Limit Controller

SA200L

*Communication
Instruction Manual*

RKC® **RKC INSTRUMENT INC.**   **IMR03H04-E1**

NOTICE

This manual assumes that the reader has a fundamental knowledge of the principles of electricity, process control, computer technology and communications.

- The figures, diagrams and numeric values used in this manual are only for explanation purpose.

- RKC is not responsible for any damage or injury that is caused as a result of using this instrument, instrument failure or indirect damage.

- RKC is not responsible for any damage and/or injury resulting from the use of instruments made by imitating this instrument.

- Periodic maintenance is required for safe and proper operation of this instrument. Some components have a limited service life, or characteristics that change over time.

- Every effort has been made to ensure accuracy of all information contained herein. RKC makes no warranty, expressed or implied, with respect to the accuracy of the information. The information in this manual is subject to change without prior notice.

- No portion of this document may be reprinted, modified, copied, transmitted, digitized, stored, processed or retrieved through any mechanical, electronic, optical or other means without prior written approval from RKC.

Safety Precautions

■ Pictorial Symbols (safety symbols)

Various pictorial symbols are used in this manual to ensure safe use of the product, to protect you and other people from harm, and to prevent damage to property. The symbols are described below.
Be sure you thoroughly understand the meaning of the symbols before reading this manual.

⚠ **WARNING** : This mark indicates precautions that must be taken if there is danger of electric shock, fire, etc., which could result in loss of life or injury.

⚠ **CAUTION** : This mark indicates that if these precautions and operating procedures are not taken, damage to the instrument may result.

⚠ : This mark indicates that all precautions should be taken for safe usage.

⚠ WARNING

● To prevent injury to persons, damage to the instrument and the equipment, a suitable external protection device shall be required.

● All wiring must be completed before power is turned on to prevent electric shock, fire or damage to the instrument and the equipment.

● This instrument must be used in accordance with the specifications to prevent fire or damage to the instrument and the equipment.

● This instrument is not intended for use in locations subject to flammable or explosive gases.

● Do not touch high-voltage connections such as power supply terminals, etc. to avoid electric shock.

● RKC is not responsible if this instrument is repaired, modified or disassembled by other than factory-approved personnel. Malfunction may occur and warranty is void under these conditions.

⚠ CAUTION

- This product is intended for use with industrial machines, test and measuring equipment. (It is not designed for use with medical equipment and nuclear energy plant.)

- This is a Class A instrument. In a domestic environment, this instrument may cause radio interference, in which case the user may be required to take additional measures.

- This instrument is protected from electric shock by reinforced insulation. Provide reinforced insulation between the wire for the input signal and the wires for instrument power supply, source of power and loads.

- Be sure to provide an appropriate surge control circuit respectively for the following:
  - If input/output or signal lines within the building are longer than 30 meters.
  - If input/output or signal lines leave the building, regardless the length.

- This instrument is designed for installation in an enclosed instrumentation panel. All high-voltage connections such as power supply terminals must be enclosed in the instrumentation panel to avoid electric shock to operating personnel.

- All precautions described in this manual should be taken to avoid damage to the instrument or equipment.

- If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

- All wiring must be in accordance with local codes and regulations.

- All wiring must be completed before power is turned on to prevent electric shock, instrument failure, or incorrect action. The power must be turned off before repairing work for input break and output failure including replacement of sensor, contactor or SSR, and all wiring must be completed before power is turned on again.

- To prevent instrument damage as a result of failure, protect the power line and the input/output lines from high currents with a suitable overcurrent protection device with adequate breaking capacity such as a fuse, circuit breaker, etc.

- A malfunction in this product may occasionally prevent alarm outputs, resulting in a possible hazard to the devices connected to this instrument. Take appropriate measures in the end use to prevent hazards in the event of malfunction.

- Prevent metal fragments or lead wire scraps from falling inside instrument case to avoid electric shock, fire or malfunction.

- Tighten each terminal screw to the specified torque found in the manual to avoid electric shock, fire or malfunction.

- For proper operation of this instrument, provide adequate ventilation for heat dissipation.

- Do not connect wires to unused terminals as this will interfere with proper operation of the instrument.

- Turn off the power supply before cleaning the instrument.

- Do not use a volatile solvent such as paint thinner to clean the instrument. Deformation or discoloration may occur. Use a soft, dry cloth to remove stains from the instrument.

- To avoid damage to the instrument display, do not rub with an abrasive material or push the front panel with a hard object.

For Proper Disposal

When disposing of each part used for this instrument, always follows the procedure for disposing of industrial wastes stipulated by the respective local community.

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Symbols

■ Pictorial Symbols (safety symbols)

📖 **NOTE** : This mark indicates important information on installation, handling and operating procedures.

📖 : This mark indicates supplemental information on installation, handling and operating procedures.

👉 : This mark indicates where additional information may be located.

■ Character Symbols

7-segment character

0	1	2	3	4	5	6	7	8	9	Minus	Period
0	1	2	3	4	5	6	7	8	9	-	.

A	B (b)	C	c	D (d)	E	F	G	H	I	J	K
A	b	C	c	d	E	F	G	H	I	J	k

L	M	N (n)	O (o)	P	Q	R	S	T	t	U	u
L	m̄	n	o	P	q	r	S	t	t	U	u

V	W	X	Y	Z	Degree	/	Prime	* (Asterisk)
V	w̄	y	y	Ξ	o	⌐	'	U

◼ Abbreviation symbols

These abbreviations are used in this manual:

Abbreviation symbols	Name	Abbreviation symbols	Name
PV	Measured value	AHS	Transmission output scale high
SV	Limit set value	ALS	Transmission output scale low
PHLd	Peak hold	LCK	Set data lock
bHLd	Bottom hold	SLH	Setting limiter [high limit]
TIME	EXCD time	SLL	Setting limiter [low limit]
ILr	Alarm interlock release	TC (input)	Thermocouple (input)
ALM1	Alarm 1	RTD (input)	Resistance temperature detector (input)
ALM2	Alarm 2	V (input)	Voltage (input)
AO	Transmission output	I (input)	Current (input)
DEV	Deviation	OUT (1, 2)	Output (1, 2)

Document Configuration

There are four manuals pertaining to this product. Please be sure to read all manuals specific to your application requirements.

The following manuals can be downloaded from the official RKC website:
https://www.rkcinst.co.jp/english/download-center/

Manual	Manual Number	Remarks
SA200L Installation Manual	IMR03H01-X □	This manual is enclosed with instrument. This manual explains the mounting and wiring.
SA200L Quick Operation Manual	IMR03H02-E□	This manual is enclosed with instrument. This manual explains the basic key operation, mode menu, and data setting.
SA200L Instruction Manual	IMR03H03-E□	This manual you are reading now. This manual describes installation, wiring, operation of each function, and troubleshooting.
SA200L Communication Instruction Manual	**IMR03H04-E1**	This manual you are reading now. This manual explains RKC communication protocol (ANSI X3.28-1976) and Modbus relating to communication parameters setting.

📖 Read this manual carefully before operating the instrument. Please place the manual in a convenient location for easy reference.

About This Manual

This manual consists of 7 chapters and an appendix. If you are looking for topics concerning the host communication, you may be able to find one in the following table.

	What do you want to do?	See the following section for more details
☐	I want to know the features of the host communication	1 OUTLINE
☐	I want to know how to connect to the host computer	2. WIRING
☐	I want to know how to set up the communication parameters	3. PARAMETER SETTING
☐	I want to know the content of RKC communication protocol	4. RKC COMMUNICATION PROTOCOL
☐	I want to know the content of Modbus protocol	5. MODBUS PROTOCOL
☐	I want to know how to read the table	4.3.1 How to read the RKC communication identifier list 5.8.1 Reference to Modbus communication identifier list
☐	I want to check RKC communication/Modbus [identifier, data register address, data attribute, data range and factory set values]	4.3.2 RKC communication identifier list 5.8.2 Modbus communication data list
☐	I want to know how to cope with errors	6. TROUBLESHOOTING
☐	I want to know the specification of the host communication	7. SPECIFICATIONS
☐	I want to see the table of ASCII/JIS 7-bit code	A. APPENDIX
☐	I want to see the input range table	A. APPENDIX

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Chapter 4 describes the RKC communication protocol.

5. MODBUS PROTOCOL 5-1

Chapter 5 describes the Modbus protocol.

6. TROUBLESHOOTING 6-1

Chapter 6 describes how to cope with errors during the communication.

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7. SPECIFICATIONS 7-1

Chapter 7 describes the specification of the host communication.

A. APPENDIX.. A-1

MEMO

OUTLINE

1

This chapter describes the host communication of SA200L.

The communication function makes it possible to monitor and set the data of the Limit Controller SA200L from a host computer. The SA200L interfaces with the host computer via Modbus or RKC communication (ANSI X3.28-1976 subcategories 2.5 and A4) protocols. Communication function is available only when optional communication function has been specified at the time of ordering.

For reference purposes, the Modbus protocol identifies the host computer as master, the controller as slave.

■ Host communication (RKC communication, Modbus) [Optional]

Communication interface: RS-485

● Multi-drop connection

One host computer (master) can communicate with up to 31 SA200Ls.

Host computer (master), etc.

RKC communication or Modbus [Communication interface: RS-485]

SA200L (slave) maximum connections: Up to 31 controllers

WIRING

2
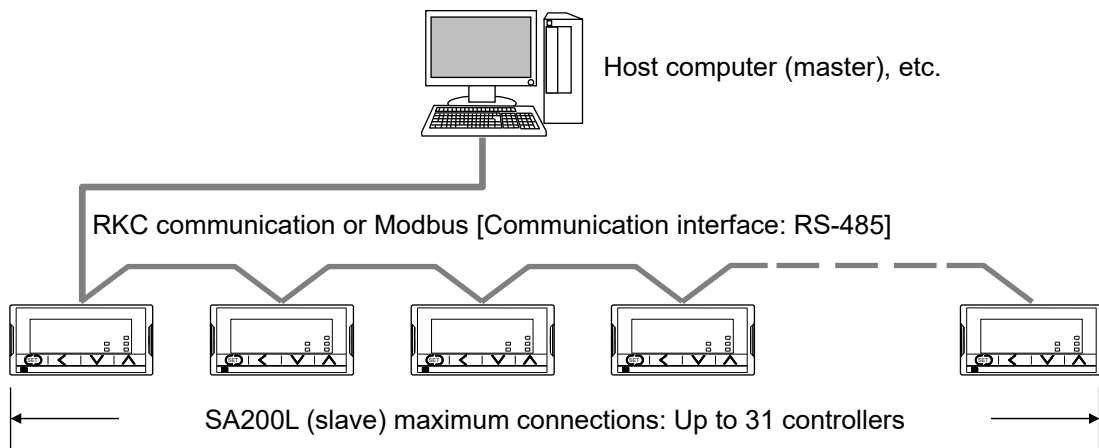
This chapter describes how to connect to the host computer.

⚠ **WARNING**

To prevent electric shock or instrument failure, do not turn on the power until all wiring is completed. Make sure that the wiring is correct before applying power to the instrument.

2.1 Wiring Cautions

- To avoid noise induction, keep communication wire away from instrument power line, load lines and power lines of other electric equipment.

- Always use recommended solderless terminal lugs or equivalent.
  Screw size:　　　　M3 × 6 (With 5.8 × 5.8 square washer)
  Recommended tightening torque:
  　　　　　　　　0.4 N・m [4 kgf・cm]
  Applicable wire:　Solid/twisted wire of 2 mm^2
  Recommended dimension:
  　　　　　　　　See Fig. at the right
  Recommended solderless terminals:
  　　　　　　　　Circular terminal with isolation
  　　　　　　　　(M3 screw, width 5.5 mm, hole diameter 3.2 mm)

Recommended dimension:

- Make sure that during field wiring parts of conductors cannot come into contact with adjacent conductive parts.

- Always connect external wires starting from the lower terminals (No.1 to 6). Disconnect the wires starting from the upper terminals (No.7 to 12).

- When multiple instruments are vertically closely mounted, do not connect two or more solderless terminal lugs to one terminal.

- If multiple instruments are vertically closely mounted, it is necessary to bend the terminal lugs when they are connected to the lower terminals.
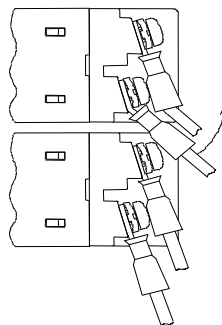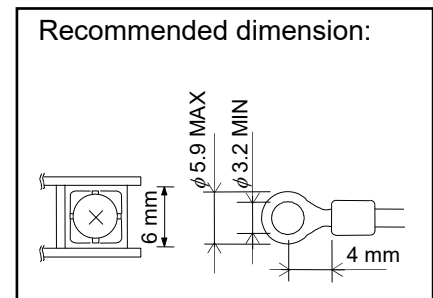
2.2 Wiring for Host Communication

■ Communication terminal number and signal details
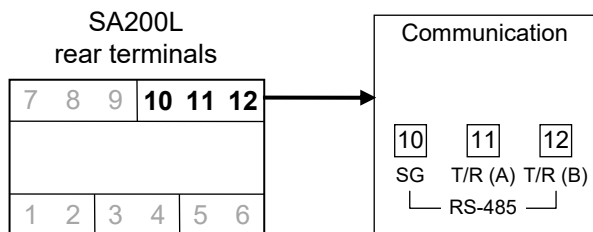
Terminal No.	Signal name	Symbol
10	Signal ground	SG
11	Send data/Receive data	T/R (A)
12	Send data/Receive data	T/R (B)

■ Wiring method

● Connection to the RS-485 port of the host computer (master)
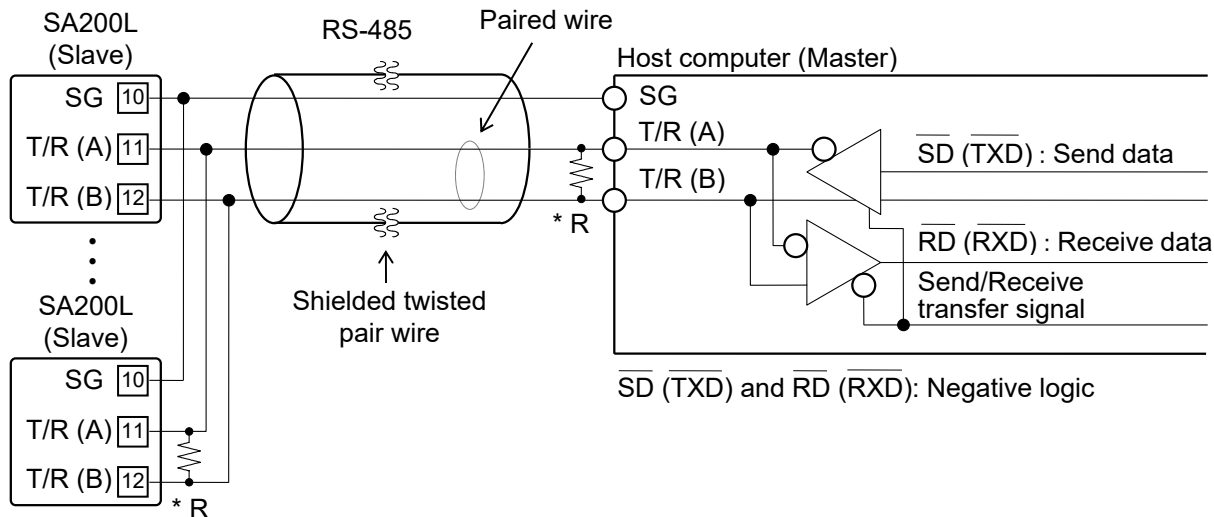
31 max.

* R: Termination resistors (Example: 120 Ω   1/2 W)
If communication errors occur frequently due to the operation environment or the communication distance, connect termination resistors.

📖   The communication cable and termination resistor(s) must be provided by the customer.

● **Connection to the RS-232C port of the host computer (master)**

Use a RS-232C/RS-485 converter with an automatic send/receive transfer function.
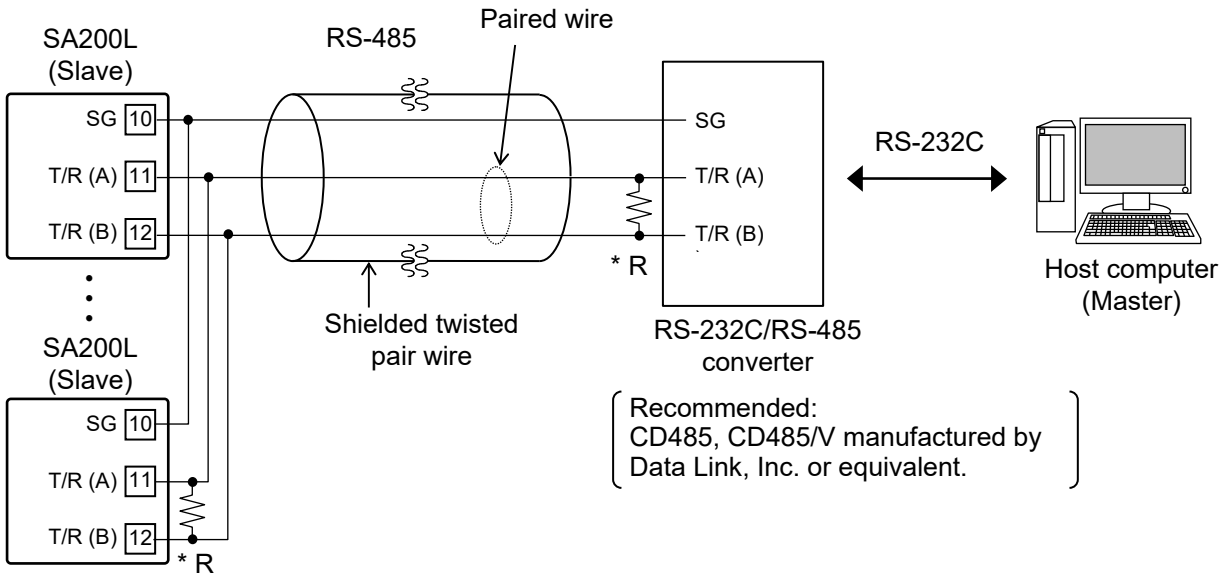
* R: Termination resistors (Example: 120 Ω   1/2 W)
If communication errors occur frequently due to the operation environment or the communication distance, connect termination resistors.

📖   The communication cable and termination resistor(s) must be provided by the customer.

■ **Wiring example**

● **Connection with up to 31 SA200L (slaves) and one host computer (master)**

PARAMETER SETTING

3
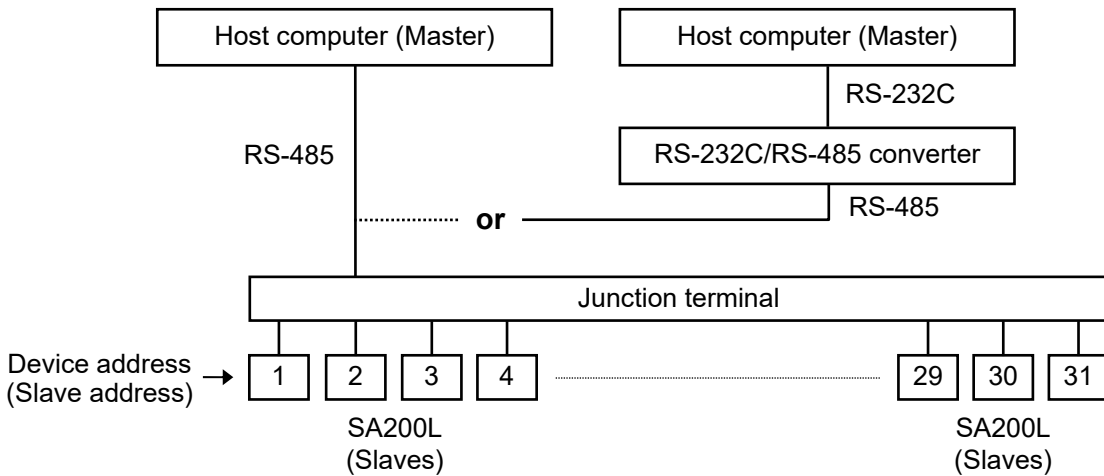
This chapter describes how to set up parameters necessary for the host communication.

To establish communication parameters between host computer (master) and SA200L (slave), it is necessary to set the device address (slave address), Communication speed, Data bit configuration and Interval time on each SA200L (slave) in the communication mode.

3.1 Communication Setting Mode

1. When the power to the SA200L is turned on, the input type, input range and PV/SV monitor will be automatically displayed in that order.

2. To go to the Communication setting mode, you must be in PV/SV monitor. Press and hold the SET key and press the <RST key at the same time to initiate communication settings. The first parameter to be displayed will be the Device address (slave address), *Add*.

PV/SV monitor

Communication setting mode
Device address (Slave address)
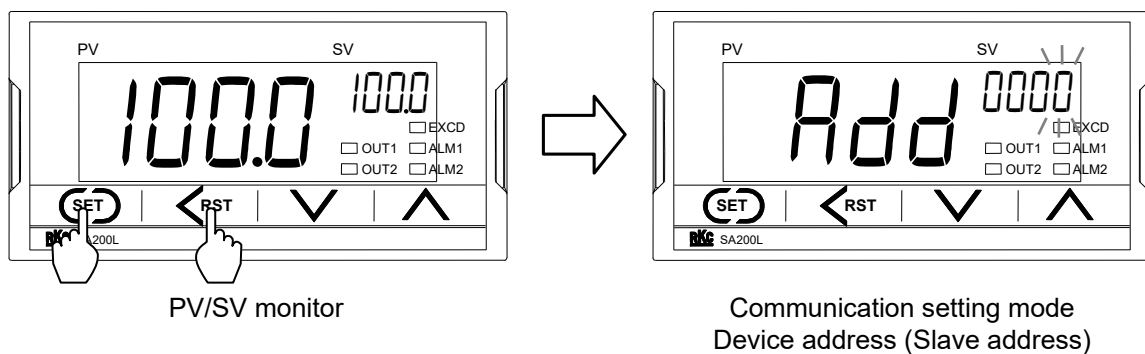
📖 To return to the PV/SV monitor, press and hold the SET key and press the <RST key at the same time. When the Communication setting mode is done, the display changes to the PV/SV monitor.

3.2 Setting the Communication Parameters

To select parameters in the communication setting mode, press the SET key. The parameters are displayed and sequenced in the order of Device address (slave address), *Add*, Communication speed, *bPS*, Data bit configuration, *bIT* and Interval time set value, *InT*.

■ Display flowchart
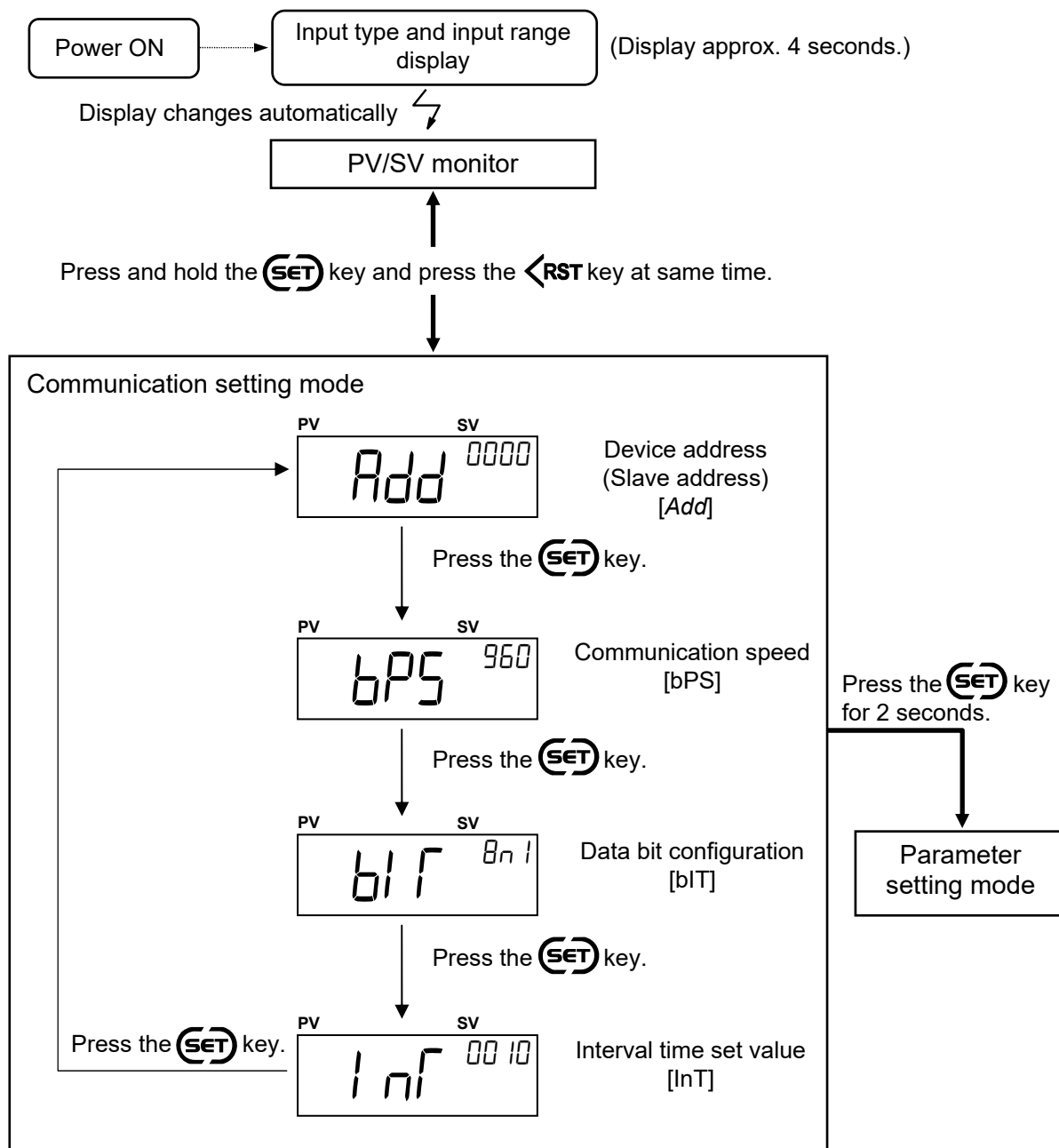
3.3 Device Address (Slave Address) Setting

The Device address (slave address) must be set before communication can begin. The Device address (slave address) number is set with numbers from 0 to 99.

Symbol	Name	Setting range	Description	Factory set value
Add Add	Device address (Slave address)	0 to 99	Set the **SA200L** device address (slave address).	0

📖 **NOTE**

- **If the slave address is set to *0* in Modbus communication, two-way communication cannot be performed.**
- **To establish communication using the changed communication parameters, be sure to do any one of the following:**
  - ・ **Apply power again.**
  - ・ **Change the "Set engineering mode attribute" setting from 1 to 0.**
  - ・ **Use keystrokes to switch from the Engineering mode to other modes.**
  - **If none of the above is done, no communication will be established using the changed values.**

📖 All device address (slave address) settings must be stored by pressing the SET key. If changes are made and the SET key is not pressed within one minute, the display will automatically return to the PV/SV monitor and the device address (slave address) will return to the value prior to set change.

■ Setting procedure

Example: When setting the Device address (slave address) to 15.

1. Go to the Communication setting mode so that Device address (slave address), *Add*, is displayed.

   ☞ See **3.1 Communication Setting Mode (P. 3-2)**, **3.2 Select Communication Parameters (P. 3-3)**.
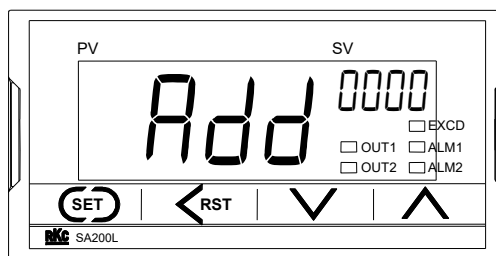
Device address (Slave address)

2. Press the UP key to enter 5 at the first digit from the right.
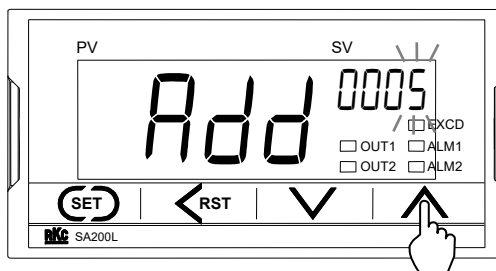
3. Press the <RST key to blink the second digit from the right.
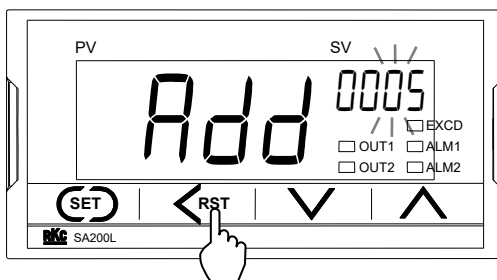
4. Press the UP key to enter *1* at the second digit from the right.
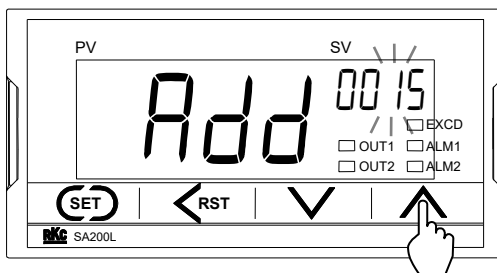
5. Press the SET key to store the new Device address (slave address). The display automatically goes to the next communication parameter, *bPS*.

3.4 Communication Speed Setting

The Communication speed of 2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps or 57600 bps is selectable. To select the speed of the *bPS* setting, press the UP or DOWN key.

Symbol	Name	Setting range	Description	Factory set value
bPS bPS	Communication speed	240: 2400 bps 480: 4800 bps 960: 9600 bps 1920: 19200 bps 3840: 38400 bps 1920: 19200 bps 5760: 57600 bps	Select the communication speed	960

📖 **NOTE**
- **Set the same communication speed for both the SA200L (slave) and the host computer (master).**
- **To establish communication using the changed communication parameters, be sure to do any one of the following:**
  - **Apply power again.**
  - **Change the "Set engineering mode attribute" setting from 1 to 0.**
  - **Use keystrokes to switch from the Engineering mode to other modes.**
  - **If none of the above is done, no communication will be established using the changed values.**

📖 All Communication speed settings must be stored by pressing the SET key. If changes are made and the SET key is not pressed within one minute, the display will automatically return to the PV/SV monitor and the Communication speed will return to the value prior to set change.

■ Setting procedure

Example: Setting Communication speed 480: 4800 bps.

1. Go to the Communication setting mode so that slave address, *Add*, is displayed. Then, press the SET key once, so the communication speed symbol, *bPS*, appears.

☞ See **3.1 Communication Setting Mode (P. 3-2)**, **3.2 Select Communication Parameters (P. 3-3)**.
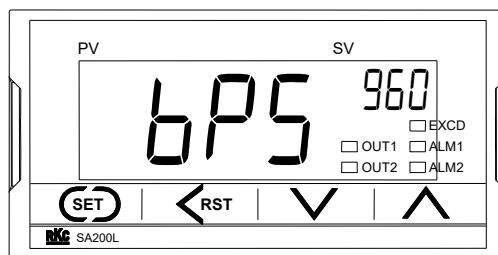
Communication speed

2. Press the DOWN key to set *480*.
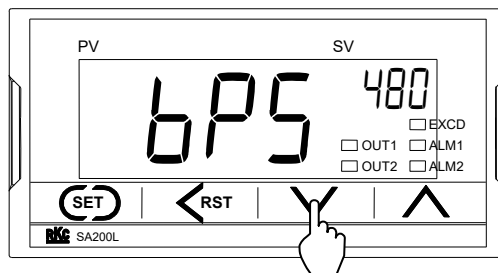
3. Press the SET key to store the new Communication speed. The display automatically goes to the next communication parameter, *bIT*.

3.5 Data Bit Configuration Setting

To select the Data bit configuration setting, press the UP or DOWN key.

Symbol	Name	Setting range	Description	Factory set value
bI⌐ bIT	Data bit configuration	See **Data bit configuration table**.	Select Data bit configuration during communication	8n1

Data bit configuration table

Setting	Data bit	Parity bit	Stop bit
⅂ın¹ (7n1)	7	None	1
⅂ın² (7n2)	7	None	2
⅂ıE¹ (7E1)	7	Even	1
⅂ıE² (7E2)	7	Even	2
⅂ıo¹ (7o1)	7	Odd	1
⅂ıo² (7o2)	7	Odd	2
8n¹ (8n1)	8	None	1
8n² (8n2)	8	None	2
8E¹ (8E1)	8	Even	1
8E² (8E2)	8	Even	2
8o¹ (8o1)	8	Odd	1
8o² (8o2)	8	Odd	2

▨▨▨: Not settable for Modbus

📖 **NOTE**
- **Set the same Data bit configuration for both the SA200L (slave) and the host computer (master).**
- **To establish communication using the changed communication parameters, be sure to do any one of the following:**
  - **Apply power again.**
  - **Change the "Set engineering mode attribute" setting from 1 to 0.**
  - **Use keystrokes to switch from the Engineering mode to other modes.**
  - **If none of the above is done, no communication will be established using the changed values.**

📖 All Data bit configuration settings must be stored by pressing the SET key. If changes are made and the SET key is not pressed within one minute, the display will automatically return to the PV/SV monitor and the Data bit configuration will return to the value prior to set change.

■ Setting procedure

Example: When setting the Data bit configuration to "Data bit: 8, Parity bit: Odd, Stop bit: 1."

1. Go to the Communication setting mode so that Device address (slave address), *Add*, is displayed. Then, press the SET key once, so the Data bit configuration symbol, *bIT*, appears.

☞ See **3.1 Communication Setting Mode (P. 3-2)**, **3.2 Select Communication Parameters (P. 3-3)**.
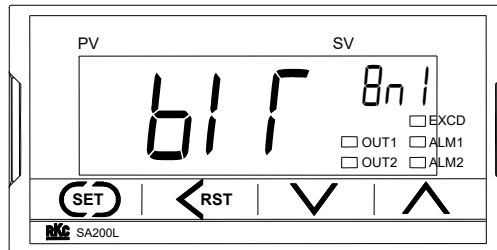
Data bit configuration

2. Press the Up key to set "*8o1*."
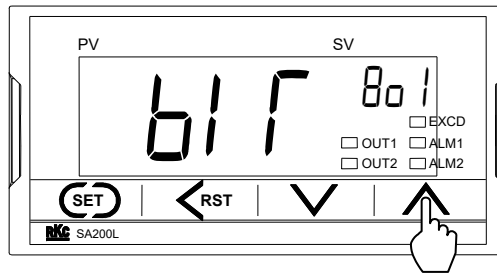
3. Press the SET key to store the new Data bit configuration. The display automatically goes to the next communication parameter, *InT*.

3.6 Interval Time Setting

The interval time is set with numbers from 0 to 250 ms. To shift the digit, press the <RST key. To change the number of the digit, press the UP or DOWN key.

Symbol	Name	Setting range	Description	Factory set value
$I \ulcorner\urcorner\Gamma$ InT	Interval time set value	0 to 250 ms	Set the value to set the interval time	10

📖 **NOTE**
> **To establish communication using the changed communication parameters, be sure to do any one of the following:**
> ・ **Apply power again.**
> ・ **Change the "Set engineering mode attribute" setting from 1 to 0.**
> ・ **Use keystrokes to switch from the Engineering mode to other modes.**
> **If none of the above is done, no communication will be established using the changed values.**

📖 All interval times must be stored by pressing the SET key. If changes are made and the SET key is not pressed within one minute, the display will automatically return to the PV/SV monitor and the interval time will return to the value prior to set change.

■ Setting procedure

Example: When setting the Interval time set value to "25."

1. Go to the Communication setting mode so that slave address, *Add*, is displayed. Press the SET key until the interval time symbol, *InT*, appears.

☞ See **3.1 Communication Setting Mode (P. 3-2)**, **3.2 Select Communication Parameters (P. 3-3)**.
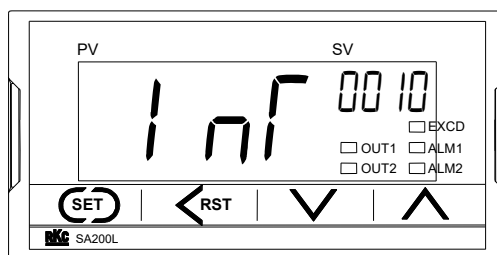
Interval time set value

2. Press the UP key to enter 5 at the first digit from the right.
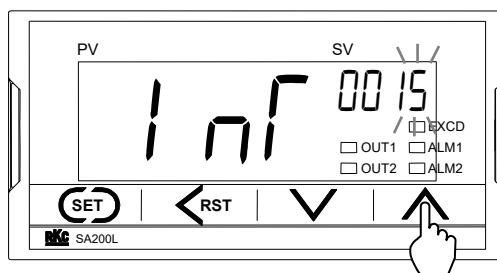
3. Press the <RST key to blink the second digit from the right.
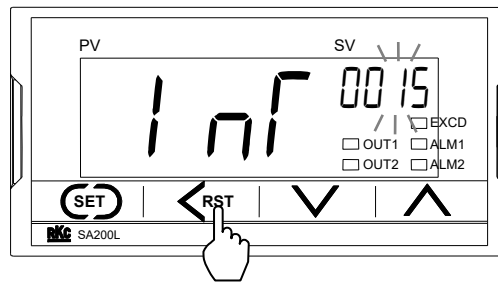
4. Press the UP key to enter 2 at the second digit from the right.
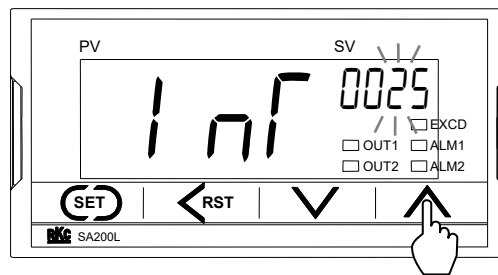
5. Press the SET key to store the new Interval time set value. The display automatically goes to the next communication parameter, *Add*.

3.7 Communication Protocol Setting

⚠ **WARNING**

The instrument is shipped with the communication protocol specified by the customer at the time of ordering.
The communication protocol does not need to be changed in normal use.
If they are changed unnecessarily, it may result in malfunction or failure of the instrument. RKC will not bear any responsibility for malfunction or failure as a result of improper changes in the Engineering mode.

There are two types of communication protocols. Either RKC communication or Modbus can be selected.

■ Setting procedure

Example: Change the communication protocol from the RKC communication to Modbus

☞ To go to the Engineering mode, refer to **SA200L Quick Operation Manual (IMR03H02-E□)**.

1. Press the <RST key while pressing the SET key for 2 seconds or more in the Monitor & SV setting mode until the Engineering mode is displayed.

Engineering mode
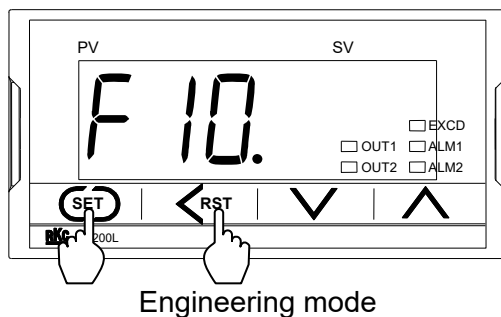
2. Press the down key several times until Function block 61 will be displayed.

Function block 61
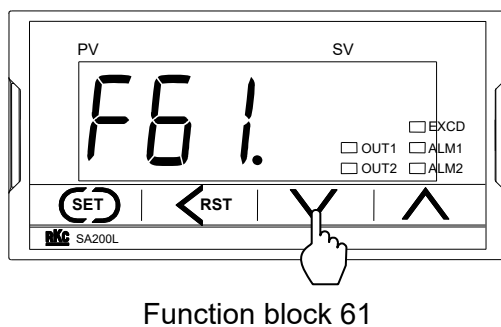
3. Press the SET key to change to the communication protocol selection display.
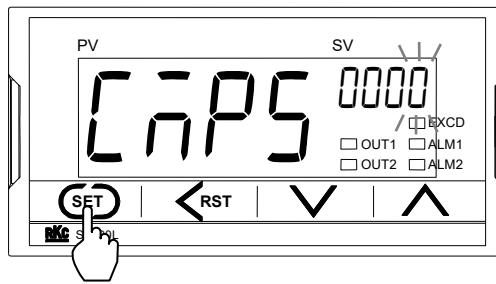
Communication protocol selection

4. Press the UP key to enter 1 at the least significant digit.
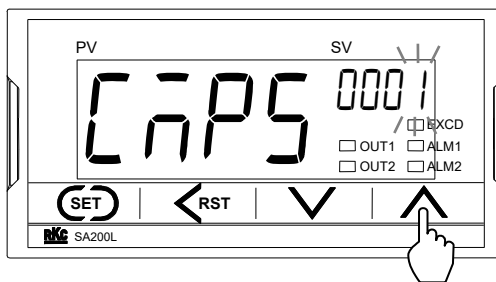
Setting range:
0000: RKC communication
0001: Modbus

5. Press the SET key to store the new communication protocol.

3.8 Communication Requirements

■ Processing times during data send/receive

The SA200L requires the following processing times during data send/receive.

Whether the host computer is using either the polling or selecting procedure for communication, the following processing times are required for SA200L to send data:

– Response wait time after SA200L sends BCC in polling procedure
– Response wait time after SA200L sends ACK or NAK in selecting procedure

📖　Response send time is time at having set interval time in 0 ms.

RKC communication (Polling procedure)

Procedure details	Time (ms)		
	MIN	TYP	MAX
Response send time after SA200L receives ENQ	1.6	4.0	12
Response send time after SA200L receives ACK	1.6	–	10
Response send time after SA200L receives NAK	1.6	–	10
Response send time after SA200L sends BCC	–	–	1.0

RKC communication (Selecting procedure)

Procedure details	Time (ms)		
	MIN	TYP	MAX
Response send time after SA200L receives BCC	1.6	3.0	10
Response wait time after SA200L sends ACK	–	–	1.0
Response wait time after SA200L sends NAK	–	–	1.0

Modbus

Procedure details	Time (ms)
Read holding registers [03H] Response transmission time after the slave receives the query message	13 ms max.
Preset single register [06H] Response transmission time after the slave receives the query message	6 ms max.
Diagnostics (loopback test) [08H] Response transmission time after the slave receives the query message	6 ms max.

■ RS-485 (2-wire system) send/receive timing (RKC communication)

The sending and receiving of RS-485 communication is conducted through two wires; consequently, the transmission and reception of data requires precise timing. Typical polling and selecting procedures between the host computer and SA200L are described below:

● Polling procedure

Host computer	Send data (Possible/Impossible)	Possible / Impossible	
	Sending status		E O T ----- E N Q ... A C K or N A K
SA200L	Send data (Possible/Impossible)	Possible / Impossible	a / b / c
	Sending status		S T X ----- B C C
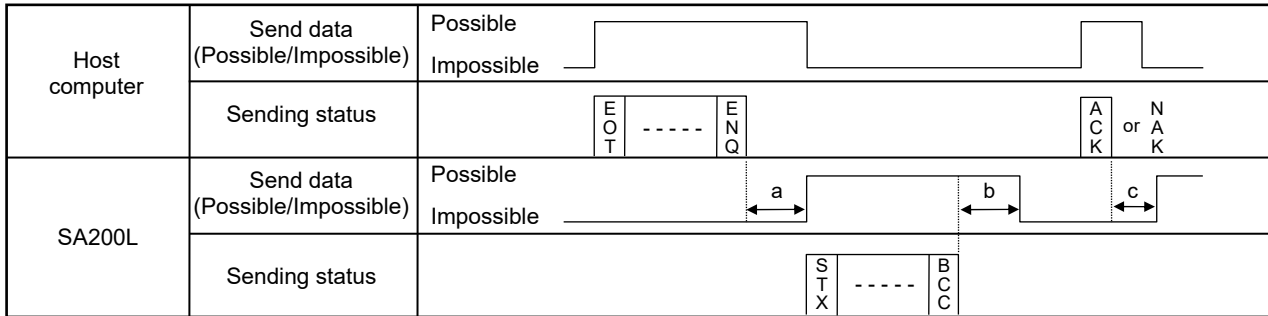
(a): Response send time after the SA200L receives ENQ + Interval time
(b): Response send time after the SA200L sends BCC
(c): Response send time after the SA200L receives ACK + Interval time or
Response send time after the SA200L receives NAK + Interval time

● Selecting procedure

Host computer	Send data (Possible/Impossible)	Possible / Impossible	
	Sending status		S T X ----- B C C
SA200L	Send data (Possible/Impossible)	Possible / Impossible	a / b
	Sending status		A C K or N A K
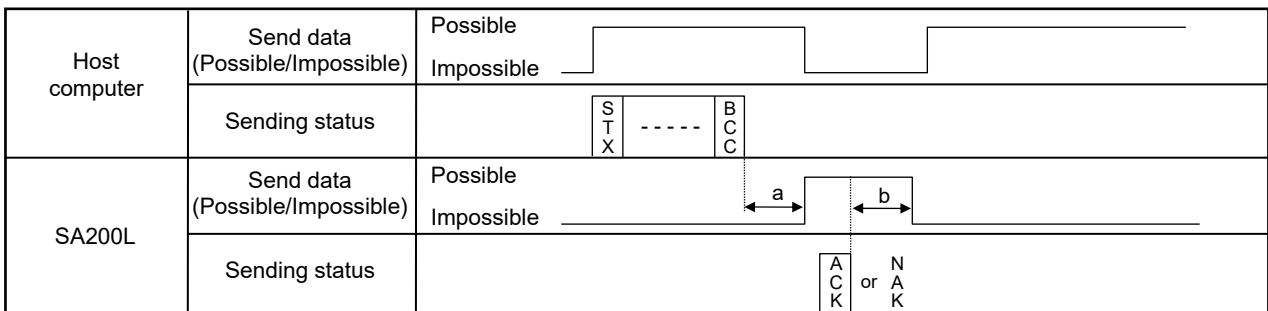
(a): Response send time after the SA200L receives BCC + Interval time
(b): Response wait time after the SA200L sends ACK or Response wait time after SA200L sends NAK

📖 To switch the host computer from transmission to reception, send data must be on line. To check if data is on line, do not use the host computer's transmission buffer but confirm it by the shift register.

📖 Whether the host computer is using either the polling or selecting procedure for communication, the following processing times are required for SA200L to send data:
 – Response wait time after SA200L sends BCC in polling procedure
 – Response wait time after SA200L sends ACK or NAK in selecting procedure

■ Fail-safe

A transmission error may occur with the transmission line disconnected, shorted or set to the high-impedance state. In order to prevent the above error, it is recommended that the fail-safe function be provided on the receiver side of the host computer. The fail-safe function can prevent a framing error from its occurrence by making the receiver output stable to the MARK (1) when the transmission line is in the high-impedance state.

RKC COMMUNICATION PROTOCOL

4

This chapter describes the RKC communication protocol.

The limit controller SA200L (hereinafter, the controller) uses the polling/selecting method to establish a data link. The basic procedure is followed ANSI X3.28 subcategory 2.5, A4 basic mode data transmission control procedure (Fast selecting is the selecting method used in this controller).

- The polling/selecting procedures are a centralized control method where the host computer controls the entire process. The host computer initiates all communication so the controller responds according to queries and commands from the host.
- The code use in communication is 7-bit ASCII code including transmission control characters. The transmission control characters are EOT (04H), ENQ (05H), ACK (06H), NAK (15H), STX (02H) and ETX (03H). The figures in the parenthesis indicate the corresponding hexadecimal number.

4.1 Polling

Polling is the action where the host computer requests one of the connected controllers to transmit data. An example of the polling procedure is shown below:
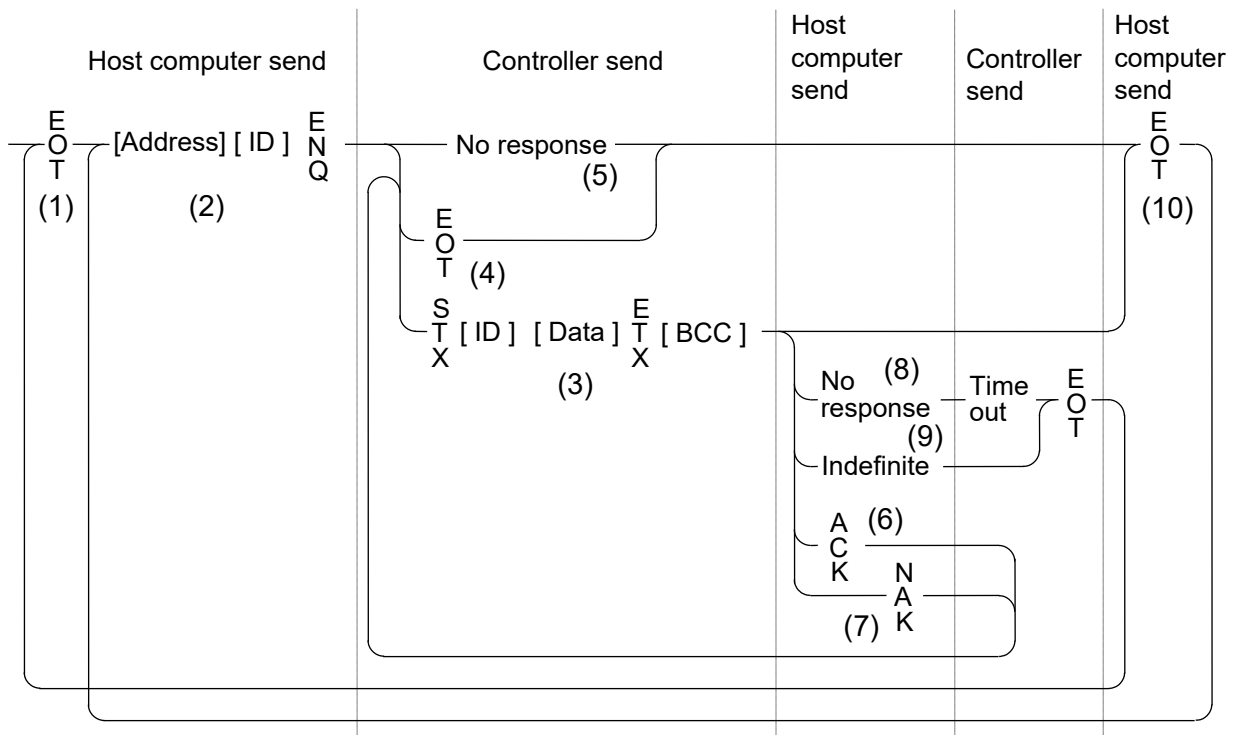
ID: Identifier

4.1.1 Polling procedures

(1) Data link initialization

Host computer sends EOT to the controllers to initiate data link before polling sequence.

(2) Data sent from host computer - Polling sequence

Host computer sends polling sequence with the format shown below:

1.   *2.*   *3.*

		ENQ

Device address   Identifier

Example:

0	2	M	1	ENQ

1. Device address (2 digits)

   The device address specifies the controller to be polled and each controller must have its own unique device address.

   ☞   See **3.3 Device Address (Slave Address) Setting (P. 3-4)**.

2. Identifier (2 digits)

   The identifier specifies the type of data that is requested from the controller.

   ☞   See **4.3 RKC Communication Identifier List (P. 4-11)**.

3. ENQ

   The ENQ is the transmission control character that indicates the end of the polling sequence. The ENQ must be attached to the end of the identifier. The host computer then must wait for a response from the controller.

(3) Data sent from the controller

If the polling sequence is received correctly, the controller sends data in the following format:

1.   *2.*   *3.*   *4.*   *5.*

STX	Identifier	Data	ETX	BCC
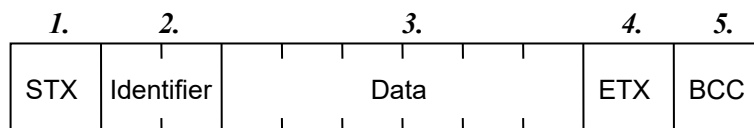
1. STX

   STX is the transmission control character which indicates the start of the text transmission (identifier and data).

2. Identifier (2 digits)

   The identifier indicates the type of data (measured value, status and set value) sent to the host computer.

   ☞   See **4.3 RKC Communication Identifier List (P. 4-11)**.

3. Data (6 digits [Expect model code.])

   Data is the information being sent from the controller. It is expressed in decimal ASCII code including a minus sign (−) and a decimal point. No zero suppression is made.

4. ETX

ETX is a transmission control character used to indicate the end of text transmission.

5. BCC

BCC (Block Check Character) detects error using horizontal parity and is calculated by horizontal parity (even number).

Calculation method of BCC:
Exclusive OR all data and characters from STX through ETX, not including STX.

Example:

STX	M	1	0	0	0	5	0	0	ETX	BCC

       4DH 31H 30H 30H 30H 35H 30H 30H 03H ←—————— Hexadecimal numbers

BCC = 4DH ⊕ 31H ⊕ 30H ⊕ 30H ⊕ 30H ⊕ 35H ⊕ 30H ⊕ 30H ⊕ 03H = 7AH
Value of BCC becomes 7AH.

(4) EOT sent from the controller (Ending data transmission from the controller)

In the following cases, the controller sends EOT to terminate the data link:

- When the specified identifier is invalid
- When there is an error in the data type
- When all the data has been sent

(5) No response from the controller

The controller will not respond if the polling address is not received correctly. It may be necessary for the host computer to take corrective action such as a time-out.

(6) ACK (Acknowledgment)

An acknowledgment ACK is sent by the host computer when data received is correct. When the controller receives ACK from the host computer, the controller will send any remaining data of the next identifier without additional action from the host computer.

☞ For details of identifier, see **4.3 RKC Communication Identifier List (P. 4-11)**.

When host computer determines to terminate the data link, EOT is sent from the host computer.

(7) NAK (Negative acknowledge)

If the host computer does not receive correct data from the controller, it sends a negative acknowledgment NAK to the controller. The controller will re-send the same data when NAK is received. This cycle will go on continuously until either recovery is achieved or the data link is corrected at the host computer.

(8) No response from host computer

When the host computer does not respond within approximately three seconds after the controller sends data, the controller sends EOT to terminate the data link.

(9) Indefinite response from host computer

The controller sends EOT to terminate the data link when the host computer response is indefinite.

(10) EOT (Data link termination)

The host computer sends EOT message when it is necessary to suspend communication with the controller or to terminate the data link due lack of response from the controller.

4.1.2 Polling procedure example

Example: When the Measured value (identifier: M1) is polled

■ Normal transmission

Host computer send

E O T	0	1	M	1	E N Q

Polling address / Identifier

S T X	M	1	0	0	1	0	.	0	E T X	B C C

Identifier / Data

Send data
Controller send

Host computer send

A C K

S T X	O	Z	0	0	0	0	0	0	E T X	B C C

Next send data
Controller send

Host computer send

E O T

■ Error transmission

Host computer send

E O T	0	1	M	1	E N Q

Polling address / Identifier

Error data

S T X	M	1	0	0	1	▓	.	0	E T X	B C C

Identifier / Data

Send data
Controller send

Host computer send

N A K

S T X	M	1	0	0	1	0	.	0	E T X	B C C

Re-send data
Controller send

Host computer send

A C K

4.2 Selecting

Selecting is the action where the host computer requests one of the connected controllers to receive data. An example of the selecting procedure is shown below:
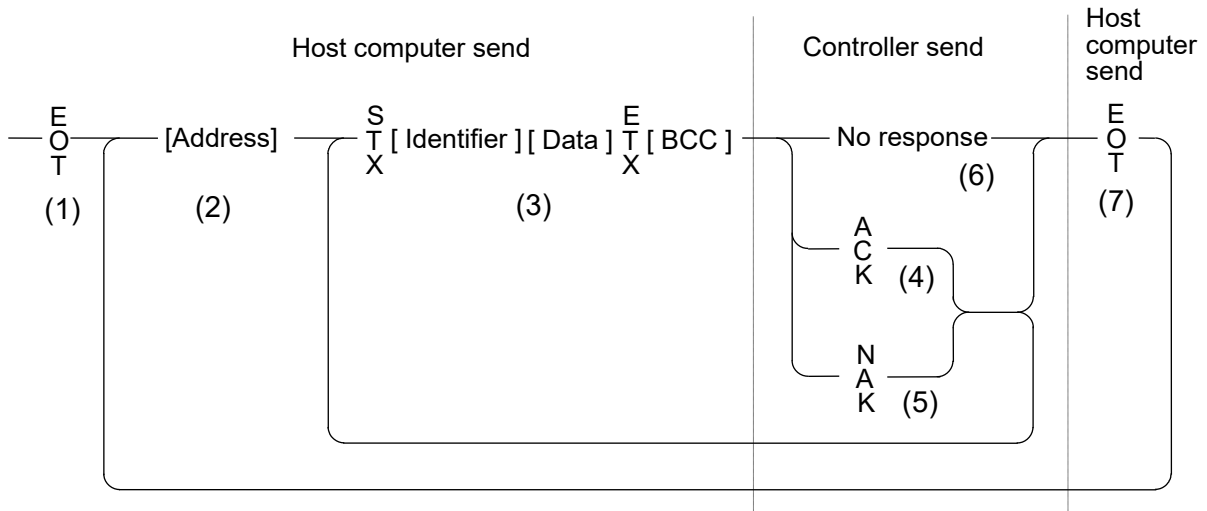
4.2.1 Selecting procedures

(1) Data link initialization

Host computer sends EOT to the controllers to initiate data link before selecting sequence.

(2) Sending selecting address from the host computer

Host computer sends selecting address for the selecting sequence.

Device address (2 digits)
The device address specifies the controller to be selected and each controller must have its own unique device address.

☞ See **3.3 Device Address (Slave Address) Setting (P. 3-4)**.

(3) Data sent from the host computer

The host computer sends data for the selecting sequence with the following format:

	1.		*2.*			
STX	Identifier		Data		ETX	BCC

☞ For the STX, ETX and BCC, see item **4.1 Polling (P. 4-2)**.

1. Identifier (2 digits)

The identifier specifies the type of data that is requested from the controller, such as set value.

☞ See **4.3 RKC Communication Identifier List (P. 4-11)**.

2. Data (Maximum 6 digits)

Data is the information being sent to the controller. It is expressed in decimal ASCII code including a minus sign (−) and a decimal point (period).

● **About numerical data**

The data that receipt of letter is possible

- Data with numbers below the decimal point omitted or zero suppressed data can be received.

  <Example> When data send with −001.5, −01.5, −1.5, −1.50, −1.500 at the time of −1.5, controller can receive a data.

- When the host computer send data with decimal point to item of without decimal point, controller receives a message with the value which cut off below the decimal point.

  <Example> When setting range is 0 to 200, controller receives as a following.

Send data	0.5	100.5
Receive data	0	100

- Controller receives value in accordance with decided place after the decimal point. The value below the decided place after the decimal point is cut off.

  <Example> When setting range is -10.00 to +10.00, controller receives as a following.

Send data	−.5	−.058	.05	−0
Receive data	−0.50	−0.05	0.05	0.00

The data that receipt of letter is impossible

Controller sends NAK when received a following data.

+	Plus sign and the data that gained plus sing
−	Only minus sign (there is no figure)
.	Only decimal point (period)
−.	Only minus sign and decimal point (period)

(4) ACK (Acknowledgment)

An acknowledgment ACK is sent by the controller when data received is correct. When the host computer receives ACK from the controller, the host computer will send any remaining data. If there is no more data to be sent to controller, the host computer sends EOT to terminate the data link.

(5) NAK (Negative acknowledge)

If the controller does not receive correct data from the host computer, it sends a negative acknowledgment NAK to the host computer. Corrections, such as re-send, must be made at the host computer. The controller will send NAK in the following cases:

- When an error occurs on communication the line (parity error, framing error, etc.)
- When a BCC check error occurs
- When the specified identifier is invalid
- When receive data exceeds the setting range

(6) No response from controller

The controller does not respond when it can not receive the selecting address, STX, ETX or BCC.

(7) EOT (Data link termination)

The host computer sends EOT when there is no more data to be sent from the host computer or there is no response from the controller.

4.2.2 Selecting procedure example

Example: When the Limit set value (identifier: S1) is selected

■ Normal transmission
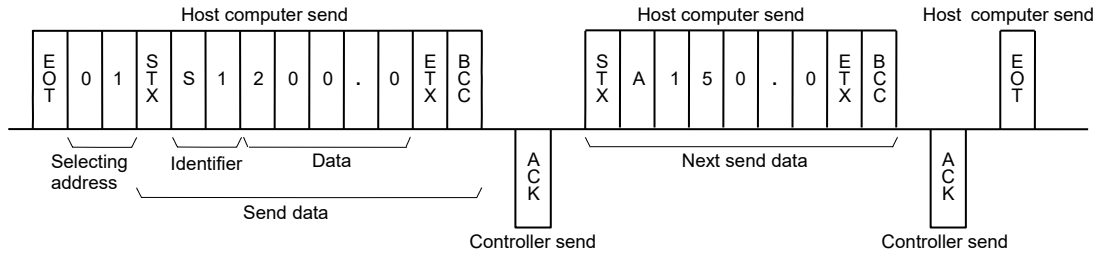
■ Error transmission
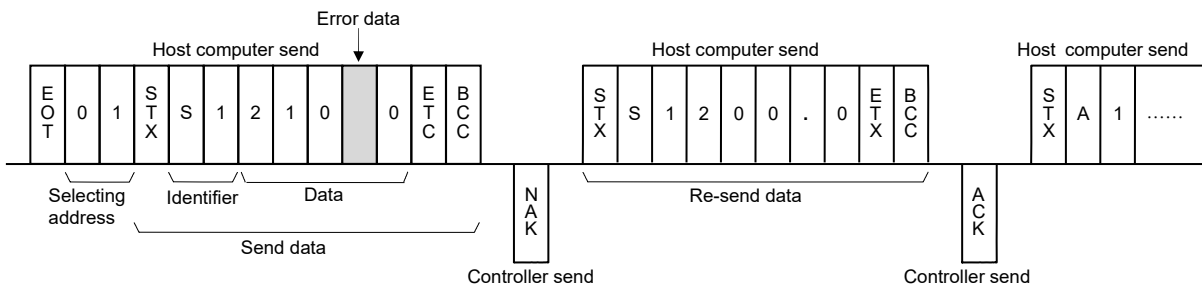
4.3 RKC Communication Identifier List

4.3.1 How to read the RKC communication identifier list

No.	Name	Iden-tifier	Digits	Attri-bute	Data range	Factory set value
1	Model code	**ID**	32	RO	Model code (character)	—
2	Error code [1]	**ER**	6	RO	0: No error 1: Adjustment data	—

(1) Name:　　　　　　Communication data name

(2) Identifier:　　　　Communication identifier of RKC communication

(3) Digits:　　　　　　The number of maximum digits

(4) Attribute:　　　　A method of how communication data items are read or written when viewed from the host computer is described

RO:　Read only data

Data direction

Host computer　◀──────────　Controller

R/W: Read and Write data

Data direction

Host computer　◀───────▶　Controller

(5) Data range:　　　　Read or write range of communication data

(6) Factory set value: Factory set value of communication data

4.3.2 RKC communication identifier list

No.	Name	Iden-tifier	Digits	Attri-bute	Data range	Factory set value
1	Model code	**ID**	32	RO	Model code (character)	—
2	Error code [1]	**ER**	6	RO	0: No error 1: Adjustment data 2: EEPROM error 4: A/D conversion error 8: RAM check error 128: Watchdog timer error When multiple items are applicable, they are summed up.	—
3	Measured value (PV)	**M1**	6	RO	Within input range [Setting limiter [low limit] – (5 % of Span) to Setting limiter [high limit] + (5 % of Span)] Varies with the setting of the Decimal point position.	—
4	Limit action monitor	**OZ**	6	RO	0: Normal 1: Limit output ON 2: EXCD state	—
5	Burnout	**B1**	6	RO	0: OFF 1: ON	—
6	Alarm 1 status	**AA**	6	RO	0: OFF 1: ON	—
7	Alarm 2 status	**AB**	6	RO	0: OFF 1: ON	—
8	Peak hold	**HP**	6	RO	Within input range (Setting limiter [low limit] to Setting limiter [high limit]) Varies with the setting of the Decimal point position.	—
9	Bottom hold	**HQ**	6	RO	Within input range (Setting limiter [low limit] to Setting limiter [high limit]) Varies with the setting of the Decimal point position.	—
10	EXCD time	**TH**	6	RO	0.00 to 999.59 (0 minutes 00 seconds to 999 minutes 59 seconds)	—
11	Limit action release	**HR**	6	R/W	When the setting of "Switch limit action release signal" (No.57) is "0": ・Limit action release (No.11) can always read out "1". ・When the Limit action release is set to zero, the reset procedure will be started. [2] When the setting of "Switch limit action release signal" (No.57) is "1": ・Limit action release (No.11) can always read out "0". ・When the Limit action release is set to 1, the reset procedure will be started. [2]	1

[1] Any number other than 0 indicates errors (RAM write error, etc.) detected by the controller self-diagnosis function. Please contact RKC sales office or the agent.

[2] When the reset process is executed, the following actions will also be executed.
・Release the Limit output
・Clear the Peak and the Bottom hold values
・Clear the EXCD time

No.	Name	Iden-tifier	Digits	Attri-bute	Data range	Factory set value
12	Alarm interlock release (ILr)	**IR**	6	R/W	0: Alarm interlock release state [1]	—
13	Limit set value (SV)	**S1**	6	R/W	Within input range (Setting limiter [low limit] to Setting limiter [high limit]) Varies with the setting of the Decimal point position.	TC/RTD inputs: 0 (0.0) Voltage/Current inputs: 0.0
14	Alarm 1 (ALM1)	**A1**	6	R/W [2]	Process alarm, SV alarm: Same as input range * (Setting limiter [low limit] to Setting limiter [high limit]) Deviation alarm: −Span to +Span * (However, within −1999 to +9999 digits) * Varies with the setting of the Decimal point position.	TC/RTD inputs: 50 (50.0) Voltage/Current inputs: 5.0
15	Alarm 1 delay timer	**TD**	6	R/W [3]	0 to 9999 seconds [4]	0
16	Alarm 2 (ALM2)	**A2**	6	R/W [5]	Process alarm, SV alarm: Same as input range * (Setting limiter [low limit] to Setting limiter [high limit]) Deviation alarm: −Span to +Span * (However, within −1999 to +9999 digits) * Varies with the setting of the Decimal point position.	TC/RTD inputs: 50 (50.0) Voltage/Current inputs: 5.0
17	Alarm 2 delay timer	**TG**	6	R/W [6]	0 to 9999 seconds [4]	0
18	PV bias	**PB**	6	R/W	−Span to +Span (However, within −1999 to +9999 digits) Varies with the setting of the Decimal point position.	TC/RTD inputs: 0 (0.0) Voltage/Current inputs: 0.0
19	PV ratio (Pr)	**PR**	6	R/W	0.500 to 1.500 times	1.000
20	Digital filter	**F1**	6	R/W	0 to 100 seconds (0: Digital filter OFF)	0
21	Transmission output (AO) specification	**LA**	6	R/W [7]	0: Measured value (PV) 1: Limit set value (SV) 2: Deviation (DEV)	0

[1] The interlock is released by setting the "0." In the read state, becomes "1."

📖 **NOTE**

Release the alarm interlock when the Alarm OFF conditions are satisfied.

[2] If "No alarm" for Alarm 1 [ALM1] is selected, the attribute becomes RO.

[3] When the Alarm 1 delay timer unit is "0", the attribute will be RO.

[4] The actual delay time is the value obtained by multiplying the delay timer value and the delay timer unit value.
Example: Alarm 1 delay timer (10 seconds) × Alarm 1 delay timer unit (30 seconds) = 300 seconds

[5] If "No alarm" for Alarm 2 [ALM2] is selected, the attribute becomes RO.

[6] When the Alarm 2 delay timer unit is "0", the attribute will be RO.

[7] If the Output 1 (OUT1) is a transmission output, the attribute is R/W and is RO for all other cases.

No.	Name	Iden-tifier	Digits	Attri-bute	Data range	Factory set value
22	Transmission output scale high (AHS)	HV	6	R/W [1]	Measured value (PV), Limit set value (SV): Same as input range * [Transmission output scale low to Setting limiter (high limit)] Deviation (DEV): −Span to +Span * (However, within −1999 to +9999 digits) [Transmission output scale low to +Span] * Varies with the setting of the Decimal point position.	TC/RTD inputs: Input range high or +Span Voltage/Current inputs: 100.0
23	Transmission output scale low (ALS)	HW	6	R/W [1]	Measured value (PV), Set value (SV): Same as input range * [Setting limiter (low limit) to Transmission output scale high] Deviation (DEV): −Span to +Span * (However, within −1999 to +9999 digits) [−Span to Transmission output scale high] * Varies with the setting of the Decimal point position.	TC/RTD inputs: Input range low or −Span Voltage/Current inputs: 0.0
24	Set data lock (LCK)	LK	6	R/W	Set in the binary format (0000 to 1111) [4]	0000
25	EEPROM storage mode [2]	EB	6	R/W	0: Backup mode (Set values are store to the EEPROM) 1: Buffer mode (No set values are store to the EEPROM)	0
26	EEPROM storage status [3]	EM	6	RO	0: Mismatch 1: Match	—
27	Enter password for Show/Hide	LL	6	R/W	0000 to 9999	0000
28	Set password for Show/Hide	LM	6	R/W	0000 to 9999	0000
29	Hide LCK	LN	6	R/W	0: Unlock 1: Lock	0

[1] If the Output 1 (OUT1) is a transmission output, the attribute is R/W and is RO for all other cases.

[2] The non-volatile memory (EEPROM) has limitations on the number of memory rewrite times. If the buffer mode is selected as an EEPROM storage mode, all of the set values changed are not written to the EEPROM and thus a problem of limitations on the number of memory rewrite times can be solved. When the memory is used to frequently change the set value via communication, select the buffer mode.

When selecting any EEPROM storage mode, take notice of the following.

- If power failure occurs while the buffer mode is selected, the set value returns to the value before the storage mode is selected.
- If the buffer mode is changed to the backup mode, all of the set values at that time are stored to the EEPROM. If necessary to backup the final value of each set item, select the backup mode.
- When the power is turned on, the backup mode is always set.

[3] The contents of the buffer memory and those of the EEPROM can be checked.

When data is 0: The contents of the buffer memory do not match with those of the EEPROM.
- As data is being written to the EEPROM in backup mode, do not turn the power off. If turned off, no set values are stored.
- If the set value is changed after the backup mode is changed to the buffer mode, 0 is set (mismatch). As the set value changed is not backup, select the backup mode if necessary.

When data is 1: The contents of the buffer memory match with those of the EEPROM.
(Data write to the EEPROM is completed.)

[4] Details of set data lock function:

The data lock function only prevents setting changes being made from the front keys. Setting changes can still be made through communication transmission.

	×: Operable −: Not operable	×: Changeable −: Not changeable		
Setting data	Switch to the Engineering mode	Limit set value (SV)	Alarm setting [1]	Other setting items [2]
0000	−	×	×	×
0001	−	×	×	−
0010	−	×	−	×
0011	−	×	−	−
0100	−	−	×	×
0101	−	−	×	−
0110	−	−	−	×
0111	−	−	−	−
1000	×	×	×	×
1001	×	×	×	−
1010	×	×	−	×
1011	×	×	−	−
1100	×	−	×	×
1101	×	−	×	−
1110	×	−	−	×
1111	×	−	−	−

[1] Alarm (ALM1), Alarm 2 (ALM2), Alarm 1 delay timer, and Alarm 2 delay timer
[2] Setting items except Alarm setting and Limit set value (SV)

📖 The following parameters are not covered by the Set data lock.
- Set data lock (LCK)
- Enter password for Show/Hide
- Set password for Show/Hide
- Hide LCK
- Parameter in the Communication setting mode

No.	Name	Iden-tifier	Digits	Attri-bute	Data range	Factory set value
30	Set engineering mode attribute [1,2,3]	**IO**	6	R/W	0 : When the attribute of the "Engineering mode setting item" is [RO]. 1 : When the attribute of the "Engineering mode setting item" is [R/W].	0
31	Monitor display configuration selection [4]	**DW**	6	R/W	0: PV/SV display 1: Only PV display 2: Only SV display	0
32	Input type selection [4]	**XI**	6	R/W	0: Thermocouple K [5] 1: Thermocouple J [5] 2: Thermocouple R [5] 3: Thermocouple S [5] 4: Thermocouple B [5] 5: Thermocouple E [5] 6: Thermocouple N [5] 7: Thermocouple T [5] 8: Thermocouple W5Re/W26Re [5] 9: Thermocouple PL II [5] 10: Thermocouple U [5] 11: Thermocouple L [5] 12: RTD Pt100 [5] 13: RTD JPt100 [5] 14: Voltage 0 to 5 V DC or Current 0 to 20 mA DC [5,6] 15: Voltage 1 to 5 V DC or Current 4 to 20 mA DC [5,6] 16: Voltage 0 to 10 V DC [5]	Factory set value varies depending on the instrument specification.
33	Display unit selection [4]	**PU**	6	R/W	0: °C 1: °F	0
34	Decimal point position setting [4]	**XU**	6	R/W	0: No digit below decimal point 1: 1 digit below decimal point 2: 2 digits below decimal point 3: 3 digits below decimal point	Factory set value varies depending on the instrument specification.
35	Setting limiter [high limit] [4]	**XV**	6	R/W	−1999 to +9999 • Set the Setting limiter by referring to the **"A.3 Input Range Table" (P. A-4)**. • This instrument sets the input range with the Setting limiter. Please note that changing the Setting limiter will also change the input range.	Factory set value varies depending on the instrument specification.
36	Setting limiter [low limit] [4]	**XW**	6	R/W		Factory set value varies depending on the instrument specification.

[1] Release the lock for the Engineering mode first. Then, change the "Set engineering mode attribute" to "1". After having completed the setting change of the setting items in the Engineering mode, set the "Set engineering mode attribute" back to "0".

[2] Changing the "Set engineering mode attribute" to "1" will reset the following items.
・Limit output: Changed to OFF
・EXCD time: Cleared to 0 seconds

[3] While the setting of "Set engineering mode attribute" is "1", the instrument will not enter the EXCD mode even if all of the EXCD conditions are satisfied. The Limit output will not turn on either.

[4] While the setting of "Set engineering mode attribute" is "0", the attribute of this communication data is RO.

[5] Input type (TC/RTD to voltage/current inputs or voltage/current inputs to TC/RTD) cannot be changed because the hardware is different.

[6] For the current input specification, a resistor of 250 Ω must be connected between the input terminals.

No.	Name	Iden-tifier	Digits	Attri-bute	Data range	Factory set value
37	Output logic operation selection [1]	**LO**	6	R/W	1: OUT1: Limit output (De-energized) OUT2: *OR* output of Alarm 1 and Alarm 2 (Energized) 2: OUT1: Limit output (De-energized) OUT2: *AND* output of Alarm 1 and Alarm 2 (Energized) 3: OUT1: Limit output (De-energized) OUT2: Alarm 1 output (Energized) 4: OUT1: Limit output (De-energized) OUT2: *OR* output of Alarm 1 and Alarm 2 (De-energized) 5: OUT1: Limit output (De-energized) OUT2: *AND* output of Alarm 1 and Alarm 2 (De-energized) 6: OUT1: Limit output (De-energized) OUT2: Alarm 1 output (De-energized) 7: OUT1: Limit output (De-energized) OUT2: Not output [3] 8: OUT1: Limit output (Energized) OUT2: *OR* output of Alarm 1 and Alarm 2 (Energized) 9: OUT1: Limit output (Energized) OUT2: *AND* output of Alarm 1 and Alarm 2 (Energized) 10: OUT1: Limit output (Energized) OUT2: Alarm 1 output (Energized) 11: OUT1: Limit output (Energized) OUT2: *OR* output of Alarm 1 and Alarm 2 (De-energized) 12: OUT1: Limit output (Energized) OUT2: *AND* output of Alarm 1 and Alarm 2 (De-energized) 13: OUT1: Limit output (Energized) OUT2: Alarm 1 output (De-energized) 14: OUT1: Limit output (Energized) OUT2: Not output [3] 15: OUT1: Transmission output OUT2: Limit output (De-energized) 16: OUT1: Transmission output OUT2: Limit output (Energized)	Factory set value varies depending on the instrument specification. [2]

[1] While the setting of "Set engineering mode attribute" is "0", the attribute of this communication data is RO.

[2] Factory set value when an Output assignment code is not specified at the time of ordering:
The output assignment code is set to either of the following according to the output 1 (OUT1) type specified at the time of ordering.
- When OUT1 is a relay contact output: 1
- When OUT1 is a current output (0 to 20 mA DC or 4 to 20 mA DC): 15

[3] The Alarm state can be checked via communication or by lamp lighting.

No.	Name	Iden-tifier	Digits	Attri-bute	Data range	Factory set value
38	Alarm 1 type selection *	**XA**	6	R/W	0: Alarm not provided 1: SV high alarm 2: SV low alarm 3: Process high alarm 4: Process low alarm 5: Deviation high alarm 6: Deviation low alarm 7: Deviation high/low alarm 8: Band alarm	Factory set value varies depending on the instrument specification.

39	Alarm 1 hold action *	**WA**	6	R/W	0: Without alarm hold action
					1: Effective
					  • When the power is turned on.
					  • When the Set engineering mode attribute is changed from "1 (R/W)" to "0 (RO)".
					2: Effective
					  • When the power is turned on.
					  • When the Set engineering mode attribute is changed from "1 (R/W)" to "0 (RO)".
					  • When the Limit set value (SV) is changed.
						Factory set value varies depending on the instrument specification.

40	Alarm 1 differential gap *	**HA**	6	R/W	0 (0.0) to Span (However, 9999 digits or less) Varies with the setting of the Decimal point position.	TC/RTD inputs: 2 (2.0) Voltage/Current inputs: 0.2
41	Alarm 1 process abnormality action *	**OA**	6	R/W	0: Normal processing 1: Forcibly turned on when abnormal	Alarm 1 not provided: 0 Alarm 1 provided: 1
42	Alarm 1 interlock function selection *	**QA**	6	R/W	0: Disable Alarm 1 interlock function 1: Enable Alarm 1 interlock function	0
43	Alarm 1 delay timer unit *	**TU**	6	R/W	0 to 60 seconds (0: Alarm 1 delay timer function OFF)	0
44	Alarm 2 type selection *	**XB**	6	R/W	0: Alarm not provided 1: SV high alarm 2: SV low alarm 3: Process high alarm 4: Process low alarm 5: Deviation high alarm 6: Deviation low alarm 7: Deviation high/low alarm 8: Band alarm	Factory set value varies depending on the instrument specification.

45	Alarm 2 hold action *	**WB**	6	R/W	0: Without alarm hold action
					1: Effective
					  • When the power is turned on.
					  • When the Set engineering mode attribute is changed from "1 (R/W)" to "0 (RO)".
					2: Effective
					  • When the power is turned on.
					  • When the Set engineering mode attribute is changed from "1 (R/W)" to "0 (RO)".
					  • When the Limit set value (SV) is changed.
						Factory set value varies depending on the instrument specification.

46	Alarm 2 differential gap *	**HB**	6	R/W	0 (0.0) to Span (However, 9999 digits or less) Varies with the setting of the Decimal point position.	TC/RTD inputs: 2 (2.0) Voltage/Current inputs: 0.2
47	ALM2 process abnormality action *	**OB**	6	R/W	0: Normal processing 1: Forcibly turned on when abnormal	Alarm 2 not provided: 0 Alarm 2 provided: 1

* While the setting of "Set engineering mode attribute" is "0", the attribute of this communication data is RO.

No.	Name	Iden-tifier	Digits	Attri-bute	Data range	Factory set value
48	Alarm 2 interlock function selection [1]	QB	6	R/W	0: Disable Alarm 2 interlock function 1: Enable Alarm 2 interlock function	0
49	Alarm 2 delay timer unit [1]	TV	6	R/W	0 to 60 seconds (0: Alarm 1 delay timer function OFF)	0
50	Limit action type selection [1]	XE	6	R/W	0: Limit action (high limit) 1: Limit action (low limit)	0
51	Limit action differential gap [1]	MH	6	R/W	0 (0.0) to Span (However, 9999 digits or less) Varies with the setting of the Decimal point position.	TC/RTD inputs: 2 (2.0) Voltage/Current inputs: 0.2

52	Limit action hold action selection [1]	LH	6	R/W	0: Without hold action
					1: Effective
					  • W when the power is turned on.
					  • When the Set engineering mode attribute is changed from "1 (R/W)" to "0 (RO)".
						0

53	Limit action process abnormality action selection [1]	LE	6	R/W	0: Normal processing 1: Forced ON at input error [2]	0
54	Limit action at the time of power ON [1]	LP	6	R/W	0: Normal processing 1: Forced ON at power-on [3]	0
55	<RST key operation time selection [1]	RT	6	R/W	0: Press and hold (for one second) 1: Press once	0
56	Reset action selection [1]	RS	6	R/W	0: All data is reset on each monitoring screen [4] 1: Each data is reset on each monitoring screen [4]	0
57	Switch limit action release signal [1]	RO	6	R/W	0: Reset when "Limit action release" = 0 1: Reset when "Limit action release" = 1	0
58	Sampling cycle [1]	TZ	6	R/W	0: 250 ms (0.25 seconds) 1: 500 ms (0.5 seconds)	1
59	Integrated operating time	UT	6	RO	0 to 99999 hours	—
60	Holding peak ambient temperature	Hp	6	RO	−256.0 to +256.0 °C	—
61	ROM version	VR	6	RO	Display the version of loading software.	—

[1] While the setting of "Set engineering mode attribute" is "0", the attribute of this communication data is RO.

[2] The Limit output will be forced ON when the input goes abnormal.

[3] After power is applied, the Limit output is kept ON regardless of the Measured value and this state is maintained until the reset action is taken. This state is maintained until the reset action is taken.

[4] "All data" described in the Data range mean Peak hold value, Bottom hold value, and EXCD time. Parameters cleared in each screen are as follows.

When the set value of the Reset action selection is set to "0."

Screen	Parameters cleared by Reset operation
PV/SV monitor	Limit output, Peak hold value,
Peak hold	Bottom hold value, EXCD time
Bottom hold	
EXCD time	

When the set value of the Reset action selection is set to "1."

Screen	Parameters cleared by Reset operation
PV/SV monitor	Limit output
Peak hold	Limit output, Peak hold value,
Bottom hold	Bottom hold value
EXCD time	Limit output, EXCD time

MEMO

MODBUS PROTOCOL

5

This chapter describes the Modbus protocol.

In this chapter a host computer is called Master and SA200L is called Slave.

The master controls communication between master and slave. A typical message consists of a request (query message) sent from the master followed by an answer (response message) from the slave. When master begins data transmission, a set of data is sent to the slave in a fixed sequence. When it is received, the slave decodes it, takes the necessary action, and returns data to the master.

5.1 Message Format

The message consists of four parts: slave address, function code, data, and error check code which are always transmitted in the same sequence.

Slave address
Function code
Data
Error check CRC-16

Message format

■ Slave address

The slave address is a number from 1 to 99 manually set at the front key panel of the controller.

☞　　For details, see **3.3 Device Address (Slave Address) Setting (P. 3-4)**.

Although all connected slaves receive the query message sent from the master, only the slave with the slave address coinciding with the query message will accept the message.

■ Function code

The function codes are the instructions set at the master and sent to the slave describing the action to be executed. The function codes are included when the slave responds to the master.

☞　　For details, see **5.2 Function Code (P. 5-3)**.

■ Data

The data to execute the function specified by the function code is sent to the slave and corresponding data returned to the master from the slave.

☞　　For details, see **5.6 Message Format (P. 5-7)**, **5.8 Modbus Communication Data List (P. 5-14)**.

■ Error check

An error checking code (CRC-16: Cyclic Redundancy Check) is used to detect an error in the signal transmission.

☞　　For details, see **5.5 Calculating CRC-16 (P. 5-5)**.

5.2 Function Code

Function code contents

Function code (Hexadecimal)	Function	Contents
03H	Read holding registers	Measured value (PV), alarm status, etc.
06H	Preset single register	Limit set value (SV), alarm set value, PV bias, etc. (For each word)
08H	Diagnostics (loopback test)	Diagnostics (loopback test)

Message length of each function (Unit: byte)

Function code (Hexadecimal)	Function	Query message		Response message	
		Min	Max	Min	Max
03H	Read holding registers	8	8	7	255
06H	Preset single register	8	8	8	8
08H	Diagnostics (loopback test)	8	8	8	8

5.3 Communication Mode

Signal transmission between the master and slaves is conducted in Remote Terminal Unit (RTU) mode.

RTU mode

Items	Contents
Data bit length	8-bit (Binary)
Start mark of message	Unused
End mark of message	Unused
Message length	See **5.2 Function Code (P. 5-3)**
Data time interval	24-bit time or less*
Error check	CRC-16 (Cyclic Redundancy Check)

*The data time intervals in one query message from the master must be 24-bit time or less. If the data time interval exceeds 24-bit time, the slave regards the transmission as ended and because the message format is incomplete, the slave does not respond.

5.4 Slave Responses

(1) Normal response

- In the response message of the Read Holding Registers, the slave returns the read out data and the number of data items with the same slave address and function code as the query message.

- In the response message of the Preset Single Resister, the slave returns the same message as the query message.

- In the response message of the Diagnostics (loopback test), the slave returns the same message as the query message.

(2) Defective message response

- If the query message from the master is defective, except for transmission error, the slave returns the error response message without any action.

Slave address
Function code
Error code
Error check CRC-16

Error response message

- If the self-diagnostic function of the slave detects an error, the slave will return an error response message to all query messages.

- The function code of each error response message is obtained by adding 80H to the function code of the query message.

Error code	Contents
1	Function code error (Specifying nonexistent function code)
2	When the mismatched address is specified.
3	When the data written exceeds the setting range, When the specified number of data items in the query message exceeds the maximum number of data items available
4	Self-diagnostic error response

- Order of determination of error

Error code 1 > Error code 3 > Error code 2 > Error code 4

(3) No response

The slave ignores the query message and does not respond when:
- The slave address in the query message does not coincide with any slave address settings.
- The CRC code of the master does not coincide with that of the slave.
- Transmission error such as overrun, framing, parity and etc., is found in the query message.
- Data time interval in the query message from the master exceeds 24-bit time.

5.5 Calculating CRC-16

The Cyclic Redundancy Check (CRC) is a 2 byte (16-bit) error check code. After constructing the data message, not including start, stop, or parity bit, the master calculates a CRC code and appends this to the end of the message. The slave will calculate a CRC code from the received message, and compare it with the CRC code from the master. If they do not coincide, a communication error has occurred and the slave does not respond.

The CRC code is formed in the following sequence:

1. Load a 16-bit CRC register with FFFFH.

2. *Exclusive OR* ($\oplus$) the first byte (8 bits) of the message with the CRC register. Return the result to the CRC register

3. Shift the CRC register 1 bit to the right.

4. If the carry flag is *1*, *exclusive OR* the CRC register with A001 hexadecimal and return the result to the CRC register.　If the carry flag is *0*, repeat step *3*.

5. Repeat step *3* and *4* until there have been 8 shifts.

6. *Exclusive OR* the next byte (8 bits) of the message with the CRC register.

7. Repeat step *3* through *6* for all bytes of the message (except the CRC).

8. The CRC register contains the 2 byte CRC error code. When they are appended to the message, the low-order byte is appended first, followed by the high-order byte.

■ The flow chart of CRC-16

```
                        ┌─────────────────┐
                        │      START      │
                        └─────────────────┘
                                 │
                ┌────────────────────────────────────┐
                │   FFFFH  →  CRC Register            │
                └────────────────────────────────────┘
                                 │
    ┌─────────────────────────────────────────────────────────┐
    │   CRC Register ⊕ next byte of the message  →  CRC Register│
    └─────────────────────────────────────────────────────────┘
                                 │
                        ┌─────────────────┐
                        │     0 → n        │
                        └─────────────────┘
                                 │
                ┌────────────────────────────────────┐
                │   Shift CRC Register right 1 bit    │
                └────────────────────────────────────┘
                                 │
                         ╱────────────╲         No
                        ╱ Carry flag is 1 ╲──────────┐
                         ╲────────────╱              │
                                 │ Yes               │
                ┌────────────────────────────────────┐
                │  CRC Register ⊕ A001H  →  CRC Register│
                └────────────────────────────────────┘
                                 │                   │
                        ┌─────────────────┐
                        │   n + 1 → n      │
                        └─────────────────┘
                                 │
           No            ╱────────────╲
        ┌────────────────   n > 7      ╲
        │                ╲────────────╱
        │                        │ Yes
        │                ╱────────────╲
   No   │               ╱  Is message  ╲
   ─────┼───────────────   complete ?   ╲
        │                ╲────────────╱
        │                        │ Yes
        │                ┌─────────────────┐
        │                │       END       │
        │                └─────────────────┘
```
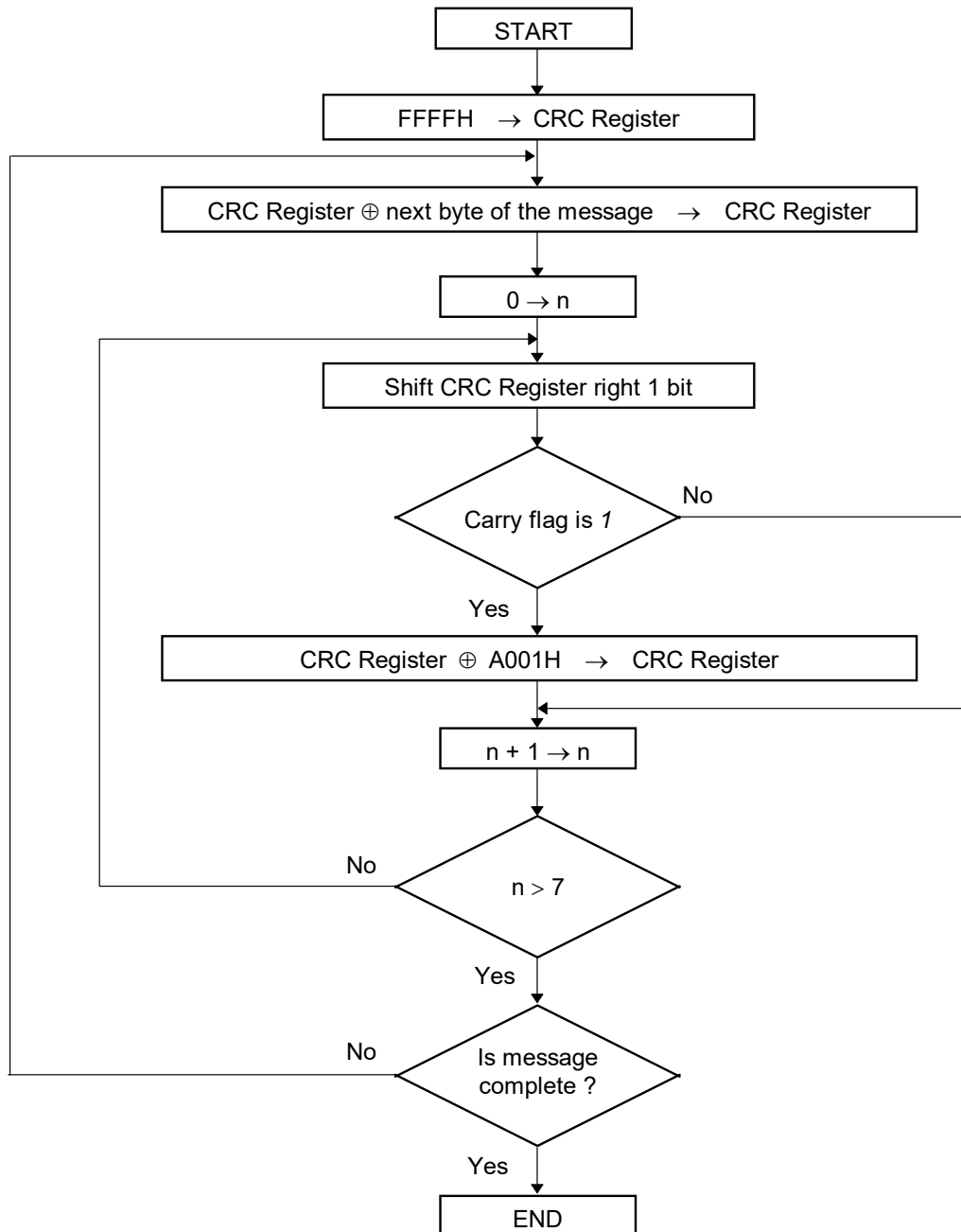
    📖   The ⊕ symbol indicates an *exclusive OR* operation. The symbol for the number of data bits is *n*.

2. MODBUS PROTOCOL

5.6 Message Format

5.6.1 Read holding registers [03H]

The query message specifies the starting register address and quantity of registers to be read.

The contents of the holding registers are entered in the response message as data, divided into two parts: the high-order 8 bits and the low-order 8 bits, arranged in the order of the register numbers.

Example: The contents of the three holding registers from 0000H to 0002H are the read out from slave address 2.

Query message

Slave address		02H
Function code		03H
Starting number	High	00H
	Low	00H
Quantity	High	00H
	Low	03H
CRC-16	High	05H
	Low	F8H

First holding register address

The setting must be between 1 (0001H) and 125 (007DH).

Normal response message

Slave address		02H
Function code		03H
Number of data		06H
First holding register contents	High	00H
	Low	00H
Next holding register contents	High	00H
	Low	00H
Next holding register contents	High	00H
	Low	00H
CRC-16	High	35H
	Low	85H

→ Number of holding registers × 2

Error response message

Slave address		02H
80H + Function code		83H
Error code		03H
CRC-16	High	F1H
	Low	31H

5.6.2 Preset single register [06H]

The query message specifies data to be written into the designated holding register. The write data is arranged in the query message with high-order 8 bits first and low-order 8 bits next. Only R/W holding registers can be specified.

Example: Data is written into the holding register 0010H of slave address 1.

Query message

Slave address		01H
Function code		06H
Holding register number	High	00H
	Low	10H
Write data	High	01H
	Low	02H
CRC-16	High	08H
	Low	5EH

Any data within the range (for Write data rows)

Normal response message

Slave address		01H
Function code		06H
Holding register number	High	00H
	Low	10H
Write data	High	01H
	Low	02H
CRC-16	High	08H
	Low	5EH

Contents will be the same as query message data.

Error response message

Slave address		01H
80H + Function code		86H
Error code		02H
CRC-16	High	C3H
	Low	A1H

5.6.3 Diagnostics (loopback test) [08H]

The master's query message will be returned as the response message from the slave. This function checks the communication system between the master and slave.

Example: Loopback test for slave address 1

Query message

Slave address		01H
Function code		08H
Test code	High	00H
	Low	00H
Data	High	1FH
	Low	34H
CRC-16	High	E9H
	Low	ECH

Test code must be set to *00*

Any pertinent data

Normal response message

Slave address		01H
Function code		08H
Test code	High	00H
	Low	00H
Data	High	1FH
	Low	34H
CRC-16	High	E9H
	Low	ECH

Contents will be the same as query message data.

Error response message

Slave address		01H
80H + Function code		88H
Error code		03H
CRC-16	High	06H
	Low	01H

5.7 Data Configuration

5.7.1 Data range

The numeric range of data used in Modbus protocol is 0000H to FFFFH. Only the set value within the setting range is effective.

📖 FFFFH represents −1.

■ Data processing with decimal points

The Modbus protocol does not recognize data with decimal points during communication.

● Data with three decimal places

PV ratio (Pr)

Example: When the PV ratio (Pr) is 0.555 minutes; 0.555 is processed as 555,
555 = 022BH

PV ratio (Pr)	High	02H
	Low	2BH

● Data whose decimal point's presence and/or position depends on input range

The position of the decimal point changes depending on the Input range type and the decimal point position setting, because the Modbus protocol does not recognize data with decimal points during communication.

[Type of decimal points position]
TC/RTD inputs: No decimal place, One decimal place
Voltage/Current inputs: No decimal place, One decimal place, Two decimal places, Three decimal places

☞ For details, see **A.3 Input Range Table (P. A-4)**.

Measured value (PV)
Peak hold, Bottom hold
Limit set value (SV)
Alarm 1 (ALM1), Alarm 2 (ALM2)
PV bias
Measured value (PV), Limit set value (SV) and Deviation (DEV) of Transmission output scale high (AHS)
Measured value (PV), Limit set value (SV) and Deviation (DEV) of Transmission output scale low (ALS)
Setting limiter [high limit], Setting limiter [low limit]
Alarm 1 differential gap, Alarm 2 differential gap
Limit action differential gap

Example: When the limit set value is −20.0 °C; −20.0 is processed as −200,
−200 = 0000H − 00C8H = FF38H

Limit set value (SV)	High	FFH
	Low	38H

● **Data without decimal points**

Limit action monitor	Display unit selection
Burnout	Decimal point position setting
Alarm 1 status	Output logic operation selection
Alarm 2 status	Alarm 1 type selection
EXCD time (minutes)	Alarm 1 hold action
EXCD time (seconds)	Alarm 1 process abnormality action
Limit action release	Alarm 1 interlock function selection
Alarm interlock release (ILr)	Alarm 1 delay timer unit
Alarm 1 delay timer	Alarm 2 type selection
Alarm 2 delay timer	Alarm 2 hold action
Digital filter	ALM2 process abnormality action
Transmission output (AO) specification selection	Alarm 2 interlock function selection
Set data lock (LCK)	Alarm 2 delay timer unit
EEPROM storage mode	Limit action type selection
EEPROM storage status	Limit action hold action selection
Enter password for Show/Hide	Limit action process abnormality action selection
Set password for Show/Hide	Limit action at the time of power ON
Hide LCK	<RST key operation time selection
Set engineering mode attribute	Reset action selection
Monitor display configuration selection	Switch limit action release signal
Input type selection	Sampling cycle

Example: When the Alarm 1 delay timer unit is 50 seconds; 50 is processed as 50, 50 = 0032H

Alarm 1 delay timer unit	High	00H
	Low	32H

5.7.2 Data processing precautions

• Definitions of registers

  ① Undefined register

    Reserved register for extension within the data map range defined in Specification.

  ② Illegal register

    Register outside of the data map range defined in Specification.

  ③ Unused register

    Register that can be used/unused depending on the selected function and that is set to unused.

• Register handling

  (1) Reading register

Register types contained in communication data	Action at the time of reading
① Undefined register	Return 0000H only for undefined register.
② Illegal register	Error code 2* is returned if illegal register is included. When the communication data is sequentially read, an error code 0000H may be returned if an incorrect register is included.
③ Unused register	A factory set value is returned for an unused register.
④ Registers except the above	Register can be read.

  (2) Preset single register

Register types contained in communication data	Action at the time of writing
① Undefined register	Destroy write data.
② Illegal register	Return error code 2* and destroy write data.
③ Write-protected register (Read-only register)	
④ Write a value outside the setting range	Return error code 3* and destroy write data.
⑤ Unused register	Destroy write data.
⑥ Registers except the above	Capable of writing into register.

    * When an error with higher error code determination is active, priority is given to it.

• For 03H (read holding register), an error response message (error code 2) is returned when the starting number (start address) of the query message is larger than 004CH.

• For 06H (preset single register), an error message (error code 2) is returned when the write address is larger than 004CH.

• If data range or address error occurs during data writing, the data written before error is in effect.

5.8 Modbus Communication Data List

5.8.1 Reference to Modbus communication identifier list

No.	Name	Register address		Attri-bute	Data range	Factory set value
		HEX	DEC			
1	Measured value (PV)	0000	0	RO	Within input range. [Setting limiter [low limit] – (5 % of Span) to Setting limiter [high limit] + (5 % of Span)] Varies with the setting of the Decimal point position.	—

(1), (2), (3), (4), (5) labels point to the columns Name, Register address, Attribute, Data range, and Factory set value respectively.

(1) Name: Communication data name

(2) Register address: Modbus communication data register addresses
  HEX: Hexadecimal
  DEC: Decimal

(3) Attribute: A method of how communication data items are read or written when viewed from the host computer is described.

RO: Only reading data is possible.

Data direction

Host computer ◄——— Controller
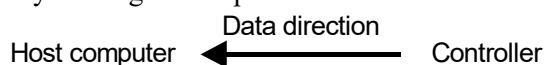
R/W: Reading and writing data is possible.

Data direction

Host computer ◄———► Controller
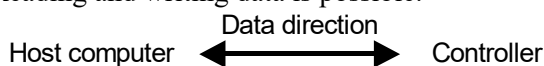
(4) Data range: Read or write range of communication data

(5) Factory set value: Factory set value of communication data

5.8.2 Modbus communication data list

No.	Name	Register address		Attri-bute	Data range	Factory set value
		HEX	DEC			
1	Measured value (PV)	0000	0	RO	Within input range [Setting limiter [low limit] – (5 % of Span) to Setting limiter [high limit] + (5 % of Span)] Varies with the setting of the Decimal point position.	—
2	Limit action monitor	0001	1	RO	0: Normal 1: Limit output ON 2: EXCD state	—
3	Burnout	0002	2	RO	0: OFF 1: ON	—
4	Alarm 1 status	0003	3	RO	0: OFF 1: ON	—
5	Alarm 2 status	0004	4	RO	0: OFF 1: ON	—
6	Peak hold	0005	5	RO	Within input range (Setting limiter [low limit] to Setting limiter [high limit]) Varies with the setting of the Decimal point position.	—
7	Bottom hold	0006	6	RO	Within input range (Setting limiter [low limit] to Setting limiter [high limit]) Varies with the setting of the Decimal point position.	—
8	EXCD time (minutes)	0007	7	RO	0 to 999 (0 to 999 minutes)	—
9	EXCD time (seconds)	0008	8	RO	0 to 59 (0 to 59 seconds)	—
10	Limit action release	0009	9	R/W	When the setting of "Switch limit action release signal" (No.57) is "0": ・Limit action release (No.10) can always read out "1". ・When the Limit action release is set to zero, the reset procedure will be started. [1] When the setting of "Switch limit action release signal" (No.57) is "1": ・Limit action release (No.10) can always read out "0". ・When the Limit action release is set to 1, the reset procedure will be started. [1]	1
11	Alarm interlock release (ILr)	000A	10	R/W	0: Alarm interlock release state [2]	—

[1] When the reset process is executed, the following actions will also be executed.
 ・Release the Limit output
 ・Clear the Peak and the Bottom hold values
 ・Clear the EXCD time

[2] The interlock is released by setting the "0." In the read state, becomes "1."

📖 **NOTE**
   Release the alarm interlock when the Alarm OFF conditions are satisfied.

No.	Name	Register address		Attri-bute	Data range	Factory set value
		HEX	DEC			
12	Limit set value (SV)	000B	11	R/W	Within input range (Setting limiter [low limit] to Setting limiter [high limit]) Varies with the setting of the Decimal point position.	TC/RTD inputs: 0 (0.0) Voltage/Current inputs: 0.0
13	Alarm 1 (ALM1)	000C	12	R/W [1]	Process alarm, SV alarm: 　Same as input range * 　(Setting limiter [low limit] to Setting limiter [high limit]) Deviation alarm: 　−Span to +Span * 　(However, within −1999 to +9999 digits) * Varies with the setting of the Decimal point position.	TC/RTD inputs: 50 (50.0) Voltage/Current inputs: 5.0
14	Alarm 1 delay timer	000D	13	R/W [2]	0 to 9999 seconds [3]	0
15	Alarm 2 (ALM2)	000E	14	R/W [4]	Process alarm, SV alarm: 　Same as input range * 　(Setting limiter [low limit] to Setting limiter [high limit]) Deviation alarm: 　−Span to +Span * 　(However, within −1999 to +9999 digits) * Varies with the setting of the Decimal point position.	TC/RTD inputs: 50 (50.0) Voltage/Current inputs: 5.0
16	Alarm 2 delay timer	000F	15	R/W [5]	0 to 9999 seconds [3]	0
17	PV bias	0010	16	R/W	−Span to +Span (However, within −1999 to +9999 digits) Varies with the setting of the Decimal point position.	TC/RTD inputs: 0 (0.0) Voltage/Current inputs: 0.0
18	PV ratio (Pr)	0011	17	R/W	0.500 to 1.500 times	1.000
19	Digital filter	0012	18	R/W	0 to 100 seconds (0: Digital filter OFF)	0
20	Transmission output (AO) specification	0013	19	R/W [6]	0:　Measured value (PV) 1:　Limit set value (SV) 2:　Deviation (DEV)	0

[1]　If "No alarm" for Alarm 1 [ALM1] is selected, the attribute becomes RO.

[2]　When the Alarm 1 delay timer unit is "0", the attribute will be RO.

[3]　The actual delay time is the value obtained by multiplying the delay timer value and the delay timer unit value.
　　Example: Alarm 1 delay timer (10 seconds) × Alarm 1 delay timer unit (30 seconds) = 300 seconds

[4]　If "No alarm" for Alarm 2 [ALM2] is selected, the attribute becomes RO.

[5]　When the Alarm 2 delay timer unit is "0", the attribute will be RO.

[6]　If the Output 1 (OUT1) is a transmission output, the attribute is R/W and is RO for all other cases.

No.	Name	Register address		Attri-bute	Data range	Factory set value
		HEX	DEC			
21	Transmission output scale high (AHS)	0014	20	R/W [1]	Measured value (PV), Limit set value (SV): Same as input range * [Transmission output scale low to Setting limiter (high limit)] Deviation (DEV): −Span to +Span * (However, within −1999 to +9999 digits) [Transmission output scale low to +Span] * Varies with the setting of the Decimal point position.	TC/RTD inputs: Input range high or +Span Voltage/Current inputs: 100.0
22	Transmission output scale low (ALS)	0015	21	R/W [1]	Measured value (PV), Set value (SV): Same as input range * [Setting limiter (low limit) to Transmission output scale high] Deviation (DEV): −Span to +Span * (However, within −1999 to +9999 digits) [−Span to Transmission output scale high] * Varies with the setting of the Decimal point position.	TC/RTD inputs: Input range low or −Span Voltage/Current inputs: 0.0
23	Set data lock (LCK)	0016	22	R/W	Set in the decimal format (0 to 15) [4]	0
24	EEPROM storage mode [2]	0017	23	R/W	0: Backup mode (Set values are store to the EEPROM) 1: Buffer mode (No set values are store to the EEPROM)	0
25	EEPROM storage status [3]	0018	24	RO	0: Mismatch 1: Match	—
26	Enter password for Show/Hide	0019	25	R/W	0000 to 9999	0000
27	Set password for Show/Hide	001A	26	R/W	0000 to 9999	0000
28	Hide LCK	001B	27	R/W	0: Unlock 1: Lock	0

[1] If the Output 1 (OUT1) is a transmission output, the attribute is R/W and is RO for all other cases.

[2] The non-volatile memory (EEPROM) has limitations on the number of memory rewrite times. If the buffer mode is selected as an EEPROM storage mode, all of the set values changed are not written to the EEPROM and thus a problem of limitations on the number of memory rewrite times can be solved. When the memory is used to frequently change the set value via communication, select the buffer mode.

When selecting any EEPROM storage mode, take notice of the following.

- If power failure occurs while the buffer mode is selected, the set value returns to the value before the storage mode is selected.
- If the buffer mode is changed to the backup mode, all of the set values at that time are stored to the EEPROM. If necessary to backup the final value of each set item, select the backup mode.
- When the power is turned on, the backup mode is always set.

[3] The contents of the buffer memory and those of the EEPROM can be checked.

When data is 0: The contents of the buffer memory do not match with those of the EEPROM.

- As data is being written to the EEPROM in backup mode, do not turn the power off. If turned off, no set values are stored.
- If the set value is changed after the backup mode is changed to the buffer mode, 0 is set (mismatch). As the set value changed is not backup, select the backup mode if necessary.

When data is 1: The contents of the buffer memory match with those of the EEPROM. (Data write to the EEPROM is completed.)

[4] Details of set data lock function:

The data lock function only prevents setting changes being made from the front keys. Setting changes can still be made through communication transmission.

Setting data	×: Operable −: Not operable	×: Changeable −: Not changeable		
	Switch to the Engineering mode	Limit set value (SV)	Alarm setting [1]	Other setting items [2]
0	−	×	×	×
1	−	×	×	−
2	−	×	−	×
3	−	×	−	−
4	−	−	×	×
5	−	−	×	−
6	−	−	−	×
7	−	−	−	−
8	×	×	×	×
9	×	×	×	−
10	×	×	−	×
11	×	×	−	−
12	×	−	×	×
13	×	−	×	−
14	×	−	−	×
15	×	−	−	−

[1] Alarm (ALM1), Alarm 2 (ALM2), Alarm 1 delay timer, and Alarm 2 delay timer
[2] Setting items except Alarm setting and Limit set value (SV)

📖 The following parameters are not covered by the Set data lock.
- Set data lock (LCK)
- Enter password for Show/Hide
- Set password for Show/Hide
- Hide LCK
- Parameter in the Communication setting mode

No.	Name	Register address HEX	Register address DEC	Attri-bute	Data range	Factory set value
29	Undefined	001C ⋮ 002F	28 ⋮ 47	—	—	—
30	Set engineering mode attribute [1, 2, 3]	0030	48	R/W	0 : When the attribute of the "Engineering mode setting item" is [RO]. 1 : When the attribute of the "Engineering mode setting item" is [R/W].	0
31	Monitor display configuration selection [4]	0031	49	R/W	0: PV/SV display 1: Only PV display 2: Only SV display	0
32	Input type selection [4]	0032	50	R/W	0: Thermocouple K [5] 1: Thermocouple J [5] 2: Thermocouple R [5] 3: Thermocouple S [5] 4: Thermocouple B [5] 5: Thermocouple E [5] 6: Thermocouple N [5] 7: Thermocouple T [5] 8: Thermocouple W5Re/W26Re [5] 9: Thermocouple PL II [5] 10: Thermocouple U [5] 11: Thermocouple L [5] 12: RTD Pt100 [5] 13: RTD JPt100 [5] 14: Voltage 0 to 5 V DC or Current 0 to 20 mA DC [5, 6] 15: Voltage 1 to 5 V DC or Current 4 to 20 mA DC [5, 6] 16: Voltage 0 to 10 V DC [5]	Factory set value varies depending on the instrument specification.
33	Display unit selection [4]	0033	51	R/W	0: °C 1: °F	0
34	Decimal point position setting [4]	0034	52	R/W	0: No digit below decimal point 1: 1 digit below decimal point 2: 2 digits below decimal point 3: 3 digits below decimal point	Factory set value varies depending on the instrument specification.
35	Setting limiter [high limit] [4]	0035	53	R/W	−1999 to +9999 • Set the Setting limiter by referring to the **"A.3 Input Range Table" (P. A-4)**. • This instrument sets the input range with the Setting limiter. Please note that changing the Setting limiter will also change the input range.	Factory set value varies depending on the instrument specification.
36	Setting limiter [low limit] [4]	0036	54	R/W		Factory set value varies depending on the instrument specification.

[1] Release the lock for the Engineering mode first. Then, change the "Set engineering mode attribute" to "1". After having completed the setting change of the setting items in the Engineering mode, set the "Set engineering mode attribute" back to "0".

[2] Changing the "Set engineering mode attribute" to "1" will reset the following items.
・Limit output: Changed to OFF
・EXCD time: Cleared to 0 seconds

[3] While the setting of "Set engineering mode attribute" is "1", the instrument will not enter the EXCD mode even if all of the EXCD conditions are satisfied. The Limit output will not turn on either.

[4] While the setting of "Set engineering mode attribute" is "0", the attribute of this communication data is RO.

[5] Input type (TC/RTD to voltage/current inputs or voltage/current inputs to TC/RTD) cannot be changed because the hardware is different.

[6] For the current input specification, a resistor of 250 Ω must be connected between the input terminals.

No.	Name	Register address		Attri-bute	Data range	Factory set value
		HEX	DEC			
37	Output logic operation selection [1]	0037	55	R/W	1: OUT1: Limit output (De-energized) OUT2: *OR* output of Alarm 1 and Alarm 2 (Energized) 2: OUT1: Limit output (De-energized) OUT2: *AND* output of Alarm 1 and Alarm 2 (Energized) 3: OUT1: Limit output (De-energized) OUT2: Alarm 1 output (Energized) 4: OUT1: Limit output (De-energized) OUT2: *OR* output of Alarm 1 and Alarm 2 (De-energized) 5: OUT1: Limit output (De-energized) OUT2: *AND* output of Alarm 1 and Alarm 2 (De-energized) 6: OUT1: Limit output (De-energized) OUT2: Alarm 1 output (De-energized) 7: OUT1: Limit output (De-energized) OUT2: Not output [3] 8: OUT1: Limit output (Energized) OUT2: *OR* output of Alarm 1 and Alarm 2 (Energized) 9: OUT1: Limit output (Energized) OUT2: *AND* output of Alarm 1 and Alarm 2 (Energized) 10: OUT1: Limit output (Energized) OUT2: Alarm 1 output (Energized) 11: OUT1: Limit output (Energized) OUT2: *OR* output of Alarm 1 and Alarm 2 (De-energized) 12: OUT1: Limit output (Energized) OUT2: *AND* output of Alarm 1 and Alarm 2 (De-energized) 13: OUT1: Limit output (Energized) OUT2: Alarm 1 output (De-energized) 14: OUT1: Limit output (Energized) OUT2: Not output [3] 15: OUT1: Transmission output OUT2: Limit output (De-energized) 16: OUT1: Transmission output OUT2: Limit output (Energized)	Factory set value varies depending on the instrument specification.[2]

[1] While the setting of "Set engineering mode attribute" is "0", the attribute of this communication data is RO.

[2] Factory set value when an Output assignment code is not specified at the time of ordering:
The output assignment code is set to either of the following according to the output 1 (OUT1) type specified at the time of ordering.
• When OUT1 is a relay contact output: 1
• When OUT1 is a current output (0 to 20 mA DC or 4 to 20 mA DC): 15

[3] The Alarm state can be checked via communication or by lamp lighting.

No.	Name	Register address		Attri-bute	Data range	Factory set value
		HEX	DEC			
38	Alarm 1 type selection *	0038	56	R/W	0: Alarm not provided 1: SV high alarm 2: SV low alarm 3: Process high alarm 4: Process low alarm 5: Deviation high alarm 6: Deviation low alarm 7: Deviation high/low alarm 8: Band alarm	Factory set value varies depending on the instrument specification.
39	Alarm 1 hold action *	0039	57	R/W	0: Without alarm hold action 1: Effective • When the power is turned on. • When the Set engineering mode attribute is changed from "1 (R/W)" to "0 (RO)". 2: Effective • When the power is turned on. • When the Set engineering mode attribute is changed from "1 (R/W)" to "0 (RO)". • When the Limit set value (SV) is changed.	Factory set value varies depending on the instrument specification.
40	Alarm 1 differential gap *	003A	58	R/W	0 (0.0) to Span (However, 9999 digits or less) Varies with the setting of the Decimal point position.	TC/RTD inputs: 2 (2.0) Voltage/Current inputs: 0.2
41	Alarm 1 process abnormality action *	003B	59	R/W	0: Normal processing 1: Forcibly turned on when abnormal	Alarm 1 not provided: 0 Alarm 1 provided: 1
42	Alarm 1 interlock function selection *	003C	60	R/W	0: Disable Alarm 1 interlock function 1: Enable Alarm 1 interlock function	0
43	Alarm 1 delay timer unit *	003D	61	R/W	0 to 60 seconds (0: Alarm 1 delay timer function OFF)	0
44	Alarm 2 type selection *	003E	62	R/W	0: Alarm not provided 1: SV high alarm 2: SV low alarm 3: Process high alarm 4: Process low alarm 5: Deviation high alarm 6: Deviation low alarm 7: Deviation high/low alarm 8: Band alarm	Factory set value varies depending on the instrument specification.
45	Alarm 2 hold action *	003F	63	R/W	0: Without alarm hold action 1: Effective • When the power is turned on. • When the Set engineering mode attribute is changed from "1 (R/W)" to "0 (RO)". 2: Effective • When the power is turned on. • When the Set engineering mode attribute is changed from "1 (R/W)" to "0 (RO)". • When the Limit set value (SV) is changed.	Factory set value varies depending on the instrument specification.
46	Alarm 2 differential gap *	0040	64	R/W	0 (0.0) to Span (However, 9999 digits or less) Varies with the setting of the Decimal point position.	TC/RTD inputs: 2 (2.0) Voltage/Current inputs: 0.2
47	ALM2 process abnormality action *	0041	65	R/W	0: Normal processing 1: Forcibly turned on when abnormal	Alarm 2 not provided: 0 Alarm 2 provided: 1

* While the setting of "Set engineering mode attribute" is "0", the attribute of this communication data is RO.

No.	Name	Register address		Attri-bute	Data range	Factory set value
		HEX	DEC			
48	Alarm 2 interlock function selection [1]	0042	66	R/W	0: Disable Alarm 2 interlock function 1: Enable Alarm 2 interlock function	0
49	Alarm 2 delay timer unit [1]	0043	67	R/W	0 to 60 seconds (0: Alarm 1 delay timer function OFF)	0
50	Limit action type selection [1]	0044	68	R/W	0: Limit action (high limit) 1: Limit action (low limit)	0
51	Limit action differential gap [1]	0045	69	R/W	0 (0.0) to Span (However, 9999 digits or less) Varies with the setting of the Decimal point position.	TC/RTD inputs: 2 (2.0) Voltage/Current inputs: 0.2
52	Limit action hold action selection [1]	0046	70	R/W	0: Without hold action 1: Effective • W when the power is turned on. • When the Set engineering mode attribute is changed from "1 (R/W)" to "0 (RO)".	0
53	Limit action process abnormality action selection [1]	0047	71	R/W	0: Normal processing 1: Forced ON at input error [2]	0
54	Limit action at the time of power ON [1]	0048	72	R/W	0: Normal processing 1: Forced ON at power-on [3]	0
55	<RST key operation time selection [1]	0049	73	R/W	0: Press and hold (for one second) 1: Press once	0
56	Reset action selection [1]	004A	74	R/W	0: All data is reset on each monitoring screen [4] 1: Each data is reset on each monitoring screen [4]	0
57	Switch limit action release signal [1]	004B	75	R/W	0: Reset when "Limit action release" = 0 1: Reset when "Limit action release" = 1	0
58	Sampling cycle [1]	004C	76	R/W	0: 250 ms (0.25 seconds) 1: 500 ms (0.5 seconds)	1

[1] While the setting of "Set engineering mode attribute" is "0", the attribute of this communication data is RO.

[2] The Limit output will be forced ON when the input goes abnormal.

[3] After power is applied, the Limit output is kept ON regardless of the Measured value and this state is maintained until the reset action is taken. This state is maintained until the reset action is taken.

[4] "All data" described in the Data range mean Peak hold value, Bottom hold value, and EXCD time. Parameters cleared in each screen are as follows.

When the set value of the Reset action selection is set to "0."

Screen	Parameters cleared by Reset operation
PV/SV monitor	Limit output, Peak hold value,
Peak hold	Bottom hold value, EXCD time
Bottom hold	
EXCD time	

When the set value of the Reset action selection is set to "1."

Screen	Parameters cleared by Reset operation
PV/SV monitor	Limit output
Peak hold	Limit output, Peak hold value,
Bottom hold	Bottom hold value
EXCD time	Limit output, EXCD time

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TROUBLE SHOOTING

6

This chapter describes how to cope with errors during the communication.

⚠ **WARNING**

- To prevent electric shock or instrument failure, always turn off the system power before replacing the instrument.

- To prevent electric shock or instrument failure, always turn off the power before mounting or removing the instrument.

- To prevent electric shock or instrument failure, do not turn on the power until all wiring is completed. Make sure that the wiring is correct before applying power to the instrument.

- To prevent electric shock or instrument failure, do not touch the inside of the instrument.

- All wiring must be performed by authorized personnel with electrical experience in this type of work.

⚠ **CAUTION**

All wiring must be completed before power is turned on to prevent electric shock, instrument failure, or incorrect action. The power must be turned off before repairing work for input break and output failure including replacement of sensor, contactor or SSR, and all wiring must be completed before power is turned on again.

This section lists some of the main causes and solutions for communication problems.
If you cannot solve a problem, please contact RKC sales office or the agent, on confirming the type name and specifications of the product.

6.1 RKC Communication

Problem	Possible cause	Solution
No response	Wrong connection, no connection or disconnection of the communication cable	Confirm the connection method or condition and connect correctly
	Breakage, wrong wiring, or imperfect contact of the communication cable	Confirm the wiring or connector and repair or replace the wrong one
	Mismatch of the setting data of communication speed and data configuration with those of the host computer	Confirm the settings and set them correctly
	Wrong address setting	
	Error in the data format	Re-examine the communication program
	Transmission line is not set to the receive state after data send (for RS-485)	
EOT return	The specified identifier is invalid	Confirm the identifier is correct or that with the correct function is specified. Otherwise correct it
	Error in the data format	Reexamine the communication program
NAK return	Error occurs on the line (parity bit error, framing error, etc.)	Confirm the cause of error, and solve the problem appropriately. (Confirm the transmitting data, and resend data)
	BCC error	
	The data exceeds the setting range	Confirm the setting range and transmit correct data
	The specified identifier is invalid	Confirm the identifier is correct or that with the correct function is specified. Otherwise correct it

6.2 Modbus

Problem	Possible cause	Solution
No response	Wrong connection, no connection or disconnection of the communication cable	Confirm the connection method or condition and connect correctly
	Breakage, wrong wiring, or imperfect contact of the communication cable	Confirm the wiring or connector and repair or replace the wrong one
	Mismatch of the setting data of communication speed and data bit configuration with those of the host computer	Confirm the settings and set them correctly
	Wrong address setting	
	A transmission error (overrun error, framing error, parity error or CRC-16 error) is found in the query message	Re-transmit after time-out occurs or verify communication program
	The time interval between adjacent data in the query message is too long, exceeding 24-bit time	
Error code 1	Function code error (Specifying nonexistent function code)	Confirm the function code
Error code 2	An illegal register was specified for the starting address at the time of reading from a holding register (03H).	Confirm the address of holding register
	Written to a read-only (RO) data.	
	Written to an illegal register.	
Error code 3	When the specified number of data items in the query message exceeds the maximum number of data items available	Confirm the setting data
Error code 4	Self-diagnostic error	Turn off the power to the instrument. If the same error occurs when the power is turned back on, please contact RKC sales office or the agent.

SPECIFICATIONS

This chapter describes the specification of the host communication.

7.1 RKC Communication

Interface: Based on RS-485, EIA standard

Connection method: 2-wire system, half-duplex multi-drop connection

Communication distance: 1 km max.
(The maximum communication distance will be affected by the surrounding conditions.)

Synchronous method: Start/Stop synchronous type

Communication speed: 2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps

Interval time: 0 to 250 ms

Data bit configuration:
Start bit: 1
Data bit: 7 or 8
Parity bit: None, Odd or Even
Stop bit: 1 or 2

Protocol: ANSI X3.28-1976 subcategories 2.5 and A4
Polling/Selecting type

Error control: Vertical parity (With parity bit selected)
Horizontal parity (BCC check)

Communication code: ASCII   7-bit code

Termination resistor: Externally terminal connected (120 Ω   1/2 W)

Xon/Xoff control: None

Maximum connections: 31 instruments (32 instruments maximum including a host computer)

Signal logic: RS-485

Signal logic	Logic
V (A) − V (B) ≥ 2 V	0 (SPACE)
V (A) − V (B) ≤ −2 V	1 (MARK)

Voltage between V (A) and V (B) is the voltage of (A) terminal for the (B) terminal.

7.2 Modbus

Interface:	Based on RS-485, EIA standard
Connection method:	2-wire system, half-duplex multi-drop connection
Communication distance:	1 km max.
	(The maximum communication distance will be affected by the surrounding conditions.)
Synchronous method:	Start/Stop synchronous type
Communication speed:	2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps (Selectable)

Data bit configuration:
Start bit: 1
Data bit: 8 (Byte data corresponding to binary data or bit.)
Parity bit: None, Odd or Even
Stop bit: 1 or 2

Protocol:	Modbus
Signal transmission mode:	Remote Terminal Unit (RTU) mode

Function code:
03H (Read holding registers)
06H (Preset single register)
08H (Diagnostics: loopback test)

Error check method: CRC-16

Error code:
1: Function code error
2: When the mismatched address is specified.
3: When the data written exceeds the setting range, When the specified number of data items in the query message exceeds the maximum number of data items available
4: Self-diagnostic error response

Termination resistor:	Externally terminal connected (Example: 120 Ω 1/2 W)
Maximum connections:	31 instruments (32 instruments maximum including a host computer)
Signal logic:	RS-485

Signal logic	Logic
V (A) − V (B) ≥ 2 V	0 (SPACE)
V (A) − V (B) ≤ −2 V	1 (MARK)

Voltage between V (A) and V (B) is the voltage
of (A) terminal for the (B) terminal.

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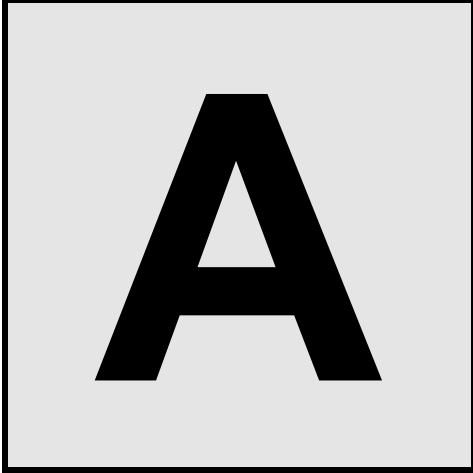# APPENDIX **A**

A.1 ASCII 7-Bit Code Table

This table is only for use with RKC communication.

					b7	0	0	0	0	1	1	1	1
					b6	0	0	1	1	0	0	1	1
					b5	0	1	0	1	0	1	0	1
b5 to b7	b4	b3	b2	b1		0	1	2	3	4	5	6	7
	0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p
	0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
	0	0	1	0	2	STX	DC2	"	2	B	R	b	r
	0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
	0	1	0	0	4	EOT	DC4	$	4	D	T	d	t
	0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
	0	1	1	0	6	ACK	SYM	&	6	F	V	f	v
	0	1	1	1	7	BEL	ETB	'	7	G	W	g	w
	1	0	0	0	8	BS	CAN	(	8	H	X	h	x
	1	0	0	1	9	HT	EM	)	9	I	Y	i	y
	1	0	1	0	A	LF	SUB	*	:	J	Z	j	z
	1	0	1	1	B	VT	ESC	+	;	K	[	k	{
	1	1	0	0	C	FF	FS	,	<	L	¥	l	|
	1	1	0	1	D	CR	GS	-	=	M	]	m	}
	1	1	1	0	E	SO	RS	.	>	N	^	n	~
	1	1	1	1	F	SI	US	/	?	O	_	o	DEL

A.2 Input Type Table

Input type		Measured range
Thermocouple (TC)	K	−199 to +1372 °C (−326 to +2502 °F)
		−199.9 to +999.9 °C (−199.9 to +999.9 °F)
	J	−199 to +1200 °C (−326 to +2192 °F)
		−199.9 to +999.9 °C (−199.9 to +999.9 °F)
	R	0 to 1769 °C (0 to 3216 °F)
	S	0 to 1769 °C (0 to 3216 °F)
	B	0 to 1820 °C (0 to 3308 °F)
	E	0 to 1000 °C (0 to 1832 °F)
	N	0 to 1300 °C (0 to 2372 °F)
		0.0 to 999.9°C (0.0 to 999.9 °F)
	T	−199 to +400 °C (−326 to +752 °F)
		−199.9 to +400.0 °C (−199.9 to +752.0 °F)
	W5Re/W26Re	0 to 2320 °C (0 to 4208 °F)
	PL II	0 to 1390 °C (0 to 2534 °F)
	U	−199 to +600 °C (−326 to +1112 °F)
		−199.9 to +600.0 °C (−199.9 to +999.9 °F)
	L	0 to 900 °C (0 to 1652 °F)
RTD	Pt100 (JIS/IEC) [1]	−199.9 to +649.0 °C (−199.9 to +999.9 °F)
	JPt100 (JIS)	
Voltage [2]	0 to 5 V DC	−1999 to +9999 (programmable scale)
	1 to 5 V DC	
	0 to 10 V DC	
Current [2, 3]	0 to 20 mA DC	−1999 to +9999 (programmable scale)
	4 to 20 mA DC	

[1] **IEC** (International Electrotechnical Commission) is equivalent to **JIS**, **DIN** and **ANSI**.

[2] In case of voltage/current inputs, SLH can be set below SLL.

[3] For the current input specification, a resistor of 250 Ω must be connected between the input terminals.

A.3 Input Range Tables

Input Range Table 1

Input type		Input range	Code Input	Code Range	Input range	Code Input	Code Range
Thermocouple	K	0 to 200 °C	K	01	0 to 800 °F	K	A1
		0 to 400 °C	K	02	0 to 1600 °F	K	A2
		0 to 600 °C	K	03	0 to 2502 °F	K	A3
		0 to 800 °C	K	04	0.0 to 800.0 °F	K	A4
		0 to 1000 °C	K	05	20 to 70 °F	K	A9
		0 to 1200 °C	K	06	−199.9 to +999.9 °F	K	B2
		0 to 1372 °C	K	07			
		−199.9 to +300.0 °C	K	08			
		0.0 to 400.0 °C	K	09			
		0.0 to 800.0 °C	K	10			
		0 to 100 °C	K	13			
		0 to 300 °C	K	14			
		0 to 450 °C	K	17			
		0 to 500 °C	K	20			
		0.0 to 200.0 °C	K	29			
		0.0 to 600.0 °C	K	37			
		−199.9 to +800.0 °C	K	38			
	J	0 to 200 °C	J	01	0 to 800 °F	J	A1
		0 to 400 °C	J	02	0 to 1600 °F	J	A2
		0 to 600 °C	J	03	0 to 2192 °F	J	A3
		0 to 800 °C	J	04	0 to 400 °F	J	A6
		0 to 1000 °C	J	05	−199.9 to +999.9 °F	J	A9
		0 to 1200 °C	J	06	0.0 to 800.0 °F	J	B6
		−199.9 to +300.0 °C	J	07			
		0.0 to 400.0 °C	J	08			
		0.0 to 800.0 °C	J	09			
		0 to 450 °C	J	10			
		0.0 to 200.0 °C	J	22			
		0.0 to 600.0 °C	J	23			
		−199.9 to +600.0 °C	J	30			
	R	0 to 1600 °C *	R	01	0 to 3200 °F *	K	A1
		0 to 1769 °C *	R	02	0 to 3216 °F *	K	A2
		0 to 1350 °C *	R	04			
	S	0 to 1600 °C *	S	01	0 to 3200 °F *	S	A1
		0 to 1769 °C *	S	02	0 to 3216 °F *	S	A2
	B	400 to 1800 °C	B	01	800 to 3200 °F	B	A1
		0 to 1820 °C *	B	02	0 to 3308 °F *	B	A2
	E	0 to 800 °C	E	01	0 to 1600 °F	E	A1
		0 to 1000 °C	E	02	0 to 1832 °F	E	A2
	N	0 to 1200 °C	N	01	0 to 2300 °F	N	A1
		0 to 1300 °C	N	02	0 to 2372 °F	N	A2
		0.0 to 800.0 °C	N	06	0.0 to 999.9 °F	N	A5

* Accuracy is not guaranteed below 399 °C (751 °F) or less for types R, S and B.

Input Range Table 1

Input type		Input range	Code		Input range	Code	
			Input	Range		Input	Range
Thermocouple	T	−199.9 to +400.0 °C *	T	01	−199.9 to +752.0 °F *	T	A1
		−199.9 to +100.0 °C *	T	02	−100.0 to +200.0 °F	T	A2
		−100.0 to +200.0 °C	T	03	−100.0 to +400.0 °F	T	A3
		0.0 to 350.0 °C	T	04	0.0 to 450.0 °F	T	A4
					0.0 to 752.0 °F	T	A5
	W5Re/W26Re	0 to 2000 °C	W	01	0 to 4000 °F	W	A1
		0 to 2320 °C	W	02			
	PL II	0 to 1300 °C	A	01	0 to 2400 °F	A	A1
		0 to 1390 °C	A	02	0 to 2534 °F	A	A2
		0 to 1200 °C	A	03			
	U	−199.9 to +600.0 °C *	U	01	−199.9 to +999.9 °F *	U	A1
		−199.9 to +100.0 °C *	U	02	−100.0 to +200.0 °F	U	A2
		0.0 to 400.0 °C	U	03	0.0 to 999.9 °F	U	A3
	L	0 to 400 °C	L	01	0 to 800 °F	L	A1
		0 to 800 °C	L	02	0 to 1600 °F	L	A2
RTD	Pt100	−199.9 to +649.0 °C	D	01	−199.9 to +999.9 °F	D	A1
		−199.9 to +200.0 °C	D	02	−199.9 to +400.0 °F	D	A2
		−100.0 to +50.0 °C	D	03	−199.9 to +200.0 °F	D	A3
		−100.0 to +100.0 °C	D	04	−100.0 to +100.0 °F	D	A4
		−100.0 to +200.0 °C	D	05	−100.0 to +300.0 °F	D	A5
		0.0 to 50.0 °C	D	06	0.0 to 100.0 °F	D	A6
		0.0 to 100.0 °C	D	07	0.0 to 200.0 °F	D	A7
		0.0 to 200.0 °C	D	08	0.0 to 400.0 °F	D	A8
		0.0 to 300.0 °C	D	09	0.0 to 500.0 °F	D	A9
		0.0 to 500.0 °C	D	10			
	JPt100	−199.9 to +649.0 °C	P	01			
		−199.9 to +200.0 °C	P	02			
		−100.0 to +50.0 °C	P	03			
		−100.0 to +100.0 °C	P	04			
		−100.0 to +200.0 °C	P	05			
		0.0 to 50.0 °C	P	06			
		0.0 to 100.0 °C	P	07			
		0.0 to 200.0 °C	P	08			
		0.0 to 300.0 °C	P	09			
		0.0 to 500.0 °C	P	10			

* Accuracy is not guaranteed below −100.0 °C (−148.0 °F) or less for types T and U.

Input Range Table 2

Input type		Input range	Code	
			Input	Range
Voltage (V)	0 to 5 V DC		4	01
	0 to 10 V DC	0. 0 to 100.0 %	5	01
	1 to 5 V DC		6	01
Current (mA)	0 to 20 mA DC		7	01
	4 to 20 mA DC		8	01

📖   For the current input specification, a resistor of 250 Ω must be connected between the input terminals.

MEMO

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