RIKEN KEIKI

T1E-0742

Indicator/Alarm Unit

RM-5000 Series

RS-485(Modbus-RTU)

Manual for Communication Function

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<Preface>

- Preface

  Thank you for purchasing our indicator/alarm unit RM-5000 series.

  This manual is a guide to use communication function of RM-5000 series. All persons who use this unit for the first time and who has ever used this unit are requested to read through this manual to understand the contents before use.

  Communication function of RM-5000 is a part of communication equipment in a network system on a field. Be sure to read manuals of the equipment related to the network system.

- Limitation of Liability

  We do not take the responsibility for the result which is caused by the program of the equipment which communicates with RM-5000.

- Numerical notation

  Decimal notation : Only numerical value (1, 100, 1000 etc.)
  Hexadecimal notation : “0x” is added to the head of the value (0x00, 0x64, 0x3EB etc.)

NOTE

<Contents>

1

Basic Information

Basic information to use communication function RS-485(Modbus-RTU) of RM-5000

- Setting address
  You can set Modbus address of RM-5000 to 1-128

- The number of the simultaneous connection
  Max. 127 sets against 1 x master unit

- Transmission Mode
  RM-5000 supports RTU mode only although Modbus has ASCII mode (transmitted by ASCII strings) and RTU mode (transmitted by binary transmission).

- Available function
  The following Modbus function is available.
  0x03：Read Holding Register

- Exceptional response
  In the following cases, RM-5000 responds exceptional response of Modbus

  1) In a case that unavailable function is selected
  (Available function on RM-5000 is 0x03)

  Example:
  Query : 010500000000**** ←Function code = 0x05
  Response : 018500000000**** ←Exceptional response: Incorrect function
  (0x80's or is replied to receiving function)

  2) In a case that nonexistent data field is selected.
  (Data field of RM-5000 is 40001～40032)

  Example:
  Query : 010300870001**** ←Data field = 40136
  Response : 018300870001**** ←Exceptional response: Incorrect data field
  (0x80's or is replied to receiving function)

2

Register Map

2-1. RM-5000 Modbus Register Map

RM-5000 Modbus register map

address	Item	Content
40001	Status Data (Refer to the graph in page 7) *1	Bit 0 to 1 = Magnification (0: actual size, 1: one tenth, 2: one hundredths, 3:one thousandth) Bit 2 to 3 = Unit (0: vol%, 1: %LEL, 2: ppm, 3: ppb) Bit 4 = Setting information for double range (1: L side, 0: H side and single range) Bit 5 = Flag for flow trouble Bit 6 = Not used Bit 7 = Flag for sensor trouble Bit 8 = Flag for 1st alarm Bit 9 = Flag for 2nd alarm Bit 10 = Flag for smoke alarm (SiO2) Bit 11 = Flag for full scale over Bit 12 = Initial flag Bit 13 = INHIBIT flag Bit 14 = Flag for alarm test Bit 15 = Flag for maintenance mode
40002	4-20mA Input/output Information	SC type (4-20mA input) = 800 to 4000 Except for SC type (4-20mA output) = 800 to 4000 (Notice) ・4-20mA input can be 0mA to 33mA and the data range is 0 to 6600. ・4-20mA output is set at 800 even it is in negative value. Upper limit is normally F.S.+1digit, and in maintenance it is until 1.2 times of F.S. (F.S. equivalent = 4000)
40003	Gas Concentration Data *2, *3	Signed integer Significant figures of gas concentration which is made to integer. Actual Gas concentration is calculated by multiplying this integer by bit 0 to 1 of address 40001, 40018 or 40028.
40004 to 40011	Reservation	
40012	Full Scale Value	Signed integer Significant figures of full scale value which is made to integer. Actual full scale is calculated by multiplying this integer by bit 0 to 1 of address 40001 or 40018.
40013	1st Alarm Point	Signed integer Significant figures of 1st alarm point which is made to integer. Actual 1st alarm point is calculated by multiplying this integer by bit 0 to1 of address 40001, 40018 or 40028.
40014	2nd Alarm Point	Signed integer Significant figures of 2nd alarm point which is made to integer. Actual 2nd alarm point is calculated by multiplying this integer by bit 0 to 1 of address 40001, 40018 or 40028.
40015	Peak Value	Signed integer Significant figures of peak value which is made to integer. Actual peak value is calculated by multiplying this integer by bit 0 to 1 of address 40001, 40018 or 40028.
40016	New Flag for Alarm/trouble	Bit 0 = New flag for 1st alarm Bit 1 = New flag for 2nd alarm Bit 2 = New flag for trouble

Address	Item	Content
40017	Digit	Signed integer Significant figures of digit which is made to integer. Actual digit is calculated by multiplying this integer by bit 0 to 1 of address 40001 or 40018.
40018	Decimal Point Position	0: actual size, 1: one tenth, 2: one hundredth, 3: one thousandth
40019	Unit	0: vol%, 1: %LEL, 2: ppm, 3: ppb
40020	X 10 Scale Information	Information of ten times measuring range(H side and single range) Address 40012: Full scale value, Address 40013: 1st alarm point, Address 40014: 2nd alarm point, address 40015: convert peak value by ten times.
40021 to 40025	Gas Name	Gas name = ASCII code 10 letters
40026	Full Scale Value in L side	Signed integer: L side full scale in double range Significant figures of L side full scale which is made to integer. Actual L side full scale is calculated by multiplying this integer by bit 0 to1 of address 40028.
40027	L side Digit	Signed integer: L side digit in double (W) range Significant figures of L side digit which is made to integer. Actual L side digit is calculated by multiplying this integer by bit 0 to 1 of address 40028.
40028	Decimal Point Position in L side	Position of L side decimal in double (W) range 0: actual size, 1: one tenth, 2: one hundredth, 3: one thousandth
40029	L side Unit	L side Unit in double (W) range 0: vol%, 1: %LEL, 2: ppm, 3:ppb
40030	x10 Scale Information in L side	Information of ten times measuring range (L side in double (W) range) Address 40026: full scale value, Address 40013: 1st alarm, Address 40014: 2nd alarm, Address 40015: convert peak value by ten times
40031	Concentration Value of H (High) side in case of double (W) range	Signed integer: Concentration value of H (High) side in case of double (W) range Significant figures of concentration of H side which is made to integer. Actual concentration of H side is calculated by multiplying this integer by bit 0 to 1 of address 40001 or 40018.
40032	AMP Types	0: GP, 1: NC, 2: NCW, 3: OX, 4: GH, 5: HART, 6: SC

2-2. Operation List of Status Data (address40001)

S t a t u s	15	14	13	12	11	10	9	8	7	6	5	4	3, 2	1, 0
	maintenance	Test	Inhibit	Initial	Range over	Smoke(SiO2)	2nd Alarm	1st Alarm	Trouble sensor	Unused	Trouble : flow	Information of double range	Unit Code of gas concentration	Decimal Code
Normal : Measuring	○	○	○	○	○	○	○	○	○	○	○	○	—	—
Alarm : 1st	○	○	○	○	○	○	○	●	○	○	○	○	—	—
Alarm : 2 nd	○	○	○	○	○	○	●	※	○	○	○	○	—	—
Alarm : Smoke	○	○	○	○	●	●	●	●	○	○	○	○	—	—
F.S. over	○	○	○	○	●	○	—	—	○	○	○	○	—	—
Constant time after power on (or after reboot)	○	○	○	●	○	○	○	○	○	○	○	○	—	—
Maintenance	●	○	○	○	—	○	—	—	○	○	○	○	—	—
Alarm Test	●	●	○	○	—	○	—	—	○	○	○	○	—	—
Trouble : Sensor	○	○	○	○	○	○	○	○	●	○	○	○	—	—
Trouble : Flow	○	○	○	○	○	○	○	○	○	○	●	○	—	—
Measuring of L side	○	○	○	○	○	○	○	○	○	○	○	●	—	—
Inhibit	●	○	●	○	○	○	○	○	○	○	○	○	—	—

●: Bit ON ○: Bit OFF —: Unsettled

※ In H-HH/L-LL alarm type : ● In L-H alarm type : ○

NOTES:

*1 In maintenance mode, the alarms do not work even if the gas concentration gets over the alarm point.

*2 In maintenance mode, the gas concentration could be minus. When alarm process is activated by gas concentration data, make a design with consideration of negative value (complete representation).

*3 The gas concentration becomes an integer which maintains the number of significant digits.

Examples)

① If the gas concentration is 20.9 in full scale 25.0 → 209

② If the gas concentration is 0.2 in full scale 50.0→ 2

③ If the gas concentration is 0.20 in full scale 5.00→ 20

3

Communication Specification

3-1. RM-5000 Series

Contents	Specification
Electrical specification	Based on EIA RS-485
Communication specification	2 wire Half Duplex
Synchronization method	Asynchronous
Connection form	1:N
Maximum connectable number	127 ea against 1 x master unit
Protocol	Modbus-RTU Available Function 03 Read Holdind Register
Transmission speed	19200bps/38400bps*
Length of data	8bit
Parity	nothing/odd/even*
Stop bit	1bit*/2bit
Error check	CRC-16

* : Default value

＊NOTICE

Maximum transmission distance is 1.2km

3-2. Modbus Protocol

Modbus communication is based on master/slave method, that can communicate with some slaves. Master sends a message to slaves, and slaves send back a response.

Message frame of Modbus-RTU mode

Address	Function	Data	Error Check
8bit(0 –128)	8bit	N*8bit(Depends on the function)	16bit(CRC-16)

Address
Setting address of slaves

Function
Setting function code you want to carry out

Error check (CRC-16)
CRC -16 is binary of 16 bits, and sending side calculates and adds the calculated value to the message. Receiving side must confirm that the error check value is same as the calculated value. If it is not same, the received message becomes error.

CRC-16 Calculation Method

- It performs XOR of the register initialized by FFFF(Hex) and the byte data of the message.
- The result value is shifted 1 bit to the direction of the last figure.(Shift 1 bit to right)
- In case that the last figure is 1, performs XOR of register and A001(Hex).
- This is repeated 8 times(for 8bit)
- The value of this register becomes the CRC level when this calculation is performed for the byte data of the message.

4

Appendix

4-1. Address Setting Method

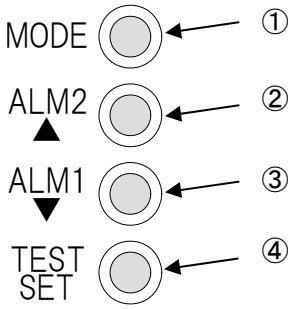
Explanation of the keys

① MODE key

② ALM2/▲ key

③ ALM1/▼ key

④ TEST/SET key



Setting procedure

① Move to a maintenance mode by pressing and holding MODE key.
(Display : [1-1／ZERO])

② Select display [1-8／M MODE] by pressing ▲▼ key, and press SET key.
(Display : [－－－－／M MODE])

③ Press and hold SET key again.
(Display : [2-0／GAS TEST])

④ Select display [2-6／SETTING2] by pressing ▲▼ key, and press SET key
(Display : [SE 0／ADDRESS])

⑤ Press SET key
(Display : [XX／MAC1])

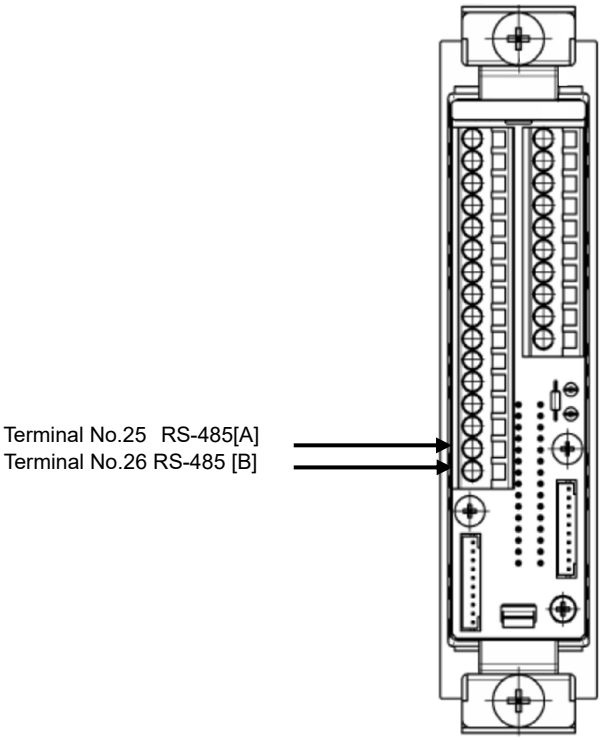
⑥ Set address by pressing ▲▼ key and press SET key.
(Display : [SE 0／ADDRESS])

⑦ Press and hold MODE key to complete the maintenance mode.

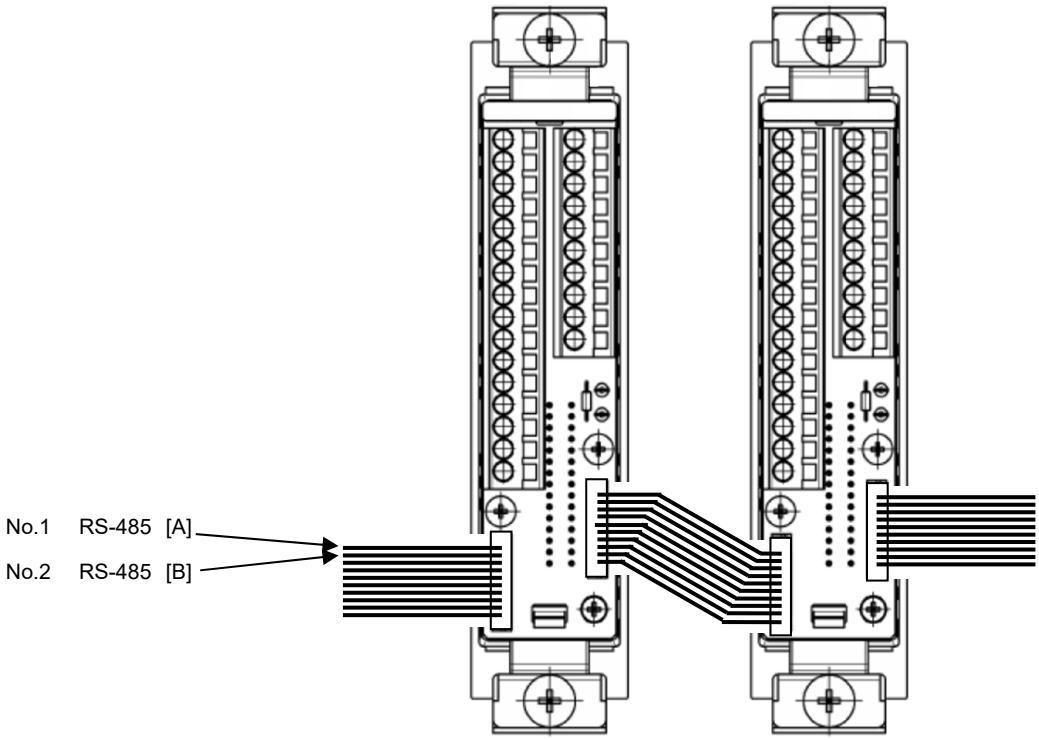
4-2. Wire Connection Method

Single case (SR-5000)

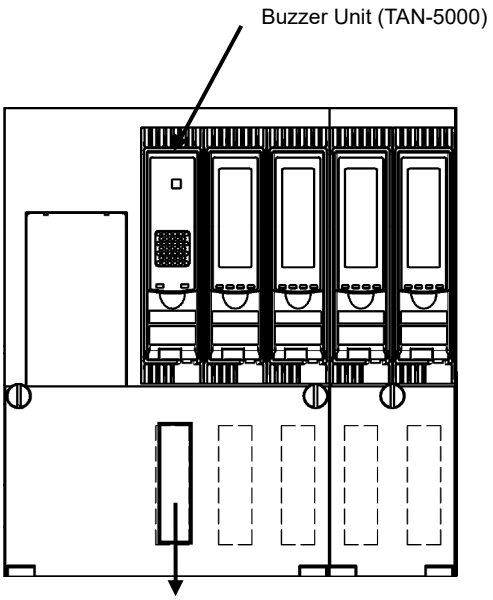
In case of terminal connection



In case of using connectors for signal crossovers among single case.

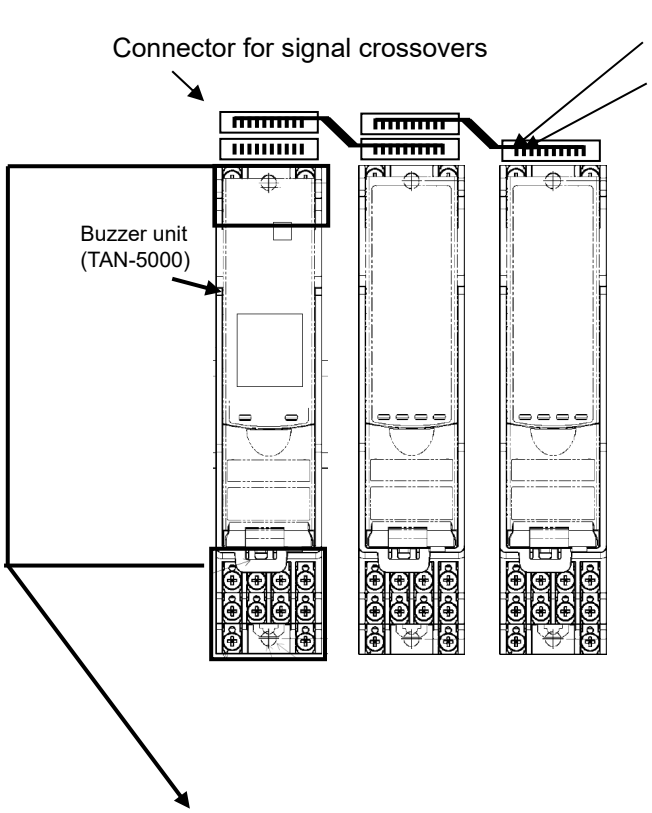


Multi cases (5000-☐☐)



RS-485 Input/output	A	①	⑦	T.ALM1	Total 1st alarm contact output
	B	②	⑧		
Buzzer Stop Signal Input	EX. BZ-STOP	③	⑨	T.ALM2	Total 2nd alarm contact output
Test Input	EX.TEST	④	⑩		
DC24V Output	+	⑤	⑪	T.FAULT	Total trouble alarm contact output
	−	⑥	⑫		
Terminal for grounding	FG	⏚	⑬	EX.RESET	Reset signal input
			⑭	COM	Common

Plugin socket (5000-TM)
When buzzer unit is attached



Signal		NO.		Signal
Power supply DC24V	+	⑪	①	Total 1st alarm contact output
	−	⑫	②	
Total trouble alarm contact output		⑬	③	Empty terminal
		⑭	④	
Test input		⑮	⑤	Buzzer stop Signal input
Common(for 5,6,15)		⑯	⑥	Reset signal input
			⑦	Total 2nd alarm contact output
			⑧	
			⑨ A	RS-485 input/output
			⑩ B	

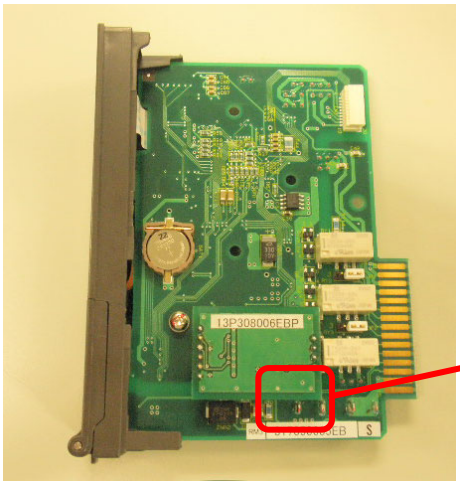
Notice
*Be careful when you attach an indicator unit to a plug-in socket because Terminal No.9, 10 are for 4-20mA output.

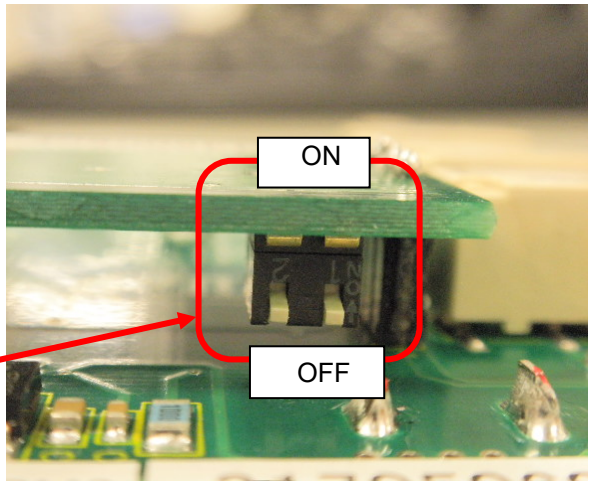
4-3. Setting of the terminating resistance

Set terminating resistance to the equipment of the both ends of the transmission line.

Setting terminating resistance by DIP switch.

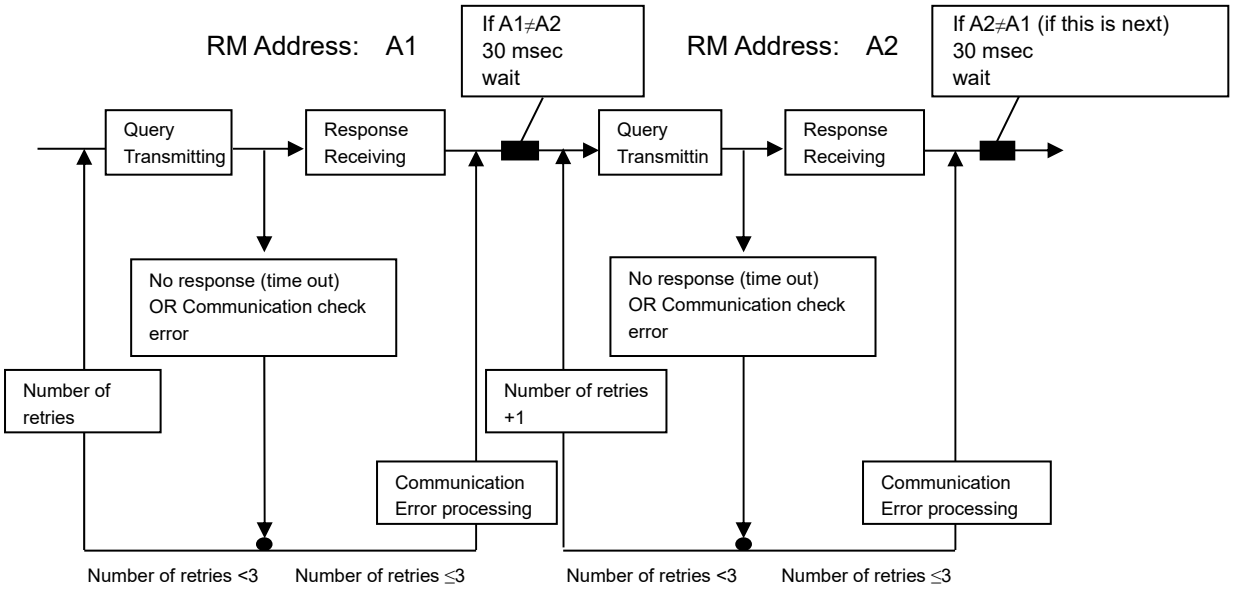
In case of with terminating resistance : SW-1, SW-2 ON
In case of without terminating resistance : SW-1,SW-2 OFF





4-4. Example of communication procedure

Communication procedure examples of the control station (PLC etc.)



Normal process

After transmitting the query to RM-5000, the control station waits for response.
Once the response is received from RM-5000, a receiving process is performed, and a transmission process for the next query is carried out.
After completing the communication process with one RM-5000, the receiving process from the next RM-5000 address in the order is performed. Before transmitting query to the next RM-5000, 30 msec wait time is observed.

Abnormal process

If RM-5000 does not give any response (no response) and becomes communication timeout, and if in case of a response receiving error, another query transmission is given (retry).
Countermeasure for these errors are made by processing three retries. If a normal response cannot be received after making the retry process, communication error process is then made.

If communication errors occur even after continuous retry processes as described above, make query transmissions after a while, such as transmitting another query after performing communication process for other addresses, etc. This may improve the situation.