T1E-0770

RIKEN KEIKI

Indicator/Alarm Unit

RM-6000 Series

RS-485 (Modbus-RTU)

Manual for Communication Function

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<Introduction>

- Introduction

Thank you for purchasing our indicator/alarm unit RM-6000 series.

This manual is a guide to use communication function of RM-6000 series. All persons who use this unit for the first time and who have ever used this unit are requested to read through this manual to understand the contents before use.

Note Communication function of RM-6000 is a part of communication equipment in a network system in 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 communicating with this unit.

- Notation in this manual

Numerical notation
Decimal notation : Numerical values only (1, 100, 1000 etc.)
Hexadecimal notation : “0x” is added before the numerical values (0x00, 0x64, 0x3EB etc.)

NOTE

<Table of Contents>

1

Basic Information

This section provides basic information to use communication function RS-485 (Modbus-RTU) of RM-6000.

- Address setting
  You can set Modbus address of RM-6000 to 1-128.

- The number of the simultaneous connection
  Max. 127 units for 1 master unit.

- Transmission Mode
  RM-6000 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-6000 returns exceptional responses of Modbus.

  1) In a case that unavailable function is selected
  (Available function on RM-6000 is 0x03)

  Example:
  Query : 010500000000**** ←Function code = 0x05
  Response : 018500000000**** ←Exceptional response: Invalid function
  (0x80's OR is returned to the received function)

  2) In a case that nonexistent data field is selected
  (Data field of RM-6000 is 40001 - 40032)

  Example:
  Query: 010300870001**** ←Data field = 40136
  Response: 018300870001**** ←Exceptional response: Invalid data field
  (0x80's OR is returned to the received function)

2

Register Map

2-1. RM-6000 Modbus Register Map

Address	Item	Description
40001	Status Data (Refer to the Operation List of Status Data on page 7) *1	Bit 0 to 1 = Magnification (0: actual size, 1: one tenth, 2: one hundredth, 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 Non- 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 fixed to 800 even it is in a negative value. Upper limit is normally F.S.+1digit, and in maintenance it is up to 1.2 times of F.S. (F.S. equivalent = 4000)
40003	Gas Concentration Data *2, *3	Signed integer Significant figures of gas concentration converted to integers. Actual Gas concentration is calculated by multiplying this integer by bit 0 to 1 of address 40001 (= magnification), or 40018 (or 40028).
40004 - 40011	Reserved failure codes	Most significant bit of address 40004 = error flags starting from 0 Least significant bit of address 40011 = error flag 127 100 - 127 are not used
40012	Full Scale Value	Signed integer Significant figures of full-scale value converted to integers. Actual full scale is calculated by multiplying this integer by bit 0 to 1 of address 40001 (= magnification) or 40018.
40013	1st Alarm Point	Signed integer Significant figures of 1st alarm point converted to integers. Actual 1st alarm point is calculated by multiplying this integer by bit 0 to1 of address 40001 (= magnification), or 40018 (or 40028).
40014	2nd Alarm Point	Signed integer Significant figures of 2nd alarm point converted to integers. Actual 2nd alarm point is calculated by multiplying this integer by bit 0 to1 of address 40001 (= magnification), or 40018 (or 40028).
40015	Peak Value	Signed integer Significant figures of peak value converted to integers. Actual peak value is calculated by multiplying this integer by bit 0 to 1 of address 40001 (=magnification), or 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 failure

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 (=magnification) 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 - 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 converted to integers. Actual L side full scale is calculated by multiplying this integer by bit 0 to1 of address 40028 (= magnification).
40027	L side Digit	Signed integer: L side digit in double (W) range Significant figures of L side digit converted to integers. Actual L side digit is calculated by multiplying this integer by bit 0 to 1 of address 40028 (= magnification).
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 point, Address 40014: 2nd alarm point, 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 (= magnification) 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 (address 40001)

Status	15	14	13	12	11	10	9	8	7	6	5	4	3, 2	1, 0
	Maintenance	Test	Inhibit	Initial	RENGE 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: 2nd	○	○	○	○	○	○	●	*	○	○	○	○	–	–
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 are not flagged even if the gas concentration gets over the alarm point. However, while performing “2-0 GAS TEST” in maintenance mode by operating the main unit, both the maintenance flag and alarm flag turn ON.

*2 In maintenance mode, the gas concentration could be negative. When alarm process is activated by gas concentration data, make a design with consideration of negative values (two's complement representation).

* 3 The gas concentration is represented by 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-6000 Series Communication Specification

Description	Specifications
Electrical specification	EIA RS-485 compliant
Communication specification	2 wire Half Duplex
Synchronization method	Asynchronous
Connection form	1: N
Maximum number of connections	127 units for 1 master unit
Protocol	Modbus-RTU Available Function 03 Read Holding Register
Transmission speed	19200bps/38400bps*
Length of data	8 bits
Parity	none/odd/even*
Stop bit	1bit*/2bit
Error check	CRC-16

* Default values

* NOTICE

Maximum transmission distance is 1.2km.

3-2. Modbus Protocol Communication Specification

Modbus communication is based on the master/slave method that allows communication with multiple slaves.
The master sends a message to slaves, and slaves send back responses.

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
Configure addresses of slaves.

Function
Configure function codes you want to execute.

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

CRC-16 Calculation Method
- XOR is performed on the register initialized by FFFF (Hex) and the byte data of the message.
- The result value is shifted by 1 bit to the direction of the last figure. (Shift 1 bit to right)
- In case that the last digit is 1, XOR is performed on the register and A001 (Hex).
- This is repeated 8 times (for 8 bits).
- 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

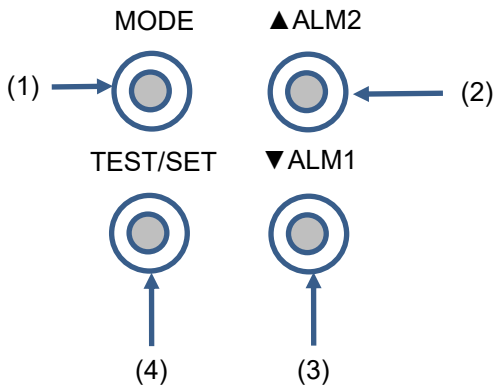
Explanation of the keys

(1) MODE key

(2) ALM2/▲ key

(3) ALM1/▼ key

(4) TEST/SET key



Setting procedure

(1) Enter the maintenance mode by pressing and holding MODE key.
(Display: [1-1/ZERO])

(2) Select display [1-8／M MODE] by pressing the ▲▼ keys, 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 the ▲▼ keys and press SET key.
(Display: [SE 0/ADDRESS])

(5) Press SET key.
(Display: [XX/ADDRESS])

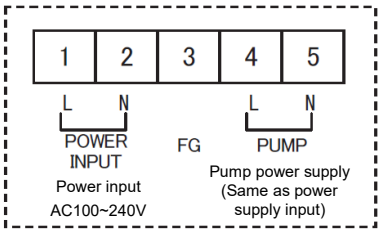
(6) Set address by pressing the ▲▼ keys and press SET key.
(Display: [SE 0/ADDRESS])

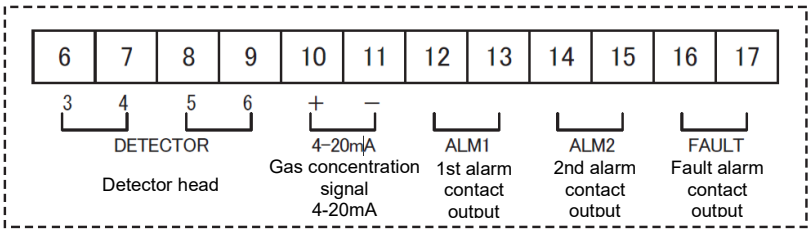
(7) Press and hold MODE key to exit from the maintenance mode.

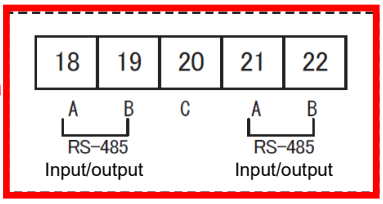
4-2. Wire Connection Method

<Terminal block diagram>

AC specifications

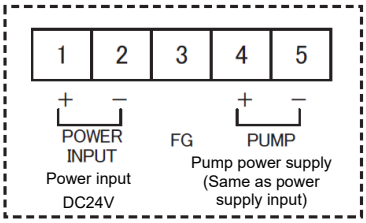


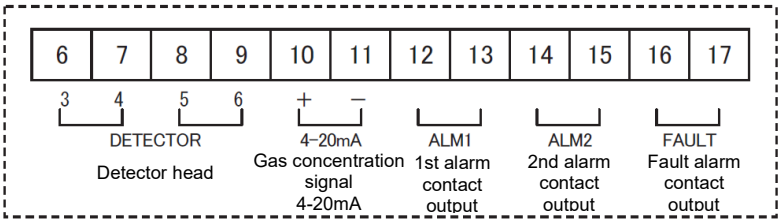


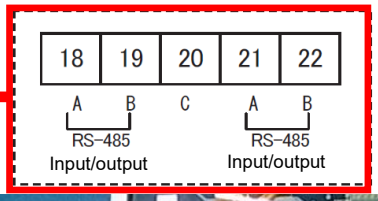


* Compatible ferrule terminal: 216 series (manufactured by WAGO), compatible wire: size 0.5–2.0 mm^2 (stranded wire) or ϕ0.8–2.0 mm (solid wire); bare wire length 10–11 mm
* RS-485 [Option]

DC specification







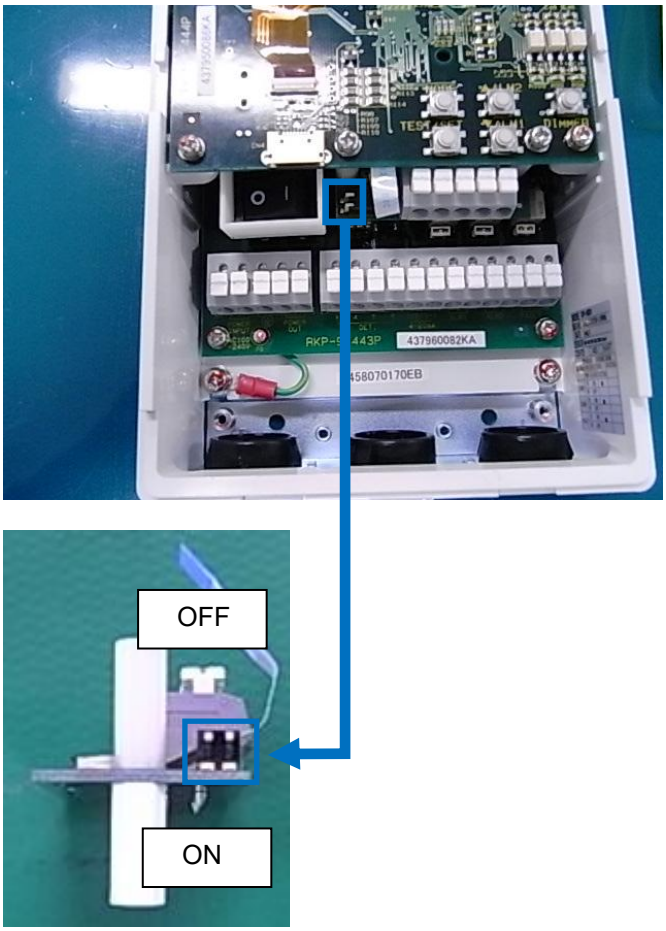
* Compatible ferrule terminal: 216 series (manufactured by WAGO), compatible wire: size 0.5–2.0 mm² (stranded wire) or φ0.8–2.0 mm (solid wire); bare wire length 10–11 mm
* RS-485 [Option]

4-3. Setting of the terminating resistance

Configure the terminating resistance on the equipment of the both ends of the transmission line.

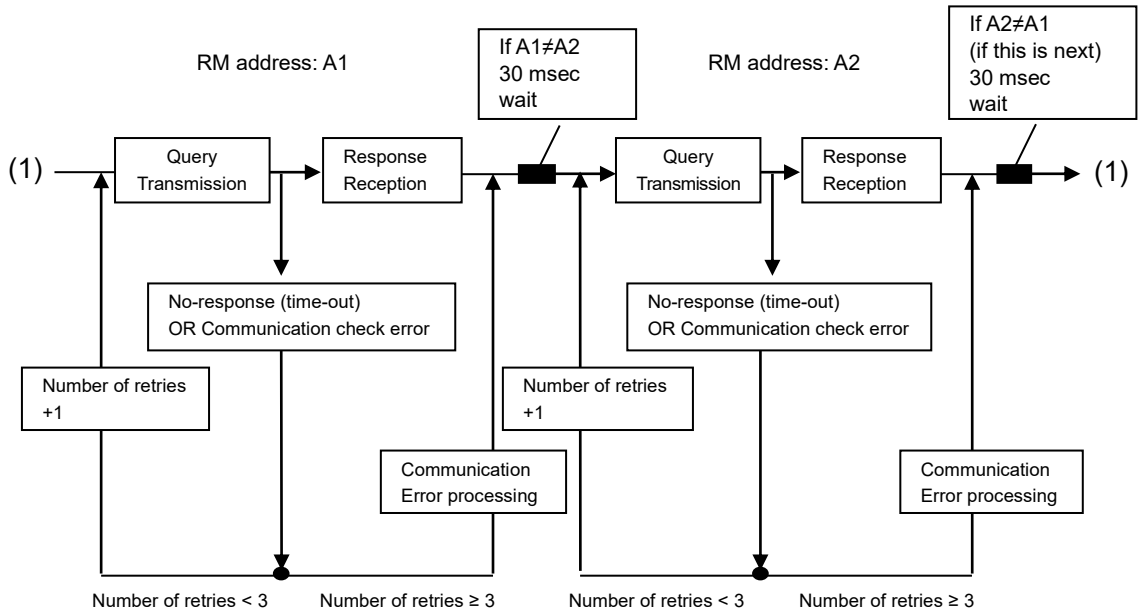
Configuration of the terminating resistance by DIP switch.

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 example of the control station (PLC etc.)



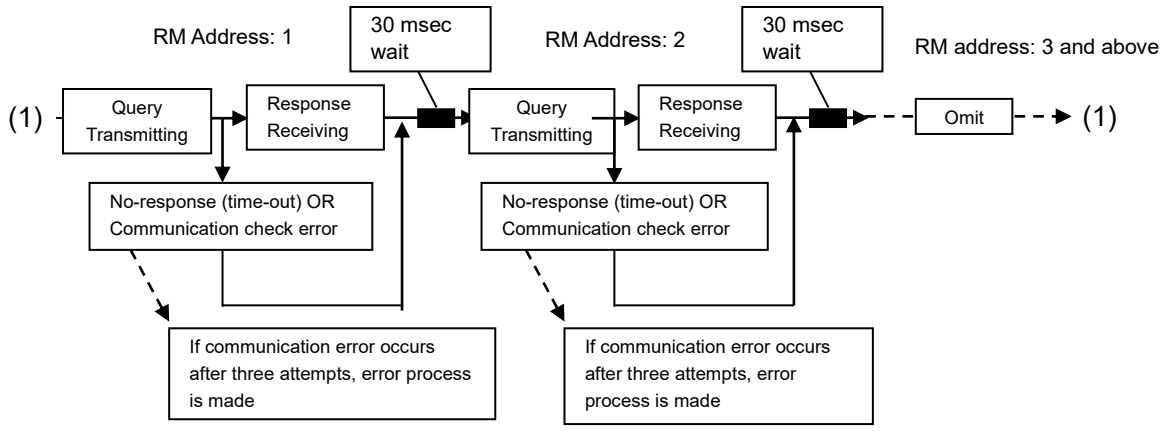
Normal process

After transmitting the query to RM-6000, the control station waits for a response.
Once the response is received from RM-6000, a reception process is performed, and a transmission process for the next query is carried out.
After completing the communication process with one RM-6000, the reception process from the next RM-6000 address in the order is performed. Before transmitting a query to the next RM-6000, 30 msec wait time is observed.

Abnormal process

If RM-6000 does not give any response (no response) and becomes communication timeout, and if in case of a response reception 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 (after inserting a longer wait [e.g., increase from 30 msec to 50 msec]), such as transmitting another query after performing communication process for other addresses, etc. This may improve the situation.



Revision and deletion history

Edition	Corrections	Issue date
0	First edition (T1-0772)	Jun. 22, 2026