

Smart transmitter/Gas Detector Head SD-3

Safety Manual

Document Number: PT2E-306(Rev.14)

[NOTE] The SD-3 is certified for functional safety (IEC 61508:2010 Part 2 and Part 3). To ensure certified functionality, maintain the product as described in this document.

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Revision history

Rev.	Details	Approved	Checked	Created
		KOGURE Shinsuke	MUTOU Hiroki	SAIKI Yuki
0	New document	Jun 25, 2021	Jun 25, 2021	Jun 25, 2021
1	Only rev up to match the Japanese version	KOGURE Shinsuke	MUTOU Hiroki	SAIKI Yuki
1		Jun 25,2021	Jun 25,2021	Jun 25,2021
2	Add SD-3EC	KOGURE Shinsuke	MUTOU Hiroki	SAIKI Yuki
	Add 3D-3EC /2	Nov 16,2021	Nov 16,2021	Nov 16,2021
	P8 2-4 Change Diagnosis response 15s -> 20s.	KOGURE Shinsuke	MUTOU Hiroki	SAIKI Yuki
3	P11 2-15 Product service life. Chang to the sensor and Oter than the Sensor	Dec 2,2021	Dec 2,2021	Dec 2,2021
	P8 2-6 Proof test Add wording	KOGURE Shinsuke	MUTOU Hiroki	SAIKI Yuki
4	P11 2-11 Reliability data update P12 2-19 H/W,S/W version update	Jun 28,2022	Jun 28,2022	Jun 28,2022
	P4 Change wording 1-1 Ambient conditions	KOGURE Shinsuke	MUTOU Hiroki	SAIKI Yuki
5	P5 Add 1-3 Applicable standards P6 Add Table 2 Environmental condition P9 Add item in 2-3 Safety accuracy P12 Update 2-11 Reliability data P13 Add item 2-19 H/W S/W version	Jan 10,2023	Jan 10,2023	Jan 10,2023
	P12 Update 2-11 Reliability data	KOGURE Shinsuke	HIRAO Keisuke	SAIKI Yuki
6	P13 Delete item and Version UP 2-19 H/W S/W version	Apr 27,2023	Apr 27,2023	Apr 27,2023
7	P12 Update 2-11 Reliability data	KOGURE Shinsuke	HIRAO Keisuke	SAIKI Yuki
7	<u> </u>	May 17,2023	May 17,2023	May 17,2023
	P7 Change to Table2.Environmental condition	KOGURE Shinsuke	HIRAO Keisuke	SAIKI Yuki
8	P13 Update 2-11 Reliability data P14 Update 2-19 H/W S/W version	Aug 4,2023	Aug 4,2023	Aug 4,2023
	Change from "operating manual" to	KOGURE Shinsuke	HIRAO Keisuke	SAIKI Yuki
9	"SD-3 Series Export Specifications Technical Manual for SIL and FM Specifications (PT2E-287) rev.7" Update 2-19 Identification of hardware/software configurations	Aug 10,2023	Aug 10,2023	Aug 10,2023
	Update 2-11 Reliability data			

40	Update note of Table2	KOGURE Shinsuke	HIRAO Keisuke	SAIKI Yuki
10	<u>/10\</u>	Aug 16,2023	Aug 16,2023	Aug 16,2023
11	Update 1-1 Ambient conditions	KOGURE Shinsuke	HIRAO Keisuke	SAIKI Yuki
11	<u> </u>	Aug 17,2023	Aug 17,2023	Aug 17,2023
	Update 1-1 Ambient conditions	KOGURE Shinsuke	HIRAO Keisuke	SAIKI Yuki
12	Update 2-19 Identification of 12 hardware/software configurations	Aug 21,2023	Aug 21,2023	Aug 21,2023
	Update Table2 in 1-1 Ambient condition.	KOGURE Shinsuke	HIRAO Keisuke	Masahiro Suzuki
	Update 2-11 Reliability data.			
	Update 2-19 Identification of			Jul 23,2024
13	13 hardware/software configurations.	L.I. 00. 0004	Jul 23,2024	
	Update "SD-3 Series Export Specifications	Jul 23,2024		
	Technical Manual for SIL and FM Specifications			
	(PT2E-287) "Version.			
	Add SD-3RIP:	YAMADA Kazunori	TSUTSIYA	SANO Ryota
	1-1, 1-3, 2-3, 2-5, 2-6, 2-7, 2-8, 2-9, 2-10, 2-14,	17 W// D/ CTGZGTOT	Noriaki	o, ii to Ttyota
	2-15, 2-17, 2-18, 2-19, 2-20, 2-21, and 2-22.			
	Update 1-3 Applicable standards (other than			
	functional safety standards)			
	Update Table2.			
14	Corrected typos <u>14</u>			
	2-4, 2-6, 2-15	Jun 10,2025	Jun 10,2025	Jun 10,2025
	Update 2-11 Reliability data.	0411 10,2020	04.1.10,2020	0411 10,2020
	Update 2-19 Identification of hardware/software			
	configurations.			
	Change of reference (Addition of Appendix);			
	2-5, 2-6, 2-7, 2-8, 2-9, 2-10, 2-17, 2-18, 2-20,			
	2-21, and 2-20.			

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Safety Manual

1 Purpose

This Safety Manual can be used at SIL2 in HFT 0 and SIL 3 in HFT 1. (SIL 3 Capable) This document discusses topics for which the user is responsible if the SD-3 (this product), a certified device, functions as or is part of a configuration functioning as a safety instrument. These topics include proof testing, repairs and replacement, reliability data, product service life, environmental limitations, operational limitations, and various parameters. To ensure product safety, carefully read this document and all related documents.

This product monitors combustible gases, toxic gases, and oxygen concentrations at sampling points.

This safety device is designed to prevent gas-related accidents and injury by outputting a current (4 - 20 mA) to indicate the gas concentrations detected.

Classified as a sensor (subsystem) for safety devices, this product outputs 4 - 20 mA current according to the gas concentrations detected, or HART protocol signals when requested by the upstream system, to a logic section of the upstream system.

This product was developed for use as a single sensor in a SIL2 loop (IEC 61508).

1-1 Ambient conditions

- SD-3RI, SD-3NC, SD-3EC, SD-3ECB
 Operating temperature range
 Absolute Maximum temperature range
 Operating humidity range
 Storage temperature range
 Storage humidity range
 See Table 2. for SD-3EC and SD-3ECB
- SD-3RIP
 Operating temperature range
 Absolute Maximum temperature range
 Operating humidity range
 Storage temperature range
 Storage humidity range



- : -40 to +70 °C (no sudden changes) :-45 to +75 °C (no sudden changes)
- : 10 to 90 %RH (no condensation)
- : -10 to +40 °C (no sudden changes)
- : 10 to 90 %RH (no condensation)



- : -40 to +70 °C (no sudden changes)
- :-45 to +75 °C (no sudden changes)
- : 0 to 95 %RH (no condensation)
- : -40 to +70 °C (no sudden changes)
- : 0 to 95 %RH (no condensation)
- 1-2 Regulations and applicable standards (functional safety)

IEC 61508:2010 Parts 1 to 7

Functional Safety of Electrical/Electronic/Programmable Electronic

Safety-Related Systems



1-3 Applicable standards (other than functional safety standards)

	Japanese explosion-proof	General provisions in 2015 technological
		standards
		Flameproof enclosures in technological
		standard 2018
$\sqrt{5}$	EMC related	EN 50270:2015 (Type 2)
		BS EN 50270:2015 (Type 2)
$\sqrt{5}$	IECEx standards	IEC 60079-0:2017
		IEC 60079-1:2014
14		IEC 60079-11:2011
		IEC 60079-28:2015
	ATEX related	EN IEC 60079-0:2018
Λ		EN 60079-1:2014
14		EN 60079-28:2015
		BS EN IEC 60079-0:2018
		BS EN 60079-1:2014
		BS EN 60079-28:2015
	Performance related	IEC/EN 60079-29-1
		EN 45544-3
		EN 50104
	HART	HART7

1-4 Magnetic field threshold limit values (immunity level)EN 50270:2015 request level

Table 1 Immunity test requirements: EN 50270:2015 (Type 2)

Item	Test Procedure	Specification	Criteria
Electrostatic	EN	±6 kV (CD: contact discharge)	Α
discharges	61000-4-2:2009	±8 kV (AD: air discharge)	
Radio-frequency	EN	10 V/m: 80 – 1,000 MHz	Α
electromagnetic field	61000-4-3:2006	10 V/m: 1.4 - 2 GHz	
	+A1:2008	3 V/m: 2 - 2.7 GHz	
	+A2:2010	80 %AM, 1 kHz (unmodulated, rms)	
Electrical fast	EN	(DC power, earth line)	Α
transient/burst	61000-4-4:2004	±2 kV (5/50 ns, 5 kHz)	
(DC power)	+A1:2010		
(Earth line)		(I/O Signal)	
(I/O signal)		±1 kV (5/50 ns, 5 kHz)	
Surges	EN	(DC power)	В
(DC power)	61000-4-5:2006	±2 kV (line to ground)	
(I/O signal)		±1 kV (line to line)	
		(1.2/50 (8/20) µs)	
		(I/O signal)	
		±1 kV (line to ground)	
		(1.2/50 (8/20) μs)	
Radio-frequency	EN	0.15 - 80 MHz, 10 V (unmodulated,	Α
common mode	61000-4-6:2009	rms) 80 %AM, 1 kHz	
(I/O signal)			_
Power frequency	EN	50/60 Hz, 30 A/m (rms)	Α
magnetic field	61000-4-8:2010		
Voltage dips	EN61000-4-29	0 % residual voltage / 1,000 ms	С
		duration	
		40 % residual voltage / 1,000 ms	
		duration	
Short interruptions	EN61000-4-29	0 % residual voltage / 20 ms duration	С





Model	Gas type	Operating temperature range %1	Absolute Maximum temperature range※1	Operating humidity range %1	storage conditions ※1	note
ESF-A24P	СО	-25∼55℃	-30∼60°C	20~90%RH	-10°C~+40°C 0%RH~ 90%RH	-
ESF-A24R	H2S	-40∼70°C	-50∼80°C	20~90%RH	-10°C~+40°C 0%RH~ 90%RH	-
ESF-B22	NH3	-25∼55°C	-30~60°C	30~80%RH	-10°C~+40°C 0%RH~ 90%RH	-
ESF-A24A	NO2	-25∼55°C	-30∼60°C	20~90%RH	-10°C~+40°C 0%RH~ 90%RH	-
ESF-X24P2	O2	-25∼55°C	-30~60°C	20~90%RH	-10°C~+40°C 0%RH~ 90%RH	-
ESF-C92	CL2	-20∼55°C	-25∼60°C	30~80%RH	-10°C~+40°C 0%RH~ 90%RH	-
ESF-A24R3	H2S	-40∼70°C	-50∼80°C	5∼95%RH	-10°C~+40°C 0%RH~ 90%RH	-

[%]1 No sudden changes in temperature or condensation (no fluctuations of 10°C or more per hour).

If the temperature fluctuates more than 10°C or more per hour, please use optional accessories.

2 Usage Instructions

2-1 Safety Functions

The following items are the safety functions of this product.

- Monitors combustible gases, toxic gases, and oxygen concentrations at sampling points.
- Safe status means the current is output to the upstream system according to the concentrations of the combustible gases, toxic gases, or oxygen being monitored. The product outputs 4 20 mA signals and HART protocol signals (*).

• 4 - 20 mA output

The relationship between the measured gas concentrations and 4 - 20 mA output is proportional. The output is 4 mA at F.S ×0 %, and when concentration is full scale, the output is 20mA at F.S×100 %.

* HART output is not included in the safety functions.

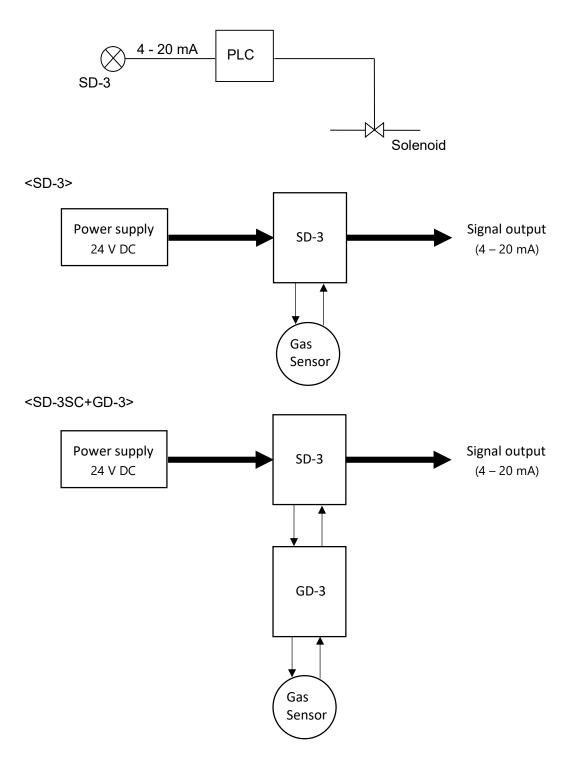
2-2 Non-functional safety features

The following features are not functional safety features:

- HART output
- Contact output (optional)
- RS485 output (optional)

System example

An example of a system that controls a solenoid valve via PLCs to create a shut off.



2-3 Safety accuracy

Safety accuracy: 20 %

*The FMEDA failure rate includes failures of internal parts causing deviations exceeding this accuracy.

Applicable sensors: NCF series

Gas response: 50 % of response time is within 20 seconds

90 % of response time is within 60 seconds

Applicable sensors: IRF series

Gas response: 50 % of response time is within 20 seconds

90 % of response time is within 60 seconds

Applicable sensors: ESF(Toxic) series

Gas response: 50 % of response time is within 60 seconds

90 % of response time is within 150 seconds

Applicable sensors: ESF(O2) series

Gas response: 20 % of response time is within 10 seconds

90 % of response time is within 45 seconds

Applicable sensors: IRS series

Gas response: 50 % of response time is within 20 seconds

90 % of response time is within 30 seconds

2-4 Diagnosis response

ROM/RAM check self-diagnostic: 24 hours

Maximum response time for self-diagnostic results other than the above: 20 seconds $\sqrt{3}$

*This indicates that notification is output within this time with regard to part failures detected by the self-diagnostics. Note that this is the combined total time for the self-diagnostic test interval and failure response time.



2-5 Setup

· SD-3RI, SD-3NC, SD-3EC, SD-3ECB



Refer to 'A2 Usage Instructions' in the "Appendix A".



· SD-3RIP

Refer to 'B2 Usage Instructions' in the "Appendix B".



2-6 Proof test

Proof test details: Calibration, adjustment of 4 - 20 mA output values, sensor

replacement, etc.

Do not replace the sensor by yourself. $\sqrt{4}$

· SD-3RI, SD-3NC, SD-3EC, SD-3ECB



(Refer to 'A3-7-1 Replacement of periodic replacement parts' in the

"Appendix A" for the frequency for replacing sensors.)



· SD-3RIP



(Refer to 'B3-7-1 Replacement of periodic replacement parts' in the

"Appendix B" for the frequency for replacing sensors.)

Proof test standards: Must allow/perform calibration.

Alarm delay times and gas response times must meet performance

expectations.

24 hours MTTR: Tools used: Refer below

Tools used	Specifications	Maintenance
Calibration gas	Depends on gas type.	Must be traceable.
Calibration	Dedicated calibration adapter for IRF sensors	Undamaged
adapter	(4283 9011 00)	
	Dedicated calibration adapter for combustible F	
	sensors (4283 9012 70)	
\wedge	Dedicated calibration adapter for ESF sensors	
/2\	(4283 9013 40)	
\wedge	Dedicated calibration adapter for IRS sensors	
<u> </u>	(4613 9523 50, 4613 9528 10)	
Pump	One with flow rate of 0.5 L/min or more	Maintenance by the
	One meeting explosion-proof specifications	manufacturer
Flowmeter	One capable of measuring to 0.1 L tolerances	Maintenance by the
	One with markings allowing identification of flow	manufacturer

	rate settings and tolerances	
	It is also possible to adjust the flow rate with a	
	pump equipped with a flowmeter	
Piping	For general combustible gases –	Undamaged
	Material: Polyurethane	
	Internal diameter: 4 mm	
	Pipe length: Within 1 m	
	For organic solvent gases –	
	Material: Teflon	
	Internal diameter: 4 mm	
	Pipe length: Within 1 m	
	For strongly adsorptive gases –	
	Material: Teflon	
	Internal diameter: 4 mm	
	Pipe length: Within 10 cm	

Proof test procedure

- 1) Bypass the safety function and take appropriate action to avoid a false trip.
- 2) Use HART communications to retrieve any diagnostics and take appropriate action.



- 3) Send a HART command to the gas detector to go to the high alarm current output and verify that the analog current reaches that value.*1
- 4) Send a HART command to the gas detector to go to the low alarm current output and verify that the analog current reaches that value.*2
- 5) Inspect the gas detector for any leaks, visible damage, or contamination.
- 6) Perform a two-point calibration of the gas detector over the full working range.
- 7) Remove the bypass and otherwise restore normal operation
- *1 This tests for compliance voltage problems such as a low loop power supply voltage or increased wiring resistance. This also tests for other possible failures.
- *2 This tests for possible quiescent current related failures.
- * Functionality anticipates disabling of product functions when performing the proof test.
- * Keep a record of proof test results.
- · SD-3RI, SD-3NC, SD-3EC, SD-3ECB



Refer to the "Appendix A" for more information.

· SD-3RIP



Refer to the "Appendix B" for more information.

^{*}This product may malfunction if the proof test is not performed correctly. The proof test

must be performed by trained service personnel.

2-7 Maintenance

For maintenance items other than the proof test,

· SD-3RI, SD-3NC, SD-3EC, SD-3ECBA



Refer to 'A3 Maintenance' in the "Appendix A".

· SD-3RIP

Refer to 'B3 Maintenance' in the "Appendix B".



2-8 Repairs and replacements

· SD-3RI, SD-3NC, SD-3EC, SD-3ECB



Refer to 'A3-7 Parts replacement' in the "Appendix A".

· SD-3RIP



Refer to 'B3-7 Parts replacement' in the "Appendix B".

2-9 Storage, Relocation, and Disposal

· SD-3RI, SD-3NC, SD-3EC, SD-3ECB



Refer to 'A4 Storage, Relocation, and Disposal' in the "Appendix A".

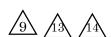
· SD-3RIP



Refer to 'B4 Storage, Relocation, and Disposal' in the "Appendix B".

2-10 Startup time (initialization time)

· SD-3RI, SD-3NC, SD-3EC, SD-3ECB



Refer to 'A2 Usage Instructions' in the "Appendix A".

· SD-3RIP



Refer to 'B2 Usage Instructions' in the "Appendix B".

2-11 Reliability data

Failure rates, failure modes, and other information are recorded in the following FMEDA report.

<H/W Version 2.1 or earlier>

,	Model	FMEDA report Report No.:	^ ^ ^
$\sqrt{5}$	SD-3EC	RK 21/04-192 R003 V3R3	4 5 7

<H/W Version 2.2 or 2.3> 29 14

Model	FMEDA report Report No.:
SD-3RI	RK 19/01-130 R001 V4R3 /13\
SD-3NC	RK 20/05-036 R002 V2R5
SD-3EC	RK 21/04-192 R003 V4R2 /13

		Λ
SD-3ECB	RK 22/05-277 R004 V2R2	13)

<H/W Version 3.0> 14

Model	FMEDA report Report No.:
SD-3RI/RIP	RK 19/01-130 R001 V5R2
SD-3NC	RK 20/05-036 R002 V3R2
SD-3EC	RK 21/04-192 R003 V5R3
SD-3ECB	RK 22/05-277 R004 V3R2

Refer to the separate 'FMEDA Report'.

To satisfy SIL2, use at HFT = 0. To satisfy SIL3, use at HFT = 1.

2-12 Operation mode

Low frequency operation request mode (frequency of operation requests is once annually or less)

2-13 Availability rate

Availability rate: Constantly available

2-14 Power source

Rating: 24 V DC

Allowable range 18.0 to 30.0 V DC; except for SD-3SC+GD-3RIP (SD-3RIP Remote).

20.0 to 30.0 V DC; SD-3SC+GD-3RIP (SD-3RIP Remote).

/14

2-15 Product service life

Product service life: 10 years (Other than the sensor).

3 years (NCF, IRF, and ESF sensors)

7 years (IRS sensor)

ors) $\frac{\cancel{14}}{\cancel{3}}$ $\cancel{14}$

The reliability data in the FMEDA report is valid only during this period.

2-16 Requested parameter settings

- The 4 20 mA output value in the event of a use involving burnout (failure) is 3.6 mA or less or 21 mA or greater.
- From a security perspective, use a write protect function that prevents changes in settings via HART protocol signals.
- The above requirements must be met for applications involving functional safety.

2-17 Limitations on installation and operating environments Installation:

· SD-3RI, SD-3NC, SD-3EC, SD-3ECB

9 13 14

Refer to 'A1 Installation' in the "Appendix A".

· SD-3RIP



Refer to 'B1 Installation' in the "Appendix B".

Operating environment:

· SD-3RI, SD-3NC, SD-3EC, SD-3ECB



Refer to 'A6 Product Specifications' in the "Appendix A".

· SD-3RIP



Refer to 'B6 Product Specifications' in the "Appendix B".

2-18 Application limitations

· SD-3RI, SD-3NC, SD-3EC, SD-3ECB



Refer to 'A2 Usage Instruction' in the "Appendix A".

· SD-3RIP



Refer to 'B2 Usage Instruction' in the "Appendix B.

2-19 Identification of hardware/software configurations



		Applicable models				
Hardware	Software			SD-3EC		
Ver	Ver	SD-3RI	SD-3NC	(H2S,CO,	SD-3ECB	SD-3RIP
				O2)		
2.1	2.1	•	•	•	•	_
2.2	2.2	•	•	•	•	_
2.3	2.3	•	•	•	•	_
3.0	3.0	•	•	•	•	•

•; Applicable

-; Not applicable

2-20 Product Specifications

· SD-3RI, SD-3NC, SD-3EC, SD-3ECB



Refer to 'A6 Product Specifications' in the Appendix A.

· SD-3RIP



Refer to 'B6 Product Specifications' in the Appendix B.

2-21 Error codes and message

Corrective action and procedures when faults or errors occur

· SD-3RI, SD-3NC, SD-3EC, SD-3ECB



Refer to 'A5 Troubleshooting' in the "Appendix A".

· SD-3RIP

Refer to 'B5 Troubleshooting' in the Appendix B.



2-22 Operator interfaces

• SD-3RI, SD-3NC, SD-3EC, SD-3ECB



Refer to 'A2. Usage Instruction' in the "Appendix A".

· SD-3RIP



Refer to 'B2. Usage Instruction' in the "Appendix B".

2-23 Prohibited items

Modification of this product is prohibited.

2-24 Terminology and abbreviations

Term

Safety	Freedom from unacceptable risk of harm.
Functional Safety	The ability of a system to carry out the actions necessary to achieve
	or to maintain a defined safe state for the equipment under control of
	system
Basic Safety	The equipment must be designed and manufactured such that it
	protects against resulting fire and explosion under explosive
	atmosphere
Safety Assessment	The investigation to arrive at a judgment - based on
	evidence - of the safety achieved by safety-related systems
Fail-Safe State	State that the defined fail-safe
Fail Safe	Failure that go to the defined fail-safe state without a demand from
	the process
Fail Dangerous	Failure that does not respond to a demand from the process
	(i.e. being unable to go to the defined fail-safe state).
	Failure that deviates the process signal or the actual output by more
	than 15% of span, drifts away from the user defined threshold (Trip
	Point) and that leaves the output within active scale.
Fail Dangerous	Failure that is dangerous and that is not being diagnosed by
Undetected	automatic stroke testing.
Fail Dangerous	Failure that is dangerous but is detected by automatic stroke testing.
Detected	
Fail Annunciation	Failure that does not cause a false trip or prevent the safety function
Undetected	but does cause loss of an automatic diagnostic and is not detected
	by another diagnostic.
Fail Annunciation	Failure that does not cause a false trip or prevent the safety function
Detected	but does cause loss of an automatic diagnostic or false diagnostic
	indication.
Fail No Effect	Failure of a component that is part of the safety function but that has
	no effect on the safety function.
Low demand mode	Mode, where the frequency of demands for operation made on a
	safety-related system is no greater than twice the proof test
	frequency.

Abbreviations

FMEDA	Failure Modes, Effects and Diagnostic Analysis	
HFT	Hardware Fault Tolerance	
	Tolerance that to keep executing the function requested under the	
	hardware fault and error condition	
MOC	Management of Change	
	Management of change the hardware or software elements, and	
	keep traceability	
PFDavg	Average Probability of Failure on Demand	
SFF	Safe Failure Fraction	
	The fraction of the overall failure rate of a device that results in either	
	a safe fault or a diagnosed unsafe fault.	
SIF	Safety Instrumented Function	
	A set of equipment intended to reduce the risk due to a specific	
	hazard.	
SIL	Safety Integrity Level	
	Discrete level (one out of a possible four) for specifying the safety	
	integrity requirements of the safety functions to be allocated to the	
	E/E/PE safety-related systems where Safety Integrity Level 4 has the	
	highest level of safety integrity and Safety Integrity Level 1 has the	
	lowest.	
SIS	Safety Instrumented System	
	Implementation of one or more Safety	
	Instrumented Functions. A SIS is composed of any combination of	
	sensor(s), logic solver(s), and final element(s).	

Appendix A

A1

Installation

A1-1 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.



- 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.

A1-1-1 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 if 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.
- Wisually 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.
- ② In order to completely dry the Teflon film, warm it up for 10 minutes before use.

A1-1-2 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 'A6-3. Detection target gases for individual detection principles'.

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

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

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

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

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

The product requires periodic maintenance.

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

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

<Do not install in improperly grounded system housings.>

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

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

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

Sensor type	Gases affecting sensor sensitivity	Sensor-corroding gases
SGF	O i iii D.4 .ii D.5 .ii	
SHF	 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)
NCF	Juliur gases (e.g., 500x, 1120)	
IRF	None	(1.5.4 g (1.5., 1.7.)
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
SGF	Hydrocarbona alaabala argania salyanta ata atbar than the target gas
SHF	Hydrocarbons, alcohols, organic solvents, etc. other than the target 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 (Current consumption of SD-3) x B (Resistor value of the cable to be installed) + 18V

A: Current consumption of SD-3

Choose from the list below. (@18V)

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

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

Voltage supply at the power source =
$$170\text{mA} \times (24\Omega \times 2) + 18\text{V}$$

= $8.16\text{V} + 18\text{V}$
= 26.16V (or higher)

<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 A3-3-2 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 A3-3-3 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.

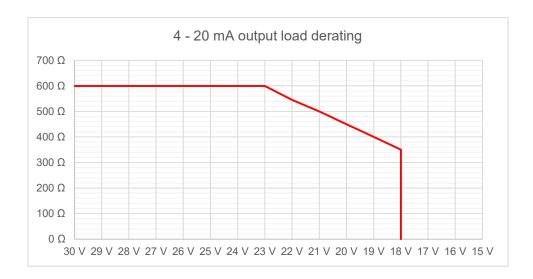
<Install away from noise-emitting devices (main unit and cables).>

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	Min. 250 Ω in range 18 V - 30 V DC
(HART mode)	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

<us>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.

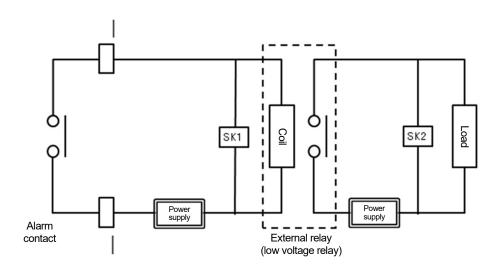
The alarm contact specifications for the product apply under resistance load conditions. If inductive loads occur at the alarm contacts, a counter-electromotive force will be generated at the contacts, leading to the following potential problems:

- · 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



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



- 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.



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.

A1-2 System design precautions

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



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

A1-2-1 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.

A1-2-2 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

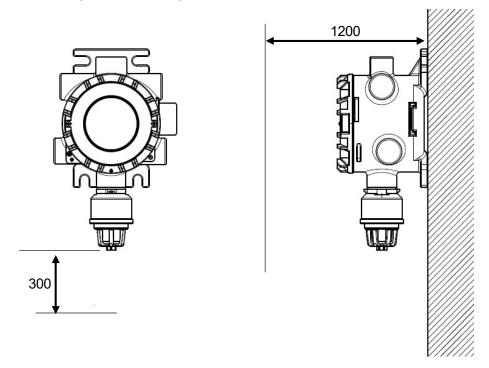
Lightning arresters contain circuitry to remove voltage surges that could damage field devices. Installing lightning arresters may therefore cause signal attenuation.

Perform an operation check before installing a lightning arrester. Also note that lightning arresters cannot remove all voltage surges.

A1-3 Providing maintenance space

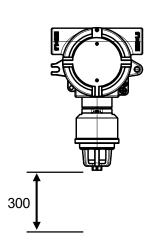
When mounting the product, allow space to open and close the covers during maintenance.

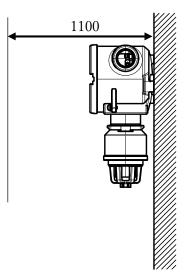
<Main unit (SD-3/SD-3SC)>



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

<Remote sensor head (GD-3)>







The product requires periodic maintenance.

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

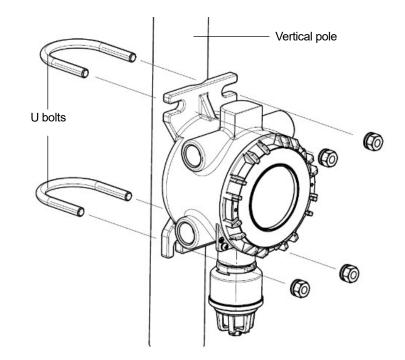
- Locations such as within systems that must be stopped for maintenance
- · Locations where part of the system must be detached to allow maintenance
- Locations where the product cannot be removed due to the presence of pipes or racks
- Locations where maintenance work is hazardous—for example, close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

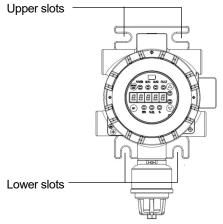
A1-4 Main unit installation

A1-4-1 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.



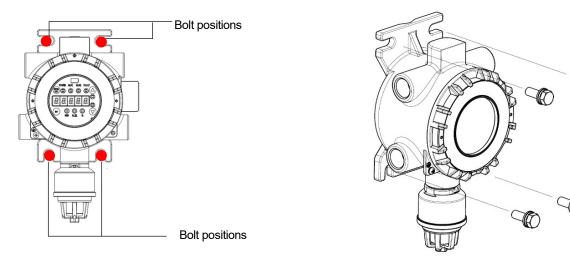


^{*}The diagram illustrates the SD-3. The mounting method for the SD-3SC is identical.

A1-4-2 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.



The product requires periodic maintenance.

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

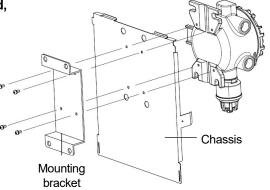
- Locations such as within systems that must be stopped for maintenance
- Locations where part of the system must be detached to allow maintenance
- Locations where the product cannot be removed due to the presence of pipes or racks
- · Locations where maintenance work is hazardous—for example, close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

A1-4-3 Attaching protective cover

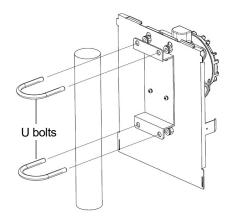
Attach the protective cover to the main unit (SD-3/SD-3SC).

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

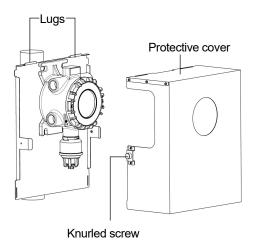
1 Attach the chassis and mounting bracket to the main unit. Secure with four $M5 \times 6$ double SEMS bolts from behind, as shown in the diagram to the right.



- 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.



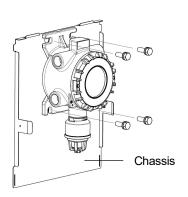
- 4 Attach the protective cover, aligning it with the two lugs at the top of the chassis.
- 5 Secure the protective cover in place by tightening the knurled screws on either side of the cover.



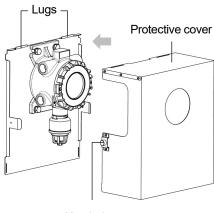
^{*}The diagram illustrates the SD-3. The mounting method for the SD-3SC is identical.

<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.



Knurled screw

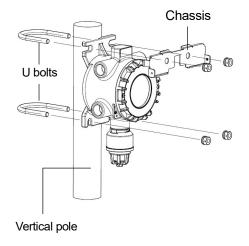
^{*}The diagram illustrates the SD-3. The mounting method for the SD-3SC is identical.

A1-4-4 Attaching sunshade cover

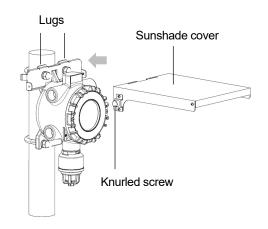
Attach the sunshade cover to the main unit (SD-3/SD-3SC).

<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.



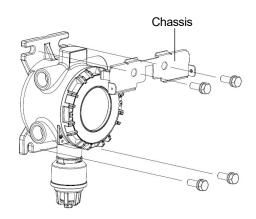
- 3 Attach the sunshade cover, aligning it with the two lugs at the top of the chassis.
- 4 Secure the sunshade cover in place by tightening the knurled screws on either side of the cover.



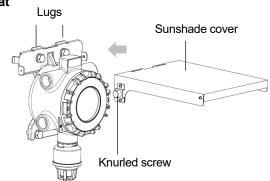
^{*}The diagram illustrates the SD-3. The mounting method for the SD-3SC is identical.

<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.

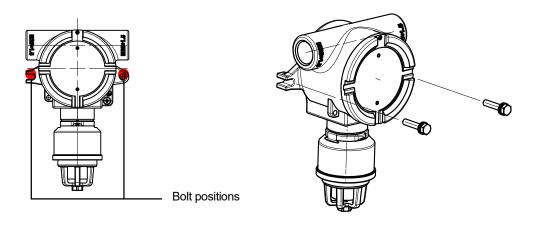


^{*}The diagram illustrates the SD-3. The mounting method for the SD-3SC is identical.

A1-5 Remote sensor head (GD-3) installation

A1-5-1 Wall mounting

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

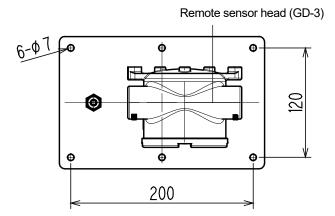


A1-5-2 Duct mounting

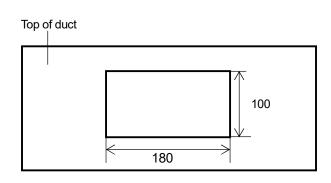
Attach the remote sensor head (GD-3) to a duct.

Attach to a duct using the duct mounting kit.

The duct mounting kit has the following dimensions:

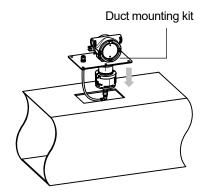


1 Cut out an opening in the top of the duct. Refer to the diagram to the right for the dimensions of the opening.

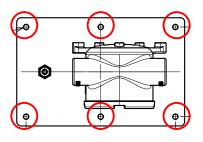


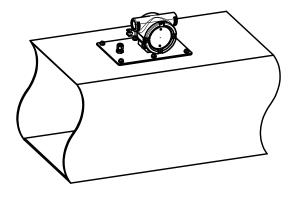
2 Insert the remote sensor head (GD-3) into the duct mounting kit and secure with four M5 bolts.

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.



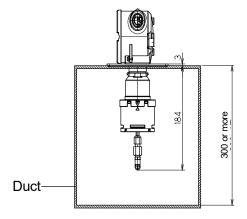
3 Insert the duct mounting kit into the opening in the duct. Secure in place with six M6 bolts.





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.

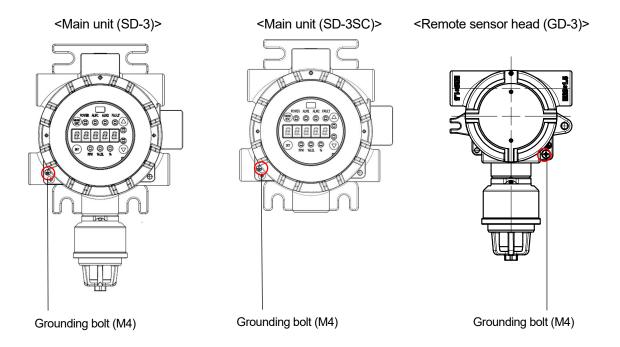


A1-6 Connecting the grounding terminal



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

Connect the grounding bolt to the local grounding terminal.



NOTE

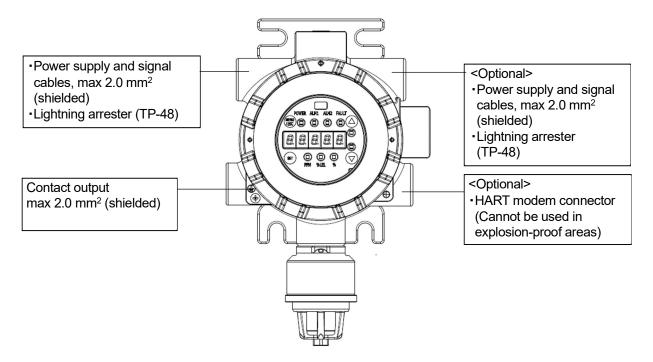
▶ The grounding bolt is marked with the (symbol.

A1-7 Connecting the power and signal cables

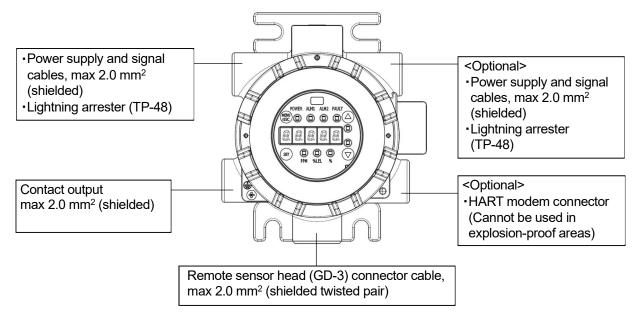
A1-7-1 Main unit cable and device connectors

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.

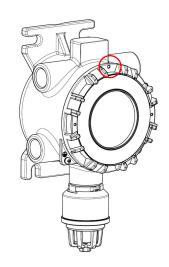
A1-7-2 Connecting the power and signal cables to the main unit

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.

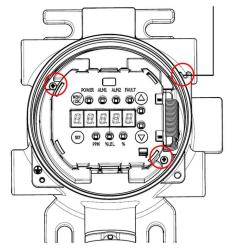
Use a hex key wrench (2 across flats) to unscrew the M4 hex socket set screw.

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



2 Unscrew the two M3 screws securing the display unit.





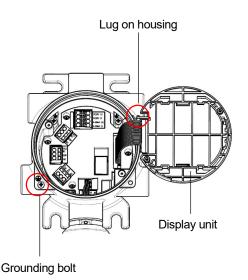
3 Pull out the display unit and hang on the lug on the housing.

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.

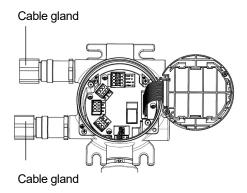
4 Ground the main unit.

Make sure the grounding is Class D equivalent (grounding resistance not exceeding 100 Ω). For information on grounding, refer to 'A1-6 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.

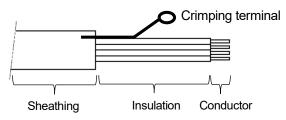
Connect the cables to the following terminals on the power and signal terminal plate. For more information on the contact cable connections, refer to 'A1-9 Alarm relay setting (option)'. For information on connecting cables to the terminal plate, refer to 'A1-7-5 Connecting cables to the terminal plate'.

<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 (-)	



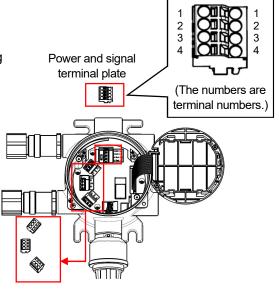
Recommended insulation length: 40 - 50 mm

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.

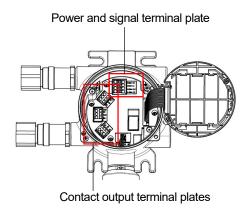
For information on connecting cables to the terminal plate, refer to 'A1-7-5 Connecting cables to the terminal plate'.



Contact output terminal plates

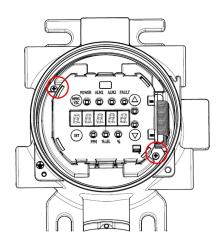
^{*}No contact output terminal plate is present with the no contact output option.

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.

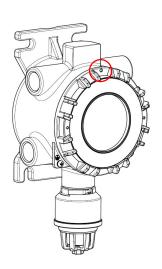
Take care not to trap the cable here.



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.



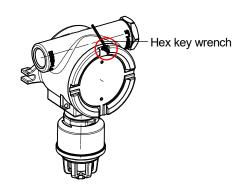
^{*}The diagram illustrates the SD-3. The connection method for the SD-3SC and RS-485 are identical.

A1-7-3 Connecting the power and signal cables to the remote sensor head (GD-3)

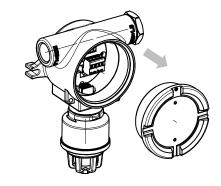
1 Unscrew the single M4 screw on the remote sensor head (GD-3) cover.

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.

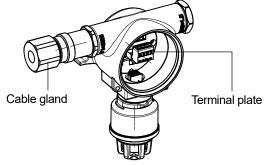


2 Rotate the cover counterclockwise and remove.

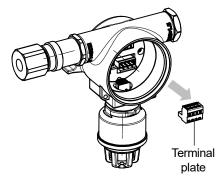


3 Attach a cable gland or conduit to the connector on the remote sensor head (GD-3).

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



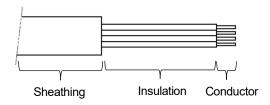
4 Pull out the terminal plate (TN1) from the terminal plate board.

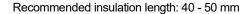


5 Connect the power and signal cables to the terminal plate.

Connect the cables to the following terminals on the terminal plate. For information on how to connect cables to the terminal plate, refer to 'A1-7-5 Connecting cables to the terminal plate'.

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





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

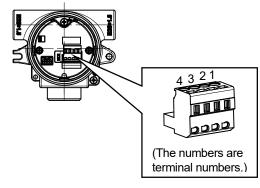
Depending on the installation location, noise interference may result.

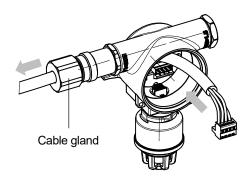
In such cases, remove the shielding.

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

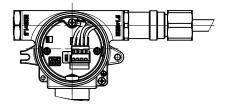
Route to the connector on the side where the cable gland or conduit is attached.

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

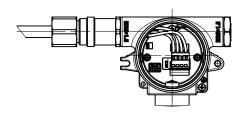




<With cable (external cable) routed to right-hand side>



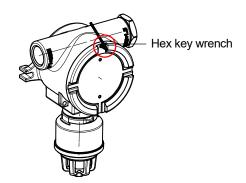
<With cable (external cable) routed to left-hand side>



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.

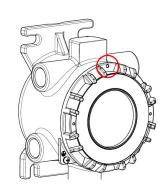


A1-7-4 Connecting the main unit (SD-3SC) and remote sensor head (GD-3)

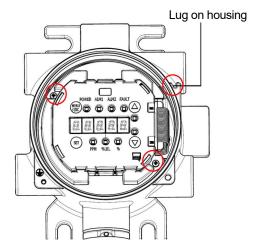
1 Unscrew the M4 hex socket set screw on the main unit (SD-3SC) cover, then rotate the cover counterclockwise to remove.

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.



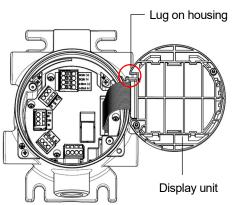
2 Unscrew the two M3 screws securing the display unit.



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

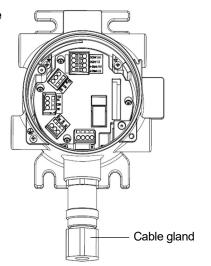
The display unit is connected to the terminal plate unit by a flat cable. Pulling with excessive force may disconnect the cable.

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

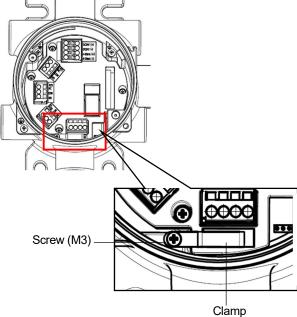


4 Attach a cable gland or conduit to the connector on the main unit.

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



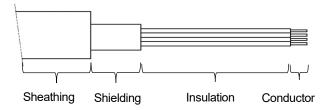
- 5 Pull out the remote connection terminal plate from the terminal plate board.
- 6 Unscrew the single M3 screw securing the clamp and remove the clamp.



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

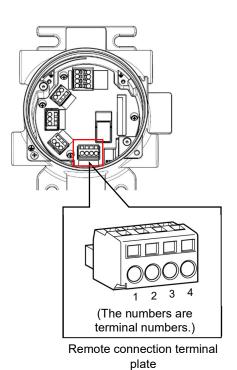
Connect the cables to the following terminals on the remote connection terminal plate. For information on connecting cables to the terminal plate, refer to 'A1-7-5 Connecting cables to the terminal plate'.

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



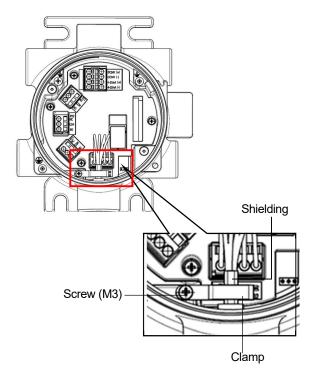
Recommended shielding length: 30 - 40 mm Recommended insulation length: 130 - 140 mm

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



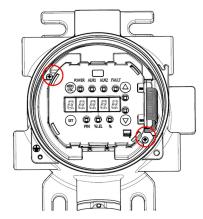
9 Clamp the shield wire.

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.

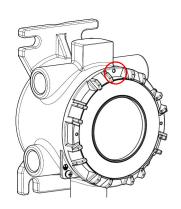
Take care not to trap the cable here.



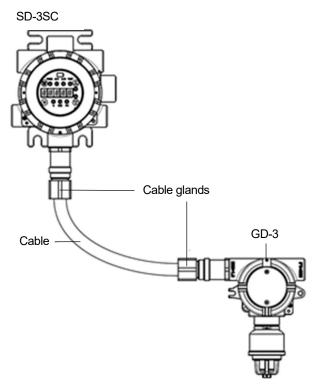
11 Rotate the cover clockwise to attach and secure with the single M4 hex socket set screw.

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

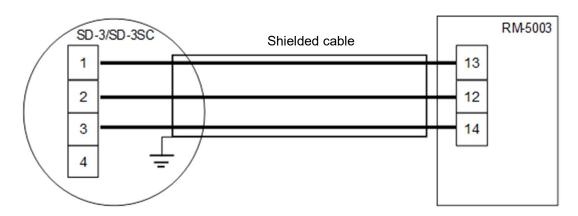
Take care not to trap the cable when attaching the cover. Rotate the cover clockwise until it moves no further to securely fasten in place.



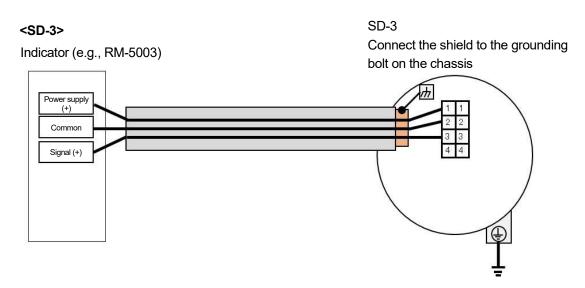
<SD-3SC and GD-3 connection example>

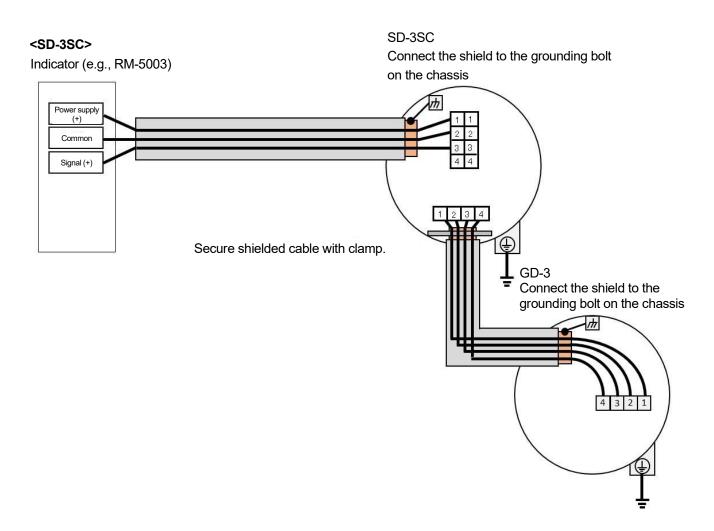


<SD-3/SD-3SC and RM-5003 terminal plate connection example>



<Indicator connection example>





A1-7-5 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 ACRated 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 $2.5 \text{ mm} \times 0.5 \text{ mm}$).

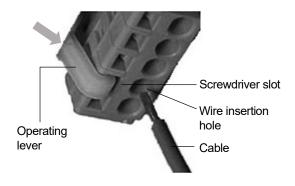
The operating lever provided as a standard accessory cannot be used when connecting power and signal cables to TN1 on the SD-3. Use a flathead screwdriver in this case.



- 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.



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.

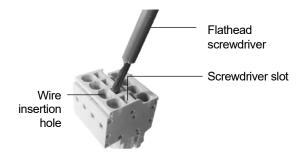
The cable is now connected to the terminal plate.

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

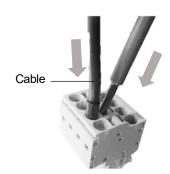
Avoid pulling with excessive force.

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.



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.

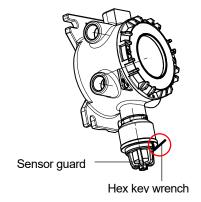
Gently pull on the cable to confirm that it is correctly connected.

Avoid pulling with excessive force.

A1-8 Mounting the sensor

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

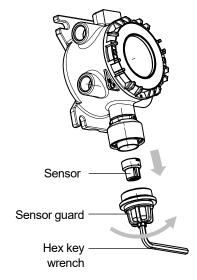
- 1 Remove suction cap, splash guard, and filter, if fitted.
- 2 Unscrew the single M4 bolt securing the sensor guard.
 Use a hex key wrench (2 across flats) to unscrew the M4 hex socket set screw.



3 Rotate and remove the sensor guard.

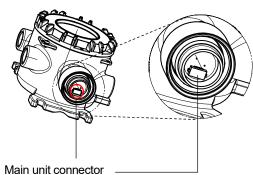
Remove using a hex key wrench (8 across flats) or wrench.

4 Pull out and remove the sensor, if fitted.

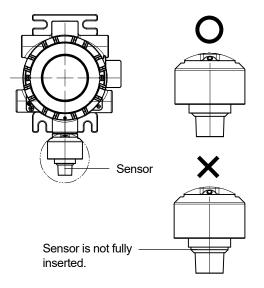


5 Match the main unit connector and sensor connector and fully insert the sensor.

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.

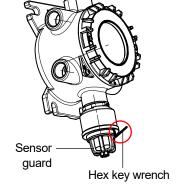


6 Confirm that the sensor is fully inserted.



- 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.



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

A1-9 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.



• 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.



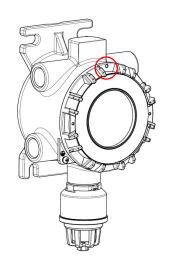
- Note that recurring use with the alarm relay contacts normally closed may result in the contacts seizing
 due to minute vibrations.
- Connect the alarm relay cable and sensor before turning on the power to the product.

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).

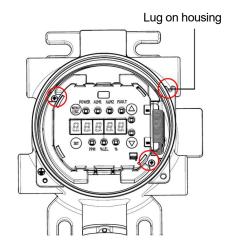
1 Unscrew the M4 hex socket set screw on the main unit cover, then rotate the cover counterclockwise to remove.

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.



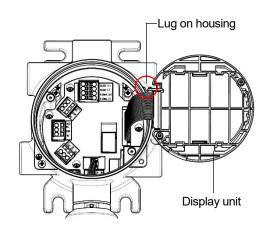
2 Unscrew the two M3 screws securing the display unit.



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.

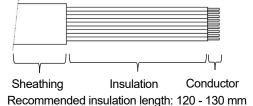
For information on how to connect cables to the terminal plates, refer to 'A1-7-5 Connecting cables to the terminal plate'.

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

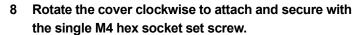


Mount the terminal plates (TN2 (Relay1: ALARM1), TN3 (Relay2: ALARM2), and TN4 (Relay3: FAULT)) on the terminal plate board.

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

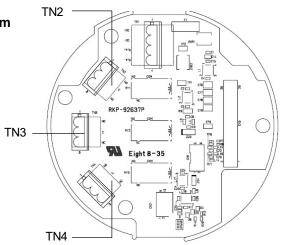
7 Return the display unit to its original position and secure with the two M3 screws.

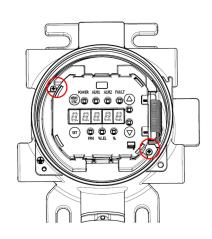
Take care not to trap the cable here.

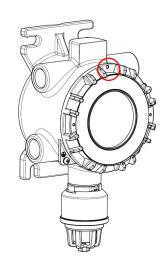


Use a hex key wrench (2 across flats) to tighten the M4 hex socket set screw.

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.







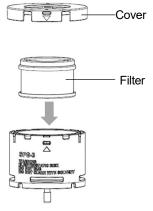
^{*}The diagram illustrates the SD-3. The connection method for the SD-3SC is identical.

A1-10 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.

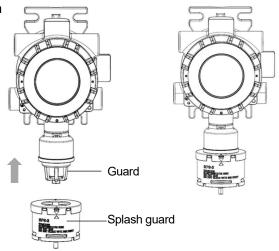
This step is required only when using a silicone removal filter or activated carbon filter.



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:

 Combustible gas sensor identification number: 2

• ESF sensor identification number:

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

GD-3SP

1

<for IRF sensor>

<tor in="" sensor=""></tor>	•
TOTAL SCHOOL	sensor>
SD-3RI	SD-3NC
GD-3RI	SD-3GH
_	SD-3GHS
	SD-3SP
	GD-3NC
	GD-3GH
	GD-3GHS

number

Identification

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

<for ESF sensor>

A1-11 RS-485 setting (optional)

RS-485 enables digital communication.



CAUTION

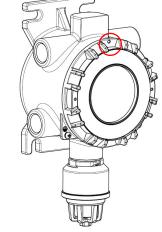
- · Use shielded twisted pair cable.
- Do not wire near trunk cables or high-voltage equipment.
- Do not connect to any device other than the SD-3 series in the Modbus.

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.

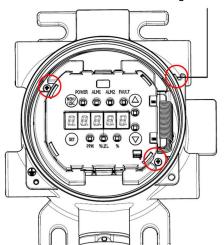
Use a hex key wrench (2 across flats) to unscrew the M4 hex socket set screw.

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



Lug on housing

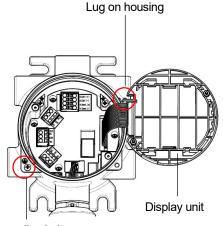
2 Unscrew the two M3 screws securing the display unit.



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 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(120Ω)

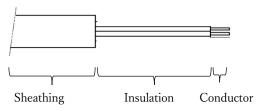
6 Connect the wiring for RS-485 communication to the corresponding terminals on the removed terminal block For information on connecting cables to the terminal plate, refer to 'A1-7-5 Connecting cables to the terminal plate'.

TN2(RS-485)

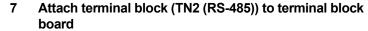
Terminal No.	Cable connection
1	RS-485(A1)
2	RS-485(B1)
3	RS-485(A2)
4	RS-485(B2)

TN3

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



Recommended insulation length: 40 - 50 mm



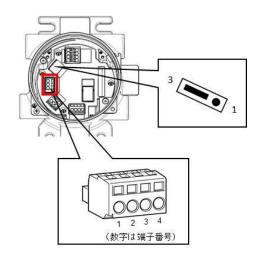
Adjust the position of the cable so that there is no load on the terminal block.

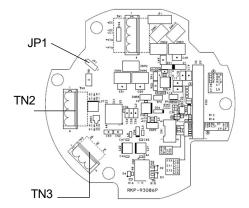
8 Return the display unit to its original position and secure with the two M3 screws.

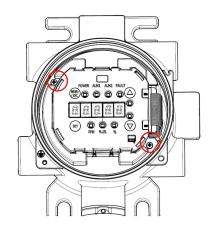
Take care not to trap the cable here.

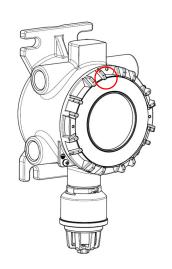
9 Rotate the cover clockwise to attach and secure with the single M4 hex socket set screw.

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.

 $^{\star}\,$ The diagram illustrates the SD-3. The connection method for the SD-3SC is identical.

A2

Usage Instructions

A2-1 Preparations for startup

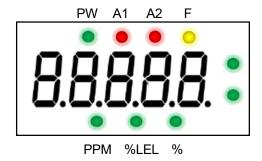
Carry out the following checks before connecting the power supply. Failure to perform these checks may result in electric shock or damage to the product.

- · 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) 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)

A2-2 Startup



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

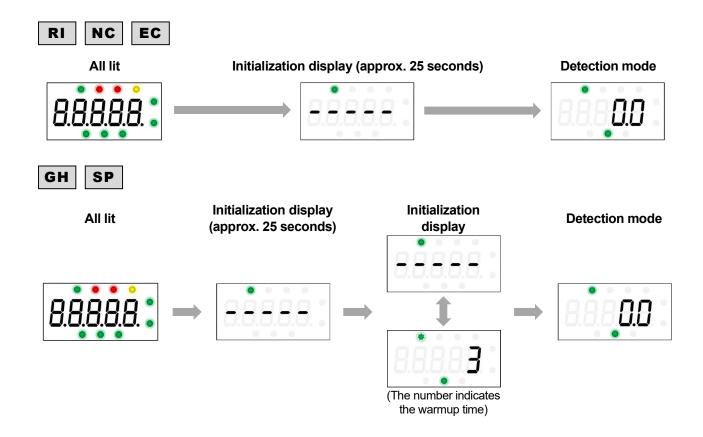
Turn on the power supply (24 V DC) and start the product.

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.

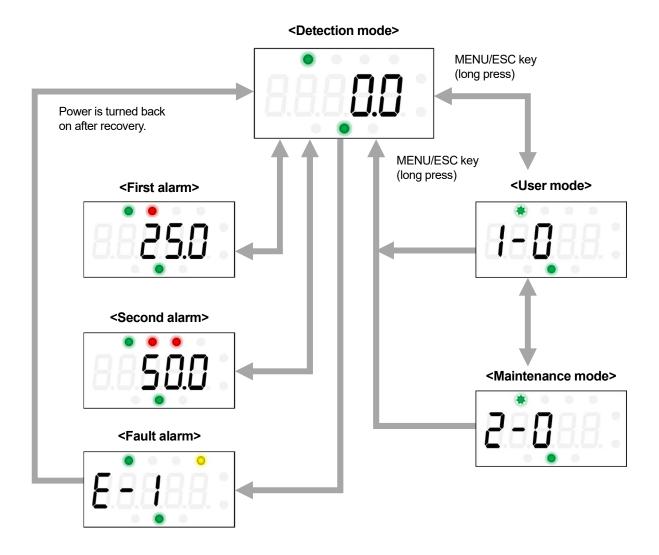




- Never turn off the power while initialization is underway. The internal memory is read during initialization.
- A specific warmup is required for each sensor type at startup and after sensor replacement. Allow the
 product to warm up for the specified time. Expected warmup completion times for the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

A2-3 Basic operation flow

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





• 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 'A2-5-1 User mode setting items' and 'A3-2-1 Maintenance mode setting items'.)

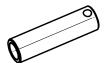
A2-4 Operating procedure

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>





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

A2-5 User mode

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



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

A2-5-1 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	8.8.8.8.	Performs zero calibration. (Refer to 'A2-6 Performing zero calibration'.)
1-2	Setting display	88.28.8.	Displays the alarm settings. (Refer to 'A2-7 Checking settings'.)
1-3	Maintenance mode selection	8.8.8.	Switches to maintenance mode. (Refer to 'A3-2 Maintenance mode'.)

A2-5-2 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.



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.

A2-6 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 'A3-4-1 Calibration preparation'.



 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.



- 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 'A3-4-3 Performing span adjustment'.

A2-7 Checking settings

Displays the alarm settings.

It	em 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 dislpay	Displays settings for RS-485 communication.

A2-7-1 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.
- ▶ The sensitivity correction ON/OFF display appears only with sensors that rely on the electrochemical type detection principle.
- 1 Press the ▲ or ▼ key in user mode to select [1-2], then press the SET key.



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



3 Check the individual alarm setpoints.

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

First alarm setpoint display
 Displays the first alarm setpoint.



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

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



4 Press the MENU/ESC key.

Returns to the [1-2.0] display.

NOTE

▶ The alarm setpoints, alarm delay time, and zero suppression value can be set in environmental settings 1 in maintenance mode. (Refer to 'A3-5 Setting environmental settings 1'.)

A2-7-2 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 setting.

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.

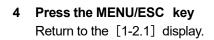


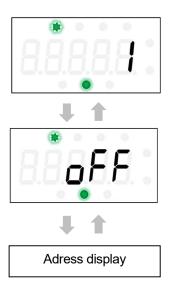
Parity display
 Displays the parity.



- 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 address display.





A2-8 Shutting down

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



- 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.

A3

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.

A3-1 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.	0	0	0
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.	0	0	0
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.	_	0	0
Calibration	Perform sensitivity calibration using a calibration gas.	_	_	0
Gas alarm check	Check the gas alarm using a calibration gas.	_	_	0
Grounding cable check	To ensure EMC performance, check to confirm that the grounding cable connection is secure and free of corrosion.	_	_	0

<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 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.

A3-2 Maintenance mode

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

A3-2-1 Maintenance mode setting items

Item No.	Setting item	LED display	Details
2-0	Test mode	2-0-8	Performs the gas test, alarm test, fault test, LED test, and RAM test. (Refer to 'A3-3 Performing tests (test mode)'.)
2-1	Zero calibration	2.8.8.8.2	Performs zero calibration. (Refer to 'A3-4-2 Performing zero calibration'.)
2-2	Span adjustment	2.5.2.8.8	Performs span adjustment. (Refer to 'A3-4-3 Performing span adjustment'.)
2-3	Display	2.3.8.8.	This is not normally used by the user.
2-4	Environmental settings 1	2.8.8.8.	Configures settings such as alarm setpoints, alarm pattern, fault alarm pattern, zero suppression value, and the date and time. (Refer to 'A3-5 Setting environmental settings 1'.)
2-5	Environmental settings 2	2.5.8.8	This is not normally used by the user.
2-6	Environmental settings 3	2-5-8-8	Configures settings such as used contact settings and various external outputs. (Refer to 'A3-6 Setting environmental settings 3'.)
2-7	Communication settings	2888	This is not normally used by the user.

Item No.	Setting item	LED display	Details
2-8	Factory mode selection	2-8	This is not normally used by the user.
2-9	User mode selection	2-9-8	Switches to user mode. (Refer to 'A2-5 User mode'.)

A3-2-2 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.



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.



A3-3 Performing tests (test mode)

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

It	em 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

A3-3-1 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 'A3-4-1 Calibration preparation'.



- Depending on the settings, contact and gas concentration outputs may be activated during gas testing, even in maintenance mode. Take care during gas testing.
- 1 Press the ▲ or ▼ key in maintenance mode several times to select [2-0], then press the SET key.



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



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



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



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



Returns to the [2-0.0] display.

A3-3-2 Performing alarm test

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



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

NOTE

- ▶ The procedure in step 3 is required even if the product is a no alarm relay model. Note that the contact will not operate even when [on] is selected.
- 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 [2-0.1], then press the SET key.



3 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.





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



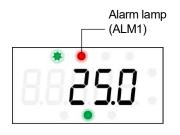
5 Check to confirm that an alarm is triggered.

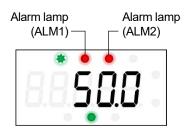
The first alarm is triggered when the reading reaches the first alarm setpoint.

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.

A3-3-3 Performing fault test

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



- 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.



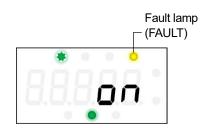
2 Press the ▲ or ▼ key to select [2-0.2], then press the SET key.



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.



A3-3-4 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.



A3-3-5 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.

A3-4 Performing calibration

A3-4-1 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	Applic	able specifications							
	Dedicated adapter for IRF sensor	Part No.: 4283 9011 00							
Calibration adapter	Dedicated calibration adapter for combustible F sensors	Part No.: 4283 9012 70							
'	Dedicated adapter for ESF sensor	Part No.: 4283 9013 40							
Dump	One that can provide a flow rate of 0.	5 mL or greater							
Pump	Explosion-proof specifications								
Flowmeter	Measures tolerances to 0.1 ml.								
Flowmeter	Has passed regular inspection.								
Stopwatch	Has passed regular inspection								
		Material: polyurethane							
	For general combustible gases	Internal diameter: 4 mm							
		Pipe length between gas and adapter: Within 1m							
		Material: Teflon							
Piping	For organic solvents	Internal diameter: 4 mm							
i ipilig	Ğ	Pipe length between gas and adapter: Within 1m							
		Material: Teflon							
	For strongly adsorptive gases	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
	IRF-1301	Methane	CH₄	100 %LEL		Methane		50 %LEL					
	IRF-1303	Isobutane	i-C ₄ H ₁₀	100 %LEL	1	Isobutane	1	50 %LEL]				
	IRF-1317	propane	C₃H ₈	100 %LEL		Propane (Isobutane)		50 %LEL (40 %LEL)					
	IRF-1315	propane	C₃H ₈	100 vol%		Propane		80 vol%					
	IRF-1435			2000 ppm		Carbon dioxide		1000 ppm		0.5 ± 0.1L/min		0.4 – 1.5 L/min	Warm up for at least 10 minutes before making adjustments.
	IRF-1436		500	5000 ppm		Carbon dioxide		2500 ppm	For IRF sensor (4283 9011 00)				
	IRF-1433	Carbon dioxide	CO ₂	10000 ppm	N ₂	Carbon dioxide	N ₂	5000 ppm					
SD-3RI	IRF-1437	Carbon dioxide	CO ₂	2 vol%		Carbon dioxide		1 vol%			120 seconds		
SD-3DRI	IRF-1438			5 vol%		Carbon dioxide		2.5 vol%					
GD-3RI	IRF-1439	1		10 vol%		Carbon dioxide		5 vol%					
	IRF-1334	Methane	CH ₄	100 vol%		Methane		50 vol%]				
	IRF-1316	eEhylene	C ₂ H ₄	100 %LEL		Ethylene		50 %LEL					
	114-1010	CETIVICIE	O21 14	100 70222	_	(Methane)	_	(10 %LEL)					
	IRF-1340	Isobutylene	i-C₄H ₈	100 %LEL		Isobutylene		50 %LEL					
		,				(Isobutane)		(40 %LEL)	-				
	IRF-1308	Normal Hexane	n-C ₆ H ₁₄	100 %LEL		n-Hexane		50 %LEL	-				
	-				-	(Isobutane)	-	(40 %LEL)					
	IRF-1332	1,3-Butadiene	1,3-C₄H ₆	100 %LEL		1,3-Butadiene (Methane)		50 %LEL (10 %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 adapter	Applicable flow rate for calibration jig	Time Required for calibration	Sample flow range	Remarks
SD-3NC	NCF-6318	Methane	CH₄	100 %LEL		Methane		50 %LEL	For combustible				Warm up for at least 30
SD-3DNC	NCF-6319	Isobutane	i-C₄H₁0	100 %LEL	Atmosph eric air	Isobutane	Atmosph eric air	40 %LEL	F sensors	0.5 ± 0.1L/min	60 seconds	0.4 – 1.5 L/min	minutes before making
GD-3NC	NCF-6320	Hydrogen	H ₂	100 %LEL	GIN all	Hydrogen	GIOGII	40 %LEL	(4283 9012 70)			1.0 ()11111	adjustments.

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
	SHF-8601	Carbon monoxide	со	1000 ppm		Carbon monoxide		400 ppm			120 seconds		Perform the necessary warm-up depending on the sensor non-energization
SD-3SP SD-3DSP	SHF-8601	Methane	CH₄	5000 ppm	Atmosph	Methane	Atmosph	3200 ppm	For combustible F sensors 0.5	0.5 ± 0.1L/min		0.4 –	period (warm-up time: see page 195). • Use zero gas and calibration gas with a
GD-3SP	SHF-8603	Hydrogen	H ₂	2000 ppm	eric air	Hydrogen	eric air	800 ppm	(4283 9012 70)		60 seconds	1.5 L/min	humidity of 20% RH or higher. For information on how to humidify the gas, contact your dealer or our nearest sales office.

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-3GH	SGF-8562	Hydrogen sulfide	H₂S	100 ppm		Hydrogen sulfide		40 ppm	For combustible				Perform the necessary warm-up depending on the sensor non-energization
SD-3DGH GD-3GH	SGF-8563	Ethylene oxide	C ₂ H ₄ O	100 ppm	Atmosph	Ethylene oxide	Atmosph eric air	40 ppm	F sensors (4283 9012 70)	. 0.5 ± 0.1L/min	120 seconds	0.4 – 1.5 L/min	period (warm-up time: see page 193). • Use zero gas and calibration gas with a
SD-3GHS SD-3DGHS GD-3GHS	SGF-8562	Carbon disulfide	CS ₂	200 ppm	eric air	Carbon disulfide		80 ppm	For combustible F sensor (4283 9011 00)				humidity of 20% RH or higher. For information on how to humidify the gas, contact your dealer or our nearest sales office.

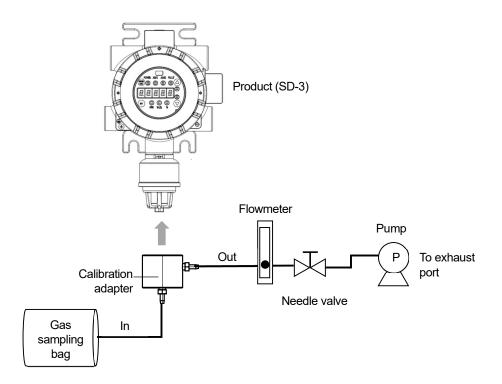
Gas detector model	Sensor model	Detection target	Chemical formula	Detection concentration	Zero gas	Calibration gas (alternative gas)	Dilution gas	Calibration gas concentration (alternative gas concentration)	Calibration cap	Applicable flow rate for calibration jig	Time Required for calibration	Sample flow range	Remarks
	ESF-B22	Ammonia	NH ₃	75 ppm		Ammonia		75 ppm			120 seconds		
	ESF-A24P	Carbon monoxide	со	150 ppm	-	Carbon monoxide		150 ppm			60 seconds		
	ESF-A24R	Hydrogen sulfide	H₂S	100 ppm		Hydrogen sulfide		32 ppm	For ESF sensor (4283 9013 40) 0.5		60 seconds		At temperatures below - 25°C, allow to acclimatize for the operating environment before adjustments.
SD-3ES	ESF-A24R3	Hydrogen sulfide	H ₂ S	100 ppm		Hydrogen sulfide	N ₂	32 ppm			60 seconds		
SD-3DES GD-3ES	ESF-A24RH	Hydrogen sulfide	H₂S	30 ppm	N ₂	Hydrogen sulfide		30 ppm		0.5 ± 0.1L/min	60 seconds	0.4 – 1.5 L/min	
	ESF-A24A	Nitrogen dioxide	NO ₂	15 ppm		Nitrogen dioxide		15 ppm			60 seconds		
	ESF-X24P2	Oxygen	O ₂	25 vol%		Oxygen		25 vol%			60 seconds		
	ESF-C92	Chlorine	CL ₂	1.5 ppm		Chlorine		1.5 ppm			120 seconds		Calibration must be performed at -10°C or higher

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

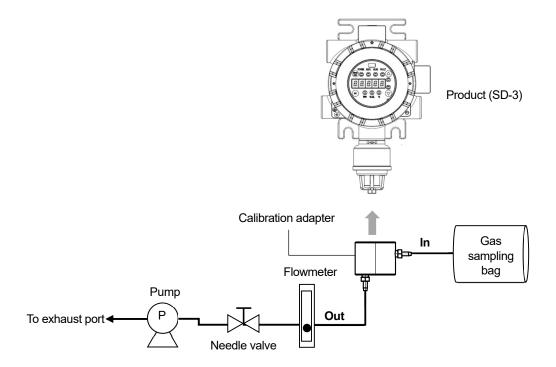
NOTE

- ▶ 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

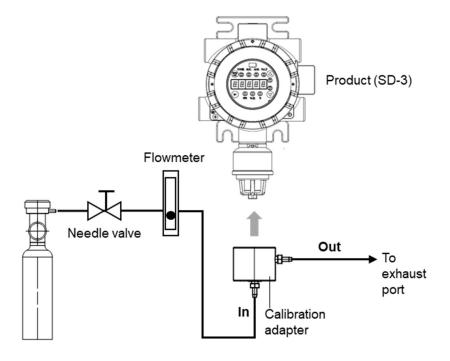


<Using a gas sampling bag> NC GH SP

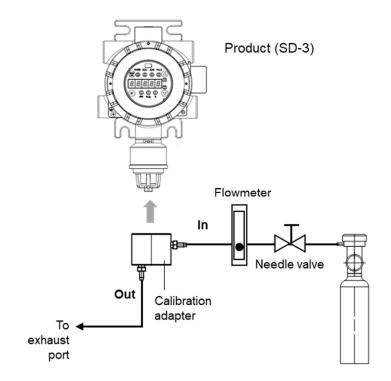


^{*} The diagram illustrates the SD-3. The connection method is the same for the remote sensor head (GD-3).

<Using a gas can> RI EC



<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>

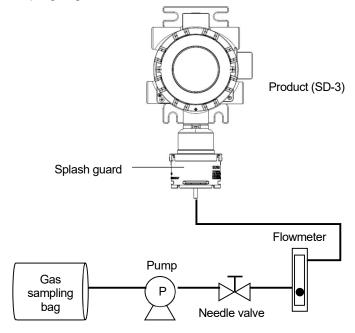
NOTE

- ▶ 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 absorption type (infrared type)	
New ceramic type	Max. 6 m/s
Semiconductor type	
Hot-wire semiconductor type	
Electrochemical type	Max. 1 m/s

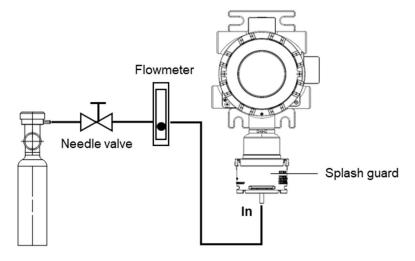
- ▶ If calibration is unsuccessful, fit the calibration adapter and calibrate again.
- ▶ When calibrating adsorptive gas, fit the calibration adapter.
- ▶ Use a flow rate of 0.5 L/min ±0.1 L/min when calibrating. Calibration accuracy may be reduced if calibration is performed using a different flow rate.

<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.



• 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.



- 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.



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.

A3-4-2 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 'A3-4-1 Calibration preparation'.



 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.



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.

A3-4-3 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 'A3-4-1 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.



Fress the SET key.Returns to the [2-2] display.

NOTE

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

<With double range>





- Perform span adjustment after supplying the span adjustment gas and waiting for the reading to stabilize.
- For double range span adjustment, perform span adjustment first for the L range, followed by the H range in succession. If span adjustment was aborted midway, repeat from the L range.
- 1 Press the ▲ or ▼ key in maintenance mode several times to select [2-2], then press the SET key.



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



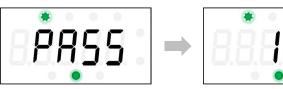
3 Press the ▲ or ▼ key to adjust the reading to match the concentration of the gas introduced, then press the SET key.



Span adjustment starts for the L range.



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



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



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

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



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

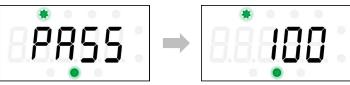


Span adjustment starts for the H range.



7 Check the H range span adjustment result.

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



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



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

NOTE

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

A3-5 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	

A3-5-1 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.

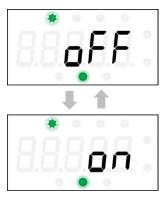
1 Press the ▲ or ▼ key in maintenance mode to select [2-4], then press the SET key.



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.

A3-5-2 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	Combustible gas	First alarm setpoint to 60 % of full scale (H-HH)
([AL2])	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.

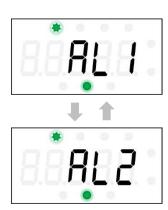


2 Press the ▲ or ▼ key to select [2-4.1], then press the SET key.



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 'A2-7-1 Checking alarm setpoints'.)

A3-5-3 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.

A3-6 Setting environmental settings 3

The following items can be set in environmental settings 3:

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

A3-6-1 Double range external output setting

Sets the double range external output range.

Select one of the following:

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

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

NOTE

▶ The double range external output setting can be set only with sensors that rely on the new ceramic detection principle.

NC

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



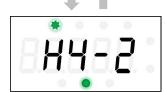
2 Press the ▲ or ▼ key to select [2-6.6], then press the SET key.



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







Returns to the [2-6.6] display.

A3-7 Parts replacement

A3-7-1 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
	IRF-1301	Methane	CH ₄	100 %LEL	%LEL	
	IRF-1303	Isobutane	i-C ₄ H ₁₀	100 %LEL	%LEL	
	IRF-1317	Propane	C ₃ H ₈	100 %LEL	%LEL	
	IRF-1315	Propane	C₃H ₈	100 vol%	vol%	
	IRF-1435	Carbon dioxide	CO ₂	2000 ppm	ppm	3 years
	IRF-1436			5000 ppm	ppm	
SD-3RI	IRF-1433			10000ppm	ppm	
SD-3DRI	IRF-1437			2 vol%	vol%	
GD-3RI	IRF-1438			5 vol%	vol%	
	IRF-1439			10 vol%	vol%	
	IRF-1334	Methane	CH ₄	100 vol%	vol%	
	IRF-1316	Ethylene	C ₂ H ₄	100 %LEL	%LEL	
	IRF-1340	Isobutylene	i-C ₄ H ₈	100 %LEL	%LEL	
	IRF-1308	Normal Hexane	n-C ₆ H ₁₄	100 %LEL	%LEL	
	IRF-1332	1,3-Butadiene	1,3-C ₄ H ₆	100 %LEL	%LEL	

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

Gas detector model	Sensor model	Detection target gas	Chemical formula	Detection concentration	Unit	Sensor replacement cycle
SD-3SP	SHF-8601	Carbon monoxide	CO	1000 ppm		
SD-3DSP	SHF-8601	Methane	CH ₄	5000 ppm	ppm	3 years
GD-3SP	SHF-8603	Hydrogen	H ₂	2000 ppm		

Gas detector model	Sensor model	Detection target gas	Chemical formula	Detection concentration	Unit	Sensor replacement cycle
SD-3GH SD-3DGH	SGF-8562	Hydrogen sulfide	H ₂ S	100 ppm		
GD-3GH SGF-8563		Ethylene oxide	C ₂ H ₄ O	100 ppm		
SD-3GHS SD-3DGHS GD-3GHS	SGF-8562	Carbon disulfide	CS ₂	200 ppm	ppm	3 years

Gas detector model	Sensor model	Detection target gas	Chemical formula	Detection concentration	Unit	Sensor replacement cycle
SD-3EC	ESF-A24P	Carbon monoxide	СО	150 ppm		3 years
SD-3DEC GD-3EC ESF-X24P2	Oxygen	O ₂	25vol%		3 years	
SD-3ECS SD-3DECS GD-3ECS	ESF-A24R	Hydrogen sulfide	H₂S	100 ppm		3 years
	ESF-A24R3	Hydrogen sulfide	H ₂ S	100 ppm	vol%	3 years
	ESF-A24RH	Hydrogen sulfide	H₂S	30 ppm	ppm	3 years
en aren	ESF-A24A	Nitrogen dioxide	NO ₂	15 ppm		3 years
SD-3ECB SD-3DECB	ESF-B22,	Ammonia	NH₃	75 ppm		3 years
GD-3ECB -	ESF-C92	Chlorine	CL ₂	1.5 ppm		3 years



- Precautions regarding sensor replacement
- Be sure to turn OFF the power supplied to the sensor before replacing the sensor.
- Refer to 'A1-8 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.
- 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.

A3-7-2 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/GHS)				
Sensor guard (for SD-3NC/GH/SP)		3 - 8 years		
Sensor guard (for SD-3EC/ECS/ECB)	6 months		1	
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.

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.

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

^{*3:} For combustible gas sensor (CF-8304)/Part No.: 4383 0040 10

A4

Storage, Relocation, and Disposal

A4-1 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
	1	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum			
SGF	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		
SHF	0.5	-10	40	0	90	80	120	 sunlight. Store in an environment free of corrosive gas, vibration, and dust. 		
NCF	0.5	-10	40	0	90	80	120	 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/m 3 (33.6 °C, 90 %RH) or less.

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

Model	Storage limit (years)	Temperature (°C)			Humidity*1 (% RH)		sure Pa)	Remarks
	ı	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	
SGF	0.5	-10	40	0	90	80	120	Store in a location away from direct sunlight. Store in an environment free of
SHF	0.5	-10	40	0	90	80	120	corrosive gas, vibration, and dust. • Avoid condensation and moisture. • Store in an environment free of
NCF	0.5	-10	40	0	90	80	120	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.
ESF-X*3	0.5	-10	40	20	90	00	120	Store in an environment free of gases that may act as a catalyst poison (e.g., silicone, chlorine, sulfur gases).
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.

A4-2 Procedures for relocation or reuse

Before relocating and resuming use of the product, refer to 'A1-1 Installation precautions' for information on relocation locations.

For information on installation procedures, refer to 'A1. Installation'.



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.

A4-3 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

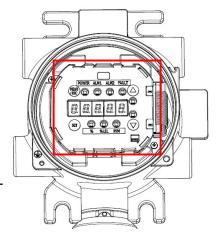
Remove the main PCB unit indicated by the red box in the figure to the right. Remove the PCB holder.

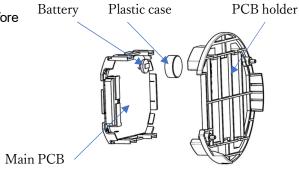
The battery is located on the underside of the main PCB (on the rear of the 7-segment LCD).

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

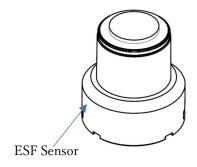
Item name	Lithium manganese dioxide battery
Nominal voltage:	3.0 V
Nominal capacity	140 mAh

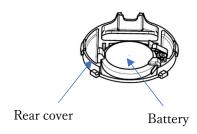
Removal method

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.

NOTE

- ▶ The product contains a battery.
- Crossed-out recycle dustbin mark

This pictogram is affixed to products containing batteries to which EU Battery Directive 2006/66/EC applies.

Such batteries must be disposed of appropriately.

This pictogram means batteries must be separated from ordinary waste and disposed of appropriately.



A5

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.

A5-1 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)		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.		
	(Lamp on)	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)	0	A main unit (SD-3/ SD-3SC) or remote sensor head (GD-3) fuse has blown.	Replacement required. Contact RIKEN KEIKI.
	(Lamp on)	Main unit (SD-3/SD-3SC) or remote sensor head (GD-3) internal circuit abnormality	Replacement required. Contact RIKEN KEIKI.
System abnormality		4 - 20 mA output disconnection	Turn off the power and check the 4 - 20 mA output connection.
(E-9)	(Lamp on)	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)		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.
	(Lamp on)	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.

A5-2 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. 	_	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.
Response is slow.		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.

A6

Product Specifications

A6-1 SD-3 specifications

A6-1-1 SD-3 (model without EC barrier)

Model	SD-3	SD-3 (contact model)	
Specifications	Standard	Contact	
Display	7-segment LED (5 digits)		
Sensor	F sensor (RIKEN KEIKI)		
Detection principle	Infrared/electrochemical/new ceramic	/semiconductor/hot-wire semiconductor	
Detection target gas	Depends on sen	sor specifications.	
Detection range	Depends on sen	sor specifications.	
Sampling method	Diffusion type/suction type	(introduced via external unit)	
Set flow rate	0.4 - 1	.5 L/min	
Power supply indication	Power lam	np lit (green)	
External output	Gas concentration signal (4	- 20 mA DC + HART output)	
Alarm setpoints	Depends on sen	sor specifications.	
Alarm accuracy	Depends on sen	sor specifications.	
Alarm delay time	Depends on sen	sor specifications.	
Repeatability (for identical conditions)	Depends on sensor specifications.		
Indication accuracy (for identical conditions)	Depends on sensor specifications.		
Gas alarm type	Two-step alarm (O2 other:H-HH, O2: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	System abnorma	ality: Self-latching	
operation	Sensor abnormality: Auto reset (self-latching if sensor is disconnected)		
Contact operation	_	SPDT (× 3): 2 alarms, 1 fault output 250 V AC, 2 A; 30 V DC, 1 A (resistance load) Minimum load 5 V DC, 0.1 A	
Warnings	Sensor life assessment***/clock abnormality diagnosis/communication diagnosis/ sensor warning		
Warning display	Blinking display alternating between	en gas concentration and error code	
Warning operation	Same as normal operation		
Functions	Alarm delay/suppression/HART communication		

Model	SD-3	SD-3 (contact model)	
Transmission	3-wire analog transmission (common power supply <power signal,<="" supply,="" td=""></power>		
method (4 - 20 mA)	common>) or		
,		ission (current source)	
Transmission		i-insulated linear output)	
specifications		rating depending on power supply voltage)	
(4 - 20 mA)		s (depending on specifications)	
		(1.308 mm ² /AWG16) or	
Transmission cable		same as power supply cable)	
(4 - 20 mA)	*To ensure explosion protection, use a cal		
- · ·	least 5 °C above the maximum anticipate		
Transmission		G16): Not exceeding 1.25 km	
distance (4 - 20 mA)		eeding 2 km (with derating depending on	
(4 - 20 IIIA)		voltage) V - 30 V DC)	
Power source	,	,	
rower source	*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.		
	Shielded cable 1.25 sq (1.308 mm²/AWG16) or		
	2.0 sq (2.08 mm²/AWG14) (same as transmission cable)		
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.		
Power consumption	Refer to 'A6-1-3 Electrical ratings (SD-3)'.		
Cable connectors	M25 × 1.5		
Operation method	Dedicated magnet control key		
Operating	−40 °C - +70 °C (n	no sudden changes)	
temperature range	In accordance with sensor specifications if restrictions apply due to sensor		
temperature range	specifications		
Operating humidity	0 %RH - 95 %RH (no condensation)		
range	In accordance with sensor specifications if restrictions apply due to sensor		
specifications			
Housing material		teel (SCS14)	
Protection level	**IP44/67 equivalent		
Installation type	, , , , , , , , , , , , , , , , , , ,	2B pole mounting (optional)	
External	Diffusion type: Approx. 171 mm (W) × 277 m		
dimensions	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		

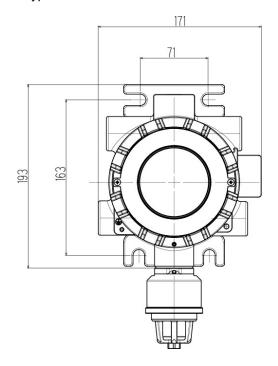
^{*} When used with the contacts closed, the contacts may seize due to vibration. Keep this precaution in mind.

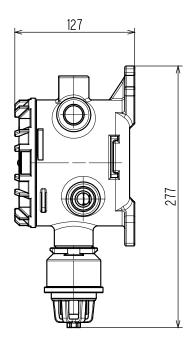
^{**} In case of ANSI/FM/UL 60079-29-1 is applied. IP44 when IRF and ESF-A24R is installed. IP67 when NCF is installed.

^{***} SIL specification is not supported.

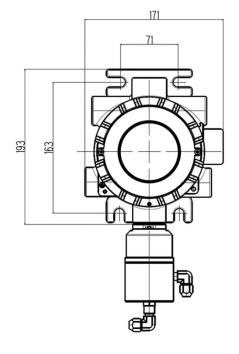
<Dimensional drawings (SD-3 (model without EC barrier))>

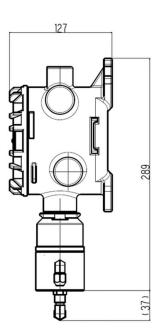
<Diffusion type>





<Suction type>





A6-1-2 SD-3 (model with EC barrier)

Model	SD-3	SD-3 (contact model)	
Specifications	Standard	Contact	
Display	7-segment L	ED (5 digits)	
Sensor	F sensor (RIKEN KEIKI)		
Detection principle	Electroche	emical type	
Detection target gas	Depends on sens	sor specifications.	
Detection range	Depends on sens	sor specifications.	
Sampling method	Diffusion type/suction type (introduced via external unit)	
Set flow rate		5 L/min	
Power supply indication	Power lam	p lit (green)	
External output	Gas concentration signal (4	- 20 mA DC + HART output)	
Alarm setpoints		sor specifications.	
Alarm accuracy	Depends on sens	sor specifications.	
Alarm delay time	Depends on sens	sor specifications.	
Repeatability (for identical conditions)	Depends on sens	sor specifications.	
Indication accuracy (for identical conditions)	Depends on sens	sor specifications.	
Gas alarm type	Two-step alarm (H	I-HH, H-L, or L-LL)	
Gas alarm	Δlarm lan	np lit (red)	
indication		<u> </u>	
Gas alarm reset	Auto reset or self-latching		
operation			
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	System abnormality: Self-latching		
operation	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 abnorma	ality diagnosis/communication diagnosis/ warning	
Warning display	<u> </u>	n gas concentration and error code	
Warning operation	Same as non	mal operation	
Functions	Alarm delay/suppression/HART communication		
Transmission method (4 - 20 mA)	commo	power supply <power on="" signal,="" supply,="">) or</power>	
` '		ssion (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 mm²/AWG16) or 2.0 sq (2.08 mm²/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 mm²/AWG16): Not exceeding 1.25 km For 2.0 sq (2.08 mm²/AWG14): Not exceeding 2 km (with derating depending on supply voltage)		

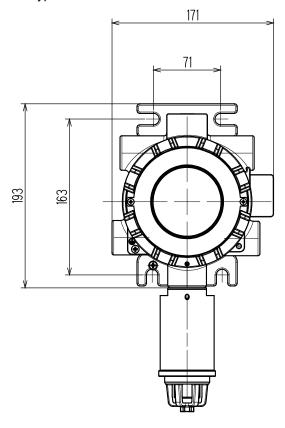
Model	SD-3	SD-3 (contact model)	
_	24 V DC (18 V - 30 V DC)		
Power source	*Use a power supply capable of minimum fuses blow normally in the event of a proc		
	j	(1.308 mm²/AWG16) or	
		same as transmission cable)	
Power supply cable	*To ensure explosion protection, use a cal		
	least 5 °C above the maximum anticipate	d ambient temperature.	
Power consumption	Refer to 'A6-1-3 Elec	ctrical ratings (SD-3)'.	
Cable connectors	M25	× 1.5	
Operation method	Dedicated magnet control key		
Operating	−40 °C - +70 °C (no sudden changes)		
temperature range	In accordance with sensor specifications if restrictions apply due to sensor		
1 0	specifications 0 %RH - 95 %RH (no condensation)		
Operating humidity		,	
range	In accordance with sensor specifications if restrictions apply due to se specifications		
Housing material	Stainless steel (SCS14)		
Protection level	IP66/67 equivalent		
Installation type	Wall mounting (standard)/2B pole mounting (optional)		
External	Diffusion type: Approx. 171 mm (W) × 322 mm (H) × 127 mm (D) (excluding projections)		
dimensions	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		

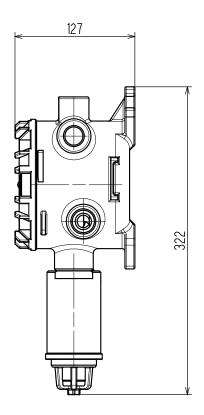
^{*} When used with the contacts closed, the contacts may seize due to vibration. Keep this precaution in mind.

^{**} SIL specification is not supported.

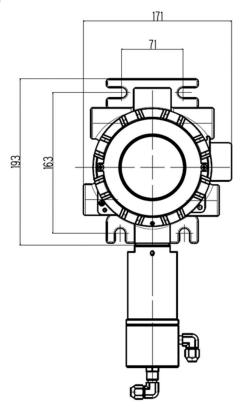
<Dimensional drawings (SD-3 (model with EC barrier))>

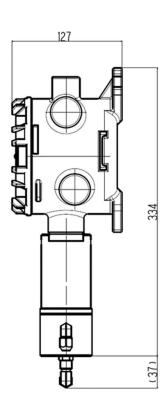
<Diffusion type>





<Suction type>





A6-1-3 Electrical ratings (SD-3)

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

A6-2 SD-3SC + GD-3 specifications

A6-2-1 SD-3SC + GD-3 (model without EC barrier)

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

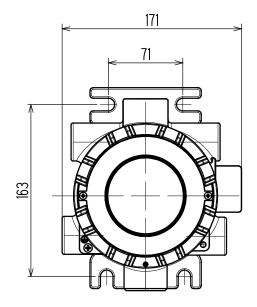
Model	SD-3SC + GD-3	SD-3SC (contact model) + GD-3
Transmission cable (4 - 20 mA)	Shielded cable 1.25 sq (1.308 mm²/AWG16) or 2.0 sq (2.08 mm²/AWG14) (same as power supply cable) *To ensure explosion protection, use a cable designed for use in temperatures at least 5 °C above the maximum anticipated ambient temperature.	
Transmission distance (4 - 20 mA)	For 2.0 sq (2.08 mm ² /AWG14): Not exc	/G16): Not exceeding 1.25 km ceeding 2 km (with derating depending on v voltage)
Transmission cable (between GD-3 units)		1.25 sq (1.308 mm²/AWG16) able designed for use in temperatures at ted ambient temperature.
Transmission distance (between GD-3 units)	20 m (r	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 mm²/AWG16) or 2.0 sq (2.08 mm²/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 'A6-2-3 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	**IP44/67 equivalent	
Installation type	Wall mounting (standard)/2B pole mounting (optional)	
External dimensions (SD-3SC)	Diffusion type: Approx. 125 mm (W) × 195	mm (H) × 88 mm (D) (excluding projections)
Weight (SD-3SC)	Appro	x. 6.0 kg
External dimensions (GD-3)	Approx. 125 mm (W) × 195 mm (H) × 88 mm (D)	
Weight (GD-3)	Approx. 3.0 kg	

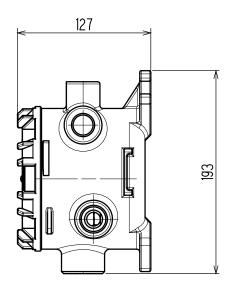
^{*}When used with the contacts closed, the contacts may seize due to vibration. Keep this precaution in mind.

^{**} In case of ANSI/FM/UL 60079-29-1 is applied. IP44 when IRF and ESF-A24R is installed. IP67 when NCF is installed.

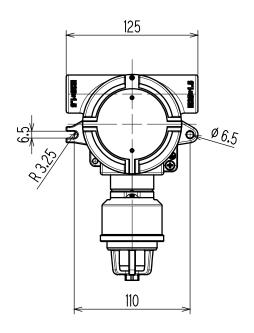
^{***} SIL specification is not supported.

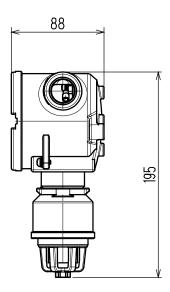
<Dimensional drawings (SD-3SC + GD-3 (model without EC barrier))>





<Diffusion type>





A6-2-2 SD-3SC + GD-3 (model with EC barrier)

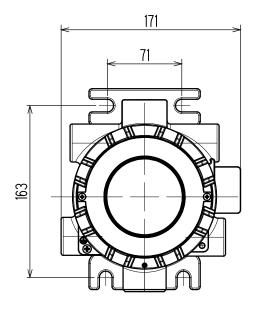
Model	SD-3SC + GD-3	SD-3SC (contact model) + GD-3	
Specifications	Standard	Contact	
Display	7-segment l	LED (5 digits)	
Sensor	F sensor (RIKEN KEIKI)		
Detection principle	Electroch	emical type	
Detection target gas	Depends on sen	sor specifications.	
Detection range	Depends on sen	sor specifications.	
Sampling method	Diffus	ion type	
Power supply indication	Power lam	np lit (green)	
External output	Gas concentration signal (4	- 20 mA DC + HART output)	
Alarm setpoints	Depends on sen	sor specifications.	
Alarm accuracy	Depends on sen	sor specifications.	
Alarm delay time	Depends on sen	sor specifications.	
Repeatability (for identical conditions)	Depends on sen	sor 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	System abnormality: Self-latching		
operation	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		ality diagnosis/communication diagnosis/ warning	
Warning display	Blinking display alternating between gas concentration and error code		
Warning operation	Same as no	rmal operation	
Functions	Alarm delay/suppression	on/HART communication	
Transmission method (4 - 20 mA)	3-wire analog transmission (common power supply <power common="" signal,="" supply,="">) or 2-wire analog transmission (current source)</power>		
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 mm²/AWG16) or 2.0 sq (2.08 mm²/AWG14) (same as power supply cable) *To ensure explosion protection, use a cable designed for use in temperatures at least 5 °C above the maximum anticipated ambient temperature.		

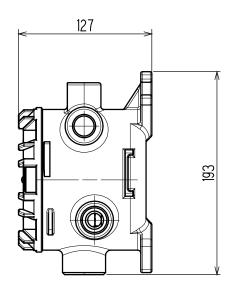
Model	SD-3SC + GD-3	SD-3SC (contact model) + GD-3
Transmission distance (4 - 20 mA)	For 1.25 sq (1.308 mm²/AWG16): Not exceeding 1.25 km For 2.0 sq (2.08 mm²/AWG14): Not exceeding 2 km (with derating depending on supply voltage)	
Transmission cable (between GD-3 units)		1.25 sq (1.308 mm²/AWG16) able designed for use in temperatures at ted ambient temperature.
Transmission distance (between GD-3 units)	20 m (n	naximum)
Power source		B V - 30 V DC) in temporary output of 2.5 A to ensure that oduct abnormality.
Power supply cable	Shielded cable 1.25 sq (1.308 mm²/AWG16) or 2.0 sq (2.08 mm²/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 'A6-2-3 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)	
External dimensions (SD-3SC)	Diffusion type: Approx. 125 mm (W) × 240 mm (H) × 88 mm (D) (excluding projections)	
Weight (SD-3SC)	Approx	k. 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.

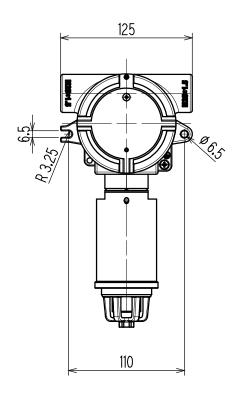
 $^{^{\}star\star}$ SIL specification is not supported.

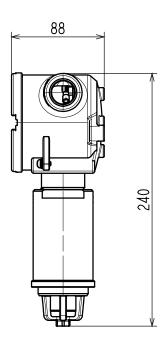
<Dimensional drawings (SD-3SC + GD-3 (model with EC barrier))>





<Diffusion type>





A6-2-3 Electrical ratings (SD-3SC + GD-3)

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

A6-3 Detection target gases for individual detection principles

A6-3-1 Non-dispersive infrared absorption type (Infrared type)

Sensor model	Gas name	Gas symbol	F.S.	1 digit	First Alarm setpoint	Second Alarm setpoint	Calibration gas	Operating temperature range	Operating humidity range	Years of warranty
IRF-1301*	Methane	CH₄	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	CH ₄			
IRF-1303*	Isobutane	i-C ₄ H ₁₀	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	i-C ₄ H ₁₀		95 %RH or less (no conden- sation)	
IRF-1317*	Propane	C₃H ₈	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	C ₃ H ₈ i-C ₄ H ₁₀			
IRF-1435	Carbon dioxide	CO ₂	2,000 ppm	1 ppm	1,000 ppm	-	CO ₂			3 years
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	−40 °C -		
IRF-1439	Carbon dioxide	CO ₂	10 vol%	0.01 vol%	1 vol%	-	CO ₂	70 °C		
IRF-1334*	Methane	CH ₄	100 vol%	0.5 vol%	25 vol%	50 vol%	CH₄			
IRF-1316*	Ethylene	C₂H₄	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	C ₂ H ₄ CH ₄			
IRF-1340*	Isobutylene	i-C ₄ H ₈	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	i-C ₄ H ₈ i-C ₄ H ₁₀			
IRF-1308*	n-Hexane	n-C ₆ H ₁₄	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	n-C ₆ H ₁₄ i-C ₄ H ₁₀			
IRF-1332*	Butadiene	C ₄ H ₆	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	C ₄ H ₆ CH ₄			
IRF-1315	Propane	C ₃ H ₈	100 vol%	0.5 vol%	25 vol%	50 vol%	C ₃ H ₈			

^{*}Interference occurs due to other hydrocarbon gases.

- ▶ 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.)
- ▶ For ethylene or butadiene to which the product has low gas sensitivity, set the alarm set point to 25 %LEL or higher.
- ▶ Due to infrared absorption characteristics, readings may differ even for the same target gas concentration if the base gas composition differs significantly between calibration and measurement—for example, if an air base is used for calibration and a CO₂ base is used for measurement.

- ▶ Perform maintenance if a warning appears while the self-diagnostic function is active.
- ▶ Regardless of the detection target gas, the warranty period for IRF sensors is 3 years.

A6-3-2 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	CH₄	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	CH ₄ * ²	-40 °C - 70 °C	0 %RH - 95 %RH*1 (no condensation) 3 years	
NCF-6319	VCM	VCM	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	i-C ₄ H ₁₀			3 years
NCF-6320	Hydrogen	H ₂	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	H ₂ * ³			

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

- ▶ Install in a location with stable conditions within the specified operating temperature range and free of sudden fluctuations.
- ➤ The sensor characteristics may deteriorate significantly if silicone gases (organic silicone gases), halogen gases, sulfide gases, or acid gases are present.
- ▶ A silicone removal filter and activated carbon filter are available as options.
- ► For models with a F.S. of 5,000 ppm or less, allow the product to warm up for at least 120 minutes in clean air before performing zero calibration and span adjustment.
- ▶ For models with a F.S. of 5,000 ppm or less, the effects of ambient humidity and temperature fluctuations will become more significant, and the zero point may drift. If this occurs, enable the zero follower function. However, we recommend using a sensor with a different detection principle where gas is constantly present. The zero follower function cannot be used under such conditions.
- The reading may change even for combustible gases other than the detection target gas.
- Readings may fall as oxygen concentrations decrease.
- ▶ Interference may occur if gases with high thermal conductivity, such as high-concentration CO₂, Ar, or He, are present as the base gas.
- ▶ In detecting gases with low vapor pressure by the suction method, the gas may form a mist when drawn in from the high-temperature side and detected at the low-temperature side, possibly forming condensation inside the sensor or causing clogging due to sintering. Keep vapor pressure in mind during use.
- ▶ Perform maintenance if a warning appears while the 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.

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

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

A6-3-3 Semiconductor type

Sensor model	Gas name	Gas symbol	F.S.	1 digit	First Alarm setpoint	Second Alarm setpoint	Calibration gas	Operating temperature range	Operating humidity range	Years of warranty
SGF-8562	Carbon disulfide	CS ₂	200 ppm	1 ppm	50 ppm	100 ppm	CS ₂	−20 °C - 65 °C	20 %RH -	
SGF-8563	Ethylene oxide	EO	100 ppm	1 ppm	25 ppm	50 ppm	EO		95 %RH* (no	3 years
SGF-8562	Hydrogen sulfide	H₂S	100 ppm	1 ppm	25 ppm	50 ppm	H₂S		condensation)	

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

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

<Semiconductor type sensor warmup times>

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

A6-3-4 Hot-wire semiconductor type

Sensor model	Gas name	Gas symbol	F.S.	1 digit	First Alarm setpoint	Second Alarm setpoint	Calibration gas	Operating temperature range	Operating humidity range	Years of warranty
SHF-8601	Methane	CH ₄	5,000 ppm	25 ppm	2,000 ppm	4,000 ppm	CH₄	−30 °C - 70 °C	20 %RH -	
SHF-8601	Carbon monoxide	со	1,000 ppm	10 ppm	250 ppm	500 ppm	со	0 °C - 70 °C	95 %RH* (no	3 years
SHF-8603	Hydrogen	H ₂	2,000 ppm	10 ppm	500 ppm	1,000 ppm	H ₂	-30 °C - 70 °C	condensation)	

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

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

<Hot-wire semiconductor type sensor warmup times>

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

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

A6-3-5 Electrochemical type

Sensor model	Gas name	Gas symbol	F.S.	1 digit	First Alarm setpoint	Second Alarm setpoint	Calibration gas	Operating temperature range *5	Operating humidity range	Years of warranty
ESF-A24A	Nitrgen 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	со	150 ppm	1 ppm	50 ppm	80 ppm	СО	−40 °C - 70 °C*²	20 %RH - 90 %RH (no condensation)	3 years
ESF-A24R	Hydrogen sulfide	H₂S	100 ppm	0.5 ppm	20 ppm	40 ppm	H₂S	−40 °C - 70 °C*²	95 %RH or less (no condensation)	3 years
ESF-A24R3	Hydrogen sulfide	H₂S	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-A24RH*1	Hydrogen sulfide	H₂S	30 ppm	0.2 ppm	10 ppm	20 ppm	H₂S	−40 °C - 70 °C*²	40 %RH - 95 %RH (no condensation)	3 years
ESF-B22	Ammonia	NH₃	75 ppm	0.5 ppm	25 ppm	50 ppm	NH₃	−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.

- ▶ 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

^{*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.

Appendix B

B1

Installation

B1-1 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.



- The product is a precision device. The expected performance of this product may be affected by the location (environment) in which it is installed. Assess conditions at the installation location and take necessary measures accordingly.
- Install the number of units needed at the appropriate locations to ensure that the product plays an important role in safety and disaster prevention.
- Areas where gas is likely to leak or accumulate will differ depending on the gas type and individual work areas. Thoroughly consider the installation locations and number of units to be installed before installation.
- Gas or vapor contact with the sensor must not be obstructed by debris, snow, mud, or external devices.
 The protection rating does not constitute a guarantee that the product is capable of detecting gas correctly during or after exposure to these conditions. Check the product operation and calibrate if it has been exposed to accumulated dust, immersion in water, or high pressure water spray.
- Use genuine optional accessories.
- The SD-3RIP uses a different length cable from other SD-3 Series models, as the power consumption differs. Thoroughly consider the installation locations and number of units to be installed before installation.
- The SD-3SC used in conjunction with the GD-3RIP differs from other SD-3 Series models. Check the specifications when installing.

B1-1-1 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-3RIP 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-3RIP 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.
- · 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 a 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.

B1-1-2 Restrictions regarding installation1

<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 fielding water, oil, chemicals, or other liquids. Deploy the optional protective cover (main unit protection) and field 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 'B6-2. Detection target gases for detection principle'.

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.>

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

The IRS sensor sunshade or SD-3RIP protective cover must be used even in locations not exposed to direct sunlight.

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

The product requires periodic maintenance.

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

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

<Use the appropriate power supply and power cable.>

The product requires 24 V DC (18 V - 30 V DC, 20 - 30 V for SD-3SC) power to operate. The power cable used should have a cross section of 1.308 mm² (AWG16) or 2.082 mm² (AWG14). Use shielded 3-core cable or 4-core cable.

Cables and power supply

Voltage drop may occur due to the cable resistance, resulting in the product being supplied with a lower voltage (at the SD-3RIP terminal plate) than the power supply voltage at the source. If the actual voltage supplied to the SD-3RIP drops below 18 V DC (20 V for the SD-3SC) due to voltage drop caused by the cable, the power supply voltage at the source must be increased.

This voltage drop depends on the type and length of the cable, ambient temperatures, and the current consumed by the product.

The current consumed by the product depends on the model and the state of alarm relays within the SD-3RIP.

<Method for calculating the power supply voltage at the source -1>

Use the following equation to calculate the power supply voltage at the source:

Power supply voltage at source = A (SD-3RIP consumption current) × B (installed cable resistance × 2) + 18 V (+ 20 V for SD-3SC)

A: SD-3RIP consumption current (@ 18 V (20 V for SD-3SC + GD-3RIP))

Select from the following table

Model	Max. consumption current	Remarks
SD-3RIP, SD-3DRIP	465mA	@18V
SD-3SC+GD-3RIP	440mA	@20V

B: Installed cable resistance

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

Example:

A: Consumption current = 465 mA (SD-3RIP)

B: Maximum installed cable resistance = 5.76 Ω (CVV-S, 1.308 mm₂, 300 m, @ 70 °C)

Power supply voltage at source = 465 mA × (5.76 Ω × 2) + 18 V

= 5.36V + 18V

= 23.36 V (minimum required voltage)

To account for voltage fluctuations, provide a safety margin for the result obtained above.

< Method for calculating the power supply voltage at the source -2>

If the type and length of the installed cable are unknown and method -1 cannot be used, use this method to verify whether the actual supplied voltage is acceptable based on the voltage obtained with method -1.

Perform an alarm test using the following conditions. (Refer to 'B3-3-2 Performing alarm test'.)

• Enable the contact operation.

Press the ▲ key to increase the reading until the full scale is exceeded ([nnnn]). Check to confirm that the voltage at the product terminal plate is at least 18 V DC (20 V for the SD-3SC) here.

Perform a fault test using the following conditions. (Refer to 'B3-3-3 Performing fault test'.)

• Enable the contact operation.

Check to confirm that the voltage at the product terminal plate is at least 18 V DC (20 V for the SD-3SC). If the voltage is less than 18 V DC (20 V for the SD-3SC), boost the supply voltage. If the temperature rises during use, make sure that the power supply voltage is sufficient to compensate for the voltage drop due to the increased cable resistance.

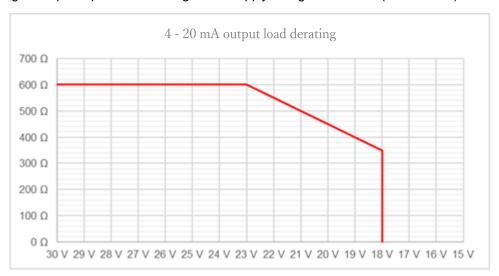
<Install away from noise-emitting devices (main unit and cables).>

Install away from locations where high-frequency or high-voltage devices are present. The product may be affected by electromagnetic noise, etc.

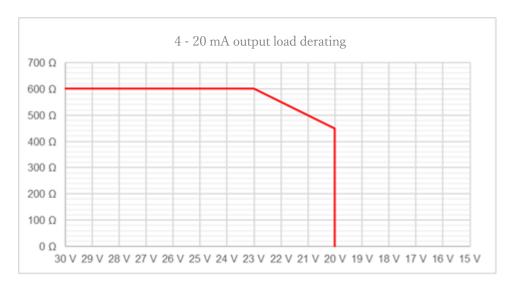
<Use the appropriate impedance for the 4 - 20 mA signal output.>

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

<4 - 20 mA signal output impedance derating due to supply voltage differences (for SD-3RIP)>



<4 - 20 mA signal output impedance derating due to supply voltage differences (for SD-3SC)>



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

<us>Use alarm contacts correctly.>

The alarm contacts on this product are designed to transmit signals to activate external buzzers, alarm indicators, revolving lights, etc. Never use for controls on which human life depends or other mission critical controls (e.g., shutoff valve controls).

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

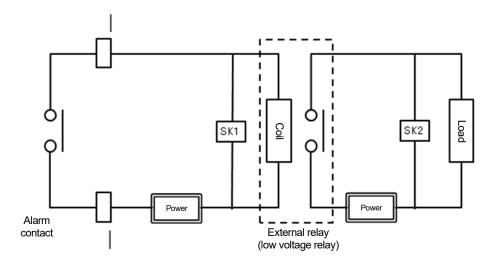
The alarm contact specifications for the product apply under resistance load conditions. If inductive loads occur at the alarm contacts, a counter-electromotive force will be generated at the contacts, leading to the following potential problems:

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

When operating a load, stabilize the operation of this product, then take the following measures, where appropriate, to protect the alarm contacts.

- Use an external relay (low voltage, not exceeding 100 V AC) to link the circuits (contact amplification). Add a surge absorber (SK1) appropriate for the rating to the external relay.
- Where necessary, add a surge absorber (SK2) on the load side of the external relay.
- In certain cases, due to load conditions, it may be preferable to attach the surge absorber to the contact side. Confirm load behavior and determine the optimal attachment point.

<SD-3RIP>



* SK1, SK2: Surge absorbers



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



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



A de-energized b contact (break contact) may cause a momentary open operation due to external
forces or other physical impact. If a b contact is used as an alarm contact, implement measures to
account for such momentary operations—for example, add a delay operation (of approximately one
second) to the signal on the b contact receiving side.

<Pre><Pre>recautions when installing in the presence of interference gases>

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

Sensor type	Interference gas
IRS	Combustible gas sensor: Hydrocarbons, alcohols, organic solvents, H2O, etc. other than the target gas

<Install oriented only in the direction shown below>

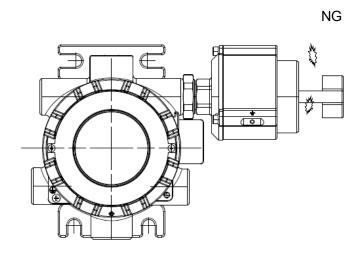
Do not install the IRS sensor oriented in any direction other than that indicated below.



<Pre>cautions when installing in the presence of interference gases>

The IRS sensor is an optical gas measuring device. Do not install in locations where there are interfering objects blocking the light path.

Install the detector in a location away from air pollutants and sources of vapor or condensation that could build up on the optical surfaces.



B1-2 System design precautions

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



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

B1-2-1 Using a stable power supply

The product's external output and alarm contacts may activate while the system stabilizes at power-on or in the event of an instantaneous power failure.

If external outputs or alarm contacts are activated due to power failure or other reasons, take appropriate measures such as using an UPS(uninterruptible power supply).

Supply this product with the following power sources:

Power supply voltage	24 V DC (18 V - 30 V DC; 20 V - 30 \ voltage	/ DC for SD-3SC): Main unit terminal
Time allowed for instantaneous power failures	Up to approx. 20 ms*1	Example of countermeasure: Use an external uninterruptible power supply or similar system to guarantee continuous operation and functionality.
Miscellaneous	Do not use with power supplies subject to very high power loads or high frequency noise.	Example of countermeasure: Where necessary, use a line filter or other device. Keep the product away from sources of noise.

^{*1:} Restart the product to recover from instantaneous power failures exceeding 20 ms.

B1-2-2 Lightning strike protective measures

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

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

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

<Protection against lightning>

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

<Grounding>

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

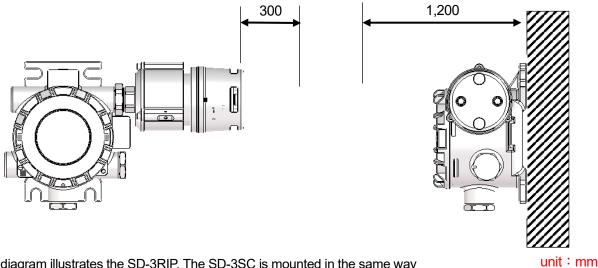
NOTE

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

Providing maintenance space

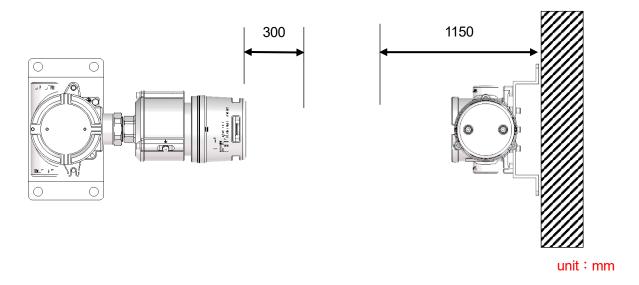
When mounting the product, allow space to open and close the covers during maintenance.

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



^{*}The diagram illustrates the SD-3RIP. The SD-3SC is mounted in the same way

<Remote sensor head (GD-3RIP)>





The product requires periodic maintenance.

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

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

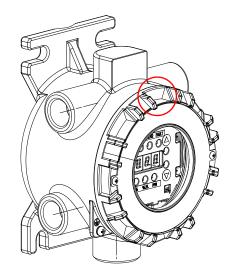
B1-4 Connecting the sensor to the main unit

The SD-3RIP Series is shipped as a separate gas monitor (SD-3RIP) and IRS sensor. Connect the IRS sensor to the gas monitor as described below.

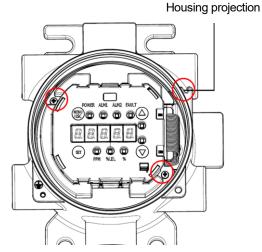
1 Unscrew the single M4 hex socket set screw on the main unit cover, then rotate the cover counterclockwise to remove.

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

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



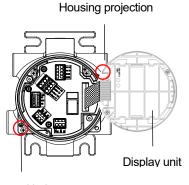
2 Unscrew the two M3 screws securing the display unit.



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

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

Avoid pulling on the display unit with excessive force while removing it.

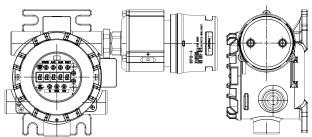


Ground bolt

4 Check to confirm that the nut on the sensor to be mounted is tightened up to the sensor, rotate the sensor all the way clockwise, then rotate the sensor

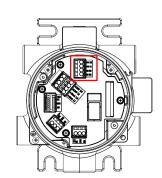
counterclockwise until it is oriented as shown in the figure before securing with the nut.

Do not rotate the sensor back by more than one rotation.

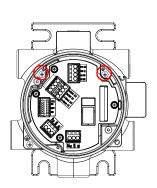


5 Connect the sensor cables to the sensor terminal plate.

Terminal	Power supply/signal cable connection
PW(+)	Red cable
PW(-)	Black cable
RS(A)	Blue cable
RS(B)	White cable

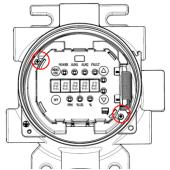


6 Connect the sensor cable ground wire (green cable) to the ground screw inside the main unit.



- 7 Mount the sensor terminal plate on the terminal plate PCB.
- 8 Return the display unit to its original position, and secure with the two M3 screws.

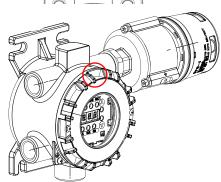
Take care not to trap the cable here.



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



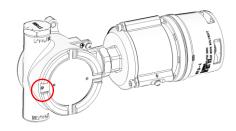
B1-5 Connecting the remote sensor head to the main unit

The SD-3RIP Series is shipped as a separate remote sensor head (GD-3RIP) and IRS sensor. Connect the IRS sensor to the remote sensor head as described below.

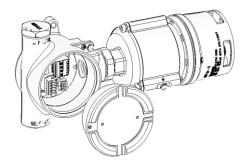
1 Unscrew the single M4 screw on the remote sensor head (GD-3RIP) cover.

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

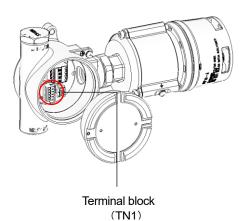
Be careful to avoid dropping the cover while unscrewing and removing it.



2 Rotate the cover counterclockwise and remove.

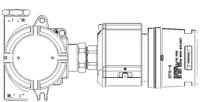


3 Pull out the terminal block (TN1) on the terminal block board to remove it.



4 Check to confirm that the nut on the sensor to be mounted is tightened up to the sensor, rotate the sensor all the way clockwise, then rotate the sensor counterclockwise until it is oriented as shown in the figure before securing with the nut.

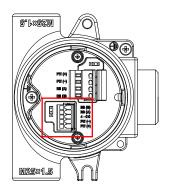
Do not rotate the sensor back by more than one rotation.



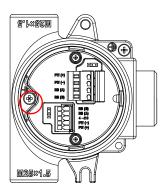


5 Connect the sensor cables to the sensor terminal plate.

Terminal	Power supply/signal cable connection
PW(+)	Red cable
PW(-)	Black cable
RS(A)	Blue cable
RS(B)	White cable



6 Connect the sensor cable ground wire (green cable) to the ground screw inside the remote sensor unit.

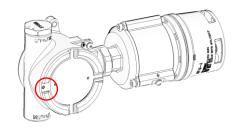


7 Mount the sensor terminal plate on the terminal plate PCB.

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

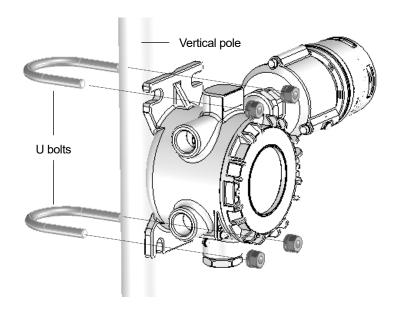


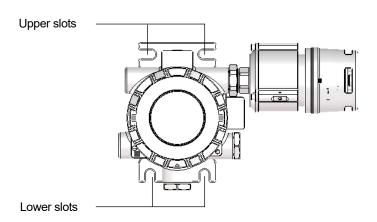
B1-6 Installing the main unit

B1-6-1 Vertical pole mounting

Mount the main unit (SD-3RIP/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 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 spring washers and two M10 nuts.



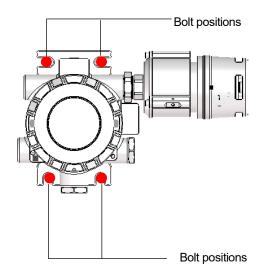


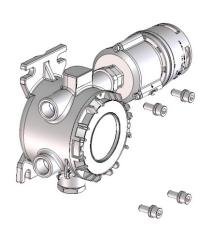
^{*}The diagram illustrates the SD-3RIP. The SD-3SC is mounted in the same way

B1-6-2 Wall mounting

Mount the main unit (SD-3RIP/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-3RIP. The SD-3SC is mounted in the same way



The product requires periodic maintenance.

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

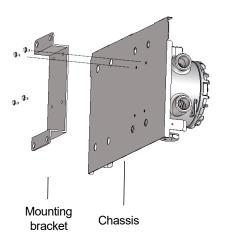
- Within systems where the system must be stopped for maintenance
- · Locations where part of the system must be detached to allow maintenance
- Locations where the product cannot be removed due to the presence of pipes or racks
- Locations where maintenance work is hazardous—for example, near high-voltage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

B1-6-3 Attaching protective cover

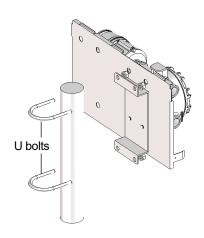
Attach the protective cover to the main unit (SD-3RIP/SD-3SC).

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

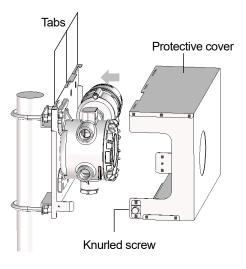
1 Secure the chassis and mounting bracket to the main unit, then secure with four $M5 \times 6$ double SEMS bolts from the rear, as shown in the figure to the right.



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



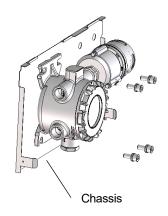
- 4 Align the protective cover with the three tabs on top of the chassis to attach.
- 5 Tighten the knurled screws on either side of the protective cover to secure in place.



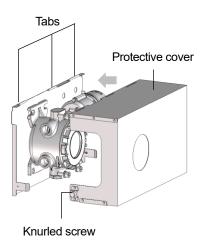
^{*}The diagram illustrates the SD-3RIP. The SD-3SC is mounted in the same way

<Attach to a wall>

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.



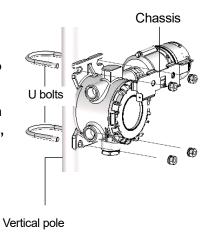
^{*}The diagram illustrates the SD-3RIP. The SD-3SC is mounted in the same way

B1-6-4 Attaching the sunshade

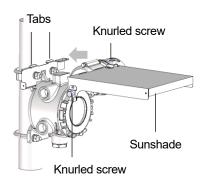
Attach the sunshade to the main unit (SD-3RIP/SD-3SC).

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

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



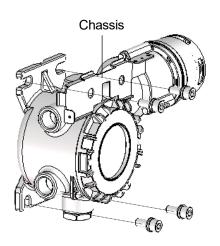
- 3 Align the sunshade with the two tabs on top of the chassis to attach.
- 4 Tighten the knurled screws on either side of the sunshade to secure in place.



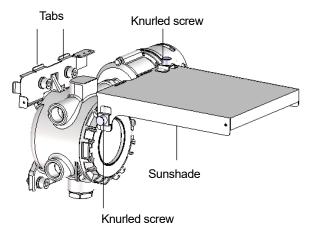
^{*}The diagram illustrates the SD-3RIP. The SD-3SC is mounted in the same way

<Attach to a wall>

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



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

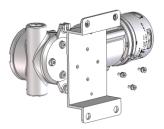


^{*}The diagram illustrates the SD-3RIP. The SD-3SC is mounted in the same way

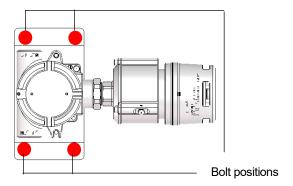
B1-7 Remote sensor head (GD-3RIP) installation

B1-7-1 Wall mounting

1 Attach the mounting bracket to the remote sensor head (GD-3RIP). Secure with four M5 double SEMS bolts.



2 Press the remote sensor head (GD-3RIP) against the wall surface and secure with four M10 double SEMS bolts.

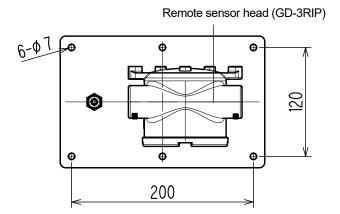


B1-7-2 Duct mounting

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

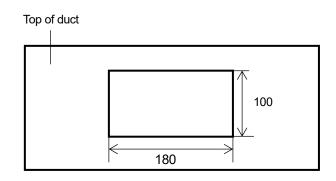
Use the duct mounting kit when attaching to a duct.

The dimensions of the duct mounting kit are as follows:



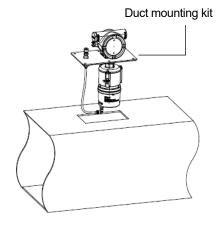
1 Cut out an opening in the top of the duct.

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

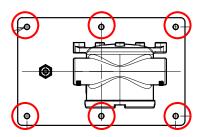


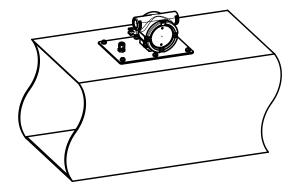
2 Insert the remote sensor head (GD-3RIP) into the duct mounting kit and secure with four M5 bolts.

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



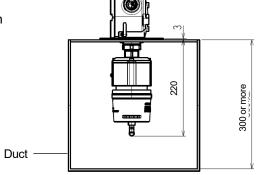
3 Insert the duct mounting kit into the opening in the duct. Secure in place with six M6 bolts.





NOTE

- ▶ When mounting the remote sensor head (GD-3RIP) inside a duct, make sure the sensor is not in contact with the duct inner wall, as shown in the figure to the right.
- Duct-mounted models are provided with a dedicated guard instead of the field guard. Connect this guard to the duct-mounted model's gas inlet with a pipe for external calibration.

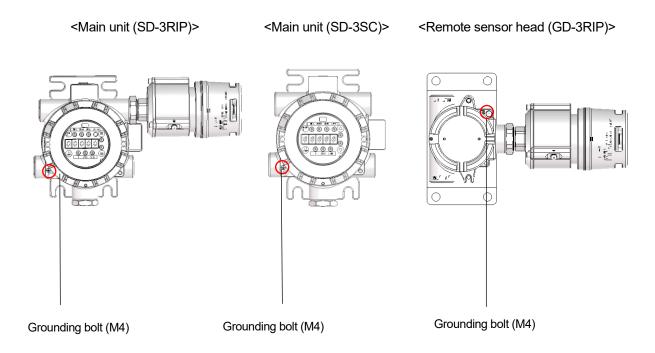


B1-8 Connecting the grounding terminal

WARNING

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

Connect the grounding bolt to the local grounding terminal.



NOTE

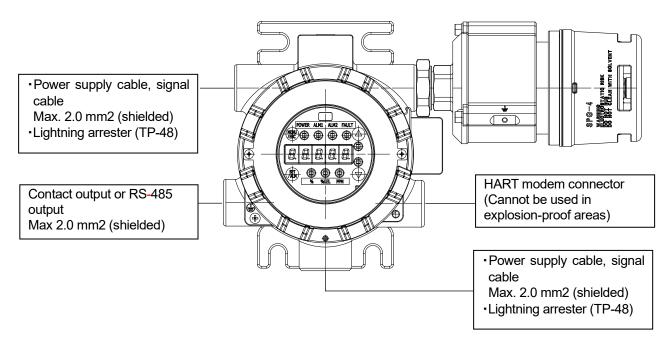
▶ The grounding bolt is marked with the (symbo

B1-9 Cable connection

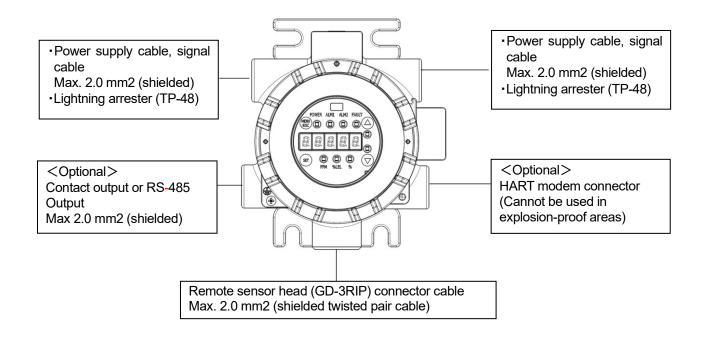
B1-9-1 Main unit cable and device connectors1

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

<SD-3RIP>



<SD-3SC>



NOTE

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

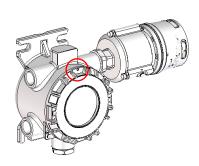
B1-9-2 Connecting cables to the main unit

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

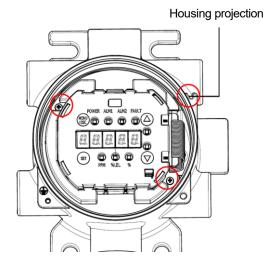
1 Unscrew the single M4 hex socket set screw on the main unit cover, then rotate the cover counterclockwise to remove.

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

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



2 Unscrew the two M3 screws securing the display unit.



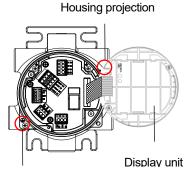
3 Take out the display unit and hook onto the housing projection.

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

Avoid pulling on the display unit with excessive force while removing it.

4 Ground the main unit.

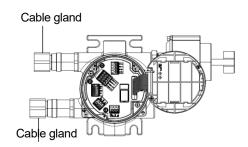
Install with Class D equivalent grounding (grounding resistance not exceeding 100 Ω). Refer to 'B1-8 Connecting the grounding terminal' for information about grounding.



Ground bolt

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

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



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

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

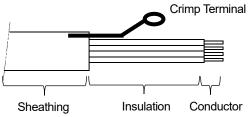
Connect each of the cables to the following terminals on the power supply/signal terminal plate: For more information on the contact cable connections, refer to 'B1-10 Alarm relay setting (option)'. For more information on connecting the cables to the terminal plates, refer to 'B1-9-5 Connecting cables to the terminal plate'.

<Using 3-core cable>

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

<Using 4-core cable>

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

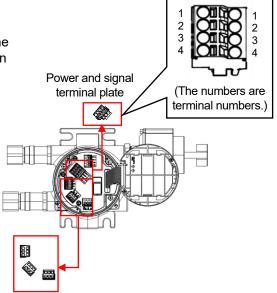


Recommended insulation length: 40 - 50 mm

When connecting the cable, connect the shield of the cable to the upper left or right terminal inside the main unit. Depending on the installation location, noise interference may result. If this happens, remove the shielding.

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

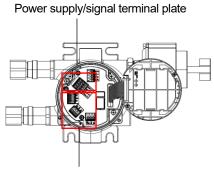
For more information on connecting cables to the terminal plates, refer to 'B1-9-5 Connecting cables to the terminal plate'.



Contact output terminal plates

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

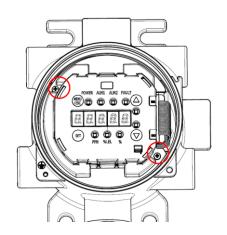
9 Mount the terminal plates on the terminal plate board. Adjust the cable position so that no load is applied to the terminal plates.



Contact output terminal plates

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

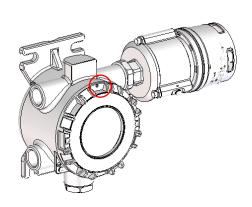
Take care not to trap the cable here.



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.



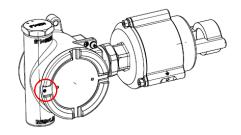
^{*}The diagram illustrates the SD-3RIP. The SD-3SC is connected in the same way.

B1-9-3 Connecting the power and signal cables to the remote sensor head (GD-3RIP)

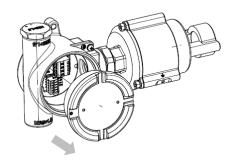
 Unscrew the single M4 screw on the remote sensor head (GD-3RIP) cover.

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.

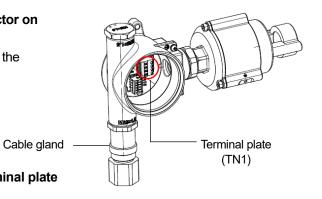


2 Rotate the cover counterclockwise and remove.

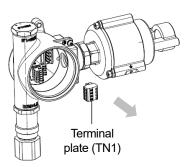


3 Attach a cable gland or conduit to the connector on the remote sensor head (GD-3RIP).

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



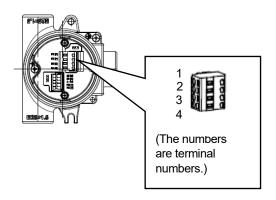
Pull out the terminal plate (TN1) from the terminal plate PCB.

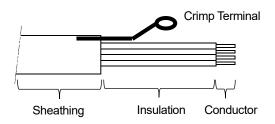


5 Connect the power and signal cables to the terminal plate.

Connect the cables to the following terminals on the terminal plate. For more information on connecting cables to the terminal plates, refer to 'B1-9-5 Connecting cables to the terminal plate'.

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





Recommended insulation length: 50 - 60 mm

When connecting the cable, connect the shield of the cable to the upper left or right terminal inside the main unit. Depending on the installation location, noise interference may result. If this happens, remove the shielding.

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

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

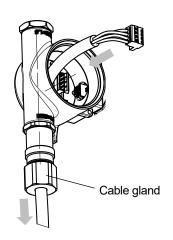
7 Mount the terminal plate on the terminal plate board.

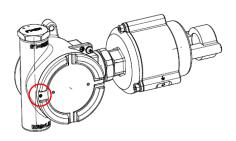
Adjust the cable position so that no load is applied to the terminal plates.

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.



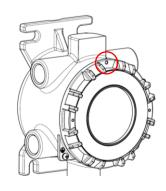


B1-9-4 Connecting the main unit (SD-3SC) and remote sensor head (GD-3RIP)

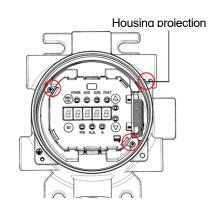
1 Unscrew the single M4 hex socket set screw on the main unit (SD-3SC) cover, then rotate the cover counterclockwise to remove.

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

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

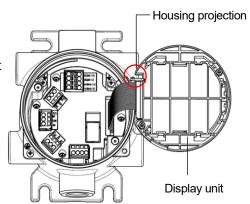


2 Unscrew the two M3 screws securing the display unit.



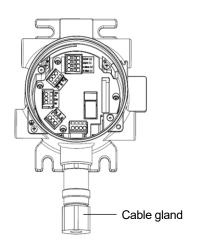
3 Take out the display unit and hook onto the housing projection.

The display unit is connected to the terminal plate unit by a flat cable. Pulling with excessive force may disconnect the cable. Avoid pulling on the display unit with excessive force while removing it.



4 Attach a cable gland or conduct to the connector on the main unit

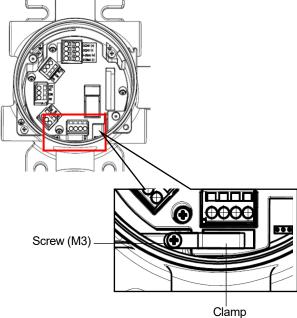
Use a cable gland or conduit appropriate for the cable purpose and type.



.

5 Pull out the remote connections terminal plate from the terminal plate PCB.

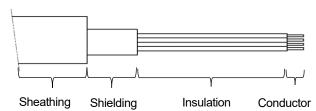
6 Unscrew the single M3 screw securing the clamp and remove the clamp.



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

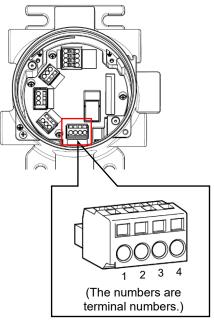
Connect the cables to the following terminals on the remote connections terminal plate. For more information on connecting cables to the terminal plates, refer to 'B1-9-5 Connecting cables to the terminal plate'.

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



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

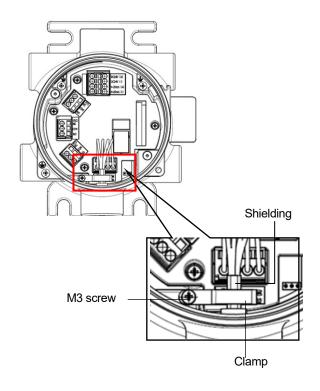
8 Mount the terminal plate on the terminal plate PCB. Adjust the cable position so that no load is applied to the terminal plates.



Remote connection terminal plate

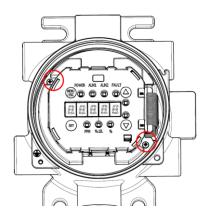
9 Put the shield clamp on the cable.

Use the single M3 screw to clamp the cable shielding.



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

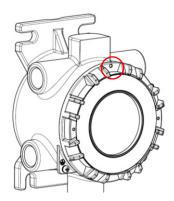
Take care not to trap the cable here.



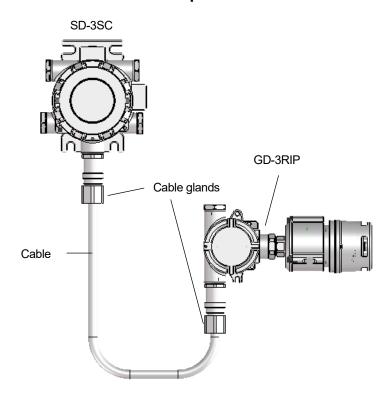
11 Rotate the cover clockwise to attach, and secure with the single M4 hex socket set screw.

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

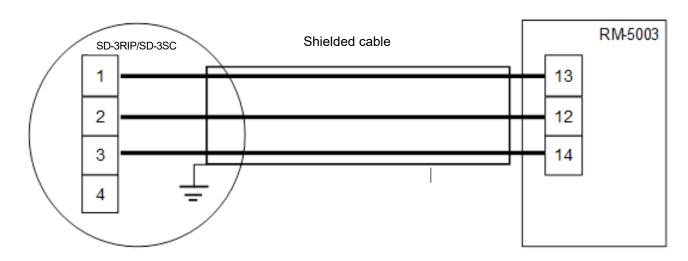
Take care not to trap the cable when attaching the cover. Rotate the cover clockwise until it moves no further to securely fasten in place.



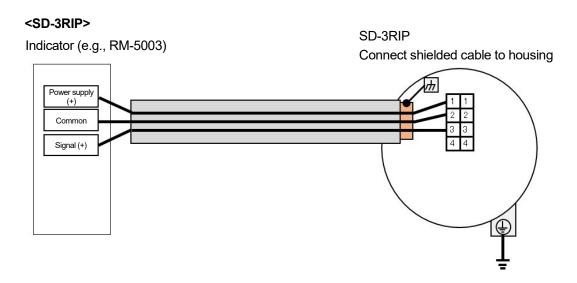
<SD-3SC and GD-3RIP connection example>

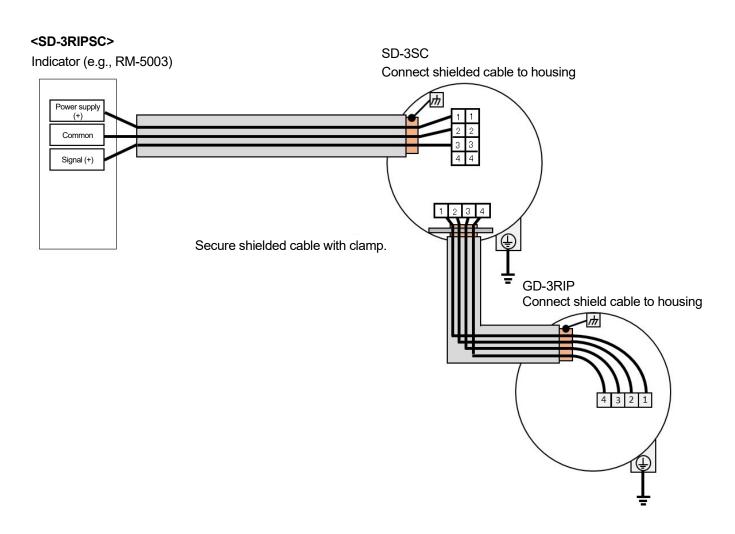


<SD-3RIP/SD-3SC and RM-5003 terminal plate connection example>



<Indicator connection example>





B1-9-5 Connecting cables to the terminal plate

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

<Terminal plate specifications>

Rated voltage: 300 V ACRated current: 10 A

This 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-3RIP 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. Insulation failure or overheating may result if the wire splays when inserted.
- To prevent the above, we recommend the use of bar terminals (ferrule) when bare wires are stranded.



< Compatible bar terminal >

Use the following bar terminals:

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



 Be sure to use the specified rod terminals. Performance is guaranteed only for the bar terminals specified.

<Connecting cables to terminal plate>

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

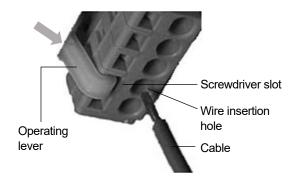
The operating lever provided as a standard accessory cannot be used to connect power and signal cables to TN1 on the SD-3RIP. Use a flathead screwdriver in this case.



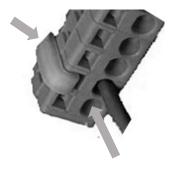
- Be sure to use the correct tools.
- In general, connect only one cable to one wire insertion hole.
- If a cable is inserted into the screwdriver slot, the conductor may not make contact, resulting in conduction faults or overheating.

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.



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.

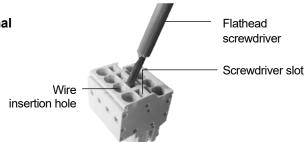
The cable is now connected to the terminal plate.

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

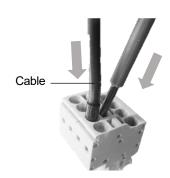
Avoid pulling with excessive force.

When using a flathead screwdriver to connect to TN1 on the SD-3RIP, 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.



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



3 Release the flathead screwdriver.

The cable is now connected to the terminal plate.

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

Avoid pulling with excessive force.

B1-10 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.



For supply voltages of 30 V AC or 42.4 V DC or greater, either fit protective tubing to the cable or use a
double insulation cable.



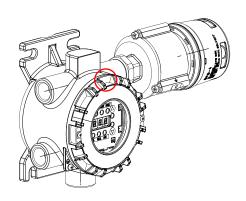
- Note that recurring use with the alarm relay contacts normally closed may result in the contacts seizing
 due to minute vibrations.
- Connect the relay cable and sensor before turning on the power to the product.

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-3RIP/SD-3SC).

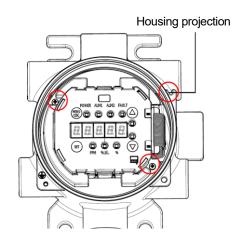
1 Unscrew the single M4 hex socket set screw on the main unit cover, then rotate the cover counterclockwise to remove.

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.



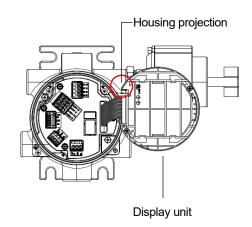
2 Unscrew the two M3 screws securing the display unit.



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

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

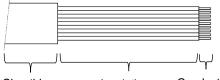
For more information on connecting cables to the terminal plates, refer to 'B1-9-5 Connecting cables to the terminal plate'.

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 PCB.

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

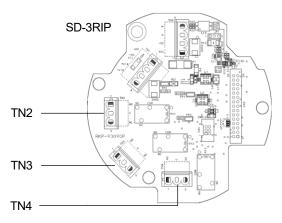
7 Return the display unit to its original position and secure with the two M3 screws.

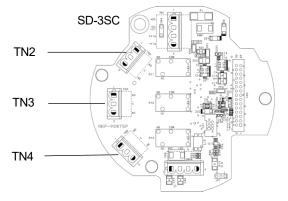
Take care not to trap the cable here.

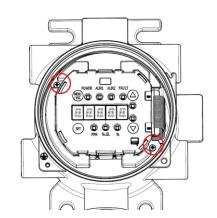
8 Rotate the cover clockwise to attach, and secure with the single M4 hex socket set screw.

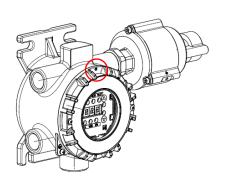
Use a hex key wrench (2 across flats) to tighten the M4 hex socket set screw.

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-3RIP. The SD-3SC is connected in the same way.

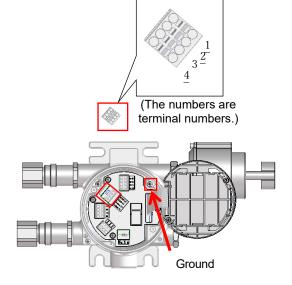
B1-11 Mounting the lightning arrester

The SD-3 allows for easy connection of a lightning arrester.

Be sure to use the specified model, and connect to the power supply/signal terminal plate.

<3-wire>

•			
Terminal No.	Power supply/signal connection	Lightning arrester connection	
1	Power supply (+)	Blue	
2	Common (-)	Brown	
3	Signal (+)	Black	
Ground	-	Yellow/green	



<4-wire>

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

NOTE

► [Specified lightning arrester]

Model: TP48-3-N-NDI TP48-4-N-NDI

- * When connecting a lightning arrester, use connector 2, 4, or 6.
 - Explosion-proof performance cannot be guaranteed if other connectors are used.
- ▶ Perform an operation check before installing lightning arresters. Additionally, lightning arresters cannot remove all surge voltages.

CAUTION

- This is available for IECEx/ATEX models only.
- Stop using the product if any operating irregularities occur.

B1-12 RS-485 Settings (option)

Using RS485 allows digital communication.



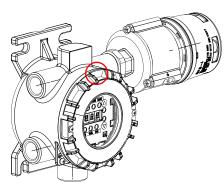
- Use a shielded twisted pair cable.
- Do not install wiring near main cables or high voltage equipment.
- Do not connect any devices other than the SD-3 series on the Modbus.

To use RS-485, connect the RS-485 communication wiring to the TN2 terminal block on the main unit (SD-3RIP, SD-3SC).

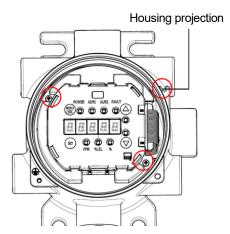
1 Unscrew the single M4 hex socket set screw on the main unit cover, then rotate the cover counterclockwise to remove.

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.



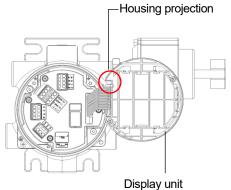
2 Unscrew the two M3 screws securing the display unit.



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.

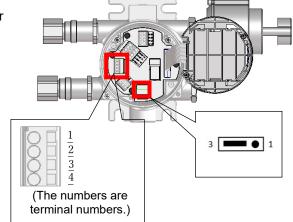


- 4 Pull out the terminal plate (TN2(RS-485)) from the terminal plate PCB.
- Only turn on the termination resistance of the termination resistance of the device that is connected at the furthest position on the Modbus.

Do not turn on the termination resistance of any other devices.

JP2

Terminal number	Termination Resistor
1-2(standard)	OFF.
3-2	ON(120Ω)



6 Connect the RS-485 communication wiring to the corresponding terminals on the removed terminal block.

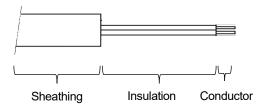
For instructions on how to connect cables to the terminal block, see 'B1-9-5 Connecting cables to the terminal plate'.

TN2(RS-485)

Terminal number	Cable connection
1	RS-485(A1).
2	RS-485(B1)
3	RS-485(A2)
4	RS-485(B2).

TN3 (If communication is unstable, please review the connection.)

Terminal number	Cable connection
1	Signal ground
2	N.C.
3	Frame ground



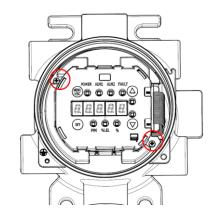
Recommended insulation length: 40 to 50 mm

6 Mount the terminal plate (TN2 (RS-485)) to the terminal plate PCB.

Adjust the cable position so that no load is placed on the terminal plate.

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

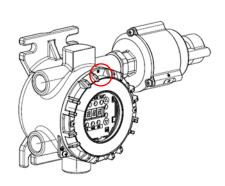
Take care not to trap the cable here.



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-3RIP. The SD-3SC is connected in the same way.

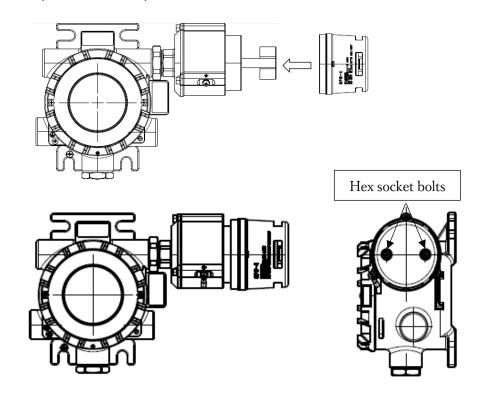
B1-13 Mounting the field guard

1 Mount the field guard over the IRS sensor, then secure using the bolts

Mount the field guard securely by tightening the bolts.

Be careful to avoid overtightening.

Hex socket bolts (two M5 × 12 bolts)



^{*} The diagram illustrates the SD-3RIP. The remote sensor head (GD-3RIP) is mounted in the same way.

B2

Usage Instructions

B2-1 Preparations for startup

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

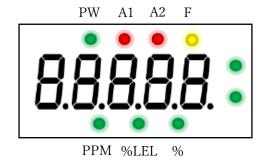
- · Check to confirm that the product is grounded.
- · Check to confirm that external wiring is correctly connected.
- Check to confirm that the power supply voltage is within the rated range.
- External contacts may activate while adjustments are underway. Take precautions to prevent unwanted consequences due to activated contacts.

<How to read display examples>

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

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

PW:



lights up (green) / flashes (green). A1: ALM1 (alarm lamp) | lights up (red). A2: ALM2 (alarm lamp) lights up (red). F: FAULT (fault lamp) | lights up (yellow). PPM: lights up (green). Unit lamp %LEL: Unit lamp lights up (green). %: Unit lamp lights up (green).

POWER (power lamp)

B2-2 Startup



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

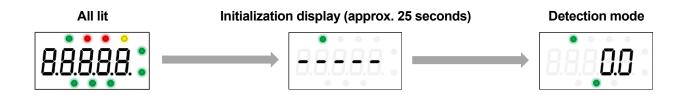
Turn on the power supply (24 V DC) and start the product.

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.

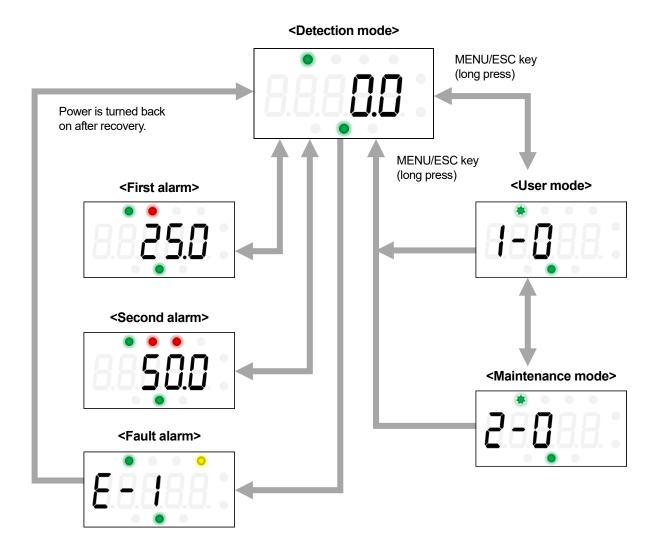




- Never turn off the power while initialization is underway. The internal memory is read during initialization.
- Depending on the sensor, warmup may be required after startup or when replacing the sensor.
 Allow the product to warm up for the specified time. Alarm behavior and output signals will be unstable during warmup. To avoid problems, notify any departments that may be affected beforehand.
- Perform calibration once warmup is complete.

B2-3 Basic operation flow

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





• 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 'B2-5-1 User mode setting items' and 'B3-2-1 Maintenance mode setting items'.)

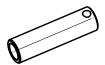
B2-4 Operating procedure

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>





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

B2-5 User mode

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



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

B2-5-1 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	8.8.8.8.	Performs zero calibration. (Refer to 'B2-6 Performing zero calibration'.)
1-2	Setting display	8.8.8.8	Displays various setting values such as alarm settings and RS-485 communication settings. (Refer to 'B2-7 Checking settings'.)
1-3	Maintenance mode selection	H.B.B.B.	Switches to maintenance mode. (Refer to 'B3-2 Maintenance mode'.)

B2-5-2 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.



Once the operation is complete, be sure to hold down the MENU/ESC key to return to detection mode.
 The product will not detect gases while in adjustment/setting state. If left in user mode, the product will take 10 hours to return to detection mode. This is dangerous because no monitoring occurs during this time.

B2-6 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 'B3-4-1 Calibration preparation'.



 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.



- 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] appears and the display returns to [1-1] when the SET pressed.



NOTE

- ▶ If zero calibration is unsuccessful because the zero point fluctuates significantly around zero, [FAIL] will appear before the display returns to [1-1]. If this occurs, zero calibration was not performed.
- ▶ Refer to 'B3-4-3 Performing span adjustment' for more information.

B2-7 Checking settings

Displays the alarm settings and RS-485 settings.

It	em No.	Setting item	Remarks
1-2		Setting display	
	1-2.0	Alarm setting display	
	1-2.1	RS-485 setting display	Displays the settings for RS-485 communication.

B2-7-1 Checking alarm setpoints

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

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).
 (Normally, it is not possible for the customer to change these settings.)



Zero suppression value display
 Displays the positive side suppression value.



 Not used with this product Setting: OFF



 Not used with this product Setting: OFF



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 'B3-5 Setting environmental settings 1'.)

B2-7-2 Checking RS-485 setpoints

Displays RS485 settings such as address, communication speed, data length, and parity.

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



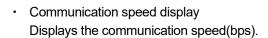
2 Select [1-2.1], then press the SET key.



3 Check the setting value of RS485 setting.

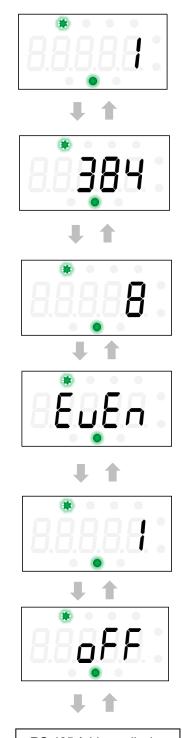
Press the ▲ or ▼ key to toggle between different setpoints.

 Address display Displays the address.



- Data length display
 Displays the data length.
- Parity display
 Displays the parity.
 [odd]: odd parity
 [EuEn] (EVEN)*1: even parity
 [nonE]: none
- Stop bit display
 Displays the stop bit.
- Communication abnormality display
 Displays the "E-6" message when no communication for a certain period.

Press the ▲key to return to the address display.



RS-485 Address display

4 Press the MENU/ESC key.

Returns to the [1-2.1] display.

^{*1} The LED is labeled "EuEn" for display convenience.

NOTE

▶ RS-485 communication settings can be configured in the communication settings in the maintenance mode. (See '7-6 Make communication settings (RS-485)')

B2-8 Shutting down

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



- 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 in the upstream
 (central) system. Additionally, check the devices connected to the external output of this product and
 the external contact output terminals to determine whether you should turn off the power to those
 devices.
- If using contacts (optional), the contacts may activate when the power supply is turned off.

B3

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.

B3-1 Maintenance intervals and items

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

Daily maintenance: Perform maintenance before commencing work.
 Monthly maintenance: Inspect the alarm circuit (alarm test) once a month.

• Regular maintenance: Perform calibration at least once a year to ensure adequate performance as a safety

device. The order of calibration is zero adjustment first and then span adjustment.

For information on the sensor warranty, review the warranty policy at the end of this

document

Maintenance item	Maintenance details	Daily maintenance	Monthly maintenance	Regular maintenance
Power supply check	Check to confirm that the power LED lights up.	0	0	0
Concentration display check	Check to confirm that the concentration reading is zero. If the reading is offset, perform zero calibration after confirming that no miscellaneous gas is present in the vicinity.	0	0	0
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.	_	0	0
Calibration	Perform sensitivity calibration using a calibration gas.	_	_	0
Gas alarm check	Check the gas alarm using a calibration gas.	_	1	0
Grounding cable check	To ensure EMC performance, check to confirm that the grounding cable connection is secure and free of corrosion.	_	-	0
Sensor check	Check the sensor mirror for dirt, and clean any problem areas with a cleaning cloth. For more information, refer to 'B3-8 Cleaning the optical system'.	_	_	0

<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 LED lights up. (Confirm that the power lamp (POWER), alarm lamps (ALM1, ALM2), fault lamp (FAULT), unit lamps (PPM, %LEL, %) are clearly visible e on the system.) 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. 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.
Sensor check	Check the sensor mirror for dirt and clean any problem areas. For more information, refer to 'B3-8 Cleaning the optical system'.

<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]

IRS: 12 months [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 (field 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.

B3-2 Maintenance mode

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

B3-2-1 Maintenance mode setting items

Item No.	Setting item	LED display	Details
2-0	Test mode	2-0	Performs the gas test, alarm test, fault test, LED test, and RAM test. (Refer to 'B3-3 Performing tests (test mode)'.)
2-1	Zero calibration	2.5.6.6.6.	Performs zero calibration. (Refer to 'B3-4-2 Performing zero calibration'.)
2-2	Span adjustment	2.8.2.8.8.	Performs span adjustment. (Refer to 'B3-4-3 Performing span adjustment'.)
2-3	Display	2.8.8.8.	This is not normally used by the user.
2-4	Environmental settings 1	2.8.8.8.	Configures settings such as alarm setpoints, alarm pattern, fault alarm pattern, zero suppression value, and the date and time. (Refer to 'B3-5 Setting environmental settings 1'.)
2-5	Environmental settings 2	2.5.5.8.	This is not normally used by the user.
2-6	Environmental settings 3	2.5.5.	This is not normally used by the user.
2-7	Communication settings	2.5.2.6.5.	Configure various settings for RS-485 communication. (See '7-6 Setting communication settings (RS-485)')

Item No.	Setting item	LED display	Details
2-8	Factory mode selection	2-8-8	This is not normally used by the user.
2-9	User mode selection	2.5.5.8.	Switches to user mode. (Refer to 'B2-5 User mode'.)

B3-2-2 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.



Once the operation is complete, be sure to hold down the MENU/ESC key to return to detection mode.
The product will not detect gases while in adjustment/setting state. If left in maintenance mode, the
product will take 10 hours to return to detection mode. This is dangerous because no monitoring
occurs during this time.

NOTE

- ▶ If password setting is enabled, a password must be entered to switch to maintenance mode..
- ► The password is set beforehand 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.



B3-3 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

B3-3-1 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 'B3-4-1 Calibration preparation'.



- Depending on the settings, contact and gas concentration outputs may be activated during gas testing, even in maintenance mode. Take care during gas testing.
- 1 Press the ▲ or ▼ key in maintenance mode several times to select [2-0], then press the SET key.



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



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



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



5 Once the reading has returned to [0.0], press the MENU/ESC key.



Returns to the [2-0.0] display.

B3-3-2 Performing alarm test

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



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

NOTE

- ▶ Step 3 must be performed even if the product is a model without a relay. Note that the contact will not operate even when [on] is selected.
- 1 Press the ▲ or ▼ key in maintenance mode several times to select [2-0], then press the SET key.

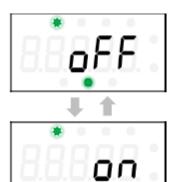


2 Press the ▲ or ▼ key to select [2-0.1], then press the SET key.



3 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.



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



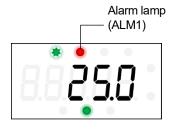
5 Check to confirm that an alarm is triggered.

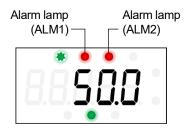
The first alarm is triggered when the reading reaches the first alarm setpoint.

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

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

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





6 Once the alarm test is complete, press the MENU/ESC key. Returns to the [2-0.1] display.

B3-3-3 Performing fault test

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



- Depending on the settings, contact and gas concentration outputs may be activated during fault testing, even in maintenance mode. Note this when performing this operation.
- 1 Press the ▲ or ▼ key in maintenance mode several times to select [2-0], then press the SET key.



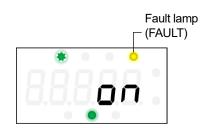
2 Press the ▲ or ▼ key to select [2-0.2], then press the SET key.



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



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



When the fault alarm is reset, the fault lamp (FAULT) turns off. The fault alarm can also be reset by pressing the MENU/ESC key.

B3-3-4 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.



B3-3-5 Performing memory test (RAM test)

Perform a memory test.

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



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



3 Press the SET key.



The memory test starts.



4 Check the memory test result.

No problems with memory: [PASS] appears.



Problems with RAM:

[F-rA] appears.

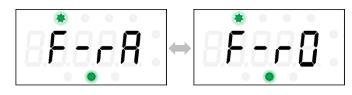


Problems with ROM:

[F-rO] appears.



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



5 Once you have checked the result, press the SET key.

Returns to the [2-0.4] display.

B3-4 Performing calibration

B3-4-1 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 field guard

<List of adjustment jigs>

Item name	Applicable specifications						
Calibration adapter	With field guard	Part No.: 4613 9523 50					
Precision calibration adapter	Without field guard	Part No.: 4613 9528 10					
Diverse	One that can provide a flow rate of 1.0 mL/min or greater						
Pump	Explosion-proof specifications						
Classes at a v	Measures tolerances to 0.1 ml.						
Flowmeter	Has passed regular inspection.						
Stopwatch	Has passed regular inspection						
		Material: polyurethane					
	For general combustible gases	Internal diameter: 4 mm					
		Pipe length between gas and adapter: Within 1m					
		Material: Teflon					
Piping	For organic solvents	Internal diameter: 4 mm					
T iping		Pipe length between gas and adapter: Within 1m					
		Material: Teflon					
	For strongly adsorptive gases	Internal diameter: 4 mm					
		Pipe length between gas and adapter: Within					
		10cm					

<List of adjustment conditions>

Gas detector model	Sensor model	Detection target	Chemica I 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-3RIP SD-3DRIP GD-3RIP	IRS-1301	Methane	CH₄	100 %LEL	N₂	Methane	N ₂	50 %LEL	For IRS sensor (4283 9011 00) 0.5	0.5 ± 0.1L/min	120 seconds	0.4 – 1.5 L/min	Warm up for at least 1 hours before adjusting.
	IRS-1303	Isobutane	i-C ₄ H ₁₀	100 %LEL		Isobutane		50 %LEL					
	IRS-1317	propane	C₃H ₈	100 %LEL		Propane (Isobutane)		50 %LEL (40 %LEL)					
	IRS-1315	propane	C₃H₃	100 vol%		Propane		80 vol%					
	IRS-1334	Methane	CH₄	100 vol%		Methane		50 vol%					
	IRS-1316	Ethylene	C ₂ H ₄	100 %LEL		Ethylene (Methane)		50 %LEL (10 %LEL)					
	IRS-1340	Isobutylene	i-C₄H ₈	100 %LEL		Isobutylene (Isobutane)		50 %LEL (40 %LEL)					
	IRS-1308	Normal Hexane	n-C ₆ H ₁₄	100 %LEL		n-Hexane (Isobutane)		50 %LEL (40 %LEL)					
	IRS-1332	1,3-Butadiene	1,3-C₄H ₆	100 %LEL		1,3-Butadiene (Methane)		50 %LEL (10 %LEL)					

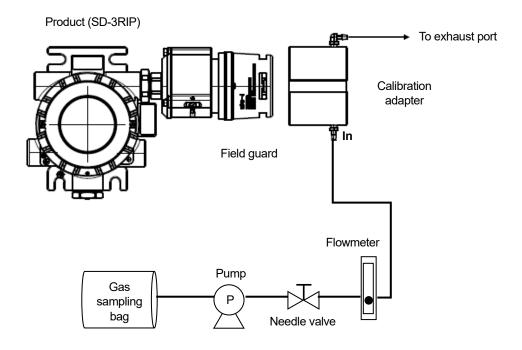
^{*} For FM specifications, do not use alternative gas for adjustment.

< When using the field guard>

NOTE

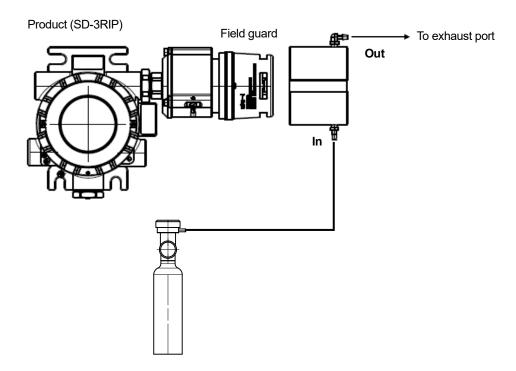
- ▶ Use a flow rate of 1.0 L/min ± 0.1 L/min when calibrating. Calibration accuracy may be impaired if calibration is performed using a different flow rate.
- ▶ When using the field guard, calibrate using under 6 m/s wind speed.
- ▶ If calibration is unsuccessful, remove the field guard, fit the precision calibration adapter, and calibrate again.
- ▶ When calibrating adsorptive gas, fit the calibration adapter.
- ► Correct calibration may not be possible if there is foreign matter or dirt inside the optical system or guard. In such cases, clean as described in 'B3-8 Cleaning the optical system'.

<Using a gas sampling bag>



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

<Using a gas can>



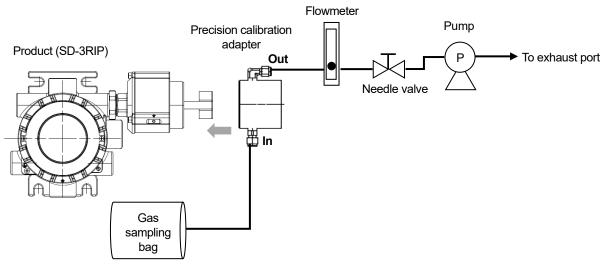
^{*} The diagram illustrates the SD-3RIP. The connection method is the same for the remote sensor head (GD-3RIP)

<When using the precision calibration adapter>

NOTE

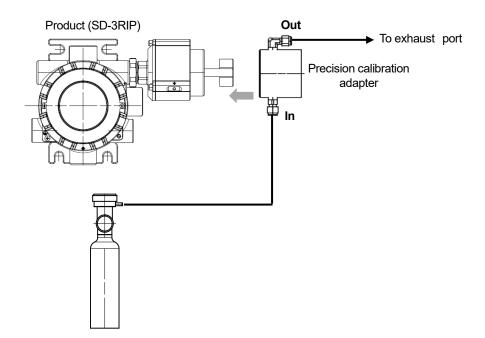
- ▶ Use a flow rate of 1.0 L/min ± 0.1 L/min when calibrating. Calibration accuracy may be impaired if calibration is performed using a different flow rate.
- ▶ The sensor will be shut off from the atmosphere when the calibration adapter is fitted, so detection will not be possible in this state.
- ▶ Ensure adequate warmup time (at least one hour and ideally three hours) before calibrating.
- ► Correct calibration may not be possible if there is foreign matter or dirt inside the optical system or guard. In such cases, clean as described in 'B3-8 Cleaning the optical system'.

<Using a gas sampling bag>



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<Using a gas can>



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

<Duct mount specification>

NOTE

- When performing calibration, the flow rate should be 1.0 ± 0.1 L/min. Calibration performed at a different flow rate may result in reduced calibration accuracy.
- · When calibrating with the duct mount specification, perform the calibration in a windless environment.
- If the calibration fails, remove the field guard and replace it with the precision calibration cap and perform the
- · When calibrating an absorbent gas, replace the cap with the calibration cap and perform the calibration.
- If there is any foreign matter or dirt inside the optical system or guard, calibration may not be performed correctly. In that case, clean it according to 'B3-8. Cleaning the optical system'.

<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.



 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 procedure>

NOTE

 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.

<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.
- 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 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.



- 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.



Response

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

Adjustment

When adjusting highly adsorptive gases, replace with the adjustment adapter before performing the adjustments. Adjusting with a field guard influences the wind speed.

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

B3-4-2 Performing zero calibration

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

Zero calibration is essential for accurate measurements.

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

For information on zero calibration preparation, refer to 'B3-4-1 Calibration preparation'.



 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.



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 fluctuates significantly around zero, [FAIL] appears. If this occurs, zero calibration was not performed.

B3-4-3 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 'B3-4-1 Calibration preparation'.

NOTE

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



- 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.
- 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.

B3-5 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			

B3-5-1 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.

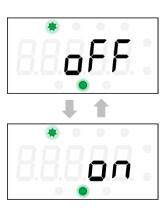
1 Press the ▲ or ▼ key in maintenance mode to select [2-4], then press the SET key.



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.

B3-5-2 Alarm setpoint setting

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

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

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

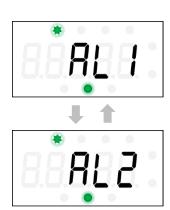


2 Press the ▲ or ▼ key to select [2-4.1], then press the SET key.



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 'B2-7-1 Checking alarm setpoints'.)

B3-5-3 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.

B3-6 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

B3-6-1 Address setting

Sets the RS-485 communication address (0 to 128). The default setting is 0 ([0]).

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].

B3-6-2 Communication speed setting

Sets the RS-485 communication speed (bps). Set to 38,400 bps ([384]), 19,200 bps ([192]). 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 [384] or [192] , then press the SET key.



The display returns to [2-7.01].



B3-6-3 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].



B3-6-4 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.



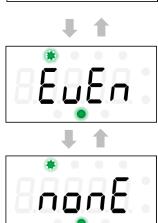
3 Select [2-7.03], then press the SET key.



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



The display returns to [2-7.03].



B3-6-5 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].



B3-6-6 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].



B3-7 Parts replacement

B3-7-1 Sensor replacement

Please contact RIKEN KEIKI for sensor replacement.



- · Precautions regarding sensor replacement
- Be sure to turn OFF the power supplied to the sensor before replacing the sensor.
- Refer to 'B1-4 Connecting the sensor to the main unit' for instructions on how to mount the sensor.
- Perform air calibration and span adjustment after replacing the sensor.
- If a sensor of the same type (same part number) has been previously installed, the instrument-specific configuration (e.g., detection gas, measurement range, alarm point, zero suppression, etc.) is retained. Otherwise, the factory default settings of the new sensor are uploaded, overwriting the instrument-specific configuration. The sensor is identified by the sensor auto-recognition function. See '6-B2-2 Sensor Auto-Recognition Function' for more information on the sensor auto-recognition function.
- 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.

B3-7-2 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
Field guard for SD-3RIP	6 months	3 - 8 years	1	
Gas sensor		7 years		*1

^{*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.

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.

B3-8 Cleaning the optical system

The Field guard is designed to prevent the ingress of foreign matter and moisture into the optical system. It also incorporates a heater to prevent condensation. However, in harsh environments, foreign matter may still accumulate on the optical system surfaces. The optical system should therefore be cleaned periodically. Note that the sensor optical system must also be cleaned in cases in which a warning or fault occurs due to obstruction of the optical system.

NOTE

- The window plate is made of a durable material that is resistant to scratches. However, avoid excessively rough handling that may damage it.
- Switch to maintenance mode while cleaning. Cleaning while in measurement mode may lead to false alarms.
- Use a blower or the like to blow away dust and other foreign matter when cleaning.
- · Clean using a clean cloth or cotton swab free of oil.
- · Wipe off any moisture on the window plate.
- If the window plate is heavily fouled with oil or other substances, wipe clean using a cloth dampened with distilled water or alcohol, then allow to dry completely.
- Do not use excessive amounts of alcohol. (* Alcohol remaining on the optical system may be detected and trigger a false alarm.)
- · Be sure to perform zero calibration after cleaning.
- · If using a suction cap or sensor guard, also clean inside the cap or field guard.

B4

Storage, Relocation, and Disposal

B4-1 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	Temperature (°C)			Humidity*1 (% RH)		sure Pa)	Remarks	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum		
IRS	-40	70	0	95	80	120	 The sensor must be stored in the specified packing case. Store in a location not exposed to direct sunlight. Store in an environment free of corrosive gas, vibration, and dust. Avoid condensation and moisture. 	

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

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

Model	Model Temperature (°C)		Humidity*1 P (% RH)		Pressure (kPa)		Remarks
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	
IRS	-40	70	0	95	80	120	 Store in a location not exposed to direct sunlight. Store in an environment free of corrosive gas, vibration, and dust. Avoid condensation and moisture.

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



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

B4-2 Procedures for relocation or reuse

Before relocating and resuming use of the product, refer to 'B1-1 Installation precautions' for information on relocation locations.

For information on installation procedures, refer to 'B1. Installation'.



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.

B4-3 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.
- The product contains button-type batteries. These batteries must be properly separated before disposal. Contact your nearest sales office for advice.

<SD-3RIP main unit>

Button-type lithium battery specifications

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

Removal method

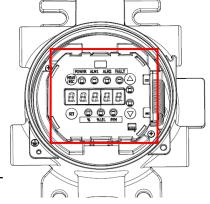
Remove the main PCB unit indicated by the red box in the figure to the right. Remove the PCB holder.

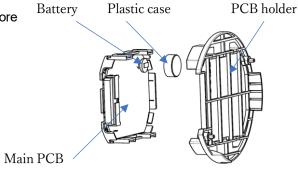
The battery is located on the underside of the main PCB (on the rear of the 7-segment LCD).

The battery is covered by a plastic case. The plastic case is attached to the PCB, and so should be removed using pliers or a flathead screwdriver.

Cut the terminals on both sides of the battery using nippers, then remove.

Wrap the removed battery in tape to prevent short-circuiting before disposal.





NOTE

- ▶ The product contains a battery.
- ► Crossed-out recycle dustbin mark

This pictogram is affixed to products containing batteries to which EU Battery Directive 2006/66/EC applies.

Such batteries must be disposed of appropriately.

This pictogram means batteries must be separated from ordinary waste and disposed of appropriately.



B5

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.

B5-1 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)		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.
	(Lamp on)	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.

Symptom/display	FAULT lamp	Cause	Action	
Sensor abnormality (E-1)		The main unit (SD-3RIP/ SD-3SC) or remote sensor head (GD-3RIP) internal wiring is connected incorrectly.	Connect internal wiring of the main unit (SD-3RIP/SD-3SC) or remote sensor head (GD-3RIP) correctly.	
		Cable abnormality between the main unit (SD-3SC) and remote sensor head (GD-3RIP)	Check the cable between the main unit (SD-3SC) and remote sensor head (GD-3RIP).	
	(Lamp	A main unit (SD-3RIP/ SD-3SC) or remote sensor head (GD-3RIP) fuse has blown.	Replacement required. Contact RIKEN KEIKI.	
	Oil)	Main unit (SD-3RIP/SD- 3SC) or remote sensor head (GD-3RIP) internal circuit abnormality	Replacement required. Contact RIKEN KEIKI.	
		There is dirt or foreign matter on the optical system.	Clean the optical system as described in 'B3-8 Cleaning the optical system'.	
		There is an abnormality in the sensor.	Contact RIKEN KEIKI.	
System abnormality		4 - 20 mA output disconnection	Turn off the power and check the 4 - 20 mA output connection.	
(E-9)	(Lamp on)	Internal ROM, RAM, or EEPROM fault	Turn off the power and restart. If the problem persists, replacement is necessary. Contact RIKEN KEIKI.	
GD-3RIP abnormality (E-1A)		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.	
	(Lamp on)	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.	

B5-2 Reading abnormalities

Symptom/display	FAULT lamp	Cause	Action
The reading rises (or drops) and remains		The sensor zero or span has altered (drifted).	Perform zero calibration or span adjustment.
unchanged. • A gas alarm is triggered		Presence of interference gases	Check for the presence of interference gases such as solvents and take appropriate action.
despite the absence of a gas leak or any other		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.
abnormalities at the detection area.	_	Environmental fluctuations	Perform zero calibration or span adjustment.
Response is slow.		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.
		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 optical system is dirty.	Clean the optical system as described in 'B3-8 Cleaning the optical system'.
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 warning (E-1)	_	There is dirt or foreign matter on the optical system.	Clean the optical system as described in '7-8 Cleaning the optical system'.

Symptom/display	FAULT lamp	Cause	Action
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.

B6

Product Specifications

B6-1 SD-3RIP specifications

B6-1-1 SD-3RIP

Model	SD-3RIP	SD-3RIP (contact model)	SD-3RIP (RS485 model)			
Specifications	Standard	Contact *1	RS-485			
Display	7-segment LED (5 digits)					
Sensor		IRS sensor (RIKEN KEIKI)				
Detection principle	Non-disp	persive infrared absorption type (infr	rared type)			
Detection target gas		Combustible gas				
Detection range		0 - 100 %LEL				
Sampling method	Diffusion t	ype/suction type (introduced via e	external unit)			
Set flow rate		0.4 - 1.5 L/min	·			
Power supply indication		Power lamp lit (green)				
External output	Gas conce	ntration signal (4 - 20 mA DC + H	IART output)			
Alarm setpoints	Us	er setting (Setting range: 10 - 60 %	LEL)			
Alarm accuracy		Within ± 25 % of alarm setpoint				
Alarm delay time		T90 ≤ 30 seconds				
Repeatability (for identical conditions)	Within ± 2 %LEL					
Indication accuracy (for identical conditions)		Within ± 5 %LEL				
Gas alarm type	Two-step alarm (H-HH)					
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 abnorm	ality (E-1)			
Fault alarm indication	Fa	ult lamp lit (yellow)/error code dis	play			
Fault alarm reset operation	Sensor abnormali	System abnormality: Self-latching ty: Auto reset (self-latching if sens				
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	_			
External Communications	— RS-485(2-wire half duplex)					
Warnings	Outside operating temperature range warning (E-9)/optical system dirty/ clock abnormality diagnosis/communication diagnosis/sensor warning					
Warning display	Blinking display a	Iternating between gas concentra	ition and error code			

Model	SD-3RIP	SD-3RIP (contact model)	SD-3RIP (RS485 model)			
Warning operation	Same as normal operation					
Functions	Alarm delay/suppression/HART communication					
Transmission	3-wire analog transmission (common power supply <power signal,<="" supply,="" td=""></power>					
method (4 - 20 mA)	common>) or 2-wire analog transmission (current source)					
Transmission		· 20 mA DC (non-insulated linear o				
specifications		e 600 Ω (with derating depending				
(4 - 20 mA)		ax. 250 divisions (depending on s	•			
Transmission cable (4 - 20 mA)	Shielded cable 1.25 sq (1.308 mm²/AWG16) or 2.0 sq (2.08 mm²/AWG14) (same as power supply cable) *2					
Transmission	For 1.25 sq (1.308 mm²/AWG16): Not exceeding 1.25 km					
distance	For 2.0 sq (2.08 mm²/AWG14): Not exceeding 2 km (with derating depending on					
(4 - 20 mA)		supply voltage)				
Transmission distance (between power source and detector)	For 1.25 sq (1.308 mm²/AWG16): Not exceeding 300 m For 2.0 sq (2.08 mm²/AWG14): Not exceeding 500 m (cable resistance 5.75 Ω)					
Transmission cable (RS485)	_	_	Shielded twisted pair cable 1.25sq (1.308mm2/AWG16) *2			
Transmission distance (RS485) Maximum bus length	_	_	38400bps:500m 19200bps:1200m *3			
Maximum number of connections (RS485)	_	_	127 units (1 master) *4			
Power source		24 V DC (18 V - 30 V DC) *5				
Power supply cable	Shielded cable 1.25 sq (1.308 mm²/AWG16) or 2.0 sq (2.08 mm²/AWG14) (same as transmission cable) *2					
Power consumption	Maximum 10 W.					
Cable connectors	Pressure proof packing gland, M25 × 1.5					
Operation method	Dedicated magnet control key					
Onenetine	-40 °C - +70 °C (no sudden changes)					
Operating	In accordance with sensor specifications if restrictions apply due to sensor					
temperature range	specifications					
Operating humidity	0 %RH - 95 %RH (no condensation)					
range	In accordance with sensor specifications if restrictions apply due to sensor					
		specifications				
Housing material	Stainless steel (SCS14)					
Protection level	**IP66/67 equivalent					
Installation type	Wall mounting (standard)/2B pole mounting (optional)					
Explosion-proof construction	Flame-proof construction					
Explosion-proof class	II 2 G Ex db [op is] II C T4 Gb (ATEX)/Ex db [op is] II C T4 Gb (IECEx)					
External	Diffusion type: Approx. 325 (W) × 201 (H) × 127 (D) mm					
dimensions	Suction type: Approx. 322 (W) × 213 (H) × 127 (D) mm					
Weight	Diffusion type: approx. 8.8 kg/Suction type: approx. 9.4 kg					

^{*1} When used with the contacts closed, the contacts may seize due to vibration. Keep this precaution in mind.

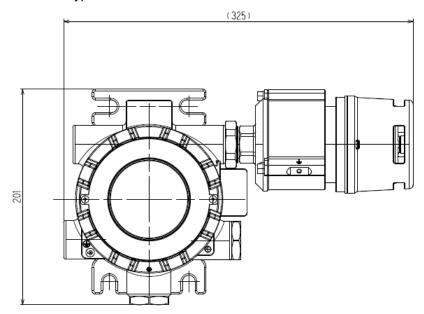
^{*2} To ensure explosion protection, use a cable designed for use in temperatures at least 5 °C above the maximum anticipated ambient temperature.

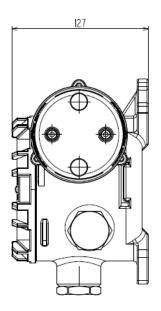
^{*3} The maximum cable length is a guideline and does not guarantee communication. Communication may be affected by the surrounding environment, regardless of whether the maximum cable length is exceeded.

- *4 The maximum number of connected devices does not guarantee communication. It also depends on the driver characteristics of the devices used on the same bus. Please check the connected devices carefully before designing your system.
- *5 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.

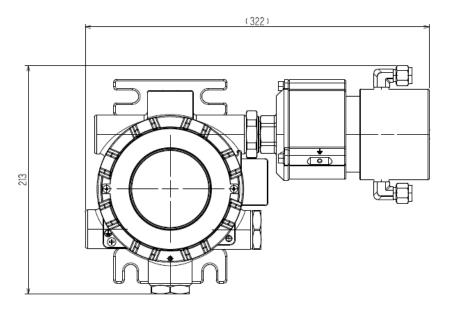
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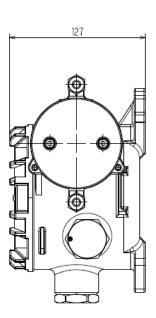
<Diffusion type>





<Suction type>





B6-1-2 SD-3SC + GD-3RIP

Model	SD-3SC + GD-3RIP	SD-3SC (contact model) + GD-3RIP	SD-3SC (RS-485 model) + GD-3RIP		
Specifications	Standard	Contact *1	RS485		
Display		7-segment LED (5 digits)			
Sensor	IRS sensor (RIKEN KEIKI)				
Detection principle	Non-dispersive infrared absorption type (infrared type)				
Detection target gas	Combustible gas				
Detection range	0 - 100 %LEL				
Sampling method	Diffusion type				
Power supply indication	Power lamp lit (green)				
External output	Gas conce	entration signal (4 - 20 mA DC	+ HART output)		
Alarm setpoints	Us	er setting (Setting range: 10 - 60	O %LEL)		
Alarm accuracy		Within ± 25 % of alarm setpo	int		
Alarm delay time		T90 ≤ 30 seconds			
Repeatability (for identical conditions)	Within ± 2 %LEL				
Indication accuracy (for identical conditions)	Within ± 5 %LEL				
Gas alarm type	Two-step alarm (H-HH)				
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	System abnormality: Self-latching				
operation	Sensor abnormality: Auto reset (self-latching if sensor is disconnected)				
Contact operation	l	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	_		
External Communications		_	RS-485(2-wire half duplex)		
Warnings	Outside operating temperature range warning (E-9)/optical system dirty/ 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 common="" signal,="" supply,="">) or 2-wire analog transmission (current source)</power>				
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 mm²/AWG16) or 2.0 sq (2.08 mm²/AWG14) (same as power supply cable) *2				

Model	SD-3SC + GD-3RIP	SD-3SC (contact model) + GD-3RIP	SD-3SC (RS-485 model) + GD-3RIP			
Transmission distance (4 - 20 mA)	For 1.25 sq (1.308 mm²/AWG16): Not exceeding 1.25 km For 2.0 sq (2.08 mm²/AWG14): Not exceeding 2 km (with derating depending on supply voltage)					
Transmission cable (between GD-3RIP units)	Shielded twisted pair cable 1.25 sq (1.308 mm²/AWG16) *2					
Transmission distance (between GD-3RIP units)	20 m (maximum)					
Transmission cable	_	_	Shielded twisted pair cable 1.25sq (1.308mm2/AWG16) *2			
(RS485)	_	_	38400bps:500m 19200bps:1200m *3			
Transmission distance	_	_	127 units (1 master) *4			
Power source	24 V DC (20 V - 30 V DC) *5					
Power supply cable	Shielded cable 1.25 sq (1.308 mm²/AWG16) or 2.0 sq (2.08 mm²/AWG14) (same as transmission cable) *2					
Power consumption		Max. 10.5 W (SD-3SC + GD-3RIP).				
Cable connectors	Pi	ressure proof packing gland, M	25 × 1.5			
Operation method		Dedicated magnet control	key			
Operating temperature range	 -40 °C - +70 °C (no sudden changes) In accordance with sensor specifications if restrictions apply due to sensor specifications 					
Operating humidity range	0 %RH - 95 %RH (no condensation) In accordance with sensor specifications if restrictions apply due to sensor specifications					
Housing material	Stainless steel (SCS14)					
Protection level	**IP66/67 equivalent					
Installation type	Wall mounting (standard)/2B pole mounting (optional)					
Explosion-proof construction	Flame-proof construction					
Explosion-proof class	II 2 G Ex d	(SD-3SC) Ex db II C T4 Gb (ATEX)/Ex db II C T4 Gb (IECEx) (GD-3RIP)				
	II 2 G Ex db [op is] II C T4 Gb (ATEX)/Ex db [op is] II C T4 Gb (IECEx)					
External dimensions (SD-3RIPSC)	Approx. 171 (W) \times 193 (H) \times 127 (D) mm (excluding projections)					
Weight (SD-3SC)	Approx. 6.0 kg					
External dimensions (GD-3RIP)	Approx. 289 (W) \times 185 (H) \times 121 (D) mm (excluding projections)					
Weight (GD-3RIP)	Approx. 5.0 kg (excluding mounting bracket)					

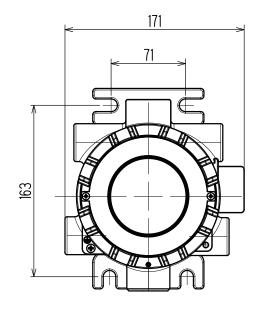
^{*1} When used with the contacts closed, the contacts may seize due to vibration. Keep this precaution in mind.

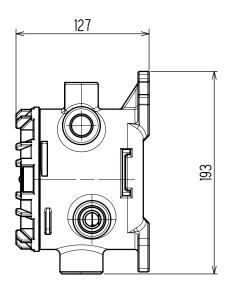
^{*2} To ensure explosion protection, use a cable designed for use in temperatures at least 5 °C above the maximum anticipated ambient temperature.

^{*3} The maximum cable length is a guideline and does not guarantee communication. Communication may be affected by the surrounding environment, regardless of whether the maximum cable length is exceeded.

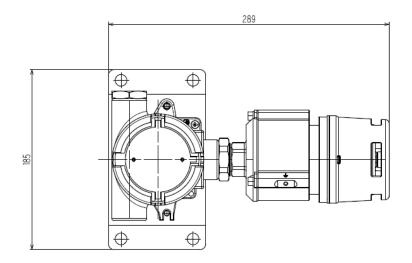
- *4 The maximum number of connected devices does not guarantee communication. It also depends on the driver characteristics of the devices used on the same bus. Please check the connected devices carefully before designing your system.
- *5 Use a power supply capable of minimum temporary output of 2.5 A to ensure that fuses blow normally in the event of a product abnormality.

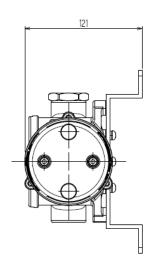
<Dimensional drawings (SD-3SC + GD-3RIP)>





<Diffusion type>





B6-2 Detection target gases for detection principle

B6-2-1 Non-dispersive infrared absorption type (Infrared type)

Sensor model	Gas name	Gas symbol	F.S.	1 digit	First Alarm setpoint	Second Alarm setpoint	Calibration gas	Operating temperature range	Operating humidity range	Years of warranty
IRS-3301*	Methane	CH₄	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	CH₄			3 years
IRS-3303*	Isobutane	i-C ₄ H ₁₀	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	i-C ₄ H ₁₀ C ₃ H ₈	-40 °C - 70 °C	95 %RH or less (no conden- sation)	
IRS-3317*	Propane	C₃H ₈	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	C ₃ H ₈			
IRS-3331*	Ethane	C ₂ H ₆	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	C ₂ H ₆ C ₃ H ₈			
IRS-3316*	Ethylene	C ₂ H ₄	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	C ₂ H ₄ CH ₄			
IRS-3340*	Isobutylene	i-C ₄ H ₈	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	i-C ₄ H ₈ C ₃ H ₈			
IRS-3332*	Butadiene	C ₄ H ₆	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	C ₄ H ₆ CH ₄			
IRS-3329*	n-pentane	n-C₅H ₁₂	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	n-C₅H ₁₂ C₃H ₈			
IRS-3308*	n-hexane	n-C ₆ H ₁₄	100 %LEL	0.5 %LEL	25 %LEL	50 %LEL	n-C ₆ H ₁₄ C ₃ H ₈			

^{*}Interference occurs due to other hydrocarbon gases.

NOTE

- ▶ Install in a location with stable conditions within the specified operating temperature range and free of sudden fluctuations.
- ▶ When calibrating, allow the product to warm up for at least one hour to meet the performance certification standards before performing zero calibration and span adjustment.
- ▶ Ensure identical temperatures, humidity, and pressure in the calibration and measurement environments. (Readings may fluctuate due to temperature, humidity, and pressure characteristics. In some cases, readings may exceed the zero suppression value due to sensor characteristics.).
- ▶ For low gas sensitivity ethylene and butadiene, we recommend using with the alarm settings at 25 %LEL or greater.
- ▶ If the composition of the base gas differs greatly for calibration and measurement—for example, if an air base is used for calibration but a CO2 base is used for measurement—reading may differ due to infrared adsorption characteristics, even if the concentration of the target gas is the same.
- Perform maintenance if a warning appears while the self-diagnostic function is active.
- ▶ Use the calibration adapter when calibrating. Use the IRS sensor precision calibration adapter to meet the performance certification standards
- ▶ Regardless of the detection target gas, the warranty period for IRS sensors is 3 years.