Residual chlorine meter
HR-480P

Instruction Manual

CODE:GZ0000397156

Preface

This manual describes the operation of the Residual chlorine meter, HR-480P.
Be sure to read this manual before using the product to ensure proper and safe operation of the product. Also safely store the manual so it is readily available whenever necessary.

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

Warranty and responsibility

HORIBA Advanced Techno, Co., Ltd. warrants that the Product shall be free from defects in material and workmanship and agrees to repair or replace free of charge, at option of HORIBA Advanced Techno, Co., Ltd., any malfunctioned or damaged Product attributable to responsibility of HORIBA Advanced Techno, Co., Ltd. for a period of one (1) year from the delivery unless otherwise agreed with a written agreement. In any one of the following cases, none of the warranties set forth herein shall be extended;

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

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

Trademarks

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

Regulations

Conformable Directive

This equipment conforms to the following directives and standards:

CE

EMC: EN61326-1
Class A, Industrial electromagnetic environment

Safety: EN61010-1

Warning: This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Note

When the sensor cable, the transmission cable, or the contact input cable is extended to 30 m or longer, the surge test specified in the EMC directive for CE marking is not applied.

Installation environment

This product is designed for the following environment.

- Overvoltage Category II
- Pollution degree 2

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

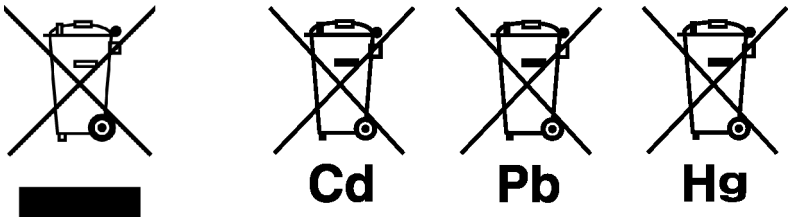
The crossed out wheeled bin symbol with underbar shown on the product or accompanying documents indicates the product requires appropriate treatment, collection and recycle for waste electrical and electronic equipment (WEEE) under the Directive 2012/19/EU, and/or waste batteries and accumulators under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

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

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

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

Contact your supplier for information on applicable disposal methods.



FCC rules

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

Warning

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

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

For Your Safety

Hazard classification and warning symbols

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

- **Hazard classification**

⚠DANGER	This indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This is to be limited to the most extreme situations.
⚠WARNING	This indicates a potentially hazardous situation which, if not avoided, could 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 against unsafe practices.

- **Warning symbols**

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

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

Safety precautions

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

⚠ WARNING
To connect a load beyond the contact capacity or use inductive load (such as a motor, or pump), be sure to use a power relay whose ratio is higher than the load.
If there is a possibility of a lightning strike, install arresters on the output side and receiving converter side of the converter.
Electric shock Be sure to turn OFF the power before wiring power source. Do not turn ON the power until your work is completed.
Caution strong acid If nitric acid gets into the eye, the mucous membrane may be damaged, leading to blindness. In handling nitric acid, be sure to use protective goggles, protective gloves, and a protective mask. If dilute hydrochloric acid gets into your eye, immediately rinse the eye with a large quantity of water for more than 15 min (In rinsing off nitric acid, ensure that the eyeball and the eyelid are entirely exposed to water by fully opening the eyelid with your fingers). If nitric acid remains in contact with body and clothes, chemical burns may result. Therefore, if a spill or splashing occurs, immediately take off the clothes and rinse off the nitric acid with plenty of water.

⚠ CAUTION
When the converter is turned OFF, the C-NC contact is shorted. Be careful when connecting a load.
Operating the converter using a voltage out of the rated range may cause it to malfunction. Be sure to check the voltage of the power supply. Also make sure that the fluctuation of the power supply voltage is within the range of ±10% of the rated voltage.
In piping the sample inlet, exercise extreme care because the piping may be disconnected when pressure is increased by manipulating the flow control valve, leading to a serious accident.
Check that there are no beads on the top of the beads cell or around the O-ring when installing the beads cell. If the cell is installed with beads attached to either part, the sample may leak out, affecting or damaging your peripheral equipment.

Product Handling Information

Operational precautions

Use of the product in a manner not specified by the manufacturer may impair the protection provided by the product. And it may also reduce product performance.
Exercise the following precautions:

- Do not press any operation key with the tip of your fingernail or something pointed.
- Do not use any organic solvent.
- If the residual chlorine sensor is exposed to direct sunlight, deterioration of the electrode, discoloration of the cell, and/or a decrease in the concentration of residual chlorine may result. Install the sensor indoors or in a location where it is not exposed to direct sunlight.

Disposal of the product

When disposing of the product, follow the related laws and/or regulations of your country.

Manual Information

Description in this manual

Note

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

Reference

This indicates the part where to refer for information.

Tip

This indicates reference information.

Glossary

For explaining the operation of the converter, the following terms are being used.

Term	Explanation
Hold down	To hold down the object until the lamp lights or the display changes.
Single press	To lightly press the object once.
Flash	To flicker quickly several times, and the setting is finished.

Contents

Overview

The HR-480P is designed to measure the concentration of free residual chlorine accurately contained in tap water, swimming pool water, public bath water, or the like. The measuring principle is three-electrode polarography method without any treatment by reagents for simple measurement of residual chlorine. In addition, combination of beads cleaning and electro chemical cleaning enables stable measurement over a long time. In principle, constant flow rate is required for stable measurement. For the stable flow rate, we offer two types of measurement cell. The RA-10 is overflow type sensor that regulates flow rate to the sensor by built in overflow tank. The RA-20 is in-line type sensor that can measure pressurized sample with a constant flow valve outside.

Features

- IP65 (dust and water proof) panel
- Concentrated control keys on the front panel for all settings
- A rich set of maintenance features
- Automatic validation of the sensor characteristics are acceptable at the time of calibration
- Free transmission output range
- Free voltage power supply (100 V to 240 V AC, 50/60 Hz)
- Nonvolatile memory
- Easy-to-read display (large characters)
- Improvement in operability of the keys using the embossed sheet
- Relaxed resistance limit of the loads to the transmission output (max. 900 Ω)
  (250 Ω receiver × 3 + wiring resistance)
- Improved and expanded status display with icons
- Downsized converter (the volume is reduced by 20% compared to its predecessor).

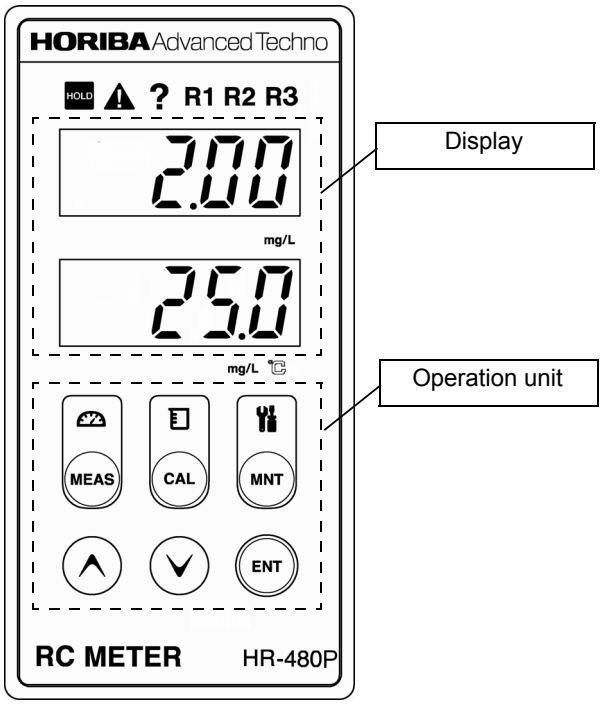
● Connectable sensors

The following sensors can be connected to the HR-480P.

- RA-10 (Overflow type)
- RA-20 (Inline type)

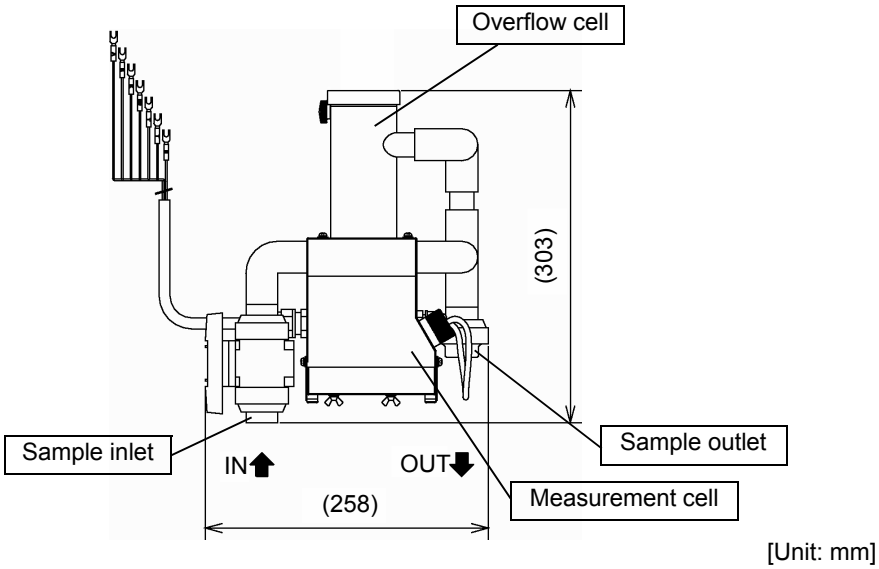
Configuration of the residual chlorine monitor

■ Converter



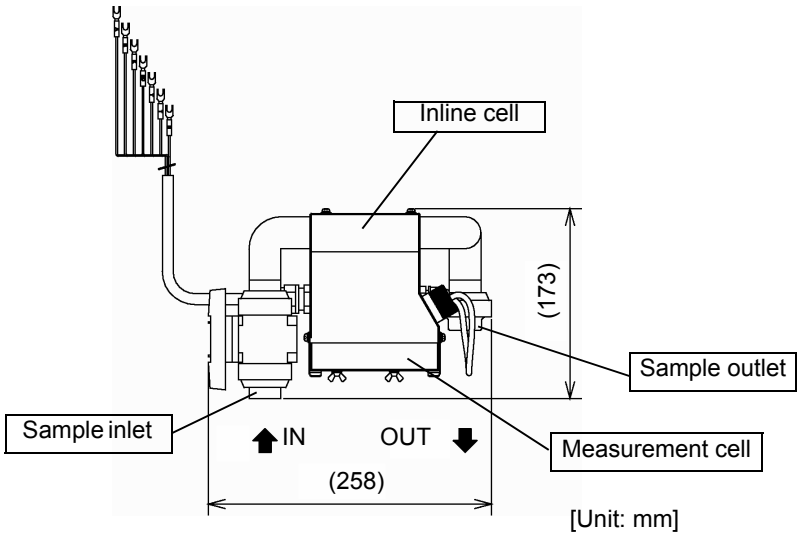
■ Sensor

● RA-10



[Unit: mm]

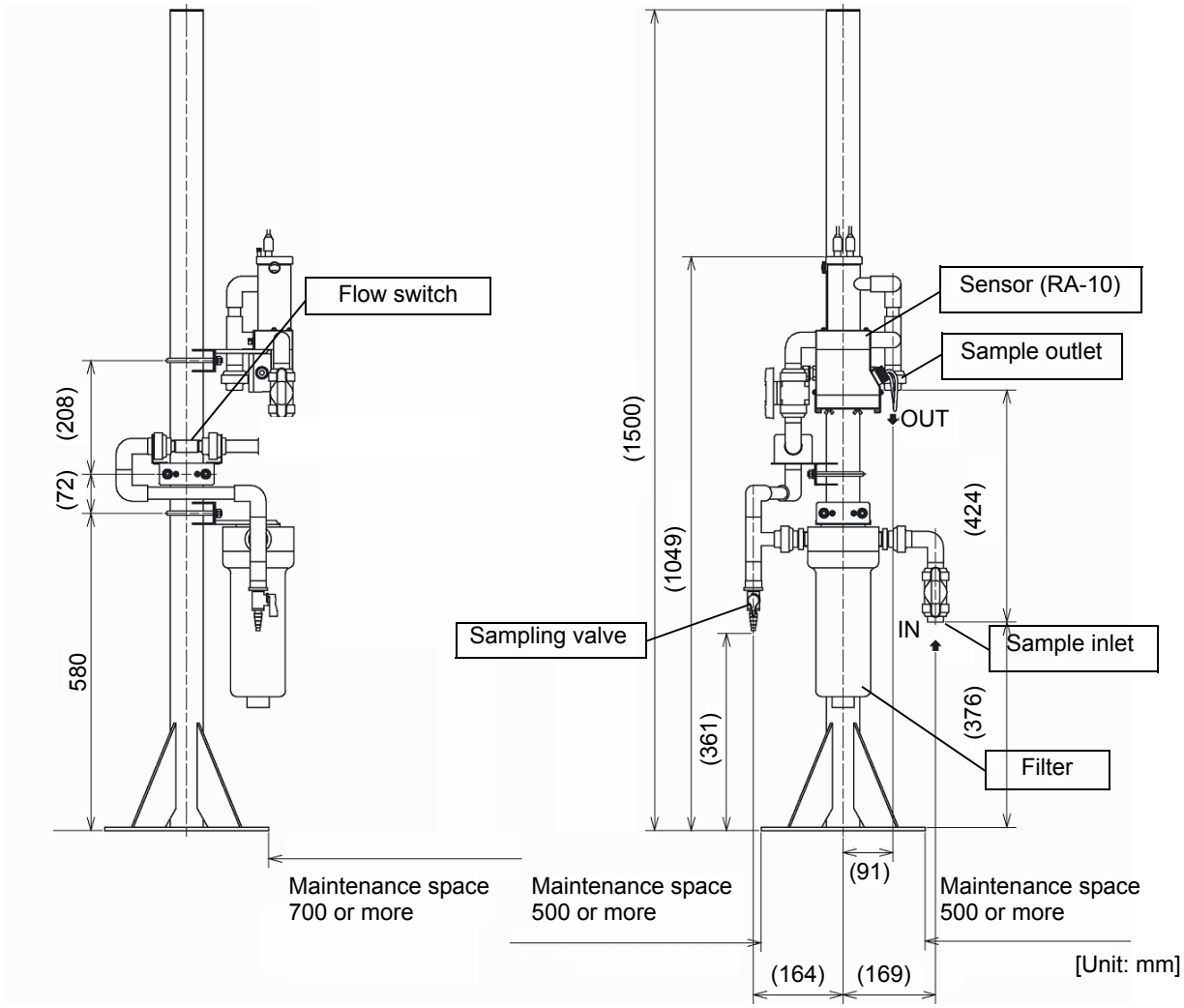
● **RA-20**



[Unit: mm]

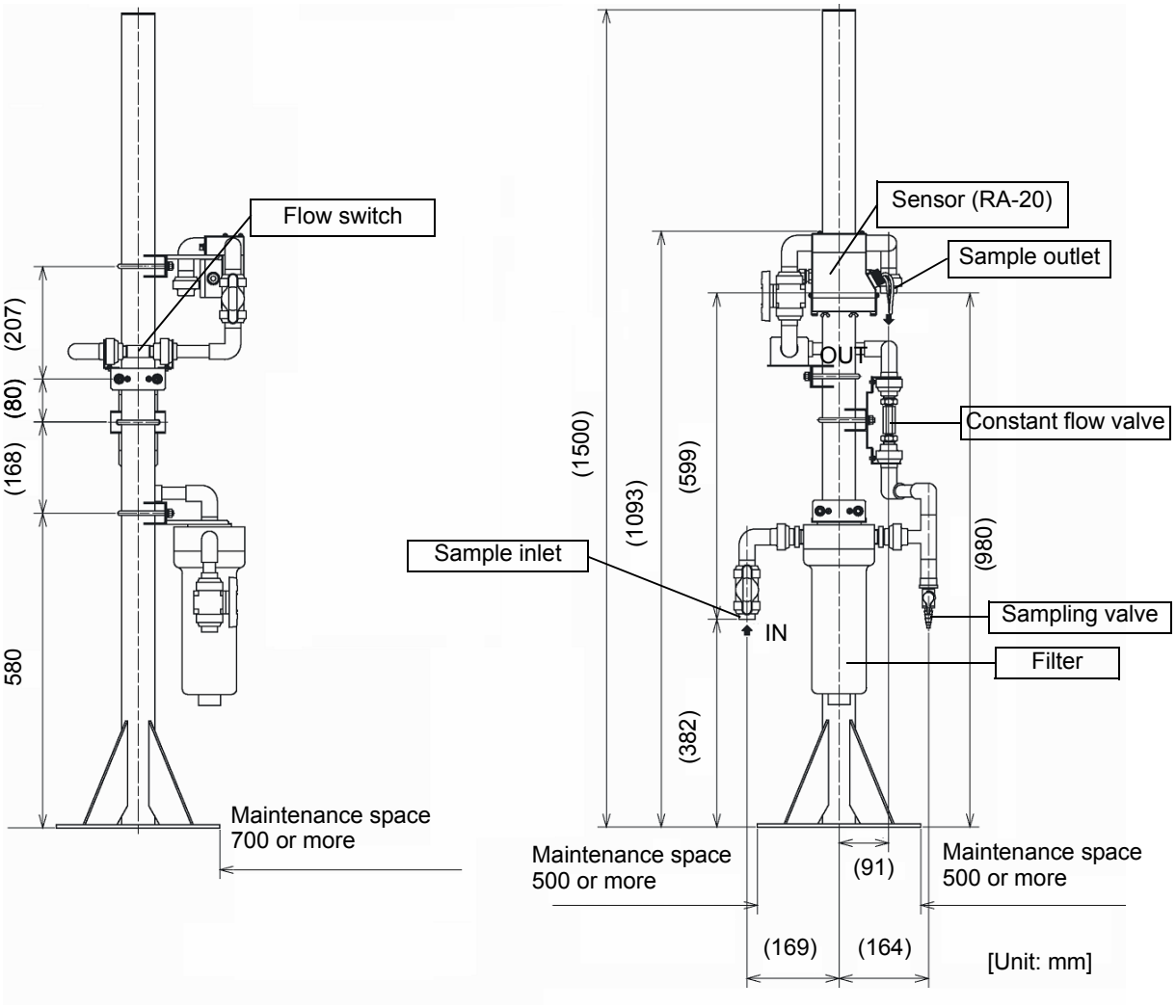
■ Example of pole stand setup

● **For RA-10 (HR-480P-10P-F-FS10)**



[Unit: mm]

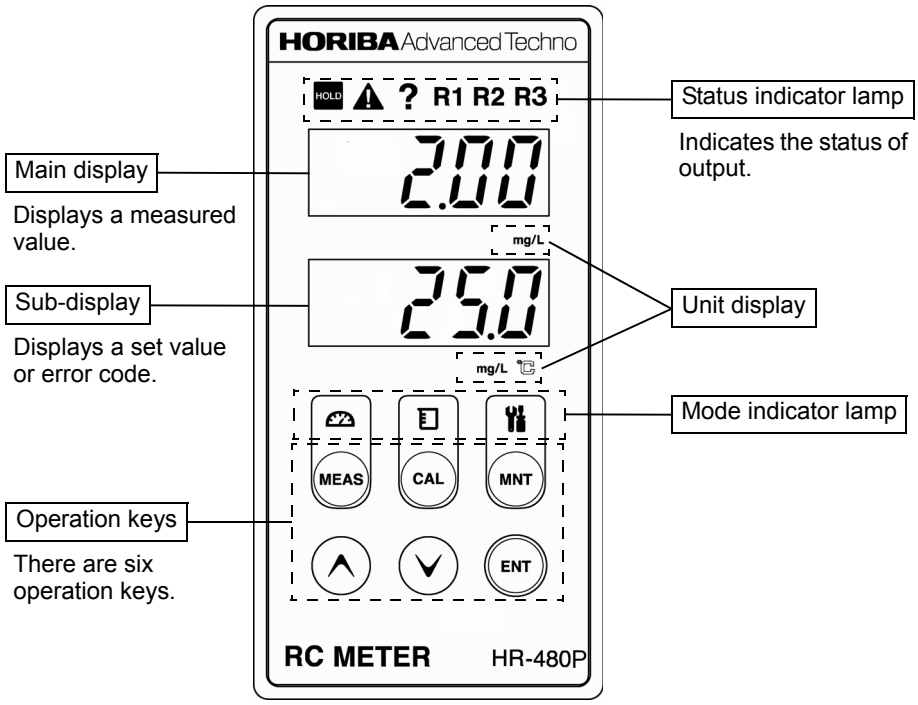
For RA-20 (HR-480P-20P-F-CFV-FS20)



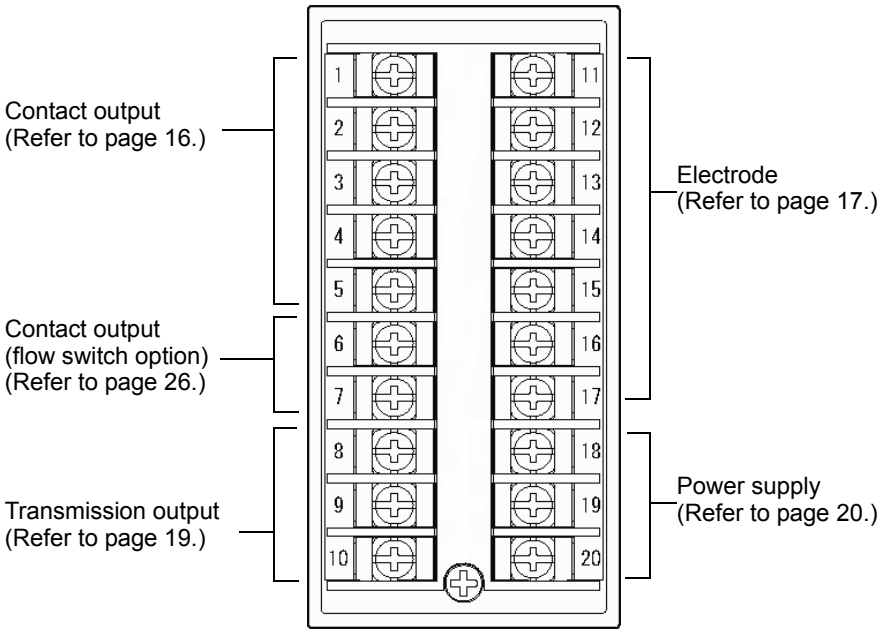
Names and functions of each part

■ Converter

● Front panel

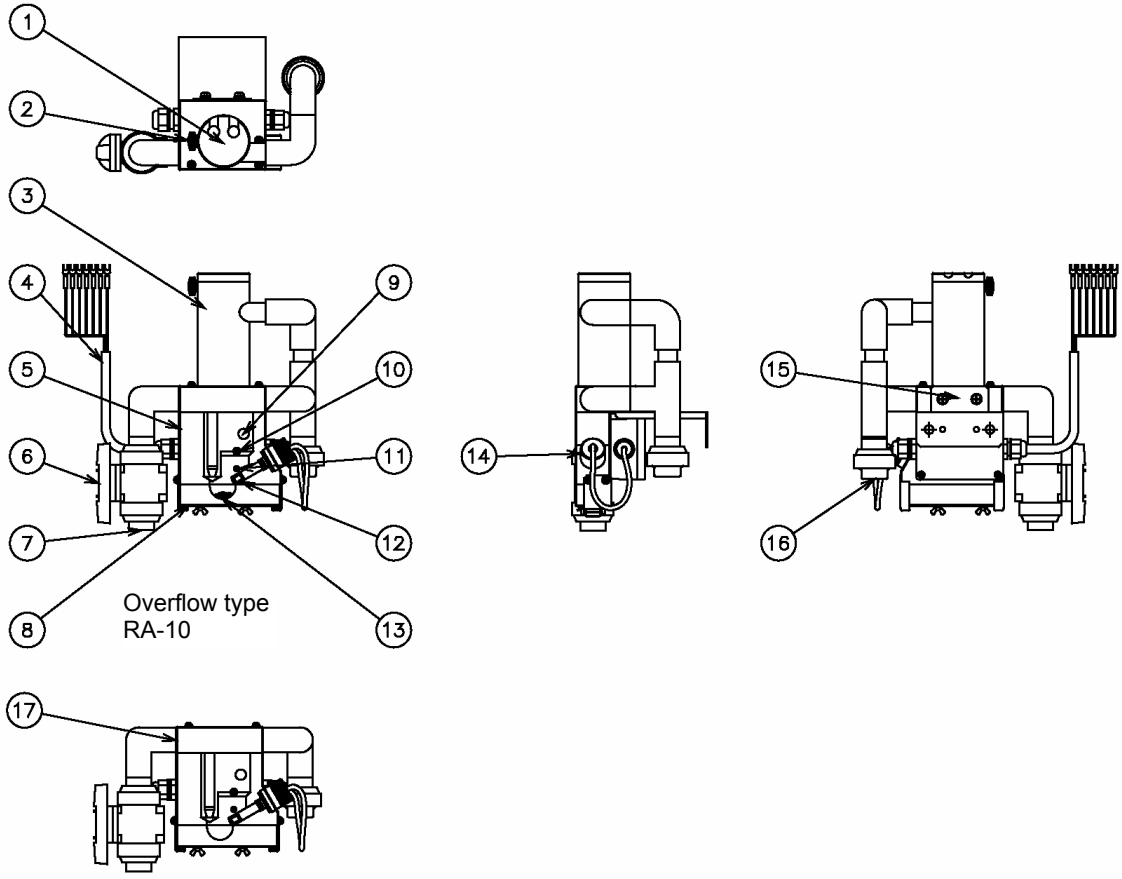


● Terminal block



Sensor

● Free residual chlorine sensor



(1) Overflow lid

The overflow lid has holes used to install the pH and ORP electrodes. To clean the inside of the overflow cell, remove this lid.

(2) Knurled screw

This screw is used to secure the overflow cell and the lid.

To remove the lid, loosen the screw. In order to prevent the knurled screw from being lost, do not remove it from the overflow lid.

(3) Overflow cell

This cell is used to ensure a stable flow rate in the measurement cell.

Even if the flow rate at the sample inlet fluctuates within the specified range (1.3 L/min to 2.0 L/min), the flow rate in the measurement cell can be maintained at a constant level.

(4) Converter cable

This cable is connected to the converter (HR-480P).

(5) Measurement cell

This cell is used to abrasively clean the sensor surface by shooting out beads while exposing the cathode electrode surface to the sample at a constant flow rate.

(6) Stop valve (flow control valve)

This valve is used to stop the sample from being sent to the residual chlorine sensor. It can also be used as the flow control valve for the sample going to the overflow cell (inline cell).

Note

- **For the overflow type RA-10, adjust the flow rate of the sample at 1.3 L/min to 2.0 L/min. For the inline type RA-20, adjust the flow rate at a constant level in the range from 0.6 L/min to 1.0 L/min.**
- **Carry out piping work by following the procedure for PVC piping.**
- **The quality and residual chlorine ranges of the sample are specified in the specifications. Do not exceed any specified rate range when releasing the sample. Normal measurements may become impossible.**

(7) Sample inlet

This is the inlet for the liquid under measurement. The sample inlet consists of the TS16 fitting.

(8) Beads cell

This cell contains beads that are used to abrasively clean the cathode electrode surface.

Beads can be easily replaced by loosening the thumbscrew at the bottom of the beads cell (which will not fall off), then drawing out the cell toward you.

Note

An O-ring (S30) to prevent the sample from leaking is used between the beads cell and the measurement cell. Take care not to lose this O-ring.

(9) Anode electrode

(10) Electrical cleaning electrode (EC electrode)

This electrode is used to generate voltage so that metallic contamination and other foreign matter on the cathode electrode surface, which cannot be removed by beads cleaning alone, can be removed. The electrode is made of carbon and incorporates a temperature sensor.

Note

Subjecting the electrode to a strong impact may damage it. In cleaning the measurement cell, exercise extreme care.

(11) Reference electrode

(12) Cathode electrode

Reference

Refer to " Replacing the sensor (cathode electrode) " (page 67).

(13) Cleaning beads

These beads are used to abrasively clean the cathode electrode surface.

Reference

Refer to " Replacing the cleaning beads " (page 65).

(14) Sensor cap

This cap is used to fasten the cathode electrode to the measurement cell.

To replace the cathode electrode, remove the sensor cap, draw out the sensor holder, then replace only the cathode electrode located at the leading end.

(15) Mounting bracket

This bracket is made of stainless steel, and is used to install the HR-480P on a wall or pole.

To install the HR-480P on a pole, purchase the pole stand and pole installation brackets, which are optionally available.

(16) Sample outlet

This outlet is used for the liquid under measurement. For the sample outlet, carry out piping work by connecting a 16 A PVC pipe.

Reference

Refer to " For RA-10 (Overflow type) " (page 25).

(17) Inline cell

This cell is used to send the sample to the measurement cell.

When the differential pressure between the sample inlet and outlet is maintained at least 0.01 MPa, the measured liquid can be returned to the main line for the sample.

Operation section

■ Operation keys

Operation keys are used to switch displays, enter settings, and perform calibration, etc.
You can change the value or item while the display is blinking.
Select a value or item using ▲/▼ and press ENT. And the display will flash, and the setting will be finished.
To disabled the key operations use the security menu.

Key	Notations in the text (Meaning)	Description/Operation	
MEAS	MEAS (Measurement)	Use this key to return to the measurement mode from another mode. In the setup menus of the measurement and maintenance modes, pressing once will cancel the last change and make the display return to the previous item. To return to the measurement mode, press this key repeatedly until the MEAS lamp lights up.	
CAL	CAL (Calibration)	Hold down	Hold down this key until the CAL lamp lights up, and the calibration mode will be enabled.
MNT	MNT (Maintenance)	Single press	The control value setup menu will be enabled, and “SEt” will be displayed.
		Hold down	Hold down this key until the MNT lamp lights up and the MEAS lamp turns OFF, and the maintenance mode will be enabled.
▲ ▼	▲ ▼ (Selection)	Use these keys to change the displayed value or item. For a numerical value, pressing once will increment/decrement the value by one count, and holding down the key will increase/decrease the value continuously. ▲ and ▼ scroll the display in the opposite directions. When you have pressed one of the buttons excessively, press the other key, to go back.	
ENT	ENT (Enter)	Use this key to finish set values and calibration values. **Note** **If you use MEAS instead of ENT to return to the previous menu, the last changes are canceled.**	

Note

Do not press any operation key with the tip of your nail or any thing pointed.

■ Indicator lamps

● Mode display

	Measurement lamp Lights up during the measurement mode. This lamp is turned OFF during the calibration and maintenance modes, during which measurement is stopped.
	Calibration lamp Lights up during the calibration mode. To enter the calibration mode, hold down the CAL key until this lamp lights up. Calibration can be performed while this lamp lights up is being lit. Measurement is stopped in this state.
	Maintenance lamp Lights up during the maintenance mode. To enter the maintenance mode, hold down the MNT key until this lamp lights up. Setups can be made while this lamp lights up. Measurement is stopped in this state.

● Status display

HOLD	Lights up when the transmission output is held constant.
	Lights up when an alarm (FAIL) has been issued.
?	Lights up when an error has occurred.
R1 R2 R3	Lights up when the relevant contact output is ON (C-NO is conducted).

Operation modes and menus

This converter has 3 operation modes and 5 menus in its major category.

● Operation modes

● Measurement mode

Measurements and converter control are performed.

● Calibration mode

Calibration are performed.

● Maintenance mode

Measurements and outputs are stopped, and performs various setups are performed.

● Menu

The following menus are provided under the measurement and maintenance mode.
For how to enter each of the modes and menus, see the respective description pages.

● Basic setup menu

This menu allows you to set up all the parameters related to measurement, such as terminal allocation of detector information.

● Calibration menu

This menu allows you to performs calibration.

● User check menu

This menu allows you to check the output state or measured values, and to reset the set values to the factory settings.

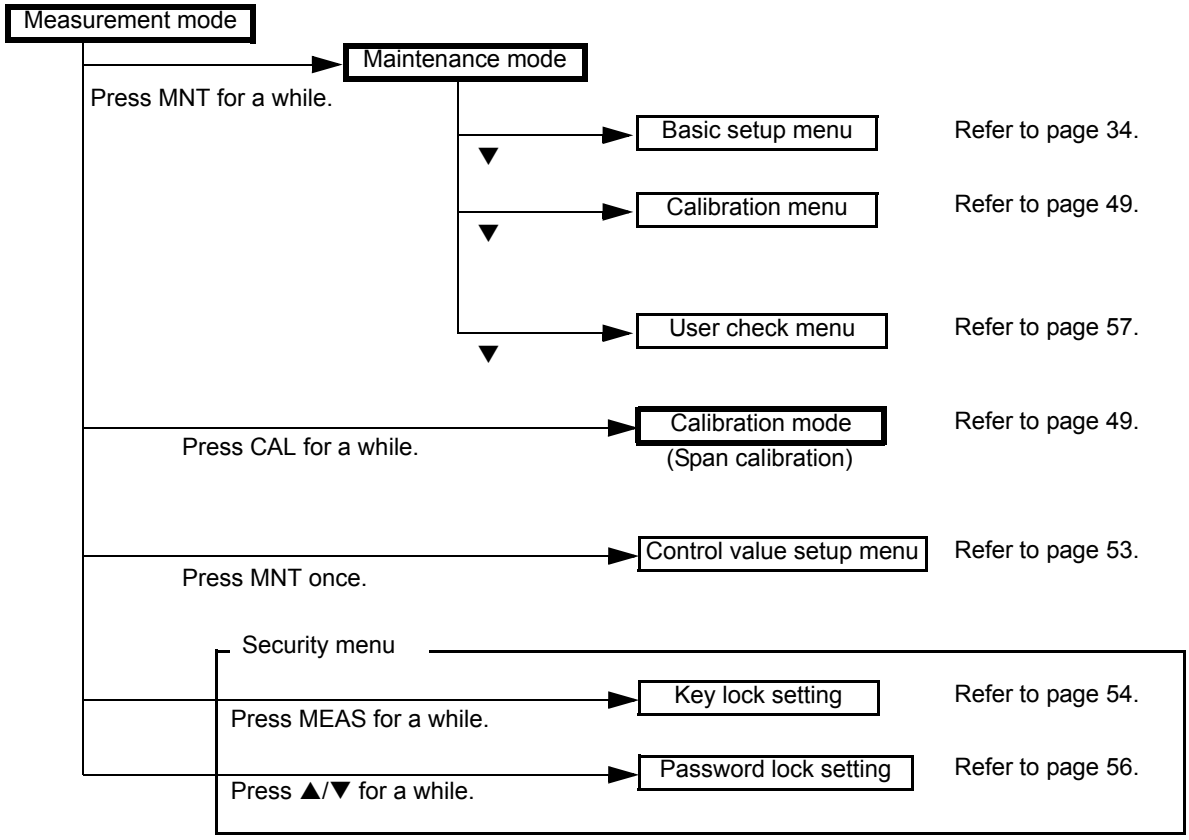
● Control value setup menu

This menu allows you to set or change control values while checking the output during measurement.

● Security menu

This menu prevents you from wrong or illegal operation.

Modes and menus from the measurement mode



Installation

Installation environment

To keep the converter stable and reliable for use, install it in a place where the following conditions are satisfied.

Converter

- Well-ventilated
- Ambient temperature is in the range of –5°C to 45°C.
- Where the air is not hot.
- Not exposed to direct sunlight.
- Not to exposed to direct radiant heat.
- Ambient relative humidity is in the range of 20% to 85%.
- The converter is not splashed with water or chemicals.
- Mechanical vibration is rare.
- There is enough space for maintenance and wiring.
- Dust and corrosive gases are not present.
- The influence of electromagnetic fields is rare.
- The altitude is less than 2000 m.
- The range of power supply voltage fluctuation is within 10% of the rated voltage.
- Overvoltage Category II is satisfied (this regulation is applied to the electrical machinery that is powered by stationary equipment such as a switchboard).

Sensor

- The location should have adequate space to allow for check and maintenance of the sensor.
- Ambient temperature is in the range of 0°C to 45°C.
- Spilled water should not adversely affect the location.
- The solution being measured should be free from air bubbles.
- The sample should not corrode the wetted part of the sensor.
- The sample should not be allowed to freeze.
- Not exposed to direct sunlight.

Note

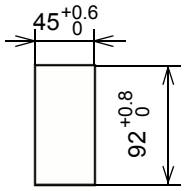
- **If the residual chlorine sensor is exposed to direct sunlight, deterioration of the electrode, discoloration of the cell, and/or a decrease in the concentration of residual chlorine may result. Install the sensor indoors or in a location where it is not exposed to direct sunlight.**
- **For more information, refer to " Installation method " (page 14), " Installing the measurement cell " (page 21) and the instruction manual that comes with the sensor.**
- **The sensor has no atmospheric pressure correction capability. It assumes measurements at standard atmospheric pressure.**

Installation method

Installing the converter

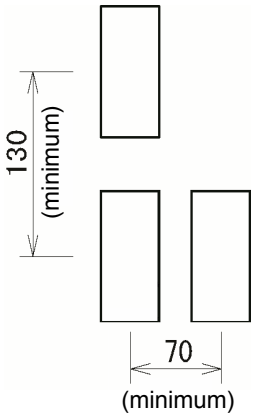
Mount the converter on a control panel.
The panel thickness should be 1.0 mm to 9.0 mm.

Cut a square with dimensions shown in the figure below from the control panel.



[Unit: mm]

When installing the converters in a row, leave an interval of 70 mm or more horizontally and 130 mm or more vertically between the square openings.



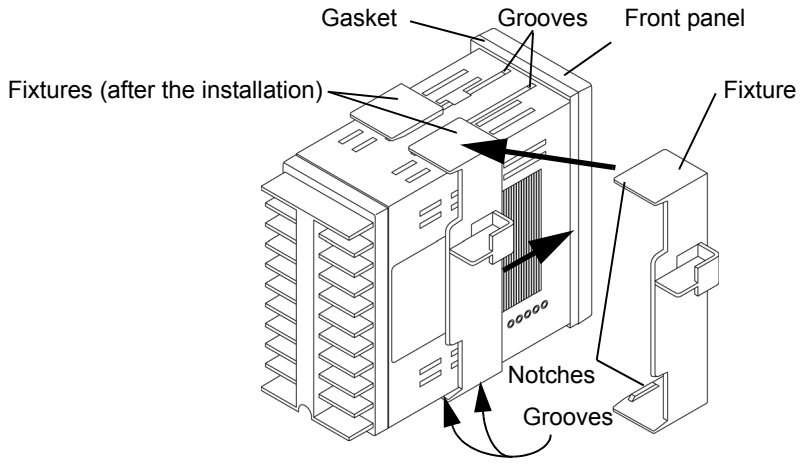
[Unit: mm]

● Mounting

Insert the converter into the square opening and secure it with fixtures.

Operation

1. **Insert the converter body from into the opening the front of the control panel.**
2. **Attach one of the two fixtures on the converter, fitting its notches into the grooves located on the top and bottom of the body case.**
3. **Attach the other fixture, in the same way.**
4. **Slide the both fixtures to the front panel to secure the converter body.**



Note

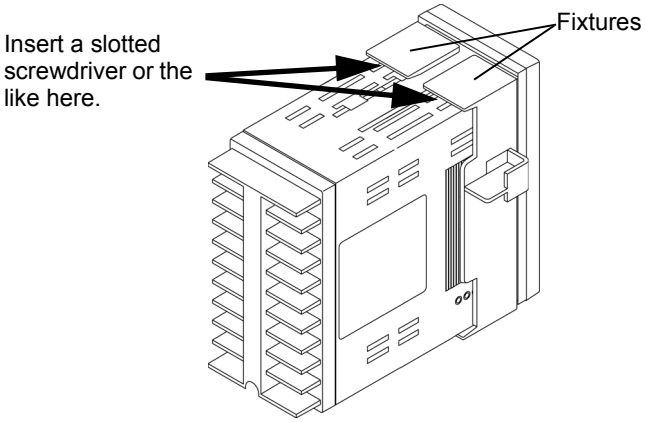
The gasket is a consumable. Replace it with a new one when its holding power has become weak.

● Dismounting

Remove the cables from the terminal block.
Remove the fixtures one by one, then the converter body from the panel.

Operation

1. **Insert a slotted screwdriver or the like into the gap between a fixture and the converter body to detach a notch from the groove.**
2. **Remove the fixture.**
3. **Remove the other fixture, in the same way.**
4. **Pull out the converter body from the control panel.**



Connection

■ Connecting the contact outputs

- The contact capacity is 240 V AC 3 A or less, or 30 V DC 3 A or less.
- If load noise is observed, use a varistor or noise killer.

⚠ WARNING

To connect a load beyond the contact capacity or use inductive load (such as a motor, or pump), be sure to use a power relay whose ratio is higher than the load.

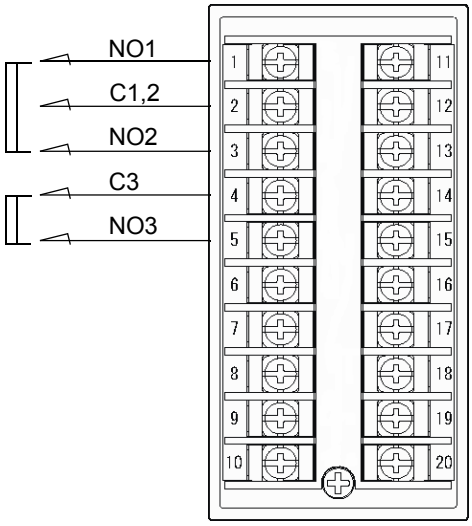
⚠ CAUTION

When the converter is turned OFF, the C-NC contact is shorted. Be careful when connecting a load.

Make output connections as shown in the figure shown below.

R1, R2 contact output:
capacity (load resistance) 24 V AC, 3 A

R3 contact output:
capacity (load resistance) 30 V DC, 3 A



● Relationship between terminals to be connected and contact outputs ON/OFF

	Setting of control output inversion	
	no	yES
Contact ON	CLOSE	OPEN
Contact OFF	OPEN	CLOSE
Power OFF	OPEN	OPEN

Connecting the sensor cable

Sensor cable precautions

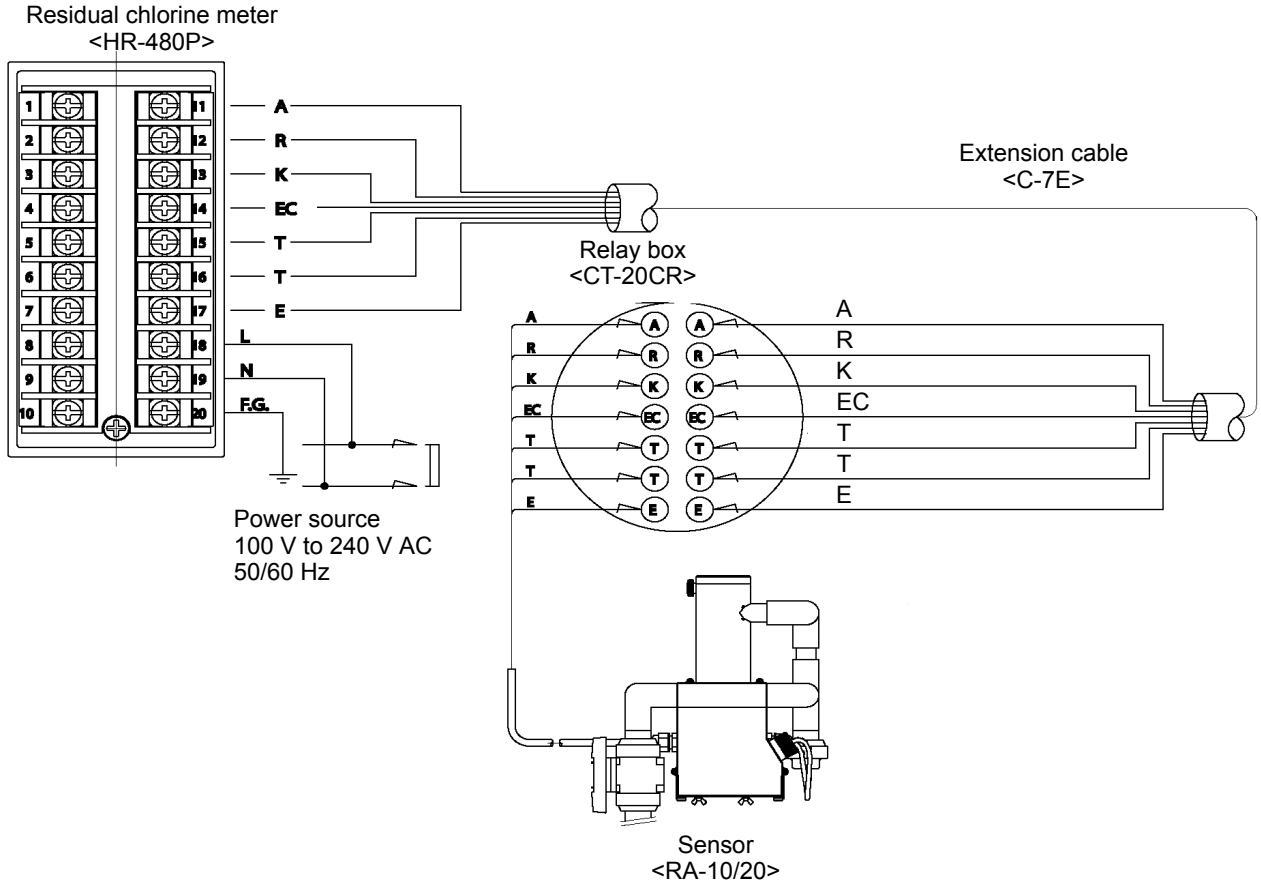
The sensor cable for the residual chlorine monitor is a high-insulation cable. In handling the sensor cable, pay attention to the following points.
In wiring the sensor cable and the extension cable, keep them away from a motor or any other inductive device, and their power cables.

Connections

The sensor cable has the following terminals.

A:	Anode terminal (brown)
R:	Reference electrode terminal (red)
K:	Cathode terminal (orange)
EC:	Electrical cleaning electrode terminal (yellow)
T, T:	Temperature compensation terminals (blue and green)
E:	Shielded terminal (black)

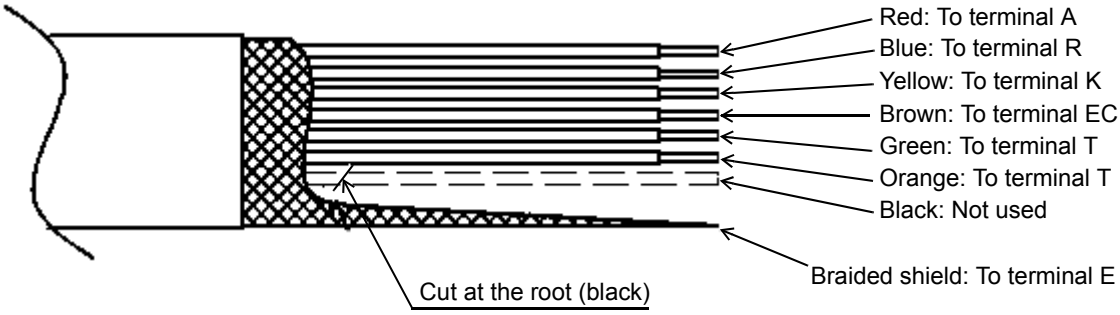
As shown in the following diagram, connect the sensor cable to the terminal block being careful not to make any mistakes in matching between terminals.



● Extending the sensor cable

- To lengthen the sensor cable, be sure to use a HORIBA Advanced Techno extension cable (C-7E) and relay box (CT-20CR) exclusively for this purpose.
- The maximum extendable length from the HR-480P to the sensor is 40 m.
- It is recommended that the dedicated extension cable be placed in a conduit to prevent static electricity from being generated by inductive vibration or the like. In this case, the piping near the converter should be passed through a flexible tube.

Terminal treatment method of C-7E cable

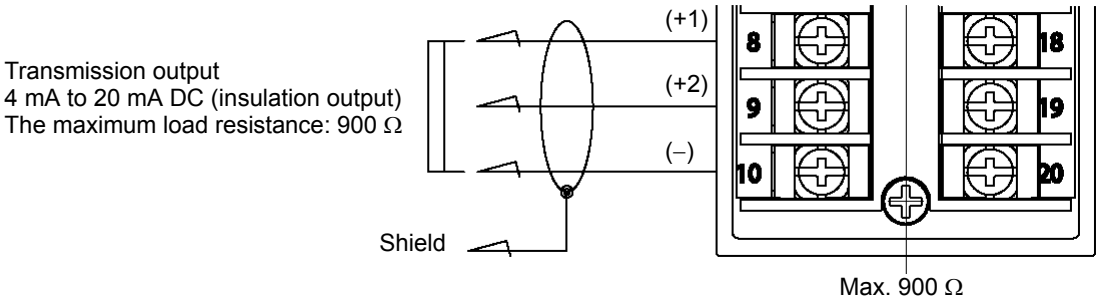


Connecting the transmission output cable

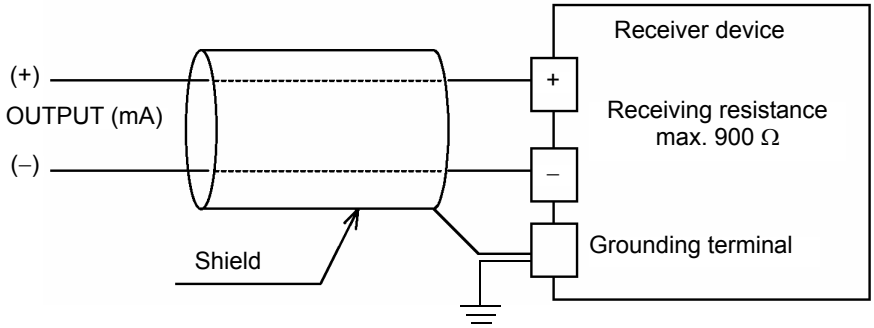
A signal of 4 mA to 20 mA DC corresponding to the measurement range is output.
The maximum allowable input resistance of the receiver device is 900 Ω.
Select an appropriate receiver device (recorder or meter relay).

Operation

1. **Connect the cable to the terminal block referring to the figure below.**
Use a shielded wire for the transmission cable.

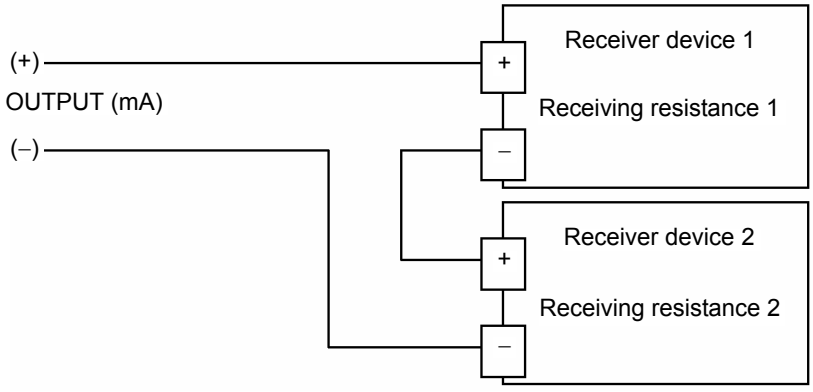


2. **Ground the shielded line via the grounding terminal of the receiver device side.**



● **When two or more receiver devices are connected.**

Connect them in a series as shown in the figure below.
The allowable total resistance of the connected receiver devices is max. 900 Ω.



⚠ WARNING

If there is a possibility of a lightning strike, install arresters on the output side and receiving converter side of the converter.

Connecting the power supply

WARNING

Electric shock
Be sure to turn OFF the power before wiring power source.
Do not turn ON the power until your work is completed.

About the power switch

This converter has no power switch. Install a power switch or circuit breaker around to turn ON/OFF the converter.

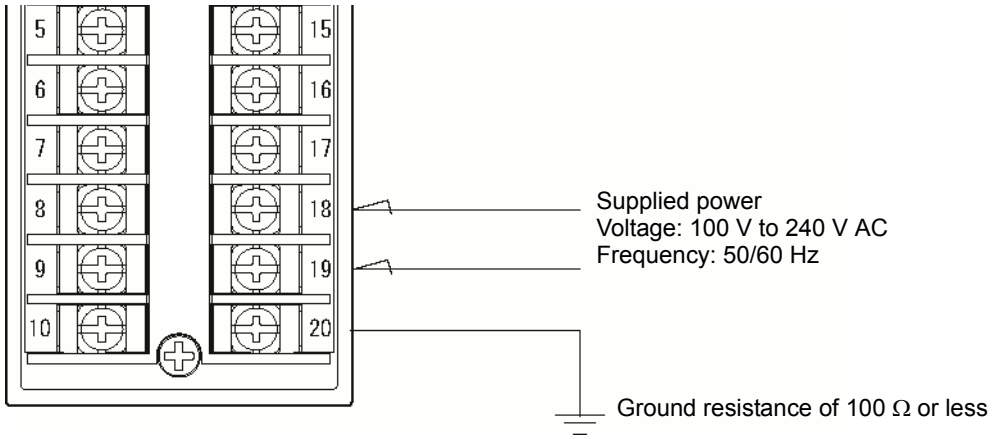
Connecting the power cable

The power supply of this converter is a free voltage power supply (100 V to 240 V AC, 50/60 Hz). The maximum power is 15 VA.

CAUTION

Operating the converter using a voltage out of the rated range may cause it to malfunction. Be sure to check the voltage of the power supply. Also make sure that the fluctuation of the power supply voltage is within the range of ±10% of the rated voltage.

Connect and ground the power cable referring to the figure below.



Note

Be sure to ground the converter (ground resistance of 100 Ω or less) to ensure performance of immunity and emission though the insulation is class 2 (double insulation). Separate the grounding for the converter from that of electrical devices such as a motor.

Double insulation structure

Attaching the terminal covers

Be sure to attach the terminal cover after wiring to the terminal block is completed.

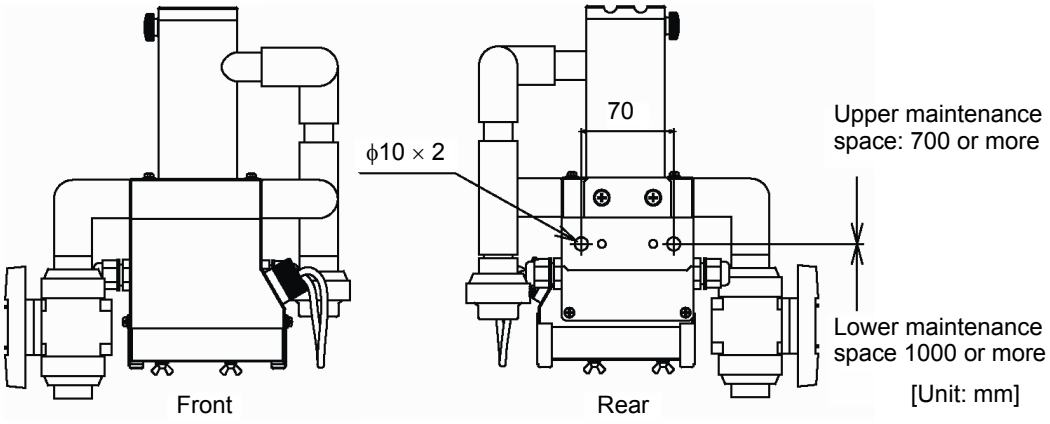
Installing the measurement cell

The measurement cell is installed on the wall or the pole (optionally available).

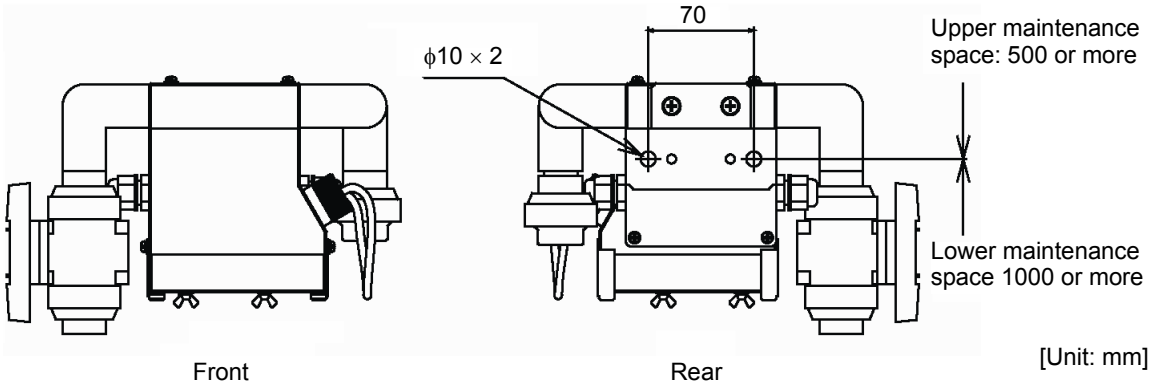
● For installation on the wall

To install the measurement cell on the vertical wall, use the holes in the base shown in the following figure and also M8 bolts.

● RA-10 (Overflow type)



● RA-20 (Inline type)

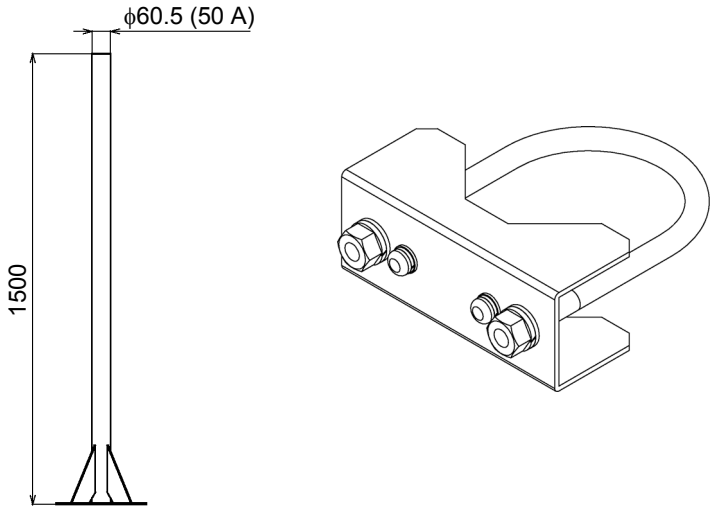


Note

Install the cell in parallel with the ground.
If the installed cell is oblique, beads cleaning may become impossible, preventing normal measurements from being made.

● For installation on the pole (Optionally available)

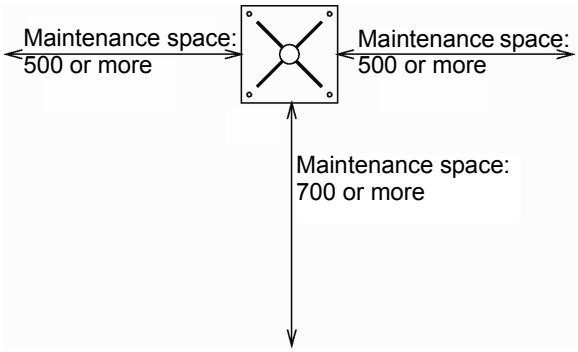
To install the cell on the pole, the optionally available pole stand and mounting brackets are required.



[Unit: mm]

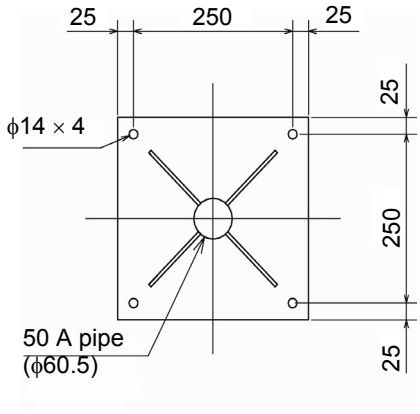
● Installing the cell (our standard product) on the pole stand

Provide a sufficient maintenance area as shown in the following figure.



[Unit: mm]

To install the pole stand, use M10 anchor bolts or the like so that the pole stand does not fall down.



[Unit: mm]

Note

Install the pole stand in a flat location. If the pole stand is installed in a tilted location, proper beads cleaning may become impossible, preventing normal measurements from being made.

Piping procedure

To ensure that measurements can be made in a stable state, carry out piping so that the following requirements are satisfied.
For piping connections, use a nominal 16 TS socket at the sample inlet and outlet.

● Piping for sample inlet

- Sample the liquid from a line where the flow rate less fluctuates.*1
- On the piping line, be sure to provide a bypass line.*2
- Install the reel filter (100 μm: optionally available) if the sample contains any dirt, solid, or the like.
- Use PVC piping and minimize its length without any bend.
- Lay the piping in a location where the sample is not frozen.*3

⚠ CAUTION

In piping the sample inlet, exercise extreme care because the piping may be disconnected when pressure is increased by manipulating the flow control valve, leading to a serious accident.

Note

For piping the sample inlet, do not use a braided hose or the like.If you still want to use a hose, use a designated HORIBA Advanced Techno hose.

***1: To lay the piping on a line where the flow rate fluctuates greatly, use the overflow-type sensor (RA-10), or constant flow valve or the like for the RA-20, so that a stable flow rate can be provided to the measurement cell.**

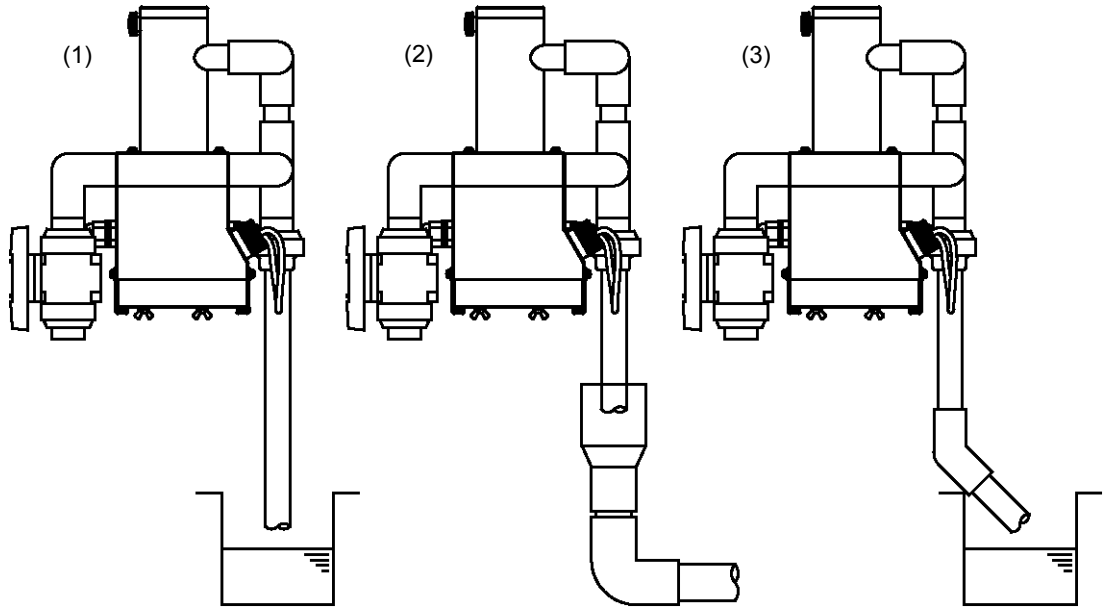
***2: If there is no bypass line, the entire system must be shut down when maintenance or replacement work is carried out.**

***3: If there is a possibility of freezing, take anti-freezing measures for the measurement section and the piping.**

● Piping for sample outlet (in the case of RA-10)

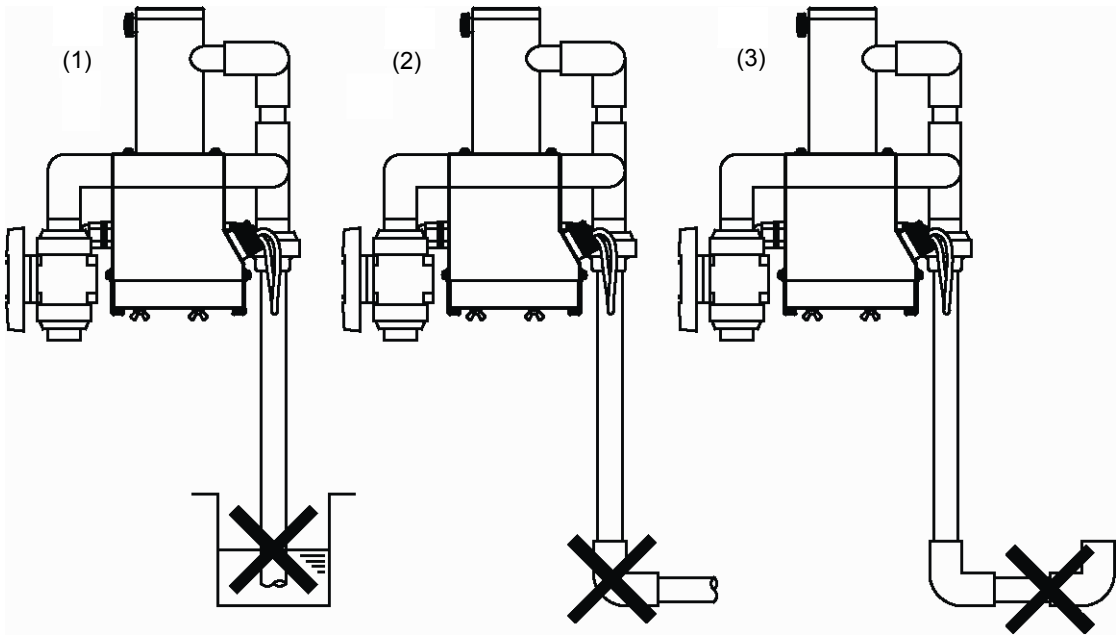
● Proper piping procedure

1. **Make the piping end open-air and minimize the piping length so that no back pressure is applied (1).**
2. **If the distance to the drain becomes long, provide an open-air portion and horizontally carry out piping with a pipe of 20 A or larger (2).**
3. **Carry out piping at falling gradient with no horizontal piping at right angles (piping: 16 A or larger)(3).**



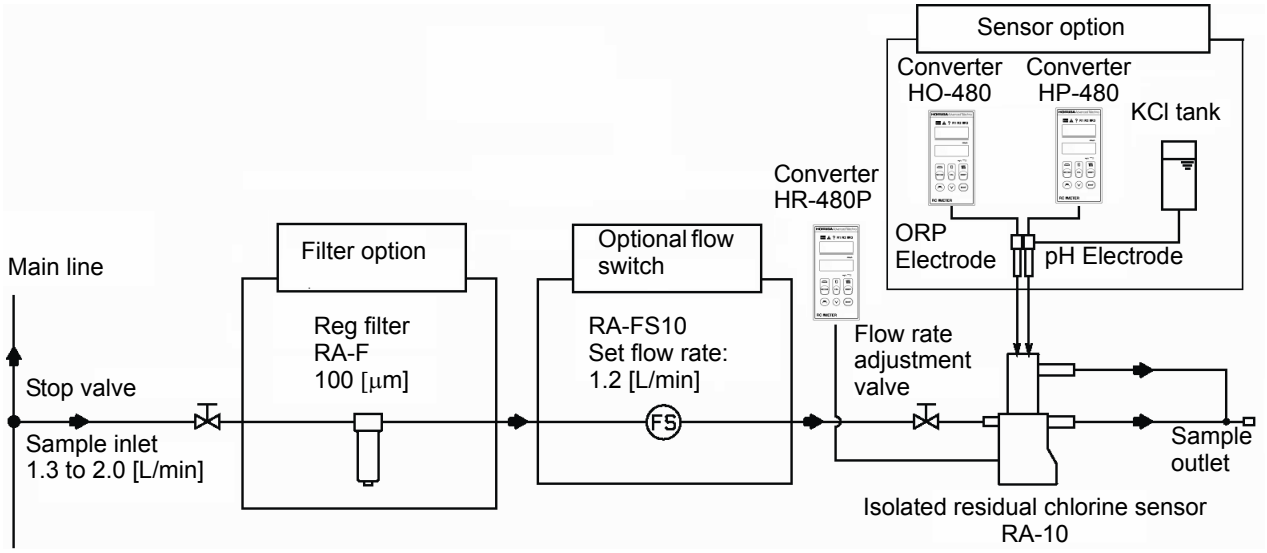
● Improper piping procedure

1. **Make the piping end open-air. Water seal piping is prohibited (1).**
2. **Horizontal piping is prohibited (2).**
3. **Uphill piping is prohibited (3).**



Example of recommended piping

● For RA-10 (Overflow type)

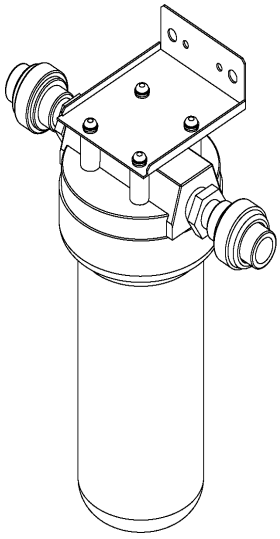


● Sensor option

For the overflow type, various types of sensors (pH and ORP electrodes) are available for optional installation (a converter is required).
The maintenance frequency can be reduced by using the KCl tank to refill the pH/ORP electrode with KCl.

● Filter option

If there is a possibility that solids or any other foreign matter may be included in the sample, use a reel filter. For the maintenance of the reel filter, install a stop valve before the filter.



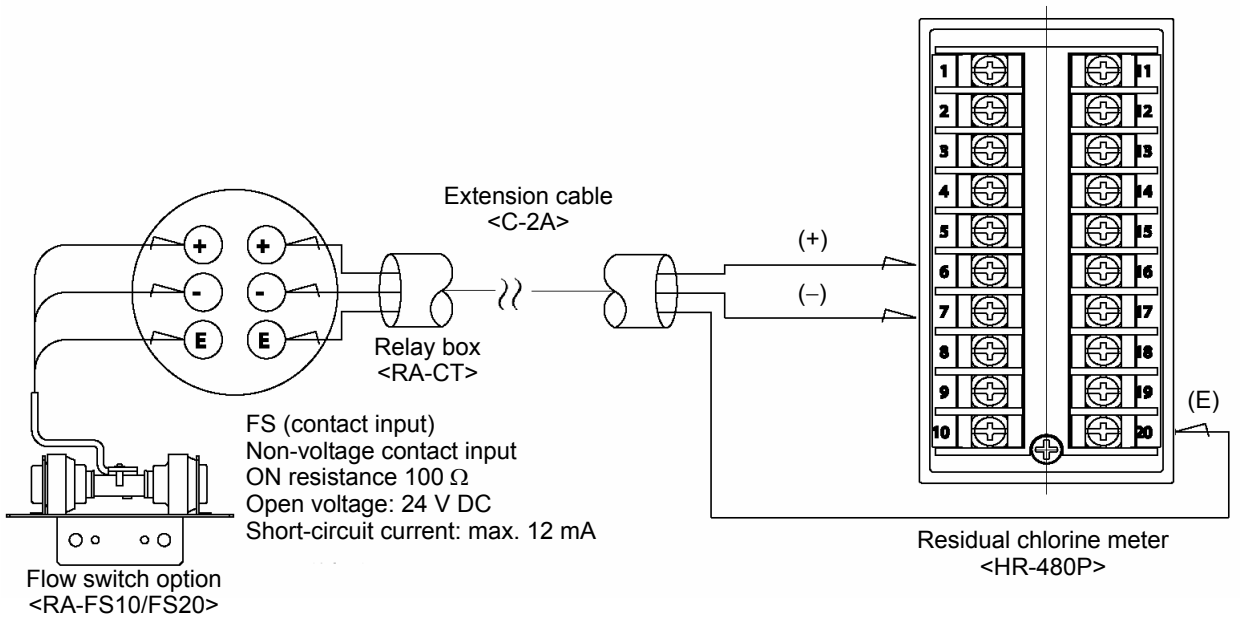
● Contact input (Flow switch option)

The residual chlorine monitor shows a great negative measurement error when the flow rate of the sample decreases below the specified value. Use the flow switch to prevent accidental over-injection due to a decreased flow rate when a chlorine agent is automatically injected.

Note

If the following conditions are not met, the flow switch will not function properly.

- **Be sure to install the flow switch horizontally.**
- **The flow switch has orientation. Install it in accordance with the caution plate (arrow).**
- **Install the flow switch with the cable-connected part oriented upward.**

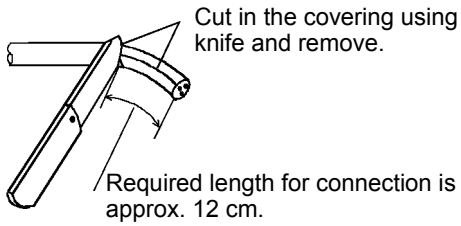


● C-2A extension cable terminal crimping

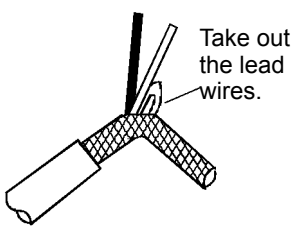
Crimp the terminals in the following procedure.

Operation

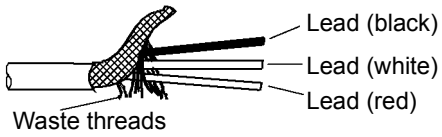
1. **Cut and remove the covering of the cable end.**



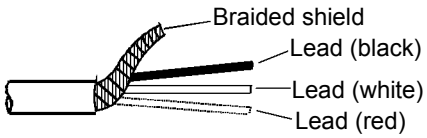
2. **Cut in the braided shield near the base, and take out the lead wires.**



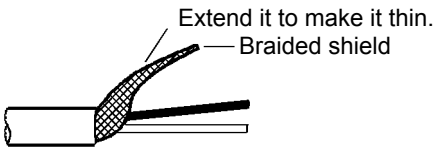
3. **Trim the cut edge.**



4. **Cut the lead wire (red) from its base.**

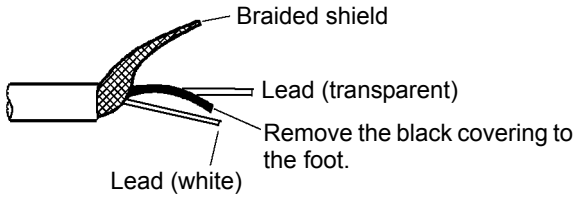


5. **Extend the braided shield to make it thin.**



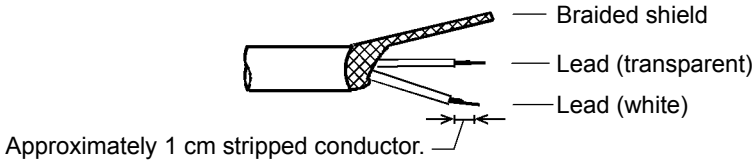
6. **Remove the covering of the lead wire (black), and a transparent lead wire will appear.**

Be sure to remove the covering (conducting plastic: black) to the base of the lead wire (transparent).

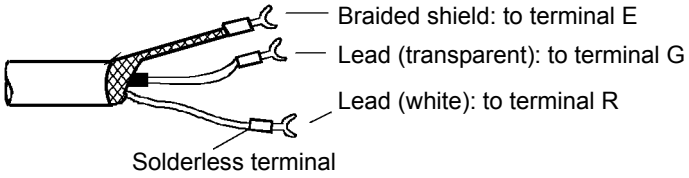


7. **Remove approximately 1 cm of covering from the end of each lead wire to strip the conductor wire.**

Be careful not to cut the conductor wire.



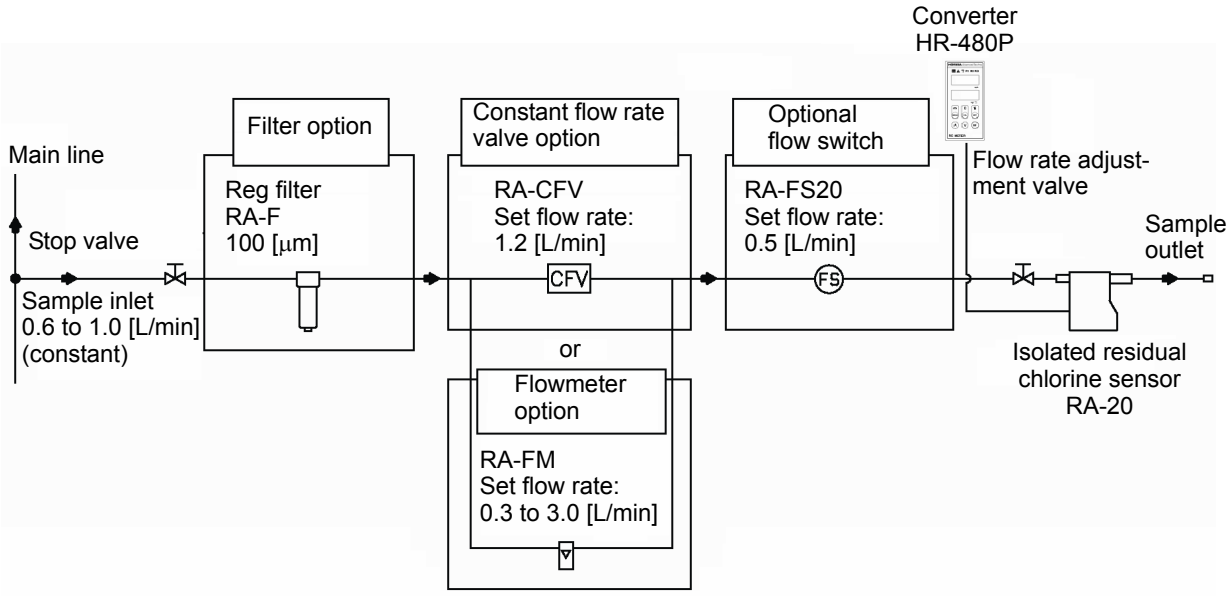
8. **Attach solderless terminal to the end of the leading wires, and crimp them securely using a crimp tool.**



9. **Pull the solderless terminals to confirm that they are crimped firmly.**

For RA-20 (Inline)

For the inline type, the measured liquid can be returned to the main line for the sample by maintaining the pressure difference between the sample inlet and outlet at least 0.01 MPa. When the constant flow valve is used, the pressure at the outlet may decline greatly. If the differential pressure cannot be maintained, a sampling pump must be used to increase the pressure.



Constant flow valve option

For the RA-20, the reading fluctuates depending on the varied flow rate of the sample. To sample the liquid from any line where the flow rate is not stable, be sure to use the constant flow valve.

Note

The constant flow valve has orientation. Install it in accordance with the caution plate (arrow).

Flowmeter option

When the flow rate of the sample decreases below the specified value, the residual chlorine monitor shows a great negative measurement error. Use the flowmeter to check that the proper flow rate is maintained in the measurement cell. When a chlorine agent is automatically injected, use the flow switch to prevent accidental over-injection due to a decreased flow rate.

Operation

Preparation for operation

When using the HR-480P for the first time after it has been shipped from the factory or reset to the factory settings, perform the following.

● Checking the wire

Check the following points.

- Confirm that the power cable (transmission cable) and the sensor cable are wired properly.
- Make sure the terminal block screws are tight.
- The voltage fluctuations fall within the range of 100 V to 240 V AC ±10%.

● Checking the flow

Operation

1. **Check the piping for any mistake.**
2. **Send tap water to check the piping for any leakage.**
   And, flush out foreign matter and the like in the piping.

Reference

Refer to " Example of recommended piping " (page 25).

● Checking the cathode electrode

Operation

1. **Check that the valve at the sample source is closed.**
2. **Loosen the sensor cap on the lateral side of the measurement cell, then remove the sensor holder.**
3. **Check that the cathode electrode is properly attached to the leading end of the sensor holder.**
4. **Insert the sensor holder into the measurement cell, then tightly close the sensor cap.**

Note

Ensure that the gold pole part on the surface of the cathode electrode is free from any flaw and dirt. Such flaws or dirt may affect measurements.

Reference

Refer to " Replacing the sensor (cathode electrode) " (page 67).

Checking beads

Operation

1. **Check that the valve at the sample source is closed.**
2. **Loosen the 2 thumbscrews located at the bottom of the beads cell, then remove the beads cell.**
3. **Fill the beads cell with one container of cleaning beads.**
4. **Install the beads cell.**

⚠ CAUTION

Check that there are no beads on the top of the beads cell or around the O-ring when installing the beads cell. If the cell is installed with beads attached to either part, the sample may leak out, affecting or damaging your peripheral equipment.

Note

- **Fill the beads cell with all the beads while taking care not to spill any of them. If the quantity of beads is too small, adequate cleaning might not be possible.**
- **When removing the beads cell, take care not to lose the O-ring (S30_EPDM).**
- **When replacing the beads, be sure to replace all the old beads with new ones.**

Reference

Refer to " Replacing the cleaning beads " (page 65).

Checking the flow rate and pressure

Operation

1. **Slowly open the valve at the sample source.**
2. **Use the flow control valve to regulate the flow rate at an appropriate value.**
   For the RA-10, the flow rate for sending the sample is 1.3 L/min to 2.0 L/min.
   For the RA-20, the flow rate for sending the sample is 0.6 L/min to 1.0 L/min (constant).
   Refer to " Checking the flow rate of the sample " (page 62).

Note

- **Gradually open the valve at the source. When the valve is fully opened at once, any flow rate or pressure exceeding the specified value, if applied, may cause the sample to overflow from the overflow cell, affecting or damaging your peripheral equipment.**
- **For RA-10**
  Check that the sample overflows. If not, the sample does not flow at a constant flow rate in the measurement cell, resulting in unstable measurements.
- **For RA-20**
  Control the flow rate and pressure so that the primary pressure does not exceed the specified value (0.5 MPa max.).

● Initial set up

When the converter is powered ON in the factory setting state, it starts up in the Maintenance mode.
Check the current settings referring to the Table 1.
If necessary, change settings following the instructions in " Basic setup menu " (page 34).
To finish the initial setup, press MEAS repeatedly until the MEAS lamp lights up to go to the measurement mode.
Once the initial setup is finished, the converter starts up in the measurement mode since then. This is the normal measurement mode.

Table 1 Basic setup items

Display	Item	Description	Initial value	Refer to page
PArA	Parameter setting			35
dFct	Number of moving averages (dumping factor)	Set the number of moving averages for measurements to be displayed.	10	35
F.in	Flow switch	Select whether the flow switch is used or not.	no	35
diSP	Display method			36
di9	Decimal place selection	Select the number of decimal places of residual chlorine value to be displayed in the sub-display during measurement.	3.00	36
SdSP	Sub-display	Select the item to be displayed on the sub-display during measurement.	non	36
r.cut	Measurement range cut ON/OFF	Select whether values outside the measurement range, are displayed or not.	yES	37
r1	Contact output: R1, R2 or R3 Tip **The R2 or R3 can be set in the same manner.**			38
1SEL	Control target	Select the control target of the contact output.	non	39
1rE	Reverse output	Select whether or not to invert the control output of the control target.	*	40
1H-L	Control direction	Select the limit operation, upper or lower.		40
1SEt	Control value	Set the control value, used as the criterion for switching the relay output ON/OFF.		41
1diF	Control width	Sets the same width is set both over and under the control value at the center.		41
1ond	Delay time (for relay ON)	Set the alarm output duration from the start until the C-NO contact output turns ON.		42
1oFd	Delay time (for relay OFF)	Set the alarm clear duration from the cancellation until the C-NO contact output turns OFF.		42

Display	Item	Description	Initial value	Refer to page
rF	FAIL output			43
SC	Sensor error	Specify whether or not to enable the FAIL output when the sensor error has occurred (E-75).	no	43
oF	Over full-scale	Specify whether or not to enable FAIL output when the measured value has exceeded the full-scale value.	no	43
tF	Temperature sensor error	Specify whether or not to enable FAIL output when the temperature sensor error has occurred (E-21 or E-22).	yES	43
tE	Temperature measurable range error	Specify whether or not to enable FAIL output when the temperature measurement range has been exceeded (E-25).	no	43
FLo	Flow switch input	Specify whether or not to enable FAIL output when the flow switch input has occurred (E-61).	no	43
Cur1	Transmission output: Cur1 or Cur2 Tip **The Cur2 can be set in the same manner.**			44
rng0	Zero point of the transmission output	Set the value interpreted as the zero point (4 mA).	Cur 1: 0.00 Cur 2: 0.0	44
rng5	Span point of the transmission output	Set the measurement value corresponding to the span point (20 mA) output.	Cur 1:3.00 Cur 2:100.0	45
Hold	Hold output	Select the hold method when the mode is switched from measurement to calibration.	Cur 1: yES Cur 2: yES	46
PrES	Preset hold	Set the value to be used for transmission output during hold output, which is relevant when the “PrES” has been selected in the hold output setting.	Cur 1: 3.00 Cur 2: 100.0	46
C.cut	Transmission output limit	Select the transmission output setting, whether values outside the range of 4 mA to 20 mA are output or not.	Cur 1: yES Cur 2: yES	47
CLn	Electrochemical cleaning			48
StAt	Electrochemical cleaning when the power is turned ON	Specify whether or not to enable cleaning when the power is turned ON.	no	48
FLo	Cleaning when the electrochemical flow switch has been reset	Specify whether or not to enable cleaning when the flow error has been reset.	no	48
CYC	Frequency of electrochemical cleaning	Specify the cleaning frequency in hours or days when the contact output type is “nor”, “or”, or “And”.	no	48
CLnt	Electrochemical cleaning time	Specify the cleaning time in seconds.	5	48
Ht	HOLD output time	Specify the HOLD output time in seconds after cleaning has been finished.	60	48

*: For relay output settings “r1”, “r2” and “r3”, the setting of initial value varies depending on the setting status of relay output target (“1.SEL”) as shown in the " Table 2 Initial values for control target and their available options " (page 33).

Table 2 Initial values for control target and their available options

Display	Initial value	Display is enable or not					
1.SEL	non	non	rc	t	FAiL	HoLd	CLn
1.rE	no	-	✓	✓	✓	✓	✓
1.H-L	H	-	✓	✓	-	-	-
1.SEt (rc)	3.00 mg/L	-	✓	-	-	-	-
1.SEt (t)	50.0°C	-	-	✓	-	-	-
1.diF (1.SEt (rc))	0.10 mg/L	-	✓	-	-	-	-
1.diF (1.SEt (t))	2.0°C	-	-	✓	-	-	-
1.ond	0 s	-	✓	✓	✓	✓	-
1.oFd	0 s	-	✓	✓	✓	-	-

Tip

Press MEAS to return to the menu one tier up.

Calibration

Operation

1. **Carry out the warm-up for at least 3 h (for break-in) after turning ON the power of the converter.**
2. **Check that the reading has been stabilized.**
3. **Refer to the following pages to carry out residual chlorine concentration calibration and the temperature calibration.**
   - Refer to " Residual chlorine concentration calibration " (page 49).
   - Refer to " Temperature calibration " (page 52).

Tip

It is possible to short the stabilizing time by performing the electrochemical cleaning for 5 seconds after staring the water supply.

Measurement

Measurement mode

Power ON the residual chlorine meter with the " Preparation for operation " (page 29) is completed, and the residual chlorine meter will start up in the measurement mode.

1. **Turn the power ON.**
   The measurement target appears on the main display.
   The measurement range is then displayed and the converter enters the measurement mode.
   After the measurement value is displayed, the measurement starts.
   This is the normal measurement mode.

Basic settings

Enter the maintenance mode to set up the measurement conditions, display settings, calibration method, contact output, and transmission output.

■ Precautions

- Previous value hold is used for transmission output.
- Contact outputs are the following status:
  - OFF when the control target is set to non, rc or t
  - ON when the control target is set to Hold
  - FAIL when the control target is set to FAiL and a system error occurs.

■ Basic setup menu

● How to open basic setup menus

1. **Hold down MNT in the measurement mode until the MNT lamp lights up.**
   “SEt” will be displayed on the main display.
2. **Press ENT**
   “PArA” will be displayed on the sub display.
3. **Press ▲/▼ to display the item to be set up on the sub-display.**
   The displays shown on the sub-display and setting items are shown in the " Table 1 Basic setup items " (page 31).
4. **Press ENT.**
   It is ready to adjust the setting items.

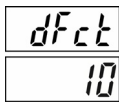
● Parameter setting

● Number of moving averages (dumping factor)

Set the number of moving averages for measurements to be displayed.

Operation

1. **Open “Parameter setting” referring to " How to open basic setup menus " (page 34).**
   “dFct” will be displayed on the main display.



: Current setting

2. **Press ENT.**
   The sub-display starts blinking. Now you can change the setting.
3. **Press ▲/▼ to adjust the value.**
   ▲: Increments the value by one.
   ▼: Decrements the value by one.
   The allowable value is 1 to 120.
4. **Press ENT to establish the setting.**

Tip

- **Press ▼ to set other items of “Parameter setting”.**
- **Press MEAS to return to the basic setup menu.**

● Flow switch

Select whether the flow switch is used or not.

1. **Open “Parameter setting” referring to " How to open basic setup menus " (page 34).**
   “dFct” will be displayed on the main display.

Operation

2. **Display “F.in” on the main display using ▼, and press ENT.**
   The sub-display starts blinking. Now you can change the setting.
3. **Press ▲/▼ to set a setting.**
   ▲ (yES): Uses the flow switch.
   ▼ (no): Does not use the flow switch.
4. **Press ENT to establish the setting.**

Tip

- **Press ▲ to set other items of “Parameter setting”.**
- **Press MEAS to return to the basic setup menu.**

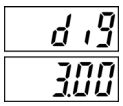
● Display method

● Decimal place selection

Select the number of decimal places of residual chlorine value to be displayed in the sub-display during measurement.

Operation

1. **Open “Display method” referring to " How to open basic setup menus " (page 34).**
   “dig” will be displayed on the main display.



: Current setting

2. **Press ENT.**
   The sub-display starts blinking. Now you can change the setting.
3. **Press ▲/▼ to set a setting.**
   ▲ (3.00): Displays down to the second decimal place.
   ▼ (3.0): Displays down to the first decimal place.

Tip

The computation is always made down to the second decimal place even if this setting has been set to the first decimal place.

4. **Press ENT to establish the setting.**

Tip

- **Press ▼ to set other items of “Display method”.**
- **Press MEAS to return to the basic setup menu.**

● Sub-display

Select the item to be displayed on the sub-display during measurement.

Operation

1. **Open “Display method” referring to " How to open basic setup menus " (page 34).**
   “dig” will be displayed on the main display.
2. **Display “S.dSP” on the main display using ▼, and press ENT.**
   The sub-display starts blinking. Now you can change the setting.
3. **Press ▲/▼ to set a setting.**
   non: Nothing is displayed.
   1.SEt: Control value of relay 1
   2.SEt: Control value of relay 2
   3.SEt: Control value of relay 3
   t: Temperature
4. **Press ENT to establish the setting.**

Tip

- **Press ▲/▼ to set other items of “Display method”.**
- **Press MEAS to return to the basic setup menu.**

● Measurement range cut ON/OFF

Select whether values outside the measurement range, are displayed or not.

Operation

1. **Open “Display method” referring to " How to open basic setup menus " (page 34).**
   “dig” will be displayed on the main display.
2. **Display “r.cut” on the main display using ▼, and press ENT.**
   The sub-display starts blinking. Now you can change the setting.
3. **Press ▲/▼ to set a setting.**
   ▲ (yES): Values outside the measurement range are not displayed.
   ▼ (no): Values outside the measurement range are displayed.
4. **Press ENT to establish the setting.**

Tip

- **Press ▲ to set other items of “Display method”.**
- **Press MEAS to return to the basic setup menu.**

● Contact output: R1, R2 or R3

Set control actions for R1, R2, or R3 respectively.
This section explains the setup procedures using R1 as an example. Set up the R2 or R3 actions in the same way.
The following control items can be set:

Table 3 Contact output: the setting items for R1 (R2, R3)

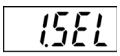
Display	Item	Description	Refer to page
1.SEL	Control target	Select the control target of the contact output.	39
When the control target has been set to “rc”, “t”, “FAiL”, “Hold” or “CLn”			
1.rE	Reverse output	Select whether or not to invert the control output of the control target.	40
When the control target has been set to “rc” or “t”			
1.H-L	Control direction	Select the limit operation, upper or lower.	40
1.SEt	Control value	Set the control value, used as the criterion for switching the relay output ON/OFF.	41
1.dIF	Control width	Sets the same width is set both over and under the control value at the center.	41
When the control target has been set to “rc”, “t”, “FAiL” or “Hold”.			
1.ond	Delay time (for relay ON)	Set the alarm output duration from the start until the C-NO contact output turns ON.	42
When the control target has been set to “rc”, “t” or “FAiL”.			
1.oFd	Delay time (for relay OFF)	Set the alarm clear duration from the cancellation until the C-NO contact output turns OFF.	42

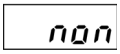
● Control target

Select the control target of the contact output.

Operation

1. **Open “Contact output” referring to " How to open basic setup menus " (page 34).**
   “1.SEL” will be displayed on the main display.

   : Current setting
2. **Press ENT.**
   The sub-display starts blinking. Now you can change the setting.
3. **Press ▲/▼ to set a setting.**
   non (No target):
   Disables the contact output.
   rc (Measured value):
   Controls the contact output using the residual chlorine value of sampled liquid.
   t (Temperature):
   Controls the temperature using the measured liquid temperature.
   FAiL (FAIL):
   Outputs an alarm if “FAIL” is detected.
   HoLd (During maintenance):
   Outputs the “during maintenance” signal during error generation, calibration, or maintenance.
   CLn (During cleaning):
   Outputs the signal during cleaning (including HOLD time after cleaning).
4. **Press ENT to establish the setting.**

Tip

- **Press ▼ to set other items of “Contact output: R1, R2 or R3”.**
- **Press MEAS to return to the basic setup menu.**

● Reverse output

Select whether or not to invert the control output of the control target.
Use the reverse control output only when the control target has been set to “FAiL”.

Note

When this function is enable, the target of the delay time setting is also reversed. To delay the FAIL output, use the delay time setting for relay OFF.

Operation

1. **Open “Contact output” referring to " How to open basic setup menus " (page 34).**
   “1.SEL” will be displayed on the main display.
2. **Display “1.rE” on the main display using ▼, and press ENT.**
   The sub-display starts blinking. Now you can change the setting.
3. **Press ▲/▼ to set a setting.**
   ▲ (yES): The control output is reversed.
   ▼ (no): The control output is not reversed.
4. **Press ENT to establish the setting.**

Tip

- **Press ▲/▼ to set other items of “Contact output: R1, R2 or R3”.**
- **Press MEAS to return to the basic setup menu.**

How to output FAIL during power OFF

When the following settings are made, the line between C and NO for both of power shutdown and FAIL output becomes open.

- Connect a cable between C and NO.
- Set the control target to FAiL.
- Set the reverse (yES) output setting.

● Control direction

Select the limit operation, upper or lower.

Operation

1. **Open “Contact output” referring to " How to open basic setup menus " (page 34).**
   “1.SEL” will be displayed on the main display.
2. **Display “1.H-L” on the main display using ▼, and press ENT.**
   The sub-display starts blinking. Now you can change the setting.
3. **Press ▲/▼ to set a setting.**
   ▲ (H): Upper limit operation.
   ▼ (L): Lower limit operation.
4. **Press ENT to establish the setting.**

Tip

- **Press ▲/▼ to set other items of “Contact output: R1, R2 or R3”.**
- **Press MEAS to return to the basic setup menu.**

● Control value

Set the control value, used as the criterion for switching the relay output ON/OFF.

Operation

1. **Open "Contact output" referring to " How to open basic setup menus " (page 34).**
   "1.SEL" will be displayed on the main display.
2. **Display "1.SEt" on the main display using ▼, and press ENT.**
   The sub-display starts blinking. Now you can change the setting.
3. **Press ▲/▼ to adjust the value.**
   - When the set value of "1.SEL" is "rc":
     ▲: Increments in units of 0.01.
     ▼: Decrements in units of 0.01.
     The setting range is 0.00 mg/L to 3.00 mg/L.
   - When the set value of "1.SEL" is "t":
     ▲: Increments in units of 0.1°C.
     ▼: Decrements in units of 0.1°C.
     The setting range is 0.0°C to 100.0°C.
4. **Press ENT to establish the setting.**

Tip

- **Press ▲/▼ to set other items of "Contact output: R1, R2 or R3".**
- **Press MEAS to return to the basic setup menu.**

● Control width

Sets the same width is set both over and under the control value at the center.

Operation

1. **Open "Contact output" referring to " How to open basic setup menus " (page 34).**
   "1.SEL" will be displayed on the main display.
2. **Display "1.diF" on the main display using ▼, and press ENT.**
   The sub-display starts blinking. Now you can change the setting.
3. **Press ▲/▼ to adjust the value.**
   - When the set value of "1.SEL" is "rc":
     ▲: Increments the value by 0.01.
     ▼: Decrements the value by 0.01.
     The setting range is 0.00 mg/L to 0.60 mg/L.
   - When the set value of "1.SEL" is "t":
     ▲: Increments in units of 0.1°C.
     ▼: Decrements in units of 0.1°C.
     The setting range is 0.0°C to 10.0°C.
4. **Press ENT to establish the setting.**

Tip

- **Press ▲/▼ to set other items of "Contact output: R1, R2 or R3".**
- **Press MEAS to return to the basic setup menu.**

● **Delay time (for relay ON)**

Set the alarm output duration from the start until the C-NO contact output turns ON.

Operation

1. **Open “Contact output” referring to " How to open basic setup menus " (page 34).**
   “1.SEL” will be displayed on the main display.
2. **Display “1.ond” on the main display using ▼, and press ENT.**
   The sub-display starts blinking. Now you can change the setting.
3. **Press ▲/▼ to adjust the delay time (seconds).**
   ▲: Increments the value by one second.
   ▼: Decrements the value by one second.
   The setting range is 0 seconds to 600 seconds.
4. **Press ENT to establish the setting.**

Tip

- **Press ▲/▼ to set other items of “Contact output: R1, R2 or R3”.**
- **Press MEAS to return to the basic setup menu.**

● **Delay time (for relay OFF)**

Set the alarm clear duration from the cancellation until the C-NO contact output turns OFF.

Operation

1. **Open “Contact output” referring to " How to open basic setup menus " (page 34).**
   “1.SEL” will be displayed on the main display.
2. **Display “1.oFd” on the main display using ▼, and press ENT.**
   The sub-display starts blinking. Now you can change the setting.
3. **Press ▲/▼ to adjust the delay time (seconds).**
   ▲: Increments the value by one second.
   ▼: Decrements the value by one second.
   The allowable value is 0 seconds to 600 seconds.
4. **Press ENT to establish the setting.**

Tip

- **Press ▲ to set other items of “Contact output: R1, R2 or R3”.**
- **Press MEAS to return to the basic setup menu.**

● FAIL output

Set up the specifications related to FAIL output.

Table 4 Setting items for FAIL output

Display	Item	Description	Setting range	Initial value
SC no	Sensor error	Specify whether or not to enable the FAIL output when the sensor error has occurred (E-75).	yES, no	no
oF no	Over full-scale	Specify whether or not to enable FAIL output when the measured value has exceeded the full-scale value.	yES, no	no
tF YES	Temperature sensor error	Specify whether or not to enable FAIL output when the temperature sensor error has occurred (E-21 or E-22).	yES, no	yES
tE YES	Temperature measurable range error	Specify whether or not to enable FAIL output when the temperature measurement range has been exceeded (E-25).	yES, no	no
FLo no	Flow switch input	Specify whether or not to enable FAIL output when the flow switch input has occurred (E-61).	yES, no	no

● Transmission output: Cur1 or Cur2

Set up the specifications related to transmission output.

Table 5 Settings for transmission output

Display	Item	Description	Refer to page
rng.0	Zero point of the transmission output	Set the value interpreted as the zero point (4 mA).	44
rng.S	Span point of the transmission output	Set the measurement value corresponding to the span point (20 mA) output.	45
HoLd	Hold output	Select the hold method when the mode is switched from measurement to calibration.	46
PrES	Preset hold	Set the value to be used for transmission output during hold output, which is relevant when the “PrES” has been selected in the hold output setting.	46
C.cut	Transmission output limit	Select the transmission output setting, whether values outside the range of 4 mA to 20 mA are output or not.	47

● Zero point of the transmission output

Set the value interpreted as the zero point (4 mA).

Operation

1. **Open “Transmission output” referring to " How to open basic setup menus " (page 34).**
   “rng.0” will be displayed on the main display.

   : Current setting
2. **Press ENT.**
   The sub-display starts blinking. Now you can change the setting.
3. **Press ▲/▼ to specify residual chlorine value or temperature corresponding to the zero point output.**
   - For Cur1:
     ▲: Increments the value by 0.01 mg/L.
     ▼: Decrements the value by 0.01 mg/L.
     The allowable value is 0.00 mg/L to 5.00 mg/L.
   - For Cur2:
     ▲: Increments in units of 0.1°C.
     ▼: Decrements in units of 0.1°C.
     The allowable value is 0.0°C to 110.0°C.
4. **Press ENT to establish the setting.**

Tip

- **Press ▼ to set other items of “Transmission output: Cur1 or Cur2”.**
- **Press MEAS to return to the basic setup menu.**

● Span point of the transmission output

Set the measurement value corresponding to the span point (20 mA) output.

Operation

1. **Open "Transmission output" referring to " How to open basic setup menus " (page 34).**
   "rng.0" will be displayed on the main display.
2. **Display "rng.S" on the main display using ▼, and press ENT.**
   The sub-display starts blinking. Now you can change the setting.
3. **Press ▲/▼ to specify residual chlorine value or temperature corresponding to the span point output.**
   - For Cur1:
     ▲: Increments the value by 0.01 mg/L.
     ▼: Decrements the value by 0.01 mg/L.
     The allowable value is 0.00 mg/L to 5.00 mg/L.
   - For Cur2:
     ▲: Increments in units of 0.1°C.
     ▼: Decrements in units of 0.1°C.
     The allowable value is 0.0°C to 110.0°C.
4. **Press ENT to establish the setting.**

Note

If the zero point and span point are set to the same value, the actual output is fixed to 20 mA.

Tip

- **Press ▲/▼ to set other items of "Transmission output: Cur1 or Cur2".**
- **Press MEAS to return to the basic setup menu.**

● Hold output

Select the hold method when the mode is switched from measurement to calibration.

Tip

When the mode is switched to maintenance, previous value hold is used as the hold value.

Operation

1. **Open “Transmission output” referring to " How to open basic setup menus " (page 34).**
   “rng.0” will be displayed on the main display.
2. **Display “HoLd” on the main display using ▼, and press ENT.**
   The sub-display starts blinking. Now you can change the setting.
3. **Press ▲/▼ to set a setting.**
   ▲ (yES): previous value is used as the hold value (Previous value hold).
   ▼ (PrES): A preset value is used as the hold value (Preset hold).
4. **Press ENT to establish the setting.**

Tip

- **Press ▲/▼ to set other items of “Transmission output: Cur1 or Cur2”.**
- **Press MEAS to return to the basic setup menu.**

● Preset hold

Set the value to be used for transmission output during hold output, which is relevant when the “PrES” has been selected in the hold output setting.

Operation

1. **Open “Transmission output” referring to " How to open basic setup menus " (page 34).**
   “rng.0” will be displayed on the main display.
2. **Display “PrES” on the main display using ▼, or press ENT.**
   The sub-display starts blinking. Now you can change the setting.
3. **Press ▲/▼ to specify residual chlorine value or temperature to output as the hold value.**
   - For Cur1:
     ▲: Increments the value by 0.01 mg/L.
     ▼: Decrements the value by 0.01 mg/L.
     The setting range is 0.00 mg/L to 5.00 mg/L.
   - For Cur2:
     ▲: Increments in units of 0.1°C.
     ▼: Decrements in units of 0.1°C.
     The setting range is 0.0°C to 110.0°C.
4. **Press ENT to establish the setting.**

Tip

- **Press ▲/▼ to set other items of “Transmission output: Cur1 or Cur2”.**
- **Press MEAS to return to the basic setup menu.**

● Transmission output limit

Select the transmission output setting, whether values outside the range of 4 mA to 20 mA are output or not.

Operation

1. **Open “Transmission output” referring to " How to open basic setup menus " (page 34).**
   “rng.0” will be displayed on the main display.
2. **Display “C.cut” on the main display using ▼, and press ENT.**
   The sub-display starts blinking. Now you can change the setting.
3. **Press ▲/▼ to set a setting.**
   ▲ (yES): Values under the zero point or over the span point are not output.
   ▼ (no): Values below the zero point or over the span point are output.
4. **Press ENT to establish the setting.**

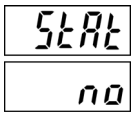
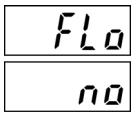
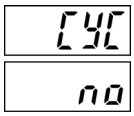
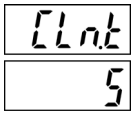
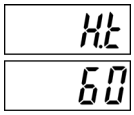
Tip

- **Press ▲ to set other items of “Transmission output: Cur1 or Cur2”.**
- **Press MEAS to return to the basic setup menu.**

● Electrochemical cleaning

Set up the electrochemical cleaning options.

Table 6 Setting items for electrochemical cleaning

Display	Item	Description	Setting range	Initial value
	Electrochemical cleaning when the power is turned ON	Specify whether or not to enable cleaning when the power is turned ON. “no”: Disables cleaning. “yES”: Enables cleaning.	yES, no	no
	Cleaning when the electrochemical flow switch has been reset	Specify whether or not to enable cleaning when the flow error has been reset. “no”: Disables cleaning. “yES”: Enables cleaning.	yES, no	no
	Frequency of electrochemical cleaning	Specify the cleaning frequency in hours or days when the contact output type is “nor”, “or”, or “And”.	no 1, 2, 3, 4, 6, 8, 12 (h) 1, 2, 4, 5, 6, 7 (day)	no
	Electrochemical cleaning time	Specify the cleaning time in seconds.	5 to 600 (s)	5
	HOLD output time	Specify the HOLD output time in seconds after cleaning has been finished.	10 to 600 (s)	60

Calibration menu

The calibration is classified into the zero calibration, the span calibration, and the temperature calibration.

Note

After first turning ON power or replacing the sensor, be sure to perform the calibration.

Residual chlorine concentration calibration

The residual chlorine concentration calibration is classified into the zero calibration and the span calibration.
In the zero calibration, the zero liquid is sent to the measurement cell to calibrate the zero point.
In the span calibration, the electrical zero calibration is combined with the value measured by the DPD method. More accurate calibration is made possible by performing the zero calibration after the span calibration.

Tip

The Span Cal mode can be made active directly by holding down CAL in the measurement mode.

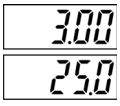
Note

When the Hold mode is selected, the transmission output becomes the value specified on the Setup menu. Refer to " Hold output " (page 46).

Operation

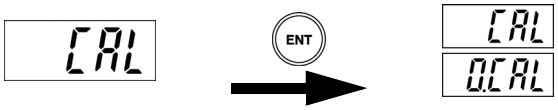
Enter the Cal mode from the measurement mode.

1. **Hold down HOLD until the HOLD indicator lights up in the measurement mode.**
   The Hold mode will become active with HOLD displayed at the upper left part.



: Current setting

2. **Use the arrow keys ▼ and select "CAL" on the measured value display, then press ENT.**
   The calibration mode will become active with **"**0.CAL**"** displayed on the auxiliary display.



   Carry out the calibration in accordance with the operation procedures for the zero and span calibration described on the next and subsequent pages.

Tip

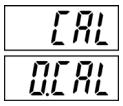
To cancel calibration when calibration is in process, press ESC. Returns to Cal menu or Hold mode without calibration data change.

● Zero calibration

The zero calibration allows you to more accurately calibrate the zero point by sending the zero liquid.

Operation

1. **Enter the Cal mode by performing the operation described in " Calibration menu " (page 49), then go to the Zero Cal screen.**



: Current setting

2. **Send the zero liquid to the measurement cell.**
3. **To carry out the zero calibration, press ENT.**
   The zero calibration will start with the measured value blinking on the measured value display.
   When the reading becomes stable, press ENT.
   The measured value will stop blinking and “good” is appeared on the display, indicating the completion of the calibration.

: Current setting

4. **Send the liquid under measurement.**

Now the zero calibration is complete. The display returns to the Cal mode.

Tip

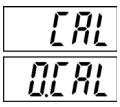
To return to the measure mode, press MEAS.
The Hold mode is canceled, returning to the measurement mode.

● Span calibration

In the calibration, the electrical zero calibration is first carried out automatically.
The span calibration is performed using the value of the sample measured by the DPD method.

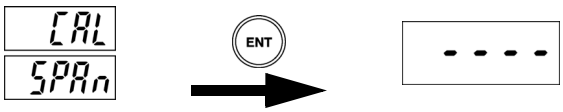
Operation

1. **Enter the Cal mode by performing the operation described in " Calibration menu " (page 49), then go to the Zero Cal screen.**



: Current setting

2. **Use the arrow keys ▼ and select "SPAn" on the auxiliary display, then press ENT.**
The zero calibration will start with "- - - -" blinking on the measured value display.
When the zero calibration is finished, the measured value blinks on the measured value display.

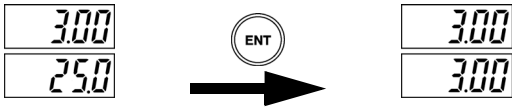


Proceed to the span calibration.

3. **Use a residual chlorine tester (using the DPD method) or the like to measure the sample that is currently sent.**

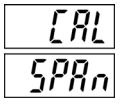
:

4. **When the measured value becomes stable, press ENT.**

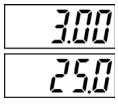


5. **The value will start blinking at the auxiliary display.**
Use the arrow keys ▲/▼ to adjust the reading to the residual chlorine value measured with a residual chlorine tester (using the DPD method) or the like.
▲: Changes the value in increments of 0.01 mg/L.
▼: Changes the value in decrements of 0.01 mg/L.
The input range is between 0.01 mg/L and 5.00 mg/L.

6. **Press ENT. The sub-display starts blinking.**
At this point, the new calibration value is applied. Now the span calibration is complete. The display returns to the Cal menu or the Hold mode.



When you perform the calibration via the Cal menu:



When you hold down CAL to enter the Span Cal mode, then perform the calibration:

Temperature calibration

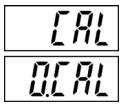
Temperature calibration is used to correct temperature.

Note

- **Check the temperature of the sample that is currently being sent and equalize the temperature of the sensor with this value.**
- **When the Hold mode is selected, the transmission output becomes the value specified on the Setup menu.**
  Refer to " Hold output " (page 46).

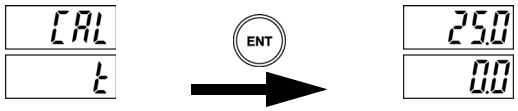
Operation

1. **Enter the measurement mode by performing the operation described in " Calibration menu " (page 49), then go to the Zero Cal screen.**



: Current setting

2. **Use the arrow keys ▼ and select “t” on the auxiliary display, then press ENT.**
   The Temp Cal mode will become active and the auxiliary display part will start blinking.



3. **Use the arrow keys ▲/▼ to adjust the value displayed on the measured value display to the water temperature.**
   ▲: Changes the value in increments of 0.1°C.
   ▼: Changes the value in decrements of 0.1°C.
   The setting range is between –5.0°C and 5.0°C.
4. **Press ENT.**
   The temperature calibration coefficient will be updated.
   Now the temperature calibration is complete.The display returns to the Cal menu.

Tip

- **To cancel calibration when calibration is in process, press MEAS.**
  You will return to the Cal menu without updating the calibration data.
- **To subsequently set any other calibration parameters, use the arrow keys ▲/▼ to select parameter to be set.**
- **To return to the measurement mode, hold down MEAS.**
  The Hold mode is canceled, returning to the measurement mode.

■ Control value setup menu

This menu allows you to change the following control-related settings while performing measurements in the measurement mode.

Table 7 Setting items for control value setup menu

Display	Item	Description	Refer to page
dFct	Number of moving averages (dumping factor)	Set the number of moving averages for measurements to be displayed.	35
When measurement value “rc”, temperature “t”, FAIL “FAil”, during maintenance “HoLd”, or during cleaning “CLn” has been selected in " Control target " (page 39)			
r 1	Contact output: R1, R2 or R3	Set up the control actions. R1 is assumed as an example to explain the setup procedure. To set R2 and R3, read R1 as R2 and R3, respectively.	38
When measurement value “rc” or temperature “t” has been selected in " Control target " (page 39)			
1.SEt	Control value	Set the control value, used as the criterion for switching the relay output ON/OFF.	41
1.d iF	Control width	Sets the same width is set both over and under the control value at the center.	41
When measurement value “rc”, temperature “t”, FAIL “FAil”, or during maintenance “HoLd” has been selected in " Control target " (page 39)			
1.ond	Delay time (for relay ON)	Set the alarm output duration from the start until the C-NO contact output turns ON.	42
1.oFd	Delay time (for relay OFF)	Set the alarm clear duration from the cancellation until the C-NO contact output turns OFF.	42
CLn	Electrochemical cleaning	Test the wait time to start the automatic cleaning, and the electrochemical cleaning.	48
1.59.59	Wait time to start the automatic cleaning	Indicate the time (hours, minutes, seconds) which will take before the next cleaning starts. * For the wait time of 10 hours or longer, indicate it in hours and minutes. If the electrochemical frequency was set to “no”, “- - - -” is displayed.	-
tESt	Electrochemical cleaning test	The cleaning will continue to be performed while ENT is held down. After ENT has been released, the cleaning is performed, then the output will be held for the HOLD time.	-

Operation

1. **Press MNT in the measurement mode.**
   “dFct” will be displayed on the sub-display.
   The main display keeps showing a measured value.
2. **Press ▲/▼ to display on the sub-display, then press ENT.**
   The setting items are displayed in the order shown in the Table 7.
3. **Change the setting, referring to the instruction page of the selected item.**

Tip

If you do not operate any keys for 10 seconds during item selection, this function is closed automatically (the display returns to the normal measurement status).
During setting change, this function is always open.

Security menu

This menu allows you two functions:
Key lock, to prevent accidental operation, and password lock, to prevent illegal operation.

Key lock

This function prevents accidental key operation, which may cause unintended setting change or hold output.

Set up

1. **Hold down MEAS in the measurement mode displayed until “Lock” for the set up menu and “on” on the sub-display respectively.**
   The key lock displayed function starts working. Releasing the key lets the converter return to the measurement mode, and the setup for the key locking is completed.
   No key operation is accepted hereafter and when any key is pressed, “Lock” is displayed on the main display and “on” on the sub-display respectively.

Release

1. **Hold down MEAS in the measurement mode continuously until the display of the sub-display turns into “oFF” from “on”.**
   When you release MEAS with “oFF” displayed on the sub-display, key lock release is completed.
   The converter returns to the measurement mode, and now all keys are enabled.

Note

You cannot release the key lock immediately after key lock setup, with the displays showing “Lock” and “on”. Make sure to start the release operation with a measured value displayed.

● Password locking

This function prevents illegal operation by unauthorized persons using the preset first and second passwords.
Each password is a 4-digit number.
When the password lock is enabled, the converter performs measurement and rejects any key operations except for password lock setup (mentioned below).
You can enable/disable the lock only by following the procedure described below.

Note

- **Note that if the password locking is enabled, the maintenance functions such as calibration and settings are disabled. Set it up carefully.**
- **The password before factory shipment has been set to 0000-0000.**

Operation

1. **Hold down ▲ and ▼ at the same time in the measurement mode until "PASS" is shown on the main display.**
   When you release the buttons, the main display shows "PAS1", and the sub-display shows "0000" with the leftmost digit blinking. You can change the value of the blinking digit.

Tip

To cancel the whole password setting and return to the measurement mode, press MEAS with a digit blinking.

2. **Press ▲/▼ to select a value for the blinking digit.**
3. **Press ENT.**
   The setting is established and the digit stops blinking.
   Then the next digit starts blinking.
4. **Repeat steps 2. to 3. to the rightmost digit.**
   When the rightmost digit is established, all the four digits flashes and the first password is read into the converter.
   And then the main display shows "PAS2" and the sub-display shows "0000".
5. **Input the second password in the same way.**
   When the two passwords are correct, the main display shows "Lock" and the sub-display shows the current lock status, "on" for enabled or "oFF" for disabled.

Note

If either of the passwords is wrong, the main display shows "PASS" and the sub-display shows "bad", and the converter returns to the measurement mode. The converter does not tell you which password was wrong.

6. **If necessary, to change the setting press ENT.**
   The converter enters the setup state and the sub-display starts blinking.
7. **Press ▲/▼ to set the password locking.**
   ▲ (on): Enables the password lock.
   ▼ (oFF): Disables the password lock.
8. **Press ENT.**
   The sub-display flashes, and the setting is established. The main display shows "Lock" and the sub-display shows the current lock status, "on" for enabled or "oFF" for disabled.
9. **Press MEAS to return to the measurement mode.**

Password setting

The password used for this converter is consisted of the first and second passwords, which are 4-digit numbers respectively and totals eight digits.
You must input the current passwords before setting up new passwords.

Note

- **It is recommended to use numbers which is easy to remember and hard to forget.**
- **If you forget the password you set, you cannot change the password.**
  If you forget the passwords you set, send the converter back to HORIBA Advanced Techno.
  We will send it back to you after resetting the passwords to the default setting "0000-0000" (charged).

Operation

1. **Perform the steps 1. to 5. of " Operation " (page 55).**
   Main display shows "Lock" and the sub-display shows the current lock status, "on" for enabled or "oFF" for disabled.
2. **Press ▲/▼ to select the password to be set.**
3. **Press ENT.**
   The converter enters the setup state and the sub-display starts blinking.

Tip

To cancel the whole password setting and return to the measurement mode, press MEAS with a digit blinking.

4. **Press ▲/▼ to set a new password.**
5. **Press ENT.**
   The setting is established and the digit stops blinking.
   Then the next digit starts blinking.
6. **Repeat steps 4. to 5. to the rightmost digit.**
   When the rightmost digit is established, all the four digits flashes and the password is read into the converter.
   To change the other password next, press ▲/▼ to select the other password, and change it in the same way.

■ User check menu

The user check menu allow you to check the converter status, and to reset it to the default. Operate it from the user check menu.

How to open the user check menu

Start the operation it from the measurement mode.

Operation

1. **Hold down MNT until the MNT lamp lights up.**
   "SEt" will be displayed on the main display.
2. **Display "USr" on the main display using ▼, and press ENT.**
   The converter opens the user check menu, and "LEd" is shown on the sub-display.
   Refer to the below instructions for perform each of the available operations in accordance with the following description.

● Status check

You can check the four items shown below.

- LEDs
- Transmission output
- Relay operation
- Measured value and temperature

Perform the following operations after opening the user check menu.

● LEDs

Operation

1. **Display "LEd" on the sub-display using ▲/▼, and press ENT.**
   All the LED will light up normally.
2. **Check that LEDs light up without problems.**
3. **Press MEAS.**
   The converter returns to the user check menu entrance.

● Transmission output

Operation

You can output an electric current of 4 mA, 12 mA, and 20 mA from the transmission output.

1. **Display "Cur" on the sub-display using ▲/▼, and press ENT.**
2. **Press ENT.**
   "4-20" is shown on the main display and "4" on the sub-display outputting a 4 mA transmission output.
3. **To switch the current output, press ▲/▼ to select the value corresponding to the current (mA) to be output from 4, 12, or 20.**
4. **Check that the electric current is being output properly.**
5. **Press MEAS.**
   The converter returns to the user check menu entrance.

● Relay operations

Check the operations of contact outputs R1, R2, or R3

Checking the contact output R1

Operation

1. **Display “rLy” on the sub-display using ▲/▼, and press ENT.**
2. **Press ENT.**
   “rLy1” is shown on the main display and “r1” on the sub-display.
3. **Press ENT.**
   The relay lamp R1 lights up and the relay is turned ON, normally.
   Press ENT to switch the relay ON/OFF to check the operation.
4. **Press MEAS.**
   The converter returns to the user check menu entrance.

Checking the contact output R2 or R3

You can check R2 or R3 in the same way as R1. But, press ▲/▼ to display “r2” for R2 or “r3” for R3 on the sub-display after the step 2.

● Measured value and temperature

Operation

1. **Display “diSP” on the sub-display using ▲/▼, and press ENT.**
2. **Press ENT.**
   The current measured value is shown on the main display.
3. **Press MEAS.**
   The converter returns to the user check menu entrance.

Converter reset

This operation allows you to initialize all the settings and restart the converter.
Then preform the steps in " Initial set up " (page 31) in the automatically opened basic setup menu.
Calibration values are also reset. Be sure to perform the steps in " Calibration menu " (page 49) before use.

Operation

1. **Enter the “User check menu”, referring to " How to open the user check menu " (page 57).**
   “USr” is shown on the main display and “LEd” on the sub-display.
2. **Display “init” on the sub-display using ▼, and then press ENT.**
   The sub-display shows “no” and starts blinking.
3. **Press ▼ to select “yES”, then press ENT.**
   The converter is reset to the state before factory shipment.
   The sub-display shows “- - - - -” with flashing, and the converter restarts.

Tip

- **The initial settings are shown in " Table 1 Basic setup items " (page 31).**
- **To return to the user check menu entrance without resetting, select “no” in step 3., and press ENT.**

Output conditions for various kinds of output

The output conditions for various output types are shown below.

<table>
<tr><td colspan="6" rowspan="3">Status</td><td colspan="6">Contact Output r1 to r3</td><td colspan="2" rowspan="2">Transmission output</td></tr>
<tr><td colspan="6">Setting of contact output and control target (1.SEL)</td></tr>
<tr><td>non</td><td>rc</td><td>t</td><td>FAiL</td><td>HoLd</td><td>CLn</td><td>Transmission output 1</td><td>Transmission output 2</td></tr>
<tr><td colspan="6">Power shutdown</td><td colspan="6">Open between C and NO</td><td colspan="2">No output</td></tr>
<tr><td rowspan="16">Measurement mode</td><td colspan="5">When normal</td><td rowspan="16">OFF</td><td colspan="6">Enable</td><td colspan="2">Measured value</td></tr>
<tr><td colspan="2" rowspan="2">When measured value is off the scale</td><td rowspan="14">Setting items of FAiL output (rF)</td><td rowspan="2">oF</td><td>yES</td><td rowspan="2">En-able</td><td rowspan="2">En-able</td><td>ON</td><td>ON</td><td rowspan="15">En-able</td><td colspan="2">Immediately previous value HOLD</td></tr>
<tr><td>no</td><td>OFF</td><td>En-able</td><td colspan="2">Measured value</td></tr>
<tr><td rowspan="13">When error occurs</td><td rowspan="2">E-25</td><td rowspan="2">tE</td><td>yES</td><td rowspan="13">OFF</td><td rowspan="13">OFF</td><td>ON</td><td rowspan="13">ON</td><td colspan="2" rowspan="13">Immediately previous value HOLD</td></tr>
<tr><td>no</td><td>OFF</td></tr>
<tr><td rowspan="2">E-21, E-22</td><td rowspan="2">tF</td><td>yES</td><td>ON</td></tr>
<tr><td>no</td><td>OFF</td></tr>
<tr><td rowspan="2">E-61</td><td rowspan="2">FLo</td><td>yES</td><td>ON</td></tr>
<tr><td>no</td><td>OFF</td></tr>
<tr><td rowspan="2">E-75</td><td rowspan="2">SC</td><td>yES</td><td>ON</td></tr>
<tr><td>no</td><td>OFF</td></tr>
<tr><td colspan="2">E-90 to E-92</td><td>ON</td></tr>
<tr><td rowspan="2">During cleaning</td><td colspan="2" rowspan="2">When error occurs</td><td rowspan="2">E-90 to E-92</td><td>OFF</td><td rowspan="2">ON</td></tr>
<tr><td>ON</td></tr>
<tr><td rowspan="3">HOLD mode</td><td colspan="5" rowspan="2">Residual chlorine concentration calibration</td><td rowspan="3">OFF</td><td rowspan="3">OFF</td><td rowspan="3">OFF</td><td rowspan="2">OFF</td><td rowspan="3">ON</td><td rowspan="3">OFF</td><td colspan="2">Immediately previous value HOLD</td></tr>
<tr><td colspan="2">Setting of transmission output/hold output (Hold)</td><td>yES</td><td colspan="2">Preset value</td></tr>
<tr><td colspan="2">When error occurs</td><td colspan="2">E-90 to E-92</td><td>ON</td><td colspan="2">Immediately previous value HOLD</td></tr>
</table>

Note

- **ON: When the output reverse (1.rE) is “no”, the line between C and NO becomes close.**
- **OFF: When the output reverse (1.rE) is “no”, the line between C and NO becomes open.**

Maintenance

This chapter provides information on maintenance in order to ensure the highest accuracy and optimum use of the HR-480P.
It describes accuracy-related maintenance, including the daily calibration.

List of periodic checks

This section describes the general check items for the residual chlorine sensor. Accurate measurements can be made possible by conducting periodic checks of the following items.

Check item	Check frequency (recommended)	Description
Check of flow rate of sample	Once a day	Check the flow rate at the sample inlet of the measurement cell. If the flow rate is low, correct measurements cannot be made.
Check of residual chlorine concentration (cross-check)	Once a day	Measure the residual chlorine concentration of the sample with a residual chlorine tester or the like. If the value is greatly different, perform calibration.
Removal of sensor contamination	Varies depending on the contamination level (once or more per 3 months).	-
Replacement of cleaning beads	Varies depending on the contamination level (once or more per 3 months). Replace when the electrode is replaced.	-
Replacement of sensor (cathode electrode)	Once daily (varies depending on the water quality condition and the operating situation).	The cathode electrode must be replace periodically. For predicting the life of the sensor, see " Replacing the sensor (cathode electrode) " (page 67).
Calibration	At least once per month (depending on the water quality condition).	Be sure to perform calibration after the sensor or the measurement cell has been replaced " Calibration menu " (page 49).
Cleaning of measurement cell	Varies depending on the contamination level.	The clogged measurement cell may prevent correct measurements from being made.
Cleaning of beads filter	Varies depending on the contamination level.	When the beads filter is clogged, the flow rate decreases, preventing correct measurements from being made.
Replacement of filter	Varies depending on the contamination level (at least once every 3 months is recommended).	When the beads filter is clogged, the flow rate decreases, preventing correct measurements from being made.

Maintenance for the converter

■ Inspection of the converter

If the insulation of the sensor connection terminal deteriorates, accurate measurement becomes difficult.
Check the electrode plate periodically (about once every year) to see whether it is free from rust and any other cause of decreased insulation.
Wipe off any dirt on the case of the main unit with a soft cloth.

Note

Do not use an organic solvent or something similar.

Maintenance of sensor

This section describes the maintenance procedure for a general residual chlorine sensor.

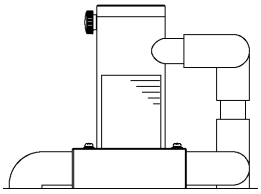
■ Checking the flow rate of the sample

For the residual chlorine sensor, changes in the sample flow rate affect the reading. If the flow rate decreases due to clogged piping or the like, the reading may become lower. Be sure to check the flow rate of the sample that goes to the measurement cell. The procedure for checking the flow rate is shown below.

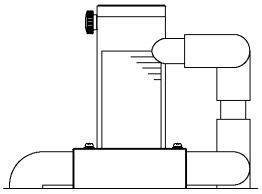
● Liquid level in the overflow cell

For the RA-10, the flow rate can be checked by viewing the liquid level in the overflow cell. Use this method along with the following method using beads:

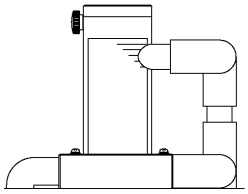
Insufficient flow rate



Correct flow rate



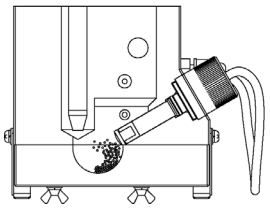
Overflow rate



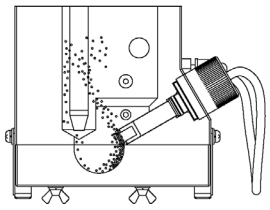
● Method using beads

It is possible for the beads that are used to clean the sensor surface to be properly moved using the flow of the sample. Observing the movement of beads allows you to determine whether the flow rate falls within the specified range.

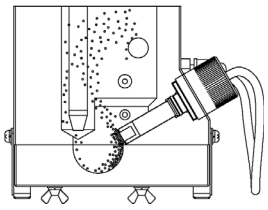
Insufficient flow rate



Correct flow rate



Overflow rate



● Method using a flowmeter

When a flowmeter is installed at the inlet of the measurement cell (or at the outlet for the RA-20), the flow rate of the sample can be checked by sending it to the measurement cell.

■ Check of residual chlorine concentration

This converter makes measurements without using any reagent. It is susceptible to changes in water quality. Check for any significant deviation with a residual chlorine tester (using the DPD method) or the like. Once daily is recommended. Perform calibration with a residual chlorine tester (using the DPD method) or the like when the water quality changes or during maintenance checks (i.e., when the sample is shut off to clean the sensor or the measurement cell or to replace the sensor). If various kinds of maintenance are performed by shutting off the sample, be sure to warm up for at least 3 h (for break-in) before performing calibration.

Reference

- **Refer to " Calibration menu " (page 49).**
- **Refer to " Data " (page 75).**

Note

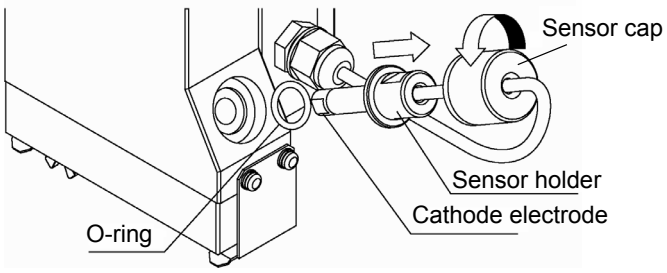
- **To use the sampling cock, send about 500 mL of the sample to clean the cock. If any foreign matter remains, a lower value may be displayed.**
- **If a large quantity of sample is taken at a time, the quantity sent to the measurement cell may become lower than the necessary level, resulting in showing an abnormal value. Take care to ensure that sampling is performed gradually.**

■ Removal of sensor contamination

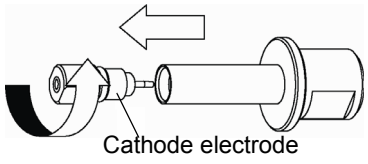
This converter uses a combination of two cleaning methods: physical abrasive cleaning using beads and electrochemical cleaning. If any foreign matter that is difficult to remove should adhere to the sensor surface, the measurements might be affected greatly. If the reading decreases or is visually found abnormal, clean the sensor by the following procedure.

Cleaning the cathode electrode

1. **Check that the converter is OFF.**
2. **Close the valve to shut off the sample.**
3. **Remove the sensor cap and take out the sensor holder.**



4. **Remove the cathode electrode from the sensor holder.**



Note

Do not unnecessarily touch the gold pole surface of the cathode electrode. If the gold pole surface is damaged, the reading will be affected.

5. **Rinse off foreign matter on the cathode electrode surface.**

- Wipe off any remaining foreign matter on the cathode electrode with soft cloth or the like.
- If the foreign matter is difficult to remove, rinse the cathode electrode surface with detergent or nitric acid (0.1 M).
- If the foreign matter is still difficult to remove by the above method or if the above chemicals are not available, polish the surface with the provided abrasive paper.

After cleaning, thoroughly rinse the cathode electrode surface with tap water or the like. If tap water should adhere to the pin jack, wipe it off with dry cloth or the like.

⚠ WARNING

Caution strong acid

If nitric acid gets into the eye, the mucous membrane may be damaged, leading to blindness.
In handling nitric acid, be sure to use protective goggles, protective gloves, and a protective mask. If dilute hydrochloric acid gets into your eye, immediately rinse the eye with a large quantity of water for more than 15 min (In rinsing off nitric acid, ensure that the eyeball and the eyelid are entirely exposed to water by fully opening the eyelid with your fingers). If nitric acid remains in contact with body and clothes, chemical burns may result. Therefore, if a spill or splashing occurs, immediately take off the clothes and rinse off the nitric acid with plenty of water.

6. **Attach the cathode electrode to the sensor holder while taking care not to touch the gold pole surface.**

7. **Install the sensor holder on the measurement cell, then close the sensor cap.**

8. **Turn ON the converter.**

9. **Warm up for at least 3 h (for break-in), then perform calibration.**

Note

For the RA-10 (overflow cell type), the nozzle may be clogged from time to time with air bubbles. In such a case, eliminate air bubbles, by inserting an appropriate rod into the nozzle.

Reference

Refer to " Calibration menu " (page 49).

Tip

The restoration time can be shortened by performing electrochemical cleaning for about 5 s after starting to send the sample.

● Cleaning the other electrodes

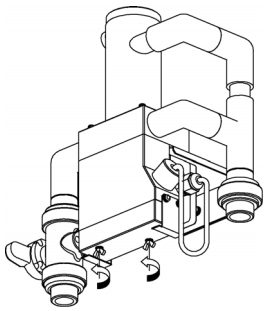
The surfaces of the anode and reference electrodes are coated with silver chloride. If these surfaces are damaged, the silver chloride will fall off. To remove any foreign matter, softly wipe it off with soft cloth or the like. The electrochemical cleaning electrode uses carbon. Giving an impact damages this electrode. When handling the electrode, exercise sufficient care.

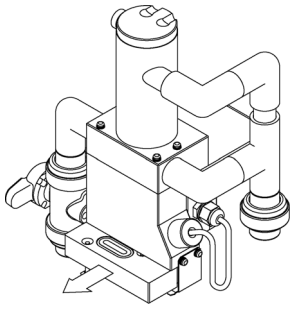
Replacing the cleaning beads

Periodically replace the cleaning beads (about every three months).

Operation

1. **Turn OFF the converter.**
2. **Close the root valve to shut off the sample.**
3. **Loosen the two thumbscrews located at the bottom of the beads cell, remove the beads cell, then draw it out toward you.**

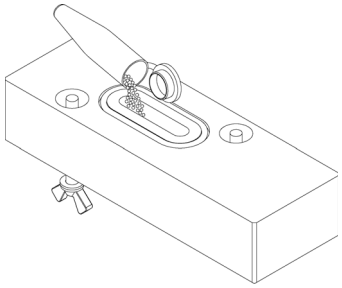




Note

Use a bucket or the like to receive the sample that comes out of the measurement cell.
Take care not to lose the O-ring (S30_EPDM).

4. **Discard the old cleaning beads, and replace with new cleaning beads.**



Note

Fill the beads cell with all the cleaning beads without spilling any of them. If the quantity of cleaning beads is too small, adequate cleaning might not be possible.
Do not add new beads to old ones. This will lead to insufficient cleaning effect.

5. **Install the beads cell by reversing the steps for removing it.**

Note

When installing the beads cell, check that there are no beads on the top of the beads cell or around the O-ring. If the cell is installed with beads attached to either part, the sample may leak out, affecting or damaging your peripheral equipment.

Tip

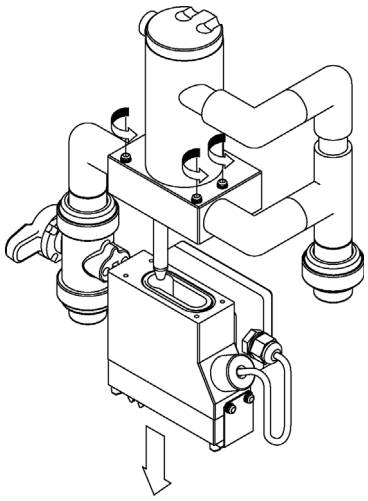
The diagrams in this chapter are for the RA-10. For the RA-20, however, the same steps are also applicable for replacing the beads.

Cleaning and replacing the beads filter

If the beads filter is clogged, the flow rate decreases, preventing proper measurements. Periodically check or replace the beads filter.

Operation

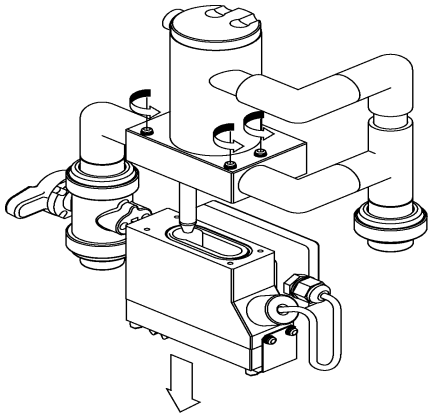
1. **Loosen four M4 screws located on the top of the overflow cell, then pull the measurement cell straight down.**



Note

- **When loosening the four M4 screws, hold the measurement cell. The cell may otherwise fall and be damaged.**
- **In removing the measurement cell, be sure to pull it straight down. The measurement cell nozzle may otherwise be broken.**

2. **Remove the O-ring attached to the measurement cell nozzle, then take off the mesh filter. Clean or replace the filter depending on how contaminated it is.**



3. **Install the measurement cell by reversing the steps for removing it.**

Tip

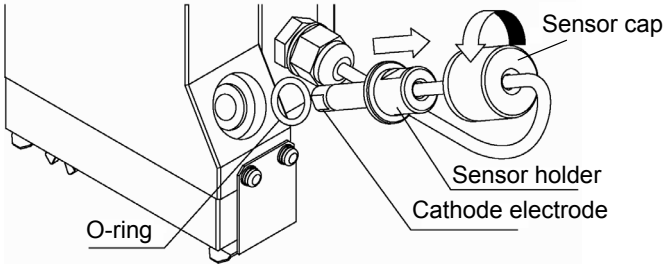
The diagrams in this chapter are for the RA-10. For the RA-20, however, the same steps are also applicable for replacing the filter.

Replacing the sensor (cathode electrode)

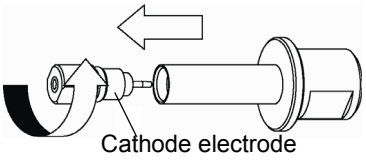
The cathode electrode must be replaced about once yearly, although this frequency varies depending on water quality and operating conditions. Replacement of the electrode requires no tools, and can be carried out easily by the customer.
This section describes the procedure for replacing the cathode electrode.

Operation

1. **Check that the converter is OFF.**
2. **Close the valve to shut off the sample.**
3. **Remove the sensor cap and take out the sensor holder.**



4. **Remove the cathode electrode from the sensor holder.**



5. **Supply a new cathode electrode and attach it to the sensor holder.**

Note

Do not unnecessarily touch the gold pole surface of the cathode tip. If the gold pole surface is damaged, the reading will be affected.

6. **Install the sensor holder on the measurement cell, then close the sensor cap.**
7. **Open the valve to start sending the sample.**
8. **Turn ON the converter.**
9. **Warm up for at least 3 h (for break-in), then start calibration.**

Note

For the RA-10 (overflow cell type), the nozzle may be clogged from time to time with air bubbles. In such a case, eliminate air bubbles, by inserting an appropriate rod into the nozzle.

Reference

Refer to " Calibration menu " (page 49).

Tip

The restoration time can be shortened by performing electrochemical cleaning for about 5 seconds after starting to send the sample.

Cleaning of measurement cell

Periodically clean the measurement cell as water stains will adhere to its inside over time.

Operation

1. **Turn OFF the converter.**
2. **Close the root valve to shut off the sample.**
3. **Remove the measurement cell, the beads cell, the sensor holder, etc. to clean the inside of the measurement cell.**

Note

- **When loosening the four M4 screws, hold the measurement cell. The cell may otherwise fall and be damaged.**
- **In removing the measurement cell, be sure to pull it straight down. The measurement cell nozzle may otherwise be broken.**
- **During the cleaning of the measurement cell, take care not to damage the brown parts on the surfaces of the anode and reference electrodes.**
- **When cleaning the measurement cell, take this opportunity to replace all the cleaning beads.**

Cleaning the overflow cell (RA-10)

Water stains or the like that adhere to the overflow cell over time eventually flake off and flow into the measurement cell, causing the beads filter to be clogged.

Operation

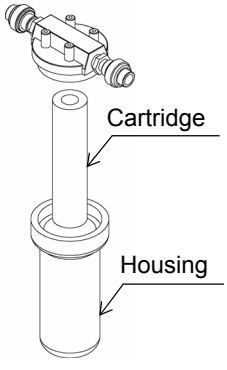
1. **Turn OFF the converter.**
2. **Close the root valve to shut off the sample.**
3. **Clean the inside of the overflow cell using soft cloth or a soft brush.**

Replacing the filter (optional)

As the filter becomes dirty, the reading values may decrease, preventing stable measurement from being made.
Periodically check and replace the filter.

Operation

1. **Turn OFF the converter.**
2. **Close the root valve (before the filter) to shut off the sample.**
3. **Loosen the housing, then pull it down.**
4. **Replace the cartridge in the housing.**



■ Pausing the analyzer

To pause the analyzer by stopping water sent to the residual chlorine analyzer, perform the following steps:

Operation

1. **Turn OFF the converter.**
2. **Close the valve for the source of water under measurement.**
3. **Loosen two wing bolts located at the lower part of the beads cell and remove the beads cell.**
4. **Remove the water under measurement and beads in the cell.**
5. **Attach the beads cell.**

Note

If the pH/ORP electrode (optional) is connected, follow the instructions given in the corresponding instruction manual.

● Restarting the analyzer from the pause mode

To restart the analyzer after stopping its operation, the analyzer must be warmed up by performing the following steps:

Operation

1. **During the pause period, the inside of the sensor may be contaminated. As necessary, decontaminate the sensor, clean/replace the beads filter, clean the measurement cell and the overflow cell, and replace the filter (optional). Check that the O-ring has not deteriorated.**

Reference

Refer to " Maintenance of sensor " (page 62).

2. **Replace the cleaning beads.**

Reference

Refer to " Replacing the cleaning beads " (page 65).

3. **Closely open the valve for the source of water under measurement.**
4. **Use the flow rate control valve to regulate the flow rate at a proper level.**

Note

- **Gradually open the source valve. If the source valve is fully opened suddenly, water under measurement, which is potentially sent at such a flow rate or pressure as exceeds the ratings, may overflow from the overflow cell. This may affect the adjacent equipment.**
- **For RA-10**
  Check that water under measurement has overflowed. If it has not overflowed, a certain level of flow rate is not achieved in the measurement cell. This makes the reading unstable.
- **For RA-20**
  Regulate the flow rate/pressure so that the primary pressure does not exceed the standard value (0.5 MPa max.).

Reference

Refer to " Checking the flow rate and pressure " (page 30) and " Checking the flow rate of the sample " (page 62).

Tip

- **For the RA-10, the flow rate should be 1.3 L/min to 2.0 L/min.**
- **For the RA-20, the flow rate should be 0.6 L/min to 1.0 L/min (constant).**

5. **Turn ON the converter.**
6. **Warm up for at least 3 h (for break-in).**
   After starting warm-up, manually carry out the electrochemical cleaning for about 5 seconds (if “Cleaning when the power is turned ON” was set to “yES”, the cleaning will be performed automatically).

Reference

Refer to " Basic setup menu " (page 34).

7. **Check that the reading has become stable.**
8. **Refer to the following pages to calibrate the residual chlorine concentration and the temperature:**
   - " Residual chlorine concentration calibration " (page 49)
   - " Temperature calibration " (page 52)

Troubleshooting

When measurements fail

Symptom	Possible cause	Remedial action
Fluctuation in measured value	● Air bubbles adhere to the sensor. ● Air bubbles are generated due to a fast flow rate.	● Ensure that no air bubbles are generated in the solution being measured. ● Control the flow rate.
	A sudden change in solution temperature has occurred.	Install the HR-480P in a location free from sudden changes in solution temperature.
	The pH value changes.	● Install the HR-480P in an environment where the pH value does not change significantly. ● Refer to " Effect of sample pH " (page 84).
	The electrical conductivity falls outside the specified range.	Measure the sample at 10 mS/m minimum.
	The flow rate of the sample is unstable (outside the specified range).	[RA-10] Control the flow rate at the inlet of the overflow cell at a value within the specified range.
		[RA-20] ● Control the flow rate of the sample so that it becomes constant within the specified range. ● When using a constant flow valve, make sure that the sample line pressure falls within the specified range for the constant flow vale.
		[Common] ● Remove any clogging due to dirt or other foreign matter in the cell. ● Check to see whether the piping at the outlet is correct.
	Too many beads are supplied.	Supply the specified quantity of beads.
	Screws on the terminal block are loosened.	Firmly tighten the screws on the terminal block.
	The insulation of the terminal block has deteriorated.	Remove condensation and dirt from the terminal block.
An abnormal value is displayed.	The flow rate of the sample falls outside the specified range.	[RA-10] Control the flow rate at the inlet of the overflow cell at a value within the specified range.
		[RA-20] ● Control the flow rate of the sample so that it becomes constant within the specified range. ● When a constant flow valve is used, make sure that the sample line pressure falls within the specified range for the constant flow valve.
		[Common] ● Remove any clogging due to dirt or other foreign matter in the cell. ● Check to see whether the sample flows into the measurement section.

Symptom	Possible cause	Remedial action
An abnormal value is displayed.	The sensor deteriorates due to metallic ions.	● Carry out electrochemical cleaning. ● The electrochemical cleaning conditions in the installation environment are not appropriate. Carry out the periodic cleaning at shortened intervals for extended cleaning time. ● The metallic ion concentration in the installation environment deviates from the specified range.No measurements can be made.
	There is a wiring problem.	Check to see whether the wiring is properly connected to the terminal block.
	The sensor surface is dirty.	● Remove dirt adhering to the sensor surface. ● For the cleaning procedure, refer to " Removal of sensor contamination " (page 63).
	The sensor cable has electrical discontinuity or a short-circuit.	Check the sensor cable.
	The terminal block has a contact failure.	Check the terminal block.
Abnormal operation	The circuit board is corroded by corrosive gas.	Send clean instrumentation air from the air purge inlet.
There is no power.	The power supply voltage falls outside the rated voltage range.	Check the power supply voltage.
	There is a wiring problem.	Check the power wiring.
	The HR-480P has an internal problem.	Contact HORIBA Advanced Techno.

Out of the measurement range

The measured value for residual chlorine blinks when it falls outside the measurable range (3.00 mg/L min; 5.00 mg/L min when Range Cut is not selected).
Take remedial action as instructed below:

Symptom	Possible cause	Remedial action
Blinking display (Out of the measurable range)	The concentration is high.	Use a manual analysis or the like to check to see whether the concentration falls within the measurable range. When the concentration falls within the measurable range, contact HORIBA Advanced Techno.
	The temperature sensor is abnormal.	Perform the temperature calibration.
	The sensor is not correctly connected.	Check the wiring and properly connect the lead wires. If the sensor is not restored by properly connecting it, contact HORIBA Advanced Techno.

Error code

The HR-480P has the capability of displaying various error codes.
A blinking error code is displayed on the auxiliary display.

■ Description of error codes

Display		Priority levels of errors	Error	Description	Occurs during
E-13	SENSOR ERROR	8	Zero calibration error	The sensor current is high during the zero calibration.	During calibration*1
E-21		4	Temperature sensor disconnection error	The lead wire from the temperature sensor has electrical discontinuity.	During measurement or calibration
E-22		4	Temperature sensor short-circuit error	The lead wire from the temperature sensor is short-circuited.	
E-25		7	Temperature measurable range error	The measured temperature value is between −5°C and 55°C (both inclusive).	
E-61		5	Flow rate error	The flow rate of the sample is not appropriate.	During measurement or calibration*2
E-75		6	Sensor error	The current flowing between A and K of the sensor.	During measurement or calibration
E-90	SYSTEM ERROR	1	System error	Internal communication error	At any time System error
E-91		2	System error	The stored data, such as settings and calibration values, has been lost.	

*1: More than one error cannot be displayed at a time. When multiple errors occur, the error having the highest priority level is displayed.

*2: For E-13, recalibration is possible. However, if any of E-21 to E-27 occurs during calibration, no-recalibration can be performed. Take remedial action in accordance with " Remedies for error codes " (page 73).

*3: For E-61, the warning is issued only when the flow switch is installed and the warning is specified on the converter.

Tip

When an error code is displayed, the HOLD indicator starts blinking and the transmission output becomes the value specified on the Setup menu. Refer to " Hold output " (page 46).

■ Remedies for error codes

When an error code is displayed, take remedial action in accordance with the table below.

Priority levels of errors*1 code	Triggering condition	Reset condition	Possible cause	Remedial action
E-12 Span calibration error	When span calibration performed, sensor sensitivity decreases than the initial standard value or increases over the initial standard value.	● Press ESC. ● Perform re-calibration.	● Deterioration of the sensor sensitivity ● Sample concentration are not appropriate.	● Replace the sensor ● Confirm the concentration of sample.

Priority levels of errors[*1] code	Triggering condition	Reset condition	Possible cause	Remedial action
E-13 Zero calibration error	Current of ±0.8 mA or more flows between A and K during zero calibration.	● Press ESC. ● Perform re-calibration.	The calibration is not properly carried out or the converter itself is faulty.	● After the controlled value becomes stable, press ENT. ● If the converter is not restored after calibration has been performed with lead wires A and K disconnected, the converter itself is faulty.
E-21 (Temperature sensor disconnection error)	The resistance value of the temperature sensor is about 1.58 kΩ. (The temperature sensor of 1 kΩ is at about 150°C or more.)	The condition on the left no longer exists.	The resistance between T and T on the sensor is abnormal.	If the resistance value does not fall within the range specified on the left side, the sensor is faulty. Replace the electrode.
			There is a mistake in wiring the sensor cable and the extension cable.	Check the wiring between T and T to see if it is open.
E-22 The temperature sensor is short-circuited.	The resistance value of the temperature sensor is about 0.8 kΩ or less. (The temperature sensor of 1 kΩ is at about less than −50°C)	The condition on the left no longer exists.	The resistance between T and T on the sensor is abnormal.	If the resistance value does not fall within the range specified on the left side, the sensor is faulty. Replace the electrode.
			There is a mistake in wiring the sensor cable and the extension cable.	Check to see whether the wiring between T and T is short-circuited.
E-25 The temperature falls outside the measurable range.	The temperature is less than −5°C or more than 55°C.	The condition on the left no longer exists.	The circuit between terminals T and T is open. The lead wire is disconnected.	Check the wiring.
			The temperature sensor is faulty.	Check that the resistance between T and T is 1.00 kΩ to 1.21 kΩ.
			The temperature of the sample is less than −5°C or more than 55°C.	Control the sample within the range from −5°C to 55°C.
E-61 Flow error	The flow error signal is input.	The condition on the left no longer exists.	The flow rate of the sample is not appropriate.	Check the flow rate.
E-75 Sensor error	The current flowing between A and K of the sensor.	The condition on the left no longer exists.	● The sensor is not properly connected. ● The sensor is damaged.	Check the connections and make reconnections if necessary.
E-90 System error	Internal communication error	The power is turned ON/OFF.	Internal system error	Temporarily turn OFF the power, then turn it ON again. If the system error does not disappear after the HR-480P is restarted, contact us.
E-91 System error	The stored data, such as settings and calibration values, has been lost.			
E-92 System error	A/D converter malfunction			

Data

Specifications

■ Converter

Product name	Residual chlorine meter		
Model	HR-480P Residual chlorine meter for industrial use		
Sensor type	RA-10 or RA-20 three-pole polarographic sensor		
Measurable range	Concentration		0.00 mg/L to 3.00 mg/L (display range: 0.00 mg to 5.00 mg/L)
	Temperature		0°C to 50°C (display range: −10°C to 110°C)
Display resolution	Concentration		0.01 mg/L
	Temperature		0.1°C
Performance	Concentration	Repeatability	Within ±0.05 mg/L (with equivalent input)
		Linearity	Within ±0.05 mg/L (with equivalent input)
	Temperature	Repeatability	±0.5°C (with equivalent input)
		Linearity	±0.5°C (with equivalent input)
Transmission output	Number of output points		2 (the negative terminals for transmission output are internally connected and at the same electric potential)
	Output type		4 mA to 20 mA DC: input/output insulation type
	Load resistance		900 Ω max.
	Linearity		Within ±0.08 mA (output only)
	Repeatability		Within ±0.02 mA (output only)
	Output range	Output 1	Residual chlorine concentration: Can be freely specified within the range from 0.00 mg/L to 5.00 mg/L.
		Output 2	Temperature: Can be freely specified within the range from 0°C to 110°C.
	Hold capability		Either the last value hold or the preset value hold is to be selected.
Contact output	Number of output points		3
	Output type		No-voltage contact output
	Contact type		Relay contact; SPDT (1a)
	Contact capacity		240 V AC, 3 A; 30 V DC, 3 A (resistance load)
	Contact capability		Selectable from among upper limit warning, lower limit warning, ON/OFF control, during maintenance, or anomaly warning
	Description of alarm		● Setting range: 0.00 mg/L to 3.00 mg/L ● Control width: 0.02 mg/L to 0.20 mg/L (±0.01 mg/L to ±0.10 mg/L) ● Delay time: 0 seconds to 600 seconds
Contact input	Number of input points		1
	Contact type		Open collector no-voltage a-contact
	Condition		ON resistance: 100 Ω max. Open voltage: 24 V DC Short-circuit current: 12 mA DC max.
	Contact capability		Flow switch input for interlock (opened when the flow rate decreases)

Temperature compensation	Applicable temperature element			Platinum resistor: 1 kΩ (0°C) (incorporated in the sensor unit)	
	Temperature compensation range			0°C to 50°C	
	Temperature calibration function			Calibration by comparing one point with reference temperature	
Cleaning function	Cleaning type			Electrochemical cleaning between cleaned and cathode electrode	
	Settings		Cleaning frequency	1, 2, 4, 6, 8, and 12 (hours)	1, 2, 3, 4, 5, 6, and 7 (days)
			Cleaning time	5 seconds to 600 seconds	
			Hold time	10 seconds to 600 seconds	
	Timer accuracy			Within 2 minutes per month	
Calibration	Calibration method			Zero calibration (using zero liquid) Span calibration (by comparison with the measure value by the DPD method including the electrochemical zero calibration)	
	Added capabilities			Automatic assessment of unsuccessful calibration (zero) Calibration history (zero, elapsed days from the last calibration either zero or span)	
Self-check	Calibration error			Zero calibration error and deviation from temperature calibration range	
	Temperature sensor diagnosis			Short-circuit and electrical discontinuity of temperature sensor	
	Converter error			CPU error, ADC error, and memory error	
Operating temperature range	−5°C to 45°C (without freezing)				
Operating humidity range	Relative humidity: 20% to 85% (without condensation)				
Storage temperature	−25°C to 65°C				
Power source	Rated voltage			100 V to 240 V AC 50/60 Hz	
	Power consumption			15 VA (max.)	
Applicable standards	CE marking			EMC directive: EN61326-1 Low-voltage directive: EN61010-1	
		EMC	Immunity Industrial electromagnetic environment	Electrostatic discharge	IEC61000-4-2
				Radio radiation frequency electromagnetic field	IEC61000-4-3
				Electric first transient/burst	IEC61000-4-4
				Surge	IEC61000-4-5*1,2
				Conducted disturbances induced by radio frequency	IEC61000-4-6
				Voltage dips, short interruptions and voltage variations	IEC61000-4-11
			Emission Class A	Radiation disturbances	CISPR 11 CLASS A
				Noise terminal voltage	CISPR 11 CLASS A
		Low-voltage		Pollution level 2	
	FCC regulations			Part15 CLASS A	

Structure	Installation	Panel mounted indoor installation type
	Protection class	Panel: IP65 (IEC60529, JIS C0920) Rear case: IP20 Terminal section: IP00 Class II equipment (IEC61010-1) Pollution level 2 (IEC61010-1)
	Material	Panel case: ABS Terminal section: PBT
External dimensions	48 (W) × 96 (H) × 115 (D) mm Depth of case: Approx. 105 mm (at panel mount)	
Mass	Approx. 400 g	

*1: When the sensor cable, the transmission cable, or the contact input cable is extended to 30 m or longer, the surge test specified in the EMC directive for CE marking is not applied.

*2: For transmission output and contact input, use the most suitable surge absorbing element on the connection line considering the ambient environment, the analyzer installation situation, the externally connected equipment, and other factors, although the internal circuit is provided with a surge protecting element.

Sensor

Product name		Polarographic residual chlorine sensor	
Model	Name	RA-10	RA-20
	Sampling method	Overflow type	Inline type
Measuring method		Polarographic type	
Measurable object		Free residual chlorine in water under measurement	
Measurable range		0.00 mg/L to 3.00 mg/L	
Measurement compensation		Automatic temperature compensation using platinum resistance-temperature detector (Pt1000)	
Performance	Linearity	Within ±5% of full-scale value	
	Repeatability	Within ±3% of full-scale value	
	Response time	Within 60 seconds to 90%	
	Zero drift	Within ±1% of full-scale value per month	
	Span drift	Within ±10% of full-scale value per month	
Sampling condition	Temperature	0°C to 45°C (without freezing)	
	Flow rate	1.3 L/min to 2.0 L/min	0.6 L/min to 1.0 L/min (constant flow rate)[*1, 2]
	Primary pressure	0.5 MPa max.	
	pH value	5.8 to 8.6 (constant)[*3]	
	Electrical conductivity	More than 10 mS/m min[*4]	
Calibration	Zero calibration	Zero water calibration	
	Span calibration	Calibration using comparison with measured value by DPD method (including electric zero calibration)	
Material of wetted part		PVC, PPO, EPDM	
Material of electrode		Au, AgCl, C	
Material of fuse		S_iO_2	
Material of filter		Nylon	
Piping connections	Sample inlet	Prefabricated joint, TS16A	
	Sample outlet	Prefabricated joint, TS16A[*5]	
Cleaning method		Physical polishing and electrochemical cleaning using beads[*6]	
Cable length		Provided standard cable: 2 m Max. extendable length: 40 m	
Ambient temperature		0°C to 45°C[*7]	
Storage temperature		0°C to 45°C	
External dimensions		221(W) × 278(H) × 201(D) mm[*8]	221(W) × 157(H) × 201(D) mm[*8]
Mass		Approx. 2.3 kg	Approx. 1.8 kg
Standard accessories		Cleaning beads, mesh filter, abrasive paper, O-ring (S30), O-ring (P14) Tools to replace electrode	

*1: The residual chlorine concentration value changes as the flow rate of the sample being measured changes. Be sure to measure the sample at a constant flow rate.

*2: When the optionally available constant flow valve (model: RA-CFV) is installed, ensure that the differential pressure of the constant flow valve is 0.05 MPa to 0.7 MPa. (Check the specifications for the RA-CVF.)

*3: The residual chlorine concentration value changes as the pH value of the sample being measured changes. Be sure to measure the sample at a constant pH value.

*4: If the electrical conductivity becomes below 10 mS/m (100 μS/cm), normal measurements cannot be made. Be sure to measure the sample under the above conditions.

*5: In carrying out the piping for the RA-10, ensure that the sample outlet is open-air with no possibility of liquid pooling in the piping. Minimize the piping length so that no back pressure is applied.

*6: Ensure that substances such as metallic ions are below the standard values specified by the water supply law.

*7: If the sensor is exposed to direct sunlight, the electrode may deteriorate. Install the sensor in a location free from direct sunlight (indoors).

*8: No protrusions are included.

Cathode electrode

Product name	Cathode electrode for RA-10/20
Model	RA-K
Material of electrode	Au
Material of wetted part	PPO, EPDM
Operating temperature	0°C to 45°C
Mass	Approx. 1.8 g

Filter

Product name	Filter unit for residual chlorine meter	
Model	RA-F	
Material of wetted part	PVC, EPDM, PP, AS	
Operating temperature	0°C to 50°C (without freezing)	
Primary pressure	0 MPa to 0.5 MPa	
Piping connections	Sample inlet	Prefabricated joint, TS16A
	Sample outlet	Prefabricated joint, TS16A
Mass	Approx. 3.0 g	

Flow switch

Product name	Flow switch for residual chlorine meter (RA-10)	
Model	RA-FS10	
Specified flow rate	1.2 L/min (open due to decreased flow)	
Material of wetted part	PVC, EPDM, PPO	
Operating temperature	0°C to 50°C (without freezing)	
Primary pressure	0 MPa to 0.5 MPa	
Installation method	Horizontal installation (with switch case positioned above)	
Piping connections	Sample inlet	Prefabricated joint, TS16A
	Sample outlet	Prefabricated joint, TS16A
Mass	Approx. 0.17 g	

Product name	Flow switch for residual chlorine meter (RA-20)	
Model	RA-FS20	
Specified flow rate	0.5 L/min (open due to decreased flow)	
Material of wetted part	PVC, EPDM, PPO	
Operating temperature	0°C to 50°C (without freezing)	
Primary pressure	0 MPa to 0.5 MPa	
Installation method	Horizontal installation (with switch case positioned above)	
Piping connections	Sample inlet	Prefabricated joint, TS16A
	Sample outlet	Prefabricated joint, TS16A
Mass	Approx. 0.17 g	

Flowmeter

Product name	Flowmeter for residual chlorine meter	
Model	RA-FM	
Specified flow rate	0.3 L/min to 3.0 L/min	
Material of wetted part	PVC, EPDM, PMMA, SUS316	
Operating temperature	0°C to 50°C (without freezing)	
Primary pressure	0 MPa to 0.5 MPa	
Piping connections	Sample inlet	Prefabricated joint, TS16A
	Sample outlet	Prefabricated joint, TS16A
Mass	Approx. 0.3 g	

Constant flow valve

Product name	Constant flow valve for residual chlorine meter	
Model	RA-CFV	
Specified flow rate	0.7 L/min ±10%	
Control pressure difference	0.05 MPa to 0.7 MPa	
Material of wetted part	PVC, EPDM, SUS304	
Operating temperature	5°C to 50°C	
Primary pressure	0.05 MPa to 0.7 MPa	
Piping connections	Sample inlet	Prefabricated joint, TS16A
	Sample outlet	Prefabricated joint, TS16A
Mass	Approx. 0.3 g	

Technical data

What is residual chlorine?

Residual chlorine means hypochlorous acid that is produced when chlorine agent is dissolved in water and chloroamine that is produced when hypochlorous acid is combined with ammonia. The former is called free residual chlorine and the latter combined residual chlorine. The two are collectively called residual chlorine.When chlorine gas or sodium hypochlorite is injected into water, is will be present as hypochlorous acid and ions. (See equations 1 and 2.)

$Cl_2 + H_2O \Leftrightarrow HClO + HCl$ ··· Equation 1

$HClO \Leftrightarrow H^+ + ClO^-$ ··· Equation 2

This equilibrium is affected by the pH and temperature of water. On the acid side, the majority is present as hypochlorous acid. Fig. 1 shows the percentage of hypochlorous acid hypochlorous ions against pH changes. The disinfecting power changes with pH (i.e., it is higher on the acid side and lower on the alkaline side) because the disinfecting power of HClO is higher than that of ClO^-. The high oxidizing power of hypochlorous acid/ions breaks the cell membranes and walls of pathogenic organisms, such as microorganisms and viruses, and denaturalizes the internal proteins and nucleic acid, there by exerting a disinfecting effect.

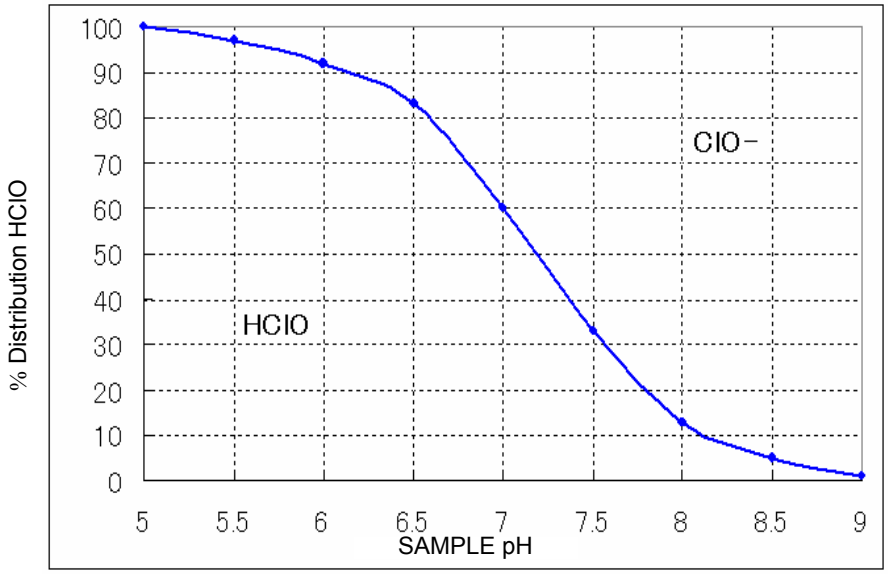


Fig. 1 Changes in chemical form of hypochlorous acid due to pH of sample

Measuring principle

The HR-480P uses the three-pole polarographic method as its measuring principle. For the cathode electrode, a gold pole is used and for the anode and reference electrodes, silver and silver chloride poles are used, respectively. In the three-pole polarographic method, the electrical potentials of the sample and the cathode electrode are controlled to be constant by using the reference electrode (Fig. 2).

As electrical analysis methods, the galvanic method and the polalographic method are also known. In the former method, measurements are made with an electrochemical reaction that has been caused by immersing the anode and cathode electrodes in the sample without externally applying voltage. In the latter method, an electrochemical reaction is caused by giving an electrical potential difference to the anode and cathode electrodes via an external circuit. These methods have a disadvantage of being susceptible to the properties of the sample (electrical conductivity and residual chlorine concentration).

As opposed to these methods, the three-pole polalographic method is less affected by the properties of the sample, enabling more stable measurements. For this reason, the three-pole polalographic method has been used for the HR-480P. When DC voltage is externally applied with the cathode and anode electrodes immersed in the sample, the following reaction occurs on the surfaces of these electrodes.

Acting electrode: $Cl_2 + 2e^- \rightarrow 2Cl^-$

Opposite electrode: $Ag + Cl^- \rightarrow AgCl + e^-$

As the reaction progresses on the surface of the cathode electrode, the concentration of the reaction substance on the surface of the electrode changes with time. For example, if chlorine is oxidized on the surface of the cathode electrode, when the electrical potential reaches an enough value to progress the reaction, chlorine is immediately oxidized on arrival at the surface of the cathode electrode, becoming chloride ions. At the time, the chlorine concentration on the surface of the electrode becomes closest to zero. The amount of current does not increase even if the electrical potential of the electrode is further increased. This means that current which is only dependent upon the concentration of the reaction substance is obtained. The current at this time is called diffusion current. The diffusion current is in proportion to the diffusion coefficient of the reacting substance and the concentration gradient on the electrode surface. Since the diffusion coefficient is dependent on the temperature, the diffusion current is expressed as follows.

Id (diffusion current) = K (constant) × D [t] (diffusion coefficient) × C (concentration of reacting substance)

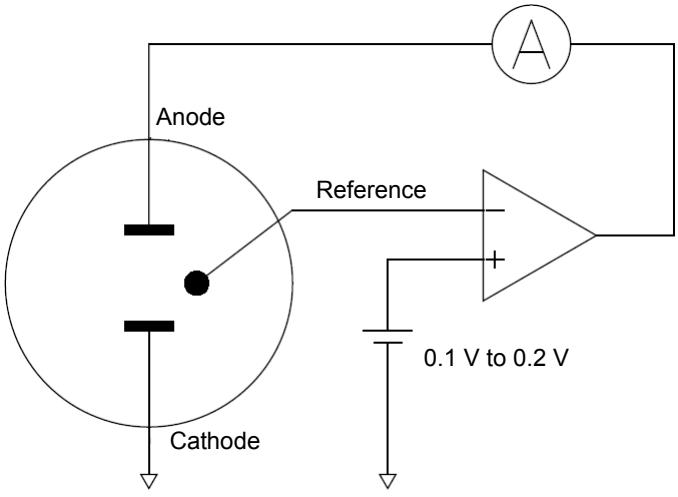


Fig. 2 Circuit architecture of HR-480P

Conditions for sample

● Effect of sample pH

As mentioned above, the chemical form of free residual chlorine changes with the pH value of the sample.
Fig. 3 shows changes in the reading depending on the pH value on the HR-480P. As shown in Fig. 3, the reading decreases as the sample changes from acidity to alkaline. Fig. 3 assumes changes in the reading that was calibrated at pH7. Therefore, if the pH value of the sample greatly changes from that during calibration, the reading is affected. Control the pH value of the sample so that it becomes as constant as possible.

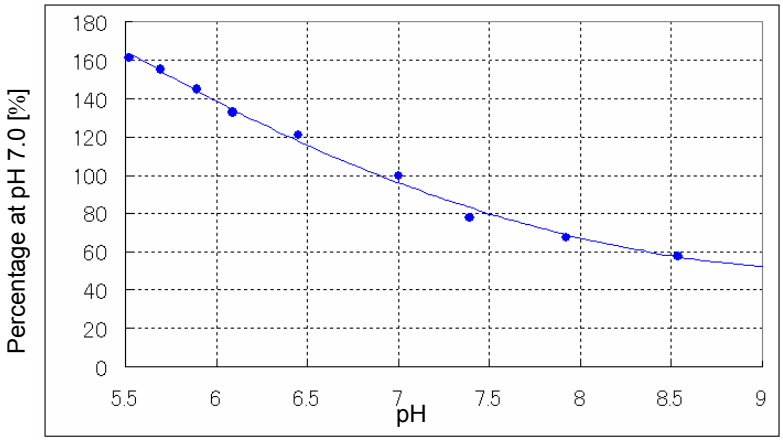


Fig. 3 Changes in the reading depending on the pH value of the sample

Tip

For the RA-10, the pH electrode can be installed on the overflow cell.
For the electrodes that are available for this installation, consult a distributor.

● Effect of electrical conductivity of sample

The HR-480P uses an electrochemical reaction to measure the concentration of free residual chlorine.
Therefore, when the electrical conductivity of the sample is low, the reading may be affected (Fig. 4).
Control the electrical conductivity of the sample at 100 μS/cm minimum, then send the sample to the sensor. In general, however, there is no problem with tap water and swimming pool water, which have electrical conductivity exceeding 100 μS/cm.

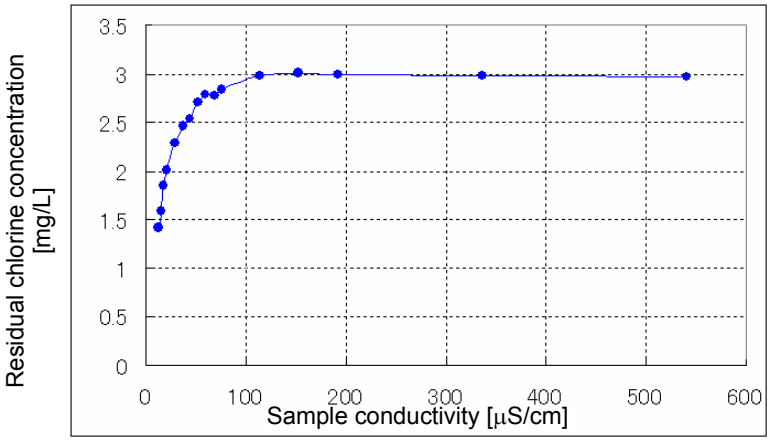


Fig. 4 Changes in the reading depending on the electrical conductivity of the sample

● Effect of flow rate

In the polarographic method, the reading is affected by changes in the flow rate on the surface of the cathode electrode.
This is attributable to the fact that the concentration gradient is dependent on the flow rate.
In order to achieve stable measurements, a new sample must be send to the surface of the cathode electrode so that the concentration gradient on the surface of the electrode can be made constant regardless of the time elapsed.
The overflow type sensor is designed to be free from the effect of changes in the flow rate of the process by making the measurement cell itself an overflow cell (RA-10).
When the inline type sensor (RA-20) is used, stable measurements will essentially require making the flow rate constant by using the constant flow valve.

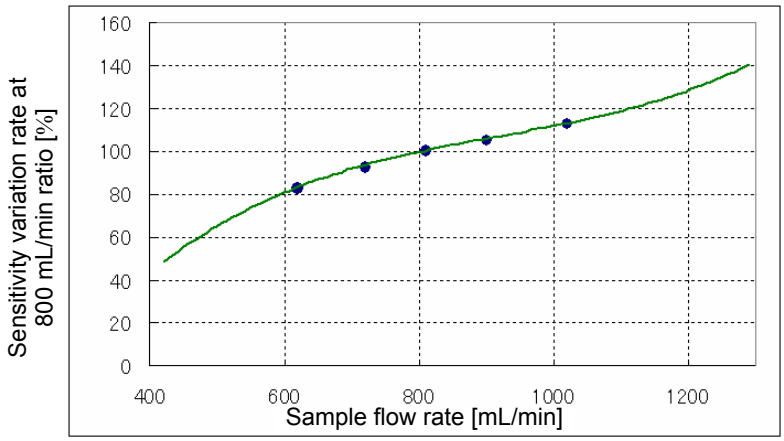


Fig. 5 Changes in the reading depending on the flow rate of the sample (for the RA-20)

Note

The flow rate should be controlled so that it becomes constant within the range from 0.6 L/min to 1.0 L/min.
If the flow rate deviates from the proper range, correct measurements cannot be made.

● Effect of temperature of sample

In the polarographic method used by the HR-480P, the reading is affected by the temperature of the sample.
This is attributable to two reasons: (1) since the diffusion coefficient is dependent on the temperature, the obtained diffusion current changes; and (2) the chemical equilibrium of hypochlorous acid is dependent on the temperature. The HR-480P offsets the effect of the temperature of the sample by continuously measuring the temperature and performing temperature compensation using a function considering the above two causes.

● Electrochemical cleaning capability

The HR-480P uses an electrochemical reaction to measure the concentration of residual chlorine. General tap water, swimming pool water, and bath water contain metallic ions. When metallic ions reach the surface of the cathode electrode, electrons are released to adhere to (plate) the surface of the cathode electrode. For example, a ferric ion (II) is reduced by receiving two electrons, then adheres to (plate) the surface of the cathode electrode as iron (equation 3).

$Fe^{2+} + 2_e - F_e$ ... equation 3

When metal adheres to (plates) the surface of the cathode electrode, the measured value is affected. The electrochemical cleaning is performed to remove metal adhering to the surface of the cathode electrode. The HR-480P develops a reaction to reduce metal on the surface of the cathode electrode by making the electrical potential of the electrochemical cleaning electrode negative against the cathode electrode. On the other hand, the electrochemical cleaning electrode develops the same oxidation reaction as in equation 3, causing metal to adhere to its surface. However, since the electrochemical electrode is not used to measure the concentration of residual chlorine, the measured value is not affected.
The electrochemical cleaning is not intended to selectively clean the adhering metal. If the electrochemical cleaning is unnecessarily performed, the cathode electrode may be corroded, becoming markedly shorter in life.For general tap water, swimming pool water, or bath water, sufficiently stable measurements can be made using the initial settings.

■ Ion component of sample

It becomes difficult to measure residual chlorine in high ion concentration. If the cathode is plated by metals, clean the electrode in accordance with the " Removal of sensor contamination " (page 63) or replace the cathode.
It is recommended to make electrochemical cleaning often for the sample high metal ions are included.

Note

When the sensor is replaced, also replace all the beads.
After replacing the sensor, warm up for at least 3 h (for break-in), then start the calibration.

Parts list

Optionally available parts

Model	Part name	Specification	Part No.
PS-50	Pole stand	50 A 1500 mm	3030047360
RA-F*1	Mesh filter	100 μm	3200303108
RA-FS10*2	Flow switch	For RA-10	3200313530
RA-FS20*2	Flow switch	For RA-20	3200315158
RA-CFV*2	Constant flow valve	For RA-20	3200303043
RA-FM*2	Flowmeter	For RA-20	3200303045
CT-20CR*3	Relay box	-	3200051435
RA-CT*4	Relay box for flow switch	For RA-FS10/FS20	3200319095

*1: The filter cartridge is required as consumables.

*2: The on-piping installation (standard), the on-wall installation, and the on-pole installation (optional) are also available.

*3: The extension cable (C-7E) is required. Make arrangements for the cable length within 40 m.

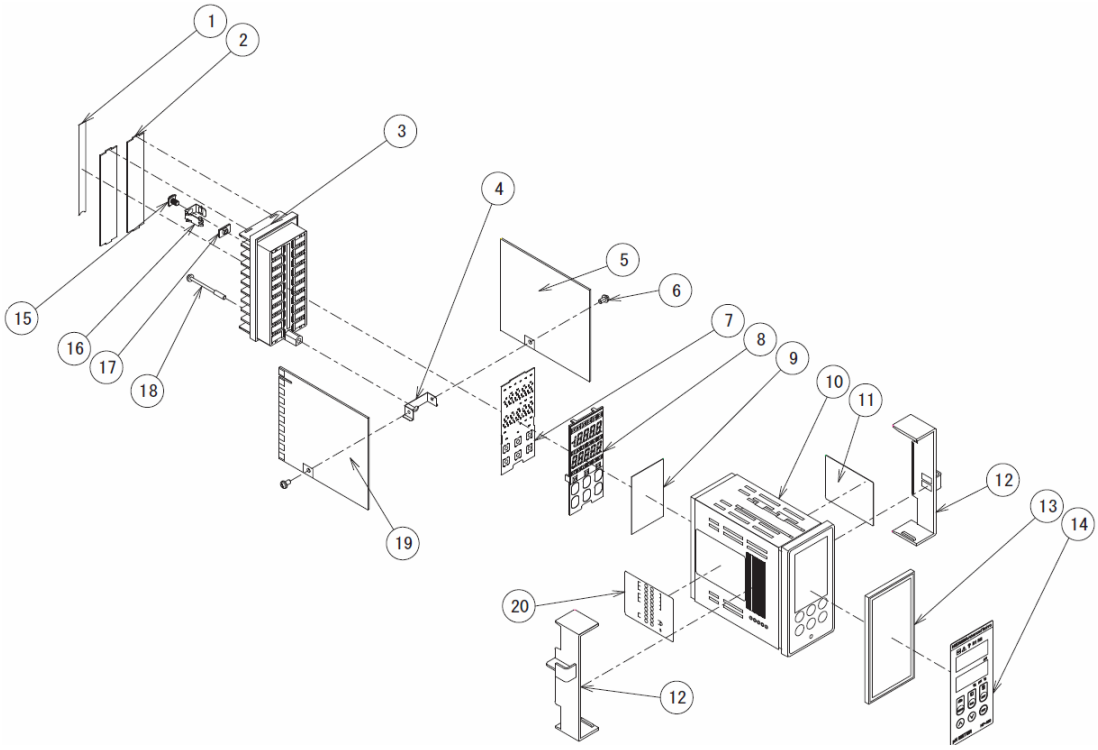
*4: The extension cable (RA-FC) is required. Make arrangements for the cable length within 40 m

Spare parts

Model	Part name	Content	Quantity	Replacement frequency (recommended)	Part No.
RA-K	Cathode electrode	-	1 piece	2 year	3200282762
RA-B	Consumables kit	Cleaning beads	5 pieces	3 months	3200285395
		Abrasive paper	1 piece	-	-
		Filter	5 pieces	3 months	-
		O-ring (S30)	1 piece	1 year	-
		O-ring (P14)	1 piece	1 year	-
RA-A	Anode electrode	Main body	1 piece	-	3200316404
		Desiccant agent	1 piece		
RA-R	Reference electrode	Main body	1 piece	-	3200316405
		Desiccant agent	1 piece		
RA-EC	Electrochemical cleaning (EC) electrode	Main body	1 piece	-	3200316406
		Desiccant agent	1 piece		

Disposing of the converter

When disposing of the converter be sure to follow the laws and regulations stipulated by your national and local governments.
The parts of this converter are made of the following materials.



No.	Name	Material	No.	Name	Material
1	Terminal label	PET	11	Rating nameplate	PP
2	Terminal cover	PC	12	Fixture	POM-N
3	Terminal block	PBT	13	Gasket	EPDM
4	F.G. bracket	C5210	14	Panel sheet	PET
5	PIO board	Printed board	15	Terminal screw	Carbon steel
6	Pan-head tapping screw	S-ZN3	16	Terminal spring	C5210
7	MTH board	Printed board	17	Terminal retainer	C2680
8	LED panel	PPE	18	Case screw	Carbon steel
9	Diffuser sheet	PET	19	ANL board	Printed board
10	Case	ABS	20	Terminal nameplate	PET

● Disposing of the printed boards after classifying their parts

When it is required to classify the parts of the printed boards before disposing of them, disassemble them referring to the figure shown below.

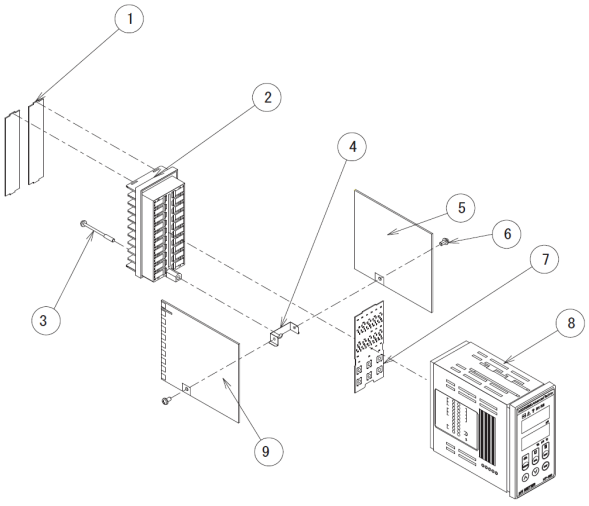
● Tool

Phillips screwdriver

● How to disassemble

⚠ WARNING

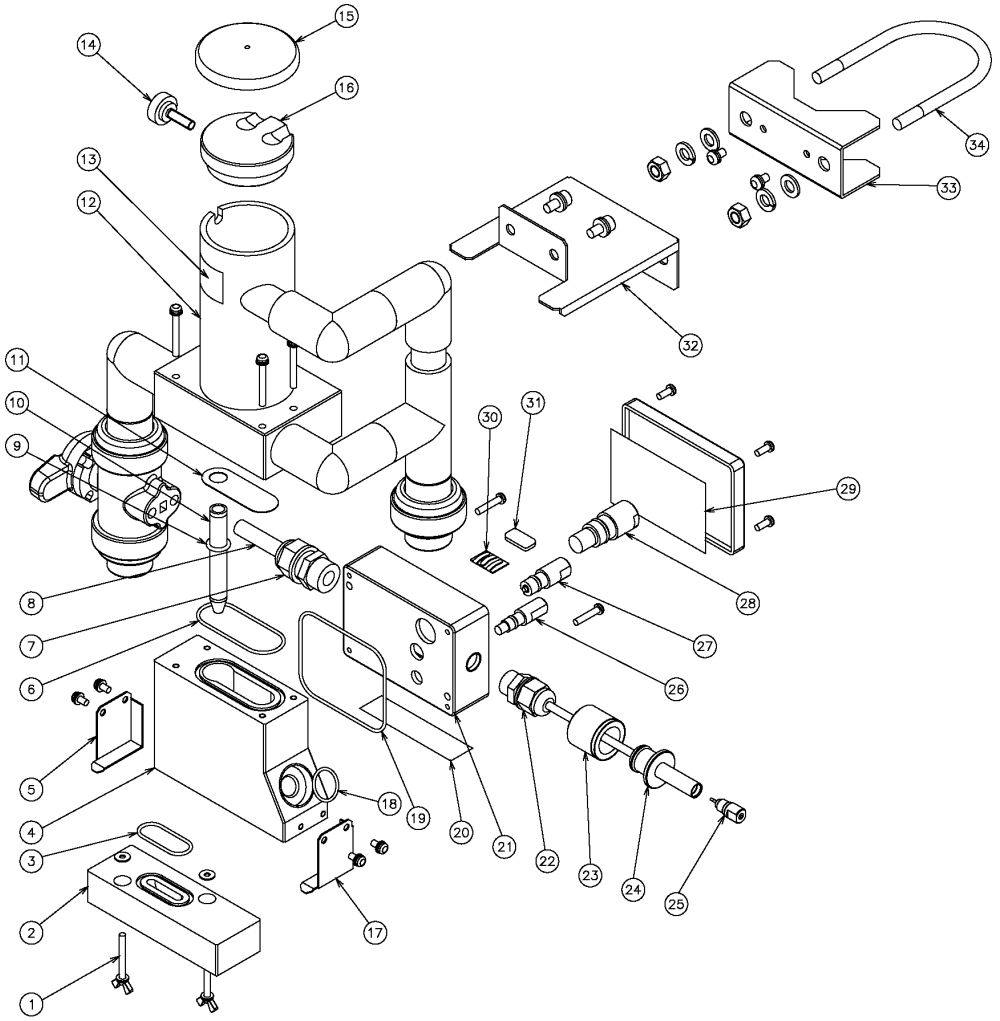
Electric shock
Be sure to turn OFF the power before wiring power source.
Do not turn ON the power until your work is completed.



Operation

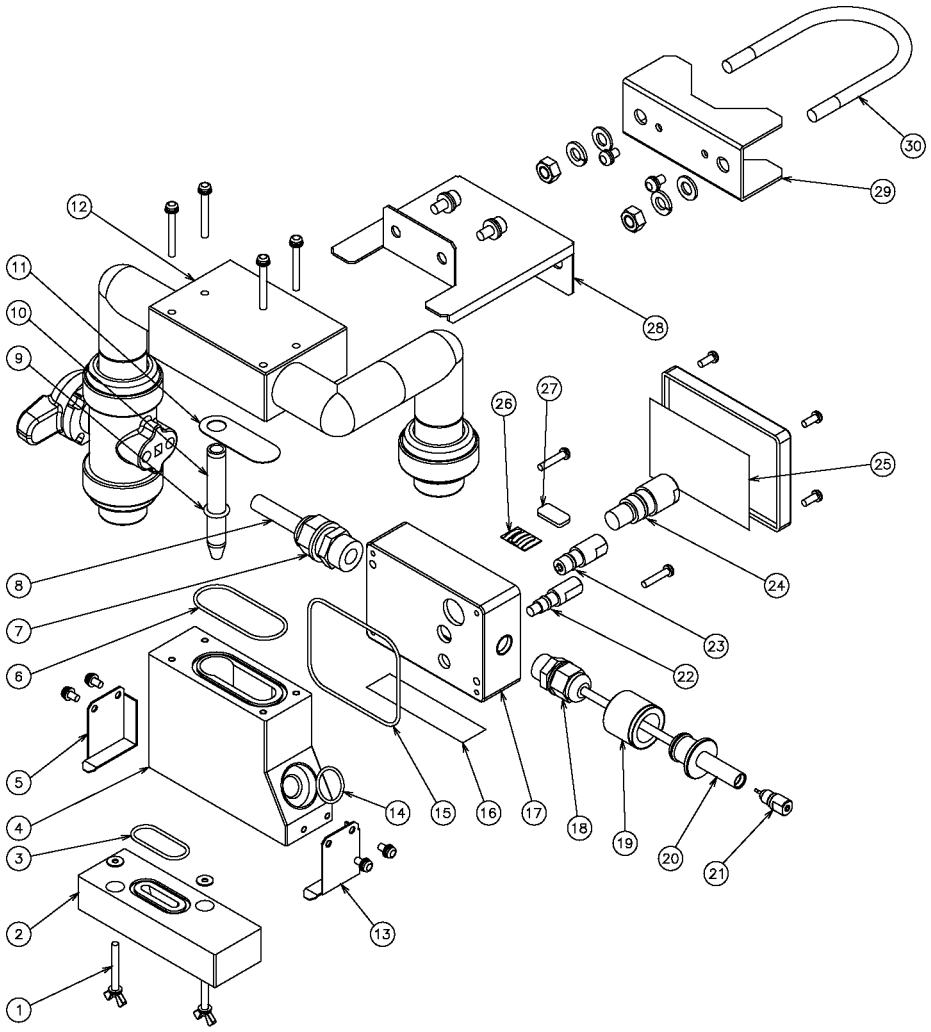
1. **Make sure that no electric power is supplied to the converter, and then remove terminal cover (1).**
2. **Disconnect all the wires to terminal block (2).**
3. **Unscrew the case screw located at the center of the bottom of terminal block (2).**
4. **Pull out terminal block (2) from the case.**
   The terminal block will come out with the printed boards attached.
5. **Pull out printed boards (5), (7), and (9) from terminal block (2).**
6. **Unscrew two pan-head tapping screws (6) to detach the F.G. bracket connecting printed boards (5) and (9).**

Overflow type sensor



No.	Name	Material	No.	Name	Material
1	Thumbscrew	SUS304	18	O-ring (P14)	EPDM
2	Fuse cell 2	PVC	19	O-ring (S80)	EPDM
3	O-ring (S30)	EPDM	20	Rating plate B1	PET
4	Measurement cell	PVC	21	Case paint 3	ADC12
5	Cell support L	SUS304	22	Cable gland	66 Nylon + EPDM
6	O-ring (S50)	EPDM	23	Sensor cap	PVC
7	Super gland	66 Nylon + EPDM	24	Sensor holder	PVC
8	C-7E cable (standard 2 m)	-	25	Cathode tip (RA-K)	Au + PPO + EPDM
9	O-ring (P11)	EPDM	26	Reference electrode (RA-R)	Ag + PPO + EPDM
10	Cell nozzle	PVC	27	EC electrode (RA-EC)	C + PPO + EPDM
11	Filter	Nylon	28	Anode electrode (RA-A)	Ag + PPO + EPDM
12	Overflow cell	PVC	29	Maintenance information plate	PET
13	Note plate	PET	30	High sticker	-
14	Knurled heads screw	PVC	31	Desiccant	-
15	Additional cap hole	PVC	32	Cell bracket	SUS304
16	Overflow lid 2	PVC	33	Pole bracket	SUS304
17	Sensor port R	SUS304	34	U-bolt	SUS304

Inline type sensor



No.	Name	Material	No.	Name	Material
1	Thumbscrew	SUS304	16	Rating plate B1	PET
2	Fuse cell 2	PVC	17	Case paint 3	ADC12
3	O-ring (S30)	EPDM	18	Cable gland	66 Nylon + EPDM
4	Measurement cell	PVC	19	Sensor cap	PVC
5	Cell support L	SUS304	20	Sensor holder	PVC
6	O-ring (S50)	EPDM	21	Cathode tip (RA-K)	Au + PPO + EPDM
7	Super gland	66 Nylon + EPDM	22	Reference electrode (RA-R)	Ag + PPO + EPDM
8	C-7E cable (standard 2 m)	-	23	EC electrode (RA-EC)	C + PPO + EPDM
9	O-ring (P11)	EPDM	24	Anode electrode (RA-A)	Ag + PPO + EPDM
10	Cell nozzle	PVC	25	Maintenance information plate	PET
11	Filter	Nylon	26	High sticker	-
12	Inline cell	PVC	27	Desiccant	-
13	Sensor port R	SUS304	28	Cell bracket	SUS304
14	O-ring (S14)	EPDM	29	Pole bracket	SUS304
15	O-ring (S80)	EPDM	30	U-bolt	SUS304

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