Digital Controller

HA400/HA900
HA401/HA901

Communication
Instruction Manual

RKC® RKC INSTRUMENT INC.

IMR01N03-E5

- Modbus is a registered trademark of Schneider Electric.
- Company names and product names used in this manual are the trademarks or registered trademarks of the respective companies.

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.

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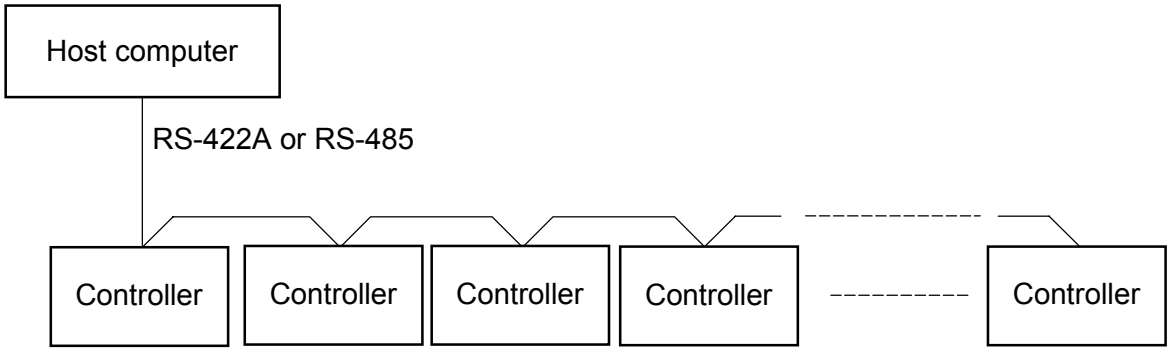
1. OUTLINE

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.

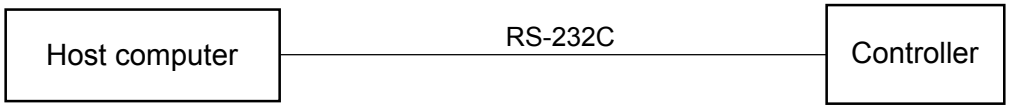
* Correspond to only communication port 2

■ Multi-drop connection

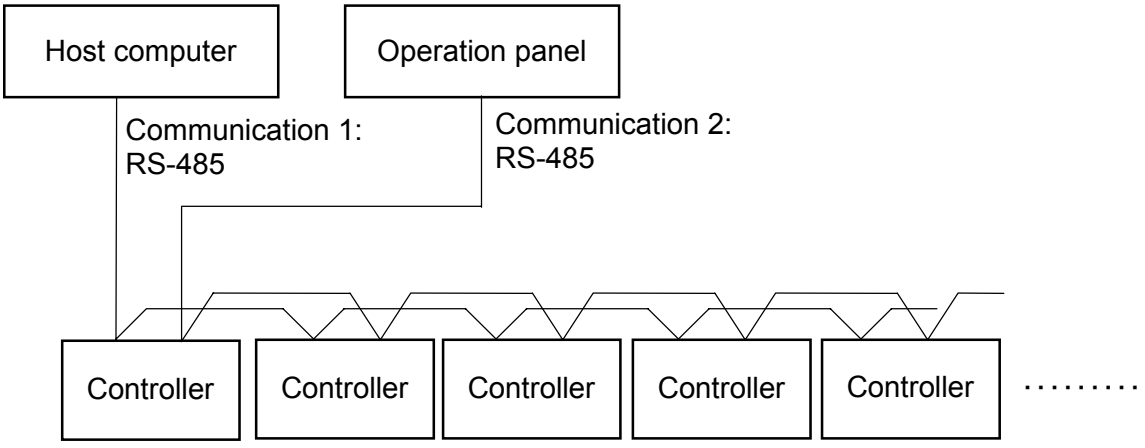


Maximum connections: 31 instruments

■ 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.

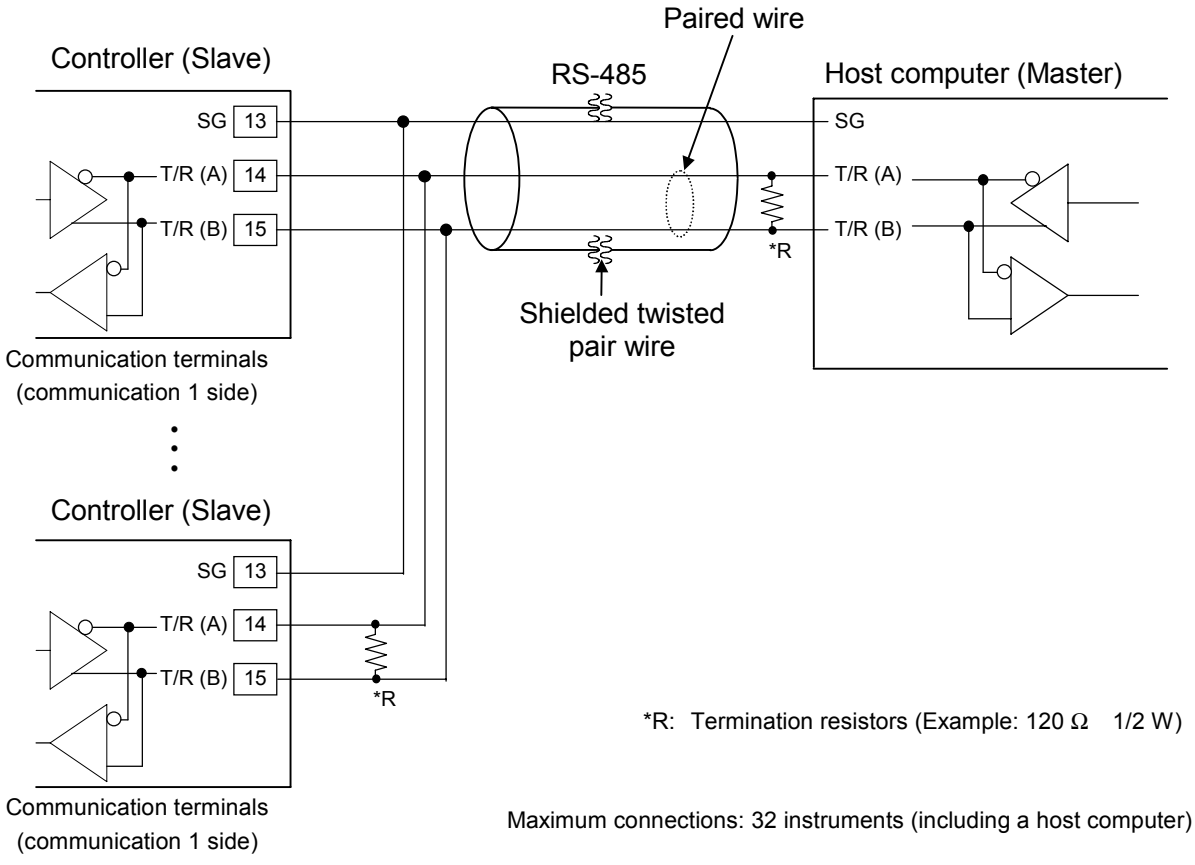
3.1 Connect the Communication 1

■ 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)

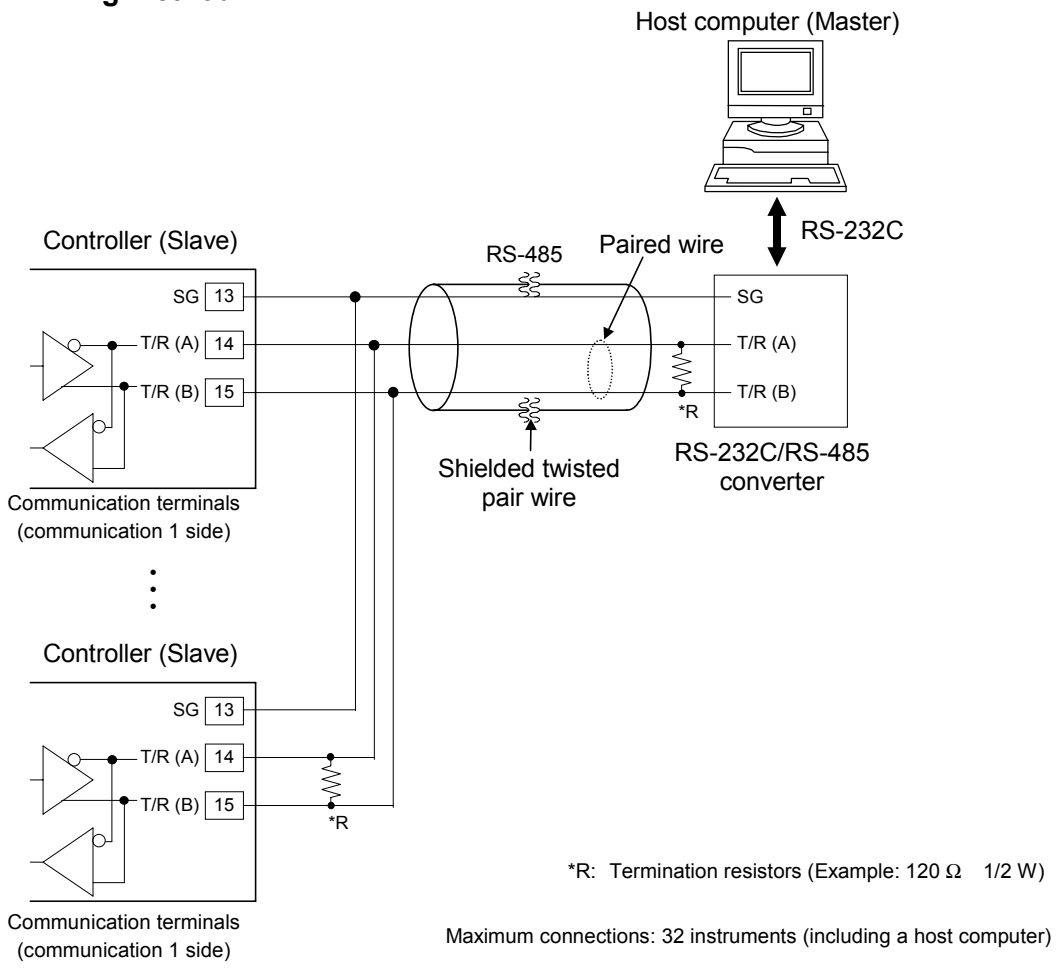
A RS-232C/RS-485 converter is required.

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.

- **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)

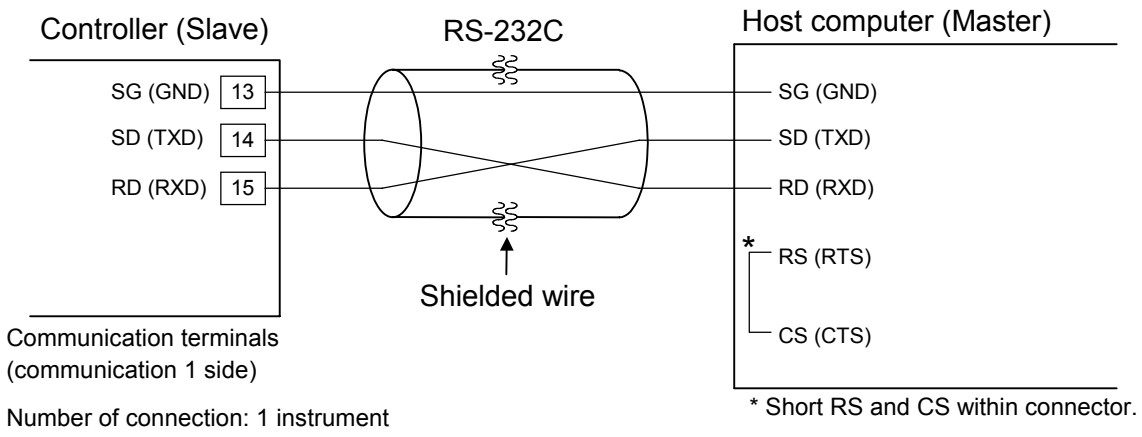
The cable is provided by the customer.

(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.

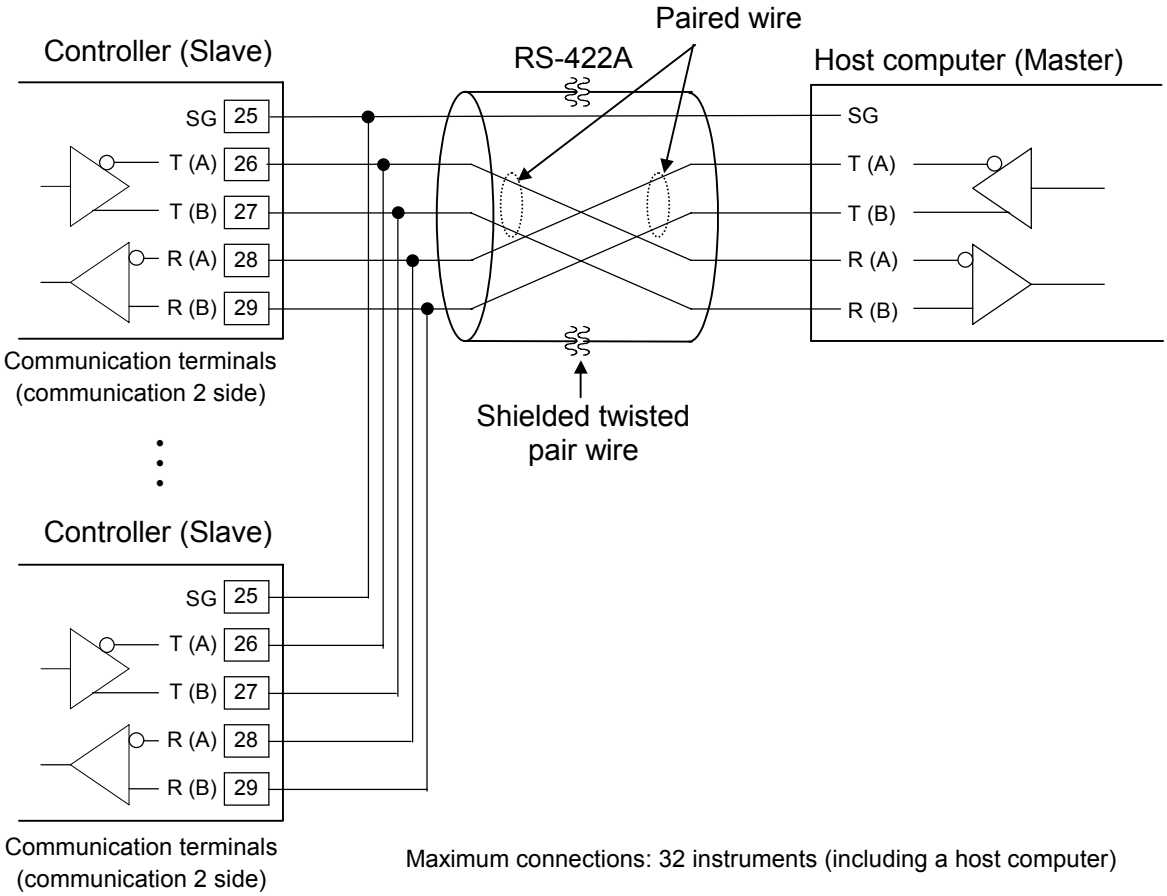
3.2 Connect the Communication 2

■ 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**



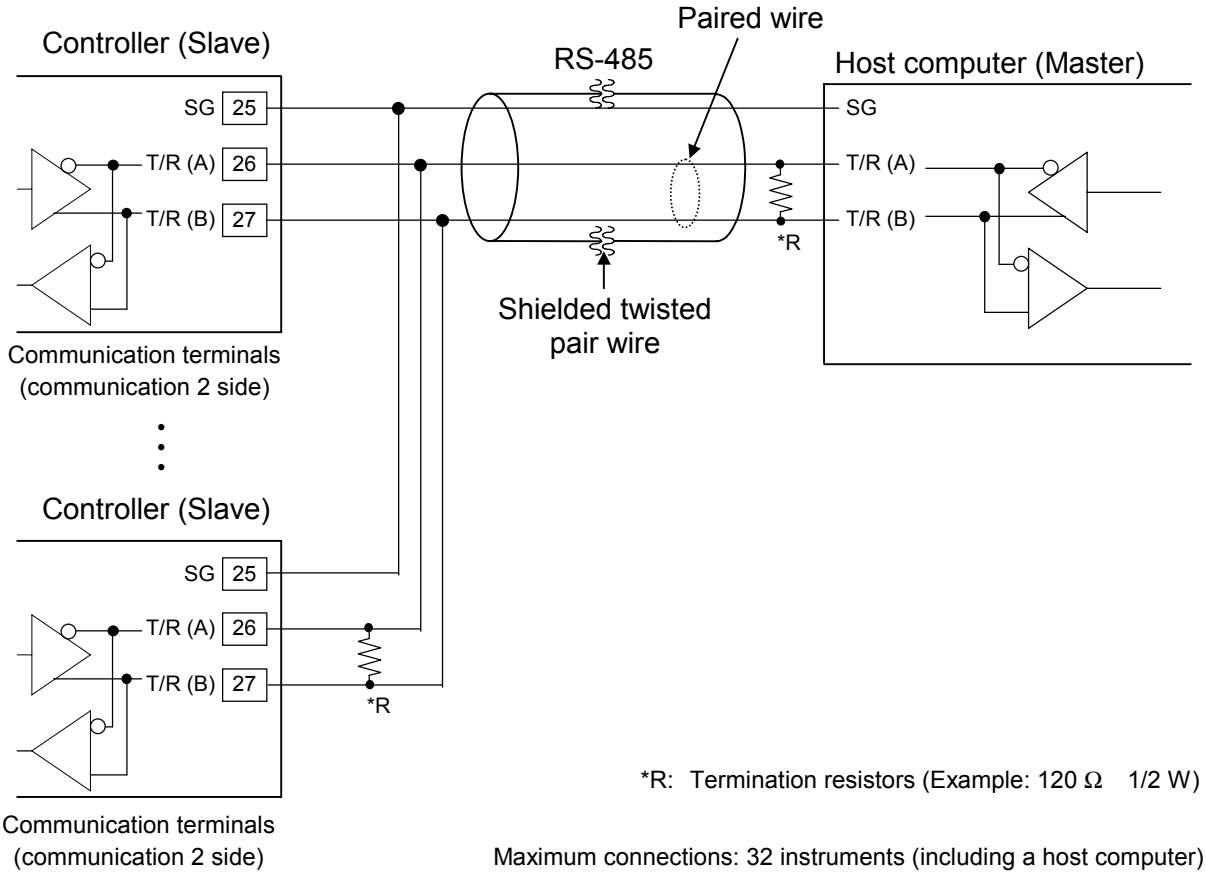
The cable is provided by the customer.

■ 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)

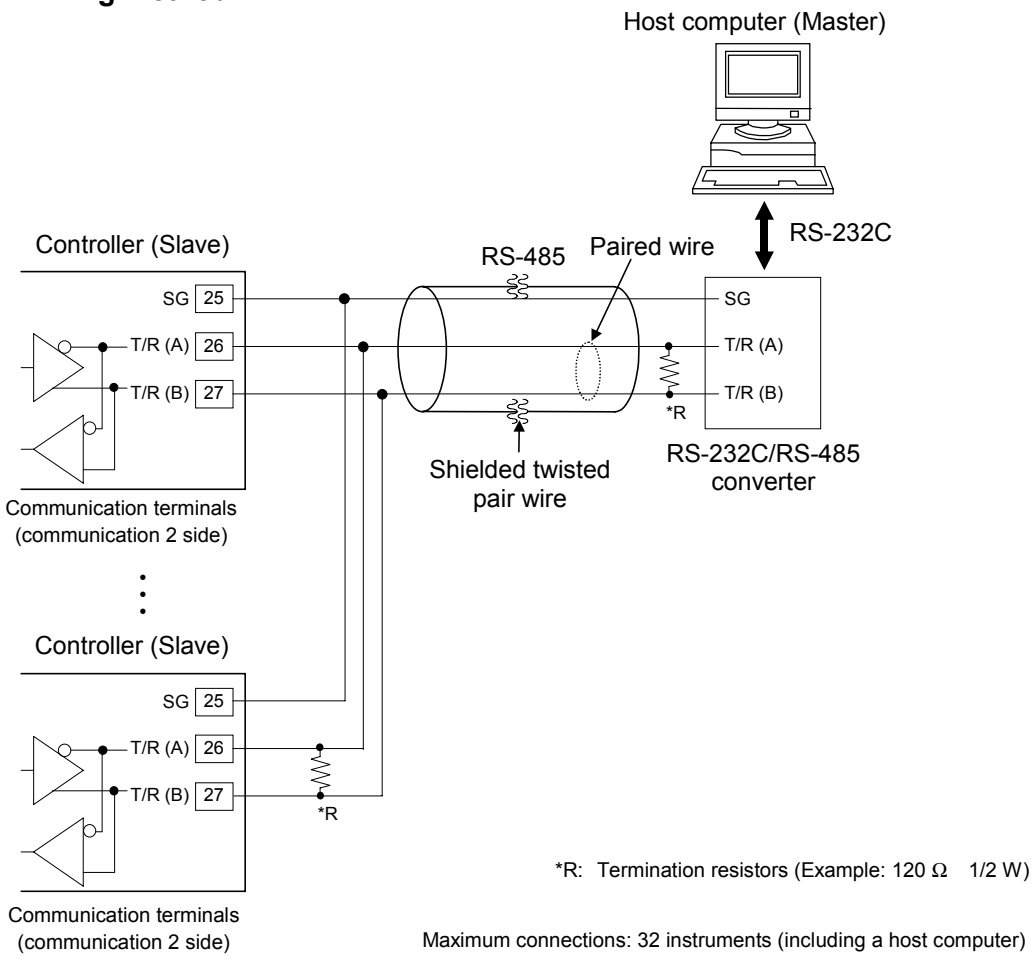
A RS-232C/RS-485 converter is required.

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.

- **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**



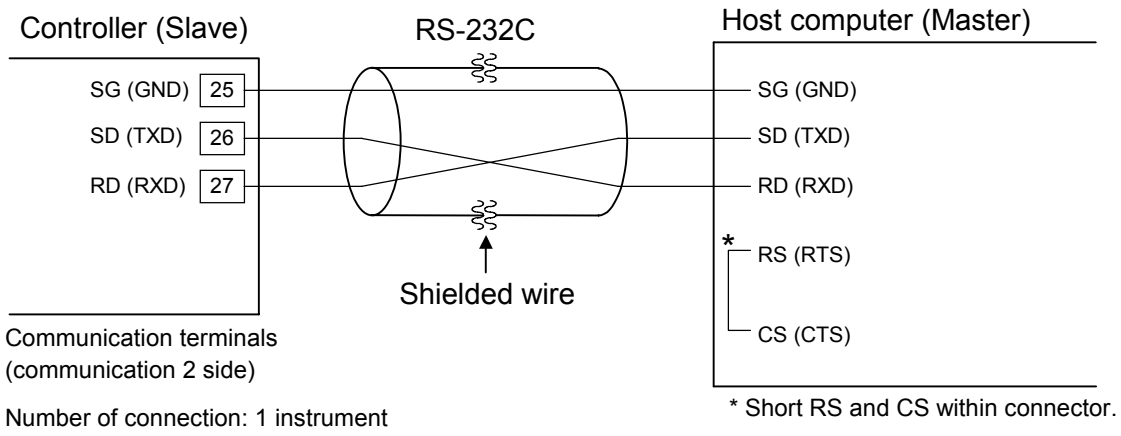
The cable is provided by the customer.

(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)

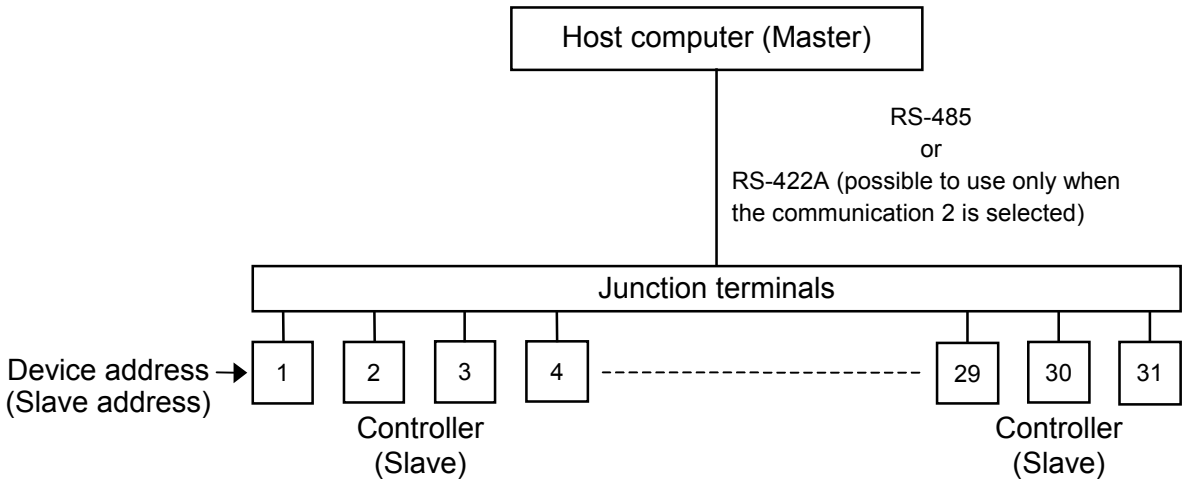
- **Wiring method**



The cable is provided by the customer.

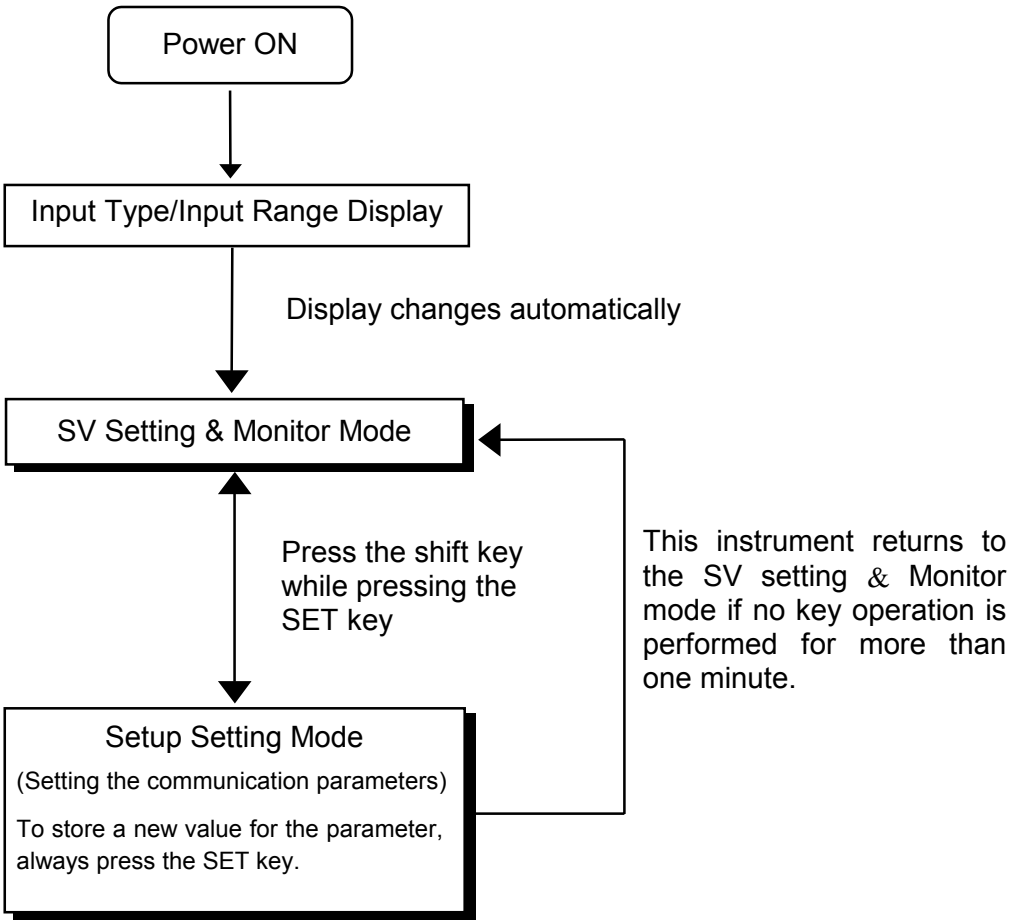
■ Wiring example

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.

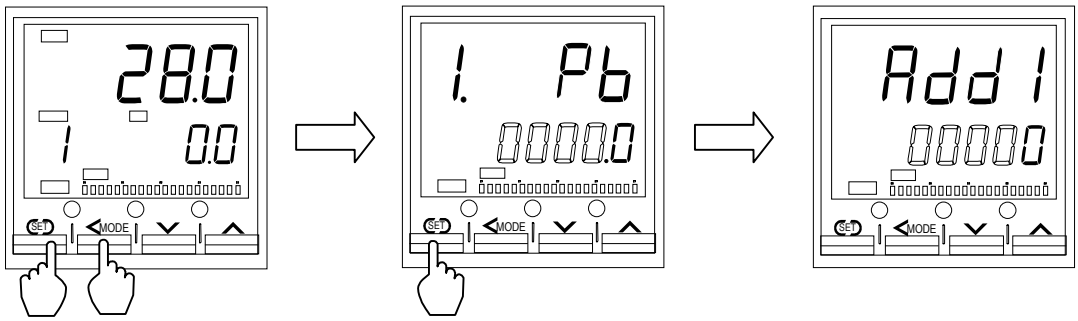


4.1 Transfer to Setup Setting Mode

The first displayed parameter in the Setup Setting mode varies depending on the instrument specification.

This item describes when the first displayed parameter in the 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
Input 1_PV bias setting

Device address 1 setting
(Slave address 1)

When let setup setting mode finish, press the shift key while pressing the SET key.
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.

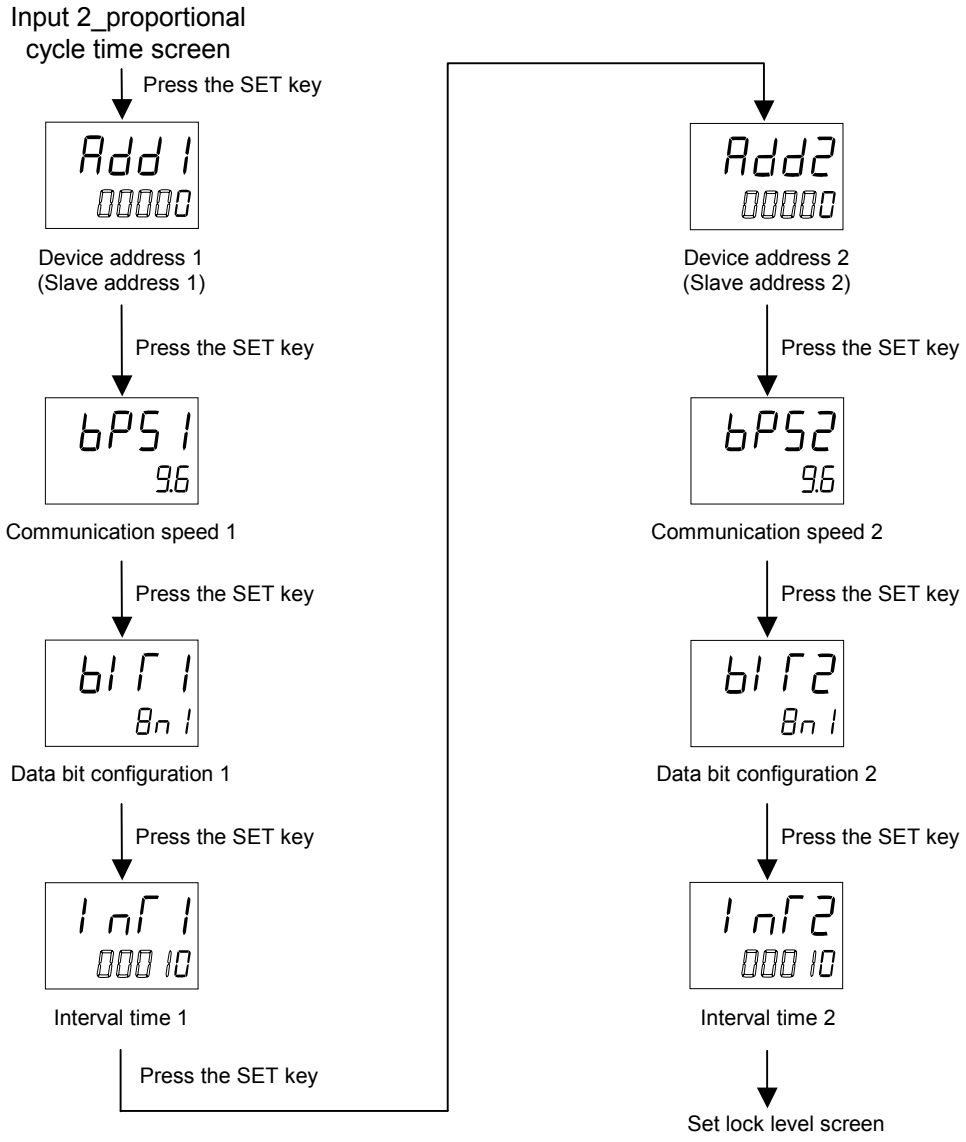
4.2 Setting the Communication Parameters

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

To select parameters in the 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: *Add1, Add2*, interval time: *InT1, InT2*
  Operate UP, DOWN and shift key, and input numerals.
- Communication speed: *bPS1, bPS2*, data bit configuration: *bIT1, bIT2*
  Operate UP or DOWN key, and choose one among the displayed set value.

■ Store the set value

Press the SET key to store the new value.
After all communication parameters are set, in order to make these values thus set valid perform any of the following operations.

- The power is turned on again.
- The RUN/STOP mode is changed from STOP mode to RUN mode.

A new value will not be stored without pressing SET key after the new value is displayed on the display. No communication using the value changed can be performed even with the SET key pressed.

When the RUN/STOP mode is changed from STOP mode to RUN mode, the controller performs the same operation as that of Power-on.

After a new value has been displayed by using the UP and DOWN keys, the SET key must be pressed within one minute, or the new value is not stored and the display will return to the PV1/SV1 monitor screen.

For the RUN/STOP transfer, see **HA400/HA900/HA401/HA901 Operation Manual (IMR01N02-E□)**.

■ 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	Do not use the same device address for more than one controller in multi-drop connection. Each controller must have a unique address in multi-drop connection. In Modbus communication, two-way communication is not possible when the address is 0.	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	Do not use the same device address for more than one controller in multi-drop connection. Each controller must have a unique address in multi-drop connection. In Modbus communication, two-way communication is not possible when the address is 0.	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 status for the host. 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.

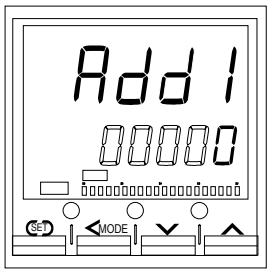
When the "1: Lock" is selected at the "Lock only setting items other than SV and events (EV1 to EV4)" in the set lock level, the communication parameters are not able to change the set values.

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

■ Setting procedure example

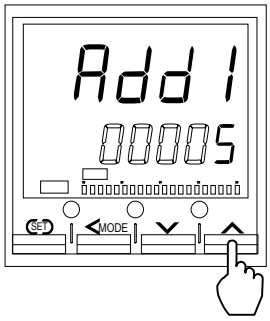
HA900/HA901 is used in the below figures for explanation, but the same setting procedures also apply to HA400/HA401.

1. Go to the Setup Setting mode. Press the shift key while pressing the SET key to go to the Setup Setting mode from the SV setting & Monitor mode. Press the SET key until "Add1" (Device address 1 [slave address 1]) will be displayed.

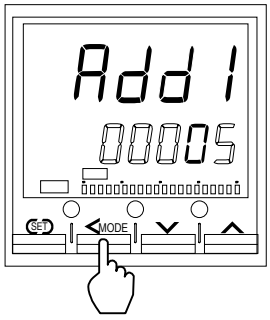


Device address 1 setting
(Slave address 1)

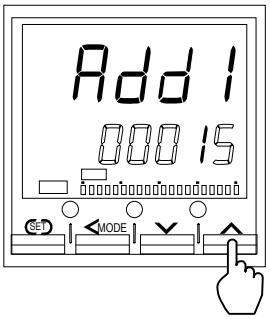
2. Set the device address 1 (slave address 1). The high-lighted digit indicates which digit can be set. Press the UP key to change the number to 5.
Example: Setting the device address 1 (slave address 1) to 15.



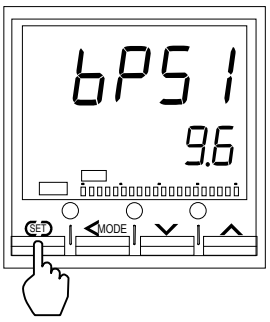
3. Press the shift key to high-light the tens digit.



4. Press the UP key to change the number to 1.



5. Press the SET key to store the new set value. The display goes to the next communication parameter. It the SET key is not pressed within one 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

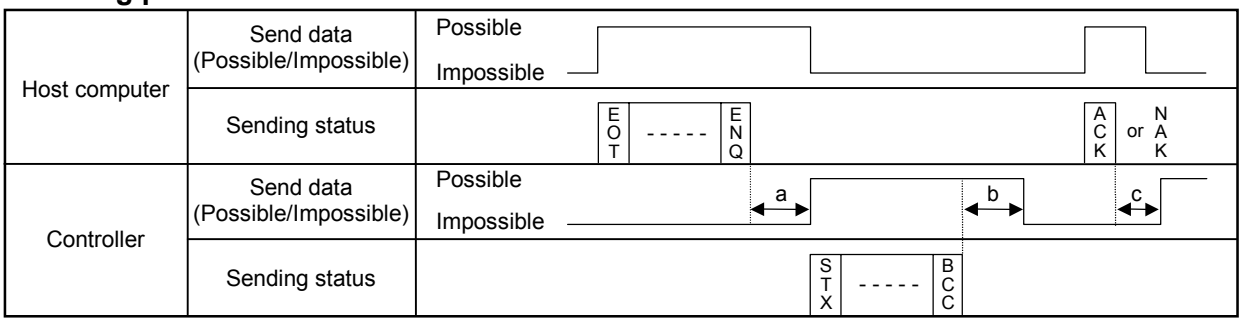
Procedure details	Time
Read holding registers [03H] Response transmission time after the slave receives the query message	20 ms max.
Preset single register [06H] Response transmission time after the slave receives the query message	3 ms max.
Diagnostics (loopback test) [08H] Response transmission time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

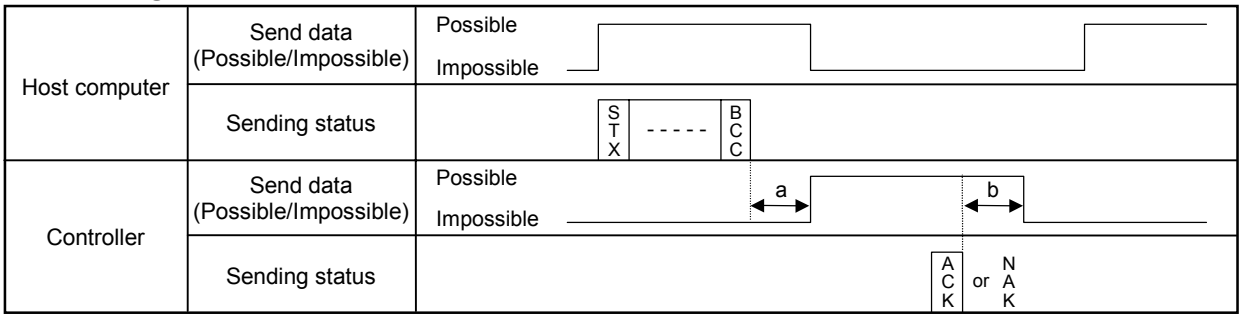
The sending and receiving of RS-485 communication is conducted through two wires; consequently, the transmission and reception of data requires precise timing. Typical polling and selecting procedures between the host computer and the controller are described below:

● 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.

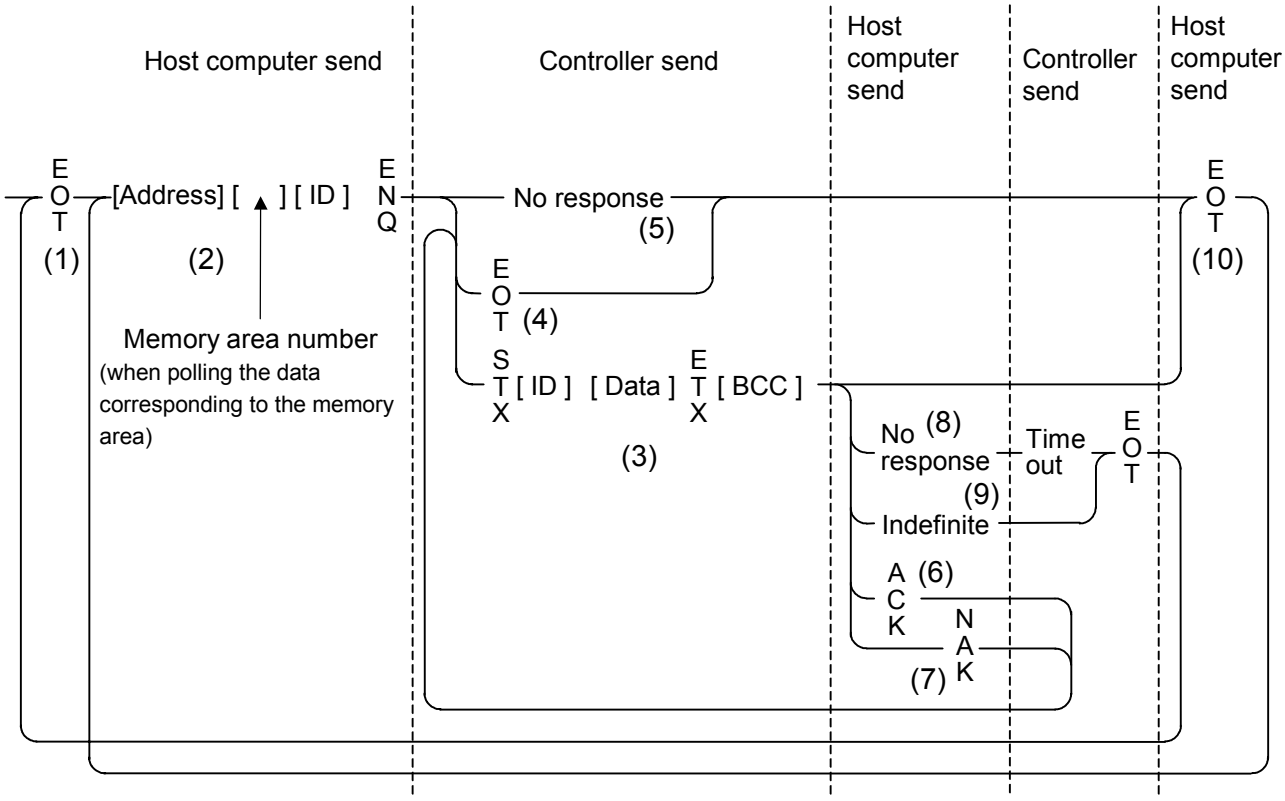
5. RKC COMMUNICATION PROTOCOL

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.

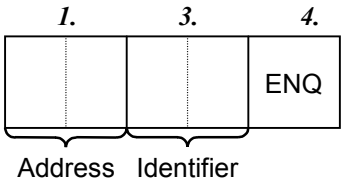
(2) Data sent from host computer - Polling sequence

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.

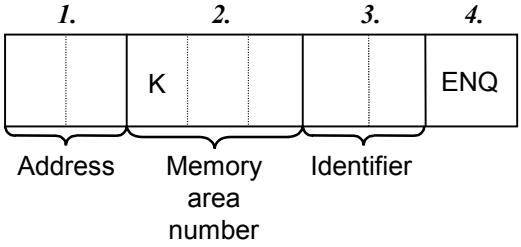


Example:

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	0	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.

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.

For details, see **4.2 Setting the Communication Parameters (P. 14)**.

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. 37)**.

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. 37)**.

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 by using 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	1	0	0	.	0	ETX	BCC
4DH	31H	30H	30H	31H	30H	30H	2EH	30H	03H	←	Hexadecimal numbers

BCC＝4DH ⊕ 31H ⊕ 30H ⊕ 30H ⊕ 31H ⊕ 30H ⊕ 30H ⊕ 2EH ⊕ 30H ⊕ 03H＝50H

(⊕: *Exclusive OR*)

Value of BCC becomes 50H.

(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. 37)**.

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.

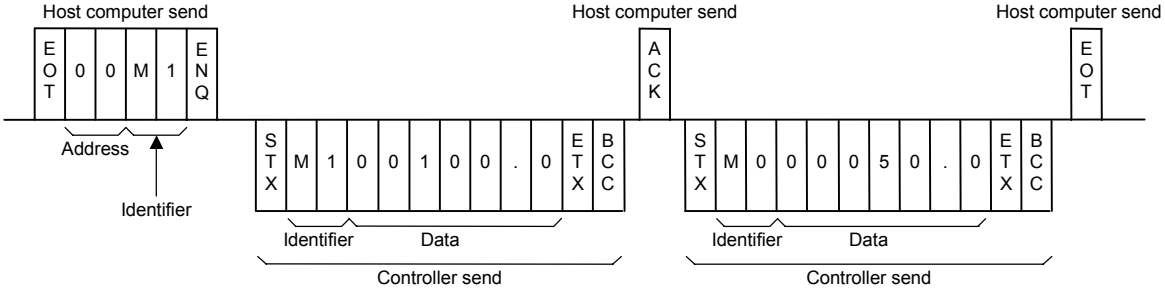
(10) EOT (Data link termination)

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.

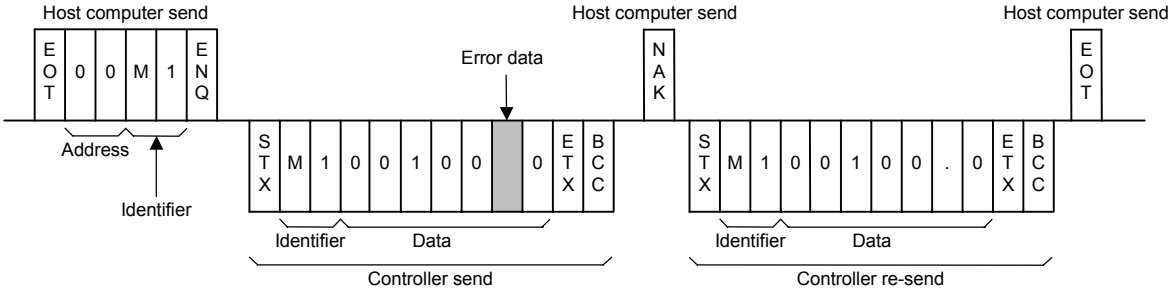
5.1.2 Polling procedure example

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

■ **Normal transmission**

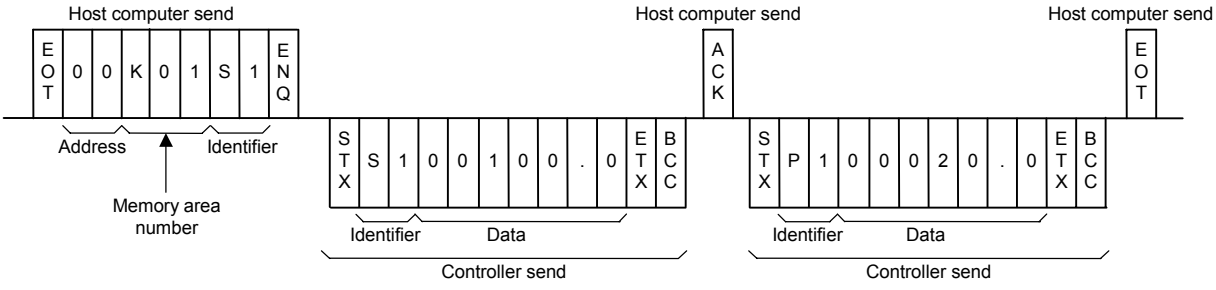


■ **Error transmission**

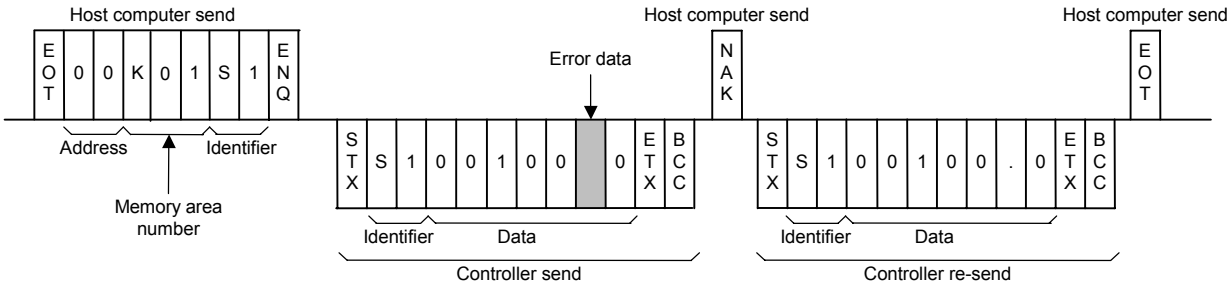


(2) When the items corresponding to the memory area is polled [Example: set value (SV1) S1]

■ **Normal transmission**

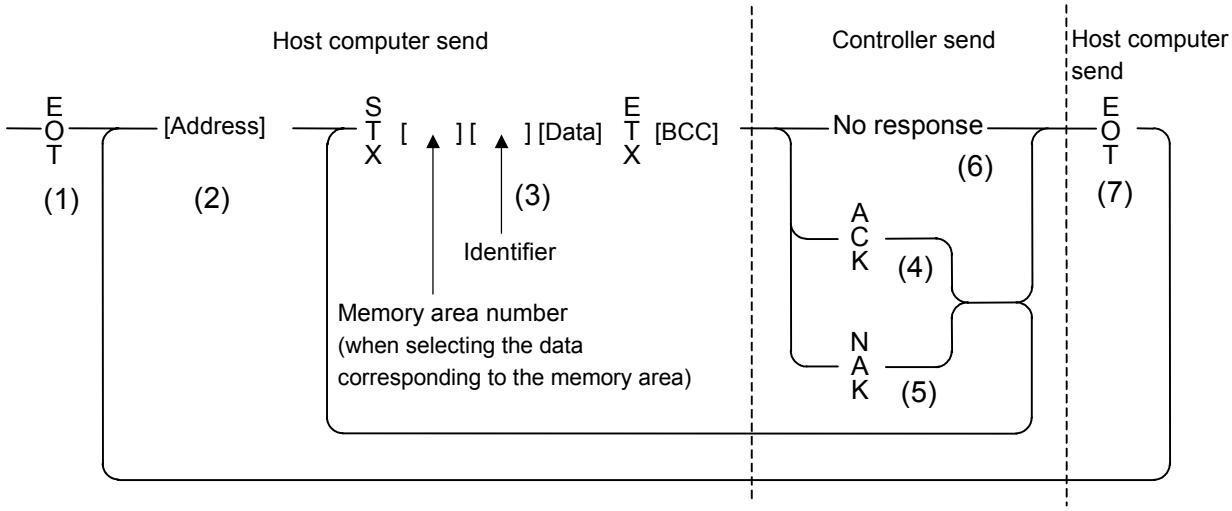


■ **Error transmission**



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. 14)**.

📖 **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. 22)**.

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. 37)**.

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
- When receive data is the identifier of RO (read only)

(6) No response from controller

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

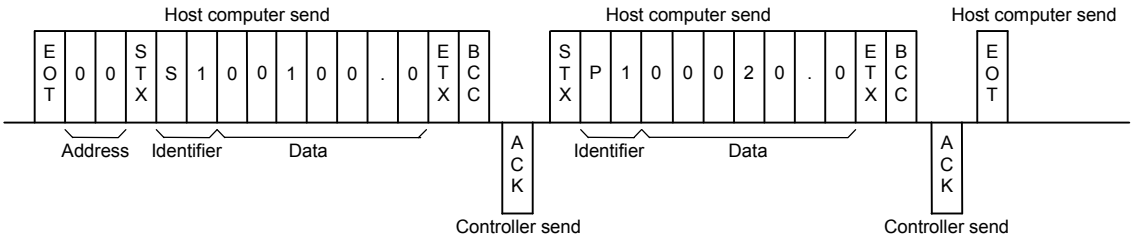
(7) EOT (Data link termination)

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.

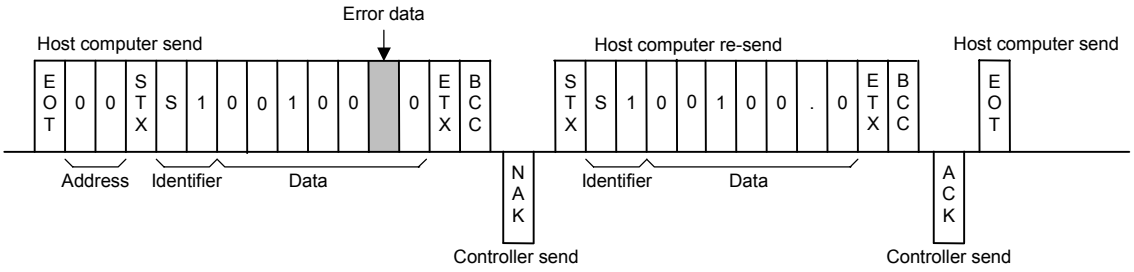
5.2.2 Selecting procedure example

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

■ **Normal transmission**

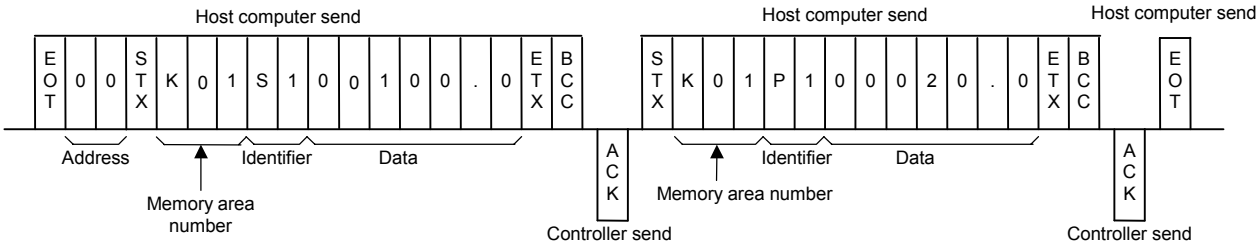


■ **Error transmission**

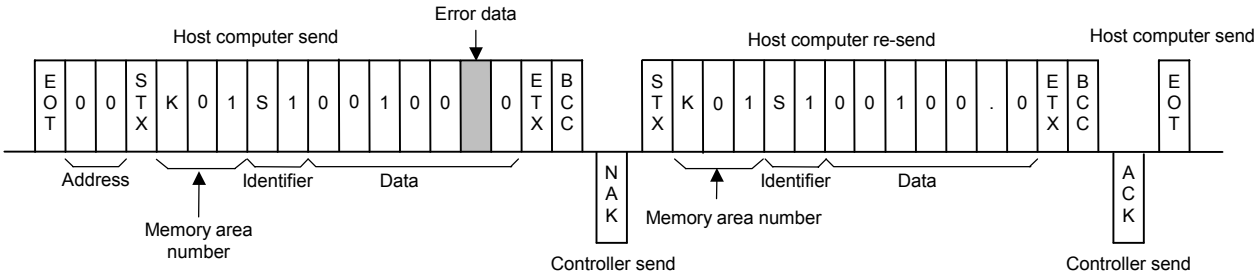


(2) When the items corresponding to the memory area is selected [Example: set value (SV1) S1]

■ **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 *
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
```

* 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$(BCC)                                       Data configuration setting 2
1210      GOSUB *TEXT
1220      GOSUB *RXDT
1230 '
1240 *J20
1250      J=0
1260 '
1270 *IF2
1280      IF LOC(1)=0 THEN J=J+1:IF J<500 THEN *IF2 ELSE PRINT " TIME   Setting of the receiving waiting time *
          OUT ":END                                               (Timeout processing)
1290 '
1300      K$=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 '
```

* 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

Each item whose name is described as "Unused" in the following list is not used for the HA400/HA900/HA401/HA901. However, indefinite data is sent when data is sent by ACK (acknowledge) from the host computer.

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. 96
2	Input 1_measured value (PV1) monitor	**M1**	RO	Input 1_input scale low to Input 1_input scale high	—	P. 96
3	Input 2_measured value (PV2) monitor	**M0**	RO	Input 2_input scale low to Input 2_input scale high	—	P. 96
4	Feedback resistance input value monitor	**M2**	RO	0.0 to 100.0 %	—	P. 96
5	Current transformer input value 1 (CT1) monitor	**M3**	RO	0.0 to 30.0 A or 0.0 to 100.0 A	—	P. 97
6	Current transformer input value 2 (CT2) monitor	**M4**	RO		—	P. 97
7	Input 1_ set value (SV1) monitor	**MS**	RO	Input 1_setting limiter (low) to Input 1_setting limiter (high)	—	P. 97
8	Input 2_ set value (SV2) monitor	**MT**	RO	Input 2_setting limiter (low) to Input 2_setting limiter (high)	—	P. 97
9	Remote input value monitor	**S2**	RO	Input 1_setting limiter (low) to Input 1_setting limiter (high)	—	P. 98
10	Cascade monitor	**KH**	RO	Input 2_setting limiter (low) to Input 2_setting limiter (high)	—	P. 98
11	Input 1_burnout state	**B1**	RO	0: OFF 1: ON	—	P. 98
12	Input 2_burnout state	**B0**	RO		—	P. 98
13	Feedback resistance input burnout state	**B2**	RO	0: OFF 1: ON	—	P. 99
14	Event 1 state	**AA**	RO	0: OFF 1: ON	—	P. 99
15	Event 2 state	**AB**	RO		—	P. 99
16	Event 3 state	**AC**	RO		—	P. 99
17	Event 4 state	**AD**	RO		—	P. 99
18	Heater break alarm 1 (HBA1) state	**AE**	RO	0: OFF 1: ON	—	P. 100
19	Heater break alarm 2 (HBA2) state	**AF**	RO		—	P. 100
20	Input 1_manipulated output value (MV1) monitor	**O1**	RO	−5.0 to +105.0 %	—	P. 100
21	Input 2_manipulated output value (MV2) monitor	**O0**	RO		—	P. 100

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
22	Error code	**ER**	RO	1: Adjustment data error 2: EEPROM error 4: A/D conversion error 8: RAM check error 16: Hardware configuration error 32: Software configuration error 128: Watchdog timer error 2048: Program busy	—	P. 101
23	Event input (DI) state	**L1**	RO	Least significant digit: The state of DI1 2nd digit: The state of DI2 3rd digit: The state of DI3 4th digit: The state of DI4 5th digit: The state of DI5 6th digit: The state of DI6 Most significant digit: The state of DI7 Data 0: Contact open 1: Contact closed	—	P. 102
24	Operation mode state	**L0**	RO	Least significant digit: Control STOP 2nd digit: Control RUN 3rd digit: Input 1_Manual mode (Including Input 1_Remote mode) 4th digit: Input 2_Manual mode (Including Input 2_Remote mode) 5th digit: Remote mode or Cascade control 6th digit and Most significant digit: Unused Data 0: OFF 1: ON	—	P. 103
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. 104
26	Input 1_PID/AT transfer	**G1**	R/W	0: PID control 1: Autotuning (AT)	0	P. 104
27	Input 2_PID/AT transfer	**G0**	R/W		0	P. 104

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
28	Input 1_ Auto/Manual transfer	**J1**	R/W	0: Auto mode 1: Manual mode	0	P. 106
29	Input 2_ Auto/Manual transfer	**J0**	R/W		0	P. 106
30	Remote/Local transfer	**C1**	R/W	0: Local mode 1: Remote mode or Cascade control	0	P. 107
31	RUN/STOP transfer	**SR**	R/W	0: Control RUN 1: Control STOP	0	P. 107
32	Memory area selection	**ZA**	R/W	1 to 16	1	P. 107
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. 108
34	Event 2 set value	**A2**	R/W		50.0	P. 108
35	Event 3 set value	**A3**	R/W		50.0	P. 108
36	Control loop break alarm 1 (LBA1) time	**A5**	R/W	0 to 7200 seconds 0: OFF (Unused)	480	P. 109
37	LBA1 deadband	**N1**	R/W	0.0 to Input span	0.0	P. 109
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. 108
39	Control loop break alarm 2 (LBA2) time	**A6**	R/W	0 to 7200 seconds 0: OFF (Unused)	480	P. 109
40	LBA2 deadband	**N2**	R/W	0.0 to Input span	0.0	P. 109
41	Input 1_set value (SV1)	**S1**	R/W	Input 1_setting limiter (low) to Input 1_setting limiter (high)	0.0	P. 112
42	Input 1_ proportional band	**P1**	R/W	TC/RTD inputs: 0 to Input span Voltage/current inputs: 0.0 to 1000.0 % of input span (0 or 0.0: ON/OFF action)	30.0	P. 112
43	Input 1_integral time	**I1**	R/W	0 to 3600 seconds, 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds * (0, 0.0 or 0.00: PD action) * Varies with the setting of the integral/derivative time decimal point position selection.	240.00	P. 113

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No.	Name	Identifier	Attribute	Data range	Factory set value	Reference page
44	Input 1_derivative time	**D1**	R/W	0 to 3600 seconds, 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds * (0, 0.0 or 0.00: PI action) * Varies with the setting of the integral/derivative time decimal point position selection.	60.00	P. 113
45	Input 1_ control response parameter	**CA**	R/W	0: Slow 1: Medium 2: Fast	0	P. 114
46	Input 2_set value (SV2)	**S0**	R/W	Input 2_setting limiter (low) to Input 2_setting limiter (high)	0.0	P. 112
47	Input 2_proportional band	**P0**	R/W	TC/RTD inputs: 0 to Input span Voltage/current inputs: 0.0 to 1000.0 % of input span (0 or 0.0: ON/OFF action)	30.0	P. 112
48	Input 2_integral time	**I0**	R/W	0 to 3600 seconds, 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds * (0, 0.0 or 0.00: PD action) * Varies with the setting of the integral/derivative time decimal point position selection.	240.00	P. 113
49	Input 2_derivative time	**D0**	R/W	0 to 3600 seconds, 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds * (0, 0.0 or 0.00: PI action) * Varies with the setting of the integral/derivative time decimal point position selection.	60.00	P. 113
50	Input 2_ control response parameter	**C9**	R/W	0: Slow 1: Medium 2: Fast	0	P. 114
51	Input 1_setting change rate limiter (up)	**HH**	R/W	0.0 to Input span/unit time * 0.0: OFF (Unused) * Unit time: 60 seconds (factory set value)	0.0	P. 115
52	Input 1_setting change rate limiter (down)	**HL**	R/W		0.0	P. 115
53	Input 2_setting change rate limiter (up)	**HX**	R/W		0.0	P. 115
54	Input 2_setting change rate limiter (down)	**HY**	R/W		0.0	P. 115
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. 117

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
56	Link area number	**LP**	R/W	0 to 16 0: OFF (No link)	0	P. 118
57	Heater break alarm 1 (HBA1) set value	**A7**	R/W	0.0 to 30.0 A or 0.0 to 100.0 A 0.0: Not used	0.0	P. 119
58	Heater break alarm 2 (HBA2) set value	**A8**	R/W		0.0	P. 119
59	Input 1_PV bias	**PB**	R/W	–Input span to +Input span	0	P. 121
60	Input 1_PV digital filter	**F1**	R/W	0.00 to 10.00 seconds 0.00: OFF (Unused)	HA400/ HA900: 0.00 HA401/ HA901: 1.00	P. 121
61	Input 1_PV ratio	**PR**	R/W	0.500 to 1.500	1.000	P. 122
62	Input 1_ PV low input cut-off	**DP**	R/W	0.00 to 25.00 % of input span	0.00	P. 123
63	Input 1_ proportional cycle time	**T0**	R/W	0.1 to 100.0 seconds	Relay contact output: 20.0 seconds Voltage pulse output and triac output: 2.0 seconds	P. 124
64	Input 1_ manual output value	**ON**	R/W	Input 1_output limiter (low) to Input 1_output limiter (high)	0	P. 124
65	Input 2_PV bias	**PA**	R/W	–Input span to +Input span	0	P. 121
66	Input 2_PV digital filter	**F0**	R/W	0.00 to 10.00 seconds 0.00: OFF (Unused)	HA400/ HA900: 0.00 HA401/ HA901: 1.00	P. 121
67	Input 2_PV ratio	**PQ**	R/W	0.500 to 1.500	1.000	P. 122
68	Input 2_ PV low input cut-off	**DO**	R/W	0.00 to 25.00 % of input span	0.00	P. 123
69	Input 2_ proportional cycle time	**T2**	R/W	0.1 to 100.0 seconds	Relay contact output: 20.0 seconds Voltage pulse output and triac output: 2.0 seconds	P. 124
70	Input 2_ manual output value	**OM**	R/W	Input 2_output limiter (low) to Input 2_output limiter (high)	0.0	P. 124

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No.	Name	Identifier	Attribute	Data range	Factory set value	Reference page
71	Set lock level	**LK**	R/W	Least significant digit: Lock only setting items other than SV and events (EV1 to EV4). 0: Unlock, 1: Lock 2nd digit: Lock only events (EV1 to EV4). 0: Unlock, 1: Lock 3rd digit: Lock only set value (SV). 0: Unlock, 1: Lock 4th digit to Most significant digit: Unused	0	P. 125
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. 126
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. 126
74	Heater break determination point 1	**NE**	R/W	0.0 to 100.0 % of heater break alarm 1 (HBA1) set value (0.0: Heater break determination is invalid)	30.0	P. 127
75	Heater melting determination point 1	**NF**	R/W	0.0 to 100.0 % of heater break alarm 1 (HBA1) set value (0.0: Heater melting determination is invalid)	30.0	P. 128
76	Heater break determination point 2	**NH**	R/W	0.0 to 100.0 % of heater break alarm 2 (HBA2) set value (0.0: Heater break determination is invalid)	30.0	P. 127
77	Heater melting determination point 2	**NI**	R/W	0.0 to 100.0 % of heater break alarm 2 (HBA2) set value (0.0: Heater melting determination is invalid)	30.0	P. 128
78	Unused	**HP**	—	—	—	—
79	Unused	**HQ**	—	—	—	—
80	Unused	**HR**	—	—	—	—
81	Unused	**FP**	—	—	—	—
82	Unused	**FQ**	—	—	—	—

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No.	Name	Identifier	Attribute	Data range	Factory set value	Reference page
83	Unused	**FR**	—	—	—	—
84	Unused	**IL**	—	—	—	—
85	Unused	**AZ**	—	—	—	—
86	Unused	**FS**	—	—	—	—
87	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. 129
88	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. 130
89	Bar graph resolution setting	**DE**	R/W	1 to 100 digit/dot	100	P. 131
90	Auto/Manual transfer key operation selection (A/M)	**DK**	R/W	0: Unused 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. 131
91	Remote/Local transfer key operation selection (R/L)	**DL**	R/W	0: Unused 1: Remote/Local transfer	1	P. 132
92	RUN/STOP transfer key operation selection (R/S)	**DM**	R/W	0: Unused 1: RUN/STOP transfer	1	P. 132
93	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	Depends on model code. When not specifying: Type K	P. 133

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No.	Name	Identifier	Attribute	Data range	Factory set value	Reference page
93	Input 1_ input type selection	**XI**	R/W	TC input 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	Depends on model code. When not specifying: Type K	P. 133
94	Input 1_ display unit selection	**PU**	R/W	0: °C 1: °F	0	P. 134
95	Input 1_ decimal point position	**XU**	R/W	0: No decimal place 1: One decimal place 2: Two decimal places 3: Three decimal places 4: Four decimal places	1	P. 135
96	Input 1_input scale high	**XV**	R/W	TC/RTD inputs: Input scale low to Maximum value of the selected input range Voltage (V)/current (I) inputs: −19999 to +99999 (Varies with the setting of the decimal point position)	TC/RTD: Maximum value of the selected input range V/I: 100.0	P. 136
97	Input 1_input scale low	**XW**	R/W	TC/RTD inputs: Minimum value of the selected input range to Input scale high Voltage (V)/current (I) inputs: −19999 to +99999 (Varies with the setting of the decimal point position)	TC/RTD: Minimum value of the selected input range V/I: 0.0	P. 137

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No.	Name	Identifier	Attribute	Data range	Factory set value	Reference page
98	Input 1_input error determination point (high)	**AV**	R/W	Input scale low – (5 % of input span) to Input scale high + (5 % of input span)	TC/RTD: Input scale high + (5 % of input span) V/I: 105.0	P. 138
99	Input 1_input error determination point (low)	**AW**	R/W		TC/RTD: Input scale low – (5 % of input span) V/I: –5.0	P. 139
100	Input 1_burnout direction	**BS**	R/W	0: Upscale 1: Downscale	0	P. 139
101	Input 1_square root extraction selection	**XH**	R/W	0: Unused 1: Used	0	P. 140
102	Power supply frequency selection	**JT**	R/W	0: 50 Hz 1: 60 Hz	0	P. 140
103	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	Depends on model code. When not specifying: Type K	P. 133

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
104	Input 2_ display unit selection	**PT**	R/W	0: °C 1: °F	0	P. 134
105	Input 2_ decimal point position	**XT**	R/W	0: No decimal place 1: One decimal place 2: Two decimal places 3: Three decimal places 4: Four decimal places	1	P. 135
106	Input 2_input scale high	**XX**	R/W	TC/RTD inputs: Input scale low to Maximum value of the selected input range Voltage (V)/current (I) inputs: −19999 to +99999 (Varies with the setting of the decimal point position)	TC/RTD: Maximum value of the selected input range V/I: 100.0	P. 136
107	Input 2_input scale low	**XY**	R/W	TC/RTD inputs: Minimum value of the selected input range to Input scale high Voltage (V)/current (I) inputs: −19999 to +99999 (Varies with the setting of the decimal point position)	TC/RTD: Minimum value of the selected input range V/I: 0.0	P. 137
108	Input 2_input error determination point (high)	**AX**	R/W	Input scale low − (5 % of input span) to Input scale high + (5 % of input span)	TC/RTD: Input scale high + (5 % of input span) V/I: 105.0	P. 138
109	Input 2_input error determination point (low)	**AY**	R/W		TC/RTD: Input scale low − (5 % of input span) V/I: −5.0	P. 139
110	Input 2_ burnout direction	**BR**	R/W	0: Upscale 1: Downscale	0	P. 139
111	Input 2_square root extraction selection	**XG**	R/W	0: Unused 1: Used	0	P. 140
112	Event input logic selection	**H2**	R/W	0 to 6	1	P. 141
113	Output logic selection	**E0**	R/W	1 to 11	1-input controller: 1 2-input controller: 5	P. 144
114	Output 1 timer setting	**TD**	R/W	0.0 to 600.0 seconds	0.0	P. 146
115	Output 2 timer setting	**TG**	R/W		0.0	P. 146
116	Output 3 timer setting	**TH**	R/W		0.0	P. 146
117	Output 4 timer setting	**TI**	R/W		0.0	P. 146

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
118	Output 5 timer setting	**TJ**	R/W	0.0 to 600.0 seconds	0.0	P. 146
119	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 value 4: Input 1_manipulated output value (MV) 5: Input 2_measured value (PV) 6: Input 2_set value (SV) 7: Input 2_deviation value 8: Input 2_manipulated output value (MV) 9: Feedback resistance input value (POS)	0	P. 148
120	Transmission output 1_ scale high	**HV**	R/W	Measured value (PV) and set value (SV): Input scale low to Input scale high Manipulated output value (MV) and feedback resistance input value (POS): −5.0 to +105.0 % Deviation: −Input span to +Input span	PV/SV: Input scale high MV/POS: 100.0 Deviation: +Input span	P. 149
121	Transmission output 1_ scale low	**HW**	R/W		PV/SV: Input scale low MV/POS: 0.0 Deviation: −Input span	P. 150
122	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 value 4: Input 1_manipulated output value (MV) 5: Input 2_measured value (PV) 6: Input 2_set value (SV) 7: Input 2_deviation value 8: Input 2_manipulated output value (MV) 9: Feedback resistance input value (POS)	0	P. 148

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No.	Name	Identifier	Attribute	Data range	Factory set value	Reference page
123	Transmission output 2_ scale high	**CV**	R/W	Measured value (PV) and set value (SV): Input scale low to Input scale high Manipulated output value (MV) and feedback resistance input value (POS): −5.0 to +105.0 % Deviation: −Input span to +Input span	PV/SV: Input scale high MV/POS: 100.0 Deviation: +Input span	P. 149
124	Transmission output 2_ scale low	**CW**	R/W		PV/SV: Input scale low MV/POS: 0.0 Deviation: −Input span	P. 150
125	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 value 4: Input 1_manipulated output value (MV) 5: Input 2_measured value (PV) 6: Input 2_set value (SV) 7: Input 2_deviation value 8: Input 2_manipulated output value (MV) 9: Feedback resistance input value (POS)	0	P. 148
126	Transmission output 3_ scale high	**EV**	R/W	Measured value (PV) and set value (SV): Input scale low to Input scale high Manipulated output value (MV) and feedback resistance input value (POS): −5.0 to +105.0 % Deviation: −Input span to +Input span	PV/SV: Input scale high MV/POS: 100.0 Deviation: +Input span	P. 149
127	Transmission output 3_ scale low	**EW**	R/W		PV/SV: Input scale low MV/POS: 0.0 Deviation: −Input span	P. 150
128	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

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
129	Event 1 hold action	**WA**	R/W	0: OFF 1: ON 2: Re-hold action ON	0	P. 153
130	Event 1 differential gap	**HA**	R/W	0 to Input span	TC/RTD: 2.0 °C [°F] V/I: 0.2 % of input span	P. 155
131	Event 1 action at input error	**OA**	R/W	0: Normal processing 1: Turn the event output ON	0	P. 157
132	Event 1 assignment	**FA**	R/W	1: For input 1 2: For input 2	1	P. 159
133	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
134	Event 2 hold action	**WB**	R/W	0: OFF 1: ON 2: Re-hold action ON	0	P. 153
135	Event 2 differential gap	**HB**	R/W	0 to Input span	TC/RTD: 2.0 °C [°F] V/I: 0.2 % of input span	P. 155
136	Event 2 action at input error	**OB**	R/W	0: Normal processing 1: Turn the event output ON	0	P. 157
137	Event 2 assignment	**FB**	R/W	1: For input 1 2: For input 2	1	P. 159
138	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
139	Event 3 hold action	**WC**	R/W	0: OFF 1: ON 2: Re-hold action ON	0	P. 153

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
140	Event 3 differential gap	**HC**	R/W	0 to Input span	TC/RTD: 2.0 °C [°F] V/I: 0.2 % of input span	P. 155
141	Event 3 action at input error	**OC**	R/W	0: Normal processing 1: Turn the event output ON	0	P. 157
142	Event 3 assignment	**FC**	R/W	1: For input 1 2: For input 2	1	P. 159
143	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
144	Event 4 hold action	**WD**	R/W	0: OFF 1: ON 2: Re-hold action ON	0	P. 153
145	Event 4 differential gap	**HD**	R/W	0 to Input span	TC/RTD: 2.0 °C [°F] V/I: 0.2 % of input span	P. 155
146	Event 4 action at input error	**OD**	R/W	0: Normal processing 1: Turn the event output ON	0	P. 157
147	Event 4 assignment	**FD**	R/W	1: For input 1 2: For input 2	1	P. 159
148	CT1 ratio	**XR**	R/W	0 to 9999	Depend on model code	P. 159
149	CT1 assignment	**ZF**	R/W	0: None 1: OUT1 2: OUT2 3: OUT3 4: OUT4 5: OUT5	CT1 provided: 1 (When HBA1 is specified) CT1 not provided: 0	P. 160
150	CT2 ratio	**XS**	R/W	0 to 9999	Depend on model code	P. 159
151	CT2 assignment	**ZG**	R/W	0: None 1: OUT1 2: OUT2 3: OUT3 4: OUT4 5: OUT5	CT2 provided: 2 (When HBA2 is specified) CT2 not provided: 0	P. 160

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
152	Hot/Cold start selection	**XN**	R/W	Power failure less than 3 seconds: 0: Hot 1 5: Cold 1: Hot 1 6: Hot 1 2: Hot 1 7: Hot 2 3: Hot 2 8: Stop 4: Hot 2 Power failure 3 seconds or more: 0: Hot 1 5: Cold 1: Hot 2 6: Stop 2: Cold 7: Stop 3: Hot 2 8: Stop 4: Cold	0	P. 161
153	Input 2_use selection	**KM**	R/W	0: Single loop control 1: Remote input 2: Cascade control (slave)	0	P. 162
154	Cascade ratio	**RR**	R/W	0.0000 to 1.5000	1.0000	P. 162
155	Cascade bias	**RB**	R/W	−Input span to +Input span	0.0	P. 163
156	SV tracking	**XL**	R/W	0: Unused 1: Used	1	P. 165
157	Input 1_control action type selection	**XE**	R/W	0: Direct action 1: Reverse action	1	P. 166
158	Input 1_integral/derivative time decimal point position selection	**PK**	R/W	0: No decimal place 1: One decimal place 2: Two decimal places	2	P. 167
159	Input 1_derivative gain	**DG**	R/W	0.1 to 10.0	6.0	P. 167
160	Input 1_ON/OFF action differential gap (upper)	**IV**	R/W	0 to Input span	TC/RTD: 1.0 °C [°F] V/I: 0.1 % of input span	P. 168
161	Input 1_ON/OFF action differential gap (lower)	**IW**	R/W		TC/RTD: 1.0 °C [°F] V/I: 0.1 % of input span	P. 169
162	Input 1_action at input error (high)	**WH**	R/W	0: Normal control 1: Manipulated Output Value at Input Error	0	P. 170
163	Input 1_action at input error (low)	**WL**	R/W		0	P. 171
164	Input 1_manipulated output value at input error	**OE**	R/W	−5.0 to +105.0 %	−5.0	P. 171
165	Input 1_output change rate limiter (up)	**PH**	R/W	0.0 to 1000.0 %/second 0.0: OFF (Unused)	0.0	P. 172
166	Input 1_output change rate limiter (down)	**PL**	R/W		0.0	P. 172

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No.	Name	Identifier	Attribute	Data range	Factory set value	Reference page
167	Input 1_output limiter (high)	**OH**	R/W	Input 1_output limiter (low) to 105.0 %	105.0	P. 174
168	Input 1_output limiter (low)	**OL**	R/W	−5.0 % to Input 1_output limiter (high)	−5.0	P. 174
169	Input 1_power feed forward selection	**PF**	R/W	0: Unused 1: Used	Depends on model code.	P. 175
170	Input 2_control action type selection	**XF**	R/W	0: Direct action 1: Reverse action	1	P. 166
171	Input 2_integral/derivative time decimal point position selection	**PJ**	R/W	0: No decimal place 1: One decimal place 2: Two decimal places	2	P. 167
172	Input 2_derivative gain	**DJ**	R/W	0.1 to 10.0	6.0	P. 167
173	Input 2_ON/OFF action differential gap (upper)	**IX**	R/W	0 to Input span	TC/RTD: 1.0 °C [°F] V/I: 0.1 % of input span	P. 168
174	Input 2_ON/OFF action differential gap (lower)	**IY**	R/W		TC/RTD: 1.0 °C [°F] V/I: 0.1 % of input span	P. 169
175	Input 2_action at input error (high)	**WX**	R/W	0: Normal control 1: Manipulated Output Value at Input Error	0	P. 170
176	Input 2_action at input error (low)	**WY**	R/W		0	P. 171
177	Input 2_manipulated output value at input error	**OF**	R/W	−5.0 to +105.0 %	−5.0	P. 171
178	Input 2_output change rate limiter (up)	**PX**	R/W	0.0 to 1000.0 %/second 0.0: OFF (Unused)	0.0	P. 172
179	Input 2_output change rate limiter (down)	**PY**	R/W		0.0	P. 172
180	Input 2_output limiter (high)	**OX**	R/W	Input 2_output limiter (low) to 105.0 %	105.0	P. 174
181	Input 2_output limiter (low)	**OY**	R/W	−5.0 % to Input 2_output limiter (high)	−5.0	P. 174
182	Input 2_power feed forward selection	**PG**	R/W	0: Unused 1: Used	Depends on model code.	P. 175
183	Input 1_AT bias	**GB**	R/W	−Input span to +Input span	0	P. 177
184	Input 1_AT cycle	**G3**	R/W	0: 1.5 cycles 1: 2.0 cycles 2: 2.5 cycles 3: 3.0 cycles	1	P. 178

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
185	Input 1_ AT differential gap time	**GH**	R/W	0.00 to 50.00 seconds	HA400/ HA900: 0.10 HA401/ HA901: 10.00	P. 179
186	Input 2_AT bias	**GA**	R/W	–Input span to +Input span	0	P. 177
187	Input 2_AT cycle	**G2**	R/W	0: 1.5 cycles 1: 2.0 cycles 2: 2.5 cycles 3: 3.0 cycles	1	P. 178
188	Input 2_ AT differential gap time	**GG**	R/W	0.00 to 50.00 seconds	HA400/ HA900: 0.10 HA401/ HA901: 10.00	P. 179
189	Open/Close output neutral zone	**V2**	R/W	0.1 to 10.0 % of output	10.0	P. 181
190	Open/Close output differential gap	**VH**	R/W	0.1 to 5.0 % of output	0.2	P. 182
191	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. 183
192	Feedback adjustment	**FV**	R/W	0: Adjustment end 1: During the Open-side adjusting 2: During the Close-side adjusting	—	P. 184
193	Setting change rate limiter unit time	**HU**	R/W	1 to 3600 seconds	60	P. 185
194	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. 185
195	Input 1_setting limiter (high)	**SH**	R/W	Input 1_setting limiter (low) to Input 1_input scale high	Input 1_ input scale high	P. 186
196	Input 1_setting limiter (low)	**SL**	R/W	Input 1_input scale low to Input 1_setting limiter (high)	Input 1_ input scale low	P. 187
197	Input 2_setting limiter (high)	**ST**	R/W	Input 2_setting limiter (low) to Input 2_input scale high	Input 2_ input scale high	P. 186
198	Input 2_setting limiter (low)	**SU**	R/W	Input 2_input scale low to Input 2_setting limiter (high)	Input 2_ input scale low	P. 187
199	ROM version display	**VR**	RO	Display the version of loading software.	—	P. 188

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
200	Integrated operating time display	**UT**	RO	0 to 99999 hours	—	P. 188
201	Holding peak value ambient temperature display	**Hp**	RO	−10.0 to +100.0 °C	—	P. 188
202	Power feed transformer input value display	**HM**	RO	0.0 to 160.0 % (Display in the engineering unit of % corresponding to the rated value.)	—	P. 189
203	Feedback resistance (FBR) input assignment	**VG**	R/W	1: Input 1 2: Input 2	1	P. 189
204	Input 1_ power feed forward gain	**PZ**	R/W	0.01 to 5.00	1.00	P. 190
205	Input 2_ power feed forward gain	**PW**	R/W		1.00	P. 190
206	Heater break alarm 1 (HBA1) type selection	**ND**	R/W	0: Heater break alarm (HBA) type A 1: Heater break alarm (HBA) type B	1	P. 191
207	Number of heater break alarm 1 (HBA1) delay times	**DH**	R/W	0 to 255	5	P. 192
208	Heater break alarm 2 (HBA2) type selection	**NG**	R/W	0: Heater break alarm (HBA) type A 1: Heater break alarm (HBA) type B	1	P. 191
209	Number of heater break alarm 2 (HBA2) delay times	**DF**	R/W	0 to 255	5	P. 192
210	Alarm lamp lighting condition setting 1	**LY**	R/W	Least significant digit: Event 1 0: ALM lamp is not lit, 1: ALM lamp is lit 2nd digit: Event 2 0: ALM lamp is not lit, 1: ALM lamp is lit 3rd digit: Event 3 0: ALM lamp is not lit, 1: ALM lamp is lit 4th digit: Event 4 0: ALM lamp is not lit, 1: ALM lamp is lit 5th digit to Most significant digit: Unused	1111	P. 193
211	Alarm lamp lighting condition setting 2	**LZ**	R/W	Least significant digit: HBA1 0: ALM lamp is not lit, 1: ALM lamp is lit 2nd digit: HBA2 0: ALM lamp is not lit, 1: ALM lamp is lit 3rd digit to Most significant digit: Unused	11	P. 193

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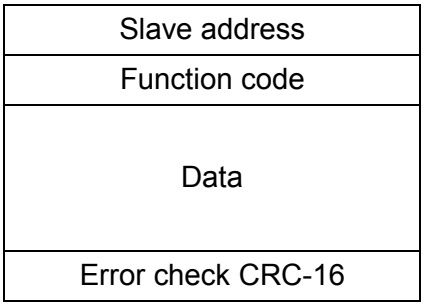
No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
212	Unused	**HT**	—	—	—	—
213	Unused	**FT**	—	—	—	—
214	Unused	**OG**	—	—	—	—
215	Unused	**LI**	—	—	—	—
216	Unused	**OR**	—	—	—	—
217	Unused	**TS**	—	—	—	—
218	Unused	**US**	—	—	—	—
219	Unused	**RH**	—	—	—	—
220	Unused	**RL**	—	—	—	—
221	Unused	**RP**	—	—	—	—
222	Unused	**JI**	—	—	—	—
223	Unused	**JJ**	—	—	—	—
224	Unused	**OI**	—	—	—	—
225	Unused	**OJ**	—	—	—	—
226	Unused	**QA**	—	—	—	—
227	Unused	**OT**	—	—	—	—
228	Unused	**OU**	—	—	—	—
229	Unused	**MY**	—	—	—	—
230	Unused	**NY**	—	—	—	—
231	Unused	**MZ**	—	—	—	—
232	Unused	**NZ**	—	—	—	—

6. MODBUS COMMUNICATION PROTOCOL

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 1 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. 14)**.

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. 57)**.

■ 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. 62)**, **6.7 Data Configuration (P. 66)** and **6.8 Data Map List (P. 71)**.

■ 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. 59)**.

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 009BH, 0200H to 02FBH, 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. *

* When this case is operated, there is when the slave does not sometimes make a response.

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***.

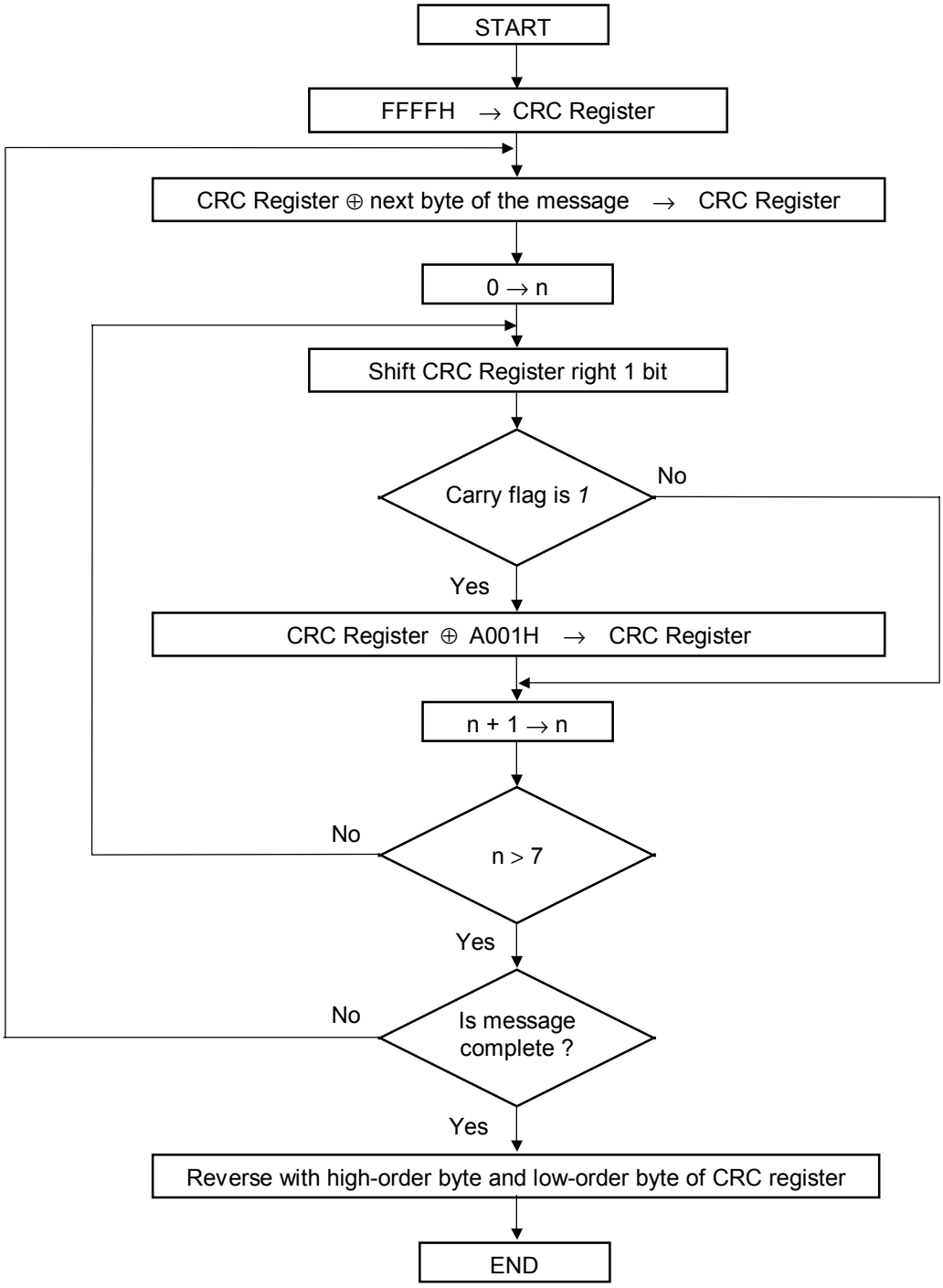
5. Repeat step ***3*** and ***4*** until there have been 8 shifts.

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	First holding register address
	Low	00H	
Quantity	High	00H	The setting must be between 1 (0001H) and 125 (007DH).
	Low	04H	
CRC-16	High	44H	
	Low	3AH	

Normal response message

Slave address		02H	
Function code		03H	
Number of data		08H	→ Number of holding registers × 2
First 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 first data)	Low	00H	
Next holding register contents	High	00H	
(Low-order word of the next data)	Low	19H	
Next holding register contents	High	00H	
(High-order word of the next data)	Low	00H	
CRC-16	High	C3H	
	Low	95H	

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 (Low-order word)	High	00H	Any pertinent data
	Low	64H	
Data to next register (High-order word)	High	00H	
	Low	00H	
CRC-16	High	B7H	
	Low	E6H	

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 one decimal place**

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
Heater break determination point 1
Heater melting determination point 1
Heater break determination point 2
Heater melting determination point 2
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)
Input 1_output limiter (low)
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)
Input 2_output limiter (low)
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 two decimal places**

Memory area soak time monitor
Area soak time
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
Input 1 _power feed forward gain
Input 2 _power feed forward gain

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 three decimal places**

Input 1_PV ratio
Input 2_PV 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 with four decimal places**

Cascade ratio

Example: When Cascade ratio is 0.5555, 0.5555 is processed as 5555, 5555 = 15B3H

Cascade ratio	High	15H
	Low	B3H

- **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 decimal place, One decimal place, Two decimal places

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 decimal place, One decimal place, Two decimal places

Voltage/current input: No decimal place, One decimal place, Two decimal places, Three decimal places, Four decimal places

☞ For details, see **Input range table (P. 133)**.

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)
Input 1_input error determination point (low)
Input 2_input scale high
Input 2_input scale low
Input 2_input error determination point (high)
Input 2_input error determination point (low)
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)
Input 1_setting limiter (low)
Input 2_setting limiter (high)
Input 2_setting limiter (low)

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 with no decimal place

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 (DI) state
Operation mode state
Memory area soak time monitor
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
Area soak time
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)
Input 1_action at input error (low)
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)
Input 2_action at input error (low)
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
Heater break alarm 1 (HBA1) type selection
Number of heater break alarm 1 (HBA1) delay times
Heater break alarm 2 (HBA2) type selection
Number of heater break alarm 2 (HBA2) delay times
Feedback resistance (FBR) input assignment
Alarm lamp lighting condition setting 1
Alarm lamp lighting condition setting 2

Continued on the next page.

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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).
- Tow-word data is read and written from low-order words to high-order words in order.

  If Modbus 1 is selected in the communication protocol selection of the engineering mode, data is read and written from high-order words to low-order words in 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 “0020H” in low-order word.
    The controller interprets high-order word as “0000H.”

    Example 2: When did a writing only of “FFFFH (–1) ” in low-order word.
    The controller interprets high-order word as “FFFFH.”
- Addresses in which data (holding register) is accessible are from 0000H to 009BH, from 0200H to 02FBH, and from 0500H to 0535H. If any address other than 0000H to 009BH, 0200H to 02FBH, 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 that 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. 71)**.
- 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).

Tow-word data is read and written from low-order words to high-order words in order. *

* If Modbus 1 is selected in the communication protocol selection of the engineering mode, data is read and written from high-order words to low-order words in order.

Register address 0500H to 0535H handles it when I do confirmation and change of set value belonging to memory area except control area. (See P. 93)

RO: Read only R/W: Read and Write

Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
Input 1_measured value (PV1) monitor	0000	0001	0	1	RO	Input 1_input scale low to Input 1_input scale high	—	P. 96
Input 2_measured value (PV2) monitor	0002	0003	2	3	RO	Input 2_input scale low to Input 2_input scale high	—	P. 96
Feedback resistance input value monitor	0004	0005	4	5	RO	0.0 to 100.0 %	—	P. 96
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. 97
Current transformer input value 2 (CT2) monitor	0008	0009	8	9	RO		—	P. 97
Input 1_ set value (SV1) monitor	000A	000B	10	11	RO	Input 1_setting limiter (low) to Input 1_setting limiter (high)	—	P. 97
Input 2_ set value (SV2) monitor	000C	000D	12	13	RO	Input 2_setting limiter (low) to Input 2_setting limiter (high)	—	P. 97
Remote input value monitor	000E	000F	14	15	RO	Input 1_setting limiter (low) to Input 1_setting limiter (high)	—	P. 98
Cascade monitor	0010	0011	16	17	RO	Input 2_setting limiter (low) to Input 2_setting limiter (high)	—	P. 98

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
Input 1_burnout state	0012	0013	18	19	RO	0: OFF 1: ON	—	P. 98
Input 2_burnout state	0014	0015	20	21	RO		—	P. 98
Feedback resistance input burnout state	0016	0017	22	23	RO	0: OFF 1: ON	—	P. 99
Event 1 state	0018	0019	24	25	RO	0: OFF 1: ON	—	P. 99
Event 2 state	001A	001B	26	27	RO		—	P. 99
Event 3 state	001C	001D	28	29	RO		—	P. 99
Event 4 state	001E	001F	30	31	RO		—	P. 99
Heater break alarm 1 (HBA1) state	0020	0021	32	33	RO	0: OFF 1: ON	—	P. 100
Heater break alarm 2 (HBA2) state	0022	0023	34	35	RO		—	P. 100
Input 1_ manipulated output value (MV1) monitor	0024	0025	36	37	RO	–5.0 to +105.0 %	—	P. 100
Input 2_ manipulated output value (MV2) monitor	0026	0027	38	39	RO		—	P. 100
Error code	0028	0029	40	41	RO	Bit data b0: Adjustment data error b1: EEPROM error b2: A/D conversion error b3: RAM check error b4: Hardware configuration error b5: Software configuration error b6: Unused b7: Watchdog timer error b8 to b10: Unused b11: Program busy b12 to b31: Unused Data 0: OFF 1: ON [Decimal number: 0 to 4095]	—	P. 101

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
Event input state	002A	002B	42	43	RO	Bit data b0: DI 1 state b1: DI 2 state b2: DI 3 state b3: DI 4 state b4: DI 5 state b5: DI 6 state b6: DI 7 state b7 to b31: Unused Data 0: Contact open 1: Contact closed [Decimal number: 0 to 127]	—	P. 102
Operation mode state	002C	002D	44	45	RO	Bit data b0: Control STOP b1: Control RUN b2: Input 1_Manual mode (Including Input 1_ Remote mode) b3: Input 2_Manual mode (Including Input 2_ Remote mode) b4: Remote mode or Cascade control b5 to b31: Unused Data 0: OFF 1: ON [Decimal number: 0 to 31]	—	P. 103
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. 104
Input 1_PID/AT transfer	0030	0031	48	49	R/W	0: PID control 1: Autotuning (AT)	0	P. 104
Input 2_PID/AT transfer	0032	0033	50	51	R/W		0	P. 104
Input 1_ Auto/Manual transfer	0034	0035	52	53	R/W	0: Auto mode 1: Manual mode	0	P. 106
Input 2_ Auto/Manual transfer	0036	0037	54	55	R/W		0	P. 106

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
Remote/Local transfer	0038	0039	56	57	R/W	0: Local mode 1: Remote mode or Cascade control	0	P. 107
RUN/STOP transfer	003A	003B	58	59	R/W	0: Control RUN 1: Control STOP	0	P. 107
Memory area selection	003C	003D	60	61	R/W	1 to 16	1	P. 107
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. 108
Event 2 set value	0040	0041	64	65	R/W		50.0	P. 108
Event 3 set value	0042	0043	66	67	R/W		50.0	P. 108
Control loop break alarm 1 (LBA1) time	0044	0045	68	69	R/W	0 to 7200 seconds 0: OFF (Unused)	480	P. 109
LBA1 deadband	0046	0047	70	71	R/W	0.0 to Input span	0.0	P. 109
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. 108
Control loop break alarm 2 (LBA2) time	004A	004B	74	75	R/W	0 to 7200 seconds 0: OFF (Unused)	480	P. 109
LBA2 deadband	004C	004D	76	77	R/W	0.0 to Input span	0.0	P. 109
Input 1_set value (SV1)	004E	004F	78	79	R/W	Input 1_setting limiter (low) to Input 1_setting limiter (high)	0.0	P. 112
Input 1_ proportional band	0050	0051	80	81	R/W	TC/RTD inputs: 0 to Input span Voltage/current inputs: 0.0 to 1000.0 % of input span (0 or 0.0: ON/OFF action)	30.0	P. 112
Input 1_integral time	0052	0053	82	83	R/W	0 to 3600 seconds, 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds * (0, 0.0 or 0.00: PD action) * Varies with the setting of the integral/derivative time decimal point position selection.	240.00	P. 113

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
Input 1_derivative time	0054	0055	84	85	R/W	0 to 3600 seconds, 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds * (0, 0.0 or 0.00: PI action) * Varies with the setting of the integral/derivative time decimal point position selection.	60.00	P. 113
Input 1_control response parameter	0056	0057	86	87	R/W	0: Slow 1: Medium 2: Fast	0	P. 114
Unused	0058	0059	88	89	—	—	—	—
Input 2_set value (SV2)	005A	005B	90	91	R/W	Input 2_setting limiter (low) to Input 2_setting limiter (high)	0.0	P. 112
Input 2_ proportional band	005C	005D	92	93	R/W	TC/RTD inputs: 0 to Input span Voltage/current inputs: 0.0 to 1000.0 % of input span (0 or 0.0: ON/OFF action)	30.0	P. 112
Input 2_integral time	005E	005F	94	95	R/W	0 to 3600 seconds, 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds * (0, 0.0 or 0.00: PD action) * Varies with the setting of the integral/derivative time decimal point position selection.	240.00	P. 113
Input 2_derivative time	0060	0061	96	97	R/W	0 to 3600 seconds, 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds * (0, 0.0 or 0.00: PI action) * Varies with the setting of the integral/derivative time decimal point position selection.	60.00	P. 113
Input 2_control response parameter	0062	0063	98	99	R/W	0: Slow 1: Medium 2: Fast	0	P. 114
Unused	0064	0065	100	101	—	—	—	—

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
Input 1_setting change rate limiter (up)	0066	0067	102	103	R/W	0.0 to Input span/unit time * 0.0: OFF (Unused) * Unit time:60 seconds (factory set value)	0.0	P. 115
Input 1_setting change rate limiter (down)	0068	0069	104	105	R/W		0.0	P. 115
Input 2_setting change rate limiter (up)	006A	006B	106	107	R/W		0.0	P. 115
Input 2_setting change rate limiter (down)	006C	006D	108	109	R/W		0.0	P. 115
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. 117
Link area number	0070	0071	112	1113	R/W	0 to 16 0: OFF (No link)	0	P. 118
Heater break alarm 1 (HBA1) set value	0072	0073	114	115	R/W	0.0 to 30.0 A or 0.0 to 100.0 A 0.0: OFF (Unused)	0.0	P. 119
Heater break alarm 2 (HBA2) set value	0074	0075	116	117	R/W		0.0	P. 119
Input 1_PV bias	0076	0077	118	119	R/W	–Input span to +Input span	0	P. 121
Input 1_PV digital filter	0078	0079	120	121	R/W	0.00 to 10.00 seconds 0.00: OFF (Unused)	HA400/ HA900: 0.00 HA401/ HA901: 1.00	P. 121
Input 1_PV ratio	007A	007B	122	123	R/W	0.500 to 1.500	1.000	P. 122
Input 1_ PV low input cut-off	007C	007D	124	125	R/W	0.00 to 25.00 % of input span	0.00	P. 123
Input 1_proportional cycle time	007E	007F	126	127	R/W	0.1 to 100.0 seconds	Relay contact output: 20.0 seconds Voltage pulse output and triac output: 2.0 seconds	P. 124
Input 1_ manual output value	0080	0081	128	129	R/W	Input 1_output limiter (low) to Input 1_output limiter (high)	0.0	P. 124

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
Input 2_ PV bias	0082	0083	130	131	R/W	–Input span to +Input span	0	P. 121
Input 2_ PV digital filter	0084	0085	132	133	R/W	0.00 to 10.00 seconds 0.00: OFF (Unused)	HA400/ HA900: 0.00 HA401/ HA901: 1.00	P. 121
Input 2_PV ratio	0086	0087	134	135	R/W	0.500 to 1.500	1.000	P. 122
Input 2_ PV low input cut-off	0088	0089	136	137	R/W	0.00 to 25.00 % of input span	0.00	P. 123
Input 2_ proportional cycle time	008A	008B	138	139	R/W	0.1 to 100.0 seconds	Relay contact output: 20.0 seconds Voltage pulse output and triac output: 2.0 seconds	P. 124
Input 2_ manual output value	008C	008D	140	141	R/W	Input 2_output limiter (low) to Input 2_output limiter (high)	0.0	P. 124
Set lock level	008E	008F	142	143	R/W	Bit data b0: Lock only setting items other than SV and events (EV1 to EV4). b1: Lock only events (EV1 to EV4). b2: Lock only set value (SV). b3 to b31: Unused Data 0: Unlock 1: Lock [Decimal number: 0 to 7]	0	P. 125
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. 126
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. 126

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
Heater break determination point 1	0094	0095	148	149	R/W	0.0 to 100.0 % of heater break alarm 1 (HBA1) set value (0.0: Heater break determination is invalid)	30.0	P. 127
Heater melting determination point 1	0096	0097	150	151	R/W	0.0 to 100.0 % of heater break alarm 1 (HBA1) set value (0.0: Heater melting determination is invalid)	30.0	P. 128
Heater break determination point 2	0098	0099	152	153	R/W	0.0 to 100.0 % of heater break alarm 2 (HBA2) set value (0.0: Heater break determination is invalid)	30.0	P. 127
Heater melting determination point 2	009A	009B	154	155	R/W	0.0 to 100.0 % of heater break alarm 2 (HBA2) set value (0.0: Heater melting determination is invalid)	30.0	P. 128
Unused	009C · · · 01FE	009D · · · 01FF	156 · · · 510	157 · · · 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. 129
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. 130

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
Bar graph resolution setting	0204	0205	516	517	R/W	1 to 100 digit/dot	100	P. 131
Unused	0206	0207	518	519	—	—	—	—
Auto/Manual transfer key operation selection (A/M)	0208	0209	520	521	R/W	0: Unused 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. 131
Remote/Local transfer key operation selection (R/L)	020A	020B	522	523	R/W	0: Unused 1: Remote/Local transfer	1	P. 132
RUN/STOP transfer key operation selection (R/S)	020C	020D	524	525	R/W	0: Unused 1: RUN/STOP transfer	1	P. 132
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	Depends on model code. When not specifying: Type K	P. 133

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
Input 1_ input type selection	020E	020F	526	527	R/W	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	Depends on model code. When not specifying: Type K	P. 133
Input 1_ display unit selection	0210	0211	528	529	R/W	0: °C 1: °F	0	P. 134
Input 1_ decimal point position	0212	0213	530	531	R/W	0: No decimal place 1: One decimal place 2: Two decimal places 3: Three decimal places 4: Four decimal places	1	P. 135
Input 1_input scale high	0214	0215	532	533	R/W	TC/RTD inputs: Input scale low to Maximum value of the selected input range Voltage (V)/current (I) inputs: −19999 to +99999 (Varies with the setting of the decimal point position)	TC/RTD: Maximum value of the selected input range V/I: 100.0	P. 136
Input 1_input scale low	0216	0217	534	535	R/W	TC/RTD inputs: Minimum value of the selected input range to Input scale high Voltage (V)/current (I) inputs: −19999 to +99999 (Varies with the setting of the decimal point position)	TC/RTD: Minimum value of the selected input range V/I: 0.0	P. 137

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
Input 1_input error determination point (high)	0218	0219	536	537	R/W	Input scale low – (5 % of input span) to Input scale high + (5 % of input span)	TC/RTD: Input scale high + (5 % of input span) V/I: 105.0	P. 138
Input 1_input error determination point (low)	021A	021B	538	539	R/W		TC/RTD: Input scale low – (5 % of input span) V/I: –5.0	P. 139
Input 1_ burnout direction	021C	021D	540	541	R/W	0: Upscale 1: Downscale	0	P. 139
Input 1_square root extraction selection	021E	021F	542	543	R/W	0: Unused 1: Used	0	P. 140
Power supply frequency selection	0220	0221	544	545	R/W	0: 50 Hz 1: 60 Hz	0	P. 140
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	Depends on model code. When not specifying: Type K	P. 133

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
Input 2_ input type selection	0222	0223	546	547	R/W	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	Depends on model code. When not specifying: Type K	P. 133
Input 2_ display unit selection	0224	0225	548	549	R/W	0: °C 1: °F	0	P. 134
Input 2_ decimal point position	0226	0227	550	551	R/W	0: No decimal place 1: One decimal place 2: Two decimal places 3: Three decimal places 4: Four decimal places	1	P. 135
Input 2_input scale high	0228	0229	552	553	R/W	TC/RTD inputs: Input scale low to Maximum value of the selected input range Voltage (V)/current (I) inputs: −19999 to +99999 (Varies with the setting of the decimal point position)	TC/RTD: Maximum value of the selected input range V/I: 100.0	P. 136
Input 2_input scale low	022A	022B	554	555	R/W	TC/RTD inputs: Minimum value of the selected input range to Input scale high Voltage (V)/current (I) inputs: −19999 to +99999 (Varies with the setting of the decimal point position)	TC/RTD: Minimum value of the selected input range V/I: 0.0	P. 137

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
Input 2_input error determination point (high)	022C	022D	556	557	R/W	Input scale low – (5 % of input span) to Input scale high + (5 % of input span)	TC/RTD: Input scale high + (5 % of input span) V/I: 105.0	P. 138
Input 2_input error determination point (low)	022E	022F	558	559	R/W		TC/RTD: Input scale low – (5 % of input span) V/I: –5.0	P. 139
Input 2_ burnout direction	0230	0231	560	561	R/W	0: Upscale 1: Downscale	0	P. 139
Input 2_square root extraction selection	0232	0233	562	563	R/W	0: Unused 1: Used	0	P. 140
Event input logic selection	0234	0235	564	565	R/W	0 to 6	1	P. 141
Output logic selection	0236	0237	566	567	R/W	1 to 11	1-input controller: 1 2-input controller: 5	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	P. 146
Output 3 timer setting	023C	023D	572	573	R/W		0.0	P. 146
Output 4 timer setting	023E	023F	574	575	R/W		0.0	P. 146
Output 5 timer setting	0240	0241	576	577	R/W		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 value 4: Input 1_manipulated output value (MV) 5: Input 2_measured value (PV) 6: Input 2_set value (SV) 7: Input 2_deviation value 8: Input 2_manipulated output value (MV) 9: Feedback resistance input value (POS)	0	P. 148

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
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) and feedback resistance input value (POS): −5.0 to +105.0 % Deviation: −Input span to +Input span	PV/SV: Input scale high MV/POS: 100.0 Deviation: +Input span	P. 149
Transmission output 1_ scale low	0246	0247	582	583	R/W		PV/SV: Input scale low MV/POS: 0.0 Deviation: −Input span	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 value 4: Input 1_manipulated output value (MV) 5: Input 2_measured value (PV) 6: Input 2_set value (SV) 7: Input 2_deviation value 8: Input 2_manipulated output value (MV) 9: Feedback resistance input value (POS)	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) and feedback resistance input value (POS): −5.0 to +105.0 % Deviation: −Input span to +Input span	PV/SV: Input scale high MV/POS: 100.0 Deviation: +Input span	P. 149
Transmission output 2_ scale low	024C	024D	588	589	R/W		PV/SV: Input scale low MV/POS: 0.0 Deviation: −Input span	P. 150

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
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 value 4: Input 1_manipulated output value (MV) 5: Input 2_measured value (PV) 6: Input 2_set value (SV) 7: Input 2_deviation value 8: Input 2_manipulated output value (MV) 9: Feedback resistance input value (POS)	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) and feedback resistance input value (POS): –5.0 to +105.0 % Deviation: –Input span to +Input span	PV/SV: Input scale high MV/POS: 100.0 Deviation: +Input span	P. 149
Transmission output 3_ scale low	0252	0253	594	595	R/W		PV/SV: Input scale low MV/POS: 0.0 Deviation: –Input span	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: OFF 1: ON 2: Re-hold action ON	0	P. 153
Event 1 differential gap	0258	0259	600	601	R/W	0 to Input span	TC/RTD: 2.0 °C [°F] V/I: 0.2 % of input span	P. 155

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
Event 1 action at input error	025A	025B	602	603	R/W	0: Normal processing 1: Turn the event output ON	0	P. 157
Event 1 assignment	025C	025D	604	605	R/W	1: For input 1 2: For input 2	1	P. 159
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: OFF 1: ON 2: Re-hold action ON	0	P. 153
Event 2 differential gap	0262	0263	610	611	R/W	0 to Input span	TC/RTD: 2.0 °C [°F] V/I: 0.2 % of input span	P. 155
Event 2 action at input error	0264	0265	612	613	R/W	0: Normal processing 1: Turn the event output ON	0	P. 157
Event 2 assignment	0266	0267	614	615	R/W	1: For input 1 2: For input 2	1	P. 159
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 9: Control loop break alarm (LBA)	0	P. 151
Event 3 hold action	026A	026B	618	619	R/W	0: OFF 1: ON 2: Re-hold action ON	0	P. 153
Event 3 differential gap	026C	026D	620	621	R/W	0 to Input span	TC/RTD: 2.0 °C [°F] V/I: 0.2 % of input span	P. 155
Event 3 action at input error	026E	026F	622	623	R/W	0: Normal processing 1: Turn the event output ON	0	P. 157
Event 3 assignment	0270	0271	624	625	R/W	1: For input 1 2: For input 2	1	P. 159

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
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 9: Control loop break alarm (LBA)	0	P. 151
Event 4 hold action	0274	0275	628	629	R/W	0: OFF 1: ON 2: Re-hold action ON	0	P. 153
Event 4 differential gap	0276	0277	630	631	R/W	0 to Input span	TC/RTD: 2.0 °C [°F] V/I: 0.2 % of input span	P. 155
Event 4 action at input error	0278	0279	632	633	R/W	0: Normal processing 1: Turn the event output ON	0	P. 157
Event 4 assignment	027A	027B	634	635	R/W	1: For input 1 2: For input 2	1	P. 159
CT1 ratio	027C	027D	636	637	R/W	0 to 9999	Depend on model code	P. 159
CT1 assignment	027E	027F	638	639	R/W	0: None 1: OUT1 2: OUT2 3: OUT3 4: OUT4 5: OUT5	CT1 provided: 1 (When HBA1 is specified) CT1 not provided: 0	P. 160
CT2 ratio	0280	0281	640	641	R/W	0 to 9999	Depend on model code	P. 159
CT2 assignment	0282	0283	642	645	R/W	0: None 1: OUT1 2: OUT2 3: OUT3 4: OUT4 5: OUT5	CT2 provided: 2 (When HBA2 is specified) CT2 not provided: 0	P. 160

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
Hot/Cold start selection	0284	0285	644	645	R/W	Power failure less than 3 seconds: 0: Hot 1 5: Cold 1: Hot 1 6: Hot 1 2: Hot 1 7: Hot 2 3: Hot 2 8: Stop 4: Hot 2 Power failure 3 seconds or more: 0: Hot 1 5: Cold 1: Hot 2 6: Stop 2: Cold 7: Stop 3: Hot 2 8: Stop 4: Cold	0	P. 161
Input 2_use selection	0286	0287	646	647	R/W	0: Single loop control 1: Remote input 2: Cascade control (slave)	0	P. 162
Cascade ratio	0288	0289	648	649	R/W	0.0000 to 1.5000	1.0000	P. 162
Cascade bias	028A	028B	650	651	R/W	−Input span to +Input span	0.0	P. 163
SV tracking	028C	028D	652	653	R/W	0: Unused 1: Used	1	P. 165
Input 1_control action type selection	028E	028F	654	655	R/W	0: Direct action 1: Reverse action	1	P. 166
Input 1_ integral/derivative time decimal point position selection	0290	0291	656	657	R/W	0: No decimal place 1: One decimal place 2: Two decimal places	2	P. 167
Input 1_derivative gain	0292	0293	658	659	R/W	0.1 to 10.0	6.0	P. 167
Input 1_ON/OFF action differential gap (upper)	0294	0295	660	661	R/W	0 to Input span	TC/RTD: 1.0 °C [°F] V/I: 0.1 % of input span	P. 168
Input 1_ON/OFF action differential gap (lower)	0296	0297	662	663	R/W		TC/RTD: 1.0 °C [°F] V/I: 0.1 % of input span	P. 169
Input 1_action at input error (high)	0298	0299	664	665	R/W	0: Normal control 1: Manipulated Output Value at Input Error	0	P. 170
Input 1_action at input error (low)	029A	029B	666	667	R/W		0	P. 171

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
Input 1_ manipulated output value at input error	029C	029D	668	669	R/W	−5.0 to +105.0 %	−5.0	P. 171
Input 1_output change rate limiter (up)	029E	029F	670	671	R/W	0.0 to 1000.0 %/second 0.0: OFF (Unused)	0.0	P. 172
Input 1_output change rate limiter (down)	02A0	02A1	672	673	R/W		0.0	P. 172
Input 1_output limiter (high)	02A2	02A3	674	675	R/W	Input 1_output limiter (low) to 105.0 %	105.0	P. 174
Input 1_output limiter (low)	02A4	02A5	676	677	R/W	−5.0 % to Input 1_output limiter (high)	−5.0	P. 174
Input 1_power feed forward selection	02A6	02A7	678	679	R/W	0: Unused 1: Used	Depends on model code.	P. 175
Input 2_control action type selection	02A8	02A9	680	681	R/W	0: Direct action 1: Reverse action	1	P. 166
Input 2_ integral/derivative time decimal point position selection	02AA	02AB	682	683	R/W	0: No decimal place 1: One decimal place 2: Two decimal places	2	P. 167
Input 2_derivative gain	02AC	02AD	684	685	R/W	0.1 to 10.0	6.0	P. 167
Input 2_ON/OFF action differential gap (upper)	02AE	02AF	686	687	R/W	0 to Input span	TC/RTD: 1.0 °C [°F] V/I: 0.1 % of input span	P. 168
Input 2_ON/OFF action differential gap (lower)	02B0	02B1	688	689	R/W		TC/RTD: 1.0 °C [°F] V/I: 0.1 % of input span	P. 169
Input 2_action at input error (high)	02B2	02B3	690	691	R/W	0: Normal control 1: Manipulated Output Value at Input Error	0	P. 170
Input 2_action at input error (low)	02B4	02B5	692	693	R/W		0	P. 171
Input 2_ manipulated output value at input error	02B6	02B7	694	695	R/W	−5.0 to +105.0 %	−5.0	P. 171
Input 2_output change rate limiter (up)	02B8	02B9	696	697	R/W	0.0 to 1000.0 %/second 0.0: OFF (Unused)	0.0	P. 172
Input 2_output change rate limiter (down)	02BA	02BB	698	699	R/W		0.0	P. 172

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
Input 2_output limiter (high)	02BC	02BD	700	701	R/W	Input 2_output limiter (low) to 105.0 %	105.0	P. 174
Input 2_output limiter (low)	02BE	02BF	702	703	R/W	−5.0 % to Input 2_output limiter (high)	−5.0	P. 174
Input 2_power feed forward selection	02C0	02C1	704	705	R/W	0: Unused 1: Used	Depends on model code.	P. 175
Input 1_AT bias	02C2	02C3	706	707	R/W	−Input span to +Input span	0	P. 177
Input 1_AT cycle	02C4	02C5	708	709	R/W	0: 1.5 cycles 1: 2.0 cycles 2: 2.5 cycles 3: 3.0 cycles	1	P. 178
Input 1_ AT differential gap time	02C6	02C7	710	711	R/W	0.00 to 50.00 seconds	HA400/ HA900: 0.00 HA401/ HA901: 1.00	P. 179
Input 2_AT bias	02C8	02C9	712	713	R/W	−Input span to +Input span	0	P. 177
Input 2_AT cycle	02CA	02CB	714	715	R/W	0: 1.5 cycles 1: 2.0 cycles 2: 2.5 cycles 3: 3.0 cycles	1	P. 178
Input 2_ AT differential gap time	02CC	02CD	716	717	R/W	0.00 to 50.00 seconds	HA400/ HA900: 0.00 HA401/ HA901: 1.00	P. 179
Open/Close output neutral zone	02CE	02CF	718	719	R/W	0.1 to 10.0 % of output	10.0	P. 181
Open/Close output differential gap	02D0	02D1	720	721	R/W	0.1 to 5.0 % of output	0.2	P. 182
Action at feedback resistance (FBR) input 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. 183
Feedback adjustment	02D4	02D5	724	725	R/W	0: Adjustment end 1: During the Open-side adjusting 2: During the Close-side adjusting	—	P. 184
Setting change rate limiter unit time	02D6	02D7	726	727	R/W	1 to 3600 seconds	60	P. 185

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
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. 185
Input 1_setting limiter (high)	02DA	02DB	730	731	R/W	Input 1_setting limiter (low) to Input 1_input scale high	Input 1_ input scale high	P. 186
Input 1_setting limiter (low)	02DC	02DD	732	733	R/W	Input 1_input scale low to Input 1_setting limiter (high)	Input 1_ input scale low	P. 187
Input 2_setting limiter (high)	02DE	02DF	734	735	R/W	Input 2_setting limiter (low) to Input 2_input scale high	Input 2_ input scale high	P. 186
Input 2_setting limiter (low)	02E0	02E1	736	737	R/W	Input 2_input scale low to Input 2_setting limiter (high)	Input 2_ input scale low	P. 187
ROM version display	02E2	02E3	738	739	RO	Display the version of loading software.	—	P. 188
Integrated operating time display	02E4	02E5	740	741	RO	0 to 99999 hours	—	P. 188
Holding peak value ambient temperature display	02E6	02E7	742	743	RO	−10.0 to +100.0 °C	—	P. 188
Power feed transformer input value display	02E8	02E9	744	745	RO	0.0 to 160.0 % (Display in the engineering unit of % corresponding to the rated value.)	—	P. 189
Feedback resistance (FBR) input assignment	02EA	02EB	746	747	R/W	1: Input 1 2: Input 2	1	P. 189
Input 1_ power feed forward gain	02EC	02ED	748	749	R/W	0.01 to 5.00	1.00	P. 190
Input 2_ power feed forward gain	02EE	02EF	750	751	R/W		1.00	P. 190
Heater break alarm 1 (HBA1) type selection	02F0	02F1	752	753	R/W	0: Heater break alarm (HBA) type A 1: Heater break alarm (HBA) type B	1	P. 191

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
Number of heater break alarm 1 (HBA1) delay times	02F2	02F3	754	755	R/W	0 to 255	5	P. 192
Heater break alarm 2 (HBA2) type selection	02F4	02F5	756	757	R/W	0: Heater break alarm (HBA) type A 1: Heater break alarm (HBA) type B	1	P. 191
Number of heater break alarm 2 (HBA2) delay times	02F6	02F7	758	759	R/W	0 to 255	5	P. 192
Alarm lamp lighting condition setting 1	02F8	02F9	760	761	R/W	Bit data b0: Event 1 b1: Event 2 b2: Event 3 b3: Event 4 b4 to b31: Unused Data 0: ALM lamp is not lit 1: ALM lamp is lit [Decimal number: 0 to 15]	15	P. 193
Alarm lamp lighting condition setting 2	02FA	02FB	762	763	R/W	Bit data b0: HBA1 b1: HBA2 b2 to b31: Unused Data 0: ALM lamp is not lit 1: ALM lamp is lit [Decimal number: 0 to 3]	3	P. 193
Unused	02FC · · · 04FE	02FD · · · 04FF	764 · · · 1278	765 · · · 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					
	Low-order	High-order	Low-order	High-order				
Memory area selection	0500	0501	1280	1281	R/W	1 to 16	1	P. 194
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. 194
Event 2 set value	0504	0505	1284	1285	R/W		50.0	P. 194
Event 3 set value	0506	0507	1286	1287	R/W		50.0	P. 194
Control loop break alarm 1 (LBA1) time	0508	0509	1288	1289	R/W	0 to 7200 seconds 0: OFF (Unused)	480	P. 195
LBA1 deadband	050A	050B	1290	1291	R/W	0.0 to Input span	0.0	P. 196
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. 194
Control loop break alarm 2 (LBA2) time	050E	050F	1294	1295	R/W	0 to 7200 seconds 0: OFF (Unused)	480	P. 195
LBA2 deadband	0510	0511	1296	1297	R/W	0.0 to Input span	0.0	P. 196
Input 1_set value (SV1)	0512	0513	1298	1299	R/W	Input 1_setting limiter (low) to Input 1_setting limiter (high)	0.0	P. 196
Input 1_ proportional band	0514	0515	1300	1301	R/W	TC/RTD inputs: 0 to input span Voltage/current inputs: 0.0 to 1000.0 % of input span (0 or 0.0: ON/OFF action)	30.0	P. 197
Input 1_integral time	0516	0517	1302	1303	R/W	0 to 3600 seconds, 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds * (0, 0.0 or 0.00: PD action) * Varies with the setting of the integral/derivative time decimal point position selection.	240.00	P. 197
Input 1_derivative time	0518	0519	1304	1305	R/W	0 to 3600 seconds, 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds * (0, 0.0 or 0.00: PI action) * Varies with the setting of the integral/derivative time decimal point position selection.	60.00	P. 198

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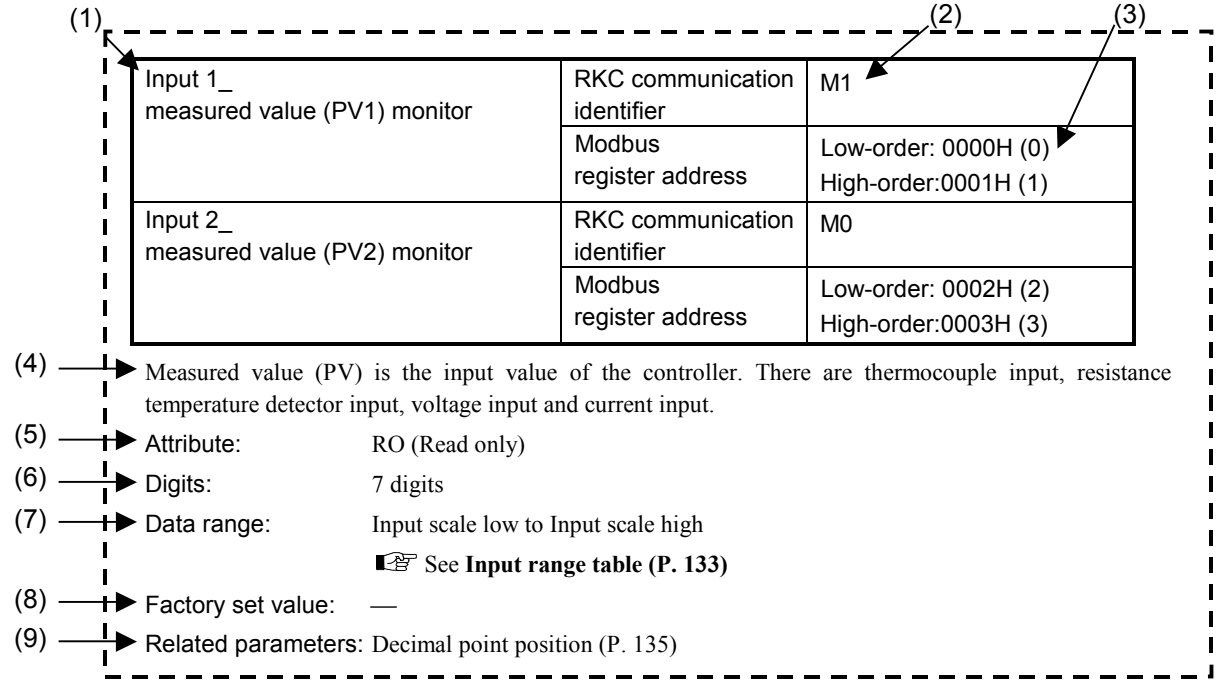
Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	Low-order	High-order	Low-order	High-order				
Input 1_control response parameter	051A	051B	1306	1307	R/W	0: Slow 1: Medium 2: Fast	0	P. 198
Unused	051C	051D	1308	1309	—	—	—	—
Input 2_set value (SV2)	051E	051F	1310	1311	R/W	Input 2_setting limiter (low) to Input 2_setting limiter (high)	0.0	P. 196
Input 2_ proportional band	0520	0521	1312	1313	R/W	TC/RTD inputs: 0 to Input span Voltage/current inputs: 0.0 to 1000.0 % of input span (0 or 0.0: ON/OFF action)	30.0	P. 197
Input 2_integral time	0522	0523	1314	1315	R/W	0 to 3600 seconds, 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds * (0, 0.0 or 0.00: PD action) * Varies with the setting of the integral/derivative time decimal point position selection.	240.00	P. 197
Input 2_derivative time	0524	0525	1316	1317	R/W	0 to 3600 seconds, 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds * (0, 0.0 or 0.00: PI action) * Varies with the setting of the integral/derivative time decimal point position selection.	60.00	P. 198
Input 2_control response parameter	0526	0527	1318	1319	R/W	0: Slow 1: Medium 2: Fast	0	P. 198
Unused	0528	0529	1320	1321	—	—	—	—
Input 1_setting change rate limiter (up)	052A	052B	1322	1323	R/W	0.0 to Input span/unit time * 0.0: OFF (Unused) * Unit time: 60 seconds (factory set value)	0.0	P. 199
Input 1_setting change rate limiter (down)	052C	052D	1324	1325	R/W		0.0	P. 199
Input 2_setting change rate limiter (up)	052E	052F	1326	1327	R/W		0.0	P. 199
Input 2_setting change rate limiter (down)	0530	0531	1328	1329	R/W		0.0	P. 199
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. 200
Link area number	0534	0535	1332	1333	R/W	0 to 16 0: OFF (No link)	0	P. 200

7. COMMUNICATION DATA DESCRIPTION

■ Reference to communication data contents



(1) Name: Communication data name is written.

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

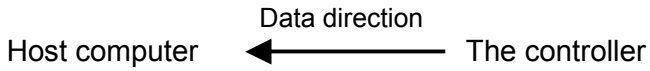
(3) Modbus register address:
Modbus communication data register addresses are written. These register addresses are written using both of hexadecimal and decimal (in parentheses) numbers.

📖 If Modbus 1 is selected in the communication protocol selection of the engineering mode, the address of high-order words and that of low-order words are reversed.

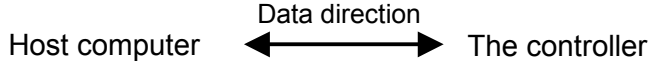
(4) Description: A short description of the communication data item is written.

(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 is possible.



R/W: Reading and writing data 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) Related parameters: A name and a page of related parameters 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	Low-order: 0000H (0) High-order: 0001H (1)
Input 2_ measured value (PV2) monitor	RKC communication identifier	M0
	Modbus register address	Low-order: 0002H (2) High-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 to Input scale high
☞ See **Input range table (P. 133)**
Factory set value: —
Related parameters: Decimal point position (P. 135)

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

The feedback resistance input value in position proportioning PID control.

Attribute: RO (Read only)
Digits: 7 digits
Data range: 0.0 to 100.0 %
Factory set value: —
Related parameters: Open/Close output neutral zone (P. 181),
Open/Close output differential gap (P. 182)

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

The CT input cannot measure less than 0.4 A.

Factory set value: —
Related parameters: Heater break alarm (HBA) state (P. 100),
Heater break alarm (HBA) set value (P. 119),
CT ratio (P. 159), CT assignment (P. 160)

Input 1_set value (SV1) monitor	RKC communication identifier	MS
	Modbus register address	Low-order: 000AH (10) High-order: 000BH (11)
Input 2_set value (SV2) monitor	RKC communication identifier	MT
	Modbus register address	Low-order: 000CH (12) High-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) to Setting limiter (high)
See **Input range table (P. 133)**
Factory set value: —
Related parameters: Decimal point position (P. 135)

Remote input value monitor	RKC communication identifier	S2
	Modbus register address	Low-order: 000EH (14) High-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) to Input 1_setting limiter (high)
☞ See **Input range table (P. 133)**
Factory set value: —

Cascade monitor	RKC communication identifier	KH
	Modbus register address	Low-order: 0010H (16) High-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) to Input 2_setting limiter (high)
☞ See **Input range table (P. 133)**
Factory set value: —
Related parameters: Input 2_use selection (P. 162)

Input 1_burnout state	RKC communication identifier	B1
	Modbus register address	Low-order: 0012H (18) High-order: 0013H (19)
Input 2_burnout state	RKC communication identifier	B0
	Modbus register address	Low-order: 0014H (20) High-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: —
Related parameters: Burnout direction (P. 139)

Feedback resistance input burnout state	RKC communication identifier	B2
	Modbus register address	Low-order: 0016H (22) High-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: —
Related parameters: Action at feedback resistance (FBR) input error (P. 183)

Event 1 state	RKC communication identifier	AA
	Modbus register address	Low-order: 0018H (24) High-order: 0019H (25)
Event 2 state	RKC communication identifier	AB
	Modbus register address	Low-order: 001AH (26) High-order: 001BH (27)
Event 3 state	RKC communication identifier	AC
	Modbus register address	Low-order: 001CH (28) High-order: 001DH (29)
Event 4 state	RKC communication identifier	AD
	Modbus register address	Low-order: 001EH (30) High-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: —
Related parameters: Event set value (P. 108), Output logic selection (P. 144),
Event type selection (P. 151), Event hold action (P. 153),
Event differential gap (P. 155), Event action at input error (P. 157),
Event assignment (P. 159)

Heater break alarm 1 (HBA1) state	RKC communication identifier	AE
	Modbus register address	Low-order: 0020H (32) High-order: 0021H (33)
Heater break alarm 2 (HBA2) state	RKC communication identifier	AF
	Modbus register address	Low-order: 0022H (34) High-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: —
Related parameters: Current transformer input value (CT) monitor (P. 97),
Heater break alarm (HBA) set value (P. 119),
CT ratio (P. 159), CT assignment (P. 160)

Input 1_ manipulated output value (MV1) monitor	RKC communication identifier	O1
	Modbus register address	Low-order: 0024H (36) High-order: 0025H (37)
Input 2_ manipulated output value (MV2) monitor	RKC communication identifier	O0
	Modbus register address	Low-order: 0026H (38) High-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: —
Related parameters: Manual output value (P. 124), Output logic selection (P. 144),
Output change rate limiter (up/down) (P. 172),
Output limiter (high/low) (P. 174)

Error code	RKC communication identifier	ER
	Modbus register address	Low-order: 0028H (40) High-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: Hardware configuration error
bit 5: Software 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: —

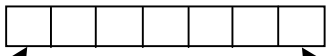
Event input (DI) state	RKC communication identifier	L1
	Modbus register address	Low-order: 002AH (42) High-order: 002BH (43)

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:



Most significant digit ····· Least significant digit

Data: 0: Contact open
1: Contact closed

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: Contact open
1: Contact closed

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: —
Related parameters: Event input logic selection (P. 141)

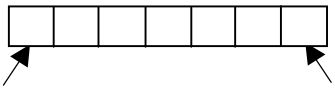
Operation mode state	RKC communication identifier	L0
	Modbus register address	Low-order: 002CH (44) High-order: 002DH (45)

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

Data: 0: OFF
1: ON

Least significant digit: Control STOP
2nd digit: Control RUN
3rd digit: Input 1_Manual mode (Including Input 1_Remote mode)
4th digit: Input 2_Manual mode (Including Input 2_Remote mode)
5th digit: Remote mode or Cascade control
6th digit and 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 data: 0: OFF
1: ON

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

Factory set value: —
Related parameters: Auto/Manual transfer (P. 106), Remote/Local transfer (P. 107), RUN/STOP transfer (P. 107), Input 2_use selection (P. 162)

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

Monitors the time elapsed for memory area operation (soak time) when ramp/soak control by using Multi-memory Area is performed.

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 59999 seconds
0 hour 00 minute 00 second to 9 hours 59 minutes 59 seconds: 0 to 35999 seconds

Factory set value: —
Related parameters: Area soak time (P. 117), Soak time unit selection (P. 187)

As the area soak time for the memory area linked last becomes invalid, no area soak time is monitored.

Input 1_PID/AT transfer	RKC communication identifier	G1
	Modbus register address	Low-order: 0030H (48) High-order: 0031H (49)
Input 2_PID/AT transfer	RKC communication identifier	G0
	Modbus register address	Low-order: 0032H (50) High-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 1-input controller.

Digits: 7 digits
Data range: 0: PID control
1: Autotuning (AT)
Factory set value: Input 1_PID/AT transfer: 0
Input 2_PID/AT transfer: 0
Related parameters: AT bias (P. 177), AT cycle (P. 178), AT differential gap time (P. 179)

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Autotuning (AT):

Autotuning (AT) function automatically measures, calculates and sets the optimum PID constants. The followings are the conditions necessary to carry out autotuning and the conditions which will cause the autotuning to stop.

Requirements for AT start:

Start the autotuning when all following conditions are satisfied:

- Operation mode conditions are as follows:

– Auto/Manual transfer → Auto mode
– Remote/Local transfer → Local mode
– PID/AT transfer → PID control
– RUN/STOP transfer → Control RUN

- The measured value (PV1) is not underscale or overscale.
- The output limiter high limit is 0.1 % or higher and the output limiter low limit is 99.9 % or less.

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

When the cascade control is activated, the AT function can not be turned on.

Requirements for AT 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 mode is changed to the Manual mode.
- When the Remote/Local mode is changed to the Remote mode.
- When the measured value (PV) goes to underscale or overscale.
- When the power failure occurs.
- When the instrument is in the FAIL state.
- When the PID/AT transfer is changed to the PID control.
- When the RUN/STOP mode is changed to the control STOP.

If the AT is canceled, the controller immediately changes to PID control.
The PID values will be the same as before AT was activated.

Input 1_Auto/Manual transfer	RKC communication identifier	J1
	Modbus register address	Low-order: 0034H (52) High-order: 0035H (53)
Input 2_Auto/Manual transfer	RKC communication identifier	J0
	Modbus register address	Low-order: 0036H (54) High-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 1-input controller.

Digits: 7 digits

Data range: 0: Auto mode
1: Manual mode

Factory set value: Input 1_Auto/Manual transfer: 0
Input 2_Auto/Manual transfer: 0

Related parameters: Operation mode state (P. 103)

Remote/Local transfer	RKC communication identifier	C1
	Modbus register address	Low-order: 0038H (56) High-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
Related parameters: Operation mode state (P. 103)

RUN/STOP transfer	RKC communication identifier	SR
	Modbus register address	Low-order: 003AH (58) High-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
Related parameters: Operation mode state (P. 103)

The controller status at STOP mode is the same as that of Power-off. However for the specification with current output (other than 0 to 20 mA) or voltage output, an output of –5 % is fed when at STOP.

If the instrument is transferred to RUN mode from STOP mode, it performs the same operation (control RUN, Event determination start-up) as the power-on.

Memory area selection	RKC communication identifier	ZA
	Modbus register address	Low-order: 003CH (60) High-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	Low-order: 003EH (62) High-order: 003FH (63)
Event 2 set value	RKC communication identifier	A2
	Modbus register address	Low-order: 0040H (64) High-order: 0041H (65)
Event 3 set value	RKC communication identifier	A3
	Modbus register address	Low-order: 0042H (66) High-order: 0043H (67)
Event 4 set value	RKC communication identifier	A4
	Modbus register address	Low-order: 0048H (72) High-order: 0049H (73)

Event 1 through Event 4 are set values 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

Related parameters: Event state (P. 99), Event type selection (P. 151), Event hold action (P. 153), Event differential gap (P. 155), Event action at input error (P. 157), Event assignment (P. 159)

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

The LBA time sets the time required for the LBA function to determine there is a loop failure. When the LBA is output (under alarm status), the LBA function still monitors the measured value (PV) variation at an interval of the 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: Unused)
Factory set value: 480
Related parameters: Event state (P. 99), Event assignment (P. 159), LBA deadband (P. 109)
LBA Function: See the next page.

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

The LBA deadband gives a neutral 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
Related parameters: Event state (P. 99), Event assignment (P. 159),
Control loop break alarm (LBA) time (P. 109)
LBA Deadband function: See the next page.

■ LBA Function

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 (power controller, magnet relay, etc.), or a failure in the control loop caused by an input (sensor) break. The LBA function is activated when control output reaches 0 % (low limit with output limit function) or 100 % (high limit with output limit function). LBA monitors variation of the measured value (PV) for the length of LBA time. When the LBA time has elapsed and the PV is still within the alarm determination range, the LBA will be ON.

[Alarm action]

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

- **When the output reaches 0 % (low limit with output limit function)**

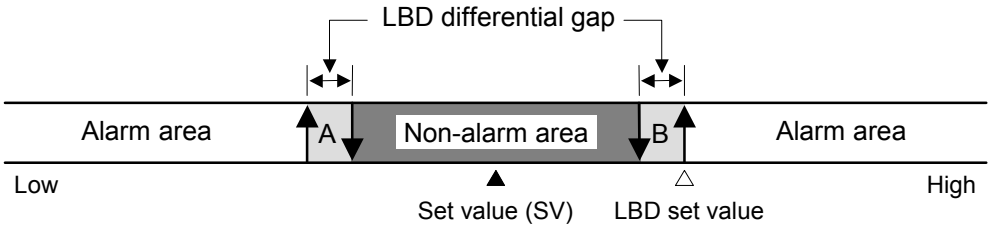
For direct action: When the LBA time has passed and the PV has not risen beyond the alarm determination range, the alarm will be turned on.
For reverse action: When the LBA time has passed and the PV has not fallen below the alarm determination range, the alarm will be turned on.

- **When the output exceeds 100 % (high limit with output limit function)**

For direct action: When the LBA time has passed and the PV has not fallen below the alarm determination range, the alarm will be turned on.
For reverse action: When the LBA time has passed and the PV has not risen beyond the alarm determination range, the alarm will be turned on.

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

LBA Deadband function:
The LBA may malfunction due to external disturbances. To prevent malfunctioning due to external disturbance, LBA deadband (LBD) sets a neutral zone in which LBA is not activated. When the measured value (PV) is within the LBD area, LBA will not be activated. If the LBD setting is not correct, the LBA will not work correctly.



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

LBD differential gap: TC/RTD input: 0.8 °C [°F] (Fixed)
Voltage/current input: 0.8 % of input span (Fixed)

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- If the LBA function detects an error occurring in the control loop, but cannot specify the location, a check of the control loop in order. The LBA function does not detect a location which causes alarm status. If LBA alarm is ON, check each device or wiring of the control loop.
- When AT function is activated or the controller is in STOP mode, the LBA function is not activated.
- If the LBA setting time does not match the controlled object requirements, the LBA setting time should be lengthened. If setting time is not correct, the LBA will malfunction by turning on or off at inappropriate times or not turning on at all.
- While the LBA is ON (under alarm status), the following conditions cancel the alarm status and LBA will be OFF.
  - The measured value (PV) rises beyond (or falls below) the LBA determination range within the LBA time.
  - The measured value (PV) enters within the LBA deadband.

Input 1_set value (SV1)	RKC communication identifier	S1
	Modbus register address	Low-order: 004EH (78) High-order: 004FH (79)
Input 2_set value (SV2)	RKC communication identifier	S0
	Modbus register address	Low-order: 005AH (90) High-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 1-input controller.

Digits: 7 digits

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

See **Input range table (P. 133)**

Factory set value: Input 1_set value (SV1): 0
Input 2_set value (SV2): 0

Related parameters: Setting limiter (high/low) (P. 187)

Input 1_proportional band	RKC communication identifier	P1
	Modbus register address	Low-order: 0050H (80) High-order: 0051H (81)
Input 2_proportional band	RKC communication identifier	P0
	Modbus register address	Low-order: 005CH (92) High-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 1-input controller.

Digits: 7 digits

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

Factory set value: Input 1_proportional band: 30.0
Input 2_proportional band: 30.0

Related parameters: ON/OFF action differential gap upper (P. 168),
ON/OFF action differential gap lower (P. 169)

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

Integral action is to eliminate offset between SV and PV by proportional action. The degree of Integral action is set by time in seconds.

Attribute: R/W (Read and Write)

The Input 2_integral time (I0) becomes RO (Read only) for the 1-input controller.

Digits: 7 digits
Data range: 0 to 3600 seconds, 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds
(0, 0.0 or 0.00: PD action)
Factory set value: Input 1_integral time: 240.00
Input 2_integral time: 240.00
Related parameters: Integral/derivative time decimal point position selection (P. 167)

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

Derivative action is to prevent rippling and make control stable by monitoring output change. The degree of Derivative action is set by time in seconds.

Attribute: R/W (Read and Write)

The Input 2_derivative time (D0) becomes RO (Read only) for the 1-input controller.

Digits: 7 digits
Data range: 0 to 3600 seconds, 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds
(0, 0.0 or 0.00: PI action)
Factory set value: Input 1_derivative time: 60.00
Input 2_derivative time: 60.00
Related parameters: Integral/derivative time decimal point position selection (P. 167)

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

The control response for the set value (SV) change can be selected among Slow, Medium, and Fast.

Attribute: R/W (Read and Write)

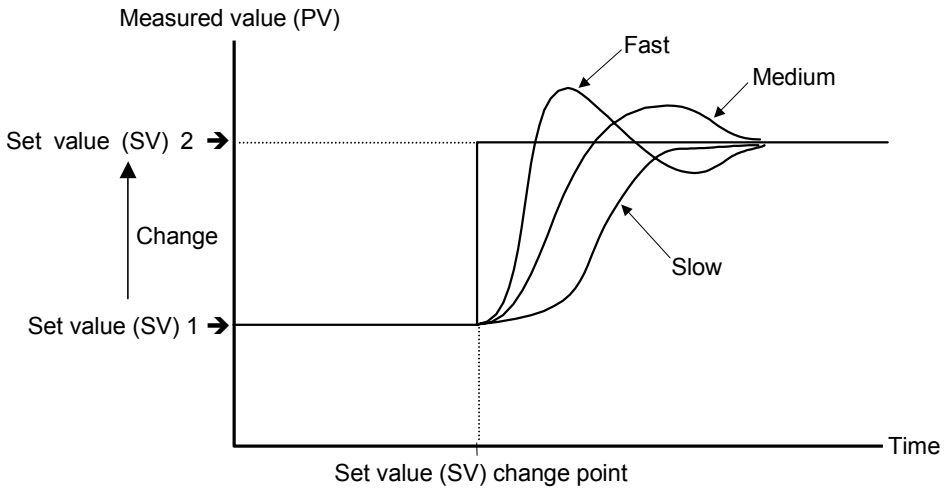
The Input 2_control response parameter (C9) becomes RO (Read only) for the 1-input controller.

Digits: 7 digits

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

Factory set value: Input 1_control response parameter: 0
Input 2_control response parameter: 0

Control Response: The control response for the set value (SV) change can be selected among Slow, Medium, and Fast. If a fast response is required, Fast is chosen. Fast may cause overshoot. If overshoot is critical, Slow is chosen.



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

This function is to allow the set value (SV) to be automatically changed at specific rates when a new set value (SV).

Attribute: R/W (Read and Write)

The Input 2_setting change rate limiter up (HX) becomes RO (Read only) for the 1-input controller.

Digits: 7 digits
Data range: 0.0 to Input span/unit time * * Unit time: 60 seconds (factory set value)
0.0: OFF (Unused)
Factory set value: Input 1_setting change rate limiter (up): 0.0
Input 2_setting change rate limiter (up): 0.0
Related parameters: Setting change rate limiter unit time (P. 185)

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

This function is to allow the set value (SV) to be automatically changed at specific rates when a new set value (SV).

Attribute: R/W (Read and Write)

The Input 2_setting change rate limiter down (HY) becomes RO (Read only) for the 1-input controller.

Digits: 7 digits
Data range: 0.0 to Input span/unit time * * Unit time: 60 seconds (factory set value)
0.0: OFF (Unused)
Factory set value: Input 1_setting change rate limiter (down): 0.0
Input 2_setting change rate limiter (down): 0.0
Related parameters: Setting change rate limiter unit time (P. 185)

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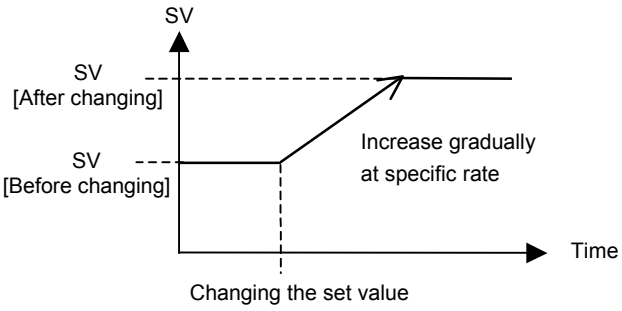
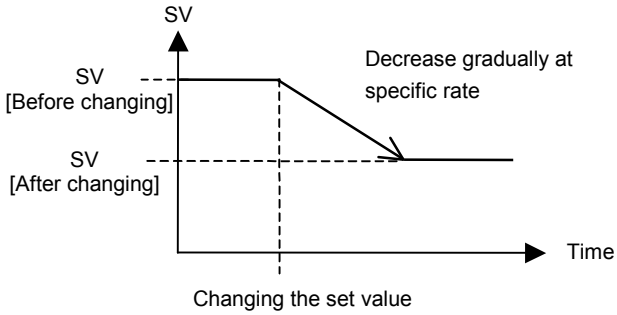
■ Setting change rate limiter

Application examples of setting change rate limiter:

● **Increasing the SV to a higher value**



● **Decreasing the SV to a lower value**



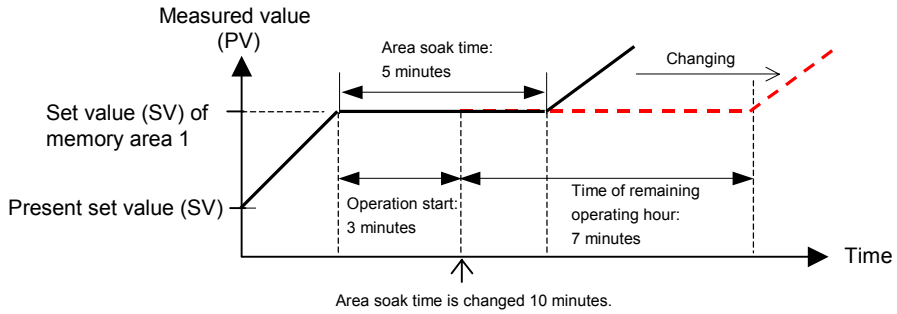
- When the setting change rate limiter is used, the SV will also ramp up or ramp down by the function at power-on and operation mode change from STOP to RUN.
- If the autotuning (AT) function is activated while the SV is ramping up or ramping down by the setting change rate limiter, AT will starts after the SV finishes ramp-up or ramp-down by the limiter, and the controller is in PID control mode until AT starts.
- When the value of setting change rate limiter is changed during normal operation, the ramp-up or ramp-down rate will be changed unless the SV already has finished ramp-up or ramp-down by the function.
- If the rate of setting change limiter is set to any value other than “0.0: OFF (Unused),” the event re-hold action to be taken by a set value (SV) change becomes invalid.

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

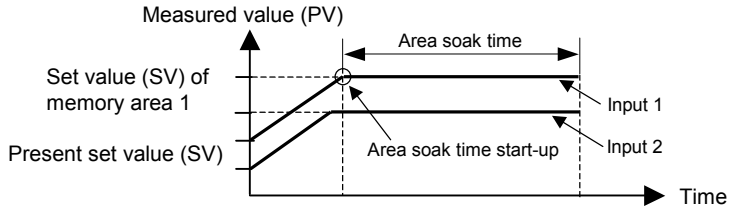
Area Soak Time is used for ramp/soak control function in conjunction with Link Area Number and Setting Change Rate Limiter (up/down). (see P. 118)

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)
Related parameters: Soak time unit selection (P. 185)

The Area Soak Time can be changed during normal operation with ramp/soak control function, but Read the following example carefully how the time change affects ramp/soak control time. For example, the Memory area which has 5-minute soak time is executed. When 3 minutes passed, the Area Soak Time is changed from 5 minutes to 10 minutes. The remaining time of the currently executed Memory Area is calculated as follows.
(The new soak time 10 minutes) – (lapsed time 3 minutes) = (remaining time 7 minutes)
The old soak time does not have any effect on remaining time.



For the instrument with the 2-input specification, its area soaking starts based on the arrival at the memory area set value of Input 1 or that of Input 2, whichever later.

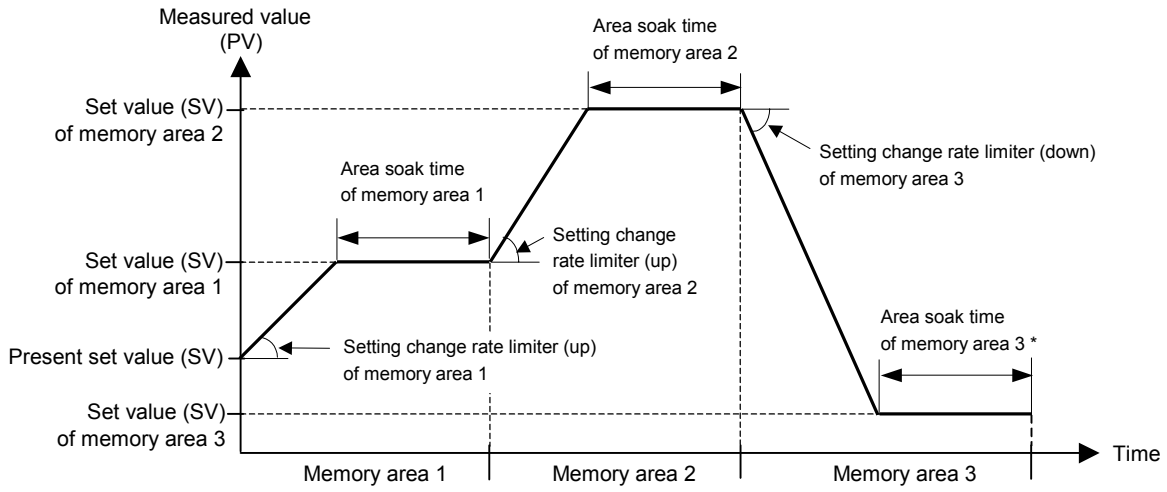


Link area number	RKC communication identifier	LP
	Modbus register address	Low-order: 0070H (112) High-order: 0071H (113)

Link Area Number is used for ramp/soak control function in conjunction with Area Soak Time and Setting Change Rate Limiter (up/down).

Attribute: R/W (Read and Write)
Digits: 7 digits
Data range: 0 to 16
0: OFF (No link)
Factory set value: 0
Ramp/Soak Control Function:
Ramp/soak control is possible by using Area Soak Time, Link Area Number and Setting Change Rate Limiter (up/down) in Parameter Setting mode.

[Usage example]



* The area soak time for the memory area linked last becomes invalid to continue the state of the set value (SV) reached.

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

HBA1 and HBA2 are to set the set values for the heater break alarm (HBA) function. The HBA function detects a fault in the heating circuit by monitoring the current flowing through the load by a dedicated current transformer (CT).
Up to two heater break alarms are available with the controller. CT input 1 is for HBA1, and CT input 2 for HBA2. CT inputs can be assigned to one output from OUT1 to OUT5. To use HBA for a three-phase load, both CT inputs can be assigned to the same output.
Two types of heater break alarms, TYPE "A" and TYPE "B" (factory set value: TYPE "B"), are available. An appropriate type should be selected depending on the application. (Please see "Heater Break Alarm Function" below.)
These parameters, HBA set values are used for both types. However, each type has different function and care must be used to set an appropriate set value.

For type "A" HBA,
- Set the set value to approximately 85 % of the maximum reading of the CT input.
- Set the set value to a slightly smaller value to prevent a false alarm if the power supply may become unstable.
- When more than one heater is connected in parallel, it may be necessary to increase the HBA set value to detect a single heater failure.

For type "B" HBA,
Set the set value to the maximum CT input value. This will be the current when the control is at 100 % control output. The set value is used to calculate the width of a non-alarm range.

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: With CTL-6-P-N: 0.0 to 30.0 A (0.0: Not used)
With CTL-12-S56-10L-N: 0.0 to 100.0 A (0.0: Not used)

Factory set value: Heater break alarm 1 (HBA1) set value: 0.0
Heater break alarm 2 (HBA2) set value: 0.0

Related parameters: Heater break determination point (P. 127),
Heater melting determination point (P. 128),
Heater break alarm (HBA) type selection (P. 191),
Number of heater break alarm (HBA) delay times (P. 192)

Heater Break Alarm Function:

■ **Heater break alarm (HBA) type A**

Heater Break Alarm (HBA) type A can only be used with time-proportional control output (relay, voltage pulse, or triac output). The HBA function monitors the current flowing through the load by a dedicated current transformer (CT), compares the measured value with the HBA set values, and detects a fault in the heating circuit.

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Low or No current flow (Heater break, malfunction of the control device, etc.):
When the control output is ON and the CT input value is equal to or less than the heater break determination point for the preset number of consecutive sampling cycles, an alarm is activated.

Over current or short-circuit:
When the control output is OFF and the CT input value is equal to or greater than the heater break determination point for the preset number of consecutive sampling cycles, an alarm is activated.

■ Heater break alarm (HBA) type B

Heater Break Alarm (HBA) type B can be used with both continuous control output (current/voltage continuous output) and time-proportional control output (relay, voltage pulse output, or triac). The HBA function assumes that the heater current value is proportional* to the control output value of the controller, otherwise viewed as the manipulated variable (MV), and compare it with the CT input value to detect a fault in the heating or cooling circuit.

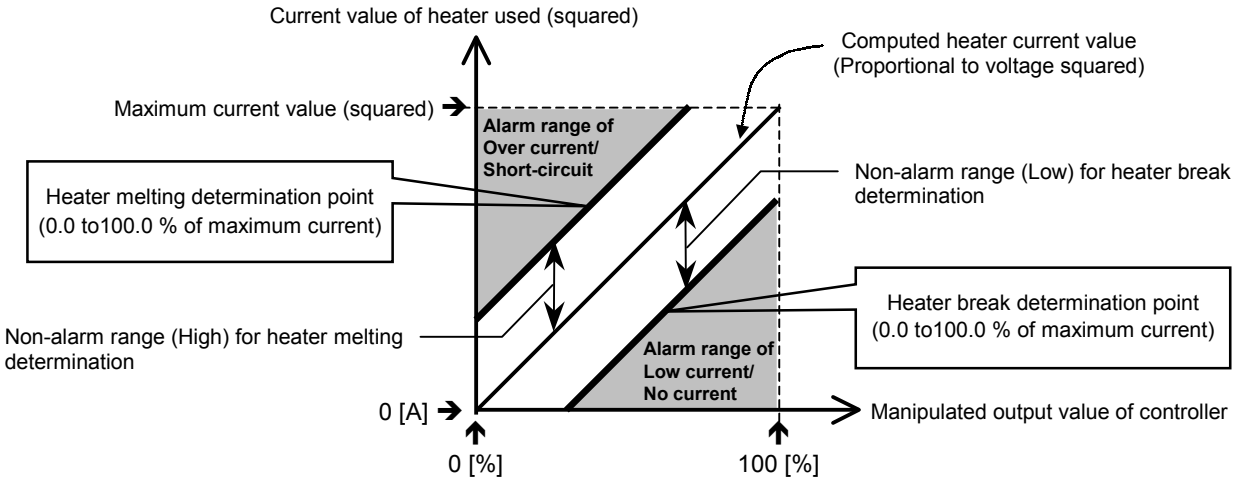
* It is assumed that the current value flowing through the load is at maximum when the control output from the controller is 100 %, and the minimum current value flowing through the load is zero (0) when the control output from the controller is 0 %.

Low or No current flow (Heater break, malfunction of the control device, etc.)
The alarm determination point (Low) is calculated as follows:
(Non-alarm range (Low) width) = (HbL1 or HbL2) × (HbA1 or HbA2)
(Alarm determination point (Low)) = ((HbA1 or HbA2) × (MV1 or MV2)) – (Non-alarm range (Low) width)

When the CT input value is equal to or less than the heater break determination point for the preset number of consecutive sampling cycles, an alarm status is produced.

Over current or short-circuit
The alarm determination point (High) is calculated as follows:
(Non-alarm range (High) width) = (HbH1 or HbH2) × (HbA1 or HbA2)
(Alarm determination point (High)) = ((HbA1 or HbA2) × (MV1 or MV2)) + (Non-alarm range (High) width)

When the CT input value is equal to or greater than the heater melting determination point for the preset number of consecutive sampling cycles, an alarm status is produced.



The current factory set values of HbLs (Heater break determination point) and HbHs (Heater melting determination point) are set to 30.0 %. If any of the following conditions exists, set them to a slightly larger value to prevent a false alarm.

- **Heater current values is not proportional to the control output in Phase control.**
- **There is difference on control output accuracy between the controller and the operating unit (scr Power Controller).**
- **There is a delay on control output between the controller and the operating unit (scr Power Controller).**

The factory set value of the HBA type is heater break alarm (HBA) type B.

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

PV bias adds bias to the measured value (PV). The PV bias is used to compensate the individual variations of the sensors or correct the 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 1-input controller.

Digits: 7 digits
Data range: −Input span to +Input span
Factory set value: Input 1_PV bias: 0
Input 2_PV bias: 0

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

This item is the time of the first-order lag filter eliminate noise against the measured input.

Attribute: R/W (Read and Write)

The Input 2_PV digital filter (F0) becomes RO (Read only) for the 1-input controller.

Digits: 7 digits
Data range: 0.00 to 10.00 seconds
0.00: OFF (Unused)
Factory set value: HA400/HA900: Input 1_PV digital filter: 0.00
Input 2_PV digital filter: 0.00
HA401/HA901: Input 1_PV digital filter: 1.00
Input 2_PV digital filter: 1.00

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

PV ratio is a multiplier to be applied to the measured value (PV). The PV bias is used to compensate the individual variations of the sensors or correct the 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 1-input controller.

Digits: 7 digits
Data range: 0.500 to 1.500
Factory set value: Input 1_PV ratio: 1.000
Input 2_PV ratio: 1.000

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

PV low input cut-off is used with Square Root Extraction function. The measured value less than the PV low input cut-off is ignored to prevent control disturbance caused by input variation at low measured value range.

Attribute: R/W (Read and Write)

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

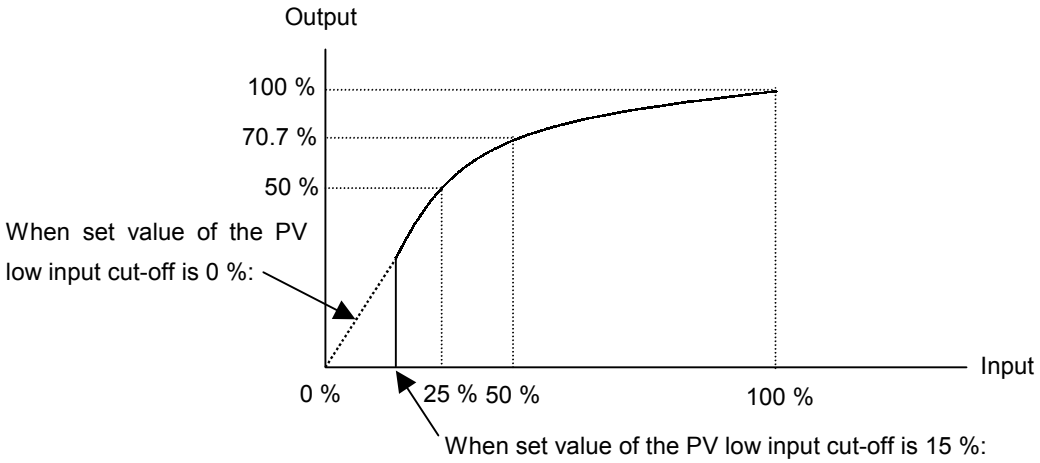
Digits: 7 digits

Data range: 0.00 to 25.00 % of input span

Factory set value: Input 1_PV low input cut-off: 0.00
Input 2_PV low input cut-off: 0.00

PV Low Input Cut-off Function:

When input signal square root extraction is used for flow control, etc., the square root extraction result varies widely at the low measured value range. The measured value less than the PV low input cut-off is ignored to calculate control output in order to prevent control disturbance caused by input variation at low measured value range.



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

Proportional Cycle Time is to set control cycle time for time based control output such as voltage pulse for SSR, triac and relay 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: Input 1_proportional cycle time:
Relay contact output: 20.0 seconds
Voltage pulse output and triac output: 2.0 seconds
Input 2_proportional cycle time:
Relay contact output: 20.0 seconds
Voltage pulse output and triac output: 2.0 seconds

The proportional cycle time becomes invalid when the voltage/current output is selected as control output type.

Input 1_manual output value	RKC communication identifier	ON
	Modbus register address	Low-order: 0080H (128) High-order: 0081H (129)
Input 2_manual output value	RKC communication identifier	OM
	Modbus register address	Low-order: 008CH (140) High-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) to Output limiter (high)
Factory set value: Input 1_manual output value: 0.0
Input 2_manual output value: 0.0
Related parameters: Output limiter (high/low) (P. 174)

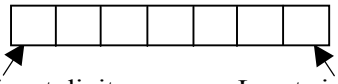
Set lock level	RKC communication identifier	LK
	Modbus register address	Low-order: 008EH (142) High-order: 008FH (143)

The set lock level restricts parameter setting changes by key operation (Set data lock function). This function prevents the operator from making errors during operation.

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:



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

Least significant digit:	Lock only setting items other than SV and events (EV1 to EV4). 0: Unlock, 1: Lock
2nd digit:	Lock only events (EV1 to EV4). 0: Unlock, 1: Lock
3rd digit:	Lock only set value (SV). 0: Unlock, 1: Lock
4th digit to Most significant digit:	Unused

Modbus: 0 to 7 (bit data)

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

Bit image: 0000

bit 2 · · · · bit 0

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: Unlock 1: Lock

Factory set value: 0

EEPROM storage state	RKC communication identifier	EM
	Modbus register address	Low-order: 0090H (144) High-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	Low-order: 0092H (146) High-order: 0093H (147)

It is set whether the data storage in the non-volatile memory (EEPROM) is executed 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."

For the following case, data is stored into the EEPROM regardless of the EEPROM mode setting.
- **When the data is changed through key operation**
- **Data written into the controller by specifying the memory area number**

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.

Heater break determination point 1	RKC communication identifier	NE
	Modbus register address	Low-order: 0094H (148) High-order: 0095H (149)
Heater break determination point 2	RKC communication identifier	NH
	Modbus register address	Low-order: 0098H (152) High-order: 0099H (153)

The heater break determination point set value used for heater break alarm (HBA) type B is set.

Attribute: R/W (Read and Write)

Heater break determination point 1 set value (NE) becomes RO (Read only) for no current transformer input 1 (CT1) specification and heater break alarm (HBA) type A.

Heater break determination point 2 set value (NH) becomes RO (Read only) for no current transformer input 2 (CT2) specification and heater break alarm (HBA) type A.

Digits: 7 digits

Data range: Heater break determination point 1:
0.0 to 100.0 % of heater break alarm 1 (HBA1) set value
(0.0: Heater break determination is invalid)
Heater break determination point 2:
0.0 to 100.0 % of heater break alarm 2 (HBA2) set value
(0.0: Heater break determination is invalid)

Factory set value: Heater break determination point 1: 30.0
Heater break determination point 2: 30.0

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Related parameters: Heater break alarm (HBA) set value (P. 119),
Heater melting determination point (P. 128),
Heater break alarm (HBA) type selection (P. 193),
Number of heater break alarm (HBA) delay times (P. 194)

Functional description:
See Heater break alarm (HBA) set value (P. 119)

Heater melting determination point 1	RKC communication identifier	NF
	Modbus register address	Low-order: 0096H (150) High-order: 0097H (151)
Heater melting determination point 2	RKC communication identifier	NI
	Modbus register address	Low-order: 009AH (154) High-order: 009BH (155)

The heater melting determination point set value used for heater break alarm (HBA) type B is set.

Attribute: R/W (Read and Write)

Heater melting determination point 1 set value (NF) becomes RO (Read only) for no current transformer input 1 (CT1) specification and heater break alarm (HBA) type A.

Heater melting determination point 2 set value (NI) becomes RO (Read only) for no current transformer input 2 (CT2) specification and heater break alarm (HBA) type A.

Digits: 7 digits

Data range: Heater melting determination point 1:
0.0 to 100.0 % of heater break alarm 1 (HBA1) set value
(0.0: Heater melting determination is invalid)
Heater melting determination point 2:
0.0 to 100.0 % of heater break alarm 2 (HBA2) set value
(0.0: Heater melting determination is invalid)

Factory set value: Heater melting determination point 1: 30.0
Heater melting determination point 2: 30.0

Related parameters: Heater break alarm (HBA) set value (P. 119),
Heater break determination point (P. 127),
Heater break alarm (HBA) type selection (P. 191),
Number of heater break alarm (HBA) delay times (P. 192)

Functional description:
See Heater break alarm (HBA) set value (P. 119)

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

STOP message for control STOP mode can be displayed either on the upper display or the lower display. This item is to select the display to show the STOP message.

Attribute: R/W (Read and Write)

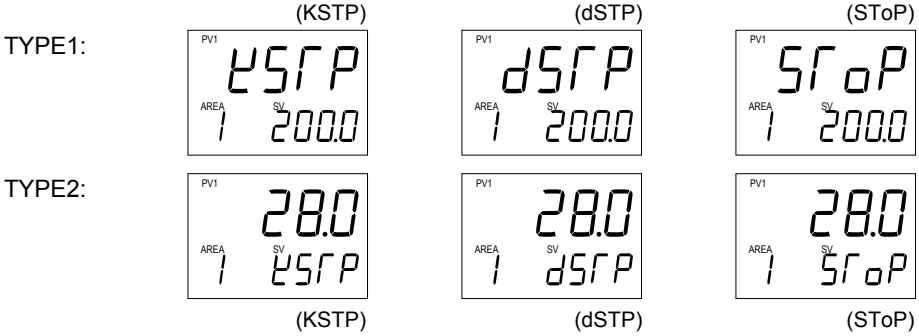
This item becomes RO (Read only) during control RUN.

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

There are three different Characters for STOP mode depending on how to be transferred from RUN to STOP.



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

Use to select the contents of the bar graph display.

Attribute: R/W (Read and Write)

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

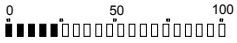
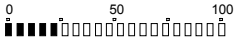
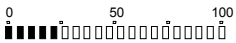
Digits: 7 digits

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

Related parameters: Bar graph resolution setting (P. 131)

Bar graph display explanation:

Manipulated output value (MV) display	Displays the manipulated output value (MV). When manipulated output value (MV) is at 0 % or less, the left-end dot of the bar-graph flashes. When MV exceeds 100 %, the right-end dot flashes. [Display example] 
Measured value (PV) display	Scaling is available within the input range. [Display example] 
Set value (SV) display	Scaling is available within the input range. [Display example] 
Deviation value display	Displays the deviation between the measured value (PV) and the set value (SV). When the Deviation display is selected, the dots at both ends of bar-graph light. A display resolution per dot is settable from 1 to 100. [Display example] 
Feedback resistance input value (POS) display	Displays the feedback resistance input value (POS). It is available only with position proportioning PID control. [Display example] 

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

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

Use to set 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
Related parameters: Bar graph display selection (P. 130)

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

Use to select Use/Unuse of Auto/Manual transfer key (A/M).

Attribute: R/W (Read and Write)

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

Digits: 7 digits
Data range: 0: Unused
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	Low-order: 020AH (522) High-order: 020BH (523)

Use to select Use/Unuse of Remote/Local transfer key (R/L).

Attribute: R/W (Read and Write)

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

Digits: 7 digits

Data range: 0: Unused
1: Remote/Local transfer

Factory set value: 1

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

Use to select Use/Unuse of RUN/STOP transfer key (R/S).

Attribute: R/W (Read and Write)

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

Digits: 7 digits

Data range: 0: Unused
1: RUN/STOP transfer

Factory set value: 1

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

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 to 1 V	Programmable range (–19999 to +99999)	
20		0 to 100 mV		
21		0 to 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 to 20 mA	Programmable range (–19999 to +99999)	
15		4 to 20 mA		
16	Voltage (High) input	0 to 10 V	Programmable range (–19999 to +99999)	Voltage (High) input group
17		0 to 5 V		
18		1 to 5 V		

An input type change may only be made within the hardware groups as shown above.

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

4-wire RTD input type (22 and 23) can not be selected for Input type selection of Input 2.

See the above input range table to select input type of the remote input. Input range 0 through 13, 22 or 23 can not be selected for the remote input.

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Factory set value: Input 1_input type selection:
Depend on model code. (when not specifying: Type K)
Input 2_input type selection:
Depend on model code. (when not specifying: Type K)
Related parameters: Display unit selection (P. 134), Decimal point position (P. 135), Input scale high (P. 136), Input scale low (P. 137)

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

Use to select the 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: Input 1_display unit selection: 0
Input 2_display unit selection: 0

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

Use to select the 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 decimal place
- 1: One decimal place

RTD inputs:
- 0: No decimal place
- 1: One decimal place
- 2: Two decimal places

Voltage (V)/current (I) inputs:
- 0: No decimal place
- 1: One decimal place
- 2: Two decimal places
- 3: Three decimal places
- 4: Four decimal places

Factory set value: Input 1_decimal point position: 1
Input 2_decimal point position: 1

Related parameters: Input type selection (P. 133), Input scale high (P. 136), Input scale low (P. 137)

Input 1_input scale high	RKC communication identifier	XV
	Modbus register address	Low-order: 0214H (532) High-order: 0215H (533)
Input 2_input scale high	RKC communication identifier	XX
	Modbus register address	Low-order: 0228H (552) High-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 the selected input range
Voltage (V)/current (I) inputs:
−19999 to +99999
(Varies with the setting of the decimal point position)

Factory set value: Input 1_input scale high:
Thermocouple (TC)/RTD inputs: Maximum value of the selected input range
Voltage (V)/current (I) inputs: 100.0
Input 2_input scale high:
Thermocouple (TC)/RTD inputs: Maximum value of the selected input range
Voltage (V)/current (I) inputs: 100.0

Related parameters: Input type selection (P. 133), Decimal point position (P. 135), Input scale low (P. 137)

Input Scale High function:
The input scale range can be easily set by setting the input scale high limit/low limit.

When a voltage/current input type is selected, the input scale high limit can be set lower than the input scale low limit. (Input scale high limit < Input scale low limit)

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

This value is to set the 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 the selected input range to Input scale high
Voltage (V)/current (I) inputs:
−19999 to +99999
(Varies with the setting of the decimal point position)

Factory set value: Input 1_input scale low:
Thermocouple (TC)/RTD inputs: Minimum value of the selected input range
Voltage (V)/current (I) inputs: 0.0
Input 2_input scale low:
Thermocouple (TC)/RTD inputs: Minimum value of the selected input range
Voltage (V)/current (I) inputs: 0.0

Related parameters: Input type selection (P. 133), Decimal point position (P. 135), Input scale high (P. 136)

Input Scale Low function:
See the input scale high.

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

Use to set Input Error Determination Point (high). Input Error Determination function is activated when a measured value reaches the limit, and control output value selected by Action at input error will be output.

Attribute: R/W (Read and Write)

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

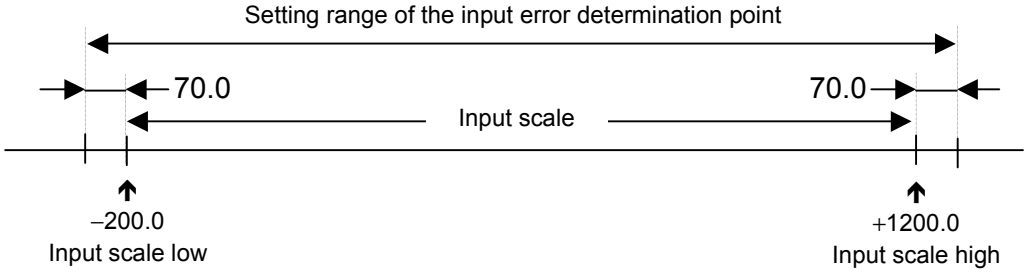
Digits: 7 digits

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

Factory set value: Input 1_input error determination point (high):
Thermocouple (TC)/RTD inputs: Input scale high + (5 % of input span)
Voltage (V)/current (I) inputs: 105.0
Input 2_input error determination point (high):
Thermocouple (TC)/RTD inputs: Input scale high + (5 % of input span)
Voltage (V)/current (I) inputs: 105.0

Related parameters: Input error determination point (low) (P. 139),
Action at input error (high) (P. 170),
Action at input error (low) (P. 171),
Manipulated output value at input error (P. 171)

[Example] When the input scale is −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)	RKC communication identifier	AW
	Modbus register address	Low-order: 021AH (538) High-order: 021BH (539)
Input 2_input error determination point (low)	RKC communication identifier	AY
	Modbus register address	Low-order: 022EH (558) High-order: 022FH (559)

Use to set Input Error Determination Point (low). Input Error Determination function is activated when a measured value reaches the limit, and control output value selected by Action at input error will be output.

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: Input 1_input error determination point (low):
Thermocouple (TC)/RTD inputs: Input scale low – (5 % of input span)
Voltage (V)/current (I) inputs: –5.0
Input 2_input error determination point (low):
Thermocouple (TC)/RTD inputs: Input scale low – (5 % of input span)
Voltage (V)/current (I) inputs: –5.0

Related parameters: Input error determination point (high) (P. 138),
Action at input error (high) (P. 170),
Action at input error (low) (P. 171),
Manipulated output value at input error (P. 171)

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

Use to select Burnout Direction in input break. When input break is detected by the controller, the measured value go either Upscale or Downscale according to the Burnout Direction setting.

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: Input 1_burnout direction: 0
Input 2_burnout direction: 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 (Indicates value near 0 V.)**
- **Current (I) inputs: Downscale (Indicates value near 0 mA.)**

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

Use to select Use/Unuse of the square root extraction for the measured value.

Attribute: R/W (Read and Write)

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

Digits: 7 digits

Data range: 0: Unused
1: Used

Factory set value: Input 1_square root extraction selection: 0
Input 2_square root extraction selection: 0

Square Root Extraction Function:

The controller can receive the input signal directly from a differential pressure type flow transmitter by using Square Root Extraction Function without using a square root extractor.

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

Use to select the power supply frequency of the controller suited to the application.

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	Low-order: 0234H (564) High-order: 0235H (565)

Use to assign the function (memory area, operation mode) for the event inputs (DI 1 to DI 7).

Attribute: R/W (Read and Write)

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

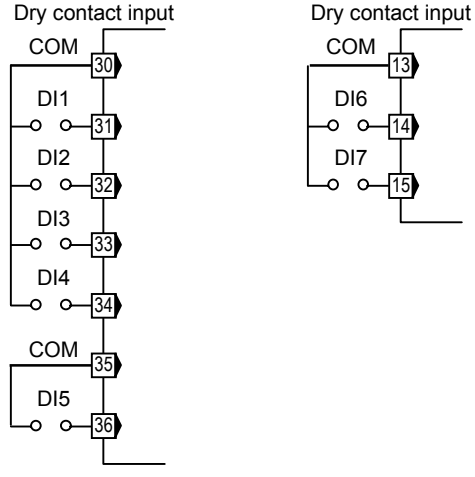
Digits: 7 digits
Data range: 0 to 6 (see the following table)

[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 cannot be used when the communication 1 function is specified.

Event input terminals



Contact input from external devices or equipment should be dry contact input. If it is not dry contact input, the input should meet the specification below.
Contact resistance: At OFF (contact open) 500 kΩ or more
At ON (contact closed) 10 Ω or less

Factory set value: 1
Event Input function: See the next page.

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- Contact status of memory area number selection

To store a new Memory Area number as the Control Area, close the DI for Memory Area Set.

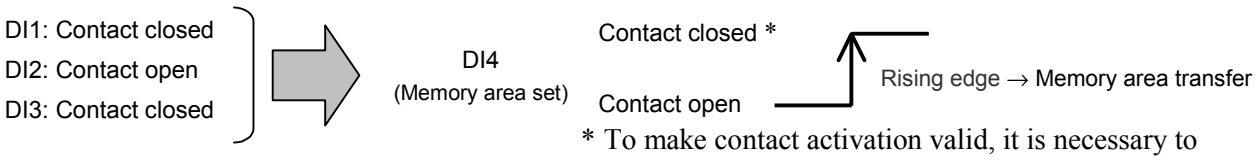
Event input	Memory area number															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DI 1	×	–	×	–	×	–	×	–	×	–	×	–	×	–	×	–
DI 2	×	×	–	–	×	×	–	–	×	×	–	–	×	×	–	–
DI 3	×	×	×	×	–	–	–	–	×	×	×	×	–	–	–	–
DI 4	×	×	×	×	×	×	×	×	–	–	–	–	–	–	–	–

×: Contact open –: Contact closed

Transfer timing of memory area number:

[Example] Change the memory area number to 6
(when "4" is selected in "Event input logic selection")

First, close the contacts between DI1 and DI3 and the common terminal. Next, open the contact between DI2 and the common. Then, close the contact between DI4 and the common from open status, the memory area in the controller will change to "6".



* To make contact activation valid, it is necessary to maintain the same contact state (contact closed) for more than 200 ms.

- **DI Status for mode transfer**

	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

* If "Input 2_use selection (CAM)" is changed to "2: Cascade control (Slave)," "Remote/Local" needs to be changed to "Cascade/Local."

- **RUN/STOP transfer**

Mode select from 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	
	Contact open	

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- **Auto/Manual transfer**

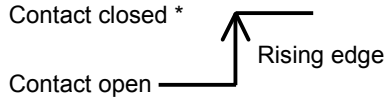
Mode select from front key or communication	Status of event input (DI)	Actual operation mode
Auto	Contact closed	Auto
	Contact open	Manual
Manual	Contact closed	
	Contact open	

- **Remote/Local transfer**

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

Transfer timing of RUN/STOP, Auto/Manual, and Remote/Local:

The selection operation is taken when DI contact is closed from the open condition (Rising edge).



* To make contact activation valid, it is necessary to maintain the same contact state (contact closed) for more than 200 ms.

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

This is used to assign 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 11 (see the following table)

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

Set value	OUT1 (M/ V / R/ E/ T)	OUT2 (M/ V/ R/ E/ T)	OUT3 (M/ V/ R/ E/ T)	OUT4 (M)	OUT5 (M)	Remarks
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
11	MV 1	EV 4 (Energized) or HBA 2 (Energized)	EV 3 (Energized) or HBA 1 (Energized)	EV 2 (Energized)	EV 1 (Energized)	Energized alarm

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 logic becomes *OR* output when two or more output functions are assigned to one output.

- When three transmission outputs are selected, the transmission outputs are automatically assigned to OUT1 through OUT3 and it has priority over the Output Logic Selection. To select Manipulated Output Value of Input 1 or Input 2 as output type of OUT1, OUT2 or OUT3, select "4: Input 1_manipulated output value (MV)" or "8: Input 2_manipulated output value (MV)" at the parameters of Transmission Output Type Selection.

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 1-input controller: 1
For 2-input controller: 5

Related parameters: Output timer setting (P. 146), Transmission output type selection (P. 148), Event input logic selection (P. 141), CT assignment (P. 160), Heater break alarm (HBA) type selection (P. 191), Alarm lamp lighting condition setting (P. 193)

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

Output Timer Setting is to set an output delay time for event outputs.

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

Related parameters: Output logic selection (P. 144), Event type selection (P. 151)
Alarm lamp lighting condition setting (P. 193)

Output Timer Setting function:

See the next page.

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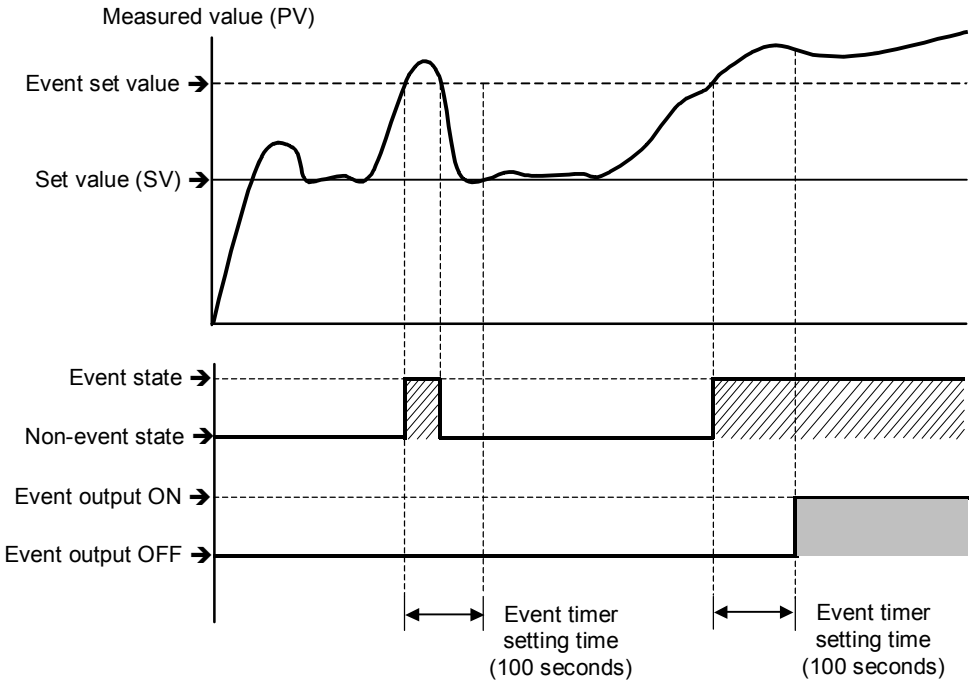
When an event condition becomes On status, the output is suppressed until the Output Timer set time elapses. After the time is up, if the event output is still ON status, the output will be produced.

Example: When set the event timer to 100.0 seconds.



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

Use to select the transmission output type.

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 value
4: Input 1_manipulated output value (MV)
5: Input 2_measured value (PV)
6: Input 2_set value (SV)
7: Input 2_deviation value
8: Input 2_manipulated output value (MV)
9: Feedback resistance input value (POS)

Factory set value: 0

Related parameters: Transmission output scale high (P. 149),
Transmission output scale low (P. 150)

Specify the output type of the transmission output when ordering.

When transmission outputs are selected and used, the outputs are allocated as follows.
- Transmission output 1: Output 1 (OUT1)
- Transmission output 2: Output 2 (OUT2)
- Transmission output 3: Output 3 (OUT3)

The transmission has priority over the Output Logic Selection.

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

Use to set 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) and feedback resistance input value (POS): −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) and feedback resistance input value (POS): 100.0
Deviation: + Input span

Related parameters: Transmission output type selection (P. 148),
Transmission output scale low (P. 150)

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

Use to set 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) and feedback resistance input value (POS):
−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) and feedback resistance input value (POS):
0.0
Deviation: −Input span

Related parameters: Transmission output type selection (P. 148),
Transmission output scale high (P. 149)

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

Use to select a type of the event 1, 2, 3 and 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] Event hold action is available.

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

Factory set value: 0

Related parameters: Event set value (P. 108), Control loop break alarm (LBA) time (P. 109), LBA deadband (P. 109), Output logic selection (P. 144), Output timer setting (P. 146), Event hold action (P. 153), Event differential gap (P. 155), Event action at input error (P. 157), Event assignment (P. 159), Alarm lamp lighting condition setting (P. 193)

Functional description:

See the next page.

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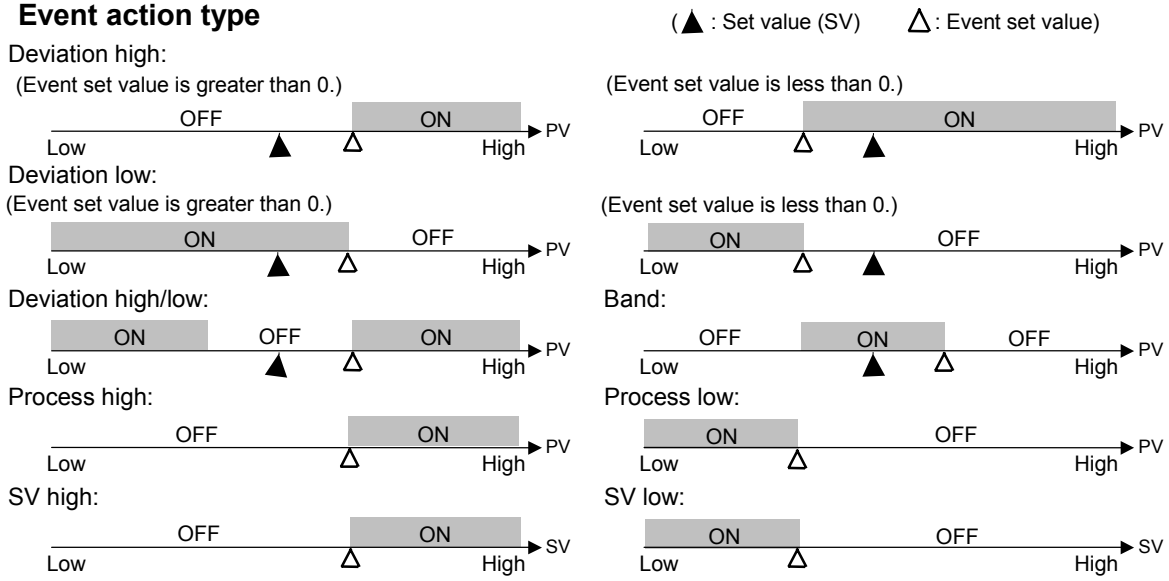
- **Event action type**



- **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. The LBA function is activated when control output reaches 0 % (low limit with output limit function) or 100 % (high limit with output limit function). LBA monitors variation of the measured value (PV) for the length of LBA time. When the LBA time has elapsed and the PV is still within the alarm determination range, the LBA will be ON.

[Alarm action]

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

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

- **When the control output reaches 0 % (low limit with output limit function)**

For direct action: When the LBA time has passed and the PV has not risen beyond the alarm determination range, the alarm will be turned on.

For reverse action: When the LBA time has passed and the PV has not fallen below the alarm determination range, the alarm will be turned on.

- **When the output exceeds 100 % (low limit with output high function)**

For direct action: When the LBA time has passed and the PV has not fallen below the alarm determination range, the alarm will be turned on.

For reverse action: When the LBA time has passed and the PV has not risen beyond the alarm determination range, the alarm will be turned on.

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- If the autotuning function is used, the LBA time is automatically set twice as large as the integral time. The LBA setting time will not be changed even if the integral time is changed.
- When AT function is activated or the controller is in STOP mode, the LBA function is not activated.
- The LBA function does not detect a location which causes alarm status. If LBA alarm is ON, check each device or wiring of the control loop.
- While the LBA is ON (under alarm status), the following conditions cancel the alarm status and LBA will be OFF.
  - The measured value (PV) rises beyond (or falls below) the LBA determination range within the LBA time.
  - The measured value (PV) enters within the LBA deadband.

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

Use to set a event hold action for 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: OFF
1: ON
2: Re-hold action ON

Factory set value: 0

Related parameters: Event set value (P. 108), Event type selection (P. 151), Event differential gap (P. 155), Event action at input error (P. 157), Event assignment (P. 159)

Functional description:

See the next page.

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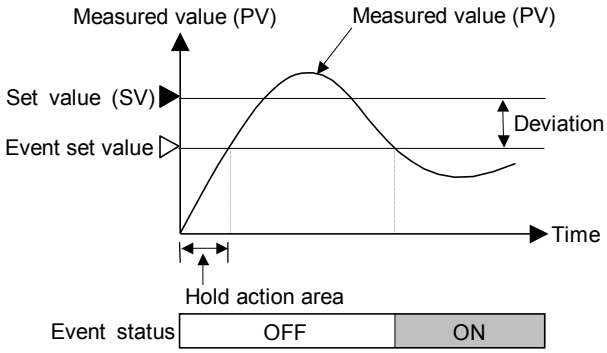
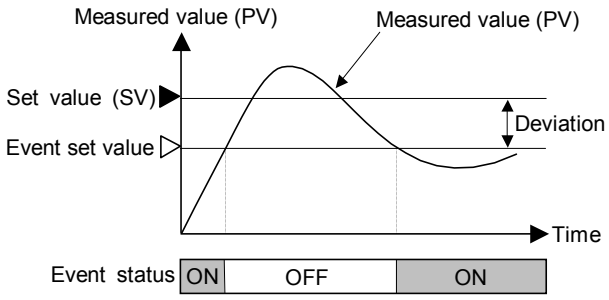
● Hold action

When Hold action is ON, the event action is suppressed at start-up or STOP to RUN until the measured value has entered the non-event range.

[With hold action]



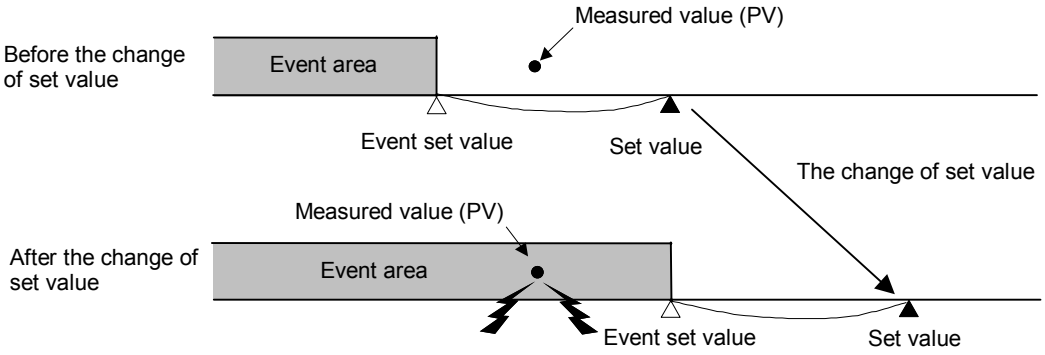
[Without hold action]



● Re-hold action

When Re-hold action is ON, the event action is also suppressed at the control set value change as well as start-up and STOP to RUN until the measured value has entered the non-event range. However, if the rate of setting change limiter is set to any function other than "0.0: OFF (Unused)" or in the remote setting, the re-hold action becomes invalid.

Example: When Re-hold action is OFF and event output type is deviation, the event output is produced due to the set value change. The Re-hold action suppresses the alarm output until the measured value has entered the non-event range again.



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

Use to set 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 [°F]
Voltage (V)/current (I) inputs: 0.2 % of input span

Related parameters: Event set value (P. 108), Event type selection (P. 151),
Event hold action (P. 153), Event action at input error (P. 157),
Event assignment (P. 159)

Event differential gap function:

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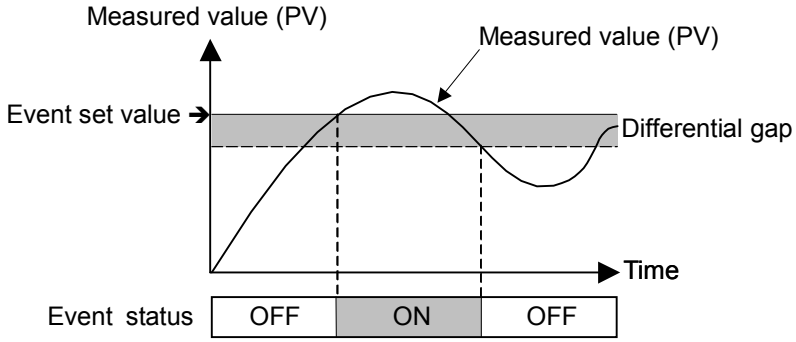
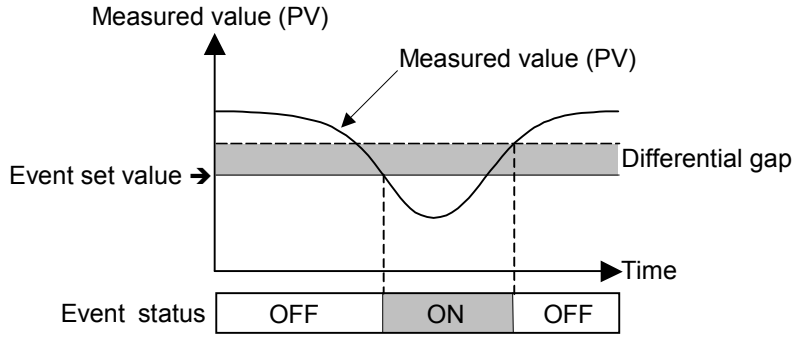
It prevents chattering of event output due to the measured value fluctuation around the event set value.

[Event high]



[Event low]



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

Event action at input error is to select the event action when the measured value reaches 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: Turn the event output ON

Factory set value: 0

Related parameters: Input error determination point (high) (P. 138),
Input error determination point (low) (P. 139)

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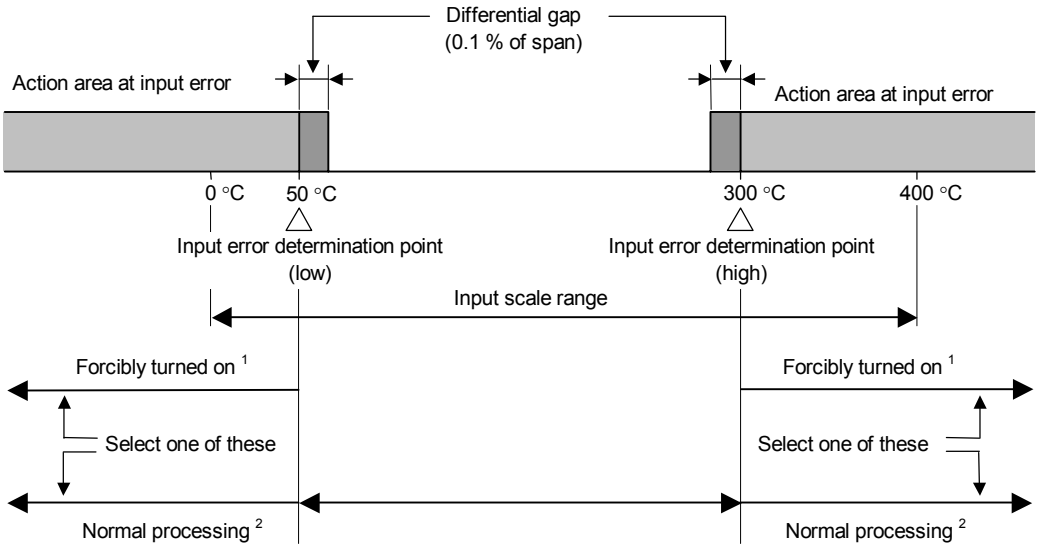
Event action at input error:

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



[1] The event output is forcibly turned on regardless of the selected event action status when the input is abnormal.

[2] The event output is produced depending on the selected event action status even if the input is abnormal.

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

Use to assign event outputs to either Input 1 or Input 2.

Attribute: R/W (Read and Write)

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

Digits: 7 digits

Data range: 1: For input 1
2: For input 2

Factory set value: 1

Related parameters: Event set value (P. 108), Event type selection (P. 151), Event hold action (P. 153), Event differential gap (P. 155), Event action at input error (P. 157)

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

Use to set the number of turns in the current transformer which is used to monitor the current flowing through the load. There are two types of dedicated current transformers.

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

Related parameters: Heater break alarm (HBA) set value (P. 119), CT assignment (P. 160)
Heater break determination point (P. 127),
Heater melting determination point (P. 128)

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

Use to assign the current transformer input to an output from OUT1 to OUT5. The CT input 1 is tied to HBA1, and the CT input 2 tied to HBA2, so when CT1 is assigned to OUT1, HBA1 is also automatically assigned to OUT1.

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:
CT1 for:
Current transformer 1 (CT1) input not provided: 0
Current transformer 1 (CT 1) input provided: 1 (When HBA1 is specified)
CT2 for:
Current transformer 2 (CT2) input not provided: 0
Current transformer 2 (CT2) input provided: 2 (When HBA2 is specified)

Related parameters: Heater break alarm (HBA) set value (P. 119), Output logic selection (P. 144), CT ratio (P. 159)

The current transformer 1 (CT1) is for the heater break alarm 1 (HBA1). The current transformer 2 (CT2) is for the heater break alarm 2 (HBA2). Select an appropriate output number by checking the Output Logic Selection or Transmission Output Type.

To use HBA for a three-phase load, both CT inputs can be assigned to the same output.

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

Use to select 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	Power failure less than 3 seconds	Power failure 3 seconds or more
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
6	Hot start 1	Stop start
7	Hot start 2	Stop start
8	Stop start	Stop start

Factory set value: 0

Hot/Cold start function:

After the power failure, when power is back to the controller,

Hot start 1: the controller will return to the same operation mode and the same manipulated value which were used or calculated by the controller before power failure.

Hot start 2: the controller will return to the same operation mode which was used by the controller before power failure.

- In the Manual mode, the output value will be at the low output limit value.
- In the Auto mode, the controller will calculate the manipulated output value regardless that before power failure. So, the manipulated output varies.

Cold start: the controller will automatically go to Manual mode and output the low output limit value.

Stop start: Started in the control stop (STOP) state regardless of the RUN mode (Auto/Manual) before power failure. Set to the RUN mode before power failure when changed to RUN from STOP by RUN/STOP selection.

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

Use to select the usage of Input 2. Cascade control can be selected by this parameter.

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	Low-order: 0288H (648) High-order: 0289H (649)

Cascade ratio is a multiplier which is used to convert the manipulated output (%) to cascade signal (°C or °F) at the cascade master.

Attribute: R/W (Read and Write)

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

Digits: 7 digits

Data range: 0.0000 to 1.5000

Factory set value: 1.0000

Related parameters: Cascade bias (P. 163)

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

The cascade bias is applied 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 (heater, refrigeration device, etc). As a result, the controlled object temperature can be reached and controlled at the target value. Cascade control is suitable for an application which has a large time lag between the heat/refrigeration source and section whose temperature is necessary to be controlled.

- **Cascade ratio**

The conversion rate when the manipulated output (%) in the cascade master is converted to the relevant cascade signal (°C or °F) can by changed from 0.0000 to 1.5000 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)

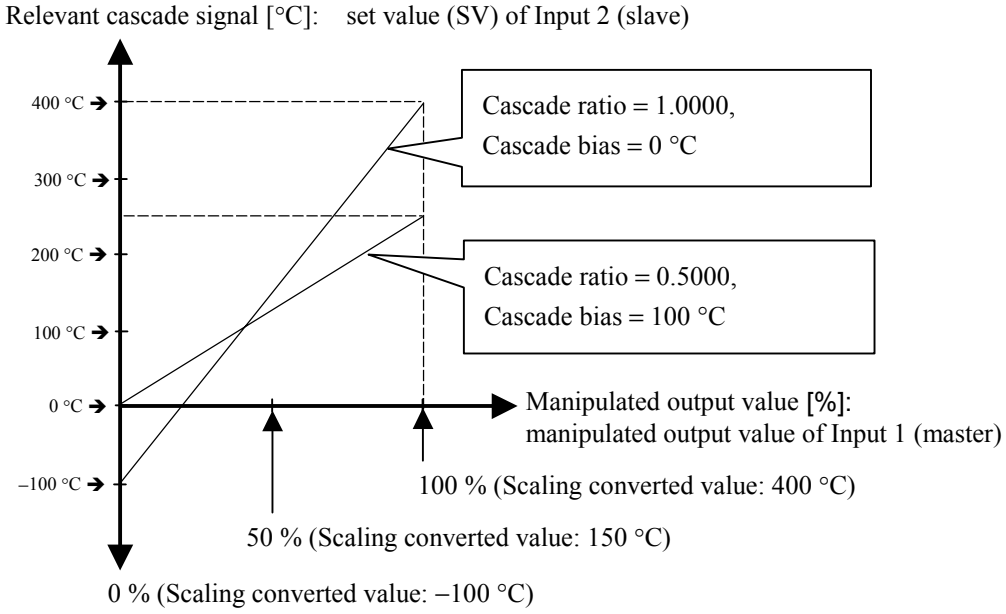
Output scale of Input 1 (master): 0 to 100 %
Input scale of Input 2: −100 to +400 °C

Manipulated output of Input 1 (master) = 100 %
Cascade ratio = 1.0000
Cascade bias = 0 °C
→ Relevant cascade signal (Input 2: set value on the slave side) = 400 °C

Manipulated output of Input 1 (master) = 0 %
Cascade ratio = 1.0000
Cascade bias = 0 °C
→ Relevant cascade signal (input 2: set value on the slave side) = −100 °C

Manipulated output of Input 1 (master) = 100 %
Cascade ratio = 0.5000
Cascade bias = 100 °C
→ Relevant cascade signal (Input 2: set value on the slave side) = 250 °C

Manipulated output of Input 1 (master) = 0 %
Cascade ratio = 0.5000
Cascade bias = 100 °C
→ Relevant cascade signal (input 2: set value on the slave side) = 0 °C



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

To select Use/Unuse of SV tracking.

Attribute: R/W (Read and Write)

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

Digits: 7 digits

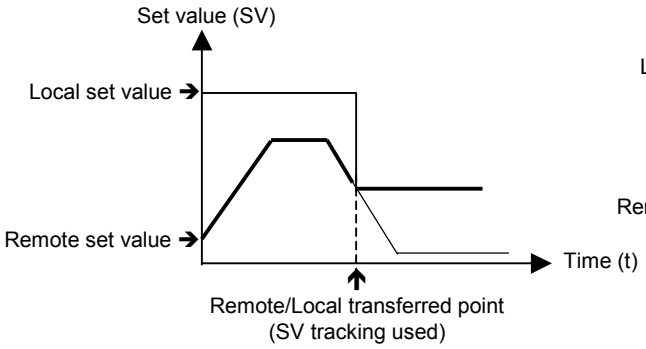
Data range: 0: Unused
1: Used

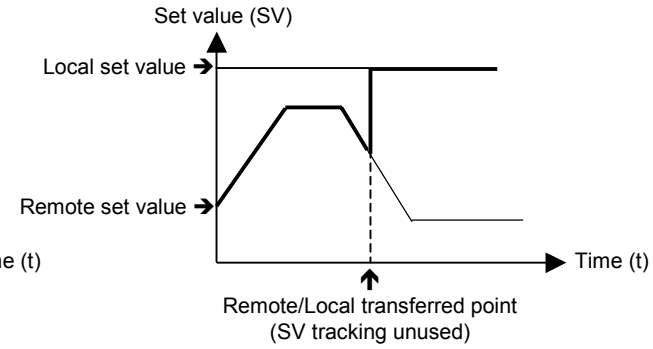
Factory set value: 1

SV Tracking function:

With SV Tracking function, when Remote/Local mode is transferred from Remote to Local, the set value used in Remote mode before the mode transfer will be kept using in Local mode to prevent rapid set value change.

Operation mode:	Local →	Remote →	Local
Set value used	Local set value	Remote set value	Local set value
SV tracking used	Local set value ≠ Remote set value	Local set value = Remote set value	Local set value = Remote set value
SV tracking unused	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	Low-order: 028EH (654) High-order: 028FH (655)
Input 2_control action type selection	RKC communication identifier	XF
	Modbus register address	Low-order: 02A8H (680) High-order: 02A9H (681)

Use to select direct action/reverse action.

Attribute: R/W (Read and Write)

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

Digits: 7 digits

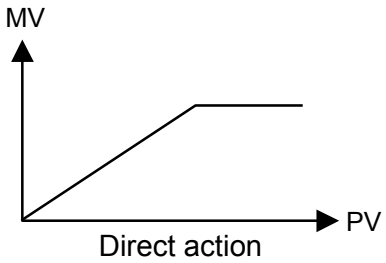
Data range: 0: Direct action
1: Reverse action

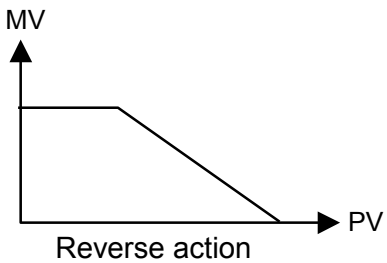
Factory set value: Input 1_control action type selection: 1
Input 2_control action type selection: 1

Control action type:

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

Use to select 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 decimal place
1: One decimal place
2: Two decimal places

Factory set value: Input 1_integral/derivative time decimal point position selection: 2
Input 2_integral/derivative time decimal point position selection: 2

Related parameters: Integral time (P. 113), Derivative time (P. 113)

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

Use to set a gain used for derivative action in PID control. Derivative gain should not be changed under ordinary operation.

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: Input 1_derivative gain: 6.0
Input 2_derivative gain: 6.0

📖 Under ordinary operation, it is not necessary to change Derivative gain set value.

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

Use to set 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: Input 1_ON/OFF action differential gap (upper):
Thermocouple (TC) /RTD inputs: 1.0 °C [°F]
Voltage (V)/current (I) inputs: 0.1 % of input span
Input 2_ON/OFF action differential gap (upper):
Thermocouple (TC) /RTD inputs: 1.0 °C [°F]
Voltage (V)/current (I) inputs: 0.1 % of input span

Related parameters: ON/OFF action differential gap (lower) (P. 169)

ON/OFF Action Differential Gap:
See the ON/OFF action differential gap (lower).

Input 1_ON/OFF action differential gap (lower)	RKC communication identifier	IW
	Modbus register address	Low-order: 296H (662) High-order: 0297H (663)
Input 2_ON/OFF action differential gap (lower)	RKC communication identifier	IY
	Modbus register address	Low-order: 02B0H (688) High-order: 02B1H (689)

Use to set 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

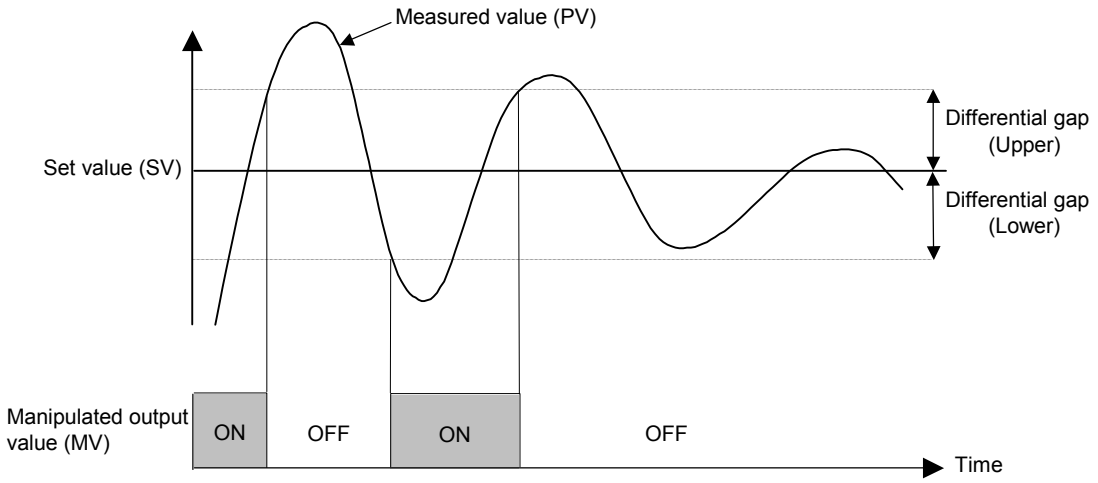
Data range: 0 to Input span

Factory set value: Input 1_ON/OFF action differential gap (lower):
Thermocouple (TC) /RTD inputs: 1.0 °C [°F]
Voltage (V)/current (I) inputs: 0.1 % of input span
Input 2_ON/OFF action differential gap (lower):
Thermocouple (TC) /RTD inputs: 1.0 °C [°F]
Voltage (V)/current (I) inputs: 0.1 % of input span

Related parameters: ON/OFF action differential gap (upper) (P. 168)

ON/OFF Action Differential Gap:

ON/OFF control is possible when the proportional band is set to "0" or "0.0." In ON/OFF control with Reverse action, when the measured value (PV) is smaller than the set value (SV), the manipulated output (MV) is 100 % or ON. When the PV is higher than the SV, the MV is 0 % or OFF. Differential gap setting prevents control output from repeating ON and OFF too frequently.



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

Use to select the action when the measured value reaches the input error determination point (high) or more.

Attribute: R/W (Read and Write)

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

Digits: 7 digits

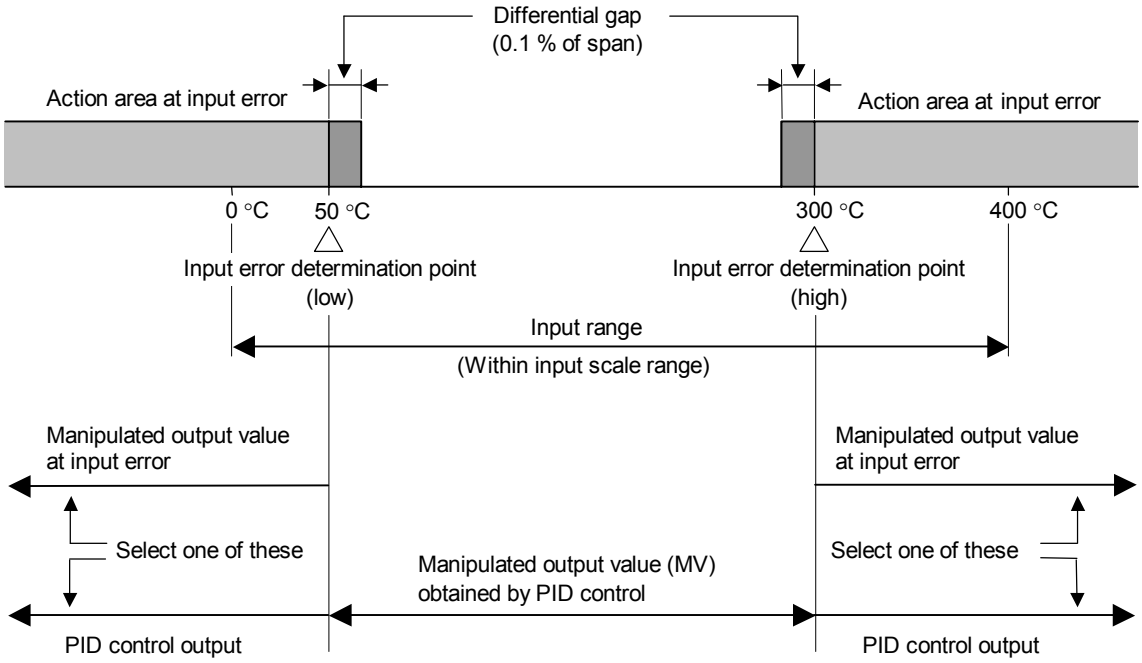
Data range: 0: Normal control
1: Manipulated Output Value at Input Error

Factory set value: Input 1_action at input error (high): 0
Input 2_action at input error (high): 0

Related parameters: Input error determination point (high) (P. 138),
Manipulated output value at input error (P. 171)

Input Error Determination:

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



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

Use to select the action when the measured value reaches the input error determination point (low).

Attribute: R/W (Read and Write)

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

Digits: 7 digits

Data range: 0: Normal control
1: Manipulated Output Value at Input Error

Factory set value: Input 1_action at input error (low): 0
Input 2_action at input error (low): 0

Related parameters: Input error determination point (low) (P. 139),
Manipulated output value at input error (P. 171)

Input Error Determination:
See the action at input error (high).

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

When the measured value reaches Input Error Determination Point and Action at Input Error is set to "1," this manipulated value is output.

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: Input 1_manipulated output value at input error: –5.0
Input 2_manipulated output value at input error: –5.0

Related parameters: Input error determination point (high) (P. 138),
Input error determination point (low) (P. 139),
Action at input error (high) (P. 170),
Action at input error (low) (P. 171)

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

Use to set 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 %/second
0.0: OFF (Unused)

Factory set value: Input 1_output change rate limiter (up): 0.0
Input 2_output change rate limiter (up): 0.0

Related parameters: Output change rate limiter (down) (P. 172), Output limiter (high) (P. 174), Output limiter (low) (P. 174)

Output Change Rate Limiter:
See the next page.

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

Use to set the output change rate limiter (down).

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 %/second
0.0: OFF (Unused)

Factory set value: Input 1_output change rate limiter (down): 0.0
Input 2_output change rate limiter (down): 0.0

Related parameters: Output change rate limiter (up) (P. 172), Output limiter (high) (P. 174), Output limiter (low) (P. 174)

Output Change Rate Limiter:
See the next page.

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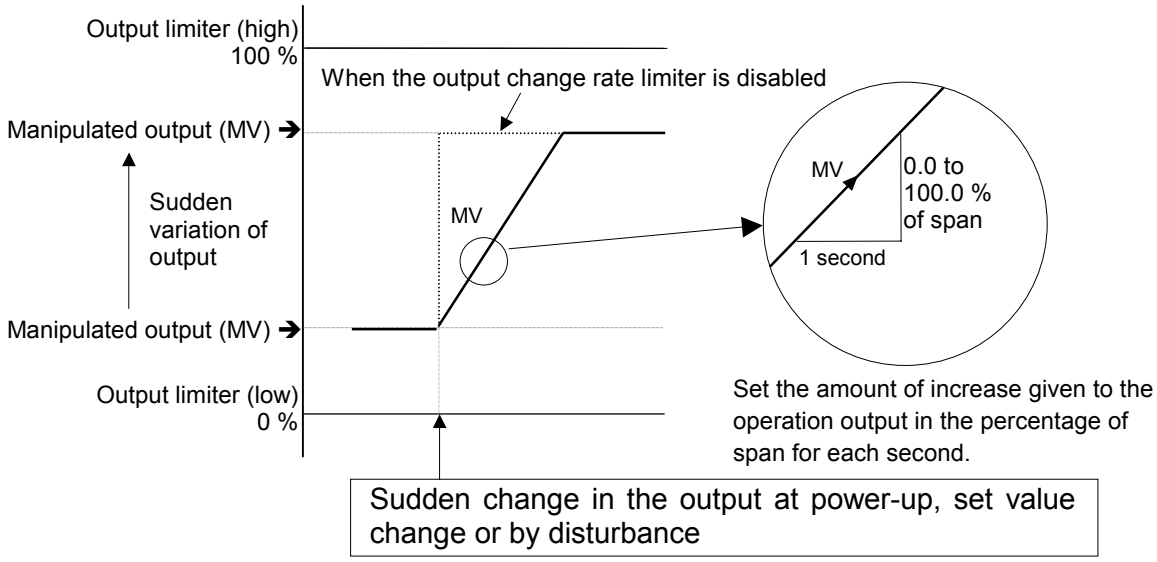
Output Change Rate Limiter:

The output change rate limiter limits the variation of manipulated output (MV) per second. This function is suitable for an application in which a sudden MV change is not acceptable.

[Example]

The output change rate limiter is effective

- The MV reaches 100 % when the power is turned on to the controller and such a sudden output change is not acceptable in the application.
- A sudden output change occurs at the SV change and it is not acceptable in the application.



The output changes at specific rates set by Output Change Rate Limiter (up) even under the situations where a sudden output change would occur without Output Change Rate Limiter function. There is also independent Output Change Rate Limiter (down).

- If the Output Change Rate is set smaller, it will cause slow control response and affect Derivative action.
- When the Output Change Rate Limiter is used, you may not be able to obtain appropriate PID constants by autotuning.
- The Output Change Rate Limiter is particularly effective when a sudden MV change may create uncontrollable situation cause a large current flow. Also, it is very effective current output or voltage output is used as control output.

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

Use to set 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) to 105.0 %
Factory set value: Input 1_output limiter (high): 105.0
Input 2_output limiter (high): 105.0
Related parameters: Output change rate limiter (up) (P. 172),
Output change rate limiter (down) (P. 172), Output limiter (low) (P. 174)

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

Use to set 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)
Factory set value: Input 1_output limiter (low): –5.0
Input 2_output limiter (low): –5.0
Related parameters: Output change rate limiter (up) (P. 172),
Output change rate limiter (down) (P. 172), Output limiter (high) (P. 174)

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

Use to select Use/Unuse of the power feed forward (PFF) function.

Attribute: R/W (Read and Write)

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

Digits: 7 digits

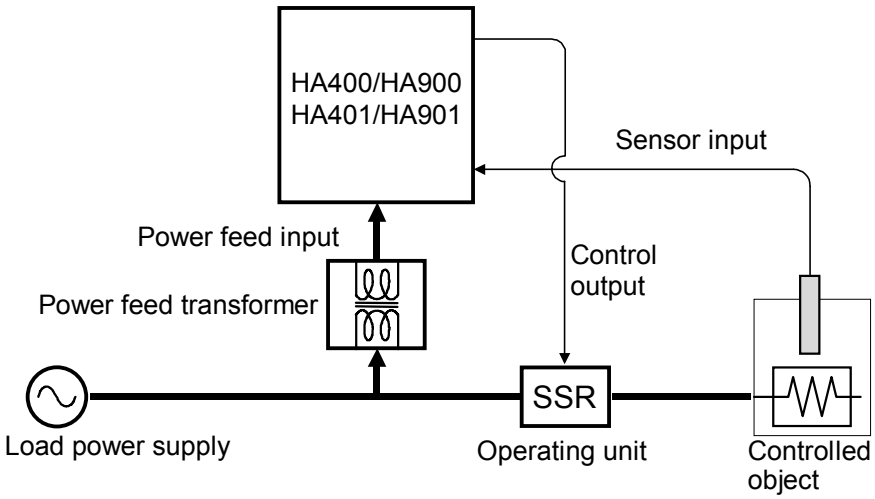
Data range: 0: Unused
1: Used

Factory set value: Input 1_power feed forward selection:
Depends on the model code specified when ordered.
Input 2_power feed forward selection:
Depends on the model code specified when ordered.

Related parameters: Power feed forward gain (P. 190)

Power Feed Forward function:

The power feed forward function monitors the electrical load through a dedicated transformer, and adjusts manipulated output to compensate power supply fluctuation. If the function detects approximately 30 % voltage drop, the controller automatically stops PID control.



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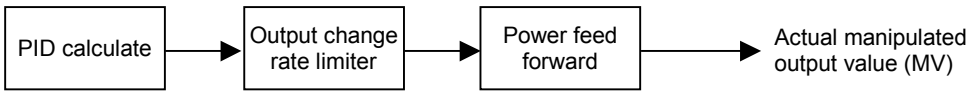
The power feed forward function is used together with the output change rate limiter function, the manipulated output value may exceed the limit of the output change rate limiter.



Relationship between the power feed forward and output change rate limiter

The controller with Power Feed Forward Function (optional) must be used with the dedicated power feed transformer. The controller will not output the manipulated value (MV), if the transformer is not connected to the controller.

This parameter applies only to instruments specified with the power feed forward function (optional) when ordered.

When the power feed forward function is used for two-loop control, the power supply for controlled objects of both loops is required to be common.

Always use the dedicated power feed transformer included.

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

Use to set a bias to move the set value only when autotuning 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

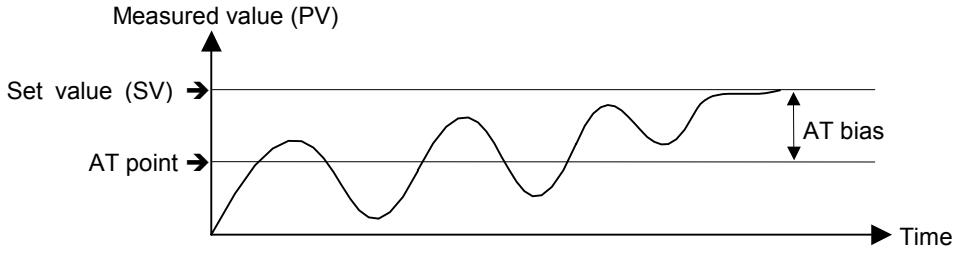
Factory set value: Input 1_AT bias: 0
Input 2_AT bias: 0

Related parameters: PID/AT transfer (P. 104)

Functional description:

The AT bias is used to prevent overshoot during autotuning in the application which does not allow overshoot even during autotuning. RKC autotuning method uses ON/OFF control at the set value to calculate the PID values. However, if overshoot is a concern during autotuning, the desired AT bias should be set to lower the set point during autotuning so that overshoot is prevented.

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



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

Use to select the number of ON/OFF cycles used to calculate PID values during autotuning.

Attribute: R/W (Read and Write)

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

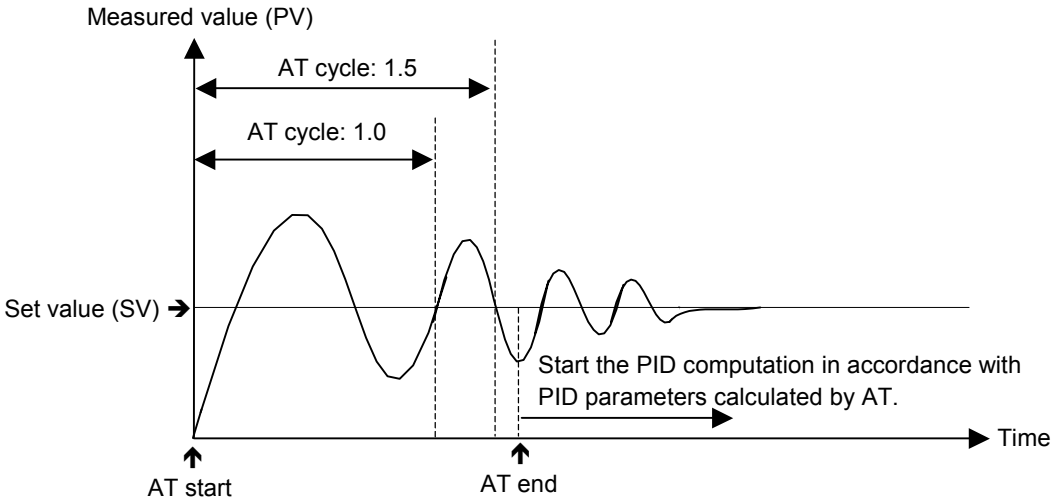
Digits: 7 digits

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

Factory set value: Input 1_AT cycle: 1
Input 2_AT cycle: 1

Related parameters: PID/AT transfer (P. 104)

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	Low-order: 02C6H (710) High-order: 02C7H (711)
Input 2_AT differential gap time	RKC communication identifier	GG
	Modbus register address	Low-order: 02CCH (716) High-order: 02CDH (717)

Use to set an ON/OFF action differential gap time for autotuning. This function 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: Input 1_AT differential gap time: 0.10
Input 2_AT differential gap time: 0.10
HA401/HA901: Input 1_AT differential gap time: 10.00
Input 2_AT differential gap time: 10.00

Related parameters: PID/AT transfer (P. 104)

Functional description:

In order to prevent the output from chattering due to the fluctuation of a measured value (PV) caused by noise during autotuning, the output on or off state is held until "AT differential gap time" has passed after the output on/off state is changed to the other. Set "AT differential gap time" to "1/100 × Time required for temperature rise."

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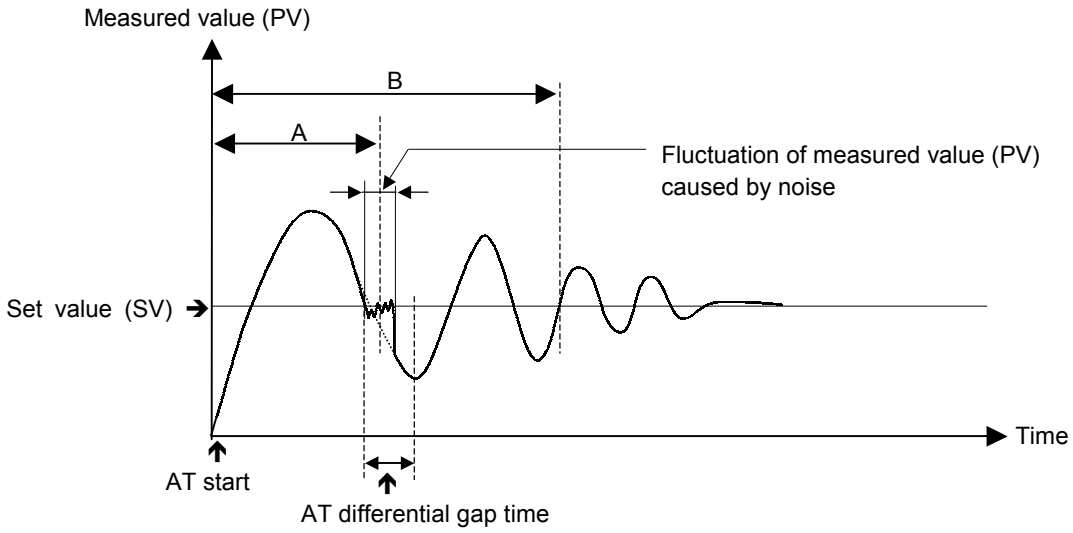
Example:

A: AT cycle time when the AT differential gap time is set to 0.00 second
The output chatters due to the fluctuation of the measured value (PV) caused by noise, and autotuning function is not able to monitor appropriate cycles to calculate suitable PID values.

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 autotuning function is able to monitor appropriate cycles to calculate suitable PID values.



The factory set value of the AT cycle is 2 cycles.

Open/Close output neutral zone	RKC communication identifier	V2
	Modbus register address	Low-order: 02CEH (718) High-order: 02CFH (719)

Use to set Open/Close output neutral zone in position proportioning PID control.

Attribute: R/W (Read and Write)

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

Digits: 7 digits

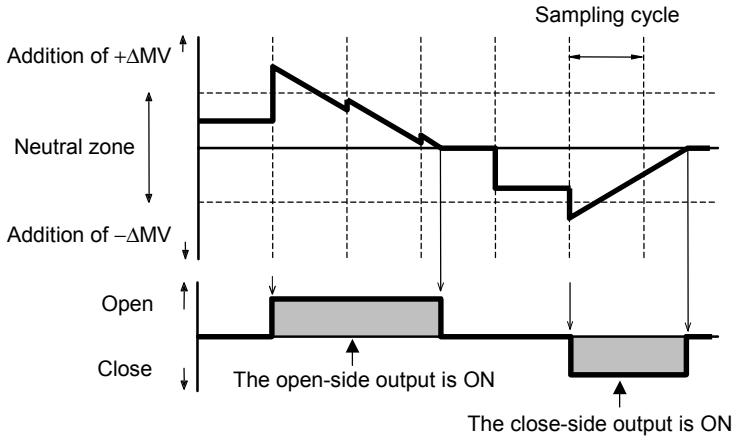
Data range: 0.1 to 10.0 % of output

Factory set value: 10.0

Related parameters: Open/Close output differential gap (P. 182),
Action at feedback resistance (FBR) input error (P. 183),
Feedback adjustment (P. 184)

Open/Close Output Neutral Zone:

The neutral zone is used to prevent a control motor from repeating ON/OFF too frequently. When the PID calculated output value is within the neutral zone, the controller will not output the MV to a control motor.



The controller does not output the MV to a control motor when the PID calculated output value is within the neutral zone.

Open/Close output differential gap	RKC communication identifier	VH
	Modbus register address	Low-order: 02D0H (720) High-order: 02D1H (721)

Use to set 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

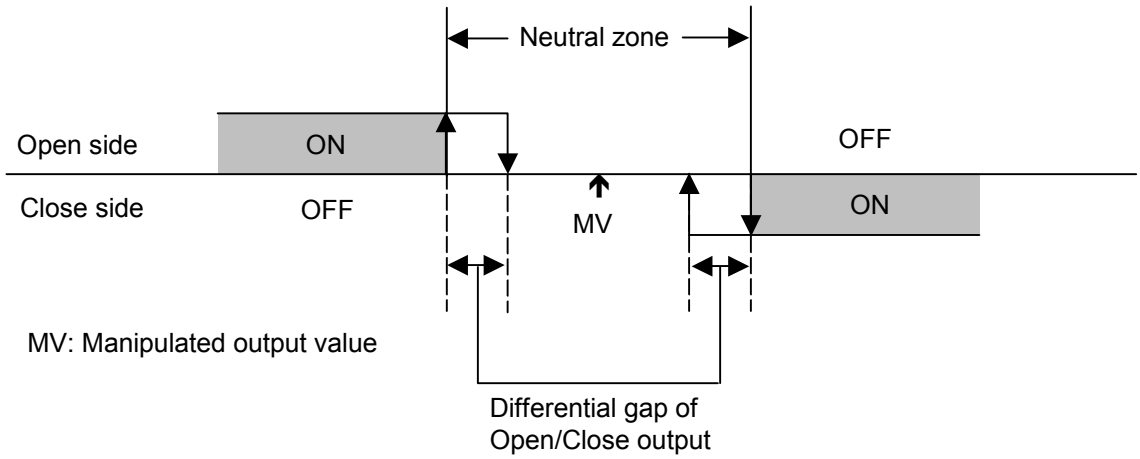
Data range: 0.1 to 5.0 % of output

Factory set value: 0.2

Related parameters: Open/Close output neutral zone (P. 181),
Action at feedback resistance (FBR) input error (P. 183),
Feedback adjustment (P. 184)

Open/Close Output Differential Gap:

The Open/Close output differential gap prevents output ON/OFF chattering caused by fluctuation of feedback resistance input.



Action at feedback resistance (FBR) input error	RKC communication identifier	SY
	Modbus register address	Low-order: 02D2H (722) High-order: 02D3H (723)

Use to select 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: 0

Related parameters: Open/Close output neutral zone (P. 181),
Open/Close output differential gap (P. 182), Feedback adjustment (P. 184)

Feedback adjustment	RKC communication identifier	FV
	Modbus register address	Low-order: 02D4H (724) High-order: 02D5H (725)

Feedback Adjustment function is to adjust controller's output value to match the feedback resistance (FBR) of the control motor. After the adjustment, the manipulated output value of 0 to 100 % obtained after PID computation matches the valve position signal of the fully closed position to the fully opened position [feedback resistance (FBR) input] sent from the control motor. The adjustment have to be completed before starting operation. Always make sure that the wiring is correct and the control motor operates normally before the adjustment.

Attribute: R/W (Read and Write)

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

Digits: 7 digits

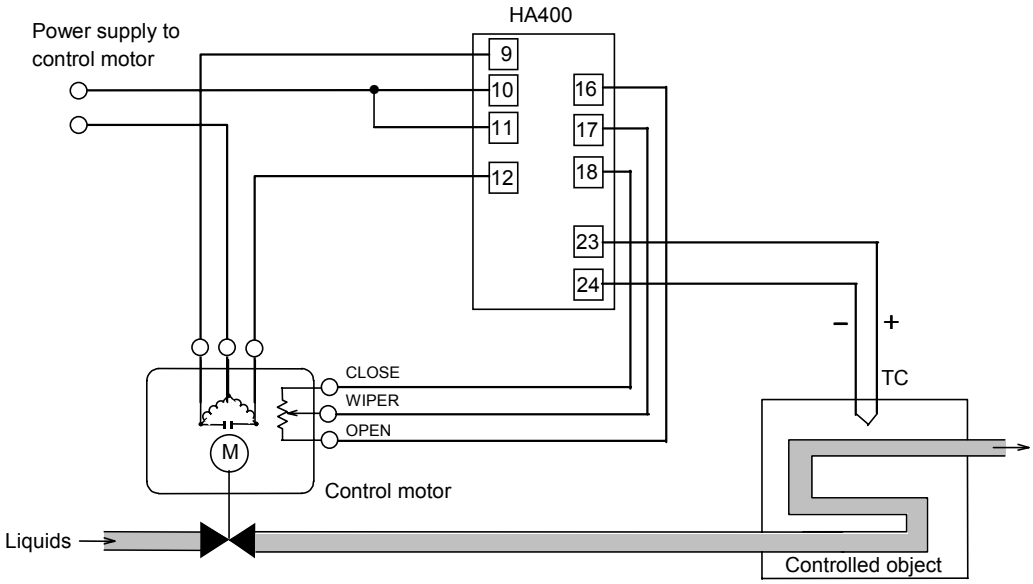
Data range: 0: Adjustment end
1: During the Open-side adjusting
2: During the Close-side adjusting

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.

[Wiring Example]



Setting change rate limiter unit time	RKC communication identifier	HU
	Modbus register address	Low-order: 02D6H (726) High-order: 02D7H (727)

Set the time unit for 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

Related parameters: Setting change rate limiter (up/down) (P. 115)

Soak time unit selection	RKC communication identifier	RU
	Modbus register address	Low-order: 02D8H (728) High-order: 02D9H (729)

Use to select the time unit for 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

Related parameters: Area soak time (P. 117)

Input 1_setting limiter (high)	RKC communication identifier	SH
	Modbus register address	Low-order: 02DAH (730) High-order: 02DBH (731)
Input 2_setting limiter (high)	RKC communication identifier	ST
	Modbus register address	Low-order: 02DEH (734) High-order: 02DFH (735)

Use to set a high limit of the set value.

Attribute: R/W (Read and Write)

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

Digits: 7 digits

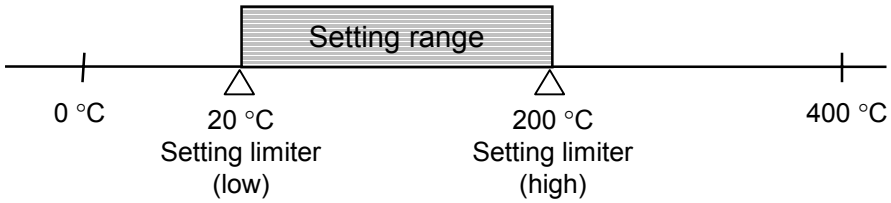
Data range: Setting limiter (low) to Input scale high

Factory set value: Input 1_setting limiter (high): Input 1_input scale high
Input 2_setting limiter (high): Input 2_input scale high

Related parameters: Decimal point position (P. 135), Input scale high (P. 136), Setting limiter (low) (P. 187)

Setting Limiter: Setting Limiter is to set the range of the set value (SV).

Example: The input range (input scale range) is from 0 to 400 °C, the setting limiter (high) is 200 °C, and the setting limiter (low) is 20 °C.



Input 1_setting limiter (low)	RKC communication identifier	SL
	Modbus register address	Low-order: 02DCH (732) High-order: 02DDH (733)
Input 2_setting limiter (low)	RKC communication identifier	SU
	Modbus register address	Low-order: 02E0H (736) High-order: 02E1H (737)

Use to set a low limit of the set value.

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)

Factory set value: Input 1_setting limiter (low): Input 1_input scale low
Input 2_setting limiter (low): Input 2_input scale low

Related parameters: Decimal point position (P. 135), Input scale low (P. 137), Setting limiter (high) (P. 186)

Functional description:

See the setting limiter (high).

ROM version display	RKC communication identifier	VR
	Modbus register address	Low-order: 02E2H (738) High-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	Low-order: 02E4H (740) High-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	Low-order: 02E6H (742) High-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 display	RKC communication identifier	HM
	Modbus register address	Low-order: 02E8H (744) High-order: 02E9H (745)

This value is a monitored value of the power feed forward (PFF) input.

Attribute: RO (Read only)
Digits: 7 digits
Data range: 0.0 to 160.0 %
Display in the percentage of the rated value.
Factory set value: —

Feedback resistance (FBR) input assignment	RKC communication identifier	VG
	Modbus register address	Low-order: 02EA (746) High-order: 02EB (747)

Use to assign the feedback resistance (FBR) input to an input.

Attribute: R/W (Read and Write)
This item becomes RO (Read only) during control RUN.

Digits: 7 digits
Data range: 1: Input 1
2: Input 2
Factory set value: 1
Related parameters: Open/Close output differential gap (P. 182),
Action at feedback resistance (FBR) input error (P. 183),
Feedback adjustment (P. 184)

Input 1_power feed forward gain	RKC communication identifier	PZ
	Modbus register address	Low-order: 02EC (748) High-order: 02ED (749)
Input 2_power feed forward gain	RKC communication identifier	PW
	Modbus register address	Low-order: 02EE (750) High-order: 02EF (751)

Use to set a gain used for the power feed forward (PFF) function. Power Feed Forward gain should not be changed under ordinary operation.

Attribute: R/W (Read and Write)

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

Digits: 7 digits

Data range: 0.01 to 5.00

Factory set value: Input 1_power feed forward gain: 1.00
Input 2_power feed forward gain: 1.00

Related parameters: Power feed forward selection (P. 175)

Functional description:

Power supply voltage variations may give disturbances to the controlled temperature as they make an effect on external devices other than heaters. If in such a case, control stability can be maintained by adjusting the power feed forward gain. Usually, the instrument is used at a gain of 1.00.

📖 Under ordinary operation, it is not necessary to change Power Feed Forward gain set value.

Heater break alarm 1 (HBA1) type selection	RKC communication identifier	ND
	Modbus register address	Low-order: 02F0 (752) High-order: 02F1 (753)
Heater break alarm 2 (HBA2) type selection	RKC communication identifier	NG
	Modbus register address	Low-order: 02F4 (756) High-order: 02F5 (757)

Use to select the heater break alarm type.

Attribute: R/W (Read and Write)

HBA1 type selection (ND) becomes RO (Read only) for no current transformer input 1 (CT1) specification.

HBA2 type selection (NG) becomes RO (Read only) for no current transformer input 2 (CT2) specification.

Digits: 7 digits

Data range: 0: Heater break alarm (HBA) type A
1: Heater break alarm (HBA) type B

Factory set value: Heater break alarm (HBA1) type selection: 1
Heater break alarm (HBA2) type selection: 1

Related parameters: Heater break alarm (HBA) state (P. 100),
Heater break alarm (HBA) set value (P. 119),
Heater break determination point (P. 127),
Heater melting determination point (P. 128), Output logic selection (P. 144),
CT ratio (P. 159), CT assignment (P. 160),
Number of heater break alarm (HBA) delay times (P. 192)

Functional description:

■ Heater break alarm (HBA) type A

Heater Break Alarm (HBA) type A can only be used with time-proportional control output (relay, voltage pulse, or triac output). The HBA function monitors the current flowing through the load by a dedicated current transformer (CT), compares the measured value with the HBA set values, and detects a fault in the heating circuit.

■ Heater break alarm (HBA) type B

Heater Break Alarm (HBA) type B can be used with both continuous control output (current/voltage continuous output) and time-proportional control output (relay, voltage pulse output, or triac). The HBA function assumes that the heater current value is proportional* to the control output value of the controller, otherwise viewed as the manipulated variable (MV), and compare it with the CT input value to detect a fault in the heating or cooling circuit.

* It is assumed that the current value flowing through the load is at maximum when the control output from the controller is 100 %, and the minimum current value flowing through the load is zero (0) when the control output from the controller is 0 %.

Number of heater break alarm 1 (HBA1) delay times	RKC communication identifier	DH
	Modbus register address	Low-order: 02F2 (754) High-order: 02F3 (755)
Number of heater break alarm 2 (HBA2) delay times	RKC communication identifier	DF
	Modbus register address	Low-order: 02F6 (758) High-order: 02F7 (759)

To prevent producing a false alarm, the alarm function waits to produce an alarm status until the measured CT input value is in an alarm range for the preset number of consecutive sampling cycles (HBA sampling cycle time: 500 ms).

Attribute: R/W (Read and Write)

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

Digits: 7 digits

Data range: 0 to 255

Factory set value: Number of heater break alarm 1 (HBA1) delay times: 5
Number of heater break alarm 2 (HBA2) delay times: 5

Related parameters: Heater break alarm (HBA) state (P. 100),
Heater break alarm (HBA) set value (P. 119),
Heater break determination point (P. 127),
Heater melting determination point (P. 128), Output logic selection (P. 144),
CT ratio (P. 159), CT assignment (P. 160),
Heater break alarm (HBA) type selection (P. 191)

Alarm lamp lighting condition setting 1	RKC communication identifier	LY
	Modbus register address	Low-order: 02F8 (760) High-order: 02F9 (761)
Alarm lamp lighting condition setting 2	RKC communication identifier	LZ
	Modbus register address	Low-order: 02FA (762) High-order: 02FB (763)

Use to set an alarm (ALM) lamp lighting conditions to Event 1 to Event 4, HBA1 and HBA2.

Attribute: R/W (Read and Write)

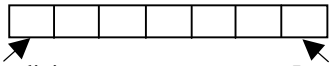
This item becomes RO (Read only) during control RUN.

Digits: 7 digits

Data range: **RKC communication:** ASCII code data of 7 digits

The alarm lamp lighting condition setting 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

[Alarm lamp lighting condition setting 1]
Least significant digit: Event 1
2nd digit: Event 2
3rd digit: Event 3
4th digit: Event 4
5th digit to Most significant digit: Unused

[Alarm lamp lighting condition setting 2]
Least significant digit: HBA1
2nd digit: HBA2
3rd digit to Most significant digit: Unused

Data:
0: ALM lamp is not lit
1: ALM lamp is lit

MODBUS* : 0 to 15 (bit data) 0 to 3 (bit data)

Bit image: 0000 00

bit 3 · · · · bit 0 bit 1 bit 0

[Alarm lamp lighting condition setting 1]
bit 0: Event 1 bit 4 to bit 31: Unused
bit 1: Event 2
bit 2: Event 3
bit 3: Event 4

[Alarm lamp lighting condition setting 2]
bit 0: HBA1
bit 1: HBA2
bit 2 to bit 31: Unused

Bit data:
0: ALM lamp is not lit
1: ALM lamp is lit

* The alarm lamp lighting condition setting is assigned as a bit image in binary numbers.

Factory set value: Event 1 to Event 4: 1 (ALM lamp is lit)
HBA1, HBA2: 1 (ALM lamp is lit)

Related parameters: Output logic selection (P. 144), Output timer setting (P. 146), Event type selection (P. 151)

The alarm lamp is lit through the *OR* operation of Event 1 to Event 4, HBA1 and HBA2 each of which is set to "1: ALM lamp is lit."

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	Low-order: 0500H (1280) High-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	Low-order: 0502H (1282) High-order: 0503H (1283)
Event 2 set value	RKC communication identifier	A2
	Modbus register address	Low-order: 0504H (1284) High-order: 0505H (1285)
Event 3 set value	RKC communication identifier	A3
	Modbus register address	Low-order: 0506H (1286) High-order: 0507H (1287)
Event 4 set value	RKC communication identifier	A4
	Modbus register address	Low-order: 050CH (1292) High-order: 050DH (1293)

Event 1 through Event 4 are set values 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).

Continued on the next page.

Continued from the previous page.

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
Related parameters: Event state (P. 99), Event type selection (P. 151), Event hold action (P. 153), Event differential gap (P. 155), Event action at input error (P. 157), Event assignment (P. 159)

Control loop break alarm 1 (LBA1) time	RKC communication identifier	A5
	Modbus register address	Low-order: 0508H (1288) High-order: 0509H (1289)
Control loop break alarm 2 (LBA2) time	RKC communication identifier	A6
	Modbus register address	Low-order: 050EH (1294) High-order: 050FH (1295)

The LBA time sets the time required for the LBA function to determine there is a loop failure. When the LBA is output (under alarm status), the LBA function still monitors the measured value (PV) variation at an interval of the 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: Unused)
Factory set value: 480
Related parameters: Event state (P. 99), Event assignment (P. 159), LBA deadband (P. 109)

LBA1 deadband	RKC communication identifier	N1
	Modbus register address	Low-order: 050AH (1290) High-order: 050BH (1291)
LBA2 deadband	RKC communication identifier	N2
	Modbus register address	Low-order: 0510H (1296) High-order: 0511H (1297)

The LBA deadband gives a neutral 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
Related parameters: Event state (P. 99), Event assignment (P. 159), Control loop break alarm (LBA) time (P. 109)

Input 1_set value (SV1)	RKC communication identifier	S1
	Modbus register address	Low-order: 0512H (1298) High-order: 0513H (1299)
Input 2_set value (SV2)	RKC communication identifier	S0
	Modbus register address	Low-order: 051EH (1310) High-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 1-input controller.**

Digits: 7 digits
Data range: Setting limiter (low) to Setting limiter (high)
☞ See **Input range table (P. 133)**
Factory set value: Input 1_set value (SV1): 0
Input 2_set value (SV2): 0
Related parameters: Setting limiter (high) (P. 186), Setting limiter (low) (P. 187)

Input 1_proportional band	RKC communication identifier	P1
	Modbus register address	Low-order: 0514H (1300) High-order: 0515H (1301)
Input 2_proportional band	RKC communication identifier	P0
	Modbus register address	Low-order: 0520H (1312) High-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 1-input controller.

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: Input 1_proportional band: 30.0
Input 2_proportional band: 30.0

Related parameters: ON/OFF action differential gap (upper) (P. 168),
ON/OFF action differential gap (lower) (P. 169)

Input 1_integral time	RKC communication identifier	I1
	Modbus register address	Low-order: 0516H (1302) High-order: 0517H (1303)
Input 2_integral time	RKC communication identifier	I0
	Modbus register address	Low-order: 0522H (1314) High-order: 0523H (1315)

Integral action is to eliminate offset between SV and PV by proportional action. The degree of Integral action is set by time in seconds.

Attribute: R/W (Read and Write)

The Input 2_integral time (I0) becomes RO (Read only) for the 1-input controller.

Digits: 7 digits

Data range: 0 to 3600 seconds, 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds
0, 0.0 or 0.00: PD action

Factory set value: Input 1_integral time: 240.00
Input 2_integral time: 240.00

Related parameters: Integral/derivative time decimal point position selection (P. 167)

Input 1_derivative time	RKC communication identifier	D1
	Modbus register address	Low-order: 0518H (1304) High-order: 0519H (1305)
Input 2_derivative time	RKC communication identifier	D0
	Modbus register address	Low-order: 0524H (1316) High-order: 0525H (1317)

Derivative action is to prevent rippling and make control stable by monitoring output change. The degree of Derivative action is set by time in seconds.

Attribute: R/W (Read and Write)

The Input 2_derivative time (D0) becomes RO (Read only) for the 1-input controller.

Digits: 7 digits

Data range: 0 to 3600 seconds, 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds
0, 0.0 or 0.00: PI action

Factory set value: Input 1_derivative time: 60.00
Input 2_derivative time: 60.00

Related parameters: Integral/derivative time decimal point position selection (P. 167)

Input 1_control response parameter	RKC communication identifier	CA
	Modbus register address	Low-order: 051AH (1306) High-order: 051BH (1307)
Input 2_control response parameter	RKC communication identifier	C9
	Modbus register address	Low-order: 0526H (1318) High-order: 0527H (1319)

The control response for the set value (SV) change can be selected among Slow, Medium, and Fast.

Attribute: R/W (Read and Write)

The Input 2_control response parameter (C9) becomes RO (Read only) for the 1-input controller.

Digits: 7 digits

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

Factory set value: Input 1_control response parameter: 0
Input 2_control response parameter: 0

Input 1_ setting change rate limiter (up)	RKC communication identifier	HH
	Modbus register address	Low-order: 052AH (1322) High-order: 052BH (1323)
Input 2_ setting change rate limiter (up)	RKC communication identifier	HX
	Modbus register address	Low-order: 052EH (1326) High-order: 052FH (1327)

This function is to allow the set value (SV) to be automatically changed at specific rates when a new set value (SV).

Attribute: R/W (Read and Write)

The Input 2_setting change rate limiter up (HX) becomes RO (Read only) for the 1-input controller.

Digits: 7 digits

Data range: 0.0 to Input span/unit time * * Unit time: 60 seconds (factory set value)
0.0: OFF (Unused)

Factory set value: Input 1_setting change rate limiter (up): 0.0
Input 2_setting change rate limiter (up): 0.0

Related parameters: Setting change rate limiter unit time (P. 185)

Input 1_ setting change rate limiter (down)	RKC communication identifier	HL
	Modbus register address	Low-order: 052CH (1324) High-order: 052DH (1325)
Input 2_ setting change rate limiter (down)	RKC communication identifier	HY
	Modbus register address	Low-order: 0530H (1328) High-order: 0531H (1329)

This function is to allow the set value (SV) to be automatically changed at specific rates when a new set value (SV).

Attribute: R/W (Read and Write)

The Input 2_setting change rate limiter down (HY) becomes RO (Read only) for the 1-input controller.

Digits: 7 digits

Data range: 0.1 to Input span/unit time * * Unit time: 60 seconds (factory set value)
0.0: OFF (Unused)

Factory set value: Input 1_setting change rate limiter (down): 0.0
Input 2_setting change rate limiter (down): 0.0

Related parameters: Setting change rate limiter unit time (P. 185)

Area soak time	RKC communication identifier	TM
	Modbus register address	Low-order: 0532H (1330) High-order: 0533H (1331)

Area Soak Time is used for ramp/soak control function in conjunction with Link Area Number and Setting Change Rate Limiter (up/down). (see P. 118)

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)
Related parameters: Soak time unit selection (P. 185)

Link area number	RKC communication identifier	LP
	Modbus register address	Low-order: 0534H (1332) High-order: 0535H (1333)

Link Area Number is used for ramp/soak control function in conjunction with Area Soak Time and Setting Change Rate Limiter (up/down) (see P. 118)

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

The area soak time for the memory area linked last becomes invalid to continue the state of the set value (SV) reached.

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 009BH, 0200H to 02FBH, 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
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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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