Module Type Controller

SRX

Communication Instruction Manual

RKC® RKC INSTRUMENT INC.

IMS01N01-E1

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

SYMBOLS

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

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

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

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

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

 : This mark indicates where additional information may be located.

⚠ WARNING

- An external protection device must be installed if failure of this instrument could result in damage to the instrument, equipment or injury to personnel.
- All wiring must be completed before power is turned on to prevent electric shock, fire or damage to instrument and equipment.
- This instrument must be used in accordance with the specifications to prevent fire or damage to instrument and equipment.
- This instrument is not intended for use in locations subject to flammable or explosive gases.
- Do not touch high-voltage connections such as power supply terminals, etc. to avoid electric shock.
- RKC is not responsible if this instrument is repaired, modified or disassembled by other than factory-approved personnel. Malfunction can occur and warranty is void under these conditions.

CAUTION

- This is a Class A instrument. In a domestic environment, this instrument may cause radio interference, in which case the user may be required to take adequate measures.
- This instrument is protected from electric shock by reinforced insulation. Provide reinforced insulation between the wire for the input signal and the wires for instrument power supply, source of power and loads.
- Be sure to provide an appropriate surge control circuit respectively for the following:
  - If input/output or signal lines within the building are longer than 30 meters.
  - If input/output or signal lines leave the building, regardless the length.
- This instrument is designed for installation in an enclosed instrumentation panel. All high-voltage connections such as power supply terminals must be enclosed in the instrumentation panel to avoid electric shock by operating personnel.
- All precautions described in this manual should be taken to avoid damage to the instrument or equipment.
- All wiring must be in accordance with local codes and regulations.
- All wiring must be completed before power is turned on to prevent electric shock, instrument failure, or incorrect action.
  The power must be turned off before repairing work for input break and output failure including replacement of sensor, contactor or SSR, and all wiring must be completed before power is turned on again.
- To prevent instrument damage or failure, protect the power line and the input/output lines from high currents with a protection device such as fuse, circuit breaker, etc.
- Prevent metal fragments or lead wire scraps from falling inside instrument case to avoid electric shock, fire or malfunction.
- Tighten each terminal screw to the specified torque found in the manual to avoid electric shock, fire or malfunction.
- For proper operation of this instrument, provide adequate ventilation for heat dispensation.
- Do not connect wires to unused terminals as this will interfere with proper operation of the instrument.
- Turn off the power supply before cleaning the instrument.
- Do not use a volatile solvent such as paint thinner to clean the instrument. Deformation or discoloration will occur. Use a soft, dry cloth to remove stains from the instrument.
- To avoid damage to instrument display, do not rub with an abrasive material or push front panel with a hard object.
- Do not connect modular connectors to telephone line.

NOTICE

- This manual assumes that the reader has a fundamental knowledge of the principles of electricity, process control, computer technology and communications.
- The figures, diagrams and numeric values used in this manual are only for purpose of illustration.
- RKC is not responsible for any damage or injury that is caused as a result of using this instrument, instrument failure or indirect damage.
- Periodic maintenance is required for safe and proper operation of this instrument. Some components have a limited service life, or characteristics that change over time.
- Every effort has been made to ensure accuracy of all information contained herein. RKC makes no warranty expressed or implied, with respect to the accuracy of the information. The information in this manual is subject to change without prior notice.
- No portion of this document may be reprinted, modified, copied, transmitted, digitized, stored, processed or retrieved through any mechanical, electronic, optical or other means without prior written approval from RKC.

CONTENTS

Page

1. OUTLINE 1

2. COMMUNICATION SPECIFICATIONS 2

3. SETTING PROCEDURE TO OPERATION 4

4. WIRING 6

4.1 Wiring Configuration 6
4.2 Wiring Details 8
4.3 Installation of Termination Resistor 10

5. COMMUNICATION SETTING 14

5.1 Module Address Setting 14
5.2 Protocol Selections and Communication Speed Setting 15
5.3 Communication Time Setting 16
5.4 Communication Requirements 18

6. RKC COMMUNICATION 20

6.1 Protocol 20
6.1.1 Polling 20
6.1.2 Selecting 25
6.1.3 Communication data structure 28
6.1.4 Examples of polling and selecting check programs 30
6.2 Communication Identifier List 34
6.2.1 Data items for normal setting mode 34
6.2.2 Data items for initial setting mode 40

7. MODBUS 43

7.1 Protocol 43
7.1.1 Message format 43
7.1.2 Function code 44
7.1.3 Communication mode 44

Page
7.1.4 Slave responses 45
7.1.5 Calculating CRC-16 46
7.2 Message Format 49
7.2.1 Read holding registers [03H] 49
7.2.2 Preset single register [06H] 50
7.2.3 Diagnostics (Loopback test) [08H] 51
7.2.4 Preset multiple registers [10H] 52
7.3 Data Configuration 53
7.3.1 Data processing with decimal points 53
7.3.2 Data processing precautions 55
7.4 Data Map 56
7.4.1 Normal setting data items 56
7.4.2 Level PID data items 61
7.4.3 Program control data items 62
7.4.4 Initial setting data items 65

8. COMMUNICATION DATA DESCRIPTION 69

8.1 Normal Setting Data Items 70
8.2 Level PID Data Items 93
8.3 Program Control Data Items 96
8.4 Initial Setting Data Items 115

9. TROUBLESHOOTING 128

10. APPENDIX 132

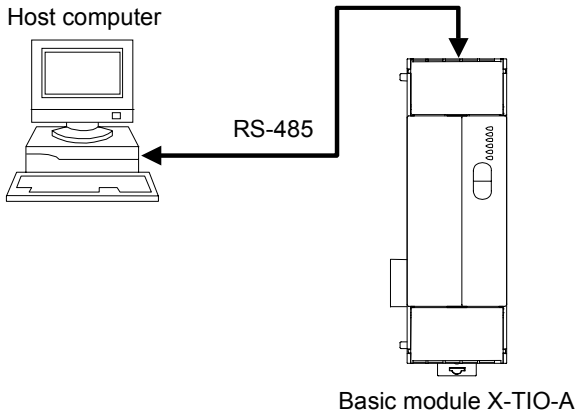
10.1 ASCII 7-bit Code Table 132
10.2 Terminal Configuration 133
10.3 Product Specifications 134

1. OUTLINE

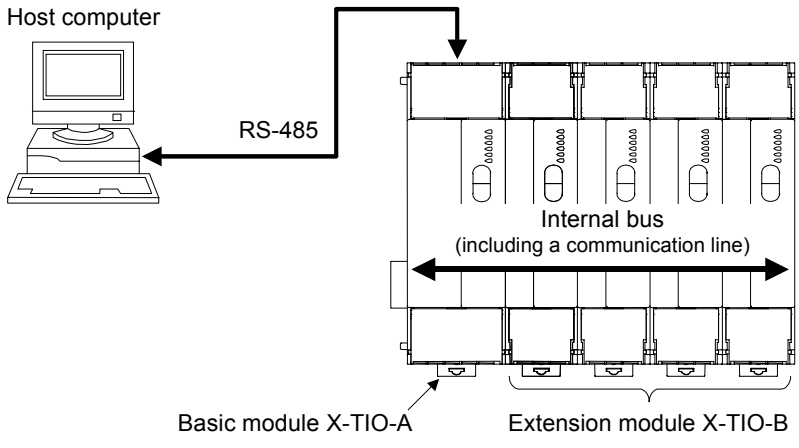
Module type controller SRX interfaces with the host computer via Modbus or RKC communication protocols. The SRX sets all of the data items via communication. Therefore before operation, it is necessary to set value of each data item via communication.

- A user can select RKC communication or Modbus.
- The basic module (X-TIO-A) can communicate independently with the host computer. In addition, as the extension module (X-TIO-B) is not provide with power supply and host communication terminals, communication with the host computer is always made with this module connected to the basic module (X-TIO-A).
- As the communication line passes on the internal bus when the extension module (X-TIO-B) is connected to the basic module (X-TIO-A), no communication wiring for each module is required, thereby being able to achieve wire saving.
- It uses RS-485 as a communication interface and also can connect up to 31 modules.

For reference purposes, the Modbus protocol identifies the host computer as master, each module of SRX as slave.



When connected basic module alone



When connected one or more extension module to basic module

2. COMMUNICATION SPECIFICATIONS

■ RKC communication

Interface: Based on RS-485, EIA standard

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

Synchronous method: Start/stop synchronous type

Communication speed: 2400 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

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:
Basic module: Externally terminal connected
Extension module: Select with the internal switch

Maximum connections: 32 instruments maximum including a host computer

Signal logic: 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.

■ MODBUS

Interface: Based on RS-485, EIA standard

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

Synchronous method: Start/stop synchronous type

Communication speed: 2400 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

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
(An unsupported function code was specified)
2: When the mismatched address is specified.
3: • When the data written exceeds the setting range.
• When the specified number of data items in the query message exceeds the maximum number (1 to 125) of data items available

Termination resistor: Basic module: Externally terminal connected
Extension module: Select with the internal switch

Maximum connections: 32 instruments maximum including a host computer

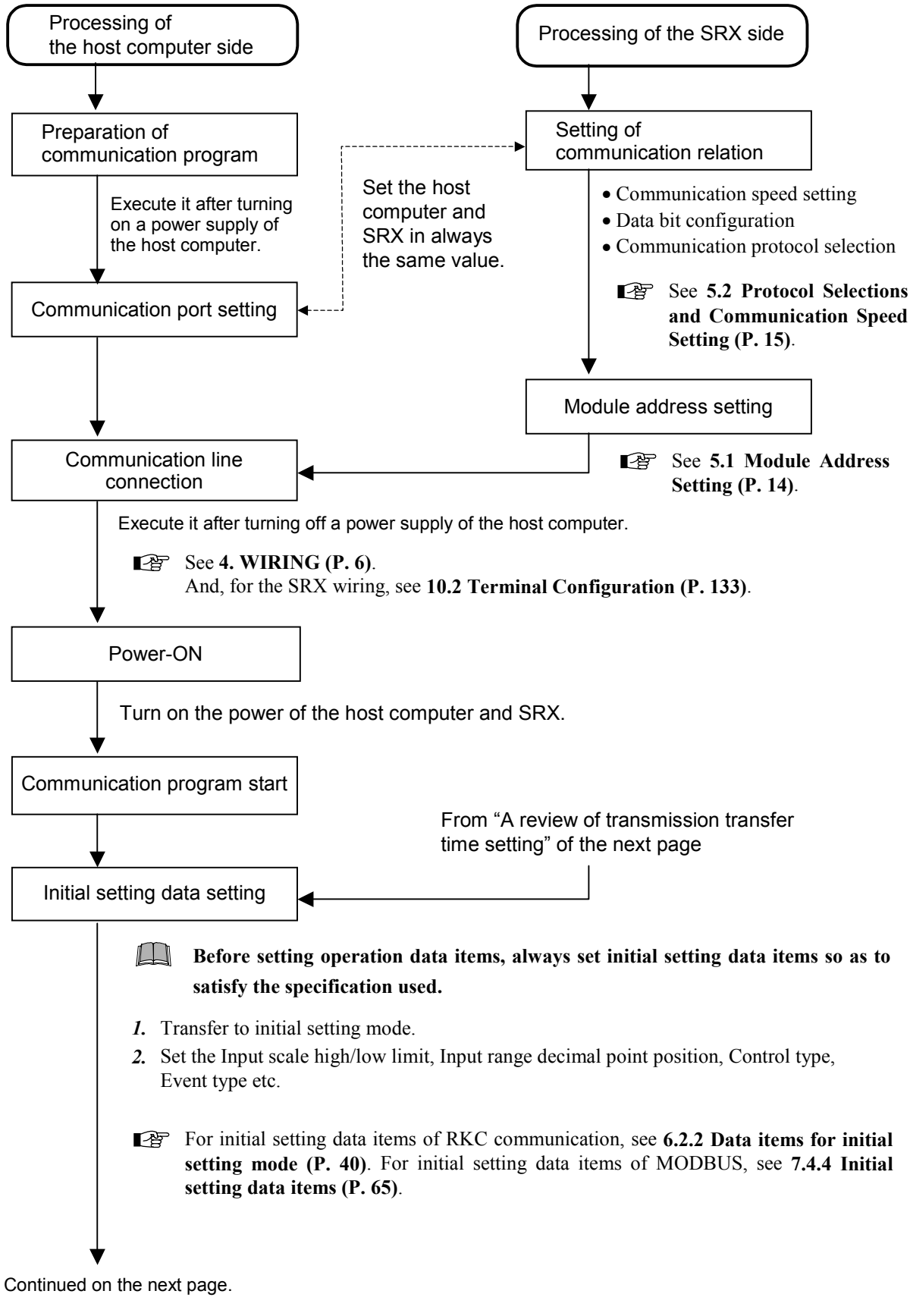
Signal logic: RS-485

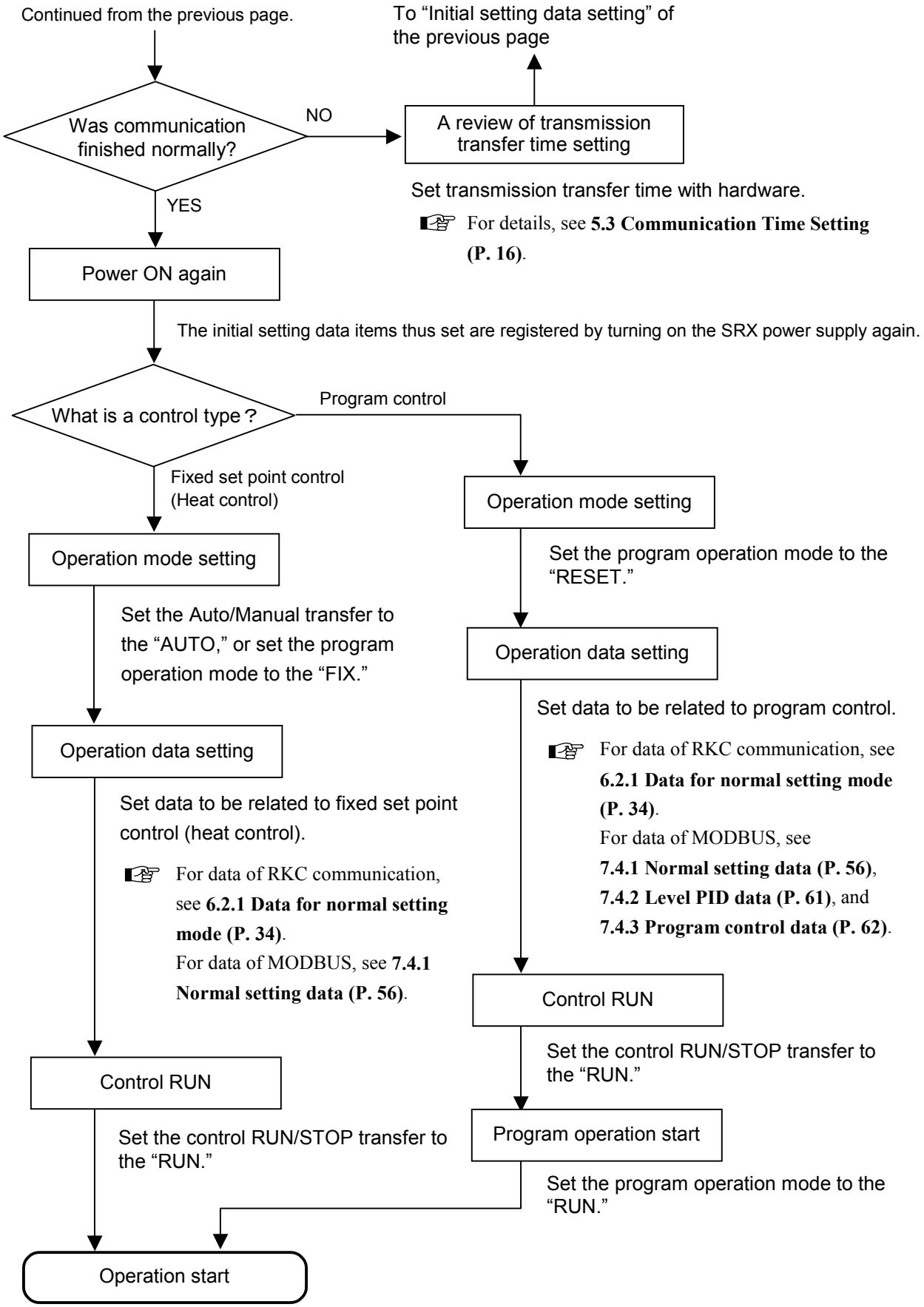
Signal voltage	Logic
V (A) – V (B) ≥ 2 V	0 (SPACE)
V (A) – V (B) ≤ –2 V	1 (MARK)

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

3. SETTING PROCEDURE TO OPERATION

Conduct necessary setting before operation according to the procedure described below.




Continued from the previous page.
To “Initial setting data setting” of the previous page
Was communication finished normally?
NO
A review of transmission transfer time setting
Set transmission transfer time with hardware.
☞ For details, see 5.3 Communication Time Setting (P. 16).
YES
Power ON again
The initial setting data items thus set are registered by turning on the SRX power supply again.
What is a control type ?
Program control
Fixed set point control (Heat control)
Operation mode setting
Set the Auto/Manual transfer to the “AUTO,” or set the program operation mode to the “FIX.”
Operation data setting
Set data to be related to fixed set point control (heat control).
☞ For data of RKC communication, see 6.2.1 Data for normal setting mode (P. 34).
For data of MODBUS, see 7.4.1 Normal setting data (P. 56).
Control RUN
Set the control RUN/STOP transfer to the “RUN.”
Operation start
Operation mode setting
Set the program operation mode to the “RESET.”
Operation data setting
Set data to be related to program control.
☞ For data of RKC communication, see 6.2.1 Data for normal setting mode (P. 34).
For data of MODBUS, see 7.4.1 Normal setting data (P. 56), 7.4.2 Level PID data (P. 61), and 7.4.3 Program control data (P. 62).
Control RUN
Set the control RUN/STOP transfer to the “RUN.”
Program operation start
Set the program operation mode to the “RUN.”

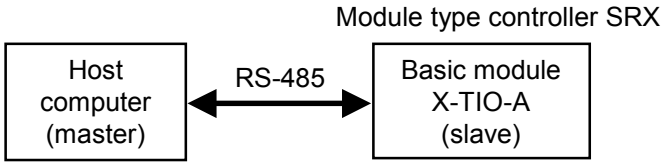
4. WIRING

⚠ WARNING

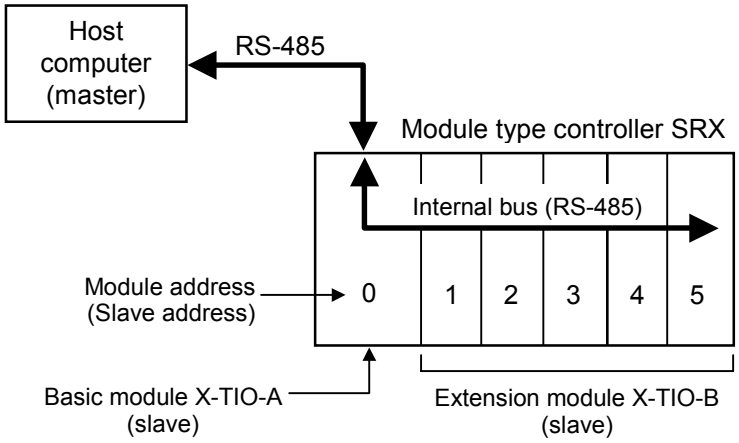
To prevent electric shock or instrument failure, turn off the power before connecting or disconnecting the instrument and peripheral equipment.

4.1 Wiring Configuration

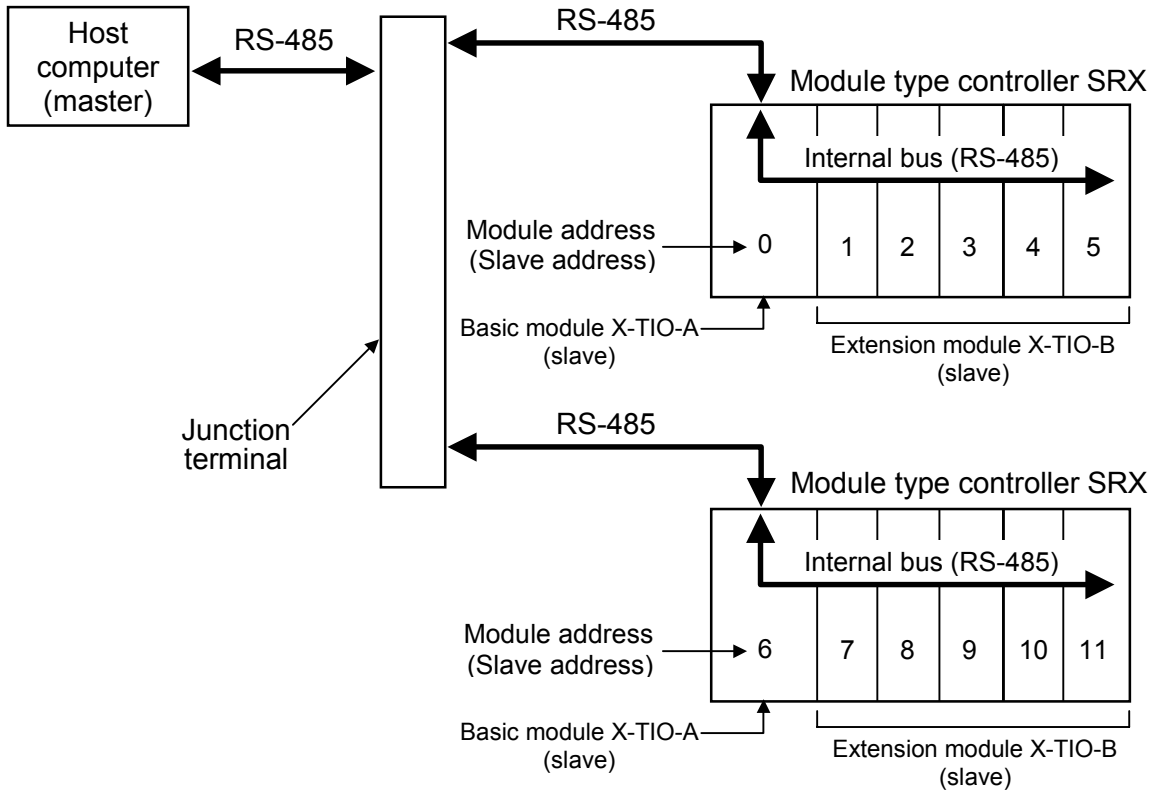
■ **When connected basic module alone**



■ **When two or more extension module are connected to one basic module**



■ When two or more SRX units are connected



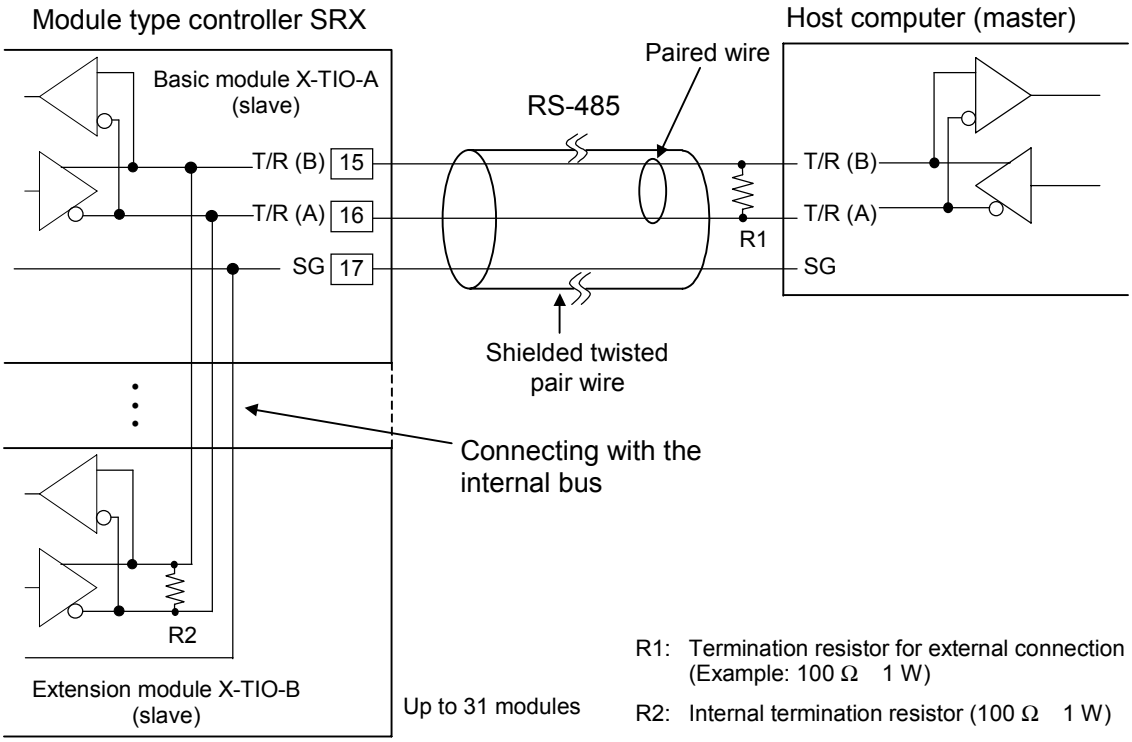
4.2 Wiring Details

■ Terminal number and signal details

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

■ Wiring figure

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

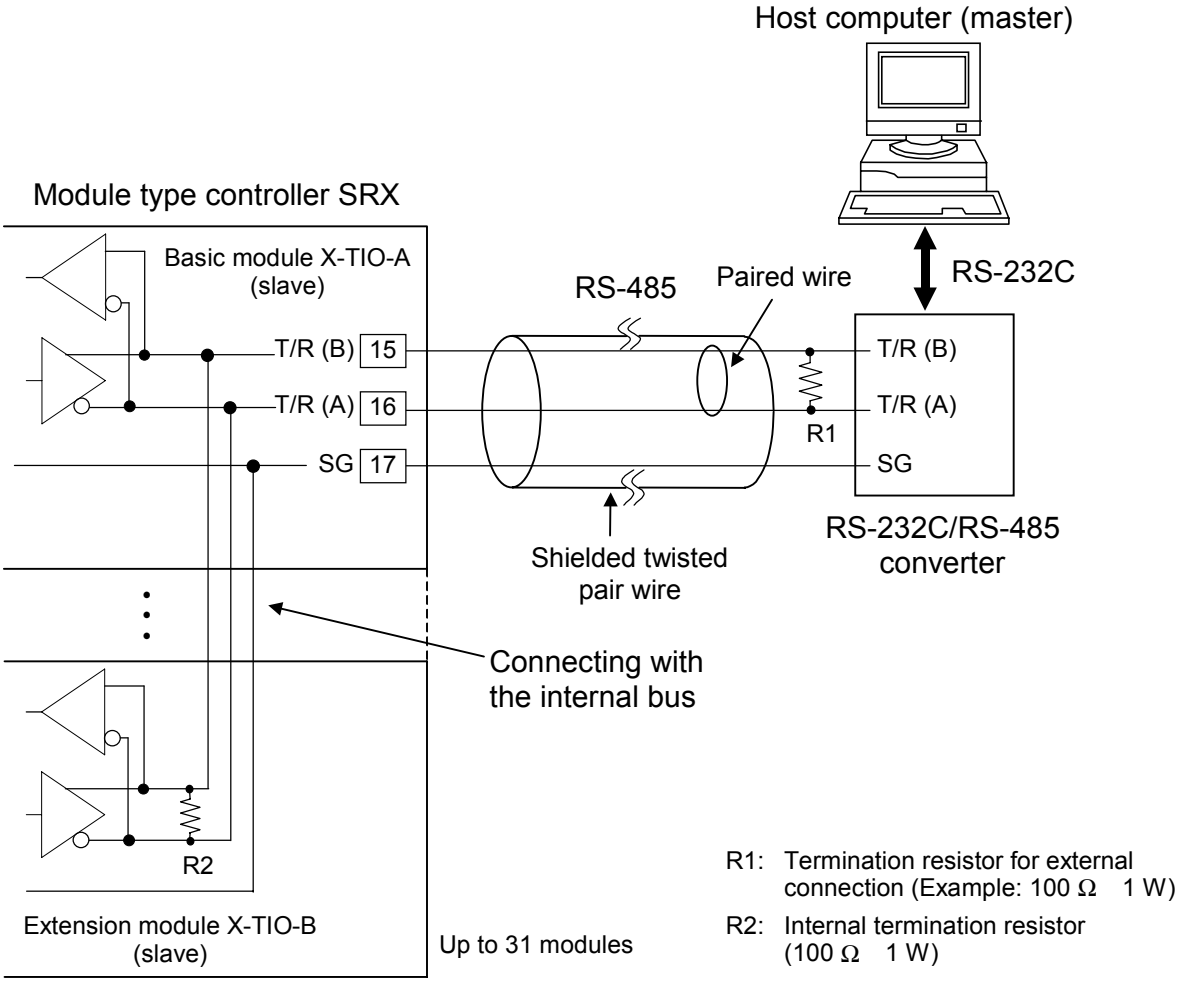


The cable is provided by the customer.

For installation method of termination resistor in the extension module X-TIO-B, see **4.3 Installation of Termination Resistor (P. 10)**.

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

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.

The cable is provided by the customer.

For installation method of termination resistor in the extension module X-TIO-B, see **4.3 Installation of Termination Resistor (P. 10)**.

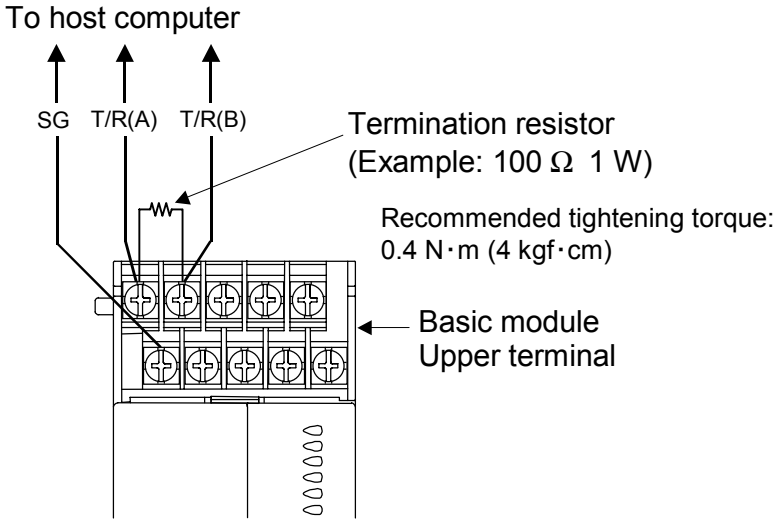
4.3 Installation of Termination Resistor

When a termination resistor is connected to both ends of the RS-485 communication line, a procedure for connecting the termination resistor on the SRX side is described.

For the termination resistor on the host computer side, connect it so as to satisfy the host computer used.

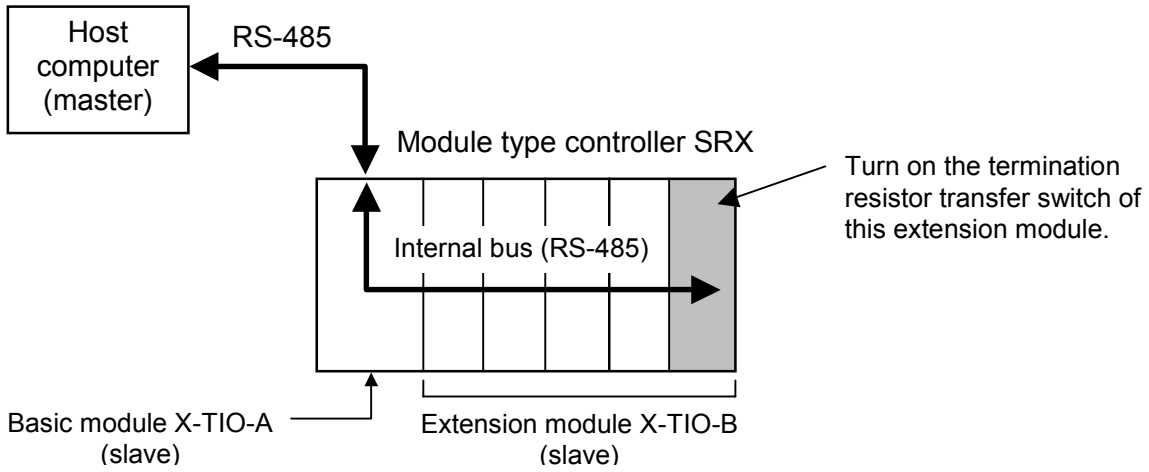
■ When connected basic module alone

Install termination resistor in terminal directly.



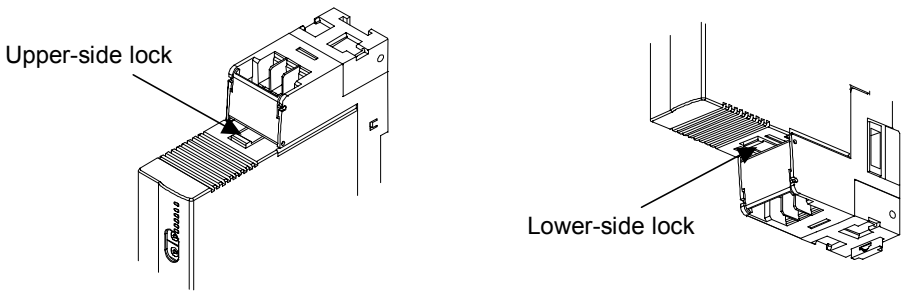
■ When two or more extension module are connected to one basic module

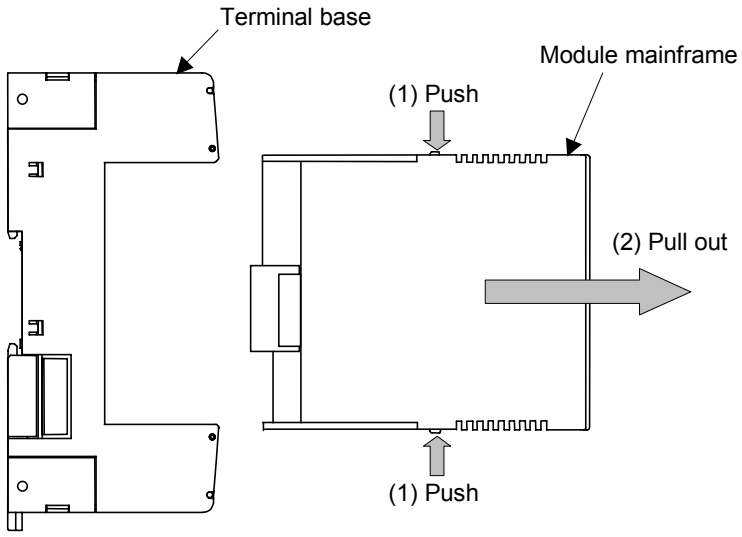
When the extension module is connected to the basic module, it is necessary to connect a termination resistor to the termination of the communication line in the extension module at the extreme end.
A termination resistor is built in the extension module and it can be connected to the circuit by selecting the switch.



- **Transfer procedure of internal termination resistor**

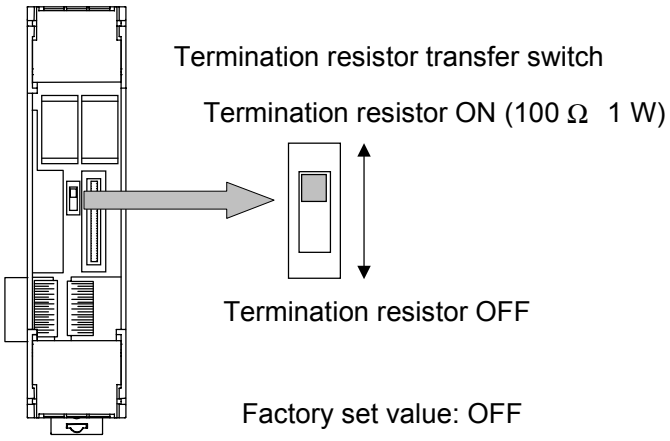
1. Pull out the extension module mainframe itself toward you while pushing the locks at its top and bottom, and then separate it from the terminal base.





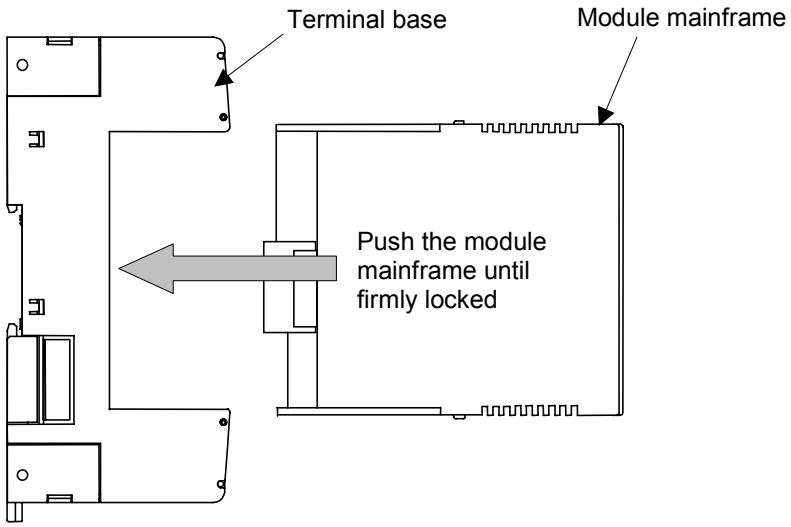
Removing the extension module mainframe

2. Turn on the termination resistor transfer switch in the terminal base.



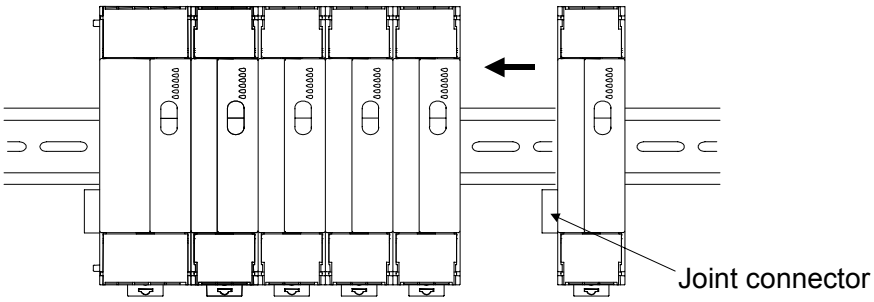
A terminal base of the state which removed extension module mainframe

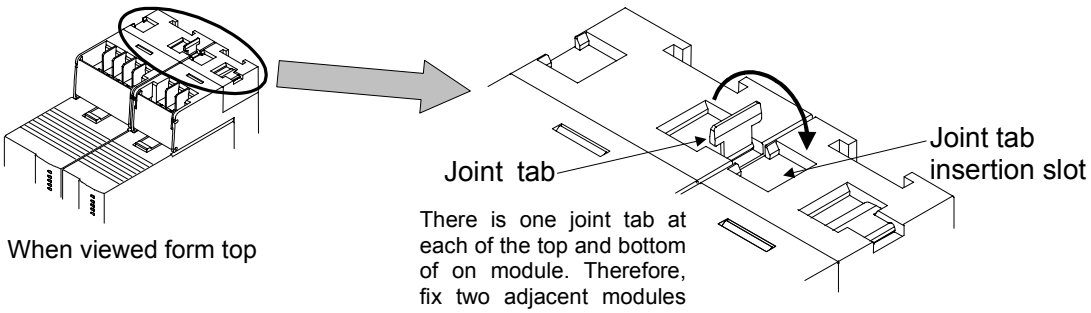
3. Push the extension module mainframe thus separated in the terminal base until firmly locked.



Mounting the extension module mainframe

4. Connect the extension module whose termination resistor transfer switch is turned to the ON position to the right end.
Connect each module using joint connector while sliding the extension module. And, lift each of the joint tabs located at the top and bottom of the module and then insert it in the slot of the adjacent module to fix these two modules.



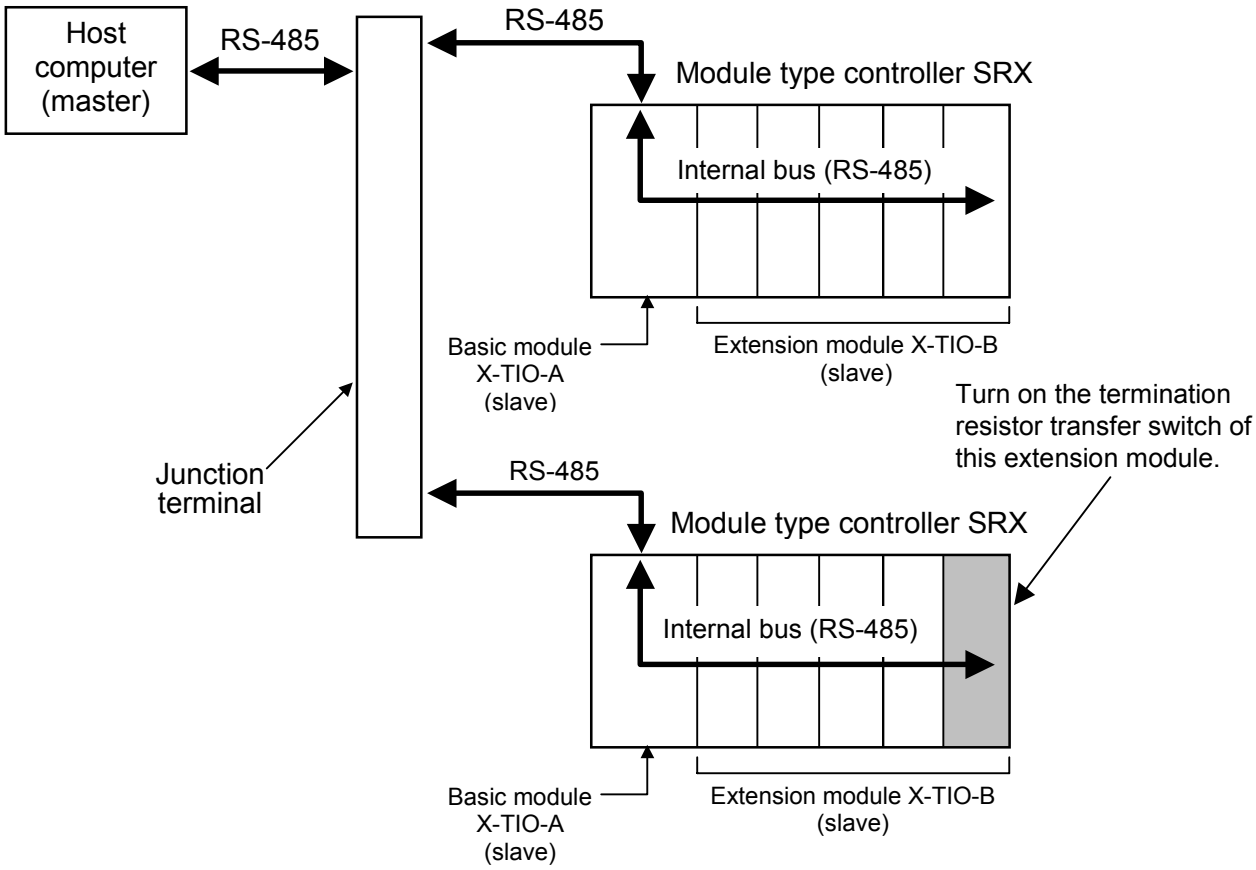


When viewed form top

There is one joint tab at each of the top and bottom of on module. Therefore, fix two adjacent modules with these two joint tabs.

■ When two or more SRX units are connected

When two or more SRX units (consisting of one basic module and several extension modules) are connected, it is necessary to connect a termination resistor to the termination of the communication line in the extension module located most distantly from the host computer (master). A termination resistor is built in the extension module and it can be connected to the circuit by selecting the switch.



☞ For the termination resistor installation of extension module, see ■**When two or more extension module are connected to one basic module (P. 10)**.

5. COMMUNICATION SETTING

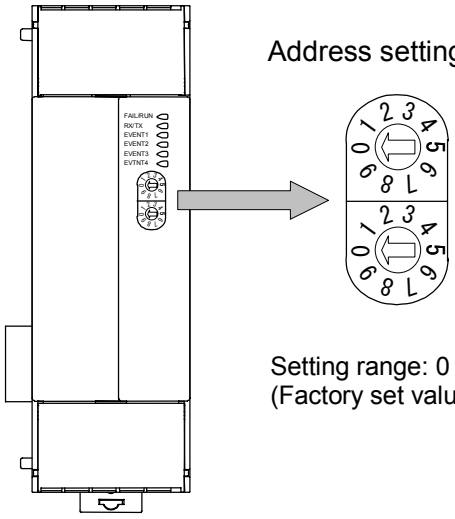
⚠ WARNING

- To prevent electric shock or instrument failure, always turn off the power before setting the switch.
- To prevent electric shock or instrument failure, never touch any section other than those instructed in this manual.

Set the following communication setting before operation.

5.1 Module Address Setting

When using two or more modules, set the desired address to each module.
Set the module address by address setting switches of front of module. For this setting, use a small blade screwdriver.



Address setting switch

High-order digit setting
(set value × 10)

Low-order digit setting
(set value × 1)

Setting range: 0 to 99
(Factory set value: 00)

For Modbus, the value obtained by adding "1" to the set address corresponds to the address used for the actual program.

Set the module address such that it is different to the other addresses on the same line. Otherwise, problems or malfunction may result.

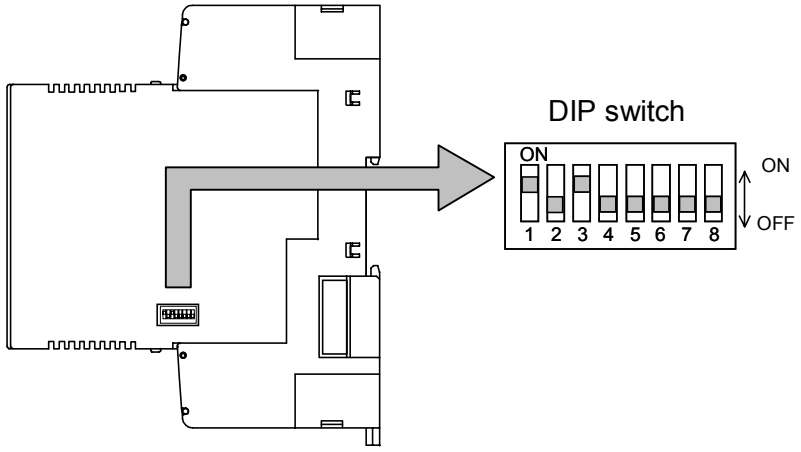
When two or more extension module are connected to one basic module, set the smallest address number to that basic module.

The above figure is basic module. The figure of expansion module is the same as a basic module.

5.2 Protocol Selections and Communication Speed Setting

With the DIP switch which there is on the right side of module, select communication speed, data bit configuration and protocol.

When two or more modules are connected on the same line, turn each switch in the DIP switches of all of the modules to the same position. Otherwise the module may fail or malfunction.



Right side view

1	2	Communication speed
OFF	OFF	2400 bps
ON	OFF	9600 bps
OFF	ON	19200 bps
ON	ON	38400 bps

Factory set value: 9600 bps

3	4	5	Data bit configuration
OFF	OFF	OFF	Data 7-bit, without parity
OFF	OFF	ON	Data 7-bit, Even parity
OFF	ON	ON	Data 7-bit, Odd parity
ON	OFF	OFF	Data 8-bit, without parity
ON	OFF	ON	Data 8-bit, Even parity
ON	ON	ON	Data 8-bit, Odd parity

Factory set value: Data 8-bit, without parity

6	Protocol selection
OFF	RKC communication
ON	MODBUS

Factory set value: RKC communication

Switch No. 7, 8: OFF fixed (Do not change this one)

5.3 Communication Time Setting

There are transmission transfer time and data interval extension time (MODBUS).

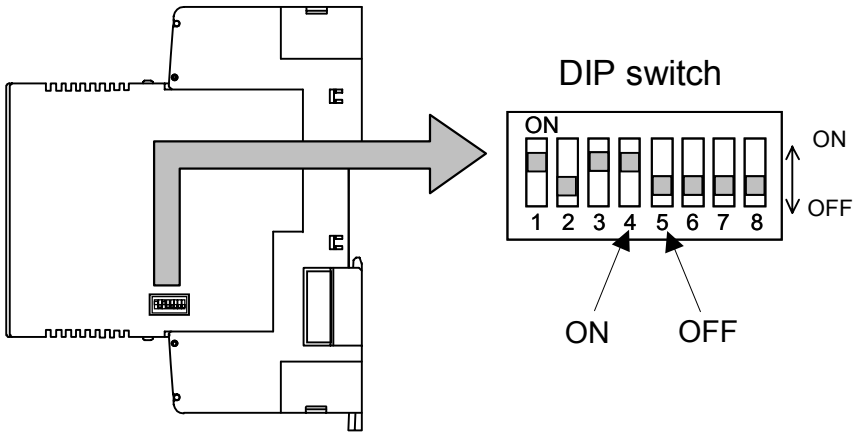
Transmission transfer time: The sending and receiving of RS-485 communication is conducted through two wires; consequently, the transmission and reception of data requires precise timing. Then, set the desired transmission transfer time to secure the time until the transmission line is changed to data receiving after the host computer ends its sending.

☞ See **5.4 Communication Requirements (P. 18)**.

Data interval extension time: For MODBUS, a data time interval is set to less than 24 bits' time. However, it may become more than 24 bits' time depending on the type of master. In that case, extend the data time interval in the range of 0 to 99 ms.

● Setting procedure of communication time

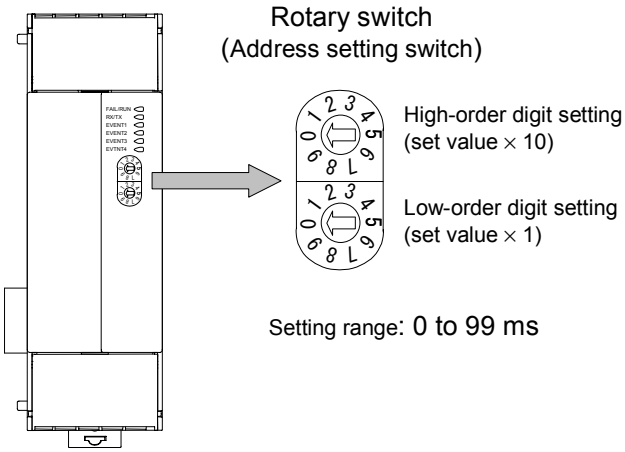
1. Set the module to the communication time setting mode by turning No. 4 switch in the DIP switch at the right side to the ON position and No. 5 switch in the same DIP switch to the OFF position with the power supply turned off. At this time the module is set to the transmission transfer time setting mode with No. 6 switch turned to the OFF position or to the data interval extension time setting mode with No. 6 switch turned to the ON position.
Switch Nos. other than Nos. 4, 5 and 6 may be turned to any of ON/OFF positions.



Right side view

4	5	6	Communication Time Setting
ON	OFF	OFF	Transmission transfer time
		ON	Data interval extension time

2. Set "Transmission transfer time" or "Data interval extension time" by the rotary switches (address setting switches) at the front. Set the tens digit by the upper rotary switch, while units digit, by the lower rotary switch.



3. Under the above condition, turn on the SRX power supply. The FAIL/RUN lamp lights in green to make the time thus set valid.

4. Turn the power supply off, and then return the DIP and rotary switches to their original positions to end the setting.

5.4 Communication Requirements

■ Processing times during data send/receive

The SRX 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 SRX to send data:

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

RKC communication (Polling procedure)

Procedure details	Time
Response send time after SRX receives ENQ	5 ms max.
Response send time after SRX receives ACK	5 ms max.
Response send time after SRX receives NAK	5 ms max.
Response wait time after SRX sends BCC	1 ms max.

RKC communication (Selecting procedure)

Procedure details	Time
Response send time after SRX receives BCC	5 ms max. *
Response wait time after SRX sends ACK	1 ms max.
Response wait time after SRX sends NAK	1 ms max.

MODBUS

Procedure details	Time
Read holding registers [03H] Response send time after the slave receives the query message	5 ms max.
Preset single register [06H] Response send time after the slave receives the query message	5 ms max. *
Diagnostics (loopback test) [08H] Response send time after the slave receives the query message	5 ms max.
Preset multiple register [10H] Response send time after the slave receives the query message	5 ms max. *

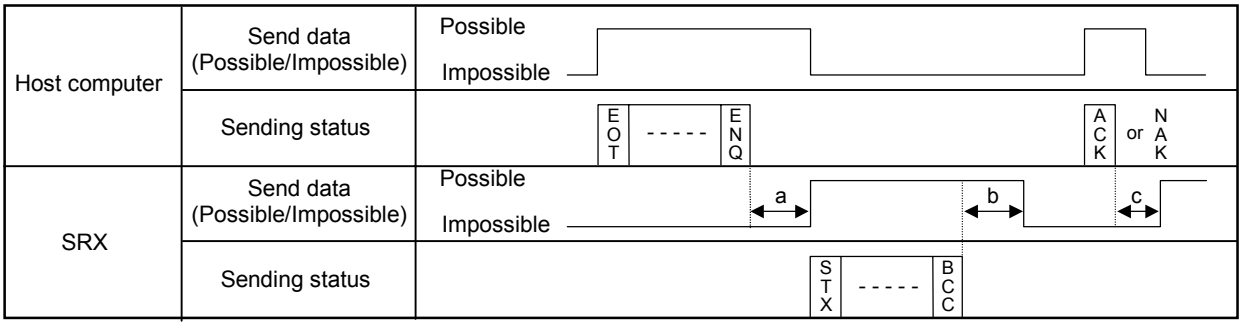
* When the following data items are set, the maximum response sending time becomes 200 ms.
Input rang number, Input scale high limit, Input scale low limit, Input range decimal point position, Temperature unit selection, Event 1 type selection, Event 2 type selection

Only 1 port uses communication port, and response send time is time at having set transmission transfer time in 0 ms.

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

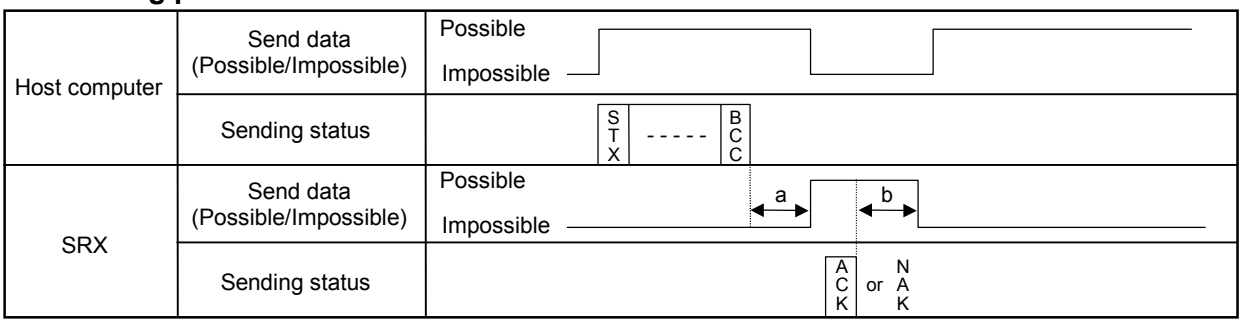
The sending and receiving of RS-485 communication is conducted through two wires; consequently, the transmission and reception of data requires precise timing.

● Polling procedure



a: Response send time after SRX receives ENQ + Transmission transfer time
b: Response wait time after SRX sends BCC
c: Response send time after SRX receives ACK + Transmission transfer time or
Response send time after SRX receives NAK + Transmission transfer time

● Selecting procedure



a: Response send time after SRX receives BCC + Transmission transfer time
b: Response wait time after SRX sends ACK or Response wait time after SRX 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 SRX to send data:
-Response wait time after SRX sends BCC in polling procedure
-Response wait time after SRX sends ACK or NAK in selecting procedure

■ Fail-safe

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

6. RKC COMMUNICATION

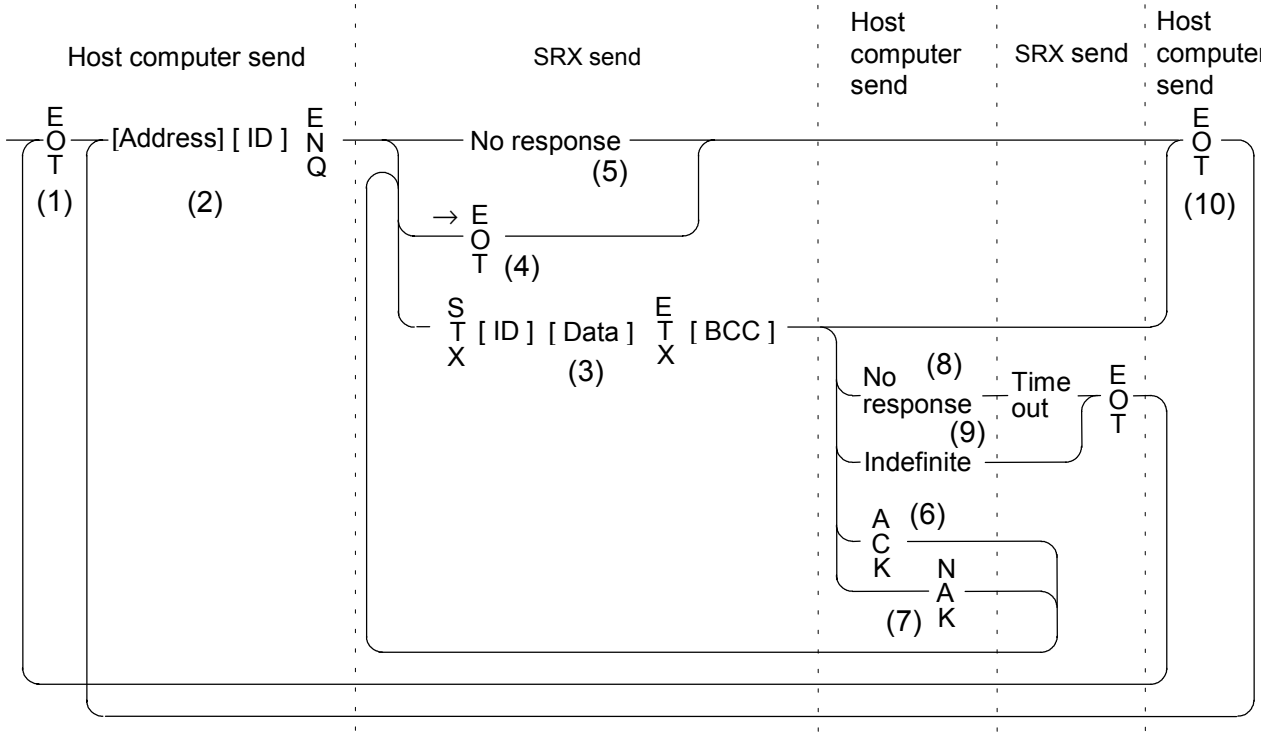
6.1 Protocol

RKC communication 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 SRX).

- 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.
  Transmission control characters used in SRX:
  EOT (04H), ENQ (05H), ACK (06H), NAK (15H), STX (02H), ETX (03H)
  ( ): Hexadecimal

6.1.1 Polling

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



ID: Identifier

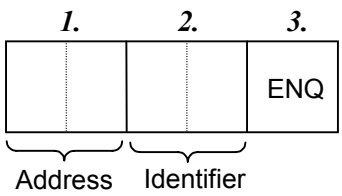
■ Polling procedures

(1) Data link initialization

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

(2) Data sent from host computer - Polling sequence

Host computer sends polling sequence with the format shown below:



Example:

0	2	M	1	ENQ

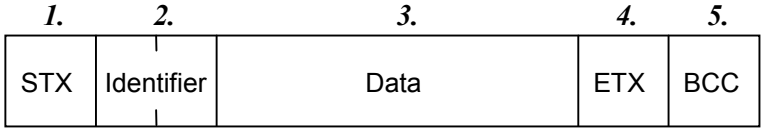
1. Address (2 digits)
This data is a module address of the SRX for polled and must be the same as the module address set value in item **5.1 Module Address Setting (P. 14).**

2. Identifier (2 digits)
The identifier specifies the type of data that is requested from the SRX. Always attach the ENQ code to the end of the identifier.
☞ See **6.2 Communication Identifier List (P. 34)**.

3. ENQ
The ENQ is the transmission control character that indicates the end of the polling sequence. The host computer then must wait for a response from the SRX.

(3) Data sent from the SRX

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



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

2. Identifier (2 digits)
The identifier indicates the type of data (measured value, status and set value) sent to the host computer.
☞ See **6.2 Communication Identifier List (P. 34)**

Continued on the next page.

3. Data

Data which is indicated by an identifier of SRX, consisting of channel numbers, data, etc. Each channel number and data are delimited by a space (20H). The data and the next channel number are delimited by a comma.

- Channel number: 2-digit ASCII code, not zero-suppressed. Channels without channel numbers may exist depending on the type of identifier.
- Data: ASCII code, zero-suppressed with spaces (20H). The number of digits varies depending on the type of identifier.

☞ See **6.1.3 Communication data structure (P. 28)**

4. ETX

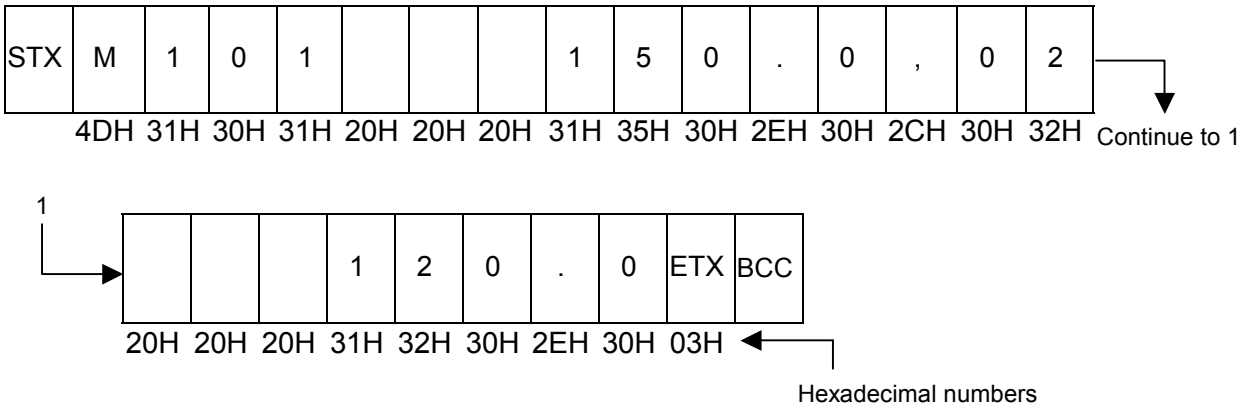
Transmission control character indicating the end of the text.

5. BCC

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

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

Example:



BCC = 4DH ⊕ 31H ⊕ 30H ⊕ 31H ⊕ 20H ⊕ 20H ⊕ 20H ⊕ 31H ⊕ 35H ⊕ 30H ⊕ 2EH ⊕ 30H ⊕ 2CH ⊕ 30H ⊕ 32H ⊕ 20H ⊕ 20H ⊕ 20H ⊕ 31H ⊕ 32H ⊕ 30H ⊕ 2EH ⊕ 30H ⊕ 03H

= 57H

(⊕: *Exclusive OR*)

Value of BCC becomes 57H

(4) EOT send (Ending data transmission from the SRX)

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

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

(5) No response from the SRX

The SRX 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 SRX receives ACK from the host computer, the SRX will send any remaining data of the next identifier without additional action from the host computer. When ACK was sent in succession, identifier data item down to "No.58 Step action" in the communication identifier list are sent. However, no level PID data items are included.

☞ For the identifier, see **6.2 Communication Identifier List (P. 34)**.

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 SRX, it sends a negative acknowledgment NAK to the SRX. The SRX 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 SRX sends data, the SRX sends EOT to terminate the data link (time-out time: about 3 seconds).

(9) Indefinite response from host computer

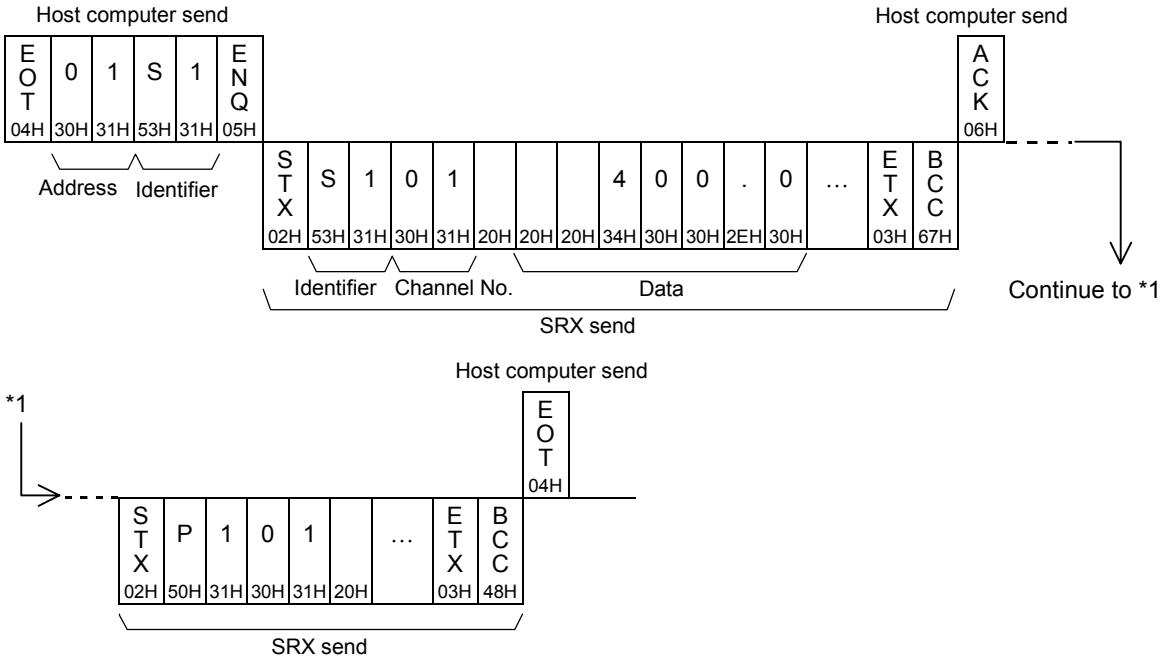
The SRX sends EOT to terminate the data link when the host computer response is indefinite.

(10) EOT (Data link termination)

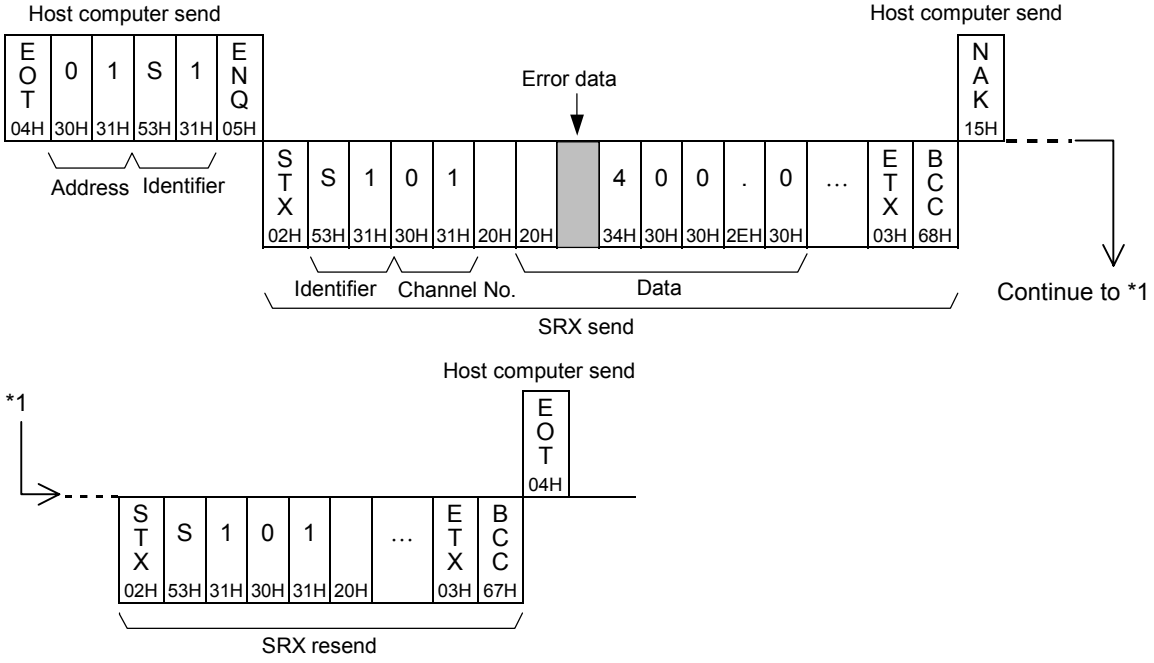
The host computer sends EOT message when it is necessary to suspend communication with the SRX or to terminate the data link due lack of response from the SRX.

■ Polling procedure example (When the host computer requests data)

● Normal transmission

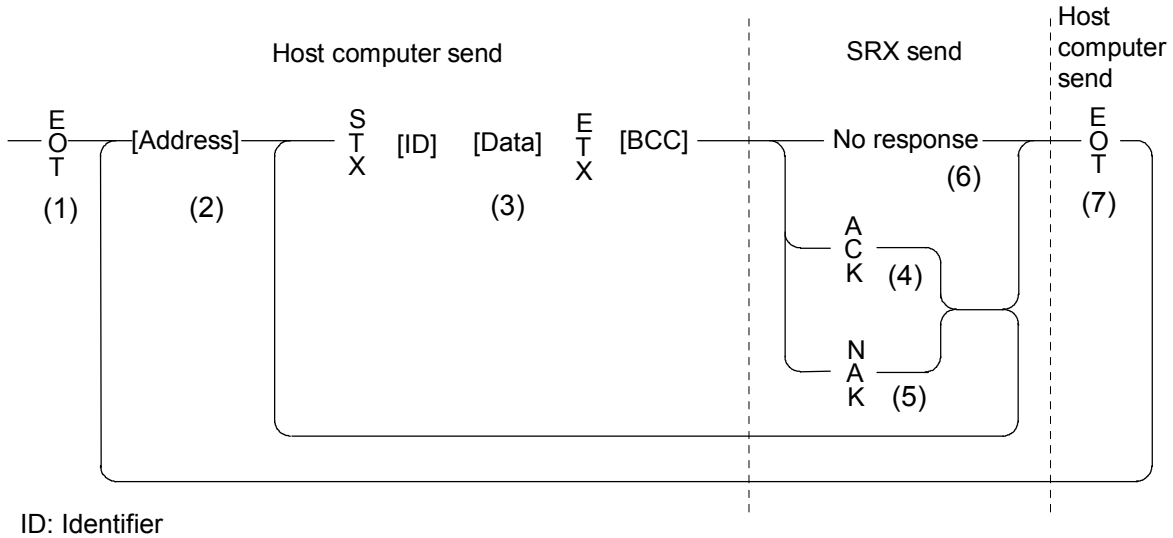


● Error transmission



6.1.2 Selecting

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



ID: Identifier

■ Selecting procedures

(1) Data link initialization

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

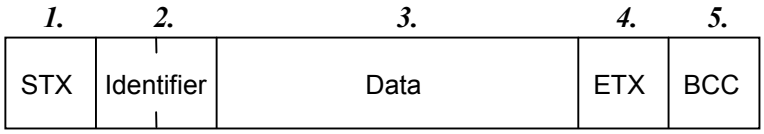
(2) Sending selecting address from the host computer

Host computer sends selecting address for the selecting sequence.

Address (2 digits):
This data is a unit address of the SRX to be selected and must be the same as the unit address set value in item **5.1 Module Address Setting (P. 14)**.

(3) Data sent from the host computer

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



☞ Details for *1* to *5*, see **6.1.1 Polling (P. 20)**.

(4) ACK (Acknowledgment)

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

(5) NAK (Negative acknowledge)

In the following cases, the SRX sends NAK. Then the appropriate recovery processing steps should be taken, such as resending the data on the host computer side.

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

(6) No response from SRX

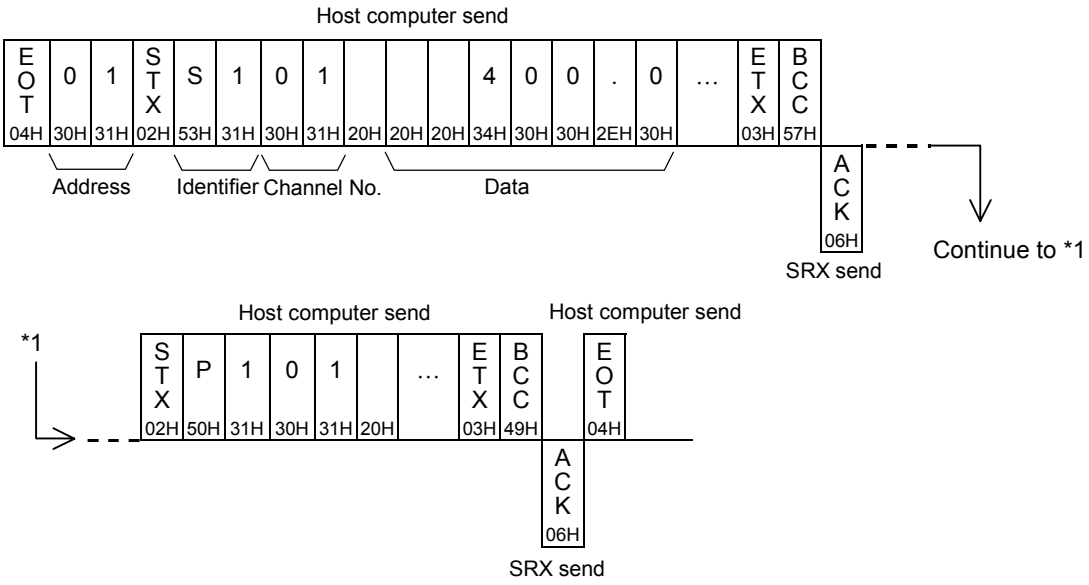
The SRX does not respond when it cannot receive the selecting address, STX, ETX or BCC.

(7) EOT (Data link termination)

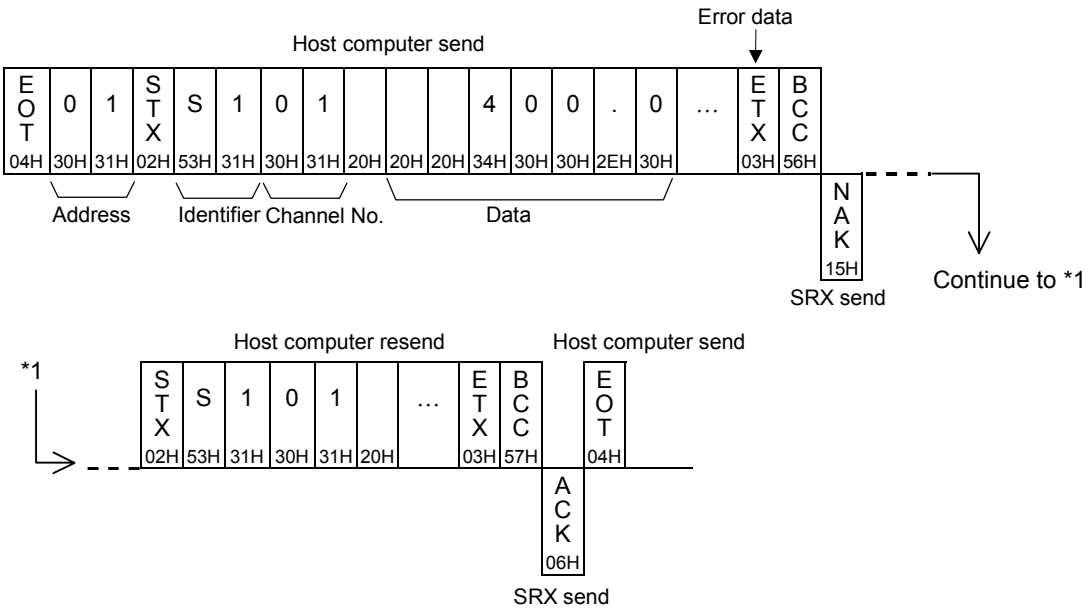
The host computer sends EOT when there is no more data to be sent from the host computer or there is no response from the SRX.

■ Selecting procedure example (when the host computer sends data)

● Normal transmission

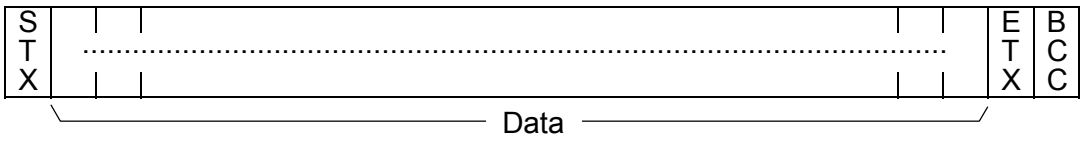


● Error transmission



6.1.3 Communication data structure

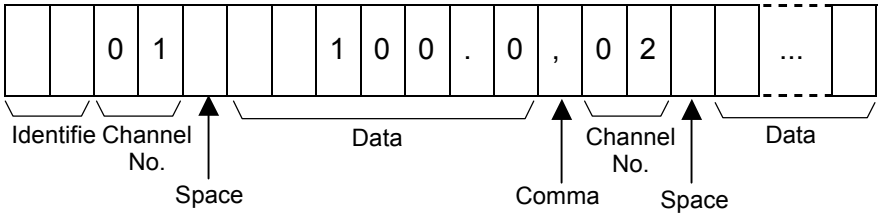
■ Data description (Transmission/receive data structure)



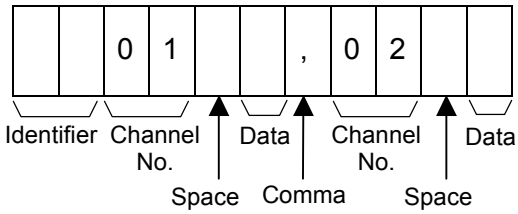
Part of the data above is shown below.

- **Data for each channel**

Data length 7 digits

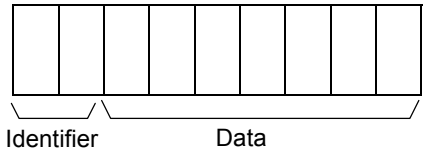


Data length 1 digit

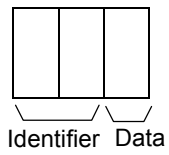


- **Data for each module (Without channel)**

Data length 7 digits



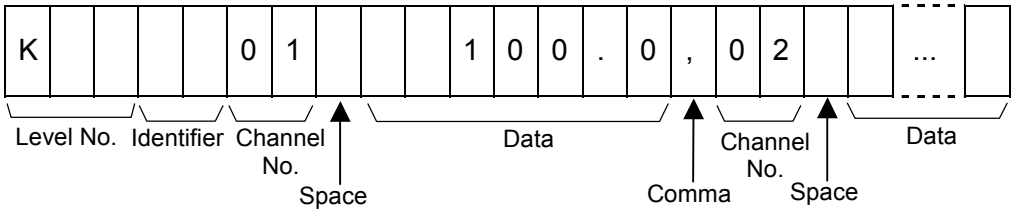
Data length 1 digit



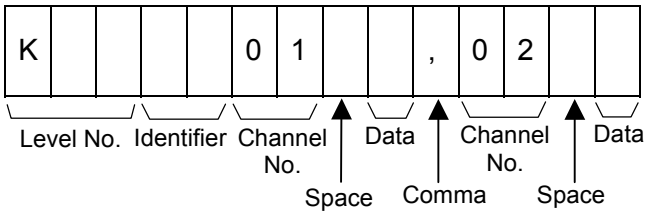
Continued on the next page.

● **Data for level PID**

Data length 7 digits



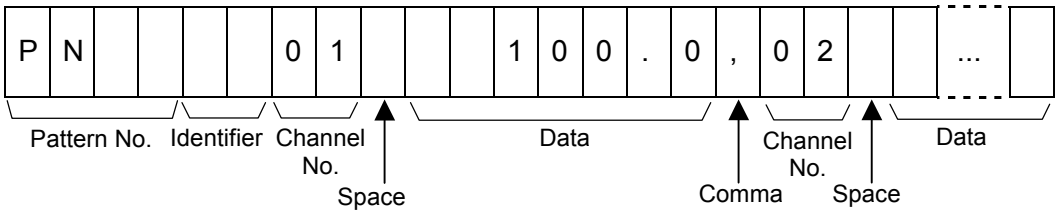
Data length 1 digit



● **Data for program control**

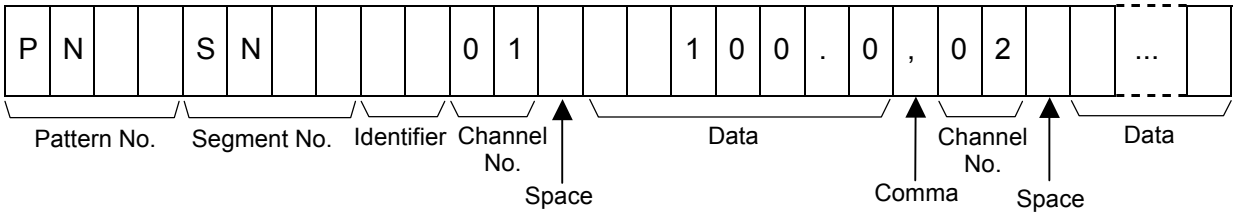
• **Pattern group**

Data length 7 digits



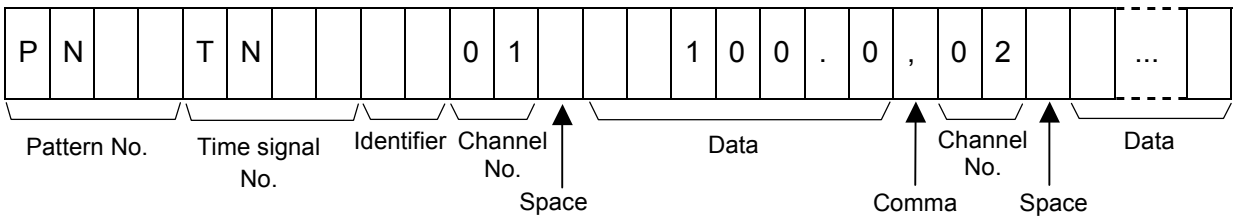
• **Segment group**

Data length 7 digits



• **Time signal group**

Data length 7 digits



6.1.4 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.)

■ 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 " Module address=";ADD$                                        Module 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
```

■ 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 "Module No.=";ADD$:INPUT "Channel No.=";C$   Input of the Module and channel number,
          :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 "Module 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
```

6.2 Communication Identifier List

6.2.1 Data items for normal setting mode

RO: Read only R/W: Read and Write

No.	Name	Identifier	Attribute	Data range	Factory set value	Reference page
1	Measured value (PV)	**M1**	RO	Input scale low limit to Input scale high limit	—	P. 70
2	Comprehensive event status	**AJ**	RO	0 to 31 (Bit data) b0: Burnout b1: Event 1 status b2: Event 2 status b3: Heater break alarm status b4: Control loop break alarm (LBA) status b5 to b7: Unused	—	P. 70
3	Burnout status	**B1**	RO	0: OFF 1: ON	—	P. 71
4	Event 1 status	**AA**	RO	0: OFF 1: ON	—	P. 71
5	Event 2 status	**AB**	RO	0: OFF 1: ON	—	P. 71
6	Heater break alarm (HBA) status	**AC**	RO	0: OFF 1: Heater break 2: Relay welding	—	P. 72
7	Control loop break alarm (LBA) status	**AP**	RO	0: OFF 1: ON	—	P. 72
8	Manipulated output value	**O1**	RO	−5.0 to +105.0 %	—	P. 72
9	Current transformer input measured value	**M3**	RO	0.0 to 30.0 A or 0.0 to 100.0 A	—	P. 73
10	Set value monitor	**MS**	RO	Input scale low limit to Input scale high limit	—	P. 73
11	Error code (Data of each module)	**ER**	RO	0 to 255 (Bit data) b0: Memory backup error b1: Unused b2: Unused b3: Adjustment data error b4: Input A/D error b5: Current transformer input A/D error b6: Temperature compensation A/D error b7: Unused	—	P. 74

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No.	Name	Identifier	Attribute	Data range	Factory set value	Reference page
12	Set value (SV)	**S1**	R/W	Input scale low limit to Input scale high limit	0	P. 74
13	Proportional band	**P1**	R/W	TC/RTD input: 0 (0.0) to Input span Voltage (V)/Current (I) input: 0.0 to 1000.0 % of input span 0 (0.0): ON/OFF action	TC/RTD: 10.0 °C V/I: 10.0 %	P. 75 P. 94
14	Integral time	**I1**	R/W	0.1 to 3600.0 seconds 0.01 to 360.00 seconds	40.00	P. 75 P. 94
15	Derivative time	**D1**	R/W	0.0 to 3600.0 seconds 0.00 to 360.00 seconds 0.0 (0.00): Derivative action OFF (PI action)	10.00	P. 75 P. 94
16	Control response parameters	**CA**	R/W	0: Slow 1: Medium 2: Fast	0	P. 76 P.95
17	PV bias	**PB**	R/W	−Input span to +Input span	0	P. 77
18	Event 1 set value	**A1**	R/W	Deviation high/Deviation low: −Input span to +Input span Deviation high/low, Band: 0 to Input span	0	P. 77
19	Event 2 set value	**A2**	R/W	Process high/Process low: Input scale low limit to Input scale high limit	0	P. 77
20	Operation mode	**EI**	R/W	0: Unused 1: Monitor 1 2: Monitor 2 3: Control	3	P. 78
21	Level PID high limit set value	**PW**	R/W	Input scale low limit to Input scale high limit	Input scale high limit	P. 95
22	PID/AT transfer	**G1**	R/W	0: PID control operation 1: AT (Autotuning) operation	0	P. 79
23	Auto/Manual transfer	**J1**	R/W	0: Auto mode 1: Manual mode	0	P. 80
24	Manual output value	**ON**	R/W	Within output limiter	0.0	P. 80
25	Output limiter (high limit)	**OH**	R/W	Output limiter (low limit) to 105.0 %	100.0	P. 81

Continued on the next page.

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
26	Output limiter (low limit)	**OL**	R/W	–5.0 % to Output limiter (high limit)	0.0	P. 81
27	Proportional cycle time	**T0**	R/W	0.2 to 50.0 seconds	2.0	P. 81
28	Digital filter	**F1**	R/W	0.00 to 10.00 seconds 0.00: Digital filter OFF	0.00	P. 81
29	Heater break alarm (HBA) set value	**A3**	R/W	0.0 to 30.0 A or 0.0 to 100.0 A	0.0	P. 82
30	Number of heater break alarm (HBA) delay times	**DH**	R/W	1 to 255 times	5	P. 83
31	Hot/cold start selection	**XN**	R/W	0: Hot start 1 1: Hot start 2 2: Cold start 1 3: Cold start 2	0	P. 83
32	Start determination point	**SX**	R/W	0 to Input span	0.0	P. 84
33	Control RUN/STOP transfer (Data of each module)	**SR**	R/W	0: Control STOP 1: Control RUN	0	P. 84
34	Input error determination point (high limit)	**AV**	R/W	Input scale low limit to Input scale high limit	Input scale high limit	P. 85
35	Input error determination point (low limit)	**AW**	R/W	Input scale low limit to Input scale high limit	Input scale low limit	P. 85
36	Action at input error (high limit)	**WH**	R/W	0: Normal control 1: Manipulated output value at input error	0	P. 85
37	Action at input error (low limit)	**WL**	R/W	0: Normal control 1: Manipulated output value at input error	0	P. 85
38	Manipulated output value at input error	**OE**	R/W	Within output limiter	0.0	P. 86
39	AT differential gap time	**GH**	R/W	0.00 to 50.00 seconds	0.10	P. 87
40	AT bias	**GB**	R/W	–Input span to +Input span	0	P. 88
41	Remote/Local transfer	**C1**	R/W	0: Local mode 1: Remote mode	0	P. 88

Continued on the next page.

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No.	Name	Identifier	Attribute	Data range	Factory set value	Reference page
42	Event LED mode setting (Data of each module)	**XH**	R/W	1: Mode 1 2: Mode 2 3: Mode 3 10: Mode 10 11: Mode 11 12: Mode 12 13: Mode 13 Except the above: Unused	0	P. 89
43	Reserve	**R1**	—	—	—	—
44	Reserve	**E1**	—	—	—	—
45	Reserve	**R2**	—	—	—	—
46	Reserve	**E2**	—	—	—	—
47	Program operation mode selection	**XM**	R/W	0: RESET 1: RUN (Program control) 2: FIX (Fixed set point control) 3: MAN (Manual control)	2	P. 99
48	Execution pattern	**PS**	R/W	1 to 16	1	P. 100
49	Execution segment	**SN**	RO	1 to 16	—	P. 100
50	Segment remaining time	**TR**	RO	0.00 to 300.00 seconds 0.0 to 3000.0 seconds 0 to 30000 seconds 0 to 30000 minutes	—	P. 101
51	Number of program execution times	**RT**	RO	0 to 9999 times	—	P. 101
52	Time signal output status 1	**T8**	RO	0 to 255 (Bit data) b0: Time signal 1 output status b1: Time signal 2 output status b2: Time signal 3 output status b3: Time signal 4 output status b4: Time signal 5 output status b5: Time signal 6 output status b6: Time signal 7 output status b7: Time signal 8 output status	—	P. 102

Continued on the next page.

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
53	Time signal output status 2	**T9**	RO	0 to 255 (Bit data) b0: Time signal 9 output status b1: Time signal 10 output status b2: Time signal 11 output status b3: Time signal 12 output status b4: Time signal 13 output status b5: Time signal 14 output status b6: Time signal 15 output status b7: Time signal 16 output status	—	P. 102
54	Pattern end output status	**EO**	RO	0: Pattern end output OFF 1: Pattern end output ON	—	P. 103
55	End status	**EN**	RO	0: End status OFF 1: End status ON	—	P. 103
56	Wait status	**WT**	RO	0: Wait status OFF 1: Wait status ON	—	P. 103
57	Hold status	**HO**	R/W	0: Hold status OFF 1: Hold status ON	0	P. 104
58	Step action	**SK**	R/W	0: Not step action 1: Step action execution	0	P. 105
59	Setting of the number of program execution times (Pattern group)	**RR**	R/W	1 to 1000 times 1000: Number of infinite times	1	P. 106
60	End segment (Pattern group)	**PE**	R/W	1 to 16	16	P. 106
61	Link pattern (Pattern group)	**LP**	R/W	0 to 16 0: Not link pattern	0	P. 107
62	Pattern end output time (Pattern group)	**ET**	R/W	0.00 to 300.00 seconds 0.0 to 3000.0 seconds 0 to 30000 seconds 0 to 30000 minutes	0.00	P. 108
63	Wait zone (Pattern group)	**ZW**	R/W	0 to Input span	0.0	P. 109
64	Segment level (Segment group)	**LE**	R/W	Input scale low limit to Input scale high limit	0	P. 110
65	Segment time (Segment group)	**TM**	R/W	0.00 to 300.00 seconds 0.0 to 3000.0 seconds 0 to 30000 seconds 0 to 30000 minutes	0.00	P. 110
66	Time signal output number (Time signal group)	**RE**	R/W	0 to 16 0: Not time signal output	0	P. 111

Continued on the next page.

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
67	Time signal ON segment (Time signal group)	**SO**	R/W	1 to 16	1	P. 112
68	Time signal ON time (Time signal group)	**TO**	R/W	0.00 to 300.00 seconds 0.0 to 3000.0 seconds 0 to 30000 seconds 0 to 30000 minutes	0.00	P. 112
69	Time signal OFF segment (Time signal group)	**SF**	R/W	1 to 16	1	P. 113
70	Time signal OFF time (Time signal group)	**TF**	R/W	0.00 to 300.00 seconds 0.0 to 3000.0 seconds 0 to 30000 seconds 0 to 30000 minutes	0.00	P. 113
71	Program operation start mode	**SS**	R/W	0: Zero start 1: PV start 1 2: PV start 2	0	P. 114
72	Control loop break alarm (LBA) use selection	**HP**	R/W	0: Unused 1: Used	0	P. 90
73	Control loop break alarm (LBA) time	**C6**	R/W	1 to 7200 seconds	480	P. 90
74	Control loop break alarm (LBA) deadband	**V2**	R/W	0 to Input span	0	P. 91
75	Integral/derivative time decimal point position	**PK**	R/W	0: 2 digits below decimal point 1: 1 digit below decimal point	0	P. 92
76	Initial setting mode (Data of each module)	**IN**	R/W	0: Normal setting mode 1: Initial setting mode	0	P. 92

6.2.2 Data items for initial setting mode

CAUTION

Initial setting data items are those set initially so as meet the operation condition of the module but unnecessary to be changed afterward as far as the module is normally used. In addition, if they are changed unnecessarily, the module may result in malfunction or failure. Even if it malfunctions or fails caused by their unnecessary changes, RKC will not bear any responsibility for its malfunction or failure.

■ Transfer to initial setting mode.

Transfer to initial setting mode sets in "1" with identifier IN (normally setting mode).

The instrument cannot be changed to the initial setting mode state at control start (during control). If it needs to be changed to the above state, first stop the control by "Control RUN/STOP transfer."

No control can be started during initial setting mode. If the control needs to be re-started, first change the instrument the normal setting mode state (set identifier "IN" by 0).

No.	Name	Identifier	Attribute	Data range	Factory set value	Reference page
1	Input range number	**XI**	R/W	TC input: 0: K −200 to +1372 °C or −328 to +2501 °F 1: J −200 to +1200 °C or −328 to +2192 °F 2: R −50 to +1768 °C or −58 to +3000 °F 3: S −50 to +1768 °C or −58 to +3000 °F 4: B 0 to 1800 °C or 32 to 3000 °F 5: E −200 to +1000 °C or −328 to +1832 °F 6: N 0 to 1300 °C or 32 to 2372 °F 7: T −200 to +400 °C or −328 to +752 °F 8: W5Re/W26Re 0 to 2300 °C or 32 to 3000 °F 9: PLII 0 to 1390 °C or 32 to 2534 °F	Specify when ordering	P. 116

Continued on the next page.

Continued from the previous page.

No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
1	Input range number	**XI**	R/W	RTD input: 12: Pt100 −200 to +850 °C or −328 to +1562 °F 13: JPt100 −200 to +600 °C or −328 to +1112 °F Voltage/Current input: 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	Specify when ordering	P. 116
2	Input scale high limit	**XV**	R/W	Input scale low limit to 20000	Depend on input range	P. 117
3	Input scale low limit	**XW**	R/W	−20000 to Input scale high limit	Depend on input range	P. 117
4	Input range decimal point position	**XU**	R/W	TC/RTD input: 0 to 1 Voltage/Current input: 0 to 4 0: No digits below decimal point 1: 1 digit below decimal point 2: 2 digits below decimal point 3: 3 digits below decimal point 4: 4 digits below decimal point	1	P. 117
5	Temperature unit selection	**PU**	R/W	0: °C 1: °F	0	P. 118
6	Control type selection	**XE**	R/W	0: Direct action 1: Reverse action	1	P. 118
7	ON/OFF control differential gap (Upper)	**IV**	R/W	0 to Input span	TC/RTD: 1.0 °C V/I: 0.1 % of input span	P. 119
8	ON/OFF control differential gap (Lower)	**IW**	R/W			P. 119

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
9	Event 1 differential gap	**HA**	R/W	0 to Input span	TC/ RTD: 2.0 °C V/I: 0.2 % of input span	P. 120
10	Event 2 differential gap	**HB**	R/W			P. 120
11	Event 1 type selection	**XA**	R/W	0: Not provided 1: Process high 2: Process low 3: Deviation high 4: Deviation low 5: Deviation high/low 6: Band	0	P. 121
12	Event 2 type selection	**XB**	R/W		0	P. 121
13	Event 1 hold action	**WA**	R/W	0: Not provided 1: Hold action (2: Unused) 3: Re-hold action	3	P. 123
14	Event 2 hold action	**WB**	R/W		3	P. 123
15	Number of event delay times	**DF**	R/W	0 to 255 times	0	P. 124
16	Transmission transfer time setting (Data of each module)	**ZX**	R/W	0 to 100 ms	6	P. 125
17	Segment time unit setting	**XP**	R/W	0: 0.01 second 1: 0.1 second 2: 1 second 3: 1 minute	0	P. 125
18	Operation mode holding setting (Data of module unit)	**X2**	R/W	0: Not hold 1: Hold	1	P. 125
19	Output change rate limiter (up)	**PH**	R/W	0.0 to 100.0 %/second 0.0: Limiter OFF	0.0	P. 126
20	Output change rate limiter (down)	**PL**	R/W	0.0 to 100.0 %/second 0.0: Limiter OFF	0.0	P. 126

7. MODBUS

7.1 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.

7.1.1 Message format

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

Slave address
Function code
Data
Error check CRC-16

Message format

■ Slave address

The slave address is a number from 0 to 99 manually set at the module address setting switch located at the front of the SRX module. 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 **7.1.2 Function code (P. 44)**.

■ 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 **7.2 Message Format (P. 49)**, **7.3 Data Configuration (P. 53), 7.4 Data Map (P. 56)** and **8. COMMUNICATION DATA DESCRIPTION (P. 69)**.

■ Error check

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

☞ For details, see **7.1.5 Calculating CRC-16 (P. 46).**

7.1.2 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

7.1.3 Communication mode

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

RTU mode

Items	Contents
Data bit length	8-bit (Binary)
Start mark of message	Unused
End mark of message	Unused
Message length	See **7.1.2 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.

A data time interval may become more than 24 bits depending on the type of master used. In that case, the data time interval can be extended in the range of 1 to 99 ms.
For setting procedure, see **5.3 Communication Time Setting (P. 16)**.

7.1.4 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 and 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.
- 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.

Slave address
Function code
Error code
Error check CRC-16

Error response message

Error code	Contents
1	Function code error (An unsupported function code was specified)
2	When the mismatched address is specified.
3	When the data written exceeds the setting range When the specified number of data items in the query message exceeds the maximum number (1 to 125) of data items available

(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 transmission parameter 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.
- There is length of query message exceeds set range.
- The number of data points is not twice the specified number of data points at the time of data write.
- If data time interval in the query message from the master is following
  24 bits' time or more
  24 bits' time plus a few milliseconds or more

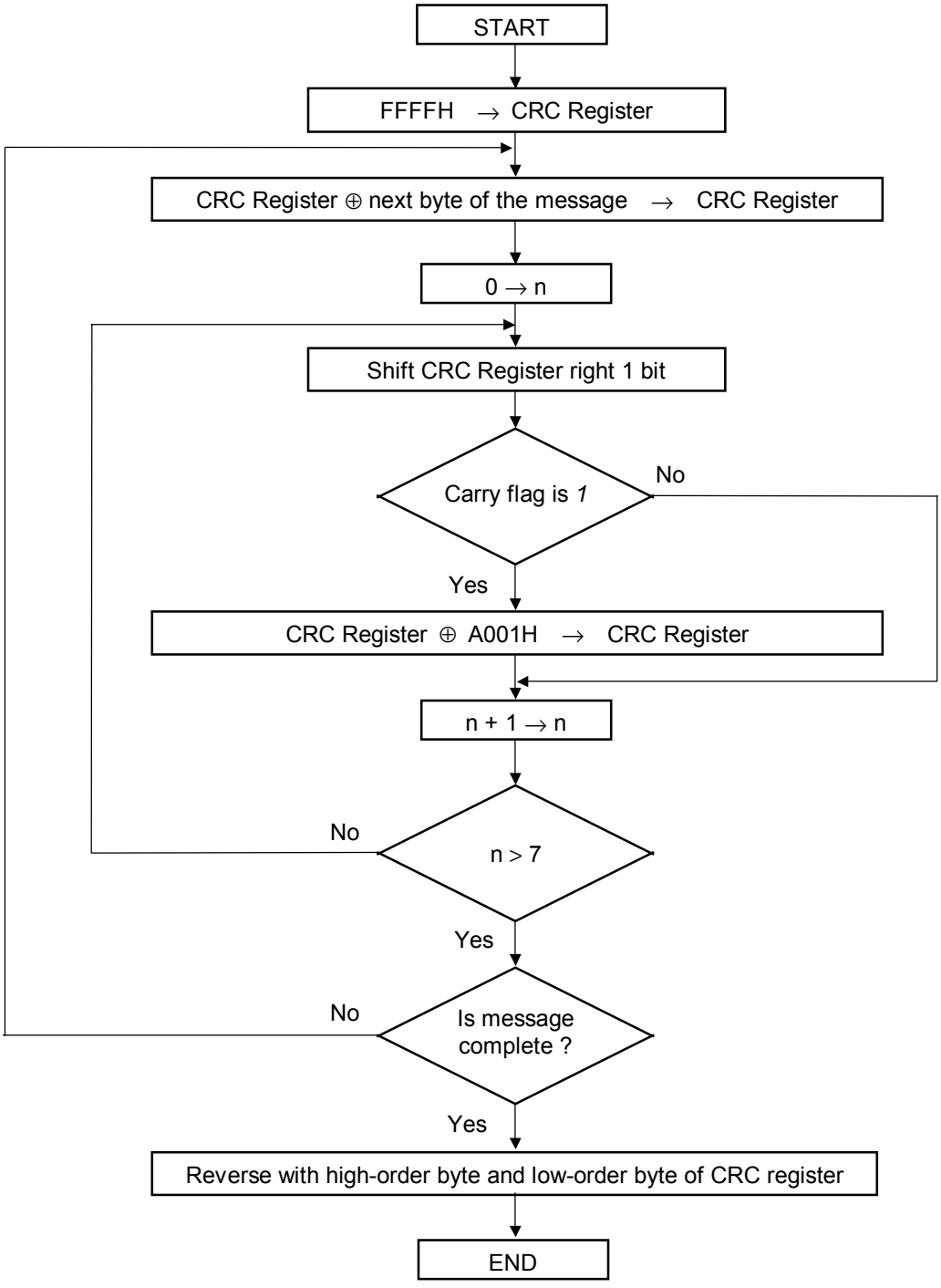
7.1.5 Calculating CRC-16

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-bit) 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-bit) 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;
}
```

7.2 Message Format

7.2.1 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 three holding registers from 0000H to 0002H 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	03H	
CRC-16	High	05H	
	Low	F8H	

Normal response message

Slave address		02H	
Function code		03H	
Number of data		06H	→ Number of holding registers × 2
First holding register contents	High	00H	
	Low	78H	
Next holding register contents	High	00H	
	Low	00H	
Next holding register contents	High	00H	
	Low	14H	
CRC-16	High	95H	
	Low	80H	

Error response message

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

7.2.2 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 0010H of slave address 1.

Query message

Slave address		01H
Function code		06H
Holding register number	High	00H
	Low	10H
Write data	High	00H
	Low	64H
CRC-16	High	89H
	Low	E4H

} Any data within the range

Normal response message

Slave address		01H
Function code		06H
Holding register number	High	00H
	Low	10H
Write data	High	00H
	Low	64H
CRC-16	High	89H
	Low	E4H

} Contents will be the same as query message data

Error response message

Slave address		01H
80H + Function code		86H
Error code		03H
CRC-16	High	02H
	Low	61H

7.2.3 Diagnostics (Loopback test) [08H]

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

Example: Loopback test for slave address 1

Query message

Slave address		01H	
Function code		08H	
Test code	High	00H	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

7.2.4 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 0010H to 0011H of slave address 1.

Query message

Slave address		01H	
Function code		10H	
Starting number	High	00H	First holding register address
	Low	10H	
Quantity	High	00H	The setting must be between 1 (0001H) and 123 (007BH).
	Low	02H	
Number of data		04H	→ Number of holding registers × 2
Data to first register	High	00H	
	Low	64H	
Data to next register	High	00H	
	Low	1EH	
CRC-16	High	33H	
	Low	74H	

Normal response message

Slave address		01H
Function code		10H
Starting number	High	00H
	Low	10H
Quantity	High	00H
	Low	02H
CRC-16	High	40H
	Low	0DH

Error response message

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

7.3 Data Configuration

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.

7.3.1 Data processing with decimal points

■ Data without decimal points

Comprehensive event status
Error code
Event 1 status
Event 2 status
Heater break alarm status
Control loop break alarm (LBA) status
Control response parameters
Operation mode
PID/AT transfer
Auto/Manual transfer
Number of heater break alarm delay times
Hot/cold start selection
Control RUN/STOP transfer
Input error determination point (high limit)
Input error determination point (low limit)
Remote/Local transfer
Event LED mode setting
Program operation mode selection
Execution pattern
Execution segment
Number of program execution times
Time signal output status 1
Time signal output status 2
Pattern end output status
End status
Wait status
Hold status
Step action
Setting of the number of program execution times
End segment
Link pattern
Time signal output number
Time signal ON segment
Time signal OFF segment
Program operation start mode
Control loop break alarm (LBA) use selection
Control loop break alarm (LBA) time
Integral/derivative time decimal point position
Initial setting mode
Input rang number
Input range decimal point position
Temperature unit selection
Control type selection
Event 1 type selection
Event 2 type selection
Event 1 hold action
Event 2 hold action
Number of event delay times
Transmission transfer time setting
Segment time unit setting
Operation mode holding setting

Example: When input range number is 18, 18 = 12H

Input range number	High	00H
	Low	12H

■ Data with decimal points

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

- **Data with 1 digit below decimal point**

Manual output value	Manipulated output value at input error
Current transformer input measured value	Output change rate limiter (up)
Heater break alarm set value	Output change rate limiter (down)
Manual output value	Output limiter (high limit)
Proportional cycle time	Output limiter (low limit)

Example: When heater break alarm set value 1 is 20.0 A, 20.0 is processed as 200,
200 = C8H

Heater break alarm set value	High	00H
	Low	C8H

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

Digital filter
AT differential gap time

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

Input measured value (PV)	AT bias
Set value (SV)	Segment level
Set value monitor	Wait zone
Proportional band	Control loop break alarm (LBA) deadband
PV bias	Input scale high limit
Event 1 set value	Input scale low limit
Event 2 set value	ON/OFF control differential gap (upper)
Level PID high limit set value	ON/OFF control differential gap (lower)
Start determination point	Event 1 differential gap
Input error determination point (high limit)	Event 2 differential gap
Input error determination point (low limit)	

Example: When the set value is –20.0 °C, –20.00 is processed as –200,
–200 = 0000H – 00C8H = FF38H

Set value	High	FFH
	Low	38H

■ Data whose decimal point's presence and/or position depends on segment time unit setting

The position of the decimal point changes depending on the segment time unit setting because the Modbus protocol does not recognize data with decimal points during communication.

- Type of decimal points position:
  No digits below decimal point, 1 digit below decimal point, 2 digits below decimal point

Segment remaining time	Time signal ON time
Pattern end output time	Time signal OFF time
Segment time	

■ Data whose decimal point's position depends on Integral/ derivative time decimal point position

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

- Type of decimal points position:
  1 digit below decimal point, 2 digits below decimal point

Integral time
Derivative time

7.3.2 Data processing precautions

- With Modbus protocol, the maximum number of channels per slave address is 2.
- Do not write data to any address which is not described in a list of data maps.
- Read data of unused channel and undefined address is *0*.
- Any attempt to write to an unused channel is not processed as an error. Data can not be written into an unused channel.
- If data range or address error occurs during data writing, the data written before error is in effect.
- Some communication data may become invalid depending on the module selection or the configuration of the SRX.
  If any one of the conditions listed below occurs and data items written are within the setting range, read data becomes *0*. Under these conditions, no error response message will occur.
  - When ON/OFF control, proportional band, integral time and derivative time are invalid.
  - When current/voltage output, proportioning cycle time are invalid.
  - When only the heater break alarm function is provided, current transformer input measured value, heater break alarm status, heater break alarm set value and number of heater break alarm delay times are valid.
  - When only the control loop break alarm (LBA) function is provided, control loop break alarm (LBA) status, use selection, time and deadband are valid.

7.4 Data Map

7.4.1 Normal setting data items

RO: Read only R/W: Read and Write

Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	CH1	CH2	CH1	CH2				
Measured value (PV)	0000	1000	0	4096	RO	Input scale low limit to Input scale high limit	—	P. 70
Comprehensive event status	0001	1001	1	4097	RO	0 to 31 (Bit data) b0: Burnout b1: Event 1 status b2: Event 2 status b3: Heater break alarm status b4: Control loop break alarm (LBA) status b5 to b7: Unused	—	P. 70
Manipulated output value	0002	1002	2	4098	RO	–5.0 to +105.0 %	—	P. 72
Set value monitor	0003	1003	3	4099	RO	Input scale low limit to Input scale high limit	—	P. 73
Error code (Data of each module)	0004		4		RO	0 to 255 (Bit data) b0: Memory backup error b1: Unused b2: Unused b3: Adjustment data error b4: Input error b5: Current transformer input error b6: Temperature compensation error b7: Unused	—	P. 74
Unused	0005	1005	5	4101	—	—	—	—
Current transformer input measured value	0006	1006	6	4102	RO	0.0 to 30.0 A or 0.0 to 100.0 A		P. 73
Unused	0007	1007	7	4103	—	—	—	—
Burnout status	0008	1008	8	4104	RO	0: OFF 1: ON	—	P. 71
Event 1 status	0009	1009	9	4105	RO	0: OFF 1: ON	—	P. 71
Event 2 status	000A	100A	10	4106	RO	0: OFF 1: ON	—	P. 71

Continued on the next page.

Continued from the previous page.

Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	CH1	CH2	CH1	CH2				
Heater break alarm (HBA) status	000B	100B	11	4107	RO	0: OFF 1: Heater break 2: Relay welding	—	P. 72
Control loop break alarm (LBA) status	000C	100C	12	4108	RO	0: OFF 1: ON	—	P. 72
Unused	000D	100D	13	4109	—	—	—	—
Unused	000E	100E	14	4110	—	—	—	—
Operation mode	000F	100F	15	4111	R/W	0: Unused 1: Monitor 1 2: Monitor 2 3: Control	3	P. 78
Set value (SV)	0010	1010	16	4112	R/W	Input scale low limit to Input scale high limit	0	P. 74
Proportional band	0011	1011	17	4113	R/W	TC/RTD input: 0 (0.0) to Input span Voltage/Current (I) input: 0.0 to 1000.0 % of input span 0 (0.0): ON/OFF action	TC/RTD: 10.0 °C V/I: 10.0 %	P. 75
Integral time	0012	1012	18	4114	R/W	0.1 to 3600.0 seconds or 0.01 to 360.00 seconds	40.00	P. 75
Derivative time	0013	1013	19	4115	R/W	0.0 to 3600.0 seconds or 0.00 to 360.00 seconds 0.0 (0.00): Derivative action OFF (PI action)	10.00	P. 75
Control response parameters	0014	1014	20	4116	R/W	0: Slow 1: Medium 2: Fast	0	P. 76
PV bias	0015	1015	21	4117	R/W	–Input span to +Input span	0	P. 77
Event 1 set value	0016	1016	22	4118	R/W	Deviation high/Deviation low: –Input span to +Input span Deviation high/low, Band: 0 to input span Process high/Process low: Input scale low limit to Input scale high limit	0	P. 77
Event 2 set value	0017	1017	23	4119	R/W		0	P. 77

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	CH1	CH2	CH1	CH2				
Unused	0018 ⋮ 001F	1018 ⋮ 101F	24 ⋮ 31	4120 ⋮ 4127	—	—	—	—
PID/AT transfer	0020	1020	32	4128	R/W	0: PID control operation 1: AT (Autotuning) operation	0	P. 79
Auto/Manual transfer	0021	1021	33	4129	R/W	0: Auto mode 1: Manual mode	0	P. 80
Manual output value	0022	1022	34	4130	R/W	Within output limiter	0.0	P. 80
Output limiter (high limit)	0023	1023	35	4131	R/W	Output limiter (low limit) to 105.0 %	100.0	P. 81
Output limiter (low limit)	0024	1024	36	4132	R/W	–5.0 % to Output limiter (high limit)	0.0	P. 81
Proportional cycle time	0025	1025	37	4133	R/W	0.2 to 50.0 seconds	2.0	P. 81
Unused	0026	1026	38	4134	—	—	—	—
Digital filter	0027	1027	39	4135	R/W	0.00 to 10.00 seconds	0.00	P. 81
Heater break alarm (HBA) set value	0028	1028	40	4136	R/W	0.0 to 30.0 A or 0.0 to 100.0 A	0.0	P. 82
Number of heater break alarm (HBA) delay times	0029	1029	41	4137	R/W	1 to 255 times	5	P. 83
Hot/cold start selection	002A	102A	42	4138	R/W	0: Hot start 1 1: Hot start 2 2: Cold start 1 3: Cold start 2	0	P. 83
Start determination point	002B	102B	43	4139	R/W	0 to Input span	0.0	P. 84
Unused	002C ⋮ 002F	102C ⋮ 102F	44 ⋮ 47	4140 ⋮ 4143	—	—	—	—
Control RUN/STOP transfer (Data of each module)	0030		48		R/W	0: Control STOP 1: Control RUN	0	P. 84
Input error determination point (high limit)	0031	1031	49	4145	R/W	Input scale low limit to Input scale high limit	Input scale high limit	P. 85
Input error determination point (low limit)	0032	1032	50	4146	R/W	Input scale low limit to Input scale high limit	Input scale low limit	P. 85

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Name	Register address				Attri-bute	Data range	Factory set value	Refer-ence page
	Hexadecimal		Decimal					
	CH1	CH2	CH1	CH2				
Action at input error (high limit)	0033	1033	51	4147	R/W	0: Normal control 1: Manipulated output value at input error	0	P. 85
Action at input error (low limit)	0034	1034	52	4148	R/W	0: Normal control 1: Manipulated output value at input error	0	P. 85
Manipulated output value at input error	0035	1035	53	4149	R/W	Within output limiter	0.0	P. 86
AT differential gap time	0036	1036	54	4150	R/W	0.00 to 50.00 seconds	0.10	P. 87
Unused	0037	1037	55	4151	—	—	—	—
AT bias	0038	1038	56	4152	R/W	−Input span to +Input span	0	P. 88
Unused	0039	1039	57	4153	—	—	—	—
Unused	003A	103A	58	4154	—	—	—	—
Remote/Local transfer	003B	103B	59	4155	R/W	0: Local mode 1: Remote mode	0	P. 88
Event LED mode setting (Data of each module)	003C		60		R/W	1: Mode 1 2: Mode 2 3: Mode 3 10: Mode 10 11: Mode 11 12: Mode 12 13: Mode 13 Except the above: Unused	0	P. 89
Reserve	003D	103D	61	4157	—	—	—	—
Reserve	003E	103E	62	4158	—	—	—	—
Reserve	003F	103F	63	4159	—	—	—	—
Reserve	0040	1040	64	4160	—	—	—	—
Unused	003F ⋮ 0057	103F ⋮ 1057	63 ⋮ 87	4161 ⋮ 4183	—	—	—	—
Level PID data **For details, see 7.4.2 Level PID data (P. 61)**	0058 ⋮ 00CF	1058 ⋮ 10CF	88 ⋮ 207	4184 ⋮ 4303	—	—	—	P. 61
Program control data **For details, see 7.4.3 Program control data (P. 62)**	00D0 ⋮ 0858	10D0 ⋮ 1858	208 ⋮ 2136	4304 ⋮ 6232	—	—	—	P. 62

Continued on the next page.

Continued from the previous page.

Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	CH1	CH2	CH1	CH2				
Control loop break alarm (LBA) use selection	0859	1859	2137	6233	R/W	0: Unused 1: Used	0	P. 90
Control loop break alarm (LBA) time	085A	185A	2138	6234	R/W	1 to 7200 seconds	480	P. 90
Control loop break alarm (LBA) deadband	085B	185B	2139	6235	R/W	0 to Input span	0	P. 91
Integral/derivative time decimal point position	085C	185C	2140	6236	R/W	0: 2 digits below decimal point 1: 1 digit below decimal point	0	P. 92
Unused	085D ⋮ 086F	185D ⋮ 186F	2141 ⋮ 2159	6237 ⋮ 6255	—	—	—	—

7.4.2 Level PID data items

Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	CH1	CH2	CH1	CH2				
Proportional band	0058 ⋮ 005F	1058 ⋮ 105F	88 ⋮ 95	4184 ⋮ 4191	R/W	TC/RTD input: 0 (0.0) to Input span Voltage/Current (I) input: 0.0 to 1000.0 % of input span 0 (0.0): ON/OFF action	TC/RTD: 10.0 °C V/I: 10.0 %	P. 94
Integral time	0060 ⋮ 0067	1060 ⋮ 1067	96 ⋮ 103	4192 ⋮ 4199	R/W	0.1 to 3600.0 seconds or 0.01 to 360.00 seconds	40.00	P. 94
Derivative time	0068 ⋮ 006F	1068 ⋮ 106F	104 ⋮ 111	4200 ⋮ 4207	R/W	0.0 to 3600.0 seconds or 0.00 to 360.00 seconds 0.0 (0.00): Derivative action OFF (PI action)	10.00	P. 94
Control response parameters	0070 ⋮ 0077	1070 ⋮ 1077	112 ⋮ 119	4208 ⋮ 4215	R/W	0: Slow 1: Medium 2: Fast	0	P. 95
Unused	0078 ⋮ 00AF	1078 ⋮ 10AF	120 ⋮ 175	4216 ⋮ 4271	—	—	—	—
Level PID high limit set value	00B0 ⋮ 00B7	10B0 ⋮ 10B7	176 ⋮ 183	4272 ⋮ 4279	R/W	Input scale low limit to Input scale high limit	Input scale high limit	P. 95
Unused	00B8 ⋮ 00CF	10B8 ⋮ 10CF	184 ⋮ 207	4280 ⋮ 4303	—	—	—	—

7.4.3 Program control data items

Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	CH1	CH2	CH1	CH2				
Program operation mode selection	00D0	10D0	208	4304	R/W	0: RESET 1: RUN (Program control) 2: FIX (Fixed set point control) 3: MAN (Manual control)	2	P. 99
Execution pattern	00D1	10D1	209	4305	R/W	1 to 16	1	P. 100
Execution segment	00D2	10D2	210	4306	RO	1 to 16	—	P. 100
Segment remaining time	00D3	10D3	211	4307	RO	0.00 to 300.00 seconds 0.0 to 3000.0 seconds 0 to 30000 seconds 0 to 30000 minutes	—	P. 101
Number of program execution times	00D4	10D4	212	4308	RO	0 to 9999 times	—	P. 101
Time signal output status 1	00D5	10D5	213	4309	RO	0 to 255 (Bit data) b0: Time signal 1 output status b1: Time signal 2 output status b2: Time signal 3 output status b3: Time signal 4 output status b4: Time signal 5 output status b5: Time signal 6 output status b6: Time signal 7 output status b7: Time signal 8 output status	—	P. 102

Continued on the next page.

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	CH1	CH2	CH1	CH2				
Time signal output status 2	00D5	10D5	213	4309	RO	0 to 255 (Bit data) b0: Time signal 9 output status b1: Time signal 10 output status b2: Time signal 11 output status b3: Time signal 12 output status b4: Time signal 13 output status b5: Time signal 14 output status b6: Time signal 15 output status b7: Time signal 16 output status	—	P. 102
Pattern end output status	00D6	10D6	214	4310	RO	0: Pattern end output OFF 1: Pattern end output ON	—	P. 103
End status	00D7	10D7	215	4311	RO	0: End status OFF 1: End status ON	—	P. 103
Wait status	00D8	10D8	216	4312	RO	0: Wait status OFF 1: Wait status ON	—	P. 103
Hold status	00D9	10D9	217	4313	R/W	0: Hold status OFF 1: Hold status ON	0	P. 104
Step action	00DA	10DA	218	4314	R/W	0: Not step action 1: Step action execution	0	P. 105
Unused	00DB ⋮ 00EF	10DB ⋮ 10EF	219 ⋮ 239	4315 ⋮ 4335	—	—	—	—
Setting of the number of program execution times	00F0 ⋮ 00FF	10F0 ⋮ 10FF	240 ⋮ 255	4336 ⋮ 4351	R/W	1 to 1000 times 1000: Number of infinite times	1	P. 106
End segment	0100 ⋮ 010F	1100 ⋮ 110F	256 ⋮ 271	4352 ⋮ 4367	R/W	1 to 16	16	P. 106
Link pattern	0110 ⋮ 011F	1110 ⋮ 111F	272 ⋮ 287	4368 ⋮ 4383	R/W	0 to 16 0: Not link pattern	0	P. 107

Continued on the next page.

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	CH1	CH2	CH1	CH2				
Pattern end output time	0120 : 012F	1120 : 112F	288 : 303	4384 : 4399	R/W	0.00 to 300.00 seconds 0.0 to 3000.0 seconds 0 to 30000 seconds 0 to 30000 minutes	0.00	P. 108
Wait zone	0130 : 013F	1130 : 113F	304 : 319	4400 : 4415	R/W	0 to Input span	0.0	P. 109
Segment level	0140 : 023F	1140 : 123F	320 : 575	4416 : 4671	R/W	Input scale low limit to Input scale high limit	0	P. 110
Segment time	0240 : 033F	1240 : 133F	576 : 831	4672 : 4927	R/W	0.00 to 300.00 seconds 0.0 to 3000.0 seconds 0 to 30000 seconds 0 to 30000 minutes	0.00	P. 110
Time signal output number	0340 : 043F	1340 : 143F	832 : 1087	4928 : 5183	R/W	0 to 16 0: Not time signal output	0	P. 111
Time signal ON segment	0440 : 053F	1440 : 153F	1088 : 1343	5184 : 5439	R/W	1 to 16	1	P. 112
Time signal ON time	0540 : 063F	1540 : 163F	1344 : 1599	5440 : 5695	R/W	0.00 to 300.00 seconds 0.0 to 3000.0 seconds 0 to 30000 seconds 0 to 30000 minutes	0.00	P. 112
Time signal OFF segment	0640 : 073F	1640 : 173F	1600 : 1855	5696 : 5951	R/W	1 to 16	1	P. 113
Time signal OFF time	0740 : 083F	1740 : 183F	1856 : 2111	5952 : 6207	R/W	0.00 to 300.00 seconds 0.0 to 3000.0 seconds 0 to 30000 seconds 0 to 30000 minutes	0.00	P. 113
Unused	0840 : 0857	1840 : 1857	2112 : 2135	6208 : 6231	—	—	—	—
Program operation start mode	0858	1858	2136	6232	R/W	0: Zero start 1: PV start 1 2: PV start 2	0	P. 114

7.4.4 Initial setting data items

CAUTION

Initial setting data items are those set initially so as meet the operation condition of the module but unnecessary to be changed afterward as far as the module is normally used. In addition, if they are changed unnecessarily, the module may result in malfunction or failure. Even if it malfunctions or fails caused by their unnecessary changes, RKC will not bear any responsibility for its malfunction or failure.

When setting initial setting data items, stop control by normal setting data "Control RUN/STOP transfer."

Even if control is stopped by "Control RUN/STOP transfer" while program control is being performed (RUN state), the program continues running. If it is necessary to stop running the program, set "Program operation mode selection" to RESET.

Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	CH1	CH2	CH1	CH2				
Input range number	0870	1870	2160	6256	R/W	TC input: 0: K −200 to +1372 °C −328 to +2501 °F 1: J −200 to +1200 °C −328 to +2192 °F 2: R −50 to +1768 °C −58 to +3000 °F 3: S −50 to +1768 °C −58 to +3000 °F 4: B 0 to 1800 °C 32 to 3000 °F 5: E −200 to +1000 °C −328 to +1832 °F 6: N 0 to 1300 °C 32 to 2372 °F 7: T −200 to +400 °C −328 to +752 °F 8: W5Re/W26Re 0 to 2300 °C 32 to 3000 °F 9: PLII 0 to 1390 °C 32 to 2534 °F	Specify when ordering	P. 116

Continued on the next page.

Continued from the previous page.

Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	CH1	CH2	CH1	CH2				
Input range number	0870	1870	2160	6256	R/W	RTD input: 12: Pt100 –200 to +850 °C –328 to +1562 °F 13: JPt100 –200 to +600 °C –328 to +1112 °F Voltage / current input: 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	Specify when ordering	P. 116
Input scale high limit	0871	1871	2161	6257	R/W	Input scale low limit to 20000	Depend on input range	P. 117
Input scale low limit	0872	1872	2162	6258	R/W	–20000 to Input scale high limit	Depend on input range	P. 117
Input range decimal point position	0873	1873	2163	6259	R/W	TC/RTD input: 0 to 1 Voltage/Current input: 0 to 4 0: No digits below decimal point 1: 1 digit below decimal point 2: 2 digits below decimal point 3: 3 digits below decimal point 4: 4 digits below decimal point	1	P. 117
Temperature unit selection	0874	1874	2164	6260	R/W	0: °C 1: °F	0	P. 118
Control type selection	0875	1875	2165	6261	R/W	0: Direct action 1: Reverse action	1	P. 118

Continued on the next page.

Continued from the previous page.

Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	CH1	CH2	CH1	CH2				
ON/OFF control differential gap (Upper)	0876	1876	2166	6262	R/W	0 to Input span	TC/RTD: 1.0 °C V/I: 0.1 % of input span	P. 119
ON/OFF control differential gap (Lower)	0877	1877	2167	6263	R/W			P. 119
Event 1 differential gap	0878	1878	2168	6264	R/W	0 to Input span	TC/RTD: 2.0 °C V/I: 0.2 % of input span	P. 120
Event 2 differential gap	0879	1879	2169	6265	R/W			P. 120
Event 1 type selection	087A	187A	2170	6266	R/W	0: Not provided 1: Process high 2: Process low 3: Deviation high 4: Deviation low 5: Deviation high/low 6: Band	0	P. 121
Event 2 type selection	087B	187B	2171	6267	R/W		0	P. 121
Event 1 hold action	087C	187C	2172	6268	R/W	0: Not provided 1: Hold action (2: Unused) 3: Re-hold action	3	P. 123
Event 2 hold action	087D	187D	2173	6269	R/W		3	P. 123
Number of event delay times	087E	187E	2174	6270	R/W	0 to 255 times	0	P. 124
Transmission transfer time setting (Data of each module)	087F		2175		R/W	0 to 100 ms	6	P. 125
Segment time unit setting	0880	1880	2176	6272	R/W	0: 0.01 second 1: 0.1 second 2: 1 second 3: 1 minute	0	P. 125
Operation mode holding setting (Data of each module)	0881		2177		R/W	0: Not hold 1: Hold	1	P. 125

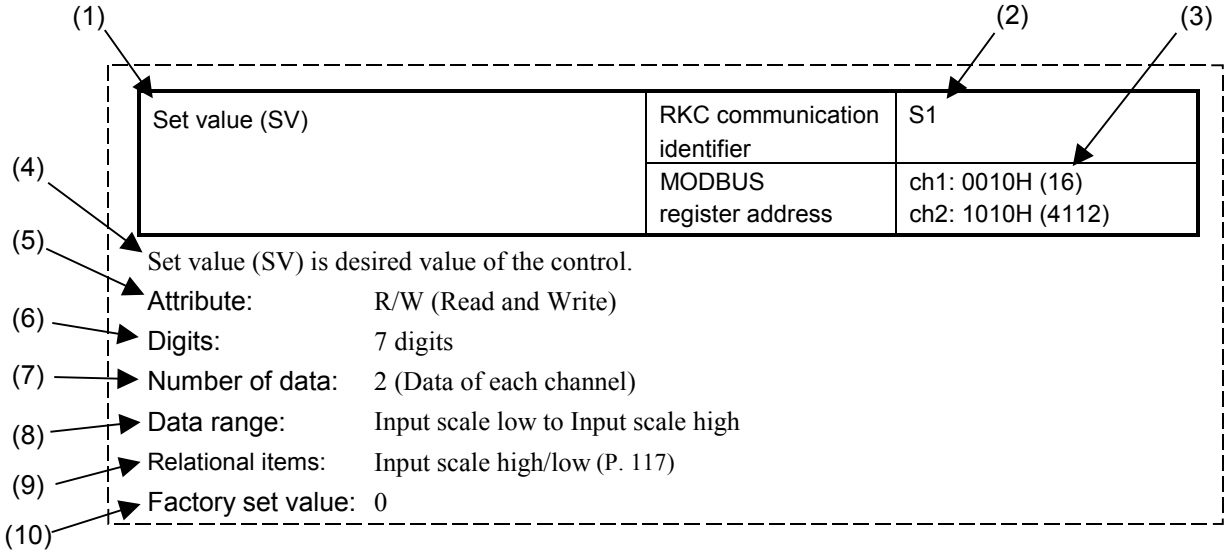
Continued on the next page.

Continued from the previous page.

Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	CH1	CH2	CH1	CH2				
Output change rate limiter (up)	0882	1882	2178	6274	R/W	0.0 to 100.0 %/second 0.0: Limiter OFF	0.0	P. 126
Output change rate limiter (down)	0883	1883	2179	6275	R/W	0.0 to 100.0 %/second 0.0: Limiter OFF	0.0	P. 126

8. COMMUNICATION DATA DESCRIPTION

■ **Referance to communication data contents**



(1) Name: Communication data name is written.

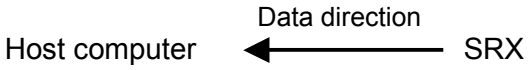
(2) RKC communication identifier:
Communication identifier of RKC communication is written.

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

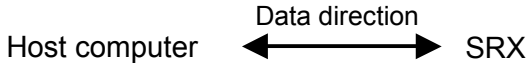
(4) Description: A short description of the communication data item is written.

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

RO: Only reading data from SRX is possible.



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



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

(7) Number of data: The number of data points is written.
Number of each channel data: 2
Number of each module data: 1

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

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

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

 There is item including the functional description.

8.1 Normal Setting Data Items

Measured value (PV)	RKC communication identifier	M1
	MODBUS register address	ch1: 0000H (0) ch2: 1000H (4096)

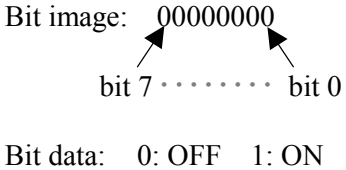
Measured value (PV) is the input value of SRX. There are thermocouple input, resistance temperature detector input, voltage input and current input.

Attribute: RO (Read only)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: Input scale low limit to Input scale high limit
Factory set value: —

Comprehensive event status	RKC communication identifier	AJ
	MODBUS register address	ch1: 0001H (1) ch2: 1001H (4097)

Each event status such as burnout, heater break alarm or control loop break alarm is expressed in bit data items.

Attribute: RO (Read only)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0 to 31 (bit data)
Each event status is assigned as a bit image in binary numbers.
However, send data from the SRX be changed to decimal ASCII code from the bit image in binary numbers.



bit 0: Burnout
bit 1: Event 1 status
bit 2: Event 2 status
bit 3: Heater break alarm (HBA) status
bit 4: Control loop break alarm (LBA) status
bit 5: Unused
bit 6: Unused
bit 7: Unused

Relational items: Event LED mode setting (P. 89)
Factory set value: —

Burnout status	RKC communication identifier	B1
	MODBUS register address	ch1: 0008H (8) ch2: 1008H (4104)

Monitor a state in input break.

Attribute: RO (Read only)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: OFF
1: ON
Factory set value: —

Event 1 status	RKC communication identifier	AA
	MODBUS register address	ch1: 0009H (9) ch2: 1009H (4105)
Event 2 status	RKC communication identifier	AB
	MODBUS register address	ch1: 000AH (10) ch2: 100AH (4106)

Monitor an ON/OFF state of the event.

Attribute: RO (Read only)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: OFF
1: ON
Relational items: Event set value (P. 77), Event LED mode setting (P. 89), Event differential gap (P. 120), Event type selection (P. 121), Event hold action (P. 123), Number of event delay times (P. 124)
Factory set value: —

Heater break alarm (HBA) status	RKC communication identifier	AC
	MODBUS register address	ch1: 000BH (11) ch2: 100BH (4107)

Monitor a state of heater break alarm.

Attribute: RO (Read only)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: OFF
1: Heater break
2: Relay welding
Relational items: Current transformer input measured value (P. 73), Heater break alarm (HBA) set value (P. 82), Number of heater break alarm (HBA) delay times (P. 83)
Factory set value: —

Control loop break alarm (LBA) status	RKC communication identifier	AP
	MODBUS register address	ch1: 000CH (12) ch2: 100CH (4108)

Load (heater) break, faulty external actuaters (electromagnetic relays, etc.) or failure in control system (control loop) caused by input (sensor) break is indicated by the output state or control loop break alarm (LBA) time.

Attribute: RO (Read only)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: OFF
1: ON
Relational items: Control loop break alarm (LBA) use selection (P. 90), Control loop break alarm (LBA) time (P. 90), Control loop break alarm (LBA) deadband (P. 91)
Factory set value: —

Manipulated output value	RKC communication identifier	O1
	MODBUS register address	ch1: 0002H (2) ch2: 1002H (4098)

Manipulated output value is theoutput value of SRX.

Attribute: RO (Read only)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: −5.0 to +105.0 %
Relational items: Manual output value (P. 80), Output limiter (high limit/low limit) (P. 81), Event LED mode setting (P. 89), Output change rate limiter (up/down) (P. 126)
Factory set value: —

Current transformer input measured value	RKC communication identifier	M3
	MODBUS register address	ch1: 0006H (6) ch2: 1006H (4102)

This item is current transformer input value to use by a heater break alarm (HBA) function.

Attribute: RO (Read only)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0.0 to 30.0 A (CT type: CTL-6-P-N)
0.0 to 100.0 A (CT type: CTL-12-S56-10L-N)
Relational items: Heater break alarm (HBA) status (P. 72), Heater break alarm (HBA) set value (P. 82), Number of heater break alarm (HBA) delay times (P. 83)
Factory set value: —

Set value monitor	RKC communication identifier	MS
	MODBUS register address	ch1: 0003H (3) ch2: 1003H (4099)

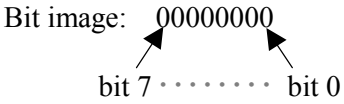
This item is monitor of the set value (SV) which is the desired value for control.

Attribute: RO (Read only)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: Input scale low limit to Input scale high limit
Factory set value: —

Error code	RKC communication identifier	ER
	MODBUS register address	0004H (4)

Error status of SRX is expressed as a bit image in decimal number.

Attribute: RO (Read only)
Digits: 7 digits
Number of data: 1 (Data of each module)
Data range: 0 to 255 (bit data)
Each error status is assigned as a bit image in binary numbers.
However, send data from the SRX be changed to decimal ASCII code from the bit image in binary numbers.



Bit data: 0: OFF 1: ON

bit 0: Memory backup error
bit 1: Unused
bit 2: Unused
bit 3: Adjustment data error
bit 4: Input A/D error
bit 5: Current transformer input A/D error
bit 6: Temperature compensation A/D error
bit 7: Unused

Factory set value: —

Set value (SV)	RKC communication identifier	S1
	MODBUS register address	ch1: 0010H (16) ch2: 1010H (4112)

Set value (SV) is desired value of the control.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: Input scale low limit to Input scale high limit
Relational items: Input scale high limit/low limit (P. 117)
Factory set value: 0

Proportional band	RKC communication identifier	P1
	MODBUS register address	ch1: 0011H (17) ch2: 1011H (4113)

This item is the proportional band of the PI and PID control.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: TC/RTD input: 0 (0.0) to Input span
Voltage/current input: 0.0 to 1000.0 % of input span
0 (0.0): ON/OFF action
(Input span: Input scale low limit to Input scale high limit)
Relational items: ON/OFF control differential gap (Upper/Lower) (P. 119)
Factory set value: TC/RTD input: 10.0 °C
Voltage/current input: 10.0 %

Integral time	RKC communication identifier	I1
	MODBUS register address	ch1: 0012H (18) ch2: 1012H (4114)

This item is the time of integral action which eliminates the offset occurring in proportional control.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0.1 to 3600.0 seconds
0.01 to 360.00 seconds
☞ A decimal point position selects with an **Integral/derivative time decimal point position (P. 92)**.
Factory set value: 40.00

Derivative time	RKC communication identifier	D1
	MODBUS register address	ch1: 0013H (19) ch2: 1013H (4115)

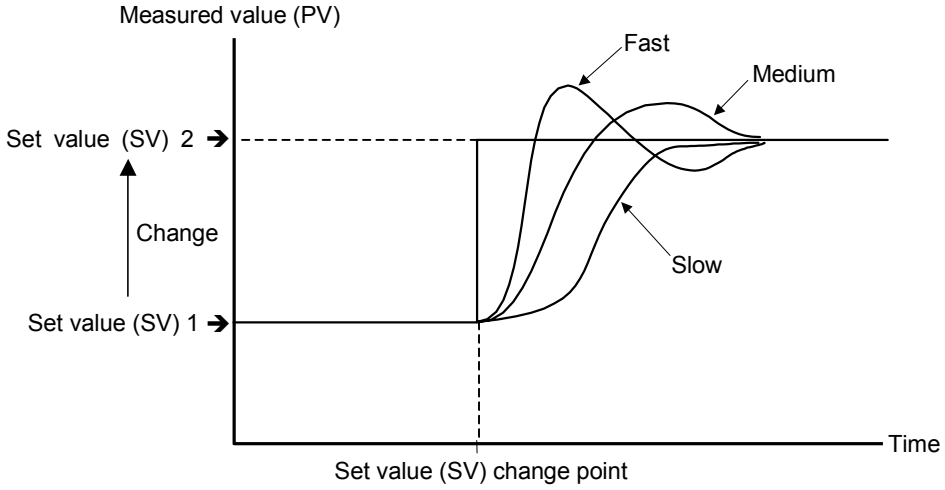
This item is the time of derivative action which prevents ripples by predicting output changes and thus improves control stability.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0.0 to 3600.0 seconds
0.00 to 360.00 seconds
0.0 (0.00): Derivative action OFF (PI action)
☞ A decimal point position selects with an **Integral/derivative time decimal point position (P. 92)**.
Factory set value: 10.00

Control response parameters	RKC communication identifier	CA
	MODBUS register address	ch1: 0014H (20) ch2: 1014H (4116)

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

Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: Slow
1: Medium
2: Fast
Factory set value: 0: Slow
Function: This is the function of enabling the setting of response to set value (SV) change in select any one of 3 steps (**Slow**, **Medium**, **Fast**) in PID control.
In order to achieve faster controlled object response to set value (SV) change, select **Fast**. However, slight overshoot is unavoidable when selecting **Fast**. Depending on the controlled object, specify **Slow** if overshoot should be avoided.



PV bias	RKC communication identifier	PB
	MODBUS register address	ch1: 0015H (21) ch2: 1015H (4117)

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

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: –Input span to +Input span
(Input span: Input scale low limit to Input scale high limit)
Factory set value: 0

Event 1 set value	RKC communication identifier	A1
	MODBUS register address	ch1: 0016H (22) ch2: 1016H (4118)
Event 2 set value	RKC communication identifier	A2
	MODBUS register address	ch1: 0017H (23) ch2: 1017H (4119)

This item is setting value of an event action.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: Deviation high/Deviation low: –Input span to +Input span
Deviation high/low, Band: 0 to Input span
Process high/Process low: Input scale low limit to Input scale high limit
(Input span: Input scale low limit to Input scale high limit)
Relational items: Event status (P. 71), Event differential gap (P. 120), Event type selection (P. 121), Event hold action (P. 123), Number of event delay times (P. 124)
Factory set value: 0

Operation mode	RKC communication identifier	EI
	MODBUS register address	ch1: 000FH (15) ch2: 100FH (4111)

This item selects Unused, Monitor or Control for each channel.

Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: Unused: Execute neither monitor nor the control
1: Monitor 1: Execute only data monitor
2: Monitor 2: Execute data monitor and an event action (include HBA and LBA)
3: Control: Execute the control
Relational items: Event LED mode setting (P. 89), Operation mode holding setting (P. 125)
Factory set value: 3: Control

Relationship between operation mode and program operation mode

- The program operation mode becomes "0: RESET (Reset mode)" when the operation mode is set to "0: Unused."
- It the operation mode is set to any mode other than "0: Unused" with the program operation mode set to "0: RESET (Reset mode)" or "2: FIX (fixed set point control)," it is set to the latter.
- The program operation mode becomes "1: Monitor 1" when the operation mode is set to "0: RESET (reset mode)."
- The program operation mode becomes "3: Control" when the operation mode is set to any mode other than "0: RESET (reset mode)."

Item	Operation [1]	Status	
		Operation mode	Program operation mode
Operation mode	Other than "Unused" → Unused	Unused	RESET
	Any mode → Other than "Unused"	Other than "Unused"	FIX [2]
Program operation mode	Other than "RESET" → RESET	Monitor 1	RESET
	Any mode → Other than "RESET"	Control	Other than "RESET"

[1] If must be set to the different mode before or after operation.

[2] This is valid only when the program run mode before operation is set to RESET or FIX.

PID/AT transfer	RKC communication identifier	G1
	MODBUS register address	ch1: 0020H (32) ch2: 1020H (4128)

This item transfers PID control and autotuning (AT).

Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: PID control operation
1: AT (Autotuning) operation
Relational items: AT differential gap time (P. 87), AT bias (P. 88)
Factory set value: 0: PID control operation
Function: Autotuning (AT) is the function which automatically measures, calculates and sets the optimum PID constants according to the set temperature. The following is the conditions necessary to carry out autotuning and the conditions which will cause the autotuning to stop.

Conditions necessary for autotuning:

The autotuning should be executed after satisfying all of the following conditions:

- Operation mode conditions:
  - Auto/Manual transfer (Identifier J1) → Auto mode
  - PID/AT transfer (Identifier G1) → PID control mode
  - Control RUN/STOP transfer (Identifier SR) → Control RUN mode
- The input value should not be an underscale or overscale displayed.
- The output limiter high limit should be more than 0.1 % and the output limiter low limit should be less than 99.9 %.
- When operation mode is set to "Control."

When the autotuning is finished, the display of each channel automatically returns to "0: PID control operation."

Conditions which will cause the autotuning to stop:

- When the temperature set value (SV) is changed.
- When the PV bias value is changed.
- When the AT bias value is changed.
- When transfer to Manual mode using the Auto/Manual transfer.
- When the input value becomes an underscale or overscale display.
- When the power is cut off.
- When FAIL occurs in the module.
- When transfer to the PID control mode by the PID/AT transfer.
- When operation mode is set to "Unused," "Monitor 1" or "Monitor 2."
- When the Control RUN/STOP function is changed to the "Control STOP" function.
- When executed a step action during program operation.

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

Auto/Manual transfer	RKC communication identifier	J1
	MODBUS register address	ch1: 0021H (33) ch2: 1021H (4129)

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

Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: Auto mode
1: Manual mode
Factory set value: 0: Auto mode

Relationship between Auto/Manual transfer and program peration mode

- The program operation mode becomes "2: FIX (fixed set point control mode)" when the Auto/Manual transfer is set to "0: Auto mode."
- The program operation mode becomes "3: MAN (manual control mode)" when the Auto/Manual transfer is set to "1: Manual mode."
- The Auto/Manual transfer becomes "1: Manual mode" when the program operation mode is set to "3: MAN (manual control mode)."
- The Auto/Manual transfer becomes "0: Auto mode" when the program operation mode is set to any mode Other than "3: MAN (manual control mode)."

Item	Operation *	Status	
		Auto/Manual	Program operation mode
Auto/Manual transfer	Auto → Manual	Manual	MAN
	Manual → Auto	Auto	FIX
Program operation mode	Other than "MAN" → MAN	Manual	MAN
	Any mode → Other than "MAN"	Auto	Other than "MAN"

* If must be set to the different mode before or after operation.

Manual output value	RKC communication identifier	ON
	MODBUS register address	ch1: 0022H (34) ch2: 1022H (4130)

This item is the output value in the manual control.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: Output limiter (low limit) to Output limiter (high limit)
Relational items: Output limiter (high limit/low limit) (P. 81)
Factory set value: 0.0

Output limiter (high limit)	RKC communication identifier	OH
	MODBUS register address	ch1: 0023H (35) ch2: 1023H (4131)
Output limiter (low limit)	RKC communication identifier	OL
	MODBUS register address	ch1: 0024H (36) ch2: 1024H (4132)

This item is the high limit value (or low limit value) of manipulated output.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: Output limiter (high limit): Output limiter (low limit) to 105.0 %
Output limiter (low limit): −5.0 % to Output limiter (high limit)
Relational items: Manipulated output value (P. 72), Output change rate limiter (up/down) (P. 126)
Factory set value: Output limiter (high limit): 100.0
Output limiter (low limit): 0.0

Proportional cycle time	RKC communication identifier	T0
	MODBUS register address	ch1: 0025H (37) ch2: 1025H (4133)

This item is proportional cycle time of control output.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0.2 to 50.0 seconds
Factory set value: 2.0


The invalidity in case of the voltage/current outputs.

Digital filter	RKC communication identifier	F1
	MODBUS register address	ch1: 0027H (39) ch2: 1027H (4135)

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

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0.00 to 10.00 seconds
0.00: Digital filter OFF
Factory set value: 0.00

Heater break alarm (HBA) set value	RKC communication identifier	A3
	MODBUS register address	ch1: 0028H (40) ch2: 1028H (4136)

This item is setting value of heater break alarm (HBA). HBA set value is set by referring to CT input measured value.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0.0 to 30.0 A (CT type: CTL-6-P-N)
0.0 to 100.0 A (CT type: CTL-12-S56-10L-N)
Relational items: Heater break alarm (HBA) status (P. 72), Current transformer input measured value (P. 73), Number of heater break alarm (HBA) delay times (P. 83)
Factory set value: 0.0
Function: The heater break alarm (HBA) function is used to detect the current flowing through the load (heater) by using a current transformer (CT), to compare the current thus detected to the heater break alarm set value, and thus to produce a heater break alarm when any of the following causes occurs.

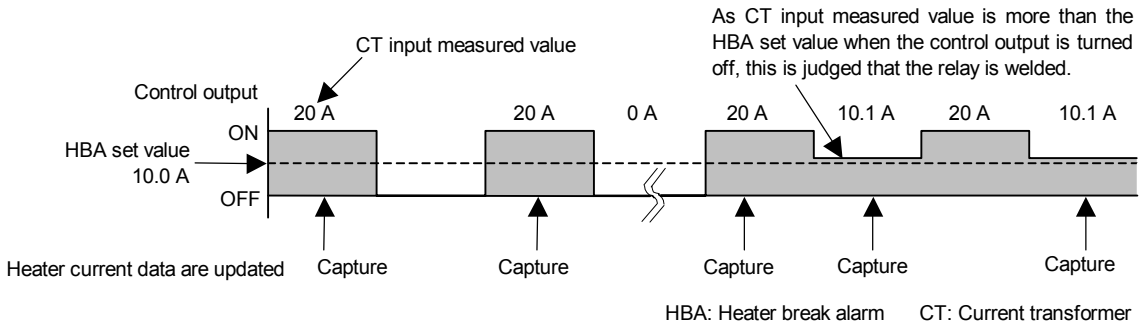
- When the heater current does not flow: Heater break or abnormality in the operating unit, etc.

When the control output is on and the current transformer (CT) input value is the HBA set value or less, the alarm is set up. However, heater break alarm does not action when control output ON time is 0.1 second or less.

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

When the control output is off and the current transformer (CT) input value is the HBA set value or more, the alarm is set up. However, heater break alarm does not action when control output OFF time is 0.1 second or less.

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



Number of heater break alarm (HBA) delay times	RKC communication identifier	DH
	MODBUS register address	ch1: 0029H (41) ch2: 1029H (4137)

It the number of heater break alarm (HBA) times continues its preset times (the number of sampling times), the heater break alarm is turned on.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 1 to 255 times
Relational items: Heater break alarm (HBA) status (P. 72), Current transformer input measured value (P. 73), Heater break alarm (HBA) set value (P. 72)
Factory set value: 5

Hot/cold start selection	RKC communication identifier	XN
	MODBUS register address	ch1: 002AH (42) ch2: 102AH (4138)

Select the start mode at power recovery.

Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: Hot start 1
1: Hot start 2
2: Cold start 1
3: Cold start 2
Relational items: Start determination point (P. 84)
Factory set value: 0
Function: Hot/cold start status

	Control status at restarting	Output value at restarting
Hot start 1	Same mode as that before power failure	Same as that before power failure
Hot start 2		Low limit value of output
Cold start 1	Start at MANUAL mode	
Cold start 2	Start at RESET mode	

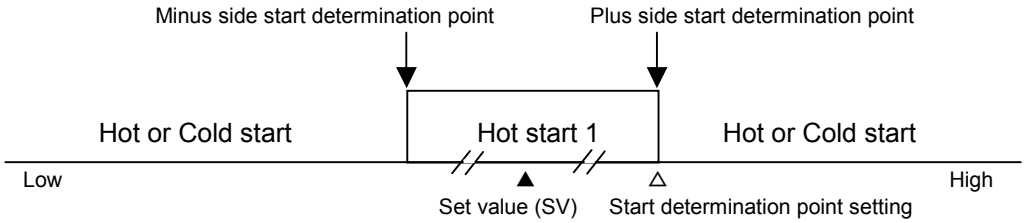
RESET mode: Control: Stop
Segment: Return to segment No.1
Time signal output: OFF
End output: OFF
Event: OFF
Set value (SV) : 0

Also when the program run mode is turned to RUN from RESET, the selection of Hot/Cold start becomes valid. However, even when "Hot start 1" is selected, the output starts from the low limit.

Start determination point	RKC communication identifier	SX
	MODBUS register address	ch1: 002BH (43) ch2: 102BH (4139)

This item is the determination point of the hot start. Setting is deviation setting with temperature setting value.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0 to Input span (Input span: Input scale low limit to Input scale high limit)
Relational items: Hot/cold start selection (P. 83)
Factory set value: 0
Function:
- The start status is determined according to the measured value (PV) level (deviation from set value) at power recovery.
- When the measured value (PV) is between the + (plus) and − (minus) side determination points, start power recovery always bscomes “Hot start 1.” (However, except “Cold start 2”)
- When the measured value (PV) is outside the determination points, operation starts in the start status selected by hot/cold start selection.



Control RUN/STOP transfer	RKC communication identifier	SR
	MODBUS register address	0030H (48)

This item transfers RUN and STOP of the control.

Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 1 (Data of each module)
Data range: 0: Control STOP
1: Control RUN
Factory set value: 0

The program goes progressing even when control stops. In order to stop the progress of the program, set the program run mode to RESET.

Input error determination point (high limit)	RKC communication identifier	AV
	MODBUS register address	ch1: 0031H (49) ch2: 1031H (4145)

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

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: Input scale low limit to Input scale high limit
Relational items: Input error determination point (low limit) (P. 85), Action at input error (high limit/low limit) (P. 85), Manipulated output value at input error (P. 86)
Factory set value: Input scale high limit

Input error determination point (low limit)	RKC communication identifier	AW
	MODBUS register address	ch1: 0032H (50) ch2: 1032H (4146)

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

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: Input scale low limit to Input scale high limit
Relational items: Input error determination point (high limit) (P. 85), Action at input error (high limit/low limit) (P. 85), Manipulated output value at input error (P. 86)
Factory set value: Input scale low limit

Action at input error (high limit)	RKC communication identifier	WH
	MODBUS register address	ch1: 0033H (51) ch2: 1033H (4147)
Action at input error (low limit)	RKC communication identifier	WL
	MODBUS register address	ch1: 0034H (52) ch2: 1034H (4148)

Selects the action when input measured value exceeds the input error determination point (high or low limit).

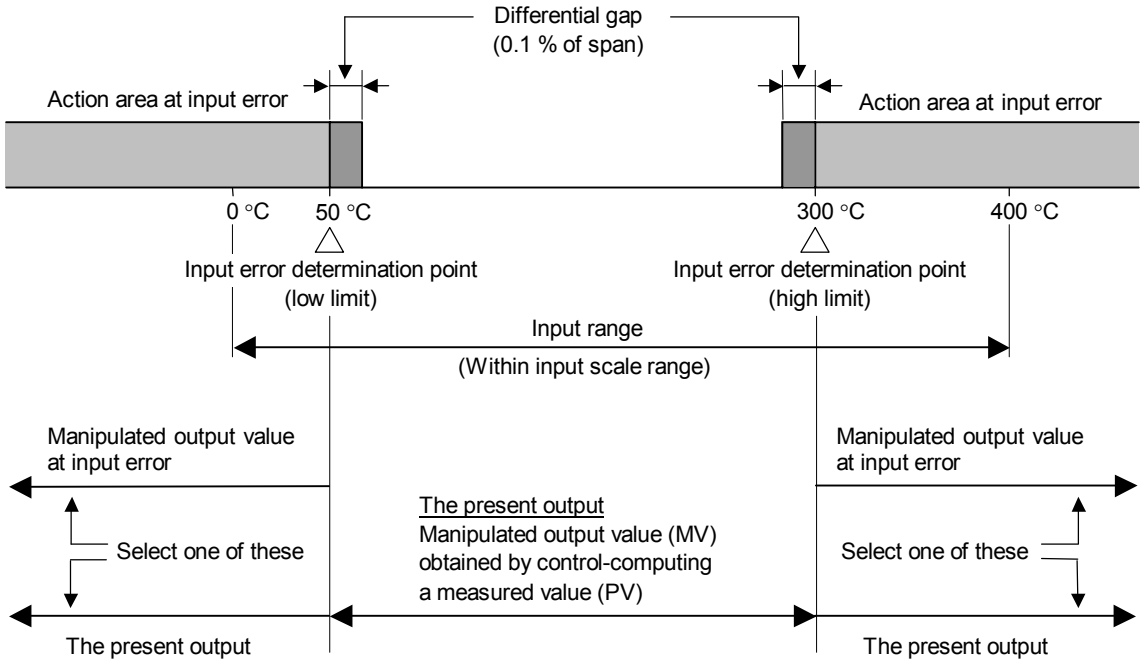
Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 2 (Data of each channel)

Continued on the next page.

Continued from the previous page.

Data range: 0: Normal control (The present output)
1: Manipulated output value at input error
Relational items: Input error determination point (high limit/low limit) (P. 85), Manipulated output value at input error (P. 86)
Factory set value: 0: Normal control (The present output)
Function: An example of the following explains input error determination point and action at input error.

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



Manipulated output value at input error	RKC communication identifier	OE
	MODBUS register address	ch1: 0035H (53) ch2: 1035H (4149)

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

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: Output limiter (low limit) to Output limiter (high limit)
Relational items: Input error determination point (high limit/low limit) (P. 85), Action at input error (high limit/low limit) (P. 85)
Factory set value: 0.0

AT differential gap time	RKC communication identifier	GH
	MODBUS register address	ch1: 0036H (54) ch2: 1036H (4150)

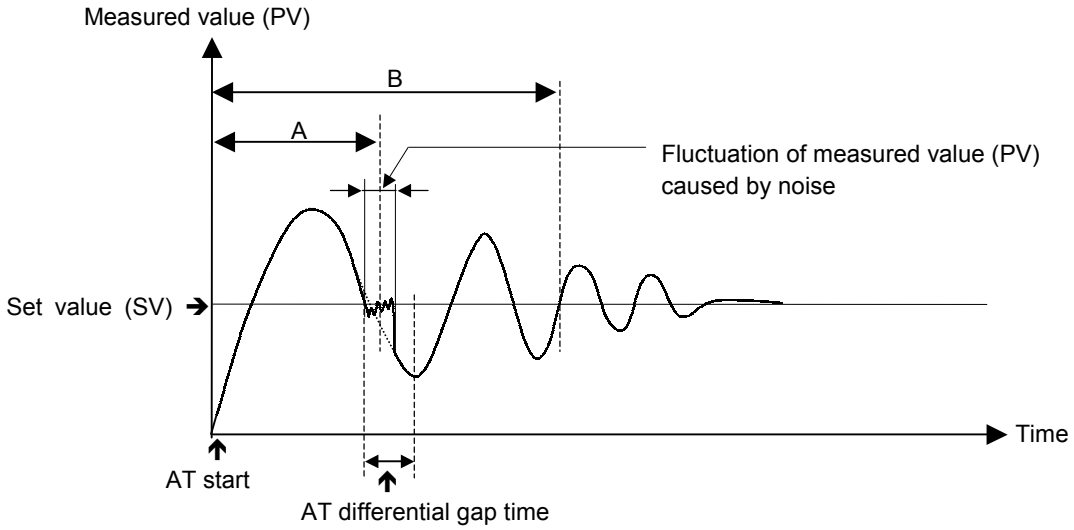
This item is for setting the desired ON/OFF action differential gap time when the autotuning function is activated. This prevents the AT function from malfunctioning caused by noise.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0.00 to 50.00 seconds
Relational items: PID/AT transfer (P. 79)
Factory set value: 0.10
Function: In order to prevent the output from chattering due to the fluctuation of a measured value (PV) caused by noise when the autotuning (AT) function is activated, the output on or off state is held until "AT differential gap time" passes after the output on/off state is selected. Set "AT differential gap time" to "1/100 × Time required for temperature rise."

[Example]

A: AT cycle time at an AT differential gap time of 0.00 second
If the output chatters due to the fluctuation of a measured value (PV) caused by noise, the AT function is likely to be terminated halfway.

B: AT cycle time when the AT differential gap time is set to "Time corresponding to 0.25 cycles"
The fluctuation of a measured value (PV) caused by noise is ignored and as a result the normal AT function is activated.



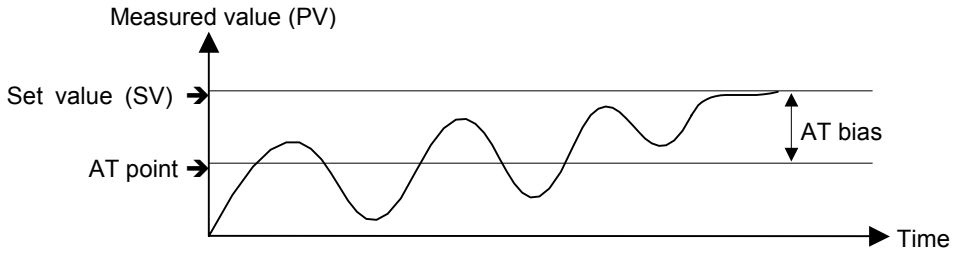
The AT cycle of SRX is 2 cycles.

AT bias	RKC communication identifier	GB
	MODBUS register address	ch1: 0038H (56) ch2: 1038H (4152)

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

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: –Input span to +Input span
(Input span: Input scale low limit to Input scale high limit)
Relational items: PID/AT transfer (P. 79)
Factory set value: 0
Function: The AT bias is set when the autotuning function in which the measured value (PV) does not exceed the set value (SV) is activated. Our autotuning method performs ON/OFF control centering around the set value (SV), then calculates and sets each of the PID constants by hunting the measured value (PV). However, overshooting caused by this hunting may not be preferable depending on the controlled object. In such a case, the desired AT bias is set.
If it is set, another set value (SV) to activate the autotuning function [AT point] can be set.

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



Remote/Local transfer	RKC communication identifier	C1
	MODBUS register address	003BH (59)

This item transfers the remote mode and the local mode. For the remote mode, the input of channel 2 (the remote input) becomes set value (SV) of channel 1.

Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 1 (Data of each module)
Data range: 0: Local mode
1: Remote mode
Factory set value: 0: Local mode

For the remote mode, the input of channel 2 corresponds to a scale of channel 1.
[Example] Channel 1 input scale range: 0 to 400 °C
Channel 2 input (remote input): 0 to 10 V
- Channel 2 input: 10 V → Channel 1 set value: 400 °C
- Channel 2 input: 5 V → Channel 1 set value: 200 °C

Event LED mode setting	RKC communication identifier	XH
	MODBUS register address	003CH (60)

This item is for selecting the indicating details of 4 EVENT lamps located at the front of the module.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 1 (Data of each module)
Data range: 0: Unused (No display)
1: Mode 1
2: Mode 2
3: Mode 3
10: Mode 10
11: Mode 11
12: Mode 12
13: Mode 13
Except the above: Unused
Factory set value: 0 (No display)
Function: Relationship between the content of each mode and each EVENT lamp

Mode	EVENT 1 lamp	EVENT 2 lamp	EVENT 3 lamp	EVENT 4 lamp
1	ch1 Event 1	ch1 Event 2	ch2 Event 1	ch2 Event 2
2	ch1 Comprehensive event [1]	ch2 Comprehensive event [1]	ch1 Output status [2]	ch2 Output status [2]
3	ch1 Comprehensive event [1]	ch2 Comprehensive event [1]	ch1 Control status [3]	ch2 Control status [3]
10	ch1 Execution segment (Sixteen segments are expressed in combination of these lamps.) [4]			
11	ch2 Execution segment (Sixteen segments are expressed in combination of these lamps.) [4]			
12	ch1 Time signal 1	ch1 Time signal 2	ch1 Time signal 3	ch1 Time signal 4
13	ch2 Time signal 1	ch2 Time signal 2	ch2 Time signal 3	ch2 Time signal 4

[1] If any one of burnout, event 1, event 2, heater break alarm and control loop break alarm is turned on, the comprehensive event is turned on (lit).

[2] For voltage output/current output, it is always turned off (extinguished).

[3] When "Control RUN/STOP" is set to "Control RUN" and the operation mode is set to "Control," it is turned on (lit).

[4] Relationship between EVENT lamp lighting state and segment number

Segment No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
EVENT 1 lamp	–	×	–	×	–	×	–	×	–	×	–	×	–	×	–	×
EVENT 2 lamp	–	–	×	×	–	–	×	×	–	–	×	×	–	–	×	×
EVENT 3 lamp	–	–	–	–	×	×	×	×	–	–	–	–	×	×	×	×
EVENT 4 lamp	–	–	–	–	–	–	–	–	×	×	×	×	×	×	×	×

×: ON –: OFF

Control loop break alarm (LBA) use selection	RKC communication identifier	HP
	MODBUS register address	ch1: 0859H (2137) ch2: 1859H (6233)

This item is for selecting the use/unused of control loop break alarm.

Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: Unused
1: Used
Relational items: Control loop break alarm (LBA) status (P. 72), Control loop break alarm (LBA) time (P. 90), Control loop break alarm (LBA) deadband (P. 91)
Factory set value: 0: Unused
Function: The control loop break alarm (LBA) function is used to detect a load (heater) break or a failure in the external actuator (magnet relay, etc.), or a failure in the control loop caused by an input (sensor) break.
This function monitors the measured value (PV) variation at LBA time intervals from the time the output exceeds 100 % (or output limiter: high limit) or falls below 0 % (or output limiter: low limit), then detects a heater or input break.

[Alarm action]

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

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

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

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

Control loop break alarm (LBA) time	RKC communication identifier	C6
	MODBUS register address	ch1: 085AH (2138) ch2: 185AH (6234)

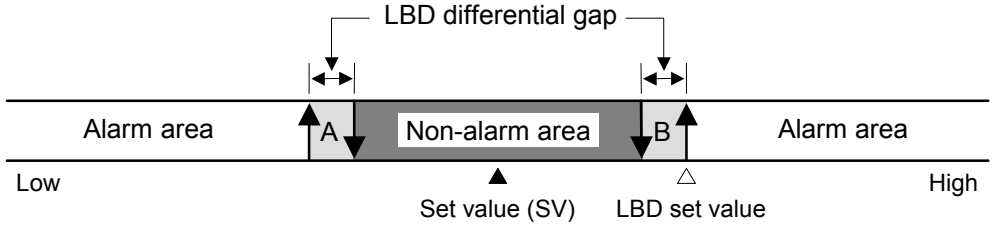
The variation of measured value (PV) is monitored for each control loop break alarm (LBA) time.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 1 to 7200 seconds
Relational items: Control loop break alarm (LBA) status (P. 72), Control loop break alarm (LBA) use selection (P. 90), Control loop break alarm (LBA) deadband (P. 91)
Factory set value: 480

Control loop break alarm (LBA) deadband	RKC communication identifier	V2
	MODBUS register address	ch1: 085BH (2139) ch2: 185BH (6235)

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

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0 to Input span (Input span: Input scale low limit to Input scale high limit)
Relational items: Control loop break alarm (LBA) status (P. 72), Control loop break alarm (LBA) use selection (P. 90), Control loop break alarm (LBA) time (P. 90)
Factory set value: 0
Function: The LBA may be produced by disturbances (other heat sources) even if the control system is not abnormal. In such a case, an area in which no alarm is produced can be set by setting the desired LBA deadband (LBD).
When the measured value (PV) is within the LBD area, no alarm is produced even if all of the conditions to produce the alarm are satisfied. Therefore, carefully set the LBD.



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

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

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

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

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

Integral/derivative time decimal point position	RKC communication identifier	PK
	MODBUS register address	ch1: 085CH (2140) ch2: 185CH (6236)

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

Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: 2 digits below decimal point
1: 1 digit below decimal point
Relational items: Integral time (P. 75), Derivative time (P. 75)
Factory set value: 0: 2 digits below decimal point

Initial setting mode	RKC communication identifier	IN
	MODBUS register address	085FH (2143)

It is necessary to transfer the initial setting mode when read and write the initial setting data.

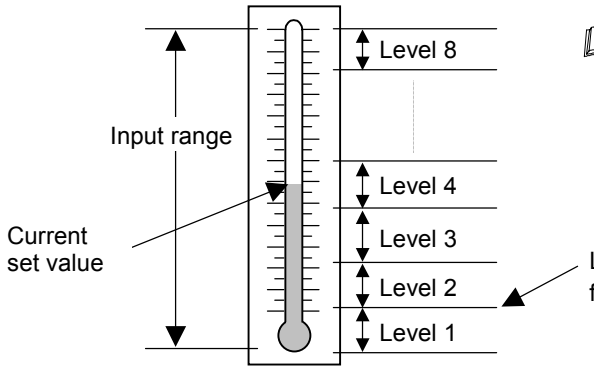
Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 1 (Data of each module)
Data range: 0: Normal setting mode
1: Initial setting mode
Factory set value: 0: Normal setting mode


When “Control RUN/STOP” is set to “Control RUN” and the program operation mode is set to RUN, no initial set mode can be set.


For initial setting data, see **8.4 Initial Setting Data (P. 115)**.

8.2 Level PID Data Items

The level PID function divides the input range into 8 levels or less and sets level PID data items to each level in advance. Level PID data items used differ depending on what level number zone the set value exists in.

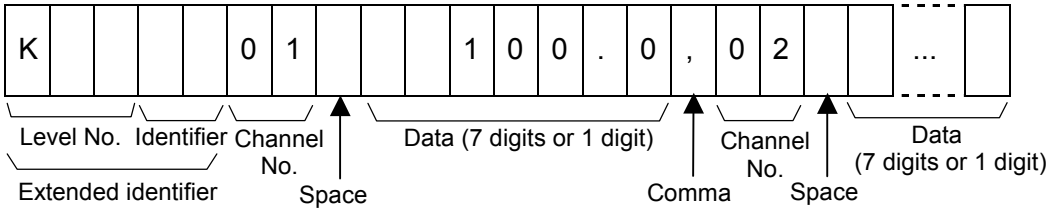


The level number zone is determined by setting the "level PID high limit set value" corresponding to each level.

■ Setting method of a level

● RKC communication

"Level No." (K is prefixed) is specified before each identifier. This "Level No." together with the "identifier" is called "Extended identifier."



If no level number is specified, data item in the level number zone in which the set value is now entered are specified. AS the current set value is entered in "Level 4" in the above level PID illustration, level PID data items in "Level 4" are specified.

● MODBUS

Eight addresses are assured for each data item and the data item in the address with the smallest number corresponds to that in "Level 1."

[Example] Proportional band addresses in channel 1 correspond to 0058H to 005FH. Each level corresponds as follows.

Address	0058H	0059H	005AH	005BH	005CH	005DH	005EH	005FH
Level	1	2	3	4	5	6	7	8

■ Data description

Proportional band	RKC communication expansion identifier	KxxP1 (Kxx: Level No.)
	MODBUS register address	ch1: 0058H to 005FH (88 to 95) ch2: 1058H to 105FH (4184 to 4191)

This item is the proportional band of the PI and PID control.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: TC/RTD input: 0 (0.0) to Input span
Voltage/current input: 0.0 to 1000.0 % of input span
0 (0.0): ON/OFF action
(Input span: Input scale low limit to Input scale high limit)
Factory set value: TC/RTD input: 10.0 °C
Voltage/current input: 10.0 %

Integral time	RKC communication expansion identifier	KxxI1 (Kxx: Level No.)
	MODBUS register address	ch1: 0060H to 0067H (96 to 103) ch2: 1060H to 1067H (4192 to 4199)

This item is the time of integral action which eliminates the offset occurring in proportional control.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0.1 to 3600.0 seconds
0.01 to 360.00 seconds
☞ A decimal point position selects with an **Integral/derivative time decimal point position (P. 92)**.
Factory set value: 40.00

Derivative time	RKC communication expansion identifier	KxxD1 (Kxx: Level No.)
	MODBUS register address	ch1: 0068H to 006FH (104 to 111) ch2: 1068H to 106FH (4200 to 4207)

This item is the time of derivative action which prevents ripples by predicting output changes and thus improves control stability.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0.0 to 3600.0 seconds
0.00 to 360.00 seconds
0.0 (0.00): Derivative action OFF (PI action)
☞ A decimal point position selects with an **Integral/derivative time decimal point position (P. 92)**.
Factory set value: 10.00

Control response parameters	RKC communication expansion identifier	KxxCA (Kxx: Level No.)
	MODBUS register address	ch1: 0070H to 0077H (112 to 119) ch2: 1070H to 1077H (4208 to 4215)

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

Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: Slow
1: Medium
2: Fast
Factory set value: 0: Slow

Level PID high limit set value	RKC communication expansion identifier	KxxPW (Kxx: Level No.)
	MODBUS register address	ch1: 00B0H to 00B7H (176 to 183) ch2: 10B0H to 10B7H (4272 to 4279)

This item is the high limit value of each level area.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: Input scale low limit to Input scale high limit
Factory set value: Input scale high limit

8.3 Program Control Data Items

Four kinds of data items are available for program control data items: normal, pattern group, segment group and time signal group data items.

■ Normal data items

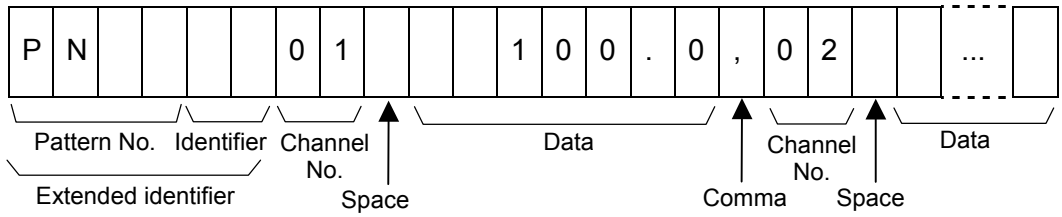
For three kinds of pattern group, segment group and time signal group data items, it is necessary to specify pattern, segment and time signal numbers. However for normal data items, it is not necessary to specify these numbers. These data items can be sent in the same procedure as in **8.1 Normal Setting Data Items (P. 70)**.

■ Pattern group data items

For pattern group data items, it is necessary to specify the pattern numbers.

● RKC communication

"Pattern No." (PN is prefixed) is specified before each identifier. This "Pattern No." together with the "Identifier" is called "Extended identifier."



● MODBUS

For each data item, 16 addresses are assured and the data item in the address with the smallest number corresponds to that in "pattern 1."

[Example] "Setting of the number of program execution times" addresses in channel 1 correspond to 00F0H to 00FFH. Each pattern corresponds as follows.

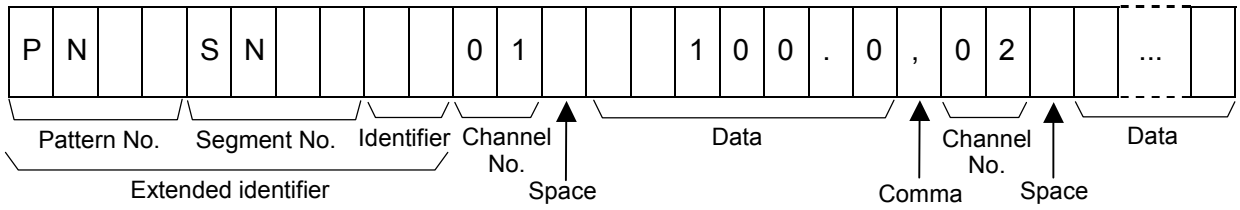
Address	00F0H	00F1H	00F2H	00F3H	…	00FCH	00FDH	00FEH	00FFH
Pattern No.	1	2	3	4	…	13	14	15	16

■ Segment group data items

For segment group data items, it is necessary to specify the pattern and segment numbers.

● RKC communication

"Pattern No." (PN is prefixed) and "Segment No." (SN is prefixed) are specified before each identifier. This "Pattern No." and "Segment No." together with the "Identifier" are called "Extended identifier."



● MODBUS

For each data item, 256 addresses are assured and the data item in the address with the smallest number corresponds to the pattern No. 1/segment No. 1 data item. Hereafter, the address number goes increasing until the segment number reaches No. 16 with the pattern number left as it is.
The data item in address next to pattern No. 1/segment No. 16 corresponds to the pattern No. 2/ segment No. 1 data item. Hereafter, the address number goes increasing in the same way as for pattern No. 1 and the data item in the address with the largest number corresponds to the pattern No. 16/ segment No. 16 data item.

[Example] "Segment level" addresses in channel 1 correspond to 0140H to 023FH. Each pattern No./segment No. corresponds as follows.

Address	0140H	0141H	0142H	0143H	…	014CH	014DH	014EH	014FH
Pattern No./ Segment No.	1/1	1/2	1/3	1/4	…	1/13	1/14	1/15	1/16

0150H	0151H	0152H	0153H	…	015CH	015DH	015EH	015FH
2/1	2/2	2/3	2/4	…	2/13	2/14	2/15	2/16

⋮

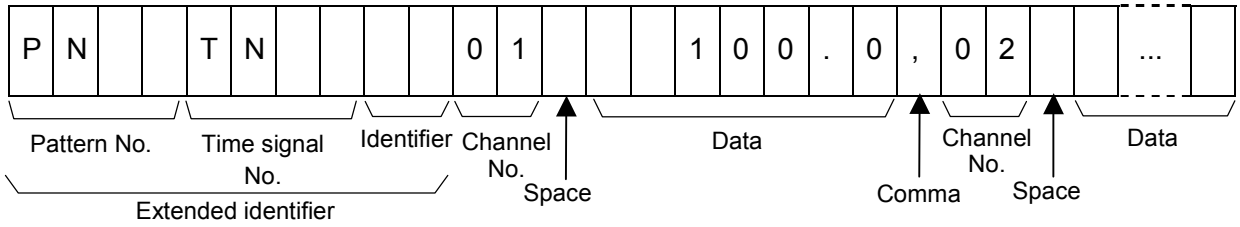
0230H	0231H	0232H	0233H	…	023CH	023DH	023EH	023FH
16/1	16/2	16/3	16/4	…	16/13	16/14	16/15	16/16

■ Time signal group data items

For time signal group data items, it is necessary to specify the pattern and time signal numbers.

● RKC communication

"Pattern No." (PN is prefixed) and "Time signal No." (TN is prefixed) are specified before each identifier. This "Pattern No." and "Time signal No." together with the "Identifier" are called "Extended identifier."



● MODBUS

For each data item, 256 addresses are assured and the data item in the address with the smallest number corresponds to the pattern No. 1/time signal No. 1 data item. Hereafter, the address number goes increasing until the time signal number reaches No. 16 with the pattern number left as it is.
The data item in address next to pattern No. 1/time signal No. 16 corresponds to the pattern No. 2/time signal No. 1 data item. Hereafter, the address number goes increasing in the same way as for pattern No. 1 and the data item in the address with the largest number corresponds to the pattern No. 16/ time signal No. 16 data item.

[Example] "Time signal output number" addresses in channel 1 correspond to 0340H to 043FH. Each pattern No./time signal No. corresponds as follows.

Address	0340H	0341H	0342H	0343H	…	034CH	034DH	034EH	034FH
Pattern No./ Time signal No.	1/1	1/2	1/3	1/4	…	1/13	1/14	1/15	1/16

0350H	0351H	0352H	0353H	…	035CH	035DH	035EH	035FH
2/1	2/2	2/3	2/4	…	2/13	2/14	2/15	2/16

⋮

0430H	0431H	0432H	0433H	…	043CH	043DH	043EH	043FH
16/1	16/2	16/3	16/4	…	16/13	16/14	16/15	16/16

■ Data description

Program operation mode selection	RKC communication identifier	XM
	MODBUS register address	ch1: 00D0H (208) ch2: 10D0H (4304)

Transfer the operation mode in program control.

Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: RESET (Reset mode)
1: RUN (Program control mode)
2: FIX (Fixed set point control mode)
3: MAN (Manual control mode)
Factory set value: 2: FIX (Fixed control mode)
Function:
- RESET (Reset mode)
  Stop control and return the segment number to No. 1.
  Turn off the time signal output and the end output.
  An event becomes OFF.
  A set value becomes 0.
- RUN (Program control mode)
  Execute program control.
- FIX (Fixed set point control mode)
  Execute fixed set point.
- MAN (Manual control mode)
  Manual control can be performed.

Relationship between operation mode, Auto/Manual transfer and program operation mode

- The program operation mode becomes “0: RESET (Reset mode)” when the operation mode is set to “0: Unused.”
- It the operation mode is set to any mode other than “0: Unused” with the program operation mode set to “0: RESET (Reset mode)” or “2: FIX (fixed set point control),” it is set to the latter.
- The program operation mode becomes “2: FIX (fixed set point control mode)” when the Auto/Manual transfer is set to “0: Auto mode.”
- The program operation mode becomes “3: MAN (manual control mode)” when the Auto/Manual transfer is set to “1: Manual mode.”
- The program operation mode becomes “1: Monitor 1” when the operation mode is set to “0: RESET (reset mode).”
- The program operation mode becomes “3: Control” when the operation mode is set to any mode other than “0: RESET (reset mode).”
- The Auto/Manual transfer becomes “1: Manual mode” when the program operation mode is set to “3: MAN (manual control mode).”
- The Auto/Manual transfer becomes “0: Auto mode” when the program operation mode is set to any mode other than “3: MAN (manual control mode).”

Continued on the next page.

Continued from the previous page.

Item	Operation [1]	Status		
		Operation mode	Auto/Manual	Program operation mode
Operation mode	Other than "Unused" → Unused	Unused	Do not change	RESET
	Any mode → Other than "Unused"	Other than "Unused"	Do not change	FIX [2]
Auto/Manual transfer	Auto → Manual	Do not change	Manual	MAN
	Manual → Auto	Do not change	Auto	FIX
Program operation mode	Other than "RESET" → RESET	Monitor 1	Auto	Other than "RESET"
	Other than "MAN" → MAN	Control	Manual	MAN
	Any mode → Other than "MAN"	Control	Auto	Other than "MAN"

[1] If must be set to the different mode before or after operation.

[2] This is valid only when the program run mode before operation is set to RESET or FIX.

Execution pattern	RKC communication identifier	PS
	MODBUS register address	ch1: 00D1H (209) ch2: 10D1H (4305)

Only when the program operation mode is set to RESET, the pattern number needing to be executed is set. The pattern number under execution is monitored during program execution. No setting can be made during program execution.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 1 to 16
Factory set value: 1

Execution segment	RKC communication identifier	SN
	MODBUS register address	ch1: 00D2H (210) ch2: 10D2H (4306)

The segment number now under program execution is monitored.

Attribute: RO (Read only)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 1 to 16
Relational items: Event LED mode setting (P. 89)
Factory set value: —

Segment remaining time	RKC communication identifier	TR
	MODBUS register address	ch1: 00D3H (211) ch2: 10D3H (4307)

The segment remaining time now under program execution is monitored.

Attribute: RO (Read only)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0.00 to 300.00 seconds
0.0 to 3000.0 seconds
0 to 30000 seconds
0 to 30000 minutes
☞ The time unit is selected with **Segment time unit setting (P.125)**.
Factory set value: —

Number of program execution times	RKC communication identifier	RT
	MODBUS register address	ch1: 00D4H (212) ch2: 10D4H (4308)

Number of program execution times now under program execution is monitored.

Attribute: RO (Read only)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0 to 9999 times
Factory set value: —

Time signal output status 1	RKC communication identifier	T8
	MODBUS register address	ch1: 00D5H (213) ch2: 10D5H (4309)
Time signal output status 2	RKC communication identifier	T9
	MODBUS register address	ch1: 00D5H (213) ch2: 10D5H (4309)

The time signal output status is expressed in bit data.
For RKC communication, "Time signal output status 1" monitors the state of time signal Nos. 1 to 8 while "Time signal output status 2," the state of time signal Nos. 9 to 16.
For MODBUS, the time signal output status is displayed in one address.

Attribute: RO (Read only)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range:

- RKC communication

  0 to 255 (bit data)
  Each time signal status is assigned as a bit image in binary numbers.
  However, send data from the SRX be changed to decimal ASCII code from the bit image in binary numbers.

  Bit image: 00000000
  bit 7 ····· bit 0

  Bit data: 0: OFF 1: ON

  bit 0: Time signal No. 1 (No. 9)
  bit 1: Time signal No. 2 (No. 10)
  bit 2: Time signal No. 3 (No. 11)
  bit 3: Time signal No. 4 (No. 12)
  bit 4: Time signal No. 5 (No. 13)
  bit 5: Time signal No. 6 (No. 14)
  bit 6: Time signal No. 7 (No. 15)
  bit 7: Time signal No. 8 (No. 16)
  ( ): For time signal output status 2

- MODBUS

  0000H to FFFFH (bit data)
  Each time signal status is assigned as a bit image in binary numbers.

  Bit image: 0000000000000000 Bit data: 0: OFF 1: ON
  bit 15 ····· bit 0

  bit 0: Time signal No. 1
  bit 1: Time signal No. 2
  bit 2: Time signal No. 3
  bit 3: Time signal No. 4
  bit 4: Time signal No. 5
  bit 5: Time signal No. 6
  bit 6: Time signal No. 7
  bit 7: Time signal No. 8
  bit 8: Time signal No. 9
  bit 9: Time signal No. 10
  bit 10: Time signal No. 11
  bit 11: Time signal No. 12
  bit 12: Time signal No. 13
  bit 13: Time signal No. 14
  bit 14: Time signal No. 15
  bit 15: Time signal No. 16

Relational items: Event LED mode setting (P. 89)
Factory set value: —

Pattern end output status	RKC communication identifier	EO
	MODBUS register address	ch1: 00D6H (214) ch2: 10D6H (4310)

The pattern end output status output at the end of program operation is monitored.
It is turned on at the end of program operation. Time to be turned on can be set by setting the pattern end output time.

Attribute: RO (Read only)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: Pattern end output OFF
1: Pattern end output ON
Factory set value: —

End status	RKC communication identifier	EN
	MODBUS register address	ch1: 00D7H (215) ch2: 10D7H (4311)

The state at the end of program operation is monitored.
It is turned on at the end of program operation. The state of being turned on is kept until the program is executed again.

Attribute: RO (Read only)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: End status OFF
1: End status ON
Factory set value: —

Wait status	RKC communication identifier	WT
	MODBUS register address	ch1: 00D8H (216) ch2: 10D8H (4312)

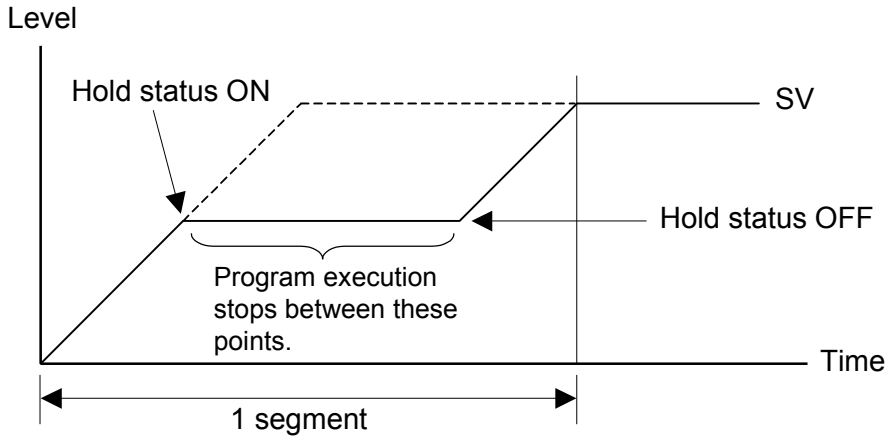
Program operation is turned on in the wait state.

Attribute: RO (Read only)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: Wait status OFF
1: Wait status ON
Relational items: Wait zoon (P. 109)
Factory set value: —

Hold status	RKC communication identifier	HO
	MODBUS register address	ch1: 00D9H (217) ch2: 10D9H (4313)

The program stops its progress temporarily. This function becomes valid during program operation.

Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: Hold status OFF
1: Hold status ON
Factory set value: 0: Hold status OFF
Function: The program stops its progress temporarily if the hold status is turned on. In addition, the program re-starts from the temporarily stopped point if the hold status is turned off.

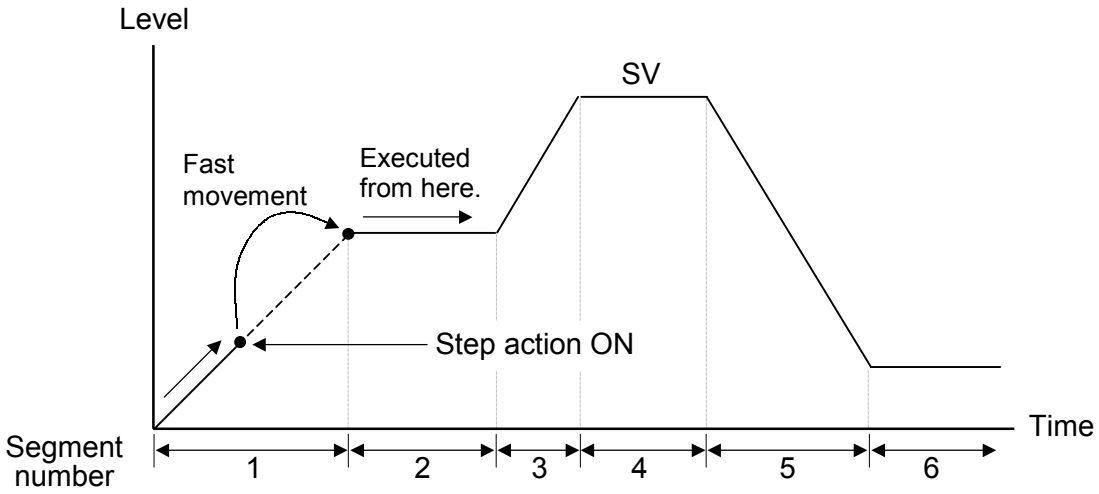


The hold status is not released if set to any of other program operation modes (FIX or MAN).

Step action	RKC communication identifier	SK
	MODBUS register address	ch1: 00DAH (217) ch2: 10DAH (4313)

The program progresses by one segment. This function becomes valid during program operation.

Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: Not step action
1: Step action execution
Factory set value: 0: Not step action
Function: Used when control needs to be performed by jumping to the next segment. One segment progresses by the setting per once.

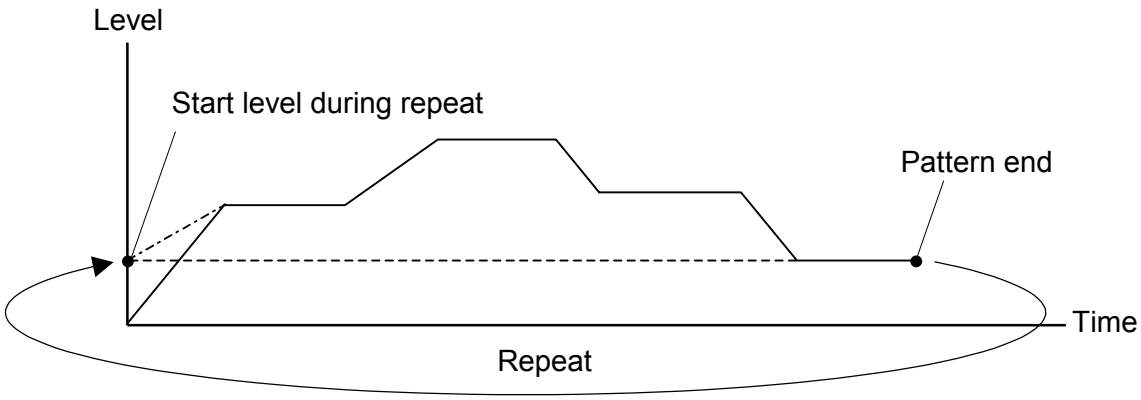


The step action cannot be used in the hold state.

Setting of the number of program execution times (Pattern group data)	RKC communication expansion identifier	PNxxRR (PNxx: Pattern No.)
	MODBUS register address	ch1: 00F0H to 00FFH (240 to 255) ch2: 10F0H to 10FFH (4336 to 4351)

This is the number of program execution times (the number of repeating times) per pattern.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 1 to 1000 times
1000: Number of infinite times
Factory set value: 1
Function: The start level when the pattern is repeated is the same as the level at the pattern end.



When the pattern is repeated, the pattern end output signal is output for about 0.5 seconds regardless of the pattern end output time setting.

End segment (Pattern group data)	RKC communication expansion identifier	PNxxPE (PNxx: Pattern No.)
	MODBUS register address	ch1: 0100H to 010FH (256 to 271) ch2: 1100H to 110FH (4352 to 4367)

This item is the end segment of program pattern.

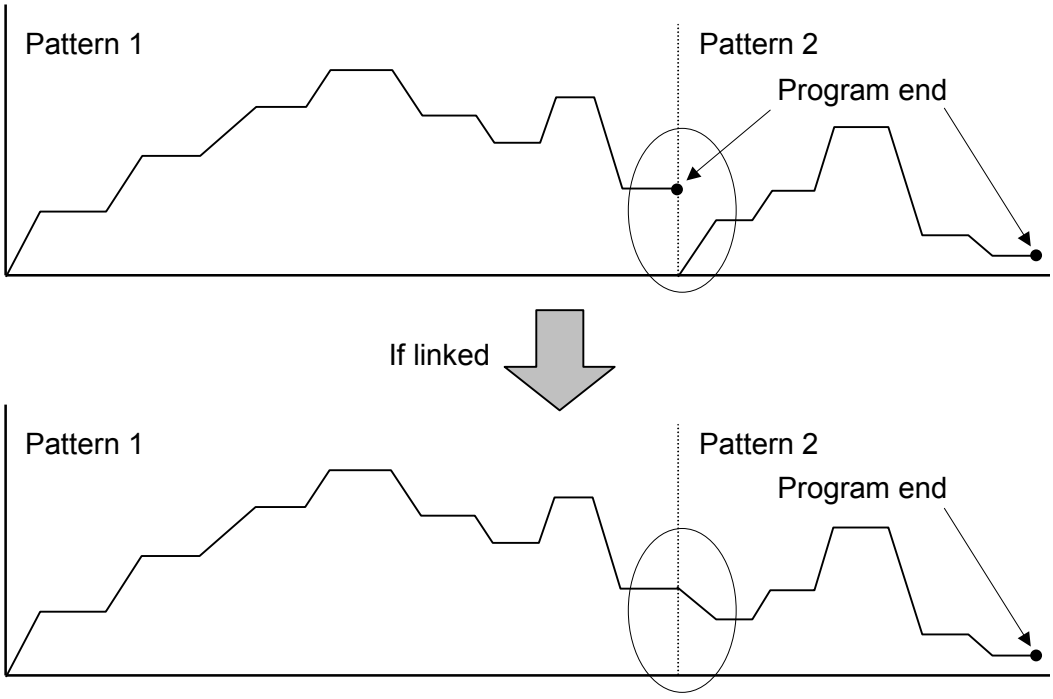
Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 1 to 16
Factory set value: 16

Link pattern (Pattern group data)	RKC communication expansion identifier	PNxxLP (PNxx: Pattern No.)
	MODBUS register address	ch1: 0110H to 011FH (272 to 287) ch2: 1110H to 111FH (4368 to 4383)

This item is a link point number of program pattern.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0 to 16
0: Not link pattern
Factory set value: 0
Function: One program pattern consists of up to 16 segments.
A program pattern consisting of more than 16 segments can be created by linking these program patterns.

[Example] When linked pattern 1 and pattern 2



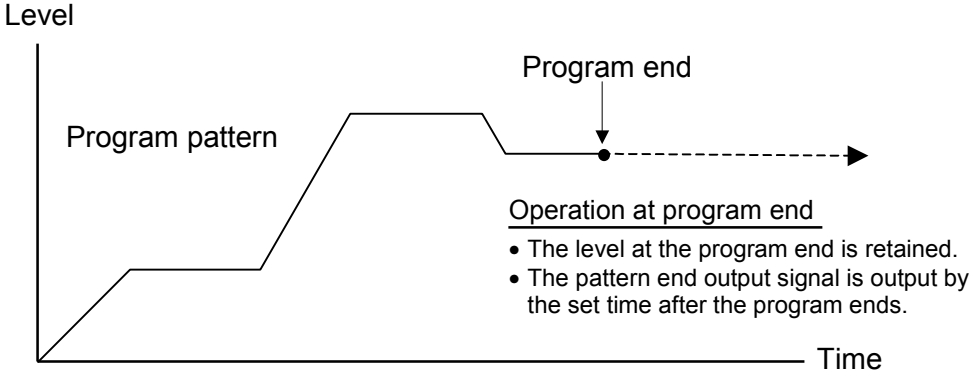
Pattern end output time (Pattern group data)	RKC communication expansion identifier	PNxxET (PNxx: Pattern No.)
	MODBUS register address	ch1: 0120H to 012FH (288 to 303) ch2: 1120H to 112FH (4384 to 4399)

This is the time when the pattern end output signal is turned on at the end of the program pattern.

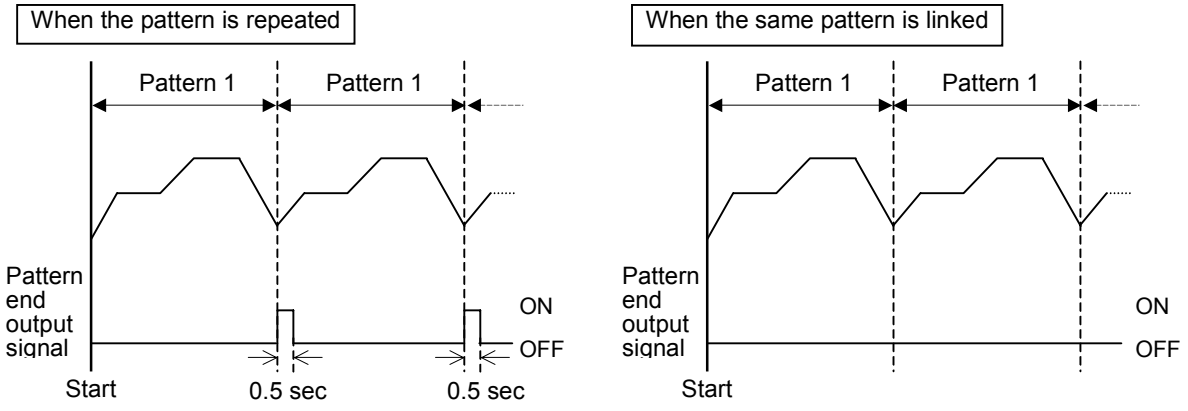
Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0.00 to 300.00 seconds
0.0 to 3000.0 seconds
0 to 30000 seconds
0 to 30000 minutes
0: The state where the pattern end output signal is turned on continues until reset or the power supply is turned off (the same for 0.0 and 0.00).

☞ The time unit is selected with **Segment time unit setting (P.125)**.

Factory set value: 0.00
Function: After the program ends, the pattern end output signal is output. The ON time of this pattern end output signal can be set.



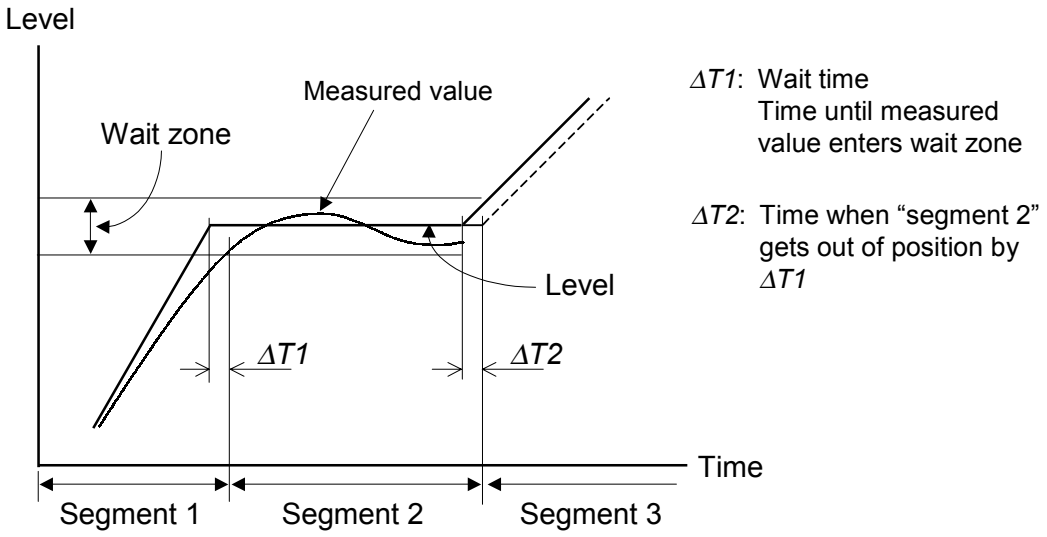
📖 When the pattern is repeated by setting the number of program execution times, the pattern end output signal is output for about 0.5 sec regardless of the pattern end output time setting. Linking the same patterns results in the same program shape as in pattern repetition but no pattern end output signal is output.



Wait zone (Pattern group data)	RKC communication expansion identifier	PNxxZW (PNxx: Pattern No.)
	MODBUS register address	ch1: 0130H～013FH (304～319) ch2: 1130H～113FH (4400～4415)

This is an area where the program stops to wait for moving to the next segment when a measured value is difficult to follow the progress of the program.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0 to Input span (Input span: Input scale low limit to Input scale high limit)
Factory set value: 0.0
Function: When the measured value is difficult to follow the progress of the program, the program stops to wait for moving to the next program until the measured value enters the wait zone by setting the wait zone to stop the program at each end of the relevant segment.



The actual wait zone is obtained by distributing the wait zone set value to the plus and minus sides centering around the segment level.
For example, if at a segment level of 100 °C and a wait zone set value of 10 °C, the actual wait zone becomes 90 to 110 °C.

If step action is taken in the wait state, the program segment now in the wait state progress to the next.

Segment level (Segment group data)	RKC communication expansion identifier	PNxxSNxxLE (PNxx: Pattern No.) (SNxx: Segment No.)
	MODBUS register address	ch1: 0140H to 023FH (320 to 575) ch2: 1140H to 123FH (4416 to 4671)

This is the segment level of the program pattern.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: Input scale low limit to Input scale high limit
Factory set value: 0

Segment time (Segment group data)	RKC communication expansion identifier	PNxxSNxxTM (PNxx: Pattern No.) (SNxx: Segment No.)
	MODBUS register address	ch1: 0240H to 033FH (576 to 831) ch2: 1240H to 133FH (4672 to 4927)

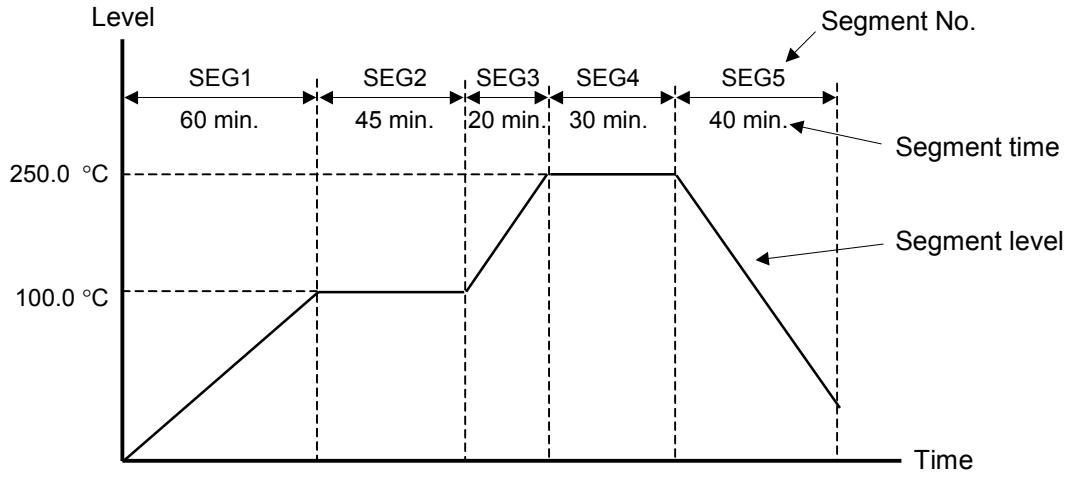
This is the segment time of the program pattern.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0.00 to 300.00 seconds
0.0 to 3000.0 seconds
0 to 30000 seconds
0 to 30000 minutes

☞ The time unit is selected with **Segment time unit setting (P.125)**.

Factory set value: 0.00

[Segment level and Segment time]



Time signal output number (Time signal group data)	RKC communication expansion identifier	PNxxTNxxRE (PNxx: Pattern No.) (TNxx: Time signal No.)
	MODBUS register address	ch1: 0340H to 043FH (832 to 1087) ch2: 1340H to 143FH (4928 to 5183)

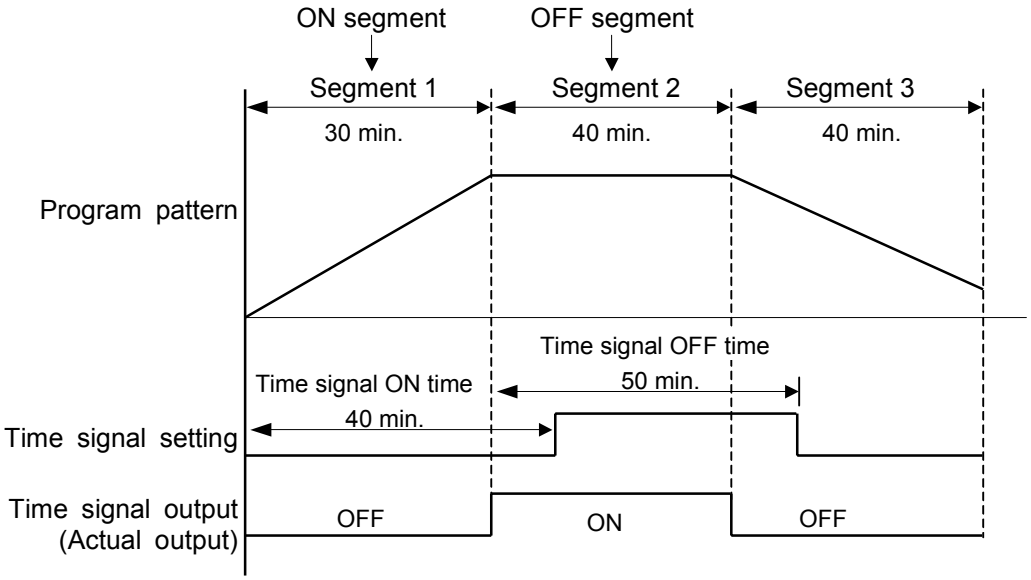
This is the output number of time signal output.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0 to 16
0: Not time signal output
Factory set value: 0

[The description about time signal]

- Set the time signal segment and time as follows.
  "ON segment/Time signal ON time" < "OFF segment/Time signal OFF time"
- The time signal output state is held in the wait or hole state.
  For example, if the instrument is set to the hold state with the time signal turned on, the time signal ON state is held.
- The time signal output is turned off in fixed set point control or manual control.
  If selected to fixed set point or manual control with the time signal set to the on state, the time signal output is turned off but it returns to the on state if set to program control again.
- If the time signal ON time and the time signal OFF time are set larger than the segment time, the time signal ON time and the time signal OFF time become the same time as the segment time.

[Example] ON segment: 1 Time signal ON time: 40 minutes
OFF segment: 2 Time signal OFF time: 50 minutes



Time signal ON segment (Time signal group data)	RKC communication expansion identifier	PNxxTNxxSO (PNxx: Pattern No.) (TNxx: Time signal No.)
	MODBUS register address	ch1: 0440H to 053FH (1088 to 1343) ch2: 1440H to 153FH (5184 to 5439)

This is the segment number by which the time signal output is turned on.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 1 to 16
Relational items: Time signal ON time (P. 112), Time signal OFF segment (P. 113), Time signal OFF time (P. 113)
Factory set value: 1

Time signal ON time (Time signal group data)	RKC communication expansion identifier	PNxxTNxxTO (PNxx: Pattern No.) (TNxx: Time signal No.)
	MODBUS register address	ch1: 0540H to 063FH (1344 to 1599) ch2: 1540H to 163FH (5440 to 5695)

This is the time period until the time signal output is turned on from the start of that segment in which the time signal output is turned on.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0.00 to 300.00 seconds
0.0 to 3000.0 seconds
0 to 30000 seconds
0 to 30000 minutes

☞ The time unit is selected with **Segment time unit setting (P.125)**.

Relational items: Time signal ON segment (P. 112), Time signal OFF segment (P. 113), Time signal OFF time (P. 113)
Factory set value: 0.00

Time signal OFF segment (Time signal group data)	RKC communication expansion identifier	PNxxTNxxSF (PNxx: Pattern No.) (TNxx: Time signal No.)
	MODBUS register address	ch1: 0640H to 073FH (1600 to 1855) ch2: 1640H to 173FH (5696 to 5951)

This is the segment number by which the time signal output is turned off.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 1 to 16
Relational items: Time signal ON time (P. 112), Time signal ON segment (P. 112), Time signal OFF time (P. 113)
Factory set value: 1

Time signal OFF time (Time signal group data)	RKC communication expansion identifier	PNxxTNxxTO (PNxx: Pattern No.) (TNxx: Time signal No.)
	MODBUS register address	ch1: 0740H to 083FH (1856 to 2111) ch2: 1740H to 183FH (5952 to 6207)

This is the time period until the time signal output is turned off from the start of that segment in which the time signal output is turned off.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0.00 to 300.00 seconds
0.0 to 3000.0 seconds
0 to 30000 seconds
0 to 30000 minutes

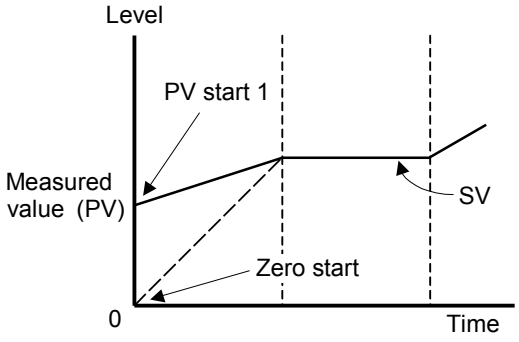
☞ The time unit is selected with **Segment time unit setting (P.125)**.

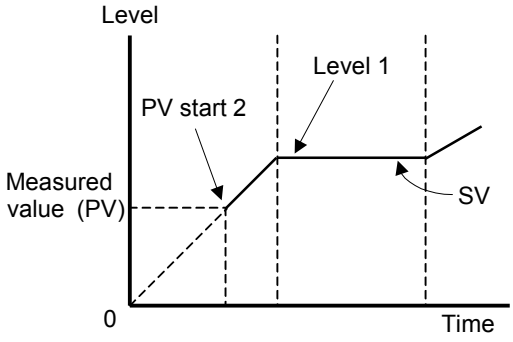
Relational items: Time signal ON segment (P. 112), Time signal ON time (P. 112), Time signal OFF segment (P. 113)
Factory set value: 0.00

Program operation start mode	RKC communication identifier	SS
	MODBUS register address	ch1: 0858H (2136) ch2: 1858H (6232)

This is a method of starting set value (SV) when the program starts.

Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: Zero start
1: PV start 1 (Fixed time type)
2: PV start 2 (Time shortening type)
Factory set value: 0
Function: Set from which level SV is started when program control is performed.
However, started form the input range low limit for the voltage/current input.





- At PV ≤ 0 °C:
  SV is started from 0 °C.
- At PV ≥ Level 1:
  SV is started from level 1.

8.4 Initial Setting Data Items

CAUTION

Initial setting data items are those set initially so as meet the operation condition of the module but unnecessary to be changed afterward as far as the module is normally used. In addition, if they are changed unnecessarily, the module may result in malfunction or failure. Even if it malfunctions or fails caused by their unnecessary changes, RKC will not bear any responsibility for its malfunction or failure.

■ Setting procedure of initial setting data items

The procedure for setting initial setting data items for RKC communication differs from that for MODBUS.

● RKC communication

For RKC communication, the initial setting data items can be set by changing to the initial setting mode. Transfer to initial setting mode sets in "1" with identifier IN (normally setting mode).

The instrument cannot be changed to the initial setting mode state at control start (during control). If it needs to be changed to the above state, first stop the control by "Control RUN/STOP transfer."

No control can be started during initial setting mode. If the control needs to be re-started, first change the instrument the normal setting mode state (set identifier "IN" by 0).

● MODBUS

For MODBUS, the initial setting data items can be set if control is stopped by normal setting data "Control RUN/STOP transfer."

Even if control is stopped by "Control RUN/STOP transfer" while program control is being performed (RUN state), the program continues running. If it is necessary to stop running the program, set "Program operation mode selection" to RESET.

■ Data description

Input range number	RKC communication identifier	XI
	MODBUS register address	ch1: 0870H (2160) ch2: 1870H (6256)

Input range number is a number to indicate an input type and input range.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: See input range table

[Input range table]

Data range	Input type	Input range	Hardware
0	K	−200 to +1372 °C or −328 to +2502 °F	Voltage (low) input group
1	J	−200 to +1200 °C or −328 to +2192 °F	
2	R	−50 to +1768 °C or −58 to +3000 °F	
3	S	−50 to +1768 °C or −58 to +3000 °F	
4	B	0 to 1800 °C or 32 to 3000 °F	
5	E	−200 to +1000 °C or −328 to +1832 °F	
6	N	0 to 1300 °C or 32 to 2372 °F	
7	T	−200 to +400 °C or −328 to +752 °F	
8	W5Re/W26Re	0 to 2300 °C or 32 to 3000 °F	
9	PLII	0 to 1390 °C or 32 to 2534 °F	
19	0 to 1 V	Programmable	
20	0 to 100 mV		
21	0 to 10 mV		
12	Pt100	−200 to +850 °C or −328 to +1562 °F	RTD input group
13	JPt100	−200 to +600 °C or −328 to +1112 °F	
14	0 to 20 mA	Programmable	Current input group
15	4 to 20 mA		
16	0 to 10 V	Programmable	Voltage (high) input group
17	0 to 5 V		
18	1 to 5 V		

If it is the same hardware, a change of the input range is possible. A change between different hardware groups is impossible.

Relational items: Input scale high limit/Input scale low limit (P. 117), Input range decimal point position (P. 117)
Factory set value: Factory set value varies depending on the model code specified when ordering.

Input scale high limit	RKC communication identifier	XV
	MODBUS register address	ch1: 0871H (2161) ch2: 1871H (6257)
Input scale low limit	RKC communication identifier	XW
	MODBUS register address	ch1: 0872H (2162) ch2: 1872H (6258)

This item is the high/low limit value of input scale.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: Input scale high limit: Input scale low limit to 20000
Input scale low limit: –20000 to Input scale high limit
However, a span is 20000 or less.
Relational items: Input range number (P. 116), Input range decimal point position (P. 117)
Factory set value: Input scale high limit: High limit of the input range in ordering
Input scale low limit: Low limit of the input range in ordering
Function: For the SRX, an input range provided for each input type is only one type of maximum input range. Therefore, the input scale range can be freely set by setting the input scale high limit/low limit.

Input range decimal point position	RKC communication identifier	XU
	MODBUS register address	ch1: 0873H (2163) ch2: 1873H (6259)

This item is the decimal point position of input range.

Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: Thermocouple/RTD input: 0 to 1
Voltage/Current input: 0 to 4
0: No digits below decimal point
1: 1 digit below decimal point
2: 2 digits below decimal point
3: 3 digits below decimal point
4: 4 digits below decimal point
Relational items: Input range number (P. 116), Input scale high limit/Input scale low limit (P. 117)
Factory set value: 1

Temperature unit selection	RKC communication identifier	PU
	MODBUS register address	ch1: 0874H (2164) ch2: 1874H (6260)

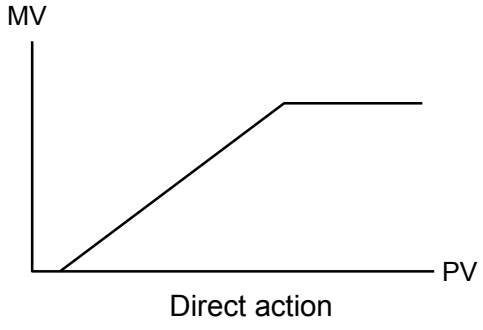
This item is the temperature unit selection of thermocouple/resistance temperature detector input.

Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: °C
1: °F
Factory set value: 0

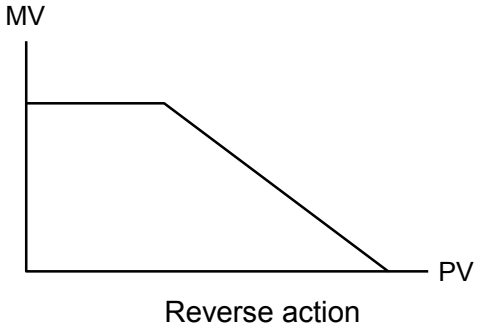
Control type selection	RKC communication identifier	XE
	MODBUS register address	ch1: 0875H (2165) ch2: 1875H (6261)

This item selects direct action/reverse action.

Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: Direct action
1: Reverse action
Factory set value: 1
Function: 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.



Direct action

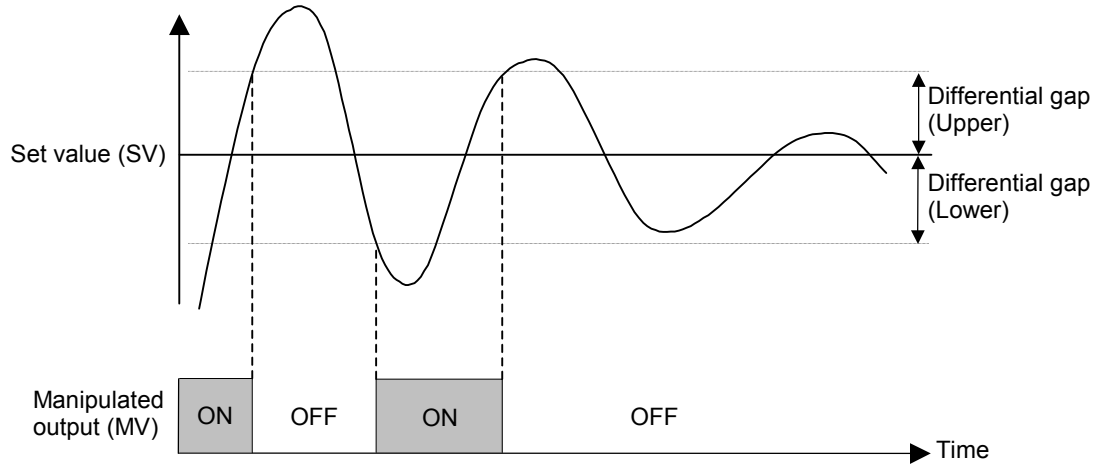


Reverse action

ON/OFF control differential gap (Upper)	RKC communication identifier	IV
	MODBUS register address	ch1: 0876H (2166) ch2: 1876H (6262)
ON/OFF control differential gap (Lower)	RKC communication identifier	IW
	MODBUS register address	ch1: 0877H (2167) ch2: 1877H (6263)

This item sets ON/OFF control differential gap.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0 to Input span (Input span: Input scale low limit to Input scale high limit)
Relational items: Proportional band (P. 70)
Factory set value: Thermocouple/RTD input: 1.0 °C
Voltage/Current input: 0.1 % of input span
Function: It is ON/OFF control when it sets proportional band in "0" or "0.0."
In ON/OFF control, the manipulated output (MV) is turned on and off depending on whether measured value (PV) is larger or smaller than set value (SV). Differential gap setting can prevent relay contact from on or off repetition around set value (SV).

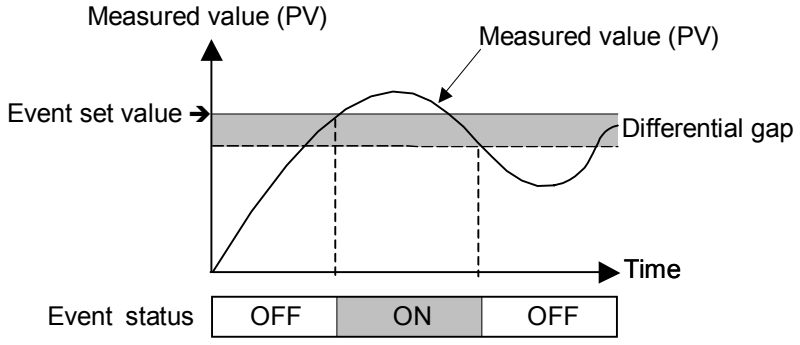


Event 1 differential gap	RKC communication identifier	HA
	MODBUS register address	ch1: 0878H (2168) ch2: 1878H (6264)
Event 2 differential gap	RKC communication identifier	HB
	MODBUS register address	ch1: 0879H (2169) ch2: 1879H (6265)

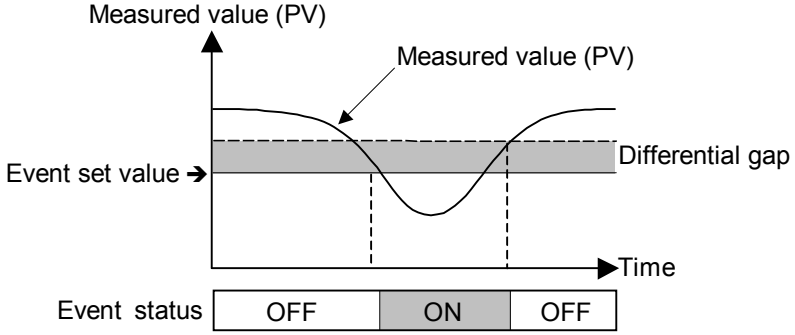
This item sets the event differential gap.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0 to Input span (Input span: Input scale low limit to Input scale high limit)
Relational items: Event set value (P. 77), Event type selection (P. 121), Event hold action (P. 123), Number of event delay times (P. 124)
Factory set value: Thermocouple/RTD input: 2.0 °C
Voltage/Current input: 0.2 % of input span
Function: If measured value (PV) is close to the event set value, the event relay contact may repeatedly turn on and off due to input fluctuations. If the event differential gap is set, repeated turning on and off of the relay contact can be prevented.

[Event high]



[Event low]



Event 1 type selection	RKC communication identifier	XA
	MODBUS register address	ch1: 087AH (2170) ch2: 187AH (6266)
Event 2 type selection	RKC communication identifier	XB
	MODBUS register address	ch1: 087BH (2171) ch2: 187BH (6267)

This item selects the event type.

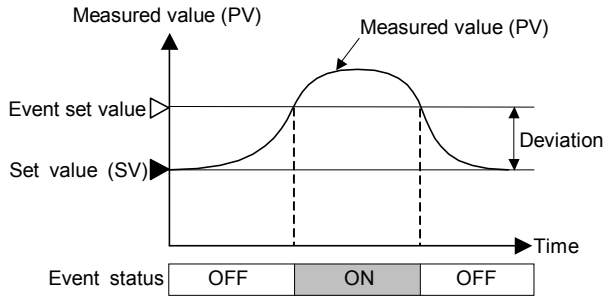
Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: Not provided 3: Deviation high 6: Band
1: Process high 4: Deviation low
2: Process low 5: Deviation high/low
Relational items: Event set value (P. 77), Event differential gap (P. 120), Event hold action (P. 123), Number of event delay times (P. 124)
Factory set value: 0
Function: There are two types of event: deviation and input value

Deviation:
If the deviation [Measured value (PV) – Set value (SV)] reaches the event set value, the event status is set up. Consequently, if the set value (SV) changes, the event set value will also change.

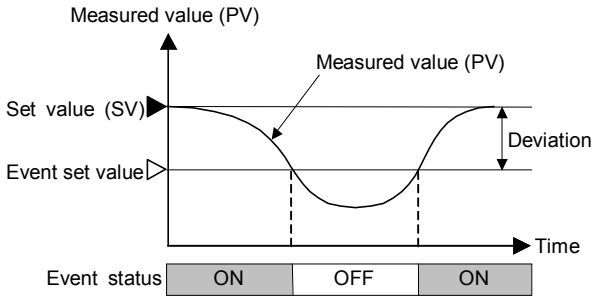
- **Deviation high**

When the deviation (PV−SV) is the event set value or more, the event status is set up.

[When the deviation is on the positive side]



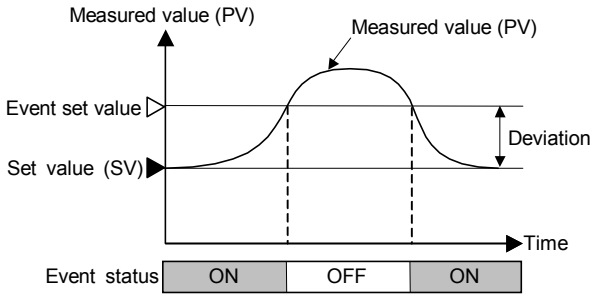
[When the deviation is on the negative side]



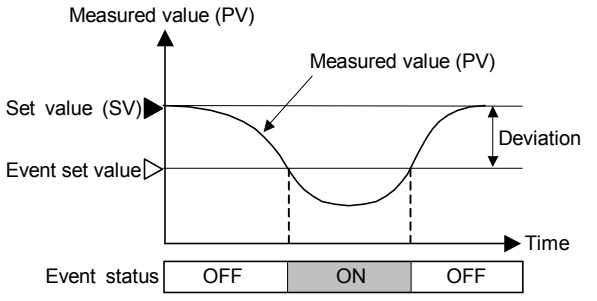
- **Deviation low**

When the deviation (PV−SV) is the event set value or less, the event status is set up.

[When the deviation is on the positive side]



[When the deviation is on the negative side]



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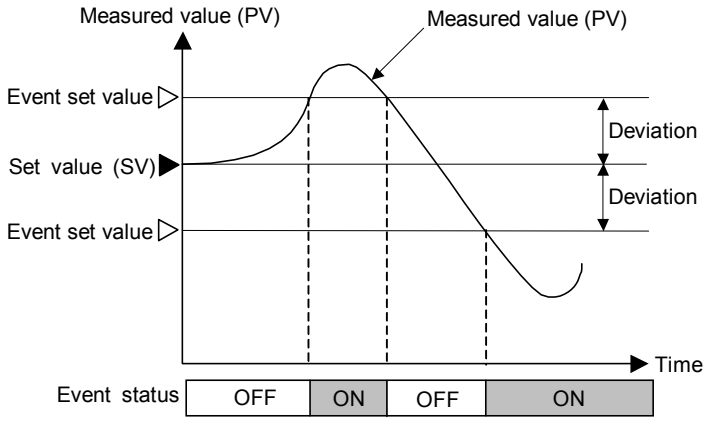
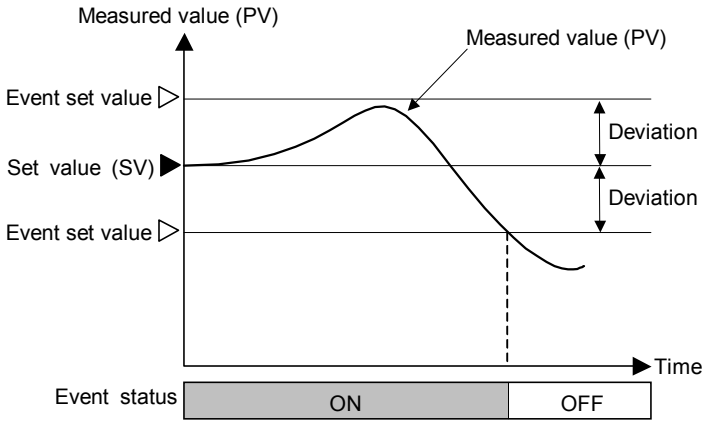
● Deviation high/low

When the absolute deviation (|PV−SV|) is the event set value or more/less, the event status is set up.



● Band

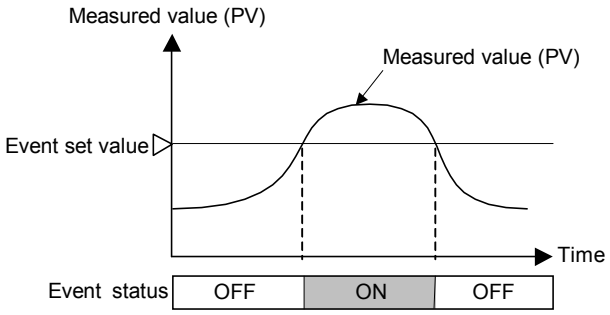
When the absolute deviation (|PV−SV|) is within the event set values, the event status is set up.



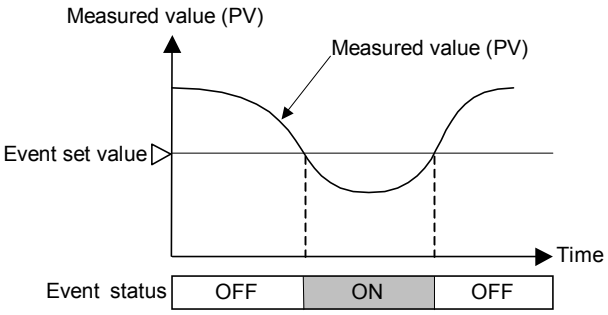
Process:

When the measured value (PV) reaches the event set value, the event status is set up.

● Process high



● Process low



Event 1 hold action	RKC communication identifier	WA
	MODBUS register address	ch1: 087CH (2172) ch2: 187CH (6268)
Event 2 hold action	RKC communication identifier	WB
	MODBUS register address	ch1: 087DH (2173) ch2: 187DH (6269)

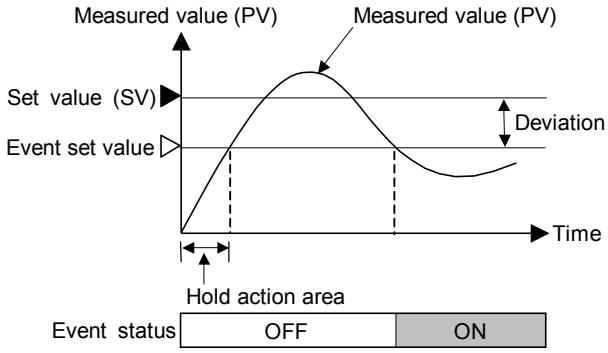
This item selects presence/absence of event hold action.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0: Not provided
1: Hold action
(2: Unused)
3: Re-hold action
Relational items: Event set value (P. 77), Event differential gap (P. 120), Event type selection (P. 121), Number of event delay times (P. 124)
Factory set value: 3
Function: Show it to the following hold action and re-hold action.

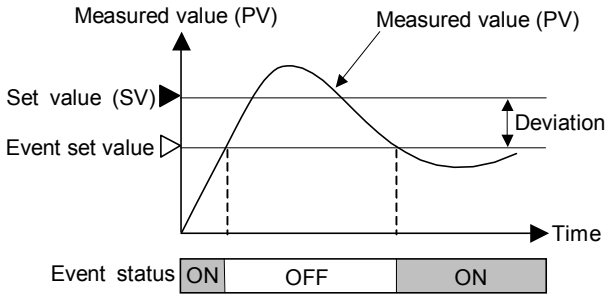
- **Hold action**

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

[With alarm hold action]



[Without alarm hold action]



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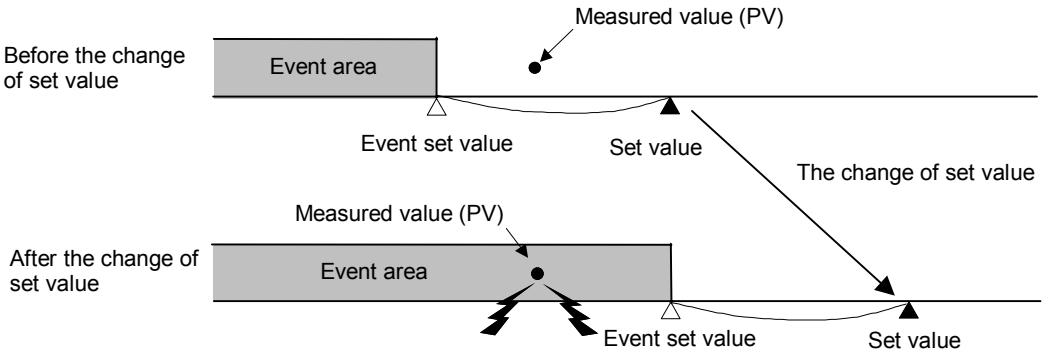
- **Re-hold action**

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

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



Number of event delay times	RKC communication identifier	DF
	MODBUS register address	ch1: 087EH (2174) ch2: 187EH (6270)

The number of event delay times as an event generation filter is set.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0 to 255 times
Relational items: Event set value (P. 77), Event differential gap (P. 120), Event type selection (P. 121), Event hold action (P. 123)
Factory set value: 0
Function: In order to prevent any event from its generation caused by inputting noise, etc., this function is used to generate the event for the first time after sampling cycles are counted several times following an entry of a measured value (PV) in the event range. To set the number of event delay times is to set the number of sampling cycle counting times.

Transmission transfer time setting	RKC communication identifier	ZX
	MODBUS register address	087FH (2175)

RS-485 sets the transmission transfer time to accurately assure the sending/receiving selection timing.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 1 (Data of each module)
Data range: 0 to 100 ms
Factory set value: 6

☞ For detail, see **5.4 Communication Requirements (P. 18)**.

Segment time unit setting	RKC communication identifier	XP
	MODBUS register address	ch1: 0880H (2176) ch2: 1880H (6272)

The unit of segment time used for program control and that of time signal ON/OFF time, etc. are set.

Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: 0.01 second
1: 0.1 second
2: 1 second
3: 1 minute
Relational items: Segment remaining time (P. 101), Pattern end output time (P. 108), Segment time (P. 110), Time signal ON time (P. 112), Time signal OFF time (P. 113)
Factory set value: 0

Operation mode holding setting	RKC communication identifier	X2
	MODBUS register address	0881H (2177)

It is set whether or not the operation mode before the power supply is turned off is held when the power supply is turned on or power failure recovers.

Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 1 (Data of each module)
Data range: 0: Not hold (Operation mode: Monitor 1)
1: Hold
Relational items: Operation mode (P. 78)
Factory set value: 1

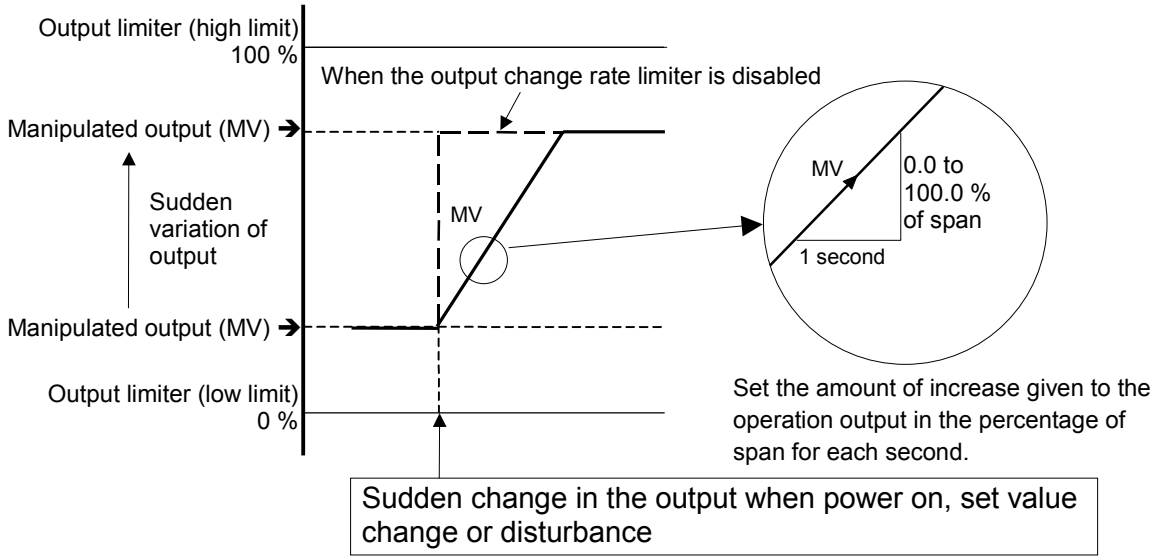
Output change rate limiter (up)	RKC communication identifier	PH
	MODBUS register address	ch1: 0882H (2178) ch2: 1882H (6274)
Output change rate limiter (down)	RKC communication identifier	PL
	MODBUS register address	ch1: 0883H (2179) ch2: 1883H (6275)

The output change rate limiter to limit of the variation of output is set.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0.0 to 100.0 %/second
0.0: Limiter OFF
Relational items: Manipulated output value (P. 72), Output limiter (high limit/low limit) (P. 81)
Factory set value: 0.0
Function: The output change rate limiter limits the variation of manipulated output (MV) for a time unit. You can set an output variation, and control the output, when your object requires to avoid sudden variation.

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

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



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

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

9. TROUBLESHOOTING

This section lists some basic causes and solutions to be taken when any problem would arise in this instrument.
If you can not find a solution, please contact RKC sales office or the agent.

If the instrument is necessary to be replaced, observe the following warning.

⚠ 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.

When replacing the module with a new one, always use the module with the same model code. If the module is replaced, it is necessary to re-set each data item.

■ X-TIO-A/X-TIO-B module

Problem	Probable cause	Solution
FAIL/RUN lamp does not light up	Power not being supplied	Check external breaker etc.
	Appropriate power supply voltage not being supplied	Check the power supply
	Power supply terminal contact defect	Retighten the terminals
	Power supply section defect	Replace X-TIO-☐ module
RX/TX lamp does not flash	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
	CPU section defect	Replace X-TIO-☐ module
The FAIL/RUN lamp is lit (red): FAIL status	CPU section or power section defect	Replace X-TIO-☐ module

■ 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	
	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 in the data format	Reexamine the communication program
	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	
	There is length of query message exceeds set range	
	The number of data points is not twice the specified number of data points at the time of data write	
	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, 24-bit time (or 24-bit time + a few ms) or more	Re-transmit after time-out occurs or verify communication program
Error code 1	Function cod error (Specifying nonexistent function code)	Confirm the function code
Error code 2	When the mismatched address is specified	Confirm the address of holding register
Error code 3	When the data written exceeds the setting range	Confirm the setting data
	When the specified number of data items in the query message exceeds the maximum number of data items available	

10. APPENDIX

10.1 ASCII 7-bit Code Table

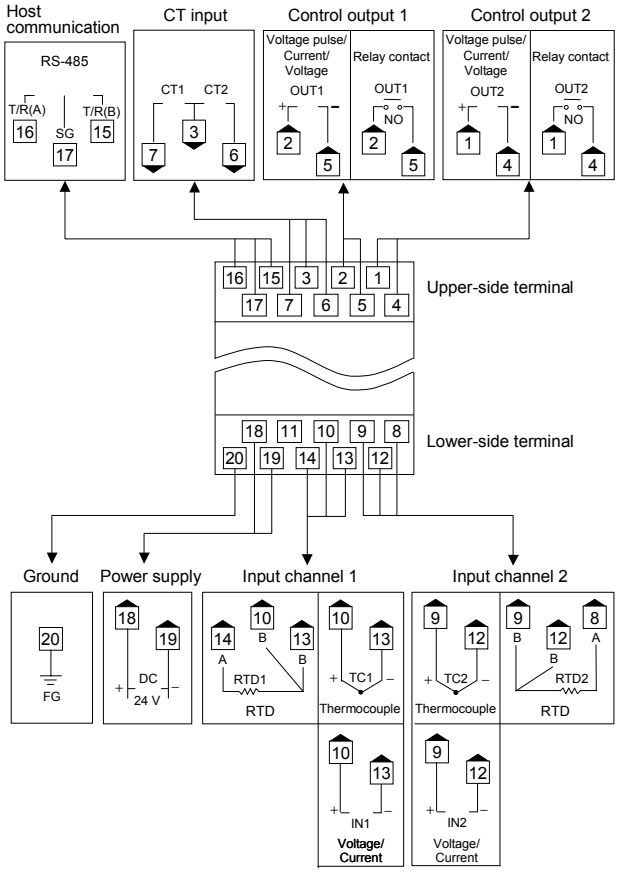
b5～b7	b4	b3	b2	b1		0	1	2	3	4	5	6	7
					b7	0	0	0	0	1	1	1	1
					b6	0	0	1	1	0	0	1	1
					b5	0	1	0	1	0	1	0	1
	0	0	0	0	0	NUL	DLE	SP	0	@	P	‘	p
	0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
	0	0	1	0	2	STX	DC2	”	2	B	R	b	r
	0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
	0	1	0	0	4	EOT	DC4	$	4	D	T	d	t
	0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
	0	1	1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

10.2 Terminal Configuration

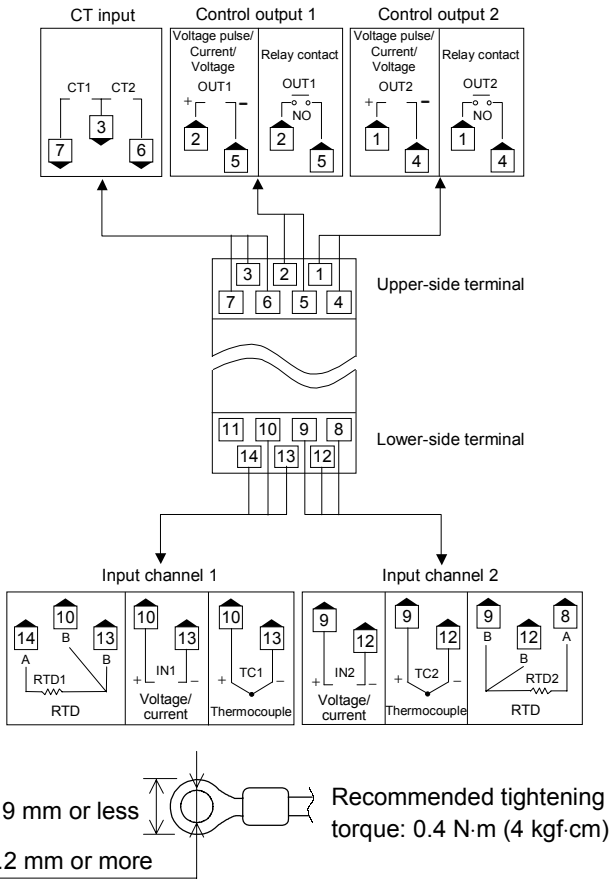
■ Wiring cautions

- For thermocouple input, use the appropriate compensation wire.
- For RTD input, use low resistance lead wire with no difference in resistance between the three lead wires.
- To avoid noise induction, keep input signal wire away from instrument power line, load lines and power lines of other electric equipment.
- If there is electrical noise in the vicinity of the instrument that could affect operation, use a noise filter.
  - Shorten the distance between the twisted power supply wire pitches to achieve the most effective noise reduction.
  - Always install the noise filter on a grounded panel. Minimize the wiring distance between the noise filter output and the instrument power supply terminals to achieve the most effective noise reduction.
  - Do not connect fuses or switches to the noise filter output wiring as this will reduce the effectiveness of the noise filter.
- Power supply wiring must be twisted and have a low voltage drop.
- For an instrument with 24 V power supply, supply power from a SELV circuit.

■ Basic module (X-TIO-A)



■ Extension module (X-TIO-B)



Recommended tightening torque: 0.4 N·m (4 kgf·cm)

- Terminal No. 11 is not used.
- Input channel 2 can be used as remote setting input (only for voltage/current input). In this case, control output 2 and CT input 2 become unused.
- Use the solderless terminals appropriate to the screw size (M3).

10.3 Product Specifications

■ Input

Measuring input:

Number of inputs: 2 points (Isolated between each input channel)
Channel 2 can be used as remote input.

Input type:

- Voltage (low) input group
  Thermocouple: K, J, T, S, R, E, B (JIS-C1602-1995)
  PLII (NBS), N (NBS), W5Re/W26Re (ASTM)
  Voltage (low): 0 to 10 mV, 0 to 100 mV, 0 to 1 V
- Resistance temperature detector (RTD) input group (3-wire system)
  Pt100 (JIS-C1604-1997)
  JPt100 (JIS-C1604-1989, Pt100 of JIS-C1604-1981)
- Voltage (high)/Current input group
  Voltage (high): 0 to 5 V, 1 to 5 V, 0 to 10 V
  Current: 0 to 20 mA, 4 to 20 mA (Input impedance: 250 Ω)

-The type of input needs to be specified when ordering and then fixed.
-The type of input can be selected independently for each channel.

Input range:

- Temperature input (Thermocouple/RTD input)

Input type	Input range
K	–200 to +1372 °C or –328 to +2502 °F
J	–200 to +1200 °C or –328 to +2192 °F
R	–50 to +1768 °C or –58 to +3000 °F
S	–50 to +1768 °C or –58 to +3000 °F
B	0 to 1800 °C or 32 to 3000 °F
E	–200 to +1000 °C or –328 to +1832 °F
N	0 to 1300 °C or 32 to 2372 °F
T	–200 to +400 °C or –328 to +752 °F
W5Re/W26Re	0 to 2300 °C or 32 to 3000 °F
PLII	0 to 1390 °C or 32 to 2534 °F
Pt100	–200 to +850 °C or –328 to +1562 °F
JPt100	–200 to +600 °C or –328 to +1112 °F

However, within “Input scale low limit to Input scale high limit.”

- Voltage/Current input
  Programmable range
  Input scale high limit: Input scale low limit to 20000
  Input scale low limit: –20000 to Input scale high limit
  However, a span is 20000 or less.

Accuracy:

- Thermocouple input (K, J, T, PLII, E)
  Less than −100 °C: ±1.0 °C
  −100 °C to less than +500 °C: ±0.5 °C
  500 °C or more: ± (0.1 % of reading + 1digit)
  Less than −148 °F: ±1.8 °F
  −148 °F to less than +932 °F: ±0.9 °F
  932 °F or more: ± (0.1 % of reading + 1digit)
- Thermocouple input (R, S, N, W5Re/W26Re)
  −50 °C to less than +1000 °C: ±1.0 °C
  1000 °C or more: ± (0.1 % of reading + 1digit)
  −58 °F to less than +1832 °F: ±1.8 °F
  1832 °F or more: ± (0.1 % of reading + 1digit)
- Thermocouple input (B)
  Less than 400 °C: ±70.0 °C
  400 °C to less than 1000 °C: ±1.0 °C
  1000 °C or more: ± (0.1 % of reading + 1digit)
  Less than 752 °F: ±126.0 °F
  752 °F to less than 1832 °F: ±1.8 °F
  1832 °F or more: ± (0.1 % of reading + 1digit)
- RTD input
  Less than 200 °C: ±0.2 °C
  200 °C or more: ± (0.1 % of reading + 1digit)
  Less than 392 °F: ±0.4 °F
  392 °F or more: ± (0.1 % of reading + 1digit)
- Voltage/Current input
  ± 0.1 % of span
- Cold junction temperature compensation accuracy
  ±1.0 °C (Ambient temperature 23 °C ±2 °C)
  Within ±1.5 °C between 0 to 50 °C of ambient temperature
  ±1.8 °F (Ambient temperature 73.4 °F ±3.6 °F)
  Within ±2.7 °F between 14 to 122 °F of ambient temperature

Sampling cycle: 25 ms

Input resolution:
Thermocouple input: 1 °C or 0.1 °C
RTD input: 1 °C or 0.1 °C
Voltage/Current input: 1 to 0.0001 (programmable)

RTD sensor current: Approx. 1 mA

Action at input break:
Thermocouple input: Upscale
RTD input: Upscale
Voltage input
0 to 10 mV, 0 to 100 mV: Upscale
0 to 1 V, 0 to 5 V, 1 to 5 V, 0 to 10 V: Show a value of 0 V neighborhood
Current input
0 to 20 mA, 4 to 20 mA: Show a value of 0 mA neighborhood

Signal source resistance effect:
0.25 μV/Ω (Only for thermocouple input)

Allowable influence of input lead:
10 Ω or less per wire (Only for RTD input)

Input digital filter: First order lag digital filter
Time constant: 0.01 to 10.00 seconds (Setting 0.00: Filter OFF)

PV bias: ±Input range span

Normal mode rejection ratio (NMRR):
60 dB or more

CT input:
Number of inputs: 2 points
Sampling cycle: 500 ms (Data update cycle)
Resolution of A/D transfer:
10-bit or more
Input current: 0.0 to 30.0 A (CTL-6-P-N)
0.0 to 100.0 A (CTL-12-S56-10L-N)
Current measuring accuracy:
±5 % of input value or ±2 A
(The value whichever is greater)

■ Output

Number of outputs: 2 points
Isolated between input and output and between output and power supply. Not isolated between each output channel.

Output type: The type of output needs to be specified when ordering and then fixed. (The type of output can be selected independently for each channel.)

- Relay contact output
  Contact type: 1a contact
  250 V AC 3 A (Resistive load)
  Electrical life: 300,000 times or more (Rated load)
- Voltage pulse output
  Output voltage: 0/12 V DC
  Allowable load resistance: 600 Ω or more
- Current output
  Output type: 0 to 20 mA DC, 4 to 20 mA DC
  Allowable load resistance: 600 Ω or less
  Output resolution: 11-bit or more
- Voltage output
  Output voltage: 0 to 5 V DC, 1 to 5 V DC, 0 to 10 V DC
  Allowable load resistance: 1 kΩ or more
  Output resolution: 11-bit or more

■ Indication lamp

Number of indicates: 6 points

Indication contents:
- Operation status indication (1 point)
  During normal operation: Green lamp: ON (RUN)
  During error: Red lamp: ON (FAIL)
  During self-diagnostic error: Green lamp: flashing
- Communication status indication (1 point)
  During data send or receive: Green lamp: ON
- Event display (4 points)
  Various states are displayed depending on setting.
  Display contents: Event 1 status, Event 2 status, Comprehensive event status, Output status, Control status, Executing segment status, Time signal status

■ Setting

Setting method: Setting by communication

Setting range: Same as input range

Setting resolution: Same as input resolution

■ Control

Number of controls: 2 points

Control method: Brilliant PID control
- Correspond to the direct action and the reverse action.
- Do not support the heat/cool control.

Additional functions: Autotuning function
-With output limiter function
-With output change rate limiter

Setting range: Proportional band:
Temperature input: 0 to Input span
Voltage/Current input: 0.0 to 1000.0 % of Input span
(0 or 0.0: ON/OFF action)
Integral time:
0.01 to 360.00 seconds or 0.1 to 3600.0 seconds
(Selectable)
Derivative time:
0.00 to 360.00 seconds or 0.0 to 3600.0 seconds
(Selectable)
(0.00 or 0.0: PI action)

Control response parameter: Slow, Medium, Fast

Output limiter (high limit): –5.0 to +105.0 %

Output limiter (low limit): −5.0 to +105.0 %

Output change rate limiter: 0.0 to 100.0 %/second

Proportioning cycle time: 0.2 to 50.0 seconds

Direct/Reverse action selection: Direct action, Reverse action

Hot/Cold start selection: Hot 1, Hot 2, Cold 1, Cold 2

AUTO/MAN selection: Auto mode (AUTO), Manual mode (MAN)

Manual output setting: Within output limiter range

Start determination point: 0 to Input span

PID/AT transfer: PID control, Autotuning (AT)

AT bias: ±Input span

Remote/Local transfer: Local mode, Remote mode

Setting method of PID constants:

Level PID
Eight types of PID parameters are selectable depending on level PID high limit setting positions.
Setting range of Level 1to 8: Same as input range
Level 1< Level 2< Level 3< ····· < Level 7< Level 8
(Set of level 8 is fixed with input scale high limit.)

■ Event function

Number of events: 2 points/channel

Event type: Deviation high, Deviation low, Deviation high/low, Band, Process high, Process low

Additional function: Hold action

Setting range:
Deviation high, Deviation low: −Input span to +Input span
Deviation high/low, Band: 0 to Input span
Process high, Process low: Same as input range

Differential gap: 0 to Input span

Event status: Output the event status as communication data.

■ Heater break alarm (HBA) function

Number of HBA: 2 points

Setting range: 0.0 to 100.0 A (0.0 A: OFF)

Additional function: Number of event delay times: 0 to 255 times

HBA status: Output the HBA status as communication data.

■ Control loop break alarm (LBA) function

Number of LBA: 2 points

LBA time: 1 to 7200 seconds

LBA deadband (LBD) setting: 0 to Input span

LBA status: Output the LBA status as communication data.

■ Comprehensive event status

Event status: Bit data items are expressed in decimal number from 0 to 255.

Burnout:	bit 0
Event 1 status:	bit 1
Event 2 status:	bit 2
Heater break alarm (HBA) status:	bit 3
Control loop break alarm (LBA) status:	bit 4
	(bit 5 to bit 7: Unused)

■ Program control

Program setting: Level setting (Setting of each channel)
Segment time (Setting of each channel)

Setting range:

Level:	Same as main set value
Segment time:	0.00 to 300.00 seconds (factory set value) 0.0 to 3000.0 seconds 0 to 30000 seconds 0 to 30000 minutes Either transfer is possible.

Number of program execution times:
1 to 1000 times
(1000 times: Program executes an infinite number of times.)

Time accuracy: ± (0.01 % of Reading + 1digit)

Number of patterns: Up to 16 patterns (Up to 16 segments/pattern)
Pattern link function provided

Number of segments: Up to 256 segments (16 patterns × 16 segments)

Program operation start mode:
Zero start
PV start 1 (Fixed time type)
PV start 2 (Time shortening type)

Hold function:
- The program stops its progress temporarily.
- This function becomes valid during program operation.
- The hold status is not released if set to any of other program operation modes (FIX or MAN).

Step function:
- The program progress by one segment.
  (One segment progresses by the setting per one.)
- This function becomes valid during program operation.
- The step action cannot be used in the hold state.

Wait function:

This is the function the program stops to wait for moving to the next segment when a measured value is difficult to follow the progress of the program.

Setting range of wait zone: 0 to Input span
(Setting 0: Wait function OFF)

- Wait zone is setting for each pattern
- Can confirm wait status with communication

Pattern end output:

Number of outputs: 2 points

Pattern end output time:

0.00 to 300.00 seconds or 0.00 to 300.00 minutes
When 0 is set, the pattern end output is not turned off.

Output reset:

The output can be turned off by changing to the reset state.

- When program is repeated: Output turned on for about 0.5 seconds
- When programs are linked: To be turned on on final pattern
- The pattern end output is turned off when fixed set point (FIX) or manual (MAN) control is performed, but the time signal output state returns to the original state if returned to the program control state.

Program operation mode:
- Reset mode (RESET status)
  Stop control and return the segment number to No. 1.
  Turn off the time signal output and the end output.
  An event becomes OFF.
  A set value becomes 0.
- Program control mode (RUN status)
  Execute program control.
- Fixed set point control mode (FIX status)
  Execute fixed set point.
- Manual control mode (MAN status)
  Manual control can be performed.

Time signal output:

Number of settings: 16 (per pattern)
Time signal ON segment: 1 to 16
Time signal ON time: The time setting unit is the same as the segment time setting unit.
Time signal OFF segment: 1 to 16
(However, it needs to be the same as the start segment or larger.)
Time signal OFF time: The time setting unit is the same as the segment time setting unit.

- Always make the setting as follows.
  "ON segment/ON time < OFF segment/OFF time"
  If the above inequality is not satisfied, no time signal is output.
- If the ON and OFF time are set larger than the segment time, become the same time as the segment time.
- When no time signal is used, set the same "ON segment/ON time" and "OFF segment/OFF rime." In this case, no time signal is output.
- The time signal output state is held in the wait or hold state.
- The pattern end output is turned off when fixed set point (FIX) or manual (MAN) control is performed, but the time signal output state returns to the original state if returned to the program control state.
- The time signal output is turned off when the autotuning (AT) function is activated.

■ Control action selection function at input error

Function: This function is used to change to the manual mode when the input is abnormal [Input error determination point (low limit) ≥ PV ≥ Input error determination point (high limit)] in the control state.

Action selection: It is selected whether or not the manual output is changed independently of the high limit and low limit.

Setting range:
Input error determination point (high limit): Within input scale range
Input error determination point (low limit): Within input scale range
Manipulated output value at input error: Within output limiter

■ Control RUN/STOP function

Function: RUN/STOP action is taken simultaneously for two channels.
The function and output in the control stop state are the same as those when the power supply is turned off.
Control STOP: 0
Control RUN: 1

■ Communication function

Number of communications: 1 point

Communication interface: Based on RS-485, EIA standerd

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

Synchronous method: Start-stop synchronous type

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

Data bit configuration:
Start bit: 1
Data bit: 7 or 8
Parity bit: Without or 1 (Odd or Even)
Stop bit: 1

Protocol: RKC communication (ANSI X3.28 subcategory 2.5, A4)
MODBUS
(Selectable)

Error control:
RKC communication: Vertical parity, Horizontal parity
MODBUS: CRC-16

Maximum connections: Up to 32 modules including a host computer

■ Self-diagnostic function

Check item (error code): Bit data items in the error state are expressed in decimal numbers from 0 to 255.

Memory backup error:	bit 0
Adjustment data error:	bit 3
Input A/D error:	bit 4
Current transformer input A/D error:	bit 5
Temperature compensation A/D error:	bit 6

(bit 1, bit2 and bit 7: Unused)

■ General specifications

Power supply:

Power supply voltage:	24 V DC
Power supply voltage range:	21.6 to 26.4 V DC
Current consumption:	120 mA or less/module

Insulation resistance: 20 MΩ or more at 500 V DC (Between each insulation block)

Withstand voltage: 600 V AC for 1 minute (Between each insulation block)

Power failure effect: No influence even under power failure of 20 ms or less.

Memory backup: Backed up by FRAM (Ferroelectric RAM).
Number of write times: 10,000 million times or more
Data storage period: Approx. 10 years

Working environment conditions:

Ambient temperature: −10 to +50 °C
Ambient humidity: 20 to 85 %RH (Non condensing)

■ Mounting and structure

Mounting procedure:	DIN rail mounting	
Case color:	Terminal base:	Black
	Module mainframe:	Gray
Dimensions:	Basic module:	40.5 (W) ×125.0 (H) ×110.0 (D) mm
	Extension module:	30.0 (W) ×125.0 (H) ×110.0 (D) mm
Weight:	Basic module:	Approx. 220 g
	Extension module:	Approx. 190 g

■ Standard

Safety standard:	UL, CSA, C-Tick and CE (Corresponding to the near future)	
	UL:	UL3101-1: 1993
	CSA:	CAN/CSA-C22.2 No1010.1: 1992
	EMC directive:	EN55011: 1998 (EMI), EN61326: 1998 (EMS)
	C-Tick:	AS/NZS 2064:1997 (equivalent to EN55011)

MEMO

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