Module Type Controller

SRX

Communication Instruction Manual

RKC® RKC INSTRUMENT INC.

IMS01N01-E5

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

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

SYMBOLS

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

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

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

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

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

 : This mark indicates where additional information may be located.

⚠ WARNING

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

CAUTION

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

NOTICE

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

CONTENTS

Page

Page

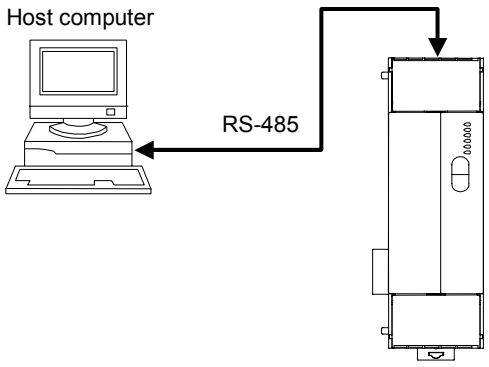
MEMO

1. OUTLINE

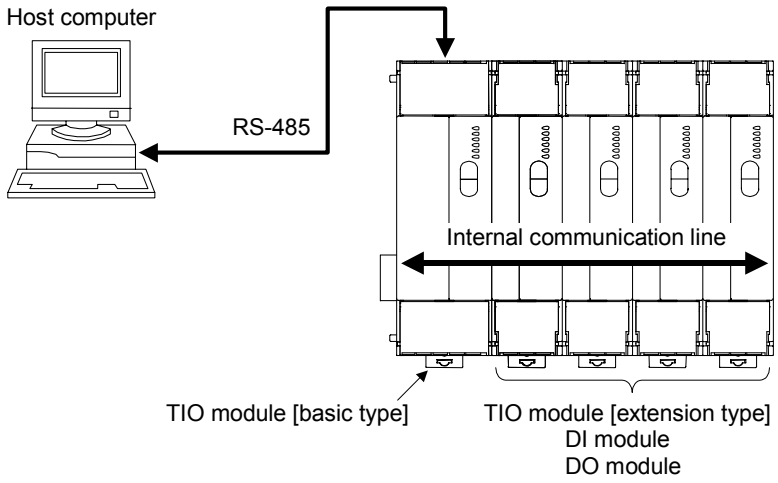
Module type controller SRX interfaces with the host computer via Modbus or RKC communication protocols. The SRX sets all of the data items via communication. Therefore before operation, it is necessary to set value of each data item via communication.

- A user can select RKC communication or Modbus.
- The temperature control (TIO) module [basic type] (hereafter called TIO module [basic type]) can communicate independently with the host computer. In addition, as the temperature control (TIO) module [extension type] (hereafter called TIO module [extension type]), the digital input (DI) module (hereafter called DI module) and the digital output (DO) module (hereafter called DO module) are not provide with power supply and host communication terminals, communication with the host computer is always made with this module connected to the TIO module [basic type].
- As the communication line passes on the internal bus when the TIO module [extension type] or the other modules are connected to the TIO module [basic type], 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 TIO module [basic type] alone



When connected one or more module to TIO module [basic type]

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:
Externally terminal connected: TIO module [basic type]
Select with the internal switch: TIO module [extension type]
DI module
DO module

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: 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:
Externally terminal connected: TIO module [basic type]
Select with the internal switch: TIO module [extension type]
DI module
DO module

Maximum connections: 32 instruments maximum including a host computer

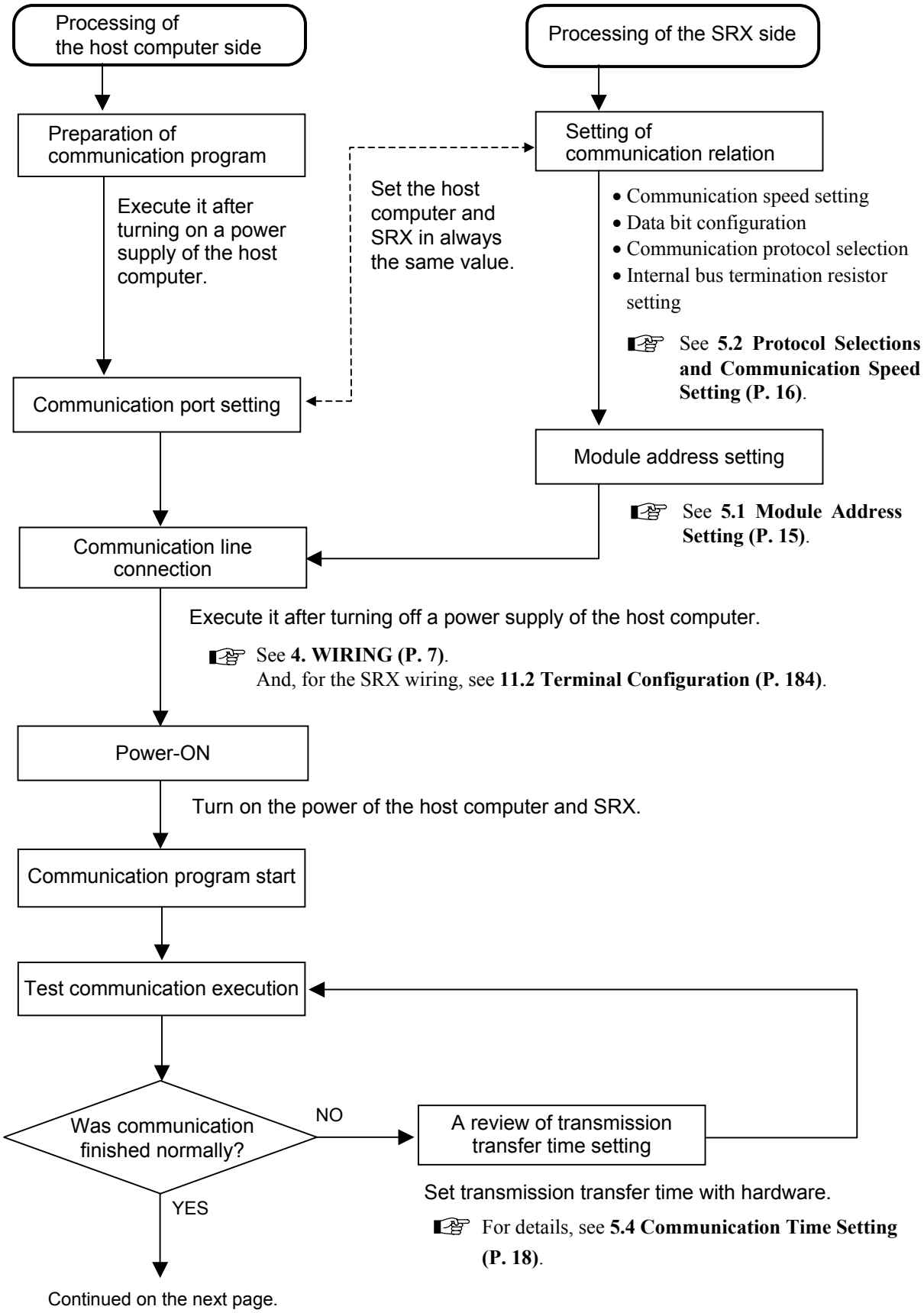
Signal logic: RS-485

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.



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Initial setting data setting

Before setting operation data items, always set initial setting data items so as to satisfy the specification used.

Set the Input scale high/low limit, Input range decimal point position, Control type, Event type etc.

☞ For initial setting data items, see following pages.

RKC communication
- TIO module: **7.5.2 Data items for initial setting mode (P. 55)**
- DI module: **7.6.2 Data items for initial setting mode (P. 60)**
- DO module: **7.7.2 Data items for initial setting mode (P. 63)**

Modbus
- TIO module: **8.8.4 Initial setting data items (P. 87)**
- DI module: **8.9.2 Initial setting data items (P. 92)**
- DO module: **8.10.2 Initial setting data items (P. 96)**

Power ON again

The initial setting data items thus set are registered by turning on the SRX power supply again.

Do use DI/DO modules?

NO

YES

DI/DO assignment

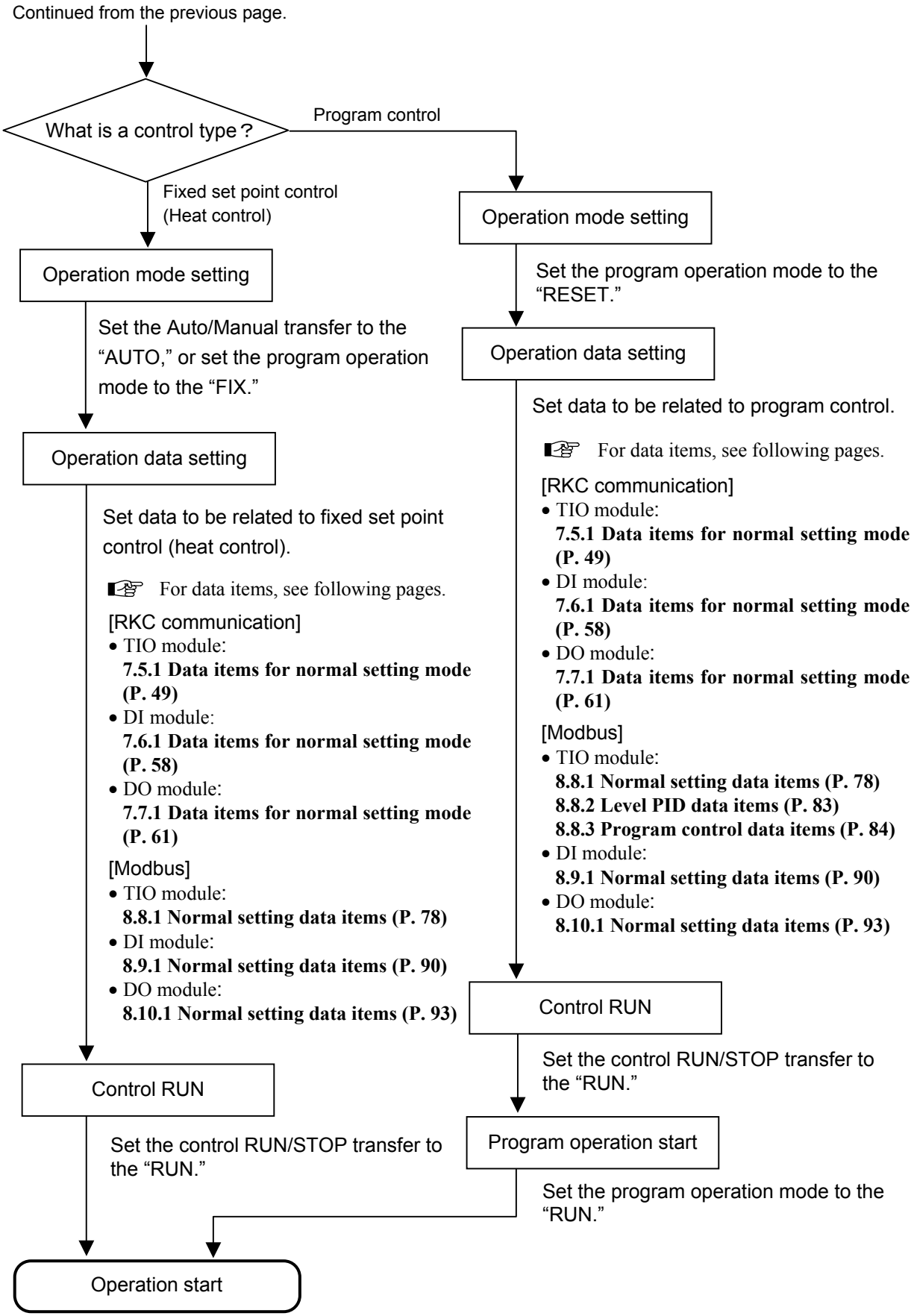
The contents of digital input are assigned to the TIO module.
In addition, the contents of digital output are assigned to the DO module.

[Contents of digital input assignment]
- Program operation mode selection
  RESET, RUN, FIX, MAN, HOLD, STEP
- Program pattern selection
  PSET, SEL1, SEL2, SEL3, SEL4
- Autotuning (AT)/PID control transfer
  AT/PID

[Contents of digital output assignment]
- Burnout output
- Event 1 output
- Event 2 output
- Heater break alarm (HBA) output
- Control loop break alarm (LBA) output
- Program end state output
- Pattern end output
- Wait state output
- Time signal 1 to 16 output
- Input state of DI module CH1 to 28

☞ For details, see **6. DIGITAL INPUT/OUTPUT (P. 22)**.

Continued on the next page.


Continued from the previous page.
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 items, see following pages.
[RKC communication]
• TIO module:
7.5.1 Data items for normal setting mode (P. 49)
• DI module:
7.6.1 Data items for normal setting mode (P. 58)
• DO module:
7.7.1 Data items for normal setting mode (P. 61)
[Modbus]
• TIO module:
8.8.1 Normal setting data items (P. 78)
• DI module:
8.9.1 Normal setting data items (P. 90)
• DO module:
8.10.1 Normal setting data items (P. 93)
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 items, see following pages.
[RKC communication]
• TIO module:
7.5.1 Data items for normal setting mode (P. 49)
• DI module:
7.6.1 Data items for normal setting mode (P. 58)
• DO module:
7.7.1 Data items for normal setting mode (P. 61)
[Modbus]
• TIO module:
8.8.1 Normal setting data items (P. 78)
8.8.2 Level PID data items (P. 83)
8.8.3 Program control data items (P. 84)
• DI module:
8.9.1 Normal setting data items (P. 90)
• DO module:
8.10.1 Normal setting data items (P. 93)
Control RUN
Set the control RUN/STOP transfer to the "RUN."
Program operation start
Set the program operation mode to the "RUN."

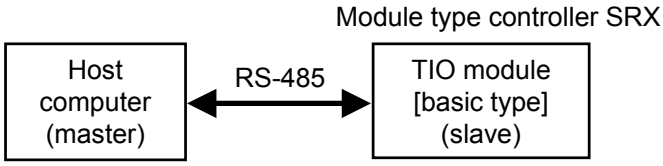
4. WIRING

⚠ WARNING

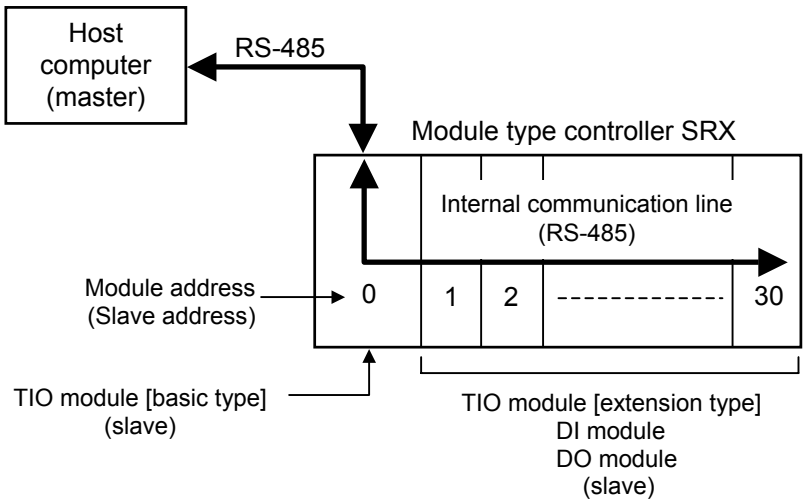
To prevent electric shock or instrument failure, turn off the power before connecting or disconnecting the instrument and peripheral equipment.

4.1 Wiring Configuration

■ **When connected TIO module [basic type] alone**

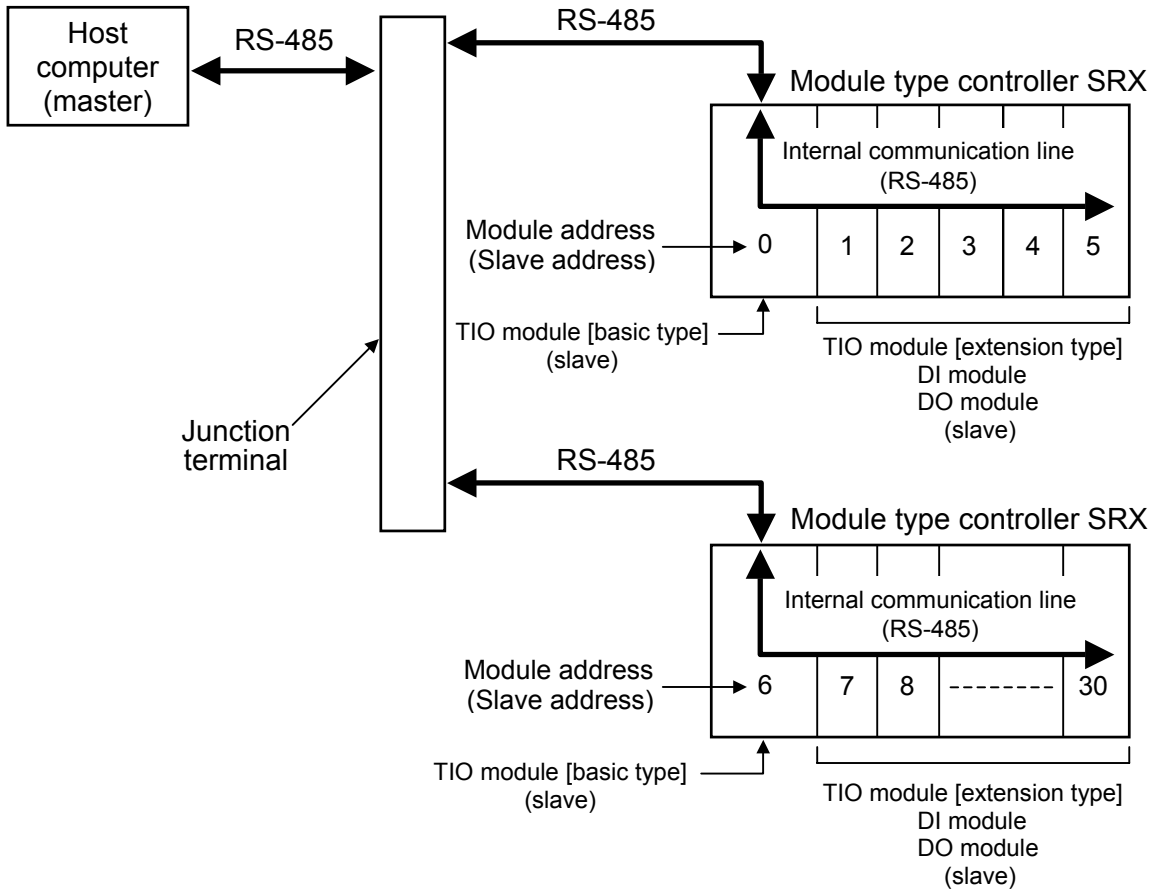


■ **When two or more other modules are connected to one TIO module [basic type]**



The TIO module of SRX can connect up to 31 modules.

■ When two or more SRX units are connected



One SRX unit consists of one TIO module [basic type] and several other modules.

The TIO module of SRX can connect up to 31 modules regardless of the number of units.

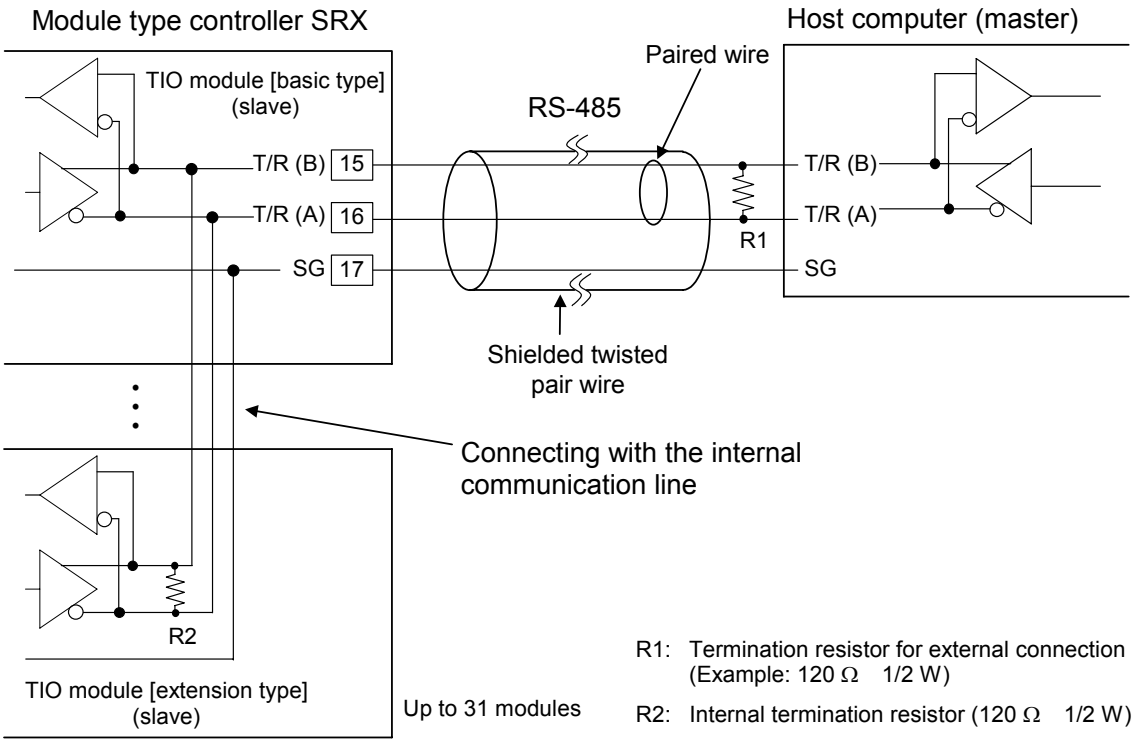
4.2 Wiring Details

■ 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)**



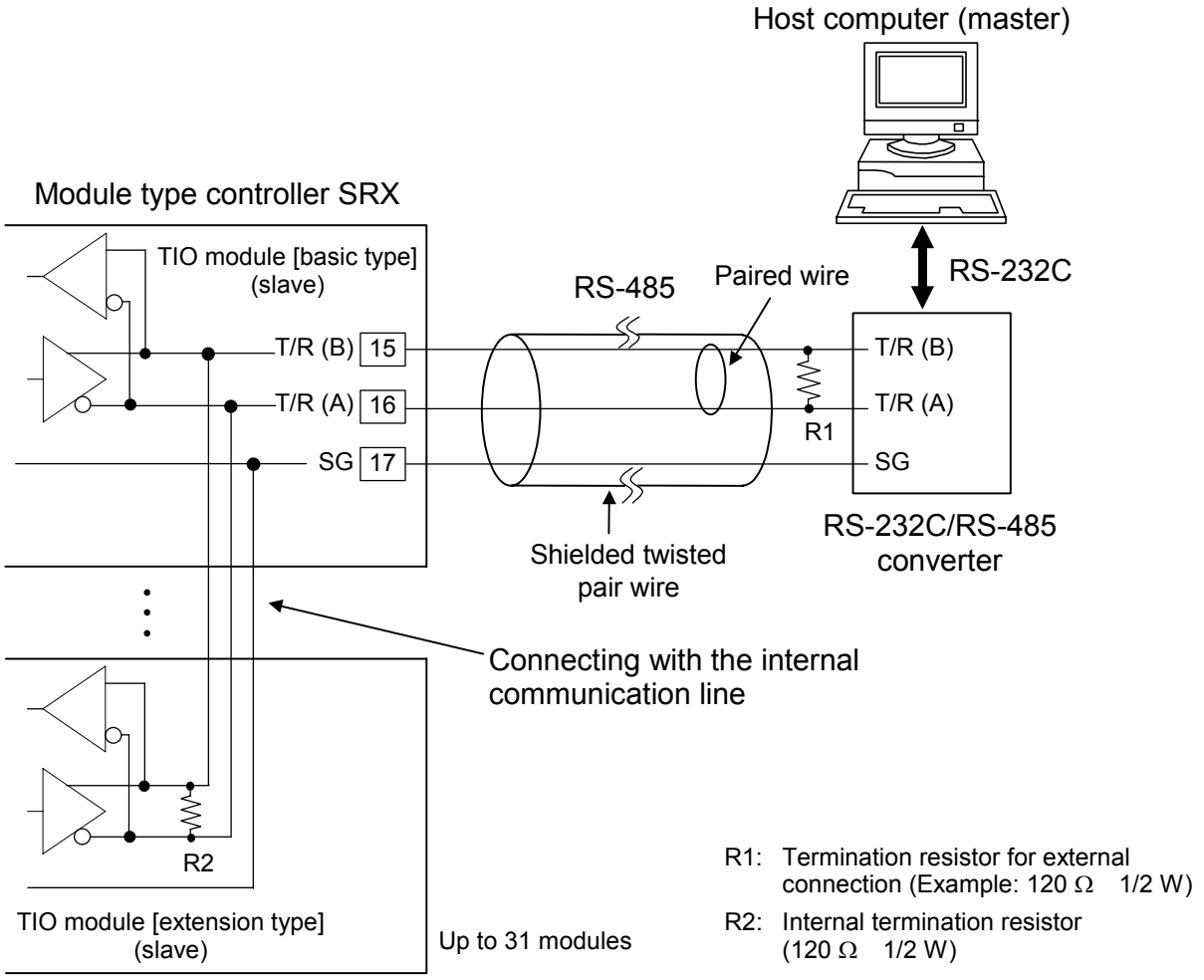
The cable is provided by the customer.

The above figure shows an example of connecting the basic and extension type of TIO module. However, this figure is also used even when the DI or DO module is connected instead of the TIO module [extension type].

For installation method of termination resistor of the SRX side, see **4.3 Installation of Termination Resistor for Host Communication (P. 11)**.

- **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.

The above figure shows an example of connecting the basic and extension type of TIO module. However, this figure is also used even when the DI or DO module is connected instead of the TIO module [extension type].

For installation method of termination resistor of the SRX side, see **4.3 Installation of Termination Resistor for Host Communication (P. 11)**.

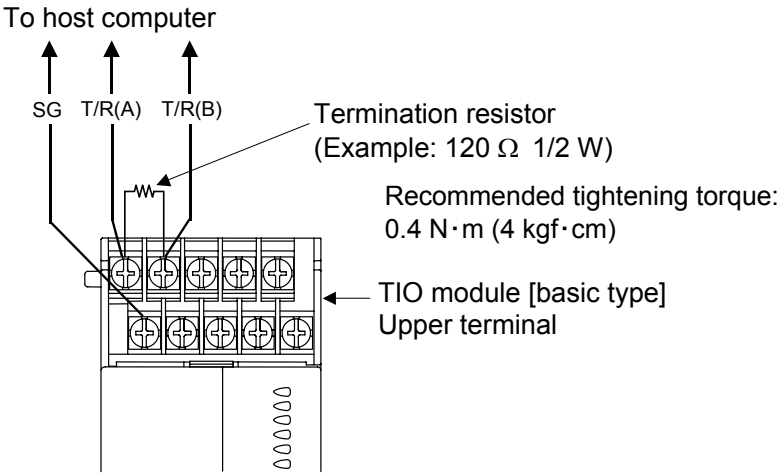
4.3 Installation of Termination Resistor for Host Communication

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.

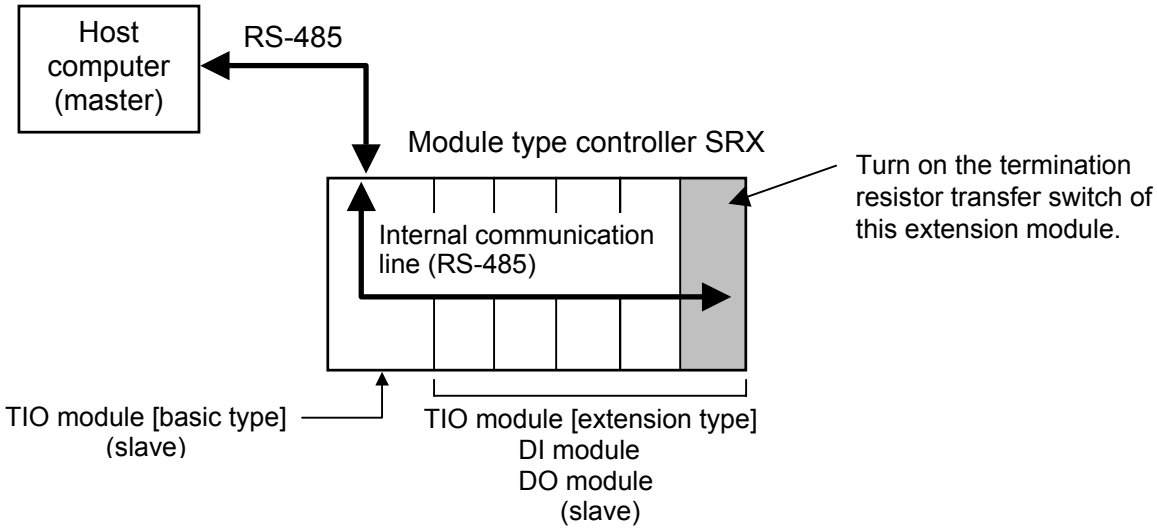
■ When connected basic module alone

Install termination resistor in terminal directly.



■ When two or more other modules are connected to one TIO module [basic type]

When the other module is connected to the TIO module [basic type], it is necessary to connect a termination resistor to the termination of the communication line in the module at the extreme end.
As no termination resistor is externally connected to the TIO module [extension type], DI module or DO module, the termination resistor built in the module is connected by switch selection.

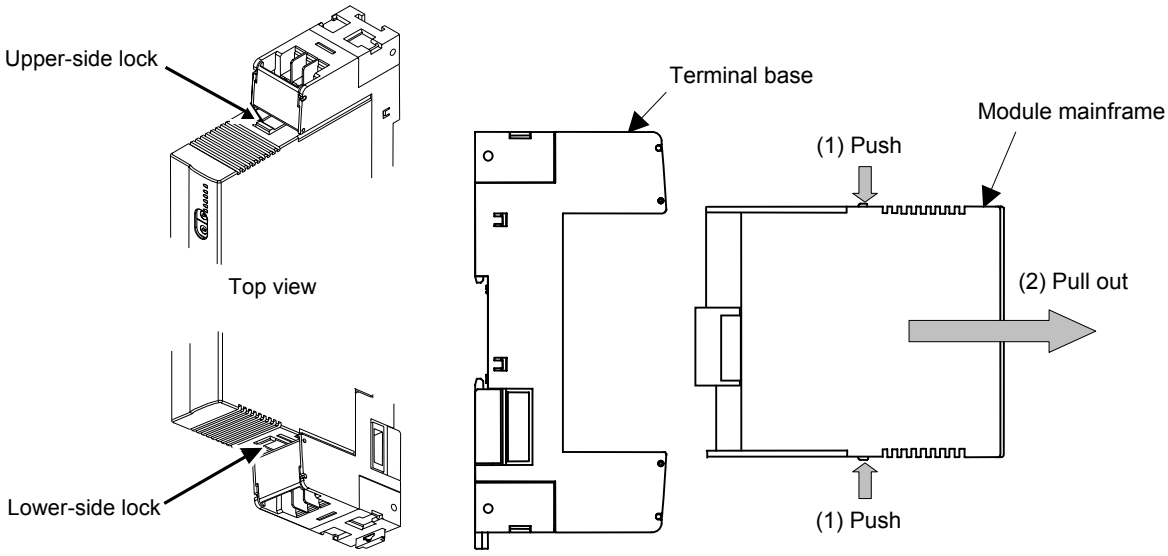


● Transfer procedure of internal termination resistor

The following description is made by referring to the TIO module [extension type] as an example. This description also applies even when the DI or DO module is connected.

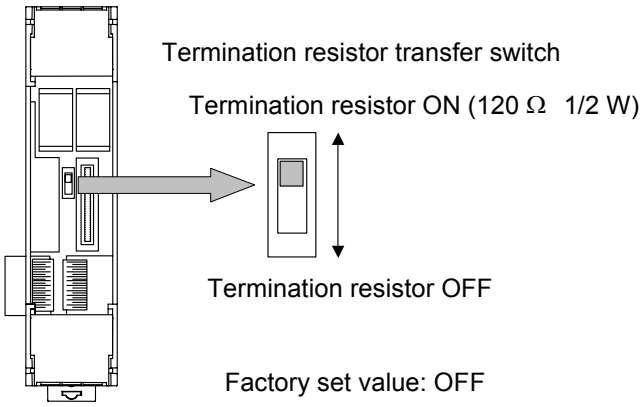
1. Turn off the power supply of the module.
Do not separate the module mainframe from the terminal base with the power turned on. If so, instrument failure may result.

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



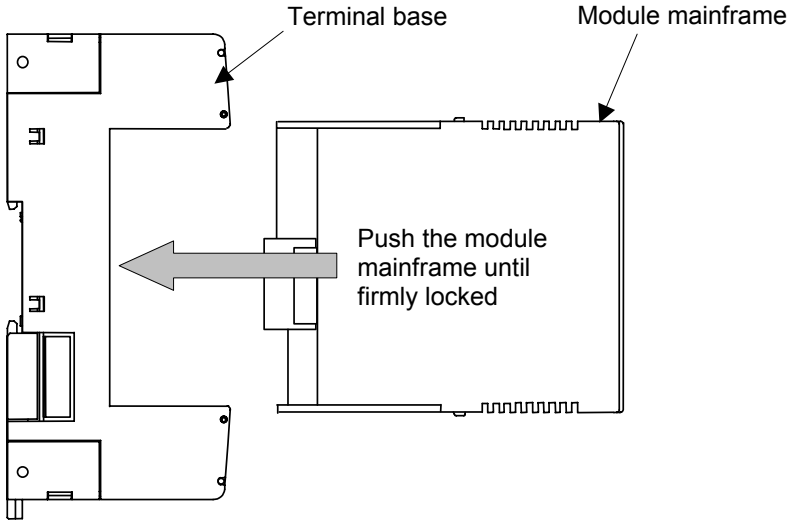
Removing the module mainframe

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



A terminal base of the state which removed module mainframe

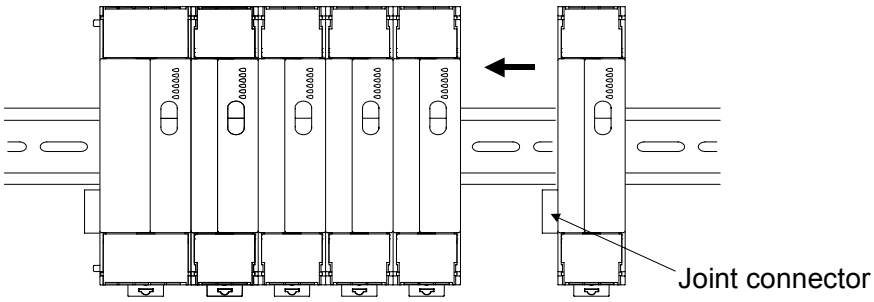
4. Push the module mainframe thus separated in the terminal base until firmly locked.

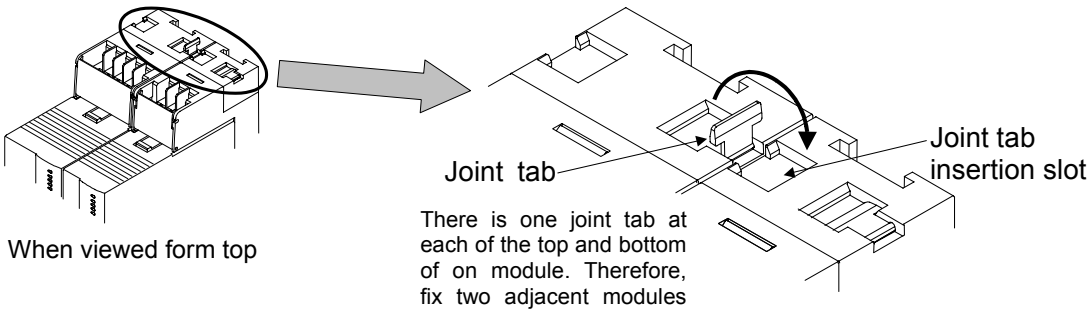


Mounting the module mainframe

5. Connect the module whose termination resistor transfer switch is turned to the ON position to the right end.

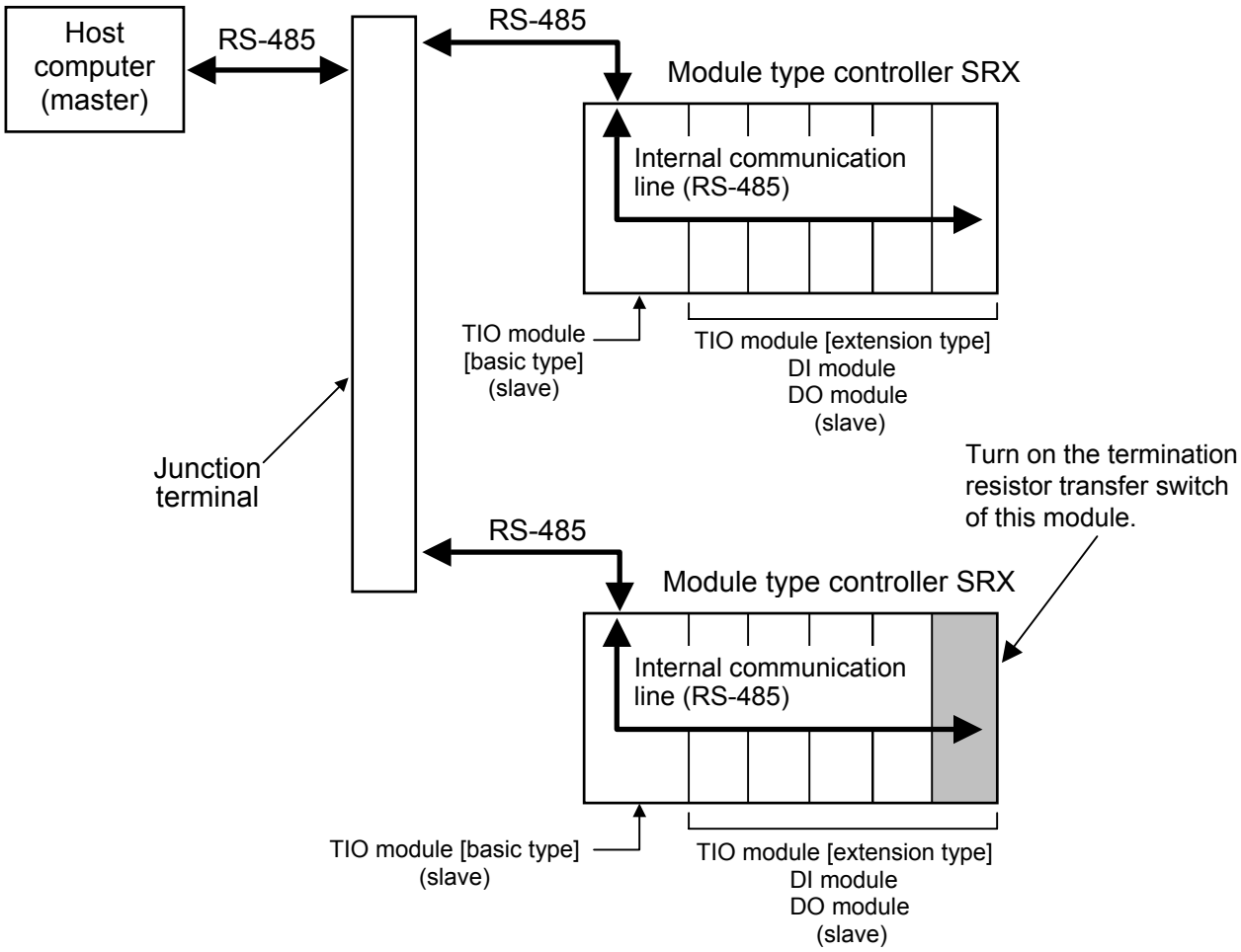
Connect each module using joint connector while sliding the module. And, lift each of the joint tabs located at the top and bottom of the module and then insert it in the slot of the adjacent module to fix these two modules.





■ When two or more SRX units are connected

When two or more SRX units are connected, it is necessary to connect a termination resistor to the termination of the communication line in the module located most distantly from the host computer (master). A termination resistor is built in the TIO module [extension type], DI module and DO module, and it can be connected to the circuit by selecting the switch.



☞ For the termination resistor installation, see ■ **When two or more other modules are connected to one TIO module [basic type] (P. 11)**.

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.

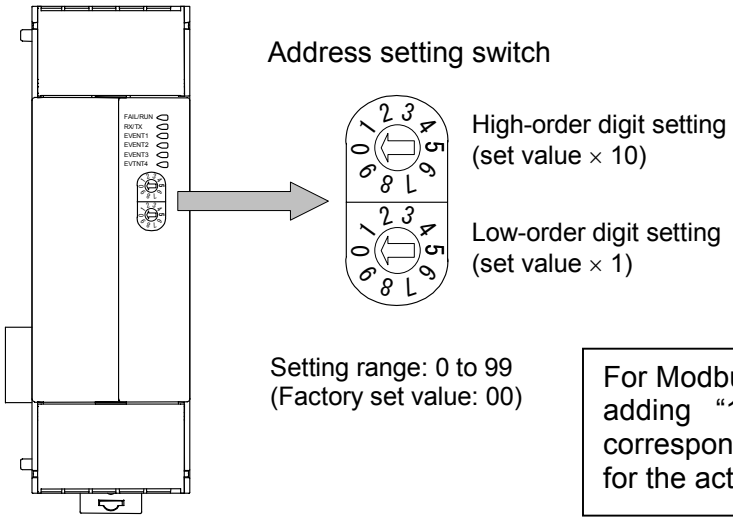
CAUTION

Do not separate the module mainframe from the terminal base with the power turned on.
If so, instrument failure may result.

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.



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.

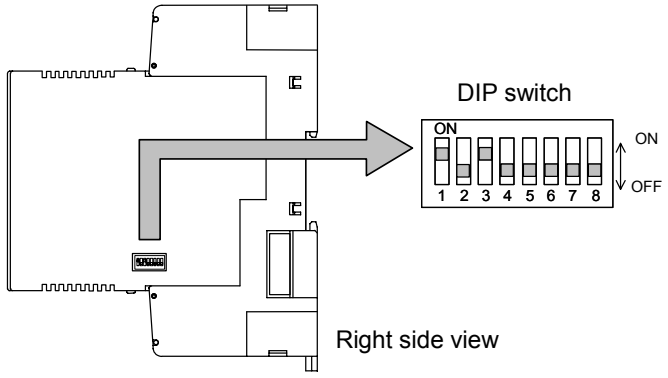
When two or more other modules are connected to one TIO module [basic type], set the smallest address number to that TIO module [basic type].

The above figure is TIO module [basic type]. The figure of TIO module [expansion type], DI module and DO module are the same as a TIO module [basic type].

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, protocol and termination resistor setting of internal data bus.

When two or more modules are connected on the same line for their use, set DIP switches corresponding to the switches, 1 to 6 on all of the modules to the same positions. Otherwise the module may fail or malfunction.



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 *	Setting range of RKC communication
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	Setting range of Modbus
ON	ON	ON	Data 8-bit, Odd parity	

* When the Modbus communication protocol selected, this setting becomes invalid. (Stop 1-bit: fixed)

Factory set value: Data 8-bit, without parity

6	Protocol selection
OFF	RKC communication
ON	Modbus

Factory set value: RKC communication

8	Internal data bus termination resistor setting
OFF	Termination resistor OFF
ON	Termination resistor ON

Factory set value: Termination resistor ON: X-TIO-A
Termination resistor OFF: X-TIO-B, X-DI-A/B, X-DO-A/B

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

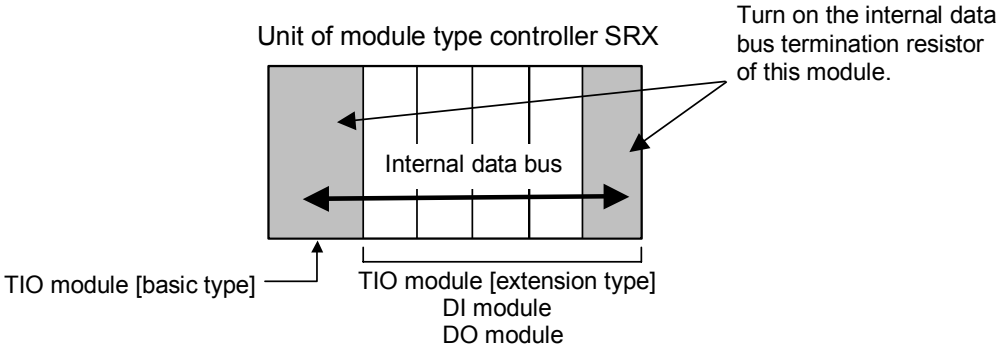
Switch No. 8 sets it only in the DI module or the DO module use.
For details, see **5.3 Internal Data Bus Termination Resistor Setting (P. 17)**.

5.3 Internal Data Bus Termination Resistor Setting

In addition to the host communication termination resistor, it is necessary to set the internal data bus termination resistor to the SRX unit. It is set by DIP switch No. 8 located at the right side of the module.

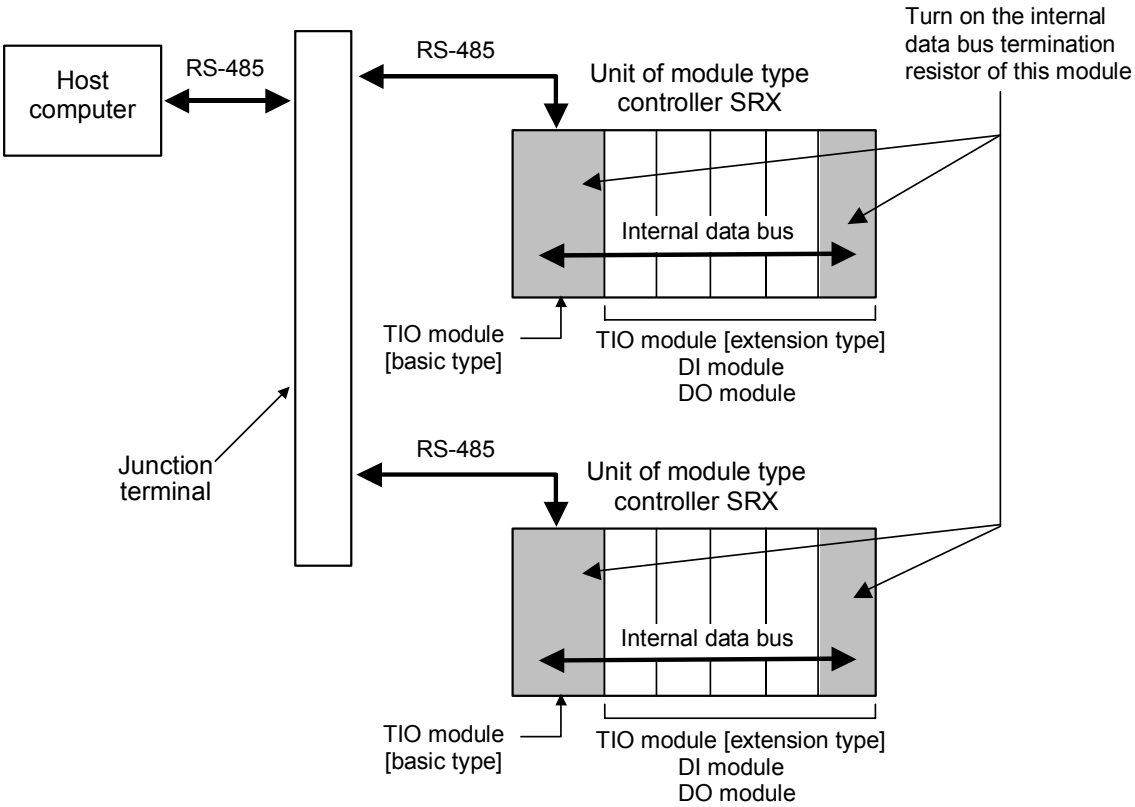
- **When the SRX unit is one**

Turn on the internal data bus termination resistor in module of both ends.



- **When two or more SRX units are connected**

Turn on the internal data bus termination resistor in module of both ends for each unit.



5.4 Communication Time Setting

The DIP switch on the right side of the module enables the setting of "transmission transfer time" and "data interval extension time (during Modbus communication)" by hardware.

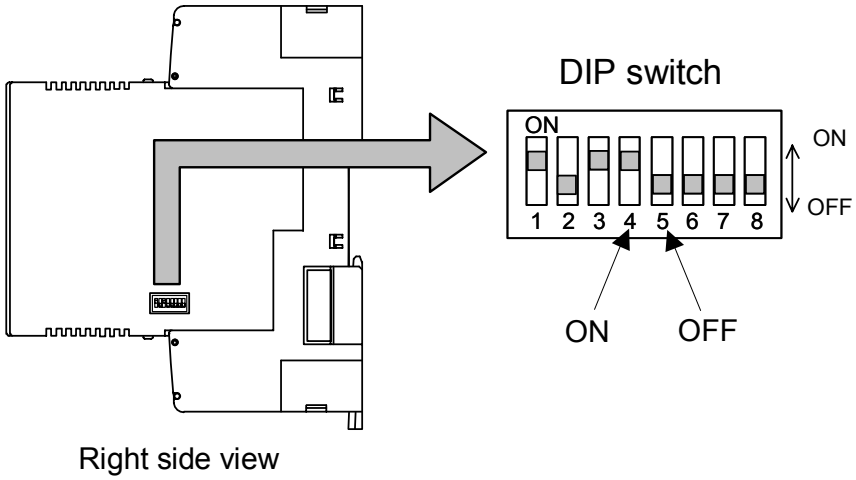
Transmission transfer time: The sending and receiving of RS-485 communication is conducted through two wires; consequently, the transmission and reception of data requires precise timing. Then, set the desired transmission transfer time to secure the time until the transmission line is changed to data receiving after the host computer ends its sending.
(Factory set value: 6 ms)

☞ See **5.5 Communication Requirements (P. 20)**.

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. (Factory set value: 0 ms)

- **Setting procedure of communication time**

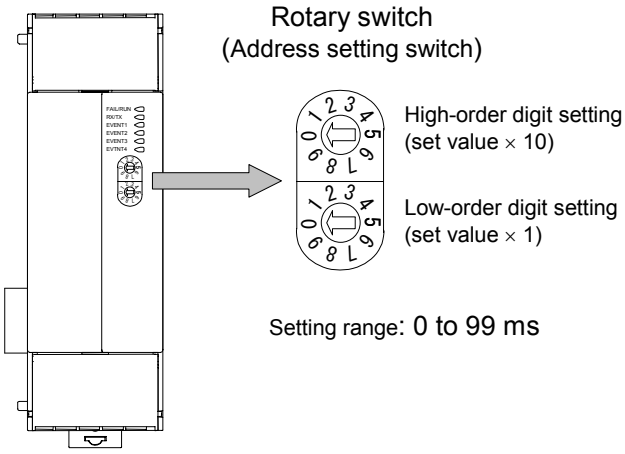
1. Set the module to the communication time setting mode by turning No. 4 switch in the DIP switch at the right side to the ON position and No. 5 switch in the same DIP switch to the OFF position with the power supply turned off. At this time the module is set to the transmission transfer time setting 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.

5.5 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. *

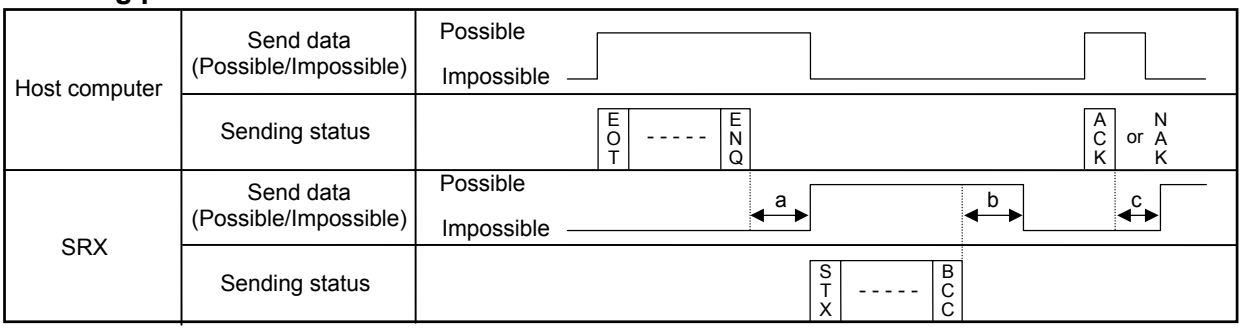
* When the following data items are set, the maximum response sending time becomes 200 ms.
Input rang number, Input scale high limit, Input scale low limit, Input range decimal point position, Temperature unit selection, Event 1 type selection, Event 2 type selection

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

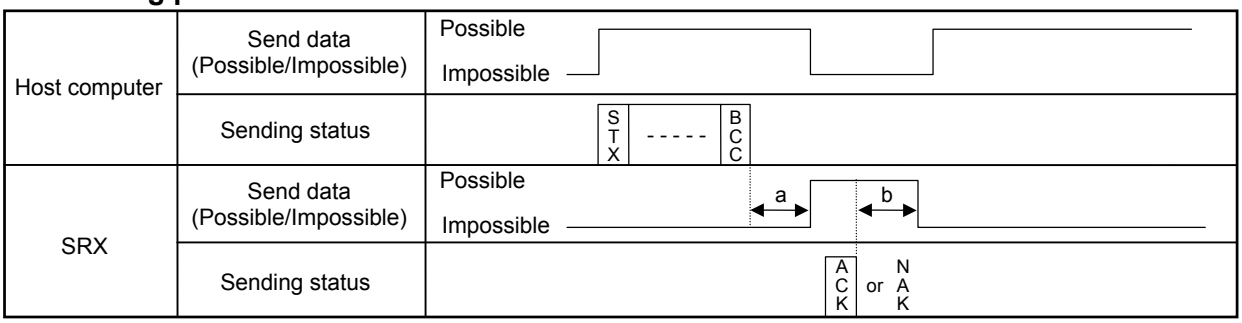
The sending and receiving of RS-485 communication is conducted through two wires; consequently, the transmission and reception of data requires precise timing.

● 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

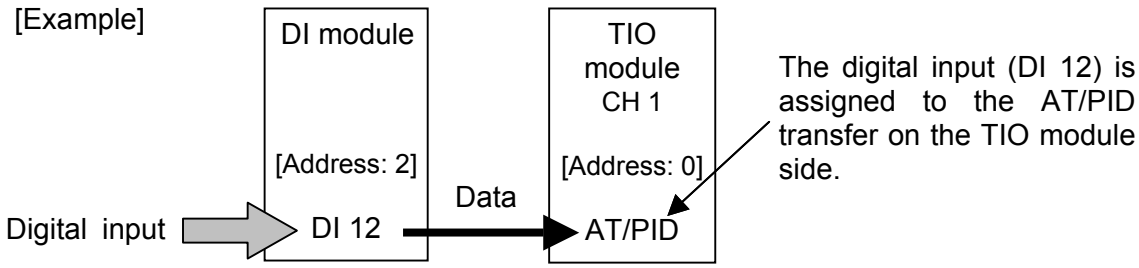
A transmission error may occur with the transmission line disconnected, shorted or set to the high-impedance state. In order to prevent the above error, it is recommended that the fail-safe function be provided on the receiver side of the host computer. The fail-safe function can prevent a framing error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

6. DIGITAL INPUT/OUTPUT

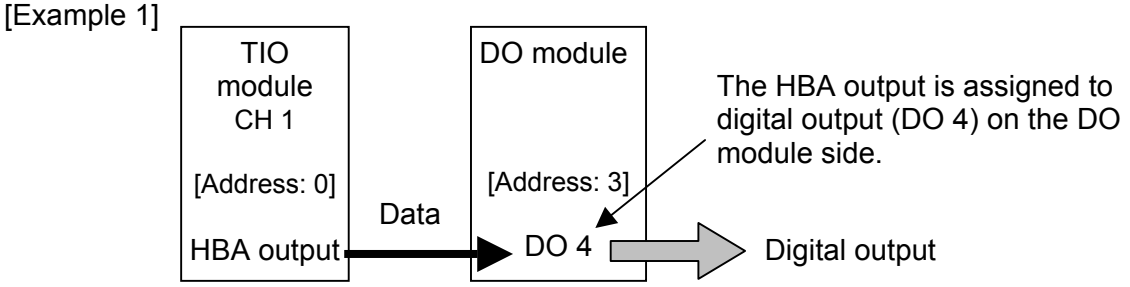
6.1 Outline of Digital Input/Output Assignment

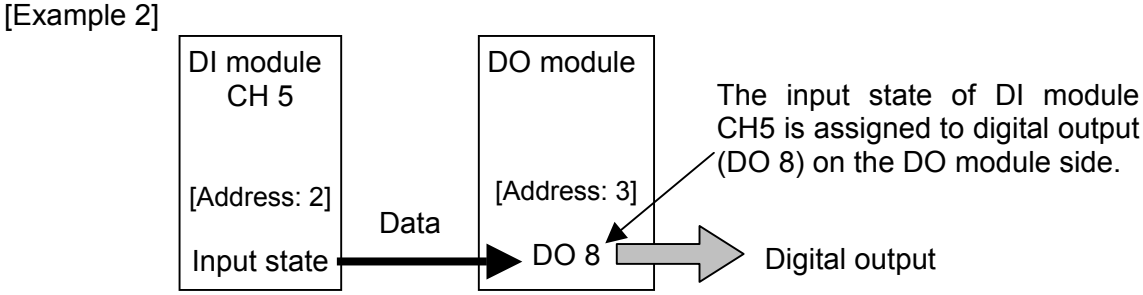
For digital input, the TIO module receives and processes contact status data items from the DI module. For digital output, the DO module receives event and time signal data items from the TIO or DI module and then outputs them to the outside.
The assignment of these digital input and digital output is made in the module receiving the respective data items.

- The assignment of digital input is made in the TIO module receiving the respective data items. Digital input is assigned by setting the address and channel number of the respective DI module to each digital input item of the TIO module.



- The assignment of digital output is made in the DO module receiving the respective data items. Digital output is assigned by setting the address and data type to be output of the respective TIO or DI module to each channel of the DO module.





6.2 Digital Input

The following signals become selectable as digital input when the DI module is used.

- Program operation mode selection (6 points): RESET, RUN, FIX, MAN, HOLD, STEP
- Program pattern selection (5 points): PSET, SEL1, SEL2, SEL3, SEL4
- Autotuning (AT)/PID control transfer (1 point): AT/PID

6.2.1 Program operation mode selection

Transfer the program operation mode and an action in program control.

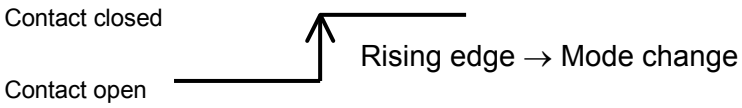
■ Signal contents

DI channels can be freely assigned to each mode of the TIO module shown in the following.
(Settable for each temperature control channel.)

RESET: Reset mode
RUN: Program control mode
FIX: Fixed set point control mode
MAN: Manual control mode
HOLD: Hold action (This action is enabled in program control)
STEP: Step action (This action is enabled in program control)

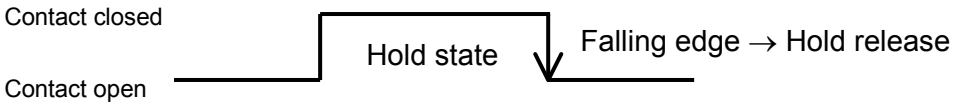
■ Transfer timing

- The RESET, RUN, FIX or MAN mode is changed when the contact is closed from the open condition (rising edge).

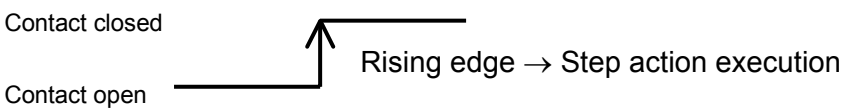


Priority order when each contact of RESET, RUN, FIX and MAN is closed simultaneously.
MAN > FIX > RUN > RESET

- The HOLD state is kept while the contact is being closed. At this time, no HOLD state can be released via communication (the contact status has priority over others). In addition, the HOLD state is released when the contact is opened from the closed condition (falling edge).



- The STEP action is taken when the contact is closed from the open condition (rising edge).



6.2.2 Program pattern selection

Transfer the run program pattern.
This function is enabled only in Reset mode.

■ Signal contents

- Select pattern at four contacts of SEL1, SEL2, SEL3, and SEL4, and change pattern with PSET.
- A DI channel to select the program pattern is specified to the TIO module.
  As the five contacts, PSET, SEL1, SEL2, SEL3 and SEL4 are handled as one set and the contents corresponding to five channels are automatically assigned in order of PSET, SEL1, SEL2, SEL3 and SEL4 with the preset DI channel number at the head.
  (Settable for each temperature control channel.)
- When assigning contacts for program pattern selection to the X-DI-A module with up to 12 input channels, the contacts corresponding to five channels are required for program pattern selection. Therefore, they are assigned to DI channels 1 to 8.
  (For the X-DI-B module with up to 28 input channels, they are assigned to DI channels 1 to 24.)

[For X-DI-A module]

Digital input (DI) module assignment channel No.	
1	These channels can set program pattern selection.
2	
3	
4	
5	
6	
7	
8	
9	No setting available
10	
11	
12	

Program pattern selection

PSET
SEL1
SEL2
SEL3
SEL4

In this order, the contacts corresponding to five channels are automatically assigned.

If the contacts for program pattern selection are assigned to DI channel 8, the following results.

DI channel	Program pattern selection
8	PSET
9	SEL1
10	SEL2
11	SEL3
12	SEL4

- Contact state and pattern number

Contact	Pattern number															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
SEL1	–	×	–	×	–	×	–	×	–	×	–	×	–	×	–	×
SEL2	–	–	×	×	–	–	×	×	–	–	×	×	–	–	×	×
SEL3	–	–	–	–	×	×	×	×	–	–	–	–	×	×	×	×
SEL4	–	–	–	–	–	–	–	–	×	×	×	×	×	×	×	×

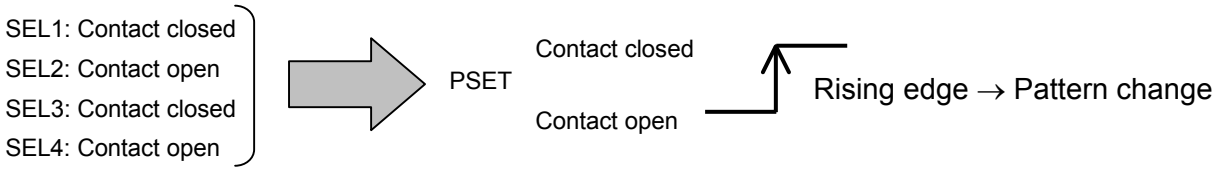
–: Contact open ×: Contact closed

■ Transfer timing

After selecting the pattern number by four contacts SEL1, SEL2, SEL3 and SEL4, the pattern number is changed when contact PSET is closed from the open condition (rising edge).

[Example] When change it to pattern No. 6

After the contacts SEL1 and SEL3 are closed and contacts SEL2 and SEL4 are opened, the present pattern number is changed to Pattern No. 6 if contact PSET is closed from the condition where opened (rising edge).



6.2.3 Autotuning (AT)/PID control transfer

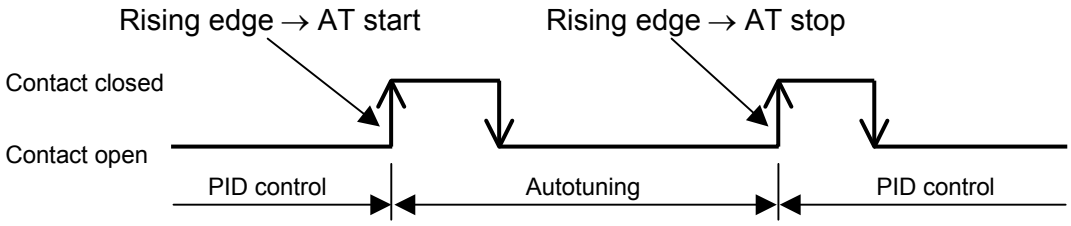
Switch start/stop of an autotuning (AT) function.
Become PID control during autotuning (AT) suspension

■ Signal contents

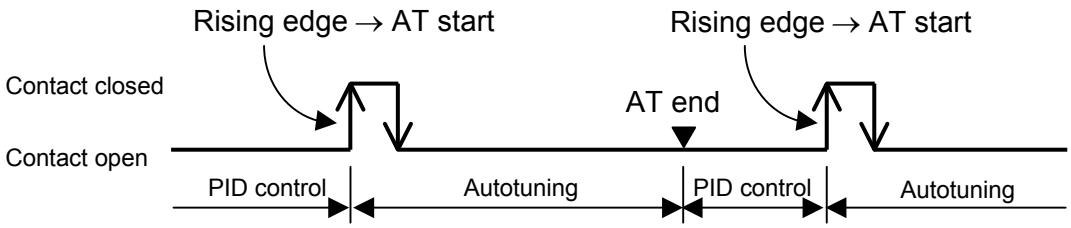
A DI channel to select START/STOP of autotuning (AT) function is specified to the temperature control (TIO) module. (Settable for each temperature control channel.)

■ Transfer timing

The autotuning (AT) function starts activating when the contact is closed from the open condition (rising edge) during PID control. In addition, the autotuning (AT) function stops activating (canceled) when the contact is closed from the open condition (rising edge).



If the contact is closed from the open condition after the autotuning (AT) function ends its activation. The autotuning (AT) function is re-activated.

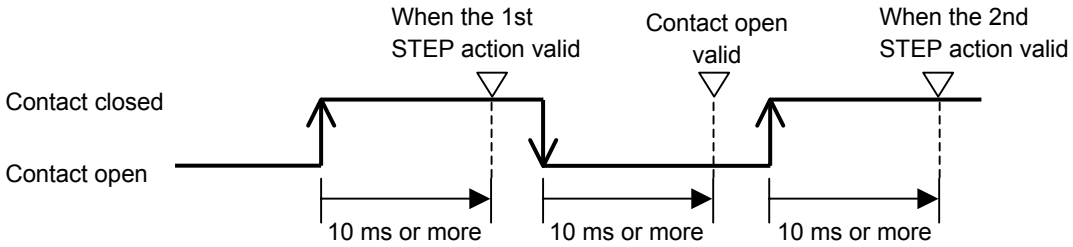


6.2.4 Caution in the digital input

- The maximum delay time is 30 ms from the time when the contact in the DI module is going to be closed or opened until activated in the TIO module.
- In order to make contact activation valid, it is necessary to maintain the same contact state for more than 10 ms. Otherwise, that contact state is ignored.

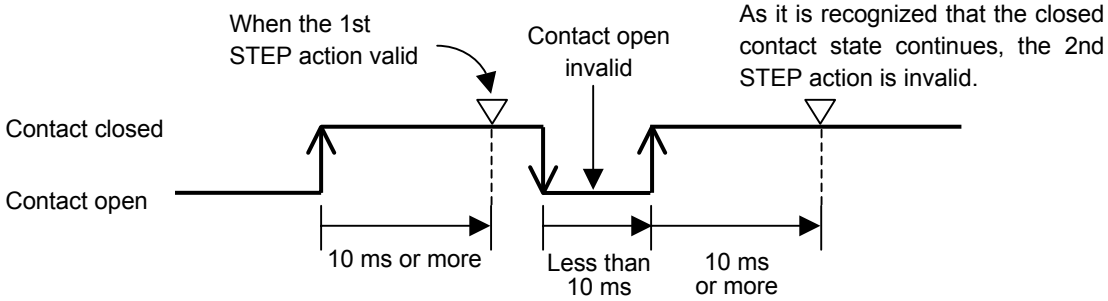
[Example]
When the STEP action is taken in succession by digital input, as it is taken by the rising edge the contact needs to be activated in order of "OPEN → CLOSED → OPEN → CLOSED" in order to advance two segments. In order to make contact activation valid, it is necessary to hold the present contact state for more than 10 ms. Therefore in this case, a time of more than 30 ms becomes necessary.

[When the STEP action is valid twice]

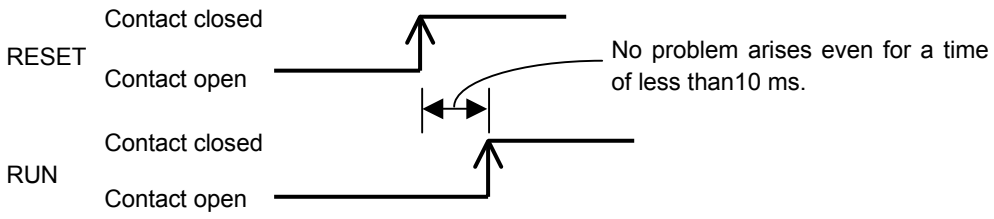


[When the STEP action is valid only once]

If the contact open time is less than 10 ms after the STEP action becomes valid with the contact closed, it is not recognized that the contact is in the open state. Therefore, no STEP action is taken even if the contact is closed one more.

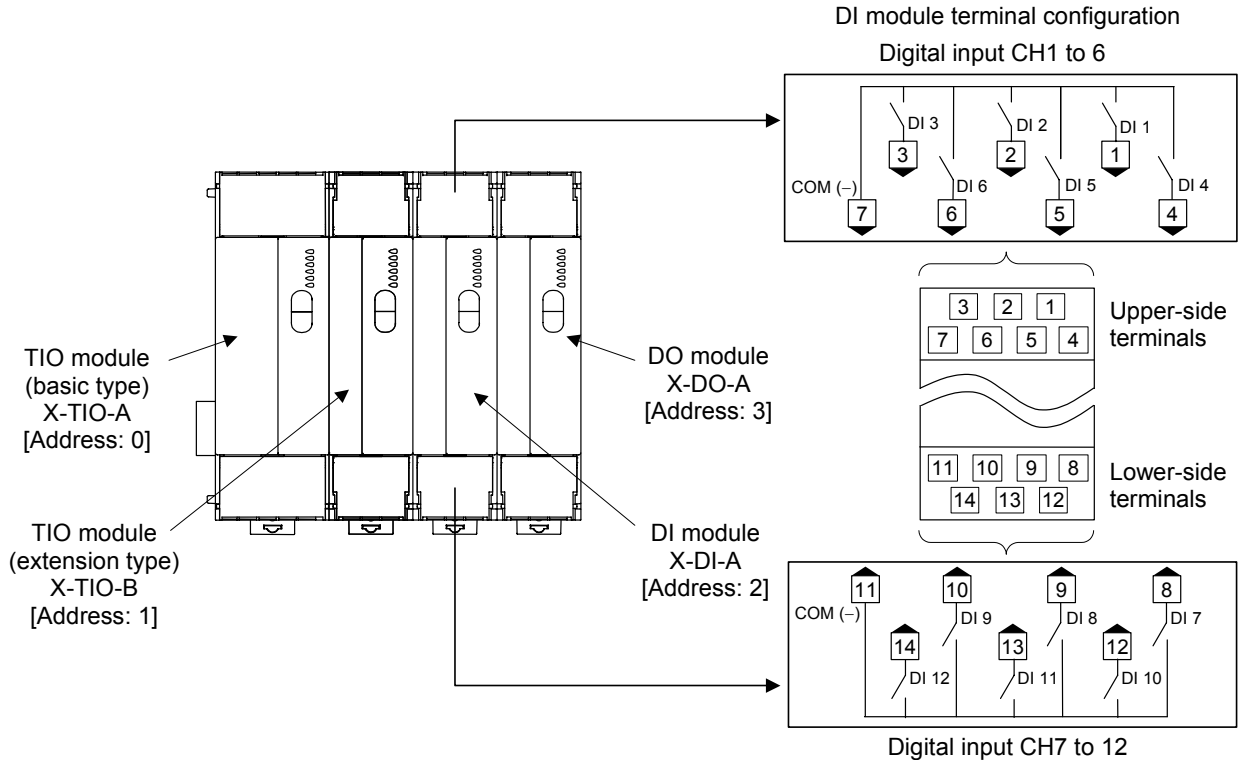


As each contact (RESET, RUN, FIX or MAN) which selects the program operation mode is different, it is not necessary to take a time of more than 10 ms when selected to the respective mode. However, as the same mode once more it is necessary to take a time of more than 20 ms (for more than10 ms required for contact open from close and for more than 10 ms required for contact close from open).



6.2.5 Example of digital input assignment

This is when channel numbers of the DI module are assigned as follows to RESET, RUN, FIX, MAN, HOLD, STEP, PSET, SEL1, SEL2, SEL3, SEL4, and each digital input item of AT/PID in CH1 of the TIO module with each module in the SRX configured as shown in the following.



Contents of assignment example

TIO module (Address 00) Digital input items		DI module assignment channel No.
Program operation mode selection	RESET (Reset mode)	1
	RUN (Program control mode)	2
	FIX (Fixed set point control mode)	3
	MAN (Manual control mode)	4
Action at program operation	HOLD (Hold action)	5
	STEP (Step action)	6
Program pattern selection	PSET	7
	SEL1	8
	SEL2	9
	SEL3	10
	SEL4	11
Autotuning (AT)/PID control transfer	AT/PID	12

■ RKC communication

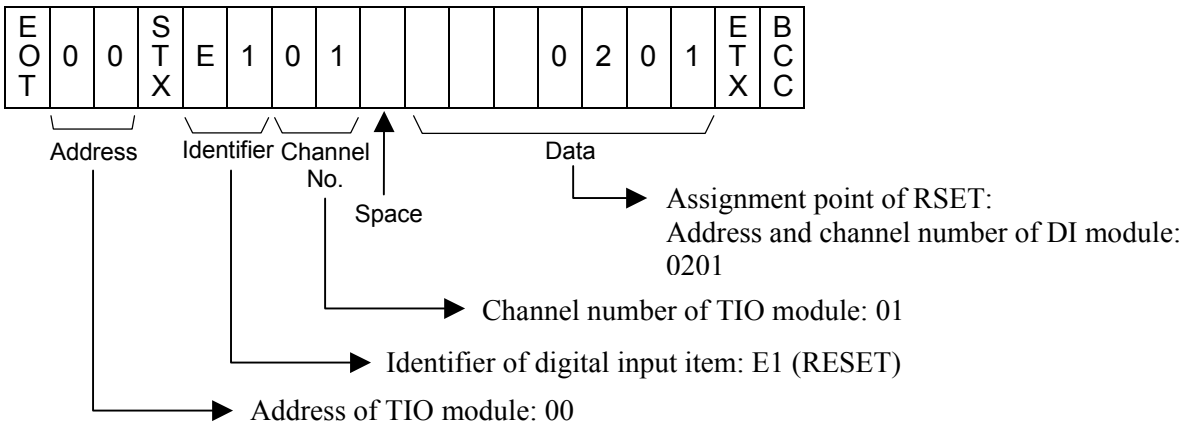
The address and channel number of the DI module are specified to communication identifiers E1 to E8 for the TIO module.

Setting object: TIO module [basic type] X-TIO-A: CH 1

Identifier	Name	Set value	Setting contents
E1	RESET (Reset mode)	0201	Upper two digits (Thousands and hundreds digits): Address of DI module Lower two digits (Tens and units digits): Channel number of DI module
E2	RUN (Program control mode)	0202	
E3	FIX (Fixed set point control mode)	0203	
E4	MAN (Manual control mode)	0204	
E5	HOLD (Hold action)	0205	
E6	STEP (Step action)	0206	
E7	Program pattern selection *	0207	
E8	Autotuning (AT)/PID control transfer	0212	

* For program pattern selection, five contacts PSET, SEL1, SEL2, SEL3 and SEL4 are used as one set and the contacts corresponding to five channels are automatically assigned in order of PSET, SEL1, SEL2, SEL3 and SEL4 with the preset DI channel number at the head.

● Communication example (selecting)



■ Modbus

The address and channel number of the DI module are specified to each register address for setting digital input on the data map for the TIO module.

Setting object: TIO module [basic type] X-TIO-A CH 1

TIO module CH 1 register address		Name	Set value	Setting contents
HEX	DEC			
003D	61	RESET (Reset mode)	0201	Upper two digits (Thousands and hundreds digits): Address of DI module Lower two digits (Tens and units digits): Channel number of DI module
003E	62	RUN (Program control mode)	0202	
003F	63	FIX (Fixed set point control mode)	0203	
0040	64	MAN (Manual control mode)	0204	
0041	65	HOLD (Hold action)	0205	
0042	66	STEP (Step action)	0206	
0043	67	Program pattern selection *	0207	
0044	68	Autotuning (AT)/PID control transfer	0212	

* For program pattern selection, five contacts PSET, SEL1, SEL2, SEL3 and SEL4 are used as one set and the contacts corresponding to five channels are automatically assigned in order of PSET, SEL1, SEL2, SEL3 and SEL4 with the preset DI channel number at the head.

● Communication example (Preset multiple registers [10H])

Data is written into the two holding registers from 003DH to 003EH of TIO module (slave address 1).

Query message

Slave address		01H	→ Address of TIO module: For Modbus, the slave address is obtained by adding "1" to the value set by the address setting switch.
Function code		10H	
Starting number	High	00H	→ First holding register address
	Low	3DH	
Quantity	High	00H	
	Low	02H	
Number of data		04H	→ Number of holding registers × 2
Data to first register	High	00H	→ Assignment point of RSET: Address and channel number of DI module (hexadecimal) [Decimal: 0201]
	Low	C9H	
Data of next register	High	00H	→ Assignment point of RUN: Address and channel number of DI module (hexadecimal) [Decimal: 0202]
	Low	CAH	
CRC-16	High	61H	
	Low	4BH	

6.3 Digital Output

6.3.1 Contents of digital output signal

If the DO module is used, each state of the TIO or DI module can be freely assigned to each DO channel as an output signal.

📖 The maximum delay time from a digital output event occurrence until actually output is 30 ms.

■ TIO module

The address and function number of the output signal of the TIO module are specified to the respective DO channel by the function selection of DO1 to DO12 (terminal) and that of DO13 to DO28 (connector) in the DO module.

- **Type of output signals**
  The output signal of the following can be selected to every channel of TIO module.

  Burnout output
  Event 1 output
  Event 2 output
  Heater break alarm (HBA) output
  Control loop break alarm (LBA) output
  Program end state output
  Pattern end output
  Wait state output
  Time signal 1 to 16 output

■ DI module

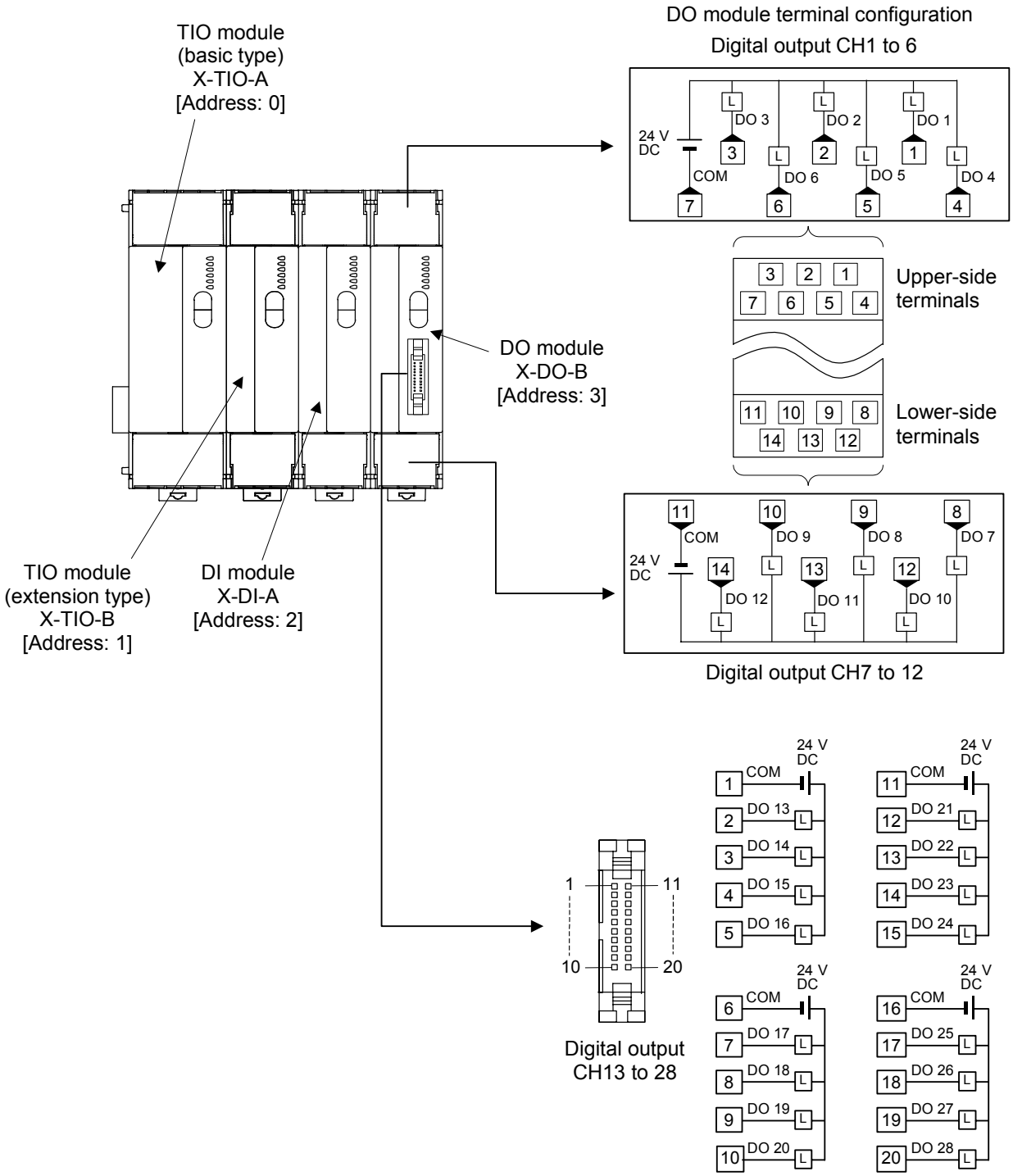
The address and function number of the output signal of the DI module are specified to the respective DO channel by the function selection of DO1 to DO12 (terminal) and that of DO13 to DO28 (connector) in the DO module.

- **Type of output signals**
  Input state of DI module CH1 to 28

📖 Function selection of DO 13 to 28 (connector) is valid only when DO module type is X-DO-B.

6.3.2 Example of digital output assignment

This is when the address and function number of the output signal of the TIO module are assigned as follows to the respective DO channel by the function selection of DO1 to DO12 (terminal) and that of DO13 to DO28 (connector) in the DO module with each module in the SRX configured as follows.



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Contents of assignment example

DO module channel No.	TIO module function selection of output signals	
	Contents	Function No.
DO 1	CH 1 Burnout output	01
DO 2	CH 1 Event 1 output	02
DO 3	CH 1 Event 2 output	03
DO 4	CH 2 Burnout output	17
DO 5	CH 2 Event 1 output	18
DO 6	CH 2 Event 2 output	19
DO 7	CH 1 Program end state output	09
DO 8	CH 1 Pattern end output	10
DO 9	CH 1 Wait state output	11
DO 10	Unused	—
DO 11		
DO 12		
DO 13	CH 1 Time signal 1 output	33
DO 14	CH 1 Time signal 2 output	34
DO 15	CH 1 Time signal 3 output	35
DO 16	CH 1 Time signal 4 output	36
DO 17	Unused	—
DO 18		
DO 19		
DO 20		
DO 21		
DO 22		
DO 23		
DO 24		
DO 25		
DO 26		
DO 27		
DO 28		

☞ For function number, see **TIO module Function Number Table (P. 174)**.

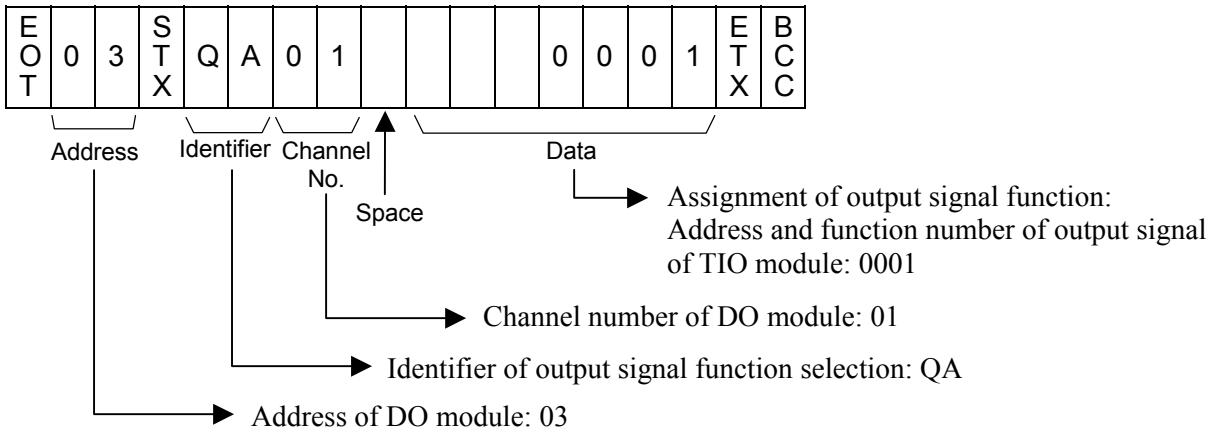
■ RKC communication

The address and function number of output signal of the TIO module are specified to communication identifiers QA and QB for the DO module.

Setting object: Digital output module X-DO-B

Identifier	Name	DO module channel No.	Set value	Setting contents
QA	Function selection of DO 1 to 12 (terminal)	1	0001	Upper two digits (Thousands and hundreds digits): Address of TIO module Lower two digits (Tens and units digits): Function number of output signal 00: No function ☞ For function number, see **TIO module Function Number Table (P. 174)**.
		2	0002	
		3	0003	
		4	0017	
		5	0018	
		6	0019	
		7	0009	
		8	0010	
		9	0011	
		10 to 12	—	
QB	Function selection of DO 13 to 28 (connector) (DO 13 to 28 is used as DO 1 to 16 on communication.)	1	0033	
		2	0034	
		3	0035	
		4	0036	
		5 to 16	—	

● Communication example (selecting)



■ Modbus

The address and function number of output signal of the TIO module are specified to each register address for setting digital input on the data map for the DO module.

Setting object: Digital output module X-DO-B

Name	DO module channel No.	DO module register address		Set value	Setting contents
		HEX	DEC		
Function selection of DO 1 to 12 (terminal)	1	2440	9280	0001	Upper two digits (Thousands and hundreds digits): Address of TIO module Lower two digits (Tens and units digits): Function number of output signal 00: No function ☞ For function number, see **TIO module Function Number Table (P. 174)**.
	2	2441	9281	0002	
	3	2442	9282	0003	
	4	2443	9283	0017	
	5	2444	9284	0018	
	6	2445	9285	0019	
	7	2446	9286	0009	
	8	2447	9287	0010	
	9	2448	9288	0011	
	10 to 12	2449 to 244B	9289 to 9291	—	
Function selection of DO 13 to 28 (connector)	13	2450	9296	0033	
	14	2451	9297	0034	
	15	2452	9298	0035	
	16	2453	9299	0036	
	17 to 28	2454 to 245F	9300 to 9311	—	

● Communication example (Preset multiple registers [10H])

Data is written into the two holding registers from 2440H to 2441H of DO module (slave address 4).

Query message

Slave address		04H
Function code		10H
Starting number	High	24H
	Low	40H
Quantity	High	00H
	Low	02H
Number of data		04H
Data of first register	High	00H
	Low	01H
Data of next register	High	00H
	Low	02H
CRC-16	High	9DH
	Low	53H

Address of DO module:
For Modbus, the slave address is obtained by adding "1" to the value set by the address setting switch.

First holding register address

Number of holding registers × 2

Assignment of DO 1:
Address and function number of output signal of TIO module (hexadecimal) [Decimal: 0001]

Assignment of DO 2:
Address and function number of output signal of TIO module (hexadecimal) [Decimal: 0002]

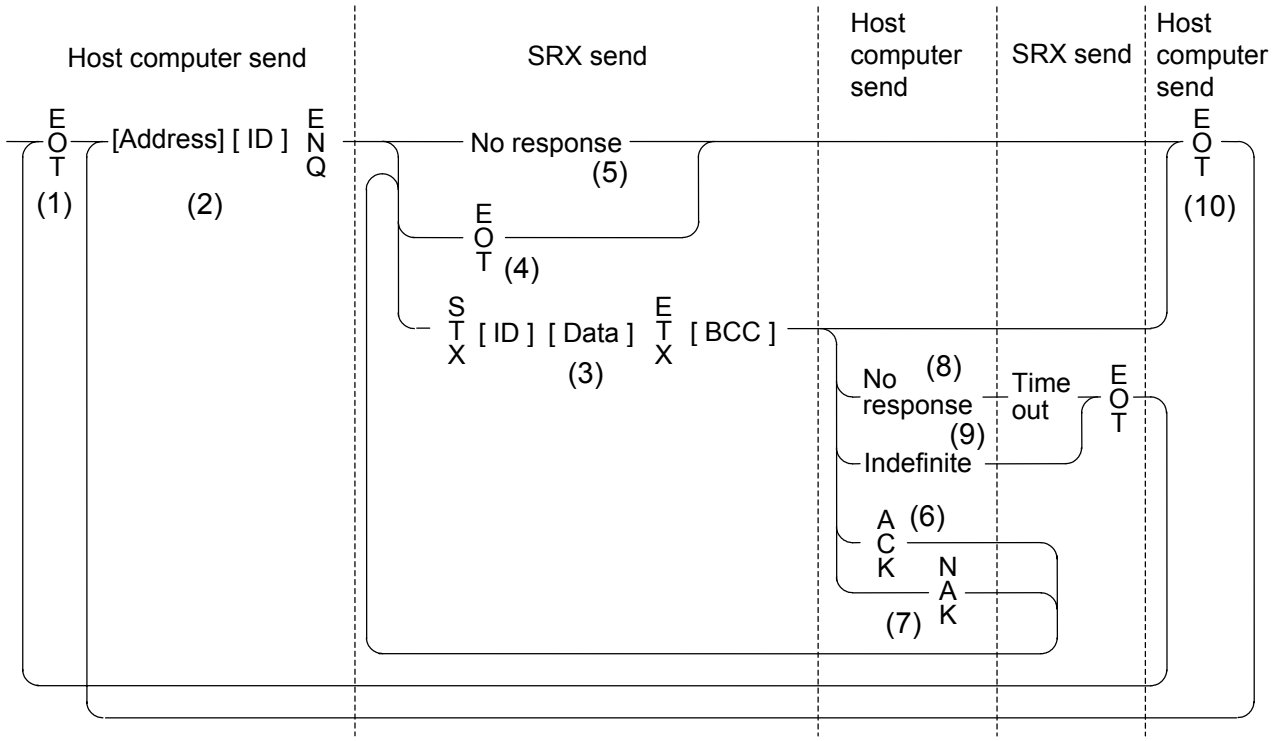
7. RKC COMMUNICATION PROTOCOL

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

7.1 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

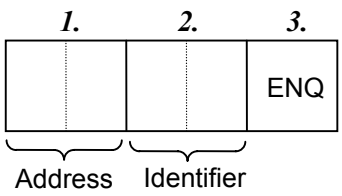
7.1.1 Polling procedures

(1) Data link initialization

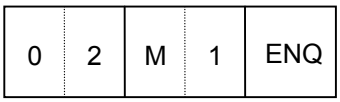
Host computer sends EOT to the controllers to initiate data link before polling sequence.

(2) Data sent from host computer - Polling sequence

Host computer sends polling sequence with the format shown below:



Example:



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. 15).**

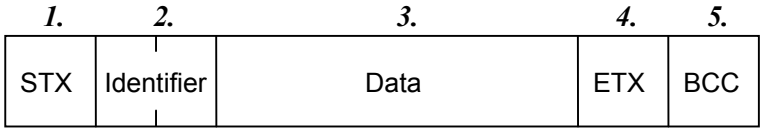
2. Identifier (2 digits)
The identifier specifies the type of data that is requested from the SRX. Always attach the ENQ code to the end of the identifier.

☞ See **7.5 Communication Identifier List of TIO Module (P. 49), 7.6 Communication Identifier List of DI Module (P. 58),** and **7.7 Communication Identifier List of DO Module (P. 61)**.

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 **7.5 Communication Identifier List of TIO Module (P. 49), 7.6 Communication Identifier List of DI Module (P. 58),** and **7.7 Communication Identifier List of DO Module (P. 61)**.

Continued on the next page.

3. Data

Data which is indicated by an identifier of this instrument, 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 **7.3 Communication Data Structure (P. 43)**

4. ETX

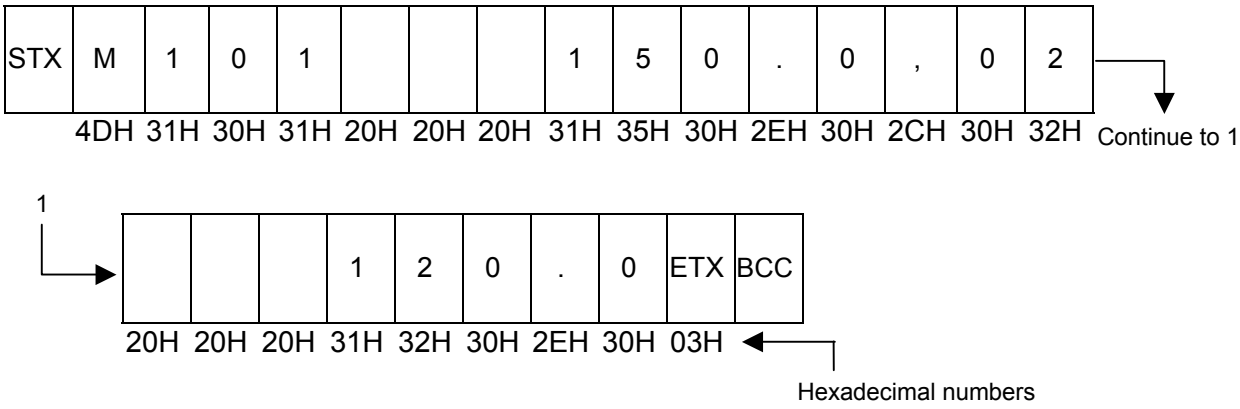
Transmission control character indicating the end of the text.

5. BCC

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

Calculation method of BCC: *Exclusive OR* all data and characters from STX through ETB or 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 for TIO module, identifier data item down to “No.62 Step action” in the communication identifier list are sent. However, no level PID data items are included.
- When ACK was sent in succession for digital input (DI) module, identifier data item down to “No.7 Initial setting mode” in the communication identifier list are sent.
- When ACK was sent in succession for digital output (DO) module, identifier data item down to “No.9 Initial setting mode” in the communication identifier list are sent.

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

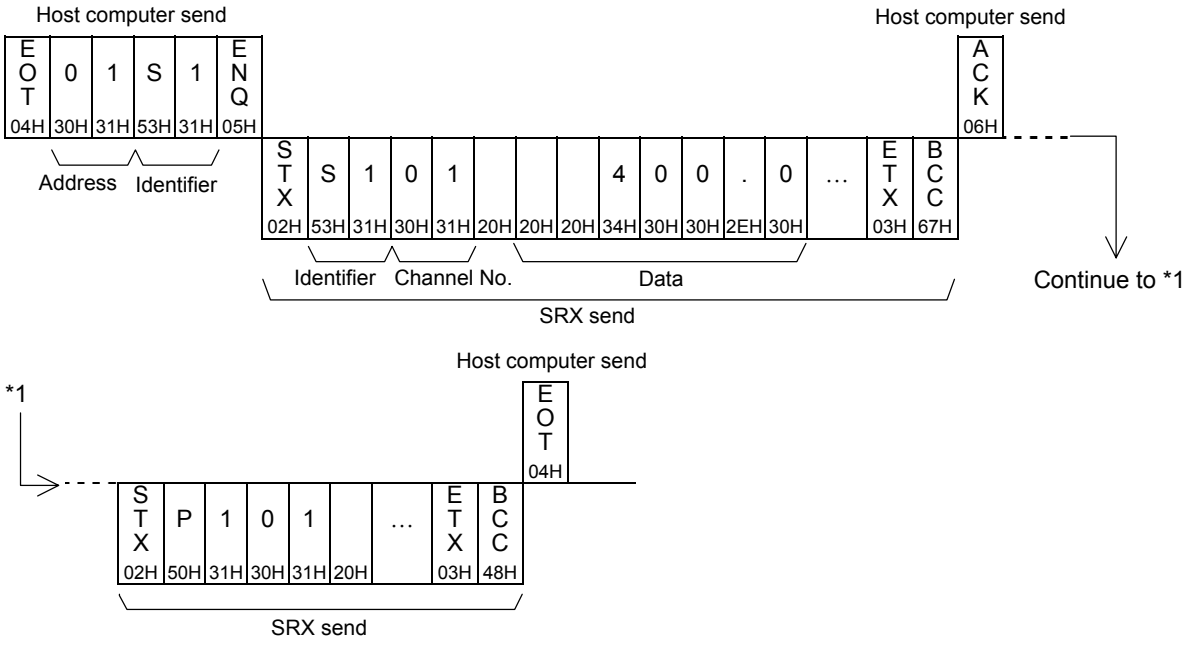
The SRX sends EOT to terminate the data link when the host computer response is indefinite.

(10) EOT (Data link termination)

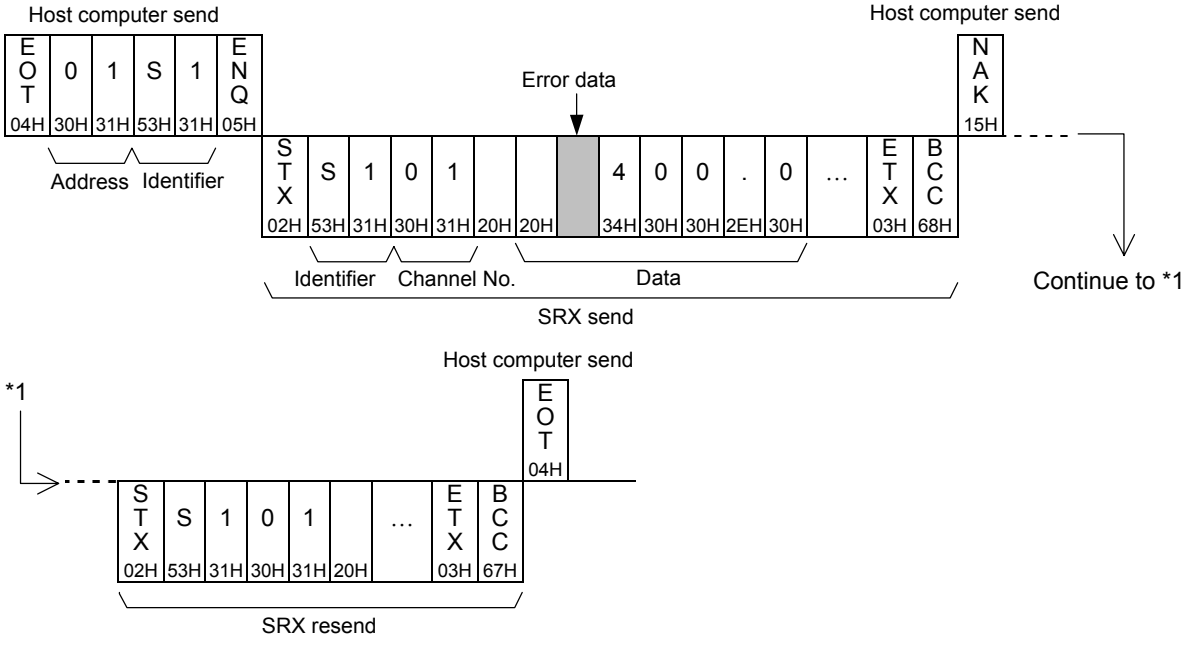
The host computer sends EOT message when it is necessary to suspend communication with the SRX or to terminate the data link due lack of response from the SRX.

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

- **Normal transmission**

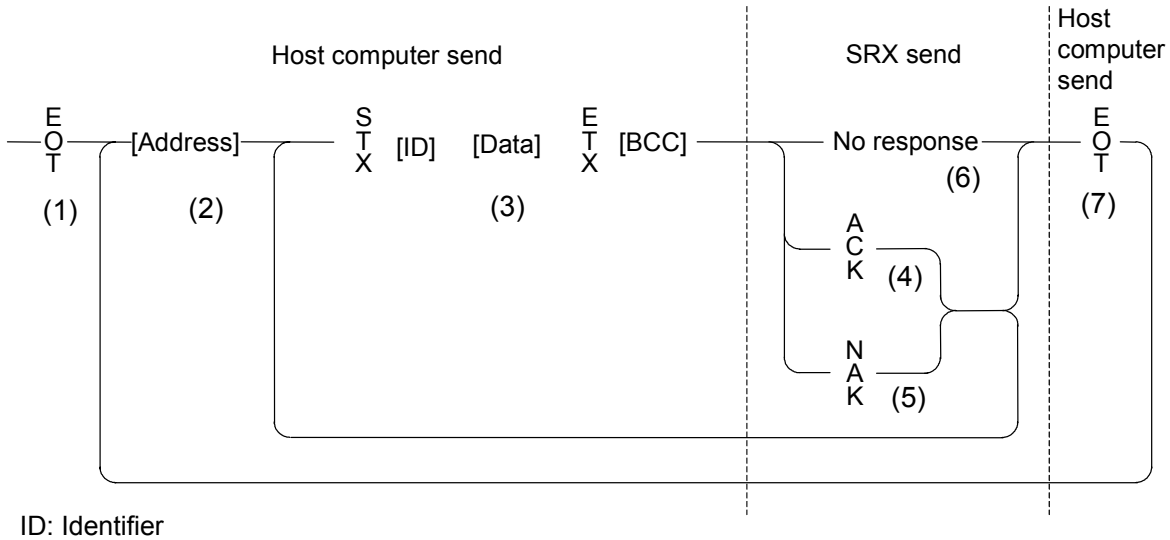


- **Error transmission**



7.2 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

7.2.1 Selecting procedures

(1) Data link initialization

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

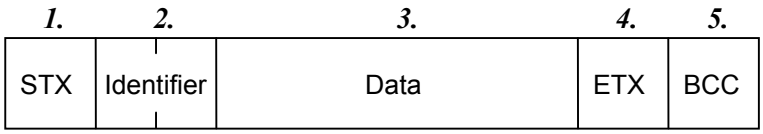
(2) Sending selecting address from the host computer

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. 15)**.

(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 **7.1 Polling (P. 35)**.

(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)

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

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

(6) No response from SRX

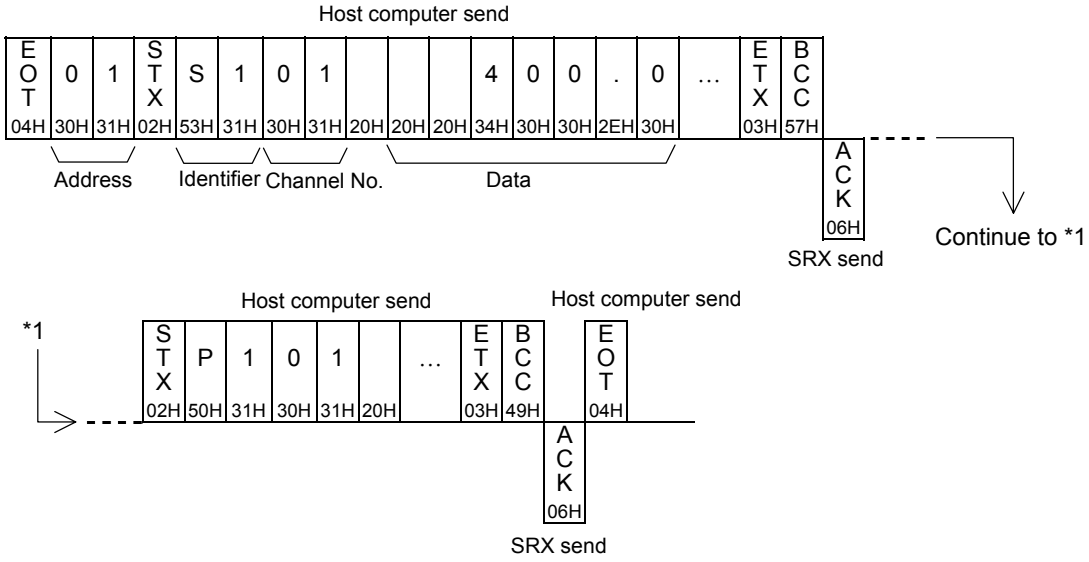
The SRX does not respond when it cannot receive the selecting address, STX, ETX or BCC.

(7) EOT (Data link termination)

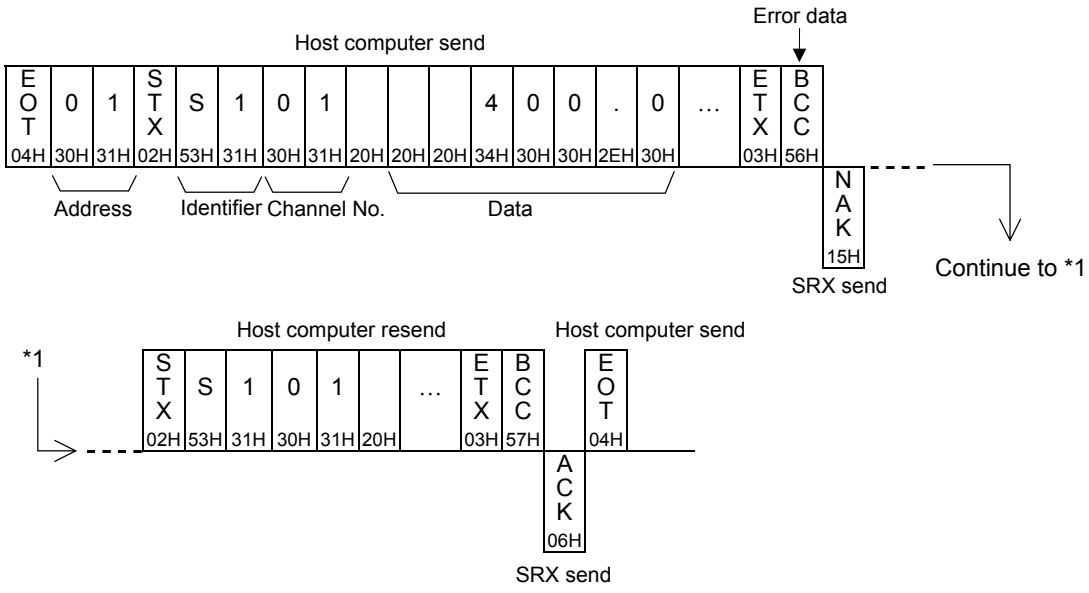
The host computer sends EOT when there is no more data to be sent from the host computer or there is no response from the SRX.

7.2.2 Selecting procedure example (When the host computer sends data)

- **Normal transmission**

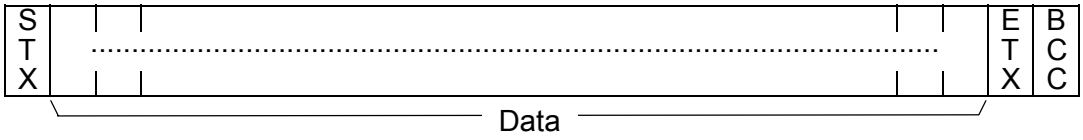


- **Error transmission**



7.3 Communication Data Structure

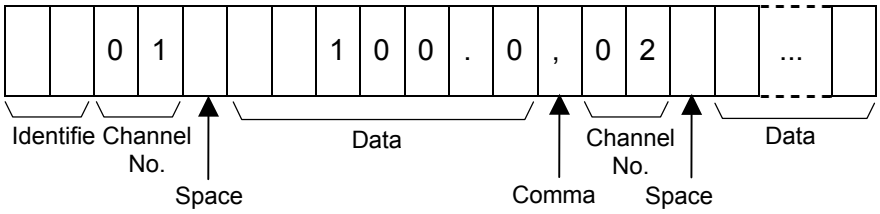
■ Data description (Transmission/receive data structure)



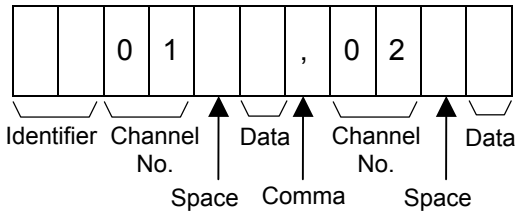
Part of the data above is shown below.

■ Data for each channel

Data length 7 digits

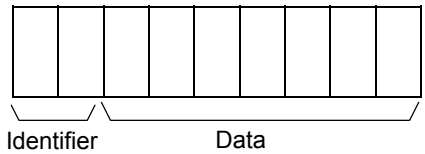


Data length 1 digit

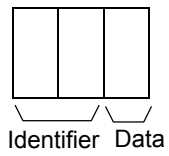


■ Data for each module address (Without channel)

Data length 7 digits



Data length 1 digit



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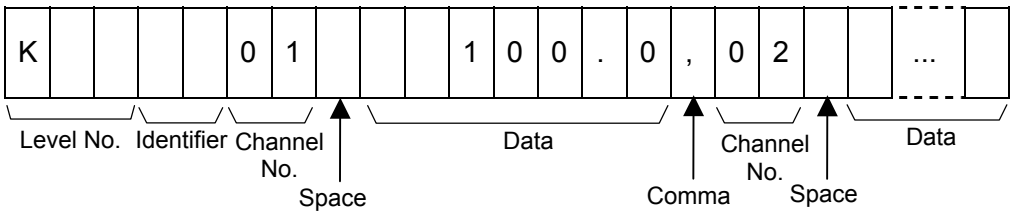
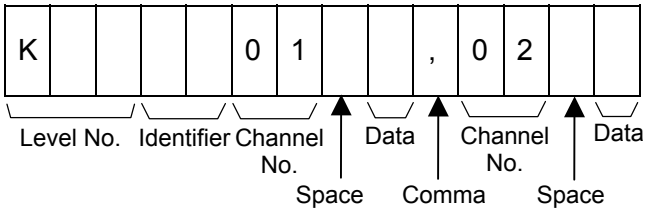
■ Data for level PID

Data length 7 digits



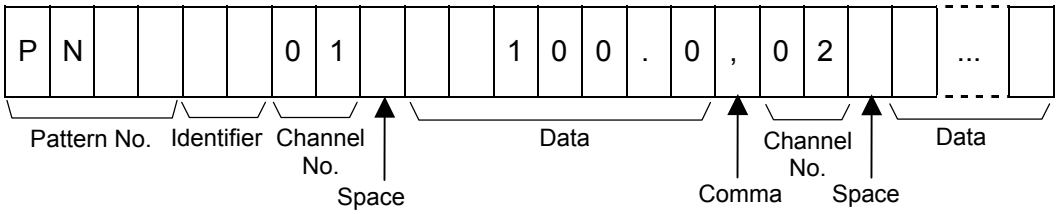
Data length 1 digit



■ Data for program control

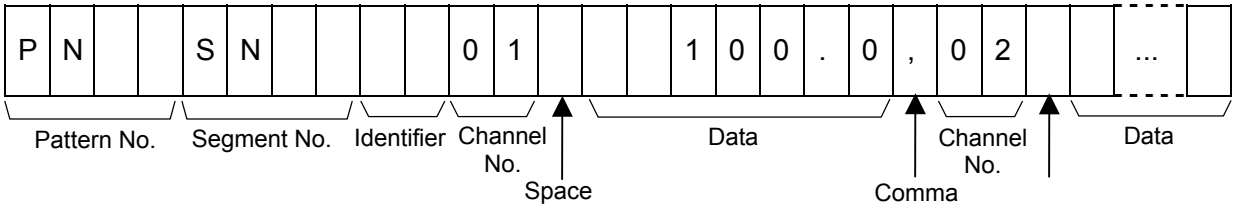
- **Pattern group**

Data length 7 digits



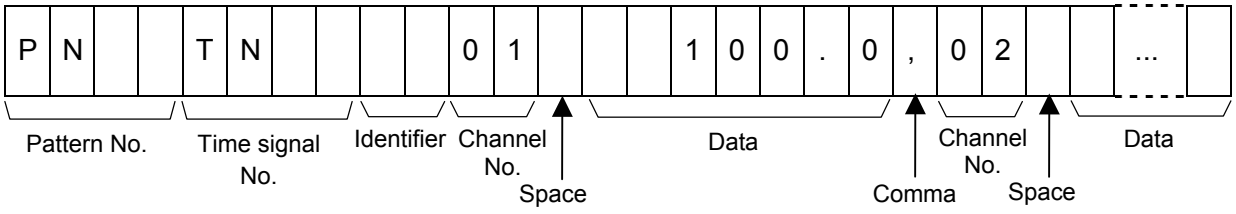
- **Segment group**

Data length 7 digits



- **Time signal group**

Data length 7 digits



7.4 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.)

7.4.1 Example of temperature set values polling check program

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

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

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

7.4.2 Example of temperature set values selecting checking program

```
1000 '---------- Identifier setting ----------                    
1010   ID$="S1"                                                   Identifier setting
1020 '
1030 '---------- Communications initial setting ----------
1040 CM$="N81NN"                                                  Communications data configuration setting
1050 STX$=CHR$(&H2) : EOT$=CHR$(&H4) : ENQ$=CHR$(&H5)             Communications character setting
1060 ACK$=CHR$(&H6) : NAK$=CHR$(&H15): ETX$=CHR$(&H3)
1070 OPEN "COM1:"+CM$    AS #1                                    Opening of RS-232C circuit
1080 CONSOLE ,,,1
1090 COLOR 7:CLS 3
1100 '
1110 '---------- Program main routine ----------
1120 *SEL
1130      PRINT "          (Selection check)          "
1140      PRINT "********** Transmission of set values **********"
1150      PRINT "
1160      INPUT "Module No.=";ADD$:INPUT "Channel No.=";C$         Input of the unit 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$(BCC)                                        Data configuration setting 2
1210      GOSUB *TEXT
1220      GOSUB *RXDT
1230 '
1240 *J20
1250      J=0
1260 '
1270 *IF2
1280      IF LOC(1)=0 THEN J=J+1:IF J<500 THEN *IF2 ELSE PRINT " TIME   Setting of the receiving waiting time [1]
          OUT ":END                                                (Timeout processing)
1290 '
1300      K$=INPUT$(1,#1)                                          Communications condition check,
1310      IF K$=NAK$ THEN PRINT "      NAK":END                    Display of communication result,
1320      IF K$=ACK$ THEN PRINT "Control unit has received the data"  and closing of RS-232C circuit
          :END
1330 '
1340 '
1350 '
```

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

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

7.5 Communication Identifier List of TIO Module

7.5.1 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. 98
2	Comprehensive event state	**AJ**	RO	0 to 31 (Bit data) b0: Burnout b1: Event 1 state b2: Event 2 state b3: Heater break alarm state b4: Control loop break alarm (LBA) state	—	P. 98
3	Burnout state	**B1**	RO	0: OFF 1: ON	—	P. 99
4	Event 1 state	**AA**	RO	0: OFF 1: ON	—	P. 99
5	Event 2 state	**AB**	RO	0: OFF 1: ON	—	P. 99
6	Heater break alarm (HBA) state	**AC**	RO	0: OFF 1: Heater break 2: Relay welding	—	P. 100
7	Control loop break alarm (LBA) state	**AP**	RO	0: OFF 1: ON	—	P. 100
8	Manipulated output value	**O1**	RO	–5.0 to +105.0 %	—	P. 100
9	Current transformer input measured value	**M3**	RO	0.0 to 30.0 A or 0.0 to 100.0 A	—	P. 101
10	Set value monitor	**MS**	RO	Input scale low limit to Input scale high limit	—	P. 101
11	Error code (Data of each module)	**ER**	RO	0 to 255 (Bit data) b0: Memory backup error b1: Unused b2: Internal communication error 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. 102
12	Set value (SV)	**S1**	R/W	Input scale low limit to Input scale high limit	0	P. 102

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No.	Name	Identifier	Attribute	Data range	Factory set value	Reference page
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: ON/OFF action	TC/RTD: 10.0 °C (10.0 °F) V/I: 10.0 %	P. 103 P. 130
14	Integral time	**I1**	R/W	0.1 to 3600.0 seconds 0.01 to 360.00 seconds	40.00	P. 103 P. 130
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. 104 P. 131
16	Control response parameters	**CA**	R/W	0: Slow 1: Medium 2: Fast	0	P. 104 P.131
17	PV bias	**PB**	R/W	–Input span to +Input span	0	P. 105
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 Process high/Process low: Input scale low limit to Input scale high limit	0	P. 105
19	Event 2 set value	**A2**	R/W		0	P. 105
20	Operation mode	**EI**	R/W	0: Unused 1: Monitor 1 2: Monitor 2 3: Control	3	P. 106
21	Level PID high limit set value	**PW**	R/W	Input scale low limit to Input scale high limit	Input scale high limit	P. 131
22	PID/AT transfer	**G1**	R/W	0: PID control operation 1: AT (Autotuning) operation	0	P. 107
23	Auto/Manual transfer	**J1**	R/W	0: Auto mode 1: Manual mode	0	P. 108
24	Manual output value	**ON**	R/W	–5.0 to +105.0 %	0.0	P. 108
25	Output limiter (high)	**OH**	R/W	Output limiter (low) to 105.0 %	100.0	P. 109
26	Output limiter (low)	**OL**	R/W	–5.0 % to Output limiter (high)	0.0	P. 109

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
27	Proportional cycle time	**T0**	R/W	0.2 to 50.0 seconds	Relay contact output: 20.0 Voltage pulse output: 2.0	P. 109
28	Digital filter	**F1**	R/W	0.00 to 10.00 seconds 0.00: OFF (Not provided)	0.00	P. 109
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. 110
30	Number of heater break alarm (HBA) delay times	**DH**	R/W	1 to 255 times	5	P. 111
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. 112
32	Start determination point	**SX**	R/W	0 to input span	0.0	P. 113
33	Control RUN/STOP transfer (Data of each module)	**SR**	R/W	0: Control STOP 1: Control RUN	0	P. 113
34	Input error determination point (high)	**AV**	R/W	Input scale low limit to Input scale high limit	Input scale high limit	P. 114
35	Input error determination point (low)	**AW**	R/W	Input scale low limit to Input scale high limit	Input scale low limit	P. 114
36	Action at input error (high)	**WH**	R/W	0: Normal control 1: Manipulated output value at input error	0	P. 115
37	Action at input error (low)	**WL**	R/W	0: Normal control 1: Manipulated output value at input error	0	P. 115
38	Manipulated output value at input error	**OE**	R/W	–5.0 to +105.0 %	0.0	P. 116
39	AT differential gap time	**GH**	R/W	0.00 to 50.00 seconds	0.10	P. 117
40	AT bias	**GB**	R/W	–Input span to +Input span	0	P. 118
41	Remote/Local transfer (Data of each module)	**C1**	R/W	0: Local mode 1: Remote mode	0	P. 118

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 11: Mode 11 2: Mode 2 12: Mode 12 3: Mode 3 13: Mode 13 10: Mode 10 Except the above: Unused	0 (Unused)	P. 119
43	Digital input setting 1 (RESET)	**E1**	R/W	0000 to 9999 Upper two digits (Thousands and hundreds digits): Address of DI module Lower two digits (Tens and units digits): Channel number of DI module 00: No function	0000	P. 120
44	Digital input setting 2 (RUN)	**E2**	R/W		0000	P. 120
45	Digital input setting 3 (FIX)	**E3**	R/W		0000	P. 120
46	Digital input setting 4 (MAN)	**E4**	R/W		0000	P. 120
47	Digital input setting 5 (HOLD)	**E5**	R/W		0000	P. 121
48	Digital input setting 6 (STEP)	**E6**	R/W		0000	P. 122
49	Digital input setting 7 (Program pattern selection)	**E7**	R/W		0000	P. 123
50	Digital input setting 8 (AT/PID)	**E8**	R/W		0000	P. 124
51	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. 135
52	Execution pattern	**PS**	R/W	1 to 16	1	P. 136
53	Execution segment	**SN**	RO	1 to 16	—	P. 136
54	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. 137
55	Number of program execution times	**RT**	RO	0 to 9999 times	—	P. 137
56	Time signal output state 1	**T8**	RO	0 to 255 (Bit data) b0: Time signal 1 output state b1: Time signal 2 output state b2: Time signal 3 output state b3: Time signal 4 output state b4: Time signal 5 output state b5: Time signal 6 output state b6: Time signal 7 output state b7: Time signal 8 output state	—	P. 138

Continued on the next page.

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
57	Time signal output state 2	**T9**	RO	0 to 255 (Bit data) b0: Time signal 9 output state b1: Time signal 10 output state b2: Time signal 11 output state b3: Time signal 12 output state b4: Time signal 13 output state b5: Time signal 14 output state b6: Time signal 15 output state b7: Time signal 16 output state	—	P. 138
58	Pattern end output state	**EO**	RO	0: Pattern end output OFF 1: Pattern end output ON	—	P. 139
59	End state	**EN**	RO	0: End state OFF 1: End state ON	—	P. 139
60	Wait state	**WT**	RO	0: Wait state OFF 1: Wait state ON	—	P. 139
61	Hold state	**HO**	R/W	0: Hold state OFF 1: Hold state ON	0	P. 140
62	Step action	**SK**	R/W	0: Not step action 1: Step action execution	0	P. 141
63	Setting of the number of program execution times (Pattern group)	**RR**	R/W	1 to 1000 times 1000: Number of infinite times	1	P. 142
64	End segment (Pattern group)	**PE**	R/W	1 to 16	16	P. 142
65	Link pattern (Pattern group)	**LP**	R/W	0 to 16 0: No link pattern	0	P. 143
66	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. 144
67	Wait zone (Pattern group)	**ZW**	R/W	0 to Input span	0.0	P. 145
68	Segment level (Segment group)	**LE**	R/W	Input scale low limit to Input scale high limit	0	P. 146
69	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. 146
70	Time signal output number (Time signal group)	**RE**	R/W	0 to 16 0: No time signal output	0	P. 147

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
71	Time signal ON segment (Time signal group)	**SO**	R/W	1 to 16	1	P. 148
72	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. 148
73	Time signal OFF segment (Time signal group)	**SF**	R/W	1 to 16	1	P. 149
74	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. 149
75	Program operation start mode	**SS**	R/W	0: Zero start 1: PV start 1 2: PV start 2	0	P. 150
76	Control loop break alarm (LBA) use selection	**HP**	R/W	0: Unused 1: Used	0	P. 125
77	Control loop break alarm (LBA) time	**C6**	R/W	1 to 7200 seconds	80	P. 126
78	Control loop break alarm (LBA) deadband	**V2**	R/W	0 to Input span	0	P. 127
79	Integral/derivative time decimal point position	**PK**	R/W	0: Two decimal places 1: One decimal places	0	P. 128
80	Initial setting mode (Data of each module)	**IN**	R/W	0: Normal setting mode 1: Initial setting mode	0	P. 128

7.5.2 Data items for initial setting mode

⚠ WARNING

The Initial setting data should be set according to the application before setting any parameter related to operation. Once the Initial setting data is set correctly, those data is not necessary to be changed for the same application under normal conditions. If they are changed unnecessarily, it may result in malfunction or failure of the instrument. RKC will not bear any responsibility for malfunction or failure as a result of improper changes in the Initial setting.

■ 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. 152

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 100mV DC 21: 0 to 10 mV DC	Specify when ordering	P. 152
2	Input scale high limit	**XV**	R/W	Input scale low limit to 20000	Depend on input range	P. 153
3	Input scale low limit	**XW**	R/W	–20000 to Input scale high limit	Depend on input range	P. 153
4	Input range decimal point position	**XU**	R/W	TC/RTD input: 0 to 1 Voltage/Current input: 0 to 4 0: No decimal place 1: One decimal place 2: Two decimal places 3: Three decimal places 4: Four decimal places	1	P. 153
5	Temperature unit selection	**PU**	R/W	0: °C 1: °F	0	P. 154
6	Control type selection	**XE**	R/W	0: Direct action 1: Reverse action	1	P. 154
7	ON/OFF control differential gap (upper)	**IV**	R/W	0 to Input span	TC/RTD: 1.0 °C (1.0 °F) V/I: 0.1 % of input span	P. 155
8	ON/OFF control differential gap (lower)	**IW**	R/W			P. 155

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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 (2.0 °F) V/I: 0.2 % of input span	P. 156
10	Event 2 differential gap	**HB**	R/W			P. 156
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. 157
12	Event 2 type selection	**XB**	R/W		0	P. 157
13	Event 1 hold action	**WA**	R/W	0: Not provided 1: Hold action (2: Unused) 3: Re-hold action	3	P. 159
14	Event 2 hold action	**WB**	R/W		3	P. 159
15	Number of event delay times	**DF**	R/W	0 to 255 times	0	P. 160
16	Transmission transfer time setting (Data of each module)	**ZX**	R/W	0 to 100 ms	6	P. 161
17	Segment time unit setting	**XP**	R/W	0: 0.01 second 1: 0.1 second 2: 1 second 3: 1 minute	0	P. 161
18	Operation mode holding setting (Data of module unit)	**X2**	R/W	0: Not hold 1: Hold	1	P. 161
19	Output change rate limiter (up)	**PH**	R/W	0.0 to 100.0 %/second 0.0: Limiter OFF	0.0	P. 162
20	Output change rate limiter (down)	**PL**	R/W	0.0 to 100.0 %/second 0.0: Limiter OFF	0.0	P. 162

7.6 Communication Identifier List of DI Module

7.6.1 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	Input state of digital input (terminal) (Data of module unit)	**L1**	RO	0 to 4095 (Bit data) b0: DI channel 1 b1: DI channel 2 b2: DI channel 3 b3: DI channel 4 b4: DI channel 5 b5: DI channel 6 b6: DI channel 7 b7: DI channel 8 b8: DI channel 9 b9: DI channel 10 b10: DI channel 11 b11: DI channel 12 b12 to b15: Unused	—	P. 164
2	Input state of digital input (connector) 1 (Data of module unit)	**L2**	RO	0 to 255 (Bit data) b0: DI channel 13 b1: DI channel 14 b2: DI channel 15 b3: DI channel 16 b4: DI channel 17 b5: DI channel 18 b6: DI channel 19 b7: DI channel 20 b8 to b15: Unused	—	P. 165
3	Input state of digital input (connector) 2 (Data of module unit)	**L3**	RO	0 to 255 (Bit data) b0: DI channel 21 b1: DI channel 22 b2: DI channel 23 b3: DI channel 24 b4: DI channel 25 b5: DI channel 26 b6: DI channel 27 b7: DI channel 28 b8 to b15: Unused	—	P. 165

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
4	Event LED selection: terminal input (DI channel 1 to 12)	**QI**	R/W	0: Unused 1: EVENT1 lamp 2: EVENT2 lamp 3: EVENT3 lamp 4: EVENT4 lamp	0	P. 166
5	Event LED selection: connector input (DI channel 13to 28) (DO channel 13 to 28 is used as DO channel 1 to 16 on communication.)	**QJ**	R/W		0	P. 167
6	Error code (Data of module unit)	**ER**	RO	0 to 1 (Bit data) b0: Backup error b1 to b15: Unused	—	P. 162
7	Initial setting mode (Data of each module)	**IN**	R/W	0: Normal setting mode 1: Initial setting mode	0	P. 162

7.6.2 Data items for initial setting mode

⚠ WARNING

The Initial setting data should be set according to the application before setting any parameter related to operation. Once the Initial setting data is set correctly, those data is not necessary to be changed for the same application under normal conditions. If they are changed unnecessarily, it may result in malfunction or failure of the instrument. RKC will not bear any responsibility for malfunction or failure as a result of improper changes in the Initial setting.

■ Transfer to initial setting mode

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

■ Data of initial setting mode

No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
1	Transmission transfer time setting (Data of each module)	**ZX**	R/W	0 to 100 ms	6	P. 169

7.7 Communication Identifier List of DO Module

7.7.1 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	Output state of digital output (terminal) (Data of module unit)	**Q1**	RO	0 to 4095 (Bit data) b0: DO channel 1 b1: DO channel 2 b2: DO channel 3 b3: DO channel 4 b4: DO channel 5 b5: DO channel 6 b6: DO channel 7 b7: DO channel 8 b8: DO channel 9 b9: DO channel 10 b10: DO channel 11 b11: DO channel 12 b12 to b15: Unused	—	P. 170
2	Output state of digital output (connector) 1 (Data of module unit)	**Q2**	RO	0 to 255 (Bit data) b0: DO channel 13 b1: DO channel 14 b2: DO channel 15 b3: DO channel 16 b4: DO channel 17 b5: DO channel 18 b6: DO channel 19 b7: DO channel 20 b8 to b15: Unused	—	P. 171
3	Output state of digital output (connector) 2 (Data of module unit)	**Q3**	RO	0 to 255 (Bit data) b0: DO channel 21 b1: DO channel 22 b2: DO channel 23 b3: DO channel 24 b4: DO channel 25 b5: DO channel 26 b6: DO channel 27 b7: DO channel 28 b8 to b15: Unused	—	P. 171
4	Function selection of DO channel 1 to 12 (terminal)	**QA**	R/W	0000 to 9999 Upper two digits (Thousands and hundreds digits): Address of TIO module or DI module Lower two digits (Tens and units digits): Function number of output signal 00: No function	0	P. 172

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
5	Function selection of DO channel 13 to 28 (connector) (DO channel 13 to 28 is used as DO channel 1 to 16 on communication.)	**QB**	R/W	0000 to 9999 Upper two digits (Thousands and hundreds digits): Address of TIO module or DI module Lower two digits (Tens and units digits): Function number of output signal 00: No function	0	P. 173
6	Event LED selection: terminal input (DI channel 1 to 12)	**QI**	R/W	0: Unused 1: EVENT1 lamp 2: EVENT2 lamp 3: EVENT3 lamp 4: EVENT4 lamp	0	P. 175
7	Event LED selection: connector input (DI channel 13 to 28) (DO channel 13 to 28 is used as DO channel 1 to 16 on communication.)	**QJ**	R/W		0	P. 176
8	Error code (Data of module unit)	**ER**	RO	0 to 1 (Bit data) b0: Backup error b1 to b15: Unused	—	P. 177
9	Initial setting mode (Data of each module)	**IN**	R/W	0: Normal setting mode 1: Initial setting mode	0	P. 177

7.7.2 Data items for initial setting mode

⚠ WARNING

The Initial setting data should be set according to the application before setting any parameter related to operation. Once the Initial setting data is set correctly, those data is not necessary to be changed for the same application under normal conditions. If they are changed unnecessarily, it may result in malfunction or failure of the instrument. RKC will not bear any responsibility for malfunction or failure as a result of improper changes in the Initial setting.

■ 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).

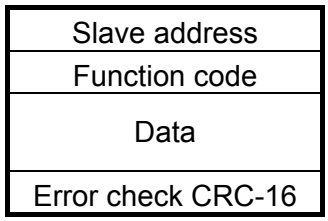
No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value	Refer-ence page
1	Transmission transfer time setting (Data of each module)	**ZX**	R/W	0 to 100 ms	6	P. 178

8. MODBUS COMMUNICATION PROTOCOL

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

8.1 Message Format

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



Message format

■ Slave address

The slave address is a number from 0 to 99 manually set at the 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 **8.2 Function Code (P. 65)**.

■ 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 **8.6 Message Format (P. 70)**, **8.7 Data Configuration (P. 74), 8.8 Data Map of TIO Module (P. 78), 8.9 Data Map of DI Module (P. 90), 8.10 Data Map of DO Module (P. 93)** and **9. COMMUNICATION DATA DESCRIPTION (P. 97)**.

■ Error check

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

☞ For details, see **8.5 Calculating CRC-16 (P. 67)**.

8.2 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

8.3 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 **8.2 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 **5.4 Communication Time Setting (P. 18)**.

8.4 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

8.5 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***.

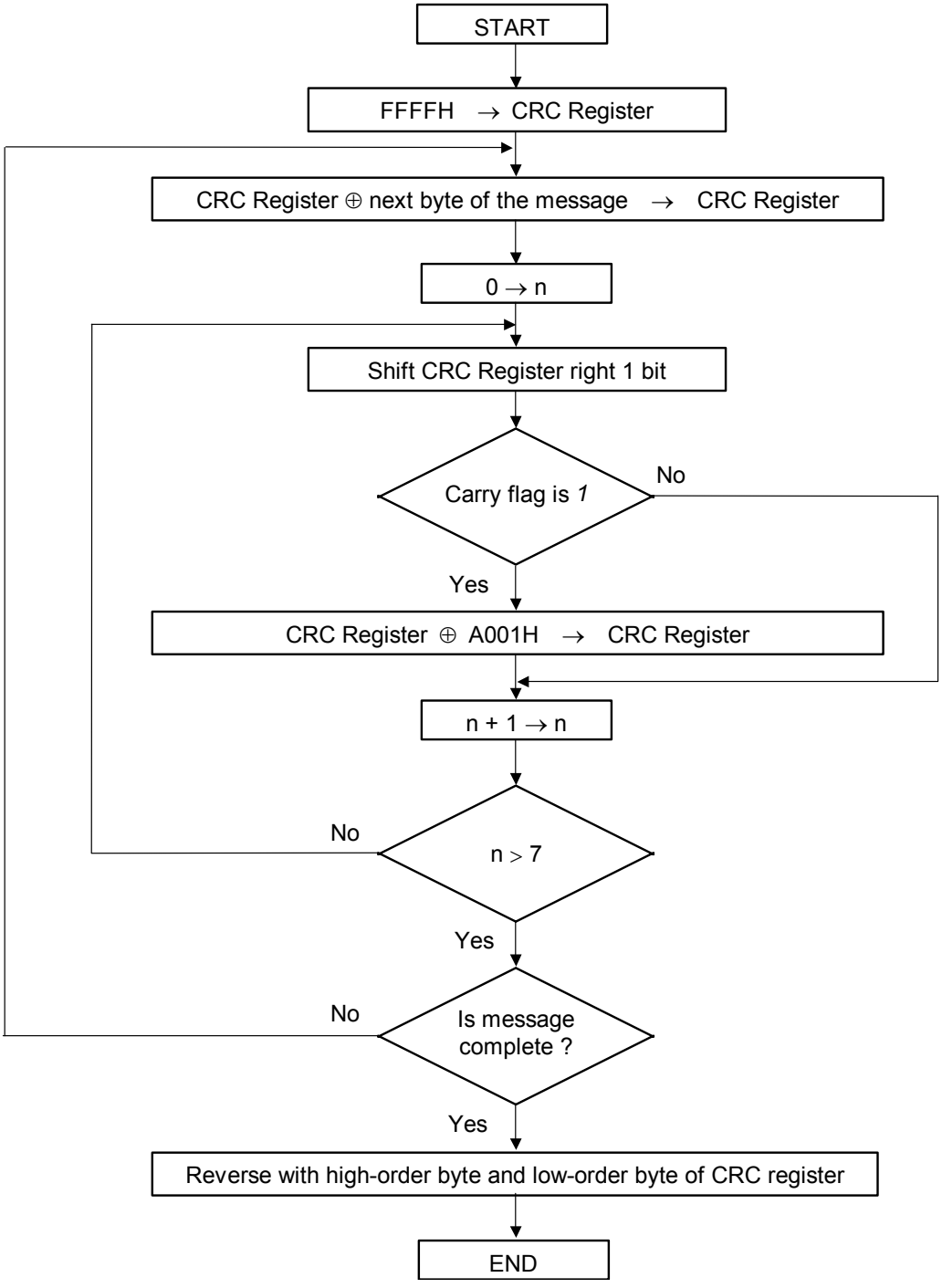
5. Repeat step ***3*** and ***4*** until there have been 8 shifts.

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;
}
```

8.6 Message Format

8.6.1 Read holding registers [03H]

The query message specifies the starting register address and quantity of registers to be read.
The contents of the holding registers are entered in the response message as data, divided into two parts: the high-order 8-bit and the low-order 8-bit, arranged in the order of the register numbers.

Example: The contents of the 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

8.6.2 Preset single register [06H]

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

Example: Data is written into the holding register 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

8.6.3 Diagnostics (Loopback test) [08H]

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

Example: Loopback test for slave address 1

Query message

Slave address		01H	
Function code		08H	
Test code	High	00H	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	
Function code		08H	
Test code	High	00H	Contents will be the same as query message data
	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

8.6.4 Preset multiple registers [10H]

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

Example: Data is written into the two holding registers from 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

8.7 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.

8.7.1 Data processing with decimal points

■ Data without decimal points

- **Data of TIO module**

Comprehensive event state
Error code
Burnout state
Event 1 state
Event 2 state
Heater break alarm state
Control loop break alarm (LBA) state
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)
Input error determination point (low)
Remote/Local transfer
Digital input setting 1 (RESET)
Digital input setting 2 (RUN)
Digital input setting 3 (FIX)
Digital input setting 4 (MAN)
Digital input setting 5 (HOLD)
Digital input setting 6 (STEP)
Digital input setting 7 (Program pattern selection)
Digital input setting 8 (AT/PID)
Event LED mode setting
Program operation mode selection
Execution pattern
Execution segment
Number of program execution times
Time signal output state 1
Time signal output state 2
Pattern end output state
End state
Wait state
Hold state
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

- **Data of DI module**

Input state of digital input (terminal)
Input state of digital input (connector) 1
Input state of digital input (connector) 2
Event LED selection (terminal input)
Event LED selection (connector input)
Error code
Initial setting mode
Transmission transfer time setting

- **Data of DO module**

Output state of digital output (terminal)
Output state of digital output (connector) 1
Output state of digital output (connector) 2
Function selection of DO channel 1 to 12 (terminal)
Function selection of DO channel 13 to 28 (connector)
Event LED selection (terminal output)
Event LED selection (connector output)
Error code
Initial setting mode
Transmission transfer time 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 one decimal place**

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

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 two decimal places**

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 decimal place, one decimal place
Voltage/current input: No decimal place, one decimal place, two decimal places, three decimal places, four decimal places

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

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 decimal place, one decimal place, two decimal places

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

One decimal place, two decimal places

Integral time
Derivative time

8.7.2 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.
- 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.
- Send the next command message at time intervals of 30 bits after the master receives the response message.

8.8 Data Map of TIO Module

8.8.1 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. 98
Comprehensive event state	0001	1001	1	4097	RO	0 to 31 (Bit data) b0: Burnout b1: Event 1 state b2: Event 2 state b3: Heater break alarm state b4: Control loop break alarm (LBA) state	—	P. 98
Manipulated output value	0002	1002	2	4098	RO	–5.0 to +105.0 %	—	P. 100
Set value monitor	0003	1003	3	4099	RO	Input scale low limit to Input scale high limit	—	P. 101
Error code (Data of each module)	0004		4		RO	0 to 255 (Bit data) b0: Memory backup error b1: Unused b2: Internal communication error b3: Adjustment data error b4: Input error b5: Current transformer input error b6: Temperature compensation error b7: Unused	—	P. 102
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. 101
Unused	0007	1007	7	4103	—	—	—	—
Burnout state	0008	1008	8	4104	RO	0: OFF 1: ON	—	P. 99
Event 1 state	0009	1009	9	4105	RO	0: OFF 1: ON	—	P. 99
Event 2 state	000A	100A	10	4106	RO	0: OFF 1: ON	—	P. 99

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) state	000B	100B	11	4107	RO	0: OFF 1: Heater break 2: Relay welding	—	P. 100
Control loop break alarm (LBA) state	000C	100C	12	4108	RO	0: OFF 1: ON	—	P. 100
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. 106
Set value (SV)	0010	1010	16	4112	R/W	Input scale low limit to Input scale high limit	0	P. 102
Proportional band	0011	1011	17	4113	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: ON/OFF action	TC/RTD: 10.0 °C (10.0 °F) V/I: 10.0 %	P. 103
Integral time	0012	1012	18	4114	R/W	0.1 to 3600.0 seconds or 0.01 to 360.00 seconds	40.00	P. 103
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. 104
Control response parameters	0014	1014	20	4116	R/W	0: Slow 1: Medium 2: Fast	0	P. 104
PV bias	0015	1015	21	4117	R/W	–Input span to +Input span	0	P. 105
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	0	P. 105
Event 2 set value	0017	1017	23	4119	R/W	Process high/Process low: Input scale low limit to Input scale high limit	0	P. 105

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Continued from the previous page.

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. 107
Auto/Manual transfer	0021	1021	33	4129	R/W	0: Auto mode 1: Manual mode	0	P. 108
Manual output value	0022	1022	34	4130	R/W	–5.0 to +105.0 %	0.0	P. 108
Output limiter (high)	0023	1023	35	4131	R/W	Output limiter (low) to 105.0 %	100.0	P. 109
Output limiter (low)	0024	1024	36	4132	R/W	–5.0 % to Output limiter (high)	0.0	P. 109
Proportional cycle time	0025	1025	37	4133	R/W	0.2 to 50.0 seconds	Relay contact output: 20.0 Voltage pulse output: 2.0	P. 109
Unused	0026	1026	38	4134	—	—	—	—
Digital filter	0027	1027	39	4135	R/W	0.00 to 10.00 seconds	0.00	P. 109
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. 110
Number of heater break alarm (HBA) delay times	0029	1029	41	4137	R/W	1 to 255 times	5	P. 111
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. 112
Start determination point	002B	102B	43	4139	R/W	0 to Input span	0.0	P. 113
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. 113
Input error determination point (high)	0031	1031	49	4145	R/W	Input scale low limit to Input scale high limit	Input scale high limit	P. 114

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 error determination point (low)	0032	1032	50	4146	R/W	Input scale low limit to Input scale high limit	Input scale low limit	P. 114
Action at input error (high)	0033	1033	51	4147	R/W	0: Normal control 1: Manipulated output value at input error	0	P. 115
Action at input error (low)	0034	1034	52	4148	R/W	0: Normal control 1: Manipulated output value at input error	0	P. 115
Manipulated output value at input error	0035	1035	53	4149	R/W	–5.0 to +105.0 %	0.0	P. 116
AT differential gap time	0036	1036	54	4150	R/W	0.00 to 50.00 seconds	0.10	P. 117
Unused	0037	1037	55	4151	—	—	—	—
AT bias	0038	1038	56	4152	R/W	–Input span to +Input span	0	P. 117
Unused	0039	1039	57	4153	—	—	—	—
Unused	003A	103A	58	4154	—	—	—	—
Remote/Local transfer (Data of each module)	003B		59		R/W	0: Local mode 1: Remote mode	0	P. 118
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 (Unused)	P. 119
Digital input setting 1 (RESET)	003D	103D	61	4157	R/W	0000 to 9999 Upper two digits (Thousands and hundreds digits): Address of DI module Lower two digits (Tens and units digits): Channel number of DI module 00: No function	0000	P. 120
Digital input setting 2 (RUN)	003E	103E	62	4158	R/W		0000	P. 120
Digital input setting 3 (FIX)	003F	103F	63	4159	R/W		0000	P. 120
Digital input setting 4 (MAN)	0040	1040	64	4160	R/W		0000	P. 120
Digital input setting 5 (HOLD)	0041	1041	65	4161	R/W		0000	P. 121
Digital input setting 6 (STEP)	0042	1042	66	4162	R/W		0000	P. 122
Digital input setting 7 (Program pattern selection)	0043	1043	67	4163	R/W		0000	P. 123
Digital input setting 8 (AT/PID)	0044	1044	68	4164	R/W		0000	P. 124

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				
Unused	0045 ⋮ 0057	1045 ⋮ 1057	69 ⋮ 87	4165 ⋮ 4183	—	—	—	—
Level PID data **For details, see 8.8.2 Level PID data (P. 83)**	0058 ⋮ 00CF	1058 ⋮ 10CF	88 ⋮ 207	4184 ⋮ 4303	—	—	—	P. 83
Program control data **For details, see 8.8.3 Program control data (P. 84)**	00D0 ⋮ 0858	10D0 ⋮ 1858	208 ⋮ 2136	4304 ⋮ 6232	—	—	—	P. 84
Control loop break alarm (LBA) use selection	0859	1859	2137	6233	R/W	0: Unused 1: Used	0	P. 125
Control loop break alarm (LBA) time	085A	185A	2138	6234	R/W	1 to 7200 seconds	80	P. 126
Control loop break alarm (LBA) deadband	085B	185B	2139	6235	R/W	0 to Input span	0	P. 127
Integral/derivative time decimal point position	085C	185C	2140	6236	R/W	0: Two decimal places 1: One decimal place	0	P. 128
Unused	085D ⋮ 086F	185D ⋮ 186F	2141 ⋮ 2159	6237 ⋮ 6255	—	—	—	—

8.8.2 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 (V)/Current (I) input: 0.0 to 1000.0 % of input span 0: ON/OFF action	TC/RTD: 10.0 °C (10.0 °F) V/I: 10.0 %	P. 130
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. 130
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. 131
Control response parameters	0070 : 0077	1070 : 1077	112 : 119	4208 : 4215	R/W	0: Slow 1: Medium 2: Fast	0	P. 131
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. 131
Unused	00B8 : 00CF	10B8 : 10CF	184 : 207	4280 : 4303	—	—	—	—

8.8.3 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. 135
Execution pattern	00D1	10D1	209	4305	R/W	1 to 16	1	P. 136
Execution segment	00D2	10D2	210	4306	RO	1 to 16	—	P. 136
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. 137
Number of program execution times	00D4	10D4	212	4308	RO	0 to 9999 times	—	P. 137
Time signal output state 1	00D5	10D5	213	4309	RO	0 to 255 (Bit data) b0: Time signal 1 output state b1: Time signal 2 output state b2: Time signal 3 output state b3: Time signal 4 output state b4: Time signal 5 output state b5: Time signal 6 output state b6: Time signal 7 output state b7: Time signal 8 output state	—	P. 138
Time signal output state 2	00D5	10D5	213	4309	RO	0 to 255 (Bit data) b8: Time signal 9 output state b9: Time signal 10 output state b10: Time signal 11 output state b11: Time signal 12 output state b12: Time signal 13 output state b13: Time signal 14 output state b14: Time signal 15 output state b15: Time signal 16 output state	—	P. 138

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				
Pattern end output state	00D6	10D6	214	4310	RO	0: Pattern end output OFF 1: Pattern end output ON	—	P. 139
End state	00D7	10D7	215	4311	RO	0: End state OFF 1: End state ON	—	P. 139
Wait state	00D8	10D8	216	4312	RO	0: Wait state OFF 1: Wait state ON	—	P. 139
Hold state	00D9	10D9	217	4313	R/W	0: Hold state OFF 1: Hold state ON	0	P. 140
Step action	00DA	10DA	218	4314	R/W	0: Not step action 1: Step action execution	0	P. 141
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. 142
End segment	0100 ⋮ 010F	1100 ⋮ 110F	256 ⋮ 271	4352 ⋮ 4367	R/W	1 to 16	16	P. 142
Link pattern	0110 ⋮ 011F	1110 ⋮ 111F	272 ⋮ 287	4368 ⋮ 4383	R/W	0 to 16 0: Not link pattern	0	P. 143
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. 144
Wait zone	0130 ⋮ 013F	1130 ⋮ 113F	304 ⋮ 319	4400 ⋮ 4415	R/W	0 to Input span	0.0	P. 145
Segment level	0140 ⋮ 023F	1140 ⋮ 123F	320 ⋮ 575	4416 ⋮ 4671	R/W	Input scale low limit to Input scale high limit	0	P. 146
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. 146
Time signal output number	0340 ⋮ 043F	1340 ⋮ 143F	832 ⋮ 1087	4928 ⋮ 5183	R/W	0 to 16 0: Not time signal output	0	P. 147

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				
Time signal ON segment	0440 ⋮ 053F	1440 ⋮ 153F	1088 ⋮ 1343	5184 ⋮ 5439	R/W	1 to 16	1	P. 148
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. 148
Time signal OFF segment	0640 ⋮ 073F	1640 ⋮ 173F	1600 ⋮ 1855	5696 ⋮ 5951	R/W	1 to 16	1	P. 149
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. 149
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. 150

8.8.4 Initial setting data items

⚠ WARNING

The Initial setting data should be set according to the application before setting any parameter related to operation. Once the Initial setting data is set correctly, those data is not necessary to be changed for the same application under normal conditions. If they are changed unnecessarily, it may result in malfunction or failure of the instrument. RKC will not bear any responsibility for malfunction or failure as a result of improper changes in the Initial setting.

📖 **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. 152

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. 152
Input scale high limit	0871	1871	2161	6257	R/W	Input scale low limit to 20000	Depend on input range	P. 153
Input scale low limit	0872	1872	2162	6258	R/W	−20000 to Input scale high limit	Depend on input range	P. 153
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 decimal place 1: One decimal place 2: Two decimal places 3: Three decimal places 4: Four decimal places	1	P. 153
Temperature unit selection	0874	1874	2164	6260	R/W	0: °C 1: °F	0	P. 154
Control type selection	0875	1875	2165	6261	R/W	0: Direct action 1: Reverse action	1	P. 154
ON/OFF control differential gap (upper)	0876	1876	2166	6262	R/W	0 to Input span	TC/RTD: 1.0 °C (1.0 °F) V/I: 0.1 % of input span	P. 155
ON/OFF control differential gap (lower)	0877	1877	2167	6263	R/W			P. 155

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Name	Register address				Attribute	Data range	Factory set value	Reference page
	Hexadecimal		Decimal					
	CH1	CH2	CH1	CH2				
Event 1 differential gap	0878	1878	2168	6264	R/W	0 to Input span	TC/RTD: 2.0 °C (2.0 °F) V/I: 0.2 % of input span	P. 156
Event 2 differential gap	0879	1879	2169	6265	R/W			P. 156
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. 157
Event 2 type selection	087B	187B	2171	6267	R/W		0	P. 157
Event 1 hold action	087C	187C	2172	6268	R/W	0: Not provided 1: Hold action (2: Unused) 3: Re-hold action	3	P. 159
Event 2 hold action	087D	187D	2173	6269	R/W		3	P. 159
Number of event delay times	087E	187E	2174	6270	R/W	0 to 255 times	0	P. 160
Transmission transfer time setting (Data of each module)	087F		2175		R/W	0 to 100 ms	6	P. 161
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. 161
Operation mode holding setting (Data of each module)	0881		2177		R/W	0: Not hold 1: Hold	1	P. 161
Output change rate limiter (up)	0882	1882	2178	6274	R/W	0.0 to 100.0 %/second 0.0: Limiter OFF	0.0	P. 162
Output change rate limiter (down)	0883	1883	2179	6275	R/W	0.0 to 100.0 %/second 0.0: Limiter OFF	0.0	P. 162

8.9 Data Map of DI Module

8.9.1 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				
Input state of digital input (terminal) (Data of module unit)	2000	8192	RO	0 to 4095 (Bit data) b0: DI channel 1 b1: DI channel 2 b2: DI channel 3 b3: DI channel 4 b4: DI channel 5 b5: DI channel 6 b6: DI channel 7 b7: DI channel 8 b8: DI channel 9 b9: DI channel 10 b10: DI channel 11 b11: DI channel 12 b12 to b15: Unused	—	P. 164
Input state of digital input (connector) 1 (Data of module unit)	2001	8193	RO	0 to 255 (Bit data) b0: DI channel 13 b1: DI channel 14 b2: DI channel 15 b3: DI channel 16 b4: DI channel 17 b5: DI channel 18 b6: DI channel 19 b7: DI channel 20 b8 to b15: Unused	—	P. 165
Input state of digital input (connector) 2 (Data of module unit)	2002	8194	RO	0 to 255 (Bit data) b0: DI channel 21 b1: DI channel 22 b2: DI channel 23 b3: DI channel 24 b4: DI channel 25 b5: DI channel 26 b6: DI channel 27 b7: DI channel 28 b8 to b15: Unused	—	P. 165
Unused	2003 ⋮ 25FF	8195 ⋮ 9727	—	—	—	—
Error code (Data of module unit)	2600	9728	RO	0 to 1 (Bit data) b0: Backup error b1 to b15: Unused	—	P. 168

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Name	Register address		Attribute	Data range	Factory set value	Reference page
	Hexadecimal	Decimal				
Unused	2601 ⋮ 261F	9729 ⋮ 9759	—	—	—	—
Event LED selection: terminal input (DI channel 1 to 12)	CH1: 2620 CH2: 2621 CH3: 2622 CH4: 2623 CH5: 2624 CH6: 2625 CH7: 2626 CH8: 2627 CH9: 2628 CH10: 2629 CH11: 262A CH12: 262B	CH1: 9760 CH2: 9761 CH3: 9762 CH4: 9763 CH5: 9764 CH6: 9765 CH7: 9766 CH8: 9767 CH9: 9768 CH10: 9769 CH11: 9770 CH12: 9771	R/W	0: Unused 1: EVENT1 lamp 2: EVENT2 lamp 3: EVENT3 lamp 4: EVENT4 lamp	0	P. 166
Unused	262C ⋮ 262F	9772 ⋮ 9775	—	—	—	—
Event LED selection: connector input (DI channel 13 to 28)	CH13: 2630 CH14: 2631 CH15: 2632 CH16: 2633 CH17: 2634 CH18: 2635 CH19: 2636 CH20: 2637 CH21: 2638 CH22: 2639 CH23: 263A CH24: 263B CH25: 263C CH26: 263D CH27: 263E CH28: 263F	CH13: 9776 CH14: 9777 CH15: 9778 CH16: 9779 CH17: 9780 CH18: 9781 CH19: 9782 CH20: 9783 CH21: 9784 CH22: 9785 CH23: 9786 CH24: 9787 CH25: 9788 CH26: 9789 CH27: 9790 CH28: 9791	R/W	0: Unused 1: EVENT1 lamp 2: EVENT2 lamp 3: EVENT3 lamp 4: EVENT4 lamp	0	P. 167
Unused	2640 ⋮ 287E	9792 ⋮ 10366	—	—	—	—

8.9.2 Initial setting data items

⚠ WARNING

The Initial setting data should be set according to the application before setting any parameter related to operation. Once the Initial setting data is set correctly, those data is not necessary to be changed for the same application under normal conditions. If they are changed unnecessarily, it may result in malfunction or failure of the instrument. RKC will not bear any responsibility for malfunction or failure as a result of improper changes in the Initial setting.

Name	Register address		Attribute	Data range	Factory set value	Reference page
	Hexadecimal	Decimal				
Transmission transfer time setting (Data of each module)	287F	10367	R/W	0 to 100 ms	6	P. 169

8.10 Data Map of DO Module

8.10.1 Normal setting data items

RO: Read only R/W: Read and Write

Name	Register address		Attri-bute	Data range	Factory set value	Refer-ence page
	Hexadecimal	Decimal				
Output state of digital output (terminal) (Data of module unit)	2300	8960	RO	0 to 4095 (Bit data) b0: DO channel 1 b1: DO channel 2 b2: DO channel 3 b3: DO channel 4 b4: DO channel 5 b5: DO channel 6 b6: DO channel 7 b7: DO channel 8 b8: DO channel 9 b9: DO channel 10 b10: DO channel 11 b11: DO channel 12 b12 to b15: Unused	—	P. 170
Output state of digital output (connector) 1 (Data of module unit)	2301	8961	RO	0 to 255 (Bit data) b0: DO channel 13 b1: DO channel 14 b2: DO channel 15 b3: DO channel 16 b4: DO channel 17 b5: DO channel 18 b6: DO channel 19 b7: DO channel 20 b8 to b15: Unused	—	P. 171
Output state of digital output (connector) 2 (Data of module unit)	2302	8962	RO	0 to 255 (Bit data) b0: DO channel 21 b1: DO channel 22 b2: DO channel 23 b3: DO channel 24 b4: DO channel 25 b5: DO channel 26 b6: DO channel 27 b7: DO channel 28 b8 to b15: Unused	—	P. 171
Unused	2303 : 243F	8963 : 9279	—	—	—	—

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Name	Register address		Attribute	Data range	Factory set value	Reference page
	Hexadecimal	Decimal				
Function selection of DO channel 1 to 12 (terminal)	CH1: 2440 CH2: 2441 CH3: 2442 CH4: 2443 CH5: 2444 CH6: 2445 CH7: 2446 CH8: 2447 CH9: 2448 CH10: 2449 CH11: 244A CH12: 244B	CH1: 9280 CH2: 9281 CH3: 9282 CH4: 9283 CH5: 9284 CH6: 9285 CH7: 9286 CH8: 9287 CH9: 9288 CH10: 9289 CH11: 9290 CH12: 9291	R/W	0000 to 9999 Upper two digits (Thousands and hundreds digits): Address of TIO module or DI module Lower two digits (Tens and units digits): Function number of output signal 00: No function	0	P. 172
Unused	244C ⋮ 244F	9292 ⋮ 9295	—	—	—	—
Function selection of DO channel 13 to 28 (connector)	CH13: 2450 CH14: 2451 CH15: 2452 CH16: 2453 CH17: 2454 CH18: 2455 CH19: 2456 CH20 2457 CH21: 2458 CH22: 2459 CH23: 245A CH24: 245B CH25: 245C CH26: 245D CH27: 245E CH28: 245F	CH13: 9296 CH14: 9297 CH15: 9298 CH16: 9299 CH17: 9300 CH18: 9301 CH19: 9302 CH20: 9303 CH21: 9304 CH22: 9305 CH23: 9306 CH24: 9307 CH25: 9308 CH26: 9309 CH27: 9310 CH28: 9311	R/W	0000 to 9999 Upper two digits (Thousands and hundreds digits): Address of TIO module or DI module Lower two digits (Tens and units digits): Function number of output signal 00: No function	0	P. 173
Unused	2460 ⋮ 255F	9312 ⋮ 9727	—	—	—	—
Error code (Data of module unit)	2600	9728	RO	0 to 1 (Bit data) b0: Backup error b1 to b15: Unused	—	P. 177
Unused	2601 ⋮ 261F	9729 ⋮ 9759	—	—	—	—

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Name	Register address		Attribute	Data range	Factory set value	Reference page
	Hexadecimal	Decimal				
Event LED selection: terminal input (DI channel 1 to 12)	CH1: 2620 CH2: 2621 CH3: 2622 CH4: 2623 CH5: 2624 CH6: 2625 CH7: 2626 CH8: 2627 CH9: 2628 CH10: 2629 CH11: 262A CH12: 262B	CH1: 9760 CH2: 9761 CH3: 9762 CH4: 9763 CH5: 9764 CH6: 9765 CH7: 9766 CH8: 9767 CH9: 9768 CH10: 9769 CH11: 9770 CH12: 9771	R/W	0: Unused 1: EVENT1 lamp 2: EVENT2 lamp 3: EVENT3 lamp 4: EVENT4 lamp	0	P. 175
Unused	262C ⋮ 262F	9772 ⋮ 9775	—	—	—	—
Event LED selection: connector input (DI channel 13 to 28)	CH13: 2630 CH14: 2631 CH15: 2632 CH16: 2633 CH17: 2634 CH18: 2635 CH19: 2636 CH20: 2637 CH21: 2638 CH22: 2639 CH23: 263A CH24: 263B CH25: 263C CH26: 263D CH27: 263E CH28: 263F	CH13: 9776 CH14: 9777 CH15: 9778 CH16: 9779 CH17: 9780 CH18: 9781 CH19: 9782 CH20: 9783 CH21: 9784 CH22: 9785 CH23: 9786 CH24: 9787 CH25: 9788 CH26: 9789 CH27: 9790 CH28: 9791	R/W	0: Unused 1: EVENT1 lamp 2: EVENT2 lamp 3: EVENT3 lamp 4: EVENT4 lamp	0	P. 176
Unused	2640 ⋮ 287E	9792 ⋮ 10366	—	—	—	—

8.10.2 Initial setting data items

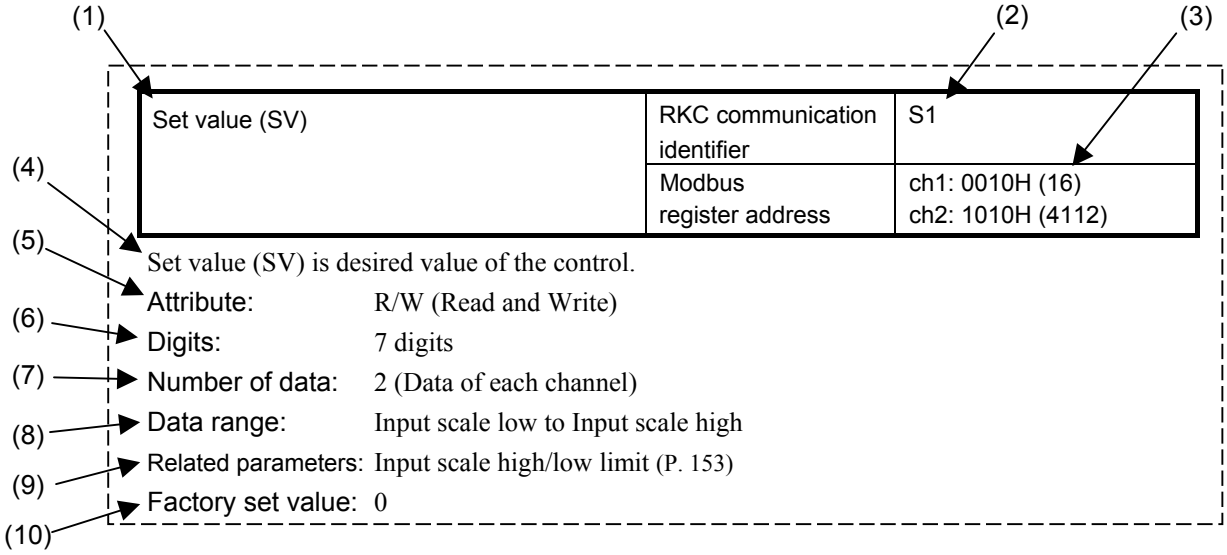
⚠ WARNING

The Initial setting data should be set according to the application before setting any parameter related to operation. Once the Initial setting data is set correctly, those data is not necessary to be changed for the same application under normal conditions. If they are changed unnecessarily, it may result in malfunction or failure of the instrument. RKC will not bear any responsibility for malfunction or failure as a result of improper changes in the Initial setting.

Name	Register address		Attribute	Data range	Factory set value	Reference page
	Hexadecimal	Decimal				
Transmission transfer time setting (Data of each module)	287F	10367	R/W	0 to 100 ms	6	P. 178

9. COMMUNICATION DATA DESCRIPTION

■ Referance to communication data contents



(1) Name: Communication data name is written.

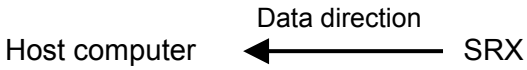
(2) RKC communication identifier:
Communication identifier of RKC communication is written.

(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.

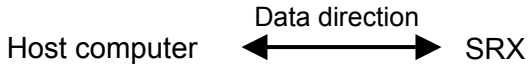
(4) Description: A short description of the communication data item is written.

(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 is possible.



R/W: Reading and writing data is possible.



(6) Digits: The data number of digits in RKC 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) Related parameters: 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.

9.1 Communication Data of TIO Module

9.1.1 Normal setting data items

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

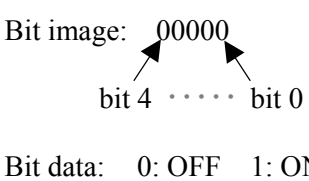
Measured value (PV) is the input value of SRX. There are thermocouple input, resistance temperature detector input, voltage input and current input.

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 state	RKC communication identifier	AJ
	Modbus register address	ch1: 0001H (1) ch2: 1001H (4097)

Each event state 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 state 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 for RKC communication.



bit 0: Burnout
bit 1: Event 1 state
bit 2: Event 2 state
bit 3: Heater break alarm (HBA) state
bit 4: Control loop break alarm (LBA) state

Related parameters: Event LED mode setting (P. 119)
Factory set value: —

Burnout state	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 state	RKC communication identifier	AA
	Modbus register address	ch1: 0009H (9) ch2: 1009H (4105)
Event 2 state	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
Related parameters: Event set value (P. 105), Event LED mode setting (P. 119), Event differential gap (P. 156), Event type selection (P. 157), Event hold action (P. 159), Number of event delay times (P. 160)
Factory set value: —

Heater break alarm (HBA) state	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
Related parameters: Current transformer input measured value (P. 101), Heater break alarm (HBA) set value (P. 110), Number of heater break alarm (HBA) delay times (P. 111)
Factory set value: —

Control loop break alarm (LBA) state	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
Related parameters: Control loop break alarm (LBA) use selection (P. 125), Control loop break alarm (LBA) time (P. 126), Control loop break alarm (LBA) deadband (P. 127)
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 %
Related parameters: Manual output value (P. 108), Output limiter (high/low) (P. 109), Event LED mode setting (P. 119), Output change rate limiter (up/down) (P. 162)
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)
Related parameters: Heater break alarm (HBA) state (P. 100), Heater break alarm (HBA) set value (P. 110), Number of heater break alarm (HBA) delay times (P. 111)
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 state 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 state 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 for RKC communication.

Bit image: 00000000
bit 7 ····· bit 0

Bit data: 0: OFF 1: ON

bit 0: Memory backup error
bit 1: Unused
bit 2: Internal communication error
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
Related parameters: Input scale high limit/low limit (P. 153)
Factory set value: 0

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

Use to set 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: ON/OFF action
(Input span: Input scale low limit to Input scale high limit)
Related parameters: ON/OFF control differential gap (upper/lower) (P. 155)
Factory set value: TC/RTD input: 10.0 °C (10.0 °F)
Voltage/current input: 10.0 %

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

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

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. 128)**.
Factory set value: 40.00

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

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

Attribute: R/W (Read and Write)
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)

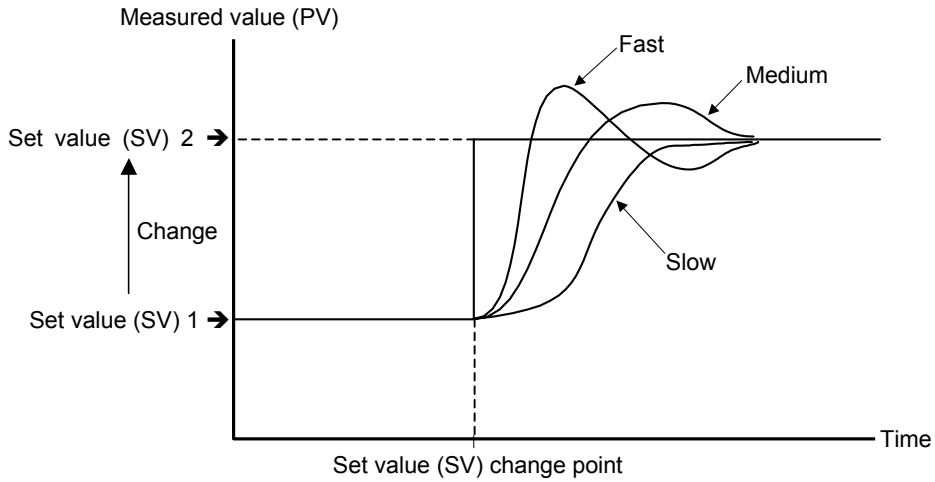
☞ A decimal point position selects with an **Integral/derivative time decimal point position (P. 128)**.

Factory set value: 10.00

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

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

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



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

PV bias adds bias to the measured value (PV). The PV bias is used to compensate the individual variations of the sensors or correct the difference between the measured value (PV) of other instruments.

Attribute: R/W (Read and Write)
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)
Related parameters: Event state (P. 99), Event differential gap (P. 156), Event type selection (P. 157), Event hold action (P. 159), Number of event delay times (P. 160)
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
Related parameters: Event LED mode setting (P. 119), Hot/cold start selection (P. 112), Operation mode holding setting (P. 161)
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)

Use to 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
Related parameters: AT differential gap time (P. 117), AT bias (P. 118)
Factory set value: 0: PID control operation
Function: Autotuning (AT) function automatically measures, calculates and sets the optimum PID constants. The followings are the conditions necessary to carry out autotuning and the conditions which will cause the autotuning to stop.

Requirements for AT start

Start the autotuning when all following conditions are satisfied:

- Operation mode conditions are as follows:
  - Auto/Manual transfer (Identifier J1) → Auto mode
  - PID/AT transfer (Identifier G1) → PID control mode
  - Control RUN/STOP transfer (Identifier SR) → Control RUN mode
- The measured value (PV) is not underscale or overscale.
- The output limiter high limit is 0.1 % higher and the output limiter low limit is 99.9 % or less.
- When operation mode is set to "Control."

When the autotuning is finished, the controller will automatically returns to "0: PID control operation."

AT cancellation

The autotuning is canceled if any of the following conditions exist:

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

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

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

Use to 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 operation 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 *	State	
		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)

Use to set 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: −5.0 to +105.0 %
(However, the actual output value is within output limiter range.)
Related parameters: Output limiter (high/low) (P. 109)
Factory set value: 0.0

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

Use to set 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): Output limiter (low) to 105.0 %
Output limiter (low): −5.0 % to Output limiter (high)
Related parameters: Manipulated output value (P. 100), Output change rate limiter (up/down) (P. 162)
Factory set value: Output limiter (high): 100.0
Output limiter (low): 0.0

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

Proportional cycle time is to set control cycle time for time based control output such as voltage pulse output and relay contact 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: Relay contact output: 20.0
Voltage pulse output: 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 to eliminate noise against 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

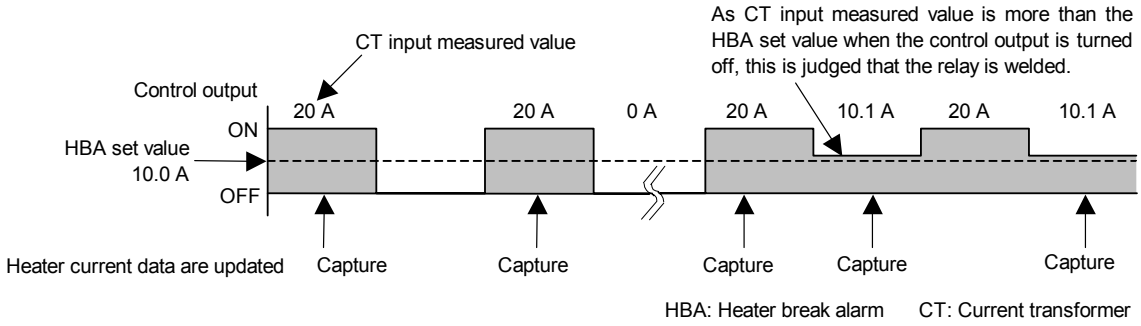
Heater break alarm (HBA) set value	RKC communication identifier	A3
	Modbus register address	ch1: 0028H (40) ch2: 1028H (4136)

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)
Related parameters: Heater break alarm (HBA) state (P. 100), Current transformer input measured value (P. 101), Number of heater break alarm (HBA) delay times (P. 111)
Factory set value: 0.0
Function: The heater break alarm (HBA) function detects a fault in the heating or cooling circuit and displays actual amperage on the display by monitoring the current draw of the load by the current transformer.

- **When no heater current flows:** Heater break or faulty operating unit, etc.
  When the control output is on and the current transformer (CT) input value is equal to or less than the HBA set value, an alarm status is produced. However, heater break alarm does not action when control output ON time is 0.1 second or less.
- **When the heater current cannot be turned off:** Welded realy contact, etc.
  When the control output is off and the current transformer (CT) input value is equal to greater than the HBA set value, an alarm status is produced. However, heater break alarm does not action when control output OFF time is 0.1 second or less.

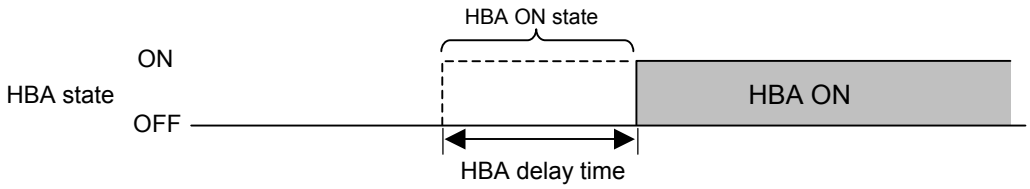
Heater current data items are updated using data items captured when the control output is turned on. However when the relay is welded, they are updated using data items captured when the control output is turned off.



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
Related parameters: Heater break alarm (HBA) state (P. 100), Current transformer input measured value (P. 101), Heater break alarm (HBA) set value (P. 110)
Factory set value: 5
Function: Heater break alarm (HBA) delay time = Number of delay times × Sampling time (Sampling time: 500 ms)



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

The start mode is selected when the power failure recovers; control is started; the operation mode is set to Control; or the program operation mode is set to RUN or FIX from RESET.

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
Related parameters: Operation mode (P. 106), Start determination point (P. 113), Control RUN/STOP transfer (P. 113), Program operation mode selection (P. 135)
Factory set value: 0
Function: Hot/cold start state

	Power recovery	Control RUN/STOP	Operation mode	Program operation mode
		STOP → RUN	Other than → Control	RESET → RUN FIX
Hot start 1	Same as that before power failure	Same as that before STOP	Same as that before Other than Control	Low limit value of output
Hot start 2	Value as a result of control computation [1, 2, 3]	Value as a result of control computation [2, 3]	Value as a result of control computation [2, 3]	
Cold start 1	Low limit value of output [3] (Change to MAN mode)	Low limit value of output [3] (Change to MAN mode)	Low limit value of output [3] (Change to MAN mode)	Low limit value of output (Change to MAN mode)
Cold start 2	Low limit value of output (Change to RESET mode [4])	Same as that before STOP	Same as that before Other than Control	Low limit value of output

[1] Same as that before power failure when mode is MAN mode.

[2] The result of control computation varies with the control designation parameter.

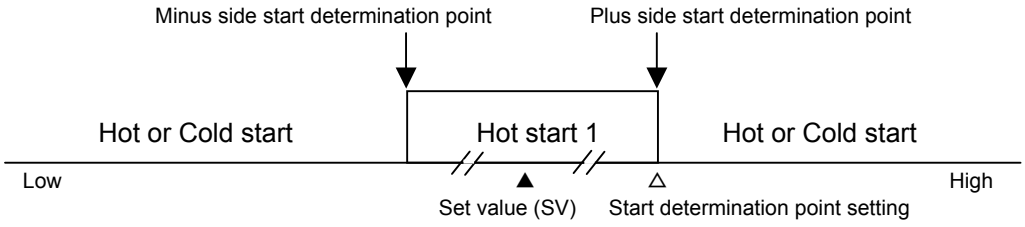
[3] The value becomes the same output as in Hot start 1 when measured value (PV) is within the range of the start determination point.

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

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)
Related parameters: Hot/cold start selection (P. 112)
Factory set value: 0
Function:
- The start state 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 becomes "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)

Use to 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
Related parameters: Hot/cold start selection (P. 112)
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.

When used together with RKC panel mounted controllers (HA400/900/401/901, CB100/400/700/900, etc.), be careful that the numbers of indicating "Control RUN/STOP" of this instrument are opposite from those of the above controllers (0: ControlRUN and 1: Control STOP).

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

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

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: Input scale low limit to Input scale high limit
Related parameters: Input error determination point (low) (P. 114), Action at input error (high/low) (P. 115), Manipulated output value at input error (P. 116)
Factory set value: Input scale high limit

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

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

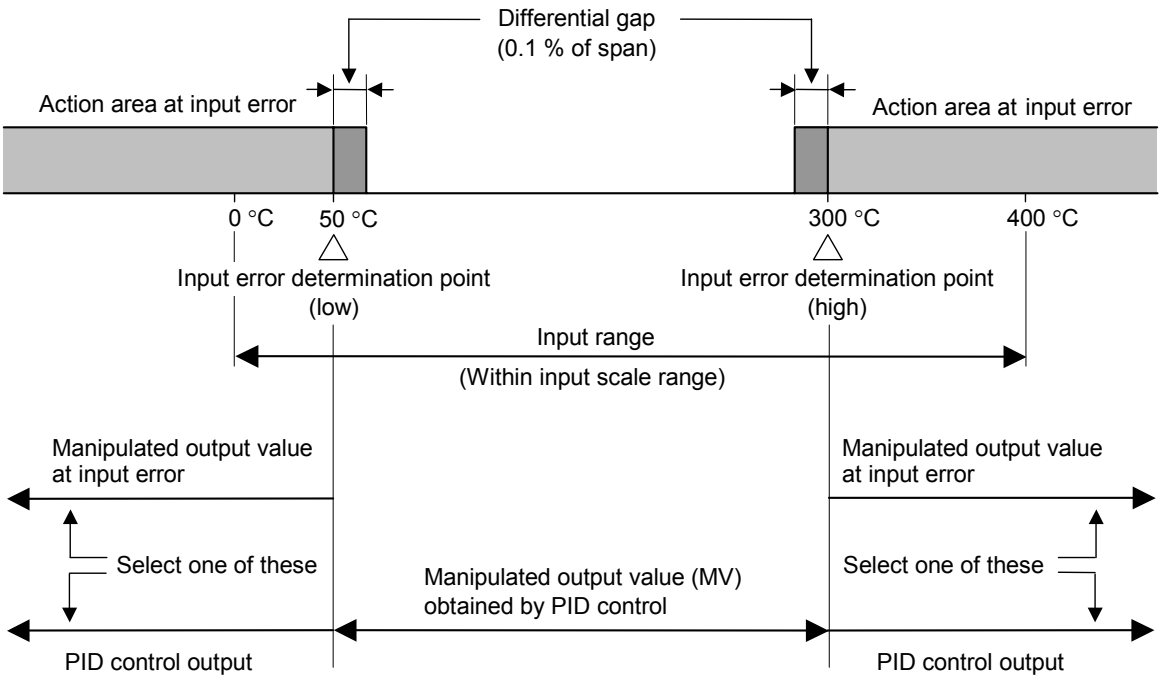
Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: Input scale low limit to Input scale high limit
Related parameters: Input error determination point (high) (P. 114), Action at input error (high/low) (P. 115), Manipulated output value at input error (P. 116)
Factory set value: Input scale low limit

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

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

Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: Normal control (The present output)
1: Manipulated output value at input error
Related parameters: Input error determination point (high/low) (P. 114), Manipulated output value at input error (P. 116)
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): 300 °C
Input error determination point (low): 50 °C



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

When the measured value reaches input error determination point and action at input error is set to "1," this manipulated value is output.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: –5.0 to +105.0 %
(However, the actual output value is within output limiter range.)
Related parameters: Input error determination point (high/low) (P. 114), Action at input error (high/low) (P. 115)
Factory set value: 0.0

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

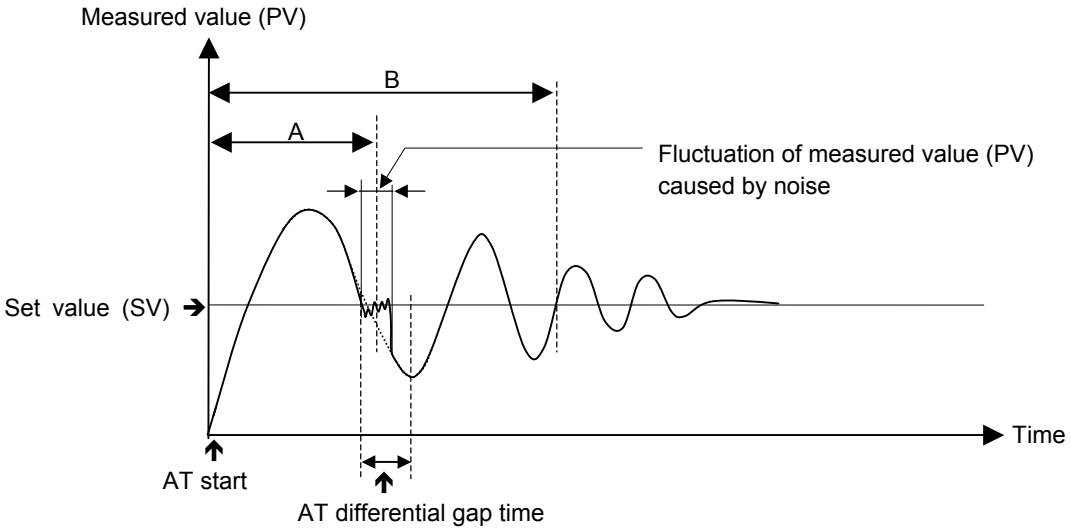
Use to set an ON/OFF action differential gap time for autotuning. This function prevents the AT function from malfunctioning caused by noise.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0.00 to 50.00 seconds
Related parameters: PID/AT transfer (P. 107)
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 during autotuning, the output on or off state is held until "AT differential gap time" has passed after the output on/off state is changed to the other. Set "AT differential gap time" to "1/100 × Time required for temperature rise."

[Example]

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

B: AT cycle time when the AT differential gap time is set to "Time corresponding to 0.25 cycles"
The fluctuation of a measured value (PV) caused by noise is ignored and as a result autotuning function is able to monitor appropriate cycles to calculate suitable PID values.



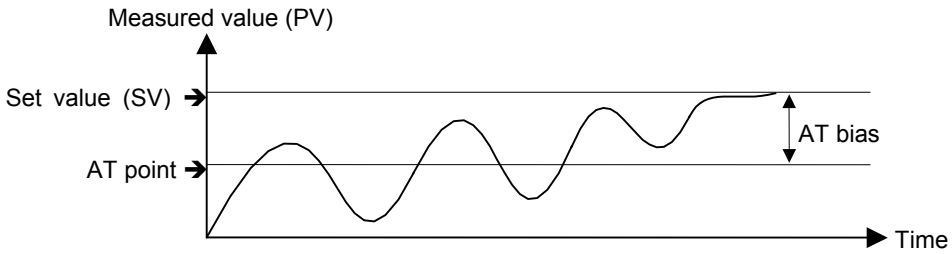
The AT cycle of SRX is 2 cycles.

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

Use to set a bias to move the set value only when autotuning 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)
Related parameters: PID/AT transfer (P. 107)
Factory set value: 0
Function: The AT bias is used to prevent overshoot during autotuning in the application which does not allow overshoot even during autotuning. RKC autotuning method uses ON/OFF control at the set value to calculate the PID values. However, if overshoot is a concern during autotuning, the desired AT bias should be set to lower the set point during autotuning so that overshoot is prevented.

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



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

Use to 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

Digital input setting 1 (RESET)	RKC communication identifier	E1
	Modbus register address	ch1: 003DH (61) ch2: 103DH (4157)
Digital input setting 2 (RUN)	RKC communication identifier	E2
	Modbus register address	ch1: 003EH (62) ch2: 103EH (4158)
Digital input setting 3 (FIX)	RKC communication identifier	E3
	Modbus register address	ch1: 003FH (63) ch2: 103FH (4159)
Digital input setting 4 (MAN)	RKC communication identifier	E4
	Modbus register address	ch1: 0040H (64) ch2: 1040H (4160)

To contact of DI module, assigned to the input of program operation mode transfer.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0000 to 9999
Upper two digits (Thousands and hundreds digits): Address of DI module
Lower two digits (Tens and units digits): Channel number of DI module
Related parameters: Program operation mode selection (P. 135)
Factory set value: 0000 (No function)
Function:

- When the contact corresponding to the channel set by "Digital input setting 1" is closed from the open condition (rising edge), the program operation mode is set to the RESET mode.
- When the contact corresponding to the channel set by "Digital input setting 2" is closed from the open condition (rising edge), the program operation mode is set to the program control mode (RUN).
- When the contact corresponding to the channel set by "Digital input setting 3" is closed from the open condition (rising edge), the program operation mode is set to the fixed set point control mode (FIX).
- When the contact corresponding to the channel set by "Digital input setting 4" is closed from the open condition (rising edge), the program operation mode is set to the manual control mode (MAN).

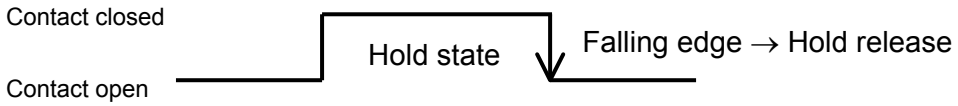
The maximum delay time is 30 ms from the time when the contact in the DI module is going to be closed or opened until activated in the TIO module.

In order to make contact activation valid, it is necessary to maintain the same contact state for more than 10 ms. Otherwise, that contact state is ignored.

Digital input setting 5 (HOLD)	RKC communication identifier	E5
	Modbus register address	ch1: 0041H (65) ch2: 1041H (4161)

Inputs to take the HOLD action in program operation are assigned to the contacts in the DI module.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0000 to 9999
Upper two digits (Thousands and hundreds digits): Address of DI module
Lower two digits (Tens and units digits): Channel number of DI module
Related parameters: Hold state (P. 140)
Factory set value: 0000 (No function)
Function: When the contact corresponding to the channel set by "Digital input setting 5" is in the closed state, the HOLD state is kept. At this time, no HOLD state can be released via communication (the contact status has priority over others). In addition, the HOLD state is released when the contact is opened from the closed condition (falling edge).



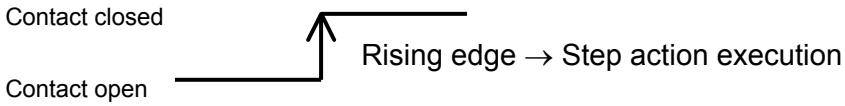
The maximum delay time is 30 ms from the time when the contact in the DI module is going to be closed or opened until activated in the TIO module.

In order to make contact activation valid, it is necessary to maintain the same contact state for more than 10 ms. Otherwise, that contact state is ignored.

Digital input setting 6 (STEP)	RKC communication identifier	E6
	Modbus register address	ch1: 0042H (66) ch2: 1042H (4162)

Inputs to take the STEP action in program operation are assigned to the contacts in the DI module.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0000 to 9999
Upper two digits (Thousands and hundreds digits): Address of DI module
Lower two digits (Tens and units digits): Channel number of DI module
Related parameters: Step action (P. 141)
Factory set value: 0000 (No function)
Function: When the contact corresponding to the channel set by "Digital input setting 6" is closed from the open condition (rising edge), the STEP action is taken.



- The maximum delay time is 30 ms from the time when the contact in the DI module is going to be closed or opened until activated in the TIO module.
- In order to make contact activation valid, it is necessary to maintain the same contact state for more than 10 ms. Otherwise, that contact state is ignored.

Digital input setting 7 (Program pattern selection)	RKC communication identifier	E7
	Modbus register address	ch1: 0043H (67) ch2: 1043H (4163)

Inputs to select the program pattern are assigned to the contacts in the DI module. This is valid only when the program operation mode is in the RESET mode.

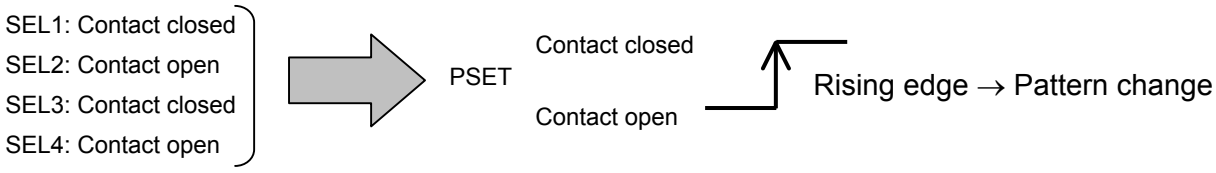
Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0000 to 9999
Upper two digits (Thousands and hundreds digits): Address of DI module
Lower two digits (Tens and units digits): Channel number of DI module
Related parameters: Execution pattern (P. 136)
Factory set value: 0000 (No function)
Function:

- As the five contacts, PSET, SEL1, SEL2, SEL3 and SEL4 are handled as one set and the contents corresponding to five channels are automatically assigned in order of PSET, SEL1, SEL2, SEL3 and SEL4 with the preset DI channel number at the head.
- After selecting the pattern number by the four contacts, SEL1, SEL2, SEL3, and SEL4, the pattern number is changed when the contact, PSET (pattern set) is closed from the condition where opened (rising edge).
- Contact state and Pattern number

Contact	Pattern number															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
SEL1	–	×	–	×	–	×	–	×	–	×	–	×	–	×	–	×
SEL2	–	–	×	×	–	–	×	×	–	–	×	×	–	–	×	×
SEL3	–	–	–	–	×	×	×	×	–	–	–	–	×	×	×	×
SEL4	–	–	–	–	–	–	–	–	×	×	×	×	×	×	×	×

–: Contact open ×: Contact closed

[Example] When change it to pattern No. 6
After the contacts SEL1 and SEL3 are closed and the contacts, SEL2 and SEL4 are opened, the present pattern number is changed to Pattern No. 6 if the contact, PSET is closed from the condition where opened (rising edge).



The maximum delay time is 30 ms from the time when the contact in the DI module is going to be closed or opened until activated in the TIO module.

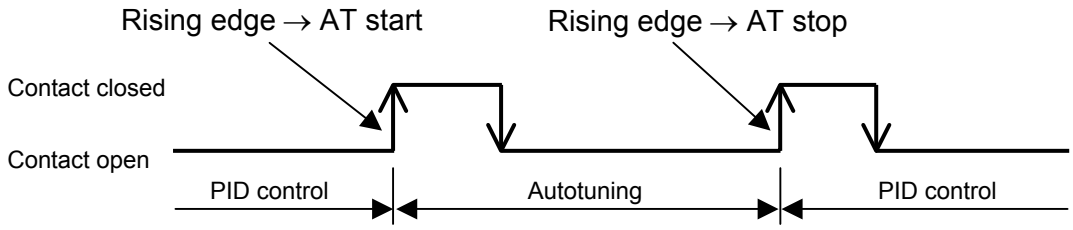
In order to make contact activation valid, it is necessary to maintain the same contact state for more than 10 ms. Otherwise, that contact state is ignored.

As five channels are hadled as one set for program pattern selection, for the X-DI-A (with up to 12 input channels), to be assigned to DI channels 1 to 8. (For the X-DI-B with up to 28 input channels, to be assigned to DI channels 1 to 24.)

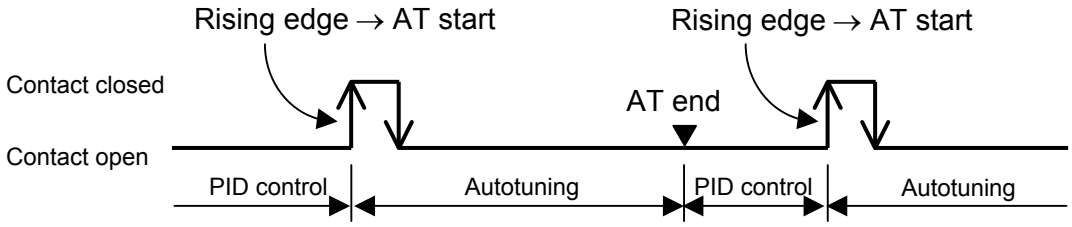
Digital input setting 8 (AT/PID)	RKC communication identifier	E8
	Modbus register address	ch1: 0044H (68) ch2: 1044H (4164)

Inputs to start/stop the autotuning (AT) function are assigned to the contacts in the DI module.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0000 to 9999
Upper two digits (Thousands and hundreds digits): Address of DI module
Lower two digits (Tens and units digits): Channel number of DI module
Related parameters: PID/AT transfer (P. 107)
Factory set value: 0000 (No function)
Function: When the contact corresponding to the channel set by "Digital input setting 6" is closed from the open condition (rising edge) during PID control, the autotuning (AT) function starts activating. In addition, the autotuning (AT) function stops activating (canceled) when the contact is closed from the open condition (rising edge).



- Become PID control during autotuning (AT) suspension.
- The maximum delay time is 30 ms from the time when the contact in the DI module is going to be closed or opened until activated in the TIO module.
- In order to make contact activation valid, it is necessary to maintain the same contact state for more than 10 ms. Otherwise, that contact state is ignored.
- If the contact is closed from the open condition after the autotuning (AT) function ends its activation. The autotuning (AT) function is re-activated.



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
Related parameters: Control loop break alarm (LBA) state (P. 100), Control loop break alarm (LBA) time (P. 126), Control loop break alarm (LBA) deadband (P. 127)
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 (power controller, magnet relay, etc.), or a failure in the control loop caused by an input (sensor) break.
The LBA function is activated when control output reaches 0% (low limit with output limit function) or 100% (high limit with output limit function). LBA monitors variation of the measured value (PV) for the length of LBA time, and when the LBA time has passed and the PV is still within the alarm determination range, the LBA will be output.

[Alarm action]

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

- **When the output reaches 0 % (low limit with output limit function)**
  For direct action: When the LBA time has passed and the PV has not risen beyond the alarm determination range, the alarm will be turned on.
  For reverse action: When the LBA time has passed and the PV has not fallen below the alarm determination range, the alarm will be turned on.

- **When the output exceeds 100 % (high limit with output limit function)**
  For direct action: When the LBA time has passed and the PV has not fallen below the alarm determination range, the alarm will be turned on.
  For reverse action: When the LBA time has passed and the PV has not risen beyond the alarm determination range, the alarm will be turned on.

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

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

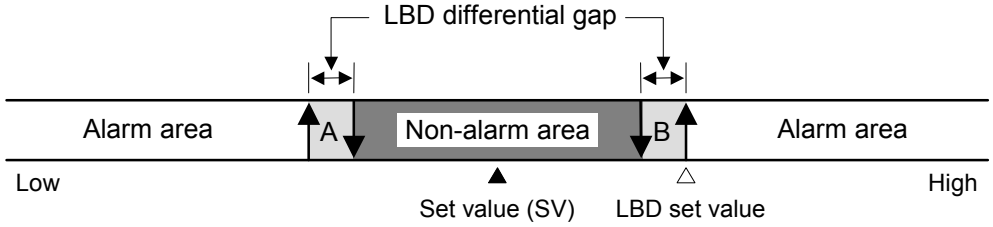
The LBA time sets the time required for the LBA function to determine there is a loop failure. When the LBA is output (under alarm status), the LBA function still monitors the measured value (PV) variation at an interval of the LBA time.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 1 to 7200 seconds
Related parameters: Control loop break alarm (LBA) state (P. 100), Control loop break alarm (LBA) use selection (P. 125), Control loop break alarm (LBA) deadband (P. 127)
Factory set value: 80

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 gives a neutral 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)
Related parameters: Control loop break alarm (LBA) state (P. 100), Control loop break alarm (LBA) use selection (P. 125), Control loop break alarm (LBA) time (P. 126)
Factory set value: 0
Function: The LBA may malfunction due to external disturbance from outside even when the control does not have any problem. To prevent malfunctioning due to external disturbance, LBA deadband (LBD) sets a neutral zone in which LBA is not activated.
When the measured value (PV) is within the LBD area, LBA will not be activated. If the LBD setting is not correct, the LBA will not work correctly.



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

LBD differential gap:
TC/RTD input: 0.8 °C (1.44 °F)
Voltage/Current input: 0.8 % of span

If the LBA function detects an error occurring in the control loop, but cannot specify the location, a check of the control loop in order. The LBA function does not detect a location which causes alarm status. If LBA alarm is ON, check each device or wiring of the control loop.

When AT function is activated or the controller is in STOP mode, the LBA function is not activated.

If the LBA setting time match the controlled object requirements, the LBA setting time should be adjusted. If setting time is not correct, the LBA will malfunction by turning on or off at inappropriate time or not turning on at all.

While the LBA is ON (under alarm status), the following conditions cancel the alarm status and LBA will be OFF.
- The measured value (PV) rises beyond (or falls below) the LBA determination range within the LBA time.
- The measured value (PV) enters within the LBA deadband.

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: Two decimal places
1: One decimal place
Related parameters: Integral time (P. 103), Derivative time (P. 104)
Factory set value: 0: Two decimal places

Initial setting mode	RKC communication identifier	IN

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

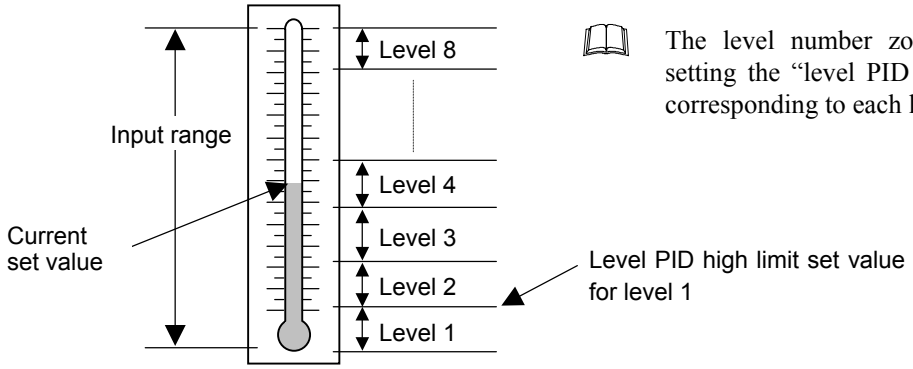
Initial setting mode is valid only when RKC communication is used.

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 **9.1.4 Initial setting data (P. 151)**.

9.1.2 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.

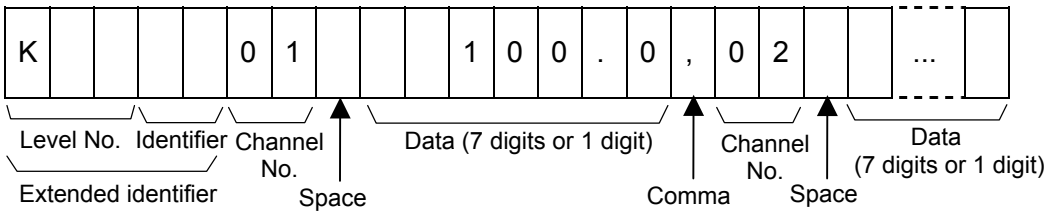


The level number zone is determined by setting the "level PID high limit set value" corresponding to each level.

■ 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)

Use to set 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: ON/OFF action
(Input span: Input scale low limit to Input scale high limit)
Factory set value: TC/RTD input: 10.0 °C (10.0 °F)
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)

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

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. 128)**.
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)

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

Attribute: R/W (Read and Write)
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. 128)**.

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)

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

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

9.1.3 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

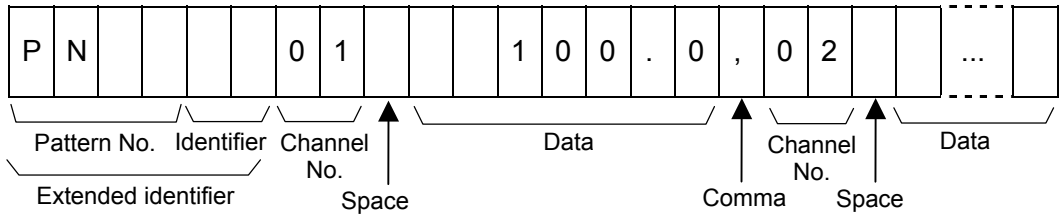
For three kinds of pattern group, segment group and time signal group data items, it is necessary to specify pattern, segment and time signal numbers. However for normal data items, it is not necessary to specify these numbers. These data items can be sent in the same procedure as in **9.1.1 Normal setting data items (P. 98)**.

■ 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.

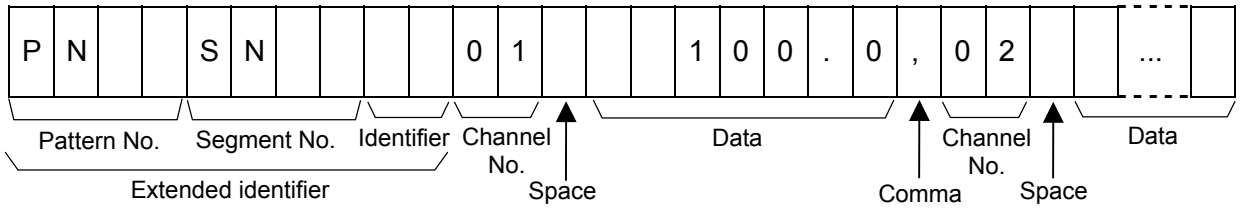
Address	00F0H	00F1H	00F2H	00F3H	…	00FCH	00FDH	00FEH	00FFH
Pattern No.	1	2	3	4	…	13	14	15	16

■ 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

⋮

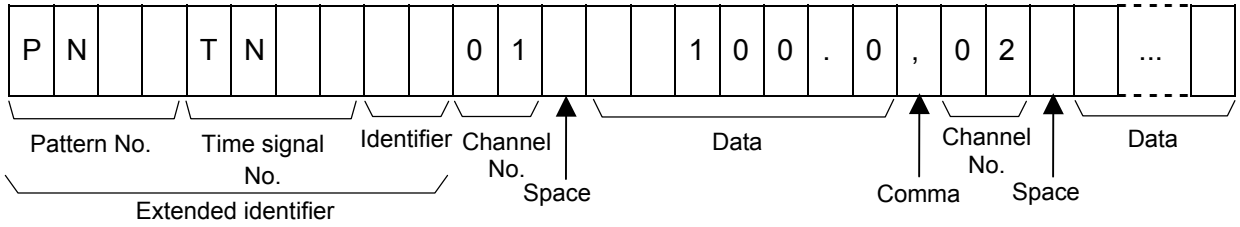
0230H	0231H	0232H	0233H	…	023CH	023DH	023EH	023FH
16/1	16/2	16/3	16/4	…	16/13	16/14	16/15	16/16

■ 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)
Related parameters: Hot/cold start selection (P. 112)
Factory set value: 2: FIX (Fixed control mode)
Function:
- RESET (Reset mode)
  Stop program operation 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]	State		
		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
Related parameters: Event LED mode setting (P. 119)
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.161)**.
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 state 1	RKC communication identifier	T8
	Modbus register address	ch1: 00D5H (213) ch2: 10D5H (4309)
Time signal output state 2	RKC communication identifier	T9
	Modbus register address	ch1: 00D5H (213) ch2: 10D5H (4309)

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

Related parameters: Event LED mode setting (P. 119)
Factory set value: —

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

The pattern end output state 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 state	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 state OFF
1: End state ON
Factory set value: —

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

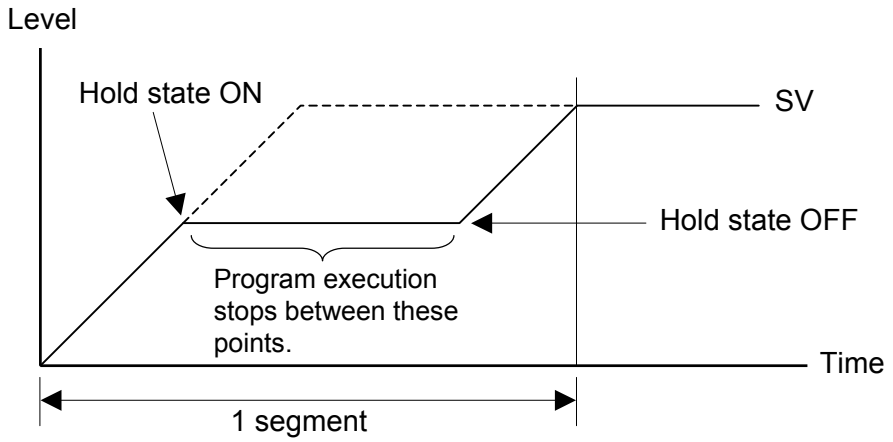
Program operation is turned on in the wait state.

Attribute: RO (Read only)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: Wait state OFF
1: Wait state ON
Related parameters: Wait zone (P. 145)
Factory set value: —

Hold state	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 state OFF
1: Hold state ON
Factory set value: 0: Hold state OFF
Function: The program stops its progress temporarily if the hold state is turned on. In addition, the program re-starts from the temporarily stopped point if the hold state is turned off.

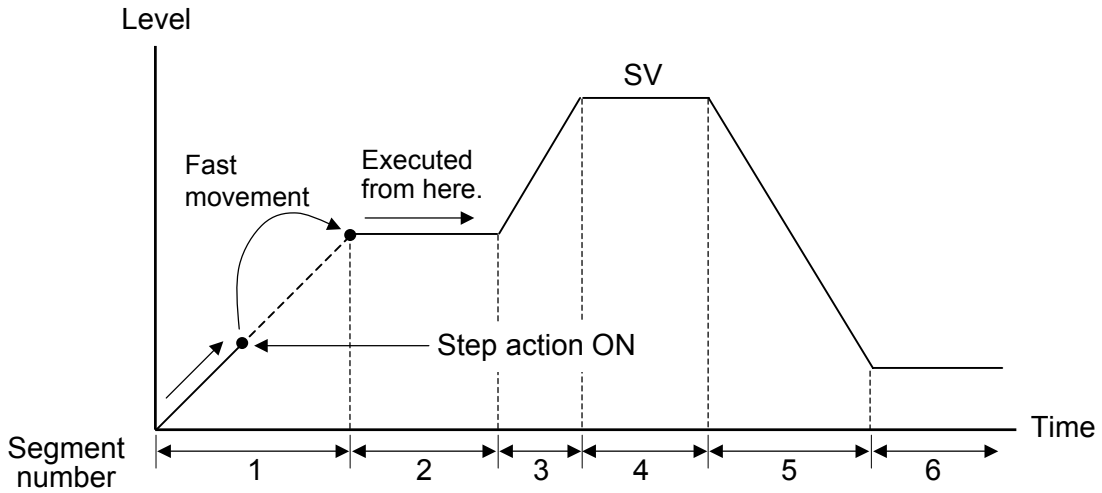


The hold state is not released if set to any of other program operation modes (FIX or MAN).

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.

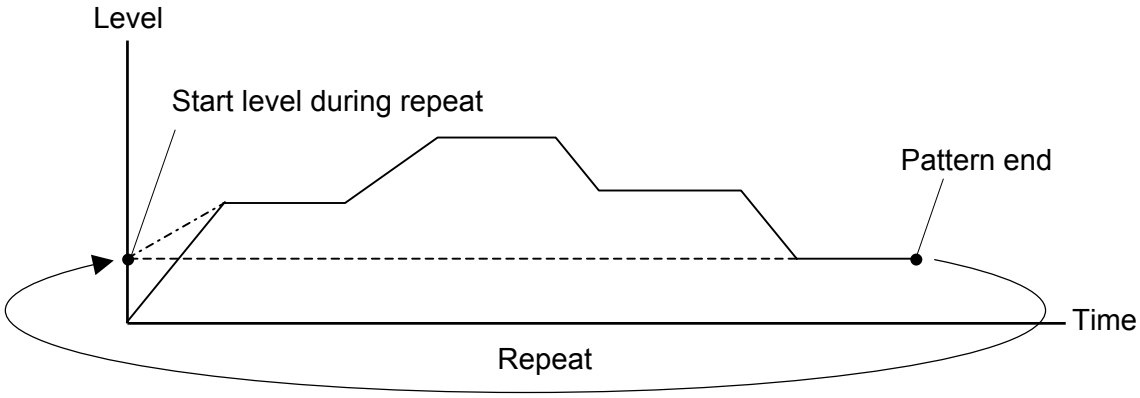


The step action cannot be used in the hold state.

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.

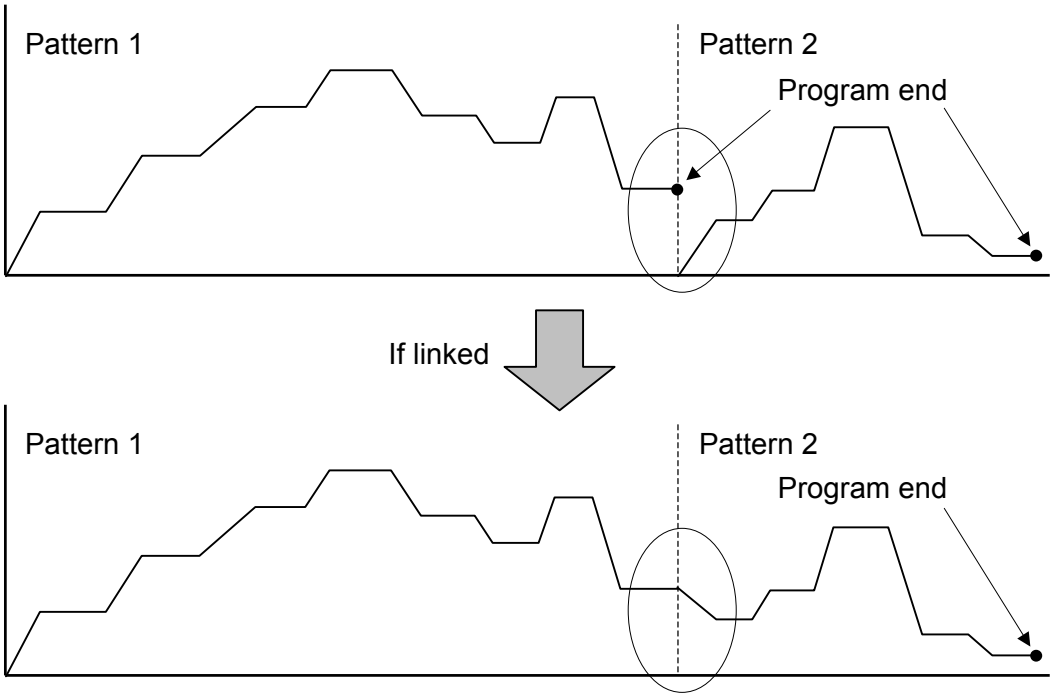
Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 1 to 16
Factory set value: 16

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



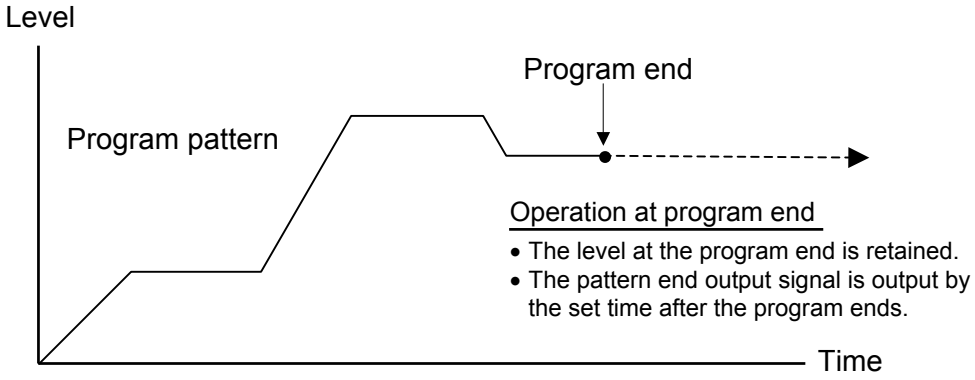
Pattern end output time (Pattern group data)	RKC communication expansion identifier	PNxxET (PNxx: Pattern No.)
	Modbus register address	ch1: 0120H to 012FH (288 to 303) ch2: 1120H to 112FH (4384 to 4399)

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

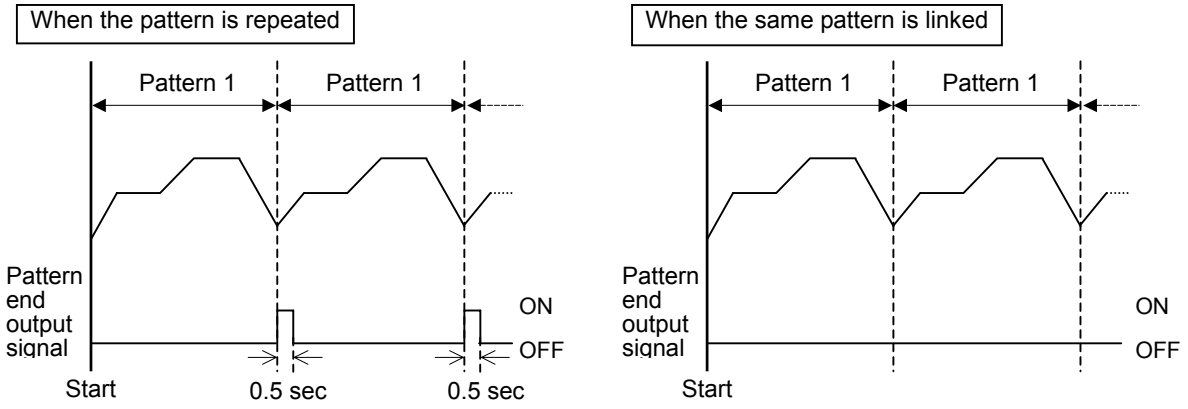
Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 2 (Data of each channel)
Data range: 0.00 to 300.00 seconds
0.0 to 3000.0 seconds
0 to 30000 seconds
0 to 30000 minutes
0: The state where the pattern end output signal is turned on continues until reset or the power supply is turned off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

☞ The time unit is selected with **Segment time unit setting (P.161)**.

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.



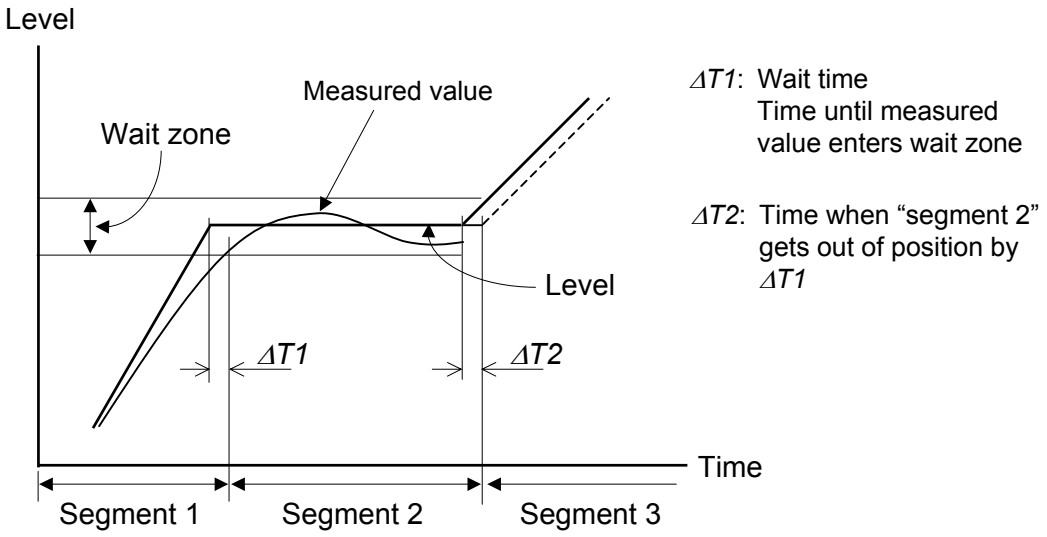
When the pattern is repeated by setting the number of program execution times, the pattern end output signal is output for about 0.5 sec regardless of the pattern end output time setting. Linking the same patterns results in the same program shape as in pattern repetition but no pattern end output signal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

The segment level can be changed during program execution. However if changed, it becomes valid from the next time.

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)

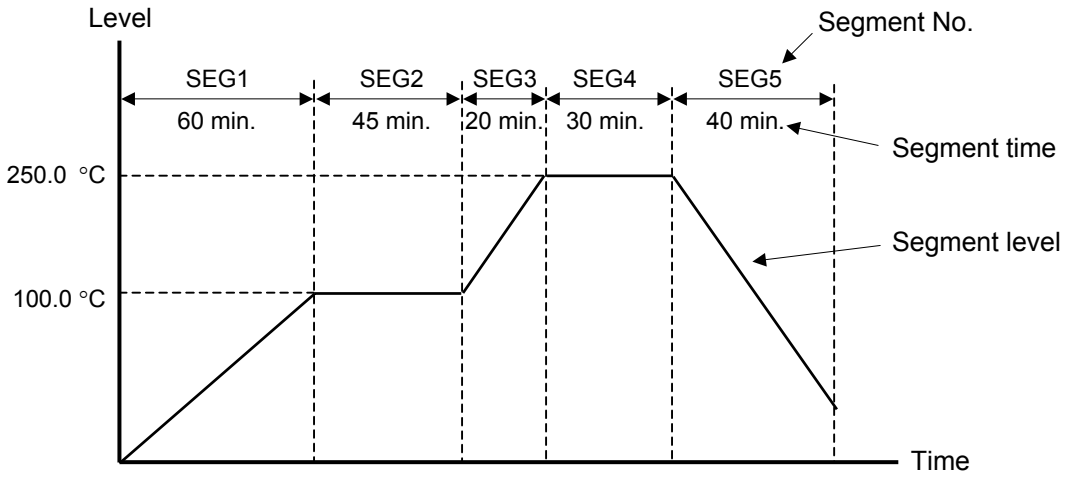
This is the segment time of the program pattern.

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.161)**.

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)

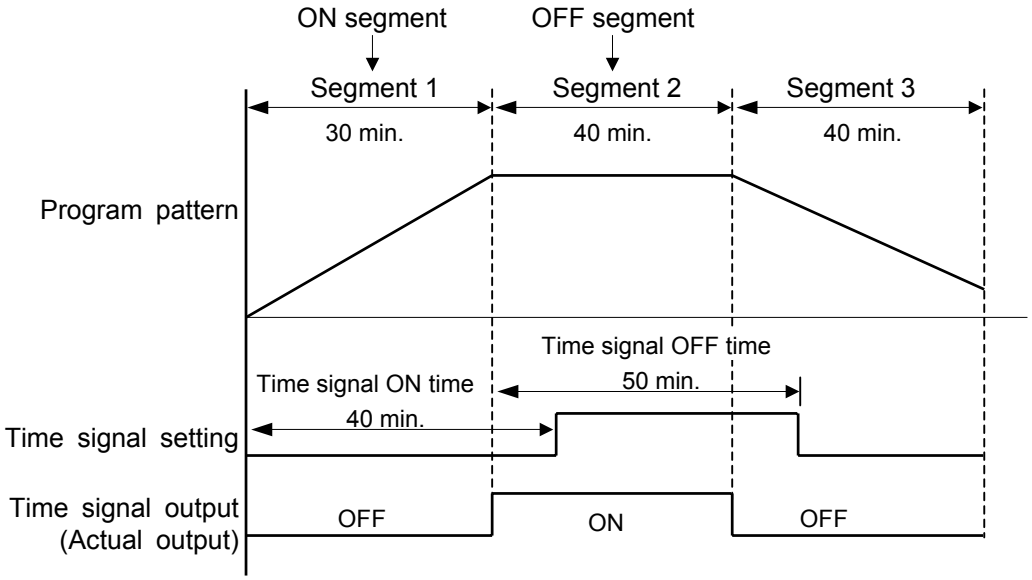
This is the output number of time signal output.

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
Related parameters: Time signal ON time (P. 148), Time signal OFF segment (P. 149), Time signal OFF time (P. 149)
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.161)**.

Related parameters: Time signal ON segment (P. 148), Time signal OFF segment (P. 149), Time signal OFF time (P. 149)
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
Related parameters: Time signal ON time (P. 148), Time signal ON segment (P. 148), Time signal OFF time (P. 149)
Factory set value: 1

Time signal OFF time (Time signal group data)	RKC communication expansion identifier	PNxxTNxxTF (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

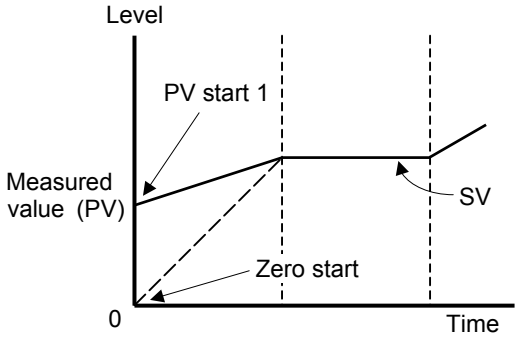
☞ The time unit is selected with **Segment time unit setting (P.161)**.

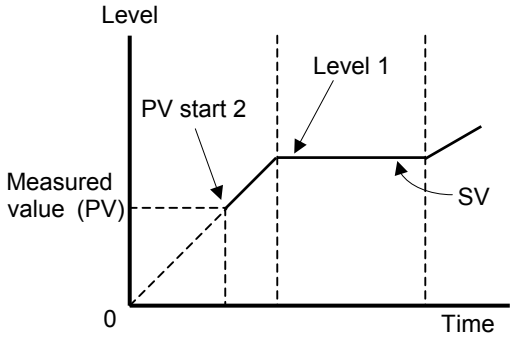
Related parameters: Time signal ON segment (P. 148), Time signal ON time (P. 148), Time signal OFF segment (P. 149)
Factory set value: 0.00

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.

9.1.4 Initial setting data items

⚠ WARNING

The Initial setting data should be set according to the application before setting any parameter related to operation. Once the Initial setting data is set correctly, those data is not necessary to be changed for the same application under normal conditions. If they are changed unnecessarily, it may result in malfunction or failure of the instrument. RKC will not bear any responsibility for malfunction or failure as a result of improper changes in the Initial setting.

■ 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		

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

Related parameters: Input scale high limit/Input scale low limit (P. 153), Input range decimal point position (P. 153)
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)

Use to set 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.
Related parameters: Input range number (P. 152), Input range decimal point position (P. 153)
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.


The decimal point position varies with the setting of the input range decimal point position.

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

Use to select 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 decimal place
1: One decimal place
2: Two decimal places
3: Three decimal places
4: Four decimal places
Related parameters: Input range number (P. 152), Input scale high limit/Input scale low limit (P. 153)
Factory set value: 1

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

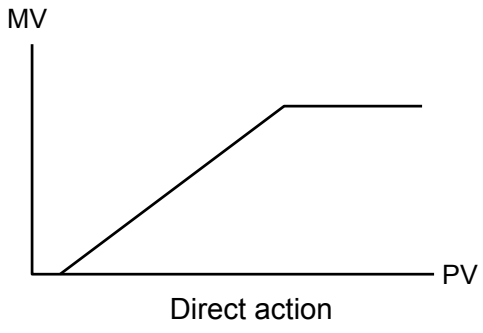
Use to select the temperature unit for thermocouple (TC) and RTD inputs.

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

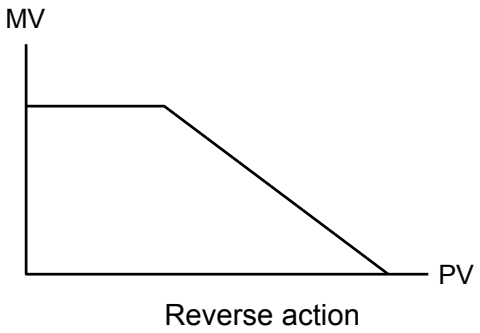
Control type selection	RKC communication identifier	XE
	Modbus register address	ch1: 0875H (2165) ch2: 1875H (6261)

Use to 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

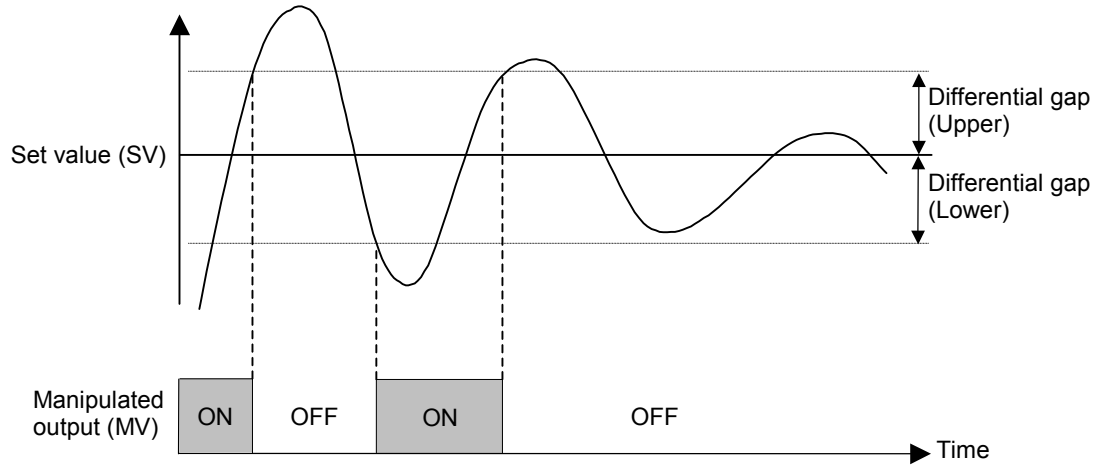


Reverse action

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)

Use to set the 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)
Related parameters: Proportional band (P. 103)
Factory set value: Thermocouple/RTD input: 1.0 °C (1.0 °F)
Voltage/Current input: 0.1 % of input span
Function: ON/OFF control is possible when the proportional band is set to "0" or "0.0."
In ON/OFF control with Reverse action, when the measured value (PV) is smaller than the set value (SV), the manipulated output (MV) is 100% or ON. When the PV is higher than the SV, the MV is 0% or OFF. Differential gap setting prevents control output from repeating ON and OFF too frequently.

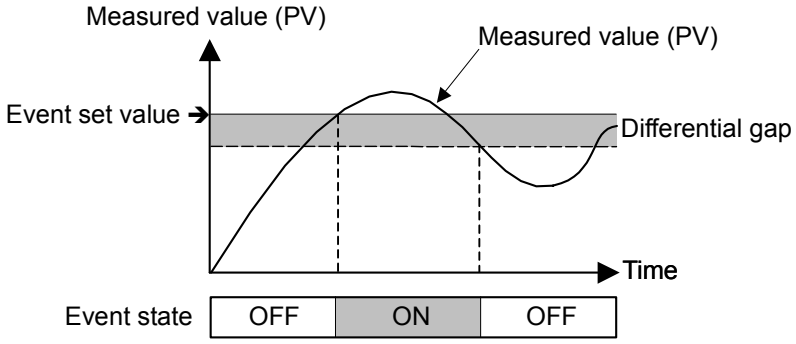


Event 1 differential gap	RKC communication identifier	HA
	Modbus register address	ch1: 0878H (2168) ch2: 1878H (6264)
Event 2 differential gap	RKC communication identifier	HB
	Modbus register address	ch1: 0879H (2169) ch2: 1879H (6265)

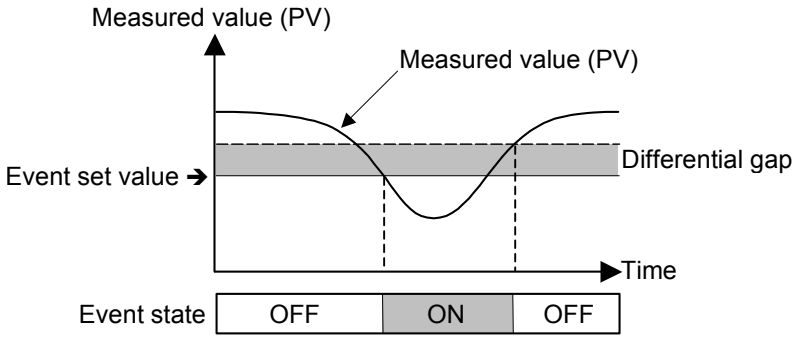
Use to set the event differential gap.

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)
Related parameters: Event set value (P. 105), Event type selection (P. 157), Event hold action (P. 159), Number of event delay times (P. 160)
Factory set value: Thermocouple/RTD input: 2.0 °C (2.0 °F)
Voltage/Current input: 0.2 % of input span
Function: It prevents chattering of event output due to the measured value fluctuation around the event set value.

[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)

Use to select the event type.

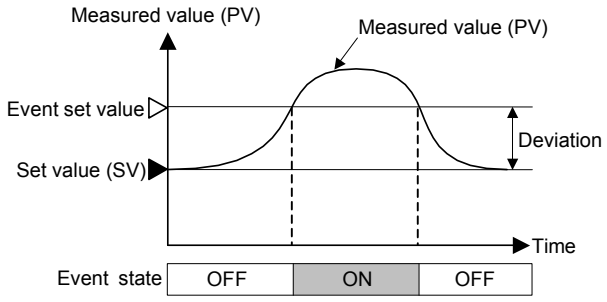
Attribute: R/W (Read and Write)
Digits: 1 digit
Number of data: 2 (Data of each channel)
Data range: 0: Not provided 3: Deviation high 6: Band
1: Process high 4: Deviation low
2: Process low 5: Deviation high/low
Related parameters: Event set value (P. 105), Event differential gap (P. 156), Event hold action (P. 159), Number of event delay times (P. 160)
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 state is set up. Consequently, if the set value (SV) changes, the event action point will also change.

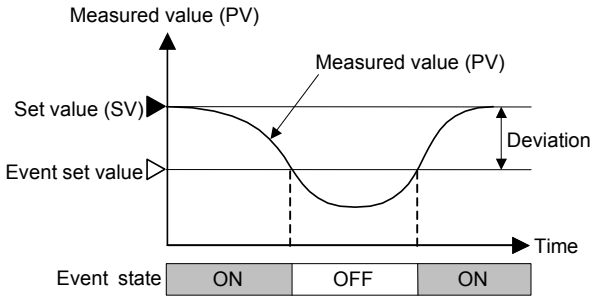
- **Deviation high**

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

[When the event set value is on the positive side]



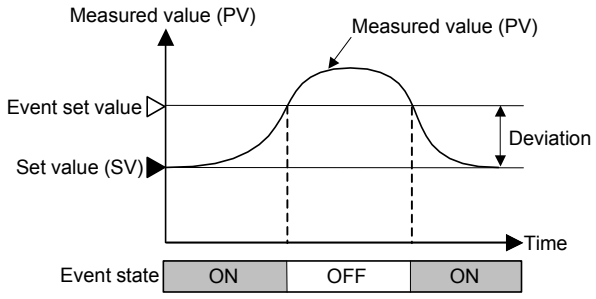
[When the event set value is on the negative side]



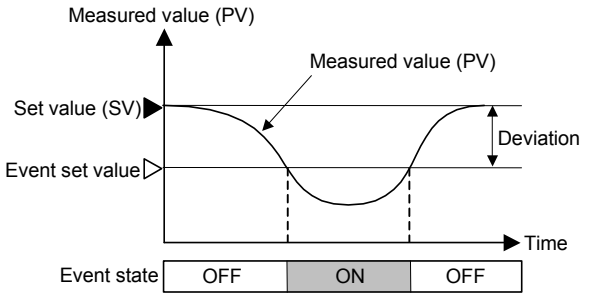
- **Deviation low**

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

[When the event set value is on the positive side]



[When the event set value is on the negative side]



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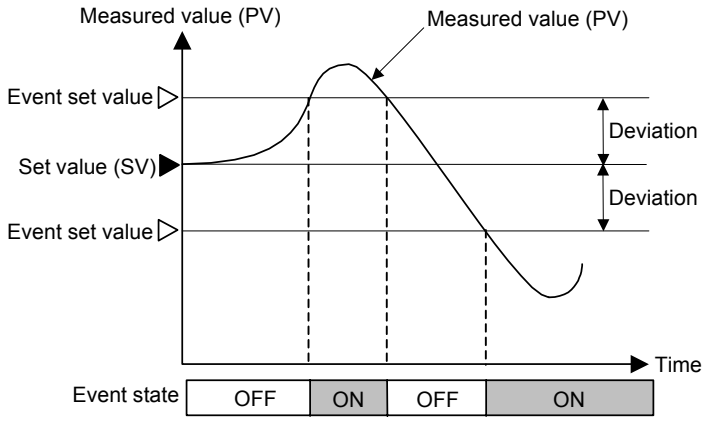
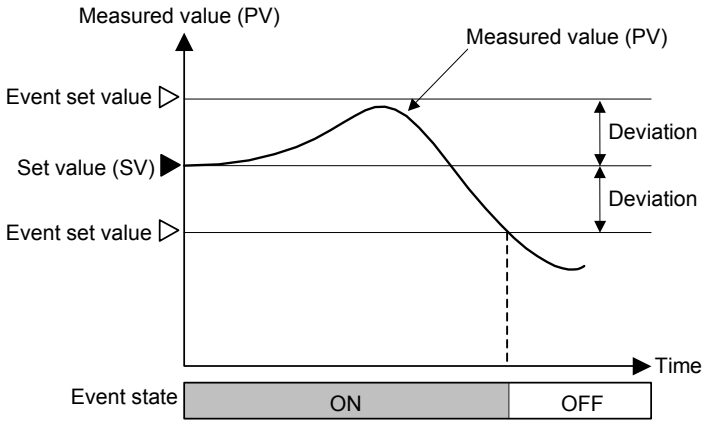
● Deviation high/low

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



● Band

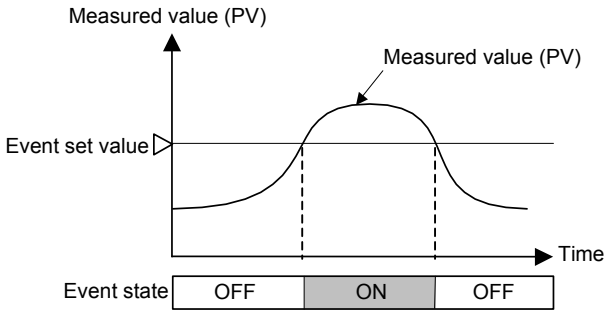
When the absolute deviation (|PV−SV|) is within the event set values, the event state is set up.



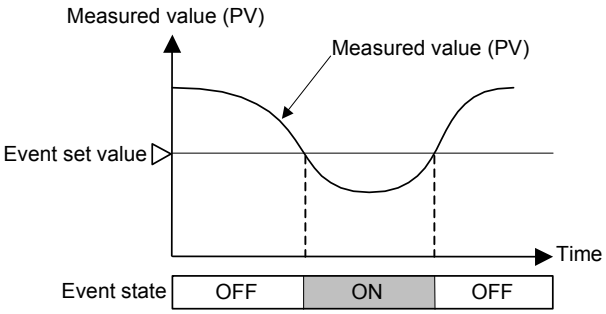
Process:

When the measured value (PV) reaches the event set value, the event state 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)

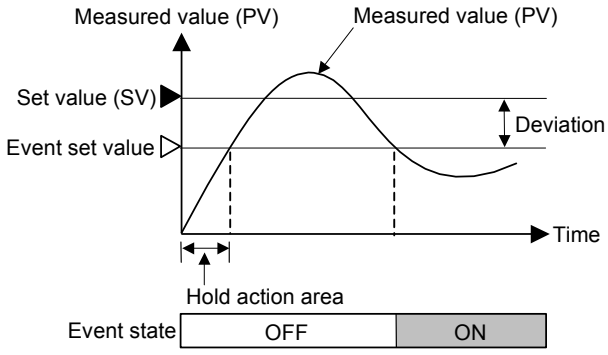
Use to select presence/absence of event hold action.

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
Related parameters: Event set value (P. 105), Event differential gap (P. 156), Event type selection (P. 157), Number of event delay times (P. 160)
Factory set value: 3
Function: Show it to the following hold action and re-hold action.

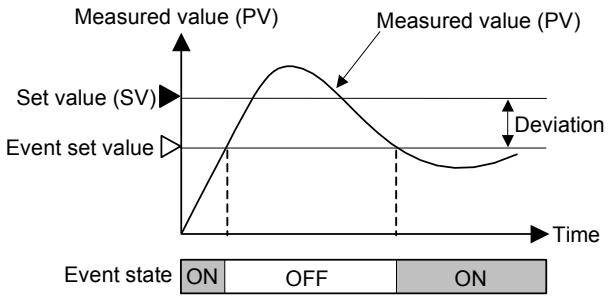
- **Hold action**

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

[With hold action]



[Without hold action]



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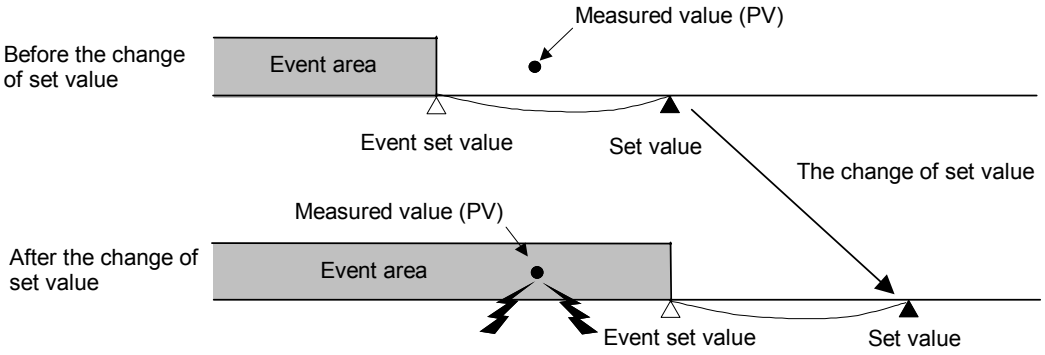
- **Re-hold action**

When re-hold action is ON, the event action is also suppressed at the control set value change as well as start-up and STOP to RUN until the measured value has entered the non-event range.

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



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
Related parameters: Event set value (P. 105), Event differential gap (P. 156), Event type selection (P. 157), Event hold action (P. 159)
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 **5.5 Communication Requirements (P. 20)**.

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
Related parameters: Segment remaining time (P. 137), Pattern end output time (P. 144), Segment time (P. 146), Time signal ON time (P. 148), Time signal OFF time (P. 149)
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
Related parameters: Operation mode (P. 106)
Factory set value: 1

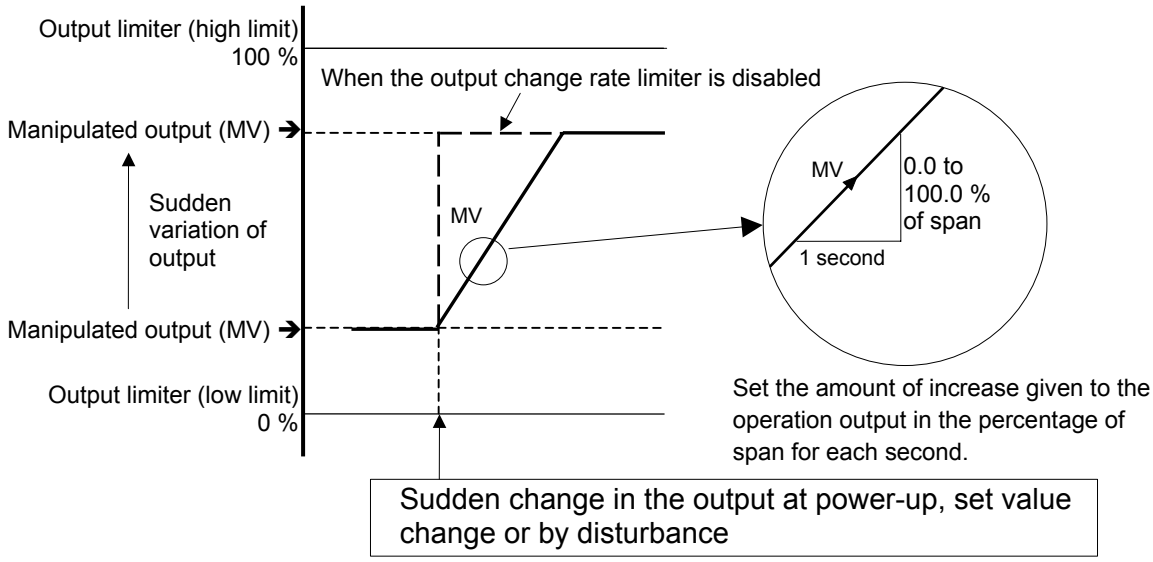
Output change rate limiter (up)	RKC communication identifier	PH
	Modbus register address	ch1: 0882H (2178) ch2: 1882H (6274)
Output change rate limiter (down)	RKC communication identifier	PL
	Modbus register address	ch1: 0883H (2179) ch2: 1883H (6275)

Use to set 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
Related parameters: Manipulated output value (P. 100), Output limiter (high/low) (P. 109)
Factory set value: 0.0
Function: The output change rate limiter limits the variation of manipulated output (MV) per second. This function is suitable for an application in which a sudden MV change is not acceptable.

[Example]
The output change rate limiter is effective.

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



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

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

9.2 Communication Data of DI Module

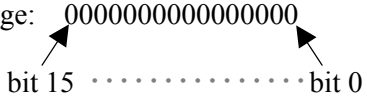
9.2.1 Normal setting data items

Input state of digital input (terminal)	RKC communication identifier	L1
	Modbus register address	2000H (8192)

Digital signals (DI channels 1 to 12) input to the terminal board of the DI module are expressed as bit data.

Attribute: RO (Read only)
Digits: 7 digits
Number of data: 1 (Data of each module)
Data range: 0 to 4095 (bit data)
Input state 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 for RKC communication.

Bit image: 0000000000000000



Bit data: 0: OFF (Contact open)
1: ON (Contact close)

bit 0: DI channel 1	bit 8: DI channel 9
bit 1: DI channel 2	bit 9: DI channel 10
bit 2: DI channel 3	bit 10: DI channel 11
bit 3: DI channel 4	bit 11: DI channel 12
bit 4: DI channel 5	bit 12: Unused
bit 5: DI channel 6	bit 13: Unused
bit 6: DI channel 7	bit 14: Unused
bit 7: DI channel 8	bit 15: Unused

Related parameters: Input state of digital input (connector) 1 (P. 165), Input state of digital input (connector) 2 (P. 165)
Factory set value: —

Input state of digital input (connector) 1	RKC communication identifier	L2
	Modbus register address	2001H (8193)
Input state of digital input (connector) 2	RKC communication identifier	L3
	Modbus register address	2002H (8194)

Digital signals (DI channels 13 to 20 and 21 to 28) input to the connector of the DI module are expressed as bit data.

Attribute: RO (Read only)
Digits: 7 digits
Number of data: 1 (Data of each module)
Data range: 0 to 255 (bit data)
Input state 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 for RKC communication.

Bit image: 0000000000000000
bit 15 ····· bit 0

Bit data: 0: OFF (Contact open)
1: ON (Contact close)

bit 0: DI channel 13 (21)
bit 1: DI channel 14 (22)
bit 2: DI channel 15 (23)
bit 3: DI channel 16 (24)
bit 4: DI channel 17 (25)
bit 5: DI channel 18 (26)
bit 6: DI channel 19 (27)
bit 7: DI channel 20 (28)
bit 8 to 15: Unused
( ): Input state of digital input (connector) 2

Related parameters: Input state of digital input (terminal) (P. 164)
Factory set value: —

This item is valid only when the X-DI-B module is used.

Event LED selection: terminal input (DI channel 1 to 12)	RKC communication identifier	QI
	Modbus register address	ch1: 2620H (9760) ch2: 2621H (9761) ch3: 2622H (9762) ch4: 2623H (9763) ch5: 2624H (9764) ch6: 2625H (9765) ch7: 2626H (9766) ch8: 2627H (9767) ch9: 2628H (9768) ch10: 2629H (9769) ch11: 262AH (9770) ch12: 262BH (9771)

Any EVENT lamp to indicate the input state is selected from DI channels on the terminal board.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 12 (Data of each channel)
Data range: 0: Unused
1: EVENT1 lamp
2: EVENT2 lamp
3: EVENT3 lamp
4: EVENT4 lamp
Related parameters: Event LED selection: connector input (P. 167)
Factory set value: 0: Unused
Function: An EVENT lamp turns on in an input state.
In addition, if several DI channels are assigned to one EVENT lamp, the lamp is lit by the *OR* operation of inputs from each DI channel.

Event LED selection: connector input (DI channel 13 to 28)	RKC communication identifier	QJ
	Modbus register address	ch13: 2630H (9776) ch14: 2631H (9777) ch15: 2632H (9778) ch16: 2633H (9779) ch17: 2634H (9780) ch18: 2635H (9781) ch19: 2636H (9782) ch20: 2637H (9783) ch21: 2638H (9784) ch22: 2639H (9785) ch23: 263AH (9786) ch24: 263BH (9787) ch25: 263CH (9788) ch26: 263DH (9789) ch27: 263EH (9790) ch28: 263FH (9791)

Any EVENT lamp to indicate the input state is selected from DI channels on the connector.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 16 (Data of each channel)
Data range: 0: Unused
1: EVENT1 lamp
2: EVENT2 lamp
3: EVENT3 lamp
4: EVENT4 lamp
Related parameters: Event LED selection: terminal input (P. 166)
Factory set value: 0: Unused
Function: An EVENT lamp turns on in an input state.
In addition, if several DI channels are assigned to one EVENT lamp, the lamp is lit by the *OR* operation of inputs from each DI channel.

For RKC communication, channels 1 to 16 are specified.
Therefore channel 1 is specified to DI channel 13. Hereafter, specify the channel corresponding to the numeric value obtained by subtracting 12 from the actual channel number.

The actual channel number	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
A channel number to set by RKC communication	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

This item is valid only when the X-DI-B module is used.

Error code	RKC communication identifier	ER
	Modbus register address	2600H (9728)

Error state of DI module 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 1 (bit data)
Each error state 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 for RKC communication.

Bit image: 0000000000000000
bit 15 ····· bit 0

bit 0: Backup error
bit 1 to 15: Unused

Bit data: 0: OFF
1: ON

Factory set value: —

Initial setting mode	RKC communication identifier	IN

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

Initial setting mode is valid only when RKC communication is used.

For initial setting data, see **9.2.2 Initial setting data items (P. 169)**.

9.2.2 Initial setting data items

⚠ WARNING

The Initial setting data should be set according to the application before setting any parameter related to operation. Once the Initial setting data is set correctly, those data is not necessary to be changed for the same application under normal conditions. If they are changed unnecessarily, it may result in malfunction or failure of the instrument. RKC will not bear any responsibility for malfunction or failure as a result of improper changes in the Initial setting.

■ 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).

- **Modbus**

For Modbus, setting of initial set data is always possible.

■ Data description

Transmission transfer time setting	RKC communication identifier	ZX
	Modbus register address	287FH (10367)

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 **5.5 Communication Requirements (P. 20)**.

9.3 Communication Data of DO Module

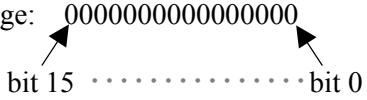
9.3.1 Normal setting data items

Output state of digital output (terminal)	RKC communication identifier	Q1
	Modbus register address	2300H (8960)

Digital signals (DO channels 1 to 12) output from the terminal board of the DO module are expressed as bit data.

Attribute: RO (Read only)
Digits: 7 digits
Number of data: 1 (Data of each module)
Data range: 0 to 4095 (bit data)
Output state 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 for RKC communication.

Bit image: 0000000000000000



Bit data: 0: Output OFF
1: Output ON

bit 0: DO channel 1	bit 8: DO channel 9
bit 1: DO channel 2	bit 9: DO channel 10
bit 2: DO channel 3	bit 10: DO channel 11
bit 3: DO channel 4	bit 11: DO channel 12
bit 4: DO channel 5	bit 12: Unused
bit 5: DO channel 6	bit 13: Unused
bit 6: DO channel 7	bit 14: Unused
bit 7: DO channel 8	bit 15: Unused

Related parameters: Output state of digital output (connector) 1 (P. 171), Output state of digital output (connector) 2 (P. 171)
Factory set value: —

Output state of digital output (connector) 1	RKC communication identifier	Q2
	Modbus register address	2301H (8961)
Output state of digital output (connector) 2	RKC communication identifier	Q3
	Modbus register address	2302H (8962)

Digital signals (DO channels 13 to 20 and 21 to 28) output from the connector of the DO module are expressed as bit data.

Attribute: RO (Read only)
Digits: 7 digits
Number of data: 1 (Data of each module)
Data range: 0 to 255 (bit data)
Output state 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 for RKC communication.

Bit image: 0000000000000000
bit 15 ····· bit 0

Bit data: 0: Output OFF
1: Output ON

bit 0: DO channel 13 (21)
bit 1: DO channel 14 (22)
bit 2: DO channel 15 (23)
bit 3: DO channel 16 (24)
bit 4: DO channel 17 (25)
bit 5: DO channel 18 (26)
bit 6: DO channel 19 (27)
bit 7: DO channel 20 (28)
bit 8 to 15: Unused
( ): Output state of digital output (connector) 2

Related parameters: Output state of digital output (terminal) (P. 170)
Factory set value: —

This item is valid only when the X-DO-B module is used.

Function selection of DO channel 1 to 12 (terminal)	RKC communication identifier	QA
	Modbus register address	ch1: 2440H (9280) ch2: 2441H (9281) ch3: 2442H (9282) ch4: 2443H (9283) ch5: 2444H (9284) ch6: 2445H (9285) ch7: 2446H (9286) ch8: 2447H (9287) ch9: 2448H (9288) ch10: 2449H (9289) ch11: 244AH (9290) ch12: 244BH (9291)

The type of output data on the TIO or DI module are set to channels 1 to 12 of the DO module.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 12 (Data of each channel)
Data range: 0000 to 9999
Upper two digits (Thousands and hundreds digits): Address of TIO module or DI module
Lower two digits (Tens and units digits): Function number of output signal
00: No function

☞ See **Function Number Table (P. 174)**.

In order to prevent malfunctioning, do not set any items other than the address of the TIO or DI module connected. In addition, do not set any function numbers indicated as unused in the Function Number Table (P. 174).

Factory set value: 0000 (No function)

Function selection of DO channel 13 to 28 (connector)	RKC communication identifier	QB
	Modbus register address	ch13: 2450H (9296) ch14: 2451H (9297) ch15: 2452H (9298) ch16: 2453H (9299) ch17: 2454H (9300) ch18: 2455H (9301) ch19: 2456H (9302) ch20: 2457H (9303) ch21: 2458H (9304) ch22 2459H (9305) ch23: 245AH (9306) ch24: 245BH (9307) ch25: 245CH (9308) ch26: 245DH (9309) ch27: 245EH (9310) ch28: 245FH (9311)

The type of output data on the TIO or DI module are set to channels 13 to 28 of the DO module.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 16 (Data of each channel)
Data range: 0000 to 9999
Upper two digits (Thousands and hundreds digits): Address of TIO module or DI module
Lower two digits (Tens and units digits): Function number of output signal
00: No function

☞ See **Function Number Table (P. 174)**.

📖 **In order to prevent malfunctioning, do not set any items other than the address of the TIO or DI module connected. In addition, do not set any function numbers indicated as unused in the Function Number Table (P. 174).**

Factory set value: 0000 (No function)

📖 **For RKC communication, channels 1 to 16 are specified to DO channels 13 to 28 as shown in the following.**

The actual channel number	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
A channel number to set by RKC communication	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

📖 This item is valid only when the X-DO-B module is used.

Function Number Table (TIO module)

Function No.	Contents
00	No function
01	CH1 Burnout output
02	CH1 Event 1 output
03	CH1 Event 2 output
04	CH1 Heater break alarm (HBA) output
05	CH1 Control loop break alarm (LBA) output
06 to 08	Unused
09	CH1 Program end state output
10	CH1 Pattern end output
11	CH1 Wait state output
12 to 16	Unused
17	CH2 Burnout output
18	CH2 Event 1 output
19	CH2 Event 2 output
20	CH2 Heater break alarm (HBA) output
21	CH2 Control loop break alarm (LBA) output
22 to 24	Unused
25	CH2 Program end state output
26	CH2 Pattern end output
27	CH2 Wait state output
28 to 32	Unused
33	CH1 Time signal 1 output
34	CH1 Time signal 2 output
35	CH1 Time signal 3 output
36	CH1 Time signal 4 output
37	CH1 Time signal 5 output
38	CH1 Time signal 6 output

Function No.	Contents
39	CH1 Time signal 7 output
40	CH1 Time signal 8 output
41	CH1 Time signal 9 output
42	CH1 Time signal 10 output
43	CH1 Time signal 11 output
44	CH1 Time signal 12 output
45	CH1 Time signal 13 output
46	CH1 Time signal 14 output
47	CH1 Time signal 15 output
48	CH1 Time signal 16 output
49	CH2 Time signal 1 output
50	CH2 Time signal 2 output
51	CH2 Time signal 3 output
52	CH2 Time signal 4 output
53	CH2 Time signal 5 output
54	CH2 Time signal 6 output
55	CH2 Time signal 7 output
56	CH2 Time signal 8 output
57	CH2 Time signal 9 output
58	CH2 Time signal 10 output
59	CH2 Time signal 11 output
60	CH2 Time signal 12 output
61	CH2 Time signal 13 output
62	CH2 Time signal 14 output
63	CH2 Time signal 15 output
64	CH2 Time signal 16 output
65 to 99	Unused

Function Number Table (DI module)

Function No.	Contents
00	No function
01	DI module CH1 Input state
02	DI module CH2 Input state
03	DI module CH3 Input state
04	DI module CH4 Input state
05	DI module CH5 Input state
06	DI module CH6 Input state
07	DI module CH7 Input state
08	DI module CH8 Input state
09	DI module CH9 Input state
10	DI module CH10 Input state
11	DI module CH11 Input state
12	DI module CH12 Input state
13 to 16	Unused
17	DI module CH13 Input state
18	DI module CH14 Input state

Function No.	Contents
19	DI module CH15 Input state
20	DI module CH16 Input state
21	DI module CH17 Input state
22	DI module CH18 Input state
23	DI module CH19 Input state
24	DI module CH20 Input state
25	DI module CH21 Input state
26	DI module CH22 Input state
27	DI module CH23 Input state
28	DI module CH24 Input state
29	DI module CH25 Input state
30	DI module CH26 Input state
31	DI module CH27 Input state
32	DI module CH28 Input state
33 to 99	Unused

Event LED selection: terminal output (DO channel 1 to 12)	RKC communication identifier	QI
	Modbus register address	ch1: 2620H (9760) ch2: 2621H (9761) ch3: 2622H (9762) ch4: 2623H (9763) ch5: 2624H (9764) ch6: 2625H (9765) ch7: 2626H (9766) ch8: 2627H (9767) ch9: 2628H (9768) ch10: 2629H (9769) ch11: 262AH (9770) ch12: 262BH (9771)

Any EVENT lamp to indicate the output state is selected from DO channels on the terminal board.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 12 (Data of each channel)
Data range: 0: Unused
1: EVENT1 lamp
2: EVENT2 lamp
3: EVENT3 lamp
4: EVENT4 lamp
Related parameters: Event LED selection: connector output (P. 176)
Factory set value: 0: Unused
Function: An EVENT lamp turns on in an output state.
In addition, if several DO channels are assigned to one EVENT lamp, the lamp is lit by the *OR* operation of inputs from each DO channel.

Event LED selection: connector output (DO channel 13 to 28)	RKC communication identifier	QJ
	Modbus register address	ch13: 2630H (9776) ch14: 2631H (9777) ch15: 2632H (9778) ch16: 2633H (9779) ch17: 2634H (9780) ch18: 2635H (9781) ch19: 2636H (9782) ch20: 2637H (9783) ch21: 2638H (9784) ch22: 2639H (9785) ch23: 263AH (9786) ch24: 263BH (9787) ch25: 263CH (9788) ch26: 263DH (9789) ch27: 263EH (9790) ch28: 263FH (9791)

Any EVENT lamp to indicate the output state is selected from DO channels on the connector.

Attribute: R/W (Read and Write)
Digits: 7 digits
Number of data: 16 (Data of each channel)
Data range: 0: Unused
1: EVENT1 lamp
2: EVENT2 lamp
3: EVENT3 lamp
4: EVENT4 lamp
Related parameters: Event LED selection: terminal output (P. 175)
Factory set value: 0: Unused
Function: An EVENT lamp turns on in an output state.
In addition, if several DO channels are assigned to one EVENT lamp, the lamp is lit by the *OR* operation of inputs from each DO channel.

For RKC communication, channels 1 to 16 are specified.
Therefore channel 1 is specified to DO channel 13. Hereafter, specify the channel corresponding to the numeric value obtained by subtracting 12 from the actual channel number.

The actual channel number	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
A channel number to set by RKC communication	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

This item is valid only when the X-DO-B module is used.

Error code	RKC communication identifier	ER
	Modbus register address	2600H (9728)

Error state of DO module 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 1 (bit data)
Each error state 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 for RKC communication.

Bit image: 0000000000000000
bit 15 ····· bit 0

bit 0: Backup error
bit 1 to 15: Unused

Bit data: 0: OFF
1: ON

Factory set value: —

Initial setting mode	RKC communication identifier	IN

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

Initial setting mode is valid only when RKC communication is used.

For initial setting data, see **9.3.2 Initial setting data items (P. 178)**.

9.3.2 Initial setting data items

⚠ WARNING

The Initial setting data should be set according to the application before setting any parameter related to operation. Once the Initial setting data is set correctly, those data is not necessary to be changed for the same application under normal conditions. If they are changed unnecessarily, it may result in malfunction or failure of the instrument. RKC will not bear any responsibility for malfunction or failure as a result of improper changes in the Initial setting.

■ 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).

- **Modbus**

For Modbus, setting of initial set data is always possible.

■ Data description

Transmission transfer time setting	RKC communication identifier	ZX
	Modbus register address	287FH (10367)

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 **5.5 Communication Requirements (P. 20)**.

10. 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	

11. APPENDIX

11.1 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

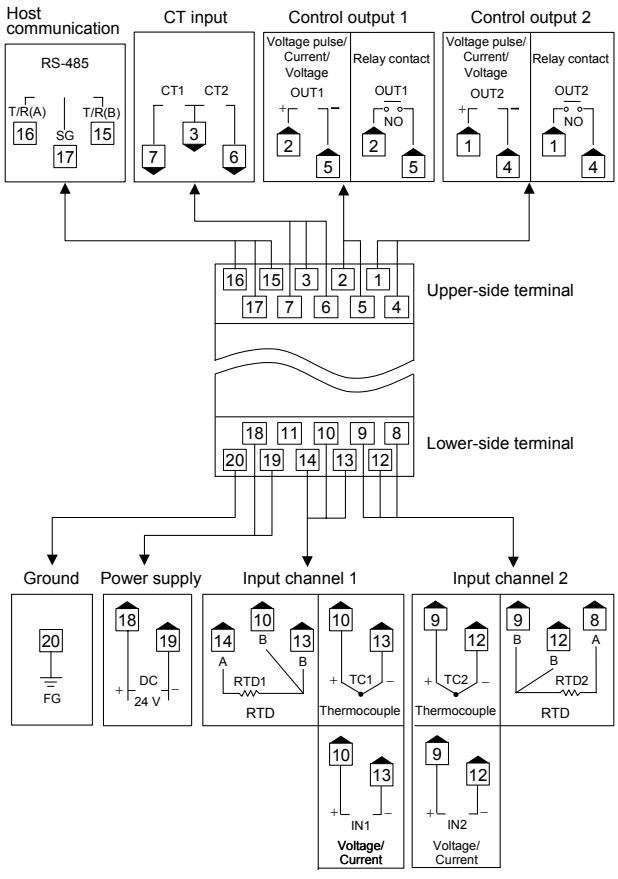
11.2 Terminal Configuration

11.2.1 TIO module

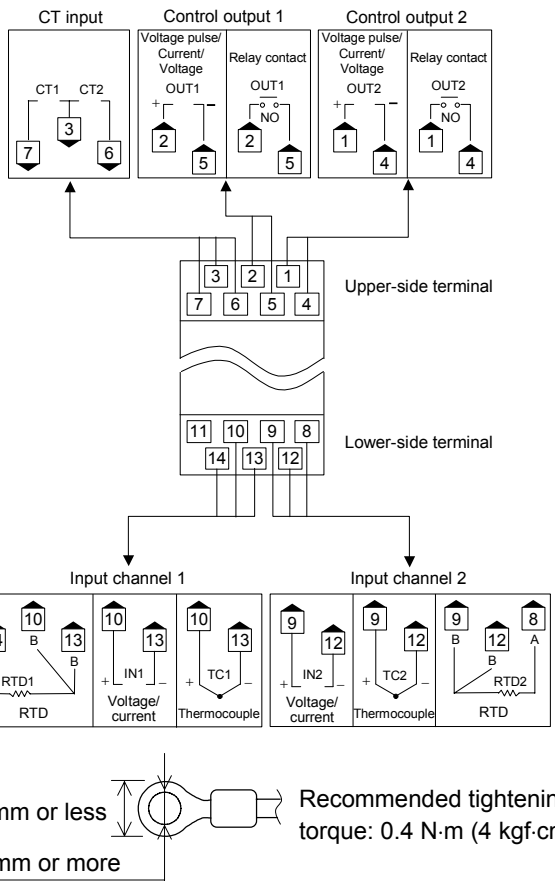
■ Wiring cautions

- 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 type (X-TIO-A)



■ Extension type (X-TIO-B)



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

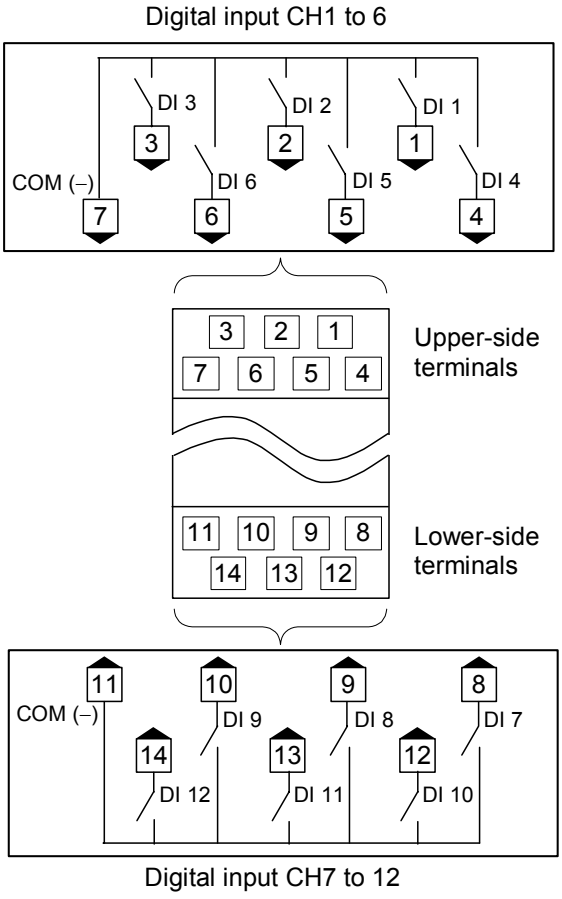
- Terminal No. 11 is not used.
- Input channel 2 can be used as remote setting input (only for voltage/current input). In this case, control output 2 and CT input 2 become unused.
- Use the solderless terminals appropriate to the screw size (M3).

11.2.2 DI module

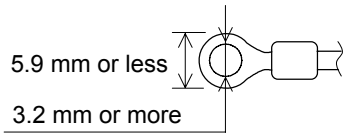
■ Wiring caution

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

■ X-DI-A/X-DI-B (common)

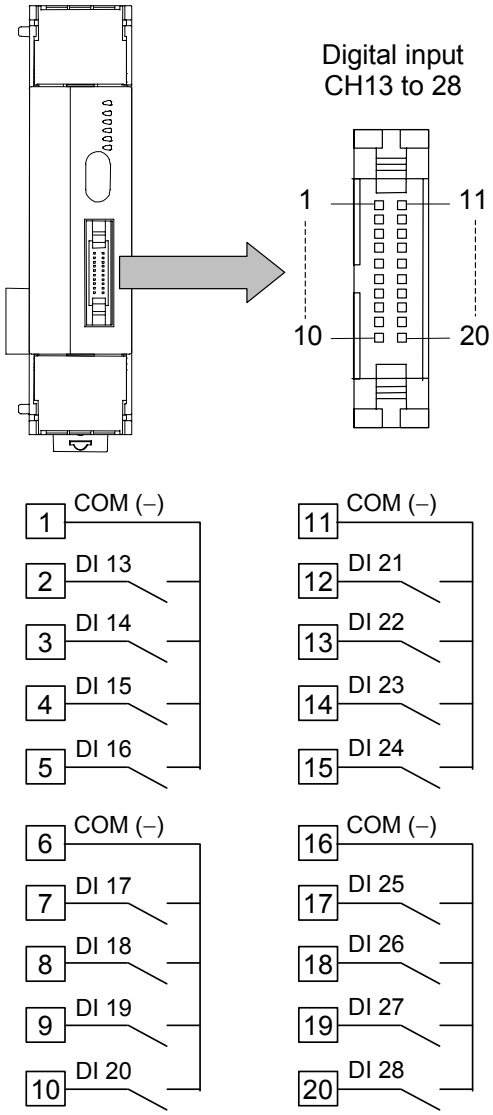


Use the solderless terminals appropriate to the screw size (M3).



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

■ X-DI-B

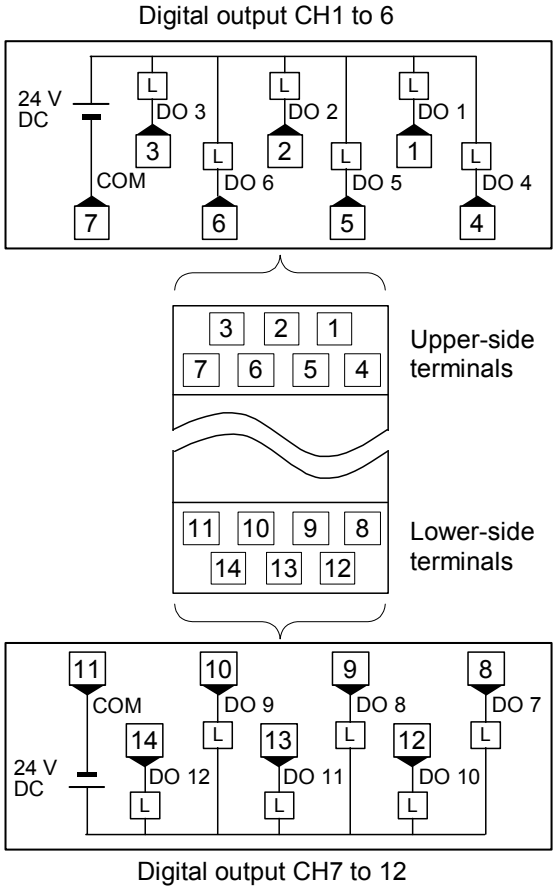


11.2.3 DO module

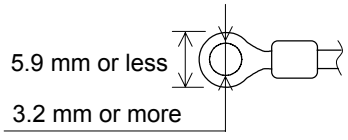
■ Wiring caution

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

■ X-DO-A/X-DO-B (common)

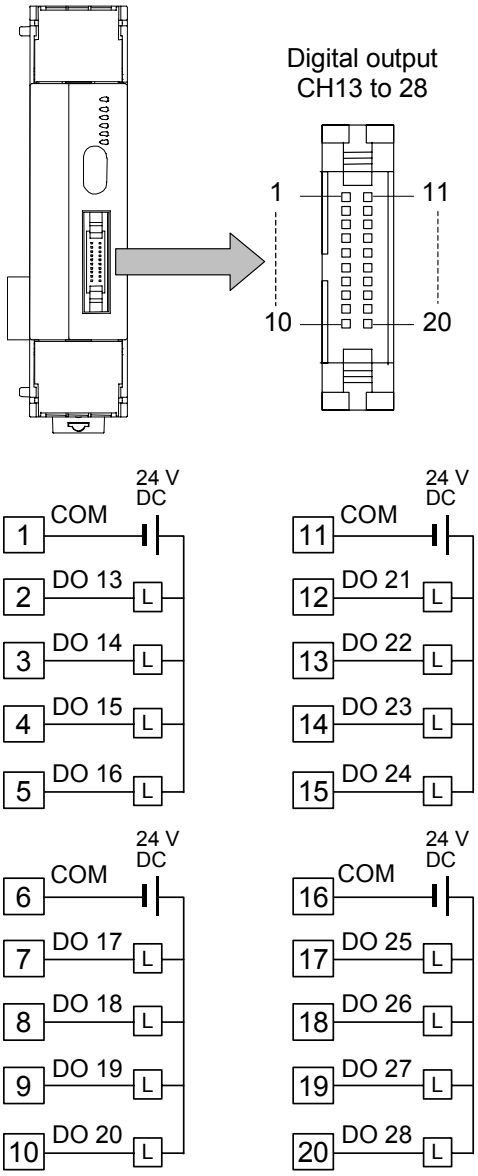


Use the solderless terminals appropriate to the screw size (M3).



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

■ X-DO-B



Pin Nos. 1 and 6, and pin Nos. 11 and 16 are internally connected, respectively.

11.3 Product Specifications

11.3.1 TIO module

■ 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, N (JIS-C1602-1995)
  PLII (NBS)
  W5Re/W26Re (ASTM-E988-96)
  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 and 50 °C of ambient temperature
  ±1.8 °F (Ambient temperature 73.4 °F ±3.6 °F)
  Within ±2.7 °F between 14 and 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: Indicate value near 0 V
Current input
0 to 20 mA, 4 to 20 mA: Indicate value near 0 mA

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 state indication (1 point)
  During normal operation: Green lamp: ON (RUN)
  During error: Red lamp: ON (FAIL)
  During self-diagnostic error: Green lamp: flashing
- Communication state 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 state, Event 2 state, Comprehensive event state, Output state, Control state, Executing segment state, Time signal state

■ 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: −5.0 to +105.0 %
However, the actual output value is 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, Re-hold action
Number of event delay times: 0 to 255 times

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 state: Output the event state 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: 1 to 255 times

HBA state: Output the HBA state 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 state: Output the LBA state as communication data.

■ Comprehensive event state

Event state: Bit data items are expressed in decimal number from 0 to 31.

Burnout:	bit 0
Event 1 state:	bit 1
Event 2 state:	bit 2
Heater break alarm (HBA) state:	bit 3
Control loop break alarm (LBA) state:	bit 4

■ 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 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 state)
  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 state)
  Execute program control.
- Fixed set point control mode (FIX state)
  Execute fixed set point.
- Manual control mode (MAN state)
  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 or 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: −5.0 to +105.0 %
(However, the actual output value is within output limiter range.)

■ 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 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 (RKC communication)
8 (Modbus)
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
Internal communication error:	bit 2
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 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:
Allowable ambient temperature: −10 to +50 °C
Allowable ambient humidity: 5 to 95 %RH (Non condensing)
Absolute humidity:
MAX.W.C 29 g/m^3 dry air at 101.3 kPa

■ 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 type: Approx. 220 g
Extension type: Approx. 190 g

■ Standard

Safety standard:
UL: UL61010A-1
CSA: CAN/CSA-C22.2 No1010.1

CE marking:
LVD: EN61010-1
EMC: EN55011, EN61326-1

C-Tick: AS/NZS 2064 (equivalent to EN55011)

11.3.2 DI module

■ Input

Input type: Dry contact input
Open state: 500 kΩ or more
Close state: 10 Ω or less
Contact current: 3.2 mA TYP.
Voltage at open: Approx. 24 V DC

Number of inputs: X-DI-A: 12 points (6 points/common): Terminal
X-DI-B: 28 points
Terminal: 12 points (6 points/common)
Connector: 16 points (4 points/common)

■ Digital input function

Every temperature control channel can be set.

Program operation mode selection:
RESET, RUN, FIX, MAN, HOLD, STEP

Program pattern selection: PSET, SEL1, SEL2, SEL3, SEL4

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

■ LED display

Number of display: 6 points

Display contents:
Operation: RUN/FAIL lamp
Communication: RX/TX lamp
Event: EVENT1 to 4 lamps

■ Communication function

Number of communications: 1 point

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 (RKC communication)
8 (Modbus)
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

■ General specifications

Power supply: Power supply voltage: 24 V DC
Supplied by TIO module [basic type]
Power supply voltage range: 21.6 to 26.4 V DC
Current consumption: X-DI-A: 115 mA or less/module
X-DI-B: 160 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:
Allowable ambient temperature: −10 to +50 °C
Allowable ambient humidity: 5 to 95 %RH (Non condensing)
Absolute humidity:
MAX.W.C 29 g/m^3 dry air at 101.3 kPa

■ Mounting and structure

Mounting procedure: DIN rail mounting

Case color: Terminal base: Black
Module mainframe: Gray

Dimensions: X-DI-A: 30.0 (W) × 125.0 (H) × 110.0 (D) mm
X-DI-B: 30.0 (W) × 125.0 (H) × 124.3 (D) mm

Weight: X-DI-A: Approx. 150 g
X-DI-B: Approx. 160 g

■ Standard

Safety standard: UL: UL61010A-1
CSA: CAN/CSA-C22.2 No1010.1

CE marking: LVD: EN61010-1
EMC: EN55011, EN61326-1

C-Tick: AS/NZS 2064 (equivalent to EN55011)

11.3.3 DO module

■ Output

Output type: Transistor output (sink type)
Rated load: 24 V DC
Maximum load current: 50 mA/point
ON voltage: 2 V max.

Number of outputs: X-DO-A: 12 points (6 points/common): Terminal
X-DO-B: 28 points
Terminal: 12 points (6 points/common)
Connector: 16 points (4 points/common)

■ Digital output function

The signal of the following can be selected.

TIO module:
Burnout state
Event 1 state
Event 2 state
Heater break alarm (HBA) state
Control loop break alarm (LBA) state
Program end state
Pattern end output
Wait state
Time signal 1 to 16 output state

DI module: Input state of DI module CH1 to 28

■ LED display

Number of display: 6 points

Display contents:
Operation: RUN/FAIL lamp
Communication: RX/TX lamp
Event: EVENT1 to 4 lamps

■ Communication function

Number of communications: 1 point

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 (RKC communication)
8 (Modbus)
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

■ General specifications

Power supply: Power supply voltage: 24 V DC
Supplied by TIO module [basic type]
Power supply voltage range: 21.6 to 26.4 V DC
Current consumption: X-DO-A: 70 mA or less/module
X-DO-B: 90 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:
Allowable ambient temperature: −10 to +50 °C
Allowable ambient humidity: 5 to 95 %RH (Non condensing)
Absolute humidity:
MAX.W.C 29 g/m^3 dry air at 101.3 kPa

■ Mounting and structure

Mounting procedure: DIN rail mounting

Case color: Terminal base: Black
Module mainframe: Gray

Dimensions: X-DO-A: 30.0 (W) × 125.0 (H) × 110.0 (D) mm
X-DO-B: 30.0 (W) × 125.0 (H) × 124.3 (D) mm

Weight: X-DO-A: Approx. 150 g
X-DO-B: Approx. 160 g

■ Standard

Safety standard: UL: UL61010A-1
CSA: CAN/CSA-C22.2 No1010.1

CE marking: LVD: EN61010-1
EMC: EN55011, EN61326-1

C-Tick: AS/NZS 2064 (equivalent to EN55011)

INDEX OF DATA ITEMS

Continued on the next page.

Continued from the previous page.

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RKC INSTRUMENT INC.

HEADQUARTERS: 16-6, KUGAHARA 5-CHOME, OHTA-KU TOKYO 146-8515 JAPAN
PHONE: 03-3751-9799 (+81 3 3751 9799)
E-mail: info@rkcinst.co.jp
FAX: 03-3751-8585 (+81 3 3751 8585)

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