

Gas Detector with Signal Converter

SD-3 Series

Export models

Operating Manual

Technical Manual

(PT2-287)

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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.

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-3DNPM
	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-3NPM	
	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
Thermal conductivity type	NPM
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 ④ ⑤ ⑥ ⑦ ⑧)

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

SD-3SC (③ ④ ⑤ ⑥ ⑦ ⑧)

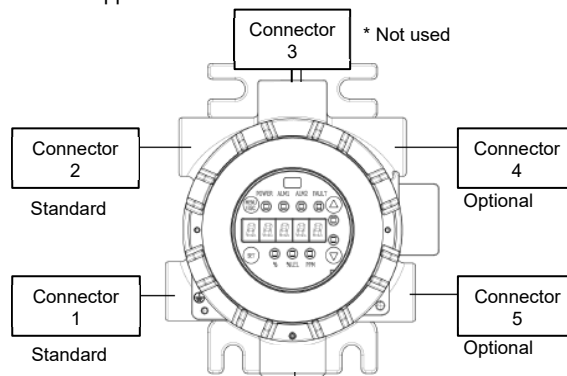
GD-3 ②

①	Diffusion type/suction type selection	
	Blank	Diffusion type
	D	Suction type (introduced via an external unit)
②	Sensor type selection	
	RI	Non-dispersive infrared absorption type (infrared type)
	NC	New ceramic type
	GH	Semiconductor type
	GHS	Semiconductor type (selectable for CS ₂ only)
	SP	Hot-wire semiconductor type
	NPM	Thermal conductivity 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 S)
③	Cable connectors	
	0	Connector 1 + Connector 2
	1	Connector 1 + Connector 2 + Connector 4 + Connector 5
④	Explosion-proof	
	1	ATEX/IECEX
	2	FM (US) [Zone] ^{*1}
	3	Japan Ex
	4	cFM (CANADA) [Zone] ^{*1}
	5	-
	6	Taiwanese explosion-proof (TS)
	7	Chinese explosion-proof (NEPSI)
⑤	Functional safety IEC 61508	
	0	Blank
	1	SIL ^{*1}

⑥	Performance certification	
	0	Blank
	1	EN performance ^{*1}
	2	US/CANADA performance ^{*1}
	3	IEC performance ^{*1}
⑦	Range setting ^{*2}	
	0	Single range
	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 with HART
	1	4 - 20 mA with HART + contact (3c)
	2	4 - 20 mA + RS-485

^{*1}: Compliance status varies depending on sensor.

^{*2}: HART communication is not available when double range is selected.
SIL and performance certification are also not supported.



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 sampling method and detection principle.

Check the specifications before use to detect gas correctly in accordance with the intended purpose.

<List of detection target gases by model>

Main unit model	Sampling 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-3DNPM		Thermal conductivity 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	Sampling 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-3NPM		Thermal conductivity 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	Non-dispersive infrared absorption type (infrared type)
NCF	New ceramic type
SGF	Semiconductor type
SHF	Hot-wire semiconductor type
TCF	Thermal conductivity 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.
- The product requires a 24 V DC (18 to 30 V DC) power supply.
- The gas concentration, status, and command selection menu are displayed using seven-segment LEDs.
- Depending on the model, the detected gas concentration is converted to a 4 to 20 mA analog output (NAMUR NE43 compliant) or a digital signal output (HART output signal or RS-485).
- 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 Use as a standalone unit requires setting additional alarm signals.

1-3 Usage zones and conditions

The product is approved for use in areas where gases belonging to 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.

CAUTION

- There is a risk of combustible or explosive gases being ignited. This product has not been tested in oxygen-rich atmospheres (> 21 % O₂).
 - This product, including the main unit and components, may be used in locations with explosion hazards under the conditions specified by the certifications obtained in accordance with explosion-proof regulations in Japan, Europe, or internationally.
-

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.

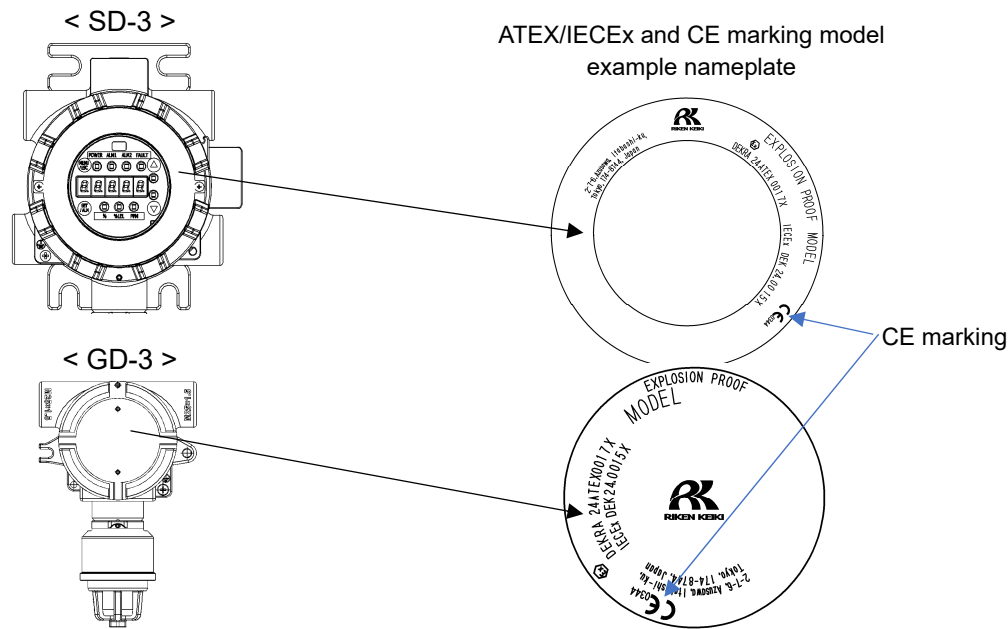
Additionally, usage recommendations are indicated as follows:

NOTE	This indicates items that will be helpful to know when using the product.
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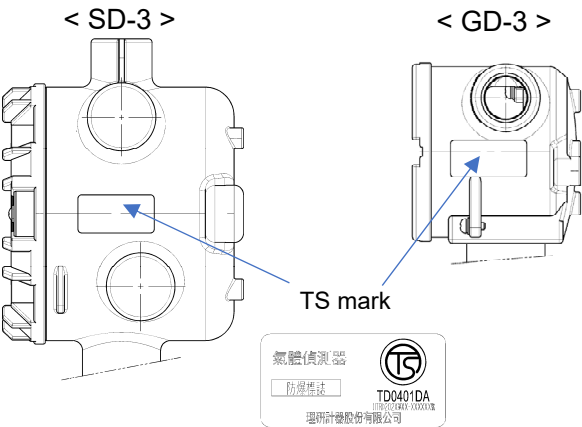
1-5 Checking standards and explosion-proof specifications

The product specifications will vary depending on the specific standards and explosion-proof certification. Check the actual product specifications before use.

Check the nameplates affixed as shown in the following figures for product specifications.



Taiwanese explosion-proof (TS) model nameplate position



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 performing zero calibration for the surrounding atmosphere, confirm that the surrounding atmosphere contains clean air.
The presence of interference gases will prevent proper zero calibration. The presence of interference 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 Precautions



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 attempt to 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 product is an explosion-proof construction gas detector.
- Sensors are divided into three different types, depending on the corresponding detection principles. The two sampling methods available are 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 measured gas readings as a 4 - 20 mA signal or HART signal.
- The following three product output options are available:
 - No alarm relay, no digital communication
 - Three alarm relays (contact output) (alarm relays operate in conjunction with gas alarms and faults)/no digital communication
 - No alarm relay, digital communication (RS485 output)
- Adding an EC barrier will provide the electrochemical sensor with an intrinsically safe explosion-proof construction.

<Detection principles and models>

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

Detection principle (Sampling 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 (Sampling 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
	Thermal conductivity type	SD-3DNPM
Electrochemical sensor	Electrochemical type	SD-3DEC
		SD-3DECS
		SD-3DECB

- When the SD-3SC is combined with the remote sensor head (GD-3), it forms the following models:

Detection principle (Sampling 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	
	Hot-wire semiconductor type	GD-3SP	
	Thermal conductivity type	GD-3NPM	
Electrochemical sensor	Electrochemical type	GD-3EC	
		GD-3ECS	
		GD-3ECB	



WARNING

- The SD-3EC, SD-3DEC, and GD-3EC models are offered in configurations that feature/do not feature explosion-proof flame arresters fitted to the sensor and feature/do not feature an EC barrier. Explosion-proof performance cannot be maintained if different flame arrestor models are used. Do not replace with a different flame arrester.
- The SD-3GH, SD-3DGH, and GD-3GH models are offered in configurations that feature/do not feature explosion-proof flame arresters fitted to the sensor. Explosion-proof performance cannot be maintained if different flame arrestor models are 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	2 G	Ex db IIC T6 Ex db IIC T5	Gb	-50 °C ≤ Ta ≤ +60 °C -50 °C ≤ Ta ≤ +70 °C
SD-3DRI						
GD-3RI						
SD-3GH	d	II	2 G	Ex db IIC T5 Ex db IIC T4	Gb	-50 °C ≤ Ta ≤ +44 °C -50 °C ≤ Ta ≤ +70 °C
SD-3DGH						
GD-3GH						
SD-3GHS	d	II	2 G	Ex db IIC T6 Ex db IIC T4	Gb	-50 °C ≤ Ta ≤ +47 °C -50 °C ≤ Ta ≤ +70 °C
SD-3DGHS						
GD-3GHS						
SD-3NC	d	II	2 G	Ex db IIC T5 Ex db IIC T4	Gb	-50 °C ≤ Ta ≤ +44 °C -50 °C ≤ Ta ≤ +70 °C
SD-3DNC						
GD-3NC						
SD-3SP	d	II	2 G	Ex db IIC T5 Ex db IIC T4	Gb	-50 °C ≤ Ta ≤ +55 °C -50 °C ≤ Ta ≤ +70 °C
SD-3DSP						
GD-3SP						
SD-3DNPM	d	II	2 G	Ex db IIC T4	Gb	-50 °C ≤ Ta ≤ +70 °C
GD-3NPM						
SD-3EC	d	II	2 G	Ex db IIC T4	Gb	-50 °C ≤ Ta ≤ +70 °C
SD-3DEC						
GD-3EC						
SD-3ECS	d	II	2 G	Ex db IIC T4	Gb	-50 °C ≤ Ta ≤ +70 °C
SD-3DECS						
GD-3ECS						
SD-3ECB	d+i	II	2 G	Ex db ia IIC T4	Gb	-40 °C ≤ Ta ≤ +70 °C
SD-3DECB						
GD-3ECB						
SD-3SC*2	d	II	2 G	Ex db IIC T6 Ex db IIC T5 Ex db IIC T4	Gb	-50 °C ≤ Ta ≤ +47 °C -50 °C ≤ Ta ≤ +55 °C -50 °C ≤ Ta ≤ +70 °C
SD-3SC*3	d	II	2 G	Ex db IIC T5 Ex db IIC T4	Gb	-50 °C ≤ Ta ≤ +44 °C -50 °C ≤ Ta ≤ +70 °C
SD-3SC*4	d	II	2 G	Ex db IIC T6 Ex db IIC T5	Gb	-50 °C ≤ Ta ≤ +60 °C -50 °C ≤ Ta ≤ +70 °C
SD-3SC*5	d	II	2 G	Ex db IIC T4	Gb	-40 °C ≤ Ta ≤ +70 °C

*1 Ambient temperature refers to the temperature range in which the explosion-proof performance is maintained. It does not refer to the temperature range in which product performance is guaranteed. For information on the operating temperature range, refer to '10-3. Detection target gases for individual detection principles'.

*2 When combined with GD-3GHS, GD-3SP, GD-3NPM, GD-3EC, and GD-3ECS

*3 When combined with GD-3GH and GD-3NC

*4 When combined with GD-3RI

*5 When combined with GD-3ECB

<With lightning arrester>

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

*1 Ambient temperature refers to the temperature range in which the explosion-proof performance is maintained. It does not refer to the temperature range in which product performance is guaranteed. For information on the operating temperature range, refer to '10-3. Detection target gases for individual detection principles'.

*2 When combined with GD-3GHS, GD-3SP, GD-3NPM, GD-3EC, and GD-3ECS

*3 When combined with GD-3GH and GD-3NC

*4 When combined with GD-3RI

*5 When combined with GD-3ECB

<Electrical data>

Model	Supply voltage	Power consumption	Signal output	Option (select one)		
				No alarm relay/ No digital communication	With 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 with HART	—	30 V DC, 1 A 250 V AC, 2 A	RS485 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 with HART	—	30 V DC, 1 A 250 V AC, 2 A	RS485 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 with HART	—	30 V DC, 1 A 250 V AC, 2 A	RS485 output
SD-3DGHS		2 W max.	—	—	—	—
GD-3GHS		—	—	—	—	—
SD-3NC	24 V DC (18 V - 30 V DC max.)	4.5 W max.	0 - 22 mA with HART	—	30 V DC, 1 A 250 V AC, 2 A	RS485 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 with HART	—	30 V DC, 1 A 250 V AC, 2 A	RS485 output
SD-3DSP		1 W max.	—	—	—	—
GD-3SP		—	—	—	—	—
SD-3DNPM	24 V DC (18 V - 30 V DC max.)	3 W max.	0 - 22 mA with HART	—	30 V DC, 1 A 250 V AC, 2 A	RS485 output
GD-3NPM		1 W max.	—	—	—	—
SD-3EC	24 V DC (18 V - 30 V DC max.)	2.8 W max.	0 - 22 mA with HART	—	30 V DC, 1 A 250 V AC, 2 A	RS485 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 with HART	—	30 V DC, 1 A 250 V AC, 2 A	RS485 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 with HART	—	30 V DC, 1 A 250 V AC, 2 A	RS485 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 with HART	—	30 V DC, 1 A 250 V AC, 2 A	RS485 output

<Certificate numbers>

- IECEx DEK 24.0015 X
- DEKRA 24 ATEX 0017 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. (Refer to Section 26.4.2 of EN 60079-0.)
- 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.
- If attaching a lightning arrester to the SD-3, apply high-strength thread-locking compound to the mounting screw.
- Refer to <Explosion-proof performance data> in ‘2-4 Safety information’ for the explosion-proof operating temperature range.

<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

<Operating manual no.>

- PT2-287

<Product code/Date>

INST. No.: Serial number

DATE: Date (year/month)

**RIKEN KEIKI Co., Ltd.**

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

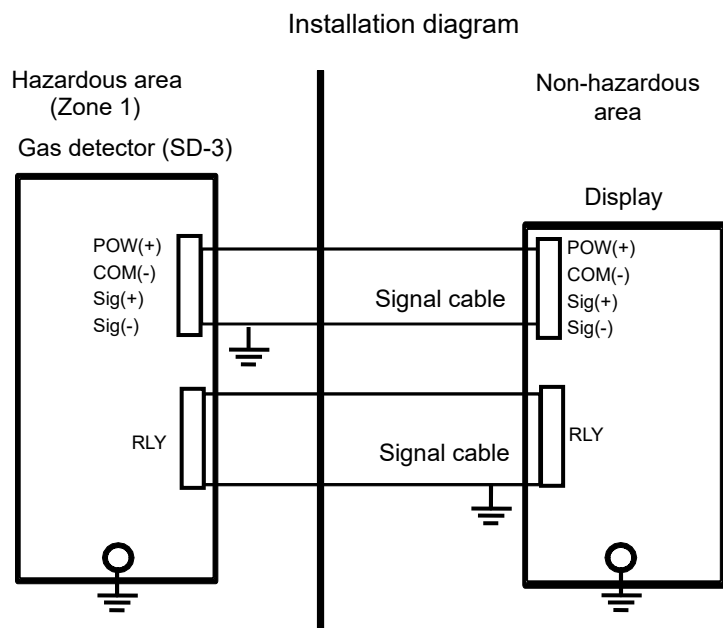
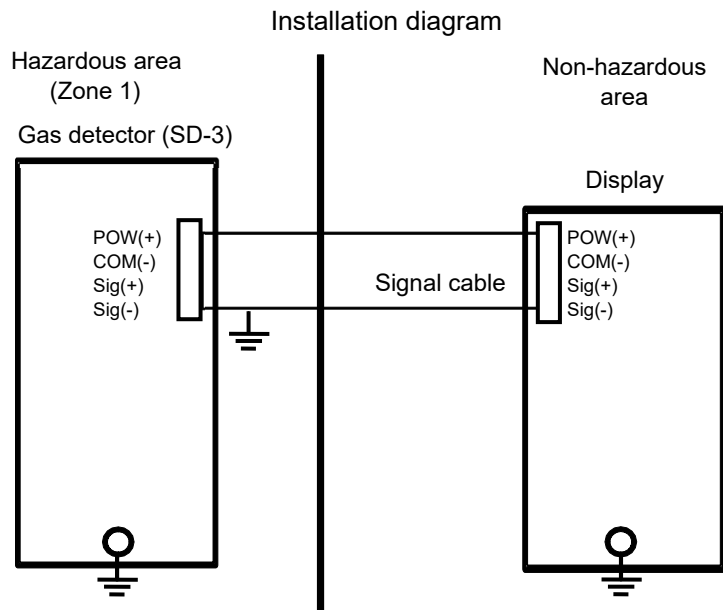
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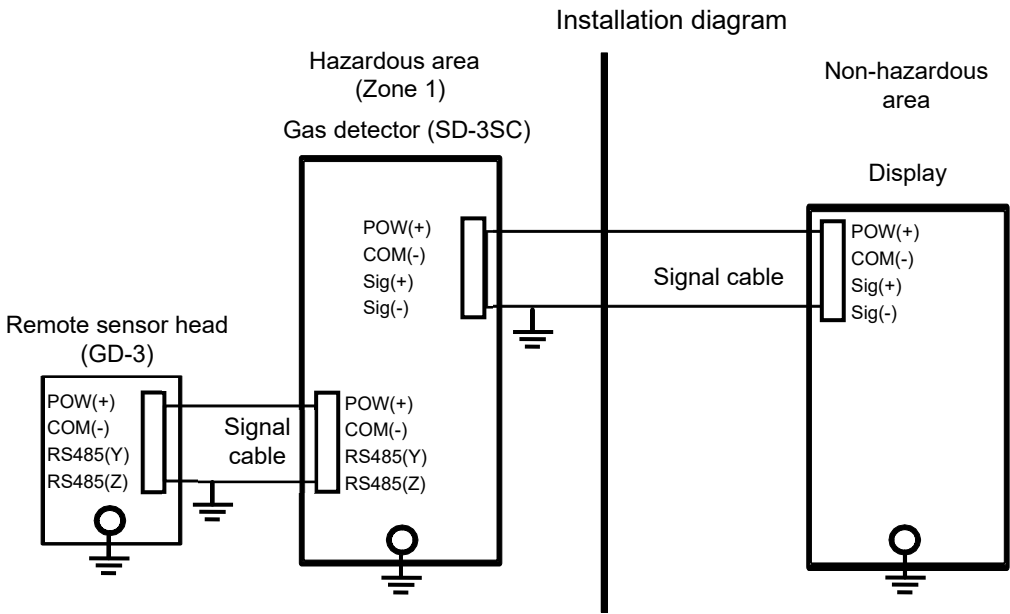
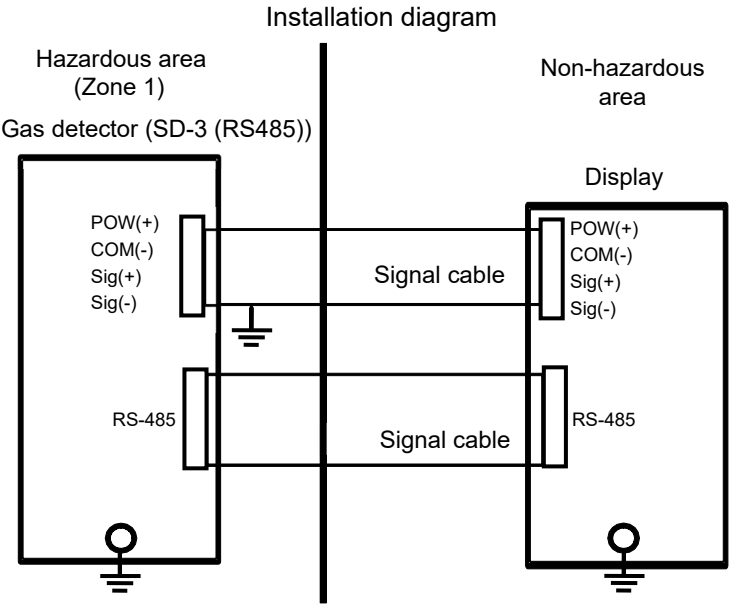
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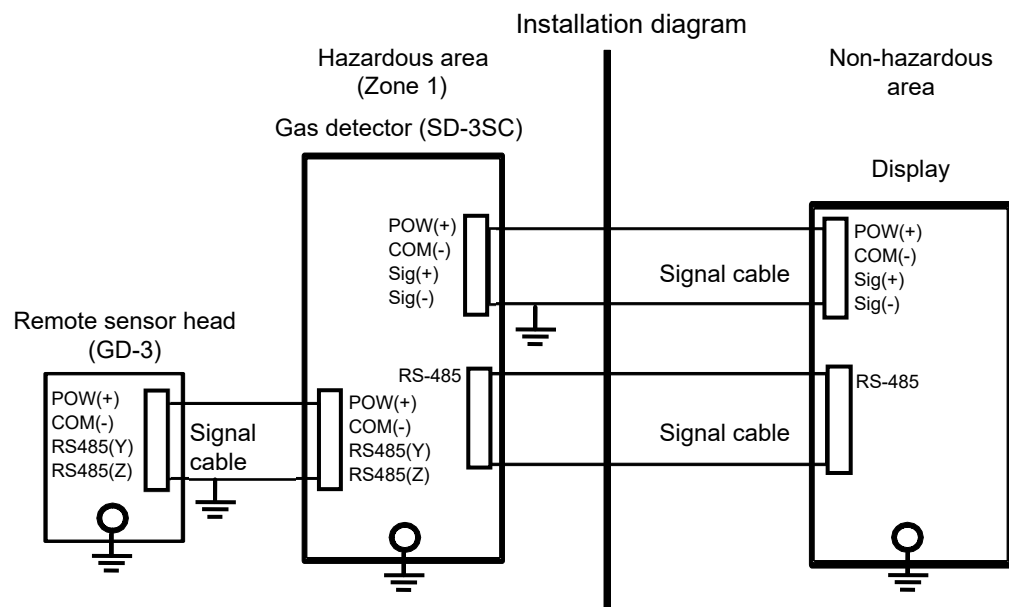
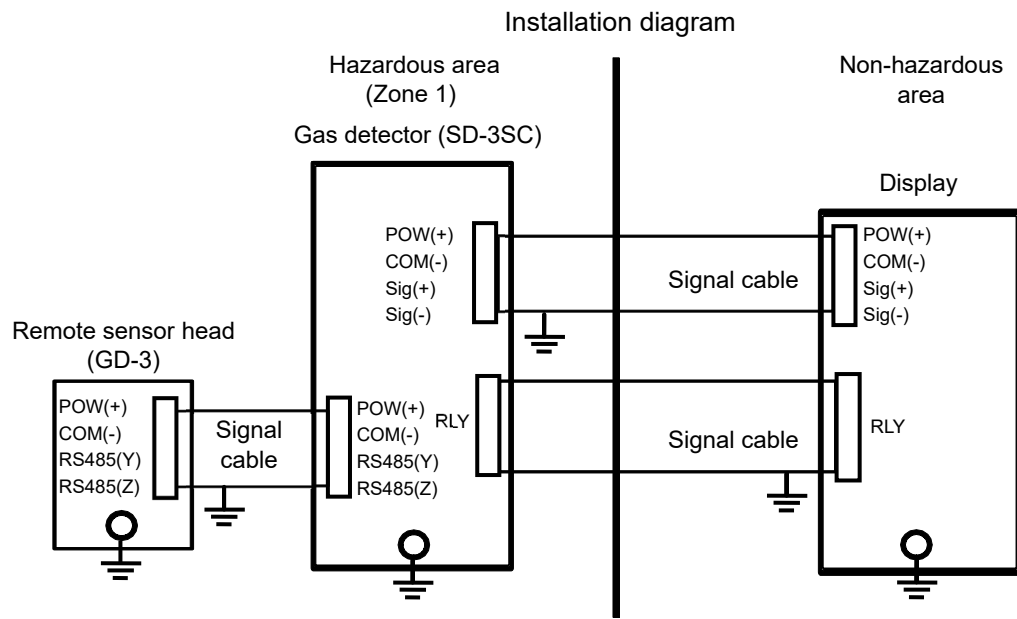
Email: intdept@rikenkeiki.co.jp

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

<System configuration diagrams>







 CAUTION

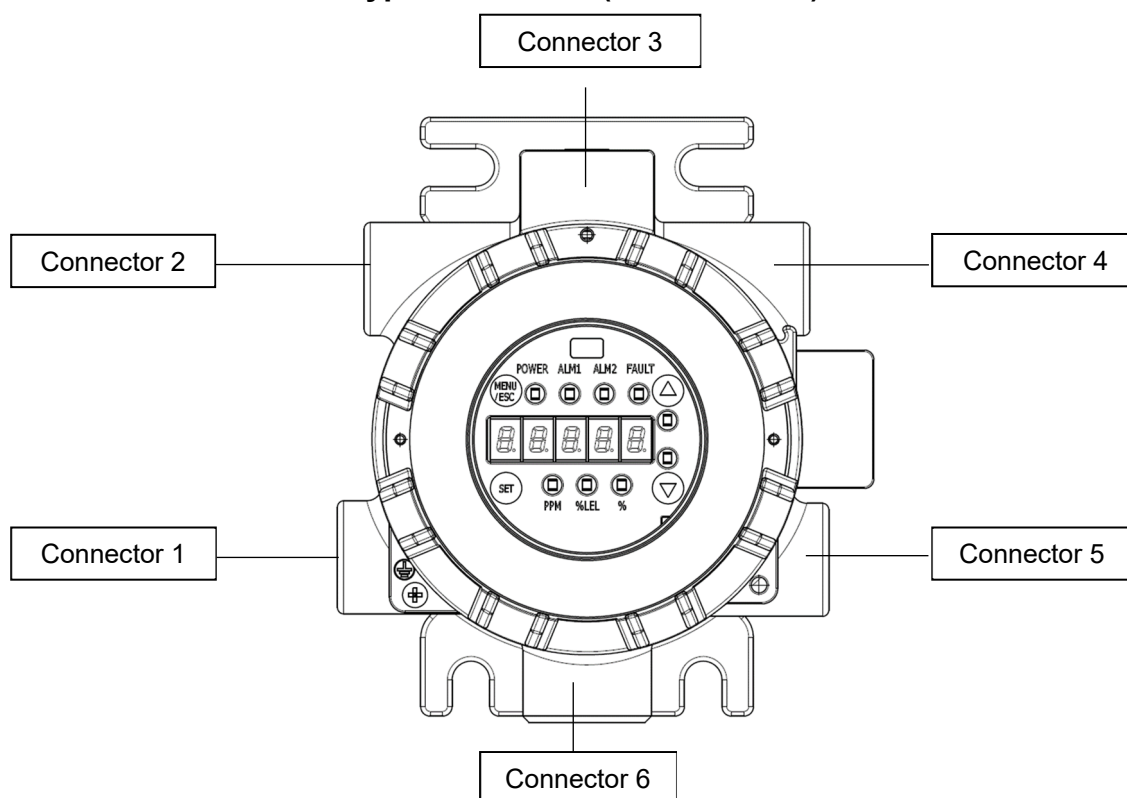
- Install the product in accordance with the required installation conditions.
 - Do not disassemble, modify, or alter the product.
 - Contact RIKEN KEIKI to request readjustment or parts replacement, including calibration.
 - Use cable lugs for grounding wire and bonding conductor connections. Make 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.
 - Provide Class D equivalent grounding (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.
 - Do not attempt to replace the batteries.
-

 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 the 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 remote sensor head (GD-3) connector cable)
- Connector 2 or 4 can be used to connect the optional lightning arrester with the optional adapter (to convert M25 × 1.5 screw thread to 1/2 NPT screw thread).
- Connector 5 is used to enable HART protocol communication with the optional HART modem connector. Do not use to insert external cables or to connect lightning arresters. Blank off with a blanking plug if you are not using 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 ⇔ 1/2 NPT)	○	○	×	○	×	○
Adapter (M25 ⇔ 3/4 NPT)	○	○	×	○	×	○
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>

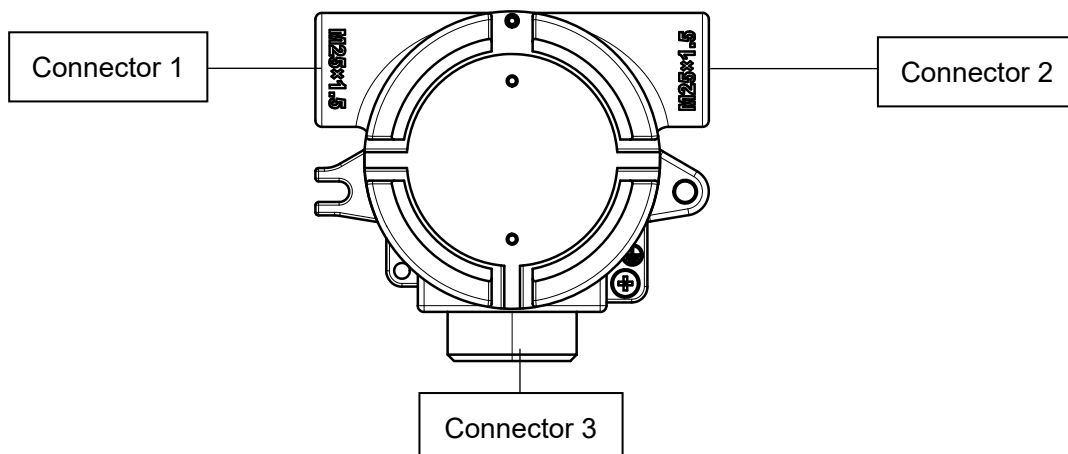
Part	Manufacturer	Eaton Electric Limited
	Name/No.	TP48 or TP32 series surge protector
	Explosion-proof	II 2G Ex db IIC T6 Gb
Certification No.	No. and issue	IECEX BAS 15.0056X Issue 1 Baseefa 04 ATEX 0053X
	Applicable standards	EN 60079-0:2012+A11:2013 EN 60079-1:2014 IEC 60079-0:2011 Edition 6.0 IEC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

* The lower ambient temperature limit for 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 ⇔ 1/2 NPT)	○	○	○
Adapter (M25 ⇔ 3/4 NPT)	○	○	○
Adapter (M25 ⇔ M20)	○	○	○

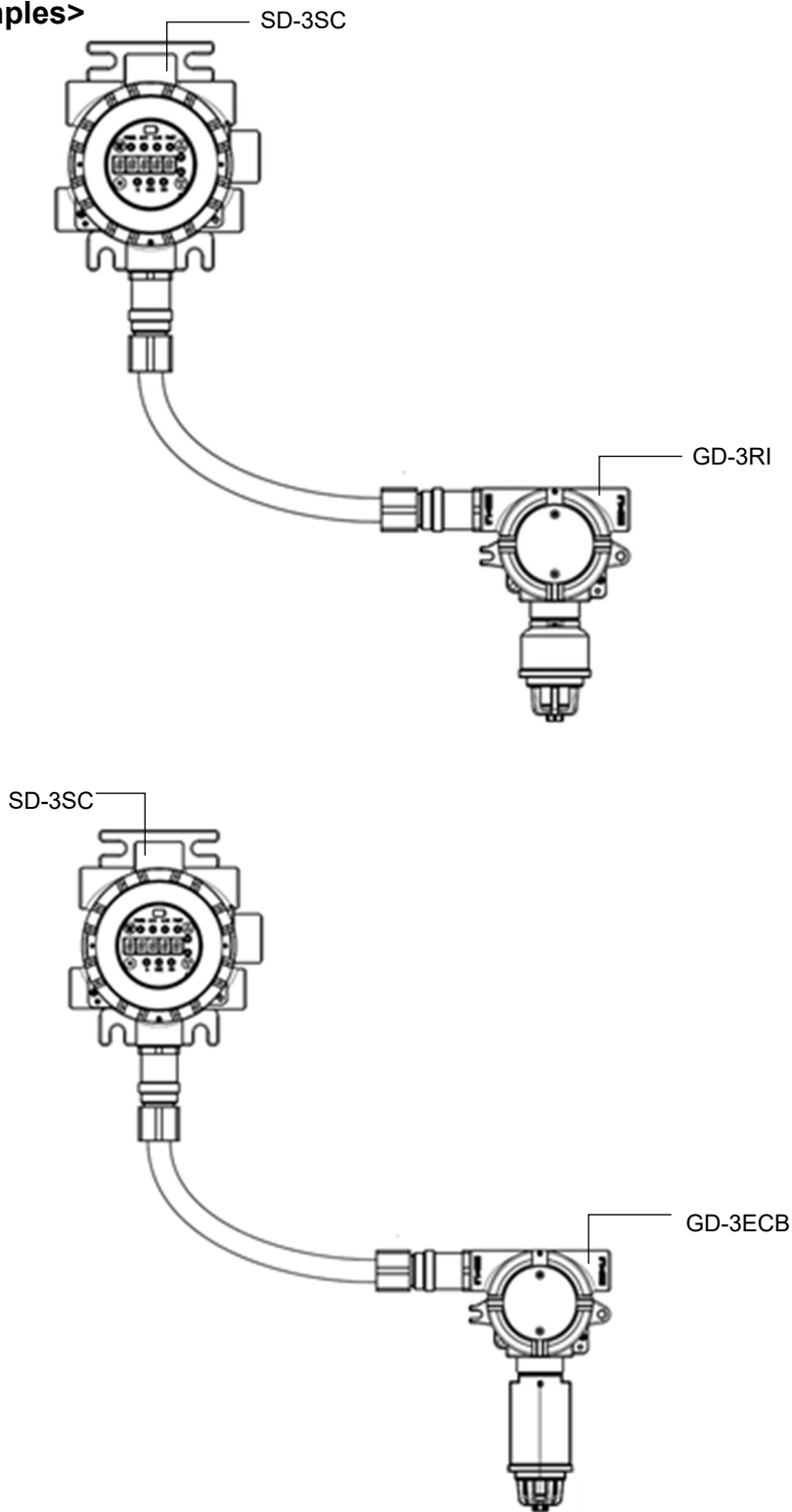
○: Can be connected

×: Cannot be connected

NOTE

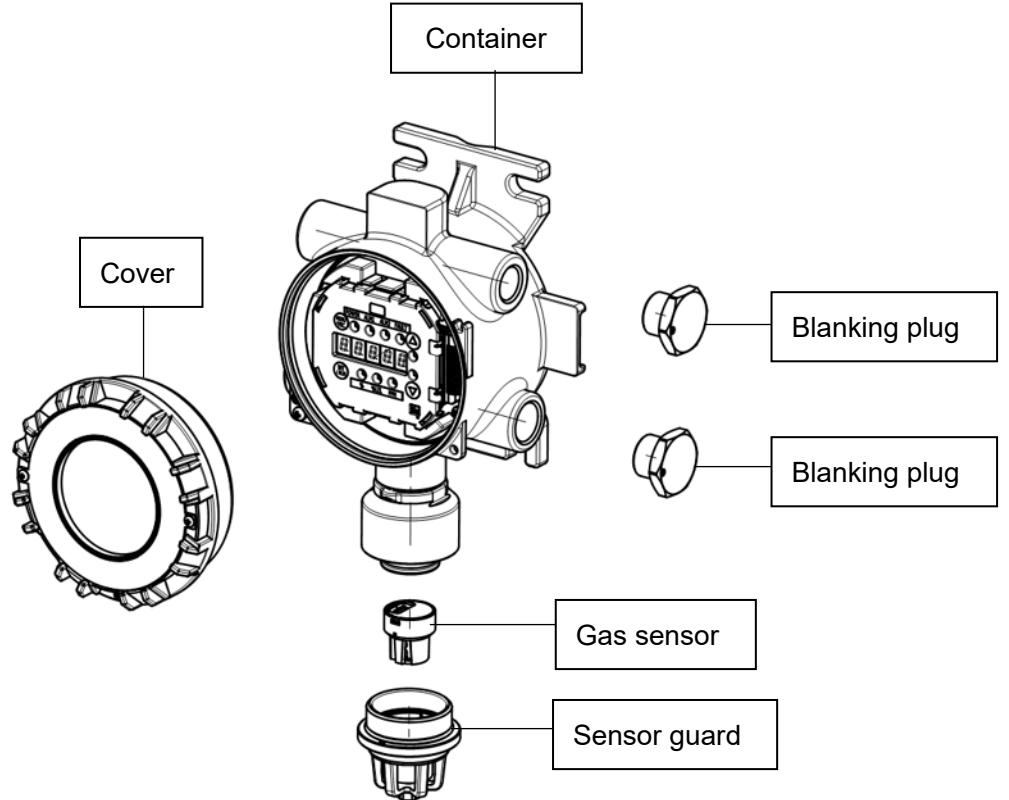
- ▶ Connect only components that are compatible with the individual connectors on the remote sensor head (GD-3).
- ▶ Tighten M25 plugs and adapters to a torque of at least 30 Nm.
- ▶ Secure a minimum thread engagement of five threads.

<Connection examples>

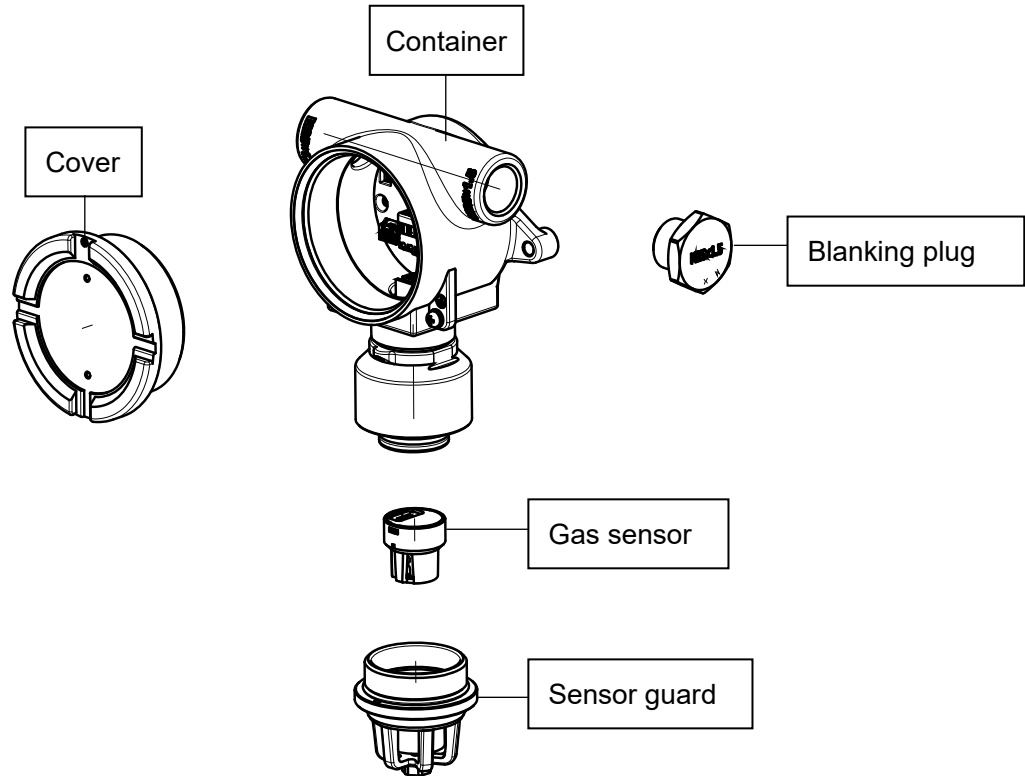


<Exploded view>

<SD-3>



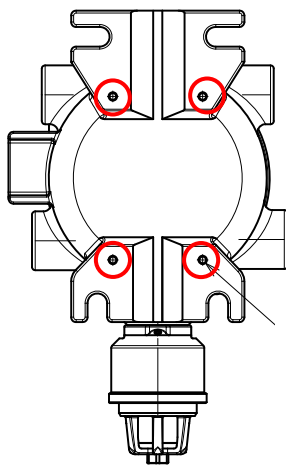
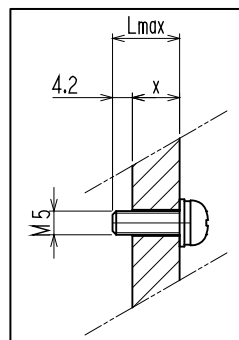
<GD-3>



<Bolt holes in the rear of the container (SD-3)>

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

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

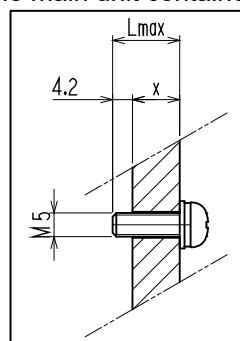


Bolt holes in the rear of the container (4 locations)

<Bolt holes in the rear and bottom of the container (GD-3)>

Four bolt holes each are located on the rear and the bottom of the main unit container.

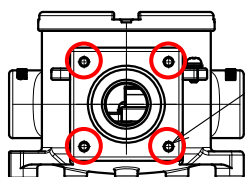
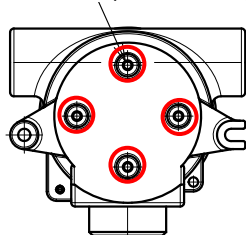
- Screw size: M5
- Pitch: 0.8
- Screw depth: 5
- Maximum allowable length for bolts: $L_{max} = 4.2 \text{ mm} + x$
("x" is the thickness of the intervening parts)



<Container rear>

<Container bottom>

Bolt holes in the rear of the container (4 locations)



Bolt holes in the bottom of the container (4 locations)

3

Product Configuration

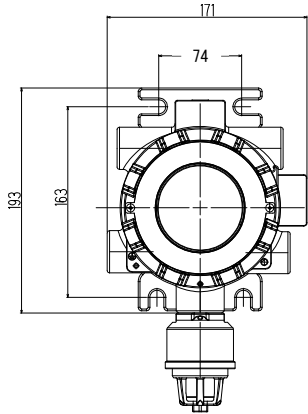
3-1 Main unit and accessories

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

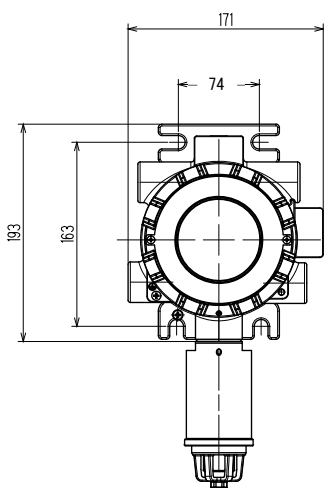
3-1-1 Main unit (SD-3)

<Diffusion type>

<Model without EC barrier>

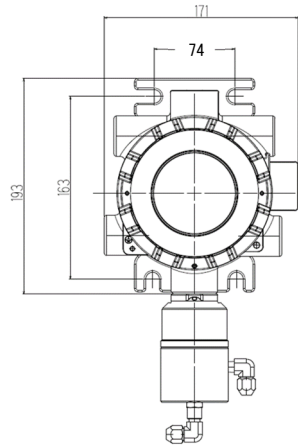


<Model with EC barrier>

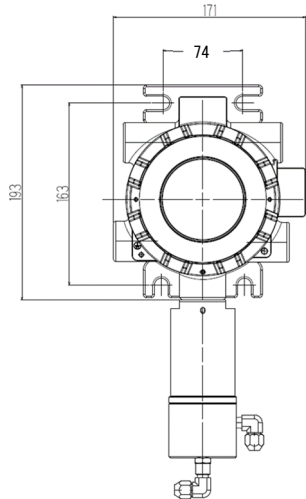


<Suction type>

<Model without EC barrier>

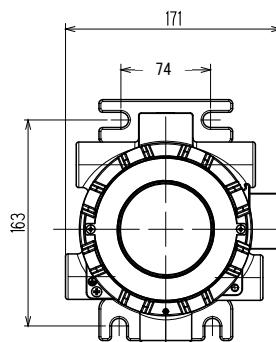


<Model with EC barrier>



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

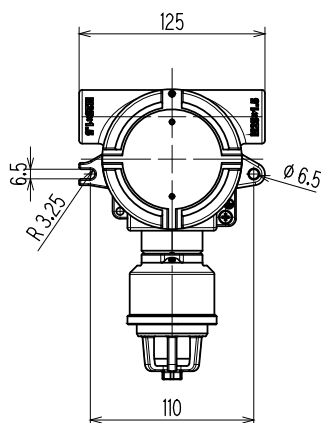
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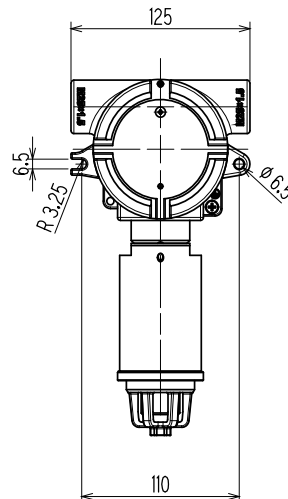
3-1-3 Remote sensor head (GD-3)

<Remote sensor head>

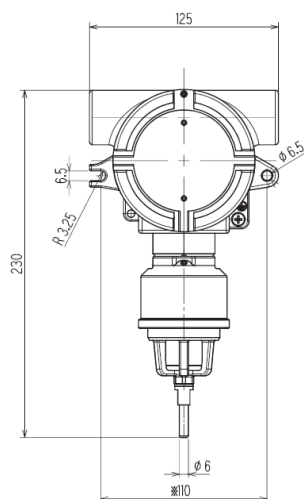
<Model without EC barrier>



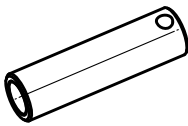
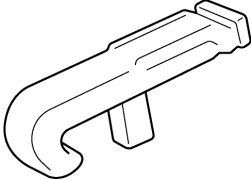
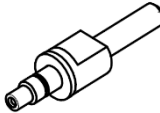
<Model with EC barrier>



<NPM models>



3-1-4 Standard accessories

Standard accessories		Quantity	Part No.	Description
	Control key	Varies depending on quantity ordered.	4286 9200 80	Key used to operate the product
	Operating lever	×1	2594 0481 90	Tool used to connect cables to the terminal plate
	Hex key wrench (2 across flats)	Varies depending on quantity ordered.	1510 5020 40	Tool used to tighten M4 hex socket set screws
	Nipple	×1	4262 9775 20	Tool used for introducing calibration gas. Provided with GD-3NPM only.
	Operating Manual	×1		

NOTE

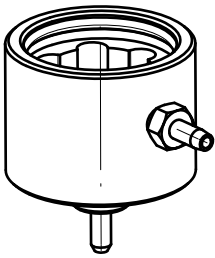
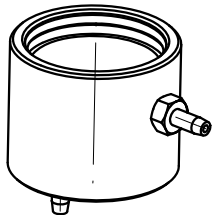
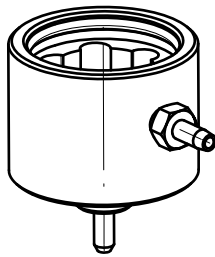
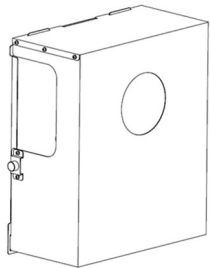
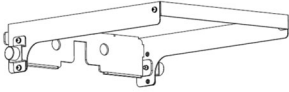
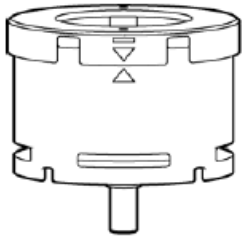
- The number of control keys and hex key wrenches varies depending on the number of units delivered.

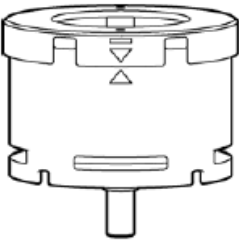
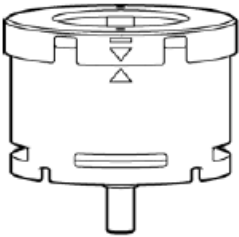
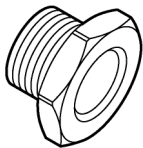
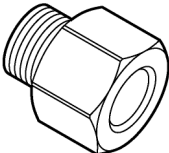
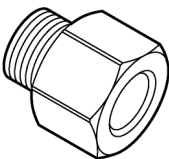
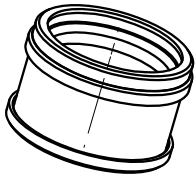
1 to 10 units:	1 of each
11 to 20 units:	2 of each
21 to 50 units:	3 of each
51 units or more:	4 of each

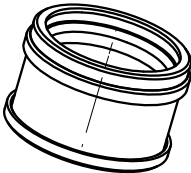
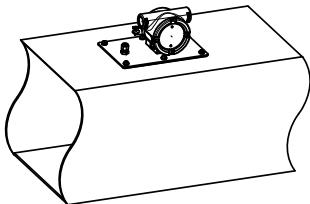
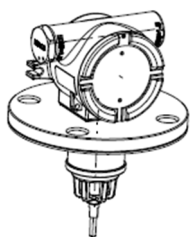
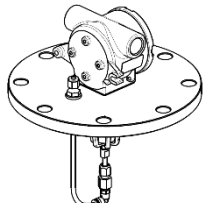
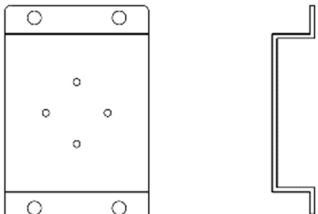
**CAUTION**

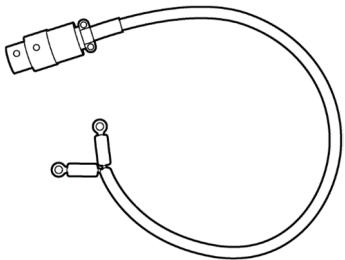
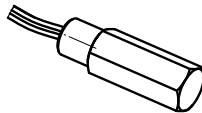
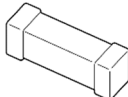
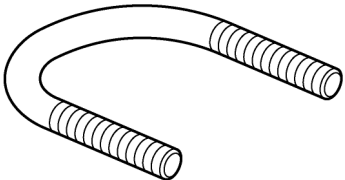
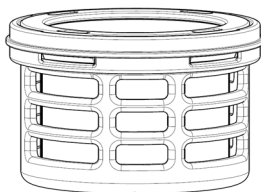
- Use the control key provided to operate the product. The product may not respond properly to commands if an object other than the supplied control key is used.
- The control key provided incorporates an extremely strong magnet. Holding the control key close to credit cards, ID cards, or other magnetized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

3-1-5 Optional accessories

Optional accessories		Part No.	Description
	Calibration adapter (for IRF sensor)	4283 9011 00	Calibration adapter for the SD-3RI <Material> Body: PP Nipple: stainless steel/Teflon
	Calibration adapter (for NCF/SGF/SHF sensors)	4283 9012 70	Calibration adapter for the SD-3NC/GH/GHS/SP <Material> Body: PP Nipple: stainless steel/Teflon
	Calibration adapter (for ESF sensor)	4283 9013 40	Calibration adapter for the SD-3EC/ECS/ECB <Material> Body: PP Nipple: stainless steel/Teflon
	Protective cover	Wall-mounted 4283 9019 80 Pipe-mounted 4283 9045 60	Cover to protect the SD-3 main unit <Material> SUS316
	Sunshade	4283 9015 90	Cover to minimize rise in temperature due to direct sunlight or radiant heat <Material> SUS316
	Splash guard (for IRF sensor)	4283 9076 60	SD-3RI cover to protect sensor from water and dust The identification number "1" is engraved on the underside. <Material> Resin

Optional accessories		Part No.	Description
	Splash guard (for NCF/SGF/SHF sensors)	4283 9077 80	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/TCF sensor)	4283 9078 50	SD-3EC/ECS/ECB and GD-3NPM 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 9058 70	Adapter for converting M25 × 1.5 threads to 1/2 NPT threads <Material> Equivalent to SUS316
	Adapter	4283 9057 00	Adapter for converting M25 × 1.5 threads to 3/4 NPT threads <Material> Equivalent to SUS316
	Adapter	4283 9047 10	Adapter for converting M25 × 1.5 threads to M20 × 1.5 threads <Material> Equivalent to SUS316
	Silicone removal filter (Model: SI-8)* ¹ (for NCF/SGF/SHF sensors)	4283 0030 20	Filter for SD-3NC/GH/GHS/SP for removing trace amounts of silicone from the air. This can extend sensor life.* ²

Optional accessories		Part No.	Description
	Activated carbon filter (Model: CF-8304) ^{*1} (for NCF/SGF/SHF sensors)	4283 0040 10	Filter for SD-3NC/GH/GHS/SP for removing trace amounts of silicone from the air. Fitting the filter extends the sensor service life. The silicone removal capability of this filter exceeds that of the silicone removal filter. ^{*3} It can also be used to remove interference gas. This minimizes interference effects from gases other than the detection target gas.
	Duct mounting kit (for GD-3RI) (for GD-3NC/GH/SP) (for GD-3EC) (for GD-3ECB)	4262 9674 10 4262 9675 90 4262 9676 60 4262 9774 50	Kit for mounting the remote sensor head (GD-3) on a duct <Material> SUS316
	Duct flange kit (for GD-3NPM)	4283 9573 70	Tool for attaching the remote sensor head (GD-3) to a flange Flange size: JIS 5K80A * A separate calibration port must be attached to the piping.
	Duct flange kit (with calibration port) (for GD-3NPM)	4283 9579 10	Tool for attaching the remote sensor head (GD-3) to a flange Flange size: JIS 5K150A
	GD-3 mounting bracket	4283 4319 20	Bracket used for mounting the GD-3 with splash guard fitted to a wall <Material> SUS316
	Tag plate with wire chain	0717 0319 40	SUS316 tag plate Can be attached to the product housing.

Optional accessories		Part No.	Description
	For HART communication Cable	2905 2439 10	Connector cable used when connecting a HART modem
	Lightning arrester (3-wire connection) (TP48-3-N-NDI)	4283 9055 50	Device for limiting lightning-induced instantaneous overvoltage. With adapter (M25 × 1.5 → 1/2 NPT)
	Lightning arrester (4-wire connection) (TP48-4-N-NDI)	4283 9056 20	Device for limiting lightning-induced instantaneous overvoltage. With adapter (M25 × 1.5 → 1/2 NPT)
	Fuse	2564 0125 10	Littelfuse fuse (1.25 A 100 V DC)
	U bolt components	4283 9046 30	U bolt, spring lock washer, and hex nut used for mounting the main unit on a pole (size: 50A (2B)) <Material> SUS316
	Waterproof cap	4283 9162 60	Waterproof cap to protect the sensor with a rating equivalent to IP66/67 <Material> Resin ^{*4*5}

*1 We recommend fitting a splash guard when using a filter.

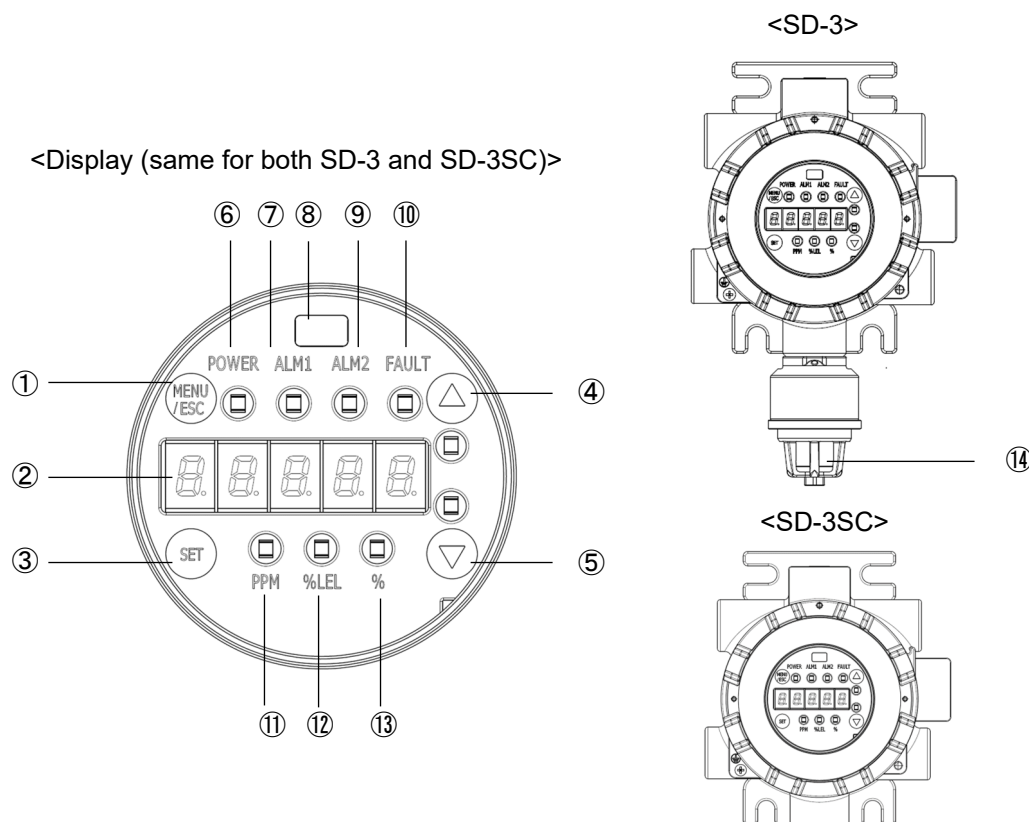
*2 Installing the silicone removal filter will limit the target gases that can be detected.

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

*4 Compatible sensors: ESF (H₂S), IRF, SGF (CS₂), SHF

*5 Performance specifications will not be met with the waterproof cap in place.

3-2 Part names and functions

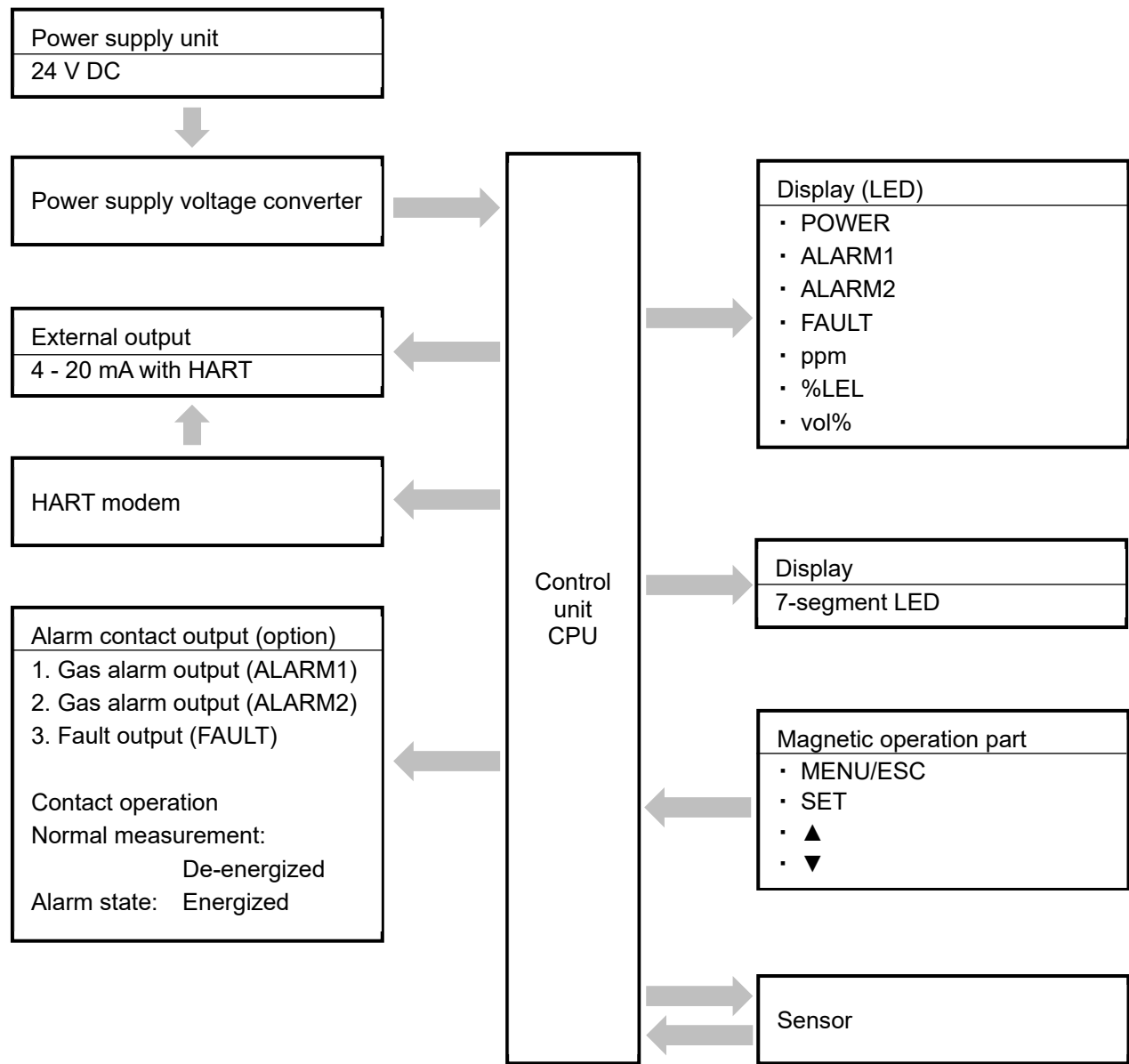


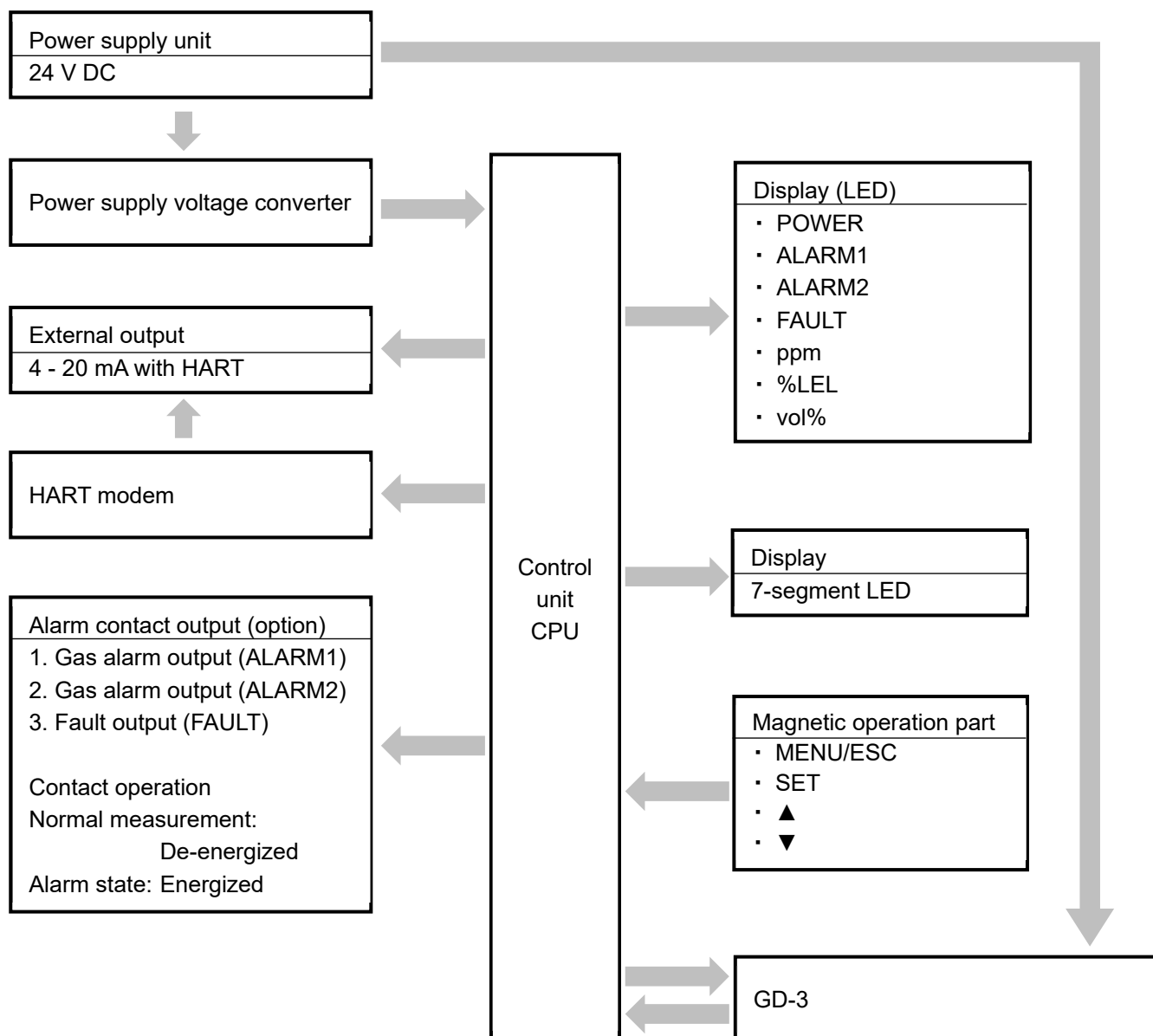
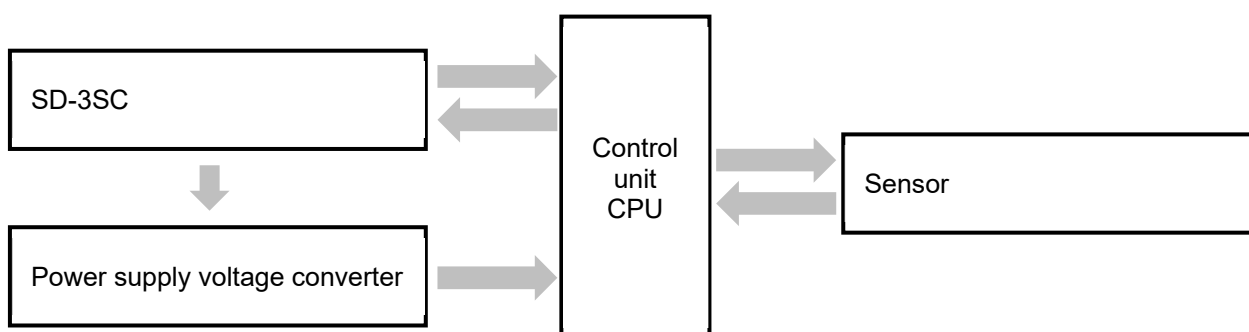
No.	Name	Function
①	MENU/ESC key	Hold down this key in detection mode to switch to user mode. In user mode and maintenance mode, this key is used to cancel a setting or return to the previous screen. Hold down this key in user mode or maintenance mode to return to detection mode.
②	7-segment LED display	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 or adjust (increase) a value.
⑤	▼ key	In user mode, this key is used to switch menus or adjust (decrease) a value. Press in detection mode to display the external output.
⑥	Power lamp (POWER)	This is the 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)	This is the ALM1 (first alarm) alarm lamp. This lights up (red) when the alarm setpoint for ALM1 (first alarm) is reached.
⑧	Infrared port	IrDA communication port
⑨	Alarm lamp (ALM2)	This is the ALM2 (second alarm) alarm lamp. This lights up (red) when the alarm setpoint for ALM2 (second alarm) is reached.
⑩	Fault lamp (FAULT)	This is the fault lamp. This lights up (yellow) when there is an abnormality with the product.
⑪	PPM lamp	Lights up (green) when displaying a gas concentration in the ppm concentration range.
⑫	%LEL lamp	Lights up (green) when displaying a gas concentration within the %LEL concentration range.
⑬	% lamp	Lights up (green) when displaying a gas concentration within the vol% concentration range.
⑭	Sensor	A sensor for detecting gas is installed.

3-3 Block diagrams

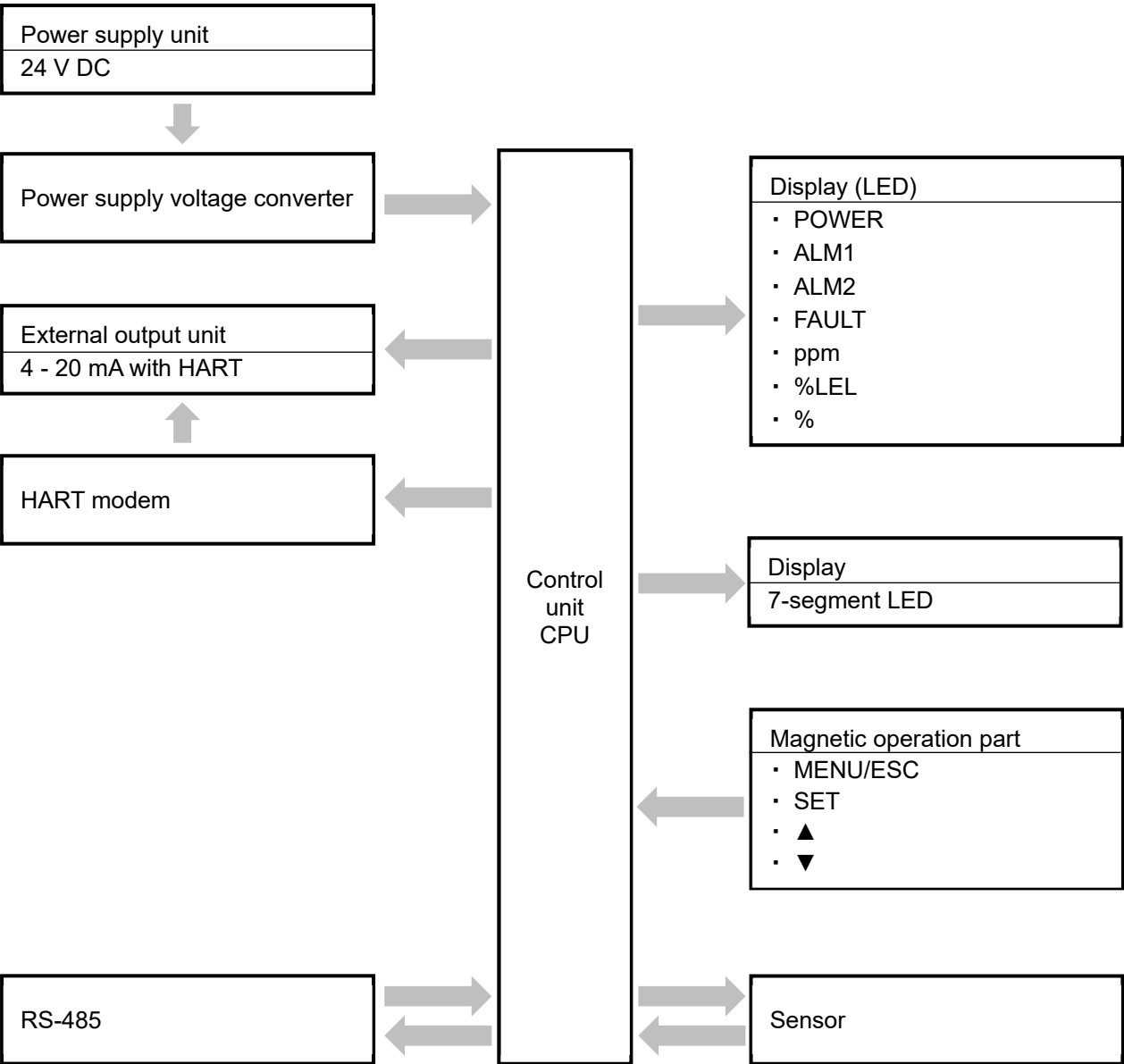
The block diagrams (electrical circuit diagrams) for the product are given below.

<SD-3>

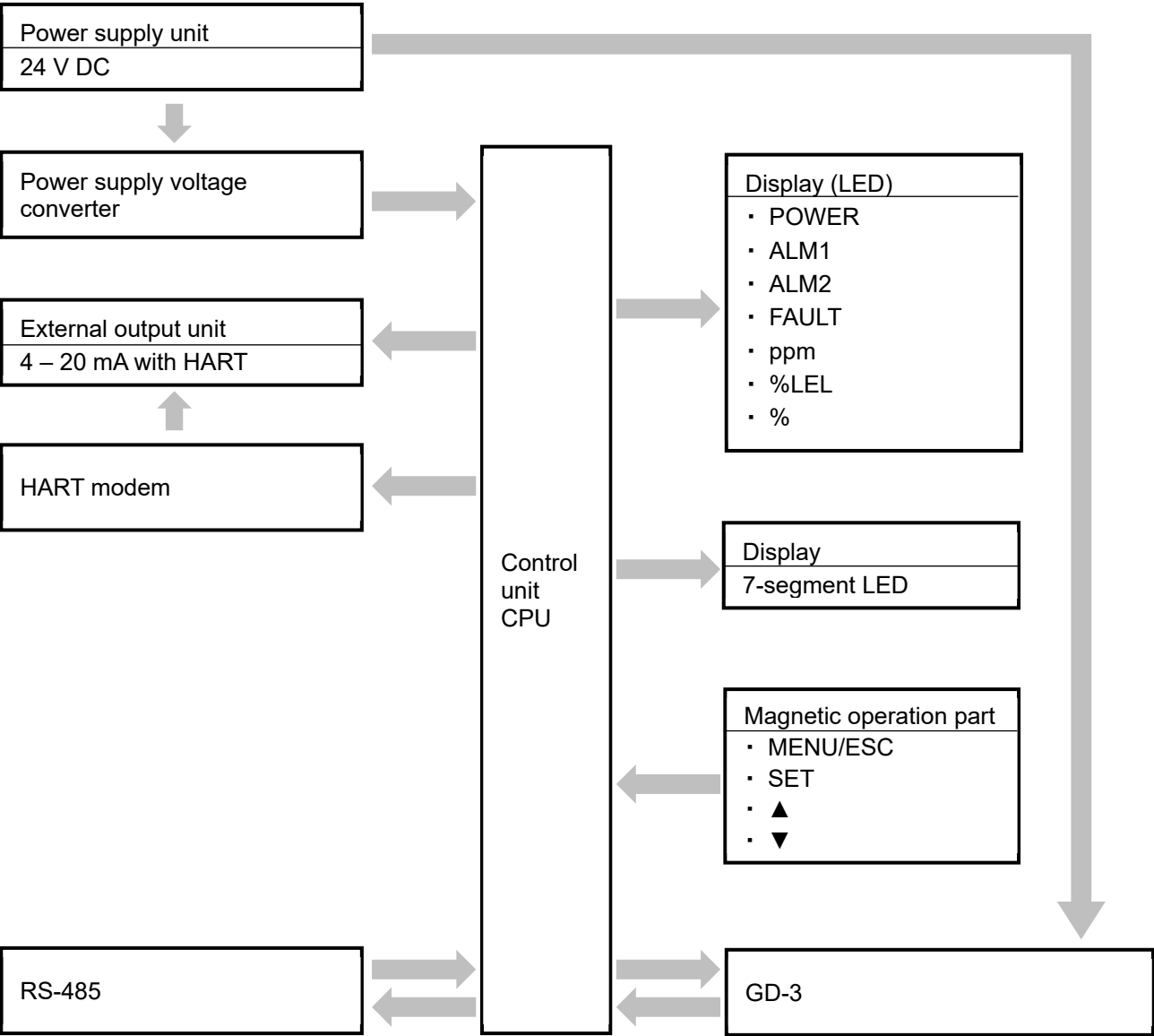


<SD-3SC>**<GD-3>**

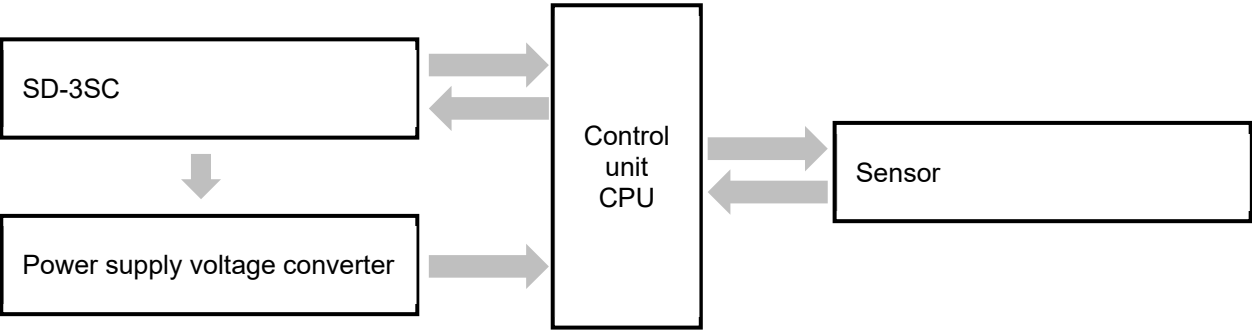
<SD-3> (RS-485)



<SD-3SC> (RS-485)



<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 when performing installation work. 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 (environment) at the location where the product is installed may prevent optimum performance. Assess conditions at the installation location and take necessary measures accordingly.
- 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.
- Gas or vapor contact with the sensor must not be obstructed by debris, snow, mud, or external devices. The protection rating does not constitute a guarantee that the product is capable of detecting gas correctly during or after exposure to these conditions. Check the product operation and calibrate if it has been exposed to accumulated dust, immersion in water, or high pressure water spray.
- It is recommended that the detector is installed with the sensor facing downward. Provided the sensor is protected from mechanical damage, dirt, and water ingress, it can be installed facing in other directions.
- Use genuine optional accessories.

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. To satisfy NEMA 4X performance requirements, use cable glands that comply with both explosion-proof certification and NEMA 4X.
- 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.
- Use shielded twisted pair cable for RS-485 communication connections.

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
 - Make sure dirt, snow, mud, external equipment, or other obstructions do not prevent gas or vapor from coming into contact with the sensor.
 - Remove any dust or water droplets adhering to the sensor. Remove any dust or water inside the splash guard.
 - Replace the sensor if it is damaged.
 - The IP rating does not guarantee that the product will be able to detect gas while exposed to these conditions or after such exposure.
 - We recommend installing the detector with the sensor facing down. It can be installed facing in other directions provided that the sensor is protected from mechanical damage, dirt, and water. However, to meet NEMA 4X performance requirements, the sensor must always be installed facing down.
 - NCF and ESF sensors may respond more slowly if water adheres to the Teflon membrane. Under conditions of heavy rain or flooding, visually inspect the surface of the Teflon membrane on the NCF and ESF sensors.
 - The response speed of TCF sensors may decrease if water adheres to the wire mesh. If the wire mesh is exposed to water, check visually. If it is wet, wipe it dry with a cotton swab.
- <Checking procedure>
- ① Turn off the power to the main unit.
 - ② Remove the sensor guard.
 - ③ Wipe off any water droplets adhering to the Teflon membrane.
Wipe off using a cloth or similar article that will neither tear nor leave lint behind.
 - ④ Visually inspect the Teflon membrane to confirm that no water droplets remain.
 - ⑤ Reattach the sensor guard.
 - ⑥ Turn on the power to the main unit.
 - ⑦ To ensure that the Teflon membrane is completely dry, allow to warm up for 10 minutes before use.

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 associated with risk of splashing water, oil, chemicals, or other liquids. 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 location where temperature is stable and does not exceed the operating temperature range during use.

<Do not install in locations exposed to direct sunlight or sudden temperature fluctuations.>

Avoid installing in locations subject to direct sunlight or radiant heat (infrared radiation from high-temperature bodies) or in 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 hazardous or not possible.>

The product requires periodic maintenance.

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

- Within systems where the system 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, near high-voltage cables

<Do not install in improperly grounded systems.>

When installing within a system chassis, make sure the system is properly grounded to Class D or equivalent.

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

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

Sensor type	Gases affecting sensor sensitivity	Sensor-corroding gases
SGF	• Organic silicone gases (e.g., D4 siloxane, D5 siloxane) • Sulfur gases (e.g., SO_x, H₂S)	• Corrosive gases (e.g., SO_x, NO_x) • Acid gases (e.g., HF, HCl)
SHF		
NCF		
TCF	• NH ₃	None
IRF	None	
ESF	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	
TCF	Hydrocarbons, alcohols, organic solvents, H ₂ O, oxygen, 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 24 V DC (18 - 30 V DC) power 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 or 4-core cables.

<Cable and power supply installation>

A voltage drop may occur due to the cable resistance, resulting in a lower supply voltage at the product (at the product terminal) than the supply voltage of the power supply. If the actual voltage supplied drops below 18 V DC due to voltage drop caused by the cable, the power supply voltage at the source must be increased.

This voltage drop is determined by the type and length of the cable, ambient temperature, and the product consumption current.

The product consumption current varies depending on the sensor type and the state of internal alarm relays.

<Method for calculating the required power supply voltage (1)>

Use the following equation to calculate the required power supply voltage:

$$\text{Power supply voltage} = A (\text{product consumption current}) \times B (\text{installed cable resistance}) + 18 \text{ V}$$

A: Product consumption current

Select from the following:

Model	Max. consumption current	Remarks
SD-3RI, SD-3DRI	170 mA	
SD-3NC, SD-3DNC	200 mA	
SD-3EC, SD-3DEC	140 mA	
SD-3ECS, SD-3DECS	140 mA	
SD-3ECB, SD-3DECB	150 mA	
SD-3GH, SD-3DGH	200 mA	
SD-3GHS, SD-3DGHS	200 mA	
SD-3SP, SD-3DSP	160 mA	
SD-3DNPM	160 mA	
SD-3SC + GD-3RI	180 mA	
SD-3SC + GD-3NC	220 mA	
SD-3SC + GD-3EC	150 mA	
SD-3SC + GD-3ECS	150 mA	
SD-3SC + GD-3ECB	160 mA	
SD-3SC + GD-3GH	220 mA	
SD-3SCS + GD-3GHS	220 mA	
SD-3SC + GD-3SP	180 mA	
SD-3 SC + GD-3NPM	180 mA	

B: Installed cable resistance

The maximum resistance is determined by the type and length of the cable and the maximum operating temperature.

Example:

A: Maximum consumption current = 170 mA (SD-3RI)

B: Maximum installed cable resistance = 24 Ω (CVV-S, 1.308 mm², 1,250 m, @ 70 °C)

$$\begin{aligned}
 \text{Power supply voltage} &= 170 \text{ mA} \times (24 \text{ } \Omega \times 2) + 18 \text{ V} \\
 &= 8.16 \text{ V} + 18 \text{ V} \\
 &= 26.16 \text{ V (or greater)}
 \end{aligned}$$

<Method for calculating the required power supply voltage (2)>

Use this method if method (1) cannot be used due to the type and length of the installed cable being unknown, and also to verify whether the voltage obtained using method (1) is acceptable as the actual supply voltage.

Perform an alarm test as follows. For more information, refer to '7-3-2 Performing alarm test'.

- Enable contact operation.

Press the ▲ key until the indicator exceeds the full scale (nnnn), then check here to confirm that the voltage at the product terminal plate is at least 18 V DC.

Perform a fault test as follows. For more information, refer to '7-3-3 Performing fault test'.

- Enable fault testing.

Check here to confirm that the voltage at the product terminal plate is at least 18 V DC.

If the voltage is less than 18 V DC, boost the power supply voltage. If the temperature rises during operation, make sure that the power supply voltage is sufficient to compensate for the voltage drop due to the increased cable resistance.

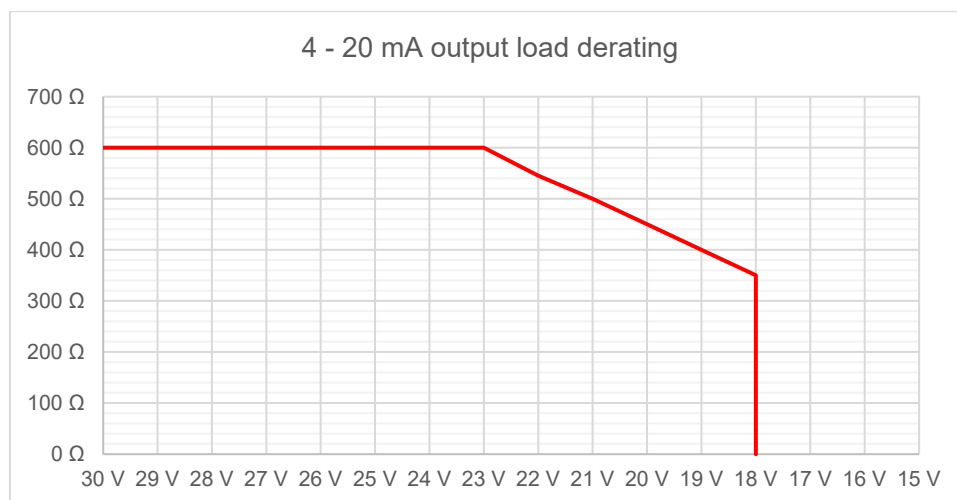
<Install away from noise-emitting devices (main unit and cables).>

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 . 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 protocol 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	Maximum 300 Ω at 18 V DC Linear increase to maximum 600 Ω at 23 V DC
Operation with HART communication (HART mode)	Minimum 250 Ω in the range 18 V to 30 V DC
	Maximum 300 Ω at 18 V DC Linear increase to maximum 600 Ω at 23 V DC
HART multidrop operation	250 Ω to 600 Ω in the range 18 V to 30 V DC

<Use the alarm contacts correctly.>

The alarm contacts on this product are designed to transmit signals to activate external buzzers, alarm indicators, revolving lights, etc. 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 of the product assume resistance loads. If the alarm contacts use inductive loads, a counter-electromotive force will occur at the contacts, leading to the following potential problems:

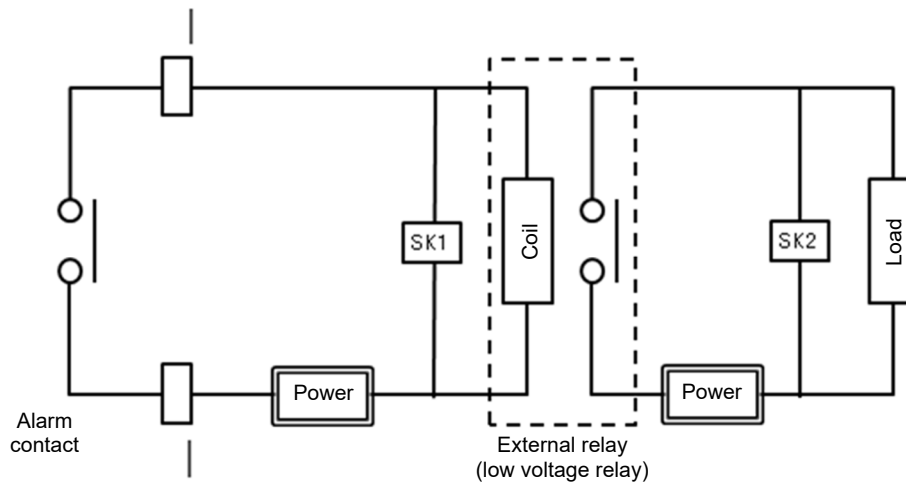
- Alarm relay contact welding, insulation failure, contact failure
- Damage to electrical components due to high voltages occurring inside the product
- Malfunctions due to CPU runaway

When operating a load, stabilize the operation of this product, then take the following measures, where appropriate, to 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) to the load side of the external relay.

- In certain cases, due to load conditions, it may be preferable to attach the surge absorber to the contact side. Confirm load behavior and determine the optimal attachment point.

<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.
- As a rule, 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 cause a momentary open operation due to external forces or other physical impact. If a b contact is used as an alarm contact, implement measures to account for such momentary operations—for example, add a delay operation (of approximately 1 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:



CAUTION

- 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 at power-on or in the event of an instantaneous power failure. If the external output and alarm contacts activate due to power problems, take appropriate measures, such as installing a UPS (uninterruptible power system). Supply this product with the following power sources:

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

*1 Restart the product to recover from instantaneous power failures exceeding 20 ms.

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

Lightning strikes may damage devices connected to the cables. Additionally, note that inductive lightning surges due to lightning strikes cannot be entirely prevented, even if cables are installed in metal ducts or buried underground. While it is not possible to completely protect against lightning disasters, the following protective measures are available:

<Protection against lightning>

Take 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.

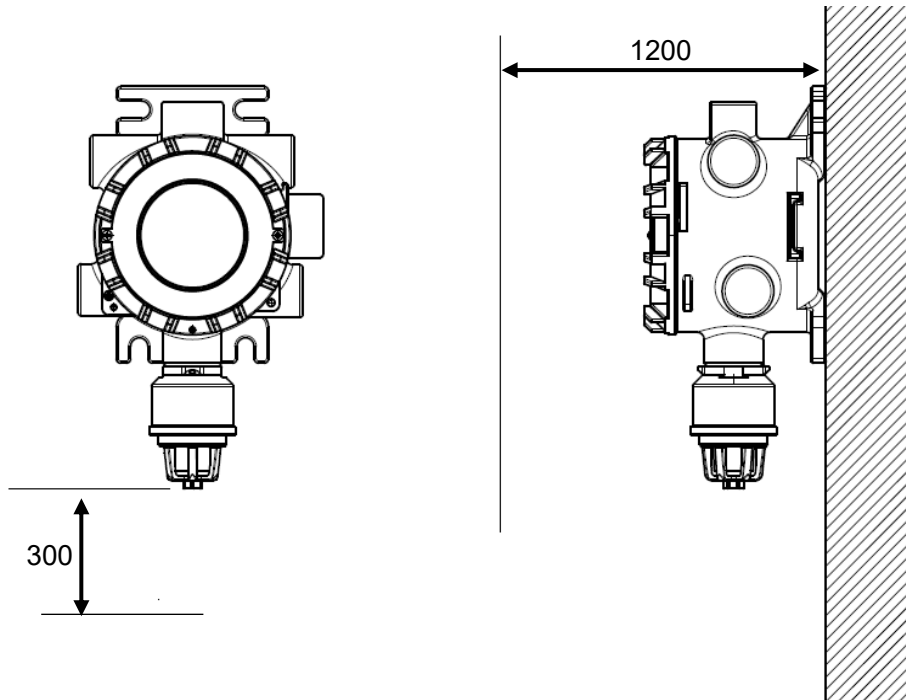
NOTE

- ▶ Lightning arresters contain circuitry to remove voltage surges that could potentially damage field devices. For this reason, installing a lightning arrester can attenuate signals. Perform an operation check before installing lightning arresters. Additionally, lightning arresters cannot remove all surge voltages.

4-3 Providing maintenance space

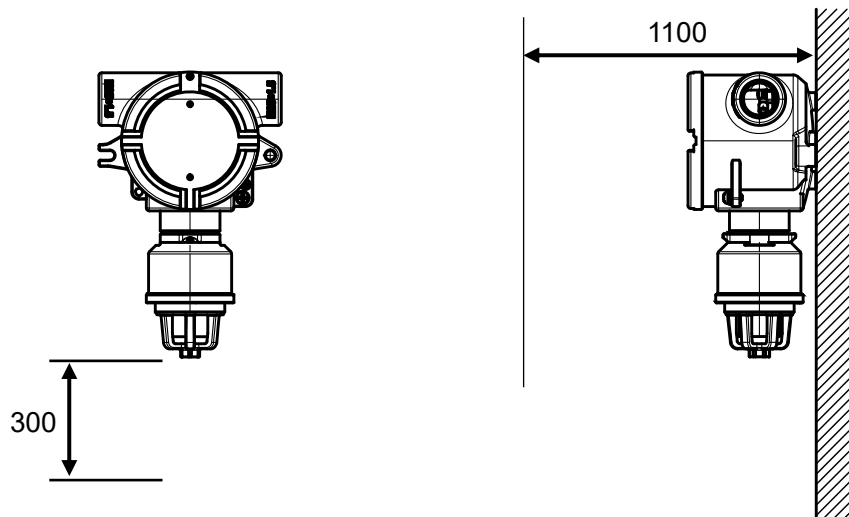
When mounting the product, allow space to open and close the covers during maintenance.

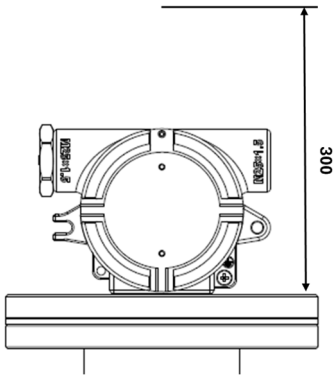
<Main unit (SD-3/SD-3SC)>



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

<Remote sensor head (GD-3)>



<Remote sensor head (GD-3NPM) + flange kit>**CAUTION**

The product requires periodic maintenance.

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

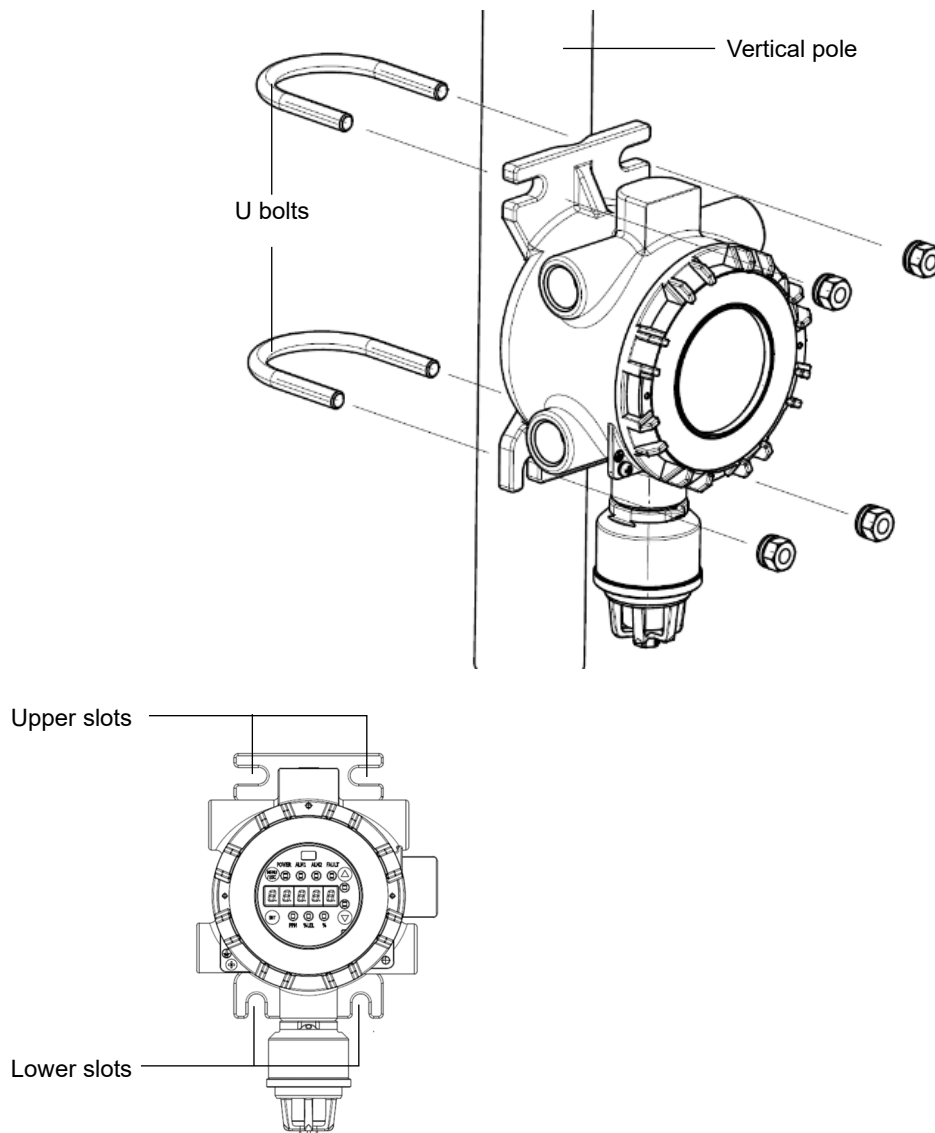
- Within systems where the system must be stopped for maintenance
- Locations where part of the system must be detached to allow maintenance
- Locations where the product cannot be removed due to the presence of pipes or racks
- Locations where maintenance work is hazardous—for example, near high-voltage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

4-4 Installing the main unit

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.**

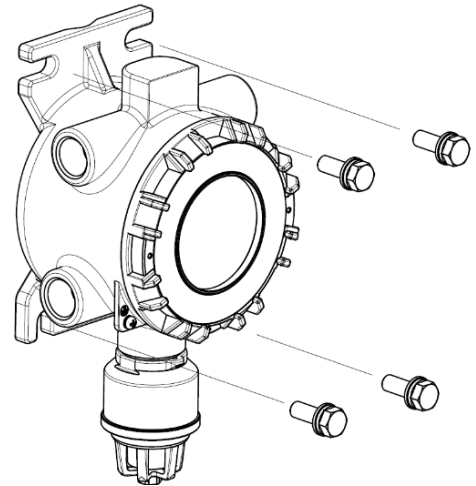
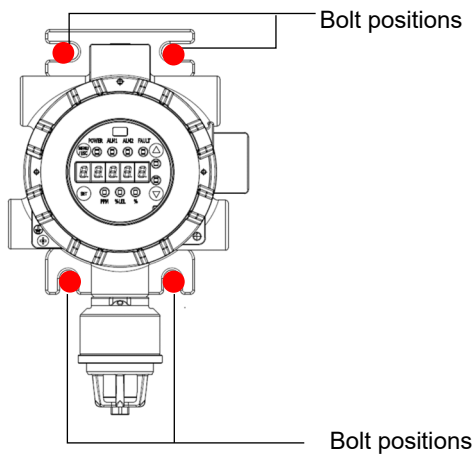


* The diagram illustrates the SD-3. Mount the SD-3SC in the same way.

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. Mount the SD-3SC in the same way.

CAUTION

The product requires periodic maintenance.

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

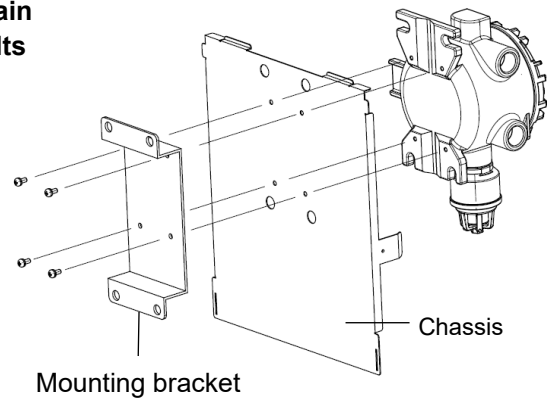
- Within systems where the system must be stopped for maintenance
- Locations where part of the system must be detached to allow maintenance
- Locations where the product cannot be removed due to the presence of pipes or racks
- Locations where maintenance work is hazardous—for example, near high-voltage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

4-4-3 Attaching protective cover

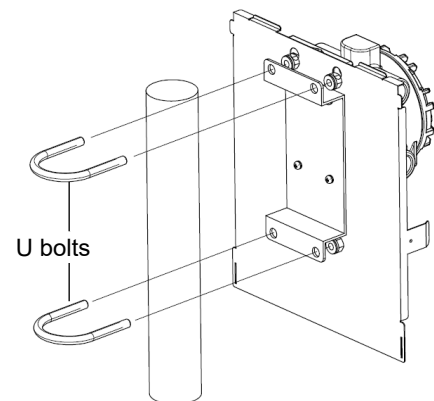
Attach the protective cover to the main unit (SD-3/SD-3SC).

<Attach to the pole (Size: 50A (2B))>

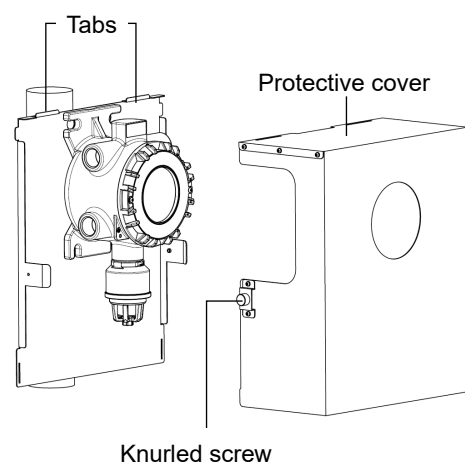
- 1 Secure the chassis and mounting bracket to the main unit, then secure with four M5 × 6 double SEMS bolts from the rear, as shown in the figure to the right.



- 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.



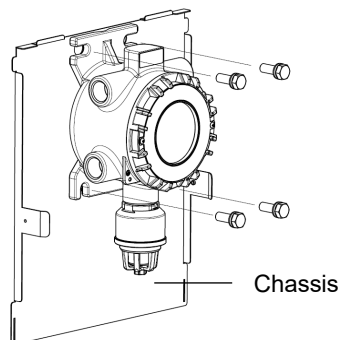
- 4 Match the protective cover to the two tabs on top of the chassis to attach.
- 5 Tighten the knurled screws on either side of the protective cover to secure in place.



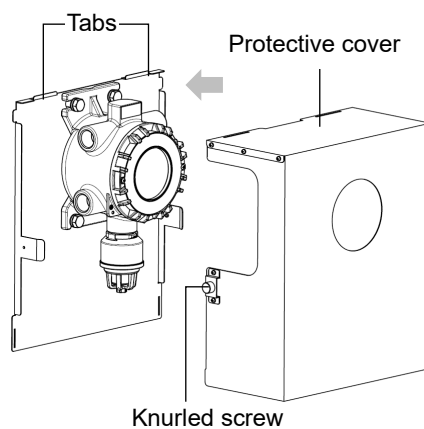
* The diagram illustrates the SD-3. Mount the SD-3SC in the same way.

<Attach to a wall>

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



- 2 **Match the protective cover to the two tabs on top of the chassis to attach.**
- 3 **Tighten the knurled screws on either side of the sunshade to secure in place.**



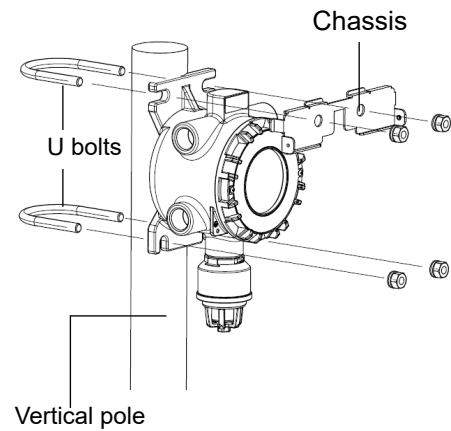
* The diagram illustrates the SD-3. Mount the SD-3SC in the same way.

4-4-4 Attaching the sunshade

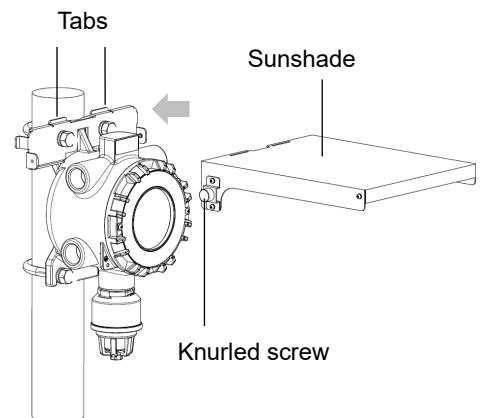
Attach the sunshade to the main unit (SD-3/SD-3SC).

<Attach to the pole (Size: 50A (2B))>

- 1 Fit one U bolt around the vertical pole and through the upper slots on the main unit. Secure to the chassis with 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.



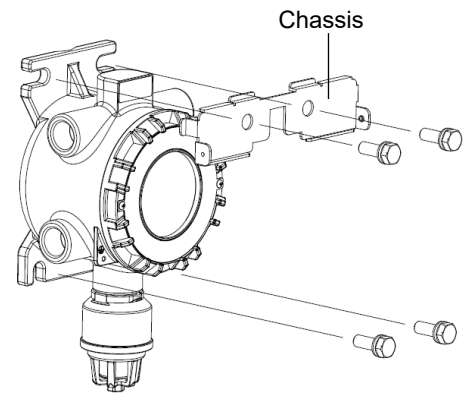
- 3 Match the sunshade to the two tabs on top of the chassis to attach.
- 4 Tighten the knurled screws on either side of the sunshade to secure in place.



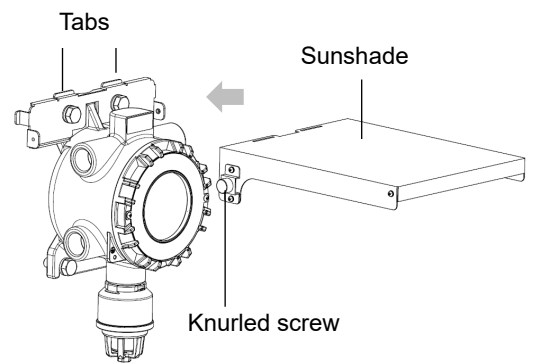
* The diagram illustrates the SD-3. Mount the SD-3SC in the same way.

<Attach to a wall>

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



- 2 **Match the sunshade to the two tabs on top of the chassis to attach.**
- 3 **Tighten the knurled screws on either side of the sunshade to secure in place.**

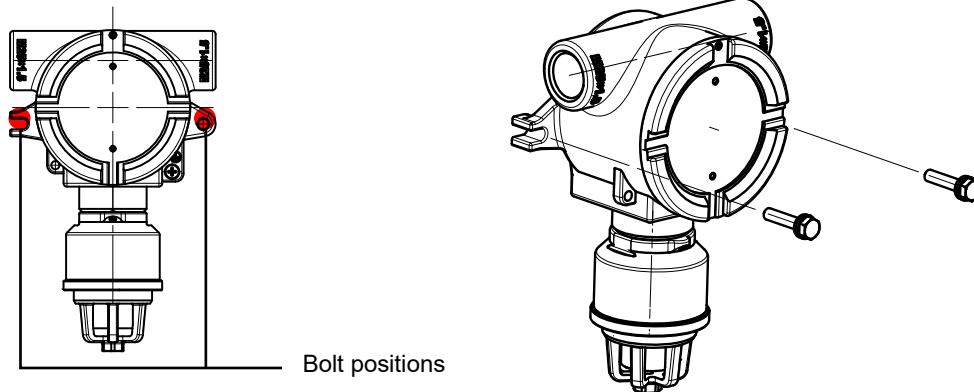


* The diagram illustrates the SD-3. Mount the SD-3SC in the same way.

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

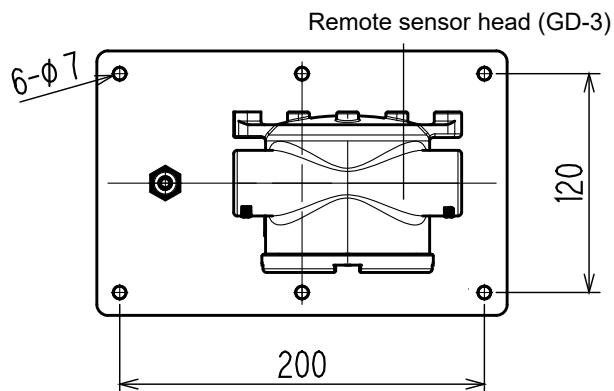
4-5-1 Wall mounting

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

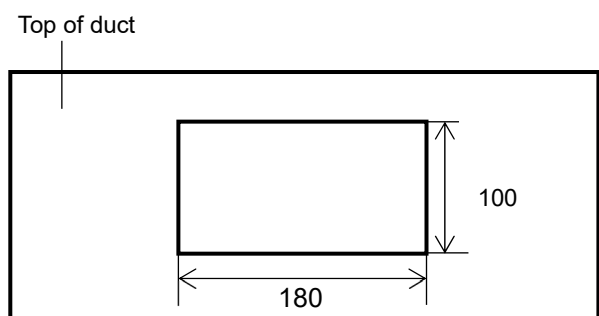


4-5-2 Duct mounting

Attach the remote sensor head (GD-3) to a duct.
Use the duct mounting kit when attaching to a duct.
The dimensions of the duct mounting kit are as follows:

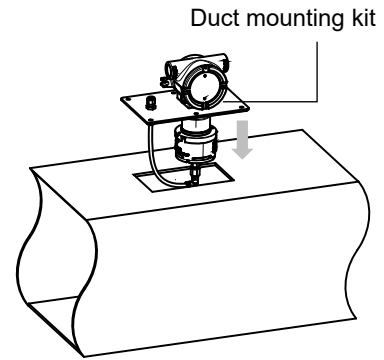


- 1 Cut the top panel of the duct to form a hole. Refer to the diagram at right for the dimensions of the hole.

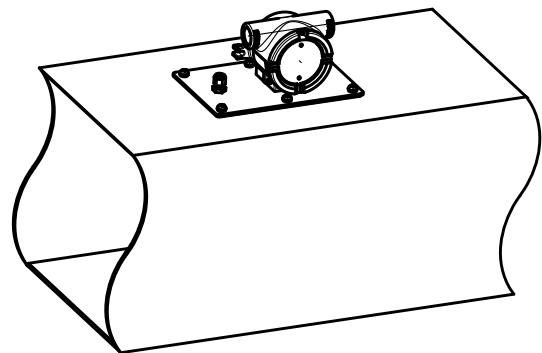
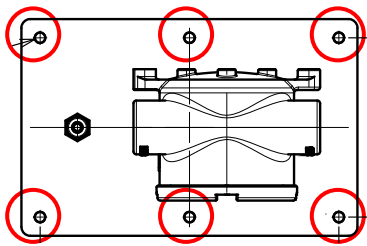


2 Insert the remote sensor head (GD-3) into the duct mounting kit and secure with four M5 bolts.

To allow calibration, connect the tube to the sensor of the remote sensor head (GD-3) and draw out from the top of the duct mounting kit.

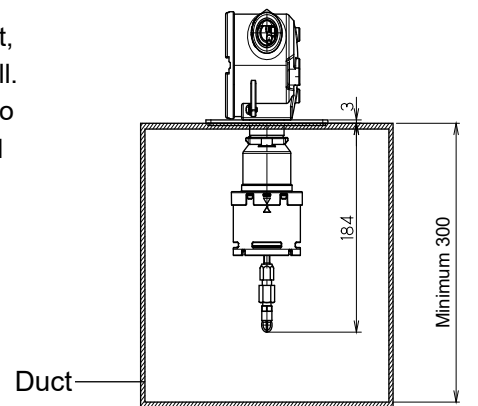


3 Insert the duct mounting kit into the opening in the duct. Secure in place with six M6 bolts.



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.
- ▶ With the duct-mounted version, connect the guard attached to the sensor to the duct mount gas inlet with piping for external gas calibration purposes.



* When using GD-3ECB
 Inserted section length: 229 mm
 Duct diameter: Minimum 345 mm

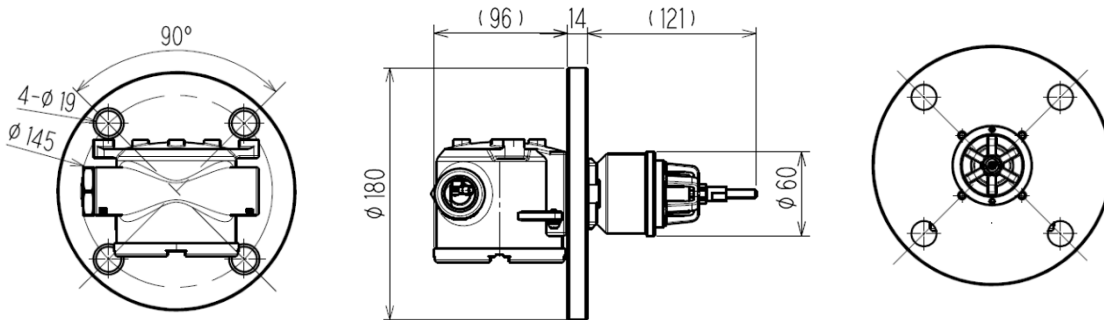
4-5-3 Flange mounting

When using the optional duct flange kit, install in accordance with the following requirements:

<Version without calibration port>

Secure the product to the flange with four M16 screws.

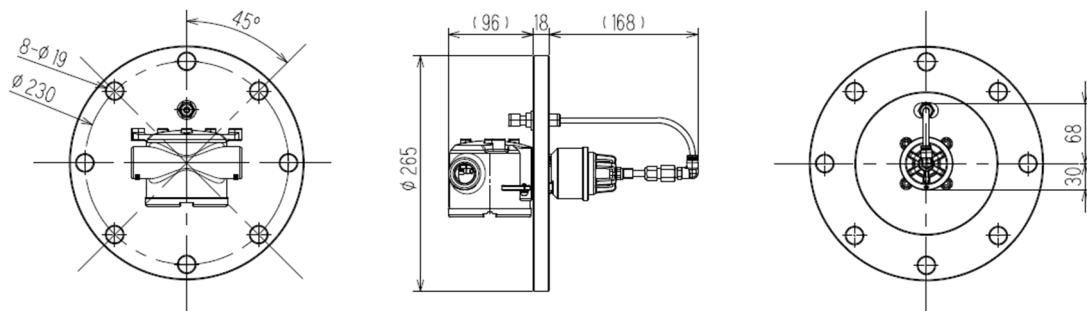
Flange size: JIS 5K80A SUS316



<Version with calibration port>

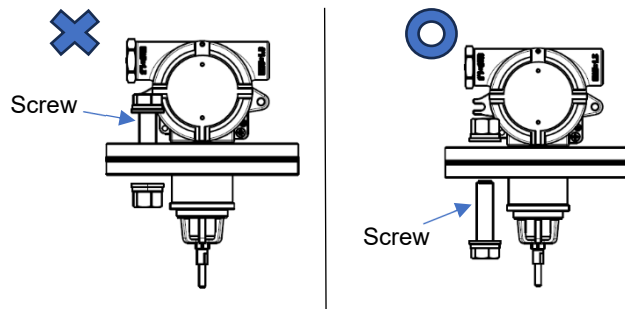
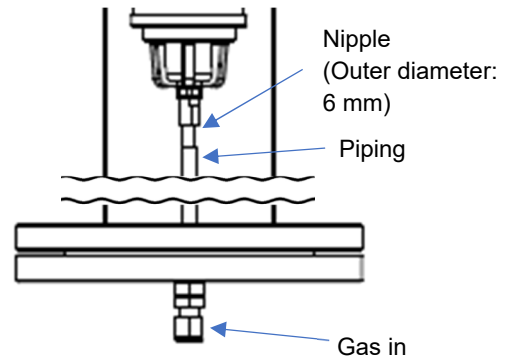
Secure the product to the flange with eight M16 screws.

Flange size: JIS 5K150A SUS316

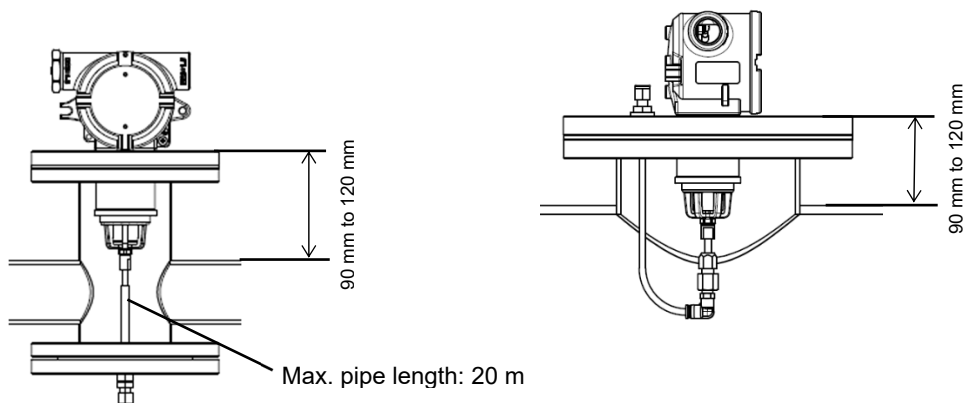


NOTE

- ▶ When mounting the remote sensor head (GD-3NPM) inside a duct, make sure the sensor and nipple are not in contact with the inner wall of the duct.
- ▶ When using the duct flange kit, install a separate gas inlet for external gas calibration, then connect to the nipple (outer diameter: 6 mm) on the sensor via piping.
- ▶ When installing the duct flange kit, insert the screws from the sensor side to eliminate the risk of interference with other parts.

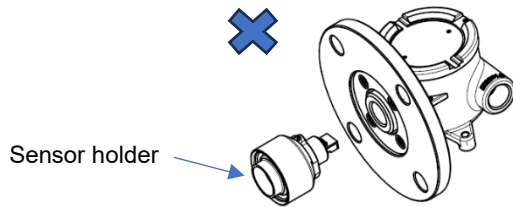


- ▶ Install the duct flange kit so that the mounting surface is 90 to 120 mm from the outer wall of the duct.
- ▶ Account for the site environment when choosing an installation location.
- ▶ Install the piping so that the length from the end of the nipple to the calibration port is not more than 20 m.

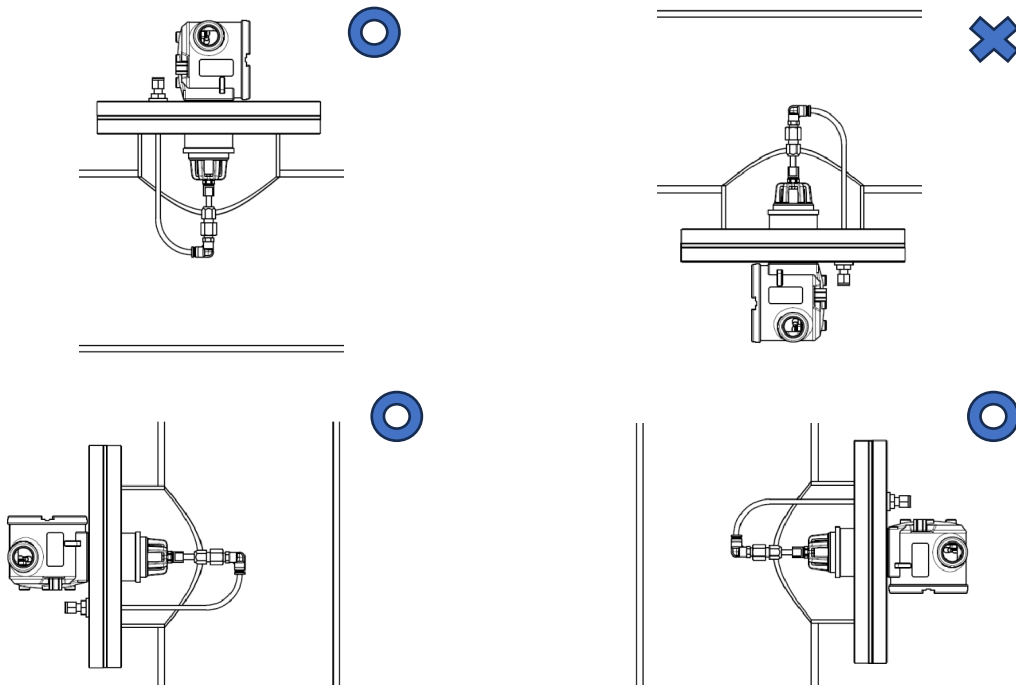


WARNING

- This product is an explosion-proof product. Do not attempt to disassemble or modify any parts other than those where attachment or removal is specified in this operating manual.
Example: Removing the sensor holder from the remote sensor head (GD-3NPM)



- Attach the detector in the specified direction.
- Correct readings may not be obtained unless it is attached in the specified direction.



4-6 Connecting the grounding terminal

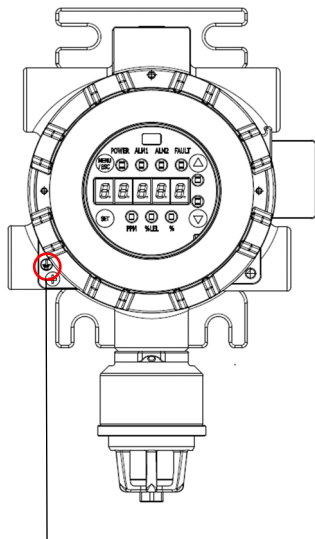


WARNING

- 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 or near the same point used to ground other high-frequency or high-voltage devices.

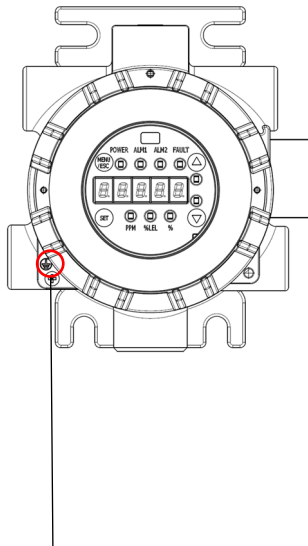
Connect the grounding bolt to the local grounding terminal.

<Main unit (SD-3)>



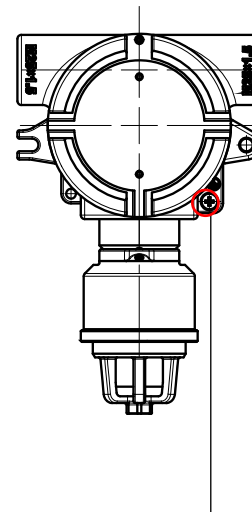
Grounding bolt (M4)

<Main unit (SD-3SC)>



Grounding bolt (M4)

<Remote sensor head (GD-3)>



Grounding bolt (M4)

NOTE

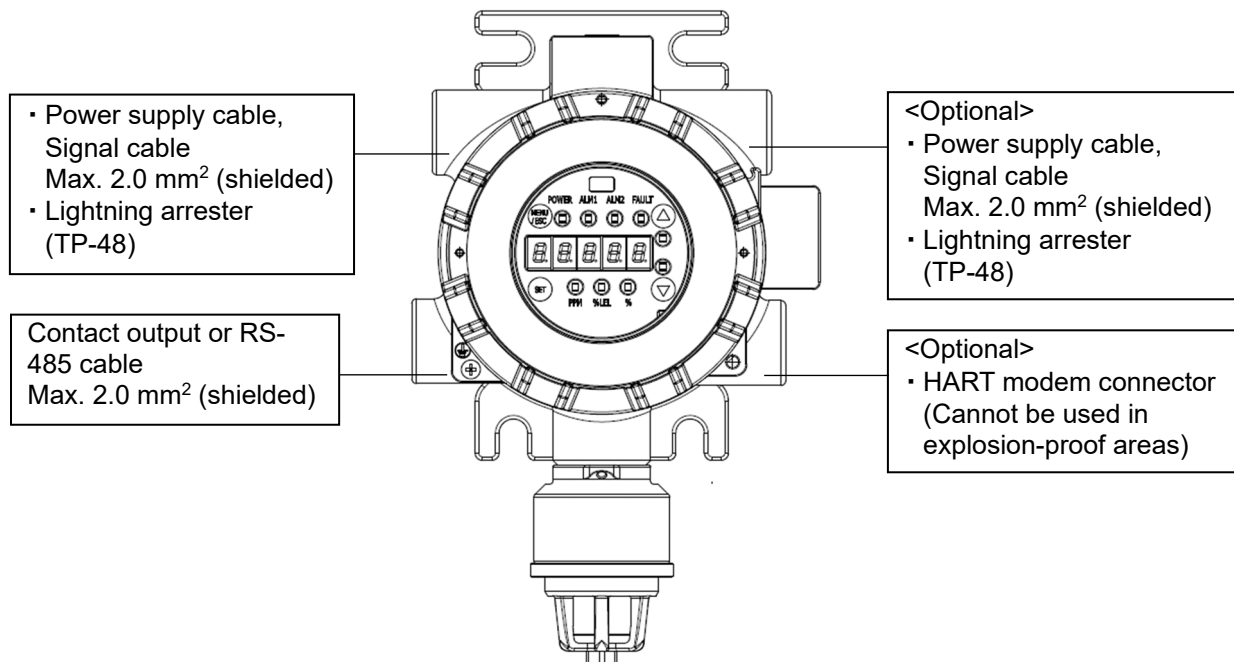
- The grounding bolt is marked with the  symbol.

4-7 Cable connection

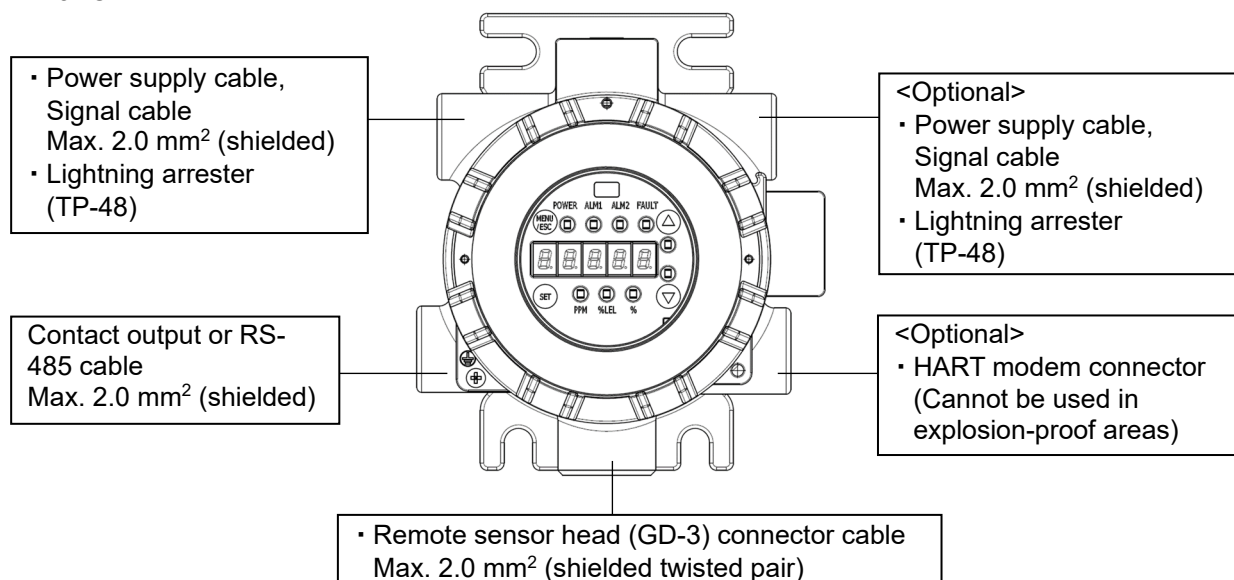
4-7-1 Main unit cable and device connectors

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

<SD-3>



<SD-3SC>



NOTE

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

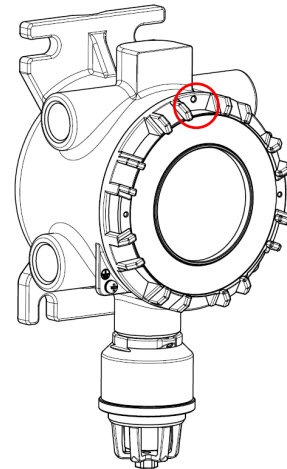
4-7-2 Connecting cables to the main unit

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

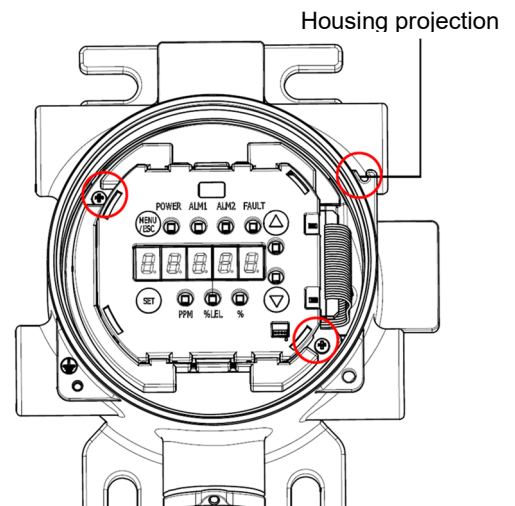
- 1 **Unscrew the M4 hex socket set screw on the main unit cover, then rotate the cover counterclockwise to remove.**

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.**



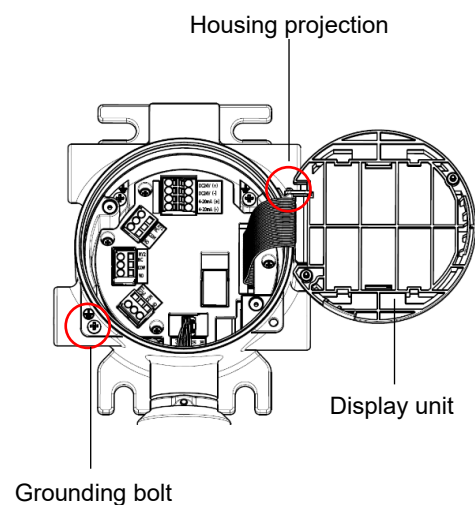
- 3 **Take out the display unit and hook onto the housing projection.**

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.**

Install with Class D equivalent grounding (grounding resistance not exceeding 100 Ω). Refer to '4-6 Connecting the grounding terminal' for information about grounding.



5 Attach a cable gland or conduit to the connector on the main unit.

Use a cable gland or conduit appropriate for the cable purpose and type.

Tighten the M25 plugs and adapters to a torque of at least 30 Nm.

6 Pull out the terminal plate from the terminal plate PCB.

7 Connect the power and signal cables to the power supply/signal terminal plate.

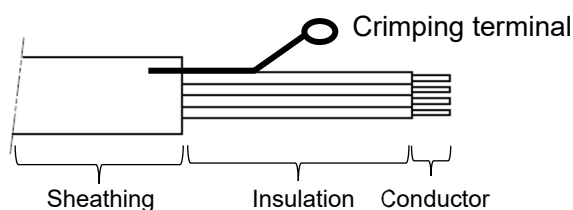
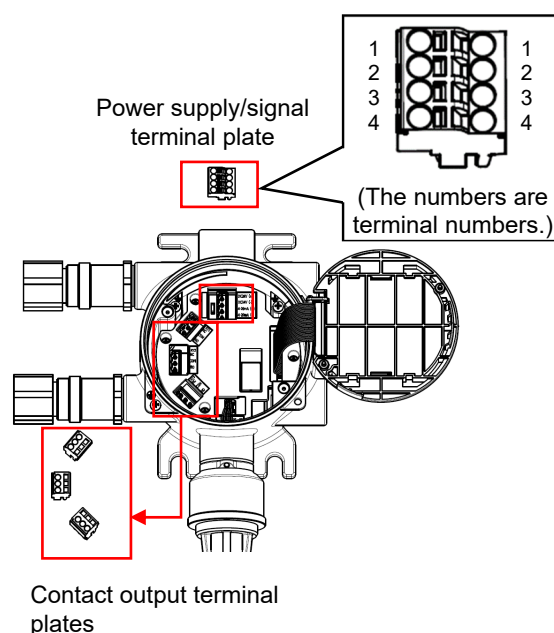
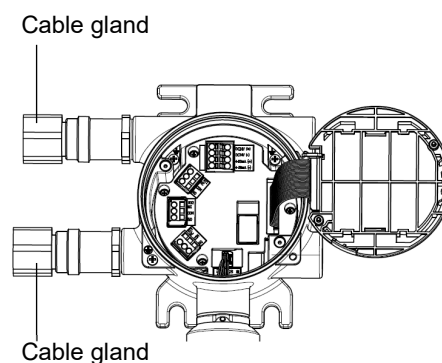
Connect each of the cables to the following terminals on the power supply/signal terminal plate: For more information on the contact cable connections, refer to '4-9 Alarm relay setting (option)'. For more information on connecting the cables to the terminal plates, refer to '4-7-5 Connecting cables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

<Using 3-core cable>

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

<Using 4-core cable>

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



Recommended insulation length: 40 mm to 50 mm

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

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

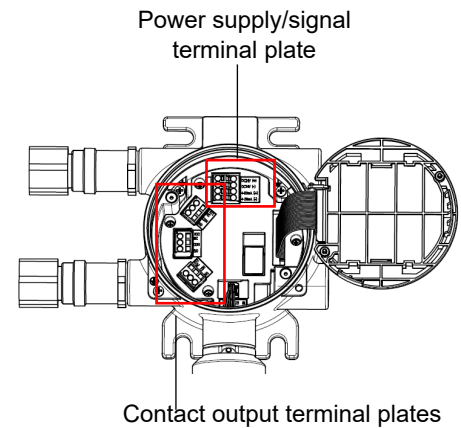
8 Connect as many contact cables as necessary to the contact output terminal plate.

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

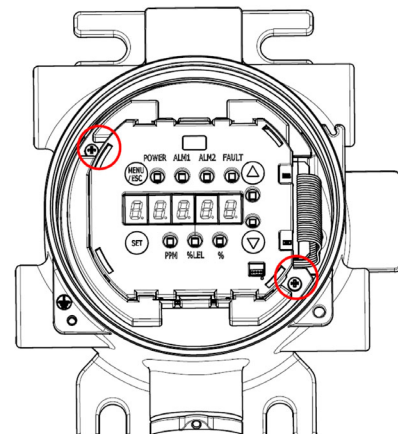
* No contact output terminal plate is present with the no contact output option.

9 Mount the terminal plate on the terminal plate PCB.

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

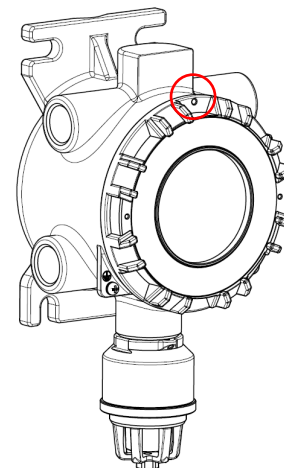
**10 Return the display unit to its original position and secure with the two M3 screws.**

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.



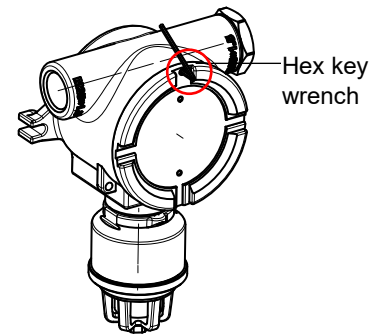
* The diagram illustrates the SD-3. The connection method is the same for the SD-3GS.

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

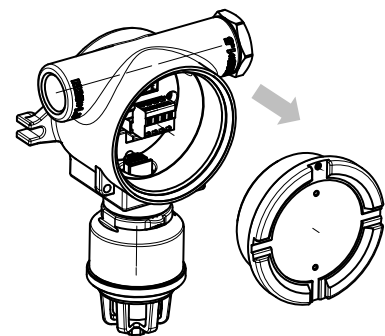
1 Unscrew the single M4 screw on the remote sensor head (GD-3) cover.

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.



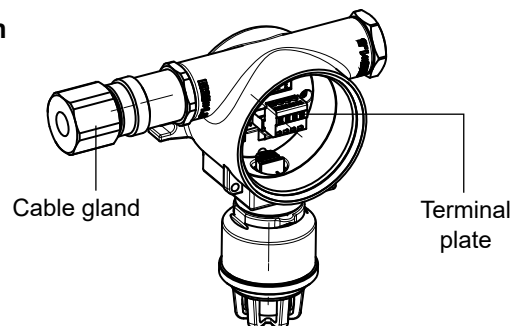
2 Rotate the cover counterclockwise and remove.



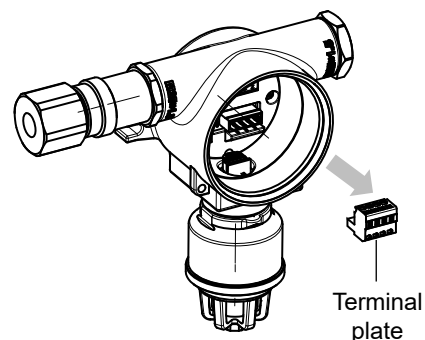
3 Attach a cable gland or conduit to the connector on the remote sensor head (GD-3).

Use a cable gland or conduit appropriate for the cable purpose and type.

Tighten the M25 plugs and adapters to a torque of at least 30 Nm.



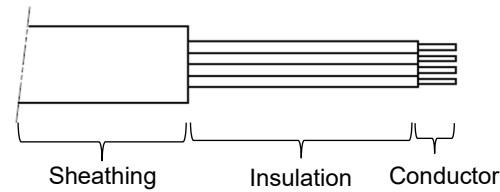
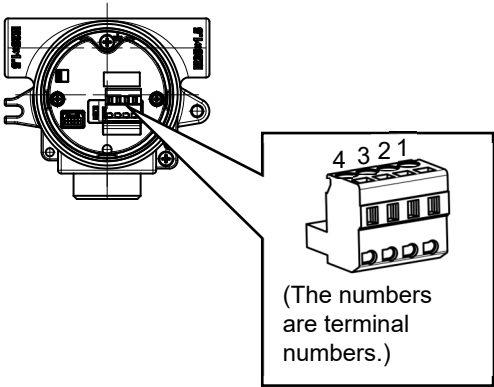
4 Pull out the terminal plate (TN1) from the terminal plate board.



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

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

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



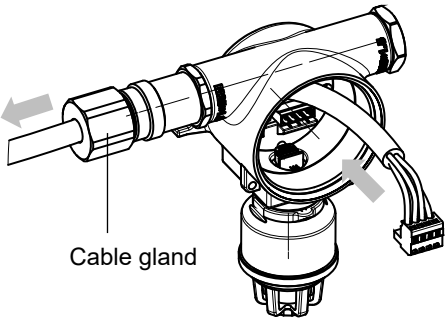
Recommended insulation length: 50 mm to 60 mm

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

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

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

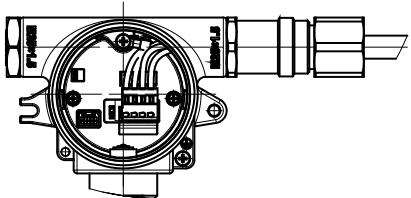
Route to the connector on the side where the cable gland or conduit is attached.



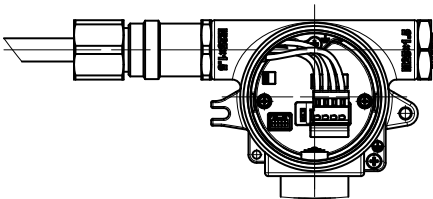
7 Mount the terminal plate on the terminal plate PCB.

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

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



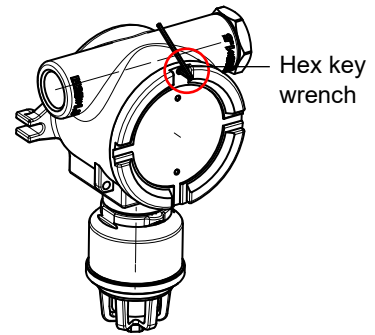
<With cable (external cable) routed to left-hand side>



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.

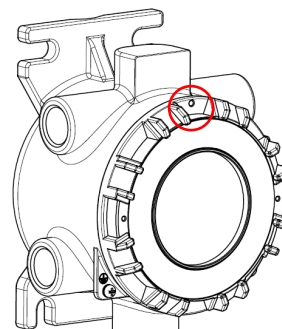


4-7-4 Connecting the main unit (SD-3SC) and remote sensor head (GD-3)

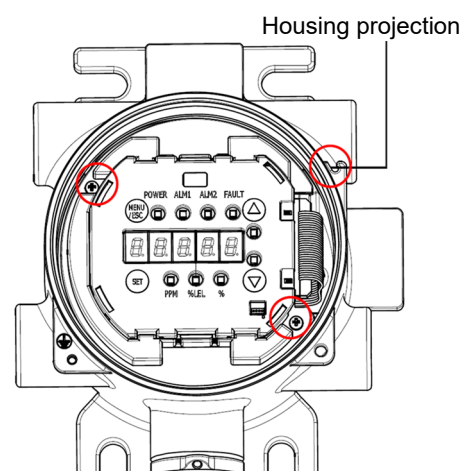
- 1 **Unscrew the single M4 hex socket set screw on the main unit (SD-3SC) cover, then rotate the cover counterclockwise to remove.**

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.



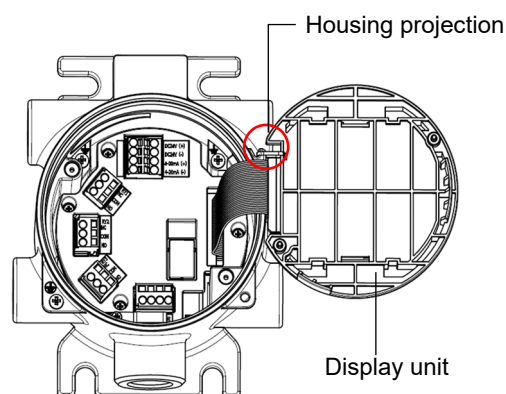
- 2 **Unscrew the two M3 screws securing the display unit.**



- 3 **Take out the display unit and hook onto the housing projection.**

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

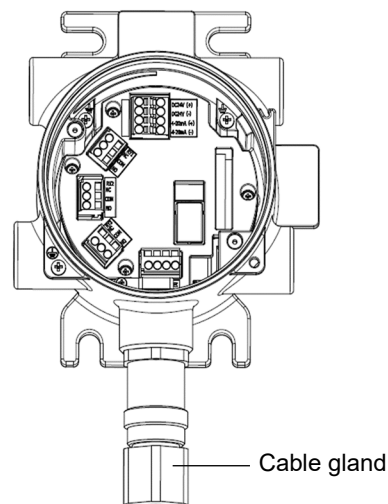
During the removal process, avoid pulling on the display unit with excessive force.



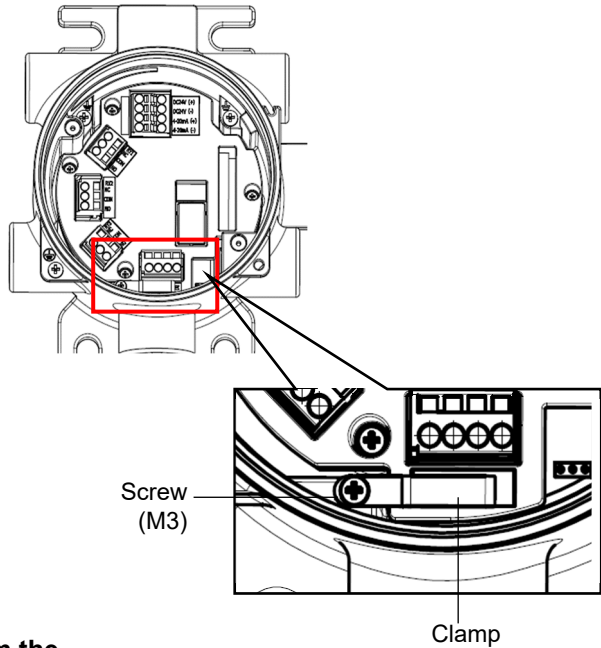
- 4 **Attach a cable gland or conduit to the connector on the main unit.**

Use a cable gland or conduit appropriate for the cable purpose and type.

Tighten the M25 plugs and adapters to a torque of at least 30 Nm.

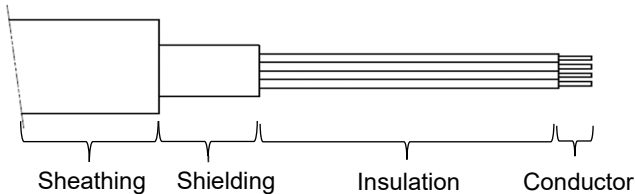


- 5 Pull out the remote connections terminal plate from the terminal plate PCB.
- 6 Unscrew the single M3 screw securing the clamp, then remove the clamp.

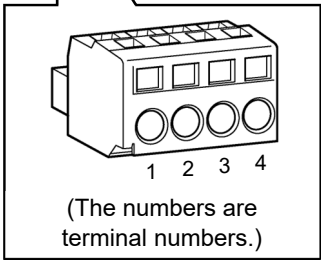
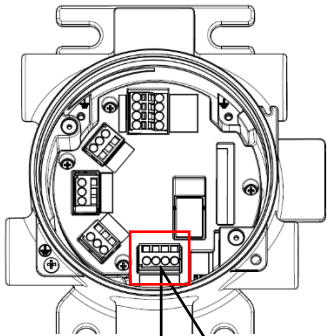


- 7 Connect the power and signal cables leading from the remote sensor head (GD-3) to the remote connections terminal plate.
Connect the cables to the following terminals on the remote connections terminal plate. For more information on connecting cables to the terminal plates, refer to '4-7-5 Connecting cables to the terminal plate'.

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



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

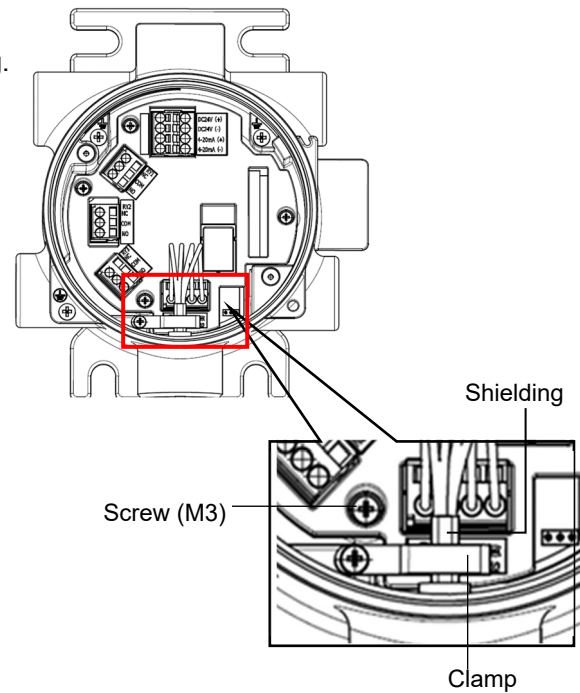


Remote connections terminal plate

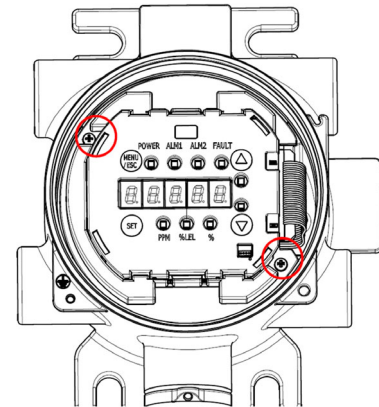
- 8 Mount the terminal plate on the terminal plate PCB.
Adjust the cable position so that no load is applied to the terminal plates.

9 Put the shield clamp on the cable.

Use the single M3 screw to clamp the cable shielding.

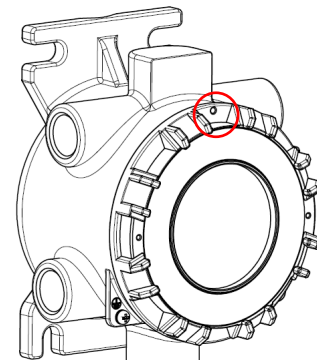
**10 Return the display unit to its original position and secure with the two M3 screws.**

Take care not to trap the cable here.

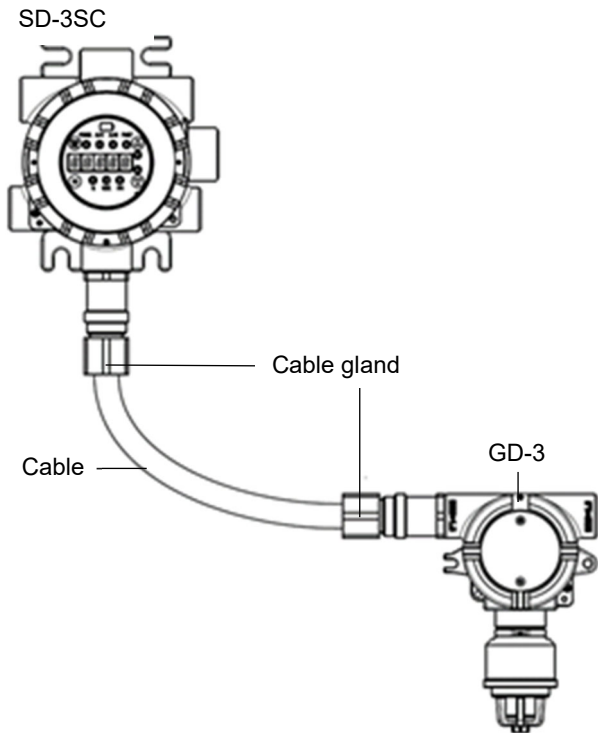
**11 Rotate the cover clockwise to attach, then secure with the single M4 hex socket set screw.**

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

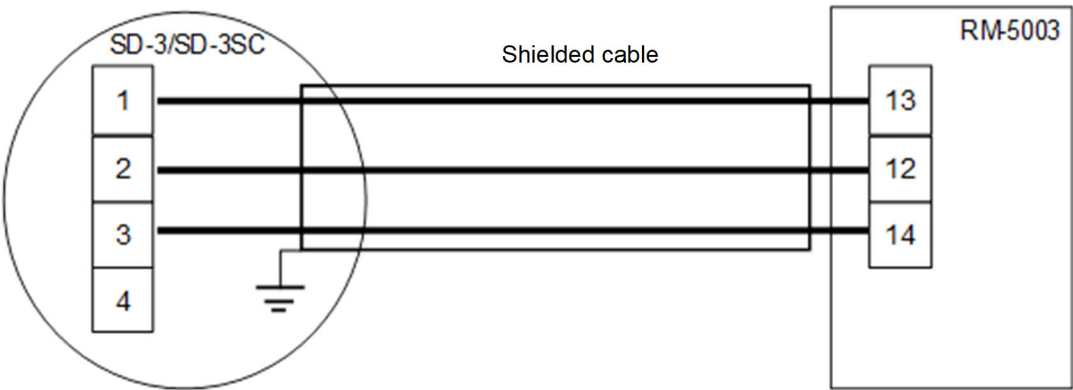
Take care not to trap the cable when attaching the cover.
Rotate the cover clockwise until it moves no further to securely fasten in place.



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



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

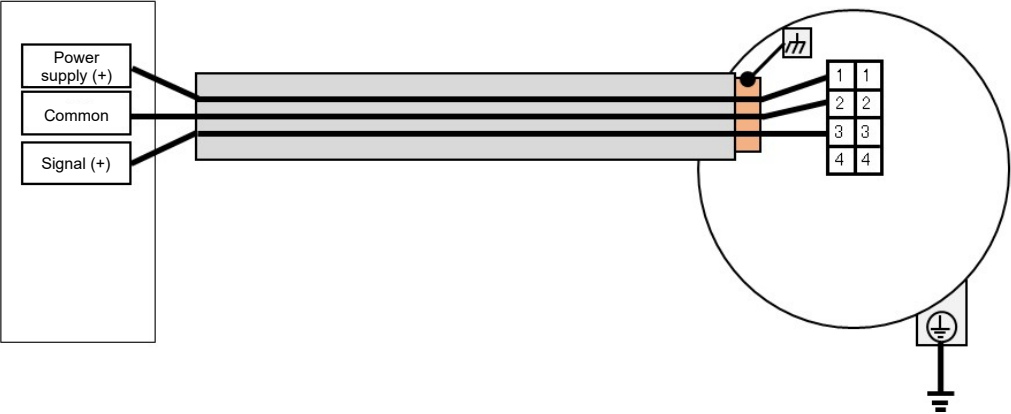


<Indicator connection example>

<SD-3>

Indicator (e.g., RM-5003)

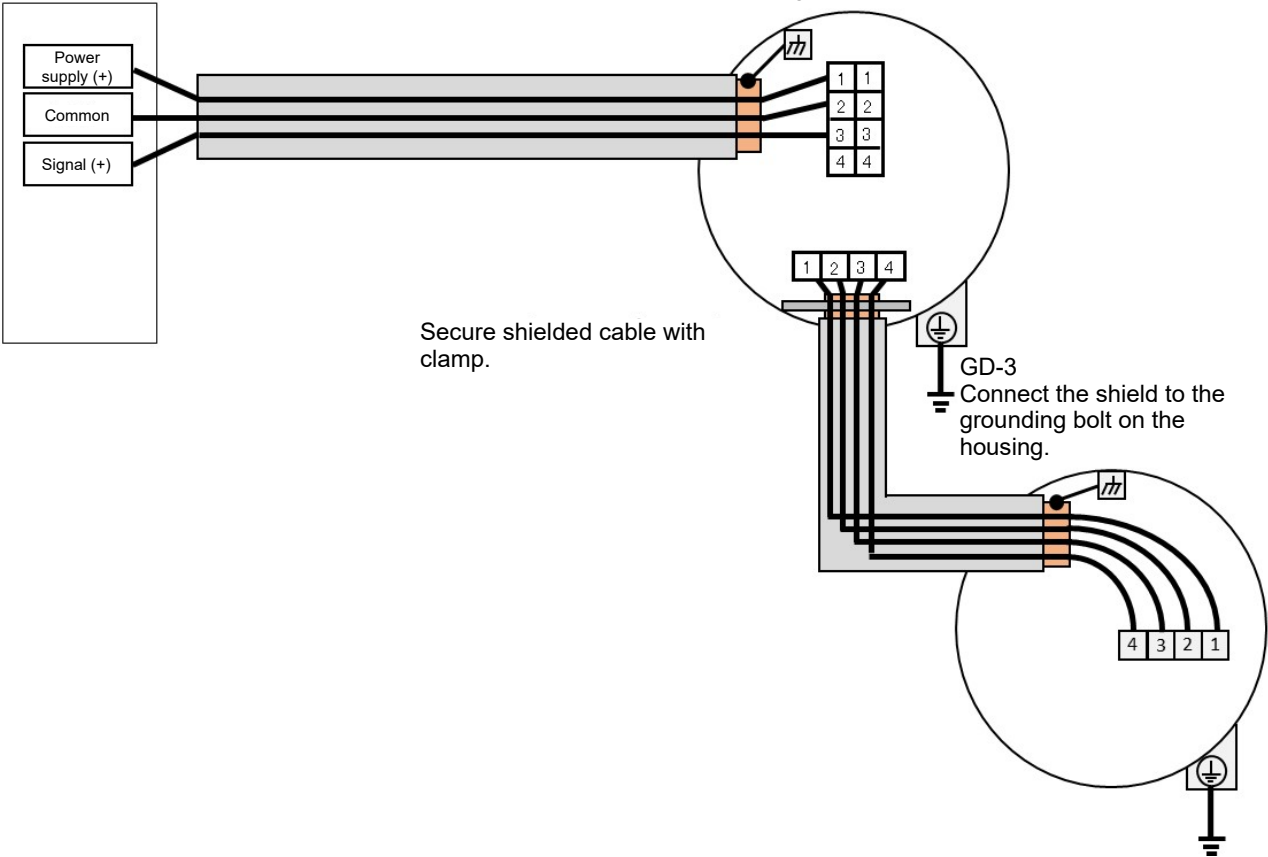
SD-3
Connect the shield to the grounding bolt on the housing.



<SD-3SC>

Indicator (e.g., RM-5003)

SD-3SC
Connect the shield to the grounding bolt on the housing.



4-7-5 Connecting cables to the terminal plate

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

<Terminal plate specifications>

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

This will vary depending on the cable used.

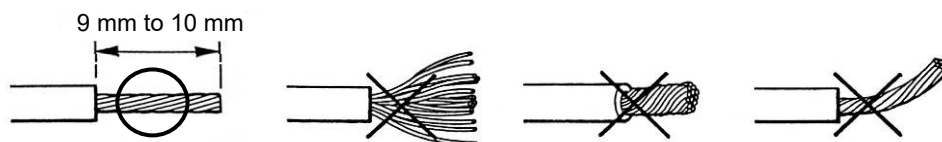
<Connecting conditions>

- Cable used: 0.25 mm² to 2.5 mm²
- Maximum sheathing external diameter: 4.1 mm
- Stripped wire (conductor) length: 8 mm to 9 mm (9 mm to 10 mm for SD-3 TN1 only)
- Connection tools: Flathead screwdriver (blade tip 2.5 × 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. Insulation failure or overheating may result if the wire splays when inserted.
- To avoid this, we recommend using a bar terminal (ferrule) if the stripped wire is stranded wire cable.



<Compatible bar terminal >

If you use a bar terminal, use one of the following:

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



- Be sure to use the specified bar terminals. Performance is guaranteed only for the bar terminals 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 2.5×0.5 mm).

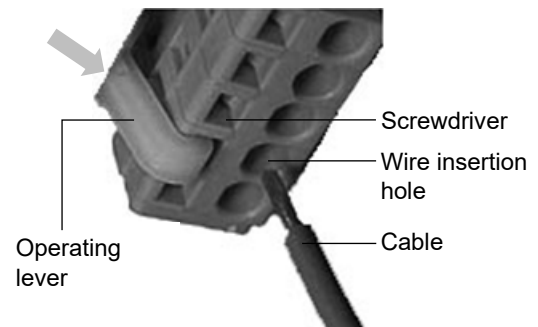
The operating lever provided as a standard accessory cannot be used to connect power and signal cables to TN1 on the SD-3. Use a flathead screwdriver in this case.

CAUTION

- Be sure to use the correct tools.
- Normally, 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:

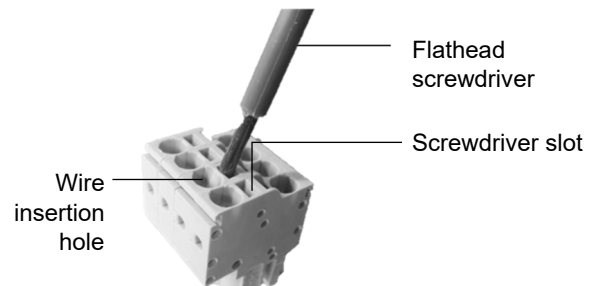
- 1 Hook the operating lever on to the screwdriver slot (rectangular hole) in the terminal plate as shown in the figure to the right.**
- 2 Push the operating lever with your finger to push down the spring inside the terminal plate.**
- 3 While continuing to press the operating lever, insert the cable into the wire insertion hole (round hole) until it touches the end.**
- 4 Release the operating lever.**



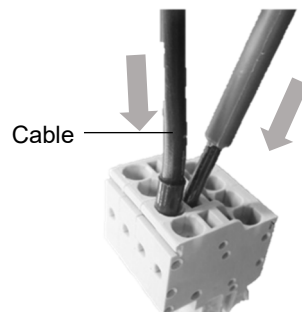
The cable is now connected to the terminal plate.
Gently pull on the cable to confirm that it is correctly connected.
Avoid pulling with excessive force.

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 While continuing to press the screwdriver in, insert the cable into the wire insertion hole (round hole) until it touches 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.

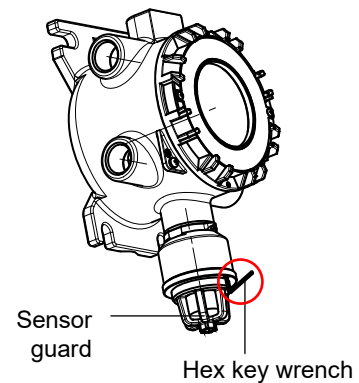
4-8 Mounting the sensor

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 screw securing the sensor guard.**

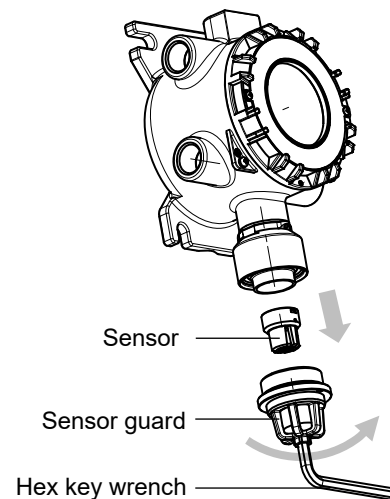
Use a hex key wrench (2 across flats) to unscrew the M4 hex socket set screw.



- 3 **Rotate and remove the sensor guard.**

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

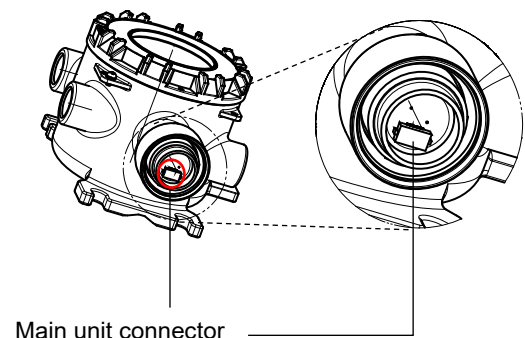
- 4 **Pull out and remove the sensor, if fitted.**

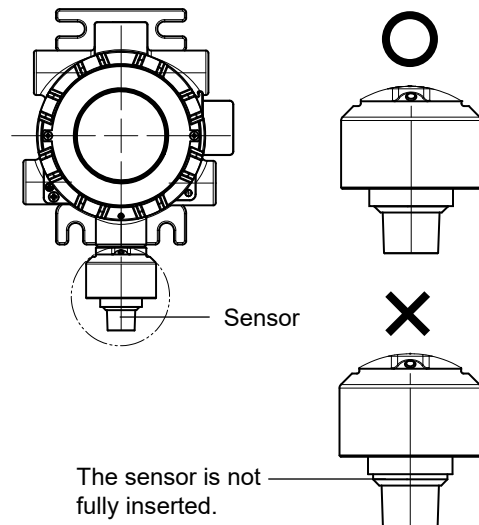


- 5 **Match the main unit connector and sensor connector and fully insert the sensor.**

Push the sensor all the way into the main unit connector.

To avoid damaging the main unit, avoid turning or pushing with excessive force when inserting the sensor.

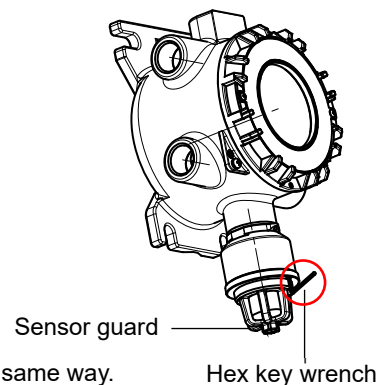


6 Confirm that the sensor is fully inserted.**7 Attach the sensor guard to the main unit.**

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. Mount the remote sensor head (GD-3) in the same way.

**CAUTION**

- With some sensors, infiltration of foreign matter during sensor replacement may cause fluctuation of the reading.

4-9 Alarm relay setting (option)

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

**WARNING**

- For supply voltages 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

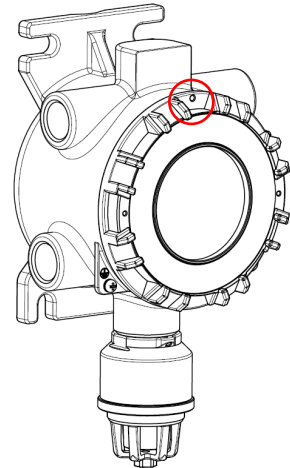
- Note that recurring use with the alarm relay contacts normally closed may result in the contacts seizing due to minute vibrations.
- Connect the alarm relay cable and sensor before turning on the power to the product.

To set the alarm relay, connect the alarm unit cables to the TN2 (Relay1: ALARM1), TN3 (Relay2: ALARM2), and TN4 (Relay3: FAULT) terminal plates on the main unit (SD-3/SD-3SC).

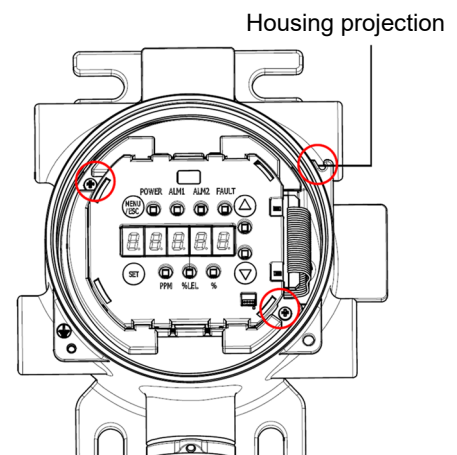
1 Unscrew the M4 hex socket set screw on the main unit cover, then rotate the cover counterclockwise to remove.

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.



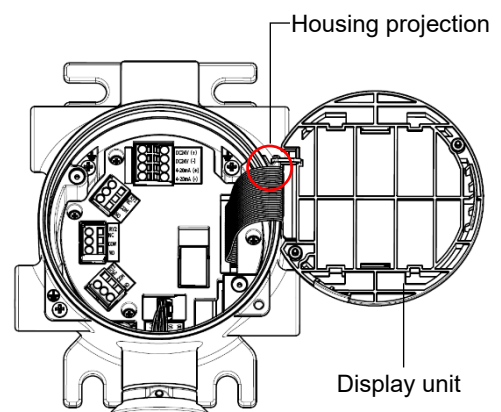
2 Unscrew the two M3 screws securing the display unit.



3 Take out the display unit and hook onto the housing projection.

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: ALARM1), TN3 (Relay2: ALARM2), and TN4 (Relay3: FAULT)) from the terminal plate PCB.**

- 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 more information on connecting cables to the terminal plates, refer to '4-7-5 Connecting cables to the terminal plate'.

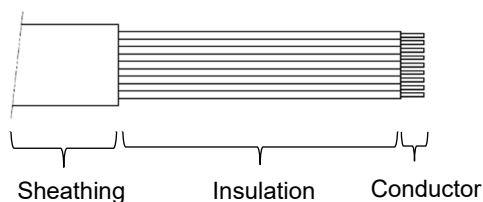
Identical for TN2 (Relay 1: ALARM1), TN3 (Relay 2: ALARM2), and TN4 (Relay3)

(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



Recommended insulation length: 120 mm to 130 mm

- 6 Mount the terminal plates (TN2 (Relay1: ALARM1), TN3 (Relay2: ALARM2), and TN4 (Relay3: FAULT)) on the terminal plate PCB.**

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

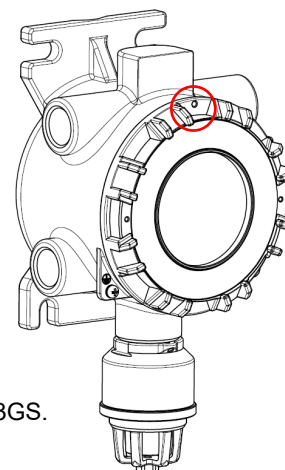
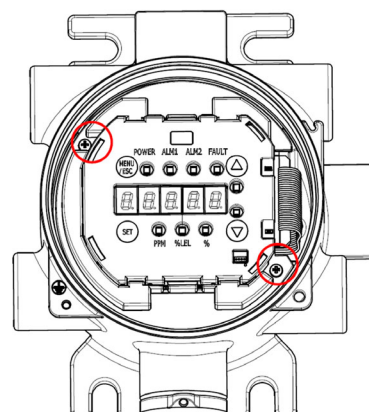
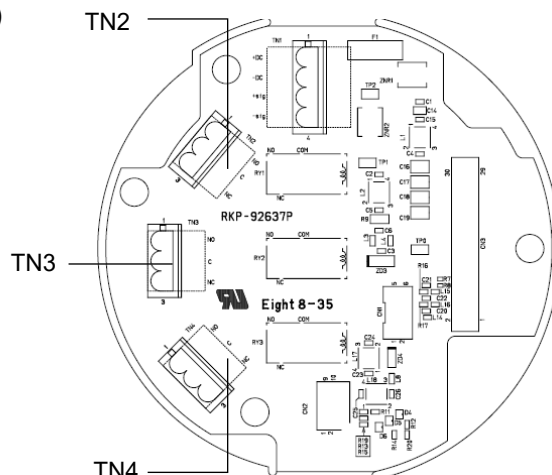
- 7 Return the display unit to its original position and secure with the two M3 screws.**

Take care not to trap the cable here.

- 8 Rotate the cover clockwise to attach, then 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.



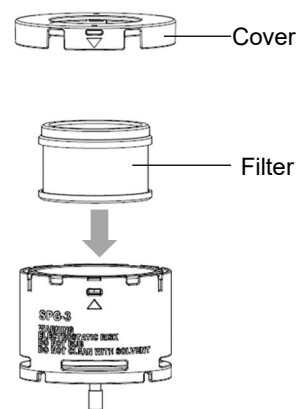
* The diagram illustrates the SD-3. :The connection method is the same for the SD-3GS.

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.**

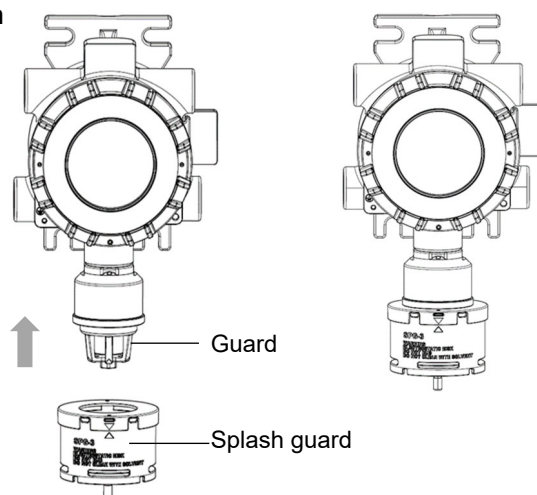
This step is required only when using a silicone removal filter or activated carbon filter.



- 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. Mount the remote sensor head (GD-3) in the same way.

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.

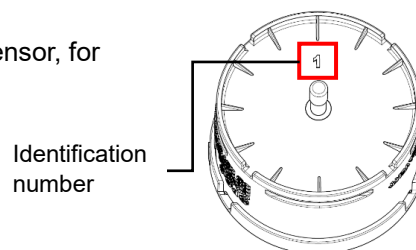
- IRF sensor identification number: 1
- NCF/SGF/SHF sensor identification number: 2
- ESF/TCF sensor identification number: 3

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

<for IRF sensor>
SD-3RI
GD-3RI

<for NCF/SGF/SHF sensor>
SD-3NC
SD-3GH
SD-3GHS
SD-3SP
GD-3NC
GD-3GH
GD-3GHS
GD-3SP

<for ESF/ TCF sensor>
SD-3EC
SD-3ECS
SD-3ECB
GD-3EC
GD-3ECS
GD-3ECB
GD-3NPM



Identification number

4-11 Mounting the lightning arrester

The SD-3 allows a lightning arrester to be connected easily.

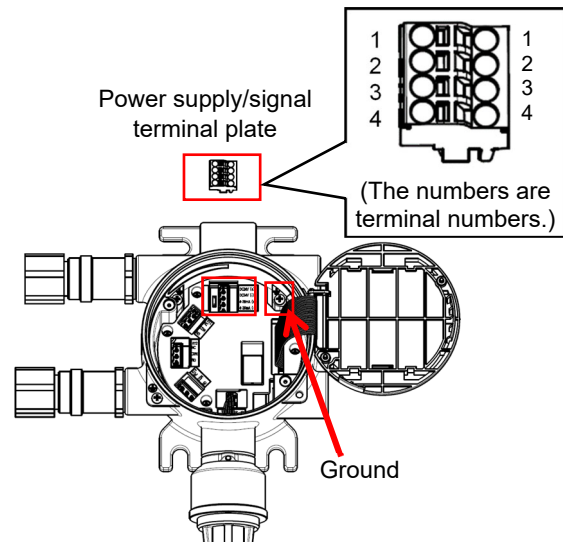
Be sure to use the specified model and connect it to the power and signal terminal plate.

<3-wire type>

Terminal No.	Power supply/signal connection	Lightning arrester connection
1	Power supply (+)	Blue
2	Common (-)	Brown
3	Signal (+)	Black
Ground	—	Green/yellow

<4-wire type>

Terminal No.	Power supply/signal connection	Lightning arrester connection
1	Power supply (+)	Blue
2	Power supply (-)	Brown
3	Signal (+)	Black
4	Signal (-)	White
Ground	—	Green/yellow



NOTE

► [Lightning arrester]

Model: TP48-3-N-NDI

TP48-4-N-NDI

* Use connector 2 or 4 to connect the lightning arrester.

Explosion-proof performance requirements cannot be guaranteed if any other connectors are used.

► Perform an operation check before installing lightning arresters. Additionally, lightning arresters cannot remove all surge voltages.



CAUTION

- This applies to ATEX/IECEx models only.
- Stop using the product if any irregularities occur during operation.

4-12 RS-485 setting (option)

RS-485 can be used to allow digital communication.



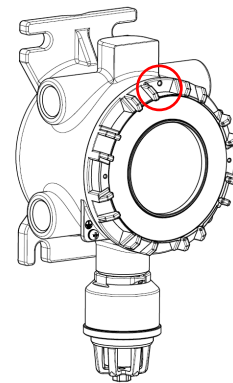
- Use shielded twisted pair cable.
- Do not route cables close to trunk cables or high-voltage equipment.
- Do not connect devices other than the SD-3 Series to Modbus.

When using RS-485, connect the RS-485 communication wiring to the TN2 terminal plate 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.**

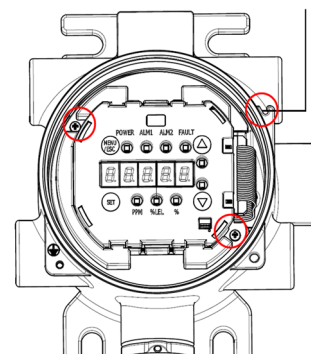
Use a hex key wrench (2 across flats) to unscrew the M4 hex socket set screw.

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



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

Housing projection

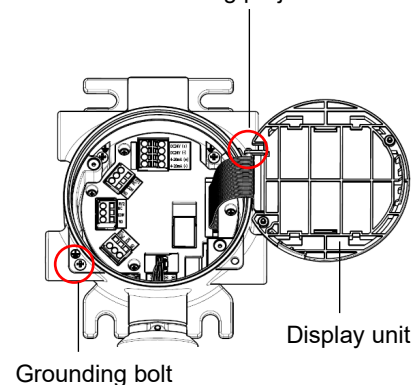


- 3 Take out the display unit and hook onto the housing projection.**

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.

Housing projection



- 4 Pull out the terminal plate (TN2 (RS-485)) from the terminal plate board.

- 5 Set the termination resistor to ON only for the device connected at the furthest position on the Modbus network.

Do not set the termination resistor to ON for any other device.
JP1

Terminal No.	Termination resistor
1 to 2 (standard)	OFF
3-2	ON (120 Ω)

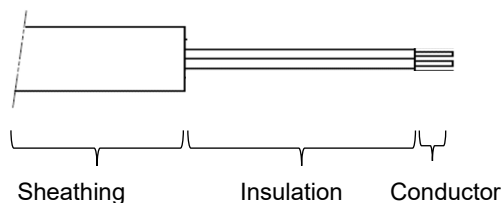
- 6 Connect the RS-485 communication wires to the corresponding terminals on the detached terminal plate.
For more information on connecting cables to the terminal plates, refer to '4-7-5 Connecting cables to the terminal plate'.

TN2 (RS-485)

Terminal No.	Cable connection
1	RS-485 (A1)
2	RS-485 (B1)
3	RS-485 (A2)
4	RS-485 (B2)

TN3

Terminal No.	Cable connection
1	Signal ground
2	N.C.
3	Function ground



Recommended insulation length: 40 mm to 50 mm

- 7 Mount the terminal plate (TN2 (RS-485)) on the terminal plate PCB.

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

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

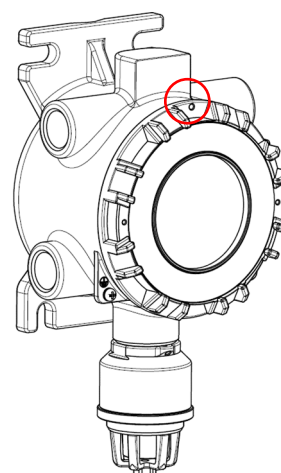
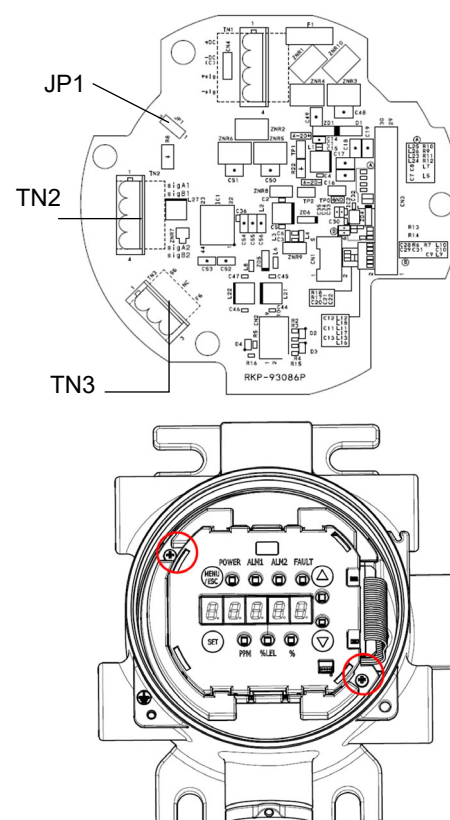
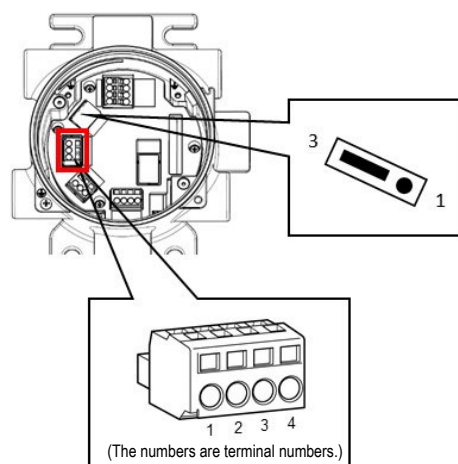
Take care not to trap the cable here.

- 9 Rotate the cover clockwise to attach, then 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 is the same for the SD-3GS.



5

Usage Instructions

5-1 Preparations for startup

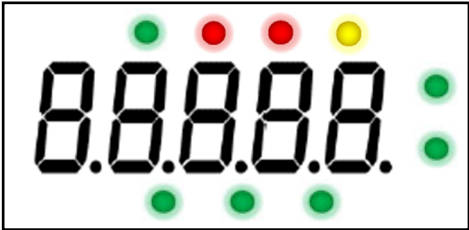
Perform the following checks before connecting the power supply. Failure to perform these checks may result in electric shock or damage to the product.

- 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 activate while adjustments are underway. Take precautions to prevent unwanted consequences due to activated contacts.

<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 AL1 AL2 F



PPM %LEL %

PW: POWER (power lamp)  lights up (green)/  flashes (green).

AL1: ALM1 (alarm lamp)  lights up (red).

AL2: ALM2 (alarm lamp)  lights up (red).

F: FAULT (fault lamp)  lights up (yellow).

PPM: Unit lamp  lights up (green).

%LEL: Unit lamp  lights up (green).

%: Unit lamp  lights up (green).

5-2 Startup



CAUTION

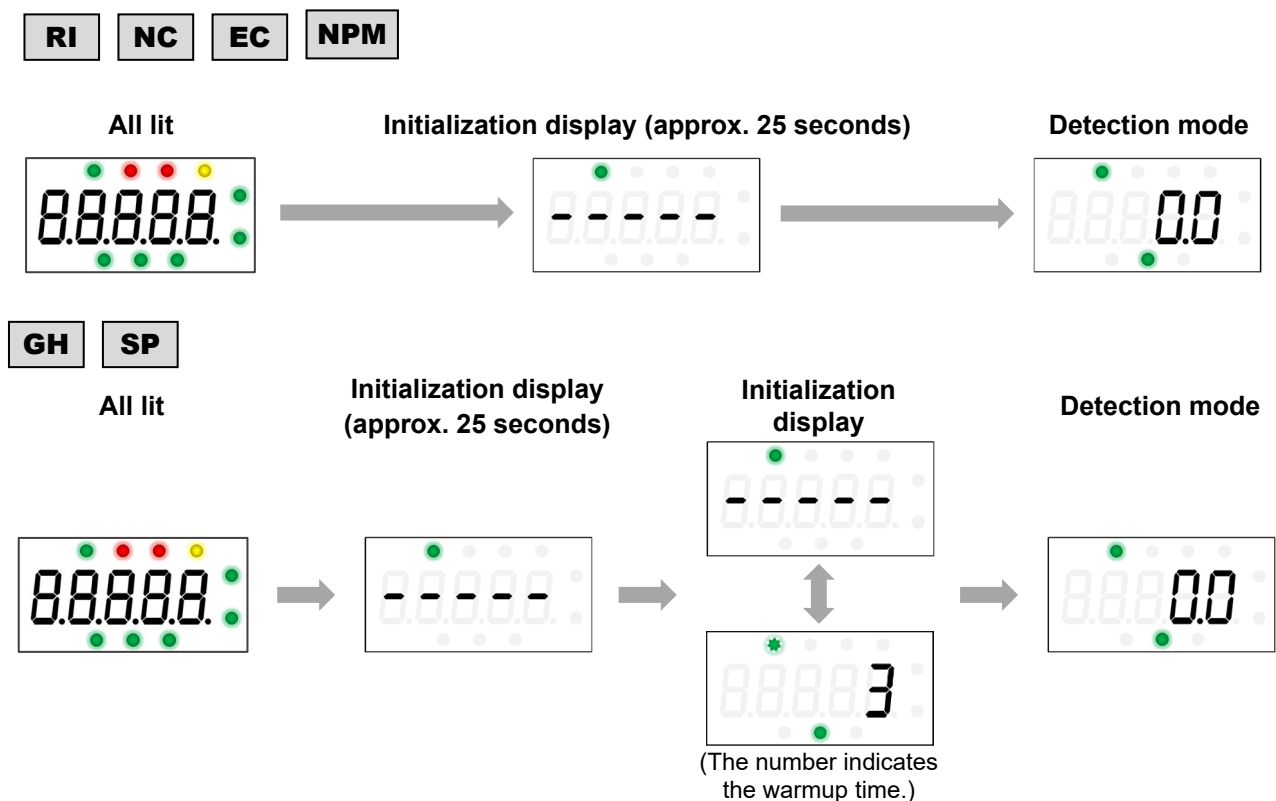
- Check to confirm that the product has been correctly installed before turning on the power supply (24 V DC).

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.

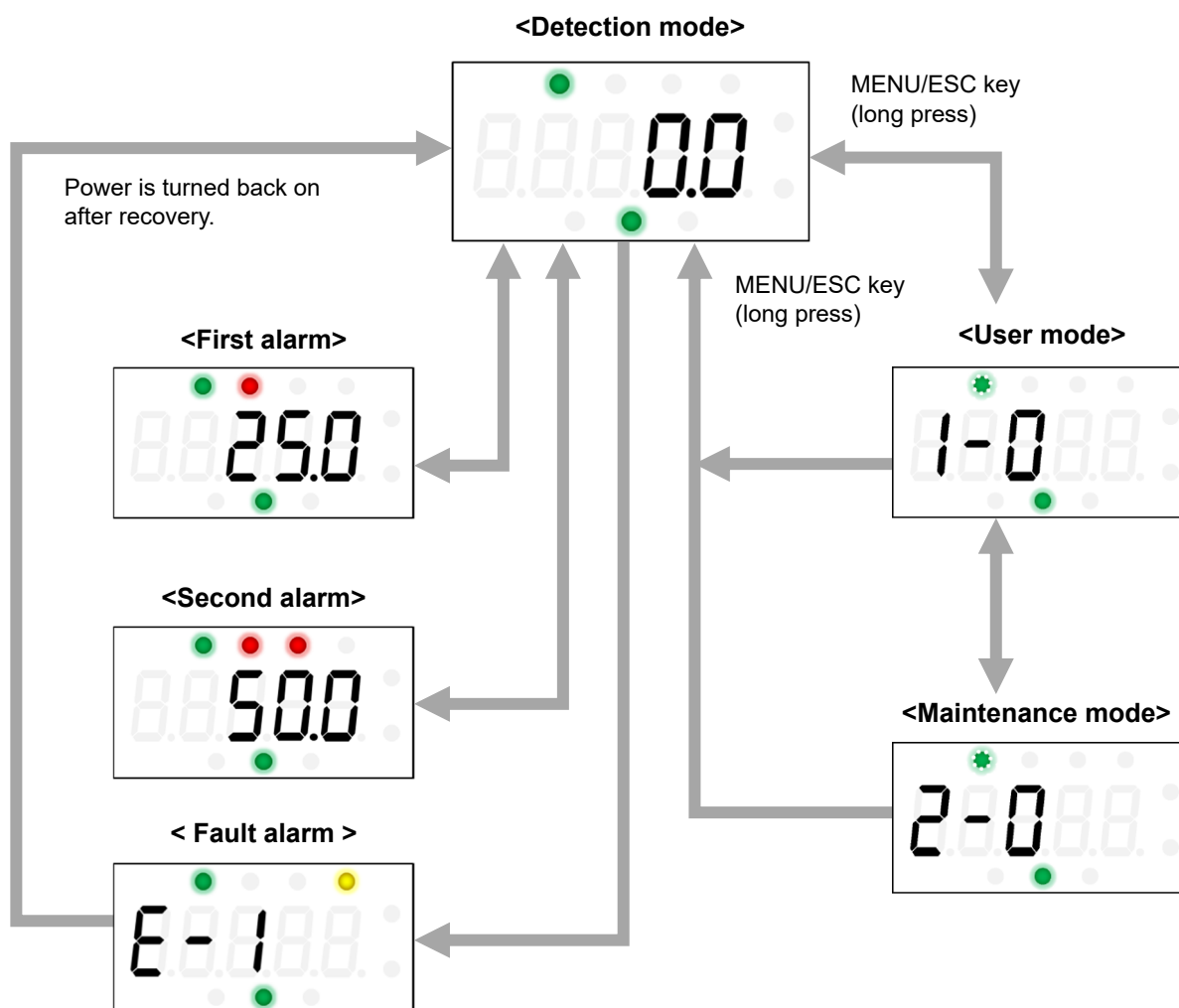


CAUTION

- Never turn off the power while initialization is underway. The internal memory is read during initialization.
- Depending on the sensor, warmup may be required after startup or when replacing the sensor. 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. To avoid problems, notify any departments that may be affected beforehand.
- 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'.)

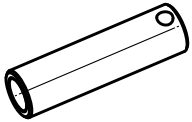
5-4 Operating procedure

The product is operated using a 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 end users.
1-1	Zero calibration		Performs zero calibration. (Refer to '5-6 Performing zero calibration'.)
1-2	Setting display		Sets various settings such as alarm settings and RS-485 communication 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. This is dangerous because no monitoring occurs during this time.

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 interference 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 adjustment is unsuccessful because the zero point fluctuates significantly around zero, a [FAIL] message will appear 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 more information, refer to '7-4-3 Performing span adjustment'.
-

5-7 Checking settings

Sets various settings such as alarm settings and RS-485 communication 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	RS-485 setting display	Displays the RS-485 communication settings.

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.

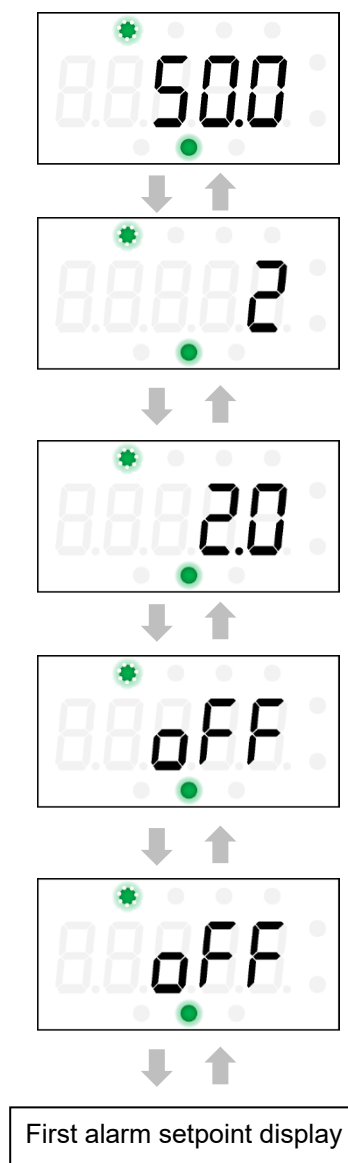
Press the ▲ or ▼ key to toggle between different setpoints.

- First alarm setpoint display
Displays the first alarm setpoint.



- Second alarm setpoint display
Displays the second alarm setpoint.
- Alarm delay time display
Displays the alarm delay time (in seconds).
(There is not normally a need for end users to change these settings.)
- Zero suppression value display
Displays the positive side suppression value.
- Zero follower ON/OFF display
Displays the zero follower ON/OFF setting.
(There is not normally a need for end users to change these settings.)
- Sensitivity correction ON/OFF display
Displays the sensitivity correction ON/OFF setting.
(There is not normally a need for end users to change these settings.)

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



- 4 Press the MENU/ESC key.**
The display returns to [1-2.0].

NOTE

- The first alarm setpoint, second alarm setpoint, and zero suppression values can be set in environmental settings 1 in maintenance mode. (Refer to '7-5 Setting environmental settings 1'.)

5-7-2 Checking the RS-485 communication settings

Display the RS-485 settings, including address, communication speed, data length, and parity.

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

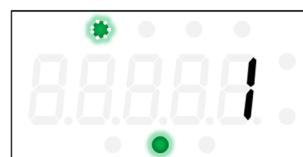


- 2 Select [1-2.1], then press the SET key.



- 3 Check the individual RS-485 communication settings.
Press the ▲ key or ▼ key to toggle between different settings.

- Address display
Displays the address.



- Communication speed display
Displays the communication speed (bps).



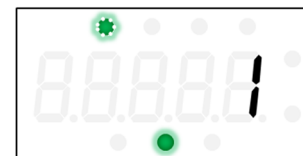
- Data length display
Displays the data length.



- Parity display
Displays the parity.
[odd]: Odd parity
[EuEn] (Even)*1: Even parity
[nonE]: None



- Stop bit display
Displays the stop bit.



*1: Displayed as [EuEn] due to the LED display limitations.

- **Communication error display**
Displays whether the communication error display setting is on or off.



Press the ▲ key to return to the RS-485 address display.

RS-485 address display

- 4 Press the MENU/ESC key.**
The display returns to [1-2.1].

NOTE

- ▶ The RS-485 communication settings can be set in the maintenance mode communication settings. (Refer to '7-7 Communication settings (RS-485)'.)
-

5-8 Shutting down

To shut down the product, 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.
- Shut down the product only after setting enabling INHIBIT 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 (default setting: two seconds) is set to prevent accidental alarm activation.

<Gas concentration display>

If the reading exceeds the detection range (i.e., exceeds the full scale), “〇〇〇〇” will appear on the LED display.

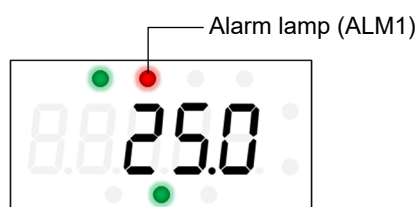
<Power/alarm lamp display>

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

The ALM1 and ALM2 alarm lamps light up (red) as shown below.

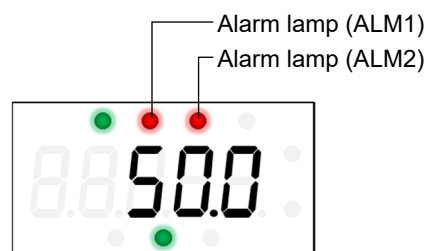
The power lamp (POWER) remains lit (green).

<First alarm>



ALM1 lights up (red).

<Second alarm>



ALM1 and ALM2 light up (red).

NOTE

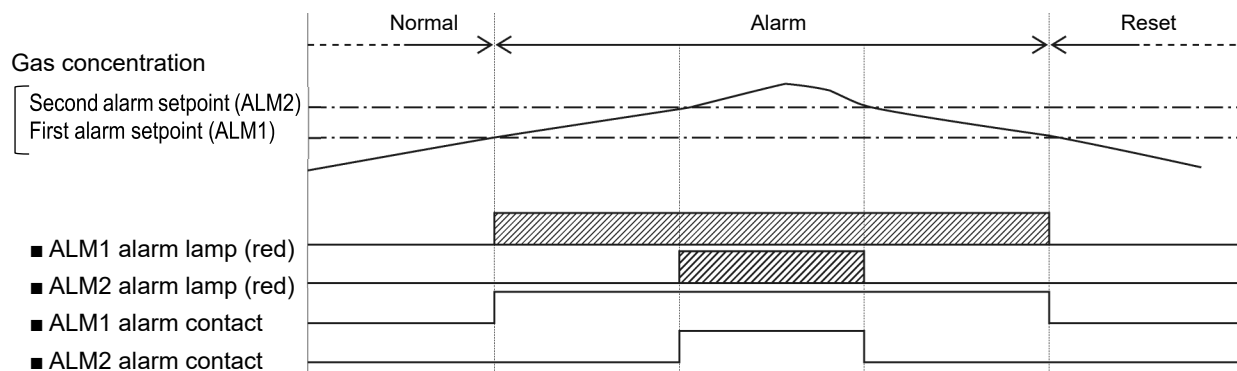
- ▶ If the alarm pattern is set to self-latching, the alarm will continue even when the gas concentration falls below the alarm setpoint.
Confirm that there is no gas in the vicinity before performing key operations. The alarm state will be canceled by key operation.

6-1-2 Contact operation (auto reset)

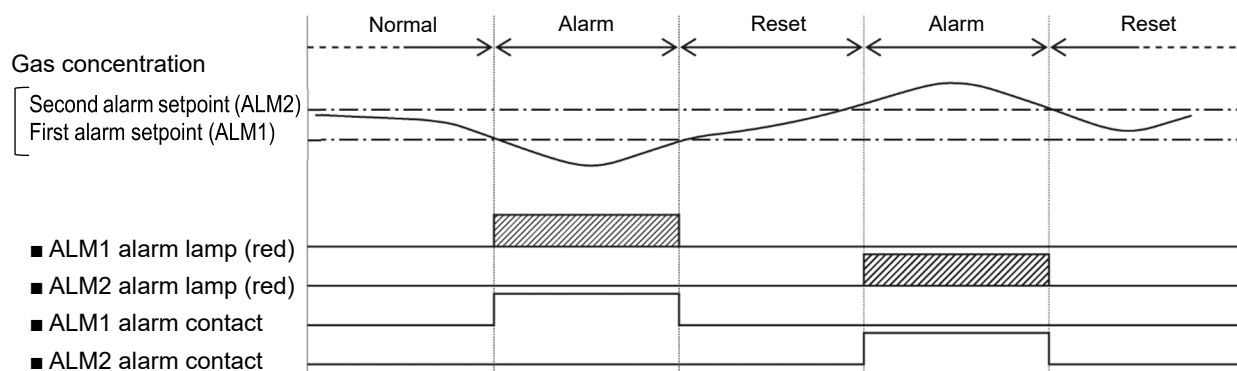
If auto reset is set, the contacts will activate when the gas concentration reaches or exceeds the alarm setpoint.

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

<Alarm pattern (H-HH)>

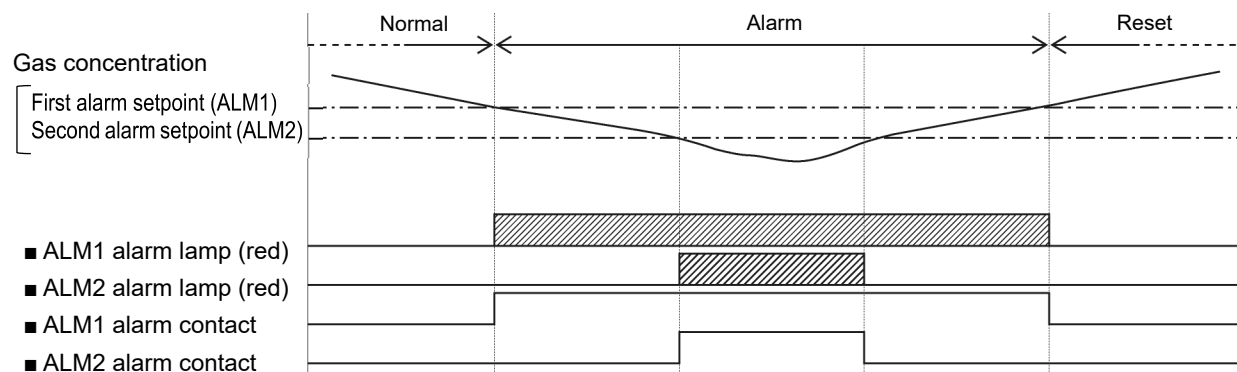


<Alarm pattern (L-H)>



<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.

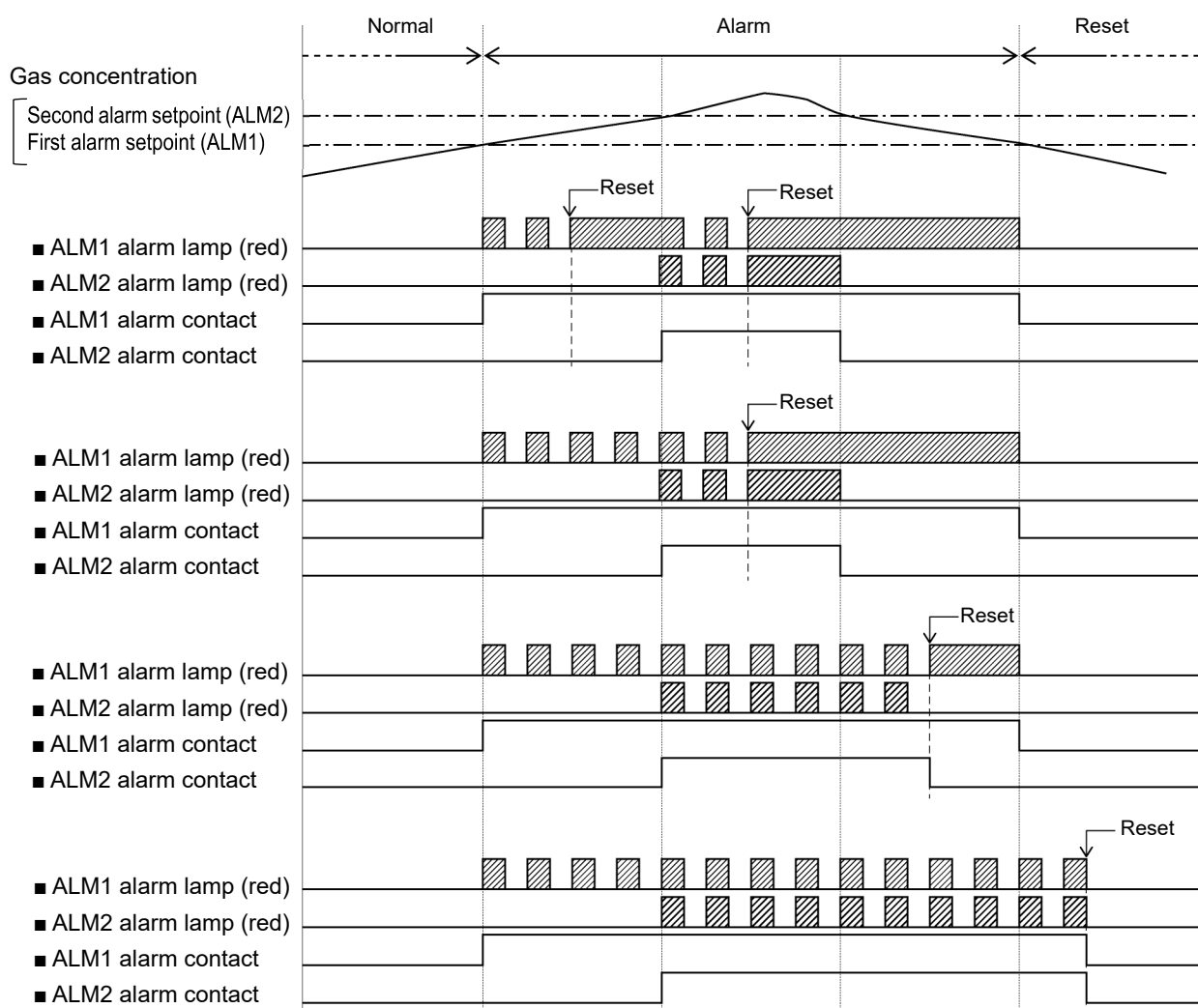
The contact operation is automatically reset when the gas concentration falls below the alarm setpoint after resetting.

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

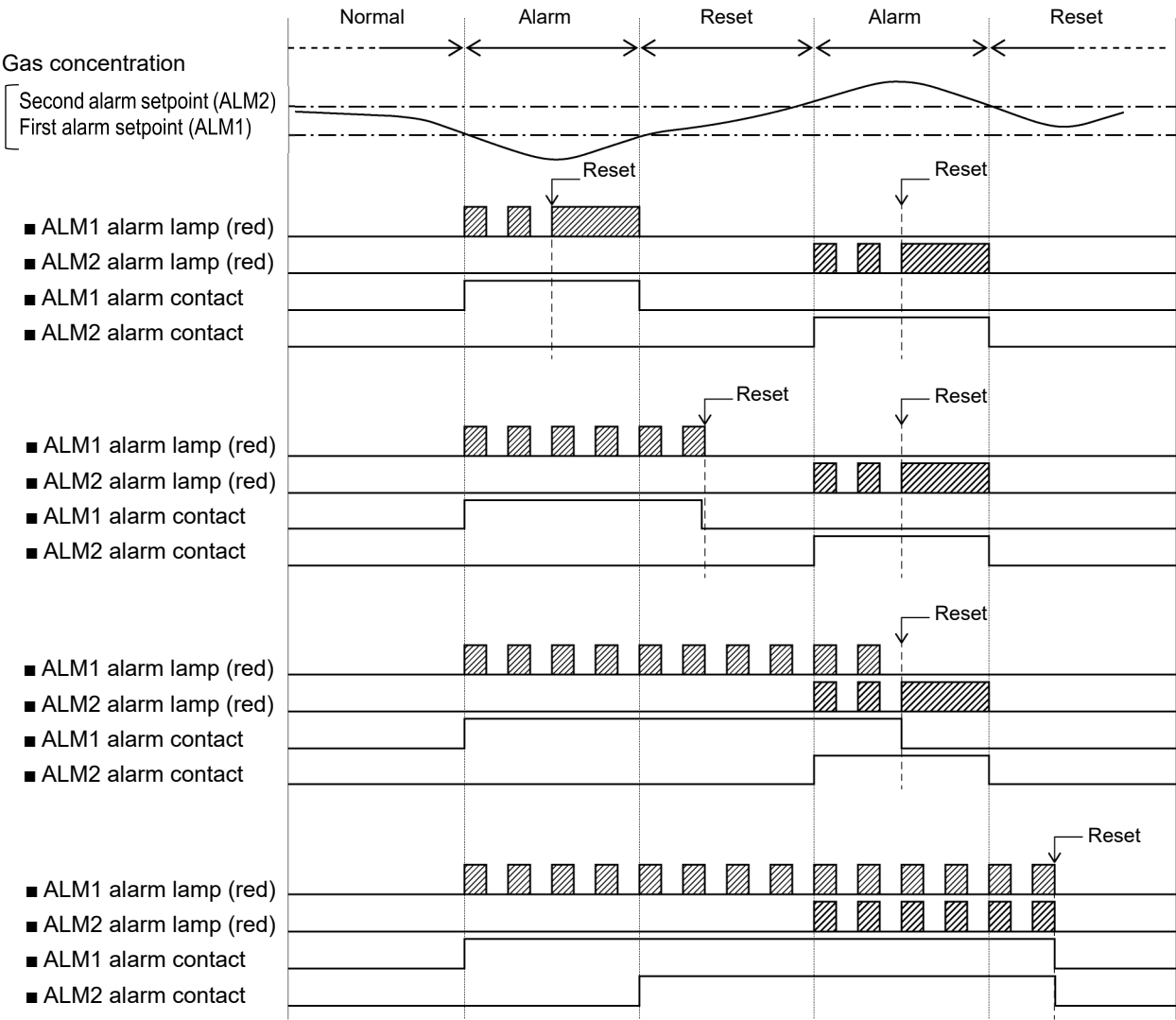
NOTE

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

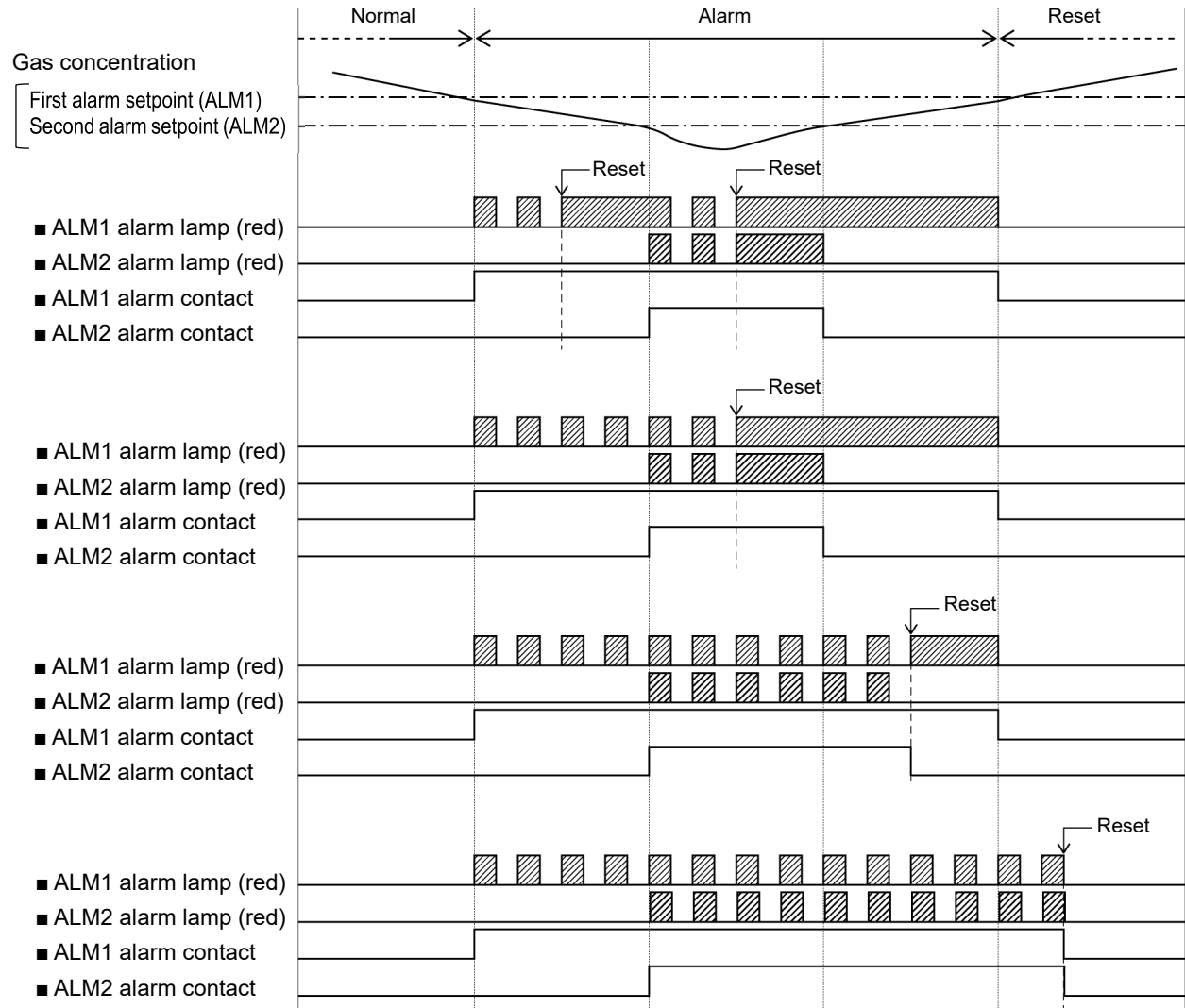
<Alarm pattern (H-HH)>



<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 already have dropped by the time it 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 persons out of the monitored zone to ensure safety in accordance with 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.

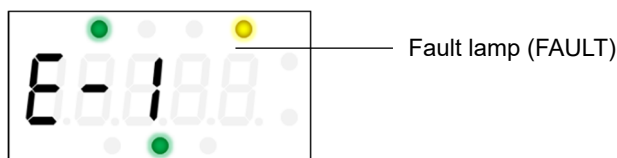
Step 5 Once you have determined that no hazard remains, take action to fix the gas leak.

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) will light up in yellow, and an error code will be displayed as shown below.

<In case of sensor abnormality>



FAULT lights up (yellow).

NOTE

- ▶ Following fault recovery, initialization is performed and the product restarts.
- ▶ 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 a warning code [E-27] will be displayed alternately.

Gas can still be measured in this state, as this is not a product fault. The device will issue a 4 - 20 mA external output based on the target gas concentration. The fault lamp will not illuminate.

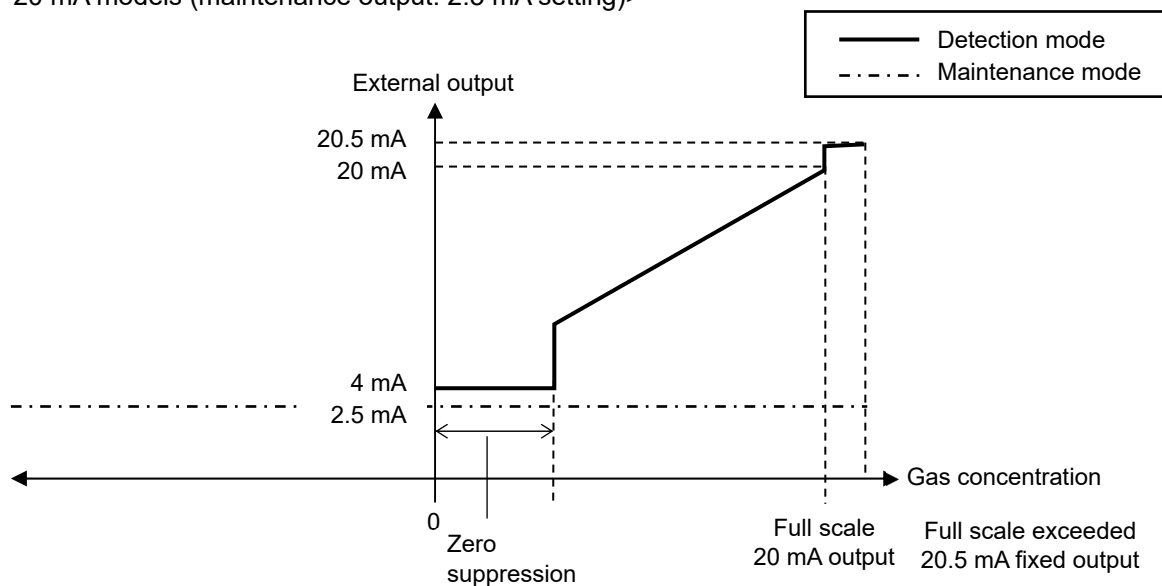
6-4 External output operations

6-4-1 For target gases other than oxygen

	Mode	4 - 20 mA (output value)
1	Power supply off	0 mA
2	Initialization	Depends on the settings for item 11. 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	Depends on the settings for item 11. 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	Depends on the settings for item 11. 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 models (maintenance output: 2.5 mA setting)>



CAUTION

- 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/active or during initialization, the output will be based on the 4 - 20 mA output setting (as 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.
- If the suppression function is disabled, the signal will be a 4 mA (0 %LEL) linear output.
- When the suppression function on the minus side is disabled, the signal will become 3.2 mA (-5 %LEL) linear output.

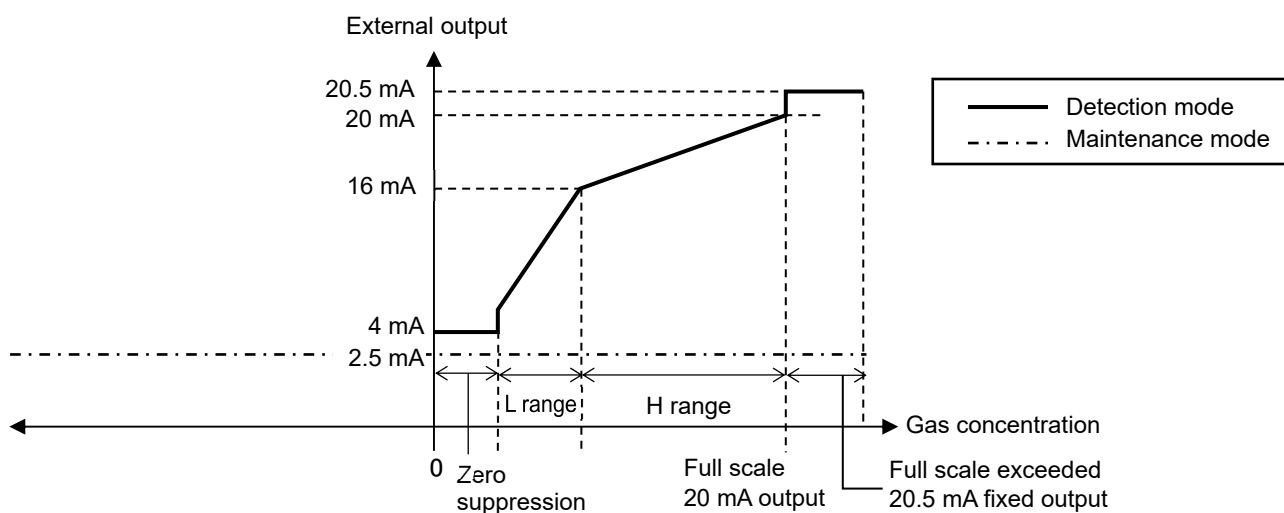
<Gas concentration and external output example (with double range)> **NC**

Two display ranges (L range and H range) are provided when using a new ceramic type sensor.

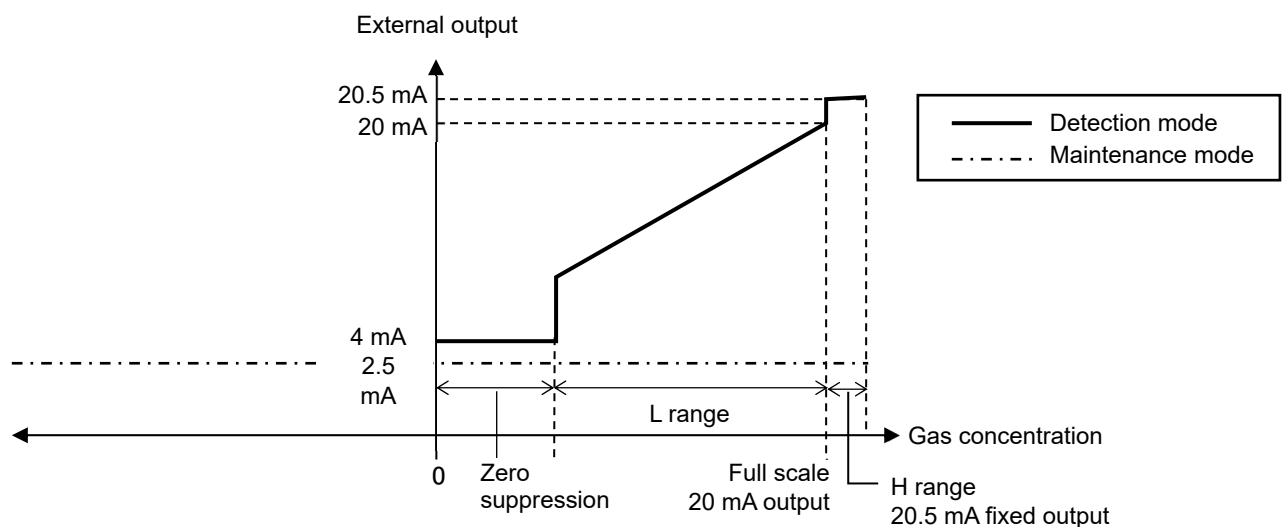
The display automatically switches to the H range if the combustible gas concentration reading exceeds the full scale of the L range. The range also automatically switches back to the L range when the gas concentration drops below the full scale of the L range.

For example, if the target gas is isobutane, readings between 0 and 2000 ppm will appear in the L range. The display will switch to the H range for readings between 12.0 and 100.0 % LEL.

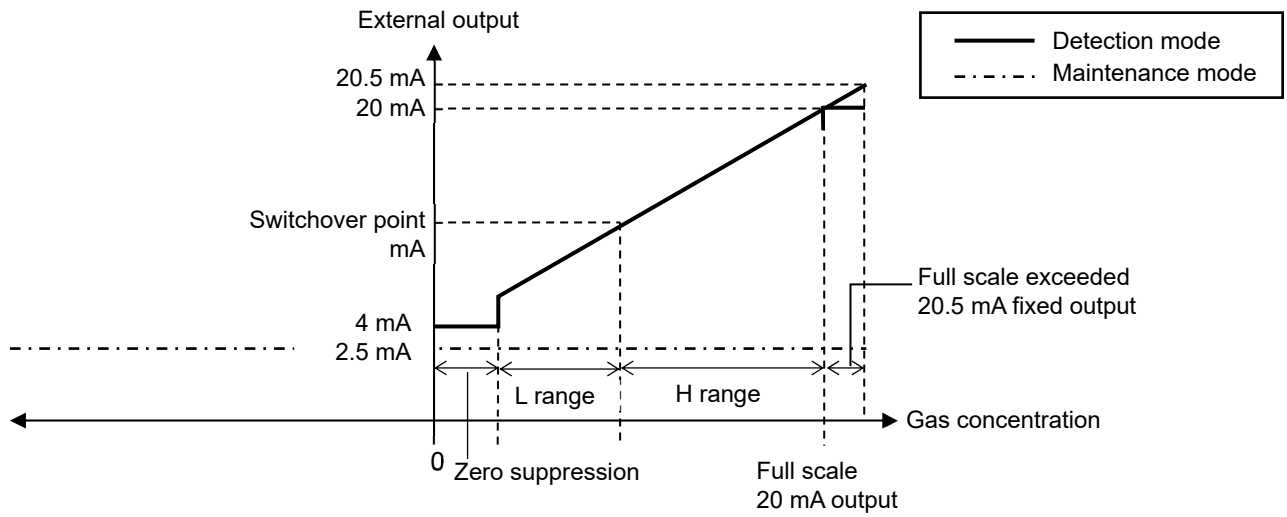
<4-16 mA (L range)/16-20 mA (H range) setting>



<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	Depends on the settings for item 11. 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	Depends on the settings for item 11. 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	Depends on the settings for item 11. 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 – 25 vol%) is equivalent to air (20.9 vol% = 17.4 mA)



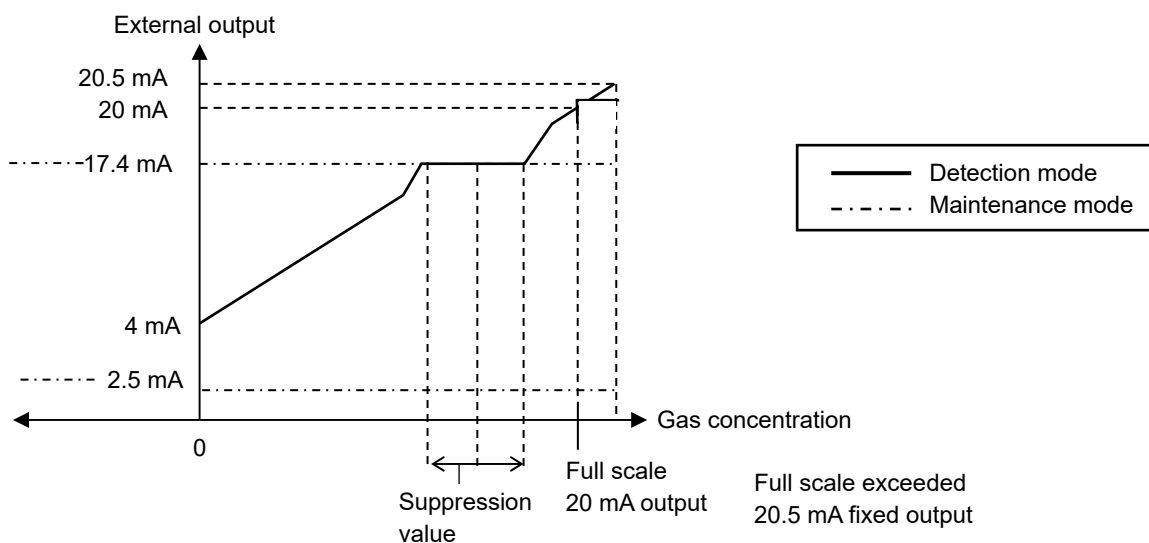
<Analog transmission (4 - 20 mA)>

- 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/active or during initialization, the output will be based on the 4 - 20 mA output setting (as in maintenance mode). Note that the output may be low, such as 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 operational specifics 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 models
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.
Specifications change Changing to ESF (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).
Specifications change Change from ESF (detection target gas: oxygen 0 - 25 vol%)	Following a change from 0 - 25 vol% (L-LL, L-H), 17.4 mA (equivalent to approx. 84 %F.S.) is output until the change is confirmed (until [C-02] is displayed).

<Gas concentration and external output example>

0 - 25 vol% (oxygen deficiency alarm model)

**CAUTION**

- 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/active or during initialization, the output will be based on the 4 - 20 mA output setting (as 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 on the minus side is disabled, the signal will become 3.2 mA (-5 %LEL) linear output.

6-5 Various functions to ensure proper 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.
- ▶ If 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%) if 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 '7-5-4 Zero suppression type setting'.
- ▶ Set the positive zero suppression value within the range from 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 up to 5 % of full scale + 1 digit (if full scale is 100 %LEL, the -5 %LEL + 1 digit). (This is not normally used by end users.)



CAUTION

- The negative suppression value (below zero) is subject to suppression corresponding to 5 % of full scale. The error code "E-1" is displayed when the reading falls below 5 % of full scale. Accurate gas detection will not be possible in this state, so check to confirm that no interference 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 sensor replacement or if sensor specifications change.

The following display warns against incorrect fitting if a sensor with a different serial number, detection principle, or specifications is fitted:

<After sensor replacement>

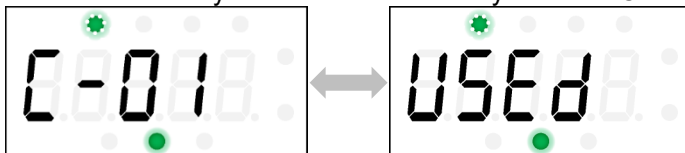
The display appears as follows when the sensor has been replaced with a sensor of the same specifications (e.g., detection principle and model)—for example at periodic replacement.

Press the SET key to have the sensor recognized as a new sensor and to 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).

Press the SET key to have the sensor recognized as a sensor with new specifications and to start up.

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



- When [C-02] is displayed, if you confirm changes in sensor specifications (e.g., detection principle, sensor type, detection target gas, and detection range), the gas detector specifications will change accordingly.
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 SET key when [C-02] is displayed will start initialization and switch the operation. The initialization output will also change at the same time.
- In maintenance mode, settings for external output remain unchanged from before the sensor replacement. Take particular note of this.
- 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 maintenance 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 : Check detection accuracy and perform calibration using a calibration gas.
<Recommended calibration interval>
 ESF/IRF/TCF sensors: At least once every 6 to 12 months
 NCF/SGF/SHF sensors: At least once every 4 to 6 months
 Perform calibration at least once a year to ensure adequate performance as a safety device.
 For information on the sensor warranty, review the warranty policy at the end of this document.

NOTE

- ▶ Calibration must be performed with zero calibration first, followed by span adjustment.
- ▶ For SGF sensors only, perform span adjustment first, followed by zero calibration. Zero calibration is not possible if the value displayed exceeds the zero suppression value.

Maintenance item	Maintenance details	Daily maintenance	Monthly maintenance	Regular maintenance
Power supply check	Check to confirm that the power lamp lights up.	○	○	○
Concentration reading check	Check to confirm that the concentration reading is zero (or [20.9] (vol%) for oxygen deficiency). If the reading is offset, perform zero calibration after confirming that no interference 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 service>

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.

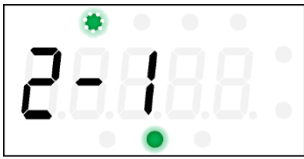
The main details of the maintenance services are as follows. Please contact RIKEN KEIKI for more information.

Service	Service details
Power supply check	- 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 reading check	Check to confirm that the concentration reading indicates zero using a zero calibration gas. Perform zero calibration if the reading is not zero. For oxygen deficiency alarm models, introduce clean air and confirm that the concentration reading becomes [20.9] (vol%). Perform span adjustment if the reading is offset.
Filter check	Check to confirm that the dust filter is neither contaminated nor clogged. Replace the filter if the filter is dirty or clogged.
Alarm test	Use the alarm test function to inspect the alarm circuit. - Check alarm lamps. (Check the ALM1 and ALM2 operations.) - Check external alarms. (Check the buzzer, reset signal, and other external alarm operations.)
Calibration	Perform sensitivity calibration using a calibration gas.
Gas alarm check	Check the gas alarm using a calibration gas. - 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)	Check the product exterior, cover, and interior for dirt and damage. Clean/repair problem areas. Replace cracked or damaged parts.
Product operation check	Operate the keys to check individual functions and parameters.
Consumable part replacement	Replace degraded components such as sensors and filters.

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 end users.
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 end users.
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		Sets various RS-485 communication settings. (Refer to '7-7 Communication settings (RS-485)').

Item No.	Setting item	LED display	Details
2-8	Factory mode selection		This is not normally used by end users.
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. This is dangerous because no monitoring occurs during this time.

NOTE

- ▶ If password setting is [ON], a password must be entered to switch to maintenance mode.
 - ▶ The password is set beforehand by RIKEN KEIKI.
- If you are unsure, please 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'.



WARNING

- Depending on the settings, contact and gas concentration outputs may be activated during gas testing, even in maintenance mode. Note this when performing this operation.

- 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.



The display returns to [2-0.0].

7-3-2 Performing alarm test

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



WARNING

- Depending on the settings, contact and gas concentration outputs may activate during alarm testing, even in maintenance mode. Note this when performing this operation.

NOTE

- Step 3 is required even if the product is a model without an alarm relay. 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 of the contact to be used is warning or fault. Select [oFF] for other cases.



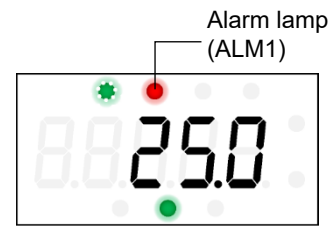
- Press the ▲ or ▼ key to increase or decrease the reading.



5 Check to confirm that an alarm is triggered.

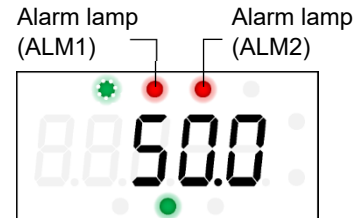
The first alarm is triggered when the reading reaches the first alarm setpoint.

When the first alarm is triggered, the alarm lamp (ALM1) lights up (red).



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

When the second alarm is triggered, alarm lamp (ALM1) and alarm lamp (ALM2) light up (red).

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

The display returns to [2-0.1].

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. Note this when performing this operation.

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



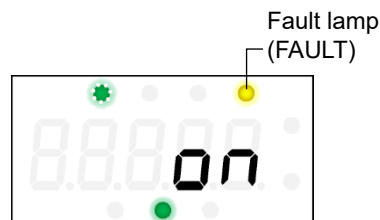
- 2 Press the ▲ or ▼ key to select [2-0.2], then press the SET key.



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



- 4 Check to confirm that a fault alarm is triggered.
When the fault alarm is triggered, the fault lamp (FAULT) lights up (yellow).



- 5 Once the fault test is complete, press the ▲ or ▼ key to select [oFF], then press the SET key.
When the fault alarm is reset, the fault lamp (FAULT) turns off.
The fault alarm can also be reset 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.



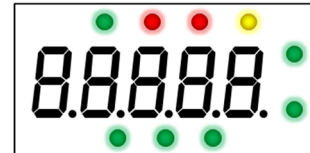
- 2 Press the ▲ or ▼ key to select [2-0.3], then press the SET key.



- 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 is complete.
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.

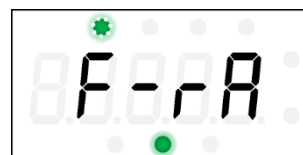


- 4 Check the memory test result.

No problems with memory:
[PASS] appears.



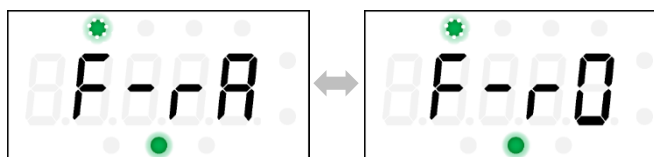
Problems with RAM:
[F-rA] appears.



Problems with ROM:
[F-rO] appears.



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



- 5 Once you have checked the result, press the SET key.
The display returns to [2-0.4].

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

<List of adjustment jigs>

Item name	Applicable specifications	
Calibration adapter	For IRF sensors	Part No.: 4283 9011 00
	For NCF/SGF/SHF sensors	Part No.: 4283 9012 70
	For ESF/TCF sensors	Part No.: 4283 9013 40
Pump	Capable of providing a flow rate of 0.5 mL/min or greater	
	Explosion-proof specifications	
Flowmeter	Capable of measuring tolerances of 0.1 L/min.	
	Has passed regular inspection.	
Stopwatch	Has passed regular inspection.	
Piping	For general combustible gases	Material: Polyurethane Internal diameter: 4 mm Pipe length between gas and adapter: Within 1 m
	For organic solvents	Material: Teflon Internal diameter: 4 mm Pipe length between gas and adapter: Within 1 m
	For strongly adsorptive gases	Material: Teflon Internal diameter: 4 mm Pipe length between gas and adapter: Within 10 cm

<Zero calibration gas>

- The zero calibration gas is a gas for calibrating the zero point. The ambient air can be used as the zero calibration gas if there are no interfering impurities or target gases present. Nitrogen (N₂) is used for O₂ and CO₂ sensors and for TCF sensors. With TCF sensors, wait at least 10 minutes after introducing the N₂ before performing zero calibration.

- The span adjustment gas is a gas for calibrating the sensitivity of the sensors during span adjustment. The span adjustment gas is a gas of known concentration diluted with clean air or nitrogen. For O₂ sensors, the oxygen in the ambient atmosphere is used, so a span adjustment gas is not required.
- We recommend calibrating the device using the detection target gas (actual gas calibration). This method is more accurate than using a replacement gas. Use of a replacement gas for calibration is permissible in circumstances when it is not possible to use actual gas calibration.
- It is necessary to calibrate for methane and hydrogen using only the actual gases. Do not use replacement gases for calibration.
- Span adjustment must be performed within 24 hours of the most recent valid zero calibration.

- For managing the concentration of calibration gases, we recommend the use of a RIKEN KEIKI portable detector.
- Contact RIKEN KEIKI.



WARNING

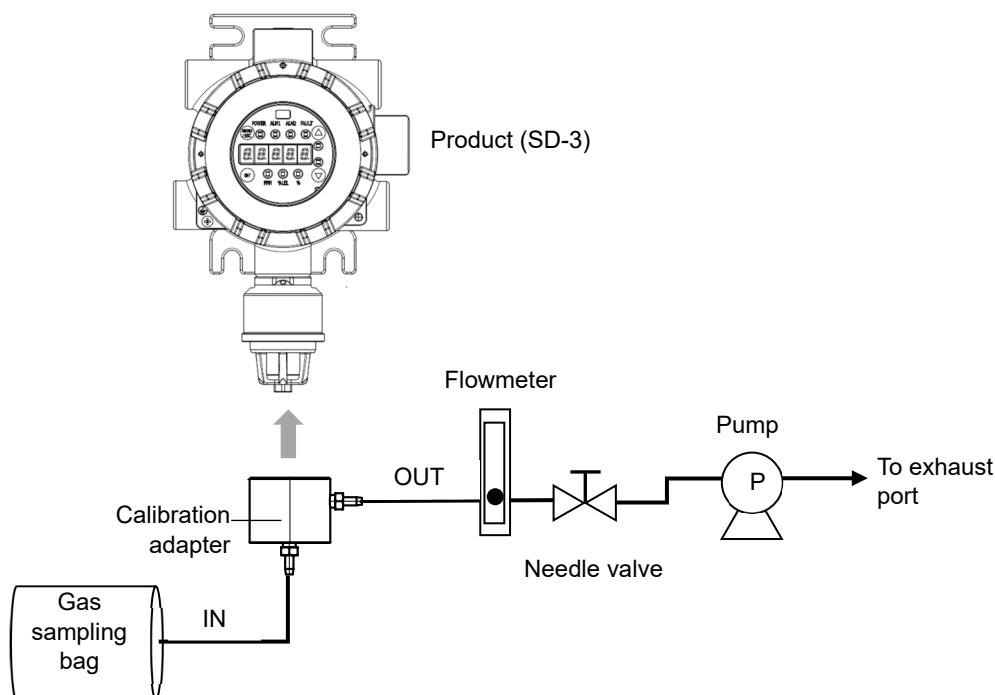
- Span adjustment gases include combustible gases and toxic gases. Never inhale the calibration gas. Accidental inhalation may be fatal or harmful to health.

<When using the calibration adapter>

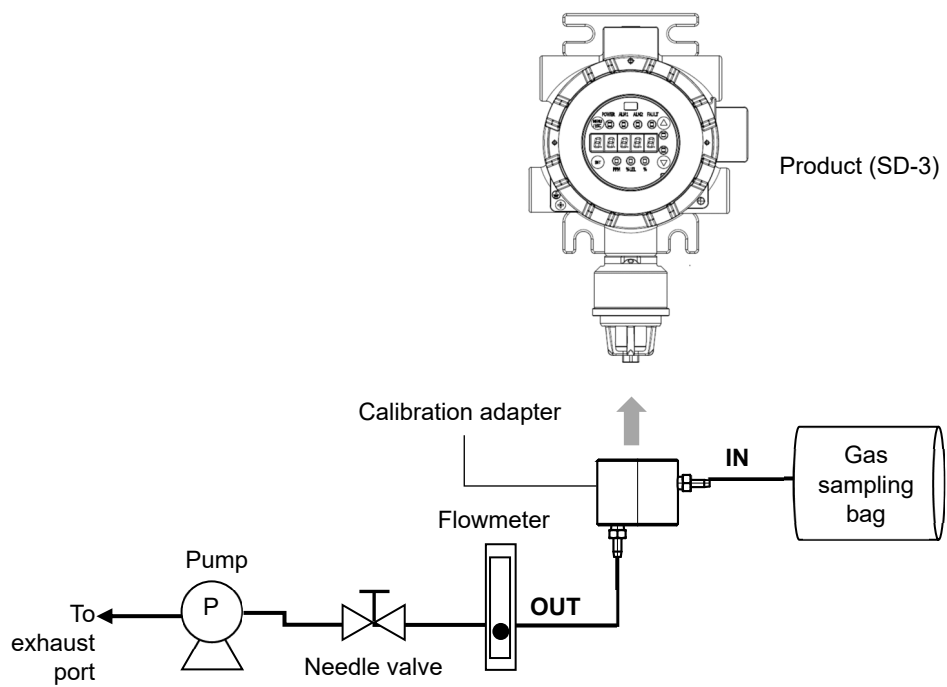
NOTE

- ▶ Use a flow rate of $0.5 \text{ L/min} \pm 0.1 \text{ L/min}$ when calibrating. Calibration accuracy may be impaired if calibration is performed using a different flow rate.
- ▶ Three types of calibration adapters are used according to the gas detector model: one for IRF sensors, one for NCF/SHF/SGF sensors, and one for ESF/TCF sensors. Note that the SD-3GHS and the GD-3GHS use the IRF sensor adapter as an exception.
- ▶ Leaving the suction cap and calibration adapter attached in a windless state for 10 minutes or more may cause adsorbed gas to accumulate, which can cause the reading to rise (for oxygen, the pipes and adapter interior become oxygen deficient, causing the reading to fall). If this occurs, push clean air through to return the reading to zero. Furthermore, as the sensor will be shut off from the atmosphere, detection will not be possible in this state.

<Using a gas sampling bag>

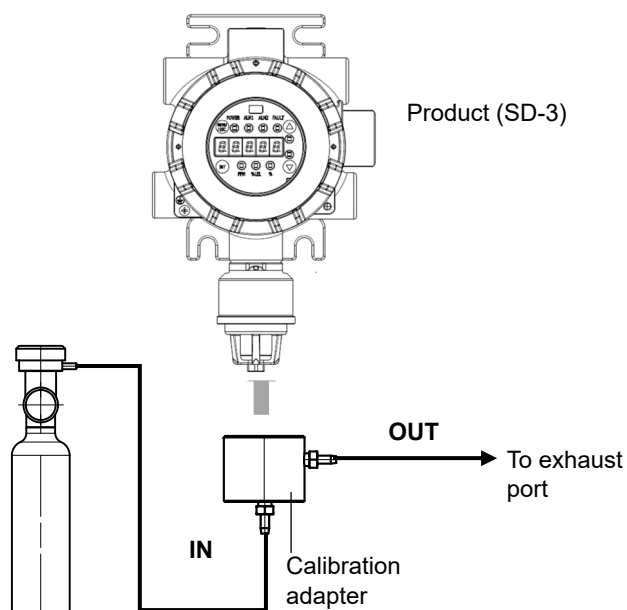


<Using a gas sampling bag>

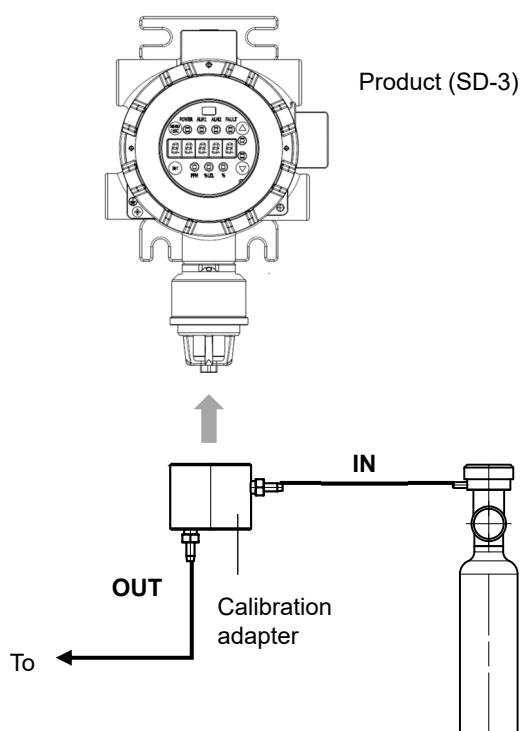
NC**GH****SP**

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

<Using a gas can>

RI**EC****NPM**

<Using a gas can>

NC**GH****SP**

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

<When using the calibration nipple>

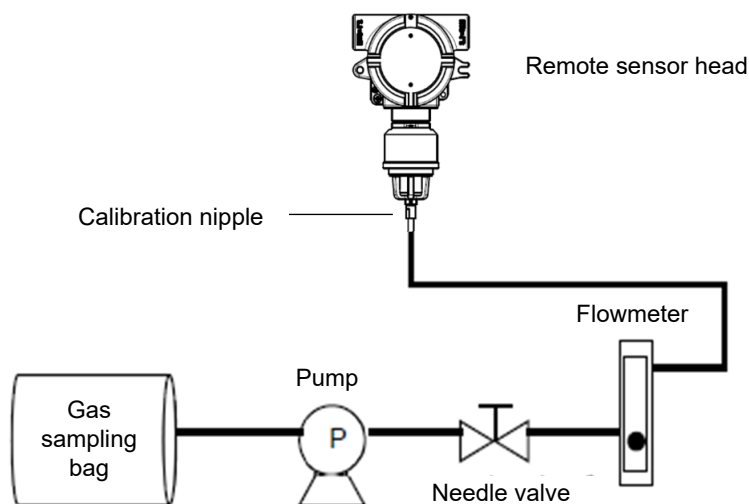
NOTE

- ▶ If using the calibration nipple, calibrate at the following wind speeds:

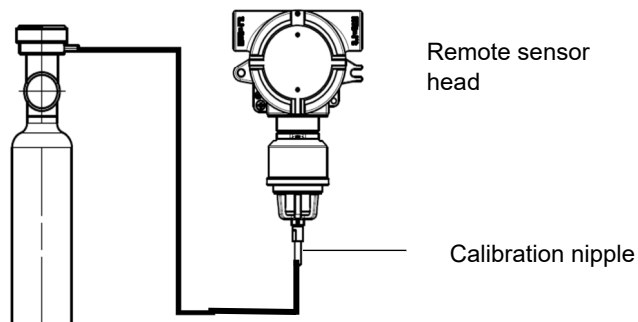
Detection principle	Wind speed
Thermal conductivity type	Max. 6 m/s

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

<Using a gas sampling bag>



<Using a gas can>



<When using the splash guard>

**WARNING**

- Gas response times can be affected when a splash guard is used.
- The gas response time increases and this can increase the time until the alarm occurs.

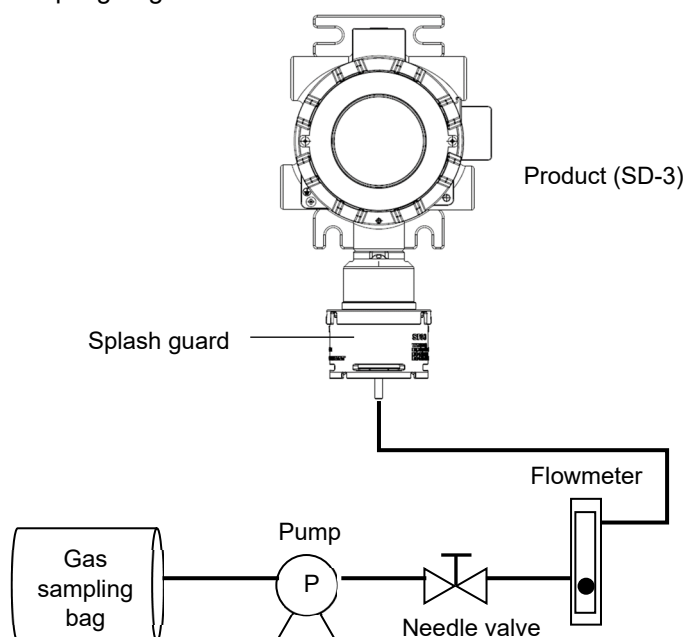
NOTE

- ▶ The calibration adapter is not required when using the splash guard.
- ▶ If using a splash guard, calibrate at the following wind speeds:

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

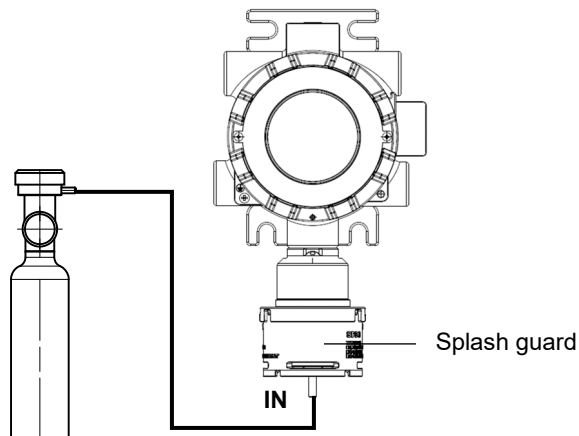
- ▶ If calibration is unsuccessful, fit the calibration adapter and calibrate again.
- ▶ When calibrating adsorptive gas, fit the calibration adapter.
- ▶ Use a flow rate of 0.5 L/min $\pm$ 0.1 L/min when calibrating. Calibration accuracy may be impaired if calibration is performed using a different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

<When using a filter>



WARNING

- Sensitivity, gas response times, and replacement gas sensitivity can be affected when a filter is attached.
- The gas response time increases when a filter is used, and this can increase the time until the alarm occurs.

<When using a protective cover >



WARNING

- Sensitivity, gas response times, and replacement gas sensitivity can be affected when a protective cover is attached.
- The gas response time increases when a protective cover is used, and this can increase the time until the alarm occurs.

7-4-2 Performing zero calibration

Correct zero calibration is required for accurate measurements of gas concentrations.

Zero calibration is essential for accurate measurements.

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 interference 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.

NOTE

- ▶ Perform zero calibration and span adjustment in the specified order. Sensor characteristics may be affected if adjustment is not performed in the correct order.
GHF sensor: Perform span adjustment first, followed by zero calibration.
Sensor other than GHF: Perform zero calibration first, followed by span adjustment.

- 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 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>

**CAUTION**

- 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.
The display returns to [2-2].

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.**

The display returns to [2-2].

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.

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 end users.
2-4.3	Alarm pattern setting	This is not normally used by end users.
2-4.4	Alarm setpoint limiter setting	This is not normally used by end users.
2-4.5	Alarm type setting	This is not normally used by end users.
2-4.6	Fault alarm pattern setting	This is not normally used by end users.
2-4.7	Zero suppression value setting	
2-4.8	Zero suppression type setting	
2-4.9	Password	
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 OFF.

- 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.



The display returns to [2-4.0].

NOTE

- ▶ Enabling the INHIBIT setting causes the LED display to alternate between [InHI.] 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])	10 % of full scale - Second alarm setpoint (H-HH)	
Second alarm setpoint ([AL2])	Combustible gas	First alarm setpoint - Up to 60% of full scale (H-HH)
	Other than combustible gases	First alarm setpoint - Up 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 Zero suppression value setting

Set the positive and negative zero suppression values.

Set the zero suppression values within the following ranges:

- Positive suppression value setting ([P-SuP]): 0 to 2/3 of first alarm setpoint
- Negative suppression value setting ([n-SuP]): 0 to 5 % of full scale + 1 digit

NOTE

- For more information on the zero suppression function, refer to '6-5-1 Zero suppression function'.

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



- 2 Press the ▲ or ▼ key to select [2-4.7], then press the SET key.**



- 3 Press the ▲ or ▼ key to select [P-SuP] or [n-SuP], then press the SET key.**

To set the positive zero suppression value, select [P-SuP]. To set the negative zero suppression value, select [n-SuP].



- 4 Press the ▲ or ▼ key to set the zero suppression value, then press the SET key.**



The display returns to [P-SuP] or [n-SuP].

7-5-4 Zero suppression type setting

Set the zero suppression type.

Select either of the following:

- Cut type ([Cut]): Values that exceed the zero suppression value are displayed unchanged.
- Slope type ([SLOPE]): Values that exceed the zero suppression value are displayed smoothly.

The default setting is cut type ([Cut]).

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



- 2 Press the ▲ or ▼ key to select [2-4.8], then press the SET key.



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



The display returns to [2-4.8].

7-5-5 Password setting

Set a password for accessing maintenance mode.

If you enable password setting, the product will display a password input screen to access maintenance mode.

The default setting is enabled.

NOTE

- ▶ The password is set beforehand by RIKEN KEIKI.
If you are unsure, please contact RIKEN KEIKI.

- 1 Press the ▲ or ▼ key in maintenance mode to select [2-4], then press the SET key.
- 2 Press the ▲ or ▼ key to select [2-4.9], then press the SET key.
- 3 Press the ▲ or ▼ key to select [on] or [oFF], then press the SET key.



The display returns to [2-4.9].

7-5-6 Date and time setting

Set 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 ▲ key 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 ▲ key or ▼ key to set the month, then press the SET key.
The selected item (month) flashes.



- 5 Press the ▲ key or ▼ key to set the day, then press the SET key.
The selected item (day) flashes.



- 6 Press the ▲ key or ▼ key to set the hour (24-hour clock display), then press the SET key.
The selected item (hour) flashes.



- 7 Press the ▲ key 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 end users.
	2-6.1	Energized/de-energized setting	This is not normally used by end users.
	2-6.2	Maintenance external output setting	This is not normally used by end users.
	2-6.3	External output adjustment (4 - 20 mA)	This is not normally used by end users.
	2-6.4	Alarm test external output	This is not normally used by end users.
	2-6.5	Fault alarm external output setting	This is not normally used by end users.
	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 '6-4 External output operation'.)

Select one of the following:

- 4 - 20 mA (L range)/22 mA (H range) ([L4-2])
- 4 - 20 mA (H range) ([H4-2])
- 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], [L4-2], or [H4-2], then press the SET key.



The display returns to [2-6.6].

7-7 Communication settings (RS-485)

The following items can be set in the communication settings (RS-485):

Item No.		Setting item
2-7		Communication settings
	2-7.0	RS-485 setting
	2-7.00	Address setting
	2-7.01	Communication speed setting
	2-7.02	Data length setting
	2-7.03	Parity display
	2-7.04	Stop bit setting
	2-7.05	Communication error display setting

7-7-1 Address setting

Set the RS-485 communication address (0 to 128).

The default setting is 0 ([0]).

- 1 Press the ▲ or ▼ key in maintenance mode to select [2-7], then press the SET key.



- 2 Select [2-7.0], then press the SET key.



- 3 Select [2-7.00], then press the SET key.



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



The display returns to [2-7.00]

7-7-2 Communication speed setting

Set the RS-485 communication speed (bps).

Set to 76800 bps ([768]), 38400 bps ([384]), 19200 bps ([192]), 9600 bps ([96]), or 4800 bps ([48]).

The default setting is 38400 bps ([384]).

- 1 Press the ▲ or ▼ key in maintenance mode to select [2-7], then press the SET key.



- 2 Select [2-7.0], then press the SET key.



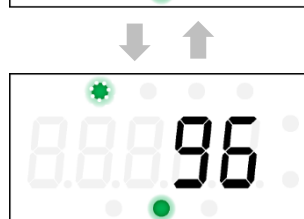
- 3 Press the ▲ or ▼ key to select [2-7.01], then press the SET key.



- 4 Press the ▲ or ▼ key to select [768], [384], [192], [96], or [48], then press the SET key.



The display returns to [2-7.01]



7-7-3 Data length setting

Set the RS-485 communication data length (bits).

This can be set to 7 bits or 8 bits.

The default setting is 8 bits.

- 1 Press the ▲ or ▼ key in maintenance mode to select [2-7], then press the SET key.



- 2 Select [2-7.0], then press the SET key.



- 3 Select [2-7.02], then press the SET key.



- 4 Press the ▲ or ▼ key to select [8] or [7], then press the SET key.



The display returns to [2-7.02]



7-7-4 Parity setting

Set the RS-485 communication parity.

Set to odd parity ([odd]), even parity ([EuEn]), or no parity ([nonE]).

The default setting is even parity ([EuEn]).

- 1 Press the ▲ or ▼ key in maintenance mode to select [2-7], then press the SET key.



- 2 Select [2-7.0], then press the SET key.



- 3 Select [2-7.03], then press the SET key.



- 4 Press the ▲ or ▼ key to select [odd], [EuEn], or [nonE], then press the SET key.



The display returns to [2-7.03]



7-7-5 Stop bit setting

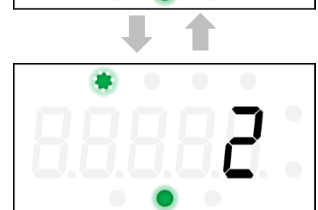
Set the RS-485 communication stop bit.

This can be set to 1 bit or 2 bits.

The default setting is 1 bit.

- 1 Press the ▲ or ▼ key in maintenance mode to select [2-7], then press the SET key.
- 2 Select [2-7.0], then press the SET key.
- 3 Select [2-7.04], then press the SET key.
- 4 Press the ▲ or ▼ key to select [1] or [2], then press the SET key.

The display returns to [2-7.04]



7-7-6 Communication error display setting

Enable or disable the communication error display.
The default setting is OFF.

- 1 Press the ▲ or ▼ key in maintenance mode to select [2-7], then press the SET key.



- 2 Select [2-7.0], then press the SET key.



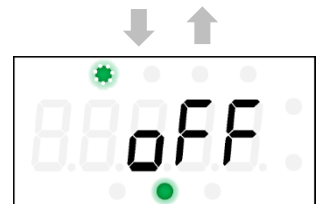
- 3 Select [2-7.05], then press the SET key.



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



The display returns to [2-7.05]



7-8 Parts replacement

7-8-1 Sensor replacement

A functional check by a qualified maintenance engineer (or similarly qualified technician) is required after sensor replacement. To ensure safety and the stable operation of the product, request checking by a qualified maintenance engineer. Contact RIKEN KEIKI to request checking.

<Sensor replacement intervals>

Sensor model	Gas type	Chemical formula	Detection concentration	Sensor replacement interval
IRF	—	—	—	3 years
NCF	—	—	—	3 years
SHF	—	—	—	3 years
SGF	—	—	—	3 years
TCF	—	—	—	3 years
ESF-A ^{*1}	—	—	—	3 years
ESF-B ^{*2}	—	—	—	3 years ^{*5}
ESF-C ^{*3}	—	—	—	3 years
ESF-X ^{*4}	—	—	—	3 years

*1 ESF-A refers to sensor models that start with "ESF-A".

*2 ESF-B refers to sensor models that start with "ESF-B".

*3 ESF-C refers to sensor models that start with "ESF-C".

*4 ESF-X refers to sensor models that start with "ESF-X".

*5 Three years when used at room temperature conditions, and two years when used in other conditions.



CAUTION

- Be sure to turn OFF the power supplied to the sensor before replacing the sensor.
- Refer to '4-8 Mounting the sensor' for instructions on how to mount the sensor.
- Perform zero calibration and span adjustment after replacing the sensor.
- The sensor can be replaced in zones classified as hazardous without turning off the main unit power supply.
- If the same type of sensor (the same part number) was previously installed, the particular configurations of the device (detection target gas, measurement range, alarm setpoints, zero suppression, etc.) are maintained. In other cases, the default factory settings of the new sensor are uploaded, overwriting the current configurations. The sensor is recognized by the automatic sensor recognition function. Refer to '6-5-2 Automatic sensor recognition function' for information on the automatic sensor recognition function.

NOTE

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

7-8-2 Replacement of periodic replacement parts

The recommended replacement parts for this product are as follows. Replace using the recommended replacement intervals as a guide.

<Recommended replacement parts list>

Name	Recommended check interval	Recommended replacement interval	Quantity (per unit)	Remarks
Sensor guard for SD-3RI/GHS	6 months	3 to 8 years	1	
Sensor guard for SD-3NC/GH/SP				
Sensor guard for SD-3EC/ECS/ECB				
Sensor guard for SD-3NPM				
Silicone removal filter (Model: SI-8)		1 year		Product No.: 4383 0030 20
Activated carbon filter (Model: CF-8304)		1 year		Product No.: 4383 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 (Sensors)>

Model	Storage limit (years)	Temperature (°C)		Humidity*1 (%RH)		Pressure (kPa)		Remarks
	—	Min	Max	Min	Max	Min	Max	
SGF	0.5	-10	40	0	90	80	120	• The sensor must be stored in the specified packing case. • Store in a location not exposed to 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 result in catalyst poisoning (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	• The sensor must be stored in the specified packing case. • Store in a location not exposed to direct sunlight. • Store in an environment free of corrosive gas, vibration, and dust. • Avoid condensation and moisture.
TCF	0.5	-10	40	0	90	80	120	
ESF	0.5	-10	40	0	90	80	120	• The sensor must be stored in the specified packing case. • Store in a location not exposed to 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 result in catalyst poisoning (e.g., silicone, chlorine, sulfur gases).

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

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

Model	Storage limit (years)	Temperature (°C)		Humidity* ¹ (%RH)		Pressure (kPa)		Remarks
	—	Min	Max	Min	Max	Min	Max	
SGF	0.5	-10	40	0	90	80	120	• Store in a location not exposed to 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 result in catalyst poisoning (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	• Store in a location not exposed to direct sunlight. • Store in an environment free of corrosive gas, vibration, and dust. • Avoid condensation and moisture.
TCF	0.5	-10	40	0	90	80	120	
ESF-A* ²	0.5	-10	40	20	90	80	120	• Store in a location not exposed to 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 result in catalyst poisoning (e.g., silicone, chlorine, sulfur gases). • Store in the dedicated sensor storage container.*⁶ Open the dedicated sensor storage container immediately before use, remove the sensor, and fit into the detector.
ESF-X* ³								
ESF-B* ⁴	0.5	-10	40	30	80	80	120	
ESF-C* ⁵								

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

*² ESF-A refers to sensor models that start with "ESF-A".

*³ ESF-X refers to sensor models that start with "ESF-X".

*⁴ ESF-B refers to sensor models that start with "ESF-B".

*⁵ ESF-C refers to sensor models that start with "ESF-C".

*⁶ Storage outside a container will increase the risk of fluid leakage in environments with a humidity of 90 %RH or greater. Fluid shortage may occur with the ESF-B*⁴ under low humidity conditions.

**CAUTION**

- This product is extremely heavy and has projecting parts. This poses a risk of damage to the product and to other parts if packaged in normal packaging materials. Use the packaging in which the product was shipped if the product needs to be stored or returned to RIKEN KEIKI. If the packaging is not available, double-wrap the product and fill spaces with solid objects so that the product will not shift inside the packaging. Do not pack with 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'.



- Calibration must be performed before resuming use of a product that was relocated or was 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.
- Used sensor units must be returned to RIKEN KEIKI. Submit returns to RIKEN KEIKI.
- Avoid direct contact with any fluid that may leak from electrochemical type sensors (ESF sensors). Place the unit in a plastic bag and make sure the fluid cannot leak out.
- The product and ESF sensor contain button-type batteries. These batteries must be properly separated before disposal. Contact your nearest sales office for advice.

<SD-3 main unit>

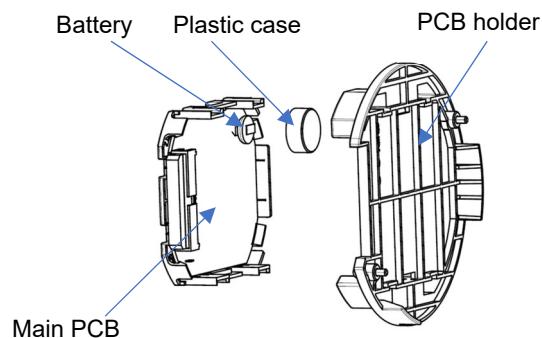
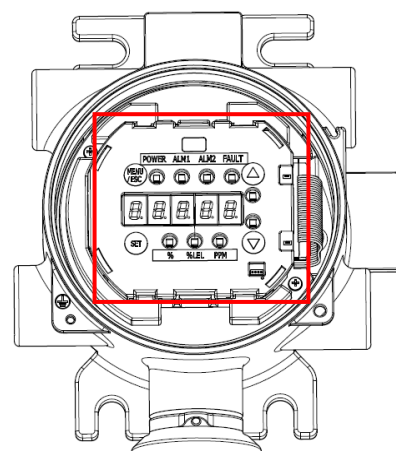
Button-type lithium battery specifications

Item name	Lithium battery
Nominal voltage	3.0 V
Nominal capacity	48 mAh

Removal method

Remove the main PCB unit indicated by the red box in the figure to the right. Remove the PCB holder. The battery is located on the underside of the main PCB (on the back side of the 7-segment LCD).

The battery is covered by a plastic case. The plastic case is attached to the PCB, and so should be removed using pliers or a flathead screwdriver. Cut the terminals on both sides of the battery using nippers, then remove. Wrap the removed battery in tape to prevent short-circuiting before disposal.



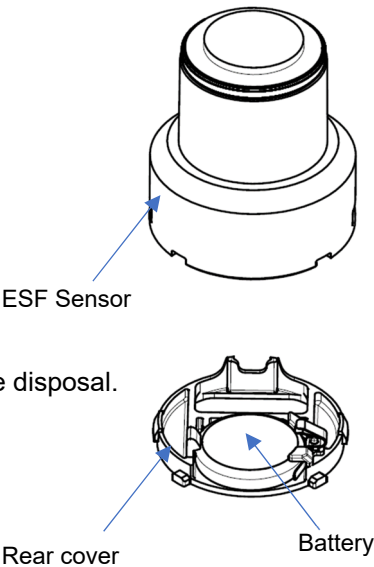
<ESF Sensor>

Button-type lithium battery specifications

Item name	Lithium manganese dioxide battery
Nominal voltage	3.0 V
Nominal capacity	140 mAh

Removal method

Remove the ESF sensor rear cover (white cover).
Remove the battery from the rear cover.
Wrap the removed battery in tape to prevent short-circuiting before disposal.



WARNING

- Never attempt to disassemble ESF sensors. They contain electrolyte. Blistering may result if the electrolyte comes into contact with the skin. Contact with eyes may result in blindness. Discoloration or holes may result if contact with clothing occurs. If contact with electrolyte occurs, rinse the area immediately with plenty of water.

<Disposal in EU member states>

- Waste Electrical and Electronic Equipment (WEEE) Directive



The symbol shown on the left is affixed to the product to indicate that the product and its components must not be disposed of as general or household waste and must be disposed of separately in the appropriate manner. Proper disposal helps prevent potential harm to human health and the environment. When disposing of the product, use the return and collection systems available in your country to ensure appropriate treatment, collection, and recycling. For more information on the collection and recycling of used products, contact your retailer or supplier.

- Battery regulations



The symbol shown on the left is affixed to the product or the battery to indicate that batteries must be disposed of separately from general or household waste. When disposing of the battery, use the collection systems available in your country to ensure appropriate treatment, collection, and recycling.

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 (FAULT)	Cause	Corrective 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 deploying an uninterruptible power system, power supply filter, or insulated transformer. Add such devices where appropriate.
		Cable abnormality (disconnections, loose connections, short circuits)	Check the wiring for this product and for other devices in the vicinity.
		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)	 (Lamp on)	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 the internal wiring of the main unit (SD-3/SD-3SC) or remote sensor head (GD-3) correctly.

Symptom/display	Fault lamp (FAULT)	Cause	Corrective 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)	 (Lamp on)	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)	 (Lamp on)	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)	 (Lamp on)	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 (FAULT)	Cause	Corrective action
- 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 (FAULT)	Cause	Corrective 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. 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 reading increases periodically. (SD-3EC/ECS/ECB)	—	The sensor is faulty.	Replace with a new sensor.
System abnormality (E-9)	—	Clock abnormality	Set the date and time. The correction may not work if you use the EC sensitivity correction function. If this symptom occurs frequently, the internal clock may be faulty. Contact RIKEN KEIKI.
Outside operating temperature range (E-27)	—	Ambient temperatures at the location where the product will be installed fall outside the operating temperature range	The operating temperature range for the product depends on the specific detection principle. You cannot use the product if ambient temperatures exceed the operating temperature range. Take appropriate measures.
Sensor service life warning (E-8)	—	The sensor is approaching the end of its service life.	This function may not operate correctly under certain operating conditions and environments. Replacement of the sensor is recommended. Contact RIKEN KEIKI.
Sensor warning (E-1)	—		Contact RIKEN KEIKI.
RS-485 communication abnormality (E-6)	—	The communication cable is not connected or is improperly connected.	Check the communication cable and communication settings. Check the termination resistor setting. Make sure only the farthest termination resistor is turned on.

10

Product Specifications

10-1 SD-3 specifications

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

Model	SD-3	SD-3 (contact specifications)	SD-3 (RS-485 specifications)
Specifications	Standard	Contact	RS-485
Display	7-segment LED (5 digits)		
Sensor	F sensor (RIKEN KEIKI)		
Detection principle	Non-dispersive infrared absorption(infrared type)/electrochemical/new ceramic/semiconductor/hot-wire semiconductor/thermal conductivity		
Detection target gas	Depends on sensor specifications.		
Detection range	Depends on sensor specifications.		
Sampling method	Diffusion (except NPM)/Suction (introduced via an external unit)		
Set flow rate	0.4 - 1.5 L/min		
Power supply indication	Power lamp on (green)		
External output	Gas concentration signal (4 - 20 mA DC with HART)	Gas concentration signal (4 - 20 mA DC with HART), contact output	Gas concentration signal (4 - 20 mA DC), RS-485 (half duplex)
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 (Other than O ₂ : H-HH, O ₂ : L-LL)		
Gas alarm indication	Alarm lamp on (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 on (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	—
Warning	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		

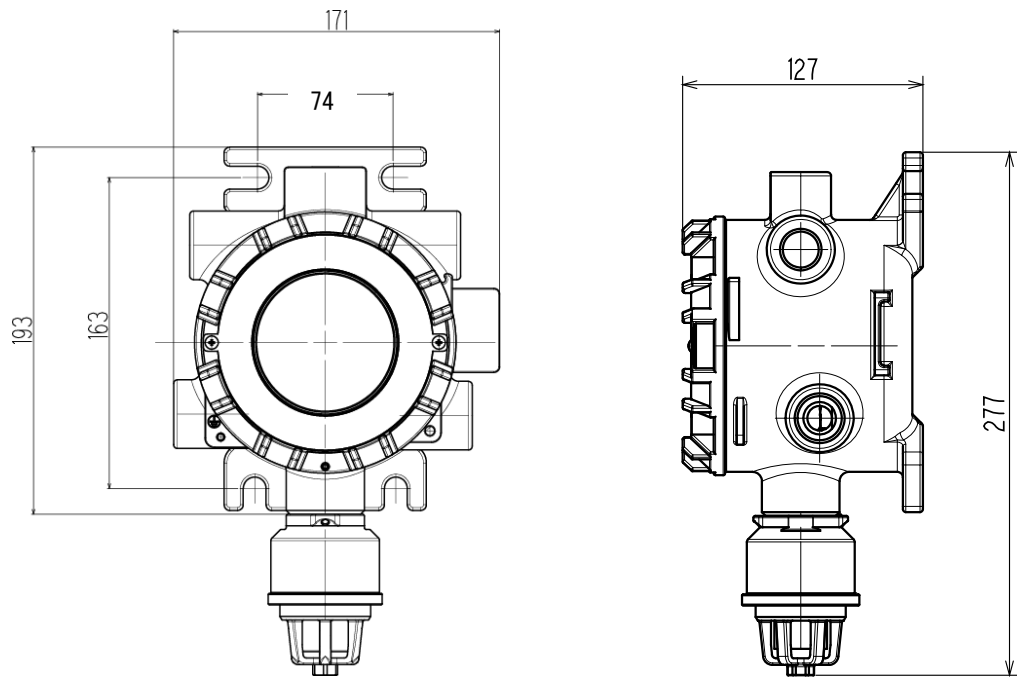
Model	SD-3	SD-3 (contact specifications)	SD-3 (RS-485 specifications)
Transmission method (4 - 20 mA)	3-wire analog transmission (common power supply <power supply, signal, common>) or 2-wire analog transmission (current source)		
Transmission specifications (4 - 20 mA)	4 - 20 mA DC (non-insulated linear output) Maximum load resistance 600 Ω (with derating depending on supply voltage) Resolution: max. 250 divisions (Depends on specifications.)		
Transmission cable (4 - 20 mA)	Shielded cable 1.25 sq (1.308 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 (1.308 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 (RS-485)	—	—	Shielded twisted pair cable 1.25 sq (1.308 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 (RS-485)	—	—	Depends on system design conditions.
Power supply	24 V DC (18 - 30 V DC) * Use a power source 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 (1.308 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 to +70 °C (no sudden fluctuations) In accordance with sensor specifications if restrictions apply due to sensor specifications		
Operating humidity range	0 - 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, NEMA 4X equivalent ^{*1}		
Installation	Wall mounting (standard)/2B pole mounting (optional)		
Explosion-proof construction	Flame-proof enclosure		
Explosion-proof class	Varies depending on model. Refer to '<Explosion-proof performance data>' in '2-4 Safety information'.		
External dimensions (excluding projections)	Diffusion type: Approx. 171 (W) × 277 (H) × 127 (D) mm Suction type: Approx. 171 (W) × 289 (H) × 127 (D) mm		
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.

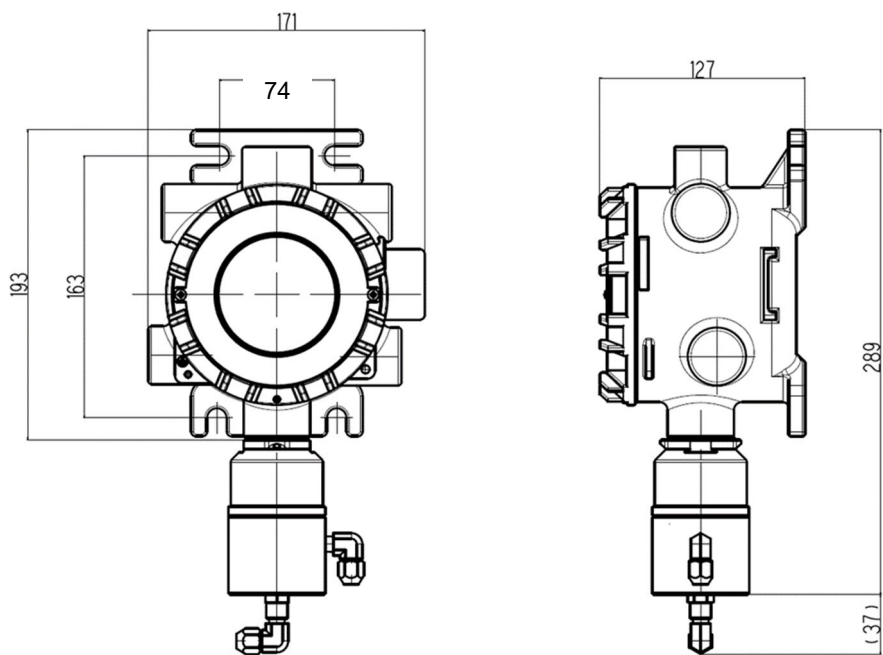
*1 To satisfy NEMA 4X performance requirements, use cable glands that comply with both explosion-proof certification and NEMA 4X.

<Dimensional drawing (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 specifications)	SD-3 (RS-485 specifications)
Specifications	Standard	Contact	RS-485
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/Suction (introduced via an external unit)		
Set flow rate	0.4 - 1.5 L/min		
Power supply indication	Power lamp on (green)		
External output	Gas concentration signal (4 - 20 mA DC with HART)	Gas concentration signal (4 - 20 mA DC with HART), contact output	Gas concentration signal (4 - 20 mA DC), RS-485 (half duplex)
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)		
Gas alarm indication	Alarm lamp on (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 on (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	—
Warning	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 - 20 mA DC (non-insulated linear output) Maximum load resistance 600 Ω (with derating depending on supply voltage) Resolution: max. 250 divisions (Depends on specifications.)		
Transmission cable (4 - 20 mA)	Shielded cable 1.25 sq (1.308 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 (1.308 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 (RS-485)	—	—	Shielded twisted pair cable 1.25 sq (1.308 mm ² /AWG16)

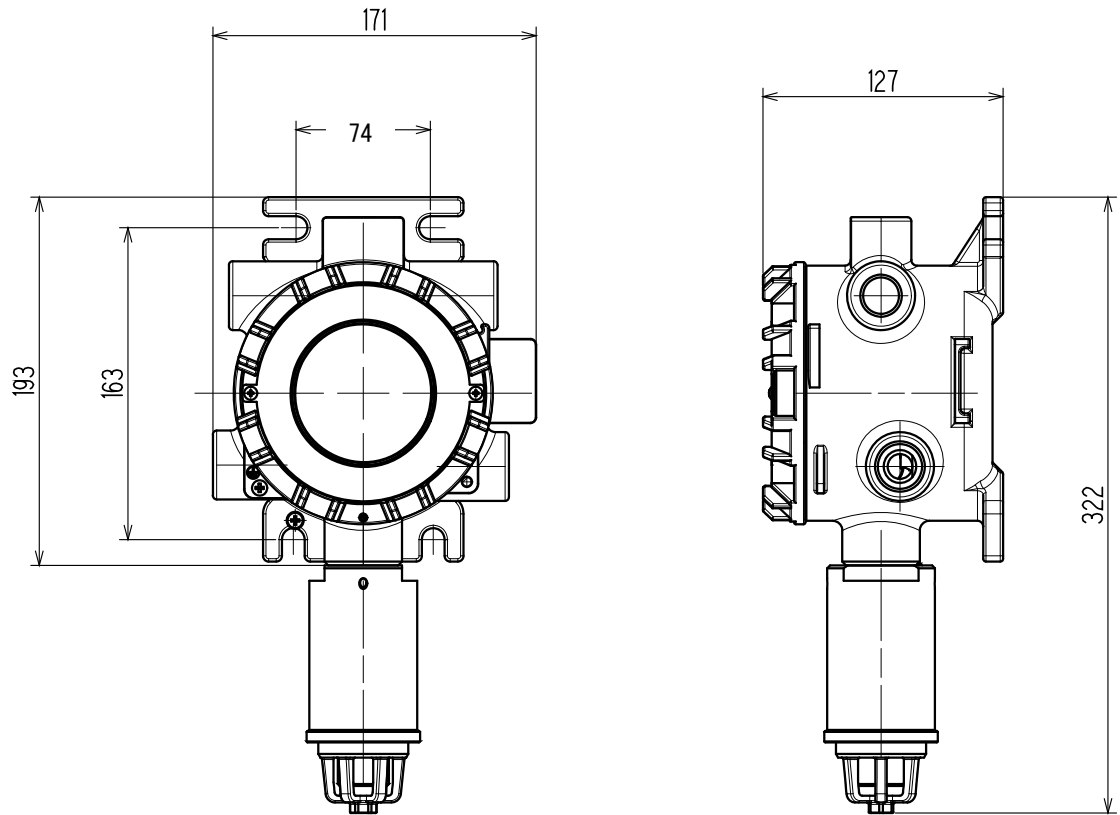
Model	SD-3	SD-3 (contact specifications)	SD-3 (RS-485 specifications)
	* To ensure explosion protection, use a cable designed for use in temperatures at least 5 °C above the maximum anticipated ambient temperature.		
Transmission distance (RS-485)	—	—	Depends on system design conditions.
Power supply	24 V DC (18 - 30 V DC) * Use a power source 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 (1.308 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 to +70 °C (no sudden fluctuations) In accordance with sensor specifications if restrictions apply due to sensor specifications		
Operating humidity range	0 - 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, NEMA 4X equivalent ^{*1}		
Installation	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 (excluding projections)	Diffusion type: Approx. 171 (W) × 322 (H) × 127 (D) mm Suction type: Approx. 171 (W) × 334 (H) × 127 (D) mm		
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.

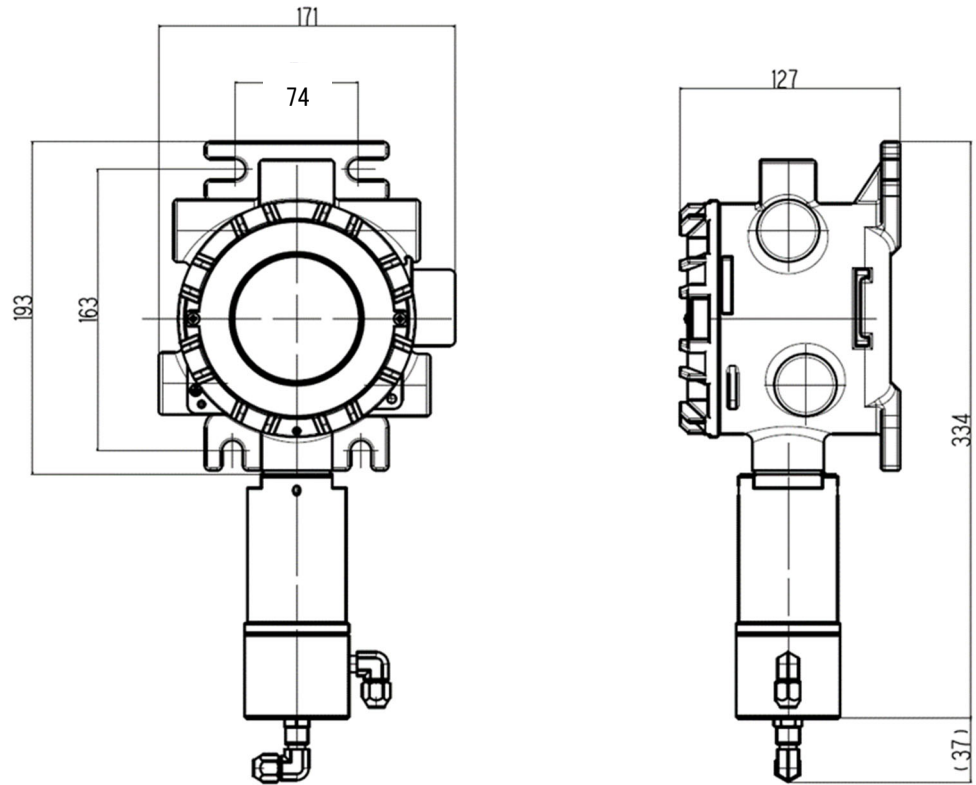
*1 To satisfy NEMA 4X performance requirements, use cable glands that comply with both explosion-proof certification and NEMA 4X.

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

<Diffusion type>



<Suction type>



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

Model	Power supply	Power consumption
SD-3RI, SD-3DRI	24 V DC (18 - 30 V DC)	Maximum 3.8 W
SD-3GH, SD-3DGH	24 V DC (18 - 30 V DC)	Maximum 4.5 W
SD-3GHS, SD-3DGHS	24 V DC (18 - 30 V DC)	Maximum 4.5 W
SD-3NC, SD-3DNC	24 V DC (18 - 30 V DC)	Maximum 4.5 W
SD-3SP, SD-3DSP	24 V DC (18 - 30 V DC)	Maximum 3.5 W
SD-3DNPM	24 V DC (18 - 30 V DC)	Maximum 3 W
SD-3EC, SD-3DEC	24 V DC (18 - 30 V DC)	Maximum 2.8 W
SD-3ECS, SD-3DECS	24 V DC (18 - 30 V DC)	Maximum 2.8 W
SD-3ECB, SD-3DECB	24 V DC (18 - 30 V DC)	Maximum 3.1 W

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

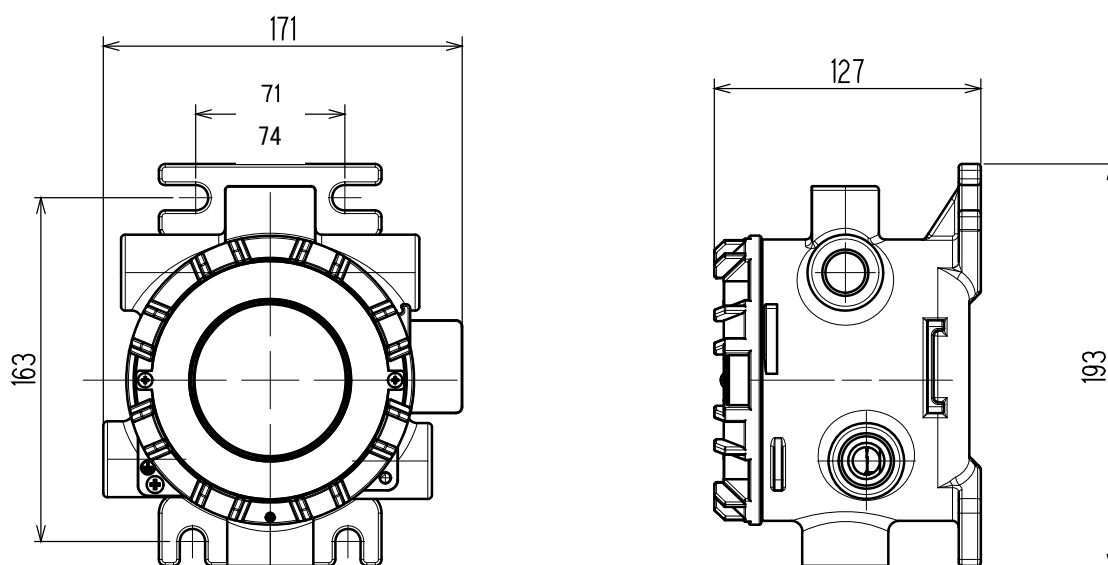
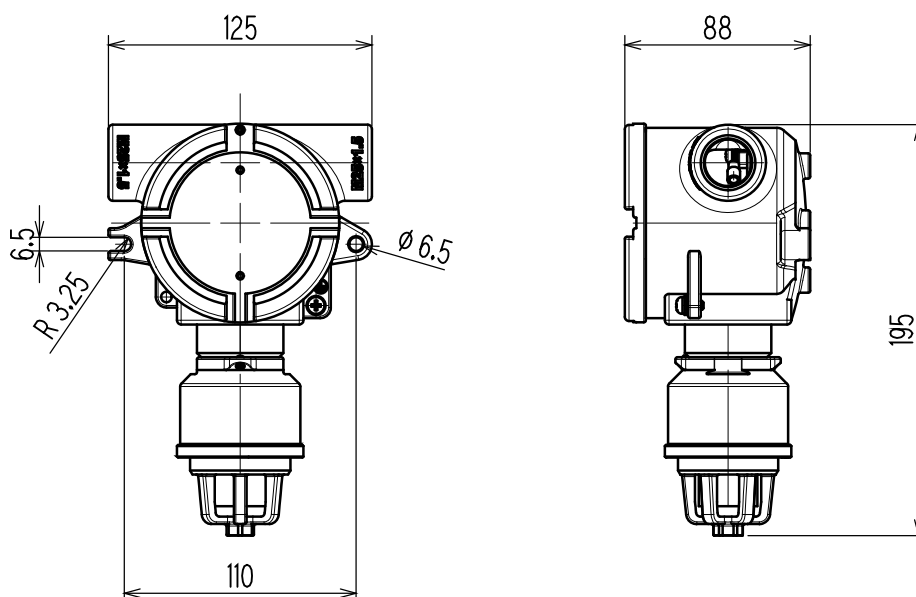
10-2-1 SD-3SC + GD-3 (model without EC barrier)

Model	SD-3SC + GD-3	SD-3SC (contact specifications) + GD-3	SD-3SC (RS-485 specifications) + GD-3
Specifications	Standard	Contact	RS-485
Display	7-segment LED (5 digits)		
Sensor	F sensor (RIKEN KEIKI)		
Detection principle	Non-dispersive infrared absorption(infrared type)/electrochemical/new ceramic/semiconductor/hot-wire semiconductor/thermal conductivity		
Detection target gas	Depends on sensor specifications.		
Detection range	Depends on sensor specifications.		
Sampling method	Diffusion type		
Power supply indication	Power lamp on (green)		
External output	Gas concentration signal (4 - 20 mA DC with HART)	Gas concentration signal (4 - 20 mA DC with HART), contact output	Gas concentration signal (4 - 20 mA DC), RS-485 (half duplex)
Alarm setpoints	Depends on sensor specifications.		
Alarm accuracy	Depends on sensor specifications.		
Alarm delay time	Depends on sensor specifications.		
Repeatability (under identical conditions)	Depends on sensor specifications.		
Indication accuracy (under identical conditions)	Depends on sensor specifications.		
Gas alarm type	Two-step alarm (Other than O ₂ : H-HH, O ₂ : L-LL)		
Gas alarm indication	Alarm lamp on (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 on (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	—
Warning	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)		

Model	SD-3SC + GD-3	SD-3SC (contact specifications) + GD-3	SD-3SC (RS-485 specifications) + GD-3
Transmission specifications (4 - 20 mA)	4 - 20 mA DC (non-insulated linear output) Maximum load resistance 600 Ω (with derating depending on supply voltage) Resolution: max. 250 divisions (Depends on specifications.)		
Transmission cable (4 - 20 mA)	Shielded cable 1.25 sq (1.308 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 (1.308 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 (RS-485)	—	—	Shielded twisted pair cable 1.25 sq (1.308 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 (RS-485)	—	—	Depends on system design conditions.
Transmission cable (between GD-3 units)	Shielded twisted pair cable 1.25 sq (1.308 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 - 30 V DC) * Use a power source 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 (1.308 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 to +70 °C (no sudden fluctuations) In accordance with sensor specifications if restrictions apply due to sensor specifications		
Operating humidity range	0 - 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, NEMA 4X equivalent ^{*1}		
Installation	Wall mounting (standard)/2B pole mounting (optional)		
Explosion-proof construction	Flame-proof enclosure		
Explosion-proof class	Varies depending on model. Refer to '<Explosion-proof performance data>' in '2-4 Safety information'.		
External dimensions (SD-3SC)	Approximately 171 (W) × 193 (H) × 127 (D) mm (excluding projections)		
Weight (SD-3SC)	Approx. 6.0 kg		
External dimensions (GD-3)	Approximately 125 (W) × 195 (H) × 88 (D) mm		
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.

*1 To satisfy NEMA 4X performance requirements, use cable glands that comply with both explosion-proof certification and NEMA 4X.

<Dimensional drawing (SD-3SC + GD-3 (model without EC barrier))>**<Main unit (SD-3SC)>****<Remote sensor unit (GD-3 (model without EC barrier))>**

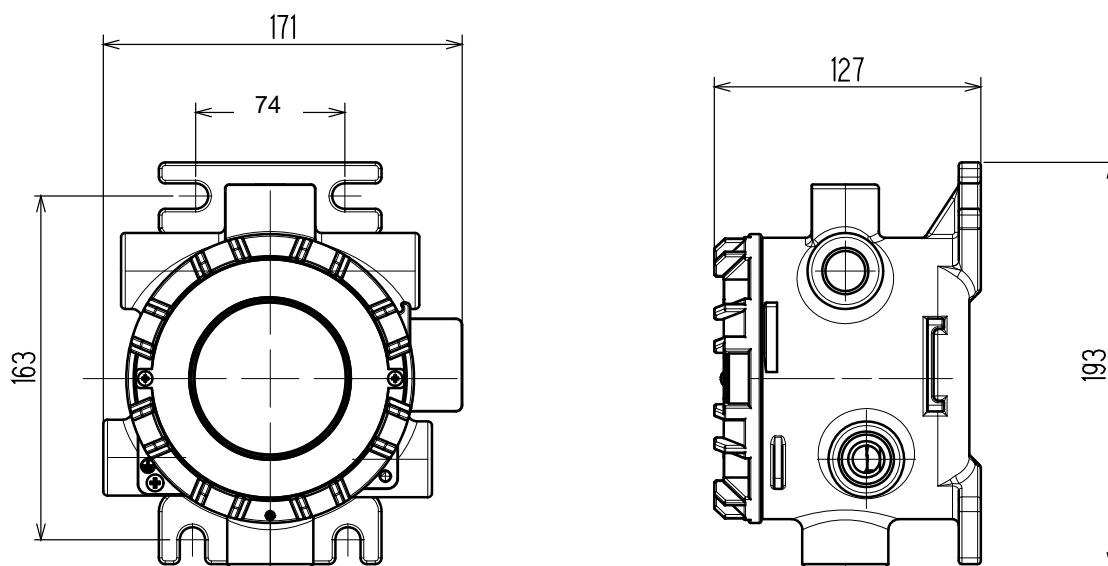
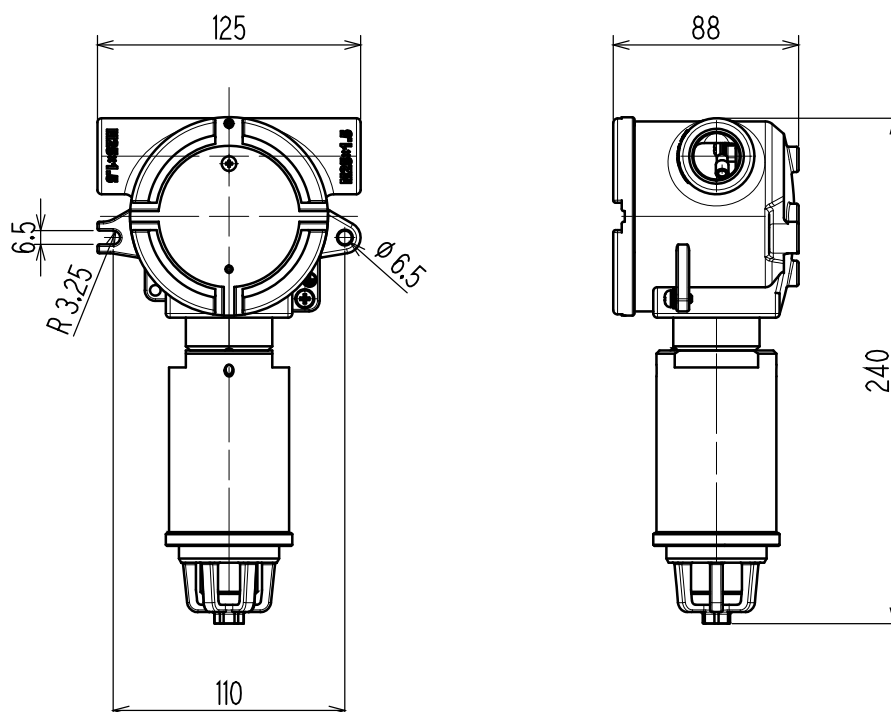
10-2-2 SD-3SC + GD-3 (model with EC barrier)

Model	SD-3SC + GD-3	SD-3SC (contact specifications) + GD-3	SD-3SC (RS-485 specifications) + GD-3
Specifications	Standard	Contact	RS-485
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 on (green)		
External output	Gas concentration signal (4 - 20 mA DC with HART)	Gas concentration signal (4 - 20 mA DC with HART), contact output	Gas concentration signal (4 - 20 mA DC), RS-485 (half duplex)
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)		
Gas alarm indication	Power lamp on (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 on (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	—
Warning	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 - 20 mA DC (non-insulated linear output) Maximum load resistance 600 Ω (with derating depending on supply voltage) Resolution: max. 250 divisions (Depends on specifications.)		

Model	SD-3SC + GD-3	SD-3SC (contact specifications) + GD-3	SD-3SC (RS-485 specifications) + GD-3
Transmission cable (4 - 20 mA)	Shielded cable 1.25 sq (1.308 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 (1.308 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 (RS-485)	—	—	Shielded twisted pair cable 1.25 sq (1.308 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 (RS-485)	—	—	Depends on system design conditions.
Transmission cable (between GD-3 units)	Shielded twisted pair cable 1.25 sq (1.308 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 - 30 V DC) * Use a power source 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 (1.308 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 to +70 °C (no sudden fluctuations) In accordance with sensor specifications if restrictions apply due to sensor specifications		
Operating humidity range	0 - 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, NEMA 4X equivalent* ¹		
Installation	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)	Approximately 171 (W) × 193 (H) × 127 (D) mm (excluding projections)		
Weight (SD-3SC)	Approx. 6.0 kg		
External dimensions (GD-3)	Approximately 125 (W) × 240 (H) × 88 (D) mm		
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.

*¹ To satisfy NEMA 4X performance requirements, use cable glands that comply with both NEMA 4X and explosion-proof certification.

<Dimensional drawing (SD-3SC+ GD-3 (model with EC barrier))>**<Main unit (SD-3SC)>****<Remote sensor unit (GD-3 (model with EC barrier))>**

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

Model	Power supply	Power consumption
SD-3SC	24 V DC (18 - 30 V DC)	Maximum 5 W
GD-3RI	24 V DC (18 - 30 V DC)	Maximum 1.2 W
GD-3GH	24 V DC (18 - 30 V DC)	Maximum 2 W
GD-3GHS	24 V DC (18 - 30 V DC)	Maximum 2 W
GD-3NC	24 V DC (18 - 30 V DC)	Maximum 2 W
GD-3SP	24 V DC (18 - 30 V DC)	Maximum 1 W
GD-3NPM	24 V DC (18 - 30 V DC)	Maximum 1 W
GD-3EC	24 V DC (18 - 30 V DC)	Maximum 1 W
GD-3ECS	24 V DC (18 - 30 V DC)	Maximum 1 W
GD-3ECB	24 V DC (18 - 30 V DC)	Maximum 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 (replacement gas)	Operating temperature range	Operating humidity range	Warranty period
IRF-1301*	Methane	CH ₄	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	CH ₄	-40 °C to 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-1317*	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	2000 ppm	1 ppm	1000 ppm	-	CO ₂			
IRF-1436	Carbon dioxide	CO ₂	5000 ppm	10 ppm	1000 ppm	-	CO ₂			
IRF-1433	Carbon dioxide	CO ₂	10000 ppm	10 ppm	1000 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)			
IRF-1315	Propane	C ₃ H ₈	100 vol%	0.5 vol%	25 vol%	50 vol%	C ₃ H ₈			

* 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.
- ▶ Ensure identical temperatures, humidity, and pressure in the calibration and measurement environments. (Readings may fluctuate due to temperature, humidity, and pressure characteristics. In some cases, readings may exceed the zero suppression value due to sensor characteristics.)
- ▶ For low gas sensitivity ethylene and butadiene, we recommend using with the alarm settings at 25 %LEL or greater.
- ▶ If the composition of the base gas differs greatly for calibration and measurement—for example, if an air base is used for calibration but a CO₂ base is used for measurement—the reading may differ due to infrared adsorption characteristics even if the concentration of the target gas is the same.
- ▶ Perform maintenance if a warning appears while the life assessment or self-diagnostic function is active.
- ▶ Use the IRF sensor adapter when calibrating. Calibration accuracy may be impaired without the IRF sensor adapter.
- ▶ The warranty period for IRF sensors is three years, regardless of detection target gas.
- ▶ Please contact RIKEN KEIKI for information on other gas types and detection ranges.

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	Warranty period
NCF-6318	Methane	CH ₄	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	CH ₄ ^{*2}	-40 °C to 70 °C	0 - 95 %RH or less ^{*1} (no condensation)	3 years
NCF-6319	VCM	VCM	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	i-C ₄ H ₁₀			
NCF-6320	Hydrogen	H ₂	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	H ₂ ^{*3}			

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

*2 Use NCF-6318 if methane calibration is required or if 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 stable location within the specified operating temperature range and free of sudden temperature fluctuations.
- ▶ Sensor characteristics may degrade significantly in the presence of silicone gases (organic silicone gases), the various types of halogen gases, sulfide gases, or acidic gases.
- ▶ A silicone removal filter and activated carbon filter are available as options.
- ▶ For models with a F.S. of 5000 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 5000 ppm or less, the effects of ambient humidity and temperature fluctuations will become more significant, and the zero point may drift. If so, turn the zero follower function ON. However, we recommend using a sensor with a different detection principle. The zero follower function is not available if gases are always present.
- ▶ Readings may be affected by combustible gases other than the detection target gas.
- ▶ When oxygen concentrations fall, the readings may also fall.
- ▶ Some interference may occur in the presence of highly thermally conductive gases such as CO₂, Ar, and He in high concentrations as base gases.
- ▶ When low vapor pressure gases are detected by aspiration, the gas may condense when aspirated from warmer areas and detected in cooler areas, or blockages may occur in sintered alloy. Keep vapor pressure in mind when using the product.
- ▶ 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 impaired without the combustible gas sensor adapter.
- ▶ Indication accuracy may degrade in situations in which temperatures fluctuate significantly (±40 °C or greater) above or below the ambient temperature in which zero calibration or span adjustment was performed. If this occurs, repeat zero calibration or span adjustment.
- ▶ Readings may fluctuate if the product is subjected to strong external impact or vibrations. If this occurs, perform zero calibration and span adjustment.
- ▶ The zero point may fluctuate if the sensor is in continuous contact with high-concentration gas of 100 %LEL or more 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.
- ▶ The sensor top is covered with a Teflon film. Damage to this Teflon film may affect sensor characteristics. Avoid applying excessive pressure or sharp objects to the Teflon film.
- ▶ The warranty period for NCF sensors is 3 years, irrespective of detection target gas.
- ▶ Please contact RIKEN KEIKI for information on other gas types and detection ranges.

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	Warranty period
SGF-8562	Carbon disulfide	CS ₂	200 ppm	1 ppm	50 ppm	100 ppm	CS ₂	-20 °C to 65 °C	20 - 95 %RH or less* (no condensation)	3 years
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

- ▶ Sensor characteristics may degrade significantly in the presence of silicone gases (organic silicone gases), the various types of halogen gases, sulfide gases, or acidic gases.
- ▶ A silicone removal filter and activated carbon filter are available as options.
- ▶ Select the calibration gas after accounting for typical humidity in the operating environment.
- ▶ When calibrating, allow a warmup time corresponding to the unpowered period in clean air before proceeding with the zero calibration and span adjustment. Refer to '< Warmup times for semiconductor type sensors>' below for warmup times.
- ▶ Readings may be affected by combustible gases other than the detection target gas.
- ▶ Readings may fluctuate in the presence of fluctuations (e.g., temperature and humidity) in the installation location.
- ▶ When oxygen concentrations fall, the readings may also fall.
- ▶ Some interference may occur in the presence of highly thermally conductive gases such as CO₂, Ar, and He in high concentrations as base gases.
- ▶ When low vapor pressure gases are detected by aspiration, the gas may condense when aspirated from warmer areas and detected in cooler areas, or blockages may occur in sintered alloy. Keep vapor pressure in mind when using the product.
- ▶ 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 impaired without the combustible gas sensor adapter.
- ▶ Indication accuracy may degrade in situations in which temperatures fluctuate significantly (±20 °C or greater) above or below the ambient temperature in which zero calibration or span adjustment was performed. If this occurs, repeat zero calibration or span adjustment.
- ▶ Readings may fluctuate if the product is subjected to strong external impact or vibrations. 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 sensor top is covered with a Teflon film. Damage to this Teflon film may affect sensor characteristics. Avoid applying excessive pressure or sharp objects to the Teflon film.
- ▶ 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.
- ▶ 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.
- ▶ The warranty period for SGF sensors is three years, regardless of detection target gas.
- ▶ Please contact RIKEN KEIKI for information on other gas types and detection ranges.

< Warmup times for semiconductor type sensors>

Unpowered period	Warmup time
Within 10 minutes	30 minutes or more
Within 1 hour	2 hours or more
Within 24 hours	4 hours or more
Within 72 hours	24 hours or more
Within 10 days	2 days or more
Less than 1 month	7 days or more
1 month to less than 3 months	14 days or more
3 months or more	1 month or more

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	Warranty period
SHF-8601	Methane	CH ₄	5000 ppm	25 ppm	2000 ppm	4000 ppm	CH ₄	-30 °C to 70 °C	20 - 95 %RH or less* (no condensation)	3 years
SHF-8601	Carbon monoxide	CO	1000 ppm	10 ppm	250 ppm	500 ppm	CO	0 °C to 70 °C		
SHF-8603	Hydrogen	H ₂	2000 ppm	10 ppm	500 ppm	1000 ppm	H ₂	-30 °C to 70 °C		

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

NOTE

- ▶ Sensor characteristics may degrade significantly in the presence of silicon gases (organic silicon gases), the various types of halogen gases, sulfide gases, or acidic gases.
- ▶ A silicone removal filter and activated carbon filter are available as options.
- ▶ Select the calibration gas after accounting for typical humidity in the operating environment.
- ▶ When calibrating, allow a warmup time corresponding to the unpowered period in clean air before proceeding with the zero calibration and span adjustment. Refer to '< Warmup times for hot-wire semiconductor type sensors>' below for warmup times.
- ▶ The reading may change even for combustible gases other than the detection target gas.
- ▶ Readings may fluctuate in the presence of fluctuations (e.g., temperature and humidity) in the installation location.
- ▶ When oxygen concentrations fall, the readings may also fall.
- ▶ Some interference may occur in the presence of highly thermally conductive gases such as CO₂, Ar, and He in high concentrations as base gases.
- ▶ When low vapor pressure gases are detected by aspiration, the gas may condense when aspirated from warmer areas and detected in cooler areas, or blockages may occur in sintered alloy. Keep vapor pressure in mind when using the product.
- ▶ 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 impaired without the combustible gas sensor adapter.
- ▶ Indication accuracy may degrade in situations in which temperatures fluctuate significantly (±20 °C or greater) above or below the ambient temperature in which zero calibration or span adjustment was performed. If this occurs, repeat zero calibration or span adjustment.
- ▶ Readings may fluctuate if the product is subjected to strong external impact or vibrations. 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 minimize 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 is left in place 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.
- ▶ The warranty period for SHF sensors is three years, regardless of detection target gas.
- ▶ Please contact RIKEN KEIKI for information on other gas types and detection ranges.

< Warmup times for hot-wire semiconductor type sensors>

Unpowered period	Warmup time	
	SHF-8603	Other SHF sensors
Within 10 minutes	10 minutes or more	1 hour or more
Within 1 hour	30 minutes or more	2 hours or more
Within 24 hours	1 hour or more	4 hours or more
Within 72 hours	4 hours or more	24 hours or more
Within 10 days	2 days or more	2 days or more
Less than 1 month	7 days or more	7 days or more
1 month to less than 3 months	14 days or more	14 days or more
3 months or more	1 month or more	1 month or more

* Note that the warmup time for the SHF-8603 differs from that for 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 (no sudden changes)	Operating humidity range (no condensation)	Warranty period
ESF-A24A	Nitrogen dioxide	NO ₂	15 ppm	0.1 ppm	5.0 ppm	10.0 ppm	NO ₂	-40 °C to 70 °C	20 %RH to 90 %RH	3 years
ESF-A24P	Carbon monoxide	CO	150 ppm	1 ppm	50 ppm	100 ppm	CO	-40 °C to 70 °C	20 %RH to 90 %RH	3 years
ESF-A24R	Hydrogen sulfide	H ₂ S	100 ppm	1 ppm	20 ppm	40 ppm	H ₂ S	-40 °C to 70 °C	20 %RH to 90 %RH	3 years
ESF-A24RH ^{*1}	Hydrogen sulfide	H ₂ S	30 ppm	0.2 ppm	10 ppm	20 ppm	H ₂ S	-40 °C to 70 °C	40 %RH to 95 %RH	3 years
ESF-B22	Ammonia	NH ₃	75 ppm	0.5 ppm	25 ppm	50 ppm	NH ₃	-40 °C to 70 °C	30 %RH to 80 %RH	3 years ^{*2}
ESF-B22	Ammonia	NH ₃	150 ppm	0.5 ppm	50 ppm	100 ppm	NH ₃	-40 °C to 70 °C	30 %RH to 80 %RH	3 years ^{*2}
ESF-B22	Ammonia	NH ₃	400 ppm	1 ppm	25 ppm	300 ppm	NH ₃	-40 °C to 70 °C	30 %RH to 80 %RH	3 years ^{*2}
ESF-X24P2	Oxygen	O ₂	25 %	0.1 %	18.0 %	18.0 %	N ₂	-40 °C to 70 °C	20 %RH to 90 %RH	3 years
ESF-C92	Chlorine	Cl ₂	1.5 ppm	0.01 ppm	0.5 ppm	1.0 ppm	Cl ₂	-20 °C to 70 °C	30 %RH to 80 %RH	3 years
ESF-C92	Chlorine	Cl ₂	3 ppm	0.02 ppm	1 ppm	2 ppm	Cl ₂	-20 °C to 70 °C	30 %RH to 80 %RH	3 years
ESF-C92	Chlorine	Cl ₂	10 ppm	0.1 ppm	3 ppm	10 ppm	Cl ₂	-20 °C to 70 °C	30 %RH to 80 %RH	3 years

*1 High-humidity sensor.

*2 Three years when used at room temperature conditions, and two years when used in other conditions.

NOTE

- ▶ (1) Product storage and distribution precautions
 - Store the sensor in its sensor container.
- ▶ (2) Calibration precautions
 - Use the SD-3EC/ECS/ECB calibration adapter.
 - Calibrate using a flow rate of 0.5 L/min ± 0.1 L/min.
 - Perform zero calibration and span adjustment in a normal atmosphere.
 - Use air or N₂ as the balance gas.
 - Use N₂ for zero calibrations of O₂ sensors.
- ▶ (3) General operation related precautions
 - If used for extended periods in an environment outside the range of -25 °C to 55 °C, allow the product to acclimatize to the operating environment before calibration.
 - Indication accuracy may be impaired when used in high- or low-humidity environments.
 - The response may slow at low temperatures.
 - Use within the range of 55 °C to 70 °C is limited to a cumulative total of one week.
 - Indication accuracy may be impaired if calibrations are performed at high or low temperatures and a large temperature shift occurs.
 - The reading may fluctuate if the temperature, humidity, or pressure varies suddenly.
 - Diffusion type detectors may be affected by wind speeds due to the gas characteristics.
 - Perform maintenance if a warning appears while the life assessment or self-diagnostic function is active.
- ▶ The warranty period for ESF sensors differs for each sensor model. Refer to the above table.

10-3-6 Thermal conductivity type

Sensor model	Gas name	Gas symbol	F.S.	1 digit	First alarm setpoint	Second alarm setpoint	Calibration Gas	Operating temperature range (no sudden changes)	Operating humidity range (no condensation)	Warranty period
TCF-7544	Hydrogen	H ₂	100 %LEL	1 %LEL	25 %LEL ^{*1}	50 %LEL	H ₂ (N ₂ base)	-20 °C to 60 °C	0 %RH to 95 %RH ^{*2}	3 years

*1 Minimum alarm concentration: 20 %LEL

*2 Absolute humidity not exceeding 46 g/m³ (equivalent to 40 °C, 90 %RH)

NOTE

- ▶ The alarm setpoint should be set within the range 20 %LEL to 60 %LEL.
- ▶ Install in a stable location within the specified operating temperature range and free of sudden temperature fluctuations.
- ▶ An activated carbon filter is available as an option.
- ▶ Readings may be affected by combustible gases other than the detection target gas.
- ▶ Responds to gases whose thermal conductivity differs significantly from that of the N₂ base gas.
- ▶ If air is present instead of N₂ as the base gas, the reading will be 7 %LEL to 11 %LEL.
- ▶ Some interference may occur in the presence of highly thermally conductive gases such as CO₂, Ar, and He in high concentrations as base gases.
- ▶ When low vapor pressure gases are detected by aspiration, the gas may condense when aspirated from warmer areas and detected in cooler areas, or blockages may occur in sintered alloy. Take vapor pressure into account when using the product.
- ▶ Perform maintenance if a warning appears while the life assessment or self-diagnostic function is active.
- ▶ Use the ESF/TCF sensor adapter when calibrating. Calibration accuracy may be impaired without the ESF/TCF sensor adapter.
- ▶ Indication accuracy may degrade in situations in which temperatures fluctuate significantly (± 40 °C or greater) above or below the ambient temperature in which zero calibration or span adjustment was performed. If this occurs, repeat zero calibration or span adjustment.
- ▶ Wait at least 10 minutes after introducing the N₂ before performing zero calibration.
- ▶ If the sensor is in continuous contact with hydrogen for 60 minutes or longer, the zero point may remain unstable and fail to return to normal. If the zero point is unstable due to extended contact with hydrogen, allow the product to warm up for at least 24 hours in an atmosphere free of hydrogen, then check to confirm that the zero point has returned to normal.
- ▶ High concentrations of substances such as organic gases and alcohols may damage the sensor.
- ▶ Exposure to NH₃ or similar substances may damage the sensor. If the zero point fluctuates, readjust it.

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>

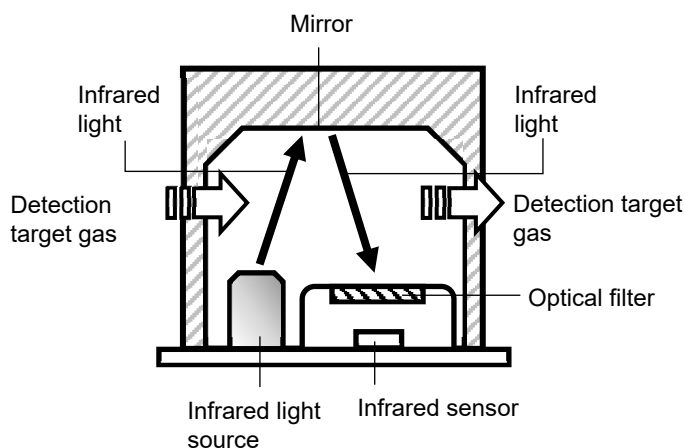
- Construction

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.

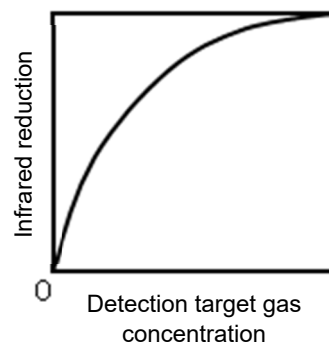
- Principle

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 designed specifically to detect combustible gases.

<Sensor structure and principle>

- Construction

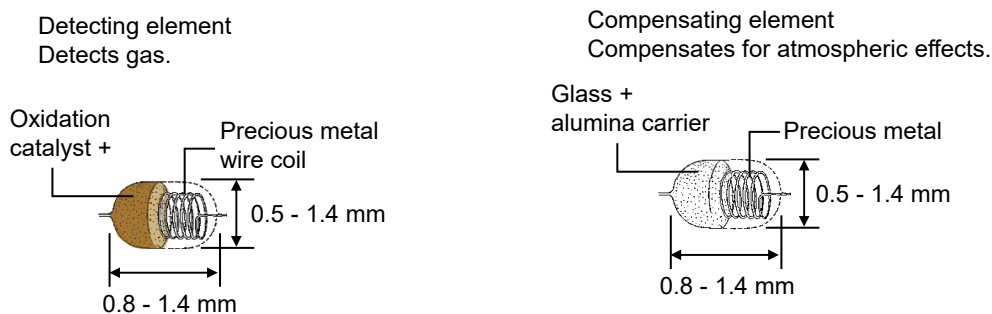
The new ceramic sensors consist of a detecting element and a compensating element. (Some sensors lack a compensating element.) The detecting element consists of an ultrafine particle oxidation catalyst (new ceramic) that reacts with combustible gases sintered on top of a precious metal coil. This undergoes 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.

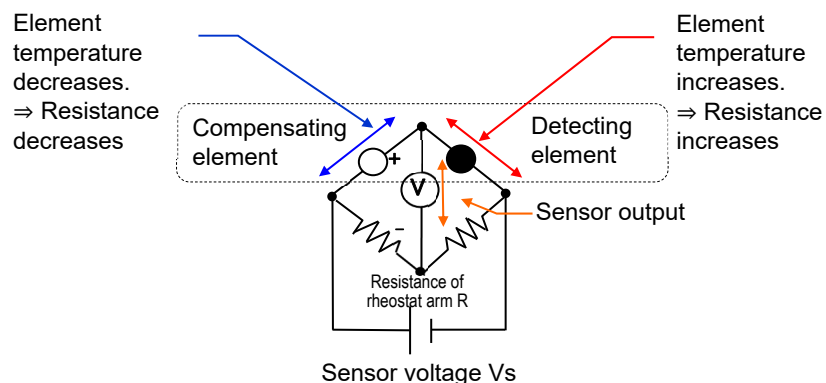
- Principle

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. The resistance of the precious metal wire coil forming the element also varies in accordance with this temperature variation. The resistance variation is roughly proportional to gas concentration. This variation in resistance is thus extracted as a voltage using a bridge circuit and the gas concentration is worked out.

<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>

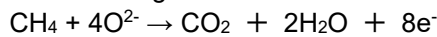
- Construction

The sensor consists of a metal oxide semiconductor (SnO_2) formed around a heater coil and alumina tube. The alumina tube has two gold electrodes at each end to measure semiconductor resistance.

- Principle

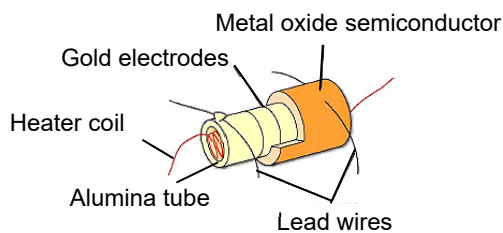
Oxygen from the atmosphere is adsorbed as O^- and O^{2-} to the surface of the metal oxide semiconductor heated to between 350°C and 400°C by the heater coil. The semiconductor maintains constant resistance. If a methane or other such gas comes into contact with this surface and becomes chemically adsorbed, the oxygen is oxidized and released by the adsorbed O^{2-} ions.

The following chemical reaction occurs here at the sensor surface:

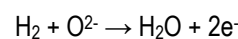
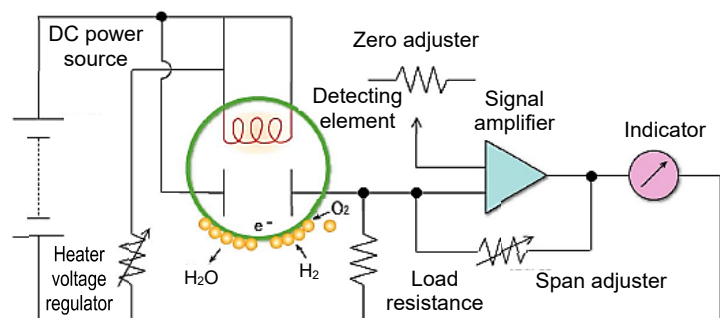


In other words, as methane gas is adsorbed to the sensor surface removing adsorbed oxygen, the increase in free electrons inside the sensor reduces the resistance. This variation in resistance can be measured and used to calculate the gas concentration.

<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>

- Construction

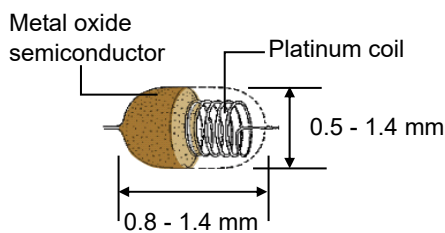
The sensor consists simply of a detecting element formed of a metal oxide semiconductor sintered around a platinum coil.

- Principle

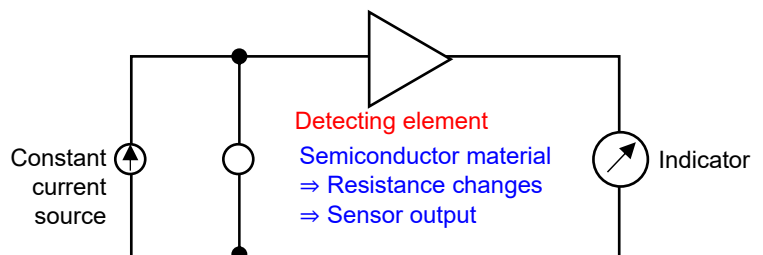
The resistance (R) of the detecting element is the combined resistance of the semiconductor resistance (R_S) and the platinum coil resistance (R_H).

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 if 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>

- Construction

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 an electrolyte solution.

- Principle

A potentiostat circuit is used to maintain 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.

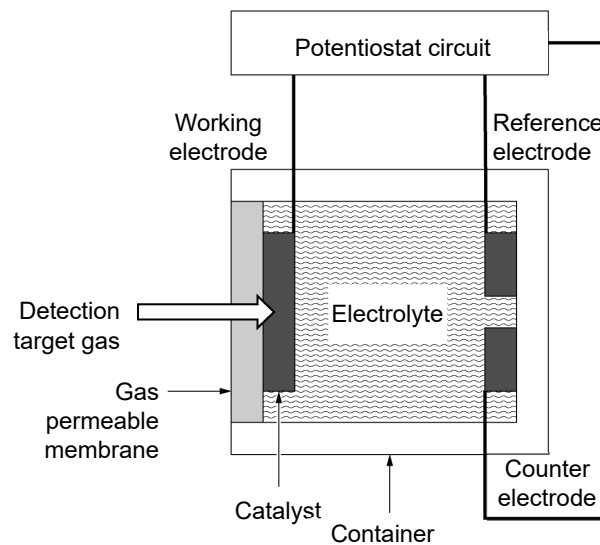
Example: In the case of hydrogen sulfide (H_2S), the following chemical reaction occurs:

Working electrode: $\text{H}_2\text{S} + 4\text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4 + 8\text{H}^+ + 8\text{e}^-$ (e^- is an electron)

Counter electrode: $2\text{O}_2 + 8\text{H}^+ + 8\text{e}^- \rightarrow 4\text{H}_2\text{O}$

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

<Structure diagram>



11-1-6 Thermal conductivity type

<Sensor overview>

Detects gas thermal conductivity differences as gas concentrations.

<Sensor structure and principle>

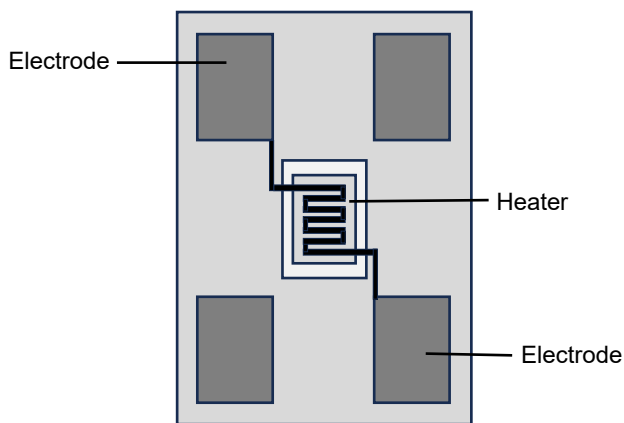
- Construction

The detecting element consists only of a heater formed using MEMS technology.

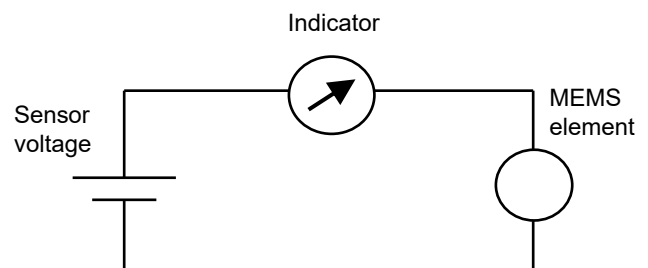
- Principle

When the target gas comes into contact with the detecting element heated by the heater, the detecting element temperature varies according to the heat dissipation determined by the characteristic thermal conductivity of the gas. The resistance of the heater forming the element also varies in accordance with this temperature variation. The resistance variation correlates to the gas concentration. The variation in resistance can be extracted as a current and used to calculate the gas concentration.

<Structure diagram>



<Drive circuit>



11-2 Terminology

Term	Definition
Initialization	This function prevents alarms from being issued for a while after the power is turned on. This prevents alarms from being issued, as the output from the detector fluctuates for a while after the power is turned on.
Full scale	The maximum value of the detection range
Calibration	This refers to the process of checking the product reading against a calibration gas. The process includes adjusting the product reading to match the concentration of the calibration gas.
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.
vol%	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. In the event of defects, we will repair the product at no cost for three years from the date of purchase as long as the product has been used correctly in accordance with the operating manual, labels affixed to the product, and other such warnings.
2. For information about repairs, maintenance, and after sales servicing, please contact RIKEN KEIKI.
3. When on-site repairs are required at remote locations, we will request that you defray the cost of traveling to the site.
4. Even within the warranty period, a fee will be charged for repairs in the following cases:
 - (a) The defect or damage is as the result of erroneous operation, unwarranted repair, or modification.
 - (b) When faults or damages are due to the item being repaired or modified at service agencies other than RIKEN KEIKI or service agencies designated by RIKEN KEIKI.
 - (c) When the faults or damages are due to the item being incorrectly moved, transported, toppled, dropped, or stored after the product was purchased.
 - (d) When the faults or damages are due to external factors such as; acts of providence such as fire, earthquake, flood, lightning strikes, etc.; pollution; abnormal voltage; use of power sources outside of rated ranges (voltage, frequency); etc.
 - (e) When the cause of the fault is something other than this product.
 - (f) Replacing consumable parts (e.g., batteries, fuses)

Sensor warranty

1. In the event of defects, we will replace at no cost for three years from the date of purchase or the date on which the sensor was replaced for a fee (with certain exceptions) as long as the product has been used correctly in accordance with the operating manual, labels affixed to the product, and other such warnings. For information on the warranty period for each sensor model, refer to '10-3. Detection target gases for individual detection principles'.
However, a condition of the sensor's warranty shall be maintenance performed at least once annually from the date of purchase or the date on which the sensor was replaced for a fee.
2. For information about repairs, maintenance, and after sales servicing, please contact RIKEN KEIKI.
3. When on-site replacement is required at remote locations, we will request that you defray the cost of traveling to the site.
4. Even within the warranty period, a fee will be charged for replacement in the following cases:
 - (a) Replacement is required due to failure to comply with warnings in the operating manual, labels affixed to the product, and other such warnings.
 - (b) When faults or damages are due to the item being repaired or modified at service agencies other than RIKEN KEIKI or service agencies designated by RIKEN KEIKI.
 - (c) When the faults or damages are due to the item being incorrectly moved, transported, toppled, dropped, or stored after the product was purchased.
 - (d) When the faults or damages are due to external factors such as; acts of providence such as fire, earthquake, flood, lightning strikes, etc.; pollution; abnormal voltage; use of power sources outside of rated ranges (voltage, frequency); etc.
 - (e) When the cause of the fault is something other than this product.
 - (f) If changes in the gas sensitivity of the sensor, faults, or damages are due to the effects of coexisting gases in the installation environment (e.g., acidic gases, alkaline gases, alcohol, silicone)

Revision history

Issue	Revision details	Issue date
0	First issue (PT2E-2874)	July 14, 2023
1	'1-2-1 Models and codes' modified. '3-1-5 Optional accessories' expanded and modified. Explanation of cable and power supply installation added to 4-1-2. External output operation tables modified in 6-4-1 and 6-4-2. 7-7, 8-1, and 10-3-5 modified with additional ESF sensor models.	August 21, 2023
2	Tag plate with wire chain added to 3-1-5. '4-11 Mounting the lightning arrester' added.	December 25, 2023
3	RS-485 communication specifications added. UKEX/UKCA deleted and CE Declaration of conformity altered '1-2-1 Models and codes' modified. '2-4 Safety information' modified. Waterproof cap added to '3-1-5 Optional accessories'. '9-2 Reading abnormalities' expanded and modified.	March 18, 2025
4	GD-3ECB duct mounting kit added to '3-1-5 Optional accessories'. GD-3ECB duct mounting kit external dimensions and duct diameter added to '4-5-2 Duct mounting'.	July 14, 2025
5	CE Declaration of Conformity deleted. '8-3 Product disposal' modified.	October 31, 2025
6	NPM specifications added. NEMA 4X compliant cable glands added to 4-1-1. NEMA 4X compliance added to protection ratings in 10-1.	July 2, 2026