Digital Controller

HA400/HA900
HA401/HA901

Communication
Instruction Manual

RKC® RKC INSTRUMENT INC.

IMR01N03-E1

Thank you for purchasing this RKC instrument. In order to achieve maximum performance and ensure proper operation of your new instrument, carefully read all the instructions in this manual. Please place this manual in a convenient location for easy reference.

SYMBOLS

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.

 : 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.

⚠ WARNING

- An external protection device must be installed if failure of this instrument could result in damage to the instrument, equipment or injury to personnel.
- All wiring must be completed before power is turned on to prevent electric shock, fire or damage to instrument and equipment.
- This instrument must be used in accordance with the specifications to prevent fire or damage to instrument and 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 can occur and warranty is void under these conditions.

CAUTION

- 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 adequate 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 by operating personnel.
- All precautions described in this manual should be taken to avoid damage to the instrument or equipment.
- 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 or failure, protect the power line and the input/output lines from high currents with a protection device such as fuse, circuit breaker, etc.
- 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 dispensation.
- 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 will occur. Use a soft, dry cloth to remove stains from the instrument.
- To avoid damage to instrument display, do not rub with an abrasive material or push front panel with a hard object.
- Do not connect modular connectors to telephone line.

NOTICE

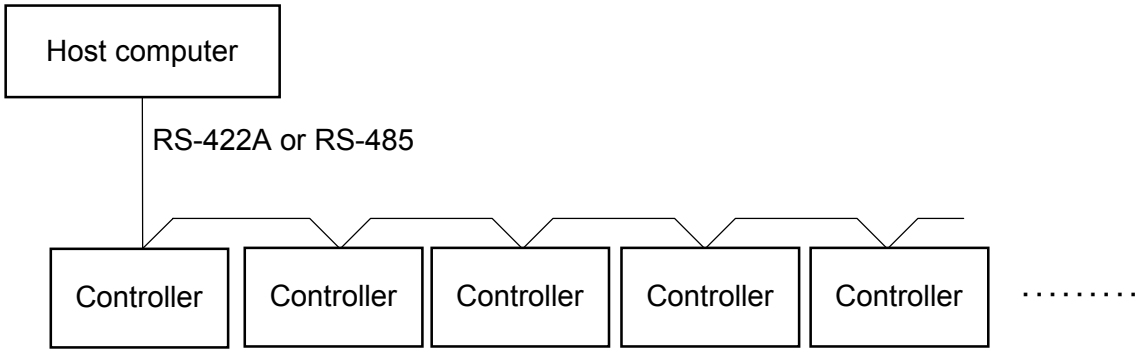
- This manual assumes that the reader has a fundamental knowledge of the principles of electricity, process control, computer technology and communications.
- The figures, diagrams and numeric values used in this manual are only for purpose of illustration.
- RKC is not responsible for any damage or injury that is caused as a result of using this instrument, instrument failure or indirect damage.
- 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.

CONTENTS

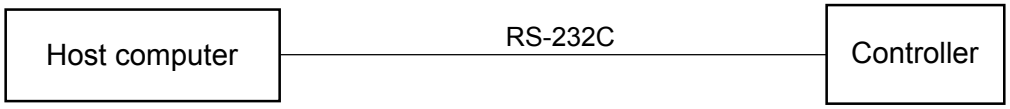
1. OUTLINE

Digital Controller HA400/HA900/HA401/HA901 (hereafter, called controller) interfaces with the host computer via Modbus or RKC communication protocols.
In addition, the controller has two communication ports, the three types of communication interfaces are available: RS-422A, RS-485 and RS-232C.
For reference purposes, the Modbus protocol identifies the host computer as master, the controller as slave.

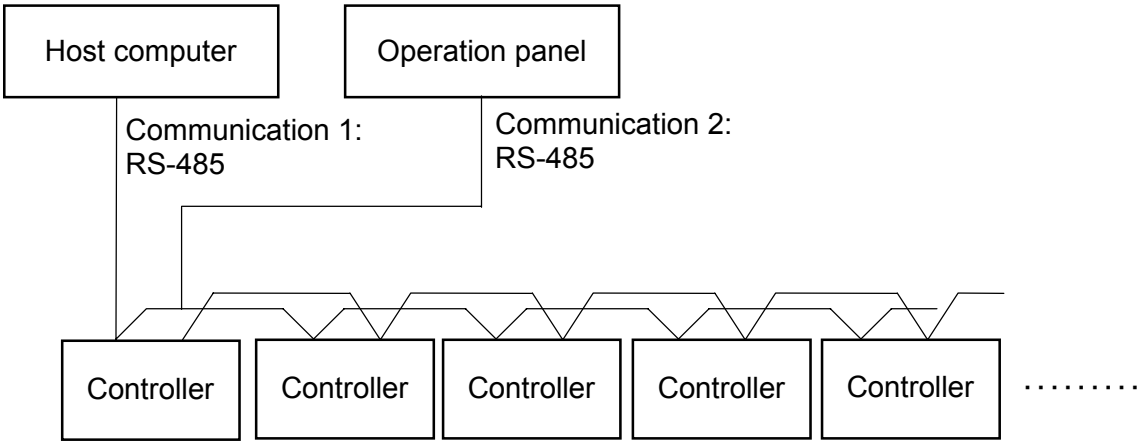
■ Multi-drop connection



■ Point-to-point connection



■ Usage example of two communication ports



2. SPECIFICATIONS

■ RKC communication

Interface:
Communication 1: Based on RS-485, EIA standard
Based on RS-232C, EIA standard
Communication 2: Based on RS-485, EIA standard
Based on RS-422A, EIA standard
Based on RS-232C, EIA standard
Specify the communication 1 and communication 2 separately when ordering

Connection method:
2-wire system, half-duplex multi-drop connection (RS-485)
4-wire system, half-duplex multi-drop connection (RS-422A)
3-wire system, point-to-point connection (RS-232C)

Synchronous method: Half-duplex start-stop synchronous type

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

Data bit configuration:
Start bit: 1
Data bit: 7 or 8
Parity bit: Without, Odd or Even
Stop bit: 1 or 2

Protocol:
ANSI X3.28 subcategory 2.5, A4
Polling/selecting type

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

Communication code: ASCII 7-bit code

Termination resistor: Connected to terminals (RS-485)

Xon/Xoff control:: None

Maximum connections:
RS-422A, RS-485: 32 instruments maximum including a host computer
RS-232C: 1 instrument

Signal logic:
RS-422A, RS-485

Signal voltage	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.

RS-232C

Signal voltage	Logic
+3 V or more	0 (SPACE)
–3 V or less	1 (MARK)

■ Modbus

Interface:
Communication 1: Based on RS-485, EIA standard
Based on RS-232C, EIA standard
Communication 2: Based on RS-485, EIA standard
Based on RS-422A, EIA standard
Based on RS-232C, EIA standard
Specify the communication 1 and communication 2 separately when ordering

Connection method:
2-wire system, half-duplex multi-drop connection (RS-485)
4-wire system, half-duplex multi-drop connection (RS-422A)
3-wire system, point-to-point connection (RS-232C)

Synchronous method:
Half-duplex start-stop synchronous type

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

Data bit configuration:
Data bit: 8 (Byte data corresponding to binary data or bit.)
Parity bit: Without, Odd or Even
Stop bit: 1 or 2 (However, with the parity bit selected: 1 bit fixed)

Protocol:
Modbus

Signal transmission mode:
Remote Terminal Unit (RTU) mode

Function code:
03H (Read holding registers)
06H (Preset single register)
08H (Diagnostics: loopback test)
10H (Preset multiple registers)

Error check method:
CRC-16

Error code:
1: Function code error
2: When any address other than 0000H to 0093H, 0200H to 02E9H, and 0500H to 0535H are specified
3: 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:
Connected to terminals (RS-485)

Maximum connections:
RS-422A, RS-485: 32 instruments maximum including a host computer
RS-232C: 1 instrument

Signal logic:

RS-422A, RS-485

Signal voltage	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.

RS-232C

Signal voltage	Logic
+3 V or more	0 (SPACE)
–3 V or less	1 (MARK)

3. WIRING

> ⚠ WARNING
>
> To prevent electric shock or instrument failure, do not turn on the power until all the wiring is completed.

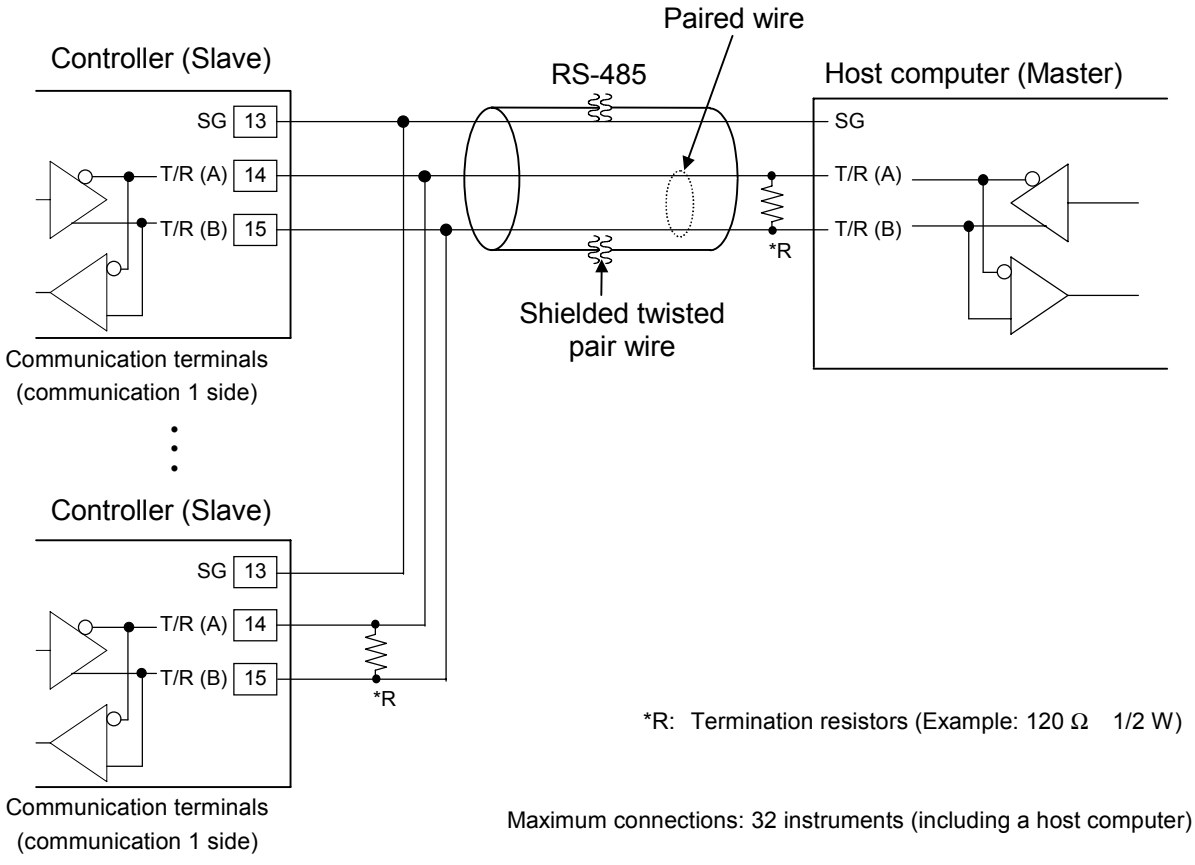
3.1 Connect the Communication 1

■ Connection to the RS-485 port of the host computer (master)

- **Communication terminal number and signal details**

Terminal No.	Signal name	Symbol
13	Signal ground	SG
14	Send data/Receive data	T/R (A)
15	Send data/Receive data	T/R (B)

- **Wiring method**



*R: Termination resistors (Example: 120 Ω 1/2 W)

Maximum connections: 32 instruments (including a host computer)

📖 The cable is provided by the customer.

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

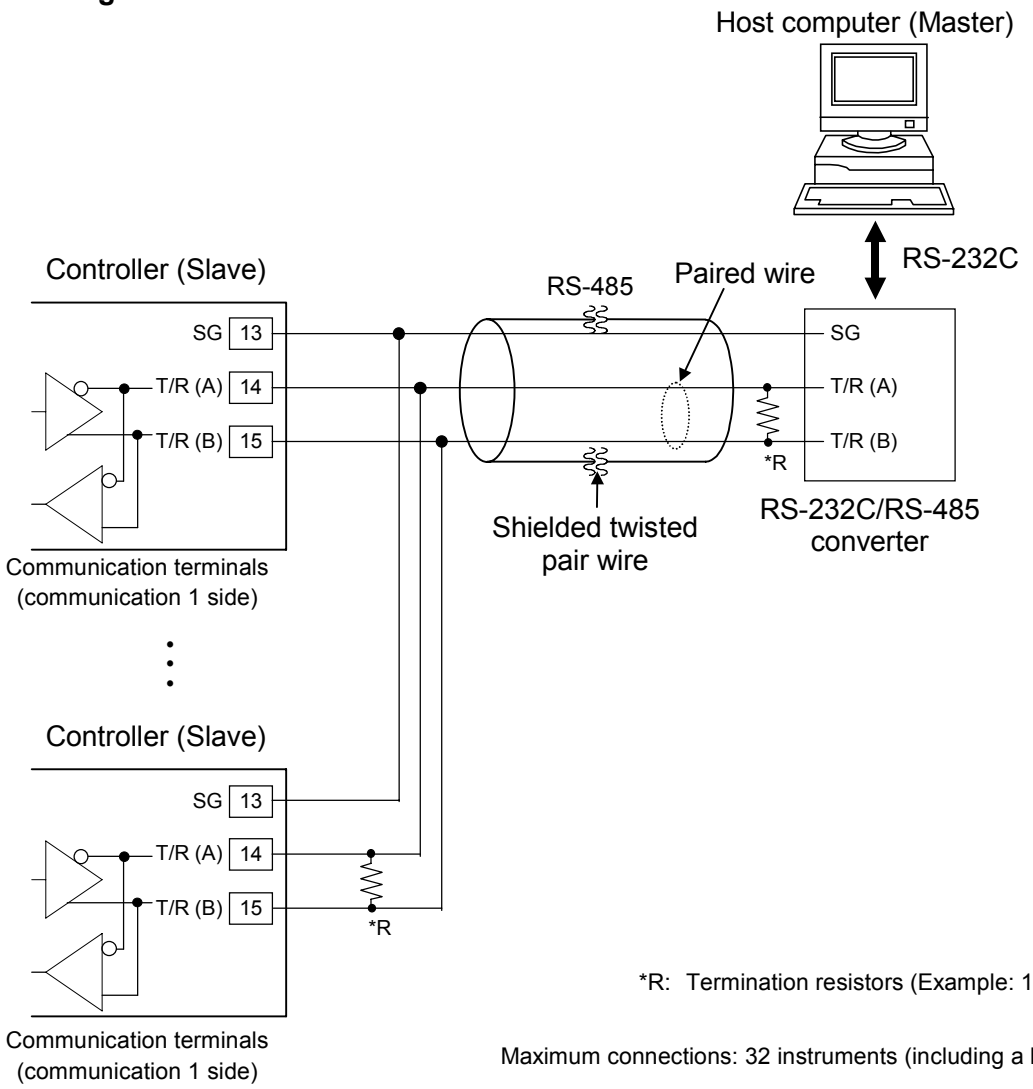
(1) Connection to the RS-485 port of the controller (slave)

A RS-232C/RS-485 converter is required.

- **Communication terminal number and signal details**

Terminal No.	Signal name	Symbol
13	Signal ground	SG
14	Send data/Receive data	T/R (A)
15	Send data/Receive data	T/R (B)

- **Wiring method**



*R: Termination resistors (Example: 120 Ω 1/2 W)

Maximum connections: 32 instruments (including a host computer)

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When the host computer (master) uses Windows 95/98/NT, use a RS-232C/RS-485 converter with an automatic send/receive transfer function.
Recommended: CD485, CD485/V manufactured by Data Link, Inc. or equivalent.

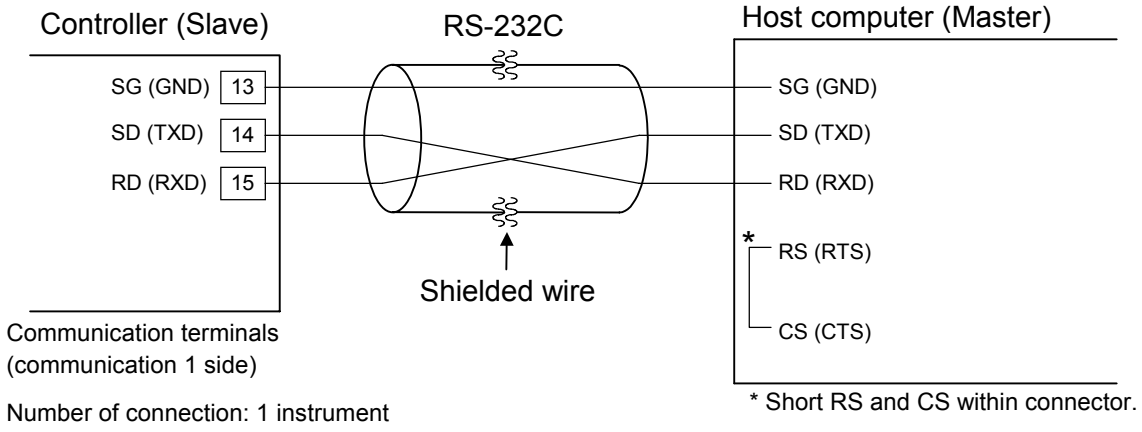
The cable is provided by the customer.

(2) Connection to the RS-232C port of the controller (slave)

- **Communication terminal number and signal details**

Terminal No.	Signal name	Symbol
13	Signal ground	SG (GND)
14	Send data	SD (TXD)
15	Receive data	RD (RXD)

- **Wiring method**



The cable is provided by the customer.

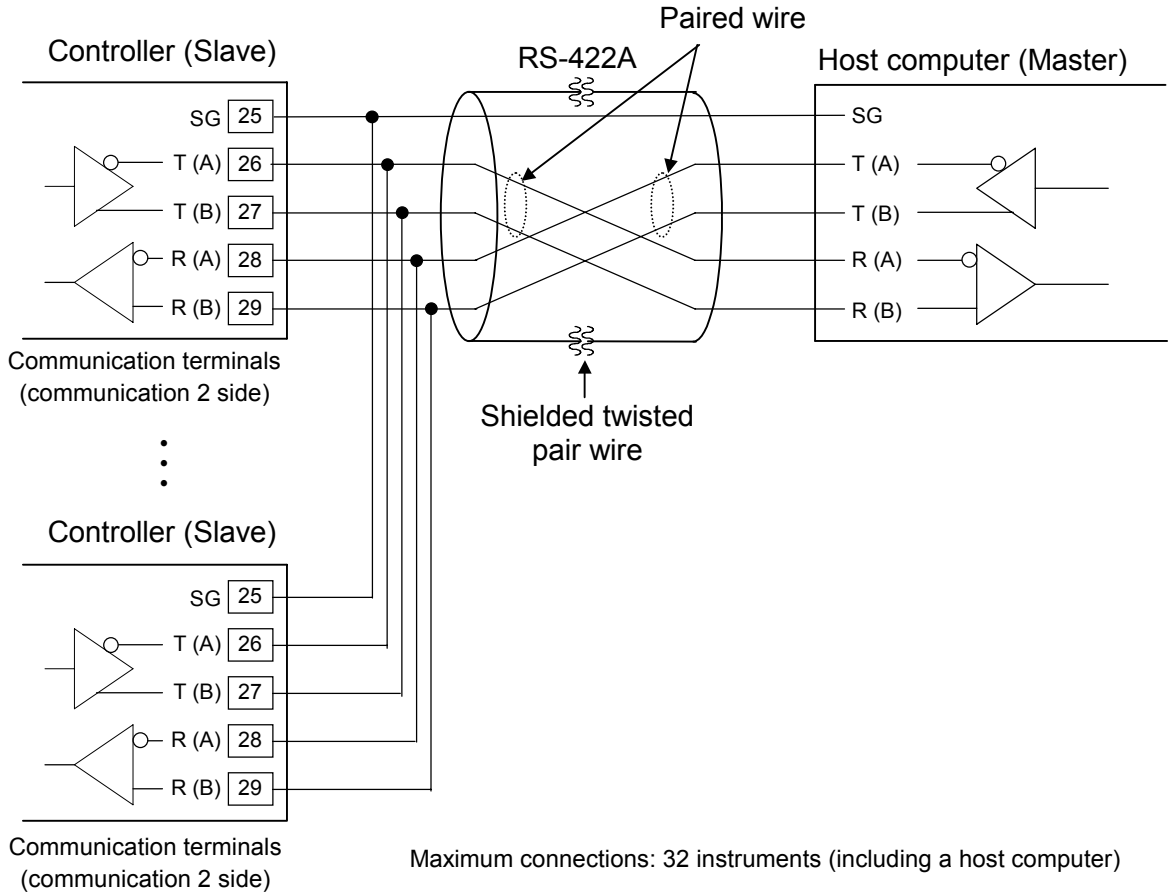
3.2 Connect the Communication 2

■ Connection to the RS-422A port of the host computer (master)

● Communication terminal number and signal details

Terminal No.	Signal name	Symbol
25	Signal ground	SG
26	Send data	T (A)
27	Send data	T (B)
28	Receive data	R (A)
29	Receive data	R (B)

● Wiring method



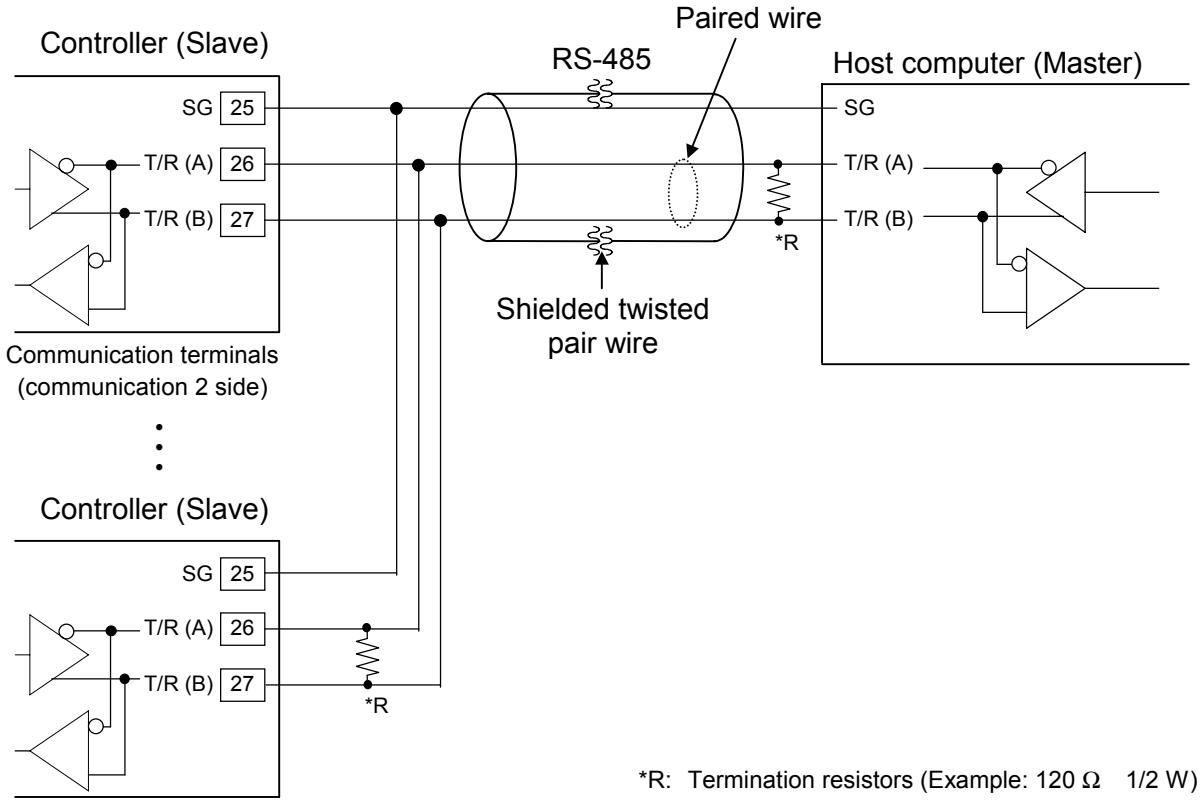
The cable is provided by the customer.

■ Connection to the RS-485 port of the host computer (master)

● Communication terminal number and signal details

Terminal No.	Signal name	Symbol
25	Signal ground	SG
26	Send data/Receive data	T/R (A)
27	Send data/Receive data	T/R (B)

● Wiring method



*R: Termination resistors (Example: 120 Ω 1/2 W)

Maximum connections: 32 instruments (including a host computer)

The cable is provided by the customer.

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

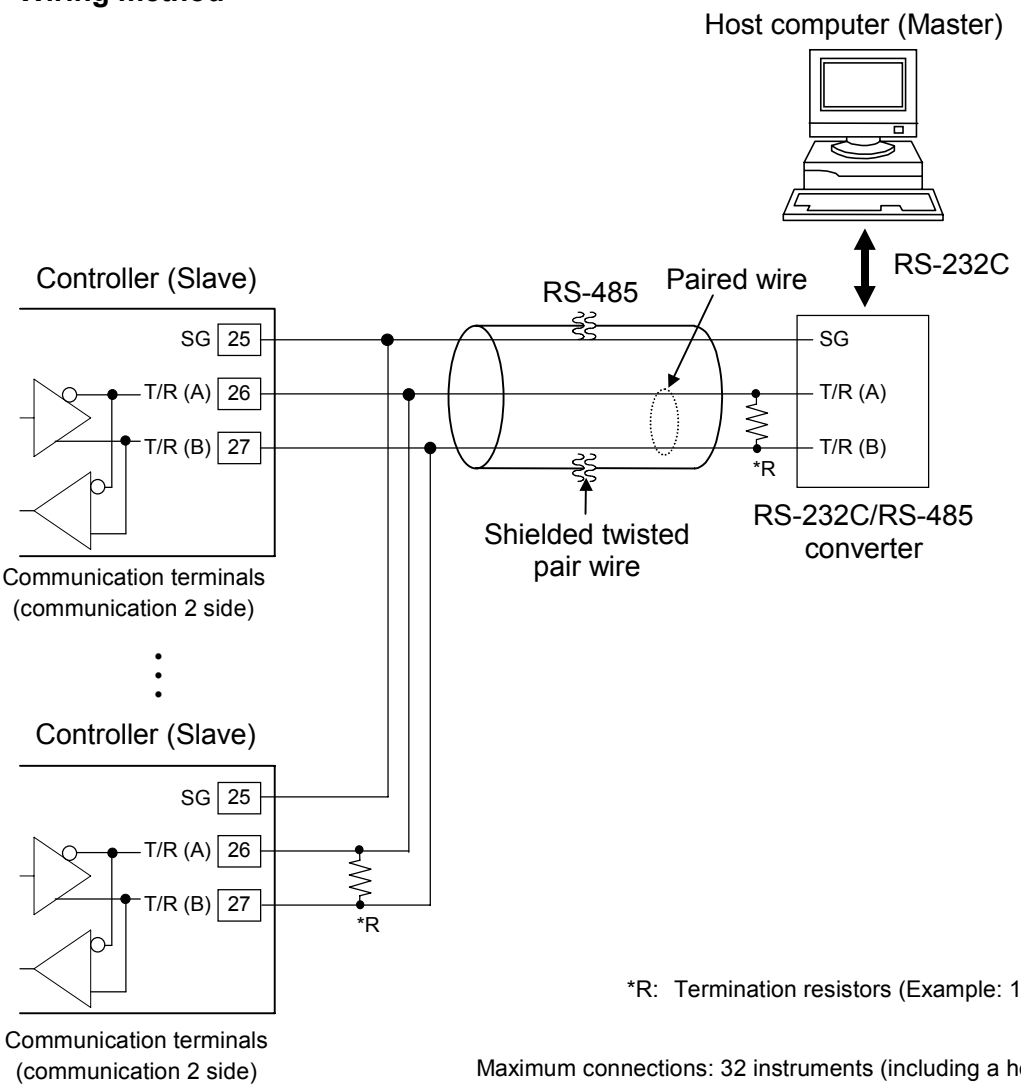
(1) Connection to the RS-485 port of the controller (slave)

A RS-232C/RS-485 converter is required.

- **Communication terminal number and signal details**

Terminal No.	Signal name	Symbol
25	Signal ground	SG
26	Send data/Receive data	T/R (A)
27	Send data/Receive data	T/R (B)

- **Wiring method**



*R: Termination resistors (Example: 120 Ω 1/2 W)

Maximum connections: 32 instruments (including a host computer)

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Continued from the previous page.

When the host computer (master) uses Windows 95/98/NT, use a RS-232C/RS-485 converter with an automatic send/receive transfer function.
Recommended: CD485, CD485/V manufactured by Data Link, Inc. or equivalent.

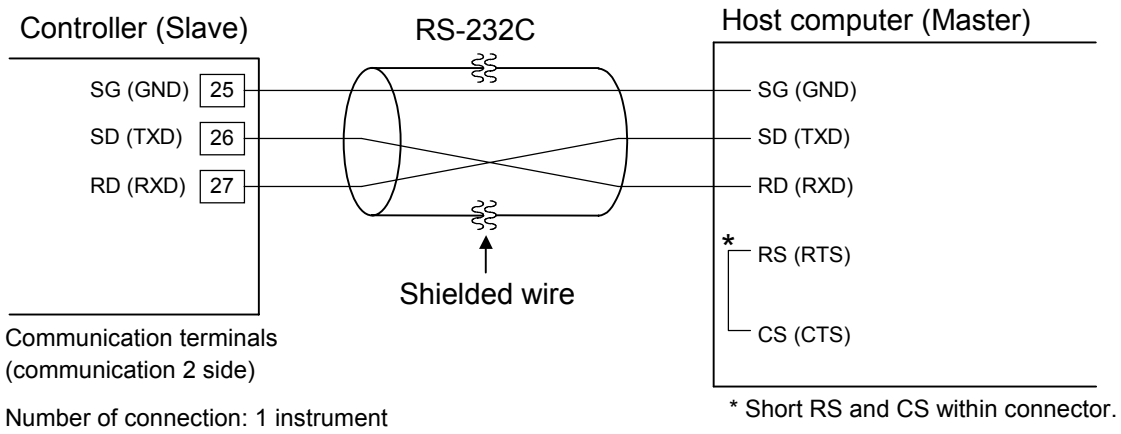
The cable is provided by the customer.

(2) Connection to the RS-232C port of the controller (slave)

- **Communication terminal number and signal details**

Terminal No.	Signal name	Symbol
25	Signal ground	SG (GND)
26	Send data	SD (TXD)
27	Receive data	RD (RXD)

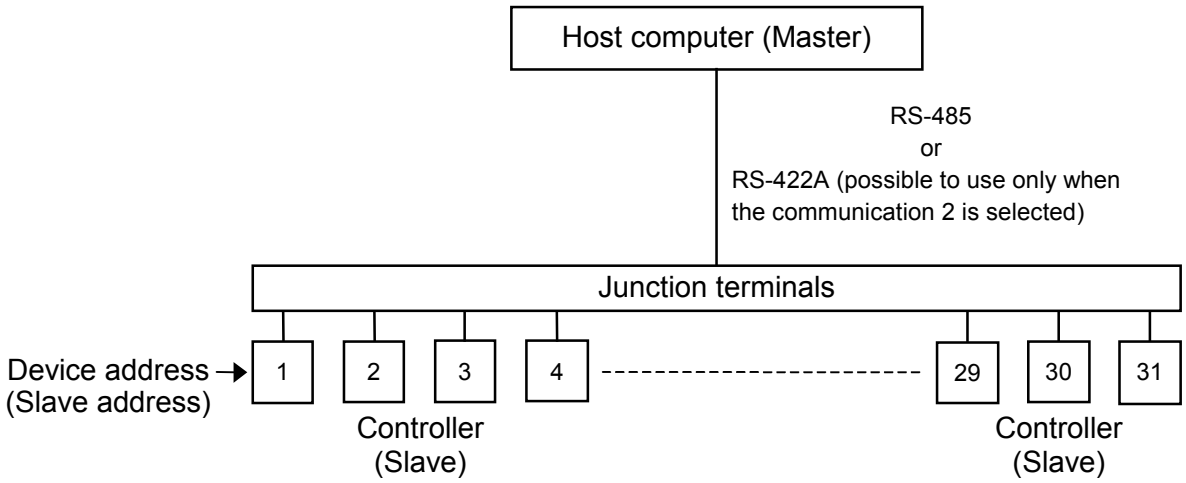
- **Wiring method**



The cable is provided by the customer.

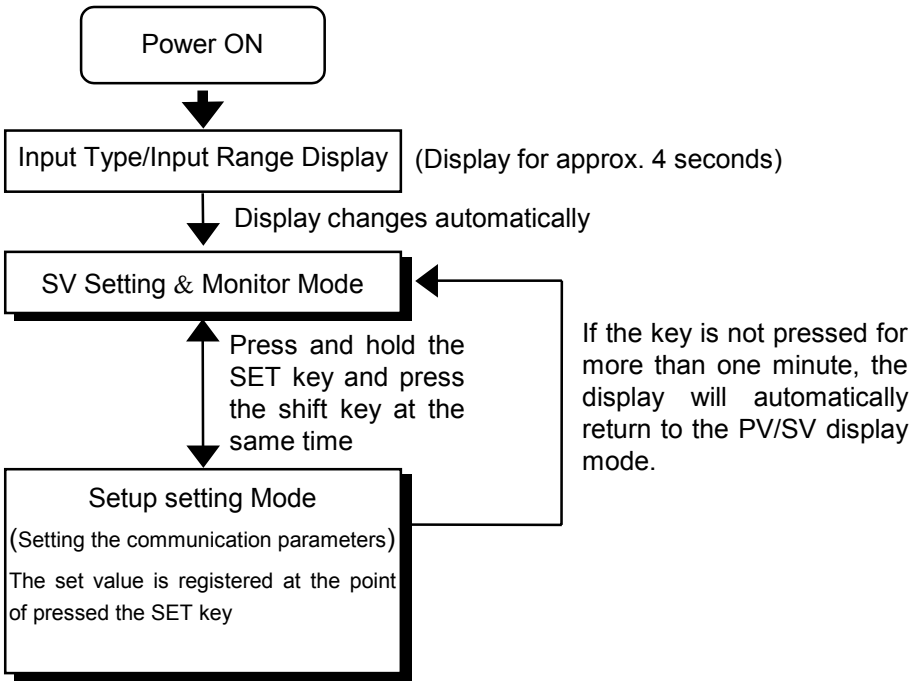
■ Wiring example

Connection with up to 31 controller (slaves) and one host computer (master)



4. SETTING

To establish communication parameters between host computer (master) and controller (slave), it is necessary to set the device address (slave address), communication speed, data bit configuration and interval time on each controller (slave) in the setup setting mode.

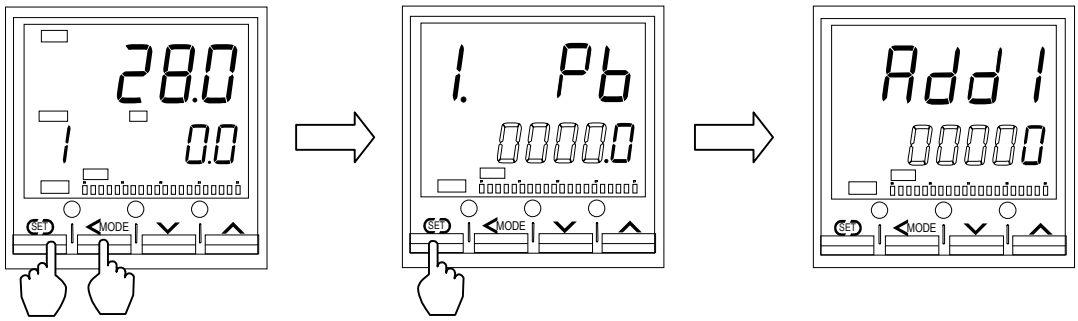


4.1 Transfer to Setup Setting Mode

The first displayed parameter in setup setting mode varies depending on the instrument specification.

This item describes when the first displayed parameter in setup setting mode is the PV bias, *Pb*.

To go the setup setting mode, you must be in SV setting & monitor mode. The first parameter to be displayed will be the Input 1_PV bias, *1. Pb*. Press the SET key several times to change to the device address 1, *Add1*.



SV setting & monitor mode

Setup setting mode
The Input 1_PV bias setting

Device address 1 setting
(Slave address 1)

When let setup setting mode finish, press and hold the SET key and press the shift key at the same time. The display changes to the SV setting & monitor mode.

HA900/HA901 is used in the above figures for explanation, but the same setting procedures also apply to HA400/HA401.

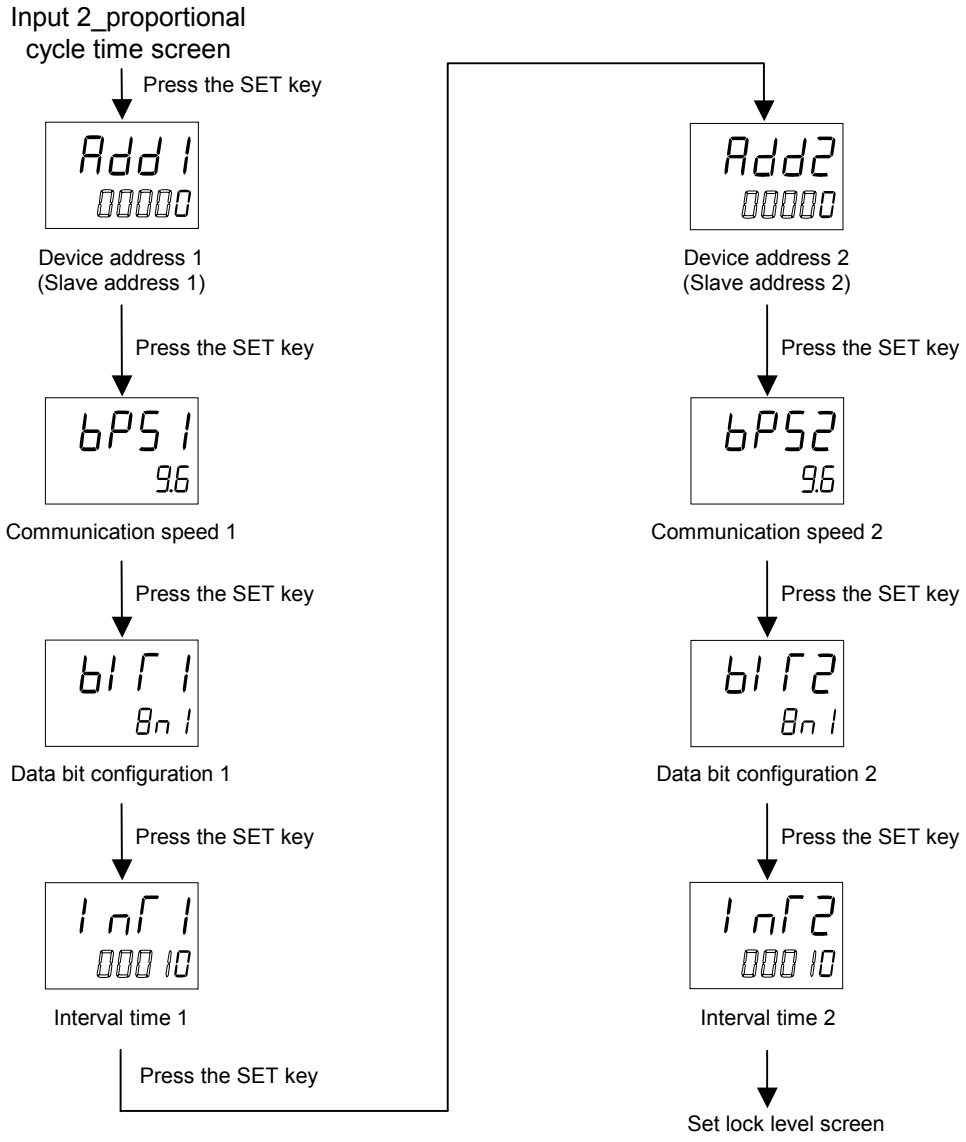
4.2 Setting the Communication Parameters

This item describes when the communication 1 and communication 2 is used under the two input specification.

To select parameters in setup setting mode, press the SET key.
The parameters relating to communication is shown below.

- Communication 1 side: Device address 1 (slave address 1), *Add1*,
  Communication speed 1, *bPS1*,
  Data bit configuration 1, *bIT1*, Interval time 1, *InT1*,
- Communication 2 side: Device address 2 (slave address 2), *Add2*,
  Communication speed 2, *bPS2*,
  Data bit configuration 2, *bIT2*, Interval time 2, *InT2*

To be changed in the above order.



■ Setting procedure

Setting procedures vary depending on the communication parameter.

- Device address, *Add*□, interval time, *InT*□ (□: 1,2)
  Operate UP, DOWN and shift key, and input numerals.
- Communication speed, *bPS*□, data bit configuration, *bIT*□ (□: 1,2)
  Operate UP or DOWN key, and choose one among the displayed set value.

■ Registration of set value

The set value is registered at the point of pressed the SET key. After completing all communication parameter settings, return the SV setting & monitor mode, and communication is mode using the set value changed.

Even if the UP and DOWN key are operated, the contents of the set value changed are not registered.

If the register procedure is not performed for more than one minute, return the Input 1_measured value (PV1)/set value (SV1) monitor screen. In this case, the contents of the set value changed are not registered.

■ Description of each parameters

● Communication 1

Symbol	Name	Setting range	Description	Factory set value
Add 1 (Add1)	Device address 1 (Slave address 1)	0 to 99	Set it not to duplication in multi-drop connection. If the slave address is set to *0* in Modbus, two-way communication cannot be performed.	0
bPS 1 (bPS1)	Communication speed 1	2.4: 2400 bps 4.8: 4800 bps 9.6: 9600 bps 19.2: 19200 bps 38.4: 38400 bps	Set the same communication speed for both the controller (slave) and the host computer (master).	9.6
bIT 1 (bIT1)	Data bit configuration 1	See data bit configuration table	Set the same data bit configuration for both the controller (slave) and the host computer (master).	8n1
InT 1 (InT1)	Interval time 1 *	0 to 250 ms	The controller's interval time must match the specifications of the host computer.	10

● Communication 2

Symbol	Name	Setting range	Description	Factory set value
Add2 (Add2)	Device address 2 (Slave address 2)	0 to 99	Set it not to duplication in multi-drop connection. If the slave address is set to *0* in Modbus, two-way communication cannot be performed.	0
bPS2 (bPS2)	Communication speed 2	2.4: 2400 bps 4.8: 4800 bps 9.6: 9600 bps 19.2: 19200 bps 38.4: 38400 bps	Set the same communication speed for both the controller (slave) and the host computer (master).	9.6
bIT2 (bIT2)	Data bit configuration 2	See data bit configuration table	Set the same data bit configuration for both the controller (slave) and the host computer (master).	8n1
InT2 (InT2)	Interval time 2 *	0 to 250 ms	The controller's interval time must match the specifications of the host computer.	10

Data bit configuration table

Set value	Data bit	Parity bit	Stop bit
8n1 (8n1)	8	Without	1
8n2 (8n2)	8	Without	2
8E1 (8E1)	8	Even	1
8E2 (8E2)	8	Even	2
8o1 (8o1)	8	Odd	1
8o2 (8o2)	8	Odd	2
7n1 (7n1) [1]	7	Without	1
7n2 (7n2) [1]	7	Without	2
7E1 (7E1) [1]	7	Even	1
7E2 (7E2) [1]	7	Even	2
7o1 (7o1) [1]	7	Odd	1
7o2 (7o2) [1]	7	Odd	2

Setting range of Modbus

Setting range of RKC communication

[1] When the Modbus communication protocol selected, this setting becomes invalid.

* The interval time for the controller should be set to provide a time for host computer to finish sending all data including stop bit and to switch the line to receive data. If the interval time between the two is too short, the controller may send data before the host computer is ready to receive it. In this case, communication transmission can not be conducted correctly. For a successful communication sequence to occur, the controller's interval time must match the specifications of the host computer.

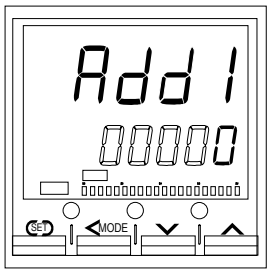
When the "1: Not settable (Lock)" is selected at the "Lock only setting items other than SV and events (EV1 to EV4)" in the set lock level, the communication parameters are not able to change the set values.

For the set lock level, see the **Operation Manual (IMR01N02-J□)**.

■ Setting procedure example

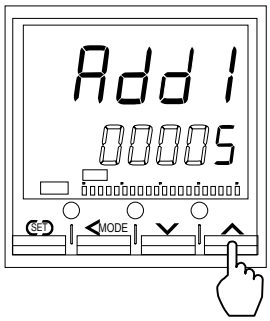
HA900/HA901 is used in the below figures for explanation, but the same setting procedures also apply to HA400/HA401.

1. Go to the setup setting mode so that device address 1 (slave address 1), *Add1*, is displayed. Present set value is displayed, and the least significant digit light brightly.

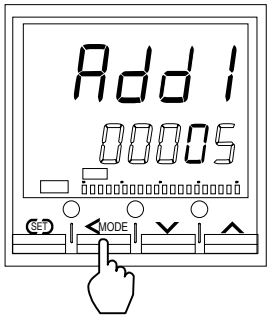


Device address 1 setting
(Slave address 1)

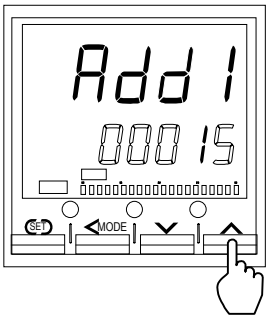
2. Set the device address 1. Press the UP key to enter *5* at the least significant digit.
Example: Setting the device address 1 (slave address 1) to 15.



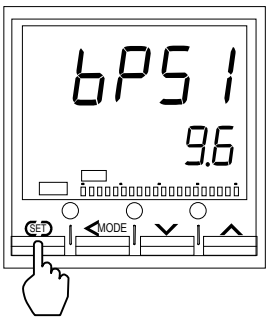
3. Press the shift key to brightly light the tens digit.



4. Press the UP key to enter *1* at the tens digit.



5. Press the SET key to set the value thus set. The display changes to the next communication parameter. It the SET key is not pressed within 1 minute, the present display returns to the SV setting & monitor mode and the value set here returns to that before the setting is changed.



6. After completing all communication parameter settings, return the SV setting & monitor mode, and communication is mode using the set value changed.

4.3 Communication Requirements

■ Processing times during data send/receive

The controller 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 controller to send data:

-Response wait time after controller sends BCC in polling procedure
-Response wait time after controller sends ACK or NAK in selecting procedure

RKC communication (Polling procedure)

Procedure details	Time (ms)		
	MIN	TYP	MAX
Response send time after controller receives ENQ	1	2	4
Response send time after controller receives ACK	1	—	4
Response send time after controller receives NAK	1	—	4
Response send time after controller sends BCC	—	—	1

RKC communication (Selecting procedure)

Procedure details	Time (ms)		
	MIN	TYP	MAX
Response send time after controller receives BCC	1	2	3
Response wait time after controller sends ACK	—	—	1
Response wait time after controller sends NAK	—	—	1

Modbus

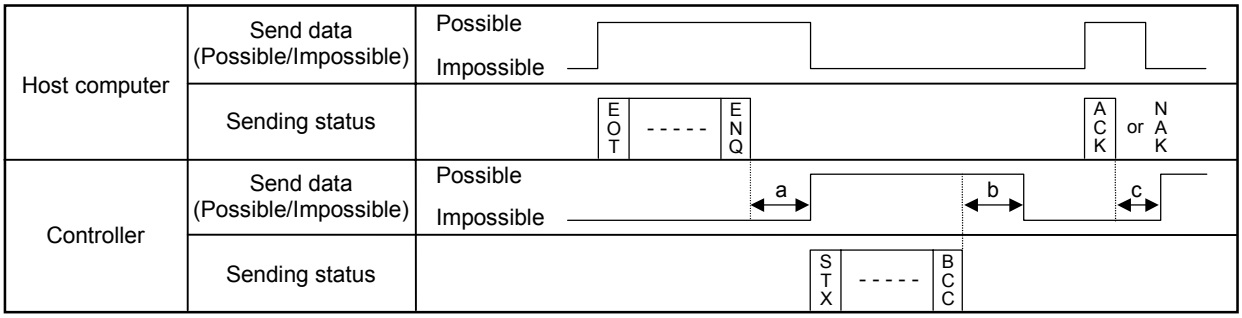
Procedure details	時　間
Read holding registers [03H] Response transmission time after the slave receives the query message	20 ms max.
Preset single register [06H] Response transmission time after the slave receives the query message	3 ms max.
Diagnostics (loopback test) [08H] Response transmission time after the slave receives the query message	3 ms max.
Preset multiple registers [10H] Response transmission time after the slave receives the query message	20 ms max.


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

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

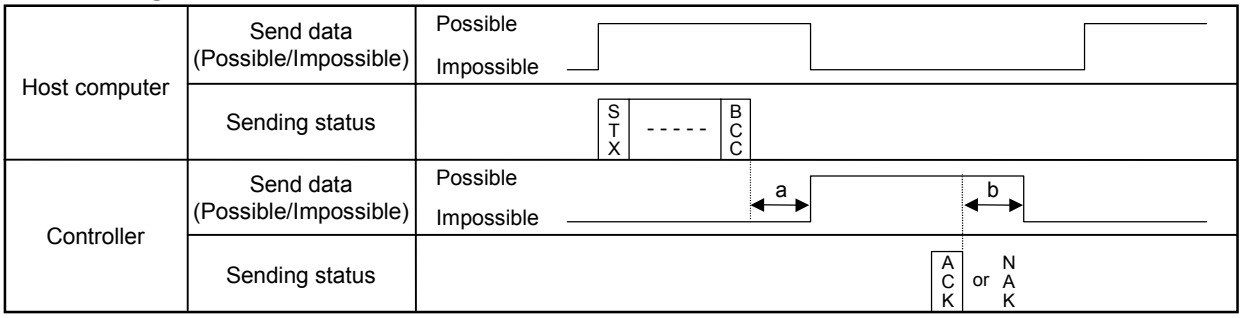
The sending and receiving of RS-485 communication is conducted through two wires; consequently, the transmission and reception of data requires precise timing. Typical polling and selecting procedures between the host computer and the controller are described below:

● Polling procedure



a: Response send time after the controller receives [ENQ] + Interval time
b: Response send time after the controller sends BCC
c: Response send time after the controller receives [ACK] + Interval time or
Response send time after the controller receives [NAK] + Interval time

● Selecting procedure



a: Response send time after the controller receives BCC + Interval time
b: Response wait time after the controller sends ACK or Response wait time after the controller 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 the controller to send data:
-Response wait time after the controller sends BCC in polling procedure
-Response wait time after the controller sends ACK or NAK in selecting procedure

■ RS-422A/RS-485 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.

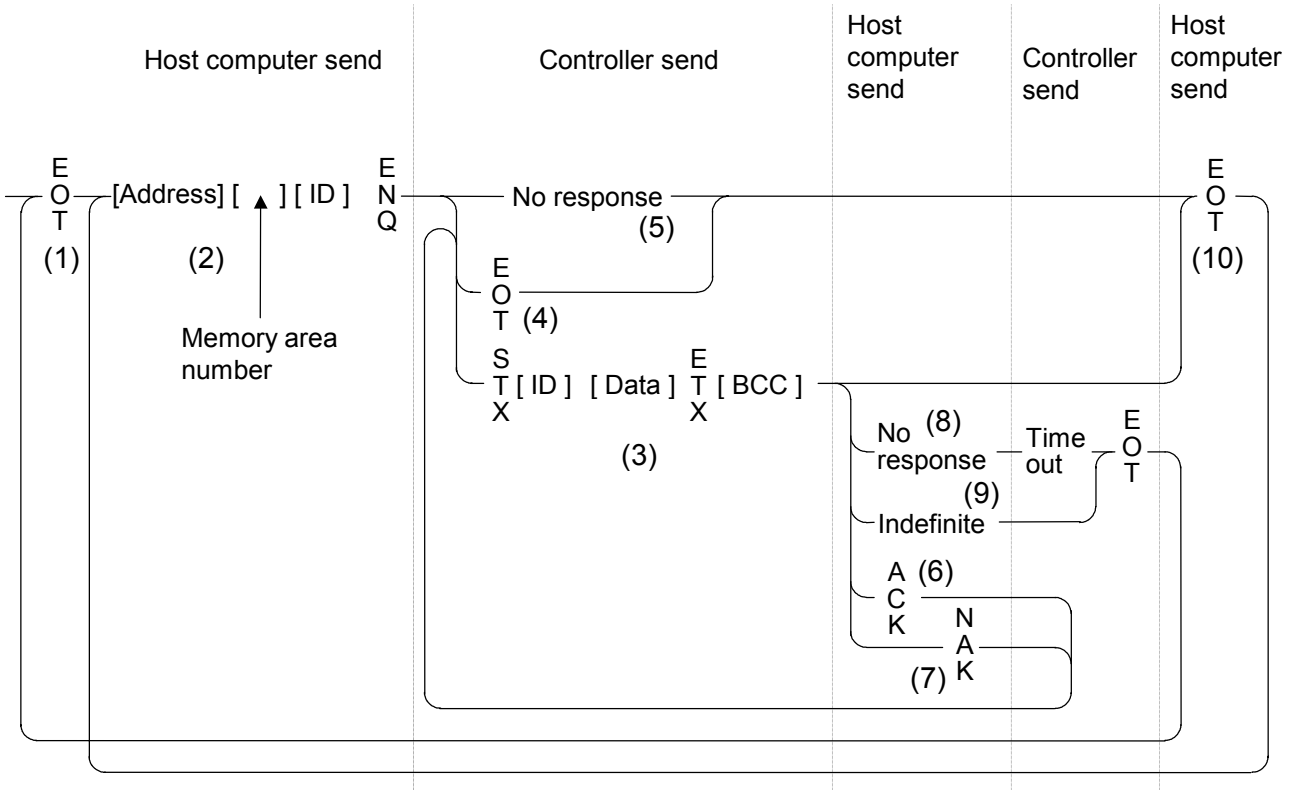
5. RKC COMMUNICATION

The HA400/HA900/HA401/HA901 (hereafter, called 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.

5.1 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

5.1.1 Polling procedures

(1) Data link initialization

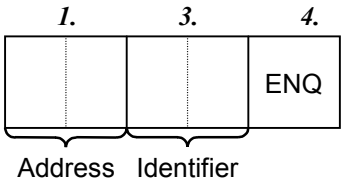
Host computer sends EOT to the controllers to initiate data link before polling sequence.

(2) Data sent from host computer - Polling sequence

The host computer sends the polling sequence in the following two types of formats:
- Format in which no memory area number is specified, and
- Format in which the memory area number is specified.

■ When no memory area number is specified

To be sent in this format for any identifier not corresponding to the memory area.

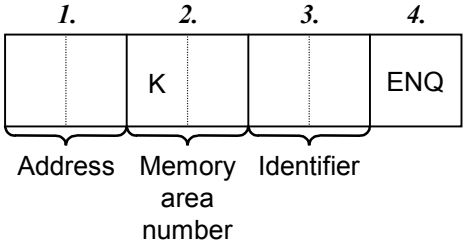


Example:

0	1	M	1	ENQ

■ When the memory area number is specified

To be sent in this format for any identifier corresponding to the memory area.



Example:

0	1	K	1	S	1	ENQ

1. Address (2 digits)

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

☞ For details, see **4.2 Setting the Communication Parameters (P. 15)**.

📖 **Please specify *00* not to omit device address in RS-232C specification.**

📖 The polling address which transmitted a message once becomes effective so long as data link is not initialized by transmit and receive of EOT.

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2. Memory area number (3 digits)
This is the identifier to specify the memory area number. It is expressed by “K01” to “K16” to each memory area number (from 1 to 16). When one column of memory area number (1 to 9) is specified, it can be specified with “K1” to “K9.” In addition, if the memory area number is assigned with “K0” or “K00”, this represents that control area is specified.

- The memory area now used for control is called “Control area.”
- If the memory area number is not specified when polling the identifier corresponding to the memory area, this represents that the control area is specified.
- If any identifier not corresponding to the memory area is assigned with a memory area number, this memory area number is ignored.

3. Identifier (2 digits)
The identifier specifies the type of data that is requested from the controller. Always attach the ENQ code to the end of the identifier.

☞ For details, see **5.4 Communication Items List (P. 38)**.

4. 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.

☞ For details, see **5.4 Communication Items List (P. 38)**.

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3. Data (7 digits)

Data which is indicated by an identifier of the controller, consisting of channel numbers, data, etc. It is expressed in decimal ASCII code including a minus sign (-) and a decimal point. Data is not zero-suppressed.

📖 Only Model codes (ID) , the number of data digits (length) is 32 digits.

📖 Memory area soak time monitor and area soak time become the following data:

- When data range is 0 hour 00 minute 00 second to 9 hours 59 minutes 59 seconds:
  Data range is 0:00:00 to 9:59:59, punctuation of time unit is expressed in colon (:).
- When data range is 0 minute 00.00 second to 9 minutes 59.99 seconds:
  Data range is 0:00.00 to 9:59.99, punctuation of time unit is expressed in colon (:) and period (.).

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 data is not sent from the host computer even if the data link is initialized
- 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 the identifier, see **5.4 Communication Items list (P. 38)**.

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. (Time out: 3 seconds)

(9) Indefinite response from host computer

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

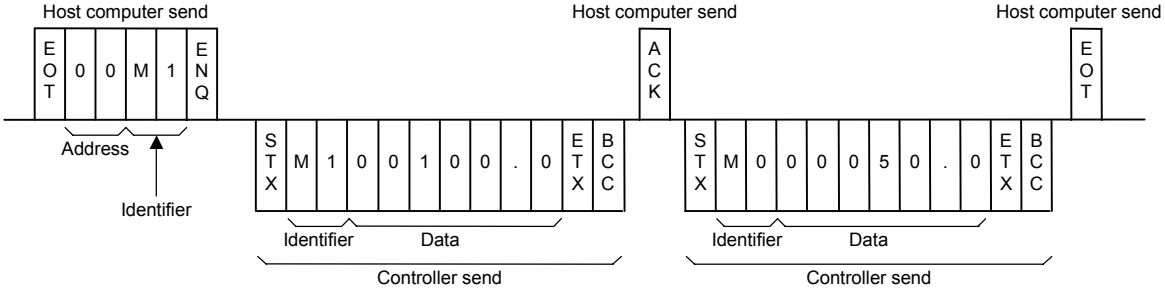
(10) EOT (Data link termination)

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.

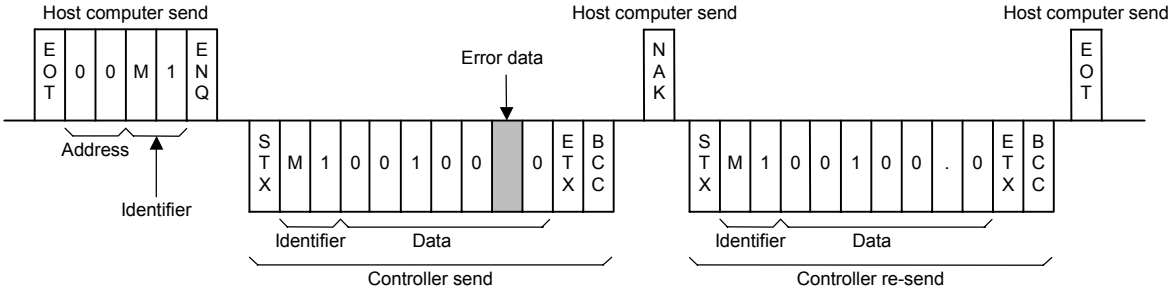
5.1.2 Polling procedure example

(1) When the monitored items is polled [Example: measured value (PV1) monitor M1]

■ **Normal transmission**

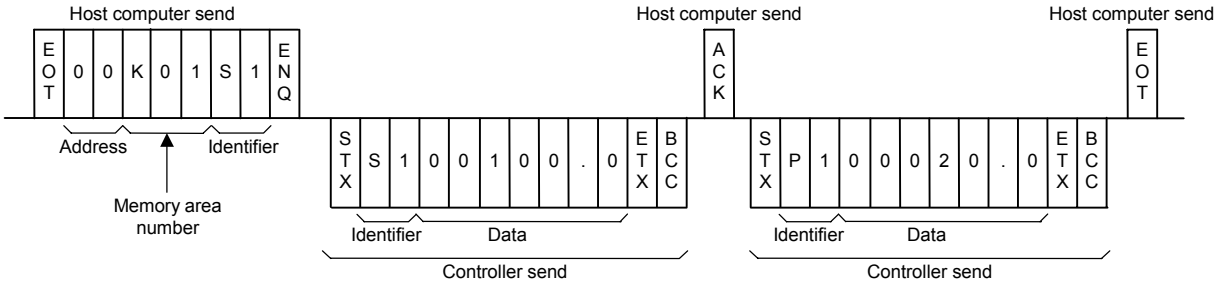


■ **Error transmission**

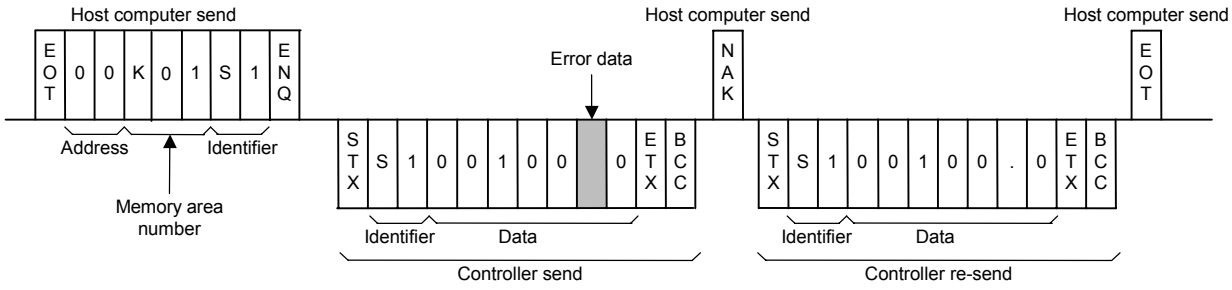


(2) When the items corresponding to the memory area is polled [Example: set value (SV1) S1]

■ **Normal transmission**

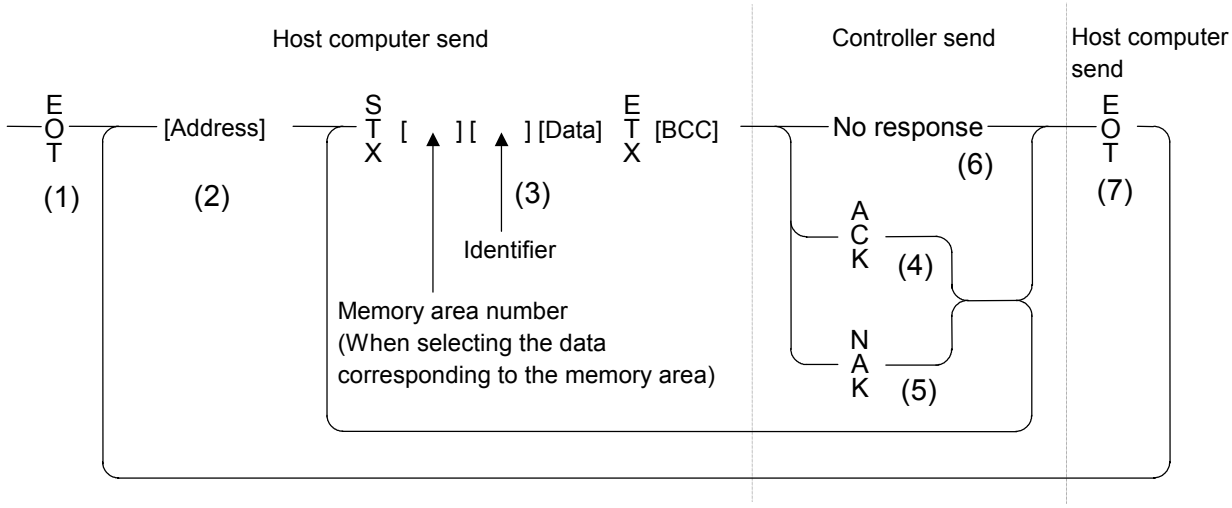


■ **Error transmission**



5.2 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:



5.2.1 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.

■ **Address (2 digits)**

This data is a device address of the controller to be selected and must be the same as the device address set value in item **4.2 Setting the Communication Parameters (P. 15)**.

Specify *00* not to omit device address with the RS-232C specification.

As long as the data link is not initialized by sending or receiving EOT, the selecting address once sent becomes valid.

(3) Data sent from the host computer

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

■ When no memory area number is specified

	2.	*3.*		
STX	Identifier	Data	ETX	BCC

■ When the memory area number is specified

	1.	*2.*	*3.*		
STX	Memory area number	Identifier	Data	ETX	BCC

☞ For the STX, ETX and BCC, see **5.1 Polling (P. 23)**.

1. Memory area number (3 digits)

This is the identifier to specify the memory area number. It is expressed by "K01" to "K16" to each memory area number (from 1 to 16). When one column of memory area number (1 to 9) is specified, it can be specified with "K1" to "K9." In addition, if the memory area number is assigned with "K0" or "K00", this represents that control area is specified.

📖 The memory area now used for control is called "Control area."

📖 If the memory area number is not specified when selecting the identifier corresponding to the memory area, selecting is made to the memory area.

📖 If any identifier not corresponding to the memory area is assigned with a memory area number, this memory area number is ignored.

2. Identifier (2 digits)

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

☞ For details, see **5.4 Communication Items List (P. 38)**.

3. Data

Data which is indicated by an identifier of the controller. It is expressed in decimal ASCII code including a minus sign (–) and a decimal point. The channel number can be zero-suppressed. The number of digits varies depending on the type of identifier. (Within 7 digits)

📖 Area soak time set data as the following:

- When data range is 0 hour 00 minute 00 second to 9 hours 59 minutes 59 seconds: Data range is 0:00:00 to 9:59:59, punctuation of time unit is expressed in colon (:).
- When data range is 0 minute 00.00 second to 9 minutes 59.99 seconds: Data range is 0:00.00 to 9:59.99, punctuation of time unit is expressed in colon (:) and period (.).

In addition to above, when minute and second data are set in more than 60, become as the following:

Example: 0:65.00 (0 minute 65.00 seconds) → 1:05.00 (1 minute 05.00 seconds)
1:65:00 (1 hour 65 minutes 00 second) →
2:05:00 (2 hours 05 minutes 00 second)

- **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.
  (Number of digits: Within 7 digits)
  <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 sends data with decimal point to item of without decimal point, the controller receives a message with the value that cut off below the decimal point.
  <Example> When setting range is 0 to 200, the controller receives as a following.

Send data	0.5	100.5
Receive data	0	100

- The 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, the 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

The 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 the 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, 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.

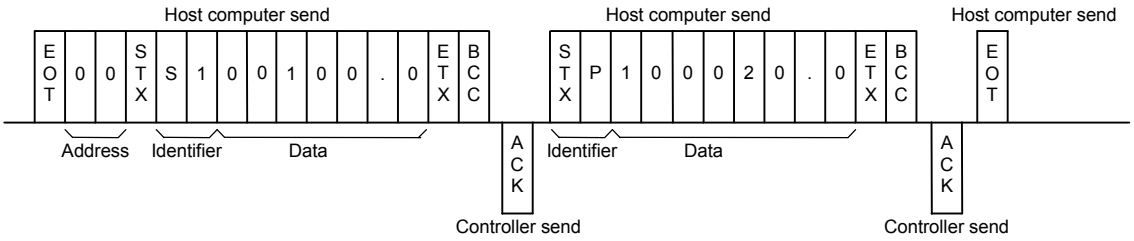
(7) EOT (Data link termination)

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.

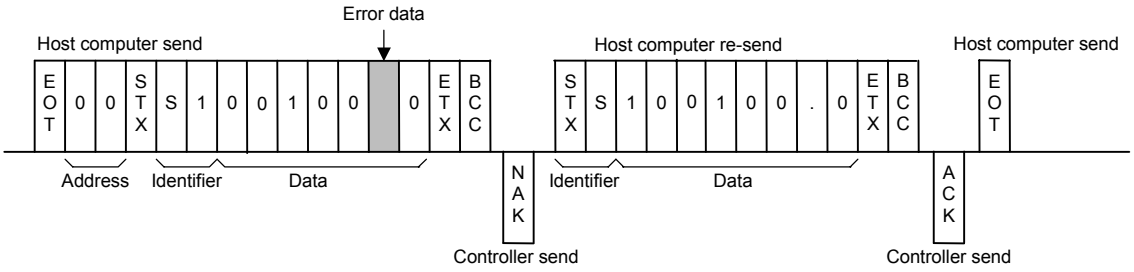
5.2.2 Selecting procedure example

(1) When the items corresponding to the control area is selected [Example: set value (SV1) S1]

■ **Normal transmission**

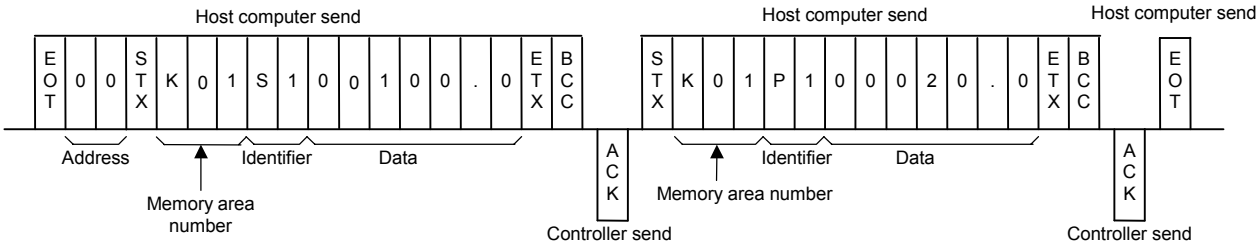


■ **Error transmission**

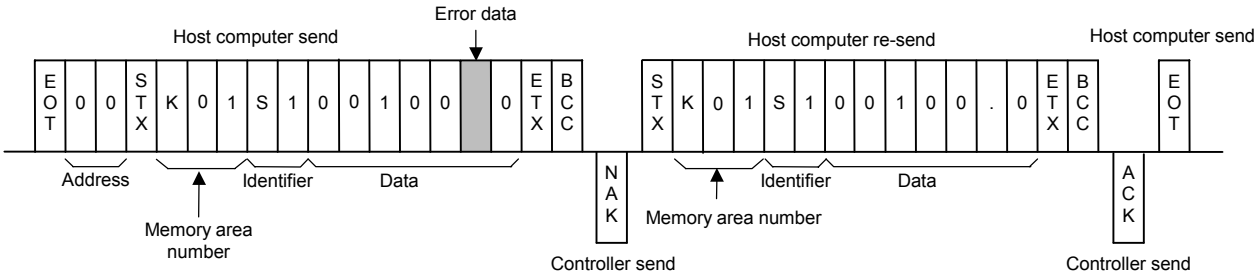


(2) When the items corresponding to the memory area is selected [Example: set value (SV1) S1]

■ **Normal transmission**



■ **Error transmission**



5.3 Examples of Polling and Selecting Check Programs

The following is the sample program for NEC PC-9800 series computers in BASIC language for carrying out polling and selecting checking by RS-232C specification. There will be some differences in the computer languages according to the type of computer. Before executing the program, confirm that there is no mistake in the wiring of the communications cable and check that the instrument data bit configuration is set to *8* for data bit and *Without* for parity bit. In addition, the communications speed setting should be set to match the host computer speed setting.

When this program example is used for RS-485, the automatic sending/receiving selection type of RS-232C/RS-485 is required.
(Recommended: CD485, CD485/V manufactured by Data Link, Inc. or equivalent.)

5.3.1 Example of temperature set values polling check program

```
1000 '---------- Identifier setting ----------                    
1010   ID$="S1"                                                   Identifier setting
1020 '
1030 '---------- Communications initial setting ----------
1040 CM$="N81NN"                                                  Communications data configuration setting
1050 INPUT " Device address=";ADD$                                Device address input
1060 STX$=CHR$(&H2) : EOT$=CHR$(&H4) : ENQ$=CHR$(&H5)             Communications character setting
1070 ACK$=CHR$(&H6) : NAK$=CHR$(&H15): ETX$=CHR$(&H3)
1080 OPEN "COM1:"+CM$   AS #1                                     Open RS-232C circuit
1090 CONSOLE ,,,1
1100 COLOR 7:CLS 3
1110 '
1120 '---------- Program main routine ----------
1130 *POL
1140      PRINT "            (Polling check)            "
1150      PRINT "********** Receiving the set values **********"
1160      PRINT "                                                "
1170      DT$=EOT$+ADD$+ID$+ENQ$                                  Data configuration setting
1180      GOSUB *TEXT
1190      GOSUB *RXDT
1200 '
1210 *J10
1220      J=0
1230 '
1240 *IF1
1250      IF LOC(1)=0 THEN J=J+1:IF J<500 THEN *IF1 ELSE PRINT "  Setting of the receiving waiting time [1]
TIME OUT ":END                                                    (Timeout processing)
1260 '
1270      K$=INPUT$(1,#1)
1280           IF K$=ETX$ GOTO *ETXRX                             Communications condition checking
1290           IF K$=NAK$ THEN PRINT "     NAK":END
1300           IF K$=EOT$ THEN PRINT "     EOT":END
1310           IF K$=ACK$ THEN PRINT "     ACK":END
```

[1] Setting of the receiving waiting time:
If time out occurs in using high speed computer (Except no response), the numeral value of *500* in the program should be changed to an appropriately-sized numeral value.

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```
1320 '
1330      DT$=DT$+K$
1340      GOTO *J10
1350 '
1360 *ETXRX
1370      DT$=DT$+K$
1380            BCCRX$=INPUT$(1,#1)
1390            BCCRX=ASC(BCCRX$)                    BCC checking
1400            GOSUB *BCCCH
1410      IF BCC<>BCCRX THEN GOSUB *NAKTX
1420      IF BCC<>BCCRX THEN GOSUB *RXDT: GOTO *J10
1430 '
1440      PRINT "Data has been correctly received"   Display of received data and
1450      PRINT "Received data=";DT$ : END           closing of RS-232C circuit
1460 '
1470 '---------------------- Sub-routine ----------------------
1480 '
1490 *NAKTX                                          Processing on occurrence of a BCC error
1500      PRINT "BCC error"
1510      DT$=NAK$
1520            GOSUB *TEXT
1530      RETURN
1540 '
1550 *RXDT
1560      DT$=""                                     Clearing of circuit buffer
1570      RETURN
1580 '
1590 *TEXT
1600      PRINT #1,DT$;                              Transfer of polling identifier
1610      RETURN
1620 '
1630 *BCCCH                                          BCC calculation
1640      FOR II=1 TO LEN(DT$)
1650            BCCA$=MID$(DT$,II,1)
1660            IF BCCA$=STX$ THEN BCC=0 : GOTO *IINEXT
1670            BCC=BCC XOR ASC(BCCA$)
1680 *IINEXT
1690      NEXT II
1700      RETURN
```

5.3.2 Example of temperature set values selecting checking program

```
1000 '---------- Identifier setting ----------                    
1010   ID$="S1"                                                   Identifier setting
1020 '
1030 '---------- Communications initial setting ----------
1040 CM$="N81NN"                                                  Communications data configuration setting
1050 STX$=CHR$(&H2) : EOT$=CHR$(&H4) : ENQ$=CHR$(&H5)             Communications character setting
1060 ACK$=CHR$(&H6) : NAK$=CHR$(&H15): ETX$=CHR$(&H3)
1070 OPEN "COM1:"+CM$    AS #1                                    Opening of RS-232C circuit
1080 CONSOLE ,,,1
1090 COLOR 7:CLS 3
1100 '
1110 '---------- Program main routine ----------
1120 *SEL
1130      PRINT "          (Selection check)          "
1140      PRINT "********** Transmission of set values **********"
1150      PRINT "
1160      INPUT "Device address=";ADD$                            Input of the device address,
          :INPUT "Set value=";S$                                  and the temperature set value
1170      DT$=EOT$+ADD$+STX$+Z$+C$+" "+S$+ETX$                    Data configuration setting 1
1180      PRINT "Transmitting data=";DT$                          Display of transmitting data
1190      GOSUB *BCCCH
1200      DT$=DT$+CHR$(BCC)                                       Data configuration setting 2
1210      GOSUB *TEXT
1220      GOSUB *RXDT
1230 '
1240 *J20
1250      J=0
1260 '
1270 *IF2
1280      IF LOC(1)=0 THEN J=J+1:IF J<500 THEN *IF2 ELSE PRINT " TIME   Setting of the receiving waiting time [1]
          OUT ":END                                               (Timeout processing)
1290 '
1300      K$=INPUT$(1,#1)                                         Communications condition check,
1310      IF K$=NAK$ THEN PRINT "      NAK":END                   Display of communication result,
1320      IF K$=ACK$ THEN PRINT "Control unit has received the data"  and closing of RS-232C circuit
          :END
1330 '
1340 '
1350 '
```

[1] Setting of the receiving waiting time:
If time out occurs in using high speed computer (Except no response), the numeral value of *500* in the program should be changed to an appropriately-sized numeral value.

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```
1360 '---------------------- Sub-routine ----------------------
1370 '
1380 *RXDT'
1390       DT$=""                                              Clearing of circuit buffer
1400       RETURN
1410 '
1420 *TEXT
1430       PRINT #1,DT$;
1440       RETURN                                              Transfer of selection data
1450 '
1460 *BCCCH                                                    BCC calculation
1470       FOR II=1 TO LEN(DT$)
1480             BCCA$=MID$(DT$,II,1)
1490             IF BCCA$=STX$ THEN BCC=0 : GOTO *IINEXT
1500             BCC=BCC XOR ASC(BCCA$)
1510 *IINEXT
1520       NEXT II
1530       RETURN
```

5.4 Communication Items List

RO: Read only R/W: Read and Write

No.	Name	Identifier	Attribute	Data range	Factory set value	Reference page
1	Model codes	**ID**	RO	Model character codes	—	P. 100
2	Input 1_ measured value (PV1) monitor	**M1**	RO	Input 1_input scale low to Input 1_input scale high	—	P. 100
3	Input 2_ measured value (PV2) monitor	**M0**	RO	Input 2_input scale low to Input 2_input scale high	—	P. 100
4	Feedback resistance input value monitor	**M2**	RO	0.0 to 100.0 %	—	P. 100
5	Current transformer input value 1 (CT1) monitor	**M3**	RO	0.0 to 30.0 A or 0.0 to 100.0 A	—	P. 101
6	Current transformer input value 2 (CT2) monitor	**M4**	RO	0.0 to 30.0 A or 0.0 to 100.0 A	—	P. 101
7	Input 1_ set value (SV1) monitor	**MS**	RO	Input 1_setting limiter (low limit) to Input 1_setting limiter (high limit)	—	P. 101
8	Input 2_ set value (SV2) monitor	**MT**	RO	Input 2_setting limiter (low limit) to Input 2_setting limiter (high limit)	—	P. 101
9	Remote input value monitor	**S2**	RO	Input 1_setting limiter (low limit) to Input 1_setting limiter (high limit)	—	P. 102
10	Cascade monitor	**KH**	RO	Input 2_ setting limiter (low limit) to Input 2_ setting limiter (high limit)	—	P. 102
11	Input 1_burnout state	**B1**	RO	0: OFF 1: ON	—	P. 102
12	Input 2_burnout state	**B0**	RO	0: OFF 1: ON	—	P. 102
13	Feedback resistance input burnout state	**B2**	RO	0: OFF 1: ON	—	P. 103
14	Event 1 state	**AA**	RO	0: OFF 1: ON	—	P. 103
15	Event 2 state	**AB**	RO	0: OFF 1: ON	—	P. 103
16	Event 3 state	**AC**	RO	0: OFF 1: ON	—	P. 103
17	Event 4 state	**AD**	RO	0: OFF 1: ON	—	P. 103

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No.	Name	Identifier	Attribute	Data range	Factory set value	Reference page
18	Heater break alarm 1 (HBA1) state	**AE**	RO	0: OFF 1: ON	—	P. 104
19	Heater break alarm 2 (HBA2) state	**AF**	RO	0: OFF 1: ON	—	P. 104
20	Input 1_ manipulated output value (MV1) monitor	**O1**	RO	−5.0 to +105.0 %	—	P. 104
21	Input 2_ manipulated output value (MV2) monitor	**O0**	RO	−5.0 to +105.0 %	—	P. 104
22	Error codes	**ER**	RO	1: Adjustment data error 2: EEPROM error 4: A/D conversion error 8: RAM check error 16: Hard configuration error 32: Soft configuration error 128: Watchdog timer error 2048: Program busy	—	P. 105
23	Event input state	**L1**	RO	Least significant digit (DI 1) : 0: Open, 1: Close 2nd digit (DI2) : 0: Open, 1: Close 3rd digit (DI3) : 0: Open, 1: Close 4th digit (DI4) : 0: Open, 1: Close 5th digit (DI5) : 0: Open, 1: Close 6th digit (DI6) : 0: Open, 1: Close Most significant digit (DI7) : 0: Open, 1: Close	—	P. 106

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
24	Operation mode state	**L0**	RO	Least significant digit: 1: Control STOP 2nd digit: 1: Control RUN 3rd digit: 1: Input 1_Manual mode (Including Input 1_Remote mode) 4th digit: 1: Input 2_Manual mode (Including Input 2_Remote mode) 5th digit: 1: Remote mode or Cascade control 6th digit to Most significant digit: Unused	—	P. 107
25	Memory area soak time monitor	**TR**	RO	0 minute 00.00 second to 9 minutes 59.99 seconds or 0 hour 00 minute 00 second to 9 hours 59 minutes 59 seconds	—	P. 108
26	Input 1_PID/AT transfer	**G1**	R/W	0: PID control 1: Autotuning (AT)	0	P. 108
27	Input 2_PID/AT transfer	**G0**	R/W	0: PID control 1: Autotuning (AT)	0	P. 108
28	Input 1_Auto/Manual transfer	**J1**	R/W	0: Input 1_Auto mode 1: Input 1_Manual mode	0	P. 110
29	Input 2_Auto/Manual transfer	**J0**	R/W	0: Input 2_Auto mode 1: Input 2_Manual mode	0	P. 110
30	Remote/Local transfer	**C1**	R/W	0: Local mode 1: Remote mode or Cascade control	0	P. 111
31	RUN/STOP transfer	**SR**	R/W	0: Control RUN 1: Control STOP	0	P. 111
32	Memory area selection	**ZA**	R/W	1 to 16	1	P. 111
33	Event 1 set value	**A1**	R/W	Deviation: −Input span to +input span Process/SV: Input scale low to input scale high	50.0	P. 112
34	Event 2 set value	**A2**	R/W	Deviation: −Input span to +input span Process/SV: Input scale low to input scale high	50.0	P. 112

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
35	Event 3 set value	**A3**	R/W	Deviation: −Input span to +input span Process/SV: Input scale low to input scale high	50.0	P. 112
36	Control loop break alarm 1 (LBA1) time	**A5**	R/W	0: OFF (Not provided) 1 to 7200 seconds	480	P. 113
37	LBA1 deadband	**N1**	R/W	0.0 to input span	0.0	P. 113
38	Event 4 set value	**A4**	R/W	Deviation: −Input span to +input span Process/SV: Input scale low to input scale high	50.0	P. 112
39	Control loop break alarm 2 (LBA2) time	**A6**	R/W	0: OFF (Not provided) 1 to 7200 seconds	480	P. 113
40	LBA2 deadband	**N2**	R/W	0.0 to input span	0.0	P. 113
41	Input 1_set value (SV1)	**S1**	R/W	Input 1_setting limiter (low limit) to input 1_setting limiter (high limit)	0.0	P. 116
42	Input 1_proportional band	**P1**	R/W	TC/RTD input: 0 to input span Voltage/current input: 0.0 to 1000.0 % of input span	30.0	P. 116
43	Input 1_integral time	**I1**	R/W	0.0 to 3600.0 seconds or 0.00 to 360.00 seconds (0.0 or 0.00: PD action)	240.00	P. 117
44	Input 1_derivative time	**D1**	R/W	0.0 to 3600.0 seconds or 0.00 to 360.00 seconds (0.0 or 0.00: PI action)	60.00	P. 117
45	Input 1_control response parameter	**CA**	R/W	0: Slow 1: Medium 2: Fast	0	P. 118
46	Input 2_set value (SV2)	**S0**	R/W	Input 2_setting limiter (low limit) to input 2_setting limiter (high limit)	0.0	P. 116

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
47	Input 2_proportional band	**P0**	R/W	TC/RTD input: 0 to input span Voltage/current input: 0.0 to 1000.0 % of input span	30.0	P. 116
48	Input 2_integral time	**I0**	R/W	0.0 to 3600.0 seconds or 0.00 to 360.00 seconds (0.0 or 0.00: PD action)	240.00	P. 117
49	Input 2_derivative time	**D0**	R/W	0.0 to 3600.0 seconds or 0.00 to 360.00 seconds (0.0 or 0.00: PI action)	60.00	P. 117
50	Input 2_control response parameter	**C9**	R/W	0: Slow 1: Medium 2: Fast	0	P. 118
51	Input 1_setting change rate limiter (up)	**HH**	R/W	0.0: OFF (Not provided) 0.1 to input span/one minute	0.0	P. 119
52	Input 1_setting change rate limiter (down)	**HL**	R/W	0.0: OFF (Not provided) 0.1 to input span/one minute	0.0	P. 119
53	Input 2_setting change rate limiter (up)	**HX**	R/W	0.0: OFF (Not provided) 0.1 to input span/one minute	0.0	P. 119
54	Input 2_setting change rate limiter (down)	**HY**	R/W	0.0: OFF (Not provided) 0.1 to input span/one minute	0.0	P. 119
55	Area soak time	**TM**	R/W	0 minute 00.00 second to 9 minutes 59.99 seconds or 0 hour 00 minute 00 second to 9 hours 59 minutes 59 seconds	0.00.00	P. 121
56	Link area number	**LP**	R/W	0: OFF (No link) 1 to 16	0	P. 122
57	Heater break alarm 1 (HBA1) set value	**A5**	R/W	0.0: OFF (Not provided) 0.1 to 30.0 A or 0.1 to 100.0 A	0.0	P. 123
58	Heater break alarm 2 (HBA2) set value	**A6**	R/W	0.0: OFF (Not provided) 0.1 to 30.0 A or 0.1 to 100.0 A	0.0	P. 123
59	Input 1_PV bias	**PB**	R/W	−Input span to +input span	0	P. 124

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
60	Input 1_PV digital filter	**F1**	R/W	0: OFF (Not provided) 0.01 to 10.00 seconds	Note1	P. 124
61	Input 1_PV ratio	**PR**	R/W	0.500 to 1.500	1.000	P. 125
62	Input 1_PV low input cut-off	**DP**	R/W	0.00 to 25.00 % of input span	0.00	P. 126
63	Input 1_proportional cycle time	**T0**	R/W	0.1 to 100.0 seconds Other outputs: Voltage pulse output and triac output	Note2	P. 127
64	Input 1_manipulated output value	**ON**	R/W	Input 1_output limiter (low limit) to Input 1_output limiter (high limit)	0	P. 127
65	Input 2_PV bias	**PA**	R/W	−Input span to +input span	0	P. 124
66	Input 2_PV digital filter	**F0**	R/W	0: OFF (Not provided) 0.01 to 10.00 seconds	Note1	P. 124
67	Input 2_PV ratio	**PQ**	R/W	0.500 to 1.500	1.000	P. 125
68	Input 2_PV low input cut-off	**DO**	R/W	0.00 to 25.00 % of input span	0.00	P. 126
69	Input 2_proportional cycle time	**T2**	R/W	0.1 to 100.0 seconds Other outputs: Voltage pulse output and triac output	Note2	P. 127
70	Input 2_manipulated output value	**OM**	R/W	Input 2_output limiter (low limit) to Input 2_output limiter (high limit)	0.0	P. 127
71	Set lock level	**LK**	R/W	Least significant digit: Lock only setting items other than SV and events (EV1 to EV4). 0: Settable, 1: Not settable (Lock) 2nd digit: Lock only events (EV1 to EV4). 0: Settable, 1: Not settable (Lock) 3rd digit: Lock only set value (SV). 0: Settable, 1: Not settable (Lock) 4th digit to Most significant digit: Unused	0	P. 128

Note1 HA400/HA900: 0.00 HA401/HA901: 1.00
Note2 Relay contact output: 20.0 sec Other outputs: 2.0 sec

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
72	EEPROM storage state	**EM**	RO	0: The content of the EEPROM does not coincide with that of the RAM. 1: The content of the EEPROM coincides with that of the RAM.	—	P. 129
73	EEPROM storage mode	**EB**	R/W	0: Set values are store to the EEPROM when set values are changed. 1: Not set values are store to the EEPROM when set values are changed.	0	P. 129
74	STOP display selection	**DX**	R/W	0: Displays on the measured value (PV1/PV2) unit 1: Displays on the set value (SV) unit	0	P. 130
75	Bar graph display selection	**DA**	R/W	0: No display 1: Input 1_ manipulated output value (MV) 2: Input 1_measured value (PV) 3: Input 1_set value (SV) 4: Input 1_deviation value 5: Feedback resistance input value (POS) 6: Input 2_ manipulated output value (MV) 7: Input 2_measured value (PV) 8: Input 2_set value (SV) 9: Input 2_deviation value	0	P. 131
76	Bar graph resolution setting	**DE**	R/W	1 to 100 digit/dot	100	P. 132
77	Auto/Manual transfer key operation selection (A/M)	**DK**	R/W	0: No direct key operation 1: Auto/Manual transfer for input 1 2: Auto/Manual transfer for input 2 3: Auto/Manual transfer for input 1 and input 2	3	P. 132
78	Remote/Local transfer key operation selection (R/L)	**DL**	R/W	0: No direct key operation 1: Remote/Local transfer	1	P. 133
79	RUN/STOP transfer key operation selection (R/S)	**DM**	R/W	0: No direct key operation 1: RUN/STOP transfer	1	P. 133

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
80	Input 1_input type selection	**XI**	R/W	TC input 0: K –200 to +1372 °C –328.0 to 2501.6 °F 1: J –200 to +1200 °C –328.0 to 2192.0 °F 2: R –50 to +1768 °C –58.0 to 3214.4 °F 3: S –50 to +1768 °C –58.0 to 3214.4 °F 4: B 0 to 1800 °C 32.0 to 3272.0 °F 5: E –200 to +1000 °C –328.0 to 1832.0 °F 6: N 0 to 1300 °C 32.0 to 2372.0 °F 7: T –200 to +400 °C –328.0 to 752.0 °F 8: W5Re/W26Re 0 to 2300 °C 32.0 to 4172.0 °F 9: PLII 0 to 1390 °C 32.0 to 2534.0 °F RTD input (3-wire system) 12: Pt100 –200 to +850 °C –328.0 to 1562.0 °F 13: JPt100 –200 to +600 °C –328.0 to 1112.0 °F Voltage (V)/current (I) inputs –19999 to +99999 14: 0 to 20 mA DC 15: 4 to 20 mA DC 16: 0 to 10 V DC 17: 0 to 5 V DC 18: 1 to 5 V DC 19: 0 to 1 V DC 20: 0 to 100 mV DC 21: 0 to 10 mV DC RTD input (4-wire system) 22: Pt100 –200 to +850 °C –328.0 to 1562.0 °F 23: JPt100 –200 to +600 °C –328.0 to 1112.0 °F	Depend on model code When not specify-ing: Type K	P. 134
81	Input 1_display unit selection	**PU**	R/W	0: °C 1: °F	0	P. 135

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No.	Name	Identifier	Attribute	Data range	Factory set value	Reference page
82	Input 1_decimal point position	**XU**	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 4: 4 digits below decimal point	1	P. 136
83	Input 1_input scale high	**XV**	R/W	TC/RTD input: Input scale low to maximum value of input range Voltage (V)/current (I) input: −19999 to +99999 (Varies depending on the position of the decimal point setting)	Note1	P. 137
84	Input 1_input scale low	**XW**	R/W	TC/RTD input: Minimum value of input range to input scale high Voltage (V)/current (I) input: −19999 to +99999 (Varies depending on the position of the decimal point setting)	Note2	P. 138
85	Input 1_input error determination point (high limit)	**AV**	R/W	Input scale low – (5 % of input span) to input scale high + (5 % of input span)	Note3	P. 139
86	Input 1_input error determination point (low limit)	**AW**	R/W	Input scale low – (5 % of input span) to input scale high + (5 % of input span)	Note4	P. 140
87	Input 1_ burnout direction	**BS**	R/W	0: Upscale 1: Downscale	TC/RTD: 0 V/I: 1	P. 140
88	Input 1_square root extraction selection	**XH**	R/W	0: Not provided 1: Provided	0	P. 141
89	Power supply frequency selection	**JT**	R/W	0: 50 Hz 1: 60 Hz	0	P. 141

Note1 TC/RTD: Maximum value of input range V/I: 100.0
Note2 TC/RTD: Minimum value of input range V/I: 0.0
Note3 TC/RTD: Input scale high + (5 % of input span) V/I: 105.0
Note4 TC/RTD: Input scale low – (5 % of input span) V/I: −5.0

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
90	Input 2_ input type selection	**XJ**	R/W	TC input 0: K –200 to +1372 °C –328.0 to 2501.6 °F 1: J –200 to +1200 °C –328.0 to 2192.0 °F 2: R –50 to +1768 °C –58.0 to 3214.4 °F 3: S –50 to +1768 °C –58.0 to 3214.4 °F 4: B 0 to 1800 °C 32.0 to 3272.0 °F 5: E –200 to +1000 °C –328.0 to 1832.0 °F 6: N 0 to 1300 °C 32.0 to 2372.0 °F 7: T –200 to +400 °C –328.0 to 752.0 °F 8: W5Re/W26Re 0 to 2300 °C 32.0 to 4172.0 °F 9: PLII 0 to 1390 °C 32.0 to 2534.0 °F RTD input (3-wire system) 12: Pt100 –200 to +850 °C –328.0 to 1562.0 °F 13: JPt100 –200 to +600 °C –328.0 to 1112.0 °F Voltage (V)/current (I) inputs –19999 to +99999 14: 0 to 20 mA DC 15: 4 to 20 mA DC 16: 0 to 10 V DC 17: 0 to 5 V DC 18: 1 to 5 V DC 19: 0 to 1 V DC 20: 0 to 100 mV DC 21: 0 to 10 mV DC RTD input (4-wire system) 22: Pt100 –200 to +850 °C –328.0 to 1562.0 °F 23: JPt100 –200 to +600 °C –328.0 to 1112.0 °F	Depend on model code When not specify-ing: Type K	P. 134
91	Input 2_ display unit selection	**PT**	R/W	0: °C 1: °F	0	P. 135

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
92	Input 2_decimal point position	**XT**	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 4: 4 digits below decimal point	1	P. 136
93	Input 2_input scale high	**XX**	R/W	TC/RTD input: Input scale low to maximum value of input range Voltage (V)/current (I) input: –19999 to +99999 (Varies depending on the position of the decimal point setting)	Note1	P. 137
94	Input 2_input scale low	**XY**	R/W	TC/RTD input: Minimum value of input range to input scale high Voltage (V)/current (I) input: –19999 to +99999 (Varies depending on the position of the decimal point setting)	Note2	P. 138
95	Input 2_input error determination point (high limit)	**AX**	R/W	Input scale low – (5 % of input span) to input scale high + (5 % of input span)	Note3	P. 139
96	Input 2_input error determination point (low limit)	**AY**	R/W	Input scale low – (5 % of input span) to input scale high + (5 % of input span)	Note4	P. 140
97	Input 2_ burnout direction	**BR**	R/W	0: Upscale 1: Downscale	TC/RTD: 0 V/I: 1	P. 140
98	Input 2_square root extraction selection	**XG**	R/W	0: Not provided 1: Provided	0	P. 141
99	Event input logic selection	**H2**	R/W	0 to 6	1	P. 142
100	Output logic selection	**E0**	R/W	1 to 10	Note5	P. 144
101	Output 1 timer setting	**TD**	R/W	0.0 to 600.0 seconds	0.0	P. 146
102	Output 2 timer setting	**TG**	R/W	0.0 to 600.0 seconds	0.0	P. 146
103	Output 3 timer setting	**TH**	R/W	0.0 to 600.0 seconds	0.0	P. 146

Note1 TC/RTD: Maximum value of input range V/I: 100.0
Note2 TC/RTD: Minimum value of input range V/I: 0.0
Note3 TC/RTD: Input scale high + (5 % of input span) V/I: 105.0
Note4 TC/RTD: Input scale low – (5 % of input span) V/I: –5.0
Note5 1 input: 1 2 input: 5

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
104	Output 4 timer setting	**TI**	R/W	0.0 to 600.0 seconds	0.0	P. 146
105	Output 5 timer setting	**TJ**	R/W	0.0 to 600.0 seconds	0.0	P. 146
106	Transmission output 1_ type selection	**LA**	R/W	0: None 1: Input 1_measured value (PV) 2: Input 1_set value (SV) 3: Input 1_deviation 4: Input 1_manipulated output value (MV) 5: Input 2_ measured value (PV) 6: Input 2_ set value (SV) 7: Input 2_deviation 8: Input 2_ manipulated output value (MV)	0	P. 148
107	Transmission output 1_ scale high	**KA**	R/W	Measured value (PV) and set value (SV): Input scale low to input scale high Manipulated output value (MV): –5.0 to +105.0 % Deviation: –Input span to +Input span	Note1	P. 149
108	Transmission output 1_ scale low	**NA**	R/W	Measured value (PV) and set value (SV): Input scale low to input scale high Manipulated output value (MV): –5.0 to +105.0 % Deviation: –Input span to +Input span	Note2	P. 150
109	Transmission output 2_ type selection	**LB**	R/W	0: None 1: Input 1_measured value (PV) 2: Input 1_set value (SV) 3: Input 1_deviation 4: Input 1_manipulated output value (MV) 5: Input 2_ measured value (PV) 6: Input 2_ set value (SV) 7: Input 2_deviation 8: Input 2_ manipulated output value (MV)	0	P. 148

Note1 PV/SV: Input scale high MV: 100.0 Deviation: +Input span
Note2 PV/SV: Input scale low MV: 0.0 Deviation: –Input span

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No.	Name	Identifier	Attribute	Data range	Factory set value	Reference page
110	Transmission output 2_ scale high	**KB**	R/W	Measured value (PV) and set value (SV): Input scale low to input scale high Manipulated output value (MV): −5.0 to +105.0 % Deviation: −Input span to +Input span	Note1	P. 149
111	Transmission output 2_ scale low	**NB**	R/W	Measured value (PV) and set value (SV): Input scale low to input scale high Manipulated output value (MV): −5.0 to +105.0 % Deviation: −Input span to +Input span	Note2	P. 150
112	Transmission output 3_ type selection	**LC**	R/W	0: None 1: Input 1_measured value (PV) 2: Input 1_set value (SV) 3: Input 1_deviation 4: Input 1_manipulated output value (MV) 5: Input 2_ measured value (PV) 6: Input 2_ set value (SV) 7: Input 2_deviation 8: Input 2_ manipulated output value (MV)	0	P. 148
113	Transmission output 3_ scale high	**KC**	R/W	Measured value (PV) and set value (SV): Input scale low to input scale high Manipulated output value (MV): −5.0 to +105.0 % Deviation: −Input span to +Input span	Note1	P. 149

Note1 PV/SV: Input scale high MV: 100.0 Deviation: +Input span
Note2 PV/SV: Input scale low MV: 0.0 Deviation: −Input span

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
114	Transmission output 3_ scale low	**NC**	R/W	Measured value (PV) and set value (SV): Input scale low to input scale high Manipulated output value (MV): −5.0 to +105.0 % Deviation: −Input span to +Input span	Note1	P. 150
115	Event 1 type selection	**XA**	R/W	0: None 1: Deviation high 2: Deviation low 3: Deviation high/low 4: Band 5: Process high 6: Process low 7: SV high 8: SV low	0	P. 151
116	Event 1 hold action	**WA**	R/W	0: Not provided 1: Provided 2: Re-hold action	0	P. 154
117	Event 1 differential gap	**HA**	R/W	0 to input span	Note2	P. 156
118	Event 1 action at input error	**OA**	R/W	0: Normal processing 1: Forcibly turned on	0	P. 158
119	Event 1 assignment	**FA**	R/W	1: For input 1 2: For input 2	0	P. 160
120	Event 2 type selection	**XB**	R/W	0: None 1: Deviation high 2: Deviation low 3: Deviation high/low 4: Band 5: Process high 6: Process low 7: SV high 8: SV low	0	P. 151
121	Event 2 hold action	**WB**	R/W	0: Not provided 1: Provided 2: Re-hold action	0	P. 154
122	Event 2 differential gap	**HB**	R/W	0 to input span	Note2	P. 156
123	Event 2 action at input error	**OB**	R/W	0: Normal processing 1: Forcibly turned on	0	P. 158

Note1 PV/SV: Input scale low MV: 0.0 Deviation: −Input span
Note2 TC/RTD: 2.0 °C V/I: 0.2 % of input span

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
124	Event 2 assignment	**FB**	R/W	1: For input 1 2: For input 2	0	P. 160
125	Event 3 type selection	**XC**	R/W	0: None 1: Deviation high 2: Deviation low 3: Deviation high/low 4: Band 5: Process high 6: Process low 7: SV high 8: SV low 9: Control loop break alarm (LBA)	0	P. 151
126	Event 3 hold action	**WC**	R/W	0: Not provided 1: Provided 2: Re-hold action	0	P. 154
127	Event 3 differential gap	**HC**	R/W	0 to input span	Note1	P. 156
128	Event 3 action at input error	**OC**	R/W	0: Normal processing 1: Forcibly turned on	0	P. 158
129	Event 3 assignment	**FC**	R/W	1: For input 1 2: For input 2	0	P. 160
130	Event 4 type selection	**XD**	R/W	0: None 1: Deviation high 2: Deviation low 3: Deviation high/low 4: Band 5: Process high 6: Process low 7: SV high 8: SV low 9: Control loop break alarm (LBA)	0	P. 151
131	Event 4 hold action	**WD**	R/W	0: Not provided 1: Provided 2: Re-hold action	0	P. 154
132	Event 4 differential gap	**HD**	R/W	0 to input span	Note1	P. 156
133	Event 4 action at input error	**OD**	R/W	0: Normal processing 1: Forcibly turned on	0	P. 158
134	Event 4 assignment	**FD**	R/W	1: For input 1 2: For input 2	0	P. 160
135	CT1 ratio	**XR**	R/W	0 to 9999	Depend on model code	P. 161

Note1 TC/RTD: 2.0 °C V/I: 0.2 % of input span

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
136	CT1 assignment	**ZF**	R/W	0: None 3: OUT3 1: OUT1 4: OUT4 2: OUT2 5: OUT5	Note1	P. 162
137	CT2 ratio	**XS**	R/W	0 to 9999	Depend on model code	P. 161
138	CT2 assignment	**ZG**	R/W	0: None 3: OUT3 1: OUT1 4: OUT4 2: OUT2 5: OUT5	Note2	P. 162
139	Hot/Cold start selection	**XN**	R/W	Power failure of 3 seconds or less 0: Hot 1 3: Hot 2 1: Hot 1 4: Hot 2 2: Hot 1 5: Cold Power failure of 3 seconds or more 0: Hot 1 3: Hot 2 1: Hot 2 4: Cold 2: Cold 5: Cold	0	P. 163
140	Input 2_use selection	**KM**	R/W	0: Single loop control 1: Remote input 2: Cascade control (Slave)	0	P. 164
141	Cascade ratio	**RR**	R/W	0.000 to 1.500	1.000	P. 165
142	Cascade bias	**RB**	R/W	−Input span to +input span	0.0	P. 165
143	SV tracking	**XL**	R/W	0: Not provided 1: Provided	1	P. 167
144	Input 1_control action type selection	**XE**	R/W	0: Direct action 1: Reverse action	1	P. 168
145	Input 1_ integral/derivative time decimal point position selection	**PK**	R/W	0: No digit below decimal point 1: 1 digit below decimal point 2: 2 digits below decimal point	2	P. 169
146	Input 1_derivative gain	**DG**	R/W	0.1 to 10.0	6.0	P. 170
147	Input 1_ON/OFF action differential gap (upper)	**IV**	R/W	0 to input span	Note3	P. 170
148	Input 1_ON/OFF action differential gap (lower)	**IW**	R/W	0 to input span	Note3	P. 171
149	Input 1_action at input error (high limit)	**WH**	R/W	0: Normal control (present output) 1: Manipulated output value at input error	0	P. 172

Note1 CT1 provided: 1 CT1 not provided: 0
Note2 CT2 provided: 1 CT2 not provided: 0
Note3 TC/RTD: 1.0 °C V/I: 0.1 % of input span

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No.	Name	Identifier	Attribute	Data range	Factory set value	Reference page
150	Input 1_action at input error (low limit)	**WL**	R/W	0: Normal control (present output) 1: Manipulated output value at input error	0	P. 173
151	Input 1_manipulated output value at input error	**OE**	R/W	−5.0 to +105.0 %	−5.0	P. 173
152	Input 1_output change rate limiter (up)	**PH**	R/W	0.0 to 1000.0 %/seconds	0.0	P. 174
153	Input 1_output change rate limiter (down)	**PL**	R/W	0.0 to 1000.0 %/seconds	0.0	P. 174
154	Input 1_output limiter (high limit)	**OH**	R/W	Input 1_output limiter (low limit) to 105.0 %	105.0	P. 176
155	Input 1_output limiter (low limit)	**OL**	R/W	−5.0 % to input 1_output limiter (high limit)	−5.0	P. 176
156	Input 1_power feed forward	**PF**	R/W	0: Not provided 1: Provided	Note1	P. 177
157	Input 2_control action type selection	**XF**	R/W	0: Direct action 1: Reverse action	1	P. 168
158	Input 2_ integral/derivative time decimal point position selection	**PJ**	R/W	0: No digit below decimal point 1: 1 digit below decimal point 2: 2 digits below decimal point	2	P. 169
159	Input 2_derivative gain	**DJ**	R/W	0.1 to 10.0	6.0	P. 170
160	Input 2_ON/OFF action differential gap (upper)	**IX**	R/W	0 to input span	Note2	P. 170
161	Input 2_ON/OFF action differential gap (lower)	**IY**	R/W	0 to input span	Note2	P. 171
162	Input 2_action at input error (high limit)	**WX**	R/W	0: Normal control (present output) 1: Manipulated output value at input error	0	P. 172
163	Input 2_action at input error (low limit)	**WY**	R/W	0: Normal control (present output) 1: Manipulated output value at input error	0	P. 173
164	Input 2_manipulated output value at input error	**OF**	R/W	−5.0 to +105.0 %	−5.0	P. 173
165	Input 2_output change rate limiter (up)	**PX**	R/W	0.0 to 1000.0 %/seconds	0.0	P. 174

Note1 Not provided: 0 Provided: 1
Note2 TC/RTD: 1.0 °C V/I: 0.1 % of input span

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
166	Input 2_output change rate limiter (down)	**PY**	R/W	0.0 to 1000.0 %/seconds	0.0	P. 174
167	Input 2_output limiter (high limit)	**OX**	R/W	Input 2_output limiter (low limit) to 105.0 %	105.0	P. 176
168	Input 2_output limiter (low limit)	**OY**	R/W	–5.0 % to input 2_output limiter (high limit)	–5.0	P. 176
169	Input 2_power feed forward	**PG**	R/W	0: Not provided 1: Provided	Note1	P. 177
170	Input 1_AT bias	**GB**	R/W	–Input span to +input span	0	P. 178
171	Input 1_AT cycle	**G3**	R/W	0: 1.5 cycle 1: 2.0 cycle 2: 2.5 cycle 3: 3.0 cycle	1	P. 179
172	Input 1_AT differential gap time	**GH**	R/W	0.00 to 50.00 seconds	Note2	P. 180
173	Input 2_AT bias	**GA**	R/W	–Input span to +input span	0	P. 178
174	Input 2_AT cycle	**G2**	R/W	0: 1.5 cycle 1: 2.0 cycle 2: 2.5 cycle 3: 3.0 cycle	1	P. 179
175	Input 2_AT differential gap time	**GG**	R/W	0.00 to 50.00 seconds	Note2	P. 180
176	Open/Close output neutral zone	**V2**	R/W	0.1 to 10.0 %	10.0	P. 182
177	Open/Close output differential gap	**VH**	R/W	0.1 to 5.0 %	0.2	P. 183
178	Action at feedback resistance (FBR) input error	**SY**	R/W	0: Close-side output ON, Open-side output OFF 1: Close-side output OFF, Open-side output OFF 2: Close-side output OFF, Open-side output ON	0	P. 184
179	Feedback adjustment	**FV**	R/W	0: Adjustment end 1: During the Open-side adjusting 2: During the Close-side adjusting	—	P. 185
180	Setting change rate limiter unit time	**HU**	R/W	1 to 3600 seconds	60	P. 186

Note1 Not provided: 0 Provided: 1
Note2 HA400/HA900: 0.10 HA401/HA901: 10.00

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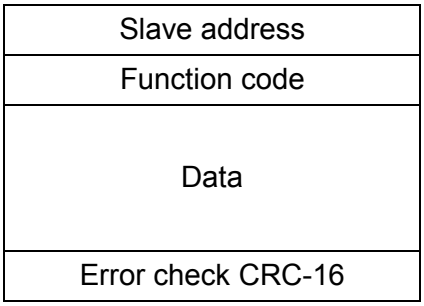
No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
181	Soak time unit selection	**RU**	R/W	0: 0 hour 00 minutes 00 second to 9 hours 59 minutes 59 seconds 2: 0 minutes 00.00 seconds to 9 minutes 59.99 seconds	2	P. 186
182	Input 1_setting limiter (high limit)	**SH**	R/W	Input 1_setting limiter (low limit) to input 1_input scale high	Input 1_ input scale high	P. 187
183	Input 1_setting limiter (low limit)	**SL**	R/W	Input 1_input scale low to input 1_setting limiter (high limit)	Input 1_ input scale low	P. 188
184	Input 2_setting limiter (high limit)	**ST**	R/W	Input 2_setting limiter (low limit) to input 2_input scale high	Input 2_ input scale high	P. 187
185	Input 2_setting limiter (low limit)	**SU**	R/W	Input 2_input scale low to input 2_setting limiter (high limit)	Input 2_ input scale low	P. 188
186	ROM version display	**VR**	RO	Display the version of loading software.	—	P. 189
187	Integrated operating time display	**UT**	RO	0 to 99999 hours	—	P. 189
188	Holding peak value ambient temperature display	**Hp**	RO	−10.0 to +100.0 °C The maximum ambient temperature of the instrument is displayed.	—	P. 189
189	Power feed transformer input value monitor	**HM**	RO	0.0 to 160.0 % (Display in the engineering unit of % corresponding to the rated value.) The input value of a power feed transformer is displayed.	—	P. 190

6. MODBUS

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.

6.1 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.



Message format

■ Slave address

The slave address is a number from 0 to 99 manually set at the controller address setting switch located at the front of the controller.

☞ For details, see **4.2 Setting the Communication Parameters (P. 15)**.

Although all connected slave units 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 **6.2 Function Code (P. 58)**.

■ 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 **6.6 Message Format (P. 63)**, **6.7 Data Configuration (P. 67)** and **6.8 Data Map List (P. 72)**.

■ Error check

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

☞ For details, see **6.5 Calculating CRC-16 (P. 60)**.

6.2 Function Code

Function code contents

Function code (Hexadecimal)	Function	Contents
03H	Read holding registers	Measured value, control output value, current transformer input measured value, Event status, etc.
06H	Preset single register	Set value, PID constants, event set value, etc.
08H	Diagnostics (loopback test)	loopback test
10H	Preset multiple registers	Set value, PID constants, event set value, etc.

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
10H	Preset multiple registers	11	255	8	8

6.3 Communication Mode

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

Items	Contents
Data bit length	8-bit (Binary)
Start mark of message	Unused
End mark of message	Unused
Message length	See **6.2 Function code**
Data time interval	Less than 24 bits' time *
Error check	CRC-16 (Cyclic Redundancy Check)

* When sending a command message from the master, set intervals of data configuring one message to time shorter than the 24 bits' time or the 24 bits' time plus a few milliseconds. If time intervals become time longer than the 24 bits' time or the 24 bits' time plus a few milliseconds, the relevant slave assumes that message sending from the master is terminated to deform the message format. As a result, the slave does not make a response.

6.4 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 Register, 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.
- In the response message of the Preset Multiple Registers, the slave returns the slave address, the function code, starting number, and number of holding registers in the multi-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 (An unsupported function code was specified)
2	When any address other than 0000H to 0093H, 0200H to 02E9H, and 0500H to 0535H are specified.
3	When the specified number of data items in the query message exceeds the maximum number of data items available
4	Self-diagnostic error response

(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's time.

6.5 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* (⊕) 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***.

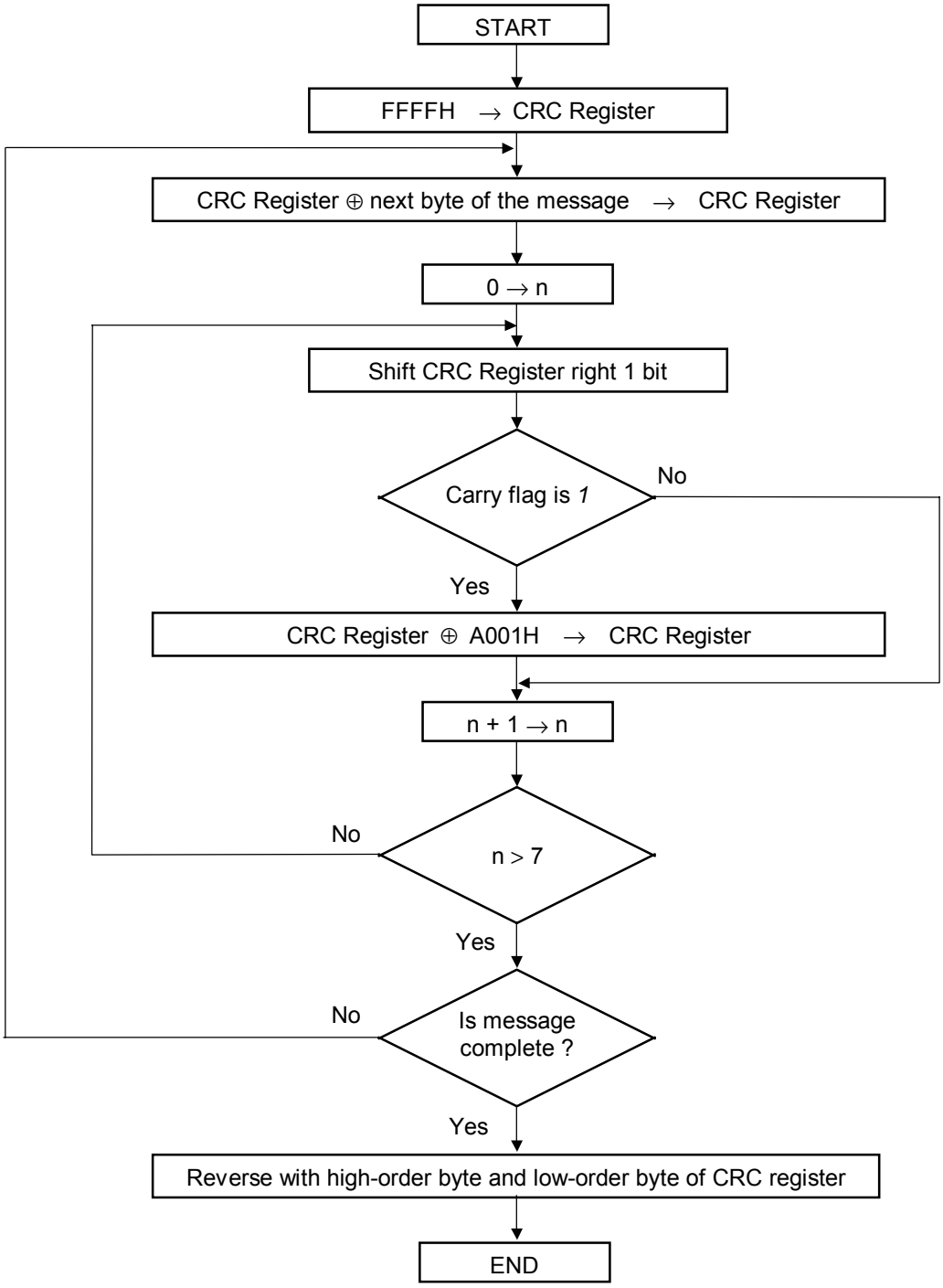
5. Repeat step ***3*** and ***4*** until there have been 8 shifts.

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



The ⊕ symbol indicates an *exclusive OR* operation. The symbol for the number of data bits is *n*.

■ Example of a CRC calculation in the 'C' language

This routine assumes that the data types 'uint16' and 'uint8' exists. Theses are unsigned 16-bit integer (usually an 'unsigned short int' for most compiler types) and unsigned 8-bit integer (unsigned char). 'z_p' is a pointer to a Modbus message, and z_messaage_length is its length, excluding the CRC. Note that the Modbus message will probably contain NULL characters and so normal C string handling techniques will not work.

uint16 calculate_crc （byte *z_p, unit16 z_message_length）

```
/* CRC runs cyclic Redundancy Check Algorithm on input z_p  */
/* Returns value of 16 bit CRC after completion and         */
/* always adds 2 crc bytes to message                       */
/* returns 0 if incoming message has correct CRC            */

{
    uint16 CRC= 0xffff;
    uint16 next;
    uint16 carry;
    uint16 n;
    uint8 crch, crcl;

    while (z_messaage_length--) {
        next = (uint16) *z_p;
        CRC ^= next;
        for (n = 0; n < 8; n++) {
            carry = CRC & 1;
            CRC >>= 1;
            if (carry) {
              CRC ^= 0xA001;
            }
        }
        z_p++;
    }
    crch = CRC / 256;
    crcl = CRC % 256
    z_p [z_messaage_length++] = crcl;
    z_p [z_messaage_length] = crch;
    return CRC;
}
```

6.6 Message Format

6.6.1 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-bit and the low-order 8-bit, arranged in the order of the register numbers.

Example: The contents of the four holding registers from 0000H to 0003H are the read out from slave address 2.

Query message

Slave address		02H
Function code		03H
Starting No.	High	00H
	Low	00H
Quantity	High	00H
	Low	04H
CRC-16	High	44H
	Low	3AH

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		08H
First holding register contents	High	00H
(High order word of the first data)	Low	00H
Next holding register contents	High	00H
(Low order word of the first data)	Low	19H
Next holding register contents	High	00H
(High order word of the next data)	Low	00H
Next holding register contents	High	00H
(Low order word of the next data)	Low	19H
CRC-16	High	46H
	Low	9BH

→ Number of holding registers × 2

Error response message

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

6.6.2 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-bit first and low-order 8-bit next. Only R/W holding registers can be specified.

Example: Data is written into the holding register 0049H of slave address 1.

Query message

Slave address		01H
Function code		06H
Holding register number	High	00H
	Low	49H
Write data	High	00H
	Low	64H
CRC-16	High	59H
	Low	F7H

} Any data within the range

Normal response message

Slave address		01H
Function code		06H
Holding register number	High	00H
	Low	49H
Write data	High	00H
	Low	64H
CRC-16	High	59H
	Low	F7H

} 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

6.6.3 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 (the controller).

Example: Loopback test for slave address 1

Query message

Slave address		01H	
Function code		08H	
Test code	High	00H	Test code must be set to *00*
	Low	00H	
Data	High	1FH	Any pertinent data
	Low	34H	
CRC-16	High	E9H	
	Low	ECH	

Normal response message

Slave address		01H	Contents will be the same as query message data
Function code		08H	
Test code	High	00H	
	Low	00H	
Data	High	1FH	
	Low	34H	
CRC-16	High	E9H	
	Low	ECH	

Error response message

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

6.6.4 Preset multiple registers [10H]

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

Example: Data is written into the two holding registers from 0048H to 0049H of slave address 1.

Query message

Slave address		01H	
Function code		10H	
Starting number	High	00H	First holding register address
	Low	48H	
Quantity	High	00H	The setting must be between 1 (0001H) and 100 (0064H).
	Low	02H	
Number of data		04H	→ Number of holding registers × 2
Data to first register (High order word)	High	00H	Any pertinent data
	Low	00H	
Data to next register (Low order word)	High	00H	
	Low	64H	
CRC-16	High	F7H	
	Low	D2H	

Normal response message

Slave address		01H
Function code		10H
Starting number	High	00H
	Low	48H
Quantity	High	00H
	Low	02H
CRC-16	High	C1H
	Low	DEH

Error response message

Slave address		01H
80H + Function code		90H
Error code		02H
CRC-16	High	CDH
	Low	C1H

6.7 Data Configuration

6.7.1 Data scale

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 1 digit below decimal point**

Feedback resistance input value
Current transformer input value 1 (CT1)
Current transformer input value 2 (CT2)
Input 1_manipulated output value (MV1) monitor
Input 2_manipulated output value (MV2) monitor
LBA1 deadband
LBA2 deadband
Input 1_setting change rate limiter (up)
Input 1_setting change rate limiter (down)
Input 2_setting change rate limiter (up)
Input 2_setting change rate limiter (down)
Heater break alarm 1 (HBA1) set value
Heater break alarm 2 (HBA2) set value
Input 1_proportional cycle time
Input 1_manipulated output value
Input 2_ proportional cycle time
Input 2_manipulated output value
Output 1 timer setting
Output 2 timer setting
Output 3 timer setting
Output 4 timer setting
Output 5 timer setting
Input 1_derivative gain
Input 1_manipulated output value at input error
Input 1_output change rate limiter (up)
Input 1_output change rate limiter (down)
Input 1_output limiter (high limit)
Input 1_output limiter (low limit)
Input 2_derivative gain
Input 2_manipulated output value at input error
Input 2_output change rate limiter (up)
Input 2_output change rate limiter (down)
Input 2_output limiter (high limit)
Input 2_output limiter (low limit)
Open/Close output neutral zone
Open/Close output differential gap
Holding peak value ambient temperature display
Power feed transformer input value

Example: When Input 1_manipulated output value (MV1) is 5.0 %, 5.0 is processed as 50, 50 = 0032H

Input 1_ manipulated output value	High	00H
	Low	32H

- **Data with 2 digit below decimal point**

Input 1_PV digital filter
Input 1_PV low input cut-off
Input 2_PV digital filter
Input 2_PV low input cut-off
Input 1_AT differential gap time
Input 2_AT differential gap time

Example: When Input 1_PV digital filter is 0.55 second, 0.55 is processed as 55,
55 = 0037H

Input 1_PV digital filter	High	00H
	Low	37H

- **Data with 3 digit below decimal point**

Input 1_PV ratio
Input 2_PV ratio
Cascade ratio

Example: When Input 1_PV ratio is 0.555, 0.555 is processed as 555,
555 = 022BH

Input 1_PV ratio	High	02H
	Low	2BH

- **Data whose decimal point's presence and/or position depends on integral/derivative time decimal point position selection**

The position of the decimal point changes depending on the integral/derivative time decimal point position selection type because the Modbus protocol does not recognize data with decimal points during communication.

[Type of decimal points position]

No digit below decimal point, 1 digit below decimal point, 2 digit below decimal point

Input 1_integral time
Input 1_derivative time
Input 2_integral time
Input 2_derivative time

Example: When Input 1_integral time is 240.00 seconds, 240.00 is processed as 24000,
24000 = 5DC0H

Input 1_integral time	High	5DH
	Low	C0H

● 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 because the Modbus protocol does not recognize data with decimal points during communication.

[Type of decimal points position]

Temperature input: No digit below decimal point, 1 digit below decimal point, 2 digit below decimal point

Voltage/current input: No digit below decimal point, 1 digit below decimal point, 2 digit below decimal point, 3 digit below decimal point, 4 digit below decimal point

☞ For details, see **Input range table (P. 134)**.

Input 1_measured value (PV1)
Input 2_measured value (PV2)
Input 1_set value (SV1) monitor
Input 2_set value (SV2) monitor
Remote input value monitor
Cascade monitor
Event 1 set value
Event 2 set value
Event 3 set value
Event 4 set value
Input 1_set value (SV1)
Input 1_proportional band
Input 2_set value (SV2)
Input 2_ proportional band
Input 1_PV bias
Input 2_ PV bias
Input 1_input scale high
Input 1_input scale low
Input 1_input error determination point (high limit)
Input 1_input error determination point (low limit)
Input 2_input scale high
Input 2_input scale low
Input 2_input error determination point (high limit)
Input 2_input error determination point (low limit)
Transmission output 1_scale high
Transmission output 1_scale low
Transmission output 2_scale high
Transmission output 2_scale low
Transmission output 3_scale high
Transmission output 3_scale low
Event 1 differential gap
Event 2 differential gap
Event 3 differential gap
Event 4 differential gap
Cascade bias
Input 1_ON/OFF action differential gap (upper)
Input 1_ON/OFF action differential gap (lower)
Input 2_ON/OFF action differential gap (upper)
Input 2_ON/OFF action differential gap (lower)
Input 1_AT bias
Input 2_AT bias
Input 1_setting limiter (high limit)
Input 1_setting limiter (low limit)
Input 2_setting limiter (high limit)
Input 2_setting limiter (low limit)

Example: When Input 1_set value (SV1) is −20.0 °C, −20.0 is processed as −200,
−200 = 0000H − 00C8H = FF38H

Input 1_set value (SV1)	High	FFH
	Low	38H

● Data without decimal points

Model codes
Input 1_burnout state
Input 2_burnout state
Feedback resistance input burnout state
Event 1 state
Event 2 state
Event 3 state
Event 4 state
Heater break alarm 1 (HBA1) state
Heater break alarm 2 (HBA2) state
Error codes
Event input state
Operation mode state
Input 1_PID/AT transfer
Input 2_PID/AT transfer
Input 1_Auto/Manual transfer
Input 2_Auto/Manual transfer
Remote/Local transfer
RUN/STOP transfer
Memory area selection
Control loop break alarm 1 (LBA1)
Control loop break alarm 2 (LBA2)
Input 1_control response parameter
Input 2_control response parameter
Link area number
Set lock level
EEPROM storage state
EEPROM storage mode
STOP display selection
Bar graph display selection
Bar graph resolution setting
Auto/Manual transfer key operation selection (A/M)
Remote/Local transfer key operation selection (R/L)
RUN/STOP transfer key operation selection (R/S)
Input 1_input type selection
Input 1_display unit selection
Input 1_decimal point position
Input 1_burnout direction
Input 1_square root extraction selection
Power supply frequency selection
Input 2_ input type selection
Input 2_ display unit selection
Input 2_decimal point position
Input 2_burnout direction
Input 2_square root extraction selection
Event input logic selection
Output logic selection
Transmission output 1_type selection
Transmission output 2_type selection
Transmission output 3_type selection
Event 1 type selection
Event 1 hold action
Event 1 action at input error
Event 1 assignment
Event 2 type selection
Event 2 hold action
Event 2 action at input error
Event 2 assignment
Event 3 type selection
Event 3 hold action
Event 3 action at input error
Event 3 assignment
Event 4 type selection
Event 4 hold action
Event 4 action at input error
Event 4 assignment
CT1 ratio
CT1 assignment
CT2 ratio
CT2 assignment
Hot/Cold start selection
Input 2_use selection
SV tracking
Input 1_control action type selection
Input 1_integral/derivative time decimal point position selection
Input 1_action at input error (high limit)
Input 1_action at input error (low limit)
Input 1_power feed forward
Input 2_control action type selection
Input 2_integral/derivative time decimal point position selection
Input 2_action at input error (high limit)
Input 2_action at input error (low limit)
Input 2_power feed forward
Input 1_AT cycle
Input 2_AT cycle
Action at feedback resistance input (FBR) error
Feedback adjustment
Setting change rate limiter unit time
Soak time unit selection
ROM version display
Integrated operating time display

Example: When Integrated operating time display is 72 hour,
72 = 0048H

Integrated operating time display	High	00H
	Low	48H

6.7.2 Caution for handling communication data

- In this communication, the variable is handled as 4 bytes data.
- In this communication, one variable use two register addresses (Address of high order word, Address of low order word).
- Turn of high order word and low order word is handled as Motorola Semiconductor type approval (high order sequence of low order).
- In this communication, the variables that memory area includes handles different address with for control area and for setting area.
- There is the following constraint in writing data in order to treat the variable as 4 bytes data in this communication.

– It is not possible to write only of high order word. The communication response becomes normal response, but do not writing.

– A writing only of low order word does sign extend and does it.

Example 1: When did a writing only of “20H” in low order word.
The controller interprets high order word as “00H.”

Example 2: When did a writing only of “FFH (–1) ” in low order word.
The controller interprets high order word as “FFH.”

- Addresses in which data (holding register) is accessible are from 0000H to 0093H, from 0200H to 02E9H, and from 0500H to 0535H. If any address other than 0000H to 0093H, 0200H to 02E9H, and 0500H to 0535H is accessed, an error response message returns.
- Read data of unused item is a default value.
- Any attempt to write to an unused item is not processed as an error. Data can not be written into an unused item.
- If data range or address error occurs during data writing, it is not processed as an error. Except the data that error occurred, normal data is written in data register. Therefore, it is necessary to confirm data after the end of setting data.
- Communication data includes data which becomes RO (read only) depending on the specification. No error occurs even if data is written when set to RO. However in this case, no data is written.

☞ For details, see **6.8 Data Map List (P. 72)**.

- Send the next command message at time intervals of 30 bits after the master receives the response message.

6.8 Data Map List

- In this communication, the variable is handled as 4 bytes data.
- In this communication, one variable use two register addresses (Address of high order word, Address of low order word).
- Turn of high order word and low order word is handled as Motorola Semiconductor type approval (high order sequence of low order).
- Register address 0500 H to 0535 H handles it when I do confirmation and change of set value belonging to memory area except control area. (see P. 96)

RO: Read only R/W: Read and Write

Name	Register address				Attri-bute	Data range	Factory set value	Refer-ence page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Input 1_ measured value (PV1) monitor	0000	0001	0	1	RO	Input 1_input scale low to Input 1_input scale high	—	P. 100
Input 2_ measured value (PV2) monitor	0002	0003	2	3	RO	Input 2_input scale low to Input 2_input scale high	—	P. 100
Feedback resistance input value monitor	0004	0005	4	5	RO	0.0 to 100.0 %	—	P. 100
Current transformer input value 1 (CT1) monitor	0006	0007	6	7	RO	0.0 to 30.0 A or 0.0 to 100.0 A	—	P. 101
Current transformer input value 2 (CT2) monitor	0008	0009	8	9	RO	0.0 to 30.0 A or 0.0 to 100.0 A	—	P. 101
Input 1_ set value (SV1) monitor	000A	000B	10	11	RO	Input 1_setting limiter (low limit) to Input 1_setting limiter (high limit)	—	P. 101
Input 2_ set value (SV2) monitor	000C	000D	12	13	RO	Input 2_setting limiter (low limit) to Input 2_setting limiter (high limit)	—	P. 101
Remote input value monitor	000E	000F	14	15	RO	Input 1_setting limiter (low limit) to Input 1_setting limiter (high limit)	—	P. 102
Cascade monitor	0010	0011	16	17	RO	Input 2_ setting limiter (low limit) to Input 2_ setting limiter (high limit)	—	P. 102

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Input 1_burnout state	0012	0013	18	19	RO	0: OFF 1: ON	—	P. 102
Input 2_burnout state	0014	0015	20	21	RO	0: OFF 1: ON	—	P. 102
Feedback resistance input burnout state	0016	0017	22	23	RO	0: OFF 1: ON	—	P. 103
Event 1 state	0018	0019	24	25	RO	0: OFF 1: ON	—	P. 103
Event 2 state	001A	001B	26	27	RO	0: OFF 1: ON	—	P. 103
Event 3 state	001C	001D	28	29	RO	0: OFF 1: ON	—	P. 103
Event 4 state	001E	001F	30	31	RO	0: OFF 1: ON	—	P. 103
Heater break alarm 1 (HBA1) state	0020	0021	32	33	RO	0: OFF 1: ON	—	P. 104
Heater break alarm 2 (HBA2) state	0022	0023	34	35	RO	0: OFF 1: ON	—	P. 104
Input 1_ manipulated output value (MV1) monitor	0024	0025	36	37	RO	−5.0 to +105.0 %	—	P. 104
Input 2_ manipulated output value (MV2) monitor	0026	0027	38	39	RO	−5.0 to +105.0 %	—	P. 104
Error codes	0028	0029	40	41	RO	0 to 4095 (Bit data) b0: 1: Adjustment data error b1: 1: EEPROM error b2: 1: A/D conversion error b3: 1: RAM check error b4: 1: Hard configuration error b5: 1: Soft configuration error b6: Unused b7: 1: Watchdog timer error b8～b10: Unused b11: 1: Program busy b12～b31: Unused	—	P. 105

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Event input state	002A	002B	42	43	RO	0 to 127 (Bit data) b0: DI 1 state 0: Open, 1: Close b1: DI 2 state 0: Open, 1: Close b2: DI 3 state 0: Open, 1: Close b3: DI 4 state 0: Open, 1: Close b4: DI 5 state 0: Open, 1: Close b5: DI 6 state 0: Open, 1: Close b6: DI 7 state 0: Open, 1: Close b7 to b31: Unused	—	P. 106
Operation mode state	002C	002D	44	45	RO	0 to 31 (Bit data) b0: 1: Control STOP b1: 1: Control RUN b2: 1: Input 1_Manual mode (Including Input 1_Remote mode) b3: 1: Input 2_Manual mode (Including Input 2_Remote mode) b4: 1: Remote mode or Cascade control b5 to b31: Unused	—	P. 107
Memory area soak time monitor	002E	002F	46	47	RO	0 minute 00.00 second to 9 minutes 59.99 seconds or 0 hour 00 minute 00 second to 9 hours 59 minutes 59 seconds	—	P. 108
Input 1_PID/AT transfer	0030	0031	48	49	R/W	0: PID control 1: Autotuning (AT)	0	P. 108

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Input 2_PID/AT transfer	0032	0033	50	51	R/W	0: PID control 1: Autotuning (AT)	0	P. 108
Input 1_Auto/Manual transfer	0034	0035	52	53	R/W	0: Input 1_Auto mode 1: Input 1_Manual mode	0	P. 110
Input 2_Auto/Manual transfer	0036	0037	54	55	R/W	0: Input 2_Auto mode 1: Input 2_Manual mode	0	P. 110
Remote/Local transfer	0038	0039	56	57	R/W	0: Local mode 1: Remote mode or Cascade control	0	P. 111
RUN/STOP transfer	003A	003B	58	59	R/W	0: Control RUN 1: Control STOP	0	P. 111
Memory area selection	003C	003D	60	61	R/W	1 to 16	1	P. 111
Event 1 set value	003E	003F	62	63	R/W	Deviation: –Input span to +input span Process/SV: Input scale low to input scale high	50.0	P. 112
Event 2 set value	0040	0041	64	65	R/W	Deviation: –Input span to +input span Process/SV: Input scale low to input scale high	50.0	P. 112
Event 3 set value	0042	0043	66	67	R/W	Deviation: –Input span to +input span Process/SV: Input scale low to input scale high	50.0	P. 112
Control loop break alarm 1 (LBA1)	0044	0045	68	69	R/W	0: OFF (Not provided) 1 to 7200 seconds	480	P. 113
LBA1 deadband	0046	0047	70	71	R/W	0.0 to input span	0.0	P. 113
Event 4 set value	0048	0049	72	73	R/W	Deviation: –Input span to +input span Process/SV: Input scale low to input scale high	50.0	P. 112

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Control loop break alarm 2 (LBA2)	004A	004B	74	75	R/W	0: OFF (Not provided) 1 to 7200 seconds	480	P. 113
LBA2 deadband	004C	004D	76	77	R/W	0.0 to input span	0.0	P. 113
Input 1_set value (SV1)	004E	004F	78	79	R/W	Input 1_setting limiter (low limit) to input 1_ setting limiter (high limit)	0.0	P. 116
Input 1_proportional band	0050	0051	80	81	R/W	TC/RTD input: 0 to input span Voltage/current input: 0.0 to 1000.0 % of input span	30.0	P. 116
Input 1_integral time	0052	0053	82	83	R/W	0.0 to 3600.0 seconds or 0.00 to 360.00 seconds (0.0 or 0.00: PD action)	240.00	P. 117
Input 1_derivative time	0054	0055	84	85	R/W	0.0 to 3600.0 seconds or 0.00 to 360.00 seconds (0.0 or 0.00: PI action)	60.00	P. 117
Input 1_control response parameter	0056	0057	86	87	R/W	0: Slow 1: Medium 2: Fast	0	P. 118
Unused	0058	0059	88	89	—	—	—	—
Input 2_set value (SV2)	005A	005B	90	91	R/W	Input 2_setting limiter (low limit) to input 2_ setting limiter (high limit)	0.0	P. 116
Input 2_ proportional band	005C	005D	92	93	R/W	TC/RTD input: 0 to input span Voltage/current input: 0.0 to 1000.0 % of input span	30.0	P. 116
Input 2_ integral time	005E	005F	94	95	R/W	0.0 to 3600.0 seconds or 0.00 to 360.00 seconds (0.0 or 0.00: PD action)	240.00	P. 117
Input 2_ derivative time	0060	0061	96	97	R/W	0.0 to 3600.0 seconds or 0.00 to 360.00 seconds (0.0 or 0.00: PI action)	60.00	P. 117
Input 2_control response parameter	0062	0063	98	99	R/W	0: Slow 1: Medium 2: Fast	0	P. 118
Unused	0064	0065	100	101	—	—	—	—

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Input 1_setting change rate limiter (up)	0066	0067	102	103	R/W	0: OFF (Not provided) 0.1 to input span/one minute	0.0	P. 119
Input 1_setting change rate limiter (down)	0068	0069	104	105	R/W	0: OFF (Not provided) 0.1 to input span/one minute	0.0	P. 119
Input 2_setting change rate limiter (up)	006A	006B	106	107	R/W	0: OFF (Not provided) 0.1 to input span/one minute	0.0	P. 119
Input 2_setting change rate limiter (down)	006C	006D	108	109	R/W	0: OFF (Not provided) 0.1 to input span/one minute	0.0	P. 119
Area soak time	006E	006F	110	111	R/W	0 minute 00.00 second to 9 minutes 59.99 seconds or 0 hour 00 minute 00 second to 9 hours 59 minutes 59 seconds	0.00.00	P. 121
Link area number	0070	0071	112	1113	R/W	0: OFF (No link) 1 to 16	0	P. 122
Heater break alarm 1 (HBA1) set value	0072	0073	114	115	R/W	0.0: OFF (Not provided) 0.1 to 30.0 A or 0.1 to 100.0 A	0.0	P. 123
Heater break alarm 2 (HBA2) set value	0074	0075	116	117	R/W	0.0: OFF (Not provided) 0.1 to 30.0 A or 0.1 to 100.0 A	0.0	P. 123
Input 1_PV bias	0076	0077	118	119	R/W	–Input span to +input span	0	P. 124
Input 1_PV digital filter	0078	0079	120	121	R/W	0: OFF (Not provided) 0.01 to 10.00 seconds	Note1	P. 124
Input 1_PV ratio	007A	007B	122	123	R/W	0.500 to 1.500	1.000	P. 125
Input 1_PV low input cut-off	007C	007D	124	125	R/W	0.00 to 25.00 % of input span	0.00	P. 126
Input 1_proportional cycle time	007E	007F	126	127	R/W	0.1 to 100.0 seconds Other outputs: Voltage pulse output and triac output	Note2	P. 127

Note1 HA400/HA900: 0.00 HA401/HA901: 1.00
Note2 Relay contact output: 20.0 sec Other outputs: 2.0 sec

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Input 1_manipulated output value	0080	0081	128	129	R/W	Input 1_output limiter (low limit) to Input 1_ output limiter (high limit)	0.0	P. 127
Input 2_ PV bias	0082	0083	130	131	R/W	–Input span to +input span	0	P. 124
Input 2_ PV digital filter	0084	0085	132	133	R/W	0: OFF (Not provided) 0.01 to 10.00 seconds	Note1	P. 124
Input 2_PV ratio	0086	0087	134	135	R/W	0.500 to 1.500	1.000	P. 125
Input 2_PV low input cut-off	0088	0089	136	137	R/W	0.00 to 25.00 % of input span	0.00	P. 126
Input 2_ proportional cycle time	008A	008B	138	139	R/W	0.1 to 100.0 seconds Other outputs: Voltage pulse output and triac output	Note2	P. 127
Input 2_manipulated output value	008C	008D	140	141	R/W	Input 2_output limiter (low limit) to Input 2_ output limiter (high limit)	0.0	P. 127
Set lock level	008E	008F	142	143	R/W	0 to 15 (Bit data) b0: Lock only setting items other than SV and events (EV1 to EV4). 0: Settable, 1: Not settable (Lock) b1: Lock only events (EV1 to EV4). 0: Settable, 1: Not settable (Lock) b2: Lock only set value (SV). 0: Settable, 1: Not settable (Lock) b3～b31: Unused	0	P. 128

Note1 HA400/HA900: 0.00 HA401/HA901: 1.00
Note2 Relay contact output: 20.0 sec Other outputs: 2.0 sec

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
EEPROM storage state	0090	0091	144	145	RO	0: The content of the EEPROM does not coincide with that of the RAM. 1: The content of the EEPROM coincides with that of the RAM.	—	P. 129
EEPROM storage mode	0092	0093	146	147	R/W	0: Set values are store to the EEPROM when set values are changed. 1: Not set values are store to the EEPROM when set values are changed.	0	P. 129
Unused	0094 · · · 01FE	0095 · · · 01FF	148 · · · 510	149 · · · 511	—	—	—	—
STOP display selection	0200	0201	512	513	R/W	0: Displays on the measured value (PV1/PV2) unit 1: Displays on the set value (SV) unit	0	P. 130
Bar graph display selection	0202	0203	514	515	R/W	0: No display 1: input 1_manipulated output value (MV) 2: Input 1_measured value (PV) 3: Input 1_set value (SV) 4: Input 1_deviation value 5: Feedback resistance input value (POS) 6: Input 2_manipulated output value (MV) 7: Input 2_measured value (PV) 8: Input 2_set value (SV) 9: Input 2_deviation value	0	P. 131

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Bar graph resolution setting	0204	0205	516	517	R/W	1 to 100 digit/dot	100	P. 132
Unused	0206	0207	518	519	—	—	—	—
Auto/Manual transfer key operation selection (A/M)	0208	0209	520	521	R/W	0: No direct key operation 1: Auto/Manual transfer for input 1 2: Auto/Manual transfer for input 2 3: Auto/Manual transfer for input 1 and input 2	3	P. 132
Remote/Local transfer key operation selection (R/L)	020A	020B	522	523	R/W	0: No direct key operation 1: Remote/Local transfer	1	P. 133
RUN/STOP transfer key operation selection (R/S)	020C	020D	524	525	R/W	0: No direct key operation 1: RUN/STOP transfer	1	P. 133

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Input 1_input type selection	020E	020F	526	527	R/W	TC input 0: K −200 to +1372 °C −328.0 to 2501.6 °F 1: J −200 to +1200 °C −328.0 to 2192.0 °F 2: R −50 to +1768 °C −58.0 to 3214.4 °F 3: S −50 to +1768 °C −58.0 to 3214.4 °F 4: B 0 to 1800 °C 32.0 to 3272.0 °F 5: E −200 to +1000 °C −328.0 to 1832.0 °F 6: N 0 to 1300 °C 32.0 to 2372.0 °F 7: T −200 to +400 °C −328.0 to 752.0 °F 8: W5Re/W26Re 0 to 2300 °C 32.0 to 4172.0 °F 9: PLII 0 to 1390 °C 32.0 to 2534.0 °F RTD input (3-wire system) 12: Pt100 −200 to +850 °C −328.0 to 1562.0 °F 13: JPt100 −200 to +600 °C −328.0 to 1112.0 °F Voltage (V)/ current (I) inputs −19999 to +99999 14: 0 to 20 mA DC 15: 4 to 20 mA DC 16: 0 to 10 V DC 17: 0 to 5 V DC 18: 1 to 5 V DC 19: 0 to 1 V DC 20: 0 to 100 mV DC 21: 0 to 10 mV DC RTD input (4-wire system) 22: Pt100 −200 to +850 °C −328.0 to 1562.0 °F 23: JPt100 −200 to +600 °C −328.0 to 1112.0 °F	Depend on model code When not specifying: Type K	P. 134

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Input 1_display unit selection	0210	0211	528	529	R/W	0: °C 1: °F	0	P. 135
Input 1_decimal point position	0212	0213	530	531	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 4: 4 digits below decimal point	1	P. 136
Input 1_input scale high	0214	0215	532	533	R/W	TC/RTD input: Input scale low to maximum value of input range Voltage (V)/current (I) input: −19999 to +99999 (Varies depending on the position of the decimal point setting)	Note1	P. 137
Input 1_input scale low	0216	0217	534	535	R/W	TC/RTD input: Minimum value of input range to input scale high Voltage (V)/current (I) input: −19999 to +99999 (Varies depending on the position of the decimal point setting)	Note2	P. 138
Input 1_input error determination point (high limit)	0218	0219	536	537	R/W	Input scale low − (5 % of input span) to input scale high + (5 % of input span)	Note3	P. 139
Input 1_input error determination point (low limit)	021A	021B	538	539	R/W	Input scale low − (5 % of input span) to input scale high + (5 % of input span)	Note4	P. 140

Note1 TC/RTD: Maximum value of input range V/I: 100.0
Note2 TC/RTD: Minimum value of input range V/I: 0.0
Note3 TC/RTD: Input scale high + (5 % of input span) V/I: 105.0
Note4 TC/RTD: Input scale low − (5 % of input span) V/I: −5.0

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Input 1_ burnout direction	021C	021D	540	541	R/W	0: Upscale 1: Downscale	Note1	P. 140
Input 1_square root extraction selection	021E	021F	542	543	R/W	0: Not provided 1: Provided	0	P. 141
Power supply frequency selection	0220	0221	544	545	R/W	0: 50 Hz 1: 60 Hz	0	P. 141

Note1 TC/RTD: 0 V/I: 1

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Input 2_ input type selection	0222	0223	546	547	R/W	TC input 0: K −200 to +1372 °C −328.0 to 2501.6 °F 1: J −200 to +1200 °C −328.0 to 2192.0 °F 2: R −50 to +1768 °C −58.0 to 3214.4 °F 3: S −50 to +1768 °C −58.0 to 3214.4 °F 4: B 0 to 1800 °C 32.0 to 3272.0 °F 5: E −200 to +1000 °C −328.0 to 1832.0 °F 6: N 0 to 1300 °C 32.0 to 2372.0 °F 7: T −200 to +400 °C −328.0 to 752.0 °F 8: W5Re/W26Re 0 to 2300 °C 32.0 to 4172.0 °F 9: PLII 0 to 1390 °C 32.0 to 2534.0 °F RTD input (3-wire system) 12: Pt100 −200 to +850 °C −328.0 to 1562.0 °F 13: JPt100 −200 to +600 °C −328.0 to 1112.0 °F Voltage (V)/ current (I) inputs −19999 to +99999 14: 0 to 20 mA DC 15: 4 to 20 mA DC 16: 0 to 10 V DC 17: 0 to 5 V DC 18: 1 to 5 V DC 19: 0 to 1 V DC 20: 0 to 100 mV DC 21: 0 to 10 mV DC RTD input (4-wire system) 22: Pt100 −200 to +850 °C −328.0 to 1562.0 °F 23: JPt100 −200 to +600 °C −328.0 to 1112.0 °F	Depend on model code When not specifying: Type K	P. 134

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Input 2_ display unit selection	0224	0225	548	549	R/W	0: °C 1: °F	0	P. 135
Input 2_decimal point position	0226	0227	550	551	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 4: 4 digits below decimal point	1	P. 136
Input 2_input scale high	0228	0229	552	553	R/W	TC/RTD input: Input scale low to maximum value of input range Voltage (V)/current (I) input: −19999 to +99999 (Varies depending on the position of the decimal point setting)	Note1	P. 137
Input 2_input scale low	022A	022B	554	555	R/W	TC/RTD input: Minimum value of input range to input scale high Voltage (V)/current (I) input: −19999 to +99999 (Varies depending on the position of the decimal point setting)	Note2	P. 138
Input 2_input error determination point (high limit)	022C	022D	556	557	R/W	Input scale low − (5 % of input span) to input scale high + (5 % of input span)	Note3	P. 139
Input 2_input error determination point (low limit)	022E	022F	558	559	R/W	Input scale low − (5 % of input span) to input scale high + (5 % of input span)	Note4	P. 140

Note1 TC/RTD: Maximum value of input range V/I: 100.0
Note2 TC/RTD: Minimum value of input range V/I: 0.0
Note3 TC/RTD: Input scale high + (5 % of input span) V/I: 105.0
Note4 TC/RTD: Input scale low − (5 % of input span) V/I: −5.0

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Input 2_ burnout direction	0230	0231	560	561	R/W	0: Upscale 1: Downscale	Note1	P. 140
Input 2_square root extraction selection	0232	0233	562	563	R/W	0: Not provided 1: Provided	0	P. 141
Event input logic selection	0234	0235	564	565	R/W	0 to 6	1	P. 142
Output logic selection	0236	0237	566	567	R/W	1 to 10	Note2	P. 144
Output 1 timer setting	0238	0239	568	569	R/W	0.0 to 600.0 seconds	0.0	P. 146
Output 2 timer setting	023A	023B	570	571	R/W	0.0 to 600.0 seconds	0.0	P. 146
Output 3 timer setting	023C	023D	572	573	R/W	0.0 to 600.0 seconds	0.0	P. 146
Output 4 timer setting	023E	023F	574	575	R/W	0.0 to 600.0 seconds	0.0	P. 146
Output 5 timer setting	0240	0241	576	577	R/W	0.0 to 600.0 seconds	0.0	P. 146
Transmission output 1_ type selection	0242	0243	578	579	R/W	0: None 1: Input 1_measured value (PV) 2: Input 1_set value (SV) 3: Input 1_deviation 4: Input 1_manipulated output value (MV) 5: Input 2_ measured value (PV) 6: Input 2_ set value (SV) 7: Input 2_deviation 8: Input 2_ manipulated output value (MV)	0	P. 148
Transmission output 1_ scale high	0244	0245	580	581	R/W	Measured value (PV) and set value (SV): Input scale low to input scale high Manipulated output value (MV): −5.0 to +105.0 % Deviation: −Input span to +Input span	Note3	P. 149

Note1 TC/RTD: 0 V/I: 1
Note2 1 input: 1 2 input: 5
Note3 PV/SV: Input scale high MV: 100.0 Deviation: +Input span

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Transmission output 1_ scale low	0246	0247	582	583	R/W	Measured value (PV) and set value (SV): Input scale low to input scale high Manipulated output value (MV): −5.0 to +105.0 % Deviation: −Input span to +Input span	Note1	P. 150
Transmission output 2_ type selection	0248	0249	584	585	R/W	0: None 1: Input 1_measured value (PV) 2: Input 1_set value (SV) 3: Input 1_deviation 4: Input 1_manipulated output value (MV) 5: Input 2_ measured value (PV) 6: Input 2_ set value (SV) 7: Input 2_deviation 8: Input 2_ manipulated output value (MV)	0	P. 148
Transmission output 2_ scale high	024A	024B	586	587	R/W	Measured value (PV) and set value (SV): Input scale low to input scale high Manipulated output value (MV): −5.0 to +105.0 % Deviation: −Input span to +Input span	Note2	P. 149

Note1 PV/SV: Input scale low MV: 0.0 Deviation: −Input span
Note2 PV/SV: Input scale high MV: 100.0 Deviation: +Input span

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Transmission output 2_ scale low	024C	024D	588	589	R/W	Measured value (PV) and set value (SV): Input scale low to input scale high Manipulated output value (MV): −5.0 to +105.0 % Deviation: −Input span to +Input span	Note1	P. 150
Transmission output 3_ type selection	024E	024F	590	591	R/W	0: None 1: Input 1_measured value (PV) 2: Input 1_set value (SV) 3: Input 1_deviation 4: Input 1_manipulated output value (MV) 5: Input 2_ measured value (PV) 6: Input 2_ set value (SV) 7: Input 2_deviation 8: Input 2_ manipulated output value (MV)	0	P. 148
Transmission output 3_ scale high	0250	0251	592	593	R/W	Measured value (PV) and set value (SV): Input scale low to input scale high Manipulated output value (MV): −5.0 to +105.0 % Deviation: −Input span to +Input span	Note2	P. 149

Note1 PV/SV: Input scale low MV: 0.0 Deviation: −Input span
Note2 PV/SV: Input scale high MV: 100.0 Deviation: +Input span

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Transmission output 3_ scale low	0252	0253	594	595	R/W	Measured value (PV) and set value (SV): Input scale low to input scale high Manipulated output value (MV): −5.0 to +105.0 % Deviation: −Input span to +Input span	Note1	P. 150
Event 1 type selection	0254	0255	596	597	R/W	0: None 1: Deviation high 2: Deviation low 3: Deviation high/low 4: Band 5: Process high 6: Process low 7: SV high 8: SV low	0	P. 151
Event 1 hold action	0256	0257	598	599	R/W	0: Not provided 1: Provided 2: Re-hold action	0	P. 154
Event 1 differential gap	0258	0259	600	601	R/W	0 to input span	Note2	P. 156
Event 1 action at input error	025A	025B	602	603	R/W	0: Normal processing 1: Forcibly turned on	0	P. 158
Event 1 assignment	025C	025D	604	605	R/W	1: For input 1 2: For input 2	0	P. 160
Event 2 type selection	025E	025F	606	607	R/W	0: None 1: Deviation high 2: Deviation low 3: Deviation high/low 4: Band 5: Process high 6: Process low 7: SV high 8: SV low	0	P. 151
Event 2 hold action	0260	0261	608	609	R/W	0: Not provided 1: Provided 2: Re-hold action	0	P. 154

Note1 PV/SV: Input scale low MV: 0.0 Deviation: −Input span
Note2 TC/RTD: 2.0 °C V/I: 0.2 % of input span

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Event 2 differential gap	0262	0263	610	611	R/W	0 to input span	Note1	P. 156
Event 2 action at input error	0264	0265	612	613	R/W	0: Normal processing 1: Forcibly turned on	0	P. 158
Event 2 assignment	0266	0267	614	615	R/W	1: For input 1 2: For input 2	0	P. 160
Event 3 type selection	0268	0269	616	617	R/W	0: None 1: Deviation high 2: Deviation low 3: Deviation high/low 4: Band 5: Process high 6: Process low 7: SV high 8: SV low	0	P. 151
Event 3 hold action	026A	026B	618	619	R/W	0: Not provided 1: Provided 2: Re-hold action	0	P. 154
Event 3 differential gap	026C	026D	620	621	R/W	0 to input span	Note1	P. 156
Event 3 action at input error	026E	026F	622	623	R/W	0: Normal processing 1: Forcibly turned on	0	P. 158
Event 3 assignment	0270	0271	624	625	R/W	1: For input 1 2: For input 2	0	P. 160
Event 4 type selection	0272	0273	626	627	R/W	0: None 1: Deviation high 2: Deviation low 3: Deviation high/low 4: Band 5: Process high 6: Process low 7: SV high 8: SV low	0	P. 151
Event 4 hold action	0274	0275	628	629	R/W	0: Not provided 1: Provided 2: Re-hold action	0	P. 154
Event 4 differential gap	0276	0277	630	631	R/W	0 to input span	Note1	P. 156
Event 4 action at input error	0278	0279	632	633	R/W	0: Normal processing 1: Forcibly turned on	0	P. 158
Event 4 assignment	027A	027B	634	635	R/W	1: For input 1 2: For input 2	0	P. 160

Note1 TC/RTD: 2.0 °C V/I: 0.2 % of input span

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
CT1 ratio	027C	027D	636	637	R/W	0 to 9999	Depend on model code	P. 161
CT1 assignment	027E	027F	638	639	R/W	0: None 3: OUT3 1: OUT1 4: OUT4 2: OUT2 5: OUT5	Note1	P. 162
CT2 ratio	0280	0281	640	641	R/W	0 to 9999	Depend on model code	P. 161
CT2 assignment	0282	0283	642	645	R/W	0: None 3: OUT3 1: OUT1 4: OUT4 2: OUT2 5: OUT5	Note2	P. 162
Hot/Cold start selection	0284	0285	644	645	R/W	Power failure of 3 seconds or less 0: Hot 1 3: Hot 2 1: Hot 1 4: Hot 2 2: Hot 1 5: Cold Power failure of 3 seconds or more 0: Hot 1 3: Hot 2 1: Hot 2 4: Cold 2: Cold 5: Cold	0	P. 163
Input 2_use selection	0286	0287	646	647	R/W	0: Single loop control 1: Remote input 2: Cascade control (Slave)	0	P. 164
Cascade ratio	0288	0289	648	649	R/W	0.000 to 1.500	1.000	P. 165
Cascade bias	028A	028B	650	651	R/W	–Input span to +input span	0.0	P. 165
SV tracking	028C	028D	652	653	R/W	0: Not provided 1: Provided	1	P. 167
Input 1_control action type selection	028E	028F	654	655	R/W	0: Direct action 1: Reverse action	1	P. 168

Note1 CT1 provided: 1 CT1 not provided: 0
Note2 CT2 provided: 1 CT2 not provided: 0

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Input 1_ integral/derivative time decimal point position selection	0290	0291	656	657	R/W	0: No digit below decimal point 1: 1 digit below decimal point 2: 2 digits below decimal point	2	P. 169
Input 1_derivative gain	0292	0293	658	659	R/W	0.1 to 10.0	6.0	P. 170
Input 1_ON/OFF action differential gap (upper)	0294	0295	660	661	R/W	0 to input span	Note1	P. 170
Input 1_ON/OFF action differential gap (lower)	0296	0297	662	663	R/W	0 to input span	Note1	P. 171
Input 1_action at input error (high limit)	0298	0299	664	665	R/W	0: Normal control (present output) 1: Manipulated output value at input error	0	P. 172
Input 1_action at input error (low limit)	029A	029B	666	667	R/W	0: Normal control (present output) 1: Manipulated output value at input error	0	P. 173
Input 1_manipulated output value at input error	029C	029D	668	669	R/W	−5.0 to +105.0 %	−5.0	P. 173
Input 1_output change rate limiter (up)	029E	029F	670	671	R/W	0.0 to 1000.0 %/seconds	0.0	P. 174
Input 1_output change rate limiter (down)	02A0	02A1	672	673	R/W	0.0 to 1000.0 %/seconds	0.0	P. 174
Input 1_output limiter (high limit)	02A2	02A3	674	675	R/W	Input 1_output limiter (low limit) to 105.0 %	105.0	P. 176
Input 1_output limiter (low limit)	02A4	02A5	676	677	R/W	−5.0 % to input 1_output limiter (high limit)	−5.0	P. 176
Input 1_power feed forward	02A6	02A7	678	679	R/W	0: Not provided 1: Provided	Note2	P. 177
Input 2_control action type selection	02A8	02A9	680	681	R/W	0: Direct action 1: Reverse action	1	P. 168

Note1 TC/RTD: 1.0 °C V/I: 0.1 % of input span
Note2 Not provided: 0 Provided: 1

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Input 2_ integral/derivative time decimal point position selection	02AA	02AB	682	683	R/W	0: No digit below decimal point 1: 1 digit below decimal point 2: 2 digits below decimal point	2	P. 169
Input 2_derivative gain	02AC	02AD	684	685	R/W	0.1 to 10.0	6.0	P. 170
Input 2_ON/OFF action differential gap (upper)	02AE	02AF	686	687	R/W	0 to input span	Note1	P. 170
Input 2_ON/OFF action differential gap (lower)	02B0	02B1	688	689	R/W	0 to input span	Note1	P. 171
Input 2_action at input error (high limit)	02B2	02B3	690	691	R/W	0: Normal control (present output) 1: Manipulated output value at input error	0	P. 172
Input 2_action at input error (low limit)	02B4	02B5	692	693	R/W	0: Normal control (present output) 1: Manipulated output value at input error	0	P. 173
Input 2_manipulated output value at input error	02B6	02B7	694	695	R/W	–5.0 to +105.0 %	–5.0	P. 173
Input 2_output change rate limiter (up)	02B8	02B9	696	697	R/W	0.0 to 1000.0 %/seconds	0.0	P. 174
Input 2_output change rate limiter (down)	02BA	02BB	698	699	R/W	0.0 to 1000.0 %/seconds	0.0	P. 174
Input 2_output limiter (high limit)	02BC	02BD	700	701	R/W	Input 2_output limiter (low limit) to 105.0 %	105.0	P. 176
Input 2_output limiter (low limit)	02BE	02BF	702	703	R/W	–5.0 % to input 2_output limiter (high limit)	–5.0	P. 176
Input 2_power feed forward	02C0	02C1	704	705	R/W	0: Not provided 1: Provided	Note2	P. 177
Input 1_AT bias	02C2	02C3	706	707	R/W	–Input span to +input span	0	P. 178
Input 1_AT cycle	02C4	02C5	708	709	R/W	0: 1.5 cycle 1: 2.0 cycle 2: 2.5 cycle 3: 3.0 cycle	1	P. 179

Note1 TC/RTD: 1.0 °C V/I: 0.1 % of input span
Note2 Not provided: 0 Provided: 1

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Input 1_AT differential gap time	02C6	02C7	710	711	R/W	0.00 to 50.00 seconds	Note1	P. 180
Input 2_AT bias	02C8	02C9	712	713	R/W	–Input span to +input span	0	P. 178
Input 2_AT cycle	02CA	02CB	714	715	R/W	0: 1.5 cycle 1: 2.0 cycle 2: 2.5 cycle 3: 3.0 cycle	1	P. 179
Input 2_AT differential gap time	02CC	02CD	716	717	R/W	0.00 to 50.00 seconds	Note1	P. 180
Open/Close output neutral zone	02CE	02CF	718	719	R/W	0.1 to 10.0 %	10.0	P. 182
Open/Close output differential gap	02D0	02D1	720	721	R/W	0.1 to 5.0 %	0.2	P. 183
Action at feedback resistance input (FBR) error	02D2	02D3	722	723	R/W	0: Close-side output ON, Open-side output OFF 1: Close-side output OFF, Open-side output OFF 2: Close-side output OFF, Open-side output ON	0	P. 184
Feedback adjustment	02D4	02D5	724	725	R/W	0: Adjustment end 1: During the Open-side adjusting 2: During the Close-side adjusting	—	P. 185
Setting change rate limiter unit time	02D6	02D7	726	727	R/W	1 to 3600 seconds	60	P. 186
Soak time unit selection	02D8	02D9	728	729	R/W	0: 0 hour 00 minutes 00 second to 9 hours 59 minutes 59 seconds 2: 0 minutes 00.00 seconds to 9 minutes 59.99 seconds	2	P. 186
Input 1_setting limiter (high limit)	02DA	02DB	730	731	R/W	Input 1_setting limiter (low limit) to input 1_ input scale high	Input 1_ input scale high	P. 187

Note1 HA400/HA900: 0.10 HA401/HA901: 10.00

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Input 1_setting limiter (low limit)	02DC	02DD	732	733	R/W	Input 1_input scale low to input 1_setting limiter (high limit)	Input 1_ input scale low	P. 188
Input 2_setting limiter (high limit)	02DE	02DF	734	735	R/W	Input 2_setting limiter (low limit) to input 2_ input scale high	Input 2_ input scale high	P. 187
Input 2_setting limiter (low limit)	02E0	02E1	736	737	R/W	Input 2_input scale low to input 2_setting limiter (high limit)	Input 2_ input scale low	P. 188
ROM version display	02E2	02E3	738	739	RO	Display the version of loading software.	—	P. 189
Integrated operating time display	02E4	02E5	740	741	RO	0 to 99999 hours	—	P. 189
Holding peak value ambient temperature display	02E6	02E7	742	743	RO	–10.0 to +100.0 °C The maximum ambient temperature of the instrument is displayed.	—	P. 189
Power feed transformer input value monitor	02E8	02E9	744	745	RO	0.0 to 160.0 % (Display in the engineering unit of % corresponding to the rated value.) The input value of a power feed transformer is displayed.	—	P. 190
Unused	02EA ⋮ 04FE	02EB ⋮ 04FF	746 ⋮ 1278	747 ⋮ 1279	—	—	—	—

Items relating to the memory area other than the control area

Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Memory area selection	0500	0501	1280	1281	R/W	1 to 16	1	P. 191
Event 1 set value	0502	0503	1282	1283	R/W	Deviation: –Input span to +input span Process/SV: Input scale low to input scale high	50.0	P. 192
Event 2 set value	0504	0505	1284	1285	R/W	Deviation: –Input span to +input span Process/SV: Input scale low to input scale high	50.0	P. 192
Event 3 set value	0506	0507	1286	1287	R/W	Deviation: –Input span to +input span Process/SV: Input scale low to input scale high	50.0	P. 192
Control loop break alarm 1 (LBA1)	0508	0509	1288	1289	R/W	0: OFF (Not provided) 1 to 7200 seconds	480	P. 193
LBA1 deadband	050A	050B	1290	1291	R/W	0.0 to input span	0.0	P. 193
Event 4 set value	050C	050D	1292	1293	R/W	Deviation: –Input span to +input span Process/SV: Input scale low to input scale high	50.0	P. 192
Control loop break alarm 2 (LBA2)	050E	050F	1294	1295	R/W	0: OFF (Not provided) 1 to 7200 seconds	480	P. 193
LBA2 deadband	0510	0511	1296	1297	R/W	0.0 to input span	0.0	P. 193
Input 1_set value (SV1)	0512	0513	1298	1299	R/W	Input 1_setting limiter (low limit) to input 1_ setting limiter (high limit)	0.0	P. 194
Input 1_proportional band	0514	0515	1300	1301	R/W	TC/RTD input: 0 to input span Voltage/current input: 0.0 to 1000.0 % of input span	30.0	P. 194

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Input 1_integral time	0516	0517	1302	1303	R/W	0.0 to 3600.0 seconds or 0.00 to 360.00 seconds (0.0 or 0.00: PD action)	240.00	P. 195
Input 1_derivative time	0518	0519	1304	1305	R/W	0.0 to 3600.0 seconds or 0.00 to 360.00 seconds (0.0 or 0.00: PI action)	60.00	P. 195
Input 1_control response parameter	051A	051B	1306	1307	R/W	0: Slow 1: Medium 2: Fast	0	P. 196
Unused	051C	051D	1308	1309	—	—	—	—
Input 2_set value (SV2)	051E	051F	1310	1311	R/W	Input 2_setting limiter (low limit) to input 2_ setting limiter (high limit)	0.0	P. 194
Input 2_ proportional band	0520	0521	1312	1313	R/W	TC/RTD input: 0 to input span Voltage/current input: 0.0 to 1000.0 % of input span	30.0	P. 194
Input 2_ integral time	0522	0523	1314	1315	R/W	0.0 to 3600.0 seconds or 0.00 to 360.00 seconds (0.0 or 0.00: PD action)	240.00	P. 195
Input 2_ derivative time	0524	0525	1316	1317	R/W	0.0 to 3600.0 seconds or 0.00 to 360.00 seconds (0.0 or 0.00: PI action)	60.00	P. 195
Input 2_control response parameter	0526	0527	1318	1319	R/W	0: Slow 1: Medium 2: Fast	0	P. 196
Unused	0528	0529	1320	1321	—	—	—	—
Input 1_setting change rate limiter (up)	052A	052B	1322	1323	R/W	0: OFF (Not provided) 0.1 to input span/one minute	0.0	P. 196
Input 1_setting change rate limiter (down)	052C	052D	1324	1325	R/W	0: OFF (Not provided) 0.1 to input span/one minute	0.0	P. 197
Input 2_setting change rate limiter (up)	052E	052F	1326	1327	R/W	0: OFF (Not provided) 0.1 to input span/one minute	0.0	P. 196
Input 2_setting change rate limiter (down)	0530	0531	1328	1329	R/W	0: OFF (Not provided) 0.1 to input span/one minute	0.0	P. 197

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	High-order	Low-order	High-order	Low-order				
Area soak time	0532	0533	1330	1331	R/W	0 minute 00.00 second to 9 minutes 59.99 seconds or 0 hour 00 minute 00 second to 9 hours 59 minutes 59 seconds	0.00.00	P. 197
Link area number	0534	0535	1332	1333	R/W	0: OFF (No link) 1 to 16	0	P. 198

7. COMMUNICATION DATA DESCRIPTION

■ Referance to communication data contents

(1) (2) (3)

Input 1_ measured value (PV1) monitor	RKC communication identifier	M1
	MODBUS register address	High order: 0000H (0) Low order: 0001H (1)
Input 2_ measured value (PV2) monitor	RKC communication identifier	M0
	MODBUS register address	High order: 0002H (2) Low order: 0003H (3)

(4) → Measured value (PV) is the input value of the controller. There are thermocouple input, resistance temperature detector input, voltage input and current input.

(5) → Attribute: RO (Read only)

(6) → Digits: 7 digits

(7) → Data range: Input scale low limit to Input scale high limit

☞ See Input range table (P. 134)

(8) → Factory set value: —

(9) → Relational items: Decimal point position (P. 136)

(1) Name: Communication data name is written.

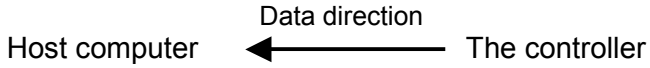
(2) RKC communication identifier:
Communication identifier of RKC communication is written.

(3) MODBUS register address:
MODBUS communication data register addresses are written. These register addresses are written using both of hexadecimal and decimal (in parantheses) numbers.

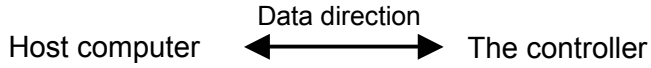
(4) Description: A short description of the communication data item is written.

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

RO: Only reading data from the controller is possible.



R/W: Reading and writing data from the controller is possible.



(6) Digits: The data number of digits in RKC communication is written.

(7) Data range: The reading range or the writing range of communication data is written.

(8) Factory set value: The factory set value of communication data is written.

(9) Relational items: A name and a page of relational items are written.

📖 There is item including the functional description.

Model codes	RKC communication identifier	ID
	MODBUS register address	Absence

This value is the type identifier code of the controller. It is the same content as a stuck imprint in side face of the case.

Attribute: RO (Read only)
Digits: 32 digits
Data range: —
Factory set value: —

Input 1_ measured value (PV1) monitor	RKC communication identifier	M1
	MODBUS register address	High order: 0000H (0) Low order: 0001H (1)
Input 2_ measured value (PV2) monitor	RKC communication identifier	M0
	MODBUS register address	High order: 0002H (2) Low order: 0003H (3)

Measured value (PV) is an input value of the controller. There are thermocouple input (TC), resistance temperature detector input (RTD), voltage input (V) and current input (I).

Attribute: RO (Read only)
Digits: 7 digits
Data range: Input scale low limit to Input scale high limit
☞ See **Input range table (P. 134)**
Factory set value: —
Relational items: Decimal point position (P. 136)

Feedback resistance input value monitor	RKC communication identifier	M2
	MODBUS register address	High order: 0004H (4) Low order: 0005H (5)

This value is a feedback resistance input value of the controller.

Attribute: RO (Read only)
Digits: 7 digits
Data range: 0.0 to 100.0 %
Factory set value: —
Relational items: Open/Close output neutral zone (P. 182),
Open/Close output differential gap (P. 183)

Current transformer input value 1 (CT1) monitor	RKC communication identifier	M3
	MODBUS register address	High order: 0006H (6) Low order: 0007H (7)
Current transformer input value 2 (CT2) monitor	RKC communication identifier	M4
	MODBUS register address	High order: 0008H (8) Low order: 0009H (9)

This value is a current transformer input value that is used for heater break alarm function.

Attribute: RO (Read only)
Digits: 7 digits
Data range: When the CT type is CTL-6-P-N: 0.0 to 30.0 A
When the CT type is CTL-12-S56-10L-N: 0.0 to 100.0 A
Factory set value: —
Relational items: Heater break alarm (HBA) state (P. 104),
Heater break alarm (HBA) set value (P. 123),
CT ratio (P. 161), CT assignment (P. 162)

Input 1_set value (SV1) monitor	RKC communication identifier	MS
	MODBUS register address	High order: 000AH (10) Low order: 000BH (11)
Input 2_set value (SV2) monitor	RKC communication identifier	MT
	MODBUS register address	High order: 000CH (12) Low order: 000DH (13)

This value is a monitor of the set value (SV) that is a desired value for control.

Attribute: RO (Read only)
Digits: 7 digits
Data range: Setting limiter (low limit) to Setting limiter (high limit)
☞ See **Input range table (P. 134)**
Factory set value: —
Relational items: Decimal point position (P. 136)

Remote input value monitor	RKC communication identifier	S2
	MODBUS register address	High order: 000EH (14) Low order: 000FH (15)

This value is an input value that is used for remote input function.

Attribute: RO (Read only)
Digits: 7 digits
Data range: Input 1_setting limiter (low limit) to Input 1_setting limiter (high limit)
☞ See **Input range table (P. 134)**
Factory set value: —

Cascade monitor	RKC communication identifier	KH
	MODBUS register address	High order: 0010H (16) Low order: 0011H (17)

This value is an input value (a commanding value from the master) that is used for cascade control function.

Attribute: RO (Read only)
Digits: 7 digits
Data range: Input 2_ setting limiter (low limit) to Input 2_ setting limiter (high limit)
☞ See **Input range table (P. 134)**
Factory set value: —
Relational items: Input 2_use selection (P. 164)

Input 1_burnout state	RKC communication identifier	B1
	MODBUS register address	High order: 0012H (18) Low order: 0013H (19)
Input 2_burnout state	RKC communication identifier	B0
	MODBUS register address	High order: 0014H (20) Low order: 0015H (21)

This value expresses a state in input break.

Attribute: RO (Read only)
Digits: 7 digits
Data range: 0: OFF
1: ON
Factory set value: —
Relational items: Burnout direction (P. 140)

Feedback resistance input burnout state	RKC communication identifier	B2
	MODBUS register address	High order: 0016H (22) Low order: 0017H (23)

This value expresses a state in feedback resistance input break.

Attribute: RO (Read only)
Digits: 7 digits
Data range: 0: OFF
1: ON
Factory set value: —
Relational items: Action at feedback resistance input (FBR) error (P. 184)

Event 1 state	RKC communication identifier	AA
	MODBUS register address	High order: 0018H (24) Low order: 0019H (25)
Event 2 state	RKC communication identifier	AB
	MODBUS register address	High order: 001AH (26) Low order: 001BH (27)
Event 3 state	RKC communication identifier	AC
	MODBUS register address	High order: 001CH (28) Low order: 001DH (29)
Event 4 state	RKC communication identifier	AD
	MODBUS register address	High order: 001EH (30) Low order: 001FH (31)

This value expresses a state of the event ON/OFF.

Attribute: RO (Read only)
Digits: 7 digits
Data range: 0: OFF
1: ON
Factory set value: —
Relational items: Event set value (P. 112), Output logic selection (P. 144),
Event type selection (P. 151), Event hold action (P. 154),
Event differential gap (P. 156), Event action at input error (P. 158),
Event assignment (P. 160)

Heater break alarm 1 (HBA1) state	RKC communication identifier	AE
	MODBUS register address	High order: 0020H (32) Low order: 0021H (33)
Heater break alarm 2 (HBA2) state	RKC communication identifier	AF
	MODBUS register address	High order: 0022H (34) Low order: 0023H (35)

This value expresses a state of the heater break alarm ON/OFF.

Attribute: RO (Read only)
Digits: 7 digits
Data range: 0: OFF
1: ON
Factory set value: —
Relational items: Current transformer input value (CT) monitor (P. 101),
Heater break alarm (HBA) set value (P. 123),
CT ratio (P. 161), CT assignment (P. 162)

Input 1_ manipulated output value (MV1) monitor	RKC communication identifier	O1
	MODBUS register address	High order: 0024H (36) Low order: 0025H (37)
Input 2_ manipulated output value (MV2) monitor	RKC communication identifier	O0
	MODBUS register address	High order: 0026H (38) Low order: 0027H (39)

This value is an output value of the controller.

Attribute: RO (Read only)
Digits: 7 digits
Data range: −5.0 to +105.0 %
Factory set value: —
Relational items: Manipulated output value (P. 127), Output logic selection (P. 144),
Output change rate limiter (up/down) (P. 174),
Output limiter (high limit/low limit) (P. 176)

Error codes	RKC communication identifier	ER
	MODBUS register address	High order: 0028H (40) Low order: 0029H (41)

Each error state of the controller is expressed in bit data items.

Attribute: RO (Read only)
Digits: 7 digits
Data range: 0 to 4095 (bit data)
The error state is assigned as a bit image in binary numbers.
However, send data from the controller be changed to decimal ASCII code from the bit image in binary numbers for RKC communication.

Bit image: 000000000000
bit 11 ····· bit 0

Bit data: 0: OFF 1: ON

bit 0: Adjustment data error
bit 1: EEPROM error
bit 2: A/D conversion error
bit 3: RAM check error
bit 4: Hard configuration error
bit 5: Soft configuration error
bit 6: Unused
bit 7: Watchdog timer error
bit 8 to bit 10:
Unused
bit 11: Program busy
bit 12 to bit 31:
Unused

Factory set value: —

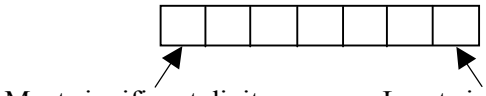
Event input state	RKC communication identifier	L1
	MODBUS register address	High order: 002AH (42) Low order: 002BH (43)

Each event input state of the controller is expressed in bit data items.

Attribute: RO (Read only)
Digits: 7 digits
Data range: RKC communication: ASCII code data of 7 digits

The event input state is assigned as a digit image in ASCII code data of 7 digits.

ASCII code data of 7 digits:



Data: 0: Open 1: Close

Least significant digit:	The state of DI 1
2nd digit:	The state of DI 2
3rd digit:	The state of DI 3
4th digit:	The state of DI 4
5th digit:	The state of DI 5
6th digit:	The state of DI 6
Most significant digit:	The state of DI 7

MODBUS: 0 to 127 (bit data)

The event input state is assigned as a bit image in binary numbers.

Bit image: 0000000

bit 6 ····· bit 0

Bit data: 0: Open 1: Close

bit 0: The state of DI 1
bit 1: The state of DI 2
bit 2: The state of DI 3
bit 3: The state of DI 4
bit 4: The state of DI 5
bit 5: The state of DI 6
bit 6: The state of DI 7
bit 7 to bit 31:
Unused

Factory set value: —
Relational items: Event input logic selection (P. 142)

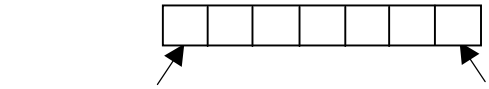
Operation mode state	RKC communication identifier	L0
	MODBUS register address	High order: 002CH (44) Low order: 002DH (45)

Each operation mode state of the controller is expressed in bit data items.

Attribute: RO (Read only)
Digits: 7 digits
Data range: RKC communication: ASCII code data of 7 digits

The operation mode state is assigned as a digit image in ASCII code data of 7 digits.

ASCII code data of 7 digits:



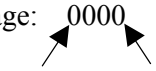
Most significant digit · · · · · · · · Least significant digit

Least significant digit: 1: Control STOP
2nd digit: 1: Control RUN
3rd digit: 1: Input 1_Manual mode (Including Input 1_Remote mode)
4th digit: 1: Input 2_Manual mode (Including Input 2_Remote mode)
5th digit: 1: Remote mode or Cascade control
6th digit to Most significant digit:
Unused

MODBUS: 0 to 31 (bit data)

The operation mode state is assigned as a bit image in binary numbers.

Bit image: 0000



bit 4 bit 0

bit 0: 1: Control STOP
bit 1: 1: Control RUN
bit 2: 1: Input 1_Manual mode (Including Input 1_Remote mode)
bit 3: 1: Input 2_Manual mode (Including Input 2_Remote mode)
bit 4: 1: Remote mode or Cascade control
bit 5 to bit 31:
Unused

Factory set value: —
Relational items: Auto/Manual transfer (P. 110), Remote/Local transfer (P. 111), RUN/STOP transfer (P. 111), Input 2_use selection (P. 164)

Memory area soak time monitor	RKC communication identifier	TR
	MODBUS register address	High order: 002EH (46) Low order: 002FH (47)

This value expresses memory area soak time to use in case of simple program operation (see P. 109) that used memory area.

Attribute: RO (Read only)
Digits: 7 digits
Data range: 0 minute 00.00 second to 9 minutes 59.99 seconds or
0 hour 00 minute 00 second to 9 hours 59 minutes 59 seconds

Memory area soak time monitor is expressed in second unit for MODBUS.
0 minute 00.00 second to 9 minutes 59.99 seconds: 0 to 35999 seconds
0 hour 00 minute 00 second to 9 hours 59 minutes 59 seconds: 0 to 59999 seconds

Factory set value: —
Relational items: Area soak time (P. 121), Soak time unit selection (P. 186)

Input 1_PID/AT transfer	RKC communication identifier	G1
	MODBUS register address	High order: 0030H (48) Low order: 0031H (49)
Input 2_PID/AT transfer	RKC communication identifier	G0
	MODBUS register address	High order: 0032H (50) Low order: 0033H (51)

This item transfers PID control and autotuning (AT).

Attribute: R/W (Read and Write)

Input 2_PID/AT transfer (G0) becomes RO (Read only) for one input specification.

Digits: 7 digits
Data range: 0: PID control
1: Autotuning (AT)
Factory set value: 0
Relational items: AT bias (P. 178), AT cycle (P. 179), AT differential gap time (P. 180)

Functional description:

Autotuning (AT) is the function which automatically measures, calculates and sets the optimum PID constants according to the set temperature. The following is the conditions necessary to carry out autotuning and the conditions which will cause the autotuning to stop.

Continued on the next page.

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The autotuning start:
Start the autotuning when all following conditions are satisfied:

- Operation mode conditions:
  – Auto/Manual transfer → Auto mode
  – Remote/Local transfer → Local mode
  – PID/AT transfer → PID control
  – RUN/STOP transfer → Control RUN
- The measured value (PV1) should not be an underscale or overscale displayed.
- The output limiter high limit should be 0.1 % or more and the output limiter low limit should be 99.9 % or less.

When the autotuning is finished, the control will automatically returns to PID control.

The autotuning cancellation:

- When the temperature set value (SV) is changed.
- When the control area is changed.
- When the output limiter high limit or the output limiter low limit is changed.
- When the PV bias, the PV digital filter, or the PV ratio is changed.
- When the Auto/Manual transfer is changed to the Manual mode.
- When the Remote/Local transfer is changed to the Remote mode.
- When the measured value (PV1) becomes an underscale or overscale display.
- When the power failure occurs.
- When FAIL occurs in the controller.
- When the PID/AT transfer is changed to the PID control.
- When the RUN/STOP transfer is changed to the Control STOP.

When the above-mentioned conditions to stop the autotuning occurs, the autotuning is immediately stopped and switch over to the PID control mode. The PID constants return to the values at the start of the autotuning.

Input 1_Auto/Manual transfer	RKC communication identifier	J1
	MODBUS register address	High order: 0034H (52) Low order: 0035H (53)
Input 2_Auto/Manual transfer	RKC communication identifier	J0
	MODBUS register address	High order: 0036H (54) Low order: 0037H (55)

This item transfers the automatic (AUTO) control and the manual (MAN) control.

Attribute: R/W (Read and Write)

The Input 2_Auto/Manual transfer (J0) becomes RO (Read only) for the one input specification.

Digits: 7 digits
Data range: 0: Auto mode
1: Manual mode
Factory set value: 0
Relational items: Operation mode state (P. 107)

Remote/Local transfer	RKC communication identifier	C1
	MODBUS register address	High order: 0038H (56) Low order: 0039H (57)

This item selects to use the set value of local or remote input.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) besides the remote input specification or the cascade control specification.

Digits: 7 digits
Data range: 0: Local mode
1: Remote mode or Cascade control
Factory set value: 0
Relational items: Operation mode state (P. 107)

RUN/STOP transfer	RKC communication identifier	SR
	MODBUS register address	High order: 003AH (58) Low order: 003BH (59)

This item transfers Control RUN and Control STOP.

Attribute: R/W (Read and Write)
Digits: 7 digits
Data range: 0: Control RUN
1: Control STOP
Factory set value: 0
Relational items: Operation mode state (P. 107)

Memory area selection	RKC communication identifier	ZA
	MODBUS register address	High order: 003CH (60) Low order: 003DH (61)

This item selects the memory area to use for control.

Attribute: R/W (Read and Write)
Digits: 7 digits
Data range: 1 to 16
Factory set value: 1

Event 1 set value	RKC communication identifier	A1
	MODBUS register address	High order: 003EH (62) Low order: 003FH (63)
Event 2 set value	RKC communication identifier	A2
	MODBUS register address	High order: 0040H (64) Low order: 0041H (65)
Event 3 set value	RKC communication identifier	A3
	MODBUS register address	High order: 0042H (66) Low order: 0043H (67)
Event 4 set value	RKC communication identifier	A4
	MODBUS register address	High order: 0048H (72) Low order: 0049H (73)

This value expresses a set value of the event action.

Attribute: R/W (Read and Write)

The event 3 set value (A3) becomes RO (Read only) when it was selected "9: Control loop break alarm (LBA) " from the event 3 type selection (XC).

The event 4 set value (A4) becomes RO (Read only) when it was selected "9: Control loop break alarm (LBA) " from the event 4 type selection (XD).

Digits: 7 digits

Data range: Deviation: −Input span to +input span
Process: Input scale low to input scale high
SV: Input scale low to input scale high

Factory set value: 50.0

Relational items: Event state (P. 103), Event type selection (P. 151), Event hold action (P. 154), Event differential gap (P. 156), Event action at input error (P. 158), Event assignment (P. 160)

Control loop break alarm 1 (LBA1) time	RKC communication identifier	A5
	MODBUS register address	High order: 0044H (68) Low order: 0045H (69)
Control loop break alarm 2 (LBA2) time	RKC communication identifier	A6
	MODBUS register address	High order: 004AH (74) Low order: 004BH (75)

The variation of measured value (PV) is monitored for each control loop break alarm (LBA) time.

Attribute: R/W (Read and Write)

The control loop break alarm 1 (LBA1) time (A5) becomes RO (Read only) when it was selected "1 to 8" from the event 3 type selection (XC).

The control loop break alarm 2 (LBA2) time (A6) becomes RO (Read only) when it was selected "1 to 8" from the event 4 type selection (XD).

Digits: 7 digits
Data range: 0 to 7200 seconds (0: Not provided)
Factory set value: 480
Relational items: Event state (P. 103), Event assignment (P. 160), LBA deadband (P. 113)

LBA1 deadband	RKC communication identifier	N1
	MODBUS register address	High order: 0046H (70) Low order: 0047H (71)
LBA2 deadband	RKC communication identifier	N2
	MODBUS register address	High order: 004CH (76) Low order: 004DH (77)

The LBA deadband is a zone to prevent the control loop break alarm (LBA) from malfunctioning caused by disturbance.

Attribute: R/W (Read and Write)

The LBA1 deadband (N1) becomes RO (Read only) when it was selected "1 to 8" from the event 3 type selection (XC).

The LBA2 deadband (N2) becomes RO (Read only) when it was selected "1 to 8" from the event 4 type selection (XD).

Digits: 7 digits
Data range: 0.0 to input span
Factory set value: 0.0
Relational items: Event state (P. 103), Event assignment (P. 160),
Control loop break alarm (LBA) time (P. 113)

■ Functional description

Control loop break alarm (LBA) :

The control loop break alarm (LBA) function is used to detect a load (heater) break or a failure in the external actuator (magnet relay, etc.), or a failure in the control loop caused by an input (sensor) break.

This function monitors the measured value (PV) variation at LBA time intervals from the time the output exceeds 100 % (or output limiter: high limit) or falls below 0 % (or output limiter: low limit), then detects a heater or input break.

[Alarm action]

The LBA function produces the alarm when any of the following causes occurs.

LBA triggering width: Temperature input: 2 °C [2 °F] fixed
Voltage/current input: 0.2% fixed

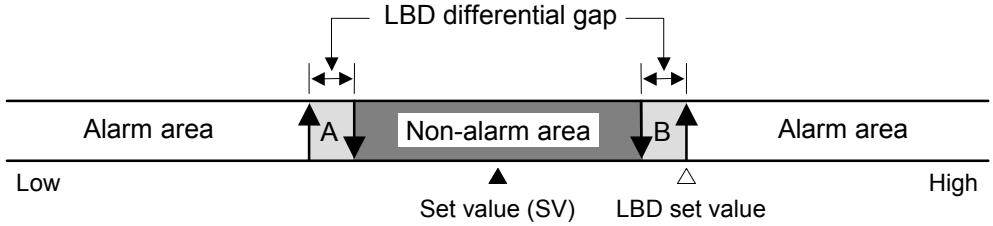
- **When the output falls below 0 % (or output limiter: low limit)**
  For direct action: This alarm is produced when the measured value (PV) does not rise beyond the LBA triggering width within the LBA time.
  For reverse action: This alarm is produced when the measured value (PV) does not fall below the LBA triggering width within the LBA time.
- **When the output exceeds 100 % (or output limiter: high limit)**
  For direct action: This alarm is produced when the measured value (PV) does not fall below the LBA triggering width within the LBA time.
  For reverse action: This alarm is produced when the measured value (PV) does not rise beyond the LBA triggering width within the LBA time.

If the autotuning function is used, the LBA time twice as large as the integral time is automatically set. The LBA setting time does not change even if the integral time is changed.

Control loop break alarm (LBA) deadband:

The LBA may be produced by disturbances (other heat sources) even if the control system is not abnormal. In such a case, an area in which no alarm is produced can be set by setting the desired LBA deadband (LBD).

When the measured value (PV) is within the LBD area, no alarm is produced even if all of the conditions to produce the alarm are satisfied. Therefore, carefully set the LBD.



A: During temperature rise: Alarm area
During temperature fall: Non-alarm area

B: During temperature rise: Non-alarm area
During temperature fall: Alarm area

The LBA function detects an error occurring in the control loop, but cannot specify the erroneous location. Therefore, check the control loop in order.

Continued on the next page.

Continued from the previous page.

The LBA function is not activated when any of the following cases occurs.
- When the autotuning function is being executed.
- When operation mode is not in Control mode.

When the LBA setting time is extremely short or does not meet the controlled object, the LBA may be turned on and off, or may not be turned on. In such a case, change the LBA time depending on the situation.

The LBA output is turned off when any of the following cases occurs with the LBA output turned on.
- When the measured value (PV) rises beyond (or falls below) the LBA triggering width within the LBA time.
- When the measured value (PV) is within the LBA deadband

Input 1_set value (SV1)	RKC communication identifier	S1
	MODBUS register address	High order: 004EH (78) Low order: 004FH (79)
Input 2_set value (SV2)	RKC communication identifier	S0
	MODBUS register address	High order: 005AH (90) Low order: 005BH (91)

The set value (SV) is a desired value of the control.

Attribute: R/W (Read and Write)

The Input 2_set value (SV2: S0) becomes RO (Read only) for the one input specification.

Digits: 7 digits

Data range: Setting limiter (low limit) to setting limiter (high limit)

See **Input range table (P. 134)**

Factory set value: 0

Relational items: Setting limiter high limit/ low limit (P. 188)

Input 1_proportional band	RKC communication identifier	P1
	MODBUS register address	High order: 0050H (80) Low order: 0051H (81)
Input 2_proportional band	RKC communication identifier	P0
	MODBUS register address	High order: 005CH (92) Low order: 005DH (93)

This value expresses a proportional band of the PI and PID control.

Attribute: R/W (Read and Write)

The Input 2_proportional band (P0) becomes RO (Read only) for the one input specification.

Digits: 7 digits

Data range: TC/RTD input: 0 to input span
Voltage/current input: 0.0 to 1000.0 % of input span
0 (0.0): ON/OFF action

Factory set value: 30.0

Relational items: ON/OFF action differential gap upper (P. 170),
ON/OFF action differential gap lower (P. 171)

Input 1_integral time	RKC communication identifier	I1
	MODBUS register address	High order: 0052H (82) Low order: 0053H (83)
Input 2_integral time	RKC communication identifier	I0
	MODBUS register address	High order: 005EH (94) Low order: 005FH (95)

This value expresses a time of the integral action that eliminates the offset occurring in proportional control.

Attribute: R/W (Read and Write)

The Input 2_integral time (I0) becomes RO (Read only) for the one input specification.

Digits: 7 digits
Data range: 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds
(0.0 or 0.00: PD action)
Factory set value: 240.00
Relational items: Integral/derivative time decimal point position selection (P. 169)

Input 1_derivative time	RKC communication identifier	D1
	MODBUS register address	High order: 0054H (84) Low order: 0055H (85)
Input 2_derivative time	RKC communication identifier	D0
	MODBUS register address	High order: 0060H (96) Low order: 0061H (97)

This value expresses a time of the derivative action that prevents ripples by predicting output changes and thus improves control stability.

Attribute: R/W (Read and Write)

The Input 2_derivative time (D0) becomes RO (Read only) for the one input specification.

Digits: 7 digits
Data range: 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds
(0.0 or 0.00: PI action)
Factory set value: 60.00
Relational items: Integral/derivative time decimal point position selection (P. 169)

Input 1_control response parameter	RKC communication identifier	CA
	MODBUS register address	High order: 0056H (86) Low order: 0057H (87)
Input 2_control response parameter	RKC communication identifier	C9
	MODBUS register address	High order: 0062H (98) Low order: 0063H (99)

This item is a response resulting from a set value (SV) change in PID control.

Attribute: R/W (Read and Write)

The Input 2_control response parameter (C9) becomes RO (Read only) for the one input specification.

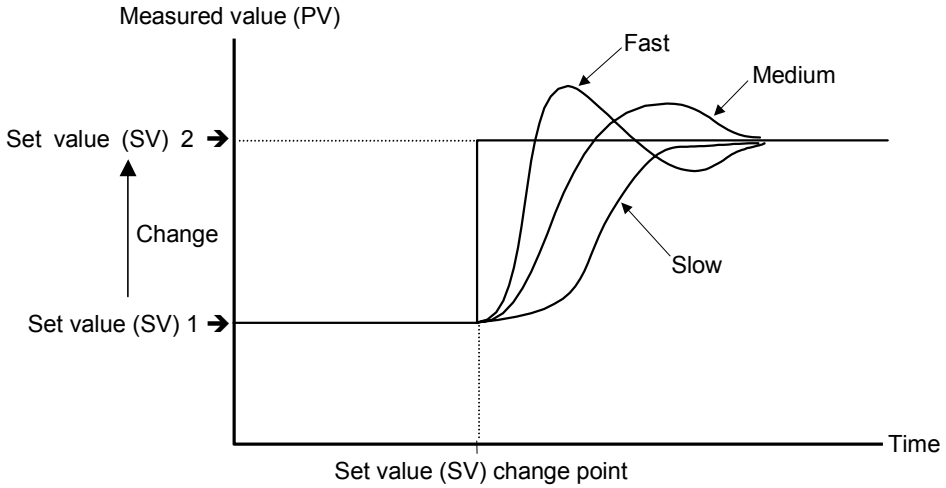
Digits: 7 digits

Data range: 0: Slow
1: Medium
2: Fast

Factory set value: 0

Functional description:

This is the function of enabling the setting of response to set value (SV) change in select any one of 3 steps (**Slow**, **Medium**, **Fast**) in PID control.
In order to achieve faster controlled object response to set value (SV) change, select **Fast**. However, slight overshoot is unavoidable when selecting **Fast**. Depending on the controlled object, specify **Slow** if overshoot should be avoided.



Input 1_ setting change rate limiter (up)	RKC communication identifier	HH
	MODBUS register address	High order: 0066H (102) Low order: 0067H (103)
Input 2_ setting change rate limiter (up)	RKC communication identifier	HX
	MODBUS register address	High order: 006AH (106) Low order: 006BH (107)

This value expresses a set value of the setting change rate limiter up.

Attribute: R/W (Read and Write)

The Input 2_setting change rate limiter up (HX) becomes RO (Read only) for the one input specification.

Digits: 7 digits
Data range: 0.1 to input span/one minute
0.0: OFF (Not provided)
Factory set value: 0.0
Relational items: Setting change rate limiter unit time (P. 186)

Input 1_ setting change rate limiter (down)	RKC communication identifier	HL
	MODBUS register address	High order: 0068H (104) Low order: 0069H (105)
Input 2_ setting change rate limiter (down)	RKC communication identifier	HY
	MODBUS register address	High order: 006CH (108) Low order: 006DH (109)

This value expresses a set value of the setting change rate limiter down.

Attribute: R/W (Read and Write)

The Input 2_setting change rate limiter down (HY) becomes RO (Read only) for the one input specification.

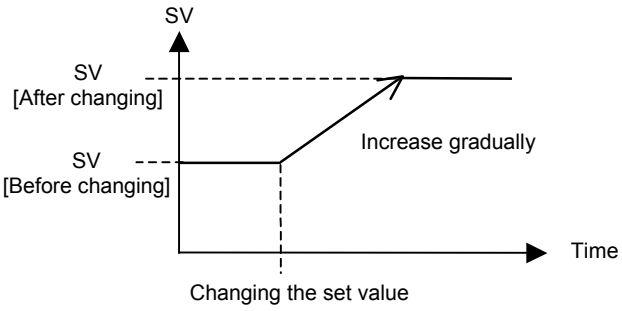
Digits: 7 digits
Data range: 0.1 to input span/one minute
0.0: OFF (Not provided)
Factory set value: 0.0
Relational items: Setting change rate limiter unit time (P. 186)

■ Functional description

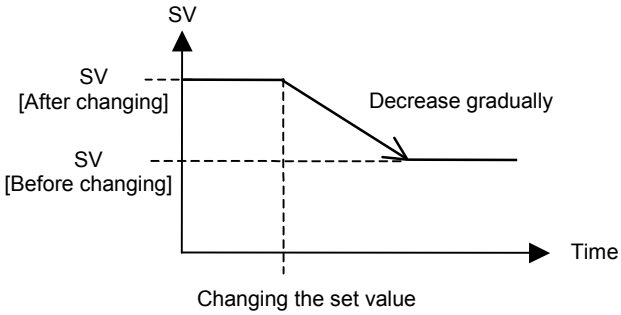
The setting change rate limiter is the function of setting amount of set value (SV) change per unit time when the set value (SV) is changed.

Application example of setting change rate limiter:

● Example of increasing set value to higher value



● Example of decreasing set value to lower value



When the power is turned on or operation is changed from STOP to RUN, the setting change rate limiter functions toward the set value (SV) from the measured value (PV) when started.

If the autotuning (AT) function is activated while the setting change rate limiter functions, PID control continues until the limiter completes its functioning, and the autotuning (AT) function is activated after the limiter completes its functioning.

When it changed the setting change rate limiter during executing the control area, the gradient is changer than the internal computation after being changed. In this case, it does not change when the gradient arrives at set value (SV).

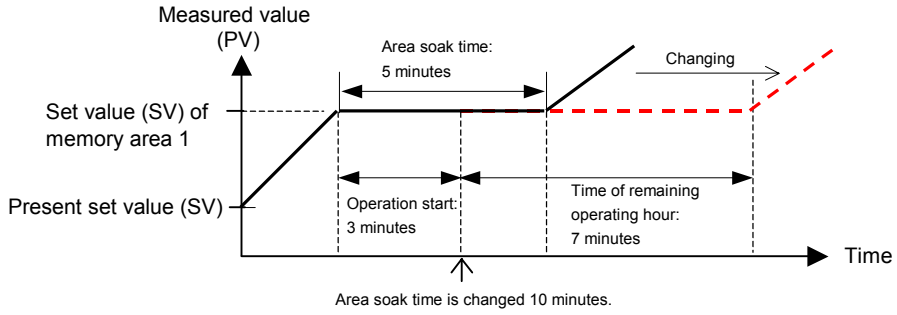
Area soak time	RKC communication identifier	TM
	MODBUS register address	High order: 006EH (110) Low order: 006FH (111)

This item uses the combination of the setting change rate limiter up/down and the link area number in case of simple program operation. (see P. 122)

Attribute: R/W (Read and Write)
Digits: 7 digits
Data range: 0 minute 00.00 second to 9 minutes 59.99 seconds or
0 hour 00 minute 00 second to 9 hours 59 minutes 59 seconds
Factory set value: 0.00.00 (0 minute 00.00 second to 9 minute 59.99 seconds)
Relational items: Soak time unit selection (P. 186)

When the setting of the area soak time is changed while the control area is being performed, the area soak time is changed the value changed. However, it is not added with the value before changing the setting of the area soak time.

For example, when the area soak time is changed 10 minutes after the control area that is setted the area soak time with 5 minutes operated for three minutes, the time of remaining operating hour becomes 7 minutes.



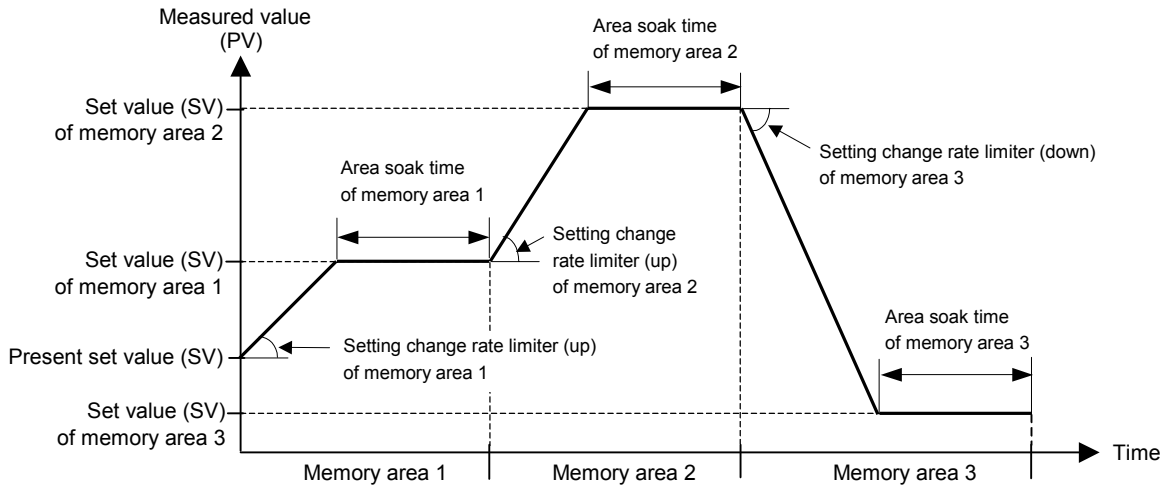
Link area number	RKC communication identifier	LP
	MODBUS register address	High order: 0070H (112) Low order: 0071H (113)

This item uses the combination of the setting change rate limiter up/down and the area soak time in case of simple program operation.

Attribute: R/W (Read and Write)
Digits: 7 digits
Data range: 0 to 16
0: OFF (No link)
Factory set value: 0
Functional description:

Simple program operation can perform to combine with the setting change rate limiter up/down, the area soak time and the link area number.

[Usage example]



Heater break alarm 1 (HBA1) set value	RKC communication identifier	A7
	MODBUS register address	High order: 0072H (114) Low order: 0073H (115)
Heater break alarm 2 (HBA2) set value	RKC communication identifier	A8
	MODBUS register address	High order: 0074H (116) Low order: 0075H (117)

HBA set value sets by referring to CT input measured value of current transformer.

Attribute: R/W (Read and Write)

Heater break alarm 1 (HBA1) set value (A7) becomes RO (Read only) for no current transformer input 1 (CT1) specification.

Heater break alarm 2 (HBA2) set value (A8) becomes RO (Read only) for no current transformer input 2 (CT2) specification.

Digits: 7 digits

Data range: When the CT type is CTL-6-P-N: 0.0 to 30.0 A
When the CT type is CTL-12-S56-10L-N: 0.0 to 100.0 A
0.0: OFF (Not provided)

Factory set value: 0.0

Functional description:

The heater break alarm (HBA) function is used to detect the current flowing through the load (heater) by using a current transformer (CT), to compare the current thus detected to the heater break alarm set value, and thus to produce a heater break alarm when any of the following causes occurs.

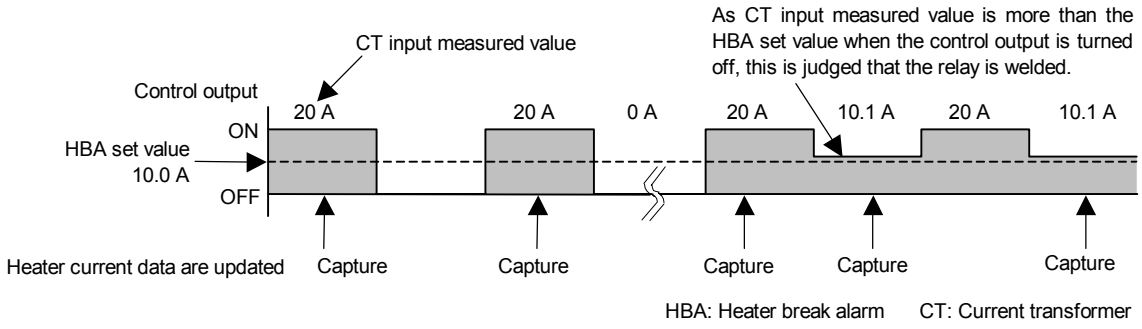
- When the heater current does not flow: Heater break or abnormality in the operating unit, etc.

  When the control output is on and the current transformer (CT) input value is the HBA set value or less, the alarm is set up.

- When the heater current does not stop: The melting of relay, etc.

  When the control output is off and the current transformer (CT) input value is the HBA set value or more, the alarm is set up.

Heater current data items are updated using data items captured when the control output is turned on. However when the relay is welded, they are updated using data items captured when the control output is turned off.



Input 1_PV bias	RKC communication identifier	PB
	MODBUS register address	High order: 0076H (118) Low order: 0077H (119)
Input 2_ PV bias	RKC communication identifier	PA
	MODBUS register address	High order: 0082H (130) Low order: 0083H (131)

This item is the PV bias to add to measured value for sensor correction, etc. The PV bias uses when you need to correct the individual variations in the sensors or difference between the measured value (PV) of other instruments.

Attribute: R/W (Read and Write)

The Input 2_PV bias (PA) becomes RO (Read only) for the one input specification.

Digits: 7 digits
Data range: –Input span to +input span
Factory set value: 0

Input 1_PV digital filter	RKC communication identifier	F1
	MODBUS register address	High order: 0078H (120) Low order: 0079H (121)
Input 2_PV digital filter	RKC communication identifier	F0
	MODBUS register address	High order: 0084H (132) Low order: 0085H (133)

This item is the time of the first-order lag filter that rejects any noise contained in the measured input.

Attribute: R/W (Read and Write)

The Input 2_PV digital filter (F0) becomes RO (Read only) for the one input specification.

Digits: 7 digits
Data range: 0: OFF (Not provided)
0.01 to 10.00 seconds
Factory set value: HA400/HA900: 0.00
HA401/HA901: 1.00

Input 1_PV ratio	RKC communication identifier	PR
	MODBUS register address	High order: 007AH (122) Low order: 007BH (123)
Input 2_PV ratio	RKC communication identifier	PQ
	MODBUS register address	High order: 0086H (134) Low order: 0087H (135)

This item is the PV ratio (magnification) to add to measured value for sensor correction, etc. The PV bias is used to correct the individual variations in the sensors or when there is difference between the measured value (PV) of other instruments.

Attribute: R/W (Read and Write)

The Input 2_PV ratio (PQ) becomes RO (Read only) for the one input specification.

Digits: 7 digits
Data range: 0.500 to 1.500
Factory set value: 1.000

Input 1_PV low input cut-off	RKC communication identifier	DP
	MODBUS register address	High order: 007CH (124) Low order: 007DH (125)
Input 2_PV low input cut-off	RKC communication identifier	DO
	MODBUS register address	High order: 0088H (136) Low order: 0089H (137)

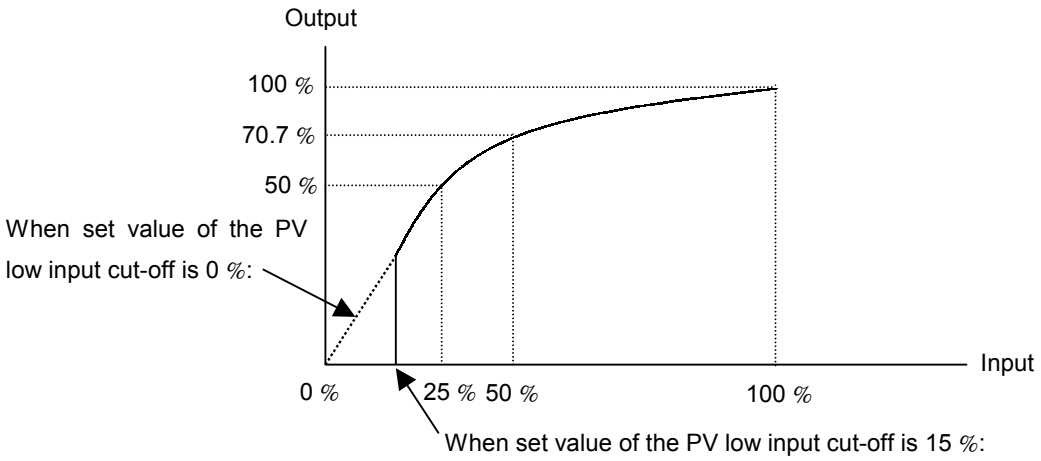
As a result of square root extraction, low input value with large variation is cut.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits
Data range: 0.00 to 25.00 % of input span
Factory set value: 0.00
Functional description:

When input signal square root extraction is used, such as in flow control, the square root extraction result varies widely in the selection with low input value. In order to eliminate control inconvenience caused by input variations at low input value, input of less than the value set is cut (0 input) and processed.



Input 1_proportional cycle time	RKC communication identifier	T0
	MODBUS register address	High order: 007EH (126) Low order: 007FH (127)
Input 2_ proportional cycle time	RKC communication identifier	T2
	MODBUS register address	High order: 008AH (138) Low order: 008BH (139)

This item is proportional cycle time of control output.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) for the voltage/current output specification.

Digits: 7 digits
Data range: 0.1 to 100.0 seconds
Factory set value: Relay contact output: 20.0 seconds
Voltage pulse output and triac output: 2.0 seconds

The proportional cycle time becomes invalid for the voltage/current output specification.

Input 1_manipulated output value	RKC communication identifier	ON
	MODBUS register address	High order: 0080H (128) Low order: 0081H (129)
Input 2_manipulated output value	RKC communication identifier	OM
	MODBUS register address	High order: 008CH (140) Low order: 008DH (141)

This item is the output value in the manual (MAN) control.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) for the automatic (AUTO) control.

Digits: 7 digits
Data range: Output limiter (low limit) to output limiter (high limit)
Factory set value: 0.0
Relational items: Output limiter high limit/low limit (P. 176)

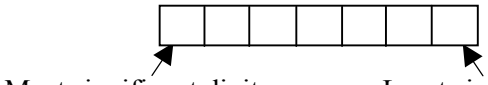
Set lock level	RKC communication identifier	LK
	MODBUS register address	High order: 008EH (142) Low order: 008FH (143)

Use this item when you need to restrict a setting change of the parameter to the operator, or to prevent the operator from doing misoperation during operation. (Data lock function)

Attribute: R/W (Read and Write)
Digits: 7 digits
Data range: RKC communication: ASCII code data of 7 digits

The set lock level is assigned as a digit image in ASCII code data of 7 digits.

ASCII code data of 7 digits:



Least significant digit: Lock only setting items other than SV and events (EV1 to EV4).
0: Settable, 1: Not settable (Lock)

2nd digit: Lock only events (EV1 to EV4).
0: Settable, 1: Not settable (Lock)

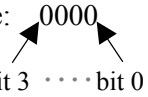
3rd digit: Lock only set value (SV).
0: Settable, 1: Not settable (Lock)

4th digit to Most significant digit: Unused

MODBUS: 0 to 15 (bit data)

The set lock level is assigned as a bit image in binary numbers.

Bit image: 0000



bit 0: Lock only setting items other than SV and events (EV1 to EV4).
bit 1: Lock only events (EV1 to EV4).
bit 2: Lock only set value (SV).
bit 3 to bit 31: Unused

Bit data: 0: Settable 1: Not settable (Lock)

Factory set value: 0

EEPROM storage state	RKC communication identifier	EM
	MODBUS register address	High order: 0090H (144) Low order: 0091H (145)

The contents of the RAM and those of the EEPROM can be checked.

Attribute: RO (Read only)
Digits: 7 digits
Data range: 0: The content of the EEPROM does not coincide with that of the RAM.
- As data is being written to the EEPROM when the EEPROM storage mode is selected "0: Set values are store to the EEPROM when set values are changed," do not turn the power off. If turned off, no set values are stored.
- If the EEPROM storage mode is changed after "0: Set values are store to the EEPROM when set values are changed" is changed to "1: Not set values are store to the EEPROM when set values are changed," *0* is set (mismatch). As the set value changed is not backup, select the backup mode if necessary.

1: The content of the EEPROM coincides with that of the RAM.
The contents of the RAM match with those of the EEPROM.
(Data write to the EEPROM is completed.)

Factory set value: —

EEPROM storage mode	RKC communication identifier	EB
	MODBUS register address	High order: 0092H (146) Low order: 0093H (147)

It is set whether the data storage in the non-volatile memory (EEPROM) is excuted or not.

Attribute: R/W (Read and Write)
Digits: 7 digits
Data range: 0: Set values are store to the EEPROM when set values are changed.
1: Not set values are store to the EEPROM when set values are changed.
Factory set value: 0

When the memory is used to frequently change the set value via communication, select "1: Not set values are store to the EEPROM when set values are changed."

The non-volatile memory (EEPROM) has limitations on the number of memory rewrite times. If "1: Not set values are store to the EEPROM when set values are changed" is selected as the 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.

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

- If power failure occurs while "1: Not set values are store to the EEPROM when set values are changed" is selected, the set value returns to the value before the storage mode is selected.
- If "1: Not set values are store to the EEPROM when set values are changed" is changed to "0: Set values are store to the EEPROM when set values are changed," 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 "0: Set values are store to the EEPROM when set values are changed."
- When the power is turned on, "0: Set values are store to the EEPROM when set values are changed" is always set.

STOP display selection	RKC communication identifier	DX
	MODBUS register address	High order: 0200H (512) Low order: 0201H (513)

This item selects the display position of the STOP characters at control stop.

Attribute: R/W (Read and Write)

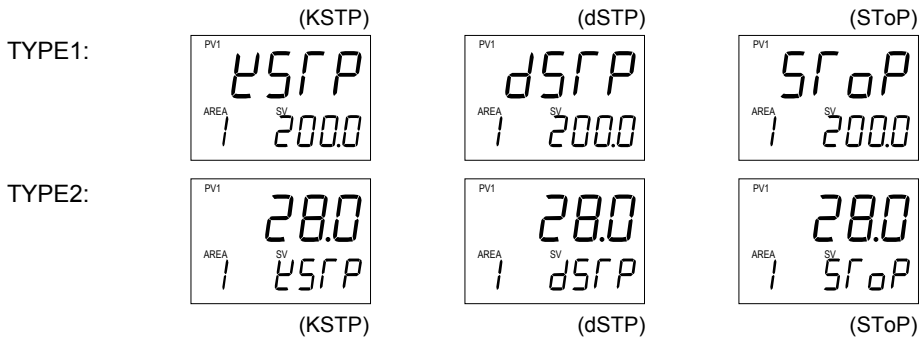
This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 0: Displays on the measured value (PV1/PV2) unit (TYPE 1)
1: Displays on the set value (SV) unit (TYPE 2)

Factory set value: 0

Displays in the STOP mode become as follows.



Bar graph display selection	RKC communication identifier	DA
	MODBUS register address	High order: 0202H (514) Low order: 0203H (515)

This item selects the contents of the bar graph display.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

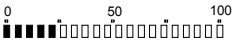
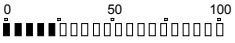
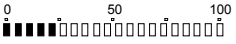
Digits: 7 digits

Data range:
0: No display
1: Input 1_manipulated output value (MV)
2: Input 1_measured value (PV)
3: Input 1_set value (SV)
4: Input 1_deviation value
5: Feedback resistance input value (POS)
6: Input 2_manipulated output value (MV)
7: Input 2_measured value (PV)
8: Input 2_set value (SV)
9: Input 2_deviation value

Factory set value: 0

Relational items: Bar graph resolution setting (P. 132)

Each bar graph display becomes as follows.

Manipulated output value (MV) display	Displays the manipulated output value (MV) in a span of from 0 to 100 %. The dot of bar graph left end blinks when the MV is less than 0 %. In addition, the dot of bar graph right end blinks when the MV is more than 100 %. [Display example] 
Measured value (PV) display	Displays the measured value (PV). Scaling in the scale range. [Display example] 
Set value (SV) display	Displays the set value (SV). Scaling in the scale range. [Display example] 
Deviation value display	Displays the deviation of measured value (PV) corresponding to the set value (SV). The dots at both ends of bar graph light to indicate deviation display. One dot is variable in a range of from 1 to 100 digit. [Display example] 
Feedback resistance input value (POS) display	The bar graph displays the feedback resistance input value (POS). (Only in case of the position proportioning PID control) [Display example] 

* The number of dot points: 10 dots (for HA400/HA401) 20 dots (for HA900/HA901)

Bar graph resolution setting	RKC communication identifier	DE
	MODBUS register address	High order: 0204H (516) Low order: 0205H (517)

This item is the bar graph display resolution for the deviation display. However, this set value becomes valid only when the bar graph display selection is "4: Input 1_deviation value" or "9: Input 2_deviation value".

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits
Data range: 1 to 100 digit/dot
Sets several digit per 1 dots of the bar graph.
Factory set value: 100
Relational items: Bar graph display selection (P. 131)

Auto/Manual transfer key operation selection (A/M)	RKC communication identifier	DK
	MODBUS register address	High order: 0208H (520) Low order: 0209H (521)

This item selects the Auto/Manual transfer key (A/M) Used/Unused.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits
Data range: 0: No direct key operation
1: Auto/Manual transfer for input 1
2: Auto/Manual transfer for input 2
3: Common Auto/Manual transfer for input 1 and input 2
Factory set value: 3

Remote/Local transfer key operation selection (R/L)	RKC communication identifier	DL
	MODBUS register address	High order: 020AH (522) Low order: 020BH (523)

This item selects the Remote/Local transfer key (R/L) Used/Unused.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 0: No direct key operation
1: Remote/Local transfer

Factory set value: 1

RUN/STOP transfer key operation selection (R/S)	RKC communication identifier	DM
	MODBUS register address	High order: 020CH (524) Low order: 020DH (525)

This item selects the RUN/STOP transfer key (R/S) Used/Unused.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 0: No direct key operation
1: RUN/STOP transfer

Factory set value: 1

Input 1_input type selection	RKC communication identifier	XI
	MODBUS register address	High order: 020EH (526) Low order: 020FH (527)
Input 2_ input type selection	RKC communication identifier	XJ
	MODBUS register address	High order: 0222H (546) Low order: 0223H (547)

This value indicates input type and input range.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 0 to 23 (see the following table)

[Input Range Table]

Set value	Input type		Input range	Hardware
0	TC input	K	–200 to +1372 °C or –328.0 to +2501.6 °F	Voltage (Low) input group
1		J	–200 to +1200 °C or –328.0 to +2192.0 °F	
2		R	–50 to +1768 °C or –58.0 to +3214.4 °F	
3		S	–50 to +1768 °C or –58.0 to +3214.4 °F	
4		B	0 to 1800 °C or 32.0 to 3272.0 °F	
5		E	–200 to +1000 °C or –328.0 to +1832.0 °F	
6		N	0 to 1300 °C or 32.0 to 2372.0 °F	
7		T	–200 to +400 °C or –328.0 to +752.0 °F	
8		W5Re/W26Re	0 to 2300 °C or 32.0 to 4172.0 °F	
9		PLII	0 to 1390 °C or 32.0 to 2534.0 °F	
19	Voltage (Low) input	0～1 V	Programmable range (–19999 to +99999)	
20		0～100 mV		
21		0～10 mV		
12	RTD input	3-wire system Pt100	–200 to +850 °C or –328.0 to +1562.0 °F	
13		3-wire system JPt100	–200 to +600 °C or –328.0 to +1112.0 °F	
22		4-wire system Pt100	–200 to +850 °C or –328.0 to +1562.0 °F	
23		4-wire system JPt100	–200 to +600 °C or –328.0 to +1112.0 °F	
14	Current input	0～20 mA	Programmable range (–19999 to +99999)	
15		4～20 mA		
16	Voltage (High) input	0～10 V	Programmable range (–19999 to +99999)	Voltage (High) input group
17		0～5 V		
18		1～5 V		

If the hardware is the same, this item enables to change the input type. Not change the different hardware group interval.

Do not set to any number (10 or 11) which is not described in the above input range table. This may cause malfunction.

The Input 2_ input type selection (2. InP) can not select 22 and 23 for the two input specification.

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See the above input range table also when you select input type of the remote input. However, the remote input specification can not select 0 to13, 22, and 23.

Factory set value: Depend on model code. (when not specifying: Type K)
Relational items: Display unit selection (P. 135), Decimal point position (P. 136), Input scale high (P. 137), Input scale low (P. 138)

Input 1_display unit selection	RKC communication identifier	PU
	MODBUS register address	High order: 0210H (528) Low order: 0211H (529)
Input 2_ display unit selection	RKC communication identifier	PT
	MODBUS register address	High order: 0224H (548) Low order: 0225H (549)

This value indicates temperature unit for thermocouple (TC) and RTD inputs.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits
Data range: 0: °C
1: °F
Factory set value: 0

Input 1_decimal point position	RKC communication identifier	XU
	MODBUS register address	High order: 0212H (530) Low order: 0213H (531)
Input 2_decimal point position	RKC communication identifier	XT
	MODBUS register address	High order: 0226H (550) Low order: 0227H (551)

This value indicates decimal point position of the input range.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range:

Thermocouple (TC) inputs:
0: No digit below decimal point
1: 1 digit below decimal point

RTD inputs:
0: No digit below decimal point
1: 1 digit below decimal point
2: 2 digits below decimal point

Voltage (V) /current (I) inputs:
0: No digit below decimal point
1: 1 digit below decimal point
2: 2 digits below decimal point
3: 3 digits below decimal point
4: 4 digits below decimal point

Factory set value: 1

Relational items: Input type selection (P. 134), Input scale high (P. 137), Input scale low (P. 138)

Input 1_input scale high	RKC communication identifier	XV
	MODBUS register address	High order: 0214H (532) Low order: 0215H (533)
Input 2_input scale high	RKC communication identifier	XX
	MODBUS register address	High order: 0228H (552) Low order: 0229H (553)

This value is high limit of the input scale range.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: Thermocouple (TC) /RTD inputs:
Input scale low to maximum value of input range
Voltage (V)/current (I) inputs:
−19999 to +99999
Varies depending on the position of the decimal point setting

Factory set value: Thermocouple (TC) /RTD inputs: Maximum value of input range
Voltage (V)/current (I) inputs: 100.0

Relational items: Input type selection (P. 134), Decimal point position (P. 136),
Input scale low (P. 138)

Functional description:
For this product, an input range provided for each input type is only one type of maximum input range. Therefore, the input scale range can be freely set by setting the input scale high limit/low limit.

This item enables to set the input scale high limit smaller than the input scale low limit for voltage (V)/current (I) inputs. (Input scale high limit < Input scale low limit)

Input 1_input scale low	RKC communication identifier	XW
	MODBUS register address	High order: 0216H (534) Low order: 0217H (535)
Input 2_input scale low	RKC communication identifier	XY
	MODBUS register address	High order: 022AH (554) Low order: 022BH (555)

This value is low limit of the input scale range.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: Thermocouple (TC) /RTD inputs:
Minimum value of input range to input scale high
Voltage (V)/current (I) inputs:
−19999 to +99999
Varies depending on the position of the decimal point setting

Factory set value: Thermocouple (TC) /RTD inputs: Minimum value of input range
Voltage (V)/current (I) inputs: 0.0

Relational items: Input type selection (P. 134), Decimal point position (P. 136),
Input scale high (P. 137)

Functional description:
See the input scale high.

Input 1_input error determination point (high limit)	RKC communication identifier	AV
	MODBUS register address	High order: 0218H (536) Low order: 0219H (537)
Input 2_input error determination point (high limit)	RKC communication identifier	AX
	MODBUS register address	High order: 022CH (556) Low order: 022DH (557)

An action at input error is activated when input measured value (PV) becomes input error determination point (high limit) or more.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

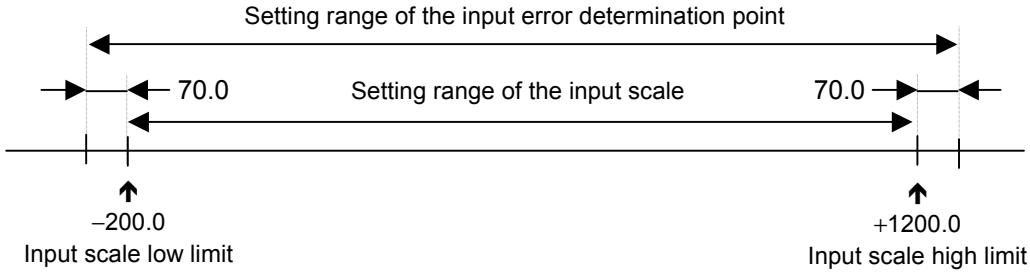
Digits: 7 digits

Data range: Input scale low – (5 % of input span) to input scale high + (5 % of input span)

Factory set value: Thermocouple (TC) /RTD inputs: Input scale high + (5 % of input span)
Voltage (V)/current (I) inputs: 105.0

Relational items: Input error determination point low limit (P. 140),
Action at input error high limit (P. 172), Action at input error low limit (P. 173),
Manipulated output value at input error (P. 173)

[Example] When the input scale is from –200.0 to +1200.0:
Input span: 1400.0
5 % of input span: 70.0
Setting range: –270.0 to +1270.0



Input 1_input error determination point (low limit)	RKC communication identifier	AW
	MODBUS register address	High order: 021AH (538) Low order: 021BH (539)
Input 2_input error determination point (low limit)	RKC communication identifier	AY
	MODBUS register address	High order: 022EH (558) Low order: 022FH (559)

An action at input error is activated when input measured value (PV) becomes input error determination point (low limit) or less.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits
Data range: Input scale low – (5 % of input span) to input scale high + (5 % of input span)
Factory set value: Thermocouple (TC) /RTD inputs: Input scale low – (5 % of input span)
Voltage (V)/current (I) inputs: –5.0
Relational items: Input error determination point high limit (P. 139),
Action at input error high limit (P. 172), Action at input error low limit (P. 173),
Manipulated output value at input error (P. 173)

Input 1_burnout direction	RKC communication identifier	BS
	MODBUS register address	High order: 021CH (540) Low order: 021DH (541)
Input 2_burnout direction	RKC communication identifier	BR
	MODBUS register address	High order: 0230H (560) Low order: 0231H (561)

This item selects a burnout direction in the input breaks.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits
Data range: 0: Upscale
1: Downscale
Factory set value: 0

The action in the input breaks fix regardless of setting a burnout direction about the following input.

- **RTD inputs: Upscale**
- **Voltage (High) inputs: Downscale**
  Value in the neighborhood of a 0 input (0 V) displayed.
- **Current (I) inputs: Downscale**
  Value in the neighborhood of a 0 input (0 mA) displayed.

Input 1_square root extraction selection	RKC communication identifier	XH
	MODBUS register address	High order: 021EH (542) Low order: 021FH (543)
Input 2_square root extraction selection	RKC communication identifier	XG
	MODBUS register address	High order: 0232H (562) Low order: 0233H (563)

This item selects the presence or absence of the square root extraction for measured value.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 0: Not provided
1: Provided

Factory set value: 0

Functional description:

This is the function of square root extracting measured value (PV). Generally, a differential pressure type flow transmitter is used in combination with a square root extractor, but the use of this function enables flow control with transmitter output connected directly to this instrument.

Power supply frequency selection	RKC communication identifier	JT
	MODBUS register address	High order: 0220H (544) Low order: 0221H (545)

This item selects power supply frequency of the controller.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 0: 50 Hz
1: 60 Hz

Factory set value: 0

Event input logic selection	RKC communication identifier	H2
	MODBUS register address	High order: 0234H (564) Low order: 0235H (565)

This item is an item that assigns the function (memory area, operation mode) for the event input (DI 1 to DI 7).

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 0 to 6 (see the following table)

[Function Assignment Table]

Set value	DI 1 Terminal No. 30-31	DI 2 Terminal No. 30-32	DI 3 Terminal No. 30-33	DI 4 Terminal No. 30-34	DI 5 Terminal No. 35-36	DI 6 Terminal No. 13-14	DI 7 Terminal No. 13-15
0	Unused (No function assignment)						
1	Memory area number selection (1 to 16)				Memory area set	RUN/STOP transfer	Auto/Manual transfer
2	Memory area number selection (1 to 16)				Memory area set	RUN/STOP transfer	Remote/Local transfer
3	Memory area number selection (1 to 16)				Memory area set	Remote/Local transfer	Auto/Manual transfer
4	Memory area number selection (1 to 8)			Memory area set	RUN/STOP transfer	Remote/Local transfer	Auto/Manual transfer
5	Memory area number selection (1 to 8)			Memory area set	Remote/Local transfer	Unused	Unused
6	Memory area number selection (1 to 8)			Memory area set	Auto/Manual transfer	Unused	Unused

DI 6 and DI 7 can not use for types with the communication 1 function.

Factory set value: 1

Functional description:

Refer to the following.

- **Contact status of memory area number selection**

Event input	Memory area number															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DI 1	×	–	×	–	×	–	×	–	×	–	×	–	×	–	×	–
DI 2	×	×	–	–	×	×	–	–	×	×	–	–	×	×	–	–
DI 3	×	×	×	×	–	–	–	–	×	×	×	×	–	–	–	–
DI 4	×	×	×	×	×	×	×	×	–	–	–	–	–	–	–	–

×: Contact open –: Contact closed

The selected memory area number is captured after the controller inputs a close signal of the memory area set.

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● Relationship between contact status of operation mode and mode status

	Contact closed	Contact open	No event input or not selected
RUN/STOP transfer	RUN (Control RUN)	STOP (Control STOP)	RUN (Control RUN)
Auto/Manual transfer	Auto	Manual	Auto
Remote/Local transfer	Remote or cascade control	Local	Local

● RUN/STOP transfer

Mode select with front key or communication	Status of event input (DI)	Actual operation mode
RUN (Control RUN)	Contact closed	RUN (Control RUN)
	Contact open	STOP (Control STOP)
STOP (Control STOP)	Contact closed	STOP (Control STOP)
	Contact open	

● Auto/Manual transfer

Mode select with front key or communication	Status of event input (DI)	Actual operation mode
Auto	Contact closed	Auto
	Contact open	Manual
Manual	Contact closed	Manual
	Contact open	

● Remote/Local transfer

Mode select with front key or communication	Status of event input (DI)	Actual operation mode
Remote	Contact closed	Remote
	Contact open	
Local	Contact closed	
	Contact open	Local

Output logic selection	RKC communication identifier	E0
	MODBUS register address	High order: 0236H (566) Low order: 0237H (567)

This item is an item that assigns the output function (control output, event, etc.) for the output (OUT1 to OUT5).

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 1 to 10 (see the following table)

(M: Relay contact output、V: Voltage pulse output、T: Triac output、R: Current output、E: Voltage)

Set value	OUT1 (M/ V / R/ E/ T)	OUT2 (M/ V/ R/ E/ T)	OUT3 (M/ V/ R/ E/ T)	OUT4 (M)	OUT5 (M)	備考
1	MV 1	HBA 1 (Energized) or HBA 2 (Energized)	EV 3 (Energized) or EV 4 (Energized)	EV 2 (Energized)	EV 1 (Energized)	—
2	MV 1	HBA 1 (De-energized) or HBA 2 (De-energized)	EV 3 (De-energized) or EV 4 (De-energized)	EV 2 (De-energized)	EV 1 (De-energized)	—
3	MV 1	EV 3 (Energized), EV 4 (Energized), HBA 1 (Energized) or HBA 2 (Energized)	EV 2 (Energized)	EV 1 (Energized)	FAIL (De-energized)	Energized alarm corresponding to FAIL output
4	MV 1	EV 3 (De-energized), EV 4 (De-energized), HBA 1 (De-energized) or HBA 2 (De-energized)	EV 2 (De-energized)	EV 1 (De-energized)	FAIL (De-energized)	De-energized alarm corresponding to FAIL output
5	MV 1	MV 2	EV 4 (Energized) or HBA 2 (Energized)	EV 3 (Energized) or HBA 1 (Energized)	EV 1 (Energized) or EV2 (Energized)	Energized alarm corresponding to two loops control
6	MV 1	MV 2	EV 4 (De-energized) or HBA 2 (De-energized)	EV 3 (De-energized) or HBA 1 (De-energized)	EV 1 (De-energized) or EV 2 (De-energized)	De-energized alarm corresponding to two loops control
7	MV 1	MV 2	EV 3 (Energized), EV 4 (Energized), HBA 1 (Energized) or HBA 2 (Energized)	EV 2 (Energized)	EV 1 (Energized)	Energized alarm corresponding to two loops control
8	MV 1	MV 2	EV 3 (De-energized), EV 4 (De-energized), HBA 1 (De-energized) or HBA 2 (De-energized)	EV 2 (De-energized)	EV 1 (De-energized)	De-energized alarm corresponding to two loops control
9	MV 1 (OPEN)	MV 1 (CLOSE)	EV 3 (Energized), EV 4 (Energized), HBA 1 (Energized) or HBA 2 (Energized)	EV 2 (Energized)	EV 1 (Energized)	Energized alarm corresponding to position proportioning PID control
10	MV 1 (OPEN)	MV 1 (CLOSE)	EV 3 (De-energized), EV 4 (De-energized), HBA 1 (De-energized) or HBA 2 (De-energized)	EV 2 (De-energized)	EV 1 (De-energized)	De-energized alarm corresponding to position proportioning PID control

MV 1 = Manipulated output value of Input 1, MV 2 = Manipulated output value of Input 2,
MV 1 (OPEN) = Open-side control output of Position proportioning PID control, MV 1 (CLOSE) = Close-side control output of Position proportioning PID control,
HBA 1 = Output of Heater break alarm 1, HBA 2 = Output of Heater break alarm 2,
EV 1 = Output of Event 1, EV 2 = Output of Event 2, EV 3 = Output of Event 3, EV 4 = Output of Event 4, FAIL = FAIL output

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An output point becomes OR output when two or more output function is assigned to it.

When the output function can use the transmission output (3 points), the transmission output is automatically assigned from out 1 to out 3 (see the following table). As the transmission output is given priority over the output function that is assigned the output logic selection, the manipulated output value (MV) that is assigned the output logic selection cannot output. In such a case, it is necessary that the transmission output type selection selects "4: Input 1_manipulated output value (MV)" or "8: Input 2_ manipulated output value (MV)."

Transmission output type	Assign location of output
Transmission output 1	Output 1 (OUT1)
Transmission output 2	Output 2 (OUT2)
Transmission output 3	Output 3 (OUT3)

Factory set value: For one input specification: 1
For two input specification: 5

Relational items: Transmission output type selection (P. 148),
Event input logic selection (P. 142), CT assignment (P. 162)

Output 1 timer setting	RKC communication identifier	TD
	MODBUS register address	High order: 0238H (568) Low order: 0239H (569)
Output 2 timer setting	RKC communication identifier	TG
	MODBUS register address	High order: 023AH (570) Low order: 023BH (571)
Output 3 timer setting	RKC communication identifier	TH
	MODBUS register address	High order: 023CH (572) Low order: 023DH (573)
Output 4 timer setting	RKC communication identifier	TI
	MODBUS register address	High order: 023EH (574) Low order: 023FH (575)
Output 5 timer setting	RKC communication identifier	TJ
	MODBUS register address	High order: 0240H (576) Low order: 0241H (577)

This item is a time until the event output is actually output after the event that is assigned for from output 1 (OUT1) to output 5 (OUT5) became the event state.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 0.0 to 600.0 seconds

Factory set value: 0.0

Relational items: Output logic selection (P. 144), Event type selection (P. 151)

Functional description:

The event timer function regards the period until the event timer is set after measured value (PV) or deviation exceeds the event set value as a non-event state and outputs an event after the event timer setting time elapses.

The event timer starts being activated if the event is turned on. In addition, if the event state is released while the event timer is being activated, no event is output.

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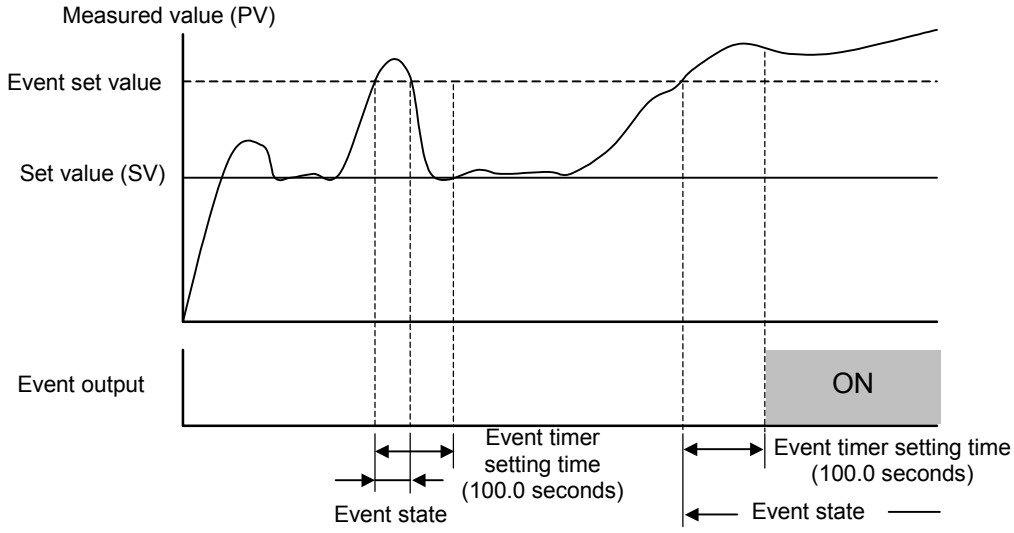
Example: When set the event timer for 100.0 seconds.



Transmission output 1_ type selection	RKC communication identifier	LA
	MODBUS register address	High order: 0242H (578) Low order: 0243H (579)
Transmission output 2_ type selection	RKC communication identifier	LB
	MODBUS register address	High order: 0248H (584) Low order: 0249H (585)
Transmission output 3_ type selection	RKC communication identifier	LC
	MODBUS register address	High order: 024EH (590) Low order: 024FH (591)

This item selects output contents of the transmission output.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range:
0: None
1: Input 1_measured value (PV)
2: Input 1_set value (SV)
3: Input 1_deviation
4: Input 1_manipulated output value (MV)
5: Input 2_ measured value (PV)
6: Input 2_ set value (SV)
7: Input 2_deviation
8: Input 2_ manipulated output value (MV)

Factory set value: 0

Relational items: Transmission output scale high (P. 149),
Transmission output scale low (P. 150)

The output type of the transmission output specify when ordering.

The transmission output corresponds for output 3 from output 1 as follows when this item is selected other than "0: None."
- When using transmission output 1: Corresponding to output 1 (OUT1)
- When using transmission output 2: Corresponding to output 2 (OUT2)
- When using transmission output 3: Corresponding to output 3 (OUT3)

The transmission output is output priority to the ouput function that is assigned to the output logic selection.

Transmission output 1_scale high	RKC communication identifier	HV
	MODBUS register address	High order: 0244H (580) Low order: 0245H (581)
Transmission output 2_scale high	RKC communication identifier	CV
	MODBUS register address	High order: 024AH (586) Low order: 024BH (587)
Transmission output 3_scale high	RKC communication identifier	EV
	MODBUS register address	High order: 0250H (592) Low order: 0251H (593)

This value is a scale high limit value of the transmission output.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range:
- Measured value (PV) and set value (SV): Input scale low to input scale high
- Manipulated output value (MV): –5.0 to +105.0 %
- Deviation: –Input span to +Input span

Factory set value:
- Measured value (PV) and set value (SV): Input scale high
- Manipulated output value (MV): 100.0
- Deviation: + Input span

Relational items: Transmission output type selection (P. 151),
Transmission output scale low (P. 150)

Transmission output 1_scale low	RKC communication identifier	HW
	MODBUS register address	High order: 0246H (582) Low order: 0247H (583)
Transmission output 2_scale low	RKC communication identifier	CW
	MODBUS register address	High order: 024CH (588) Low order: 024DH (589)
Transmission output 3_scale low	RKC communication identifier	EW
	MODBUS register address	High order: 0252H (594) Low order: 0253H (595)

This value is a scale low limit value of the transmission output.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: Measured value (PV) and set value (SV): Input scale low to input scale high
Manipulated output value (MV): −5.0 to +105.0 %
Deviation: −Input span to +Input span

Factory set value: Measured value (PV) and set value (SV): Input scale low
Manipulated output value (MV): 0.0
Deviation: −Input span

Relational items: Transmission output type selection (P. 151),
Transmission output scale high (P. 149)

Event 1 type selection	RKC communication identifier	XA
	MODBUS register address	High order: 0254H (596) Low order: 0255H (597)
Event 2 type selection	RKC communication identifier	XB
	MODBUS register address	High order: 025EH (606) Low order: 025FH (607)
Event 3 type selection	RKC communication identifier	XC
	MODBUS register address	High order: 0268H (616) Low order: 0269H (617)
Event 4 type selection	RKC communication identifier	XD
	MODBUS register address	High order: 0272H (626) Low order: 0273H (627)

This item selects a type of the event 1, 2, 3 or 4.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range:
0: None
1: Deviation high [1]
2: Deviation low [1]
3: Deviation high/low [1]
4: Band [1]
5: Process high [1]
6: Process low [1]
7: SV high
8: SV low
9: Control loop break alarm (LBA) [2]

[1] These type can select the event hold action.

[2] The "9: Control loop break alarm (LBA)" can select only event 3 and event 4.

Factory set value: 0

Relational items: Event set value (P. 112), Control loop break alarm (LBA) time (P. 113), LBA deadband (P. 113), Output logic selection (P. 144), Event hold action (P. 154), Event differential gap (P. 156), Event action at input error (P. 158), Event assignment (P. 160)

Functional description:

See the next page.

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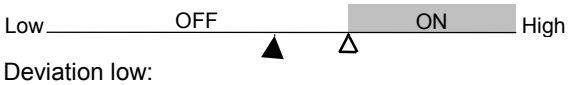
- **Event action type**

(▲ : Set value (SV) △ : Event set value)

Deviation high:

(Event state where the event set value is set to plus)



(Event state where the event set value is set to minus)

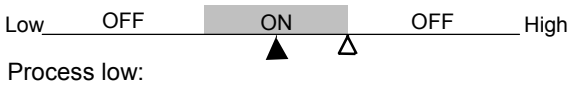
Deviation low:

(Event state where the event set value is set to plus)

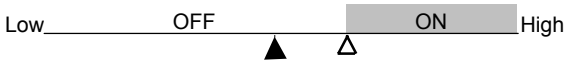
(Event state where the event set value is set to minus)

Deviation high/low:

Band:



Process high:



Process low:

SV high:

SV low:

- **Control loop break alarm (LBA)**

The control loop break alarm (LBA) function is used to detect a load (heater) break or a failure in the external actuator (magnet relay, etc.), or a failure in the control loop caused by an input (sensor) break. This function monitors the measured value (PV) variation at LBA time intervals from the time the output exceeds 100 % (or output limiter: high limit) or falls below 0 % (or output limiter: low limit), then detects a heater or input break.

[Alarm action]

The LBA function produces the alarm when any of the following causes occurs.

LBA triggering width: Temperature input: 2 °C [2 °F] fixed
Voltage/current input: 0.2% fixed

- **When the output falls below 0 % (or output limiter: low limit)**

For direct action: This alarm is produced when the measured value (PV) does not rise beyond the LBA triggering width within the LBA time.

For reverse action: This alarm is produced when the measured value (PV) does not fall below the LBA triggering width within the LBA time.

- **When the output exceeds 100 % (or output limiter: high limit)**

For direct action: This alarm is produced when the measured value (PV) does not fall below the LBA triggering width within the LBA time.

For reverse action: This alarm is produced when the measured value (PV) does not rise beyond the LBA triggering width within the LBA time.

If the autotuning function is used, the LBA time twice as large as the integral time is automatically set. The LBA setting time does not change even if the integral time is changed.

The LBA function is not activated when any of the following cases occurs.

- When the autotuning function is being executed.
- When the control stops.

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- The LBA function detects an error occurring in the control loop, but cannot specify the erroneous location. Therefore, check the control loop in order.
- The LBA output is turned off when any of the following cases occurs with the LBA output turned on.
  - When the measured value (PV) rises beyond (or falls below) the LBA triggering width within the LBA setting time.
  - When the measured value (PV) is within the LBA deadband.

Event 1 hold action	RKC communication identifier	WA
	MODBUS register address	High order: 0256H (598) Low order: 0257H (599)
Event 2 hold action	RKC communication identifier	WB
	MODBUS register address	High order: 0260H (608) Low order: 0261H (609)
Event 3 hold action	RKC communication identifier	WC
	MODBUS register address	High order: 026AH (618) Low order: 026BH (619)
Event 4 hold action	RKC communication identifier	WD
	MODBUS register address	High order: 0274H (628) Low order: 0275H (629)

This item selects a hold action of the event 1, 2, 3 or 4.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 0: Not provided
1: Provided
2: Re-hold action

Factory set value: 0

Relational items: Event set value (P. 112), Event type selection (P. 151), Event differential gap (P. 156), Event action at input error (P. 158), Event assignment (P. 160)

Functional description:

See the next page.

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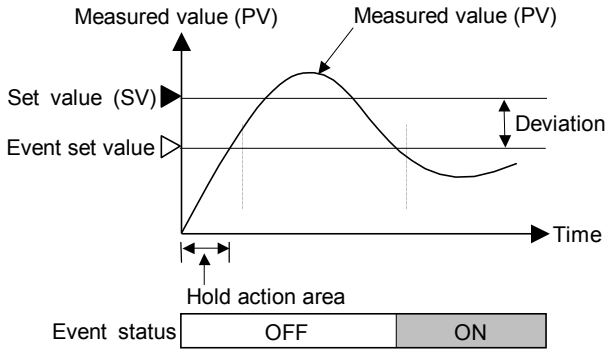
● Hold action

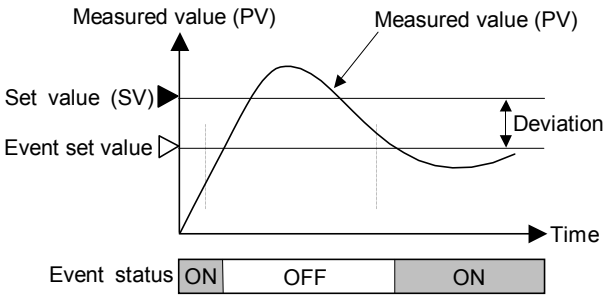
In the event hold action, the event action is kept invalid even if the measured value (PV) is in the event range when the power is on or the operation mode is switched to RUN from STOP. The event action is held until the measured value (PV) goes out of the event state once.

Example: The difference between events with "hold action" and without "hold action" are described by referring to the deviation low as an example.

[With hold action]



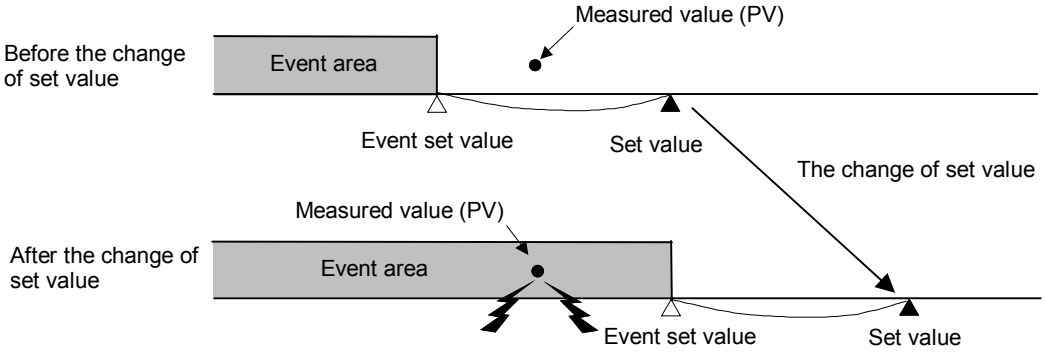
[Without hold action]



● Re-hold action

In the event hold action, the holding is effective if the input value is in the event range at the power on and is cancelled if the input value will go out of the event range. While, in the event re-hold action the hold action becomes effective when the temperature set value is changed again. This action can be only selected for deviation.

Example: When the measured value (PV) is in the position as shown in the below figure before the change of set value and then the set value is changed as shown in the figure, the measured value goes into the event area and the event is set up. To hold this event, the event re-hold action can be used effectively.



Event 1 differential gap	RKC communication identifier	HA
	MODBUS register address	High order: 0258H (600) Low order: 0259H (601)
Event 2 differential gap	RKC communication identifier	HB
	MODBUS register address	High order: 0262H (610) Low order: 0263H (611)
Event 3 differential gap	RKC communication identifier	HC
	MODBUS register address	High order: 026CH (620) Low order: 026DH (621)
Event 4 differential gap	RKC communication identifier	HD
	MODBUS register address	High order: 0276H (630) Low order: 0277H (631)

This item sets a differential gap of the event 1, 2, 3 or 4.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 0 to input span

Factory set value: Thermocouple (TC) /RTD inputs: 2.0 °C
Voltage (V)/current (I) inputs: 0.2 % of input span

Relational items: Event set value (P. 112), Event type selection (P. 151),
Event hold action (P. 154), Event action at input error (P. 158),
Event assignment (P. 160)

Functional description:

If measured value (PV) is close to the event set value, the event relay contact may repeatedly turn on and off due to input fluctuations. If the event differential gap is set, repeated turning on and off of the relay contact can be prevented.

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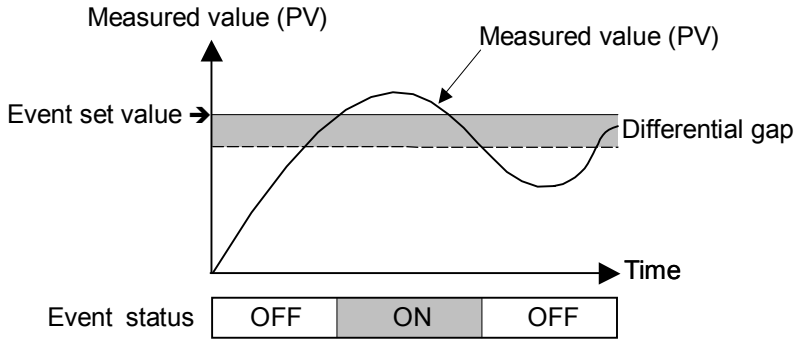
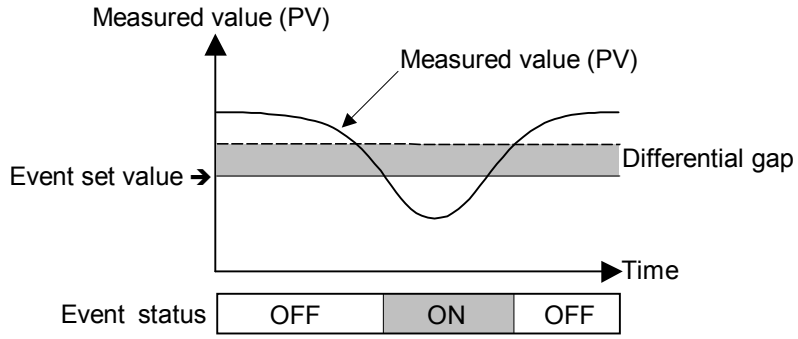
[Event high]



[Event low]



Event 1 action at input error	RKC communication identifier	OA
	MODBUS register address	High order: 025AH (602) Low order: 025BH (603)
Event 2 action at input error	RKC communication identifier	OB
	MODBUS register address	High order: 0264H (612) Low order: 0265H (613)
Event 3 action at input error	RKC communication identifier	OC
	MODBUS register address	High order: 026EH (622) Low order: 026FH (623)
Event 4 action at input error	RKC communication identifier	OD
	MODBUS register address	High order: 0278H (632) Low order: 0279H (633)

This item selects the action when measured value (PV) of the event exceeds the input error determination point (high or low limit).

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 0: Normal processing
1: Forcibly turned on

Factory set value: 0

Relational items: Input error determination point high limit (P. 139),
Input error determination point low limit (P. 140)

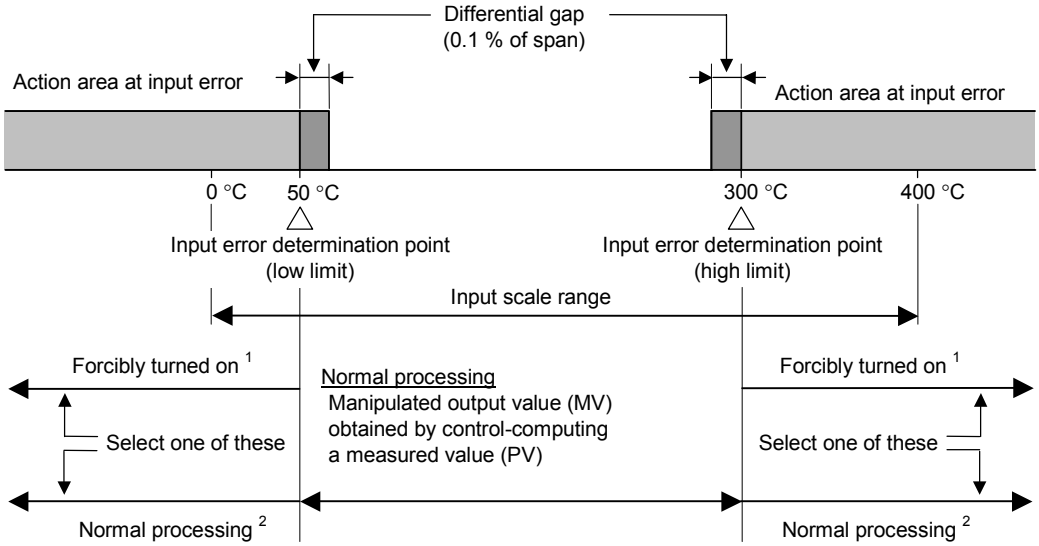
Continued on the next page.

Continued from the previous page.

Functional description:

An example of the following explains input error determination point and action at input error.

Example: Input range: 0 to 400 °C
Input error determination point (high limit): 300 °C
Input error determination point (low limit): 50 °C



[1] The event is forcibly turned on regardless of the event action selected by the event type selection when the input is abnormal.

[2] The event action selected by the event type selection is taken even if the input is abnormal.

Event 1 assignment	RKC communication identifier	FA
	MODBUS register address	High order: 025CH (604) Low order: 025DH (605)
Event 2 assignment	RKC communication identifier	FB
	MODBUS register address	High order: 0266H (614) Low order: 0267H (615)
Event 3 assignment	RKC communication identifier	FC
	MODBUS register address	High order: 0270H (624) Low order: 0271H (625)
Event 4 assignment	RKC communication identifier	FD
	MODBUS register address	High order: 027AH (634) Low order: 027BH (635)

This item selects an input that a decision of the event intends for.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits
Data range: 0: For input 1
1: For input 2
Factory set value: 0
Relational items: Event set value (P. 112), Event type selection (P. 151), Event hold action (P. 154), Event differential gap (P. 156), Event action at input error (P. 158)

CT1 ratio	RKC communication identifier	XR
	MODBUS register address	High order: 027CH (636) Low order: 027DH (637)
CT2 ratio	RKC communication identifier	XS
	MODBUS register address	High order: 0280H (640) Low order: 0281H (641)

This item sets the number of turns (ratio) of the current transformer that is used with the heater break alarm (HBA).

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits
Data range: 0 to 9999
Factory set value: When the CT type is CTL-6-P-N: 800
When the CT type is CTL-12-S56-10L-N: 1000
Relational items: Heater break alarm (HBA) set value (P. 123), CT assignment (P. 162)

CT1 assignment	RKC communication identifier	ZF
	MODBUS register address	High order: 027EH (638) Low order: 027FH (639)
CT2 assignment	RKC communication identifier	ZG
	MODBUS register address	High order: 0282H (642) Low order: 0283H (643)

This item assigns an output that a decision of the heater break alarm (HBA) intends for.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range:
0: None
1: Output 1 (OUT 1)
2: Output 2 (OUT 2)
3: Output 3 (OUT 3)
4: Output 4 (OUT 4)
5: Output 5 (OUT 5)

Factory set value:
Heater break alarm 1 (HBA1) :
Current transformer 1 (CT1) not provided: 0
Current transformer 1 (CT 1) provided: 1
Heater break alarm 2 (HBA2) :
Current transformer 2 (CT2) not provided: 0
Current transformer 2 (CT2) provided: 2

Relational items: Heater break alarm (HBA) set value (P. 123), Output logic selection (P. 144), CT ratio (P. 161)

The current transformer 1 (CT1) assignment corresponds to the heater break alarm 1 (HBA 1). The current transformer 2 (CT2) assignment corresponds to the heater break alarm 2 (HBA 2). Match the output assigned at the CT assignment with the output assigned to a control output at the output logic selection.

Hot/Cold start selection	RKC communication identifier	XN
	MODBUS register address	High order: 0284H (644) Low order: 0285H (645)

This item selects the start mode at power recovery.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 0 to 5 (see the following table)

Set value	When the time of power failure is less than 3 seconds	When the time of power failure is not less than 3 seconds
0	Hot start 1	Hot start 1
1	Hot start 1	Hot start 2
2	Hot start 1	Cold start
3	Hot start 2	Hot start 2
4	Hot start 2	Cold start
5	Cold start	Cold start

Factory set value: 0

Functional description:

Each start state is shown below.

Hot start 1: Operation is started in the operation mode and output value before power failure.

Hot start 2: Operation is started in the operation mode before power failure.

- In the manual mode, operation is started from the low output limit value.
- In the auto mode, operation is started from the output value calculated using control response designation parameters. Therefore, the initial output value does not become uniform.

Cold start: In the manual mode, operation is started from the low output limit value.

Input 2_use selection	RKC communication identifier	KM
	MODBUS register address	High order: 0286H (646) Low order: 0287H (647)

Among the single loop control, remote setting input, cascade control (slave), this item selects which application the input 2 is used by.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 0: Single loop control
1: Remote input
2: Cascade control (Slave)

Factory set value: 0

Cascade ratio	RKC communication identifier	RR
	MODBUS register address	High order: 0288H (648) Low order: 0289H (649)

This value is the ratio when the manipulated output (%) in the cascade master is converted to the relevant cascade signal (°C).

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits
Data range: 0.000 to 1.500
Factory set value: 1.000
Relational items: Cascade bias (P. 165)

Cascade bias	RKC communication identifier	RB
	MODBUS register address	High order: 028AH (650) Low order: 028BH (651)

The cascade bias is a bias added to the input value on the slave side in the cascade control.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits
Data range: –Input span to +input span
Factory set value: 0

The functional description of relative items to the cascade control is shown in the following.

Cascade control

Cascade control monitors the controlled object temperature in the master unit and then corrects the set value in the slave unit depending on the deviation between the target value (set value) and actual temperature. The slave unit controls the non-controlled object. As a result, this control matches the controlled object temperature to the target value. This cascaded control is suitable when there is a large time lag between the heat source (heater) and section whose temperature is necessary to be stabilized.

- **Cascade ratio**

The conversion rate when the manipulated output (%) in the cascade master is converted to the relevant cascade signal (°C) can by changed from 0.0 to 1.500 by the cascade ratio.

- **Cascade bias**

The cascade bias is a bias added to the input value on the slave side.

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Example: Relationship between the manipulated output (%) in the cascade master and relevant cascade signal (°C)

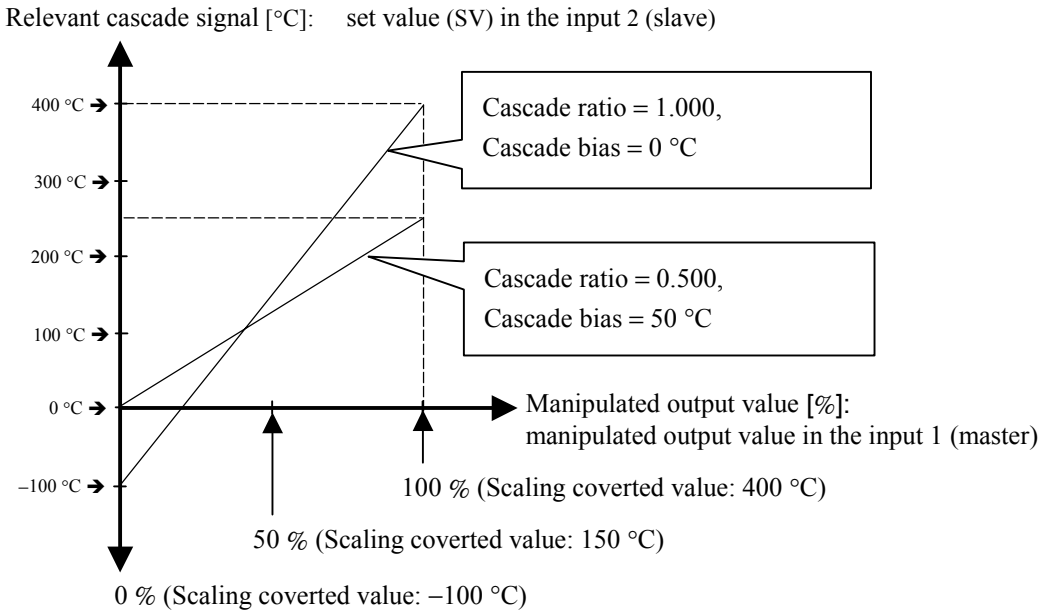
Output scale in the input 1 (master): 0 to 100 %
Input scale in the input 2: −100 to +400 °C

Manipulated output in the input 1 (master) = 100 %
Cascade ratio = 1.000
Cascade bias = 0 °C
→ Relevant cascade signal (input 2: set value on the slave side) = 400 °C

Manipulated output in the input 1 (master) = 100 %
Cascade ratio = 0.500
Cascade bias = 50 °C
→ Relevant cascade signal (input 2: set value on the slave side) = 250 °C

Manipulated output in the input 1 (master) = 0 %
Cascade ratio = 0.500
Cascade bias = 50 °C
→ Relevant cascade signal (input 2: set value on the slave side) = 0 °C

Manipulated output in the input 1 (master) = 0 %
Cascade ratio = 1.000
Cascade bias = 0 °C
→ Relevant cascade signal (input 2: set value on the slave side) = −100 °C



SV tracking	RKC communication identifier	XL
	MODBUS register address	High order: 028CH (652) Low order: 028DH (653)

This item is a function that can select whether a local setting value is followed or not in a remote setting value just before the operation mode is transferred to when the operation mode is transferred to the local setting mode from the remote setting mode.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 0: Not provided
1: Provided

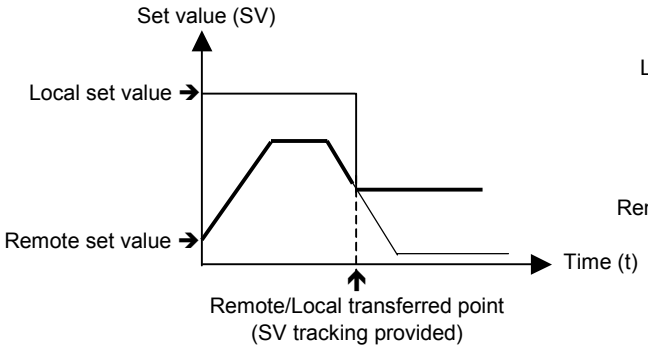
Factory set value: 1

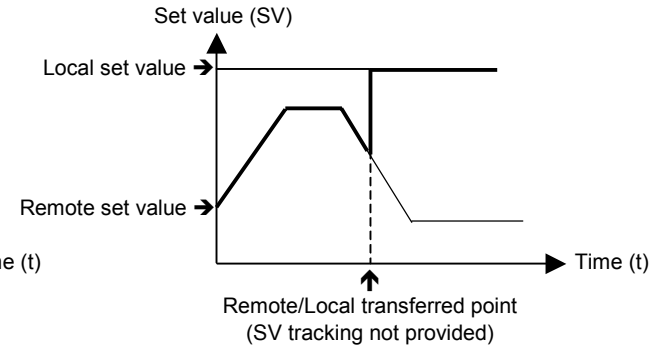
Functional description:

The SV tracking is a function that a local setting value is followed in a remote setting value just before the operation mode is transferred to when the operation mode is transferred to the local setting mode from the remote setting mode.
As a result, this function can prevent rapid set value changes when the operation mode is transferred to the local setting mode from the remote setting mode.

[About the variation of set value]

Operation mode	Local →	Remote →	Local
Set value used	Set value (SV) = Local set value	Set value (SV) = Remote set value	Set value (SV) = Local set value
SV tracking provided	Local set value ≠ Remote set value	Local set value = Remote set value	Local set value = Remote set value
SV tracking not provided	Local set value ≠ Remote set value	Local set value ≠ Remote set value	Local set value ≠ Remote set value





Input 1_control action type selection	RKC communication identifier	XE
	MODBUS register address	High order: 028EH (654) Low order: 028FH (655)
Input 2_control action type selection	RKC communication identifier	XF
	MODBUS register address	High order: 02A8H (680) Low order: 02A9H (681)

This item selects direct action/reverse action.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

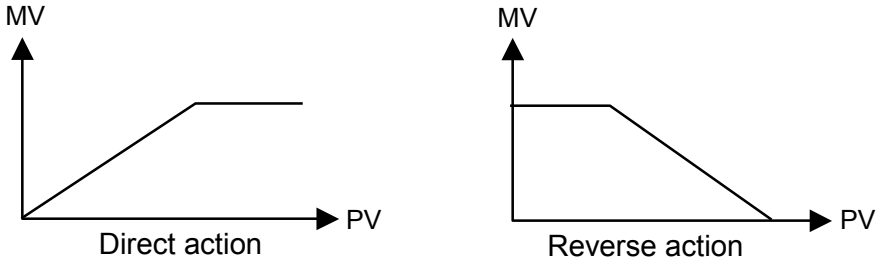
Data range: 0: Direct action
1: Reverse action

Factory set value: 1

Functional description:

Direct action: The manipulated output value (MV) increases as the measured value (PV) increases. This action is used generally for cool control.

Reverse action: The manipulated output value (MV) decreases as the measured value (PV) increases. This action is used generally for heat control.



Input 1_integral/derivative time decimal point position selection	RKC communication identifier	PK
	MODBUS register address	High order: 0290H (656) Low order: 0291H (657)
Input 2_integral/derivative time decimal point position selection	RKC communication identifier	PJ
	MODBUS register address	High order: 02AAH (682) Low order: 02ABH (683)

This item selects a decimal point position of integral time and derivative time in PID control.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 0: No digit below decimal point
1: 1 digit below decimal point
2: 2 digits below decimal point

Factory set value: 2

Relational items: Integral time (P. 117), Derivative time (P. 117)

Input 1_derivative gain	RKC communication identifier	DG
	MODBUS register address	High order: 0292H (658) Low order: 0293H (659)
Input 2_derivative gain	RKC communication identifier	DJ
	MODBUS register address	High order: 02ACH (684) Low order: 02ADH (685)

This item is a gain used for derivative action in PID control. It adjusts a worked condition by derivative action.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits
Data range: 0.1 to 10.0
Factory set value: 6.0

Under ordinary operation, it is not necessary to change the factory set value.

Input 1_ON/OFF action differential gap (upper)	RKC communication identifier	IV
	MODBUS register address	High order: 0294H (660) Low order: 0295H (661)
Input 2_ON/OFF action differential gap (upper)	RKC communication identifier	IX
	MODBUS register address	High order: 02AEH (686) Low order: 02AFH (687)

This item sets the ON/OFF control differential gap (upper).

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits
Data range: 0 to input span
Factory set value: Thermocouple (TC) /RTD inputs: 1 °C
Voltage (V)/current (I) inputs: 0.1 % of input span
Relational items: ON/OFF action differential gap lower (P. 171)
Functional description:
See the ON/OFF action differential gap lower.

Input 1_ON/OFF action differential gap (lower)	RKC communication identifier	IW
	MODBUS register address	High order: 0296H (662) Low order: 0297H (663)
Input 2_ON/OFF action differential gap (lower)	RKC communication identifier	IY
	MODBUS register address	High order: 02B0H (688) Low order: 02B1H (689)

This item sets the ON/OFF control differential gap (lower).

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 0 to input span

Factory set value: Thermocouple (TC) /RTD inputs: 1 °C

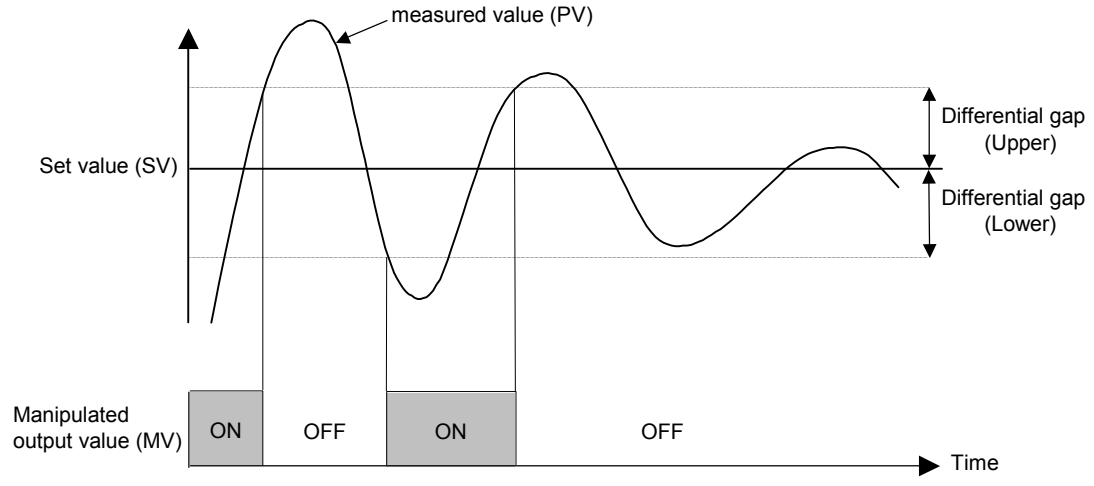
Voltage (V)/current (I) inputs: 0.1 % of input span

Relational items: ON/OFF action differential gap upper (P. 170)

Functional description:

It is ON/OFF control when it sets proportional band in "0" or "0.0."

In ON/OFF control, the manipulated output (MV) is turned on and off depending on whether measured value (PV) is larger or smaller than set value (SV). Differential gap setting can prevent relay contact from on or off repetition around set value (SV).



Input 1_ action at input error (high limit)	RKC communication identifier	WH
	MODBUS register address	High order: 0298H (664) Low order: 0299H (665)
Input 2_ action at input error (high limit)	RKC communication identifier	WX
	MODBUS register address	High order: 02B2H (690) Low order: 02B3H (691)

This item selects the action when input measured value becomes the input error determination point (high limit) or more.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 0: Normal control (present output)
1: Manipulated output value at input error

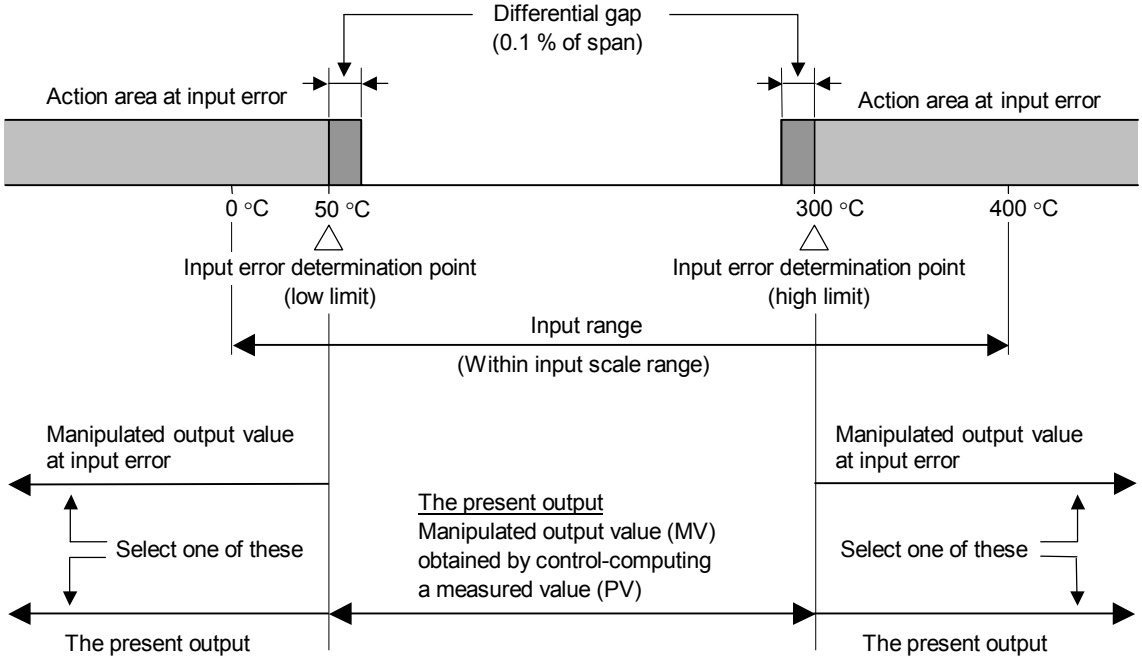
Factory set value: 0

Relational items: Input error determination point high limit (P. 139),
Manipulated output value at input error (P. 173)

Functional description:

An example of the following explains input error determination point and action at input error.

Example: Input range: 0 to 400 °C
Input error determination point (high limit): 300 °C
Input error determination point (low limit): 50 °C



Input 1_action at input error (low limit)	RKC communication identifier	WL
	MODBUS register address	High order: 029AH (666) Low order: 029BH (667)
Input 2_action at input error (low limit)	RKC communication identifier	WY
	MODBUS register address	High order: 02B4H (692) Low order: 02B5H (693)

This item selects the action when input measured value becomes the input error determination point (low limit) or less.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 0: Normal control (present output)
1: Manipulated output value at input error

Factory set value: 0

Relational items: Input error determination point low limit (P. 140),
Manipulated output value at input error (P. 173)

Functional description:

See the action at input error (high limit).

Input 1_manipulated output value at input error	RKC communication identifier	OE
	MODBUS register address	High order: 029CH (668) Low order: 029DH (669)
Input 2_manipulated output value at input error	RKC communication identifier	OF
	MODBUS register address	High order: 02B6H (694) Low order: 02B7H (695)

This item is a manipulated output value output when an input measured value goes up or down from the high or low limit of the input error discriminating point with the selection of operation at the time of input error occurrence set to "1."

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: –5.0 to +105.0 %

Factory set value: –5.0

Relational items: Input error determination point high limit (P. 139),
Input error determination point low limit (P. 140),
Action at input error high limit (P. 172),
Action at input error low limit (P. 173)

Input 1_output change rate limiter (up)	RKC communication identifier	PH
	MODBUS register address	High order: 029EH (670) Low order: 029FH (671)
Input 2_output change rate limiter (up)	RKC communication identifier	PX
	MODBUS register address	High order: 02B8H (696) Low order: 02B9H (697)

The output change rate limiter (upward side) to limit of the variation of output is set.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 0.0 to 1000.0 %/seconds
0.0: OFF (Not provided)

Factory set value: 0.0

Relational items: Output change rate limiter down (P. 174), Output limiter high limit (P. 176), Output limiter low limit (P. 176)

Functional description:
See the next page.

Input 1_ output change rate limiter (down)	RKC communication identifier	PL
	MODBUS register address	High order: 02A0H (672) Low order: 02A1H (673)
Input 2_ output change rate limiter (down)	RKC communication identifier	PY
	MODBUS register address	High order: 02BAH (698) Low order: 02BBH (699)

The output change rate limiter (downward side) to limit of the variation of output is set.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 0.0 to 1000.0 %/seconds
0.0: OFF (Not provided)

Factory set value: 0.0

Relational items: Output change rate limiter up (P. 174), Output limiter high limit (P. 176), Output limiter low limit (P. 176)

Functional description:
See the next page.

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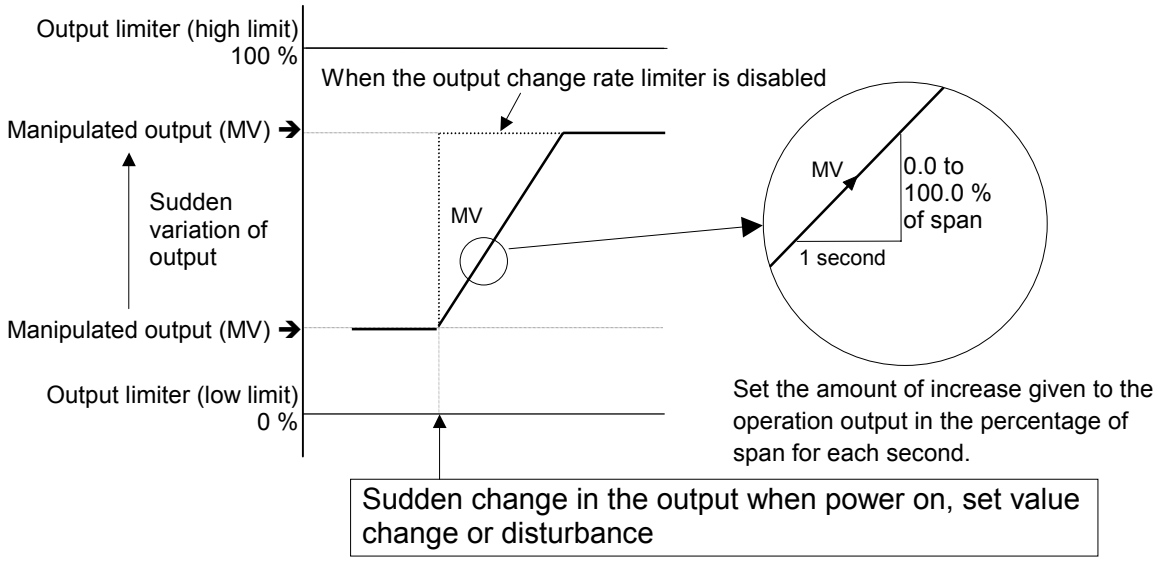
Functional description:

The output change rate limiter limits the variation of manipulated output (MV) for a time unit. You can set an output variation, and control the output, when your object requires to avoid sudden variation.

[The output change rate limiter is effective in the following cases]

- If the output starts from 100 % when putting power on (if a sudden change of 100 % causes a problem with variation of flow, etc.)
- If the output changes suddenly when changing the set value.



As it is described in the figure above, the output does not make a sudden change, but it changes based on the set inclination, when giving power (outside of the proportional band), or changing the set value (large change). The figure above is an example of upward output variation. For the downward variation, downward variation (inclination) has to be set.

- Response to the control becomes slow, and the effect of differentiation is lost, when the output change rate limiter is set too small (small inclination).
- When the output change rate limiter is used, you may not be able to obtain appropriate PID constants during autotuning.
- The output variation limiter is particularly effective when a sudden variation may cause the controller to crash, or when it may cause a large current. Also, it is very effective when you are dealing with current output or voltage output.

Input 1_output limiter (high limit)	RKC communication identifier	OH
	MODBUS register address	High order: 02A2H (674) Low order: 02A3H (675)
Input 2_output limiter (high limit)	RKC communication identifier	OX
	MODBUS register address	High order: 02BCH (700) Low order: 02BDH (701)

This item is the high limit value of manipulated output.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits
Data range: Output limiter (low limit) to 105.0 %
Factory set value: 105.0
Relational items: Output change rate limiter up (P. 174),
Output change rate limiter down (P. 174), Output limiter low limit (P. 176)

Input 1_output limiter (low limit)	RKC communication identifier	OL
	MODBUS register address	High order: 02A4H (676) Low order: 02A5H (677)
Input 2_output limiter (low limit)	RKC communication identifier	OY
	MODBUS register address	High order: 02BEH (702) Low order: 02BFH (703)

This item is the low limit value of manipulated output.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits
Data range: –5.0 % to Output limiter (high limit)
Factory set value: –5.0
Relational items: Output change rate limiter up (P. 174),
Output change rate limiter down (P. 174), Output limiter high limit (P. 176)

Input 1_power feed forward	RKC communication identifier	PF
	MODBUS register address	High order: 02A6H (678) Low order: 02A7H (679)
Input 2_power feed forward	RKC communication identifier	PG
	MODBUS register address	High order: 02C0H (704) Low order: 02C1H (705)

This item selects the provided or not provided of power feed forward function.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

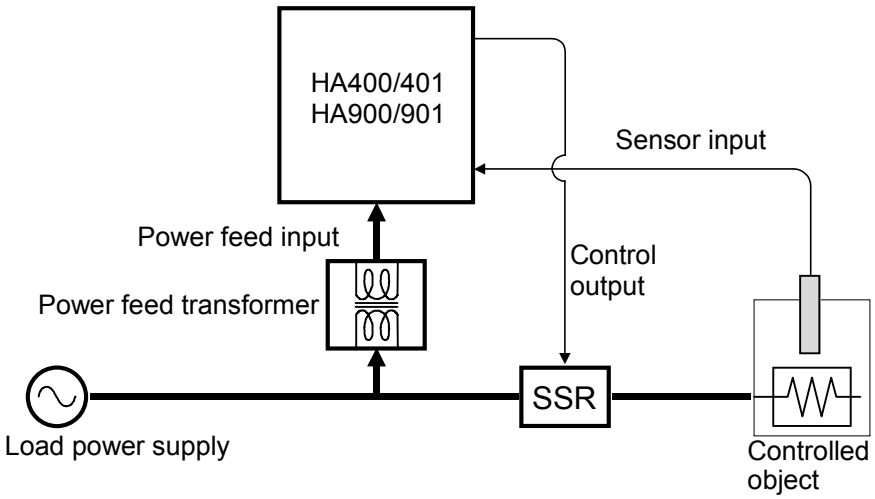
Digits: 7 digits

Data range: 0: Not provided
1: Provided

Factory set value: 0

Functional description:

The power feed forward function is used to stabilize the control point by monitoring the load voltage by the power feed transformer. If the power feed input voltage becomes less than approx. −30 % of the rated value, control automatically stops.



When a type of the controller specified the power feed forward function (option) is used with unconnected the power feed transformer, the control output is turned off.

This item becomes valid only type of the controller specified the power feed forward function (option) when ordering.

When the power feed forward function is used with a type of the controller specified the two loops control function, the power supply circuit of each loops is required to be the same

Always use the power feed transformer attached to product.

Input 1_AT bias	RKC communication identifier	GB
	MODBUS register address	High order: 02C2H (706) Low order: 02C3H (707)
Input 2_AT bias	RKC communication identifier	GA
	MODBUS register address	High order: 02C8H (712) Low order: 02C9H (713)

This item is for setting the desired bias to move the AT point when the autotuning (AT) function is activated.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: –Input span to +input span

Factory set value: 0

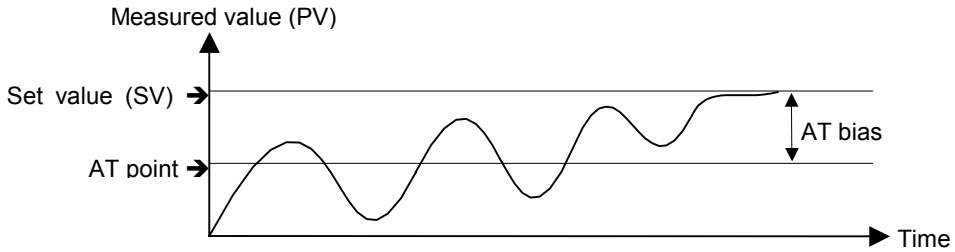
Relational items: PID/AT transfer (P. 108)

Functional description:

The AT bias is set when the autotuning function in which the measured value (PV) does not exceed the set value (SV) is activated. Our autotuning method performs ON/OFF control centering around the set value (SV), then calculates and sets each of the PID constants by hunting the measured value (PV). However, overshooting caused by this hunting may not be preferable depending on the controlled object. In such a case, the desired AT bias is set.

If it is set, another set value (SV) to activate the autotuning function [AT point] can be set.

Example: When AT bias is set to the minus (–) side



Input 1_AT cycle	RKC communication identifier	G3
	MODBUS register address	High order: 02C4H (708) Low order: 02C5H (709)
Input 2_AT cycle	RKC communication identifier	G2
	MODBUS register address	High order: 02CAH (714) Low order: 02CBH (715)

This value is the number of ON/OFF cycle when the autotuning (AT) function is activated.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 0: 1.5 cycle
1: 2.0 cycle
2: 2.5 cycle
3: 3.0 cycle

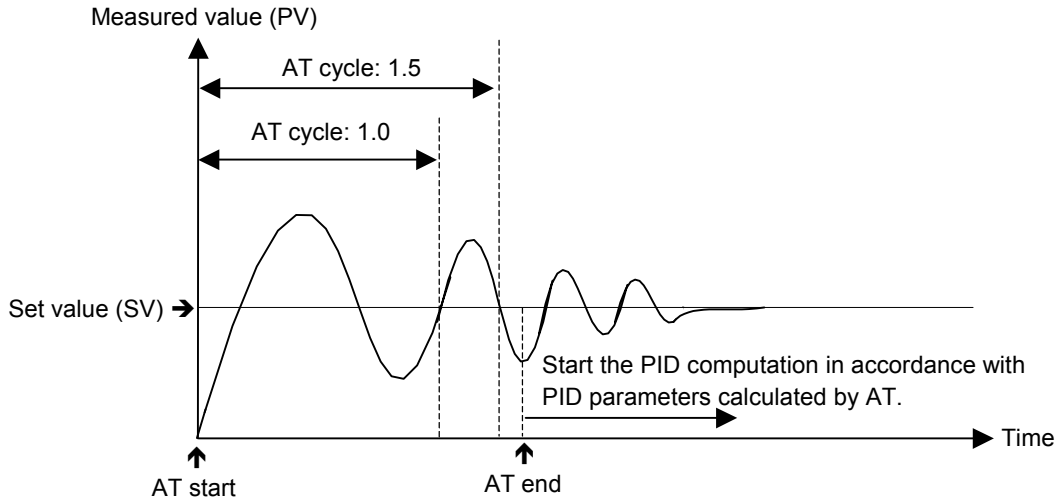
Factory set value: 1

Relational items: PID/AT transfer (P. 108)

Functional description:

The AT cycle is the number of ON/OFF cycle when the autotuning (AT) function is activated.

Example: When the AT cycle is set to 1.5 cycle and the autotuning (AT) function is executed just after the power is turned on.



Input 1_AT differential gap time	RKC communication identifier	GH
	MODBUS register address	High order: 02C6H (710) Low order: 02C7H (711)
Input 2_AT differential gap time	RKC communication identifier	GG
	MODBUS register address	High order: 02CCH (716) Low order: 02CDH (717)

This item is for setting the desired ON/OFF action differential gap time when the autotuning (AT) function is activated. This prevents the AT function from malfunctioning caused by noise.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits
Data range: 0.00 to 50.00 seconds
Factory set value: HA400/HA900: 0.10
HA401/HA901: 10.00
Relational items: PID/AT transfer (P. 108)
Functional description:

In order to prevent the output from chattering due to the fluctuation of a measured value (PV) caused by noise when the autotuning (AT) function is activated, the output on or off state is held until “AT differential gap time” passes after the output on/off state is selected. Set “AT differential gap time” to ”1/100 × Time required for temperature rise.”

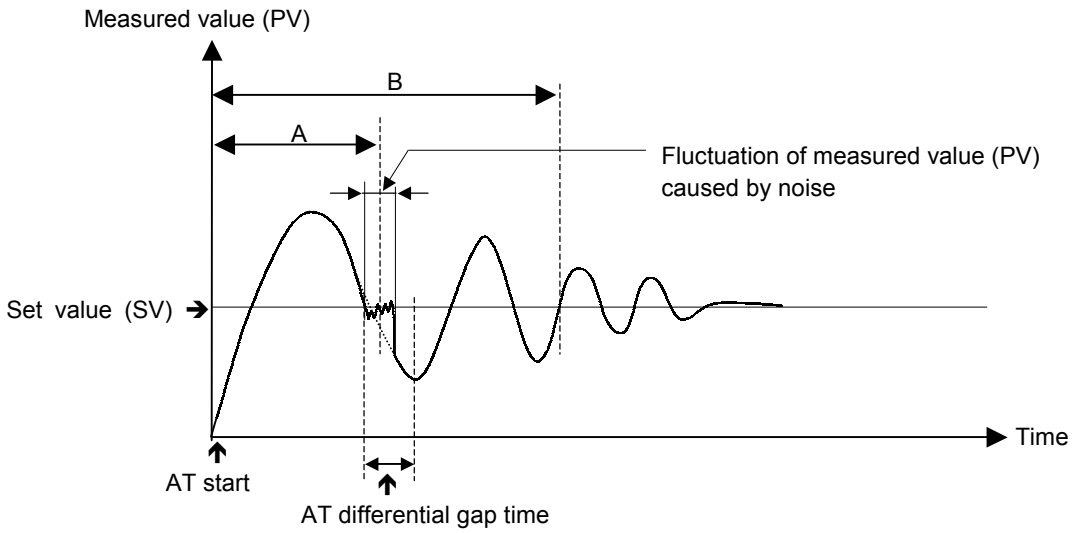
Continued on the next page.

Continued from the previous page.

Example:

A: AT cycle time at an AT differential gap time of 0.00 second
If the output chatters due to the fluctuation of a measured value (PV) caused by noise, the AT function is likely to be terminated halfway.

B: AT cycle time when the AT differential gap time is set to "Time corresponding to 0.25 cycles"
The fluctuation of a measured value (PV) caused by noise is ignored and as a result the normal AT function is activated.



The AT cycle of this instrument is 2 cycles (factory set value).

Open/Close output neutral zone	RKC communication identifier	V2
	MODBUS register address	High order: 02CEH (718) Low order: 02CFH (719)

This item is an area where the output between open-side and close-side outputs is turned off used in the position proportioning PID control.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

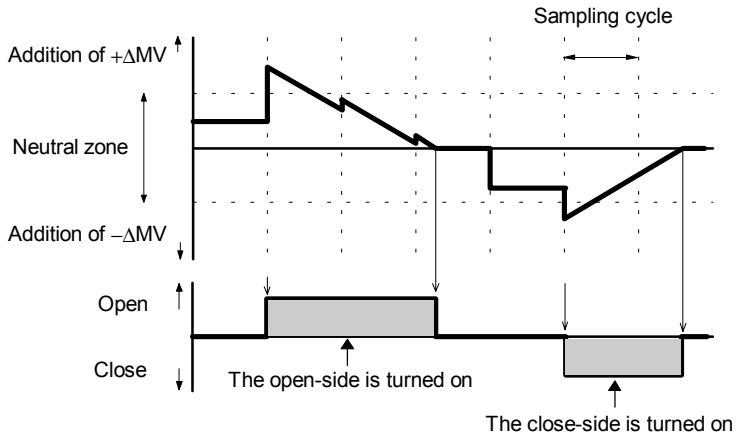
Data range: 0.1 to 10.0 %

Factory set value: 10.0

Relational items: Open/Close output differential gap (P. 183),
Action at feedback resistance (FBR) input error (P. 184),
Feedback adjustment (P. 185)

Functional description:

The neutral zone is an area where the output between open-side and close-side outputs is turned off. This zone is used to prevent the output signal from being frequently output to the control moter. The output addition value within the neutral zone is temporarily held and when it is out of the neutral zone, the output to the control motor starts.



The opening output is not turned on until the control computation result (ΔMV) becomes the neutral zone value or more.

Open/Close output differential gap	RKC communication identifier	VH
	MODBUS register address	High order: 02D0H (720) Low order: 02D1H (721)

This item is a differential gap of Open/Close output used in the position proportioning PID control.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

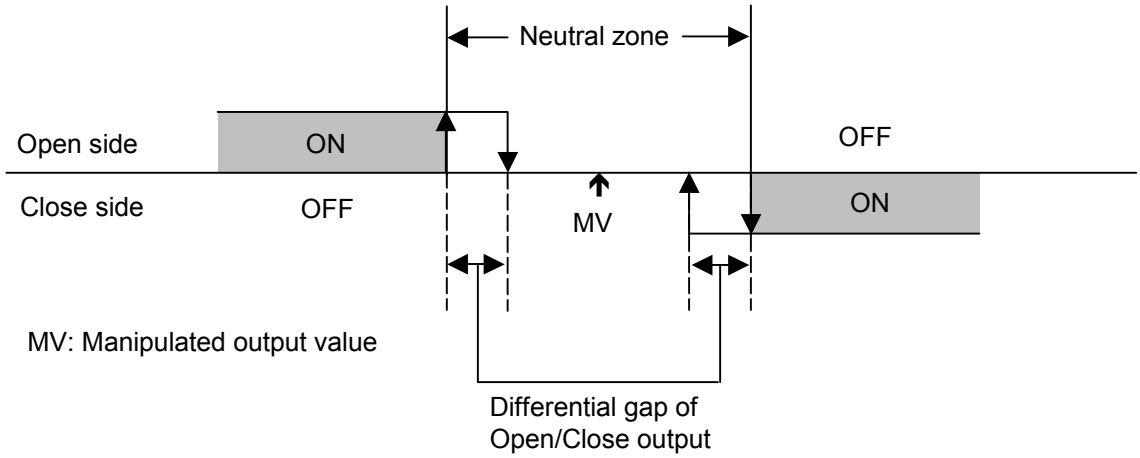
Data range: 0.1 to 5.0 %

Factory set value: 0.2

Relational items: Open/Close output neutral zone (P. 182),
Action at feedback resistance (FBR) input error (P. 184),
Feedback adjustment (P. 185)

Functional description:

Setting the Open/Close output differential gap can prevent a state where the manipulated output relay contacts on the open and close sides repeat turning ON and OFF by feedback resistance input fluctuation.



Action at feedback resistance (FBR) input error	RKC communication identifier	SY
	MODBUS register address	High order: 02D2H (722) Low order: 02D3H (723)

This item selects an action at the feedback resistance (FBR) input break.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: 0: Close-side output ON, Open-side output OFF
1: Close-side output OFF, Open-side output OFF
2: Close-side output OFF, Open-side output ON

Factory set value: 1

Relational items: Open/Close output neutral zone (P. 182),
Open/Close output differential gap (P. 183), Feedback adjustment (P. 185)

Feedback adjustment	RKC communication identifier	FV
	MODBUS register address	High order: 02D4H (724) Low order: 02D5H (725)

This item conducts an automatic adjustment of the control motor that is used for the position proportioning PID control.
This adjustment matches a valve opening signal (feedback resistance input: total closing to full admission) from the control motor with the manipulated variable range (0 to 100 %) of the PID computation result. Always conducts the feedback adjustment prior to starting operation. Prior to conducting adjustment, check that the wiring has been finished, and that the load (control motor, etc.) have been operated.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

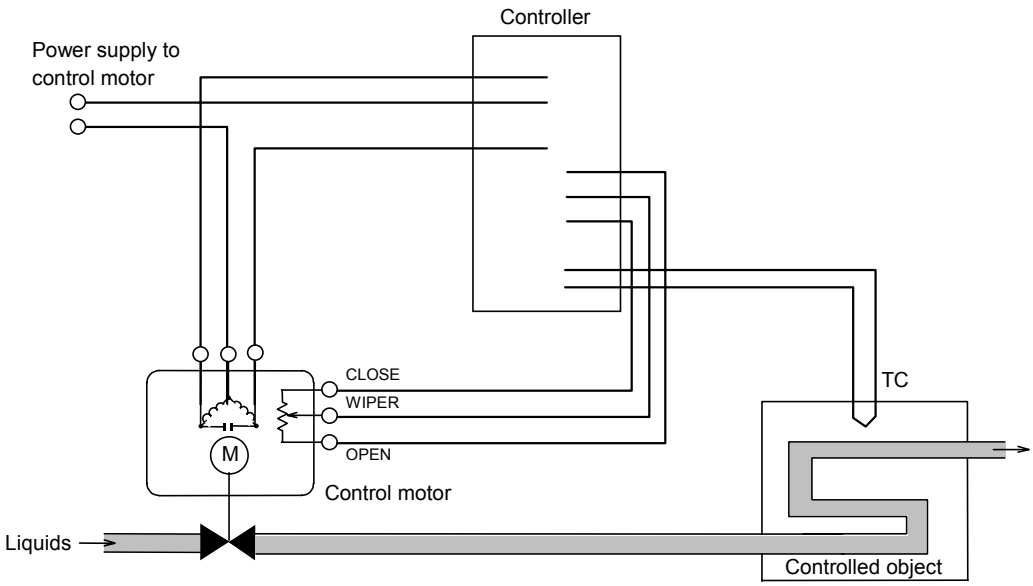
Digits: 7 digits

Data range: 0: Adjustment end
1: During the Open-side adjusting
2: During the Close-side adjusting

Factory set value: —

Functional description:

The position proportioning PID control is performed by feeding back both the valve opening (feedback resistance input) from the control motor and measured value (PV) from the controlled object in the flow control.



Setting change rate limiter unit time	RKC communication identifier	HU
	MODBUS register address	High order: 02D6H (726) Low order: 02D7H (727)

This item sets a unit time used with the setting change rate limiter (up/down).

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits
Data range: 1 to 3600 seconds
Factory set value: 60
Relational items: Setting change rate limiter up/down (P. 119)

Soak time unit selection	RKC communication identifier	RU
	MODBUS register address	High order: 02D8H (728) Low order: 02D9H (729)

This item selects a time range (span) used with the area soak time.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits
Data range: 0: 0 hour 00 minutes 00 second to 9 hours 59 minutes 59 seconds
2: 0 minutes 00.00 seconds to 9 minutes 59.99 seconds
Factory set value: 2
Relational items: Area soak time (P. 121)

Input 1_setting limiter (high limit)	RKC communication identifier	SH
	MODBUS register address	High order: 02DAH (730) Low order: 02DBH (731)
Input 2_setting limiter (high limit)	RKC communication identifier	ST
	MODBUS register address	High order: 02DEH (734) Low order: 02DFH (735)

This value is a high limit of the setting range.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: Setting limiter (low limit) to input scale high

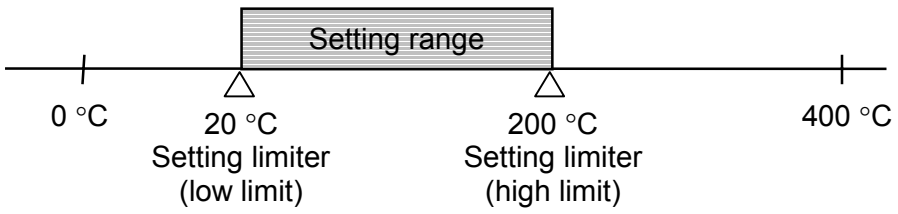
Factory set value: Input 1_setting limiter (high limit): Input 1_input scale high
Input 2_setting limiter (high limit): Input 2_input scale high

Relational items: Decimal point position (P. 136), Input scale high (P. 137), Setting limiter low limit (P. 188)

Functional description:

The setting limiter is the function of limiting the set value (SV) setting range.

Example: When the input range (input scale range) is from 0 to 400 °C, and the setting limiter (high limit) is 200 °C, and the setting limiter (low limit) is 20 °C.



Input 1_setting limiter (low limit)	RKC communication identifier	SL
	MODBUS register address	High order: 02DCH (732) Low order: 02DDH (733)
Input 2_setting limiter (low limit)	RKC communication identifier	SU
	MODBUS register address	High order: 02E0H (736) Low order: 02E1H (737)

This value is a low limit of the setting range.

Attribute: R/W (Read and Write)

This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: Input scale low to setting limiter (high limit)

Factory set value: Input 1_setting limiter (low limit): Input 1_input scale low
Input 2_setting limiter (low limit): Input 2_input scale low

Relational items: Decimal point position (P. 136), Input scale low (P. 138), Setting limiter high limit (P. 187)

Functional description:

See the setting limiter (high limit).

ROM version display	RKC communication identifier	VR
	MODBUS register address	High order: 02E2H (738) Low order: 02E3H (739)

This value is a version of the ROM loaded on the controller.

Attribute: RO (Read only)
Digits: 7 digits
Data range: Display the version of loading software.
Factory set value: —

Integrated operating time display	RKC communication identifier	UT
	MODBUS register address	High order: 02E4H (740) Low order: 02E5H (741)

This value is an integrated operating time of the controller.

Attribute: RO (Read only)
Digits: 7 digits
Data range: 0 to 99999 hours
Factory set value: —

Holding peak value ambient temperature display	RKC communication identifier	Hp
	MODBUS register address	High order: 02E6H (742) Low order: 02E7H (743)

This value is a maximum ambient temperature on the rear terminal board of the instrument.

Attribute: RO (Read only)
Digits: 7 digits
Data range: −10.0 to +100.0 °C
Factory set value: —

Power feed transformer input value monitor	RKC communication identifier	HM
	MODBUS register address	High order: 02E8H (744) Low order: 02E9H (745)

This value is a monitored value of the power feed forward (PEF) input.

Attribute: RO (Read only)
Digits: 7 digits
Data range: 0.0 to 160.0 %
Display in the engineering unit of % corresponding to the rated value.
Factory set value: —

Items relating to the memory area other than the control area:

Register addresses (0500H to 0535H) are used for checked and changed the set value relating to the memory area other than the control area.

Memory area selection	RKC communication identifier	ZA
	MODBUS register address	High order: 0500H (1280) Low order: 0501H (1281)

This item specifies a number of the memory area other than the control area.

Attribute: R/W (Read and Write)
Digits: 7 digits
Data range: 1 to 16
Factory set value: 1

Event 1 set value	RKC communication identifier	A1
	MODBUS register address	High order: 0502H (1282) Low order: 0503H (1283)
Event 2 set value	RKC communication identifier	A2
	MODBUS register address	High order: 0504H (1284) Low order: 0505H (1285)
Event 3 set value	RKC communication identifier	A3
	MODBUS register address	High order: 0506H (1286) Low order: 0507H (1287)
Event 4 set value	RKC communication identifier	A4
	MODBUS register address	High order: 050CH (1292) Low order: 050DH (1293)

This value expresses a set value of the event action.

Attribute: R/W (Read and Write)

The event 3 set value (A3) becomes RO (Read only) when it was selected "9: Control loop break alarm (LBA) " from the event 3 type selection (XC).

The event 4 set value (A4) becomes RO (Read only) when it was selected "9: Control loop break alarm (LBA) " from the event 4 type selection (XD).

Digits: 7 digits

Data range: Deviation: –Input span to +input span
Process: Input scale low to input scale high
SV: Input scale low to input scale high

Factory set value: 50.0

Relational items: Event state (P. 103), Event type selection (P. 151), Event hold action (P. 154), Event differential gap (P. 156), Event action at input error (P. 158), Event assignment (P. 160)

Control loop break alarm 1 (LBA1) time	RKC communication identifier	A5
	MODBUS register address	High order: 0508H (1288) Low order: 0509H (1289)
Control loop break alarm 2 (LBA2) time	RKC communication identifier	A6
	MODBUS register address	High order: 050EH (1294) Low order: 050FH (1295)

The variation of measured value (PV) is monitored for each control loop break alarm (LBA) time.

Attribute: R/W (Read and Write)

The control loop break alarm 1 (LBA1) time (A5) becomes RO (Read only) when it was selected "1 to 8" from the event 3 type selection (XC).

The control loop break alarm 2 (LBA2) time (A6) becomes RO (Read only) when it was selected "1 to 8" from the event 4 type selection (XD).

Digits: 7 digits
Data range: 0 to 7200 seconds (0: Not provided)
Factory set value: 480
Relational items: Event state (P. 103), Event assignment (P. 160), LBA deadband (P. 113)

LBA1 deadband	RKC communication identifier	N1
	MODBUS register address	High order: 050AH (1290) Low order: 050BH (1291)
LBA2 deadband	RKC communication identifier	N2
	MODBUS register address	High order: 0510H (1296) Low order: 0511H (1297)

The LBA deadband is a zone to prevent the control loop break alarm (LBA) from malfunctioning caused by disturbance.

Attribute: R/W (Read and Write)

The LBA1 deadband (N1) becomes RO (Read only) when it was selected "1 to 8" from the event 3 type selection (XC).

The LBA2 deadband (N2) becomes RO (Read only) when it was selected "1 to 8" from the event 4 type selection (XD).

Digits: 7 digits
Data range: 0.0 to input span
Factory set value: 0.0
Relational items: Event state (P. 103), Event assignment (P. 160),
Control loop break alarm (LBA) time (P. 113)

Input 1_set value (SV1)	RKC communication identifier	S1
	MODBUS register address	High order: 0512H (1298) Low order: 0513H (1299)
Input 2_set value (SV2)	RKC communication identifier	S0
	MODBUS register address	High order: 051EH (1310) Low order: 051FH (1311)

The set value (SV) is a desired value of the control.

Attribute: R/W (Read and Write)

The Input 2_set value (SV2: S0) becomes RO (Read only) for the one input specification.

Digits: 7 digits
Data range: Setting limiter (low limit) to setting limiter (high limit)
See **Input range table (P. 119)**
Factory set value: 0
Relational items: Setting limiter high limit/ low limit (P. 188)

Input 1_proportional band	RKC communication identifier	P1
	MODBUS register address	High order: 0514H (1300) Low order: 0515H (1301)
Input 2_proportional band	RKC communication identifier	P0
	MODBUS register address	High order: 0520H (1312) Low order: 0521H (1313)

This value expresses a proportional band of the PI and PID control.

Attribute: R/W (Read and Write)

The Input 2_proportional band (P0) becomes RO (Read only) for the one input specification.

Digits: 7 digits
Data range: TC/RTD input: 0 to input span
Voltage/current input: 0.0 to 1000.0 % of input span
0 (0.0): ON/OFF action
Factory set value: 30.0
Relational items: ON/OFF action differential gap upper (P. 170),
ON/OFF action differential gap lower (P. 171)

Input 1_integral time	RKC communication identifier	I1
	MODBUS register address	High order: 0516H (1302) Low order: 0517H (1303)
Input 2_integral time	RKC communication identifier	I0
	MODBUS register address	High order: 0522H (1314) Low order: 0523H (1315)

This value expresses a time of the integral action that eliminates the offset occurring in proportional control.

Attribute: R/W (Read and Write)

The Input 2_integral time (I0) becomes RO (Read only) for the one input specification.

Digits: 7 digits

Data range: 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds
(0.0 or 0.00: PD action)

Factory set value: 240.00

Relational items: Integral/derivative time decimal point position selection (P. 169)

Input 1_derivative time	RKC communication identifier	D1
	MODBUS register address	High order: 0518H (1304) Low order: 0519H (1305)
Input 2_derivative time	RKC communication identifier	D0
	MODBUS register address	High order: 0524H (1316) Low order: 0525H (1317)

This value expresses a time of the derivative action that prevents ripples by predicting output changes and thus improves control stability.

Attribute: R/W (Read and Write)

The Input 2_derivative time (D0) becomes RO (Read only) for the one input specification.

Digits: 7 digits

Data range: 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds
(0.0 or 0.00: PI action)

Factory set value: 60.00

Relational items: Integral/derivative time decimal point position selection (P. 169)

Input 1_control response parameter	RKC communication identifier	CA
	MODBUS register address	High order: 051AH (1306) Low order: 051BH (1307)
Input 2_control response parameter	RKC communication identifier	C9
	MODBUS register address	High order: 0526H (1318) Low order: 0527H (1319)

This item is a response resulting from a set value (SV) change in PID control.

Attribute: R/W (Read and Write)

The Input 2_control response parameter (C9) becomes RO (Read only) for the one input specification.

Digits: 7 digits

Data range: 0: Slow
1: Medium
2: Fast

Factory set value: 0

Input 1_ setting change rate limiter (up)	RKC communication identifier	HH
	MODBUS register address	High order: 052AH (1322) Low order: 052BH (1323)
Input 2_ setting change rate limiter (up)	RKC communication identifier	HX
	MODBUS register address	High order: 052EH (1326) Low order: 052FH (1327)

This value expresses a set value of the setting change rate limiter up.

Attribute: R/W (Read and Write)

The Input 2_setting change rate limiter up (HX) becomes RO (Read only) for the one input specification.

Digits: 7 digits

Data range: 0.1 to input span/one minute
0.0: OFF (Not provided)

Factory set value: 0.0

Relational items: Setting change rate limiter unit time (P. 186)

Input 1_ setting change rate limiter (down)	RKC communication identifier	HL
	MODBUS register address	High order: 052CH (1324) Low order: 052DH (1325)
Input 2_ setting change rate limiter (down)	RKC communication identifier	HY
	MODBUS register address	High order: 0530H (1328) Low order: 0531H (1329)

This value expresses a set value of the setting change rate limiter down.

Attribute: R/W (Read and Write)

The Input 2_setting change rate limiter down (HY) becomes RO (Read only) for the one input specification.

Digits: 7 digits
Data range: 0.1 to input span/one minute
0.0: OFF (Not provided)
Factory set value: 0.0
Relational items: Setting change rate limiter unit time (P. 186)

Area soak time	RKC communication identifier	TM
	MODBUS register address	High order: 0532H (1330) Low order: 0533H (1331)

This item uses the combination of the setting change rate limiter up/down and the link area number in case of simple program operation. (see P. 109)

Attribute: R/W (Read and Write)
Digits: 7 digits
Data range: 0 minute 00.00 second to 9 minutes 59.99 seconds or
0 hour 00 minute 00 second to 9 hours 59 minutes 59 seconds
Factory set value: 0.00.00 (0 minute 00.00 second to 9 minute 59.99 seconds)
Relational items: Soak time unit selection (P. 186)

Link area number	RKC communication identifier	LP
	MODBUS register address	High order: 0534H (1332) Low order: 0535H (1333)

This item uses the combination of the setting change rate limiter up/down and the area soak time in case of simple program operation. (see P. 109)

Attribute: R/W (Read and Write)
Digits: 7 digits
Data range: 0 to 16
0: OFF (No link)
Factory set value: 0

8. TROUBLESHOOTING

⚠ 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 the wiring is completed.
- 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 can not solve a problem, please contact RKC sales office or the agent, on confirming the type name and specifications of the product.

■ RKC communication

Problem	Probable 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	Confirm the settings and set them correctly
	Wrong address setting	

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Problem	Probable cause	Solution
No response	Error in the data format	Reexamine 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

■ Modbus

Problem	Probable 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	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's time	
Error code 1	Function cod error (Specifying nonexistent function code)	Confirm the function code
Error code 2	When any address other than 0000H to 0093H, 0200H to 02E9H, and 0500H to 0535H are specified	Confirm the address of holding 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.

9. 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

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RKC INSTRUMENT INC.

HEADQUARTERS: 16-6, KUGAHARA 5-CHOME, OHTA-KU TOKYO 146-8515 JAPAN
PHONE: 03-3751-9799 (+81 3 3751 9799)
E-mail: info@rkcinst.co.jp
FAX: 03-3751-8585 (+81 3 3751 8585)

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