



Optical Interferometric Gas Monitor
FI-915
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/>

Preface

Thank you for choosing our optical interferometric gas concentration reading adjustment meter FI-915. This manual describes how to use FI-915. Not only the first-time users but also the users who have already used FI-915 must read and understand the operating manual before using FI-915. 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.



SDHC Logo is a trademark of SD-3C LLC.

Use one of the following SD cards:

SD standard: SDSC, SDHC
File system: FAT16, FAT32

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1

Important Notices on Safety

1-1. Danger Cases



DANGER

- FI-915 is not explosion-proof. Do not install or use FI-915 in a location designated as a hazardous area (explosion-proof area).
- Use the rated power supply specified for FI-915.
- Ground the EARTH terminal  on the external terminal plate before use to avoid a risk of electric shock. Perform the grounding work while FI-915 is not powered.

1-2. Warning Cases



WARNING

Sampling point pressure

- FI-915 is designed to draw gases under the atmospheric pressure. If excessive pressure is applied to the gas inlet (GAS IN) and outlet (GAS OUT) of FI-915, measured gases may leak out from its inside and may cause dangerous conditions. Be sure that excessive pressure is not applied to FI-915 while used.
- Do not connect the gas sampling hose directly to a location with a pressure higher than the atmospheric pressure. The internal piping system may be damaged.

Reference calibration in the atmosphere

- When the reference calibration is performed in the atmosphere, check the atmosphere for freshness before beginning the calibration. When the calibration is performed in the atmosphere in which interference gases (gases that are neither the measured gas nor the base gas) exist, correct measurement, monitoring and control cannot be performed causing a danger.

Others

- Do not draw a high-concentration gas beyond the measuring range. Accurate readings cannot be obtained.

1-3. Precautions



CAUTION

- A low-volatile solvent that condenses (liquefies) within FI-915 or within a tube connected to FI-915 cannot be measured.
- A solvent gas with high humidity that causes condensation within FI-915 or within a tube connected to FI-915 cannot be measured.
- Do not use FI-915 near a device that significantly disturbs the waveform of power supply such as electric welder. Also, do not use a power supply of the same system as a device that significantly disturbs the waveform of power supply.
- Carefully manage the temperature around FI-915 to prevent a measuring solvent from condensing (liquefying) within FI-915 or tube connected to FI-915.

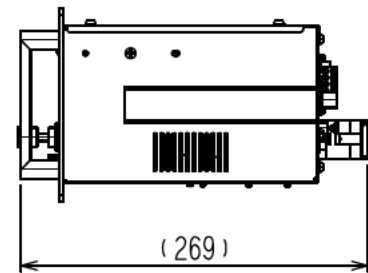
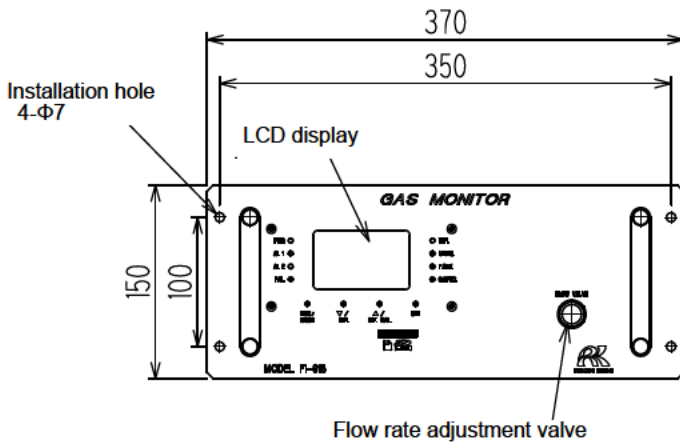
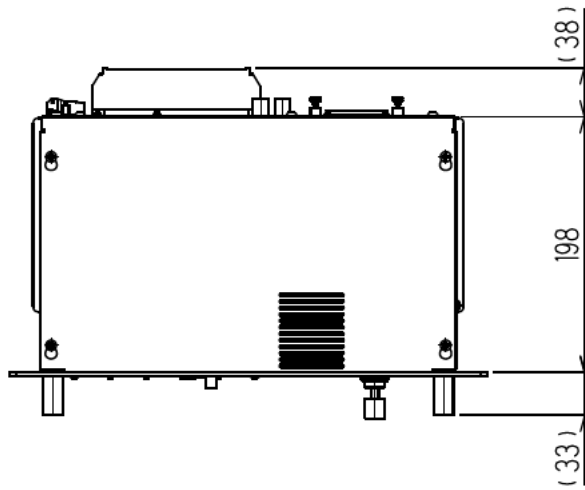
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Product Components

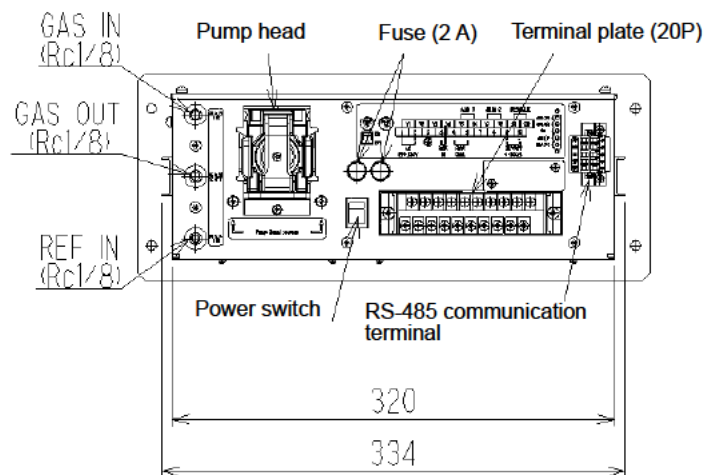
2-1. Intended Use and Features of Product

FI-915 is designed to perform continuous measurement, monitoring and control of the concentration of solvent vapor generated from drying equipment such as photogravure printing machine. The optical interferometric system has been adopted as a principle for concentration measurement to provide highly accurate, stable measurements. In addition, it has a reference calibration function that automatically performs sensor output adjustment using a reference gas (for FI-915, a zero gas such as fresh air) as a reference for concentration measurement, allowing more stable operations.

2-2. Product Outline Drawing



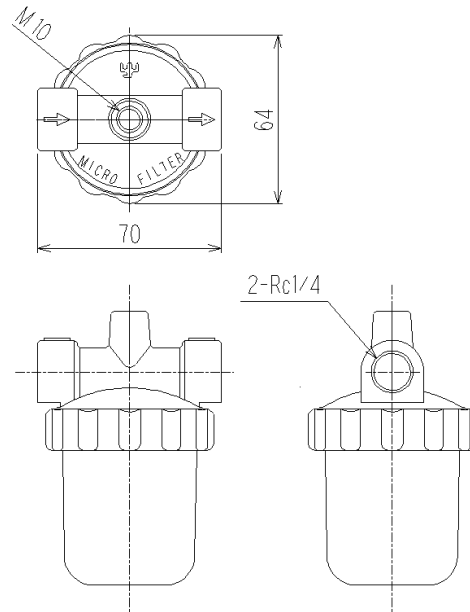
Rear view



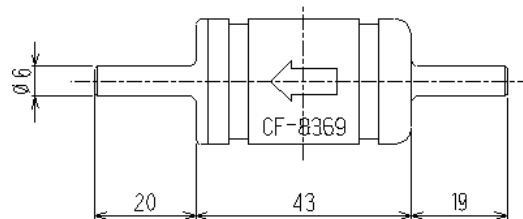
2-3. Accessories

2-3-1. Standard Accessories

- Main unit operating manual
- MC (ST) filter (GAS IN dust filter)



- Cylindrical filter CF-8369 (REF IN dust filter)



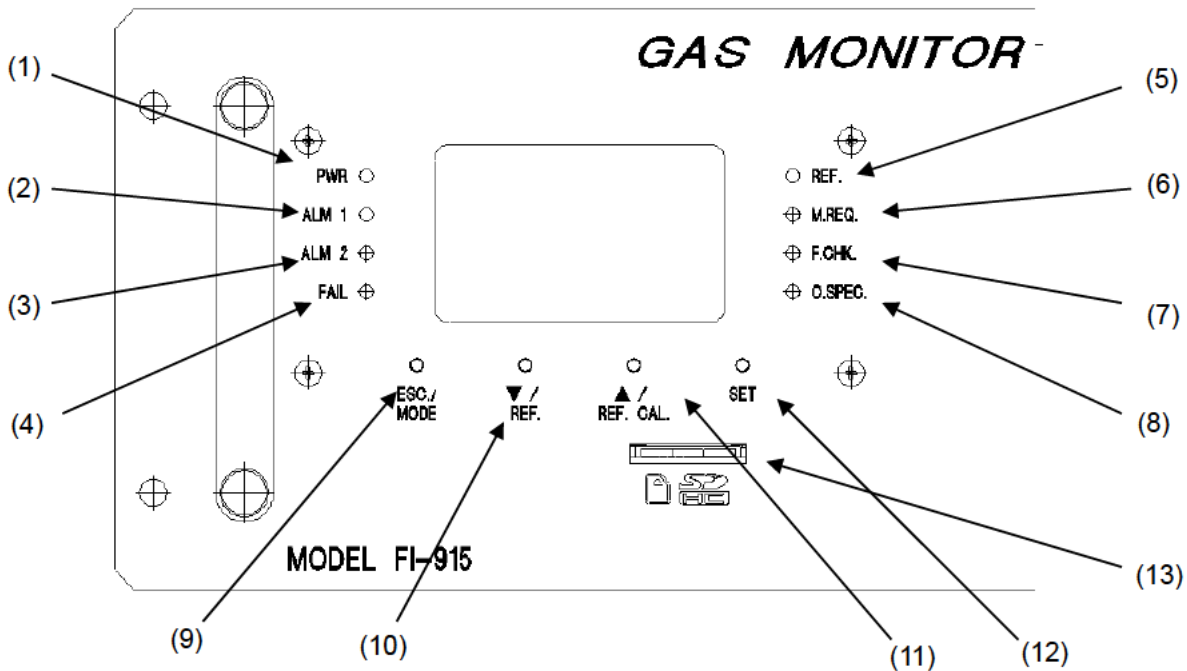
2-3-2. Optional Accessories

- SD card (2 GB)
- Fuse

2-3-3. Maintenance Parts

- Replacement interferometer Unit
- Replacement pump (RP-60)
- Fuse (250 V 2 A, $\Phi 5.2 \times 20$ mm, time-lag type)

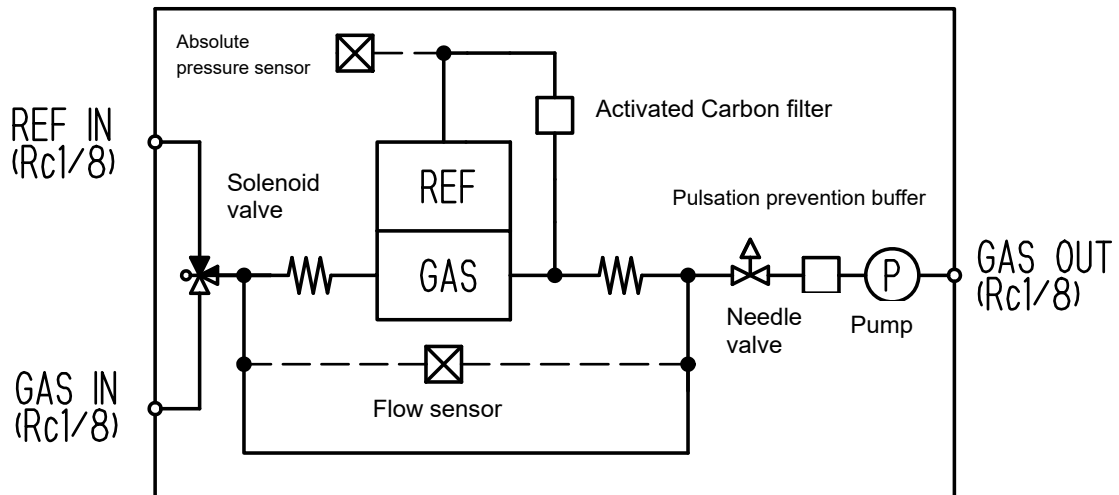
2-4. Names and Functions for Front Panel



Name	Functions
(1) PWR lamp (green)	Lights up while turned on.
(2) ALM1 lamp (red)	ALM lamp 1
(3) ALM2 lamp (red)	ALM lamp 2
(4) FAIL lamp (red)	Lights up when an abnormal state is detected.
(5) REF. lamp (green)	Lights up while a gas is drawn from REF IN.
(6) M.REQ. lamp (green)	Lights up when a condition requiring maintenance is detected.
(7) F.CHK. lamp (orange)	Lights up when a function check is in operation.
(8) O.SPEC. lamp (orange)	Lights up when a condition out of specifications is detected.
(9) ESC/MODE button	Used to change mode from measuring mode to another mode. [Used to abort a process.]
(10) ▼/REF. button	Used to flow a reference gas through the sensor. [Used to decrease a setting value and to change the screen.]
(11) ▲/REF. CAL button	Used to perform a reference calibration. [Used to increase a setting value and to change the screen.]
(12) SET button	Used to change to the information screen. [Used to confirm processing and to do others.]
(13) SD card insertion slot	Used to insert an SD card for storing product settings and log data.

* Descriptions in [] are operations in mode other than measuring mode.

2-5. Block diagram

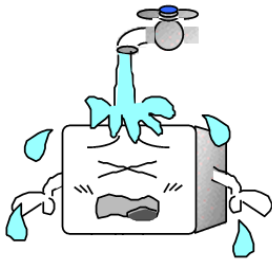


3

How to Install

3-1. Precautions on Installation Site

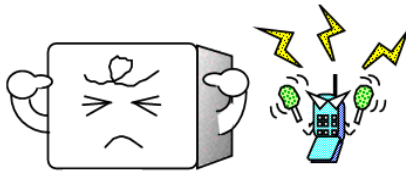
Do not install FI-915 in any of the following locations.



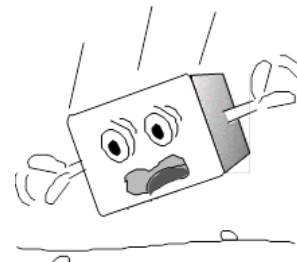
- (1) Place where FI-915 is exposed to water, oil, chemicals, etc.



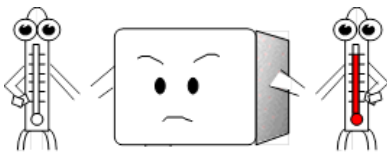
- (2) Place with vibrations



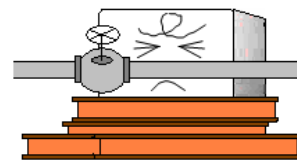
- (3) Place where radio wave or noise is generated



- (4) Place where FI-915 may drop or receive strong shock



- (5) Place exceeding the operating temperature range
Place where FI-915 is exposed to direct sunlight or radiant heat

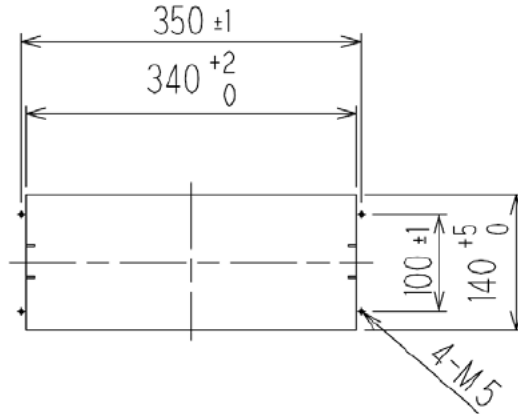


- (6) Place where maintenance of FI-915 cannot be performed
Place where handling of FI-915 involves dangers

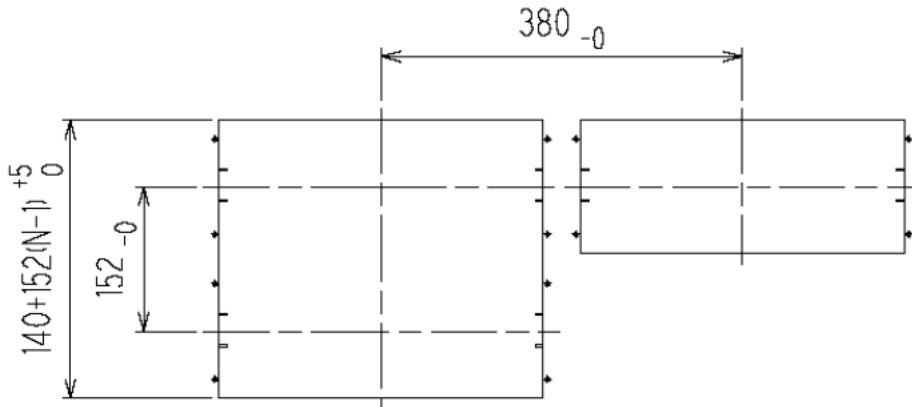
3-2. How to Install Product and Precautions

The structure of FI-915 is a rack mounting type. To install it, a rack that matches the panel cutout dimensions shown in the figure below should be provided.

One point

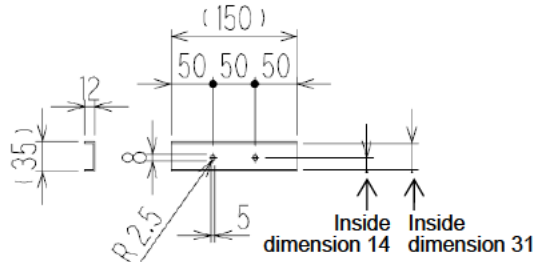


Multi-point (N point)

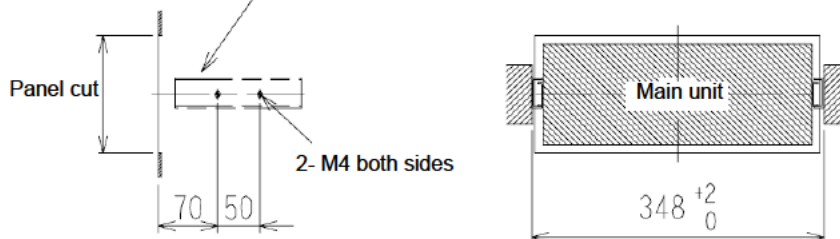


<Installation dimensions of the fixed rail>

(when it is used)



Use two fixed rails (SPCC t2).
Attach them to the rack side.



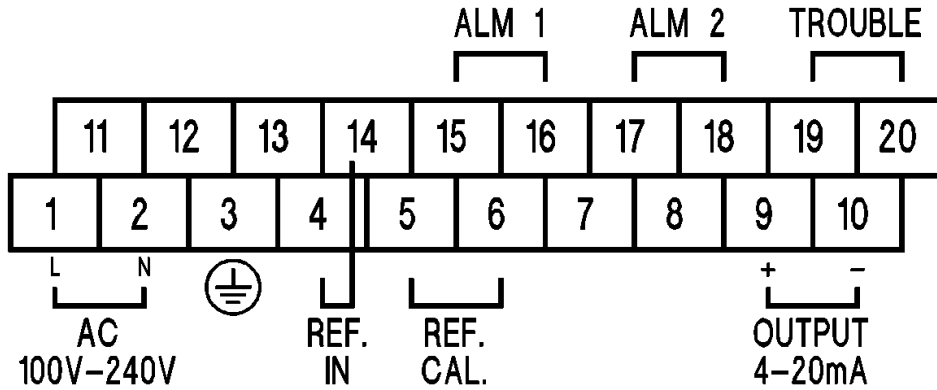
**CAUTION**

- Do not drop or give strong shock to FI-915 during installation. Otherwise, the device may be damaged.
- If FI-915 is to be fixed on a rack, etc., install it properly on a rack that can hold its weight.
- When performing construction work, prevent dust, etc., from entering the inside of FI-915.
- When installing FI-915 on a freestanding rack (fixed type), fix the rack with anchor bolts.
- Leave a space of at least 600 mm between the front/back side of FI-915 and wall to secure maintenance space.
- When installing FI-915 in an enclosed storage board, take a measure to prevent the temperature inside the storage board from rising over 50°C.
- When installing FI-915 on a storage board panel, leave sufficient length of wires and tubes so that maintenance can be performed with the unit pulled out by at least half the length of its depth without removing wires and tubes at the back.

3-3. How to Connect Wire

3-3-1. Descriptions of External Terminal Plate And How to Connect Wire

<Details of the terminal plate>



(1)	100 - 240 VAC ± 10%	(11)	
(2)	50/60 Hz	(12)	This is not used.
(3)	Grounding (EARTH) D type ground	(13)	
(4)	REF IN *	(14)	REF IN *
(5)	Reference calibration button for remote operation	(15)	Alarm contact output 1 (non-voltage contact)
(6)	(When they are short-circuited, the reference calibration function is activated)	(16)	Contact capacity: 1 A 240 VAC/1 A 30 VDC (resistance load) 1 A 240 VAC/1 A 30 VDC (resistance load)
(7)	This is not used.	(17)	Alarm contact output 2 (non-voltage contact)
(8)		(18)	Contact capacity: 1 A 240 VAC/1 A 30 VDC (resistance load) 1 A 240 VAC/1 A 30 VDC (resistance load)
(9)	Output signal 4 - 20 mA	(19)	Fault alarm contact output (non-voltage contact)
(10)		(20)	Contact capacity: 1 A 240 VAC/1 A 30 VDC (resistance load)

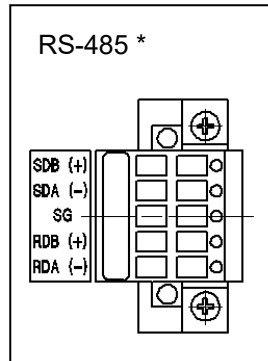
※ When (4) and (14) are short-circuited, the REF gas is drawn.

The terminal screw of the terminal plate is a screw with a square washer (M3.5 x 8). Use the cable of 1.25 mm² to attach a crimped terminal with insulating coating for M3.5 to the tip of it for wiring.

- Power supply/contact cables: Cables equivalent to CVV 1.25 mm²
- Other signal cables: Cables equivalent to CVVS 1.25 mm²

NOTE

- If you are connecting a recording meter or an external meter to the output (dc4-20ma), be sure to set the isolator immediately after the terminal to prevent the noise from being induced by the connected cable.

<Details of the RS-485 communication terminal>

Used when the RS-485 communication function is used.

<RS-485 communication terminal cable connection conditions>

Cable: 0.2 - 2.5 mm²

Bare wire length: Approx. 7 mm

Screw tightening torque: 0.5 - 0.6 Nm

Applicable screwdriver: Flathead screwdriver (width 3 mm or less)

Compatible bar terminal: For a bar terminal, the following items are available.

- Bar terminal: Model AI series (manufactured by Phoenix Contact)
- Crimping tool: Model CRIMPFOX UD 6 (manufactured by Phoenix Contact)

3-3-2. Precautions on Electrical Work

The noise induced by an unstable power supply or cable may cause malfunctions, false alarms or failures.

1. Use a stable power supply for the system.

(1) FI-915 must be provided with the following power supply.

Power voltage: 100 - 240 VAC ±10%

Allowed time of momentary blackout: Approx. 50 msec or less

(A restart may be required to recover from the momentary blackout for 50 msec or more.)

To ensure continuous operation and activation, install a UPS outside FI-915.

(2) Do not make the power supply line in parallel with another high-voltage/high-current line.

2. Take a measure against noise according to the installation environment.

(1) Measure against lightning surge

"Lightning" is a problem for the devices installed outdoors at plants, etc. Because lightning acts as a large emission source while cables act as a receiving antenna, devices connected to the cables may be damaged. Cables installed in a metal conduit or under the ground cannot be completely protected from inductive lightning surge caused by lightning. However, the following measure can be taken. Take an appropriate measure before using FI-915.

<Provide protection by a lightning arrester (cable arrester)>

Although inductive lightning surge can be transmitted through the cable, it is prevented by installing a lightning arrester before the field devices and central processing equipment. Insert lightning arresters to the points where the cables enter the building from outside. A lightning arrester has a circuit that removes a surge voltage to prevent field devices from being damaged.

(2) Measure against power line noise

The following measures can be taken to mitigate the influence of electromagnetic or electrostatic induction noise from the power line. Take an appropriate measure before using FI-915.

<Keep away from power line>

Keep enough distance between the signal and power lines, avoiding parallel layout if possible. If they need to intersect with each other, it should be done at a right angle.

<Install an electrostatic shield>

Use a shielded signal line and ground the shield. Also, take measures to make the electrical isolation such as using an iron raceway for the power line, installing a grounded metal partition plate between the lines and putting each line in an individual metal duct.

In addition to lightning, there are more sources of surge noise. To protect devices from these noise sources, the devices must be grounded.



CAUTION

- Be careful not to damage the internal electronic circuit when wiring.



CAUTION

- The "b" contact (break contact) under de-energized state may be opened momentarily by a physical shock, such as external force.
- When the "b" contact is selected for the alarm contact, take appropriate actions to prepare for a momentary activation, for example, add signal delay operation (approximately one second) to the receiving side of the "b" contact.

3-3-3. Protective grounding

For stable operation of FI-915 and safety, it must be connected to a grounding terminal. The grounding wire should be thick and short as much as possible to minimize grounding resistance. Use the EARTH terminal (terminal 3) of the external terminal plate to ground FI-915.

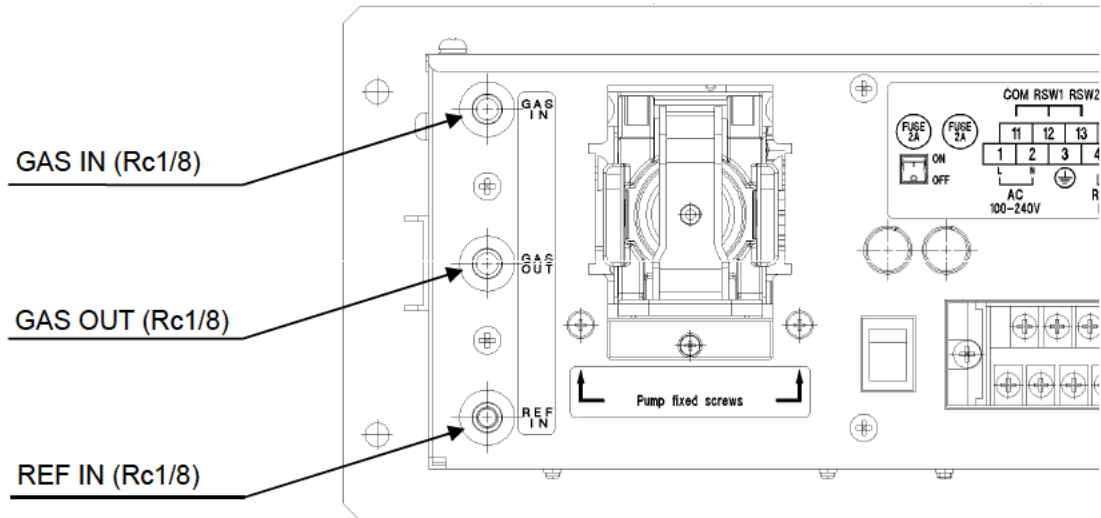


WARNING

- The grounding must be made as D type grounding (below 100 Ω of grounding resistance).
- Do not connect the grounding wire to a gas tube.

3-4. How to Tube

Use copper, stainless steel, and Teflon etc. for tube materials. Do not use any materials that may cause absorption and corrosion. Observe the following cautions in tubing.



GAS IN (Rc 1/8)	A supply port of sample gas. It draws sample gas at the flow rate of 1 L/min or more. This should be connected to the measurement point with a tube $\Phi 6$ or more in internal diameter and 50 m or less in length.
GAS OUT (Rc 1/8)	A gas outlet. This should be connected to the exhaust line etc. at atmospheric pressure level with a tube $\Phi 6$ or more in internal diameter and 50 m or less in length or a tube $\Phi 8$ or more in internal diameter and 50m or less in length.
REF IN (Rc 1/8)	Reference gas supply port. Fresh air of zero (0% LEL) should be supplied.

- (1) Make sure to connect the attached filters in the way of the tubing to remove dust.
 GAS IN: MC (ST) filter
 REF IN: Cylindrical filter CF-8369
- (2) After the tube is cut, its cut point may have a smaller inner diameter. Use a file etc. to expand the inner diameter of the cut point. To remove cut-dust or other materials remaining inside of the tube, never fail to blow compressed air into the tube before connecting it to FI-915.
- (3) The longer the GAS IN tube is, the longer it takes for a gas to be measured to reach FI-915. Because gases have a highly adsorptive property of solvents and vapors for the tube, resulting in a slow response and a lower reading than the actual value, the length of the GAS IN tube must be minimized.
- (4) When the sample gas is hot, cool it to the same level as the ambient temperature of the product.
- (5) For gas sampling in high temperature and high humidity atmosphere or in the state near saturated vapor concentration, condensation in the sampling tube may disable measurement. Avoid an U-shaped or V-shaped tubing.
- (6) Determine the inlet of the sample gas, considering the airflow of the sample gas line and the gas generating process. Also, avoid collecting a gas from the pipe, tank and the bottom of the device.

- (7) As a general rule, exhaust should be atmosphere release. When the tip is outside, bend the shape of the tube into an inverted U to prevent rain from entering the tube. When it returns to the exhaust duct etc., keep the state within the atmosphere pressure of ± 3 kPa, and the state that pressure fluctuation is not rapidly changed.
- (8) For safety, to provide a flame arrestor for line, install it into each line of the GAS IN and GAS OUT.

**CAUTION**

- FI-915 requires appropriate tubing works (selection of materials and other works) depending on types of sample gas and installation conditions. For questions about tubing works, please contact the distributor.

4

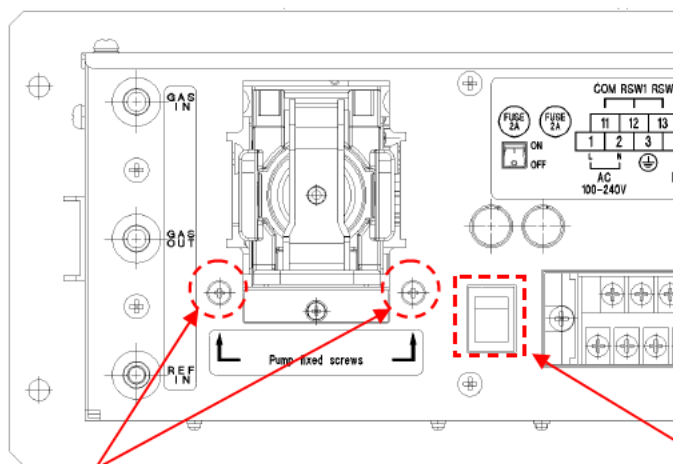
How to Operate in Measuring Mode

4-1. How to Start Measurement from Power-on Display



WARNING

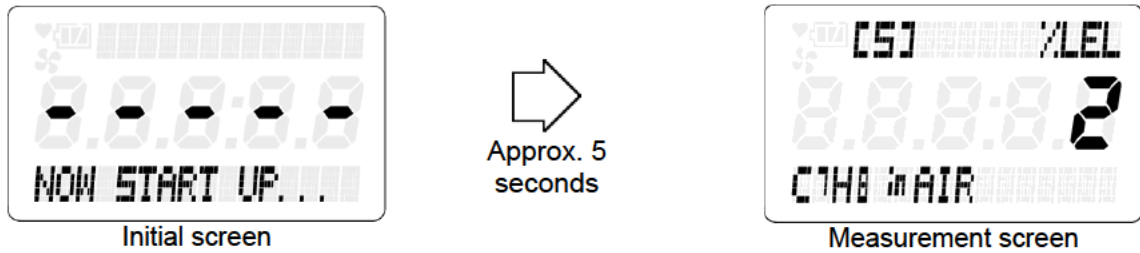
- Check the wiring, tubing, and installation for errors.
- Check that the power supply voltage is compliant with the specification (100 to 240 VAC).



Pump fixed screws

Power switch

Loosen the pump fixed screws to release the restraint on the vibration isolation mechanism of the pump, and then turn on the power switch to start FI-915. When the power is supplied, the self-diagnostic function is activated, the initial screen is displayed for approximately 5 seconds, and then the measurement screen appears.



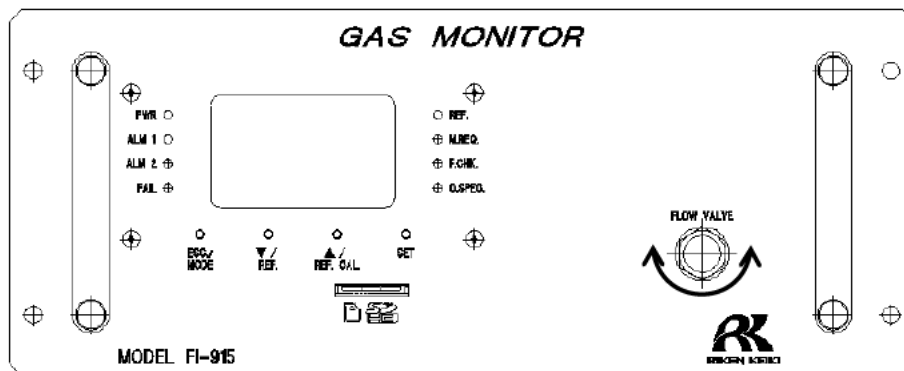
CAUTION

- Do not turn off FI-915 at start-up (initial clear). Otherwise, a failure may be caused.

4-2. LCD Screen during Measurement and How to Perform Flow Adjustment

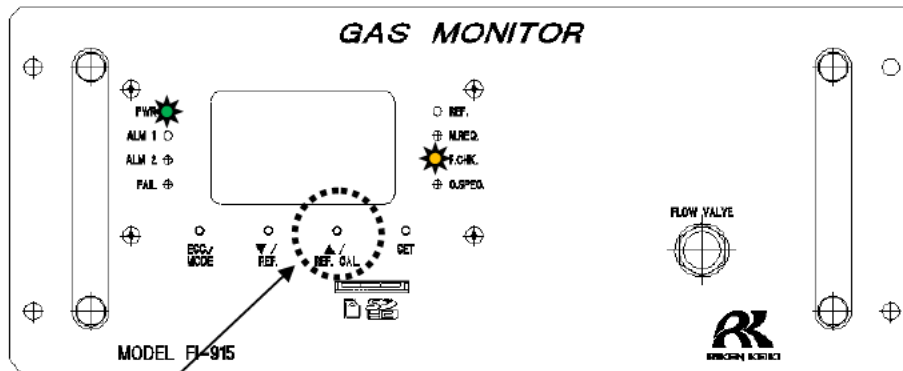


The screen shown above is displayed during measurement. Check that the flow rate of the measured gas is within the range of [4] to [6]. If the flow rate is out of the specified range, use the flow adjustment valve to adjust it.



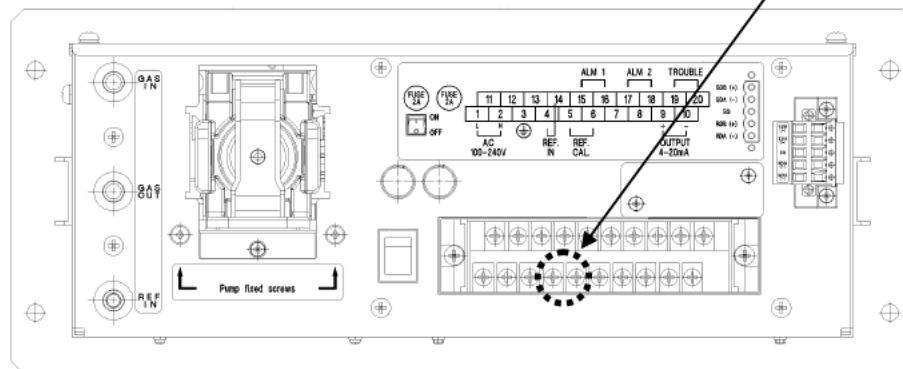
After powering on, warm up FI-915 for approximately 5 to 10 minutes, and then perform the reference calibration (See "4-3. How to Perform Reference Calibration"). After the reference calibration is complete, measurement becomes available.

4-3. How to Perform Reference Calibration



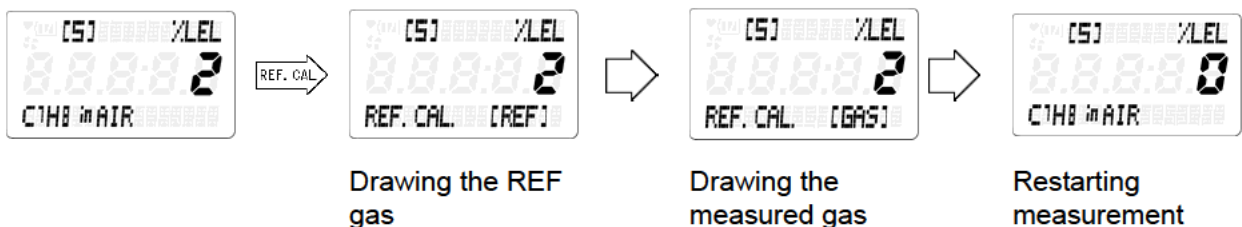
REF CAL. switch

Short-circuit (5) and (6)



During measurement, "press and hold the REF. CAL. button for 3 seconds or more" or "short-circuit (5) and (6) on the terminal plate for 3 seconds or more." The F. CHK lamp will light up and the reference calibration function will be activated. When the reference calibration function is activated, the reference gas is drawn from REF IN and adjustment is automatically performed. Incidentally, during the reference calibration, the value just before the reference calibration is held as the measurement result of the product.

Perform the reference calibration in a condition where a gas specified in the measured gas specifications can be drawn from REF IN. In addition, perform the reference calibration at start-up and also during operation as needed.



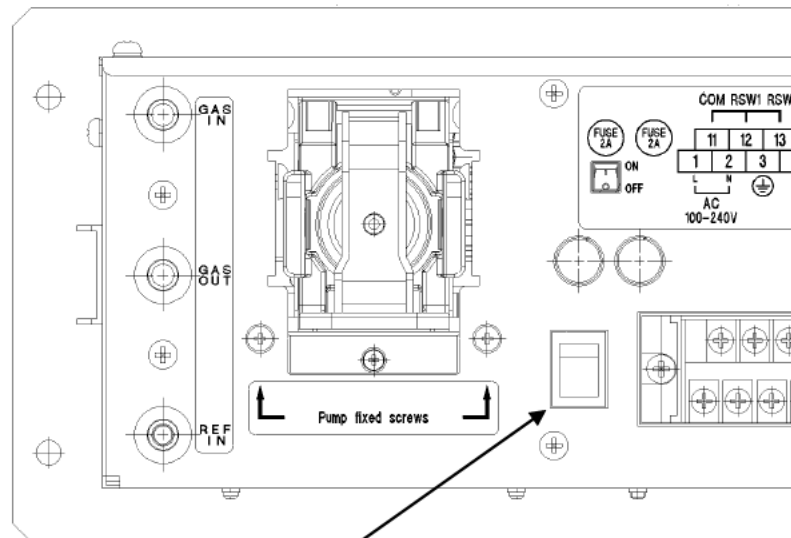
CAUTION

- Perform the reference calibration in a condition where the reference gas can be drawn from REF IN.

4-4. How to End Measurement (Power-off)

When ending measurement, do not power off with the measured gas remaining in the product. Draw fresh air from GAS IN, check that the measurement value returns to zero, clean the tube sufficiently, and then turn off the power switch in the rear of FI-915.

Also, check that waterdrops or solvents are attached inside the glass cup of the MC (ST) filter in the gas sampling line. If so, remove the cup for cleaning.



Power switch

4-5. Change to Another Mode

During measurement, press the MODE button for 3 seconds or more to display the "mode change screen."



Measuring mode screen


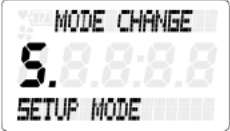
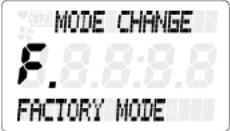
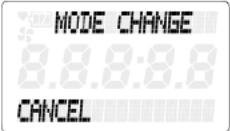
For 3 seconds
or more



Mode change screen

In this "mode change screen," use the ▲▼ buttons to select the desired mode, and then press the SET button to change to the selected mode.


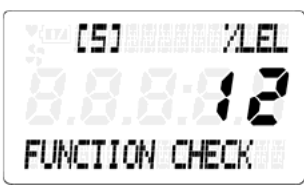

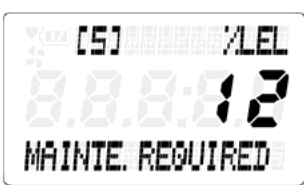
The following table shows modes selectable in the "mode change screen" and their details.

Screen	Details
 Check mode selection screen	Changes to check mode. Check mode is mode to display/check operating states of the sensor and setting conditions of the product while continuing measurement. In this mode, measurement is not stopped and the measurement result is output to the 4-20mA gas concentration output signal.
 Setup mode selection screen	Changes to setup mode. Setup mode is mode to set up the measured gas range, operate the SD card and perform other operations. Since measurement is stopped in this mode, a password is required to be entered.
 Factory mode selection screen	This mode is used for adjustment in a factory and maintenance/test operations. Since this mode is intended to be used by our service engineer or a service engineer specified by us and not intended to be used by customers, the description of this mode is omitted from this operating manual. Since measurement is stopped in this mode, a password is required to be entered.
 Cancel screen	Returns to the normal measuring mode screen.

4-6. Self-diagnostic Monitoring Function

FI-915 has an advanced self-monitoring/diagnostic function compliant with NAMUR NE107 (self-monitoring/diagnostic of field devices) and performs diagnostic/self-monitoring of device states in real time classifying into the following four categories.

The following table summarizes categories, display screens at detection and descriptions of device states.

Category	Screen	State description
FAILURE		A state where an abnormality has occurred inside or outside the device and the measurement result and output signal are invalid. The FAIL lamp (red) lights up. The signal output to output to the 4-20mA gas concentration output signal becomes 0.5 mA. *
FUNCTION CHECK		A state where measurement has been stopped due to works of the check function or another reason though the device is normal. The FUNCTION CHECK lamp (orange) lights up. The signal input to output to the 4-20mA gas concentration output signal is fixed to the previous output value. *
OUT OF SPECIFICATION		A state where the reliability of the measurement result and output signal is decreased because a condition out of specification has been detected though the device is normal and continues measurement. The OUT OF SPEC. lamp (orange) lights up. The signal output to output to the 4-20mA gas concentration output signal becomes the measurement result.
MAINTENANCE REQUIRED		A state where maintenance is required because some deterioration is detected continuing though the device is normal and continues valid measurement. The MAINTE. REQ. lamp (green) lights up. The signal output to output to the 4-20mA gas concentration output signal becomes the measurement result.

*: Operations in standard settings.

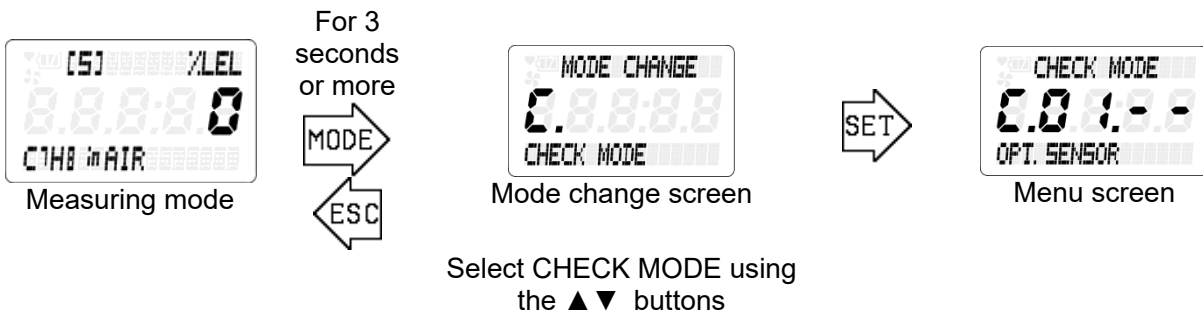
5

How to Operate in Check Mode

"Check mode" is mode to display/check operating states of the sensor, setting conditions of the product, etc., while continuing measurement. In this mode, measurement is not stopped and the measurement result is output to output to the 4-20mA gas concentration output signal.

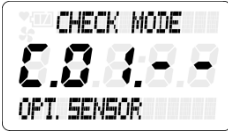




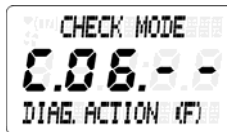



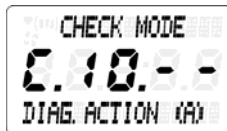
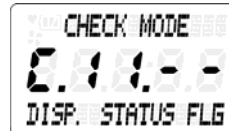

To enter "check mode," press and hold the MODE button for 3 seconds or more in measuring mode to display the mode change screen, use the ▲▼ buttons to select "CHECK MODE," and then press the SET button to confirm. This operation displays the check mode menu screen.

To return to measuring mode from the check mode menu screen, press and hold the ESC button for 3 seconds or more.



5-1. Check Mode Menu Items

The following table shows menu items selectable in check mode. The description for each item is provided on the subsequent pages.

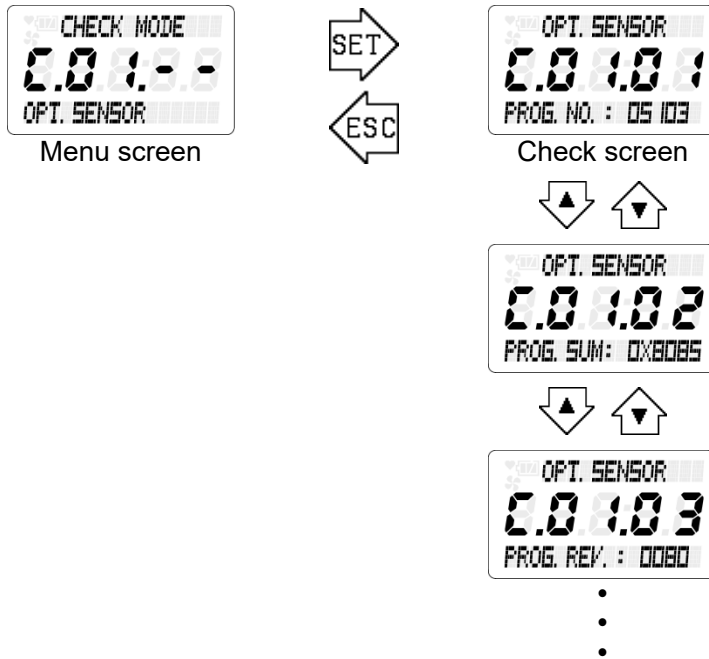
 <p>Displays the state of the interferometric sensor in the product.</p>	 <p>Displays the state of the main controller in the product.</p>	 <p>The 4 to 20 mA signal to be input to the digital reading adjustment meter.</p>	 <p>Displays the pressure sensor output.</p>
 <p>Displays the temperature sensor output.</p>	 <p>Displays the operation setting of the LCD display/lamps for when an abnormal state is detected.</p>	 <p>Displays the operation setting of the LCD display/lamps for when a state out of specification is detected.</p>	 <p>Displays the operation setting of the LCD display/lamps for when a condition requiring maintenance is detected.</p>
 <p>Displays the operation setting of the LCD display/lamps for when the function check is activated.</p>	 <p>Displays the operation setting of the LCD display/lamps for when a concentration alarm is detected.</p>	 <p>Displays the result of the self-diagnostic/monitoring function.</p>	 <p>Resets the trace display and the self-latching state of the contact.</p>

5-2. Each Item and Details

In the check mode menu screen, select an item to be checked using the ▲▼ buttons and press the SET button to display the detailed information of the item. This section describes detailed information displayed for each item.

C.01.-- Check of State of Optical Sensor 'OPT. SENSOR'

Displays program information of the optical sensor, the self-diagnostic result measured in the sensor unit, etc., one by one. In the "OPT. SENSOR" menu screen, press the SET button to display the check screen. Use the ▲▼ buttons to select the item to be checked.



Items displayed in the check screen and their details are provided on the next page.

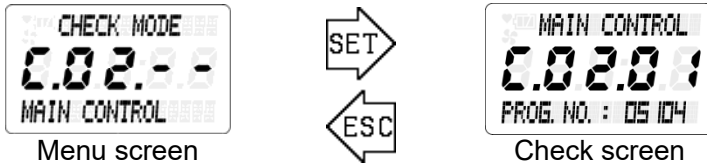
Items displayed in the optical sensor check screen and their details are as follows.

 <p>Displays the program number.</p>	 <p>Displays the sum value of the program.</p>	 <p>Displays the revision number of the program.</p>	 <p>Displays the specification number of the optical sensor.</p>
 <p>Displays the manufacturing equipment number of the optical sensor.</p>	 <p>Displays the UV intensity of the light source LED1.</p>	 <p>Displays the UV intensity of the light source LED2.</p>	 <p>Displays the contrast of the interference fringe (LED1).</p>
 <p>Displays the contrast of the interference fringe (LED2).</p>	 <p>Displays the phase θA of the interference fringe.</p>	 <p>Displays the phase θB of the interference fringe.</p>	 <p>Displays the total phase $\theta ALL (+)$ of the interference fringe.</p>
 <p>Displays the total phase amount $\theta ALL (-)$ of the interference fringe.</p>	 <p>Displays the order calculation value $\theta INT (+)$ of the interference fringe.</p>	 <p>Displays the order calculation value $\theta INT (-)$ of the interference fringe.</p>	 <p>Displays the amount of change in the refractive index $N (+)$.</p>
 <p>Displays the amount of change in the refractive index $N (-)$.</p>	 <p>Displays the voltage of the power supply system (3.3 V system).</p>	 <p>Displays the voltage of the power supply system (5.0 V system).</p>	 <p>Displays the voltage of the light source LED1 drive circuit.</p>
 <p>Displays the voltage of the light source LED2 drive circuit.</p>	  <p>Displays miscellaneous self-diagnostic flags monitored in the sensor unit.</p>		











C.02.-- Check of State of Main Controller 'MAIN CONTROLLER'

Displays program information of the main controller, the result of the self-diagnostic performed inside, etc.

In the "MAIN CONTROLLER" menu screen, press the SET button to display the check screen. Use the ▲▼ buttons to select the item to be checked.



Items displayed in the main controller check screen and their details are as follows.

 <p>Displays the program number.</p>	 <p>Displays the sum value of the program.</p>	 <p>Displays the revision number of the program.</p>	 <p>Displays the specification number of the main controller.</p>
 <p>Displays the manufacturing equipment number of the main controller.</p>	 <p>Displays the voltage of the power supply system (3.3 V system).</p>	 <p>Displays the voltage of the power supply system (5.0 V system).</p>	 <p>Displays the voltage of the power supply system (24 V system).</p>
 <p>The 4 to 20 mA signal to be input to the digital reading adjustment meter.</p>	 <p>Displays miscellaneous self-diagnostic flags monitored in the main controller.</p>		

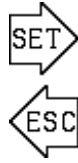
C.03.-- Check of State of 4 to 20 mA Setting '4-20mA PARAM.'

Displays the condition, setting, etc., of the 4 to 20 mA signal.

In the "4-20mA PARAM." menu screen, press the SET button to display the check screen. Use the ▲ ▼ buttons to select the item to be checked.



Menu screen



Check screen

Items displayed in the main controller check screen and their details are as follows.

<p>Displays the measurement value at which 4 mA is input in measuring mode.</p>	<p>Displays the measurement value at which 20 mA is input in measuring mode.</p>	<p>The 4 to 20 mA signal to be input to the digital reading adjustment meter when an abnormality is detected. *</p>	<p>The 4 to 20 mA signal to be input to the digital reading adjustment meter when the function check is activated.</p>

* The output value that is set to "HOLD" means that the value just before the entry into the state is input to the digital reading adjustment meter.

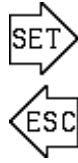
C.04.-- Check of Output of Pressure Sensor 'PRESS. SENSOR'

Displays the output of the pressure sensor integrated in the sensor unit.

In the "PRESS.SENSOR" menu screen, press the SET button to display the check screen. Use the ▲ ▼ buttons to select the item to be checked.



Menu screen



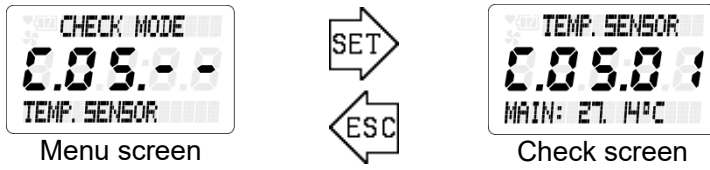
Check screen

Items displayed in the pressure sensor output check screen and their details are as follows.

<p>Displays the output of the fine pressure difference sensor that detects the flow rate of the measured gas passing through the sensor unit.</p>	<p>This is not used on FI-915.</p>	<p>Displays the output of the absolute pressure sensor used for pressure correction.</p>

C.05.-- Check of Output of Temperature Sensors 'TEMP. SENSOR'

Displays the output of the temperature sensors embedded in the LCD display and the sensor unit. In the "TEMP. SENSOR" menu screen, press the SET button to display the check screen. Use the ▲ ▼ buttons to select the item to be checked.

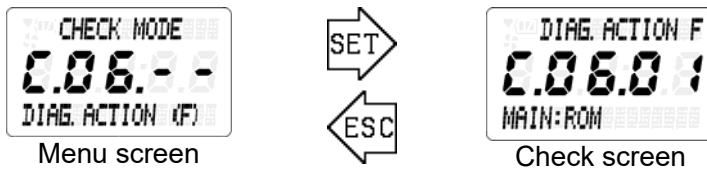


Items displayed in the main controller check screen and their details are as follows.

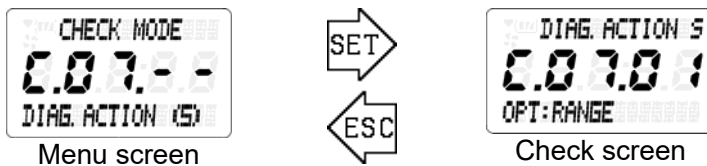
<p>Displays the temperature of the main controller.</p>	<p>Displays the temperature of the inside of the sensor unit.</p>

C.06.-- Check of Output of Self-diagnostic 'DIAG. ACTION (F)'

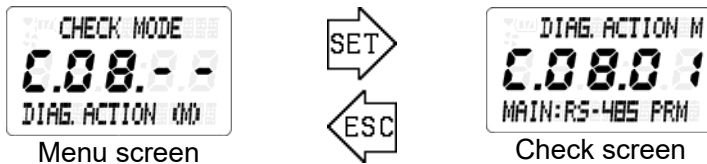
Displays detailed operation settings of the LCD display, FAIL lamp (red) and fault alarm contact output (19) - (20) for each condition for when the self-diagnostic/monitoring function detects "FAILURE." Since this function is intended to be operated by our service engineer, its description is omitted.

**C.07.-- Check of Output of Self-diagnostic 'DIAG. ACTION (S)'**

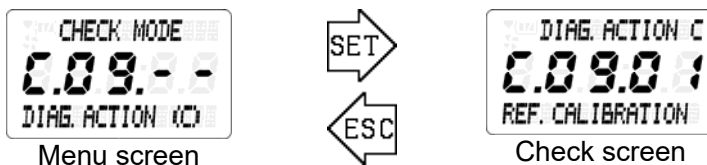
Displays detailed operation settings of the LCD display and O.SPEC lamp (orange) for each condition for when the self-diagnostic/monitoring function detects "OUT OF SPECIFICATION." Since this function is intended to be operated by our service engineer, its description is omitted.

**C.08.-- Check of Output of Self-diagnostic 'DIAG. ACTION (M)'**

Displays detailed operation settings of the LCD display and M.REQ. lamp (green) for each condition for when the self-diagnostic/monitoring function detects "MAINTENANCE REQUIRED." Since this function is intended to be operated by our service engineer, its description is omitted.

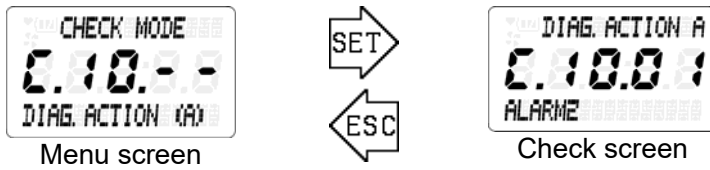
**C.09.-- Check of Output of Self-diagnostic 'DIAG. ACTION (C)'**

Displays detailed operation settings of the LCD display and F.CHK. lamp (orange) for each condition for when FI-915 enters the "FUNCTION CHECK" state. Since this function is intended to be operated by our service engineer, its description is omitted.



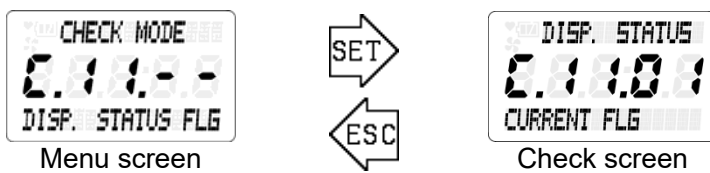
C.10.-- Check of Output of Self-diagnostic 'DIAG. ACTION (A)'

Displays operation settings of the LCD display, ALM1 lamp, ALM2 lamp, contact output 1 (15) - (16) and contact output 2 (17) - (18) for when the product's measurement result reaches an alarm condition.

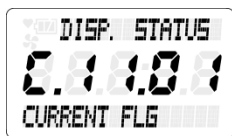


C.11.-- Check of Status Flag 'DISP. STATUS. FLG'

Displays the result of the self-diagnostic/monitoring function. In the "DISP. STATUS. FLG" menu screen, press the SET button to display the check screen. Use the ▲▼ buttons to select the item to be checked.



Items displayed in the main controller check screen and their details are as follows.



Press the SET button to display details of a problem occurring currently. When no problem is occurring, "NO FLGS" is displayed.



While a condition where the trace display *1 is performed is detected, press the SET button to display details of the condition detected. When nothing is detected, "NO FLGS" is displayed.



While a condition where the contact operation self-latching *2 is performed is detected, press the SET button to display details of the condition detected. When no problem is occurring, "NO FLGS" is displayed.

*1

The trace display is a function that alternately displays the normal measurement screen and the screen of an abnormal state that occurred in the past to inform the customer about the past event when the product recovers from some abnormal state to the normal state. FI-915 does not use this function.

*2

The contact operation self-latching is a function for a product that outputs some event state through a contact operation. The function holds a contact operation even after a product recovers from a state with an event occurring to the normal state. FI-915 does not use this function.

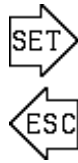
C.12.-- Reset of Latching of Display/Contact 'LATCH. RESET'

This menu item is for resetting the trace display state of the LCD display and the self-latching state of the contact. Since FI-915 does not use these functions, there is no need to use this menu usually.

In the menu screen, press the SET button to display the caution screen stating that it will reset the latching state of the display screen and contact. Press the ▲ button repeatedly to display all the texts of the "caution screen" and read them, and then press the SET button to reset the self-latching state of the display screen and the contact as well as the trace state of the LCD display.



Menu screen



Check screen

6

How to Operate in Setup Mode

"Setup mode" is mode to change the measured gas, set the condition of the 4 to 20 mA signal and set the SD card operation, etc.

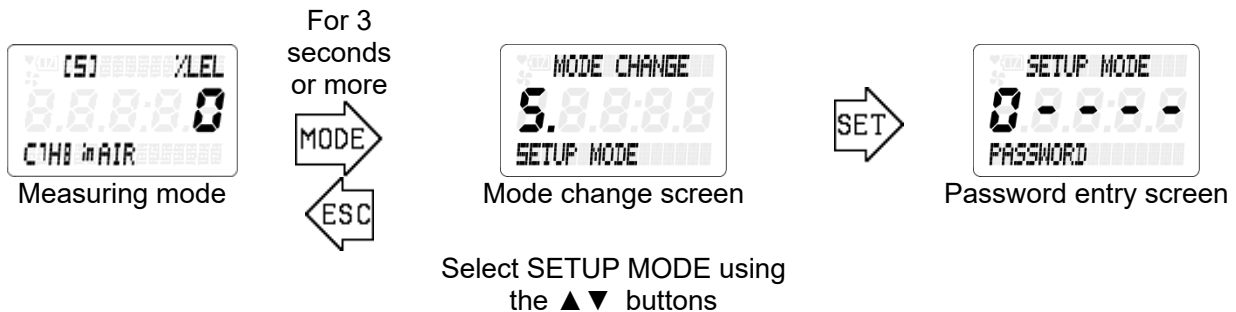
When this mode is entered, measurement is stopped, the "FUNCTION CHECK" state is entered and the 4 to 20 mA signal is fixed to the previous value.

(For how to change the output condition, see "S.02.-- Setting of 4 to 20 mA Output Signal '4-20mA SETUP'")

To enter "setup mode," press and hold the MODE button for 3 seconds or more in measuring mode to display the mode change screen, use the ▲▼ buttons to select "SETUP MODE," and then press the SET button to confirm.

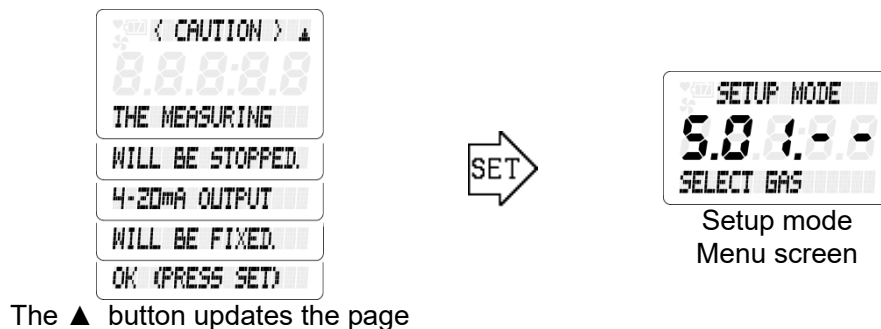
After that, the password entry screen appears. Use the ▲▼ and SET buttons to enter the characters of the password one by one. The factory-set password is "00000".

(For how to change the password, see "S.22.-- Change of Password 'CHANGE PASSWORD'")



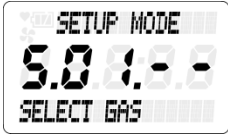



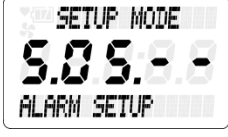
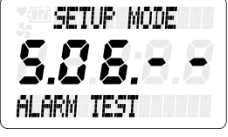
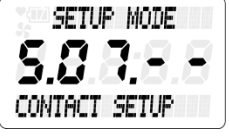
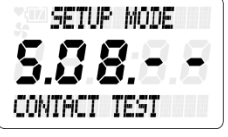
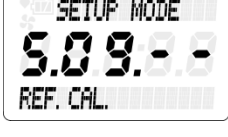

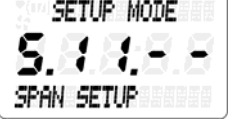

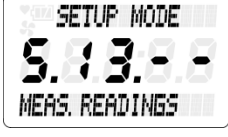

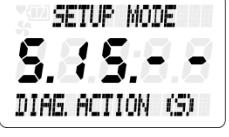
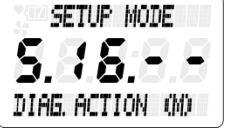
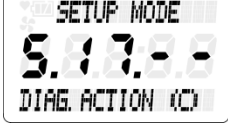
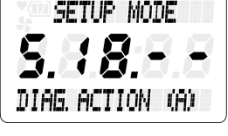


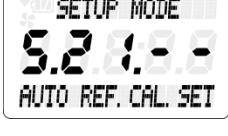

When the password is entered correctly, the "caution screen" appears stating that measurement will be stopped and the 4 to 20 mA signal to be input to the digital reading adjustment meter will be fixed. Press the ▲ button repeatedly to display all the texts of the "caution screen" and read them, and then press the SET button to stop measurement and display the setup mode menu screen.

(To return to measuring mode from the setup mode menu screen, press and hold the ESC button for 3 seconds or more.)



6-1. Items in Setup Mode

The following table shows items that are displayed in the setup mode menu screen. The description for each item is provided on the subsequent pages.

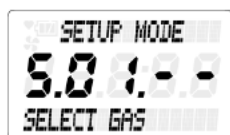
 <p>5.01.-.- SELECT GAS</p> <p>Selects the measured gas</p>	 <p>5.02.-.- 4-20mA SETUP</p> <p>Sets up the 4 to 20 mA signal to be input to the digital reading adjustment meter</p>	 <p>5.03.-.- 4-20mA ADJ.</p> <p>Adjusts the 4 to 20 mA signal to be input to the digital reading adjustment meter</p>	 <p>5.04.-.- 4-20mA TEST</p> <p>Tests the input of the 4 to 20 mA signal to the digital reading adjustment meter</p>
 <p>5.05.-.- ALARM SETUP</p> <p>Sets up the concentration alarm function</p>	 <p>5.06.-.- ALARM TEST</p> <p>Tests the concentration alarm function</p>	 <p>5.07.-.- CONTACT SETUP</p> <p>Sets up the contact output operation</p>	 <p>5.08.-.- CONTACT TEST</p> <p>Tests the contact output operation</p>
 <p>5.09.-.- REF. CAL.</p> <p>Performs the reference calibration</p>	 <p>5.10.-.- OFFSET SETUP</p> <p>Adjusts the offset of the reading</p>	 <p>5.11.-.- SPAN SETUP</p> <p>Adjusts the sensitivity of the reading</p>	 <p>5.12.-.- SUPPRESS SETUP</p> <p>Sets up the zero suppression value of the reading</p>
 <p>5.13.-.- MEAS. READINGS</p> <p>Checks miscellaneous measurement values</p>	 <p>5.14.-.- DIAG. ACTION (F)</p> <p>Sets up product operations for when an abnormal condition is detected</p>	 <p>5.15.-.- DIAG. ACTION (S)</p> <p>Sets up product operations for when a condition out of specification is detected</p>	 <p>5.16.-.- DIAG. ACTION (M)</p> <p>Sets up product operations for when a condition requiring maintenance is detected</p>
 <p>5.17.-.- DIAG. ACTION (C)</p> <p>Sets up product operations in a function check state</p>	 <p>5.18.-.- DIAG. ACTION (A)</p> <p>Sets up product operations in a gas concentration alarm state</p>	 <p>5.19.-.- RS-485/MODBUS</p> <p>Sets up the RS-485/Modbus communication</p>	 <p>5.20.-.- SD CARD</p> <p>Operates the SD card</p>
 <p>5.21.-.- AUTO REF. CAL. SET</p> <p>Sets up the automatic reference calibration</p>	 <p>5.22.-.- CHANGE PASSWORD</p> <p>Setup mode password change</p>		

6-2. Each Item And Details

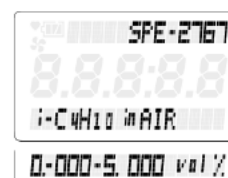
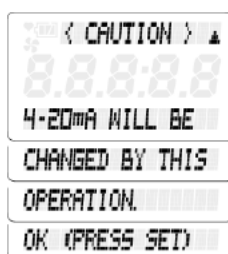
S.01.-- Selection of Measured Gas 'SELECT GAS'

Selects the measured gas. In the "SELECT GAS" menu screen, press the SET button to display details of the measured gas range selected currently. After that, press the SET button. The SPE number will start blinking.

Use the ▲▼ buttons to select the gas range to be measured, and then press the SET button to confirm.



Menu screen



* The SPE number blinks

Use the ▲▼ buttons to select the SPE number
Press the SET button to confirm

In the standard specification, the gas types shown in the following table are selectable.

SPE number	Gas type	Measuring range	Remarks
SPE-2921	C7H8 in AIR	0-100%LEL	
SPE-2922	EtAc in AIR	0-100%LEL	
SPE-2923	MEK in AIR	0-100%LEL	
SPE-2924	IPA in AIR	0-100%LEL	
SPE-2925	CH3OH in AIR	0-100%LEL	
SPE-2926	C2H5OH in AIR	0-100%LEL	
SPE-2927	MIBK in AIR	0-100%LEL	
SPE-2929	C8H10 in AIR	0-100%LEL	

S.02.-- Setting of 4 to 20 mA Output Signal '4-20mA SETUP'

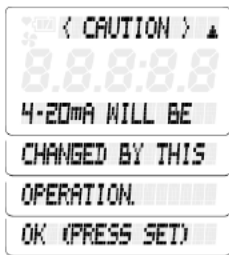
Set the output conditions for the 4-20ma signal of the concentration output from the terminal block ⑨ -⑩. (below document for FI-915)

Display contents	Description of the output value
4mA: 0 %LEL	The measurement value at which 4 mA is input in measuring mode.
20mA: 100 %LEL	The measurement value at which 20 mA is input in measuring mode.
FAILURE: 0.50 mA	The input value for when an abnormality is detected. * HOLD inputs the value just before the abnormality is detected.
F-CHECK: HOLD	The input value for when the function check is activated. HOLD inputs the value just before the check is activated.

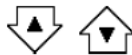
In the "4-20mA SETUP" menu screen, press the SET button to display the "caution screen" stating that the 4 to 20 mA signal will be changed. Press the ▲ button repeatedly to display all the texts of the "caution screen" and read them, and then press the SET button to display the setting change screen. Use the ▲▼ buttons to select the condition to be changed, and then press the SET button. The setting will start blinking. Use the ▲▼ and SET buttons to enter and confirm the value.



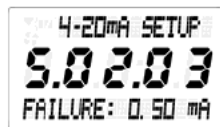
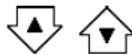
Menu screen



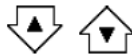
Use the ▲▼ and SET buttons to enter and confirm the gas concentration value for outputting 4 mA.



Use the ▲▼ and SET buttons to enter and confirm the gas concentration value for outputting 20 mA.



Use the ▲▼ buttons to select the 4 to 20 mA output value at an abnormality, and then press the SET button to confirm.
HOLD: The value just before the abnormality detection, or 0.50 mA



Use the ▲▼ buttons to select the 4 to 20 mA output value at the function check, and then press the SET button to confirm.

S.03.-- 4 to 20 mA Signal Adjustment '4-20mA ADJ.'

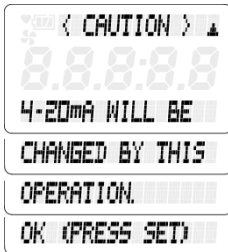
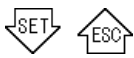
The 4 to 20 mA gas concentration output signal. In the "4-20mA ADJ." menu screen, press the SET button. The "caution screen" will appear stating that the 4 to 20 mA signal will be changed.

Press the ▲ button repeatedly to display all the texts of the "caution screen" and read them, and then press the SET button. The test signal input screen will appear and a test signal of 4 mA or 20 mA.

Use the ▲▼ buttons to select which test signals to output, and then press the SET button. The PWM value will start blinking, indicating that each signal level can be adjusted. Use the ▲▼ buttons to change the PWM value and adjust the signal level, and then press the SET button to confirm.



Menu screen



Use the ▲▼ buttons to change the value, and then press the SET button to confirm

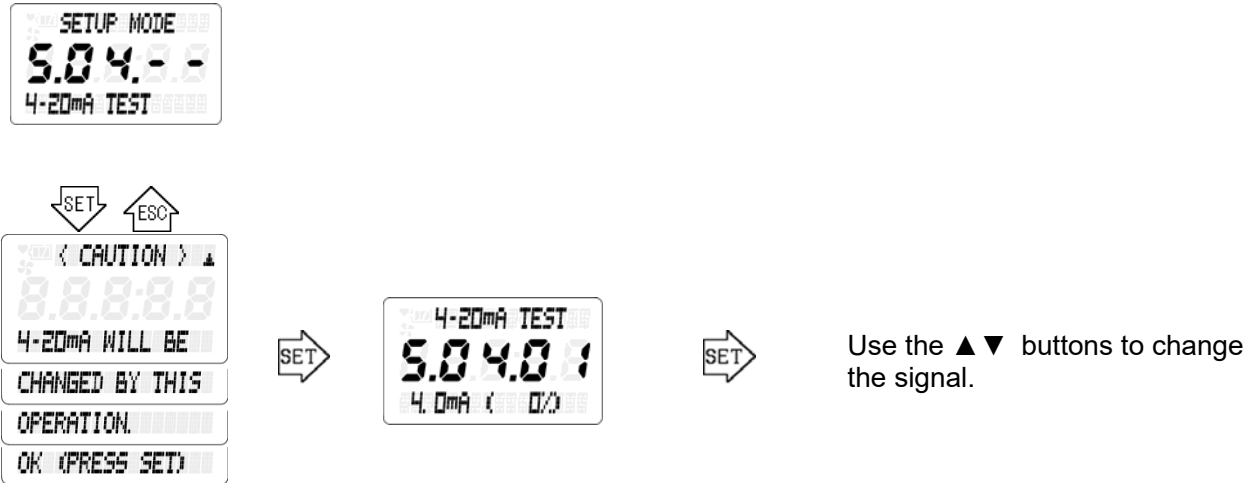


Use the ▲▼ buttons to change the value, and then press the SET button to confirm

Press the ESC button without confirming to end the adjustment, return to the menu screen and return the 4 to 20 mA signal to the state before the test.

S. 04.-- 4 to 20 mA Signal Test '4-20mA TEST'

Adjusts any test signal of the 4 to 20 mA output signal. In the "4-20mA TEST" menu screen, press the SET button. The "caution screen" will appear stating that the 4 to 20 mA signal will be changed. Press the ▲ button repeatedly to display all the texts of the "caution screen" and read them, and then press the SET button. The test signal screen will appear and a test signal. After that, press the SET button. The input value will start blinking. Use the ▲▼ buttons to change the test signal by 0.1 mA within the range from 0.5 to 22.0 mA.



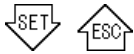
Press the ESC button to end the output test, return to the menu screen and return the 4 to 20 mA signal to be input to the digital adjustment reading meter to the state before the test.

S.05.-- Setup of Concentration Alarm Function 'ALARM SETUP'

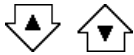
Set the concentration alarm function. In the "Alarm Setup" menu screen, press the SET button to display preset alarm function. After that, press the SET button. The setting contents will start blinking. Use the ▲▼ buttons to select the alarm function, and then press the SET button to confirm.



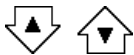
Menu screen



Select the alarm type ("h-hh" or "Off") with the ▲▼ buttons and then press the SET button to confirm.



Change the first alarm setpoint (ALM1) with the ▲▼ buttons and then press the SET button to confirm.



Change the first alarm setpoint (ALM1) with the ▲▼ buttons and then press the SET button to confirm.



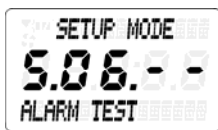
Change the number of the alarm delay time with the ▲ ▼ button and then press the SET button to confirm.

S.06.-- Alarm Test 'ALARM TEST'

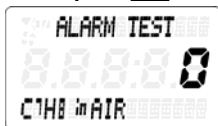
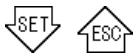
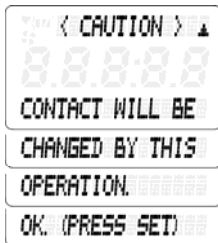
Test the concentration alarm function. In the "ALARM TEST" menu screen, press the SET button to test concentration the alarm function. The "caution screen" will appear stating that the 4 to 20 mA signal will be changed and the alarm contact will be activated.

Press the ▲ button repeatedly to display all the texts of the "caution screen" and read them, and then press the SET button. Concentration alarm function test screen will appear and the dummy signal will be output.

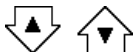
Use the ▲▼ buttons to change the dummy signal of the gas concentration measurement result. When the dummy signal of the gas concentration measurement result changes to a value that fulfills the alarm condition (ALM1, ALM2), the contact output(Alarm contact output 1, Alarm contact output 2) is activated.



Menu screen



Concentration alarm function test screen



Change the dummy signal of the gas concentration measurement result with the ▲▼ buttons.

When the dummy signal of the gas concentration measurement result changes to a value that fulfills the first alarm condition (ALM1), the contact output 1 is activated.



When the dummy signal of the gas concentration measurement result changes to a value that fulfills the second alarm condition (ALM2), the contact output 2 is activated.

S.07.-- Change of Contact Energization Setting 'CONTACT SETUP'

Sets up the usual condition of energized/de-energized of the contact used in FI-915.
 Since this function is intended to be operated by our service engineer, its description is omitted.



S.08.-- Contact Operation Check 'CONTACT TEST'

Outputs a test signal of a usual/unusual state to test the operation of the contact used in FI-915.
 Since this function is intended to be operated by our service engineer, its description is omitted.



S.09.-- Reference Calibration 'REF. CAL'

Performs the reference calibration. In the "REF. CAL" menu screen, press the SET button to display the "REF. CAL" execution standby screen. Press the SET button again to perform the reference calibration.

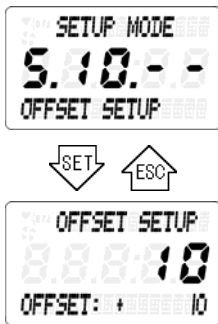


CAUTION

- Perform the reference calibration in a condition where the reference gas can be drawn from REF IN.

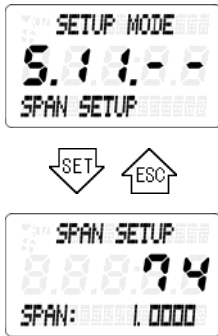
S.10.-- Offset Adjustment 'OFFSET SETUP'

Performs the offset adjustment of the measurement result. Since this operation is intended to be performed by our service engineer, the description of how to operate it is omitted.



S.11.-- Span Adjustment 'SPAN SETUP'

Performs the span adjustment of the measurement result. Since this operation is intended to be performed by our service engineer, the description of how to operate it is omitted.



S.12.-- Suppression Adjustment 'SUPPRESS'

Sets up the upper limit and lower limit for display of the measurement result. Since this operation is intended to be performed by our service engineer, the description of how to operate it is omitted.



S.13.-- Check of Miscellaneous Measurement Values 'MEAS. READINGS'

Displays miscellaneous internal data of the sensor. Since this function is intended to be used by our service engineer when checking and inspecting the operation of the product, its description is omitted.

S.14.-- Self-diagnostic Operation (at FAILURE) 'DIAG. ACTION (F)'

Sets up detailed operations of the LCD display and the contact for each condition for when the self-diagnostic/monitoring function detects "FAILURE." Since this function is intended to be operated by our service engineer, its description is omitted.

S.15.-- Self-diagnostic Operation (at OUT OF SPECIFICATION) 'DIAG. ACTION (S)'

Sets up detailed operations of the LCD display and LED lamp for each condition for when the self-diagnostic/monitoring function detects "OUT OF SPECIFICATION." Since this function is intended to be operated by our service engineer, its description is omitted.

S.16.-- Self-diagnostic Operation (at MAINTENANCE REQUIRED) 'DIAG. ACTION (M)'

Sets up detailed operations of the LCD display and LED lamp for each condition for when the self-diagnostic/monitoring function detects "MAINTENANCE REQUIRED." Since this function is intended to be operated by our service engineer, its description is omitted.

S.17.-- Self-diagnostic Operation (at FUNCTION CHECK) 'DIAG. ACTION (C)'

Sets up detailed operations of the LCD display and LED lamp for each condition for when FI-915 enters the "FUNCTION CHECK" state. Since this function is intended to be operated by our service engineer, its description is omitted.

S.18.-- Self-diagnostic Operation (at Concentration Alarm) 'DIAG. ACTION (A)'

Sets up detailed operations of the LCD display and the contact for each condition for when the measurement result fulfills a concentration alarm condition.
Since this function is intended to be operated by our service engineer, its description is omitted.

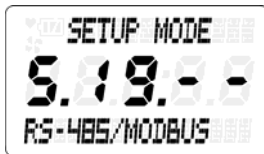
S.19.-- Setup of RS-485 Communication 'RS-485/MODBUS'

Change the RS-485 (MODBUS) communication settings. In the menu screen, press the SET key to display the setting value check screen and display the current settings of communication conditions. Use the ▲▼ buttons to select a condition for each of the items and then press the Set button to confirm

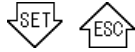


CAUTION

- The RS-485 (MODBUS) communication function is an optional function. For detailed information such as communication specifications and address maps, please contact our nearest sales office.



Menu screen

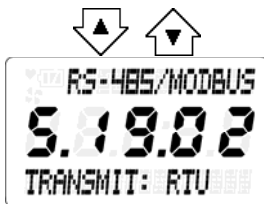


Slave ID : 1 to 247.



CAUTION

- If more than one device is connected on the same line, do not overlap the slave ID with the other devices.



TRANSMIT : RTU mode, ASCII mode



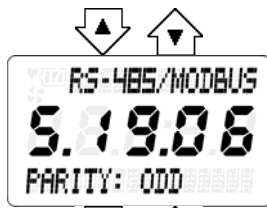
BAUD RATE: 4800bps, 9600bps, 19200bps, 38400bps, 57600bps, 115200bps



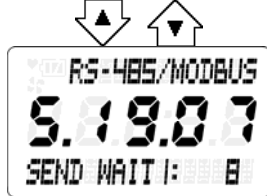
DATA BIT: 7bit, 8bit



STOP BIT: 1bit, 2bit, NONE



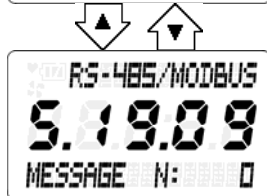
PARITY BIT: NONE, IGNORE, EVEN, ODD



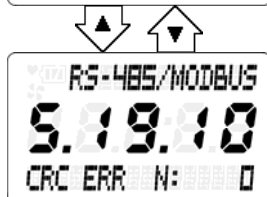
SEND WAIT 1 :8 to 127 characters(fixed value)



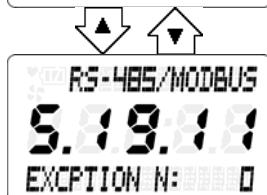
SEND WAIT 2 :8 to 127 characters(random value)



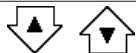
Displays all message receipt counters.



Displays the CRC error counter.



Displays the exception error counter.

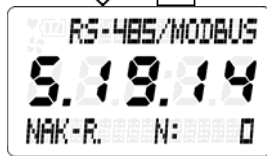




Displays the corresponding message receipt counter.



Displays no response or reply counter.



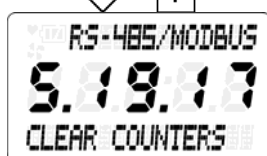
Displays the NAK reply counter.



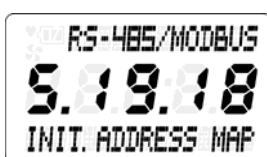
Displays the BUSY reply counter.



Displays overrun counters.



Select OK and press the Set button to clear all counter values.



Initializes the address map.

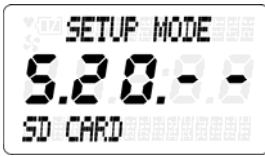


CAUTION

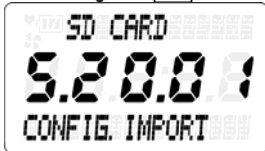
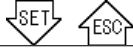
- If the address map is initialized, FI-915 might not communicate properly
- Since this function is intended to be operated by our service engineer, do not initialize the address map.

S.20.-- SD Card Operation 'SD CARD'

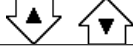
In the "SD CARD" menu screen, press the SET button to display the miscellaneous operation items. Use the ▲▼ buttons to select an operation item to be executed, and then press the SET button to display each execution screen.



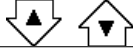
Menu screen



Imports/rewrites product settings



Exports product settings



Exports log data

Product setting information such as measured gas range, alarm point, and contact operation can be imported from the SD card and rewritten.

Product setting information such as measured gas range, alarm point, and contact operation can be exported to the SD card.

Log data of "operational status" and "self-diagnostic result" recorded in the product can be exported to the SD card.

The operation of the execution screen of each operation item is described on the subsequent pages.



CAUTION

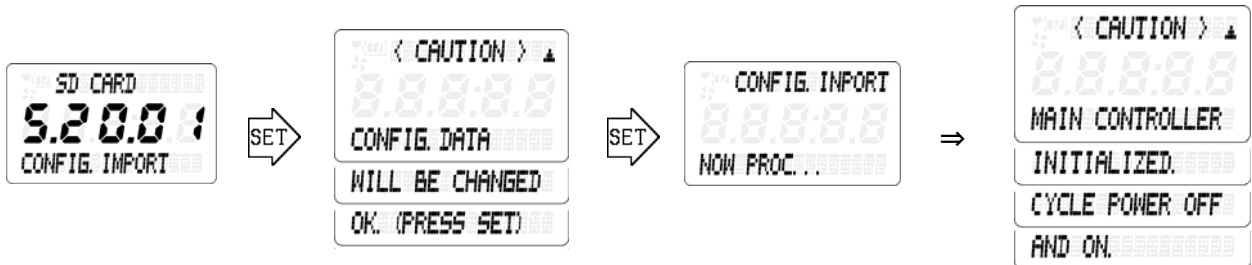
Use one of the following SD cards:

- SD standard: SDSC, SDHC
- File system: FAT16, FAT32

S.20.01 Import/Rewrite of Product Settings 'CONFIG IMPORT'

Select the "CONFIG IMPORT" operation item, and then press the SET button. The "caution screen" will appear stating that the product settings will be rewritten with data in the SD card. Press the ▲ button repeatedly to display all the texts of the "caution screen" and read them, and then press the SET button to rewrite the product settings.

After the settings are rewritten, the caution screen appears requiring to restart FI-915. Press the ▲ button repeatedly to display all the texts of the "caution screen" and read them, and then restart FI-915.



S.20.02 Export of Product Settings 'CONFIG EXPORT'

Select the "CONFIG EXPORT" operation item, and then press the SET button. The "caution screen" will appear stating that the settings of FI-915 will be exported to the SD card. Press the ▲ button repeatedly to display all the texts of the "caution screen" and read them, and then press the SET button to export to the SD card.

After the export is complete, the operation item screen reappears.



S.20.03 Export of Log Data 'LOG EXPORT'


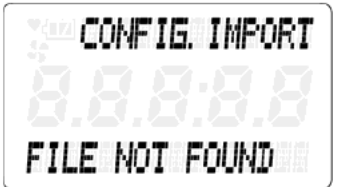
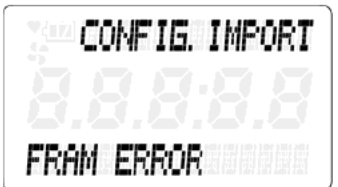


Select the "LOG EXPORT" operation item, and then press the SET button. The "caution screen" will appear stating that log data of product's "operational status" and "self-diagnostic result" recorded in FI-915 will be exported to the SD card. Press the ▲ button repeatedly to display all the texts of the "caution screen" and read them, and then press the SET button to export to the SD card (it takes 1 to 3 minutes). After the export is complete, the operation item screen reappears.



Abnormality display at an SD card operation

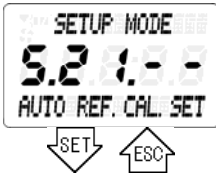
If an abnormality occurs at an SD card operation, one of the screens shown in the following table appears.

Press the SET button or ESC button to return to the menu selection screen.

Display	Meaning	Possible cause
	Cannot read the SD card.	<ul style="list-style-type: none"> No SD card is inserted. No data is saved. Data have an abnormality.
	Cannot read the setting file.	<ul style="list-style-type: none"> No setting file exists.
	Failed to write on FRAM.	FRAM data may be damaged.
	Cannot write data on the SD card.	<ul style="list-style-type: none"> No SD card is inserted. The SD card is locked to prohibit writing.
	There is not enough space on the SD card.	<ul style="list-style-type: none"> There is not enough space on the SD card.

S.21.-- Setup of Automatic Reference Calibration 'AUTO REF. CAL SET'

The automatic reference calibration is a function to perform the reference calibration at a specific time interval automatically using a built-in timer of the product. Since this function is intended to be operated by our service engineer, its detailed description is omitted.



Sets up ON/OFF of the automatic reference calibration and its operation cycle.

OFF (automatic reference calibration OFF), 3H (every 3 hours), 6H (every 6 hours), 12H (every 12 hours), 24H (every 24 hours), 2D (every 2 days), 7D (every 7 days), 28D (every 28 days)

Sets up the reference gas drawing time and measured gas drawing time for performing the reference calibration.

S.22.-- Change of Password 'CHANGE PASSWORD'

Changes the password for entering setup mode. In the "CHANGE PASSWORD" menu screen, press the SET button to display the password check screen which displays the current password. After that, press the SET button to display the password entry screen. Use the ▲▼ buttons and SET button to enter characters 0 to 9 and A to F one by one.



Menu screen



Use the ▲▼ buttons to enter characters one by one and press the SET button to confirm.



CAUTION

- Note that setup mode cannot be entered if the set password is forgotten.
- When forgetting the password, please contact the distributor.

7

Maintenance

FI-915 is supposed to be operated continuously over a long period of time. Regular maintenance is necessary to maintain the appropriate performance during the period of use.

- Maintenance Contract -

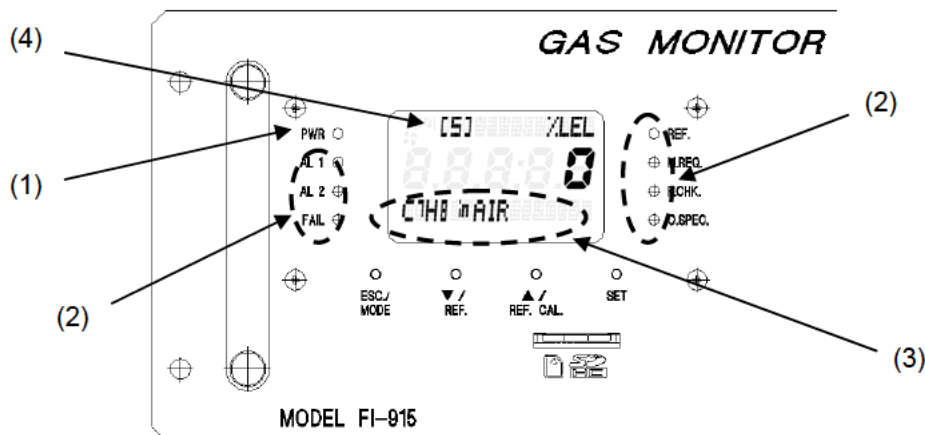
We recommend you to conclude a maintenance contract with us for regular maintenance including span adjustment, adjustment, maintenance etc. to ensure stable operation and accuracy of FI-915. Please contact the distributor for more information on a maintenance contract.

7-1. Maintenance Intervals and Items

There are two types of maintenance: "Daily maintenance" performed by the customer once a day and "regular maintenance for every 6 months" performed by us once every 6 months.

7-2. Daily Maintenance

Daily maintenance is an inspection to check the soundness of the product operation. Perform the maintenance on the basis of the maintenance items/criteria shown in the following table.



Maintenance item		Criteria
(1)	POWER lamp	At a normal state, the POWER lamp stays lit. Check that the lamp lights up properly.
(2)	Event lamps	At a normal state, all the event lamps stay out. Check that these lamps do not light up.
(3)	LCD display	Check that FAILURE, OUT OF SPECIFICATION, MAINTENANCE REQUIRED, etc., are not displayed.
(4)	Measured gas (GAS) flow rate	Check that the value indicating the measured gas (GAS) flow rate indicates [4] to [6] individually.

When finding any abnormalities, inspect/treat them on the basis of troubleshooting.

7-3. Regular Maintenance for Every 6 Months

Regular maintenance for every 6 months is an inspection to check the soundness of the sensor output, power voltage, analog signal output, etc. The following items are performed as needed.

- (1) Cleaning of the device (2) Replacement of the filter (3) Replacement of the pump unit
 (4) Check of the reading operation
 (5) Others

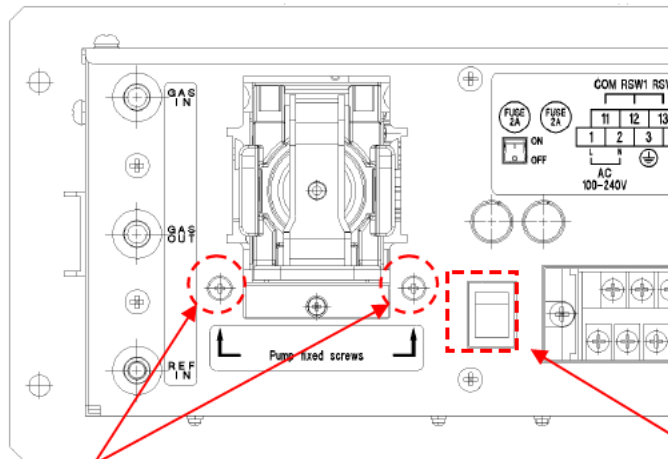
Items of daily maintenance are also performed at regular maintenance for every 6 months.

7-4. Recommended Regular Replacement Parts

Item	Replacement intervals
Pump	1 year
Filter	1 year

FI-915 is designed with the service life of 10 years.

7-5. How to Replace Pump

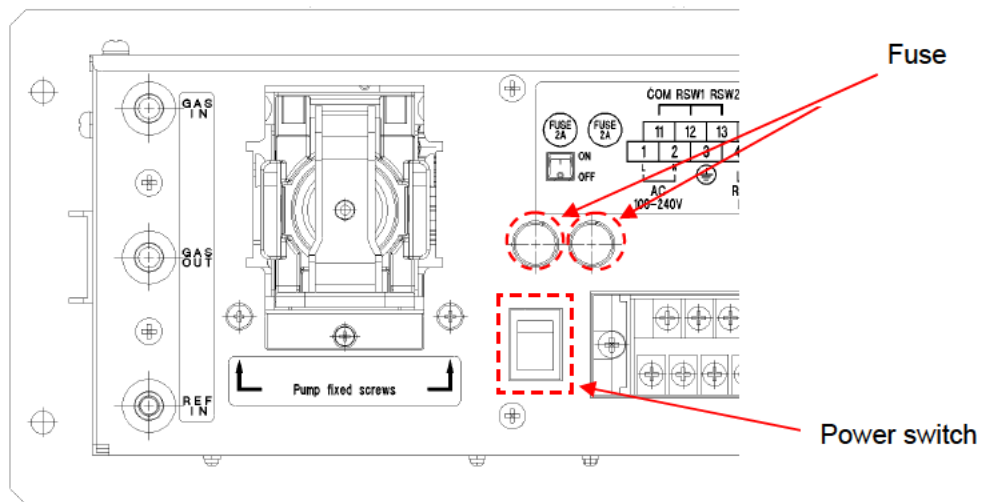


Pump fixed
screws

Power switch

- 1 Turn off the power switch of the main unit.**
- 2 Turn the two pump fixed screws clockwise to restrain the vibration isolation mechanism of the pump.**
- 3 Move the two stoppers of the pump toward the inside to release the stopper, and then pull the pump out.**
- 4 Insert a new pump in the reverse order, and then fix it with the stoppers.**
- 5 Loosen the pump fixed screws to release the restraint on the vibration isolation mechanism of the pump.**

7-6. How to Replace Fuse



- 1 Turn off the power switch of the main unit.**
- 2 Replace the attached fuse (250 V 2 A, $\Phi 5.2 \times 20$ mm, time-lag type) with a new one.**
- 3 Turn on the power switch and check that the unit operates normally.**



CAUTION

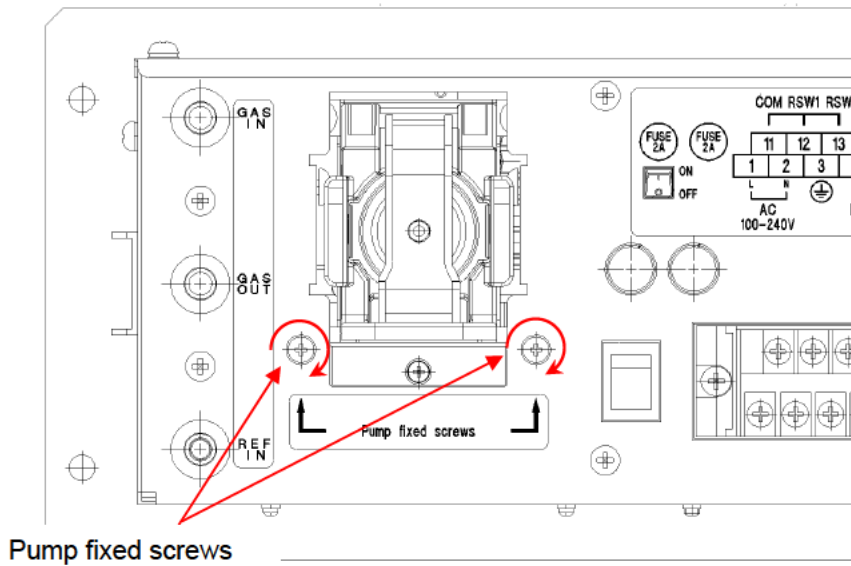
- The part around the fuse is made of glass. Applying excessive force to it may cause breakage of glass and injury.

8

Storage, Relocation and Disposal

8-1. Procedures to Store FI-915 or Leave It for a Long Time

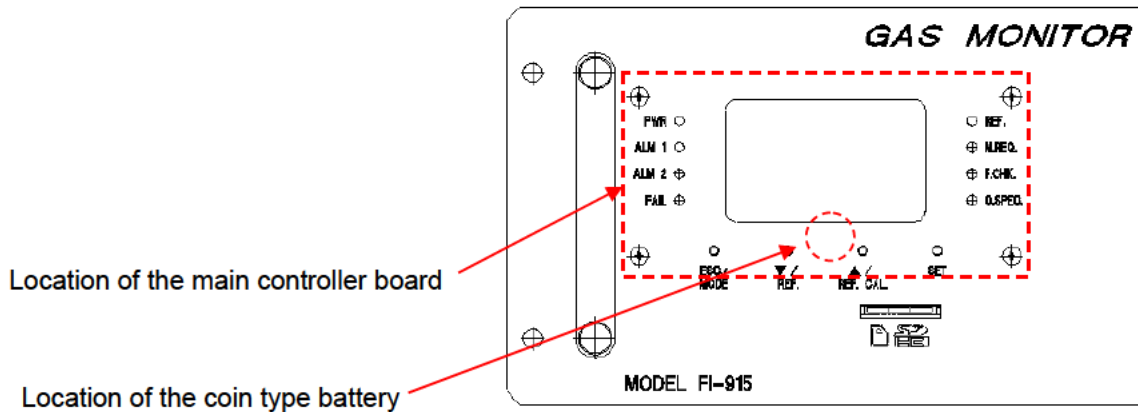
When stopping using FI-915 and store it in a warehouse, etc., for a long time, store it in a place under the normal temperature and humidity away from direct sunlight.
When moving/transporting FI-915, turn the two pump fixed screws clockwise to restrain the vibration isolation mechanism of the pump.



8-2. Disposal of Products

When FI-915 is disposed of, it must be treated properly as an industrial waste in accordance with the local regulations. The main controller board in the main unit is equipped with the following coin type battery. Remove it before disposing of FI-915.

Specifications of the coin type manganese dioxide lithium battery
 Item name: CR1220
 Nominal voltage: 3 V
 Standard capacity: 36 mAh

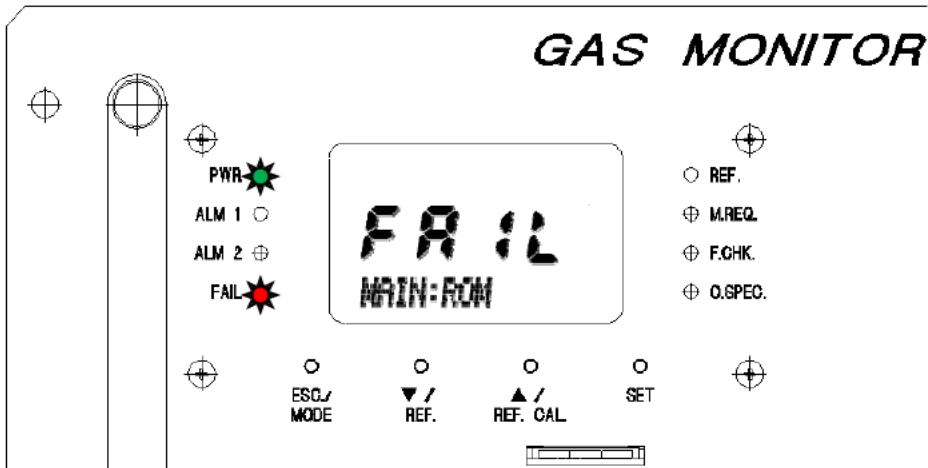


9


Troubleshooting










This material is intended to be used for inspecting a cause of a trouble, etc., by judging the state of the product on the basis of the information displayed on the main unit. Although it describes potential symptoms as much as possible, it does not show all symptoms. When this material fails to identify the cause, contact the distributor.

9-1. FAILURE



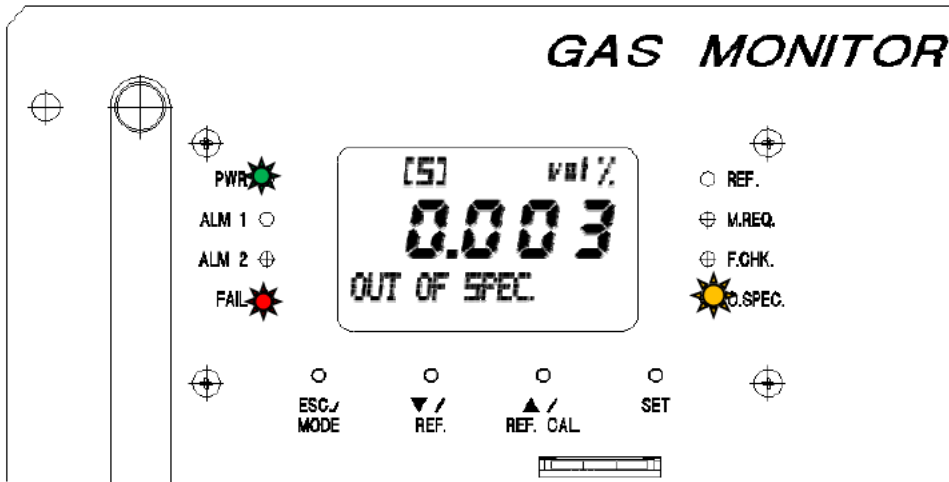
Display	Description of state	Main causes and actions
	Abnormality of the ROM of the main controller	It is an abnormality of the ROM of the main controller. The main controller needs to be replaced.
	Abnormality of the RAM of the main controller	It is an abnormality of the RAM of the main controller. The main controller needs to be replaced.
	Abnormality of the FRAM of the main controller	It is an abnormality of the FRAM of the main controller. The main controller needs to be replaced.

 <p>The image shows a digital display with a progress bar at the top. Below the bar, the word "FAIL" is displayed in large, bold, black letters. Underneath "FAIL", the text "MAIN: TEMP. SENSOR" is displayed in smaller, black letters.</p>	<p>An abnormal temperature has been detected on the main controller</p>	<p>When no abnormality is recognized in the installation environment, the main controller may malfunction.</p>
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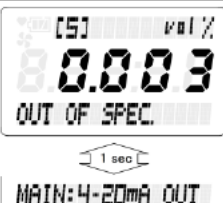
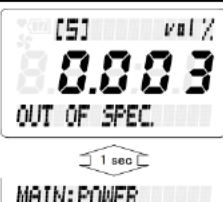

Display	Description of state	Main causes and actions
	An abnormality of the supplied power has been detected on the main controller	When no abnormality is found in the power supplied to the product, the power supply terminal plate unit or main controller may malfunction.
	An abnormality of the sensor has been detected on the main controller	The connection cable connecting the main controller and sensor or the sensor may malfunction.
	An abnormality of the 4 to 20 mA signal has been detected on the main controller	If the 4-20ma cable does not have any abnormalities such as disconnection, the power Terminal block unit or the main controller is suspected of malfunction.
	An abnormality of the ROM has been detected on the sensor	It is an abnormality of the ROM of the sensor. The sensor needs to be replaced.
	An abnormality of the RAM has been detected on the sensor	It is an abnormality of the RAM of the sensor. The sensor needs to be replaced.
	An abnormality of the FRAM has been detected on the sensor	It is an abnormality of the FRAM of the sensor. The sensor needs to be replaced.
	An abnormal temperature has been detected on the sensor	When no abnormality is found in the installation environment, the sensor may malfunction.
	An abnormal absolute pressure of GAS OUT has been detected on the sensor	When no abnormality such as the clogged gas inlet and tube is found, the sensor may malfunction.
	An abnormality of the supplied power has been detected on the sensor	When no abnormality is found in the power supplied to the product, the power supply terminal plate unit or sensor may malfunction.

Display	Description of state	Main causes and actions
<p>The image shows a close-up of an LCD display. At the top, there is a small 'Type' label and a progress bar. The main display area shows the word 'FAIL' in large, bold, black characters. Below it, the text 'OPT: BRIGHTNESS' is displayed in a smaller font. The background of the display is light gray with some faint grid lines.</p>	<p>An abnormal reduction of the UV intensity of interference fringe image data has been detected on the sensor</p>	<p>The sensor may have been damaged by a drawn foreign substance.</p>
<p>The image shows a close-up of an LCD display. At the top, there is a small 'Type' label and a progress bar. The main display area shows the word 'FAIL' in large, bold, black characters. Below it, the text 'OPT: CONTRAST' is displayed in a smaller font. The background of the display is light gray with some faint grid lines.</p>	<p>An abnormal reduction of the contrast of interference fringe image data has been detected on the sensor</p>	<p>The sensor may have been damaged by a drawn foreign substance.</p>
<p>The image shows a close-up of an LCD display. At the top, there is a small 'Type' label and a progress bar. The main display area shows the word 'FAIL' in large, bold, black characters. Below it, the text 'OPT: GAS-FLOW' is displayed in a smaller font. The background of the display is light gray with some faint grid lines.</p>	<p>An abnormal flow rate of the measured gas has been detected on the sensor</p>	<p>The amount of supply may have decreased or increased significantly, or the flow line in the product may have been clogged or may have a leak.</p>

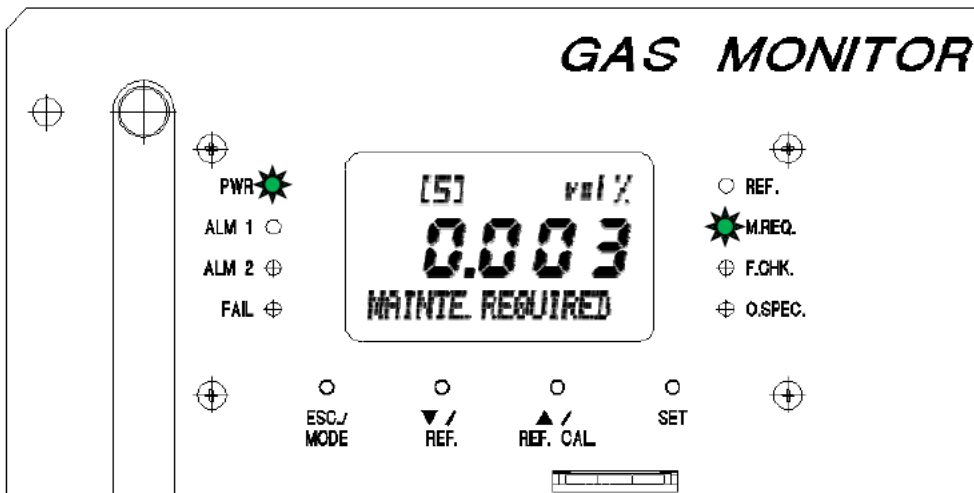
9-2. OUT OF SPECIFICATION



Display	Description of state	Main causes and actions
	A measured gas flow rate out of the specified range has been detected on the sensor	Adjust the gas flow rate to the specified flow rate.
	An abrupt change in the absolute pressure of GAS OUT has been detected on the sensor	An abnormality of drawing may occur due to an abrupt change in the pressure in the test chamber, clogging of the gas intake, etc.
	An absolute pressure of GAS OUT out of the measurement range has been detected on the sensor	The gas intake or the internal filter may have been clogged.
	An abrupt change in temperature has been detected on the sensor	Change the use environment of the sensor part.

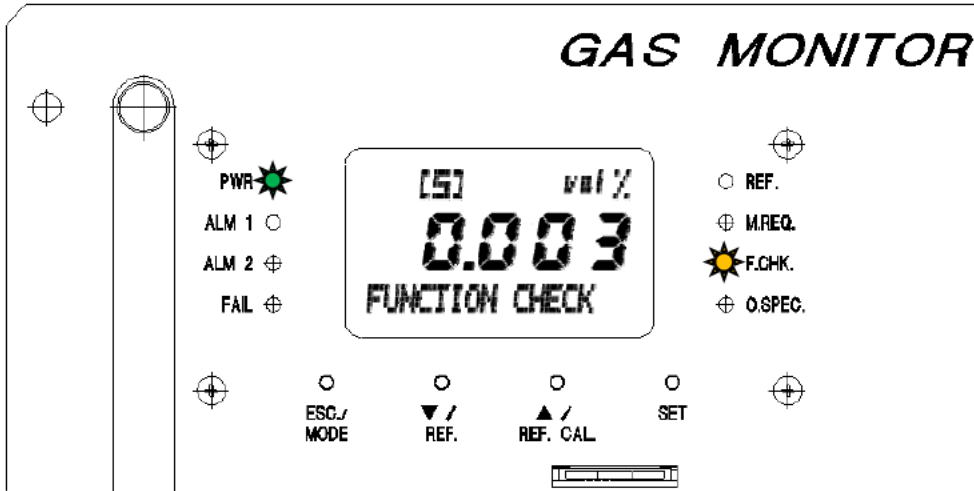
Display	Description of state	Main causes and actions
 <p>The display shows a digital reading of 0.003 with a unit of % VOL. Below the reading, it says "OUT OF SPEC." and "OPT: TEMP. RANGE". A 1-second timer icon is visible above the status text.</p>	A temperature out of specification has been detected on the sensor	Change the use environment of the sensor part.
 <p>The display shows a digital reading of 0.003 with a unit of % VOL. Below the reading, it says "OUT OF SPEC." and "MAIN: OVER SCALE". A 1-second timer icon is visible above the status text.</p>	A concentration out of specification has been detected	Check that the conditions described in the measured gas specifications are fulfilled.
 <p>The display shows a digital reading of 0.003 with a unit of % VOL. Below the reading, it says "OUT OF SPEC." and "MAIN: 4-20mA OUT". A 1-second timer icon is visible above the status text.</p>	An abnormality of the 4 to 20 mA signal to be input to the digital reading adjustment meter has been detected on the main controller	The power supply terminal plate unit, main controller or digital reading adjustment meter may malfunction.
 <p>The display shows a digital reading of 0.003 with a unit of % VOL. Below the reading, it says "OUT OF SPEC." and "MAIN: POWER". A 1-second timer icon is visible above the status text.</p>	A power supply out of the specified range has been detected on the main controller	Check that the power supplied to FI-915 fulfills the required specifications.
 <p>The display shows a digital reading of 0.003 with a unit of % VOL. Below the reading, it says "OUT OF SPEC." and "MAIN: TEMP. RANGE". A 1-second timer icon is visible above the status text.</p>	A temperature out of specification has been detected on the main controller	Change the use environment of the product.

9-3. MAINTENANCE REQUIRED



Display	Description of state	Main causes and actions
<p>The display shows the gas concentration as 0.003 vol% and 'MAINT. REQUIRED'. A 1-second timer is visible above the 'MAIN:RS-485 PRM' message.</p>	An abnormality of the RS-485 communication setting has been detected	The RS-485 communication needs to be re-set.
<p>The display shows the gas concentration as 0.003 vol% and 'MAINT. REQUIRED'. A 1-second timer is visible above the 'REF. CALIBRATION' message.</p>	A drift within the tolerable range has been detected on the sensor	Perform the reference calibration (REF. CAL).
<p>The display shows the gas concentration as 0.003 vol% and 'MAINT. REQUIRED'. A 1-second timer is visible above the 'LOW CONTRAST' message.</p>	A reduction of the contrast of the interference fringe within the tolerable range has been detected on the sensor	The optical sensor in the sensor has become dirty or been deteriorated. The sensor needs to be replaced.
<p>The display shows the gas concentration as 0.003 vol% and 'MAINT. REQUIRED'. A 1-second timer is visible above the 'LOW BRIGHTNESS' message.</p>	A reduction of the UV intensity of the interference fringe within the tolerable range has been detected on the sensor	The optical sensor in the sensor has become dirty or been deteriorated. The sensor needs to be replaced.

9-4. FUNCTION CHECK



Display	Description of state	Main causes and actions
	The function check has been activated through an external communication.	This display does not occur in normal specifications.
	The automatic reference calibration (optional function) is being performed.	This display does not occur in normal specifications.
	Warm-up is being performed.	This display does not occur in normal specifications.

10

Product Specifications

10-1. Standard Specifications

Model	FI-915
Name	Optical Interferometric Gas Monitor
Measuring principle	Synthetic wavelength light wave interferometer
Measured gas ^{**1}	Miscellaneous solvent vapors in air
Measuring range ^{**1}	0 - 100%LEL
Alarm setpoint value	25%LEL(1st)/50%LEL(2nd)
Measurement accuracy ^{**1}	±3%LEL (under the same conditions)
Response time ^{**1}	T90 15 seconds or less ^{**2}
Structure	Rack mounting type (Multi-stage installation possible)
Sampling method	Gas drawing type (flow rate of 1.0 L/min or more under 20°C environment)
Display function	Concentration display/miscellaneous maintenance display by the LCD display and state display by the LED lamps
Concentration output	DC 4 - 20 mA (source current type), tolerable load resistance 300 Ω or less
Digital output	RS-485 modbus output function (optional)
Transmission cable	Cable such as CVVS (1.25 mm ²) - 2-core
Alarm contact output 1	Non-voltage contact, contact capacity 1 A 240 VAC/1 A 30 VDC (resistance load)
Alarm contact output 2	Non-voltage contact, contact capacity 1 A 240 VAC/1 A 30 VDC (resistance load)
Fault contact output	Non-voltage contact, contact capacity 1 A 240 VAC/1 A 30 VDC (resistance load)
Contact cable	Cable such as CVV (1.25 mm ²) - 2-core
Self-diagnosis function	Low UV intensity, low contrast, abnormal pressure, abnormal temperature, low flow rate, etc.
Power supply	100 - 240 VAC ±10%, 50/60 Hz
Power consumption	max. 28VA (AC 100V), max. 39VA (AC 240V)
Power cable	Cable such as CVV (1.25 mm ²) - 2-core

Operating temperature/humidity range	-10 - +50°C, 95%RH or less (gases condensed inside the device cannot be handled)
Operating pressure range	Equivalent to the atmospheric pressure (without pulsation)
External dimensions	Approx. 370 (W) x 150 (H) x 269 (D) mm
Weight	Approx. 6 kg
Other functions	<ul style="list-style-type: none"> • Equipped with the temperature/pressure correction function (always ON) • Equipped with the automatic zero adjustment function (standard: OFF, settable) • Equipped with the zero suppression function (standard: OFF, settable) • Equipped with the setting value backup function using an SD card

- *1 The measured gas, measuring range, measuring accuracy and response time vary depending on the measured gas.
For details, see the measured gas specifications.
- *2 The response time is defined as a time taken to obtain 90% output from the initial rise when drawing a gas from GAS IN of the main unit.

Precautions

Note 1	FI-915 does not have a capability of explosion proof.
Note 2	FI-915 does not have a capability of IP protection.



CAUTION

- When FI-915 is used in an around 50°C ambient temperature, the internal temperature of the product becomes higher than that temperature. Avoid using FI-915 in an environment where the ambient temperature becomes around 50 °C continuously at any time of day or night as much as possible because it may affect the service life of the product.

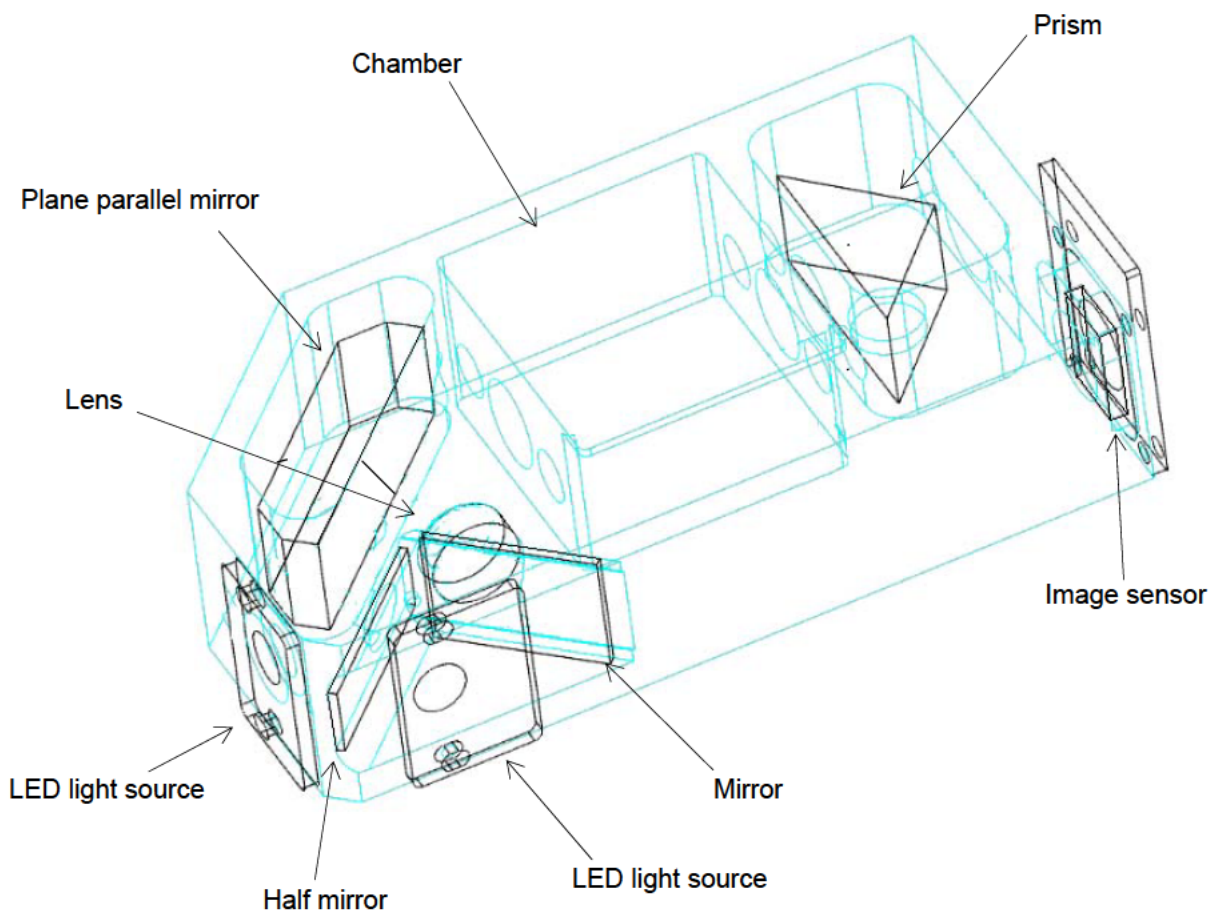
10-2. Detection principle

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 concentration 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 "measured 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

11

Definition of Terms

The terms used in this manual are defined as follows.

Lower explosive limit (LEL)	The lowest concentration of a combustible gas in air capable of causing explosion when ignited.
% LEL	A percentage unit of the concentration of a combustible gas assuming the lower explosive limit (LEL) of the combustible gas as 100.
vol%	Concentration of gases, etc. indicated in the unit of one-hundredth of the volume.
Grounding	Connect the grounding terminal of FI-915 to the specified equipment to avoid a risk of electric shock.
Measured gas	A gas targeted for measurement which is contained in a sample gas.
Base gas	The gas other than the measured gas in a sample gas. Basically, FI-915 performs measurement in the atmosphere. Therefore the base gas for FI-915 is AIR (fresh air).
Reference gas	A gas used as a reference for measuring concentration (reference for refractive index). Basically, FI-915 uses the base gas as the reference gas. Therefore the reference gas for FI-915 is AIR (fresh air).

Manual Log

Rev.	Revision	Issue date
0	First issue	2018/7/19
1	2-5. Block diagram updated	2018/10/3