



FI-900
Optical Interferometric Gas Monitor
Operating Manual
(PT3E-064)

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Thank you for choosing the FI-900 Flame-proof Optical Interferometric Gas Monitor.

This operating manual is a guide to using the FI-900. Be sure to read and fully understand the contents of this manual before using the product. This applies both to first-time users and those who have previously used the product.

This manual uses the following headings to ensure safe and effective work:

| | |
|--|---|
|  DANGER | The DANGER sign indicates that improper handling of the product may result in death, severe injury, or serious property damage. |
|  WARNING | The WARNING sign indicates that improper handling of the product may result in severe injury or serious property damage. |
|  CAUTION | The CAUTION sign indicates that improper handling of the product may result in minor injury or minor property damage. |
| * NOTE | The NOTE sign indicates recommendations for product handling. |

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==== 1. Important Safety Information =====

1-1. Danger items



<Explosion-proofing>

- Install the product in accordance with the installation requirements.
- Do not open the cover during operation.
- Be sure to turn off the power before replacing fuses.
(Fuse specifications: 250 V, 1 A, $\phi 5 \times 20$ mm time-lag fuse)
- Do not disassemble or modify the product or alter the settings unnecessarily.
- Contact Riken Keiki for readjustment, including gas calibration, and parts replacement.
- Do not attempt to replace parts or components yourself if the transparent window of the display cracks, you see abnormalities in the explosion-proof bonding surface, or the fastening screws or bolts have been changed or lost. Contact Riken Keiki immediately.
- Be sure to perform regular maintenance.
- Use suitable cables for wiring.
- Use insulation sheathed round crimped terminals for electrical connections, and attach them safely making sure they are not loose or twisted.
- Use a crimped terminal for connecting the grounding cable to the grounding terminal, and use grounding cable with a cross-sectional area of at least 4 mm² for external terminals.
- The transparent window of the display is made of polycarbonate resin. Note that it may be affected by environments in which substances such as toluene, benzene, ammonia, or aromatic hydrocarbons are present.
- Do not attempt to repair the explosion-proof bonding surface.
- Use the control key (magnet) specified by Riken Keiki.
- Gas conditions (explosion-proof requirements)

| | | |
|--------------------|-------------------------|---------------------------------------|
| Maximum flow rate: | Target gas (GAS IN): | 1 L/min |
| | Reference gas (REF IN): | 0.5 L/min |
| Pressure: | GAS IN/REF IN/OUT: | 80 kPa to 110 kPa |
| Temperature: | GAS IN/REF IN/OUT: | -20 °C to 57 °C (Japan Ex spec.) |
| | GAS IN/REF IN/OUT: | -20 °C to 60 °C (ATEX/IECEX spec.) |

1-2. Warnings

WARNING

<Explosion-proofing>

Do not open the cover on the front of the main unit in situations where an explosive atmosphere may be present.

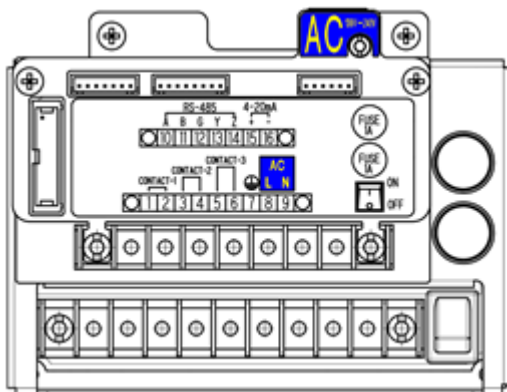
WARNING

<Power source>

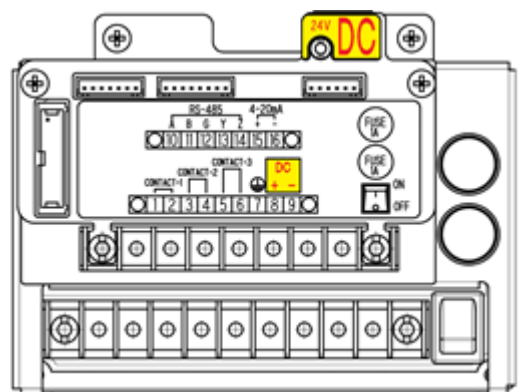
- Before turning on the power for the product, be sure to confirm that the power source meets the specified voltage requirements. Do not use unstable power sources; doing so may lead to malfunctions.
- The internal device settings differ between AC and DC power supply models. (See the following diagram.)

Incorrect settings or an incorrect power source will damage the product.

Check the model specifications to ensure that the correct power source is used.



AC model power source terminal plate unit



DC model power source terminal plate unit

<Protective grounding requirement>

Do not cut the protective grounding cable of the product or disconnect the protective grounding terminal.

<Defects involving protective functions>

Before operating the product, check the protective functions for defects. Do not operate the product if you find potential defects in protective functions, including protective grounding.

<External connections>

Connect to a protective ground before connecting to external devices.

 **WARNING**

Sampling point pressure

- The product is designed to draw in gas at atmospheric pressure. There is a danger that target gas may leak from inside the product if an excessive pressure is applied to the gas inlet (GAS IN) or outlet (GAS OUT) of the product. Avoid excessive pressure during use.

Reference gas calibration in surrounding atmosphere

- When reference gas calibration is performed in the surrounding atmosphere, check the atmosphere for freshness before starting. Calibrating in the presence of interference gases (gases other than the target gas and base gas) is hazardous preventing correct measurement/monitoring.

Miscellaneous

- Do not draw in gas at high concentrations exceeding the measurement range upper limit. Doing so will produce inaccurate readings.

1-3. Precautions



Do not use walkie-talkies near the product.

Radio waves from walkie-talkies or other radio transmitting devices near the product or cables may affect readings. If you use walkie-talkies or other radio transmitters, use in areas where they will not affect the product.

Wait at least 5 seconds after turning off the power before turning back on.

The product may not function correctly if the power is turned back on within 5 seconds.

Do not disassemble or modify the product or alter the settings unnecessarily.

Never attempt to disassemble or modify the product. Doing so will void product performance guarantees.

Additionally, altering the settings unnecessarily without a proper understanding of the details may prevent correct operation. Use the product correctly in accordance with this operating manual.

Avoid long-term contact of organic solvents on the window plate.

The display window plate is made of polycarbonate resin. Long-term contact with organic solvents (liquid or high concentration vapor) may result in discoloration or deformation.



The product cannot be used to measure low-volatility solvents that may condense (liquefy) inside the product or in pipes leading to the product.

The product cannot be used to measure high-humidity solvent gases that may condense inside the product or in pipes leading to the product.

Do not use the product near to devices that may significantly disturb power source waveforms (e.g., electric welding equipment). Similarly, do not use the product on the same power supply circuit as devices that can significantly disturb the power source waveform.

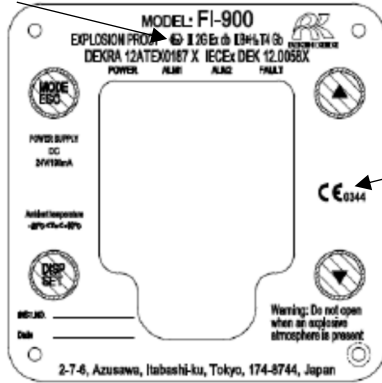
Carefully manage ambient temperatures to prevent the target solvent from condensing (liquefying) inside the product or in pipes leading to the product.

1-4. Checking standards and explosion-proof specifications

This instrument has some specification depends on standard and explosion proof certificate. Please confirm the detector specification before using. Please refer Declaration of Conformity that is at the end of this manual if you have CE marking type (DC specifications only).

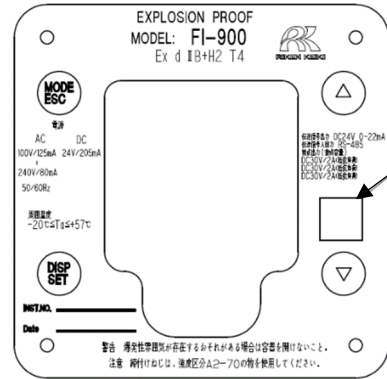
You can confirm instrument specification to see name plate as follows.

Ex marking



CE marking

ATEX/IECEx,
CE marking spec.
name plate



Japan Ex certificate

Japan Ex spec. name plate

1-5. Explosion-proof performance information (Japan Ex spec.)

1-5-1. About the FI-900

The FI-900 incorporates a refractometer in the sensor unit. The concentration is calculated from the variations in refractive index due to the measured detection target gas, and a 4-20 mA signal and digital signal are output. The product can be connected to a recorder to record the gas concentration calculated from refractive index variations and to a programmable controller for control purposes. It features three contacts, which are activated by gas alarms and device faults.

1-5-2. Technical data

| | | |
|------------------------------|----------------------------------|---|
| Explosion-proof construction | Flame-proof enclosure | |
| Certification number | TC21460 | |
| Explosion-proof class | Ex d IIB+H ₂ T4 | |
| Ambient temperature | -20 °C to 57 °C | |
| Ratings | Power source | 100 V AC / 125 mA to 240 V AC / 80 mA, 50/60 Hz, 24 V DC / 205 mA |
| | Transmission signal output | 24 V DC / 0 to 22 mA |
| | Transmission signal input/output | RS-485 |
| | Contacts (Contact capacity) | 30 V DC / 2 A (resistance load) 30 V DC / 2 A (resistance load) 30 V DC / 2 A (resistance load) |
| Applicable standards | JNIOSH-TR-No. 43 (2008) | |

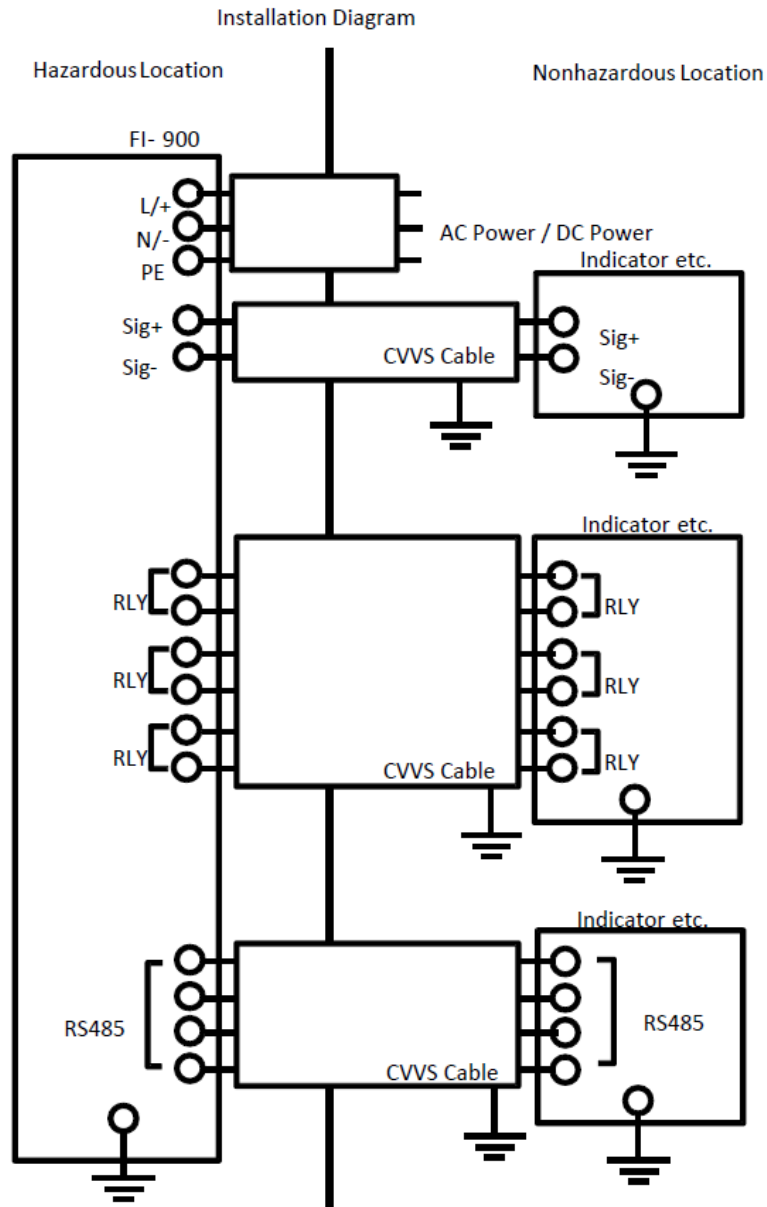
Manufacturer: Riken Keiki Co., Ltd.

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

Website: <https://www.rikenkeiki.co.jp/>

1-5-3. System configuration for use in hazardous locations

The FI-900 features a flame-proof enclosure (explosion-proof class: Ex d IIB+H₂ T4) enabling use in Zone 1 locations. However, connected power supply and display units must be installed in non-hazardous locations if they do not have an explosion-proof construction.



1-6. Explosion-proof performance information (ATEX/IECEx spec.)

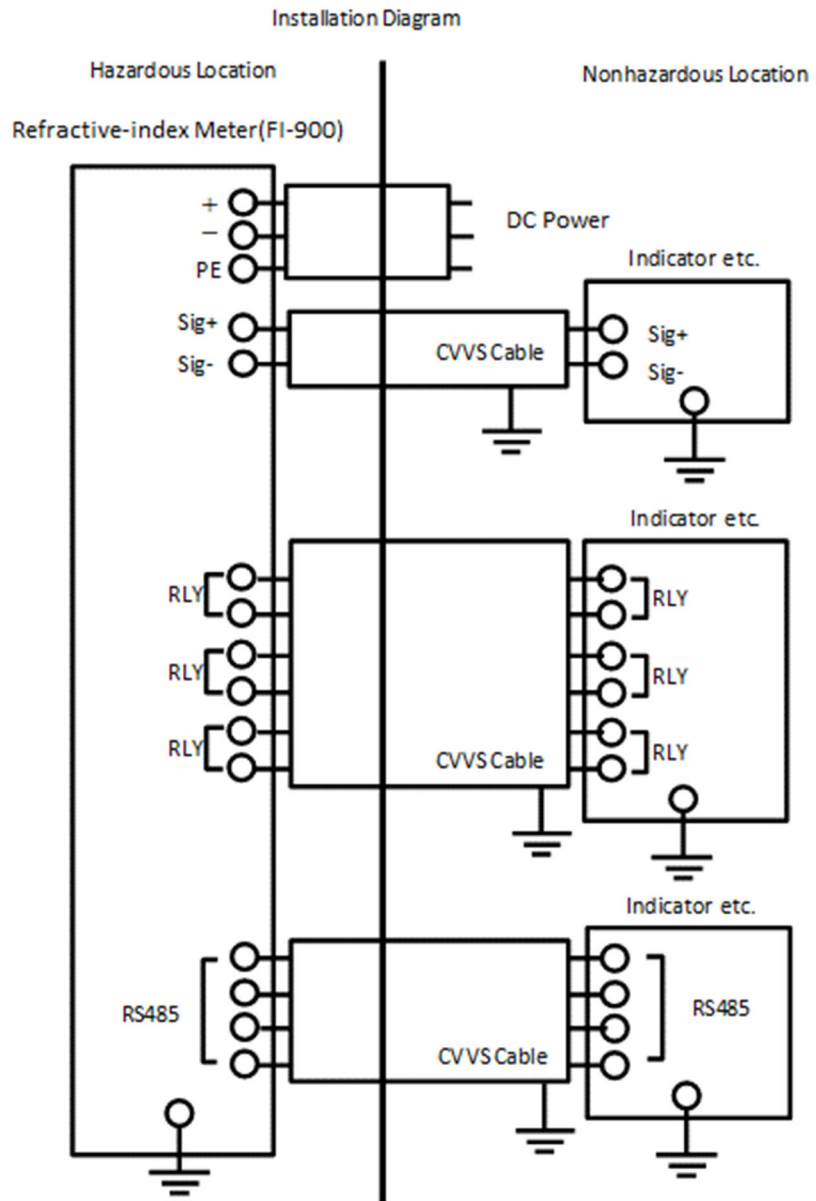
1-6-1. About the FI-900

This product is a fixed gas monitor that makes measurements by drawing in gas at constant flow rate. It can be used with a DC power source.

1-6-2. Technical data

| | | |
|-------------------------------------|---|--|
| Name | : | REFRACTIVE-INDEX METER |
| Type | : | FI-900 |
| Protection Method | : | Flameproof enclosure "d" |
| Certificate Number | : | IECEx DEK 12.0058X DEKRA 12ATEX0187X |
| Group | : | II |
| Category | : | 2 G |
| Type of Protection and Marking Code | : | Ex db IIB+H ₂ T4 |
| Equipment Protection Level | : | Gb |
| Ambient Temperature | : | -20 °C ≤ T _a ≤ +60 °C |
| Electrical Data | | |
| Supply voltage | : | 24 V DC / 190 mA |
| Contact output | : | 30 V DC / 2 A |
| Output signal | : | 4-20 mA (24 V DC / 20 mA) |
| Digital communication | : | RS-485 |
| Applicable Standards | : | EN IEC 60079-0: 2018, EN 60079-1: 2014 IEC 60079-0: 2017, IEC 60079-1: 2014 |

1-6-3. System configuration for use in hazardous locations



1-7. Safety notices

WARNING

- Do not open the cover on the front of the detector in situations where an explosive atmosphere may be present.

CAUTION

- Install the product in accordance with installation requirements.
- Do not open the cover on the front of the detector during operation.
- Be sure to turn off the power before replacing fuses.
(Fuse specifications: 250 V, 1 A, $\phi 5 \times 20$ mm time-lag fuse)
- Do not attempt to disassemble, modify, or alter the product.
- Contact Riken Keiki for product adjustment, including calibration and parts replacement.
- Do not attempt to replace parts or components yourself if the window plate cracks, you see abnormalities in the explosion-proof bonding surface, or the fastening screws or bolts have been changed or lost. Instead, contact Riken Keiki.
- The transparent window is made of polycarbonate resin. Note that it may be affected by environments in which substances such as toluene, benzene, ammonia, or aromatic hydrocarbons are present.
- Contact Riken Keiki if any abnormalities are discovered.
- Perform regular maintenance. (For details, refer to “7. Maintenance”.)
- Use suitable cables.
- Use round crimped terminals for electrical connections, and attach them safely making sure they are not loose or twisted.
- Use a crimped terminal for connecting the grounding cable to the grounding terminal, and use grounding cable with a cross-sectional area of at least 4 mm² for external terminals.
- Do not attempt to repair component faces affecting the explosion-proof construction.
- Use “A2-70” property class stainless steel for all hexagon socket bolts.
- Use cable lugs on internal and external grounding connections to prevent twisting.
- Insert cable lugs for internal grounding connections between washers and toothed washers.
- Use the control key (magnet) specified by Riken Keiki.
- Gas conditions (explosion-proof requirements)

Gas types

The product cannot be used with IIC gases other than H₂.

Maximum flow rate

GAS IN (target gas): 1 L/min; REF IN (reference gas): 0.5 L/m

Pressure range

GAS IN/REF IN/OUT: 80 kPa to 110kPa

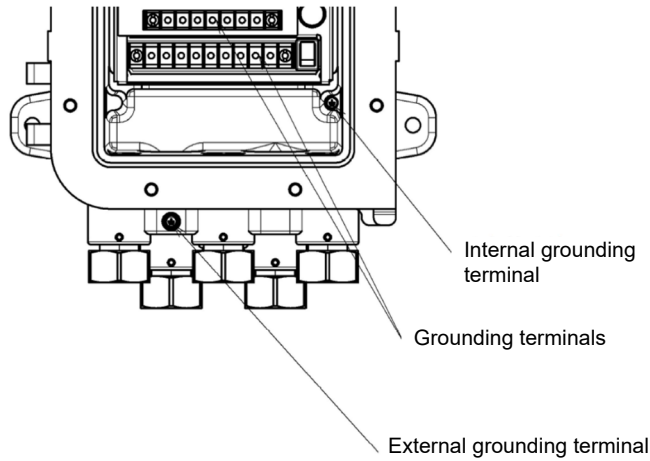
Temperature

GAS IN/REF IN/OUT: -20 °C to 57 °C (Japan Ex spec.)

GAS IN/REF IN/OUT: -20 °C to 60 °C (ATEX/IECEx spec.)

- If the target gas fed to and discharged from the FI-900 contains oxygen, the oxygen concentration will lower than oxygen concentrations in the normal atmosphere.
- Make sure that the target gas fed to and discharged from the FI-900 does not remain in the explosive concentration range for extended periods or frequently and continuously.
- Purge gas flow passages within the FI-900 using the base gas before turning on the power. Purge the gas flow passages within the FI-900 using the base gas before turning off the power.
- Confirm that there are no problems with gas containment in regular maintenance.

Grounding terminals



Cable glands

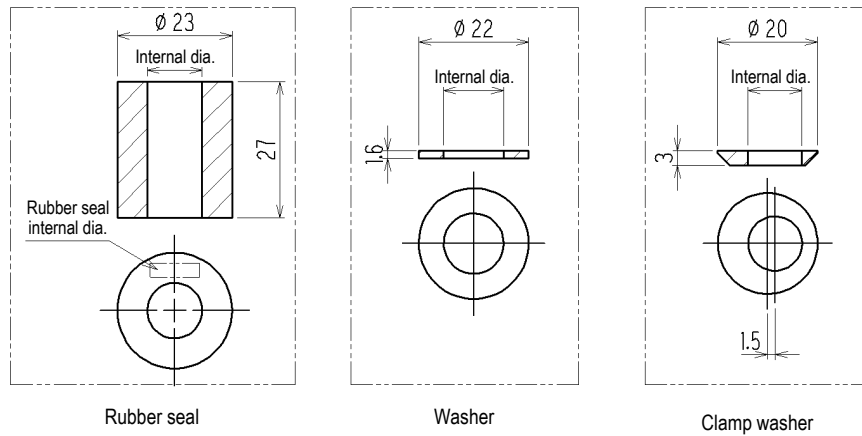
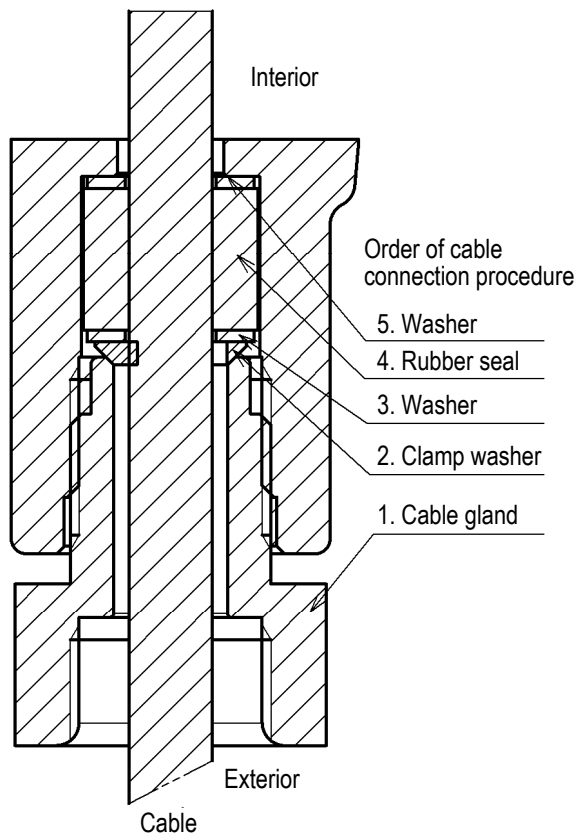


Table 1. External cable inlet parts diameters

| Cable | Rubber seal | Washer | Clamp washer |
|-------------------|-------------------|--------|--------------|
| External diameter | Internal diameter | | |
| 9.5-9.8 | 10 | 12 | 9.8 |
| 10.0-10.8 | 11 | 12 | 10.8 |
| 11.0-11.8 | 12 | 14 | 11.8 |
| 12.0-12.8 | 13 | 14 | 12.8 |
| 13.0-13.5 | 14 | 14 | 13.8 |

Install the cable glands as shown in the following diagram:



Tighten cable glands to a torque of at least 40 N□m.

Special conditions for safe use

- Do not attempt to repair connections affecting the explosion-proof construction.
- Use “A2-70” property class fasteners.

==== 2. Product Configuration =====

2-1. Product intended use and features

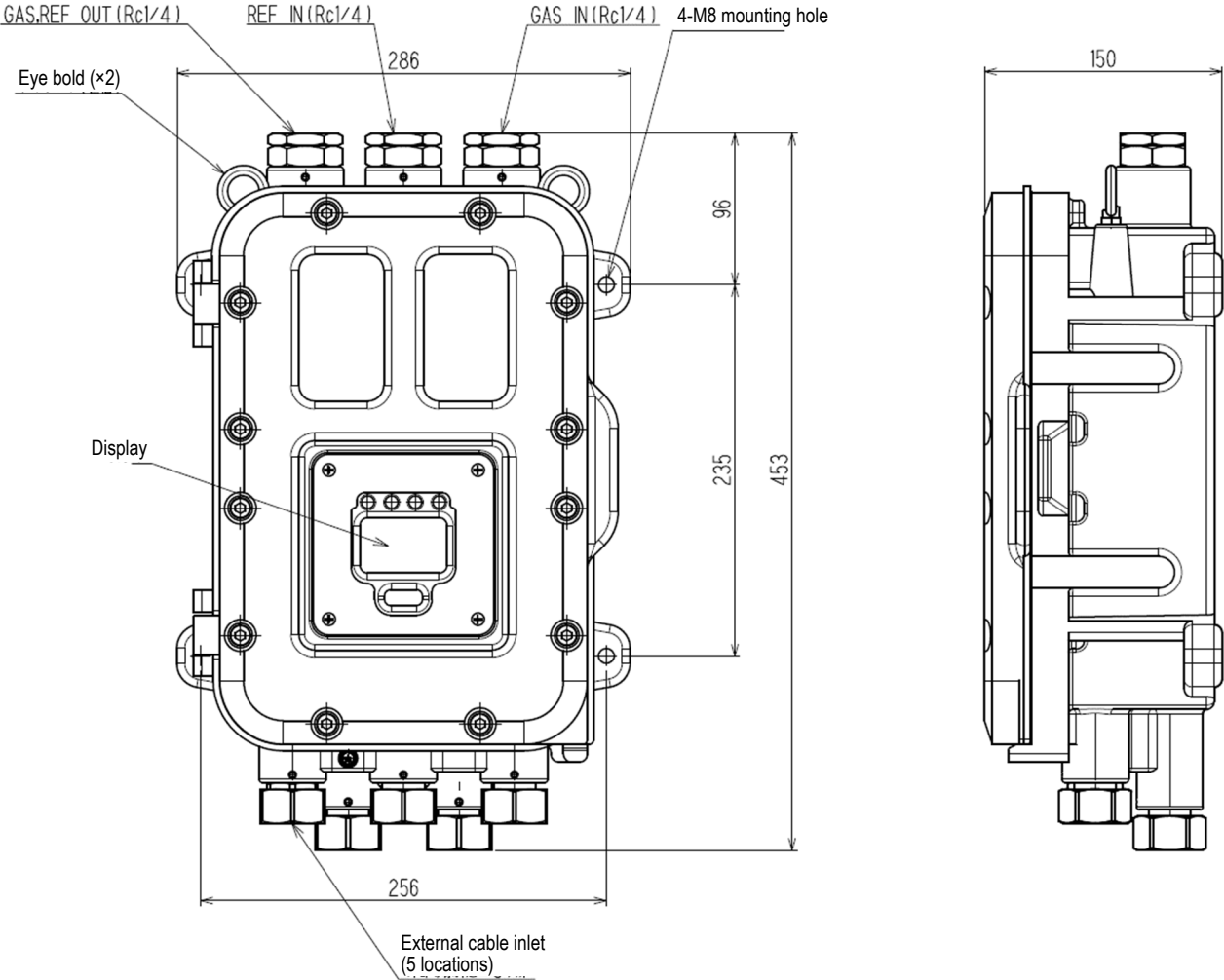
This product is a flame-proof construction (explosion-proof class: Ex d IIB+H₂ T4) fixed gas Monitor intended for continuous measurement and monitoring of concentrations of various gases, including atmospheric toluene, atmospheric acetone, and hydrogen in nitrogen (limited to gas types and measurement ranges described in the separate "Target Gas Specifications").

The product applies the optical interferometric method to measure concentrations. Measuring variations in refractive index enables highly accurate determination of target gas concentrations. The sensitivity of the optical interferometric sensor is determined by the length of the chamber through which the gas flows. This allows sensitivity to be maintained consistently over extended periods.

The product includes self-monitoring and diagnostic functions complying with the NAMUR NE107 standard (self-monitoring and diagnostics of field devices), which enable real-time monitoring of the product state and the display and notification of abnormal state and maintenance request information on the LCD screen.

The product features a fully-independent modular configuration comprising separate units. This allows rapid repair and recovery in the field by simply replacing the unit in question if a fault should arise.

2-2. Exterior drawings



2-3. Accessories

2-3-1. Standard accessories

- Operating Manual
- Target Gas Specifications
- Dedicated control key
- Hex key wrenches (2 mm and 6 mm, ×1 each)
- Fuses (250 V, 1 A, $\phi 5 \times 20$ mm time-lag fuse, ×2)

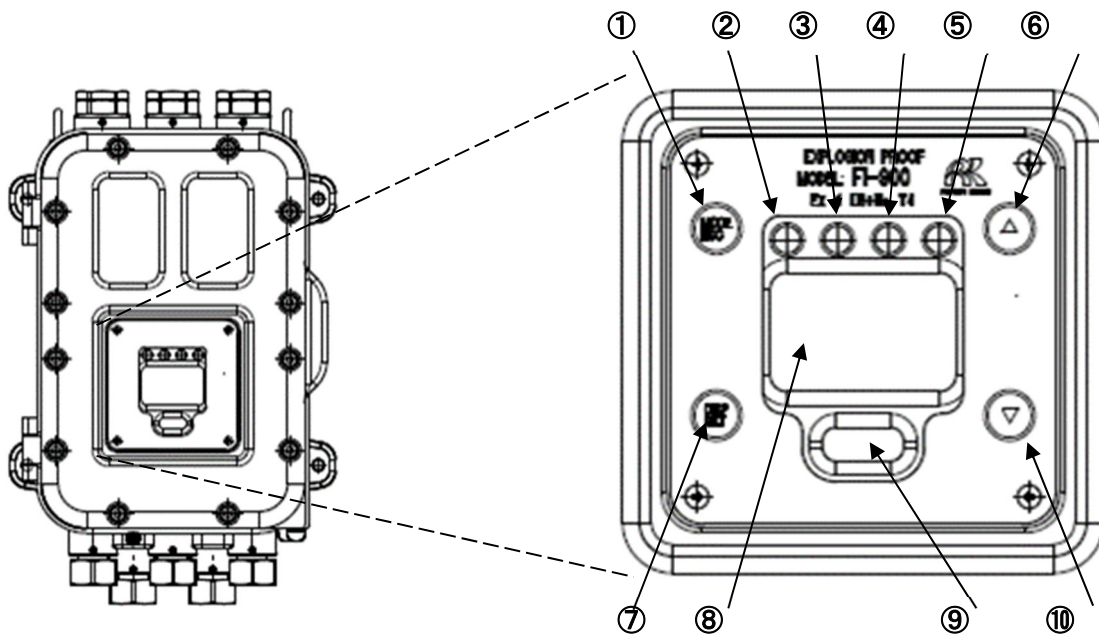
**CAUTION**

- Use the dedicated control key provided to operate the product. The product may not accept key operation commands correctly if an object other than the supplied control key is used.
- The control key used for adjustment incorporates a powerful magnet. Holding the control key close to credit cards or IC cards may corrupt data recorded on these items.

2-3-2. Maintenance parts

The product does not include any consumable parts that require periodic replacement. Refer to “7-5. Recommended periodic replacement parts” for information on recommended periodic replacement parts for use under special conditions.

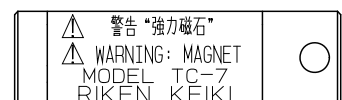
2-4. Front panel part names and functions



| | |
|---------------------------|---|
| ① MODE/ESC key | Key for selecting other modes from measuring mode [Used to abort processing] |
| ② POWER lamp (green) | Illuminates when the power is turned on. Flashes when checking functions. |
| ③ ALM1 lamp (red) | Illuminates in conjunction with the first concentration alarm state. |
| ④ ALM2 lamp (red) | Illuminates in conjunction with the second concentration alarm state. |
| ⑤ FAULT lamp (orange) | Illuminates when abnormal (FAILURE) conditions arise. |
| ⑥ ▲/REF.CAL key | Key for performing reference gas calibration Hold down for at least 3 seconds to calibrate. [Used to move the cursor and to increment setting values] |
| ⑦ DISP/SET key | Key for selecting the display contents in measuring mode [Used for confirming processing] |
| ⑧ LCD screen | Displays measurements and the product operating state. |
| ⑨ IrDA communication port | IrDA communication port for maintenance use. Used to load event logs and daily log information stored in the product |
| ⑩ ▼/REF. key | Key for performing reference gas checks Hold down for at least 3 seconds to check. [Used to move the cursor and to decrement setting values] |

* The descriptions in square brackets refer to operations when not in measuring mode.

All keys described above are operated using the control key provided. Press the control key against the key marking position for a few seconds to operate the corresponding key. In this operating manual, “Press the XYZ key” means to press the control key against the corresponding marking, such as “●”, “▼”, or “▲”.

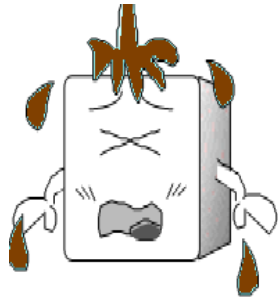


Control key

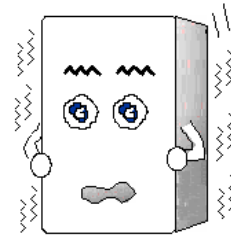
==== 3. Installation =====

3-1. Installation location precautions

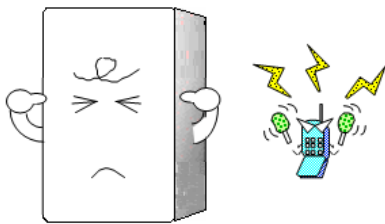
Use the product only with a sampling system specified by Riken Keiki (or an equivalent cubicle, etc.).
Avoid installing in locations like those described below:



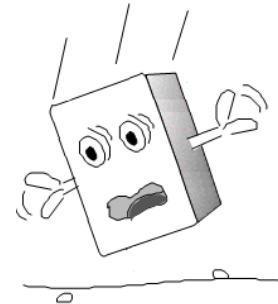
① Locations exposed to oil or chemicals



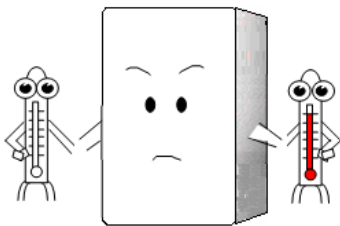
② Locations subject to vibration



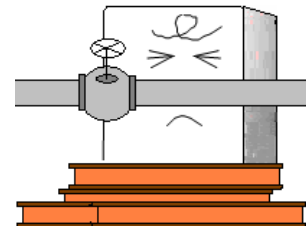
③ Locations where radio waves or noise are emitted



④ Locations where the product is likely to fall or may be exposed to impact



⑤ Locations outside the operating temperature range
Locations subject to direct sunlight or radiant heat



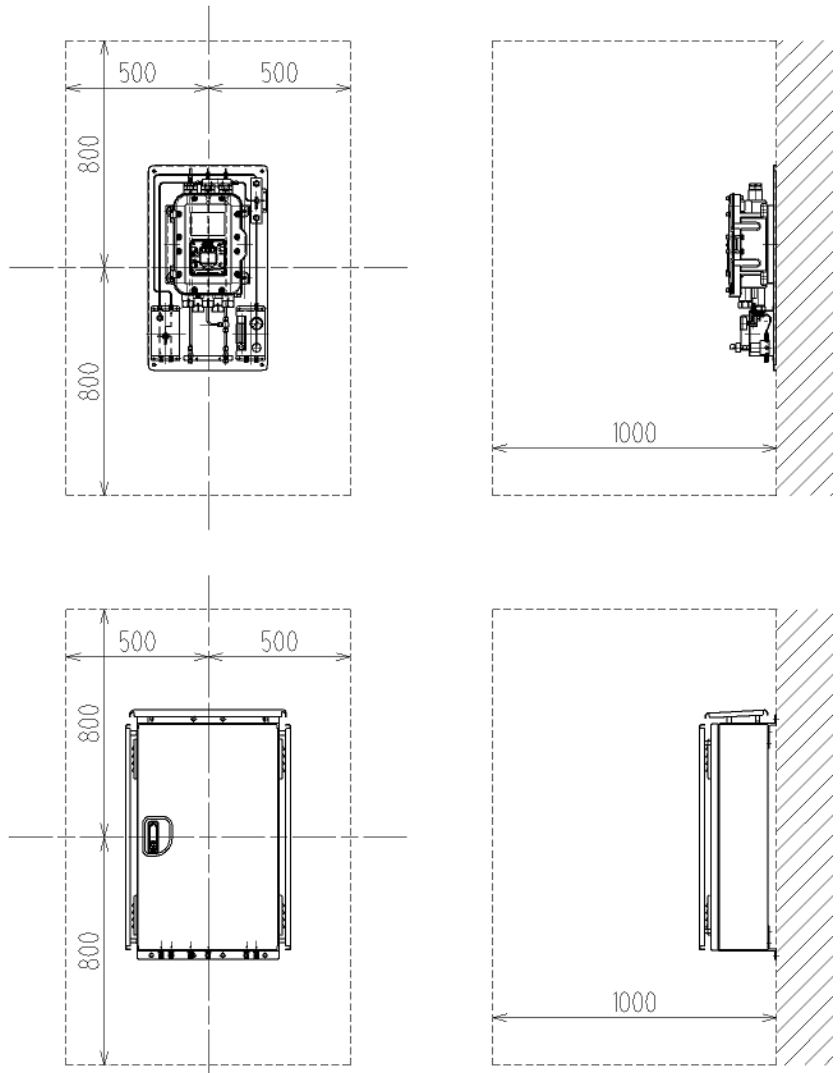
⑥ Locations that prevent maintenance
Locations where work is hazardous

3-2. Product installation procedures and precautions

Install the FI-900 and sampling system by bolting to a solid wall or self-standing rack.

Provide maintenance space shown in the diagram to the right to allow maintenance work on the product.

Be sure to provide maintenance space when planning and carrying out installation work.



Maintenance space (units: mm)

CAUTION

- Take care not to expose the product to impact, such as by dropping, during transportation and installation. Failure to do so may damage the product and impair explosion-proof performance.
- When installing the product on a self-standing rack (fixed type), make sure the rack is secured with anchor bolts.
- When securing the product to a wall, be sure to mount correctly to a wall capable of bearing the weight of the product.
- Make sure no dust or other foreign matter gets into the product during installation work.

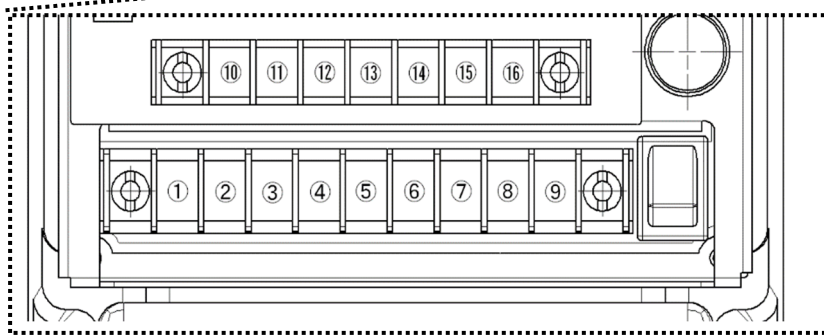
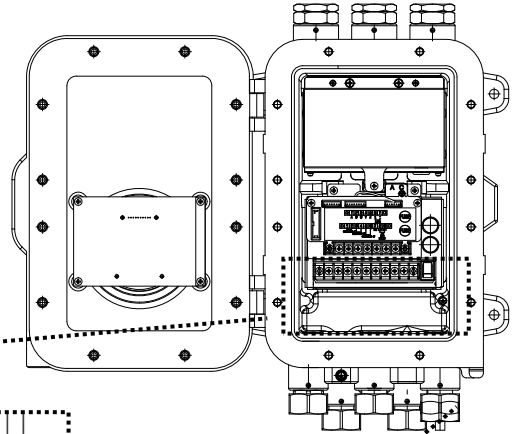
3-3. Cable connections

3-3-1. External terminal plate and cable connections

<Terminal plate details>

Opening the front cover of the FI-900 reveals the terminal plate shown in the diagram below.

The terminal plate is configured as shown in the following table.



| | | | |
|---|-----------------------|----------------------|--|
| ① | First alarm contacts | FIRST ALARM CONTACT | Operate in conjunction with the first concentration alarm state.* No-voltage contact; contact capacity: 1 A, 30 V DC (resistance load) |
| ② | | | |
| ③ | Second alarm contacts | SECOND ALARM CONTACT | Operate in conjunction with the second concentration alarm state.* No-voltage contact; contact capacity: 1 A, 30 V DC (resistance load) |
| ④ | | | |
| ⑤ | Fault alarm contacts | FAULT ALARM CONTACT | Operate when abnormal (FAILURE) conditions arise.* No-voltage contact; contact capacity: 1 A, 30 V DC (resistance load) |
| ⑥ | | | |
| ⑦ | Power terminals | FG | Function ground (EARTH) |
| ⑧ | | L / + | 100 V to 240 V AC $\pm 10\%$, 50/60 Hz, max. 20 VA or 24 V DC $\pm 10\%$, max. 6 W |
| ⑨ | | N / - | (DC power supply only for ATEX/IECEX model) |

* Operation for standard settings

| | | | |
|---|-----------------------------|-----|--|
| ⑩ | RS-485 interface connectors | A | Input/output terminal for RS-485 (Modbus) communication |
| ⑪ | | B | |
| ⑫ | | G | |
| ⑬ | | Y | |
| ⑭ | | Z | |
| ⑮ | 4-20 mA output signal | (+) | 4 mA to 20 mA DC (insulated, current discharge type), maximum load resistance 300 Ω Minimum resolution 0.01 mA or less |
| ⑯ | | (-) | |

The terminal screws on the terminal plate are M4 screws. Connect cables with M4 insulation sheathed round crimped terminals fitted to the ends.

3-3-2. Recommended cables

| Connected to | Recommended cable | Cable finished external diameter |
|------------------|---|----------------------------------|
| Power (AC) line | CVV 1.25 mm ² , 3-core | φ10.0 |
| | CVV 2 mm ² , 3-core | φ11.0 |
| Power (DC) line | CVVS 1.25 mm ² , 2-core | φ10.0 |
| | CVVS 2 mm ² , 2-core | φ11.0 |
| 4-20 mA line | CVVS 1.25 mm ² , 2-core | φ10.0 |
| | CVVS 2 mm ² , 2-core | φ11.0 |
| Contact ×1 line | CVVS 1.25 mm ² , 2-core | φ10.0 |
| | CVVS 2 mm ² , 2-core | φ11.0 |
| Contact ×2 lines | CVVS 1.25 mm ² , 4-core | φ11.0 |
| | CVVS 2 mm ² , 4-core | φ12.0 |
| Contact ×3 lines | CVVS 1.25 mm ² , 6-core | φ13.0 |
| | CVVS 2 mm ² , 6-core | φ14.0 |
| RS-485 line | KPEVS or other shielded twisted-pair cable (0.75 mm ²), 2 pairs | φ11.0 |

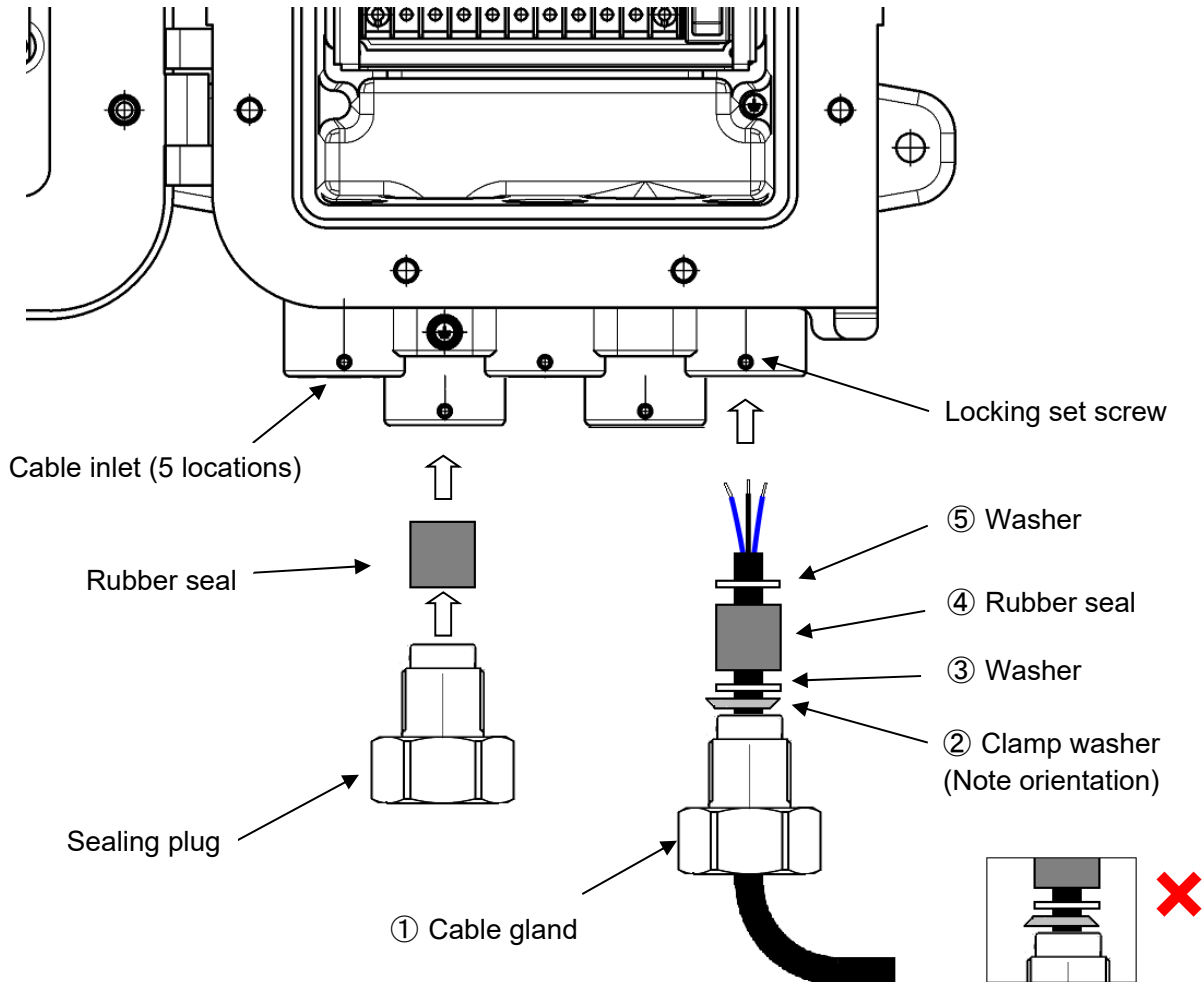
***NOTE**

Be sure to check the finished external diameter. This value varies slightly from manufacturer to manufacturer.

3-3-3. Cable routing and connection procedures

When connecting cables, insert the cables through the ① cable gland, ② clamp washer, ③ washer, ④ rubber seal, and ⑤ washer in the sequence shown in the lower right diagram below before inserting into the cast casing through the cable inlets. Attach insulation sheathed round crimped terminals to the ends and connect to the terminal plate.

Close unused cable inlets with rubber seals and sealing plugs, as shown to the left in the following diagram.

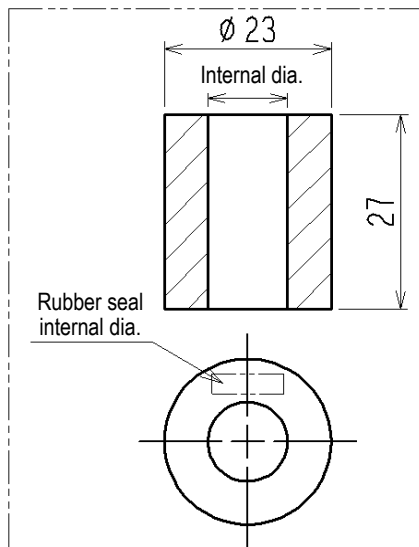


CAUTION

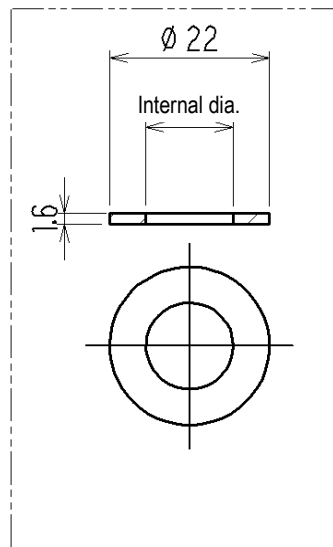
- Tighten cable glands and sealing plugs to a torque of at least 40 N·m.
- If tightening the cable glands and sealing plugs presents difficulties, apply grease to the screw thread and tighten using the appropriate tool.
- Once the cable glands and sealing plugs have been tightened, secure with set screws to keep them from coming loose.
- Ground the shield on CVVS cables to the casing interior to improve noise resistance.

The rubber seals, washers, and clamp washers required for the cable connections will differ depending on the finished external diameter of the cables being used. The following table summarizes the correspondence between the internal diameter of the individual components and the cable finished external diameter. Order the required components from Riken Keiki to match the cable being used.

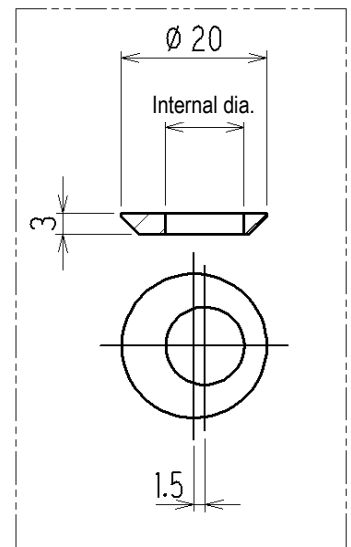
| Cable finished external diameter (mm) | Rubber seal internal diameter (mm) | Washer internal diameter (mm) | Clamp washer internal diameter (mm) |
|---------------------------------------|------------------------------------|-------------------------------|-------------------------------------|
| φ10, φ10.5 | φ11 | φ12 | φ10.8 |
| φ11, φ11.5 | φ12 | φ14 | φ11.8 |
| φ12, φ12.5 | φ13 | φ14 | φ12.8 |
| φ13, φ13.5 | φ14 | φ14 | φ13.8 |



Rubber seal



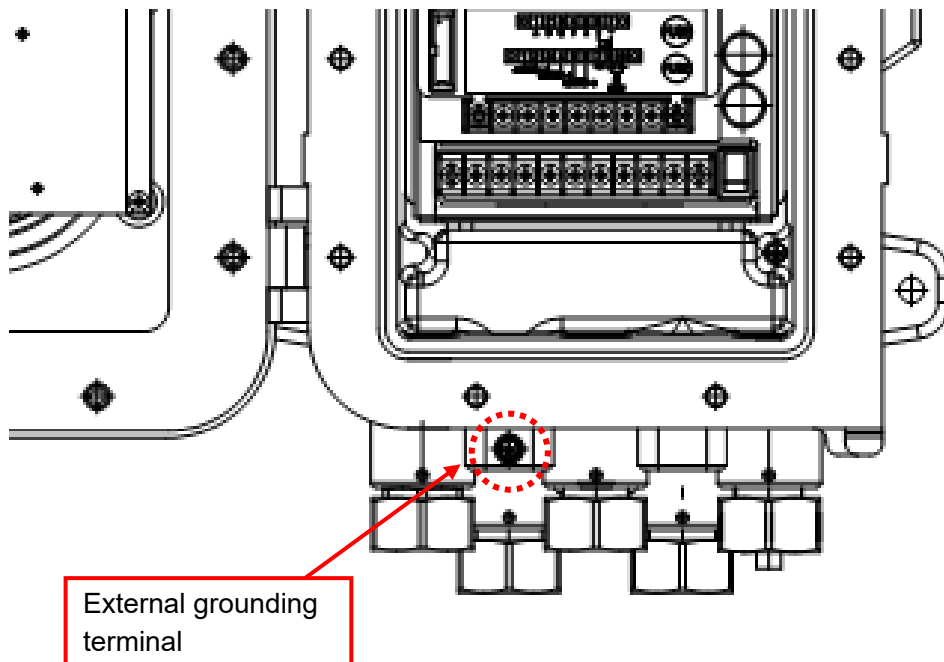
Washer



Clamp washer

3-3-4. Protective grounding

Ground the product using the external grounding terminal shown in the following diagram.



WARNING

- Be sure to ground the product before turning on the power.
- Be sure to provide grounding. This is required for the stable operation and safety of the product.
Never connect the grounding cable to a gas pipe.
- Use grounding equivalent to Class D grounding (grounding resistance 100 Ω or less).
- The grounding cable should be fitted with cable lugs and connected to the ground safely, free of slack or twisting.

3-3-5. Electrical installation precautions

An unstable power supply or noise carried by the cables may result in malfunctions, false alarms, or faults.

① Use a stable power supply for the system.

(1) The power supply for this product must meet the following requirements:

Power supply voltage: 100 V to 240 V AC $\pm 10\%$ [AC model]
24 V DC $\pm 10\%$ [DC model]

Permissible momentary power failure time: Not more than approx. 40 ms
(A power failure of 40 ms or more may result in restarting.)

Deploy an external uninterruptible power supply or similar system to guarantee continuous operation and functionality.

(2) Do not configure the power supply line in parallel with other high voltage or large current lines.

② Provide anti-noise measures to suit the installation environment.

(1) Lightning surge protection

Equipment installed outdoors at factories, etc. is susceptible to lightning strikes. Lightning constitutes a massive emission source and cables act as receiving antennas, which can result in damage to devices connected to the cables. Additionally, note that inductive lightning surges due to lightning strikes cannot be entirely prevented, even if cables are installed in metal ducts or buried underground. The following preventive measures however are available. The appropriate countermeasures should be put in place before use.

<Protection using lightning arrester (cable protector)>

A lightning arrester can be installed before the field devices and central processing equipment to protect against the possibility of inductive lightning surges transmitted through the cables. Lightning arresters are inserted at the various points where cables enter the building from outside. Lightning arresters include a circuit to remove surge voltages that might damage field devices.

(2) Power line anti-noise measures

The following methods are available to reduce the effects of electromagnetically induced noise and electrostatically induced noise from power lines. The appropriate countermeasures should be put in place before use.

<Isolation from power lines>

Signal cables should be kept away from power lines, and should not be laid in parallel where possible. Intersections should be at right angles.

<Electrostatic shielding>

Signal cables should have shielding which is grounded. Electrically isolate cables from power lines—for example, by installing power lines in steel conduits, placing grounded metal partition plates between them, or placing them in separate metal ducts.

Surge noise is caused by lightning strikes and other factors. Ground devices to protect against such noise sources.

CAUTION

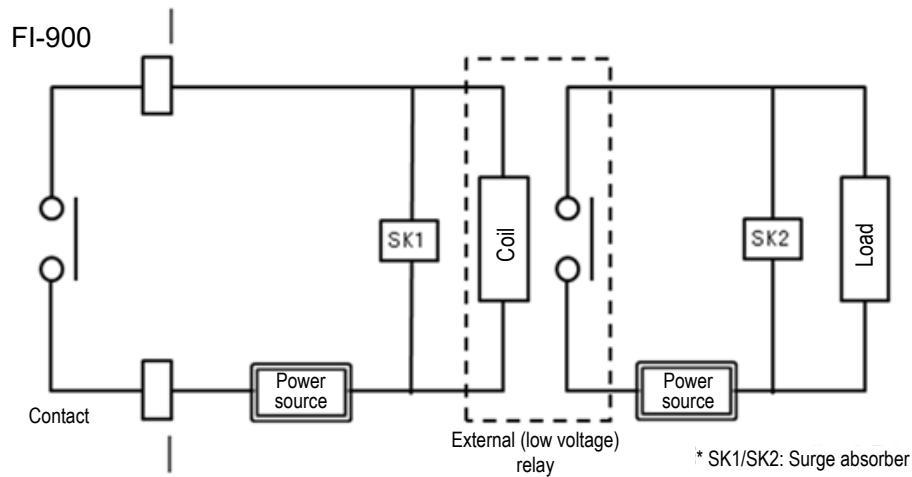
Take care to avoid damaging internal electronic circuits during wiring work.

CAUTION

A de-energized b contact (break contact) may cause a momentary open operation due to physical impact such as an external force.

If a b contact is used as an alarm contact, implement measures to account for such momentary operations—for example, adding a delay operation (of approximately 1 second) to the signal on the b contact receiving side.

When controlling a line on which large inductive loads occur, deploy protective measures for the product contacts, referring to the following diagram.

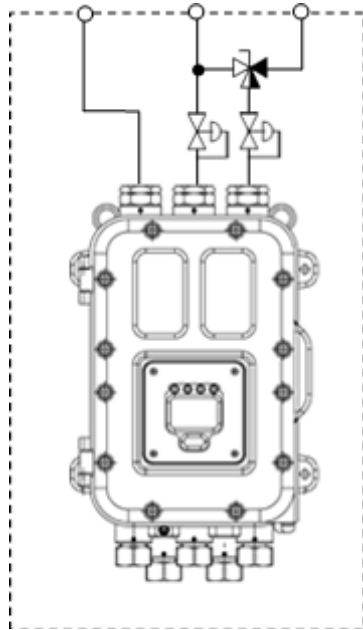


- Link the circuits (contact amplification) using an external relay. Add a surge absorber (SK1) appropriate for the rating to the external relay.
- Add a load in the form of a surge absorber (SK2) as necessary to the load side of the external relay.
- Depending on load conditions, it may be better to add the surge absorber to the contact side. Check load behavior to determine the optimal location.

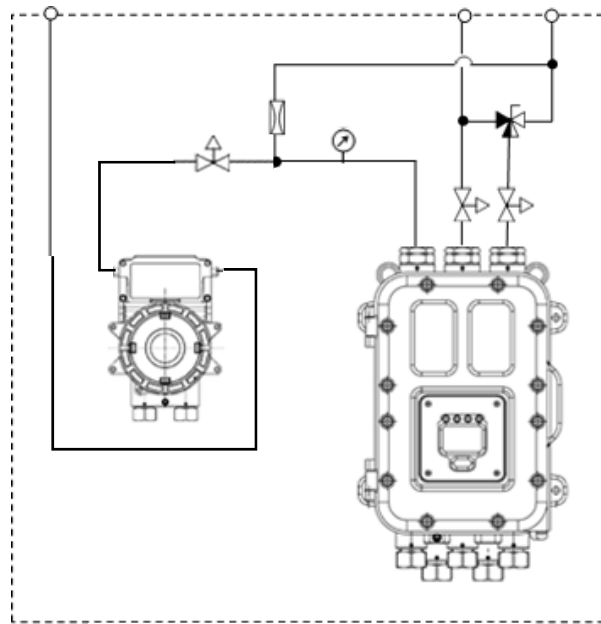
3-4. Pipe installation

3-4-1. Sampling systems

The FI-900 must be used correctly in conjunction with a sampling system to ensure that it operates to the expected level of performance. The following diagrams show typical sampling circuits for a charging arrangement from a pressurized line and a suction arrangement from an atmospheric pressure line.



Pressurized line charging arrangement



Atmospheric pressure line suction arrangement

The product requires the application of constant pressure with a pressure difference of approximately 5 kPa between GAS OUT and GAS IN. The application of constant pressure with a pressure difference of approximately 5 kPa is also required between REF IN and GAS OUT.

The sampling system of the pressurized line charging arrangement includes a precision reducing valve at the GAS IN and REF IN sides to supply target gas and reference gas at constant pressure. Adjust the precision reducing valve so that the flow rate readings coincide.

The sampling system of the atmospheric pressure line suction arrangement uses a pump to generate negative pressure. Adjust the needle valve to achieve the specified negative pressure so that the flow rate readings coincide. If the pump has a large suction capacity, the negative pressure must be controlled by including a bypass line, as shown in the piping diagram above. Install a needle valve or other such device to regulate pulsing between the pump and the product because of the possibility of reading fluctuations due to pump pulsing.

The product requires a flow of reference gas into GAS IN to confirm and adjust the zero point (reference gas calibration). The design must include a three-way valve or similar device to enable reference gas to be fed to GAS IN.

The OUT side of the sampling system must be maintained at constant pressure. It should normally be kept open to the atmosphere. Gas can be discharged to an exhaust duct at approximately atmospheric pressure (atmospheric pressure ± 3 kPa), if available.

Other forms of customization are also possible, as required, including an inline filter to remove dust and the calibration gas IN pipe. Contact Riken Keiki for more information.

3-4-2. Pipe installation precautions

- Pipes used should be made of materials such as copper, stainless steel, or Teflon. Avoid materials that could cause adsorption or corrosion. The following precautions must also be observed when installing pipes:
- Increasing the length of the GAS IN side pipe will increase the time taken for the target gas to arrive. It may also increase adsorption effects of solvent vapor on the pipe, delaying response and lowering readings. Take suitable precautions—for example, making the GAS IN pipe as short as possible or including a bypass line.
- Allow the target gas to approach ambient temperature before supplying to the sampling system. If there is a danger of drain or dust ingress, install traps and filters to prevent ingress of foreign matter.
- When sampling gas from hot and humid atmospheres or at conditions close to the saturated vapor concentration, measurement will be prevented if gas condenses inside the sampling pipes. Work with extreme care when installing pipes. Avoid “U” or “V” layouts.
- Determine the sampling inlet for the sampling gas after carefully considering gas flow inside the sampling gas line, gas generation process, and other factors. Avoid sampling gas from the bottom of pipes, tanks, or equipment.
- Gas should normally be discharged to the open atmosphere. If the end of the discharge pipe is located outdoors, bend downward to keep rain from entering the pipe. If discharging back into an exhaust duct or the like, keep pressure fluctuations within atmospheric pressure ± 3 kPa and avoid sudden changes.
- If flame arresters are provided in the line as a safety precaution, these should be installed on both the GAS IN and GAS OUT lines.
- Cutting pipes may reduce the internal diameter of the pipe at the cut face. Be sure to widen the internal diameter using a file or similar tool. Also be sure to clean the pipe interior using compressed air or the like to blow off any remaining swarf before connecting to the product.
- Determine the sampling inlet for the target gas after carefully considering gas flow inside the target gas line and mixing spots (unevenness) due to the manufacturing process of fuel gases

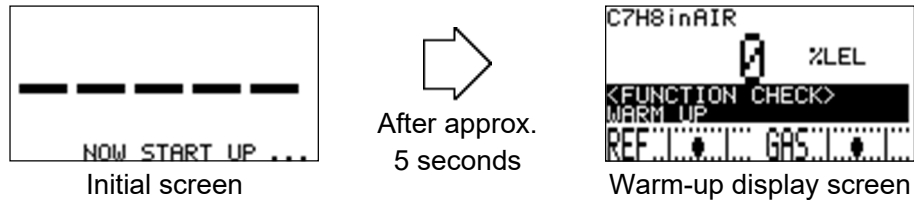


This product requires appropriate pipe installation (including choice of materials) to suit the sample gas type and installation conditions. Contact your sales agent or retailer if you have any questions about pipe installation.

==== 4. Measuring Mode Operating Procedures =====

4-1. From display after power-on to measurement start

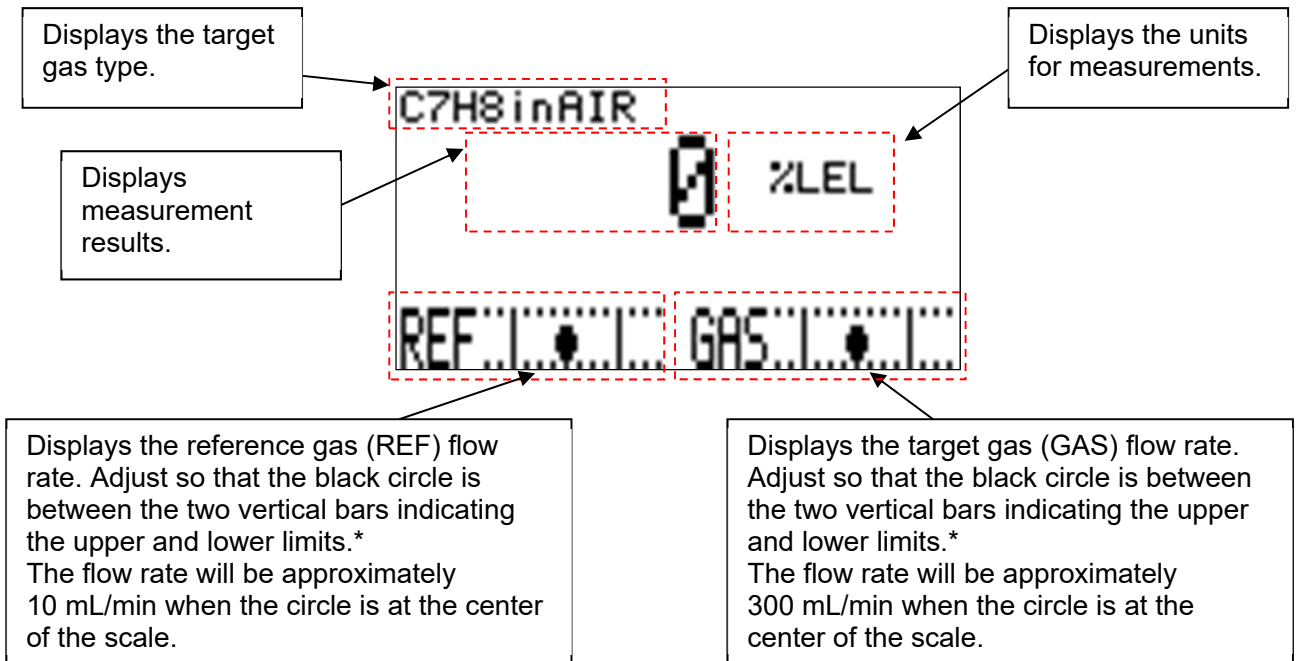
When the power is turned on, the self-diagnostic function runs, and the initial screen is displayed for approximately 5 seconds before switching to the warm-up display screen.



“WARM UP” may be displayed for approximately 60 seconds after the initial screen (Off by default).

| | |
|------------------|---|
| Related sections | <p>“4.6 Self-diagnostic monitoring function”</p> <p>“C.03.-- 4-20 mA setting state checking “4-20mA PARAMETER””</p> <p>“S.02.-- 4-20 mA output signal setting “4-20mA SETUP””</p> |
|------------------|---|

Measurement starts once warm-up is complete. A screen as shown below appears when measurement starts.



* For more precise measurements, adjust the black circle to the center of the scale.

4-2. Reference gas calibration procedure

Allow the product to warm up for approximately 5 to 10 minutes after turning on the power before starting reference gas calibration (see "S.09.-- Reference gas calibration"). Measurement is possible once reference gas calibration is complete.

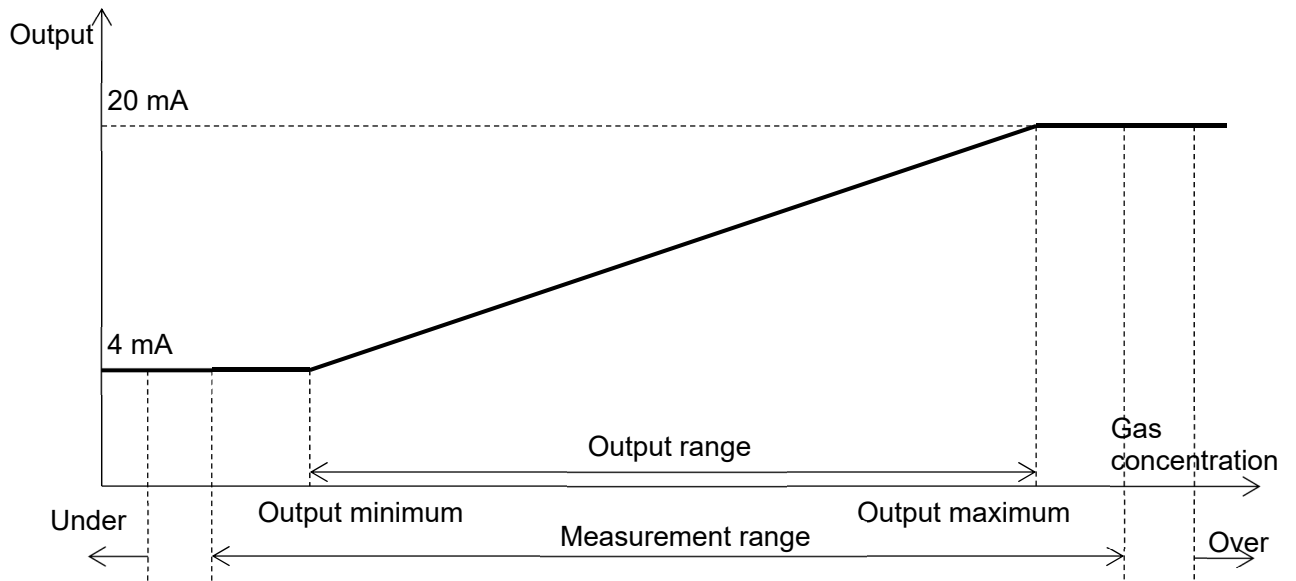
4-3. Shutdown procedure

When ending measurement, do not turn off the power while target gas remains inside the product. Introduce fresh air via GAS IN to clean thoroughly and check to confirm that the measurement reading returns to zero before turning off the power switch on the product.

For information of how to store the product, refer to "8-1. Procedures for storage or when not in use for extended periods" and "8-2. Procedures for relocation or reuse".

4-4. External output signal

The product outputs a 4-20 mA external output signal corresponding to the concentration measurement.



A preset special output value is output if an abnormality (FAILURE) is detected by self-diagnosis or during function checking (FUNCTION CHECK) (mainly in setup mode).

| Category | Operation description |
|-----------------------|--|
| Hold last value | Maintains the output value immediately prior to that state. By default, this setting is used during function checking (FUNCTION CHECK). |
| Arbitrary fixed value | Outputs a set 4-20 mA value. The default setting is 0.5 mA (fixed) for abnormality (FAILURE). |

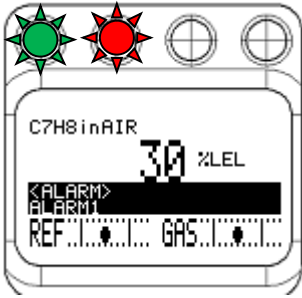
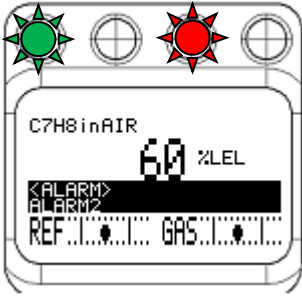
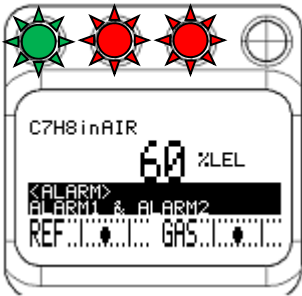
4-5. Concentration alarms and out of measurement range alarms

The product features three alarm patterns: “H-HH.alarm”, “L-LL.alarm”, and “L-H. alarm”. Each of these alarm patterns includes a first alarm setpoint (ALM1) and second alarm setpoint (ALM2) and activates when the conditions described in the table below are met.

* The alarm patterns that can be set will vary depending on target gas specifications.

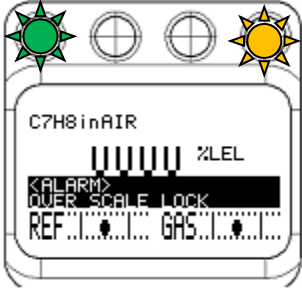
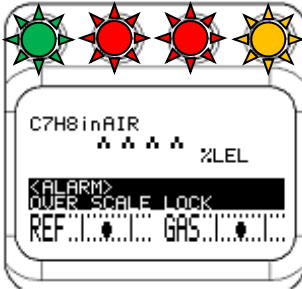
| Alarm pattern | First alarm condition | Second alarm condition |
|---------------|----------------------------|----------------------------|
| H-HH. alarm | Measured value \geq ALM1 | Measured value \geq ALM2 |
| L-LL. alarm | Measured value \leq ALM1 | Measured value \leq ALM2 |
| L-H. alarm | Measured value \leq ALM1 | Measured value \geq ALM2 |
| OFF | No alarm | No alarm |

When the measured value satisfies the first alarm condition, the first alarm contact activates, and the ALM1 lamp illuminates. If the measured value no longer satisfies the first alarm condition, the first alarm contact is reset, and the ALM1 lamp goes out. The second alarm contact operates in the same way (with default settings).


| Category | Screen | State description |
|--|---|---|
| First alarm state |  | The first alarm contact activates, and the ALM1 lamp illuminates. |
| Second alarm state |  | The second alarm contact activates, and the ALM2 lamp illuminates. |
| First alarm and second alarm occur simultaneously. |  | The first and second alarm contacts activate, and the ALM1 and ALM2 lamps illuminate. |

* Operation for standard settings

If the measured value lies significantly outside the measurement range, the product enters the underscale or overscale state, as described in the table below. The fault contact is activated in this state. The 4-20 mA signal is fixed at the upper or lower limit of the measurement range.

| Category | Screen | State description |
|------------------|--|---|
| Underscale state |  | <p>State in which the measured value is significantly below the lower limit of the measurement range. The target gas may contain an unexpected gas, or the zero point may not have been adjusted correctly. The fault alarm contact activates, and the FAULT lamp (orange) illuminates. The 4-20 mA signal is held at the lower limit value of 4 mA.</p> |
| Overscale state |  | <p>State in which the measured value is significantly above the upper limit of the measurement range. The target gas may contain an unexpected gas, or the zero point may not have been adjusted correctly. The fault alarm contact activates, and the FAULT lamp (orange) illuminates. The 4-20 mA signal is held at the upper limit value of 20 mA.</p> |

* Operations for standard settings


CAUTION

Underscale and overscale states are states outside the measurement range of the product. They indicate normal measurements are not possible. These may also occur due to incidental effects such as transient noise.

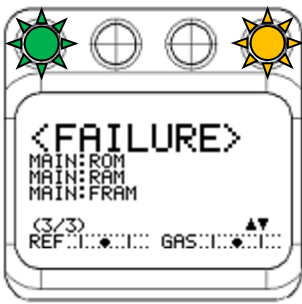
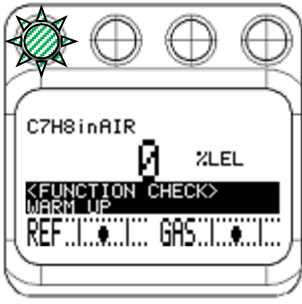

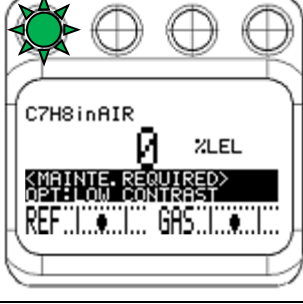
Introduce reference gas into the product to confirm that the product is normal before continuing the measurement. If you confirm that the zero point is normal, the target gas may have exceeded the measurement range. Check the conditions at the measurement point.

Even after the measured value returns to the measurement range, the underscale or overscale state will be maintained until latching resetting is performed in check mode (see “C.14.-- Display/contact latching resetting”).

4-6. Self-diagnostic monitoring function

The product includes self-monitoring and diagnostic functions complying with the NAMUR NE107 standard (self-monitoring and diagnostics of field devices), which enable real-time diagnosis and self-monitoring of the product state broadly divided into the following four categories.

The following table summarizes the screens displayed for each category together with an explanation of the corresponding product state.

| Category | Screen | State description |
|---|---|---|
| Abnormal state FAILURE |  | State in which an internal or external abnormality has occurred and the measurement results and output signal are not valid. The fault alarm contact activates, and the FAULT lamp (orange) illuminates. The 4-20 mA output signal outputs 0.5 mA. |
| Function checking FUNCTION CHECK |  | State in which the product is normal but measurement was suspended for function checking operation. The POWER lamp (green) flashes. The 4-20 mA output signal is fixed at the last output value. |
| Outside specification range OUT OF SPECIFICATION |  | State in which the product continues to measure normally but conditions outside the specification range have been detected; the measurement results and output signal have low reliability. The 4-20 mA output signal outputs measurement results. |
| Maintenance request MAINTENANCE REQUIRED |  | State in which the product continues to measure normally, but some form of deterioration requiring maintenance has been detected. The 4-20 mA output signal outputs measurement results. |

* The lamp indications, contacts, and 4-20 mA output operations in the table are for standard settings.

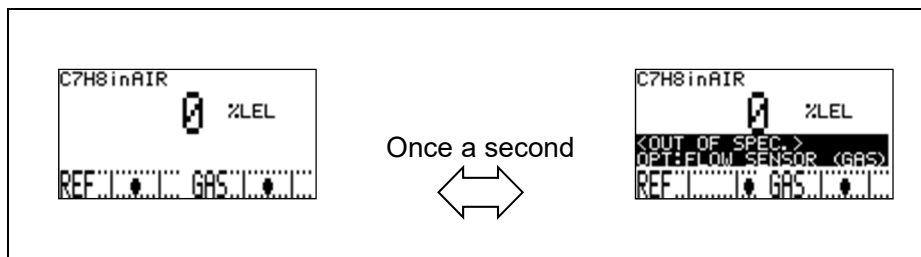
4-7. Contacts/display/signal output on returning to normal

A function is included for retaining the LCD screen display and contact states when the state returns to normal after a state corresponding to one of the categories listed below is detected by self-diagnosis. These settings can be altered in setup mode.

- Abnormal state (FAILURE)
- Outside specification range (OUT OF SPECIFICATION)
- Maintenance request (MAINTENANCE REQUIRED)

<LCD screen display>

| Name | Operation description |
|-----------------------------|--|
| TRACE DISP Trace display | A record of the state that occurred is retained by providing an alternating display after the state returns to normal. |
| AUTO RESET Auto reset | The display returns to the normal measurement screen after the state returns to normal. |
| OFF | No display is provided, even when the set state occurs. |



Trace display behavior

<Contact operation>

| Name | Operation description |
|---------------------------|---|
| LATCHING Self-latching | Retains the contact state even after the state returns to normal. |
| AUTO RESET Auto reset | Automatically restores the contact after the state returns to normal. |
| OFF | No contact operation is performed even when the set state occurs. |

<4-20 mA signal>


The 4-20 mA signal operates corresponding to the contact state.

| Contact state | Operation description |
|---------------------------|--|
| LATCHING Self-latching | The 4-20 mA signal maintains the preset abnormality detection value even after the state returns to normal. The default setting is 0.5 mA (fixed). |
| AUTO RESET Auto reset | Automatically restores the 4-20 mA output signal to the measured value after the state returns to normal. |
| OFF | No contact operation is performed even when the set state occurs. |

* Turning the power off and on clears the retained contact state and trace display operation on the LCD screen.

4-8. LCD screen display order of priority

Multiple states detected by self-diagnosis will be displayed on the screen in accordance with the following order of priority:

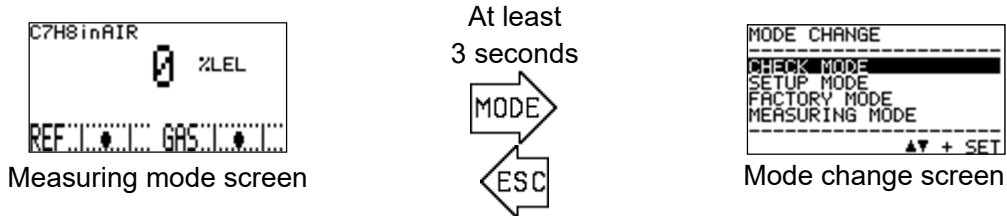
| Priority | State | Current status | Screen display |
|---|----------------------|----------------|--|
| High  | FAILURE | Occurring | Displays FAILURE screen. |
| | ALARM | Occurring | Only the state with the highest priority is displayed at the bottom of the concentration display screen. |
| | FUNCTION CHECK | Occurring | |
| | OUT OF SPECIFICATION | Occurring | |
| | MAINTENANCE REQUIRED | Occurring | |
| Low | FAILURE | Trace display | Only the state with the highest priority is displayed alternately at the bottom of the concentration display screen. |
| | ALARM | Trace display | |
| | FUNCTION CHECK | Trace display | |
| | OUT OF SPECIFICATION | Trace display | |
| | MAINTENANCE REQUIRED | Trace display | |

Check multiple states occurring simultaneously using the following screens in check mode:

- Checking current status: "C.11.-- Status flag checking "DISP. STATUS FLG (CURRENT FLG)""
- Checking trace display: "C.12.-- Status flag checking "DISP. STATUS FLG (TRACE DISP. FLG)""
- Checking contact self-latching: "C.13.-- Status flag checking "DISP. STATUS FLG (RELAY LATCH FLG)""

4-9. Switching to other modes

Hold down the MODE key for at least 3 seconds during measurement to display the MODE CHANGE screen.



Use the ▲ and ▼ keys to move the cursor (black bar) on this MODE CHANGE screen and select the required mode, then press the SET key to switch to the selected mode.

The individual mode screens and their details are as follows:

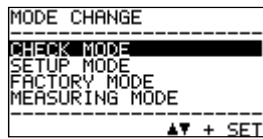
| Mode | Screen | Details |
|----------------------------------|--------|--|
| CHECK MODE Check mode | | Mode for displaying and checking the operating state of individual units and setting conditions while continuing measurement. The 4-20 mA output signal outputs measurement results in this mode without stopping measurement. |
| SETUP MODE Setup mode | | Mode for configuring product settings by the user, including alarm settings and 4-20 mA output signal conditions. Since this mode suspends measurement, you will be prompted to enter a password. |
| FACTORY MODE Factory mode | | Mode used for factory adjustment and maintenance/startup purposes. This mode is for use by Riken Keiki or qualified service engineers. It is normally not used by users. Since this mode suspends measurement, you will be prompted to enter a password. |
| MEASURING MODE Measuring mode | | Returns to the normal measuring mode screen. |

==== 5. Check Mode Operating Procedures =====

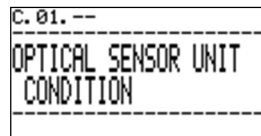
Check mode is a mode for displaying and checking items such as sensor operating status and product setting conditions while continuing measurement. The 4-20 mA output signal outputs measurement results in this mode without stopping measurement.

To enter check mode, select the mode change screen in measuring mode and use the ▲ and ▼ keys to move the cursor (black bar) to select "CHECK MODE", then press the SET key to confirm. The check mode menu screen appears. (See "4-9. Switching to other modes".)

Hold down the ESC key for at least 3 seconds on the check mode menu screen to return to measuring mode.

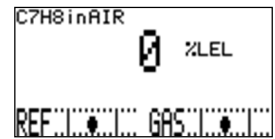


Mode change screen



Menu screen





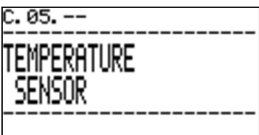
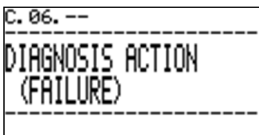
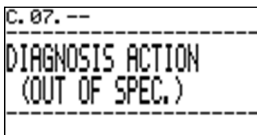
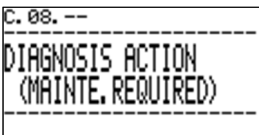
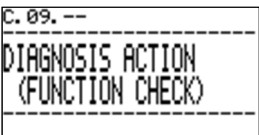
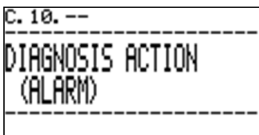

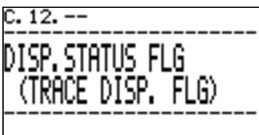


At least
3 seconds



Measuring mode

5-1. Check mode menu items

The menu items listed in the table below are available in check mode. These are explained in greater detail on the subsequent pages.

| | | | |
|---|---|--|---|
|  <p>C. 01. -- OPTICAL SENSOR UNIT CONDITION</p> <p>Displays the internal interferometer sensor state.</p> |  <p>C. 02. -- MAIN CONTROLLER CONDITION</p> <p>Displays the internal main controller state.</p> |  <p>C. 03. -- 4-20mA PARAMETER</p> <p>Displays the 4-20 mA settings.</p> |  <p>C. 04. -- PRESSURE SENSOR</p> <p>Displays the pressure sensor output.</p> |
|  <p>C. 05. -- TEMPERATURE SENSOR</p> <p>Displays the temperature sensor output.</p> |  <p>C. 06. -- DIAGNOSIS ACTION (FAILURE)</p> <p>Displays the LCD display/lamp operation settings on detecting an abnormal state.</p> |  <p>C. 07. -- DIAGNOSIS ACTION (OUT OF SPEC.)</p> <p>Displays the LCD display/lamp operation settings on detecting an outside specification range condition.</p> |  <p>C. 08. -- DIAGNOSIS ACTION (MAINT. REQUIRED)</p> <p>Displays the LCD display/lamp operation settings on detecting a maintenance request condition.</p> |
|  <p>C. 09. -- DIAGNOSIS ACTION (FUNCTION CHECK)</p> <p>Displays the LCD display/lamp operation settings for function checking.</p> |  <p>C. 10. -- DIAGNOSIS ACTION (ALARM)</p> <p>Displays the LCD display/lamp operation settings on detecting a concentration alarm.</p> |  <p>C. 11. -- DISP. STATUS FLG (CURRENT FLG)</p> <p>Displays the self-diagnostic/monitoring function results.</p> |  <p>C. 12. -- DISP. STATUS FLG (TRACE DISP. FLG)</p> <p>Displays the self-diagnostic/monitoring function results.</p> |
|  <p>C. 13. -- DISP. STATUS FLG (RELAY LATCH FLG)</p> <p>Displays the self-diagnostic/monitoring function results.</p> |  <p>C. 14. -- LATCHING RESET (DISP. & CONTACT)</p> <p>Resets the trace display and contact self-latching state.</p> | | |

5-2. Items and details

Use the ▲ and ▼ keys to select the item to be checked on the check mode menu screen, then press the SET key to confirm and display detailed information for that item. This section describes the detailed information displayed for each item.

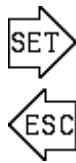
C.01.-- Optical sensor state checking “OPTICAL SENSOR UNIT CONDITION”

Sequentially displays optical sensor program information, self-diagnostic results measured within the sensor unit, and other information. Press the SET key on the “OPTICAL SENSOR UNIT CONDITION” menu screen to display the check screen. Use the ▲ and ▼ keys to select the item to be checked.

Sequentially displays optical sensor unit program information, self-diagnostic results measured within the unit, and other information.

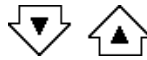
```
C.01.--
-----
OPTICAL SENSOR UNIT
CONDITION
-----
```

Menu screen



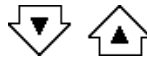
```
C.01.01
-----
PROGRAM No. : 04265
PROGRAM SUM : 0xE02D
PROGRAM Rev : 0026
SPE No. : SPE-0000
INS. : OCU-800_400
```

Displays the program number, SUM value, Rev number, SPE number, and product code.



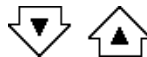
```
C.01.02
-----
Brit LED1 : 251
      LED2 : 255
Cont LED1 : 0.917
      LED2 : 0.926
N(+) : - 0.0103
N(-) : - 0.0665
```

Displays the interference fringe light intensity and contrast for LED1 and LED2.



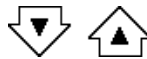
```
C.01.03
-----
0A : - 0.0443
0B : - 0.0013
0ALL (+) : - 0.0103
0ALL (-) : - 0.0104
0INT (+) : - 0.0103
0INT (-) : - 0.0103
```

Displays interference fringe phase information.



```
C.01.04
-----
3.3U : 3.299 U
5U : 5.042 U
LED1 : 3.290U-3.474U
LED2 : 3.127U-3.393U
```

Displays the power supply voltage used by the optical sensor unit, refractive index measurement results, and LED1/LED2 drive voltages.



```
C.01.05
-----
F : 0x0000 s1: 0x0000
W : 0x0000 s3: 0x0000
f1: 0x0000 s3: 0x0000
f : 0x0000 c : 0x0000
```

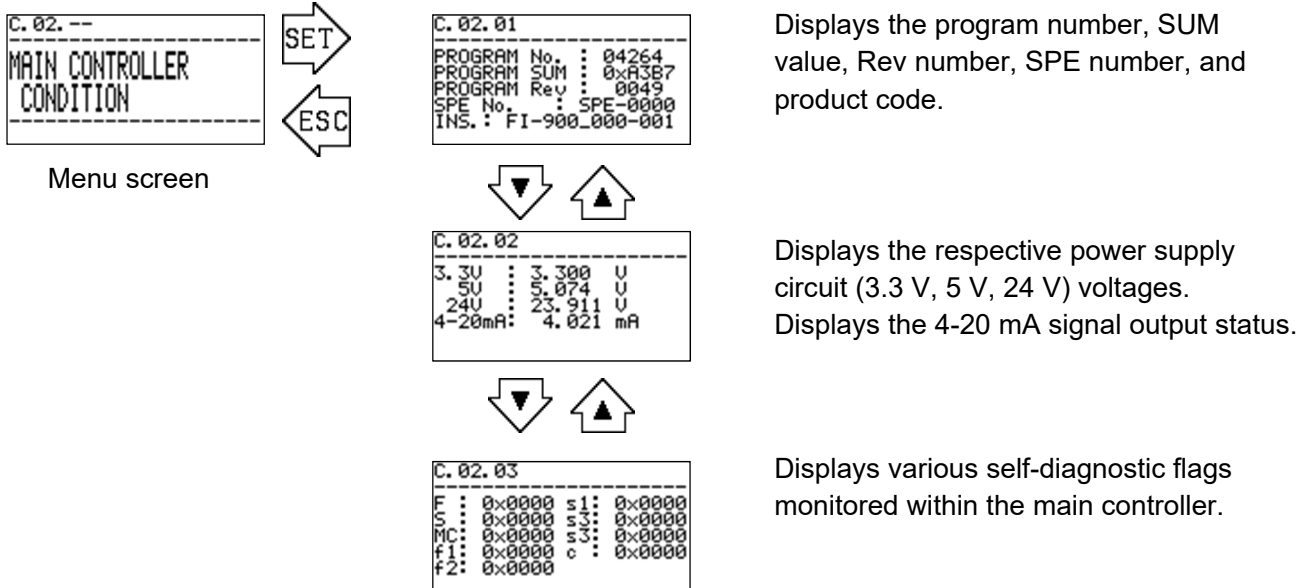
Displays self-diagnostic flags managed within the optical sensor.

C.02.-- Main controller state checking “MAIN CONTROLLER CONDITION”

Displays main controller program information, self-diagnostic results measured within the controller, and other information.

Displays main controller program information, internal self-diagnostic results, and other information.

Press the SET key on the “MAIN CONTROLLER CONDITION” menu screen to display the check screen. Use the ▲ and ▼ keys to select the item to be checked.

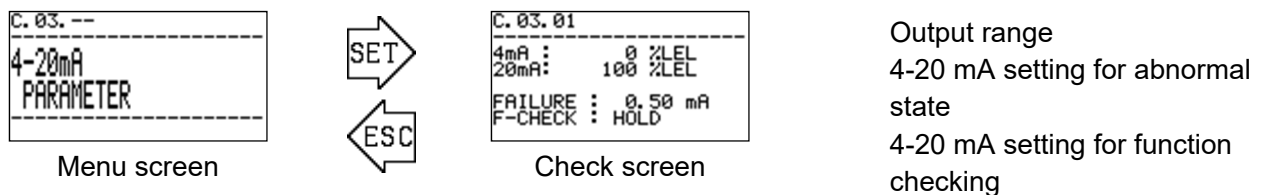


C.03.-- 4-20 mA setting state checking “4-20mA PARAMETER”

Displays the 4-20 mA output signal output conditions and settings.

Press the SET key on the “4-20mA PARAMETER” menu screen to display the check screen.

Displays the range corresponding to the 4-20 mA output signal within the measurement range, the 4-20 mA output signal value output when an abnormal state (FAILURE) is detected, and the 4-20 mA output signal value output for function checking (FUNCTION CHECK).



* If the output value is set to “HOLD”, this means the value immediately prior to the relevant state will be output.

C.04.-- Pressure sensor output checking “PRESSURE SENSOR”

Displays the output of the pressure sensor incorporated into the optical sensor unit.

Press the SET key on the “PRESSURE SENSOR” menu screen to display the check screen.

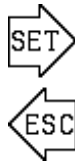
GAS: Output from the fine differential pressure sensor detecting the flow rate of the target gas supplied to the FI-900

REF: Output from the fine differential pressure sensor detecting the flow rate of the reference gas supplied to the FI-900

OUT: Output from the absolute pressure sensor for the FI-900 GAS OUT used for pressure correction

```
C. 04. --  
-----  
PRESSURE  
SENSOR  
-----
```

Menu screen



```
C. 04. 01  
-----  
GAS : 2.419 kPa  
REF : 2.137 kPa  
OUT : 100.479 kPa  
-----
```

Check screen

GAS side differential pressure sensor output value
REF side differential pressure sensor output value
OUT side absolute pressure sensor output value

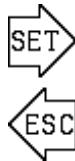
C.05.-- Temperature sensor output checking “TEMPERATURE SENSOR”

Displays the output of the temperature sensors incorporated into the main controller and optical sensor unit.

Press the SET key on the “TEMPERATURE SENSOR” menu screen to display the check screen.

```
C. 05. --  
-----  
TEMPERATURE  
SENSOR  
-----
```

Menu screen



```
C. 05. 01  
-----  
MAIN : 27.14 °C  
OPT. : 29.34 °C  
-----
```

Check screen

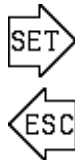
Main controller temperature
Optical sensor unit temperature

C.06.-- Self-diagnostic output checking “DIAGNOSIS ACTION (FAILURE)”

Displays the LCD display, FAULT lamp (orange), and fault alarm contact operation settings in detail for individual conditions when an abnormal state (FAILURE) is detected by the self-diagnostic/monitoring function. No description of this function is provided here because it is intended for use by Riken Keiki service engineers.

```
C. 06. --  
-----  
DIAGNOSIS ACTION  
(FAILURE)  
-----
```

Menu screen

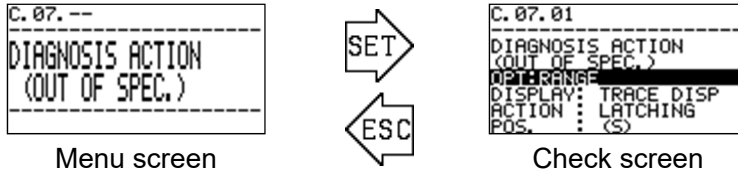


```
C. 06. 01  
-----  
DIAGNOSIS ACTION  
(FAILURE)  
MAINBROM  
DISPLAY: TRACE DISP  
ACTION : LATCHING  
POS. : (F)CONT.-3  
-----
```

Check screen

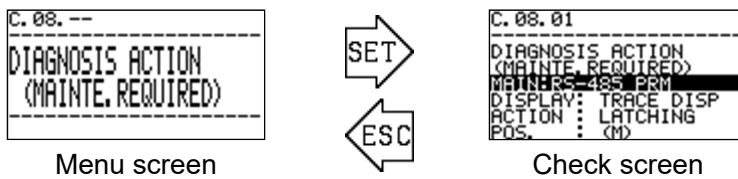
C.07.-- Self-diagnostic output checking “DIAGNOSIS ACTION (OUT OF SPEC.)”

Displays the LCD display operation settings in detail for individual conditions when an outside specification range condition (OUT OF SPECIFICATION) is detected by the self-diagnostic/monitoring function. No description of this function is provided here because it is intended for use by Riken Keiki service engineers.



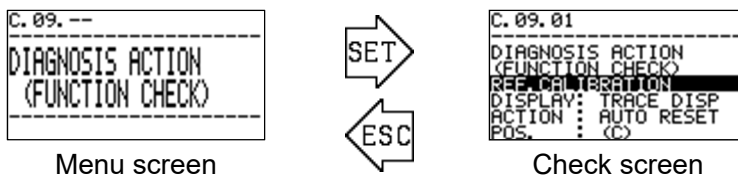
C.08.-- Self-diagnostic output checking “DIAGNOSIS ACTION (MAINTENANCE REQUIRED)”

Displays the LCD display operation settings in detail for individual conditions when a maintenance request (MAINTENANCE REQUIRED) is detected by the self-diagnostic/monitoring function. No description of this function is provided here because it is intended for use by Riken Keiki service engineers.



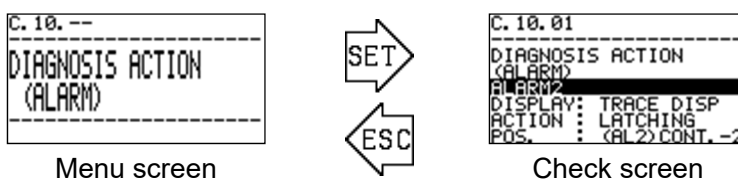
C.09.-- Self-diagnostic output checking “DIAGNOSIS ACTION (FUNCTION CHECK)”

Displays the LCD display operation settings in detail for individual conditions when the product is put in the function checking (FUNCTION CHECK) state by the self-diagnostic/monitoring function. No description of this function is provided here because it is intended for use by Riken Keiki service engineers.



C.10.-- Self-diagnostic output checking “DIAGNOSIS ACTION (ALARM)”

Displays the LCD display, ALM1 lamp, ALM2 lamp, first alarm contact, and second alarm contact operation settings when product measurement results satisfy alarm conditions.



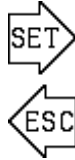
C.11.-- Status flag checking “DISP. STATUS FLG (CURRENT FLG)”

Displays detailed information on the current problems identified by the self-diagnostic/monitoring function.

Press the SET key on the “DISP. STATUS FLG” menu screen to display the check screen. “NO FLGS.” is displayed if no problems have occurred.

```
C. 11.--
-----
DISP. STATUS FLG
(CURRENT FLG)
-----
```

Menu screen



```
C. 11. 01
-----
DISP. STATUS FLG
CURRENT FLG
(1/24)
<FAILURE>
MAIN:4-20mA OUT
-----
```

Check screen

```
C. 11. 01
-----
DISP. STATUS FLG
CURRENT FLG
NO FLGS.
-----
```

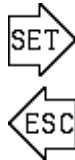
When no problems have occurred

C.12.-- Status flag checking “DISP. STATUS FLG (TRACE DISP. FLG)”

Displays the details detecting the conditions for performing trace display* identified by the self-diagnostic/monitoring function. Press the SET key on the “DISP. STATUS FLG” menu screen to display the check screen. “NO FLGS.” is displayed if no problems have occurred.

```
C. 12.--
-----
DISP. STATUS FLG
(TRACE DISP. FLG)
-----
```

Menu screen



```
C. 12. 01
-----
DISP. STATUS FLG
TRACE DISP. FLG
(1/ 4)
<OUT OF SPEC>
OPT:FLOW SENOSR (GAS)
-----
```

Check screen

```
C. 12. 01
-----
DISP. STATUS FLG
TRACE DISP. FLG
NO FLGS.
-----
```

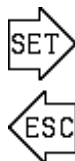
- * Trace display is a function that alternately displays the previously occurring abnormal state screen and the normal measurement screen to notify the user of past events when the product returns to normal from an abnormal state. For details of how to reset the trace state, refer to “C.14.-- Display/contact latching resetting”.

C.13.-- Status flag checking “DISP. STATUS FLG (RELAY LATCH FLG)”

Displays the details detecting the conditions for performing contact operation self-latching* identified by the self-diagnostic/monitoring function. Press the SET key on the “DISP. STATUS FLG” menu screen to display the check screen. “NO FLGS.” is displayed if no problems have occurred.

```
C. 13.--
-----
DISP. STATUS FLG
(RELAY LATCH FLG)
-----
```

Menu screen



```
C. 13. 01
-----
DISP. STATUS FLG
RELAY LATCH FLG
(1/ 4)
<MAINTN. REQUIRED>
MAIN:FACTORY SET
-----
```

Check screen

```
C. 13. 01
-----
DISP. STATUS FLG
RELAY LATCH FLG
NO FLGS.
-----
```

- * The contact operation self-latching function maintains the contact operation for a product outputting any kind of event state via a contact operation, even after resetting from the event to normal state. For details of how to reset contact operation self-latching, refer to “C.14.-- Display/contact latching resetting”.

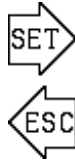
C.14.-- Display/contact latching resetting “LATCHING RESET (DISP. & CONTACT)”

This menu item is used to reset the LCD display trace display state and the contact self-latching state.

Press the SET key on the menu screen to display a caution screen indicating that the display screen and contact latching state will be reset. Review the information shown on the screen, then press the SET key to reset the display screen, contact self-latching, and LCD display trace state.



Menu screen



Check screen

***NOTE**

The LCD display and contact activation state will not be reset for current abnormal states. Refer to “C.11.-- Status flag checking “DISP. STATUS FLG (CURRENT FLG)”” and check for current abnormal states.

==== 6. Setup Mode Operating Procedures =====

Setup mode is used to change the target gas and to configure various settings such as 4-20 mA signal output conditions and contact operation conditions.

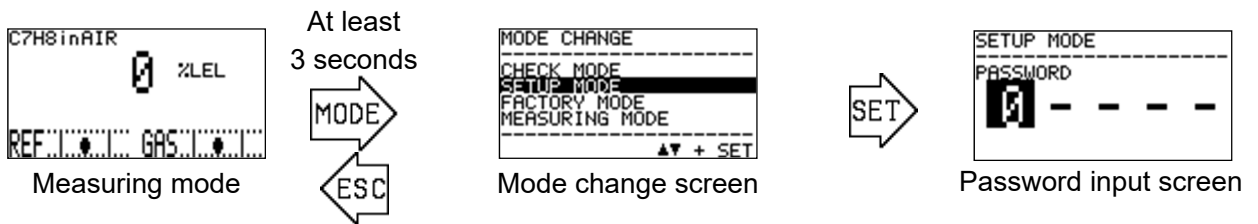
Switching to this mode suspends measurement, and the product switches to the function checking (FUNCTION CHECK) state, enabling the 4-20 mA signal to be fixed at the last output value.

(For details of how to change the output conditions, refer to “S.02.-- 4-20 mA output signal setting “4-20mA SETUP””.)

To enter setup mode, hold down the MODE key for at least 3 seconds while in measuring mode to display the mode change screen. Use the ▲ and ▼ keys to select “SETUP MODE”, then press the SET key to confirm.

A password input screen is then displayed. Use the ▲ and ▼ keys and the SET key to enter the password one character at a time. The factory default password is set to “00000”.

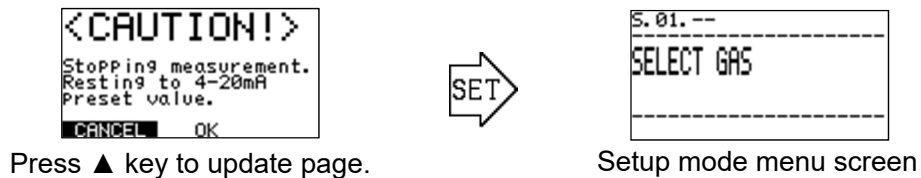
(For details of how to change the password, refer to “S.22.-- Changing password “CHANGE PASSWORD””.)



Select setup mode using
▲ and ▼ keys.

Once the correct password is entered, measurement halts, and a caution screen appears indicating that the 4-20 mA output will be fixed. Review the information shown on the screen, then press the SET key to stop measurement and display the setup mode menu screen.

(Hold down the ESC key for at least 3 seconds on the setup mode menu screen to return to measuring mode.)



Press ▲ key to update page.

Setup mode menu screen

 **CAUTION**

Entering setup mode and displaying the setup mode menu during a concentration alarm state (first alarm or second alarm) will reset the concentration alarm state.

Concentration measurement will also be treated as stopped while operations are underway in setup mode.

This means the status will not change, even if a concentration alarm or abnormal state occurs.

(* Concentration calculations continue internally.)

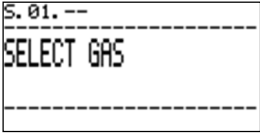



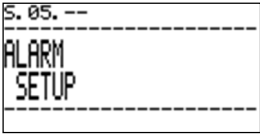

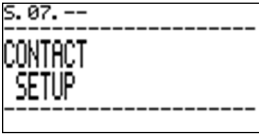
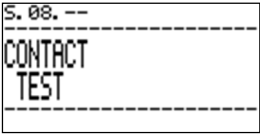
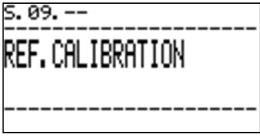

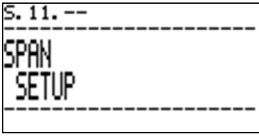
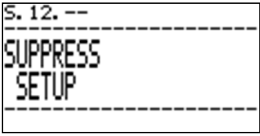

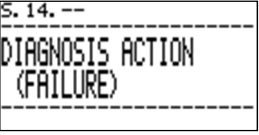
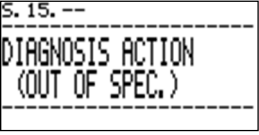
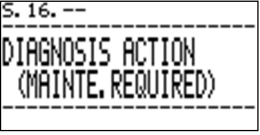
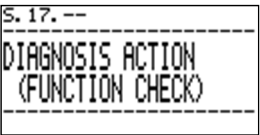
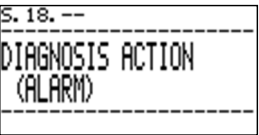
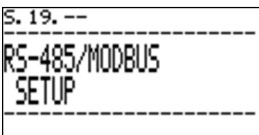
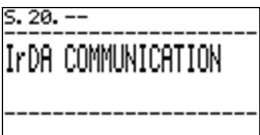
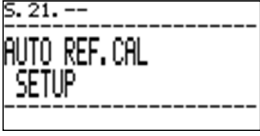
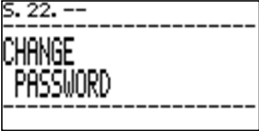

If you wish to check concentration values with the contact state and 4-20 mA signal state fixed and without sending a concentration alarm upstream, use “S.10.-- Offset adjustment “OFFSET SETUP””, “S.11.-- Span adjustment “SPAN SETUP””, or “S.13.-- Measurement checking “MEASUREMENT READINGS””.

The product will not switch to the concentration alarm state for approximately 15 minutes after exiting setup mode and switching to the measurement screen, even if the concentration alarm conditions are met.

The screen will automatically revert to the measurement screen when the product has been in setup mode for more than 10 hours.

6-1. Setup mode menu items

The items displayed on the setup mode menu screens are as follows. These are explained in detail on the subsequent pages.

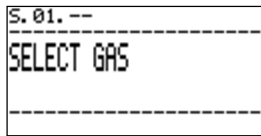
| | | | |
|--|---|---|--|
|  <p>S. 01. -- SELECT GAS</p> |  <p>S. 02. -- 4-20mA SETUP</p> |  <p>S. 03. -- 4-20mA ADJUSTMENT</p> |  <p>S. 04. -- 4-20mA TEST</p> |
| Target gas selection | 4-20 mA output signal setting | 4-20 mA output signal adjustment | 4-20 mA test signal output |
|  <p>S. 05. -- ALARM SETUP</p> |  <p>S. 06. -- ALARM TEST</p> |  <p>S. 07. -- CONTACT SETUP</p> |  <p>S. 08. -- CONTACT TEST</p> |
| Concentration alarm function setting | Concentration alarm function test | Contact operation setting | Contact operation test |
|  <p>S. 09. -- REF. CALIBRATION</p> |  <p>S. 10. -- OFFSET SETUP</p> |  <p>S. 11. -- SPAN SETUP</p> |  <p>S. 12. -- SUPPRESS SETUP</p> |
| Reference calibration | Reading offset adjustment | Reading sensitivity adjustment | Reading zero suppression value setting |
|  <p>S. 13. -- MEASUREMENT READINGS</p> |  <p>S. 14. -- DIAGNOSIS ACTION (FAILURE)</p> |  <p>S. 15. -- DIAGNOSIS ACTION (OUT OF SPEC.)</p> |  <p>S. 16. -- DIAGNOSIS ACTION (MAINTENANCE REQUIRED)</p> |
| Measurement checking | Product operation settings for abnormal condition detection | Product operation settings for outside specification range condition detection | Product operation settings for maintenance request condition detection |
|  <p>S. 17. -- DIAGNOSIS ACTION (FUNCTION CHECK)</p> |  <p>S. 18. -- DIAGNOSIS ACTION (ALARM)</p> |  <p>S. 19. -- RS-485/MODBUS SETUP</p> |  <p>S. 20. -- IrDA COMMUNICATION</p> |
| Product operation settings for function checking | Product operation settings for gas concentration alarm state | RS-485/Modbus communication setting | IrDA communication |
|  <p>S. 21. -- AUTO REF. CAL SETUP</p> |  <p>S. 22. -- CHANGE PASSWORD</p> |  <p>S. 23. -- LCD DISPLAY SETTING</p> | |
| Automatic reference calibration setting | Setup mode password change | LCD display setting | |

6-2. Items and details

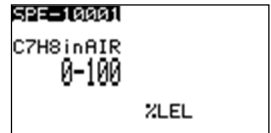
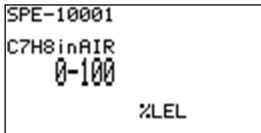
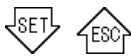
S.01.-- Target gas selection “SELECT GAS”

Selects the target gas. Press the SET key on the “SELECT GAS” menu screen to display the currently selected target gas range. Press the SET key once again to invert the SPE number display.

Use the ▲ and ▼ keys to select the required gas range, then use the SET key to confirm.



Menu screen



Select SPE No. using ▲ and ▼ keys.

Press SET key to confirm.

***NOTE**

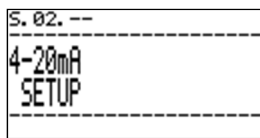
With the standard specifications, only one gas range is registered. The target gas range cannot be selected.

S.02.-- 4-20 mA output signal setting “4-20mA SETUP”

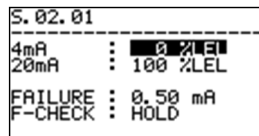
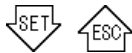
Sets the 4-20 mA output signal output conditions.

| Display contents | Description of output value |
|------------------|---|
| 4mA: 0 %LEL | Measurement for outputting 4 mA in measuring mode |
| 20mA: 100 %LEL | Measurement for outputting 20 mA in measuring mode. |
| FAILURE: 0.50 mA | Value output when an abnormal state is detected.* HOLD outputs the value immediately before abnormal state detection. |
| F-CHECK: HOLD | Value output for function checking. HOLD outputs the value immediately before function checking. |

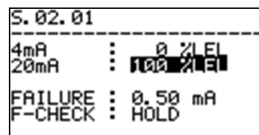
Press the SET key on the “4-20mA SETUP” menu screen to display a caution screen indicating the operations for changing the 4-20 mA signal. Review the information shown on the screen, then press the SET key to move to the setting change screen. Use the ▲ and ▼ keys to select the condition to be changed, then press the SET key. The setting details will appear in inverted display. Use the ▲ and ▼ keys and the SET key to enter and confirm the new setting.



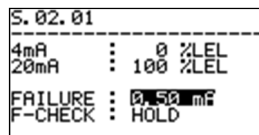
Menu screen



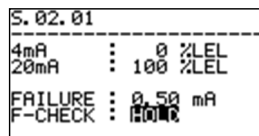
Use the ▲ and ▼ keys and SET key to enter and confirm the gas concentration for outputting 4 mA.



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



Select whether to fix the last 4-20 mA output value (HOLD) or set a specified value (0.5 mA to 22.0 mA) for an abnormality. When setting a specified value, use the ▲ and ▼ keys to set the value.

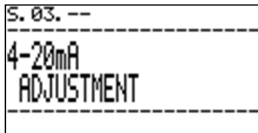


Select whether to fix the last 4-20 mA output value (HOLD) or set a specified value (0.5 mA to 22.0 mA) for function checking. When setting a specified value, use the ▲ and ▼ keys to set the value.

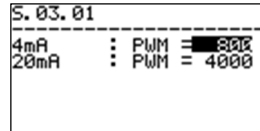
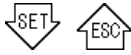
S.03.-- 4-20 mA output signal adjustment “4-20mA ADJUSTMENT”

Adjusts the 4-20 mA output signal output level. Press the SET key on the “4-20mA ADJUSTMENT” menu screen to display a caution screen indicating that the 4-20 mA signal will be changed. Review the information shown on the screen, then press the SET key to switch to the test signal output screen and output a 4 mA or 20 mA test signal.

Press the SET key to invert the respective PWM value display, allowing each output level to be adjusted. Measure the current using a calibrated tester and use the ▲ and ▼ keys to vary the PWM values to adjust output levels. Press the SET key to confirm the settings.

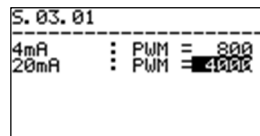


Menu screen



4 mA is output.

Use the ▲ and ▼ keys to adjust precisely to 4 mA.



20 mA is output.

Use the ▲ and ▼ keys to adjust precisely to 20 mA.

CAUTION

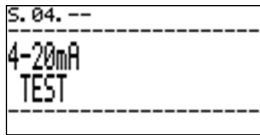
When adjusting 4-20 mA output values on this screen, make sure the ammeter or other tester remains connected. If the tester is disconnected, the disconnection detection function will activate, and adjustment may not be completed normally.

Press the ESC key to exit the output test and return to the menu screen. The 4-20 mA output values will revert to the values before adjustment.

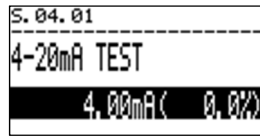
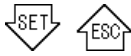
S.04.-- 4-20 mA output test “4-20mA TEST”

Adjusts the 4-20 mA output signal to output an arbitrary test signal. Press the SET key on the “4-20mA TEST” menu screen to display a caution screen indicating that the 4-20 mA output signal will be changed. Review the information shown on the screen, then press the SET key to switch to the test signal output screen and output a 4 mA test signal.

Press the SET key once again to invert the output value display. Use the ▲ and ▼ keys to change the test signal within the range from 0.50 mA to 22.00 mA in 0.05 mA steps.



Menu screen



The test signal can be changed to a value within the range from 0.50 mA to 22.00 mA.

Press the ESC key to exit the output test and return to the menu screen. The 4-20 mA output values will revert to the values before output testing.

S.05.-- Concentration alarm function setting “ALARM SETUP”

Sets the concentration alarm function. Press the SET key on the “ALARM SETUP” menu screen to display the current alarm function settings. Pressing the SET key once again will cause the settings to blink. Use the ▲ and ▼ keys to change the settings.

| Alarm type | Description |
|------------|---|
| H-HH. | Issues alarm when the concentration reading exceeds the ALM1 and ALM2 values. |
| L-H. | Issues alarm when the concentration reading falls below ALM1 or exceeds ALM2. |
| L-LL. | Issues alarm when the concentration reading falls below the ALM1 and ALM2 values. |
| OFF | No alarms are issued. |

```
S.05.--
-----
ALARM
SETUP
-----
```

Menu screen



```
S.05.01
TYPE : H-HH
ALM1 : 25 %LEL
ALM2 : 50 %LEL
DELAY : 3 SEC
```

Select the alarm type.



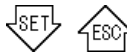
```
S.05.01
TYPE : H-HH
ALM1 : 25 %LEL
ALM2 : 50 %LEL
DELAY : 3 SEC
```

Edit the first alarm setpoint (ALM1) setting.



```
S.05.01
TYPE : H-HH
ALM1 : 25 %LEL
ALM2 : 50 %LEL
DELAY : 3 SEC
```

Edit the second alarm setpoint (ALM2) setting.



```
S.05.01
TYPE : H-HH
ALM1 : 25 %LEL
ALM2 : 50 %LEL
DELAY : 3 SEC
```

Edit the alarm delay time.

*NOTE

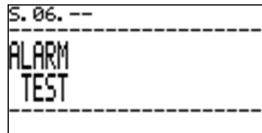
Set the alarm setpoints after taking into account factors such as measurement accuracy and environmental effects. We do not recommend setting the setpoints to values lower than 10 % or greater than 90 % of the measurement range.

S.06.-- Alarm test “ALARM TEST”

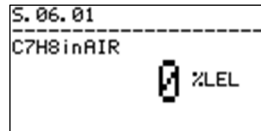
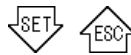
Tests the concentration alarm function. This screen allows the 4-20 mA output signal to be changed. The contacts will also activate, depending on the concentration.

Press the SET key on the “ALARM TEST” menu screen to display a caution screen. Review the information shown on the screen, then press the SET key to switch to the concentration alarm function test screen and output a simulated gas concentration measurement result signal.

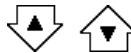
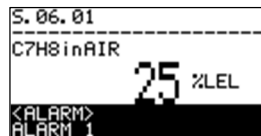
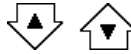
Use the ▲ and ▼ keys to change the simulated gas concentration measurement result signal. The first alarm and second alarm contacts activate when the simulated gas concentration measurement result signal satisfies the respective first and second alarm conditions.



Menu screen



Concentration alarm function test screen



Change the simulated gas concentration measurement result signal. This can be adjusted across the range from underscale to overscale.

The first alarm contact activates when the simulated gas concentration measurement result signal is changed to a value that satisfies the first alarm condition (ALM1).

The second alarm contact activates when the simulated gas concentration measurement result signal is changed to a value that satisfies the second alarm condition (ALM2).

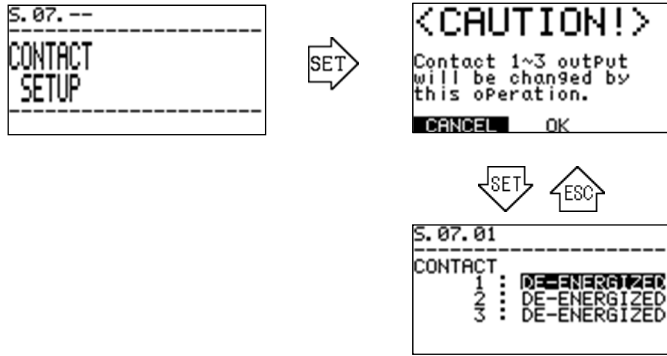
*NOTE

The alarm test screen can be used to simulate operation for measurements in the range from underscale (approximately -10 %) to overscale (approximately +10 %). The out-of-scale lock function may activate if a value is changed beyond the underscale or overscale value.

If this occurs, press the SET key to reset the out-of-scale lock state or the ESC key to return to the menu screen.

S.07.-- Contact energization setting “CONTACT SETUP”

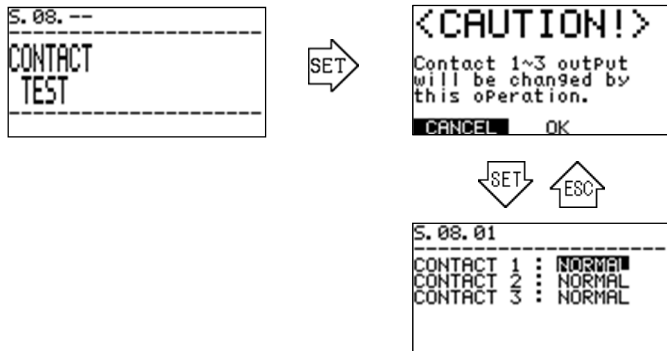
Sets the operations (always energized or always de-energized) for the contacts used by the product. No description of this function is provided here because it is intended for use by Riken Keiki service engineers.



This can be set to DE-ENERGIZED or ENERGIZED.

S.08.-- Contact operation checking “CONTACT TEST”

Outputs a normal/active state test signal for testing the contact operations used by the product. No description of this function is provided here because it is intended for use by Riken Keiki service engineers.



This can be set to NORMAL or ACTIVE.

S.09.-- Reference gas calibration “REF.CALIBRATION”

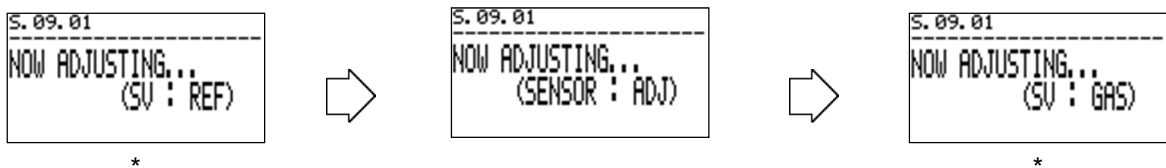
Performs reference gas calibration. Press the SET key on the “REF.CALIBRATION” menu screen to display the “REF.CALIB.” standby screen. Press the SET key once again to perform reference gas calibration.

**CAUTION**
Reference gas calibration requires adequate flow of the reference gas via the target gas IN inlet.



Ensure adequate flow of the reference gas via the target gas IN inlet in this state. Check the PHASE θ ALL value. Reference gas calibration is not required if the PHASE θ ALL value is close to 0 (e.g., within ± 0.0100).

To perform reference gas calibration, use the \blacktriangle and \blacktriangledown keys to select “REF.CALIB.”, then press the SET key to confirm.



* This is displayed only if an external solenoid valve contact (optional function) is used.

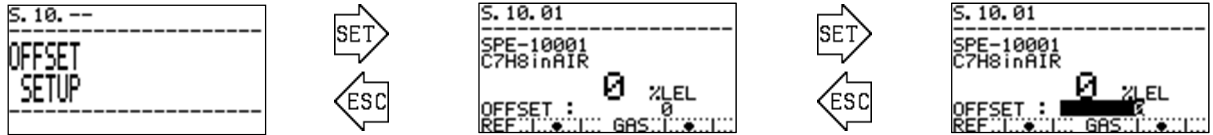
The display returns to the check screen once calibration ends. Check to confirm that the PHASE θ ALL value is close to 0 (e.g., within ± 0.0100).

To exit the operation, press the ESC key or select “CANCEL”.

***NOTE**
The function used to control an external solenoid valve to introduce reference gas in coordination with the product main unit operation is an optional function. This must be designed in conjunction with the sampling system, so contact Riken Keiki for information.

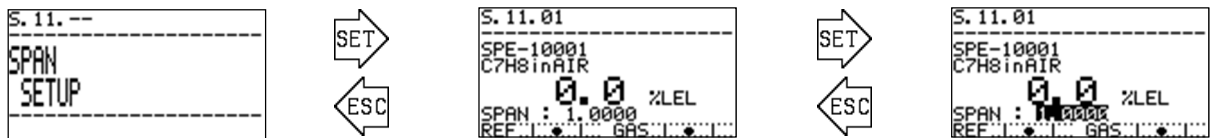
S.10.-- Offset adjustment “OFFSET SETUP”

Performs offset adjustment on the measurement results. No explanation of this procedure is provided here because it is performed only by Riken Keiki service engineers.



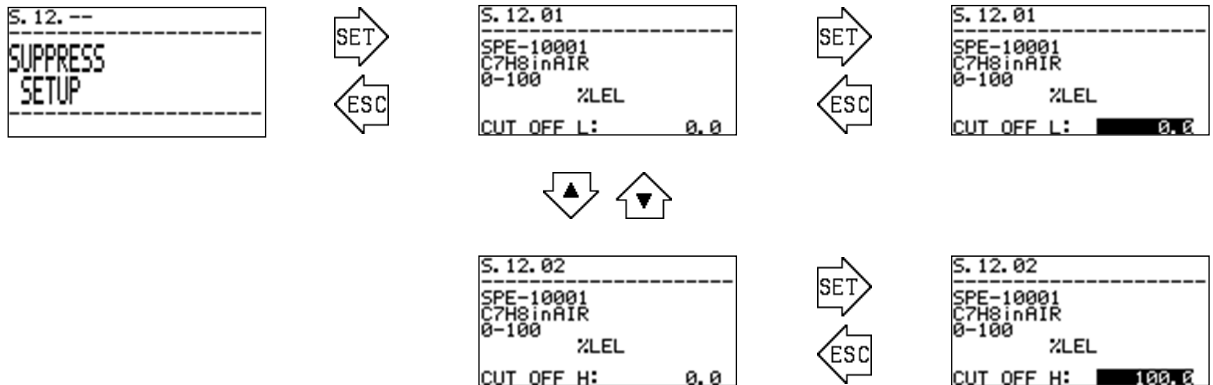
S.11.-- Span adjustment “SPAN SETUP”

Performs span adjustment on the measurement results. No explanation of this procedure is provided here because it is performed only by Riken Keiki service engineers.



S.12.-- Suppression adjustment “SUPPRESS SETUP”

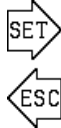
Sets upper and lower display limits for measurement results. No explanation of this procedure is provided here because it is performed only by Riken Keiki service engineers.



S.13.-- Measurement checking “MEASUREMENT READINGS”

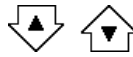
Displays various internal sensor data. No description of this function is provided here because it is intended for use by Riken Keiki service engineers when checking product operation and during maintenance.

```
S. 13. --
-----
MEASUREMENT
READINGS
-----
```



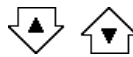
```
S. 13. 01
-----
D :      0 %LEL
DS:     0.0 %LEL
REF:***** GAS:*****
```

D: Same as displayed on the measurement screen
DS: Internally calculated value



```
S. 13. 02
-----
Nn (+) : - 0.0142
Nn (-) : - 0.0142
Nc (+) : - 0.0142
Nc (-) : - 0.0142
θALL (+) : - 0.0021
θALL (-) : - 0.0021
```

Nn (+), Nn (-): Refractive index
Nc (+), Nc (-): Refractive index (before correction)
θALL (+), θALL (-): Total phase



```
S. 13. 03. --
-----
TEMP :      30.12 °C
PRESS :    100.800 kPa
P. GAS :      0.000 kPa
P. REF :      0.000 kPa
4-20mA :    0.067 mA
```

Temperature, absolute pressure, differential pressure, 4-20 mA detection value

S.14.-- Self-diagnostic operation (abnormality) “DIAGNOSIS ACTION (FAILURE)”

Sets the LCD display and contact operations in detail for individual conditions when an abnormal state (FAILURE) is detected by the self-diagnostic/monitoring function. No description of this function is provided here because it is intended for use by Riken Keiki service engineers.

```
S. 14. --
-----
DIAGNOSIS ACTION
(FAILURE)
-----
```



```
S. 14. 01
-----
DIAGNOSIS ACTION
<FAILURE>
<FAILURE>
<FAILURE>
DISPLAY: AUTO RESET
ACTION : AUTO RESET
POS. : <F>CONT.-3
```

DISPLAY: OFF, AUTO RESET, TRACE DISP
ACTION: OFF, AUTO RESET, LATCHING
POS.: (F), (S), (C), (M), (AL1), (AL2), OFF

* F is the fault contact, and AL1/AL2 are the alarm contacts.

S.15.-- Self-diagnostic operation (outside specification range) “DIAGNOSIS ACTION (OUT OF SPEC)”

Sets the LCD display and LED lamp actions in detail for individual conditions when an outside specification range condition (OUT OF SPECIFICATION) is detected by the self-diagnostic/monitoring function. No description of this function is provided here because it is intended for use by Riken Keiki service engineers.

```
S. 15. --
-----
DIAGNOSIS ACTION
(OUT OF SPEC)
-----
```



```
S. 15. 01
-----
DIAGNOSIS ACTION
(OUT OF SPEC.)
<OUT OF SPEC.>
<OUT OF SPEC.>
DISPLAY: TRACE DISP
ACTION : LATCHING
POS. : (S)
```

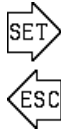
DISPLAY: OFF, AUTO RESET, TRACE DISP
ACTION: OFF, AUTO RESET, LATCHING
POS.: (F), (S), (C), (M), (AL1), (AL2), OFF

* F is the fault contact, and AL1/AL2 are the alarm contacts.

S.16.-- Self-diagnostic operation (maintenance request) “DIAGNOSIS ACTION (MAINTE.REQUIRED)”

Sets the LCD display and LED lamp operations in detail for individual conditions when a maintenance request (MAINTENANCE REQUIRED) is detected by the self-diagnostic/monitoring function. No description of this function is provided here because it is intended for use by Riken Keiki service engineers.

```
S. 16. --
-----
DIAGNOSIS ACTION
(MAINTENANCE REQUIRED)
-----
```



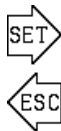
```
S. 16. 01
-----
DIAGNOSIS ACTION
(MAINTENANCE REQUIRED)
MAINTENANCE-485 PRM
-----
DISPLAY: TRACE DISP
ACTION : LATCHING
POS.   : (M)
```

DISPLAY: OFF, AUTO RESET, TRACE DISP
 ACTION: OFF, AUTO RESET, LATCHING
 POS.: (F), (S), (C), (M), (AL1), (AL2), OFF
 * F is the fault contact, and AL1/AL2 are the alarm contacts.

S.17.-- Self-diagnostic operation (function checking) “DIAGNOSIS ACTION (FUNCTION CHECK)”

Sets the LCD display and LED lamp operations in detail for individual conditions when the FI-900 is in the function checking (FUNCTION CHECK) state. No description of this function is provided here because it is intended for use by Riken Keiki service engineers.

```
S. 17. --
-----
DIAGNOSIS ACTION
(FUNCTION CHECK)
-----
```



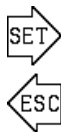
```
S. 17. 01
-----
DIAGNOSIS ACTION
(FUNCTION CHECK)
REF. CALIBRATION
-----
DISPLAY: TRACE DISP
ACTION : AUTO RESET
POS.   : (C)
```

DISPLAY: OFF, AUTO RESET, TRACE DISP
 ACTION: OFF, AUTO RESET, LATCHING
 POS.: (F), (S), (C), (M), (AL1), (AL2), OFF
 * F is the fault contact, and AL1/AL2 are the alarm contacts.

S.18.-- Self-diagnostic action (concentration alarm) “DIAGNOSIS ACTION (ALARM)”

Sets the LCD display and contact operations in detail for individual conditions when the measurement results satisfy the concentration alarm conditions. No description of this function is provided here because it is intended for use by Riken Keiki service engineers.

```
S. 18. --
-----
DIAGNOSIS ACTION
(ALARM)
-----
```



```
S. 18. 01
-----
DIAGNOSIS ACTION
(ALARM)
ALARM2
-----
DISPLAY: TRACE DISP
ACTION : LATCHING
POS.   : (AL2)CONT.-2
```

DISPLAY: OFF, AUTO RESET, TRACE DISP
 ACTION: OFF, AUTO RESET, LATCHING
 POS.: (F), (S), (C), (M), (AL1), (AL2), OFF
 * F is the fault contact, and AL1/AL2 are the alarm contacts.

S.19.-- RS-485 communication setting “RS-485/MODBUS SETUP”

Allows editing of RS-485 (Modbus) communication settings. Press the SET key on the “RS-485/MODBUS” menu screen to display the individual setting items. Use the ▲ and ▼ keys to select the item to be edited, then press the SET key to confirm. This function is intended for use by Riken Keiki service engineers.

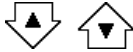
*NOTE

The RS-485 (Modbus) communication function is an optional function. For details of information such as communication specifications and address maps, contact Riken Keiki.

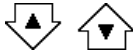
*NOTE

If multiple devices are connected on the same line, each device must have a unique slave ID.

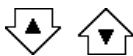
```
S. 19. --
-----
RS-485/MODBUS
SETUP
-----
```



```
S. 19. 01
-----
SLAVE ID  : 247
TRANSMIT  : RTU
BAUD      : 115200bps
DATA BIT  : 8-BIT
STOP BIT  : 1-BIT
PARITY    : ODD
-----
```



```
S. 19. 02
-----
SEND WAIT1: 8
SEND WAIT2: 8
-----
```



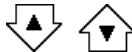
```
S. 19. 03
-----
MESSAGE  Cnt. : 0
CRC ERR  Cnt. : 0
EXCEPTION Cnt. : 0
RECEIVE  Cnt. : 0
Press SET 3sec CntClr
-----
```



The setting ranges for the individual setting items are as follows:
 SLAVE ID: 1 to 247
 TRANSMIT: RTU mode, ASCII mode
 BAUD RATE: 4800, 9600, 19200, 38400, 57600, 115200 bps
 DATA BIT: 7-bit, 8-bit
 STOP BIT: 1-bit, 2-bit, NONE
 PARITY BIT: NONE, IGNORE, EVEN, ODD
 SEND WAIT1 (fixed value): Time for sending 8 to 127 characters
 SEND WAIT2 (random value): Time for sending 8 to 127 characters

Displays the total message received count.
 Displays the CRC error count.
 Displays the exception error count.
 Displays the corresponding message received count.


```
S. 19. 04
-----
NO-REPLY Cnt. : 0
NAK-R. Cnt. : 0
BUSY-R. Cnt. : 0
OVER RUN Cnt. : 0
Press SET 3sec CntClr
```



```
S. 19. 05
-----
INIT. ADDRESS MAP
```

Displays the no-response/response count.
 Displays the NAK/response count.
 Displays the BUSY/response count.
 Displays the overrun count.

Self-diagnostic counter values described in the Modbus serial communication specifications can be cleared. Select "OK", then hold down the SET key for at least 3 seconds to clear all counter values.

Sets the address map to the default.



CAUTION

This operation may prevent normal communication. Avoid this operation. It is intended for use by Riken Keiki service engineers.

S.20.-- IrDA communication "IrDA COMMUNICATION"

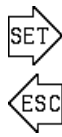
Downloads log data stored internally via IrDA communication.

Press the SET key on the "IrDA COMMUNICATION" menu screen to display the individual operation items.

Use the ▲ and ▼ keys to select the required operation item, then press the SET key to move to the corresponding execution screen.

```
S. 20. --
-----
IrDA COMMUNICATION
```

Menu screen



```
S. 20. 01
-----
STANDBY
CANCEL START
```

Start screen

```
<CAUTION!>
Now busy.
Wait for a while.
SET or ESC
```

A warning appears if other processing is currently underway. Wait for a while before restarting.

```
S. 20. 01
-----
STANDBY
CANCEL START
```

Start screen



```
S. 20. 01
-----
COMMUNICATING
```

Communication start



```
S. 20. 01
-----
SENDING DATA
```

Communicating

S.21.-- Automatic reference calibration setting “AUTO REF.CAL SETUP”

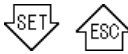
Automatic reference calibration is a function that uses a built-in timer to automatically perform reference calibration at preset intervals. No description of this function is provided here because it is intended for use by Riken Keiki service engineers.

*NOTE

Automatic reference calibration is an optional function. A solenoid valve must be included on the board, and a pipe system must be configured to enable reference gas to be introduced via the target GAS IN inlet. Additionally, the second alarm will become unavailable, as the second alarm contact is used as a solenoid valve contact.

For detailed information, contact Riken Keiki.

```
S. 21. --
-----
AUTO REF. CAL
SETUP
-----
```



```
S. 21. 01
-----
AUTO REF. CAL
CAL. CYCLE : ---
TIME       : --- sec
```

Screen when automatic reference calibration function cannot be set

```
S. 21. 01
-----
AUTO REF. CAL
CAL. CYCLE : OFF
TIME       : 45 sec
```

Sets the automatic reference calibration cycle.

OFF (auto calibration disabled), 3H (3-hour cycle), 6H (6-hour cycle), 12H (12-hour cycle), 24H (24-hour cycle), 2D (2-day cycle), 7D (7-day cycle), 28D (28-day cycle)

Sets the reference gas suction time and target gas suction time for reference calibration.

- * The reference gas suction time required will differ depending on the target gas type and external pipe system. This must be set after checking the time required for the reference gas to stabilize well after being introduced.

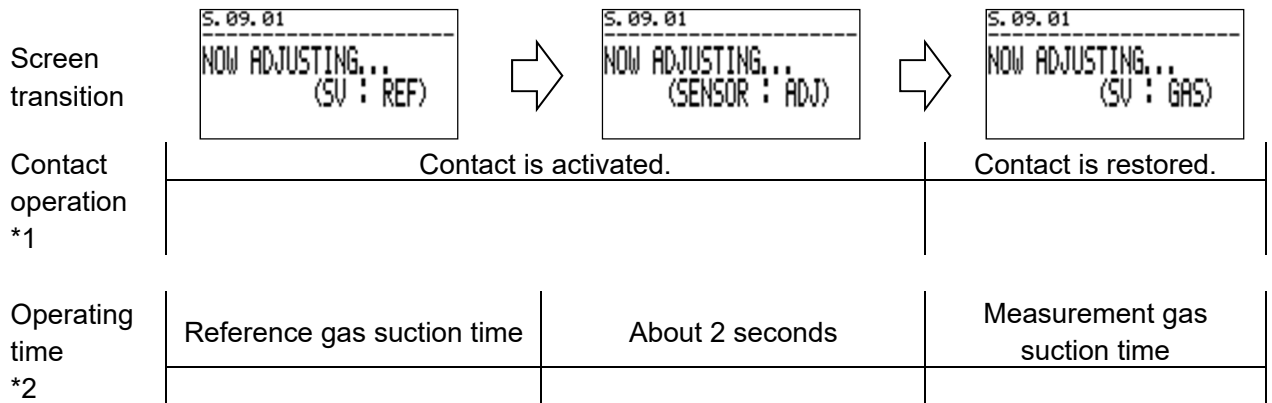
Perform reference gas calibration if the automatic reference calibration function settings have been changed on this setup screen.

```
S. 09. --
-----
REF. CALIBRATION
-----
```

- * Performing reference calibration starts the timer determining the operation cycle.

If reference gas calibration is not performed, the timer will not activate, and automatic calibration will not be performed.

The reference gas calibration operation when the automatic reference calibration is enabled is as follows.



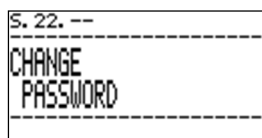
*1. For the excitation and de-excitation of the contact, follow the setting item "CONTACT2" in "S.07. CONTACT SETUP".

*2. The reference gas aspiration time and measurement gas aspiration time are common time settings. This setting can be changed from 0 to 1800 seconds (in 1-second increments) in setting item "TIME" in "S.21. AUTO REF. CAL SETUP". If you set it to 0 seconds, it will not work.

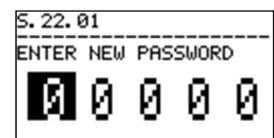
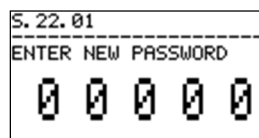
S.22.-- Changing password "CHANGE PASSWORD"

This allows you to change the password required to enter setup mode. Press the SET key on the "CHANGE PASSWORD" menu screen to display the password check screen showing the currently set password.

Press the SET key once again to switch to the password entry screen. Use the ▲ and ▼ keys and SET key to enter alphanumeric characters (0 to 9 and A to F) one character at a time.



Menu screen



Use the ▲ and ▼ keys to enter one character at a time, then press the SET key to confirm.

CAUTION

Note that you will not be able to enter setup mode if you forget the password set. If you forget the password, contact Riken Keiki.

==== 7. Maintenance =====

The product is designed to operate continuously over extended periods of time. Periodic maintenance is required to ensure sufficient performance over this period.

<Maintenance services>

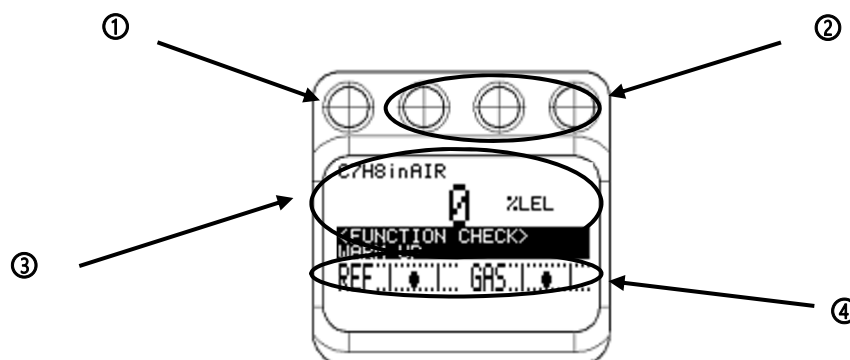
Riken Keiki provides services related to regular maintenance, adjustment, and servicing. Our certified service engineers have expert knowledge of the dedicated tools used for these services, along with expertise in products. We recommend taking advantage of our maintenance service to ensure safe use of the product.

7-1. Maintenance intervals and items

Maintenance consists of daily and monthly maintenance performed by the user and six month maintenance carried out every six months by Riken Keiki.

7-2. Daily maintenance

Daily maintenance consists of inspections to confirm the integrity of product operations. Inspect the product in accordance with the maintenance items and assessment criteria shown in the following table.



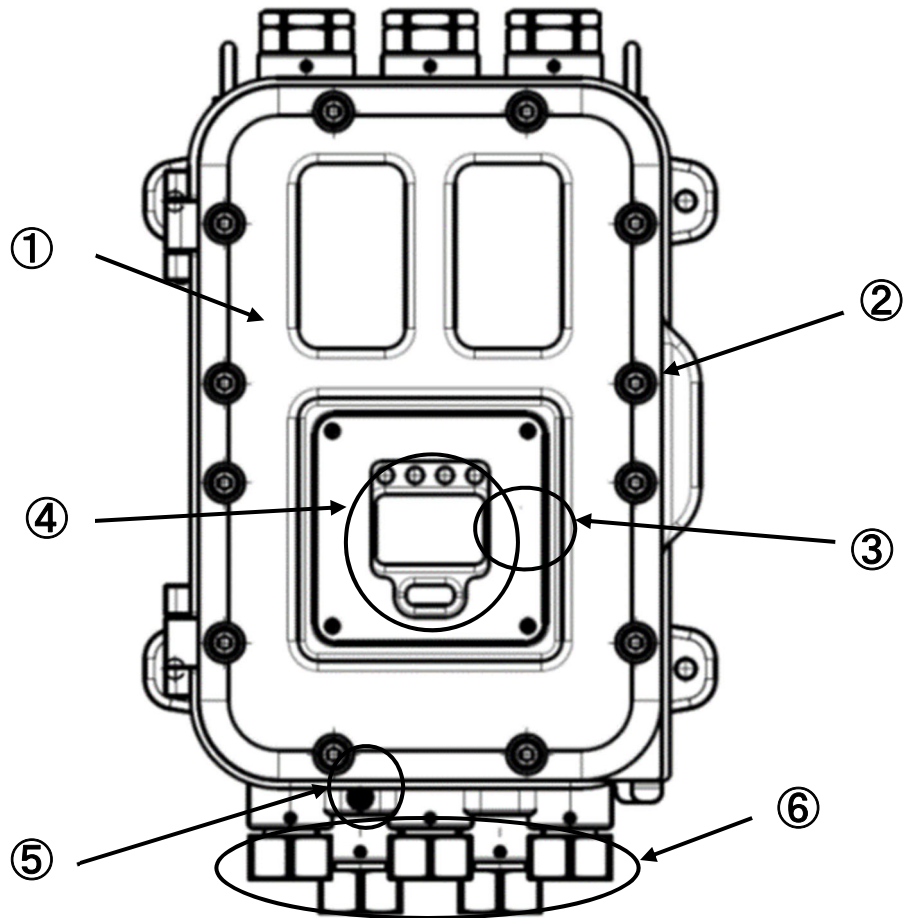
| Maintenance item | Assessment |
|---|---|
| ① POWER lamp | The POWER lamp should illuminate continuously when the product is normal. Check to confirm that it is illuminated normally. |
| ② Event lamps | The event lamps should be off continuously when the product is normal. Check to confirm that the lamps are not illuminated. |
| ③ LCD display | Check to confirm that indications such as abnormal state (FAILURE), outside specification range (OUT OF SPECIFICATION), maintenance request (MAINTENANCE REQUIRED) are not displayed. |
| ④ Target gas (GAS) flow rate Reference gas (REF) flow rate | Check to confirm that the black circles indicating the target gas (GAS) flow rate and reference gas (REF) flow rate are both between the two vertical bars corresponding to the upper and lower limits. |

If any abnormality is found, investigate and take appropriate action as described in Troubleshooting.

7-3. Monthly maintenance

Monthly maintenance consists of inspections to confirm the integrity of the product explosion-proof performance. Inspect the product in accordance with the maintenance items and assessment criteria shown in the following table.

| Maintenance item | Assessment |
|---------------------------------------|--|
| ① Cast casing | Check to confirm that the casing is normal and free of damage. |
| ② Fastening screws and bolts | Check to confirm that the fastening screws and bolts are not loose or missing. |
| ③ Explosion-proof certification plate | Check to confirm that the plate printed with the type examination certificate marking is normal and correct. |
| ④ Transparent window | Check to confirm that the transparent window is not cracked, discolored, or deformed. |
| ⑤ Grounding terminal | Check to confirm that the grounding cable is correctly connected to the grounding terminal. |
| ⑥ Cable glands, wiring | Check to confirm that the cable glands and wiring is problem-free. |



7-4. Six month maintenance

Six month maintenance consists of inspections to confirm the integrity of items such as sensor output, power supply voltage, contacts, and analog signal output. The following items are carried out as necessary.

- ① Product cleaning ② Parts replacement ③ External pipe component replacement
- ④ Reading operation check ⑤ Other

The items indicated for daily maintenance must also be carried out during the six month maintenance.

7-5. Recommended periodic replacement parts

| Mean ambient temperature | Recommended periodic replacement parts | Replacement interval |
|--------------------------|--|----------------------|
| Less than 50 °C | None | - |
| 50 °C or more | Power supply terminal plate unit | 5 years |

The product has a design life of 10 years.

The filters used with the sampling system should be replaced at appropriate intervals.

==== 8. Storage, Relocation, and Disposal =====

8-1. Procedures for storage or when not in use for extended periods

If the product is not in use for extended periods with the pipes and cables from the FI-900 and sampling system still connected, turn off the power and shut off the target gas and reference gas supplies. If there is a possibility of gas entering via the OUT side, take appropriate measures, such as disconnecting the OUT side pipes.

If the product is stored for extended periods (e.g., in a warehouse), it should be stored in a location at normal temperature and humidity, and away from direct sunlight. Store the FI-900 main unit with the front cover closed to avoid damage to the explosion-proof bonding surfaces.

8-2. Procedures for relocation or reuse

When resuming operation after reconnecting pipes and cables, contact a service agent appointed by Riken Keiki to request the relevant startup work. In cases where only the power supply and target gas/reference gas supply needs to be restarted, contact a service agent appointed by Riken Keiki as necessary to request the relevant work.

8-3. Product disposal

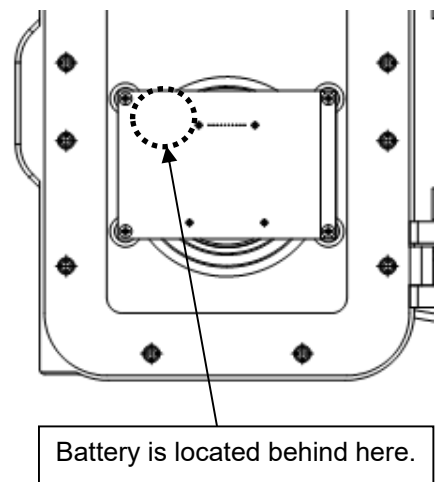
Dispose of the product appropriately as industrial waste (incombustible) in accordance with local regulations. The main controller PCB inside the main unit contains the following coin-type battery. This should be removed before disposing of the product.

Coin-type lithium manganese dioxide battery specifications

| | |
|--------------------|--------|
| Product code: | CR1220 |
| Nominal voltage: | 3 V |
| Standard capacity: | 36 mAh |

Removal method

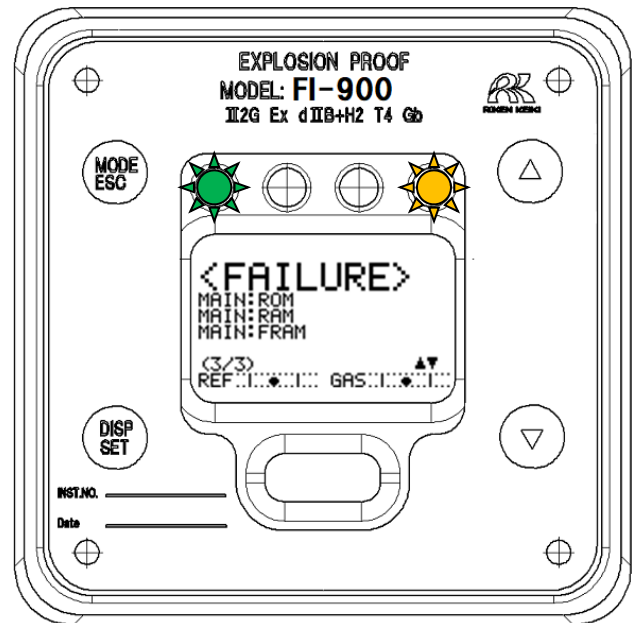
Remove the main controller unit. The battery is contained behind the part indicated in the diagram on the right. The battery is covered by the plastic case. The plastic case is attached to the PCB, and so should be removed using pliers or a screwdriver. Remove the battery by sliding it out sideways. Wrap the removed battery in insulating tape before disposing.












==== 9. Troubleshooting =====





The material provided here is intended for investigating the causes of problems by determining the state of the product from the details displayed on the main unit. While it describes as many likely symptoms as possible, it does not include every possible symptom. If the cause of a problem cannot be determined from the material provided here, contact Riken Keiki.

9-1. Abnormality <FAILURE>

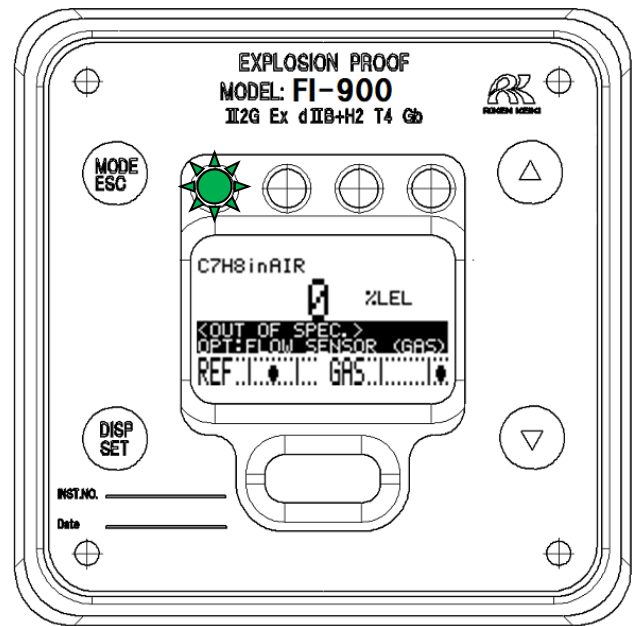


| Display | State description | Main causes and corrective action |
|--|--|---|
| <pre> <FAILURE> MAIN: ROM (1/1) REF: GAS: </pre> | Main controller ROM fault | The main controller ROM is faulty. The main controller must be replaced. |
| <pre> <FAILURE> MAIN: RAM (1/1) REF: GAS: </pre> | Main controller RAM fault | The main controller RAM is faulty. The main controller must be replaced. |
| <pre> <FAILURE> MAIN: FRAM (1/1) REF: GAS: </pre> | Main controller FRAM fault | The main controller FRAM is faulty. The main controller must be replaced. |
| <pre> <FAILURE> MAIN: TEMP. SENSOR (1/1) REF: GAS: </pre> | Abnormal temperature detected in main controller | If there is no problem in the installation environment, the main controller may be defective. |

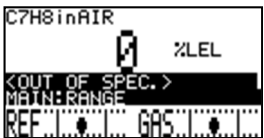
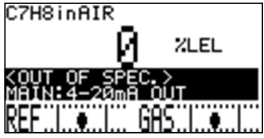
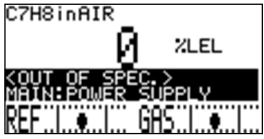
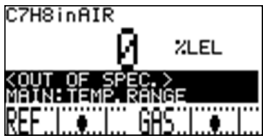
| Display | State description | Main causes and corrective action |
|---|---|--|
|  | Supply power abnormality detected in main controller | If there is no problem with the power supply to the product, the power supply terminal plate unit or main controller may be defective. |
|  | Sensor abnormality detected in main controller | The cable connecting the sensor to the main controller or the sensor may be defective. |
|  | 4-20 mA output signal abnormality detected in main controller | If there is no problem such as disconnection of the 4-20 mA cable, the power supply terminal plate unit or main controller may be defective. |
|  | ROM abnormality detected in sensor | The sensor ROM is faulty. The sensor must be replaced. |
|  | RAM abnormality detected in sensor | The sensor RAM is faulty. The sensor must be replaced. |
|  | FRAM abnormality detected in sensor | The sensor FRAM is faulty. The sensor must be replaced. |
|  | Temperature abnormality detected in sensor | If there is no problem in the installation environment, the sensor may be defective. |
|  | Abnormal GAS OUT absolute pressure detected in sensor | If there is no problem such as blockage in the gas suction inlet or pipes, the sensor may be defective. |
|  | Supply power abnormality detected in sensor | If there is no problem with the power supply to the product, the power supply terminal plate unit or sensor may be defective. |

| Display | State description | Main causes and corrective action |
|---|--|---|
|  | Abnormal light intensity drop in interference fringe image data detected in sensor | The sensor may be damaged due to foreign matter being sucked in. |
|  | Abnormal contrast drop in interference fringe image data detected in sensor | The sensor may be damaged due to foreign matter being sucked in. |
|  | Reference gas flow rate abnormality detected in sensor | The supply rate may be too low, too high, or passages inside the product may be blocked or leaking. |
|  | Target gas flow rate abnormality detected in sensor | The supply rate may be too low, too high, or passages inside the product may be blocked or leaking. |

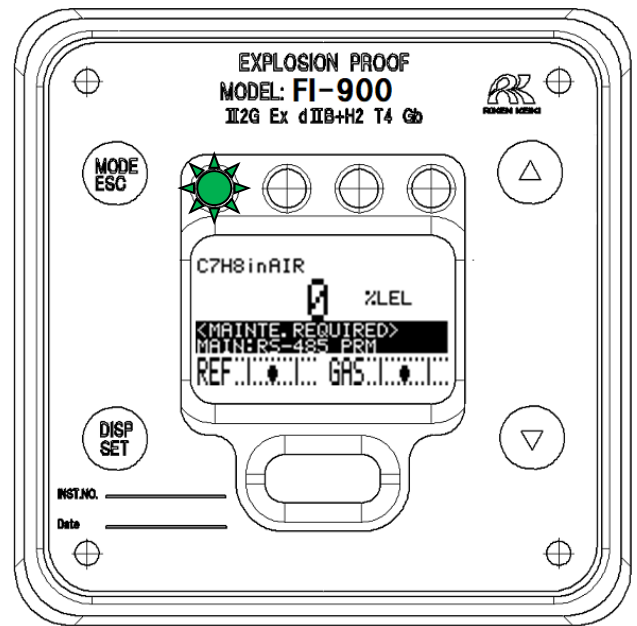
9-2. Outside specification range <OUT OF SPECIFICATION>



| Display | State description | Main causes and corrective action |
|---------|--|---|
| | Target gas flow rate outside specified range detected in sensor | Adjust the gas flow rate to within the specified range. |
| | Reference gas flow rate outside specified range detected in sensor | Adjust the reference gas flow rate to within the specified range. |
| | Sudden fluctuations in GAS OUT absolute pressure detected in sensor | There may be a suction abnormality due to sudden pressure fluctuations inside the test chamber or due to blockage of the gas suction inlet. |
| | GAS OUT absolute pressure outside specified range detected in sensor | The gas suction inlet may be blocked or the internal filter may be clogged. |
| | Sudden temperature fluctuations detected in sensor | The sensor usage environment needs to be reassessed. |
| | Temperature outside specification range detected in sensor | The sensor usage environment needs to be reassessed. |

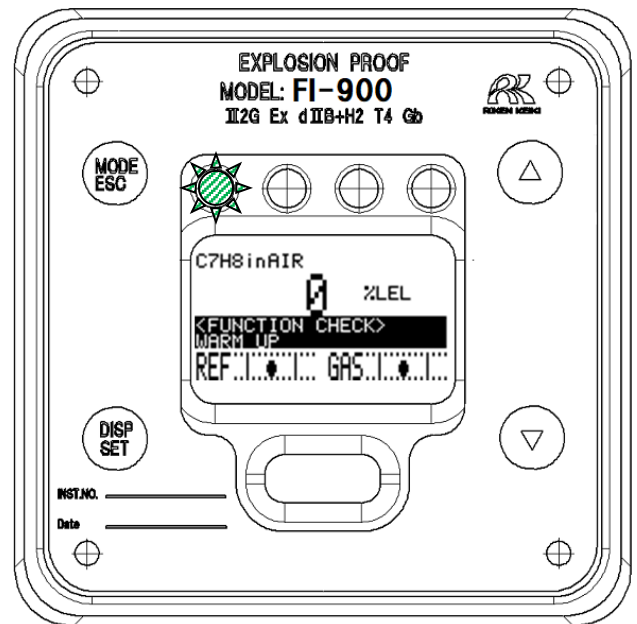
| Display | State description | Main causes and corrective action |
|--|---|--|
|  | Concentration outside specification range detected | Check to confirm that the conditions indicated in the Target Gas Specifications are satisfied. |
|  | Faulty 4-20 mA signal output detected in main controller | <p>Check to confirm that the usage method satisfies the cable connection/load resistance (max. 300 Ω) conditions.</p> <p>Short-circuit the output terminals if the 4-20 mA output is not used.</p> |
|  | Power supply outside specified range detected in main controller | Check to confirm that the power supply provided satisfies the required specifications. |
|  | Temperature outside specification range detected in main controller | The product usage environment needs to be reassessed. |

9-3. Maintenance request <MAINTENANCE REQUIRED>



| Display | State description | Main causes and corrective action |
|---------|---|---|
| | Abnormality detected in RS-485 communication settings | RS-485 communication must be reset. |
| | Drift within permitted range detected in sensor | Perform reference gas calibration (REF.CALIBRATION). |
| | Interference fringe contrast drop within permitted range detected in sensor | The optical sensor inside the sensor unit is becoming progressively dirty or degraded. The sensor must be replaced. |
| | Interference fringe light intensity drop within permitted range detected in sensor. | The optical sensor inside the sensor unit is becoming progressively dirty or degraded. The sensor must be replaced. |
| | Sensor mismatch between chamber length and gas specifications | Wrong combination of measurement gas and optical sensor unit. It is necessary to replace the optical sensor unit with an optical sensor unit of the correct chamber length. |

9-4. Function checking <FUNCTION CHECK>

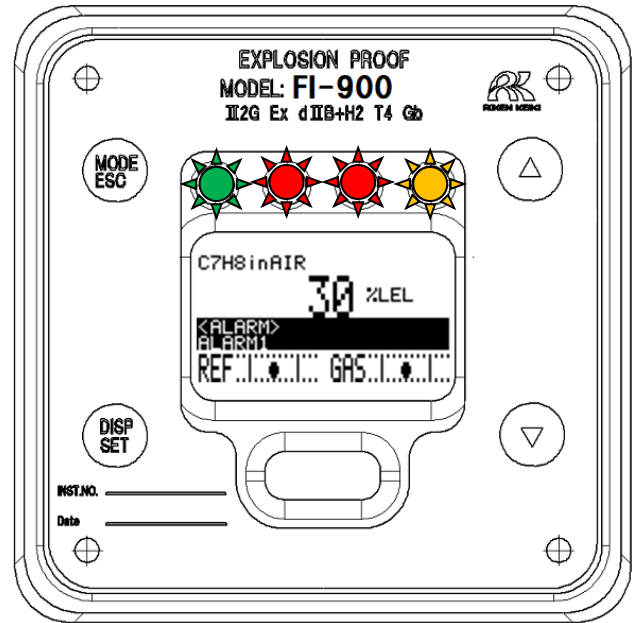


| Display | State description | Main causes and corrective action |
|---------|---|--|
| | State in which function checking is active using external communication | This display does not appear with standard specifications. |
| | Automatic reference calibration (optional function) underway | This display does not appear with standard specifications. |
| | Warm-up underway | This display does not appear with standard specifications. |
| | Check reference gas (optional function) underway | This display does not occur under normal specifications. |

*NOTE

The 4-20 mA output is linked to the reading only during FUNCTION CHECK warm-up. The warm-up function is designed to perform 4-20 mA output operations differing from other function checks in order to restore the 4-20 mA output value as quickly as possible after temporary power cut-outs due to momentary power failures.





9-5. Concentration alarm <ALARM>




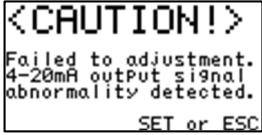
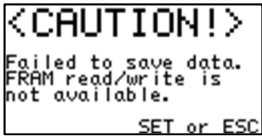
| Display | State description | Main causes and corrective action |
|---------|---|---|
| | State in which the measured value greatly exceeds the upper limit of the measurement range | If this is not reset by performing reference gas calibration, check the target gas. |
| | State in which the measured value is greatly below the lower limit of the measurement range | If this is not reset by performing reference gas calibration, check the target gas. |

9-6. Caution display <CAUTION>

A caution screen is displayed as a cautionary warning if measurement is stopped and the 4-20 mA output signal and contact signal are fixed or changed to values that differ from the measurement state. Selecting "OK" and continuing with the subsequent processing will change the output signal.

| Display | Main causes and corrective action |
|--|---|
|  | Displayed before resetting the LCD screen and contact hold state |
|  | Displayed before stopping measurement and fixing to a specified output value when entering setup mode |
|  | Displayed when the signal output will differ from the specified value in setup mode |
|  | Displayed when the contact will differ from the contact state fixed when measurement is stopped in setup mode |

The following displays may appear when operating in setup mode.

| Display | Main causes and corrective action |
|---|--|
|  | <p>Screen displayed when data differing greatly from the previous results is detected after performing "S.09.-- Reference gas calibration" in setup mode</p> <p>Sufficient reference gas may not be flowing in via the FI-900 GAS IN inlet. Thoroughly check to confirm that the operations and procedures are correct before selecting "OK".</p> <p>Note that if this screen appears frequently, the optical sensor unit or sampling system may be defective.</p> |
|  | <p>Screen displayed when the 4-20 mA output circuit is detected as open after performing "S.03.-- 4-20 mA output signal adjustment" in setup mode</p> <p>Adjust with the 4-20 mA output circuit connected.</p> <p>Note that if this screen appears frequently, the main controller unit or terminal plate unit may be defective.</p> |
|  | Displayed when writing setting information to the FRAM fails after modifying the settings in setup mode. If writing fails repeatedly or frequently, the main controller may be defective. |

| | |
|--|---|
| <pre> <CAUTION!> Supply Power too low. No data being saved. SET or ESC </pre> | <p>Displayed when the power required for writing setting information to the FRAM is not provided after modifying the settings in setup mode. If no problem is identified in the power supply fed to the FI-900, the power supply terminal plate unit or main controller may be defective.</p> |
| <pre> <CAUTION!> Time up. Failed to connect. SET or ESC </pre> | <p>Screen that may appear only under special work conditions such as FI-900 manufacturing processes</p> |

9-7. Other displays

| Display | Main causes and corrective action |
|---|--|
| <pre> SETUP MODE ----- PASSWORD ERROR ----- SET or ESC </pre> | <p>The left screen will be displayed if an incorrect password is entered when prompted to enter setup mode. Press the SET key or ESC key to perform the procedure to enter setup mode again.</p> |

9-8. Unrelated to screen display

| Display | Main causes | Corrective action |
|--|--|---|
| <p>The power cannot be turned on. Nothing is displayed.</p> | <p>The power switch is turned off.</p> | <p>Turn on the power switch.</p> |
| | <p>A fuse has blown.</p> | <p>Check the fuse and replace with a rated fuse if it has blown.</p> |
| | <p>Power supply circuit abnormality/instantaneous interruption</p> | <p>Check the power supply voltage. Make sure the power is supplied at the rated voltage. Take the appropriate action such as reassessing/adding an uninterruptible power supply, power supply line filter, and insulated transformer.</p> |
| | <p>Internal connector cable abnormality (disconnected/unconnected/short-circuit)</p> | <p>Check the internal cables for coming off, crushing, damage, short-circuit, etc. If there are abnormalities with the flat cable, the main unit will need to be replaced. Contact Riken Keiki. If there are abnormalities with a cable connecting to the terminal plate, take appropriate action such as reconnecting.</p> |
| <p>External connector cable abnormality (disconnected/unconnected/short-circuit)</p> | <p>Check the external cables for coming off, crushing, damage, short-circuit, etc. If there are abnormalities with a cable, take appropriate action such as cable replacement.</p> | |

==== 10. Product Specifications =====

10-1. Standard specifications

| | |
|-----------------------------|---|
| Model | FI-900 |
| Measuring principle | Optical interferometric method |
| Target gas | Refer to the separate "Target Gas Specifications". |
| Measurement range | Refer to the separate "Target Gas Specifications". |
| Alarm setpoints | Depending on the measuring gas. |
| Measurement accuracy | F.S. $\pm 3\%$ (Under identical conditions, refer to the separate "Target Gas Specifications".) |
| Response time | T90 within 30 s (Refer to the separate "Target Gas Specifications".) |
| Measuring method | Gas introduction at prescribed flow rate from external sampling system |
| Prescribed flow rate | Measuring gas flow rate : 300mL/min Reference gas flow rate : 10mL/min |
| Display function | Full-dot LCD (with backlight) concentration readout/maintenance indications, LED lamp status indications |
| External output | 4 mA to 20 mA DC (insulated, current discharge type), maximum permissible load resistance 300 Ω |
| Communication output | RS-485 Modbus output function (option) |
| Maintenance output | IrDA communication |
| First alarm contacts | No-voltage contact; contact capacity 1 A, 30 V DC (resistance load) |
| Second alarm contacts | No-voltage contact; contact capacity 1 A, 30 V DC (resistance load) |
| Fault alarm contacts | No-voltage contact; contact capacity 1 A, 30 V DC (resistance load) |
| Self-diagnostic function | Reduced light intensity, reduced contrast, air pressure abnormality, temperature abnormality, reduced flow rate, etc. |
| Power source | 100 V to 240 V AC $\pm 10\%$, 50/60 Hz / 24 V DC $\pm 10\%$ * DC power supply only for ATEX/IECEX spec. |
| Power consumption | Max. 20 VA (100 V to 240 V AC $\pm 10\%$, 50/60 Hz) / Max. 6 W (24 V DC $\pm 10\%$) * DC power supply only for ATEX/IECEX spec. |
| Recommended cables | Output cable: CVVS or similar shielded cable (1.25 mm ² or 2 mm ²)/2-core Communication cable: KPEVS or similar shielded twisted-pair cable (0.75 mm ²)/2 pairs Contact cable: CVVS or similar shielded cable (1.25 mm ² or 6 mm ²)/2- to 6-core AC Power cable: CVV or similar cable (1.25 mm ² or 2 mm ²)/2- or 3-core DC Power cable: CVVS or similar cable (1.25 mm ² or 2 mm ²)/2- or 3-core |
| Warm-up time | Initial: Approx. 5 seconds No warm-up time (Refer to the separate "Target Gas Specifications".) |
| Protection level | Equivalent to IP 66/67 |
| Operating temperature range | Japan Ex spec.: -20 °C to +57 °C (no sudden changes) IECEX/ATEX spec.: -20 °C to +60 °C (no sudden changes) |
| Operating humidity range | Not exceeding 95 %RH (no condensation/liquefaction of gas inside product) |
| Operating pressure range | Atmospheric pressure (with no surging) |

| | |
|------------------------------|---|
| Target gas temperature | Equal to ambient temperature at GAS IN on main unit (no condensation/liquefaction of gas inside product) |
| External dimensions | Approx. 286 mm (W) × 453 mm (H) × 150 mm (D) (excluding projections) |
| Weight | Approx. 23 kg |
| Explosion-proof construction | Flame-proof enclosure |
| Explosion-proof class | Japan Ex : Ex d II B+H ₂ T4 IECEX : Ex d IIB+H ₂ T4 Gb ATEX : II 2 G Ex db IIB+H ₂ T4 Gb |
| Self-diagnostic function | Status monitoring in four categories <ul style="list-style-type: none"> • Abnormality (FAILURE) • Function checking (FUNCTION CHECK) • Maintenance request (MAINTENANCE REQUIRED) • Outside specification range (OUT OF SPECIFICATION) |
| Other functions | <ul style="list-style-type: none"> • Ambient temperature and atmospheric pressure correction functions (depending on target gas specifications) • Flow rate display function (on target gas side, reference gas side) • Automatic light intensity adjustment function • Zero suppression function (standard: OFF, settable) |



CAUTION

The product interior temperature will be even higher than the ambient temperature when used in ambient temperatures around 50 °C. Avoid using the product in environments where the temperature may rise to 50 °C or higher at any hour of day or night, as this may negatively affect the product life.

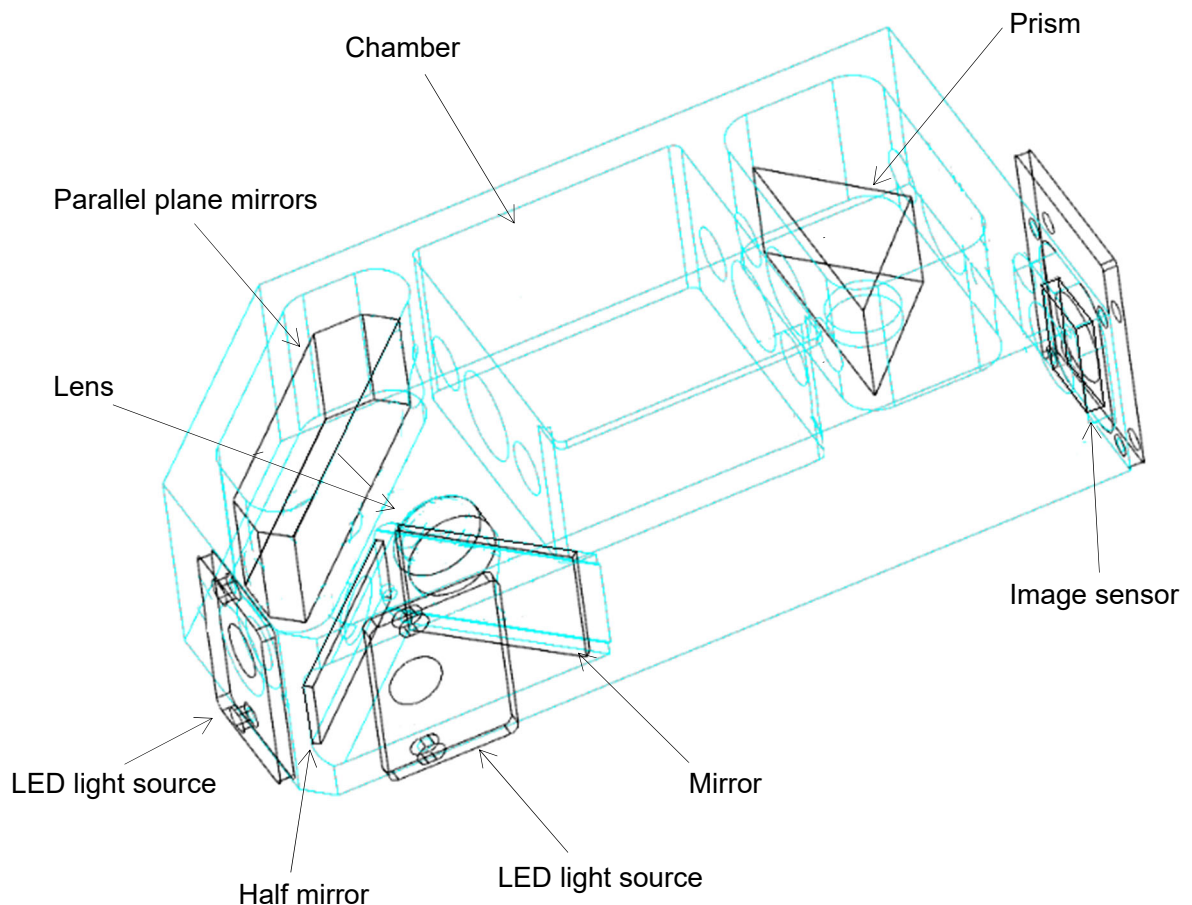
10-2. Detection principle

The refractive index of a gas mixture is determined by the types and mixing ratios of different gases contained within it. If a gas mixture consists of two known gas types, their mixing ratios (concentrations) can be determined by measuring the refractive index.

The optical interferometric sensor used in this product forms an interference fringe image on the image sensor, with these fringes moving proportionally with variations in refractive index. This interference fringe image is recorded by the image sensor and subjected to phase analysis to determine the interference fringe displacement with a high degree of precision, which is then converted to the refractive index.

Concentrations of various gas mixtures can be displayed by calculating data such as types of target gas and base gas making up the gas mixture and the precise refractive index obtained.

The sensitivity of the optical interferometric sensor is determined by the length of the chamber through which the gas flows. As the chamber length is unvarying, a high degree of precision can be maintained over extended periods.



Schematic diagram of an optical interferometric sensor

==== 11. Terminology =====

Definitions of terminology used in this manual

| | |
|-----------------------|--|
| Lower explosive limit | The minimum concentration of a combustible gas mixed in air at which ignition will result in explosion |
| %LEL | The concentration of a combustible gas expressed as a percentage of the lower explosive limit of the combustible gas |
| vol% | The concentration of gases in units of parts per 100 by volume |
| Grounding | Connect the grounding terminal of the product to a specified facility to prevent electric shock. |
| Target gas | The gas to be measured within the sample gas |
| Base gas | The remaining gas in the sample gas excluding the target gas. The product normally takes measurements in air. The base gas for the product will normally be air (fresh atmosphere). |
| Reference gas | Gas used as datum (refractive index datum) for concentration measurements The product normally uses the base gas as the reference gas. The reference gas for the product will normally be air (fresh atmosphere). |

Revision history

| Issue | Revision | Issue date |
|-------|---|------------|
| 0 | First issue | 6/15/2020 |
| 1 | Standardize words 「analyzer → monitor」 / Error correction Addition 「10-1. Standard specifications: Specified flow」 Correction 「1-6-2. Technical data: Applicable Standards」 , Declaration of conformity | 7/13/2020 |
| 2 | Correction Safety information, Declaration of conformity | 8/21/2020 |
| 3 | Correction 「9. Troubleshooting」 | 9/25/2020 |
| 4 | Addition 「S.21.-- Automatic reference calibration setting “AUTO REF.CAL SETUP”」 | 3/10/2021 |
| 5 | Declaration of conformity | 11/12/2021 |
| 6 | Addition 「UKEX specification」 , Correction CE Declaration of conformity, Addition UKCA Declaration of conformity | 10/12/2023 |
| 7 | Delete 「UKEX specification」 , Correction CE Declaration of conformity, Delete UKCA Declaration of conformity | 5/31/2024 |



EU-Declaration of Conformity

Document No. 320CE24092



We, RIKEN KEIKI Co., Ltd. 2-7-6, Azusawa, Itabashi-ku, Tokyo, 174-8744, Japan declare under our sole responsibility that the following product conforms to all the relevant provisions.

Product Name Optical Interferometric Gas Monitor
Model FI-900

| Council Directives | Applicable Standards |
|------------------------------------|--|
| EMC Directive (2014/30/EU) | EN 61326-1:2013 |
| ATEX Directive (2014/34/EU) | EN IEC 60079-0:2018 EN 60079-1:2014 |
| BATTERY Regulation ((EU)2023/1542) | - |
| RoHS Directive (2011/65/EU[1]) | EN IEC 63000:2018 |


^[1]Including substances added by Commission Delegated Directive (EU) 2015/863

EU-Type examination Certificate No. DEKRA 12ATEX0187X

Notified Body for ATEX DEKRA Certification B.V. (NB 0344)
Meander 1051, 6825 MJ Arnhem
P.O. Box 5185, 6802 ED Arnhem
The Netherlands

Auditing Organization for ATEX DEKRA Certification B.V. (NB 0344)
Meander 1051, 6825 MJ Arnhem
P.O. Box 5185, 6802 ED Arnhem
The Netherlands

The marking of the product shall include the following:

 II 2 G Ex db IIB + H₂ T4 Gb -20°C ≤ Ta ≤ +60°C

Alternative Marking: -

Place: Tokyo, Japan

Date: May. 24, 2024

Takakura Toshiyuki
General manager
Quality Control Center