

Gas Detector with Signal Converter

SD-3 Series

Export Specifications

Technical Manual

for SIL and FM Specifications

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Contents

1.	Product Overview	5
1-1	Introduction.....	5
1-2	Intended use and features	7
1-2-1	Models and Codes	7
1-2-2	Detection principles and detection target gases for individual models	8
1-2-3	Product features	9
1-3	Usage zones and conditions.....	10
1-4	DANGER, WARNING, and NOTE	11
1-5	Method of confirmation for Standards and Explosion proof specification.....	11
2.	Important Safety Information	12
2-1	Danger information.....	12
2-2	Warning information	12
2-3	Caution information	13
2-4	Safety information	14
3.	Product Configuration.....	34
3-1	Main unit and accessories	34
3-1-1	Main unit (SD-3).....	34
3-1-2	Main unit (SD-3SC)	35
3-1-3	Remote sensor head (GD-3).....	35
3-1-4	Standard accessories	36
3-1-5	Optional accessories	37
3-2	Part names and functions	41
3-3	Block diagrams.....	42
4.	Installation	46
4-1	Installation precautions	46
4-1-1	General installation information.....	46
4-1-2	Restrictions regarding installation	47
4-2	System design precautions.....	53
4-2-1	Using a stable power supply	53
4-2-2	Lightning strike protective measures	53
4-3	Providing maintenance space	54
4-4	Main unit installation.....	56
4-4-1	Vertical pole mounting	56
4-4-2	Wall mounting	57
4-4-3	Attaching protective cover	58
4-4-4	Attaching sunshade cover	60
4-5	Remote sensor head (GD-3) installation	62
4-5-1	Wall mounting	62
4-5-2	Duct mounting	62
4-6	Connecting the grounding terminal.....	64
4-7	Connecting the power and signal cables.....	65
4-7-1	Main unit cable and device connectors.....	65
4-7-2	Connecting the power and signal cables to the main unit.....	67
4-7-3	Connecting the power and signal cables to the remote sensor head (GD-3).....	70
4-7-4	Connecting the main unit (SD-3SC) and remote sensor head (GD-3).....	73
4-7-5	Connecting cables to the terminal plate.....	78
4-8	Mounting the sensor.....	81
4-9	Alarm relay setting (option)	82
4-10	Mounting the splash guard	85

4-11	How to install the lightning arrester	87
4-12	RS-485 setting (optional)	88
5.	Usage Instructions	91
5-1	Preparations for startup	91
5-2	Startup	92
5-3	Basic operation flow	93
5-4	Operating procedure	94
5-5	User mode	95
5-5-1	User mode setting items	95
5-5-2	Switching to user mode	96
5-6	Performing zero calibration	97
5-7	Checking settings	99
5-7-1	Checking alarm setpoints	99
5-7-2	Check RS-485 setting value	101
5-8	Shutting down	103
6.	Alarm Activation	104
6-1	Gas alarm activation	104
6-1-1	Alarm activation	104
6-1-2	Contact operation (auto reset)	105
6-1-3	Contact operation (self-latching)	106
6-1-4	Alarm response	108
6-2	Fault alarm activation	108
6-3	Warning operation	109
6-4	External output operation	110
6-4-1	For target gases other than oxygen	110
6-4-2	When the target gas is oxygen	112
6-5	Functions to ensure correct alarm activation	114
6-5-1	Zero suppression function	114
6-5-2	Automatic sensor recognition function	115
7.	Maintenance	116
7-1	Maintenance intervals and items	116
7-2	Maintenance mode	119
7-2-1	Maintenance mode setting items	119
7-2-2	Switching to maintenance mode	120
7-3	Performing tests (test mode)	122
7-3-1	Performing gas test	122
7-3-2	Performing alarm test	123
7-3-3	Performing fault test	125
7-3-4	Performing LED test	126
7-3-5	Performing memory test (RAM test)	127
7-4	Performing calibration	128
7-4-1	Calibration preparation	128
7-4-2	Performing zero calibration	136
7-4-3	Performing span adjustment	137
7-5	Setting environmental settings 1	140
7-5-1	Inhibit setting	140
7-5-2	Alarm setpoint setting	141
7-5-3	Date and time setting	142
7-6	Setting communication settings (RS-485)	143
7-6-1	Address setting	143
7-6-2	Communication speed setting	144
7-6-3	Data length setting	145

7-6-4 Parity setting	146
7-6-5 Stop bit setting	147
7-6-6 Communication error display setting	148
7-7 Parts replacement	149
7-7-1 Sensor replacement	149
7-7-2 Replacement of periodic replacement parts	151
8. Storage, Relocation, and Disposal	152
8-1 Procedures for storage or when not in use for extended periods	152
8-2 Procedures for relocation or reuse	154
8-3 Product disposal	154
9. Troubleshooting	156
9-1 Product abnormalities	156
9-2 Reading abnormalities	157
10. Product Specifications	159
10-1 SD-3 specifications	159
10-1-1 SD-3 (model without EC barrier)	159
10-1-2 SD-3 (model with EC barrier)	162
10-1-3 Electrical ratings (SD-3)	165
10-2 SD-3SC + GD-3 specifications	166
10-2-1 SD-3SC + GD-3 (model without EC barrier)	166
10-2-2 SD-3SC + GD-3 (model with EC barrier)	170
10-2-3 Electrical ratings (SD-3SC + GD-3)	173
10-3 Detection target gases for individual detection principles	174
10-3-1 Non-dispersive infrared type (Infrared type)	174
10-3-2 New ceramic type	175
10-3-3 Electrochemical type	176
11. Appendix	177
11-1 Detection principle	177
11-1-1 Non-dispersive infrared type (Infrared type)	177
11-1-2 New ceramic type	178
11-1-3 Electrochemical type	179
11-2 Sensor Specifications	180
11-2-1 IR sensor specification	180
11-2-2 Combustible gas sensor specification	182
11-2-3 EC sensor specification	183
11-3 Calibration curve	187
11-3-1 IRF sensor	187
11-3-2 NCF sensor	188
11-4 Terminology	189
Product warranty	190
Sensor warranty	190
Revision History	191

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.

When measuring combustible gases, follow the instructions provided in EN 60079-29-2.

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

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

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

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

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

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

<Models covered by this operating manual>

	Diffusion type	Suction type
Main unit	SD-3RI	SD-3DRI
	SD-3NC	SD-3DNC
	SD-3EC	SD-3DEC
	SD-3ECS	SD-3DECS
	SD-3ECB	SD-3DECB
Main unit	SD-3SC	
Remote sensor head	GD-3RI	
	GD-3NC	
	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 type (infrared type)	RI
New ceramic type	NC
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)]

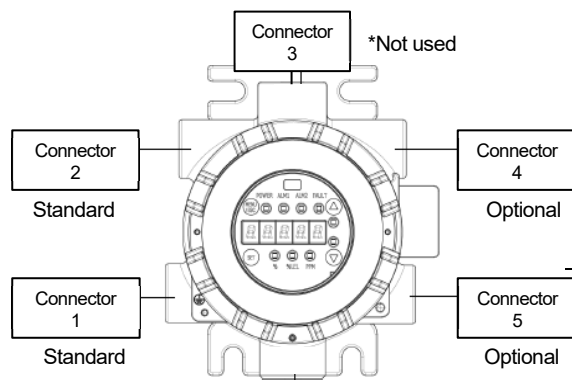
SD-3SC (3) (4) (5) (6) (7) (8)

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 type (Infrared type)
	NC	New ceramic 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	IECEX/ATEX
	2	FM(US)[Zone] * ¹
	3	Japan Ex
	4	cFM(Canada)[Zone] * ¹
	5	-
	6	Taiwan Ex (TS certification)
	7	China Ex(NEPSI)
⑤ Functional safety IEC 61508		
	0	N/A
	1	SIL * ¹

⑥ Performance certification		
	0	N/A
	1	EN performance* ¹
	3	US/Canada performance* ¹
	4	IEC performance* ¹
⑦ Range setting		
	0	Single range
⑧ Output type selection		
	0	4 to 20 mA with HART
	1	4 to 20 mA with HART + contact (3c)
	2	4 to 20 mA + RS-485

*¹ Compliance differs depending on the sensor.



Example: Cable connectors

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

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

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

<List of detection target gases by model>

Main unit model	Detection method	Detection principle	Detection target gas			Remarks
			Combustible gas	Toxic gas	Oxygen	
SD-3RI	Diffusion	Non-dispersive infrared type (infrared type)	○	○		
SD-3NC		New ceramic 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 type (infrared type)	○	○		
SD-3DNC		New ceramic type	○			
SD-3DEC		Electrochemical type		○	○	
SD-3DECS		Electrochemical type		○		H ₂ S (Hydrogen sulfide) only
SD-3DECB		Electrochemical type		○		With EC barrier*

*Differs depending on detection target gas.

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

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

Remote sensor head model	Detection method	Detection principle	Detection target gas			Remarks
			Combustible gas	Toxic gas	Oxygen	
GD-3RI	Diffusion	Non-dispersive infrared type (infrared type)	○	○		
GD-3NC		New ceramic type	○			
GD-3EC		Electrochemical type		○	○	
GD-3ECS		Electrochemical type		○		H ₂ S (Hydrogen sulfide) only
GD-3ECB		Electrochemical type		○		With EC barrier*

*Differs depending on detection target gas.

<Sensor models and detection principles>

Sensor model	Detection principle
IRF	Infrared type
NCF	New ceramic type
ESF	Electrochemical type

1-2-3 Product features

<Standard specifications>

- The product is constructed with a stainless steel housing suitable for both indoors and outdoors use.
- Requires a 24 V DC (DC 18 V to 30 V) power supply.
- The gas concentration, status, and command selection menu are displayed using seven-segment LEDs.
- The concentration of the gas detected is converted to a 4 - 20 mA analog output (NAMUR NE43 compliant) or a digital output signal (HART output signal or RS-485) to output.
- It can be connected to a RIKEN KEIKI monitoring system or programmable logic controller (PLC) via a ceiling fitting or approved cable gland.

<Optional specifications>

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

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

1-3 Usage zones and conditions

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



CAUTION

- Poses risk that combustible or explosive gases can be ignited. The product has not been tested in oxygen-enriched atmospheres (>21 %O₂).
- Using this product in locations associated with explosion risks: Devices and components may be used in locations associated with explosion risks under the conditions specified by approval obtained under explosion prevention ordinances 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:

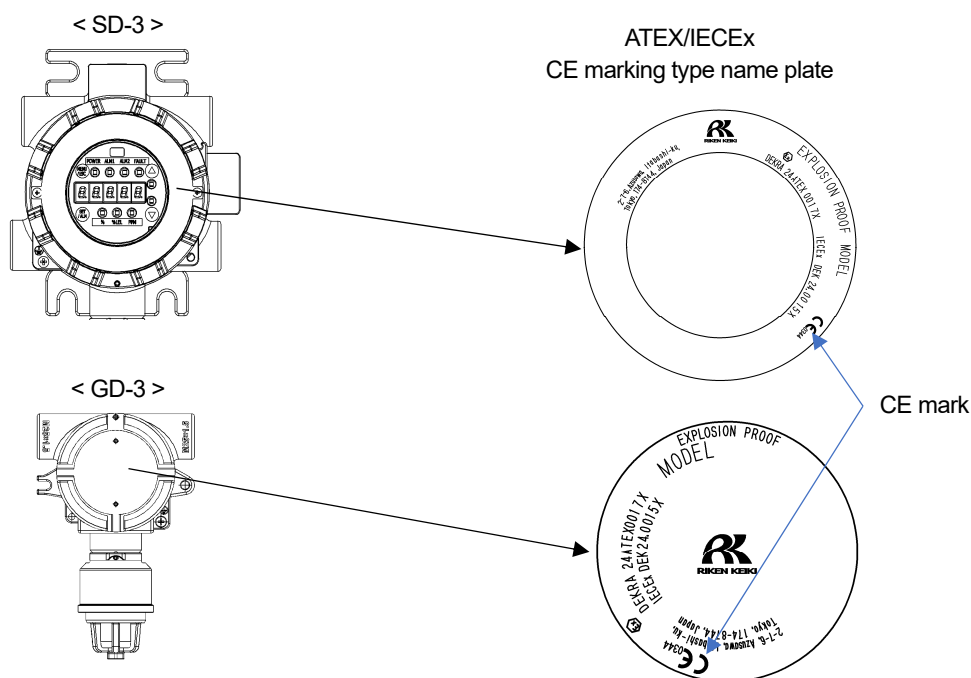
 DANGER	This indicates situations in which improper handling may result in fatal or serious injury or significant property damage.
 WARNING	This indicates situations in which improper handling may result in serious injury or significant property damage.
 CAUTION	This indicates situations in which improper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

1-5 Method of confirmation for Standards and Explosion proof specification

This instrument has some specification depends on standard and explosion proof certificate. Please confirm the detector specification before using. You can confirm instrument specification to see name plate as follows.



2

Important Safety Information

2-1 Danger information



DANGER

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

2-2 Warning information



WARNING

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

2-3 Caution information



CAUTION

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

2-4 Safety information

<Product overview>

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

<Detection principles and models>

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

Detection principle (Detection method: Diffusion type)		Model
Optical sensor	Non-dispersive infrared type (infrared type)	SD-3RI
Solid state sensor	New ceramic type	SD-3NC
Electrochemical sensor	Electrochemical type	SD-3EC
		SD-3ECS
		SD-3ECB

Detection principle (Detection method: Suction type)		Model
Optical sensor	Non-dispersive infrared type (infrared type)	SD-3DRI
Solid state sensor	New ceramic type	SD-3DNC
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 (Detection method: Diffusion type)		Model	
		GD-3 (Remote sensor head)	SD-3
Optical sensor	Non-dispersive infrared type (infrared type)	GD-3RI	SD-3SC
Solid state sensor	New ceramic type	GD-3NC	
Electrochemical sensor	Electrochemical type	GD-3EC	
		GD-3ECS	
		GD-3ECB	



WARNING

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

<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:

【US Certification】

<Without lightning arrester>

Model	Explosion-proof construction	Class	Zone	Explosion-proof class	EPL	Ambient temperature ^{*1}
SD-3RI	d	I	1	AEx db IIC T6 AEx db IIC T5	Gb	-50 °C ≤ Ta ≤ +60 °C -50 °C ≤ Ta ≤ +70 °C
SD-3DRI						
GD-3RI						
SD-3NC	d	I	1	AEx db IIC T5 AEx db IIC T4	Gb	-50 °C ≤ Ta ≤ +44 °C -50 °C ≤ Ta ≤ +70 °C
SD-3DNC						
GD-3NC						
SD-3EC	d	I	1	AEx db IIC T4	Gb	-50 °C ≤ Ta ≤ +70 °C
SD-3DEC						
GD-3EC						
SD-3ECS	d	I	1	AEx db IIC T4	Gb	-50 °C ≤ Ta ≤ +70 °C
SD-3DECS						
GD-3ECS						
SD-3SC ^{*2}	d	I	1	AEx db IIC T5 AEx db IIC T4	Gb	-50 °C ≤ Ta ≤ +44 °C -50 °C ≤ Ta ≤ +70 °C
SD-3SC ^{*3}	d	I	1	AEx db IIC T6 AEx db IIC T5	Gb	-50 °C ≤ Ta ≤ +60 °C -50 °C ≤ Ta ≤ +70 °C
SD-3SC ^{*4}	d	I	1	AEx db IIC T4	Gb	-50 °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 'Detection target gases for individual detection principles'.

*2 When combined with GD-3NC

*3 When combined with GD-3RI

*4 When combined with GD-3EC and GD-3ECS

【US Certification】

<With lightning arrester>

Model	Explosion-proof construction	Class	Zone	Explosion-proof class	EPL	Ambient temperature ^{*1}
SD-3RI	d	I	1	AEx db IIC T6 AEx db IIC T5	Gb	-40 °C ≤ Ta ≤ +60 °C -40 °C ≤ Ta ≤ +70 °C
SD-3DRI						
GD-3RI						
SD-3NC	d	I	1	AEx db IIC T5 AEx db IIC T4	Gb	-40 °C ≤ Ta ≤ +44 °C -40 °C ≤ Ta ≤ +70 °C
SD-3DNC						
GD-3NC						
SD-3EC	d	I	1	AEx db IIC T4	Gb	-40 °C ≤ Ta ≤ +70 °C
SD-3DEC						
GD-3EC						

SD-3ECS	d	I	1	AEx db IIC T4	Gb	$-40\text{ °C} \leq T_a \leq +70\text{ °C}$
SD-3DECS						
GD-3ECS						
SD-3SC ^{*2}	d	I	1	AEx db IIC T5 AEx db IIC T4	Gb	$-40\text{ °C} \leq T_a \leq +44\text{ °C}$ $-40\text{ °C} \leq T_a \leq +70\text{ °C}$
SD-3SC ^{*3}	d	I	1	AEx db IIC T6 AEx db IIC T5	Gb	$-40\text{ °C} \leq T_a \leq +60\text{ °C}$ $-40\text{ °C} \leq T_a \leq +70\text{ °C}$
SD-3SC ^{*4}	d	I	1	AEx db IIC T4	Gb	$-40\text{ °C} \leq T_a \leq +70\text{ °C}$

*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 'Detection target gases for individual detection principles'.

*2 When combined with GD-3NC

*3 When combined with GD-3RI

*4 When combined with GD-3EC and GD-3ECS

【Canadian Certification】

<Without lightning arrester>

Model	Explosion-proof construction	Explosion-proof class	EPL	Ambient temperature ^{*1}
SD-3RI	d	Ex db IIC T6 Ex db IIC T5	Gb	$-50\text{ °C} \leq T_a \leq +60\text{ °C}$ $-50\text{ °C} \leq T_a \leq +70\text{ °C}$
SD-3DRI				
GD-3RI				
SD-3NC	d	Ex db IIC T5 Ex db IIC T4	Gb	$-50\text{ °C} \leq T_a \leq +44\text{ °C}$ $-50\text{ °C} \leq T_a \leq +70\text{ °C}$
SD-3DNC				
GD-3NC				
SD-3EC	d	Ex db IIC T4	Gb	$-50\text{ °C} \leq T_a \leq +70\text{ °C}$
SD-3DEC				
GD-3EC				
SD-3ECS	d	Ex db IIC T4	Gb	$-50\text{ °C} \leq T_a \leq +70\text{ °C}$
SD-3DECS				
GD-3ECS				
SD-3SC ^{*2}	d	Ex db IIC T5 Ex db IIC T4	Gb	$-50\text{ °C} \leq T_a \leq +44\text{ °C}$ $-50\text{ °C} \leq T_a \leq +70\text{ °C}$
SD-3SC ^{*3}	d	Ex db IIC T6 Ex db IIC T5	Gb	$-50\text{ °C} \leq T_a \leq +60\text{ °C}$ $-50\text{ °C} \leq T_a \leq +70\text{ °C}$
SD-3SC ^{*4}	d	Ex db IIC T4	Gb	$-50\text{ °C} \leq T_a \leq +70\text{ °C}$

*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 'Detection target gases for individual detection principles'.

*2 When combined with GD-3NC

*3 When combined with GD-3RI

*4 When combined with GD-3EC and GD-3ECS

【Canadian Certification】

<With lightning arrester>

Model	Explosion-proof construction	Explosion-proof class	EPL	Ambient temperature*1
SD-3RI	d	Ex db IIC T6 Ex db IIC T5	Gb	-40 °C ≤ Ta ≤ +60 °C -40 °C ≤ Ta ≤ +70 °C
SD-3DRI				
GD-3RI				
SD-3NC	d	Ex db IIC T5 Ex db IIC T4	Gb	-40 °C ≤ Ta ≤ +44 °C -40 °C ≤ Ta ≤ +70 °C
SD-3DNC				
GD-3NC				
SD-3EC	d	Ex db IIC T4	Gb	-40 °C ≤ Ta ≤ +70 °C
SD-3DEC				
GD-3EC				
SD-3ECS	d	Ex db IIC T4	Gb	-40 °C ≤ Ta ≤ +70 °C
SD-3DECS				
GD-3ECS				
SD-3SC*2	d	Ex db IIC T5 Ex db IIC T4	Gb	-40 °C ≤ Ta ≤ +44 °C -40 °C ≤ Ta ≤ +70 °C
SD-3SC*3	d	Ex db IIC T6 Ex db IIC T5	Gb	-40 °C ≤ Ta ≤ +60 °C -40 °C ≤ Ta ≤ +70 °C
SD-3SC*4	d	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 'Detection target gases for individual detection principles'.

*2 When combined with GD-3NC

*3 When combined with GD-3RI

*4 When combined with GD-3EC and GD-3ECS

【ATEX / IECEx Certification】

EN/IEC 60079-29-1*6

EN/IEC 62990-1*7

<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-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-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 T4	Gb	-50 °C ≤ Ta ≤ +47 °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 'Detection target gases for individual detection principles'.

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

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

*4: When used with the GD-3RI

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

*6: SD-3RI, SD-3DRI, GD-3RI, SD-3NC, SD-3DNC, GD-3NC, SD-3SC (When used in combination with GD-3RI and GD-3NC) comply with EN/IEC 60079-29-1.

*7: SD-3EC, SD-3DEC, GD-3EC, SD-3ECS, SD-3DECS, GD-3ECS, SD-3SC (When used in combination with GD-3EC and GD-3ECS) comply with EN/IEC 62990-1.

【ATEX / IECEx Certification】

EN/IEC 60079-29-1*6

EN/IEC 62990-1*7

<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-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-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
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- *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 'Detection target gases for individual detection principles'.
- *2: When used in combination with GD-3EC, and GD-3ECS
- *3: When used in combination with GD-3NC
- *4: When used with the GD-3RI
- *5: When used in combination with GD-3ECB
- *6: SD-3RI, SD-3DRI, GD-3RI, SD-3NC, SD-3DNC, GD-3NC, SD-3SC (When used in combination with GD-3RI and GD-3NC) comply with EN/IEC 60079-29-1.
- *7: SD-3EC, SD-3DEC, GD-3EC, SD-3ECS, SD-3DECS, GD-3ECS, SD-3SC (When used in combination with GD-3EC and GD-3ECS) comply with EN/IEC 62990-1.

<Electrical data>

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

<Certificate numbers>

- IECEx DEK 24.0015 X
- DEKRA 24 ATEX 0017 X
- FM22US0043X
- FM22CA0030X
- FM22ATEX0019X
- IECEx FMG 22.0011X

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

- The flameproof joints are not intended to be repaired.
- 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 (according to clause 26.4.2 of ANSI/UL 60079-0:2019, 26.4.2 of CAN/CSA-C22.2 No. 60079-0:2019, 26.4.2 of IEC 60079-0:2017, 26.4.2 of EN IEC 60079-0:2018).
- Avoid rubbing the nameplate area with a dry cloth during use, maintenance, or cleaning. Doing so may result in a static charge buildup of up to 6 nF.
- For information on the explosive-proof operating temperature range and T-class, refer to <Explosion-proof performance data> in '2-4 Safety information'.
- If the surge protection device (lightning arrester) is attached to the flameproof enclosure, it shall be provided with a high strength locking compound on the mounting thread.
- The client should not try to replace the batteries.
- The IP ratings are IP44 for the infra-red sensors and the ESF-A24R.
- The IP ratings are IP67 for the ceramic sensors(with or without splash guard).
- The IP ratings are IP66/67 for the ESF-A24R3(with or without splash guard).
- For situations where the detector has been submerged in water, refer to the Safety Information section of the user manual.
- The GD-3 Series remote gas detectors are only for use with the SD-3SC transmitter.

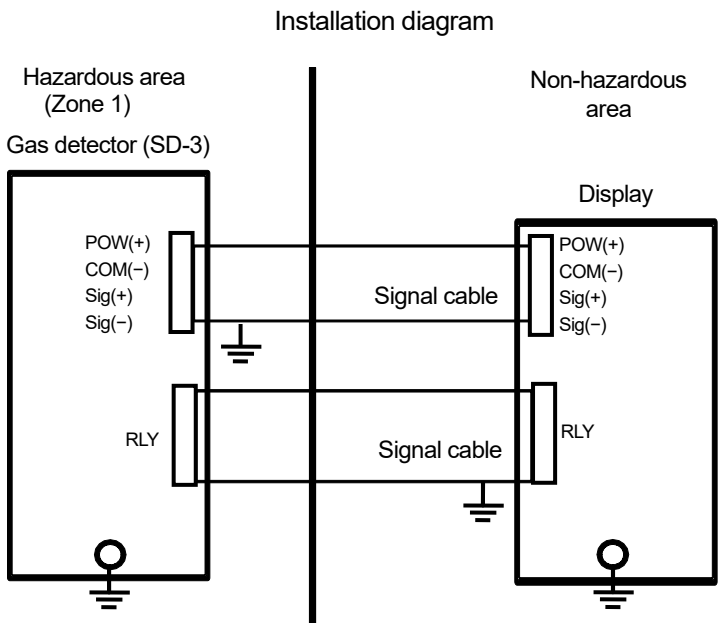
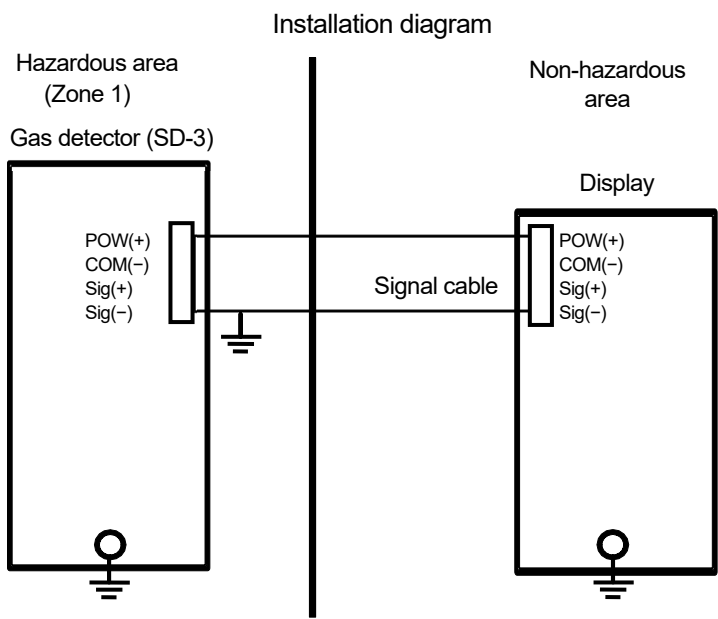
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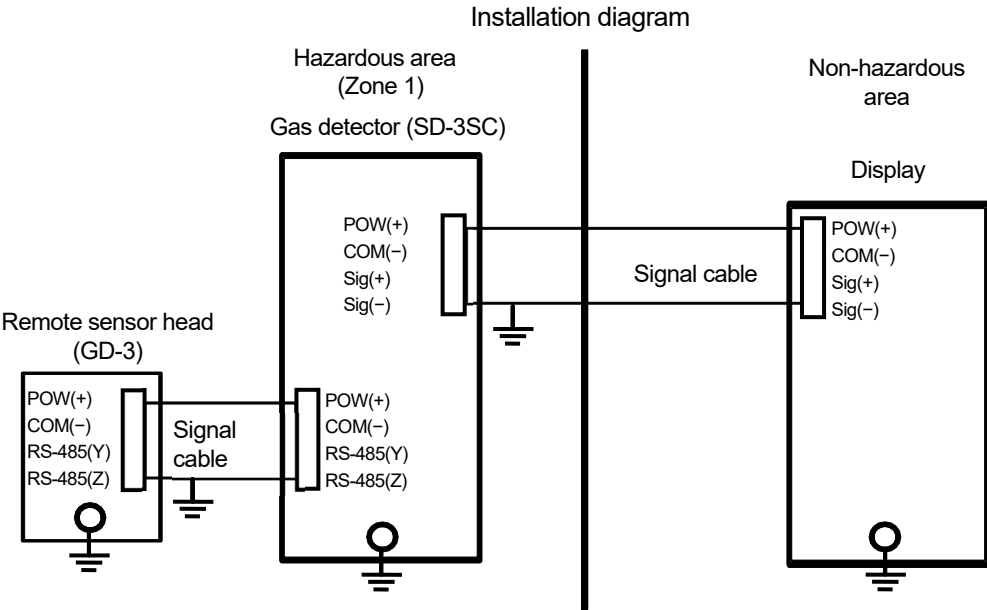
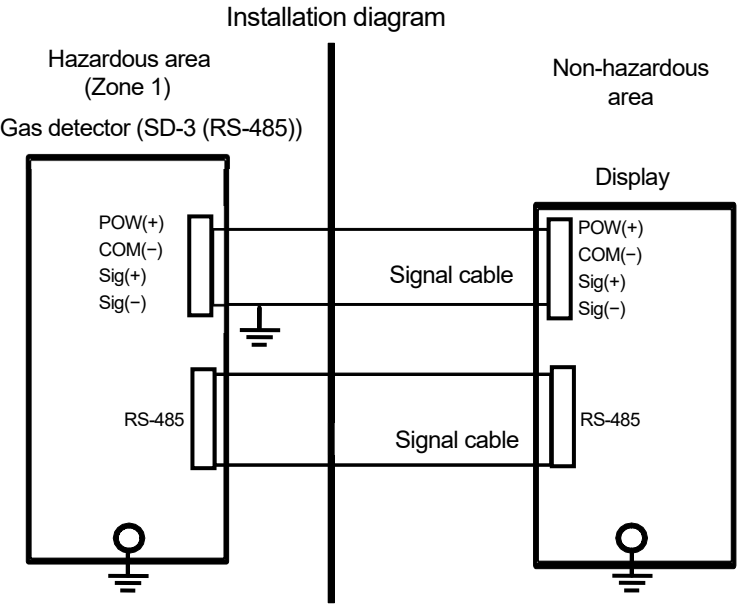
- IEC 60079-0:2017
- IEC 60079-1:2014
- IEC 60079-11:2011
- IEC 60079-29-1: 2016 +AMD 1: 2020: Edition 2.1
- IEC 62990-1:2019:Edition 1.0
- EN IEC 60079-0:2018
- EN 60079-1:2014
- EN 60079-11:2012
- EN 60079-29-1:2016 +A1:2022+A11:2022
- EN 45544-3:2015
- EN 62990-1:2022+A11:2022
- FM 6310, 6320:2024
- FM6340:2022
- ANSI/UL-61010-1:2024
- ANSI/UL 60079-0:2020
- ANSI/UL 60079-1:2015
- ANSI/FM/UL-60079-29-1:2019(R2023)
- ANSI/FM/UL-62990-1:2023
- ANSI/UL 920001:2010
- CSA C22.2 No. 60079-0:2019(R2024)
- CSA C22.2 No. 60079-1:2016(R2021)
- CSA C22.2 No. 60079-29-1:2017+AMD1:2022(R2022)
- CSA C22.2 No. 61010-1:2024
- CSA C22.2 No. 62990-1:2020

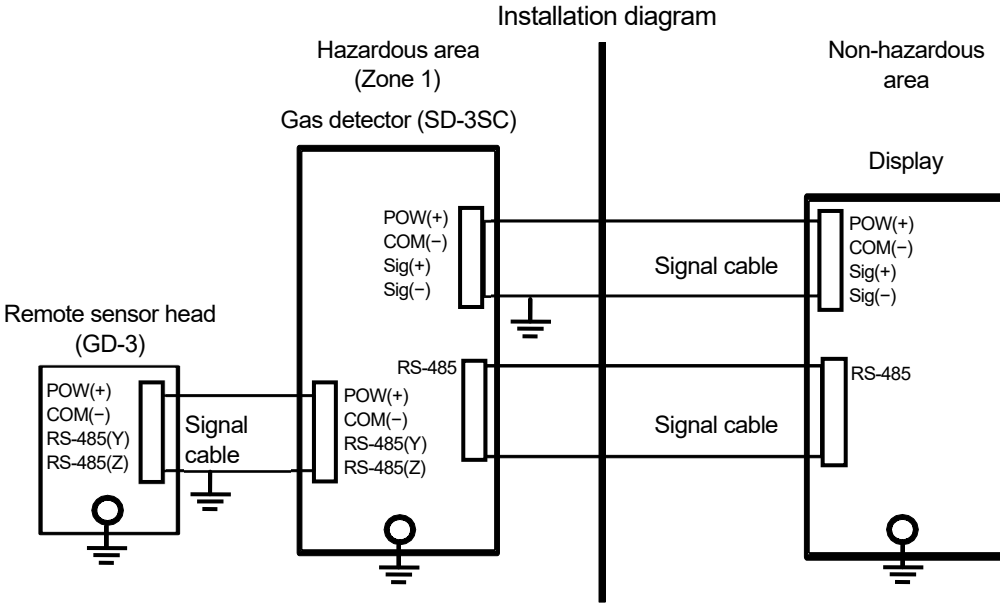
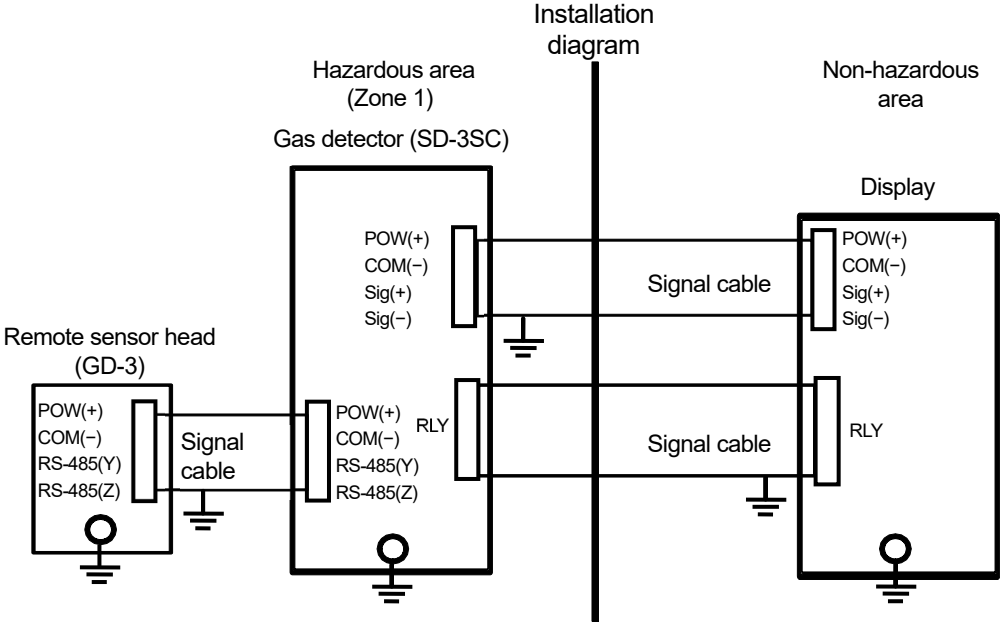
<Operating manual no.>

- PT2-287

<System configuration diagrams>







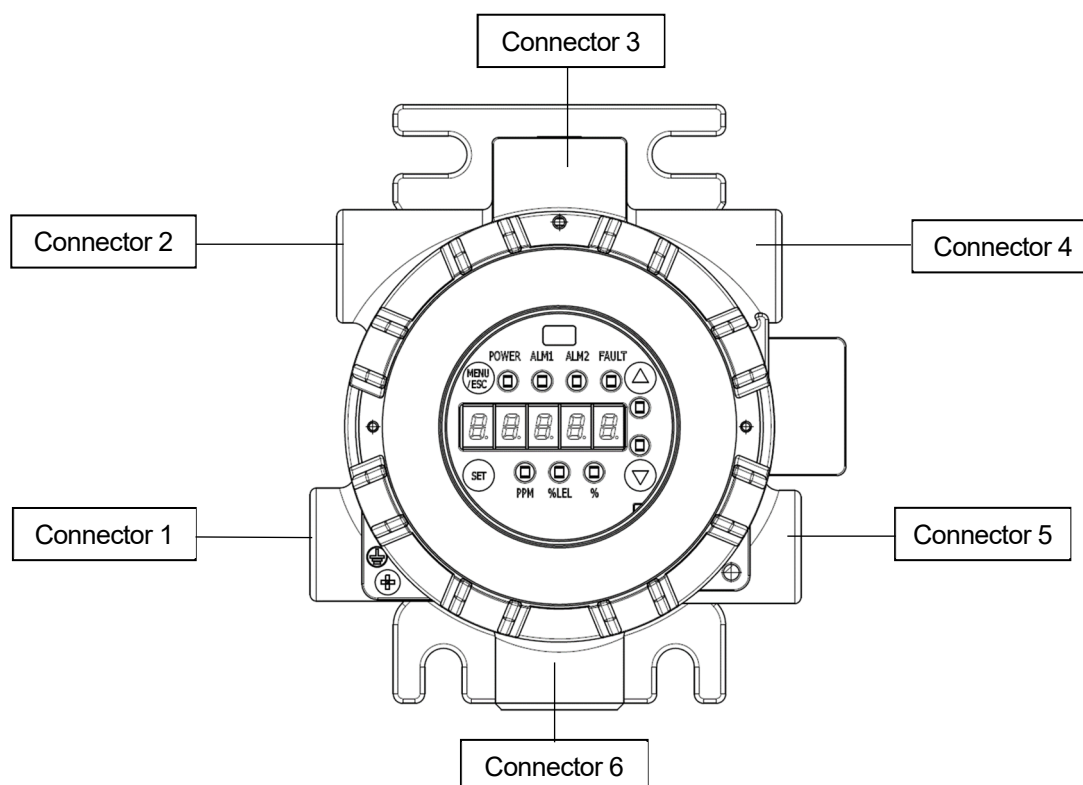
 CAUTION

- Install the product in accordance with the required installation conditions.
 - Do not disassemble, modify, or alter the product.
 - Contact RIKEN KEIKI to request readjustment or parts replacement including calibration.
 - Use cable lugs for grounding wire and bonding conductor connections. Make sure the bonding conductors are not loose or twisted.
 - Do not open the cover in locations where explosive gas may be present.
 - The maximum pressure inside the gas channels and sensor is 10.13 kPa (gauge pressure).
 - Be sure to connect the grounding terminal before turning on the power to the product.
 - Make sure the grounding is Class D equivalent (grounding resistance less than 100 Ω).
 - Use crimped terminals to connect the grounding wire to the grounding terminal inside the unit. Use a cable with a cross section area of at least 4 mm² to connect to the external grounding terminal.
 - Use approved cable glands when installing.
 - If the product is installed in a location where the ambient temperature exceeds 65 °C, use cables designed for use at temperatures at least 5 °C above the maximum ambient temperature.
 - Do not subject the window in the cover to strong forces or impact. Doing so may result in damage and impaired explosion-proof performance. (The low risk of mechanical hazards has been confirmed in testing [2 joules].)
 - Do not use more than one adapter per connector.
 - Do not replace the battery by the user.
 - The IP ratings are IP44 for the infra-red sensors and the ESF-A24R.
 - The IP ratings are IP67 for the ceramic sensors(with or without splash guard).
 - The IP ratings are IP66/67 for the ESF-A24R3(with or without splash guard).
 - For situations where the detector has been submerged in water, refer to the Safety Information section of the user manual.
-

 CAUTION**With suction type**

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

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



<Standard>

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

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

<Optional>

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

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

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

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

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

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

○: Can be connected

×: Cannot be connected

NOTE

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

<Lightning arrester details>

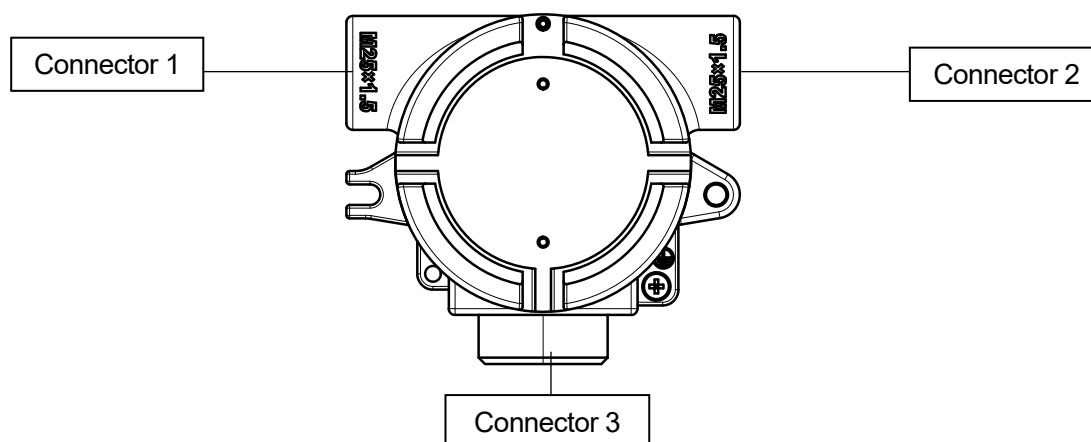
Part	Manufacturer	Eaton Electric Limited
	Name/No.	TP48 or TP32 series surge protector
	Explosion-proof performance	II 2G Ex db IIC T6 Gb
Certification Nos.	No. and issue	IECEx BAS 15.0056X Issue 1, Baseefa 04 ATEX 0053X
	Applicable standards	EN 60079-0:2012+A11:2013 EN 60079-1:2014 IEC 60079-0:2011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

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

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

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

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



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

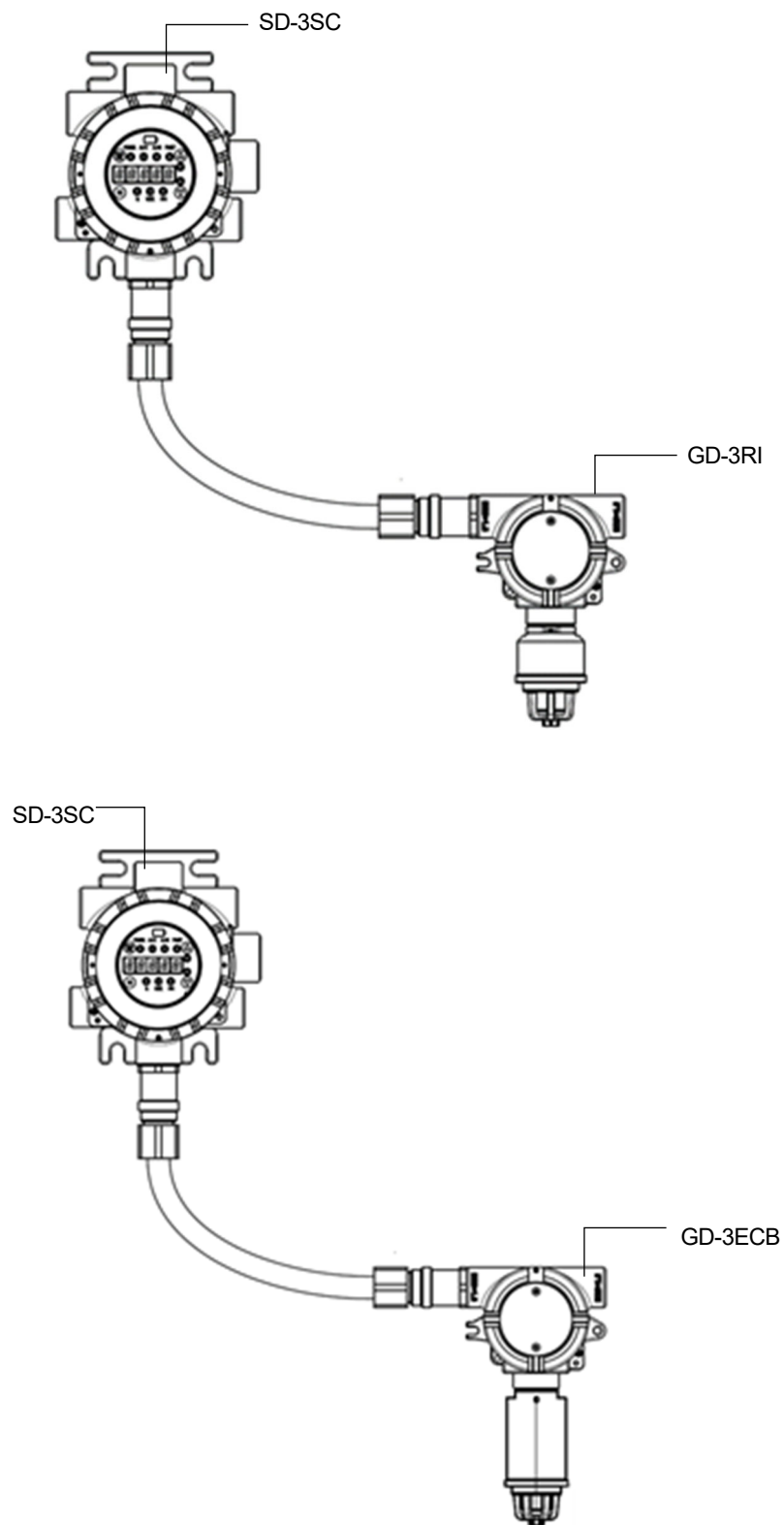
	Connector 1	Connector 2	Connector 3
Sensor assembly	×	×	○
EC barrier	×	×	○
Approved cable gland	○	○	×
M25 plug	○	○	○
Adapter (M25 ⇔ 1/2NPT)	○	○	○
Adapter (M25 ⇔ 3/4NPT)	○	○	○
Adapter (M25 ⇔ M20)	○	○	○

○: Can be connected

×: Cannot be connected

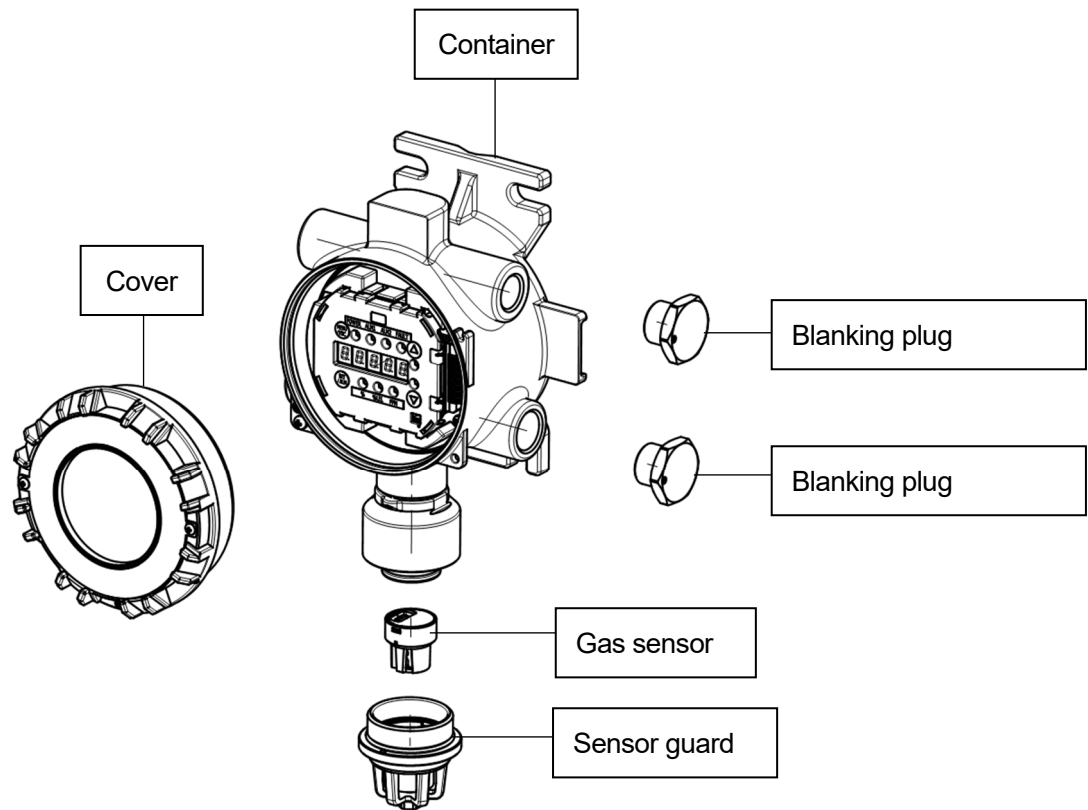
NOTE

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

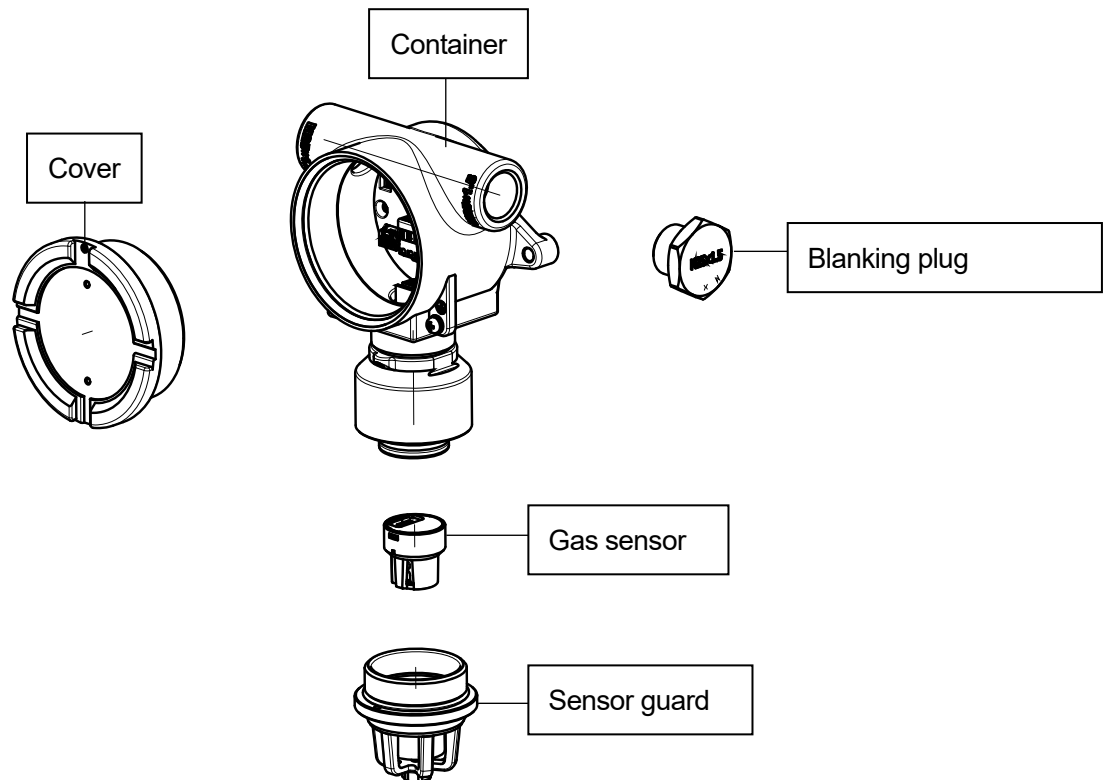
<Connection examples>

<Exploded view>

<SD-3>



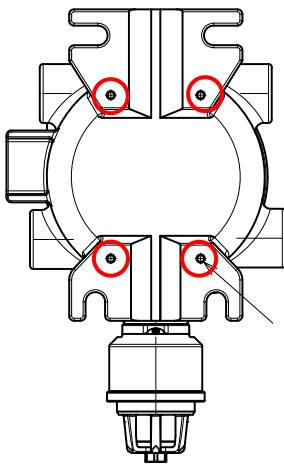
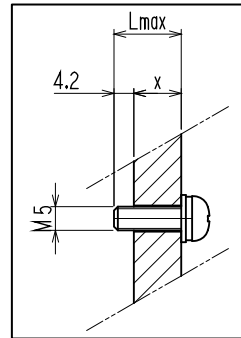
<GD-3>



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

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

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

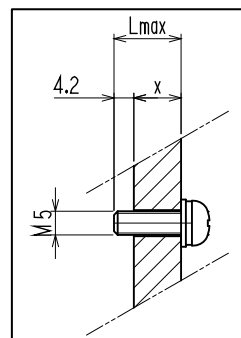


Screw holes on rear of container (four locations)

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

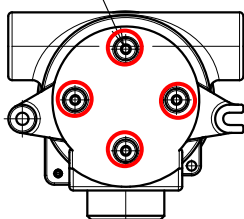
There are four screw holes on the rear of the container and four screw holes on the underside.

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



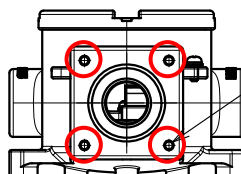
<Container rear>

Screw holes on rear of container (four locations)



<Container underside>

Screw holes on underside of container (four locations)



3

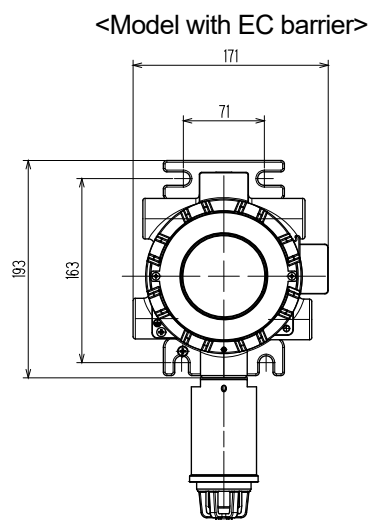
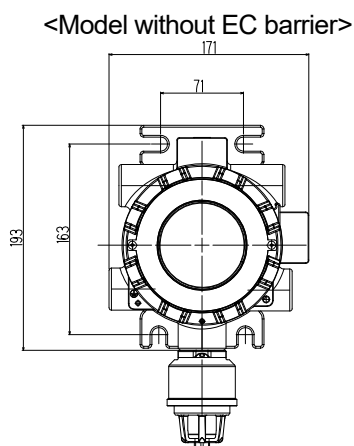
Product Configuration

3-1 Main unit and accessories

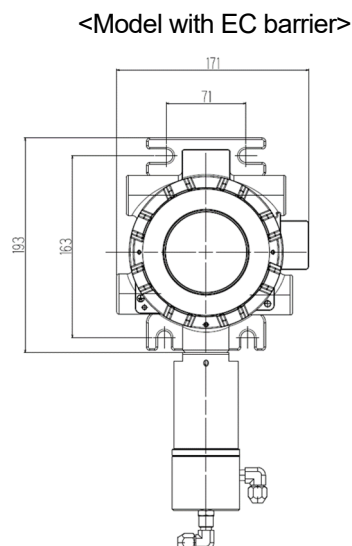
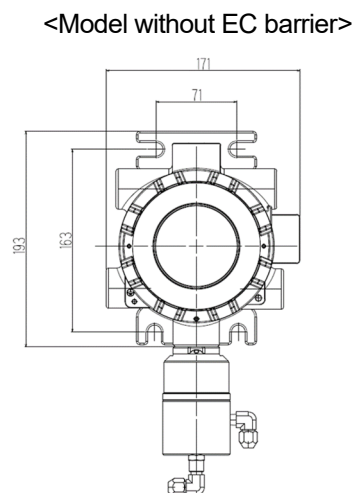
Open the box and packaging and inspect the main unit and accessories.
If anything is missing, contact RIKEN KEIKI.

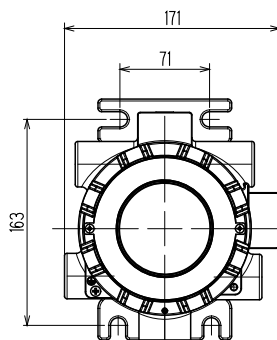
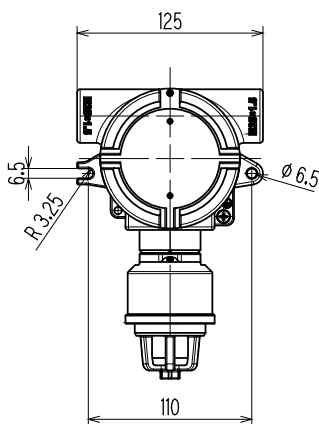
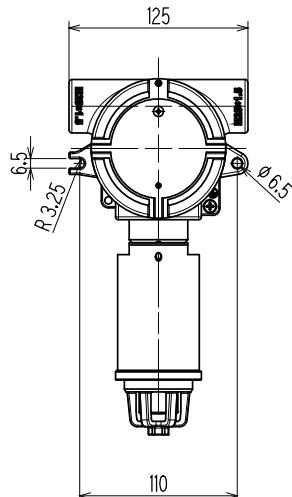
3-1-1 Main unit (SD-3)

<Diffusion type>

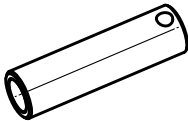
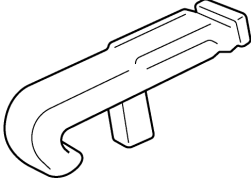


<Suction type>



3-1-2 Main unit (SD-3SC)**3-1-3 Remote sensor head (GD-3)****<Diffusion type>****<Model without EC barrier>****<Model with EC barrier>**

3-1-4 Standard accessories

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

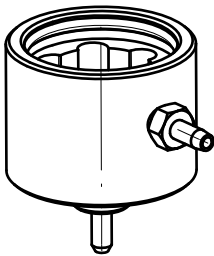
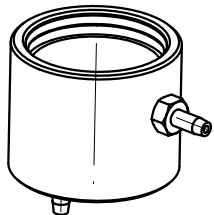
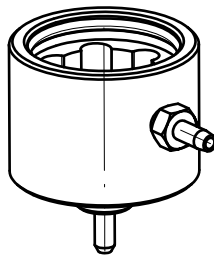
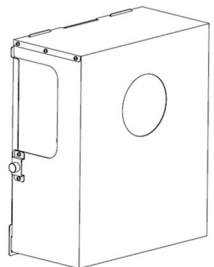
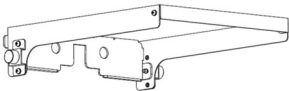
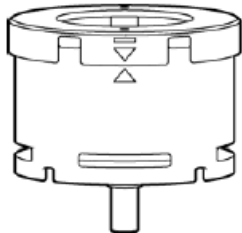
NOTE

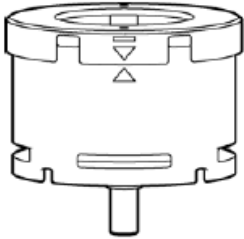
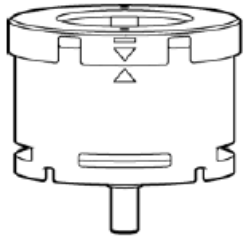
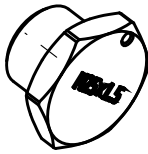
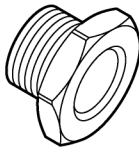
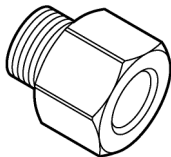
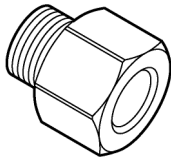
- The quantity of control keys and hex key wrenches included will vary depending on the quantity of product units ordered.
- | | |
|-------------------|----|
| 1 - 10 units: | ×1 |
| 11 - 20 units: | ×2 |
| 21 - 50 units: | ×3 |
| 51 or more units: | ×4 |

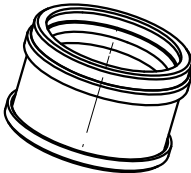
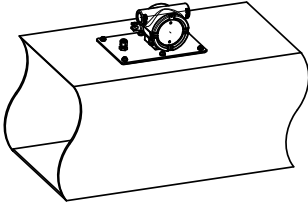
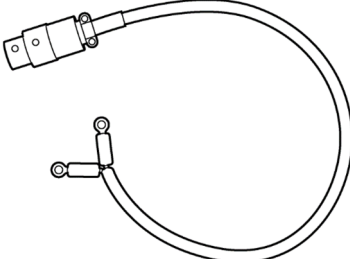
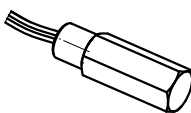
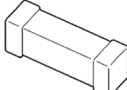
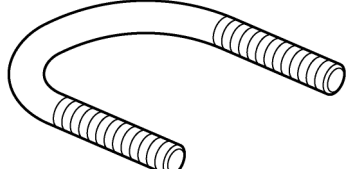
**CAUTION**

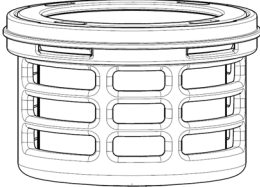
- Use the control key provided to operate the product. The product may not respond properly to commands if an object other than the supplied control key is used.
- The control key provided incorporates an extremely strong magnet. Holding the control key close to credit cards, ID cards, or other magnetized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

3-1-5 Optional accessories

Optional accessory		Part No.	Description
	Calibration adapter (for IRF sensor)	4283 9011 00	SD-3RI calibration adapter <Material> Body: PP Nipple: Stainless steel/Teflon
	Calibration adapter (for combustible gas sensor)	4283 9012 70	SD-3NC calibration adapter <Material> Body: PP Nipple: Stainless steel/Teflon
	Calibration adapter (for ESF sensor)	4283 9013 40	SD-3EC/ECS/ECB calibration adapter <Material> Body: PP Nipple: Stainless steel/Teflon
	Protective cover	Wall mounting 4283 9019 80 Pole mounting 4283 9045 60	Cover to protect the SD-3 main unit <Material> SUS316
	Sunshade cover	4283 9015 90	Cover to suppress temperature rises due to direct sunlight or radiant heat <Material> SUS316
	Splash guard (for IRF sensor)	4283 9076 10	SD-3RI cover to protect sensor from water and dust The identification number "1" is engraved on the underside. <Material> Resin

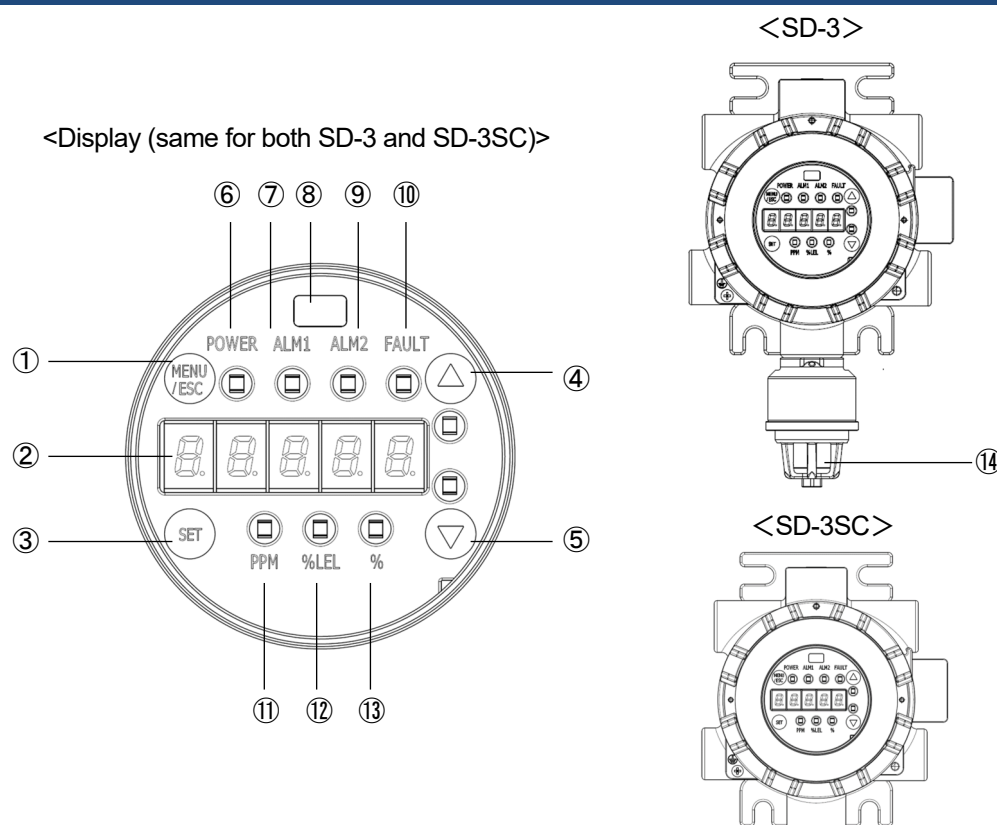
Optional accessory		Part No.	Description
	Splash guard (for combustible gas sensor)	4283 9077 80	SD-3NC cover to protect sensor from water and dust The identification number "2" is engraved on the underside. <Material> Resin
	Splash guard (for ESF sensor)	4283 9078 50	SD-3EC/ECS/ECB cover to protect sensor from water and dust The identification number "3" is engraved on the underside. <Material> Resin
	Blanking plug	4283 9018 10	M25 × 1.5 blanking plug <Material> Equivalent to SUS316
	Adapter	4283 4081 70	Adapter to convert M25 × 1.5 screw thread to 1/2NPT screw thread <Material> Equivalent to SUS316
	Adapter	4283 4082 40	Adapter to convert M25 × 1.5 screw thread to 3/4NPT screw thread <Material> Equivalent to SUS316
	Adapter	4283 4132 20	Adapter to convert M25 × 1.5 screw thread to M20 × 1.5 screw thread <Material> Equivalent to SUS316
	Silicone removal filter (SI-8) ^{*3}	4383 0030 20	Filter for removing trace amounts of silicone from the air. This can extend sensor life. ^{*1}

Optional accessory	Part No.	Description
	Activated carbon filter (CF-8304) ^{*3}	4383 0040 10 Filter for removing trace amounts of silicone from the air. This can extend sensor life. The silicone removal capability of this filter exceeds that of the silicone removal filter. ^{*2} It can also be used to remove interference gases. This can minimize interference effects from gases other than the detection target gas.
	Duct mounting kit (For GD-3RI) (For GD-3NC) (For GD-3EC) (For GD-3ECB*)	4262 9674 10 4262 9675 90 4262 9676 60 4262 9774 50 Kit for installing a remote sensor head (GD-3) to a duct. *In the GD-3ECB model, the duct-mounted configuration is applicable only to NH ₃ . <Material> SUS316
	HART modem connector	2905 2439 10 Connector used when connecting a HART modem
	Lightning arrester (3-wire connection) (TP48-3-N-NDI)	2032 0099 50 Device to limit momentary surge voltages caused by lightning strikes
	Lightning arrester (4-wire connection) (TP48-4-N-NDI)	2032 0116 40 Device to limit momentary surge voltages caused by lightning strikes
	Fuse	2564 0125 10 Littelfuse's fuse (1.25 A, 100 V DC)
	U bolt	4283 9046 30 Bolt used for mounting the main unit to a pole (size: 50A (2B)) <Material> SUS304

Optional accessory		Part No.	Description
	Waterproof cap	4283 9162 60	Cap to make the sensor section IP66/67. <Material> Resin

*1: Installing the silicone removal filter will limit the target gases that can be detected.
*2: The range of target gases that can be detected will be more limited than when the silicone removal filter is fitted.
*3 If you use a filter, we recommend fitting a splash guard.

3-2 Part names and functions

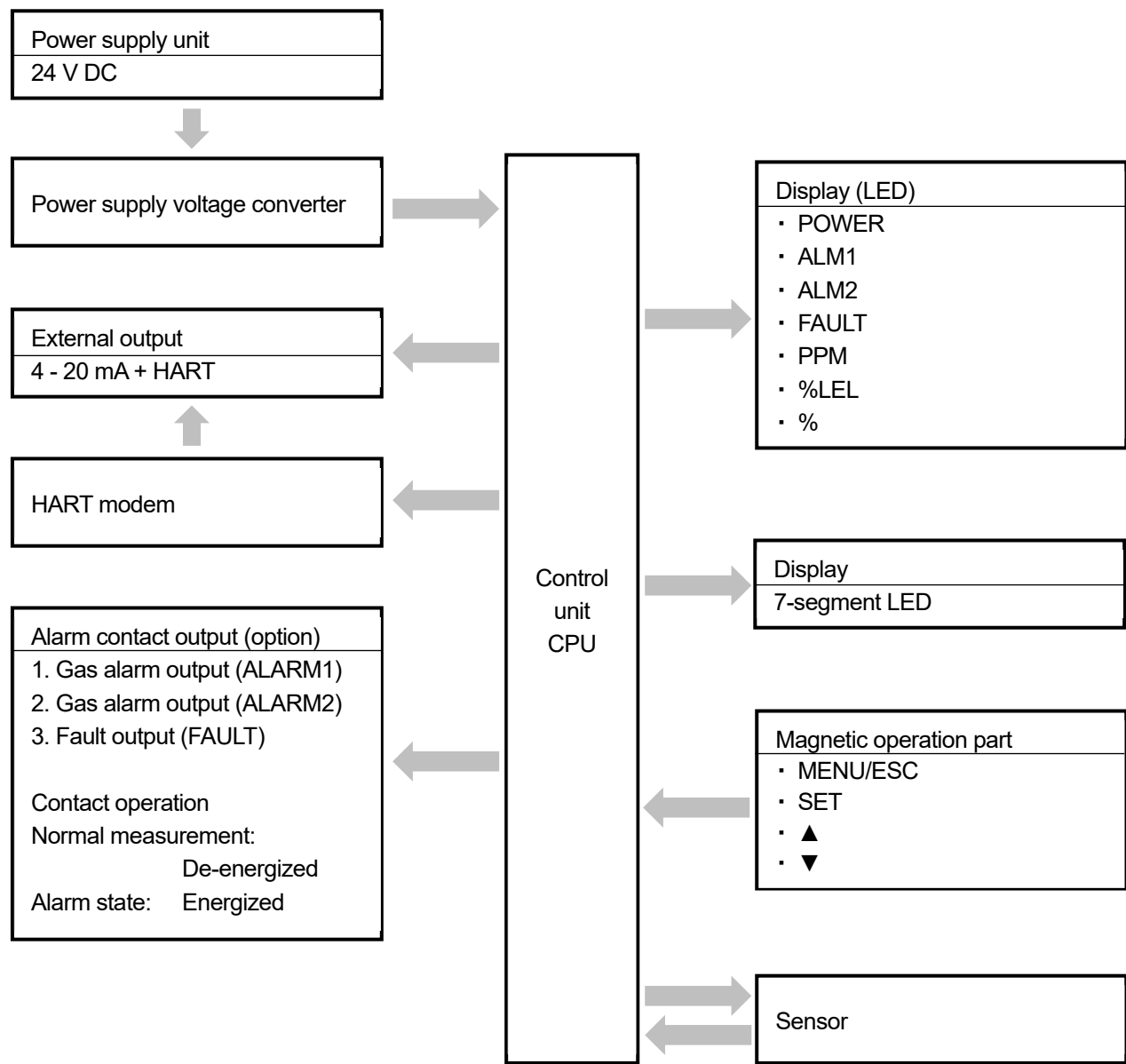


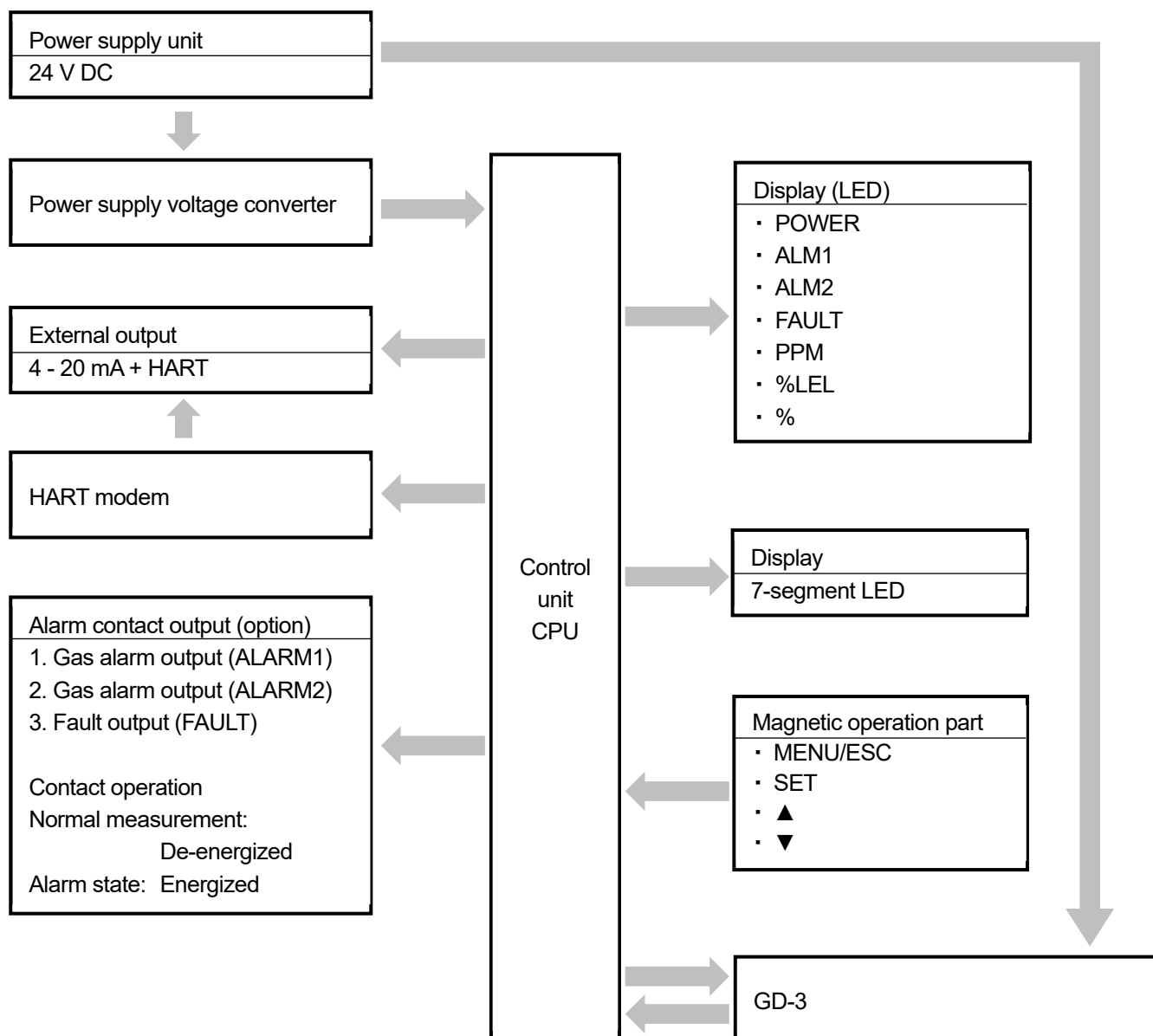
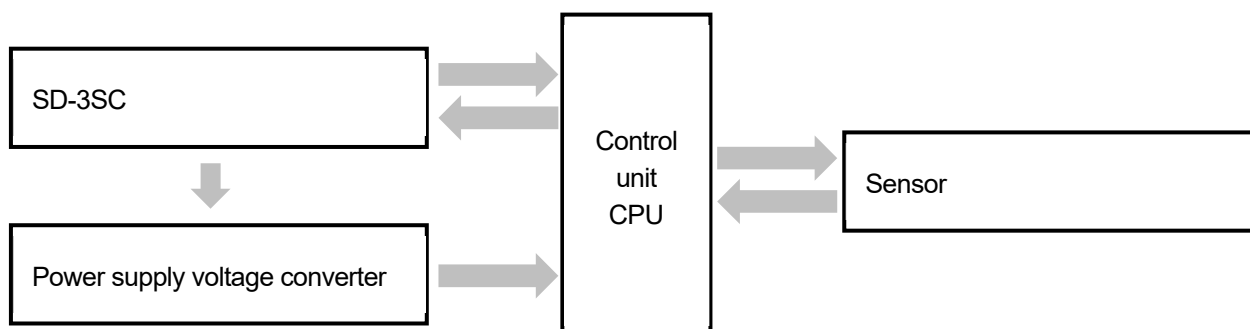
No.	Name	Function
①	MENU/ESC key	Hold down this key in detection mode to switch to user mode. In user mode and maintenance mode, this key is used to cancel a setting or return to the previous screen. Hold down this key in user mode or maintenance mode to return to detection mode.
②	7-segment LED display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

3-3 Block diagrams

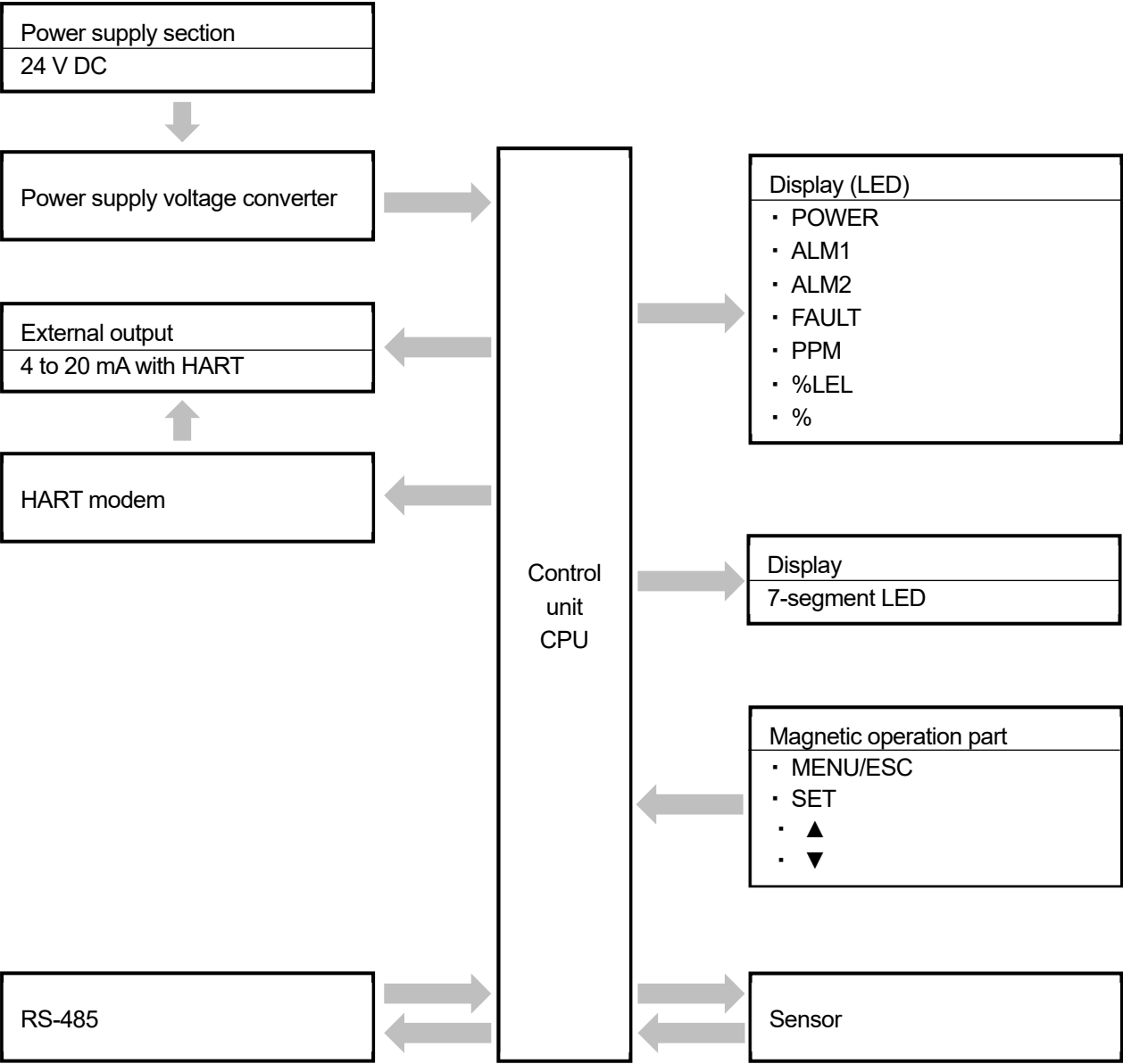
The block diagrams (electrical circuit diagrams) for the product are given below.

<SD-3>

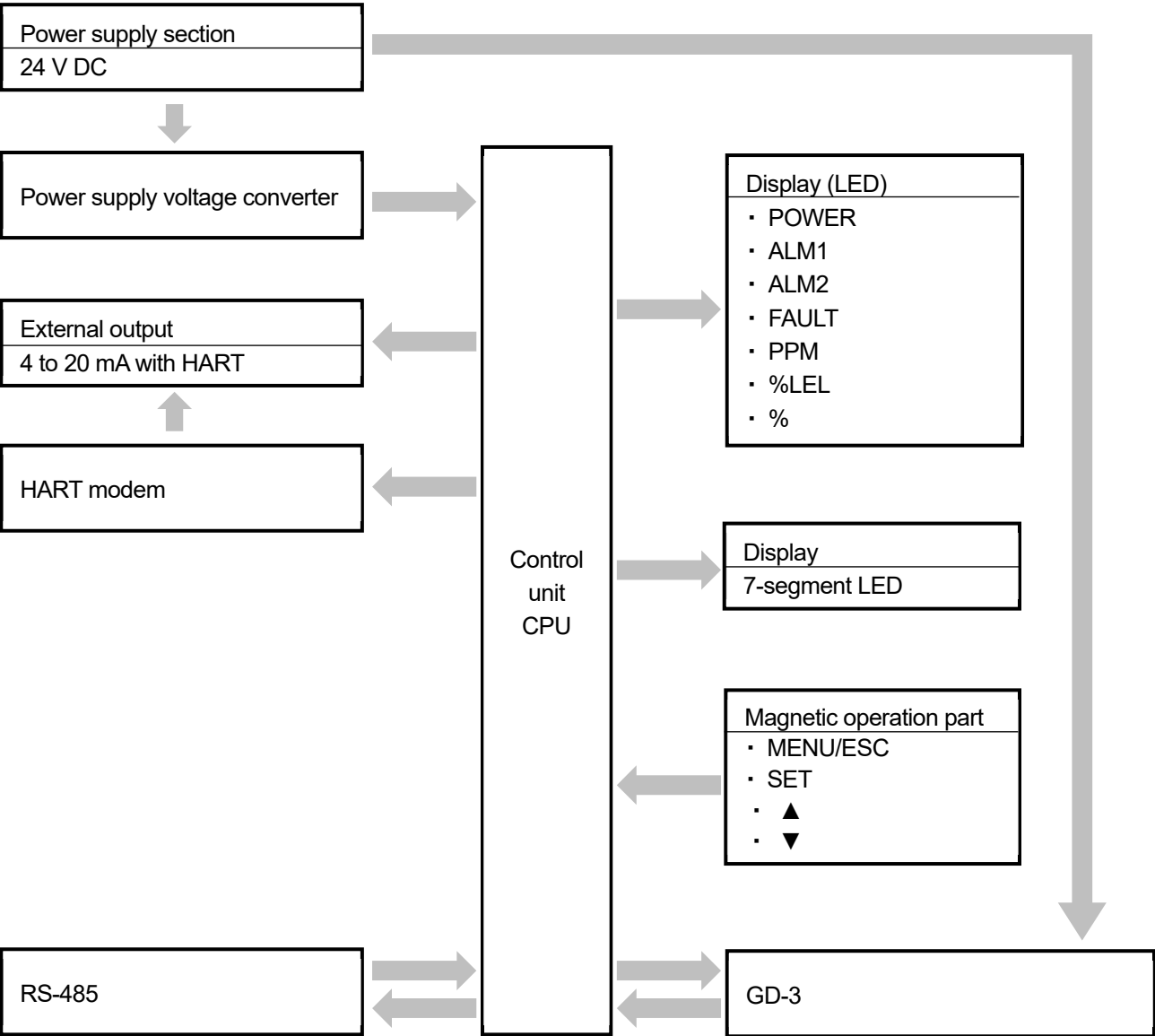


<SD-3SC>**<GD-3>**

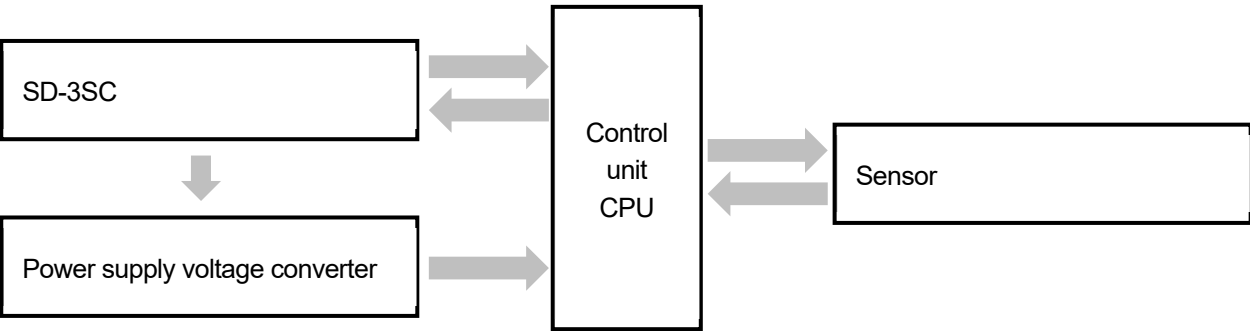
<SD-3> (RS-485)



<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 before installing.

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



CAUTION

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

4-1-1 General installation information

Observe the following precautions when installing the product:

- If the product is installed in a location where the ambient temperature exceeds 65 °C, use cables designed for use at temperatures at least 5 °C above the maximum anticipated ambient temperature.
- The SD-3 and SD-3SC main units each have two M25 × 1.5 connectors for use when wiring in the field. Connectors must always be blanked off with blanking plugs when not in use.
- The GD-3 has two M25 × 1.5 connectors for connecting the SD-3SC. The connector not in use must be blanked off with a blanking plug at all times.
- Do not mount a sensor that uses a different detection principle from the model type.
- Use ferrules on the ends of stranded cables.
- Secondary circuits should be supplied from an insulated source. (Not suited to alarm relay contacts)
- If installing without using conduits, use cable glands that comply with the explosion-proof certification. In addition, connect cable shielding to the main unit, cable glands, and indicators to increase immunity to electromagnetic noise and other external factors.
- Select the cable, terminal plate, and other parts for wiring to alarm relays (optional) to suit the rated voltage, current, and environmental conditions.
- 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
- It is not permitted to prevent gases and vapors contacting the sensor.
Dirt, snow, mud, external devices, etc.
- If there is dust or water droplets on the sensor, remove them as appropriate. If there is dust or water in the splash guard, remove them.
- If the sensor is damaged, replace it.
- The IP class does not mean that the device is capable of detecting gas during or after exposure to these conditions.
- It is recommended that the detector is installed so that the sensor faces downward. If the sensor is protected from mechanical damage, dirt, and water, then it can be installed facing in another direction.
- The NCF and ESF sensor may slow down its response if water adheres to the Teflon membrane.
In the event of heavy rain or submersion, visually check the surface of the Teflon film on the NCF and ESF sensor.

[Confirmation procedure]

- ① Turn off the power of SD-3.
- ② Remove the sensor guard.
- ③ Wipe off the Teflon film if water droplets are attached.
* For wiping, use paper such as Kimwipe that is hard to tear and does not generate paper dust.
- ④ Visually check the Teflon film and confirm that the water droplets have disappeared.
- ⑤ Install the sensor guard.
- ⑥ Turn on the power of the main unit.
- ⑦ In order to completely dry the Teflon film, warm it 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 stable location where temperatures do not exceed the operating temperature range during use.

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

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

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

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

The product requires periodic maintenance.

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

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

<Do not install in improperly grounded system housings.>

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

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

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

Sensor type	Gases affecting sensor sensitivity	Sensor-corroding gases
NCF	- Organic silicone gas (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)
IRF	None	
ESF	None	None

<Note when installing in locations where interference gases are present.>

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

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

<Use the appropriate power supply and power cable.>

The product requires a 24 V DC (18 V - 30 V DC) power supply to operate. The power cable used should have a cross section of 1.308 mm² (AWG16) or 2.082 mm² (AWG14). Use shielded 3-core cable or 4-core cable.

For the installation of cables and power supply

Due to the resistor value of the cable, a voltage drop occurs, causing the actual voltage supply to SD-3 (at the SD-3 terminal) to be lower than the voltage supply at the power source. Because of this, when the voltage drop by the cable causes the actual voltage supply to become below 18VDC, the voltage supply at the power source needs to be increased.

This voltage drop is determined by the type and length of the cable, ambient temperature, as well as the current consumption value of SD-3.

The current consumption value of SD-3 varies depending on the sensor type and the alarm relay state in the SD-3.

<How to obtain the voltage supply at the power source -1>

Use the equation below to obtain the voltage supply value at the power source.

Voltage supply at the power source

$$= A (\text{Current consumption of SD-3}) \times B (\text{Resistor value of the cable to be installed}) + 18V$$

A: Current consumption of SD-3

Choose from the list below. (@18V)

Type	Current consumption (max.)	Remarks
SD-3RI	170mA	
SD-3NC	200mA	
SD-3EC	140mA	
SD-3ECS	140mA	
SD-3ECB	150mA	
SD-3SC+GD-3RI	180mA	
SD-3 SC+GD-3NC	220mA	
SD-3 SC+GD-3EC	150mA	
SD-3 SC+GD-3ECS	150mA	
SD-3 SC+GD-3ECB	160mA	

B: Resistor value of the cable to be installed

The maximum resistor value can be determined by the type and length of the cable to be installed, and the upper limit of the operating temperature.

e.g.)

A: The maximum current consumption value = 170 mA (SD-3RI)

B: The maximum resistor value of the cable to be installed = 24Ω (CVV-S, 1.308 mm², 1250m, @70°C)

$$\begin{aligned}\text{Voltage supply at the power source} &= 170\text{mA} \times (24\Omega \times 2) + 18\text{V} \\ &= 8.16\text{V} + 18\text{V} \\ &= 26.16\text{V} \quad (\text{or higher})\end{aligned}$$

<How to obtain the voltage supply at the power source -2>

When the method in 1 cannot be applied because the type and length of the cable to be installed is unknown, or to make sure if the voltage calculated in 1 poses no problem for the actual voltage to supply, use this method described here.

Alarm test is performed under the following conditions (refer to 7-3-2 Performing alarm test).

- Set the contact action ON.

Press **▲** key to increase the indicator until it reaches full scale over (nnnn), and when that happens, make sure that the voltage of the SD-3 terminal block is over 18VDC.

Fault test is performed under the following conditions (refer to 7-3-3 Performing fault test).

- Set the Fault test ON.

When that happens, make sure that the voltage of the SD-3 terminal block is over 18VDC.

If it's below 18VDC, then increase the voltage supply at the power source. If the temperature at this point increases during the operation, give enough margin to the voltage supply by compensating the voltage drop caused by the increase of the cable resistor value.

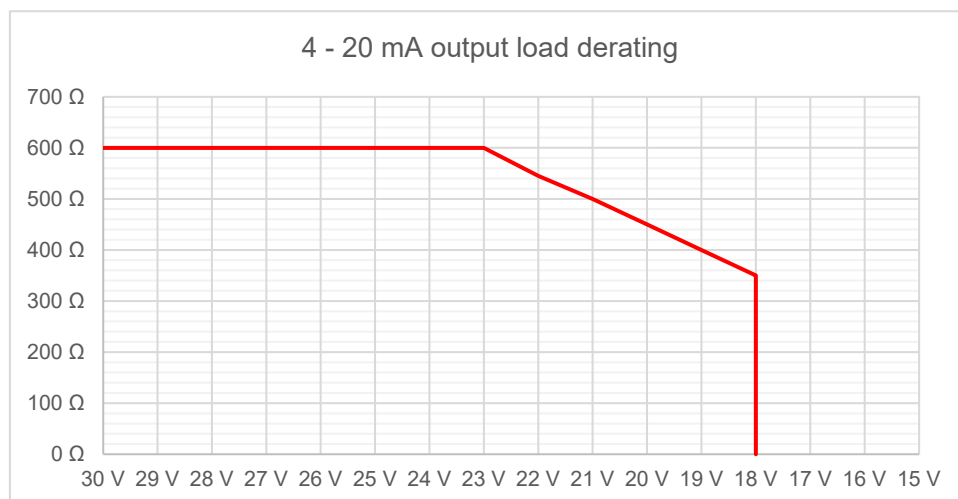
<Install away from noise-emitting devices (main unit and cables).>

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

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

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

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



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

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

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

<Use alarm contacts correctly.>

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

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

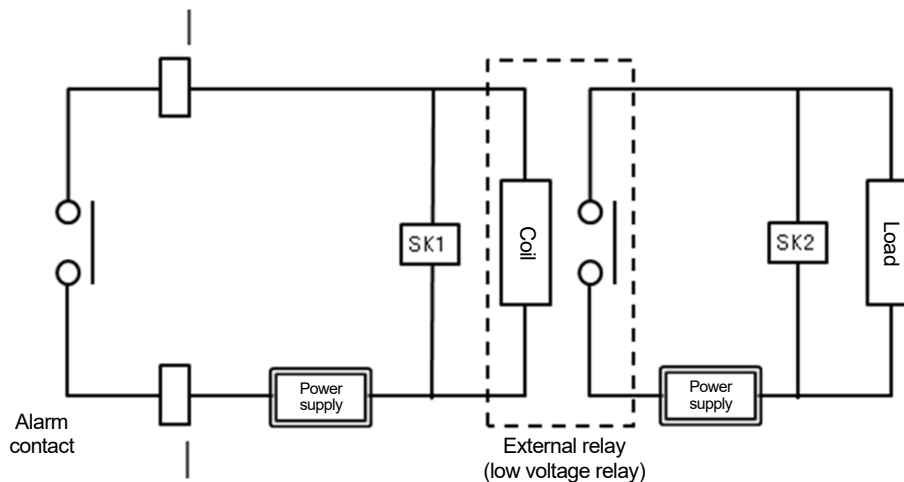
The alarm contact specifications for the product apply under resistance load conditions. If inductive loads occur at the alarm contacts, a counter-electromotive force will be generated at the contacts, leading to the following potential problems:

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

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

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

<SD-3>



* SK1, SK2: Surge absorbers

DANGER

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

WARNING

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

**CAUTION**

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

4-2 System design precautions

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



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

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

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

4-2-2 Lightning strike protective measures

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

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

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

<Lightning strike protective measures>

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

<Grounding>

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

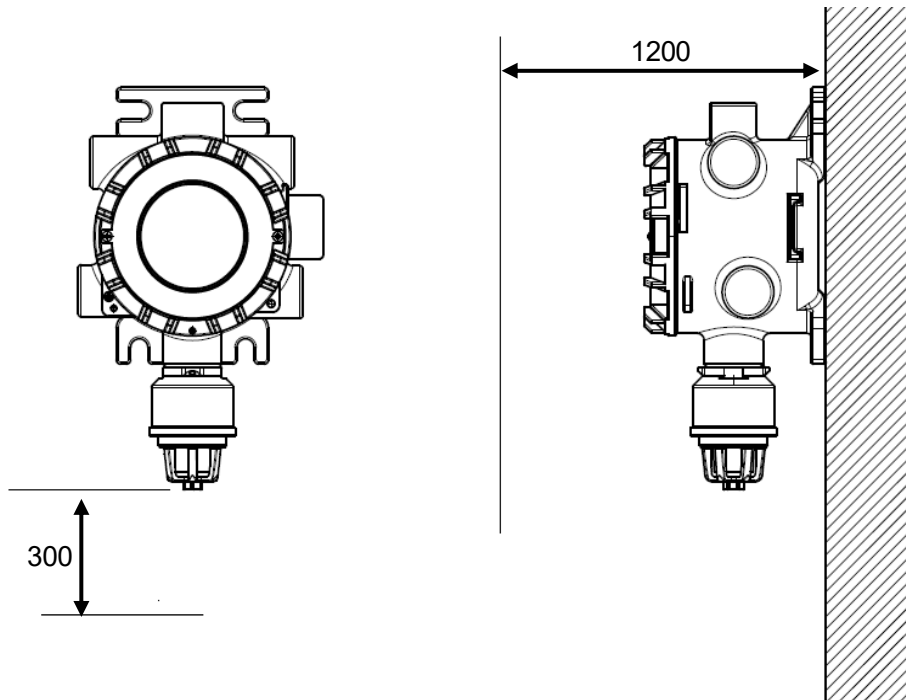
NOTE

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

4-3 Providing maintenance space

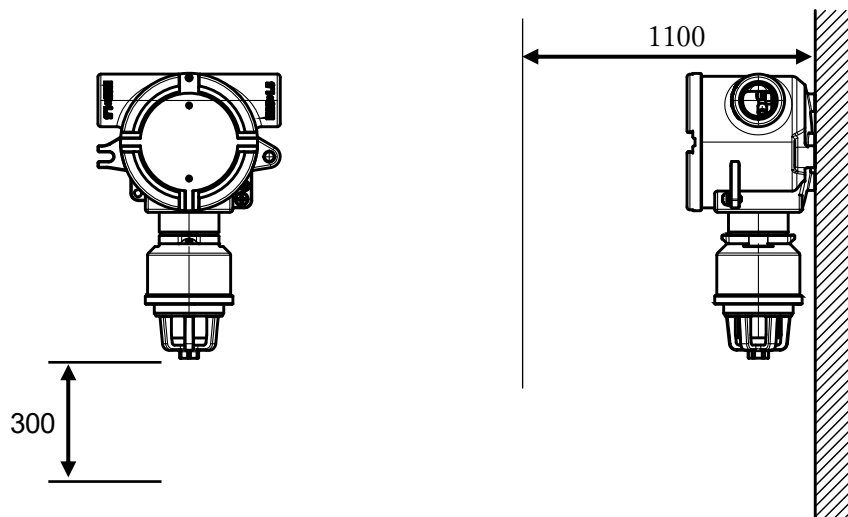
When mounting the product, allow space to open and close the covers during maintenance.

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



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

<Remote sensor head (GD-3)>



**CAUTION**

The product requires periodic maintenance.

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

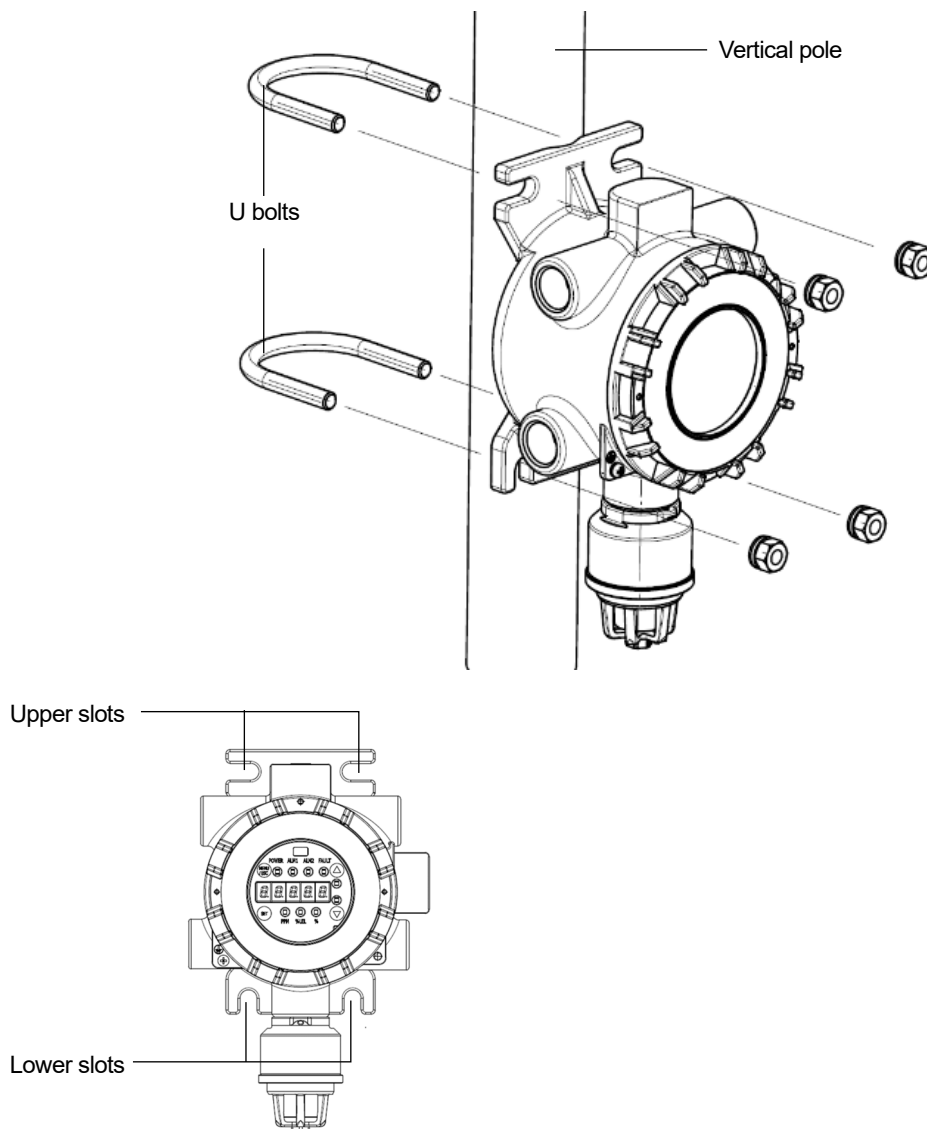
- Locations such as within systems that must be stopped for maintenance
 - Locations where part of the system must be detached to allow maintenance
 - Locations where the product cannot be removed due to the presence of pipes or racks
 - Locations where maintenance work is hazardous—for example, close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

4-4 Main unit installation

4-4-1 Vertical pole mounting

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

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

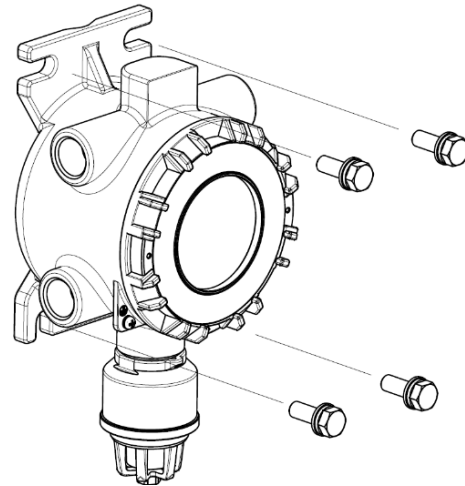
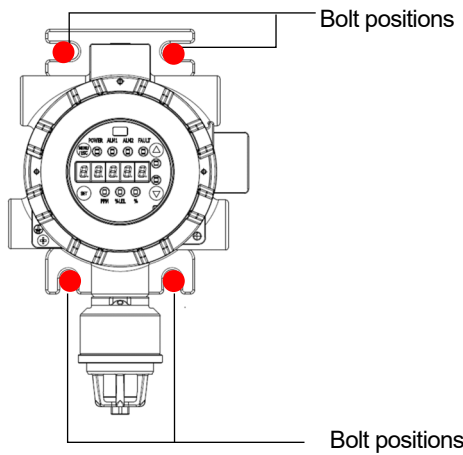


*The diagram illustrates the SD-3. The mounting method for the SD-3SC is identical.

4-4-2 Wall mounting

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

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



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

CAUTION

The product requires periodic maintenance.

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

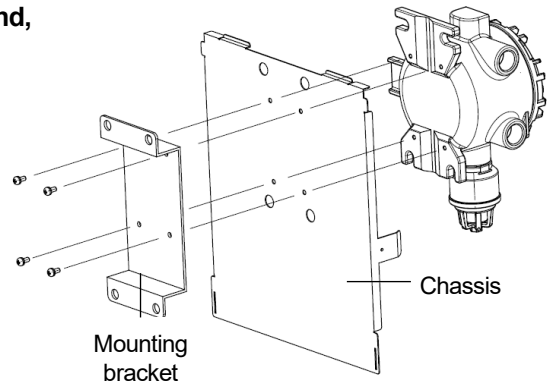
- Locations such as within systems that must be stopped for maintenance
- Locations where part of the system must be detached to allow maintenance
- Locations where the product cannot be removed due to the presence of pipes or racks
- Locations where maintenance work is hazardous—for example, close to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

4-4-3 Attaching protective cover

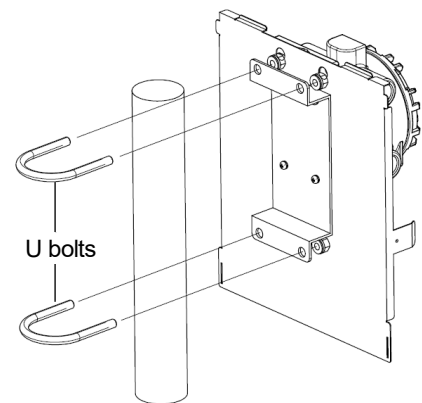
Attach the protective cover to the main unit (SD-3/SD-3SC).

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

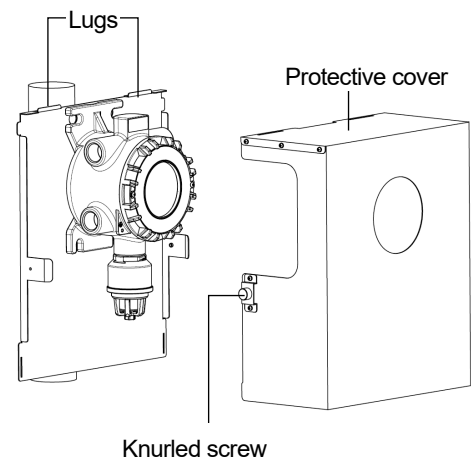
- 1 **Attach the chassis and mounting bracket to the main unit.**
Secure with four M5 × 6 double SEMS bolts from behind, as shown in the diagram to the right.



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



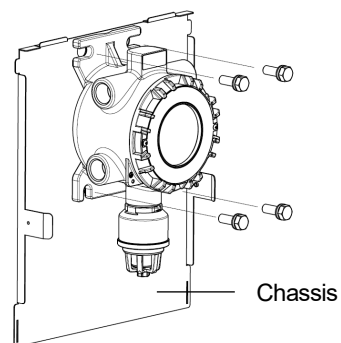
- 4 **Attach the protective cover, aligning it with the two lugs at the top of the chassis.**
- 5 **Secure the protective cover in place by tightening the knurled screws on either side of the cover.**



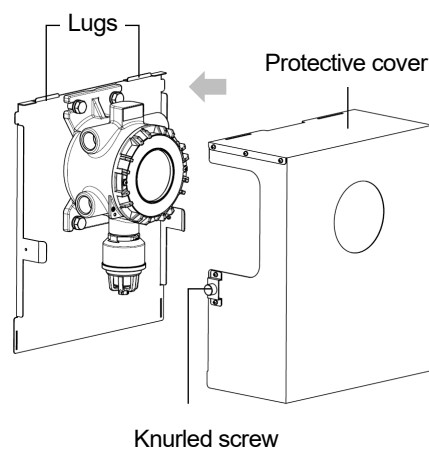
*The diagram illustrates the SD-3. The mounting method for the SD-3SC is identical.

<Wall mounting>

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



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



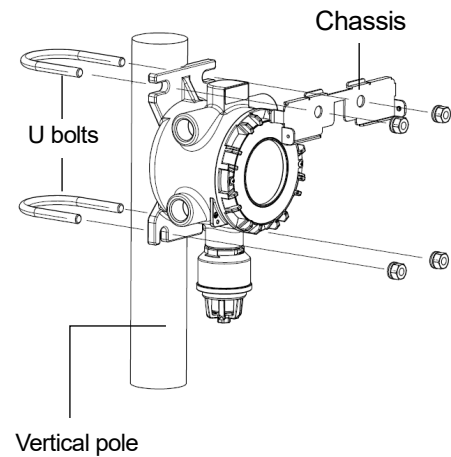
*The diagram illustrates the SD-3. The mounting method for the SD-3SC is identical.

4-4-4 Attaching sunshade cover

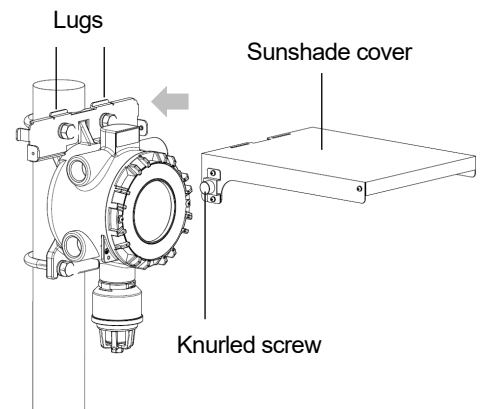
Attach the sunshade cover to the main unit (SD-3/SD-3SC).

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

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



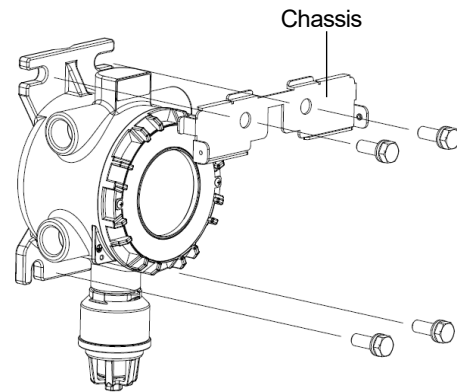
- 3 Attach the sunshade cover, aligning it with the two lugs at the top of the chassis.
- 4 Secure the sunshade cover in place by tightening the knurled screws on either side of the cover.



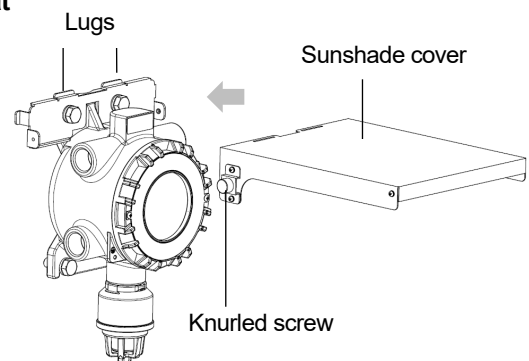
*The diagram illustrates the SD-3. The mounting method for the SD-3SC is identical.

<Wall mounting>

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



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

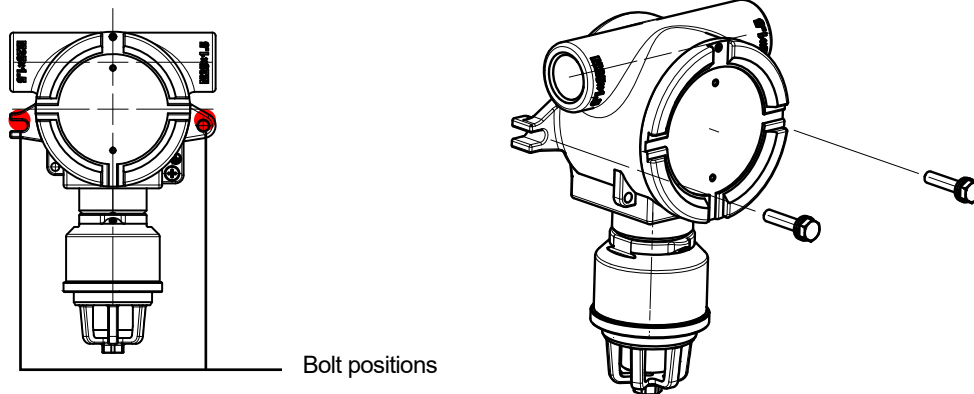


*The diagram illustrates the SD-3. The mounting method for the SD-3SC is identical.

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

4-5-1 Wall mounting

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

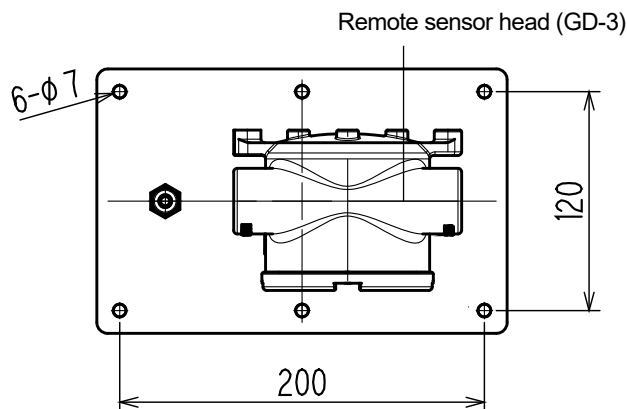


4-5-2 Duct mounting

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

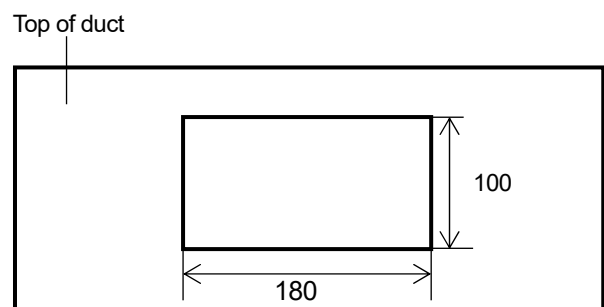
Attach to a duct using the duct mounting kit.

The duct mounting kit has the following dimensions:



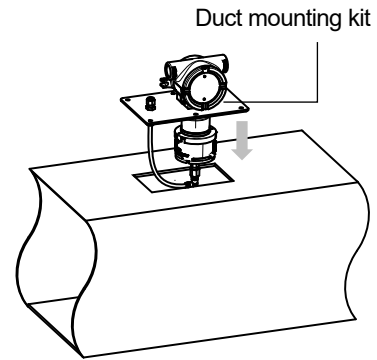
- 1 Cut out an opening in the top of the duct.

Refer to the diagram to the right for the dimensions of the opening.

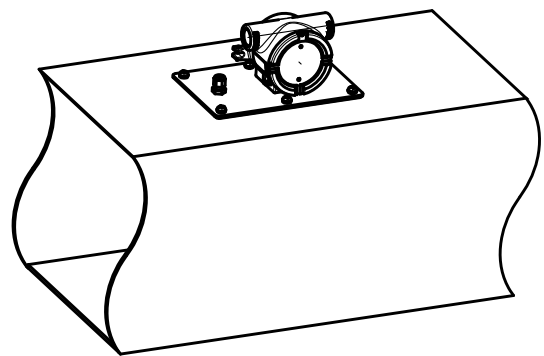
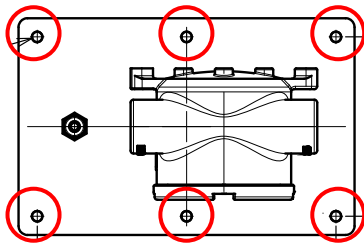


2 Insert the remote sensor head (GD-3) into the duct mounting kit and secure with four M5 bolts.

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

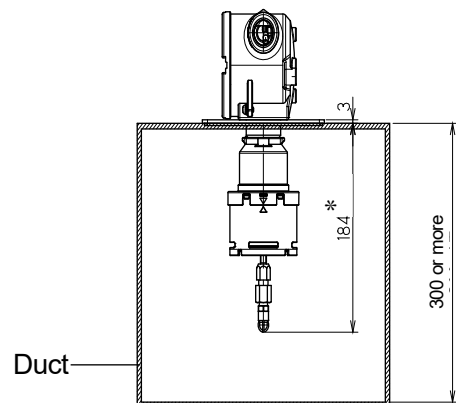


3 Insert the duct mounting kit into the opening in the duct. Secure in place with six M6 bolts.



NOTE

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



*In case of GD-3ECB, the duct-mounted configuration is applicable only to NH₃.

Length of insertion part : 229mm

Duct diameter : 345mm

4-6 Connecting the grounding terminal

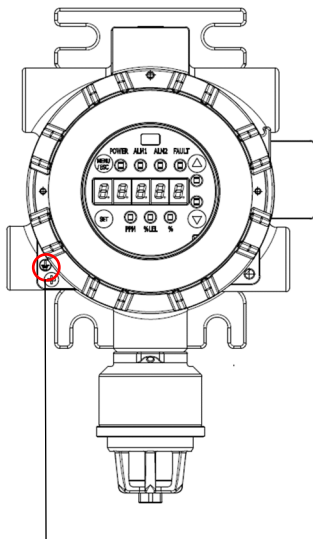


WARNING

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

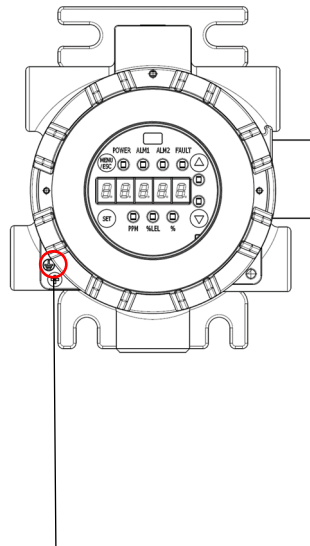
Connect the grounding bolt to the local grounding terminal.

<Main unit (SD-3)>



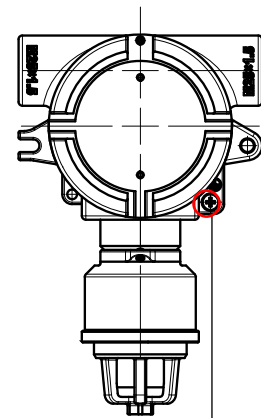
Grounding bolt (M4)

<Main unit (SD-3SC)>



Grounding bolt (M4)

<Remote sensor head (GD-3)>



Grounding bolt (M4)

NOTE

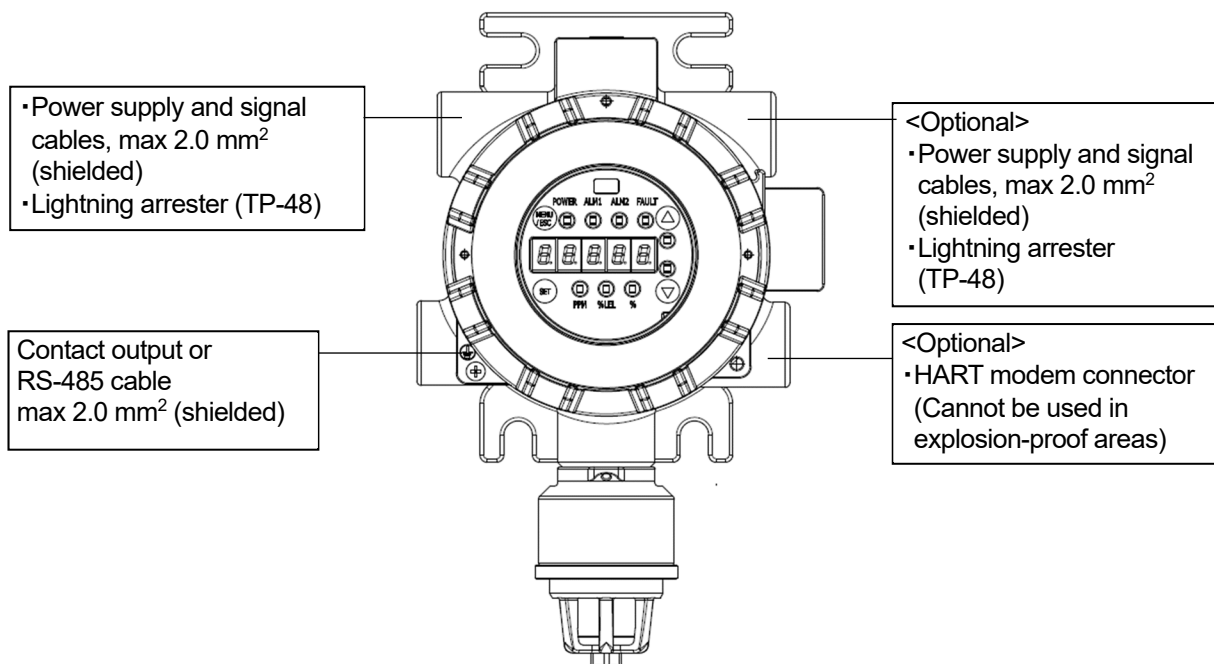
- The grounding bolt is marked with the  symbol.

4-7 Connecting the power and signal cables

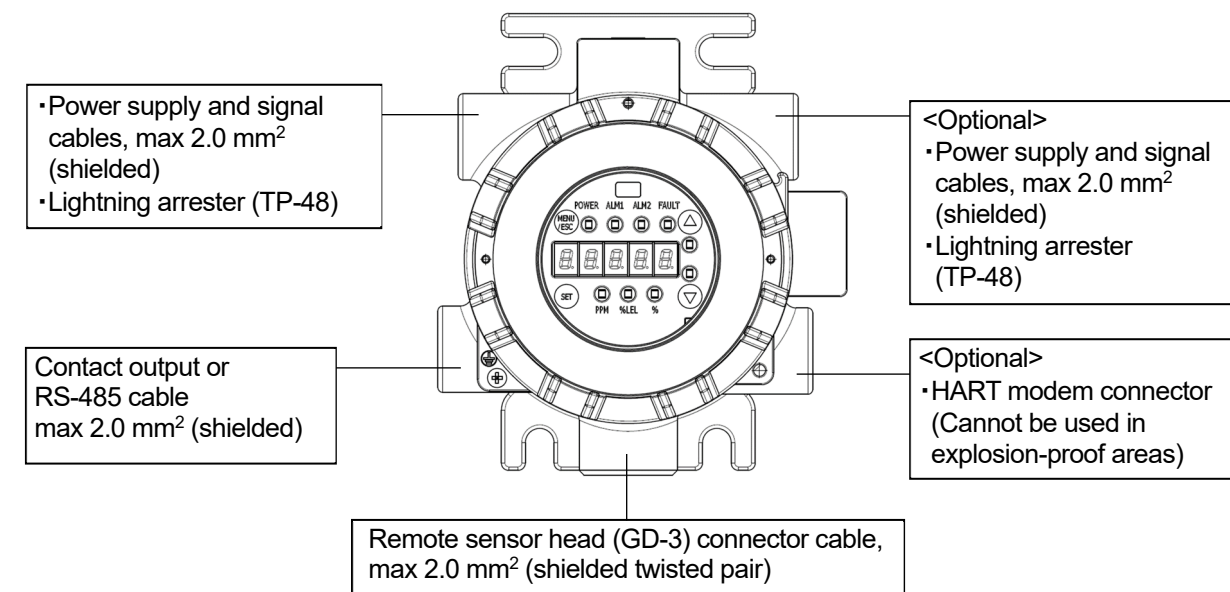
4-7-1 Main unit cable and device connectors

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

<SD-3>



<SD-3SC>



NOTE

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

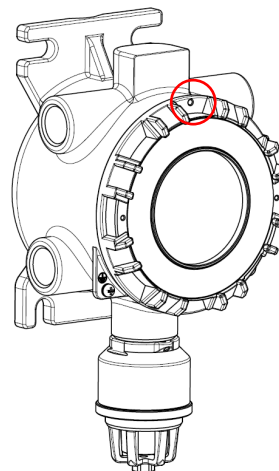
4-7-2 Connecting the power and signal cables to the main unit

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

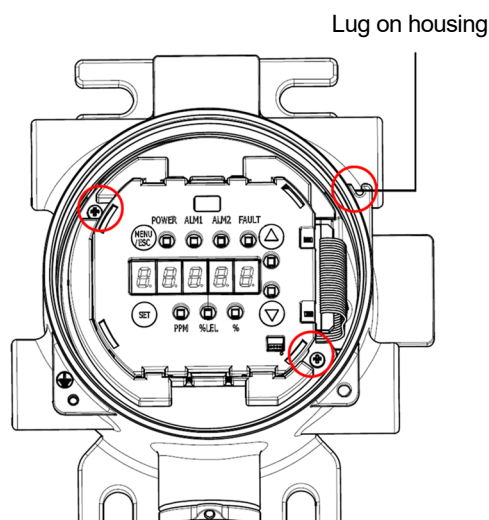
- 1 Unscrew the M4 hex socket set screw on the main unit cover, then rotate the cover counterclockwise to remove.**

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

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



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



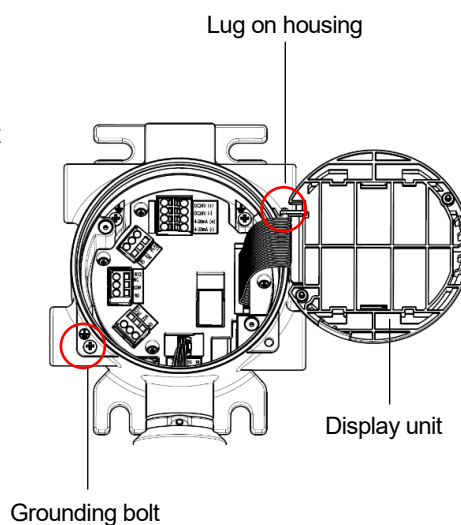
- 3 Pull out the display unit and hang on the lug on the housing.**

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

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

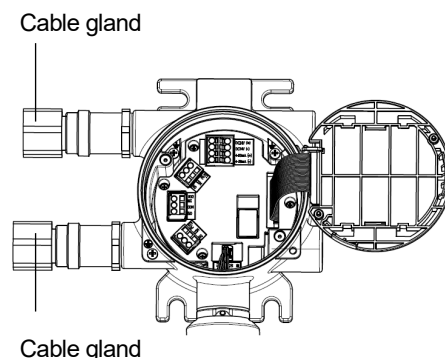
- 4 Ground the main unit.**

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



5 Attach cable glands or conduits to the connectors on the main unit.

Use appropriate cable glands or conduits to suit the purpose and type of the cable.



6 Pull out the terminal plates from the terminal plate board.

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

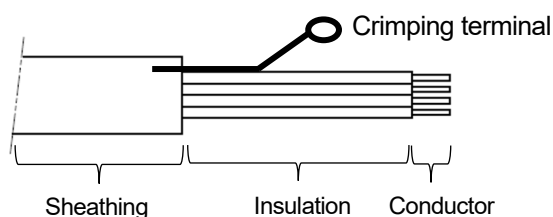
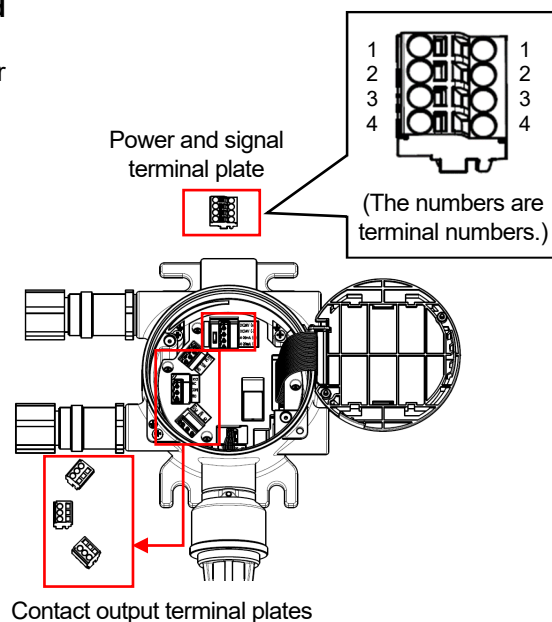
Connect the cables to the following terminals on the power and signal terminal plate. For more information on the contact cable connections, refer to '4-9 Alarm relay setting (option)'. For information on connecting cables to the terminal plate, refer to '4-7-5 Connecting cables to the terminal plate'.

<Using 3-core cable>

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

<Using 4-core cable>

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



Recommended insulation length: 40 - 50 mm

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

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

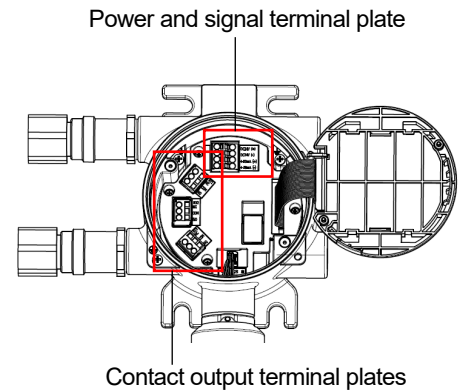
8 Connect the required number of contact cables to the contact output terminal plates.

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

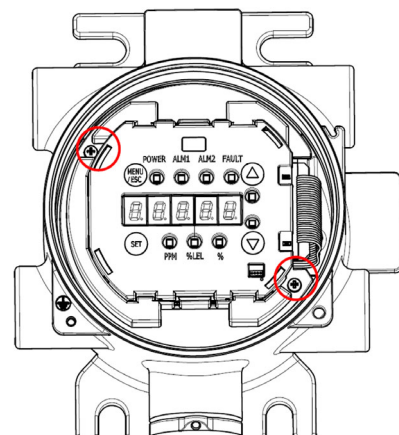
*No contact output terminal plate is present with the no contact output option.

9 Mount the terminal plates on the terminal plate board.

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

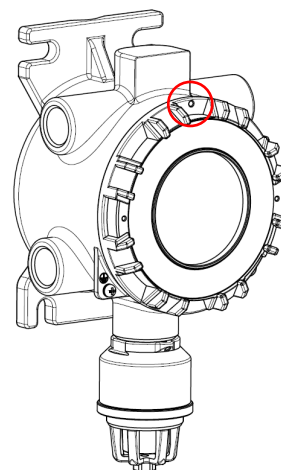
**10 Return the display unit to its original position and secure with the two M3 screws.**

Take care not to trap the cable here.

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

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

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

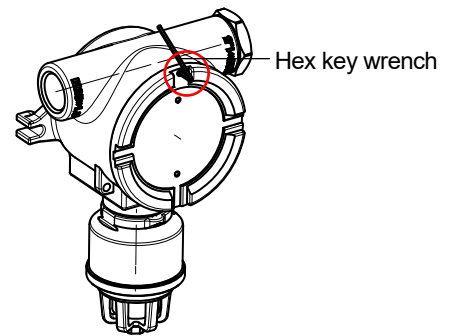
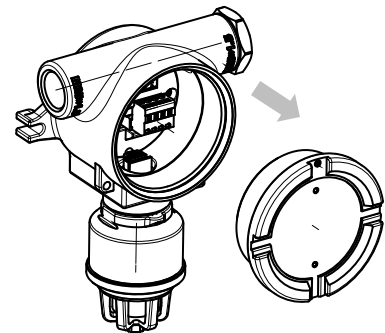


*The diagram illustrates the SD-3. The connection method for the SD-3SC and RS-485 are identical.

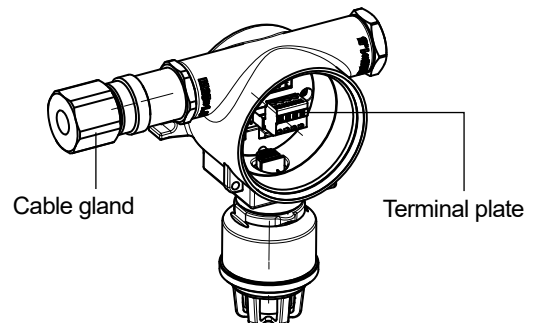
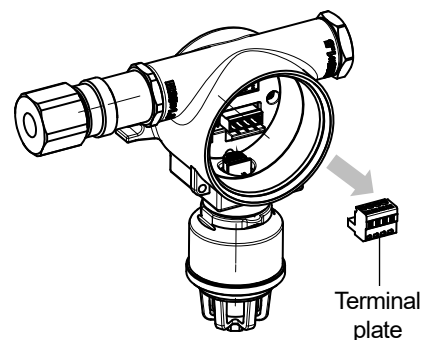
4-7-3 Connecting the power and signal cables to the remote sensor head (GD-3)**1 Unscrew the single M4 screw on the remote sensor head (GD-3) cover.**

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

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

**2 Rotate the cover counterclockwise and remove.****3 Attach a cable gland or conduit to the connector on the remote sensor head (GD-3).**

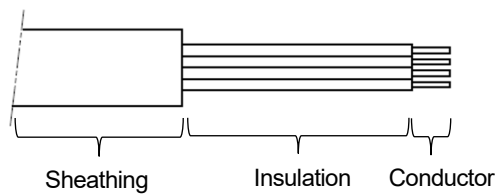
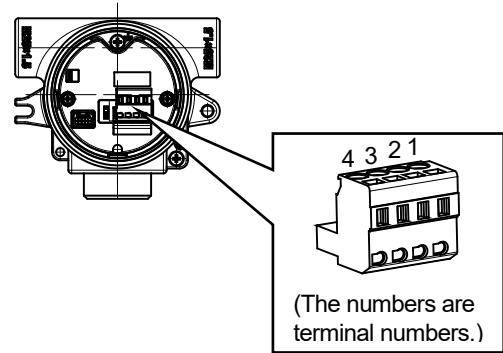
Use an appropriate cable gland or conduit to suit the purpose and type of the cable.

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

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

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

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



Recommended insulation length: 40 - 50 mm

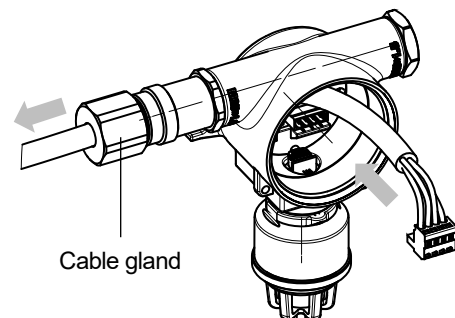
When connecting cables, connect the cable shielding to the terminals at the top left or top right on the inside of the main unit.

Depending on the installation location, noise interference may result.

In such cases, remove the shielding.

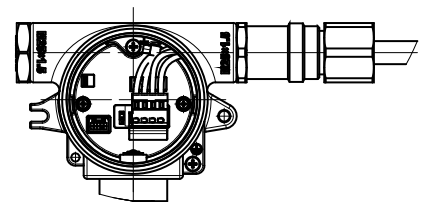
6 Route the cable from inside the main unit to the connector.

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

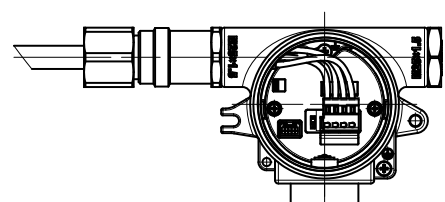
**7 Mount the terminal plate on the terminal plate board.**

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

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



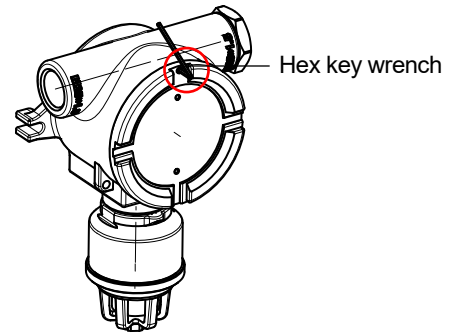
<With cable (external cable) routed to left-hand side>



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

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

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

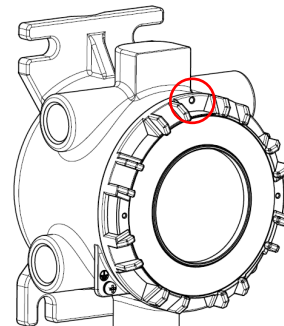


4-7-4 Connecting the main unit (SD-3SC) and remote sensor head (GD-3)

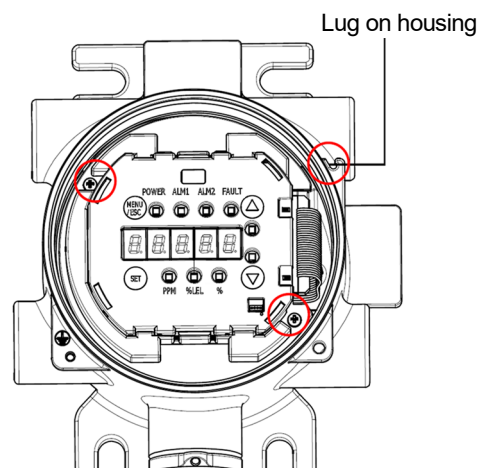
- 1 **Unscrew the M4 hex socket set screw on the main unit (SD-3SC) cover, then rotate the cover counterclockwise to remove.**

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

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



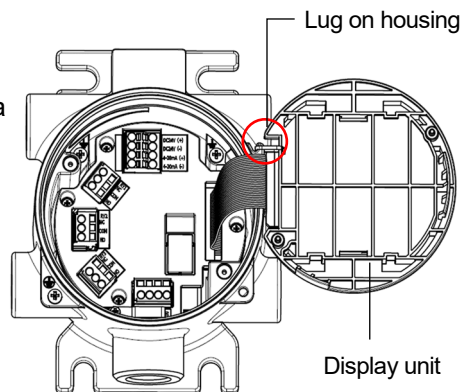
- 2 **Unscrew the two M3 screws securing the display unit.**



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

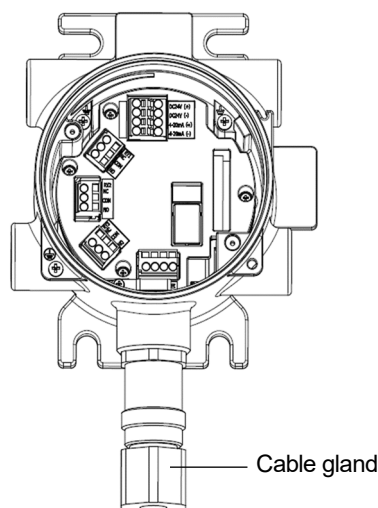
The display unit is connected to the terminal plate unit by a flat cable. Pulling with excessive force may disconnect the cable.

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

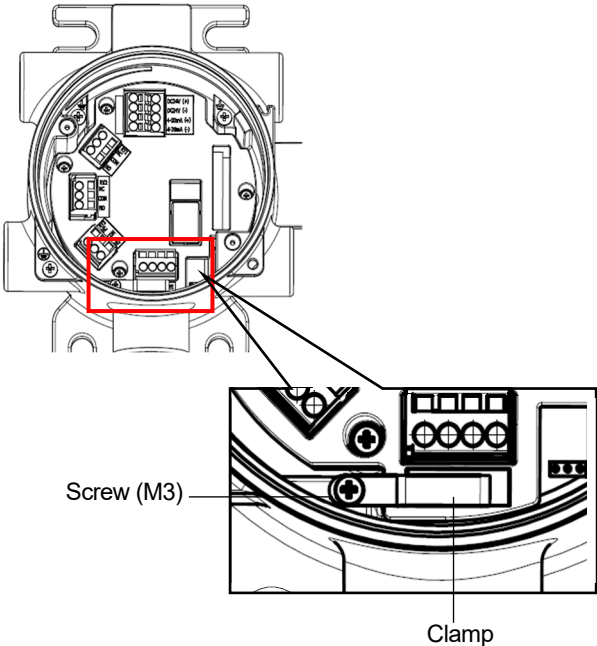


- 4 **Attach a cable gland or conduit to the connector on the main unit.**

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



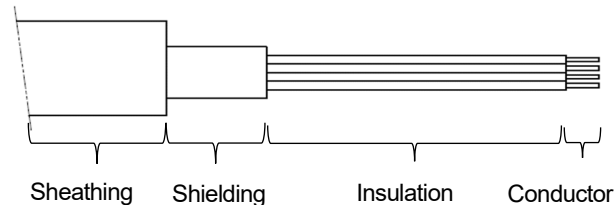
- 5 Pull out the remote connection terminal plate from the terminal plate board.
- 6 Unscrew the single M3 screw securing the clamp and remove the clamp.



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

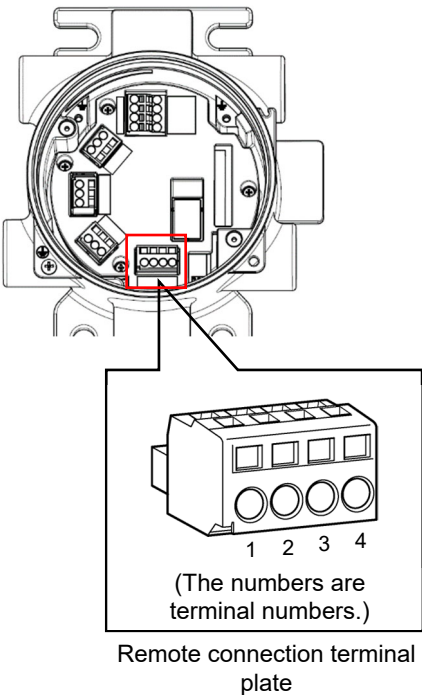
Connect the cables to the following terminals on the remote connection terminal plate. For information on connecting cables to the terminal plate, refer to '4-7-5 Connecting cables to the terminal plate'.

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



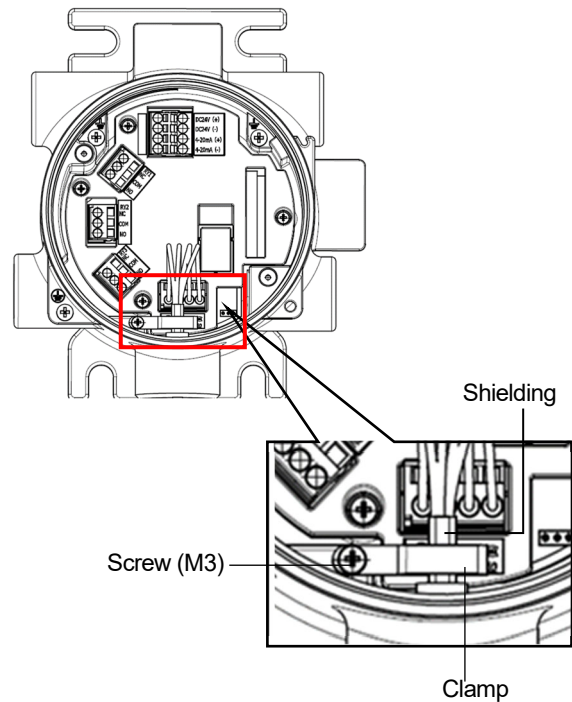
Recommended shielding length: 30 - 40 mm
Recommended insulation length: 130 - 140 mm

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

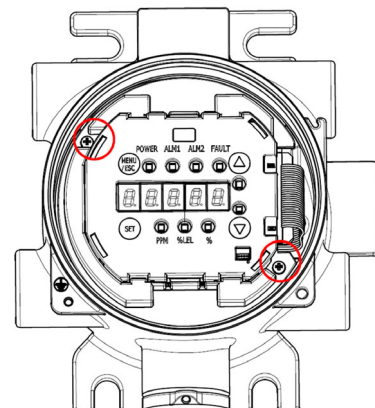


9 Clamp the shield wire.

Use the single M3 screw to clamp the cable shielding.

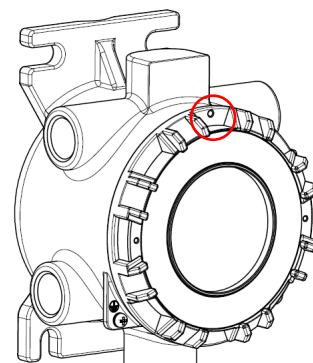
**10 Return the display unit to its original position and secure with the two M3 screws.**

Take care not to trap the cable here.

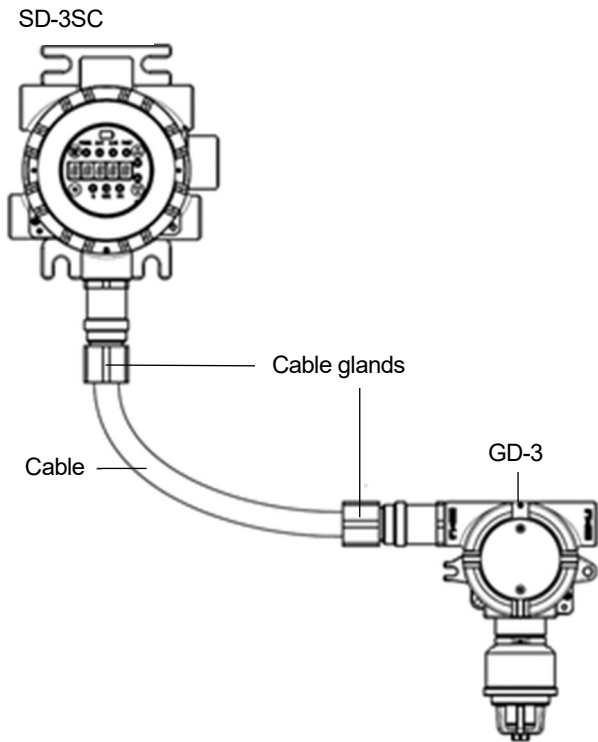
**11 Rotate the cover clockwise to attach and secure with the single M4 hex socket set screw.**

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

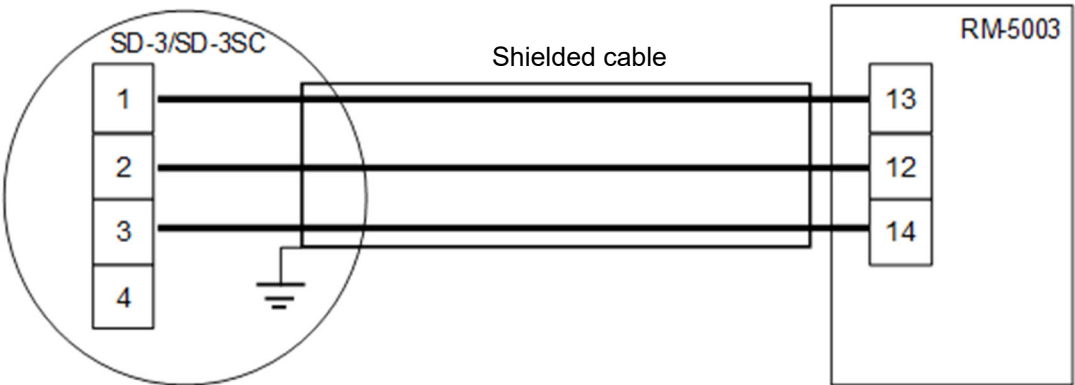
Take care not to trap the cable when attaching the cover.
Rotate the cover clockwise until it moves no further to securely fasten in place.



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



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



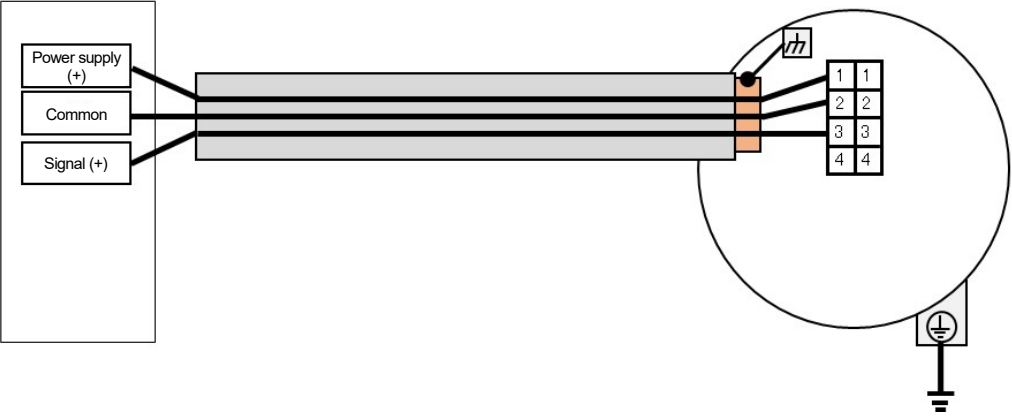
<Indicator connection example>

<SD-3>

Indicator (e.g., RM-5003)

SD-3

Connect the shield to the grounding bolt on the chassis

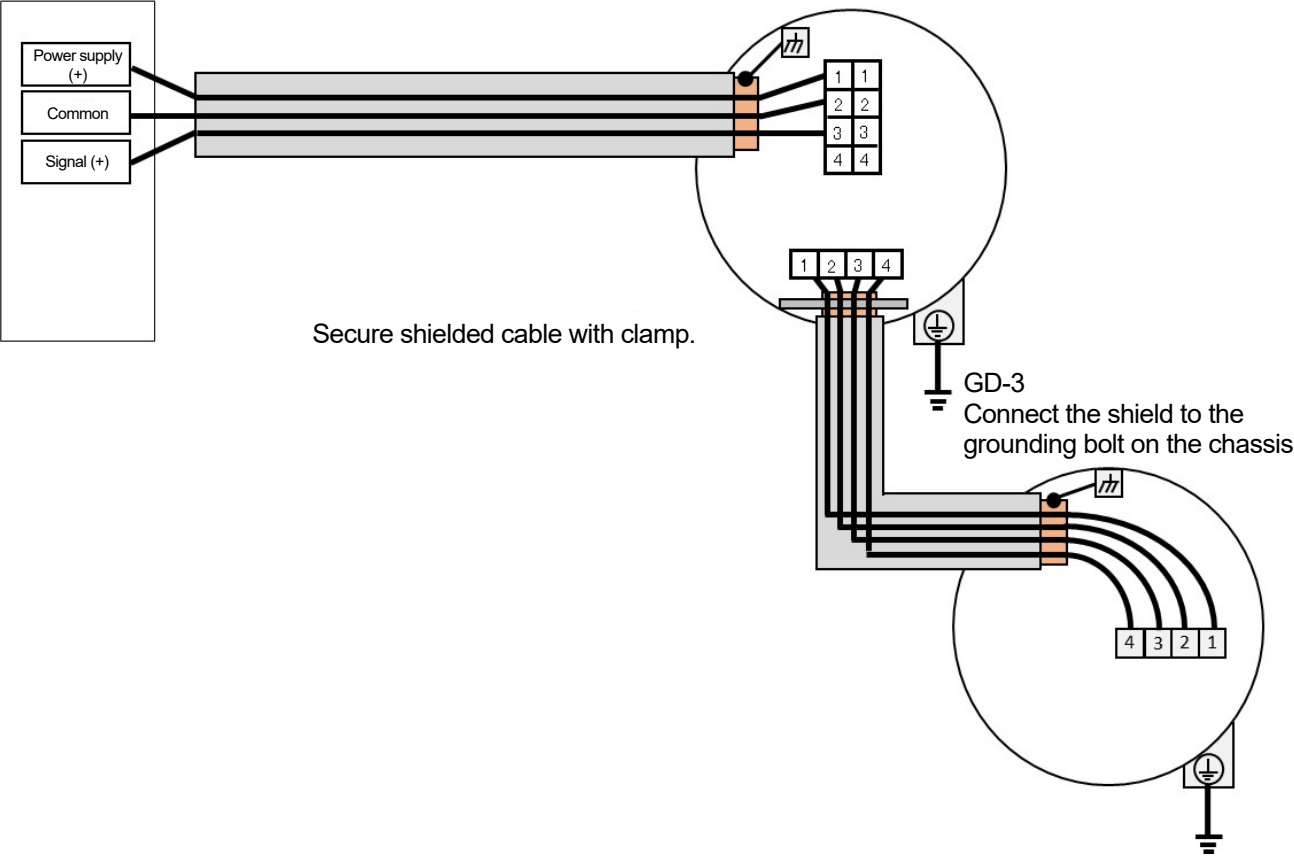


<SD-3SC>

Indicator (e.g., RM-5003)

SD-3SC

Connect the shield to the grounding bolt on the chassis



4-7-5 Connecting cables to the terminal plate

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

<Terminal plate specifications>

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

Specifications will vary depending on the cable used.

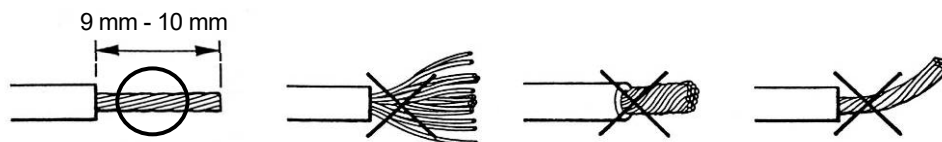
<Connecting conditions>

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



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

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



<Compatible rod terminal>

If you use rod terminals, use the following item:

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



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

<Connecting cables to terminal plate>

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

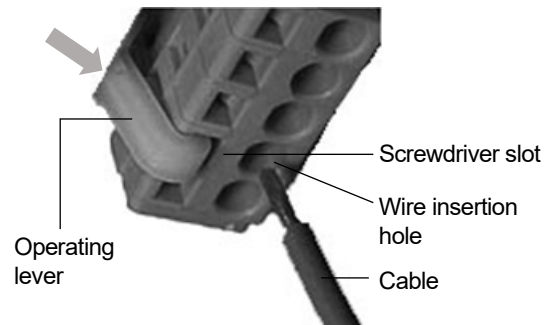
The operating lever provided as a standard accessory cannot be used when connecting power and signal cables to TN1 on the SD-3. Use a flathead screwdriver in this case.



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

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

- 1 Hook the operating lever on to the screwdriver slot (rectangular hole) in the terminal plate as shown in the figure to the right.**
- 2 Push the operating lever with your finger to push down the spring inside the terminal plate.**



- 3 While continuing to press the operating lever, insert the cable into the wire insertion hole (round hole) until it contacts the end.**



- 4 Release the operating lever.**

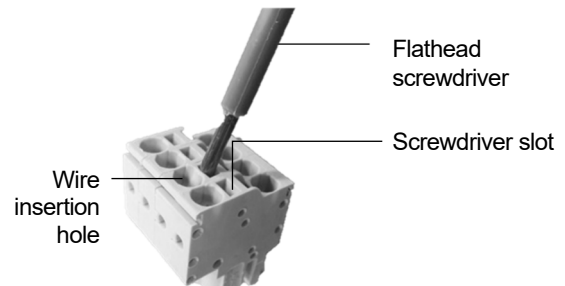
The cable is now connected to the terminal plate.

Gently pull on the cable to confirm that it is correctly connected.

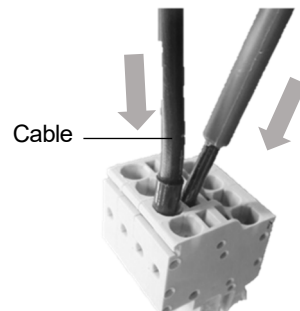
Avoid pulling with excessive force.

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

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



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



- 3 Release the flathead screwdriver.**

The cable is now connected to the terminal plate.

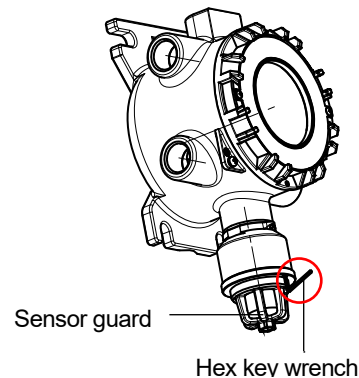
Gently pull on the cable to confirm that it is correctly connected.

Avoid pulling with excessive force.

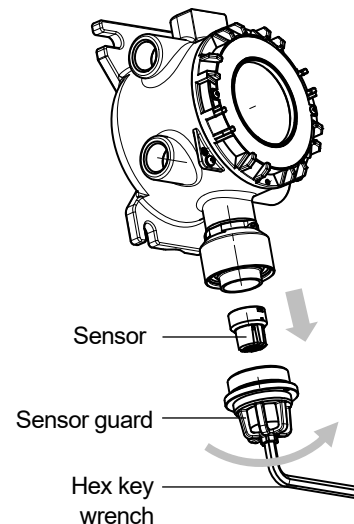
4-8 Mounting the sensor

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

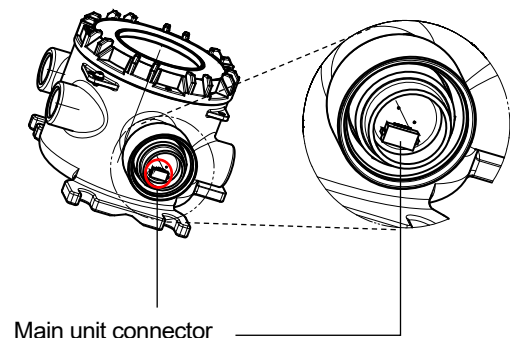
- 1 Remove suction cap, splash guard, and filter, if fitted.**
- 2 Unscrew the single M4 bolt securing the sensor guard.**
Use a hex key wrench (2 across flats) to unscrew the M4 hex socket set screw.



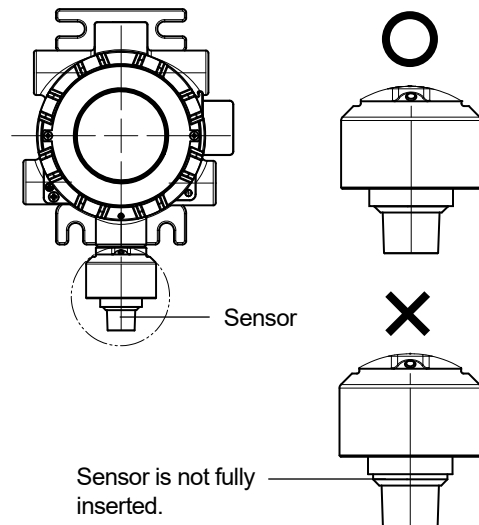
- 3 Rotate and remove the sensor guard.**
Remove using a hex key wrench (8 across flats) or wrench.
- 4 Pull out and remove the sensor, if fitted.**



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



6 Confirm that the sensor is fully inserted.

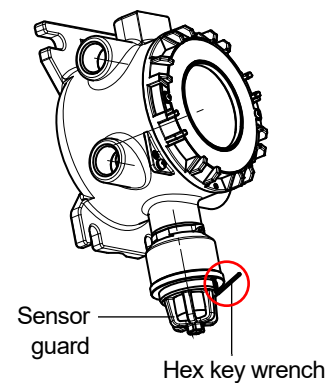


7 Attach the sensor guard to the main unit.

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

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

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



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



CAUTION

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

4-9 Alarm relay setting (option)

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



WARNING

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

CAUTION

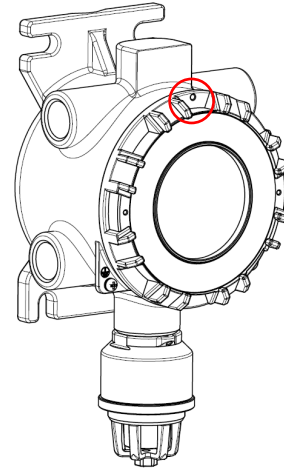
- Note that recurring use with the alarm relay contacts normally closed may result in the contacts seizing due to minute vibrations.
- Connect the alarm relay cable and sensor before turning on the power to the product.

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

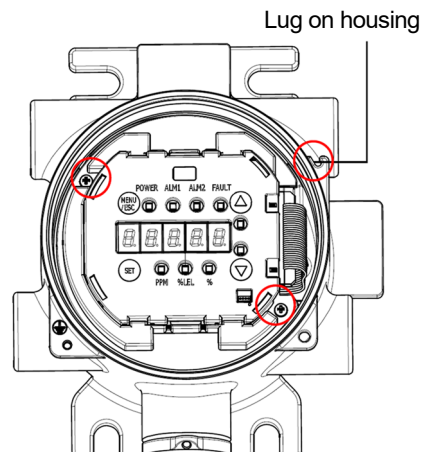
1 Unscrew the M4 hex socket set screw on the main unit cover, then rotate the cover counterclockwise to remove.

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.



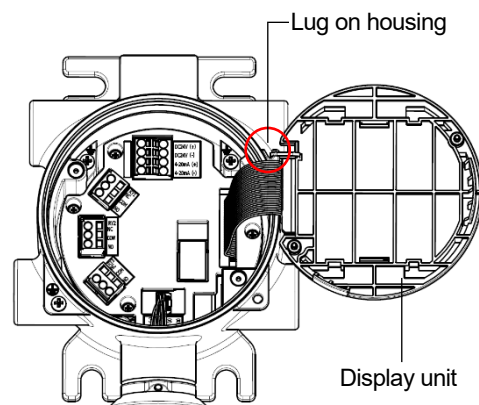
2 Unscrew the two M3 screws securing the display unit.



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

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

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



- 4 Pull out the terminal plates (TN2 (Relay1: ALARM1), TN3 (Relay2: ALARM2), and TN4 (Relay3: FAULT)) from the terminal plate board.**

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

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

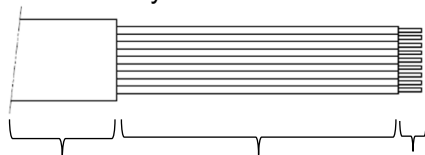
For information on how to connect cables to the terminal plates, refer to '4-7-5 Connecting cables to the terminal plate'.

Common for TN2 (Relay1: ALARM1), TN3 (Relay2: ALARM2), and TN4 (Relay3: FAULT)
(Default (normally de-energized) terminal assignment)

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

N.O.: Normally open

N.C.: Normally closed



Sheathing Insulation Conductor

Recommended insulation length: 120 - 130 mm

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

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

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

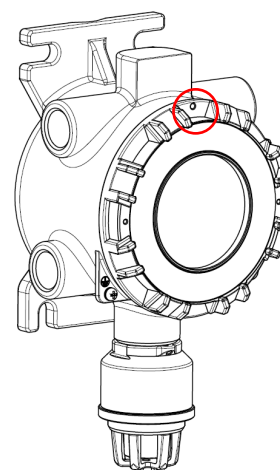
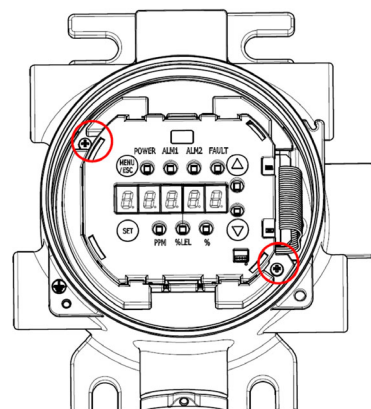
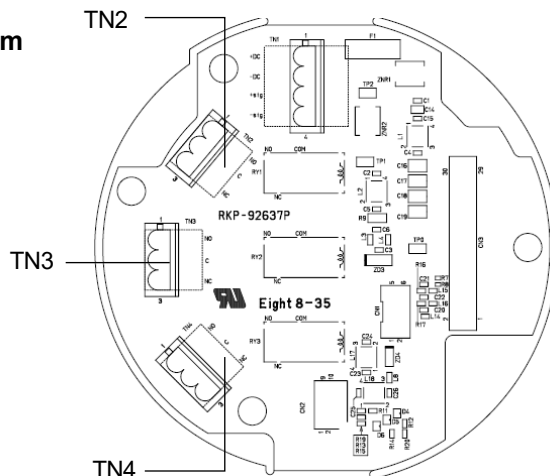
Take care not to trap the cable here.

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

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

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

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

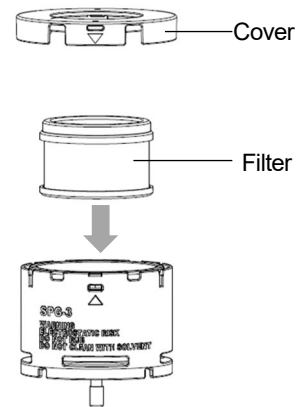


*The diagram illustrates the SD-3. The connection method for the SD-3SC is identical.

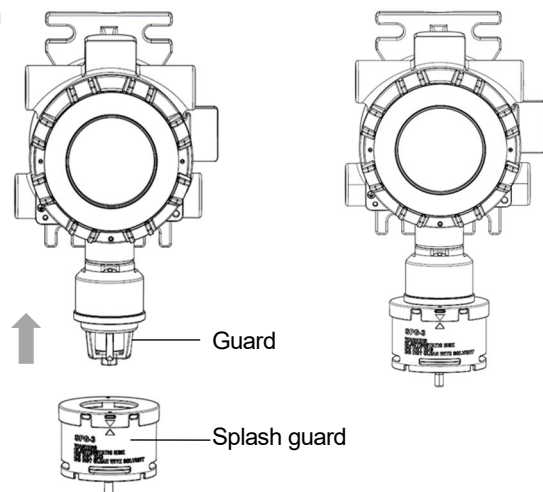
4-10 Mounting the splash guard

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

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



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



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

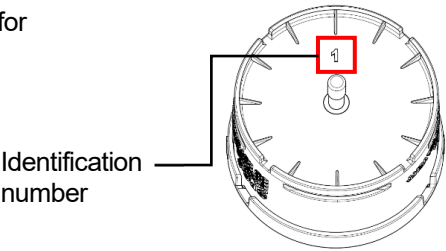
NOTE

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

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

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

<for IRF sensor>	<for combustible gas sensor>	<for ESF sensor>
SD-3RI	SD-3NC	SD-3EC
GD-3RI	GD-3NC	SD-3ECB
		GD-3EC
		GD-3ECB



4-11 How to install the lightning arrester

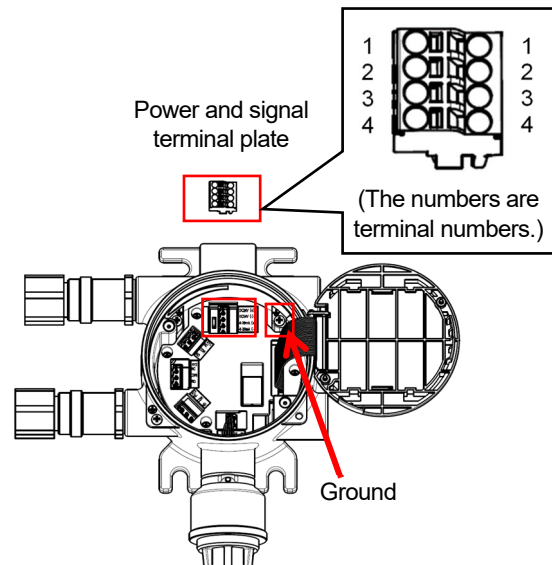
SD-3 can connect a simple lightning arrester. Be sure to use the specified model and connect it to the terminal block for power and signal.

<Using 3-core cable>

Terminal No.	Power/signal cable connection	Connection of lightning arrester
1	Power supply (+)	Blue
2	Common (power supply (-), signal (-))	Brown
3	Signal (+)	Black
Ground	—	Yellow/Green

<Using 4-core cable>

Terminal No.	Power/signal cable connection	Connection of lightning arrester
1	Power supply (+)	Blue
2	Power supply (-)	Brown
3	Signal (+)	Black
4	Signal (-)	White
Ground	—	Yellow/Green



NOTE

- ▶ [Designated lightning arrester]

Type: TP48-3-N-NDI

TP48-4-N-NDI

*When connecting a lightning arrester, use connection port 2 or 4. If a lightning arrester other than the specified one is used, the explosion-proof performance will not be satisfied.

- ▶ When installing a surge arrester, check its operation before using it. Also, surge arresters cannot remove all surge voltages.



CAUTION

- Only ATEX and IECEx specifications are applicable.
- Discontinue use if operational problems occur.

4-12 RS-485 setting (optional)

RS-485 enables digital communication.



CAUTION

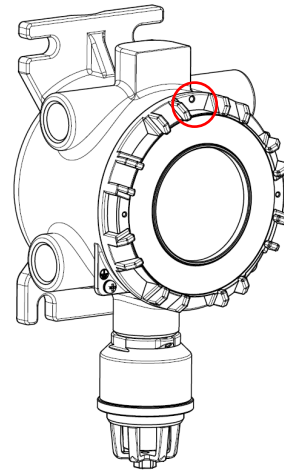
- Use shielded twisted pair cable.
- Do not wire near trunk cables or high-voltage equipment.
- Do not connect to any device other than the SD-3 series in the Modbus.

To use RS-485, connect the RS-485 communication wires to the terminal block of TN2 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.**

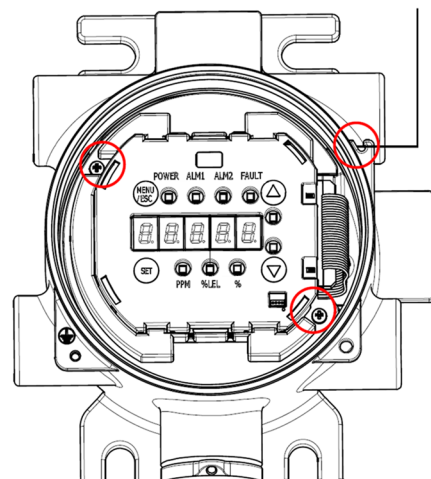
Use a hex key wrench (2 across flats) to unscrew the M4 hex socket set screw.

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



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

Lug on housing

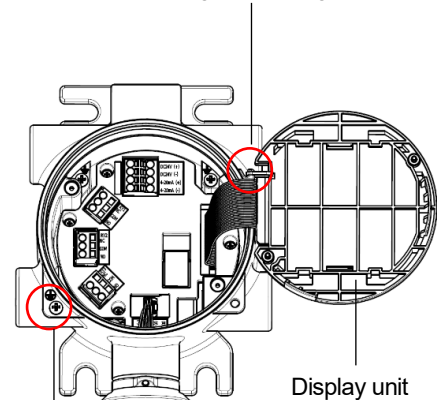


- 3 Pull out the display unit and hang on the lug on the housing.**

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

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

Lug on housing



- 4 Pull out and remove the terminal block (TN2 (RS-485)) on the terminal block board.
- 5 Only one device connected at the furthest point on the Modbus should have its terminator set to ON, other devices should not have their terminators set to ON.

JP1

Terminal No.	Terminating resistance
1-2(standard)	OFF.
3-2	ON(120 Ω)

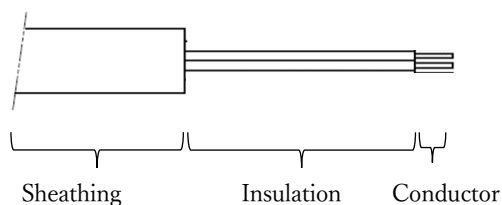
- 6 Connect the wiring for RS-485 communication to the corresponding terminals on the removed terminal block
For information on connecting cables to the terminal plate, refer to '4-7-5 Connecting cables to the terminal plate'.

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 - 50 mm

- 7 Attach terminal block (TN2 (RS-485)) to terminal block board

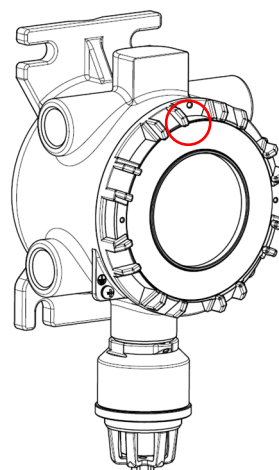
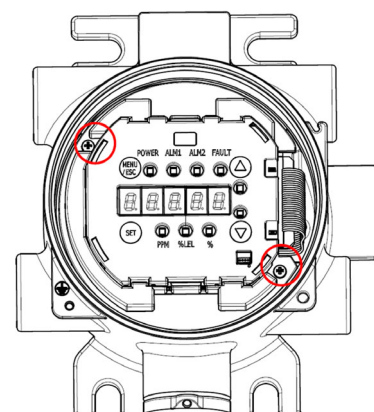
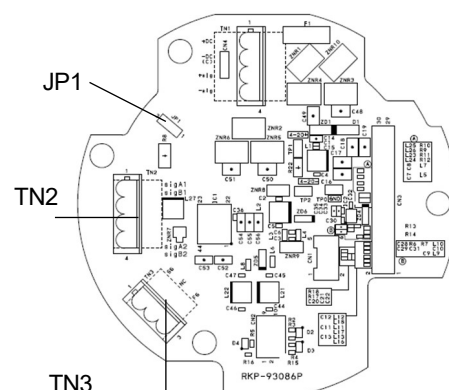
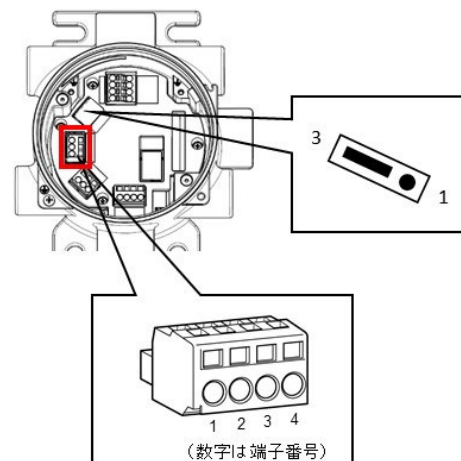
Adjust the position of the cable so that there is no load on the terminal block.

- 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 and secure with the single M4 hex socket set screw.

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



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

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

5

Usage Instructions

5-1 Preparations for startup

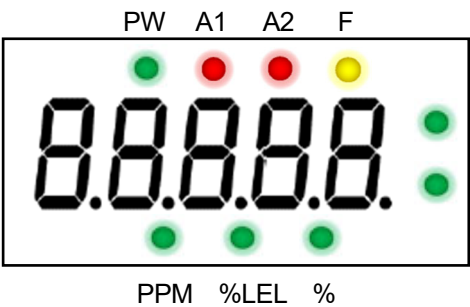
Carry out the following checks before connecting the power supply. Failure to perform these checks may result in electric shock or damage to the product.

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

<How to read display examples>

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

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



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

5-2 Startup



CAUTION

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

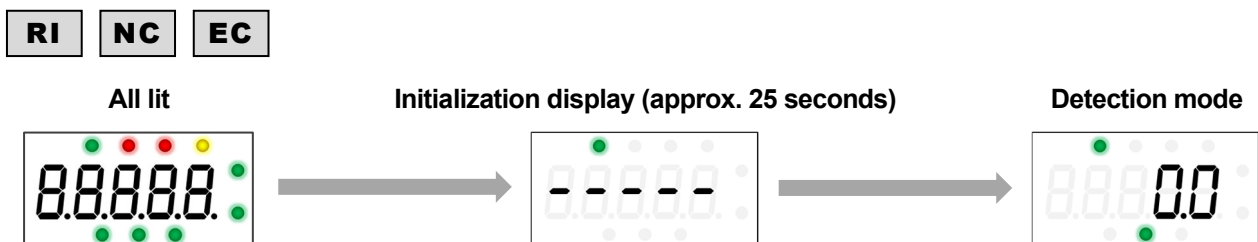
Turn on the power supply (24 V DC) and start the product.

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

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

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

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

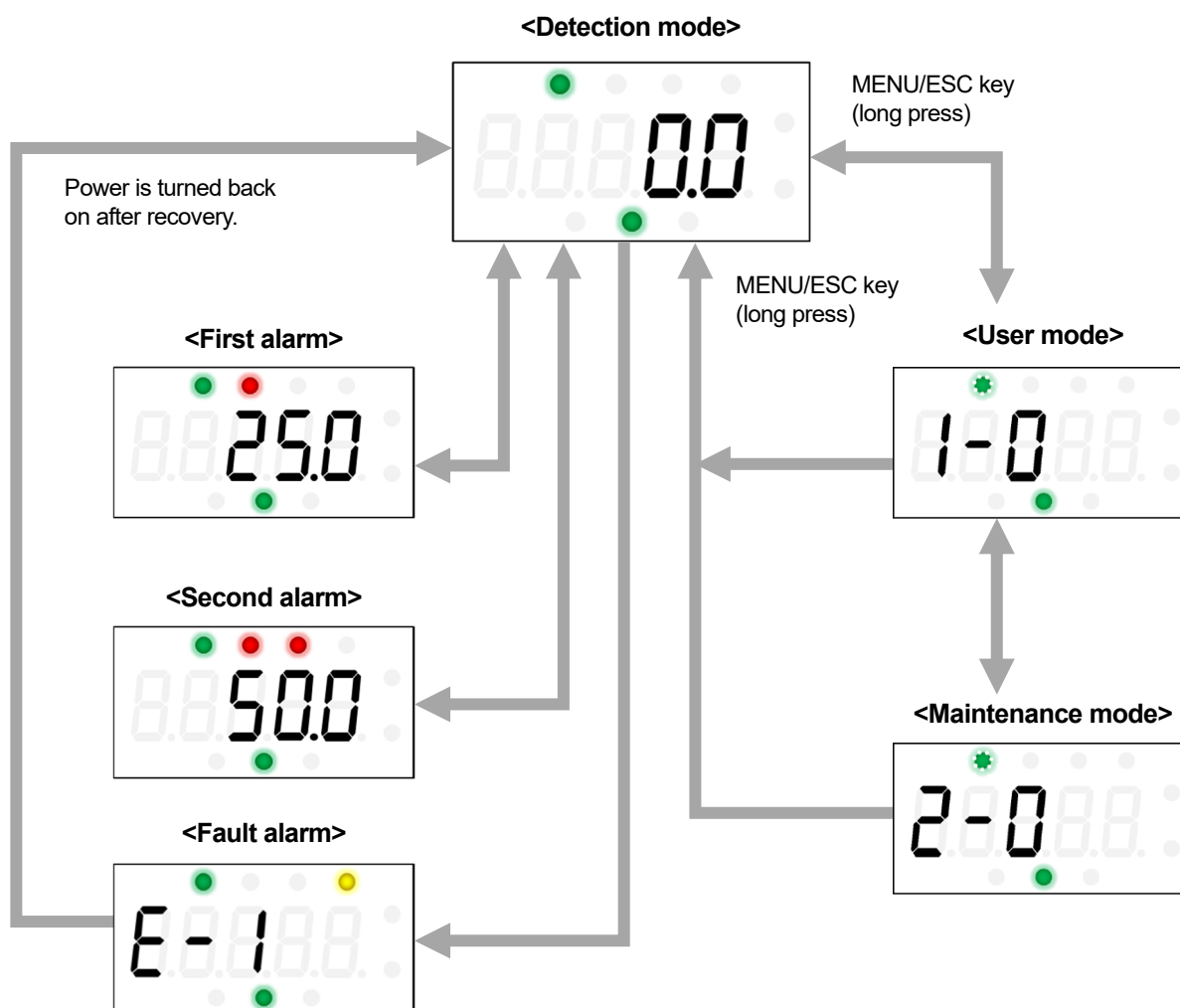


CAUTION

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

5-3 Basic operation flow

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



WARNING

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

NOTE

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

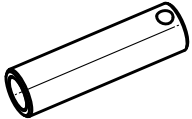
5-4 Operating procedure

The product is operated using the control key.

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

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

<Control key>



CAUTION

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

5-5 User mode

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



CAUTION

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

5-5-1 User mode setting items

Item No.	Setting item	LED display	Details
1-0	Version information		Displays the program version and other information. This is not normally used by the user.
1-1	Zero calibration		Performs zero calibration. (Refer to '5-6 Performing zero calibration'.)
1-2	Setting display		Displays the alarm settings and other settings such as the 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

- After the adjustment is completed, never fail to press MENU/ESC key to return to the detection mode. If left in user mode, the product will take 10 hours to return to detection mode. Detection will not be available during this time, posing hazards.

5-6 Performing zero calibration

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

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

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



WARNING

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



CAUTION

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

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



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



Zero calibration starts.



- 3 Check the zero calibration result.

If zero calibration is successful

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



If zero calibration is unsuccessful

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



NOTE

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

5-7 Checking settings

Displays the alarm settings and other settings such as the 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 settings for RS-485 communication.

5-7-1 Checking alarm setpoints

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

NOTE

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

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



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



- 3 Check the individual alarm setpoints.

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

- First alarm setpoint display
Displays the first alarm setpoint.



- Second alarm setpoint display
Displays the second alarm setpoint.



- Alarm delay time
Displays the alarm delay time (in seconds).



- Zero suppression value display
Displays the positive side suppression value.



- Zero follower ON/OFF display
Displays whether the zero follower setting is on or off.
(This is not normally used by the user.)



- Sensitivity correction ON/OFF display
Displays whether sensitivity correction is on or off.
(This is not normally used by the user.)



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

First alarm setpoint display

- 4 Press the MENU/ESC key.
Returns to the [1-2.0] display.

NOTE

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

5-7-2 Check RS-485 setting value

Displays RS-485 settings such as address, communication speed, data length, and parity.

- 1 In user mode, press the ▲ or ▼ key to select [1-2] and press the SET key.



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



- 3 Check each setting value of RS-485 communication settings.

Press the ▲ or ▼ key to toggle the display of setpoint values.

- Address display
Displays the address.
- Communication speed display
Displays the communication speed.
- Data length display
Displays the data length.
- Parity display
Displays the parity.



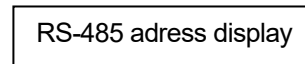
- Stop bit display
Displays the stop bit.



- Communication error display
When there is no communication for a certain period of time, the "E-6" display setting is made.



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



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

NOTE

- ▶ The RS-485 communication settings can be set in the maintenance mode communication settings. (Refer to '7-6 Setting communication settings (RS-485)'.)

5-8 Shutting down

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



WARNING

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

6

Alarm Activation

6-1 Gas alarm activation

6-1-1 Alarm activation

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

NOTE

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

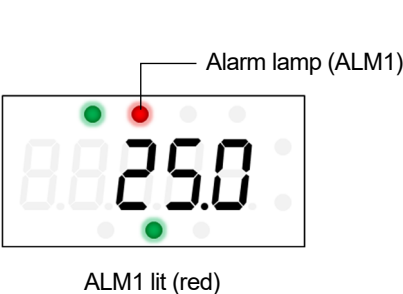
<Gas concentration display>

If the reading exceeds the detection range (full scale exceeded), “〇〇〇〇” appears on the LED display.

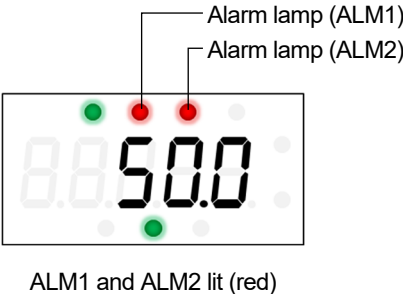
<Power/alarm lamp display>

The alarms are two-step alarms. The alarm lamps light up when the corresponding alarm setpoint is reached or exceeded.
The alarm lamps (ALM1 and ALM2) light up in red. The display appears as follows.
The power lamp (POWER) remains lit in green.

<First alarm>



<Second alarm>



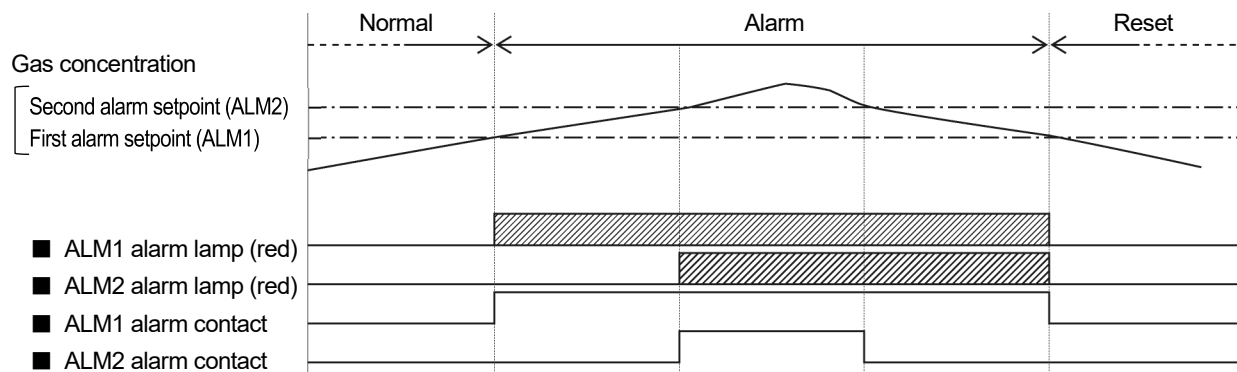
NOTE

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

6-1-2 Contact operation (auto reset)

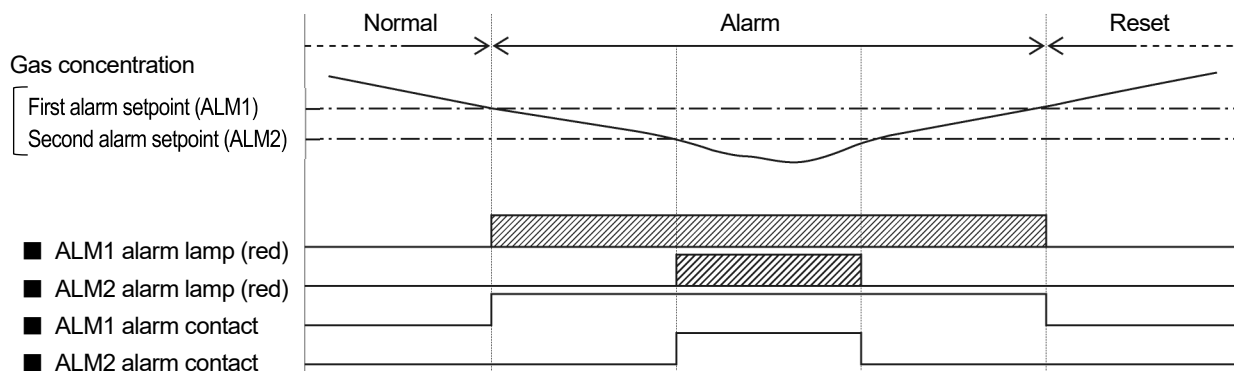
If auto reset is set, the contacts will activate when the gas concentration reaches or exceeds the alarm setpoint. The contact operation is automatically reset when the gas concentration falls below the alarm setpoint.

<Alarm pattern (H-HH)>



<Alarm pattern (L-LL)>

(Oxygen deficiency alarm)



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

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

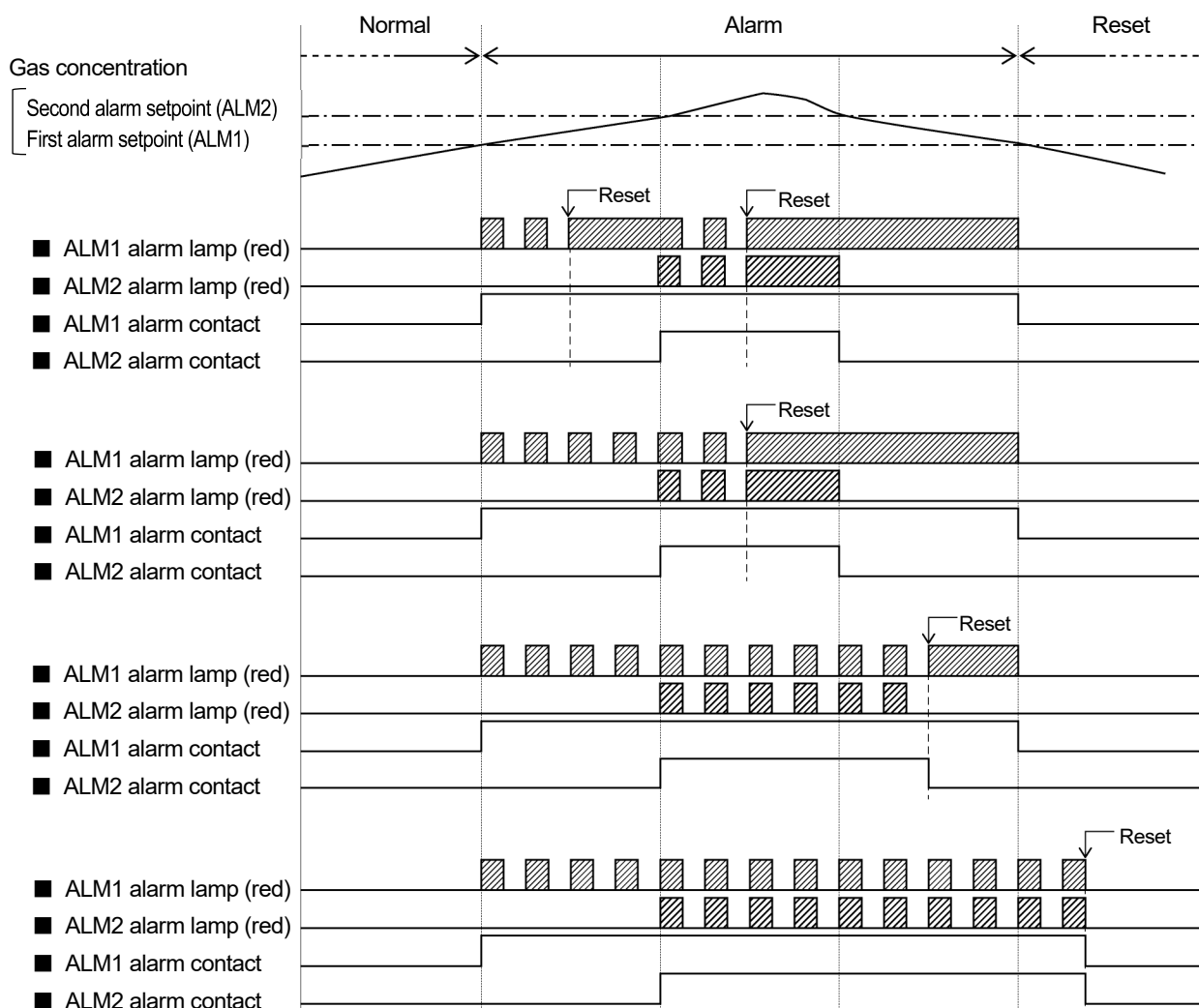
The contact operation is automatically reset when the gas concentration falls below the alarm setpoint after resetting.

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

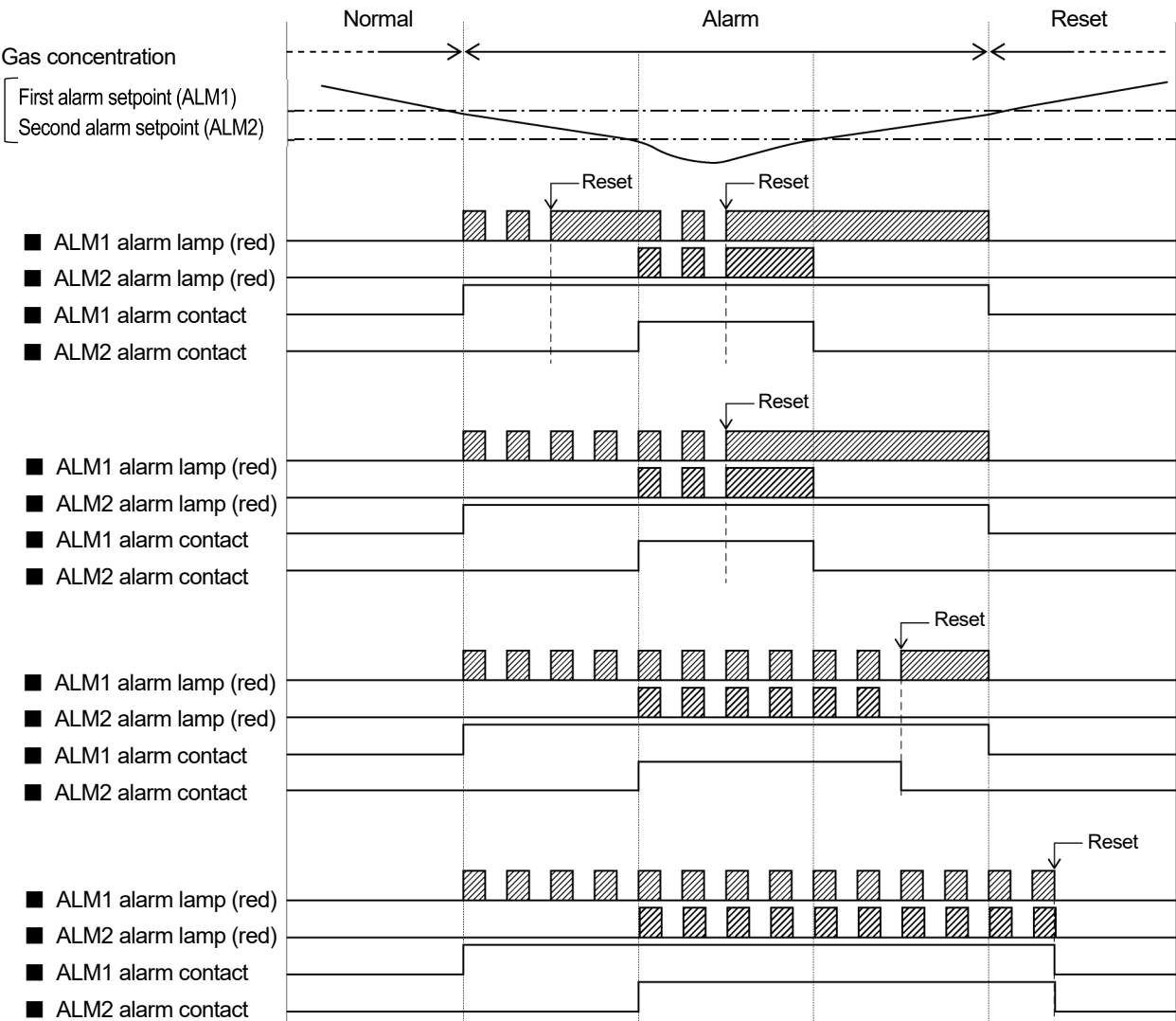
NOTE

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

<Alarm pattern (H-HH)>



<Alarm pattern (L-LL)>
(Oxygen deficiency alarm)



6-1-4 Alarm response

If an alarm is triggered, respond promptly in accordance with the user's management rules.
The typical procedures are as follows:

Step 1 Check the reading on the product.



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

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

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

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



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

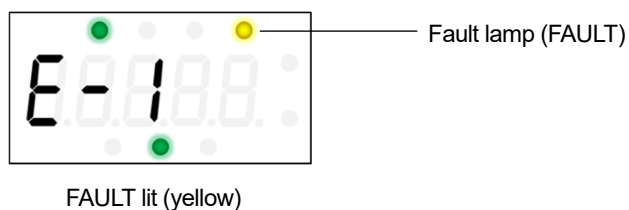
Step 5 Once you have determined that no hazard remains, take action to fix the gas leak.

6-2 Fault alarm activation

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

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

<In case of sensor abnormality>



NOTE

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

6-3 Warning operation

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

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

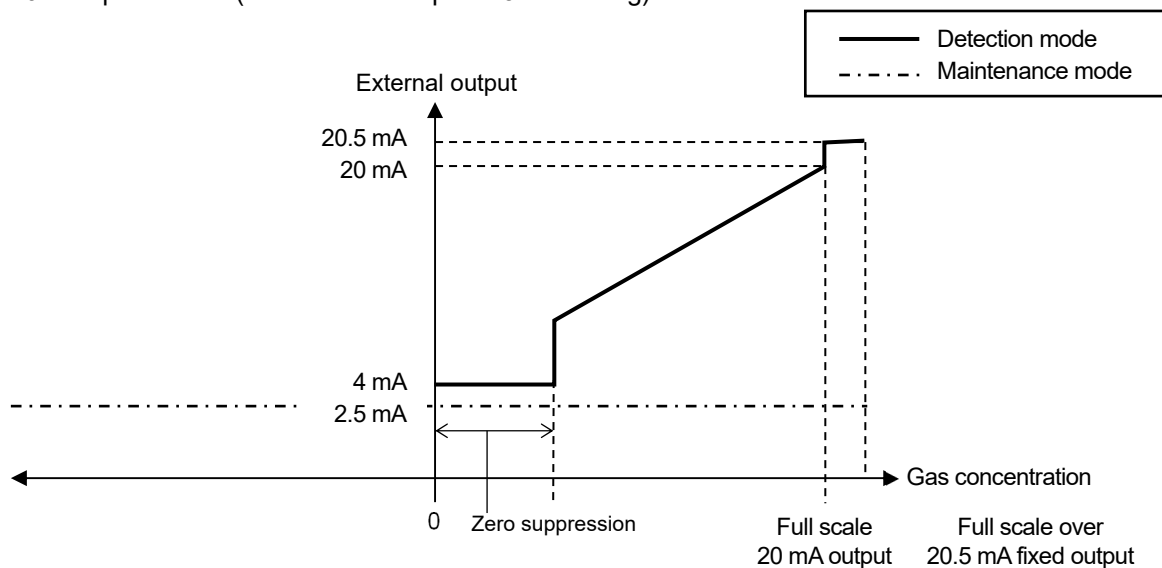
6-4 External output operation

6-4-1 For target gases other than oxygen

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

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

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

**CAUTION**

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

6-4-2 When the target gas is oxygen

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



CAUTION

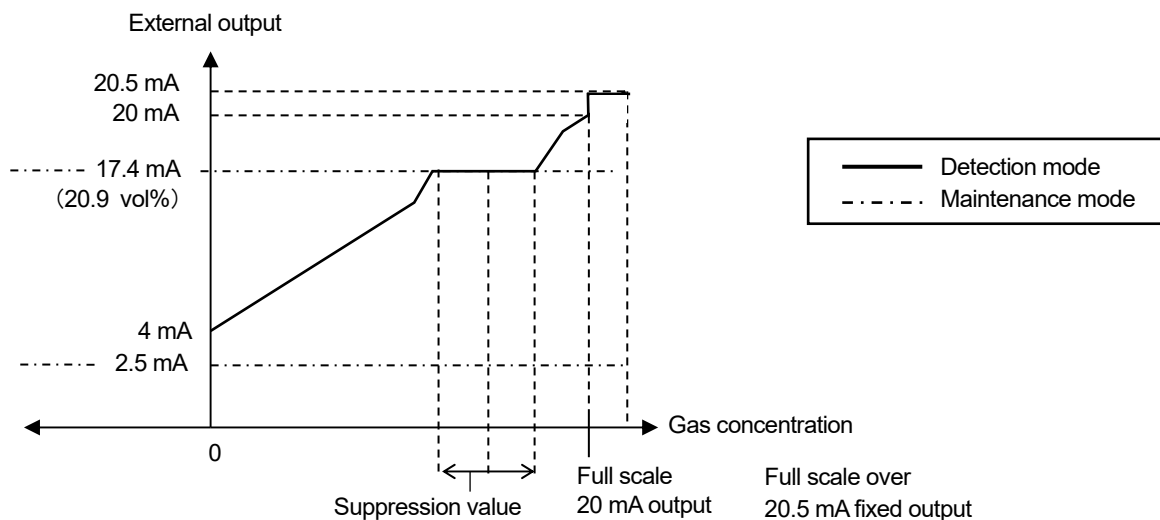
<With analog transmission (4 - 20 mA)>

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

Examples where care is required	Analog transmission 4 - 20 mA specifications
Using ESF (detection target gas: oxygen) (L-LL)	A false alarm may occur upstream (L alarm) if 2.5 mA is output in maintenance mode or if the inhibit function is enabled.

<Gas concentration and external output example>

0 - 25 vol% (oxygen deficiency alarm specification)

**CAUTION**

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

6-5 Functions to ensure correct alarm activation

6-5-1 Zero suppression function

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

<Zero suppression function disabled>



The reading fluctuates around the zero level.

<Zero suppression function enabled>



Displays zero up to the preset value.

NOTE

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



CAUTION

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

6-5-2 Automatic sensor recognition function

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

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

<After sensor replacement>

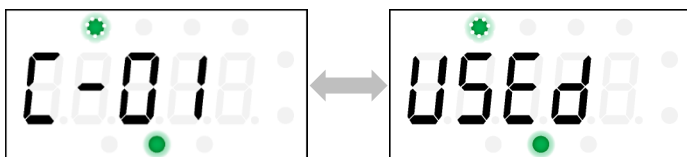
The display appears as follows when the sensor has been replaced with a sensor of the same specifications (e.g., detection principle and model)—for example at periodic replacement.

Pressing the SET key makes the product recognize the sensor as a new sensor and start up.



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

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



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

Please make sure that the sensor has the same specifications as the sensor before replacement, and install it properly.



7

Maintenance

The product is an important safety and disaster prevention device.

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

7-1 Maintenance intervals and items

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

- Daily maintenance: Perform maintenance before commencing work.
- Monthly maintenance: Inspect the alarm circuit (alarm test) once a month.
- Regular maintenance: Confirm and adjust the measurement accuracy with the calibration gas concentration. The order of calibration is zero adjustment first and then span adjustment.

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

<Maintenance services>

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

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

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

Service	Service details
Power supply check	- Check the power supply voltage. - Check to confirm that the power lamp is lit. (Confirm that the power lamp (POWER), alarm lamps (ALM1, ALM2), fault lamp (FAULT), unit lamps (PPM, %LEL, %) are clearly visible on the display.) - Check the operation of the UPS (uninterruptible power system), if used.
Concentration display check	Check to confirm that the concentration reading indicates zero using a zero calibration gas. Perform zero calibration if the reading is not zero. With the oxygen deficiency alarm specifications, introduce clean air and check that the concentration reading indicates [20.9] (vol%). Perform span adjustment if the reading is offset.
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.

<Proof tests>

Regular proof testing is a requirement according to the standards regarding the degradation of measurement performance. The effects of the environment and changes to the application of the detector can have negative effects on measurement and signal performance. Proof tests must be performed regularly. Determine the interval for proof tests according to the application of the detector.

<Checking indication accuracy>

Regular proof testing is a requirement according to the standards regarding the degradation of measurement performance. Maintenance must be performed regularly. The inspection interval depends on the ambient conditions in which the sensor operates. The sensor drifts due to ambient conditions and aging deterioration. Sensor drift has an adverse effect on measurement accuracy. This accuracy can be recovered by calibration. Shorter check intervals may need to be established according to the severity of the drift. To evaluate the ambient conditions in a new facility, it is necessary to establish shorter check intervals to record the drift. It is necessary for the plant operator to establish the check intervals based on the data they acquire. Under normal circumstances, RIKEN KEIKI recommends the following check intervals.

[Recommended check intervals]

IRF: 12 months or less

NCF: 12 months or less

ESF: 12 months or less

[Check items]

Indication accuracy: zero reading, gas reading

Response

<Visual inspection>

It is necessary to perform a visual inspection of the gas detector to check whether there are external obstructions to the flow of gas/vapor to the sensor. Things that may be included are debris, dirt, snow, mud, external devices, etc. Corrective measures include removal of such blockages if they exist.

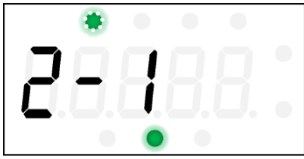
Depending on the environment, it may be necessary to make inspections at short intervals.

1. If necessary, remove protective devices (splash guard, etc.).
2. Check whether there are external obstructions to the detector. For example, debris, dirt, snow, mud, external devices, etc.
3. If such blockages exist, remove them.
4. Check the status LED/display.

7-2 Maintenance mode

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

7-2-1 Maintenance mode setting items

Item No.	Setting item	LED display	Details
2-0	Test mode		Performs the gas test, alarm test, fault test, LED test, and RAM test. (Refer to '7-3 Performing tests (test mode)').
2-1	Zero calibration		Performs zero calibration. (Refer to '7-4-2 Performing zero calibration').
2-2	Span adjustment		Performs span adjustment. (Refer to '7-4-3 Performing span adjustment').
2-3	Display		This is not normally used by the user.
2-4	Environmental settings 1		Configures settings such as alarm setpoints, alarm pattern, fault alarm pattern, zero suppression value, and the date and time. (Refer to '7-5 Setting environmental settings 1').
2-5	Environmental settings 2		This is not normally used by the user.
2-6	Environmental settings 3		This is not normally used by the user.
2-7	Communication settings		Sets various RS-485 communication settings. (Refer to '7-6 Setting communication settings (RS-485)').

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

7-2-2 Switching to maintenance mode

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



The product switches to user mode.



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



The product switches to maintenance mode.



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



Display example: With environmental settings 1 selected

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



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



WARNING

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

NOTE

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

<Switching from maintenance mode to user mode>

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



- 2 Press the SET key.



The product switches to user mode.



7-3 Performing tests (test mode)

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

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

7-3-1 Performing gas test

Perform a gas test.

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

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



WARNING

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

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



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



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



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



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



Returns to the [2-0.0] display.

7-3-2 Performing alarm test

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



WARNING

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

NOTE

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

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



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



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

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



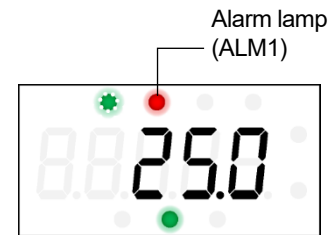
- Press the ▲ or ▼ key to increase or decrease the reading.



5 Check to confirm that an alarm is triggered.

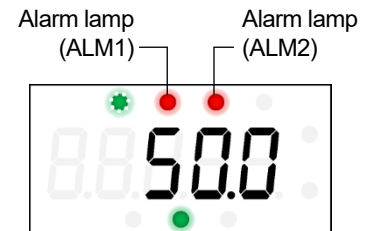
The first alarm is triggered when the reading reaches the first alarm setpoint.

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



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

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

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

Returns to the [2-0.1] display.

7-3-3 Performing fault test

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



WARNING

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

- 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.

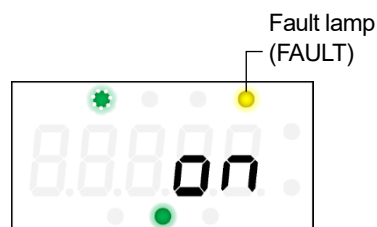


- 3 Press the ▲ or ▼ key to select [on], then press the SET key.



- 4 Check to confirm that a fault alarm is triggered.

The fault lamp (FAULT) lights up (yellow) when a fault alarm is triggered.



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

The fault alarm is cleared. The fault lamp (FAULT) goes out.

Fault alarms can also be cleared by pressing the MENU/ESC key.



7-3-4 Performing LED test

Perform an LED display test.

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



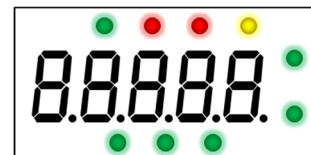
- 2 Press the ▲ or ▼ key to select [2-0.3], then press the SET key.



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



- 4 Check to confirm that all LEDs light up.



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

The LED test ends.

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



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

Perform a memory test.

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



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



- 3 Press the SET key.



The memory test starts.

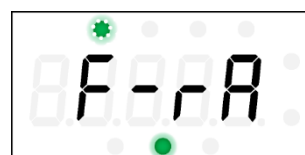


- 3 Check the memory test result.

No problems with memory:
[PASS] appears.



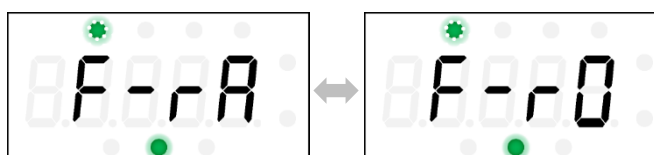
Problems with RAM:
[F-rA] appears.



Problems with ROM:
[F-rO] appears.



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



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

7-4 Performing calibration

7-4-1 Calibration preparation

Before performing calibration (zero calibration and span adjustment), prepare the calibration gas.

Also connect the calibration equipment required to the product before starting.

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

<List of adjustment jigs>

Item name	Applicable specifications	
Calibration adapter	Dedicated adapter for IRF sensor	Part No.: 4283 9011 00
	Dedicated calibration adapter for combustible F sensors	Part No.: 4283 9012 70
	Dedicated adapter for ESF sensor	Part No.: 4283 9013 40
Pump	One that can provide a flow rate of 0.5 mL or greater	
	Explosion-proof specifications	
Flowmeter	Measures tolerances to 0.1 ml.	
	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 1m
	For organic solvents	Material: Teflon Internal diameter: 4 mm Pipe length between gas and adapter: Within 1m
	For strongly adsorptive gases	Material: Teflon Internal diameter: 4 mm Pipe length between gas and adapter: Within 10cm

<List of adjustment conditions>

Gas detector model	Sensor model	Detection target	Chemical formula	Detection concentration	Zero gas	Calibration gas (alternative gas)	Dilution gas	Calibration gas concentration (alternative gas concentration)	Calibration adapter	Applicable flow rate for calibration jig	Time Required for calibration	Sample flow range	Remarks
SD-3RI SD-3DRI GD-3RI	IRF-1301	Methane	CH ₄	100 %LEL	N ₂	Methane	N ₂	50 %LEL	For IRF sensor (4283 9011 00)	0.5 ± 0.1 L/min	120 seconds	0.4 – 1.5 L/min	Warm up for at least 10 minutes before making adjustments.
	IRF-1317	Propane	C ₃ H ₈	100 %LEL		Propane		50 %LEL					
	IRF-1303	Isobutane	i-C ₄ H ₁₀	100 %LEL		Isobutane		50 %LEL					
	IRF-1340	Isobutylene	i-C ₄ H ₈	100 %LEL		Isobutylene		50 %LEL					
	IRF-1334	Methane	CH ₄	100 vol%		Methane		50 vol%					
	IRF-1315	Propane	C ₃ H ₈	100 vol%		Propane		80 vol%					
	IRF-1320	Isobutane	i-C ₄ H ₁₀	100 vol%		Isobutane		80 vol%					
	IRF-1435	Carbon dioxide	CO ₂	2000 ppm		Carbon dioxide		1000 ppm					
	IRF-1436			5000 ppm		Carbon dioxide		2500 ppm					
	IRF-1433			10000 ppm		Carbon dioxide		5000 ppm					
	IRF-1437			2 vol%		Carbon dioxide		1 vol%					
	IRF-1438			5 vol%		Carbon dioxide		2.5 vol%					
	IRF-1439			10 vol%		Carbon dioxide		5 vol%					

Gas detector model	Sensor model	Detection target	Chemical formula	Detection concentration	Zero gas	Calibration gas (alternative gas)	Dilution gas	Calibration gas concentration (alternative gas concentration)	Calibration Adapter	Applicable flow rate for calibration jig	Time Required for calibration	Sample flow range	Remarks
SD-3NC SD-3DNC GD-3NC	NCF-6318	Methane	CH ₄	100 %LEL	Atmospheric air	Methane	Atmospheric air	50 %LEL	For combustible F sensors (4283 9012 70)	0.5 ± 0.1 L/min	60 seconds	0.4 – 1.5 L/min	Warm up for at least 30 minutes before making adjustments.
	NCF-6318	Propane	C ₃ H ₈	100 %LEL		Propane		50 %LEL					
	NCF-6319	Isobutane	i-C ₄ H ₁₀	100 %LEL		Isobutane		40 %LEL					
	NCF-6320	Hydrogen	H ₂	100 %LEL		Hydrogen		50 %LEL					

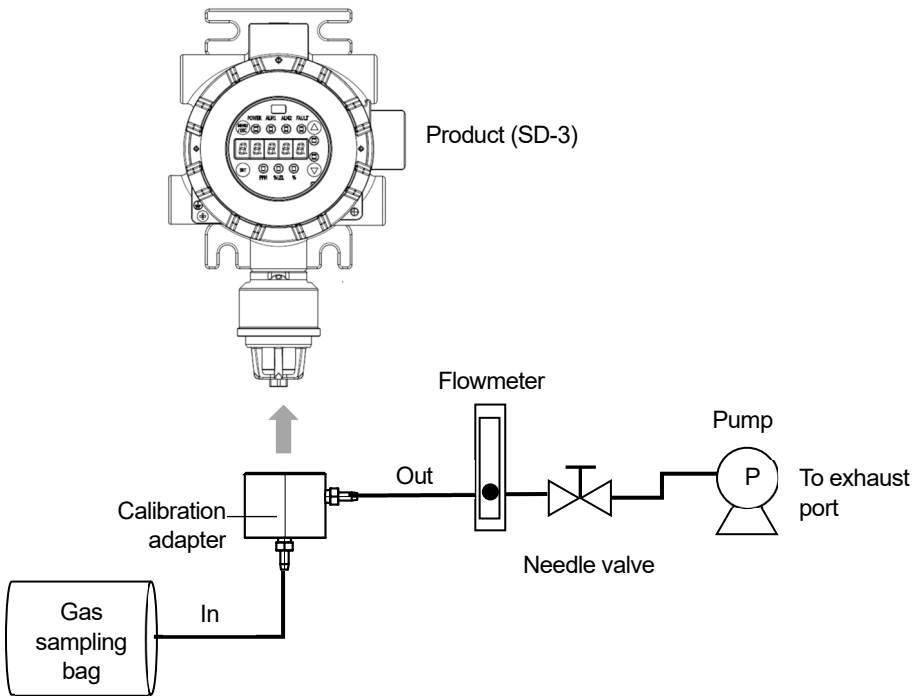
Gas detector model	Sensor model	Detection target	Chemical formula	Detection concentration	Zero gas	Calibration gas (alternative gas)	Dilution gas	Calibration gas concentration (alternative gas concentration)	Calibration cap	Applicable flow rate for calibration jig	Time Required for calibration	Sample flow range	Remarks
SD-3EC SD-3DEC GD-3EC	ESF-X24P2	Oxygen	O ₂	25 vol%	N ₂	Oxygen	Atmospheric air	20.9 vol%	For ESF sensor (4283 9013 40)	0.5 ± 0.1 L/min	60 seconds	0.4 – 1.5 L/min	At temperatures below - 25°C, allow to acclimatize for the operating environment before adjustments.
	ESF-A24P	Carbon monoxide	CO	150 ppm	Atmospheric air	Carbon monoxide	N ₂ or Air	75 ppm			60 seconds		
	ESF-A24R3	Hydrogen sulfide	H ₂ S	100 ppm		Hydrogen sulfide	N ₂ or Air	50 ppm			60 seconds		
SD-3ECS SD-3DECS GD-3ECS	ESF-A24R	Hydrogen sulfide	H ₂ S	100 ppm		Hydrogen sulfide	N ₂ or Air	50 ppm			60 seconds		
SD-3ECB SD-3DECB GD-3ECB	ESF-B22	Ammonia	NH ₃	75 ppm		Ammonia	N ₂ or Air	37.5 ppm			120 seconds		Calibration must be performed at -10°C or higher.-
	ESF-A24A	Nitrogen dioxide	NO ₂	15 ppm		Nitrogen dioxide	Air	7.5 ppm			60 seconds		
	ESF-C92	Chlorine	Cl ₂	1.5 ppm		Chlorine	N ₂ or Air	0.75 ppm			120 seconds		

* For FM specifications, do not use alternative gas for adjustment.

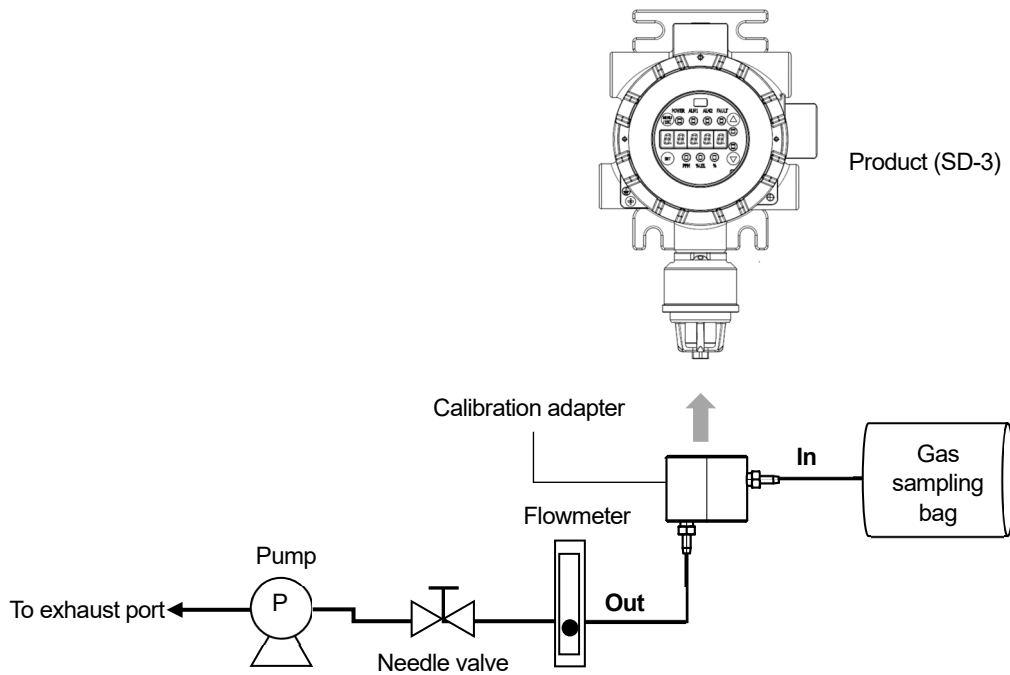
NOTE

- ▶ Use a flow rate of 0.5 ± 0.1 L/min when calibrating. Calibration accuracy may be reduced if calibration is performed using a different flow rate.
- ▶ 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 rise. If this occurs, push clean air through to return the reading to zero. Furthermore, as the sensor will be shut off from the atmosphere in this state, it will not be monitoring.

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

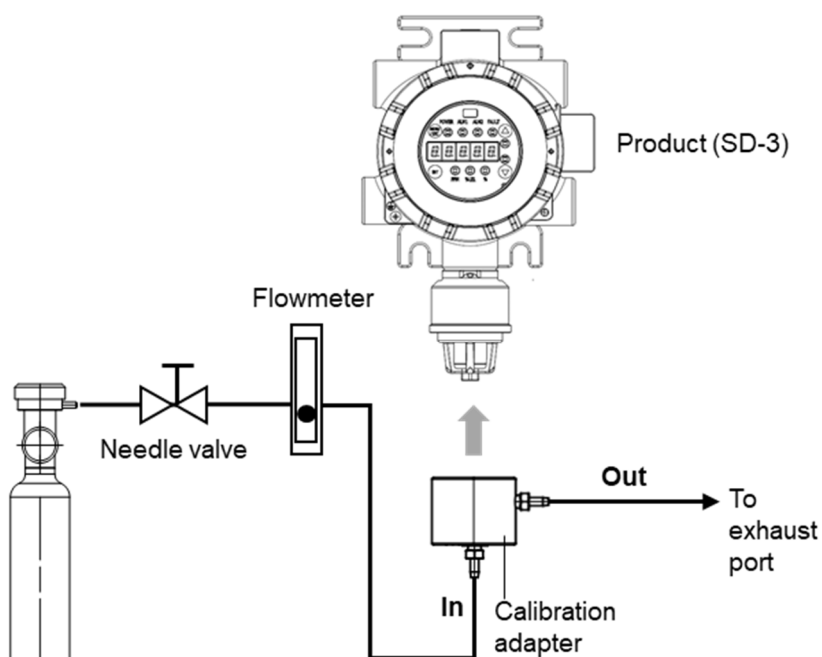


<Using a gas sampling bag> **NC**

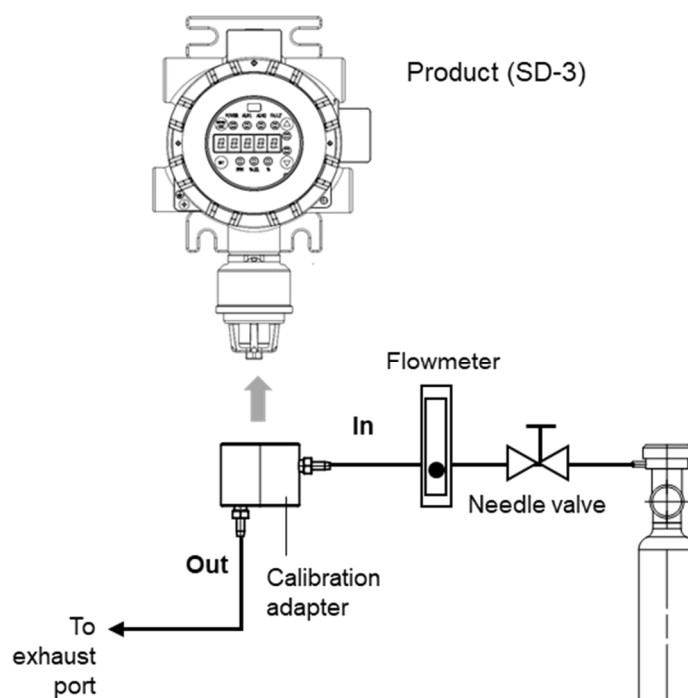


* The diagram illustrates the SD-3. The connection method is the same for the remote sensor head (GD-3).

<Using a gas can>

RI**EC**

<Using a gas can>

NC

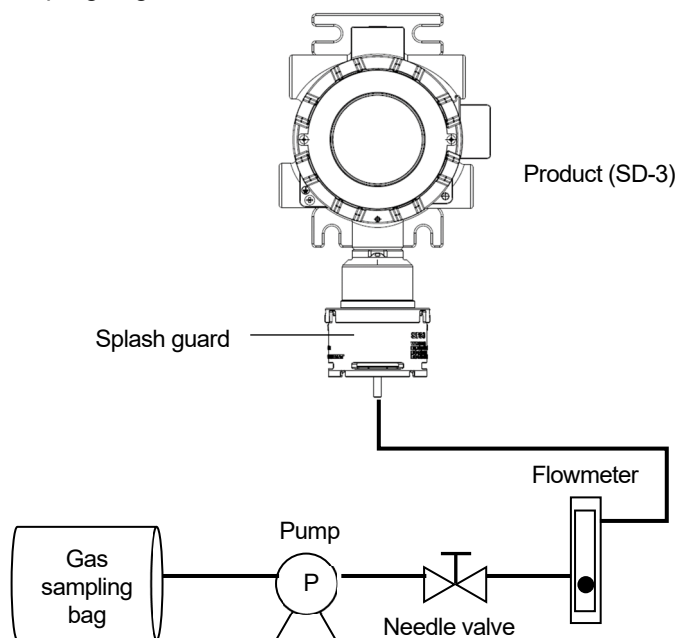
* The diagram illustrates the SD-3. The connection method is the same for the remote sensor head (GD-3).

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

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

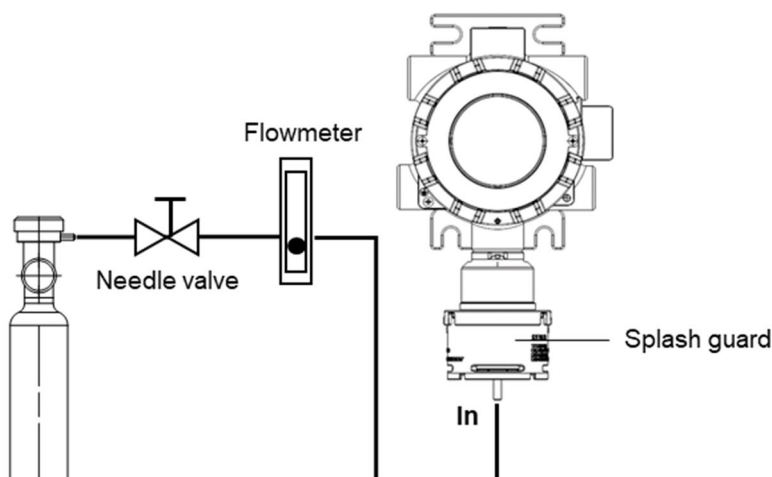
Detection principle	Wind speed
Non-dispersive infrared type (infrared type)	Max. 6 m/s
New ceramic type	
Electrochemical type	Max. 1 m/s

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

<Using a gas sampling bag>

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

<Using a gas can>



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

<Checking for piping leaks>

- Make a visual inspection for cracks in the pipes.
- When installed according to the piping diagram and with the calibration adapter covering the gas inlet, confirm that the flowmeter indicates zero.
- If the flowmeter does not indicate zero, there is a leak between the gas inlet and the pump.
- Make a visual inspection for cracks in the rubber seals on the pipes and calibration adapter.
- When using a gas cylinder for calibration, use the pump to perform checks for leaks using the same method before connecting the cylinder.
- If this does not solve the issue, the matter needs to be checked by a qualified service engineer. To ensure safety and the stable operation of the product, request checking by a qualified service engineer. Also, as a method for determining the locations of leaks, we recommend our leak tester. Contact RIKEN KEIKI to request checking.



WARNING

- If you use a method of applying pressure by introducing air through the gas inlet and blocking the gas outlet, adapters and pipes may become disconnected with great force.

<Calibration adapter>

- There are different calibration adapters for different models.
- For IRF, use the IRF dedicated adapter; for NCF, use the dedicated adapter for combustible gas sensors.
- For IRF, use the dedicated adapter for IRF sensors; for NCF, use the dedicated adapter for combustible gas sensors; for ESF, use the ESF dedicated adapter.

<Calibration procedure>

- Perform zero adjustment and span adjustment in the determined order.
- Characteristics may be affected if not performed in the correct order.

<Zero gas>

- Zero gas is a test gas for calibrating the zero point. The ambient air can be used as the zero gas if there are no interfering impurities or target gases present. For O₂ and CO₂ sensors, nitrogen (N₂) is used.

<Calibration gases>

- Calibration gas is a gas for calibrating the sensitivity of the sensors during span adjustment. Calibration gas is a known concentration of the target gas diluted with clean air or nitrogen. For O₂ sensors, the oxygen in the ambient atmosphere is used, so a calibration gas is not required.
- We recommend calibrating the device using the detection target gas. 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 target gas calibration.
- It is necessary to calibrate for methane and hydrogen using only the actual gases. Do not use replacement gases for calibration.
- It is necessary to perform span adjustment within 24 hours of the most recent valid zero adjustment.
- For managing the concentration of calibration gases, we recommend the use of a RIKEN KEIKI portable detector.
- Contact RIKEN KEIKI.

**WARNING**

- If harmful calibration gas is inhaled, your health may be harmed and there is also the possibility of death.
- Do not inhale the calibration gas.

<Confirming response time (t90)>

- Checking is performed against the piping diagram.
- 1. Confirm response time after air calibration and span adjustment.
- 2. Select Maintenance mode 2-0.0 to enter the gas test.
- 3. Use a stopwatch to measure the time it takes between when the calibration gas is introduced through the calibration adapter and the reading reaching a gas concentration of 90 %.
- 4. Compare the response time with the t90 value indicated on the corresponding sensor data sheet.
- Confirm that the required response time is being maintained.

**WARNING**

- Response

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.

In case of the splash guard is installed, the IRF is not included in the performance certification (it does not meet the response).

- Adjustment

When adjusting highly adsorptive gases, replace with the adjustment adapter before performing the adjustments. Adjusting with a splash guard has an effect on the wind speed.

- The allowable range depends on the sensor, so refer to the table.

7-4-2 Performing zero calibration

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

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

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

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



WARNING

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



CAUTION

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

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



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



Zero calibration starts.



- 3 Check the zero calibration result.

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



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



NOTE

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

7-4-3 Performing span adjustment

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

NOTE

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

<With standard range>



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

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



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



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



Span adjustment starts.



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



If span adjustment is unsuccessful [FAIL] appears.



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

NOTE

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

7-5 Setting environmental settings 1

The following items can be set in environmental settings 1:

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

7-5-1 Inhibit setting

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

The default setting is disabled.

- 1 Press the ▲ or ▼ key in maintenance mode to select [2-4], then press the SET key.
- 2 Select [2-4.0], then press the SET key.
- 3 Press the ▲ or ▼ key to select [oFF] or [on], then press the SET key.



Returns to the [2-4.0] display.

NOTE

- ▶ Enabling the inhibit setting causes the LED display to alternate between [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])	0 - 10 % of full scale (H-HH)	
Second alarm setpoint ([AL2])	Combustible gas	First alarm setpoint to 60 % of full scale (H-HH)
	Other gases	First alarm setpoint to full scale (H-HH)

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



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



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

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



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



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

NOTE

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

7-5-3 Date and time setting

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

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



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



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

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



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

The selected item (month) flashes.



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

The selected item (day) flashes.



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

The selected item (hour) flashes.



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

The selected item (minutes) flashes.



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

7-6 Setting 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

7-6-1 Address setting

Sets 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].

7-6-2 Communication speed setting

Sets the RS-485 communication speed (bps).

Set to 76,800 bps ([768]), 38,400 bps ([384]), 19,200 bps ([192]), 9,600 bps ([96]), or 4,800 bps ([48]).

The default setting is 38,400 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].



7-6-3 Data length setting

Sets 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].



7-6-4 Parity setting

Sets the RS-485 communication parity.

This can be 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].



7-6-5 Stop bit setting

Sets 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.



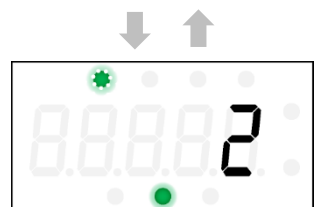
- 3 Select [2-7.04], then press the SET key.



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



The display returns to [2-7.04].



7-6-6 Communication error display setting

Sets to enable or disable the communication error display.

The default setting is disabled.

- 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].



7-7 Parts replacement

7-7-1 Sensor replacement

Please contact RIKEN KEIKI for sensor replacement.

<Sensor replacement intervals>

Gas detector model	Sensor model	Detection target	Chemical formula	Detection concentration	Unit	Sensor replacement cycle
SD-3RI SD-3DRI GD-3RI	IRF-1301	Methane	CH ₄	100 %LEL	%LEL	3 years
	IRF-1317	Propane	C ₃ H ₈	100 %LEL	%LEL	
	IRF-1303	Isobutane	i-C ₄ H ₁₀	100 %LEL	%LEL	
	IRF-1340	Isobutylene	i-C ₄ H ₈	100 %LEL	%LEL	
	IRF-1334	Methane	CH ₄	100 vol%	vol%	
	IRF-1315	Propane	C ₃ H ₈	100 vol%	vol%	
	IRF-1320	Isobutane	i-C ₄ H ₁₀	100 vol%	vol%	
	IRF-1435	Carbon dioxide	CO ₂	2000 ppm	ppm	
	IRF-1436			5000 ppm	ppm	
	IRF-1433			10000 ppm	ppm	
	IRF-1437			2 vol%	vol%	
	IRF-1438			5 vol%	vol%	
	IRF-1439			10 vol%	vol%	

Gas detector model	Sensor model	Detection target gas	Chemical formula	Detection concentration	Unit	Sensor replacement cycle
SD-3NC SD-3DNC GD-3NC	NCF-6318	Methane	CH ₄	100 %LEL	%LEL	3 years
	NCF-6318	Propane	C ₃ H ₈			
	NCF-6319	Isobutane	i-C ₄ H ₁₀			
	NCF-6320	Hydrogen	H ₂			

as detector model	Sensor model	Detection target gas	Chemical formula	Detection concentration	Unit	Sensor replacement cycle
SD-3EC SD-3DEC GD-3EC	ESF-A24P	Carbon monoxide	CO	150 ppm	vol% ppm	3 years
	ESF-X24P2	Oxygen	O ₂	25vol%		3 years
	ESF-A24R3	Hydrogen sulfide	H ₂ S	100 ppm		3 years
SD-3ECS SD-3DECS GD-3ECS	ESF-A24R	Hydrogen sulfide	H ₂ S	100 ppm		3 years
SD-3ECB SD-3DECB GD-3ECB	ESF-A24A	Nitrogen dioxide	NO ₂	15 ppm		3 years
	ESF-B22	Ammonia	NH ₃	75 ppm		3 years
	ESF-C92	Chlorine	CL ₂	1.5 ppm		3 years

**CAUTION**

- Precautions regarding sensor replacement
 - 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 air 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.
 - Use the "Sensor replacement" item from the sensor replacement function menu to replace the sensor without triggering a fault signal on the main unit.
 - Do not replace the sensor by yourself.
-

NOTE

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

7-7-2 Replacement of periodic replacement parts

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

<Recommended periodic replacement parts list>

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

*1: A functional check by a qualified service engineer is required after replacement. To ensure safety and the stable operation of the product, request checking by a qualified service engineer. Contact RIKEN KEIKI to request checking.

*2: For combustible gas sensor (SI-8)/Part No.: 4383 0030 20

*3: For combustible gas sensor (CF-8304)/Part 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 (Sensor)>

Model	Storage limit (years)	Temperature (°C)		Humidity*1 (% RH)		Pressure (kPa)		Remarks
	—	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	
NCF	0.5	-10	40	0	90	80	120	• The sensor must be stored in the specified packing case. • Store in a location away from direct sunlight. • Store in an environment free of corrosive gas, vibration, and dust. • Avoid condensation and moisture. • Store in an environment free of gases that may act as a catalyst poison (e.g., silicone, chlorine, sulfur gases).
IRF	0.5	-10	40	0	90	80	120	• The sensor must be stored in the specified packing case. • Store in a location away from direct sunlight. • Store in an environment free of corrosive gas, vibration, and dust. • Avoid condensation and moisture.
ESF	0.5	-10	40	0	90	80	120	• The sensor must be stored in the specified packing case. • Store in a location away from direct sunlight. • Store in an environment free of corrosive gas, vibration, and dust. • Avoid condensation and moisture. • Store in an environment free of gases that may act as a catalyst poison (e.g., silicone, chlorine, sulfur gases).

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

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

Model	Storage limit (years)	Temperature (°C)		Humidity*1 (% RH)		Pressure (kPa)		Remarks
	—	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	
NCF	0.5	-10	40	0	90	80	120	- Store in a location away from direct sunlight. - Store in an environment free of corrosive gas, vibration, and dust. - Avoid condensation and moisture. - Store in an environment free of gases that may act as a catalyst poison (e.g., silicone, chlorine, sulfur gases).
IRF	0.5	-10	40	0	90	80	120	- Store in a location away from direct sunlight. - Store in an environment free of corrosive gas, vibration, and dust. - Avoid condensation and moisture.
ESF-A*2	0.5	-10	40	20	90	80	120	- Store in a location away from direct sunlight. - Store in an environment free of corrosive gas, vibration, and dust. - Avoid condensation and moisture. - Store in an environment free of gases that may act as a catalyst poison (e.g., silicone, chlorine, sulfur gases).
ESF-X*3								
ESF-B*4 And ESF-C92	0.5	-10	40	30	80	80	120	- Store in the dedicated sensor storage container.*5 - Open the dedicated container just before use, remove the sensor, and mount in the detector.

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

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

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

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

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



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

8-2 Procedures for relocation or reuse

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

 CAUTION

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

8-3 Product disposal

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

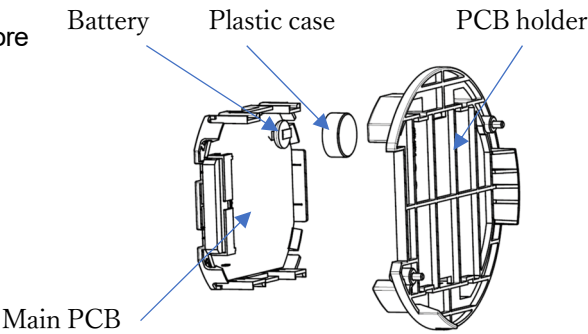
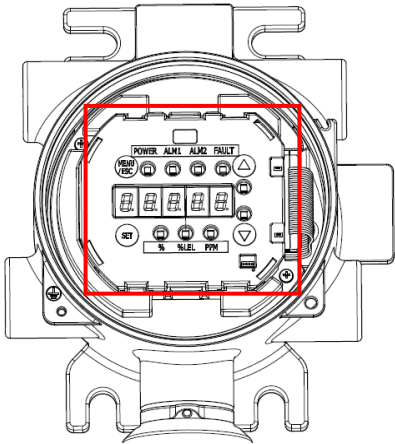
Remove the main PCB unit indicated by the red box in the figure to the right.
Remove the PCB holder.

The battery is located on the underside of the main PCB (on the rear of the 7-segment LCD).

The battery is covered by a plastic case. The plastic case is attached to the PCB. Remove the case 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.



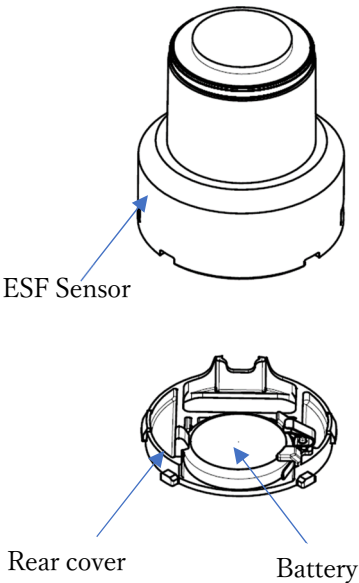
<ESF Sensor>

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 on the product shown on the left indicates that the product and its individual parts must not be disposed of with general or household waste, and must be sorted and disposed of appropriately.
Proper disposal will help prevent potential negative effects on human health and the environment.
To ensure proper treatment, collection, and recycling of the product at the time of its disposal, please use the return and collection system available in your country. For more information on collecting and recycling used products, please contact the dealer or supplier from whom you purchased the product.

- Battery regulations



The symbol on the product or battery shown on the left indicates that batteries must be disposed of separately from general or household waste.
To ensure proper treatment, collection, and recycling of batteries at the time of their disposal, please dispose of them properly using the collection system available in your country.

9

Troubleshooting

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

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

9-1 Product abnormalities

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

Symptom/display	FAULT lamp	Cause	Action
		Cable abnormality between the main unit (SD-3SC) and remote sensor head (GD-3)	Check the cable between the main unit (SD-3SC) and remote sensor head (GD-3).
Sensor abnormality (E-1)	 (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	Cause	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	Cause	Action
		Sudden environmental changes	Alarm indications may be issued by the product due to sudden environmental fluctuations (e.g., temperature). The product cannot be used in locations where sudden environmental changes occur frequently. The user should take appropriate measures.
		The sensor sensitivity has degraded.	Replace with a new sensor.
		The calibration gas concentration is inappropriate.	Prepare the correct calibration gas.
		The sensor sensitivity has degraded.	Replace with a new sensor.
The reading rises periodic (SD-3EC/ECS/ECB only)	-	Problems caused by Sensors	Replace with a new sensor.
System abnormality (E-9)	—	Clock abnormality	Set the date and time. Correction may not function correctly if the EC sensitivity correction function is enabled. If similar symptoms recur frequently, the internal clock may be defective. Replace with a new internal clock. Contact RIKEN KEIKI.
Outside operating temperature range (E-27)	—	Ambient temperatures at the location where the product is installed are outside the operating temperature range.	The product operating temperature range varies with the specific detection principle. The product cannot be used outside the operating temperature range. The user should take appropriate measures.
Sensor life expiration warning (E-8)*	—	The sensor is approaching the end of its service life.	This function may not work properly depending on the usage conditions and environment. We recommend sensor replacement. Contact RIKEN KEIKI.
Sensor warning (E-1)	—		Contact RIKEN KEIKI.
RS-485 abnormality (E-6)	—	Communication cable not connected or poor connection	Check that the communication cable wiring and communication settings are correct. Check the setting of the termination resistor. Turn ON the terminating resistor only for the farthest one.

* SIL specification is not supported.

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	Contacts	RS-485
Display	7-segment LED (5 digits)		
Sensor	F sensor (RIKEN KEIKI)		
Detection principle	Infrared/electrochemical/new ceramic		
Detection target gas	Depends on sensor specifications.		
Detection range	Depends on sensor specifications.		
Sampling method	Diffusion type/suction type (introduced via external unit)		
Set flow rate	0.4 - 1.5 L/min		
Power supply indication	Power lamp lit (green)		
External output	Gas concentration signal (4 to 20 mA DC with HART)	Gas concentration signal (4 to 20 mA DC with HART), contact output	Gas concentration signal (4 to 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 (O ₂ other:H-HH, O ₂ :L-LL)		
Gas alarm indication	Alarm lamp lit (red)		
Gas alarm reset operation	Auto reset or self-latching		
Fault alarm/self diagnosis	System abnormality (E-9)/sensor abnormality (E-1)		
Fault alarm indication	Fault lamp lit (yellow)/error code display		
Fault alarm reset operation	System abnormality: Self-latching Sensor abnormality: Auto reset (self-latching if sensor is disconnected)		
Contact operation	—	SPDT (× 3): 2 alarms, 1 fault output 250 V AC, 2 A; 30 V DC, 1 A (resistance load) Minimum load 5 V DC, 0.1 A	—
Warnings	Sensor life assessment ^{***} /clock abnormality diagnosis/communication diagnosis/ sensor warning		

Model	SD-3	SD-3 (Contact specifications)	SD-3 (RS-485 specifications)
Warning display	Blinking display alternating between gas concentration and error code		
Warning operation	Same as normal operation		
Functions	Alarm delay/suppression/HART communication		
Transmission method (4 - 20 mA)	3-wire analog transmission (common power supply <power supply, signal, common>) or 2-wire analog transmission (current source)		
Transmission specifications (4 - 20 mA)	4 mA - 20 mA DC (non-insulated linear output) Maximum load resistance 600 Ω (with derating depending on power supply voltage) Resolution: max. 250 divisions (depending on specifications)		
Transmission cable (4 - 20 mA)	Shielded cable 1.25 sq (1.308 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 source	24 V DC (18 V - 30 V DC) *Use a power supply capable of minimum temporary output of 2.5 A to ensure that fuses blow normally in the event of a product abnormality.		
Power supply cable	Shielded cable 1.25 sq (1.308 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 - +70 °C (no sudden changes) In accordance with sensor specifications if restrictions apply due to sensor specifications		
Operating humidity range	0 %RH - 95 %RH (no condensation) In accordance with sensor specifications if restrictions apply due to sensor specifications		
Housing material	Stainless steel (SCS14)		
Protection level	**IP44/66/67 equivalent		
Installation type	Wall mounting (standard)/2B pole mounting (optional)		
Explosion-proof construction	Flame-proof construction		
Explosion-proof class	Varies depending on model. Refer to <Explosion-proof performance data> in '2-4 Safety information'.		
External dimensions	Diffusion type: Approx. 171 mm (W) × 277 mm (H) × 127 mm (D) (excluding projections) Suction type: Approx. 171 mm (W) × 289 mm (H) × 127 mm (D) (excluding projections)		
Weight	Diffusion type: approx. 6.7 kg/Suction type: approx. 7.0 kg		

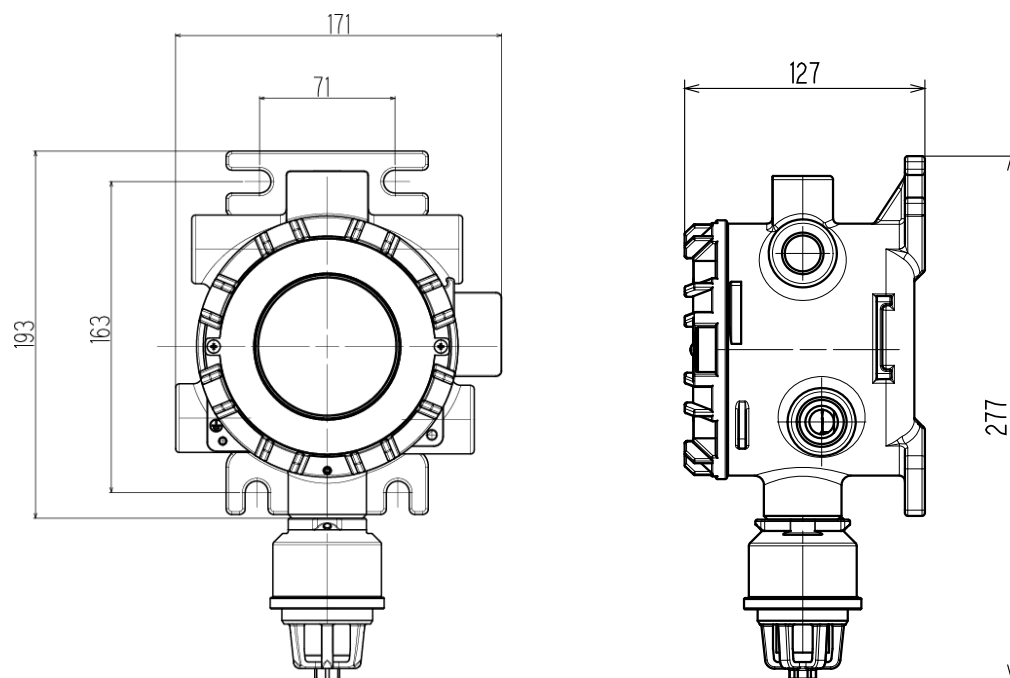
* When used with the contacts closed, the contacts may seize due to vibration. Keep this precaution in mind.

** The IP ratings are IP44 for the infra-red sensors and the ESF-A24R. The IP ratings are IP67 for the ceramic sensors(with or without splash guard). The IP ratings are IP66/67 for the ESF-A24R3(with or without splash guard).

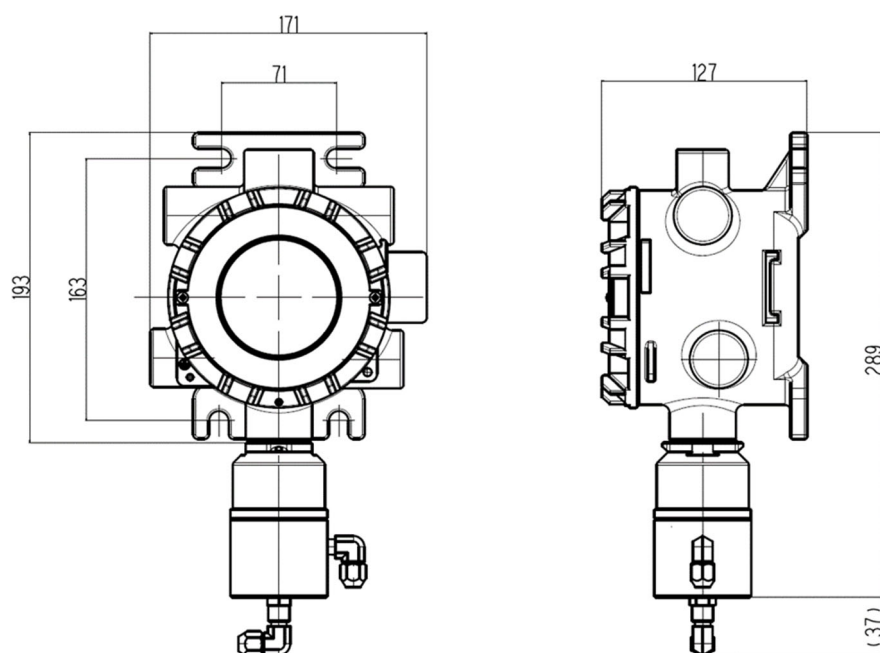
*** SIL specification is not supported.

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

<Diffusion type>



<Suction type>



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

Model	SD-3	SD-3 (Contact specifications)	SD-3 (RS-485 specifications)
Specifications	Standard	Contacts	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/suction type (introduced via external unit)		
Set flow rate	0.4 - 1.5 L/min		
Power supply indication	Power lamp lit (green)		
External output	Gas concentration signal (4 to 20 mA DC with HART)	Gas concentration signal (4 to 20 mA DC with HART), contact output	Gas concentration signal (4 to 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 or L-LL)		
Gas alarm indication	Alarm lamp lit (red)		
Gas alarm reset operation	Auto reset or self-latching		
Fault alarm/self diagnosis	System abnormality (E-9)/sensor abnormality (E-1)		
Fault alarm indication	Fault lamp lit (yellow)/error code display		
Fault alarm reset operation	System abnormality: Self-latching Sensor abnormality: Auto reset (self-latching if sensor is disconnected)		
Contact operation	—	SPDT (× 3): 2 alarms, 1 fault output 250 V AC, 2A; 30 V DC, 1 A (resistance load) Minimum load 5 V DC, 0.1 A	—
Warnings	Sensor life assessment**/clock abnormality diagnosis/communication diagnosis/sensor warning		
Warning display	Blinking display alternating between gas concentration and error code		
Warning operation	Same as normal operation		
Functions	Alarm delay/suppression/HART communication		
Transmission method (4 - 20 mA)	3-wire analog transmission (common power supply <power supply, signal, common>) or 2-wire analog transmission (current source)		
Transmission specifications (4 - 20 mA)	4 mA - 20 mA DC (non-insulated linear output) Maximum load resistance 600 Ω (with derating depending on power supply voltage) Resolution: max. 250 divisions (depending on specifications)		
Transmission cable (4 - 20 mA)	Shielded cable 1.25 sq (1.308 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.		

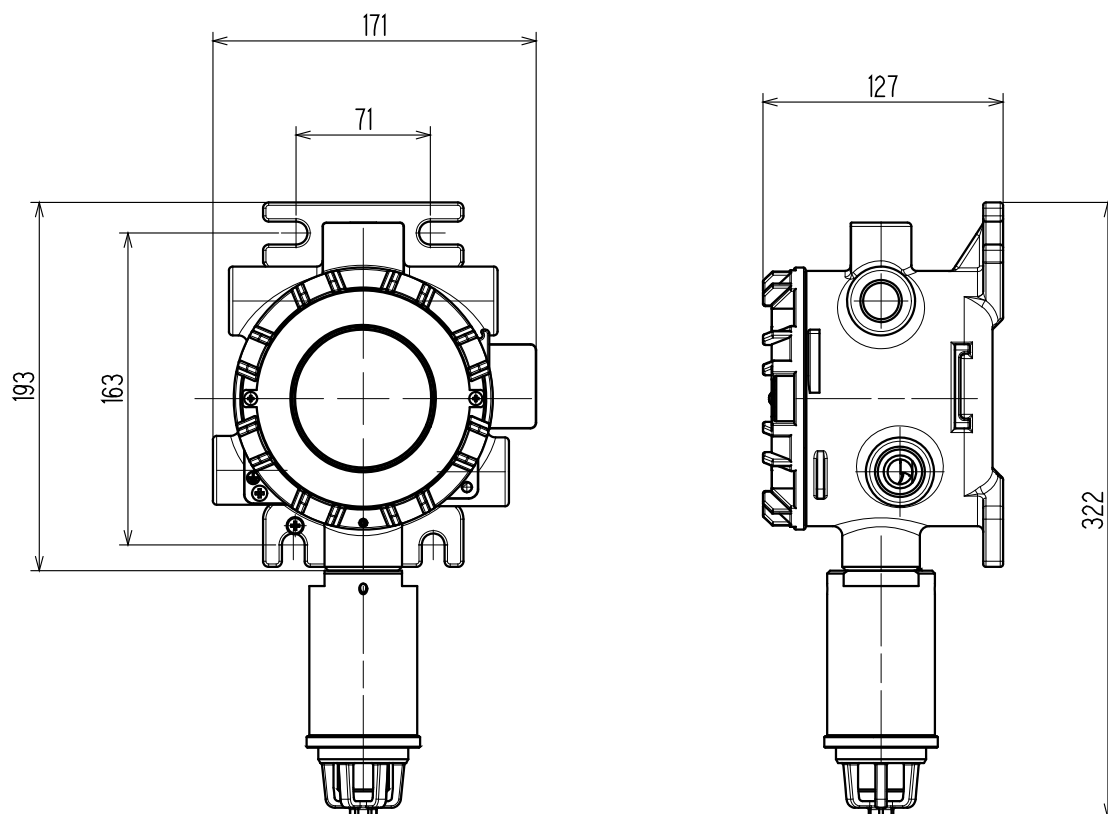
Model	SD-3	SD-3 (Contact specifications)	SD-3 (RS-485 specifications)
Transmission distance (4 - 20 mA)	For 1.25 sq (1.308 mm ² /AWG16): Not exceeding 1.25 km For 2.0 sq (2.08 mm ² /AWG14): Not exceeding 2 km (with derating depending on supply voltage)		
Transmission cable (RS-485)	—	—	Shielded twisted 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 source	24 V DC (18 V - 30 V DC) *Use a power supply capable of minimum temporary output of 2.5 A to ensure that fuses blow normally in the event of a product abnormality.		
Power supply cable	Shielded cable 1.25 sq (1.308 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 - +70 °C (no sudden changes) In accordance with sensor specifications if restrictions apply due to sensor specifications		
Operating humidity range	0 %RH - 95 %RH (no condensation) In accordance with sensor specifications if restrictions apply due to sensor specifications		
Housing material	Stainless steel (SCS14)		
Protection level	IP66/67 equivalent		
Installation type	Wall mounting (standard)/2B pole mounting (optional)		
Explosion-proof construction	Flame-proof construction + intrinsically safe explosion-proof construction		
Explosion-proof class	Varies depending on model. Refer to <Explosion-proof performance data> in '2-4 Safety information'.		
External dimensions	Diffusion type: Approx. 171 mm (W) × 322 mm (H) × 127 mm (D) (excluding projections) Suction type: Approx. 171 mm (W) × 334 mm (H) × 127 mm (D) (excluding projections)		
Weight	Diffusion type: approx. 7.3 kg/Suction type: approx. 7.6 kg		

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

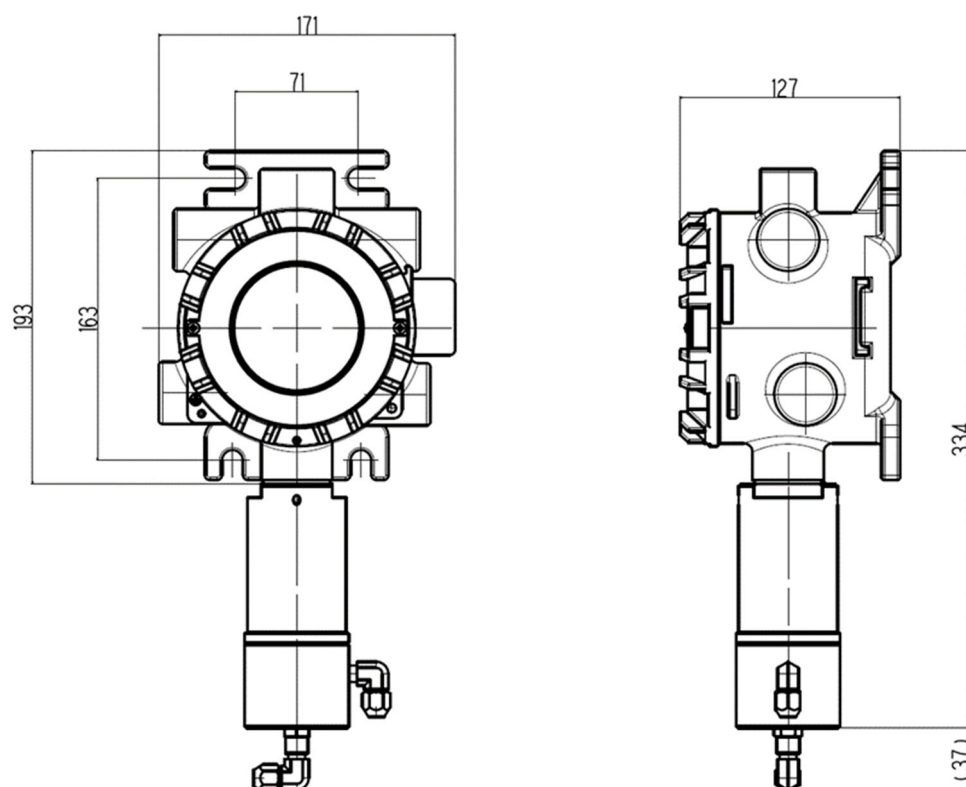
** SIL specification is not supported.

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

<Diffusion type>



<Suction type>



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

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

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

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

Model	SD-3SC + GD-3	SD-3SC + GD-3 (Contact specifications)	SD-3SC + GD-3 (RS-485 specifications)
Specifications	Standard	Contact	RS-485
Display	7-segment LED (5 digits)		
Sensor	F sensor (RIKEN KEIKI)		
Detection principle	Infrared/electrochemical/new ceramic		
Detection target gas	Depends on sensor specifications.		
Detection range	Depends on sensor specifications.		
Sampling method	Diffusion type		
Power supply indication	Power lamp lit (green)		
External output	Gas concentration signal (4 to 20 mA DC with HART)	Gas concentration signal (4 to 20 mA DC with HART), contact output	Gas concentration signal (4 to 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 or L-LL)		
Gas alarm indication	Alarm lamp lit (red)		
Gas alarm reset operation	Auto reset or self-latching		
Fault alarm/self diagnosis	System abnormality (E-9)/sensor abnormality (E-1)		
Fault alarm indication	Fault lamp lit (yellow)/error code display		
Fault alarm reset operation	System abnormality: Self-latching Sensor abnormality: Auto reset (self-latching if sensor is disconnected)		
Contact operation	—	SPDT (× 3): 2 alarms, 1 fault output 250 V AC, 2A; 30 V DC, 1 A (resistance load) Minimum load 5 V DC, 0.1 A	—
Warnings	Sensor life assessment***/clock abnormality diagnosis/communication diagnosis/ sensor warning		
Warning display	Blinking display alternating between gas concentration and error code		
Warning operation	Same as normal operation		
Functions	Alarm delay/suppression/HART communication		
Transmission method (4 - 20 mA)	3-wire analog transmission (common power supply <power supply, signal, common>) or 2-wire analog transmission (current source)		

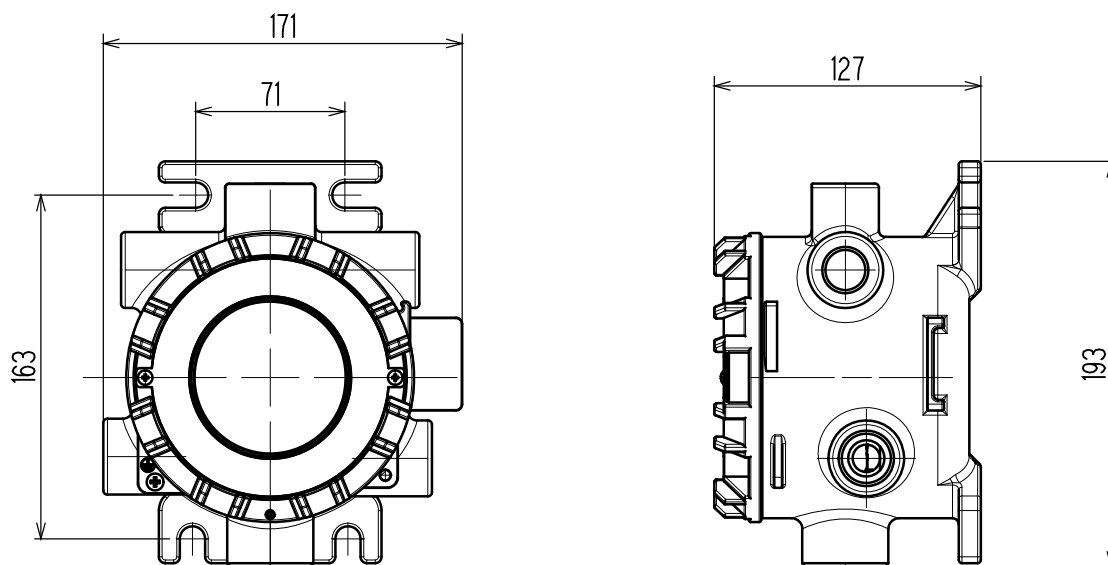
Model	SD-3SC + GD-3	SD-3SC + GD-3 (Contact specifications)	SD-3SC + GD-3 (RS-485 specifications)
Transmission specifications (4 - 20 mA)	4 mA - 20 mA DC (non-insulated linear output) Maximum load resistance 600 Ω (with derating depending on power supply voltage) Resolution: max. 250 divisions (depending on specifications)		
Transmission cable (4 - 20 mA)	Shielded cable 1.25 sq (1.308 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 V - 30 V DC) *Use a power supply capable of minimum temporary output of 2.5 A to ensure that fuses blow normally in the event of a product abnormality.		
Power supply cable	Shielded cable 1.25 sq (1.308 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 - +70 °C (no sudden changes) In accordance with sensor specifications if restrictions apply due to sensor specifications		
Operating humidity range	0 %RH - 95 %RH (no condensation) In accordance with sensor specifications if restrictions apply due to sensor specifications		
Housing material	Stainless steel (SCS14)		
Protection level	**IP44/66/67 equivalent		
Installation type	Wall mounting (standard)/2B pole mounting (optional)		
Explosion-proof construction	Flame-proof construction		
Explosion-proof class	Varies depending on model. Refer to <Explosion-proof performance data> in '2-4 Safety information'.		
External dimensions (SD-3SC)	Diffusion type: Approx. 125 mm (W) × 195 mm (H) × 88 mm (D) (excluding projections)		
Weight (SD-3SC)	Approx. 6.0 kg		
External dimensions (GD-3)	Approx. 125 mm (W) × 195 mm (H) × 88 mm (D)		
Weight (GD-3)	Approx. 3.0 kg		

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

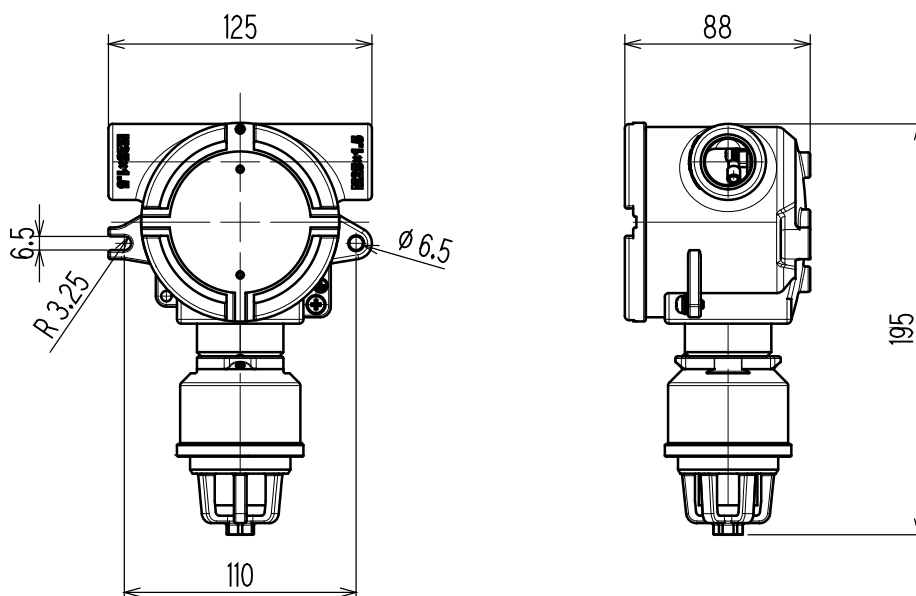
** The IP ratings are IP44 for the infra-red sensors and the ESF-A24R. The IP ratings are IP67 for the ceramic sensors(with or without splash guard). The IP ratings are IP66/67 for the ESF-A24R3(with or without splash guard).

*** SIL specification is not supported.

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



<Diffusion type>



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

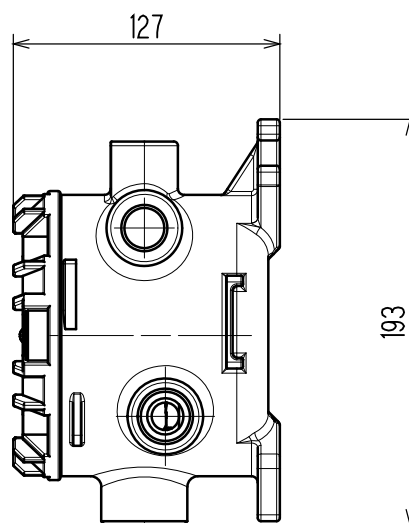
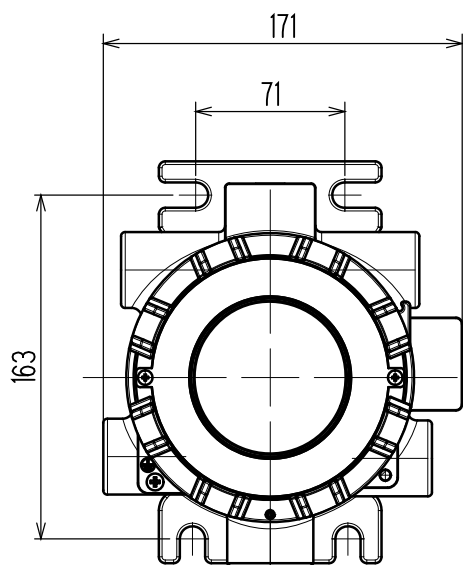
Model	SD-3SC + GD-3	SD-3SC + GD-3 (Contact specifications)	SD-3SC + GD-3 (RS-485 specifications)
Specifications	Standard	Contact	RS-485
Display	7-segment LED (5 digits)		
Sensor	F sensor (RIKEN KEIKI)		
Detection principle	Electrochemical type		
Detection target gas	Depends on sensor specifications.		
Detection range	Depends on sensor specifications.		
Sampling method	Diffusion type		
Power supply indication	Power lamp lit (green)		
External output	Gas concentration signal (4 to 20 mA DC with HART)	Gas concentration signal (4 to 20 mA DC with HART), contact output	Gas concentration signal (4 to 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, H-L, or L-LL)		
Gas alarm indication	Power lamp lit (red)		
Gas alarm reset operation	Auto reset or self-latching		
Fault alarm/self diagnosis	System abnormality (E-9)/sensor abnormality (E-1)		
Fault alarm indication	Fault lamp lit (yellow)/error code display		
Fault alarm reset operation	System abnormality: Self-latching Sensor abnormality: Auto reset (self-latching if sensor is disconnected)		
Contact operation	—	SPDT (× 3): 2 alarms, 1 fault output 250 V AC, 2A; 30 V DC, 1 A (resistance load) Minimum load 5 V DC, 0.1 A	—
Warnings	Sensor life assessment**/clock abnormality diagnosis/communication diagnosis/ sensor warning		
Warning display	Blinking display alternating between gas concentration and error code		
Warning operation	Same as normal operation		
Functions	Alarm delay/suppression/HART communication		
Transmission method (4 - 20 mA)	3-wire analog transmission (common power supply <power supply, signal, common>) or 2-wire analog transmission (current source)		
Transmission specifications (4 - 20 mA)	4 mA - 20 mA DC (non-insulated linear output) Maximum load resistance 600 Ω (with derating depending on power supply voltage) Resolution: max. 250 divisions (depending on specifications)		

Model	SD-3SC + GD-3	SD-3SC + GD-3 (Contact specifications)	SD-3SC + GD-3 (RS-485 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 V - 30 V DC) *Use a power supply capable of minimum temporary output of 2.5 A to ensure that fuses blow normally in the event of a product abnormality.		
Power supply cable	Shielded cable 1.25 sq (1.308 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 - +70 °C (no sudden changes) In accordance with sensor specifications if restrictions apply due to sensor specifications		
Operating humidity range	0 %RH - 95 %RH (no condensation) In accordance with sensor specifications if restrictions apply due to sensor specifications		
Housing material	Stainless steel (SCS14)		
Protection level	IP66/67 equivalent		
Installation type	Wall mounting (standard)/2B pole mounting (optional)		
Explosion-proof construction	Flame-proof construction + intrinsically safe explosion-proof construction		
Explosion-proof class	Varies depending on model. Refer to <Explosion-proof performance data> in '2-4 Safety information'.		
External dimensions (SD-3SC)	Diffusion type: Approx. 125 mm (W) × 240 mm (H) × 88 mm (D) (excluding projections)		
Weight (SD-3SC)	Approx. 6.0 kg		
External dimensions (GD-3)	Approx. 125 mm (W) × 240 mm (H) × 88 mm (D)		
Weight (GD-3)	Approx. 4.0 kg		

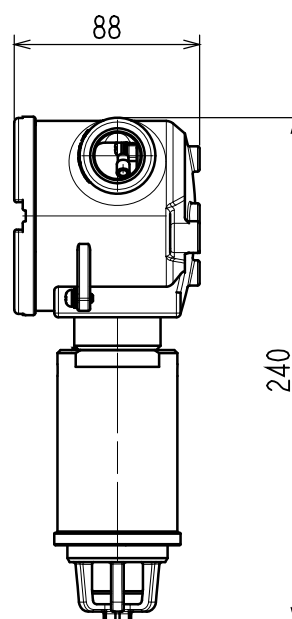
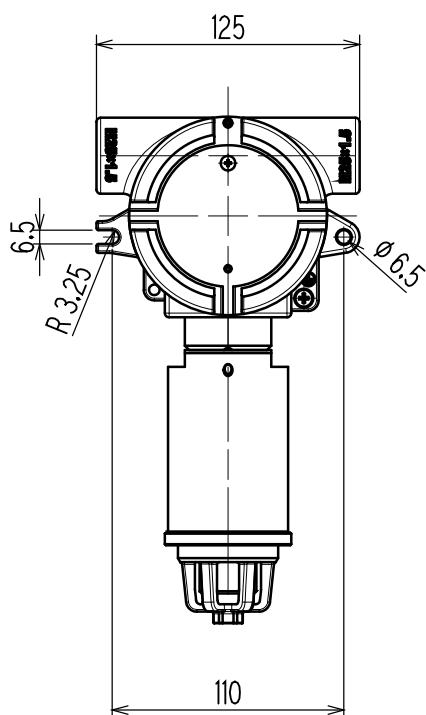
* When used with the contacts closed, the contacts may seize due to vibration. Keep this precaution in mind.

** SIL specification is not supported.

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



<Diffusion type>



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

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

10-3 Detection target gases for individual detection principles

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

Sensor model	Gas name	Gas symbol	F.S.	1 digit	First Alarm setpoint	Second Alarm setpoint	Calibration gas	Operating temperature range	Operating humidity range	Years of warranty
IRF-1301*	Methane	CH ₄	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	CH ₄	-40 °C - +70 °C	95 %RH or less (no condensation)	3 years
IRF-1317*	Propane	C ₃ H ₈	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	C ₃ H ₈			
IRF-1303*	Isobutane	i-C ₄ H ₁₀	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	i-C ₄ H ₁₀			
IRF-1340*	Isobutylene	i-C ₄ H ₈	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	i-C ₄ H ₈			
IRF-1334*	Methane	CH ₄	100 vol%	0.5 vol%	25 vol%	50 vol%	CH ₄			
IRF-1315*	Propane	C ₃ H ₈	100 vol%	0.5 vol%	25 vol%	50 vol%	C ₃ H ₈			
IRF-1320*	Isobutane	i-C ₄ H ₁₀	100 vol%	0.5 vol%	25 vol%	50 vol%	i-C ₄ H ₁₀			
IRF-1435	Carbon dioxide	CO ₂	2,000 ppm	1 ppm	1,000 ppm	-	CO ₂			
IRF-1436	Carbon dioxide	CO ₂	5,000 ppm	10 ppm	1,000 ppm	-	CO ₂			
IRF-1433	Carbon dioxide	CO ₂	10,000 ppm	10 ppm	1,000 ppm	-	CO ₂			
IRF-1437	Carbon dioxide	CO ₂	2 vol%	0.005 vol%	1 vol%	-	CO ₂			
IRF-1438	Carbon dioxide	CO ₂	5 vol%	0.010 vol%	1 vol%	-	CO ₂			
IRF-1439	Carbon dioxide	CO ₂	10 vol%	0.01 vol%	1 vol%	-	CO ₂			

*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.
- ▶ Use the IRF sensor adapter when calibrating. Calibration accuracy may be impaired without the IRF sensor adapter.
- ▶ Make sure temperature, humidity, and pressure conditions in the calibration environment are the same as for the measurement environment. (The reading may fluctuate due to temperature, humidity, and pressure characteristics and in some cases may exceed the zero suppression value due to sensor characteristics.)
- ▶ Due to infrared absorption characteristics, readings may differ even for the same target gas concentration if the base gas composition differs significantly between calibration and measurement—for example, if an air base is used for calibration and a CO₂ base is used for measurement.
- ▶ Perform maintenance if a warning appears while the self-diagnostic function is active.
- ▶ Regardless of the detection target gas, the warranty period for IRF sensors is 3 years.

10-3-2 New ceramic type

Sensor model	Gas name	Gas symbol	F.S.	1 digit	First Alarm setpoint	Second Alarm setpoint	Calibration gas	Operating temperature range	Operating humidity range	Years of warranty
NCF-6318	Methane	CH ₄	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	CH ₄	-40 °C - +70 °C	0 %RH - 95 %RH* ¹ (no condensation)	3 years
NCF-6318	Propane	C ₃ H ₈	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	C ₃ H ₈			
NCF-6319	Isobutane	i-C ₄ H ₁₀	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 * ²			

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

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

NOTE

- ▶ Install in a location with stable conditions within the specified operating temperature range and free of sudden fluctuations.
- ▶ The sensor characteristics may deteriorate significantly if silicone gases (organic silicone gases), halogen gases, sulfide gases, or acid gases are present.
- ▶ A silicone removal filter and activated carbon filter are available as options.
- ▶ The reading may change even for combustible gases other than the detection target gas.
- ▶ Readings may fall as oxygen concentrations decrease.
- ▶ Interference may occur if gases with high thermal conductivity, such as high-concentration CO₂, Ar, or He, are present as the base gas.
- ▶ In detecting gases with low vapor pressure by the suction method, the gas may form a mist when drawn in from the high-temperature side and detected at the low-temperature side, possibly forming condensation inside the sensor or causing clogging due to sintering. Keep vapor pressure in mind during use.
- ▶ Perform maintenance if a warning appears while the self-diagnostic function is active.
- ▶ Use the combustible gas sensor adapter when calibrating. Calibration accuracy may be reduced without the combustible gas sensor adapter.
- ▶ Reading accuracy may be reduced if temperature fluctuations exceed ±40 °C with respect to ambient temperature following zero calibration or span calibration. If this occurs, repeat zero calibration or span adjustment.
- ▶ Readings may fluctuate if the product is subjected to strong external impact or vibration. If this occurs, perform zero calibration and span adjustment.
- ▶ The zero point may fluctuate if the sensor comes into contact with high-concentration gas of 100 %LEL or more continuously for extended periods. If this occurs, perform zero calibration and span adjustment.
- ▶ The sensor may be hot during replacement. Be careful to avoid burns when replacing the sensor. If the sensor is hot, turn off the power and wait for it to cool.
- ▶ Regardless of the detection target gas, the warranty period for NCF sensors is 3 years.

10-3-3 Electrochemical type

Sensor model	Gas name	Gas symbol	F.S.	1 digit	First Alarm setpoint	Second Alarm setpoint	Calibration gas	Operating temperature range ^{*5}	Operating humidity range	Years of warranty
ESF-A24A	Nitrogen dioxide	NO ₂	15 ppm	0.1 ppm	5 ppm	10 ppm	NO ₂	-40 °C - 70 °C ^{*2}	20 %RH - 90 %RH (no condensation)	3 years
ESF-A24P	Carbon monoxide	CO	150 ppm	1 ppm	50 ppm	80 ppm	CO	-40 °C - 70 °C ^{*2}	20 %RH - 90 %RH (no condensation)	3 years
ESF-A24R	Hydrogen sulfide	H ₂ S	100 ppm	0.5 ppm	20 ppm	40 ppm	H ₂ S	-40 °C - 70 °C ^{*2}	95 %RH or less (no condensation)	3 years
ESF-A24R3	Hydrogen sulfide	H ₂ S	100 ppm	0.5 ppm	20 ppm	40 ppm	H ₂ S	-40 °C - 70 °C ^{*2}	95 %RH or less (no condensation)	3 years
ESF-B22	Ammonia	NH ₃	75 ppm	0.5 ppm	25 ppm	50 ppm	NH ₃	-40 °C - 70 °C ^{*2} ^{*4}	30 %RH - 80 %RH (no condensation)	3 years
ESF-X24P2	Oxygen	O ₂	25.0 vol%	0.1 vol%	18.0 vol%	18.0 vol%	O ₂	-40 °C - 70 °C ^{*2} ^{*3}	20 %RH - 90 %RH (no condensation)	3 years
ESF-C92	Chlorine	CL ₂	1.5 ppm	0.01ppm	0.5 ppm	1.0 ppm	Chlorine	-20 °C - 70 °C ^{*3}	30 %RH - 80 %RH (no condensation)	3 years

*1: Sensor for high humidity environment.

*2: Allow the product to fully adjust to the usage conditions before adjusting if below -25 °C.

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

*4: At -25°C or below, the response time may be slow.

*5 In order to ensure the accuracy of indication in an environment where the temperature difference exceeds 60°C, it is necessary to readjust it to adapt to the environmental temperature.

NOTE

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

11

Appendix

11-1 Detection principle

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

<Sensor overview>

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

<Sensor structure and principle>

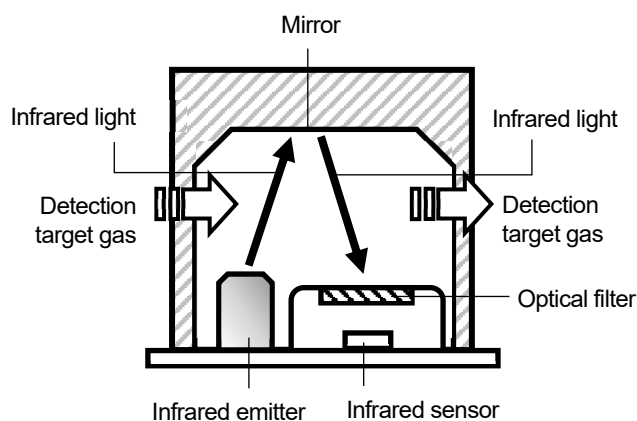
- Structure

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

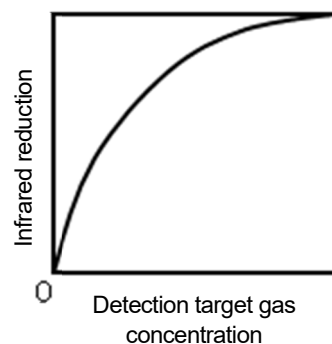
- Principle

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

<Structure diagram>



<Calibration curve (example)>



11-1-2 New ceramic type

<Sensor overview>

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

<Sensor structure and principle>

• Structure

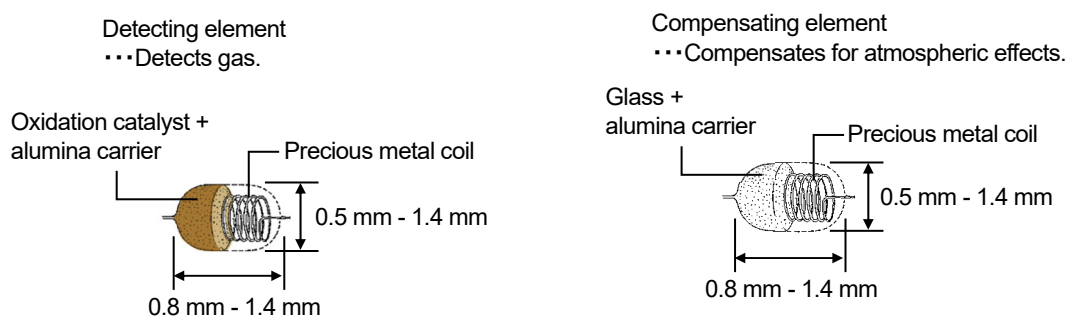
The new ceramic sensors consist of a detecting element and a compensating element. (Some sensors do not have a compensating element.) The detecting element consists of an ultrafine particle oxidation catalyst (new ceramic) that reacts with combustible gases sintered on top of a precious metal coil. This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

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

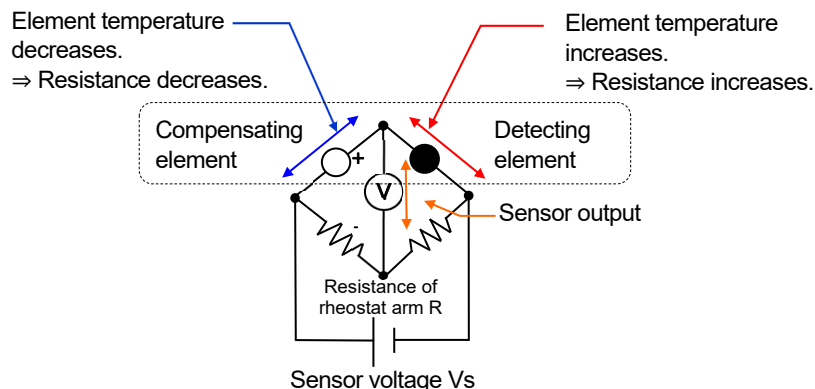
• Principle

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

<Sensor element diagram>



<Bridge circuit>



11-1-3 Electrochemical type

<Sensor overview>

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

<Sensor structure and principle>

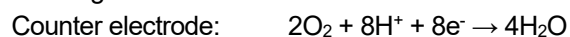
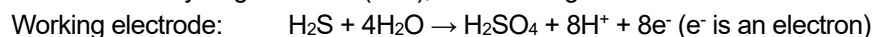
- Structure

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

- Principle

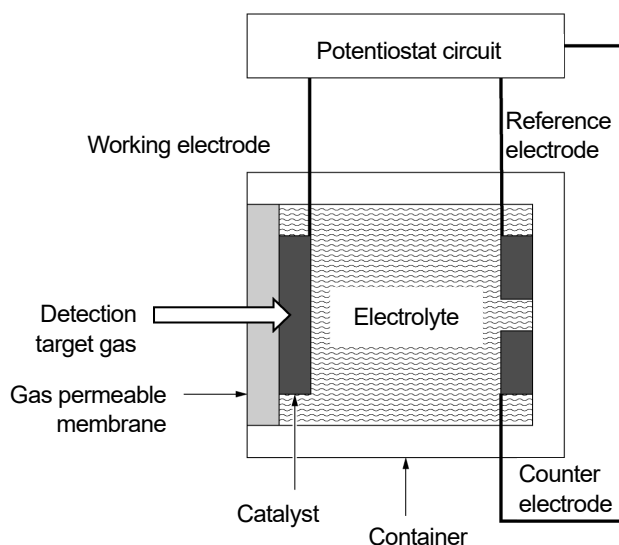
A potentiostat circuit is used to maintain a constant potential between the working electrode and reference electrode. The detection target gas passes through the gas permeable membrane and undergoes electrolysis reaction on reaching the working electrode. A side reaction also occurs at the counter electrode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

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



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

<Structure diagram>



11-2 Sensor Specifications

11-2-1 IR sensor specification

Gas detector model	SD-3RI/SD-3DRI/GD-3RI		
Sensor model	IRF-1301	IRF-1317	IRF-1303
Approval	equivalent to ANSI/FM/UL-60079-29-1 / IEC 60079-29-1 / ANSI/FM/UL-60079-29-1 / CSA C22.2 No. 60079-29-1 / EN 60079-29-1 / FM 6310, 6320	equivalent to ANSI/FM/UL-60079-29-1 / IEC 60079-29-1 / ANSI/FM/UL-60079-29-1 / CSA C22.2 No. 60079-29-1 / EN 60079-29-1 / FM 6310, 6320	equivalent to ANSI/FM/UL-60079-29-1 / IEC 60079-29-1 / ANSI/FM/UL-60079-29-1 / CSA C22.2 No. 60079-29-1 / EN 60079-29-1 / FM 6310, 6320
Parts No.	620102	620202	621203
Measuring principle	Non-dispersive infrared method (infrared type)		
Detection target gas	Methane (CH ₄)	Propane (C ₃ H ₈)	Isobutane (i-C ₄ H ₁₀)
Maximum detection concentration	100 %LEL	100 %LEL	100 %LEL
Units	%LEL	%LEL	%LEL
Digit	0.5 %LEL	0.5 %LEL	0.5 %LEL
LEL value to apply (BS EN ISO 80079-20-1:2019)	4.4 vol%	1.7 vol%	1.3 vol%
Operating temperature range	-40 to +70 °C (no sudden fluctuations) Accuracy: -20 to +60 °C (equivalent to EN 60079-29-1:2016)		
Operating humidity range	Up to 95 %RH (no condensation)		
Operating pressure range	80 to 120 kPa (no sudden changes in pressure, explosion proof is guaranteed at 80k Pa to 110 kPa)		
Operating wind speed range	0 to 6m/s (equivalent to EN 60079-29-1:2016)		
Orientation*1	Body (SD-3) + Sensor : within ± 90 ° from the normal position Remote sensor head (GD-3) + Sensor : No limit		
Sample flow rate range	0.4 to 1.5 L/min		
Warmup time	EN setting: 60 seconds		
Calibration gas	Methane 1.98 – 2.42 vol%	Propane 0.77 – 0.94 vol%	Isobutane 0.59vol - 0.72vol%
Calibration jig flow rate	0.5 ± 0.1 L/min		
Calibration time	120 seconds		
Response(T90)	without splash guard : within 60 seconds (equivalent to EN 60079-29-1: 2016,)		
Remarks	Different gases: C ₂ H ₄ , 1,3-C ₄ H ₆	Different gases: i-C ₄ H ₁₀ , i-C ₄ H ₈	—
	The reading may fluctuate due to temperature, humidity, and pressure characteristics and in some cases may exceed the zero suppression level. *1 The main body and remote sensor head have no directional restrictions. However, there may be restrictions when optional items (protective cover, etc.) are attached. The splash guard itself has no directional restrictions. A note will be added to the installation guide of the instruction manual.		

Gas detector model	SD-3RI/SD-3DRI/GD-3RI		
Sensor model	IRF-1334	IRF-1315	IRF-1320
Approval	equivalent to ANSI/FM/UL-60079-29-1 / IEC 60079-29-1 / ANSI/FM/UL-60079-29-1 / CSA C22.2 No. 60079-29-1 / EN 60079-29-1 / FM 6310, 6320	equivalent to ANSI/FM/UL-60079-29-1 / IEC 60079-29-1 / ANSI/FM/UL-60079-29-1 / CSA C22.2 No. 60079-29-1 / EN 60079-29-1 / FM 6310, 6320	equivalent to ANSI/FM/UL-60079-29-1 / IEC 60079-29-1 / ANSI/FM/UL-60079-29-1 / CSA C22.2 No. 60079-29-1 / EN 60079-29-1 / FM 6310, 6320
Parts No.	620103	620402	620403
Measuring principle	Non-dispersive infrared method (infrared type)		
Detection target gas	Methane (CH ₄)	Propane (C ₃ H ₈)	Isobutane (i-C ₄ H ₁₀)
Maximum detection concentration	100 vol%	100 vol%	100 vol%
Units	vol%	vol%	vol%
Digit	0.5 vol%	0.5 vol%	0.5 vol%
LEL value to apply (BS EN ISO 80079-20-1:2019)	—	—	—
Operating temperature range	-40 °C to +70 °C (no sudden fluctuations) Accuracy: -20 °C to +60 °C (equivalent to EN 60079-29-1:2016)		
Operating humidity range	Up to 95 %RH (no condensation)		
Operating pressure range	80 - 120 kPa (no sudden changes in pressure, explosion proof is guaranteed at 80kPa - 110kPa)		
Operating wind speed range	0 - 6m/s (equivalent to EN 60079-29-1:2016)		
Orientation*1	Body (SD-3) + Sensor : within ± 90 ° from the normal position Remote sensor head (GD-3) + Sensor : No limit		
Sample flow rate range	0.4 - 1.5 L/min		
Warmup time	EN setting: 60 seconds		
Calibration gas	Methane 45.0 – 55.0 vol%	Propane 72.0 – 88.0 vol%	Isobutane 72.0 – 88.0 vol%
Calibration jig flow rate	0.5 ± 0.1 L/min		
Calibration time	120 seconds		
Response(T90)	without splash guard : within 60 seconds (equivalent to EN 60079-29-1: 2016.)		
Remarks	—	Different gases: i-C ₄ H ₁₀ , i-C ₄ H ₈	—
	The reading may fluctuate due to temperature, humidity, and pressure characteristics and in some cases may exceed the zero suppression level. *1 The main body and remote sensor head have no directional restrictions. However, there may be restrictions when optional items (protective cover, etc.) are attached. The splash guard itself has no directional restrictions. A note will be added to the installation guide of the instruction manual.		

11-2-2 Combustible gas sensor specification

Gas detector model	SD-3NC/SD-3DNC/GD-3NC			
Sensor model	NCF-6318			NCF-6320
Approval	equivalent to ANSI/FM/UL-60079-29-1 / IEC 60079-29-1 / ANSI/FM/UL-60079-29-1 / CSA C22.2 No. 60079-29-1 / EN 60079-29-1 / FM 6310, 6320			equivalent to ANSI/FM/UL-60079-29-1 / IEC 60079-29-1 / ANSI/FM/UL-60079-29-1 / CSA C22.2 No. 60079-29-1 / EN 60079-29-1 / FM 6310, 6320
Parts No.	600019	600050	600014	600045
Measuring principle	New ceramic type			
Detection target gas	Methane (CH ₄)		Propane (C ₃ H ₈)	Hydrogen (H ₂)
Maximum detection concentration	100 %LEL			
Units	%LEL			
Digit	0.5 %LEL			
LEL value to apply (BS EN ISO 80079-20-1:2019)	4.4 vol%		1.7 vol%	4.0 vol%
Operating temperature range	-40 °C to +70 °C (no sudden fluctuations) Accuracy: -20 °C to +60 °C (equivalent to EN 60079-29-1)			
Operating humidity range	Up to 95 %RH (no condensation)*1			
Operating pressure range	80 - 120 kPa (no sudden changes in pressure, explosion proof is guaranteed at 80 kPa - 110 kPa)			
Operating wind speed range	0 - 6 m/s (equivalent to EN 60079-29-1)			
※1 Orientation	Body (SD-3) + Sensor : within ± 90 ° from the normal position Remote sensor head (GD-3) + Sensor : No limit			
Sample flow rate range	0.4 - 1.5 L/min			
Warmup time	EN setting: 60 seconds			
Calibration gas	Methane 1.98 - 2.42 vol%		Propane 0.77 - 0.94 vol%	Hydrogen 1.80 - 2.2 vol%
Calibration jig flow rate	0.5 ± 0.1 L/min			
Calibration time	60 seconds			
Response(T90)	within 60 seconds (equivalent to EN 60079-29-1)			
Remarks	Different gases: i-C ₄ H ₁₀ , C ₂ H ₄	Different gases: H ₂	—	—
	*1 The main body and remote sensor head have no directional restrictions. However, there may be restrictions when optional items (protective cover, etc.) are attached. The splash guard itself has no directional restrictions. A note will be added to the installation guide of the instruction manual.			

11-2-3 EC sensor specification

Gas detector model	SD-3EC/SD-3DEC/GD-3EC	
Sensor model	ESF-A24P	ESF-X24P2
Parts No.	610003	610034
Measuring principle	Electrochemical	
Detection target gas	Carbon monoxide (CO)	Oxygen (O ₂)
Maximum detection concentration	150 ppm	25.0 vol%
Units	ppm	%
Digit	1 ppm	0.1 vol%
LEL value to apply (BS EN ISO 80079-20-1:2019)	—	—
Operating temperature range	Standard temperature range : -25 °C to +55 °C, (Operating temperature range : -40 °C to +70 °C, See accuracy over standard temperature range item) Accuracy: -25 to +55 °C	
Operating humidity range	95 %RH or less (No condensation, Conditions to meet performance requirements : 20 %RH to 90 %RH)	
Operating pressure range	80 to 120 kPa (no sudden changes in pressure, explosion proof is guaranteed at 80 kPa to 110 kPa)	
Operating wind speed range	0 to 6 m/s	
Orientation ¹	Body (SD-3) + Sensor : within ± 90 ° from the normal position Remote sensor head (GD-3) + Sensor : No limit	
Sample flow rate range	range 0.4 to 1.5 L/min	
Warmup time	EN setting: 30 seconds	EN setting: 90 seconds
Calibration gas	Carbon monoxide 72 – 80 ppm	Nitrogen 100 vol%
Calibration jig flow rate	0.5 ± 0.1 L/min	0.5 ± 0.1 L/min
Calibration time	60 seconds	60 seconds
Response(T90)	without splash guard : T90 within 150 seconds	without splash guard : T20 within 10 seconds T90 within 45 seconds
Remarks	The reading may fluctuate due to temperature, humidity, and pressure characteristics and in some cases may exceed the zero suppression level. ※1 The main body and remote sensor head have no directional restrictions. However, there may be restrictions when optional items (protective cover, etc.) are attached. The splash guard itself has no directional restrictions. A note will be added to the installation guide of the instruction manual.	

Gas detector model	SD-3ECS/SD-3DECS/GD-3ECS	SD-3EC/SD-3DEC/GD-3EC
Sensor model	ESF-A24R	ESF-A24R3
Approval	equivalent to ANSI92.00.01 / EN45544-3 / IEC62990-1 type SM /ANSI/FM/UL 62990-1 type SM /CSA C22.2 No. 62990-1:20 type SM /EN 62990-1 type SM / FM6340	equivalent to ANSI92.00.01 / EN45544-3 / IEC62990-1 type SM /ANSI/FM/UL 62990-1 type SM /CSA C22.2 No. 62990-1:20 type SM /EN 62990-1 type SM / FM6340
Parts No.	610004	610049
Measuring principle	Electrochemical	
Detection target gas	Hydrogen sulfide (H ₂ S)	
Maximum detection concentration	100 ppm	
Units	Ppm	
Digit	0.5 ppm	
LEL value to apply (BS EN ISO 80079-20-1:2019)	—	
Operating temperature range	Standard temperature range : -25 °C to +55 °C, (Operating temperature range : -40 °C to +70 °C, See accuracy over standard temperature range item) Accuracy: -25 to +55 °C	
Operating humidity range	95 %RH or less (No condensation, Conditions to meet performance requirements : 20 %RH to 90 %RH)	95 %RH or less (No condensation, Conditions to meet performance requirements : 5 %RH to 95 %RH)
Operating pressure range	80 to 120 kPa (no sudden changes in pressure, explosion proof is guaranteed at 80 kPa to 110 kPa)	
Operating wind speed range	0 to 6m/s	
Orientation ¹	Body (SD-3) + Sensor : within ± 90 ° from the normal position Remote sensor head (GD-3) + Sensor : No limit	
Sample flow rate range	0.4 to 1.5 L/min	
Warmup time	EN setting: 30 seconds	
Calibration gas	Hydrogen sulfide 30.4 – 33.6 ppm	
Calibration jig flow rate	0.5 ± 0.1 L/min	
Calibration time	60 seconds	
Response	Within 30 seconds(T50),60 seconds(T90),30(recoveryT50), 60(recoveryT10) without splash guard	
Remarks	The reading may fluctuate due to temperature, humidity, and pressure characteristics and in some cases may exceed the zero suppression level. ※1 The main body and remote sensor head have no directional restrictions. However, there may be restrictions when optional items (protective cover, etc.) are attached. The splash guard itself has no directional restrictions. A note will be added to the installation guide of the instruction manual.	

Gas detector model	SD-3ECB/SD-3DECB/GD-3ECB	
Sensor model	ESF-A24A	ESF-B22
Parts No.	610006	610041
Measuring principle	Electrochemical	
Detection target gas	Nitrogen oxide (NO ₂)	Ammonia (NH ₃)
Maximum detection concentration	15.0 ppm	75.0 ppm
Units	ppm	ppm
Digit	0.1 ppm	0.5 ppm
LEL value to apply (BS EN ISO 80079-20-1:2019)	—	—
Operating temperature range	Standard temperature range : -25 °C to +55 °C, (Operating temperature range : -40 °C to +70 °C, See accuracy over standard temperature range item) Accuracy: -25 °C to +55 °C	
Operating humidity range	95 %RH or less (No condensation, Conditions to meet performance requirements : 20 %RH to 90 %RH)	95 %RH or less (No condensation, Conditions to meet performance requirements : 30 %RH to 80 %RH)
Operating pressure range	80 to 120 kPa (no sudden changes in pressure, explosion proof is guaranteed at 80 kPa to 110 kPa)	
Operating wind speed range	0 - 6 m/s	
Orientation ^{*1}	Body (SD-3) + Sensor : within ± 90 ° from the normal position Remote sensor head (GD-3) + Sensor : No limit	
Sample flow rate range	0.4 - 1.5 L/min	
Warmup time	EN setting: 30 seconds	
Calibration gas	Nitrogen oxide 7.2 – 8.0 ppm	Ammonia 36.0 – 40.0 ppm
Calibration jig flow rate	0.5 ± 0.1 L/min	0.5 ± 0.1 L/min
Calibration time	60 seconds	120 seconds
Response(T90)	without splash guard : within 150 seconds	
Remarks	The reading may fluctuate due to temperature, humidity, and pressure characteristics and in some cases may exceed the zero suppression level. ※1 The main body and remote sensor head have no directional restrictions. However, there may be restrictions when optional items (protective cover, etc.) are attached. The splash guard itself has no directional restrictions. A note will be added to the installation guide of the instruction manual.	

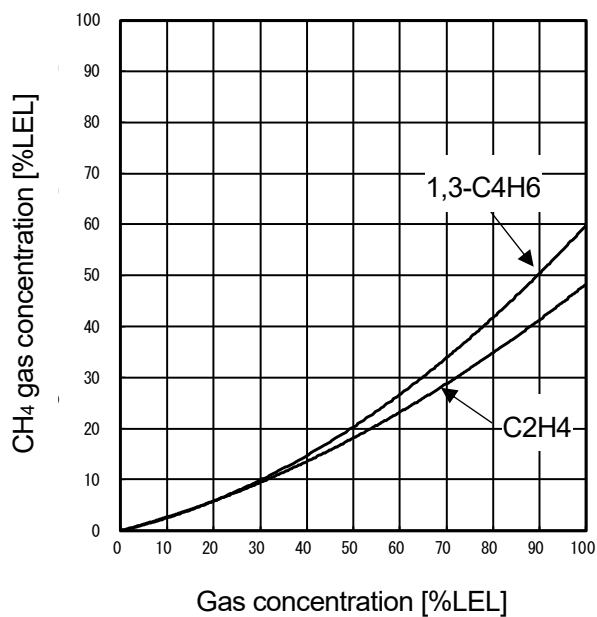
Gas detector model	SD-3ECB/SD-3DECB/GD-3ECB
Sensor model	ESF-C92
Parts No.	610036
Measuring principle	Electrochemical
Detection target gas	Chlorine (CL ₂)
Maximum detection concentration	1.5 ppm
Units	ppm
Digit	0.01 ppm
LEL value to apply (BS EN ISO 80079-20-1:2019)	—
Operating temperature range	Standard temperature range : -20 °C to +55 °C, (Operating temperature range : -20 °C to +70 °C, See accuracy over standard temperature range item) Accuracy: -20 to +55 °C
Operating humidity range	95 %RH or less (No condensation, Conditions to meet performance requirements : 30%RH to 80%RH)
Operating pressure range	80 to 120 kPa
Operating wind speed range	0 to 6m/s
Orientation ^{*1}	Body (SD-3) + Sensor : within ± 90 ° from the normal position Remote sensor head (GD-3) + Sensor : No limit
Sample flow rate range	0.4 to 1.5 L/min
Warmup time	EN setting: 30 seconds
Calibration gas	Chlorine 0.72 – 0.80 ppm
Calibration jig flow rate	0.5 ± 0.1 L/min
Calibration time	120 seconds
Response(T90)	without splash guard : within 150 seconds
Remarks	The reading may fluctuate due to temperature, humidity, and pressure characteristics and in some cases may exceed the zero suppression level. ※1 The main body and remote sensor head have no directional restrictions. However, there may be restrictions when optional items (protective cover, etc.) are attached. The splash guard itself has no directional restrictions. A note will be added to the installation guide of the instruction manual.

11-3 Calibration curve

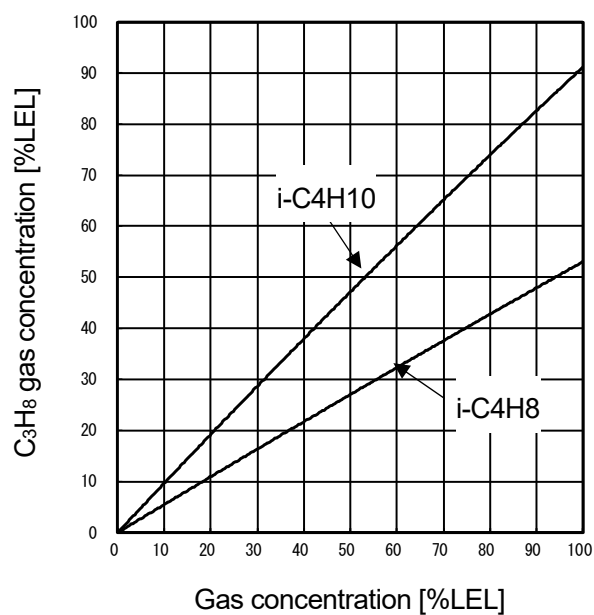
11-3-1 IRF sensor

Calibration curve for infrared gas detector (Typical Value)

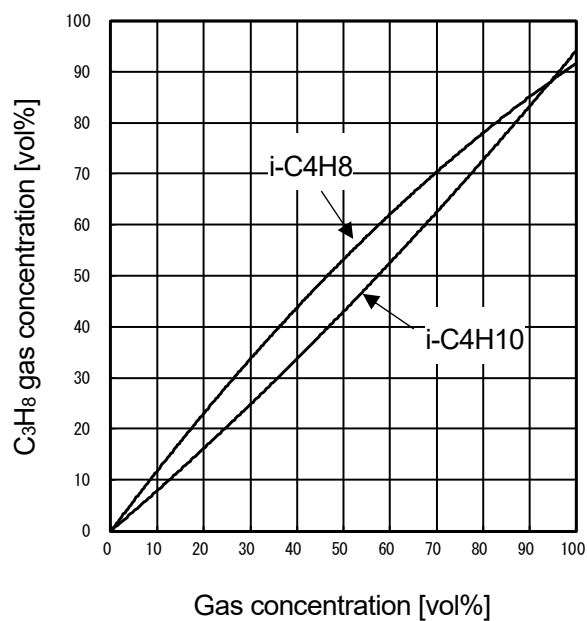
IRF-1301



IRF-1317

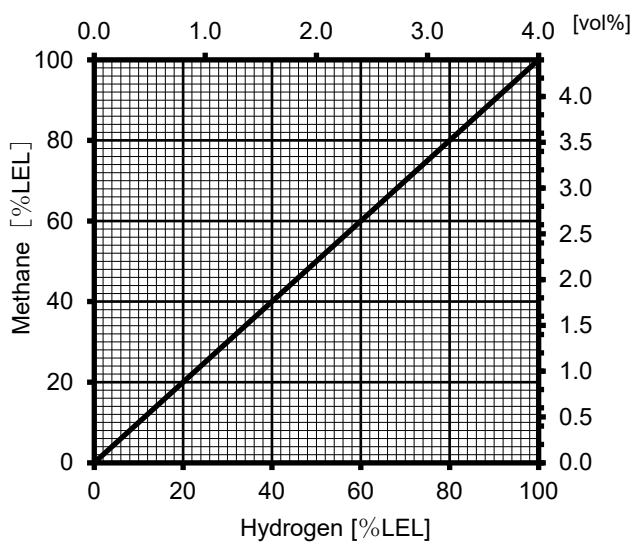
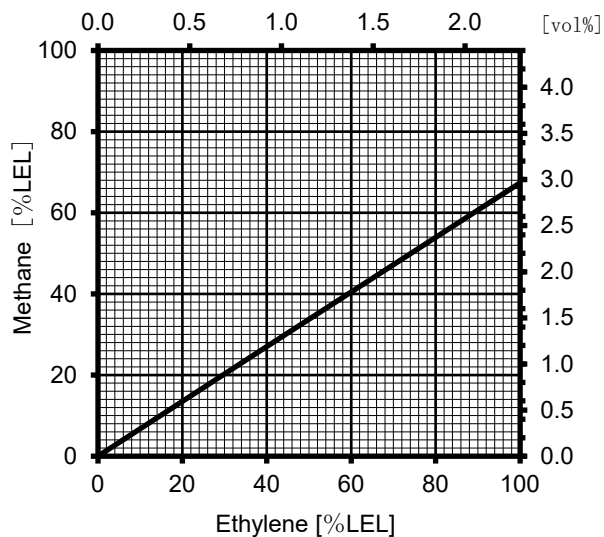
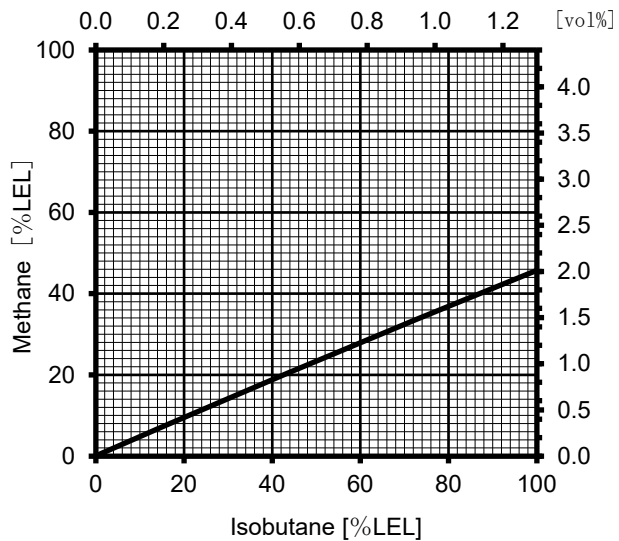


IRF-1315



11-3-2 NCF sensorCalibration curve for Combustible gas detector (Typical Value)

NCF-6318



11-4 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.
%	Unit used to express the percentage of a target gas contained in a given volume
ppm	Unit used to express the parts per million of a target gas contained in a given volume
%LEL	Unit for combustible gases in which the lower explosive limit (LEL) of the target gas is set to 100 % (Example: For methane, 5 % concentration by volume corresponds to 100 %LEL.)

Product warranty

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

Sensor warranty

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

Revision History

Issue	Revision details	Issue date
0	First issue	1/25/2021
1	Complete revision	3/15/2021
2	Safety information, Declaration of Conformity	11/12/2021
3	Added additional note on cables in "4-1-2. Restrictions regarding installation"	6/28/2022
4	1-5 addition, Safety information, Declaration of Conformity Complete revision (addition of SIL certification and FM explosion-proofing)	1/13/2023
5	Additional modifications to FM explosion protection and performance content	7/11/2023
6	Addition of CL ₂ sensor (ESF-C92) The following information has been added to the troubleshooting • The reading rises periodic (SD-3EC/ECS/ECB only) • Countermeasure for sensor life expiration warning (E-8)	8/4/2023
7	Added note on sensor life diagnostic function.	8/8/2023
8	3-1-5 Waterproof cap added, 4-11 added, Declaration of Conformity	7/23/2024
9	3-1-5 Added duct mount kit for GD-3ECB 4-5-2 Added size and duct diameter of duct mount kit for GD-3ECB 8-3 Corrected WEEE directive and Battery regulations 11-2-3, EC sensor specification revised to comply with applicable standards for ESF-A24R and ESF-A24R3 RS-485 communication specifications added Deletion of Declaration of conformity	9/3/2025
10	Addition of i-C ₄ H ₁₀ sensor (IRF-1320). Addition of NCF sensor and IRF sensor approval.	3/24/2026