared by performing the calibration again and the calibration ends successfully.
- Some commands are accepted or refused depending on the models.

● Parameter common to the commands

Parameter	Description
channel number	1: 1CH, 2: 2CH
ON, OFF	0: OFF, 1: ON
AutoHold condition	0: EXACT, 1: NORMAL, 2: BRIEF, 3: TIME(2 to 999 seconds), 4: OFF(Manual)
ion species	1: Na^+, 2: K^+, 3: NH_3, 4: Ag^+, 5: X^+
	6: CN^-, 7: Cl^-, 8: I^-, 9: Br^-, 10: SCN^-
	11: F^-, 12: NO^-, 13: X^-, 14: Cu^{2+}, 15: Cd^{2+}
	16: Pb^{2+}, 17: Ca^{2+}, 18: X^{2+}, 19: S^{2-}, 20: X^{2-}
Temperature compensation	0: Automatic (ATC), 1: Manual (MTC) 0.0 to 100.0 ℃
Conductivity temperature coefficient	0: OFF, 1: ON, 2: PURE WATER
Electrode status	0: Good, 1: Electrode check, 2: Electrode NG, 3: No calibration data, 4: Good (0), 5: Good (1), 6: Good (2), 7: Electrode exchange preparation, 9: Abnormal temperature; Check pH meter
Time	On setting: (yyyy) year (yy) month (yy) day (yy) hours (yy) minutes
	On request: (yyyy) year (yy) month (yy) day (yy) hours (yy) minutes (yy) seconds
Measurement mode	1: pH, 2: Redox potential (abs.), 3: Redox potential (relative), 4: Ion calibration curve method 5: Ion known-amount addition method (1 pt), 6: Ion known-amount addition method (2 pt) 7: Ion sample addition method (1 pt), 8: Ion sample addition method (2 pt) 9: Conductivity, 10: Salinity, 11: Resistivity
Data unit	Ion: 0: mol/L, 1: g/L Conductivity: 0: S/cm, 1: S/m Resistivity: 0: Ω・cm, 1: Ω・m
Auxiliary unit	0: none, 1: μ, 2: m, 3: k, 4: M

On-Line Operation Commands(1)

Format

Header, Item code, Parameter <CR><LF>

Command for...	Command		Parameter	Description of parameter	Note
	Header	Command code			
On-line/ off-line	C	OL	x	0: On-line 1: Off-line	ON → ON, OFF → OFF: The state remains unchanged. OFF → ON: Proceeds to standby mode for measurement in the main screen. ON → OFF: No screen transition Effective when the screen is in Measurement. For other cases, the error response (malfunction) returns.
Halt potential hunting	C	BR	x	x: channel number	The measurement or calibration in AutoHold is aborted. In the measurement with AutoHold OFF or in calibration, either calibration value is forcefully obtained (in calibration), or holds the measured value (in measurement). In the interval memory, the error response (malfunction) returns.
pH measurement mode specification	C	PH	x	x: channel number	pH Measurement proceeds to standby mode for the specified channel.
mV measurement mode specification command	C	MV	x	x: channel number	Falls into the measurement ready condition in the ABS. ORP measurement mode in the specified channel.
Ion measurement mode specification	C	IO	x	x: channel number	Falls into the ion measurement ready condition in the specified channel.
Conductivity measurement mode specification	C	CO			Falls into the COND measurement ready condition.
Saline measurement specification	C	SA			Falls into the salinity measurement ready condition.
Resistivity measurement specification	C	OH			Proceeds to standby mode for resistivity measurement.

NOTE

In RS-232C communication, the relative mV measurement is not available.

● On-Line Operation Commands(2)

Format

Header, Item code, Parameter <CR><LF>

Command for...	Command		Parameter	Description of parameter	Note
	Header	Command code			
Start measurement	C	MS	x	x: channel number	Measurement starts on the channel which is in the current mode.
Start pH standard solution calibration	C	CP	xxxxxx	xxxxxx: Value to specify for other buffers: 6 digits including decimal point (up to 3 decimal places) (When the standard solution is customized)	Effective in the pH measurement ready condition or in the HOLD condition. Calibration is executed by other buffer specify value when “Custom” is selected for the standard solution and by the specified standard solution value in other cases. In the modes other than “Custom”, calibration starts regardless of the value in other buffer. When “Check before use” is selected, the check before use is executed if this command is issued after calibrating specified points. In other cases, calibration can be performed exceeding the calibration points. However, after calibration of five points is complete, the error message (Incorrect operation) is responded for the succeeding command.
Start ion calibration	C	CI	xxxx,y	xxxx: standard solution concentration 3-digit effective number including decimal point The available range for input: 0.00 to 999 y: Auxiliary unit of the standard solution	Effective in the ion measurement ready condition or in the HOLD condition. Calibration can be performed exceeding the calibration points. However, after calibration of 5 points is complete, the error message (Incorrect operation) is responded for the succeeding command.
Start conductivity cell constant calibration	C	CD	xxxxx,y	xxxxx: Conductivity value y: Auxiliary value for the conductivity value	
Start salinity calibration	C	CS	xxxxx	xxxxx: Concentration of the standard solution	
Clear calibration	C	CC	x	x: channel number	The calibration value of the channel being displayed currently will be cleared.
Data clear	C	DC			This command clears the data retained in the memory.
Data IN specification	C	IN			Start the interval memory when the interval memory is set to ON. When set to OFF, manual data memory is applied.

Cancel interval memory	C	CN			Effective only during the interval memory
Select channels	C	CH	x	x: channel number	

NOTE

With a model that has two input channels, the calibration command is effective only on the main channel.

● Data setting command (1)

Format

Header, Item code, Parameter <CR><LF>

Command for...	Command		Parameter	Description of parameter	Note
	Header	Command code			
AutoHold setting	S	PH	x,y,zzz	x: channel number y: AutoHold condition zzz: pH AutoHold time	Channel number is ignored.

● Data setting command (2)

Format

Header, Item code, Parameter <CR><LF>

Command for...	Command		Parameter	Description of parameter	Note
	Header	Command code			
Clock data setting	S	OT	yyyy,mm,dd,hh,nn	yyyy: Year mm: Month dd: Day hh:Hours nn: Minutes	

● Data request command (1)

Format

Header, Item code, Parameter <CR><LF>

Command for...	Command		Parameter	Parameter description	Response	Note
	Header	Command code				
pH calibration history request	R	PC	x	x: channel number	RPC,zzzzzzzzzzzz,x,a,b,c,dddddd,e,yyyy,yy,yy,yy,yy,yy,ppp-ppp,qqqqq,rrrrrrr,sssss… Response when there is no calibration data RPC,**********,x,0,3	zzzzzzzzzzzz: Operator name x: channel number a: number of calibrated points b: Electrode status c: Temperature compensation dddddd: Asymmetry potential e: Check flag before use yyyy…yy: Calibration date pppppp: pH value of calibration solution qqqqq: temperature rrrrrrr: Electric potential sssss: slope Repeats calibration points only after calibration date. Check data before use is added if any.
AutoHold set value request	R	PH	x	x: channel number	RPH,x,ｙ,zzz	x: channel number y: Hold condition zzz: Set seconds to specify a fixed time, or space in other cases.

● Data request command (2)

Format

Header, Item code, Parameter <CR><LF>

Command for...	Command		Parameter	Parameter description	Response	Note
	Header	Command code				
Ion calibration history request	R	IC	x	x: channel number	RIC,zzzzzzzzzzzz,x,aa,b,c,d,eeeeee,f,yyyy,yy,yy,yy,yy,yy,pppp,q,r,sssss,tttttt,uuuuuu,… Response when there is no calibration data RIC,**********,x,0,0,3	zzzzzzzzzzzz: Operator name x: channel number aa: ion type b: number of calibrated points c: Electrode status d: Temperature compensation eeeeee: Asymmetry potential f: Check flag before use yyyy…yy: Calibration date pppp: Calibration solution value q: Sub unit r: Unit sssss: temperature tttttt: Potential uuuuuu: Sensibility Repeats calibration points only after calibration date. Check data before use is added if any.
Clock data request	R	OT			ROT,yyyy,mm,dd,hh,nn,ss	yyyy: Year mm: month dd: Day hh: Hours nn: minutes ss: Seconds

● Data request command (3)

Format

Header, Item code, Parameter <CR><LF>

Command for...	Command		Parameter	Parameter description	Response	Note
	Header	Command code				
Measure-ment request	R	MD	x	x: channel number	RMD,aaaaaaaaaaaa,bbbbbbbbbbbb,cc,e,f,g,ii,yyyy,yy,yy,yy,yy,yy,ppppp-ppp,q,r,s,ttttt,uuuu-uuu,v	aaaaaaaaaaaa: Operator name bbbbbbbbbbbb: ID No. cc: Measuring composition e: channel f: Condition (0: MEAS、 1: CAL 2: Check before use 3: (Interval memoriz-ing) g: HOLD (0: Instantaneous value, 1: Hold, 2: Measurement) ii: ion type yyyy…,yy: Measurement date pppppppp: Data q: Sub unit r: Unit s: Temperature com-pensation ttttt: temperature uuuuuuu: Electromotive force v: Error condition (2: At Upper limit alarm 1: At Lower bound alarm 0: At no alarm)

● Data request command (4)

Format

Header, Item code, Parameter <CR><LF>

Command for...	Command		Parameter	Parameter description	Response	Note
	Header	Command code				
Memory save number request	R	MC			RMC,xxx	xxx: Memory number
Memory data transfer request	R	MS	xxx	xxx: Memory No.	RMS,xxx,aaaaaaaaaaaa,bbbbbbbbbbbbb,cc,e,f,g,ii,yyyy,yy,yy,yy,yy,yy,ppppp-ppp,q,r,s,ttttt,uuuuu,v	xxx: Memory No. aaaaaaaaaaaa: Operator name bbbbbbbbbbbb: ID No. cc: Measuring composition e: Channel f: Condition (0: MEAS, 1: CAL) g: HOLD (0: Instantaneous value, 1: Hold, 2: Measurement) ii: ion type yyyy・・・,yy: Measurement date pppppppp: Data q: Sub unit r: Unit s: Temperature compensation ttttt: temperature uuuuuuu: Electromotive force v: Error condition (2: At Upper limit alarm 1: At Lower bound alarm 0: At no alarm)
Electrode set value request	R	DN	x,y	x: channel number y: Composition (0: pH 1: ION 2: COND)	RDN,x,y,zz,aaaaaaaaaaaa,bbbbbbb	x: channel number y: Composition zz: ion type aaaaaaaaaaaa: Electrode type bbbbbbb: Lot No.

Command for...	Command		Parameter	Parameter description	Response	Note
	Header	Command code				
COND calibration history request	R	CC	x	x: channel number	RCC,zzzzzzzzzzzz,x,a,b,c,yyyy,yy,yy,yy,yy,yy,ppppp,qqqq,r,sssss Response when there is no calibration data RCC,**********,x,0,3	zzzzzzzzzzz: Operator name x: channel number a: number of calibrated points c: Temperature compensation b: Electrode status yyyy…yy: Calibration date ppppp: Cell constant numeral qqqq: Cell constant digit number r: Unit for cell constant sssss: temperature
Salinity calibration history request	R	SC	x	x: channel number	RSC,zzzzzzzzzzz,x,a,b,c,yyyy,yy,yy,yy,yy,yy,pppp,qqqqq Response when there is no calibration data RSC,**********,x,0,3	zzzzzzzzzzz: Operator name x: channel number a: number of calibrated points b: Electrode status c: Temperature compensation yyyy…yy: Calibration date pppp: Calibration coefficient qqqqq: temperature

Command for...	Command		Parameter	Parameter description	Response	Note
	Header	Command code				
Alarm inquiry	R	AL	x,y	x: channel number y: Request mode (0: Model alarm, 1: pH, 2: mV, 3: ion, 4: conductivity, salinity, resistivity)	RAL,x,y,zzzzzzzz	x: channel number y: Request mode zzzzzzzz: Error contents (bit basis) 0x00000002: Battery voltage drop (model) 0x00000004: Electrode instability (other than model) 0 x 00000008: Abnormal asymmetry potential (pH) 0 x 00000010: Abnormal sensibility (pH) 0 x 00000020: Excess calibration points (pH, ion) 0 x 00000040: Standard solution discrimination incapable (pH) 0 x 00000080: Calibration interval elapsed (pH) 0 x 00000200: Excess memory data (model) 0 x 00000400: Cell constant outside range (conductivity, salinity, resistivity)

NOTE

The error is indicated by a hexadecimal number. When two or more errors have occurred, the incremental number that shows all the errors is indicated.

12.5 Communication example using the HyperTerminal

● Confirming the online

To check the Online condition, transmit the command from PC as follows after connecting correctly.

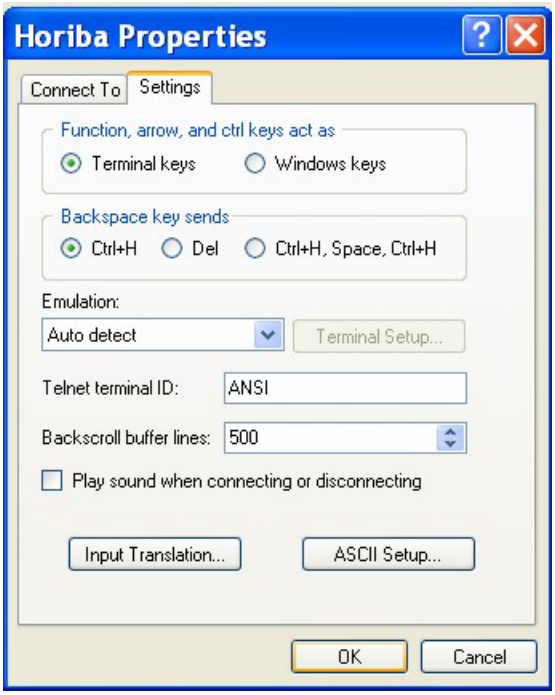
1. Display the pH Measurement screen.
   Now, the online command can be accepted.
2. C，OL，1<CR><LF>
3. Confirm the response is OK.
4. Confirm the Serial Connection is displayed in the external output connection display section in the pH Measurement screen.

● Communication sample

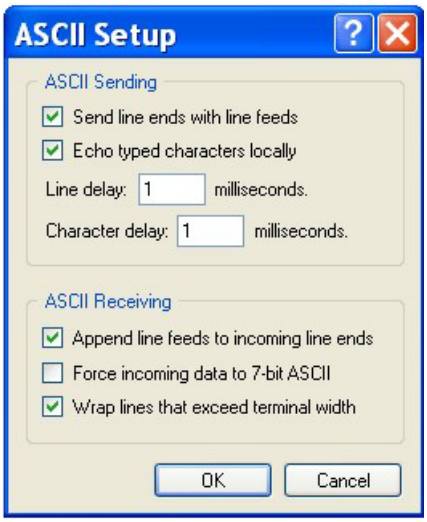
As a reference, here is the communication using the Windows hyperterminal.

1. Open the HyperTerminal.
   [Start] > [Programs] > [Accessories] > [Communications] > [HyperTerminal]
   The HyperTerminal program (Hypertrm.exe) is activated.
2. Make the setting for name, connection, and port.
   Select the COM port of your PC currently being used for the port setting.
   Set the transmission format as follows:
   Baud rate: 2400 bps
   Character length: 8 bits
   Parity: none
   Stop bit: 1 bit
   Flow control: none
3. Make the settings in the properties dialog box.

[File] > [Properties] > [Settings]



[File] > [Properties] > [Settings] > [ASCII Setup]



NOTE

You can check the contents transmitted via HyperTerminal by enabling the “Echo typed characters locally (E)” option.

4. Input the commands.

If you input a command, the corresponding response data is sent back.
Command input should be completed within 10 seconds.
Be sure to set the meter to the Online mode using the online/offline command at first.

NOTE

Windows® is a registered trademark of Microsoft Corporation.

Chapter 13 ANALOG OUTPUT

13.1 Output Terminal Connection

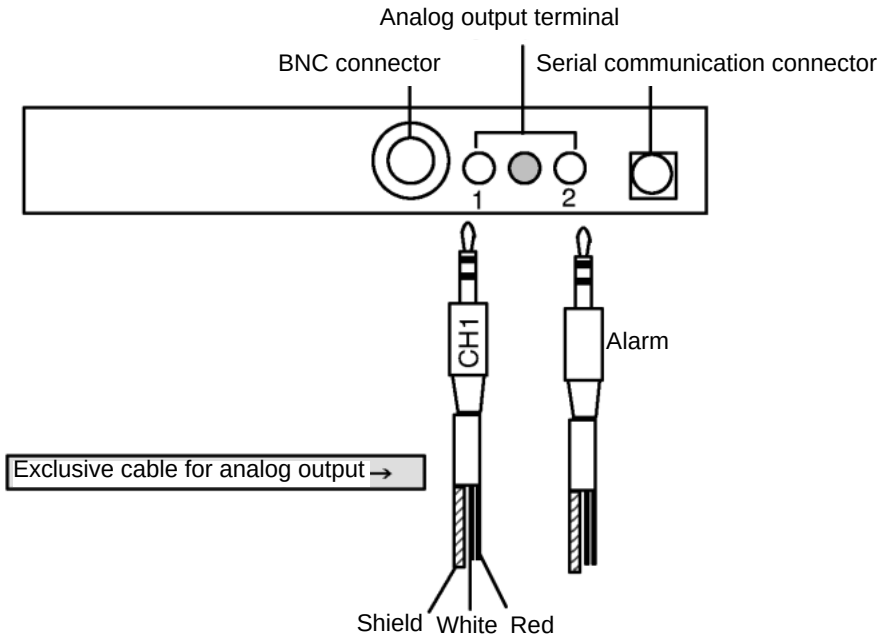
From the output terminal at the rear of meter, the voltage output for the measurement values and temperature data, and the open drain output for the alarm set can be obtained.

NOTE

The analog (alarm) output cable is optional.

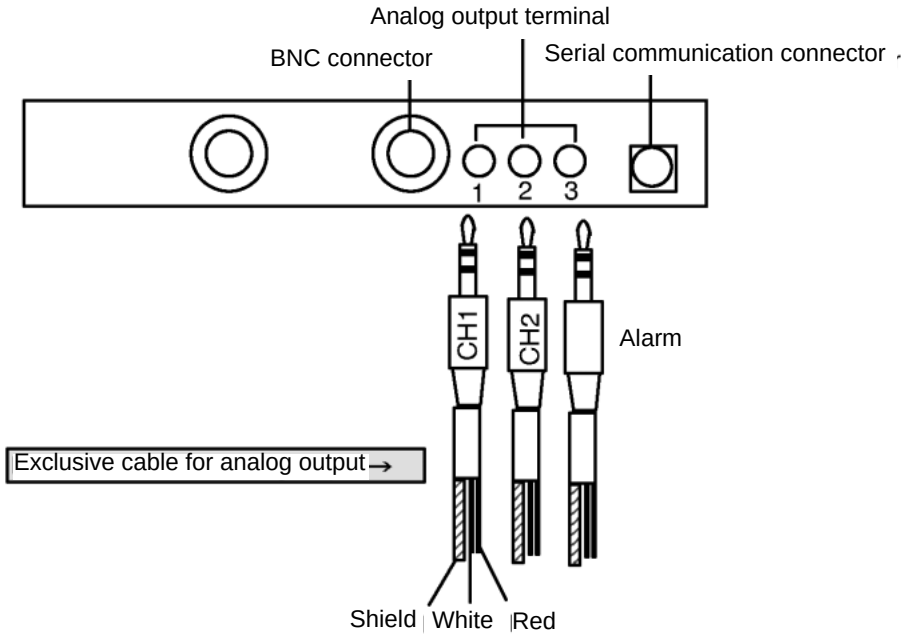
● F-52

Terminal No.	Connection cable		Output
1	For CH1	Shield	CH1 Ground
		Red	CH1 Temperature
		White	CH1 Measurement data
2	For Alarm	Shield	Alarm ground
		Red	CH1 Alarm
		White	—



● F-53 to F-55

Terminal No.	Connection cable		Output
1	For CH1	Shield	CH1 **Ground**
		Red	CH1 **Temperature**
		White	CH1 measure-ment data
2	For CH2	Shield	CH2 **Ground**
		Red	CH2 **Temperature**
		White	CH2 measure-ment data
3	For alarm	Shield	Alarm ground
		Red	CH1 alarm
		White	CH2 alarm



13.2 Analog Output Range

The resolution of the analog output is 1 mV.

Measured object	Measured value	Unit	Output	Conversion method
pH	0.000 to 14.000	pH	0 to 1400 mV (100 mV/1pH)	
mV	0 ± 1999.9	mV	0 ± 1999 mV	
Salinity	0 to 4.00%	%	0 to 400 mV	
ION	0.00 to 9.99	µg/L µmol/L	-2000 to -1600 mV	Measurement value × 4 × 10^7-2000
	10.0 to 99.9	µg/L µmol/L	-1600 to -1200 mV	Measurement value × 4 × 10^6-1600
	100 to 999	µg/L µmol/L	-1200 to -800 mV	Measurement value × 4 × 10^5-1200
	1.00 to 9.99	mg/L mmol/L	-800 to -400 mV	Measurement value × 4 × 10^4-800
	10.0 to 99.9	mg/L mmol/L	-400 to 0 mV	Measurement value × 4 × 10^3-400
	100 to 999	mg/L mmol/L	0 to 400 mV	Measurement value × 4 × 10^2
	1.00 to 9.99	g/L mol/L	400 to 800 mV	Measurement value × 4 × 100+400
	10.0 to 99.9	g/L mol/L	800 to 1200 mV	Measurement value × 4 + 800
	100 to 999	g/L mol/L	1200 to 1600 mV	Measurement value × 0.4+1200
COND In S/m	20.0 to 199.9	S/m	1000 to 1500 mV	Measurement value × 2.5+1000
	2.00 to 19.99	S/m	500 to 1000 mV	Measurement value × 25+500
	0.200 to 1.999	S/m	0 to 500 mV	Measurement value × 250
	20.0 to 199.9	mS/m	-500 to 0 mV	Measurement value × 2500-500
	2.00 to 19.99(*1)	mS/m	-1000 to -500 mV	Measurement value × 25000-1000
	0.200 to 1.999(*2)	mS/m	-1500 to -1000 mV	Measurement value × 250000 · 1500
	0 to 199.9	µS/m	-2000 to -1500 mV	Measurement value × 2500000 · 2000

Measured object	Measured value	Unit	Output	Conversion method
COND In S/cm	0.200 to 1.999	S/cm	1000 to 1500 mV	Measurement value × 250+1000
	20.0 to 199.9	mS/cm	500 to 1000 mV	Measurement value × 2500+500
	2.00 to 19.99	mS/cm	0 to 500 mV	Measurement value × 2.5 × 10^4
	0.200 to 1.999	mS/cm	-500 to 0 mV	Measurement value × 2.5 × 10^5 - 500
	20.0 to 199.9(*3)	μS/cm	-1000 to -500 mV	Measurement value × 2.5 × 10^6 - 1000
	2.00 to 19.99(*4)	μS/cm	-1500 to -1000 mV	Measurement value × 2.5 × 10^7 - 1500
	0.000 to 1.999	μS/cm	-2000 to -1500 mV	Measurement value × 2.5 × 10^8 - 2000

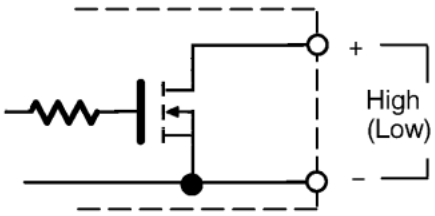
Measured object	Measured value	Unit	Output	Conversion method
Resistivity In Ω•m	0.200 to 1.999	MΩ•m	1500 to 2000 mV	Measurement value × 2.5 × 10^{-4} + 1500
	20.0 to 199.9	kΩ•m	1000 to 1500 mV	Measurement value × 2.5 × 10^{-3} + 1000
	2.00 to 19.99	kΩ•m	500 to 1000 mV	Measurement value × 2.5 × 10^{-2} + 500
	0.200 to 1.999	kΩ•m	0 to 500 mV	Measurement value × 2.5 × 10^{-1}
	20.0 to 199.9 (*5)	Ω•m	-500 to 0 mV	Measurement value × 2.5 × 2.5 - 500
	2.00 to 19.99 (*6)	Ω•m	-1000 to -500 mV	Measurement value × 2.5 × 25 - 1000
	0.50 to 1.999	Ω•m	-1500 to -1000 mV	Measurement value × 2.5 × 250 - 1500
Resistivity In Ω•cm	20.0 to 199.9	MΩ•cm	1500 to 2000 mV	Measurement value × 2.5 × 10^{-6} + 1500
	2.00 to 19.99	MΩ•cm	1000 to 1500 mV	Measurement value × 2.5 × 10^{-5} + 1000
	0.200 to 1.999	MΩ•cm	500 to 1000 mV	Measurement value × 2.5 × 10^{-4} + 500
	20.0 to 199.9	kΩ•cm	0 to 500 mV	Measurement value × 2.5 × 10^{-3}
	2.00 to 19.99 (*7)	kΩ•cm	-500 to 0 mV	Measurement value × 2.5 × 10^{-2} - 500
	0.200 to 1.999 (*8)	kΩ•cm	-1000 to -500 mV	Measurement value × 2.5 × 10^{-1} - 1000
	50.0 to 199.9	Ω•cm	-1500 to -1000 mV	Measurement value × 2.5 - 1500
Tempera-ture	0 to 100.0 ℃		0 to 1000mV	

NOTE

(*1) Cell constant 0.00 to 19.99 at 1000m-1
(*2) Cell constant 0.000 to 1.999 at 100m-1
(*3) Cell constant 0.0 to 199.9 10cm-1
(*4) Cell constant 0.00 to 19.99 at 1cm-1
(*5) Cell constant 50.0 to 199.9 at 10cm-1
(*6) Cell constant 5.00 to 19.99 at 1cm-1
(*7) Cell constant 5.00 to 19.99 at 0.1cm-1
(*8) Cell constant 0.500 to 1.999 at 1cm-1

13.3 Alarm Output

The alarm output is open drain output (15V, less than 20 mA). When the alarm is triggered, the output is ON.



Chapter 14 PRINTER

14.1 Printer Specification

The printer is optional.

Type	Model	Manufacturer
Normal paper type	CBM-910-24RJ100-A	Citizen CBM
Heat-sensitive paper type	DPU-H245AS-A03A	SII

- Baud Rate: 2400 bps
- Word Length: 8 bits
- Parity: None
- Stop Bits: 1 bit

Setting for the plain paper printer (CBM-910)

Set the DIP switch No. 6 to ON and No. 7 to OFF, and then set printer paper and ink ribbon.
Keep the LF key held down.
Keep the LF key held down. The printer prints output when the LF key is being pressed.

Setting for thermal paper printer (DPU-H245AS)

Set printer paper and turn ON the power switch with the FEED and CHARGE switches held down.
Startup the printer SETUP mode, to change to the above setting.

NOTE

Refer to the instruction manual for the printer.

14.1.1Printer output timing

The printer prints at the following times.

- ① When pressing the ENTER key in the Measurement mode
  (During AutoHold, no printout is available)
- ② When the manual data memory is performed in the Measurement mode.
- ③ When the printout is executed on the DATA OUT screen
- ④ When the printout is executed in the Calibration mode
- ⑤ When the printout is executed in the REPEATABILITY mode
- ⑥ When test printing is selected while in the Maintenance mode, a test is printed.

14.2 Cautionary items

- Connect your printer only after turning OFF the power to the main unit of the pH meter.
  Connecting the printer with powered may break the meter and devices.
- Connect the meter with the printer only with the exclusive cable.
- Assure the environment free from the noise source in the surroundings. Otherwise, the commands are not correctly recognized to cause a malfunction.
- Operation with the paper empty may miss the data when the paper is provided again. Execute the printout again when this happens.
- The model and the manufacturer may be changed according to improvement and/or change of the printer specification or features.
- Font, size of the printout data may be changed without notice.

14.3 Connection

● Connection

Confirm the following items before the connection.

- The meter power is turned OFF
- The printer power is turned OFF
- Be sure to use a cable that matches the printer.

Assure the connection by the following step:

1. Connect the meter and the printer by the exclusive cable.
2. Turn ON the printer power.
3. Turn ON the meter.

NOTE

Be sure to avoid paper from being run-out.

● Check the connection

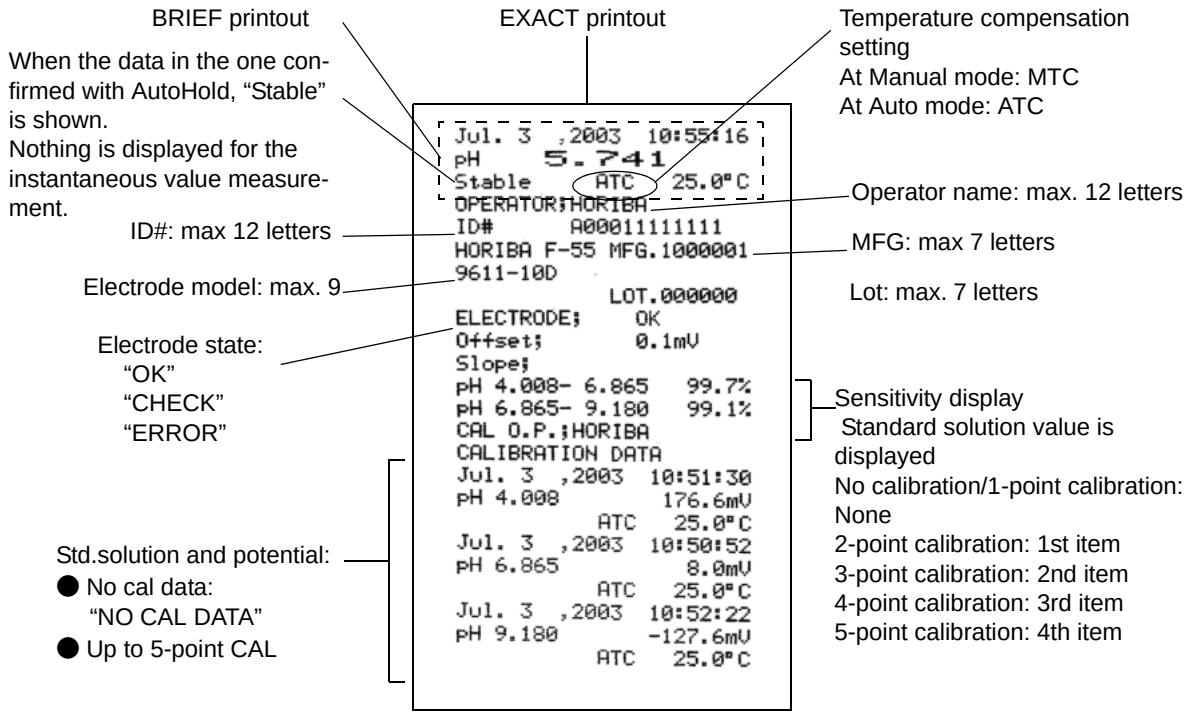
Check the external output connection indication is assured with the printer connection, which are displayed on the pH Measurement screen.

14.4 Sample Printout

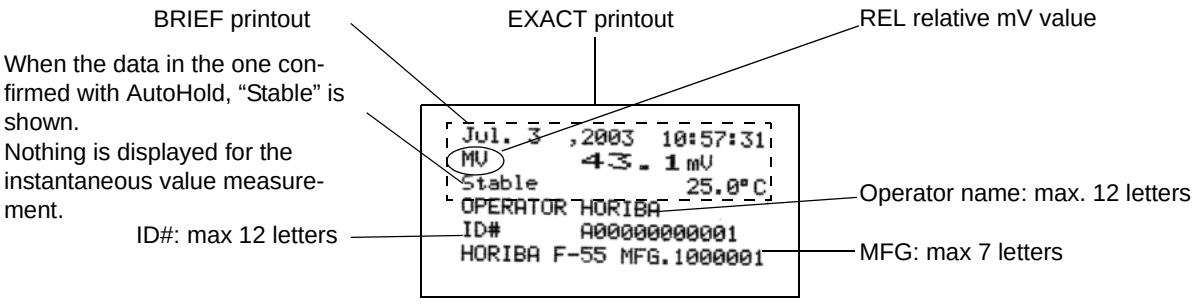
The data displayed here is the sample printout. The contents depend on the meter change/ improvement.The printer also determines the printout image.

14.4.1 When the ENTER key is pressed in the Measurement mode

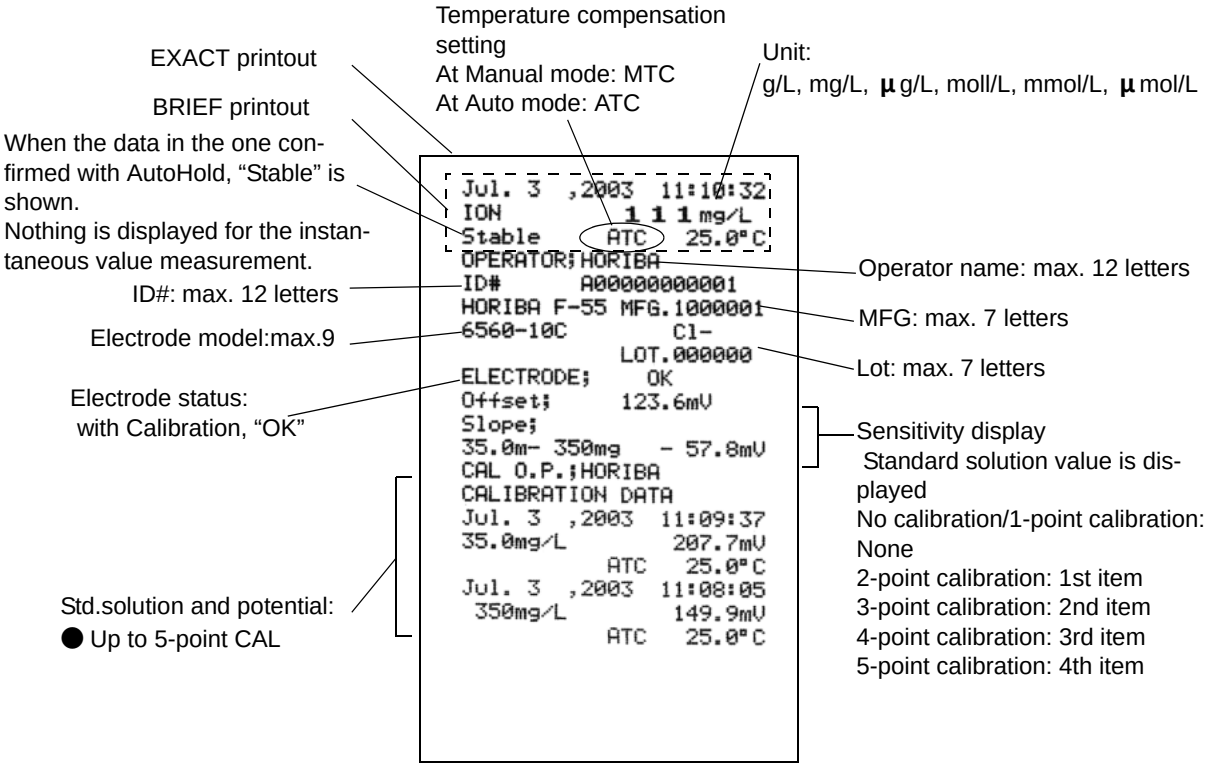
● pH Measurement mode



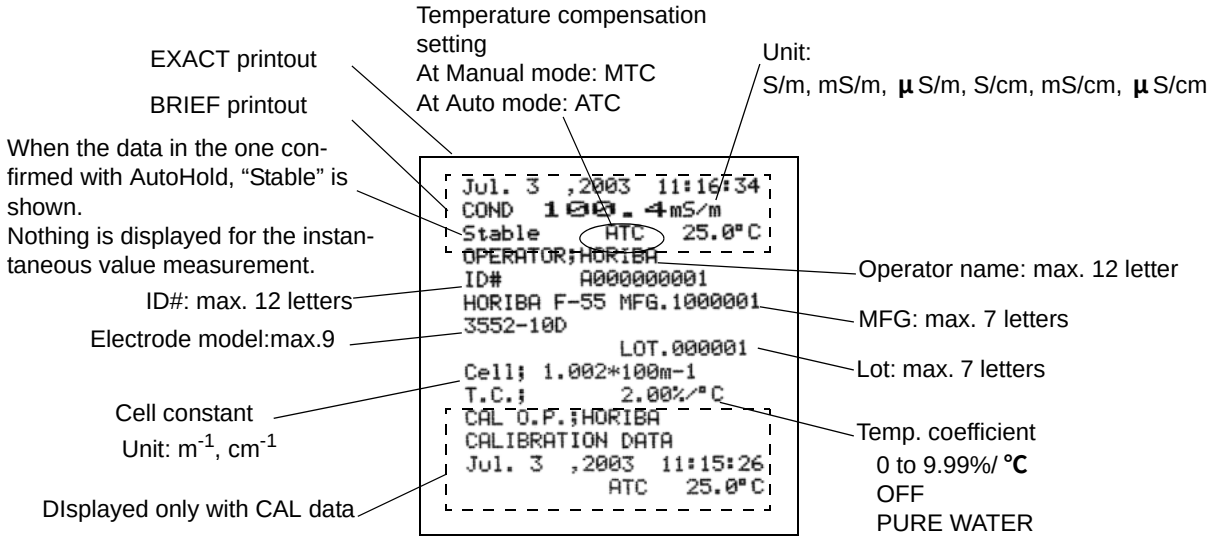
● mV Measurement mode



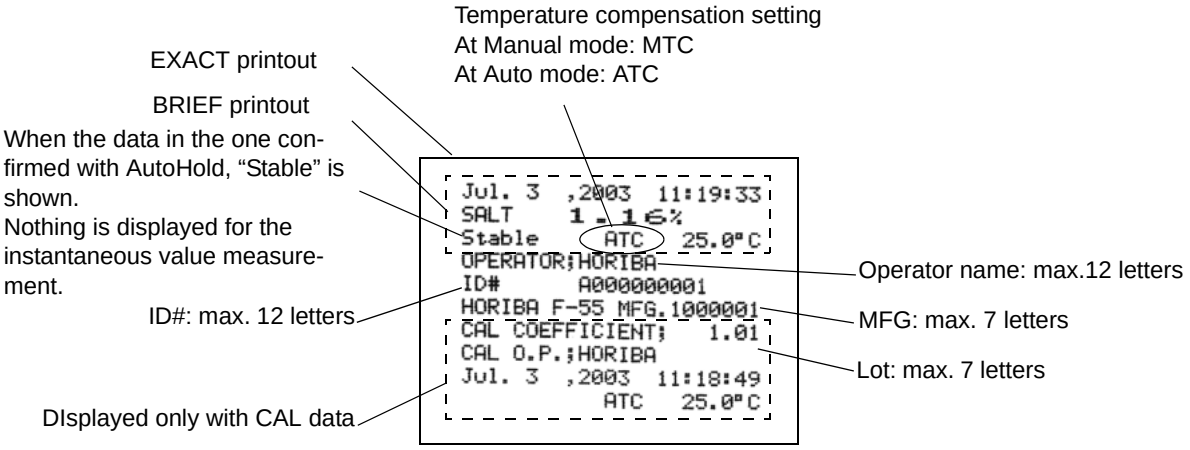
● ION Measurement mode



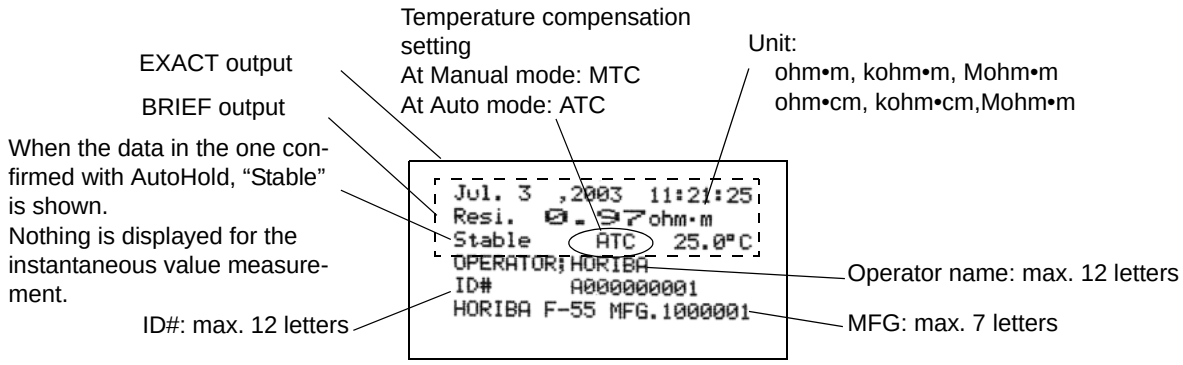
● COND Measurement mode



● Salt Measurement mode



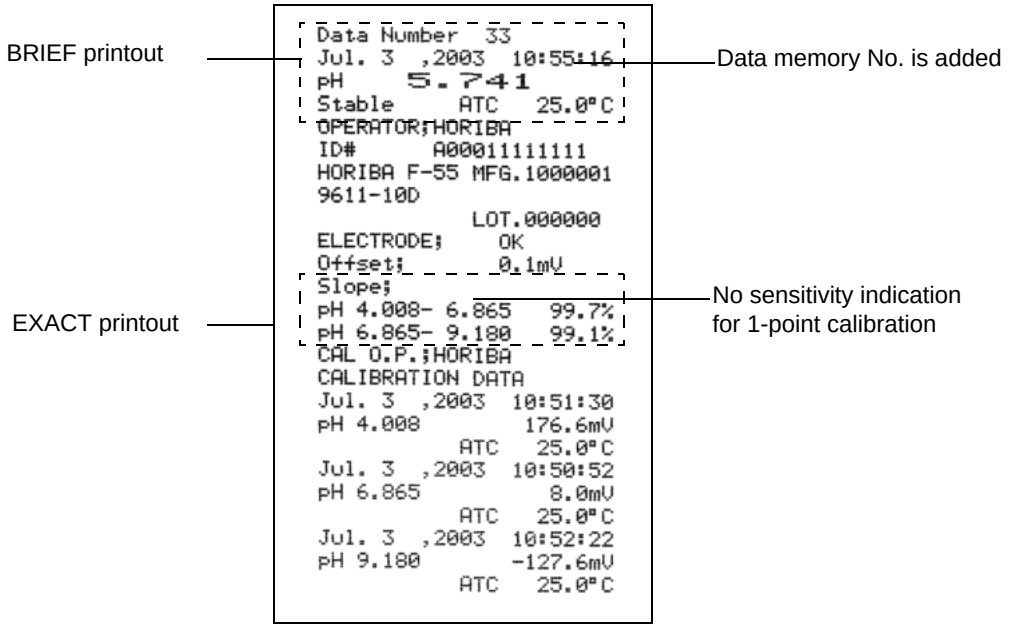
● Resistivity Measurement mode



14.4.2 When the manual data memory is performed in the Measurement mode

The printer prints the data memory No. in the first line and the data in accordance with the format same with the one in"14.4.1 When the ENTER key is pressed in the Measurement mode" page 177.

● Example in the pH Measurement mode

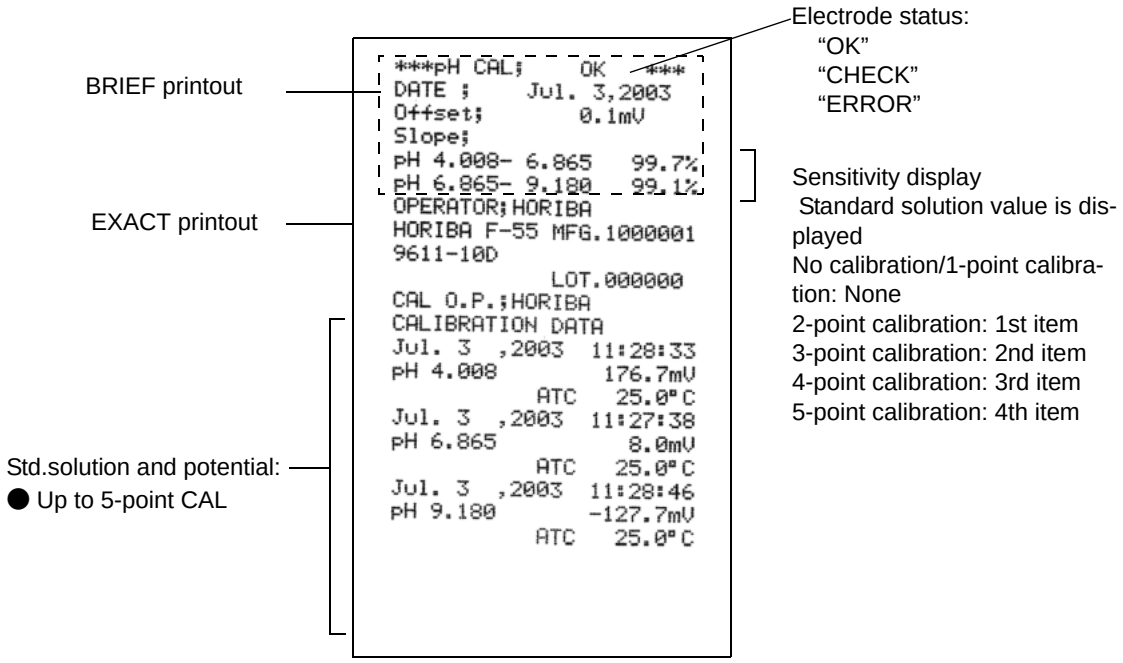


14.4.3 Printout from DATA OUT screen

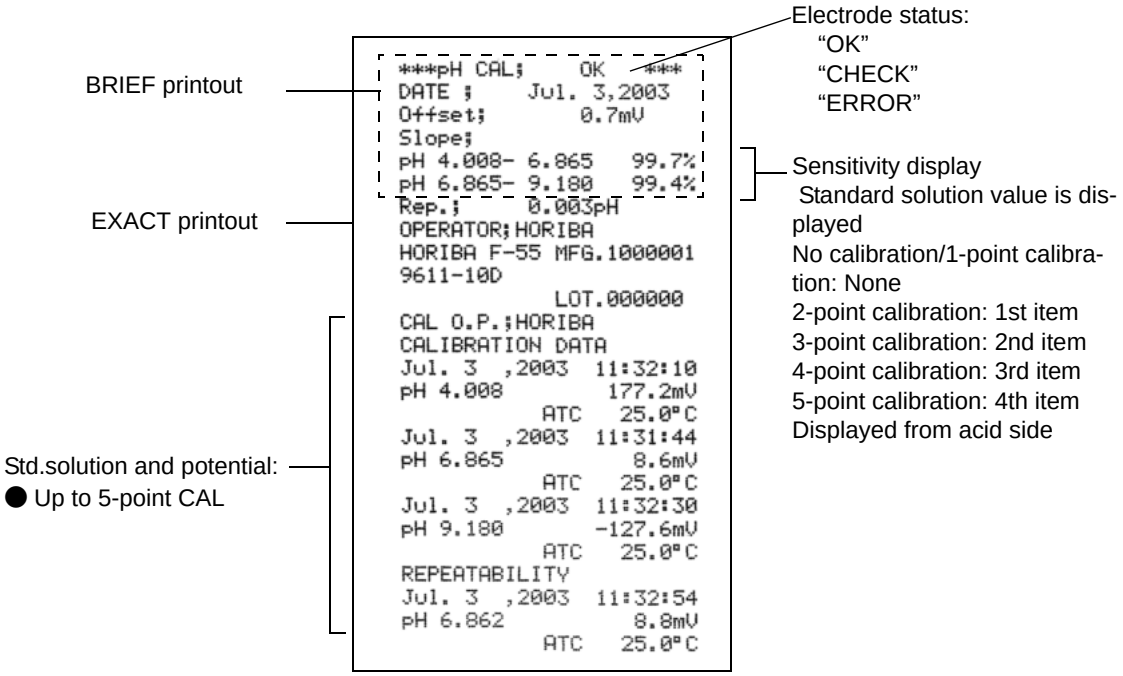
The same format with the one described in "14.4.2 When the manual data memory is performed in the Measurement mode" page 180.

14.4.4 Printout in CAL mode

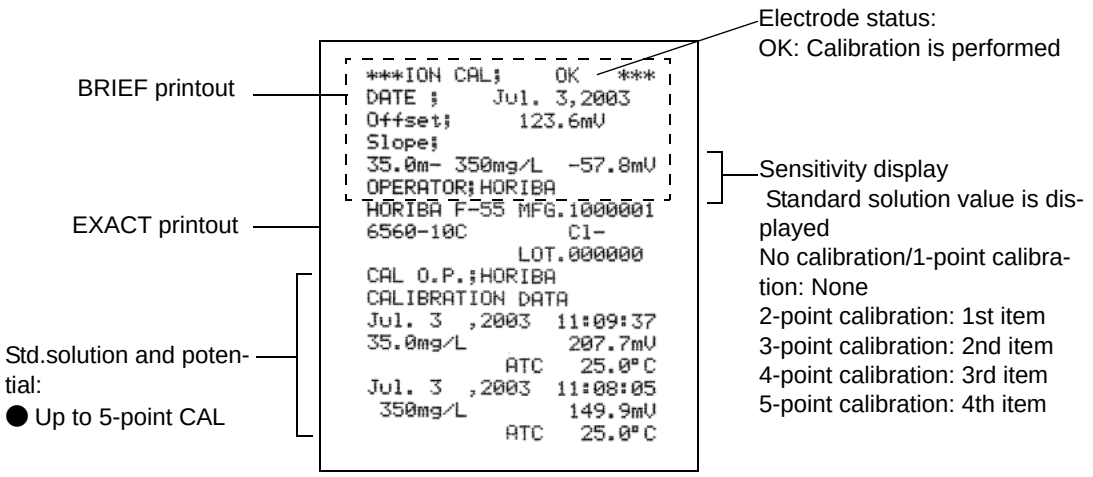
● Printout in pH CAL mode (without repeatability check data)



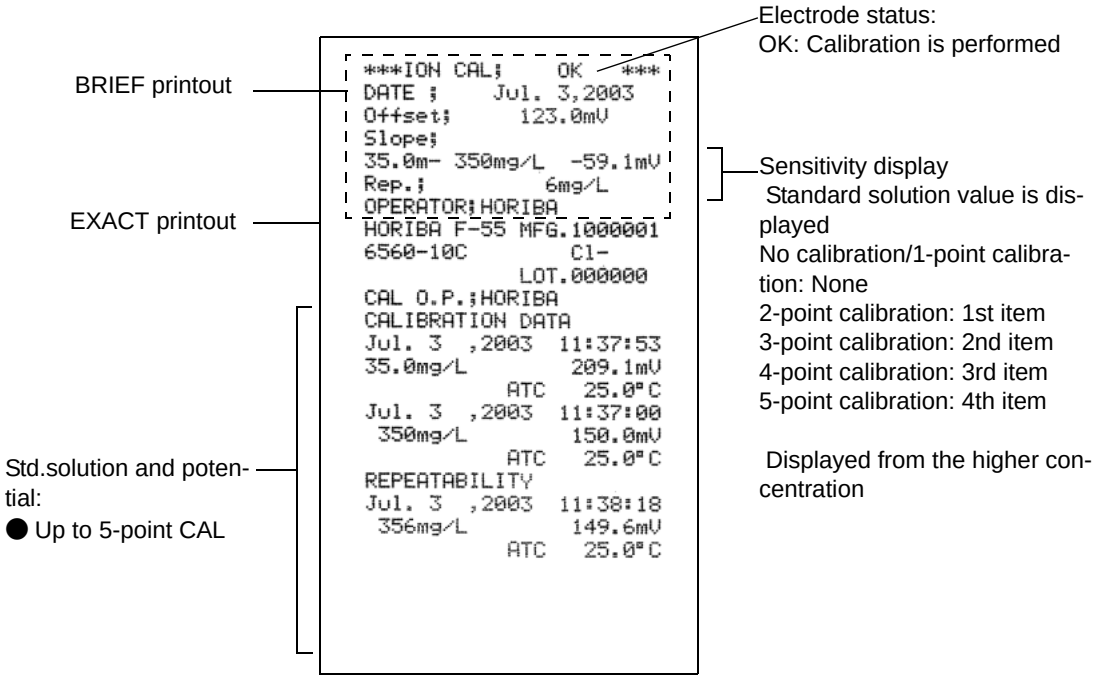
● Printout in pH CAL mode (with repeatability check data)



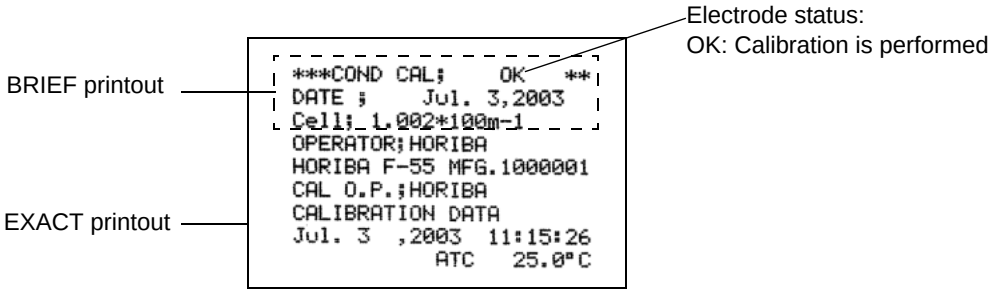
● Printout in ION CAL mode (without repeatability check data)



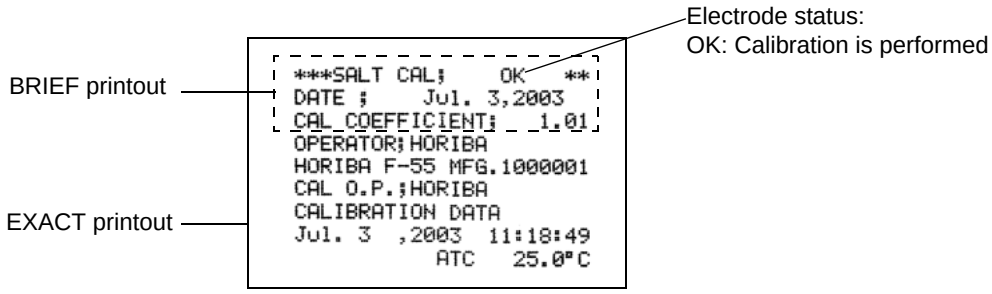
● Printout in ION CAL mode (with repeatability check data)



● Printout in COND CAL mode

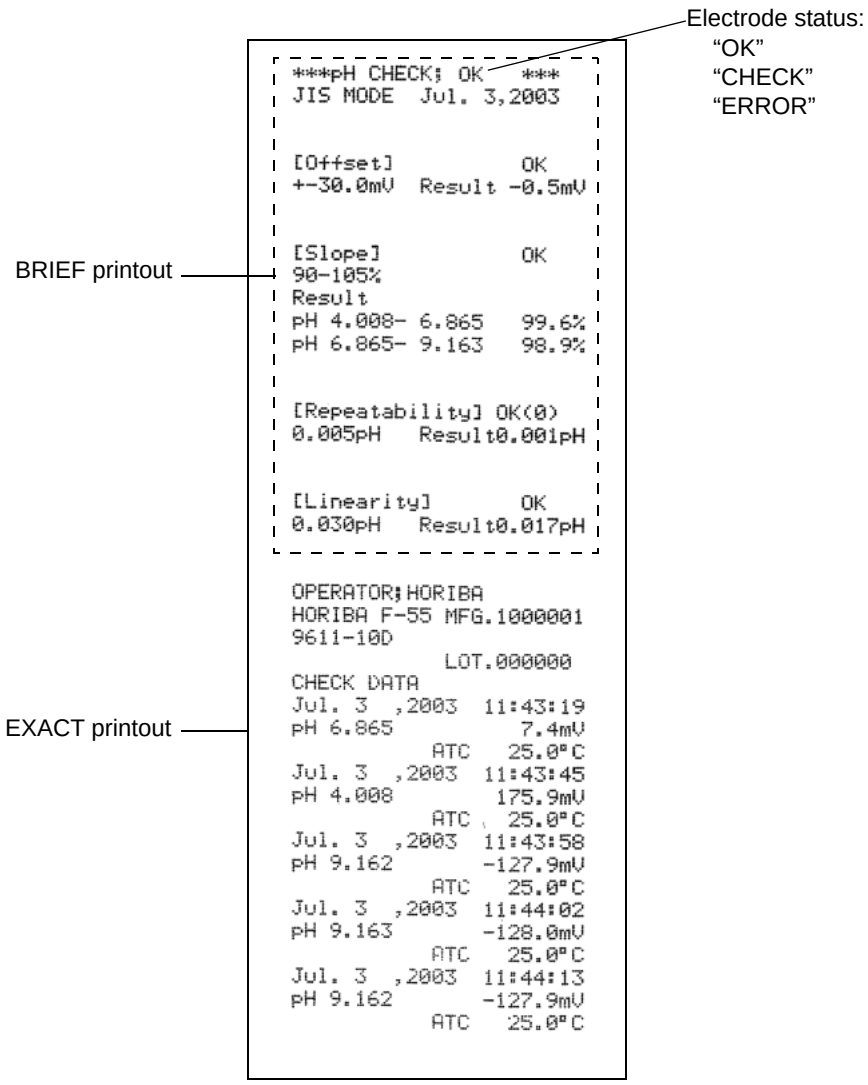


● Printout in SALT CAL mode

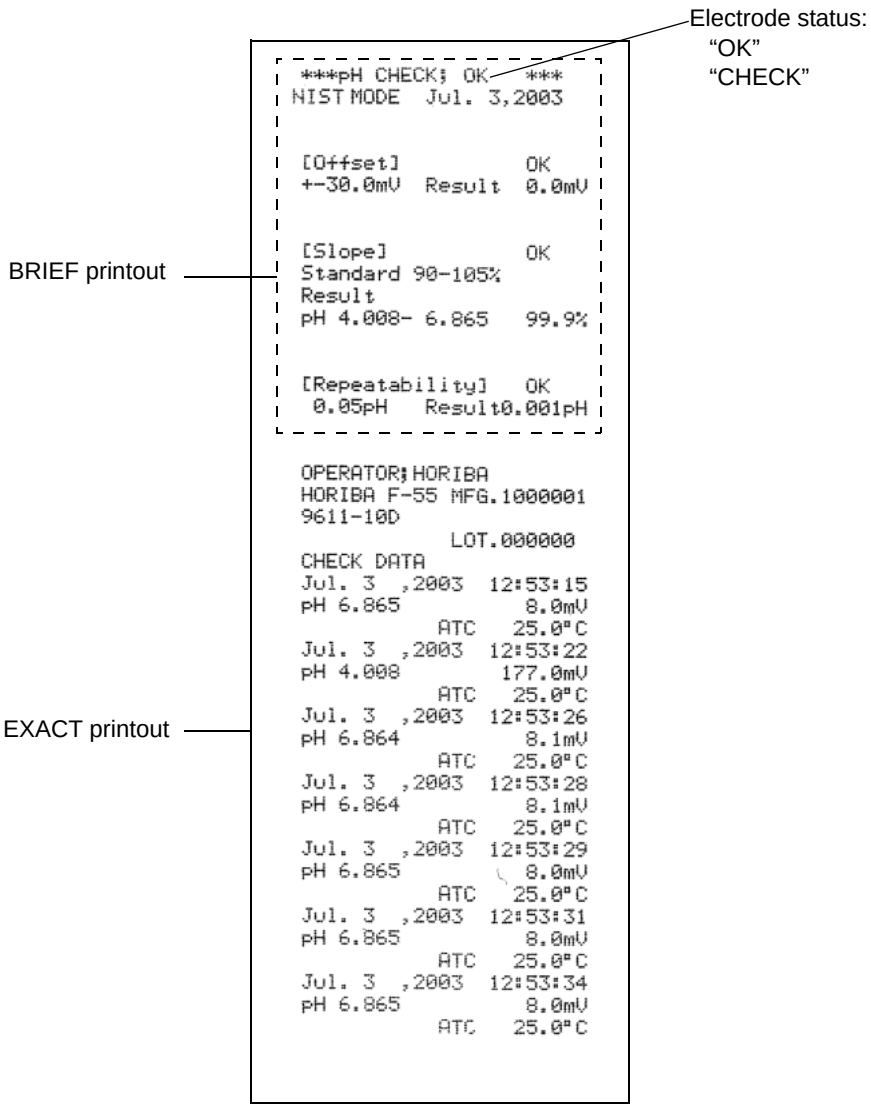


14.4.5 Printout in CHECK mode

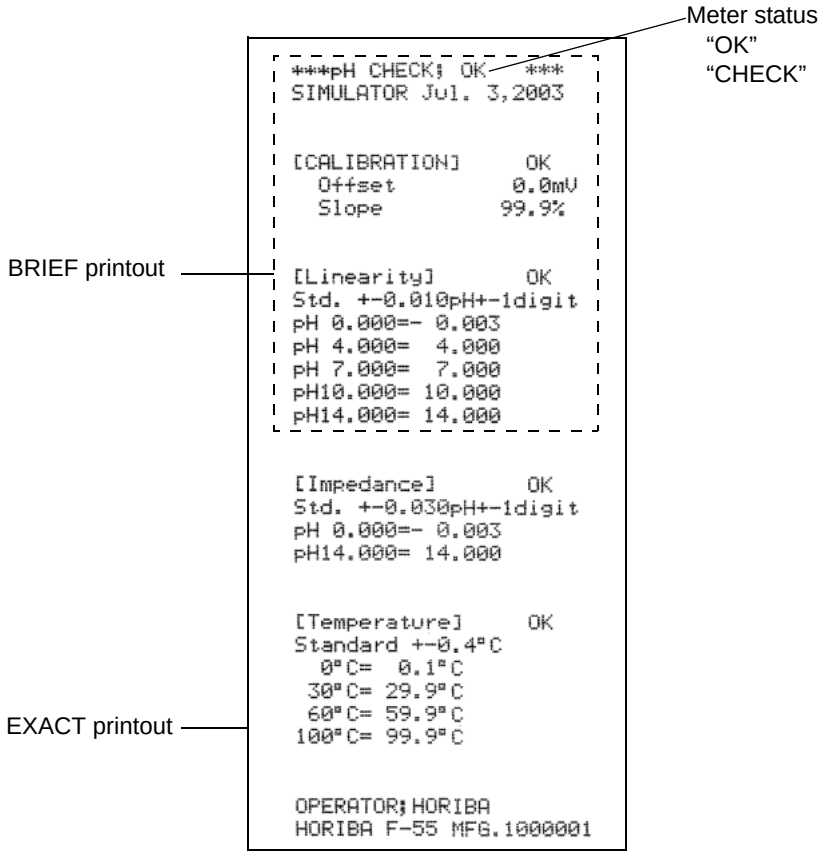
● pH CHECK (JIS mode)



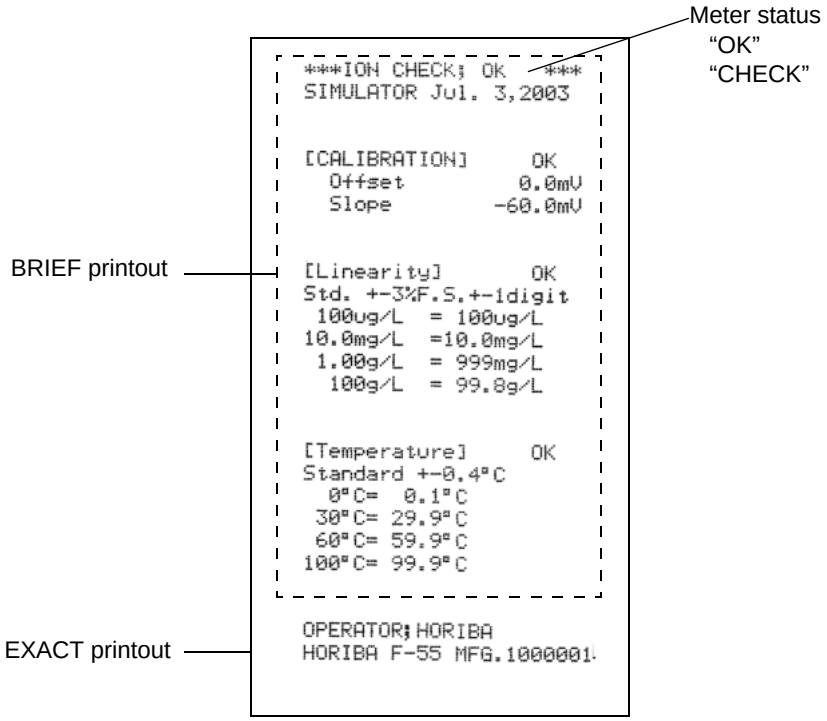
● pH CHECK (NIST mode)



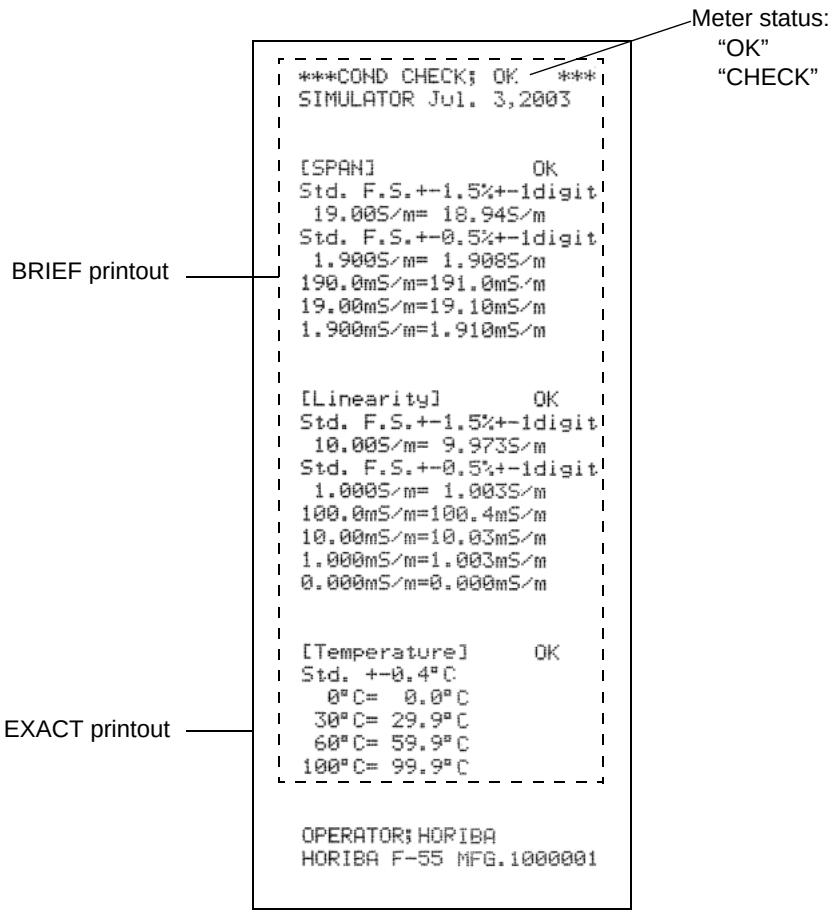
● pH CHECK (SIMULATOR mode)



● ION CHECK (SIMULATOR mode)



● COND CHECK (SIMULATOR mode)



Chapter 15 Maintenance and troubleshooting

This chapter explains how to perform daily maintenance of the pH meter and how to deal with error messages.
Daily maintenance is vital in assuring accurate measurement and preventing breakage before they occur. Maintenance of the electrodes is especially important; if ignored, various problems and erroneous measurements may result. This pH meter is equipped with a convenient error message function. If an error message appears, be sure to take appropriate action.

15.1 Maintenance

15.1.1 pH (ORP) electrode maintenance

Maintain the electrodes by referring to the following information or to the operation manuals for the electrodes.

Injury warning

Caution

Glass fragments cause injury.
The outer tube of the electrode and the tip of the electrode are made from glass. Use care not to break them.

pH electrodes (9621-10D) ORP electrodes should be cared for in the same manner.

● **Maintenance after daily use**

After making measurements, wash the electrode using pure water (de-ionized water), wipe off water from the electrode with filter or tissue paper, and store it with its cap placed on.

NOTE

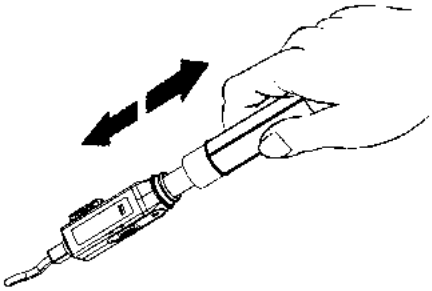
The liquid junction may be clogged if the electrode is left in distilled water or the like.

Extended storage

When an electrode is not to be used for a long period of time, store the electrode after performing the following procedure. Also, exchange the standard solution every three to six months, using the step explained below.

1. Remove the electrode from the pH meter.

2. Remove the protective cap from the electrode.

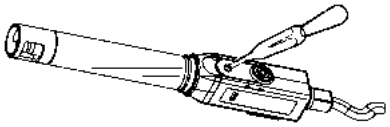


Chemical Solution

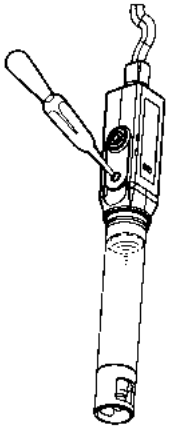
Caution

The liquid inside the electrode is highly concentrated potassium chloride (3.33 mol/L KCl). If the internal solution in the electrode comes in contact with your hands or skin, wash immediately with water. If the internal solution comes in contact with your eyes, flush immediately with large amounts of water and seek treatment by a physician.

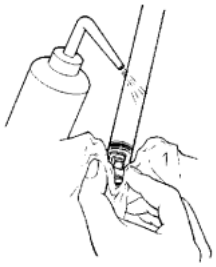
3. Open the internal solution filler port , then use a plunger to remove the standard solution.



4. Fill the electrode with new internal solution (#300), until it nears the filler port.



5. Wash the tip of the electrode well with pure (de-ionized) water and wipe it with filter or tissue paper.



6. If the solution on the inside of the protective cap has dried, wash the inside of the protective cap with pure (de-ionized) water. After shaking out the water, fill the cap with enough pure (de-ionized) water to soak the sponge.

NOTE

If the solution inside the protective cap for the electrode has dried up and the electrode has not been used for an extended period of time, the response speed of the electrode may have slowed and its sensitivity may have decreased.

● Washing electrodes

If the tip of the pH electrode is extremely dirty, the speed of its response may slow and it may cause errors in measurement. If the electrode is so dirty that it cannot be cleaned by rinsing with pure (de-ionized) water, wash the electrode using the method below that is most appropriate.

General dirt & oily grime

Wipe the dirt/grime off using cotton gauze that contains a neutral detergent.

Inorganic grime

Rinse using a hydrochloric acid solution of approximately 1 mol/L or a washing #220.
Be sure not to soak the electrode in strong acid for a long period of time.

15.1.2 Ion electrode maintenance

Refer to the electrode operation manual for how to take care of each kind of electrode.

● Ion electrodes

Ion to be measured	Ion type	Slope (*)	Measurement range	Elect-rode mod-el	Comp atible tip model	standard solution
Potassium K^+	+1	+58 mV	0.04 to 39,000 mg/L	6582 -10C	7682	3.33 mol/L NaCl
Calcium Ca^{2+}	+2	+29 mV	0.4 to 40,080 mg/L	6583 -10C	7683	3.33 mol/L KCl (#300)
Chloride Cl^-	-1	-59 mV	0.4 to 35,000 mg/L	6560 -10C	7660	1 mol/L KNO_3
Fluoride F^-	-1	-59 mV	0.02 to 19,000 mg/L	6561 -10C	7661	3.33 mol/L KCl (#300)
Nitrate NO_3^-	-1	-55 mV	0.06 to 62,000 mg/L	6581 -10C	7681	1 mol/L KCl
Ammonia NH_3	+1	-59 mV	0.1 to 1,000 mg/L	5002 -10C		Included internal solu-tion NH_4Cl

(*):
Change in the electric potential of the electrode (25ºC)
when the ion concentration is changed by a factor of 10.

NOTE

The above electrodes are subject to change without notice.

Maintenance of the ion electrodes listed in the above table begins, on next page.

Before use

Before using an electrode, condition the electrode according to the following table, to prepare it for measurement.

Ion electrode	Conditioning agent	Time
Cl^- ion electrode	No conditioning	
F^- ion electrode		
NO_3^- ion electrode	1 mol/L potassium nitrate solution (100 g/L KNO_3)	Approx. 1 h
K^+ ion electrode	0.1 mol/L potassium chloride solution (75 g/L KCl)	Approx. 12 h
Ca^{2+} ion electrode	Tap water	Approx. 3 h
NH_3 ammonia electrode	No conditioning	

Short-term storage

Immerse electrode in the following solutions, when they are to be stored for up to one day and then reused.

Ion electrode	Storage solution
Cl^- ion electrode	de-ionized water
F^- ion electrode	
NO_3^- ion electrode	1 mol/L potassium nitrate solution (100 g/L KNO_3)
K^+ ion electrode	0.1 mol/L potassium chloride solution (75 g/L KCl)
Ca^{2+} ion electrode	Tap water
NH_3 ammonia electrode	0.01 mol/L ammonium chloride solution

● 65XX-10C electrode maintenance

Refer to the electrode operation manuals for maintenance concerning other electrode models.

Long-term storage

1. Remove the tip electrode from the combined electrode and put on the rubber cap.
2. Put on the electrode protective cap.
   (Do not put water in the electrode protective cap and make sure it is dry.)
3. Store both the tip electrode and the combined electrode in dry condition.
4. To reuse the electrodes, start with the operations explained in the section entitled " ● Before using" above.

Daily maintenance

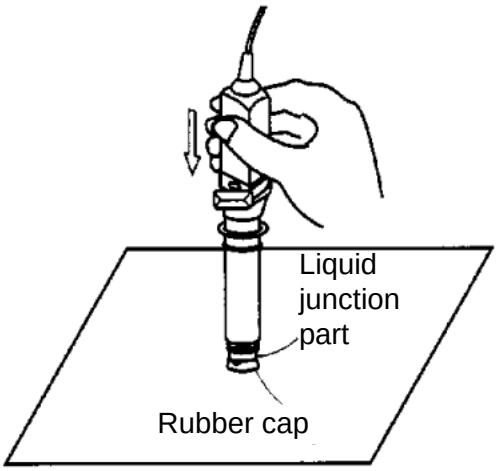
When an electrode has not been used for a long period of time, some of the sample may have entered the standard solution (outer tube) or the standard solution may have become deteriorated. For this reason, perform the following operations from once a week to once a month to replace the internal solution within the reference electrode (outer tube).

1. Open the internal solution filler port by removing the rubber stopper, then turn the electrode upside down and use a syringe to remove the standard solution.
2. Use the syringe to fill the electrode with the specified standard solution.

The ideal amount of standard solution discharge is only a tiny bit from the liquid junction. If the amount of liquid flowing out is extremely small, the electric potential of the reference electrode will not stabilize and will be affected by the stirrer. In such cases, perform the following operations to make the standard solution seep out from the liquid junction.

Standard solution outflow operations

1. Remove the protective tube from the combined electrode so that the rubber cap is mounted on the tip-type ion electrode part.
2. Remove the rubber stopper from the standard solution filler port on the top part of the electrode.
3. Stand the electrode vertically on a desk or other horizontal surface, with the bottom of the electrode (the side with the rubber cap) facing down. Push the electrode down two or three times, to make the standard solution seep out through the liquid junction.



Filling internal solution (inner tube)

The inner tube of the electrode is of an air-tight construction that allows almost no outflow. Replace the internal solution (inner tube), however, when the electrode has been used for a long period of time and only half or less of the internal solution (inner tube) remains.
(The filling frequency for internal solution varies depending on the usage and storage conditions, but under normal use it is approximately once a year.)

NOTE

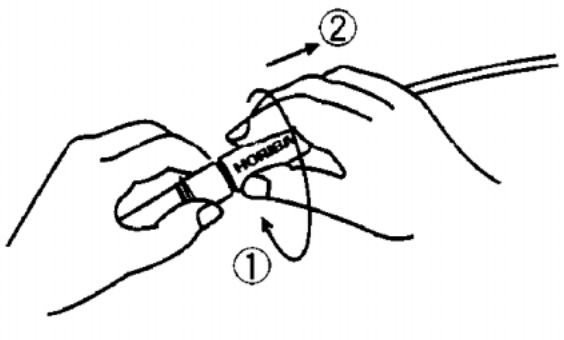
To fill an electrode with internal solution (inner tube), the electrode must be disassembled. Use sufficient care during disassembly.
Items necessary when replacing internal solution (inner tube) are: a syringe, #330 (gel) standard solution, and the standard solution specified for the particular electrode.

Filling the electrode: disassembly procedure

1. Remove the protective tube and tip-type ion electrode from the combined electrode and put the rubber cap on the tip-type ion electrode part.

2. Remove the rubber stopper from the standard solution (outer tube) filler port, then take out the internal solution using a plunger.

3. Twist the electrode cap by hand and move it approximately 5 to 10 centimeters toward the electrode connector side.



4. Remove the internal body 1 of the electrode by holding the electrode cap by hand, then pushing the electrode while it is standing vertically on a desk or other horizontal surface.

5. Move the silicon tube of the internal body 1 downward, to expose the internal solution filler port (inner tube).

6. Put the gel-form internal solution (#330) in through the filler port using a syringe and fill the electrode until the internal solution nears the filler port (inner tube).

Filling the electrode: assembly procedure

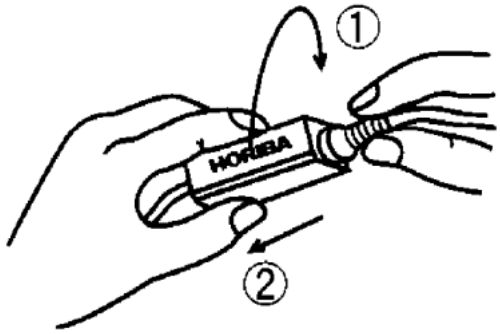
1. Return the silicon tube to its original position and seal the internal solution filler port (inner tube). (Make sure that the filler port is completely sealed.)

2. If the bodies 1 or 2 or the liquid junction are dirty, wash them with pure (de-ionized) water.

3. Insert body 1 into body 2. (Make sure that the O-ring is securely sealed.)

4. Return the spring to the top of body 1.

5. Hold the rubber sleeve in place by hand, then twist the electrode protective cap to a 90º angle and fit the rubber sleeve into the electrode protective cap.



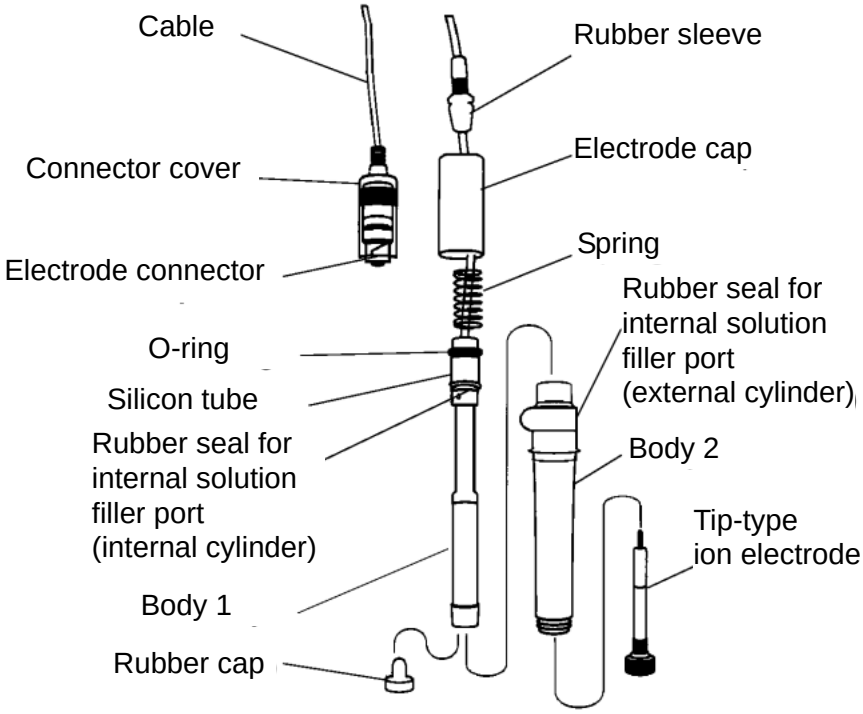
6. Set the parts such that the “HORIBA” logo faces the same direction as the standard solution filler port (outer tube), then fit the cap into body 2.

7. Twist the rubber sleeve to a 90º angle and hold it in place.

8. Use the plunger to fill the electrode with the specified standard solution.

9. Make the internal solution seep out from the liquid junction in accordance with the section entitled " Daily maintenance" page 195.

10. Store the electrode in accordance with the section entitled " ● Short-term storage" page 194.


Cable
Rubber sleeve
Connector cover
Electrode cap
Spring
Electrode connector
Rubber seal for
internal solution
filler port
(external cylinder)
O-ring
Silicon tube
Rubber seal for
internal solution
filler port
(internal cylinder)
Body 2
Tip-type
ion electrode
Body 1
Rubber cap

15.1.3 Conductivity electrode maintenance

Refer to the electrode operation manuals for how to maintain each electrode.

Long-term storage

When an electrode will not be used for a long period of time, store it after performing the following procedure. Also, perform maintenance on the electrode every three to six months.

1. Remove the electrode from the pH meter.
2. Use pure water to wash away any sample solution that may have adhered to the electrode.
3. Wash the inside of the electrode protective cap with pure water, then, after shaking out the water, fill the cap with enough pure water to soak the sponge.
4. Place the electrode protective cap on the electrode.

15.2 Troubleshooting

This type of meter is equipped with a simply error-message function to notify the operator that an operation error or problem with the equipment has occurred. Errors or other problems that occur while in the MEASUREMENT mode are announced by an “error No.” appearing in the lower left-hand corner of the display.

15.2.1 Error message chart

ERR No.	Message	Explanation
01	Memory ERROR	Data cannot be read from or written to the internal memory.
02	Low battery	The battery voltage is low.
03	Unstable reading ERROR	The electric potential did not stabilize within three minutes.
04	Zero calibration ERROR	pH: The asymmetry potential of the electrode is 45 mV or more.
05	Span calibration ERROR (pH)	pH: The electrode sensitivity is either 105% or more or 85% or less than the theoretical sensitivity.
06	Excess calibration points	Calibration exceeding the calibration points.
07	Buffer uncertain	pH: The pH meter cannot identify the standard buffer
08	Please calibrate	pH: Exceeds the calibration cycle setting.
09	Printer ERROR	There is a problem with the printer unit.
10	Data memory over	The number of data items has exceeded the limit of the memory.
11	Cell constant out of range	COND: Cell constant is out of automatic calculation range.
12	Compact flash card error	Compact flash or its contents are abnormal.
13	Compact flash card full	Capacity of Compact flash memory is exceeded.
14	No compact flash card	Compact flash is not inserted.
15	Ethernet ERROR	Abnormal Ethernet connection
16	Ethernet timeout	Abnormality has occurred in Ethernet during communication.

● ERR No. 01 Problem with memory

Explanation

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

Cause	How to solve problem
Software is not written at starting.	Seek repairs at your nearest retail outlet or HORIBA service station.
The internal IC is defective.	

● ERR No.02 The battery voltage is low

Explanation

The battery has insufficient voltage.

Cause	How to solve problem
The battery voltage is low.	Replace the dry-cell battery.

● ERR No.03 The electrode will not stabilize

Explanation

The electric potential did not stabilize within three minutes.

Cause	How to solve problem
This is caused by the effect of the sample solution (when the sample solution is pure water or other solution with low conductivity or the pH concentration or temperature change).	Press the MEAS key again while “HOLD” is either flashing or steadily lit in the display, to measure the sample using instantaneous value measurement.
The electrode is dirty.	Wash the electrode.
The electrode is cracked.	Replace the electrode.
The responsive glass membrane of the electrode has been dry for a long time.	Soak the membrane (on the electrode) in pure (de-ionized) water for 24 hours.
The temperature of the sample solution is fluctuating.	Measure after the sample solution temperature stabilizes.
AutoHold is set to ACCURATE	Change the AutoHold setting to STANDARD or HANDY

● ERR No.04 There is an error with the asymmetry potential

Definition

The asymmetry potential of the electrode is out of 45 mV or more.

Cause	How to solve problem
The electrode is dirty.	Wash 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 submerged deeply enough to cover reference junction.	Immerse the electrode in the sample, to at least 3 cm beyond the electrode tip.
There is problem with the standard buffers.	Prepare the standard buffer anew.

● ERR No.05 There is an error in electrode sensitivity (pH)

Definition

The electrode sensitivity is either 105% or more or 85% or less than the theoretical sensitivity.

Cause	How to solve problem
The electrode is dirty.	Wash the electrode.
The electrode is cracked.	Replace the electrode.
Calibration was not performed correctly.	Redo the calibration correctly.
There is a problem with the standard solution.	Prepare the standard solution anew.
The electrode is not connected correctly.	Connect the electrode correctly.
Electrode is not submerged deeply enough to cover reference junction.	Immerse the electrode in the sample, to at least three centimeters beyond the electrode tip.

● ERR No.06 Abnormal calibration point

Definition

6th point calibration was tried.

Cause	How to solve problem
6th point calibration was executed.	Regulate the calibration up to 5 points. This error message is released by setting the pH meter to measurement mode.

NOTE

There is no influence to the calibration data up to the 5th point.

REF

Refer to "3.4.3 Calibration point setting" page 46.

● ERR No.07 The pH meter cannot identify the standard buffer

Definition

If the automatic standard-buffer identification function of the meter cannot identify kinds of standard buffer, re-calibrate the meter after performing the appropriate measures, below.

Cause	How to solve problem
There is a problem with the standard solution.	Prepare the standard solution anew.
There is a problem with the standard solution setting.	Check the kind of the calibration solution of the NIST, USA standard setting and the one used for calibration and match them.
The responsive membrane is dry or dirty.	Measure after cleaning the responsive membrane and soaking it in pure water for 24 hours.
Reference internal solution is poor or dirty.	Replace the standard solution with new solution.
The responsive membrane is damaged or worn out.	Replace the electrode.

● ERR No.08 Calibration cycle error

Definition

This error appears when the number of measurements set for the calibration cycle has been exceeded since the last calibration was conducted.

Perform calibration.

● ERR No.09 There is a problem with the printer unit

Definition

If a problem occurs with the printer unit, turn OFF the power to the meter, perform the appropriate measure below, then turn the power to the meter back ON.

Cause	How to solve problem
The printer paper is jammed.	Remove the jammed paper.
There is no printer paper.	Load new paper in the printer.
There is a problem with the printer unit connection.	Reconnect the printer after making sure the connector parts are okay.
The printer is defective.	Replace the printer. Contact with the nearest sales representative when the function is not restored even after the printer is replaced.

● ERR No.10 Data memory over

Definition

The number of data items has exceeded the limit of the memory.

Cause	How to solve problem
Memory over	Delete data stored in the memory confirming their contents.

● ERR No.11 Cell constant out of range

Definition

The cell constant is out of the range of 0.7 to 1.3. Delete data stored in the memory confirming their contents.

Cause	How to solve problem
COND electrode is at the end of the useful life.	Replace the electrode.
Improper standard solution	Prepare standard solution.

● RR No.12 CF Write over defective

Definition

The compact flash card or its contents are abnormal.

Cause	How to solve problem
Compact flash is not formatted.	Format Compact flash.
I/F of Compact flash card cannot be read. File system is abnormal.	Prepare a new Compact flash.

● ERR No.13 CF over capacity

Definition

The capacity of the Compact flash memory is exceeded.

Cause	How to solve problem
Capacity of Compact flash memory is exceeded.	Delete data. Prepare a new Compact flash.

● ERR No.14 CF not inserted

Definition

The compact flash card is not correctly inserted.

Cause	How to solve problem
Compact flash is not inserted.	Confirm that the Compact flash is correctly inserted.

● ERR No.15 Ethernet error

Definition

Connection of the Ethernet is abnormal.

Cause	How to solve problem
Faulty Ethernet connection or setting	Check the connection and setting of the network. Check the PC software.

● ERR No.16 Ethernet timeout

Definition

Abnormality occurs in Ethernet during communication.

Cause	How to solve problem
Faulty Ethernet connection or setting during communication	Check the connection and setting of the network. Check the PC software.

15.2.2 More troubleshooting

This section explains how to respond to various symptoms of trouble that are not indicated by an error number.

● Nothing shows up on the display when the power is turned ON

Cause	How to solve problem
AC adaptor is not properly connected.	Check the connection of the AC adaptor.
The pH meter is defective.	Contact with the nearest sales representative.

● The indicated value fluctuates

When there is a problem with the electrode;

Cause	How to solve problem
The responsive membrane is dry or dirty.	Wash the responsive membrane.
The responsive membrane is damaged or worn out.	Replace the electrode.
There are air bubbles on the electrode.	Shake the electrode to remove the air bubbles.
There is no standard solution remaining.	Fill the electrode with new standard solution, as noted in the electrode operation manual.
The wrong standard solution is being used.	Use the correct standard solution.
Influence of sample.	Readout may fluctuate according to the characteristics of sample.

● When there is a problem with the main unit of the pH meter;

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.

When there is a problem in the sample;

Cause	How to solve problem
The liquid junction is not immersed in the sample solution.	Immerse the electrode in the sample solution up until the liquid junction.
This is caused by the effects of the sample.	Judge by measuring with a stable standard solution.

● The response is slow

Cause	How to solve problem
This is caused by the effects of the sample.	Response time may slow down, depending on the properties of the sample solution.
Wash the responsive membrane.	Wash the responsive membrane.
The responsive membrane is damaged or worn out.	Replace the electrode.
There is a problem with the standard solution.	Fill the electrode with new standard solution, as noted in the electrode operation manual.

● The indicated value does not change/There is absolutely no response

Cause	How to solve problem
The electrode connector is not attached correctly.	Turn the power OFF, then turn it back ON again.
The electrode is defective. (The responsive membrane is cracked.)	Replace the electrode.
The pH meter is defective.	Contact your nearest HORIBA sales representatives.

● The measured value is flashing

The pH value exceeds the measurement range (when pH value is displayed).

Measurement range: pH 0.00 to pH 14.00

The mV value exceeds the measurement parameters (when mV value is displayed).

Display range: ± 1999 mV

Ion measurement value is out of the range (in the ion mode).

Display range:0.0 μg/L to 999 g/L(mol/L)

The measured conductivity value exceeds the measurement parameters (when conductivity value is displayed).

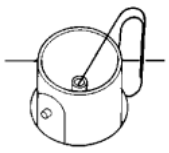
Display range:0.00 to 19.99 S/m (when cell constant is 100 m^{-1})

Cause	How to solve problem
The sample solution is inappropriate.	Change to a sample solution with properties within the measurement range.
The liquid junction is not immersed in the sample solution.	Immerse the electrode up to 3 cm from its tip.
The electrode cable has been severed.	Replace the electrode.
The meter has not been calibrated or it has been calibrated incorrectly.	Calibrate the meter correctly.
The main body of the pH meter is defective.	Check below. NOTE The main body of the pH meter cannot be used for measuring conductivity.

Check this point

As shown in the diagram, use a jumper wire or bent paper clip to short the meter by touching both the center pin and some metal part in the electrode connector.

If the flaching measured value disappears when this done, the meter is nomal.



● Key operation is invalid.

Cause	How to solve problem
During PC communication	Press the ON/OFF key.

● The temperature display is flashing.

The temperature measurement exceeds the measurement range.

Measurement range: -10 to 105.0ºC

● The temperature display does not change from 25ºC.

Cause	How to solve problem
The temperature of the sample solution exceed the measurement range.	Check the temperature of the sample solution and change to a sample solution that has a temperature within the measurement range.
The thermistor connection within the electrode is severed or shorted.	Measure the resistance of the temperature sensor connector. If it is 50 kΩ or more at room temperature, replace the electrode.
Poor connection of temperature connector	Firmly insert the temperature connector.
There is a problem with the setting for the temperature display calibration mode (see Page 143).	Perform the calibration of the temperature sensor again.
The main unit of the pH meter may be defective.	Contact with the nearest sales representative if the trouble is not corrected by the above-mentioned measures.

● Measurements are not repeatable

Cause	How to solve problem
The effects of the sample solution.	The pH or other properties of the sample solution may have changed over time, making reproducibility poor.
The responsive membrane is dry or dirty.	Wash the responsive membrane.
There is not enough standard solution or it is dirty.	Replace the standard solution with a new solution.
The responsive membrane is cracked or worn out.	Replace the electrode.

When the printing is not made even if the printer is connected

Check the following points:

- Is the printer turned ON?
- Is an error occurred in printer?
- Is the printing paper run out or clogged?
- When the test print is made according to the manual, is it done correctly?

The settings of the meter differ from those registered.

Cause	How to solve problem
ON/OFF was pressed.	Make the operator selection again.

The operator SELECT OPERATOR screen opens instead of the Measurement screen after the power is turned ON.

Cause	How to solve problem
The user management is still ON.	Newly register settings and make the operator setting, or make the Administrator turn OFF the user management.

Maintenance, Clock setting, and Security setting cannot be selected or changed.

Cause	How to solve problem
A person other than the Administrator has made the operator selection.	When the user management is ON: Ask the Administrator for change. When the user management is OFF: Restart in the *GUEST* mode.
The user management is set ON, but the Administrator is not registered.	Newly register the operator in the SELECT OPERATOR screen at the startup, and also register the Administrator.
Administrator's password was forgotten.	Reset to the settings made on the shipment from the factory. Check on our website (http://www.horiba-water.com) or contact with our customer support center.

Chapter 16 Reference

This chapter provides a simple compilation of information for people who would like to know more details about the functions of the main unit of the pH meter and other measurement principles.
Also, consumables and optional parts are explained for the reference of customers.

16.1 pH measurement

● pH measurement and temperature

The temperature of the solution being inspected is an important parameter in the accurate measurement of pH. There are many possible sources of errors during measurement, such as the state of the solution junction potential, asymmetric potential, and standard solution pH concentration, but all of these items contain factors that change with the temperature. The best way to minimize these potential causes of errors is to keep the temperature of the pH standard solution uniform at the time of calibration.

● Liquid junction potential

"Liquid junction potential" is the electric potential that occurs to a greater or lesser degree at the liquid junction. The size of the electric potential differs depending on the type of solution, temperature of the solution, and the structure of the liquid junction.

When solutions of different compositions come in contact, ion diffusion occurs on the contact surface between the two solutions. The ions are of various sizes, so a difference occurs in the diffusion transfer speed.

As diffusion proceeds, a difference in charges occurs on the contact surface of the two solutions, giving rise to a difference in potential. This potential works to reduce the transfer speed of fast ions and increase the speed of slow ions, ultimately achieving a state of equilibrium when the transfer speed of the positive and negative ions on the contact surface of the two solutions is equal. In this state of equilibrium, the potential at the contact surface between the two solutions is called the "liquid junction potential." A large liquid junction potential means very inaccurate measurement.

● Asymmetric potential

The glass electrode is immersed in a pH 7 standard solution. When the electrode is immersed in the pH 7 solution, both the internal and external sides of the electrode membrane are supposed to take on a pH of 7, making the potential 0. In actuality, however, a potential does occur. This potential is called an "asymmetric potential." The size of an asymmetric potential differs depending on any stress that may have occurred during the processing of the glass and the shape and compositions of the glass. Asymmetric potential also changes depending on the degree of contamination of the standard solution and the state of the glass membrane. Also, if the electrode membrane dries out, a large asymmetric potential will occur, giving rise to measurement errors.

● Temperature compensation

The electromotive force generated by the glass electrode changes depending on the temperature of the solution. "Temperature compensation" is what is used to compensate for the change in electromotive forces caused by temperature. There is absolutely no relation between the change in pH caused by the temperature of the solution and temperature compensation. This is often misunderstood. When pH is to be measured, the temperature of the solution when the pH is measured must be recorded along with that pH value, even if a meter that has automatic temperature compensation is used. If the solution temperature is not recorded, the results of the pH measurement are relatively meaningless.

● Temperature conversion

Difference between temperature compensation and temperature conversion

When measuring pH with the electrode, the electromotive force of the glass electrode per 1 pH changes depending on the temperature. Electrical compensation of this change is defined as the temperature compensation. Therefore, the pH meter to which only the temperature compensation is given can obtain the pH value at the measured temperature.

Potential difference (Electromotive force) per 1 pH <JIS Z8802-1978>

Temp. ℃	2.3026RT/F mV	Temp. ℃	2.3026RT/F mV
0	54.20	35	61.15
5	55.19	40	62.14
10	56.19	45	63.13
15	57.18	50	64.12
20	58.17	55	65.11
25	59.16	60	66.11
30	60.15	65	67.10

PH temperature conversion of sample

pH value of a sample changes depending on the temperature and the degree in this change differs depending on the temperature characteristic of each sample. Therefore, the pH electromotive force changes according to the change in temperature and this change in the electromotive force becomes an input to the pH meter. Then, it is called the temperature conversion to correct the change in pH value by this temperature change and convert it to the pH value at the conversion temperature.

$$pH_x = pH_t - a(t - x)$$

pHx:PH value at x ℃ after conversion
pHt:PH value at t ℃
α :Temperature conversion factor
[pH/ ℃]
t:Temperature of sample
x:Conversion temperature

Hence, the temperature coefficient of the sample is obtained by the following equation.

$$a = \frac{(pH_t - pH_x)}{(t - x)} \quad [pH/\,^{\circ}C\,]$$

Note that the error tends to occur when pH-temperature characteristics of the sample is not linear or when the temperature coefficient is not constant (i.e. pH value changes even in the same temperature).

Types of pH standard solutions

When measuring pH, the pH meter must be calibrated using a standard solution. There are several kinds of standard solutions. For normal measurement, three standard solutions —with a pH of 4, 7, and 9—are sufficient to accurately calibrate the meter.

- pH 1.68 standard solution: Oxalate
  0.05 mol/L tetra-potassium oxalate aqueous solution
- pH 4.00 standard solution:Phthalate
  0.05 mol/L potassium hydrogen phthalate aqueous solution
- pH 6.86 standard solution: Neutral phosphate
  0.025 mol/L potassium dihydrogen phosphate, 0.025 mol/L sodium dihydrogen-phosphate aqueous solution
- pH 9.18 standard solution: Borate
  0.01 mol/L tetra-sodium boric acid (boric sand) aqueous solution
- pH 12.45 standard solution: Saturated calcium hydroxide solution
  Saturated hydrogenated calcium solution

pH values of pH standard solutions at various temperatures (NIST(former NBS) settings)

NOTE

When the standard solutions use U.S. settings, pH 7 is a shown in the below table and pH 9 becomes pH 10.

pH values of pH 7 and pH 10 standard solutions at various temperatures (US-standard settings)

NOTE

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

Using standard solutions

Standard solutions are used to calibrate the scale of the pH meter employed to measure the unknown pH of a solution. Standard solutions of pH 4, 7, and 9 are used in combination according to the particular conditions of the solution that is to be inspected

When the approximate pH value is desired (1-point calibration)

Use the pH 7 standard solution or a standard solution that approximates the pH value of the solution that is to be inspected.

When it is known beforehand whether the test solution is acidic or alkaline (2-point calibration)

Acidic: Use the pH 4 and 7 standard solution.
Alkaline: Use the pH 7 and 9 standard solution.

When an unknown solution is to be inspected (3-point calibration)

Use the pH 4, 7, and 9 standard solution.

Others

When finding the pH of other solutions, perform 2-point or 3-point calibration using pH 2, 4, 7, 9, or 12 standard solutions randomly, then measure the test solution.

16.2 Measuring mV (oxidation-reduction potential [ORP])

● ORP principles

ORP (or Oxidation-Reduction Potentialî) is an abbreviation for oxidation-reduction potential. ORP is the energy level (potential) determined according to the state of equilibrium between the oxidants and reductants that coexist within a solution.

One type of equilibrium in a solution

•••••••••• ①

If only ① exists within a solution, a metal electrode (platinum, gold, etc.) and a reference electrode are inserted into the solution, forming the ORP measuring system shown in Fig.1. Measuring the potential (ORP) that exists between the two electrodes enables the potential to generally be expressed by the following equation.

$$E = E_0 - \frac{RT}{nF} \ln \frac{aM^{(Z-n)+}}{aM^{Z+}} \quad \cdots\cdots\cdots\cdots ②$$

E: Electric potential E: Coefficient R: Gas coefficient
T: Absolute temperature n: Electron count
F: Faraday constant a: Activity

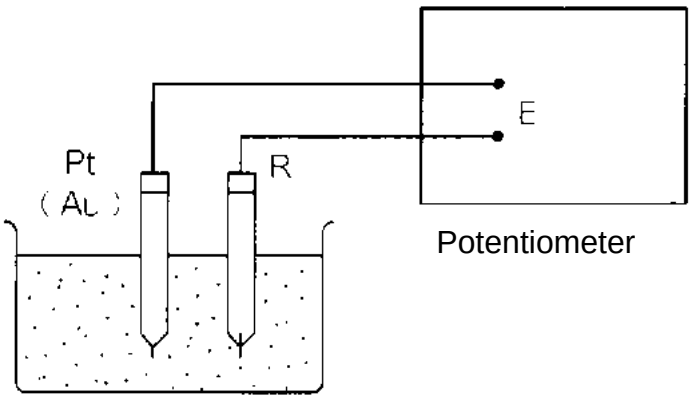


Fig.1 ORP measuring system

For example, for a solution in which trivalent iron ions coexist with bivalent iron ions, equations ① and ② would be as follows.

•••••••••••• ①'

$$E = E_0 - \frac{RT}{F} \ln \frac{aFe^{2+}}{aFe^{3+}} \quad \cdots\cdots\cdots\cdots ②'$$

When only one type of state of equilibrium ① exists in the solution, the ORP of the solution can only be determined by equation ② . What is important here is that ORP is determined by the ratio of activity between the oxidant and the reductant) (using the equation). In actuality, however many kinds of states of equilibrium exist simultaneously between various kinds of ions, in most solutions. This means that under actual circumstances, ORP cannot be expressed using the simple equation shown above and that the physical and chemical significance with respect to the solution is not very clear.

In this respect, the value of ORP must be understood to be only one indicator of the property of a solution.
The measurement of ORP is widely used, however, as an important index in the analysis of solutions (potentiometric titration) and in the disposal and treatment of solutions.
Recently, there have appeared various claims regarding this matter, such as that a high degree of ORP is effective in sterilization or that drinking water that has a low ORP reduces the chance of illness by reacting with the activated oxygen in the cells of the body. ORP is used as an index for alkaline drinking water.

● Standard electrode (reference electrode) types and ORP

The ORP of a solution that is obtained through measurement is a value that corresponds to the reference electrode employed. If different kinds of reference electrodes are used for measurement, the ORP value of the same solution may appear to be different.
HORIBA uses Ag/AgCl with 3.33 mol/L KCl as the standard solution for reference electrodes. According to general technical literature, standard hydrogen electrodes (N.H.E.) are often used as the standard electrode. The relationship between N.H.E. and the ORP that is measured using an Ag/AgCl with 3.33 mol/L KCl electrode is expressed by the following equation.
$E_{N.H.E.}$= E+206-0.7(t-25) mV t = 0 – 60ºC
$E_{N.H.E.}$: Measured ORP value using N.H.E. as the reference
electrode
E:Measured ORP value using Ag/AgCl with 3.33 mol/L
KCl as the reference electrode

● Potential sign

Standard ORP is expressed in the following way, in literature related to electrochemistry and analytical chemistry.
A
=-3.024 V VS N.H.E.
However, in some literature, the “+” and “-” signs are reversed.
B Li
=+3.024 V VS N.H.E.
In expressions like B, above, the reaction is just reversed and there is no essential difference. But this kind of expression does invite confusion. The majority of the world, today, is consistent in its use of the signs as they are used in A, above. For this reason, HORIBA, too, uses signs concerning ORP that are consistent with A, above.

● ORP standard solution

There are two kinds of standards substances. Under normal circumstances, it is sufficient to use only the one type of substance that is closest to the measured value.

Indicated value of ORP standard solution at various temperatures (mV)

Temp. (°C)	160 - 22 Phthalic-acid chloride + quinhydrone	160 - 51 Neutral phosphate + quinhydrone
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

Operation check using standard solution

NOTE

Standard solution is not used only for calibration of the meter, but to confirm whether or not the condition of electrodes is good.

1. Add 250 mL pure (ion exchange) water to one packet of any of the above listed standard solutions and mix well. (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 ORP standard solution and measure the mV value.
3. If the electrode and the meter, itself, are working correctly, numerical values within 15 mV or less of those listed in Table 1 should be obtained.
4. If measurements that fall within 15 mV of the values listed above are not obtained using this method, measure the solution again after replacing the reference electrode internal solution and removing the dirt from the surface of the metal electrode by moistening a cotton swab with alcohol or a neutral cleaning agent and lightly rubbing the electrode or by soaking the electrode in diluted Nitrate (1:1 Nitrate).
5. If measurements within 15 mV of the values listed above are still not obtained after re-measuring, the reference electrode or the meter may be faulty. Either replace the electrode or have the meter inspected.

NOTE

If the prepared ORP standard solution is allowed to stand in open air for one hour or more, it may undergo transformation. For this reasons ORP standard solution that has finished being prepared cannot be stored.
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 results of measurement might not be repeatable. If this is the case, use the meter after immersing the electrodes in the solution again and mixing it thoroughly.

● Precautions when measuring actual samples

- Note that when measuring the ORP of 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, repeatability, and stability, in general.
- When alkaline water is allowed to stand, its ORP undergoes big changes. Always measure alkaline ion water promptly.

16.3 Ion measurement

16.3.1 Ion electrode

The ion electrode responds (has an ion selectivity) to the activity (concentration) of specific ions which exist in a solution and then generates electric potential corresponding to the concentration of those ions.

The responsive membrane of the ion electrode is made of a compound or jelly organic substance that is difficult to dissolve in water. From the viewpoint of responsive membrane types, the ion electrode is classified into ones for the ion species shown below:

Glass (membrane) electrode

i.g., H^+, Na^+, K^+, NH_4^+, Ag^+, Li^+

Solid membrane electrode (with membrane which was formed by pressurizing single-crystal metallic base that is difficult to dissolve)

i.e., F^-, Cl^-, Br^-, I^-, S^{2-}, CN^-, SCN^-,
Ag^+, Cu^{2+}, Cd^{2+}, Pb^{2+}, Hg^{2+}

Liquid membrane electrode or plastic membrane electrode

A responsive substance such as an ion exchanging substance and antibiotics is dissolved in a hydrophobic solution and then retained on polyvinyl chloride to make it oily for use as membrane.

K^+, Ca^{2+}, NO_3^-, ClO_4^-, Cl^-, NH_4^+

Dissolved gas sensitive electrode (Perforated gas permeable membrane is combined with a pH electrode or an ion electrode.)

i.g., NH_3, CO_2, HCN, H_2S, HF, NO_2

16.3.2 Ion concentration measurement

When certain ions exist within the solution that is to be measured, the responsive ion electrode membrane generates an electric potential corresponding to the concentration of the ions. The potential that is generated is measured by the ion meter as potential, using the reference electrode as the standard. With ion electrodes, the measured potential and the logarithm of the ion activity within the solution being measured are generally proportional to each other and are expressed in the following way.

$E=+(2.303RT/nF) \log \gamma C$

E:Measured electric potential (V)
:Standard potential (V), determined according to the system. This includes the standard potential of the reference electrode and the liquid junction potential.
F: Faraday constant (96,480
R: General gas constant (8.314
T: Absolute temperature (K)
n: Ion charge
γ :Activity coefficient
C: Ion concentration (mol/L)

The above formula is called “Nernst’s equation” and is the basis for measuring ion concentration using an ion electrode.
The part of the above Nernst's equation that reads “2.303 RT/nF” is the change in potential generated when the ion concentration changes by a factor of 10. This change in potential is called the potential slope, incline, slope, or Nernst's factor. If the above equation is adhered to when calibrating with standard solution and determining the value of the potential slope and E0, finding the potential E of the ion electrode inside the solution being measured will enable the ion concentration to be determined.
When actual measurement is performed, the ion electrode measures the ion concentration, so a linear relationship forms between the value of the ion concentration and the electrode potential, if the concentration is plotted on a logarithmic axis, as shown in Fig.2. Conducting quantitative analysis using an ion electrode requires either an ion meter that has an antilog calculation function or the creation of a calibration curve using similog graph paper.

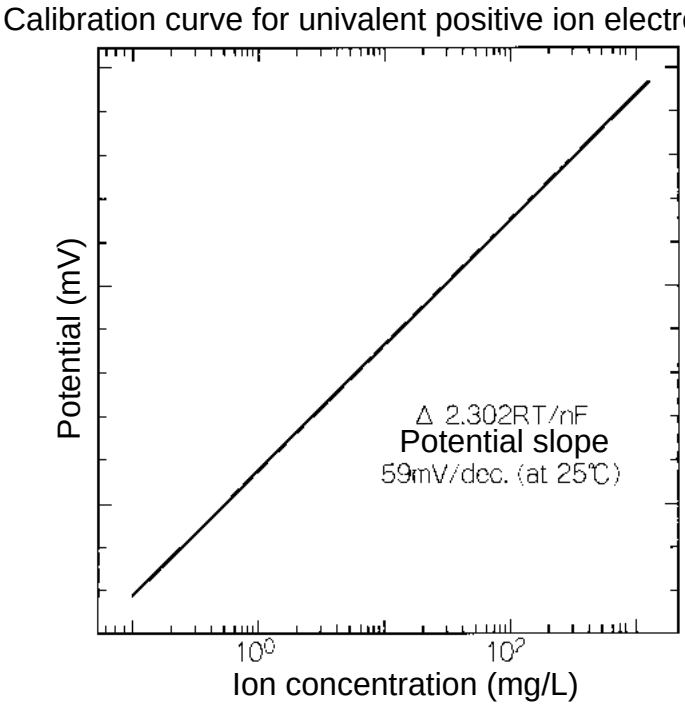


Fig.2 Relationship between ion concentration and electric potential

16.3.3 General characteristics of ion electrode

Ion species which can be measured with ion electrode

The ion electrode only responds to free target ions which exist in the solution under measurement. If the target ions, partially or in whole, are compounds, other forms of ions, or complexes in the solution, a measurement error occurs. Therefore, pretreatment may be required to carry out so that all the target ions in the solution become free.

(Example)
When fluoride ions are measured, the coexistence of polyvalent metal such as Feand Al in the sample solution results in the formation of complexes by the fluoride ions and the polyvalent metal ions. This formation decreases the concentration of free fluoride ions, causing a nominal measurement error. In such a case, add complex dissociating agent (commercially available TISAB solution for the fluoride ion electrode) to the sample solution to dissociate the complexes into fluoride ions before measurement.

Measurable range

The range which maintains a linearity between the logarithm of ion concentration and the differences in electric potential is called the measurable range. In general, the measurable range of ion concentration via the ion electrode is approximately from 10 mol/L to 10 mol/L. The low -concentration point at which a linearity is lost is called the quantitative limit or the detection limit.

(Example)
As found from Fig.3, the measurable range for the fluoride ion electrode is 1 to 10 mol/L with the detection limit being approximately 10 mol/L F^-.

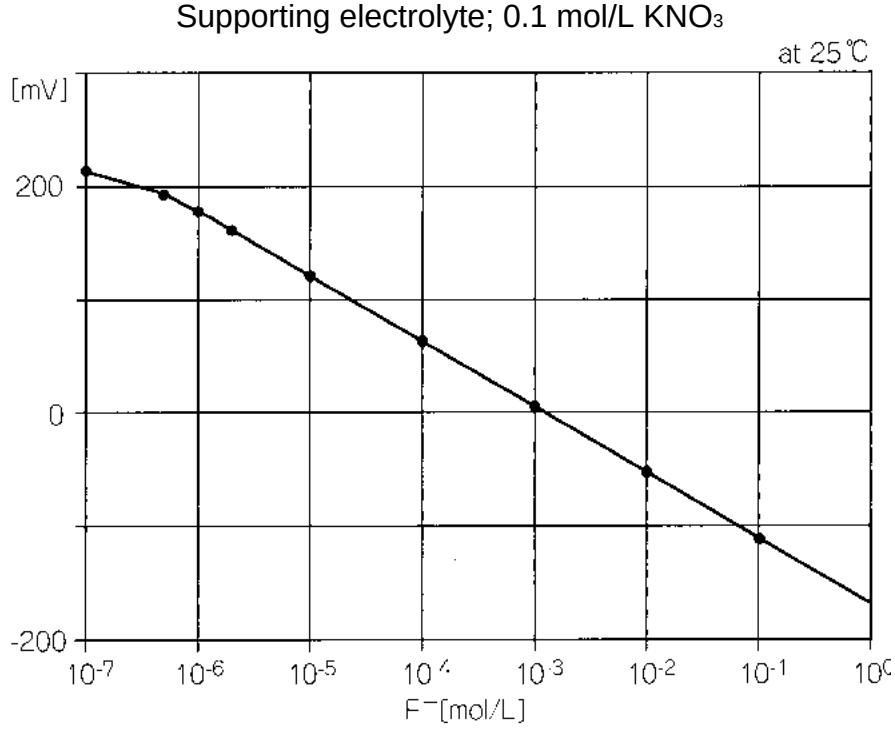


Fig.3 Calibration curve for fluoride ion electrode

Activity

As the ion concentration in the solution increases, the number of solvent molecules surrounding the ions decreases and then the distance between ions becomes shorter. Therefore, the

interaction between ions and solvent differs from that in an infinitely diluted solution. As the distance between ions becomes shorter. (infinitely larger in an infinitely diluted solution), the electrostatic interaction is gradually intensified.As a result, the ionic behavior differs from that in the ideal solution and consumes extra energy. Therefore, the ion concentration must be shown as practical one in actual solutions. This practical concentration is called activity (a), which is obtained by multiplying ion concentration (Cx) by activity coefficient (γ).

$a = \gamma \cdot Cx$

The activity coefficient (γ) decreases as the ion concentration increases.

(Example) This relation in univalent ions is shown in the table below:

Ion concentration (Cx) mol/L	Activity coefficient (γ)
10^{-5}	0.998
10^{-4}	0.988
10^{-3}	0.961
10^{-2}	0.901
10^{-1}	0.751

Ion strength

Since the activity coefficient varies with the effect of ion strength, it causes a measurement error. Therefore, the ion strength of the solution under measurement must be maintained at a certain level. Generally, this is attained by adding indifferent base which does not react with the target ions, nor influence the electric potential under measurement. the type and added amount of this indifferent base vary depending on the species and concentration of the target ions.

(Example)
For the calibration curve for the fluoride ion electrode in Fig.3, potassium nitrate in an amount of 0.1 mol/L was added to the sample solution to maintain the ion strength.

Effect of pH

The applicable pH range is determined by the type and structure of the ion electrode used. Generally, this range becomes narrower as the concentration of the target ions decreases.

The component of the reactive membrane on some ion electrodes may dissolve or electric potential may fluctuate with the effect of pH, depending on pH values. In addition, the effect of pH may lower the sensitivity of the ion electrodes or the calibration curve may horizontally shift. in order to avoid these effects, previously obtain the proper pH value and them maintain it.

To make appropriate the pH value of the solution under measurement, previously prepare a pH buffer which does not interfere the ion electrode (does not contain interfering ions) and add a small amount of this buffer to the solution to be measured. For the appropriate pH range for each ion electrode, refer to the instruction manual which comes with that electrode.

(Example)

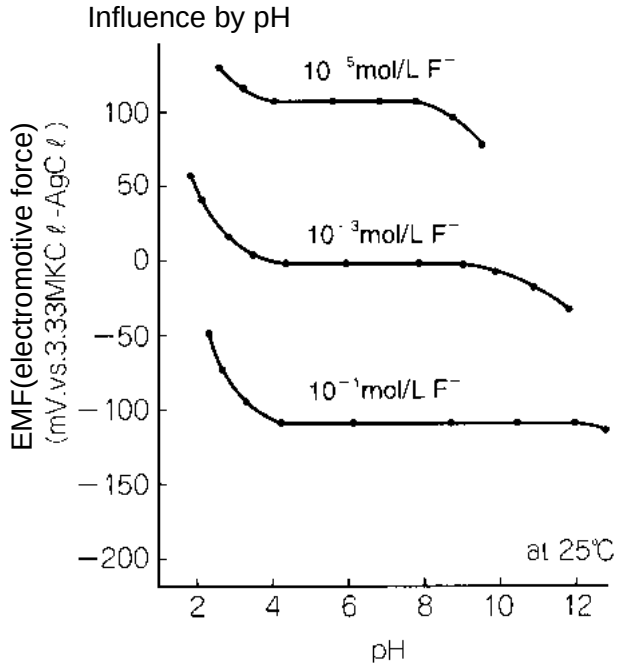


Fig.4 Effect of pH on fluoride ion electrode

Effect of temperature

The electric potential slope measured by the ion measurement method is influenced by the temperature of the solution under measurement in accordance with the Nerst formula. As the solution temperature increases, the electric potential slope becomes larger; as the solution temperature decreases, the slope becomes smaller. According to the Nerst formula, every time the solution temperature increases by 10 ℃, a change of approximately 2 mV occurs for univalent ions or a change of approximately 1 mV for bivalent ions. This requires making the temperature of the standard solution as equal as possible to that of the solution under measurement when preparing a calibration curve.

Temp.(℃)	0	10	20	25	30	40	50
Univalent ions	54.20	56.18	58.16	59.16	60.15	62.13	64.11
Bivalent ions	27.10	28.09	29.08	29.58	30.08	31.07	32.06

When you actually prepare a calibration curve at various solution temperature, you will find that electric potential stays constant at a certain point. This point is called an isothermal crosspoint. When you carry out measurement under temperature compensation with an ion meter, you must know the isothermal cross point value for the ion electrode used. In the present stage, the commercially available ion electrodes have no written information on their isothermal cross point values. In addition, the isothermal cross point values of some ion electrodes may not be found even if they are checked or you may be unable to find which cross point should be used if multiple cross points are obtained. In such a case, more accurate measurement can be carried out when the temperature compensation capability is not used. However,

this measurement must be carried out free from the fluctuation in temperature by using a constant temperature vessel or the like.

(Example)

As you will find in Fig.5, a clear isothermal cross point for the ion electrode is located at 10^{-3} mol/L(19 mg/L)

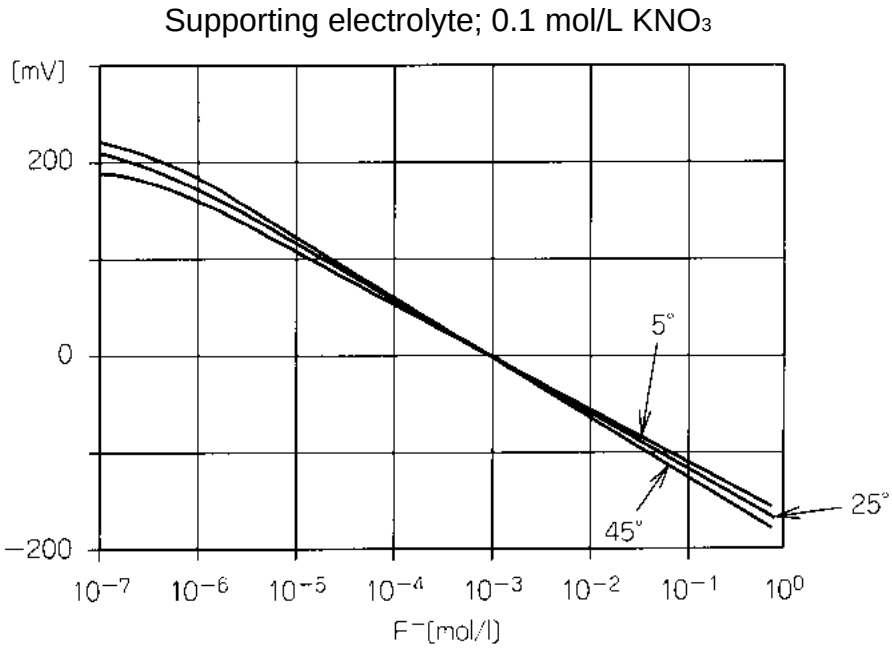


Fig.5 Effect of temperature on fluoride ion electrode

Effect of stirring

The stirred state of the solution to be measured influences the measurement of the difference in electric potential which is performed using the ion electrode, e.g., (a) the response becomes slower, (b) low concentration cannot be measured, or (c) the electric potential on the electrode changes. In order to avoid this influence, stir the solution as quickly as possible at a constant speed to the extent that measurement never be interfered.

Effect of coexisting substance

The ion electrode is excellent in its selectivity for the target ions, but it may sometimes respond to other ions. If those ions coexist with the target ions, they interfere with or influence the measurement of the target ions. Such ions are called “interfering ions.“ In the ion electrode method, it is critical to well understand the effect of the coexistent ions and then avoid their effect**.**

The effect of the coexistent ions on the electric potential differences at the ion electrode can be predicted from the component of the responsive membrane and the responsiveness of the coexistent ions. For example, those coexistent ions which may create any compound that is difficult to dissolve or any complex base with the constituent substance of the responsive membrane might exert a great effect on the solid membrane electrode. For the liquid membrane electrode, the effect of the coexistent ions which may form any ionic association with the component in the responsive membrane might become greater.

Generally, the effect of coexistent ions on the electric potentials at the ion electrode is shown by the allowable coexistence limit. The smaller is this value, the greater is the effect.

Response time

The response time of ion electrodes varies depending on their types and structures as well as ion species, ion concentration, and ion strength. In addition, the response time of electrodes of even the same type varies depending on whether their performance is good or bad and whether they are new or old. Generally, the response time tends to become longer as the ion concentration is higher; or it tends to become shorter as the concentration is lower. It also tends to become shorter when the measurement of low concentration is shifted to that of high concentration; or it also tends to become longer in the reverse case.

he change of 1 mV in electric potential difference gives a measurement error equivalent to a concentration error of approximately 4% for univalent ions or 8% for bivalent ions. Therefore, it is essential to read the displayed electric potential difference or concentration after it has been stabilized.

Effect of light

The electric potential at a certain type of ion electrode vary with the effect of light (non-crystal solid membrane electrode). When this type of electrode is used, it is not desirable to perform measurement in a place where light intensity changes. In this case, it is essential to avoid light by using a brown-colored beaker or the like.

Generally, the electrodes which are influenced by light are those using silver halide as a main component in its responsive membrane. (Cl, Br, I, CN, etc.)

Standard solution

To measure the ion concentration of a solution, previously calibrate the ion meter by using a conditioned standard solution whose concentration is known. The calibration must be performed the number of times required for attaining the desired accuracy. Normally, however, it should be carried out once every day or before measurement. If the solution is stirred with a stirrer or the like when calibration and measurement are carried out, the response stability is improved.

- To calibrate the pH meter, basically prepare two or more standard solution whose concentrations are different. When the concentrations the solution to be measured is roughly known, prepare standard solution so that the concentration value falls between their concentrations. In this case, it is recommended that the concentration of the low-end standard buffer be one tenth that of the high-end.
- If the concentration of the solution to be measured is unknown, this factor should be larger than in the above case. However, take care that any of the concentrations does not exceed the linearity and detection limits of the ion electrode.

Temperature of standard solution and measured solution

Your pH meter has a temperature compensation capability, but make the temperature of standard solution during calibration as equal as possible to that of the target solution during measurement.
This is necessary because both the ion electrode and the reference electrode has output fluctuations resulting from temperature changes. The error of the measured value becomes greater as the difference in temperature between the standard solution and the measured solution becomes larger.

Handling standard solutions after use

Never put the used standard buffers back to their containers.

Storing standard solution

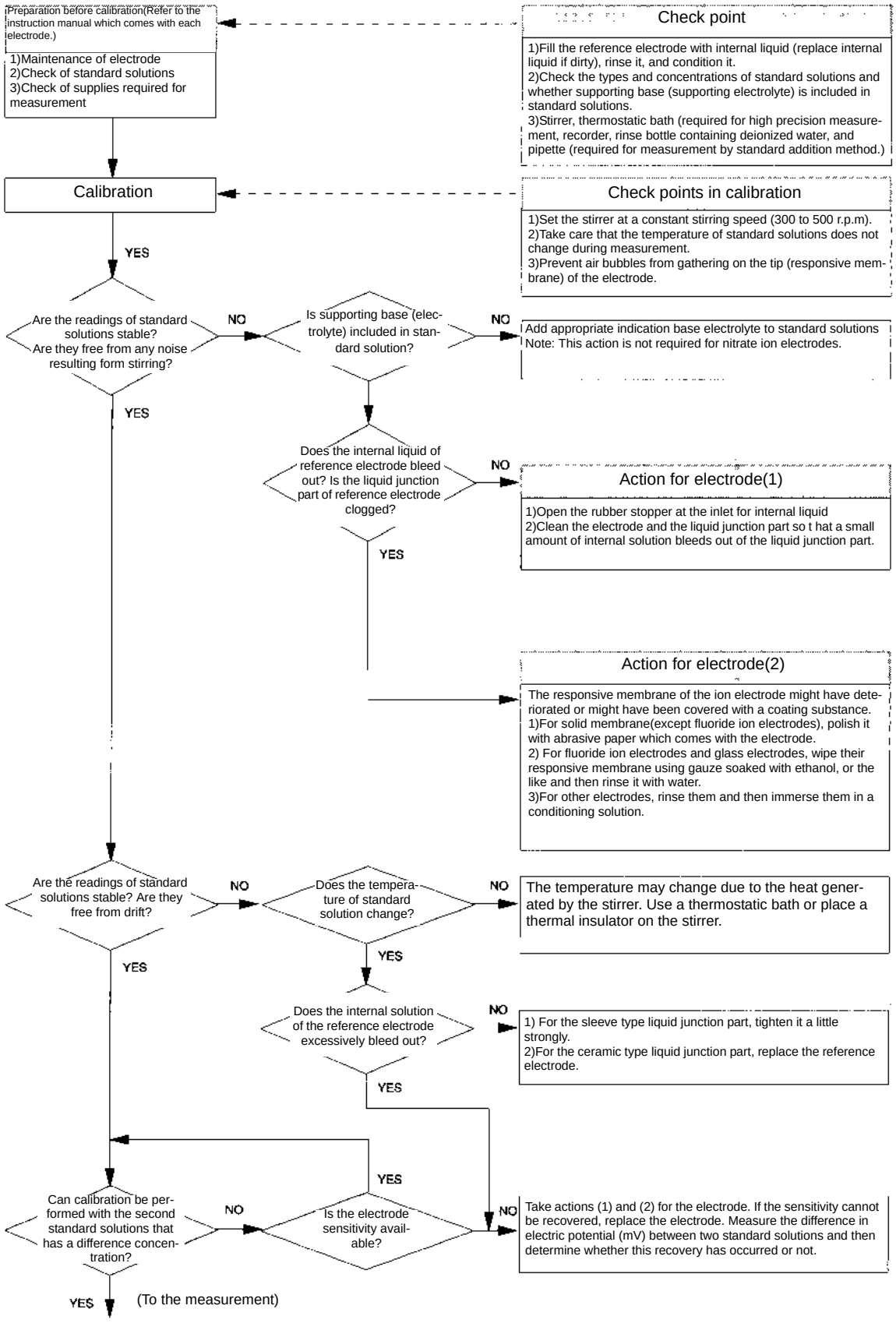
The standard solution must be put in containers which can be sealed and then stored in the sealed state preferably in a cool and dark place.
Storing them in a open state causes changes in their concentrations because of their evaporation or inclusion of impurities.

Storing ion electrode

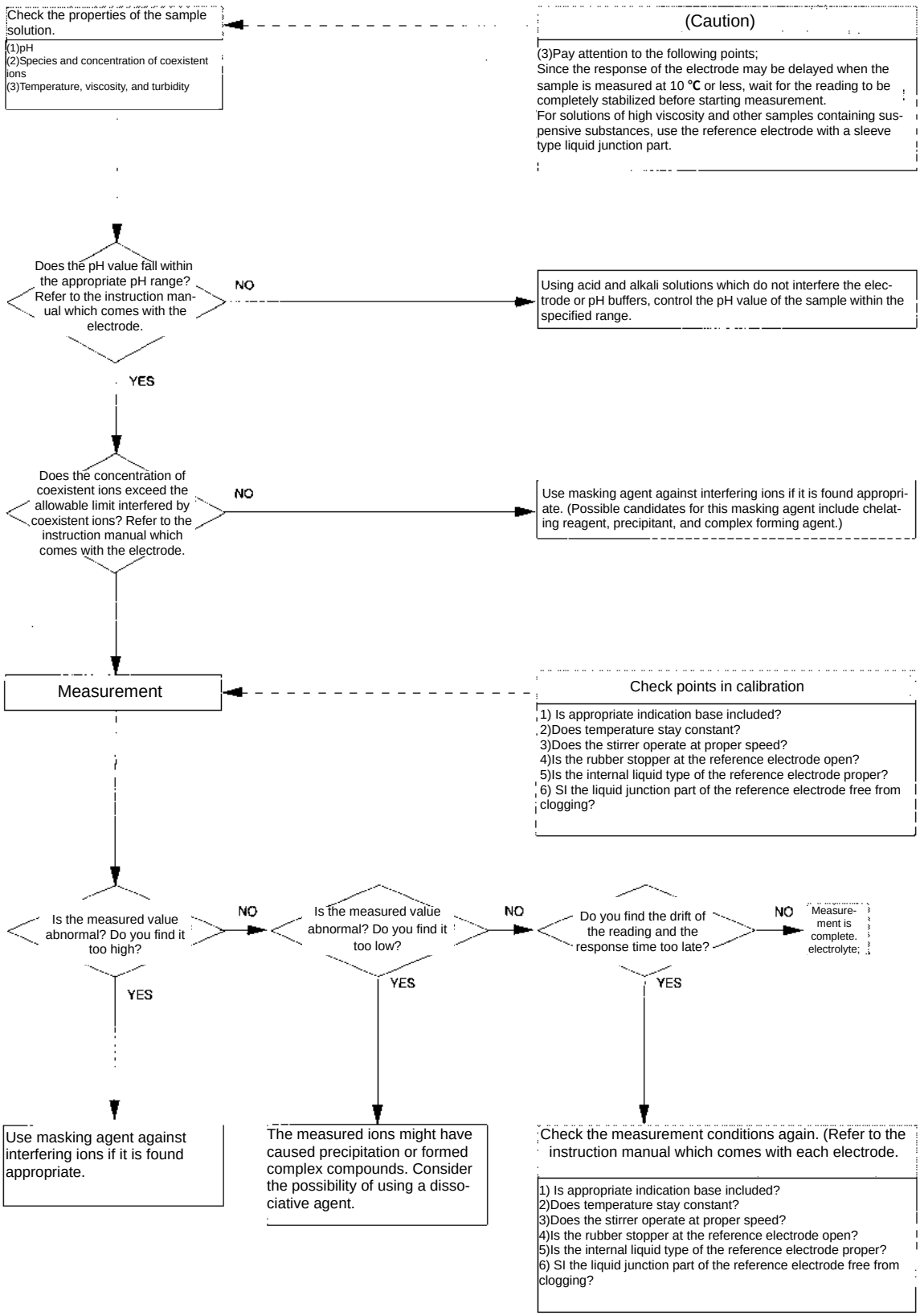
The most important point in the maintenance of the ion electrode is that the electrode is kept clean. After measurement, well rinse the electrode with deionized water and then store it. The recommended storage manner differs depending on ion electrode types and storage periods. For further information, refer to the instruction manual which comes with each ion electrode.

Troubleshooting

Troubleshooting on calibration



Troubleshooting on measurement



● Types and Features of Applicable Electrodes

(1) Ion electrode (single-pole type)

Electrode type	model and ion types	(1) Measurement range (2) pH allowable range[*1] (3) Electric potential slope[*2] (4) Temperature range	Interfering ion Coexistence allowable limit [*3]	Applicable reference electrode and its internal liquid type[*4]
Solid membrane	8001-10C Cyanide (CN^-)	① 0.03 to 2600 mg/L CN^- (10^{-1} to 10^{-4} mol/L CN^-) ② pH 11.5 to 13.9 (2.6 mg/L CN^{-1}) ③ -59 mV ④ 0 to 50 ℃	Cl^-, F^-, Br^-, HCO_3^-, SO_4^{2-}, SO_3^{2-} =10000, $S_2O_3^{2-}$=1 I^-=0.1 S^{2-}, MnO_4^-=Not applicable	2060A-10T, 2565A-10T 3.33 mol/L KCl (250 g/L potassium chloride)
	8002-10C Chloride (Cl^-)	① 0.4 to 35000 mg/L Cl^- (1 to 10^{-5} mol/L Cl^-) ② pH 3 to 11 (350 mg/L Cl^-) ③ -59 mV ④ 0 to 50 ℃	NO_3^-, F^-, HCO_3^-, SO_4^{2-}, PO_4^{2-}=more than 1000 SCN^-=0.3 MnO_4^-=0.1 Br^-=0.03 $S_2O_3^{2-}$, S^{2-}, I^-, Ag^+, Hg^{2+}=Not applicable (At 10^{-3} mol/L Cl^-)	2565A-10T 1 mol/L KNO_3 (100 g/L Potassium nitrate)
	8003-10C Sulfide (S^{2-})	① 0.3 to 32000 mg/L S^{2-} (1 to 10^{-5} mol/L S^{2-}) ② pH 12 to 14 (3.2 mg/L S^{2-}) ③ -59 mV ④ 0 to 50 ℃	NO_3^-, Br^-=10000 I^-, F^-, Cl^-, PO_4^{2-}, SO_4^{2-} =1000 $S_2O_3^{2-}$= １０ CN^-=Not applicable	2060A-10T, 2565A-10T 3.33 mol/L KCl (250 g/L potassium chloride)
	8004-10C Iodide (I^-)	① 0.3 to 13000 mg/L I^- (10^{-1} to 10^{-7} mol/L I^-) ② pH 2 to 11 (2.6 mg/L I^-) ③ -59 mV ④ 0 to 50 ℃	Cl^-, F^-, Br^-, PO_4^{2-}, SO_4^{2-} =10000, Br^-=1000 NO_3^-=100 $S_2O_3^{2-}$= １０ MnO_4^-, S^{2-}, CN^-=Not applicable	2060A-10T, 2565A-10T 3.33 mol/L KCl (250 g/L potassium chloride)
	8005-10C Bromide (Br^-)	① 0.8 to 80000 mg/L Br^- (10^{-1} to 10^{-5} mol/L Br^-) ② pH 2 to 11.5 (2.6 mg/L Br^-) ③ -59 mV ④ 0 to 50 ℃	F^-, NO_3^-, SO_4^{2-}=1000 Cl^-, PO_4^{2-}=100 MnO_4^-=1 $S_2O_3^{2-}$, S^{2-}, I^-, CN^-=Not applicable (At 10^{-3} mol/L Br^-)	2065A-10T 1 mol/L KNO_3 (100 g/L Potassium nitrate)

Solid membrane	8006-10C Copper (Cu^{2+})	① 0.06 to 6400 mg/L Cu^{2+} (10^{-1} to 10^{-6} mol/L Cu^{2+}) ② pH 2 to 6 (6.4 mg/L Cu^{2+}) ③ 29 mV ④ 0 to 50 ℃	Zn^{2+}, Mg^{2+}, NH_4^+=10000 Ni^{2+}, Na^+=1000 Fe^{3+}=0.1	2060A-10T, 2565A-10T 3.33 mol/L KCl (250 g/L potassium chloride)
	8007-10C Cadmium (Cd^{2+})	① 0.1 to 11000 mg/L Cd^{2+} (10^{-1} to 10^{-6} mol/L Cd^{2+}) ② pH 2 to 11.0 (11 mg/L Cd^{2+}) ③ 29 mV ④ 0 to 50 ℃	K^+, Mg^{2+}=100000 Zn^{2+}, NH_4^+=10000 Ni^{2+}=1000 Cr^{3+}=100 Fe^{3+}=1 Pb^{2+}=0.1 Cu^{2+}=Not applicable	2060A-10T, 2565A-10T 3.33 mol/L KCl (250 g/L potassium chloride)
	8008-10C Lead (Pb^{2+})	① 2 to 20000 mg/L Pb^{2+} (10^{-1} to 10^{-5} mol/L Pb^{2+}) ② pH 2 to 6 (20 mg/L Pb^{2+}) ③ 29 mV ④ 0 to 50 ℃	NH_4^+, K^+=1000 Ni^{2+}, Mg^{2+}, Zn^{2+}=100 Cd^{2+}=10 Cr^{3+}=1 Fe^{3+}=0.01	2565A-10T 1 mol/L KNO_3 (100 g/L Potassium nitrate)
	8009-10C Thiocyanate (SCN^-)	① 0.6 to 35000 mg/L SCN^- (1 to 10^{-5} mol/L SCN^-) ② pH 2 to 12 (5.8 mg/L SCN^-) ③ -59 mV ④ 0 to 50 ℃	NO_3^-, ClO_4^-, SO_4^{2-}=10000 Cl^-=100 Br^-=1 $S_2O_3^{2-}$, S^{2-}, I^-, CN^-=Not applicable (At 10^{-3} mol/L SCN^-)	2565A-10T 1 mol/L KNO_3 (100 g/L Potassium nitrate)
	8010-10C Fluoride (F^-)	① 0.02 to 19000 mg/L F^- (1 to 10^{-6} mol/L F^-) ② pH 4 to 10 (20 mg/L F^-) ③ -59 mV ④ 0 to 50 ℃	OH^-=10OH^- Disturbance may occur due to the formation of complex when polyvalent ions such as Al^{3+}, F^{3+}coexist.	2080A-10T, 2565A-10T 3.33 mol/L KCl (250 g/L potassium chloride)
	8011-10C Silver (Ag^+)	① 0.01 to 110000 mg/L Ag^+ (1 to 10^{-7} mol/L Ag^+) ② pH 2 to 10 (1 mg/L Ag^+) ③ 59 mV ④ 0 to 50 ℃	Cu^{2+}, Cd^{2+}, Pb^{2+}, Zn^{2+}, Mg^{2+}, Ca^{2+}, Na^+, K+= more than 10000 (Practically not interfered.)	2565A-10T 1 mol/L KNO_3 (100 g/L Potassium nitrate)

Dia-phragm	5002A-10C Ammonia (NH_3)	① 0.1 to 1000 mg/L NH_3 (1 to 10^{-6} mol/L NH_3) ② Adjust to pH 12 or more. ③ -59 mV ④ 0 to 50 ℃	Volatile amine	Because of the composite type ion electrode, the reference electrode is not reqi-ured.
Glass	1512A-10C Sodium (Na^+)	① 2.3 to 23000 mg/L Na^+ (1 to 10^{-4} mol/L Na^+) ② more than pH 4.5 (2300 mg/L Na^+) ③ +59 mV ④ 0 to 60 ℃	Ca^{2+}=500 NH_4^+=20 K^+, Li^+=10	2565A-10T Sample
Liquid mem-brane	8201-10C Nitrate (NO_3^-)	① 0.62 to 62000 mg/L NO_3^- (1 to 10^{-6} mol/L NO_3^-) ② pH 3 to 7 (62 mg/L NO_3^-) ③ -55 mV ④ 0 to 50 ℃	SO_4^{2+}=more than 1000 CH_3COO^-=300 F^-=200 Cl^-=40 NO_2^-=3 I^-=0.1 ClO_4^-=0.02 (At 10^{-3} mol/L NO_3^-)	2565A-10T 1 mol/L KCl (75 g/L potas-sium chloride)
	8202-10C Potassium (K^+)	① 0.04 to 39000 mg/L K^+ (1 to 10^{-6} mol/L K^+) ② pH 5 to 11 (3.9 mg/L K^+) ③ +58 mV ④ 0 to 50 ℃	Li^+, Na^+, Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}=more than 1000 NH_4^+=70 Cs^+=3 Rb^+=0.4 (At 10^{-4} mol/L K^+)	2565A-10T 3.33 mol/L KCl (200 g/L potas-sium chloride)
	8203-10C Calcium (Ca^{2+})	① 0.4 to 40080 mg/L Ca^{2+} (10^{-1} to 10^{-6} mol/L Ca^{2+}) ② pH 5 to 11 (4 mg/L Ca^{2+}) ③ +29 mV ④ 0 to 50 ℃	Na^+, K^+, Ba^+, NH_4^+=more than 1000 Mg^{2+}, Ni^{2+}, Cu^{2+}=1000 Mn^{2+}=500 Co^{2+}=350 Sr^{2+}=50 Fe^{2+}, Zn^{2+}=1 Fe^{3+}=0.1 (At 10^{-4} mol/L Ca^{2+})	2565A-10T 3.33 mol/L KCl (250 g/L potas-sium chloride)

Table 1 Reference value concerning ION electrode

(2) Combination type ION electrode

The composite type ion electrode is designed to allow its chip type ion electrode to be removed easily. If you wish to measure some of the ion species listed in the following table in addition to those included in the standard specification, change the chip type ion electrode and the internal liquid in the reference part of the composite type ion electrode. These changes permits you to perform measurement un up to five ion species.

Each chip type ion electrodes is available as an extra-cost option unless it is provided as one of the standard accessories. In accordance with the target ion species, select appropriate chip electrodes from the following table. The applicable temperature range is 0 to 50 ℃ for all the electrodes.

Model and ion type	Applicable chip electrode type (quantity)	(1) Measurable range (2) pH allowable range[*1] (3) Electric potential slope[*2]	interfering ions and allowable limit for their coexistence[*3]	Reference electrode (outer cylinder) and internal liquid type[*4]
6560-10C Chloride Cl^-	7660 (1 pc)	① 0.4 to 35000 mg/L Cl^- (1 to 10^{-5} mol/L Cl^-) ② pH 3 to 11 (350 mg/L Cl^-) ③ -59 mV	NO_3^-, F^-, HCO_3^-, SO_4^{2-}, PO_4^{2-}=more than 1000 SCN^-=0.3 MnO_4^-=0.1 Br^-=0.03 $S_2O_3^{2-}$, S^{2-}, I^-, Ag^+, Hg^{2+}=Not applicable (At 10^{-3} mol/L Cl^-)	1 mol/L KNO_3 (100 g/L Potassium nitrate)
6561-10C Fluoride F^-	7661 (1 pc)	① 0.02 to 19000 mg/L F^- (1 to 10^{-6} mol/L F^-) ② pH 3 to 11 (350 mg/L F^-) ③ -59 mV	OH^-=10 Disturbance may occur due to the formation of complex when polyvalent ions such as Al^{3+}, F^{3+}coexist.	3.33 mol/L KCl (250 g/L potassium chloride)
6581-10C Nitrate NO_3^-	7681 (1 pc)	① 0.62 to 62000 mg/L NO_3^- (1 to 10^{-6} mol/L NO_3^-) ② pH 3 to 7 (62 mg/L NO_3^-) ③ -55 mV	SO_4^{2+}=more than 1000 CH_3COO^-=300 F^-=200 Cl^-=40 NO_2^-=3 I^-=0.1 ClO_4^-=0.02 (At 10^{-3} mol/L NO_3^-)	1 mol/L KCl (100 g/L potassium chloride)

6582-10C Potassium K^+	7682 (1 pc)	① 0.04 to 39000 mg/L K^+ (1 to 10^{-6} mol/L K^+) ② pH 5 to 11 (3.9 mg/L K^+) ③ -58 mV	Li^+, Na^+, Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}=more than 1000 NH_4^+=70 Cs^+=3 Rb^+=0.4 (At 10^{-4} mol/L K^+)	3.33 mol/L NaCl (250 g/L Sodium chloride)
6583-10C Calcium Ca^{2+}	7683 (2 pcs)	① 0.4 to 40080 mg/L Ca^{2+} (1 to 10^{-5} mol/L Ca^{2+}) ② pH 5 to 11 (4 mg/L Ca^{2+}) ③ -29 mV	Na^+, K^+, Ba^+, NH_4^+=more than 1000 Mg^{2+}, Ni^{2+}, Cu^{2+}=1000 Mn^{2+}=500 Co^{2+}=350 Sr^{2+}=50 Fe^{2+}, Zn^{2+}=1 Fe^{3+}=0.1 (At 10^{-4} mol/L Ca^{2+})	3.33 mol/L KCl (250 g/L potassium chloride)

*1: The allowable pH range for the value specified in the parentheses under the measurable ion concentration.(pH range slightly changes depending on the ion concentration.)

*2: The change in electric potential at the electrode which occurs when the ion concentration has increased by 10 times.(25 ℃)

*3: When the concentration of interfering ions has exceeded the value which is obtained by multiplying the concentration of the measured ions by the allowable coexistence limit, the electric potential at the electrode is affected by interfering ions and this makes measurement impossible. (The effect by the coexistence of interfering ions decreases as the allowable coexistence limit becomes larger or the concentration of the measured ion becomes higher.)

*4: The internal liquid types are not limited to the solutions listed in the table. You may use other internal liquid so far as you have determined that its bleeding rarely interferes or affects the electric potential at the electrode and less frequently causes electric potential differences between the solutions.

16.4 Conductivity measuring

● Electrode sensitivity check

The cell constant of a conductivity electrode may vary, depending on the sample solution. Check the cell constant by measuring conductivity using the following solutions, at least once every three months.

Cell constant	Corresponding model	KCl standard solution	Solution temp.	Conductivity value		
1000 m^{-1} (10 cm^{-1})	#3553-10D	0.1 mol/L	0 ℃	713 mS/m (7.13 mS/cm)	7.4365 g	Dissolve capacity-weighed KCL and put it into a measuring flask (1 litter), and then add distilled water up to the marked line.
			18 ℃	1.117 S/m (11.17 mS/cm)		
			25 ℃	1.286 S/m (12.86 mS/cm)		
100 m^{-1} (1 cm^{-1})	#3552-10D	0.01 mol/L	0 ℃	77.4 mS/m (0.774 mS/cm)	0.7440 g	
			18 ℃	122.0 mS/m (1.220 mS/cm)		
			25 ℃	140.9 mS/m (1.409 mS/cm)		
10 m^{-1} (0.1 cm^{-1})	#3551-10D	0.001 mol/L	25 ℃	14.7 mS/m (147 μS/cm)	—	Scoop 100 mL of 0.01 mol/L standard solution with a transfer pipet and put it into a measuring flask (1 litter), and then add distilled water up to the marked line.

Prepare the potassium chloride standard solution (KCl 0.01 mol/L) by the below procedure. In addition, if an error of 5 % of more compared with the above values occurs, calibrate the cell constant.

● Preparing potassium chloride standard solution

How to prepare solution

Dry the potassium chloride powder (superior quality commercial potassium chloride or better) for two hours, at 105 ºC, then cool it in a desiccator. Measure out the above-listed amount of potassium chloride into a beaker and dissolve it in distilled water. Then, pour into one liter volumetric flask and add distilled water until the indication line.

Calibration of cell constant

As for the cell constant of the electrode, an officially approved value is specified in the electrode label. However, it may change according to the using condition, and in such cases, it is preferable to perform the calibration of the cell constant. Follow the following procedures for the calibration.

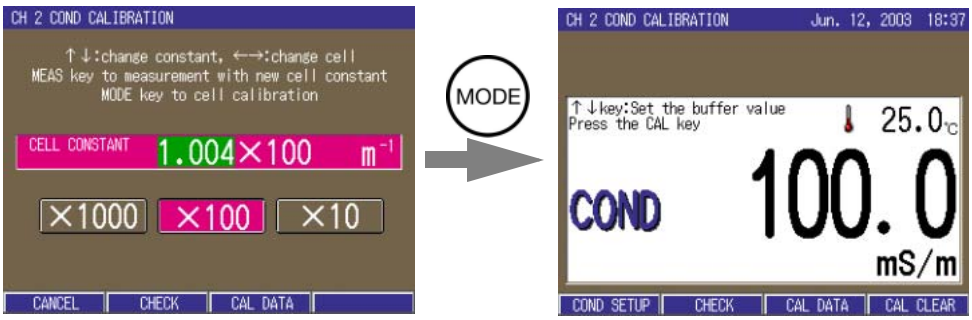
1. Wash the electrode a few times in the ion exchange water, wash it with potassium chloride standard solution (KCl 0.01 mol/L) a few times, and then immerse it into potassium chloride standard solution (KCl 0.01 mol/L) so that no bubble remains inside the cell.

NOTE

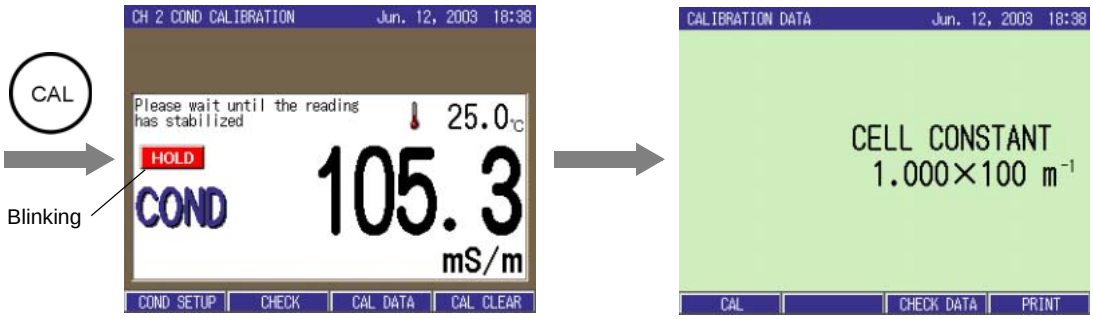
At this time, keep the temperature of the potassium chloride standard solution constant at 25 ± 0.5 ℃ .

2. Press the CALkey in the COND instant value measurement screen to open the CAL screen.

3. Press the MODE key in the cell constant input screen of the COND calibration screen to open the cell constant calibration screen.



4. Input the conductivity value of the standard solution by pressing the ↑ ↓ key and then press the CAL key. Start calibration and the obtained cell constant is set after the calibration is complete.



5. After calibration is complete, press the MEAS key to return to the COND Measurement screen.

NOTE

During the calibration, keep the standard solution constant at 25 ± 0.5 ℃ by using the temperature controlled bath, etc. Immerse the electrode to the sufficient depth into the standard solution, and slowly stir the solution with stirrer, etc.
Abandon the used standard solution, not returning it to the former container.

Measuring conductivity

"Conductivity" is an index that expresses the ease with which electric current flows through a material. Conductors are categorized either as "electron conductors," such as metals and other substances which use free electrons to conduct electricity, or "ion conductors," such as electrolytic solution or fused salt, which use ions to conduct electricity. This section deals with the kind of conductivity that pertains to ions, especially the conductivity of electrolytic solution that uses water as the solvent. As shown in Fig.6, two pole plates with an area A (expressed in m^2) are positioned parallel to each other, separated by distance l (expressed in m), then solution is poured into the cell until full and alternating current is run between the plates.

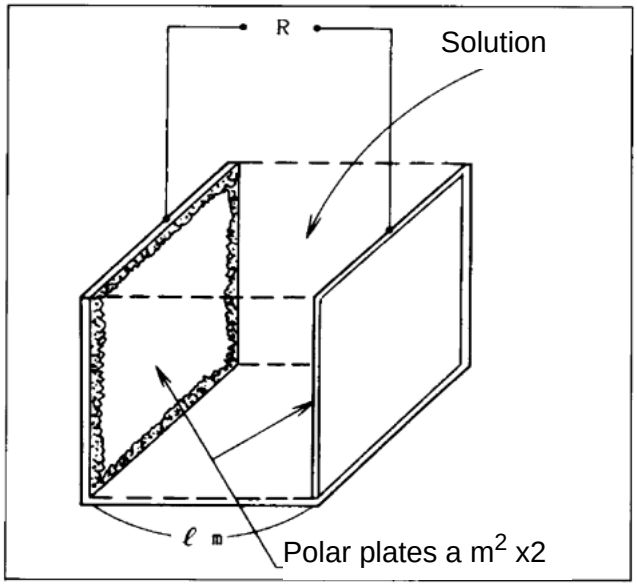


Fig.6 Conductivity cell imitative

Each positive and negative ion in the solution will migrate toward the oppositely charged pole. The result is that current flows through the solution by means of ion conductivity. When this occurs, resistance R(expressed in Ω), is in inverse proportion to the area A (expressed in m) of the pole plates, as is the case with metal and other conductors, and is proportional to the distance l (expressed in m) between the two pole plates. These relationships are expressed by equation 1, below.

$R = r \times l/a = rJ$ (Equation 1)

R: Resistance(Ω)

r: Specific resistance(Ω · m)

a: Pole plate area(m)

l: distance between pole plates(m)

J: Cell constant(m)

Specific resistance (expressed in Ω·m) is an index that indicates the difficulty with which current flows and is a constant determined according to the solution. The inverse of r (expressed in Ω·m), which is L (and is equal to 1/r), is called the "specific conductivity" and is widely used as an index to express the ease with which current flows. Specific conductivity L is generally referred to as simply "conductivity" and is expressed in units of S/m.

Inserting conductivity L (expressed in S/m) into equation 1 results in equation 2, below.

$R = J/L$ (Equation 2)

As is clear from equation 2, when a conductivity cell having a cell constant J of 1 m is used l in other words, when a conductivity cell having two pole plates that each have an area A of 1 m and are positioned parallel to each other such that the distance l between the two plates is 1

m is used l the inverse of the resistance R of the solution (expressed in Ω) between both pole plates is the conductivity. Conductivity is defined in this way, but it changes according to the temperature of the solution. The conductivity of a solution is generally expressed as the value when the solution is 25ºC.

● New units (SI units)

New measurement units, called SI units, have been in use since 1996. Accordingly, this pH meter also uses SI units. The following conversion table is provided for people who are used to using the conventional kind of conductivity meter. Note that along with the change in unit systems, the measurement values and cell counts have also changed.

	Former units	⇒	SI units
Cell constant	1 cm^{-1}	⇒	100 m^{-1}
	0.1 cm^{-1}	⇒	10 m^{-1}
	10 cm^{-1}	⇒	1000 m^{-1}
Measure-ment value	10 μS/cm	⇒	1 mS/m
	1 mS/cm	⇒	100 mS/m
	100 mS/cm	⇒	10 S/m

● Temperature coefficient

The conductivity of a solution generally varies greatly, depending on the temperature of the solution. Because the conductivity of a solution is based on its ion conductivity, as explained above, the higher the temperature of the solution the more active its ions and the higher its conductivity. Using a given temperature as the standard (and calling that the standard temperature), the “temperature coefficient” expresses how much change (expressed in %) occurs in conductivity when the temperature of the solution changes by 1ºC. The temperature coefficient is expressed in units of “%/ºC (standard temperature).” This temperature coefficient is found by assuming that the conductivity of the sample changes linearly in relation to temperature, whereas the change in conductivity of an actual sample, strictly speaking, follows a curve. The shape of this curve changes, depending on the kind of sample being measured. Most solutions, however, are said to generally have a temperature coefficient of 2 %/ºC (25ºC standard), within a range where the size of the temperature change is not very large. (Temperature coefficients of various solutions are listed on the following page.)
This pH meter is equipped with a built-in automatic temperature conversion function, enabling them to automatically calculate and display, based on the actual temperature measurement, the conductivity of a sample at 25ºC, using a temperature coefficient of 2 %/ºC.

● Conductivity and temperature coefficients for various solutions

The following table shows the conductivity (converted to 25 ºC) and the temperature coefficient at that time, for various kinds of solution.

Substance	Temp. (ºC)	Conc. (wt%)	Cond. (S/m)	Temp. coef. (%/°C)	Substance	Temp. (ºC)	Conc. (wt%)	Cond. (S/m)	Temp. coef. (%/°C)
NaOH	15	5	19.69	2.01	NaCl	18	5	6.72	2.17
		10	31.24	2.17			10	12.11	2.14
		15	34.63	2.49			15	16.42	2.12
		20	32.70	2.99			20	19.57	2.16
		30	20.22	4.50			25	21.35	2.27
		40	11.64	6.48	Na_2SO_4	18	5	4.09	2.36
KOH	15	25.2	54.03	2.09			10	6.87	2.49
		29.4	54.34	2.21			15	8.86	2.56
		33.6	52.21	2.36	Na_2CO_3	18	5	4.56	2.52
		42	42.12	2.83			10	7.05	2.71
NH_3	15	0.1	0.0251	2.46			15	8.36	2.94
		1.6	0.0867	2.38	KCl	18	5	6.90	2.01
		4.01	0.1095	2.50			10	13.59	1.88
		8.03	0.1038	2.62			15	20.20	1.79
		16.15	0.0632	3.01			20	26.77	1.68
HF	18	1.5	1.98	7.20			21	28.10	1.66
		4.8	5.93	6.66	KBr	15	5	4.65	2.06
		24.5	28.32	5.83			10	9.28	1.94
HCl	18	5	39.48	1.58			20	19.07	1.77
		10	63.02	1.56	KCN	15	3.25	5.07	2.07
		20	76.15	1.54			6.5	10.26	1.93
		30	66.20	1.54			—	—	—
H_2S0_4	18	5	20.85	1.21	NH_4Cl	18	5	9.18	1.98
		10	39.15	1.28			10	17.76	1.86
		20	65.27	1.45			15	25.86	1.71
		40	68.00	1.78			20	33.65	1.61
		50	54.05	1.93			25	40.25	1.54
		60	37.26	2.13	NH_4NO_3	15	5	5.90	2.03
		80	11.05	3.49			10	11.17	1.94
		100.14	1.87	0.30			30	28.41	1.68
		—	—	—			50	36.22	1.56
HNO_3	18	6.2	31.23	1.47	$CuSO_4$	18	2.5	10.90	2.13
		12.4	54.18	1.42			5	18.90	2.16
		31	78.19	1.39			10	32.00	2.18
		49.6	63.41	1.57			15	42.10	2.31
		62	49.64	1.57	CH_3COOH	18	10	15.26	1.69
H_3PO_4	15	10	5.66	1.04			15	16.19	1.74
		20	11.29	1.14			20	16.05	1.79
		40	20.70	1.50			30	14.01	1.86
		45	20.87	1.61			40	10.81	1.96
		50	20.73	1.74			60	4.56	2.06

Salinity conversion

Salt concentration indicates the salt concentration of the intended seawater based on the normal seawater, converting it according to its measured conductivity and temperature.
Therefore, note that all the substances detected as conductivity is indicated as salt concentration.
For instance, even if a composition in a sample is hydrochloric acid (HCl), it is indicated as salt concentration of seawater.

16.5 Specifications

● Measuring object for each model

		F-52	F-53	F-54	F-55	Description
pH	JIS form	●	●	●	●	0
	Measuring principle	●	●	●	●	Glass electrode
	Display range	●	●	●	●	pH -2.000 to 16.000
	Measuring range	●	●	●	●	pH 0.000 to 14.000
	Resolution	●	●	●	●	0.01/0.001 pH
	Repeatability	●	●	●	●	± 0.001 pH ± 1digit
mV	Measuring range	●	●	●	●	± 1999.9 mV
	Resolution	●	●	●	●	0.1 mV
	Repeatability	●	●	●	●	± 0.1 mV ± 1digit
Temp.	Measuring range	●	●	●	●	0.0 to 100.0 ℃
	Resolution	●	●	●	●	0.1 ℃
	Repeatability	●	●	●	●	± 0.1 ℃± 1digit
ION	Measuring principl		●		●	Ion electrode
	Measuring range		●		●	0.00 μg/L to 999 g/L(mol/L)
	Resolution		●		●	Valid numbers 3 digits
	Repeatability		●		●	±0.5% ±1 digit of full scale
Con-ductiv-ity	Measuring principle			●	●	2 AC bipolar method
	Measuring range			●	●	Cell constant 100 m^{-1}: 0.000 mS/m to 19.99 S/m Cell constant 10 m^{-1}: 0.0 μS/m to 1.999 S/m Cell constant 1000 m^{-1}: 0.00 mS/m to 199.9 S/m
	Resolution			●	●	0.05% of full scale
	Repeatability			●	●	±0.5% ±1 digit of full scale
Salin-ity	Measuring principle			●	●	Conversion from conductivity value
	Measuring range			●	●	0.00 to 4.00%
	Resolution			●	●	0.01%

		F-52	F-53	F-54	F-55	Description
Resis-tivity	Measuring principle			●	●	Conversion from conductivity value
	Measuring range			●	●	Cell constant 100 m^{-1}: 5.00 Ωm to 199.9 kΩ•m Cell constant 10 m^{-1}: 50.0 Ωm to 1.999 MΩ•m Cell constant 1000 m^{-1}: 0.500 Ωm to 19.99 kΩ•m
	Resolution			●	●	0.05% of full scale
	Repeatability			●	●	±0.5% ±1 digit of full scale
Input	CH number	●				1CH
			●	●	●	2CH
Output	RS-232C	●	●	●	●	
	Printer output	●	●	●	●	
	Analog output	●	●	●	●	
	Compact flash		●	●	●	
	Ethernet output				●	
Data mem-ory	Memory number	●	●	●	●	300 pcs
	Interval memory	●	●	●	●	
Dis-play	Display	●	●	●	●	Color graphic LCD
	Navigation function	●	●	●	●	
	Operator registration	●	●	●	●	
	Security function	●	●	●	●	
	AutoHold setting	●	●	●	●	
pH	number of cali-brated points	●	●	●	●	5
	Repeatability confirmation	●	●	●	●	
	Periodical inspection	●	●	●	●	
ION	Calibration curve method		●		●	5
	Addition method measurement		●		●	
COND	Distilled water temperature conversion			●	●	

		F-52	F-53	F-54	F-55	Description
Salin-ity	Salt concentration calibration			●	●	
Ambient temperature		●	●	●	●	0 to 45 ℃
Power		●	●	●	●	AC adaptor 100 to 240 V 50/60 Hz
Power consumption		●	●	●	●	Approx. 8.4 W
Mass of main unit		●	●	●	●	Approx 1.1 kg
Dimensions		●	●	●	●	79(H) × 179(W) × 230(D) mm (excluding electrode stand)

16.6 Default settings

When reset to the settings on shipment from the factory, the following setting contents, personal information, and calibration data will be reset.

NOTE

Resetting to the factory set value returns the setting data to initial values (except for language and clock).

Category	Item ○ : shows items to store setting on operator basis.		Default values (Set value on shipment from factory)	Setting range (Setting item)
pH SETUP	DISPLAY OPTION	○	0.001pH	0.001 pH, 0.01 pH
pH SETUP	TEMP COMPENSATION	○	AUTO	AUTO, MANUAL (0.0 ℃ to 100.0 ℃)
pH SETUP	TEMP COEFFICIENT	○	OFF	OFF, ON (COEF; -0.100pH to +0.100pH, Temperature; 0.0 ℃ to 100.0 ℃)
pH SETUP	ELECTRODE MODEL	○	No indication	Selection formula from attached material or freed input (9 characters)
pH SETUP	ELECTRODE LOT	○	No indication	7 digit integer
pH SETUP	LIMIT	○	OFF	OFF, ON (pH0.000 to pH14.000)
pH CALIBRATION	BUFFER		NIST	NIST, USA, Custom
pH CALIBRATION	CAL POINTS		2	1 to 5
pH CALIBRATION	CAL INTERVAL		OFF	OFF, ON (1-999 days)
pH CALIBRATION	REPEATABILITY		OFF	ON, OFF
pH CALIBRATION	SYSTEM CHECK		NIST BUFFER(pH7,4)	JIS(pH7,4,9), NIST BUFFER(pH7,4), SIMULATOR(X-51)
mV SETUP	LIMIT	○	OFF	OFF, ON (-1999.9mV to 1999.9mV)
ION SETUP	MEASUREMENT	○	AFTER CAL	AFTER CAL, INCREMENTAL
ION SETUP	TEMP COMPENSATION	○	AUTO	AUTO, MANUAL (0.0 ℃ to 100.0 ℃)
ION SETUP	ION SELECTION	○	ELECTRODE	ELECTRODE, MANUAL (-2,-1,+1,+2)
ION SETUP	UNIT	○	g/L	g/L ,mol/L

Category	Item ○ : shows items to store setting on operator basis.		Default values (Set value on shipment from factory)	Setting range (Setting item)
ION SETUP	ELECTRODE MODEL	○		Selection formula from attached material or freed input (9 characters)
ION SETUP	ELECTRODE LOT	○		7 digit integer
ION SETUP	LIMIT	○	OFF	OFF, ON(0.00μg/L to 999g/L)
COND SETUP	UNIT	○	S/m	S/m, S/cm
COND SETUP	TEMP COMPENSATION	○	AUTO	AUTO, MANUAL (0.0℃ to 100.0℃)
COND SETUP	TEMP COEFFICEINT	○	ON(2.00%/℃)	OFF, ON (0.00 to 100.00%/℃), PURE WATER
COND SETUP	ELECTRODE MODEL	○		Selection formula from attached material or freed input (9 characters)
COND SETUP	ELECTRODE LOT	○		7 digit integer
COND SETUP	LIMIT	○	OFF	OFF, ON (0.0μS/m to 199.9S/m)
SALT RESISTANCE SETUP	SALT LIMIT	○	OFF	OFF, ON(0.00% to 4.00%)
SALT RESISTANCE SETUP	RESISTANCE LIMIT	○	OFF	OFF, ON (0.0Ω•m to 199.9MΩ•m)
SYSTEM SETUP	DISPLAY	○	DIGITAL	DIGITAL, GRAPH, ANALOG
SYSTEM SETUP	2CH DISPLAY	○	ON	ON,OFF
SYSTEM SETUP	AUTO HOLD	○	NORMAL	EXACT, NORMAL, BRIEF, TIME(2 to 999 seconds), OFF
SYSTEM SETUP	INTERVAL MEMORY	○	OFF	OFF, ON(1 to 999 seconds)
SYSTEM SETUP	PRINTER OUTPUT	○	BRIEF	BRIEF, EXACT
SYSTEM SETUP	LANGUAGE	○	ENGLISH	JAPANESE, ENGLISH
SYSTEM SETUP	SOUND	○	ON	ON, OFF
DATE AND TIME SETUP	DATE AND TIME SETUP		Jun 01 2003	Jun 01 2000 to 2099
MAINTENANCE	BRIGHTNESS OF DISPLAY		Middle	26 step gradation
MAINTENANCE	DISPLAY COLOR		0	8 steps
MAINTENANCE	CHARACTER		OFF	OFF, ON
MAINTENANCE	BACK LIGHT OFF TIME		30 minutes	0 to 999 minutes *Screen does not shift to power saving mode if *0 min. is set here.

Category	Item ○ : shows items to store setting on operator basis.		Default values (Set value on shipment from factory)	Setting range (Setting item)
MAINTENANCE	TEMP CALIBRATION CH 1			No correction
MAINTENANCE	TEMP CALIBRATION CH 2			No correction
COMPACT FLASH SETUP	DATA COPY SETUP		OFF	OFF, ON
NETWORK SETUP	IP ADDRESS		192,168,0,1	192 to 223, 0 to 255, 0 to 255, 1 to 254
NETWORK SETUP	GATEWAY ADDRESS		192,168,0,100	0 to 255, 0 to 255, 0 to 255, 0 to 255
NETWORK SETUP	SUBNET MASK		255,255,255,0	0 to 255, 0 to 255, 0 to 255, 0 to 255
SECURITY SETUP	USER MANAGEMENT		OFF	OFF,ON
SECURITY SETUP	VALID TERM OF PASSWORD		OFF	OFF, ON (1-999 days)
SECURITY SETUP	PASSWORD LENGTH		1 chars or more	1 to 10 characters
SECURITY SETUP	PASSWORD RESTRICTION		OFF	OFF、ON (Limitation: 1 to 99 times)
SECURITY SETUP	LOCKOUT RESET		1 minute	1 to 999 min.
OPERATOR REGISTRATION	OPERATOR		———	50 persons (within 12 characters)

16.7 Connection of exclusive cable

16.7.1 RS-232C communications cable

Meter main unit MINI DIN8M		PC D-SUB 9PIN
2;CTS	—	7;RTS
3;TXD	—	2;RXD
4;GND	—	5;GND
5;RXD	—	3;TXD

16.7.2 Cable for CITIZEN printer

CBM-910-24RJ100-A

Meter main unit MINI DIN8M		Printer D-SUB 25PIN
2;CTS	—	20;BUSY
3;TXD	—	3;RXD
4;GND	—	7;GND
5;RXD	—	2;TXD

16.7.3 Cable for SEIKO printer

DPU-H245AS-A03A

Meter main unit MINI DIN8M		Printer D-SUB 9PIN
2;CTS	—	8;BUSY
3;TXD	—	3;DATA
4;GND	—	5;GND
5;RXD	—	2;OPEN

16.8 Spare and optional parts

This section lists spare and optional parts for the pH meter.These parts are available through HORIBA distributors. Place an order specifying their name, model, and part number.

16.8.1 Spare parts list

● pH electrode (with built-in temperature sensor)

Part name	Model	Part number	Remarks
D-50 series standard electrode	9621-10D	9096001700	Plastic-body electrode (for immersion measurement)
F-50 series standard electrode	9611-10D	9096001800	Glass-body electrode (reinforced responsive glass employed)
Laboratory-use electrode for slurry samples	9677-10D	9096002000	Built-in washable reference electrode (reinforced responsive glass employed)
Laboratory-use electrode for micro samples	9669-10D	9096001900	Electrode incorporating temperature sensor compatible with micro sample measurement Tip: φ3, 55 mm

● pH electrode (without built-in temperature sensor)

Part name	Model	Part number	Remarks
Standard type	6066-10C	9003013400	Glass-body electrode
Extreme fine test tube type	6069-10C	9003013500	For NMR tube Tip; φ3, 180 mm

● ORP electrode (with built-in temperature sensor)

Part name	Model	Part number	Remarks
Platinum compound type	9300-10D	9096000400	Flat platinum type

● Ion electrode

Part name	Model	Part number	Remarks
Chloride ion selective electrode	6560-10C	9003014500	Conbination selective electrode
Fluoride ion selective electrode	6561-10C	9003014600	Conbination selective electrode
Nitrate ion selective electrode	6581-10C	9003014700	Conbination selective electrode
Potassium ion selective electrode	6582-10C	9003014800	Conbination selective electrode
Calcium ion selective electrode	6583-10C	9003014900	Conbination selective electrode
Ammonia ion selective electrode	5002-10C	9003016600	Conbination selective electrode

● Spare chip for ion electrode

Part name	Model	Part number	Remarks
Chloride ion chip	7660	9003015000	For 6560-10C
Fluoride ion chip	7661	9003015100	For 6561-10C
Nitrate ion chip	7681	9003015200	For 6581-10C
Potassium ion chip	7682	9003015300	For 6582-10C
Calcium ion chip	7683	9003015400	For 6583-10C

● Internal standard solution for ion electrodes

Part name	Model	Part number	Remarks
Internal standard solution for chloride ion	301	9037006700	6560-10C For outer tube 50 mL
Internal standard solution for fluoride ion and calcium ion	300	9003003200	6561-10C, 6583-10C For outer tube 250 mL
Internal standard solution for Nitrate ion	302	9037006600	6581-10C For outer tube 50 mL
Internal standard solution for potassium ion	303	9037006900	6582-10C For outer tube 50 mL
Internal standard solution	330	9037005200	65XX-10C common For inner tube 250 mL

● COND electrode for F-54, 55

Part name	Model	Part number	Remarks
Immersion tyep conductivity electrode	9382-10D	9096000300	Water-proof Cell constant 100 m^{-1}
	3551-10D	9056000800	For low conductivity Cell constant 10 m^{-1}
	3552-10D	9056000900	Standard type Cell constant 100 m^{-1}
	3553-10D	9056001000	For high conductivity Cell constant 1000 m^{-1}
Flow type conductivity electrode	3561-10D	9056001100	For low conductivity Cell constant 10 m^{-1}
	3562-10D	9056001200	General purpose Cell constant 100 m^{-1}
	3573-10C	9056001300	For high conductivity Cell constant 1000 m^{-1}
	3574-10C	9056001400	For micro samples Cell constant 1000 m^{-1}

NOTE

Actual cell constants are within ±10% variation of the above values.

● pH standard solution

Part name	Model	Part number	Remarks
pH2 standard solution	100-2	9003001500	500 mL Accuracy : ± 0.02 pH
pH4 standard solution	100-4	9003001600	
pH7 standard solution	100-7	9003001700	
pH9 standard solution	100-9	9003001800	

Part name	Model	Part number	Remarks
Powdered pH2 standard solution	150-2	9003002600	500mL-equivalent pack x 10 Accuracy :±0.05pH
Powdered pH4 standard solution	150-4	9003002700	
Powdered pH7 standard solution	150-7	9003002800	
Powdered pH9 standard solution	150-9	9003002900	

● Standard solution for ORP check

Part name	Model	Part number	Remarks
Standard solution for ORP check	160-51	9003003100	ORP 95 mV For Ag/AgCl electrode at 20ºC
	160-22	9003003000	ORP 262 mV For Ag/AgCl electrode at 20ºC

● Internal standard solution

Part name	Model	Part number	Remarks
Internal standard solution	#300	9003003200	250 mL

● Cleaning liquid

Part name	Model	Part number	Remarks
Cleaning liquid for electrodes	#220	9096002500	For pH, ORP, and ion electrodes

16.8.2 Options

Part name			Part number	Remarks
AC adapter for the pH meter	AC adapter		9096003100	Be sure to purchase the cable when purchasing the AC adapter.
	Cable	For Japan	9096003200	
		For US	9096003300	
		For Europe	9096003400	
Plain paper printer	Printer	For Japan	9096003500	Purchase a printer cable when purchasing the printer.
		For US	9096003600	
		For Europe	9096003700	
	Printer cable		9096003800	
	Roll paper (20 winding set)		9096003900	
	Ink ribbon (5 piece set)		9096004000	
Serial cable			9096004800	RS-232C communication cable
Electrode stand			9096002600	
Stand arm			9096002800	
Compact flash memory card			9096003000	16MB
Analog (alarm) output cable			9096004900	
X-51 Digital Simulator			—	For pH, mV, ION, and DO
X-52 Digital Simulator			—	For COND

Technical questions regarding this product should be directed to the following HORIBA PRIORITY TECHNICAL SUPPORT CENTER.

http://www.horiba-water.com

HORIBA, Ltd.

Miyanohigashi, Kisshoin, Minami-ku, Kyoto, Japan
Phone (81) 75-313-8121

http://www.horiba.com

First edition :
CODE : I1001379000A