

Gas Detector with Signal Converter

SD-3 Series

Technical Manual

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1

Product Overview

1-1 Introduction

Thank you for purchasing the SD-3 Gas Detector with Signal Converter ("product" hereinafter).

This operating manual describes product operating procedures and specifications. It provides information essential to correct use of the product.

Make sure you have read and fully understood the contents of this manual before using the product.

Keep this operating manual on hand to allow ready reference during use.

The contents of this manual are subject to change without notice to allow product improvements. Any duplication or reproduction of this manual without permission is prohibited, whether in whole or in part.

Riken Keiki accepts no liability for accidents or damage resulting from use of the product, whether within or outside the warranty period.

Be sure to read the warranty policy at the end of this document.

Before using the product, please confirm that the model of the product you purchased matches the model of the product covered by this operating manual.

<Models covered by this operating manual>

| | Diffusion type | Suction type |
|---------------------------|----------------|--------------|
| Main unit | SD-3RI | SD-3DRI |
| | SD-3NC | SD-3DNC |
| | SD-3GH | SD-3DGH |
| | SD-3GHS | SD-3DGHS |
| | SD-3SP | SD-3DSP |
| | SD-3EC | SD-3DEC |
| | SD-3ECS | SD-3DECS |
| | SD-3ECB | SD-3DECB |
| Main unit | SD-3SC | |
| Remote sensor head | GD-3RI | |
| | GD-3NC | |
| | GD-3GH | |
| | GD-3GHS | |
| | GD-3SP | |
| | GD-3EC | |
| | GD-3ECS | |
| | GD-3ECB | |

<This operating manual>

In this operating manual, where descriptions differ according to the detection principle, these are indicated by the following icons:

| | |
|--|-----------|
| Non-dispersive infrared absorption type (infrared type) | RI |
| New ceramic type | NC |
| Semiconductor type | GH |
| Hot-wire semiconductor type | SP |
| Electrochemical type | EC |

Operating procedures and specifications for which no icons appear apply to all detection principles.

The display examples provided in this operating manual apply when the detection target gas is combustible (display units: %LEL).

1-2 Intended use and features

The product is a fixed explosion-proof device for continuous monitoring of combustible gases, toxic gases, and oxygen in the air.

An alarm is triggered if combustible gases, toxic gases, or oxygen exceeding preset concentrations are detected in the air.

The detection results are not intended to assure life or safety.

1-2-1 Models and Codes

SD-3 (1) (2) (3) 1 0 0 (7) (8)

[Remote type: Main unit (SD-3SC) + Remote sensor unit (GD-3)]

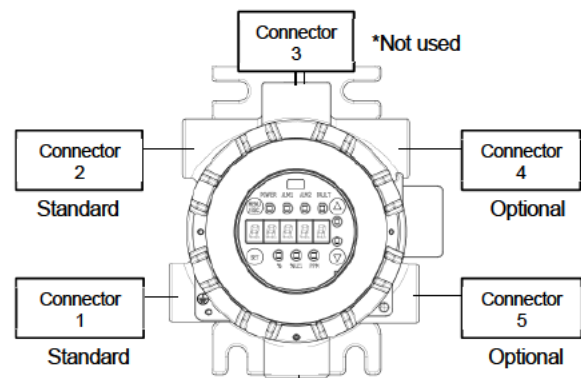
SD-3SC (3) 1 0 0 (7) (8)

GD-3 (1) (2)

| ① Diffusion type/suction type selection | |
|---|---|
| Blank | Diffusion type |
| D | Suction type (introduced via external unit) |
| ② Sensor type selection | |
| RI | Infrared type |
| NC | New ceramic type |
| GH | Semiconductor type |
| GHS | Semiconductor type (selectable for CS ₂ only) |
| SP | Hot-wire semiconductor type |
| EC | Electrochemical type (selectable for CO/O ₂ only) |
| ECS | Electrochemical type (selectable for H ₂ S only) |
| ECB | Electrochemical type (selectable for gases other than CO/O ₂ /H ₂) |
| ③ Cable connectors | |
| 0 | Connector 1 + Connector 2 [Standard] |
| 1 | Connector 1 + Connector 2+ Connector 4 + Connector 5 |
| ④ Explosion-proof | |
| 1 | ATEX/IECEX [Standard] |
| 2 | - |
| 3 | - |
| 4 | - |
| ⑤ Functional safety | |
| 0 | None [Standard] |
| 1 | - |

| ⑥ Performance certification | |
|-----------------------------|--|
| 0 | None [Standard] |
| 1 | - |
| 2 | - |
| 3 | - |
| ⑦ Range setting* | |
| 0 | Single range [Standard] |
| 1 | Double range +4-16 (selectable with NC only) |
| 2 | Double range + L4-20 (selectable with NC only) |
| 3 | Double range + H4-20 (selectable with NC only) |
| ⑧ Output type selection | |
| 0 | 4-20 mA + HART [Standard] |
| 1 | 4-20 mA + HART + contact (3c) |
| 2 | - |

*HART communication is unavailable when double range (optional) is selected.



Example: Cable connectors

1-2-2 Detection principles and detection target gases for individual models

The product is available in the following models, depending on the specific detection method and detection principle.

Check the specifications before use to confirm that correct gases will be detected in accordance with the intended purpose.

<List of detection target gases by model>

| Main unit model | Detection method | Detection principle | Detection target gas | | | Remarks |
|-----------------|------------------|---|----------------------|-----------|--------|--|
| | | | Combustible gas | Toxic gas | Oxygen | |
| SD-3RI | Diffusion | Non-dispersive infrared absorption type (infrared type) | ○ | ○ | | |
| SD-3NC | | New ceramic type | ○ | | | |
| SD-3GH | | Semiconductor type | ○ | ○ | | |
| SD-3GHS | | Semiconductor type | | ○ | | CS ₂ (carbon disulfide) only |
| SD-3SP | | Hot-wire semiconductor type | ○ | ○ | | |
| SD-3EC | | Electrochemical type | | ○ | ○ | |
| SD-3ECS | | Electrochemical type | | ○ | | H ₂ S (hydrogen sulfide) only |
| SD-3ECB | | Electrochemical type | | ○ | | With EC barrier* |
| SD-3DRI | Suction | Non-dispersive infrared absorption type (infrared type) | ○ | ○ | | |
| SD-3DNC | | New ceramic type | ○ | | | |
| SD-3DGH | | Semiconductor type | ○ | ○ | | |
| SD-3DGHHS | | Semiconductor type | | ○ | | CS ₂ (carbon disulfide) only |
| SD-3DSP | | Hot-wire semiconductor type | ○ | ○ | | |
| SD-3DEC | | Electrochemical type | | ○ | ○ | |
| SD-3DECS | | Electrochemical type | | ○ | | H ₂ S (hydrogen sulfide) only |
| SD-3DECB | | Electrochemical type | | ○ | | With EC barrier* |

*Differs depending on detection target gas.

<List of detection target gases by model (remote sensor type)>

| | |
|-----------------|--------|
| Main unit model | SD-3SC |
|-----------------|--------|

| Remote sensor head model | Detection method | Detection principle | Detection target gas | | | Remarks |
|--------------------------|------------------|---|----------------------|-----------|--------|--|
| | | | Combustible gas | Toxic gas | Oxygen | |
| GD-3RI | Diffusion | Non-dispersive infrared absorption type (infrared type) | ○ | ○ | | |
| GD-3NC | | New ceramic type | ○ | | | |
| GD-3GH | | Semiconductor type | ○ | ○ | | |
| GD-3GHS | | Semiconductor type | | ○ | | CS ₂ (carbon disulfide) only |
| GD-3SP | | Hot-wire semiconductor type | ○ | ○ | | |
| GD-3EC | | Electrochemical type | | ○ | ○ | |
| GD-3ECS | | Electrochemical type | | ○ | | H ₂ S (hydrogen sulfide) only |
| GD-3ECB | | Electrochemical type | | ○ | | With EC barrier* |

*Differs depending on detection target gas.

<Sensor models and detection principles>

| Sensor model | Detection principle |
|--------------|-----------------------------|
| IRF | Infrared type |
| NCF | New ceramic type |
| SGF | Semiconductor type |
| SHF | Hot-wire semiconductor type |
| ESF | Electrochemical type |

1-2-3 Product features

<Standard specifications>

- The product is constructed with a stainless steel housing suitable for both indoors and outdoors use.
- Requires a 24 V DC (DC 18 V to 30 V) power supply.
- The gas concentration, status, and command selection menu are displayed using seven-segment LEDs.
- The concentration of the gas detected is converted to a 4 - 20 mA analog output (NAMUR NE43 compliant) or a digital HART output signal.
- It can be connected to a Riken Keiki monitoring system or programmable logic controller (PLC) via a ceiling fitting or approved cable gland.

<Optional specifications>

- The product can be operated as a standalone unit by setting an alarm relay. Using the product as a standalone unit allows control of devices without the need for a central controller.*1




*1: Using the product as a standalone unit requires additional alarm signal settings.

1-3 Usage zones and conditions

The product is approved for use in areas where gases classified in explosive gas groups IIA, IIB, or IIC may be present. This refers to use limited to hazardous zones categorized as Zone 1 or Zone 2 within the product operating temperature range.

1-4 DANGER, WARNING, and NOTE

This operating manual uses the following categories to indicate potential damage/hazards if the user disregards the information provided and uses the product incorrectly:

| | |
|--|--|
|  DANGER | This indicates situations in which improper handling may result in fatal or serious injury or significant property damage. |
|  WARNING | This indicates situations in which improper handling may result in serious injury or significant property damage. |
|  CAUTION | This indicates situations in which improper handling may result in minor injury or minor property damage. |

Additionally, usage recommendations are indicated as follows:

| | |
|-------------|---|
| NOTE | This indicates items that will be helpful to know when using the product. |
|-------------|---|

2

Important Safety Information

2-1 Danger information



DANGER

- Do not open the cover while the power is turned on. When opening the cover, use a portable gas detector or other similar device to confirm that there is no gas present in the vicinity.
 - Do not attempt to repair the product.
 - Do not attempt to repair or replace the explosion-proof bonding surface. If you observe scratches, cracks, or deformation on the housing or explosion-proof bonding surface, stop using the product immediately and contact Riken Keiki promptly.
-

2-2 Warning information



WARNING

- Before turning on the power for the product, be sure to confirm that the power source meets the specified voltage requirements.
Using power supplies other than the stipulated voltage will damage the product. Do not use unstable power supplies. Doing so may result in malfunctions.
 - Do not disconnect the protective grounding wire or terminal.
 - Before operating the product, check the protective functions for defects.
Do not operate the product if you suspect any problems with the protective grounding or other protective functions.
 - Connect to a protective ground before connecting to external control circuits.
 - Before adjusting zero for the surrounding atmosphere, confirm that the surrounding atmosphere contains clean air.
The presence of interference gases will prevent proper air calibration. The presence of miscellaneous gases is also extremely dangerous because the product may not detect actual gas leaks correctly.
 - A gas alarm indicates the presence of extreme danger. The user must take appropriate action after taking suitable steps to ensure safety.
 - Do not immerse the product in organic solvents for extended periods. The flame arrester components are made of polyphenylene sulfide (PPS) resin.
-

2-3 Caution information



CAUTION

- The product operation may be affected by radio waves emitted from walkie-talkies or other radio transmitters used near the product or its cables. Position walkie-talkies or other similar devices so that they do not affect the product operation.
- Wait at least 10 seconds before turning the power back on again after turning off. The product may not function correctly if the power is turned back on immediately.
- The product is not a control device. Never use the product output to control other devices.
- Do not disassemble or alter the product. Product performance cannot be guaranteed if the product is disassembled or modified.
- Do not alter settings unnecessarily unless you are fully aware of the consequences. Doing so may result in improper alarm function. Avoid performing any operations not described in this operating manual.
- The product is a safety device. Be sure to maintain the product at regular intervals to ensure safety. Continuing to use the product without adequate maintenance will result in sensor sensitivity degradation and prevent proper gas detection.

2-4 Safety information

<Product overview>

- The products have an explosion-proof construction.
- Sensors are divided into three different types, depending on the corresponding detection principles. The detection methods are divided into the diffusion type and suction type. Suction-type sensors should be used with a suction cap fitted.
- The product is a fixed, continuous monitoring detector. It can be connected to a gas monitoring control unit, recorder, or programmable control unit to output the measured gas readings as a 4 - 20 mA signal or HART signal.
- The following three sets of output specifications are available for this product:
 - No alarm relay, no digital communication
 - 3 alarm relays (contact output) (alarm relays operate in conjunction with gas alarms and faults), no digital signal
 - No alarm relay, digital communication (RS-485 output)
- The electrochemical sensor is made into an explosion-proof construction by using an EC barrier.

<Detection principles and models>

- The models corresponding to the individual detection principles are as follows. The models are classified by detection principle and detection method.

| Detection principle (Detection method: Diffusion type) | | Model |
|--|---|------------------------------|
| Optical sensor | Non-dispersive infrared absorption type (infrared type) | SD-3RI |
| Solid state sensor | Semiconductor type | SD-3GH SD-3GHS |
| | New ceramic type | SD-3NC |
| | Hot-wire semiconductor type | SD-3SP |
| Electrochemical sensor | Electrochemical type | SD-3EC SD-3ECS SD-3ECB |

| Detection principle (Detection method: Suction type) | | Model |
|--|---|---------------------------------|
| Optical sensor | Non-dispersive infrared absorption type (infrared type) | SD-3DRI |
| Solid state sensor | Semiconductor type | SD-3DGH SD-3DGHS |
| | New ceramic type | SD-3DNC |
| | Hot-wire semiconductor type | SD-3DSP |
| Electrochemical sensor | Electrochemical type | SD-3DEC SD-3DECS SD-3DECB |

- The SD-3SC is used with a remote sensor head (GD-3) from among the following models:

| Detection principle (Detection method: Diffusion type) | | Model | |
|--|---|------------------------------|--------|
| | | GD-3 (Remote sensor head) | SD-3 |
| Optical sensor | Non-dispersive infrared absorption type (infrared type) | GD-3RI | SD-3SC |
| Solid state sensor | Semiconductor type | GD-3GH | |
| | | GD-3GHS | |
| | New ceramic type | GD-3NC | |
| Electrochemical sensor | Electrochemical type | GD-3SP | |
| | | GD-3EC | |
| | | GD-3ECS | |
| | | GD-3ECB | |



WARNING

- The SD-3EC and GD-3EC models are subdivided by the type of explosion-proof construction of the flame arrester fitted to the sensor and whether they include an EC barrier. The expected explosion-proof performance cannot be ensured if the incorrect flame arrester is used. Do not replace with a different flame arrester.
- The SD-3GH and GD-3GH models are subdivided by the type of explosion-proof construction of the flame arrester fitted to the sensor. The expected explosion-proof performance cannot be ensured if the incorrect flame arrester is used. Do not replace with a different flame arrester.

<Explosion-proof performance data>

The range of ambient temperatures in which explosion-proof performance can be maintained will differ depending on whether the optional lightning arrester is fitted.

Refer to the following performance data for each model:

<Without lightning arrester>

| Model | Explosion-proof construction | Group | Category | Explosion-proof class | EPL | Ambient temperature*1 |
|----------|------------------------------|-------|----------|-----------------------|-----|--|
| SD-3RI | d | II | 2G | Ex db IIC T6/T5 | Gb | -50 °C ≤ Ta ≤ +60 °C /+70 °C |
| SD-3DRI | | | | | | |
| GD-3RI | | | | | | |
| SD-3GH | d | II | 2G | Ex db IIC T5/T4 | Gb | -50 °C ≤ Ta ≤ +44 °C /+70 °C |
| SD-3DGH | | | | | | |
| GD-3GH | | | | | | |
| SD-3GHS | d | II | 2G | Ex db IIC T6/T4 | Gb | -50 °C ≤ Ta ≤ +47 °C /+70 °C |
| SD-3DGHS | | | | | | |
| GD-3GHS | | | | | | |
| SD-3NC | d | II | 2G | Ex db IIC T5/T4 | Gb | -50 °C ≤ Ta ≤ +44 °C /+70 °C |
| SD-3DNC | | | | | | |
| GD-3NC | | | | | | |
| SD-3SP | d | II | 2G | Ex db IIC T5/T4 | Gb | -50 °C ≤ Ta ≤ +55 °C /+70 °C |
| SD-3DSP | | | | | | |
| GD-3SP | | | | | | |
| SD-3EC | d | II | 2G | Ex db IIC T4 | Gb | -50 °C ≤ Ta ≤ +70 °C |
| SD-3DEC | | | | | | |
| GD-3EC | | | | | | |
| SD-3ECS | d | II | 2G | Ex db IIC T4 | Gb | -50 °C ≤ Ta ≤ +70 °C |
| SD-3DECS | | | | | | |
| GD-3ECS | | | | | | |
| SD-3ECB | d+i | II | 2G | Ex db ia IIC T4 | Gb | -40 °C ≤ Ta ≤ +70 °C |
| SD-3DECB | | | | | | |
| GD-3ECB | | | | | | |
| SD-3SC*2 | d | II | 2G | Ex db IIC T6/T5/T4 | Gb | -50 °C ≤ Ta ≤ +47 °C /+55 °C +70 °C |
| SD-3SC*3 | d | II | 2G | Ex db IIC T5/T4 | Gb | -50 °C ≤ Ta ≤ +44 °C /+70 °C |
| SD-3SC*4 | d | II | 2G | Ex db IIC T6/T5 | Gb | -50 °C ≤ Ta ≤ +60 °C /+70 °C |
| SD-3SC*5 | d | II | 2G | Ex db IIC T4 | Gb | -40 °C ≤ Ta ≤ +70 °C |

*1: The ambient temperature refers to temperatures in the range within which explosion-proof performance can be maintained. It does not imply the temperature range within which the required product performance may be achieved. For information on the operating temperature range, refer to '10-3 Detection target gases for individual detection principles'.

*2: When used in combination with GD-3GHS, GD-3SP, GD-3EC, and GD-3ECS

*3: When used in combination with GD-3GH and GD-3NC

*4: When used with the GD-3RI

*5: When used in combination with GF-3ECB

<With lightning arrester>

| Model | Explosion-proof construction | Group | Category | Explosion-proof class | EPL | Ambient temperature*1 |
|----------|------------------------------|-------|----------|-----------------------|-----|-------------------------------------|
| SD-3RI | d | II | 2G | Ex db IIC T6/T5 | Gb | -40 °C ≤ Ta ≤ +60 °C/+70 °C |
| SD-3DRI | | | | | | |
| GD-3RI | | | | | | |
| SD-3GH | d | II | 2G | Ex db IIC T5/T4 | Gb | -40 °C ≤ Ta ≤ +44 °C /+70 °C |
| SD-3DGH | | | | | | |
| GD-3GH | | | | | | |
| SD-3GHS | d | II | 2G | Ex db IIC T6/T4 | Gb | -40 °C ≤ Ta ≤ +47 °C /+70 °C |
| SD-3DGHS | | | | | | |
| GD-3GHS | | | | | | |
| SD-3NC | d | II | 2G | Ex db IIC T5/T4 | Gb | -40 °C ≤ Ta ≤ +44 °C /+70 °C |
| SD-3DNC | | | | | | |
| GD-3NC | | | | | | |
| SD-3SP | d | II | 2G | Ex db IIC T5/T4 | Gb | -40 °C ≤ Ta ≤ +55 °C /+70 °C |
| SD-3DSP | | | | | | |
| GD-3SP | | | | | | |
| SD-3EC | d | II | 2G | Ex db IIC T4 | Gb | -40 °C ≤ Ta ≤ +70 °C |
| SD-3DEC | | | | | | |
| GD-3EC | | | | | | |
| SD-3ECS | d | II | 2G | Ex db IIC T4 | Gb | -40 °C ≤ Ta ≤ +70 °C |
| SD-3DECS | | | | | | |
| GD-3ECS | | | | | | |
| SD-3ECB | d+i | II | 2G | Ex db ia IIC T4 | Gb | -40 °C ≤ Ta ≤ +70 °C |
| SD-3DECB | | | | | | |
| GD-3ECB | | | | | | |
| SD-3SC*2 | d | II | 2G | Ex db IIC T6/T5/T4 | Gb | -40 °C ≤ Ta ≤ +47 °C /+55 °C +70 °C |
| SD-3SC*3 | d | II | 2G | Ex db IIC T5/T4 | Gb | -40 °C ≤ Ta ≤ +44 °C /+70 °C |
| SD-3SC*4 | d | II | 2G | Ex db IIC T6/T5 | Gb | -40 °C ≤ Ta ≤ +60 °C /+70 °C |
| SD-3SC*5 | d | II | 2G | Ex db IIC T4 | Gb | -40 °C ≤ Ta ≤ +70 °C |

*1: The ambient temperature refers to temperatures in the range within which explosion-proof performance can be maintained. It does not imply the temperature range within which the required product performance may be achieved. For information on the operating temperature range, refer to '10-3 Detection target gases for individual detection principles'.

*2: When used in combination with GD-3GHS, GD-3SP, GD-3EC, and GD-3ECS

*3: When used in combination with GD-3GH and GD-3NC

*4: When used with the GD-3RI

*5: When used in combination with GF-3ECB

<Electrical data>

| Model | Supply voltage | Power consumption | Signal output | Option (select one) | | |
|----------|------------------------------------|-------------------|------------------|---|---|-----------------------|
| | | | | No alarm relay/ No digital communication | Alarm relay (contact output)/ Resistance load only | Digital communication |
| SD-3RI | 24 V DC (18 V - 30 V DC Max) | 3.8 W Max | 0 - 22 mA + HART | — | 30 V DC, 1 A 250 V AC, 2 A | RS-485 output |
| SD-3DRI | | 1.2 W Max | — | — | — | — |
| GD-3RI | | | — | — | — | — |
| SD-3GH | 24 V DC (18 V - 30 V DC Max) | 4.5 W Max | 0 - 22 mA + HART | — | 30 V DC, 1 A 250 V AC, 2 A | RS-485 output |
| SD-3DGH | | 2 W Max | — | — | — | — |
| GD-3GH | | | — | — | — | — |
| SD-3GHS | 24 V DC (18 V - 30 V DC Max) | 4.5 W Max | 0 - 22 mA + HART | — | 30 V DC, 1 A 250 V AC, 2 A | RS-485 output |
| SD-3DGH | | 2 W Max | — | — | — | — |
| GD-3GHS | | | — | — | — | — |
| SD-3NC | 24 V DC (18 V - 30 V DC Max) | 4.5 W Max | 0 - 22 mA + HART | — | 30 V DC, 1 A 250 V AC, 2 A | RS-485 output |
| SD-3DNC | | 2 W Max | — | — | — | — |
| GD-3NC | | | — | — | — | — |
| SD-3SP | 24 V DC (18 V - 30 V DC Max) | 3.5 W Max | 0 - 22 mA + HART | — | 30 V DC, 1 A 250 V AC, 2 A | RS-485 output |
| SD-3DSP | | 1 W Max | — | — | — | — |
| GD-3SP | | | — | — | — | — |
| SD-3EC | 24 V DC (18 V - 30 V DC Max) | 2.8 W Max | 0 - 22 mA + HART | — | 30 V DC, 1 A 250 V AC, 2 A | RS-485 output |
| SD-3DEC | | 1 W Max | — | — | — | — |
| GD-3EC | | | — | — | — | — |
| SD-3ECS | 24 V DC (18 V - 30 V DC Max) | 2.8 W Max | 0 - 22 mA + HART | — | 30 V DC, 1 A 250 V AC, 2 A | RS-485 output |
| SD-3DECS | | 1 W Max | — | — | — | — |
| GD-3ECS | | | — | — | — | — |
| SD-3ECB | 24 V DC (18 V - 30 V DC Max) | 3.1 W Max | 0 - 22 mA + HART | — | 30 V DC, 1 A 250 V AC, 2 A | RS-485 output |
| SD-3DECB | | 1 W Max | — | — | — | — |
| GD-3ECB | | | — | — | — | — |
| SD-3SC | 24 V DC (18 V - 30 V DC Max) | 5 W Max | 0 - 22 mA + HART | — | 30 V DC, 1 A 250 V AC, 2 A | RS-485 output |

<Certificate numbers>

- IECEx PRE 20.0064 X
- Presafe 20 ATEX 69725 X

* The "X" at the end of the certificate number indicates the following special operating conditions:

- Do not attempt to repair explosion-proof joints.
- Damage to the window plate due to strong impact may affect explosion-proof performance. The product is subject to "Low (2J)" explosion-proof conditions, indicating risk of mechanical damage.
- Avoid rubbing the nameplate area with a dry cloth during use, maintenance, or cleaning. Doing so may result in a static charge buildup of up to 6 nF.
- For information on the explosive-proof operating temperature range, refer to <Explosion-proof performance data> in '2-4 Safety information'.
- If attaching a lightning arrester to the SD-3, apply high-strength thread-locking compound to the mounting screw.
- The ATEX compliant models do not support the measuring functions specified in 1.5.5 of Annex II of the ATEX directive. This directive provides guidelines on the performance of gas detectors and safety devices and is based on the requirements of related EU harmonized standards.
- The IECEx models do not support the measuring functions of EUT. These guidelines address the performance of gas detectors and safety devices.

- The client should not try to replace the batteries.

<Applicable standards>

- IEC 60079-0:2017
- IEC 60079-1:2014
- IEC 60079-11:2011
- EN IEC 60079-0:2018
- EN 60079-1:2014
- EN 60079-11:2012

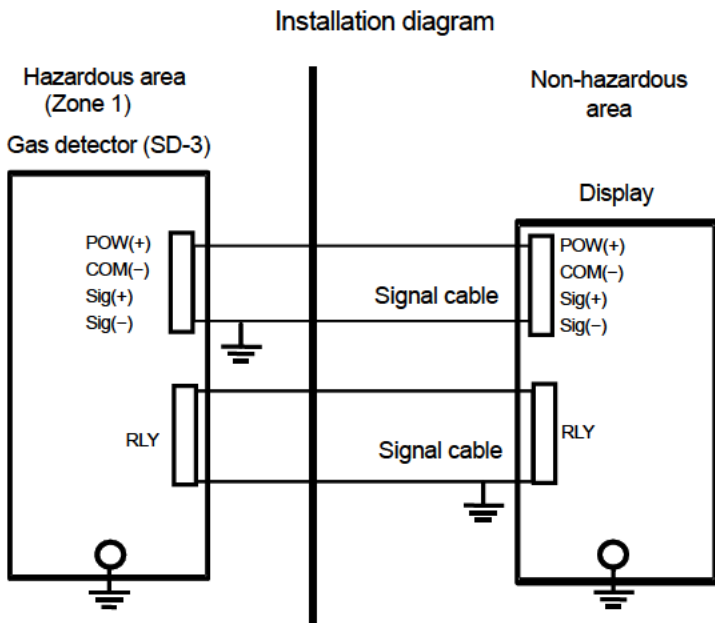
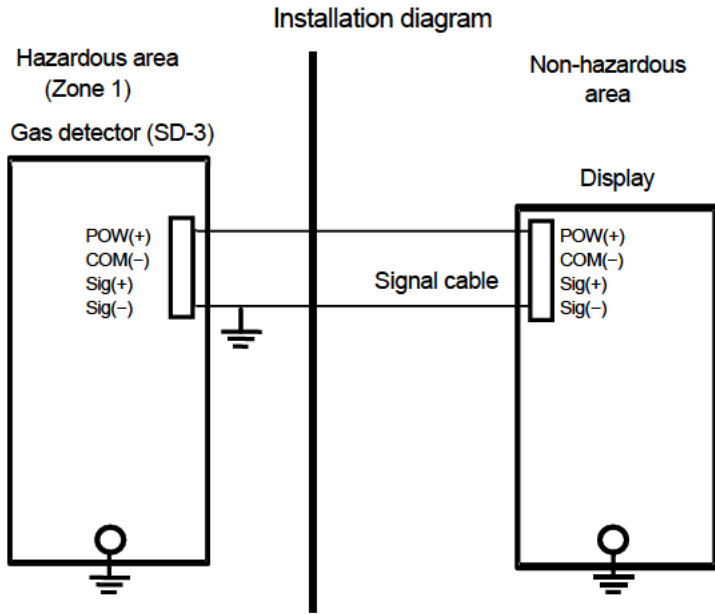
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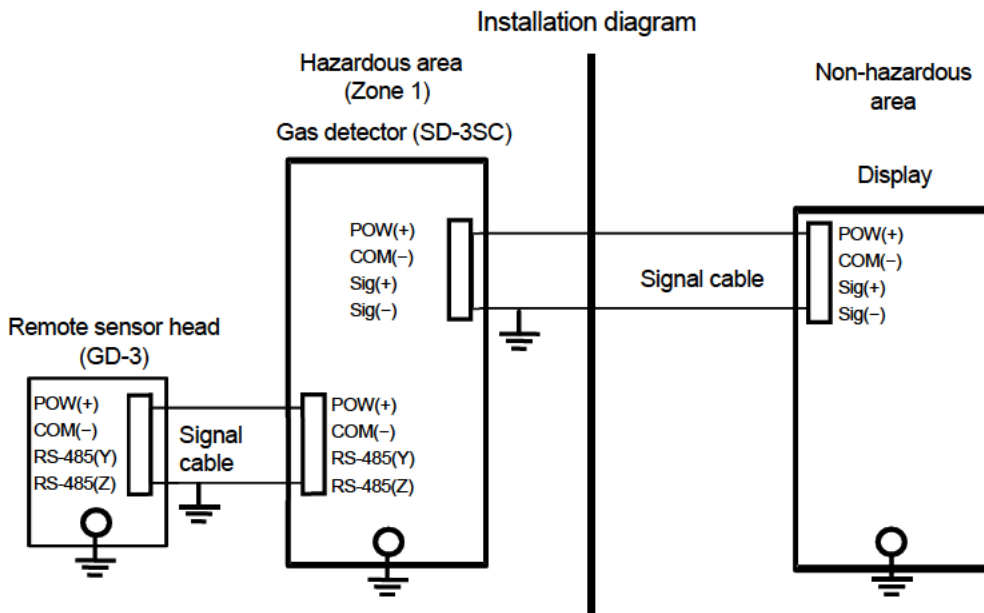
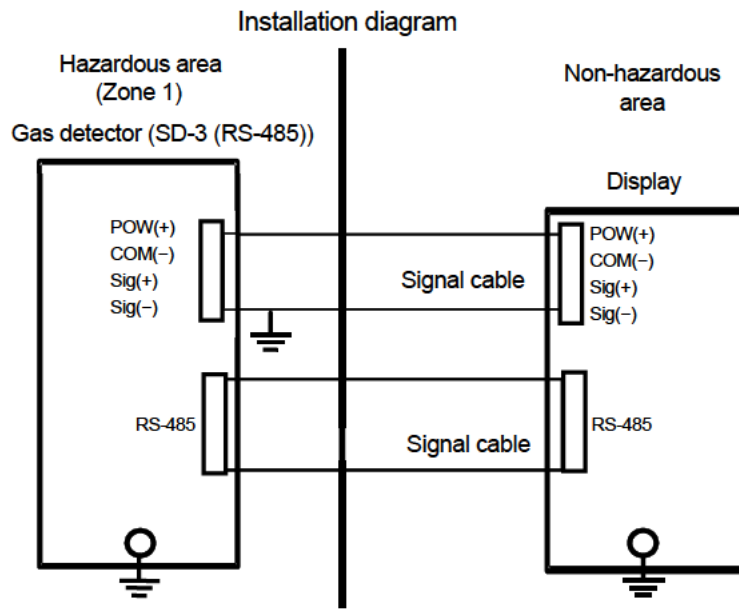
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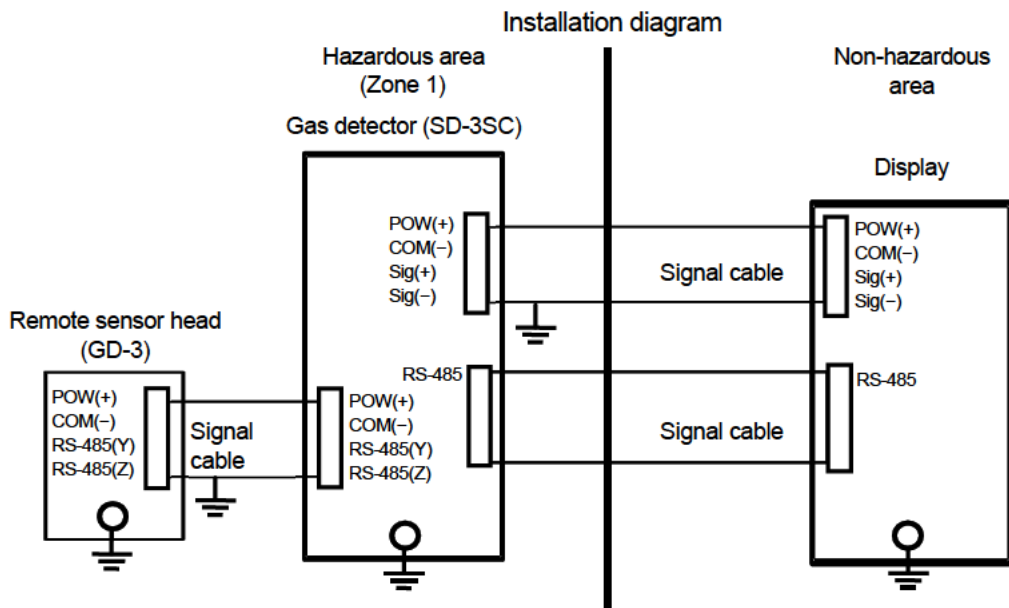
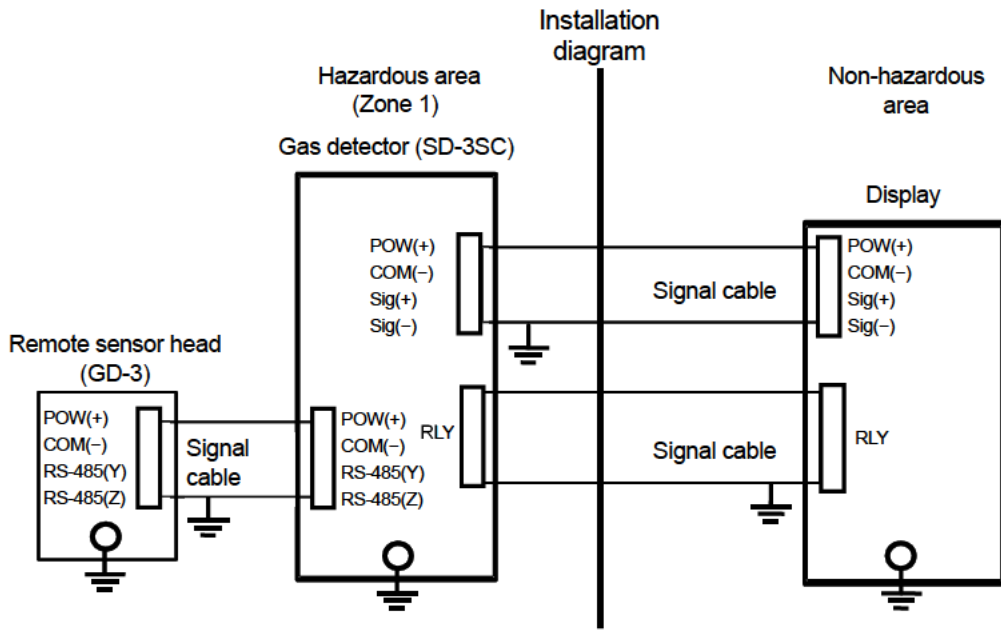


RIKEN KEIKI Co., Ltd.
2-7-6 Azusawa, Itabashi-ku, Tokyo, 174-8744, Japan
Phone: +81-3-3966-1113
Fax: +81-3-3558-9110
Email: intdept@rikenkeiki.co.jp
Website: <https://www.rikenkeiki.co.jp>

<System configuration diagrams>







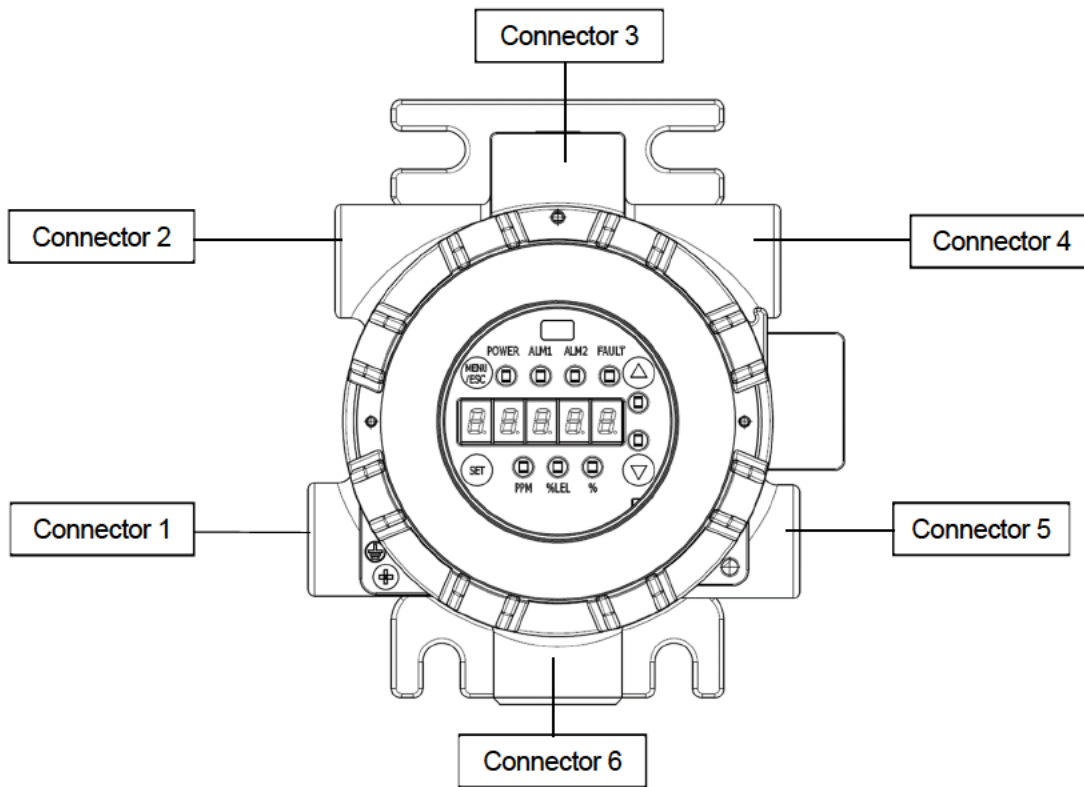
 **CAUTION**

- Install the product in accordance with the required installation conditions.
 - Do not disassemble, modify, or alter the product.
 - Contact Riken Keiki to request readjustment or parts replacement including calibration.
 - Use cable lugs for grounding wire and bonding conductor connections. Make sure the bonding conductors are not loose or twisted.
 - Do not open the cover in locations where explosive gas may be present.
 - The maximum pressure inside the gas channels and sensor is 10.13 kPa (gauge pressure).
 - Be sure to connect the grounding terminal before turning on the power to the product.
 - Make sure the grounding is Class D equivalent (grounding resistance less than 100 Ω).
 - Use crimped terminals to connect the grounding wire to the grounding terminal inside the unit. Use a cable with a cross section area of at least 4 mm² to connect to the external grounding terminal.
 - Use approved cable glands when installing.
 - If the product is installed in a location where the ambient temperature exceeds 65 °C, use cables designed for use at temperatures at least 5 °C above the maximum ambient temperature.
 - Do not subject the window in the cover to strong forces or impact. Doing so may result in damage and impaired explosion-proof performance. (The low risk of mechanical hazards has been confirmed in testing [2 joules].)
 - Do not use more than one adapter per connector.
-
-

 **CAUTION****With suction type**

- Use with a flow rate of at least 0.4 L/min and not exceeding 1.5 L/min.
-

<Connector screw thread types and sizes (SD-3/SD-3SC)>



<Standard>

| Connector 1 | Connector 2 | Connector 3 | Connector 4 | Connector 5 | Connector 6 |
|-------------|-------------|-------------|-------------|-------------|-------------|
| M25 × 1.5 | M25 × 1.5 | — | — | — | M25 × 1.5 |

- “—” indicates no connector is available.
- Connectors 1, 2, and 6 can be used as cable entry ports. Use Connector 6 if the main unit (SD-3SC) is connected to the remote sensor head (GD-3) with a cable. Use approved cable glands when connecting the remote sensor head (GD-3).
- Blank off unused connectors with blanking plugs.
- For more information on using individual connectors, refer to ‘4-7 Cable connection’.

<Optional>

Connectors 4 and 5 are available with optional screw threads, as follows:

| Connector 1 | Connector 2 | Connector 3 | Connector 4 | Connector 5 | Connector 6 |
|-------------|-------------|-------------|-------------|-------------|-------------|
| M25 × 1.5 | M25 × 1.5 | — | M25 × 1.5 | M25 × 1.5 | M25 × 1.5 |

- “—” indicates no connector is available.
- Connectors 1, 2, 4, and 6 can be used as cable entry ports. Use Connector 6 if the main unit (SD-3SC) is connected to the remote sensor head (GD-3) with a cable. Use approved cable glands when connecting the remote sensor head (GD-3).
- Up to two external cable connectors can be used at the same time. (Excluding the remote sensor head (GD-3) connector cable)
- Connector 2 or 4 can be used to connect the optional lightning arrester using the optional adapter (to convert M25 × 1.5 screw thread to 1/2 NPT screw thread).
- Connector 5 is used for HART communication with an optional HART modem connector. Do not insert external cables or connect a lightning arrester. Blank off with a blanking plug if you do not use HART communication.
- Blank off unused connectors with blanking plugs.
- For more information on using the individual connectors, refer to ‘4-7 Cable connection’.

<Components that can be connected (SD-3/SD-3SC)>

The following components can be connected to the main unit (SD-3/SD-3SC):

| | Connector 1 | Connector 2 | Connector 3 | Connector 4 | Connector 5 | Connector 6 |
|---------------------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Sensor assembly | × | × | × | × | × | ○ |
| EC barrier | × | × | × | × | × | ○ |
| Approved cable gland | ○ | ○ | × | ○ | × | ○ |
| M25 plug | ○ | ○ | × | ○ | ○ | × |
| Adapter (M25 ⇔ 1/2NPT) | ○ | ○ | × | ○ | × | ○ |
| Adapter (M25 ⇔ 3/4NPT) | ○ | ○ | × | ○ | × | ○ |
| Adapter (M25 ⇔ M20) | ○ | ○ | × | ○ | × | ○ |
| Lightning arrester | × | ○ | × | ○ | × | × |

○: Can be connected

×: Cannot be connected

NOTE

- ▶ Connect only components that are compatible with the individual connectors on the main unit (SD-3/SD-3SC).
- ▶ Tighten M25 plugs and adapters to a torque of at least 30 Nm.
- ▶ Secure a minimum thread engagement of five threads.

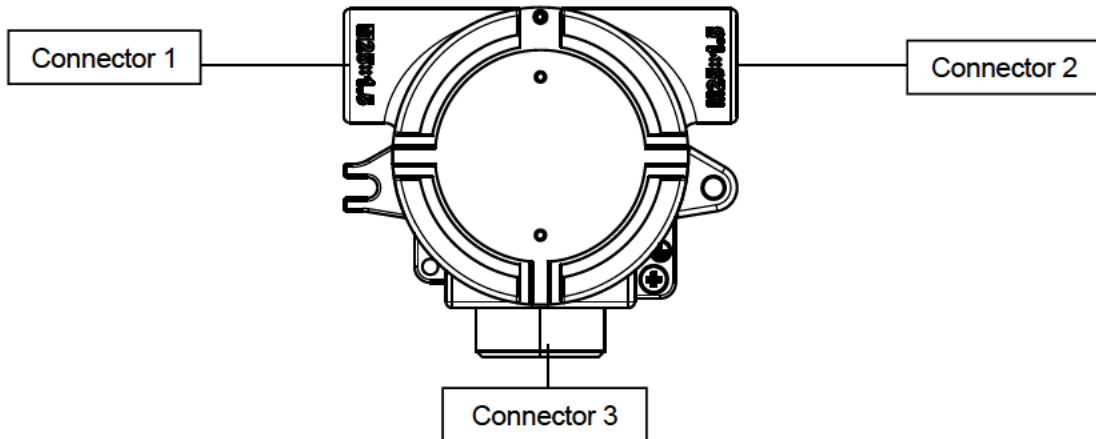
<Lightning arrester details>

| | | |
|---------------------------|-----------------------------|---|
| Part | Manufacturer | Eaton Electric Limited |
| | Name/No. | TP48 or TP32 series surge protector |
| | Explosion-proof performance | II 2G Ex db IIC T6 Gb |
| Certification Nos. | No. and issue | IECEX BAS 15.0056X Issue 1, Baseefa 04 ATEX 0053X |
| | Applicable standards | EN 60079-0:2012+A11:2013 EN 60079-1:2014 IEC 60079-0:2011 Edition 6.0 IEC 60079-1:2014 Edition 7.0 |
| Rating | Voltage/current | 48 V DC |
| | Temperature* | -40 - +70 °C |
| Installation | Attachment screw | 1/2NPT |

*The minimum ambient temperature for the SD-3/GD-3 when using a surge protector is -40 °C.

The “X” at the end of the certificate number indicates the following special operating conditions:

| Certificate numbers | “X” specific operating conditions | Judgment |
|---|--|-----------------------|
| IECEX BAS 15.0056X Baseefa 04 ATEX 0053X | Use terminals suitable for the operating conditions or use appropriate termination within the bonds to protect against mechanical damage—for example, when pulling connector cables. | Conforms as assembly. |
| | These devices are not equipped with grounding or external connectors to junction conductors. The user is responsible for attaching and ensuring adequate grounding. | Conforms as assembly. |
| | This device is also provided as an “Ex i” version and features markings for both. The user is responsible for determining explosion-proof performance. | Not applicable |
| | When attaching to a flame-proof housing, apply high-strength thread-locking compound to the mounting screw on the surge protector. | “X” marking |

<Components that can be connected (GD-3)>

The following components can be connected to the remote sensor head (GD-3):

| | Connector 1 | Connector 2 | Connector 3 |
|---------------------------|-------------|-------------|-------------|
| Sensor assembly | × | × | ○ |
| EC barrier | × | × | ○ |
| Approved cable gland | ○ | ○ | × |
| M25 plug | ○ | ○ | ○ |
| Adapter (M25 ⇔ 1/2NPT) | ○ | ○ | ○ |
| Adapter (M25 ⇔ 3/4NPT) | ○ | ○ | ○ |
| Adapter (M25 ⇔ M20) | ○ | ○ | ○ |

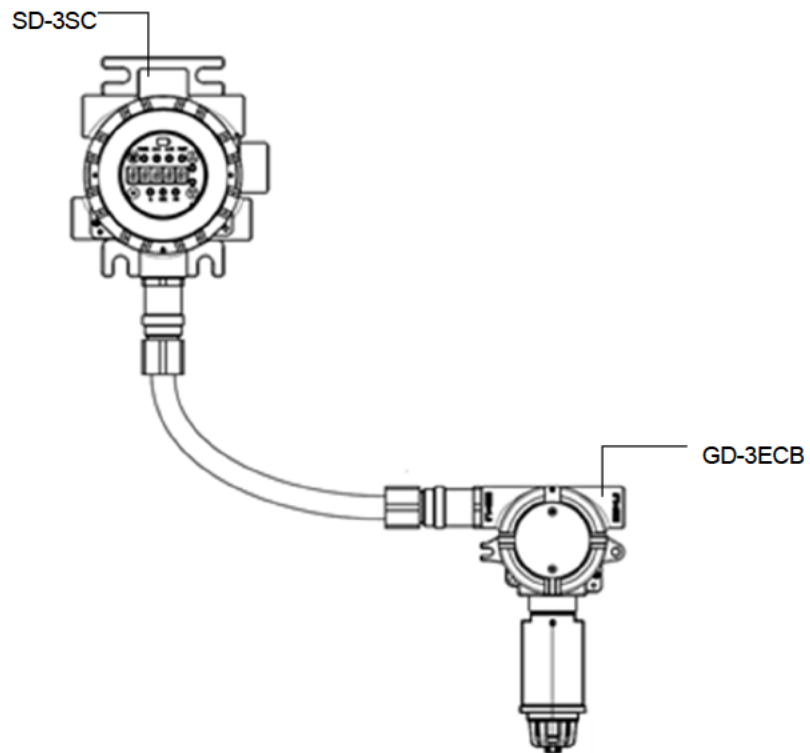
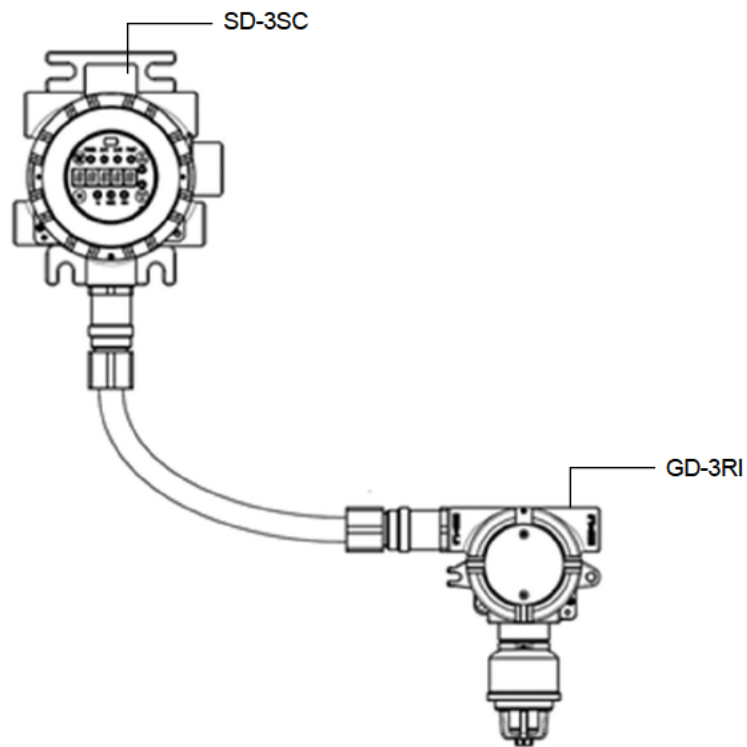
○: Can be connected

×: Cannot be connected

NOTE

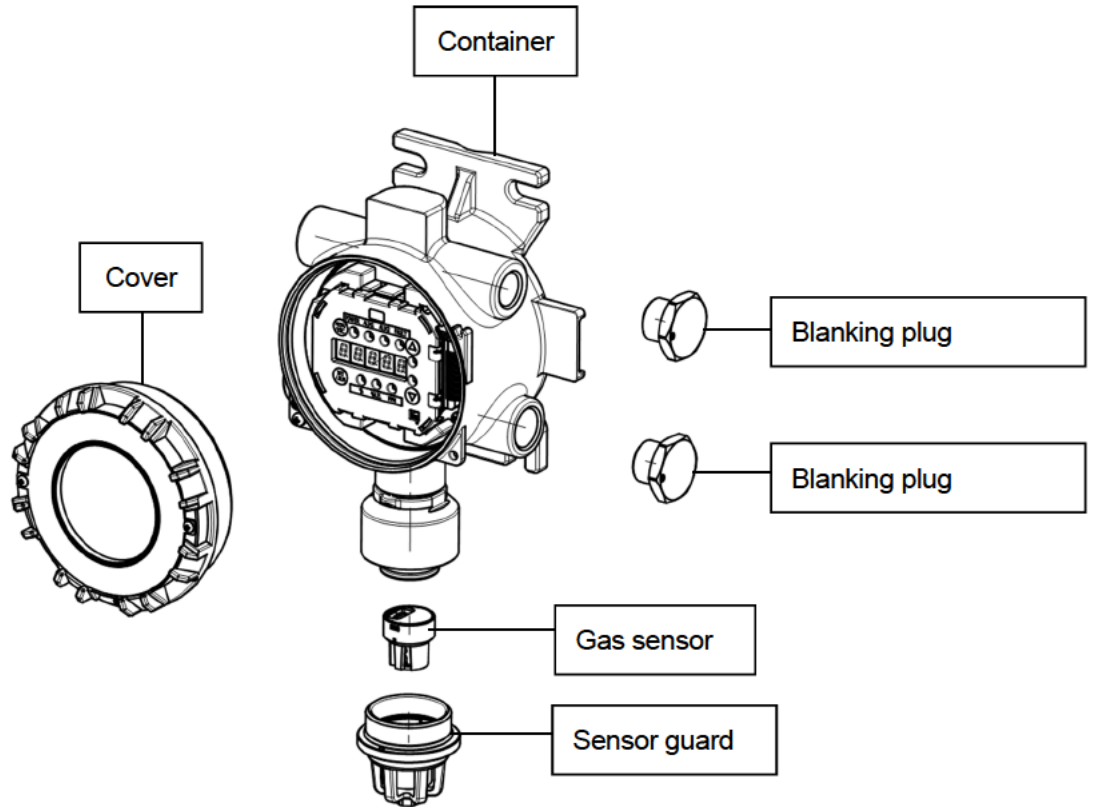
- ▶ Connect only components that are compatible with the individual connectors on the remote sensor head (GD-3).
- ▶ Tighten M25 plugs and adapters to a torque of at least 30 Nm.
- ▶ Secure a minimum thread engagement of five threads.

<Connection examples>

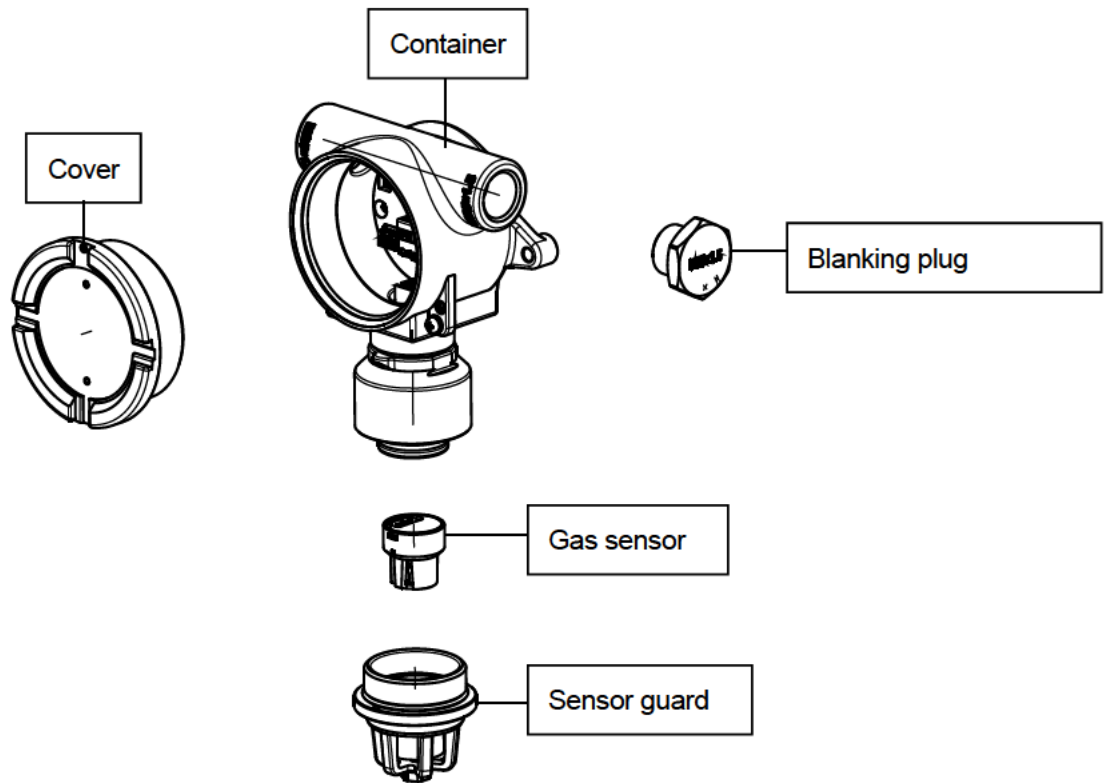


<Exploded view>

<SD-3>



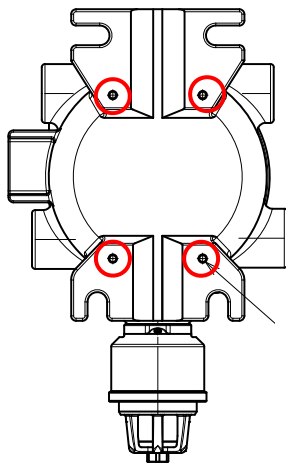
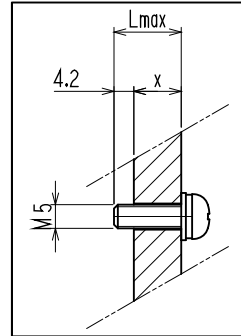
<GD-3>



<Screw holes on rear of container (SD-3)>

Four screw holes are located on the rear of the main unit container.

- Screw size: M5
- Pitch: 0.8
- Screw depth: 5
- Maximum allowable length of male screw:
 $L_{max} = 4.2 \text{ mm} + x$
 ("x" is the intermediate part thickness.)

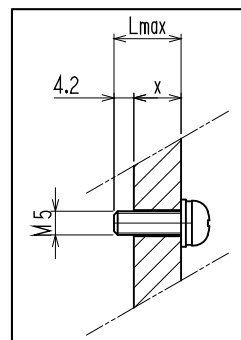


Screw holes on rear of container (four locations)

<Screw holes on rear and underside of container (GD-3)>

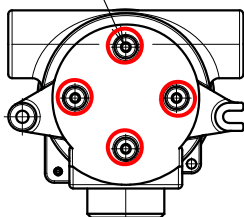
There are four screw holes on the rear of the container and four screw holes on the underside.

- Screw size: M5
- Pitch: 0.8
- Screw depth: 5
- Maximum allowable length of male screw:
 $L_{max} = 4.2 \text{ mm} + x$
 ("x" is the intermediate part thickness.)



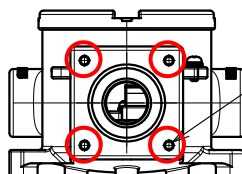
<Container rear>

Screw holes on rear of container (four locations)



<Container underside>

Screw holes on underside of container (four locations)



3

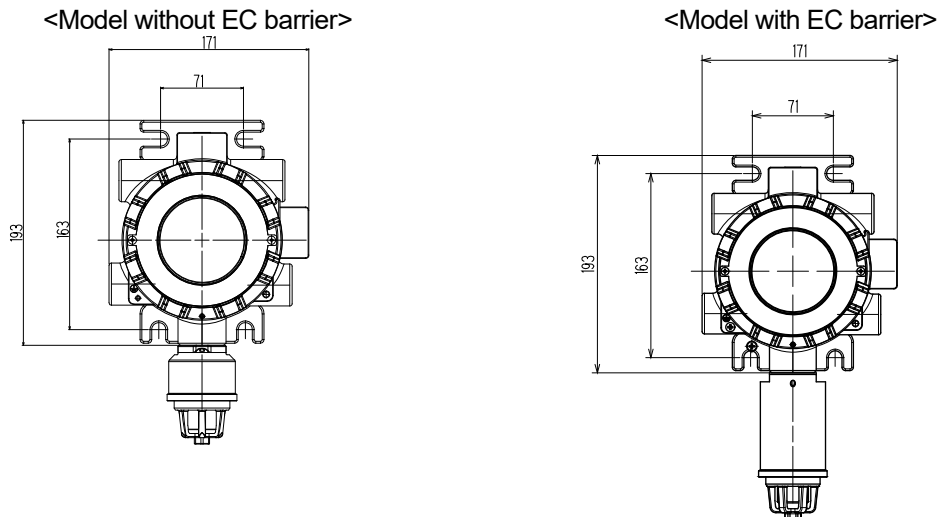
Product Configuration

3-1 Main unit and accessories

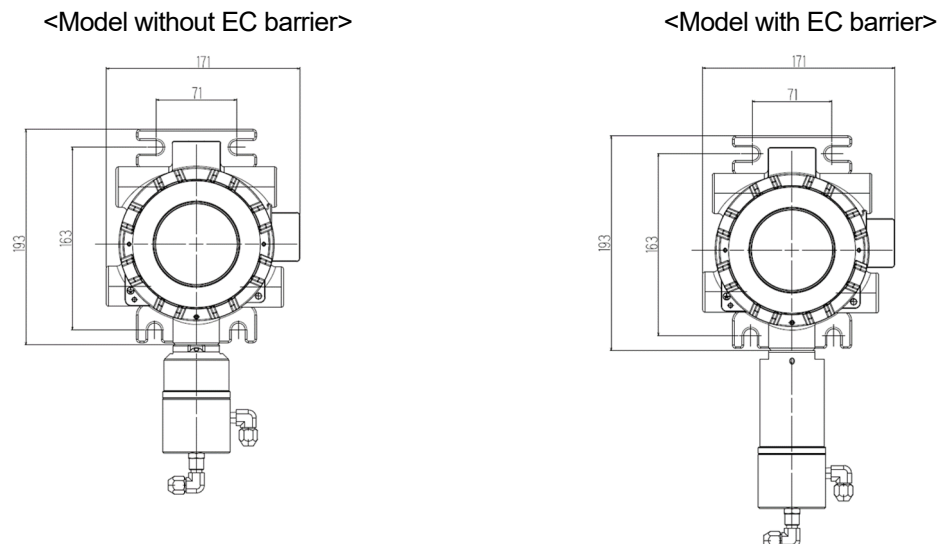
Open the box and packaging and inspect the main unit and accessories.
If anything is missing, contact Riken Keiki.

3-1-1 Main unit (SD-3)

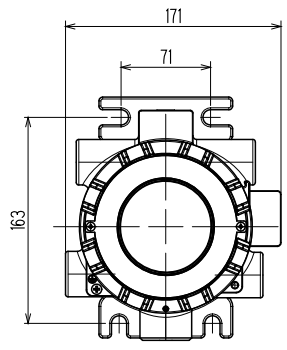
<Diffusion type>



<Suction type>



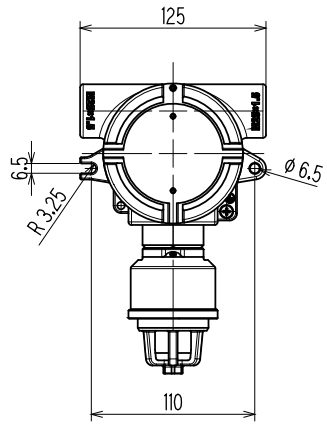
3-1-2 Main unit (SD-3SC)



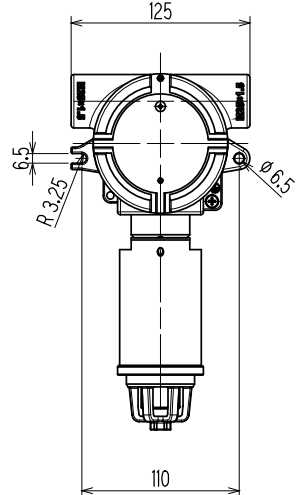
3-1-3 Remote sensor head (GD-3)

<Diffusion type>

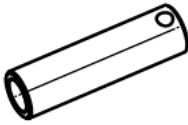
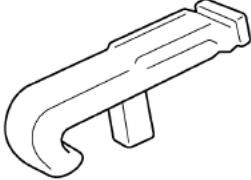

<Model without EC barrier>



<Model with EC barrier>



3-1-4 Standard accessories

| Standard accessory | Quantity | Part No. | Description | |
|---|---------------------------------|---------------------------------------|--------------|---|
|  | Control key | Varies depending on quantity ordered. | 4286 9200 80 | Key used to control the product |
|  | Operating lever | ×1 | 2594 0481 90 | Tool used when connecting cable to terminal plate |
|  | Hex key wrench (2 across flats) | Varies depending on quantity ordered. | 1510 5020 40 | Tool used for tightening M4 hex socket set screws |
| | Operating manual | ×1 | | |

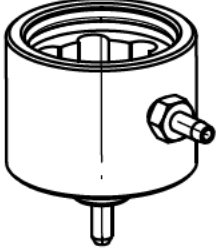
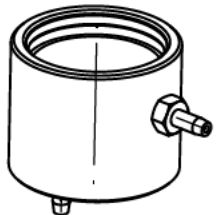
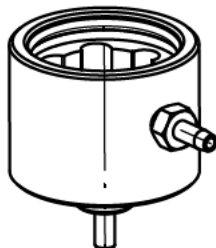

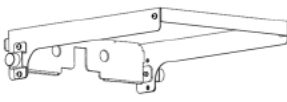
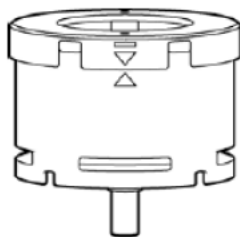
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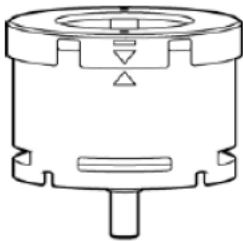
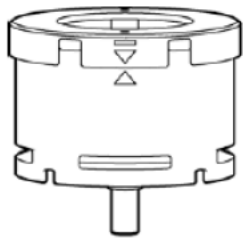

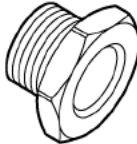
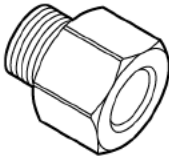
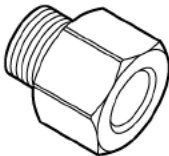

- ▶ The quantity of control keys and hex key wrenches included will vary depending on the quantity of product units ordered.
 - 1 - 10 units: ×1
 - 11 - 20 units: ×2
 - 21 - 50 units: ×3
 - 51 or more units: ×4

**CAUTION**

- Use the control key provided to operate the product. The product may not respond properly to commands if an object other than the supplied control key is used.
- The control key provided incorporates an extremely strong magnet. Holding the control key close to credit cards, ID cards, or other magnetized products may corrupt data recorded on these objects.

3-1-5 Optional accessories

| Optional accessory | Part No. | Description |
|---|--------------|--|
|  <p data-bbox="587 450 818 517">Calibration adapter (for IRF sensor)</p> | 4283 9011 00 | SD-3RI calibration adapter <Material> Body: PP Nipple: Stainless steel/Teflon |
|  <p data-bbox="587 707 818 808">Calibration adapter (for combustible gas sensor)</p> | 4283 9012 70 | SD-3NC/GH/GHS/SP calibration adapter <Material> Body: PP Nipple: Stainless steel/Teflon |
|  <p data-bbox="587 999 818 1077">Calibration adapter (for ESF sensor)</p> | 4283 9013 40 | SD-3EC/ECS/ECB calibration adapter <Material> Body: PP Nipple: Stainless steel/Teflon |
|  <p data-bbox="587 1323 786 1357">Protective cover</p> | 4283 9019 80 | Cover to protect the SD-3 main unit <Material> SUS316 |
|  <p data-bbox="587 1570 786 1603">Sunshade cover</p> | 4283 9015 90 | Cover to suppress temperature rises due to direct sunlight or radiant heat <Material> SUS316 |
|  <p data-bbox="587 1794 786 1872">Splash guard (for IRF sensor)</p> | 4283 4136 1A | SD-3RI cover to protect sensor from water and dust The identification number "1" is engraved on the underside. <Material> Resin |

| Optional accessory | Part No. | Description |
|---|--|---|
|  | Splash guard (for combustible gas sensor) | 4283 4137 9A SD-3NC/GH/GHS/SP cover to protect sensor from water and dust The identification number "2" is engraved on the underside. <Material> Resin |
|  | Splash guard (for ESF sensor) | 4283 4139 3A SD-3EC/ECS/ECB cover to protect sensor from water and dust The identification number "3" is engraved on the underside. <Material> Resin |
|  | Blanking plug | 4283 9018 10 M25 × 1.5 blanking plug <Material> Equivalent to SUS316 |
|  | Adapter | 4283 4081 70 Adapter to convert M25 × 1.5 screw thread to 1/2NPT screw thread <Material> Equivalent to SUS316 |
|  | Adapter | 4283 4082 40 Adapter to convert M25 × 1.5 screw thread to 3/4NPT screw thread <Material> Equivalent to SUS316 |
|  | Adapter | 4283 4132 20 Adapter to convert M25 × 1.5 screw thread to M20 × 1.5 screw thread <Material> Equivalent to SUS316 |
|  | Silicone removal filter (SI-8) ^{*3} | 4283 0030 20 Filter for removing trace amounts of silicone from the air. This can extend sensor life.*1 |

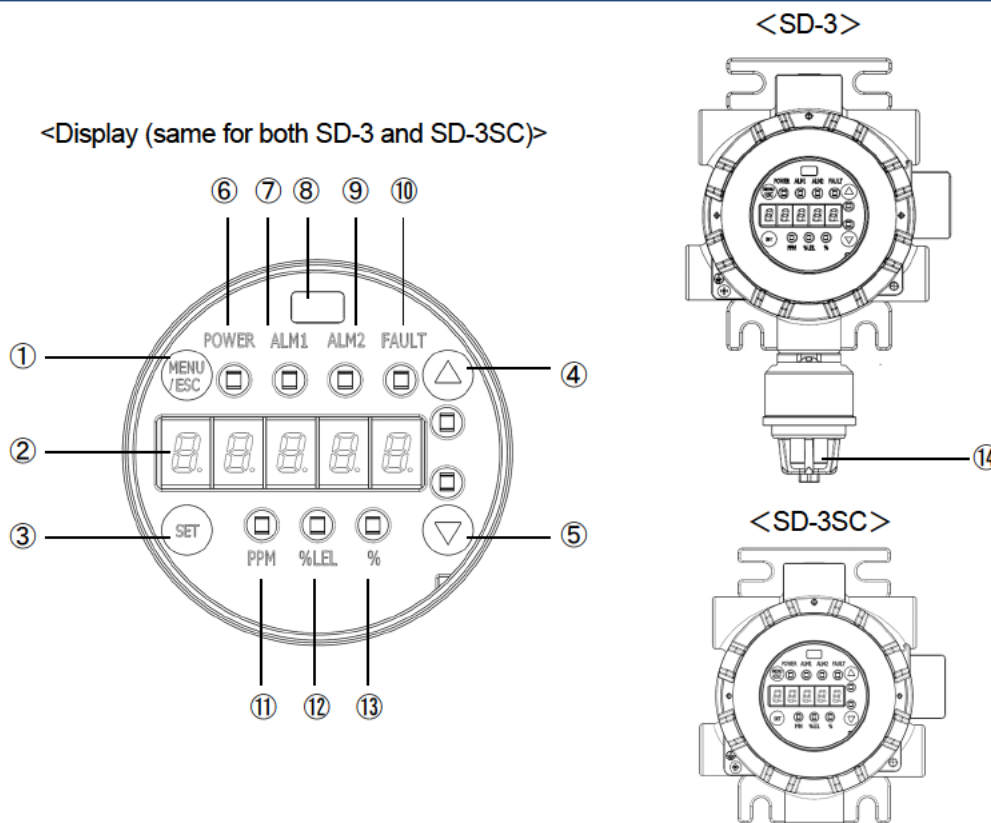
| Optional accessory | Part No. | Description |
|--------------------|---|---|
| | Activated carbon filter (CF-8304) *3 | Filter for removing trace amounts of silicone from the air. This can extend sensor life. The silicone removal capability of this filter exceeds that of the silicone removal filter.*2 It can also be used to remove interference gases. This can minimize interference effects from gases other than the detection target gas. |
| | Duct mounting kit | Kit for installing a remote sensor head (GD-3) to a duct <Material> SUS316 |
| | HART modem connector | Connector used when connecting a HART modem |
| | Lightning arrester (3-wire connection) (TP48-3-N-NDI) | Device to limit momentary surge voltages caused by lightning strikes |
| | Lightning arrester (4-wire connection) (TP48-4-N-NDI) | Device to limit momentary surge voltages caused by lightning strikes |
| | Fuse | Littelfuse's fuse (1.25 A, 100 V DC) |
| | U bolt | Bolt used for mounting the main unit to a pole (size: 50A (2B)) <Material> SUS304 |

*1: Installing the silicone removal filter will limit the target gases that can be detected.

*2: The range of target gases that can be detected will be more limited than when the silicone removal filter is fitted.

*3 If you use a filter, we recommend fitting a splash guard.

3-2 Part names and functions

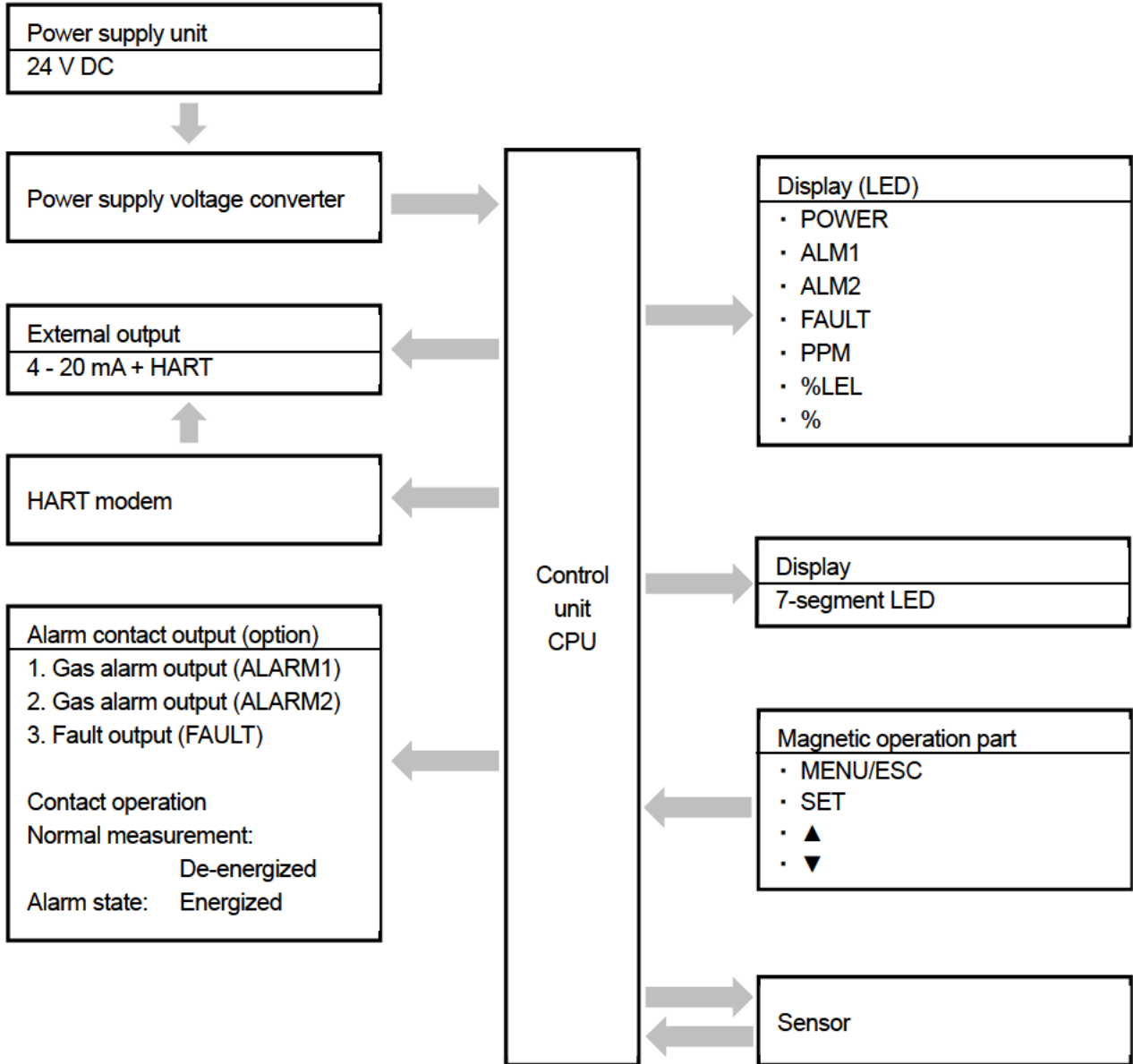


| No. | Name | Function |
|-----|-----------------------|---|
| ① | MENU/ESC key | Hold down this key in detection mode to switch to user mode. In user mode and maintenance mode, this key is used to cancel a setting or return to the previous screen. Hold down this key in user mode or maintenance mode to return to detection mode. |
| ② | 7-segment LED display | Displays the gas concentration and other information. |
| ③ | SET key | Press in detection mode to display the ALM1 (first alarm) and ALM2 (second alarm) alarm setpoints. In user mode and maintenance mode, this key is used to confirm a value or select a setting. |
| ④ | ▲ key | In user mode and maintenance mode, this key is used to select a setting item and adjust (increase) a value. |
| ⑤ | ▼ key | In user mode, this key is used to switch menus or adjust (lower) a value. Press in detection mode to display the external output. |
| ⑥ | Power lamp (POWER) | Power lamp. Lights up in green when the power is on. The lamp flashes in green in user mode and maintenance mode. |
| ⑦ | Alarm lamp (ALM1) | ALM1 (first alarm) alarm lamp. Lights up in red when the ALM1 (first alarm) alarm setpoint is reached. |
| ⑧ | Infrared port | IrDA communication port |
| ⑨ | Alarm lamp (ALM2) | ALM2 (second alarm) alarm lamp. Lights up in red when the ALM2 (second alarm) alarm setpoint is reached. |
| ⑩ | Fault lamp (FAULT) | Fault lamp. Lights up in yellow when an abnormality is detected in the product. |
| ⑪ | PPM lamp | Lights up in green when a ppm concentration range gas concentration is displayed. |
| ⑫ | %LEL lamp | Lights up (green) when a gas concentration within the %LEL concentration range is displayed. |
| ⑬ | % lamp | Lights up in green when a vol% concentration range gas concentration is displayed. |
| ⑭ | Sensor | Incorporates a gas-detecting sensor. |

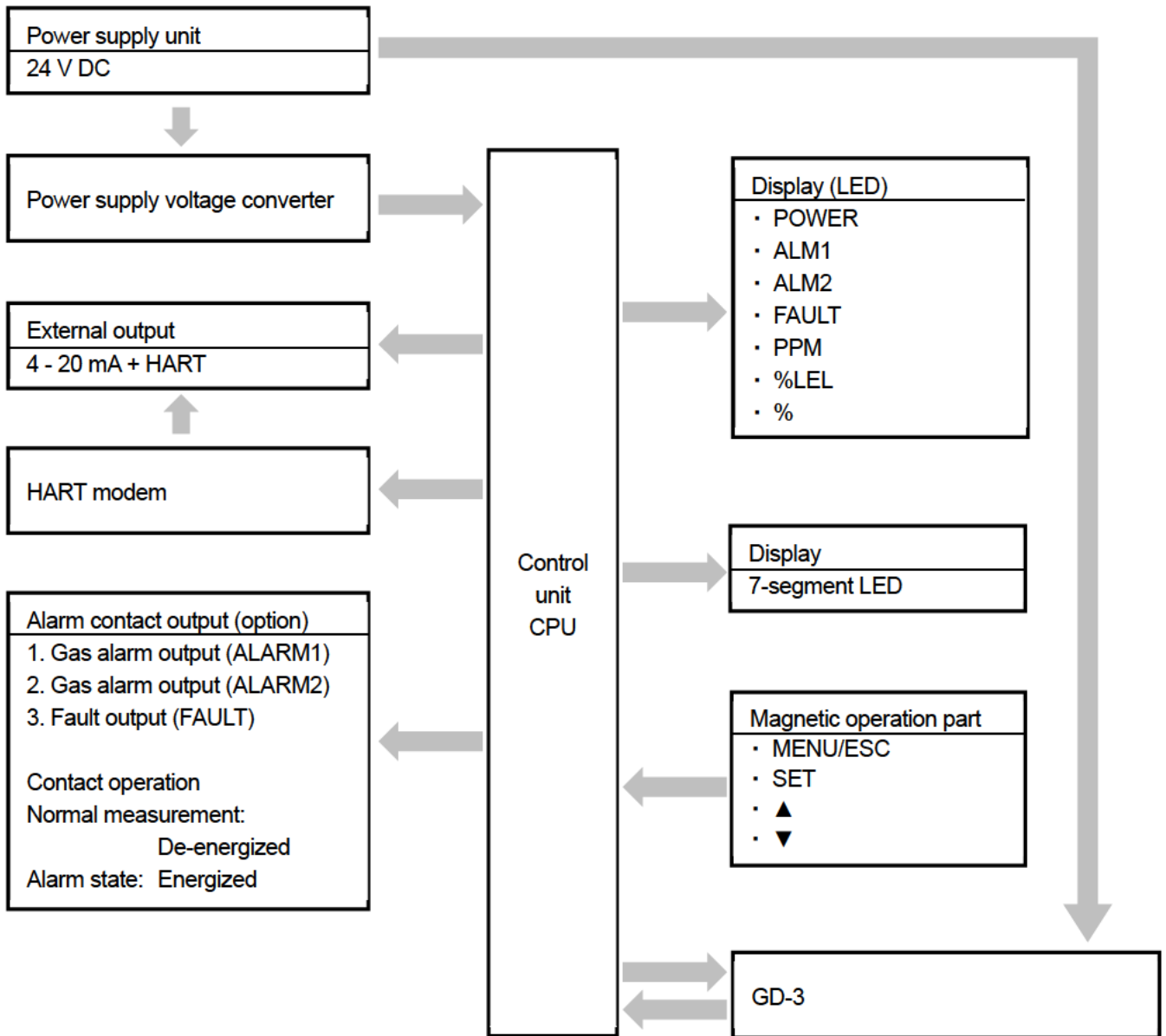
3-3 Block diagrams

The block diagrams (electrical circuit diagrams) for the product are given below.

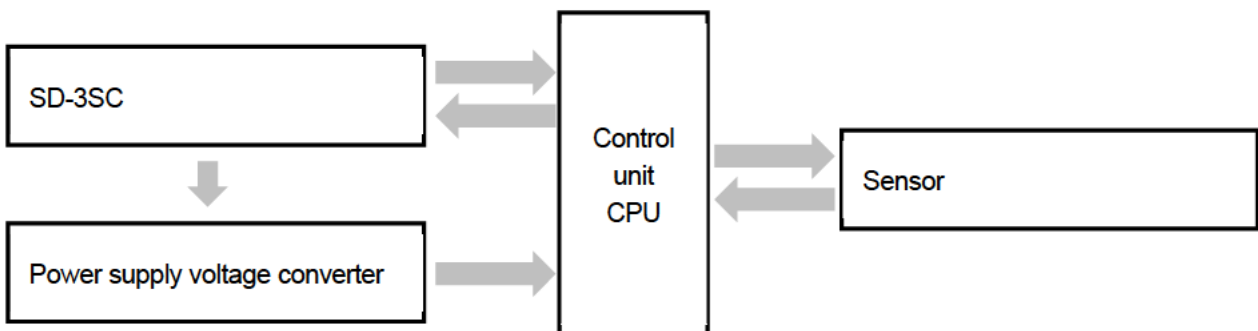
<SD-3>



<SD-3SC>



<GD-3>



4

Installation

4-1 Installation precautions

Selecting an appropriate installation location is vital for system performance.

Be sure to observe the following precautions before installing.

Failure to comply with these precautions may result in failure of the product or improper function.



CAUTION

- The product is a precision device. Certain conditions at the location (environment) where the product is installed may prevent optimum performance. Check the environment at the installation location and take all required precautionary measures depending on circumstances.
- Install the number of units needed at the appropriate locations to ensure that the product plays an important role in safety and disaster prevention.
- Areas where gas is likely to leak or accumulate will differ depending on the gas type and individual work areas. Thoroughly consider the installation locations and number of units to be installed before installation.

4-1-1 General installation information

Observe the following precautions when installing the product:

- If the product is installed in a location where the ambient temperature exceeds 65 °C, use cables designed for use at temperatures at least 5 °C above the maximum anticipated ambient temperature.
- The SD-3 and SD-3SC main units each have two M25 × 1.5 connectors for use when wiring in the field. Connectors must always be blanked off with blanking plugs when not in use.
- The GD-3 has two M25 × 1.5 connectors for connecting the SD-3SC. The connector not in use must be blanked off with a blanking plug at all times.
- Do not mount a sensor that uses a different detection principle from the model type.
- Use ferrules on the ends of stranded cables.
- Secondary circuits should be supplied from an insulated source. (Not suited to alarm relay contacts)
- If installing without using conduits, use cable glands that comply with the explosion-proof certification. In addition, connect cable shielding to the main unit, cable glands, and indicators to increase immunity to electromagnetic noise and other external factors.
- Select the cable, terminal plate, and other parts for wiring to alarm relays (optional) to suit the rated voltage, current, and environmental conditions.

In addition, carefully consider the following points when installing:

- All possible effects on the installation of the gas detector system
- Restrictions and regulations concerning the installation of the gas detector system
- Regulations concerning the operation, power supply, and signal cable connections for the gas detector system
- Ambient environmental effects to which the gas detector system may be subject
- Specifics of the physical characteristics, environmental air movement and flows, and latent leaks of the detection gas
- Accessibility for required maintenance and the shape of the accessories used

4-1-2 Restrictions regarding installation

<Do not install in locations subject to vibration or impact.>

The product contains precision electronic components. Install the product in a stable location not exposed to vibration, impact, or risk of falling.

<Do not install in locations exposed to water, oil, or chemicals.>

Avoid installing in locations that pose the risk of splashing liquids such as water, oil, and chemicals. Deploy the optional protective cover (main unit protection) and splash guard (sensor protection) if the product must be installed in a location where it may be exposed to these factors.

<Do not install in locations where temperatures exceed the operating temperature range.>

For information on the product operating temperature range, refer to '10-3. Detection target gases for individual detection principles'.

Install in a stable location where temperatures do not exceed the operating temperature range during use.

<Do not install in locations subject to direct sunlight or sudden temperature changes.>

Install away from locations subject to direct sunlight or radiant heat (infrared radiation from high temperature bodies) and locations subject to sudden temperature changes. Failure to do so may expose the product to temperatures that exceed specified thresholds, internal condensation, or rapid temperature fluctuations the product cannot handle.

Use of the optional sunshade cover is recommended when using the product in locations subject to direct sunlight.

<Do not install in locations where maintenance is dangerous or not possible.>

The product requires periodic maintenance.

Do not install in the following or similar locations where maintenance is dangerous or not possible:

- Locations where systems must be stopped to allow maintenance
- Locations where part of the system must be detached to allow maintenance
- Locations where the product cannot be removed due to the presence of pipes or racks
- Locations where maintenance work is hazardous—for example, close to high-voltage cables

<Do not install in improperly grounded system housings.>

When installing in a system housing, be sure to implement a Class D-equivalent ground connection.

<Do not install in the presence of miscellaneous gases.>

Do not install in locations where the following gases are present:

| Sensor type | Gases affecting sensor sensitivity | Sensor-corroding gases |
|-------------|--|--|
| SGF | <ul style="list-style-type: none"> • Organic silicone gas (e.g., D4 siloxane, D5 siloxane) • Sulfur gases (e.g., SO_x, H₂S) | <ul style="list-style-type: none"> • Corrosive gases (e.g., SO_x, NO_x) • Acid gases (e.g., HF, HCl) |
| SHF | | |
| NCF | | |
| IRF | None | |
| ESF | None | None |

<Precautions when installing in the presence of interference gases>

Take care when installing in locations where the following interference gases are present:

| Sensor type | Interference gas |
|-------------|--|
| SGF | Hydrocarbons, alcohols, organic solvents, etc. other than the target gas |
| SHF | |
| NCF | Hydrocarbons, alcohols, organic solvents, etc. other than the target gas |
| IRF | Combustible gas sensor: Hydrocarbons, alcohols, organic solvents, etc. other than the target gas CO ₂ sensor: CO, N ₂ O, NO, etc. |
| ESF | Differs depending on sensor. (e.g., H ₂ with CO sensor) |

<Use the appropriate power supply and power cable.>

The product requires a 24 V DC (18 V - 30 V DC) power supply to operate. The power cable used should have a cross section of 1.308 mm² (AWG16) or 2.082 mm² (AWG14).
Use shielded 3-core cable.

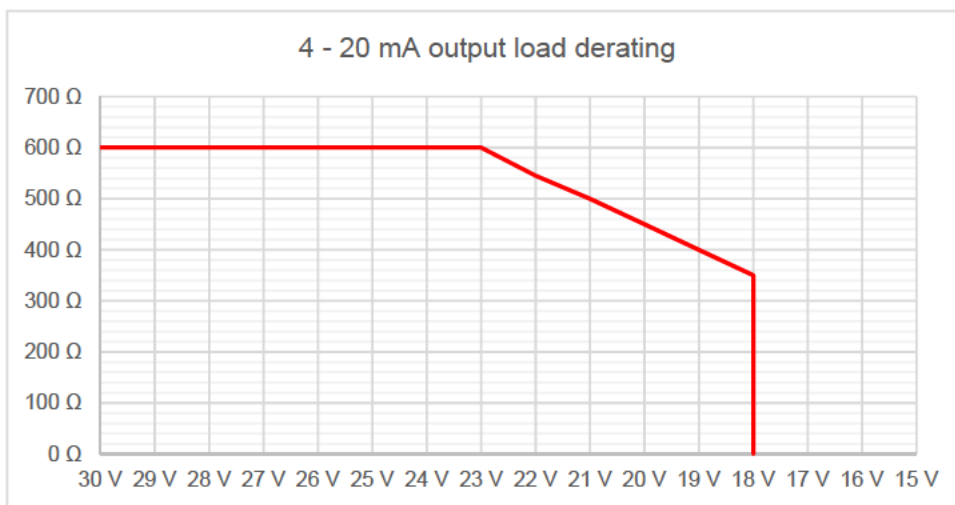
<Install away from noise-emitting devices (main unit and cables).>

Install away from locations where high-frequency or high-voltage devices are present. Failure to do so may result in electromagnetic interference.

<Use the appropriate impedance for the 4 - 20 mA signal output.>

The impedance for the 4 - 20 mA signal output must not exceed 600 Ω to ensure correct operation. This will vary depending on the voltage supplied to the product. The maximum and minimum impedance specified must be satisfied, based on factors such as product operating voltage and interface (HART).

<4 - 20 mA signal output impedance derating depending on supply voltage differences>



<4 - 20 mA signal output impedance range when using HART communication>

Devices equipped with a HART interface can be operated via HART communication or HART multidrop mode.

| Operating mode | Signal impedance range for power supply voltage |
|---|---|
| Operation without HART communication | Max. 300 Ω at 18 V DC Linear increase to max. 600 Ω at 23 V DC |
| Operation with HART communication (HART mode) | Min. 250 Ω in range 18 V - 30 V DC |
| | Max. 300 Ω at 18 V DC Linear increase to max. 600 Ω at 23 V DC |
| HART multidrop operation | 250 Ω to 600 Ω in range 18 V - 30 V DC |

<Use alarm contacts correctly.>

The alarm contacts on the product are used to transmit signals for operating external buzzers, alarm indicator lamps, or revolving lights. Never use for controls on which human life depends or other mission critical controls (e.g., shutoff valve controls).

Check contact opening and closing periodically, including during regular maintenance. Contacts may not function correctly under certain operating conditions if left inactive for extended periods.

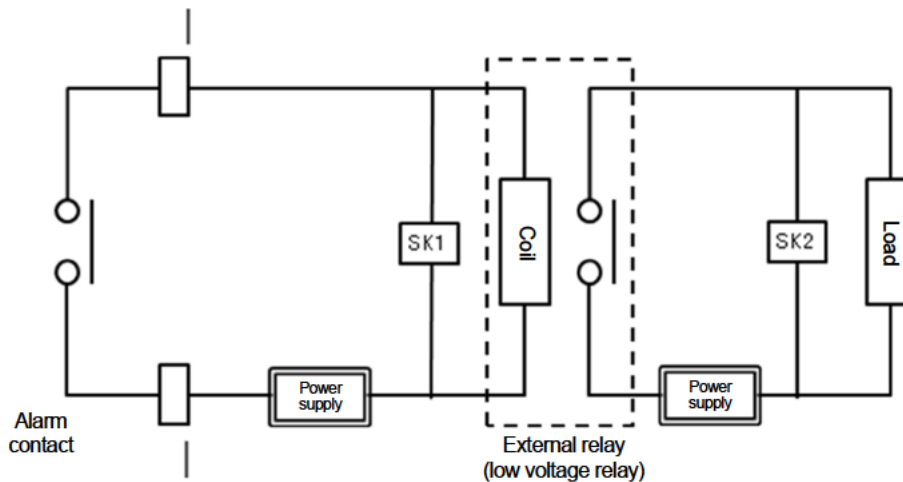
The alarm contact specifications for the product apply under resistance load conditions. If inductive loads occur at the alarm contacts, a counter-electromotive force will be generated at the contacts, leading to the following potential problems:

- Alarm relay contact welding, insulation failure, contact failure
- Damage to electrical components due to high voltage inside the product
- Malfunctions due to CPU runaway

If the product is used to operate loads, take the following measures to stabilize product operations and protect the alarm contacts:

- Use an external relay (low voltage, not exceeding 100 V AC) to link the circuits (contact amplification). Add a surge absorber (SK1) appropriate for the rating to the external relay.
- Where necessary, add a surge absorber (SK2) on the load side of the external relay.
- Depending on the load conditions, it may be better to add the surge absorber to the contact side. Check load behavior to determine the optimal location.

<SD-3>



* SK1, SK2: Surge absorbers

DANGER

- Never use for controls on which human life depends or other mission critical controls (e.g., shutoff valve controls).

WARNING

- Contacts may not function correctly if left inactive for extended periods. Check contact opening and closing periodically.
- Contact faults may occur if exposed to organic gases or sulfidizing gases for extended periods.
- In principle, do not use the alarm contacts of the product to operate inductive loads. In particular, never use to operate devices like fluorescent lamps and motors.
- If operating inductive loads is absolutely unavoidable, link the circuits using an external relay (contact amplification). Since the external relay coil constitutes another inductive load, use a relay operating at low voltage (under 100 V AC), and protect the product contacts with a suitable surge absorber (e.g., CR circuit).
- Do not use in atmospheres where silicone is present.

**CAUTION**

- A de-energized b contact (break contact) may result in momentary opening in the event of an external force or other physical impact. If a b contact is used as an alarm contact, implement measures to account for such momentary operations—for example, by adding a delay operation (of approximately one second) to the signal on the b contact receiving side.
-

4-2 System design precautions

Consider the following precautions when designing a system in which the product is used:



- An unstable power supply or noise may result in malfunctions or false alarms.
- Consider the details described in this section before designing a system that uses the product.

4-2-1 Using a stable power supply

The product's external output and alarm contacts may activate as the system stabilizes when the power is turned on or right after an instantaneous power failure. If external output and alarm contacts activate due to power failures or other reason, use a UPS (uninterruptible power system) or take other appropriate measures. The product should be powered using a power supply specified below.

| | | |
|--|--|--|
| Power supply voltage | 24 V DC (18 V - 30 V DC): Main unit terminal voltage | |
| Time allowed for instantaneous power failures | Up to approx. 20 ms ^{*1} | Typical action: Use an external uninterruptible power supply or similar system to guarantee continuous operation and functionality. |
| Miscellaneous | Do not use with power supplies subject to very high power loads or high frequency noise. | Typical action: Where necessary, use a line filter or other device. Keep the product away from sources of noise. |

*1: Restart the product when recovering after instantaneous power failures of 20 ms or more.

4-2-2 Lightning strike protective measures

In factories or plants where cabling is configured as follows, damage may result in the event of lightning strikes due to the cables connected to the devices acting as a receiving antenna for the lightning:

- When cables are installed outdoors
- When cables are installed in the same duct as cables supplied from outside

In the event of lightning strikes, devices connected to the cables may be damaged by lightning energy. 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. While it is not possible to completely protect against lightning disasters, the following protective measures are useful:

<Lightning strike protective measures>

Implement appropriate measures based on environmental conditions and the importance of the facility. A lightning arrester (cable protector) can be installed before the field devices and central processing equipment as a safeguard against inductive lightning surges transmitted through the cables. For information on how to use lightning arresters, please contact the manufacturer.

<Grounding>

Surge noise is caused by lightning strikes and other factors. Devices must be grounded to protect against these noise sources.

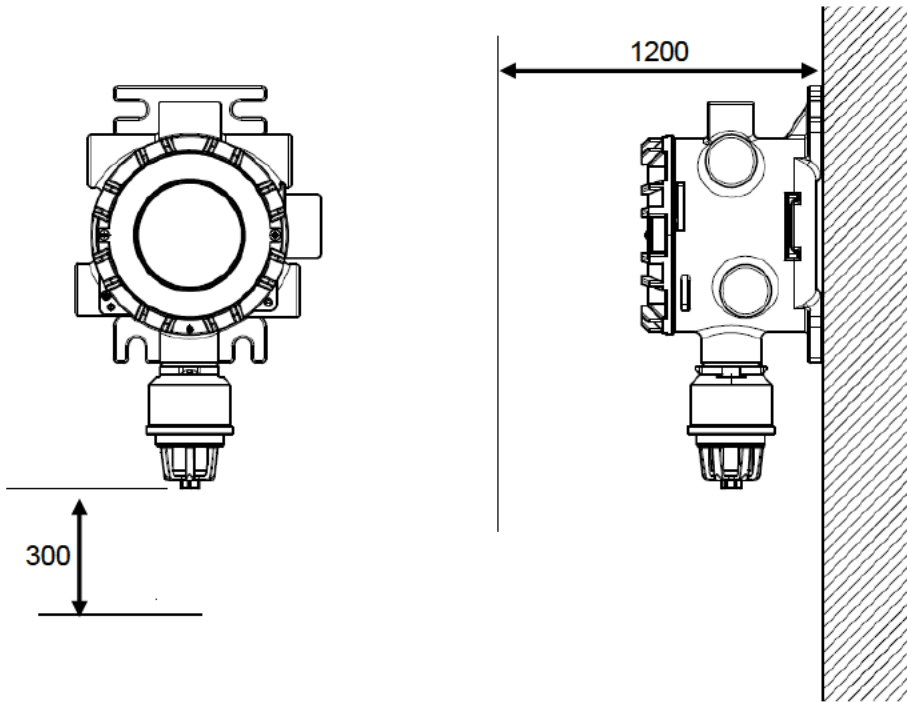
NOTE

- ▶ Lightning arresters contain circuitry to remove voltage surges that could damage field devices. Installing lightning arresters may therefore cause signal attenuation. Perform an operation check before installing a lightning arrester. Also note that lightning arresters cannot remove all voltage surges.

4-3 Providing maintenance space

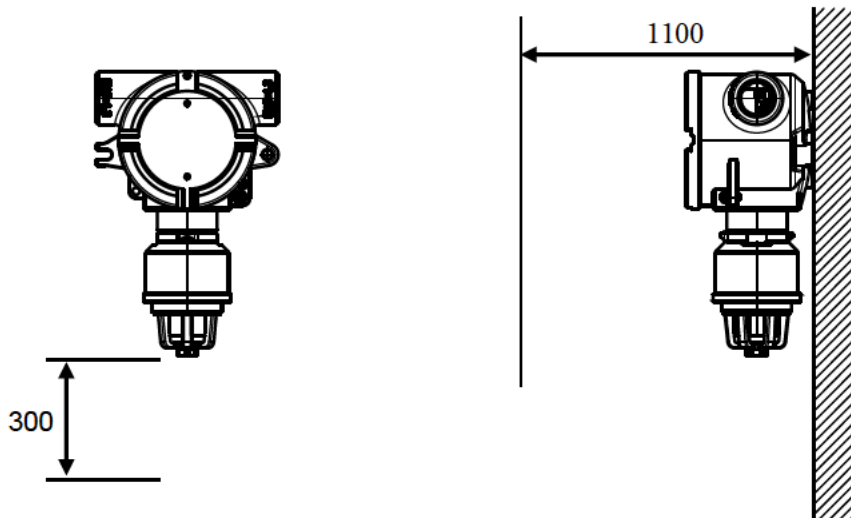
When mounting the product, allow space to open and close the covers during maintenance.

<Main unit (SD-3/SD-3SC)>



*The diagram illustrates the SD-3. The maintenance space for the SD-3SC is identical.

<Remote sensor head (GD-3)>





The product requires periodic maintenance.

Do not install in the following or similar locations where maintenance is dangerous or not possible:

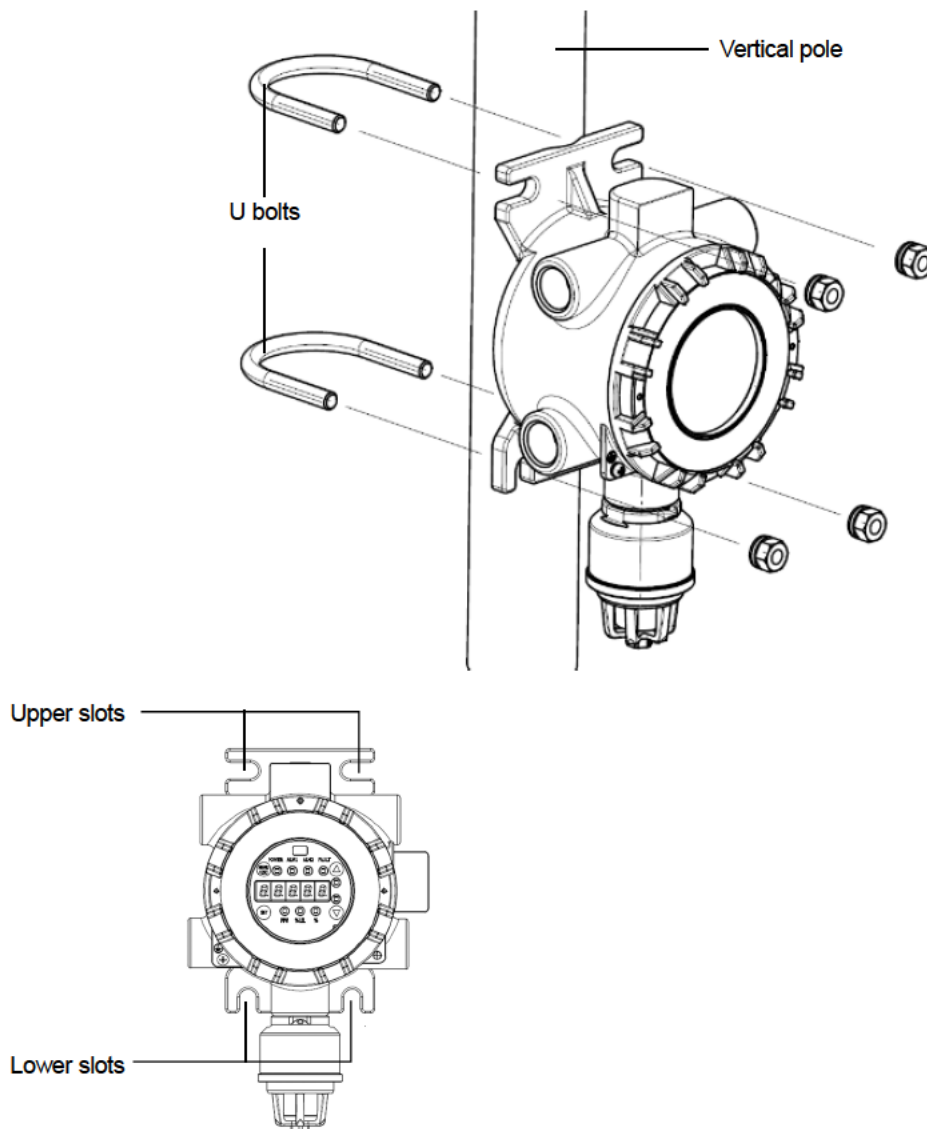
- Locations such as within systems that must be stopped for maintenance
 - Locations where part of the system must be detached to allow maintenance
 - Locations where the product cannot be removed due to the presence of pipes or racks
 - Locations where maintenance work is hazardous—for example, close to high-voltage cables
-

4-4 Main unit installation

4-4-1 Vertical pole mounting

Mount the main unit (SD-3/SD-3SC) to a vertical pole (size: 50A (2B)) using two U bolts.

- 1 Fit one U bolt around the vertical pole and through the upper slots on the main unit.
- 2 Secure the U bolt to the main unit with two washers, two spring washers, and two M10 nuts.
- 3 Fit the second U bolt around the vertical pole and through the lower slots on the main unit.
- 4 Secure the U bolt to the main unit with two washers, two spring washers, and two M10 nuts.

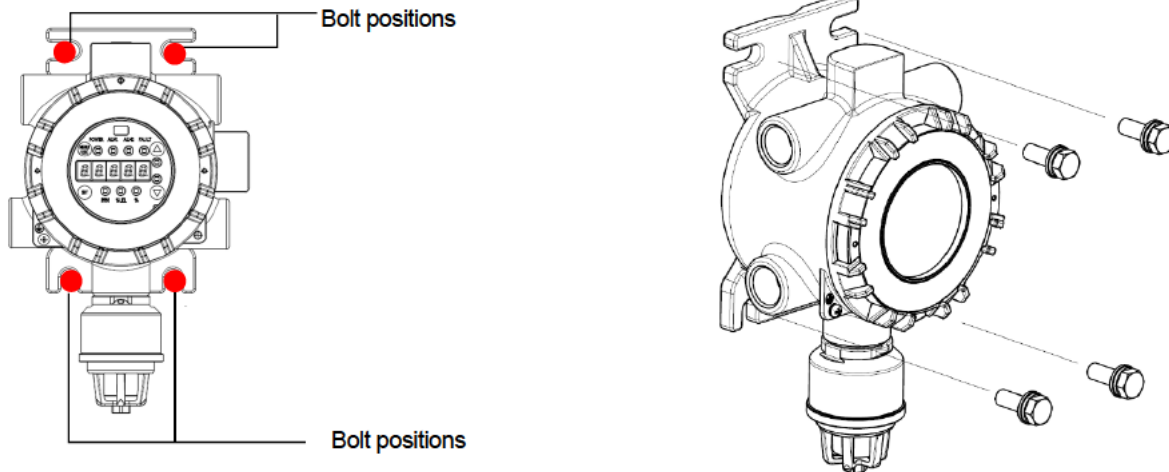


*The diagram illustrates the SD-3. The mounting method for the SD-3SC is identical.

4-4-2 Wall mounting

Mount the main unit (SD-3/SD-3SC) to a wall.

- 1 Place the main unit against the wall surface and secure with four M10 double SEMS bolts.



*The diagram illustrates the SD-3. The mounting method for the SD-3SC is identical.

CAUTION

The product requires periodic maintenance.

Do not install in the following or similar locations where maintenance is dangerous or not possible:

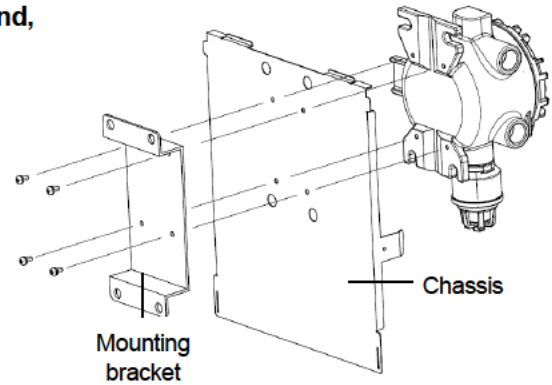
- Locations such as within systems that must be stopped for maintenance
- Locations where part of the system must be detached to allow maintenance
- Locations where the product cannot be removed due to the presence of pipes or racks
- Locations where maintenance work is hazardous—for example, close to high-voltage cables

4-4-3 Attaching protective cover

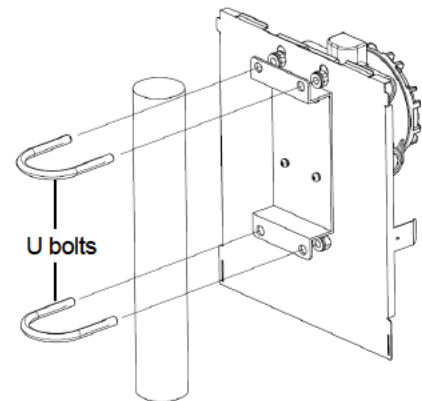
Attach the protective cover to the main unit (SD-3/SD-3SC).

<Pole mounting (pole size: 50A (2B))>

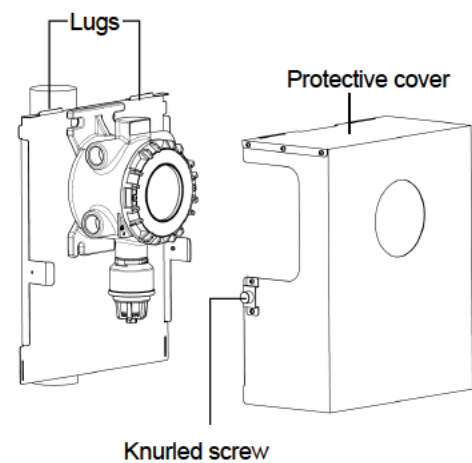
- 1 Attach the chassis and mounting bracket to the main unit.
Secure with four M5 × 6 double SEMS bolts from behind, as shown in the diagram to the right.



- 2 Fit one U bolt around the vertical pole and through the upper slots on the main unit. Secure with two washers, two spring washers, and two M10 nuts.
- 3 Fit the second U bolt around the vertical pole and through the lower slots on the main unit. Secure with two washers, two spring washers, and two M10 nuts.



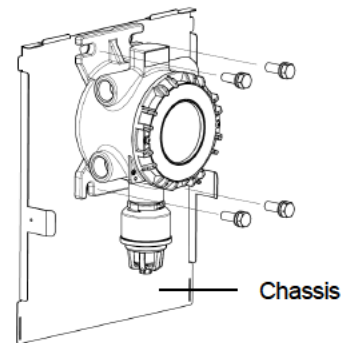
- 4 Attach the protective cover, aligning it with the two lugs at the top of the chassis.
- 5 Secure the protective cover in place by tightening the knurled screws on either side of the cover.



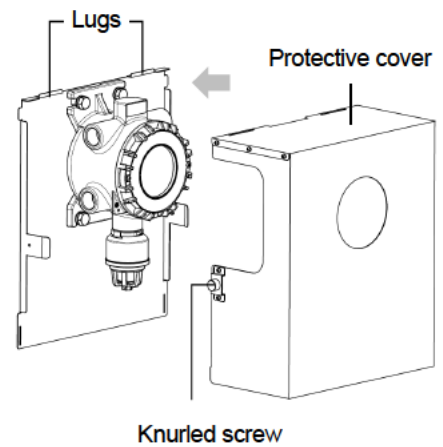
*The diagram illustrates the SD-3. The mounting method for the SD-3SC is identical.

<Wall mounting>

- 1 **Secure the main unit and chassis with four M10 double SEMS bolts.**



- 2 **Attach the protective cover, aligning it with the two lugs at the top of the chassis.**
- 3 **Secure the protective cover in place by tightening the knurled screws on either side of the cover.**



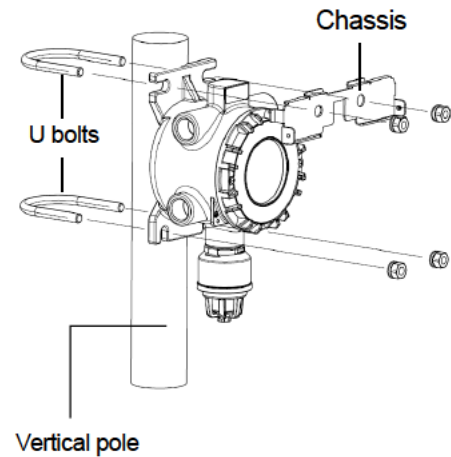
*The diagram illustrates the SD-3. The mounting method for the SD-3SC is identical.

4-4-4 Attaching sunshade cover

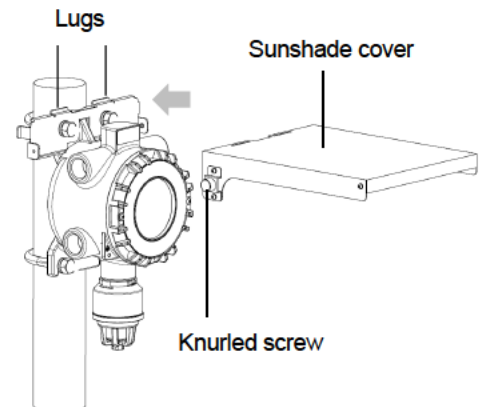
Attach the sunshade cover to the main unit (SD-3/SD-3SC).

<Pole mounting (pole size: 50A (2B))>

- 1 Fit one U bolt around the vertical pole and through the upper slots on the main unit. Secure with the chassis, two washers, two spring washers, and two M10 nuts.
- 2 Fit the second U bolt around the vertical pole and through the lower slots on the main unit. Secure with two washers, two spring washers, and two M10 nuts.



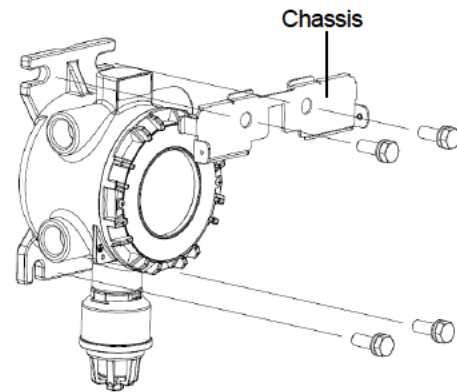
- 3 Attach the sunshade cover, aligning it with the two lugs at the top of the chassis.
- 4 Secure the sunshade cover in place by tightening the knurled screws on either side of the cover.



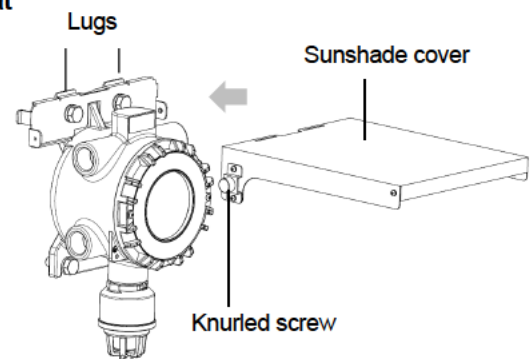
*The diagram illustrates the SD-3. The mounting method for the SD-3SC is identical.

<Wall mounting>

- 1 **Secure the main unit and chassis with four M10 double SEMS bolts.**



- 2 **Attach the sunshade cover, aligning it with the two lugs at the top of the chassis.**
- 3 **Secure the sunshade cover in place by tightening the knurled screws on either side of the cover.**

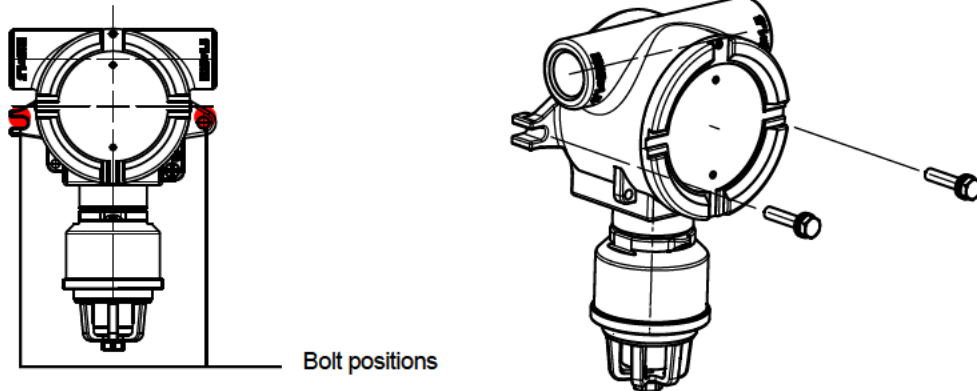


*The diagram illustrates the SD-3. The mounting method for the SD-3SC is identical.

4-5 Remote sensor head (GD-3) installation

4-5-1 Wall mounting

- 1 Place the remote sensor head (GD-3) against the wall surface and secure with two M6 double SEMS bolts.

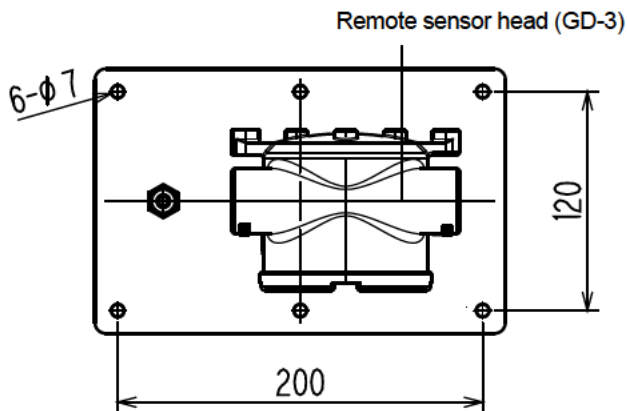


4-5-2 Duct mounting

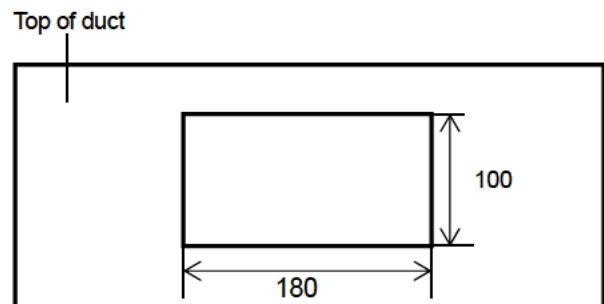
Attach the remote sensor head (GD-3) to a duct.

Attach to a duct using the duct mounting kit.

The duct mounting kit has the following dimensions:

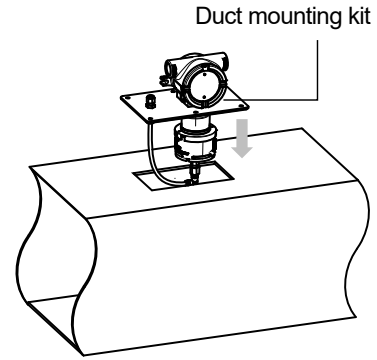


- 1 Cut out an opening in the top of the duct. Refer to the diagram to the right for the dimensions of the opening.

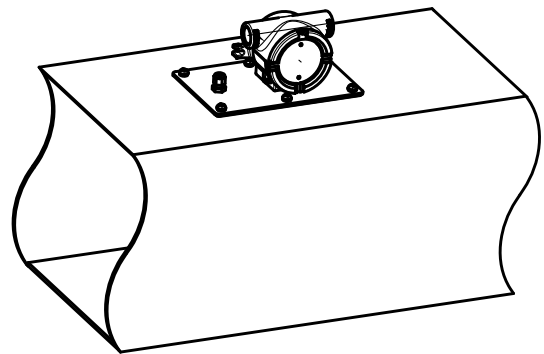
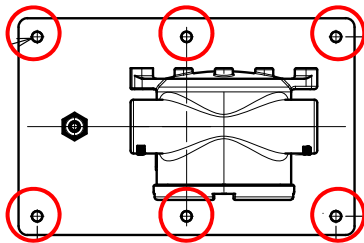


2 Insert the remote sensor head (GD-3) into the duct mounting kit and secure with four M5 bolts.

Connect a tube to the sensor on the remote sensor head (GD-3) to enable calibration. The tube should protrude from the top of the duct mounting kit.

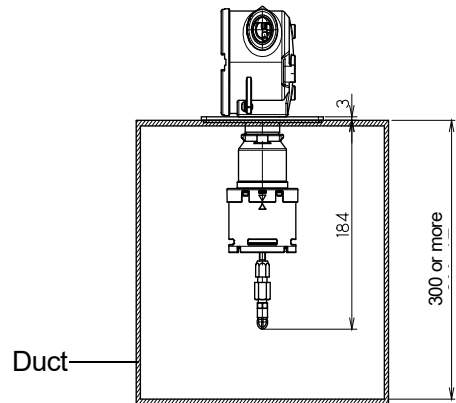


3 Insert the duct mounting kit into the opening in the duct. Secure in place with six M6 bolts.



NOTE

- ▶ When mounting the remote sensor head (GD-3) inside a duct, make sure the sensor is not in contact with the duct inner wall.



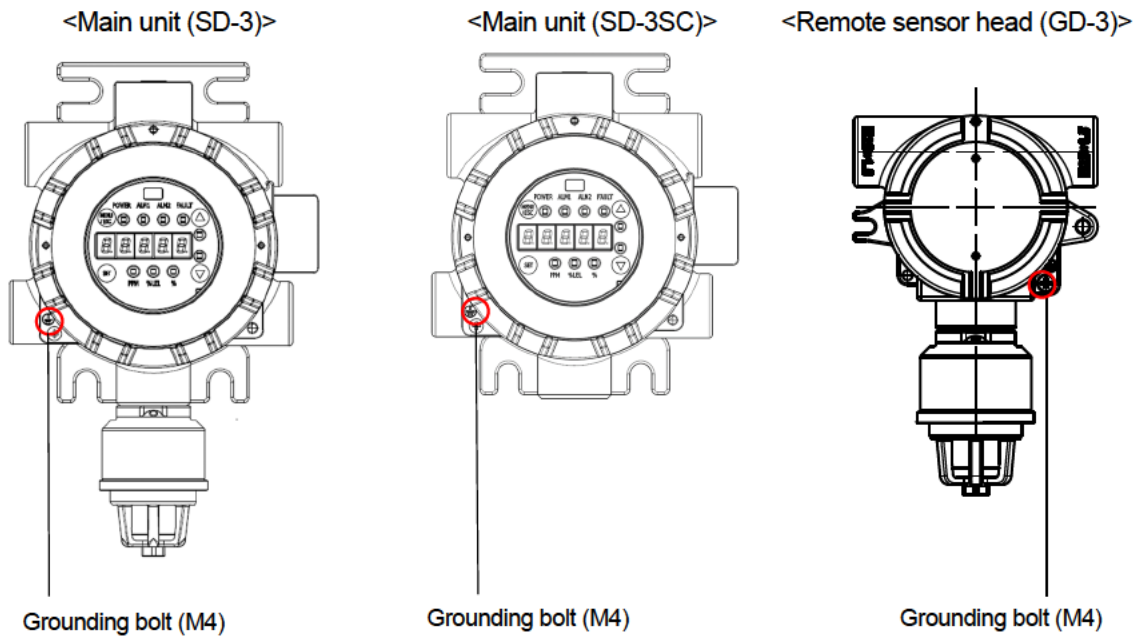
4-6 Connecting the grounding terminal




WARNING

- Be sure to ground the product before turning on the power.
- To ensure stable operation and safety, be sure to ground the product. Never connect grounding wires to gas pipes.
- Make sure the grounding is Class D equivalent (grounding resistance not exceeding 100 Ω).
- Use cable lugs on the grounding wire to ensure safe grounding with the cable free of slack and twisting.
- Do not ground to the same locations as high frequency or high voltage devices or nearby.

Connect the grounding bolt to the local grounding terminal.



NOTE

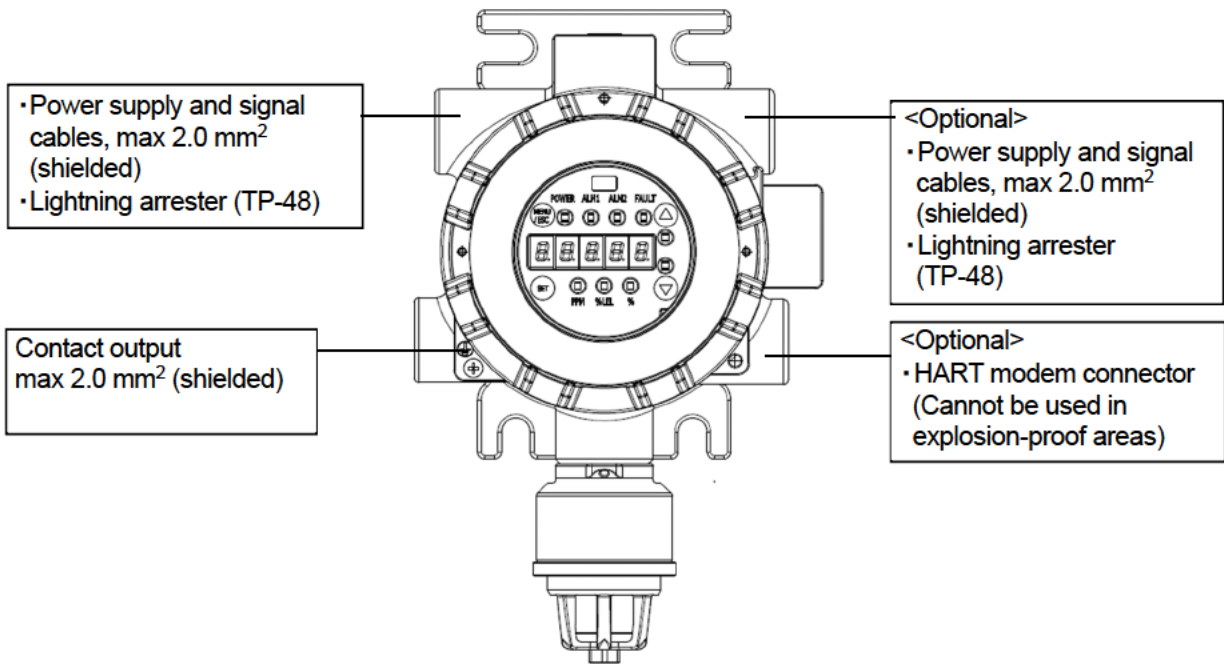
- ▶ The grounding bolt is marked with the  symbol.

4-7 Connecting the power and signal cables

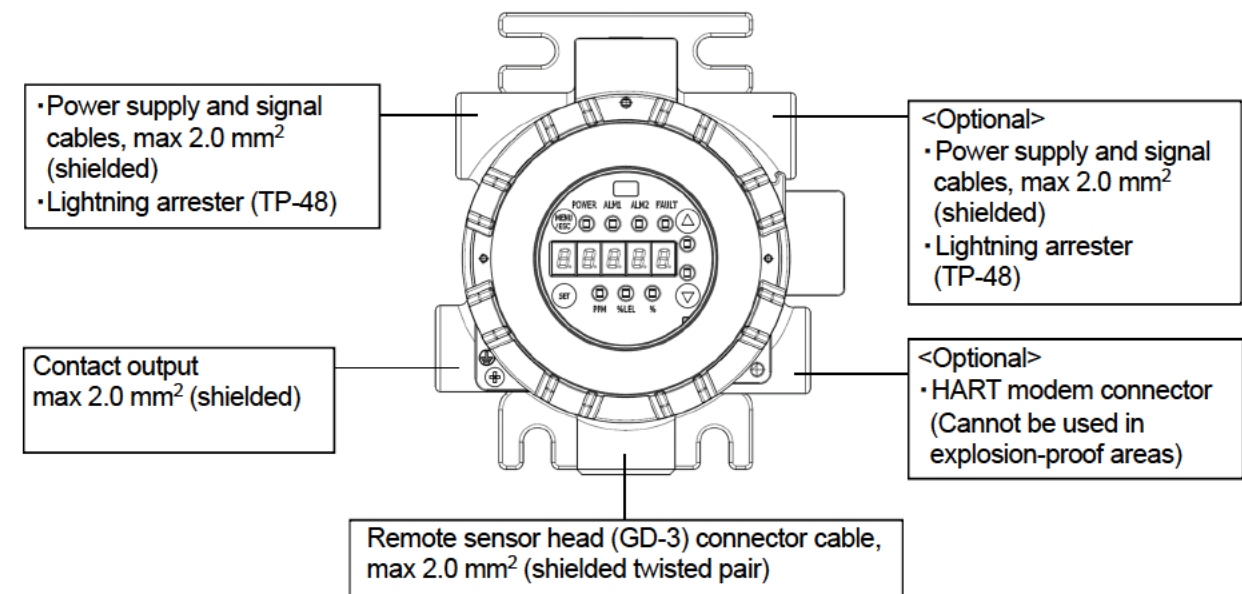
4-7-1 Main unit cable and device connectors

The cable and device connectors on the main unit are as follows:

<SD-3>



<SD-3SC>



NOTE

- ▶ Use the approved cable glands when connecting the remote sensor head (GD-3).
 - ▶ Up to two external cable connectors can be used at the same time (excluding the remote sensor head (GD-3) connector cable). Use the approved cable glands for the connection.
 - ▶ Blank off unused connectors with blanking plugs.
 - ▶ Do not use more than one adapter per connector.
 - ▶ Do not use an adapter together with a blanking plug.
-

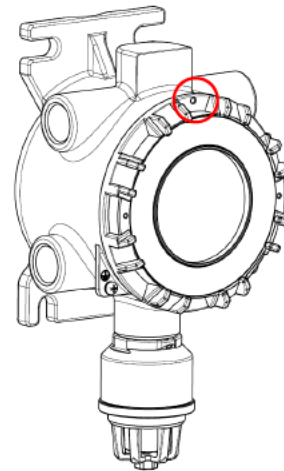
4-7-2 Connecting the power and signal cables to the main unit

Connect the power cable, signal cable, and contact cables to the main unit (SD-3/SD-3SC).

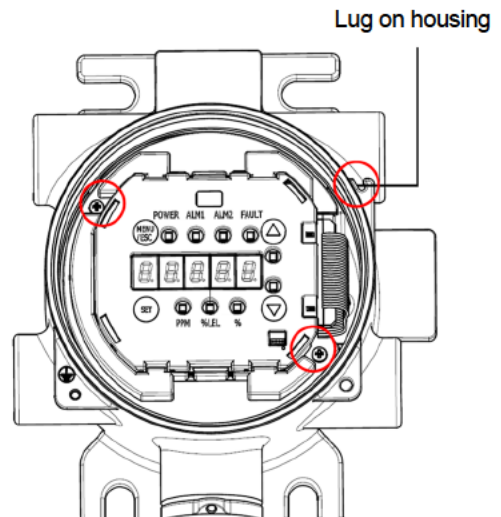
- 1 Unscrew the M4 hex socket set screw on the main unit cover, then rotate the cover counterclockwise to remove.**

Use a hex key wrench (2 across flats) to unscrew the M4 hex socket set screw.

Be careful to avoid dropping the cover while unscrewing and removing it.



- 2 Unscrew the two M3 screws securing the display unit.**



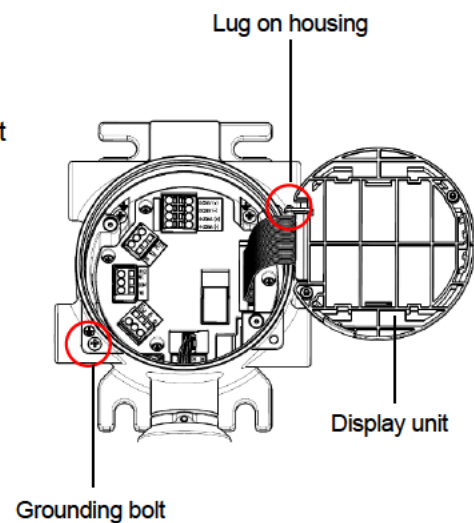
- 3 Pull out the display unit and hang on the lug on the housing.**

The display unit is connected to the terminal plate unit by a flat cable. Pulling with excessive force may disconnect the cable.

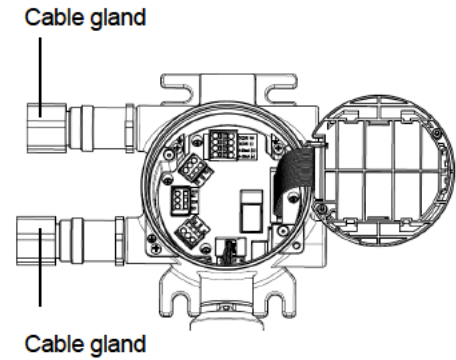
During the removal process, avoid pulling on the display unit with excessive force.

- 4 Ground the main unit.**

Make sure the grounding is Class D equivalent (grounding resistance not exceeding 100 Ω). For information on grounding, refer to '4-6 Connecting the grounding terminal'.

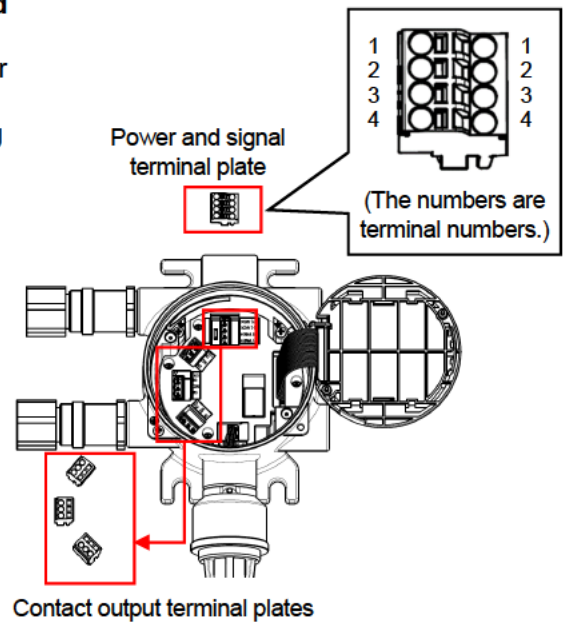


- 5 Attach cable glands or conduits to the connectors on the main unit.**
 Use appropriate cable glands or conduits to suit the purpose and type of the cable.



- 6 Pull out the terminal plates from the terminal plate board.**
7 Connect the power and signal cables to the power and signal terminal plate.

Connect the cables to the following terminals on the power and signal terminal plate. For more information on the contact cable connections, refer to '4-9 Alarm relay setting (option)'. For information on connecting cables to the terminal plate, refer to '4-7-5 Connecting cables to the terminal plate'.

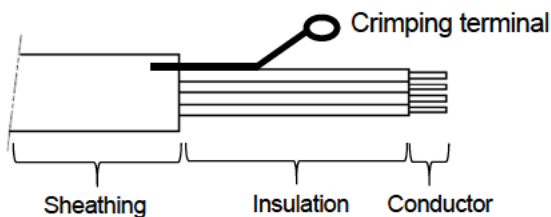


<Using 3-core cable>

| Terminal No. | Power/signal cable connection |
|--------------|---------------------------------------|
| 1 | Power supply (+) |
| 2 | Common (power supply (-), signal (-)) |
| 3 | Signal (+) |

<Using 4-core cable>

| Terminal No. | Power/signal cable connection |
|--------------|-------------------------------|
| 1 | Power supply (+) |
| 2 | Power supply (-) |
| 3 | Signal (+) |
| 4 | Signal (-) |



Recommended insulation length: 40 - 50 mm

When connecting cables, connect the cable shielding to the terminals at the top left or top right on the inside of the main unit.

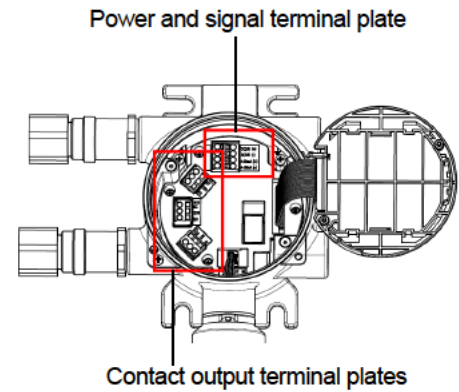
Depending on the installation location, noise interference may result. If this happens, remove the shielding.

- 8 Connect the required number of contact cables to the contact output terminal plates.**
 For information on connecting cables to the terminal plate, refer to '4-7-5 Connecting cables to the terminal plate'.

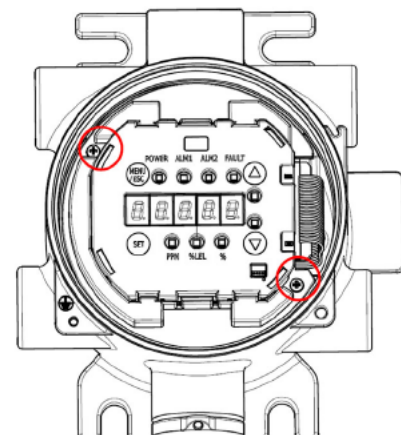
*No contact output terminal plate is present with the no contact output option.

9 Mount the terminal plates on the terminal plate board.

Adjust the cable position so that no load is applied to the terminal plates.

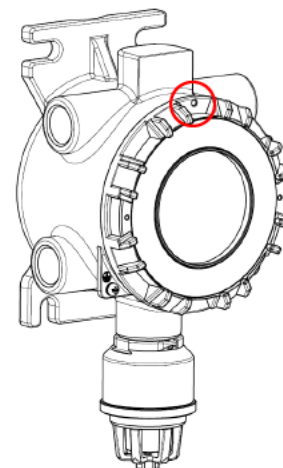
**10 Return the display unit to its original position and secure with the two M3 screws.**

Take care not to trap the cable here.

**11 Rotate the cover clockwise to attach and secure with the single M4 hex socket set screw.**

Use a hex key wrench (2 across flats) to tighten the M4 hex socket set screw.

Take care not to trap the cable when attaching the cover. Rotate the cover clockwise until it moves no further to securely fasten in place.



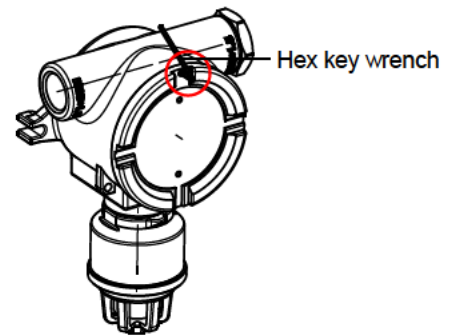
*The diagram illustrates the SD-3. The connection method for the SD-3SC is identical.

4-7-3 Connecting the power and signal cables to the remote sensor head (GD-3)

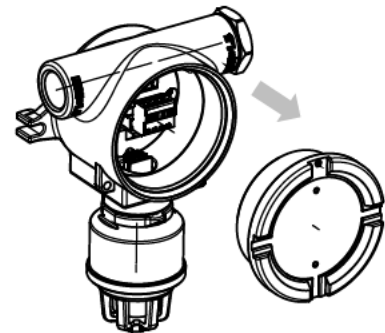
- 1 **Unscrew the single M4 screw on the remote sensor head (GD-3) cover.**

Use a hex key wrench (2 across flats) to unscrew the M4 hex socket set screw.

Be careful to avoid dropping the cover while unscrewing and removing it.

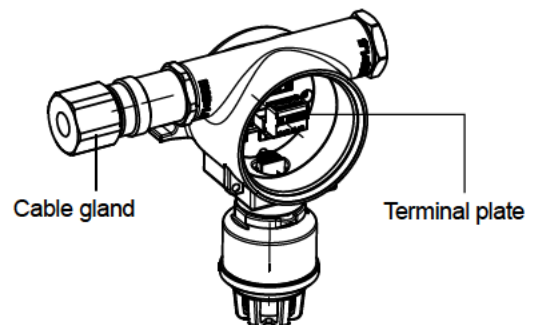


- 2 **Rotate the cover counterclockwise and remove.**

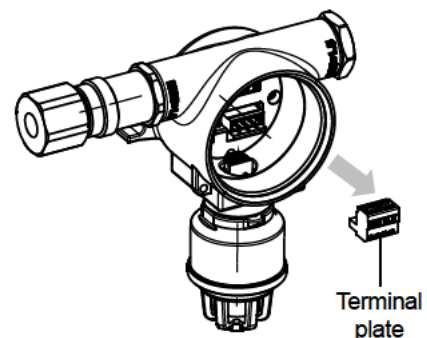


- 3 **Attach a cable gland or conduit to the connector on the remote sensor head (GD-3).**

Use an appropriate cable gland or conduit to suit the purpose and type of the cable.



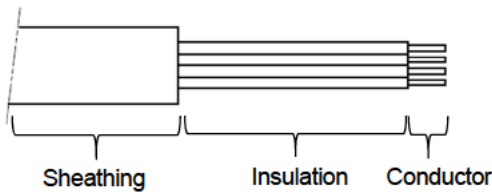
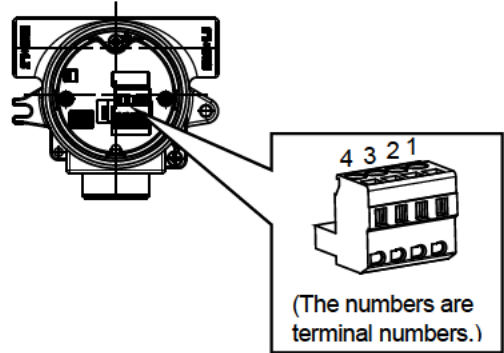
- 4 **Pull out the terminal plate (TN1) from the terminal plate board.**



5 Connect the power and signal cables to the terminal plate.

Connect the cables to the following terminals on the terminal plate. For information on how to connect cables to the terminal plate, refer to '4-7-5 Connecting cables to the terminal plate'.

| Terminal No. | Power/signal cable connection |
|--------------|-------------------------------|
| 1 | Power supply (+) |
| 2 | Power supply (-) |
| 3 | Signal (+) |
| 4 | Signal (-) |



Recommended insulation length: 40 - 50 mm

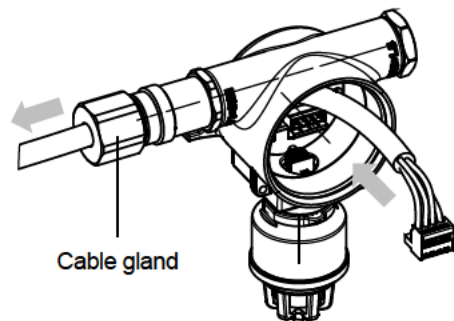
When connecting cables, connect the cable shielding to the terminals at the top left or top right on the inside of the main unit.

Depending on the installation location, noise interference may result.

In such cases, remove the shielding.

6 Route the cable from inside the main unit to the connector.

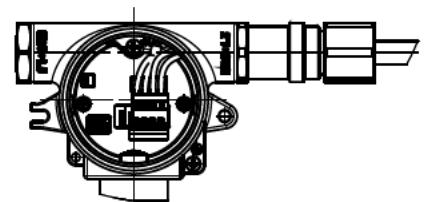
Route to the connector on the side where the cable gland or conduit is attached.



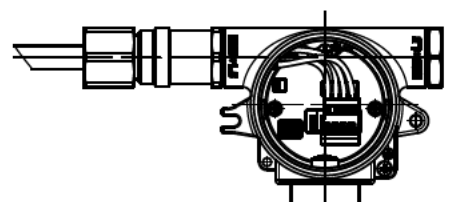
7 Mount the terminal plate on the terminal plate board.

Adjust the cable position so that no load is applied to the terminal plates.

<With cable (external cable) routed to right-hand side>



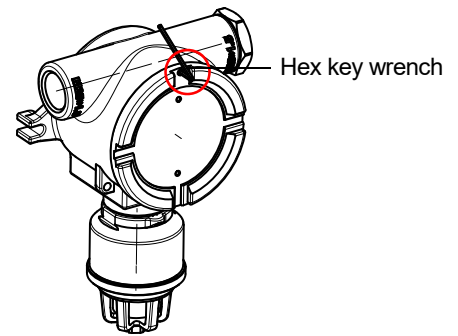
<With cable (external cable) routed to left-hand side>



8 Rotate the cover clockwise to attach and secure with the single M4 hex socket set screw.

Use a hex key wrench (2 across flats) to tighten the M4 hex socket set screw.

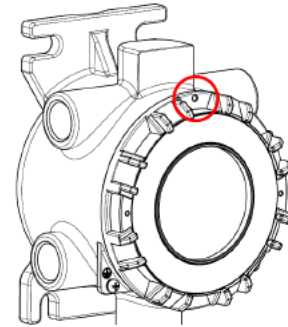
Take care not to trap the cable when attaching the cover. Rotate the cover clockwise until it moves no further to securely fasten in place.



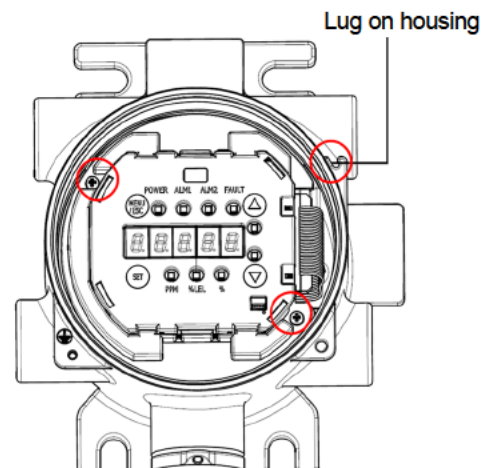
4-7-4 Connecting the main unit (SD-3SC) and remote sensor head (GD-3)

- 1 Unscrew the M4 hex socket set screw on the main unit (SD-3SC) cover, then rotate the cover counterclockwise to remove.**

Use a hex key wrench (2 across flats) to unscrew the M4 hex socket set screw.
Be careful to avoid dropping the cover while unscrewing and removing it.

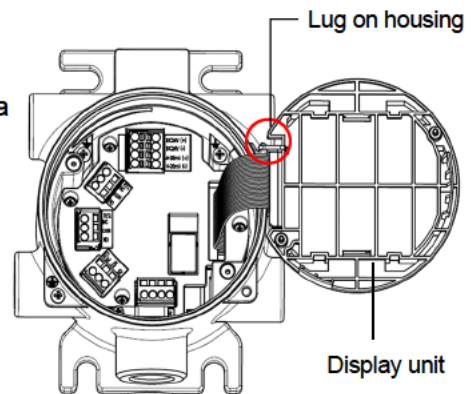


- 2 Unscrew the two M3 screws securing the display unit.**



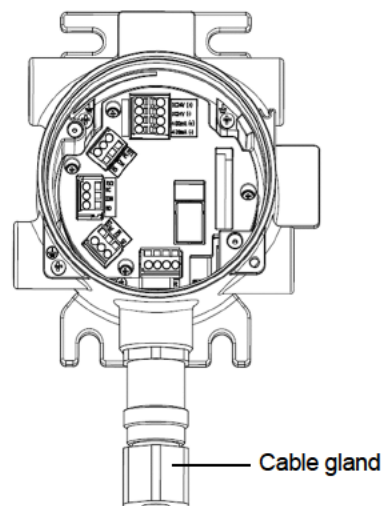
- 3 Pull out the display unit and hang on the lug on the housing.**

The display unit is connected to the terminal plate unit by a flat cable. Pulling with excessive force may disconnect the cable.
During the removal process, avoid pulling on the display unit with excessive force.

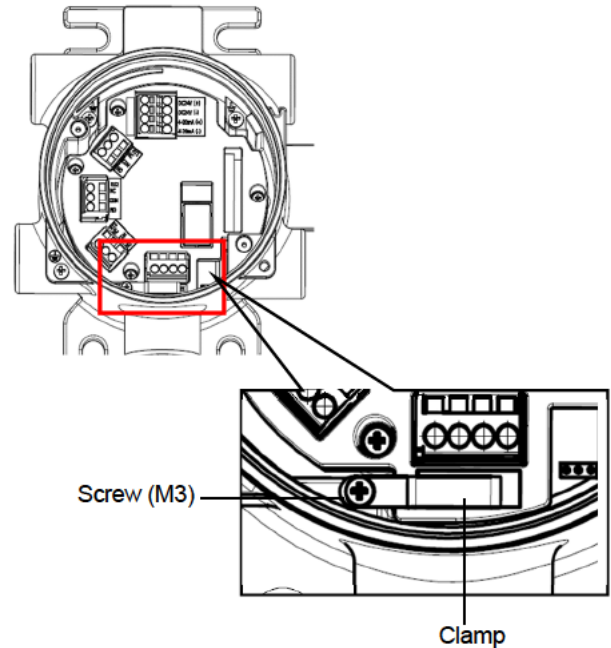


- 4 Attach a cable gland or conduit to the connector on the main unit.**

Use an appropriate cable gland or conduit to suit the purpose and type of the cable.



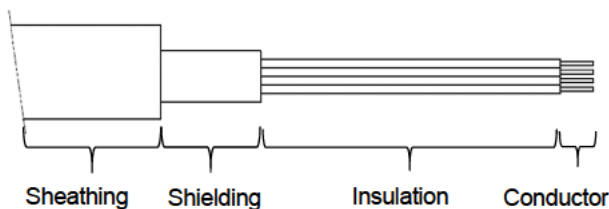
- 5 Pull out the remote connection terminal plate from the terminal plate board.
- 6 Unscrew the single M3 screw securing the clamp and remove the clamp.



- 7 Connect the power and signal cables extending from the remote sensor head (GD-3) to the remote connection terminal plate.

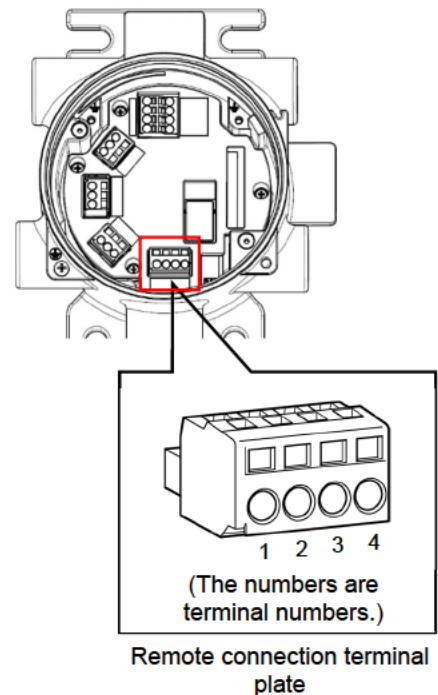
Connect the cables to the following terminals on the remote connection terminal plate. For information on connecting cables to the terminal plate, refer to '4-7-5 Connecting cables to the terminal plate'.

| Terminal No. | Power/signal cable connection |
|--------------|-------------------------------|
| 1 | Power supply (+) |
| 2 | Power supply (-) |
| 3 | Signal (+) |
| 4 | Signal (-) |



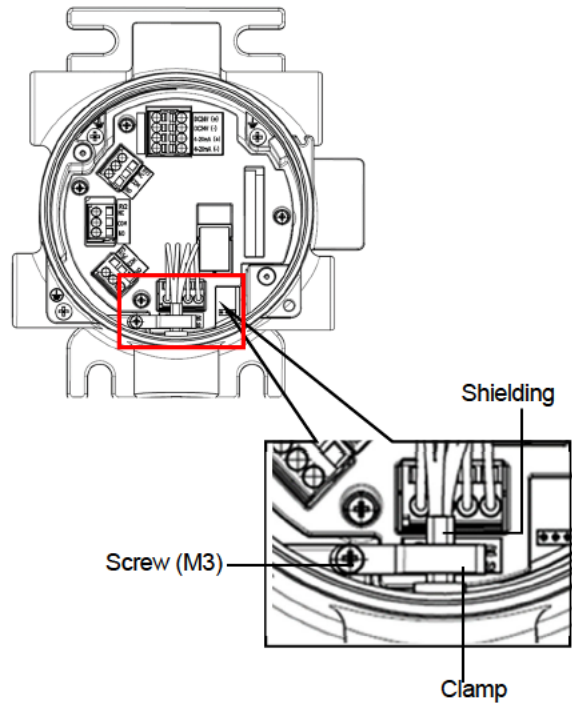
Recommended shielding length: 30 - 40 mm
 Recommended insulation length: 130 - 140 mm

- 8 Mount the terminal plate on the terminal plate board.
 Adjust the cable position so that no load is applied to the terminal plates.



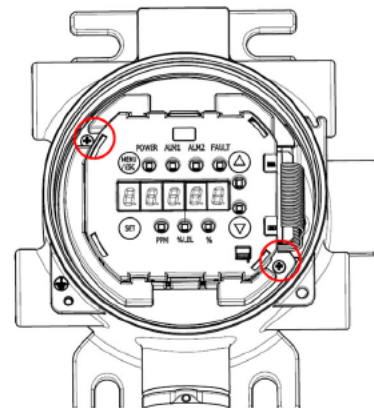
9 Clamp the shield wire.

Use the single M3 screw to clamp the cable shielding.



10 Return the display unit to its original position and secure with the two M3 screws.

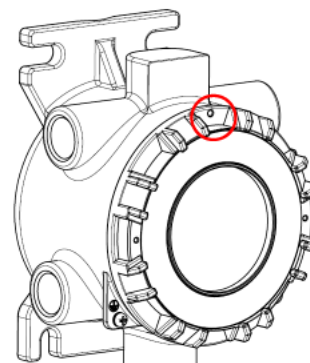
Take care not to trap the cable here.



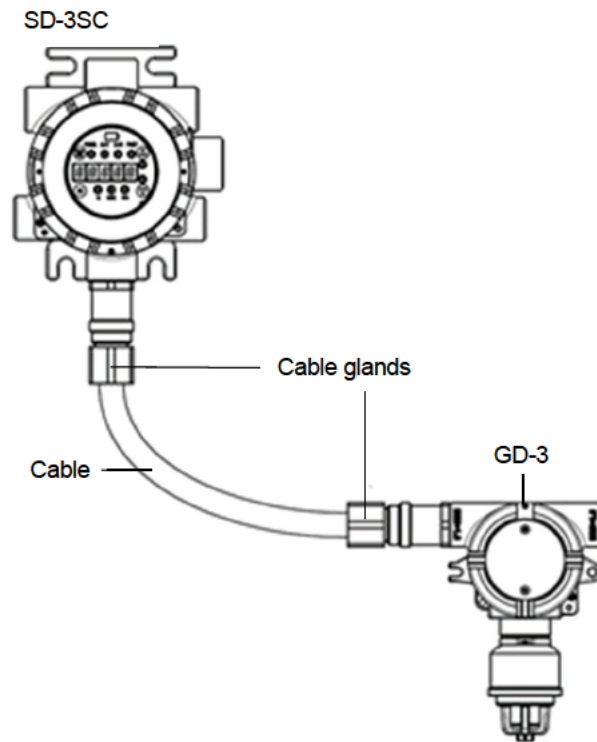
11 Rotate the cover clockwise to attach and secure with the single M4 hex socket set screw.

Use a hex key wrench (2 across flats) to tighten the M4 hex socket set screw.

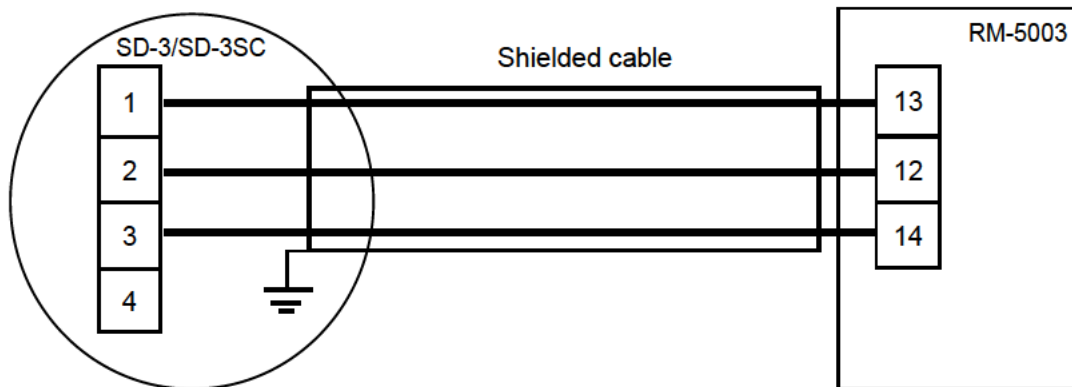
Take care not to trap the cable when attaching the cover. Rotate the cover clockwise until it moves no further to securely fasten in place.



<SD-3SC and GD-3 connection example>



<SD-3/SD-3SC and RM-5003 terminal plate connection example>



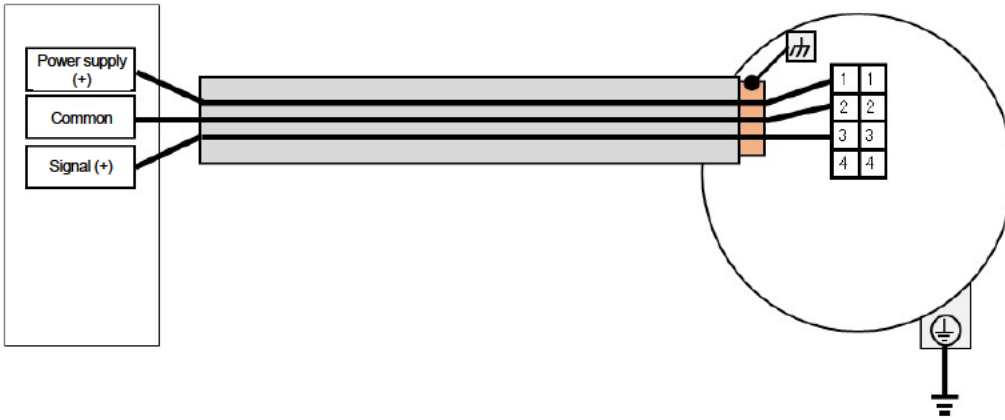
<Indicator connection example>

<SD-3>

Indicator (e.g., RM-5003)

SD-3

Connect the shield to the grounding bolt on the chassis

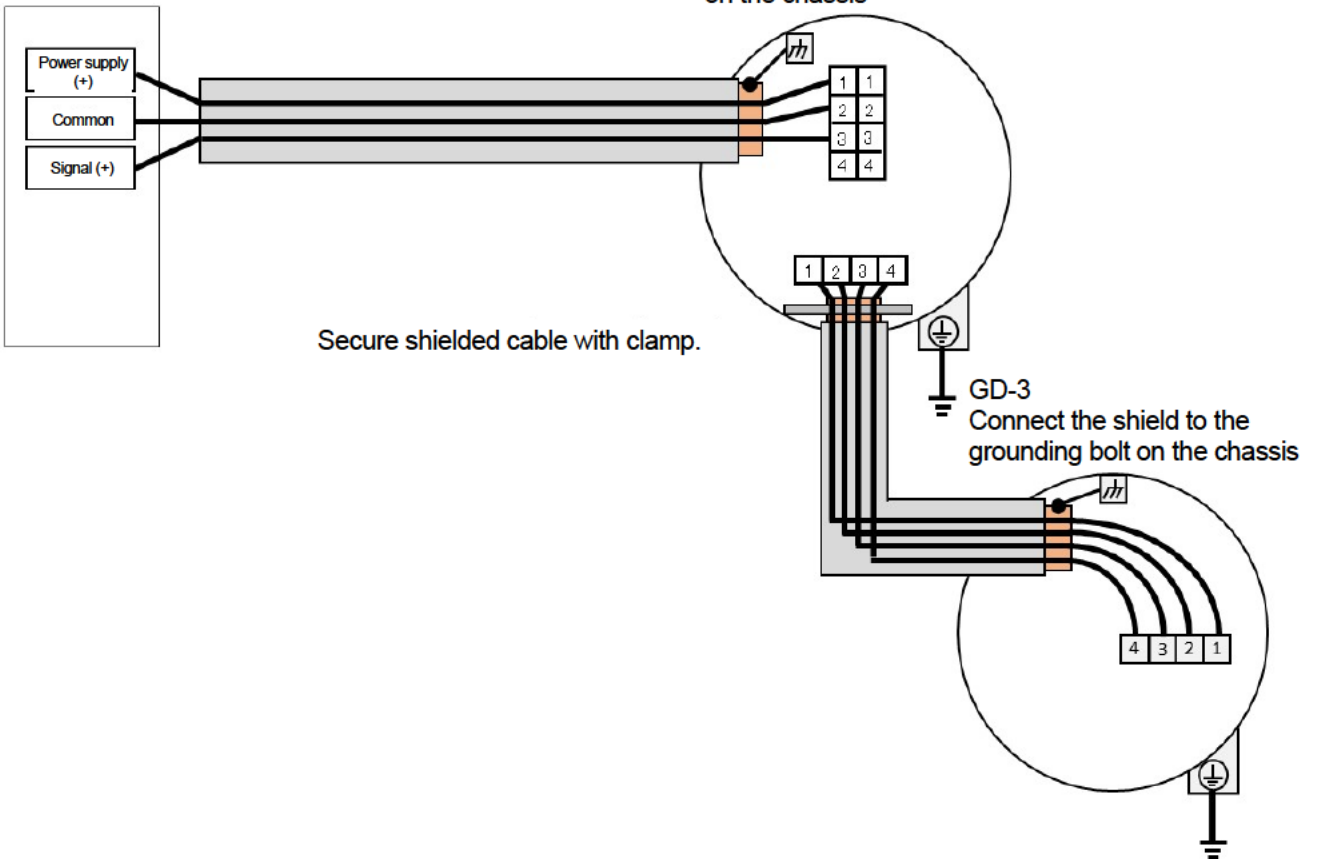


<SD-3SC>

Indicator (e.g., RM-5003)

SD-3SC

Connect the shield to the grounding bolt on the chassis



4-7-5 Connecting cables to the terminal plate

Strip the cable to the specified length and connect to the cable wire insertion holes on the terminal plate.

<Terminal plate specifications>

- Rated voltage: 300 V AC
- Rated current: 10 A

Specifications will vary depending on the cable used.

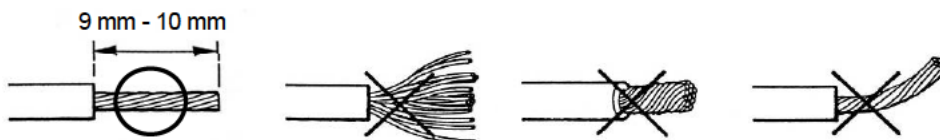
<Connecting conditions>

- Cable used: 0.25 mm² - 2.5 mm²
- Maximum sheathing external diameter: 4.1 mm
- Stripped wire (conductor) length: 8 mm - 9 mm (9 mm - 10 mm for SD-3 TN1 only)
- Connecting tool: Flathead screwdriver (blade tip 2.5 mm × 0.5 mm) or operating lever (provided)



Be sure to strip the cable to the specified (conductor) length.

- Conduction faults or overheating may result if the stripped wire (conductor) length is too short and the wire is clamped incorrectly.
- Conduction faults or overheating may result if the stripped wire (conductor) length is too short and the wire sheathing is clamped.
- An insulation failure or short circuit may result if the stripped wire (conductor) length is too long and the wire is exposed.
- Make sure the wire does not splay. An insulation failure or overheating may result if the wire splays when inserted.
- To avoid the above, if the stripped wire is stranded wire cable, we recommend using a bar terminal (ferrule).



<Compatible rod terminal>

If you use rod terminals, use the following item:

- Rod terminal (ferrule): Model 216 series (manufactured by WAGO)
- Crimping tool: Model Variocrimp 4 (206-1204) (manufactured by WAGO)



- Be sure to use the specified rod terminals. We cannot guarantee performance if you use rod terminals other than those specified.

<Connecting cables to terminal plate>

To connect cables to the terminal plate, use the operating lever provided as a standard accessory or a flathead screwdriver (blade tip 2.5 mm × 0.5 mm).

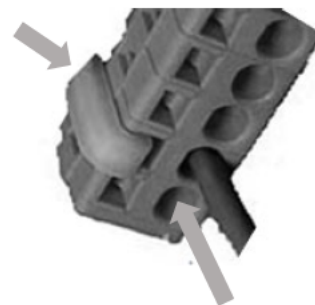
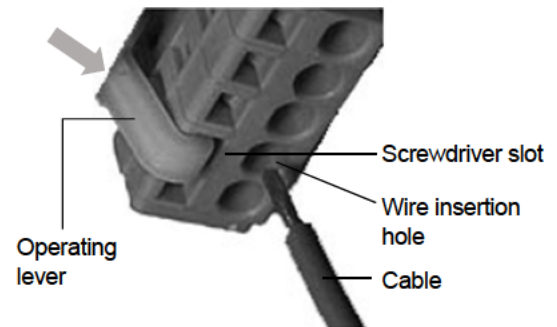
The operating lever provided as a standard accessory cannot be used when connecting power and signal cables to TN1 on the SD-3. Use a flathead screwdriver in this case.

CAUTION

- Be sure to use the correct tools.
- As a rule, only one cable can be connected to each wire insertion hole.
- If a cable is inserted into the screwdriver slot, the conductor may not make contact, resulting in conduction faults or overheating.

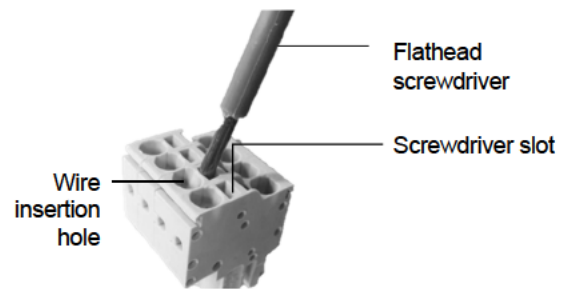
When using the operating lever provided as a standard accessory, connect the cable to the terminal plate as follows.

- 1 Hook the operating lever on to the screwdriver slot (rectangular hole) in the terminal plate as shown in the figure to the right.**
- 2 Push the operating lever with your finger to push down the spring inside the terminal plate.**
- 3 While continuing to press the operating lever, insert the cable into the wire insertion hole (round hole) until it contacts the end.**
- 4 Release the operating lever.**
The cable is now connected to the terminal plate.
Gently pull on the cable to confirm that it is correctly connected.
Avoid pulling with excessive force.

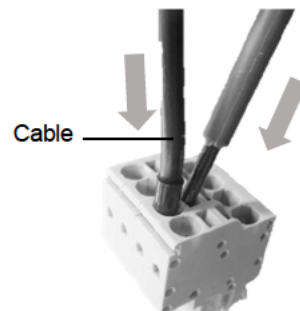


When using a flathead screwdriver to connect to TN1 on the SD-3, connect the cable to the terminal plate as follows:

- 1 Insert the flathead screwdriver into the screwdriver slot (rectangular hole) in the terminal plate as shown in the figure to the right.**



- 2 With the flathead screwdriver still being inserted, insert the cable into the wire insertion hole (round hole) until it contacts the end.**

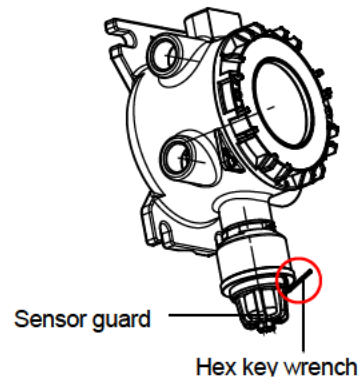


- 3 Release the flathead screwdriver.**
The cable is now connected to the terminal plate.
Gently pull on the cable to confirm that it is correctly connected.
Avoid pulling with excessive force.

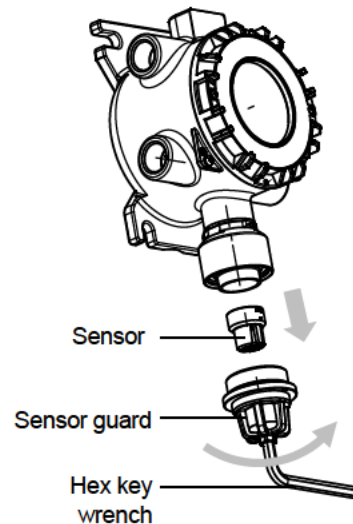
4-8 Mounting the sensor

Mount the sensor on to the main unit (SD-3) or remote sensor head (GD-3).

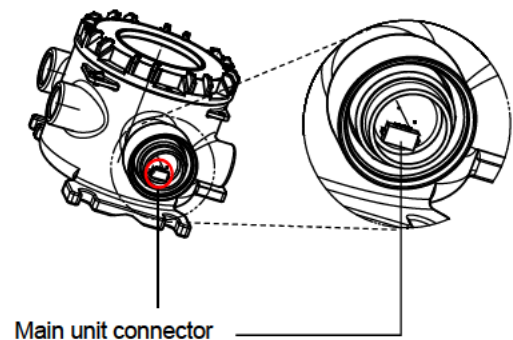
- 1 Remove suction cap, splash guard, and filter, if fitted.**
- 2 Unscrew the single M4 bolt securing the sensor guard.**
Use a hex key wrench (2 across flats) to unscrew the M4 hex socket set screw.



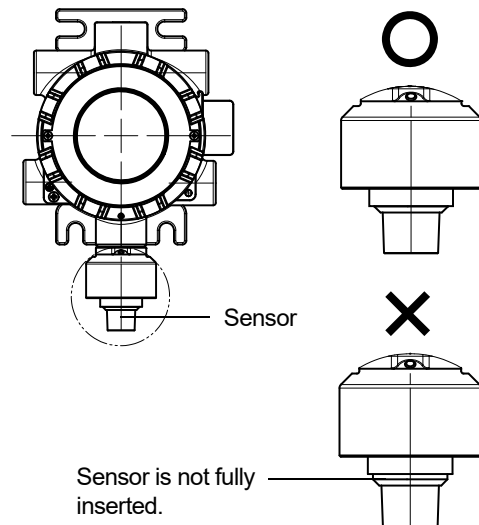
- 3 Rotate and remove the sensor guard.**
Remove using a hex key wrench (8 across flats) or wrench.
- 4 Pull out and remove the sensor, if fitted.**



- 5 Match the main unit connector and sensor connector and fully insert the sensor.**
Push the sensor all the way into the main unit connector. Avoid forcibly turning or pushing in the sensor when inserting it, as this may damage the main unit. Take care when inserting.



6 Confirm that the sensor is fully inserted.

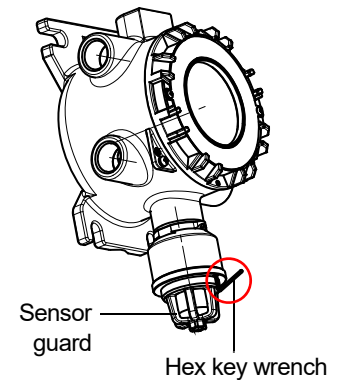


7 Attach the sensor guard to the main unit.

Attach using a hex key wrench (8 across flats) or wrench.

8 Use the single M4 hex socket set screw to secure the sensor guard in place.

Use a hex key wrench to tighten the M4 hex socket set screw.



*The diagram illustrates the SD-3. The mounting method for the remote sensor head (GD-3) is identical.

CAUTION

- Depending on the sensor, some fluctuation of the reading may occur if foreign objects are introduced while replacing the sensor.

4-9 Alarm relay setting (option)

The product can be operated as a standalone unit by setting an alarm relay. By default, the alarm relay is set to a de-energized state.

WARNING

- If using a supply voltage of 30 V AC or 42.4 V DC or greater, either fit protective tubing to the cable or use a double insulation cable.

CAUTION

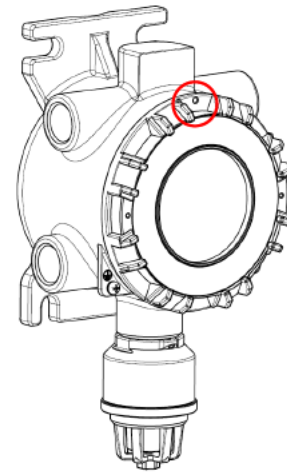
- Note that recurring use with the alarm relay contacts normally closed may result in the contacts seizing due to minute vibrations.
- Connect the alarm relay cable and sensor before turning on the power to the product.

To set the alarm relay, connect the alarm unit cables to the TN2 (Relay1), TN3 (Relay2), and TN4 (Relay3) terminal plates on the main unit (SD-3/SD-3SC).

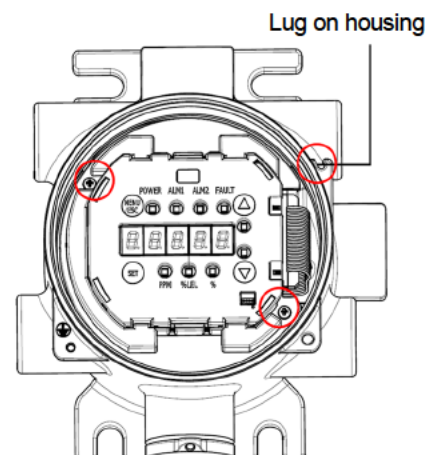
- 1 Unscrew the M4 hex socket set screw on the main unit cover, then rotate the cover counterclockwise to remove.**

Use a hex key wrench (2 across flats) to unscrew the M4 hex socket set screw.

Be careful to avoid dropping the cover while unscrewing and removing it.



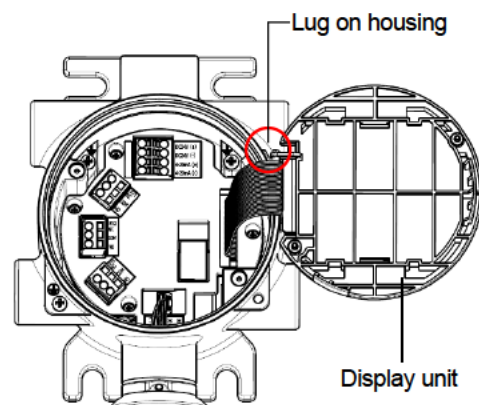
- 2 Unscrew the two M3 screws securing the display unit.**



- 3 Pull out the display unit and hang on the lug on the housing.**

The display unit is connected to the terminal plate unit by a flat cable. Pulling with excessive force may disconnect the cable.

During the removal process, avoid pulling on the display unit with excessive force.



4 Pull out the terminal plates (TN2 (Relay1), TN3 (Relay2), and TN4 (Relay3)) from the terminal plate board.

5 Connect the alarm unit wires to the corresponding terminals on the detached terminal plates.

Use either terminal 1 (N.O.) or terminal 3 (N.C.) on the terminal plate.

For information on how to connect cables to the terminal plates, refer to '4-7-5 Connecting cables to the terminal plate'.

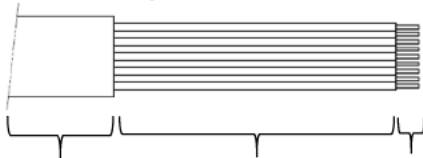
Common for TN2 (Relay1), TN3 (Relay2), and TN4 (Relay3)

(Default (normally de-energized) terminal assignment)

| Terminal No. | Cable connection |
|--------------|------------------|
| 1 | N.O. |
| 2 | Common |
| 3 | N.C. |

N.O.: Normally open

N.C.: Normally closed



Sheathing Insulation Conductor
Recommended insulation length: 120 - 130 mm

6 Mount the terminal plates (TN2 (Relay1), TN3 (Relay2), and TN4 (Relay3)) on the terminal plate board.

Adjust the cable position so that no load is applied to the terminal plates.

7 Return the display unit to its original position and secure with the two M3 screws.

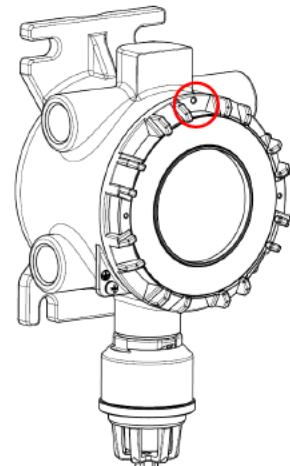
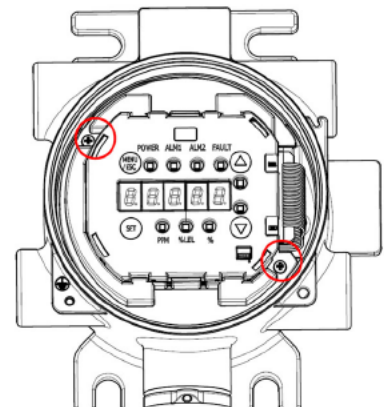
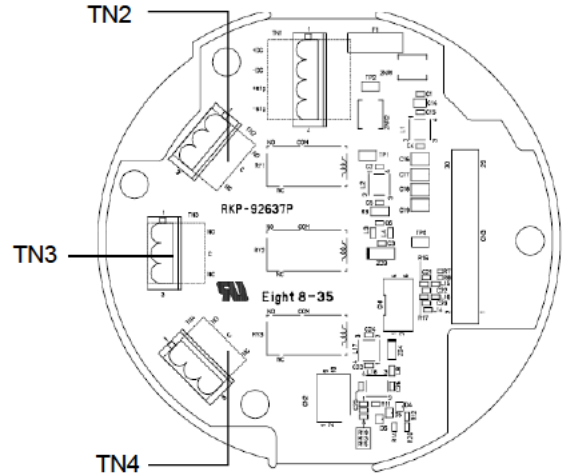
Take care not to trap the cable here.

8 Rotate the cover clockwise to attach and secure with the single M4 hex socket set screw.

Use a hex key wrench (2 across flats) to tighten the M4 hex socket set screw.

Take care not to trap the cable when attaching the cover.

Rotate the cover clockwise until it moves no further to securely fasten in place.

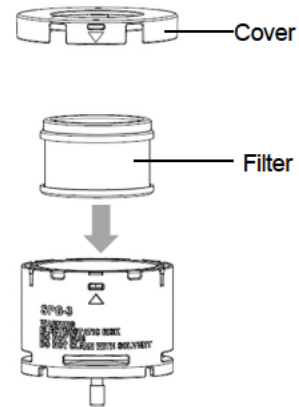


*The diagram illustrates the SD-3. The connection method for the SD-3SC is identical.

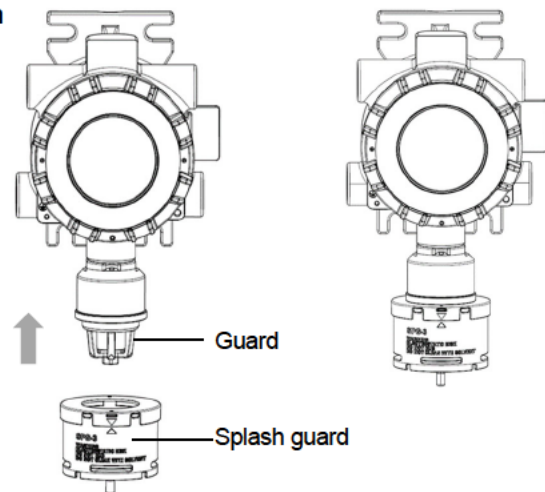
4-10 Mounting the splash guard

When using a silicone removal filter or activated carbon filter, fit the filter inside the splash guard before mounting the splash guard.

- 1 **When using a silicone removal filter or activated carbon filter, remove the splash guard cover, fit the filter inside the splash guard, and reattach the cover.**
This step is required only when using a silicone removal filter or activated carbon filter.



- 2 **Mount the splash guard over the guard on the main unit, then turn clockwise to secure into place.**
Mount the splash guard securely by rotating clockwise until it will not rotate any further.
Avoid rotating with excessive force.

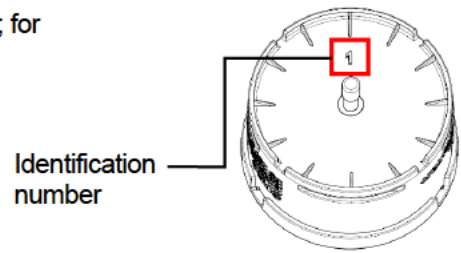


*The diagram illustrates the SD-3. The mounting method for the remote sensor head (GD-3) is identical.

NOTE

- ▶ Three different splash guard types are available: for the IRF sensor; for the combustible gas sensor; and for the ESF sensor. The corresponding identification number is engraved on the underside of each splash guard.

- IRF sensor identification number: 1
- Combustible gas sensor identification number: 2
- ESF sensor identification number: 3



- ▶ The splash guards are compatible with the following SD-3 and GD-3 models:

<for IRF sensor>

| |
|--------|
| SD-3RI |
| GD-3RI |

<for combustible gas sensor>

| |
|---------|
| SD-3NC |
| SD-3GH |
| SD-3GHS |
| SD-3SP |
| GD-3NC |
| GD-3GH |
| GD-3GHS |
| GD-3SP |

<for ESF sensor>

| |
|---------|
| SD-3EC |
| SD-3ECB |
| GD-3EC |
| GD-3ECB |

5

Usage Instructions

5-1 Preparations for startup

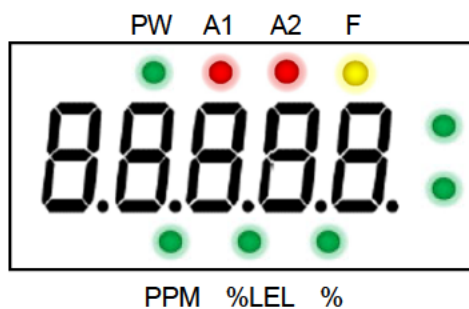
Carry out the following checks before connecting the power supply. Failure to perform these checks may result in electric shock or damage to the product.

- Check to confirm that the product is grounded.
- Check to confirm that external wiring is correctly connected.
- Check to confirm that the power supply voltage is within the rated range.
- External contacts may operate while adjustment is under way. Take precautions to prevent any external effects from the contacts operating.

<How to read display examples>

LED display examples are shown as follows in this operating manual.

The display examples are for cases in which the detection target gas is combustible gas (display units: %LEL lit).



| | | |
|-------|--------------------|------------------------------------|
| PW: | POWER (Power lamp) | ● lit (green) / ● flashing (green) |
| A1: | ALM1 (Alarm lamp) | ● lit (red) |
| A2: | ALM2 (Alarm lamp) | ● lit (red) |
| F: | FAULT (Fault lamp) | ● lit (yellow) |
| PPM: | Units lamp | ● lit (green) |
| %LEL: | Units lamp | ● lit (green) |
| %: | Units lamp | ● lit (green) |

5-2 Startup

CAUTION

- Check to confirm that the product has been correctly installed before turning on the power supply (24 V DC).

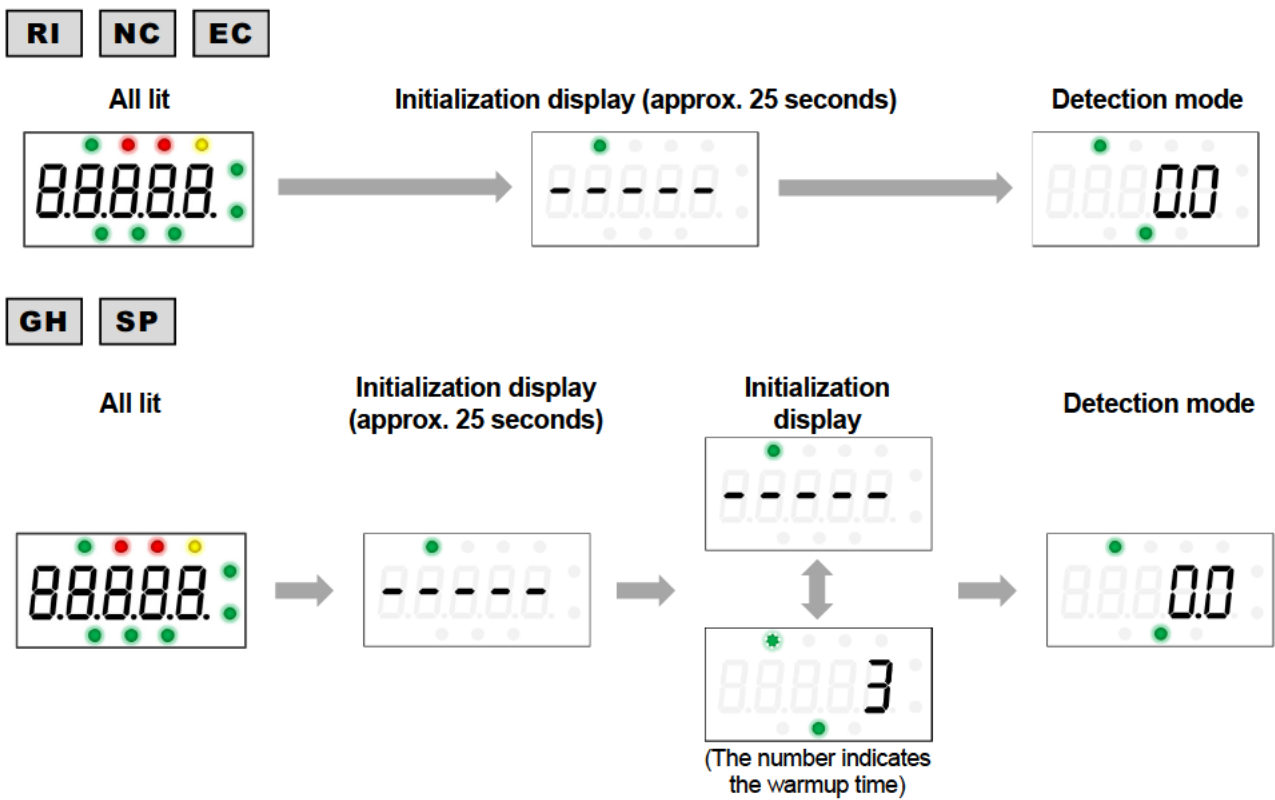
Turn on the power supply (24 V DC) and start the product.

The product takes approximately 25 seconds before switching to detection mode after the power is turned on.

System checks, alarm cutoff, and other initialization occurs during this time.

The display automatically changes as follows after the power is turned on.

The product is normally used in detection mode after the power is turned on.

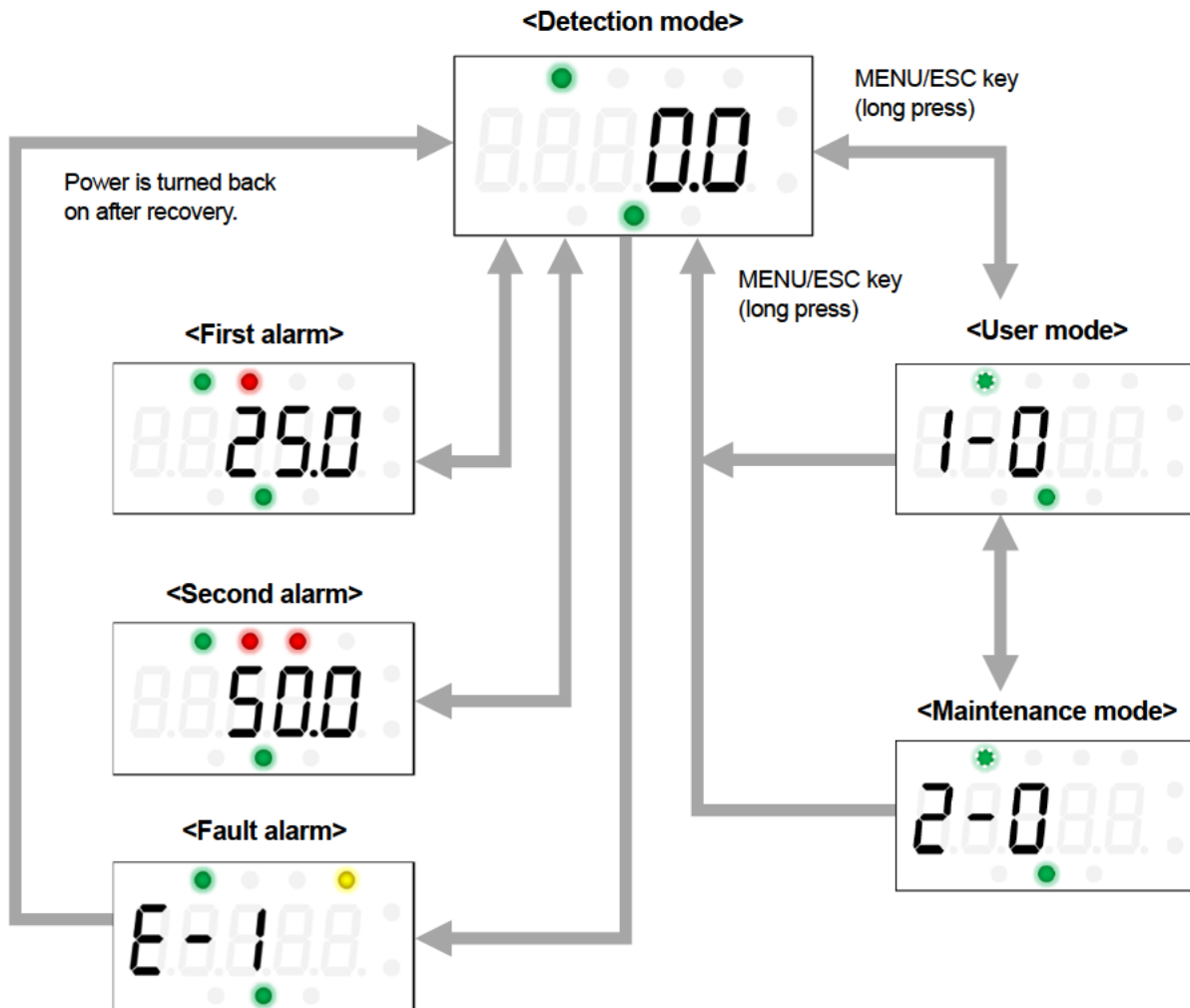


**CAUTION**

- Never turn off the power while initialization is underway. The internal memory is read during initialization.
 - A specific warmup is required for each sensor type at startup and after sensor replacement. Allow the product to warm up for the specified time. Expected warmup completion times for the semiconductor type (SGF) and hot-wire semiconductor type (SHF) sensors are indicated after initialization. Alarm activation and output signals will be unstable during warmup. Notify the relevant department beforehand to avoid conditions that may lead to errors.
 - Perform calibration once warmup is complete.
-

5-3 Basic operation flow

After the power is turned on, the product operates as follows when you press the MENU/ESC key:



WARNING

- Switching from detection mode to user mode or maintenance mode in an alarm state will cancel the alarm.

NOTE

- ▶ The LEDs on the product comprise a five-digit seven-segment display. Setting details are displayed as item numbers.
When setting in user mode or maintenance mode, select the item number corresponding to the details to be set. (Refer to '5-5-1 User mode setting items' and '7-2-1 Maintenance mode setting items'.)

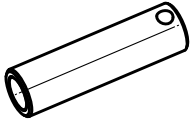
5-4 Operating procedure

The product is operated using the control key.

Use the control key to touch the four keys (MENU/ESC key, SET key, ▲ key, and ▼ key) on the front of the product.

This operating manual refers to the action of touching the individual keys using the control key as “pressing.”

<Control key>



CAUTION

- Do not press the control key forcibly against the glass.

5-5 User mode





Switching to user mode lets you perform zero calibration and check various settings.



CAUTION

- Do not alter settings unnecessarily. Altering the settings without a proper understanding of the details may prevent the product from operating correctly.

5-5-1 User mode setting items

| Item No. | Setting item | LED display | Details |
|----------|----------------------------|---|---|
| 1-0 | Version information |  | Displays the program version and other information. This is not normally used by the user. |
| 1-1 | Zero calibration |  | Performs zero calibration. (Refer to '5-6 Performing zero calibration'.) |
| 1-2 | Setting display |  | Displays the alarm settings. (Refer to '5-7 Checking settings'.) |
| 1-3 | Maintenance mode selection |  | Switches to maintenance mode. (Refer to '7-2 Maintenance mode'.) |

5-5-2 Switching to user mode

- 1 Hold down the MENU/ESC key (for approximately three seconds) in detection mode.



The product switches to user mode.



- 2 Press the ▲ or ▼ key to select the required item number, then press the SET key.



Display example: With setting display selected

The details corresponding to the item number selected are displayed.
Set or display individual items.



- 3 Once the operation is complete, hold down the MENU/ESC key (for approximately three seconds).
The product switches to detection mode.

WARNING

- Once the operation is complete, be sure to hold down the MENU/ESC key to return to detection mode. The product will not detect gases while in adjustment/setting state. If left in user mode, the product will take 10 hours to return to detection mode. Detection will not be available during this time, posing hazards.

5-6 Performing zero calibration

This performs the zero calibration required to ensure accurate measurement of gas concentrations.

Prepare the zero calibration gas, then connect to the product before starting zero calibration.

For information on zero calibration preparation, refer to '7-4-1 Calibration preparation'.



WARNING

- Before performing zero calibration for the surrounding atmosphere, confirm that the surrounding atmosphere contains clean air. Performing zero calibration in the presence of miscellaneous gases will prevent correct calibration and create safety hazards in the event of an actual gas leak.



CAUTION

- Perform zero calibration after supplying the zero calibration gas and waiting for the reading to stabilize.

- 1 Press the ▲ or ▼ key in user mode to select [1-1], then press the SET key.



- 2 Introduce the zero calibration gas, then press the SET key.



Zero calibration starts.



- 3 Check the zero calibration result.

If zero calibration is successful

[PASS] is displayed for three seconds before the display automatically returns to [1-1].



If zero calibration is unsuccessful

[FAIL] is displayed for three seconds before the display automatically returns to [1-1].



NOTE

- ▶ If zero calibration is unsuccessful because the zero point ([20.9] (vol%) in the case of oxygen) fluctuates significantly around zero, [FAIL] is displayed before the display returns to [1-1]. If this occurs, zero calibration was not performed.
 - ▶ [1-1] corresponds to span adjustment for the oxygen deficiency alarm specifications. Introduce clean air to adjust to [20.9] (vol%). For information on span adjustment, refer to '7-4-3 Performing span adjustment'.
-

5-7 Checking settings

Displays the alarm settings.

| Item No. | Setting item | Remarks |
|----------|-----------------------|---|
| 1-2 | Setting display | |
| 1-2.0 | Alarm setting display | Zero follower setting ON/OFF display: NC EC Sensitivity correction ON/OFF display: EC |
| 1-2.1 | - | This is not normally used by the user. |

5-7-1 Checking alarm setpoints

Displays the various alarm settings, including first alarm setpoint, second alarm setpoint, and alarm delay time.

NOTE

- ▶ The zero follower setting ON/OFF display appears only with sensors that rely on the new ceramic or electrochemical detection principle. (Refer to '1-2-2 Detection principles and detection target gases for individual models'.)
- ▶ The sensitivity correction ON/OFF display appears only with sensors that rely on the electrochemical type detection principle. (Refer to '1-2-2 Detection principles and detection target gases for individual models'.)

1 Press the ▲ or ▼ key in user mode to select [1-2], then press the SET key.



2 Select [1-2.0], then press the SET key.



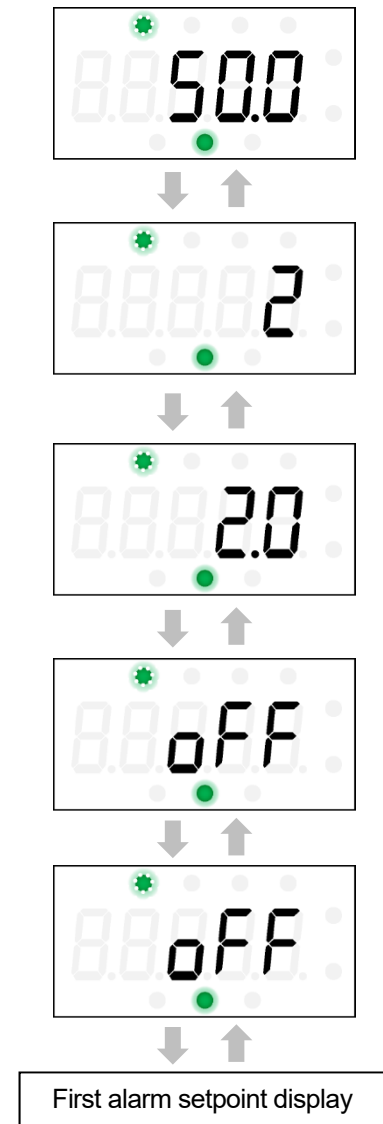
3 Check the individual alarm setpoints.
Press the ▲ or ▼ key to toggle between different setpoints.

- First alarm setpoint display
Displays the first alarm setpoint.



- Second alarm setpoint display
Displays the second alarm setpoint.
- Alarm delay time
Displays the alarm delay time (in seconds).
- Zero suppression value display
Displays the positive side suppression value.
- Zero follower ON/OFF display
Displays whether the zero follower setting is on or off.
(This is not normally used by the user.)
- Sensitivity correction ON/OFF display
Displays whether sensitivity correction is on or off.
(This is not normally used by the user.)

Press the ▲ key to return to the first alarm setpoint display.



4 Press the MENU/ESC key.

Returns to the [1-2.0] display.

NOTE

- ▶ The alarm setpoints, alarm delay time, and zero suppression value can be set in environmental settings 1 in maintenance mode. (Refer to '7-5 Setting environmental settings 1'.)

5-8 Shutting down

To shut down product operation, turn off the power supply (24 V DC) while in detection mode.



WARNING

- Shutting down product operation may activate an alarm in an upstream (central) system.
- Before shutting down product operation, make sure the INHIBIT setting is enabled (alarm processes are stopped) in the upstream (central) system. Also check the operation of any devices connected to the external output or external contact output terminal of the product to confirm shutting down the power will not cause problems.
- If using contacts (optional), the contacts may activate when the power supply is turned off.

6

Alarm Activation

6-1 Gas alarm activation

6-1-1 Alarm activation

The product issues an alarm when the detected gas or oxygen concentration reaches or exceeds the alarm setpoint. (Auto reset or self-latching)

NOTE

- ▶ The alarm setpoints (first and second alarms) and alarm pattern (auto reset or self-latching) are set at the factory before shipping.
- ▶ An alarm delay time (default setting: 2 seconds) is set to prevent accidental alarm activation. This should be canceled if not required.

<Gas concentration display>

If the reading exceeds the detection range (full scale exceeded), “∞∞∞” appears on the LED display.

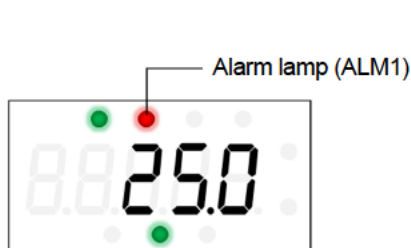
<Power/alarm lamp display>

The alarms are two-step alarms. The alarm lamps light up when the corresponding alarm setpoint is reached or exceeded.

The alarm lamps (ALM1 and ALM2) light up in red. The display appears as follows.

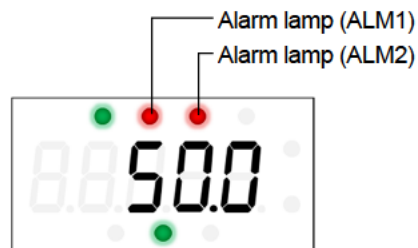
The power lamp (POWER) remains lit in green.

<First alarm>



ALM1 lit (red)

<Second alarm>



ALM1 and ALM2 lit (red)

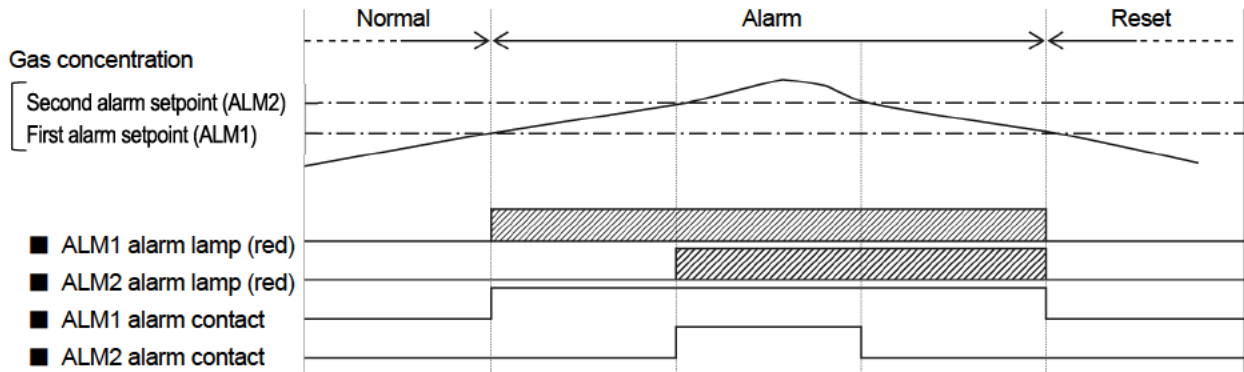
NOTE

- ▶ If the alarm pattern is set to self-latching, the alarm will continue even when the gas concentration falls below the alarm setpoint.
Operate the keys to cancel the alarm state after confirming that there is no gas present in the vicinity.

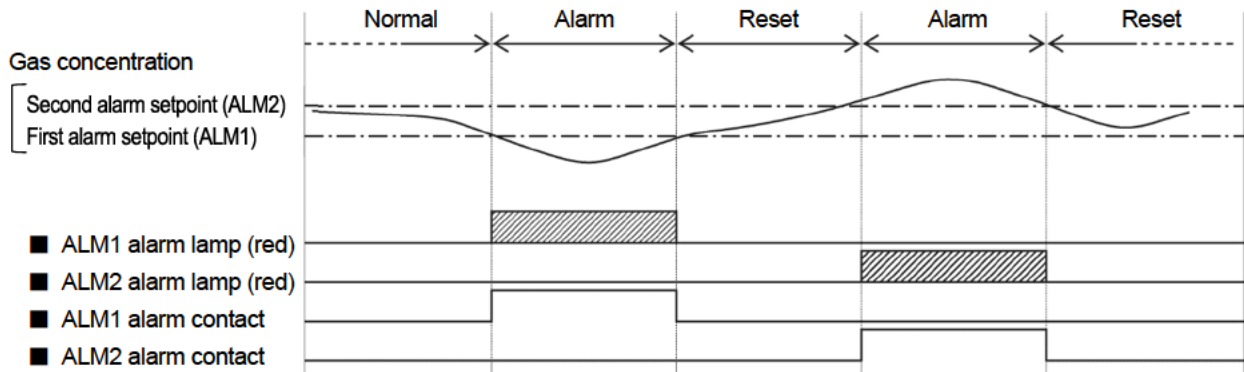
6-1-2 Contact operation (auto reset)

If auto reset is set, the contacts will activate when the gas concentration reaches or exceeds the alarm setpoint. The contact operation is automatically reset when the gas concentration falls below the alarm setpoint.

<Alarm pattern (H-HH)>

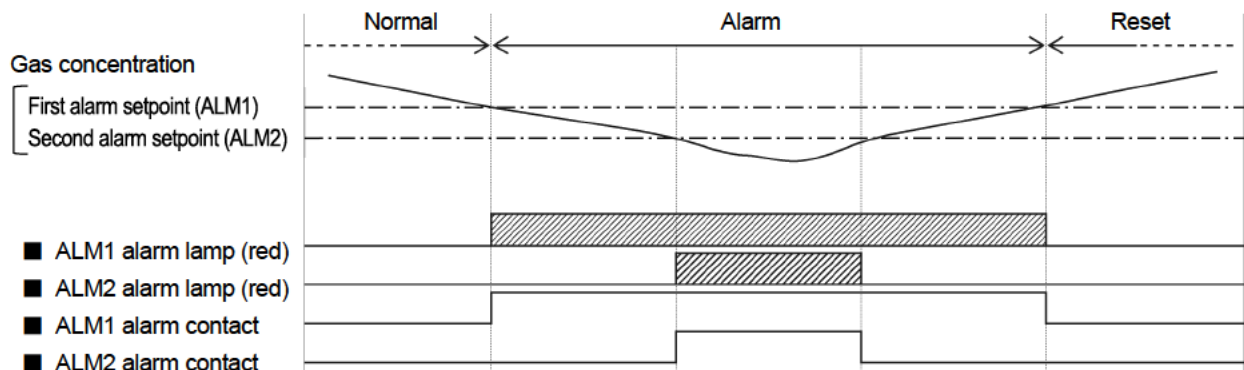


<Alarm pattern (L-H)>



<Alarm pattern (L-LL)>

(Oxygen deficiency alarm)



6-1-3 Contact operation (self-latching)

If self-latching is set, the contacts will activate when the gas concentration reaches or exceeds the alarm setpoint.

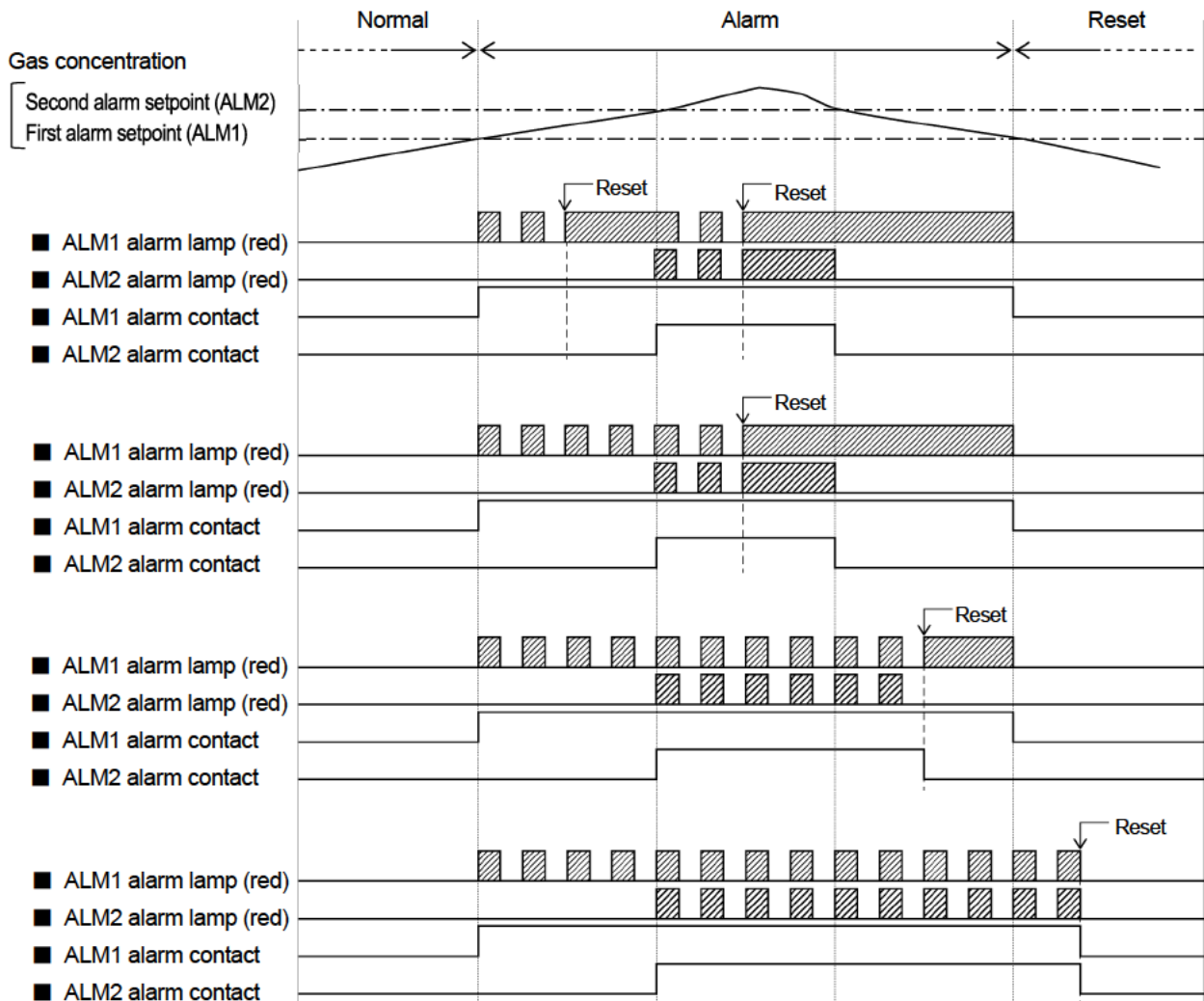
The contact operation is automatically reset when the gas concentration falls below the alarm setpoint after resetting.

The alarm lamps flash when an alarm occurs. The lamps stop flashing and remains constantly lit when reset. Then, the lamps go out when the gas concentration falls below the alarm setpoint.

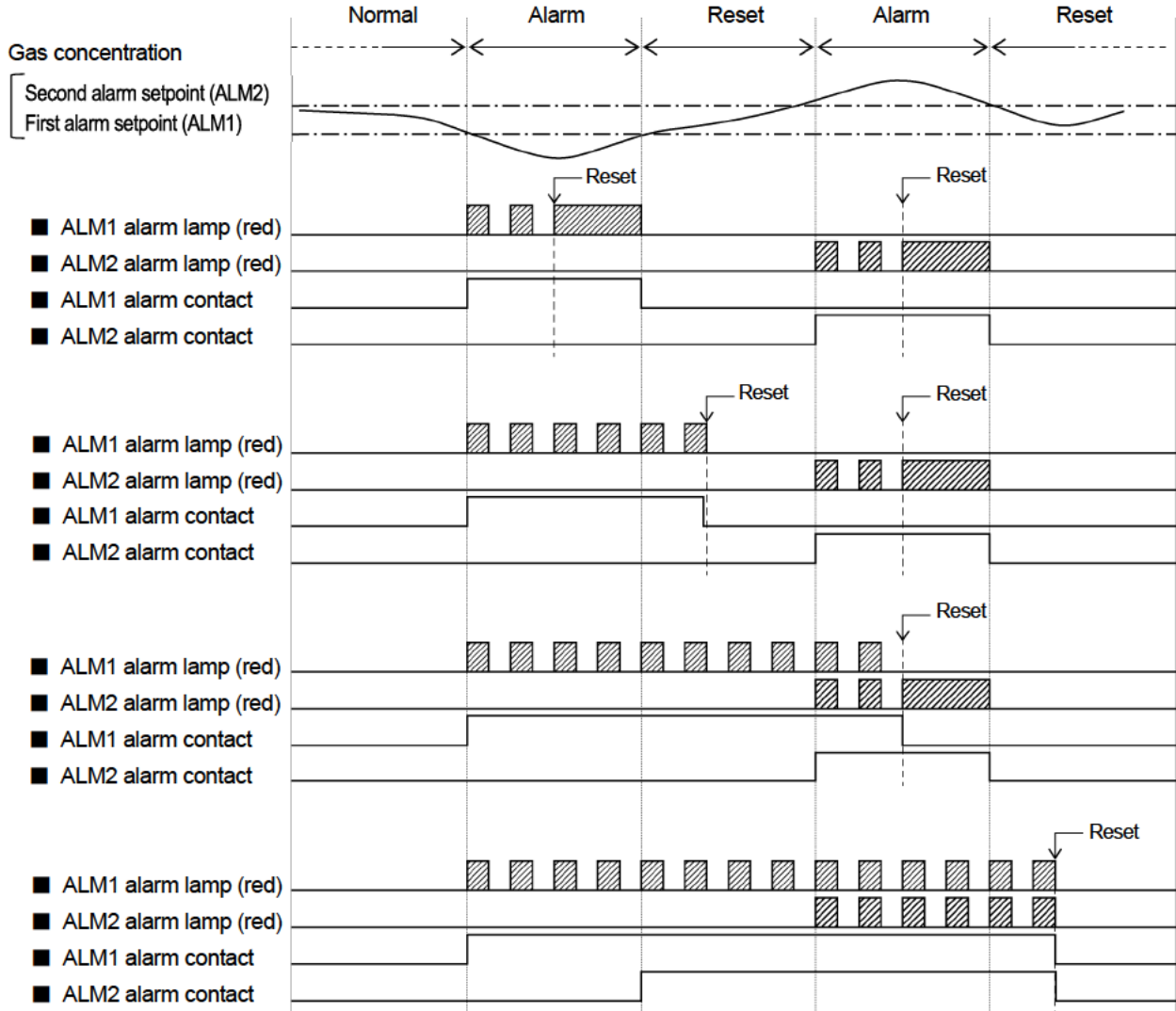
NOTE

▶ To cancel an alarm, press the MENU/ESC key, SET key, ▲ key, or ▼ key in detection mode.

<Alarm pattern (H-HH)>

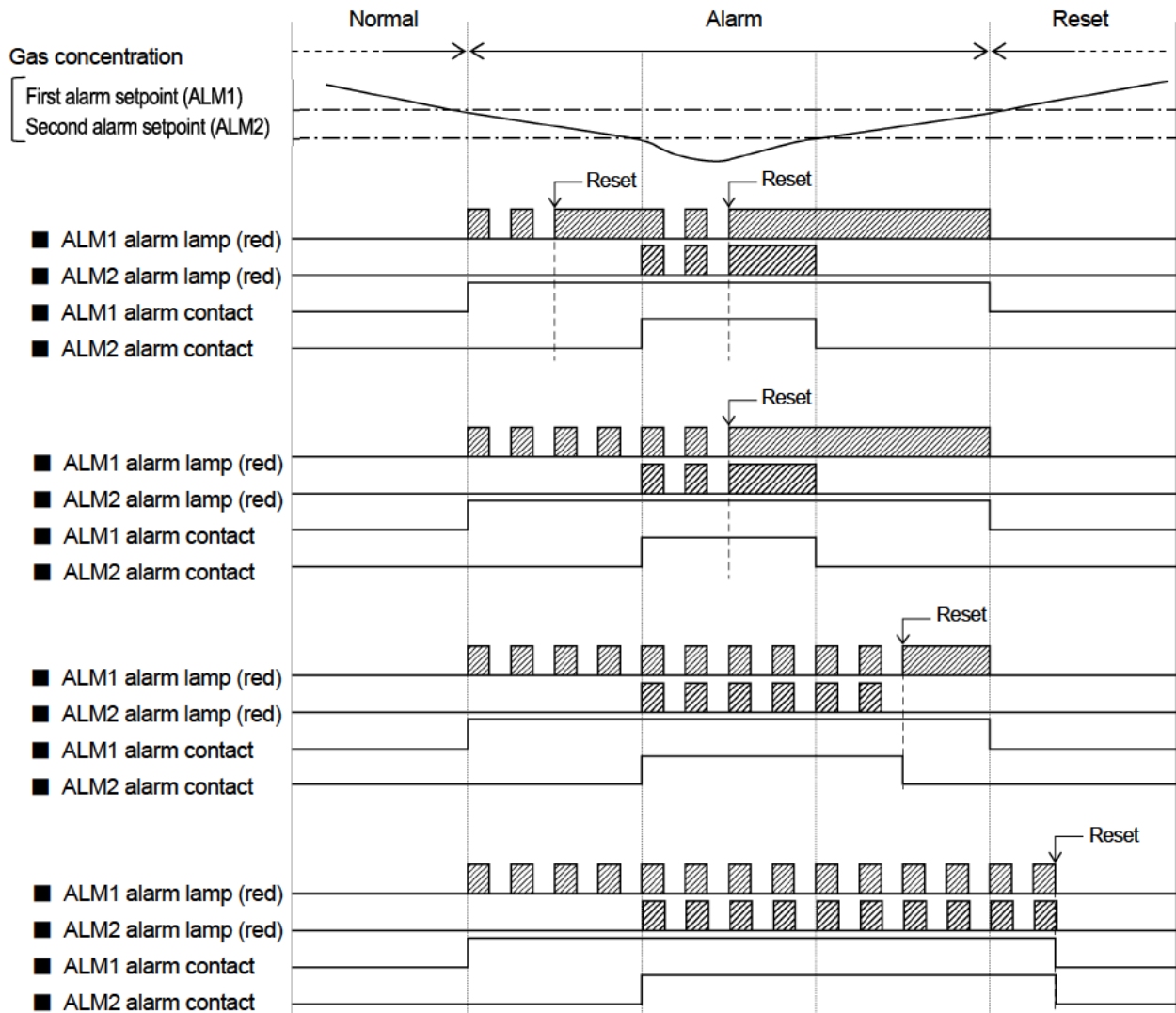


<Alarm pattern (L-H)>



<Alarm pattern (L-LL)>

(Oxygen deficiency alarm)



6-1-4 Alarm response

If an alarm is triggered, respond promptly in accordance with the user's management rules.

The typical procedures are as follows:

Step 1 Check the reading on the product.



- In the case of momentary gas leaks, the reading may have already dropped by the time the reading is checked. The reading may also drop while in a temporary alarm state due to factors other than gas alarms, such as noise or incidental conditions.

Step 2 Keep all individuals out of the monitored zone to ensure safety in accordance with your alarm control concentrations.

Step 3 If the concentration display continues, close the main valve for the gas involved and confirm that the gas concentration reading has fallen.

Step 4 Approach the gas leak location and use a portable gas detector to check for the presence of any remaining gas.



- To avoid hazards while carrying out this work, assume that the gas is still present and wear the appropriate gear.

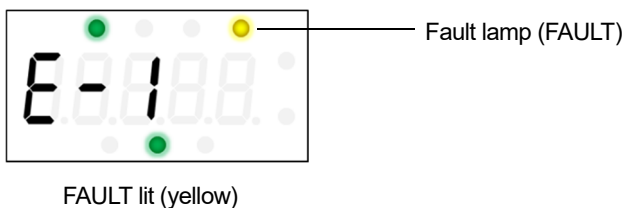
Step 5 Once you have determined that no hazard remains, take action to fix the gas leak.

6-2 Fault alarm activation

A fault alarm is triggered if an abnormality is detected in the product.

If a fault alarm occurs, the fault lamp (FAULT) illuminates in yellow, and an error code is displayed as follows:

<In case of sensor abnormality>



NOTE

- ▶ After the product has successfully recovered from the fault, it will initialize and restart.
- ▶ For more information on fault details (error codes) and appropriate corrective action, refer to '9. Troubleshooting'.
- ▶ If a fault alarm occurs, determine the cause and take appropriate action. If the product has problems and faults occur repeatedly, contact Riken Keiki immediately.

6-3 Warning operation

If the product ambient temperature exceeds the specified operating temperature range, the concentration readout and warning number [E-27] are displayed alternately.

Gas can still be measured in this state, as this is not a product fault. The external output will also be output in the range 4 mA to 20 mA according to the target gas concentration. The fault lamp will not light up.

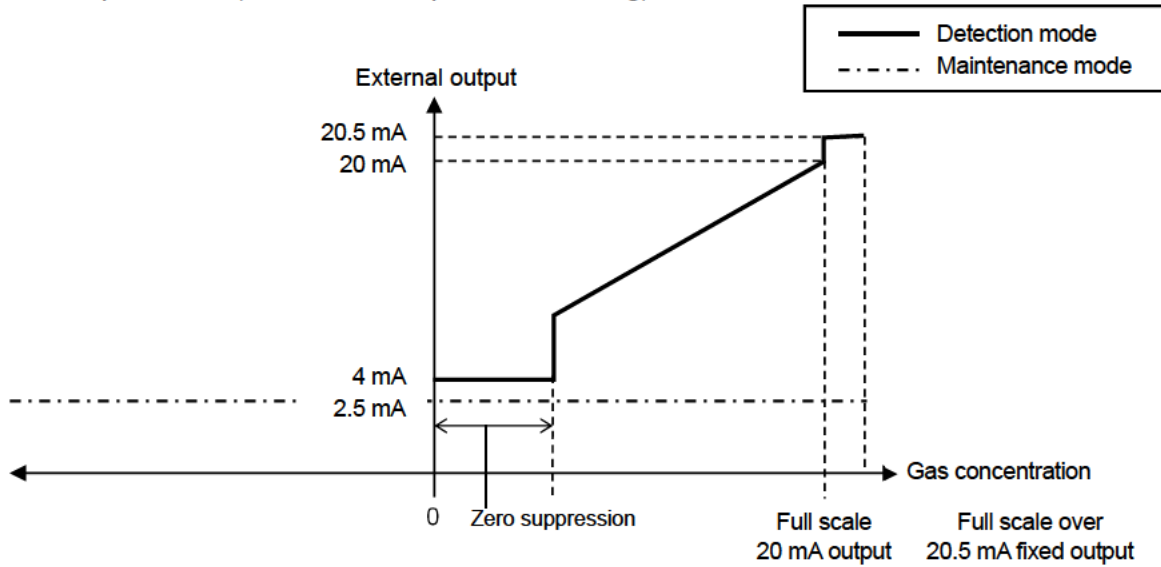
6-4 External output operation

6-4-1 For target gases other than oxygen

| | Mode | 4 - 20 mA (output value) |
|----|--------------------------------------|--|
| 1 | Power supply off | 0 mA |
| 2 | Initialization | 2.5 mA setting: 2.5 mA 4 mA, HOLD, 4 - 20 mA setting: 4 mA |
| 3 | Detection mode (no alarm) | 4 - 20 mA (concentration output) |
| 4 | Detection mode (gas alarm) | 4 - 20 mA (concentration output) |
| 5 | Detection mode (full scale exceeded) | 20.5 mA (fixed) |
| 6 | Outside operating temperature range | 4 - 20 mA (concentration output) |
| 7 | Fault alarm | 0.5 mA (fixed) |
| 8 | Inhibit | 2.5 mA setting: 2.5 mA 4 mA, HOLD, 4 - 20 mA setting: 4 mA |
| 9 | Alarm test mode | Output ON setting: 4 - 20 mA (concentration output) Output OFF setting: 4 mA |
| 10 | User mode | 2.5 mA setting: 2.5 mA 4 mA setting: 4 mA HOLD setting: Retains previous value. 4 - 20 mA setting: 4 - 20 mA (concentration output) |
| 11 | Maintenance mode | 2.5 mA setting: 2.5 mA 4 mA setting: 4 mA HOLD setting: Retains previous value. 4 - 20 mA setting: 4 - 20 mA (concentration output) |

<Gas concentration and external output example (with standard range)>

<4 - 20 mA specification (maintenance output: 2.5 mA setting)>



CAUTION

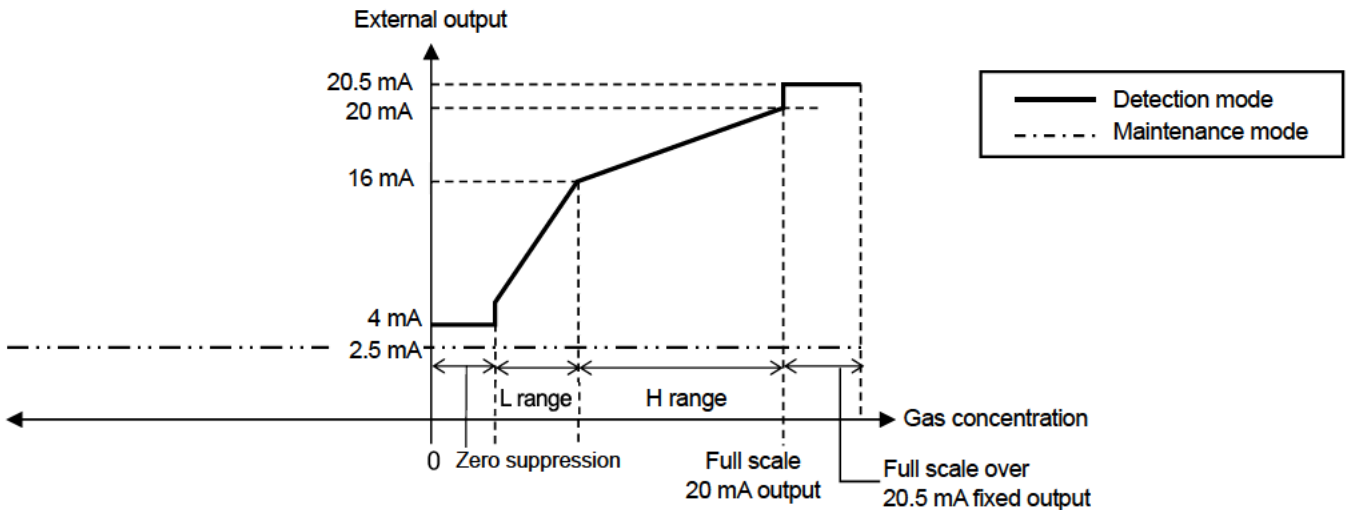
- The 4 - 20 mA output is already adjusted. When the full scale is exceeded, the output will not exceed approximately 20.5 mA.
- If the inhibit function is enabled or initialization is underway, the output follows the 4 - 20 mA output setting in maintenance mode. Special care is required when starting the product or after altering specifications.
- Make sure you fully understand the operation details. Take appropriate precautions where necessary to prevent false alarms on the receiving side.
- When the suppression function is canceled, the signal will be linearly output to 4 mA (equivalent to 0 %LEL).
- When the minus suppression function is canceled, the signal will be linearly output to 3.2 mA (equivalent to -5 %LEL).

<Gas concentration and external output example (with double range)> NC

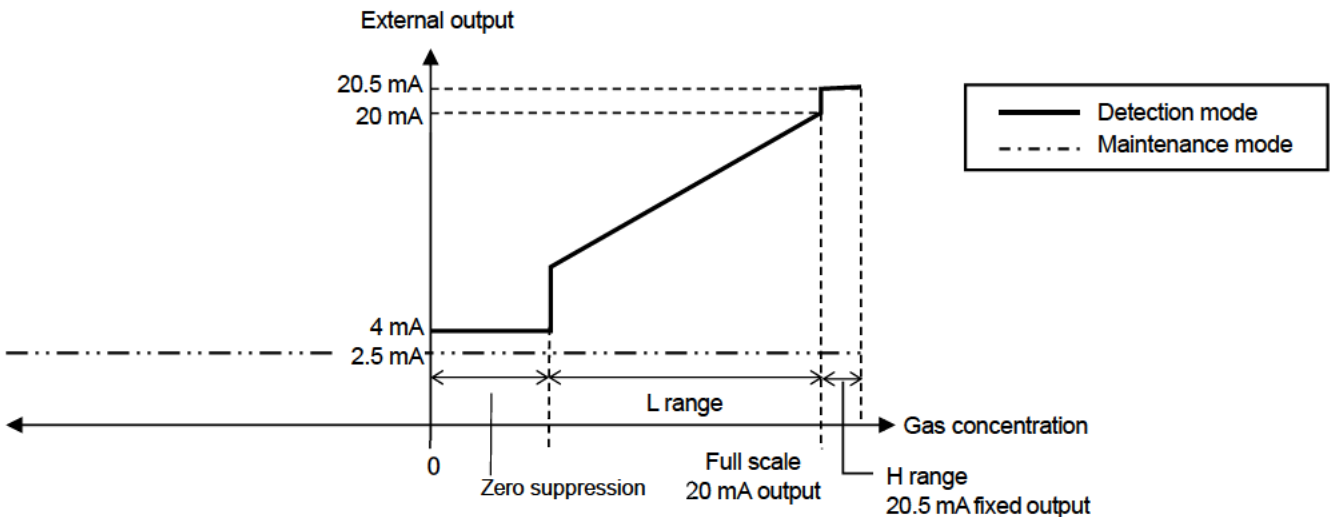
Two display ranges (L range and H range) are provided when using a new ceramic type sensor. The display automatically switches to the H range if the combustible gas concentration reading exceeds the full scale of the L range. The range also automatically switches back to the L range when the gas concentration drops below the full scale of the L range.

For example, when the target gas is isobutane, readings between 0 and 2,000 ppm appear in the L range and the display switches to the H range for readings between 12.0 and 100.0 %LEL.

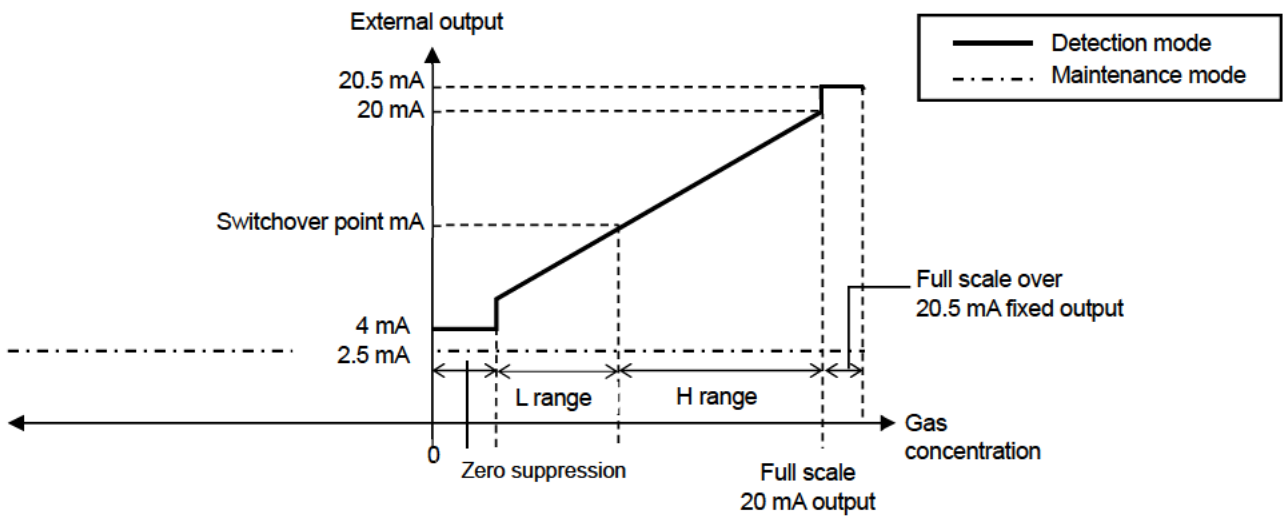
<4 - 16 mA (L range)/16 - 20 mA (H range) setting>



<4 - 20 mA (L range)/22 mA (H range) setting>



<4 - 20 mA (H range) setting>



6-4-2 When the target gas is oxygen

| | Mode | 4 - 20 mA (output value) |
|----|--------------------------------------|---|
| 1 | Power supply off | 0 mA |
| 2 | Initialization | 2.5 mA setting: 2.5 mA 4 mA, HOLD, 4 - 20 mA setting: 4 mA* |
| 3 | Detection mode (no alarm) | 4 - 20 mA (concentration output) |
| 4 | Detection mode (gas alarm) | 4 - 20 mA (concentration output) |
| 5 | Detection mode (full scale exceeded) | 20.5 mA (fixed) |
| 6 | Outside operating temperature range | 4 - 20 mA (concentration output) |
| 7 | Fault alarm | 0.5 mA (fixed) |
| 8 | Inhibit | 2.5 mA setting: 2.5 mA 4 mA, HOLD, 4 - 20 mA setting: 4 mA* |
| 9 | Alarm test mode | Output ON setting: 4 - 20 mA (concentration output) Output OFF setting: Retains previous value. |
| 10 | User mode | 2.5 mA setting: 2.5 mA 4 mA setting: 4 mA* HOLD setting: Retains previous value. 4 - 20 mA setting: 4 - 20 mA (concentration output) |
| 11 | Maintenance mode | 2.5 mA setting: 2.5 mA 4 mA setting: 4 mA* HOLD setting: Retains previous value. 4 - 20 mA setting: 4 - 20 mA (concentration output) |

*ESF (detection target gas: oxygen 0 to 25 vol%) is air equivalent (20.9 vol% = 17.4 mA).



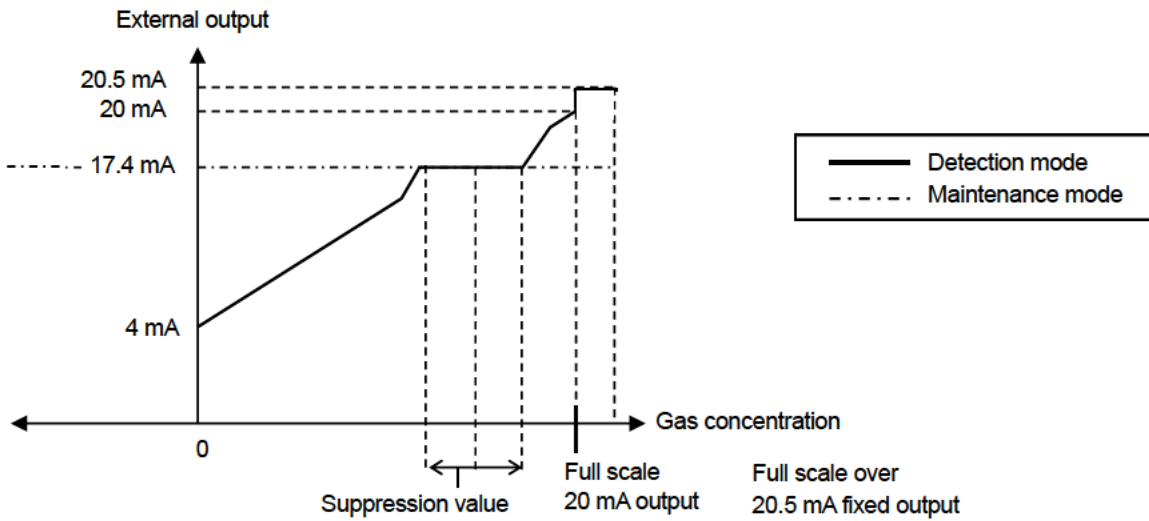
<With analog transmission (4 - 20 mA)>

- The 4 - 20 mA output is already adjusted. If the full scale is exceeded, the output will not exceed 20.5 mA.
- If the inhibit function is enabled or initialization is underway, the output follows the 4 - 20 mA output setting in maintenance mode. Note that the output may become low (e.g., 2.5 mA during initialization) when using ESF (detection target gas: oxygen). Special care is required when starting the product or after altering specifications.
- Make sure you fully understand the operation details and take appropriate precautions where necessary (e.g., setting to skip state) to prevent false alarms on the receiving side.
- Particular care is required in the following situations:

| Examples where care is required | Analog transmission 4 - 20 mA specifications |
|---|---|
| Using ESF (detection target gas: oxygen) (L-LL, L-H) | A false alarm may occur upstream (L alarm) if 2.5 mA is output in maintenance mode or if the inhibit function is enabled. |
| Changed to ESF specifications (detection target gas: oxygen 0 - 25 vol%) | If changed from another principle (H-HH), 4 mA (equivalent to zero concentration) is output until the change is confirmed (until [C-02] is displayed). |
| Changed from ESF specifications (detection target gas: oxygen 0 - 25 vol%) | If changed from 0 to 25 vol% (L-LL, L-H), 17.4 mA (equivalent to approximately 84 %FS) is output until the change is confirmed (until [C-02] is displayed). |

<Gas concentration and external output example>

0 - 25 vol% (oxygen deficiency alarm specification)

**CAUTION**

- The 4 - 20 mA output is already adjusted. When the full scale is exceeded, the output will not exceed approximately 20.5 mA.
- If the inhibit function is enabled or initialization is underway, the output follows the 4 - 20 mA output setting in maintenance mode. Special care is required when starting the product or after altering specifications.
- Make sure you fully understand the operation details. Take appropriate precautions where necessary to prevent false alarms on the receiving side.
- When the minus suppression function is canceled, the signal will be linearly output to 3.2 mA (equivalent to -5 %LEL).

6-5 Functions to ensure correct alarm activation

6-5-1 Zero suppression function

The sensors used in the product are susceptible to the effects of ambient fluctuations (e.g., temperature and humidity characteristics) and interference gases (interference characteristics), which affect the readings given by the product. Therefore, readings may fluctuate around zero levels even under normal conditions. The zero suppression function is designed to minimize the effects of these ambient fluctuations and interference gases around the zero level. Use this function to suppress reading fluctuations below the preset value to give a zero reading (or [20.9] (vol%) for oxygen).

<Zero suppression function disabled>



The reading fluctuates around the zero level.

<Zero suppression function enabled>



Displays zero up to the preset value.

NOTE

- ▶ The standard preset value for the zero suppression function differs depending on sensor specifications.
- ▶ When the detection target gas is oxygen, enabling the zero suppression function will give a reading of [20.9] (vol%) for fluctuations in the vicinity of 20.9 vol% up to the preset value. Note that the standard preset value for the zero suppression function is ± 0.5 vol% (with respect to 20.9 vol%) when the detection target gas is oxygen.
- ▶ In user mode and maintenance mode, this function is disabled and reading fluctuations below the preset value are apparent.
- ▶ The zero suppression type is initially set to [CUT]. For information on how to change the zero suppression type, refer to '7-5-9 Zero suppression type setting'.
- ▶ The positive zero suppression value can be set within the range of 0 to 2/3 of the first alarm setpoint (if the first alarm setpoint is 25%LEL, up to 16%LEL). The negative zero suppression value can be set within the range of 0 to 10 % of full scale +1 digit (if the full scale is 100%LEL, -10%LEL+1 digit). (This is not normally used by the user.)



CAUTION

- The negative suppression value (below zero) is subject to suppression corresponding to 5 % of full scale. The error code "E-1" is displayed if the reading falls below 5% of full scale. Accurate gas detection is not possible in this state. Check to confirm that no miscellaneous gases are present, then perform zero calibration.

6-5-2 Automatic sensor recognition function

This product features a function that automatically recognizes the sensor after a sensor is replaced or specifications have been changed.

The display appears as follows to prevent incorrect mounting if a sensor with a different serial number, detection principle, or specifications is mounted:

<After sensor replacement>

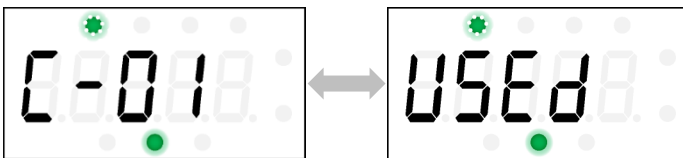
The display appears as follows when the sensor has been replaced with a sensor of the same specifications (e.g., detection principle and model)—for example at periodic replacement.

Pressing the MENU/ESC key makes the product recognize the sensor as a new sensor and start up.



If the sensor mounted after replacement has the same or an older manufacturing date than the sensor replaced, the display alternates between [C-01] and [USEd], as follows.

An old sensor may have been mounted by mistake. Check the sensor.



<After changing specifications>

The display appears as follows when the sensor has been replaced with a sensor of different specifications (e.g., detection principle and model).

Pressing the MENU/ESC key makes the product recognize the sensor as a sensor with new specifications and start up.

If you did not intend to change the specifications, the sensor may have been mounted by mistake. Check the sensor.



CAUTION

- Confirming changes in sensor specifications (e.g., detection principal, sensor type, detection target gas, and detection range) when [C-02] is displayed will reflect the changes in the specifications of the product as gas detector.
The following parameters will be reset to their initial values in addition to the alarm setpoints.
Change the parameters in maintenance mode if values other than the initial values are required.
 - Alarm delay
 - Zero suppression value
 - Alarm type
- Confirming the changes by pressing the MENU/ESC key when [C-02] is displayed will start initialization and switch the operation. The initialization output will also change at the same time.
- Settings such as external output are maintained at their previous settings in maintenance mode.
Particular care is required here.
- The ESF specifications include three different alarm types: L-LL, L-H, and H-HH.
The alarm directions will be reversed for changes from or to ESF (L-LL alarm).

7

Maintenance

The product is an important safety and disaster prevention device.

Perform product maintenance at regular intervals to ensure performance and to improve disaster prevention and safety reliability.

7-1 Maintenance intervals and items

The following items should be maintained regularly before using the product:

- Daily maintenance: Perform maintenance before commencing work.
- Monthly maintenance: Inspect the alarm circuit (alarm test) once a month.
- Regular maintenance: Perform maintenance at least once a year (ideally, at least once every six months).

| Maintenance item | Maintenance details | Daily maintenance | Monthly maintenance | Regular maintenance |
|-----------------------------|---|-------------------|---------------------|---------------------|
| Power supply check | Check to confirm that the power lamp is lit. | ○ | ○ | ○ |
| Concentration display check | Check to confirm that the concentration reading is zero (or [20.9] (vol%) for oxygen). If the reading is offset, perform zero calibration after confirming that no miscellaneous gas is present in the vicinity. | ○ | ○ | ○ |
| Alarm test | Use the alarm test function to check the alarm circuit. If you use an optional alarm relay, check the relay at the same time. | — | ○ | ○ |
| Calibration | Perform sensitivity calibration using a calibration gas. | — | — | ○ |
| Gas alarm check | Check the gas alarm using a calibration gas. | — | — | ○ |
| Grounding cable check | To ensure EMC performance, check to confirm that the grounding cable connection is secure and free of corrosion. | — | — | ○ |

<Maintenance services>

Riken Keiki provides services related to regular maintenance including calibration, adjustments, and servicing. Preparing a calibration gas requires dedicated equipment, including gas cylinders of the specified concentration and gas sampling bags.

Our certified service engineers have expert knowledge of the dedicated tools and products. We recommend taking advantage of our maintenance service to ensure safe use of the product.









The main details of the maintenance services are as follows. Please contact Riken Keiki for more information.



| Service | Service details |
|---|---|
| Power supply check | <ul style="list-style-type: none"> • Check the power supply voltage. • Check to confirm that the power lamp is lit. (Confirm that the power lamp (POWER), alarm lamps (ALM1, ALM2), fault lamp (FAULT), unit lamps (PPM, %LEL, %) are clearly visible on the display.) • Check the operation of the UPS (uninterruptible power system), if used. |
| Concentration display check | <p>Check to confirm that the concentration reading indicates zero using a zero calibration gas. Perform zero calibration if the reading is not zero.</p> <p>With the oxygen deficiency alarm specifications, introduce clean air and check that the concentration reading indicates [20.9] (vol%). Perform span adjustment if the reading is offset.</p> |
| Filter check | <p>Check to confirm that the dust filter is neither contaminated nor clogged.</p> <p>Replace the filter if the filter is dirty or clogged.</p> |
| Alarm test | <p>Use the alarm test function to inspect the alarm circuit.</p> <ul style="list-style-type: none"> • Check alarm lamps. (Check the ALM1 and ALM2 operations.) • Check external alarms. (Check the buzzer, reset signal, and other external alarm operations.) |
| Calibration | <p>Perform sensitivity calibration using a calibration gas.</p> |
| Gas alarm check | <p>Check the gas alarm using a calibration gas.</p> <ul style="list-style-type: none"> • Check alarms. (Confirm alarm activation when alarm setpoint is reached.) • Check delay time. (Check delay time until alarm activation.) • Check alarm lamps. (Check the ALM1 and ALM2 operations.) • Check external alarms. (Check the buzzer, reset signal, and other external alarm operations.) |
| Product cleaning and repair (visual inspection) | <p>Check the product exterior, cover, and interior for dirt and damage. Clean/repair problem areas.</p> <p>Replace cracked or damaged parts.</p> |
| Product operation check | <p>Operate the keys to check individual functions and parameters.</p> |
| Consumable part replacement | <p>Replace degraded components such as sensors and filters.</p> |

7-2 Maintenance mode

Switching to maintenance mode lets you perform various tests, zero calibration, and span adjustment and configure various settings.

7-2-1 Maintenance mode setting items

| Item No. | Setting item | LED display | Details |
|----------|--------------------------|---|--|
| 2-0 | Test mode |  | Performs the gas test, alarm test, fault test, LED test, and RAM test. (Refer to '7-3 Performing tests (test mode)'). |
| 2-1 | Zero calibration |  | Performs zero calibration. (Refer to '7-4-2 Performing zero calibration'.) |
| 2-2 | Span adjustment |  | Performs span adjustment. (Refer to '7-4-3 Performing span adjustment'.) |
| 2-3 | Display |  | This is not normally used by the user. |
| 2-4 | Environmental settings 1 |  | Configures settings such as alarm setpoints, alarm pattern, fault alarm pattern, zero suppression value, and the date and time. (Refer to '7-5 Setting environmental settings 1'.) |
| 2-5 | Environmental settings 2 |  | This is not normally used by the user. |
| 2-6 | Environmental settings 3 |  | Configures settings such as used contact settings and various external outputs. (Refer to '7-6 Setting environmental settings 3'.) |
| 2-7 | Communication settings |  | This is not normally used by the user. |

| Item No. | Setting item | LED display | Details |
|----------|------------------------|---|---|
| 2-8 | Factory mode selection |  | This is not normally used by the user. |
| 2-9 | User mode selection |  | Switches to user mode. (Refer to '5-5 User mode'.) |

7-2-2 Switching to maintenance mode

- 1 Hold down the MENU/ESC key (for approximately three seconds) in detection mode.



The product switches to user mode.



- 2 Press the ▲ or ▼ key to select [1-3], then press the SET key.



The product switches to maintenance mode.



- 3 Press the ▲ or ▼ key to select the required item number, then press the SET key.



Display example: With environmental settings 1 selected

The details corresponding to the item number selected are displayed. Set individual items.



- 4 Once the operation is complete, hold down the MENU/ESC key (for approximately three seconds).**
The product switches to detection mode.

WARNING

- Once the operation is complete, be sure to hold down the MENU/ESC key to return to detection mode. The product will not detect gases while in adjustment/setting state. If left in maintenance mode, the product will take 10 hours to return to detection mode. Detection will not be available during this time, posing hazards.

NOTE

- ▶ If the password setting is enabled, the password must be entered to access maintenance mode.
- ▶ The password is set in advance by Riken Keiki.
If you are unsure, contact Riken Keiki.

<Switching from maintenance mode to user mode>

- 1 Press the ▲ or ▼ key in maintenance mode several times to select [2-9], then press the SET key.**



- 2 Press the SET key.**



The product switches to user mode.



7-3 Performing tests (test mode)

Test mode is used for performing various tests, such as gas tests and alarm tests.

| Item No. | Setting item |
|----------|--------------|
| 2-0 | Test mode |
| 2-0.0 | Gas test |
| 2-0.1 | Alarm test |
| 2-0.2 | Fault test |
| 2-0.3 | LED test |
| 2-0.4 | RAM test |

7-3-1 Performing gas test

Perform a gas test.

Before starting the gas test, prepare the gas to be used and connect to the product.

For information on gas test preparation, refer to '7-4-1 Calibration preparation'.



- Depending on the settings, contact and gas concentration outputs may be activated during gas testing, even in maintenance mode. Take care during gas testing.

1 Press the ▲ or ▼ key in maintenance mode several times to select [2-0], then press the SET key.



2 Select [2-0.0], then press the SET key.



3 Introduce the gas to be used in the gas test.



4 Shut off the gas test gas once the gas concentration reading has stabilized.



5 Once the reading has returned to [0.0] (or [20.9] (vol%) for oxygen), press the MENU/ESC key.



Returns to the [2-0.0] display.

7-3-2 Performing alarm test

Test to check whether an alarm is triggered when the reading reaches the alarm setpoint.



- Depending on the settings, contact and gas concentration outputs may be activated during alarm testing, even in maintenance mode. Take care during alarm testing.

NOTE

- The procedure in step 3 is required even if the product is a no alarm relay model. Note that the contact will not operate even when [on] is selected.

- Press the ▲ or ▼ key in maintenance mode several times to select [2-0], then press the SET key.



- Press the ▲ or ▼ key to select [2-0.1], then press the SET key.



- Press the ▲ or ▼ key to select [oFF] or [on], then press the SET key.

Select [on] if the setting for the contact used is alarm only or alarm or fault, or [oFF] if the setting is other than those.



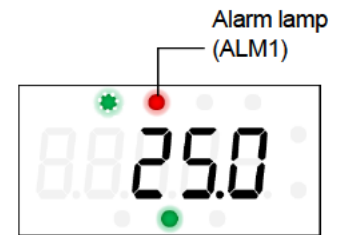
- Press the ▲ or ▼ key to increase or decrease the reading.



5 Check to confirm that an alarm is triggered.

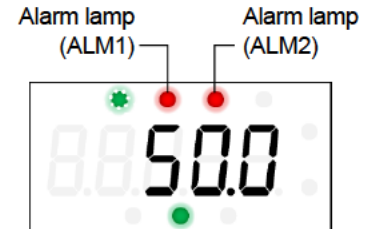
The first alarm is triggered when the reading reaches the first alarm setpoint.

The alarm lamp (ALM1) lights up (red) when the first alarm is triggered.



The second alarm is triggered when the reading reaches the second alarm setpoint.

The alarm lamps (ALM1 and ALM2) light up (red) when the second alarm is triggered.

**6 Once the alarm test is complete, press the MENU/ESC key.**

Returns to the [2-0.1] display.

7-3-3 Performing fault test

Test to check whether an alarm is triggered when a fault occurs in the product.



WARNING

- Depending on the settings, contact and gas concentration outputs may be activated during fault testing, even in maintenance mode. Take care during fault testing.

- Press the ▲ or ▼ key in maintenance mode several times to select [2-0], then press the SET key.



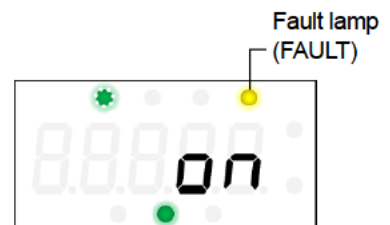
- Press the ▲ or ▼ key to select [2-0.2], then press the SET key.



- Press the ▲ or ▼ key to select [on], then press the SET key.



- Check to confirm that a fault alarm is triggered.
The fault lamp (FAULT) lights up (yellow) when a fault alarm is triggered.



- Once the fault test is complete, press the ▲ or ▼ key to select [off], then press the SET key.
The fault alarm is cleared. The fault lamp (FAULT) goes out.
Fault alarms can also be cleared by pressing the MENU/ESC key.



7-3-4 Performing LED test

Perform an LED display test.

- 1 Press the ▲ or ▼ key in maintenance mode several times to select [2-0], then press the SET key.



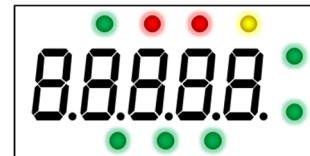
- 2 Press the ▲ or ▼ key to select [2-0.3], then press the SET key.



- 3 Press the ▲ or ▼ key to select [on], then press the SET key.



- 4 Check to confirm that all LEDs light up.



- 5 Once the LED test is complete, press the ▲ or ▼ key to select [off], then press the SET key.

The LED test ends.

The LED test can also be ended by pressing the MENU/ESC key.



7-3-5 Performing memory test (RAM test)

Perform a memory test.

- 1 Press the ▲ or ▼ key in maintenance mode several times to select [2-0], then press the SET key.



- 2 Press the ▲ or ▼ key to select [2-0.4], then press the SET key.



- 3 Press the SET key.



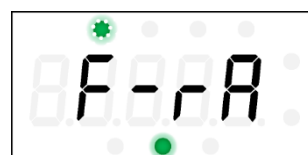
The memory test starts.



- 3 Check the memory test result.
No problems with memory:
[PASS] appears.



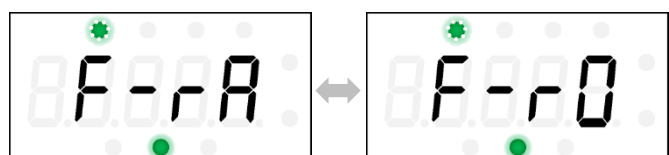
Problems with RAM:
[F-rA] appears.



Problems with ROM:
[F-rO] appears.



Problems with both RAM and ROM:
[F-rA] and [F-rO] are displayed alternately.



- 4 Once you have checked the result, press the SET key.
Returns to the [2-0.4] display.

7-4 Performing calibration

7-4-1 Calibration preparation

Before performing calibration (zero calibration and span adjustment), prepare the calibration gas. Also connect the calibration equipment required to the product before starting.

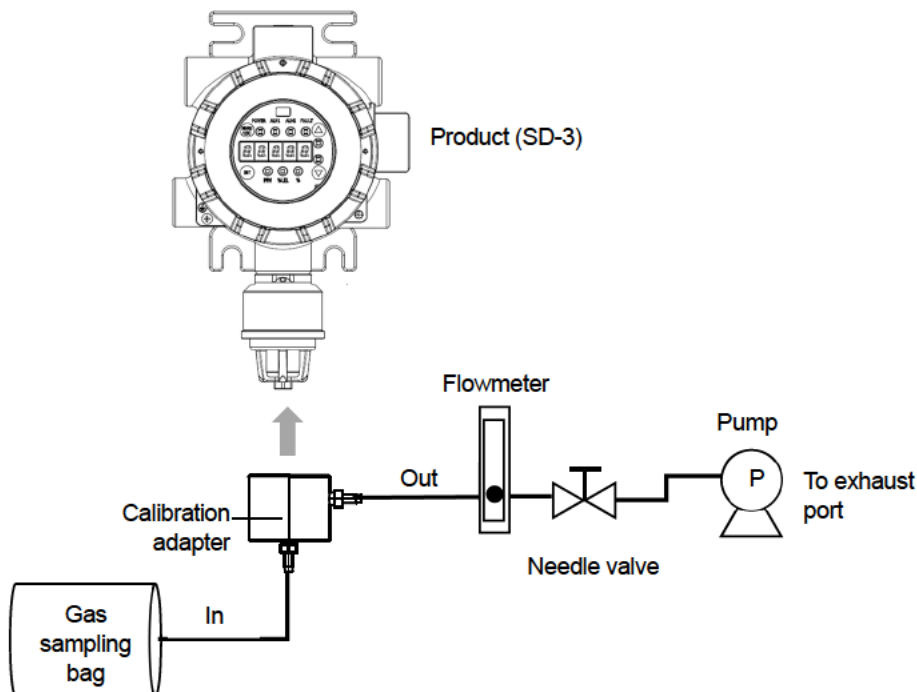
- Zero calibration gas
- Span adjustment gas (in gas sampling bag or gas can)
- Gas sampling bag for exhaust gas
- Calibration adapter or splash guard

<When using the calibration adapter>

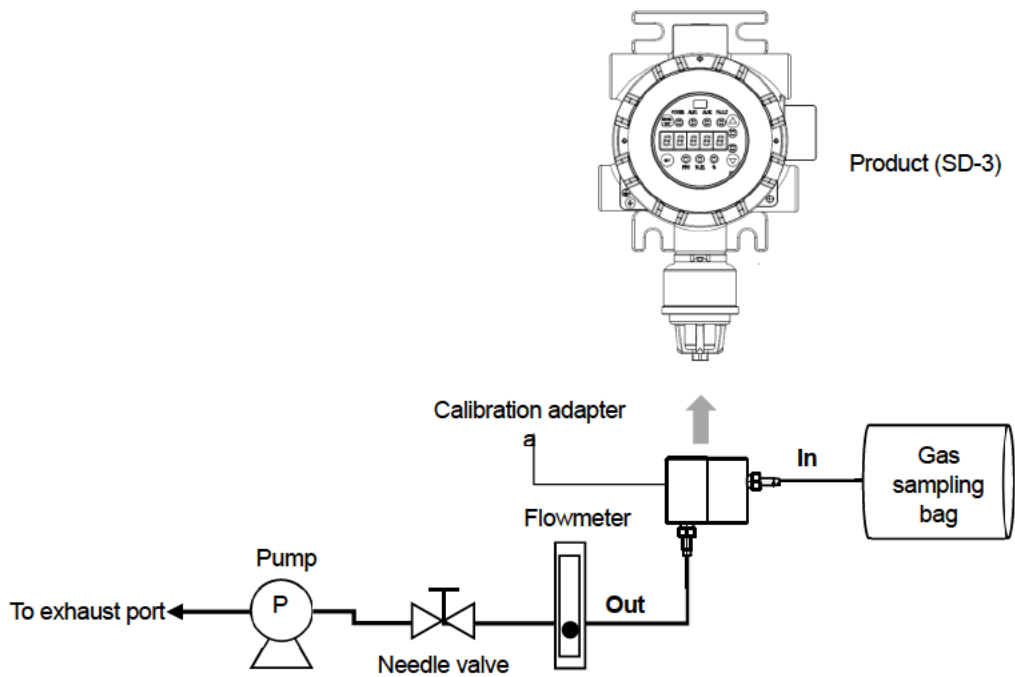
NOTE

- ▶ Use a flow rate of 0.5 ± 0.1 L/min when calibrating. Calibration accuracy may be reduced if calibration is performed using a different flow rate.
- ▶ If the suction cap and calibration adapter are left fitted for 10 minutes or more in a windless state, gas may accumulate in the pipes and on the caps, possibly causing readings to increase. If this occurs, use cleansing air to return the reading to zero. Detection will not be available during this time, as the sensor is shut off from the atmosphere.

<Using a gas sampling bag> **RI** **EC**

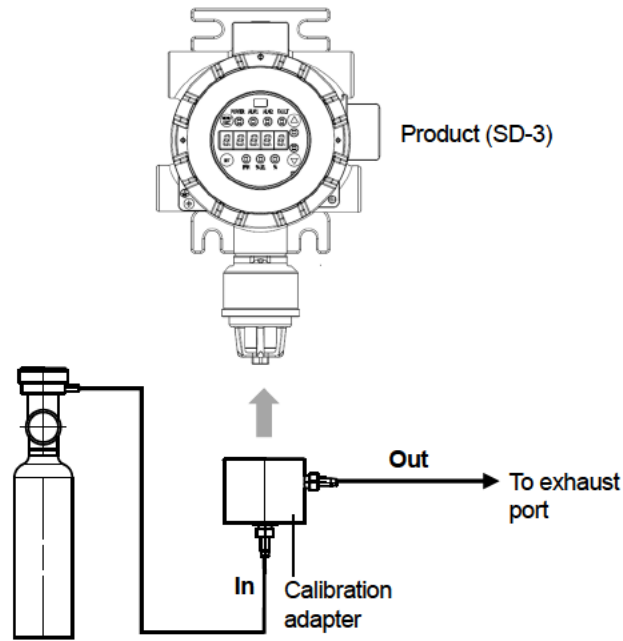


<Using a gas sampling bag> **NC** **GH** **SP**

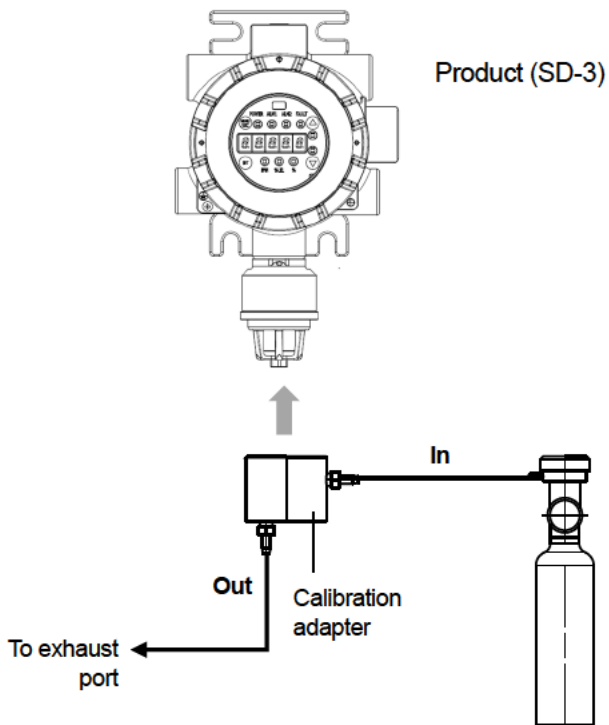


*The diagram illustrates the SD-3. The connection method for the remote sensor head (GD-3) is identical.

<Using a gas can> **RI** **EC**



<Using a gas can> **NC** **GH** **SP**



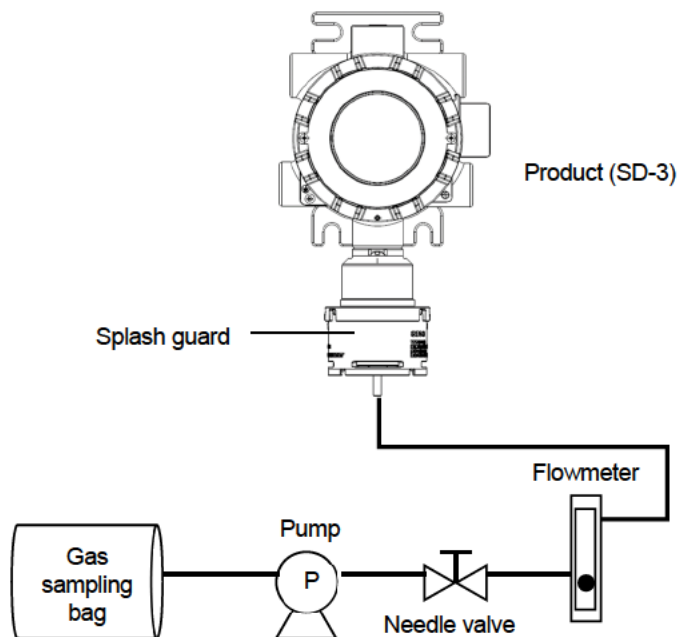
*The diagram illustrates the SD-3. The connection method for the remote sensor head (GD-3) is identical.

<When using the splash guard>**NOTE**

- ▶ The calibration adapter is not required when using the splash guard.
- ▶ When using the splash guard, calibrate using the following wind speed:

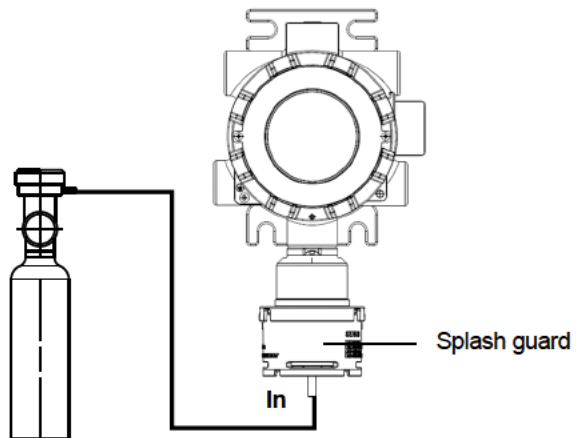
| Detection principle | Wind speed |
|---|------------|
| Non-dispersive infrared absorption type (infrared type) | Max. 6 m/s |
| New ceramic type | |
| Semiconductor type | |
| Hot-wire semiconductor type | |
| Electrochemical type | Max. 1 m/s |

- ▶ If calibration is unsuccessful, fit the calibration adapter and calibrate again.
- ▶ When calibrating adsorptive gas, fit the calibration adapter.
- ▶ Use a flow rate of 0.5 L/min \pm 0.1 L/min when calibrating. Calibration accuracy may be reduced if calibration is performed using a different flow rate.

<Using a gas sampling bag>

*The diagram illustrates the SD-3. The connection method is the same for the remote sensor head (GD-3).

<Using a gas can>



* The diagram illustrates the SD-3. The connection method is the same for the remote sensor head (GD-3).

7-4-2 Performing zero calibration

Gas concentrations cannot be accurately measured unless zero calibration is performed correctly.

Be sure to carry out zero calibration to ensure accurate measurement.

Prepare the zero calibration gas, then connect to the product before starting zero calibration.

For information on zero calibration preparation, refer to '7-4-1 Calibration preparation'.



WARNING

- Before performing zero calibration for the surrounding atmosphere, confirm that the surrounding atmosphere contains clean air. Performing zero calibration in the presence of miscellaneous gases will prevent correct calibration and create safety hazards in the event of an actual gas leak.



CAUTION

- Perform zero calibration after supplying the zero calibration gas and waiting for the reading to stabilize.
-

- 1 Press the ▲ or ▼ key in maintenance mode several times to select [2-1], then press the SET key.



- 2 Introduce the zero calibration gas, then press the SET key.



Zero calibration starts.



- 3 Check the zero calibration result.

If zero calibration is successful
[PASS] is displayed for three seconds before the display automatically returns to [2-1].



If zero calibration is unsuccessful
[FAIL] is displayed and the display returns to [2-1] when the SET key is pressed.



NOTE

- ▶ If zero calibration is unsuccessful because the zero point (N₂ in the case of oxygen) fluctuates significantly around zero, [FAIL] is displayed. If this occurs, zero calibration was not performed.

7-4-3 Performing span adjustment

Perform the span adjustment required to ensure accurate measurement of gas concentrations. Prepare the span adjustment gas, then connect to the product before starting span adjustment. For information on span adjustment preparation, refer to '7-4-1 Calibration preparation'.

NOTE

- ▶ Dedicated equipment is required for span adjustment. We recommend contacting Riken Keiki to request the required equipment.

<With standard range>



- Perform span adjustment after supplying the span adjustment gas (at a concentration of 1.6 times the alarm setpoint value or 40 % of full scale) and waiting for the reading to stabilize.
- With the oxygen deficiency alarm specifications, introduce clean air to adjust to [20.9] (vol%).

- 1 Press the ▲ or ▼ key in maintenance mode several times to select [2-2], then press the SET key.



- 2 Introduce the span adjustment gas, then press the SET key. The SET key is disabled if the reading is less than 10 % of full scale.



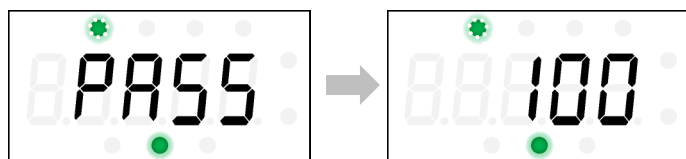
- 3 Press the ▲ or ▼ key to adjust the reading to match the concentration of the gas introduced, then press the SET key.



Span adjustment starts.



- 4 Check the span adjustment result. If span adjustment is successful [PASS] is displayed, followed by the calibration concentration upper limit.



If span adjustment is unsuccessful [FAIL] appears.



- 5 Press the SET key. Returns to the [2-2] display.

NOTE

- ▶ If span adjustment is unsuccessful because the reading fluctuates significantly compared to the concentration of the gas introduced, [FAIL] appears. If this occurs, span adjustment was not performed.
- ▶ If span adjustment was unsuccessful, check whether the correct concentration span adjustment gas was supplied and confirm that there are no leaks in the gas calibration equipment. If span adjustment was not performed correctly, repeat span adjustment.
- ▶ If span adjustment was performed correctly or if span adjustment fails even when repeated, the gas sensor may have reached the end of its service life. Turn off the power and contact Riken Keiki.

<With double range> **NC**

 **CAUTION**

- Perform span adjustment after supplying the span adjustment gas and waiting for the reading to stabilize.
- For double range span adjustment, perform span adjustment first for the L range, followed by the H range in succession. If span adjustment was aborted midway, repeat from the L range.

1 Press the ▲ or ▼ key in maintenance mode several times to select [2-2], then press the SET key.



2 Introduce the span adjustment gas, then press the SET key. The SET key is disabled if the reading is less than 10 % of full scale.



3 Press the ▲ or ▼ key to adjust the reading to match the concentration of the gas introduced, then press the SET key.



Span adjustment starts for the L range.



4 Check the L range span adjustment result.

- If L range span adjustment is successful [PASS] is displayed, followed by the calibration concentration upper limit, after which H range span adjustment automatically starts.



- If L range span adjustment is unsuccessful [FAIL] appears, and the product automatically proceeds to H range span adjustment.



5 Introduce the span adjustment gas, then press the SET key.

The SET key is disabled if the reading is less than 10 % of full scale.



6 Press the ▲ or ▼ key to adjust the reading to match the concentration of the gas introduced, then press the SET key.



Span adjustment starts for the H range.



7 Check the H range span adjustment result.

- If H range span adjustment is successful
[PASS] is displayed, followed by the calibration concentration upper limit.



- If H range span adjustment is unsuccessful
[FAIL] appears.



8 Press the SET key.

Returns to the [2-2] display.

NOTE

- ▶ If span adjustment is unsuccessful because the reading fluctuates significantly compared to the concentration of the gas introduced, [FAIL] appears. If this occurs, span adjustment was not performed.
- ▶ If span adjustment was unsuccessful, check whether the correct concentration span adjustment gas was introduced and confirm that there are no leaks in the gas calibration equipment. If span adjustment was not performed correctly, repeat span adjustment.
- ▶ If span adjustment was performed correctly or if span adjustment fails even when repeated, the gas sensor may have reached the end of its service life. Turn off the power and contact Riken Keiki.

7-5 Setting environmental settings 1

The following items can be set in environmental settings 1:

| Item No. | Setting item | Remarks |
|----------|--------------------------------|--|
| 2-4 | Environmental settings 1 | |
| 2-4.0 | Inhibit setting | |
| 2-4.1 | Alarm setpoint setting | |
| 2-4.2 | Alarm delay setting | This is not normally used by the user. |
| 2-4.3 | Alarm pattern setting | This is not normally used by the user. |
| 2-4.4 | Alarm setpoint limiter setting | This is not normally used by the user. |
| 2-4.5 | Alarm type setting | This is not normally used by the user. |
| 2-4.6 | Fault alarm pattern setting | This is not normally used by the user. |
| 2-4.7 | Zero suppression value setting | This is not normally used by the user. |
| 2-4.8 | Zero suppression type setting | This is not normally used by the user. |
| 2-4.9 | Password | This is not normally used by the user. |
| 2-4.A | Date and time setting | |

7-5-1 Inhibit setting

Enabling the inhibit setting prevents alarms from being issued externally even when the gas concentration is displayed in detection mode. This setting is primarily used when testing and maintaining the product. The default setting is disabled.

- 1 Press the ▲ or ▼ key in maintenance mode to select [2-4], then press the SET key.



- 2 Select [2-4.0], then press the SET key.



- 3 Press the ▲ or ▼ key to select [oFF] or [on], then press the SET key.



Returns to the [2-4.0] display.

NOTE

- ▶ Enabling the inhibit setting causes the LED display to alternate between [InHl.] and [0.0] (gas concentration) when in detection mode.

7-5-2 Alarm setpoint setting

Set the gas alarm setpoints (first alarm setpoint and second alarm setpoint).
Set each alarm setpoint within the following range:

| Alarm setpoint | Alarm setpoint range | |
|-------------------------------|-------------------------------|---|
| First alarm setpoint ([AL1]) | 0 - 10 % of full scale (H-HH) | |
| Second alarm setpoint ([AL2]) | Combustible gas | First alarm setpoint to 60 % of full scale (H-HH) |
| | Other gases | First alarm setpoint to full scale (H-HH) |

- 1 Press the ▲ or ▼ key in maintenance mode to select [2-4], then press the SET key.



- 2 Press the ▲ or ▼ key to select [2-4.1], then press the SET key.



- 3 Press the ▲ or ▼ key to select [AL1] or [AL2], then press the SET key.

To set the first alarm setpoint, select [AL1]. To set the second alarm setpoint, select [AL2].



- 4 Press the ▲ or ▼ key to set the alarm setpoint, then press the SET key.



The display returns to [AL1] or [AL2].

NOTE

- ▶ The alarm setpoints can be checked by displaying the settings in user mode. (Refer to '5-7-1 Checking alarm setpoints'.)

7-5-3 Date and time setting

Sets the date and time (year, month, date, hours, and minutes) for the internal clock.

- 1 Press the ▲ or ▼ key in maintenance mode to select [2-4], then press the SET key.



- 2 Press the ▲ or ▼ key to select [2-4.A], then press the SET key.



- 3 Press the ▲ or ▼ key to set the last two digits of the year, then press the SET key.

The selected item (last two digits of the year) flashes.



- 4 Press the ▲ or ▼ key to set the month, then press the SET key.

The selected item (month) flashes.



- 5 Press the ▲ or ▼ key to set the date, then press the SET key.

The selected item (day) flashes.



- 6 Press the ▲ or ▼ key to set the hours (24-hour format), then press the SET key.

The selected item (hour) flashes.



- 7 Press the ▲ or ▼ key to set the minutes, then press the SET key.

The selected item (minutes) flashes.



Returns to the [2-4.A] display.

7-6 Setting environmental settings 3

The following items can be set in environmental settings 3:

| Item No. | Setting item | Remarks |
|----------|---|--|
| 2-6 | Environmental settings 3 | |
| 2-6.0 | Used contact setting | This is not normally used by the user. |
| 2-6.1 | Energized/de-energized setting | This is not normally used by the user. |
| 2-6.2 | Maintenance external output setting | This is not normally used by the user. |
| 2-6.3 | External output adjustment (4 - 20 mA) | This is not normally used by the user. |
| 2-6.4 | Alarm test external output | This is not normally used by the user. |
| 2-6.5 | Fault alarm external output setting | This is not normally used by the user. |
| 2-6.6 | Double range external output setting | NC |

7-6-1 Double range external output setting **NC**

Sets the double range external output range. (Refer to <Gas concentration and external output example (with double range)> in '6-3 External output operation'.)

Select one of the following:

- 4 - 20 mA (L range)/22 mA (H range) ([L4-20])
- 4 - 20 mA (H range) ([H4-20])
- 4 - 16 mA (L range)/16 - 20 mA (H range) ([4-16])

The default setting is 4 - 16 mA (L range)/16 - 20 mA (H range) ([4-16]).

NOTE

- ▶ The double range external output setting can be set only with sensors that rely on the new ceramic detection principle. (Refer to '1-2-2 Detection principles and detection target gases for individual models'.)

- 1 Press the ▲ or ▼ key in maintenance mode to select [2-6], then press the SET key.



- 2 Press the ▲ or ▼ key to select [2-6.6], then press the SET key.



- 3 Press the ▲ or ▼ key to select [4-16], [L4-20], or [H4-20], then press the SET key.



Returns to the [2-6.6] display.

7-7 Parts replacement

7-7-1 Sensor replacement

Please contact Riken Keiki for sensor replacement.

NOTE

- ▶ Please contact Riken Keiki to request sensor replacement. Calibration using a calibration gas is required after sensor replacement.

7-7-2 Replacement of periodic replacement parts

The product periodic replacement parts are as follows. The parts should be replaced at the recommended replacement intervals.

<Recommended periodic replacement parts list>

| Name | Recommended check interval | Recommended replacement interval | Quantity (per unit) | Remarks |
|--------------------------------------|----------------------------|---|---------------------|---------|
| Sensor guard (for SD-3RI/GHS) | 6 months | 3 - 8 years | 1 | |
| Sensor guard (for SD-3NC/GH/SP) | | | | |
| Sensor guard (for SD-3EC/ECS/ECB) | | | | |
| Gas sensor | | Refer to separate sensor specifications. | | *1 |
| Silicone removal filter | | 1 year | | *2 |
| Activated carbon filter | | 1 year | | *3 |

*1: Function checking by a certified service engineer is required after parts replacement. Contact Riken Keiki to request checking by a certified service engineer to ensure consistent operation and safety.

*2: For combustible gas sensor (SI-8)/Part No.: 4283 0030 20

*3: For combustible gas sensor (CF-8304)/Part No.: 4283 0040 10

NOTE

- ▶ The above replacement intervals are guidelines only. Replacement intervals may vary depending on actual operating conditions. These intervals do not constitute warranty periods. Replacement intervals may vary depending on the results of regular maintenance.

8

Storage, Relocation, and Disposal

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

The product must be stored in the following environment:

- In a location at normal temperatures and humidity and away from direct sunlight
- In a location free of gases, solvents, and vapor

<Storage conditions (Sensor)>

| Model | Storage limit (years) | Temperature (°C) | | Humidity* ¹ (% RH) | | Pressure (kPa) | | Remarks |
|-------|-----------------------|------------------|---------|-------------------------------|---------|----------------|---------|--|
| | — | Minimum | Maximum | Minimum | Maximum | Minimum | Maximum | |
| SGF | 0.5 | -10 | 40 | 0 | 90 | 80 | 120 | <ul style="list-style-type: none"> • The sensor must be stored in the specified packing case. • Store in a location away from direct sunlight. • Store in an environment free of corrosive gas, vibration, and dust. • Avoid condensation and moisture. • Store in an environment free of gases that may act as a catalyst poison (e.g., silicone, chlorine, sulfur gases). |
| SHF | 0.5 | -10 | 40 | 0 | 90 | 80 | 120 | |
| NCF | 0.5 | -10 | 40 | 0 | 90 | 80 | 120 | |
| IRF | 0.5 | -10 | 40 | 0 | 90 | 80 | 120 | |
| ESF | 0.5 | -10 | 40 | 0 | 90 | 80 | 120 | |

*1: Maximum humidity corresponds to an absolute humidity of 33 g/m³ (33.6 °C, 90 %RH) or less.

<Storage conditions (Sensor-fitted SD-3)>

| Model | Storage limit (years) | Temperature (°C) | | Humidity*1 (% RH) | | Pressure (kPa) | | Remarks |
|---------------------|-----------------------|------------------|---------|-------------------|---------|----------------|---------|--|
| | — | Minimum | Maximum | Minimum | Maximum | Minimum | Maximum | |
| SGF | 0.5 | -10 | 40 | 0 | 90 | 80 | 120 | <ul style="list-style-type: none"> • Store in a location away from direct sunlight. • Store in an environment free of corrosive gas, vibration, and dust. • Avoid condensation and moisture. • Store in an environment free of gases that may act as a catalyst poison (e.g., silicone, chlorine, sulfur gases). |
| SHF | 0.5 | -10 | 40 | 0 | 90 | 80 | 120 | |
| NCF | 0.5 | -10 | 40 | 0 | 90 | 80 | 120 | |
| IRF | 0.5 | -10 | 40 | 0 | 90 | 80 | 120 | <ul style="list-style-type: none"> • Store in a location away from direct sunlight. • Store in an environment free of corrosive gas, vibration, and dust. • Avoid condensation and moisture. |
| ESF-A ^{*2} | 0.5 | -10 | 40 | 0 | 90 | 80 | 120 | <ul style="list-style-type: none"> • Store in a location away from direct sunlight. • Store in an environment free of corrosive gas, vibration, and dust. • Avoid condensation and moisture. • Store in an environment free of gases that may act as a catalyst poison (e.g., silicone, chlorine, sulfur gases). |
| ESF-X ^{*3} | | | | | | | | |
| ESF-B ^{*4} | 0.5 | -10 | 40 | 0 | 90 | 80 | 120 | <ul style="list-style-type: none"> • Store in the dedicated sensor storage container.^{*5} <p>Open the dedicated container just before use, remove the sensor, and mount in the detector.</p> |

*1: Maximum humidity corresponds to an absolute humidity of 33 g/m³ (33.6 °C, 90 %RH).

*2: ESF-A refers to sensor model names starting with "ESF-A".

*3: ESF-X refers to sensor model names starting with "ESF-X".

*4: ESF-B refers to sensor model names starting with "ESF-B".

*5: If not stored in the container, fluid leakage may occur under high humidity conditions of 90 %RH or more. Fluid shortage may occur with the ESF-B^{*4} under low humidity conditions.



- This product is very heavy and features various projections. Damage to this product and accompanying parts may result if they are packaged in general packaging materials. When storing or returning the product to Riken Keiki for any reason, use the packaging in which the product was shipped. If the original packaging is no longer available, wrap twice and place hard objects in the spaces within the packaging to ensure that the product will not shift inside the packaging. Avoid packaging fragile items.

8-2 Procedures for relocation or reuse

Before relocating and resuming use of the product, refer to '4-1 Installation precautions' for information on relocation locations.

For information on installation procedures, refer to '4. Installation'.



CAUTION

- Calibration must always be performed before resuming use of the product that has been relocated or previously stopped and stored. Contact Riken Keiki for information on readjustment procedures, including calibration.

8-3 Product disposal

Dispose of the product as industrial waste (incombustible) in accordance with local regulations.


9




Troubleshooting

This troubleshooting section does not address causes of all problems that may occur with the product. It provides brief explanations to assist in determining the causes of common problems.

If you encounter symptoms not addressed here or if problems persist even after taking corrective action, contact Riken Keiki.

9-1 Product abnormalities

| Symptom/display | FAULT lamp | Cause | Action |
|--------------------------------|--|--|---|
| The power cannot be turned on. | — | The wires are incorrectly connected. | Wire correctly. |
| | | The wires are detached from the terminal plate. | Connect correctly. |
| | | Abnormalities or instantaneous interruptions in the power supply circuit | Check to confirm that the rated voltage is supplied. Consider use of an uninterruptible power system, power supply line filter, or insulated transformer, and add such devices where appropriate. |
| | | Cable abnormality (Disconnection, cable not connected, short circuit) | Check the wiring for the product and peripheral devices. |
| | | Fuse blown | Replacement required. Contact Riken Keiki. |
| | | Internal circuit abnormality | Replacement required. Contact Riken Keiki. |
| Abnormal operation | — | Disturbances due to sudden noise, etc. | Turn off the power and restart. If similar symptoms recur frequently, take appropriate measures to address the noise source. If the problem persists even with noise prevention measures, contact Riken Keiki. |
| Sensor abnormality (E-1) |  (lit) | The sensor is not connected or connected improperly. | Turn off the power and check the sensor connection. |
| | | A sensor fault has occurred. | Replace with a new sensor. |
| | | Effects of sudden surge noise | Turn off the power and restart. If similar symptoms recur frequently, take appropriate measures to address the noise source. If the problem persists even with noise prevention measures, contact Riken Keiki. |
| | | The main unit (SD-3/SD-3SC) or remote sensor head (GD-3) internal wiring is connected incorrectly. | Connect internal wiring of the main unit (SD-3/SD-3SC) or remote sensor head (GD-3) correctly. |

| Symptom/display | FAULT lamp | Cause | Action |
|--------------------------|---|---|--|
| | | Cable abnormality between the main unit (SD-3SC) and remote sensor head (GD-3) | Check the cable between the main unit (SD-3SC) and remote sensor head (GD-3). |
| Sensor abnormality (E-1) |  (lit) | A main unit (SD-3/SD-3SC) or remote sensor head (GD-3) fuse has blown. | Replacement required. Contact Riken Keiki. |
| | | Main unit (SD-3/SD-3SC) or remote sensor head (GD-3) internal circuit abnormality | Replacement required. Contact Riken Keiki. |
| System abnormality (E-9) |  (lit) | 4 - 20 mA output disconnection | Turn off the power and check the 4 - 20 mA output connection. |
| | | Internal ROM, RAM, or EEPROM fault | Turn off the power and restart. If the problem persists, replacement is necessary. Contact Riken Keiki. |
| GD-3 abnormality (E-1A) |  (lit) | The sensor is not connected or connected improperly. | Turn off the power and check the sensor connection. |
| | | A sensor fault has occurred. | Replace with a new sensor. |
| | | Effects of sudden surge noise | Turn off the power and restart. If similar symptoms recur frequently, take appropriate measures to address the noise source. If the problem persists even with noise prevention measures, contact Riken Keiki. |

9-2 Reading abnormalities

| Symptom/display | FAULT lamp | Cause | Action |
|--|------------|--|--|
| <ul style="list-style-type: none"> • The reading rises (or drops) and remains unchanged. • A gas alarm is triggered despite the absence of a gas leak or any other abnormalities at the detection area. • Response is slow. | — | The sensor zero or span has altered (drifted). | Perform zero calibration or span adjustment. |
| | | Presence of interference gases | Check for the presence of interference gases such as solvents and take appropriate action. |
| | | Slow leakage | Trace amounts of detection target gas may be leaking. Leaving this unresolved may lead to hazardous conditions. Take the same action as for gas alarms. |
| | | Environmental fluctuations | Perform zero calibration or span adjustment. |
| | | Effects of noise | Turn off the power and restart. If similar symptoms recur frequently, take appropriate measures to address the noise source. If the problem persists even with noise prevention measures, contact Riken Keiki. |

| Symptom/display | FAULT lamp | Cause | Action |
|--|------------|--|--|
| | | Sudden environmental changes | Alarm indications may be issued by the product due to sudden environmental fluctuations (e.g., temperature). The product cannot be used in locations where sudden environmental changes occur frequently. The user should take appropriate measures. |
| | | The sensor sensitivity has degraded. | Replace with a new sensor. |
| | | The calibration gas concentration is inappropriate. | Prepare the correct calibration gas. |
| | | The sensor sensitivity has degraded. | Replace with a new sensor. |
| System abnormality (E-9) | — | Clock abnormality | Set the date and time. Correction may not function correctly if the EC sensitivity correction function is enabled. If similar symptoms recur frequently, the internal clock may be defective. Replace with a new internal clock. Contact Riken Keiki. |
| Outside operating temperature range (E-27) | — | Ambient temperatures at the location where the product is installed are outside the operating temperature range. | The product operating temperature range varies with the specific detection principle. The product cannot be used outside the operating temperature range. The user should take appropriate measures. |
| Sensor life expiration warning (E-8) | — | The sensor is approaching the end of its service life. | We recommend sensor replacement. Contact Riken Keiki. |
| Sensor warning (E-1) | — | | Contact Riken Keiki. |

10

Product Specifications

10-1 SD-3 specifications

10-1-1 SD-3 (model without EC barrier)

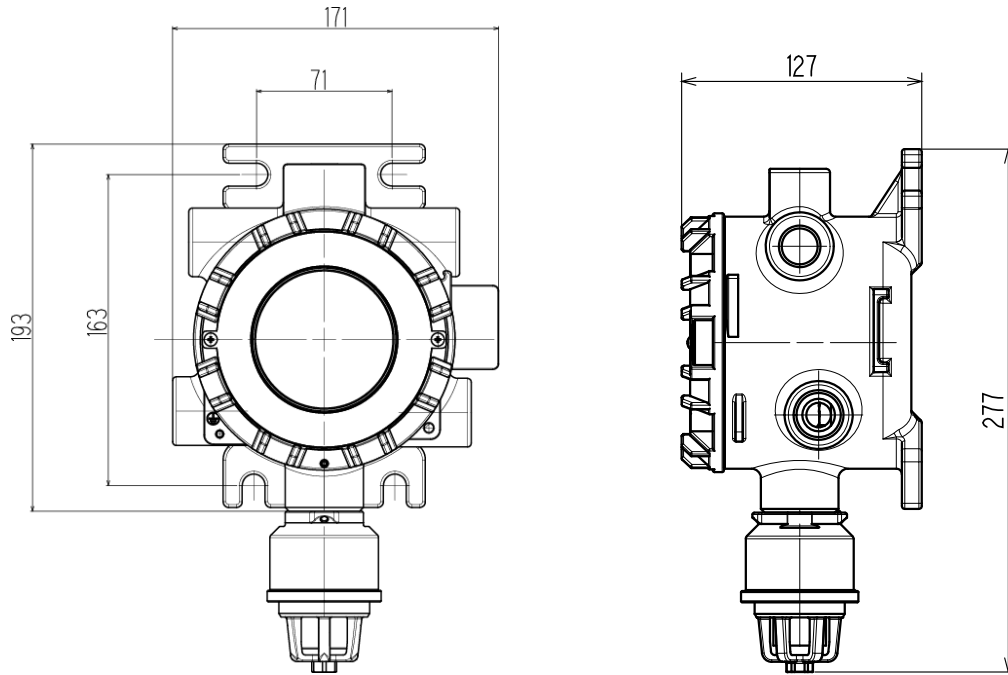
| Model | SD-3 | SD-3 (contact model) |
|--|---|--|
| Specifications | Standard | Contact |
| Display | 7-segment LED (5 digits) | |
| Sensor | F sensor (Riken Keiki) | |
| Detection principle | Infrared/electrochemical/new ceramic/semiconductor/hot-wire semiconductor | |
| Detection target gas | Depends on sensor specifications. | |
| Detection range | Depends on sensor specifications. | |
| Sampling method | Diffusion type/suction type (introduced via external unit) | |
| Set flow rate | 0.4 - 1.5 L/min | |
| Power supply indication | Power lamp lit (green) | |
| External output | Gas concentration signal (4 - 20 mA DC + HART output) | |
| Alarm setpoints | Depends on sensor specifications. | |
| Alarm accuracy | Depends on sensor specifications. | |
| Alarm delay time | Depends on sensor specifications. | |
| Repeatability (for identical conditions) | Depends on sensor specifications. | |
| Indication accuracy (for identical conditions) | Depends on sensor specifications. | |
| Gas alarm type | Two-step alarm (H-HH, H-L, or L-LL) | |
| Gas alarm indication | Alarm lamp lit (red) | |
| Gas alarm reset operation | Auto reset or self-latching | |
| Fault alarm/self diagnosis | System abnormality (E-9)/sensor abnormality (E-1) | |
| Fault alarm indication | Fault lamp lit (yellow)/error code display | |
| Fault alarm reset operation | System abnormality: Self-latching Sensor abnormality: Auto reset (self-latching if sensor is disconnected) | |
| Contact operation | — | SPDT (× 3): 2 alarms, 1 fault output 250 V AC, 2 A; 30 V DC, 1 A (resistance load) Minimum load 5 V DC, 0.1 A |
| Warnings | Sensor life assessment/clock abnormality diagnosis/communication diagnosis/sensor warning | |
| Warning display | Blinking display alternating between gas concentration and error code | |
| Warning operation | Same as normal operation | |
| Functions | Alarm delay/suppression/HART communication | |

| Model | SD-3 | SD-3 (contact model) |
|---|--|----------------------|
| Transmission method (4 - 20 mA) | 3-wire analog transmission (common power supply <power supply, signal, common>) or 2-wire analog transmission (current source) | |
| Transmission specifications (4 - 20 mA) | 4 mA - 20 mA DC (non-insulated linear output) Maximum load resistance 600 Ω (with derating depending on power supply voltage) Resolution: max. 250 divisions (depending on specifications) | |
| Transmission cable (4 - 20 mA) | Shielded cable 1.25 sq (1.38 mm ² /AWG16) or 2.0 sq (2.08 mm ² /AWG14) (same as power supply cable) *To ensure explosion protection, use a cable designed for use in temperatures at least 5 °C above the maximum anticipated ambient temperature. | |
| Transmission distance (4 - 20 mA) | For 1.25 sq (1.38 mm ² /AWG16): Not exceeding 1.25 km For 2.0 sq (2.08 mm ² /AWG14): Not exceeding 2 km (with derating depending on supply voltage) | |
| Power source | 24 V DC (18 V - 30 V DC) *Use a power supply capable of minimum temporary output of 2.5 A to ensure that fuses blow normally in the event of a product abnormality. | |
| Power supply cable | Shielded cable 1.25 sq (1.38 mm ² /AWG16) or 2.0 sq (2.08 mm ² /AWG14) (same as transmission cable) *To ensure explosion protection, use a cable designed for use in temperatures at least 5 °C above the maximum anticipated ambient temperature. | |
| Power consumption | Refer to '10-1-3 Electrical ratings (SD-3)'. | |
| Cable connectors | M25 × 1.5 | |
| Operation method | Dedicated magnet control key | |
| Operating temperature range | -40 °C - +70 °C (no sudden changes) In accordance with sensor specifications if restrictions apply due to sensor specifications | |
| Operating humidity range | 0 %RH - 95 %RH (no condensation) In accordance with sensor specifications if restrictions apply due to sensor specifications | |
| Housing material | Stainless steel (SCS14) | |
| Protection level | IP66/67 equivalent | |
| Installation type | Wall mounting (standard)/2B pole mounting (optional) | |
| Explosion-proof construction | Flame-proof construction | |
| Explosion-proof class | Varies depending on model. Refer to <Explosion-proof performance data> in '2-4 Safety information'. | |
| External dimensions | Diffusion type: Approx. 171 mm (W) × 277 mm (H) × 127 mm (D) (excluding projections) Suction type: Approx. 171 mm (W) × 289 mm (H) × 127 mm (D) (excluding projections) | |
| Weight | Diffusion type: approx. 6.7 kg/Suction type: approx. 7.0 kg | |

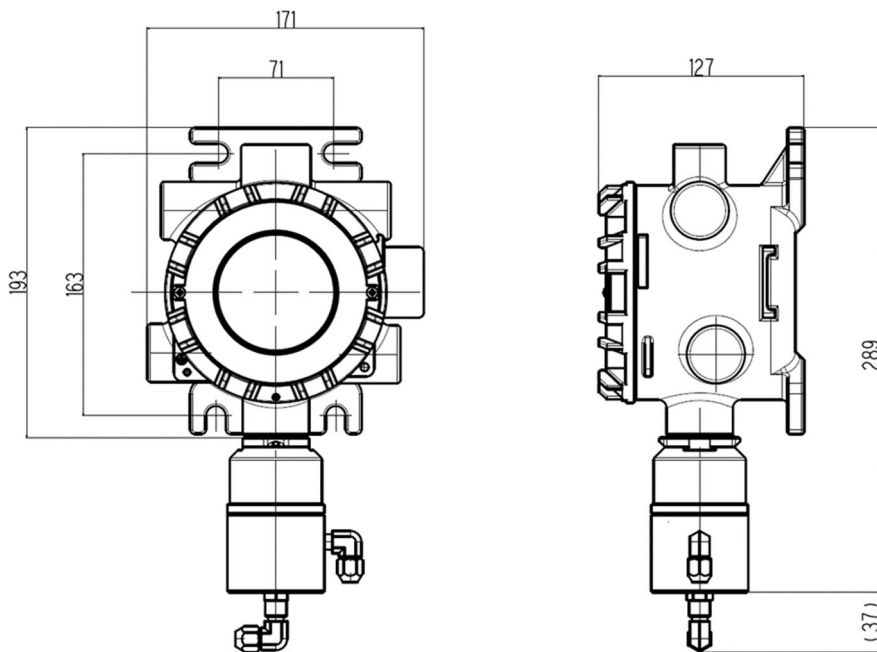
*When used with the contacts closed, the contacts may seize due to vibration. Keep this precaution in mind.

<Dimensional drawings (SD-3 (model without EC barrier))>

<Diffusion type>



<Suction type>



10-1-2 SD-3 (model with EC barrier)

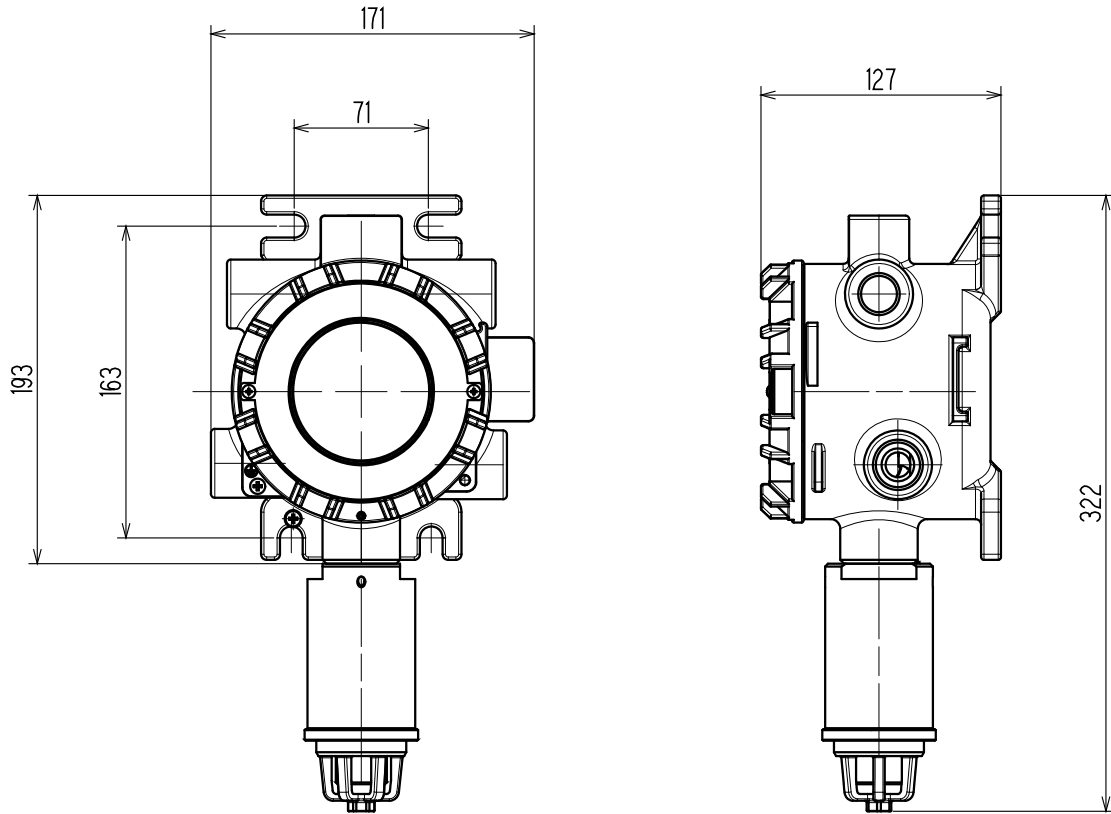
| Model | SD-3 | SD-3 (contact model) |
|--|--|---|
| Specifications | Standard | Contact |
| Display | 7-segment LED (5 digits) | |
| Sensor | F sensor (Riken Keiki) | |
| Detection principle | Electrochemical type | |
| Detection target gas | Depends on sensor specifications. | |
| Detection range | Depends on sensor specifications. | |
| Sampling method | Diffusion type/suction type (introduced via external unit) | |
| Set flow rate | 0.4 - 1.5 L/min | |
| Power supply indication | Power lamp lit (green) | |
| External output | Gas concentration signal (4 - 20 mA DC + HART output) | |
| Alarm setpoints | Depends on sensor specifications. | |
| Alarm accuracy | Depends on sensor specifications. | |
| Alarm delay time | Depends on sensor specifications. | |
| Repeatability (for identical conditions) | Depends on sensor specifications. | |
| Indication accuracy (for identical conditions) | Depends on sensor specifications. | |
| Gas alarm type | Two-step alarm (H-HH, H-L, or L-LL) | |
| Gas alarm indication | Alarm lamp lit (red) | |
| Gas alarm reset operation | Auto reset or self-latching | |
| Fault alarm/self diagnosis | System abnormality (E-9)/sensor abnormality (E-1) | |
| Fault alarm indication | Fault lamp lit (yellow)/error code display | |
| Fault alarm reset operation | System abnormality: Self-latching Sensor abnormality: Auto reset (self-latching if sensor is disconnected) | |
| Contact operation | — | SPDT (× 3): 2 alarms, 1 fault output 250 V AC, 2A; 30 V DC, 1 A (resistance load) Minimum load 5 V DC, 0.1 A |
| Warnings | Sensor life assessment/clock abnormality diagnosis/communication diagnosis/sensor warning | |
| Warning display | Blinking display alternating between gas concentration and error code | |
| Warning operation | Same as normal operation | |
| Functions | Alarm delay/suppression/HART communication | |
| Transmission method (4 - 20 mA) | 3-wire analog transmission (common power supply <power supply, signal, common>) or 2-wire analog transmission (current source) | |
| Transmission specifications (4 - 20 mA) | 4 mA - 20 mA DC (non-insulated linear output) Maximum load resistance 600 Ω (with derating depending on power supply voltage) Resolution: max. 250 divisions (depending on specifications) | |
| Transmission cable (4 - 20 mA) | Shielded cable 1.25 sq (1.38 mm ² /AWG16) or 2.0 sq (2.08 mm ² /AWG14) (same as power supply cable) *To ensure explosion protection, use a cable designed for use in temperatures at least 5 °C above the maximum anticipated ambient temperature. | |
| Transmission distance (4 - 20 mA) | For 1.25 sq (1.38 mm ² /AWG16): Not exceeding 1.25 km For 2.0 sq (2.08 mm ² /AWG14): Not exceeding 2 km (with derating depending on supply voltage) | |

| Model | SD-3 | SD-3 (contact model) |
|------------------------------|--|----------------------|
| Power source | 24 V DC (18 V - 30 V DC) *Use a power supply capable of minimum temporary output of 2.5 A to ensure that fuses blow normally in the event of a product abnormality. | |
| Power supply cable | Shielded cable 1.25 sq (1.38 mm ² /AWG16) or 2.0 sq (2.08 mm ² /AWG14) (same as transmission cable) *To ensure explosion protection, use a cable designed for use in temperatures at least 5 °C above the maximum anticipated ambient temperature. | |
| Power consumption | Refer to '10-1-3 Electrical ratings (SD-3)'. | |
| Cable connectors | M25 × 1.5 | |
| Operation method | Dedicated magnet control key | |
| Operating temperature range | -40 °C - +70 °C (no sudden changes) In accordance with sensor specifications if restrictions apply due to sensor specifications | |
| Operating humidity range | 0 %RH - 95 %RH (no condensation) In accordance with sensor specifications if restrictions apply due to sensor specifications | |
| Housing material | Stainless steel (SCS14) | |
| Protection level | IP66/67 equivalent | |
| Installation type | Wall mounting (standard)/2B pole mounting (optional) | |
| Explosion-proof construction | Flame-proof construction + intrinsically safe explosion-proof construction | |
| Explosion-proof class | Varies depending on model. Refer to <Explosion-proof performance data> in '2-4 Safety information'. | |
| External dimensions | Diffusion type: Approx. 171 mm (W) × 322 mm (H) × 127 mm (D) (excluding projections) Suction type: Approx. 171 mm (W) × 334 mm (H) × 127 mm (D) (excluding projections) | |
| Weight | Diffusion type: approx. 7.3 kg/Suction type: approx. 7.6 kg | |

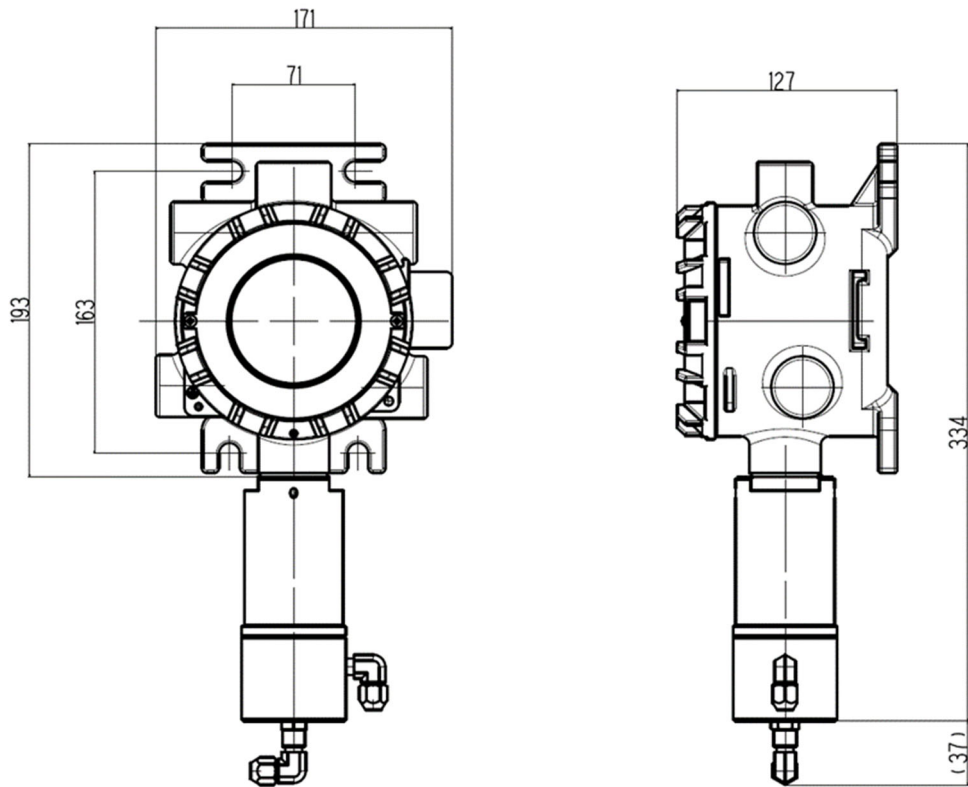
*When used with the contacts closed, the contacts may seize due to vibration. Keep this precaution in mind.

<Dimensional drawings (SD-3 (model with EC barrier))>

<Diffusion type>



<Suction type>



10-1-3 Electrical ratings (SD-3)

| Model | Power supply | Power consumption |
|---------|--------------------------|-------------------|
| SD-3RI | 24 V DC (18 V - 30 V DC) | Max. 3.8 W |
| SD-3GH | 24 V DC (18 V - 30 V DC) | Max. 4.5 W |
| SD-3GHS | 24 V DC (18 V - 30 V DC) | Max. 4.5 W |
| SD-3NC | 24 V DC (18 V - 30 V DC) | Max. 4.5 W |
| SD-3SP | 24 V DC (18 V - 30 V DC) | Max. 3.5 W |
| SD-3EC | 24 V DC (18 V - 30 V DC) | Max. 2.8 W |
| SD-3ECS | 24 V DC (18 V - 30 V DC) | Max. 2.8 W |
| SD-3ECB | 24 V DC (18 V - 30 V DC) | Max. 3.1 W |
| SD-3SC | 24 V DC (18 V - 30 V DC) | Max. 5 W |

10-2 SD-3SC + GD-3 specifications

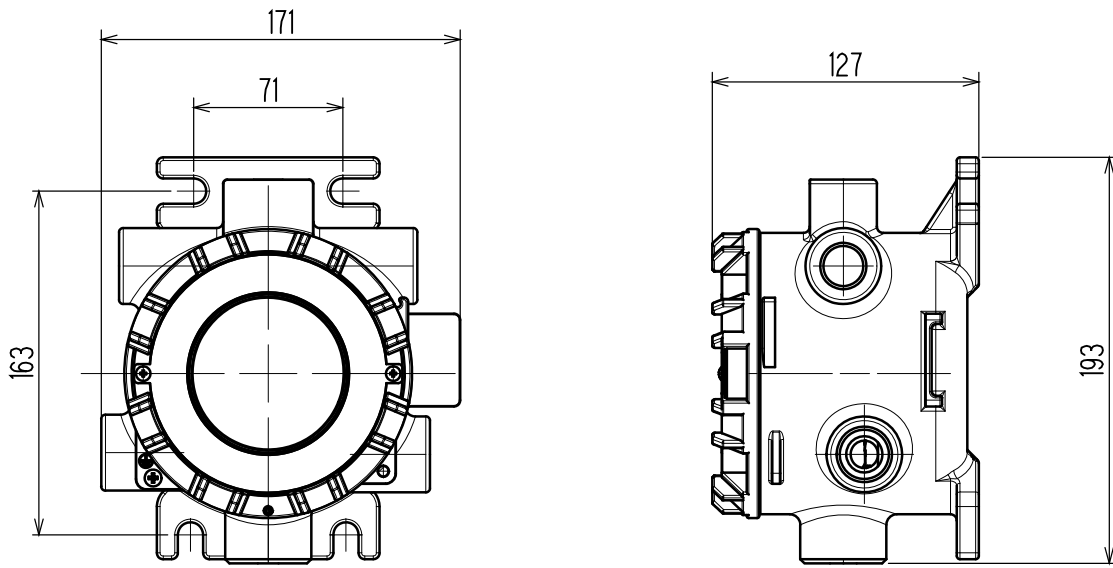
10-2-1 SD-3SC + GD-3 (model without EC barrier)

| Model | SD-3SC + GD-3 | SD-3SC (contact model) + GD-3 |
|--|--|---|
| Specifications | Standard | Contact |
| Display | 7-segment LED (5 digits) | |
| Sensor | F sensor (Riken Keiki) | |
| Detection principle | Infrared/electrochemical/new ceramic/semiconductor/hot-wire semiconductor | |
| Detection target gas | Depends on sensor specifications. | |
| Detection range | Depends on sensor specifications. | |
| Sampling method | Diffusion type | |
| Power supply indication | Power lamp lit (green) | |
| External output | Gas concentration signal (4 - 20 mA DC + HART output) | |
| Alarm setpoints | Depends on sensor specifications. | |
| Alarm accuracy | Depends on sensor specifications. | |
| Alarm delay time | Depends on sensor specifications. | |
| Repeatability (for identical conditions) | Depends on sensor specifications. | |
| Indication accuracy (for identical conditions) | Depends on sensor specifications. | |
| Gas alarm type | Two-step alarm (H-HH, H-L, or L-LL) | |
| Gas alarm indication | Alarm lamp lit (red) | |
| Gas alarm reset operation | Auto reset or self-latching | |
| Fault alarm/self diagnosis | System abnormality (E-9)/sensor abnormality (E-1) | |
| Fault alarm indication | Fault lamp lit (yellow)/error code display | |
| Fault alarm reset operation | System abnormality: Self-latching Sensor abnormality: Auto reset (self-latching if sensor is disconnected) | |
| Contact operation | — | SPDT (× 3): 2 alarms, 1 fault output 250 V AC, 2A; 30 V DC, 1 A (resistance load) Minimum load 5 V DC, 0.1 A |
| Warnings | Sensor life assessment/clock abnormality diagnosis/communication diagnosis/sensor warning | |
| Warning display | Blinking display alternating between gas concentration and error code | |
| Warning operation | Same as normal operation | |
| Functions | Alarm delay/suppression/HART communication | |
| Transmission method (4 - 20 mA) | 3-wire analog transmission (common power supply <power supply, signal, common>) or 2-wire analog transmission (current source) | |
| Transmission specifications (4 - 20 mA) | 4 mA - 20 mA DC (non-insulated linear output) Maximum load resistance 600 Ω (with derating depending on power supply voltage) Resolution: max. 250 divisions (depending on specifications) | |

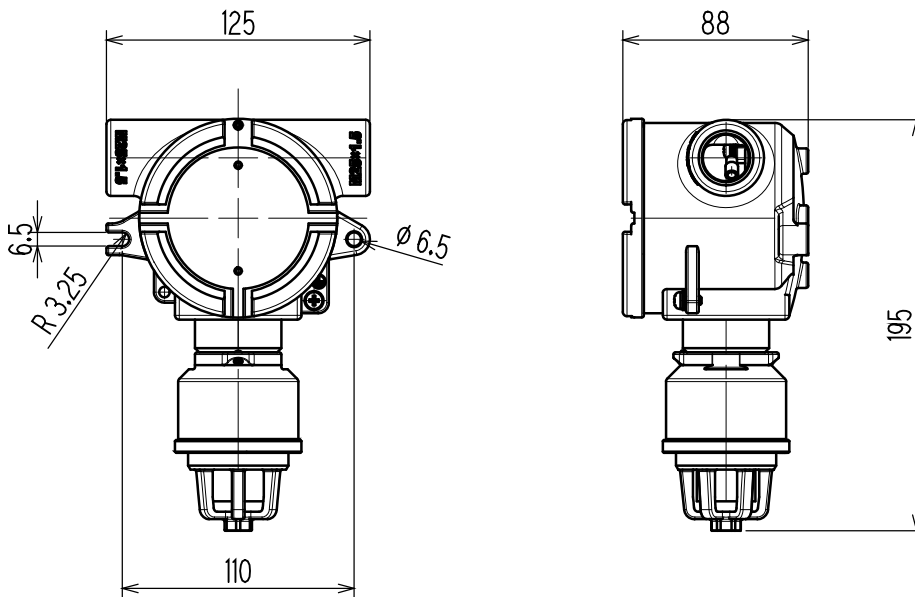
| Model | SD-3SC + GD-3 | SD-3SC (contact model) + GD-3 |
|--|---|-------------------------------|
| Transmission cable (4 - 20 mA) | Shielded cable 1.25 sq (1.38 mm ² /AWG16) or 2.0 sq (2.08 mm ² /AWG14) (same as power supply cable) *To ensure explosion protection, use a cable designed for use in temperatures at least 5 °C above the maximum anticipated ambient temperature. | |
| Transmission distance (4 - 20 mA) | For 1.25 sq (1.38 mm ² /AWG16): Not exceeding 1.25 km For 2.0 sq (2.08 mm ² /AWG14): Not exceeding 2 km (with derating depending on supply voltage) | |
| Transmission cable (between GD-3 units) | Shielded twisted pair cable 1.25 sq (1.38 mm ² /AWG16) *To ensure explosion protection, use a cable designed for use in temperatures at least 5 °C above the maximum anticipated ambient temperature. | |
| Transmission distance (between GD-3 units) | 20 m (maximum) | |
| Power source | 24 V DC (18 V - 30 V DC) *Use a power supply capable of minimum temporary output of 2.5 A to ensure that fuses blow normally in the event of a product abnormality. | |
| Power supply cable | Shielded cable 1.25 sq (1.38 mm ² /AWG16) or 2.0 sq (2.08 mm ² /AWG14) (same as transmission cable) *To ensure explosion protection, use a cable designed for use in temperatures at least 5 °C above the maximum anticipated ambient temperature. | |
| Power consumption | Refer to '10-2-3 Electrical ratings (SD-3SC + GD-3)'. | |
| Cable connectors | M25 × 1.5 | |
| Operation method | Dedicated magnet control key | |
| Operating temperature range | -40 °C - +70 °C (no sudden changes) In accordance with sensor specifications if restrictions apply due to sensor specifications | |
| Operating humidity range | 0 %RH - 95 %RH (no condensation) In accordance with sensor specifications if restrictions apply due to sensor specifications | |
| Housing material | Stainless steel (SCS14) | |
| Protection level | IP66/67 equivalent | |
| Installation type | Wall mounting (standard)/2B pole mounting (optional) | |
| Explosion-proof construction | Flame-proof construction | |
| Explosion-proof class | Varies depending on model. Refer to <Explosion-proof performance data> in '2-4 Safety information'. | |
| External dimensions (SD-3SC) | Diffusion type: Approx. 125 mm (W) × 195 mm (H) × 88 mm (D) (excluding projections) | |
| Weight (SD-3SC) | Approx. 6.0 kg | |
| External dimensions (GD-3) | Approx. 125 mm (W) × 195 mm (H) × 88 mm (D) | |
| Weight (GD-3) | Approx. 3.0 kg | |

*When used with the contacts closed, the contacts may seize due to vibration. Keep this precaution in mind.

<Dimensional drawings (SD-3SC + GD-3 (model without EC barrier))>



<Diffusion type>



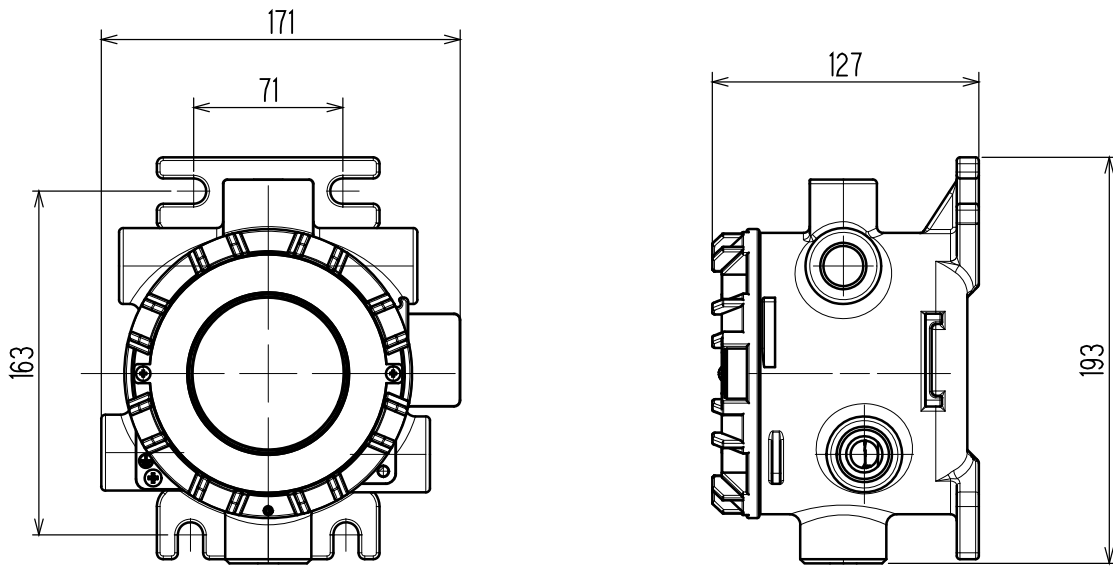
10-2-2 SD-3SC + GD-3 (model with EC barrier)

| Model | SD-3SC + GD-3 | SD-3SC (contact model) + GD-3 |
|--|--|---|
| Specifications | Standard | Contact |
| Display | 7-segment LED (5 digits) | |
| Sensor | F sensor (Riken Keiki) | |
| Detection principle | Electrochemical type | |
| Detection target gas | Depends on sensor specifications. | |
| Detection range | Depends on sensor specifications. | |
| Sampling method | Diffusion type | |
| Power supply indication | Power lamp lit (green) | |
| External output | Gas concentration signal (4 - 20 mA DC + HART output) | |
| Alarm setpoints | Depends on sensor specifications. | |
| Alarm accuracy | Depends on sensor specifications. | |
| Alarm delay time | Depends on sensor specifications. | |
| Repeatability (for identical conditions) | Depends on sensor specifications. | |
| Indication accuracy (for identical conditions) | Depends on sensor specifications. | |
| Gas alarm type | Two-step alarm (H-HH, H-L, or L-LL) | |
| Gas alarm indication | Power lamp lit (red) | |
| Gas alarm reset operation | Auto reset or self-latching | |
| Fault alarm/self diagnosis | System abnormality (E-9)/sensor abnormality (E-1) | |
| Fault alarm indication | Fault lamp lit (yellow)/error code display | |
| Fault alarm reset operation | System abnormality: Self-latching Sensor abnormality: Auto reset (self-latching if sensor is disconnected) | |
| Contact operation | — | SPDT (× 3): 2 alarms, 1 fault output 250 V AC, 2A; 30 V DC, 1 A (resistance load) Minimum load 5 V DC, 0.1 A |
| Warnings | Sensor life assessment/clock abnormality diagnosis/communication diagnosis/sensor warning | |
| Warning display | Blinking display alternating between gas concentration and error code | |
| Warning operation | Same as normal operation | |
| Functions | Alarm delay/suppression/HART communication | |
| Transmission method (4 - 20 mA) | 3-wire analog transmission (common power supply <power supply, signal, common>) or 2-wire analog transmission (current source) | |
| Transmission specifications (4 - 20 mA) | 4 mA - 20 mA DC (non-insulated linear output) Maximum load resistance 600 Ω (with derating depending on power supply voltage) Resolution: max. 250 divisions (depending on specifications) | |
| Transmission cable (4 - 20 mA) | Shielded cable 1.25 sq (1.38 mm ² /AWG16) or 2.0 sq (2.08 mm ² /AWG14) (same as power supply cable) *To ensure explosion protection, use a cable designed for use in temperatures at least 5 °C above the maximum anticipated ambient temperature. | |

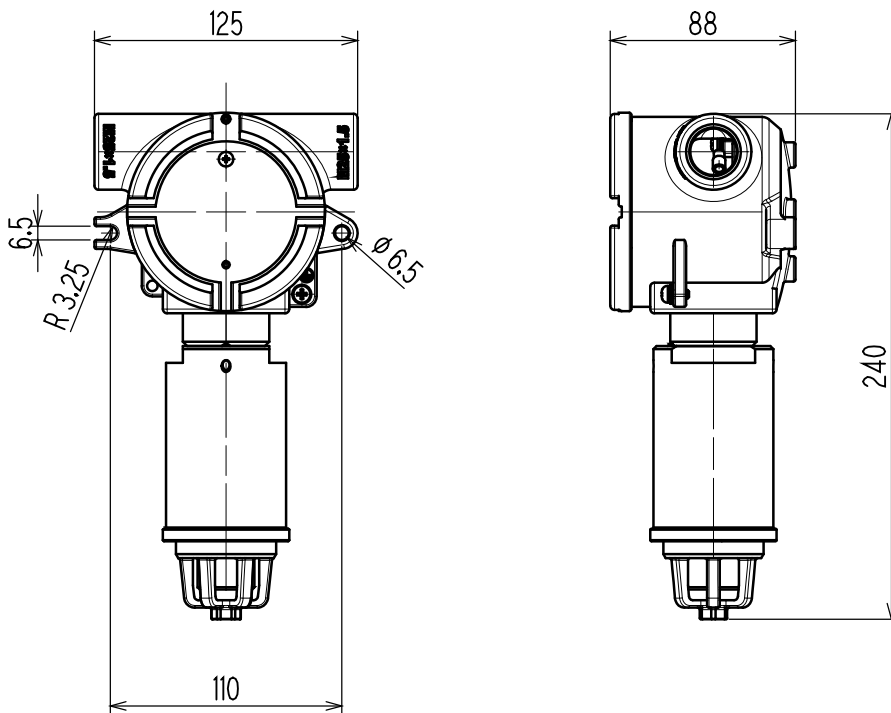
| Model | SD-3SC + GD-3 | SD-3SC (contact model) + GD-3 |
|--|---|-------------------------------|
| Transmission distance (4 - 20 mA) | For 1.25 sq (1.38 mm ² /AWG16): Not exceeding 1.25 km For 2.0 sq (2.08 mm ² /AWG14): Not exceeding 2 km (with derating depending on supply voltage) | |
| Transmission cable (between GD-3 units) | Shielded twisted pair cable 1.25 sq (1.38 mm ² /AWG16) *To ensure explosion protection, use a cable designed for use in temperatures at least 5 °C above the maximum anticipated ambient temperature. | |
| Transmission distance (between GD-3 units) | 20 m (maximum) | |
| Power source | 24 V DC (18 V - 30 V DC) *Use a power supply capable of minimum temporary output of 2.5 A to ensure that fuses blow normally in the event of a product abnormality. | |
| Power supply cable | Shielded cable 1.25 sq (1.38 mm ² /AWG16) or 2.0 sq (2.08 mm ² /AWG14) (same as transmission cable) *To ensure explosion protection, use a cable designed for use in temperatures at least 5 °C above the maximum anticipated ambient temperature. | |
| Power consumption | Refer to '10-2-3 Electrical ratings (SD-3SC + GD-3)'. | |
| Cable connectors | M25 × 1.5 | |
| Operation method | Dedicated magnet control key | |
| Operating temperature range | -40 °C - +70 °C (no sudden changes) In accordance with sensor specifications if restrictions apply due to sensor specifications | |
| Operating humidity range | 0 %RH - 95 %RH (no condensation) In accordance with sensor specifications if restrictions apply due to sensor specifications | |
| Housing material | Stainless steel (SCS14) | |
| Protection level | IP66/67 equivalent | |
| Installation type | Wall mounting (standard)/2B pole mounting (optional) | |
| Explosion-proof construction | Flame-proof construction + intrinsically safe explosion-proof construction | |
| Explosion-proof class | Varies depending on model. Refer to <Explosion-proof performance data> in '2-4 Safety information'. | |
| External dimensions (SD-3SC) | Diffusion type: Approx. 125 mm (W) × 240 mm (H) × 88 mm (D) (excluding projections) | |
| Weight (SD-3SC) | Approx. 6.0 kg | |
| External dimensions (GD-3) | Approx. 125 mm (W) × 240 mm (H) × 88 mm (D) | |
| Weight (GD-3) | Approx. 4.0 kg | |

*When used with the contacts closed, the contacts may seize due to vibration. Keep this precaution in mind.

<Dimensional drawings (SD-3SC + GD-3 (model with EC barrier))>



<Diffusion type>



10-2-3 Electrical ratings (SD-3SC + GD-3)

| Model | Power supply | Power consumption |
|--------------|--------------------------|--------------------------|
| SD-3SC | 24 V DC (18 V - 30 V DC) | Max. 5 W |
| GD-3RI | 24 V DC (18 V - 30 V DC) | Max. 1.2 W |
| GD-3GH | 24 V DC (18 V - 30 V DC) | Max. 2 W |
| GD-3GHS | 24 V DC (18 V - 30 V DC) | Max. 2 W |
| GD-3NC | 24 V DC (18 V - 30 V DC) | Max. 2 W |
| GD-3SP | 24 V DC (18 V - 30 V DC) | Max. 1 W |
| GD-3EC | 24 V DC (18 V - 30 V DC) | Max. 1 W |
| GD-3ECS | 24 V DC (18 V - 30 V DC) | Max. 1 W |
| GD-3ECB | 24 V DC (18 V - 30 V DC) | Max. 1 W |

10-3 Detection target gases for individual detection principles

10-3-1 Non-dispersive infrared absorption type (Infrared type)

| Sensor model | Gas name | Gas symbol | F.S. | 1 digit | First Alarm setpoint | Second Alarm setpoint | Calibration gas | Operating temperature range | Operating humidity range | Years of warranty |
|--------------|----------------|----------------------------------|------------|------------|----------------------|-----------------------|--|-----------------------------|-------------------------------------|-------------------|
| IRF-1301* | Methane | CH ₄ | 100 %LEL | 0.5 %LEL | 25 %LEL | 50 %LEL | CH ₄ | -40 °C - 70 °C | 95 %RH or less (no condensation) | 3 years |
| IRF-1303* | Isobutane | i-C ₄ H ₁₀ | 100 %LEL | 0.5 %LEL | 25 %LEL | 50 %LEL | i-C ₄ H ₁₀ | | | |
| IRF-1315* | Propane | C ₃ H ₈ | 100 %LEL | 0.5 %LEL | 25 %LEL | 50 %LEL | C ₃ H ₈ i-C ₄ H ₁₀ | | | |
| IRF-1435 | Carbon dioxide | CO ₂ | 2,000 ppm | 1 ppm | 1,000 ppm | - | CO ₂ | | | |
| IRF-1436 | Carbon dioxide | CO ₂ | 5,000 ppm | 10 ppm | 1,000 ppm | - | CO ₂ | | | |
| IRF-1433 | Carbon dioxide | CO ₂ | 10,000 ppm | 10 ppm | 1,000 ppm | - | CO ₂ | | | |
| IRF-1437 | Carbon dioxide | CO ₂ | 2 vol% | 0.005 vol% | 1 vol% | - | CO ₂ | | | |
| IRF-1438 | Carbon dioxide | CO ₂ | 5 vol% | 0.010 vol% | 1 vol% | - | CO ₂ | | | |
| IRF-1439 | Carbon dioxide | CO ₂ | 10 vol% | 0.01 vol% | 1 vol% | - | CO ₂ | | | |
| IRF-1334* | Methane | CH ₄ | 100 vol% | 0.5 vol% | 25 vol% | 50 vol% | CH ₄ | | | |
| IRF-1316* | Ethylene | C ₂ H ₄ | 100 %LEL | 0.5 %LEL | 25 %LEL | 50 %LEL | C ₂ H ₄ CH ₄ | | | |
| IRF-1340* | Isobutylene | i-C ₄ H ₈ | 100 %LEL | 0.5 %LEL | 25 %LEL | 50 %LEL | i-C ₄ H ₈ i-C ₄ H ₁₀ | | | |
| IRF-1308* | n-hexane | n-C ₆ H ₁₄ | 100 %LEL | 0.5 %LEL | 25 %LEL | 50 %LEL | n-C ₆ H ₁₄ i-C ₄ H ₁₀ | | | |
| IRF-1332* | Butadiene | C ₄ H ₆ | 100 %LEL | 0.5 %LEL | 25 %LEL | 50 %LEL | C ₄ H ₆ CH ₄ | | | |

*Interference occurs due to other hydrocarbon gases.

NOTE

- ▶ Install in a location with stable conditions within the specified operating temperature range and free of sudden fluctuations.
- ▶ When calibrating, allow the product to warm up for at least 10 minutes before performing zero calibration and span adjustment.
- ▶ Make sure temperature, humidity, and pressure conditions in the calibration environment are the same as for the measurement environment. (The reading may fluctuate due to temperature, humidity, and pressure characteristics and in some cases may exceed the zero suppression value due to sensor characteristics.)
- ▶ For ethylene or butadiene to which the product has low gas sensitivity, set the alarm setpoint to 25 %LEL or higher.
- ▶ Due to infrared absorption characteristics, readings may differ even for the same target gas concentration if the base gas composition differs significantly between calibration and measurement—for example, if an air base is used for calibration and a CO₂ base is used for measurement.
- ▶ Perform maintenance if a warning appears while the life assessment or self-diagnostic function is active.
- ▶ Regardless of the detection target gas, the warranty period for IRF sensors is 3 years.

10-3-2 New ceramic type

| Sensor model | Gas name | Gas symbol | F.S. | 1 digit | First Alarm setpoint | Second Alarm setpoint | Calibration gas | Operating temperature range | Operating humidity range | Years of warranty |
|--------------|----------|-----------------|----------|----------|----------------------|----------------------------------|--------------------|-----------------------------|------------------------------------|-------------------|
| NCF-6318 | Methane | CH ₄ | 100 %LEL | 0.5 %LEL | 25 %LEL | 50 %LEL | CH ₄ *2 | -40 °C - 70 °C | 0 %RH - 95 %RH*1 (no condensation) | 3 years |
| NCF-6319 | VCM | VCM | 100 %LEL | 0.5 %LEL | 25 %LEL | i-C ₄ H ₁₀ | | | | |
| NCF-6320 | Hydrogen | H ₂ | 100 %LEL | 0.5 %LEL | 25 %LEL | H ₂ *3 | | | | |

*1: Absolute humidity not exceeding 46 g/m³ (equivalent to 37 °C, 95 %RH)

*2: Use the NCF-6318 if methane calibration is required or when the detection target gas is methane, propane, or ethane. The detection target gas overlaps for the NCF-6318 and NCF-6319. Use the NCF-6319 in cases other than the above.

*3: Use the NCF-6320 if hydrogen selectivity is required.

NOTE

- ▶ Install in a location with stable conditions within the specified operating temperature range and free of sudden fluctuations.
- ▶ The sensor characteristics may deteriorate significantly if silicone gases (organic silicone gases), halogen gases, sulfide gases, or acid gases are present.
- ▶ A silicone removal filter and activated carbon filter are available as options.
- ▶ For models with a F.S. of 5,000 ppm or less, allow the product to warm up for at least 120 minutes in clean air before performing zero calibration and span adjustment.
- ▶ For models with a F.S. of 5,000 ppm or less, the effects of ambient humidity and temperature fluctuations will become more significant, and the zero point may drift. If this occurs, enable the zero follower function. However, we recommend using a sensor with a different detection principle where gas is constantly present. The zero follower function cannot be used under such conditions.
- ▶ The reading may change even for combustible gases other than the detection target gas.
- ▶ Readings may fall as oxygen concentrations decrease.
- ▶ Interference may occur if gases with high thermal conductivity, such as high-concentration CO₂, Ar, or He, are present as the base gas.
- ▶ In detecting gases with low vapor pressure by the suction method, the gas may form a mist when drawn in from the high-temperature side and detected at the low-temperature side, possibly forming condensation inside the sensor or causing clogging due to sintering. Keep vapor pressure in mind during use.
- ▶ Perform maintenance if a warning appears while the life assessment or self-diagnostic function is active.
- ▶ Use the combustible gas sensor adapter when calibrating. Calibration accuracy may be reduced without the combustible gas sensor adapter.
- ▶ Reading accuracy may be reduced if temperature fluctuations exceed ±40 °C with respect to ambient temperature following zero calibration or span calibration. If this occurs, repeat zero calibration or span adjustment.
- ▶ Readings may fluctuate if the product is subjected to strong external impact or vibration. If this occurs, perform zero calibration and span adjustment.
- ▶ The zero point may fluctuate if the sensor comes into contact with high-concentration gas of 100 %LEL or more continuously for extended periods. If this occurs, perform zero calibration and span adjustment.
- ▶ The sensor may be hot during replacement. Be careful to avoid burns when replacing the sensor. If the sensor is hot, turn off the power and wait for it to cool.
- ▶ Regardless of the detection target gas, the warranty period for NCF sensors is 3 years.

10-3-3 Semiconductor type

| Sensor model | Gas name | Gas symbol | F.S. | 1 digit | First Alarm setpoint | Second Alarm setpoint | Calibration gas | Operating temperature range | Operating humidity range | Years of warranty |
|--------------|------------------|------------------|-----------|---------|----------------------|-----------------------|------------------|-----------------------------|---------------------------------------|-------------------|
| SGF-8581 | Methane | CH ₄ | 2,000 ppm | 10 ppm | 500 ppm | 1,000 ppm | CH ₄ | -20 °C - 65 °C | 20 %RH - 95 %RH* (no condensation) | 3 years |
| SGF-8562 | Carbon disulfide | CS ₂ | 200 ppm | 1 ppm | 50 ppm | 100 ppm | CS ₂ | | | |
| SGF-8563 | Ethylene oxide | EO | 100 ppm | 1 ppm | 25 ppm | 50 ppm | EO | | | |
| SGF-8562 | Hydrogen sulfide | H ₂ S | 100 ppm | 1 ppm | 25 ppm | 50 ppm | H ₂ S | | | |

*Absolute humidity not exceeding 46 g/m³ (equivalent to 37 °C, 95 %RH)

NOTE

- ▶ The sensor characteristics may deteriorate significantly if silicone gases (organic silicone gases), halogen gases, sulfide gases, or acid gases are present.
- ▶ A silicone removal filter and activated carbon filter are available as options.
- ▶ Prepare the calibration gas to suit the humidity of the environment in which it will be used.
- ▶ When calibrating, allow the product to warm up for a period of time corresponding to the length of time turned off in clean air before performing zero calibration and span adjustment. For information on appropriate warmup times, refer to the <Semiconductor type sensor warmup times> table below.
- ▶ The reading may change even for combustible gases other than the detection target gas.
- ▶ The reading may change even for ambient fluctuations (e.g., temperature and humidity) in the installation location.
- ▶ The reading may fall as the oxygen concentration decreases.
- ▶ Interference may occur if gases with high thermal conductivity, such as high-concentration CO₂, Ar, or He, are present as the base gas.
- ▶ In detecting gases with low vapor pressure by the suction method, the gas may form a mist when drawn in from the high-temperature side and detected at the low-temperature side, possibly forming condensation inside the sensor or causing clogging due to sintering. Keep vapor pressure in mind during use.
- ▶ Perform maintenance if a warning appears while the life assessment or self-diagnostic function is active.
- ▶ Use the combustible gas sensor adapter when calibrating. Calibration accuracy may be reduced without the combustible gas sensor adapter.
- ▶ Reading accuracy may be reduced if temperature fluctuations exceed ±20 °C with respect to ambient temperature following zero calibration or span calibration. If this occurs, repeat zero calibration or span adjustment.
- ▶ Readings may fluctuate if the product is subjected to strong external impact or vibration. If this occurs, perform zero calibration and span adjustment.
- ▶ The zero point may fluctuate if the sensor comes into contact with high-concentration gas continuously for extended periods. If this occurs, perform zero calibration and span adjustment.
- ▶ Readings may fall in environments where gas is continuously present.
- ▶ The sensor may be hot during replacement. Be careful to avoid burns when replacing the sensor. If the sensor is hot, turn off the power and wait for it to cool.
- ▶ The top of the sensor has a Teflon coating. Sensor characteristics may be affected if the Teflon coating is damaged. Take care to avoid pressing on the Teflon coating with excessive force or damaging it with sharp implements.
- ▶ Calibration is not possible if the reading during calibration does not exceed the zero suppression value. If the reading is below the zero suppression value when the desired calibration gas is introduced for calibration, first calibrate using a gas that gives a reading higher than the zero suppression value, then calibrate using the desired calibration gas.
- ▶ Regardless of the detection target gas, the warranty period for SGF sensors is 3 years.

<Semiconductor type sensor warmup times>

| Time turned off | Warmup time | |
|------------------|-------------------|---------------------|
| | SGF-8581 | Other SGF sensors |
| Under 10 minutes | At least 1 hours | At least 30 minutes |
| Under 1 hour | At least 2 hours | At least 2 hours |
| Under 24 hours | At least 4 hours | At least 4 hours |
| Under 72 hours | At least 24 hours | At least 24 hours |
| Under 10 days | At least 2 days | At least 2 days |
| Under 1 month | At least 7 days | At least 7 days |
| Under 3 months | At least 14 days | At least 14 days |
| 3 months or more | At least 1 month | At least 1 month |

10-3-4 Hot-wire semiconductor type

| Sensor model | Gas name | Gas symbol | F.S. | 1 digit | First Alarm setpoint | Second Alarm setpoint | Calibration gas | Operating temperature range | Operating humidity range | Years of warranty |
|--------------|-----------------|----------------------------------|-----------|---------|----------------------|-----------------------|----------------------------------|-----------------------------|---------------------------------------|-------------------|
| SHF-8601 | Methane | CH ₄ | 5,000 ppm | 25 ppm | 2,000 ppm | 4,000 ppm | CH ₄ | -30 °C - 70 °C | 20 %RH - 95 %RH* (no condensation) | 3 years |
| SHF-8601 | Carbon monoxide | CO | 1,000 ppm | 10 ppm | 250 ppm | 500 ppm | CO | 0 °C - 70 °C | | |
| SHF-8602 | Isobutane | i-C ₄ H ₁₀ | 2,000 ppm | 10 ppm | 500 ppm | 1,000 ppm | i-C ₄ H ₁₀ | -30 °C - 70 °C | | |
| SHF-8603 | Hydrogen | H ₂ | 2,000 ppm | 10 ppm | 500 ppm | 1,000 ppm | H ₂ | -30 °C - 70 °C | | |

*Absolute humidity not exceeding 46 g/m³ (equivalent to 37 °C, 95 %RH)

NOTE

- ▶ The sensor characteristics may deteriorate significantly if silicone gases (organic silicone gases), halogen gases, sulfide gases, or acid gases are present.
- ▶ A silicone removal filter and activated carbon filter are available as options.
- ▶ Prepare the calibration gas to suit the humidity of the environment in which it will be used.
- ▶ When calibrating, allow the product to warm up for a period of time corresponding to the length of time turned off in clean air before performing zero calibration and span adjustment. For information on appropriate warmup times, refer to the <Hot-wire semiconductor type sensor warmup times> table below.
- ▶ The reading may change even for combustible gases other than the detection target gas.
- ▶ The reading may change even for ambient fluctuations (e.g., temperature and humidity) in the installation location.
- ▶ The reading may fall as the oxygen concentration decreases.
- ▶ Interference may occur if gases with high thermal conductivity, such as high-concentration CO₂, Ar, or He, are present as the base gas.
- ▶ In detecting gases with low vapor pressure by the suction method, the gas may form a mist when drawn in from the high-temperature side and detected at the low-temperature side, possibly forming condensation inside the sensor or causing clogging due to sintering. Keep vapor pressure in mind during use.
- ▶ Perform maintenance if a warning appears while the life assessment or self-diagnostic function is active.
- ▶ Use the combustible gas sensor adapter when calibrating. Calibration accuracy may be reduced without the combustible gas sensor adapter.
- ▶ Reading accuracy may be reduced if temperature fluctuations exceed ±20 °C with respect to ambient temperature following zero calibration or span calibration. If this occurs, repeat zero calibration or span adjustment.
- ▶ Readings may fluctuate if the product is subjected to strong external impact or vibration. If this occurs, perform zero calibration and span adjustment.
- ▶ The zero point may fluctuate if the sensor comes into contact with high-concentration gas continuously for extended periods. If this occurs, perform zero calibration and span adjustment.
- ▶ Readings may fall in environments where gas is continuously present.
- ▶ The calibration value may become offset if gas is detected at levels exceeding the F.S. value. Enabling the sensor protection function will help reduce these effects if there is any possibility of exposure to gas at levels exceeding the F.S. value. However, if the sensor protection function is enabled, detection is not possible after the F.S. value has been exceeded until it is reset, as the power to the sensor is cut off. Reset from the sensor protection state in an environment with clean air.
If the sensor protection state has been used for extended periods (one day or longer), warm up for a period of time corresponding to the sensor protection period. (Enabling the sensor protection function also enables the over locking function.)
- ▶ The sensor may be hot during replacement. Be careful to avoid burns when replacing the sensor. If the sensor is hot, turn off the power and wait for it to cool.
- ▶ Depending on the conditions and length of time for which the power was turned off, the reading may change when the power is turned on, even after the warmup time (three minutes) has elapsed. If this occurs, wait until the reading returns to zero.
- ▶ Regardless of the detection target gas, the warranty period for SHF sensors is 3 years.

<Hot-wire semiconductor type sensor warmup times>

| Time turned off | Warmup time | |
|------------------|---------------------|-------------------|
| | SHF-8603 | Other SHF sensors |
| Under 10 minutes | At least 10 minutes | At least 1 hour |
| Under 1 hour | At least 30 minutes | At least 2 hours |
| Under 24 hours | At least 1 hour | At least 4 hours |
| Under 72 hours | At least 4 hours | At least 24 hours |
| Under 10 days | At least 2 days | At least 2 days |
| Under 1 month | At least 7 days | At least 7 days |
| Under 3 months | At least 14 days | At least 14 days |
| 3 months or more | At least 1 month | At least 1 month |

*Note that warmup times differ between the SHF-8603 and other SHF sensors.

10-3-5 Electrochemical type

| Sensor model | Gas name | Gas symbol | F.S. | 1 digit | First Alarm setpoint | Second Alarm setpoint | Calibration gas | Operating temperature range | Operating humidity range | Years of warranty |
|-------------------------|------------------|------------------|---------|---------|----------------------|-----------------------|------------------|------------------------------|-----------------------------------|-------------------|
| ESF-A24R | Hydrogen sulfide | H ₂ S | 100 ppm | 1 ppm | 20 ppm | 40 ppm | H ₂ S | -40 °C - 70 °C ^{*2} | 20 %RH - 90 %RH (no condensation) | 3 years |
| ESF-A24RH ^{*3} | Hydrogen sulfide | H ₂ S | 30 ppm | 0.2 ppm | 10 ppm | 20 ppm | H ₂ S | -40 °C - 70 °C ^{*1} | 40 %RH - 95 %RH (no condensation) | 3 years |

*1: Allow the product to fully adjust to the usage conditions before adjusting if below -25 °C. Can be used for a total of one week between 40 °C and 70 °C.

*2: Allow the product to fully adjust to the usage conditions before adjusting if below -25 °C. Can be used for a total of one week between 55 °C and 70 °C.

NOTE

- ▶ Perform maintenance if a warning appears while the life assessment or self-diagnostic function is active.
- ▶ Use the ESF sensor adapter when calibrating. Calibration accuracy may be reduced without the ESF sensor adapter.
- ▶ Use a flow rate of 0.5 ± 0.1 L/min when calibrating. Calibration accuracy may be reduced if calibration is performed using a different flow rate.
- ▶ When using a diffusion type detector, gas sensitivity will be affected by ambient wind speeds.
- ▶ The number of years of warranty for the ESF sensor depends on the sensor model. Refer to the above table.

11

Appendix

11-1 Detection principle

11-1-1 Non-dispersive infrared absorption type (Infrared type)

<Sensor overview>

This gas detection sensor relies on the fact that many gases absorb infrared radiation. It detects the presence of a detection target gas by irradiating a measurement cell with infrared and detecting variations caused by target gas absorption of infrared. It continuously detects all infrared within a specific waveband without dividing (dispersing) infrared into differing wavelengths.

<Sensor structure and principle>

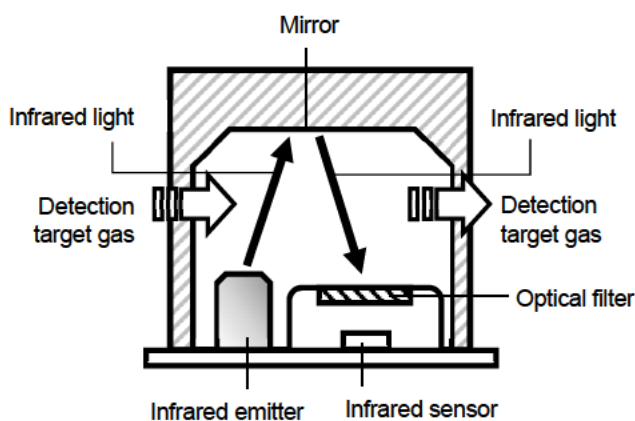
- Structure

A measurement cell and optical filter are positioned between the infrared emitter and the infrared sensor. Infrared light from the infrared emitter passes through the measurement cell and optical filter before being detected by the infrared sensor. The optical filter selectively allows the passage of infrared light in the waveband absorbed by the detection target gas.

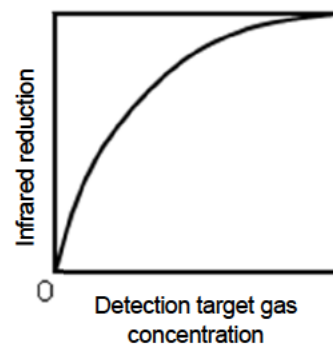
- Principle

When the detection target gas is introduced into the measurement cell, it absorbs infrared light, reducing the amount of infrared light detected at the infrared sensor. Based on this principle, a number of samples of detection target gas of known concentration is introduced to calculate the correlation (calibration curve) between infrared reduction and the concentration of the detection target gas. The calibration curve can be used to determine the gas concentration from the measured infrared reduction when an unknown concentration of detection target gas is introduced.

<Structure diagram>



<Calibration curve (example)>



11-1-2 New ceramic type

<Sensor overview>

This uses an ultrafine particle (new ceramic) oxidation catalyst to detect gas concentrations over a wide range, from low concentrations (ppm) up to the lower explosive limit (LEL). This revolutionary gas detection sensor was developed by Riken Keiki and specifically designed to detect combustible gases.

<Sensor structure and principle>

• Structure

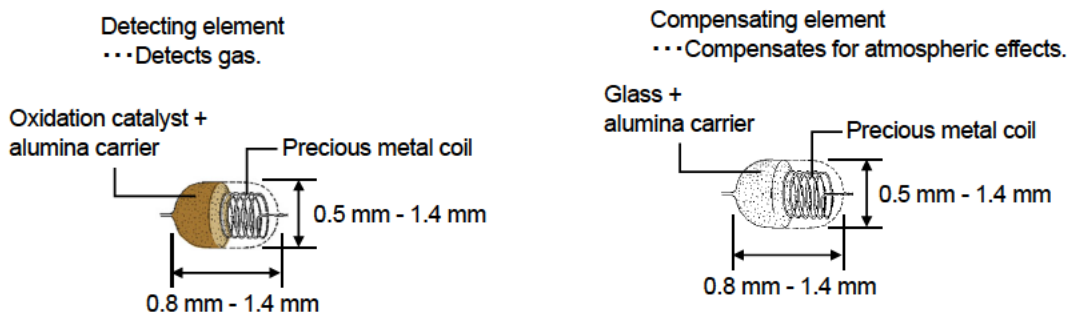
The new ceramic sensors consist of a detecting element and a compensating element. (Some sensors do not have a compensating element.) The detecting element consists of an ultrafine particle oxidation catalyst (new ceramic) that reacts with combustible gases sintered on top of a precious metal coil. This undergoes a combustion reaction in the presence of the detection target gas.

The compensating element consists of a material inert to combustible gases sintered on top of a precious metal coil. This compensates for atmospheric effects.

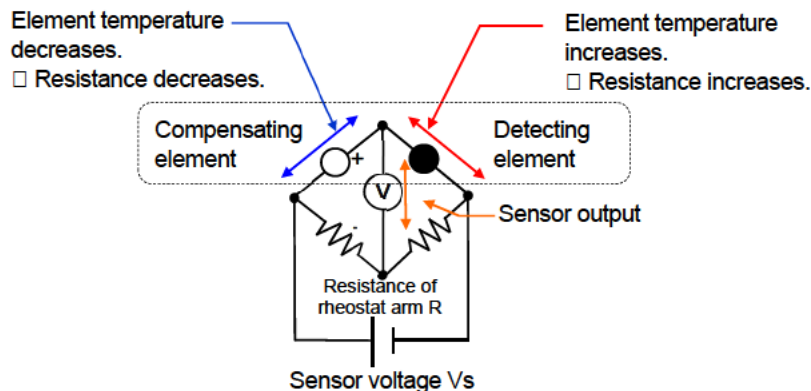
• Principle

When combustible gas burns on the surface of the detecting element heated to between 300 °C and 450 °C by the precious metal coil, this increases the temperature of the element. This temperature variation results in changes in the resistance of the precious metal coil that makes up the element. These variations in resistance are essentially proportional to gas concentrations. The resistance variation can be extracted as a voltage using a bridge circuit to calculate the gas concentration.

<Sensor element diagram>



<Bridge circuit>



11-1-3 Semiconductor type

<Sensor overview>

This method detects gas concentrations from variations in resistance that occur when a metal oxide semiconductor comes into contact with the detection target gas. This general-purpose gas detector sensor is ideal for detecting a wide range of gases, from toxic gases to combustible gases.

<Sensor structure and principle>

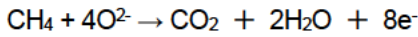
• Structure

The sensor consists of a metal oxide semiconductor (SnO₂) formed around a heater coil and alumina tube. The alumina tube has two gold electrodes at each end to measure semiconductor resistance.

• Principle

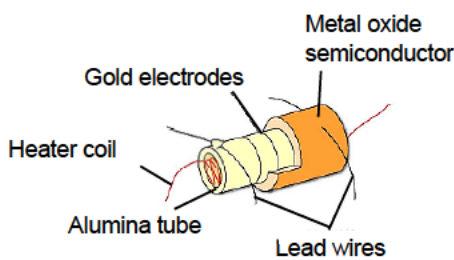
Oxygen from the atmosphere is adsorbed as O⁻ and O²⁻ to the surface of the metal oxide semiconductor heated to between 350 °C and 400 °C by the heater coil. The semiconductor maintains a constant resistance. If a methane or other such gas comes into contact with this surface and becomes chemically adsorbed, the oxygen is oxidized and released by the adsorbed O²⁻ ions.

The following chemical reaction occurs here at the sensor surface:

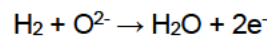
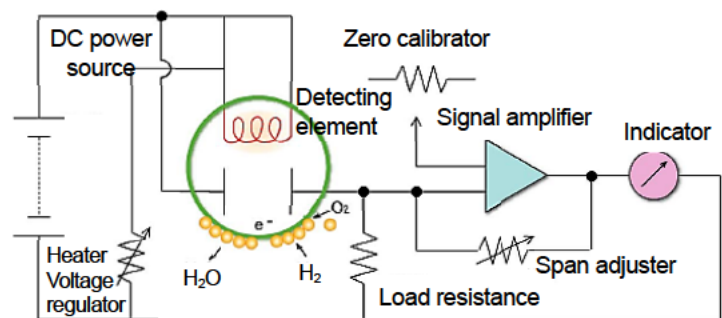


In other words, as methane gas is adsorbed to the sensor surface removing adsorbed oxygen, the increase in free electrons inside the sensor reduces the resistance. This variation in resistance can be measured and used to calculate the gas concentration.

<Sensor element diagram>



<Drive circuit>



11-1-4 Hot-wire semiconductor type

<Sensor overview>

This sensor type detects gas concentrations based on variations in the resistance of a platinum coil integrated with a metal oxide semiconductor whose resistance changes when it comes into contact with a gas. The high-sensitivity low-concentration detection gas sensor is configured simply as a detecting element of metal oxide semiconductor sintered around a platinum coil.

<Sensor structure and principle>

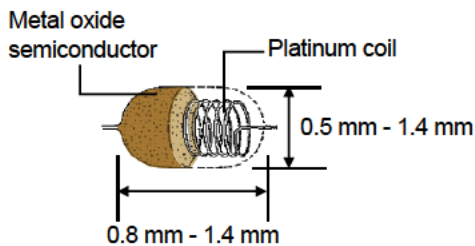
- Structure

The sensor consists simply of a detecting element formed of a metal oxide semiconductor sintered around a platinum coil.
- Principle

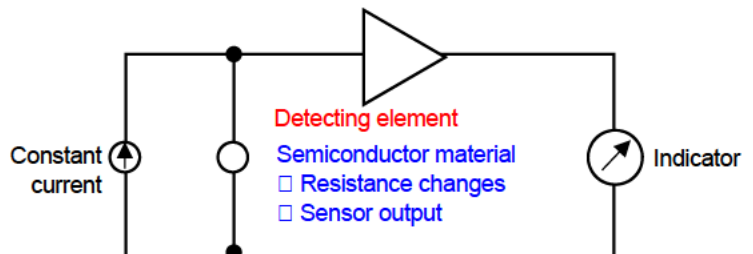
The resistance (R) of the detecting element is the combined resistance of the semiconductor resistance (RS) and the platinum coil resistance (RH).

The detecting element is heated to between 300 °C and 400 °C by the platinum coil and maintains constant resistance. If methane or another such gas comes into contact with the detecting element, oxygen adsorbed to the surface of the metal oxide semiconductor is released, increasing the number of free electrons inside the semiconductor and reducing the resistance of the semiconductor. This reduces the resistance of the entire detecting element. These variations in resistance are measured as a voltage and used to calculate gas concentrations.

<Detecting element diagram>



<Drive circuit>



11-1-5 Electrochemical type

<Sensor overview>

This sensor type detects a gas concentration in the form of a current generated when the detection target gas is electrolyzed on electrodes maintained at constant potential. This is the most effective gas sensor for detecting toxic gas. Gases can be selectively detected by selecting a specific potential.

<Sensor structure and principle>

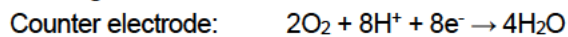
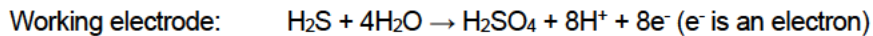
- Structure

The sensor consists of an electrode (working electrode) formed of a precious metal catalyst on a gas permeable membrane, a reference electrode, and a counter electrode, all enclosed in a plastic container filled with electrolyte solution.

- Principle

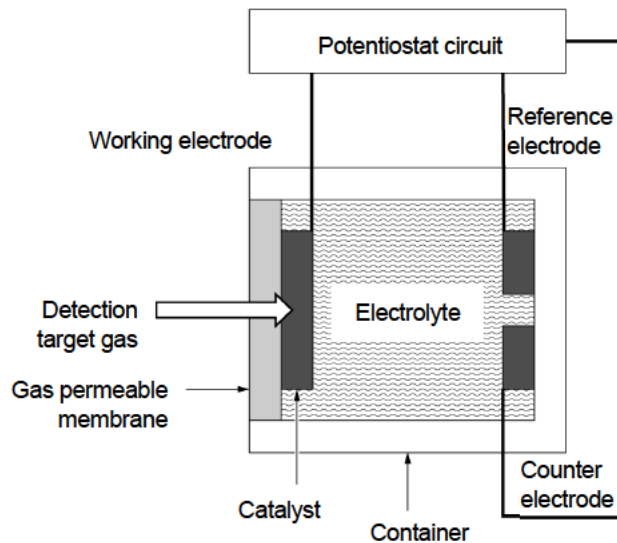
A potentiostat circuit is used to maintain a constant potential between the working electrode and reference electrode. The detection target gas passes through the gas permeable membrane and undergoes electrolysis reaction on reaching the working electrode. A side reaction also occurs at the counter electrode so that the same amount of electric current flows through it as that produced at the working electrode.

Example: In the case of hydrogen sulfide (H₂S), the following chemical reaction occurs:



The current generated here is proportional to the gas concentration. The gas concentration can therefore be determined by measuring the current flowing through the working electrode

<Structure diagram>



11-2 Terminology

| Term | Definition |
|------------------|--|
| Initialization | <p>This function prevents alarms from being issued for a while after the power is turned on.</p> <p>This prevents alarms from being issued, as the output from the detector fluctuates for a while after the power is turned on.</p> |
| Full scale | The maximum value of the detection range |
| Calibration | <p>This refers to the process of checking the product reading against a calibration gas.</p> <p>The process includes adjusting the product reading to match the concentration of the calibration gas.</p> |
| Zero suppression | This function is used to hide (suppress) reading fluctuations below a set lower limit to minimize sensor output fluctuations not caused by gas, such as temperature and humidity fluctuations and noise effects. |
| Alarm delay time | This function temporarily suspends immediate alarm activation to prevent false alarms caused by external noise, even if the reading reaches an alarm setpoint. |
| Inhibit | This function pauses gas detection—for example, when the product is undergoing maintenance. It is also sometimes referred to as point skipping. |
| % | Unit used to express the percentage of a target gas contained in a given volume |
| ppm | Unit used to express the parts per million of a target gas contained in a given volume |
| %LEL | Unit for combustible gases in which the lower explosive limit (LEL) of the target gas is set to 100 % (Example: For methane, 5 % concentration by volume corresponds to 100 %LEL.) |

Product warranty

1. If a fault occurs with the product within three years of the purchase date, with use under normal conditions in compliance with precautions indicated in the operating instructions or on labels affixed to the main unit, repairs will be cost free.
2. Contact our sales department or your nearest sales office for information on repairs, maintenance, or after-sales service.
3. You will be charged for costs incurred as the result of service rendered in remote locations.
4. Fees will be charged for repairs in the following cases, even during the warranty period:
 - (a) Fault or damage is attributable to incorrect use or improper repairs or modifications.
 - (b) Fault or damage following repairs or modifications made at locations other than Riken Keiki or a service agent specified by Riken Keiki.
 - (c) Fault or damage is attributable to moving, transporting, falling, dropping, or improper storage occurring after purchase.
 - (d) Fault or damage is attributable to external factors, including natural phenomena such as fire, earthquake, flood, or lightning; pollution; abnormal voltage; use of power sources outside of rated ranges (voltage, frequency), etc.
 - (e) The fault is attributable to a factor external to this product.
 - (f) When replacing consumables (batteries, fuses, etc.).

Sensor warranty

1. Replacements will be provided at no charge if a fault occurs within three years of the purchase date or the date on which a sensor was replaced for a fee (excluding certain sensors), with use under normal conditions in compliance with precautions indicated in the operating instructions or on labels affixed to the main unit. For information on the length of the warranty for each sensor model, refer to '10- 3 Detection target gases for individual detection principles'.
A precondition of the warranty for sensors requires sensors to be serviced once or more a year from the purchase date or the date on which a sensor was replaced for a fee.
2. Contact our sales department or your nearest sales office for information about repairs, maintenance, or after-sales service.
3. You will be charged for costs incurred as the result of replacements performed in remote locations.
4. Fees will be charged for replacements made in the following cases, even during the warranty period.
 - (a) If the product is used in disregard of the precautions provided in the operating instructions, on labels affixed to the main unit, or elsewhere.
 - (b) Fault or damage following repairs or modifications made at locations other than Riken Keiki or a service agent specified by Riken Keiki.
 - (c) Fault or damage is attributable to moving, transporting, falling, dropping, or improper storage occurring after purchase.
 - (d) Fault or damage is attributable to external factors, including natural phenomena such as fire, earthquake, flood, or lightning; pollution; abnormal voltage; use of power sources outside of rated ranges (voltage, frequency), etc.
 - (e) The fault is attributable to a factor external to this product.
 - (f) Changes in the gas sensitivity of the sensor, fault, or damage are due to the effects of coexisting gases (acidic gases, alkaline gases, alcohol, silicone, etc.) in the installation environment.

Revision History

| Issue | Revision details | Issue date |
|-------|---|------------|
| 0 | First issue | 1/25/2021 |
| 1 | Complete revision | 3/15/2021 |
| 2 | Safety information, Declaration of Conformity | 11/12/2021 |



EU-Declaration of Conformity

Document No.: 320CE21118



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: Gas Detector with Signal Converter
Model: SD-3RI, SD-3DRI, GD-3RI

| Council Directives | | Applicable Standards |
|--------------------|----------------|--|
| 2014/30/EU | EMC Directive | EN 50270:2015 |
| 2014/35/EU | LVD Directive | EN 61010-1:2010 |
| 2014/34/EU | ATEX Directive | EN IEC 60079-0:2018 EN 60079-1:2014 EN 60079-11:2012 |
| 2011/65/EU | RoHS Directive | EN IEC 63000:2018 |

EU-Type examination Certificate No.

Presafe 20 ATEX 69725 X


Notified Body for ATEX

DNV Product Assurance AS (NB 2460)
Veritasveien 3
1363 Høvik
Norway

Auditing Organization for ATEX

DNV Product Assurance AS (NB 2460)
Veritasveien 3
1363 Høvik
Norway

The marking of the product shall include the following:

 II 2 G Ex db IIC T6/T5 Gb

Alternative Marking: - T6:-50°C≤Ta≤+60°C
- T5:-50°C≤Ta≤+70°C

Place: Tokyo, Japan

Date: Sep. 22, 2021

Takakura Toshiyuki
General manager
Quality Control Center



EU-Declaration of Conformity

Document No.: 320CE21119



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: Gas Detector with Signal Converter
Model: SD-3GH, SD-3DGH, GD-3GH

| Council Directives | | Applicable Standards |
|--------------------|----------------|--|
| 2014/30/EU | EMC Directive | EN 50270:2015 |
| 2014/35/EU | LVD Directive | EN 61010-1:2010 |
| 2014/34/EU | ATEX Directive | EN IEC 60079-0:2018 EN 60079-1:2014 EN 60079-11:2012 |
| 2011/65/EU | RoHS Directive | EN IEC 63000:2018 |

EU-Type examination Certificate No.

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Auditing Organization for ATEX

DNV Product Assurance AS (NB 2460)
Veritasveien 3
1363 Høvik
Norway

The marking of the product shall include the following:

 II 2 G Ex db IIC T5/T4 Gb

Alternative Marking: - T5: $-50^{\circ}\text{C} \leq \text{Ta} \leq +44^{\circ}\text{C}$
- T4: $-50^{\circ}\text{C} \leq \text{Ta} \leq +70^{\circ}\text{C}$

Place: Tokyo, Japan

Date: Sep. 22, 2021

Takakura Toshiyuki
General manager
Quality Control Center



EU-Declaration of Conformity

Document No.: 320CE21120



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: Gas Detector with Signal Converter
Model: SD-3GHS, SD-3DGHS, GD-3GHS

| Council Directives | | Applicable Standards |
|--------------------|----------------|--|
| 2014/30/EU | EMC Directive | EN 50270:2015 |
| 2014/35/EU | LVD Directive | EN 61010-1:2010 |
| 2014/34/EU | ATEX Directive | EN IEC 60079-0:2018 EN 60079-1:2014 EN 60079-11:2012 |
| 2011/65/EU | RoHS Directive | EN IEC 63000:2018 |

EU-Type examination Certificate No.

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DNV Product Assurance AS (NB 2460)
Veritasveien 3
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Norway

The marking of the product shall include the following:

 II 2 G Ex db IIC T6/T4 Gb

Alternative Marking: - T6: $-50^{\circ}\text{C} \leq \text{Ta} \leq +47^{\circ}\text{C}$
- T4: $-50^{\circ}\text{C} \leq \text{Ta} \leq +70^{\circ}\text{C}$

Place: Tokyo, Japan

Date: Sep. 22, 2021

Takakura Toshiyuki
General manager
Quality Control Center



EU-Declaration of Conformity

Document No.: 320CE21121



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: Gas Detector with Signal Converter
Model: SD-3NC, SD-3DNC, GD-3NC

| Council Directives | | Applicable Standards |
|--------------------|----------------|--|
| 2014/30/EU | EMC Directive | EN 50270:2015 |
| 2014/35/EU | LVD Directive | EN 61010-1:2010 |
| 2014/34/EU | ATEX Directive | EN IEC 60079-0:2018 EN 60079-1:2014 EN 60079-11:2012 |
| 2011/65/EU | RoHS Directive | EN IEC 63000:2018 |

EU-Type examination Certificate No.

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DNV Product Assurance AS (NB 2460)
Veritasveien 3
1363 Høvik
Norway

The marking of the product shall include the following:



II 2 G Ex db IIC T5/T4 Gb

Alternative Marking:

- T5:-50°C≤Ta≤+44°C
- T4:-50°C≤Ta≤+70°C

Place: Tokyo, Japan

Date: Sep. 22, 2021

Takakura Toshiyuki
General manager
Quality Control Center



EU-Declaration of Conformity

Document No.: 320CE21122



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: Gas Detector with Signal Converter
Model: SD-3SP, SD-3DSP, GD-3SP

| Council Directives | | Applicable Standards |
|--------------------|----------------|--|
| 2014/30/EU | EMC Directive | EN 50270:2015 |
| 2014/35/EU | LVD Directive | EN 61010-1:2010 |
| 2014/34/EU | ATEX Directive | EN IEC 60079-0:2018 EN 60079-1:2014 EN 60079-11:2012 |
| 2011/65/EU | RoHS Directive | EN IEC 63000:2018 |

EU-Type examination Certificate No.

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DNV Product Assurance AS (NB 2460)
Veritasveien 3
1363 Høvik
Norway

The marking of the product shall include the following:

 II 2 G Ex db IIC T5/T4 Gb

Alternative Marking: - T5: $-50^{\circ}\text{C} \leq \text{Ta} \leq +55^{\circ}\text{C}$
- T4: $-50^{\circ}\text{C} \leq \text{Ta} \leq +70^{\circ}\text{C}$

Place: Tokyo, Japan

Date: Sep. 22, 2021

Takakura Toshiyuki
General manager
Quality Control Center



EU-Declaration of Conformity

Document No.: 320CE21123



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: Gas Detector with Signal Converter
Model: SD-3EC, SD-3DEC, GD-3EC

| Council Directives | | Applicable Standards |
|--------------------|----------------|--|
| 2014/30/EU | EMC Directive | EN 50270:2015 |
| 2014/35/EU | LVD Directive | EN 61010-1:2010 |
| 2014/34/EU | ATEX Directive | EN IEC 60079-0:2018 EN 60079-1:2014 EN 60079-11:2012 |
| 2011/65/EU | RoHS Directive | EN IEC 63000:2018 |

EU-Type examination Certificate No.

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Norway

The marking of the product shall include the following:

 II 2 G Ex db IIC T4 Gb

Place: Tokyo, Japan

Date: Sep. 22, 2021

Takakura Toshiyuki
General manager
Quality Control Center



EU-Declaration of Conformity

Document No.: 320CE21124



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: Gas Detector with Signal Converter
Model: SD-3ECS, SD-3DECS, GD-3ECS

| Council Directives | | Applicable Standards |
|--------------------|----------------|--|
| 2014/30/EU | EMC Directive | EN 50270:2015 |
| 2014/35/EU | LVD Directive | EN 61010-1:2010 |
| 2014/34/EU | ATEX Directive | EN IEC 60079-0:2018 EN 60079-1:2014 EN 60079-11:2012 |
| 2011/65/EU | RoHS Directive | EN IEC 63000:2018 |

EU-Type examination Certificate No.

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Norway

The marking of the product shall include the following:

 II 2 G Ex db IIC T4 Gb

Place: Tokyo, Japan

Date: Sep. 22, 2021

Takakura Toshiyuki
General manager
Quality Control Center



EU-Declaration of Conformity

Document No.: 320CE21125



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: Gas Detector with Signal Converter
Model: SD-3ECB, SD-3DECB, GD-3ECB

| Council Directives | | Applicable Standards |
|--------------------|----------------|--|
| 2014/30/EU | EMC Directive | EN 50270:2015 |
| 2014/35/EU | LVD Directive | EN 61010-1:2010 |
| 2014/34/EU | ATEX Directive | EN IEC 60079-0:2018 EN 60079-1:2014 EN 60079-11:2012 |
| 2011/65/EU | RoHS Directive | EN IEC 63000:2018 |

EU-Type examination Certificate No.

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Norway

The marking of the product shall include the following:

 II 2 G Ex db ia IIC T4 Gb

Place: Tokyo, Japan

Date: Sep. 22, 2021

Takakura Toshiyuki
General manager
Quality Control Center



EU-Declaration of Conformity

Document No.: 320CE21126



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: Gas Detector with Signal Converter
Model: SD-3SC

| Council Directives | | Applicable Standards |
|--------------------|----------------|--|
| 2014/30/EU | EMC Directive | EN 50270:2015 |
| 2014/35/EU | LVD Directive | EN 61010-1:2010 |
| 2014/34/EU | ATEX Directive | EN IEC 60079-0:2018 EN 60079-1:2014 EN 60079-11:2012 |
| 2011/65/EU | RoHS Directive | EN IEC 63000:2018 |

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Norway

The marking of the product shall include the following:

 II 2 G Ex db IIC T6/T5/T4 Gb

Alternative Marking:

- T6/T5/T4, $-50^{\circ}\text{C} \leq T_a \leq +47^{\circ}\text{C}/+55^{\circ}\text{C}/+70^{\circ}\text{C}$: combined with GD-3GHS, GD-3SP, GD-3NP, GD-3EC, GD-3ECS
- T5/T4, $-50^{\circ}\text{C} \leq T_a \leq +44^{\circ}\text{C}/+70^{\circ}\text{C}$: combined with GD-3GH GD-3NC
- T6/T5, $-50^{\circ}\text{C} \leq T_a \leq +60^{\circ}\text{C}/+70^{\circ}\text{C}$: combined with GD-3RI
- T4, $-40^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$: combined with GD-3ECB

Place: Tokyo, Japan

Date: Sep. 22, 2021

Takakura Toshiyuki
General manager
Quality Control Center