



# Smart transmitter/Gas Detector Head

## SD-1

**(TYPE GP S)**

**Safety Manual**

**(320-13141TE)**

**Project Number : 77AG265ZZ0**

[Note] SD-1GP is a SIL2 product based on the IEC 61508 standard. Installation, operation or maintenance of this product must be performed according to this safety manual to obtain compliance with the functional safety standard. If not, the safety integrity will be degraded.

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# Safety Manual

## 1. Purpose

This safety manual provides the following requirements for which the user has responsibility for the case SD-1 (TYPE GP S) (hereinafter referred to as "the device") is used as a part of safety instrumented function. Read this safety manual and all the related documents to use the device safely.

- Proof testing
- Repair and replacement
- Reliability data
- Lifetime limits
- Environmental and application limits
- Setting parameters

## 2. Safety Policy

“Creating safe working environments for workers “

RIKEN KEIKI has set this as unswerving business policy since 1939.

“Workers” to whom RIKEN KEIKI wishes to supply “Security and safety” include not only customers using our products, but also all employees and vendors who are related to our production stream.

“Work with a sense of security” leads to a perception of “Work with a sense of safety”.

Therefore, RIKEN KEIKI believes that supplying continuously wide-ranging products which can provide “Safety” with workers who work in various environments results in realizing “safe working environments”.

For the realization, the functional safety based on IEC 61508 is materialized by this product, and RIKEN KEIKI promises that we are in compliance with the following items.

- a) Functional safety management responsible person on this product is appointed, who is ultimately responsible for activities of all E/E/PE system safety lifecycles.
- b) In full compliance with documented planning and procedure, perform development, production, maintenance, customization and disposal in accordance with quality management system to realize the E/E/PE system safety lifecycle.
- c) The personnel who evaluate works and output of each phase of all E/E/PE system safety lifecycle are required to have enough level of ability for each phase, and “Education on Functional safety” is provided and “Evaluation on level of ability” is performed periodically.
- d) Validation on the product is performed by personnel who belong to an independent department in RIKEN KEIKI and have enough level of ability. In addition, perform an overall assessment of works on each phase and output to achieve functional safety with being inspected by external institution who is not interested party.

### 3. Scope

This safety manual is applied to the following IEC 61508: 2010 Part 2 SIL 2 capable certified model.

- SD-1 (TYPE GP S)

### 4. Safety Specifications

#### **4-1. Safety function**

The element safety function of the product is defined as follows:

To provide the host system signal information of the combustible gas concentration of the LEL set-point using 4-20mA and relay contact outputs.

Note: the LEL set-point is adjustable to 10% - 60%.

Output currents  $< 3.6\text{mA}$  and  $> 21\text{mA}$  are reserved for revealed failures.

Output currents  $\geq 3.6\text{mA}$  and  $\leq 21\text{mA}$  are reserved for normal conditions

#### **4-2. Safety integrity**

Safety integrity : IEC 61508: 2010 Part 2 SIL 2 capable

Operation mode : Low demand mode

HFT (Hardware Fault Tolerance) : 0

Type : Type B

#### **4-3. Reliability data**

Information about failure rate and failure mode etc. is written in FMEDA report. Contact RIKEN KEIKI for the details of FMEDA report.

Table 1 : Failure rates according to IEC 61508 SD-1 (TYPE GP S)

$\lambda_{SD}$	$\lambda_{SU}$	$\lambda_{DD}$	$\lambda_{DU}$	SFF
284 FIT	341 FIT	200 FIT	83.3 FIT	91%

PFD avg:  $1.89 \times 10^{-4}$

<Applicable condition>

Proof testing interval: 6 months

MTTR: 48 hours

#### **4-4. Safety accuracy**

Safety accuracy: 10%

\* A failure of internal part that produces an error above this value is included in FMEDA failure rate.

#### **4-5. Diagnostic response time**

Maximum response time of self-diagnosis: 15 seconds

\* A notice of a part failure detected by self-diagnosis is given within this time period. This time period is a sum of the self-diagnostic test interval and failure response time.

#### **4-6. Gas detection times**

50% response time: Within 10 seconds

90% response time: Within 30 seconds

These are the times required for the LED display or 4 to 20 mA output to indicate 50% or 90% of a combustible gas concentration after the gas makes contact with the device.

When the gas concentration reaches or exceeds an alarm point, it takes an extra time (alarm delay time) to confirm the alarming concentration internally before the contact output is activated.

#### **4-7. Fault conditions**

The device is put into the following conditions when a problem is detected by the self-diagnostic function.

- An error message is displayed on LED.
- The 4 to 20 mA output becomes lower than 3.6 mA or higher than 21 mA, and the failure contact is activated for the case [Fault alarm] or [Gas alarm or fault alarm] is selected for the alarm contact specification.
  - \* Connect the 4 to 20 mA output or contact output to the host system. This is necessary to notify that a problem has occurred and put the functional safety system into safe state.

Measure against failure

- Check the detail of failure and take a countermeasure within the recovery time of functional safety system.
  - \* Refer to the operation manual for other measures.

#### **4-8. Lifetime limits**

Product life: 10 years from manufacturing date

- The reliability data of FMEDA report is valid within this period.
- When this period has passed, the failure rate may increase.
- When this period has passed, SIL 2 will not be satisfied.

#### **4-9. Environmental limits**

Avoid the following environments to install the device. The reliability data of FMEDA report becomes invalid if the device is installed in such environments.

- Place with shock or vibration
- Place exposed to water, oil, chemical, etc.
- Place exposed to direct sunlight or rapid temperature change
- Place with a noise source (which may affect the main unit or cable)
- Place where maintenance cannot be performed or any danger may be caused during maintenance work
- Place without appropriate grounding work
- Place where the operating temperature/humidity range is exceeded  
Operating temperature range: -20 to +60°C (overseas specification), -20 to +53°C (Japanese specification)  
Operating humidity range: 95%RH or lower (no condensation)  
Storage temperature humidity range: -20 to +60°C, 95%RH or lower (no condensation)
- Place where a gas with interference or poisoning effect is not present  
Exposure to poisonous substances (silicone, halogen compound, sulfur compound, etc.) causes the sensitivity of catalytic combustion sensor to be degraded. The device cannot be used in such environment.
- Place without oxygen  
The device cannot measure a combustible gas without oxygen due to its detection principle.
- Place where a combustible gas with high concentration is present  
If the device detects a combustible gas with high concentration which exceeds the lower explosion limit (100%LEL), accurate measurement may not be performed due to lack of oxygen. It may also cause disconnection of the sensor.

#### **4-10. Application limits**

- Rated power voltage/allowable range: 24 VDC/17.0 to 26.4 VDC
- Power consumption: 3 W at maximum
- 4 to 20 mA output load resistance: 300 Ω or lower
- Contact output load capacity: 250 VAC·0.5 A / 30 VDC·0.5 A or lower

#### **4-11. Hardware/Software configuration**

Hardware identification number :

Part list

Terminal PCB : PLT-2905-1904-90 (Rev.0)

Main PCB : PLT-2905-1905-60 (Rev.0)

Circuit schematic

Terminal PCB : E3-2905-1904-90-01N (Rev.0)

Main PCB : E3-2905-1905-60-01N (Rev.0)

Software identification number :

- Program drawing number : E4-2975-0173-40-01Z (Rev.0)

## 5. Using This Detector

### **5-1. Installation**

Refer to the operation manual.

### **5-2. Configuration and calibration**

The correct operation must be performed for gas calibration after installation.

Refer to the operation manual for the gas calibration procedure.

After installation, check that the following items use the default settings. When you have requested a special setting, check that the setting is done correctly.

Refer to the operation manual for how to check the settings.

<b>Item</b>	<b>Default</b>	<b>Settable range</b>
Alarm point	25%LEL	10 to 60%LEL
Alarm contact specification	Normally energized	Normally energized/de-energized
Gas alarm delay	2 seconds	2 to 60 seconds
Analog output during alarm test	Value corresponding to indication	Value corresponding to indication/4 mA
Contact output specification	Gas alarm	Gas alarm/failure/gas alarm or failure contact
Analog output during maintenance mode	4 mA	2.5 mA/4 mA/fixed to a value just before entering maintenance mode/a value corresponding to indication



### **5-3. Proof testing**

Carry out proof testing when routine maintenance (every 6 month) is performed.

Proof testing procedure

- 1) Bypass the safety function or take an appropriate measure to prevent malfunction of the host system as needed.

Note: During proof testing, the 4 to 20 mA output signal to the host system may be disabled in order to check the 4 to 20 mA output value.

- 2) Perform routine maintenance (Zero adjustment and span adjustment)
- 3) Check gas response time (T50 and T90) with span gases introduced.

Measure the 4 to 20 mA output value while performing a gas test with zero and span gases introduced.

Check the contact output as well when it is used.

Check the 4 to 20 mA output value while performing a gas test with zero and span gases introduced.

Check the contact output as well when it is used.

\*The 4 to 20 mA output becomes 4 mA with zero gas introduced, whereas it becomes a value corresponding to gas concentration with span gas introduced.

\*Check that the contact output operation is performed according to the setting.

\* If an alarm point is higher than the span gas concentration, lower the setpoint temporarily.

- 4) Stop introducing span gas and wait for the indication to return.
- 5) Return the alarm point to the original value if it was changed in the step 3).
- 6) Restore the condition before performing the step 1).

\* Only the trained service personnel should be allowed to perform proof testing since an erroneous operation can cause malfunction of the device.

\* The combustible gas concentration measurement function is stopped during proof testing; therefore, take an appropriate measure to ensure EUC safety.

\* Replace a sensor when calibration is unable to be done.

### **5-4. Daily Check**

Refer to the operation manual for the details of daily check.

- 1) Check frequency

Check before work

- 2) Check item

Check the indication

- 3) Check content

Check that the indicated value is zero. If the indicated value is not zero, perform zero adjustment after no interference gases exist around the environment.

### **5-5. Routine maintenance**

Refer to the operation manual for the details of routine maintenance.

- 1) Periodic calibration

At least once every six months

2) Periodic sensor replacement

The sensor parts have lifetime limits. It is required to replace the parts before the limits for correct operation.

Replace a sensor when calibration is unable to be done

Even if the calibration history shows a good result, replace the sensor every three years. The sensor cannot be used for more than this period.

3) Periodic cleaning

Remove any visible dirt, etc. from the sintered metal.

The frequency of cleaning depends on the diagnostic result.

\*Only the trained service personnel should be allowed to perform routine maintenance since an erroneous operation can cause malfunction of the device.

\*The combustible gas concentration measurement function is stopped during routine maintenance; therefore, take an appropriate measure to ensure EUC safety.

**5-6. Repair and replacement**

Repair and replacement of degraded parts are performed by the service company specified by RIKEN KEIKI with the user's agreement.

**5-7. Modification**

The default setting has been performed on the device prior to shipment. Changing the setting is password protected. Please do not change the settings on the user side. If the setting needs to be changed, Please contact the service company of our specification or our sales office.

**5-8. Disposal**

Refer to the operation manual for how to dispose of the device.

**6. Terms and Definitions**

Terms	Description
Alarm point	A threshold which can be set arbitrarily within the range of 10 to 60% of the concentration of lower explosion limit.
Combustible gas	Methane, isobutane, hydrogen, etc.
Lower explosion limit	A minimum value of concentration which can trigger explosion of target combustible gas
EUC	Controlled equipment, plant, etc.

End of document