

SF6 Purity Meter

FI-8000-SF6

Operating Manual

RIKEN KEIKI Co., Ltd.

2-7-6 Azusawa, Itabashi-ku, Tokyo, 174-8744, Japan

Phone : +81-3-3966-1113

Fax : +81-3-3558-9110

E-mail : intdept@rikenkeiki.co.jp

Web site : <http://www.rikenkeiki.co.jp/english/>

Contents

1. Outline of the Product	3
Preface	3
Purpose of use	3
Definition of DANGER, WARNING, CAUTION and NOTE	3
2. Important Notices on Safety	4
2-1. Danger cases	4
2-2. Warning cases	5
2-3. Precautions	6
3. Product Components	7
3-1. Main unit and standard accessories	7
3-2. Names and functions for each part	9
3-3. Tubing diagram	13
4. How to Use	14
4-1. Before using the purity meter	14
4-2. Preparation for start-up	14
4-3. How to start the purity meter	16
4-4. Basic operating procedures	17
4-5. Self-diagnosis function at start-up	18
4-6. Reference calibration	19
4-7. Supplying measuring gas	20
4-8. Performing measurement	21
4-9. Manual memory	22
4-10. Measuring gas/range detail display	23
4-11. Checking zero point	24
4-12. Power-off	25
5. How to Set Setup Mode	26
5-1. Entering the setup mode	26
5-2. Measuring gas setting "1. SELECT GAS"	28
5-3. Date/time setting "2. SET DATE/TIME"	29
5-4. Saved data display "3. VIEW SAVED DATA"	30
5-5. Saved data clear "4. CLEAR SAVED DATA"	31
5-6. Switch to measuring mode "6. START MEAS."	32
6. Operations and Functions	33
6-1. CAUTION display	33
6-2. ERROR display	34
7. Maintenance	35
7-1. Maintenance intervals and items	35
7-2. Calibration	37
7-3. How to clean	38
7-4. Parts replacement	39
8. Storage and Disposal	40
8-1. Procedures to store the purity meter or leave it for a long time	40
8-2. Procedures to use the purity meter again	40
8-3. Disposal of products	40
9. Troubleshooting	42
9-1. Troubles on the unit	42
9-2. Troubles in reading	44
10. Product Specifications	45
10-1. List of product specifications	45
10-2. List of options	45
11. Appendix	46
12. Detection Principle	47

Outline of the Product

Preface

Thank you for choosing our SF6 Purity Meter FI-8000-SF6 (hereinafter referred to as the purity meter). Please check that the model number of the product you purchased is included in the specifications on this manual.

This manual explains how to use the purity meter and its specifications. It contains information required for using the purity meter properly. Not only the first-time users but also the users who have already used the product must read and understand the operating manual to enhance the knowledge and experience before using the purity meter.

Note that the contents of this manual are subject to change without notice for product improvement. It is also prohibited to copy or reproduce this manual, in whole or in part, without permission.

Regardless of warranty period, we shall not make any indemnification for accidents and damage caused by using the purity meter.

Make sure to read the warranty policy specified on the warranty.




Purpose of use

This product is a portable purity meter intended to measure the purity of SF6 inside the devices such as "Gas Circuit Breaker (GCB)", "Gas Insulation Switch (GIS)" and "Gas Insulation Transformer", or used in collecting or recycling of SF6.

Use this product only for the purpose of SF6 purity measurement.

Definition of DANGER, WARNING, CAUTION and NOTE

Throughout this manual, the following indications are used to ensure safe and effective work.

 DANGER	This message indicates that improper handling may cause serious damage on life, health or assets.
 WARNING	This message indicates that improper handling may cause serious damage on health or assets.
 CAUTION	This message indicates that improper handling may cause minor damage on health or assets.
NOTE	This message indicates advice on handling.

Important Notices on Safety

To maintain the performance and use the purity meter safely, observe the following instructions of DANGER, WARNING and CAUTION.

2-1. Danger cases



DANGER

- This is not an explosion-proof unit. Do not use this product in a location designated as a hazardous area (explosion-proof area).
- A measured gas is discharged from the end of handy aspirator. Use the purity meter outdoors or in a room with good ventilation, or take an appropriate measure such as collecting a measured gas in a gas sampling bag.

2-2. Warning cases



WARNING

Sampling point pressure

- The purity meter is designed to introduce a gas of 0.1 to 0.7 MPa (gauge pressure) through GAS IN. Do not introduce a gas that exceeds the range of 0.1 to 0.7 MPa (gauge pressure). Otherwise, a failure may be caused.

Reference calibration in the atmosphere

- When the reference calibration is performed in the atmosphere, check the atmosphere for freshness before beginning the calibration. If interference gases (gases other than SF₆ and air) exist, the adjustment cannot be performed properly and thus correct measurement of gas concentration may not be performed.

Use of battery

- To operate the purity meter with batteries, be sure to use AA alkaline batteries of the same type.
- Replace all of the three batteries with new ones at one time.
- To operate the purity meter with AC adapter, use the dedicated AC adapter (option).

Battery level check

- Before use, check that there remains sufficient battery power. When the purity meter is not used for a long period, the batteries may be exhausted. Never fail to replace them with new ones before use.
- If a battery error occurs, measurement cannot be performed. If an error is displayed during use, turn off the power and promptly replace the batteries in a safe area.

Others

- Do not throw the purity meter into fire.
- Do not wash the purity meter in a washing machine or ultrasonic cleaner.
- Do not block the buzzer sound opening. No buzzer sound can be heard.
- Do not remove the batteries or dedicated AC adapter (option) while the power is on.

2-3. Precautions



CAUTION

Do not measure gases that contain interference gases.

- If a measuring gas contains an interference gas (other than SF6 and air), accurate readings cannot be obtained. Do not measure gases that contain interference gases.

Use REF. IN and end of handy aspirator under atmospheric pressure.

- Use the REF. IN of purity meter and the end of handy aspirator under atmospheric pressure.

Do not use the purity meter where it is exposed to oil, chemicals, etc. Do not submerge the purity meter under water on purpose.

- Do not use in a place where the purity meter is exposed to liquids such as oil and chemicals.
- The purity meter is neither water-proof nor dust-proof.
- Do not place the purity meter where water or dirt gets accumulated. The purity meter placed at such a location may cause malfunction due to water or dirt that gets into the buzzer opening, etc.
- Note that drawing in dirty water, dust, metallic powder, etc. will significantly deteriorate the sensor sensitivities. Be careful when the purity meter is used in an environment where these elements exist.

Do not use the purity meter in a place where the temperature drops below -10°C or rises over 40°C.

- The operating temperature of the purity meter is -10 to +40°C. Do not use the purity meter at higher temperatures, humidities and pressures or at lower temperatures than the operating range.
- Do not use the purity meter in a place where the surface of it is heated above 40°C by radiant heat (infrared rays emitted from a high-temperature object) or direct sunlight.
- Do not store the purity meter in a sun-heated car.

Observe the operating restrictions to prevent condensation inside the purity meter or sampling hose.

- Condensation formed inside the purity meter or sampling hose causes clogging or gas adsorption, which may disturb accurate gas measurement. Thus, condensation must be avoided. In addition to the operating environment, carefully monitor the temperature/humidity of the sampling point to prevent condensation inside the purity meter or sampling hose. Please observe the operating restrictions.

Do not use a transceiver near the purity meter.

- Radio wave from a transceiver near the purity meter may disturb readings. If a transceiver or other radio wave transmitting device is used, it must be used in a place where it disturbs nothing.
- Do not use the purity meter near a device that emits strong electromagnetic waves (high-frequency or high-voltage devices).

Never fail to perform a regular maintenance.

- Never fail to perform a regular maintenance to ensure safety. Continuing to use the purity meter without performing maintenance will result in inaccurate gas measurement.

Usage

- A rapid temperature change in the operating environment makes the zero point unstable. Use the purity meter after adjusting it to the ambient temperature sufficiently.

Others

- Operate the purity meter using only the procedures described in this operating manual.
- Do not drop or give shock to the purity meter. The accuracy of the purity meter may be deteriorated.
- When the AC adapter (option) is used, do not use a power supply of the same system as a device that significantly disturbs the waveform of power supply.
- To use the AC adapter (option), use the rated power supply specified for the purity meter.

Product Components

3-1. Main unit and standard accessories

After opening the carton box, check the purity meter and accessories.
If there is anything missing, contact RIKEN KEIKI.

Main unit

For names and functions of individual parts of the purity meter and LCD display, see "3-2. Names and functions for each part".

<Main Unit>



Opened

Accessories

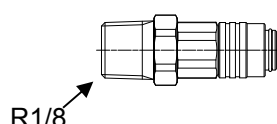
AA alkaline battery
: 3 pcs

Dry batteries used to drive the purity meter.



Gas inlet socket
: 1 pc

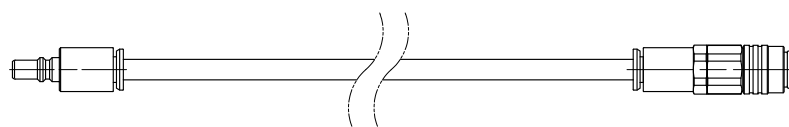
Attach this part to the sampling point as an inlet of gas to be measured.



Manufacturer: NITTO KOHKI
Model: MC-10SM
Maximum use pressure: 1.0 MPa*

Sampling hose
: 1 pc

A tube that connects the gas inlet socket attached to the sampling point with the GAS IN plug attached to GAS IN of purity meter.
(Maximum pressure: 0.7 MPa, Length: Approx. 2 m)



Manufacturer:
NITTO KOHKI
Model: MC-04PC
Maximum use pressure:
1.0 MPa*

PTFE tube
Outer diameter: $\Phi 4$,
Inner diameter: $\Phi 2$
Length: Approx. 2 m

Manufacturer:
NITTO KOHKI
Model: MC-04SC
Maximum use pressure:
1.0 MPa*

Product warranty: 1 pc

Operating manual: 1 pc

* The measuring gas supply pressure for the purity meter should be within the range of 0.1 to 0.7 MPa (gauge pressure).

Optional items (sold separately)

Dedicated AC adapter:
1 pc

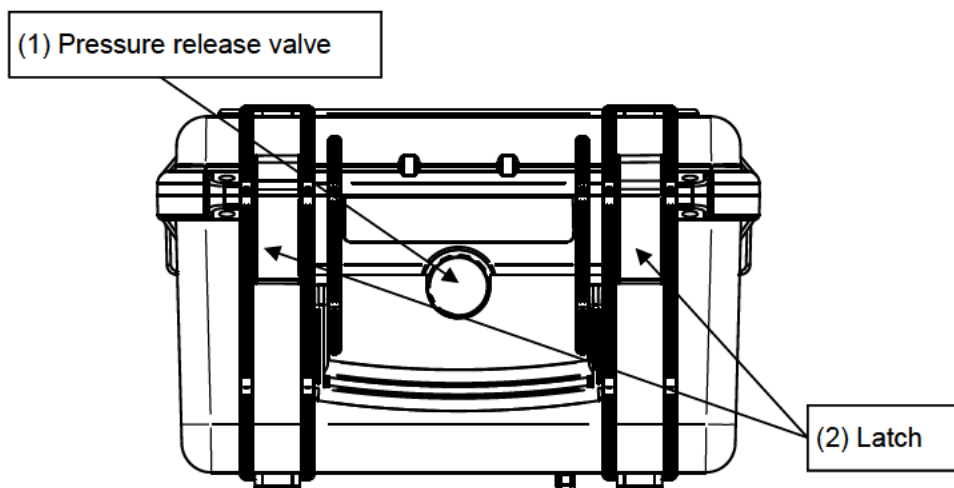
A dedicated AC adapter. (100 - 240 VAC, Cable length: Approx. 2 m)



3-2. Names and functions for each part

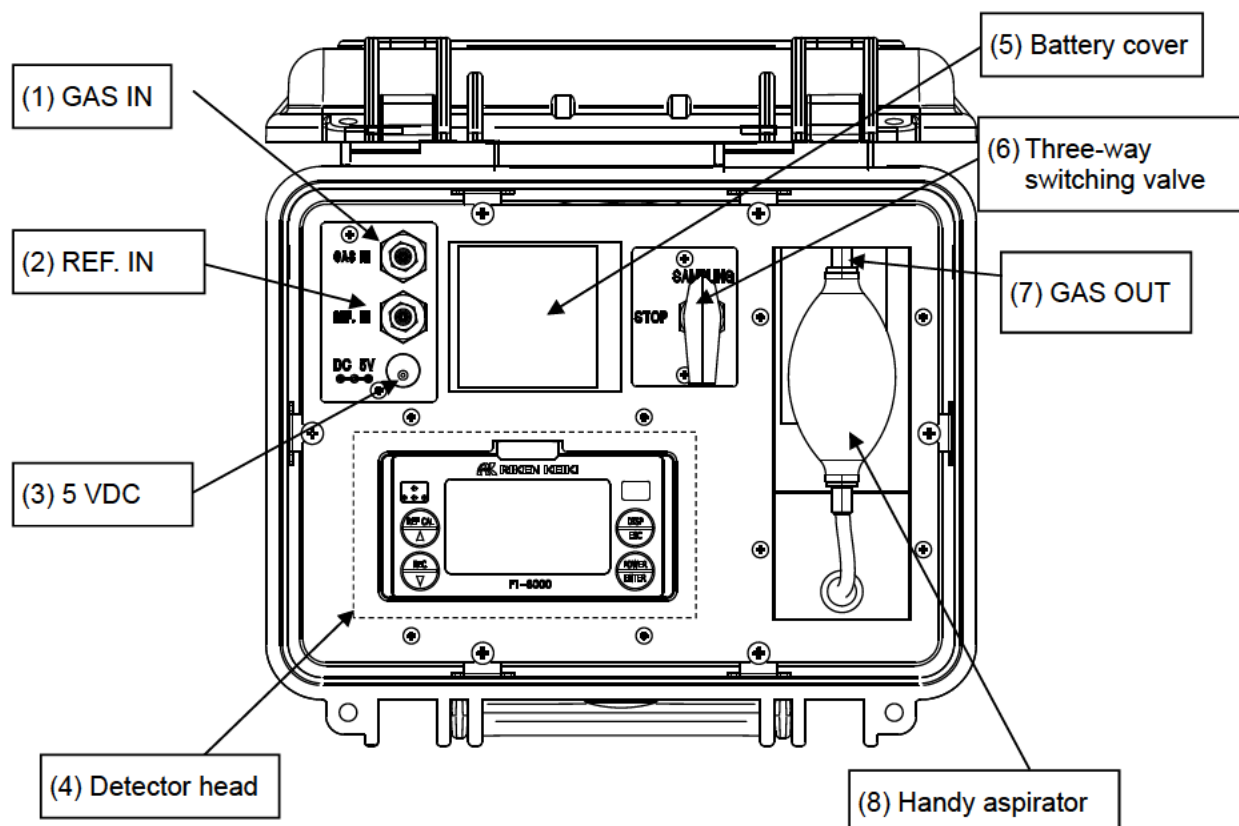
This section describes names and functions of main unit and battery unit parts and LCD display.

<Main Unit> (Case closed)



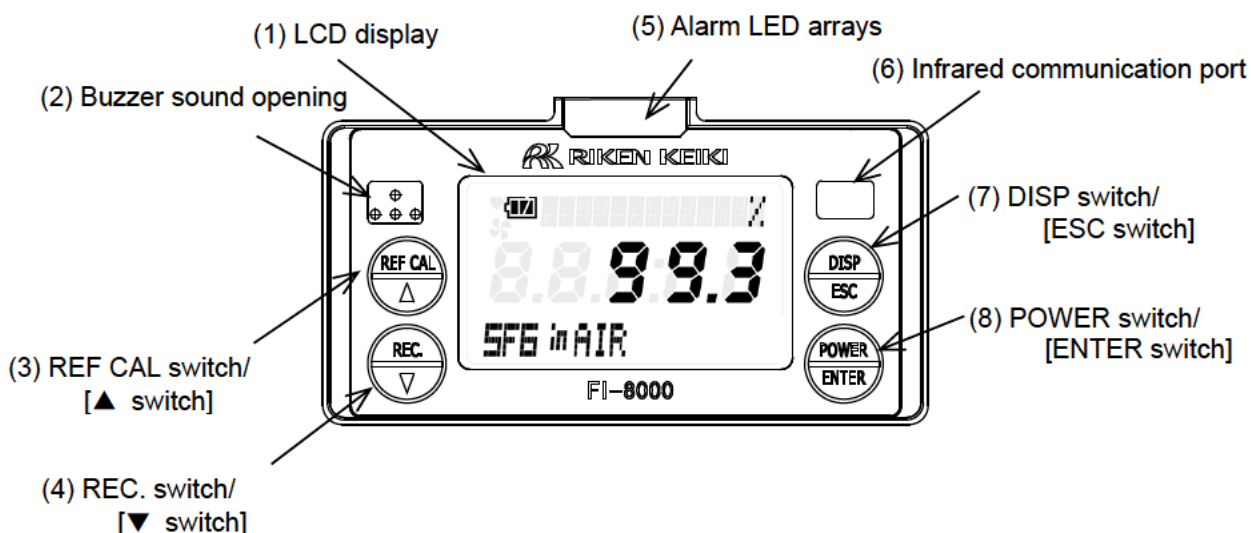
No.	Name	Function
(1)	Pressure release valve	Used when the cover cannot be opened due to pressure change. For the purity meter, fully open the valve by rotating it counterclockwise to use.
(2)	Latch	Used to fix the case cover.

<Main Unit> (Case opened)



No.	Name	Function
(1)	GAS IN	A supply port of measuring gas. Use the attached sampling hose to connect the sampling point with GAS IN, and supply a measuring gas to the purity meter. The supply pressure should be within the range of 0.1 to 0.7 MPa (gauge pressure).
(2)	REF. IN	An inlet for comparison gas. For the purity meter, fresh air is used as a comparison gas. Use the purity meter in an environment where fresh air under atmospheric pressure is always present at REF. IN.
(3)	5 VDC	A terminal used to drive the purity meter with the dedicated AC adapter. Connect/disconnect the AC adapter while the unit is powered off.
(4)	Detector head	A detector head that measures the purity of SF6.
(5)	Battery cover	A battery box cover. To drive the purity meter with batteries, use three AA alkaline batteries.
(6)	Three-way switching valve	A valve used to switch the line connected to the detector head between "SAMPLING", "STOP" and "REF.". Switching the valve to "SAMPLING" connects the GAS IN line with the detector head. Switching the valve to "REF." connects the REF. IN line with the detector head. Switching the valve to "STOP" shuts the upstream line of the detector head.
(7)	GAS OUT	An outlet for measuring gas.
(8)	Handy aspirator	Used to draw fresh air from REF. IN to the detector head.

<LCD Display>



No.	Name	Function
(1)	LCD display	Displays a measuring gas name, measurement result, battery level, etc.
(2)	Buzzer sound opening	Emits a buzzer sound at power-on/off or error occurrence. (Do not block it.)
(3)	REF CAL switch [▲ switch]	Used to perform reference calibration. [Used to enter numerical values or move a screen.]
(4)	REC. switch [▼ switch]	Used to save measurement results in the measuring mode. [Used to enter numerical values or move a screen.]
(5)	Alarm LED arrays	The lamp blinks in response to error occurrence.
(6)	Infrared communication port	Used to carry out data communications with a PC in data logger mode.
(7)	DISP switch [ESC switch]	Displays detailed information such as a range of measuring gas. [Used to stop processing and to do others.]
(8)	POWER switch [ENTER switch]	Turns ON/OFF the power. [Used to make a selection in the setup mode.]

The switches and descriptions in [] are for the setup mode.



CAUTION

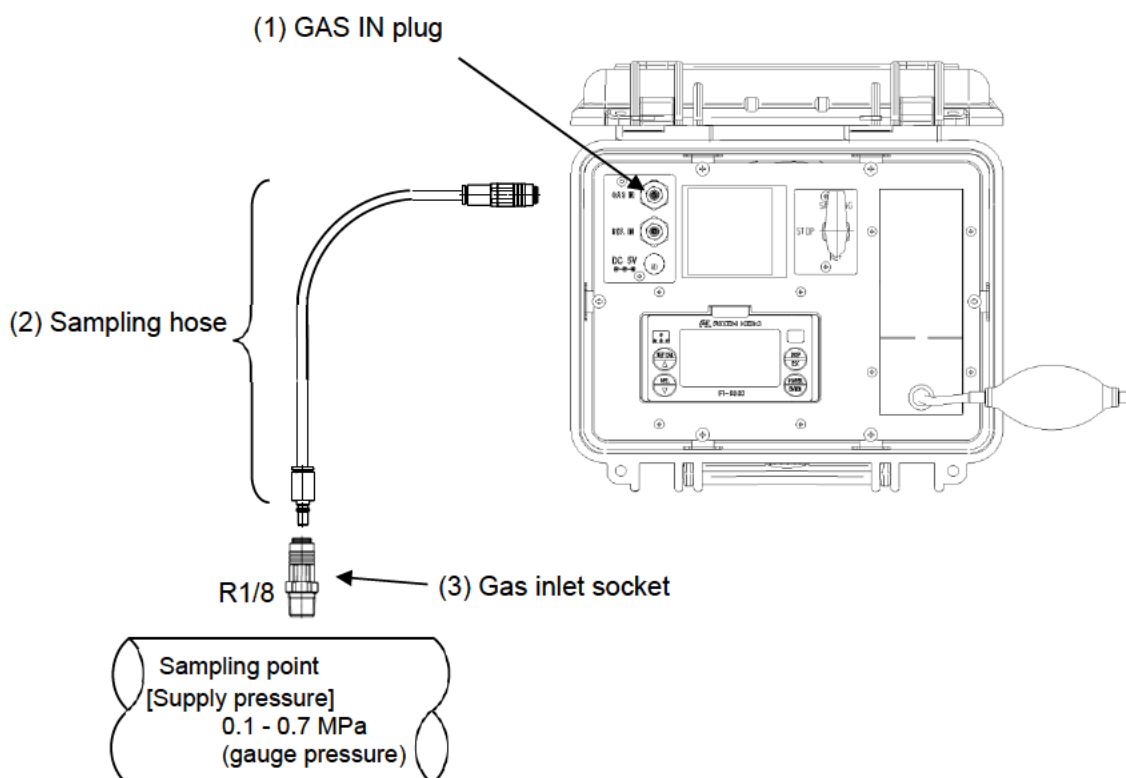
- Do not jab the buzzer sound opening with a sharp-pointed item. The unit may malfunction or get damaged, allowing water or foreign substance, etc. to get inside.
- Do not remove the panel sheet on the surface.
- Do not affix a label or the like on the infrared communication port. Infrared communications can no longer be conducted.

NOTE

- The meanings of battery level icons are as follows:
 : Sufficient/ : Low/ : Needs replacement

If the battery level further drops, the inside of the battery icon starts to blink ().

Plug, tube and socket



No.	Name	Function
(1)	GAS IN plug	A joint that connects the sampling hose with main unit. (The unit is shipped with this plug connected to GAS IN.)
(2)	Sampling hose	A tube that connects the gas inlet socket attached to the sampling point with the GAS IN plug attached to GAS IN of main unit. (Maximum pressure: 0.7 MPa, Length: Approx. 2 m)
(3)	Gas inlet socket	A joint that connects the sampling point with sampling hose.

3-3. Tubing diagram

The tubing system of purity meter is configured as shown in the following figure. The direction of three-way switching valve determines the function as follows.

Detector head connected to REF. IN line

The air under atmospheric pressure can be drawn from REF. IN.

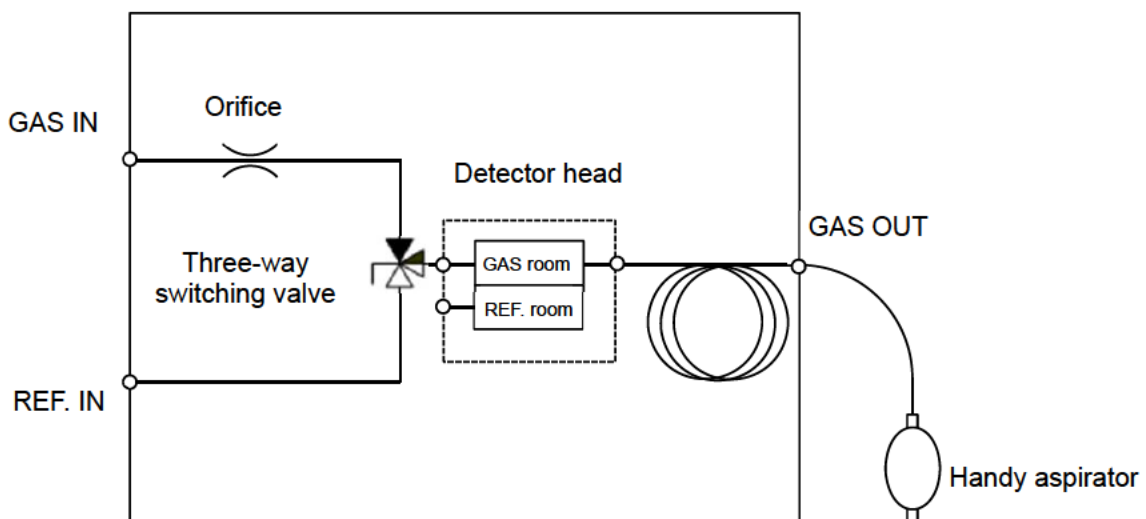
Draw in fresh air with the handy aspirator two or three times to introduce it to the GAS room of the detector head.

Detector head connected to GAS IN line

A measuring gas can be supplied from GAS IN. (Supply pressure: 0.1 - 0.7 MPa (gauge pressure))

A measuring gas pressure is reduced by passing through the orifice, and the appropriate flow rate of gas enters the gas room of the sensor.

When replacement of the gas room of the detector head is completed, stop supplying a measuring gas with the three-way switching valve and put the gas room of the detector head into the state of atmospheric pressure to perform measurement.



4

How to Use

4-1. Before using the purity meter

Not only the first-time users but also the users who have already used the purity meter must follow the operating precautions. Ignoring the precautions may damage the unit, resulting in inaccurate gas measurement.

4-2. Preparation for start-up

Before use, read and understand the following precautions. Ignoring these may cause inaccurate measurement.

- The batteries are installed (with sufficient battery level).
- Check that there is no bend or hole in the sampling hose.
- Check that the sampling hose and gas inlet socket are connected properly.

4-2-1. How to replace the batteries

When the purity meter is used for the first time, or when the battery level is low, attach new AA alkaline batteries according to the following procedures.

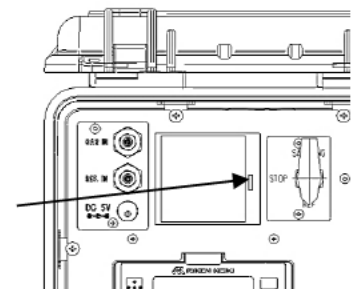


CAUTION

- Never fail to turn off the power of the purity meter before replacing the batteries.
- Replace the batteries in a safe place.
- Replace all the three batteries with new ones at one time.
- Pay attention to the polarities during replacement.
- Use AA alkaline batteries.
- If the purity meter is not used for a long time, store it after removing the batteries.

- (1) Check that the power of the purity meter is turned off. Turn off the power if it is turned on.
- (2) Press the tab of the battery cover in the direction indicated by the mark (▲) on the cover to open.
- (3) Paying attention to the polarities of batteries, replace all the three batteries with new ones.
- (4) Close the battery cover.

Tab of battery cover



4-2-2. How to use the dedicated AC adapter (option)

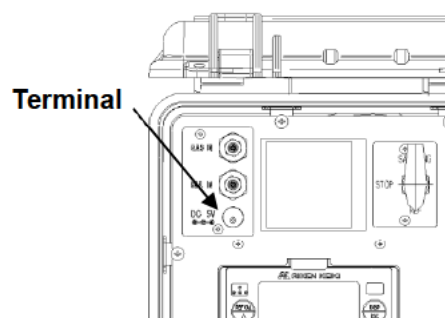
The purity meter can be operated with the dedicated AC adapter (option) as well as batteries.



DANGER

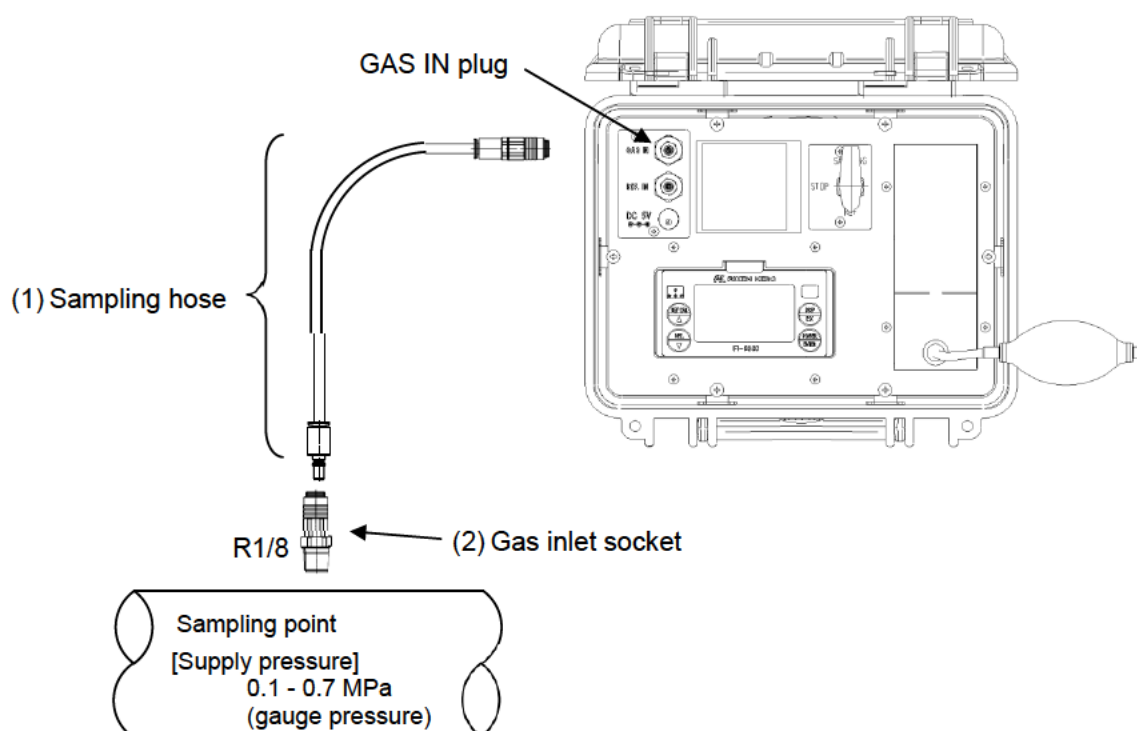
- Be sure to use the dedicated AC adapter.

- (1) Check that the power of the purity meter is turned off. Turn off the power if it is turned on.
- (2) Insert the dedicated AC adapter into the terminal.



4-2-3. Attaching plug, tube and socket

Attach the accessory parts, (1) sampling hose and (2) gas inlet socket, to the plug attached to GAS IN of purity meter and to the sampling point in the following order: (1) to the plug, (1) to (2), and then (2) to the sampling point. When attaching the sampling hose to the plug and socket, push in until a click sound is heard to ensure proper connection.



CAUTION

- Use only the parts specified by RIKEN KEIKI.

4-3. How to start the purity meter

When the power is turned on, self-diagnosis starts, and then the purity meter enters the measuring mode.

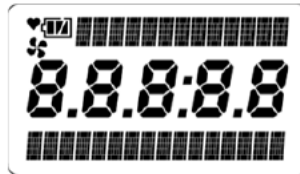
Power-on

Press and hold the POWER switch until the buzzer blips to turn on the power. When the power is turned on, the LCD display changes automatically as shown below, and the purity meter enters the measuring mode.

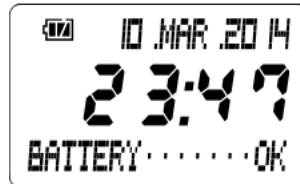
Keep the POWER switch pressed for three seconds or more.

Hold it down until all the LCDs and alarm lamp light up and the buzzer blips.

All LCDs light up

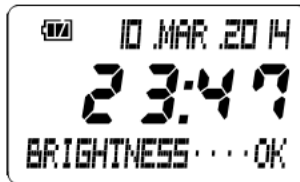


Self-diagnosis (Battery level)



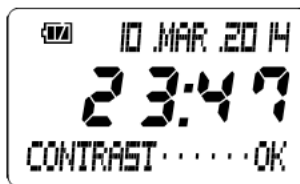
Display example:
March 10, 2014
23:47
BATTERY (battery level)
: OK (no problem)

Self-diagnosis (UV intensity)



Display example:
BRIGHTNESS (UV intensity)
: OK (no problem)

Self-diagnosis (Contrast)



Display example:
CONTRAST
: OK (no problem)

Buzzer sounds twice (Beep, beep)

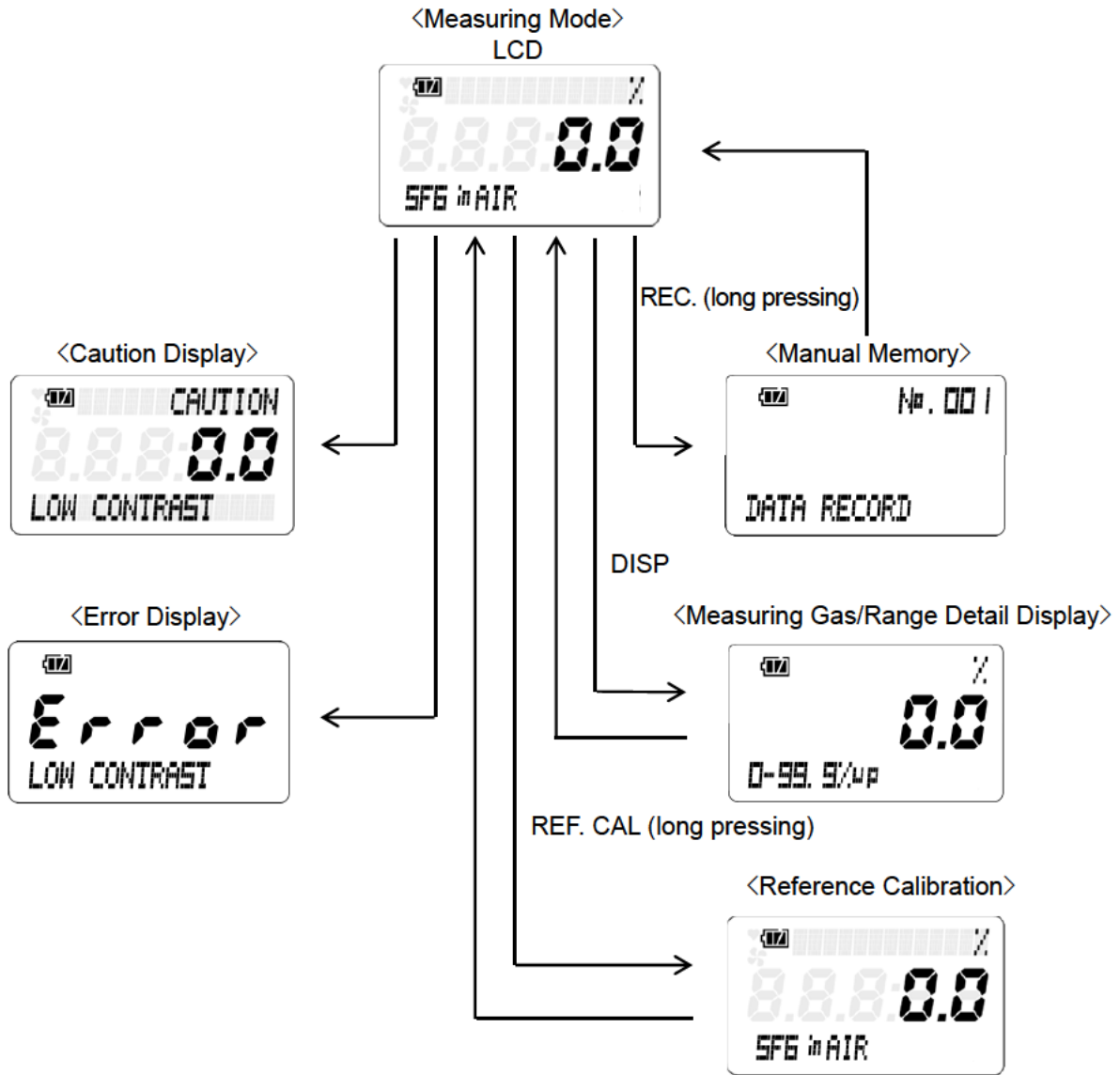
Measuring mode



CAUTION

- Before performing gas measurement after startup, make the unit draw in sufficient fresh air. If zero is not displayed, perform reference calibration (see "4-6. Reference calibration").

4-4. Basic operating procedures



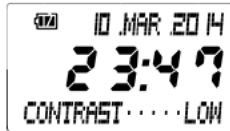
NOTE

- The purity meter provides the "Measuring mode" used to measure a predetermined gas and the "Setup mode" used to change a measuring gas or set time. The manner of turning on the power is different between these modes. See "4-3. How to start the purity meter" for the measuring mode, or see "5. How to Set Setup Mode" for the setup mode.

4-5. Self-diagnosis function at start-up

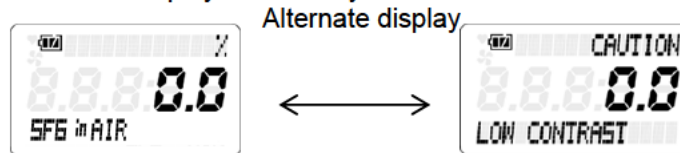
The purity meter provides the "Measuring mode" used to measure a predetermined gas and the "Setup mode" used to change a measuring gas or set time. The manner of turning on the power is different between these modes. See "4-3. How to start the purity meter" for the measuring mode, or see "5. How to Set Setup Mode" for the setup mode.

The self-diagnosis function works automatically regardless of the way to turn on the power, and the self-diagnosis screen is displayed (see start-up procedures). If a problem is found in the battery level, UV intensity or contrast as a result of self-diagnosis, the purity meter displays "LOW" in the lower part of the screen and sounds the buzzer.



Display example: Low contrast

If the problem found is a minor one, the purity meter enters the measuring mode. However, the screen provides the normal and caution displays alternately.



Display example: Caution display for low contrast

If the problem found is a major one that prevents measurement, the purity meter does not enter any mode and displays an error.



Display example: Contrast error



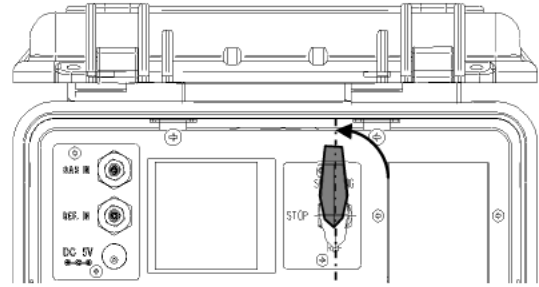
CAUTION

- If a caution or error is displayed, promptly take an appropriate remedial measure to restore the normal condition. See "9. Troubleshooting" for caution and error details and remedial actions.

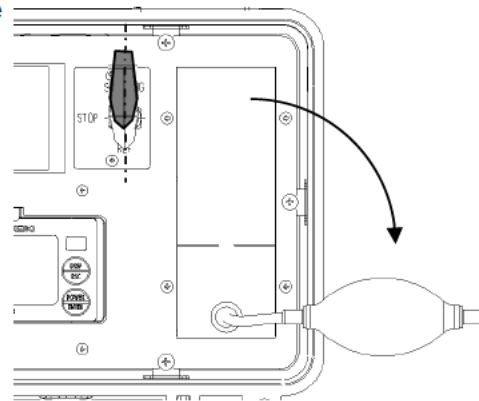
4-6. Reference calibration

Before performing measurement, perform reference calibration using fresh air.

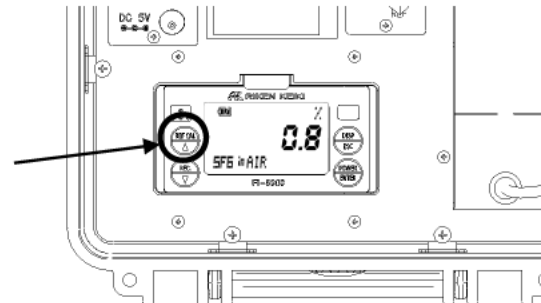
(1) Switch the three-way switching valve to the REF. side.



(2) Pick up and squeeze the handy aspirator two or three times to draw in fresh air from REF. IN.



(3) After the reading is stabilized, hold down the REF CAL switch.



(4) When the buzzer blips, release the REF CAL switch.

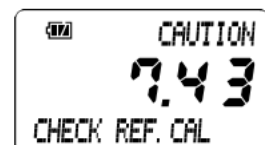


CAUTION

- Perform reference calibration under atmospheric pressure by drawing fresh air.
- Perform reference calibration after the reading is stabilized.
- If there is a sudden temperature change of 15°C or more between the storage and operation locations, turn on the power of the purity meter, leave it for about ten minutes in a similar environment to the operation location, and perform reference calibration in fresh air before using it.

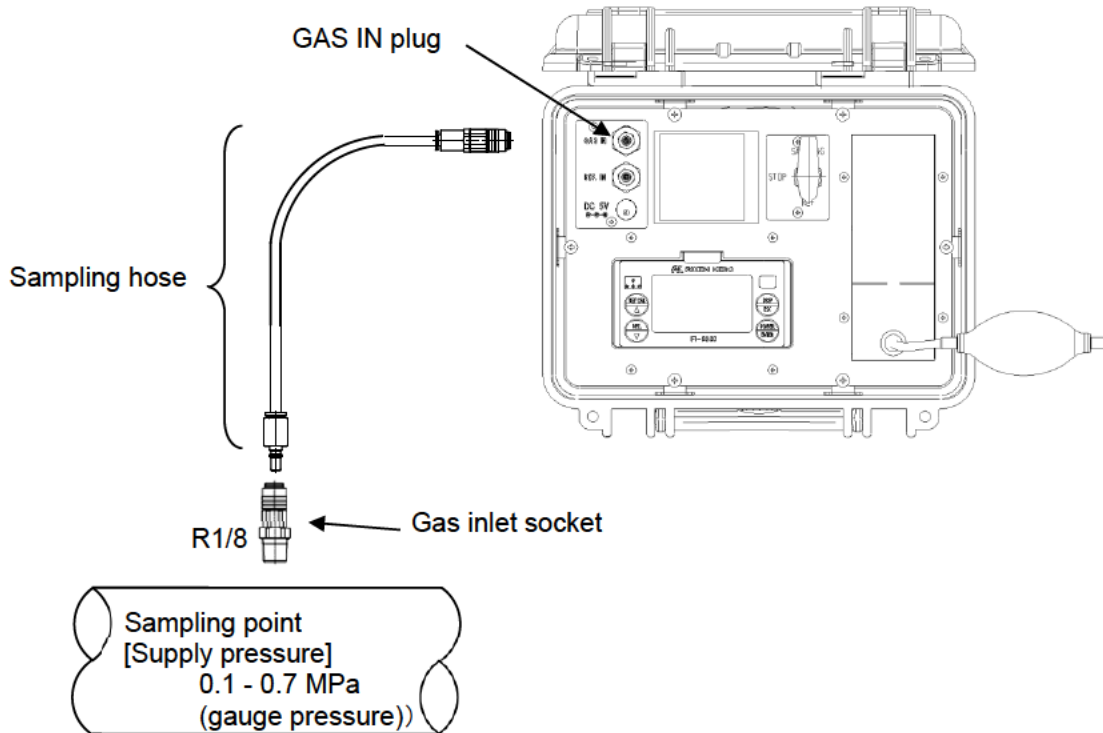
NOTE

When an occurrence of zero drift is highly likely, the caution display "CHECK REF. CAL" is displayed. If it is displayed, draw in fresh air and perform reference calibration.



4-7. Supplying measuring gas

Install the attached gas inlet socket to the sampling point and connect the sampling hose between the gas inlet socket and GAS IN plug of main unit to supply a measuring gas.
(Supply pressure: 0.1 - 0.7 MPa (gauge pressure))



WARNING

- The purity meter is designed to introduce a gas of 0.1 to 0.7 MPa (gauge pressure) through GAS IN. Do not introduce a gas that exceeds the range of 0.1 to 0.7 MPa (gauge pressure). Otherwise, a failure may be caused.
- Do not directly connect to a place where a pressure exceeding the range of 0.1 to 0.7 MPa (gauge pressure) is present. The internal tubing system may be damaged.
- When the reference calibration is performed in the atmosphere, check the atmosphere for freshness before beginning the calibration. If interference gases exist, the adjustment cannot be performed properly and thus correct measurement of gas concentration may not be performed.
- Before use, check that there remains sufficient battery power. When the purity meter is not used for a long period, the batteries may be exhausted. Never fail to replace them with new ones before use.
- If a battery error occurs, gas measurement cannot be performed. If an error is displayed during use, turn off the power and promptly replace the batteries in a safe area.
- Do not block the buzzer sound opening. No buzzer sound can be heard.



CAUTION

- If a measuring gas contains an interference gas (other than SF₆ and air), accurate readings cannot be obtained. Do not measure gases that contain interference gases.
- The end of handy aspirator of the purity meter should be opened to atmosphere.

NOTE

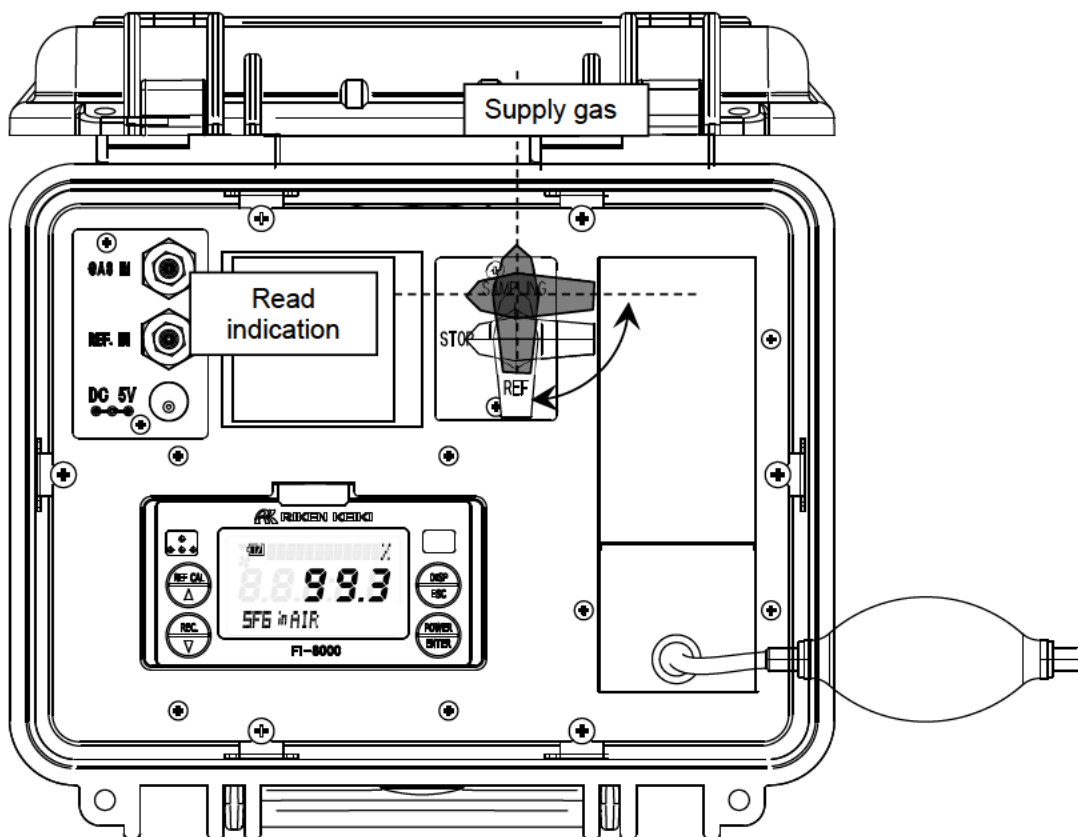
- In a low-temperature environment, the operating time is shortened due to the battery performance property.
- At a low temperature, the response of the LCD display may get slow down.

4-8. Performing measurement

Switch the three-way switching valve to the SAMPLING side to start supplying a gas to the detector head. Wait until replacement of gas inside the detector head is completed. The following table shows gas flow rates and the time required for replacement at that time for reference.

When replacement of gas is completed, switch the three-way switching valve to the STOP side read the minimum value in 5 sec after gas supplying stops.

Supply pressure	0.1 MPa	0.2 MPa	0.3 MPa	0.4 MPa	0.5 MPa	0.6 MPa	0.7 MPa
Gas flow rate	60 ml/min	90 ml/min	120 ml/min	150 ml/min	180 ml/min	210 ml/min	250 ml/min
Time required for replacement	60 seconds	45 seconds	30 seconds	25 seconds	20 seconds	15 seconds	15 seconds



NOTE

- Replacement may take extra time if air remains in the sampling hose or upstream tube.
- Note that above gas flow rates and the time required for replacement are given for reference.

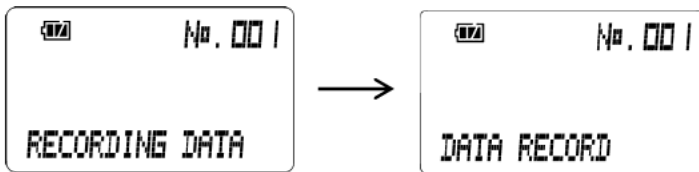
4-9. Manual memory

Any instantaneous value during measurement can be recorded. Up to 256 points of data can be recorded.

(1) In the measuring mode, press the REC. switch (for about two seconds).



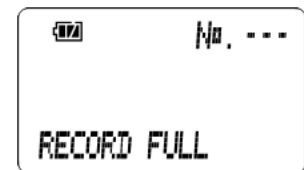
(2) The buzzer blips and the time and instantaneous value at that time are recorded. The following screens are displayed on the purity meter.



The purity meter returns to the normal display of the measuring mode automatically.

NOTE

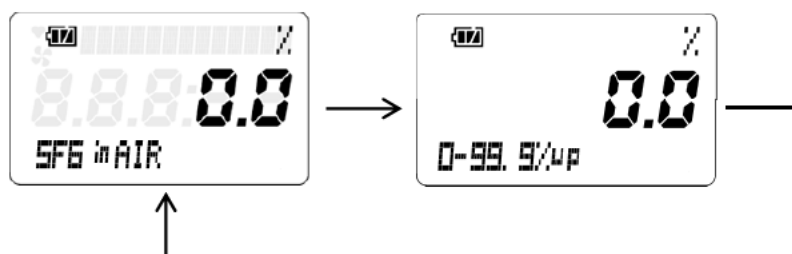
- If the maximum data amount (256 points) is exceeded, the purity meter displays "RECORD FULL" and rejects saving of further data. To save data newly, delete the saved data in the setup mode (see "5. How to Set Setup Mode" for details).



4-10. Measuring gas/range detail display

The detailed information of measuring gas/range can be checked.

- (1) Press the DISP switch. The purity meter displays the measuring gas and measuring range screens alternately.



- (2) After displaying ten cycles, the normal display returns.



4-11. Checking zero point

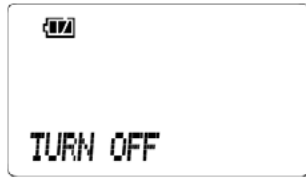
To check the zero point, switch the three-way switching valve to the REF. side and draw fresh air to the sensor using the handy aspirator.

NOTE

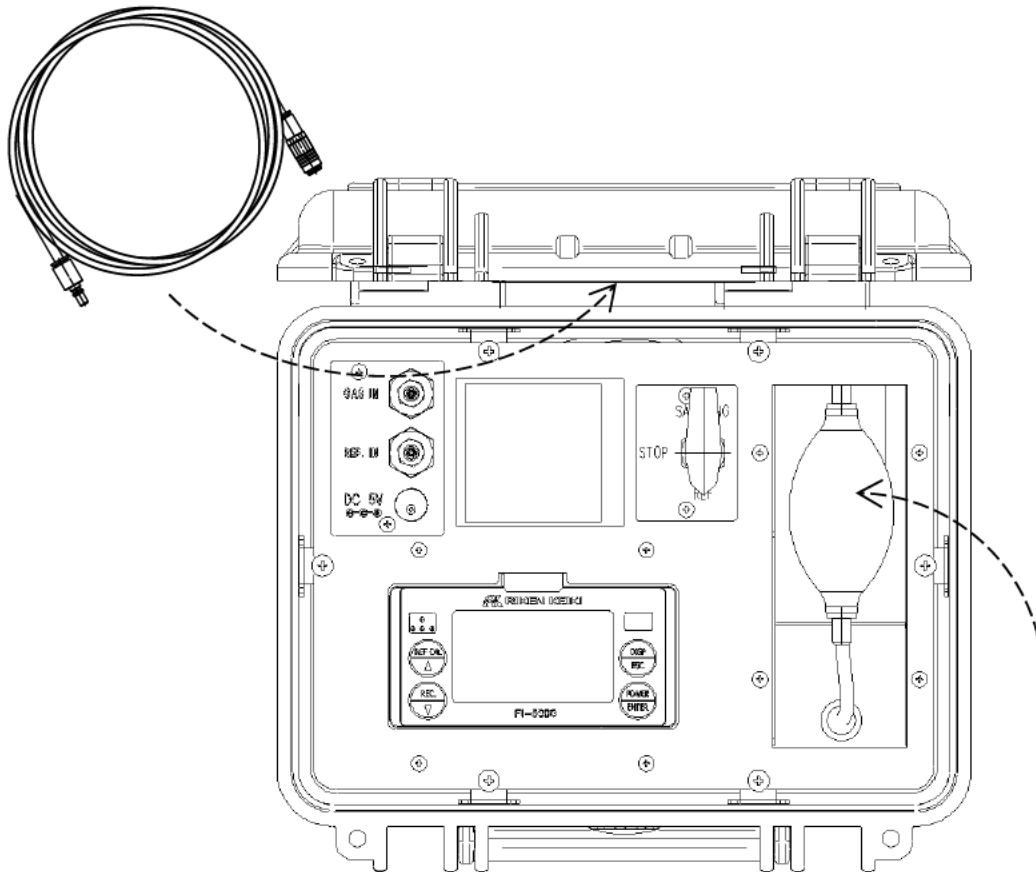
- If zero is not displayed, perform reference calibration again using fresh air. (See "4-6. Reference calibration" for details.)

4-12. Power-off

After measurement, squeeze the handy aspirator while the three-way switching valve is directed at the REF. side to draw in fresh air and discharge the measuring gas that remains inside the purity meter.
To turn off the power, hold down the POWER switch. The buzzer sounds three times. Hold down the POWER switch until the screen display disappears to turn off the power.



After turning off the power, store the handy aspirator, sampling hose, etc. and then close the cover.

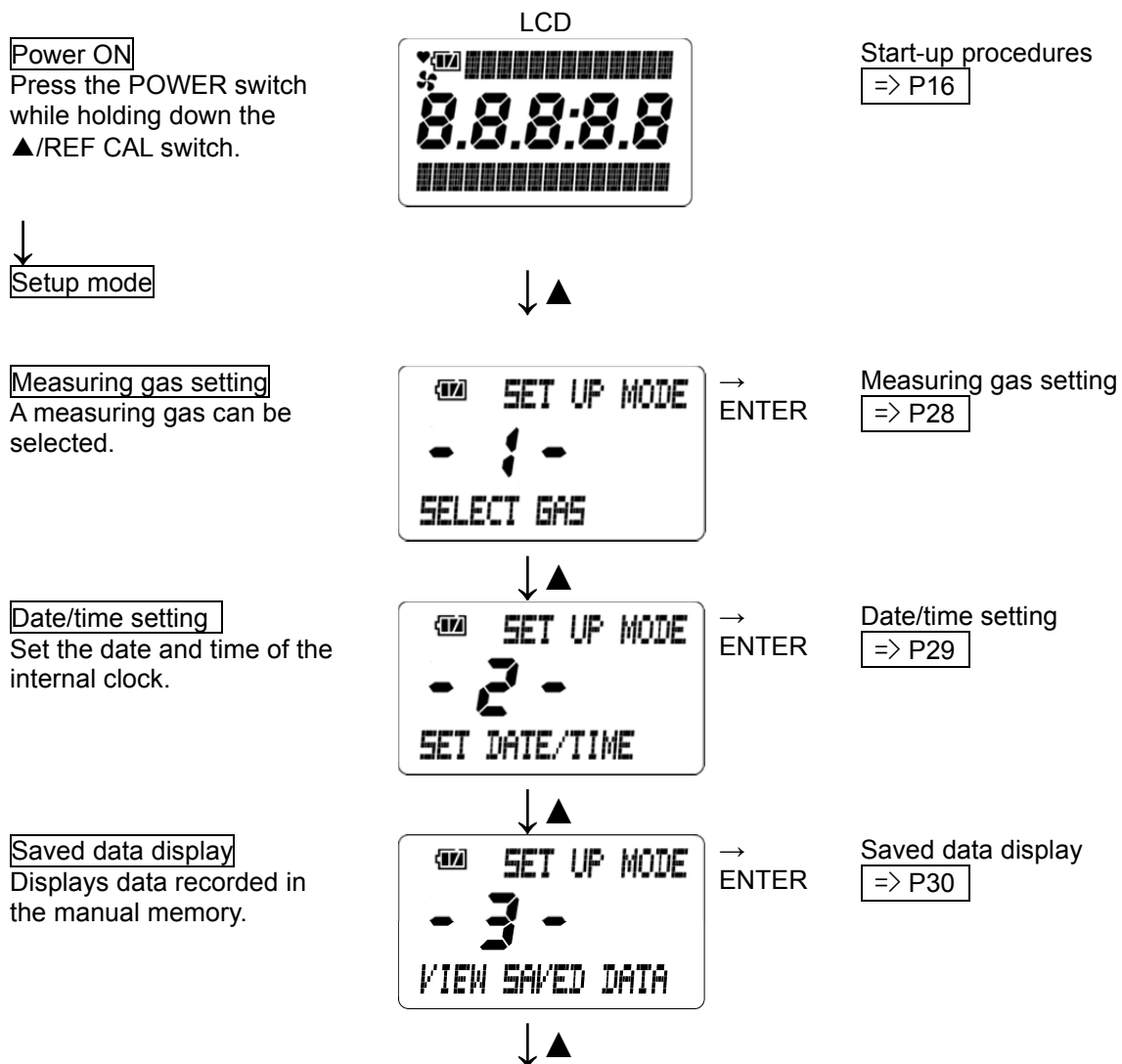


How to Set Setup Mode

5-1. Entering the setup mode

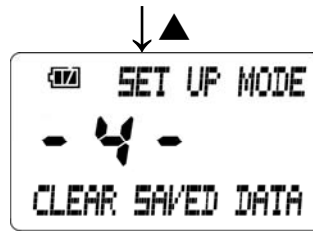
This mode allows changing various displays and settings.

This mode can be entered by pressing the POWER switch while holding down the ▲/REF CAL switch. Every time the ▲ switch is pressed, various menu screens are displayed in turn.



Saved data clear

Deletes the saved data.



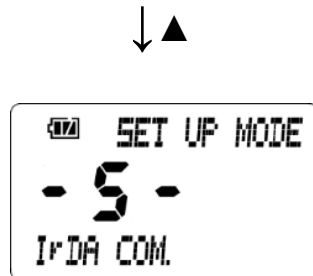
→
ENTER

Saved data clear

=> P31

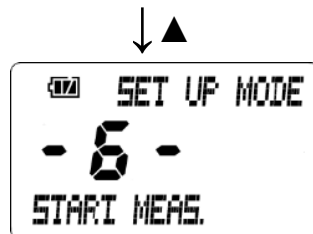
IrDA communication

Establish an infrared communication with a personal computer to perform various settings or data management. (The communication program is available as an optional accessory.)



Switch to measuring mode

Exit the setup mode and enter the measuring mode.



→
ENTER

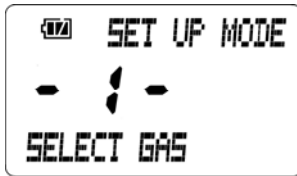
Switch to measuring mode

=> P32

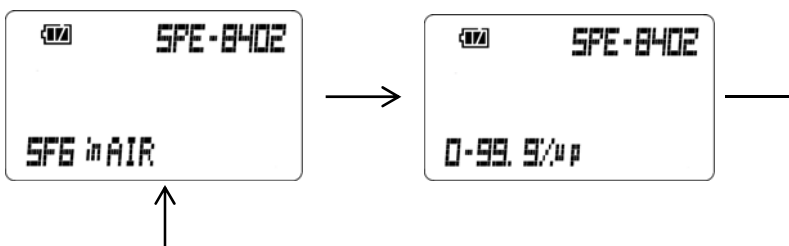
5-2. Measuring gas setting "1. SELECT GAS"

A measuring gas can be set.

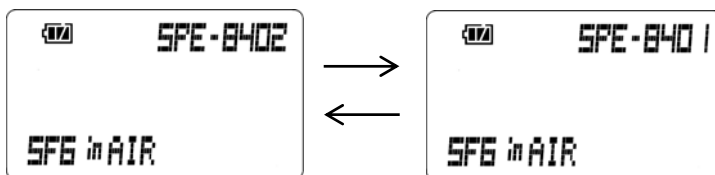
(1) Press the ▲/▼ switch and select "1. SELECT GAS" from the setup mode menu.



(2) When the ENTER switch is pressed, the currently set measuring gas, base gas, measuring range and other information are displayed as shown below.



(3) When the ENTER switch is pressed again, the SPE number (a number allocated to a combination of measuring and base gases, measuring range, etc.) in the upper right section of the screen blinks. Every time the ▲ or ▼ switch is pressed, the displayed SPE number changes.



(4) Press the ENTER switch to confirm it. After a value is confirmed, the purity meter returns to the setup mode menu automatically.

NOTE

- Pressing the ESC switch twice returns to the setup mode menu.
- The purity meter provides the following two specifications. Select one suitable for the use.

SPE number	Measuring gas	Measuring range	Description
SPE-8402 (standard setting)	SF6 (air base)	0 - 99.9% up	When the sensor detects a measurement result exceeding 99.9%, it displays "99.9%up". The purity meter is shipped with this specification set.
SPE-8401	SF6 (air base)	0 - 100.0 vol%	When the sensor detects a measurement result exceeding 99.9%, it simply displays the measurement result like "100.0%" or "100.7%". This specification is effective in checking the sensitivity or evaluating measurement including errors.

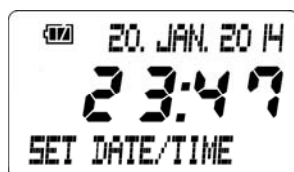
5-3. Date/time setting "2. SET DATE/TIME"

The date and time of the internal clock can be set.

- (1) Press the ▲/▼ switch and select "2. SET DATE/TIME" from the setup mode menu.



- (2) When the ENTER switch is pressed, the set time is displayed.
(Input example: January 20, 2014 23:47)



NOTE

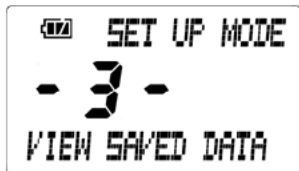
When there is no need of changing the setting, press the ESC switch to return to the setup mode menu.

- (3) When the ENTER switch is pressed again, the input area blinks. Enter the year, month, day, hour, and minute in this order. Press the ▲/▼ switch to change the values and press the ENTER switch to confirm each value (24-hour notation is used).
- (4) When the ENTER switch is pressed to confirm a change of time (minute), the purity meter returns to the setup mode menu automatically.

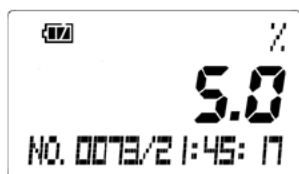
5-4. Saved data display "3. VIEW SAVED DATA"

Displays data recorded in the manual memory.

(1) Press the ▲/▼ switch and select "3. VIEW SAVED DATA" from the setup mode menu.



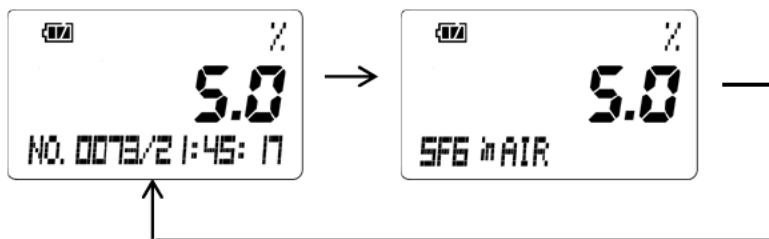
(2) Press the ENTER switch to display the saved data.



NOTE

- When there is no need of viewing the detailed information of saved data, press the ESC switch to return to the setup mode menu.

(3) Press the ▲/▼ switch to display the data numbers in turn. When the ENTER switch is pressed to make a selection, the measuring gas, range and other information are displayed alternately in the lower part of the screen.



(4) When the ESC switch is pressed, the purity meter returns to the setup mode menu.

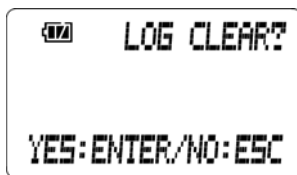
5-5. Saved data clear "4. CLEAR SAVED DATA"

The data recorded in the manual memory can be deleted.

(1) Press the ▲/▼ switch and select "4. CLEAR SAVED DATA" from the setup mode menu.



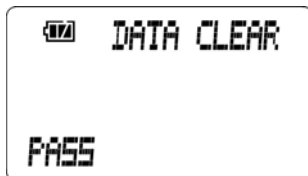
(2) When the ENTER switch is pressed, a confirmation screen asking for permission to delete the saved data appears.



NOTE

- When there is no need of deleting saved data, press the ESC switch to return to the setup mode menu.
- When saved data clear is executed, all the data recorded up to that time will be deleted.

(3) Press the ENTER switch. When deletion is completed, DATA CLEAR is displayed in the upper right section of the screen.



(4) When the ENTER or ESC switch is pressed, the purity meter returns to the setup mode menu.

5-6. Switch to measuring mode "6. START MEAS."

The measuring mode can be entered from the setup mode.

(1) Press the ▲/▼ switch and select "6. START MEAS." from the setup mode menu.



(2) When the ENTER switch is pressed, a confirmation screen asking for permission to enter the measuring mode appears.



NOTE

- When there is no need of entering the measuring mode, press the ESC switch to return to the setup mode menu.

(3) When the ENTER switch is pressed, the purity meter enters the measuring mode.



Operations and Functions

6-1. CAUTION display

The purity meter is equipped with a self-diagnosis function. When the caution display appears on the purity meter, it means that a minor abnormality is found by the self-diagnosis function.

Caution display: Appears when a minor abnormality is found in the purity meter operation by automatic check function.

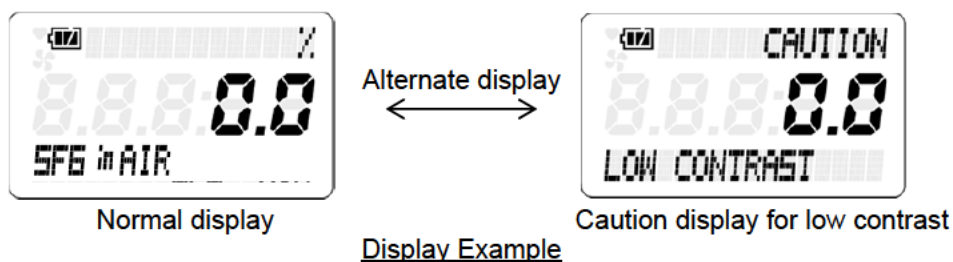
- Display operation: Displays the caution detail on the screen to notify users of it.
- Caution type: Low battery voltage, low contrast, low UV intensity, calibration failure, out-of-specification temperature, out-of-specification pressure

See troubleshooting and take appropriate actions.

If the unit has problems and the caution display appears frequently, contact RIKEN KEIKI immediately.

<Display Operation>

LCD display	Provides the normal and caution displays alternately.
-------------	---



NOTE

- The purity meter continues measurement with the caution display. However, if the caution display appears, promptly take an appropriate remedial measure to restore the normal condition.
- See "9. Troubleshooting" for caution details and appropriate actions.

6-2. ERROR display

The purity meter is equipped with a self-diagnosis function. When the error display appears on the purity meter, it means that a major abnormality that prevents measurement is found by the self-diagnosis function.

Error display: Appears when a major abnormality is found in the purity meter operation by automatic check function.

- Display operation: Displays the error detail on the screen to notify users of it.
- Error type: Battery error, contrast error, UV intensity error, setting information error, system error, built-in clock error, optical sensor unit error

See troubleshooting and take appropriate actions.

If the unit has problems and the error display appears frequently, contact RIKEN KEIKI immediately.

<Display Operation>

LCD display	Provides the error detail.
Lamp	Blinks
Buzzer	Sounds (be-beep, be-beep...)



Contrast error

Display Example

NOTE

- When the error display appears, any mode cannot be entered unless the error is eliminated. When the error display appears, promptly take an appropriate remedial measure.
- See "9. Troubleshooting" for error details and appropriate actions.

7

Maintenance

To maintain the performance of the purity meter and improve the reliability, perform regular maintenance and check.

7-1. Maintenance intervals and items

Perform the following maintenance regularly before use.

- Daily maintenance: Perform maintenance before beginning to work.
- Regular maintenance: Perform maintenance once or more every year to maintain the performance.

Maintenance item	Maintenance content	Daily maintenance	Regular maintenance
Battery level check	Check that the battery level is sufficient.	○	○
Concentration display check	Make the unit draw in fresh air and check that the concentration display value is zero. If the reading is incorrect, perform reference calibration using fresh air.	○	○
Checking the operation of the main unit	See the pilot indicator to check for abnormalities.	○	○
Span adjustment	Check the sensitivity using a calibration gas and perform span adjustment as needed.		○



WARNING

- If an abnormality is found in the purity meter, contact RIKEN KEIKI immediately.

About maintenance services

We provide services on regular maintenance including span adjustment, other adjustments and maintenance.

To make the calibration gas, dedicated tools, such as a gas cylinder of the specified concentration, gas sampling bag, etc., must be used.

Our qualified service engineers have expertise, knowledge and other information on the dedicated tools used for services, along with other products. To maintain the safety operation of the purity meter, please use our maintenance service.

The followings are typical maintenance services. For details, contact RIKEN KEIKI.

<Main Services>

Item	Services
Battery level check	Checks the battery level.
Concentration display check	Verifies that the concentration display value is zero by using the zero gas. Performs reference calibration if the reading is incorrect.
Gas sensitivity check	Performs the sensitivity check using a calibration gas. Also, performs span adjustment as needed.
Cleaning and repair of the unit (visual diagnosis)	Checks dust or damage on the surface of the unit, cleans and repairs such parts. Replaces parts which are cracked or damaged.
Unit operation check	Operates the buttons to check the operation of functions and parameters, etc.
Replacement of consumable parts	Replaces consumable parts, such as a sensor.

7-2. Calibration

Check the gas sensitivity of sensor using a calibration gas at least once a year.

Note that the span adjustment requires dedicated equipment and creation of calibration gas. Request RIKEN KEIKI to perform span adjustment.

7-3. How to clean

Clean the purity meter if it becomes extremely dirty. The purity meter must be turned off while cleaning it. Use a waste cloth or the like to remove dust. Do not use water or organic solvent for cleaning because they may cause malfunctions.



CAUTION

- When cleaning the purity meter, do not splash water over it or use organic solvents such as alcohol, benzene, etc. on it. Otherwise, it may cause discoloration or damage to the surface of the purity meter or a sensor failure.

NOTE

- When the purity meter gets wet, water may remain in the buzzer sound opening or grooves. Drain water as follows:
 - (1) Wipe away moisture on the purity meter thoroughly using a dry towel, cloth, etc.
 - (2) While holding the purity meter firmly, shake it about ten times with the buzzer sound opening facing downward.
 - (3) Wipe away moisture coming out from the inside thoroughly using a towel, cloth, etc.
 - (4) Place the purity meter on a dry towel, cloth, etc. and let it stand at normal temperatures.

7-4. Parts replacement

<Replacement of Regular Replacement Parts>

Replace the regular replacement parts of the purity meter at recommended intervals.

List of recommended regular replacement parts

Item	Maintenance intervals	Replacement intervals	Quantity (pieces per unit)	Remarks
Handy aspirator	-	5 years	1	
Sampling hose	1 year	5 years	1	Replacement interval assuming 2500 times of attachment/detachment
Plug	-	5 years	1	For GAS IN Replacement interval assuming 2500 times of attachment/detachment
Socket	1 year	5 years	1	For gas inlet Replacement interval assuming 2500 times of attachment/detachment
Alkaline battery	-	-	3	

NOTE

- The above replacement intervals are recommendation only. The intervals may change depending on the operating conditions. These intervals do not mean the warranty periods either. The result of the regular maintenance may determine when to replace the parts.

<Battery Replacement>

For battery replacement, see "4-2-1. How to replace the batteries".

Storage and Disposal

8-1. Procedures to store the purity meter or leave it for a long time

The purity meter must be stored under the following environmental conditions.

- In a dark place under the normal temperature and humidity away from direct sunlight
- In a place where gases, solvents, vapors, etc. are not present

Store the purity meter in a shipping carton, if any, in which the product was delivered.
Store the purity meter away from dust, etc. if the shipping carton is not available.



CAUTION

- If the purity meter is not used for a long time, store it after removing the batteries. Leaks from dry batteries may result in fire or injury.

8-2. Procedures to use the purity meter again



CAUTION

- When the purity meter is used again after a long-period storage, never fail to perform a calibration.
- Contact RIKEN KEIKI for information on readjustment including calibration.

8-3. Disposal of products

When the purity meter is disposed of, it must be treated properly as an industrial waste in accordance with the local regulations, etc.



WARNING

- Dispose of dry batteries in accordance with procedure specified by the local authority.

<Disposal in EU Member States>

When disposing of the purity meter in EU member states, sort the batteries as specified. Handle the removed batteries according to the classified refuse collection system and recycling system based on the regulations of EU member states.

NOTE

Crossed-out recycle dustbin mark

- This symbol mark is indicated on the products which contain the batteries which fall under EU Battery Directive 2006/66/EC. Such batteries need to be disposed of as specified by the latest Directive. This symbol mark indicates that the batteries need to be separated from the ordinary waste and disposed of appropriately.



Troubleshooting

The troubleshooting does not explain the causes of all the malfunctions which occur on the purity meter. This simply helps to find the causes of malfunctions which may frequently occur. If the purity meter shows a symptom which is not explained in this manual, or still has malfunctions even though remedial actions are taken, please contact RIKEN KEIKI.

9-1. Troubles on the unit

Symptoms	Causes	Actions
<u>The power cannot be turned on.</u>	The battery level is too low. (When dry batteries are used)	Turn off the power and replace all the three dry batteries with new ones in a non-hazardous area.
	The POWER switch was not pressed long enough.	For power-on, keep the POWER switch pressed until a beep is heard.
	The AC adapter (option) is not connected properly.	Check that the AC adapter is connected properly.
<u>Abnormal operations</u>	Disturbances by sudden static electricity noise, etc.	Turn off and restart the purity meter.
<u>Key operations are disabled.</u>	Disturbances by sudden static electricity noise, etc.	Turn off the power, and remove the battery unit and install it again in a non-hazardous area and then turn on the power to perform operations.
<u>Low battery voltage caution is displayed.</u> (CAUTION) LOW BATTERY	The battery level is low.	Turn off the power and then replace the dry batteries with new ones.
<u>Low contrast caution is displayed.</u> (CAUTION) LOW CONTRAST	The contrast of interferometric sensor has been decreased due to contamination.	Replacement or repair of the interferometric sensor is recommended. Request RIKEN KEIKI for the replacement or repair.
<u>Low UV intensity caution is displayed.</u> (CAUTION) LOW BRIGHTNESS	The UV intensity of interferometric sensor has been dropped.	Replacement or repair of the interferometric sensor is recommended. Request RIKEN KEIKI for the replacement or repair.
	Condensation occurred inside the product (light source sensor).	Draw dry air to dry the sensor.
<u>Reference calibration caution is displayed.</u> (CAUTION) CHECK REF CAL	Zero drift may have occurred.	Perform reference calibration using fresh air.
	Condensation occurred inside the product (light source sensor).	Draw dry air to dry the sensor.

<u>Out-of-specification temperature caution is displayed.</u> (CAUTION) OUT of SPEC. TEMP	The built-in temperature sensor detected a temperature exceeding the specified range.	Use the purity meter within the specified temperature range.
<u>Out-of-specification pressure caution is displayed.</u> (CAUTION) OUT of SPEC. PRES	The sensor part is not at atmospheric pressure due to clogging at the end of handy aspirator or other reasons.	Keep the end of handy aspirator at atmospheric pressure.
<u>Built-in clock error is displayed.</u> (ERROR) CLOCK	An abnormal time setting for the internal clock was detected.	Make a setting of date/time. If the symptom like this recurs frequently, contact RIKEN KEIKI.
<u>Battery error is displayed.</u> (ERROR) LOW BATTERY	The battery level is too low to perform measurement.	Turn off the power and replace the dry batteries with new ones in a non-hazardous area.
<u>Contrast error is displayed.</u> (ERROR) LOW BRIGHTNESS	The contrast of interferometric sensor has been decreased so much due to contamination that measurement cannot be performed.	Request RIKEN KEIKI for the replacement or repair of interferometric sensor.
<u>UV intensity error is displayed.</u> (ERROR) LOW BRIGHTNESS	An abnormality occurred in the system.	Request RIKEN KEIKI for the replacement or repair of interferometric sensor.
<u>Optical sensor unit error</u> (ERROR) OPTOCAL UNIT	An abnormality occurred in communication signals from the optical sensor unit.	Turn off and restart the purity meter. If the symptom like this recurs frequently, the interferometric sensor needs to be repaired. Request RIKEN KEIKI for the repair.
<u>Setting information error is displayed.</u> (ERROR) SETTING	The data set in the setup mode is damaged.	Check the setting in the setup mode. If the setting disagrees with the displayed content, set the data again.
<u>System error is displayed.</u> (ERROR) SYSTEM	An abnormality occurred in the system.	Request RIKEN KEIKI for repair.

9-2. Troubles in reading

Symptoms	Causes	Actions
<u>Incorrect reading</u>	Reference calibration has not been performed properly.	Perform reference calibration again in fresh air.
	Presence of interference gas	If an interference gas (other than SF6 and air) is included, correct measurement cannot be performed by the purity meter. Remove the interference gas and perform measurement again.

Product Specifications

10-1. List of product specifications

Model	FI-8000-SF6
Measuring gas	Sulfur hexafluoride (air base)
Reference gas	Air
Detection principle	Optical interferometric type
Measuring range	0.0 - 99.9% up
Minimum resolution	0.1%
Accuracy of the reading	±1% (under the same conditions)
Sampling method	Manual draw-in by handy aspirator
Display	LCD digital display (7-segment numeric display + symbol + 20-segment character display x 2 lines)
Sample pressure	0.1 - 0.7 MPa (gauge pressure)
Sample flow rate	Approx. 250 ml/min (with the sample pressure of 0.7 MPa (gauge pressure))
Power supply	Three AA alkaline batteries or dedicated AC adapter (option)
Continuous operating time	16 hours or more (new dry batteries, without alarms or lighting, at 25°C)
Operating temperature/humidity	-10 - +40°C (at a constant condition), 95% RH or less (non-condensing)
External dimensions	Approx. 305 (W) x 270 (H) x 194 (D) mm (projection portions excluded)
Weight	Approx. 4.5 kg
Functions	Pressure correction, temperature correction
Accessories	Sampling hose (pressure resistant tube for high-pressure sampling), gas inlet socket, AA alkaline battery: 3 pcs

10-2. List of options

- Dedicated AC adapter

Appendix

Definition of terms

Measuring gas	Of the draw-in gases, the ones targeted for concentration measurement.
Base gas	Of the draw-in gases, the ones other than measuring gases.

Detection Principle

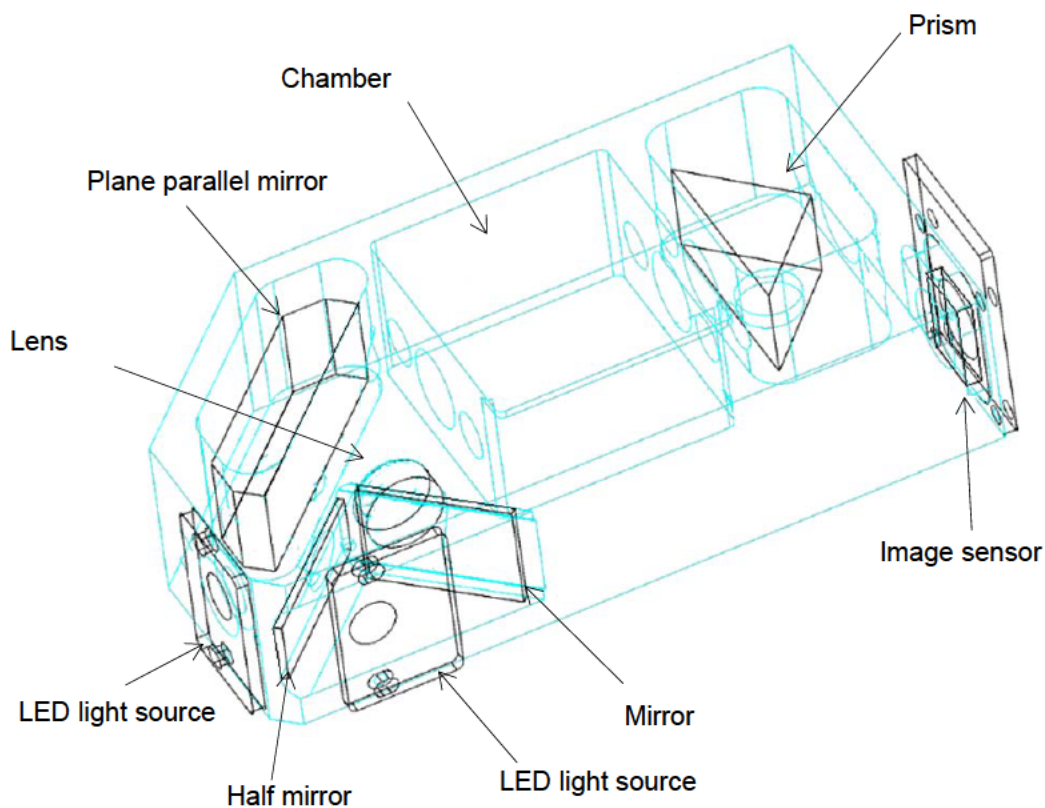
Detection principle

The refractive index of gases is determined by the types of composing gases and the mix ratio. When a mixed gas consists of two different gases and the types are known, the mix ratio (concentration) can be obtained by measuring the refractive index.

The optical interferometric sensor used for the purity meter forms an "interference fringe" that moves in proportion to changes in refractive index on the image sensor. Then the interference fringe is captured by the image sensor and converted into a refractive index after calculating the move amount of interference fringe with a high degree of accuracy through the phase analysis processing.

The "concentration" display of various mixed gases is enabled by inputting the data such as type and refractive index of "measuring gas" and "base gas" that compose a mixed gas to the "refractive index" calculated with high accuracy.

The sensitivity of optical interferometric sensor depends on the length of the chamber that flows gases. Because the chamber length is physically unchangeable, high accuracy is maintained over a long period of time.



Schematic View of Optical Interferometric Sensor