Module Type Controlle r

SRV

PLC/Host Communication Instruction Manual

RKC INSTRUMENT INC.

IMS01P05-E5

- Modbus is a registered trademark of Schneider Electric.
- The name of each programmable controller (PLC) means the products of each manufacturer.
- 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 product is intended for use with industrial machines, test and measuring equipment. It is not designed for use with medical equipment and nuclear energy.
- 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.
- RKC is not responsible for any damage and/or injury resulting from the use of instruments made by imitating this instrument.
- Periodic maintenance is required for safe and proper operation of this instrument. Some components have a limited service life, or characteristics that change over time.
- Every effort has been made to ensure accuracy of all information contained herein. RKC makes no warranty expressed or implied, with respect to the accuracy of the information. The information in this manual is subject to change without prior notice.
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CONTENTS

MEMO

1. OUTLINE

This manual describes communication with the programmable controller (hereafter called the PLC) and host computer when the temperature control module for PLC communication V-TIO-E or V-TIO-E (hereafter called the V-TIO-E/F module) for the module type controller SRV is used.

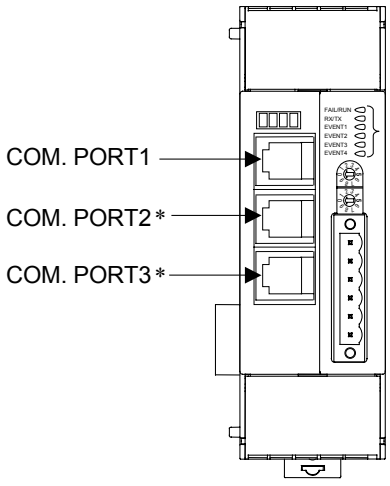
- Three communication ports (COM. PORT1 to 3) of the V-TIO-E/F module can be selected from among the following four assignments. (The communication specification of COM. PORT2 is the same as that of COM. PORT3.)

	Assignment 1	Assignment 2	Assignment 3	Assignment 4
COM. PORT1	Host communication 1	PLC communication	Host communication 1	Host communication 2
COM. PORT2/ COM. PORT3	PLC communication	Host communication 1	Host communication 2	Host communication 1

📖 For host communication 1 or 2, its data bit configuration, communication speed and communication protocol can be independently set.

- Up to 30 temperature control modules (V-TIO-A, B, C or D) can be connected to one V-TIO-E/F module.
- For PLC communication, up to four V-TIO-E/F modules can be multi-drop connected to one PLC communication port. Therefore, temperature control of up to 248 channels per one PLC communication port can be performed.
- For host communication, up to 16 V-TIO-E/F modules can be multi-drop connected to one host communication port. Therefore, temperature control of up to 992 channels per one host communication port can be performed.

☞ For specification, parts description and wiring of the V-TIO-E/F module, see **Temperature Control Module for PLC Communication V-TIO-E/V-TIO-F Instruction Manual (IMS01P04-E□)**.



* As COM. PORT2/COM. PORT3 are internally connected, multi-drop connection is easily made if either of these ports is used.

Communication port of V-TIO-E/F module

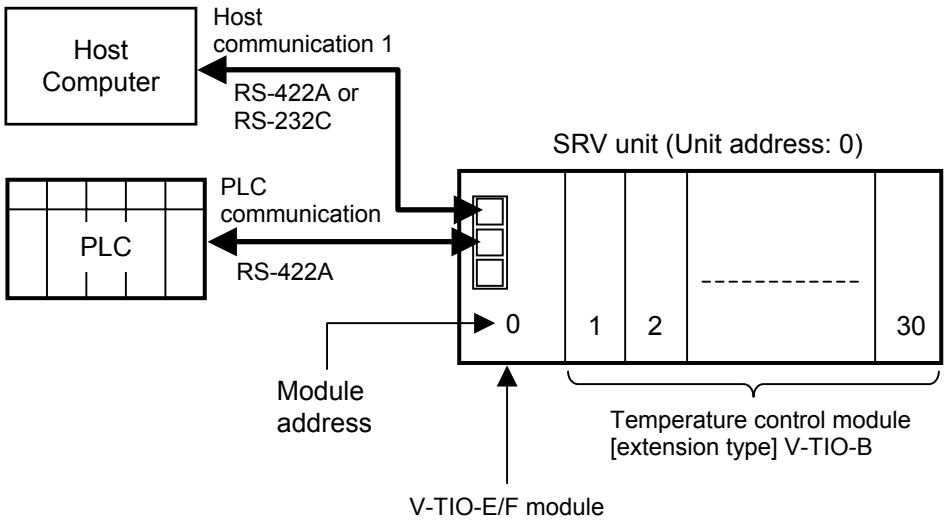
1.1 SRV Unit Configuration

One SRV unit consists of one V-TIO-E/F module and several other temperature control modules.

1.1.1 When one SRV unit is connected

- Up to 30 temperature control modules (V-TIO-A, B, C or D) can be connected to one V-TIO-E/F module with the SRV unit. (Common to PLC communication and host communication)
- As the number of temperature control channels per module is 2, the maximum number of temperature control channels per unit becomes 62. (Including the temperature control channels of the V-TIO-E/F module.)

[Example] When each communication port of the V-TIO-E/F module is assigned as follows.
COM.PORT1: Host communication 1 (RS-422A or RS-232C)
COM.PORT2/3: PLC communication (RS-422A)



Up to 30 temperature control modules can be connected to one V-TIO-E/F module

Number of temperature control channel: 62 CH max.

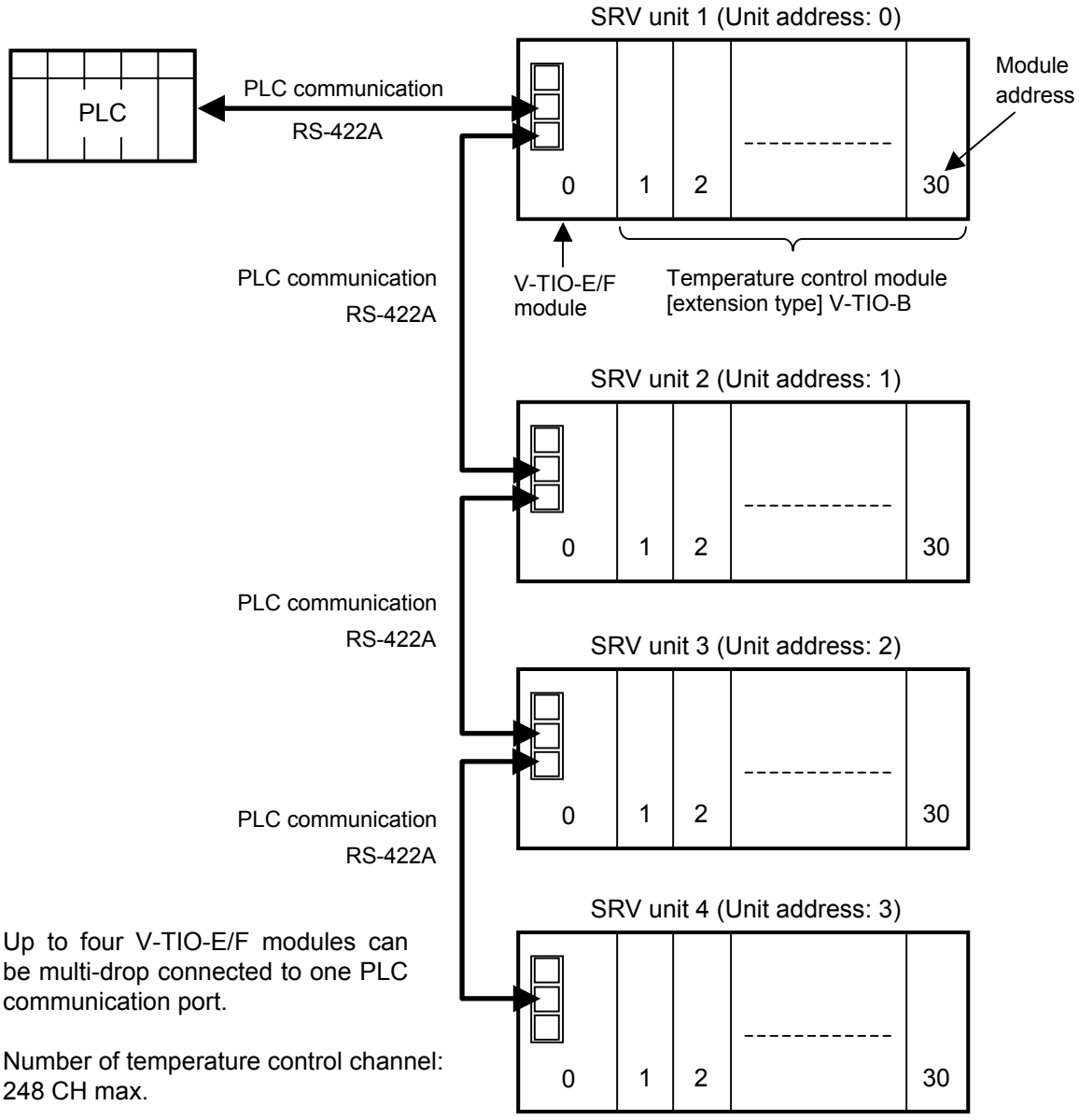
For the communication port assignment, see **4.1 Communication Port Assignments (P. 14)**.

1.1.2 When two or more SRV units are connected

■ Multi-drop connection by PLC communication

For PLC communication, up to four V-TIO-E/F modules (i.e. four SRV units) can be multi-drop connected to one PLC communication port.
In addition, as up to 30 temperature control modules can be connected to one V-TIO-E/F module, temperature control of up to 248 channels can be performed. (Including the temperature control channels of the V-TIO-E/F module.)

[Example] When each communication port of the V-TIO-E/F module is assigned as follows.
COM.PORT1: Host communication 1 (RS-422A or RS-232C)
COM.PORT2/3: PLC communication (RS-422A) [Multi-drop connection]

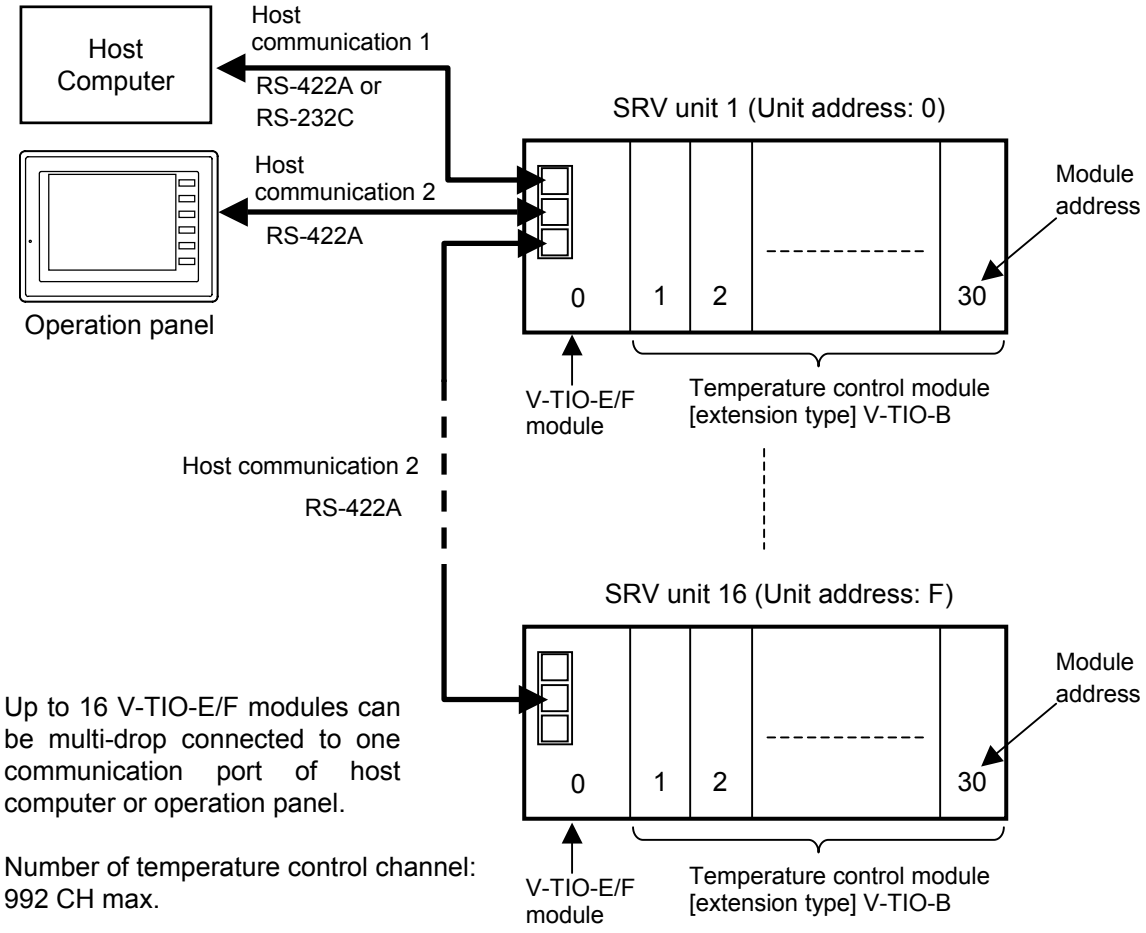


☞ For the communication port assignment, see **4.1 Communication Port Assignments (P. 14)**.

■ Multi-drop connection by host communication

For host communication, up to 16 V-TIO-E/F modules (i.e. 16 SRV units) can be multidrop-connected to one communication port of host computer or operation panel.
In addition, as up to 30 temperature control modules can be connected to one V-TIO-E/F module, temperature control of up to 992 channels can be performed. (Including the temperature control channels of the V-TIO-E/F module.)

[Example] When each communication port of the V-TIO-E/F module is assigned as follows.
COM.PORT1: Host communication 1 (RS-422A or RS-232C)
COM.PORT2/3: Host communication 2 (RS-422A) [Multi-drop connection]



📖 When in the above figure, the host computer connected to COM. PORT1 can communicate only with SRV unit 1.

📖 When connecting the operation panel to the SRV unit, please contact RKC sales office or the agent.

☞ For multi-drop connection using COM. PORT1, see **5.1.2 Wiring (P. 33)** [MITSUBISHI PLC], **5.2.2 Wiring (P. 51)** [OMRON PLC], or **6.2 Wiring (P. 97)** [host communication].

☞ For the communication port assignment, see **4.1 Communication Port Assignments (P. 14)**.

2. COMMUNICATION SPECIFICATIONS

■ PLC communication

Interface:
Based on RS-422A, EIA standard
Based on RS-232C, EIA standard
COM. PORT1: Specify when ordering
COM. PORT2/COM. PORT3: RS-422A (fixed)

Connection method:
RS-422A: 4-wire system, half-duplex multi-drop connection
RS-232C: Point-to-point connection

Synchronous method:
Start/stop synchronous type

Communication speed:
9600 bps, 19200 bps, 38400 bps
Communication speed can be selected with switch

Data bit configuration:
Start bit: 1
Data bit: 7 or 8
Parity bit: Without, Odd or Even
Without for 8 data bits
Stop bit: 1 or 2
Data bit configuration can be selected with switch

Protocol:
- MITSUBISHI MELSEC series special protocol
  −ACPU common command (A series, FX2N, FX2NCseries)
  −AnA/AnUCPU common command (AnA/QnA series, Q series)
- OMRON SYSMAC series special protocol
  C mode command

The protocol can be selected with switch

Maximum connections:
Four modules (V-TIO-E/F) per communication port of PLC
[248 CH max.]

■ Host communication

Interface:
Based on RS-422A, EIA standard
Based on RS-232C, EIA standard
COM. PORT1: Specify when ordering
COM. PORT2/COM. PORT3: RS-422A (fixed)

Connection method:
RS-422A: 4-wire system, half-duplex multi-drop connection
RS-232C: Point-to-point connection

Synchronous method:
Start/stop synchronous type

Communication speed:
2400 bps, 9600 bps, 19200 bps, 38400 bps
Communication speed can be selected with switch

Data bit configuration:
Start bit: 1
Data bit: 7 or 8 (RKC communication)
8 (Modbus)
Parity bit: Without, Odd or Even
Stop bit: 1 or 2
Data bit configuration can be selected with switch

Protocol:
- RKC communication
  Based on ANSI X3.28-1976 subcategory 2.5 B1
  Polling/selecting type
  Error control: Vertical parity (with parity bit selected)
  Horizontal parity (BCC check)
  Data types: ASCII 7-bit code
- Modbus
  Signal transmission mode: Remote Terminal Unit (RTU) mode
  Function codes:
  03H Read holding registers
  06H Preset single register
  08H Diagnostics (loopback test)
  10H Preset multiple registers
  Error check method: CRC-16
  Error codes:
  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

RKC communication or Modbus protocol can be selected with switch

Maximum connections:
RS-422A: 16 modules (V-TIO-E/F) per communication port of host computer [992 CH max.]
RS-232C: One module (V-TIO-E/F) per communication port of host computer [62 CH max.]

■ Internal communication (communication between module)

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:	38400 bps
Data bit configuration:	Start bit: 1 Data bit: 8 Parity bit: Without Stop bit: 1
Protocol:	Modbus
Maximum connections:	30 temperature control module per V-TIO-E/F module The modules can be divided into some groups by using the internal communication terminal.

3. SETTING PROCEDURE TO OPERATION

3.1 When Use PLC Communication and Host Communication

Conduct necessary setting before operation according to the procedure described below.
In beginning execute the following by a state of power supply OFF.

Address setting

Set the unit address and module address

☞ See **4.2 Module Address Setting (P. 19)** and **4.3 Unit Address Setting (P. 22)**.

PLC communication setting

Set the communication speed, data bit configuration, protocol, and communication port.

☞ See **4.1 Communication Port Assignments (P. 14)** and **4.4 Communication Setting Switch (P. 23)**.

Host communication setting

Set the communication speed, data bit configuration and protocol.

☞ See **4.4 Communication Setting Switch (P. 23)**.

Wiring of SRV

Wire a power supply and input/output of SRV.

☞ For the V-TIO-E/F module, see **APPENDIX A.1 Terminal Configuration (P. 163)**. For other modules, see the Instruction Manual of each module.

Connection of communication line

Connect PLC to SRV. For host communication, connect to host computer.

☞ See **5.1.2 Wiring (P. 33)** [MITSUBISHI PLC], **5.2.2 Wiring (P. 51)** [OMRON PLC], or **6.2 Wiring (P. 97)** [Host communication].

Power ON

Turn on the power supply of SRV, PLC and host computer.
The V-TIO-E/F module starts collecting data on each module connected from the time when the power is turned on. At this time, the RUN lamp corresponding to indication lamp 2 flashed at very short intervals.
After data collection is finished and PLC communication becomes enabled *, the RUN lamp keeps lighting and as a result “SRV communication state” is set to 1.

* Time required for enabling PLC communication differs depending on the number of modules connected.

To prevent malfunction, always turn on the power of the SRV last. In addition, if there are two or more SRV units in PLC communication, always turn on the power of the master unit last.

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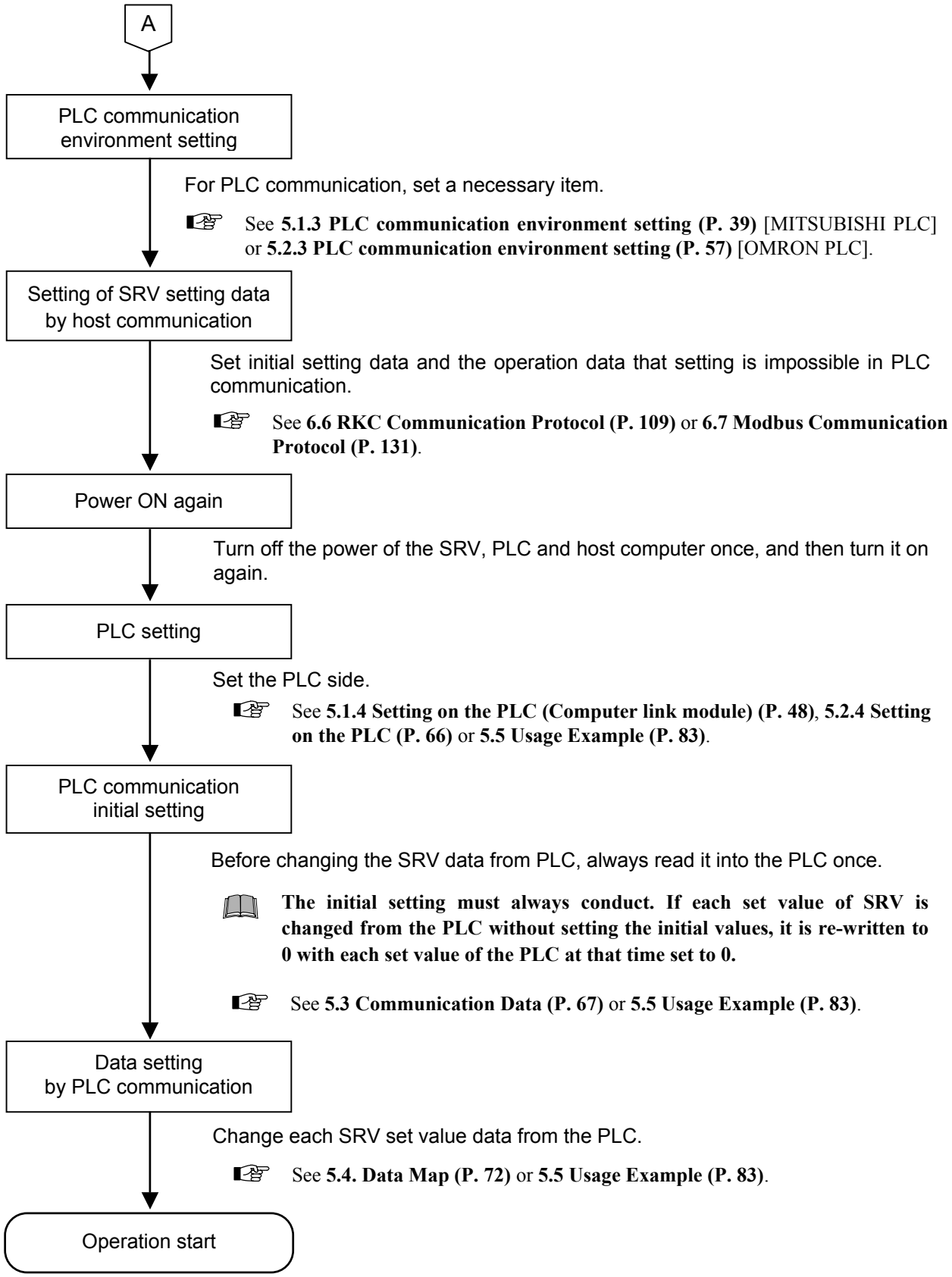
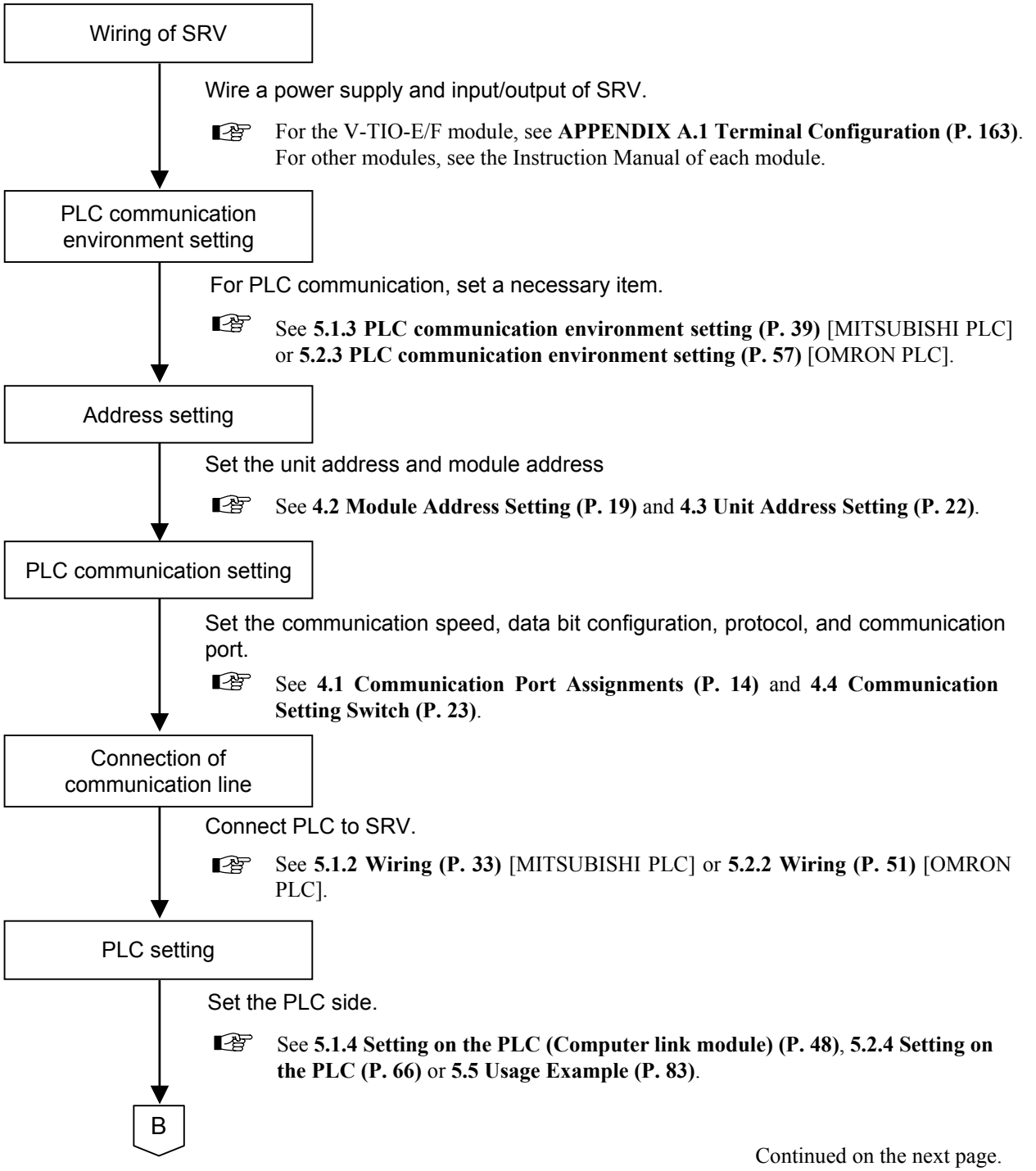


3.2 Only When Use PLC Communication

Conduct necessary setting before operation according to the procedure described below.
In beginning execute the following by a state of power supply OFF.

As some items can be set only via host communication, carefully check them and then conduct host communication, if necessary.

For details of items which can be set only via host communication, see **6.6.4 Communication identifier list (P. 120)** or **6.7.8 Data map (P. 144)**.



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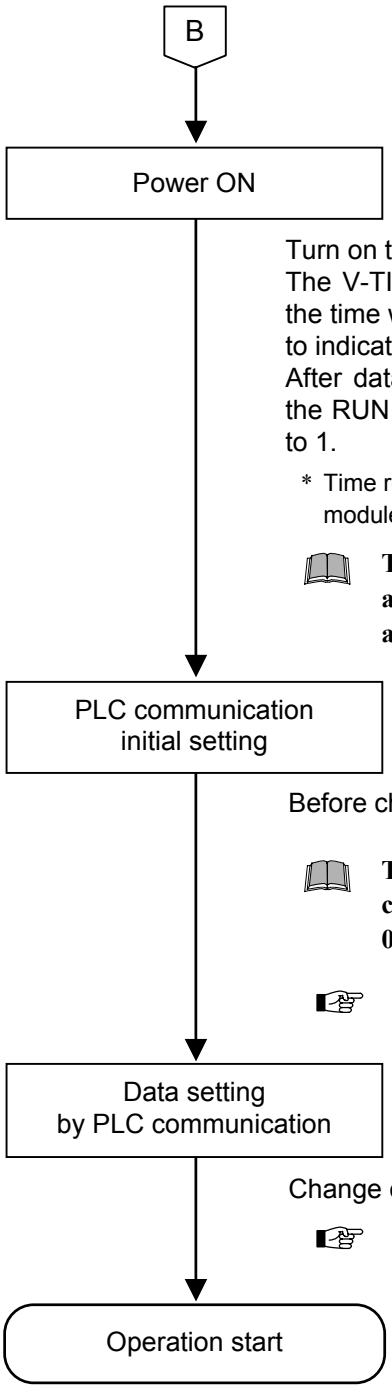


Turn on the power supply of SRV and PLC.
The V-TIO-E/F module starts collecting data on each module connected from the time when the power is turned on. At this time, the RUN lamp corresponding to indication lamp 2 flashed at very short intervals.
After data collection is finished and PLC communication becomes enabled *, the RUN lamp keeps lighting and as a result “SRV communication state” is set to 1.

* Time required for enabling PLC communication differs depending on the number of modules connected.

To prevent malfunction, always turn on the power of the SRV last. In addition, if there are two or more SRV units in PLC communication, always turn on the power of the master unit last.

Before changing the SRV data from PLC, always read it into the PLC once.

The initial setting must always conduct. If each set value of SRV is changed from the PLC without setting the initial values, it is re-written to 0 with each set value of the PLC at that time set to 0.

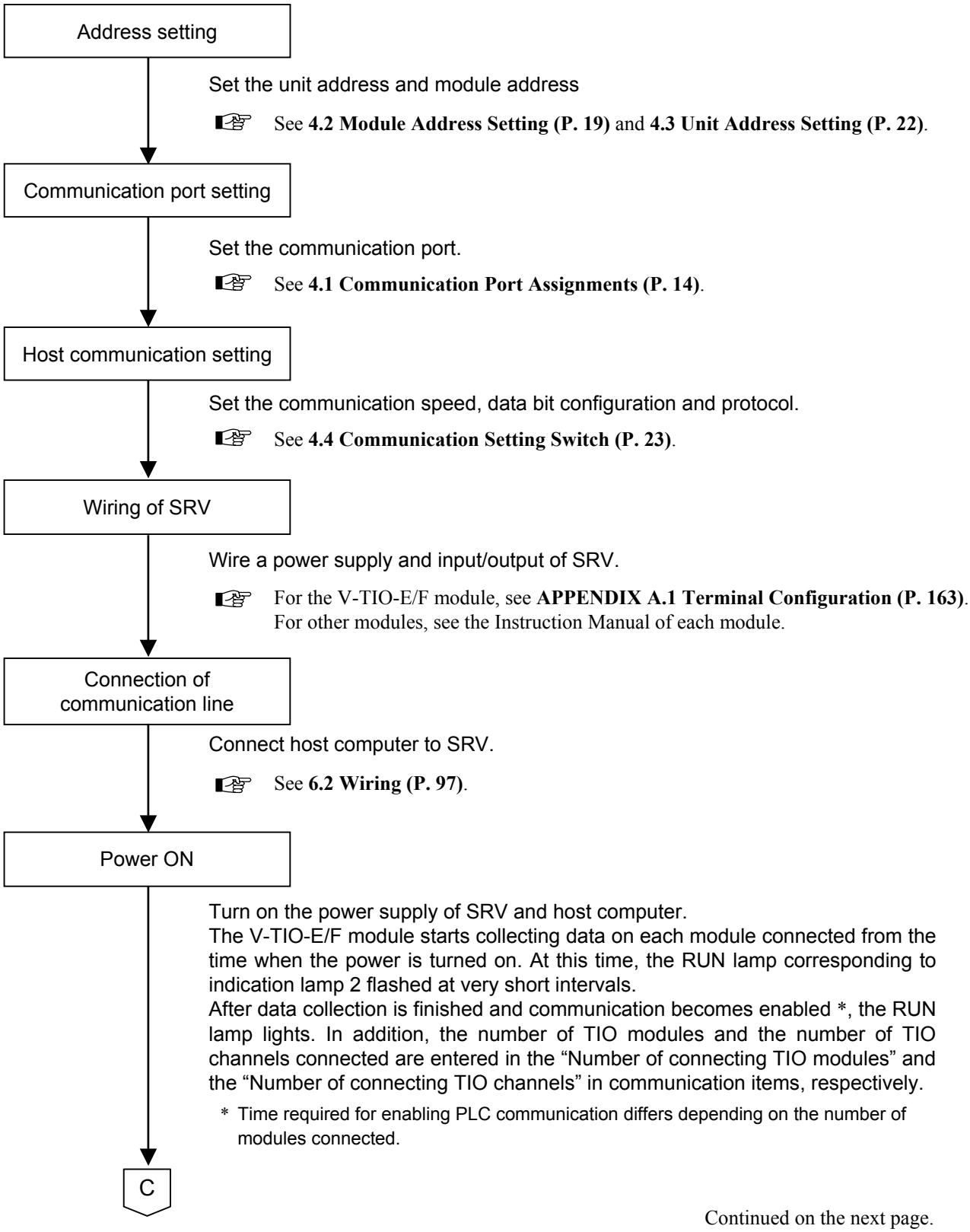
See **5.3 Communication Data (P. 67)** or **5.5 Usage Example (P. 83)**.

Change each SRV set value data from the PLC.

See **5.4. Data Map (P. 72)** or **5.5 Usage Example (P. 83)**.

3.3 Only When Use Host Communication

Conduct necessary setting before operation according to the procedure described below.
In beginning execute the following by a state of power supply OFF.



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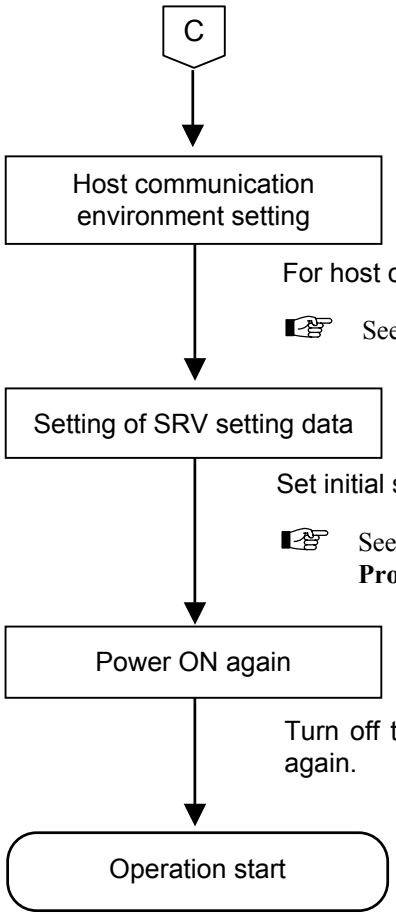


For host communication, set a necessary item.

☞ See **6.3 Host Communication Environment Setting (P. 103)**.

Set initial setting data and the operation data.

☞ See **6.6 RKC Communication Protocol (P. 109)** or **6.7 Modbus Communication Protocol (P. 131)**.

Turn off the power of the SRV and host computer once, and then turn it on again.

4. 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 separated, adjusted data may be destroyed; control be stopped, and no return can be made.

Set the following communication setting before operation.

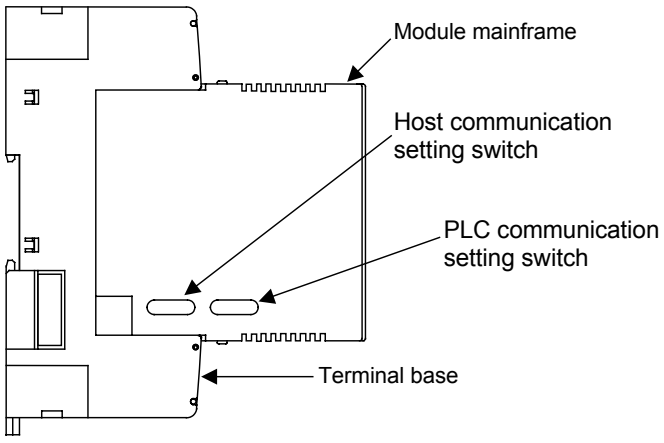
4.1 Communication Port Assignments

Three communication ports (COM. PORT1 to 3) of the V-TIO-E/F module can be selected from among the following four assignments. (The communication specification of COM. PORT2 is the same as that of COM. PORT3.)
In order to assign each communication port, PLC communication setting switches at the left side of the V-TIO-E/F module are used.

- The PLC communication setting switches are used to set the data bit configuration, communication speed and communication protocol of each of "PLC communication" and "Host communication 2." They are also used to select the assigned contents of COM. PORT1 and COM. PORT2/COM. PORT3.
- The host communication setting switches are used to set the data bit configuration, communication speed and communication protocol of "Host communication 1."

COM. PORT Assignment Table

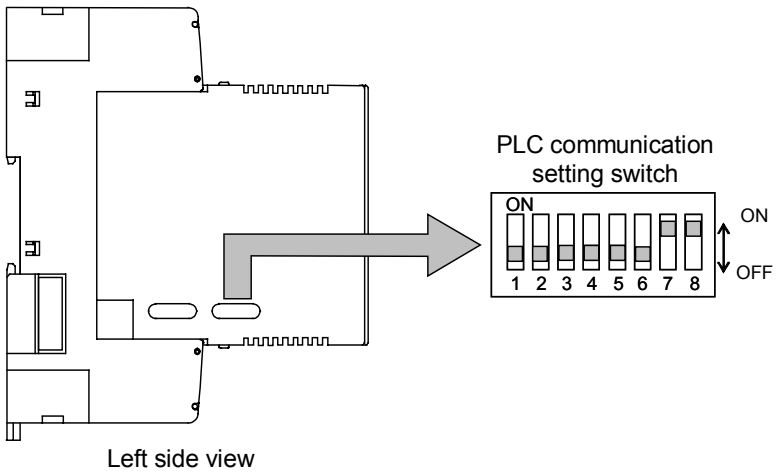
	Assignment 1	Assignment 2	Assignment 3	Assignment 4
COM. PORT1	Host communication 1	PLC communication	Host communication 1	Host communication 2
COM. PORT2/ COM. PORT3	PLC communication	Host communication 1	Host communication 2	Host communication 1



Left side view of V-TIO-E/F module

■ Assignment 1 (COM. PORT1: Host communication 1, COM. PORT2/COM. PORT3: PLC communication)

In order to set assignment 1 (COM. PORT1: Host communication 1, COM. PORT2/COM. PORT3: PLC communication), set the PLC communication setting switches as follows.



- No. 5, No. 6, No. 7: Communication protocol

The PLC communication can be selected from the following three types.

5	6	7	Communication protocol
ON	ON	OFF	PLC communication OMRON SYSMAC series special protocol C mode command (RD/WD)
OFF	OFF	ON	PLC communication MITSUBISHI MELSEC series special protocol ACPU common command (WR/WW) (A series, FX2N, FX2NC series)
ON	OFF	ON	PLC communication MITSUBISHI MELSEC series special protocol AnA/AnUCPU common command (QR/QW) (AnA/QnA series, Q series)

- No. 8: Communication port assignment

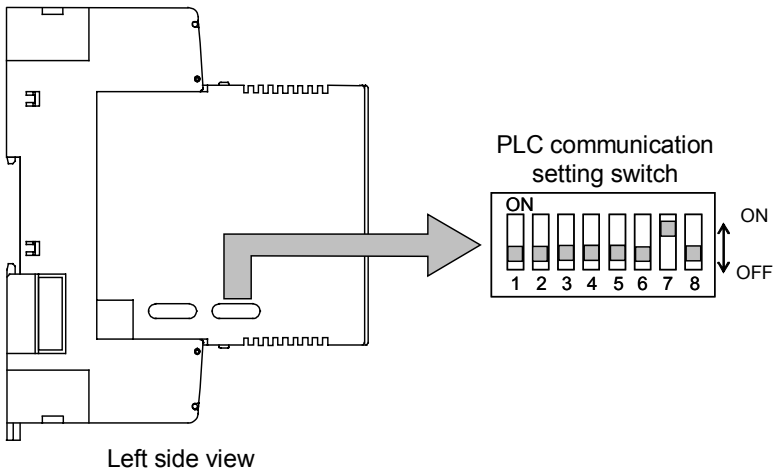
8	Communication port assignment
ON	COM. PORT1: Host communication 1 [RS-232C/RS-422A] COM. PORT2/COM. PORT3: PLC communication [RS-422A]

📖 Switch Nos. 1 to 4 are used to set the data bit configuration and communication speed of PLC communication. Set them to the same values as the PLC connected.

☞ For details of the PLC communication setting switch, see **4.4 Communication Setting Switch (P. 23)**.

■ Assignment 2 (COM. PORT1: PLC communication, COM. PORT2/COM. PORT3: Host communication 1)

In order to set assignment 2 (COM. PORT1: PLC communication, COM. PORT2/COM. PORT3: Host communication 1), set the PLC communication setting switches as follows.



- No. 5, No. 6, No. 7: Communication protocol

The PLC communication can be selected from the following three types.

5	6	7	Communication protocol
ON	ON	OFF	PLC communication OMRON SYSMAC series special protocol C mode command (RD/WD)
OFF	OFF	ON	PLC communication MITSUBISHI MELSEC series special protocol ACPU common command (WR/WW) (A series, FX2N, FX2NC series)
ON	OFF	ON	PLC communication MITSUBISHI MELSEC series special protocol AnA/AnUCPU common command (QR/QW) (AnA/QnA series, Q series)

- No. 8: Communication port assignment

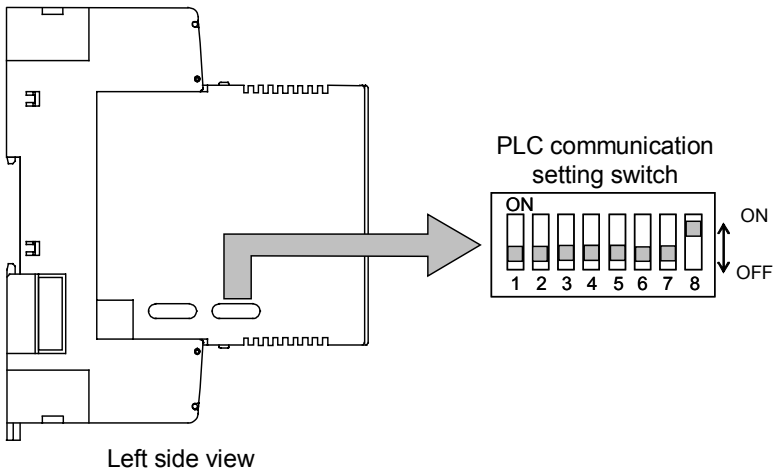
8	Communication port assignment
OFF	COM. PORT1: PLC communication [RS-232C/RS-422A] COM. PORT2/COM. PORT3: Host communication 1 [RS-422A]

📖 Switch Nos. 1 to 4 are used to set the data bit configuration and communication speed of PLC communication. Set them to the same values as the PLC connected.

☞ For details of the PLC communication setting switch, see **4.4 Communication Setting Switch (P. 23)**.

■ Assignment 3 (COM. PORT1: Host communication 1, COM. PORT2/COM. PORT3: Host communication 2)

In order to set assignment 3 (COM. PORT1: Host communication 1, COM. PORT2/COM. PORT3: Host communication 2), set the PLC communication setting switches as follows.



- No. 5, No. 6, No. 7: Communication protocol

The host communication can be selected from the following two types.

5	6	7	Communication protocol
OFF	OFF	OFF	Host communication 2 (RKC communication)
ON	OFF	OFF	Host communication 2 (Modbus)

- No. 8: Communication port assignment

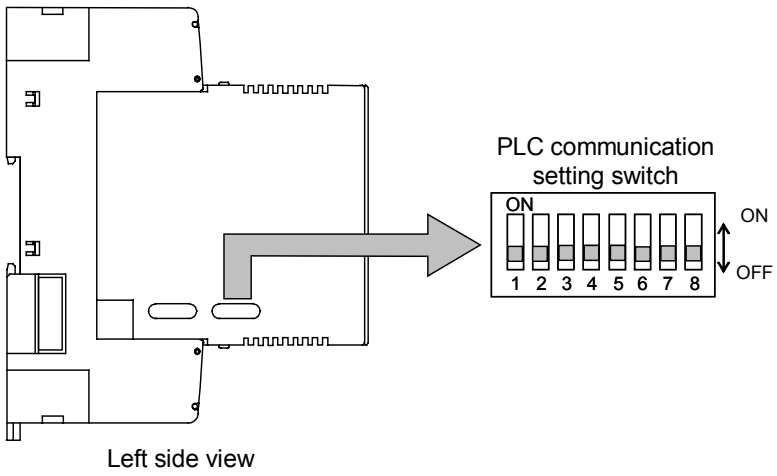
8	Communication port assignment
ON	COM. PORT1: Host communication 1 [RS-232C/RS-422A] COM. PORT2/COM. PORT3: Host communication 2 [RS-422A]

Switch Nos. 1 to 4 are used to set the data bit configuration and communication speed of host communication 2. Set them to the same values as the host computer (or operation panel etc.) connected.

For details of the PLC communication setting switch, see **4.4 Communication Setting Switch (P. 23)**.

■ Assignment 4 (COM. PORT1: Host communication 2, COM. PORT2/COM. PORT3: Host communication 1)

In order to set assignment 4 (COM. PORT1: Host communication 2, COM. PORT2/COM. PORT3: Host communication 1), set the PLC communication setting switches as follows.



- No. 5, No. 6, No. 7: Communication protocol

The host communication can be selected from the following two types.

5	6	7	Communication protocol
OFF	OFF	OFF	Host communication 2 (RKC communication)
ON	OFF	OFF	Host communication 2 (Modbus)

- No. 8: Communication port assignment

8	Communication port assignment
OFF	COM. PORT1: Host communication 2 [RS-232C/RS-422A] COM. PORT2/COM. PORT3: Host communication 1 [RS-422A]

Switch Nos. 1 to 4 are used to set the data bit configuration and communication speed of host communication 2. Set them to the same values as the host computer (or operation panel etc.) connected.

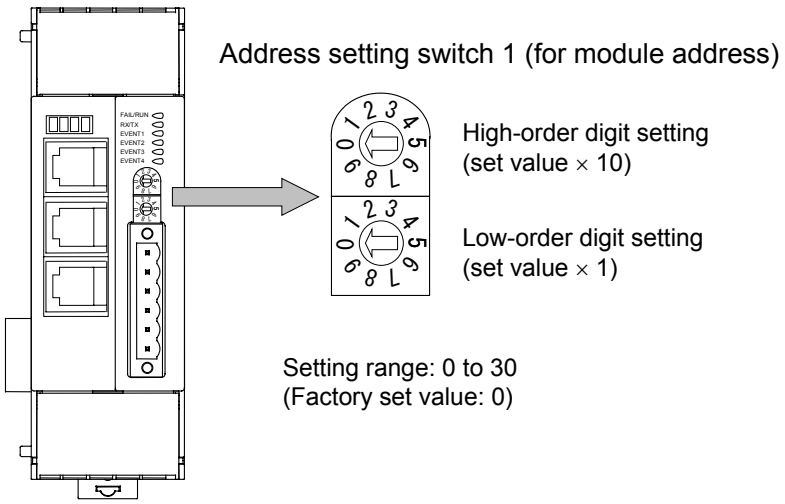
For details of the PLC communication setting switch, see **4.4 Communication Setting Switch (P. 23)**.

4.2 Module Address Setting

When using two or more modules, set the desired address to each module.
(PLC communication / host communication is common)
Module address setting differs depending on operation mode selection address settings.

☞ See ■ **Address settings (P. 20)**.

Set the module address by address setting switch 1 of front of module. For this setting, use a small blade screwdriver.



To avoid problems or malfunction, do not duplicate an address on the same communication line.
However, when a unit address is different, can set the same module address.

The above figure is V-TIO-E/F module. The figure of other module is the same as a V-TIO-E/F module.

■ Address settings

Addresses are set by either of free and continuous settings.

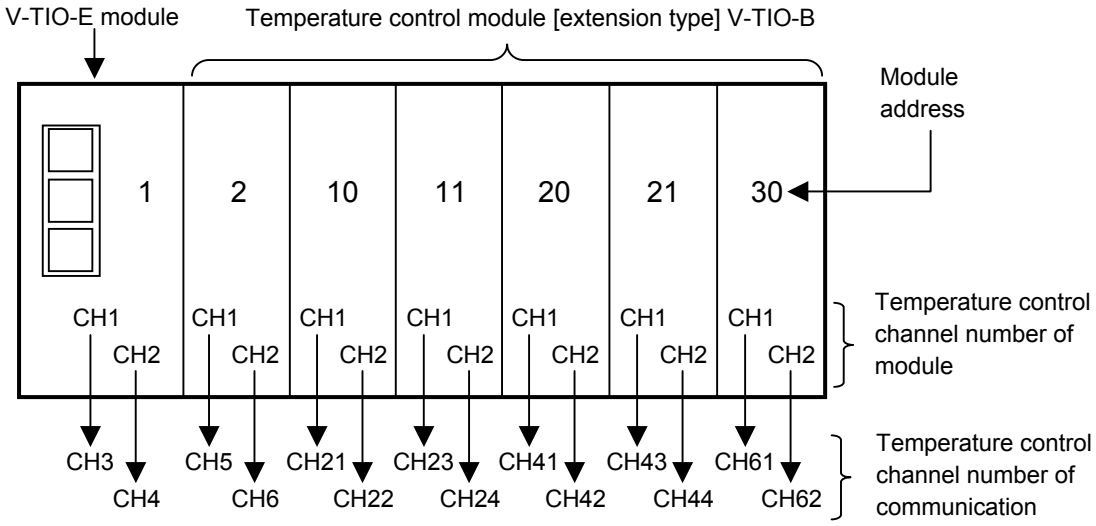
● Free setting

When in the free setting, any numbers from 0 to 30 can be freely set. In addition, to each module address, the relevant temperature control channel is assigned. Each temperature control channel number can be calculated from the following equation.

Temperature control channel number of communication

= (Module address × 2) + Temperature control channel number of module

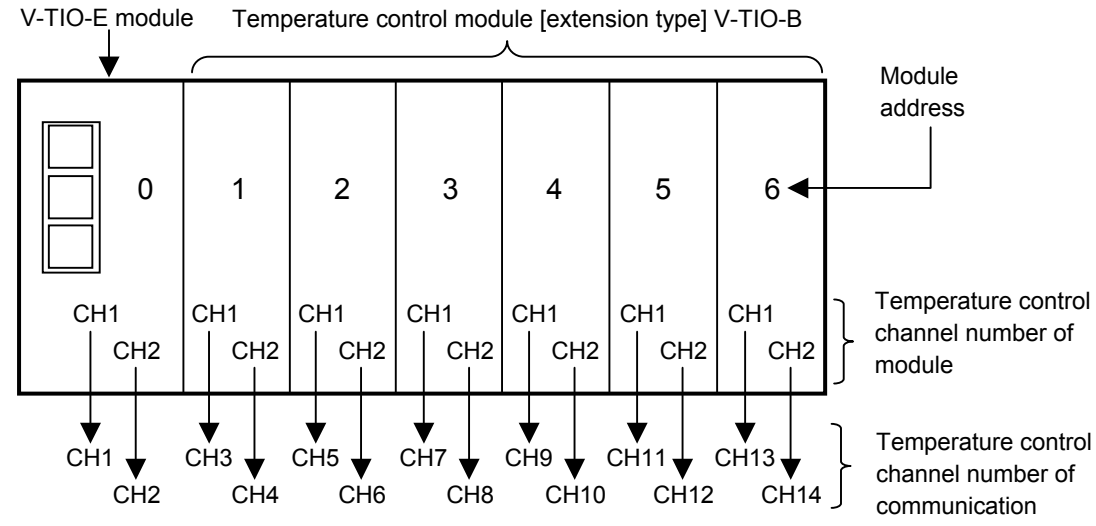
[Setting example]



● Continuous setting

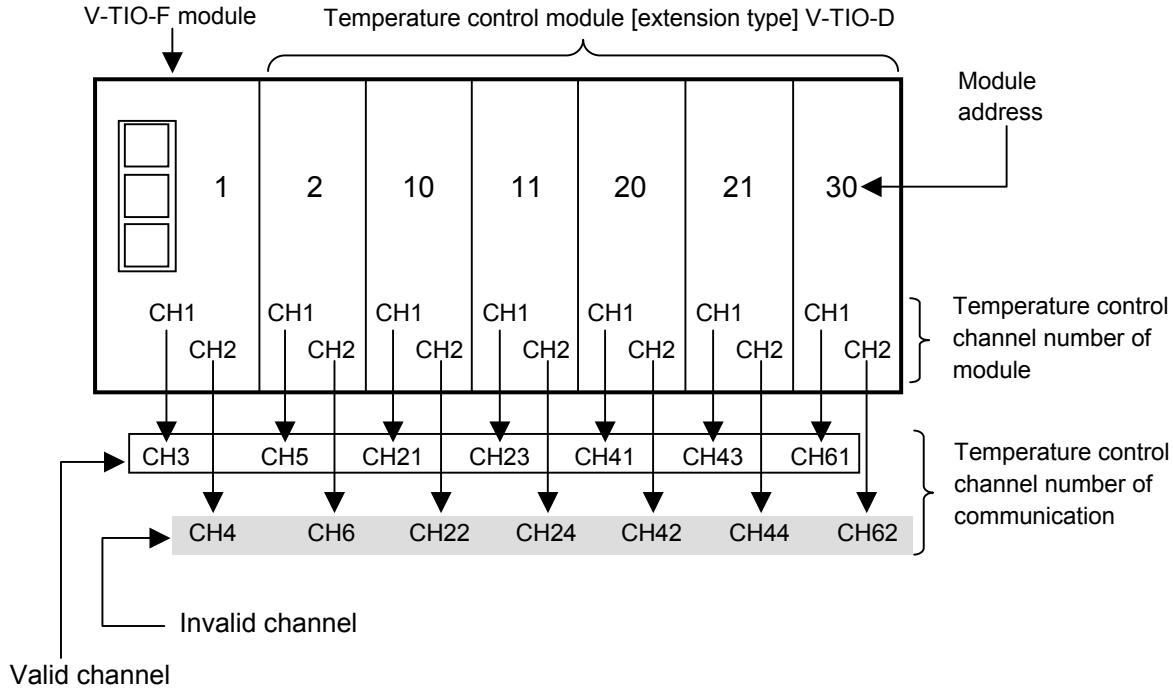
When in the continuous setting, set the V-TIO-E/F module address to 0 and also set other module addresses to consecutive numbers starting from 1. In addition, each temperature control channel number is automatically assigned in order of smaller module address number.

[Setting example]



For heat/cool control, data in the second channel of each module becomes invalid.

[Example] If module addresses of one V-TIO-F module and six V-TIO-D modules which are heat/cool temperature control modules are set as follows by the free setting, data in odd channels is used because data in even channels is invalid.
Valid channel number: 3, 5, 21, 23, 41, 43, 61
Invalid channel number: 4, 6, 22, 24, 42, 44, 62



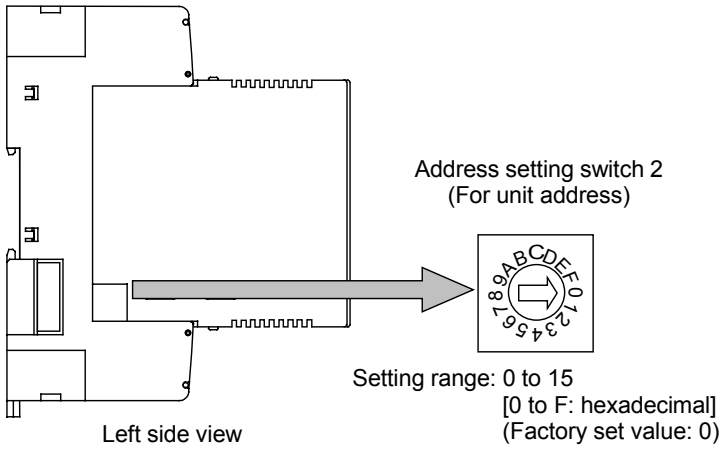
Prior to factory shipment, the module is set to "free setting" which is one of operation mode selection address settings.

When in the free setting, regardless of the number of modules connected when the power is turned on, much time is required until module recognition operation comes to an end compared to the continuous setting as this operation is performed to addresses from 0 to 30.

For operation mode selection address settings, see **5.1.3 PLC communication environment setting (P. 39)** [MITSUBISHI PLC], **5.2.3 PLC communication environment setting (P. 57)** [OMRON PLC] or **6.3 Host communication environment setting (P. 103)**.

4.3 Unit Address Setting

When two or more V-TIO-E/F modules are multi-drop connected, set an address to each V-TIO-E/F module. This becomes the unit address of the SRV unit. (Common to PLC communication/host communication)
Set the unit address by address setting switch 2 of left side of module. For this setting, use a small blade screwdriver.



To avoid problems or malfunction, do not duplicate an address on the same communication line.

■ PLC communication

Up to four V-TIO-E/F modules can be connected to a PLC communication port. Therefore the unit address uses the four V-TIO-E/F modules as a group. For V-TIO-E/F modules which are multi-drop connected to the same PLC communication port, use successive numbers assigned to any one of four groups shown in the following table as their addresses.

Always set the unit address of each group including 0, 4, 8 or C. 0, 4, 8 or C becomes the master for communication transfer.

Group	Address setting switch 2
Group 1	0
	1
	2
	3
Group 2	4
	5
	6
	7

Group	Address setting switch 2
Group 3	8
	9
	A
	B
Group 4	C
	D
	E
	F

■ Host communication

Differently from PLC communication, there are no group restrictions. Free settings can be made in the range of 0 to F.

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

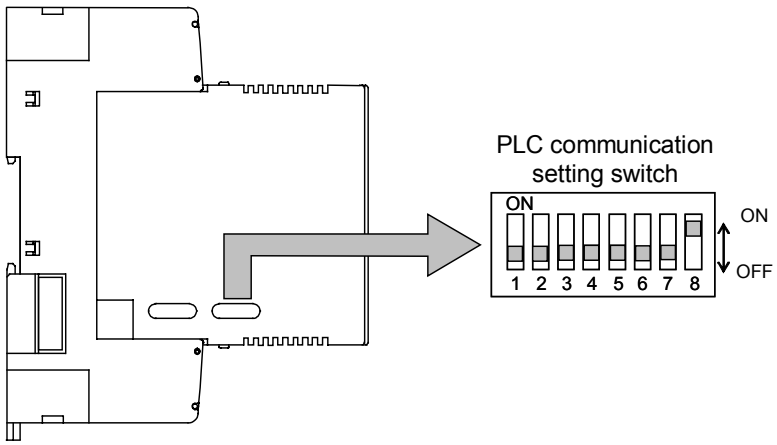
4.4 Communication Setting Switch

■ PLC communication setting switch

The PLC communication setting switches are used to set the data bit configuration, communication speed and communication protocol of each of "PLC communication" and "Host communication 2." They are also used to select the assigned contents of COM. PORT1 and COM. PORT2/COM. PORT3.

Set the same contents as communication speed, data bit configuration and communication protocol of PLC or host computer (operation panel).

When two or more V-TIO-E/F modules are multi-drop connected, set the PLC communication setting switches in all of the V-TIO-E/F modules to the same positions.



Left side view

1	2	Data bit configuration	
OFF	OFF	Data 8-bit, Without parity, Stop 1-bit	← Factory set value
ON	OFF	Data 7-bit *, Odd parity, Stop 1-bit	
OFF	ON	Data 7-bit *, Even parity, Stop 1-bit	
ON	ON	Data 7-bit *, Even parity, Stop 2-bit	

* To be changed to data 8-bit only when "Host communication 2 (Modbus)" is selected.

Continued on the next page.

Continued from the previous page.

3	4	Communication speed
OFF	OFF	9600 bps
ON	OFF	19200 bps
OFF	ON	38400 bps
ON	ON	Do not set this one

← Factory set value

5	6	7	Communication protocol
OFF	OFF	OFF	Host communication 2 (RKC communication)
ON	OFF	OFF	Host communication 2 (Modbus)
OFF	ON	OFF	Do not set this one
ON	ON	OFF	PLC communication OMRON SYSMAC series special protocol C mode command (RD/WD)
OFF	OFF	ON	PLC communication MITSUBISHI MELSEC series special protocol ACPU common command (WR/WW) (A series, FX2N, FX2NC series)
ON	OFF	ON	PLC communication MITSUBISHI MELSEC series special protocol AnA/AnUCPU common command (QR/QW) (AnA/QnA series, Q series)
OFF	ON	ON	Do not set this one
ON	ON	ON	Do not set this one

← Factory set value

8	Communication port assignment
OFF	COM. PORT1: PLC communication/Host communication 2 [RS-232C/RS-422A] COM. PORT2/COM. PORT3: Host communication 1 [RS-422A]
ON	COM. PORT1: Host communication 1 [RS-232C/RS-422A] COM. PORT2/COM. PORT3: PLC communication/Host communication 2 [RS-422A]

← Factory set value

COM. PORT2 and COM. PORT3 become the same communication specification.

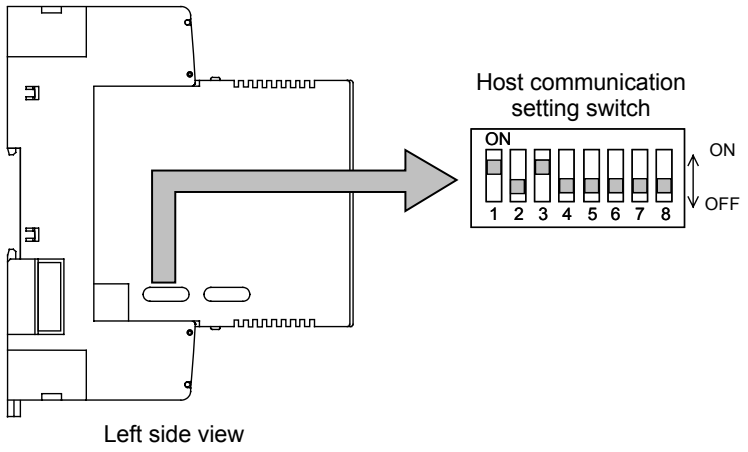
■ Host communication setting switch

The host communication setting switches are used to set the data bit configuration, communication speed and communication protocol of "Host communication 1."

Switch No. 7 and 8 must be always OFF. Do not set to ON.

Set the same contents as communication speed, data bit configuration and communication protocol of host computer.

When two or more V-TIO-E/F modules are multi-drop connected, for switch Nos.1 to 6 set the host communication setting switches in all of the V-TIO-E/F modules to the same positions.



Left side view

1	2	Communication speed	
OFF	OFF	2400 bps	
ON	OFF	9600 bps	← Factory set value
OFF	ON	19200 bps	
ON	ON	38400 bps	

3	4	5	Data bit configuration	
OFF	OFF	OFF	Data 7-bit, Without parity, Stop 1-bit *	
OFF	OFF	ON	Data 7-bit, Even parity, Stop 1-bit *	
OFF	ON	OFF	Do not set this one	
OFF	ON	ON	Data 7-bit, Odd parity, Stop 1-bit *	
ON	OFF	OFF	Data 8-bit, Without parity, Stop 1-bit	← Factory set value
ON	OFF	ON	Data 8-bit, Even parity, Stop 1-bit	
ON	ON	OFF	Do not set this one	
ON	ON	ON	Data 8-bit, Odd parity, Stop 1-bit	

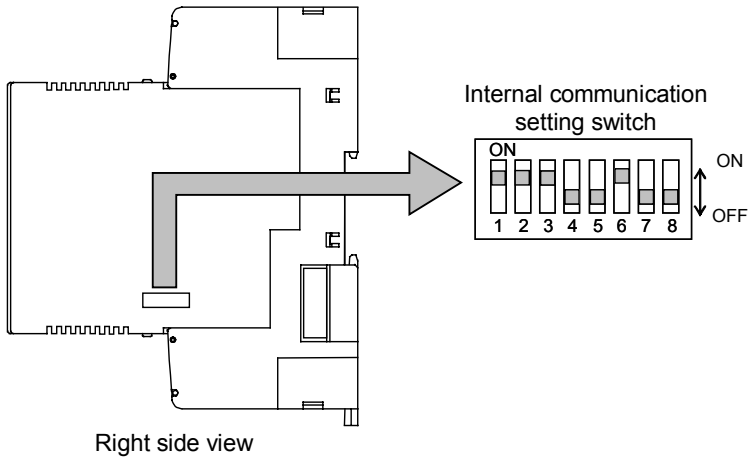
* When the Modbus communication protocol selected, this setting becomes invalid.

6	Communication protocol	
OFF	Host communication 1 (RKC communication)	← Factory set value
ON	Host communication 1 (Modbus)	

■ Internal communication setting switch

The internal communication setting switch at the right side of the V-TIO-E/F module enables all of the internal communication speed, data bit configuration and communication protocol settings. However, **use the same setting as the factory set values**.

[Factory set value]
- Communication speed: 38400 bps
- Data bit configuration: Data 8-bit, Without parity, Stop 1-bit
- Protocol: Modbus



[Factory set value of internal communication setting switch]

Internal communication setting switch		Setting contents
1	ON	Communication speed: 38400 bps
2	ON	
3	ON	Data bit configuration: Data 8-bit Without parity Stop 1-bit
4	OFF	
5	OFF	
6	ON	Communication protocol: Modbus
7	OFF	OFF fixed (Do not change this one)
8	OFF	OFF fixed (Do not change this one)

When connecting two or more modules (V-TIO-B, etc.) to the V-TIO-E/F module, match all of their communication speed, data bit configuration and communication protocol settings with the internal settings of the V-TIO-E/F module.

For details of the internal communication setting switch, see **APPENDIX A.4 Internal Communication Setting (P. 167)**.

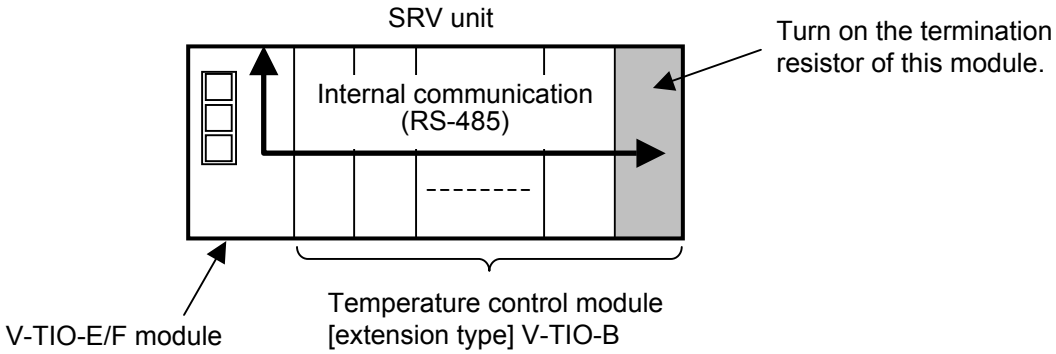
4.5 Termination Resistor Setting of Internal communication

Procedure for setting a termination resistor to internal communication (RS-485) and its setting position are described in the following.

4.5.1 Termination resistor setting position

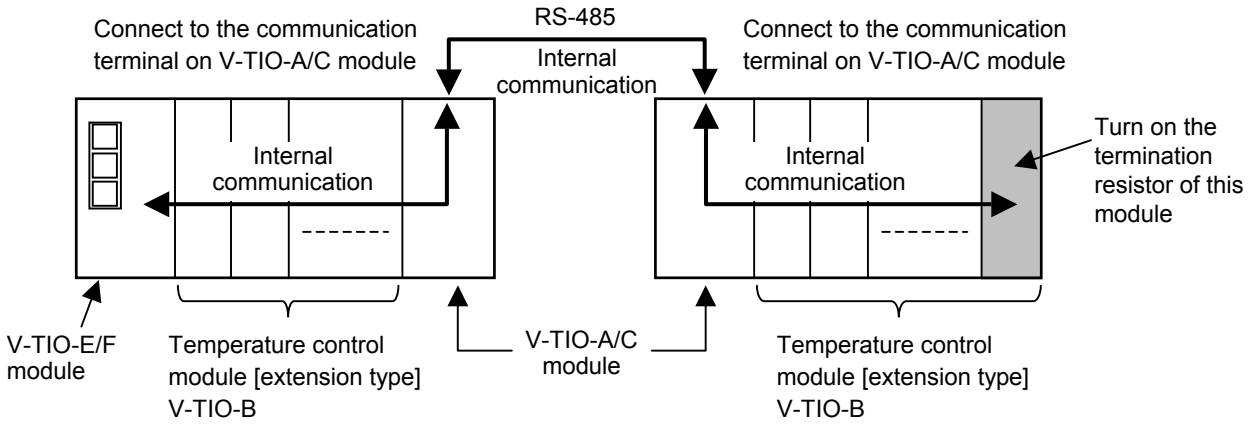
■ When two or more temperature control modules [extension type] are connected to one V-TIO-E/F module

Set a termination resistor to the communication line termination in the module located in the position farthermost from the V-TIO-E/F module.



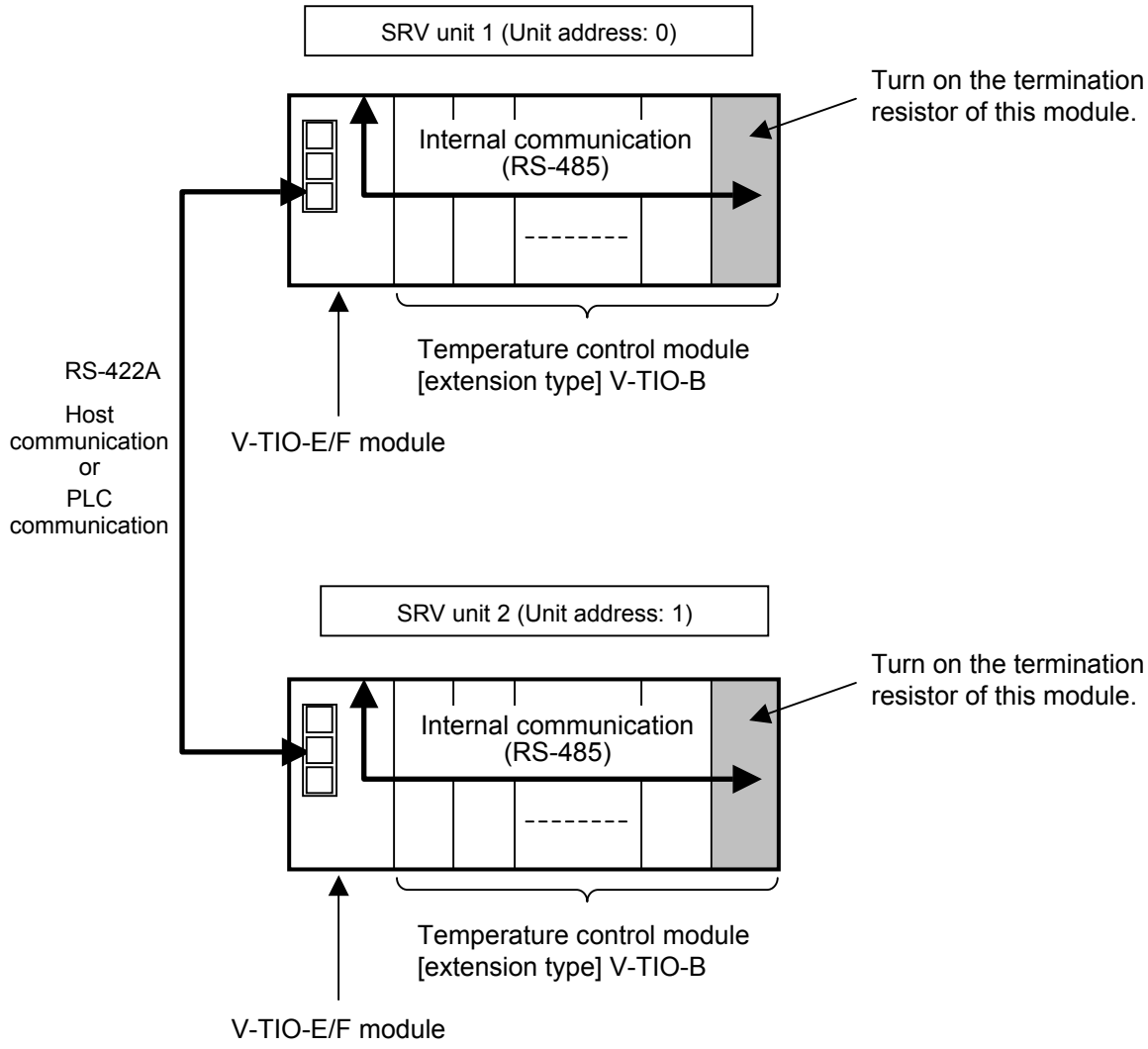
■ When the modules divided into some groups

Even when connecting the modules divided into some groups, set a termination resistor to the communication line termination in the module located in the position farthermost from the V-TIO-E/F module.



■ When two or more SRV units are connected

Set termination resistor every SRV unit. Set a termination resistor to the internal communication line termination in the module located in the position farthermost from the V-TIO-E/F module in each unit.

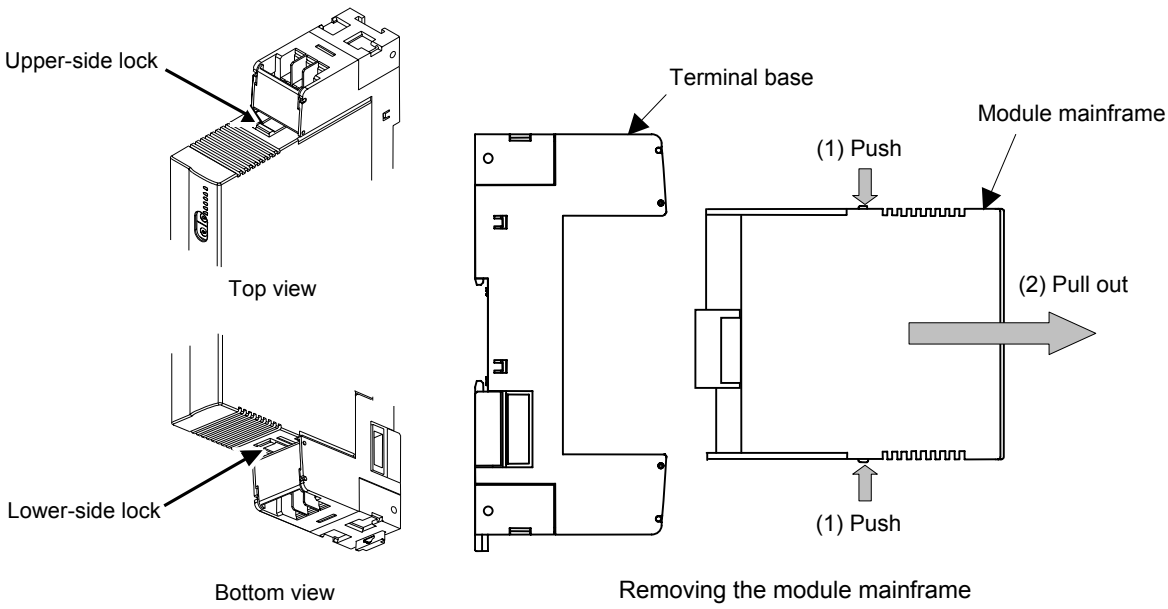


4.5.2 Setting procedure of termination resistor

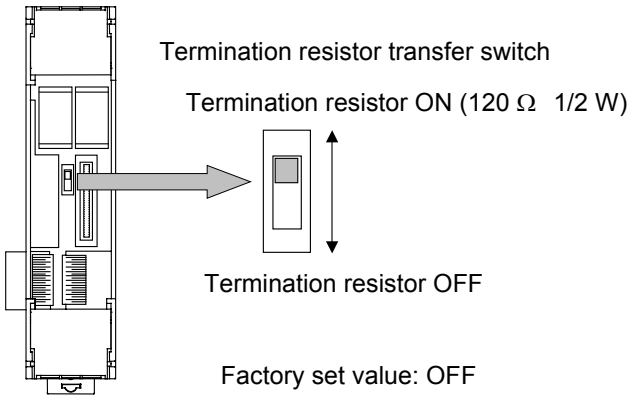
As no termination resistor is externally connected to the temperature control (TIO) module [extension type] V-TIO-B (or V-TIO-D), the termination resistor built in the module is connected by switch selection.

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 separated, adjusted data may be destroyed; control be stopped, and no return can be made.

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.

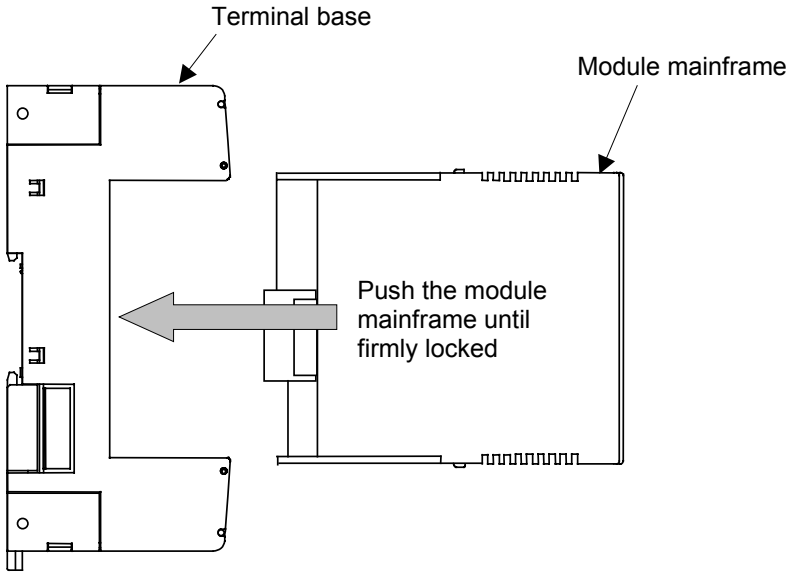


3. Turn on the termination resistor transfer switch in the terminal base.



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

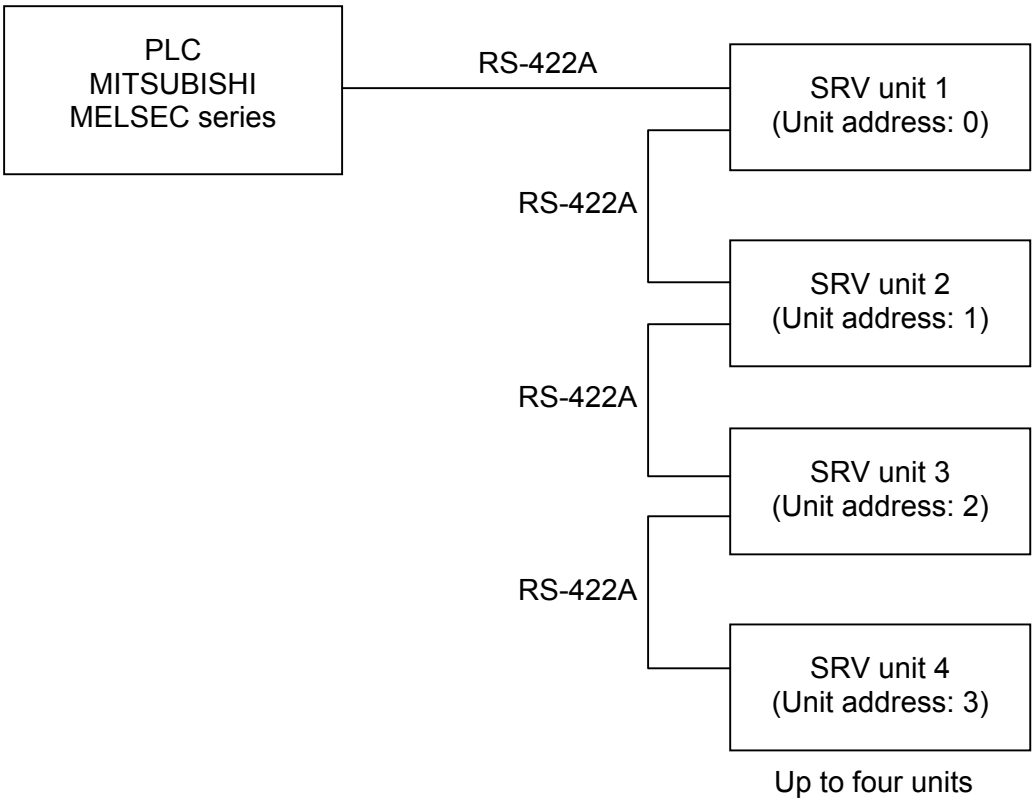
5. PLC COMMUNICATION

5.1 MITSUBISHI MELSEC series

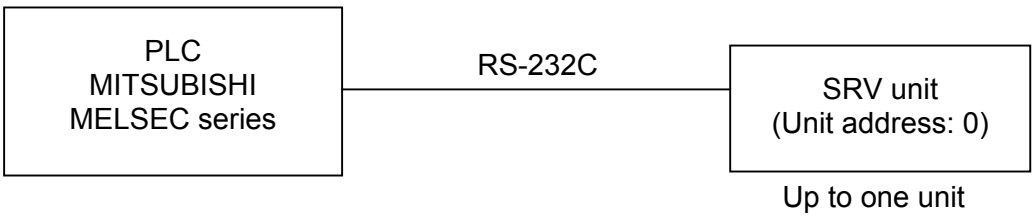
5.1.1 Outline

The SRV (V-TIO-E/F) can be connected to the MITSUBISHI MELSEC series computer link module without using any program.

- **RS-422A**



- **RS-232C**



■ Usable PLC modules (MITSUBISHI MELSEC series)

Name	Type
Computer link module	AJ71UC24 A1SJ71UC24-R2 A1SJ71UC24-R4 A1SJ71UC24-PRF A1SJ71C24-R2 A1SJ71C24-R4 A1SJ71C24-PRF A1SCPUC24-R2 A2CCPUC24 (PRF) The module which A series common command (type 4) can use.
Serial communication modules	AJ71QC24N A1SJ71QC24N QJ71C24 The module which A series common command (type 4) can use.
Adapter	FX0N-232ADP FX0N-485ADP
Expanded function board	FX2N-232BD FX2N-485BD

■ Usable SRV modules

Name	Type
Temperature control module for PLC communication	V-TIO-E (Heat control type) V-TIO-F (Heat/cool control type)
Temperature control module [basic type]	V-TIO-A (Heat control type) V-TIO-C (Heat/cool control type)
Temperature control module [extension type]	V-TIO-B (Heat control type) V-TIO-D (Heat/cool control type)

One temperature control module for PLC communication (V-TIO-E or V-TIO-F) is required.
Up to four V-TIO-E/F modules can be multi-drop connected to one PLC communication port. In addition, Up to 30 temperature control modules (V-TIO-A, B, C or D) can be connected to one V-TIO-E/F module.

☞ For each module, see Instruction Manual of the following.

- **Temperature Control Module for PLC Communication V-TIO-E/V-TIO-F Instruction Manual (IMS01P04-E□)**
- **Temperature Control Module [Basic type] V-TIO-A/V-TIO-C Instruction Manual (IMS01P02-E□)**
- **Temperature Control Module [Extension type] V-TIO-B/V-TIO-D Instruction Manual (IMS01P03-E□)**

5.1.2 Wiring

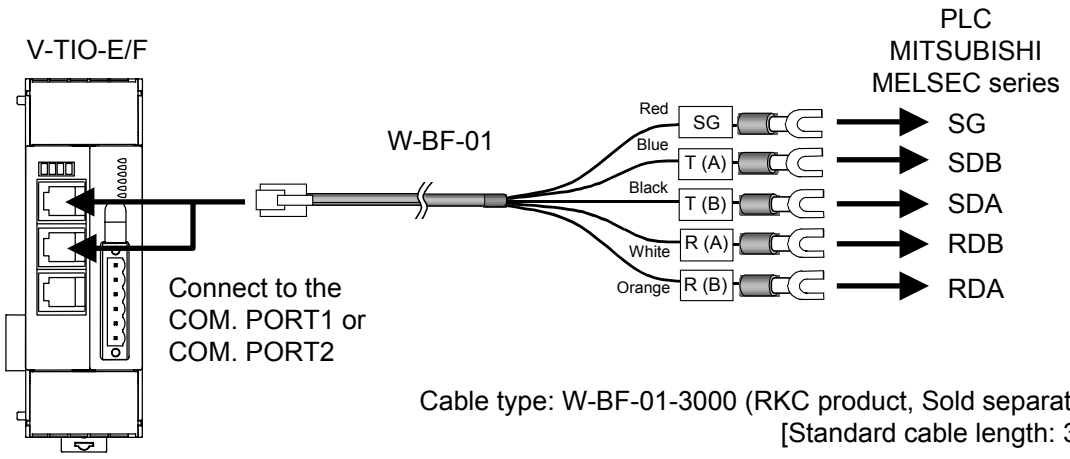
⚠ WARNING

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

CAUTION

- Connect connectors correctly in the right position. If it is forcibly pushed in with pins in the wrong positions, the pins may be bent resulting in instrument failure.
- When connecting or disconnecting the connectors, do not force it too far to right and left or up and down, but move it on the straight. Otherwise, the connector pins may be bent, causing instrument failure.
- When disconnecting a connector, hold it by the connector itself. Disconnecting connectors by yanking on their cables can cause breakdowns.
- To prevent malfunction, never touch the contact section of a connector with bare hands or with hands soiled with oil or the like.
- To prevent malfunction, connect cable connectors securely, then firmly tighten the connector fastening screws.
- To prevent damage to cables, do not bend cables over with excessive force.
- If the instrument is easily affected by noise, use the ferrite core in the both ends of the communication cable (nearest the connector).

■ RS-422A



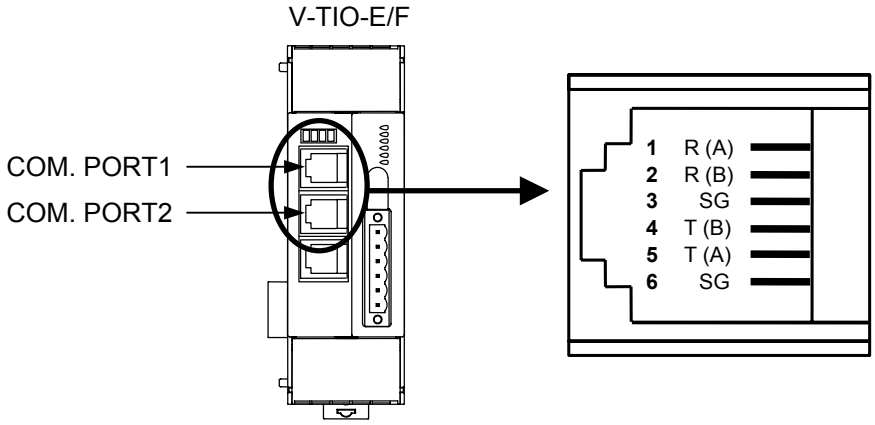
Cable type: W-BF-01-3000 (RKC product, Sold separately)
[Standard cable length: 3 m]

Connection cable W-BF-01 * (RKC product) can use to connect the PLC.
* Shields of the cable are connected to SG (No. 6 pin) of the V-TIO-E/F connector.

For the communication port assignment, see **4.1 Communication Port Assignments (P. 14)**.

The details of the connectable connector for the PLC, see the instruction manual for the used PLC.

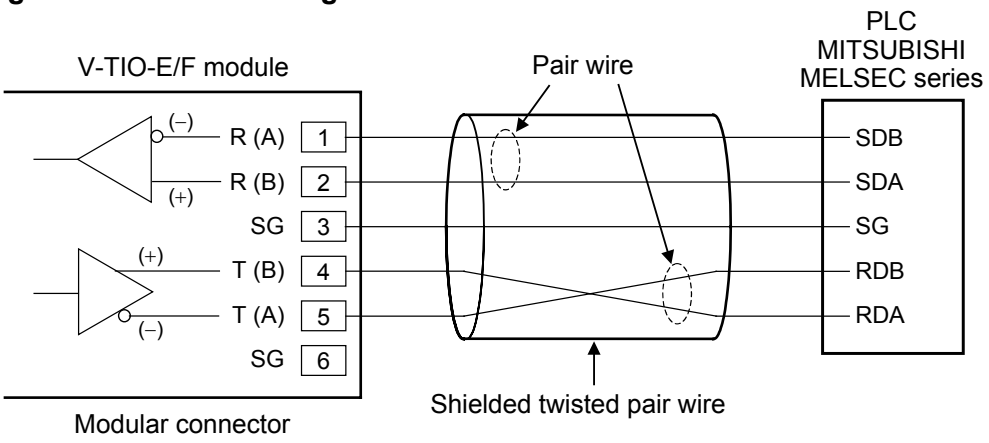
● Pin layout of modular connector



● Connector pin number and signal details

Pin No.	Signal name	Symbol
1	Receive data	R (A)
2	Receive data	R (B)
3	Signal ground	SG
4	Send data	T (B)
5	Send data	T (A)
6	Signal ground	SG

- **Diagram of RS-422A wiring**



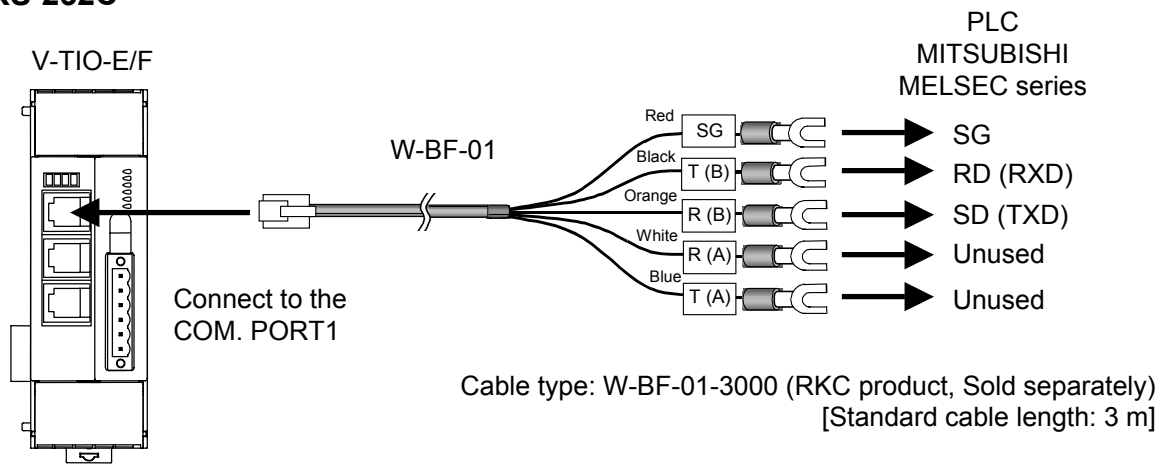
When preparing a cable of connecting the computer link module belonging to the MITSUBISHI MELSEC series to our V-TIO-E/F module, cross each pair of wires the A and B terminal positions on their terminal boards are not symmetrical.

Example: Connect the V-TIO-E/F module T (A) send data terminal to the RDB receive data terminal on the computer link module belonging to the MITSUBISHI MELSEC series.

The 6-pin type modular connector should be used for the connection to the V-TIO-E/F module.
Recommended model: TM4P-66P (Manufactured by HIROSE ELECTRIC CO., LTD.)

Customer is requested to prepare a communication cable fit for the control unit to be connected by the PLC.

■ RS-232C



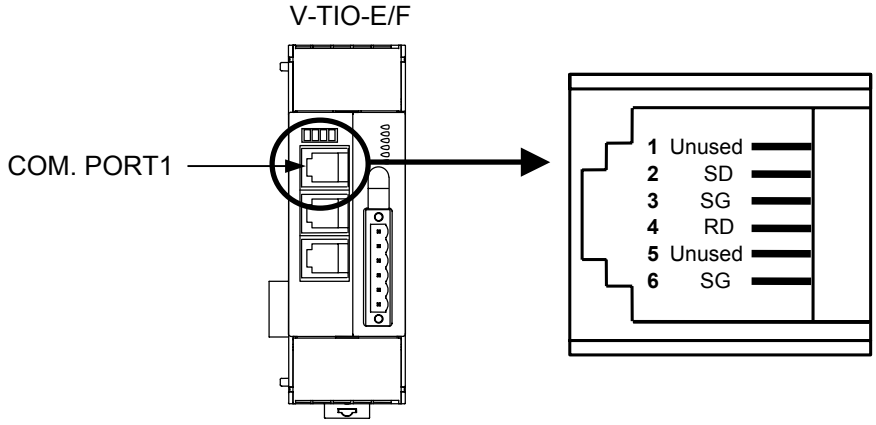
Be sure to insulate the wires that are not used by covering them with insulating tape.

Connection cable W-BF-01 * (RKC product) can use to connect the PLC.
* Shields of the cable are connected to SG (No. 6 pin) of the V-TIO-E/F connector.

For the communication port assignment, see **4.1 Communication Port Assignments (P. 14)**.

The details of the connectable connector for the PLC, see the instruction manual for the used PLC.

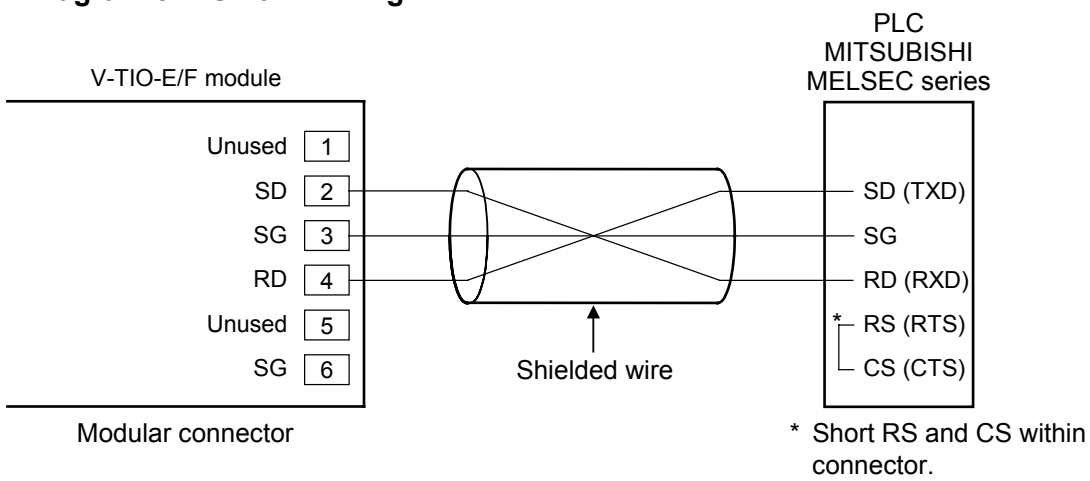
- **Pin layout of modular connector**



- **Connector pin number and signal details**

Pin No.	Signal name	Symbol
1	Unused	—
2	Send data	SD (TXD)
3	Signal ground	SG
4	Receive data	RD (RXD)
5	Unused	—
6	Signal ground	SG

- **Diagram of RS-232C wiring**



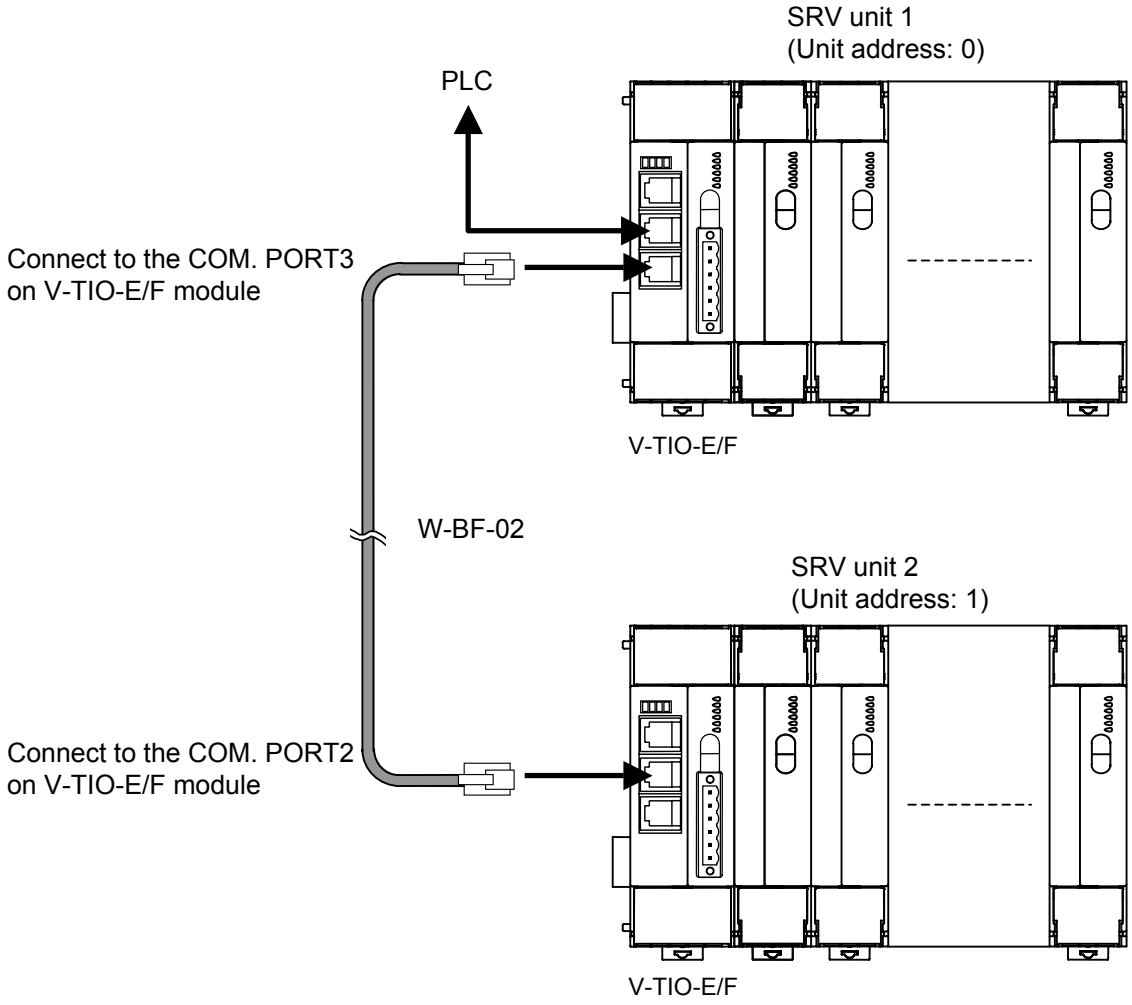
The 6-pin type modular connector should be used for the connection to the V-TIO-E/F module. Recommended model: TM4P-66P (Manufactured by HIROSE ELECTRIC CO., LTD.)

Customer is requested to prepare a communication cable fit for the control unit to be connected by the PLC.

■ Multiple SRV unit connections

● When using COM. PORT2 and COM. PORT3

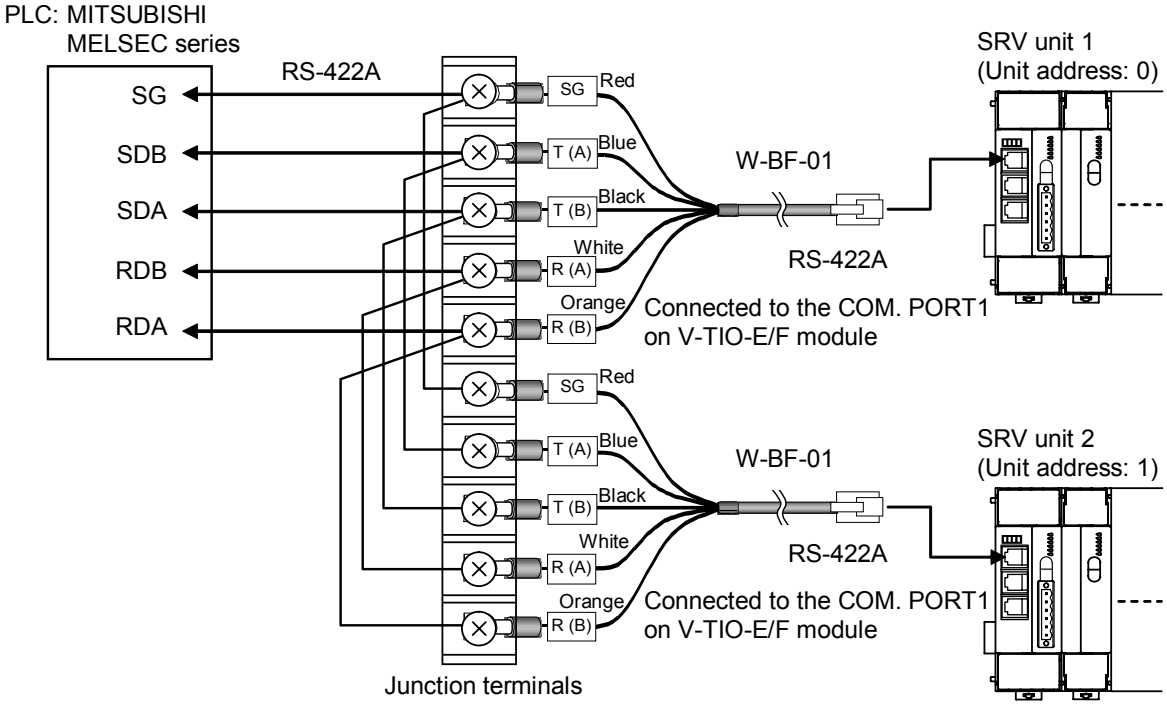
COM. PORT2/COM. PORT3 are connectors for multi-drop connection of the SRV unit.
For SRV unit extension, connect COM. PORT3 to COM. PORT2 of the SRV unit for extension using our cable (Sold separately: W-BF-02).



Cable type: W-BF-02-3000 (RKC product, Sold separately)
[Standard cable length: 3 m]

● When using COM. PORT1

When multi-drop connection is made by using COM. PORT1, it is necessary to conduct wiring by using junction terminals and our cables (Sold separately: W-BF-01).



Cable type: W-BF-01-3000 (RKC product, Sold separately)
[Standard cable length: 3 m]

5.1.3 PLC communication environment setting

There are two types of PLC communication environment settings: via host communication and by switch.

"PLC communication start time" can be set only when in host communication.

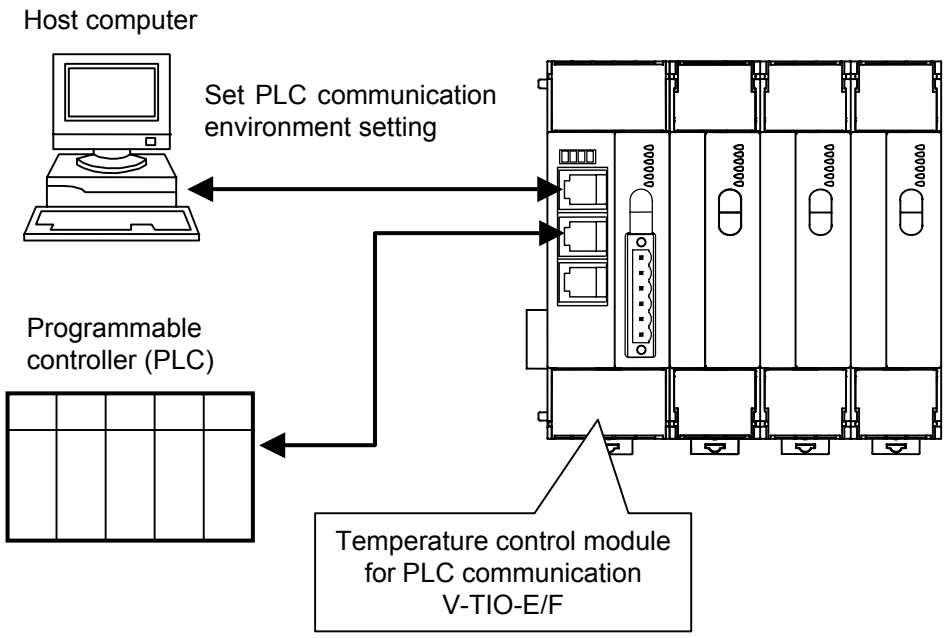
■ Setting by host communication

Set the PLC communication environment via host communication in which the V-TIO-E/F module communication port (COM. PORT1 or COM. PORT2) is used.
The V-TIO-E/F module is an object of communication.

For setting the PLC communication environment via host communication, each data becomes valid just when the power is turned off once after the data is set, and then it is turned on again.

The only PLC communication environment setting data is described here.
- For connection with host computer, see **6.2 Wiring (P. 97)**.
- For setting about host communication, see **4. COMMUNICATION SETTING (P. 14)**.
- For communication protocol of host communication, see **6.6 RKC Communication Protocol (P. 109)** or **6.7 Modbus Communication Protocol (P. 131)**.

For the communication port assignment of the V-TIO-E/F module, see **4.1 Communication Port Assignments (P. 14)**.



● Setting items list

The following items are set to the V-TIO-E/F module.

📖 **The following items become valid by turning off the power of the V-TIO-E/F module once, and then turning it on again after the settings are changed.**

📖 All of the following items can be read and written (R/W). In addition, no channel designation is required.

📖 "Identifier" and "Digits" are used for RKC communication and "Register address" is used for Modbus.

Name	Iden-tifier	Digits	Register address		Data range	Factory set value
			HEX	DEC		
Station number	**QV**	7	7D00	32000	0 to 31 Set the PLC station number. Set it to the same number as the PLC.	0
PC number	**QW**	7	7D01	32001	0 to 255 Set the PLC PC number. Set it to the same number as the PLC.	255
Register start number *	**QX**	7	7D02	32002	0 to 9994: ACPU common command (WR/WW) 0 to 32767: AnA/AnUCPU common command (QR/QW) Set the start number of the register used in PLC communication.	1000
Maximum number of PLC communication channels	**QY**	7	7D03	32003	1 to 62 CH/unit Set the maximum number of temperature control channels used in PLC communication.	20
Register type * (D, R, W)	**QZ**	7	7D04	32004	0: D register (data register) 1: R register (file register) 2: W register (link register) Set the register types used in PLC communication.	0

* Usable register ranges and types vary depending on used CPU types. For register ranges and types that can actually be used, see the PLC instruction manual.

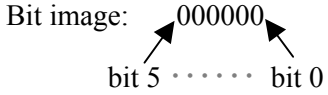
Continued on the next page.

Continued from the previous page.

Name	Iden-tifier	Digits	Register address		Data range	Factory set value
			HEX	DEC		
V-TIO-E/F module monitor item selection [1]	**QS**	7	7D06	32006	Bit data b0: Measured value (PV) b1: Set value monitor b2: Heat-side output value b3: Cool-side output value b4: CT input measured value b5: TIO state Data 0: Invalid 1: Valid [Decimal numbers expression: 0 to 63] The data updating period is shortened by selecting the only necessary data from among the above monitored data.	63
V-TIO-E/F module link recognition time [2]	**QT**	7	7D07	32007	0 to 255 seconds When connecting two or more V-TIO-E/F modules, set the time required until a module after the second module is recognized. Set this item to the master unit.	10

[1] This is the setting of shortening the data updating period by not sending unnecessary monitored items such as “Measured value (PV),” “Set value monitor,” “Heat-side output value,” “Cool-side output value,” “CT input measured value” and “TIO state” from among all items which are sent to the PLC. The only items selected by this setting are written to the PLC.

📖 Monitor item selection is assigned as a bit image in binary numbers.
However, send data from the SRV be changed to decimal ASCII code from the bit image in binary numbers for RKC communication.



[2] When two or more V-TIO-E/F modules which are multi-drop connected communicate with the PLC, the master unit with the unit address of “0,” “4,” “8” or “C” in order to recognize the existence of slave units (unit address: 1 to 3, 5 to 7, 9 to B and D to F), checks whether these slaves exist or not during the time period set by “V-TIO-E/F module Link recognition time.” Any slave with the address which did not respond at all is judged not to be in existence, and hereafter the only the remaining units start communicating with the master unit.

📖 **Set this item to the V-TIO-E/F module (master unit) with the unit address of “0,” “4,” “8” or “C.”**

📖 The slave units are necessary to be ready for communicating with the PLC during the time period set by “V-TIO-E/F module Link recognition time.” Therefore, if the power of all of the modules cannot be simultaneously turned on, turn on the power of the master unit last. Data send to the PLC starts within about 5 seconds after the power of the master unit is turned on to start processing slave unit recognition.

Continued on the next page.

Continued from the previous page.

Name	Iden-tifier	Digits	Register address		Data range	Factory set value
			HEX	DEC		
PLC scanning time setting	**ST**	7	7D09	32009	0 to 255 ms Set the time of waiting for a response from the PLC. Usually, no factory set values are necessary to be changed.	255
Action mode selection	**RZ**	7	7D0C	32012	Bit data b0: Address setting [1] 0: Continuous setting 1: Free setting b1: PLC register read/write error elimination [2] 0: Manual elimination 1: Automatic elimination b2 to b7:Unused [Decimal numbers expression: 0 to 3] Sets an action taken when the address is specified and an error occurs in PLC communication.	bit 0: 1 bit 1: 0
PLC communication start time	**RU**	7	7D0D	32015	1 to 255 seconds Time until communication with the PLC starts is set after the power is turned on.	5

[1] Module address setting differs depending on address settings.

- When in the continuous setting, set the V-TIO-E/F module address to 0 and also set other module addresses to consecutive numbers (up to 30) starting from 1.
- When in the free setting, any numbers from 0 to 30 can be freely set. Data in any address unused becomes 0.

When in the free setting, regardless of the number of modules connected when the power is turned on, much time is required until module recognition operation comes to an end compared to the continuous setting as this operation is performed to addresses from 0 to 30.

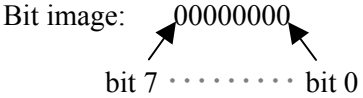
For the setting procedure of the module address, see **4.2 Module Address Setting (P. 19)**.

[2] Specifies the procedure for eliminating a PLC register read/write error. The PLC register read/write error is assigned to the PLC communication error code, bit 0.

- When manually eliminated, the request command, "2: Set value monitor" is executed and then the error is eliminated after all of the set values are written in the register.
- When automatically eliminated, the error is automatically eliminated after PLC communication returns to normal and the error is retained for more than one second (or monitor processing time).

For PLC communication error code and request command, see **5.4 Data Map (P. 72)**. In addition, for the monitor processing time, see **B.3.1 Monitor processing time (P. 182)**.

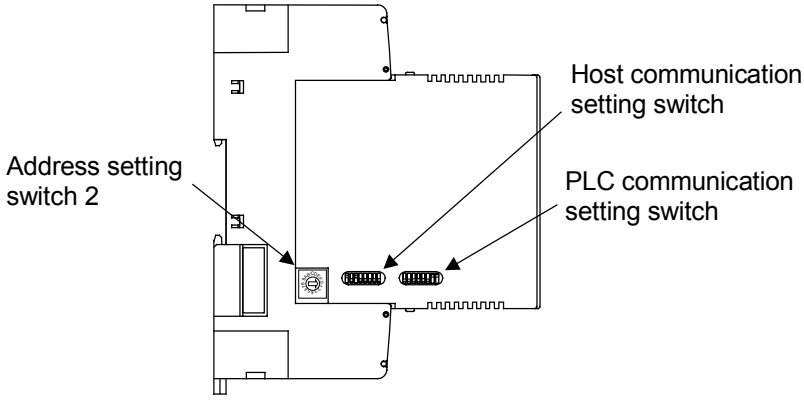
Action mode selection is assigned as a bit image in binary numbers.
However, send data from the SRV be changed to decimal ASCII code from the bit image in binary numbers for RKC communication



■ Setting by the switch

The PLC communication environment is set by using the switch in the V-TIO-E/F module without conducting host communication. The switch to use for setting is Address setting switch 2, Host communication setting switch and PLC communication setting switch.

When the PLC communication environment is set by switch, the setting details cannot be check afterwards. When checking the details thus set, check them via host communication. In addition, as each switch position is moved during the setting, **record the switch ON/OFF position before making the setting.**



V-TIO-E/F module left side view

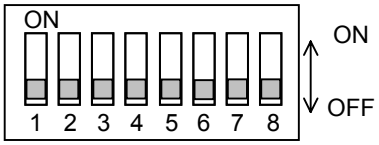
■ Setting procedure

1. Turn off the power supply.

2. Before setting the PLC communication environment, record the ON/OFF positions of address setting switch 2, and host communication setting and PLC communication setting switches.

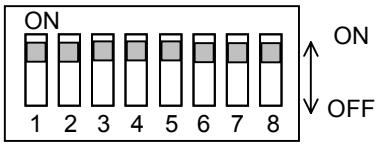
3. Turn off all of the sub switches in the host communication setting switch. In addition, turn on all of the sub switches in the PLC communication setting switch.

Host communication setting switch



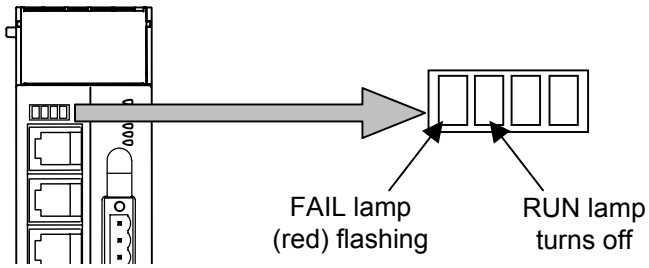
All switches: OFF

PLC communication setting switch



All switches: ON

4. Turning on the power sets the module to the PLC communication environment setting mode.
If set to the PLC communication environment setting mode, the RUN lamp goes off and the FAIL lamp flashes.



5. Select a setting item with a host communication setting switch or a PLC communication setting switch.

- For the host communication setting switch, change its position from OFF to ON.
  See **Setting items list of host communication setting switch (P. 45)**.
- For the PLC communication setting switch, change its position from ON to OFF.
  See **Setting items list of PLC communication setting switch (P. 46)**.

6. Set data with address setting switch 2.

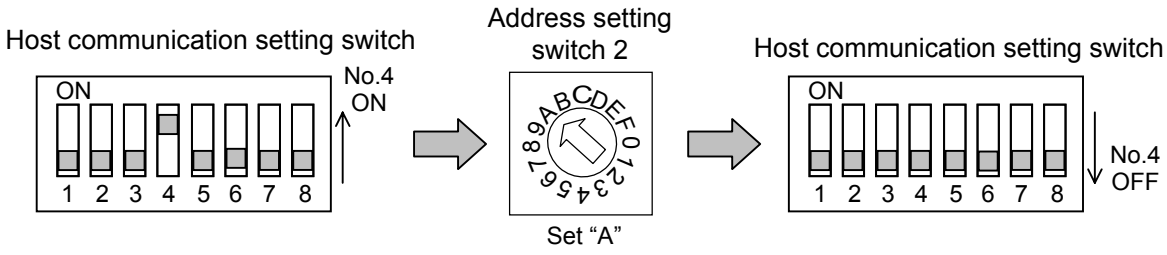
☞ See **Setting items list of host communication setting switch (P. 45)** or **Setting items list of PLC communication setting switch (P. 46)**.

7. After the setting is finished, for the host communication setting switch return its position to OFF from ON (for the PLC communication setting switch, to ON from OFF).
The RUN lamp goes on and it goes off after the set data has been registered (about 3 sec. later).

8. Repeat the above steps from ***5.*** to ***7.*** to set other setting items.

[Example] When setting maximum number of PLC communication channels to 40 CH/unit.

- Change the No. 4 position of the host communication setting switch to ON from OFF.
- Set address setting switch 2 to "A" (10 × 4 = 40).
- Return the No. 4 positions of the host communication setting switch to OFF from ON.
  The RUN lamp goes on and it goes off after the set data has been registered (about 3 sec. later).



9. First check that the RUN lamp goes off, and then turn off the power.

10. Return the ON/OFF positions of address setting switch 2, and the host communication setting and PLC communication setting switches to the positions already recorded.

11. Turn on the power again.
The set data valid if the power is turned on again.

● **Setting items list of host communication setting switch**

Switch No.	Setting item	Data range (Address setting switch 2)	Factory set value
1	Station number	0 to F: 0 to 15 Set the PLC station number. Set it to the same number as the PLC.	0
2	PC number	0 to E: 0 to 14 F: 255 Set the PLC PC number. Set it to the same number as the PLC.	255
3	Register start number [1]	0 to F: 0 to 15000 (Set value × 1000) Set the start number of the register used in PLC communication.	1000
4	Maximum number of PLC communication channels	0: 2 CH/unit 1 to E: 4 to 56 CH/unit (Set value × 4) F: 62 CH/unit Set the maximum number of temperature control channels used in PLC communication.	20 CH
5	Register type (D, R, W) [1]	0: D register (data register) 1: R register (file register) 2: W register (link register) (3 to F: D register) Set the register types used in PLC communication.	D register
6	PLC scanning time setting	0 to E: 0 to 140 ms (Set value × 10) F: 255 ms Set the response wait time from the PLC. Usually, no factory set values are necessary to be changed.	255 ms
7	V-TIO-E/F module link recognition time [2]	0: No slave unit 1 to E: 10 to 140 seconds (Set value × 10) F: 255 seconds When connecting two or more V-TIO-E/F modules, set the time required until a module after the second module is recognized.	10 seconds
8	Unused (Do not set this one)	—	—

[1] Usable register ranges and types vary depending on used CPU types. For register ranges and types that can actually be used, see the PLC instruction manual.

[2] For details, see ● **Setting items list (P. 40)** of ■ **Setting by host communication**.

- **Setting items list of PLC communication setting switch**

Switch No.	Setting item	Data range (Address setting switch 2)	Factory set value
1	V-TIO-E/F module monitor item selection *	0: Measured value (PV) 1: CT input measured value 2: Measured value (PV), CT input measured value 3: Measured value (PV), Heat-side output value 4: Measured value (PV), Heat-side output value, CT input measured value 5: Measured value (PV), Heat-side output value, Cool-side output value 6: Measured value (PV), Heat-side output value, Cool-side output value, CT input measured value 7: Measured value (PV), TIO state 8: Measured value (PV), Heat-side output value, TIO state 9: Measured value (PV), Heat-side output value, CT input measured value, TIO state A: Measured value (PV), Heat-side output value, Cool-side output value, TIO state B: Measured value (PV), Heat-side output value, Cool-side output value, CT input measured value, TIO state C: Measured value (PV), Set value monitor, Heat-side output value, TIO state D: Measured value (PV), Set value monitor, Heat-side output value, Cool-side output value, TIO state E: Measured value (PV), Set value monitor, Heat-side output value, CT input measured value, TIO state F: Measured value (PV), Set value monitor, Heat-side output value, Cool-side output value, CT input measured value, TIO state Form among combinations of the above monitored data, select a combination of the only necessary data to shorten the data updating period.	Select all items ・Measured value (PV) ・Set value monitor ・Heat-side output value ・Cool-side output value ・CT input measured value ・TIO state
2 to 5	Cannot be used for setting the PLC communication environment. (Do not set this one)	—	—

* This is the setting of shortening the data updating period by not sending unnecessary monitored items such as “Measured value (PV),” “Set value monitor,” “Heat-side output value,” “Cool-side output value,” “CT input measured value” and “TIO state” from among all items which are sent to the PLC. The only items selected by this setting are written to the PLC.

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Switch No.	Setting item	Data range (Address setting switch 2)	Factory set value
6	Action mode selection *	0: Address setting: Continuous setting PLC register read/write error elimination: Manual elimination 1: Address setting: Free setting PLC register read/write error elimination: Manual elimination 2: Address setting: Continuous setting PLC register read/write error elimination: Automatic elimination 3: Address setting: Free setting PLC register read/write error elimination: Automatic elimination 4 to F: Unused (Do not set this one) Sets an action taken when the address is specified and an error occurs in PLC communication.	Free setting Manual elimination
7, 8	Cannot be used for setting the PLC communication environment. (Do not set this one)	—	—

* **[Address setting]**
Module address setting differs depending on address settings.

- When in the continuous setting, set the V-TIO-E/F module address to 0 and also set other module addresses to consecutive numbers (up to 30) starting from 1.
- When in the free setting, any numbers from 0 to 30 can be freely set. Data in any address unused becomes 0.

  When in the free setting, regardless of the number of modules connected when the power is turned on, much time is required until module recognition operation comes to an end compared to the continuous setting as this operation is performed to addresses from 0 to 30.

[PLC register read/write error release]
Specifies the procedure for eliminating a PLC register read/write error. The PLC register read/write error is assigned to the PLC communication error code, bit 0.

- When manually eliminated, the request command, "2: Set value monitor" is executed and then the error is eliminated after all of the set values are written in the register.
- When automatically eliminated, the error is automatically eliminated after PLC communication returns to normal and the error is retained for more than one second (or monitor processing time).

For PLC communication error code and request command, see **5.4 Data Map (P. 72)**. In addition, for the monitor processing time, see **B.3.1 Monitor processing time (P. 182)**.

5.1.4 Setting on the PLC (Computer link module)

Set the PLC as follows. (Recommend setting example)

Item	Description
Protocol	Type 4 protocol mode
Station number	00
Computer link/multi-drop selection	Computer link
Communication rate	Set the same as SRV (V-TIO-E/F module)
Operation setting	Independent
Data bit	8
Parity bit	Without
Stop bit	1
Sum check code	Provided
Writing during RUN	Allowed
Setting modification	Allowed
Termination resistor	Connect the termination resistor attached to the PLC

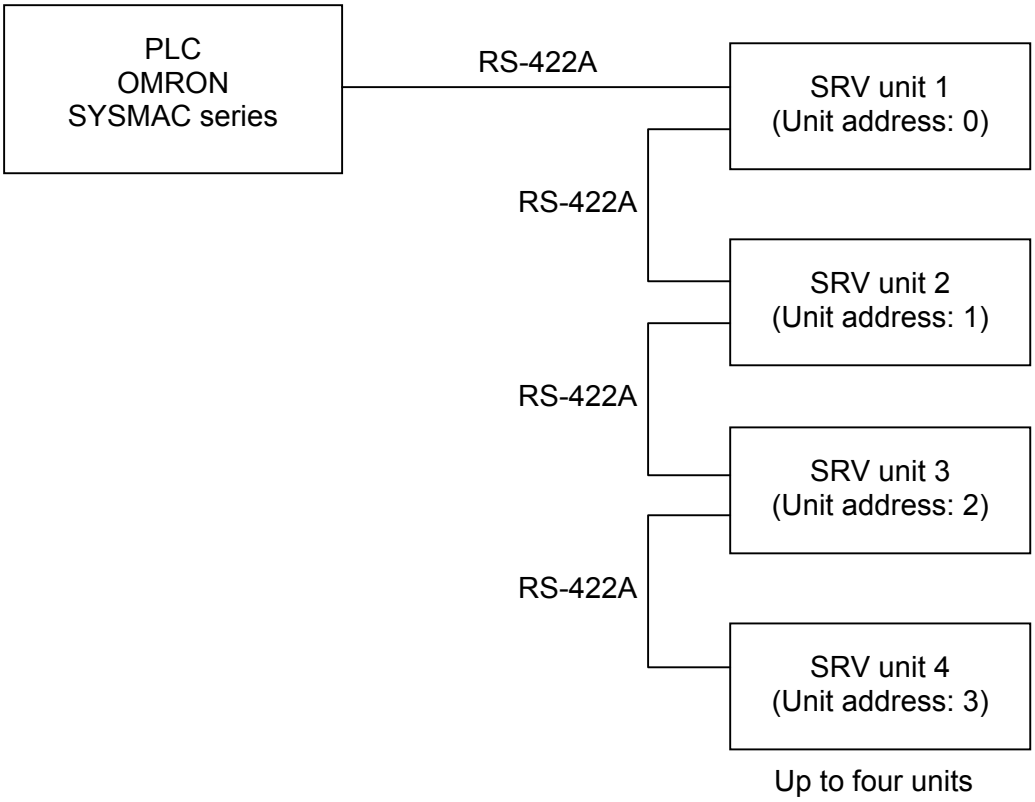
☞ The setting item varies depending on the PLC. The details of the setting procedure for the PLC, see the instruction manual for the PLC being used.

5.2 OMRON SYSMAC series

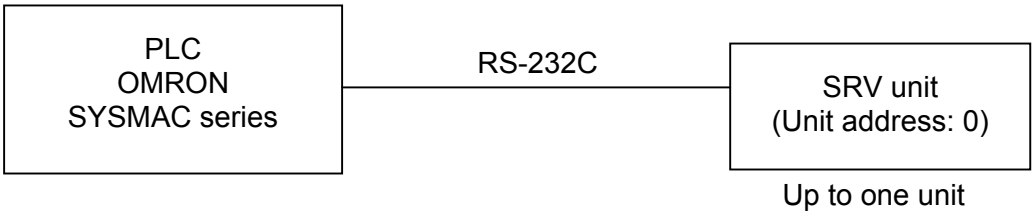
5.2.1 Outline

The SRV (V-TIO-E/F) can be connected to the OMRON SYSMAC series computer link module without using any program.

- **RS-422A**



- **RS-232C**



■ Usable PLC units (OMRON SYSMAC series)

Name	Type
High-order link unit	C200H-LK202-V1, C500-LK203, C120-LK202-V1 (SYSMAC C series), etc.
CPU unit with a built in communication port	CPU unit of SYSMAC CS1 series CPU unit of SYSMAC CJ1 series
Serial communication board	CS1W-SCB41 (SYSMAC CS1 series), etc.
Serial communication unit	CJ1W-SCU41 (SYSMAC CJ1 series), etc.

■ Usable SRV modules

Name	Type
Temperature control module for PLC communication	V-TIO-E (Heat control type) V-TIO-F (Heat/cool control type)
Temperature control module [basic type]	V-TIO-A (Heat control type) V-TIO-C (Heat/cool control type)
Temperature control module [extension type]	V-TIO-B (Heat control type) V-TIO-D (Heat/cool control type)

One temperature control module for PLC communication (V-TIO-E or V-TIO-F) is required.
Up to four V-TIO-E/F modules can be multi-drop connected to one PLC communication port. In addition, up to 30 temperature control modules (V-TIO-A, B, C or D) can be connected to one V-TIO-E/F module.

☞ For each module, see Instruction Manual of the following.

- **Temperature Control Module for PLC Communication V-TIO-E/V-TIO-F Instruction Manual (IMS01P04-E□)**
- **Temperature Control Module [Basic type] V-TIO-A/V-TIO-C Instruction Manual (IMS01P02-E□)**
- **Temperature Control Module [Extension type] V-TIO-B/V-TIO-D Instruction Manual (IMS01P03-E□)**

5.2.2 Wiring

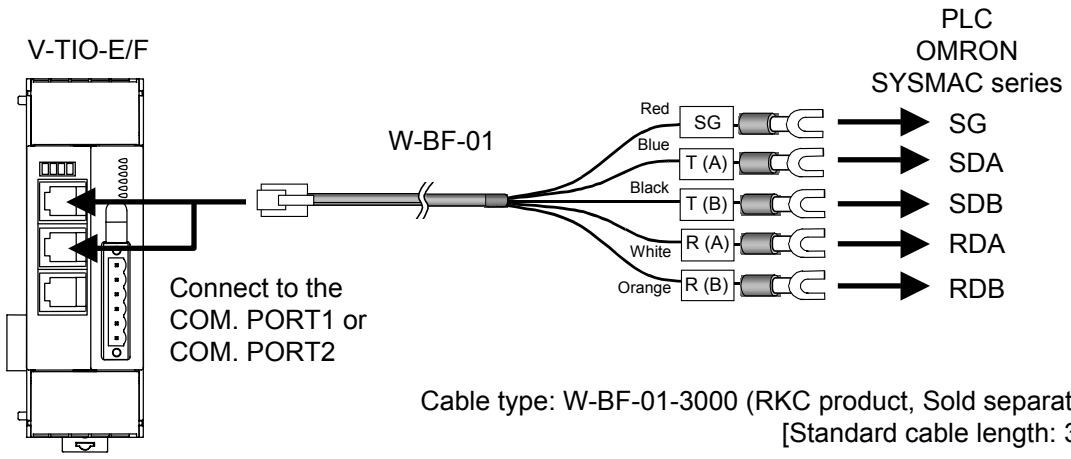
⚠ WARNING

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

CAUTION

- Connect connectors correctly in the right position. If it is forcibly pushed in with pins in the wrong positions, the pins may be bent resulting in instrument failure.
- When connecting or disconnecting the connectors, do not force it too far to right and left or up and down, but move it on the straight. Otherwise, the connector pins may be bent, causing instrument failure.
- When disconnecting a connector, hold it by the connector itself. Disconnecting connectors by yanking on their cables can cause breakdowns.
- To prevent malfunction, never touch the contact section of a connector with bare hands or with hands soiled with oil or the like.
- To prevent malfunction, connect cable connectors securely, then firmly tighten the connector fastening screws.
- To prevent damage to cables, do not bend cables over with excessive force.
- If the instrument is easily affected by noise, use the ferrite core in the both ends of the communication cable (nearest the connector).

■ RS-422A



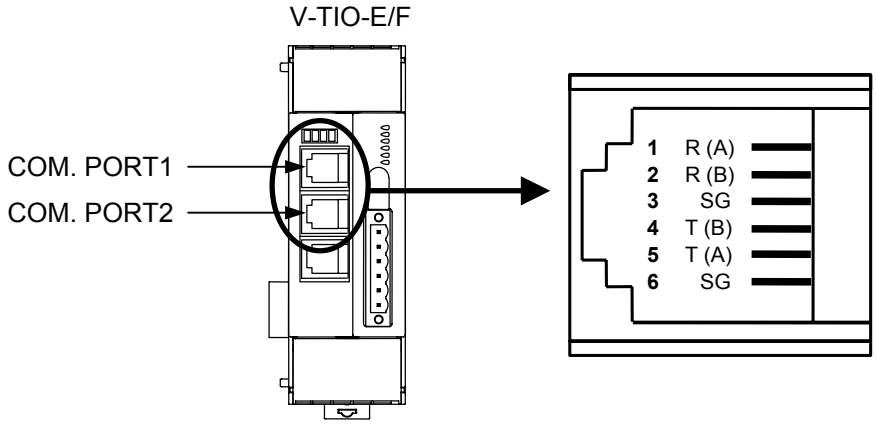
Cable type: W-BF-01-3000 (RKC product, Sold separately)
[Standard cable length: 3 m]

Connection cable W-BF-01 * (RKC product) can use to connect the PLC.
* Shields of the cable are connected to SG (No. 6 pin) of the V-TIO-E/F connector.

For the communication port assignment, see **4.1 Communication Port Assignments (P. 14)**.

The details of the connectable connector for the PLC, see the instruction manual for the used PLC.

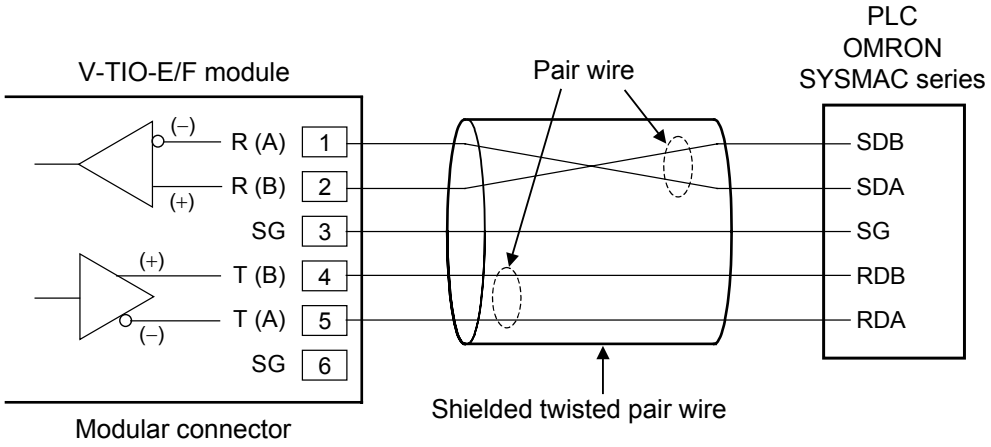
● Pin layout of modular connector



● Connector pin number and signal details

Pin No.	Signal name	Symbol
1	Receive data	R (A)
2	Receive data	R (B)
3	Signal ground	SG
4	Send data	T (B)
5	Send data	T (A)
6	Signal ground	SG

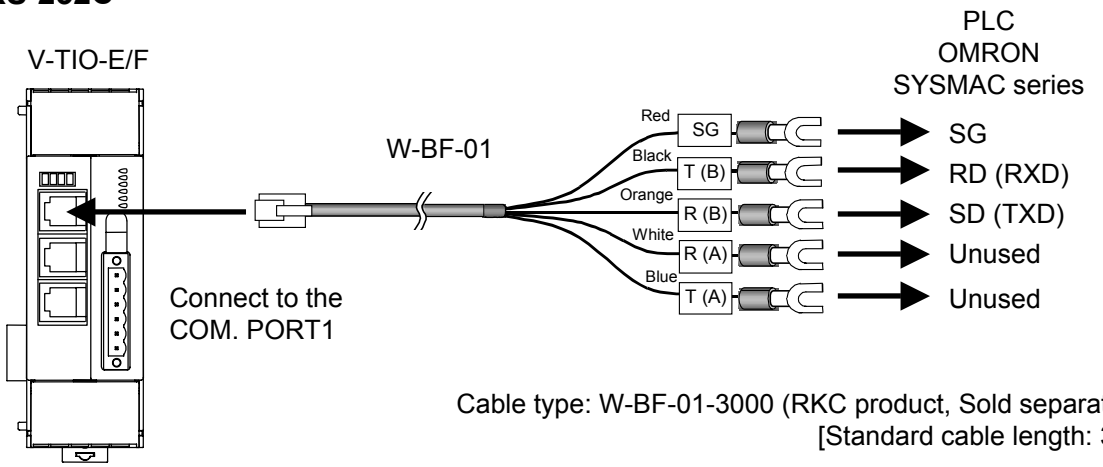
- **Diagram of RS-422A wiring**



The 6-pin type modular connector should be used for the connection to the V-TIO-E/F module. Recommended model: TM4P-66P (Manufactured by HIROSE ELECTRIC CO., LTD.)

Customer is requested to prepare a communication cable fit for the control unit to be connected by the PLC.

■ **RS-232C**



Cable type: W-BF-01-3000 (RKC product, Sold separately)
[Standard cable length: 3 m]

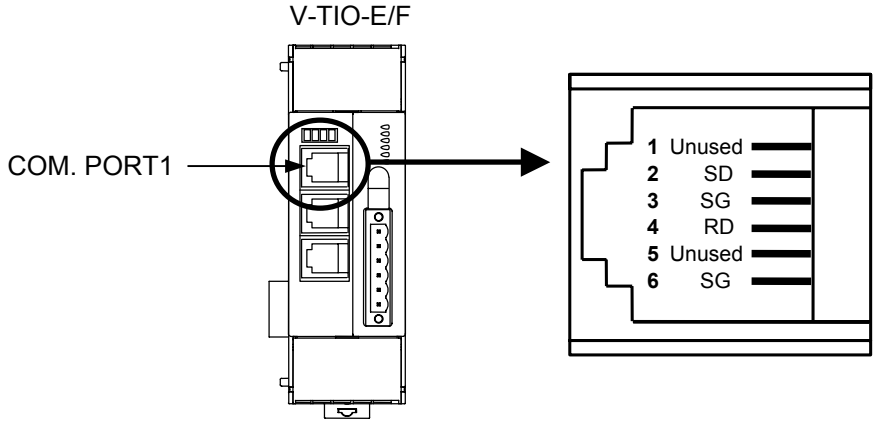
Be sure to insulate the wires that are not used by covering them with insulating tape.

Connection cable W-BF-01 * (RKC product) can use to connect the PLC.
* Shields of the cable are connected to SG (No. 6 pin) of the V-TIO-E/F connector.

For the communication port assignment, see **4.1 Communication Port Assignments (P. 14)**.

The details of the connectable connector for the PLC, see the instruction manual for the used PLC.

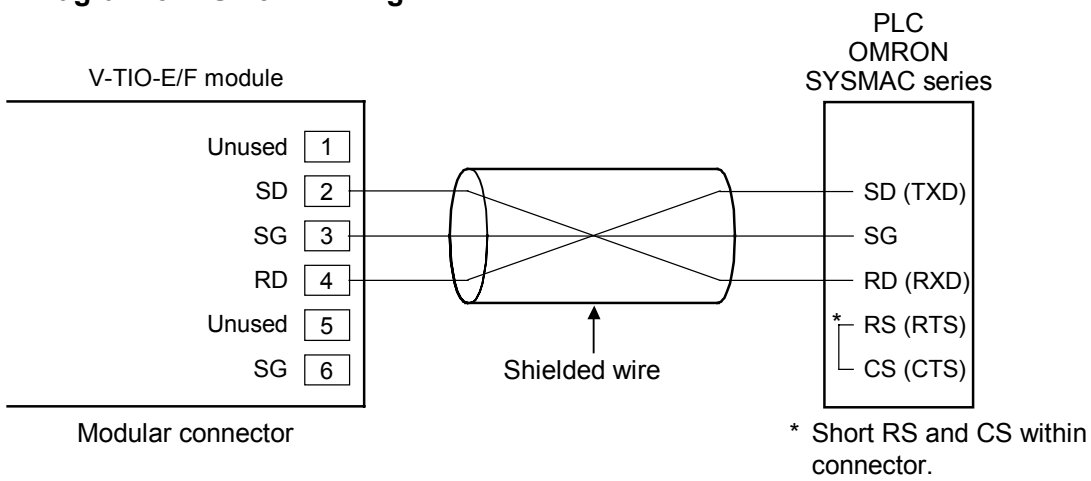
- **Pin layout of modular connector**



- **Connector pin number and signal details**

Pin No.	Signal name	Symbol
1	Unused	—
2	Send data	SD (TXD)
3	Signal ground	SG
4	Receive data	RD (RXD)
5	Unused	—
6	Signal ground	SG

- **Diagram of RS-232C wiring**



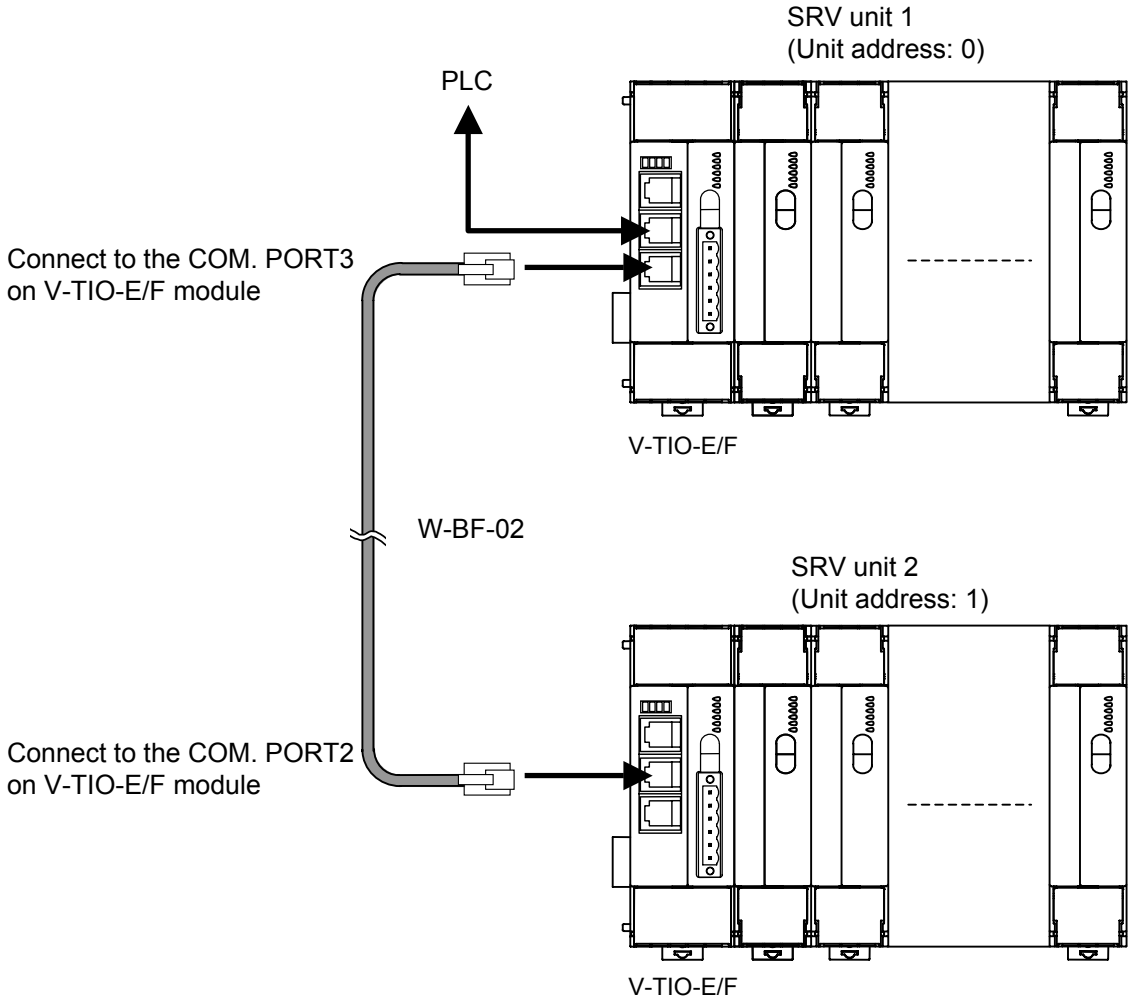
The 6-pin type modular connector should be used for the connection to the V-TIO-E/F module. Recommended model: TM4P-66P (Manufactured by HIROSE ELECTRIC CO., LTD.)

Customer is requested to prepare a communication cable fit for the control unit to be connected by the PLC.

■ Multiple SRV unit connections

● When using COM. PORT2 and COM. PORT3

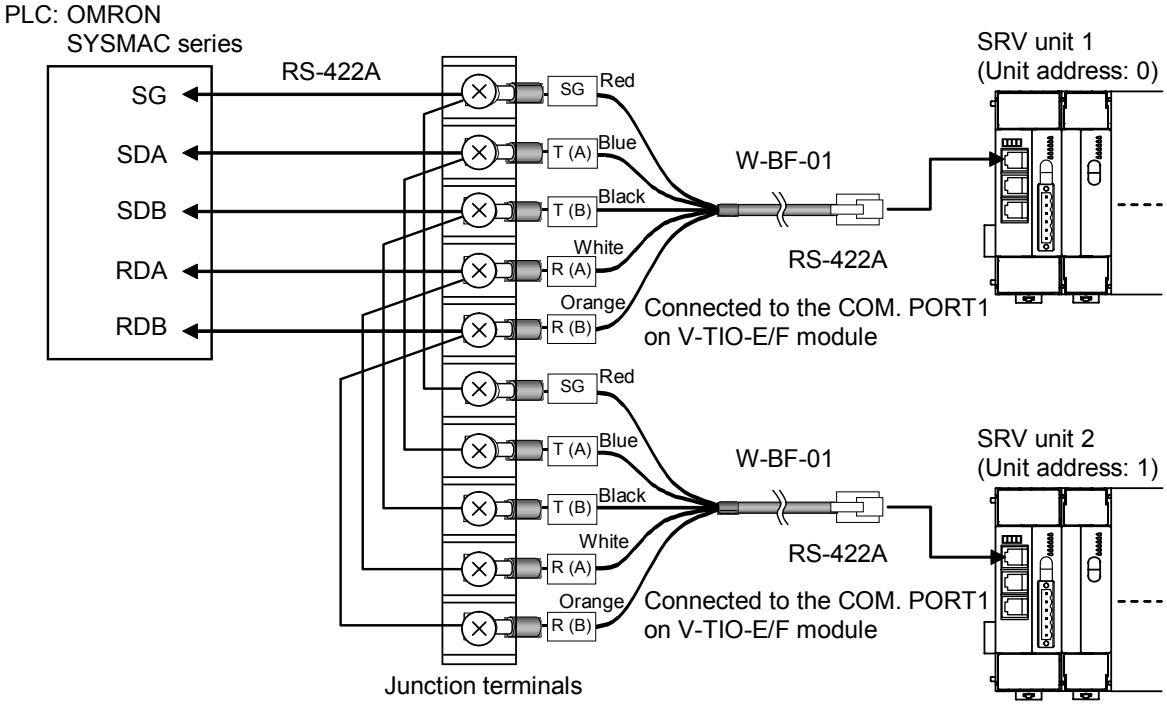
COM. PORT2/COM. PORT3 are connectors for multi-drop connection of the SRV unit.
For SRV unit extension, connect COM. PORT3 to COM. PORT2 of the SRV unit for extension using our cable (Sold separately: W-BF-02).



Cable type: W-BF-02-3000 (RKC product, Sold separately)
[Standard cable length: 3 m]

● When using COM. PORT1

When multi-drop connection is made by using COM. PORT1, it is necessary to conduct wiring by using junction terminals and our cables (Sold separately: W-BF-01).



Cable type: W-BF-01-3000 (RKC product, Sold separately)
[Standard cable length: 3 m]

5.2.3 PLC communication environment setting

There are two types of PLC communication environment settings: via host communication and by switch.

📖 "PLC communication start time" can be set only when in host communication.

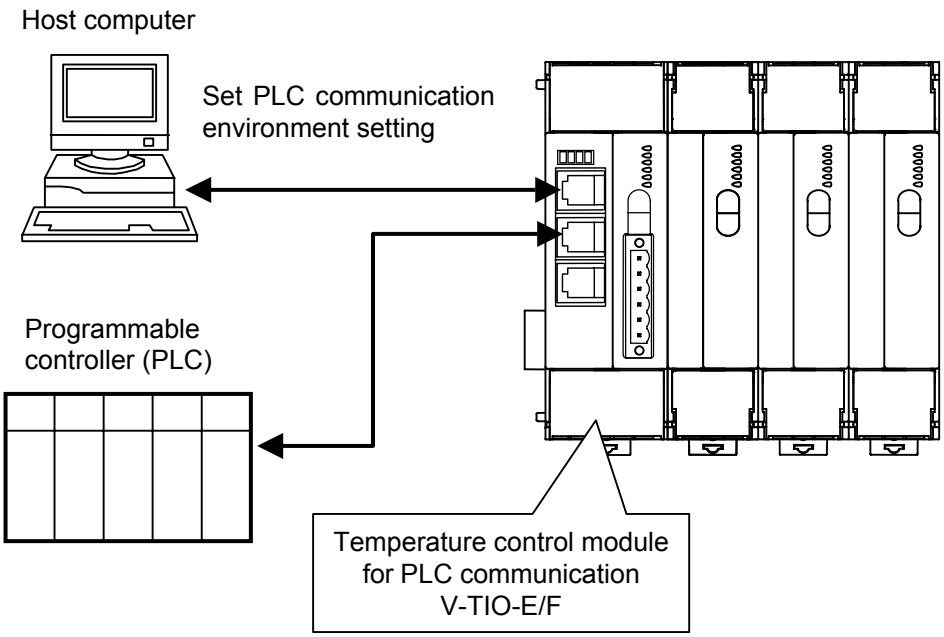
■ Setting by host communication

Set the PLC communication environment via host communication in which the V-TIO-E/F module communication port (COM. PORT1 or COM. PORT2) is used.
The V-TIO-E/F module is an object of communication.

📖 **For setting the PLC communication environment via host communication, each data becomes valid just when the power is turned off once after the data is set, and then it is turned on again.**

☞ The only PLC communication environment setting data is described here.
- For connection with host computer, see **6.2 Wiring (P. 97)**.
- For setting about host communication, see **4. COMMUNICATION SETTING (P. 14)**.
- For communication protocol of host communication, see **6.6 RKC Communication Protocol (P. 109)** or **6.7 Modbus Communication Protocol (P. 131)**.

☞ For the communication port assignment of the V-TIO-E/F module, see **4.1 Communication Port Assignments (P. 14)**.



● Setting items list

The following items are set to the V-TIO-E/F module.

The following items become valid by turning off the power of the V-TIO-E/F module once, and then turning it on again after the settings are changed.

All of the following items can be read and written (R/W). In addition, no channel designation is required.

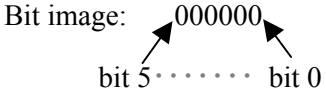
"Identifier" and "Digits" are used for RKC communication and "Register address" is used for Modbus.

Name	Iden-tifier	Digits	Register address		Data range	Factory set value
			HEX	DEC		
Unit number	**QV**	7	7D00	32000	0 to 31 Set the PLC unit number. Set it to the same number as the PLC.	0
Register start number [1]	**QX**	7	7D02	32002	0 to 9994 Set the start number of the register used in PLC communication.	1000
Maximum number of PLC communication channels	**QY**	7	7D03	32003	1 to 62 CH/unit Set the maximum number of temperature control channels used in PLC communication.	20
V-TIO-E/F module monitor item selection [2]	**QS**	7	7D06	32006	Bit data b0: Measured value (PV) b1: Set value monitor b2: Heat-side output value b3: Cool-side output value b4: CT input measured value b5: TIO state Data 0: Invalid 1: Valid [Decimal numbers expression: 0 to 63] The data updating period is shortened by selecting the only necessary data from among the above monitored data.	63

[1] Usable register ranges and types vary depending on used CPU types. For register ranges and types that can actually be used, see the PLC instruction manual.

[2] This is the setting of shortening the data updating period by not sending unnecessary monitored items such as "Measured value (PV)," "Set value monitor," "Heat-side output value," "Cool-side output value," "CT input measured value" and "TIO state" from among all items which are sent to the PLC. The only items selected by this setting are written to the PLC.

Monitor item selection is assigned as a bit image in binary numbers.
However, send data from the SRV be changed to decimal ASCII code from the bit image in binary numbers for RKC communication.



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Name	Iden-tifier	Digits	Register address		Data range	Factory set value
			HEX	DEC		
V-TIO-E/F module link recognition time *	**QT**	7	7D07	32007	0 to 255 seconds When connecting two or more V-TIO-E/F modules, set the time required until a module after the second module is recognized. Set this item to the master unit.	10
PLC scanning time setting	**ST**	7	7D09	32009	0 to 255 ms Set the time of waiting for a response from the PLC. Usually, no factory set values are necessary to be changed.	255

* When two or more V-TIO-E/F modules which are multi-drop connected communicate with the PLC, the master unit with the unit address of "0," "4," "8" or "C" in order to recognize the existence of slave units (unit address: 1 to 3, 5 to 7, 9 to B and D to F), checks whether these slaves exist or not during the time period set by "V-TIO-E/F module Link recognition time." Any slave with the address which did not respond at all is judged not to be in existence, and hereafter the only the remaining units start communicating with the master unit.

Set this item to the V-TIO-E/F module (master unit) with the unit address of "0," "4," "8" or "C."

The slave units are necessary to be ready for communicating with the PLC during the time period set by "V-TIO-E/F module Link recognition time." Therefore, if the power of all of the modules cannot be simultaneously turned on, turn on the power of the master unit last. Data send to the PLC starts within about 5 seconds after the power of the master unit is turned on to start processing slave unit recognition.

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Name	Iden-tifier	Digits	Register address		Data range	Factory set value
			HEX	DEC		
Action mode selection	**RZ**	7	7D0C	32012	Bit data b0: Address setting [1] 0: Continuous setting 1: Free setting b1: PLC register read/write error elimination [2] 0: Manual elimination 1: Automatic elimination b2 to b7:Unused [Decimal numbers expression: 0 to 3] Sets an action taken when the address is specified and an error occurs in PLC communication.	bit 0: 1 bit 1: 0
PLC communication start time	**RU**	7	7D0D	32015	1 to 255 seconds Time until communication with the PLC starts is set after the power is turned on.	5

[1] Module address setting differs depending on address settings.

- When in the continuous setting, set the V-TIO-E/F module address to 0 and also set other module addresses to consecutive numbers (up to 30) starting from 1.
- When in the free setting, any numbers from 0 to 30 can be freely set. Data in any address unused becomes 0.

When in the free setting, regardless of the number of modules connected when the power is turned on, much time is required until module recognition operation comes to an end compared to the continuous setting as this operation is performed to addresses from 0 to 30.

For the setting procedure of the module address, see **4.2 Module Address Setting (P. 19)**.

[2] Specifies the procedure for eliminating a PLC register read/write error. The PLC register read/write error is assigned to the PLC communication error code, bit 0.

- When manually eliminated, the request command, "2: Set value monitor" is executed and then the error is eliminated after all of the set values are written in the register.
- When automatically eliminated, the error is automatically eliminated after PLC communication returns to normal and the error is retained for more than one second (or monitor processing time).

For PLC communication error code and request command, see **5.4 Data Map (P. 72)**. In addition, for the monitor processing time, see **B.3.1 Monitor processing time (P. 182)**.

Action mode selection is assigned as a bit image in binary numbers.
However, send data from the SRV be changed to decimal ASCII code from the bit image in binary numbers for RKC communication

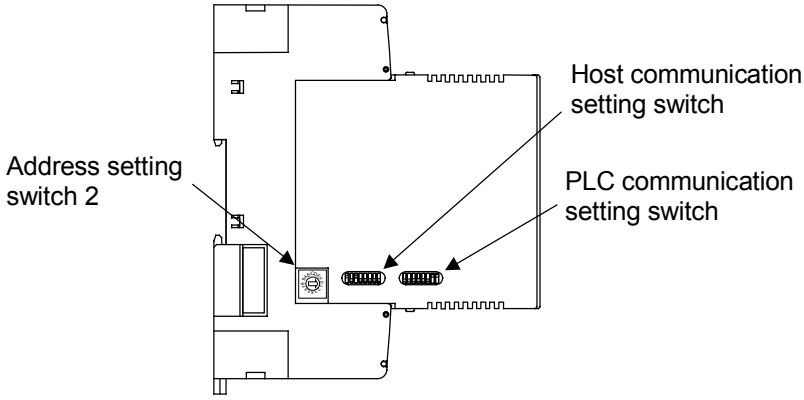
Bit image: 00000000

bit 7 ····· bit 0

■ Setting by the switch

The PLC communication environment is set by using the switch in the V-TIO-E/F module without conducting host communication. The switch to use for setting is Address setting switch 2, Host communication setting switch and PLC communication setting switch.

When the PLC communication environment is set by switch, the setting details cannot be check afterwards. When checking the details thus set, check them via host communication. In addition, as each switch position is moved during the setting, **record the switch ON/OFF position before making the setting.**



V-TIO-E/F module left side view

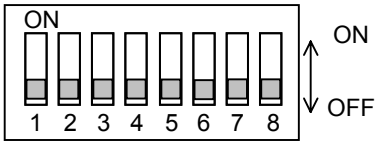
■ Setting procedure

1. Turn off the power supply.

2. Before setting the PLC communication environment, record the ON/OFF positions of address setting switch 2, and host communication setting and PLC communication setting switches.

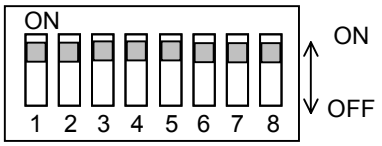
3. Turn off all of the sub switches in the host communication setting switch. In addition, turn on all of the sub switches in the PLC communication setting switch.

Host communication setting switch



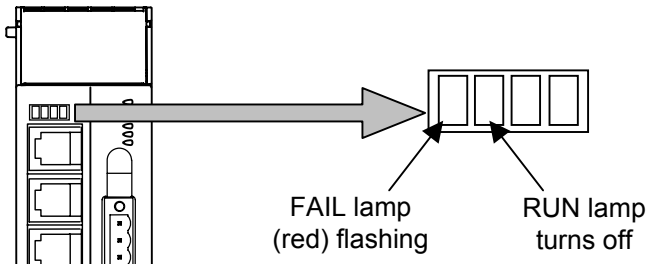
All switches: OFF

PLC communication setting switch



All switches: ON

4. Turning on the power sets the module to the PLC communication environment setting mode.
If set to the PLC communication environment setting mode, the RUN lamp goes off and the FAIL lamp flashes.



5. Select a setting item with a host communication setting switch or a PLC communication setting switch.

- For the host communication setting switch, change its position from OFF to ON.
  See **Setting items list of host communication setting switch (P. 63)**.
- For the PLC communication setting switch, change its position from ON to OFF.
  See **Setting items list of PLC communication setting switch (P. 64)**.

6. Set data with address setting switch 2.

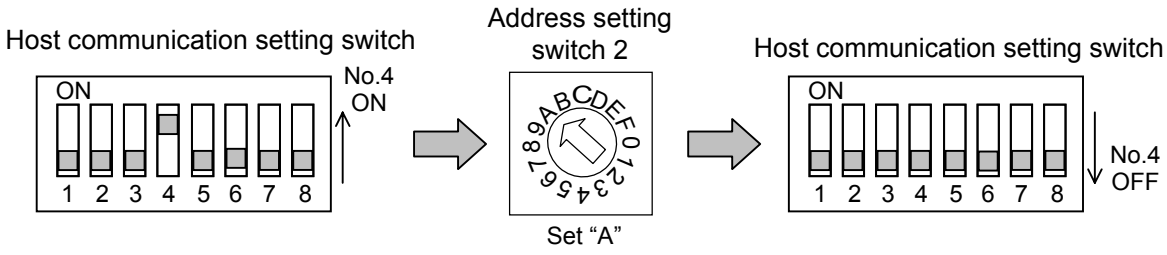
☞ See **Setting items list of host communication setting switch (P. 63)** or **Setting items list of PLC communication setting switch (P. 64)**.

7. After the setting is finished, for the host communication setting switch return its position to OFF from ON (for the PLC communication setting switch, to ON from OFF).
The RUN lamp goes on and it goes off after the set data has been registered (about 3 sec. later).

8. Repeat the above steps from ***5.*** to ***7.*** to set other setting items.

[Example] When setting maximum number of PLC communication channels to 40 CH/unit.

- Change the No. 4 position of the host communication setting switch to ON from OFF.
- Set address setting switch 2 to "A" (10 × 4 = 40).
- Return the No. 4 positions of the host communication setting switch to OFF from ON.
  The RUN lamp goes on and it goes off after the set data has been registered (about 3 sec. later).



9. First check that the RUN lamp goes off, and then turn off the power.

10. Return the ON/OFF positions of address setting switch 2, and the host communication setting and PLC communication setting switches to the positions already recorded.

11. Turn on the power again.
The set data valid if the power is turned on again.

● **Setting items list of host communication setting switch**

Switch No.	Setting item	Data range (Address setting switch 2)	Factory set value
1	Unit number	0 to F: 0 to 15 Set the PLC unit number. Set it to the same number as the PLC.	0
2	Unused (Do not set this one)	—	—
3	Register start number [1]	0 to 9: 0 to 9000 (Set value × 1000) Set the start number of the register used in PLC communication.	1000
4	Maximum number of PLC communication channels	0: 2 CH/unit 1 to E: 4 to 56 CH/unit (Set value × 4) F: 62 CH/unit Set the maximum number of temperature control channels used in PLC communication.	20 CH
5	Unused (Do not set this one)	—	—
6	PLC scanning time setting	0 to E: 0 to 140 ms (Set value × 10) F: 255 ms Set the response wait time from the PLC. Usually, no factory set values are necessary to be changed.	255 ms
7	V-TIO-E/F module link recognition time [2]	0: No slave unit 1 to E: 10 to 140 seconds (Set value × 10) F: 255 seconds When connecting two or more V-TIO-E/F modules, set the time required until a module after the second module is recognized.	10 seconds
8	Unused (Do not set this one)	—	—

[1] Usable register ranges and types vary depending on used CPU types. For register ranges and types that can actually be used, see the PLC instruction manual.

[2] For details, see ● **Setting items list (P. 58)** of ■ **Setting by host communication**.

- **Setting items list of PLC communication setting switch**

Switch No.	Setting item	Data range (Address setting switch 2)	Factory set value
1	V-TIO-E/F module monitor item selection *	0: Measured value (PV) 1: CT input measured value 2: Measured value (PV), CT input measured value 3: Measured value (PV), Heat-side output value 4: Measured value (PV), Heat-side output value, CT input measured value 5: Measured value (PV), Heat-side output value, Cool-side output value 6: Measured value (PV), Heat-side output value, Cool-side output value, CT input measured value 7: Measured value (PV), TIO state 8: Measured value (PV), Heat-side output value, TIO state 9: Measured value (PV), Heat-side output value, CT input measured value, TIO state A: Measured value (PV), Heat-side output value, Cool-side output value, TIO state B: Measured value (PV), Heat-side output value, Cool-side output value, CT input measured value, TIO state C: Measured value (PV), Set value monitor, Heat-side output value, TIO state D: Measured value (PV), Set value monitor, Heat-side output value, Cool-side output value, TIO state E: Measured value (PV), Set value monitor, Heat-side output value, CT input measured value, TIO state F: Measured value (PV), Set value monitor, Heat-side output value, Cool-side output value, CT input measured value, TIO state Form among combinations of the above monitored data, select a combination of the only necessary data to shorten the data updating period.	Select all items ・Measured value (PV) ・Set value monitor ・Heat-side output value ・Cool-side output value ・CT input measured value ・TIO state
2 to 5	Cannot be used for setting the PLC communication environment. (Do not set this one)	—	—

* This is the setting of shortening the data updating period by not sending unnecessary monitored items such as “Measured value (PV),” “Set value monitor,” “Heat-side output value,” “Cool-side output value,” “CT input measured value” and “TIO state” from among all items which are sent to the PLC. The only items selected by this setting are written to the PLC.

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Switch No.	Setting item	Data range (Address setting switch 2)	Factory set value
6	Action mode selection *	0: Address setting: Continuous setting PLC register read/write error elimination: Manual elimination 1: Address setting: Free setting PLC register read/write error elimination: Manual elimination 2: Address setting: Continuous setting PLC register read/write error elimination: Automatic elimination 3: Address setting: Free setting PLC register read/write error elimination: Automatic elimination 4 to F: Unused (Do not set this one) Sets an action taken when the address is specified and an error occurs in PLC communication.	Free setting Manual elimination
7, 8	Cannot be used for setting the PLC communication environment. (Do not set this one)	—	—

* **[Address setting]**
Module address setting differs depending on address settings.

- When in the continuous setting, set the V-TIO-E/F module address to 0 and also set other module addresses to consecutive numbers (up to 30) starting from 1.
- When in the free setting, any numbers from 0 to 30 can be freely set. Data in any address unused becomes 0.

  When in the free setting, regardless of the number of modules connected when the power is turned on, much time is required until module recognition operation comes to an end compared to the continuous setting as this operation is performed to addresses from 0 to 30.

[PLC register read/write error release]
Specifies the procedure for eliminating a PLC register read/write error. The PLC register read/write error is assigned to the PLC communication error code, bit 0.

- When manually eliminated, the request command, "2: Set value monitor" is executed and then the error is eliminated after all of the set values are written in the register.
- When automatically eliminated, the error is automatically eliminated after PLC communication returns to normal and the error is retained for more than one second (or monitor processing time).

For PLC communication error code and request command, see **5.4 Data Map (P. 72)**. In addition, for the monitor processing time, see **B.3.1 Monitor processing time (P. 182)**.

5.2.4 Setting on the PLC

Set the PLC as follows. (Recommend setting example)

Item	Description
Serial communication mode	High-order link
Unit number (Model number)	0
Start bit	1
Data bit	7
Stop bit	2
Parity bit	Even
Transmission speed	Set the same as SRV (V-TIO-E/F module)
I/O port selection	RS-422A
Synchronization selection	Internal synchronization
CTS selection	0 V (always ON)
5 V supply	OFF
Termination resistor	Termination resistor is inserted

☞ The setting item varies depending on the PLC. The details of the setting procedure for the PLC, see the instruction manual for the PLC being used.

5.3 Communication Data

■ Request command

Data transfer between PLC and SRV are executed by request command.

- **Request command "0: Monitor"**
  Command which requests the SRV to write data such as temperature measured values, etc. (attribute: RO) to the PLC side.
  The SRV always repeats data writing until "1: Setting" or "2: Set value monitor" is set to the request command.
  The SRV communication state 1 is set to "1: Writing on monitor data" during data transfer.

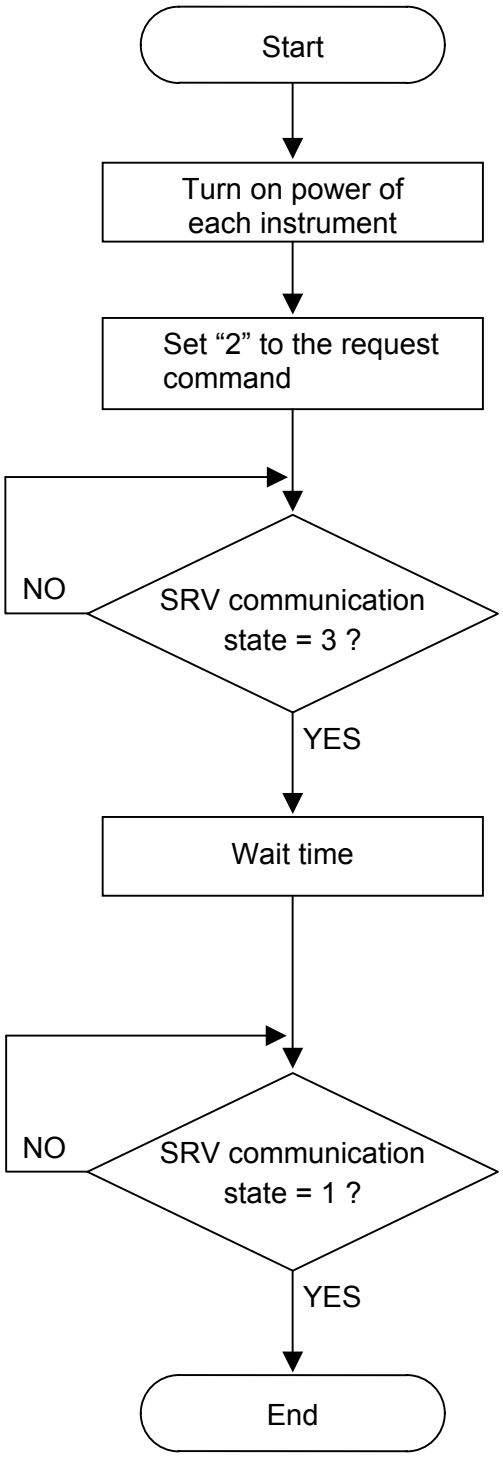
- **Request command "1: Setting"**
  Command which requests the SRV to read data such as temperature set values, etc. (attribute: RW) from the PLC side. Just when "1: Setting" is set to the request command, the SRV starts reading the data from the PLC side.
  The SRV communication state 1 is set to "2: Reading out setting data" during data transfer.
  After the data is transferred, the request command and SRV communication state 1 returns to "0: Monitor" and "1: Writing on monitor data," respectively.

- **Request command "2: Set value monitor"**
  Command which requests the SRV to write data such as temperature set values, etc. (attribute: RW) to the PLC side. Just when "2: Set value monitor" is set to the request command, the SRV starts writing the data to the PLC side.
  The SRV communication state 1 is set to "3: Writing on setting data" during data transfer.
  After the data is transferred, the request command and SRV communication state 1 returns to "0: Monitor" and "1: Writing on monitor data," respectively.

■ Data transfer procedures

Change each set value of SRV from the PLC after the initial settings are made.
If each set value of SRV is changed from the PLC without setting the initial values, it is re-written to 0 with each set value of the PLC at that time set to 0.

● Initial Setting (When transmit data of temperature setting values from SRV to PLC)



When 2 (Set value monitor) is set to request command, the SRV starts writing the data items such as temperature set value, etc. (attribute: R/W) to the PLC side.

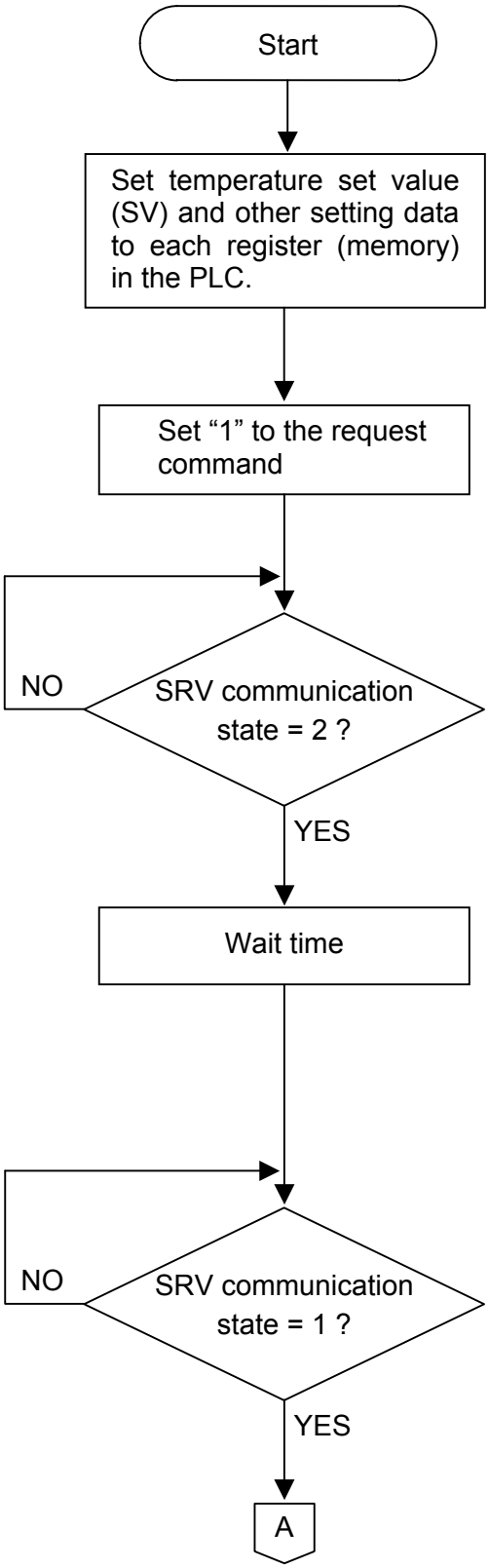
If 3 (Writing on setting data) is set to SRV communication state in the PLC, this indicates that SRV data items such as temperature set value, etc. (attribute: R/W) are being written into the PLC.

Reserve data write time as wait time. In addition, process data in each item as indefinite during this period.

☞ For writing time, see **APPENDIX B.3.3 Set value monitor processing time (P. 184)**.

If 1 (Writing on monitor data) is set to SRV communication state in the PLC, this indicates that SRV data items such as temperature set value, etc. (attribute: R/W) have been written to start writing SRV data items such as temperature measured values (PV), etc. (attribute: RO) into the PLC.

- **Data setting (When transmit data of temperature setting values from PLC to SRV)**



[Data setting]

When 1 (Setting) is set to request command, the SRV starts reading the temperature set value data set to the register (memory) on the PLC side.

If 2 (Reading out setting data) is set to SRV communication state in the PLC, this indicates that temperature set values data are being read from the PLC.

Reserve data read time as wait time. In addition, process data in each item as indefinite during this period.

☞ For readout time, see **APPENDIX B.3.2 Setting processing time (P. 183)**.

If 1 (Writing on monitor data) is set to SRV communication state in the PLC, this indicates that temperature set value data have been read to start writing SRV data items such as temperature measured values (PV) etc. (attribute: RO) into the PLC.

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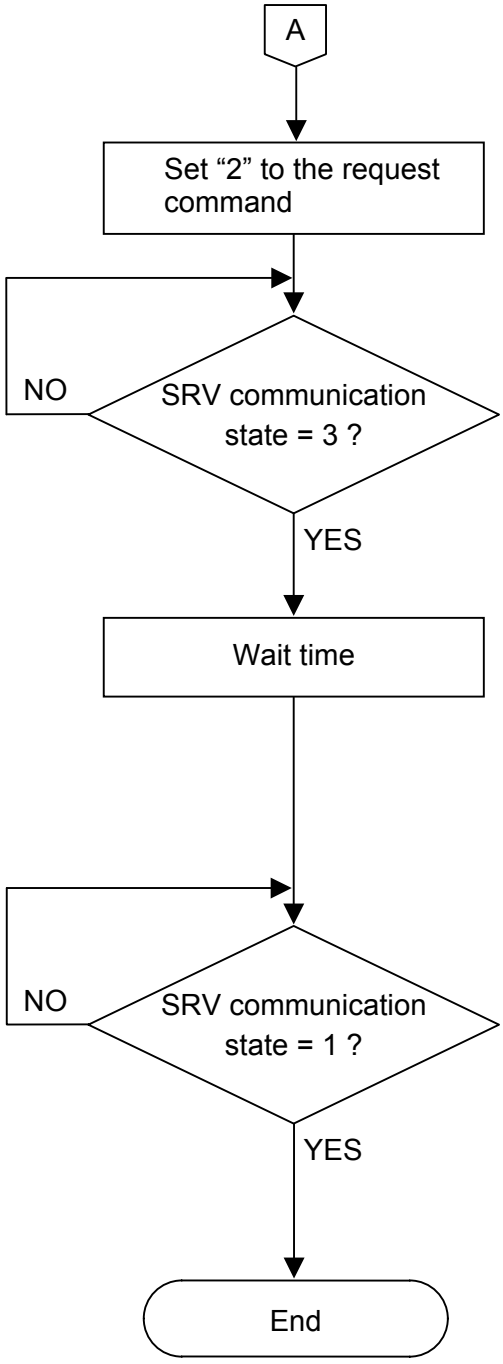

[Confirmation of setting data]

When 2 (Set value monitor) is set to request command, the SRV starts writing the temperature set value data set to the PLC side.

If 3 (Writing on setting data) is set to SRV communication state in the PLC, this indicates that SRV temperature set value data are being written into the PLC.

Reserve data write time as wait time. In addition, process data in each item as indefinite during this period.

☞ For writing time, see **APPENDIX B.3.3 Set value monitor processing time (P. 184)**.

If 1 (Writing on monitor data) is set to SRV communication state in the PLC, this indicates that temperature set values have been written to start writing SRV data items such as temperature measured values (PV), etc. (attribute: RO) into the PLC.

■ Data processing precautions

- The data type is treated as binary data with a sign and without a decimal point. For this reason, carefully express and set the data. (excluding the TIO state)

  [Example] Setting of proportional band
  Initial value of internal data: 3.0
  Communication data: 30

- If the data range error occurs during data setting, "Setting error" (bit 14 in the TIO state) is set to ON in the channel where the error occurs. The SRV continues operation at the present set value without updating the data.

   Any attempt to write to an unused channel is not processed as an error.

- The autotuning (AT) function starts its execution with PID/AT transfer and the request command set to "1: AT operation" and "1: Setting," respectively. After the autotuning function finishes its execution, PID/AT transfer returns to "0: PID control operation" and thus the PID constants are updated.

- Some communication data may become invalid depending on the function selection or the module configuration of the SRV. If the data is within the setting range even after it is written, no error response message is returned.

5.4 Data Map

The data map summarizes data addresses, channels and names which enable PLC communication.

■ Reference to data map

(1) (2) (3) (4) (5) (6)

Name	Register address	Struc-ture	Attri-bute	Data range	Factory set value
Request command	D01000 (DM01000)	U	R/W	0: Monitor 1: Setting 2: Set value monitor	—
SRV communication state	D01001 (DM01001)	U	RO	0: Unused 1: Writing on monitor data 2: Reading out setting data 3: Writing on setting data	—

(1) Name: Communication data name

(2) Register address: A register address of communication data in PLC communication
Upper section: A register address of MITSUBISHI MELSEC series
Inside of ( ): A register address of OMRON SYSMAC series

Register addresses in this manual are those assigned when the PLC communication environment is set as follows.

- Maximum number of PLC communication channels: 20
- Register start number: 1000
- Register type (D, R, W): 0 (D register)
  Set only when the PLC is MITSUBISHI MELSEC series

Setting of "Maximum number of PLC communication channels" and "Register start number" changes an assignment of a register address.

Name	Register address	
Request command	D01000 (DM01000)	← Register start number
SRV communication state	D01001 (DM01001)	
⋮	⋮	
Measured value (PV)	D01010 to D01029 (DM01010 to DM01029)	← Measured value (PV) CH1 to CH20
Set value monitor	D01030 to D01049 (DM01030 to DM01049)	← Set value monitor CH1 to CH20
Heat-side manipulated output value	D01050 to D01069 (DM01050 to DM01069)	← Heat-side manipulated output value CH1 to CH20

For the PLC communication environment setting, see **5.1.3 PLC communication environment setting (P. 39)** [MITSUBISHI PLC] or **5.2.3 PLC communication environment setting (P. 57)** [OMRON PLC].

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(3) Structure: C: Data for each channel
M: Data for each module
U: Data for each unit

For heat/cool control, data in the second channel of each module becomes invalid.

[Example] When an SRV unit is configured by one V-TIO-F module and 9 V-TIO-D modules which are heat/cool temperature control modules, up to 20 temperature control channels are available. At this time, as even channels are invalid data in odd channels is used.
Valid channel number: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19
Invalid channel number: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

(4) Attribute: RO: At the time of request command "0: Monitor," SRV writes in data to the PLC.
(SRV → PLC)
R/W: At the time of request command "1: Setting," SRV read out data form the PLC. At the time of request command "2: Set value monitor," SRV writes in data to the PLC.
(SRV ↔ PLC)

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

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

■ Data map list

Name	Register address	Structure	Attribute	Data range	Factory set value
Request command [1]	D01000 (DM01000)	U	R/W	0: Monitor 1: Setting 2: Set value monitor	0
SRV communication state	D01001 (DM01001)	U	RO	0: Unused 1: Writing on monitor data During monitor data of attribute RO is written to PLC 2: Reading out setting data During setting data of attribute R/W is read from PLC 3: Writing on setting data During setting data of attribute R/W is written to PLC	—
SRV normal communication flag [2]	D01002 (DM01002)	U	RO	0/1 transfer (For communication checking) "0" and "1" are repeated for each communication period.	—
—	D01003 (DM01003)	—	—	Do not use this register address as it is used for the internal processing.	—
—	D01004 (DM01004)	—	—		—

[1] 0: Monitor
Command which requests the SRV to write data such as temperature measured values, etc. (attribute: RO) to the PLC side. The SRV always repeats data writing until "1: Setting" or "2: Set value monitor" is set to the request command. The SRV communication state 1 is set to "1: Writing on monitor data" during data transfer.

1: Setting
Command which requests the SRV to read data such as temperature set values, etc. (attribute: RW) from the PLC side. Just when "1: Setting" is set to the request command, the SRV starts reading the data from the PLC side. The SRV communication state 1 is set to "2: Reading out setting data" during data transfer. After the data is transferred, the request command and SRV communication state 1 returns to "0: Monitor" and "1: Writing on monitor data," respectively.

2: Set value monitor
Command which requests the SRV to write data such as temperature set values, etc. (attribute: RW) to the PLC side. Just when "2: Set value monitor" is set to the request command, the SRV starts writing the data to the PLC side. The SRV communication state 1 is set to "3: Writing on setting data" during data transfer. After the data is transferred, the request command and SRV communication state 1 returns to "0: Monitor" and "1: Writing on monitor data," respectively.

[2] The SRV re-writes this area alternately in order of 0→1→0 for each communication period. It is possible to judge that the SRV does not communicate any more by periodically monitoring this area using the PLC program.

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Name	Register address	Struc-ture	Attri-bute	Data range	Factory set value
PLC communication error code [1]	D01005 (DM01005)	U	RO	Bit data b0: PLC register read/write error b1: Slave communication timeout Data 0: OFF 1: ON [Decimal numbers expression: 0 to 3]	—
Unit recognition flag [2]	D01006 (DM01006)	U	RO	Bit data b0: SRV unit 1 b1: SRV unit 2 b2: SRV unit 3 b3: SRV unit 4 Data 0: No unit exists 1: Unit exists [Decimal numbers expression: 0 to 15]	—

[1] b0: PLC register read/write error
To be turned on when data read and write cannot be made to/from the PLC register.
The PLC communication environment setting enables the PLC register read/write error to be eliminated.

☞ For the PLC communication environment setting, see **5.1.3 PLC communication environment setting (P. 39)** [MITSUBISHI PLC] or **5.2.3 PLC communication environment setting (P. 57)** [OMRON PLC].

b1: Slave communication timeout
To be turned on when communication with slave units is timed out during communication with the PLC with SRV units multi-drop connected.
If the slave unit detects the timeout, data send to the PLC stops to be set to the standby state. Communication re-starts after data send re-opens from the master unit.
In addition, if the master unit detects the timeout, data re-send starts.

🕮 Each error state is assigned as a bit image in binary numbers.

Bit image: 00
bit 1 bit 0

[2] For any unit other than a master unit (unit address: 0, 4, 8 or C), only the unit of its own can be recognized.

🕮 Unit recognition state is assigned as a bit image in binary numbers.

Bit image: 0000
bit 3 ····· bit 0

☞ For unit address, see **4.3 Unit Address Setting (P. 22)**.

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Name	Register address	Structure	Attribute	Data range	Factory set value
Maximum number of PLC communication channels *	D01007 (DM01007)	U	RO	1 to 62 CH/unit	—
Number of connected TIO modules	D01008 (DM01008)	U	RO	0 to 31 modules Number of TIO module constituting a SRV unit	—
Number of connected TIO channels	D01009 (DM01009)	U	RO	0 to 62 CH	—
Measured value (PV)	D01010 to D01029 (DM01010 to DM01029)	C	RO	Input range	—
Set value monitor	D01030 to D01049 (DM01030 to DM01049)	C	RO	Input range	—
Heat-side manipulated output value	D01050 to D01069 (DM01050 to DM01069)	C	RO	–5.0 to +105.0 %	—
Cool-side manipulated output value	D01070 to D01089 (DM01070 to DM01089)	C	RO	–5.0 to +105.0 % This is valid only during heat/cool control.	—
CT input measured value	D01090 to D01109 (DM01090 to DM01109)	C	RO	CT type and data range CTL-6-P-N: 0.0 to 30.0 A CTL-12-S56-10L-N: 0.0 to 100.0 A This item is current transformer (CT) input value to use by a heater break alarm (HBA) function.	—

* Set it by PLC communication environment setting.

☞ For the PLC communication environment setting, see **5.1.3 PLC communication environment setting (P. 39)** [MITSUBISHI PLC] or **5.2.3 PLC communication environment setting (P. 57)** [OMRON PLC].

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Name	Register address	Structure	Attribute	Data range	Factory set value
TIO state	D01110 to D01129 (DM01070 to DM01089)	C [1]	RO	Bit data [2] b0: Burnout b1: Event 1 state b2: Event 2 state b3: Heater break alarm (HBA) state b4: Control loop break alarm (LBA) state b5: Unused b6: Unused b7: Unused b8: DI state b9: DO1 state b10: DO2 state b11: Temperature rise completion state b12: Control RUN/STOP state b13: Module error b14: Setting error b15: Error code Data 0: OFF 1: ON [Decimal numbers expression: 0 to 65535]	—

[1] A DI state, a DO1 state, a DO2 state, Control RUN/STOP state and Error code are data of every module. Only channel 1 of each module is valid.
In this table, 20 channels are used. If there are two temperature control channels per module, then the DI, DO1 and DO2 states, Control RUN/STOP state and error codes are valid only for the following register address (10 pcs.).
[D01110, D01112, D01114, D01116, D01118, D01120, D01122, D01124, D01126, D01128]

[2] b0: Burnout
Become ON in input break.

b1, b2: Event 1 state, Event 2 state
Event type: Deviation high, Deviation low, Deviation high/low, Band, Process high, Process low
Can change an event type by host communication.

b3 : Heater break alarm (HBA) state
This is valid only when heater break alarm (HBA) function is used. However, heater break alarm function cannot be used when control output is voltage/current output.

b4: Control loop break alarm (LBA) state
This is valid only when control loop break alarm (LBA) function is used.
The Use/Unuse of the control loop break alarm (LBA) is selected and control loop break alarm (LBA) related settings are made via host communication.

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b5 to b7: Unused

b8: DI state
Valid only when there is optional event input (DI).

b9, b10: DO1 state, DO2 state
Valid only when there is optional event output (DO).

b11: Temperature rise completion state
A temperature rise is complete just when the temperature rise completion soak time elapses after the measured value (PV) enters the temperature rise completion zone. The setting relating to temperature rise completion is made via host communication.

b12: Control RUN/STOP state
Control RUN/STOP can be executed via communication or by DI. In this Control RUN/STOP state, the present control state is displayed regardless of the execution via communication or by DI.

When the DI setting is "Control RUN/STOP," the instrument cannot be changed to the RUN by communication, if the instrument is STOP state by the contact input. (The "STOP" has priority.)

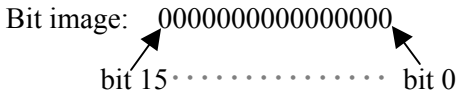
RUN/STOP state by DI	RUN/STOP transfer by communication	Instrument state
RUN (contact close)	RUN	RUN
	STOP	STOP
STOP (contact open)	RUN	STOP
	STOP	STOP

b13: Module error
To be turned on when no communication with the relevant module (channel) can be conducted (no response).

b14: Setting error
To be turned on when the setting of the relevant channel exceeds the data range.

b15: Error code
To be turned on when the value becomes more than 1 as any error occurs in the host communication error code (see P. 121 or P. 145).

TIO state is assigned as a bit image in binary numbers.



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Name	Register address	Structure	Attribute	Data range	Factory set value
Operation mode	D01130 to D01149 (DM01130 to DM01149	C	R/W	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	Heat control: CH1: 3, CH2: 3 Heat/cool control: CH1: 3, CH2: 0
Set value (SV)	D01150 to D01169 (DM01150 to DM01169)	C	R/W	TC/RTD input: Within input range Voltage/current input: Input scale low limit to Input scale high limit	0 (0.0)
Heat-side proportional band	D01170 to D01189 (DM01170 to DM01189)	C	R/W	TC/RTD input: 0 (0.0) to Input span [°C (°F)] Voltage (V)/current (I) input: 0.0 to 100.0 % of input span 0 (0.0): ON/OFF action	TC/RTD: 30 (30.0) V/I: 30.0
Integral time	D01190 to D01209 (DM01190 to DM01209)	C	R/W	1 to 3600 seconds	240
Derivative time	D01210 to D01229 (DM01210 to DM01229)	C	R/W	0 to 3600 seconds 0: Derivative action OFF (PI action)	60
PV bias	D01230 to D01249 (DM01230 to DM01249)	C	R/W	–Input span to +Input span	0 (0.0)
Event 1 set value	D01250 to D01269 (DM01250 to DM01269)	C	R/W	Deviation high/Deviation low: –Input span to +Input span Deviation high/low, Band: 0 to Input span	0 (0.0)
Event 2 set value	D01270 to D01289 (DM01270 to DM01289)	C	R/W	Process high/Process low: Within input range Can change an event type by host communication.	0 (0.0)

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Name	Register address	Structure	Attribute	Data range	Factory set value
Cool-side proportional band	D01290 to D01309 (DM01290 to DM01309)	C	R/W	TC/RTD input: 1 (0.1) to Input span [°C (°F)] Voltage (V)/current (I) input: 0.1 to 100.0 % of input span This is valid only during heat/cool control.	TC/RTD: 30 (30.0) V/I: 30.0
Overlap/Deadband	D01310 to D01329 (DM01310 to DM01329)	C	R/W	–Input span to +Input span Deadband: Control deadband between heat-side and cool-side proportional bands. Minus (–) setting results in overlap. This is valid only during heat/cool control.	0 (0.0)
Setting change rate limiter	D01330 to D01349 (DM01330 to DM01349)	C	R/W	0 (0.0) to Input span/minute 0 (0.0): Setting change rate limiter OFF	0 (0.0)
PID/AT transfer *	D01350 to D01369 (DM01350 to DM01369)	C	R/W	0: PID control 1: Autotuning (AT) When the autotuning is finished, the controller will automatically returns to "0: PID control operation."	0
Auto/Manual transfer	D01370 to D01389 (DM01370 to DM01389)	C	R/W	0: Auto mode 1: Manual mode No manual mode can be set for heat/cool control.	0
Manual output value	D01390 to D01409 (DM01390 to DM01409)	C	R/W	–5.0 to +105.0 % Manual output value cannot be output in heat/cool control.	0.0

* Caution for using the Autotuning (AT)
When a temperature change (UP and/or Down) is 1 °C (1 °F) or less per minute during Autotuning, Autotuning may be cancelled before calculating PID values. In that case, adjust the PID values manually. It is possible to happen when the set value is around the ambient temperature or is close to the maximum temperature achieved by the load.

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Name	Register address	Structure	Attribute	Data range	Factory set value
Heater break alarm (HBA) set value [1]	D01410 to D01429 (DM01410 to DM01429)	C	R/W	CT type and data range CTL-6-P-N: 0.0 to 30.0 A CTL-12-S56-10L-N: 0.0 to 100.0 A	0.0
Control RUN/STOP [2]	D01430 to D01449 (DM01430 to DM01449)	M	R/W	0: STOP 1: RUN	0
DI setting [2]	D01450 to D01469 (DM01450 to DM01469)	M	R/W	0: Unused 1: Control RUN/STOP 2: Event interlock release Except the above (within 0 to 20): Unused Valid only when there is optional event input (DI).	Specify when ordering

[1]
- Set the HBA set value to approximately 85% of the maximum reading of the CT input.
- Set the HBA set value to a slightly smaller value to prevent a false alarm if the power supply may become unstable.
- When more than one heater is connected in parallel, it may be necessary to increase the HBA setting value to detect a single heater failure.

 Heater break alarm function cannot be used with voltage/current output.

[2] Control RUN/STOP and a DI setting are data of every module. Only channel 1 of each module is valid.

In this table, 20 channels are used. If there are two temperature control channels per module, then the Control RUN/STOP and DI setting are valid only for the following register address (10 pcs.).

- Control RUN/STOP: D01430, D01432, D01434, D01436, D01438, D01440, D01442, D01444, D01446, D01448
- DI setting: D01450, D01452, D01454, D01456, D01458, D01460, D01462, D01464, D01466, D01468

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Name	Register address	Structure	Attribute	Data range	Factory set value
DO1 setting [1, 2]	D01470 to D01489 (DM01470 to DM01489)	M	R/W	0: Unused 1: CH1 Event 1 state 2: CH2 Event 1 state 3: CH1 Event 2 state 4: CH2 Event 2 state 5: CH1 Heater break alarm state 6: CH2 Heater break alarm state 7: CH1 Control loop break alarm state 8: CH2 Control loop break alarm state 9: CH1 Burnout state 10: CH2 Burnout state 11: CH1 Temperature rise completion state 12: CH2 Temperature rise completion state Except the above (within 0 to 20): Unused	Specify when ordering
DO2 setting [1, 2]	D01490 to D01509 (DM01490 to DM01509)	M	R/W		Specify when ordering
DO state [1, 2]	D01510 to D01529 (DM01070 to DM01089)	M	R/W	0: DO1: Contact open (OFF) DO2: Contact open (OFF) 1: DO1: Contact closed (ON) DO2: Contact open (OFF) 2: DO1: Contact open (OFF) DO2: Contact closed (ON) 3: DO1: Contact closed (ON) DO2: Contact closed (ON) Data write is enabled only when both of the DO1 and DO2 set values are equal to "0."	0

[1] A DO1 setting, a DO2 setting and a DO state are data of every module. Only channel 1 of each module is valid.
In this table, 20 channels are used. If there are two temperature control channels per module, then the DO1 and DO2 settings and DO state are valid only for the following register address (10 pcs.).

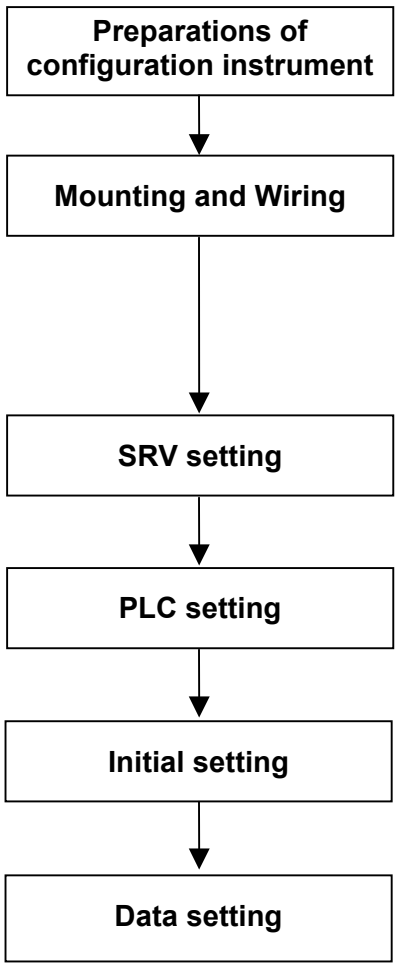
- DO1 setting: D01470, D01472, D01474, D01476, D01478, D01480, D01482, D01484, D01486, D01488
- DO2 setting: D01490, D01492, D01494, D01496, D01498, D01500, D01502, D01504, D01506, D01508
- DO state: D01510, D01512, D01514, D01516, D01518, D01520, D01522, D01524, D01526, D01528

[2] Valid only when there is optional event output (DO).

5.5 Usage Example

In this Chapter, an example of data setting procedure is explained when the SRV is connected to a PLC of MITSUBISHI MELSEC series.

5.5.1 Handling procedures



☞ See **5.5.2 System configuration (P. 84)**.

☞
- See **5.5.3 Connection with PLC (P. 85)**.
- For mounting of SRV, see the instruction manual of each module.
- For mounting and wiring of PLC, see the instruction manual for the used PLC.

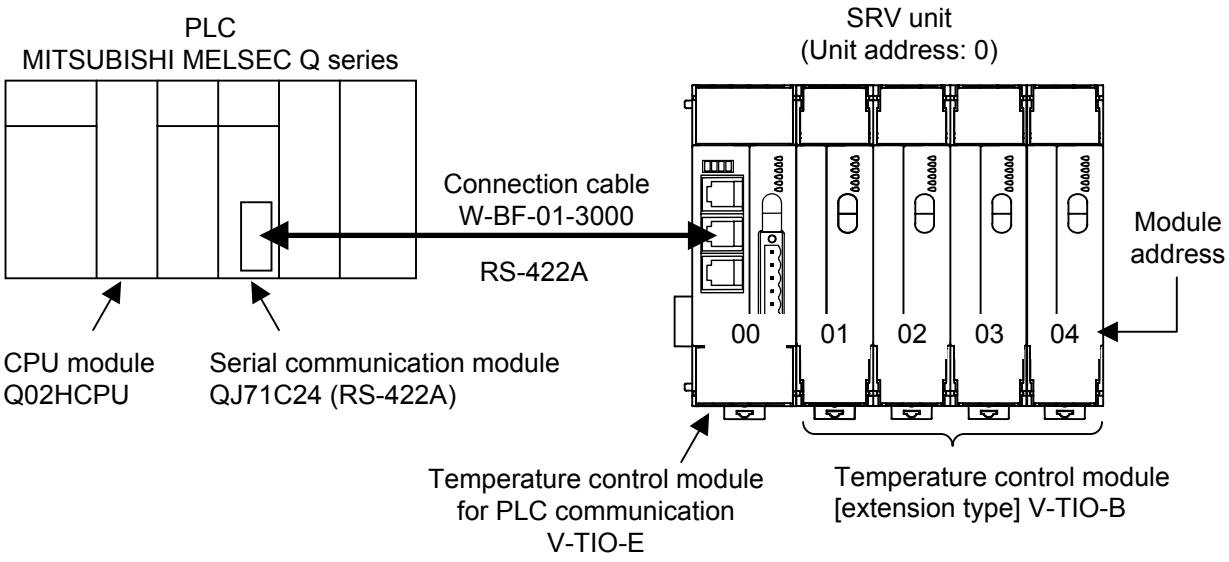
☞ See **5.5.4 SRV setting (P. 86)**.

☞ See **5.5.5 PLC setting (P. 91)**.

☞ See **5.5.6 Initial setting (P. 93)**.

☞ See **5.5.7 Data setting (P. 94)**.

5.5.2 System configuration



■ Use instruments

- **MITSUBISHI MELSEC Q series**

  CPU module Q02HCPU 1
  Serial communication module QJ71C24 (RS-422A).....1
  Power supply, I/O module, etc.

- **SRV unit**

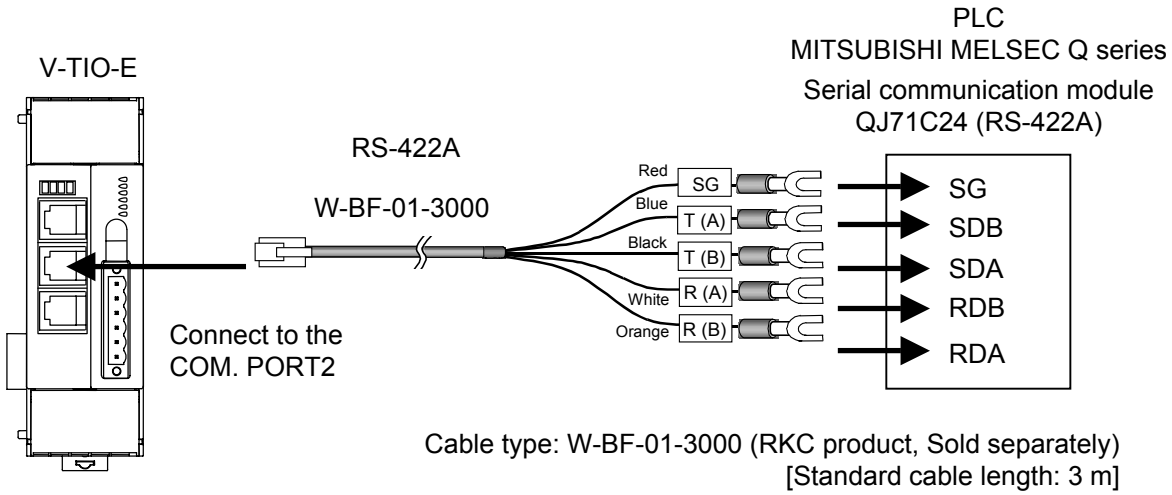
  Temperature control module for PLC communication V-TIO-E....1
  Temperature control module [extension type] V-TIO-B.....4

- **Connection cable for connecting SRV unit and PLC**

  W-BF-01-3000 (RKC product, Sold separately) [Standard cable length: 3 m] 1

5.5.3 Connection with PLC

Connect V-TIO-E module and PLC (Serial communication module).
An assignment of a communication port is “COM. PORT1: Host communication 1, COM. PORT2/3: PLC communication.”
For the connection cable, use the W-BF-01-3000 (RKC product).

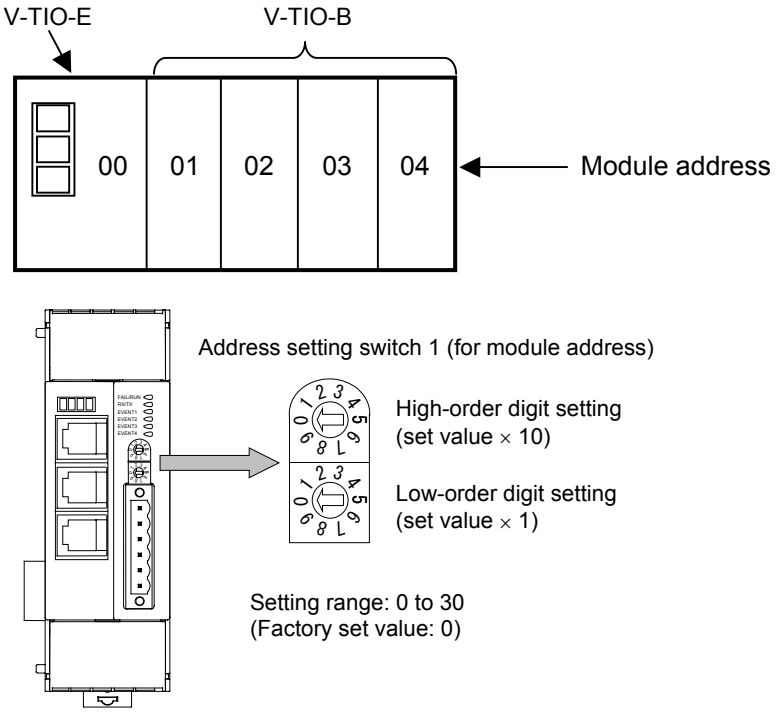


- Shields of the connection cable (W-BF-01-3000) are connected to SG (No. 6 pin) of the COM. PORT2 connector of the V-TIO-E/F module.
- ☞ For the communication port assignment, see ■ **PLC communication setting (P. 87)**.
- ☞ The details of the connectable connector for the PLC, see the instruction manual for the PLC being used.
- ☞ When be prepared cable with a customer, see **5.1.2 Wiring (P. 33)**.

5.5.4 SRV setting

■ Module address setting

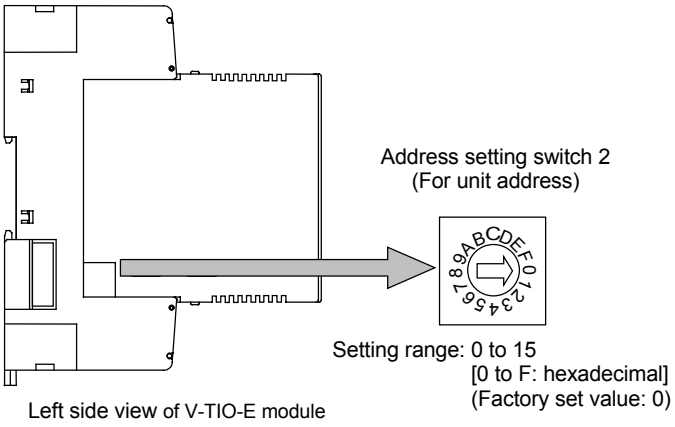
Set the module address by address setting switch 1 of front of module. For this setting, use a small blade screwdriver.
In this application, make the setting as follows.



The above figure is V-TIO-E module. The figure of V-TIO-B module is the same as a V-TIO-E module.

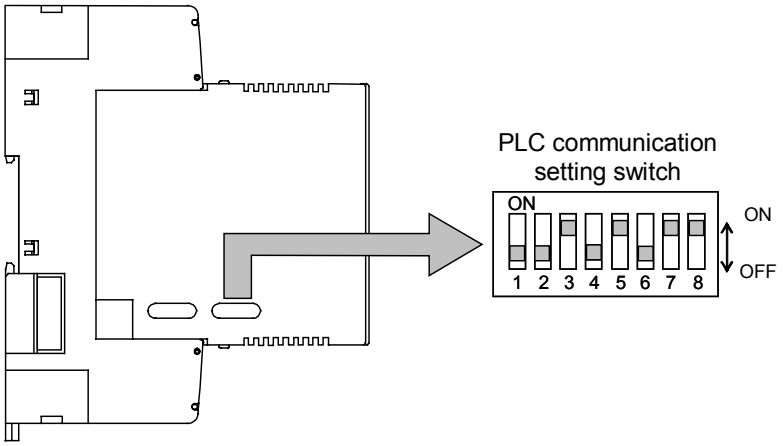
■ Unit address setting

Set the unit address by address setting switch 2 of left side of V-TIO-E module. For this setting, use a small blade screwdriver.
In this application, the unit address is assumed to be "0."



■ PLC communication setting

The PLC communication setting switch on the left side of the V-TIO-E module enables the setting of communication speed, data bit configuration and protocol, and assign the communication port to the front of the V-TIO-E module.
In the usage example, set it as follows.



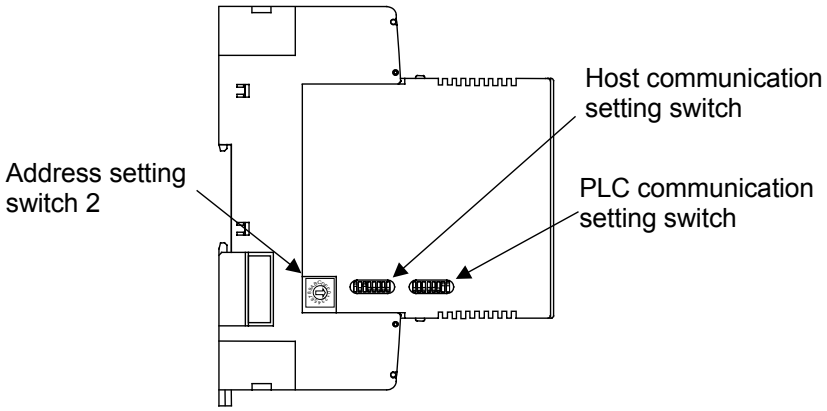
Left side view of V-TIO-E module

PLC communication setting switch		Setting contents
1	OFF	Data bit configuration
2	OFF	Data 8-bit, Without parity, Stop 1-bit
3	ON	Communication speed
4	OFF	19200 bps
5	ON	Protocol
6	OFF	MITSUBISHI MELSEC series special protocol
7	ON	AnA/AnUCPU common command (QR/QW)
8	ON	Communication port COM. PORT1: Host communication 1 [RS-232C/RS-422A] COM. PORT2/COM. PORT3: PLC communication [RS-422A]

☞ For details of setting, see **4.4 Communication Setting Switch (P. 23)**.

■ PLC communication environment setting

In this application, the PLC communication environment is set as follows by switch.
Address setting switch 2 and the host communication setting and PLC communication setting switches at the left side of the V-TIO-E module are used.



Left side view of V-TIO-E module

☞ For setting procedure, see ■ **Setting by the switch (P. 43)** of **5.1.3 PLC communication environment setting**.

- **Setting items with the host communication setting switch**

Switch No.	Setting items	Set value
1	Station number	0
2	PC number (CPU number)	255
3	Register start number	1000
4	Maximum number of PLC communication channels	10 CH
5	Register type (D, R, W)	D register
6	PLC scanning time setting	255 ms
7	V-TIO-E/F module Link recognition time	10 seconds
8	Unused (Do not set this one)	—

- **Setting items with the PLC communication setting switch**

Switch No.	Setting items	Set value
1	V-TIO-E/F module monitor item selection	C: Measured value (PV), Set value monitor, Heat-side output value, TIO state
2 to 5	Unused (Do not set this one)	—
6	Action mode selection	1: Free setting, Manual elimination
7, 8	Unused (Do not set this one)	—

■ PLC communication register address

The register address of each data in PLC communication becomes as follows with the register start number set to “1000,” the maximum number of PLC communication channels set to “10 CH” and the register type set to “D register” in PLC communication environment setting items.

Register address	Communication items	
D01000	Request command	
D01001	SRV communication state	
D01002	SRV normal communication flag	
D01003 D01004	Do not use this register address as it is used for the internal processing.	
D01005	PLC communication error code	
D01006	Unit recognition flag	
D01007	Maximum number of PLC communication channels	
D01008	Number of connected TIO modules	
D01009	Number of connected TIO channels	
D01010 to D01019	Measured value (PV)	CH1 to CH10
D01020 to D01029	Set value monitor	CH1 to CH10
D01030 to D01039	Heat-side manipulated output value	CH1 to CH10
D01040 to D01049	Cool-side manipulated output value	CH1 to CH10
D01050 to D01059	CT input measured value	CH1 to CH10
D01060 to D01069	TIO state	CH1 to CH10
D01070 to D01079	Operation mode	CH1 to CH10
D01080 to D01089	Set value (SV)	CH1 to CH10
D01090 to D01099	Heat-side proportional band	CH1 to CH10
D01100 to D01109	Integral time	CH1 to CH10
D01110 to D01119	Derivative time	CH1 to CH10
D01120 to D01129	PV bias	CH1 to CH10
D01130 to D01139	Event 1 set value	CH1 to CH10
D01140 to D01149	Event 2 set value	CH1 to CH10
D01150 to D01159	Cool-side proportional band	CH1 to CH10
D01160 to D01169	Overlap/Deadband	CH1 to CH10
D01170 to D01179	Setting change rate limiter	CH1 to CH10
D01180 to D01189	PID/AT transfer	CH1 to CH10
D01190 to D01199	Auto/Manual transfer	CH1 to CH10
D01200 to D01209	Manual output value	CH1 to CH10
D01210 to D01219	Heater break alarm (HBA) set value	CH1 to CH10
D01220 to D01229	Control RUN/STOP	CH1 to CH10
D01230 to D01239	DI setting	CH1 to CH10
D01240 to D01249	DO1 setting	CH1 to CH10
D01250 to D01259	DO2 setting	CH1 to CH10
D01260 to D01269	DO state	CH1 to CH10

■ Internal communication setting

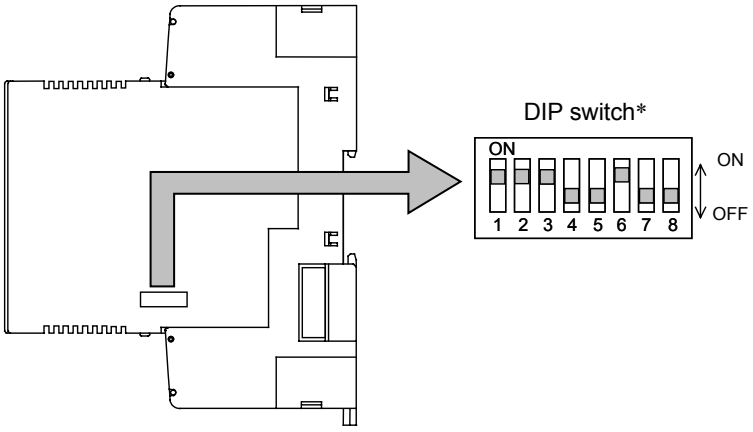
All of the modules in the SRV unit need to be set to the same settings as the internal communication settings.
The internal communication settings are made by the DIP switch* at the right side of each module. In addition, the assignment to each DIP switch* is the same.
As the factory set values set to the V-TIO-E module are also used as its internal communication settings, match the DIP switch settings of the V-TIO-B module with those of the V-TIO-E module.

[Factory set value of V-TIO-E module]

- Communication speed: 38400 bps
- Data bit configuration: Data 8-bit, Without parity, Stop 1-bit
- Protocol: Modbus

[DIP switch state of V-TIO-E and V-TIO-B module]

The V-TIO-E module is set as follows prior to factory shipment. Set the V-TIO-B module as follows.



Right side view

DIP switch*		Setting contents
1	ON	Communication speed: 38400 bps
2	ON	
3	ON	Data bit configuration: Data 8-bit
4	OFF	Without parity
5	OFF	Stop 1-bit
6	ON	Protocol: Modbus
7	OFF	OFF fixed (Do not change this one)
8	OFF	OFF fixed (Do not change this one)

* For the V-TIO-E module, the DIP switch is referred to as the "Internal communication setting switch."

5.5.5 PLC setting

Set the Serial communication module of MITSUBISHI MELSEC Q series as follows.

Setting item	Description
Operation setting	Independent
Data bit	8
Parity bit	NO
Even/odd parity	Odd
Stop bit	1
Sum check code	YES

Setting item	Description
Writing during RUN	Allowed
Setting modification	Allowed
Communication rate	19200 bps
Communication protocol	MC protocol, Format 4
Station number	0

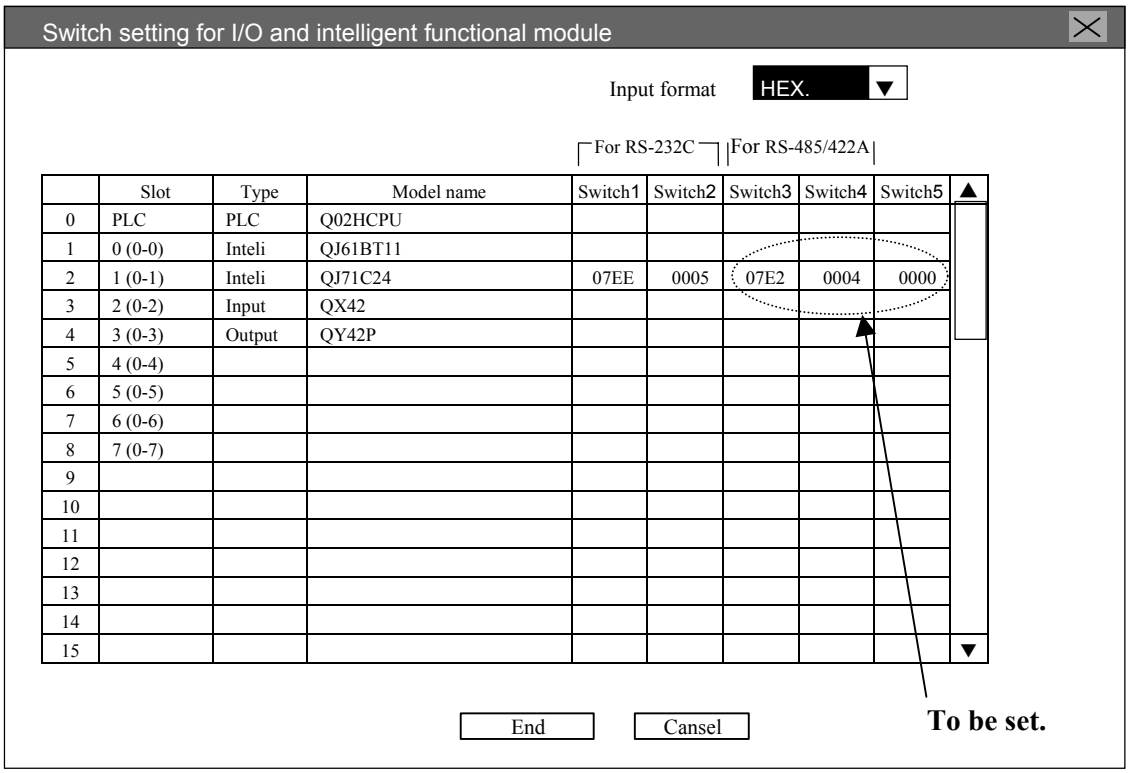
Setting in the serial communication module (QJ71C24) belonging to the MITSUBISHI MELSEC Q series do with the GX Developer of the MITSUBISHI MELSEC PLC programming software (SW□D5C-GPPW-E).
Setting set the following set value with switch setting for I/O and intelligent functional module.

Switch 3: **07E2 *** Switch 4: **0004 *** Switch 5: **0000 *** * Hexadecimal

[Setting procedure]

[GX Developer] → [PLC parameters] → [I/O assignment setting] → **Switch setting**

[Setting screen]



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- **Description Switches 1 to 5**

Switch number	Description	
Switch 1	b15 to b8	b7 to b0
	CH1 Communication rate setting	CH1 Transmission setting
Switch 2	CH1 Communication protocol setting	
Switch 3	b15 to b8	b7 to b0
	CH2 Communication rate setting	CH2 Transmission setting
Switch 4	CH2 Communication protocol setting	
Switch 5	Station number setting	

Set the transmission specifications and communication protocol of each interface using the combinations of setting values for each switch with 16-bit binary data.

- **Setting on switch 3 (CH2 Transmission setting)**

Bit	Description	OFF (0)	ON (1)	Setting	Set value
b0	Operation setting *	Independent	Link	0	2
b1	Data bit	7	8	1	
b2	Parity bit	No	Yes	0	
b3	Even/Odd parity	Odd	Even	0	
b4	Stop bit	1	2	0	E
b5	Sum check code	No	Yes	1	
b6	Write during RUN	Prohibited	Allowed	1	
b7	Setting modifications	Prohibited	Allowed	1	

* Must be set to OFF (0) on CH1

- **Setting on switch 3 (CH2 Communication rate setting)**

Communication rate (Unit: bps)	Bit position b15 to b8	Communication rate (Unit: bps)	Bit position b15 to b8
300	00H	14400	06H
600	01H	19200	07H
1200	02H	28800	08H
2400	03H	38400	09H
4800	04H	57600	0AH
9600	05H	115200	0BH

Set 19200 bps on communication rate. (Set value: 07H)

- **Setting on switch 4 (CH2 Communication protocol setting)**

Set number	Description	
0H	GX Developer connection	
1H	MC protocol	Format 1
2H		Format 2
3H		Format 3
4H		Format 4
5H		Format 5

Set number	Description
6H	Non procedure protocol
7H	Bidirectional protocol
8H	For linked operation setting
9H to DH	Setting prohibited
EH	ROM/RAM/switch test
FH	Individual station loopback test

Set MC protocol Format 4 on communication protocol setting. (Set value: 4H)

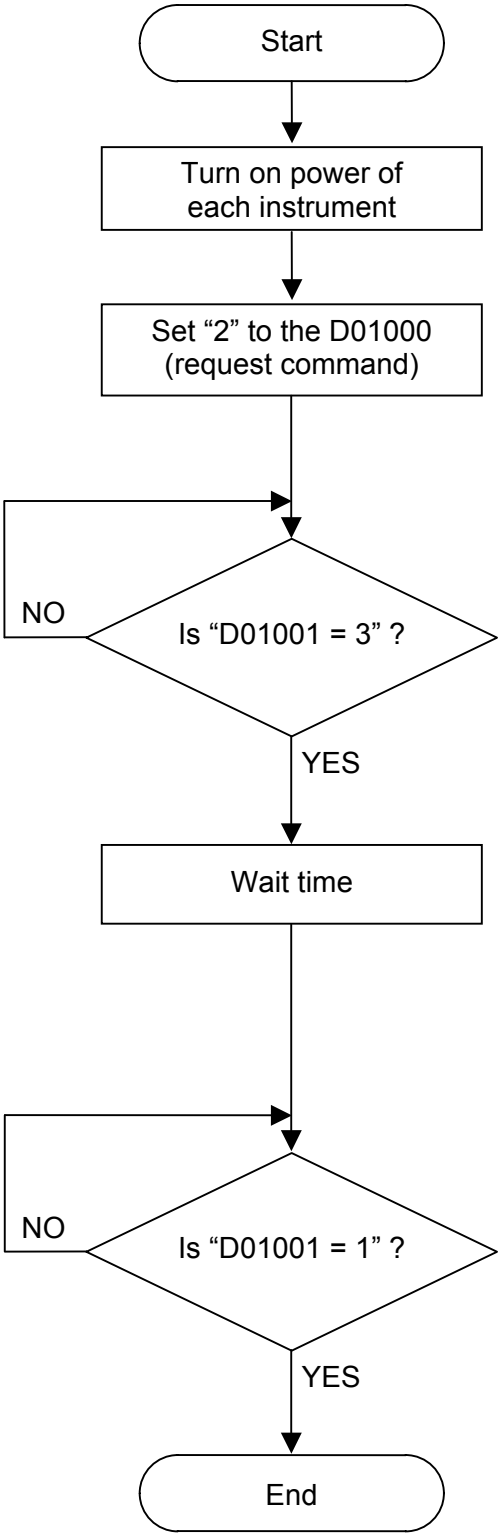
- **Setting on switch 5 (Station number setting)**

This setting is common for both CH1 and CH2 sides.
Set the station number to 0.

☞ The details of the switch setting for the PLC, see the instruction manual for the PLC being used.

5.5.6 Initial setting

Change each set value of SRV from the PLC after the initial settings are made.



When 2 (Set value monitor) is set to **D01000** (request command), the SRV starts writing the data items such as temperature set value, etc. (attribute: R/W) to the PLC side.

If 3 (Writing on setting data) is set to **D01001** (SRV communication state) in the PLC, this indicates that SRV data items such as temperature set value, etc. (attribute: R/W) are being written into the PLC.

Reserve data write time as wait time. In addition, process data in each item as indefinite during this period.

Writing time [for 38400 bps]
= About 0.7 seconds + (Maximum number of PLC communication channels × 25 ms)
+ (PLC response time [ms] × 23)

If 1 (Writing on monitor data) is set to **D01001** (SRV communication state) in the PLC, this indicates that SRV data items such as temperature set value, etc. (attribute: R/W) have been written to start writing SRV data items such as temperature measured values (PV), etc. (attribute: RO) into the PLC.

5.5.7 Data setting

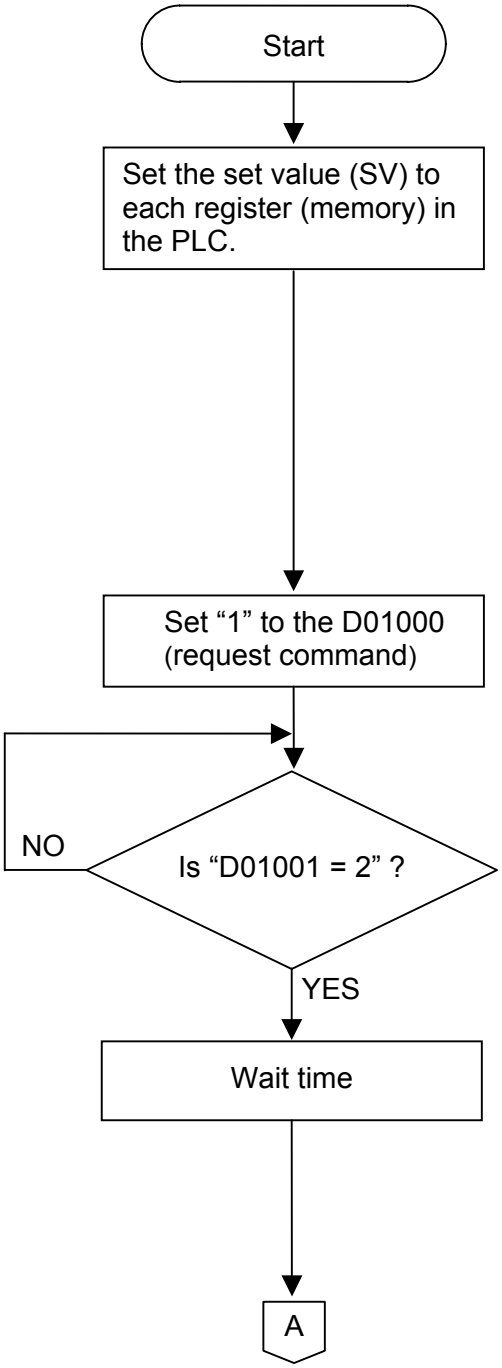
It is assumed that initial setting is finished.

If each set value of SRV is changed from the PLC without setting the initial values, it is re-written to 0 with each set value of the PLC at that time set to 0.

■ Setting example

When set the set value (SV) of SRV as follows:

Set value (SV) CH1=100 CH2=100 CH3=110 CH4=110 CH5=120
CH6=120 CH7=130 CH8=130 CH9=50 CH10=50



Register address of set value (SV) (see P. 89)

Register address	Communication item	Set value
D01080	Set value (SV) CH1	100
D01081	Set value (SV) CH2	100
D01082	Set value (SV) CH3	110
D01083	Set value (SV) CH4	110
D01084	Set value (SV) CH5	120
D01085	Set value (SV) CH6	120
D01086	Set value (SV) CH7	130
D01087	Set value (SV) CH8	130
D01088	Set value (SV) CH9	50
D01089	Set value (SV) CH10	50

[Data setting]
When 1 (Setting) is set to **D01000** (request command), the SRV starts reading the set value (SV) data set to the register (memory) on the PLC side

If 2 (Reading out setting data) is set to **D01001** (SRV communication state) in the PLC, this indicates that set values (SV) data are being read from the PLC.

Reserve data read time as wait time. In addition, process data in each item as indefinite during this period.

Readout time [for 38400 bps]
= About 0.7 seconds + (Maximum number of PLC communication channels × 25 ms)
+ (Number of connected TIO channels × 100 ms)
+ (Number of setting change channels × 100 ms)
+ (PLC response time [ms] × 23)

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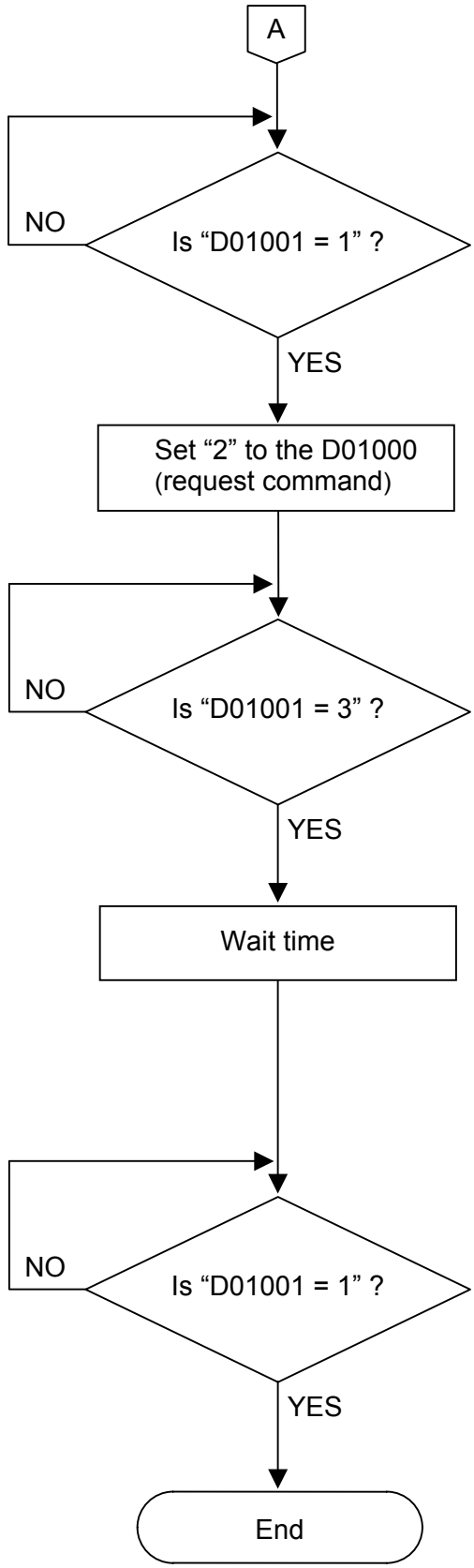


If 1 (Writing on monitor data) is set to **D01001** (SRV communication state) in the PLC, this indicates that set value (SV) data have been read to start writing SRV data items such as measured values (PV) etc. (attribute: RO) into the PLC.

[Confirmation of setting data]

When 2 (Set value monitor) is set to **D01000** (request command), the SRV starts writing the set value (SV) data set to the PLC side.

If 3 (Writing on setting data) is set to **D01001** (SRV communication state) in the PLC, this indicates that SRV set value (SV) data are being written into the PLC.

Reserve data write time as wait time. In addition, process data in each item as indefinite during this period.

Writing time [for 38400 bps]
= About 0.7 seconds + (Maximum number of PLC communication channels × 25 ms)
+ (PLC response time [ms] × 23)

If 1 (Writing on monitor data) is set to **D01001** (SRV communication state) in the PLC, this indicates that set values (SV) have been written to start writing SRV data items such as measured values (PV), etc. (attribute: RO) into the PLC.

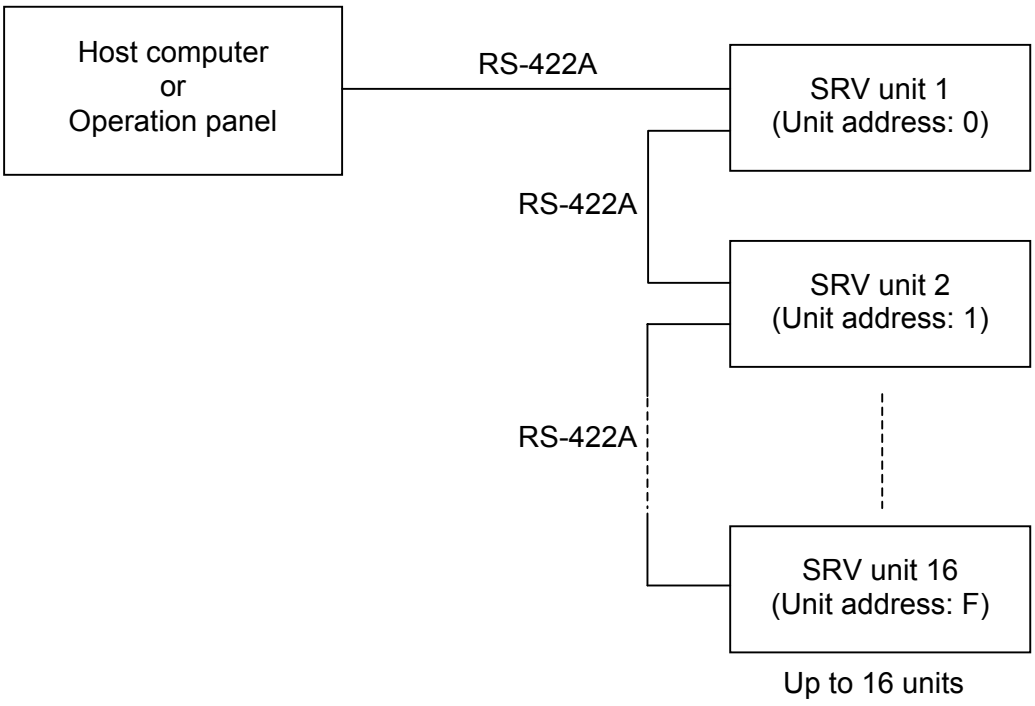
6. HOST COMMUNICATION

6.1 Outline

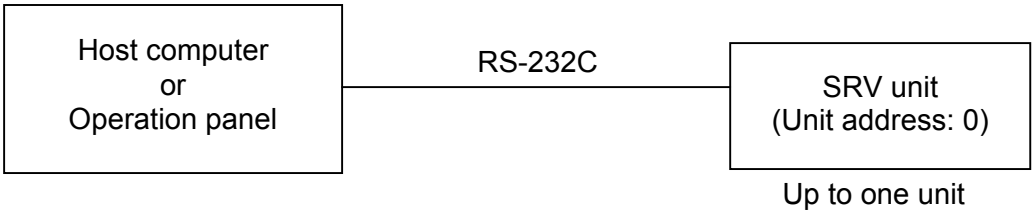
Three communication ports (COM. PORT1 to 3) of the V-TIO-E/F module can be selected from among the following four assignments. (The communication specification of COM. PORT2 is the same as that of COM. PORT3.)
Host communication 1 can be used in any communication port assignment. In addition, it is possible to use two host communication line.

	Assignment 1	Assignment 2	Assignment 3	Assignment 4
COM. PORT1	Host communication 1	PLC communication	Host communication 1	Host communication 2
COM. PORT2/ COM. PORT3	PLC communication	Host communication 1	Host communication 2	Host communication 1

- **RS-422A**



- **RS-232C**



6.2 Wiring

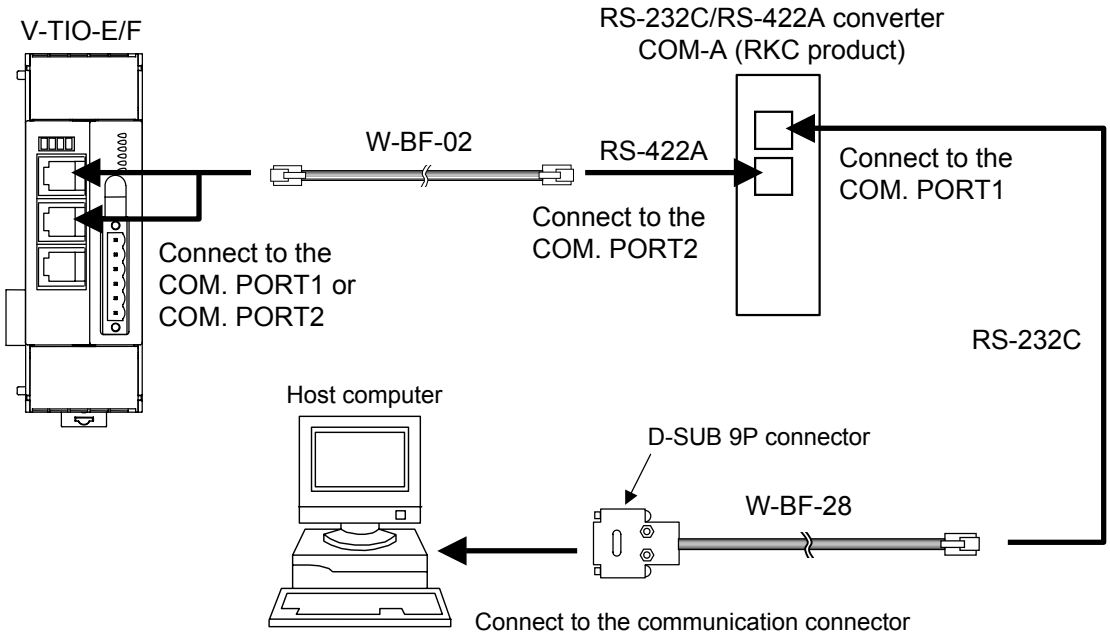
⚠ WARNING

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

CAUTION

- Connect connectors correctly in the right position. If it is forcibly pushed in with pins in the wrong positions, the pins may be bent resulting in instrument failure.
- When connecting or disconnecting the connectors, do not force it too far to right and left or up and down, but move it on the straight. Otherwise, the connector pins may be bent, causing instrument failure.
- When disconnecting a connector, hold it by the connector itself. Disconnecting connectors by yanking on their cables can cause breakdowns.
- To prevent malfunction, never touch the contact section of a connector with bare hands or with hands soiled with oil or the like.
- To prevent malfunction, connect cable connectors securely, then firmly tighten the connector fastening screws.
- To prevent damage to cables, do not bend cables over with excessive force.
- If the instrument is easily affected by noise, use the ferrite core in the both ends of the communication cable (nearest the connector).

■ RS-422A



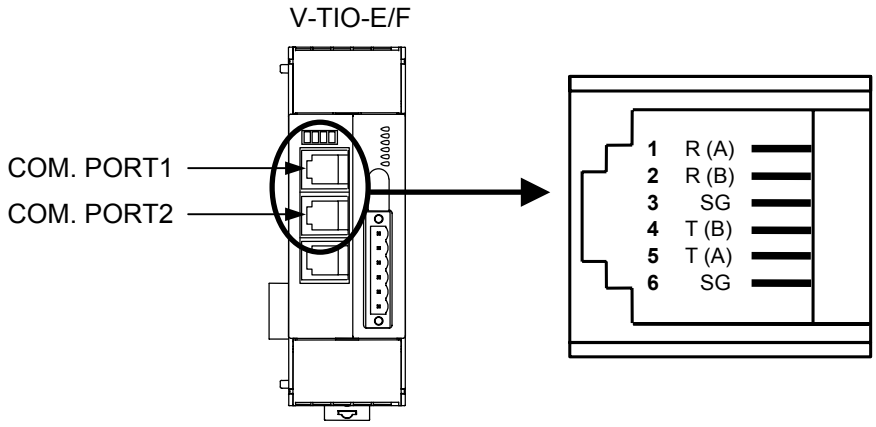
Cable type: W-BF-02-3000 (RKC product, Sold separately) [Standard cable length: 3 m]
W-BF-28-3000 (RKC product, Sold separately) [Standard cable length: 3 m]

Connection cable W-BF-02 * and W-BF-28 (RKC product) can use to connect the host computer.
* Shields of the cable are connected to SG (No. 6 pin) of the V-TIO-E/F connector.

Recommended RS-232C/RS-422A converter: **COM-A** (RKC product)
For the COM-A, see **COM-A/COM-B Instruction Manual (IMSRM33-E□)**.

For the communication port assignment of the V-TIO-E/F module, see **4.1 Communication Port Assignments (P. 14)**.

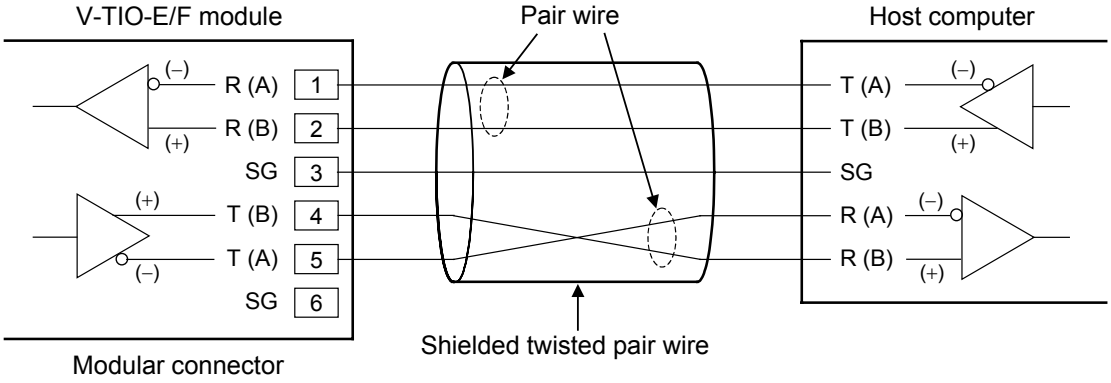
● Pin layout of modular connector



- **Connector pin number and signal details**

Pin No.	Signal name	Symbol
1	Receive data	R (A)
2	Receive data	R (B)
3	Signal ground	SG
4	Send data	T (B)
5	Send data	T (A)
6	Signal ground	SG

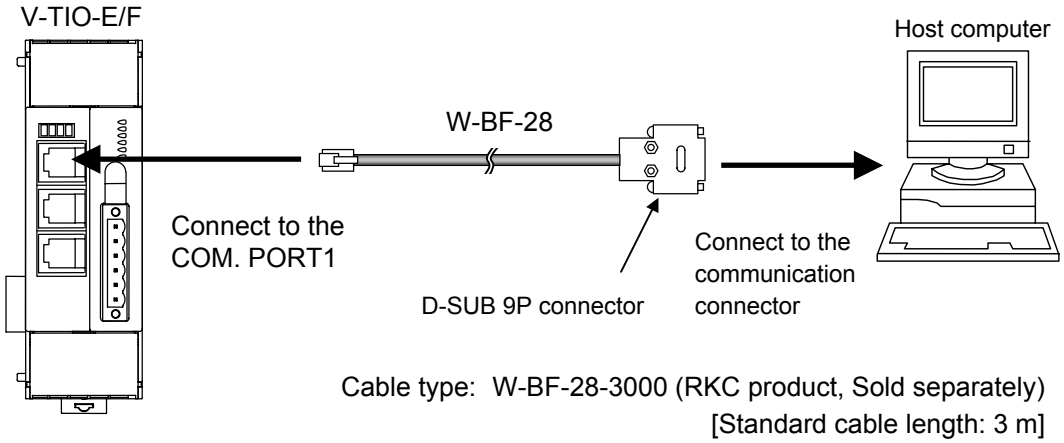
- **Diagram of RS-422A wiring**



The 6-pin type modular connector should be used for the connection to the V-TIO-E/F module. Recommended model: TM4P-66P (Manufactured by HIROSE ELECTRIC CO., LTD.)

Customer is requested to prepare a communication cable fit for the control unit to be connected by the host computer.

■ RS-232C

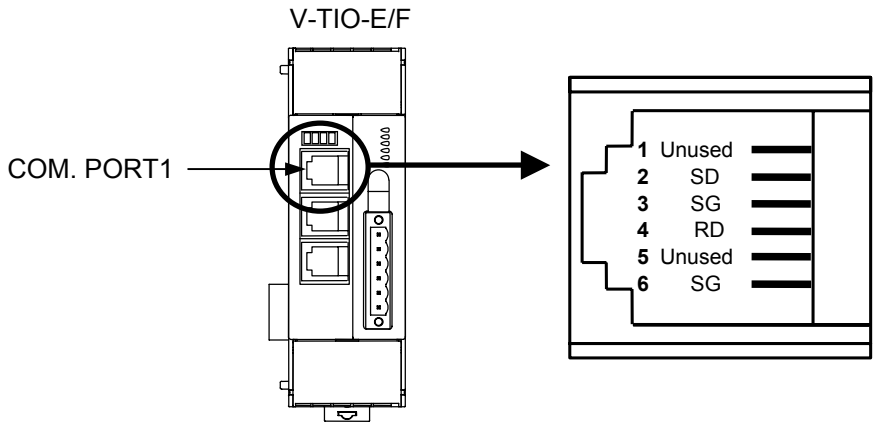


Cable type: W-BF-28-3000 (RKC product, Sold separately)
[Standard cable length: 3 m]

Connection cable W-BF-28 * (RKC product) can use to connect the host computer.
* Shields of the cable are connected to SG (No. 6 pin) of the V-TIO-E/F connector.

For the communication port assignment, see **4.1 Communication Port Assignments (P. 14)**.

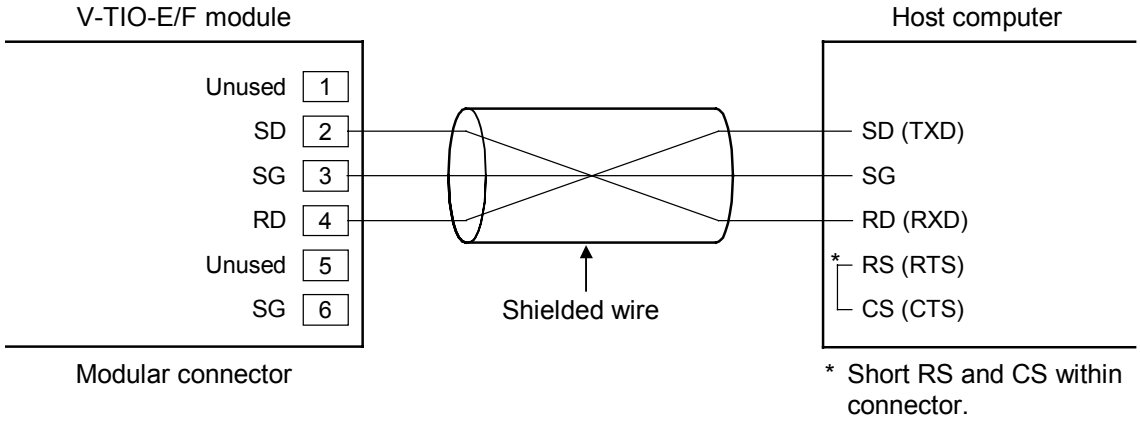
- **Pin layout of modular connector**



- **Connector pin number and signal details**

Pin No.	Signal name	Symbol
1	Unused	—
2	Send data	SD (TXD)
3	Signal ground	SG
4	Receive data	RD (RXD)
5	Unused	—
6	Signal ground	SG

- **Diagram of RS-232C wiring**



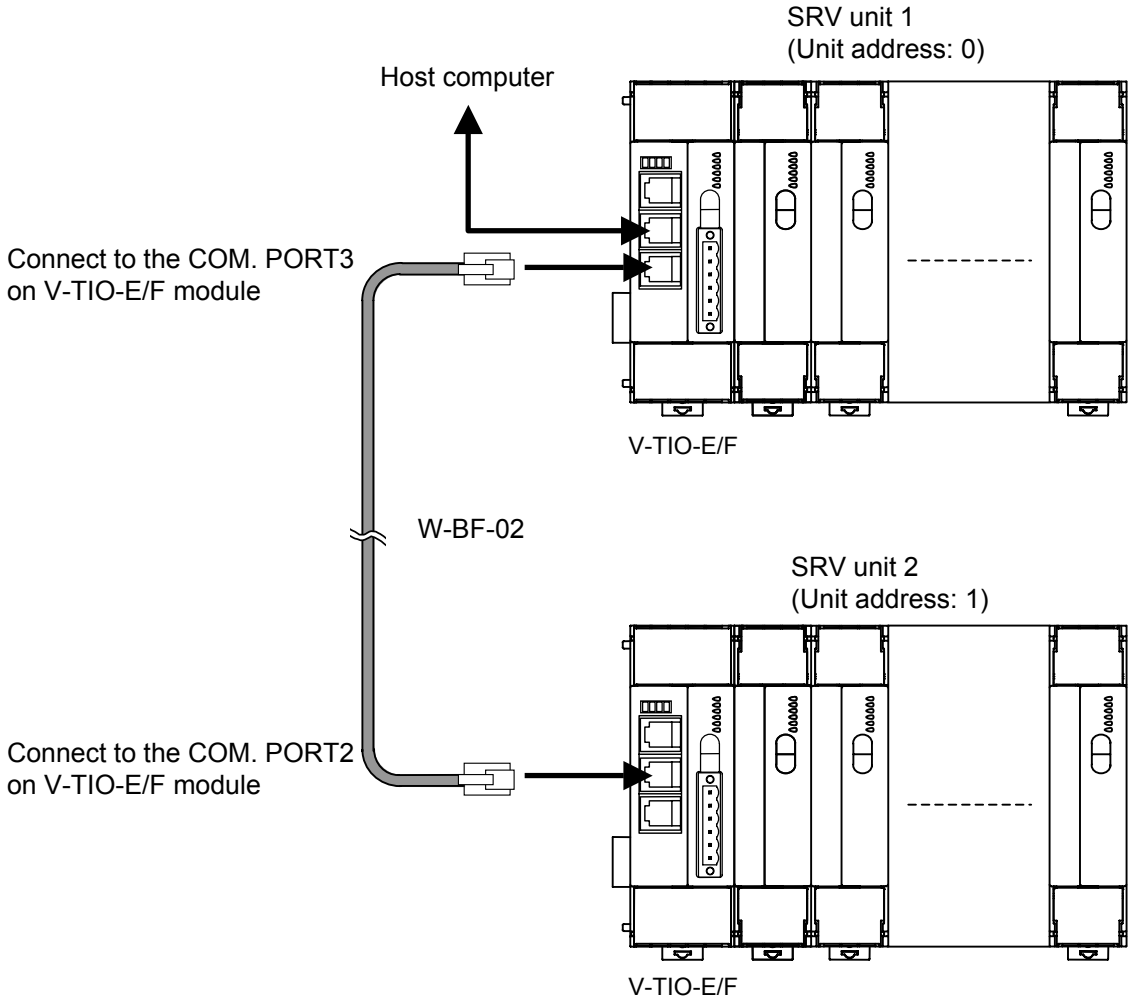
The 6-pin type modular connector should be used for the connection to the V-TIO-E/F module. Recommended model: TM4P-66P (Manufactured by HIROSE ELECTRIC CO., LTD.)

Customer is requested to prepare a communication cable fit for the control unit to be connected by the host computer.

■ Multiple SRV unit connections

● When using COM. PORT2 and COM. PORT3

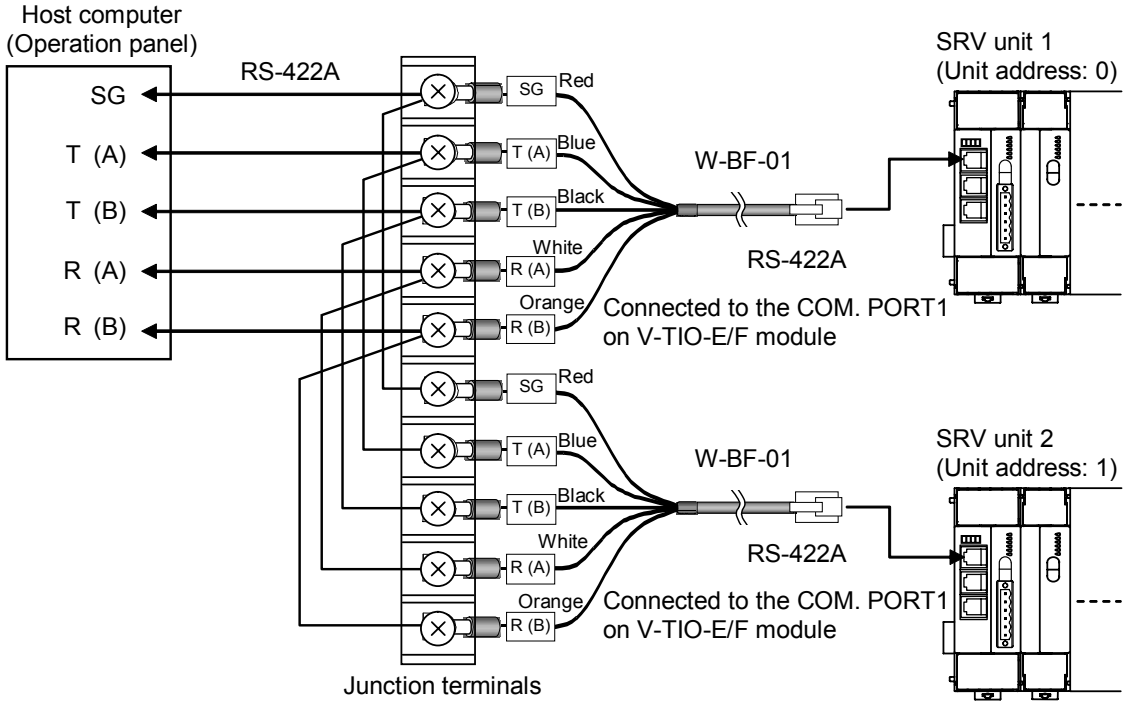
COM. PORT2/COM. PORT3 are connectors for multi-drop connection of the SRV unit.
For SRV unit extension, connect COM. PORT3 to COM. PORT2 of the SRV unit for extension using our cable (Sold separately: W-BF-02).



Cable type: W-BF-02-3000 (RKC product, Sold separately)
[Standard cable length: 3 m]

● When using COM. PORT1

When multi-drop connection is made by using COM. PORT1, it is necessary to conduct wiring by using junction terminals and our cables (Sold separately: W-BF-01).



Cable type: W-BF-01-3000 (RKC product, Sold separately)
[Standard cable length: 3 m]

6.3 Host Communication Environment Setting

Set the host communication environment via host communication in which the V-TIO-E/F module communication port (COM. PORT1 or COM. PORT2) is used.
The V-TIO-E/F module is an object of communication.

For setting the host communication environment via host communication, each data becomes valid just when the power is turned off once after the data is set, and then it is turned on again.

For the communication port assignment of the V-TIO-E/F module, see **4.1 Communication Port Assignments (P. 14)**.

● Setting item

"Identifier" and "Digits" are used for RKC communication and "Register address" is used for Modbus.

Name	Identifier	Digits	Register address		Data range	Factory set value
			HEX	DEC		
Action mode selection *	**RZ**	7	7D0C	32012	Bit data b0: Address setting [1] 0: Continuous setting 1: Free setting b1: PLC register read/write error elimination [2] 0: Manual elimination 1: Automatic elimination b2 to b7:Unused [Decimal numbers expression: 0 to 3] Sets an action taken when the address is specified and an error occurs in PLC communication.	bit 0: 1 bit 1: 0

[1] Module address setting differs depending on address settings.

- When in the continuous setting, set the V-TIO-E/F module address to 0 and also set other module addresses to consecutive numbers (up to 30) starting from 1.
- When in the free setting, any numbers from 0 to 30 can be freely set. Data in any address unused becomes 0.

When in the free setting, regardless of the number of modules connected when the power is turned on, much time is required until module recognition operation comes to an end compared to the continuous setting as this operation is performed to addresses from 0 to 30.

For the setting procedure of the module address, see **4.2 Module Address Setting (P. 19)**.

Continued on the next page.

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[2] Specifies the procedure for eliminating a PLC register read/write error. The PLC register read/write error is assigned to the PLC communication error code, bit 0.

- When manually eliminated, the request command, "2: Set value monitor" is executed and then the error is eliminated after all of the set values are written in the register.
- When automatically eliminated, the error is automatically eliminated after PLC communication returns to normal and the error is retained for more than one second (or monitor processing time).

☞ For PLC communication error code and request command, see **5.4 Data Map (P. 72)**. In addition, for the monitor processing time, see **B.3.1 Monitor processing time (P. 182)**.

Action mode selection is assigned as a bit image in binary numbers.
However, send data from the SRV be changed to decimal ASCII code from the bit image in binary numbers for RKC communication

Bit image: 00000000

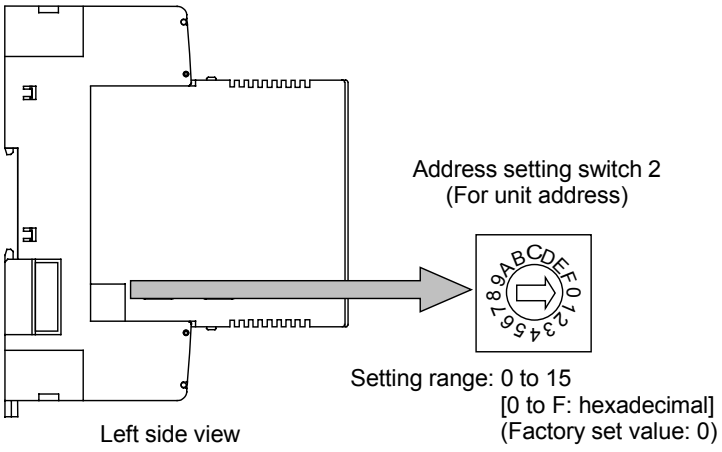
bit 7 ····· bit 0

6.4 SRV Communication Setting

☞ For module address setting and communication port assignment, see **4. COMMUNICATION SETTING (P. 14)**.

■ Unit address setting

Free settings can be made in the range of 0 to 15 (0 to F: hexadecimal).
Set the unit address by address setting switch 2 of left side of V-TIO-E/F module. For this setting, use a small blade screwdriver.



To avoid problems or malfunction, do not duplicate an address on the same communication line.

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

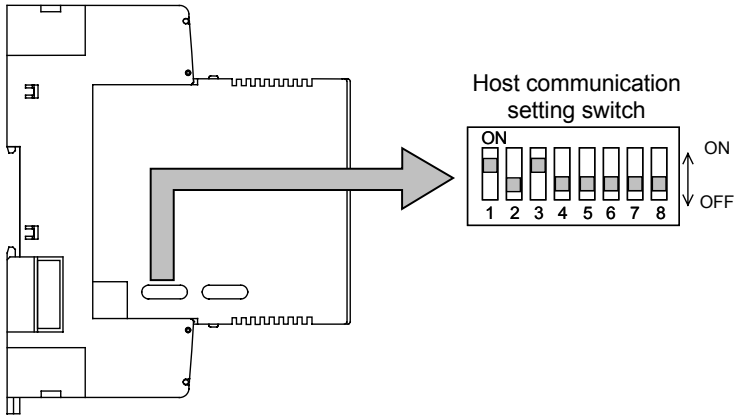
■ Setting of Host communication 1

"Host communication 1" is set the communication speed, data bit configuration and communication protocol by using the host communication setting switches.

Switch No. 7 and 8 must be always OFF. Do not set to ON.

Set the same contents as communication speed, data bit configuration and communication protocol of host computer.

When two or more V-TIO-E/F modules are multi-drop connected, for switch Nos.1 to 6 set the host communication setting switches in all of the V-TIO-E/F modules to the same positions.



1	2	Communication speed	
OFF	OFF	2400 bps	
ON	OFF	9600 bps	← Factory set value
OFF	ON	19200 bps	
ON	ON	38400 bps	

3	4	5	Data bit configuration	
OFF	OFF	OFF	Data 7-bit, Without parity, Stop 1-bit *	
OFF	OFF	ON	Data 7-bit, Even parity, Stop 1-bit *	
OFF	ON	OFF	Do not set this one	
OFF	ON	ON	Data 7-bit, Odd parity, Stop 1-bit *	
ON	OFF	OFF	Data 8-bit, Without parity, Stop 1-bit	← Factory set value
ON	OFF	ON	Data 8-bit, Even parity, Stop 1-bit	
ON	ON	OFF	Do not set this one	
ON	ON	ON	Data 8-bit, Odd parity, Stop 1-bit	

* When the Modbus communication protocol selected, this setting becomes invalid.

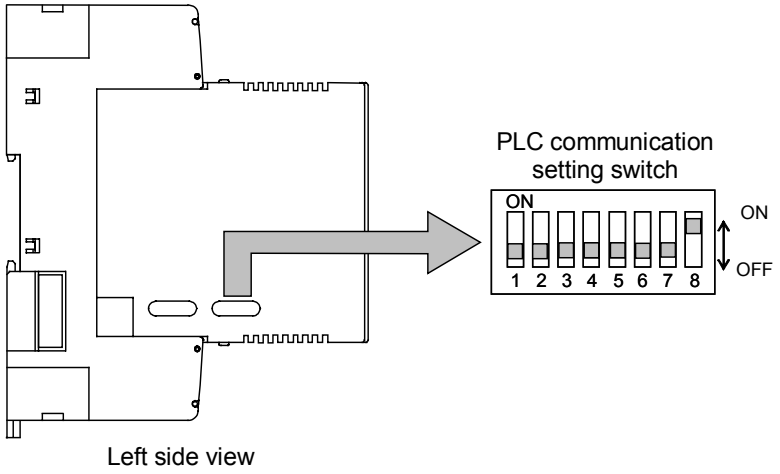
6	Communication protocol	
OFF	Host communication 1 (RKC communication)	← Factory set value
ON	Host communication 1 (Modbus)	

■ Setting of Host communication 2

"Host communication 2" is set the data bit configuration, communication speed and communication protocol by using the PLC communication setting switches. They are also used to select the assigned contents of COM. PORT1 and COM. PORT2/COM. PORT3.

Set the same contents as communication speed, data bit configuration and communication protocol of host computer (operation panel).

When two or more V-TIO-E/F modules are multi-drop connected, set the PLC communication setting switches in all of the V-TIO-E/F modules to the same positions.



1	2	Data bit configuration
OFF	OFF	Data 8-bit, Without parity, Stop 1-bit
ON	OFF	Data 7-bit *, Odd parity, Stop 1-bit
OFF	ON	Data 7-bit *, Even parity, Stop 1-bit
ON	ON	Data 7-bit *, Even parity, Stop 2-bit

← Factory set value

* To be changed to data 8-bit only when "Host communication 2 (Modbus)" is selected.

3	4	Communication speed
OFF	OFF	9600 bps
ON	OFF	19200 bps
OFF	ON	38400 bps
ON	ON	Do not set this one

← Factory set value

Continued on the next page.

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5	6	7	Communication protocol	
OFF	OFF	OFF	Host communication 2 (RKC communication)	← Factory set value
ON	OFF	OFF	Host communication 2 (Modbus)	
OFF	ON	OFF	Do not set this one	
ON	ON	OFF		
OFF	OFF	ON		
ON	OFF	ON		
OFF	ON	ON		
ON	ON	ON		

8	Communication port assignment	
OFF	COM. PORT1: Host communication 2 [RS-232C/RS-422A] COM. PORT2/COM. PORT3: Host communication 1 [RS-422A]	
ON	COM. PORT1: Host communication 1 [RS-232C/RS-422A] COM. PORT2/COM. PORT3: Host communication 2 [RS-422A]	← Factory set value

COM. PORT2 and COM. PORT3 become the same communication specification.

6.5 Communication Requirements

■ Processing times during data send/receive

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

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

RKC communication (Polling procedure)

Procedure details	Time
Response send time after SRV receives ENQ	15 ms max.
Response send time after SRV receives ACK	15 ms max.
Response send time after SRV receives NAK	15 ms max.
Response wait time after SRV sends BCC	1 ms max.

RKC communication (Selecting procedure)

Procedure details	Time
Response send time after SRV receives BCC	15 ms max.
Response wait time after SRV sends ACK	1 ms max.
Response wait time after SRV sends NAK	1 ms max.

Modbus

Procedure details	Time
Read holding registers [03H] Response send time after the slave receives the query message	15 ms max.
Preset single register [06H] Response send time after the slave receives the query message	15 ms max.
Diagnostics (loopback test) [08H] Response send time after the slave receives the query message	15 ms max.
Preset multiple register [10H] Response send time after the slave receives the query message	15 ms max.

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

■ 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

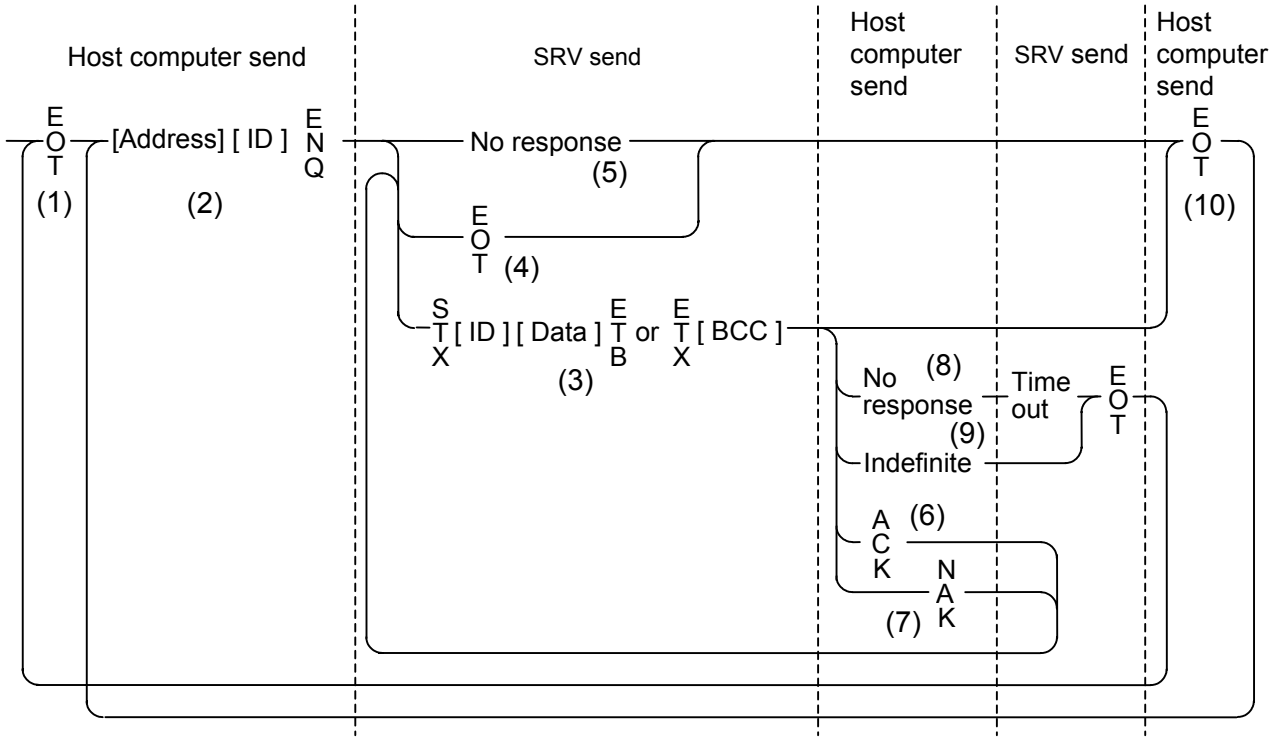
6.6 RKC Communication Protocol

RKC communication uses the polling/selecting method to establish a data link. The basic procedure is followed ANSI X3.28-1976 subcategory 2.5, B1 basic mode data transmission control procedure (Fast selecting is the selecting method used in SRV).

- 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 SRV:
  EOT (04H), ENQ (05H), ACK (06H), NAK (15H), STX (02H), ETB (17H), ETX (03H)
  ( ): Hexadecimal

6.6.1 Polling

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



ID: Identifier

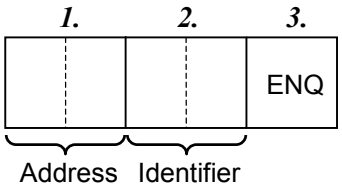
■ Polling procedures

(1) Data link initialization

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

(2) Data sent from host computer - Polling sequence

Host computer sends polling sequence with the format shown below:



Example:

0	2	M	1	ENQ

1. Address (2 digits)
This data is a unit address of the SR Mini HG SYSTEM for polled and must be the same as the unit address set value in item ■ **Unit address setting (P. 104)**.

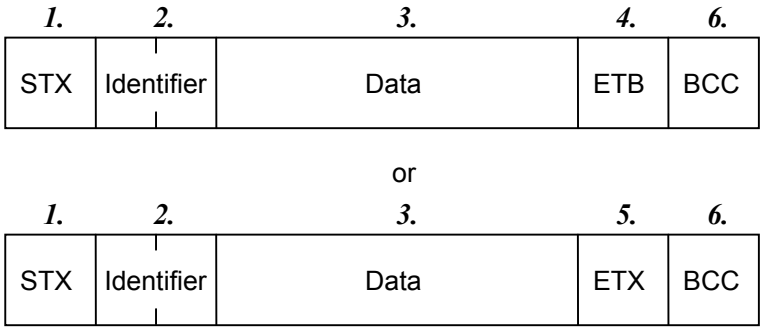
2. Identifier (2 digits)
The identifier specifies the type of data that is requested from the SRV. Always attach the ENQ code to the end of the identifier.

☞ See **6.6.4 Communication identifier list (P. 120)**.

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 SRV.

(3) Data sent from the SRV

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



🕮 If the length of send data (from STX to BCC) exceeds 255 bytes *, it is divided into blocks by ETB. In this case, the succeeding divided data is sent after STX.

* Communication data block length can be changed with "Communication data block length" (identifier Z3) of the initial setting mode.

1. STX

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

2. Identifier (2 digits)

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

☞ See **6.6.4 Communication identifier list (P. 120)**.

3. Data

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

- Channel number (Used for data corresponding to each channel):
  2-digit ASCII code, not zero-suppressed. Channels without channel numbers may exist depending on the type of identifier.
- Module address (Used for data corresponding to each module):
  2-digit ASCII code, not zero-suppressed.
  Specify the number obtained by adding "1" to the module address set at the front of each module.
  Set the same set value as that of the module address in **4.2 Module Address Setting (P. 19)**.
- Data: ASCII code, zero-suppressed with spaces (20H). The number of digits varies depending on the type of identifier.

☞ See **6.6.3 Communication data structure (P. 119)**.

4. ETB

Transmission control character indicating the end of the block.

5. ETX

Transmission control character indicating the end of the text.

6. BCC

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

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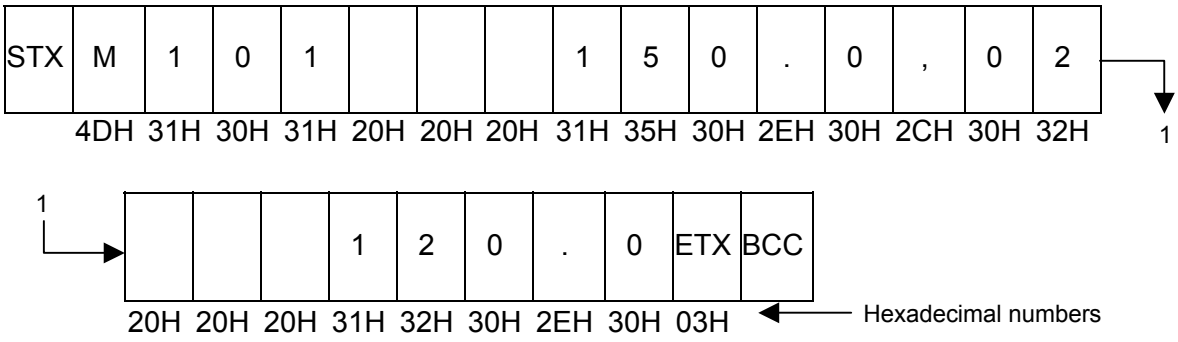
Calculation method of BCC:
Exclusive OR all data and characters from STX through ETB or ETX, not including STX.

<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 SRV)

In the following cases, the SRV 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 SRV

The SRV 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 SRV receives ACK from the host computer, the SRV will send any remaining data of the next identifier without additional action from the host computer. When ACK was sent in succession, identifier data item down to “No.52 Temperature rise completion soak time” in the communication identifier list are sent.
When host computer determines to terminate the data link, EOT is sent from the host computer.

☞ For the identifier, see **6.6.4 Communication identifier list (P. 120)**.

(7) NAK (Negative acknowledge)

If the host computer does not receive correct data from the SRV, it sends a negative acknowledgment NAK to the SRV. The SRV 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 SRV sends data, the SRV sends EOT to terminate the data link (time-out time: about 3 seconds).

(9) Indefinite response from host computer

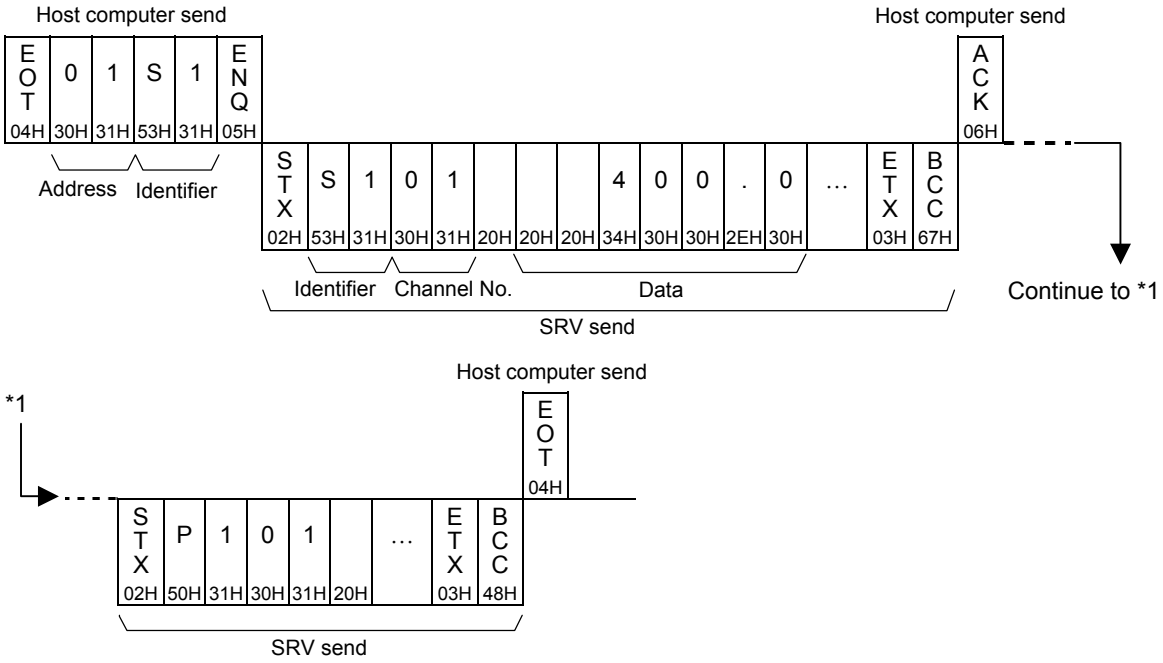
The SRV sends EOT to terminate the data link when the host computer response is indefinite.

(10) EOT (Data link termination)

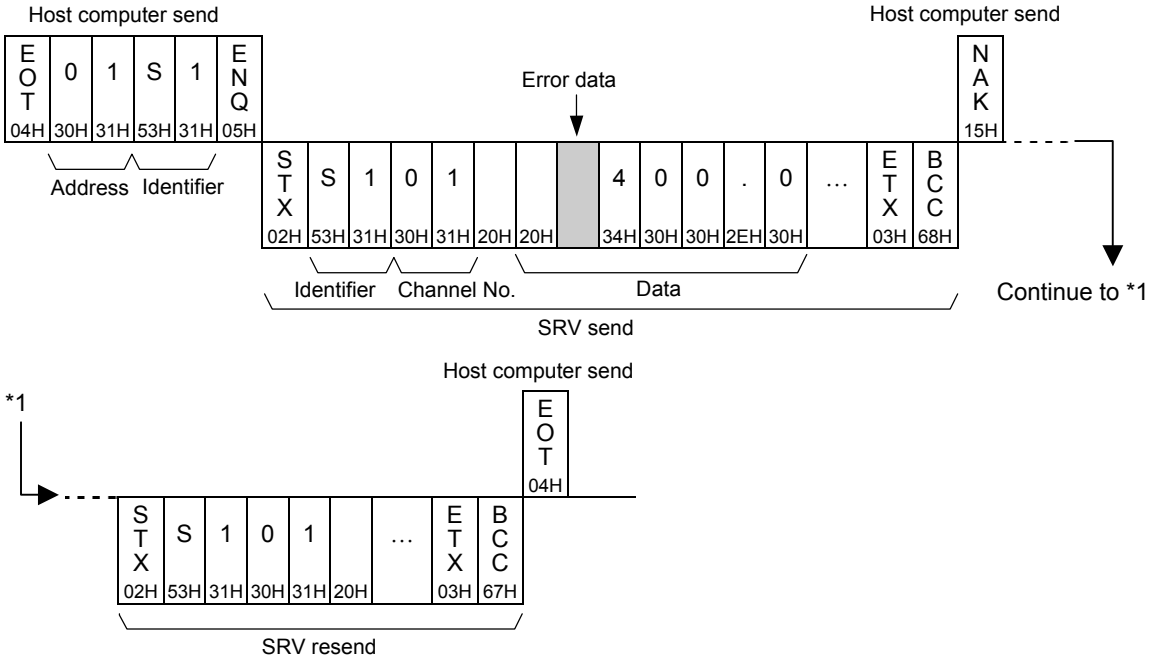
The host computer sends EOT message when it is necessary to suspend communication with the SRV or to terminate the data link due lack of response from the SRV.

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

● Normal transmission

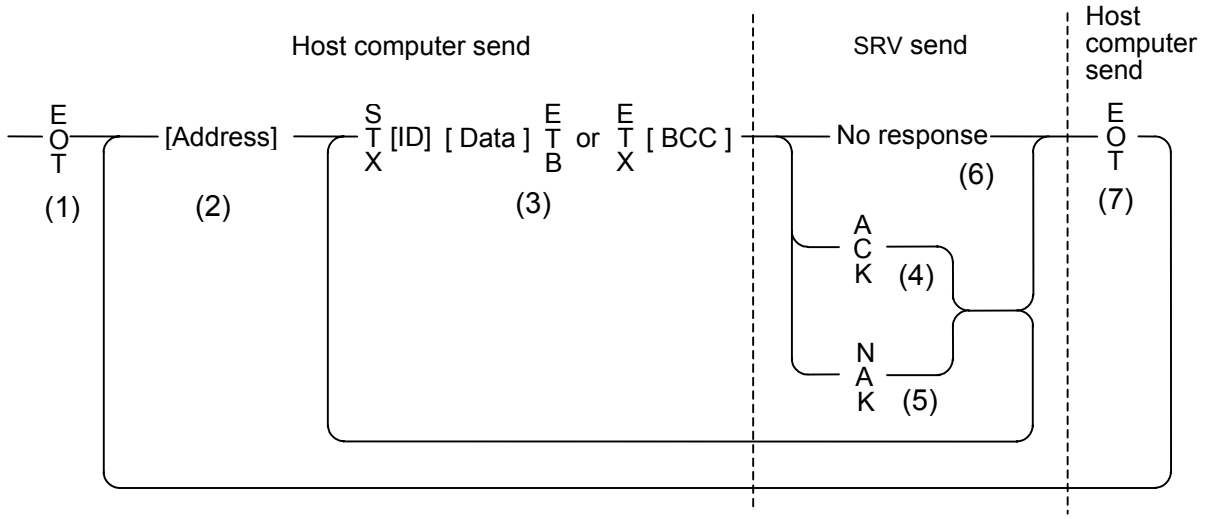


● Error transmission



6.6.2 Selecting

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



ID: Identifier

■ Selecting procedures

(1) Data link initialization

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

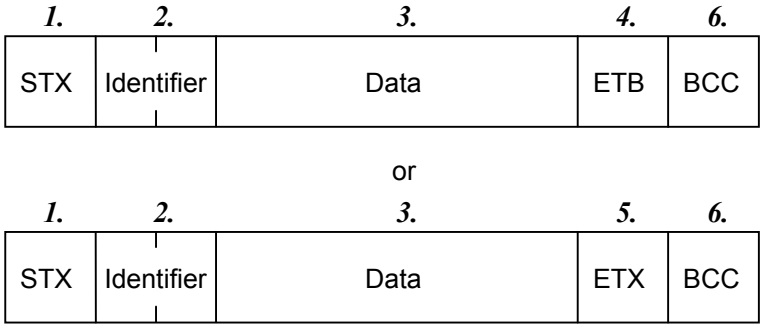
(2) Sending selecting address from the host computer

Host computer sends selecting address for the selecting sequence.

Address (2 digits):
This data is a unit address of the SRV to be selected and must be the same as the unit address set value in item ■ **Unit address setting (P. 104)**.

(3) Data sent from the host computer

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



Send data (from STX to BCC) can be divided into some groups by ETB. In this case, the succeeding divided data is sent after STX.

Details for *1* to *6*, see **6.6.1 Polling (P. 109)**.

- **About numerical data**

The data that receipt of letter is possible

- Zero-suppressed data can be received with the SRV. (Number of digits: Within 7 digits)

  <Example> When data send −001.5, −01.5, or −1.5 at the time of "−1.5," the SRV can receive a data.
  However, when data send with −1.50, or −1.500, the SRV sends NAK so that after the decimal point number of digits is different.

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

  <Example> When setting range is −10.00 to +10.00, the SRV receives as a following.

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

The data that receipt of letter is impossible

The SRV sends NAK when received a following data.

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

(4) ACK (Acknowledgment)

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

For the temperature control related set value, ACK is sent even if the set data exceeds the setting range. In this case, the value returns to the original value if the fixed time (the number of connected TIO channels × 100 ms × 2) elapses after sending ACK.
However, regarding PLC communication environment setting items, NAK is sent when the set data items exceed the setting range.

(5) NAK (Negative acknowledge)

If the SRV 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 SRV will send NAK in the following cases:

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

(6) No response from SRV

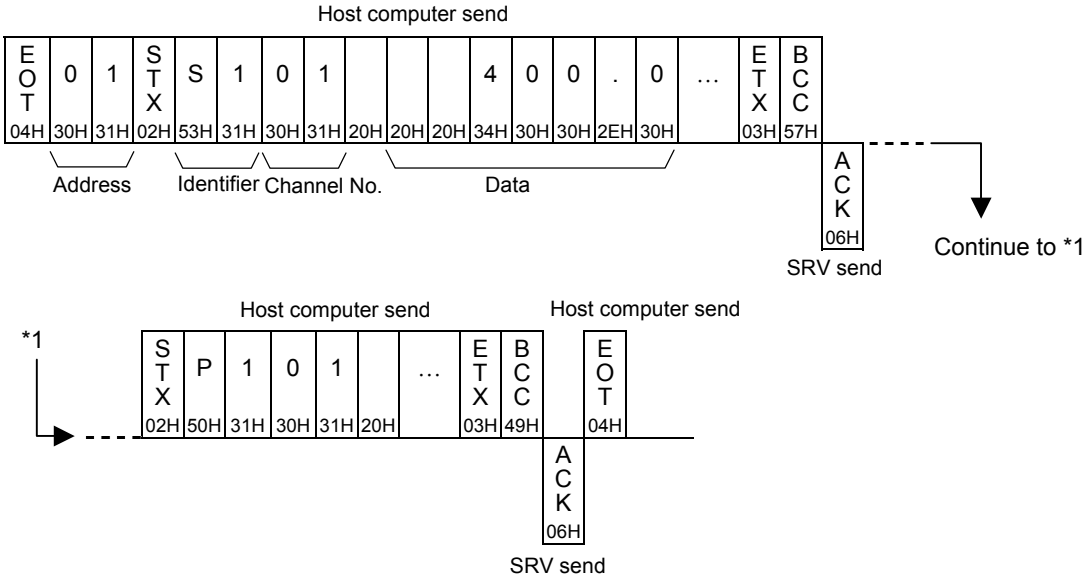
The SRV does not respond when it cannot receive the selecting address, STX, ETB, ETX or BCC.

(7) EOT (Data link termination)

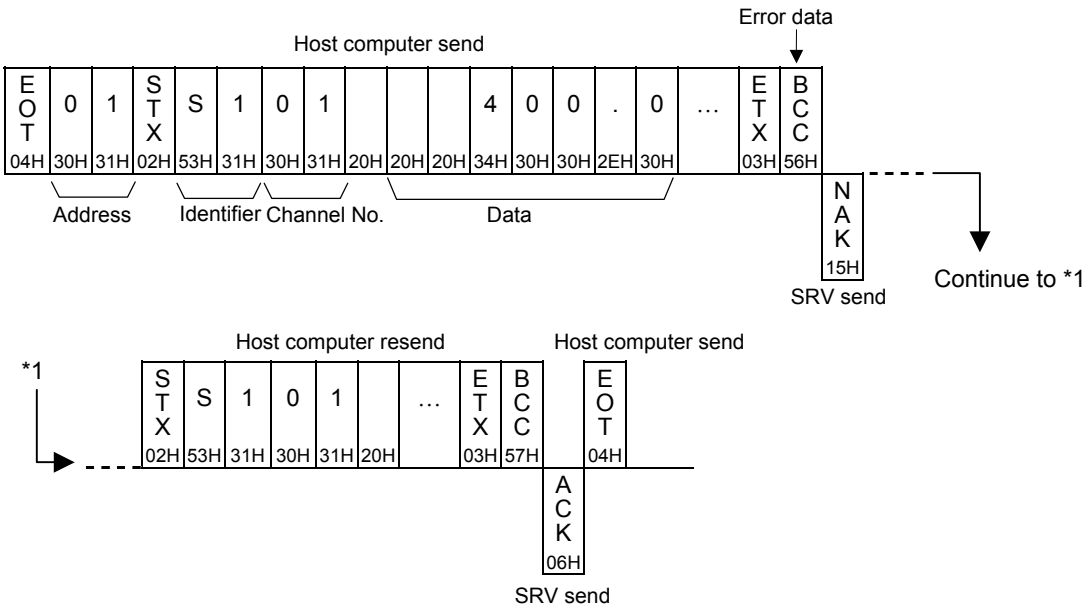
The host computer sends EOT when there is no more data to be sent from the host computer or there is no response from the SRV.

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

● Normal transmission

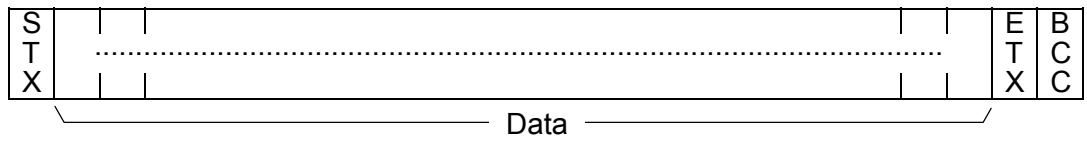


● Error transmission



6.6.3 Communication data structure

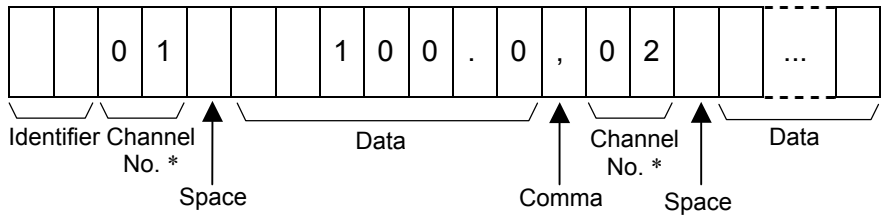
■ Data description (Transmission/receive data structure)



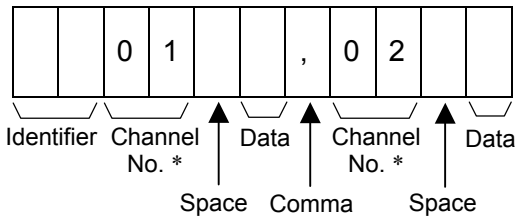
Part of the data above is shown below.

- **Data for each channel (Data for each module)**

Data length 7 digits



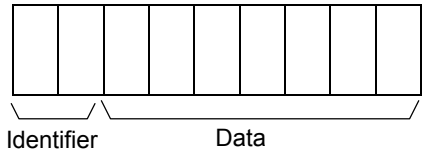
Data length 1 digit



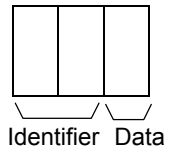
* For data corresponding to each module, it becomes the number obtained by adding "1" to the module address.

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

Data length 7 digits



Data length 1 digit



6.4.4 Communication identifier list

📖 **For heat/cool control, data in the second channel of temperature control module (V-TIO-A/B/E/F) becomes invalid.**

☞ For details of each item, see **5.1.3 PLC communication environment setting (P. 39)** [MITSUBISHI PLC], **5.2.3 PLC communication environment setting (P. 57)** [OMRON PLC], **5.4 Data Map (P. 72)**, or **Module Type Controller SRV Communication Instruction Manual (IMS01P01-E□)**.

■ Data items for normal setting mode

RO: Read only R/W: Read and Write
♦: Items which are accessible via PLC communication
: PLC communication environment setting item

No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value
1	Measured value (PV) ♦	**M1**	RO	TC/RTD input: Within input range Voltage (V)/Current (I) input: Input scale low limit to Input scale high limit	—
2	Comprehensive event state	**AJ**	RO	Bit data b0: Burnout b1: Event 1 state b2: Event 2 state b3: Heater break alarm state b4: Control loop break alarm (LBA) state Data 0: OFF 1: ON [Decimal numbers expression: 0 to 31]	—
3	Heat-side manipulated output value ♦	**O1**	RO	–5.0 to +105.0 %	—
4	Set value monitor ♦	**MS**	RO	TC/RTD input: Within input range Voltage (V)/Current (I) input: Input scale low limit to Input scale high limit	—

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value
5	Error code (Data of each module)	**ER**	RO	Bit data b0: Memory backup error b1: Unused b2: Unused b3: Adjustment data error b4: Input A/D error b5: Current transformer input A/D error b6: Temperature compensation A/D error b7: Unused Data 0: OFF 1: ON [Decimal numbers expression: 0 to 255]	—
6	Cool-side manipulated output value ♦	**O2**	RO	–5.0 to +105.0 %	—
7	Current transformer input measured value ♦	**M3**	RO	0.0 to 30.0 A or 0.0 to 100.0 A	—
8	Burnout state	**B1**	RO	0: OFF 1: ON	—
9	Event 1 state	**AA**	RO	0: OFF 1: ON	—
10	Event 2 state	**AB**	RO		—
11	Heater break alarm (HBA) state	**AC**	RO	0: OFF 1: Heater break 2: Relay welding	—
12	Control loop break alarm (LBA) state	**AP**	RO	0: OFF 1: ON	—
13	Temperature rise completion state	**HE**	RO	0: Temperature rise not complete 1: Temperature rise completion	—
14	Operation mode ♦	**EI**	R/W	0: Unused 1: Monitor 1 2: Monitor 2 3: Control	3
15	Set value (SV) ♦	**S1**	R/W	TC/RTD input: Within input range Voltage (V)/Current (I) input: Input scale low limit to Input scale high limit	0 (0.0)

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value
16	Heat-side proportional band ♦	**P1**	R/W	TC/RTD input: 0 (0.0) to Input span [°C (°F)] Voltage (V)/Current (I) input: 0.0 to 100.0 % of input span [0 (0.0): ON/OFF action]	TC/RTD: 30 (30.0) V/I: 30.0
17	Integral time ♦	**I1**	R/W	1 to 3600 seconds	240
18	Derivative time ♦	**D1**	R/W	0 to 3600 seconds [0: Derivative action OFF (PI action)]	60
19	Control response parameters	**CA**	R/W	0: Slow 1: Medium 2: Fast	0
20	PV bias ♦	**PB**	R/W	–Input span to +Input span	0 (0.0)
21	Event 1 set value ♦	**A1**	R/W	Deviation high/Deviation low: –Input span to +Input span Deviation high/low, Band: 0 (0.0) to Input span Process high/Process low: Within input range	0 (0.0)
22	Event 2 set value ♦	**A2**	R/W		0 (0.0)
23	Cool-side proportional band ♦	**P2**	R/W	TC/RTD input: 1 (0.1) to Input span [°C (°F)] Voltage (V)/Current (I) input: 0.1 to 100.0 % of input span	TC/RTD: 30 (30.0) V/I: 30.0
24	Overlap/Deadband ♦	**V1**	R/W	–Input span to +Input span	0 (0.0)
25	Setting change rate limiter	**HH**	R/W	0 (0.0) to Input span/minute [0 (0.0): Setting change rate limiter OFF]	0 (0.0)
26	PID/AT transfer * ♦	**G1**	R/W	0: PID control operation 1: AT (Autotuning) operation	0
27	Auto/Manual transfer ♦	**J1**	R/W	0: Auto mode 1: Manual mode	0
28	Manual output value ♦	**ON**	R/W	–5.0 to +105.0 %	0.0

* Caution for using the Autotuning (AT)

- When a temperature change (UP and/or Down) is 1 °C (1 °F) or less per minute during Autotuning, Autotuning may be cancelled before calculating PID values. In that case, adjust the PID values manually. It is possible to happen when the set value is around the ambient temperature or is close to the maximum temperature achieved by the load.
- When control loop break alarm (LBA) is used, control loop break alarm (LBA) time is automatically calculated by AT. However, the calculated data becomes valid by changing to the initial setting mode once after AT is executed.

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value
29	Output limiter (high)	**OH**	R/W	Output limiter (low) to 105.0 %	100.0
30	Output limiter (low)	**OL**	R/W	–5.0 % to Output limiter (high)	0.0
31	Heat-side proportional cycle time	**T0**	R/W	1 to 100 seconds	Relay contact output: 20
32	Cool-side proportional cycle time	**T1**	R/W		Voltage pulse output: 2
33	Digital filter	**F1**	R/W	0 to 100 seconds [0: Digital filter OFF]	0
34	Heater break alarm (HBA) set value ♦	**A3**	R/W	0.0 to 30.0 A or 0.0 to 100.0 A	0.0
35	Number of heater break alarm (HBA) delay times	**DH**	R/W	1 to 255 times	5
36	Control RUN/STOP transfer (Data of each module) ♦	**SR**	R/W	0: Control STOP 1: Control RUN	0
37	Input error determination point (high)	**AV**	R/W	Within input range	Input range high limit
38	Input error determination point (low)	**AW**	R/W		Input range low limit
39	Action at input error (high)	**WH**	R/W	0: Normal control 1: Manipulated output value at input error	0
40	Action at input error (low)	**WL**	R/W		0
41	Manipulated output value at input error	**OE**	R/W	–105.0 to +105.0 %	0.0
42	AT differential gap time	**GH**	R/W	0 to 100 seconds	1
43	AT bias	**GB**	R/W	–Input span to +Input span	0 (0.0)
44	Event LED mode setting (Data of each module)	**XH**	R/W	1: Mode 1 2: Mode 2 3: Mode 3 Except the above (within 0 to 255): Unused	0

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value
45	DI setting (Data of each module) ♦	**E1**	R/W	1: Control RUN/STOP 2: Event interlock release Except the above (within 0 to 20): Unused	Specify when ordering
46	DI state (Data of each module)	**L1**	RO	0: Contact open (OFF) 1: Contact close (ON)	—
47	DO1 setting (Data of each module) ♦	**QA**	R/W	1: CH1 Event 1 state 2: CH2 Event 1 state 3: CH1 Event 2 state 4: CH2 Event 2 state 5: CH1 Heater break alarm state 6: CH2 Heater break alarm state 7: CH1 Control loop break alarm state 8: CH2 Control loop break alarm state 9: CH1 Burnout state 10: CH2 Burnout state 11: CH1 Temperature rise completion 12: CH2 Temperature rise completion Except the above (within 0 to 20): Unused	Specify when ordering
48	DO2 setting (Data of each module) ♦	**QB**	R/W		Specify when ordering
49	DO state (Data of each module) ♦	**Q1**	R/W	0: DO1: Contact open (OFF) DO2: Contact open (OFF) 1: DO1: Contact close (ON) DO2: Contact open (OFF) 2: DO1: Contact open (OFF) DO2: Contact close (ON) 3: DO1: Contact close (ON) DO2: Contact close (ON) Data write is possible only when the DO1 and DO2 setting values are "0."	0
50	Event interlock release (Data of each module)	**AR**	R/W	0: Normal state 1: Event interlock release execution	0
51	Temperature rise completion zone	**HD**	R/W	0 (0.0) to Input span [0 (0.0): Unused]	0 (0.0)
52	Temperature rise completion soak time	**T3**	R/W	0 to 360 minutes	0

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value
53	TIO state ♦	**AK**	RO	Bit data b0: Burnout b1: Event 1 state b2: Event 2 state b3: Heater break alarm (HBA) state b4: Control loop break alarm (LBA) state b5: Unused b6: Unused b7: Unused b8: DI state b9: DO1 state b10: DO2 state b11: Temperature rise completion state b12: Control RUN/STOP state b13: Module error b14: Setting error b15: Error code Data 0: OFF 1: ON [Decimal numbers expression: 0 to 65535]	—
54	Station number * (Data of each unit)	**QV**	R/W	0 to 255	0
55	PC number * (Data of each unit)	**QW**	R/W		255
56	Register start number * (Data of each unit)	**QX**	R/W	0 to 32767	1000
57	Maximum number of PLC communication channels * (Data of each unit)	**QY**	R/W	1 to 62 CH	20
58	Register type (D, R, W) * (Data of each unit)	**QZ**	R/W	0: D register (data register) 1: R register (file register) 2: W register (link register)	0

* These items become valid by turning off the power of the V-TIO-E/F module once, and then turning it on again after the settings are changed.

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value
59	V-TIO-E/F module monitor item selection * (Data of each unit)	**QS**	R/W	Bit data b0: Measured value (PV) b1: Set value monitor b2: Heat-side output value b3: Cool-side output value b4: CT input measured value b5: TIO state Data 0: Invalid 1: Valid [Decimal numbers expression: 0 to 63]	63
60	V-TIO-E/F module Link recognition time * (Data of each unit)	**QT**	R/W	0 to 255 seconds	10
61	V-TIO-E/F module error code (Data of each unit)	**ES**	RO	Bit data b0: Memory backup error b2: Module configuration error b7: PLC communication error b1, b3 to b6: Unused Data 0: OFF 1: ON [Decimal numbers expression: 0 to 255]	—
62	PLC scanning time setting * (Data of each unit)	**ST**	R/W	0 to 255 ms	255
63	Number of connected TIO modules (Data of each unit)	**QN**	RO	0 to 31	—
64	Number of connected TIO channels (Data of each unit)	**QP**	RO	0 to 62 CH	—
65	Action mode selection * (Data of each unit)	**RZ**	R/W	Bit data b0: Address setting 0: Continuous setting 1: Free setting b1: PLC register read/write error elimination 0: Manual elimination 1: Automatic elimination b2 to b7: Unused [Decimal numbers expression: 0 to 3]	bit 0: 1 bit 1: 0
66	PLC communication start time * (Data of each unit)	**RU**	R/W	1 to 255 seconds	5
67	Initial setting mode (Data of each unit)	**IN**	R/W	0: Normal setting mode 1: Initial setting mode	0

* These items become valid by turning off the power of the V-TIO-E/F module once, and then turning it on again after the settings are changed.

■ 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 initial setting mode data is handled in PLC communication.

No.	Name	Identifier	Attribute	Data range	Factory set value
1	Control loop break alarm (LBA) use selection	**HP**	R/W	0: Unused 1: Used	0
2	Control loop break alarm (LBA) time	**C6**	R/W	1 to 7200 seconds	480
3	Control loop break alarm (LBA) deadband	**V2**	R/W	0 (0.0) to Input span	0 (0.0)
4	Input range number *	**XI**	R/W	TC input 0: K –200 to +1372 °C or –328 to +2501 °F 1: K 0 to 800 °C or 32 to 1472 °F 2: K 0 to 400 °C or 32 to 752 °F 3: K –200.0 to +400.0 °C or –328.0 to +752.0 °F 4: K 0.0 to 400.0 °C or 32.0 to 752.0 °F 5: J –200 to +1200 °C or –328 to +2192 °F	Specify when ordering

* These items become valid by turning off the power of the V-TIO-E/F module once, and then turning it on again after the settings are changed.

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No.	Name	Identifier	Attribute	Data range	Factory set value
4	Input range number *	**XI**	R/W	TC input 6: J 0 to 800 °C or 32 to 1472 °F 7: J 0 to 400 °C or 32 to 752 °F 8: J –200.0 to +400.0 °C or –328.0 to +752.0 °F 9: J 0.0 to 400.0 °C or 32.0 to 752.0 °F 10: T –200 to +400 °C or –328 to +752 °F 11: T 0 to 400 °C or 32 to 752 °F 12: T 0 to 200 °C or 32 to 392 °F 13: T –200.0 to +400.0 °C or –328.0 to +752.0 °F 14: T 0.0 to 400.0 °C or 32.0 to 752.0 °F 15: S 0 to 1768 °C or 32 to 3214 °F 16: R 0 to 1768 °C or 32 to 3214 °F 17: PLII 0 to 1390 °C or 32 to 2534 °F 18: N 0 to 1300 °C or 32 to 2372 °F 19: W5Re/W26Re 0 to 2300 °C or 32 to 4172 °F 20: E 0 to 1000 °C or 32 to 1832 °F 21: E 0 to 800 °C or 32 to 1472 °F 22: B 0 to 1800 °C or 32 to 3272 °F RTD input: 23: Pt100 0 to 850 °C or 32 to 1562 °F 24: Pt100 0 to 400 °C or 32 to 752 °F 25: Pt100 –200.0 to +400.0 °C or –328.0 to +752.0 °F 26: Pt100 0.0 to 400.0 °C or 32.0 to 752.0 °F	Specify when ordering

* These items become valid by turning off the power of the V-TIO-E/F module once, and then turning it on again after the settings are changed.

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No.	Name	Identifier	Attribute	Data range	Factory set value
4	Input range number [1]	**XI**	R/W	RTD input: 27: JPt100 0 to 600 °C or 32 to 1112 °F 28: JPt100 0 to 400 °C or 32 to 752 °F 29: JPt100 –200.0 to +400.0 °C or –328.0 to +752.0 °F 30: JPt100 0.0 to 400.0 °C or 32.0 to 752.0 °F Voltage/Current input: 31: 0 to 100 mV DC 32: Unused 33: 0 to 5 V DC 34: 1 to 5 V DC 35: 0 to 10 V DC 36: 0 to 20 mA DC 37: 4 to 20 mA DC	Specify when ordering
5	Input scale high limit [1, 2]	**XV**	R/W	Input scale low limit to 10000	100.0
6	Input scale low limit [1, 2]	**XW**	R/W	–2000 to Input scale high limit	0.0
7	Input range decimal point position [1, 2]	**XU**	R/W	0: No decimal place 1: One decimal place 2: Two decimal places 3: Three decimal places	1
8	Temperature unit selection	**PU**	R/W	0: °C 1: °F	0
9	Control type selection	**XE**	R/W	0: Heat control: direct action 1: Heat control: reverse action 2: Heat/cool control (water cooling) 3: Heat/cool control (air cooling)	Specify when ordering
10	ON/OFF control differential gap (upper)	**IV**	R/W	0 to Input span	TC/RTD: 1.0 V/I: 0.1
11	ON/OFF control differential gap (lower)	**IW**	R/W		
12	Event 1 differential gap	**HA**	R/W	0 to Input span	TC/RTD: 2.0 V/I: 0.2
13	Event 2 differential gap	**HB**	R/W		

[1] These items become valid by turning off the power of the V-TIO-E/F module once, and then turning it on again after the settings are changed.

[2] Valid only for voltage/current input

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No.	Name	Iden-tifier	Attri-bute	Data range	Factory set value
14	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	Specify when ordering
15	Event 2 type selection	**XB**	R/W		Specify when ordering
16	Event 1 action selection	**WA**	R/W	Bit data b0: Hold action b1: Re-hold action b2: Interlock action b3: Event action at input error b4: Hold action at control start b5 to b7: Unused Data 0: OFF 1: ON [Decimal numbers expression: 0 to 31]	b0 to b2: Specify when ordering b3 to b7: 0
17	Event 2 action selection	**WB**	R/W		b0 to b2: Specify when ordering b3 to b7: 0
18	Event delay timer	**TD**	R/W	0 to 9999 seconds	0
19	TIO module internal communication Transmission transfer time setting (Data of each module)	**ZR**	R/W	0 to 100 ms	6
20	Operation mode holding setting (Data of each module)	**X2**	R/W	0: Not hold 1: Hold	1
21	Host communication 1 Transmission transfer time setting (Data of each unit)	**ZX**	R/W	0 to 255 ms	6
22	PLC communication/ Host communication 2 Transmission transfer time setting (Data of each unit)	**QU**	R/W	0 to 255 ms	1
23	Internal communication speed setting * (Data of each unit)	**QQ**	R/W	0: 2400 bps 1: 9600 bps 2: 19200 bps 3: 38400 bps	3
24	Communication data block length (RKC communication) (Data of each unit)	**Z3**	R/W	20 to 255 byte (Valid only when communication method is polling)	255
25	Modbus data interval extension time (Data of each unit)	**ZY**	R/W	0 to 255 ms	0

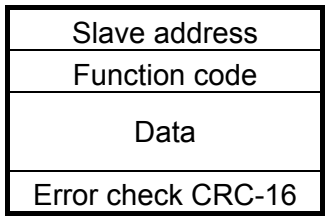
* These items become valid by turning off the power of the V-TIO-E/F module once, and then turning it on again after the settings are changed.

6.7 Modbus Communication Protocol

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

6.7.1 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 SRV 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 **6.7.2 Function code (P. 132)**.

■ Data

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

☞ For details, see **6.7.6 Message format (P. 137)**, **6.7.7 Data configuration (P. 141)**, and **6.7.8 Data map (P. 144)**.

■ Error check

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

☞ For details, see **6.7.5 Calculating CRC-16 (P. 134)**.

6.7.2 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 state, etc.
06H	Preset single register	Set value, PID constants, event set value, etc.
08H	Diagnostics (loopback test)	Loopback test
10H	Preset multiple registers	Set value, PID constants, event set value, etc.

- **Message length of each function (Unit: byte)**

Function code (Hexadecimal)	Function	Query message		Response message	
		Min	Max	Min	Max
03H	Read holding registers	8	8	7	255
06H	Preset single register	8	8	8	8
08H	Diagnostics (loopback test)	8	8	8	8
10H	Preset multiple registers	11	255	8	8

6.7.3 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 **6.7.2 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. The extension time of the data interval can be set with **Initial setting data items (P. 152)**.

6.7.4 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

6.7.5 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 match, a communication error has occurred and the slave does not respond.

The CRC code is formed in the following sequence:

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

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 hex and return the result to the CRC register. If the carry flag is *0*, repeat step ***3***.

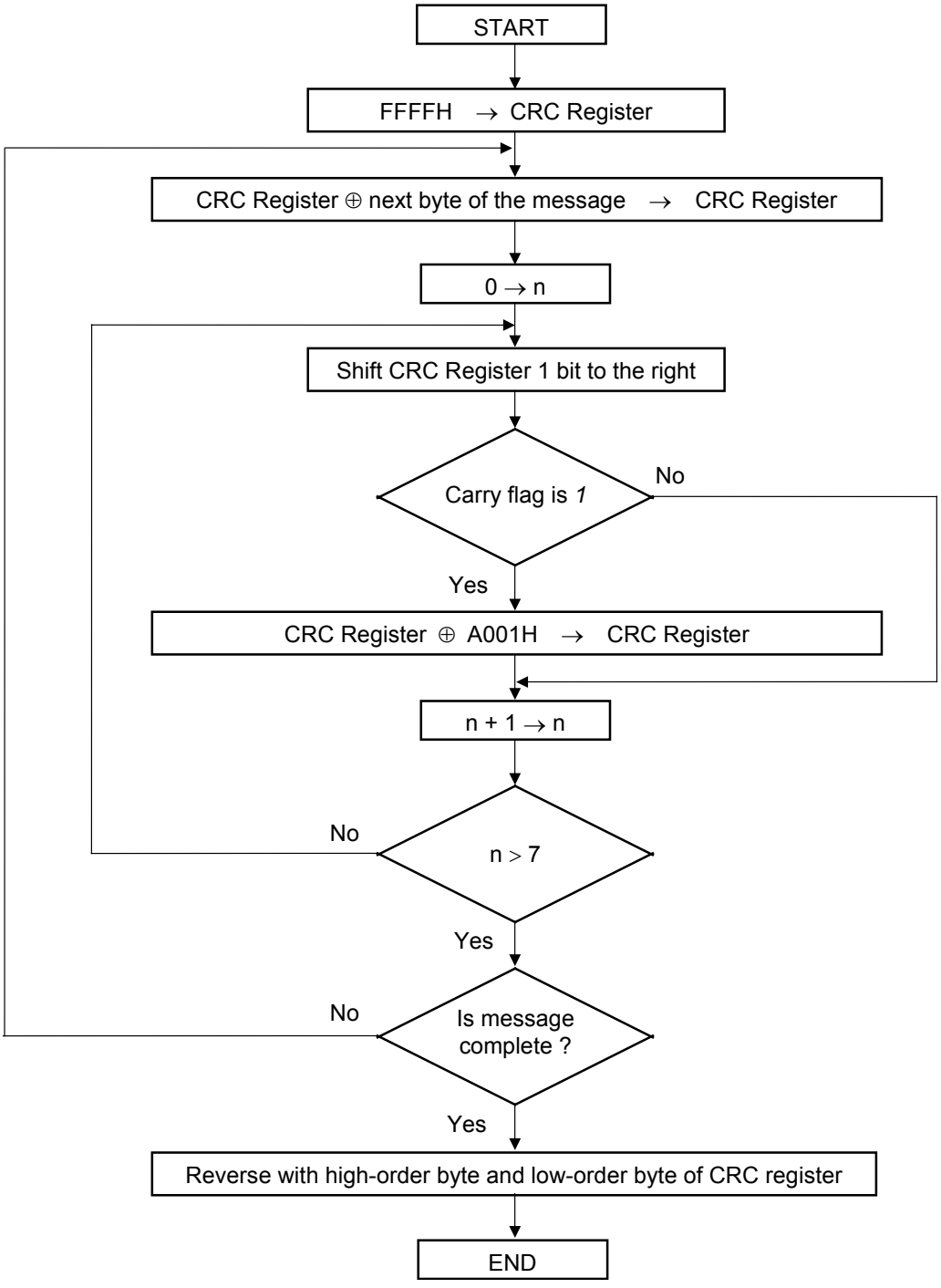
5. Repeat step ***3*** and ***4*** until there have been 8 shifts.

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;
}
```

6.7.6 Message format

■ 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

■ 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 0400H of slave address 1.

Query message

Slave address		01H
Function code		06H
Holding register number	High	04H
	Low	00H
Write data	High	00H
	Low	64H
CRC-16	High	89H
	Low	11H

} Any data within the range

Normal response message

Slave address		01H
Function code		06H
Holding register number	High	04H
	Low	00H
Write data	High	00H
	Low	64H
CRC-16	High	89H
	Low	11H

} 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

■ 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

■ 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 0400H to 0401H of slave address 1.

Query message

Slave address		01H	
Function code		10H	
Starting number	High	04H	First holding register address
	Low	00H	
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	00H	
	Low	B8H	

Normal response message

Slave address		01H
Function code		10H
Starting number	High	04H
	Low	00H
Quantity	High	00H
	Low	02H
CRC-16	High	40H
	Low	F8H

Error response message

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

6.7.7 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.

■ Data processing with decimal points

(1) Data without decimal points

Comprehensive event state
Error code
Burnout state
Event 1 state
Event 2 state
Heater break alarm state
Control loop break alarm (LBA) state
Temperature rise completion state
Operation mode
Integral time
Derivative time
Control response parameters
PID/AT transfer
Auto/Manual transfer
Heat-side proportional cycle time
Cool-side proportional cycle time
Digital filter
Number of heater break alarm delay times
Control RUN/STOP transfer
Input error determination point (high limit)
Input error determination point (low limit)
AT differential gap time
Event LED mode setting
DI setting
DI state
DO1 setting
DO2 setting
DO state
Event interlock release
Temperature rise completion soak time
TIO state
Station number
PC number
Register start number
Maximum number of PLC communication channels
Register type (D, R, W)
V-TIO-E/F module monitor item selection
V-TIO-E/F module Link recognition time
V-TIO-E/F module error code
PLC scanning time setting
Number of connected TIO modules
Number of connected TIO channels
Action mode selection
PLC communication start time
Initial setting mode
Control loop break alarm (LBA) use selection
Control loop break alarm (LBA) time
Input range number
Input range decimal point position
Temperature unit selection
Control type selection
Event 1 type selection
Event 2 type selection
Event 1 action selection
Event 2 action selection
Event delay timer
TIO module internal communication:
Transmission transfer time setting
Operation mode holding setting
Host communication:
Transmission transfer time setting
PLC communication:
Transmission transfer time setting
Internal communication speed setting
Communication data block length
(RKC communication)
Modbus data interval extension time

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

Input range number	High	00H
	Low	12H

(2) Data with decimal points

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

- **Data with one decimal place**

Heat-side manipulated output value	Output limiter (high)
Cool-side manipulated output value	Output limiter (low)
Current transformer input measured value	Heater break alarm set value
Manual output value	Manipulated output value at input error

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

(3) 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:

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

Measured value (PV)	Input error determination point (low)
Set value monitor	AT bias
Set value (SV)	Temperature rise completion range
Heat-side proportional band	Control loop break alarm (LBA) deadband
PV bias	Input scale high limit
Event 1 set value	Input scale low limit
Event 2 set value	ON/OFF control differential gap (upper)
Cool-side proportional band	ON/OFF control differential gap (lower)
Overlap/Deadband	Event 1 differential gap
Setting change rate limiter	Event 2 differential gap
Input error determination point (high)	

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 processing precautions

- With Modbus protocol, the maximum number of channels per slave address is 62.
- 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 SRV.
  Under conditions listed below, 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.

Do not write data to any address which is not described in a list of data maps.

6.7.8 Data map

For heat/cool control, data in the second channel of temperature control module (V-TIO-A/B/E/F) becomes invalid.

Register address numbers which are not described are those unused.

For details of each item, see **5.1.3 PLC communication environment setting (P. 39)** [MITSUBISHI PLC], **5.2.3 PLC communication environment setting (P. 57)** [OMRON PLC], **5.4 Data Map (P. 72)**, or **Module Type Controller SRV Communication Instruction Manual (IMS01P01-E□)**.

■ Normal setting data items

HEX: Hexadecimal DEC: Decimal
RO: Read only R/W: Read and Write
♦: Items which are accessible via PLC communication
: PLC communication environment setting item

Name	Register address		No. of data	Attribute	Data range	Factory set value
	HEX	DEC				
Measured value (PV) ♦	0000 ⋮ 003D	0 ⋮ 61	62	RO	TC/RTD input: Within input range Voltage (V)/Current (I) input: Input scale low limit to Input scale high limit	—
Comprehensive event state	0040 ⋮ 007D	64 ⋮ 125	62	RO	Bit data b0: Burnout b1: Event 1 state b2: Event 2 state b3: Heater break alarm state b4: Control loop break alarm (LBA) state Data 0: OFF 1: ON [Decimal numbers expression: 0 to 31]	—
Heat-side manipulated output value ♦	0080 ⋮ 00BD	128 ⋮ 189	62	RO	−5.0 to +105.0 %	—
Set value monitor ♦	00C0 ⋮ 00FD	192 ⋮ 253	62	RO	TC/RTD input: Within input range Voltage (V)/Current (I) input: Input scale low limit to Input scale high limit	—

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Name	Register address		No. of data	Attri-bute	Data range	Factory set value
	HEX	DEC				
Error code (Data of each module)	0100 ⋮ 011E	256 ⋮ 286	31	RO	Bit data b0: Memory backup error b1: Unused b2: Unused b3: Adjustment data error b4: Input A/D error b5: Current transformer input A/D error b6: Temperature compensation A/D error b7: Unused Data 0: OFF 1: ON [Decimal numbers expression: 0 to 255]	—
Cool-side manipulated output value ♦	0140 ⋮ 017D	320 ⋮ 381	62	RO	–5.0 to +105.0 %	—
Current transformer input measured value ♦	0180 ⋮ 01BD	384 ⋮ 445	62	RO	0.0 to 30.0 A or 0.0 to 100.0 A	—
Burnout state	0200 ⋮ 023D	512 ⋮ 573	62	RO	0: OFF 1: ON	—
Event 1 state	0240 ⋮ 027D	576 ⋮ 637	62	RO	0: OFF 1: ON	—
Event 2 state	0280 ⋮ 02BD	640 ⋮ 701	62	RO		—
Heater break alarm (HBA) state	02C0 ⋮ 02FD	704 ⋮ 765	62	RO	0: OFF 1: Heater break 2: Relay welding	—
Control loop break alarm (LBA) state	0300 ⋮ 033D	768 ⋮ 829	62	RO	0: OFF 1: ON	—
Temperature rise completion state	0340 ⋮ 037D	832 ⋮ 893	62	RO	0: Temperature rise not complete 1: Temperature rise completion	—
Operation mode ♦	03C0 ⋮ 03FD	960 ⋮ 1021	62	R/W	0: Unused 1: Monitor 1 2: Monitor 2 3: Control	3

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Name	Register address		No. of data	Attribute	Data range	Factory set value
	HEX	DEC				
Set value (SV) ♦	0400 ⋮ 043D	1024 ⋮ 1085	62	R/W	TC/RTD input: Within input range Voltage (V)/Current (I) input: Input scale low limit to Input scale high limit	0 (0.0)
Heat-side proportional band ♦	0440 ⋮ 047D	1088 ⋮ 1149	62	R/W	TC/RTD input: 0 (0.0) to Input span [°C (°F)] Voltage (V)/Current (I) input: 0.0 to 100.0 % of input span [0 (0.0): ON/OFF action]	TC/RTD: 30 (30.0) V/I: 30.0
Integral time ♦	0480 ⋮ 04BD	1152 ⋮ 1213	62	R/W	1 to 3600 seconds	240
Derivative time ♦	04C0 ⋮ 04FD	1216 ⋮ 1277	62	R/W	0 to 3600 seconds [0: Derivative action OFF (PI action)]	60
Control response parameters	0500 ⋮ 053D	1280 ⋮ 1341	62	R/W	0: Slow 1: Medium 2: Fast	0
PV bias ♦	0540 ⋮ 057D	1344 ⋮ 1405	62	R/W	–Input span to +Input span	0
Event 1 set value ♦	0580 ⋮ 05BD	1408 ⋮ 1469	62	R/W	Deviation high/Deviation low: –Input span to +Input span Deviation high/low, Band: 0 (0.0) to Input span Process high/Process low: Within input range	0
Event 2 set value ♦	05C0 ⋮ 05FD	1472 ⋮ 1533	62	R/W		0
Cool-side proportional band ♦	0700 ⋮ 073D	1792 ⋮ 1853	62	R/W	TC/RTD input: 1 (0.1) to Input span [°C (°F)] Voltage (V)/Current (I) input: 0.1 to 100.0 % of input span	TC/RTD: 30 (30.0) V/I: 30.0
Overlap/Deadband ♦	0780 ⋮ 07BD	1920 ⋮ 1981	62	R/W	–Input span to +Input span	0 (0.0)
Setting change rate limiter	07C0 ⋮ 07FD	1984 ⋮ 2045	62	R/W	0 (0.0) to Input span/minute [0 (0.0): Setting change rate limiter OFF]	0 (0.0)

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Name	Register address		No. of data	Attribute	Data range	Factory set value
	HEX	DEC				
PID/AT transfer * ♦	0800 : 083D	2048 : 2109	62	R/W	0: PID control operation 1: AT (Autotuning) operation	0
Auto/Manual transfer ♦	0840 : 087D	2112 : 2173	62	R/W	0: Auto mode 1: Manual mode	0
Manual output value ♦	0880 : 08BD	2176 : 2237	62	R/W	–5.0 to +105.0 %	0.0
Output limiter (high)	08C0 : 08FD	2240 : 2301	62	R/W	Output limiter (low) to 105.0 %	100.0
Output limiter (low)	0900 : 093D	2304 : 2365	62	R/W	–5.0 % to Output limiter (high)	0.0
Heat-side proportional cycle time	0940 : 097D	2368 : 2429	62	R/W	1 to 100 seconds	Relay contact output: 20 Voltage pulse output: 2
Cool-side proportional cycle time	0980 : 09BD	2432 : 2493	62	R/W		
Digital filter	09C0 : 09FD	2496 : 2557	62	R/W	0 to 100 seconds [0: Digital filter OFF]	0
Heater break alarm (HBA) set value ♦	0A00 : 0A3D	2560 : 2621	62	R/W	0.0 to 30.0 A or 0.0 to 100.0 A	0.0
Number of heater break alarm (HBA) delay times	0A40 : 0A7D	2624 : 2685	62	R/W	1 to 255 times	5

* Caution for using the Autotuning (AT)

- When a temperature change (UP and/or Down) is 1 °C (1 °F) or less per minute during Autotuning, Autotuning may be cancelled before calculating PID values. In that case, adjust the PID values manually. It is possible to happen when the set value is around the ambient temperature or is close to the maximum temperature achieved by the load.
- When control loop break alarm (LBA) is used, control loop break alarm (LBA) time is automatically calculated by AT. However, the calculated data becomes valid by changing to the initial setting mode once after AT is executed.

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Name	Register address		No. of data	Attribute	Data range	Factory set value
	HEX	DEC				
Control RUN/STOP transfer (Data of each module) ♦	0C00 : 0C1E	3072 : 3102	31	R/W	0: Control STOP 1: Control RUN	0
Input error determination point (high)	0C40 : 0C7D	3136 : 3197	62	R/W	Within input range	Input range high limit
Input error determination point (low)	0C80 : 0CBD	3200 : 3261	62	R/W		Input range low limit
Action at input error (high)	0CC0 : 0CFD	3264 : 3325	62	R/W	0: Normal control 1: Manipulated output value at input error	0
Action at input error (low)	0D00 : 0D3D	3328 : 3389	62	R/W		0
Manipulated output value at input error	0D40 : 0D7D	3392 : 3453	62	R/W	–105.0 to +105.0 %	0.0
AT differential gap time	0D80 : 0DBD	3456 : 3517	62	R/W	0 to 100 seconds	1
AT bias	0E00 : 0E3D	3584 : 3645	62	R/W	–Input span to +Input span	0 (0.0)
Event LED mode setting (Data of each module)	0F00 : 0F1E	3840 : 3870	31	R/W	1: Mode 1 2: Mode 2 3: Mode 3 Except the above (within 0 to 255): Unused	0
DI setting (Data of each module) ♦	0F40 : 0F5E	3904 : 3934	31	R/W	1: Control RUN/STOP 2: Event interlock release Except the above (within 0 to 20): Unused	Specify when ordering
DI state (Data of each module)	0F80 : 0F9E	3968 : 3998	31	RO	0: Contact open (OFF) 1: Contact close (ON)	—

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Name	Register address		No. of data	Attribute	Data range	Factory set value
	HEX	DEC				
DO1 setting (Data of each module) ♦	0FC0 : 0FDE	4032 : 4062	31	R/W	1: CH1 Event 1 state 2: CH2 Event 1 state 3: CH1 Event 2 state 4: CH2 Event 2 state 5: CH1 Heater break alarm state 6: CH2 Heater break alarm state 7: CH1 Control loop break alarm state 8: CH2 Control loop break alarm state 9: CH1 Burnout state 10:CH2 Burnout state 11:CH1 Temperature rise completion 12:CH2 Temperature rise completion Except the above (within 0 to 20): Unused	Specify when ordering
DO2 setting (Data of each module) ♦	1000 : 101E	4096 : 4126	31	R/W		Specify when ordering
DO state (Data of each module) ♦	1040 : 105E	4160 : 4190	31	R/W	0: DO1: Contact open (OFF) DO2: Contact open (OFF) 1: DO1: Contact close (ON) DO2: Contact open (OFF) 2: DO1: Contact open (OFF) DO2: Contact close (ON) 3: DO1: Contact close (ON) DO2: Contact close (ON) Data write is possible only when the DO1 and DO2 setting values are "0."	0
Event interlock release (Data of each module)	1080 : 109E	4224 : 4254	31	R/W	0: Normal state 1: Event interlock release execution	0
Temperature rise completion zone	10C0 : 10FD	4288 : 4349	62	R/W	0 (0.0) to Input span [0 (0.0): Unused]	0 (0.0)
Temperature rise completion soak time	1100 : 113D	4352 : 4413	62	R/W	0 to 360 minutes	0

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Name	Register address		No. of data	Attri-bute	Data range	Factory set value
	HEX	DEC				
TIO state ♦	7600 ⋮ 763D	30208 ⋮ 30296	62	RO	Bit data b0: Burnout b1: Event 1 state b2: Event 2 state b3: Heater break alarm (HBA) state b4: Control loop break alarm (LBA) state b5 to b7: Unused b8: DI state b9: DO1 state b10: DO2 state b11: Temperature rise completion state b12: Control RUN/STOP state b13: Module error b14: Setting error b15: Error code Data 0: OFF 1: ON [Decimal numbers expression: 0 to 65535]	—
Station number * (Data of each unit)	7D00	32000	1	R/W	0 to 255	0
PC number * (Data of each unit)	7D01	32001	1	R/W		255
Register start number * (Data of each unit)	7D02	32002	1	R/W	0 to 32767	1000
Maximum number of PLC communication channels * (Data of each unit)	7D03	32003	1	R/W	1 to 62 CH	20
Register type (D, R, W) * (Data of each unit)	7D04	32004	1	R/W	0: D register (data register) 1: R register (file register) 2: W register (link register)	0
V-TIO-E/F module monitor item selection * (Data of each unit)	7D06	32006	1	R/W	Bit data b0: Measured value (PV) b1: Set value monitor b2: Heat-side output value b3: Cool-side output value b4: CT input measured value b5: TIO state Data 0: Invalid 1: Valid [Decimal numbers expression: 0 to 63]	63

* These items become valid by turning off the power of the V-TIO-E/F module once, and then turning it on again after the settings are changed.

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Name	Register address		No. of data	Attri-bute	Data range	Factory set value
	HEX	DEC				
V-TIO-E/F module Link recognition time * (Data of each unit)	7D07	32007	1	R/W	0 to 255 seconds	10
V-TIO-E/F module error code (Data of each unit)	7D08	32008	1	RO	Bit data b0: Memory backup error b2: Module configuration error b7: PLC communication error b1, b3 to b6: Unused Data 0: OFF 1: ON [Decimal numbers expression: 0 to 255]	—
PLC scanning time setting * (Data of each unit)	7D09	32009	1	R/W	0 to 255 ms	255
Number of connected TIO modules (Data of each unit)	7D0A	32010	1	RO	0 to 31	—
Number of connected TIO channels (Data of each unit)	7D0B	32011	1	RO	0 to 62 CH	—
Action mode selection * (Data of each unit)	7D0C	32012	1	R/W	Bit data b0: Address setting 0: Continuous setting 1: Free setting b1: PLC register read/write error elimination 0: Manual elimination 1: Automatic elimination b2 to b7: Unused [Decimal numbers expression: 0 to 3]	bit 0: 1 bit 1: 0
PLC communication start time * (Data of each unit)	7D0F	32015	1	R/W	1 to 255 seconds	5
Initial setting mode (Data of each unit)	7D20	32032	1	R/W	0: Normal setting mode 1: Initial setting mode	0

* These items become valid by turning off the power of the V-TIO-E/F module once, and then turning it on again after the settings are changed.

■ 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.

● Transfer to initial setting mode.

Transfer to initial setting mode sets in "1" with register address 7D20H (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 register address 7D20H by 0).

No initial setting mode data is handled in PLC communication.

Name	Register address		No. of data	Attribute	Data range	Factory set value
	HEX	DEC				
Control loop break alarm (LBA) use selection	6A40 ⋮ 6A7D	27200 ⋮ 27261	62	R/W	0: Unused 1: Used	0
Control loop break alarm (LBA) time	6A80 ⋮ 6ABD	27264 ⋮ 27325	62	R/W	1 to 7200 seconds	480
Control loop break alarm (LBA) deadband	6AC0 ⋮ 6AFD	27328 ⋮ 27389	62	R/W	0 (0.0) to Input span	0 (0.0)
Input range number *	7000 ⋮ 703D	28672 ⋮ 28733	62	R/W	TC input 0: K –200 to +1372 °C or –328 to +2501 °F 1: K 0 to 800 °C or 32 to 1472 °F 2: K 0 to 400 °C or 32 to 752 °F 3: K –200.0 to +400.0 °C or –328.0 to +752.0 °F	Specify when ordering

* These items become valid by turning off the power of the V-TIO-E/F module once, and then turning it on again after the settings are changed.

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Name	Register address		No. of data	Attri-bute	Data range	Factory set value
	HEX	DEC				
Input range number *	7000 ⋮ 703D	28672 ⋮ 28733	62	R/W	TC input 4: K 0.0 to 400.0 °C or 32.0 to 752.0 °F 5: J –200 to +1200 °C or –328 to +2192 °F 6: J 0 to 800 °C or 32 to 1472 °F 7: J 0 to 400 °C or 32 to 752 °F 8: J –200.0 to +400.0 °C or –328.0 to +752.0 °F 9: J 0.0 to 400.0 °C or 32.0 to 752.0 °F 10: T –200 to +400 °C or –328 to +752 °F 11: T 0 to 400 °C or 32 to 752 °F 12: T 0 to 200 °C or 32 to 392 °F 13: T –200.0 to +400.0 °C or –328.0 to +752.0 °F 14: T 0.0 to 400.0 °C or 32.0 to 752.0 °F 15: S 0 to 1768 °C or 32 to 3214 °F 16: R 0 to 1768 °C or 32 to 3214 °F 17: PLII 0 to 1390 °C or 32 to 2534 °F 18: N 0 to 1300 °C or 32 to 2372 °F 19: W5Re/W26Re 0 to 2300 °C or 32 to 4172 °F 20: E 0 to 1000 °C or 32 to 1832 °F 21: E 0 to 800 °C or 32 to 1472 °F 22: B 0 to 1800 °C or 32 to 3272 °F RTD input: 23: Pt100 0 to 850 °C or 32 to 1562 °F 24: Pt100 0 to 400 °C or 32 to 752 °F	Specify when ordering

* These items become valid by turning off the power of the V-TIO-E/F module once, and then turning it on again after the settings are changed.

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Name	Register address		No. of data	Attribute	Data range	Factory set value
	HEX	DEC				
Input range number [1]	7000 ⋮ 703D	28672 ⋮ 28733	62	R/W	RTD input: 25: Pt100 −200.0 to +400.0 °C or −328.0 to +752.0 °F 26: Pt100 0.0 to 400.0 °C or 32.0 to 752.0 °F 27: JPt100 0 to 600 °C or 32 to 1112 °F 28: JPt100 0 to 400 °C or 32 to 752 °F 29: JPt100 −200.0 to +400.0 °C or −328.0 to +752.0 °F 30: JPt100 0.0 to 400.0 °C or 32.0 to 752.0 °F Voltage/Current input: 31: 0 to 100 mV DC 32: Unused 33: 0 to 5 V DC 34: 1 to 5 V DC 35: 0 to 10 V DC 36: 0 to 20 mA DC 37: 4 to 20 mA DC	Specify when ordering
Input scale high limit [1, 2]	7040 ⋮ 707D	28736 ⋮ 28797	62	R/W	Input scale low limit to 10000	100.0
Input scale low limit [1, 2]	7080 ⋮ 70BD	28800 ⋮ 28861	62	R/W	−2000 to Input scale high limit	0.0
Input range decimal point position [1, 2]	70C0 ⋮ 70FD	28864 ⋮ 28925	62	R/W	0: No decimal place 1: One decimal place 2: Two decimal places 3: Three decimal places	1
Temperature unit selection	7100 ⋮ 713D	28928 ⋮ 28989	62	R/W	0: °C 1: °F	0
Control type selection	7140 ⋮ 717D	28992 ⋮ 29053	62	R/W	0: Heat control: direct action 1: Heat control: reverse action 2: Heat/cool control (water cooling) 3: Heat/cool control (air cooling)	Specify when ordering

[1] These items become valid by turning off the power of the V-TIO-E/F module once, and then turning it on again after the settings are changed.
[2] Valid only for voltage/current input

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Name	Register address		No. of data	Attribute	Data range	Factory set value
	HEX	DEC				
ON/OFF control differential gap (upper)	7180 : 71BD	29056 : 29117	62	R/W	0 to Input span	TC/RTD: 1.0 V/I: 0.1
ON/OFF control differential gap (lower)	71C0 : 71FD	29120 : 29181	62	R/W		
Event 1 differential gap	7200 : 723D	29184 : 29245	62	R/W	0 to Input span	TC/RTD: 2.0 V/I: 0.2
Event 2 differential gap	7240 : 727D	29248 : 29309	62	R/W		
Event 1 type selection	7280 : 72BD	29312 : 29373	62	R/W	0: None 1: Process high 2: Process low 3: Deviation high 4: Deviation low 5: Deviation high/low 6: Band	Specify when ordering
Event 2 type selection	72C0 : 72FD	29376 : 29437	62	R/W		Specify when ordering
Event 1 action selection	7300 : 733D	29440 : 29501	62	R/W	Bit data b0: Hold action b1: Re-hold action b2: Interlock action b3: Event action at input error b4: Hold action at control start b5 to b7: Unused Data 0: OFF 1: ON [Decimal numbers expression: 0 to 31]	b0 to b2: Specify when ordering b3 to b7: 0
Event 2 action selection	7340 : 737D	29504 : 29565	62	R/W		b0 to b2: Specify when ordering b3 to b7: 0
Event delay timer	7380 : 73BD	29568 : 29629	62	R/W	0 to 9999 seconds	0
TIO module internal communication Transmission transfer time setting (Data of each module)	73C0 : 73DE	29632 : 29662	31	R/W	0 to 100 ms	6
Operation mode holding setting (Data of each module)	7440 : 745E	29760 : 29790	31	R/W	0: Not hold 1: Hold	1

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Name	Register address		No. of data	Attribute	Data range	Factory set value
	HEX	DEC				
Host communication 1 Transmission transfer time setting (Data of each unit)	7D21	32033	1	R/W	0 to 255 ms	6
PLC communication/ Host communication 2 Transmission transfer time setting (Data of each unit)	7D22	32034	1	R/W	0 to 255 ms	1
Internal communication speed setting * (Data of each unit)	7D24	32036	1	R/W	0: 2400 bps 1: 9600 bps 2: 19200 bps 3: 38400 bps	3
Communication data block length (RKC communication) (Data of each unit)	7D26	32038	1	R/W	20 to 255 byte	255
Modbus data interval extension time (Data of each unit)	7D27	32039	1	R/W	0 to 255 ms	0

* These items become valid by turning off the power of the V-TIO-E/F module once, and then turning it on again after the settings are changed.

7. TROUBLESHOOTING

This section explains probable causes and treatment procedures if any abnormality occurs in the instrument. For any inquiries, please contact RKC sales office or the agent, to confirm the specifications of the product.

If it is necessary to replace a device, always strictly observe the warnings below.

⚠ 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.

■ V-TIO-E/F module

Problem	Probable cause	Solution
FAIL/RUN lamp does not light up (temperature control side) RUN lamp does not light up (PLC/host communication side)	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 V-TIO-E/F module
RUN lamp flashes rapidly (PLC/host communication side)	Data collection just after the power is turned on	After data collection, the lamp goes on, if normal
RUN lamp flashes slowly (PLC/host communication side)	Memory backup error	Replace V-TIO-E/F module
	Module configuration error Disconnection of the module connection or disconnection of the module mainframe from terminal base	Confirm the module connection condition and connect correctly
	PLC communication error No connection or disconnection or imperfect contact of the communication cable	Confirm the cable connection condition and connect correctly
	PLC register read/write error Reset with the PLC side	PLC register read/write error elimination: Manual elimination The request command, “2: Set value monitor” is executed and then the error is eliminated after all of the set values are written in the register. PLC register read/write error elimination: Automatic elimination The error is automatically eliminated after PLC communication returns to normal and the error is retained for more than one second (or monitor processing time).
RX/TX lamp does not flash (temperature control side)	Disconnection of the module connection or imperfect contact of the junction connector	Confirm the connection condition or connector and connect correctly
	CPU section defect	Replace V-TIO-E/F module
FAIL/RUN lamp is lit (red): FAIL status (temperature control side)	CPU section or power section defect	Replace V-TIO-E/F module

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Problem	Probable cause	Solution
FAIL lamp is lit (PLC/host communication side)	CPU section defect	Replace V-TIO-E/F module
FAIL lamp flashes (PLC/host communication side)	PLC communication environment setting mode by the switch	Return the switch to its original position

☞ For the PLC communication environment setting mode by the switch, see **5.1.3 PLC communication environment setting (P. 39)** [MITSUBISHI PLC] or **5.2.3 PLC communication environment setting (P. 57)** [OMRON PLC].

■ PLC communication

Problem	Probable cause	Solution
• Even if "1: Setting" or "2: Set value monitor" is set in request command, transfer is not finished. Request command does not return to "0: Monitor" • COM. PORT1 lamp or COM. PORT2/ COM. PORT3 lamp is lit, and it can be seen to communicate normally, but monitor value is not transferred to PLC	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, data bit configuration and protocol with those of the PLC	Confirm the V-TIO-E/F module settings and set them correctly
	Wrong setting of PLC communication data	Confirm the PLC communication settings and set them correctly
		Setting of termination resistor in accordance with PLC or the insertion is done
	Setting of PLC becomes write inhibit	Setting of PLC is turned into write enable (Write enable in RUN, shift to monitor mode, etc.)
	Accesses outside the range of memory address of PLC (wrong setting of address)	Confirm the PLC communication environment setting and set them correctly
If two or more units are connected, no units after the second unit are recognized	V-TIO-F/F module Link recognition time is short	Lengthen V-TIO-F/F module link recognition time
When request command is set in "1: Setting," setting error (bit 14 of TIO state, ON) is become	Data rang error	Confirm the setting range of set value and set them correctly
Details of each setting of the PLC communication environment by switch are known	There is no record of setting details	• Initialize the set state by switch, and then re-set each value • Set it by host communication

☞ For "PLC communication environment setting," and "V-TIO-F/F module link recognition time," see **5.1.3 PLC communication environment setting (P. 39)** [MITSUBISHI PLC] or **5.2.3 PLC communication environment setting (P. 57)** [OMRON PLC].

☞ For the initialization method of PLC communication environment setting by the switch, see **APPENDIX A.3 Various Setting Change by the Switch (P. 165)**.

■ Host communication

● 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	
	Transmission transfer time is short	Lengthen transmission transfer time
EOT return	The specified identifier is invalid	Confirm the identifier is correct or that with the correct function is specified. Otherwise correct it
	Error in the data format	Reexamine the communication program
NAK return	Error occurs on the line (parity bit error, framing error, etc.	Confirm the cause of error, and solve the problem appropriately. (Confirm the transmitting data, and resend data)
	BCC error	
	The data exceeds the setting range	Confirm the setting range and transmit correct data
	The specified identifier is invalid	Confirm the identifier is correct or that with the correct function is specified. Otherwise correct it

☞ For the initialization method of PLC communication environment setting by the switch, see **APPENDIX A.3 Various Setting Change by the Switch (P. 165)**.

- **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 • Verify communication program • Set Modbus data interval extension time
	Transmission transfer time is short	Lengthen transmission transfer time
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	

☞ For the setting method of host communication transmission transfer time and Modbus data interval extension time by the switch, see **APPENDIX A.3 Various Setting Change by the Switch (P. 165)**.

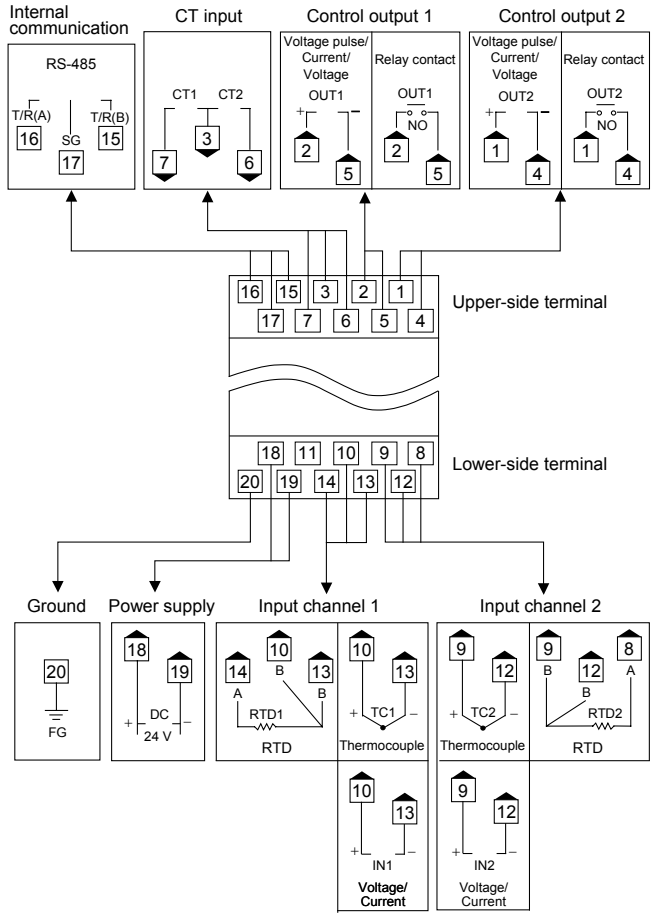
APPENDIX A. HARDWARE

A.1 Terminal Configuration

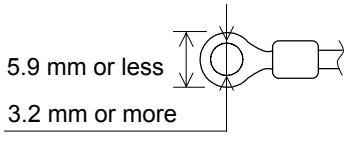
■ Wiring cautions

- For thermocouple input, use the appropriate compensation wire.
- For RTD input, use low resistance lead wire with no difference in resistance between the three lead wires.
- To avoid noise induction, keep input signal wire away from instrument power line, load lines and power lines of other electric equipment.
- If there is electrical noise in the vicinity of the instrument that could affect operation, use a noise filter.
  - Shorten the distance between the twisted power supply wire pitches to achieve the most effective noise reduction.
  - Always install the noise filter on a grounded panel. Minimize the wiring distance between the noise filter output and the instrument power supply terminals to achieve the most effective noise reduction.
  - Do not connect fuses or switches to the noise filter output wiring as this will reduce the effectiveness of the noise filter.
- Power supply wiring must be twisted and have a low voltage drop.
- For an instrument with 24 V power supply, supply power from a SELV circuit.
- A suitable power supply should be considered in the end-use equipment. The power supply must be in compliance with a limited-energy circuits (maximum available current of 8 A).

■ V-TIO-E/V-TIO-F



- Terminal No. 11 is not used.
- Use the solderless terminals appropriate to the screw size (M3).

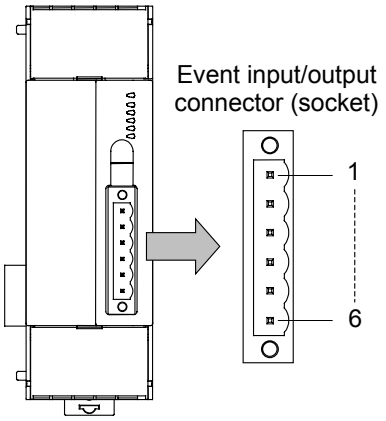


Recommended tightening torque:
0.4 N·m (4 kgf·cm)

• For heat/cool PID control (V-TIO-F), input channel 2 becomes unused.
• For heat/cool PID control (V-TIO-F), Control output 1 corresponds to the heating output and Control output 2 corresponds to the cooling output.

A.2 Pin Layout of Connector

■ When there is the event input/output

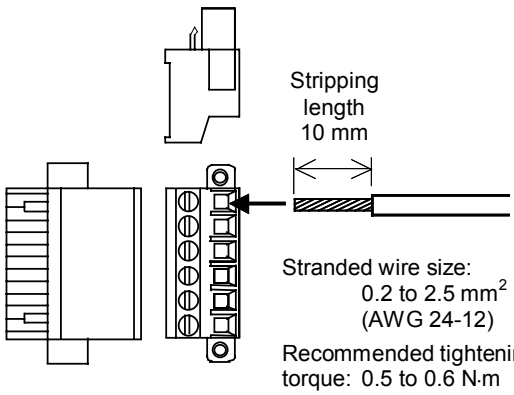


Pin No.	Description
1	Digital input (DI) (–)
2	Digital input (DI) (+)
3	Digital output (DO) 1 (Relay contact output)
4	
5	Digital output (DO) 2 (Relay contact output)
6	

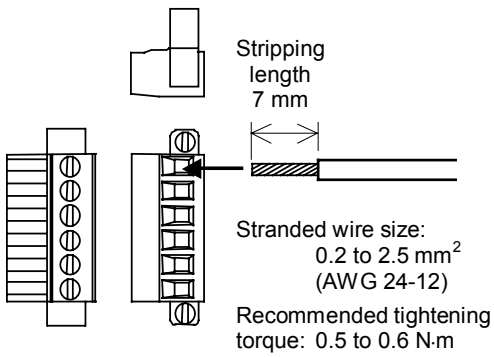
■ Attention in connector (plug) wiring

- Use the following connector (plug) as that connected to the event input/output connector.
  Connector (plug) is sold separately.
  SRVP-01 (Front-screw type)
  SRVP-02 (Side-screw type)
- The lead wires use the stranded wire.
- Use the stranded wire from size 0.2 to 2.5 mm^2 (AWG 24-12).
- Stripping length is as follows.
  SRVP-01: 10 mm
  SRVP-02: 7 mm
- Recommended tightening torque of the lead wire in the connector (plug):
  0.5 to 0.6 N·m (5 to 6 kgf·cm)
  (Screw size SRVP-01: M2.5
  SRVP-02: M3)

[SRVP-01] Front-screw type



[SRVP-02] Side-screw type



A.3 Various Setting Change by the Switch

Items which are not necessary to be frequently changed are set by the DIP switch in the V-TIO-E/F module. When changing the setting, set the module to the PLC communication environment setting mode in the same way as setting the PLC communication environment by switch. Switches used are the PLC communication setting switch and address setting switch 2.

📖 **Change the following items only when normal communication can be conducted as far as the factory set values are used.**

📖 **The following items become valid by turning off the power of the V-TIO-E/F module once, and then turning it on again after the settings are changed.**

☞ For changing method, see **5.1.3 PLC communication environment setting (P. 39)** [MITSUBISHI PLC] or **5.2.3 PLC communication environment setting (P. 57)** [OMRON PLC].

- **PLC communication setting switch**

Switch No.	Setting items	Data range (Address setting switch 2)	Factory set value
1	V-TIO-E/F module monitor item selection	This item is the item of PLC communication environment setting.	—
2	Internal communication speed setting [1, 2]	0: 2400 bps 1: 9600 bps 2: 19200 bps 3: 38400 bps (4 to F: 38400 bps) Set internal communication speed.	38400 bps
3	Host communication 1 transmission transfer time setting [2]	0 to E: 0 to 140 ms (set value × 10) F: 255 ms Set the standby time until the V-TIO-E/F module starts sending data after receiving data from the host computer.	6 ms

[1] If the internal communication speed is changed, it is necessary to match the internal communication speed set by the internal communication setting switch in the V-TIO-E/F module and the host communication speed of each temperature control module to be connected to the V-TIO-E module with the internal communication speed thus changed.

☞ For internal communication setting switch of the V-TIO-E/F module, see **4.4 Communication Setting Switch (P. 23)**.

[2] The setting can also be made in the host communication initial set mode.

☞ For initial setting mode, see **6.6.4 Communication identifier list (P. 120)** or **6.7.8 Data map (P. 144)**.

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Switch No.	Setting items	Data range (Address setting switch 2)	Factory set value
4	Modbus data interval extension time [1, 2]	0 to E: 0 to 140 ms (set value × 10) F: 255 ms Extend data time interval in Modbus.	0 ms
5	PLC communication/ Host communication 2 transmission transfer time setting [1]	0 to E: 0 to 140 ms (set value × 10) F: 255 ms Set the standby time until the V-TIO-E/F module starts sending data after receiving data from the PLC.	1 ms
6	Action mode selection	0: Address setting: Continuous setting PLC register read/write error elimination: Manual elimination 1: Address setting: Free setting PLC register read/write error elimination: Manual elimination 2: Address setting: Continuous setting PLC register read/write error elimination: Automatic elimination 3: Address setting: Free setting PLC register read/write error elimination: Automatic elimination 4 to F: Unused (Do not set this one) Sets an action taken when the address is specified and an error occurs in PLC communication.	Free setting Manual elimination
7	Unused (Do not set this one)	—	—
8	Set value initialize	0 to E: Do not initialize F: Initialize data Initialize all of the items (including items in this table) which can be set in the PLC communication environment setting mode to return to the state prior to factory shipment.	Do not initialize

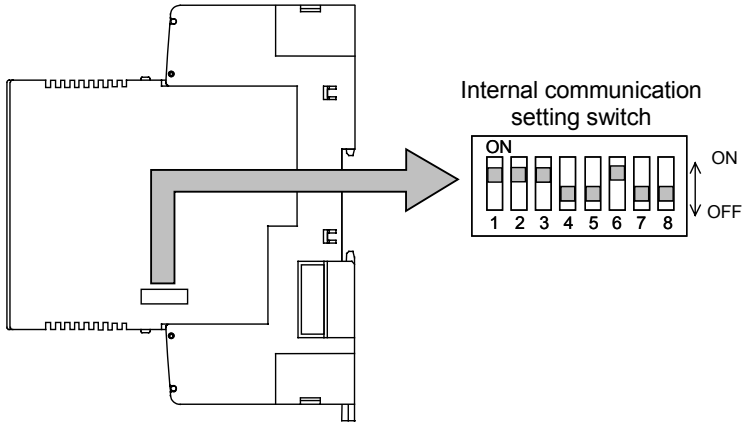
[1] The setting can also be made in the host communication initial set mode.

☞ For initial setting mode, see **6.6.4 Communication identifier list (P. 120)** or **6.7.8 Data map (P. 144)**.

[2] 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 this setting.

A.4 Internal Communication Setting

The internal communication setting switch at the right side of the V-TIO-E/F module enables all of the internal communication speed, data bit configuration and communication protocol settings. However, **use the same setting as the factory set values.**
Only when a change is required, make the setting by referring to the following.



Right side view

[Internal communication setting switch]

1	2	Communication speed	
OFF	OFF	2400 bps	
ON	OFF	9600 bps	
OFF	ON	19200 bps	
ON	ON	38400 bps	← Factory set value

3	4	5	Data bit configuration	
OFF	OFF	OFF	Data 7-bit, Without parity, Stop 1-bit *	
OFF	OFF	ON	Data 7-bit, Even parity, Stop 1-bit *	
OFF	ON	OFF	Do not set this one	
OFF	ON	ON	Data 7-bit, Odd parity, Stop 1-bit *	
ON	OFF	OFF	Data 8-bit, Without parity, Stop 1-bit	← Factory set value
ON	OFF	ON	Data 8-bit, Even parity, Stop 1-bit	
ON	ON	OFF	Do not set this one	
ON	ON	ON	Data 8-bit, Odd parity, Stop 1-bit	

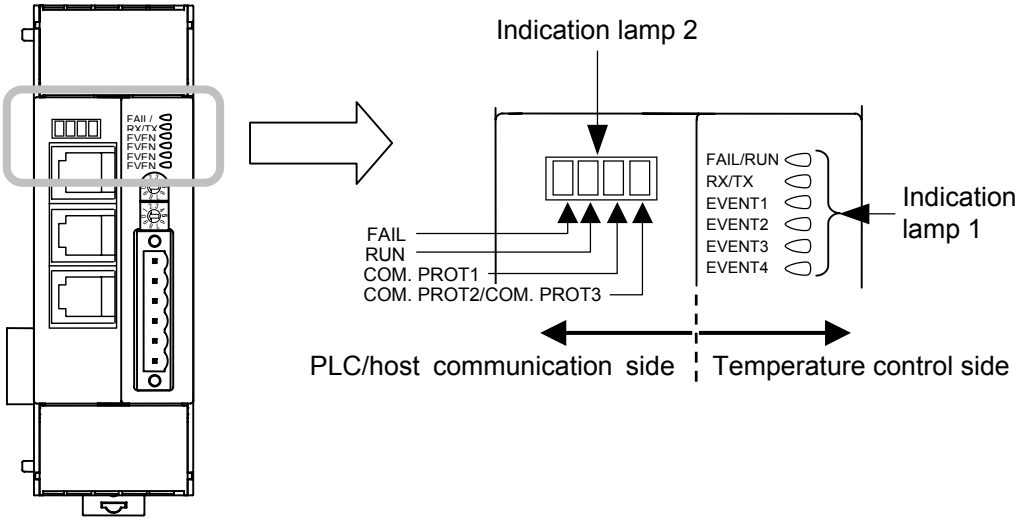
* When the Modbus communication protocol selected, this setting becomes invalid.

6	Protocol selection	
OFF	RKC communication	
ON	Modbus	← Factory set value

Switch No. 7 and 8 must be always OFF. Do not set to ON.

When connecting two or more modules (V-TIO-B, etc.) to the V-TIO-E/F module, match all of their communication speed, data bit configuration and communication protocol settings with the internal settings of the V-TIO-E/F module.

A.5 Indication Lamp



V-TIO-E/F module

[Indication lamp 1]

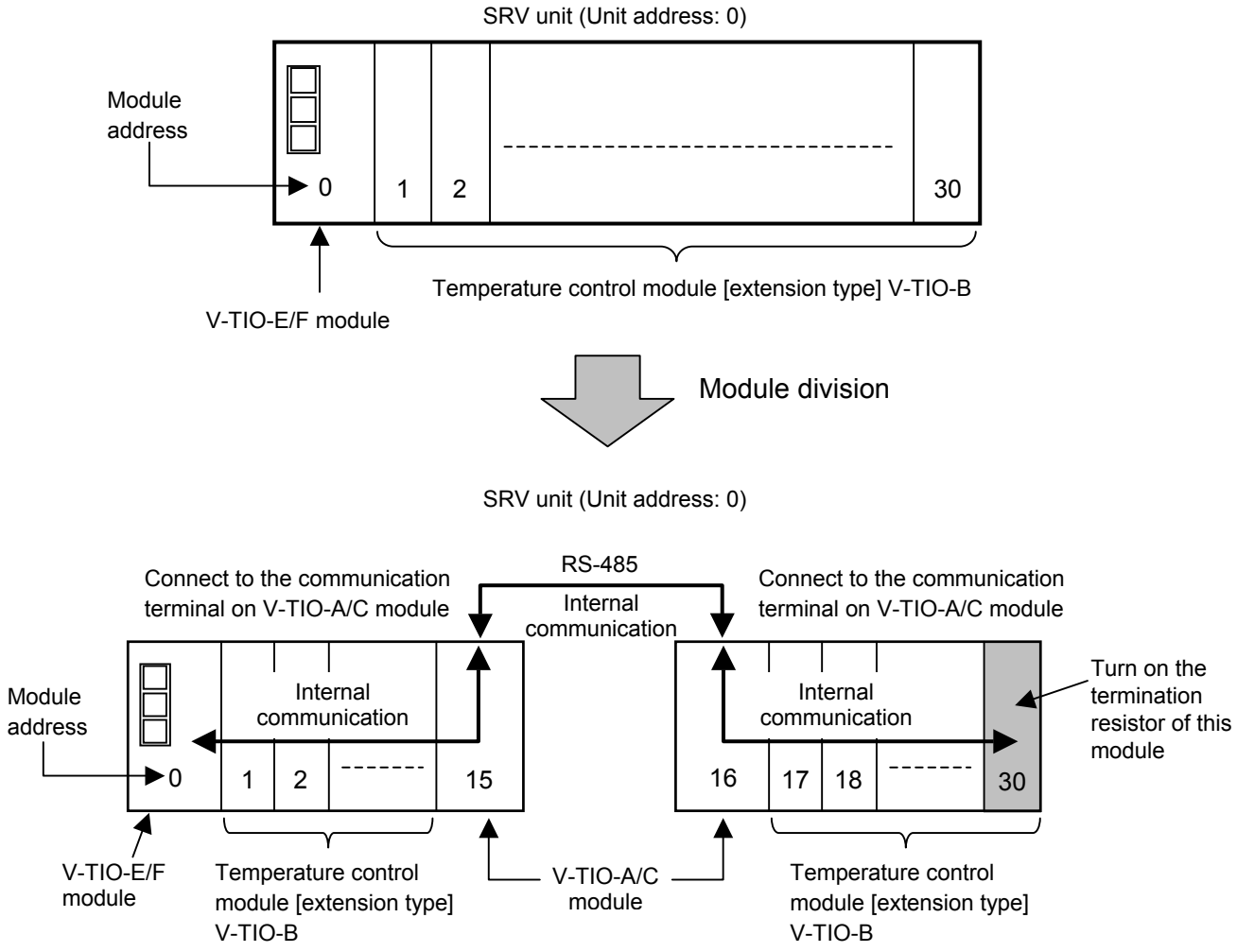
- **FAIL/RUN**
  During normal operation: Green lamp: ON (RUN)
  During error: Red lamp: ON (FAIL)
  During self-diagnostic error: Green lamp: flashing
- **RX/TX**
  During data send or receive: Green lamp: ON
- **EVENT 1 to 4**
  Display various states by setting.
  Display contents: Event 1 state, Event 2 state, Comprehensive event state, Output state, Control state

[Indication lamp 2]

- **FAIL**
  During normal operation: Red lamp: OFF
  During error: Red lamp: ON
  Communication environment setting mode by the switch: Red lamp: slow flashing
- **RUN**
  During normal operation: Green lamp: ON
  During error: Green lamp: OFF
  During memory backup error: Green lamp: slow flashing
  During module configuration error: Green lamp: slow flashing
  During PLC communication error: Green lamp: slow flashing
  During data collection after power ON: Green lamp: rapid flashing
- **COM. PORT1**
  During data send or receive: Yellow lamp: ON
- **COM. PORT2/COM. PORT3**
  During data send or receive: Yellow lamp: ON

A.6 Connection in the Module Division

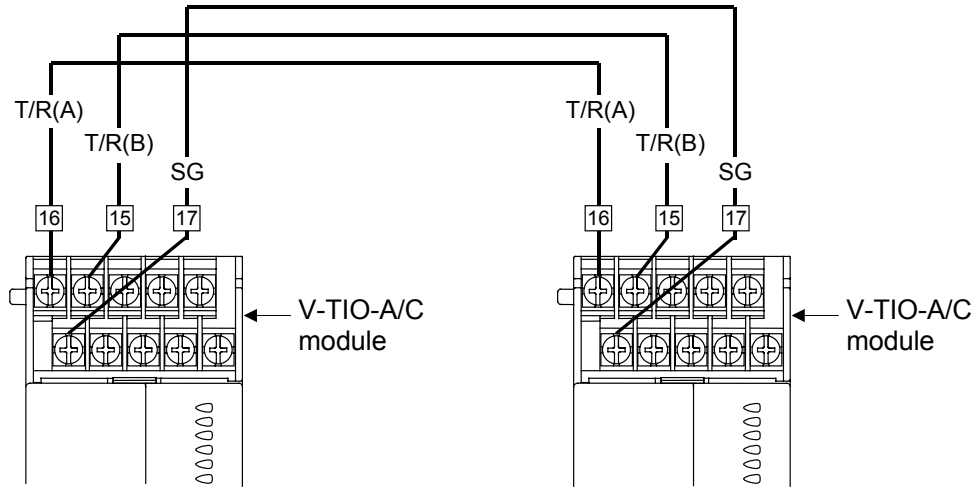
If there are restrictions on the number of modules in one unit due to environments at installing locations, it is possible to divide these modules in one unit into some groups for their installation.
When connecting the modules divided into some groups, use communication terminals (internal communication) on the terminal board for communication between each module. Therefore, one module (V-TIO-A or V-TIO-C) with the communication terminals is required for those modules divided into each group.



When connecting the modules divided into some groups, first turn on the power on the V-TIO-A/C module side and then turn on the power on the V-TIO-F/F module side.

Even if the modules are divided into some groups, one V-TIO-E/F module and one or more temperature control modules connected to the V-TIO-E/F module is counted as one unit.

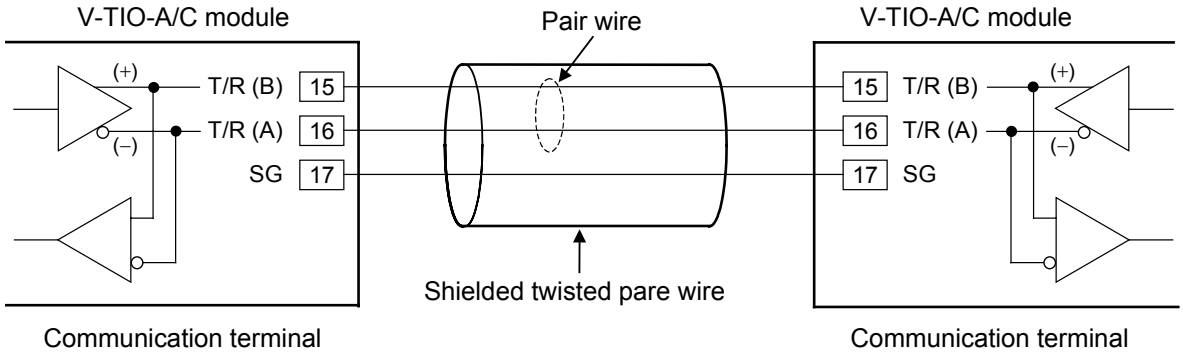
- **Connection terminals**



- **Communication terminal number and signal details (V-TIO-A/C)**

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

- **Diagram of RS-485 wiring**



Customer is requested to prepare a communication cable.

A.7 Product Specifications

■ Input

Measured input:

Number of inputs: 2 points (For heat/cool PID control, input channel 2 becomes unused.)
Isolated between each input channel:
Thermocouple input, Voltage (low)
Not isolated between each input channel:
RTD input, Voltage (high) input, Current input

Input type:
- Thermocouple: K, J, T, S, R, E, B, N (JIS-C1602-1995)
  PLII (NBS)
  W5Re/W26Re (ASTM-E988-96)
- Resistance temperature detector (RTD) input (3-wire system):
  Pt100 (JIS-C1604-1997)
  JPt100 (JIS-C1604-1989, Pt100 of JIS-C1604-1981)
- Voltage (low): 0 to 100 mV
- 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.

Input range:

- Temperature input (Thermocouple/RTD input)

Input type	Input range
K	0 to 400 °C, 0 to 800 °C, –200 to +1372 °C, 0.0 to 400.0 °C, –200.0 to +400.0 °C 32 to 752 °F, 32 to 1472 °F, –328 to +2501 °F, 32.0 to 752.0 °F, –328.0 to +752.0 °F
J	0 to 400 °C, 0 to 800 °C, –200 to +1200 °C, 0.0 to 400.0 °C, –200.0 to +400.0 °C 32 to 752 °F, 32 to 1472 °F, –328 to +2192 °F, 32.0 to 752.0 °F, –328.0 to +752.0 °F
R	0 to 200 °C, 0 to 400 °C, –200 to +400 °C, 0.0 to 400.0 °C, –200.0 to +400.0 °C 32 to 392 °F, 32 to 752 °F, –328 to +752 °F, 32.0 to 752.0 °F, –328.0 to +752.0 °F
S	0 to 1768 °C, 32 to 3214 °F
B	0 to 1768 °C, 32 to 3214 °F
E	0 to 1390 °C, 32 to 2534 °F
N	0 to 1300 °C, 32 to 2372 °F
T	0 to 2300 °C, 32 to 4172 °F
W5Re/W26Re	0 to 800 °C, 0 to 1000 °C, 32 to 1472 °F, 32 to 1832 °F
PLII	0 to 1800 °C, 32 to 3272 °F
Pt100	0 to 400 °C, 0 to 850 °C, 0.0 to 400.0 °C, –200.0 to +400.0 °C 32 to 752 °F, 32 to 1562 °F, 32.0 to 752.0 °F, –328.0 to +752.0 °F
JPt100	0 to 400 °C, 0 to 600 °C, 0.0 to 400.0 °C, –200.0 to +400.0 °C 32 to 752 °F, 32 to 1112 °F, 32.0 to 752.0 °F, –328.0 to +752.0 °F

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- Voltage/Current input
  Programmable range
  Input scale high limit: Input scale low limit to 10000
  Input scale low limit: –2000 to Input scale high limit
  However, a span is 12000 or less.

Accuracy (At the ambient temperature 23 °C ±2 °C):

- Thermocouple input (K, J, T, PLII, E)
  Less than –100 °C: ±2.0 °C
  –100 °C to less than +334 °C: ±1.0 °C
  334 °C or more: ± (0.3 % of reading + 1digit)
- Thermocouple input (R, S, N, W5Re/W26Re)
  –50 °C to less than +667 °C: ±2.0 °C
  667 °C or more: ± (0.3 % of reading + 1digit)
- Thermocouple input (B)
  Less than 400 °C: ±70.0 °C
  400 °C to less than 667 °C: ±2.0 °C
  667 °C or more: ± (0.3 % of reading + 1digit)
- RTD input
  Less than 267 °C: ±0.8 °C
  267 °C or more: ± (0.3 % of reading + 1digit)
- Voltage/Current input
  ± 0.3 % of span
- Cold junction temperature compensation accuracy
  ±1.0 °C (Ambient temperature 23 °C ±2 °C)
  Within ±1.5 °C between –10 to +50 °C of ambient temperature

Sampling cycle: 500 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. 0.25 mA

Action at input break:
Thermocouple input: Upscale
RTD input: Upscale
Voltage input
0 to 100 mV: Upscale
0 to 5 V, 1 to 5 V, 0 to 10 V: Indicates value near 0 V
Current input
0 to 20 mA, 4 to 20 mA: Indicates value near 0 mA

Action at input short circuit: Downscale (Only for RTD input)

Signal source resistance effect:
0.15 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: 1 to 100 seconds (Setting 0: 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:	1 second (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: 10 points

Indication contents:

Temperature control side

- Operation state indication [RUN/FAIL] (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 [RX/TX] (1 point)
  During data send or receive: Green lamp: ON
- Event display [EVENT1 to 4] (4 points)
  Various states are displayed depending on setting.
  Display contents: Event 1 state, Event 2 state, Comprehensive event state, Output state, Control state

PLC/host communication side

- Operation state indication [RUN, FAIL] (2points)
  During normal operation: Green lamp: ON (RUN)
  During error: Red lamp: ON (FAIL)
  During data collection after power ON:
  Green lamp: rapid flashing (RUN)
  During self-diagnostic error: Green lamp: slow flashing (RUN)
  During PLC communication environment setting mode:
  Red lamp: slow flashing (FAIL)
- Communication state indication [COM. PORT1, COM. PORT2/3] (2 points)
  During data send or receive: Yellow lamp: ON (COM. PORT1)
  During data send or receive: Yellow lamp: ON (COM. PORT2/3)

■ 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 heat control direct action, the heat control reverse action and the heat/cool control.

Additional functions: Autotuning function
With output limiter function

Setting range: Proportional band (heat-side/cool-side):
Temperature input: 0 (0.0) to Input span
[Unit: °C (°F)]
Voltage/Current input: 0.0 to 100.0 % of Input span
(0 or 0.0: ON/OFF action)
Integral time: 1 to 3600 seconds
Derivative time: 0 to 3600 seconds (0: PI action)

Control response parameter: Slow, Medium, Fast

Output limiter (high): Heat control: Output limiter (low) to +105.0 %
Heat/cool control: −5.0 to +105.0 % (For both control heat and cool)

Output limiter (low): Heat control: −5.0 % to Output limiter (high)
Heat/cool control: −5.0 % (fixed) (For both control heat and cool)
For the heat/cool control, the cool-side output limiter (high) is set by using the identifier or register address of the output limiter (low).

Overlap/Deadband: −Input span to +Input span
Minus (−) setting results in overlap.

Setting change rate limiter: 0 (0.0) to Input span/minute
0 (0.0): Setting change rate limiter OFF

Proportioning cycle time: 1 to 100 seconds (heat-side/cool-side)

Direct/Reverse action selection:
Direct action, Reverse action

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.

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

AT bias: ±Input span

■ 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, Interlock action
Event delay timer: 0 to 9999 seconds

Setting range: Deviation high, Deviation low: −Input span to +Input span
Deviation high/low, Band: 0 (0.0) to Input span
Process high, Process low: Within input range

Differential gap: 0 to Input span

Event state: Output the event state as communication data.

■ Heater break alarm (HBA) function

The heater break alarm function becomes invalid when the voltage/current output is selected as control output type.

Number of HBA: 2 points

Setting range: 0.0 to 30.0 A (Current transformer: CTL-6-P-N)
0.0 to 100.0 A (Current transformer: CTL-12-S56-10L-N)
(0.0 A: HBA 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

■ 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) ≥ PV ≥ Input error determination point (high)] 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): Within input range
Input error determination point (low): Within input range
Manipulated output value at input error: −105.0 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

■ PLC communication

Interface: Based on RS-422A, EIA standard
Based on RS-232C, EIA standard
COM. PORT1: Specify when ordering
COM. PORT2/COM. PORT3: RS-422A (fixed)

Connection method: RS-422A: 4-wire system, half-duplex multi-drop connection
RS-232C: Point-to-point connection

Synchronous method: Start/stop synchronous type

Communication speed: 9600 bps, 19200 bps, 38400 bps
Communication speed can be selected with switch

Data bit configuration: Start bit: 1
Data bit: 7 or 8
Parity bit: Without, Odd or Even
Without for 8 data bits
Stop bit: 1 or 2
Data bit configuration can be selected with switch

Protocol:
- MITSUBISHI MELSEC series special protocol
  - –ACPU common command (A series, FX2N, FX2NC series)
    - WR: Word device read for each word
    - WW: Word device write for each word
  - –AnA/AnUCPU common command (AnA/QnA series, Q series)
    - QR: Word device read for each word
    - QW: Word device write for each word
- OMRON SYSMAC series special protocol
  - C mode command

The protocol can be selected with switch

Maximum connections: Four modules (V-TIO-E/F) per communication port of PLC
[248 CH max.]

■ Host communication

Interface:
Based on RS-422A, EIA standard
Based on RS-232C, EIA standard
COM. PORT1: Specify when ordering
COM. PORT2/COM. PORT3: RS-422A (fixed)

Connection method:
RS-422A: 4-wire system, half-duplex multi-drop connection
RS-232C: Point-to-point connection

Synchronous method:
Start/stop synchronous type

Communication speed:
2400 bps, 9600 bps, 19200 bps, 38400 bps
Communication speed can be selected with switch

Data bit configuration:
Start bit: 1
Data bit: 7 or 8 (RKC communication)
8 (Modbus)
Parity bit: Without, Odd or Even
Stop bit: 1 or 2
Data bit configuration can be selected with switch

Protocol:
- RKC communication
  Based on ANSI X3.28-1976 subcategory 2.5 B1
  Polling/selecting type
  Error control: Vertical parity (with parity bit selected)
  Horizontal parity (BCC check)
  Data types: ASCII 7-bit code
- Modbus
  Signal transmission mode: Remote Terminal Unit (RTU) mode
  Function codes: 03H Read holding registers
  06H Preset single register
  08H Diagnostics (loopback test)
  10H Preset multiple registers
  Error check method: CRC-16
  Error codes: 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

RKC communication or Modbus protocol can be selected with switch

Maximum connections:
RS-422A: 16 modules (V-TIO-E/F) per communication port of host computer [992 CH max.]
RS-232C: One module (V-TIO-E/F) per communication port of host computer [62 CH max.]

■ Internal communication (communication between module)

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:	38400 bps
Data bit configuration:	Start bit: 1 Data bit: 8 Parity bit: Without Stop bit: 1
Protocol:	Modbus
Maximum connections:	30 temperature control modules per V-TIO-E/F module (The modules can be divided into some groups by using the internal communication terminal.)

■ Self-diagnostic function

Check item (error code): Bit data items in the error state are expressed in decimal numbers from 0 to 255.
b0: Memory backup error
b2: Module configuration error
b7: PLC communication error

■ Optional function

Event input:	Number of inputs:	1 point
	Input type:	Dry contact input
	Input voltage:	24 V DC (Rated)
	Input current:	Approx. 6 mA
	Isolated method:	Photocoupler
	Input details:	Control RUN/STOP, Event interlock release (Specify when ordering)
Event output:	Number of outputs:	2 points
	Output type:	Relay contact output 250 V AC, 1 A (Resistive load), 1a contact Electrical life: 300,000 times or more (Rated load)
	Output details:	Temperature event, Heater break alarm, Control loop break alarm, Burnout, Temperature rise completion (Specify when ordering)

■ General specifications

Power supply:
- Power supply voltage: 24 V DC
- Power supply voltage range: 21.6 to 26.4 V DC
- Current consumption: With event input/output (option): 160 mA max./module
  Without event input/output (option): 140 mA max./module
- Rush current: 12 A 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 EEPROM.
- Number of write times: Approx. 1 million times
- 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 29.3 g/m^3 dry air at 101.3 kPa

Installation environment conditions:
- Indoor use
- Altitude up to 2000 m

■ Mounting and structure

Mounting procedure: DIN rail mounting

Case color:
- Terminal base: Black
- Module mainframe: Bluish white

Dimensions: 40.5 (W) ×125.0 (H) ×110.0 (D) mm

Weight:
- With event input/output (option): Approx. 260 g
- Without event input/output (option): Approx. 250 g

■ Standard

Safety standard:
- UL: UL61010A-1
- CSA: CAN/CSA-C22.2 No. 1010.1

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

C-Tick: AS/NZS CISPR 11 (equivalent to EN55011)

APPENDIX B. COMMUNICATION DATA PROCESSING TIME

The following communication time is required for the SRV.

📖 Each time described in the following is the processing time per unit. When units are multi-drop connected, the total time obtained by adding the processing time per unit becomes the entire processing time.

B.1 Internal Communication Data Updating Cycle

This is the data updating time required for internal communication.

Internal communication data updating cycle = 100 ms × Number of connected TIO channels

(However, it becomes as follows in the initial setting mode.
Internal communication data updating cycle = 200 ms × Number of connected TIO channels)

[Example]
When the number of connected TIO channels is 62 (the maximum number of connected channel)
Internal communication data updating cycle = 100 ms × 62 = 6.2 seconds

📖 The number of actual control channels corresponding to temperature control modules connected to the V-TIO-E/F module is entered in the number of connected TIO channels.

B.2 Connected Module Recognition Time

This is the time required until the V-TIO-E/F module recognizes the temperature control module connected after the power is turned on.

- When address setting is "continuous setting"

  Connected module recognition time
  = 7 seconds + (Number of connected TIO channels × 0.25 seconds)

- When address setting is "free setting"

  Connected module recognition time
  = 7 seconds + (Number of connected TIO channels × 0.25 seconds)
  + (Number of nonexistent addresses × 0.7 seconds)

📖 "Number of nonexistent addresses" means the number of addresses which are not actually used from among connectable module address from 0 to 30.

[Example]
- When in "continuous setting" as address setting and at 62 as the number of connected TIO channels (the maximum number of channels connected)
  Connected module recognition time = 7 seconds + (62 × 0.25 seconds) = 22.5 seconds
- When in "free setting" as address setting and at 2 as the number of connected TIO channels (only address 0)
  Connected module recognition time
  = 7 seconds + (2 × 0.25 seconds) + (30 × 0.7 seconds) = 28.5 seconds

B.3 PLC Communication Processing Time

B.3.1 Monitor processing time (Request command: 0)

This is the monitored data item updating time required for PLC communication. The SRV writes data for the PLC.

■ MITSUBISHI PLC

PLC communication speed: 38400 bps

Monitor processing time
= 260 ms + (Maximum number of PLC communication channels × 7 ms)
+ PLC response time [ms] × (Number of monitored items + 3)

■ OMRON PLC

PLC communication speed: 38400 bps

- Maximum number of PLC communication channels: 1 to 29
  Monitor processing time
  = 260 ms + (Maximum number of PLC communication channels × 7 ms)
  + PLC response time [ms] × (Number of monitored items + 3)
- Maximum number of PLC communication channels: 30 to 58
  Monitor processing time
  = 410 ms + (Maximum number of PLC communication channels × 7 ms)
  + PLC response time [ms] × (Number of monitored items × 2 + 3)
- Maximum number of PLC communication channels: 59 to 62
  Monitor processing time
  = 570 ms + (Maximum number of PLC communication channels × 7 ms)
  + PLC response time [ms] × (Number of monitored items × 3 + 3)

The "Monitor processing time" is calculated as shown above. However the "internal communication data updating cycle" time is required for actually updating the data.

[Example]
When OMRON PLC is used, the maximum number of PLC communication channels is 62 (maximum value), the number of monitored items is 6 and the PLC response time is 20 ms

Internal communication data updating cycle = 100 ms × 62 = 6.2 seconds

Monitor processing time = 570 ms + (62 × 7 ms) + 20 ms × (6 × 3 + 3) = 1.424 seconds

Therefore, the monitored data is updated every 1.424 seconds. However it is actually updated every 6.2 seconds (every internal communication data updating cycle).

Monitored data items correspond to the six items of "Measured value (PV)," "Set value monitor," "Heat-side output value," "Cool-side output value," "CT input measured value" and "TIO state."
Any necessary items can be selected from among those described above. They are selected by setting the PLC communication environment

The maximum number of PLC communication channels is set with PLC communication environment setting.

B.3.2 Setting processing time (Request command: 1)

It is time when data is read by the SRV from the PLC.

Setting processing time is the time required for returning to "Writing on monitor data" after the SRV communication state is set to "Writing on setting data." There is a delay time of (monitor processing time) × (Number of units) until the SRV read "request commands" after the user writes those commands. However, if these commands are changed simultaneously in two or more units, there is a delay in the setting (or set value monitor) processing time corresponding to the number of units whose request commands are changed.

■ MITSUBISHI PLC

PLC communication speed: 38400 bps

Setting processing time
= About 0.7 seconds + (Maximum number of PLC communication channels × 25 ms)
+ (Number of connected TIO channels × 100 ms)
+ (Number of setting change channels × 100 ms) + (PLC response time [ms] × 23)

■ OMRON PLC

PLC communication speed: 38400 bps

- Maximum number of PLC communication channels: 1 to 29
  Setting processing time
  = About 0.7 seconds + (Maximum number of PLC communication channels × 25 ms)
  + (Number of connected TIO channels × 100 ms)
  + (Number of setting change channels × 100 ms) + (PLC response time [ms] × 23)
- Maximum number of PLC communication channels: 30 to 58
  Setting processing time
  = About 1.2 seconds + (Maximum number of PLC communication channels × 25 ms)
  + (Number of connected TIO channels × 100 ms)
  + (Number of setting change channels × 100 ms) + (PLC response time [ms] × 43)
- Maximum number of PLC communication channels: 59 to 62
  Setting processing time
  = About 1.8 seconds + (Maximum number of PLC communication channels × 25 ms)
  + (Number of connected TIO channels × 100 ms)
  + (Number of setting change channels × 100 ms) + (PLC response time [ms] × 63)

[Example]

- When MITSUBISHI PLC is used, the maximum number of PLC communication channels is 62, PLC response time is 20 ms, the number of connected TIO channels is 62 (the maximum number of connected channels) and data on all channels is revised
  Setting processing time = About 0.7 seconds + (62 × 25 ms) + (62 × 100 ms) + (62 × 100 ms)
  + (20 ms × 23) = About 15.1 seconds
- When MITSUBISHI PLC is used, the maximum number of PLC communication channels is 62, PLC response time is 20 ms, the number of connected TIO channels is 62 (the maximum number of connected channels) and data on one channel is revised
  Setting processing time = About 0.7 seconds + (62 × 25 ms) + (62 × 100 ms) + (1 × 100 ms)
  + (20 ms × 23) = About 9.0 seconds

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- When OMRON PLC is used, the maximum number of PLC communication channels is 62, PLC response time is 20 ms, the number of connected TIO channels is 62 (the maximum number of connected channels) and data on all channels is revised

  Setting processing time = About 1.8 seconds + (62 × 25 ms) + (62 × 100 ms) + (62 × 100 ms) + (20 ms × 63) = About 17.0 seconds

- When OMRON PLC is used, the maximum number of PLC communication channels is 62, PLC response time is 20 ms, the number of connected TIO channels is 62 (the maximum number of connected channels) and data on one channel is revised

  Setting processing time = About 1.8 seconds + (62 × 25 ms) + (62 × 100 ms) + (1 × 100 ms) + (20 ms × 63) = About 13.0 seconds

B.3.3 Set value monitor processing time (Request command: 2)

It is time when data is written by the SRV for the PLC.

Set value monitor processing time is the time required for returning to "Writing on monitor data" after the SRV communication state is set to "Reading out setting data." There is a delay time of (monitor processing time) × (Number of units) maximum until the SRV read "request commands" after the user writes those commands. However, if these commands are changed simultaneously in two or more units, there is a delay in the setting (or set value monitor) processing time corresponding to the number of units whose request commands are changed.

■ MITSUBISHI PLC

PLC communication speed: 38400 bps

Set value monitor processing time
= About 0.7 seconds + (Maximum number of PLC communication channels × 25 ms)
+ (PLC response time [ms] × 23)

■ OMRON PLC

PLC communication speed: 38400 bps

- Maximum number of PLC communication channels: 1 to 29
  Set value monitor processing time
  = About 0.7 seconds + (Maximum number of PLC communication channels × 25 ms)
  + (PLC response time [ms] × 23)
- Maximum number of PLC communication channels: 30 to 58
  Set value monitor processing time
  = About 1.2 seconds + (Maximum number of PLC communication channels × 25 ms)
  + (PLC response time [ms] × 43)
- Maximum number of PLC communication channels: 59 to 62
  Set value monitor processing time
  = About 1.8 seconds + (Maximum number of PLC communication channels × 25 ms)
  + (PLC response time [ms] × 63)

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[Example]
- When MITSUBISHI PLC is used, the maximum number of PLC communication channels is 20 (factory set value) and PLC response time is 20 ms
  Set value monitor processing time
  = About 0.7 seconds + (20 × 25 ms) + (20 ms × 23) = About 1.7 seconds
- When MITSUBISHI PLC is used, the maximum number of PLC communication channels is 62 (maximum value) and PLC response time is 20 ms
  Set value monitor processing time
  = About 0.7 seconds + (62 × 25 ms) + (20 ms × 23) = About 2.7 seconds
- When OMRON PLC is used, the maximum number of PLC communication channels is 62 (maximum value) and PLC response time is 20 ms
  Set value monitor processing time
  = About 1.8 seconds + (62 × 25 ms) + (20 ms × 63) = About 4.6 seconds

B.3.4 Timeout time

The timeout time is determined by the PLC scanning time setting and PLC communication transmission transfer time setting. (Any numeral of less than 10 ms is omitted)

- PLC communication speed: 38400 bps

  Timeout time = 280 ms + (PLC scanning time setting × 2)
  + PLC communication transmission transfer time setting

- PLC communication speed: 19200 bps

  Timeout time = 350 ms + (PLC scanning time setting × 2)
  + PLC communication transmission transfer time setting

- PLC communication speed: 9600 bps

  Timeout time = 490 ms + (PLC scanning time setting × 2)
  + PLC communication transmission transfer time setting

[Example]
- When the PLC communication speed is 38400 bps and the PLC communication transmission transfer time setting is 1 ms (factory set value)
  PLC scanning time: 0 ms Timeout time = 280 ms + (0 ms × 2) + 10 ms = 290 ms
  PLC scanning time: 255 ms Timeout time = 280 ms + (255 ms × 2) + 10 ms = 800 ms
- When the PLC communication speed is 19200 bps and the PLC communication transmission transfer time setting is 1 ms (factory set value)
  PLC scanning time: 0 ms Timeout time = 350 ms + (0 ms × 2) + 10 ms = 360 ms
  PLC scanning time: 255 ms Timeout time = 350 ms + (255 ms × 2) + 10 ms = 870 ms
- When the PLC communication speed is 9600 bps and the PLC communication transmission transfer time setting is 1 ms (factory set value)
  PLC scanning time: 0 ms Timeout time = 490 ms + (0 ms × 2) + 10 ms = 500 ms
  PLC scanning time: 255 ms Timeout time = 490 ms + (255 ms × 2) + 10 ms = 1.01 seconds


The PLC scanning time setting is set with PLC communication environment setting.

B.4 Maximum Host Communication Data Updating Time

This is the maximum time required until updated to the new data revised via host communication.

Maximum host communication data updating time
= 100 ms × Number of connected TIO channels × 2
= Internal communication data updating cycle × 2

[Example]
When the number of connected TIO channels is 62 (the maximum number of connected channels)
Maximum host communication data updating time = 100 ms × 62 × 2 =12.4 seconds

APPENDIX C. ASCII 7-BIT CODE TABLE

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

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