PT2E-2570

RIKEN KEIKI

Smart transmitter/
Gas Detector Head
SD-1 series
HART®Field Device Specification

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1. INTRODUCTION

1.1 Scope

RIKEN KEIKI Co., Ltd. smart transmitter/gas detector head, model SD-1, complies with HART Protocol Revision 7.0. This document specifies all the device specific features and documents HART Protocol implementation details (e.g., the Engineering Unit Codes supported). The functionality of this Field Device is described sufficiently to allow its proper application in a process and its complete support in HART capable Host Applications.

1.2 Purpose

This specification is designed to compliment other documentation (e.g., SD-1 *Installation Manual*) by providing a complete, unambiguous description of this Field Device from a HART Communication perspective

1.3 Who should use this document?

The specification is designed to be a technical reference for HART capable Host Application Developers, System Integrators and knowledgeable End Users. It also provides functional specifications (e.g., commands, enumerations and performance requirements) used during Field Device development, maintenance and testing. This document assumes the reader is familiar with HART Protocol requirements and terminology.

2. DEVICE IDENTIFICATION

Manufacturer Name:	RIKEN KEIKI Co.,Ltd.	**Model Name(s):**	SD-1
Manufacture ID Code:	605B (Hex)	**Device Type Code:**	E1B5 (Hex)
HART Protocol Revision	7.0	**Device Revision:**	1
Number of Device Variables	1		
Physical Layers Supported	FSK		
Physical Device Category	Current Output		

3. PRODUCT OVERVIEW

・The detector is a fixed type gas detector head that detects leak of combustible gases and that performs the alarm activation when the gas concentration is over the setting value.

・This detector is a safety unit, not an analyzer or densitometer which performs quantitative/qualitative analysis/measurement for gases.

・The detector detects abnormalities in the air caused by presence of gases or other reasons (leak) with the built-in gas sensor. The concentrations of detected gases are displayed on the seven-segment LED.

・The detector outputs gas concentration in 4-20 mA.

4. PRODUCT INTERFACES

4.1 Process Interface

4.1.1 Power Input Terminal

Power input provides two terminals, marked 1 and 2 (+ and －)for connection.

Refer to the Installation Manual for connection details.

An additional internal temperature sensor is mounted near the sensor terminals. This provides cold junction compensation when a thermocouple is used as the main sensor.

4.2 Host interface

4.2.1Analog Output

4-to-20mA output current is connected on two terminals marked 3 and 4. Refer to the Installation Manual for connection details.

Detection Mode (No Alarm)	4 - 20 mA (concentration output)
Detection Mode (Gas Alarm)	4 - 20 mA (concentration output)
Initial Clear	2.5 mA setting: 2.5 mA 4 mA, HOLD, 4 - 20 mA setting: 4 mA
Maintenance Mode	2.5 mA setting: 2.5 mA 4 mA setting: 4 mA HOLD setting: The previous value retained 4-20 mA setting: 4 - 20 mA (concentration output)
Alarm Test	Output ON setting: 4 - 20 mA (concentration output) Output OFF setting: 4 mA
Fault Alarm	0.5 mA (Fixed)
INHIBIT	2.5 mA setting: 2.5 mA 4 mA, HOLD, 4 - 20 mA setting: 4 mA
Power Off	0 mA

In case of over scale, an output will not exceed 22 mA.

4.3 Local Switches And Displays

4.3.1 Local Control-switches And Displays

This device has local control-switches and displays.

4.3.2 Internal Jumpers And Switches

Use the supplied dedicated control key to operate the detector. If products other than these accessories are used, key operations cannot be accepted properly.

Refer to the Installation Manual.

5. DEVICE VARIABLES

There are no device variables exposed to the user.

6. DYNAMIC VARIABLES

There is only one Dynamic Variable exposed to the user.

	Meaning	Units
PV	Gas Value	Depends on gas
SV,TV,QV	Not Applicable	-

Depends on gas detection principle

7. STATUS INFORMATION

7.1 Device Status

Bit 4 ("More Status Available") is set whenever any failure is detected. Command #48 gives further detail. (See Section 7.2.)

7.2 Extended Device Status

The Field Device cannot predict, in advance, when the maintenance will be required. This bit is set if a sensor break is detected. "Device Variable Alert" is set if the PV is out of limit.

7.3 Additional Device Status (Command #48)

Command #48 returns 2 bytes of data, with the following status information:

Byte	Bit	Meaning	Class	Device Status Bits Set
0	0	ROM checksum error	Error	7
	1	EEPROM checksum error	Error	7
	2	RAM test failure	Error	7
	3	Not used		
	4	Not used		
	5	Not used		
	6	Not used		
	7	Not used		
1	0	External sensor open circuit	Error	4
	1	Sensor Over range	Warning	4
	2	Sensor Alarm	Warning	4
	3	Not used		
	4	Initial	Info	4
	5	Inhibit	Info	4
	6	Test	Info	4
	7	ADJ	Info	4

"Not used" bits are always set to 0.

All bits used in this transmitter indicate device or sensor failure, and therefore also set bit 7 and bit 4 of the Device Status byte.

These bits are set or cleared by the self-test executed at power up. They are also set (but not cleared) by any failure detected during continuous background self-testing.

8. UNIVERSAL COMMANDS

Command #3 returns PV for a total of 14 bytes of response data. See Section 6.

Command #14: Units for sensor limits and minimum span are fixed as ppm (unit code 139 decimal). Sensor serial number is not used, and returns 0.

9. COMMON-PRACTICE COMMANDS

9.1 Supported Commands

The following common-practice commands are not implemented.

9.2 Burst Mode

This Field Device does not support Burst Mode.

9.3 Catch Device Variable

This Field Device does not support Catch Device Variable.

10. DEVICE-SPECIFIC COMMANDS

The Device Specific commands are used strictly for the unique features of the SD-1

Command#	DESCRIPTION
131	Read INHIBIT
132	Write INHIBIT
133	Read Alarm Point
134	Write Alarm Point
135	Reserved
136	Reserved
137	Read Alarm delay time
138	Write Alarm delay time
139	Read Alarm action
140	Write Alarm action
141	Read suppress method
142	Write suppress method
143	Read suppress value
144	Write suppress value
145	Reserved
146	Reserved
147	Reserved
148	Reserved
149	Read follower function
150	Write follower function
151	Read Maintenance external output
152	Write Maintenance external output
153	Read Alarm test external output
154	Write Alarm test external output
155	Reserved
156	Reserved
157	Read Password
158	Write Password
159	Read sensor failure action
160	Write sensor failure action
161	Read calibration curve No.
162	Reserved
163	Reserved
164	Reserved
165	Read Full scale
166	Reserved
167	Read model
168	Read program number
169	Read SUM value
170	Read A/D value
171	Reserved

10.0 Device Specific Commands

The Device Specific commands are used strictly for the unique features of the SD-1 and at the discretion of Riken Keiki.

10.1 Command #131: Read INHIBIT

This command read INHIBIT.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	ON:0x01,OFF:0x00

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.2 Command #132: Write INHIBIT

This command write INHIBIT.

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	ON:0x01,OFF:0x00

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	ON:0x01,OFF:0x00

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5	Error	Too Few Data Bytes Received
6-127		Undefined

10.3 Command #133: Read 1st. Alarm

This command read 1st. Alarm.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	1st. Alarm

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.4 Command #134: Write 1st. Alarm

This command write 1st. Alarm.

Request Data Bytes

Byte	Format	Description
0-3	Float	1st. Alarm

Response Data Bytes

Byte	Format	Description
0-3	Float	1st. Alarm

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Command Error
7-127		Undefined

10.5 Command #135: Reserved

10.6 Command #136: Reserved

10.7 Command #137: Read Alarm Delay

This command read Alarm Delay.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Alarm Delay

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.8 Command #138: Write Alarm Delay

This command write Alarm Delay.

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Alarm Delay

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Alarm Delay

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Command Error
7-127		Undefined

10.9 Command #139: Read Alarm Type

This command read Alarm Type.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	AUTO RESETTING:0x00, LATCHING:0x01

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.10 Command #140: Write Alarm Type

This command write Alarm Type.

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	AUTO RESETTING:0x00, LATCHING:0x01

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	AUTO RESETTING:0x00, LATCHING:0x01

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5	Error	Too Few Data Bytes Received
6-127		Undefined

10.11 Command #141: Read Suppress Type

This command read Suppress Type.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	CUT OFF:0x00,SMOOTHING:0x01

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.12 Command #142: Write Suppress Type

This command write Suppress Type.

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	CUT OFF:0x00,SMOOTHING:0x01

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	CUT OFF:0x00,SMOOTHING:0x01

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5	Error	Too Few Data Bytes Received
6-127		Undefined

10.13 Command #143: Read Suppress

This command read Suppress.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Suppress

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.14 Command #144: Write Suppress

This command write Suppress.

Request Data Bytes

Byte	Format	Description
0-3	Float	Suppress

Response Data Bytes

Byte	Format	Description
0-3	Float	Suppress

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Command Error
7-127		Undefined

10.15 Command #145: Reserved

10.16 Command #146: Reserved

10.17 Command #147: Reserved

10.18 Command #148: Reserved

10.19 Command #149: Read Zero Follower

This command read Zero Follower.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	ON:0x01,OFF:0x00

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.20 Command #150: Write Zero Follower

This command write Zero Follower.

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	ON:0x01,OFF:0x00

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	ON:0x01,OFF:0x00

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5	Error	Too Few Data Bytes Received
6-127		Undefined

10.21 Command #151: Read Mainte. Out

This command read Mainte. Out.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	2.5mA:0x00,4.0mA:0x01,4-20mA:0x02,HOLD:0x03

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.22 Command #152: Write Mainte. Out

This command write Mainte. Out.

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	2.5mA:0x00,4.0mA:0x01,4-20mA:0x02,HOLD:0x03

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	2.5mA:0x00,4.0mA:0x01,4-20mA:0x02,HOLD:0x03

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5	Error	Too Few Data Bytes Received
6-127		Undefined

10.23 Command #153: Read Test Out

This command read Test Out.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	ON：0x01,OFF:0x00

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.24 Command #154: Write Test Out

This command write Test Out.

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	ON：0x01,OFF:0x00

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	ON：0x01,OFF:0x00

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5	Error	Too Few Data Bytes Received
6-127		Undefined

10.25 Command #155: Reserved

10.26 Command #156: Reserved

10.27 Command #157: Read Password

This command read Password.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	ON:0x01,OFF:0x00

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.28 Command #158: Write Password

This command write Password.

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	ON:0x01,OFF:0x00

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	ON:0x01,OFF:0x00

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5	Error	Too Few Data Bytes Received
6-127		Undefined

10.29 Command #159: Read Sensor Fail

This command read Sensor Fail.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	AUTO RESETTING:0x00 ,LATCHING:0x01,

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.30 Command #160: Write Sensor Fail

This command write Sensor Fail.

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	AUTO RESETTING:0x00 ,LATCHING:0x01,

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	AUTO RESETTING:0x00 ,LATCHING:0x01,

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-4		Undefined
5	Error	Too Few Data Bytes Received
6-127		Undefined

10.31 Command #161: Read Liner

This command read Liner.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Liner

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.32 Command #162: Reserved

10.33 Command #163: Reserved

10.34 Command #164: Reserved

10.35 Command #165: Read Full Scale

This command read Full Scale.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	Full Scale
4-7	Float	Digit Value
8	Unsigned-8	Dot Position

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.36 Command #166: Reserved

10.37 Command #167: Read Model

This command read Model.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-19	ASCII	Model

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.38 Command #168: Read Program No.

This command read Program No.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-4	ASCII	Program No.

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.39 Command #169: Read Program SUM

This command read Program SUM.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	ASCII	Program SUM

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.40 Command #170: Read A/D Value

This command read A/D Value.

Request Data Bytes

Byte	Format	Description
None	N/A	N/A

Response Data Bytes

Byte	Format	Description
0-3	Float	AD Value00
4-7	Float	AD Value01
8-11	Float	AD Value02
12-15	Float	AD Value03
16-19	Float	AD Value04
20-23	Float	AD Value05
24-27	Float	AD Value06
28-31	Float	AD Value07
32-35	Float	EXT AD

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-127		Undefined

10.41 Command #171:Reserved

11. PERFORMANCE

11.1 Sampling Rates

Typical sampling rates are shown in the following table.

Primary Gas sensor sample	10 per second
PV digital value calculation	4 per second
Analog output update	4 per second

11.2 Power-Up

On power up, the transmitter goes through a self-test procedure , which takes approximately 2 seconds. During this period, the device will not respond to HART commands, and the analog output is set at 4.0mA.

When the self-test is satisfactorily completed, and the first measurement has been made, the PV values are set, and the analog output moves to a value representing the measurement. The slew rate of this movement is limited by the configured "damping time". Only after the PV are correctly set, will the device respond to HART commands.

If the self-test fails, all live measurement data (PV, current and percent of range) are set to "Not A Number", and the analog output is set to the configured malfunction-indicating current. The device will attempt to respond to HART commands.

11.3 Command Response Times

Minimum	20ms
Typical	50ms
Maximum	100ms *

* During self-test following a self-test command, the device may take up to 250ms to respond.

Busy and Delayed-Response

The transmitter may respond with "busy" status if a further command is received while self-test is underway.

Delayed-response is not used.

11.4 Long Messages

The largest data field used is in the response to Command 21: 34 bytes including the two status bytes.

11.5 Non-Volatile Memory

EEPROM is used to hold the device's configuration parameters. New data is written to this memory immediately on execution of a write command.

11.6 Damping

Damping is standard, affecting only the PV and the loop current signal.

ANNEX A. CAPABILITY CHECKLIST

Manufacturer, model and revision	RIKEN KEIKI SD-1, rev. 1
Device type	Analytical ／Gas Detector Head
HART revision	7.0
Device Description available	Yes
Number and type of sensors	1
Number and type of actuators	0
Number and type of host side signals	1: 4 - 20mA analog
Number of Device Variables	1
Number of Dynamic Variables	1
Mappable Dynamic Variables?	No
Number of common-practice commands	1
Number of device-specific commands	41
Bits of additional device status	16
Alternative operating modes?	No
Burst mode?	No
Write-protection?	No

Manual Log

Rev.	Amendment	Issue data
0	First issue	2017/7/10