EtherCAT
Communication Converter

COM-ML

[For SRZ]

Instruction Manual

RKC® RKC INSTRUMENT INC. IMR02E11-E3

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 explanation purpose.
- 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.
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Safety Precautions

■ Pictorial Symbols (safety symbols)

Various pictorial symbols are used in this manual to ensure safe use of the product, to protect you and other people from harm, and to prevent damage to property. The symbols are described below.
Be sure you thoroughly understand the meaning of the symbols before reading this manual.

⚠ 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.

⚠ WARNING

- To prevent injury to persons, damage to the instrument and the equipment, a suitable external protection device shall be required.
- All wiring must be completed before power is turned on to prevent electric shock, fire or damage to the instrument and the equipment.
- This instrument must be used in accordance with the specifications to prevent fire or damage to the instrument and the 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 may 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 plant.)
- 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 additional 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 to operating personnel.
- All precautions described in this manual should be taken to avoid damage to the instrument or equipment.
- If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.
- All wiring must be in accordance with local codes and regulations.
- To prevent instrument damage as a result of failure, protect the power line and the input/output lines from high currents with a suitable overcurrent protection device with adequate breaking capacity such as a fuse, circuit breaker, etc.
- A malfunction in this product may occasionally make control operations impossible or prevent alarm outputs, resulting in a possible hazard. Take appropriate measures in the end use to prevent hazards in the event of malfunction.
- 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 dissipation.
- 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 may occur. Use a soft, dry cloth to remove stains from the instrument.
- Do not connect modular connectors to telephone line.

For Proper Disposal

When disposing of each part used for this instrument, always follows the procedure for disposing of industrial wastes stipulated by the respective local community.

Symbols

■ Pictorial Symbols (safety symbols)

 **NOTE** : 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.

■ Abbreviation symbols

These abbreviations are used in this manual:

Abbreviation symbols	Name	Abbreviation symbols	Name
PV	Measured value	TC (input)	Thermocouple (input)
SV	Set value	RTD (input)	Resistance temperature detector (input)
MV	Manipulated output value	V (input)	Voltage (input)
AT	Autotuning	I (input)	Current (input)
ST	Startup tuning	HBA	Heater break alarm
OUT	Output	CT	Current transformer
DI	Digital input	LBA	Control loop break alarm
DO	Digital output	LBD	LBA deadband

About This Manual

There are three manuals pertaining to this product. Please be sure to read all manuals specific to your application requirements.

The following manuals can be downloaded from the official RKC website:
https://www.rkcinst.com/english/manual_load.htm.

Manual	Manual Number	Remarks
EtherCAT Communication Converter COM-ML [For SRZ] Installation Manual	IMR02E09-E☐	This manual is enclosed with instrument. This manual explains the mounting and wiring.
EtherCAT Communication Converter COM-ML [For SRZ] Host Communication Data List	IMR02E10-E☐	This manual is enclosed with instrument. This list is a compilation of the host communication data items.
EtherCAT Communication Converter COM-ML [For SRZ] Instruction Manual	**IMR02E11-E3**	This manual you are reading now. This manual describes mounting, wiring, communication setting, protocol, communication data, troubleshooting and product specification.

Read this manual carefully before operating the instrument. Please place the manual in a convenient location for easy reference.

Contents

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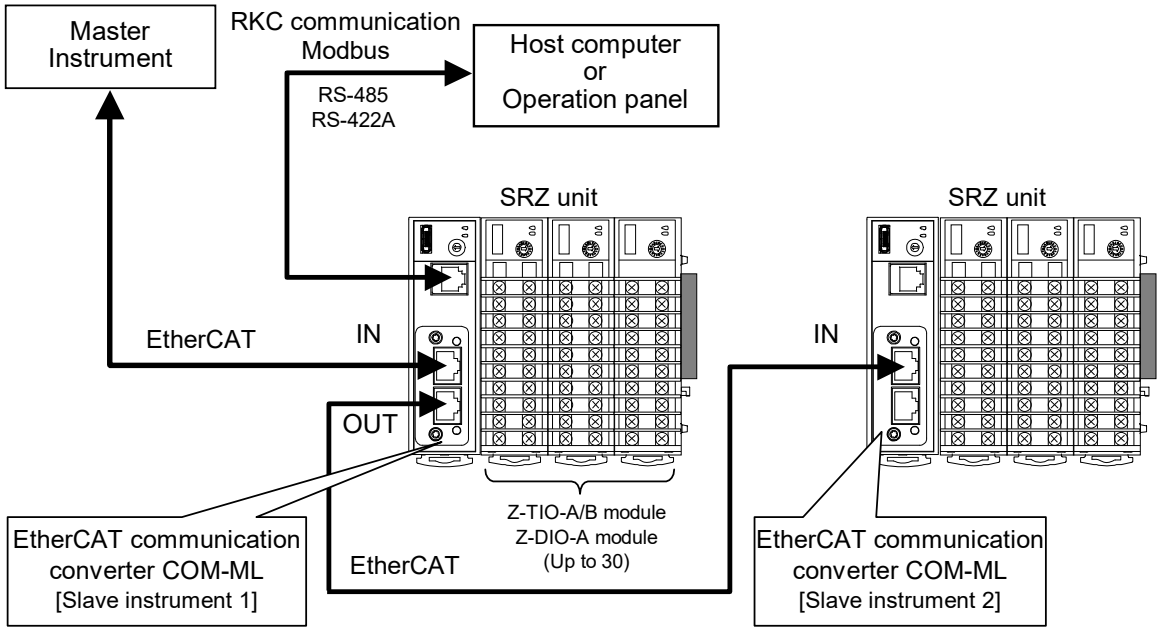
MEMO

1. OUTLINE

EtherCAT communication converter COM-ML [For SRZ] (hereafter called COM-ML) is communication converter to connect the RKC module type controller SRZ to the EtherCAT.
This chapter describes features, package contents, model code, system configuration, etc.

- EtherCAT (Ethernet for Control Automation Technology) is an ultra high-speed fieldbus system based on Ethernet.
- Protocol: CANopen over EtherCAT (CoE)
- EtherCAT communication methods supported by the COM-ML are "PDO (process data objects) communication" and "SDO (service data objects) communication."
- The master/slave architecture is implemented for EtherCAT communication and COM-ML is used as a slave device.
- Up to 30 function modules (Z-TIO and Z-DIO) can be connected to one COM-ML with SRZ unit. (However, the maximum joinable number of function modules of the same type is 16.)



☞ For EtherCAT, refer to the website of ETG (EtherCAT Technology Group).
URL: https://www.ethercat.org/

1.1 Checking the Product

Before using this product, check each of the following:

- Model code
- Check that there are no scratch or breakage in external appearance (case, front panel, or terminal, etc.)
- Check that all of the items delivered are complete. (Refer to below)

Name	Q'TY	Remarks
☐ COM-ML [For SRZ] Installation Manual (IMR02E09-E☐)	1	Enclosed with instrument
☐ COM-ML [For SRZ] Communication Data List (IMR02E10-E☐)	1	Enclosed with instrument
☐ Joint connector cover KSRZ-517A	2	Enclosed with instrument
☐ Power terminal cover KSRZ-518A	1	Enclosed with instrument
☐ COM-ML [For SRZ] Instruction Manual (IMR02E11-E3)	1	This manual (sold separately) This manual can be downloaded from the official RKC website: https://www.rkcinst.com/english/manual_load.htm

If any of the products are missing, damaged, or if your manual is incomplete, please contact RKC sales office or the agent.

■ Accessories (sold separately)

Name	Q'TY	Remarks
☐ End plate DEP-01	2	Secures the SRZ on the DIN rail
☐ Communication converter COM-K2-1	1	For loader communication (Option: with loader communication cable)
☐ Connection cable (W-BF-01-☐, ☐: cable length)	1	For host communication Modular connector and Spade lug terminal
☐ Connection cable (W-BF-02-☐, ☐: cable length)	1	For host communication Modular connectors (at both ends)
☐ Connection cable (W-BF-28-☐, ☐: cable length)	1	For host communication Modular connector and D-sub 9-pin connector

1.2 Model Code

Check whether the delivered product is as specified by referring to the following model code list.
If the product is not identical to the specifications, please contact RKC sales office or the agent.

COM- ML - 3 □* 02
(1) (2) (3)

(1) Ethernet communication type

3: EtherCAT

(2) Host communication interface (COM. PORT)

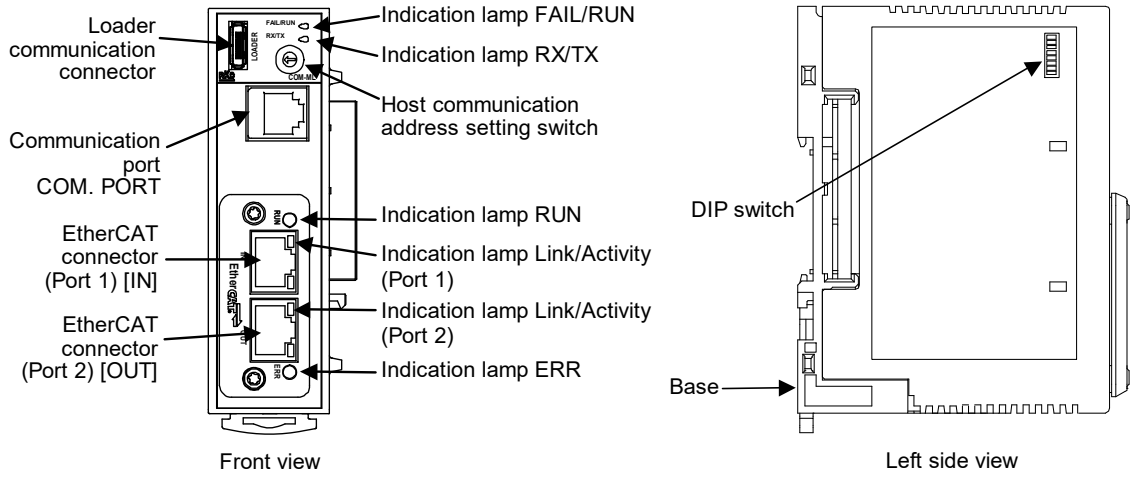
4: RS-422A
5: RS-485

(3) Corresponding to the RKC controller

02: SRZ

1.3 Parts Description

■ COM-ML mainframe



● Indication lamps

FAIL/ RUN [Green or Red]	• When normal: Green lamp turns on (RUN) • Self-diagnostic error (Recoverable fault): Green lamp flashing (FAIL) • Self-diagnostic error (Major fault): Red lamp turns on (FAIL)
RX/TX [Green]]	During host communication data send and receive: Green lamp turns on
RUN [Green or Red]	• INIT or No power: Turns off • OPRATIONAL: Green lamp turns on • PRE-OPERATIONAL: Green lamp blinking • SAFE-OPRATIONAL: Green lamp single flashing * • EXCEPTION: Red lamp turns on
Link/Activity (Port 1/Port 2) [Green]]	• No link or No power: Turns off • Link sensed, activity detected: Green lamp flashing • Link sensed, no activity: Green lamp turns on
ERR [Red]	• No error or No power: Turns off • Invalidates configuration: Red lamp blinking • Unsolicited state change: Red lamp single flashing * • Application watchdog timeout: Red lamp double flashing * • PDI watchdog timeout: Red lamp turns on

* Single flashing: Repeats ON (200 ms)/OFF (100 ms).
Double flashing: Repeats ON (200 ms)/OFF (200 ms)/ON (200 ms)/OFF (1000 ms).

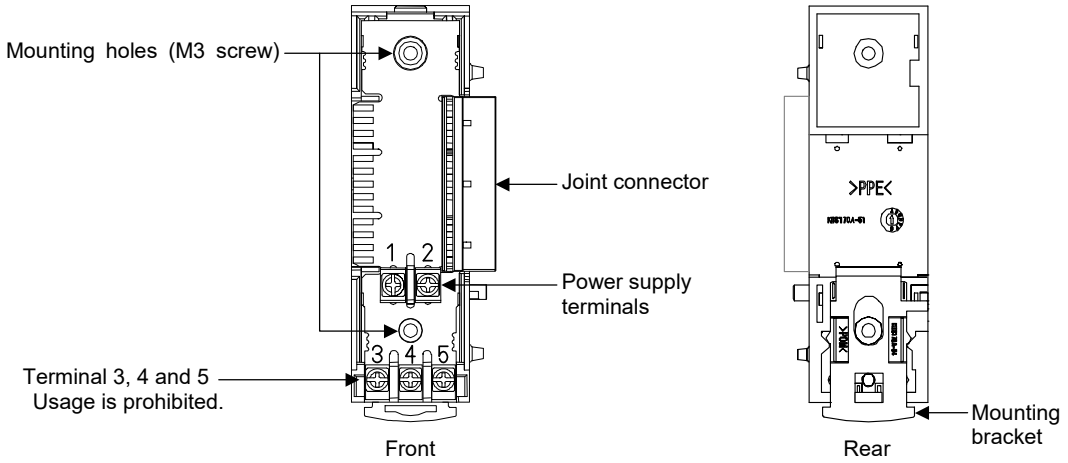
● Communication port (modular connector) and communication connector

COM. PORT	Use to connecting the Operation panel or Host computer. [RS-485 or RS-422A]
Loader communication connector	Use to connecting the communication converter and personal computer when loader communication is performed.
EtherCAT connector (Port 1) [IN]	Designed to connect EtherCAT with master instrument or slave instrument located near the master instrument.
EtherCAT connector (Port 2) [OUT]	Designed to connect EtherCAT with the next slave instrument.

● Switch

Host communication address setting switch	Sets unit address for host communication.
DIP switch	• Sets communication speed and communication protocol corresponding to host communication. • Sets DIP switch setting validate/invalidate.

■ Base



Mounting holes (M3 screw)	Holes for screws to fix the base to a panel, etc. Customer must provide the M3 screws.
Joint connector	Used to mechanically and electrically connect each module.
Power supply terminals	These are terminals to supply power to the COM-ML and joined function modules.
Terminal 3, 4 and 5	These terminals cannot be used for the COM-ML. (Usage is prohibited.) **NOTE** **When the COM-ML is connected to a function module, do not use terminals 3, 4 and 5 of the function module.**
Mounting bracket	Used to fix the module on DIN rails and also to fix each module joined together.

Terminal number	Signal name
1	24 V DC (+)
2	24 V DC (–)

2. HANDLING PROCEDURES

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

Host communication settings

The address, communication speed, communication protocol, data bit configuration, and DIP switch setting validate/invalidate of host communication are set only when host communication is used in the COM-ML.

☞ Refer to **5. HOST COMMUNICATION SETTINGS (P. 21)**.

Mounting

Install the COM-ML.

☞ • Refer to **3. MOUNTING (P. 7)**.
• For controller (SRZ), refer to **Z-TIO Instruction Manual (IMS01T01-E□)** and **Z-DIO Instruction Manual (IMS01T03-E□)**.

Wiring

Connect the COM-ML power wiring and the controller (SRZ) wiring, and connect the COM-ML to the EherCAT master. Connect the wiring for host communication or loader communication in the COM-ML.

• Refer to **4. WIRING (P. 12)**
☞ • For controller (SRZ), refer to **Z-TIO Instruction Manual (IMS01T01-E□)** and **Z-DIO Instruction Manual (IMS01T03-E□)**.

Controller (SRZ) settings

Set the communication setting of controller (SRZ).

☞ • Refer to **6. COMMUNICATIOM SETTING OF SRZ FUNCTION MODULE (P. 23)**.
• For controller (SRZ), refer to **Z-TIO Host Communication Quick Instruction Manual (IMS01T02-E□)** and **Z-DIO Instruction Manual (IMS01T03-E□)**.

EtherCAT communication settings

Configure initial settings for EtherCAT communication.

☞ • Refer to **7.1 EtherCAT Communication Setting (P. 26)**.
• Refer to **10.5 Tool Settings (P. 75)**.

Other communication data settings

Set the data for the COM-ML and controller (SRZ).

☞ • Refer to **7.2 Other Communication Data Settings (P. 31)**.
• Refer to **9. COMMUNICATION DATA LIST (P. 36)**.

EtherCAT communication

Execute PDO communication or SDO communication.

☞ • Refer to **10.6 PDO Communication (P. 86)**.
• Refer to **10.7 SDO Communication (P. 90)**.

3. MOUNTING

This chapter describes installation environment, mounting cautions, dimensions and mounting procedures.

> **⚠ WARNING**
>
> To prevent electric shock or instrument failure, always turn off the power before mounting or removing the instrument.

3.1 Mounting Cautions

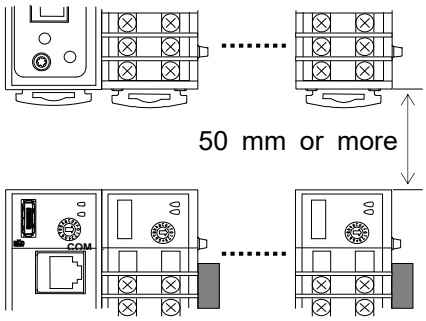
(1) This instrument is intended to be used under the following environmental conditions.
(IEC 61010-1) [POLLUTION DEGREE 2]

(2) Use this instrument within the following environment conditions:
- Allowable ambient temperature: −10 to +50 °C (14 to 122 °F)
- Allowable ambient humidity: 5 to 95 %RH
  (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

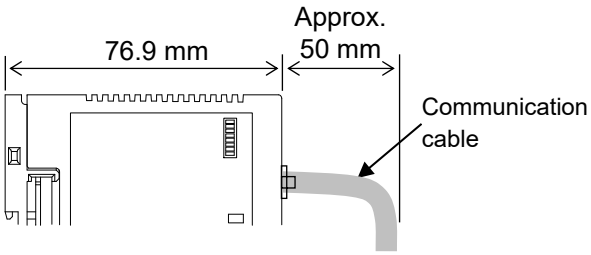
(3) Avoid the following conditions when selecting the mounting location:
- Rapid changes in ambient temperature which may cause condensation.
- Corrosive or inflammable gases.
- Direct vibration or shock to the mainframe.
- Water, oil, chemicals, vapor or steam splashes.
- Excessive dust, salt or iron particles.
- Excessive induction noise, static electricity, magnetic fields or noise.
- Direct air flow from an air conditioner.
- Exposure to direct sunlight.
- Excessive heat accumulation.

(4) Mount this instrument in the panel considering the following conditions:
- Provide adequate ventilation space so that heat does not build up.
- Do not mount this instrument directly above the equipment that generates large amount of heat (heaters, transformers, semi-conductor functional devices, large-wattage resistors.)
- If the ambient temperature rises above 50 °C (122 °F), cool this instrument with a forced air fan, cooler, or the like. Cooled air should not blow directly on this instrument.
- In order to improve safety and the immunity to withstand noise, mount this instrument as far away as possible from high voltage equipment, power lines, and rotating machinery.
  High voltage equipment: Do not mount within the same panel.
  Power lines: Separate at least 200 mm
  Rotating machinery: Separate as far as possible
- For correct functioning mount this instrument in a horizontal position.

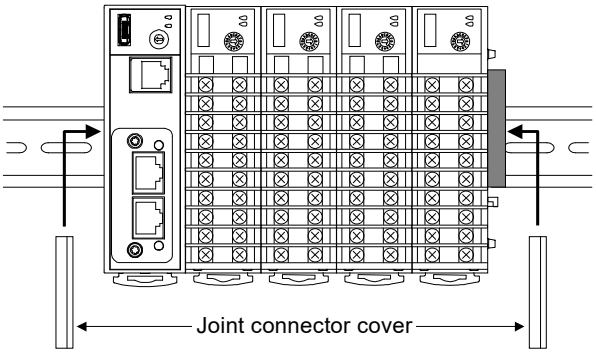
- Space required between each module vertically
  When the module is mounted on the panel, allow a minimum of 50 mm at the top and bottom of the module to attach the module to the mainframe.



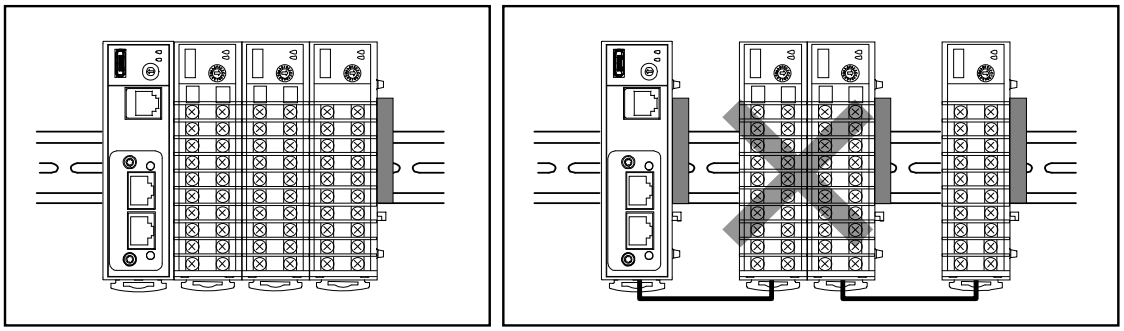
- Depth for modular cables mount type module
  Space for modular cables must be considered when installing.



- It is recommended to use a plastic cover on the connector on both sides of the mounted modules for protection of connectors.



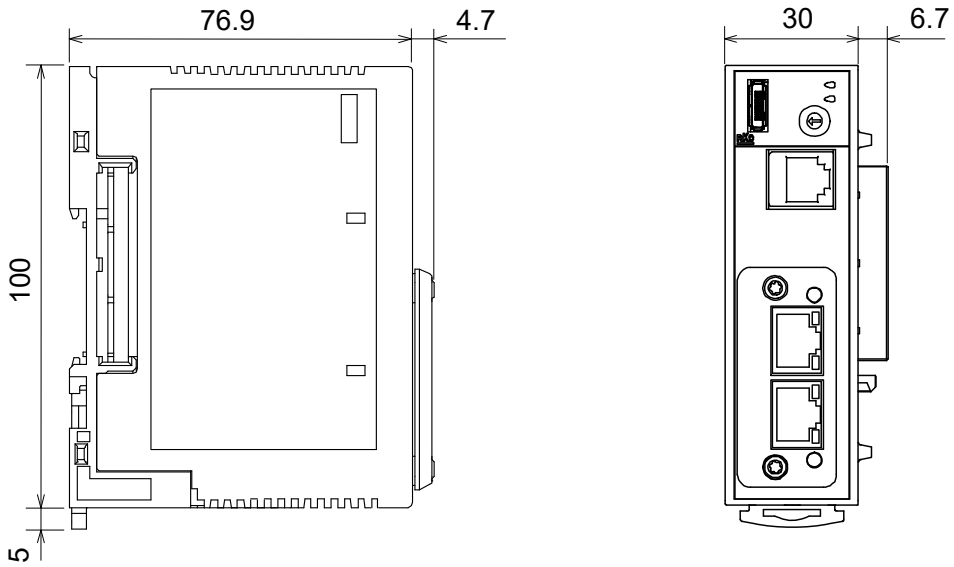
- Be sure the COM-ML and SRZ function modules (Z-TIO and Z-DIO modules) are joined when using them.



(5) In case this instrument is connected to a supply by means of a permanent connection, a switch or circuit-breaker shall be included in the installation. This shall be in close proximity to the equipment and within easy reach of the operator. It shall be marked as the disconnecting device for the equipment.

3.2 Dimensions

(Unit: mm)

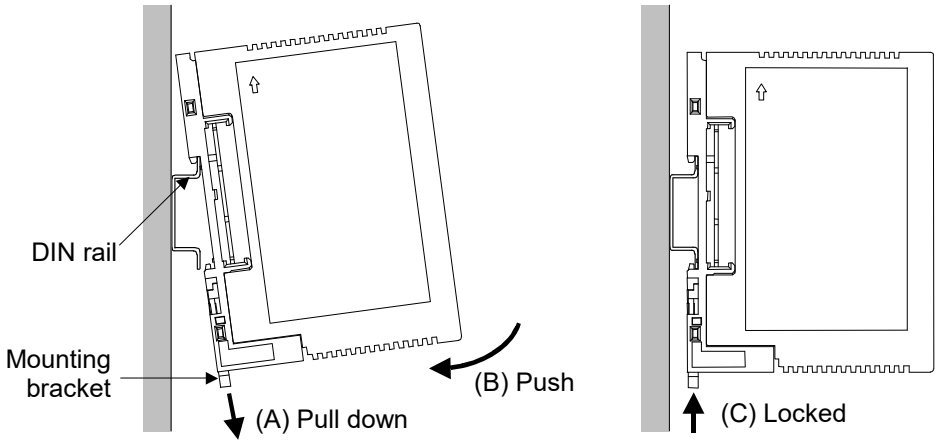


3.3 DIN Rail Mounting

■ Mounting procedures

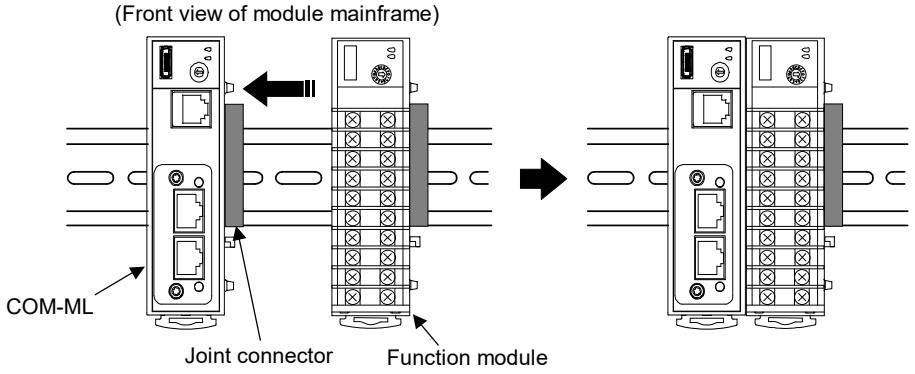
1. Pull down the mounting bracket at the bottom of the module (A). Attach the hooks on the top of the module to the DIN rail and push the lower section into place on the DIN rail (B).

2. Slide the mounting bracket up to secure the module to the DIN rail (C).

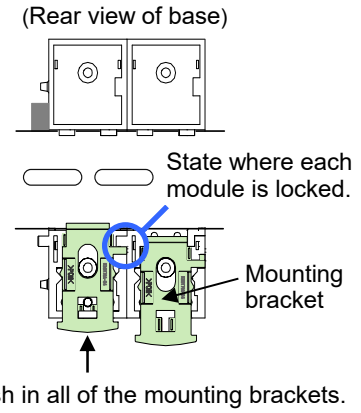


■ Module joining procedures

1. Mount the function modules on the DIN rail. Slide the modules until the modules are closely joined together and the joint connectors are securely connected.



2. Push in the mounting brackets to lock the modules together and fix to the DIN rail.



After module joining, install a plastic cover on the connector on both sides of the mounted modules for protection of connectors. (Refer to P. 8)

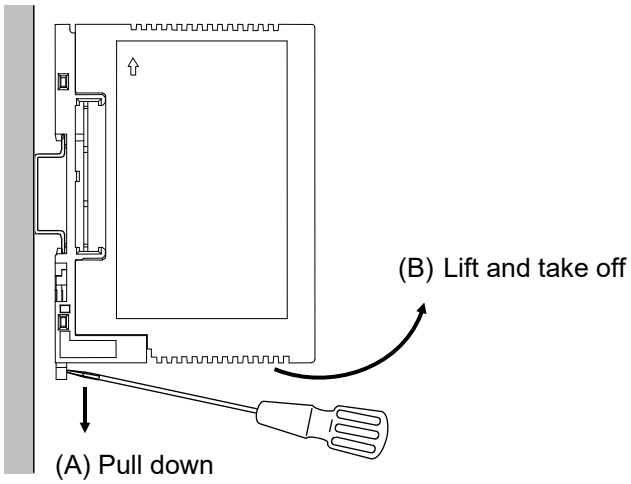
To firmly fix the modules, use end plates (DEP-01) sold separately on both sides of the mounted modules.

■ Removing procedures

1. Turn the power OFF.

2. Remove the wiring.

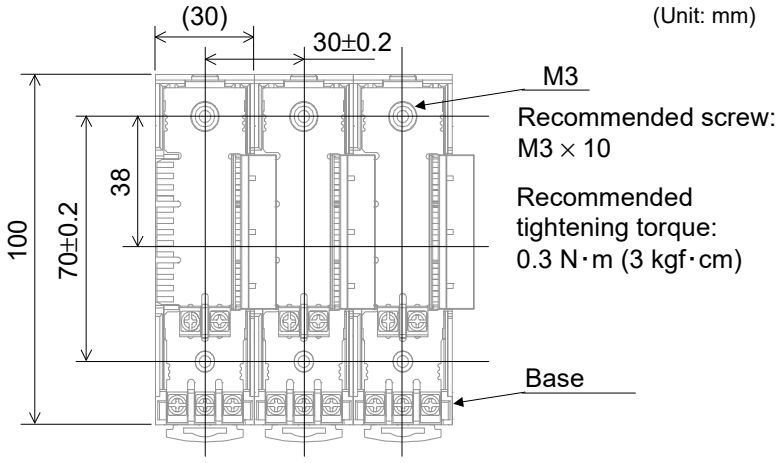
3. Pull down a mounting bracket with a slotted screwdriver (A). Lift the module from bottom, and take it off (B).



3.4 Panel Mounting

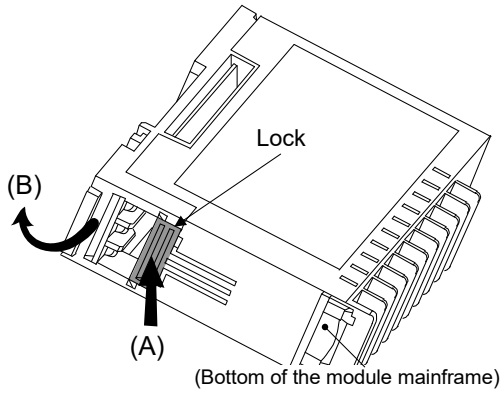
■ Mounting procedures

1. Refer to the mounting dimensions below when selecting the location.



Mounting dimensions

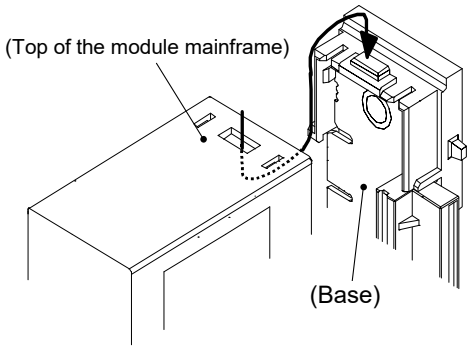
2. Remove the base from the module (B) while the lock is pressed (A).



3. Join bases. Then, lock them by pushing in the mounting brackets. (Refer to P. 10)

4. Fix the base to its mounting position using M3 screws. Customer must provide the screws.

5. Mount the module on the base.



4. WIRING

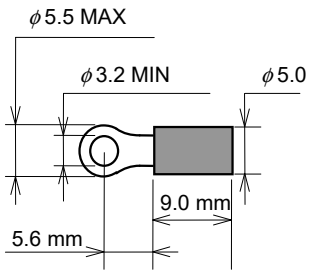
This chapter describes wiring cautions, terminal configuration and connections.

4.1 Wiring Cautions

⚠ WARNING

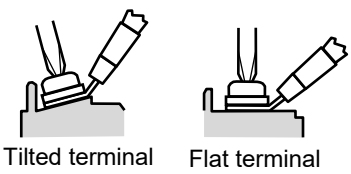
To prevent electric shock or instrument failure, do not turn on the power until all the wiring is completed. Make sure that the wiring is correct before applying power to the instrument.

- To avoid noise induction, keep communication 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 input, supply power from a "SELV" circuit defined as IEC 60950-1.
- A suitable power supply should be considered in end-use equipment. The power supply must be in compliance with a limited-energy circuits (maximum available current of 8 A).
- Supply the power to only one of the joined modules or COM-ML. When power is supplied to any one of the joined modules or COM-ML, all of the joined modules and COM-ML will receive power.
- Select the power capacity which is appropriate for the total power consumption of all joined modules (include COM-ML) and the initial current surge when the power is turned on.
  Power consumption (at maximum load): 120 mA max. (at 24 V DC)
  Rush current: 12 A or less
- When connecting the wiring to the power supply terminals on the base, use the specified solderless terminals. Only these specified solderless terminals can be used due to the insulation between the terminals.
  Screw Size: M3 × 7 (with 5.8 × 5.8 square washer)
  Recommended tightening torque:
  0.4 N·m (4 kgf·cm)
  Applicable wire: Solid/twisted wire of 0.25 to 1.65 mm^2
  Specified solderless terminal:
  Manufactured by J.S.T MFG CO., LTD.
  Circular terminal with isolation V1.25–MS3
  (M3 screw, width 5.5 mm, hole diameter 3.2 mm)



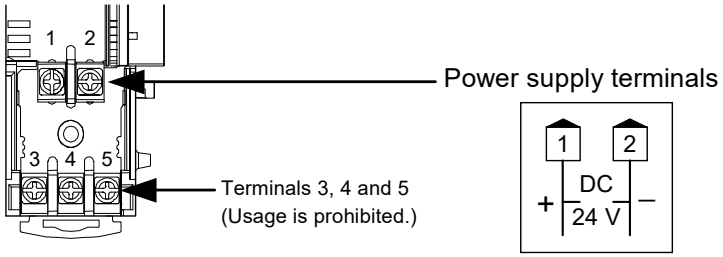
- Make sure that during field wiring parts of conductors cannot come into contact with adjacent conductive parts.

When tightening a screw of the instrument, make sure to fit the screwdriver properly into the screw head mounted tilted or flat as shown in the right figure. Tightening the screw with excessive torque may damage the screw thread. (Only function modules)



4.2 Terminal Configuration

The terminal layout of COM-ML (base) is as follows.



NOTE

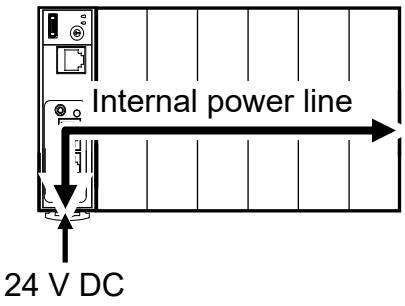
When using the COM-ML connected to function modules, terminals 3, 4 and 5 are not used. Do not connect anything to terminals 3, 4 and 5.
In addition, do not use terminals 3, 4 and 5 of function modules.

■ Wiring method

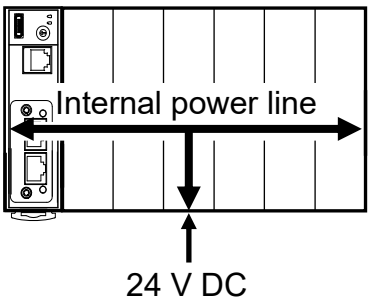
When using the COM-ML connected to function modules, the power supply wiring is connected to any one of the modules. Power is supplied from the module with the power wiring to the other modules.

[Wiring example]

When supplied a power supply to a COM-ML

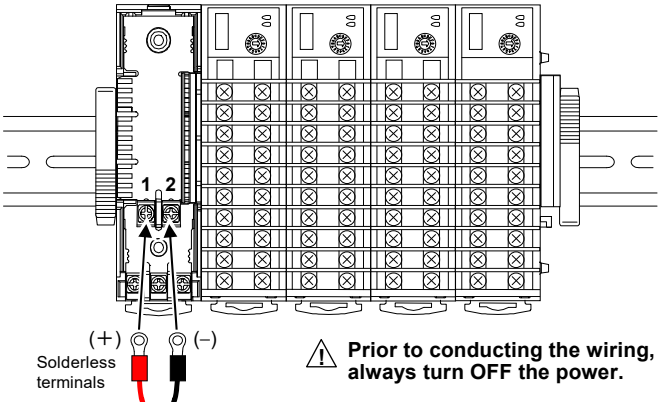


When supplied a power supply to a function module



1. Remove the module mainframe to which the power wiring will be connected.

2. Attach the solderless terminals to the power terminals with a Phillips head screwdriver. When attaching the terminals, make sure that the polarity (+ and –) is correct.

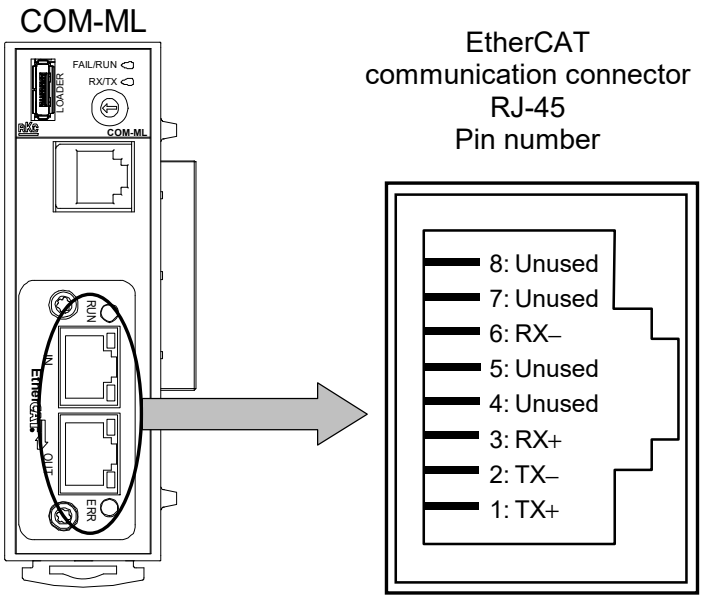


3. Return the module mainframe to the base. This completes the wiring work.

4.3 Connection to EtherCAT

Connect COM-ML to EtherCAT.

■ Pin layout of connector



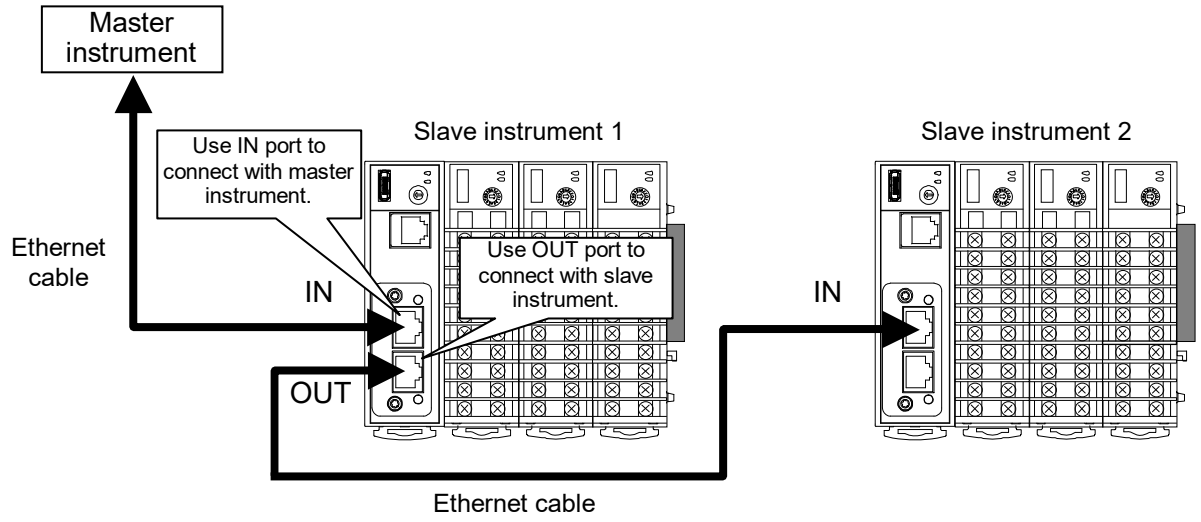
■ Connector pin number and signal details

Pin No.	Signal name	Symbol
1	Send data +	TX+
2	Send data –	TX–
3	Receive data +	RX+
4	Unused	—
5	Unused	—
6	Receive data –	RX–
7	Unused	—
8	Unused	—

The cable must be provided by the customer.
Used cable: The cable is based on the 100BASE-TX standard of Ethernet.
Used connector: RJ-45 type

■ Wiring example

Can connect with the Ethernet cable which is marketed. The Ethernet cable must be provided by the customer.



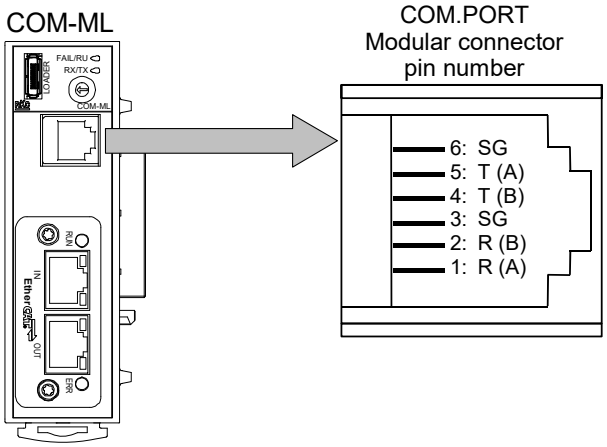
Ethernet straight through cable and Ethernet crossover cable may be used.

4.4 Connection to Host Computer

This section explains the connections for using the host computer and the operation panel to set COM-ML data and controller (SRZ) data.

4.4.1 When connected with RS-422A

■ Pin layout of connector

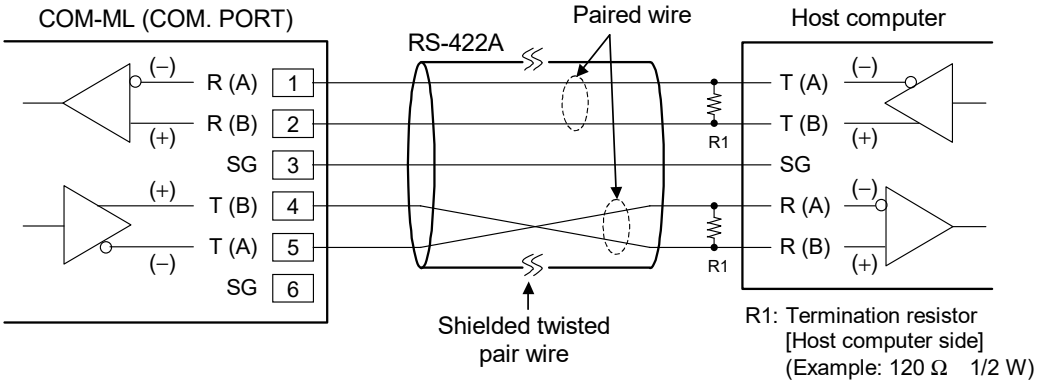


■ Connector pin number and signal details

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

The 6-pin type modular connector should be used for the connection to the COM-ML.
Recommended model: TM4P-66P
(Manufactured by HIROSE ELECTRIC CO., LTD.)

■ Wiring



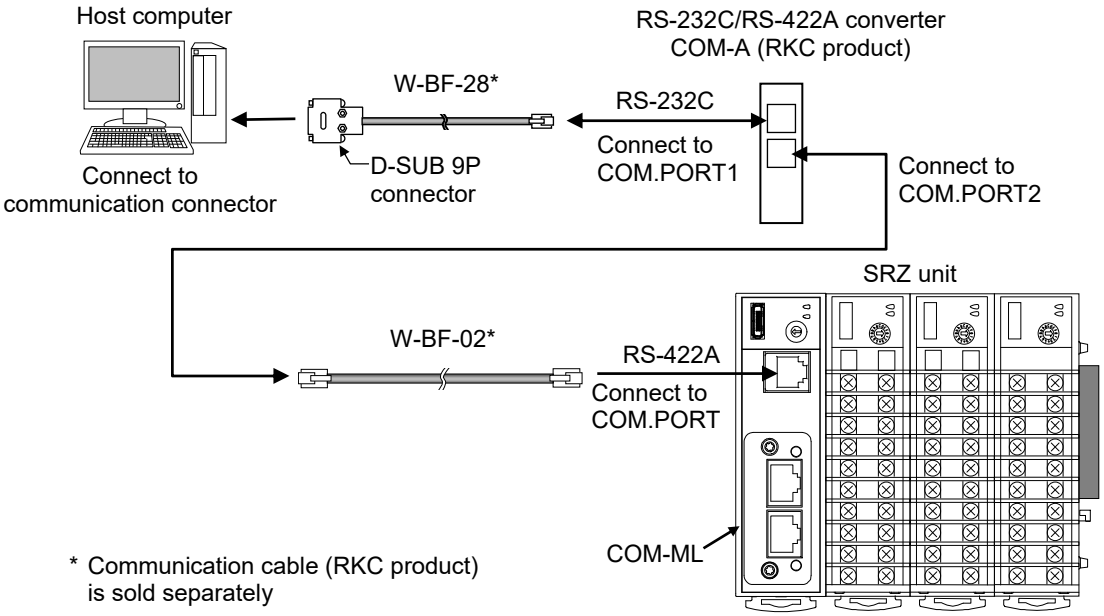
NOTE

If communication errors occur frequently due to the operation environment or the communication distance, connect termination resistors to the host computer side.

Up to 16 SRZ units can be connected to a host computer communication port.

■ When the interface of host computer is RS-232C

Connect the RS-232C/RS-422A converter between the host computer and the COM-ML.

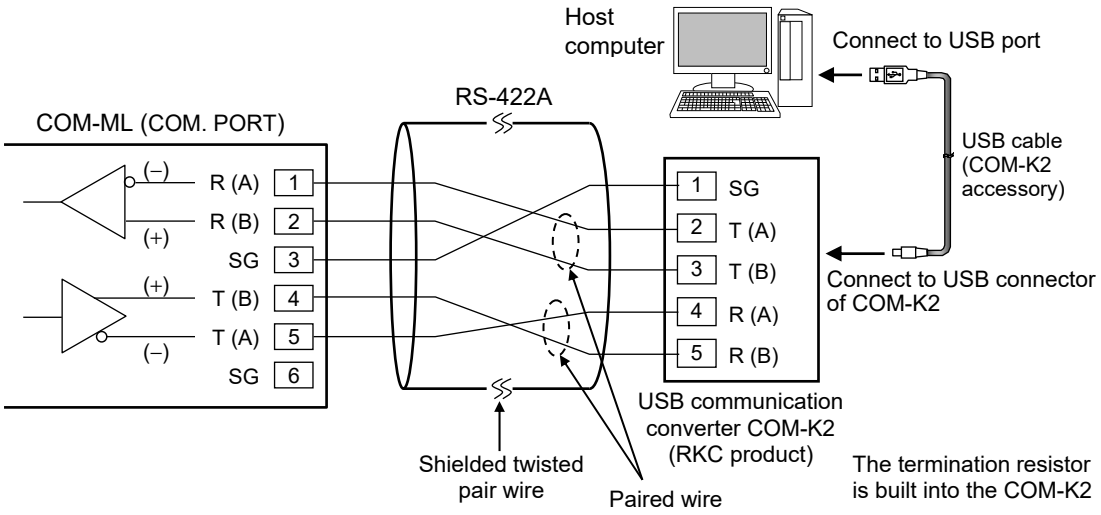


W-BF-02 and W-BF-28 communication cable (RKC product) can be used as communication cable. If noise is a factor, customer should use a twisted pair cable (not included) or something to that effect.

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

■ When the host computer has a USB connector

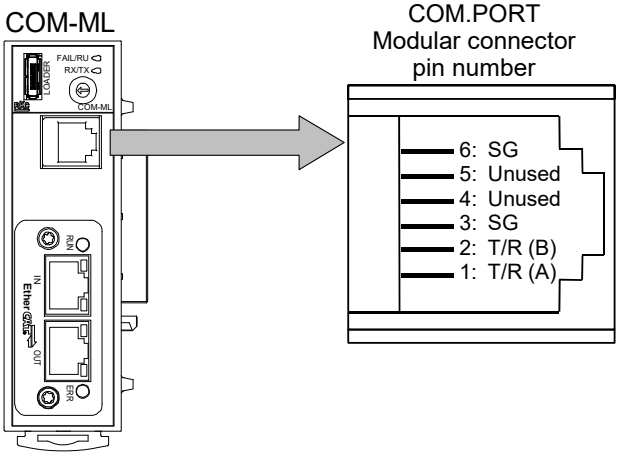
Connect the USB communication converter between the host computer and the COM-ML.



☞ For the COM-K2, refer to the **COM-K2 Instruction Manual**.

4.4.2 When connected with RS-485

■ Pin layout of connector

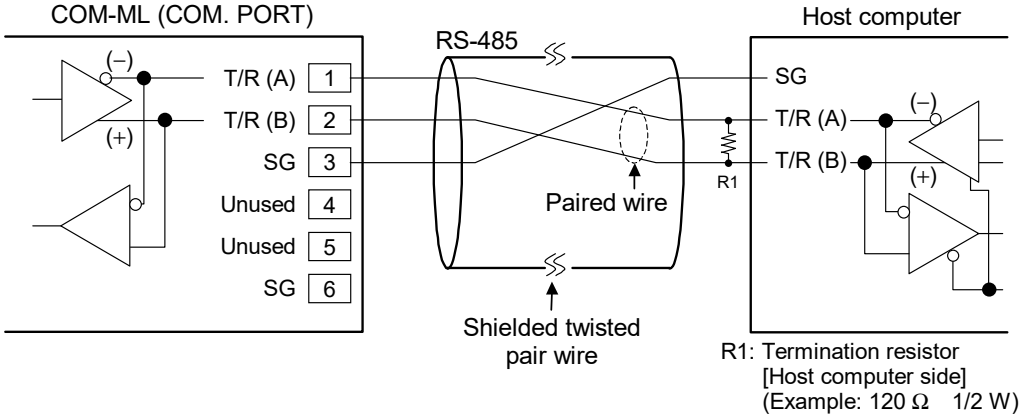


■ Connector pin number and signal details

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

The 6-pin type modular connector should be used for the connection to the COM-ML.
Recommended model: TM4P-66P
(Manufactured by HIROSE ELECTRIC CO., LTD.)

■ Wiring



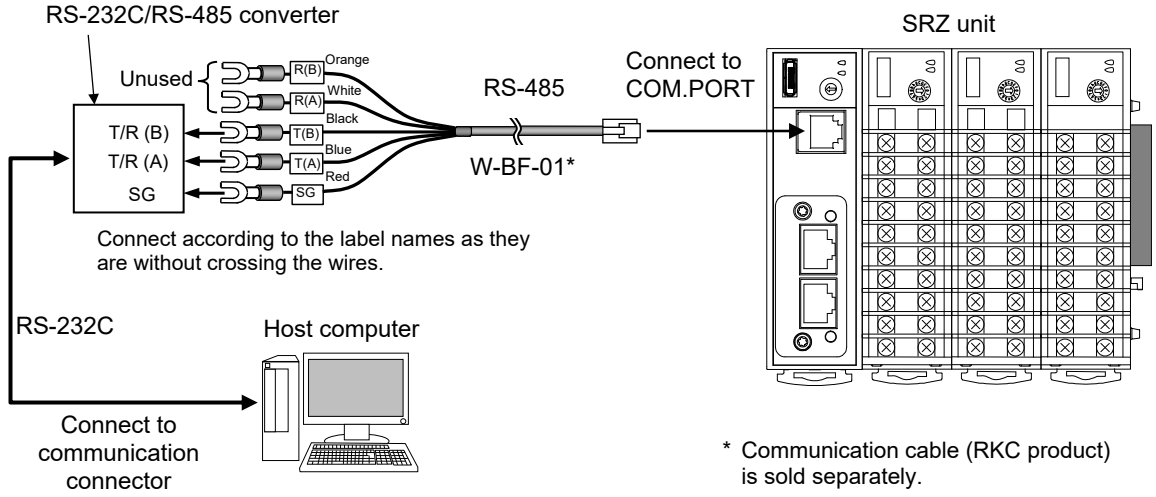
NOTE

If communication errors occur frequently due to the operation environment or the communication distance, connect termination resistors to the host computer side.

Up to 16 SRZ units can be connected to a host computer communication port.

■ When the interface of host computer is RS-232C

Connect the RS-232C/RS-485 converter between the host computer and the COM-ML.



NOTE

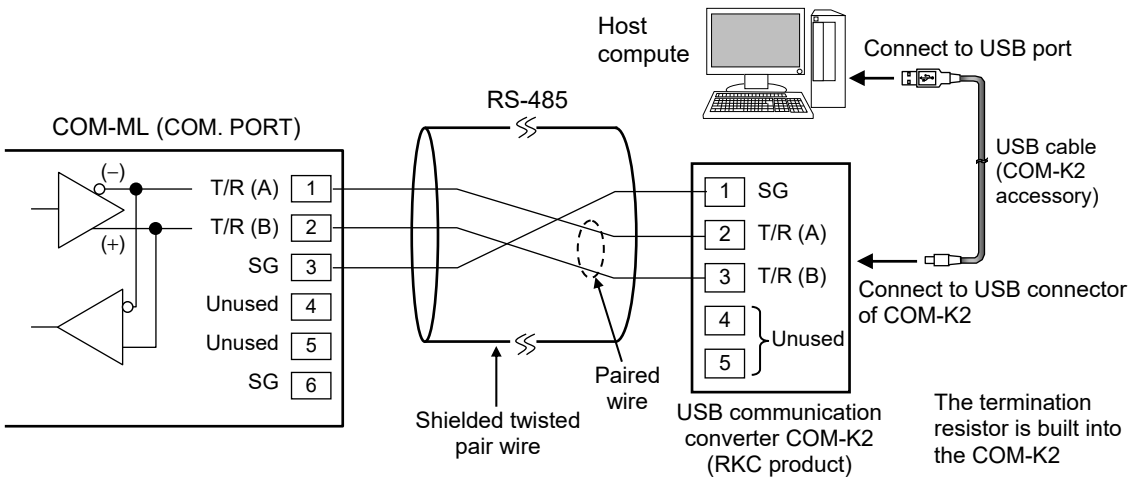
Be sure to insulate the wires that are not used by covering them with insulating tape.

Recommended RS-232C/RS-485 converter:
CD485, CD485/V Data Link product, Inc. or equivalent.

W-BF-01 communication cable (RKC product) can be used as communication cable. If noise is a factor, customer should use a twisted pair cable (not included) or something to that effect.

■ When the host computer has a USB connector

Connect the USB communication converter between the host computer and the COM-ML.

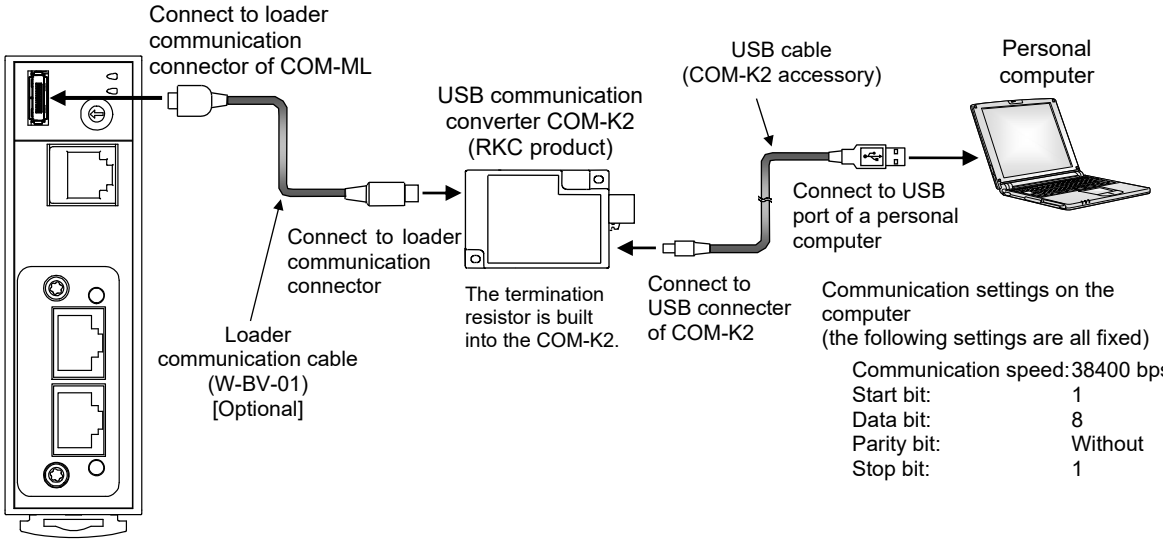


For the COM-K2, refer to the **COM-K2 Instruction Manual**.

4.4.3 Connections for loader communication

Connect a USB communication converter COM-K2 (sold separately)* between the host computer and the COM-ML.
Loader communication makes it possible to check and set data of the COM-ML and the controller (SRZ).

* A loader communication cable (option) is required for the connection to the loader communication connector on the COM-ML.
  USB communication converter COM-K2-1 (with Loader communication cable [cable length: 1 m])



NOTE

The Loader port is only for parameter setup. Not used for data logging during operation.

During the loader communication, the COM-ML requires an external power source. The COM-ML will not function on the USB power from a personal computer alone.

The module address for loader communication is fixed at "0."

Loader communication corresponds to RKC communication (based on ANSI X3.28-1976 subcategories 2.5 and B1).

For the COM-K2, refer to the **COM-K2 Instruction Manual**.

5. HOST COMMUNICATION SETTING

⚠ WARNING

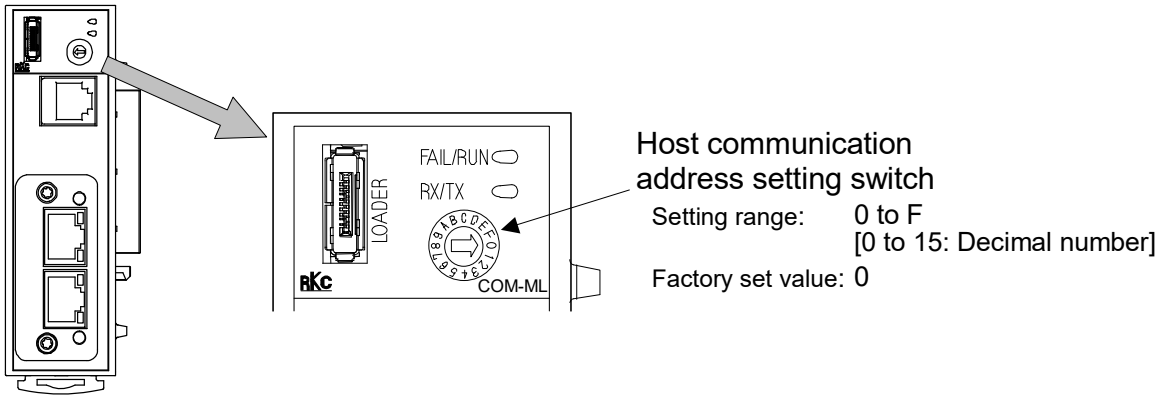
- To prevent electric shock or instrument failure, always turn off the power before setting the switch.
- To prevent electric shock or instrument failure, never touch any section other than those instructed in this manual.

5.1 Address Setting

Set host communication address of COM-ML (SRZ unit).
Set an address for the COM-ML (SRZ unit) using a small blade screwdriver.

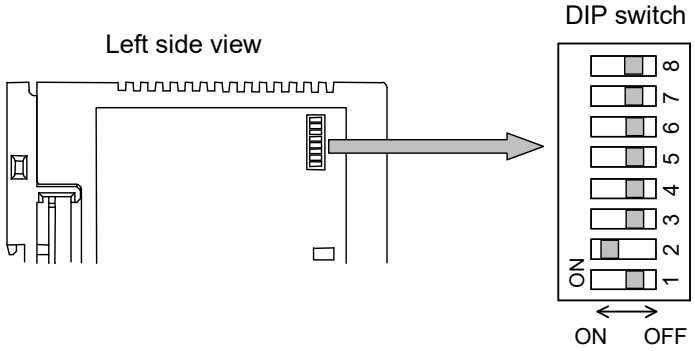
NOTE

When two or more COM-ML (SRZ unit) are connected, to avoid problems or malfunction, do not duplicate an address on the same communication line.



5.2 DIP Switch Setting

Use the DIP switch at the left side of the COM-ML to set the speed and protocol of host communication, and DIP switch validate/invalidate.



1	2	Host communication speed
OFF	OFF	4800 bps
ON	OFF	9600 bps
OFF	ON	19200 bps [Factory se value]
ON	ON	38400 bps

3	Communication protocol/Data bit configuration
OFF	RKC communication (Data 8-bit, without parity, Stop 1-bit) [Factory se value]
ON	Modbus (Data 8-bit, without parity, Stop 1-bit)

4	5	6	7	
OFF	OFF	OFF	OFF	**Fixed (Do not set this one)**

8	DIP switch validate/invalidate
OFF	Validate (validate the DIP switch settings) [Factory se value]
ON	Invalidate (validate the host communication or loader communication settings) *

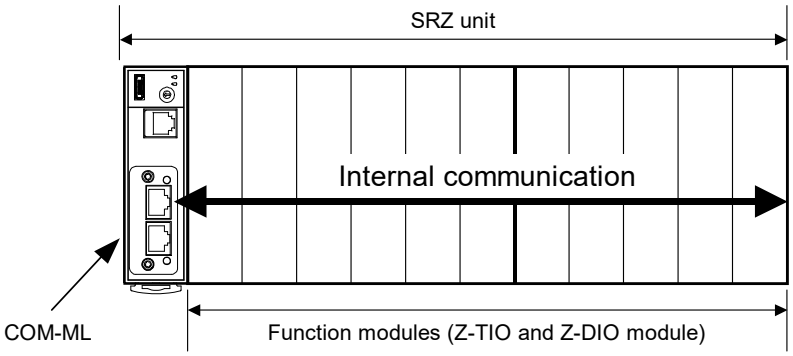
* The only host communication or loader communication settings that are validated are the host communication speed and protocol and the data bit configuration.

When the communication protocol is set with the DIP switch, the data bit configuration is automatically set to “data 8-bit, without parity, stop 1-bit.” To change to another data bit configuration, set the configuration in host communication or loader communication.

If you wish to set the data bit configuration, host communication speed, and communication protocol in host communication or loader communication, first set DIP switch No. 8 to ON.

6. COMMUNICATION SETTING OF SRZ FUNCTION MODULE

Only make the module address setting to make the SRZ function module (Z-TIOA/B and Z-DIO-A modules) communication settings. The SRZ unit performs internal communication between the COM-ML and the function module, so the communication protocol, communication speed, and data bit configuration do not need to be set.



Setting the Z-TIO module address determines the temperature control channel number used for communication.

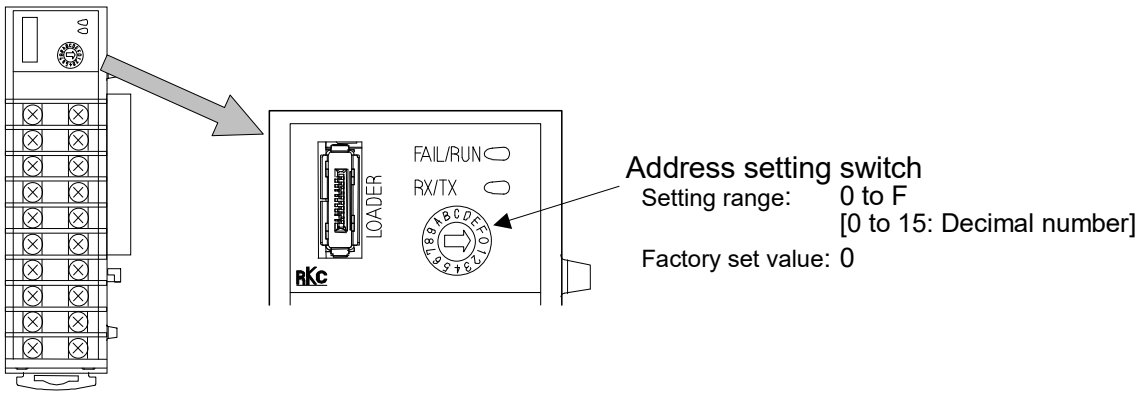
☞ For relation of the module address and channel number, refer to **6.2 Temperature Control Channel of SRZ Unit (P. 24)** and **6.3 Digital Input/Output Channel of Z-DIO Module (P. 25)**.

6.1 Address Setting of the Function Modules

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

NOTE

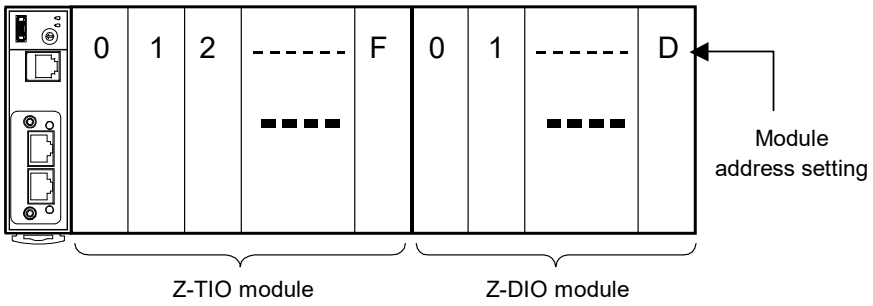
To avoid problems or malfunction, do not duplicate a module address on the same communication line.



The maximum number of function modules (Z-TIO-A/B and Z-DIO-A modules) described in the following can be joined per COM-ML.

- When joining function modules of the same type: Up to 16 modules
- When joining function modules of two or more different types: Up to 31 modules
  (However, the maximum joinable number of function modules of the same type is 16.)

Address setting example of function module (16 Z-TIO module, 14 Z-DIO module):



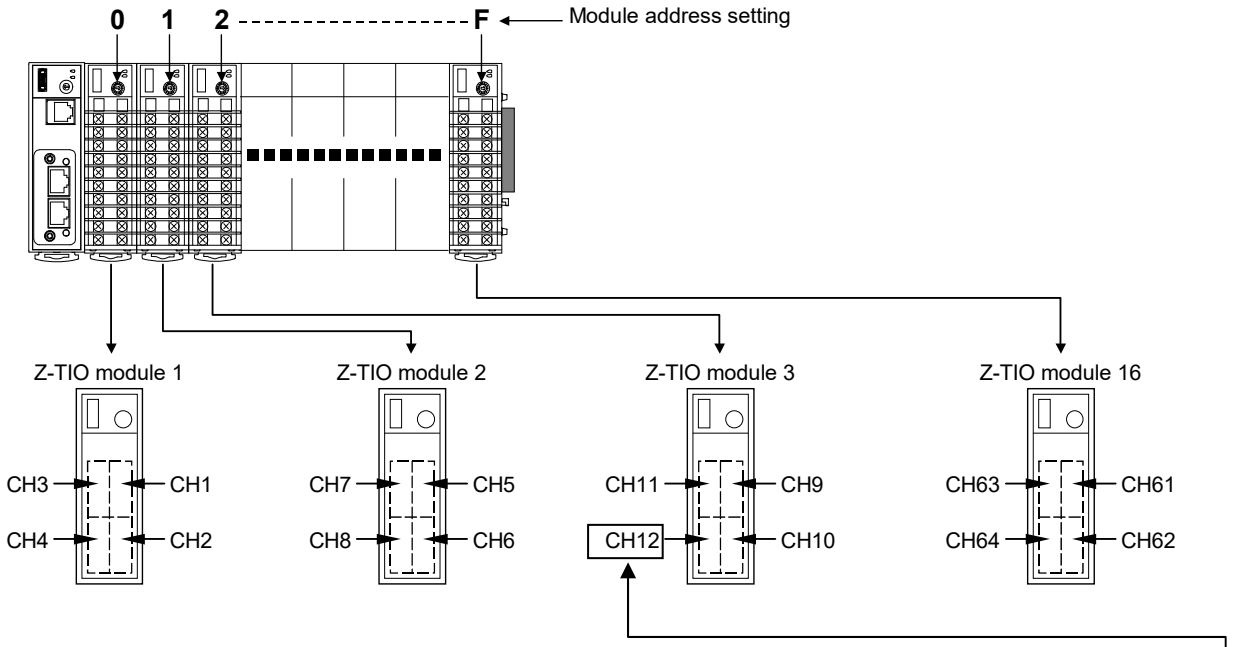
6.2 Temperature Control Channel of the SRZ Unit

Setting the Z-TIO module address determines the temperature control channel number used for communication. To each Z-TIO 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 setting [a]] × [Maximum channel number of the function module [b]]
+ [Channel number in a module]

[a] When the setting is A to F, it is a decimal number.
[b] For the Z-TIO module, it is calculated by "4."

Example: When 16 Z-TIO modules (4-channel type) are joined



- Z-TIO module 3: The temperature control channel number used for communication of channel 4
  $2 \times 4 + 4 = 12$

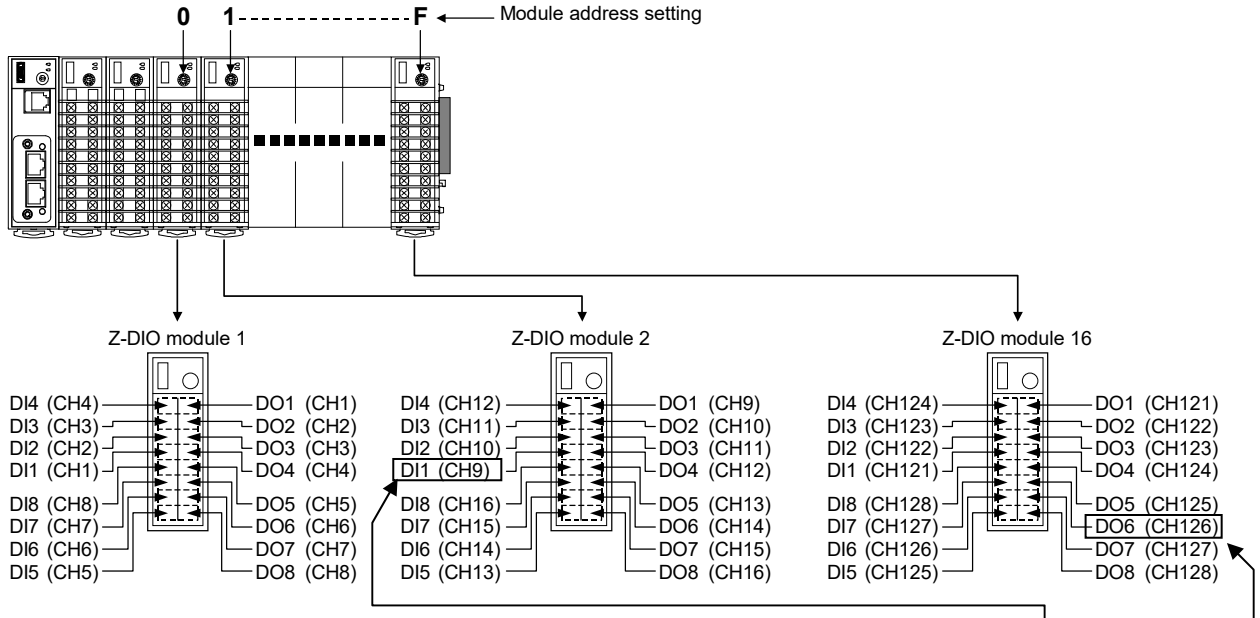
6.3 Digital Input/Output Channel of Z-DIO Module

Setting the Z-DIO module address determines the digital input/output channel number of SRZ unit. To each Z-DIO module address, the relevant digital input/output channel is assigned. Each digital input/output channel can be calculated from the following equation.

Digital input/output channel number =
[Module address setting [a]] × [Maximum channel number of the function module [b]]
+ [Input (or output) channel number in a module]

[a] When the setting is A to F, it is a decimal number.
[b] For the Z-DIO module, it is calculated by "8."

Example: When 16 Z-DIO modules are joined



- Digital input channel number of digital input (DI) channel 1 of Z-DIO module 2
  $1 \times 8 + 1 = 9$
- Digital output channel number of digital output (DO) channel 6 of Z-DIO module 16
  $15 \times 8 + 6 = 126$

7. INITIAL COMMUNICATION DATA SETTINGS

Configure the initial communication data settings for EtherCAT communication.

7.1 EtherCAT Communication Settings

Configure settings necessary for EtherCAT communication.
COM-ML supports PDO (process data objects) communication and SDO (service data objects) communication as communication methods for EtherCAT. The following Indexes should be preset:

- Index 20C5H (0x20C5): Communication Item Setting [hereafter called 0x20C5]
  Set the Modbus address of the communication items used in EtherCAT communication. (For PDO communication and SDO communication)
- Index 20C6H (0x20C6): Communication IN Setting [hereafter called 0x20C6]
  Set the number of communication items used for monitor in PDO communication. (For PDO communication)
- Index 20C7H (0x20C7): Communication OUT Setting [hereafter called 0x20C7] *
  Set the number of communication items used for setting in PDO communication. (For PDO communication)
- Index 2064H (0x2064): Controller Data [hereafter called 0x2064]
  Set the data of the item to be used for SDO communication. (For SDO communication)

The Indexes above can be set via SDO communication of EtherCAT by using the setting tool, TwinCAT (software to be used as PLC master of EtherCAT communication).
Setting via Host communication and Loader communication are also available.

Use RKC identifier or Modbus register address of the communication data map below when setting by Host communication or Loader communication.

Name and Index	RKC identifier	Modbus register address		Data range (data size indicated in brackets [ ])	Factory set value
		HEX	DEC		
Communication item setting [Index: 0x20C5]	QG	8020 ⋮ 8051	32800 ⋮ 32849	RKC communication: 0 to 65535 Modbus: 0000H to FFFFH [50]	65535 (FFFFH)
Number of measured data items (IN) [Index: 0x20C6]	QH	8052 ⋮ 8083	32850 ⋮ 32899	0 to 128 0: Unused [50]	0
Number of setting data items (OUT) [Index: 0x20C7]	QI	8084 ⋮ 80B5	32900 ⋮ 32949	0 to 127 0: Unised [50]	0

Setting data of Index 0x2064 is based on the RKC communication identifier or the Modbus register address of SDO communication item being set at the Communication item setting.

For information on SDO communication setting, refer to **10.5 Tool Settings (P. 76)** and **10.7 SDO Communication (P. 91)**.

■ Communication item setting

Set the communication items used in EtherCAT communication.
These apply to the object dictionary “Index 20C5H (0x20C5): Communication Item Setting.”

- Up to 50 communication items (Sub-Index 0x01 to 0x32) can be set.
- 0x20C5 sub-Index 0x01 to 0x32 (50 items) correspond to CH1 to CH50 of identifier QG of RKC communication, and to Modbus register addresses 8020H to 8051H.
- In each item, set the Modbus register address (PDO communication: only start address, SDO communication: all addresses of channels) of all communication items used in EtherCAT communication.
- Set items used in PDO communication in sub-Index 0x01 and following without any intervals, and then set items (all addresses of channels) that are only used in SDO communication.
- The data order in PDO communication is the same as the 0x20C5 sub-Index order. Set the number of data used in each item in 0x20C6 and 0x20C7.
- Set 65535 (FFFFH) in unused items. Communication items following sub-Index set to 65535 (FFFFH) are not used in PDO communication.

☞ For object dictionary, refer to **13. OBJECT DICTIONARY (P. 110)**. In addition, for Modbus register addresses of communication items, refer to **9. COMMUNICATION DATA LIST (P. 36)**.

☞ For setting configuration, refer to ■ **Setting example (P. 29)**.

■ Number of measured data items (IN)

Set the number of communication items used for monitor in PDO communication of EtherCAT.
These apply to the object dictionary “Index 20C6H (0x20C6): Communication IN Setting.”

- Up to 50 data can be set for each communication item (Sub-Index 0x01 to 0x32).
- In the sub-Index numbers of 0x20C6 that are the same as the sub-Index numbers of the communication items used in the measured data items (IN) of PDO communication (in the communication items set in 0x20C5), set the data size used.
- 0x20C6 sub-Index 0x01 to 0x32 (50 items) corresponds to CH1 to CH50 of identifier QH of RKC communication and to Modbus register addresses 8052H to 8083H.
- Data up to a total of the set values in the attributes of 0x20C6 (cumulative total from sub-Index 0x01) of 128 (0080H) are validated. Any data after that are disregarded.

☞ For object dictionary, refer to **13. OBJECT DICTIONARY (P. 110)**.

☞ For setting configuration, refer to ■ **Setting example (P. 29)**.

■ Number of setting data items (OUT)

Set the number of communication items used for setting in PDO communication of EtherCAT.
These apply to the object dictionary “Index 20C7H (0x20C7): Communication OUT Setting.”

- Up to 50 data can be set for each communication item (Sub-Index 0x01 to 0x32).
- In the sub-Index numbers of 0x20C7 that are the same as the sub-Index numbers of the communication items used in the setting data items (OUT) of PDO communication (in the communication items set in 0x20C5), set the data size used.
- 0x20C7 sub-Index 0x01 to 0x32 (50 items) correspond to CH1 to CH50 of identifier QI of RKC communication and to Modbus register addresses 8084H to 80B5H.
- Data up to a total of the set values in the sub-Index of 0x20C7 (cumulative total from sub-Index 0x01) of 127 (007FH) are validated. Any data after that are disregarded.
- Regardless of the setting of 0x20C7, “setting state selection” is assigned to the first-word of the setting data item (OUT).

☞ For object dictionary, refer to **13. OBJECT DICTIONARY (P. 110)**.

☞ For setting configuration, refer to ■ **Setting example (P. 29)**.

■ Data setting of each items

Set each data of SDO communication item being set at Communication item setting (Index: 0x20C5).
These apply to the object dictionary “Index 2064H (0x2064): Controller Data.”

- 0x2064 sub-Index 0x01 to 0x32 correspond to 0x20C5 sub-Index 0x01 to 0x32.
- Set the data to the same Sub-Index number of 0x2064 as the Sub-Index number being set as SDO communication item at 0x20C5.
- If data was set for a read-only (RO) item, the data will revert to the data that was read after several seconds. The attribute of unused items is read-only (RO), and the data is 0.

☞ For object dictionary, refer to **13. OBJECT DICTIONARY (P. 110)**. In addition, for Modbus register addresses of communication items, refer to **9. COMMUNICATION DATA LIST (P. 36)**.

☞ For setting configuration, refer to ■ **Setting example (P. 29)**.

■ Setting example

If one Z-TIO module is joined to the COM-ML, set the following conditions:

- For PDO communication, use CH1 to CH4 of "Measured value (PV)" and "Set value (SV)" of the Z-TIO module.
- For SDO communication, use "RUN/STOP transfer (each units)" and "PID/AT transfer (CH1 to CH4)."
- Setting condition: Measured data items (IN):
  Measured value (PV), Set value (SV)
  Setting data items (OUT):
  Set value (SV)
  Assigned destination of communication item:
  Measured value (PV): Sub-Index 0x01
  Set value (SV): Sub-Index 0x02
  } PDO communication item
  RUN/STOP transfer: Sub-Index 0x03
  PID/AT transfer (CH1): Sub-Index 0x04
  PID/AT transfer (CH2): Sub-Index 0x05
  PID/AT transfer (CH3): Sub-Index 0x06
  PID/AT transfer (CH4): Sub-Index 0x07
  } SDO communication item
  RUN/STOP transfer: 0 (STOP), 1 (RUN)
  PID/AT transfer: 0 (PID control), 1 (Autotuning)

Setting of object dictionary

● 0x20C5 setting [Communication item]

Sub-Index 0x01: 01FCH [First Modbus register address of Measured value (PV)]
Sub-Index 0x02: 0ADCH [First Modbus register address of Set value (SV)]
} PDO communication item (Set the first address only.)

Sub-Index 0x03: 0133H [Modbus register address of RUN/STOP transfer *]
Sub-Index 0x04: 080CH [Modbus register address of PID/AT transfer (CH1)]
Sub-Index 0x05: 080DH [Modbus register address of PID/AT transfer (CH2)]
Sub-Index 0x06: 080EH [Modbus register address of PID/AT transfer (CH3)]
Sub-Index 0x07: 080FH [Modbus register address of PID/AT transfer (CH4)]
} SDO communication item (Set all addresses of channels required.)

Sub-Index 0x08 to 0x32: FFFFH [Unused]

* The number of setting item is one as the data is based on a unit.

● 0x20C6 setting [Number of measured data items (IN)]

Sub-Index 0x01: 0004H [Number of Measured value (PV): For 4 channels]
Sub-Index 0x02: 0004H [Number of Set value (SV): For 4 channels]
Sub-Index 0x03 to 0x32: 0000H [Unused]

● 0x20C7 setting [Number offsetting data items (OUT)]

Sub-Index 0x01: 0000H [Unused]
Sub-Index 0x02: 0004H [Number of Set value (SV): For 4 channels]
Sub-Index 0x03 to 0x32: 0000H [Unused]

- **0x2064 setting [Data of SDO communication items]**

Sub-Index 0x01: 0000H [Unused]
Sub-Index 0x02: 0000H [Unused]
Sub-Index 0x03: RUN/STOP transfer: 0000H (0), 0001H (1)
Sub-Index 0x04: PID/AT transfer (CH1): 0000H (0), 0001H (1)
Sub-Index 0x05: PID/AT transfer (CH2): 0000H (0), 0001H (1)
Sub-Index 0x06: PID/AT transfer (CH3): 0000H (0), 0001H (1)
Sub-Index 0x07: PID/AT transfer (CH4): 0000H (0), 0001H (1)
Sub-Index 0x08 to 0x32: 0000H [Unused]

Setting of RKC communication (Set value is a decimal number.)

- **Communication item**

CH1 of identifier QG: 508 [First Modbus register address of Measured value (PV)]
CH2 of identifier QG: 2780 [First Modbus register address of Set value (SV)]
CH3 of identifier QG: 307 [Modbus register address of RUN/STOP transfer (each units)]
CH4 of identifier QG: 2060 [Modbus register address of PID/AT transfer (CH1)]
CH5 of identifier QG: 2061 [Modbus register address of PID/AT transfer (CH2)]
CH6 of identifier QG: 2062 [Modbus register address of PID/AT transfer (CH3)]
CH7 of identifier QG: 2063 [Modbus register address of PID/AT transfer (CH4)]
CH8 to 50 of identifier QG: 65535 [Unused]

- **Number of measured data items (IN)**

CH1 of identifier QH: 4 [Number of Measured value (PV): For 4 channels]
CH2 of identifier QH: 4 [Number of Set value (SV): For 4 channels]
CH3 to 50 of identifier QH: 0 [Unused]

- **Number offsetting data items (OUT)**

CH1 of identifier QI: 0 [Unused]
CH2 of identifier QI: 4 [Number of Set value (SV): For 4 channels]
CH3 to 50 of identifier QI: 0 [Unused]

- **Data of SDO communication item**

CH1 of identifier SR: 0 [RUN/STOP transfer (each units): STOP]
1 [RUN/STOP transfer (each units): RUN]
CH1 of identifier G1: 0 [PID/AT transfer (CH1): PID control]
1 [PID/AT transfer (CH1): Autotuning (AT)]
CH2 of identifier G1: 0 [PID/AT transfer (CH2): PID control]
1 [PID/AT transfer (CH2): Autotuning (AT)]
CH3 of identifier G1: 0 [PID/AT transfer (CH3): PID control]
1 [PID/AT transfer (CH3): Autotuning (AT)]
CH4 of identifier G1: 0 [PID/AT transfer (CH4): PID control]
1 [PID/AT transfer (CH4): Autotuning (AT)]

Setting of Modbus

- **Communication item**

8020H: 01FCH [First Modbus register address of Measured value (PV)]
8021H: 0ADCH [First Modbus register address of Set value (SV)]
8022H: 0133H [Modbus register address of RUN/STOP transfer (each units)]
8023H: 080CH [Modbus register address of PID/AT transfer (CH1)]
8024H: 080DH [Modbus register address of PID/AT transfer (CH2)]
8025H: 080EH [Modbus register address of PID/AT transfer (CH3)]
8026H: 080FH [Modbus register address of PID/AT transfer (CH4)]
8027H to 8051H: FFFFH [Unused]

- **Number of measured data items (IN)**

8052H: 0004H [Number of Measured value (PV): For 4 channels]
8053H: 0004H [Number of Set value (SV): For 4 channels]
8054H to 8083H: 0000H [Unused]

- **Number offsetting data items (OUT)**

8084H: 0000H [Unused]
8085H: 0004H [Number of Set value (SV): For 4 channels]
8086H to 80B5H: 0000H [Unused]

- **Data of SDO communication item**

0133H: 0000H [RUN/STOP transfer (each units): STOP]
0001H [RUN/STOP transfer (each units): RUN]
080CH: 0000H [PID/AT transfer (CH1): PID control]
0001H [PID/AT transfer (CH1): Autotuning (AT)]
080DH: 0000H [PID/AT transfer (CH2): PID control]
0001H [PID/AT transfer (CH2): Autotuning (AT)
080EH: 0000H [PID/AT transfer (CH3): PID control]
0001H [PID/AT transfer (CH3): Autotuning (AT)]
080FH: 0000H [PID/AT transfer (CH4): PID control]
0001H [PID/AT transfer (CH4): Autotuning (AT)]

7.2 Other Communication Data Settings

Set communication data (PID constants and event set values of the Z-TIO module, DO manual output of the Z-DIO module, etc.) other than the items set in **7.1 EtherCAT Communication Settings (P. 26)** using SDO communication of EtherCAT communication, Host communication, or Loader communication..

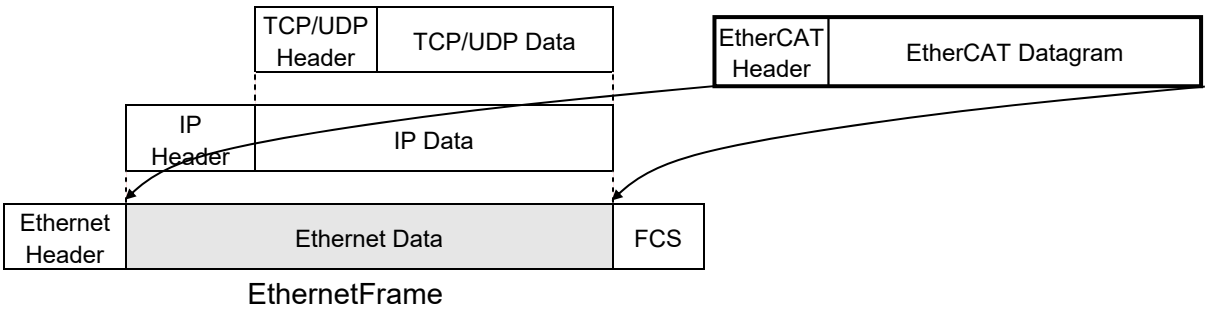
☞ For each of the communication setting items, refer to **9. COMMUNICATION DATA LIST (P. 36)**.

8. EtherCAT

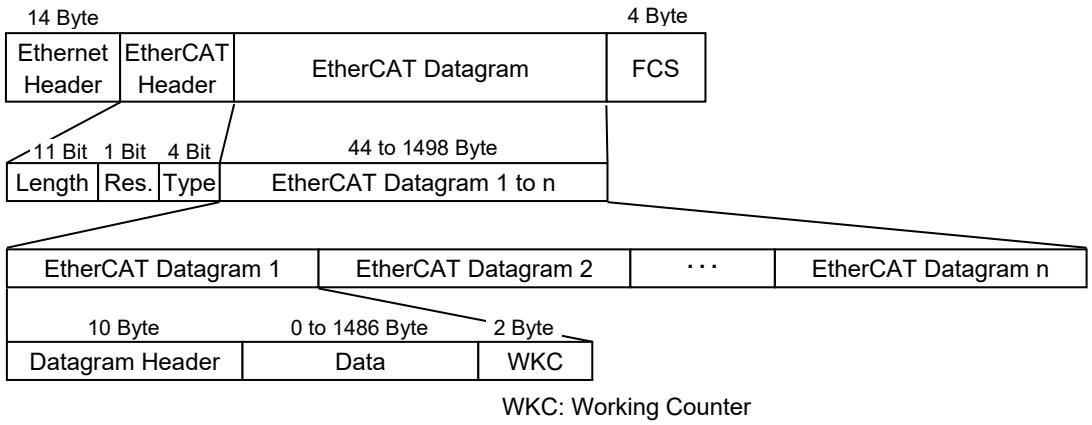
8.1 Outline of EtherCAT

■ EtherCAT protocol basics

The EtherCAT protocol can transport data within a standard Ethernet frame without changing its basic structure. When the master controller and slave devices are on the same subnet, data can be transported only by replacing the IP (Internet Protocol) in the Ethernet frame.



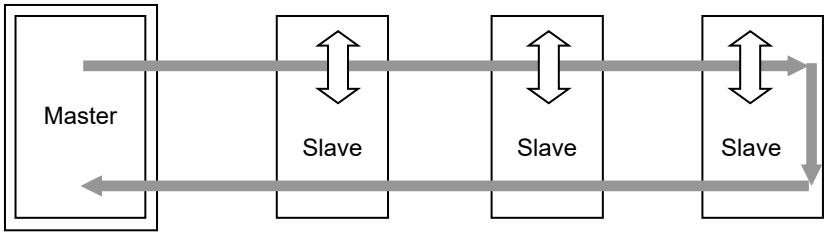
● Frame structure



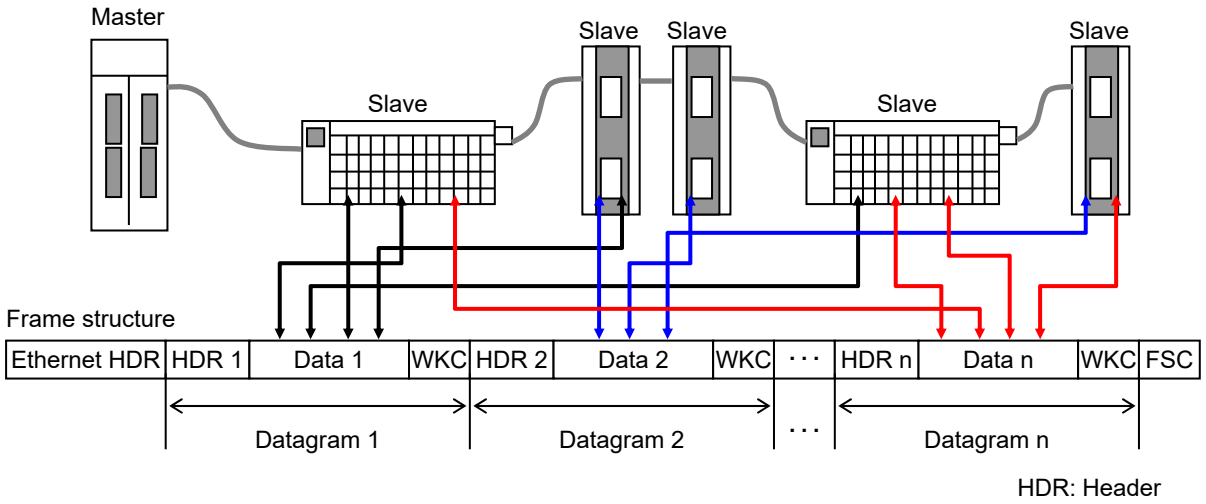
WKC: Working Counter

■ EtherCAT operation

EtherCAT sustains high-speed and real-time performances in data transfer by processing each Ethernet frame on-the-fly in all slaves to allow them to write send data or read receive data instead of sending data to each slave individually.



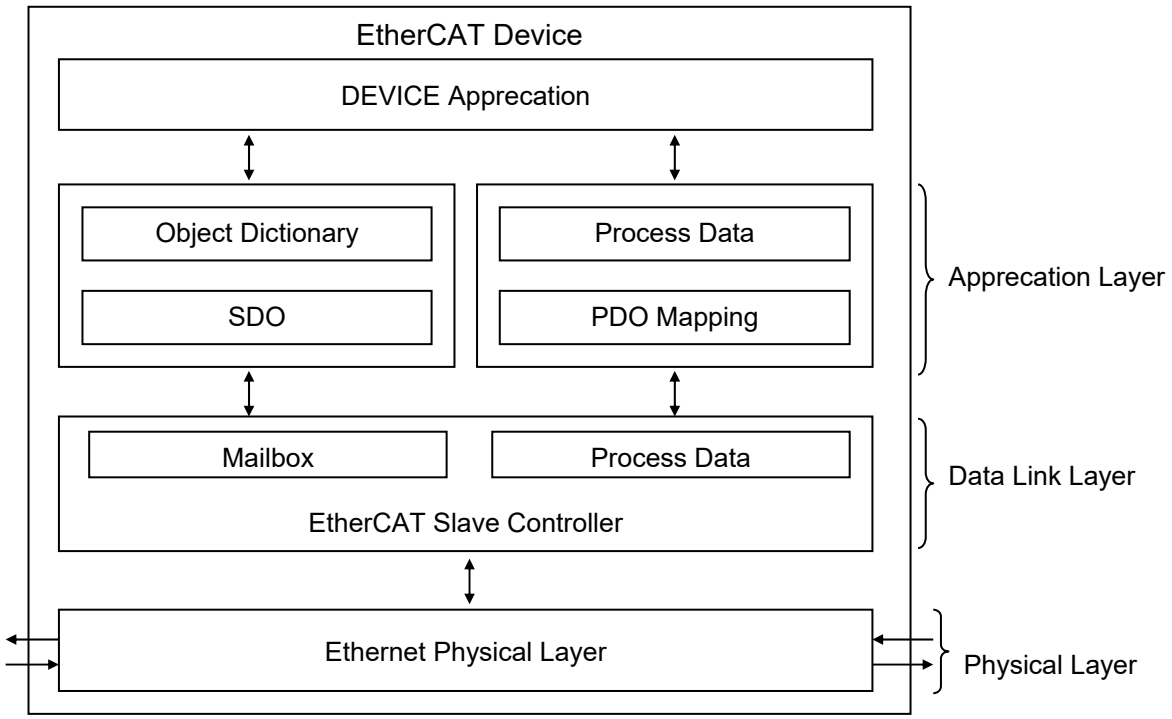
For example, imagine that the Ethernet frame is a moving train and the EtherCAT datagram is a train car. Then slave devices represent platforms of train stations and the bit of data is a passenger.
The train (Ethernet frame) passes through all platforms (slave devices) without stopping but passengers (data) can get on and off (Read/Write data) at appropriate platforms (slave devices). When the train (Ethernet frame) reaches the final platform (slave device), it returns to the first platform (slave device) and repeats the whole process.



Data for a specific slave device or various data for all slave devices can be configured as data is read or written within one Ethernet frame by EtherCAT. Data is read or written at the appropriate slave device when the Ethernet frame passes each slave device.

■ EtherCAT device architecture of COM-ML

CoE (CANopen over EtherCAT) is used as the protocol of the interface at application layer of COM-ML.



8.2 Communication Method

COM-ML supports “PDO communication” and “SDO communication” for EtherCAT.

■ PDO communication

PDO communication is used to read or write data on a regular basis.
Data is periodically exchanged between the master and slave controller.
To perform PDO communication, the following items (object dectionary) must be set.

Setting item	Description
Communication Item Setting Index 20C5H (0x20C5)	Set the first Modbus address of the communication items used in EtherCAT communication.
Communication IN Setting Index 20C6H (0x20C6)	Set the number of communication items used for monitor.
Communication OUT Setting Index 20C7H (0x20C7)	Set the number of communication items used for setting.

📖 Use tool to monitor or set data.
Setting tool: TwinCAT (software to be used as PLC master of EtherCAT communication)

■ SDO communication

SDO communication is mainly used in peer-to-peer (1 to 1) communication.
Data communication between the master and slave controller only takes place when necessary (at an event).
To perform SDO communication, the following items (object dectionary) must be set.

Setting item	Description
Communication Item Setting Index 20C5H (0x20C5)	Set the Modbus address of the communication items used in EtherCAT communication.
Controller Data Index 2064H (0x2064)	Set the Modbus register address data specified in 0x20C5. The order of the data is as specified in 0x20C5.

☞ For setting contents, refer to **7.1 EtherCAT Communication Settings (P. 26)**.

☞ For object dectionary, refer to **13. OBJECT DECTIONARY (P. 110)**. In addition, for Modbus register address of each communication items, refer to **9. COMMUNICATION DATA LIST (P. 36)**.

9. COMMUNICATION DATA LIST

9.1 Reference to Communication Data List

(1) (2) (3) (4) (5) (6) (7) (8) (9)

No.	Name	Iden-tifier	Chan-nel	Register address		Digits	Attri-bute	Struc-ture	Data range	Factory set value
				HEX	DEC					
1	Measured value (PV)	M1	CH1 : CH64	01FC : 023B	508 : 571	7	RO	C	Input scale low to Input scale high	—

(1) Name: Communication data name

(2) Identifier: Communication identifier of RKC communication

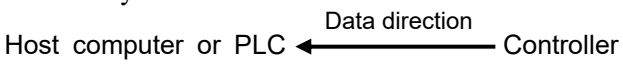
(3) Channel: Channel number of data of one unit

(4) Register address: Register address of Modbus data item specification
HEX: Hexadecimal
DEC: Decimal

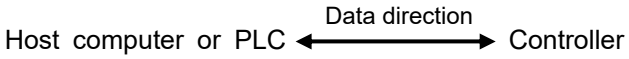
(5) Digits: The number of communication data digits in RKC communication

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

RO: Read only data



R/W: Read and Write data



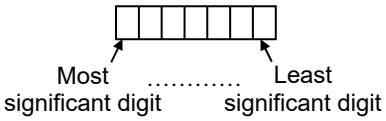
(7) Structure: U: Data for each SRZ unit
M: Data for each module
C: Data for each channel [1, 2]

[1] On a Z-TIO module (2-channel type), the communication data of the CH3 and CH4 becomes invalidates.

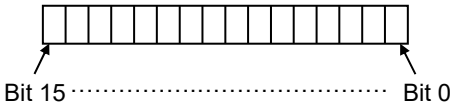
[2] Parameters only used for Heat/Cool PID control or position proportioning control, therefore data (indicated by ♣ in the name column) for CH2 and CH4 of Z-TIO modules are unused. [Read is possible (0 is shown), but the result of Write is disregarded.]

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

- ASCII code data (Example: 7 digits)



- 16-bit data (bit image)



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

⚠ WARNING

The Engineering setting data should be set according to the application before setting any parameter related to operation. Once the communication data in the Engineering mode are set correctly, no further changes need to be made to parameters 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 Engineering mode.

NOTE

Some of the communication data of the COM-ML will not be validated until the power is turned on again, or control is switched from STOP to RUN.

Communication data No. 18 to 35

NOTE

Communication data includes both Normal setting data and Engineering setting data. During RUN (control), the attribute of Engineering setting data is RO. To configure Engineering setting data, the RUN/STOP switch must be set to STOP (control stopped).

Z-TIO module: Normal setting data No. 1 to 85
Engineering setting data No. 86 to 208

Z-DIO module: Normal setting data No. 1 to 13
Engineering setting data No. 14 to 27

9.2 Communication Data of COM-ML

No.	Name	Identifier	Channel	Register address HEX	Register address DEC	Digits	Attribute	Structure	Data range	Factory set value
1	Model code (COM-ML)	ID	CH1	—	—	32	RO	M	Model code (character)	—
2	Model code (Function module*)	IE	CH1 : CH100	—	—	32	RO	M	Model code (character)	—
3	ROM version (COM-ML)	VR	CH1	—	—	8	RO	M	ROM version	—
4	ROM version (Function module*)	VQ	CH1 : CH100	—	—	8	RO	M	ROM version	—
5	Integrated operating time monitor (COM-ML)	UT	CH1	—	—	7	RO	M	0 to 19999 hours	—
6	Integrated operating time monitor (Function module*)	UV	CH1 : CH100	—	—	7	RO	M	0 to 19999 hours	—
7	Error code (COM-ML)	ER	CH1	0000	0	7	RO	U	• RKC communication 1: Adjustment data error 2: Data back-up error [1] 4: A/D conversion error 32: Logic output data error 64: Stack overflow [2] 512: Network module error [2] • Modbus Bit data Bit 0: Adjustment data error Bit 1: Data back-up error [1] Bit 2: A/D conversion error Bit 3 and Bit 4: Unused Bit 5: Logic output data error Bit 6: Stack overflow [2] Bit 7 and Bit 8: Unused Bit 9: Network module error [2] Bit 10 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 615] The error condition is shown by the *OR* of each module. When multiple errors occur, the error No. is the sum value. [1] Common item of the COM-ML and function module [2] Item of the COM-ML	—
8	Error code (Function module*)	EZ	CH1 : CH100	0001 : 0064	1 : 100	7	RO	M		—
9	Backup memory state monitor (COM-ML)	EM	CH1	0065	101	1	RO	M	0: The content of the backup memory does not coincide with that of the RAM. 1: The content of the backup memory coincides with that of the RAM.	—
10	Backup memory state monitor (Function module*)	CZ	CH1 : CH100	0066 : 00C9	102 : 201	1	RO	M		—
11	Unused	—	—	00CA 00CB	202 203	—	—	—	—	—
12	Network error code	ES	CH1	00CC	204	7	RO	U	0: Normal 1: Network operation not possible	—
13	Unused	—	—	00CD : 0131	205 : 305	—	—	—	—	—

* Function module: Z-TIO-A/B module or Z-DIO module

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No.	Name	Identifier	Channel	Register address HEX	Register address DEC	Digits	Attribute	Structure	Data range	Factory set value
14	Monitor for the number of connected modules	QK	CH1	0132	306	7	RO	U	0 to 31	—
15	RUN/STOP transfer (Each unit)	SR	CH1	0133	307	1	R/W	U	0: STOP (Control stop) 1: RUN (Control start)	0
16	RUN/STOP transfer (Each module)	SW	CH1 ⋮ CH100	0134 ⋮ 0197	308 ⋮ 407	1	R/W	M	0: STOP (Control stop) 1: RUN (Control start)	0
17	Control RUN/STOP holding setting (Each module)	X1	CH1 ⋮ CH100	0198 ⋮ 01FB	408 ⋮ 507	1	R/W	M	0: Not holding (STOP start) 1: Holding (RUN/STOP hold)	1
The following items are validated when the power is turned on again or when control is changed from STOP to RUN.										
18	Unused	—	—	8000 ⋮ 8003	32768 ⋮ 32771	—	—	—	—	—
19	Communication protocol	VP	CH1	8004	32772	1	R/W	U	0: RKC communication 1: Modbus	0
20	Communication communication speed	VU	CH1	8005	32773	1	R/W	U	0: 4800 bps 2: 19200 bps 1: 9600 bps 3: 38400 bps	2
21	Communication data bit configuration	VW	CH1	8006	32774	7	R/W	U	0 to 5 Rrefer to **Table 1: Data bit configuration**	0
22	Communication interval time	VX	CH1	8007	32775	7	R/W	U	0 to 250 ms	10
23	Unused	—	—	8008 ⋮ 8010	32776 ⋮ 32784	—	—	—	—	—
24	Method for setting the number of connected modules	RY	CH1	8011	32785	7	R/W	U	0: No action 1: Automatically set the maximum number of connected function modules only when power is turned on. 2: Execute automatic setting of the maximum number of connected function modules. (After automatic setting of the number of connected function modules, the value automatically reverts to 0.)	1
25	Unused	—	—	8012	32786	—	—	—	—	—
26	Number of connected modules * (Z-TIO module)	QY	CH1	8013	32787	7	R/W	U	0 to 16 This is the maximum address of the Z-TIO module that is connected to the COM-ML.	—
27	Number of connected modules * (Z-DIO module)	QU	CH1	8014	32788	7	R/W	U	0 to 16 This is the maximum address of the Z-DIO module that is connected to the COM-ML.	—

* When 1 or 2 is set for the communication identifier RY (method of setting the number of connected modules), the maximum number of connected modules is set automatically. When 0 is set, the maximum number of connected modules is set manually.
Maximum number of connected modules: Maximum address of function modules (address setting switch set value + 1)
COM–ML uses this set value to calculate the number of channels of communication data (RKC communication only).

Table 1: Data bit configuration

Set value	Data bit	Parity bit	Stop bit	Settable communication
0	8	Without	1	Modbus RKC communication
1	8	Even	1	
2	8	Odd	1	
3	7	Without	1	RKC communication
4	7	Even	1	
5	7	Odd	1	

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No.	Name	Identifier	Channel	Register address HEX	Register address DEC	Digits	Attribute	Structure	Data range	Factory set value
28	Unused	—	—	8015 ⋮ 801F	32789 ⋮ 32799	—	—	—	—	—
29	Communication item setting	QG	CH1 ⋮ CH50	8020 ⋮ 8051	32800 ⋮ 32849	7	R/W	M	0 to 65535	65535
30	Number of measured data items (IN)	QH	CH1 ⋮ CH50	8052 ⋮ 8083	32850 ⋮ 32899	7	R/W	M	0 to 128 0: Unused	0
31	Number of setting data items (OUT)	QI	CH1 ⋮ CH50	8084 ⋮ 80B5	32900 ⋮ 32949	7	R/W	M	0 to 127 0: Unused	0
32	Unused	—	—	80B6	32950	—	—	—	—	—
33	Control RUN/STOP holding setting (Each unit)	X2	CH1	80B7	32951	1	R/W	U	0: Not holding (STOP start) 1: Holding (RUN/STOP hold)	1
34	EtherCAT address	QJ	CH1	80B8	32952	7	RO	U	0 to 65535	—
35	Network status	—	CH1	80B9	32953	—	RO	U	Bit data Bit 0 to Bit 7: Update counter of Read data Bit 8: Toggle counter of Data mapping update Bit 9: Write completion flag Bit 10: Write error flag Bit 11: Error occurring flag Bit 12 to Bit 15: Unused	—

9.3 Communication Data of Z-TIO Module

☞ For details of Z-TIO module communication data, refer to **SRZ Instruction Manual (IMS01T04-E□)**.

No.	Name	Iden-tifier	Chan-nel	Register address		Digits	Attri-bute	Struc-ture	Data range	Factory set value
				HEX	DEC					
1	Measured value (PV)	M1	CH1 ⋮ CH64	01FC ⋮ 023B	508 ⋮ 571	7	RO	C	Input scale low to Input scale high	—
2	Comprehensive event state	AJ	CH1 ⋮ CH64	023C ⋮ 027B	572 ⋮ 635	7	RO	C	• RKC communication Least significant digit: Event 1 2nd digit: Event 2 3rd digit: Event 3 4th digit: Event 4 5th digit: Heater break alarm 6th digit: Temperature rise completion 7th digit: Burnout Data 0: OFF 1: ON • Modbus Bit data Bit 0: Event 1 Bit 1: Event 2 Bit 2: Event 3 Bit 3: Event 4 Bit 4: Heater break alarm Bit 5: Temperature rise completion Bit 6: Burnout Bit 7 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 127]	—
3	Operation mode state monitor	L0	CH1 ⋮ CH64	027C ⋮ 02BB	636 ⋮ 699	7	RO	C	• RKC communication Least significant digit: Control STOP 2nd digit: Control RUN 3rd digit: Manual mode 4th digit: Remote mode 5th digit to Most significant digit: Unused Data 0: OFF 1: ON • Modbus Bit data Bit 0: Control STOP Bit 1: Control RUN Bit 2: Manual mode Bit 3: Remote mode Bit 4 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 15]	—
4	Unused	—	—	02BC ⋮ 02CB	700 ⋮ 715	—	—	—	—	—
5	Manipulated output value (MV) monitor [heat-side] ♣	O1	CH1 ⋮ CH64	02CC ⋮ 030B	716 ⋮ 779	7	RO	C	PID control or Heat/Cool PID control: −5.0 to +105.0 % Position proportioning control with feedback resistance (FBR) input: 0.0 to 100.0 %	—
6	Manipulated output value (MV) monitor [cool-side] ♣	O2	CH1 ⋮ CH64	030C ⋮ 034B	780 ⋮ 843	7	RO	C	−5.0 to +105.0 %	—

♣ Parameters only used for Heat/Cool PID control or position proportioning control, therefore data for CH2 and CH4 of Z-TIO modules are unused.

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No.	Name	Iden-tifier	Chan-nel	Register address HEX	Register address DEC	Digits	Attri-bute	Struc-ture	Data range	Factory set value
7	Current transformer (CT) input value monitor	M3	CH1 ⋮ CH64	034C ⋮ 038B	844 ⋮ 907	7	RO	C	CTL-6-P-N: 0.0 to 30.0 A CTL-12-S56-10L-N: 0.0 to 100.0 A	—
8	Set value (SV) monitor	MS	CH1 ⋮ CH64	038C ⋮ 03CB	908 ⋮ 971	7	RO	C	Setting limiter low to Setting limiter high	—
9	Remote setting (RS) input value monitor	S2	CH1 ⋮ CH64	03CC ⋮ 040B	972 ⋮ 1035	7	RO	C	Setting limiter low to Setting limiter high	—
10	Burnout state monitor	B1	CH1 ⋮ CH64	040C ⋮ 044B	1036 ⋮ 1099	1	RO	C	0: OFF 1: ON	—
11	Event 1 state monitor	AA	CH1 ⋮ CH64	044C ⋮ 048B	1100 ⋮ 1163	1	RO	C	0: OFF 1: ON If the Event 3 type is Temperature rise completion, check the Temperature rise completion state in the comprehensive event state (Identifier: AJ, Register address: 023C to 027B). (The Event 3 state monitor does not turn ON.)	—
12	Event 2 state monitor	AB	CH1 ⋮ CH64	048C ⋮ 04CB	1164 ⋮ 1227	1	RO	C		—
13	Event 3 state monitor	AC	CH1 ⋮ CH64	04CC ⋮ 050B	1228 ⋮ 1291	1	RO	C		—
14	Event 4 state monitor	AD	CH1 ⋮ CH64	050C ⋮ 054B	1292 ⋮ 1355	1	RO	C		—
15	Heater break alarm (HBA) state monitor	AE	CH1 ⋮ CH64	054C ⋮ 058B	1356 ⋮ 1419	1	RO	C	0: OFF 1: ON	—
16	Output state monitor	Q1	CH1 ⋮ CH16	058C ⋮ 059B	1420 ⋮ 1435	7	RO	M	• RKC communication Least significant digit: OUT1 2nd digit: OUT2 3rd digit: OUT3 4th digit: OUT4 5th digit to Most significant digit: Unused Data 0: OFF 1: ON • Modbus Bit data Bit 0: OUT1 Bit 1: OUT2 Bit 2: OUT3 Bit 3: OUT4 Bit 4 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 15] Validates only for time-proportional control output.	—
17	Memory area soak time monitor	TR	CH1 ⋮ CH64	059C ⋮ 05DB	1436 ⋮ 1499	7	RO	C	0 minutes 00 seconds to 199 minutes 59 seconds: RKC communication: 0:00 to 199:59 (min:sec) Modbus: 0 to 11999 seconds 0 hours 00 minutes to 99 hours 59 minutes: RKC communication: 0:00 to 99:59 (hrs:min) Modbus: 0 to 5999 minutes Data range of Area soak time can be selected on the Soak time unit.	—

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No.	Name	Iden-tifier	Chan-nel	Register address HEX	Register address DEC	Digits	Attri-bute	Struc-ture	Data range	Factory set value
18	Unused	—	—	05DC ⋮ 05EB	1500 ⋮ 1515	—	—	—	—	—
19	Holding peak value ambient temperature monitor	Hp	CH1 ⋮ CH64	05EC ⋮ 062B	1516 ⋮ 1579	7	RO	C	−10.0 to +100.0 °C (14.0 to 212.0 °F)	—
20	Unused	—	—	062C ⋮ 063B	1580 ⋮ 1595	—	—	—	—	—
21	Logic output monitor 1	ED	CH1 ⋮ CH16	063C ⋮ 064B	1596 ⋮ 1611	7	RO	M	• RKC communication Least significant digit: Logic output 1 2nd digit: Logic output 2 3rd digit: Logic output 3 4th digit: Logic output 4 5th digit to Most significant digit: Unused Data 0: OFF 1: ON • Modbus Bit data Bit 0: Logic output 1 Bit 1: Logic output 2 Bit 2: Logic output 3 Bit 3: Logic output 4 Bit 4: Logic output 5 Bit 5: Logic output 6 Bit 6: Logic output 7 Bit 7: Logic output 8 Bit 8 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 255]	—
22	Logic output monitor 2	EE	CH1 ⋮ CH16	—	—	7	RO	M	Least significant digit: Logic output 5 2nd digit: Logic output 6 3rd digit: Logic output 7 4th digit: Logic output 8 5th digit to Most significant digit: Unused Data 0: OFF 1: ON	
23	Unused	—	—	064C ⋮ 080B	1612 ⋮ 2059	—	—	—	—	—
24	PID/AT transfer	G1	CH1 ⋮ CH64	080C ⋮ 084B	2060 ⋮ 2123	1	R/W	C	0: PID control 1: Autotuning (AT) * * Automatically reverts to 0 after autotuning ends.	0
25	Auto/Manual transfer	J1	CH1 ⋮ CH64	084C ⋮ 088B	2124 ⋮ 2187	1	R/W	C	0: Auto mode 1: Manual mode	0
26	Remote/Local transfer	C1	CH1 ⋮ CH64	088C ⋮ 08CB	2188 ⋮ 2251	1	R/W	C	0: Local mode 1: Remote mode When performing remote control by Remote setting input and also performing Cascade control and Ratio setting, transfer to the Remote mode.	0
27	Unused	—	—	08CC ⋮ 08DB	2252 ⋮ 2267	—	—	—	—	—
28	Memory area transfer	ZA	CH1 ⋮ CH64	08DC ⋮ 091B	2268 ⋮ 2331	7	R/W	C	1 to 8	1

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No.	Name	Iden-tifier	Chan-nel	Register address HEX	Register address DEC	Digits	Attri-bute	Struc-ture	Data range	Factory set value
29	Interlock release	AR	CH1 ⋮ CH64	091C ⋮ 095B	2332 ⋮ 2395	1	R/W	C	0: Normal state 1: Interlock release execution	0
30	Event 1 set value (EV1) ★	A1	CH1 ⋮ CH64	095C ⋮ 099B	2396 ⋮ 2459	7	R/W	C	Deviation action, Deviation action between channels, Temperature rise completion range: −Input span to +Input span Process action, SV action: Input scale low to Input scale high MV action: −5.0 to +105.0 % If the Event type corresponds to "0: None," set to RO (Only reading data is possible). If Event 3 corresponds to "9: Temperature rise completion," the Event 3 set value becomes the range for determining temperature rise completion. If Event 4 corresponds to "9: Control loop break alarm (LBA)," the Event 4 set value becomes RO (Only reading data is possible).	50
31	Event 2 set value (EV2) ★	A2	CH1 ⋮ CH64	099C ⋮ 09DB	2460 ⋮ 2523	7	R/W	C		50
32	Event 3 set value (EV3) ★	A3	CH1 ⋮ CH64	09DC ⋮ 0A1B	2524 ⋮ 2587	7	R/W	C		50
33	Event 4 set value (EV4) ★	A4	CH1 ⋮ CH64	0A1C ⋮ 0A5B	2588 ⋮ 2651	7	R/W	C		50
34	Control loop break alarm (LBA) time ★	A5	CH1 ⋮ CH64	0A5C ⋮ 0A9B	2652 ⋮ 2715	7	R/W	C	0 to 7200 seconds (0: Unused)	480
35	LBA deadband ★	N1	CH1 ⋮ CH64	0A9C ⋮ 0ADB	2716 ⋮ 2779	7	R/W	C	0 (0.0) to Input span	0 (0.0)
36	Set value (SV) ★	S1	CH1 ⋮ CH64	0ADC ⋮ 0B1B	2780 ⋮ 2843	7	R/W	C	Setting limiter low to Setting limiter high	TC/RTD: 0 V/I: 0.0
37	Proportional band [heat-side] ★ ♣	P1	CH1 ⋮ CH64	0B1C ⋮ 0B5B	2844 ⋮ 2907	7	R/W	C	TC/RTD inputs: 0 (0.0) to Input span (Unit: °C [°F]) Varies with the setting of the Decimal point position selection. Voltage (V)/Current (I) inputs: 0.0 to 1000.0 % of input span 0 (0.0): ON/OFF action (ON/OFF action for both heat and cool actions in case of a Heat/Cool PID control type.)	TC/RTD: 30 (30.0) V/I: 30.0
38	Integral time [heat-side] ★ ♣	I1	CH1 ⋮ CH64	0B5C ⋮ 0B9B	2908 ⋮ 2971	7	R/W	C	PID control or Heat/Cool PID control: 0 to 3600 seconds or 0.0 to 1999.9 seconds (0, 0.0: PD action) Position proportioning control: 1 to 3600 seconds or 0.1 to 1999.9 seconds Varies with the setting of the Integral/Derivative time decimal point position selection.	240
39	Derivative time [heat-side] ★ ♣	D1	CH1 ⋮ CH64	0B9C ⋮ 0BDB	2972 ⋮ 3035	7	R/W	C	0 to 3600 seconds or 0.0 to 1999.9 seconds (0, 0.0: PI action) Varies with the setting of the Integral/ Derivative time decimal point position selection.	60

★ Parameters which can be used in multi-memory area function

♣ Parameters only used for Heat/Cool PID control or position proportioning control, therefore data for CH2 and CH4 of Z-TIO modules are unused.

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No.	Name	Iden-tifier	Chan-nel	Register address HEX	Register address DEC	Digits	Attri-bute	Struc-ture	Data range	Factory set value
40	Control response parameter ★ ♣	CA	CH1 : CH64	0BDC : 0C1B	3036 : 3099	1	R/W	C	0: Slow 1: Medium 2: Fast When the P or PD action is selected, this setting becomes invalidate.	PID control, Position proportioning control: 0 Heat/Cool PID control: 2
41	Proportional band [cool-side] ★ ♣	P2	CH1 : CH64	0C1C : 0C5B	3100 : 3163	7	R/W	C	TC/RTD inputs: 1 (0.1) to Input span (Unit: °C [°F]) Varies with the setting of the Decimal point position selection. Voltage (V)/Current (I) inputs: 0.1 to 1000.0 % of input span If control is other than Heat/Cool PID control, set to RO (Only reading data is possible).	TC/RTD: 30 (30.0) V/I: 30.0
42	Integral time [cool-side] ★ ♣	I2	CH1 : CH64	0C5C : 0C9B	3164 : 3227	7	R/W	C	0 to 3600 seconds or 0.0 to 1999.9 seconds (0, 0.0: PD action) Varies with the setting of the Integral/Derivative time decimal point position selection. If control is other than Heat/Cool PID control, set to RO (Only reading data is possible).	240
43	Derivative time [cool-side] ★ ♣	D2	CH1 : CH64	0C9C : 0CDB	3228 : 3291	7	R/W	C	0 to 3600 seconds or 0.0 to 1999.9 seconds (0, 0.0: PI action) Varies with the setting of the Integral/Derivative time decimal point position selection. If control is other than Heat/Cool PID control, set to RO (Only reading data is possible).	60
44	Overlap/Deadband ★ ♣	V1	CH1 : CH64	0CDC : 0D1B	3292 : 3355	7	R/W	C	TC/RTD inputs: –Input span to +Input span (Unit:°C [°F]) Voltage (V)/Current (I) inputs: –100.0 to +100.0 % of input span Minus (–) setting results in Overlap. However, the overlapping range is within the proportional range. If control is other than Heat/Cool PID control, set to RO (Only reading data is possible).	0
45	Manual reset ★	MR	CH1 : CH64	0D1C : 0D5B	3356 : 3419	7	R/W	C	–100.0 to +100.0 % If the Integral function is validated, set to RO (Only reading data is possible). When integral action (heating or cooling side) is zero, manual reset value is added to the control output.	0.0
46	Setting change rate limiter (up) ★	HH	CH1 : CH64	0D5C : 0D9B	3420 : 3483	7	R/W	C	0 (0.0) to Input span/unit time * 0 (0.0): Unused * Unit time: 60 seconds (factory set value)	0 (0.0)
47	Setting change rate limiter (down) ★	HL	CH1 : CH64	0D9C : 0DDB	3484 : 3547	7	R/W	C		0 (0.0)

★ Parameters which can be used in multi-memory area function

♣ Parameters only used for Heat/Cool PID control or position proportioning control, therefore data for CH2 and CH4 of Z-TIO modules are unused.

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No.	Name	Iden-tifier	Chan-nel	Register address		Digits	Attri-bute	Struc-ture	Data range	Factory set value
				HEX	DEC					
48	Area soak time ★	TM	CH1 ⋮ CH64	0DDC ⋮ 0E1B	3548 ⋮ 3611	7	R/W	C	0 minutes 00 seconds to 199 minutes 59 seconds: RKC communication: 0:00 to 199:59 (min:sec) Modbus: 0 to 11999 seconds 0 hours 00 minutes to 99 hours 59 minutes: RKC communication: 0:00 to 99:59 (hrs:min) Modbus: 0 to 5999 minutes Data range of Area soak time can be selected on the Soak time unit.	RKC communication: 0:00 Modbus: 0
49	Link area number ★	LP	CH1 ⋮ CH64	0E1C ⋮ 0E5B	3612 ⋮ 3675	7	R/W	C	0 to 8 (0: No link)	0
50	Heater break alarm (HBA) set value	A7	CH1 ⋮ CH64	0E5C ⋮ 0E9B	3676 ⋮ 3739	7	R/W	C	When CT is CTL-6-P-N: 0.0 to 30.0 A (0.0: Not used) When CT is CTL-12-S56-10L-N: 0.0 to 100.0 A (0.0: Not used) If there is no Current transformer (CT) or CT is assigned to "0: None," set to RO (Only reading data is possible).	0.0
51	Heater break determination point	NE	CH1 ⋮ CH64	0E9C ⋮ 0EDB	3740 ⋮ 3803	7	R/W	C	0.0 to 100.0 % of HBA set value (0.0: Heater break determination is invalidated) If there is no Current transformer (CT) or CT is assigned to "0: None," set to RO (Only reading data is possible). If Heater break alarm (HBA) corresponds to "0: Type A," set to RO (Only reading data is possible).	30.0
52	Heater melting determination point	NF	CH1 ⋮ CH64	0EDC ⋮ 0F1B	3804 ⋮ 3867	7	R/W	C	0.0 to 100.0 % of HBA set value (0.0: Heater melting determination is invalidated) If there is no Current transformer (CT) or CT is assigned to "0: None," set to RO (Only reading data is possible). If Heater break alarm (HBA) corresponds to "0: Type A," set to RO (Only reading data is possible).	30.0
53	PV bias	PB	CH1 ⋮ CH64	0F1C ⋮ 0F5B	3868 ⋮ 3931	7	R/W	C	–Input span to +Input span	0
54	PV digital filter	F1	CH1 ⋮ CH64	0F5C ⋮ 0F9B	3932 ⋮ 3995	7	R/W	C	0.0 to 100.0 seconds (0.0: Unused)	0.0
55	PV ratio	PR	CH1 ⋮ CH64	0F9C ⋮ 0FDB	3996 ⋮ 4059	7	R/W	C	0.500 to 1.500	1.000
56	PV low input cut-off	DP	CH1 ⋮ CH64	0FDC ⋮ 101B	4060 ⋮ 4123	7	R/W	C	0.00 to 25.00 % of input span If the Square root extraction corresponds to "0: Unused," set to RO (Only reading data is possible).	0.00
57	RS bias *	RB	CH1 ⋮ CH64	101C ⋮ 105B	4124 ⋮ 4187	7	R/W	C	–Input span to +Input span	0
58	RS digital filter *	F2	CH1 ⋮ CH64	105C ⋮ 109B	4188 ⋮ 4251	7	R/W	C	0.0 to 100.0 seconds (0.0: Unused)	0.0

* Data on RS bias, RS ratio and RS digital filter is that in Cascade control or Ratio setting.

★: Parameters which can be used in multi-memory area function

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No.	Name	Iden-tifier	Chan-nel	Register address HEX	Register address DEC	Digits	Attri-bute	Struc-ture	Data range	Factory set value
59	RS ratio *	RR	CH1 ⋮ CH64	109C ⋮ 10DB	4252 ⋮ 4315	7	R/W	C	0.001 to 9.999	1.000
60	Output distribution selection	DV	CH1 ⋮ CH64	10DC ⋮ 111B	4316 ⋮ 4379	1	R/W	C	0: Control output 1: Distribution output	0
61	Output distribution bias	DW	CH1 ⋮ CH64	111C ⋮ 115B	4380 ⋮ 4443	7	R/W	C	−100.0 to +100.0 %	0.0
62	Output distribution ratio	DQ	CH1 ⋮ CH64	115C ⋮ 119B	4444 ⋮ 4507	7	R/W	C	−9.999 to +9.999	1.000
63	Proportional cycle time	T0	CH1 ⋮ CH64	119C ⋮ 11DB	4508 ⋮ 4571	7	R/W	C	0.1 to 100.0 seconds This item becomes RO (Only reading data is possible) for the Voltage/Current output specification. This parameter is validated when "0: control output" has been selected at No.95 "Output assignment."	Relay contact output: 20.0 Voltage pulse output, Triac output and Open collector output: 2.0
64	Minimum ON/OFF time of proportioning cycle	VI	CH1 ⋮ CH64	11DC ⋮ 121B	4572 ⋮ 4635	7	R/W	C	0 to 1000 ms This item becomes RO (Only reading data is possible) for the Voltage/Current output specification.	0
65	Manual manipulated output value ♣	ON	CH1 ⋮ CH64	121C ⋮ 125B	4636 ⋮ 4699	7	R/W	C	PID control: Output limiter low to Output limiter high Heat/Cool PID control: −Cool-side output limiter (high) to +Heat-side output limiter (high) Position proportioning control: When there is Feedback resistance (FBR) input and it does not break: Output limiter low to Output limiter high When there is no Feedback resistance (FBR) input or the Feedback resistance (FBR) input is disconnected: 0: Close-side output OFF, Open-side output OFF 1: Close-side output ON, Open-side output OFF 2: Close-side output OFF, Open-side output ON	0.0
66	Area soak time stop function	RV	CH1 ⋮ CH64	125C ⋮ 129B	4700 ⋮ 4763	1	R/W	C	0: No function 1: Event 1 2: Event 2 3: Event 3 4: Event 4	0
67	EDS mode (for disturbance 1)	NG	CH1 ⋮ CH64	129C ⋮ 12DB	4764 ⋮ 4827	1	R/W	C	0: No function 1: EDS function mode 2: Learning mode 3: Tuning mode EDS function: External disturbance suppression function	0
68	EDS mode (for disturbance 2)	NX	CH1 ⋮ CH64	12DC ⋮ 131B	4828 ⋮ 4891	1	R/W	C		0

* Data on RS bias, RS ratio and RS digital filter is that in Cascade control or Ratio setting.

♣ Parameters only used for Heat/Cool PID control or position proportioning control, therefore data for CH2 and CH4 of Z-TIO modules are unused.

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No.	Name	Iden-tifier	Chan-nel	Register address HEX	Register address DEC	Digits	Attri-bute	Struc-ture	Data range	Factory set value
69	EDS value 1 (for disturbance 1)	NI	CH1 ⋮ CH64	131C ⋮ 135B	4892 ⋮ 4955	7	R/W	C	−100.0 to +100.0 %	0.0
70	EDS value 1 (for disturbance 2)	NJ	CH1 ⋮ CH64	135C ⋮ 139B	4956 ⋮ 5019	7	R/W	C		0.0
71	EDS value 2 (for disturbance 1)	NK	CH1 ⋮ CH64	139C ⋮ 13DB	5020 ⋮ 5083	7	R/W	C	−100.0 to +100.0 %	0.0
72	EDS value 2 (for disturbance 2)	NM	CH1 ⋮ CH64	13DC ⋮ 141B	5084 ⋮ 5147	7	R/W	C		0.0
73	EDS transfer time (for disturbance 1)	NN	CH1 ⋮ CH64	141C ⋮ 145B	5148 ⋮ 5211	7	R/W	C	0 to 3600 seconds or 0.0 to 1999.9 seconds	0
74	EDS transfer time (for disturbance 2)	NO	CH1 ⋮ CH64	145C ⋮ 149B	5212 ⋮ 5275	7	R/W	C		0
75	EDS action time (for disturbance 1)	NQ	CH1 ⋮ CH64	149C ⋮ 14DB	5276 ⋮ 5339	7	R/W	C	1 to 3600 seconds	600
76	EDS action time (for disturbance 2)	NL	CH1 ⋮ CH64	14DC ⋮ 151B	5340 ⋮ 5403	7	R/W	C		600
77	EDS action wait time (for disturbance 1)	NR	CH1 ⋮ CH64	151C ⋮ 155B	5404 ⋮ 5467	7	R/W	C	0.0 to 600.0 seconds	0.0
78	EDS action wait time (for disturbance 2)	NY	CH1 ⋮ CH64	155C ⋮ 159B	5468 ⋮ 5531	7	R/W	C		0.0
79	EDS value learning times	NT	CH1 ⋮ CH64	159C ⋮ 15DB	5532 ⋮ 5595	7	R/W	C	0 to 10 times (0: No learning mode)	1
80	EDS start signal	NU	CH1 ⋮ CH64	15DC ⋮ 161B	5596 ⋮ 5659	1	R/W	C	0: EDS start signal OFF 1: EDS start signal ON (for disturbance 1) 2: EDS start signal ON (for disturbance 2)	0
81	Operation mode	EI	CH1 ⋮ CH64	161C ⋮ 165B	5660 ⋮ 5723	1	R/W	C	0: Unused 1: Monitor 2: Monitor + Event function 3: Control	3
82	Startup tuning (ST)	ST	CH1 ⋮ CH64	165C ⋮ 169B	5724 ⋮ 5787	1	R/W	C	0: ST unused 1: Execute once * 2: Execute always * When the Startup tuning (ST) is finished, the setting will automatically returns to "0: ST unused." The Startup tuning (ST) function is activated according to the ST start condition selected. If control is Position proportioning control, set to RO (Only reading data is possible).	0
83	Automatic temperature rise learning	Y8	CH1 ⋮ CH64	169C ⋮ 16DB	5788 ⋮ 5851	1	R/W	C	0: Unused 1: Learning * * When the automatic temperature rise learning is finished, the setting will automatically returns to "0: Unused."	0

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No.	Name	Iden-tifier	Chan-nel	Register address HEX	Register address DEC	Digits	Attri-bute	Struc-ture	Data range	Factory set value
84	Communication switch for logic	EF	CH1 ⋮ CH16	16DC ⋮ 16EB	5852 ⋮ 5867	7	R/W	M	• RKC communication Least significant digit: Communication switch 1 2nd digit: Communication switch 2 3rd digit: Communication switch 3 4th digit: Communication switch 4 5th digit to Most significant digit: Unused Data 0: OFF 1: ON • Modbus Bit data Bit 0: Communication switch 1 Bit 1: Communication switch 2 Bit 2: Communication switch 3 Bit 3: Communication switch 4 Bit 4 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 15]	0
85	Unused	—	—	16EC ⋮ 196B	5868 ⋮ 6507	—	—	—	—	—
Set data No. 86 or later are for engineering setting [Writable in the STOP mode]										
86	Input type	XI	CH1 ⋮ CH64	196C ⋮ 19AB	6508 ⋮ 6571	7	R/W	C	0: TC input K 1: TC input J 2: TC input R 3: TC input S 4: TC input B 5: TC input E 6: TC input N 7: TC input T 8: TC input W5Re/W26Re 9: TC input PLII 12: RTD input Pt100 13: RTD input JPt100 14: Current input 0 to 20 mA DC 15: Current input 4 to 20 mA DC 16: Voltage (high) input 0 to 10 V DC 17: Voltage (high) input 0 to 5 V DC 18: Voltage (high) input 1 to 5 V DC 19: Voltage (low) input 0 to 1 V DC 20: Voltage (low) input 0 to 100 mV DC 21: Voltage (low) input 0 to 10 mV DC 22: Feedback resistance input 100 to 150 Ω 23: Feedback resistance input 151 Ω to 6 kΩ If changed to Voltage (high) input from TC/RTD/Current/Voltage (low)/ Feedback resistance input, select the hardware by the input selector switch at the side of the module. Refer to **SRZ Instruction Manual (IMS01T04-E□)**.	Based on model code When not specifying: 0

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No.	Name	Iden-tifier	Chan-nel	Register address HEX	Register address DEC	Digits	Attri-bute	Struc-ture	Data range	Factory set value
87	Display unit	PU	CH1 ⋮ CH64	19AC ⋮ 19EB	6572 ⋮ 6635	7	R/W	C	0: °C 1: °F Use to select the temperature unit for Thermocouple (TC) and RTD inputs.	0
88	Decimal point position	XU	CH1 ⋮ CH64	19EC ⋮ 1A2B	6636 ⋮ 6699	7	R/W	C	0: No decimal place 1: One decimal place 2: Two decimal places 3: Three decimal places 4: Four decimal places TC input: • K, J, T, E: Only 0 or 1 can be set. • R, S, B, N, PLII, W5Re/W26Re: Only 0 can be set. RTD input: Only 0 or 1 can be set. Voltage (V)/Current (I) inputs: From 0 to 4 can be set.	Based on model code When not specifying: TC/RTD: 1 V/I: 1
89	Input scale high	XV	CH1 ⋮ CH64	1A2C ⋮ 1A6B	6700 ⋮ 6763	7	R/W	C	TC/RTD inputs: Input scale low to Maximum value of the selected input range Voltage (V)/Current (I) inputs: −19999 to +19999 (However, a span is 20000 or less.) Varies with the setting of the Decimal point position	TC/RTD: Maximum value of the selected input range V/I: 100.0
90	Input scale low	XW	CH1 ⋮ CH64	1A6C ⋮ 1AAB	6764 ⋮ 6827	7	R/W	C	TC/RTD inputs: Minimum value of the selected input range to Input scale high Voltage (V)/Current (I) inputs: −19999 to +19999 (However, a span is 20000 or less.) Varies with the setting of the Decimal point position	TC/RTD: Minimum value of the selected input range V/I: 0.0
91	Input error determination point (high)	AV	CH1 ⋮ CH64	1AAC ⋮ 1AEB	6828 ⋮ 6891	7	R/W	C	Input error determination point (low) to (Input range high + 5 % of Input span)	Input range high + (5 % of Input span)
92	Input error determination point (low)	AW	CH1 ⋮ CH64	1AEC ⋮ 1B2B	6892 ⋮ 6955	7	R/W	C	(Input range low − 5 % of Input span) to Input error determination point (high)	Input range low − (5 % of Input span)
93	Burnout direction	BS	CH1 ⋮ CH64	1B2C ⋮ 1B6B	6956 ⋮ 7019	1	R/W	C	0: Upscale 1: Downscale Validate only when the TC input and Voltage (low) input are selected.	0
94	Square root extraction	XH	CH1 ⋮ CH64	1B6C ⋮ 1BAB	7020 ⋮ 7083	1	R/W	C	0: Unused 1: Used	0
95	Output assignment (Logic output selection function)	E0	CH1 ⋮ CH64	1BAC ⋮ 1BEB	7084 ⋮ 7147	1	R/W	C	0: Control output 1: Logic output result 2: FAIL output	0
96	Energized/ De-energized (Logic output selection function)	NA	CH1 ⋮ CH64	1BEC ⋮ 1C2B	7148 ⋮ 7211	1	R/W	C	0: Energized 1: De-energized	0

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No.	Name	Iden-tifier	Chan-nel	Register address HEX	Register address DEC	Digits	Attri-bute	Struc-ture	Data range	Factory set value
97	Event 1 type	XA	CH1 ⋮ CH64	1C2C ⋮ 1C6B	7212 ⋮ 7275	7	R/W	C	0: None 1: Deviation high (Using SV monitor value) [1] 2: Deviation low (Using SV monitor value) [1] 3: Deviation high/low (Using SV monitor value) [1] 4: Band (Using SV monitor value) [1] 5: Process high [1] 6: Process low [1] 7: SV high 8: SV low 9: Unused 10: MV high [heat-side] [1, 2] 11: MV low [heat-side] [1, 2] 12: MV high [cool-side] [1] 13: MV low [cool-side] [1] 14: Deviation high (Using local SV value) [1] 15: Deviation low (Using local SV value) [1] 16: Deviation high/low (Using local SV value) [1] 17: Band (Using local SV value) [1] 18: Deviation between channels high [1] 19: Deviation between channels low [1] 20: Deviation between channels high/low [1] 21: Deviation between channels band [1] [1] Event hold action is available. [2] If there is Feedback resistance (FBR) input in Position proportioning control, set to the Feedback resistance (FBR) input value.	Based on model code When not specifying: 0
98	Event 1 channel setting	FA	CH1 ⋮ CH64	1C6C ⋮ 1CAB	7276 ⋮ 7339	1	R/W	C	1: Channel 1 3: Channel 3 2: Channel 2 4: Channel 4 This function is validated when "Deviation between channels"is selected.	1
99	Event 1 hold action	WA	CH1 ⋮ CH64	1CAC ⋮ 1CEB	7340 ⋮ 7403	1	R/W	C	0: OFF 1: Hold action ON (when power turned on; when transferred from STOP to RUN) 2: Re-hold action ON (when power turned on; when transferred from STOP to RUN; SV changed) This function is validated when input value, deviation or manipulated value action has been selected. In case of a deviation action, this function is not available while in Remote mode and while Setting changing rate limiter is working.	Based on model code When not specifying: 0
100	Event 1 interlock	LF	CH1 ⋮ CH64	1CEC ⋮ 1D2B	7404 ⋮ 7467	1	R/W	C	0: Unused 1: Used	0
101	Event 1 differential gap	HA	CH1 ⋮ CH64	1D2C ⋮ 1D6B	7468 ⋮ 7531	7	R/W	C	① Deviation, Process, Set value, or Deviation action between channels: 0 to Input span (Unit: °C [°F]) ② MV: 0.0 to 110.0 %	①: 1 ②: 1.0
102	Event 1 delay timer	TD	CH1 ⋮ CH64	1D6C ⋮ 1DAB	7532 ⋮ 7595	7	R/W	C	0 to 18000 seconds	0

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No.	Name	Iden-tifier	Chan-nel	Register address HEX	Register address DEC	Digits	Attri-bute	Struc-ture	Data range	Factory set value
103	Force ON of Event 1 action	OA	CH1 ⋮ CH64	1DAC ⋮ 1DEB	7596 ⋮ 7659	7	R/W	C	• RKC communication Least significant digit: Event output turned on at input error occurrence 2nd digit: Event output turned on in Manual mode 3rd digit: Event output turned on during the Autotuning (AT) function is being executed 4th digit: Event output turned on during the Setting change rate limiter is being operated 5th digit to Most significant digit: Unused Data 0: Invalidate 1: Validate • Modbus Bit data Bit 0: Event output turned on at input error occurrence Bit 1: Event output turned on in Manual mode Bit 2: Event output turned on during the Autotuning (AT) function is being executed Bit 3: Event output turned on during the Setting change rate limiter is being operated Bit 4 to Bit 15: Unused Data 0: Invalidate 1: Validate [Decimal number: 0 to 15]	0
104	Event 2 type	XB	CH1 ⋮ CH64	1DEC ⋮ 1E2B	7660 ⋮ 7723	7	R/W	C	0: None 1: Deviation high (Using SV monitor value) [1] 2: Deviation low (Using SV monitor value) [1] 3: Deviation high/low (Using SV monitor value) [1] 4: Band (Using SV monitor value) [1] 5: Process high [1] 6: Process low [1] 7: SV high 8: SV low 9: Unused 10: MV high [heat-side] [1, 2] 11: MV low [heat-side] [1, 2] 12: MV high [cool-side] [1] 13: MV low [cool-side] [1] 14: Deviation high (Using local SV value) [1] 15: Deviation low (Using local SV value) [1] 16: Deviation high/low (Using local SV value) [1] 17: Band (Using local SV value) [1] 18: Deviation between channels high [1] 19: Deviation between channelslow [1] 20: Deviation between channels high/low [1] 21: Deviation between channels band [1] [1] Event hold action is available. [2] If there is Feedback resistance (FBR) input in Position proportioning control, set to the Feedback resistance (FBR) input value.	Based on model code When not specifying: 0

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No.	Name	Iden-tifier	Chan-nel	Register address HEX	Register address DEC	Digits	Attri-bute	Struc-ture	Data range	Factory set value
105	Event 2 channel setting	FB	CH1 ⋮ CH64	1E2C ⋮ 1E6B	7724 ⋮ 7787	1	R/W	C	1: Channel 1 3: Channel 3 2: Channel 2 4: Channel 4 This function is validated when "Deviation between channels"is selected.	1
106	Event 2 hold action	WB	CH1 ⋮ CH64	1E6C ⋮ 1EAB	7788 ⋮ 7851	1	R/W	C	0: OFF 1: Hold action ON (when power turned on; when transferred from STOP to RUN) 2: Re-hold action ON (when power turned on; when transferred from STOP to RUN; SV changed) This function is validated when input value, deviation or manipulated value action has been selected. In case of a deviation action, this function is not available while in Remote mode and while Setting changing rate limiter is working.	Based on model code When not specifying: 0
107	Event 2 interlock	LG	CH1 ⋮ CH64	1EAC ⋮ 1EEB	7852 ⋮ 7915	1	R/W	C	0: Unused 1: Used	0
108	Event 2 differential gap	HB	CH1 ⋮ CH64	1EEC ⋮ 1F2B	7916 ⋮ 7979	7	R/W	C	① Deviation, Process, Set value, or Deviation action between channels: 0 to Input span (Unit: °C [°F]) ② MV: 0.0 to 110.0 %	①: 1 ②: 1.0
109	Event 2 delay timer	TG	CH1 ⋮ CH64	1F2C ⋮ 1F6B	7980 ⋮ 8043	7	R/W	C	0 to 18000 seconds	0
110	Force ON of Event 2 action	OB	CH1 ⋮ CH64	1F6C ⋮ 1FAB	8044 ⋮ 8107	7	R/W	C	• RKC communication Least significant digit: Event output turned on at input error occurrence 2nd digit: Event output turned on in Manual mode 3rd digit: Event output turned on during the Autotuning (AT) function is being executed 4th digit: Event output turned on during the Setting change rate limiter is being operated 5th digit to Most significant digit: Unused Data 0: Invalidate 1: Validate • Modbus Bit data Bit 0: Event output turned on at input error occurrence Bit 1: Event output turned on in Manual mode Bit 2: Event output turned on during the Autotuning (AT) function is being executed Bit 3: Event output turned on during the Setting change rate limiter is being operated Bit 4 to Bit 15: Unused Data 0: Invalidate 1: Validate [Decimal number: 0 to 15]	0

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No.	Name	Iden-tifier	Chan-nel	Register address HEX	Register address DEC	Digits	Attri-bute	Struc-ture	Data range	Factory set value
111	Event 3 type	XC	CH1 ⋮ CH64	1FAC ⋮ 1FEB	8108 ⋮ 8171	7	R/W	C	0: None 1: Deviation high (Using SV monitor value) [1] 2: Deviation low (Using SV monitor value) [1] 3: Deviation high/low (Using SV monitor value) [1] 4: Band (Using SV monitor value) [1] 5: Process high [1] 6: Process low [1] 7: SV high 8: SV low 9: Temperature rise completion 10: MV high [heat-side] [1, 2] 11: MV low [heat-side] [1, 2] 12: MV high [cool-side] [1] 13: MV low [cool-side] [1] 14: Deviation high (Using local SV value) [1] 15: Deviation low (Using local SV value) [1] 16: Deviation high/low (Using local SV value) [1] 17: Band (Using local SV value) [1] 18: Deviation between channels high [1] 19: Deviation between channels low [1] 20: Deviation between channels high/low [1] 21: Deviation between channels band [1] [1] Event hold action is available. [2] If there is Feedback resistance (FBR) input in Position proportioning control, set to the Feedback resistance (FBR) input value.	Based on model code When not specifying: 0
112	Event 3 channel setting	FC	CH1 ⋮ CH64	1FEC ⋮ 202B	8172 ⋮ 8235	1	R/W	C	1: Channel 1 3: Channel 3 2: Channel 2 4: Channel 4 This function is validated when "Deviation between channels"is selected.	1
113	Event 3 hold action	WC	CH1 ⋮ CH64	202C ⋮ 206B	8236 ⋮ 8299	1	R/W	C	0: OFF 1: Hold action ON (when power turned on; when transferred from STOP to RUN) 2: Re-hold action ON (when power turned on; when transferred from STOP to RUN; SV changed) This function is validated when input value, deviation or manipulated value action has been selected. In case of a deviation action, this function is not available while in Remote mode and while Setting changing rate limiter is working.	Based on model code When not specifying: 0
114	Event 3 interlock	LH	CH1 ⋮ CH64	206C ⋮ 20AB	8300 ⋮ 8363	1	R/W	C	0: Unused 1: Used	0
115	Event 3 differential gap	HC	CH1 ⋮ CH64	20AC ⋮ 20EB	8364 ⋮ 8427	7	R/W	C	① Deviation, Process, Set value, Deviation action between channels, or Temperature rise completion: 0 to Input span (Unit: °C [°F]) ② MV: 0.0 to 110.0 %	①: 1 ②: 1.0
116	Event 3 delay timer	TE	CH1 ⋮ CH64	20EC ⋮ 212B	8428 ⋮ 8491	7	R/W	C	0 to 18000 seconds If Event 3 corresponds to "9: Temperature rise completion," the Event 3 delay timer becomes the Temperature rise completion soak time.	0

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No.	Name	Iden-tifier	Chan-nel	Register address HEX	Register address DEC	Digits	Attri-bute	Struc-ture	Data range	Factory set value
117	Force ON of Event 3 action	OC	CH1 ⋮ CH64	212C ⋮ 216B	8492 ⋮ 8555	7	R/W	C	• RKC communication Least significant digit: Event output turned on at input error occurrence 2nd digit: Event output turned on in Manual mode 3rd digit: Event output turned on during the Autotuning (AT) function is being executed 4th digit: Event output turned on during the Setting change rate limiter is being operated 5th digit to Most significant digit: Unused Data 0: Invalidate 1: Validate • Modbus Bit data Bit 0: Event output turned on at input error occurrence Bit 1: Event output turned on in Manual mode Bit 2: Event output turned on during the Autotuning (AT) function is being executed Bit 3: Event output turned on during the Setting change rate limiter is being operated Bit 4 to Bit 15: Unused Data 0: Invalidate 1: Validate [Decimal number: 0 to 15]	0
118	Event 4 type	XD	CH1 ⋮ CH64	216C ⋮ 21AB	8556 ⋮ 8619	7	R/W	C	0: None 1: Deviation high (Using SV monitor value) [1] 2: Deviation low (Using SV monitor value) [1] 3: Deviation high/low (Using SV monitor value) [1] 4: Band (Using SV monitor value) [1] 5: Process high [1] 6: Process low [1] 7: SV high 8: SV low 9: Control loop break alarm (LBA) 10: MV high [heat-side] [1, 2] 11: MV low [heat-side] [1, 2] 12: MV high [cool-side] [1] 13: MV low [cool-side] [1] 14: Deviation high (Using local SV value) [1] 15: Deviation low (Using local SV value) [1] 16: Deviation high/low (Using local SV value) [1] 17: Band (Using local SV value) [1] 18: Deviation between channels high [1] 19: Deviation between channels low [1] 20: Deviation between channels high/low [1] 21: Deviation between channels band [1] [1] Event hold action is available. [2] If there is Feedback resistance (FBR) input in Position proportioning control, set to the Feedback resistance (FBR) input value.	Based on model code When not specifying: 0

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No.	Name	Iden-tifier	Chan-nel	Register address HEX	Register address DEC	Digits	Attri-bute	Struc-ture	Data range	Factory set value
119	Event 4 channel setting	FD	CH1 ⋮ CH64	21AC ⋮ 21EB	8620 ⋮ 8683	1	R/W	C	1: Channel 1 3: Channel 3 2: Channel 2 4: Channel 4 This function is validated when "Deviation between channels"is selected.	1
120	Event 4 hold action	WD	CH1 ⋮ CH64	21EC ⋮ 222B	8684 ⋮ 8747	1	R/W	C	0: OFF 1: Hold action ON (when power turned on; when transferred from STOP to RUN) 2: Re-hold action ON (when power turned on; when transferred from STOP to RUN; SV changed) This function is validated when input value, deviation or manipulated value action has been selected. In case of a deviation action, this function is not available while in Remote mode and while Setting changing rate limiter is working.	Based on model code When not specifying: 0
121	Event 4 interlock	LI	CH1 ⋮ CH64	222C ⋮ 226B	8748 ⋮ 8811	1	R/W	C	0: Unused 1: Used	0
122	Event 4 differential gap	HD	CH1 ⋮ CH64	226C ⋮ 22AB	8812 ⋮ 8875	7	R/W	C	① Deviation, Process, Set value, or Deviation action between channels: 0 to Input span (Unit: °C [°F]) ② MV: 0.0 to 110.0 % Becomes invalidate when the Event 4 type corresponds to "9: Control loop break alarm (LBA)."	①: 1 ②: 1.0
123	Event 4 delay timer	TF	CH1 ⋮ CH64	22AC ⋮ 22EB	8876 ⋮ 8939	7	R/W	C	0 to 18000 seconds	0
124	Force ON of Event 4 action	OD	CH1 ⋮ CH64	22EC ⋮ 232B	8940 ⋮ 9003	7	R/W	C	• RKC communication Least significant digit: Event output turned on at input error occurrence 2nd digit: Event output turned on in Manual mode 3rd digit: Event output turned on during the Autotuning (AT) function is being executed 4th digit: Event output turned on during the Setting change rate limiter is being operated 5th digit to Most significant digit: Unused Data 0: Invalidate 1: Validate • Modbus Bit data Bit 0: Event output turned on at input error occurrence Bit 1: Event output turned on in Manual mode Bit 2: Event output turned on during the Autotuning (AT) function is being executed Bit 3: Event output turned on during the Setting change rate limiter is being operated Bit 4 to Bit 15: Unused Data 0: Invalidate 1: Validate [Decimal number: 0 to 15]	0

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No.	Name	Iden-tifier	Chan-nel	Register address HEX	Register address DEC	Digits	Attri-bute	Struc-ture	Data range	Factory set value
125	CT ratio	XS	CH1 ⋮ CH64	232C ⋮ 236B	9004 ⋮ 9067	7	R/W	C	0 to 9999	CTL-6-P-N: 800 CTL-12-S56-10L-N: 1000
126	CT assignment	ZF	CH1 ⋮ CH64	236C ⋮ 23AB	9068 ⋮ 9131	1	R/W	C	0: None 1: OUT1 2: OUT2 3: OUT3 4: OUT4	1
127	Heater break alarm (HBA) type	ND	CH1 ⋮ CH64	23AC ⋮ 23EB	9132 ⋮ 9195	1	R/W	C	0: Heater break alarm (HBA) type A (Time-proportional control output) 1: Heater break alarm (HBA) type B (Continuous control output)	Based on model code
128	Number of heater break alarm (HBA) delay times	DH	CH1 ⋮ CH64	23EC ⋮ 242B	9196 ⋮ 9259	7	R/W	C	0 to 255 times	5
129	Hot/Cold start	XN	CH1 ⋮ CH64	242C ⋮ 246B	9260 ⋮ 9323	1	R/W	C	0: Hot start 1 1: Hot start 2 2: Cold start	0
130	Start determination point	SX	CH1 ⋮ CH64	246C ⋮ 24AB	9324 ⋮ 9387	7	R/W	C	0 to Input span (The unit is the same as input value.) (0: Action depending on the Hot/Cold start selection)	Based on specification
131	SV tracking	XL	CH1 ⋮ CH64	24AC ⋮ 24EB	9388 ⋮ 9451	1	R/W	C	0: Unused 1: Used	1
132	MV transfer function [Action taken when changed to Manual mode from Auto mode]	OT	CH1 ⋮ CH64	24EC ⋮ 252B	9452 ⋮ 9515	1	R/W	C	0: MV in Auto mode is used. [Balanceless-bumpless function] 1: MV in previous Manual mode is used.	0
133	Control action	XE	CH1 ⋮ CH64	252C ⋮ 256B	9516 ⋮ 9579	1	R/W	C	0: Brilliant II PID control (Direct action) 1: Brilliant II PID control (Reverse action) 2: Brilliant II Heat/Cool PID control [Water cooling type] 3: Brilliant II Heat/Cool PID control [Air cooling type] 4: Brilliant II Heat/Cool PID control [Cooling gain linear type] 5: Position proportioning control Odd channel: From 0 to 5 can be set. Even channel: Only 0 or 1 can be set. * * In Heat/Cool PID control and Position proportioning control, control action is not performed. Only PV monitor and event action is performed.	Based on model code When not specifying: 1
134	Integral/Derivative time decimal point position ♣	PK	CH1 ⋮ CH64	256C ⋮ 25AB	9580 ⋮ 9643	1	R/W	C	0: 1 second setting (No decimal place) 1: 0.1 seconds setting (One decimal place)	0
135	Derivative action ♣	KA	CH1 ⋮ CH64	25AC ⋮ 25EB	9644 ⋮ 9707	1	R/W	C	0: Measured value derivative 1: Deviation derivative	0

♣ Parameters only used for Heat/Cool PID control or position proportioning control, therefore data for CH2 and CH4 of Z-TIO modules are unused.

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No.	Name	Iden-tifier	Chan-nel	Register address HEX	Register address DEC	Digits	Attri-bute	Struc-ture	Data range	Factory set value
136	Undershoot suppression factor ♣	KB	CH1 ⋮ CH64	25EC ⋮ 262B	9708 ⋮ 9771	7	R/W	C	0.000 to 1.000	Water cooling: 0.100 Air cooling: 0.250 Cooling gain linear type: 1.000
137	Derivative gain ♣	DG	CH1 ⋮ CH64	262C ⋮ 266B	9772 ⋮ 9835	7	R/W	C	0.1 to 10.0	6.0
138	ON/OFF action differential gap (upper) ♣	IV	CH1 ⋮ CH64	266C ⋮ 26AB	9836 ⋮ 9899	7	R/W	C	TC/RTD inputs: 0 to Input span (Unit: °C [°F]) Voltage (V)/Current (I) inputs: 0.0 to 100.0 % of input span	TC/RTD: 1 V/I: 0.1
139	ON/OFF action differential gap (lower) ♣	IW	CH1 ⋮ CH64	26AC ⋮ 26EB	9900 ⋮ 9963	7	R/W	C		TC/RTD: 1 V/I: 0.1
140	Action (high) at input error ♣	WH	CH1 ⋮ CH64	26EC ⋮ 272B	9964 ⋮ 10027	1	R/W	C	0: Normal control 1: Manipulated output value at Input error	0
141	Action (low) at input error ♣	WL	CH1 ⋮ CH64	272C ⋮ 276B	10028 ⋮ 10091	1	R/W	C		0
142	Manipulated output value at input error ♣	OE	CH1 ⋮ CH64	276C ⋮ 27AB	10092 ⋮ 10155	7	R/W	C	−105.0 to +105.0 % Actual output values become those restricted by the output limiter. Position proportioning control: If there is no Feedback resistance (FBR) input or the Feedback resistance (FBR) input is disconnected, an action taken when abnormal is in accordance with the value action setting during STOP.	0.0
143	Manipulated output value at STOP mode [heat-side] ♣	OF	CH1 ⋮ CH64	27AC ⋮ 27EB	10156 ⋮ 10219	7	R/W	C	−5.0 to +105.0 % Position proportioning control: Only when there is Feedback resistance (FBR) input and it does not break, the Manipulated output value [heat-side] at STOP is output.	−5.0
144	Manipulated output value at STOP mode [cool-side] ♣	OG	CH1 ⋮ CH64	27EC ⋮ 282B	10220 ⋮ 10283	7	R/W	C		−5.0
145	Output change rate limiter (up) [heat-side] ♣	PH	CH1 ⋮ CH64	282C ⋮ 286B	10284 ⋮ 10347	7	R/W	C	0.0 to 100.0 %/seconds (0.0: OFF) Becomes invalidate when in Position proportioning control.	0.0
146	Output change rate limiter (down) [heat-side] ♣	PL	CH1 ⋮ CH64	286C ⋮ 28AB	10348 ⋮ 10411	7	R/W	C		0.0
147	Output limiter high [heat-side] ♣	OH	CH1 ⋮ CH64	28AC ⋮ 28EB	10412 ⋮ 10475	7	R/W	C	Output limiter low to 105.0 % Position proportioning control: Becomes validate only when there is Feedback resistance (FBR) input and it does not break.	105.0
148	Output limiter low [heat-side] ♣	OL	CH1 ⋮ CH64	28EC ⋮ 292B	10476 ⋮ 10539	7	R/W	C	−5.0 % to Output limiter high Position proportioning control: Becomes validate only when there is Feedback resistance (FBR) input and it does not break.	−5.0

♣ Parameters only used for Heat/Cool PID control or position proportioning control, therefore data for CH2 and CH4 of Z-TIO modules are unused.

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No.	Name	Iden-tifier	Chan-nel	Register address HEX	Register address DEC	Digits	Attri-bute	Struc-ture	Data range	Factory set value
149	Output change rate limiter (up) [cool-side] ♣	PX	CH1 ⋮ CH64	292C ⋮ 296B	10540 ⋮ 10603	7	R/W	C	0.0 to 100.0 %/seconds (0.0: OFF) Becomes invalidate when in Position proportioning control.	0.0
150	Output change rate limiter (down) [cool-side] ♣	PY	CH1 ⋮ CH64	296C ⋮ 29AB	10604 ⋮ 10667	7	R/W	C		0.0
151	Output limiter high [cool-side] ♣	OX	CH1 ⋮ CH64	29AC ⋮ 29EB	10668 ⋮ 10731	7	R/W	C	Output limiter low [cool-side] to 105.0 %	105.0
152	Output limiter low [cool-side] ♣	OY	CH1 ⋮ CH64	29EC ⋮ 2A2B	10732 ⋮ 10795	7	R/W	C	−5.0 % to Output limiter high [cool-side]	−5.0
153	AT bias ♣	GB	CH1 ⋮ CH64	2A2C ⋮ 2A6B	10796 ⋮ 10859	7	R/W	C	−Input span to +Input span	0
154	AT cycles ♣	G3	CH1 ⋮ CH64	2A6C ⋮ 2AAB	10860 ⋮ 10923	1	R/W	C	0: 1.5 cycles 1: 2.0 cycles 2: 2.5 cycles 3: 3.0 cycles	1
155	Output value with AT turned on ♣	OP	CH1 ⋮ CH64	2AAC ⋮ 2AEB	10924 ⋮ 10987	7	R/W	C	Output value with AT turned off to +105.0 % Actual output values become those restricted by the output limiter. Position proportioning control: Becomes validate only when there is Feedback resistance (FBR) input and it does not break (high limit of feedback resistance input at AT).	105.0
156	Output value with AT turned off ♣	OQ	CH1 ⋮ CH64	2AEC ⋮ 2B2B	10988 ⋮ 11051	7	R/W	C	−105.0 % to Output value with AT turned on Actual output values become those restricted by the output limiter. Position proportioning control: Becomes validate only when there is Feedback resistance (FBR) input and it does not break (low limit of feedback resistance input at AT).	−105.0
157	AT differential gap time ♣	GH	CH1 ⋮ CH64	2B2C ⋮ 2B6B	11052 ⋮ 11115	7	R/W	C	0.0 to 50.0 seconds	10.0
158	Proportional band adjusting factor [heat-side] ♣	KC	CH1 ⋮ CH64	2B6C ⋮ 2BAB	11116 ⋮ 11179	7	R/W	C	0.01 to 10.00 times	1.00
159	Integral time adjusting factor [heat-side] ♣	KD	CH1 ⋮ CH64	2BAC ⋮ 2BEB	11180 ⋮ 11243	7	R/W	C	0.01 to 10.00 times	1.00
160	Derivative time adjusting factor [heat-side] ♣	KE	CH1 ⋮ CH64	2BEC ⋮ 2C2B	11244 ⋮ 11307	7	R/W	C	0.01 to 10.00 times	1.00
161	Proportional band adjusting factor [cool-side] ♣	KF	CH1 ⋮ CH64	2C2C ⋮ 2C6B	11308 ⋮ 11371	7	R/W	C	0.01 to 10.00 times	1.00

♣ Parameters only used for Heat/Cool PID control or position proportioning control, therefore data for CH2 and CH4 of Z-TIO modules are unused.

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No.	Name	Iden-tifier	Chan-nel	Register address HEX	Register address DEC	Digits	Attri-bute	Struc-ture	Data range	Factory set value
162	Integral time adjusting factor [cool-side] ♣	KG	CH1 ⋮ CH64	2C6C ⋮ 2CAB	11372 ⋮ 11435	7	R/W	C	0.01 to 10.00 times	1.00
163	Derivative time adjusting factor [cool-side] ♣	KH	CH1 ⋮ CH64	2CAC ⋮ 2CEB	11436 ⋮ 11499	7	R/W	C	0.01 to 10.00 times	1.00
164	Proportional band limiter (high) [heat-side] ♣	P6	CH1 ⋮ CH64	2CEC ⋮ 2D2B	11500 ⋮ 11563	7	R/W	C	TC/RTD inputs: 0 (0.0) to Input span (Unit: °C [°F]) Varies with the setting of the Decimal point position selection. Voltage (V)/Current (I) inputs: 0.0 to 1000.0 % of input span 0 (0.0): ON/OFF action (ON/OFF action for both heat and cool actions in case of a Heat/Cool PID control type.)	TC/RTD: Input span V/I: 1000.0
165	Proportional band limiter (low) [heat-side] ♣	P7	CH1 ⋮ CH64	2D2C ⋮ 2D6B	11564 ⋮ 11627	7	R/W	C		TC/RTD: 0 (0.0) V/I: 0.0
166	Integral time limiter (high) [heat-side] ♣	I6	CH1 ⋮ CH64	2D6C ⋮ 2DAB	11628 ⋮ 11691	7	R/W	C	PID control or Heat/Cool PID control: 0 to 3600 seconds or 0.0 to 1999.9 seconds Position proportioning control: 1 to 3600 seconds or 0.1 to 1999.9 seconds Varies with the setting of the Integral/Derivative time decimal point position selection.	3600
167	Integral time limiter (low) [heat-side] ♣	I7	CH1 ⋮ CH64	2DAC ⋮ 2DEB	11692 ⋮ 11755	7	R/W	C		PID control, Heat/Cool PID control: 0 Position proportioning control: 1
168	Derivative time limiter (high) [heat-side] ♣	D6	CH1 ⋮ CH64	2DEC ⋮ 2E2B	11756 ⋮ 11819	7	R/W	C	0 to 3600 seconds or 0.0 to 1999.9 seconds Varies with the setting of the Integral/Derivative time decimal point position selection.	3600
169	Derivative time limiter (low) [heat-side] ♣	D7	CH1 ⋮ CH64	2E2C ⋮ 2E6B	11820 ⋮ 11883	7	R/W	C		0
170	Proportional band limiter (high) [cool-side] ♣	P8	CH1 ⋮ CH64	2E6C ⋮ 2EAB	11884 ⋮ 11947	7	R/W	C	TC/RTD inputs: 1(1.0) to Input span (Unit: °C [°F]) Varies with the setting of the Decimal point position selection. Voltage (V)/Current (I) inputs: 0.1 to 1000.0 % of input span	TC/RTD: Input span V/I: 1000.0
171	Proportional band limiter (low) [cool-side] ♣	P9	CH1 ⋮ CH64	2EAC ⋮ 2EEB	11948 ⋮ 12011	7	R/W	C		TC/RTD: 1 (0.1) V/I: 0.1
172	Integral time limiter (high) [cool-side] ♣	I8	CH1 ⋮ CH64	2EEC ⋮ 2F2B	12012 ⋮ 12075	7	R/W	C	0 to 3600 seconds or 0.0 to 1999.9 seconds Varies with the setting of the Integral/Derivative time decimal point position selection. If control is other than Heat/Cool PID control, set to RO (Only reading data is possible).	3600
173	Integral time limiter (low) [cool-side] ♣	I9	CH1 ⋮ CH64	2F2C ⋮ 2F6B	12076 ⋮ 12139	7	R/W	C		0
174	Derivative time limiter (high) [cool-side] ♣	D8	CH1 ⋮ CH64	2F6C ⋮ 2FAB	12140 ⋮ 12203	7	R/W	C	0 to 3600 seconds or 0.0 to 1999.9 seconds Varies with the setting of the Integral/Derivative time decimal point position selection. If control is other than Heat/Cool PID control, set to RO (Only reading data is possible).	3600
175	Derivative time limiter (low) [cool-side] ♣	D9	CH1 ⋮ CH64	2FAC ⋮ 2FEB	12204 ⋮ 12267	7	R/W	C		0

♣ Parameters only used for Heat/Cool PID control or position proportioning control, therefore data for CH2 and CH4 of Z-TIO modules are unused.

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No.	Name	Iden-tifier	Chan-nel	Register address HEX	Register address DEC	Digits	Attri-bute	Struc-ture	Data range	Factory set value
176	Open/Close output neutral zone ♣	V2	CH1 ⋮ CH64	2FEC ⋮ 301C	12268 ⋮ 12331	7	R/W	C	0.1 to 10.0 %	2.0
177	Action at feedback resistance (FBR) input error ♣	SY	CH1 ⋮ CH64	302C ⋮ 306B	12332 ⋮ 12395	1	R/W	C	0: Action depending on the valve action at STOP 1: Control action continued	0
178	Feedback adjustment ♣	FV	CH1 ⋮ CH64	306C ⋮ 30AB	12396 ⋮ 12459	1	R/W	C	0: Adjustment end 1: During adjustment on the open-side 2: During adjustment on the close-side	—
179	Control motor time ♣	TN	CH1 ⋮ CH64	30AC ⋮ 30EB	12460 ⋮ 12523	7	R/W	C	5 to 1000 seconds	10
180	Integrated output limiter ♣	OI	CH1 ⋮ CH64	30EC ⋮ 312B	12524 ⋮ 12587	7	R/W	C	0.0 to 200.0 % of control motor time (0.0: OFF) Becomes invalidate when there is Feedbac resistance (FBR) input.	150.0
181	Valve action at STOP ♣	VS	CH1 ⋮ CH64	312C ⋮ 316B	12588 ⋮ 12651	1	R/W	C	0: Close-side output OFF, Open-side output OFF 1: Close-side output ON, Open-side output OFF 2: Close-side output OFF, Open-side output ON Becomes validate when there is no Feedback resistance (FBR) input or the Feedback resistance (FBR) input is disconnected.	0
182	ST proportional band adjusting factor ♣	KI	CH1 ⋮ CH64	316C ⋮ 31AB	12652 ⋮ 12715	7	R/W	C	0.01 to 10.00 times	1.00
183	ST integral time adjusting factor ♣	KJ	CH1 ⋮ CH64	31AC ⋮ 31EB	12716 ⋮ 12779	7	R/W	C	0.01 to 10.00 times	1.00
184	ST derivative time adjusting factor ♣	KK	CH1 ⋮ CH64	31EC ⋮ 322B	12780 ⋮ 12843	7	R/W	C	0.01 to 10.00 times	1.00
185	ST start condition ♣	SU	CH1 ⋮ CH64	322C ⋮ 326B	12844 ⋮ 12907	1	R/W	C	0: Activate the Startup tuning (ST) function when the power is turned on; when transferred from STOP to RUN; or when the Set value (SV) is changed. 1: Activate the Startup tuning (ST) function when the power is turned on; or when transferred from STOP to RUN. 2: Activate the Startup tuning (ST) function when the Set value (SV) is changed.	0
186	Automatic temperature rise group ♣	Y7	CH1 ⋮ CH64	326C ⋮ 32AB	12908 ⋮ 12971	7	R/W	C	0 to 16 (0: Automatic temperature rise function OFF)	0
187	Automatic temperature rise dead time ♣	RT	CH1 ⋮ CH64	32AC ⋮ 32EB	12972 ⋮ 13035	7	R/W	C	0.1 to 1999.9 seconds	10.0
188	Automatic temperature rise gradient data ♣	R2	CH1 ⋮ CH64	32EC ⋮ 332B	13036 ⋮ 13099	7	R/W	C	0.1 to Input span/minutes Varies with the setting of the Decimal point position selection.	1.0

♣ Parameters only used for Heat/Cool PID control or position proportioning control, therefore data for CH2 and CH4 of Z-TIO modules are unused.

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No.	Name	Iden-tifier	Chan-nel	Register address HEX	Register address DEC	Digits	Attri-bute	Struc-ture	Data range	Factory set value
189	EDS transfer time decimal point position ♣	NS	CH1 ⋮ CH64	332C ⋮ 336B	13100 ⋮ 13163	1	R/W	C	0: 1 second setting (No decimal place) 1: 0.1 seconds setting (One decimal place)	0
190	Output average processing time for EDS ♣	NV	CH1 ⋮ CH64	336C ⋮ 33AB	13164 ⋮ 13227	7	R/W	C	0.1 to 200.0 seconds	1.0
191	Responsive action trigger point for EDS ♣	NW	CH1 ⋮ CH64	33AC ⋮ 33EB	13228 ⋮ 13291	7	R/W	C	TC/RTD inputs: 0 (0.0) to Input span (Unit: °C [°F]) Varies with the setting of the Decimal point position selection. Voltage (V)/Current (I) inputs: 0.0 to Input span (Unit: %)	TC/RTD: 1 (1.0) V/I: 1.0
192	Setting change rate limiter unit time	HU	CH1 ⋮ CH64	33EC ⋮ 342B	13292 ⋮ 13355	7	R/W	C	1 to 3600 seconds	60
193	Soak time unit	RU	CH1 ⋮ CH64	342C ⋮ 346B	13356 ⋮ 13419	7	R/W	C	• RKC communication 0: 0:00 to 99:59 (hrs:min) [0 hours 00 minutes to 99 hours 59 minutes] 1: 0:00 to 199:59 (min:sec) [0 minutes 00 seconds to 199 minutes 59 seconds] • Modbus 0: 0 to 5999 minutes [0 hours 00 minutes to 99 hours 59 minutes] 1: 0 to 11999 seconds [0 minutes 00 seconds to 199 minutes 59 seconds] Set the data range of Memory area soak time monitor and Area soak time.	1
194	Setting limiter high	SH	CH1 ⋮ CH64	346C ⋮ 34AB	13420 ⋮ 13483	7	R/W	C	Setting limiter low to Input scale high	Input scale high
195	Setting limiter low	SL	CH1 ⋮ CH64	34AC ⋮ 34EB	13484 ⋮ 13547	7	R/W	C	Input scale low to Setting limiter high	Input scale low
196	PV transfer function ♣	TS	CH1 ⋮ CH64	34EC ⋮ 352B	13548 ⋮ 13611	1	R/W	C	0: Unused 1: Used	0
197	Operation mode assignment 1 (Logic output selection function) Logic output 1 to 4	EA	CH1 ⋮ CH64	352C ⋮ 356B	13612 ⋮ 13675	7	R/W	C	0: No assignment 1: Operation mode (monitor, control) 2: Operation mode (monitor, event function, control) 3: Auto/Manual 4: Remote/Local 5: Unused (Do not set this one)	0
198	Operation mode assignment 2 (Logic output selection function) Logic output 5 to 8	EB	CH1 ⋮ CH64	356C ⋮ 35AB	13676 ⋮ 13739	7	R/W	C	0: No assignment 1: Operation mode (monitor, control) 2: Operation mode (monitor, event function, control) 3: Auto/Manual 4: Remote/Local 5: Unused (Do not set this one)	0

♣ Parameters only used for Heat/Cool PID control or position proportioning control, therefore data for CH2 and CH4 of Z-TIO modules are unused.

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No.	Name	Iden-tifier	Chan-nel	Register address HEX	Register address DEC	Digits	Attri-bute	Struc-ture	Data range	Factory set value
199	SV select function	KM	CH1 ⋮ CH64	35AC ⋮ 35EB	13740 ⋮ 13803	1	R/W	C	0: Remote SV function 1: Cascade control function 2: Ratio setting function 3: Cascade control 2 function	0
200	Remote SV function master channel module address	MC	CH1 ⋮ CH64	35EC ⋮ 362B	13804 ⋮ 13867	7	R/W	C	−1 (Master channel is selected from itself) 0 to 99 (Master channel is selected from other modules)	−1
201	Remote SV function master channel selection	MN	CH1 ⋮ CH64	362C ⋮ 366B	13868 ⋮ 13931	7	R/W	C	1 to 99	1
202	Output distribution master channel module address	DY	CH1 ⋮ CH64	366C ⋮ 36AB	13932 ⋮ 13995	7	R/W	C	−1 (Master channel is selected from itself) 0 to 99 (Master channel is selected from other modules)	−1
203	Output distribution master channel selection	DZ	CH1 ⋮ CH64	36AC ⋮ 36EB	13996 ⋮ 14059	7	R/W	C	1 to 99	1
204	Address of interacting modules	RL	CH1 ⋮ CH64	36EC ⋮ 372B	14060 ⋮ 14123	7	R/W	C	−1 (Interact with its own module address) 0 to 99 (Interact with the addresses of other modules)	−1
205	Channel selection of interacting modules	RM	CH1 ⋮ CH64	372C ⋮ 376B	14124 ⋮ 14187	7	R/W	C	1 to 99 Becomes validate when the selected module is “Z-TIO module.”	1
206	Selection switch of interacting modules	RN	CH1 ⋮ CH64	376C ⋮ 37AB	14188 ⋮ 14251	7	R/W	C	• RKC communication Least significant digit: Memory area number 2nd digit: Operation mode 3rd digit: Auto/Manual 4th digit: Remote/Local 5th digit EDS start signal 6th digit Interlock release Most significant digit: Suspension of area soak time Data 0: No interaction 1: Interact with other channels • Modbus Bit data Bit 0: Memory area number Bit 1: Operation mode Bit 2: Auto/Manual Bit 3: Remote/Local Bit 4: EDS start signal Bit 5: Interlock release Bit 6: Suspension of area soak time Bit 7 to Bit 15: Unused Data 0: No interaction 1: Interact with other channels [Decimal number: 0 to 127]	0
207	TIO Interval time	VG	CH1 ⋮ CH16	37AC ⋮ 37BB	14252 ⋮ 14267	7	R/W	M	0 to 250 ms	10
208	Unused	—	—	37BC ⋮ 386B	14268 ⋮ 14443	—	—	—	—	—

9.4 Memory Area Data Address of Z-TIO Module

The register addresses, 386CH to 3DABH are used for checking and changing each set value belonging to the memory area.

No.	Name	Chan-nel	Register address		Attri-bute	Struc-ture	Data range	Factory set value
			HEX	DEC				
1	Setting memory area number	CH1 ⋮ CH64	386C ⋮ 38AB	14444 ⋮ 14507	R/W	C	1 to 8	1
2	Event 1 set value (EV1)	CH1 ⋮ CH64	38AC ⋮ 38EB	14508 ⋮ 14571	R/W	C	Deviation action, Deviation action between channels, Temperatue rise completion range: –Input span to +Input span Process action, SV action: Input scale low to Input scale high MV action: –5.0 to +105.0 %	50
3	Event 2 set value (EV2)	CH1 ⋮ CH64	38EC ⋮ 392B	14572 ⋮ 14635	R/W	C		50
4	Event 3 set value (EV3)	CH1 ⋮ CH64	392C ⋮ 396B	14636 ⋮ 14699	R/W	C		50
5	Event 4 set value (EV4)	CH1 ⋮ CH64	396C ⋮ 39AB	14700 ⋮ 14763	R/W	C		50
6	Control loop break alarm (LBA) time	CH1 ⋮ CH64	39AC ⋮ 39EB	14764 ⋮ 14827	R/W	C	0 to 7200 seconds (0: Unused)	480
7	LBA deadband	CH1 ⋮ CH64	39EC ⋮ 3A2B	14828 ⋮ 14791	R/W	C	0 (0.0) to Input span	0 (0.0)
8	Set value (SV)	CH1 ⋮ CH64	3A2C ⋮ 3A6B	14892 ⋮ 14955	R/W	C	Setting limiter low to Setting limiter high	TC/RTD: 0 V/I: 0.0
9	Proportional band [heat-side]	CH1 ⋮ CH64	3A6C ⋮ 3AAB	14956 ⋮ 15019	R/W	C	TC/RTD inputs: 0 (0.0) to Input span (Unit: °C [°F]) Voltage (V)/Current (I) inputs: 0.0 to 1000.0 % of input span 0 (0.0): ON/OFF action (ON/OFF action for both heat and cool actions in case of a Heat/Cool PID control type.)	TC/RTD: 30 (30.0) V/I: 30.0
10	Integral time [heat-side]	CH1 ⋮ CH64	3AAC ⋮ 3AEB	15020 ⋮ 15083	R/W	C	PID control or Heat/Cool PID control: 0 to 3600 seconds or 0.0 to 1999.9 seconds (0, 0.0: PD action) Position proportioning control: 1 to 3600 seconds or 0.1 to 1999.9 seconds	240
11	Derivative time [heat-side]	CH1 ⋮ CH64	3AEC ⋮ 3B2B	15084 ⋮ 15147	R/W	C	0 to 3600 seconds or 0.0 to 1999.9 seconds (0, 0.0: PI action)	60
12	Control response parameter	CH1 ⋮ CH64	3B2C ⋮ 3B6B	15148 ⋮ 15211	R/W	C	0: Slow 1: Medium 2: Fast When the P or PD action is selected, this setting becomes invalidates.	PID control, Position proportioning control: 0 Heat/Cool PID control: 2
13	Proportional band [cool-side]	CH1 ⋮ CH64	3B6C ⋮ 3BAB	15212 ⋮ 15275	R/W	C	TC/RTD inputs: 1 to Input span or 0.1 to Input span (Unit: °C [°F]) Voltage (V)/Current (I) inputs: 0.1 to 1000.0 % of input span	TC/RTD: 30 (30.0) V/I: 30.0
14	Integral time [cool-side]	CH1 ⋮ CH64	3BAC ⋮ 3BEB	15276 ⋮ 15339	R/W	C	0 to 3600 seconds or 0.0 to 1999.9 seconds (0, 0.0: PD action)	240

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No.	Name	Chan-nel	Register address		Attri-bute	Struc-ture	Data range	Factory set value
			HEX	DEC				
15	Derivative time [cool-side]	CH1 ⋮ CH64	3BEC ⋮ 3C2B	15340 ⋮ 15403	R/W	C	0 to 3600 seconds or 0.0 to 1999.9 seconds (0, 0.0: PI action)	60
16	Overlap/Deadband	CH1 ⋮ CH64	3C2C ⋮ 3C6B	15404 ⋮ 15467	R/W	C	TC/RTD inputs: −Input span to +Input span (Unit:°C [°F]) Voltage (V)/Current (I) inputs: −100.0 to +100.0 % of input span	0
17	Manual reset	CH1 ⋮ CH64	3C6C ⋮ 3CAB	15468 ⋮ 15531	R/W	C	−100.0 to +100.0 %	0.0
18	Setting change rate limiter (up)	CH1 ⋮ CH64	3CAC ⋮ 3CEB	15532 ⋮ 15595	R/W	C	0 (0.0) to Input span/unit time * 0 (0.0): Unused * Unit time: 60 seconds (factory set value)	0 (0.0)
19	Setting change rate limiter (down)	CH1 ⋮ CH64	3CEC ⋮ 3D2B	15596 ⋮ 15659	R/W	C		0 (0.0)
20	Area soak time	CH1 ⋮ CH64	3D2C ⋮ 3D6B	15660 ⋮ 15723	R/W	C	0 minutes 00 seconds to 199 minutes 59 seconds: 0 to 11999 seconds 0 hours 00 minutes to 99 hours 59 minutes: 0 to 5999 minutes	0
21	Link area number	CH1 ⋮ CH64	3D6C ⋮ 3DAB	15724 ⋮ 15787	R/W	C	0 to 8 (0: No link)	0
22	Unused	—	3DAC ⋮ 3E6B	15788 ⋮ 15979	—	—	—	—

9.5 Communication Data of Z-DIO Module

☞ For details of Z-DIO module communication data, refer to **SRZ Instruction Manual (IMS01T04-E□)**.

No.	Name	Identifier	Channel	Register address HEX	Register address DEC	Digits	Attribute	Structure	Data range	Factory set value
1	Digital input (DI) state 1	L1	CH1 : CH16	3E6C : 3E7B	15980 : 15995	7	RO	M	• RKC communication Least significant digit: DI1 2nd digit: DI2 3rd digit: DI3 4th digit: DI4 5th digit to Most significant digit: Unused Data 0: Contact open 1: Contact closed • Modbus Bit data Bit 0: DI1 Bit 1: DI2 Bit 2: DI3 Bit 3: DI4 Bit 4: DI5 Bit 5: DI6 Bit 6: DI7 Bit 7: DI8 Bit 8 to Bit 15: Unused Data 0: Contact open 1: Contact closed [Decimal number: 0 to 255]	—
2	Digital input (DI) state 2	L6	CH1 : CH16	—	—	7	RO	M	Least significant digit: DI5 2nd digit: DI6 3rd digit: DI7 4th digit: DI8 5th digit to Most significant digit: Unused Data 0: Contact open 1: Contact closed	—
3	Digital output (DO) state 1	Q2	CH1 : CH16	3E7C : 3E8B	15996 : 16011	7	RO	M	• RKC communication Least significant digit: DO1 2nd digit: DO2 3rd digit: DO3 4th digit: DO4 5th digit to Most significant digit: Unused Data 0: OFF 1: ON • Modbus Bit data Bit 0: DO1 Bit 1: DO2 Bit 2: DO3 Bit 3: DO4 Bit 4: DO5 Bit 5: DO6 Bit 6: DO7 Bit 7: DO8 Bit 8 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 255]	—
4	Digital output (DO) state 2	Q3	CH1 : CH16	—	—	7	RO	M	Least significant digit: DO5 2nd digit: DO6 3rd digit: DO7 4th digit: DO8 5th digit to Most significant digit: Unused Data 0: OFF 1: ON	—

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No.	Name	Iden-tifier	Chan-nel	Register address HEX	Register address DEC	Digits	Attri-bute	Struc-ture	Data range	Factory set value
5	Unused	—	—	3E8C ⋮ 3FDB	16012 ⋮ 16347	—	—	—	—	—
6	DO manual output 1	Q4	CH1 ⋮ CH16	3FDC ⋮ 3FEB	16348 ⋮ 16363	7	R/W	M	• RKC communication Least significant digit: DO1 manual output 2nd digit: DO2 manual output 3rd digit: DO3 manual output 4th digit: DO4 manual output 5th digit to Most significant digit: Unused Data 0: OFF 1: ON • Modbus Bit data Bit 0: DO1 manual output Bit 1: DO2 manual output Bit 2: DO3 manual output Bit 3: DO4 manual output Bit 4: DO5 manual output Bit 5: DO6 manual output Bit 6: DO7 manual output Bit 7: DO8 manual output Bit 8 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 255]	0
7	DO manual output 2	Q5	CH1 ⋮ CH16	—	—	7	R/W	M	Least significant digit: DO5 manual output 2nd digit: DO6 manual output 3rd digit: DO7 manual output 4th digit: DO8 manual output 5th digit to Most significant digit: Unused Data 0: OFF 1: ON	0
8	DO output distribution selection	DO	CH1 ⋮ CH128	3FEC ⋮ 406B	16364 ⋮ 16491	1	R/W	C	0: DO output 1: Distribution output	0
9	DO output distribution bias	O8	CH1 ⋮ CH128	406C ⋮ 40EB	16492 ⋮ 16619	7	R/W	C	−100.0 to +100.0 %	0.0
10	DO output distribution ratio	O9	CH1 ⋮ CH128	40EC ⋮ 416B	16620 ⋮ 16747	7	R/W	C	−9.999 to +9.999	1.000
11	DO proportional cycle time	V0	CH1 ⋮ CH128	416C ⋮ 41EB	16748 ⋮ 16875	7	R/W	C	0.1 to 100.0 seconds	Relay contact output: 20.0 Open collector output: 2.0
12	DO minimum ON/OFF time of proportioning cycle	VJ	CH1 ⋮ CH128	41EC ⋮ 426B	16876 ⋮ 17003	7	R/W	C	0 to 1000 ms	0
13	Unused	—	—	426C ⋮ 433B	17004 ⋮ 17211	—	—	—	—	—
Set data No. 14 or later are for engineering setting [Writable in the STOP mode]										
14	DI function assignment	H2	CH1 ⋮ CH16	433C ⋮ 434B	17212 ⋮ 17227	7	R/W	M	0 to 29 (Refer to **P. 69**.)	Based on model code. When not specifying: 0

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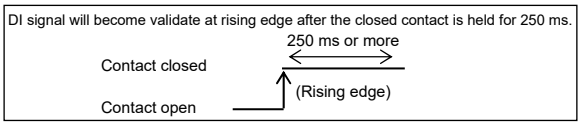
No.	Name	Iden-tifier	Chan-nel	Register address		Digits	Attri-bute	Struc-ture	Data range	Factory set value
				HEX	DEC					
15	Memory area setting signal	E1	CH1 ⋮ CH16	434C ⋮ 435B	17228 ⋮ 17243	1	R/W	M	0: Validate 1: Invalidate	1
16	DO signal assignment module address 1 [DO1 to DO4]	LQ	CH1 ⋮ CH16	435C ⋮ 436B	17244 ⋮ 17259	7	R/W	M	−1, 0 to 99 When "−1" is selected, all of the signals of the same type (except temperature rise completion and DO manual output value) are *OR*-operated and produced as outputs from DO.	−1
17	DO signal assignment module address 2 [DO5 to DO8]	LR	CH1 ⋮ CH16	436C ⋮ 437B	17260 ⋮ 17275	7	R/W	M	−1, 0 to 99 When "−1" is selected, all of the signals of the same type (except temperature rise completion and DO manual output value) are *OR*-operated and produced as outputs from DO.	−1
18	DO output assignment 1 [DO1 to DO4]	LT	CH1 ⋮ CH16	437C ⋮ 438B	17276 ⋮ 17291	7	R/W	M	0 to 13 (Refer to **P. 70**.)	Based on model code. When not specifying: 0
19	DO output assignment 2 [DO5 to DO8]	LX	CH1 ⋮ CH16	438C ⋮ 439B	17292 ⋮ 17307	7	R/W	M	0 to 13 (Refer to **P. 70**.)	Based on model code. When not specifying: 0
20	DO energized/de-energized	NB	CH1 ⋮ CH128	439C ⋮ 441B	17308 ⋮ 17435	7	R/W	C	0: Energized 1: De-energized	0
21	DO output distribution master channel module address	DD	CH1 ⋮ CH128	441C ⋮ 449B	17436 ⋮ 17563	7	R/W	C	−1 (Master channel is selected from itself) 0 to 99 (Master channel is selected from other modules)	−1
22	DO output distribution master channel selection	DJ	CH1 ⋮ CH128	449C ⋮ 451B	17564 ⋮ 17691	7	R/W	C	1 to 99	1
23	DO manipulated output value (MV) at STOP mode	OJ	CH1 ⋮ CH128	451C ⋮ 459B	17692 ⋮ 17819	7	R/W	C	−5.0 to +105.0 %	−5.0
24	DO output limiter (high)	D3	CH1 ⋮ CH128	459C ⋮ 461B	17820 ⋮ 17947	7	R/W	C	DO output limiter (low) to 105.0 %	105.0
25	DO output limiter (low)	D4	CH1 ⋮ CH128	461C ⋮ 469B	17948 ⋮ 18075	7	R/W	C	−5.0 % to DO output limiter (high)	−5.0
26	Z-DIO Interval time	VF	CH1 ⋮ CH16	469C ⋮ 46AB	18076 ⋮ 18091	7	R/W	M	0 to 250 ms	10
27	Unused	—	—	46AC ⋮ 46BB	18092 ⋮ 18107	—	—	—	—	—

Table 1: DI assignment table

<table>
<tr><th>Set value</th><th>DI1</th><th>DI2</th><th>DI3</th><th>DI4</th><th>DI5</th><th>DI6</th><th>DI7</th><th>DI8</th></tr>
<tr><td>0</td><td colspan="8">No assignment</td></tr>
<tr><td>1</td><td colspan="3" rowspan="25">Memory area transfer (1 to 8) [1]</td><td rowspan="25">Area set [2]</td><td colspan="2" rowspan="15">Operation mode [3]</td><td rowspan="5">Interlock release</td><td>AUTO/MAN [4]</td></tr>
<tr><td>2</td><td>REM/LOC [4]</td></tr>
<tr><td>3</td><td>EDS start signal 1</td></tr>
<tr><td>4</td><td>Soak stop</td></tr>
<tr><td>5</td><td>RUN/STOP [4]</td></tr>
<tr><td>6</td><td rowspan="4">AUTO/MAN [4]</td><td>REM/LOC [4]</td></tr>
<tr><td>7</td><td>EDS start signal 1</td></tr>
<tr><td>8</td><td>Soak stop</td></tr>
<tr><td>9</td><td>RUN/STOP [4]</td></tr>
<tr><td>10</td><td rowspan="3">REM/LOC [4]</td><td>EDS start signal 1</td></tr>
<tr><td>11</td><td>Soak stop</td></tr>
<tr><td>12</td><td>RUN/STOP [4]</td></tr>
<tr><td>13</td><td>EDS start signal 1</td><td>Soak stop</td></tr>
<tr><td>14</td><td rowspan="2">RUN/STOP [4]</td></tr>
<tr><td>15</td><td>Soak stop</td></tr>
<tr><td>16</td><td rowspan="7">Interlock release</td><td rowspan="7">AUTO/MAN [4]</td><td rowspan="3">REM/LOC [4]</td><td>EDS start signal 1</td></tr>
<tr><td>17</td><td>Soak stop</td></tr>
<tr><td>18</td><td>RUN/STOP [4]</td></tr>
<tr><td>19</td><td>EDS start signal 1</td><td>Soak stop</td></tr>
<tr><td>20</td><td rowspan="2">RUN/STOP [4]</td></tr>
<tr><td>21</td><td>Soak stop</td></tr>
<tr><td>22</td><td rowspan="3">AUTO/MAN</td><td rowspan="3">REM/LOC</td><td>EDS start signal 1</td><td>Soak stop</td></tr>
<tr><td>23</td><td rowspan="2">RUN/STOP [4]</td></tr>
<tr><td>24</td><td rowspan="2">Soak stop</td></tr>
<tr><td>25</td><td>REM/LOC</td><td>EDS start signal 1</td></tr>
<tr><td>26</td><td>Memory area transfer (1, 2) [1]</td><td>Area set [2]</td><td>Interlock release</td><td>RUN/STOP [4]</td><td>AUTO/MAN [4]</td><td>REM/LOC [4]</td><td colspan="2">Operation mode [3]</td></tr>
<tr><td>27</td><td colspan="3">Memory area transfer (1 to 8) [1]</td><td>Area set [2]</td><td colspan="2">Operation mode [3]</td><td rowspan="2">EDS start signal 1</td><td rowspan="2">EDS start signal 2</td></tr>
<tr><td>28</td><td>Memory area transfer (1, 2) [1]</td><td>Area set [2]</td><td rowspan="2">Interlock release</td><td rowspan="2">RUN/STOP [4]</td><td rowspan="2">AUTO/MAN [4]</td><td rowspan="2">REM/LOC [4]</td></tr>
<tr><td>29</td><td>EDS start signal 1</td><td>EDS start signal 2</td><td colspan="2">Operation mode [3]</td></tr>
</table>

RUN/STOP: RUN/STOP transfer (Contact closed: RUN)
AUTO/MAN: Auto/Manual transfer (Contact closed: Manual mode)
REM/LOC: Remote/Local transfer (Contact closed: Remote mode)
Interlock release (Interlock release when rising edge is detected)
EDS start signal 1 (EDS start signal ON when rising edge is detected [for disturbance 1])
EDS start signal 2 (EDS start signal ON when rising edge is detected [for disturbance 2])
Soak stop (Contact closed: Soak stop)



[1] Memory area transfer

(×:Contact open –: Contact closed)

	Memory area number							
	1	2	3	4	5	6	7	8
DI1	×	–	×	–	×	–	×	–
DI2	×	×	–	–	×	×	–	–
DI3	×	×	×	×	–	–	–	–

[2] Area set becomes invalidate prior to factory shipment.

[3] Operation mode transfer

(×:Contact open –: Contact closed)

	Operation mode			
	Unused	Monitor	Monitor + Event function	Control
DI5 (DI7)	×	–	×	–
DI6 (DI8)	×	×	–	–

[4] Actual device states (AUTO/MAN, REM/LOC, RUN/STOP)

	DI-switched state	Communication-switched state	Actual device state
Auto/Manual transfer [a] (AUTO/MAN)	Manual (Contact closed)	Manual → Auto	Manual mode
		Auto → Manual	
	Auto (Contact open)	Manual → Auto	Auto mode
		Auto → Manual	
Remote/Local transfer [a] (REM/LOC)	Remote (Contact closed)	Remote → Local	Remote mode
		Local → Remote	
	Local (Contact open)	Remote → Local	Local mode
		Local → Remote	
RUN/STOP [b]	RUN (Contact closed)	STOP → RUN	RUN
		RUN → STOP	STOP
	STOP (Contact open)	STOP → RUN	STOP

[a] Device state when AUTO/MAN or REM/LOC assigned to DI is set so that the Z-TIO module and Z-DIO module are linked using the Master-slave mode of the Z-TIO module.

[b] STOP of RUN/STOP switching is given priority regardless of communication or DI switching.

Table 2: DO assignment table

[DO1 to DO4]

Set value	DO1	DO2	DO3	DO4
0	No assignment			
1	DO1 manual output	DO2 manual output	DO3 manual output	DO4 manual output
2	Event 1 comprehensive output [1]	Event 2 comprehensive output [2]	Event 3 comprehensive output [3]	Event 4 comprehensive output [4]
3	Event 1 (CH1)	Event 2 (CH1)	Event 3 (CH1)	Event 4 (CH1)
4	Event 1 (CH2)	Event 2 (CH2)	Event 3 (CH2)	Event 4 (CH2)
5	Event 1 (CH3)	Event 2 (CH3)	Event 3 (CH3)	Event 4 (CH3)
6	Event 1 (CH4)	Event 2 (CH4)	Event 3 (CH4)	Event 4 (CH4)
7	Event 1 (CH1)	Event 1 (CH2)	Event 1 (CH3)	Event 1 (CH4)
8	Event 2 (CH1)	Event 2 (CH2)	Event 2 (CH3)	Event 2 (CH4)
9	Event 3 (CH1)	Event 3 (CH2)	Event 3 (CH3)	Event 3 (CH4)
10	Event 4 (CH1)	Event 4 (CH2)	Event 4 (CH3)	Event 4 (CH4)
11	HBA (CH1)	HBA (CH2)	HBA (CH3)	HBA (CH4)
12	Burnout status (CH1)	Burnout status (CH2)	Burnout status (CH3)	Burnout status (CH4)
13	Temperature rise completion [5]	HBA comprehensive output [6]	Burnout state comprehensive output [7]	DO4 manual output

[DO5 to DO8]

Set value	DO5	DO6	DO7	DO8
0	No assignment			
1	DO5 manual output	DO6 manual output	DO7 manual output	DO8 manual output
2	Event 1 comprehensive output [1]	Event 2 comprehensive output [2]	Event 3 comprehensive output [3]	Event 4 comprehensive output [4]
3	Event 1 (CH1)	Event 2 (CH1)	Event 3 (CH1)	Event 4 (CH1)
4	Event 1 (CH2)	Event 2 (CH2)	Event 3 (CH2)	Event 4 (CH2)
5	Event 1 (CH3)	Event 2 (CH3)	Event 3 (CH3)	Event 4 (CH3)
6	Event 1 (CH4)	Event 2 (CH4)	Event 3 (CH4)	Event 4 (CH4)
7	Event 1 (CH1)	Event 1 (CH2)	Event 1 (CH3)	Event 1 (CH4)
8	Event 2 (CH1)	Event 2 (CH2)	Event 2 (CH3)	Event 2 (CH4)
9	Event 3 (CH1)	Event 3 (CH2)	Event 3 (CH3)	Event 3 (CH4)
10	Event 4 (CH1)	Event 4 (CH2)	Event 4 (CH3)	Event 4 (CH4)
11	HBA (CH1)	HBA (CH2)	HBA (CH3)	HBA (CH4)
12	Burnout status (CH1)	Burnout status (CH2)	Burnout status (CH3)	Burnout status (CH4)
13	Temperature rise completion [5]	HBA comprehensive output [6]	Burnout state comprehensive output [7]	DO8 manual output

[1] Logical *OR* of Event 1 (ch1 to ch4)
[2] Logical *OR* of Event 2 (ch1 to ch4)
[3] Logical *OR* of Event 3 (ch1 to ch4)
[4] Logical *OR* of Event 4 (ch1 to ch4)
[5] Temperature rise completion status (ON when temperature rise completion occurs for all channels for which event 3 is set to temperature rise completion.)
[6] Logical *OR* of HBA (ch1 to ch4)
[7] Logical *OR* of burnout state (ch1 to ch4)

10. USAGE EXAMPLE

This chapter describes the usage example of EtherCAT communication when using the software of the PLC master installed in the personal computer as a master and connecting COM-ML to controllers (SRZ).

10.1 Handling Procedures

Preparations of configuration instrument

☞ Refer to **10.2 System Configuration (P. 72)**.

↓

Mounting and Wiring

☞
- For mounting and wiring of the COM-ML, refer to **3. MOUNTIMG (P. 7)** and **4. WIRING (P. 12)**.
- For mounting and wiring of the controller (SRZ), refer to **Z-TIO INSTRUCTION MANUAL (IMS01T01-E□)** or **Z-DIO INSTRUCTION MANUAL (IMS01T03-E□)**.
- For mounting and wiring of PLC, refer to **PLC Instruction Manual**.

↓

Use Instrument Setting

☞ Refer to **10.3 Use Instruments Settings (P. 73)**.

↓

Default setting of communication data

☞ Refer to **7. INITIAL COMMUNICATION DATA SETTINGS (P. 26)**, **10.4 Initial Communication Data Settings (P. 74)** and **10.5 Tool Settings (P. 75)**.

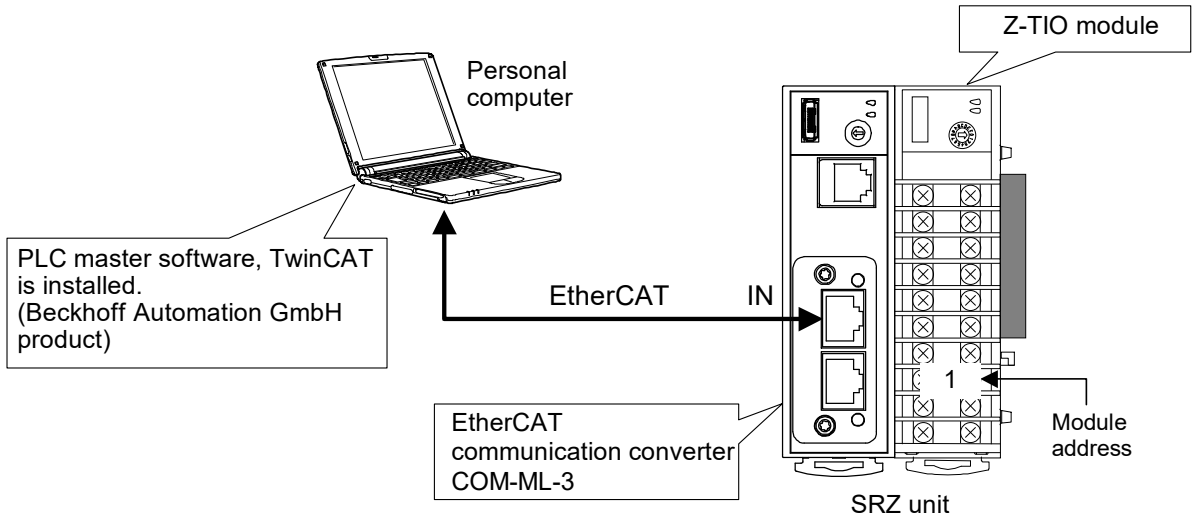
↓

EtherCAT communication

☞ Refer to **10.6 PDO Communication (P. 86)** and **10.7 SDO Communication (P. 90)**.

10.2 System Configuration

The example given in this section is based on the system configuration below.



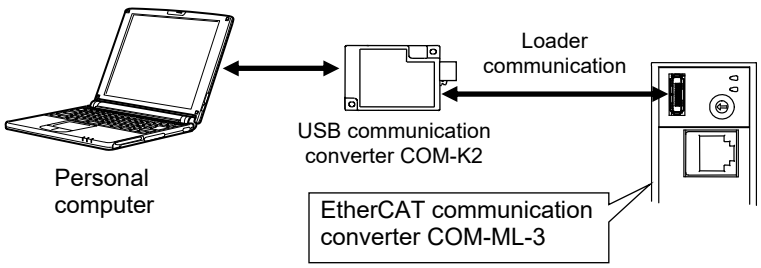
■ Devices used

- **EtherCAT communication converter: COM-ML-3 .....1**
- **Controller (SRZ): Z-TIO module.....1 (4-channel type)**
- **Ethernet cable**
- **Personal computer**

PLC master software, TwinCAT must be installed (Beckhoff Automation GmbH product).
EtherCAT communication operates with software implementing a master without using a specific hardware as a master device.

To initialize the communication data via loader communication, use USB communication converter, COM-K2 (RKC product).

Connecting example



During the loader communication, the COM-ML requires an external power source. The COM-ML will not function on the USB power from a personal computer alone.

10.3 Use Instruments Settings

■ COM-ML setting

There is not the setting of the hardware.

In this example the initial settings for COM-ML communication data are configured using PLC master software, TwinCAT, and thus COM-ML host communication settings are not necessary.

■ Controller (SRZ) setting

The COM-ML and controllers (Z-TIO modules) are connected by internal communication, and settings for the Z-TIO modules such as communication speed, protocol, and data bit configuration are not necessary.
The only setting that is configured for the controllers is the module address. The same is true when a Z-DIO module is used.

- Module address: Z-TIO module: 0

For the procedure for module address settings, refer to **Z-TIO Host Communication Quick Instruction Manual (IMS01T02-E□)** or **Z-DIO INSTRUCTION MANUAL (IMS01T03-E□)**.

■ Personal computer setting

Set arbitrary IP address and Subnet mask.
If the personal computer is connected to the network (LAN), this setting procedure is not required as the IP address and Subnet mask being used in the network can be used. When the IP address is automatically set, manual setting is not required.

NOTE

To avoid malfunction, check with the network administrator before changing the IP address and Subnet mask being used in the network (LAN).

10.4 Initial Communication Data Settings

Initialize the communication data by using PLC master software, TwinCAT.

[Set values]

- For PDO communication, use CH1 to CH4 of "Measured value (PV)" and "Set value (SV)" of the Z-TIO module.
- For SDO communication, use "RUN/STOP transfer (each units)" and "PID/AT transfer (CH1 to CH4)."
- Setting condition: Measured data items (IN):
  Measured value (PV), Set value (SV)
  Setting data items (OUT):
  Set value (SV)
  Assigned destination of communication item:
  Measured value (PV): Sub-Index 0x01 } PDO communication item
  Set value (SV): Sub-Index 0x02 }
  RUN/STOP transfer: Sub-Index 0x03 } SDO communication item
  PID/AT transfer (CH1): Sub-Index 0x04
  PID/AT transfer (CH2): Sub-Index 0x05
  PID/AT transfer (CH3): Sub-Index 0x06
  PID/AT transfer (CH4): Sub-Index 0x07
  RUN/STOP transfer: 0 (STOP), 1 (RUN)
  PID/AT transfer: 0 (PID control), 1 (Autotuning)
- Other communication data: Set other required items.

☞ For the initial settings, refer to **7. INITIAL COMMUNICATION DATA SETTINGS (P. 26)**. For information on each communication item, refer to **9. COMMUNICATION DATA LIST (P. 36)**.

10.5 Tool Settings

Configure the various settings by using PLC master software, TwinCAT.

10.5.1 To copy XML file

To recognize COM-ML in TwinCAT, copy the XML file of COM-ML to the place where TwinCAT is to be installed.

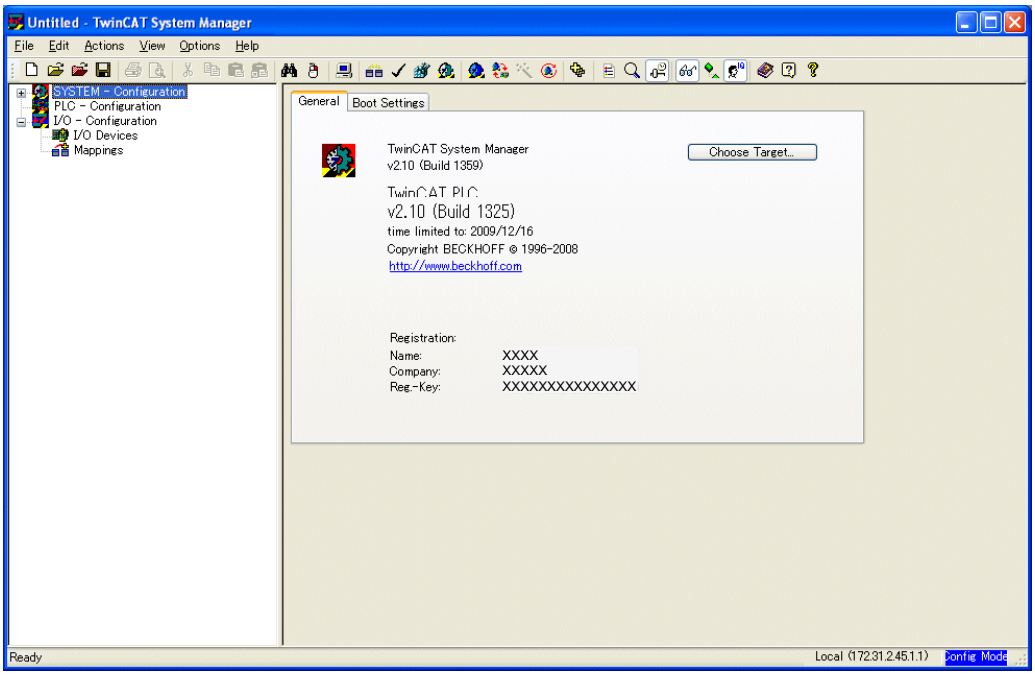
1. Access the official RKC website and download the XML file of COM-ML (COM-ML-3.XML).
URL: https://www.rkcinst.com/

2. Copy the downloaded XML file (COM-ML-3.XML) to the place where TwinCAT is to be installed.
Example: Destination of the file to save in C drive: C: \TwinCAT\Io\EtherCAT

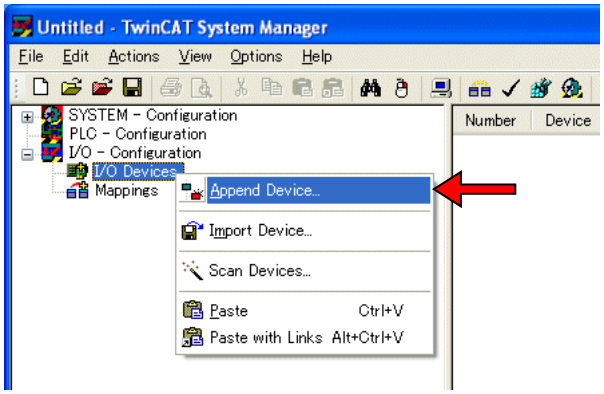
10.5.2 To register EtherCAT and COM-ML

Register EtherCAT and COM-ML by using TwinCAT.

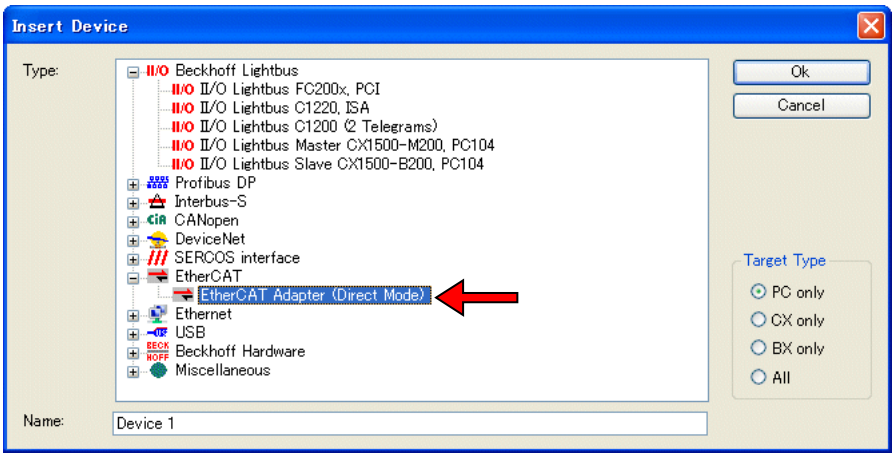
1. Start TwinCAT System Manager.



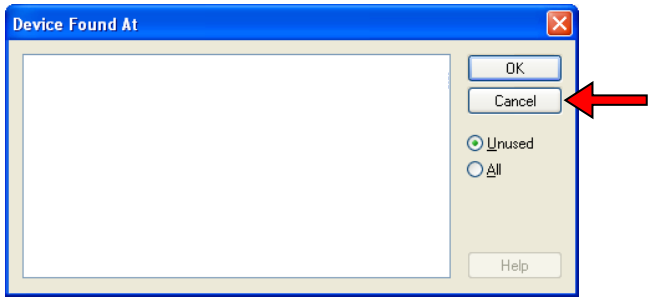
2. Right-click “I/O Devices” in the treeview at the left side of the screen and select “Append Device…”



3. Go to “Insert Device” window and click “EtherCAT.” Select “EtherCAT Adapter (Direct Mode)” and click “OK” to register EtherCAT in the treeview.

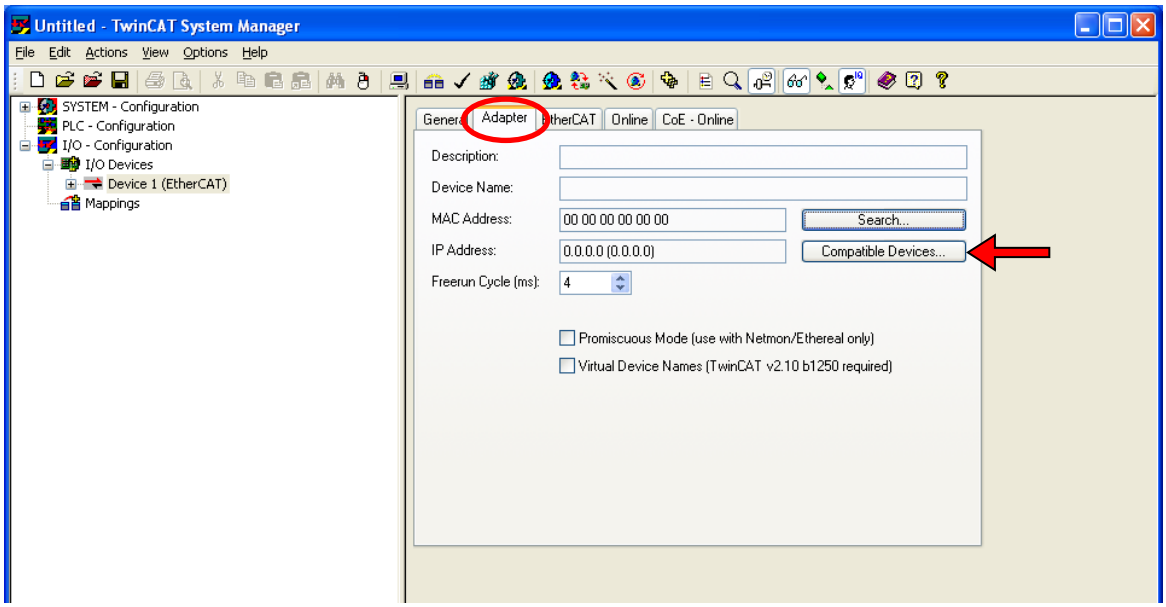


4. When “Device Found At” window displays for the first operation, click “Cancel” to close the browser window as EtherCAT driver is not installed. To install the EtherCAT driver, refer to the following procedures from No. ***4*** to ***11***.

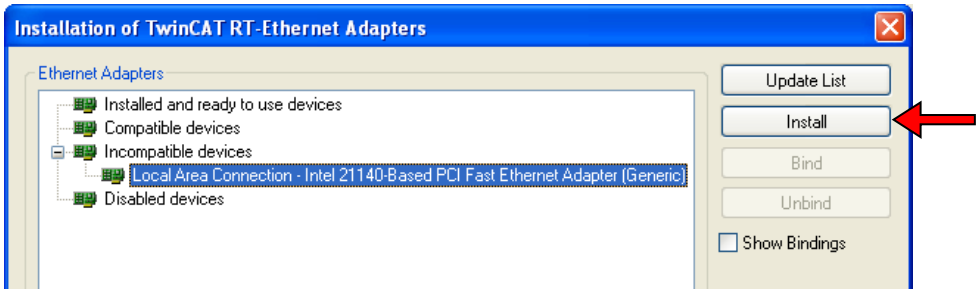


Refer to the procedure No. ***12*** for the second and subsequent times.

5. Open “I/O Devices” and click “Device 1 (EtherCAT)” in the treeview at the left side of the screen. Then select “Adapter” tab at the right side of the screen and click “Compatible Devices…”

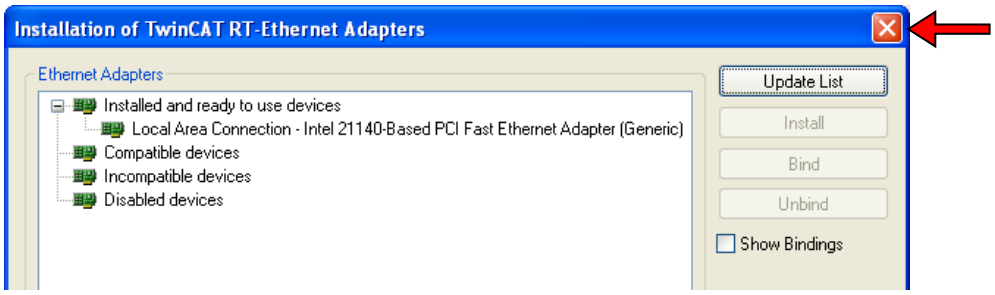


6. When “Installation of TwinCAT RT-Ethernet Adapters” window displays, open “Incompatible devices.” Then select “Local Area Connection…” and click “Install.”

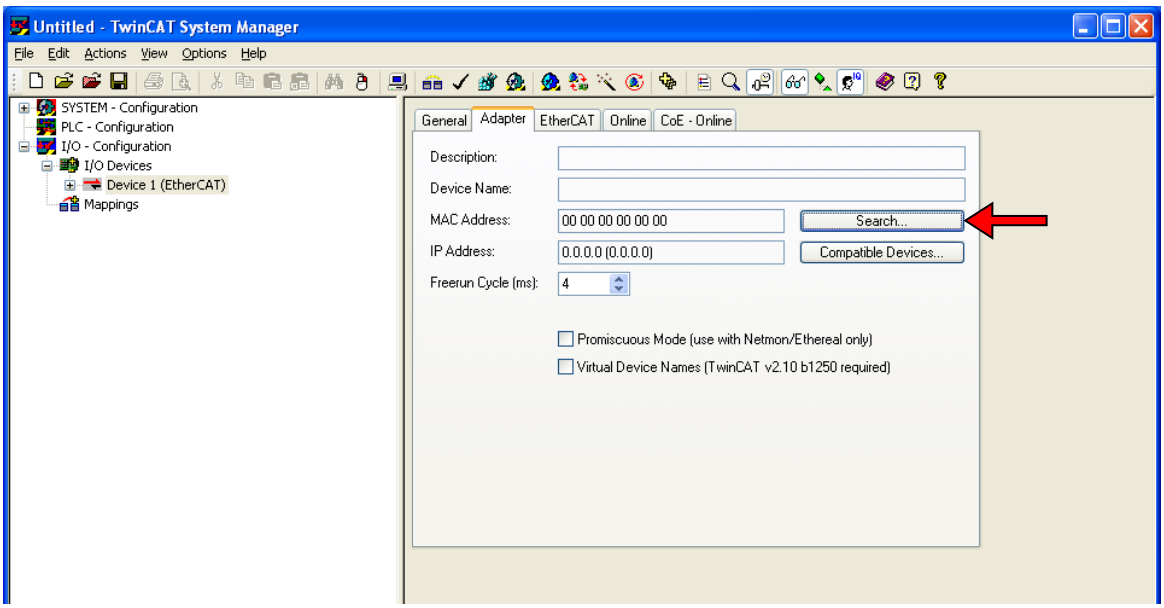


7. When “Hardware Installation” window displays, click “Continue Anyway” and start installation.

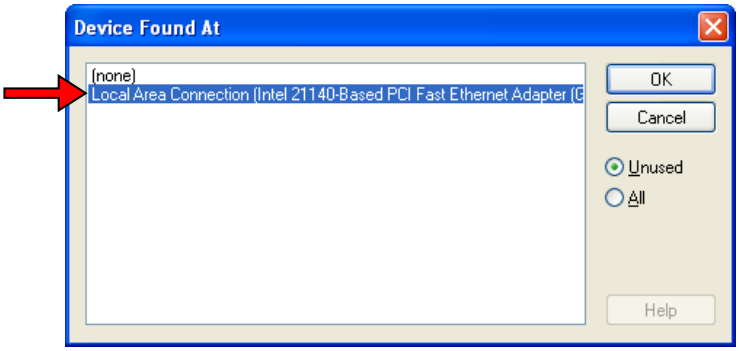
8. When the installation is completed, “Installation of TwinCAT RT-Ethernet Adapters” window displays. Click X in the upper right to close the browser window.



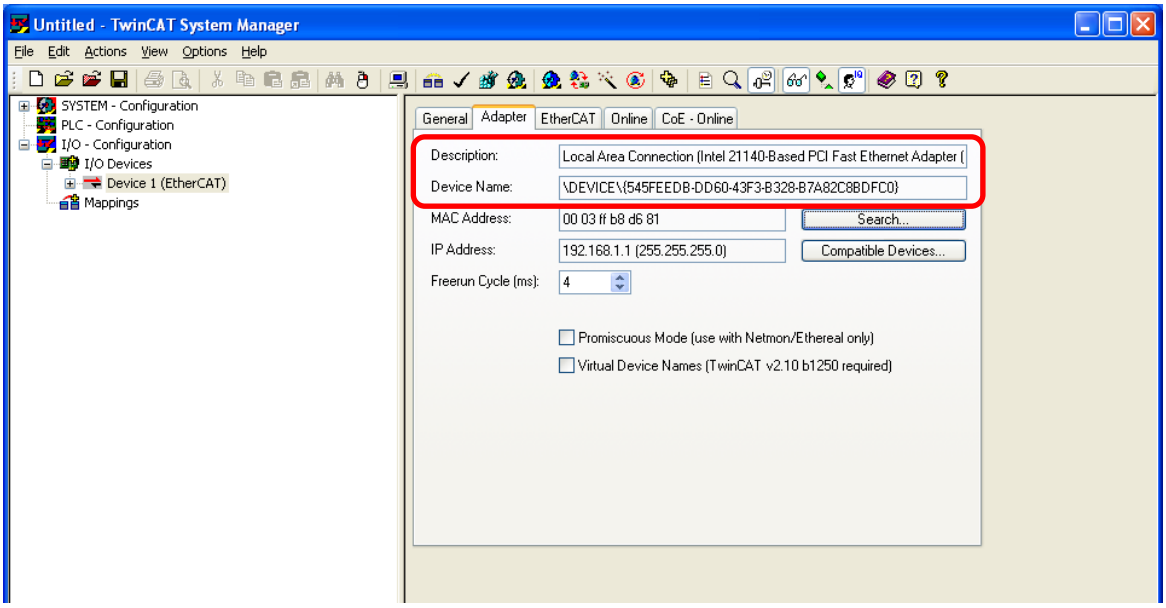
9. Click “Search” at the browser window below.



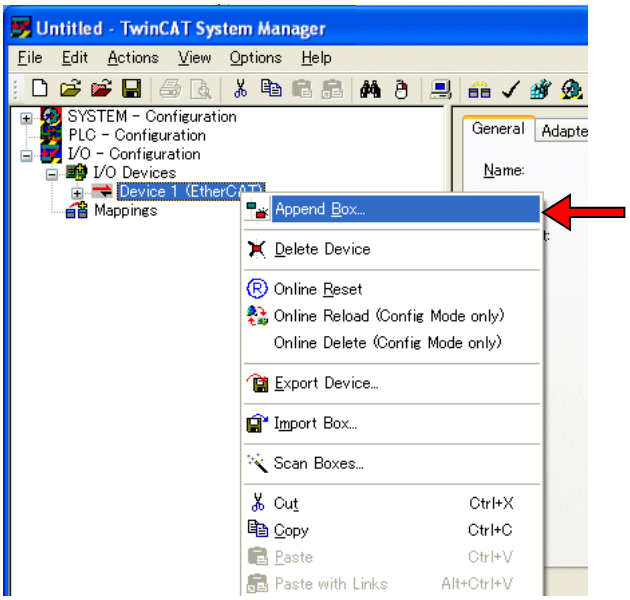
10. When “Device Found At” window displays, open “Incompatible devices.” Then select “Local Area Connection…” and click “OK.”



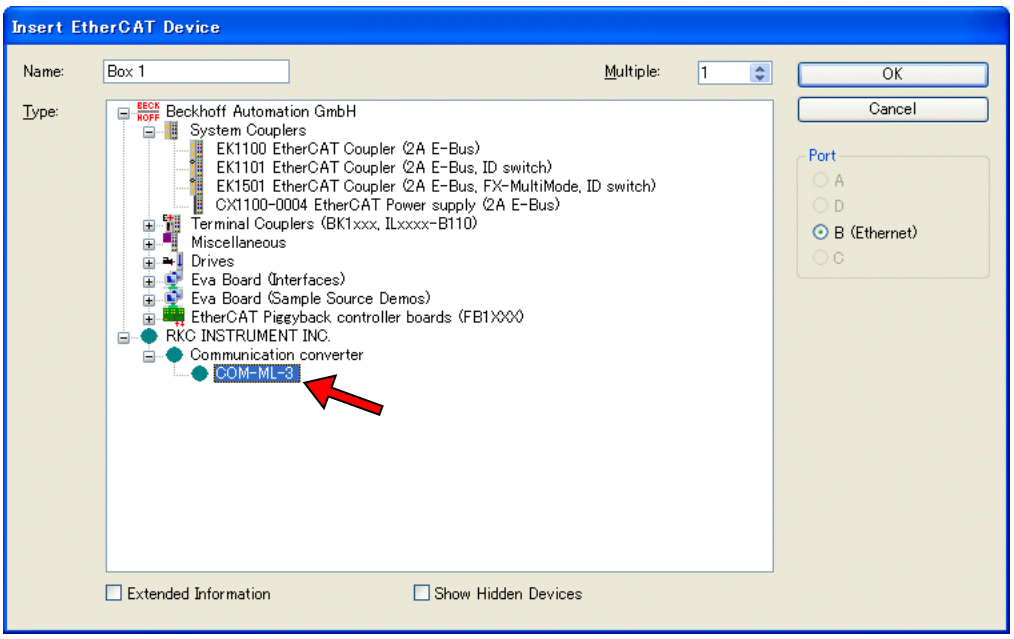
11. The contents of “Description” and “Device Name” at “Adapter” tab are updated and driver is specified.

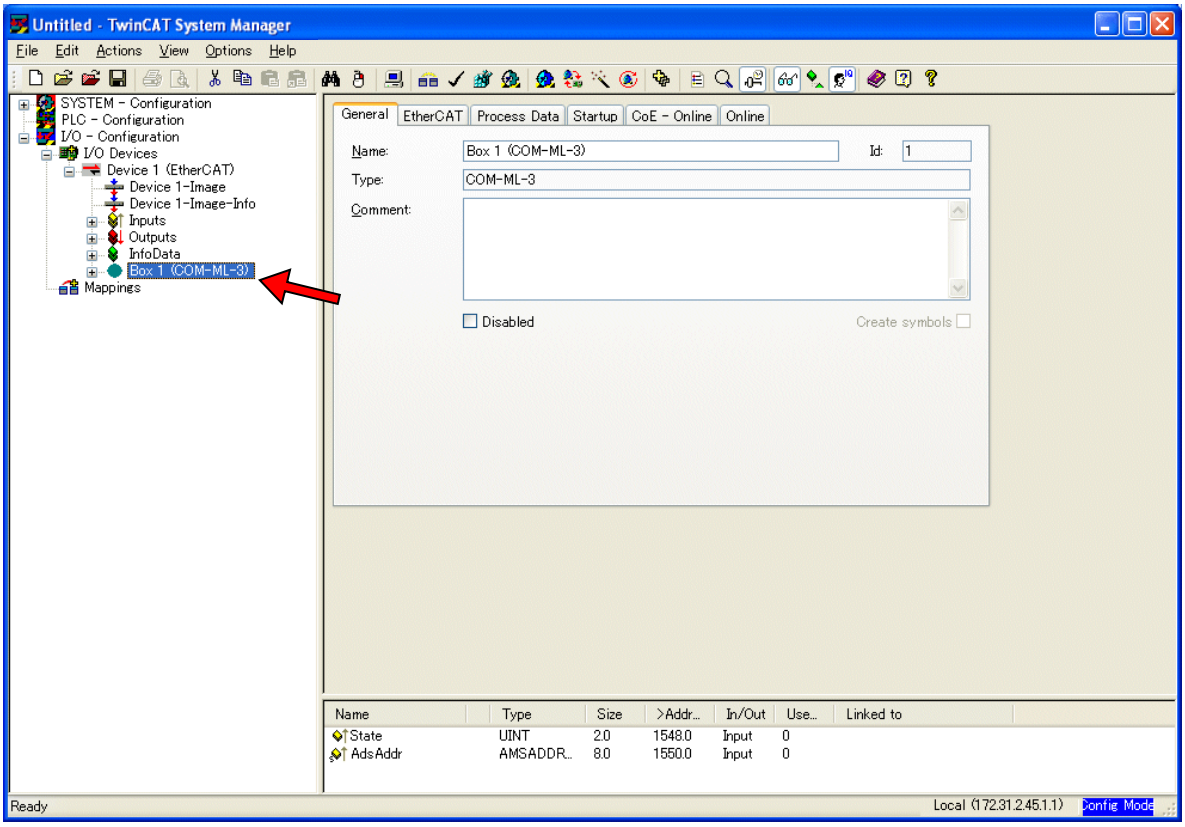


12. Go to “I/O Devices” in the treeview at the left side of the screen and right-click “Device 1 (EtherCAT).” Then select “Append box…”



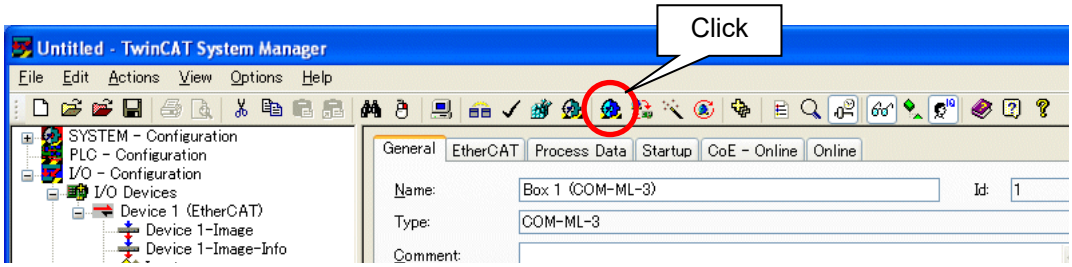
13. Register COM-ML-3 in the treeview by clicking OK after selecting COM-ML3 of "Communication converter" at "RKC INSTRUMENT INC." in "Insert EtherCAT Device" window.





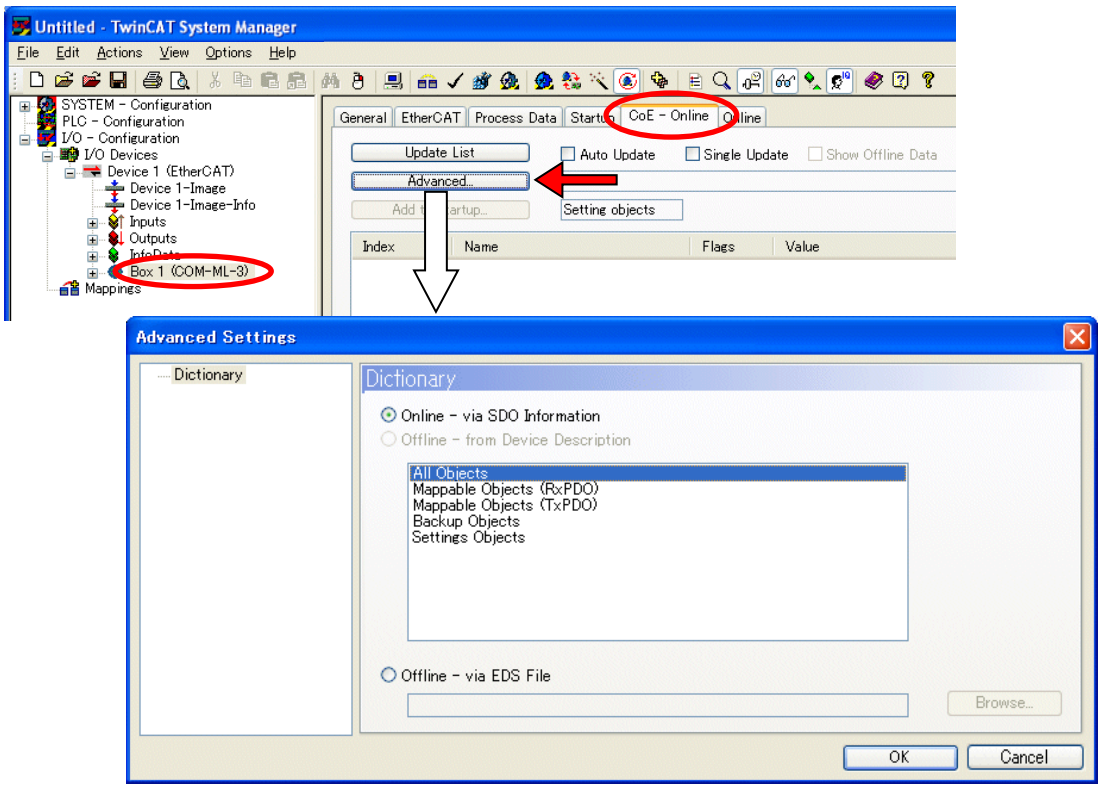
10.5.3 COM-ML Initial setting

1. Click “Set/Reset TwinCAT to Config Mode” information icon.

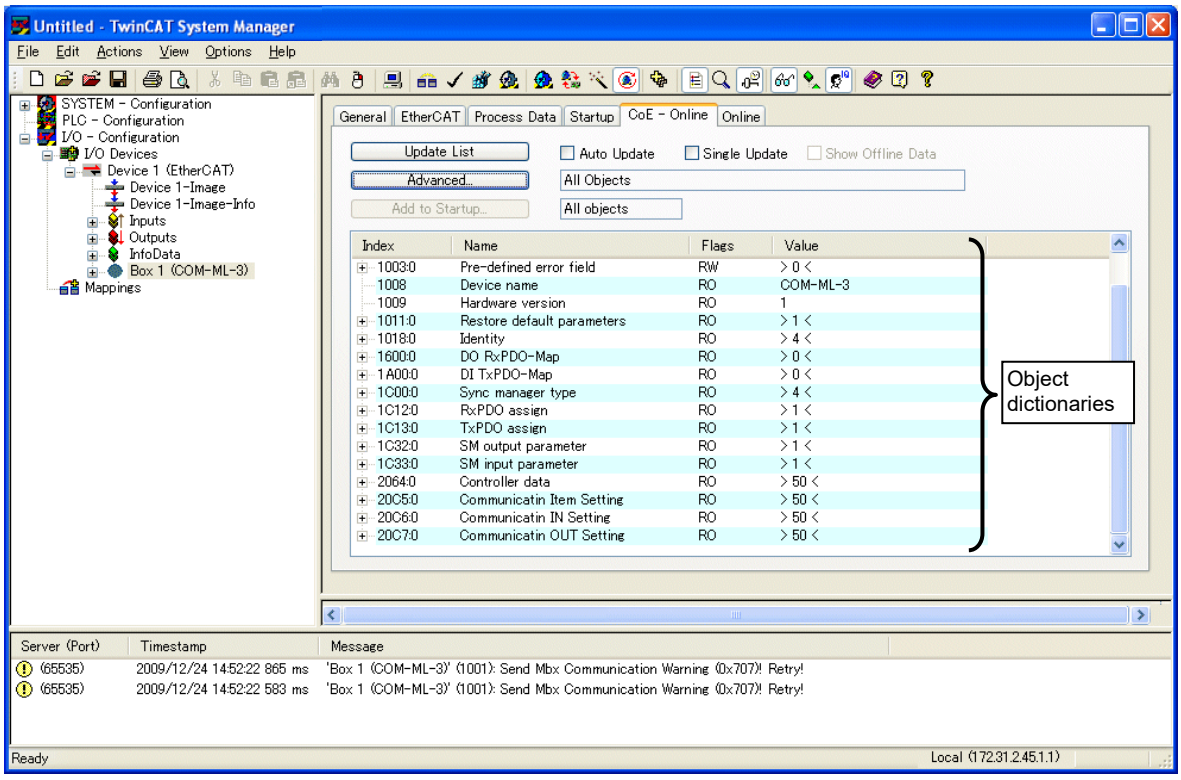


2. Click “OK” at each dialog to establish the connection between COM-ML and TwinCAT.

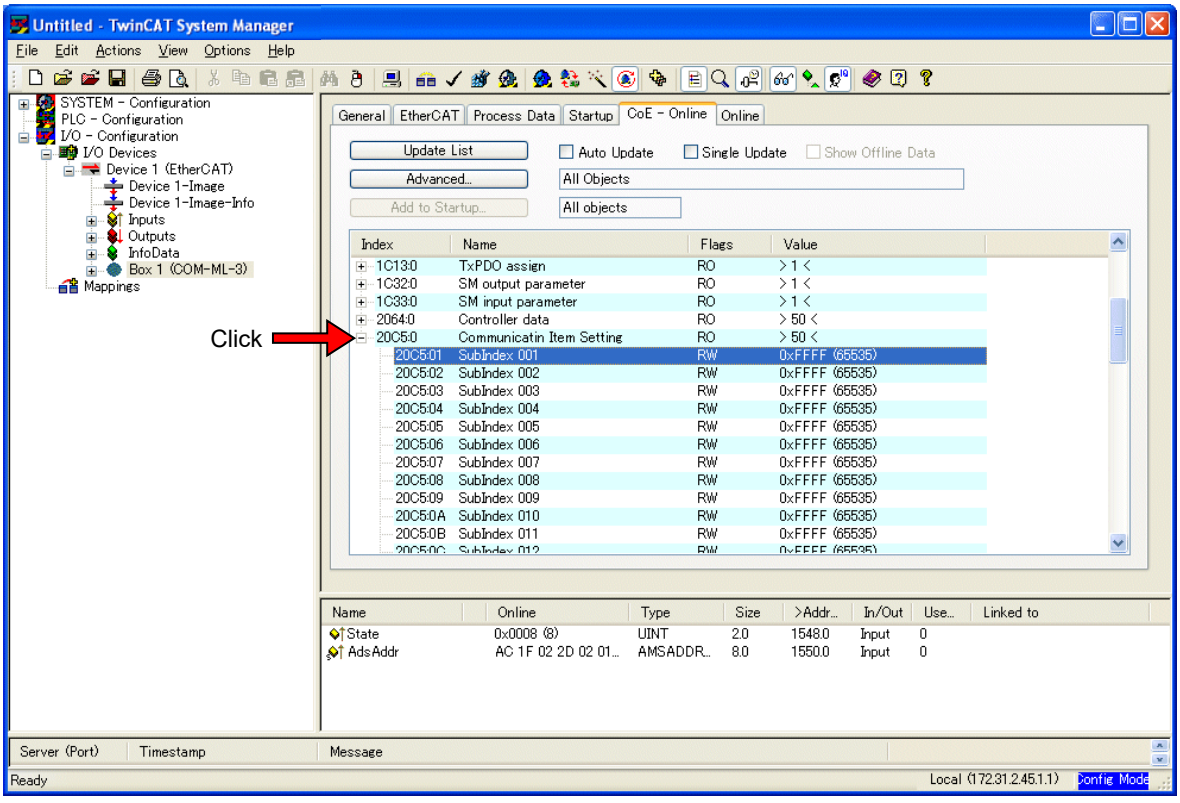
3. Select “Box 1 (COM-ML-3)”at the treeview at the left side of the screen and open “CoE-Online” tab at the right side of the screen. Then click “Advanced…” and display “Advanced setting” window. Select “All Objects” and click “OK.”



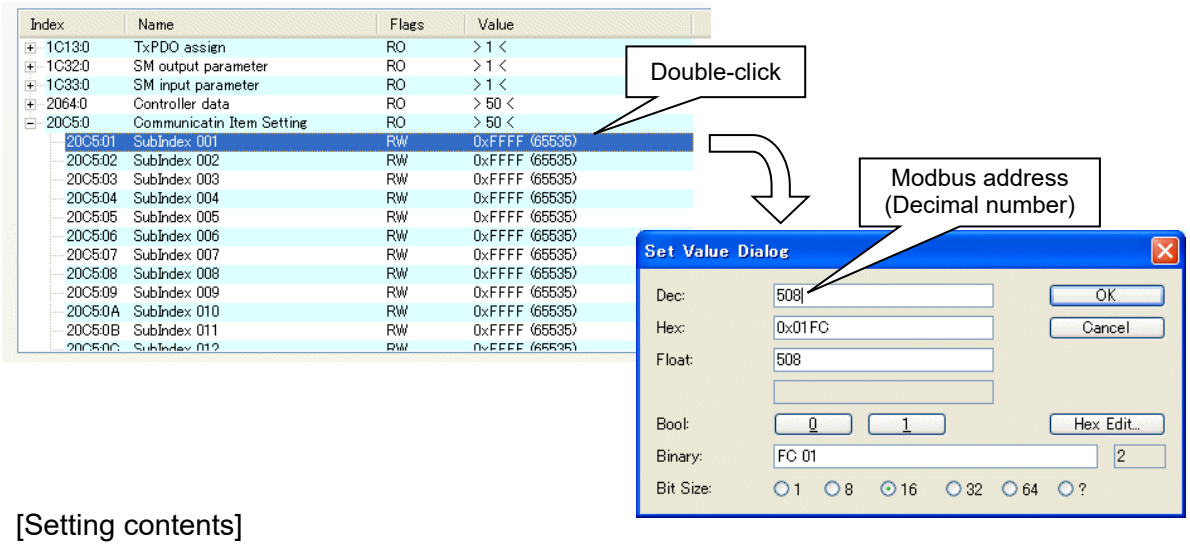
4. Reads out the Object dictionaries of COM-ML.



5. Set communication item to be used for PDO communication or SDO communication at 0x20C5 [Communication item setting]. Open “20C5: 0 Communication Item Setting” and displays Sub-Index.



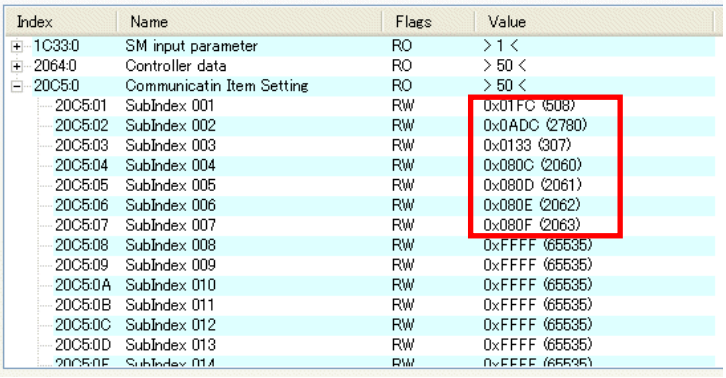
6. Double-click the Sub-Index and display Data setting dialog. Then set Modbus address of the communication item to use.



[Setting contents]

Sub-Index number	Communication item	Modbus address		Notes
		DEC (Decimal)	HEX (Hexadecimal)	
001	Measured value (PV)	508	0x01FC	Items to be used for PDO communication: Set the first address of the item to be used.
002	Set value (SV)	2780	0x0ADC	
003	RUN/STOP transfer	307	0x0133	Items to be used for SDO communication: Set addresses for all channels of the items to be used.
004	PID/AT transfer (CH1)	2060	0x080C	
005	PID/AT transfer (CH2)	2061	0x080D	
006	PID/AT transfer (CH3)	2062	0x080E	
007	PID/AT transfer (CH4)	2063	0x080F	

The values for Sub-Index number 008 and subsequent numbers remain 65535 (0xFFFF) as they will not be used.



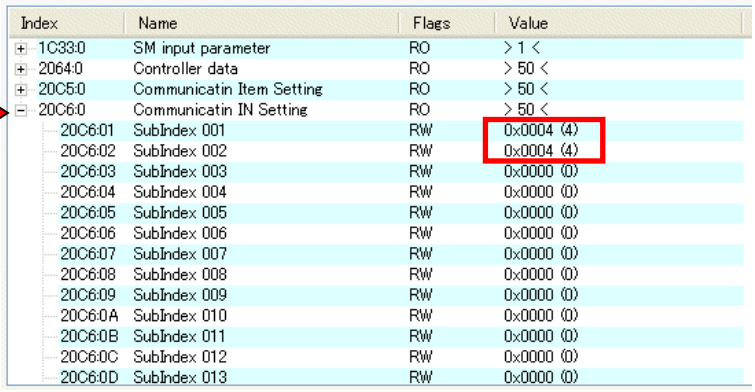
7. Set the number of communication item to be used for monitoring via PDO communication at 0x20C6 [Number of measured data items (IN)] by following the same procedure described at No. ***6***.

[Setting contents]

Sub-Index number	Setting contents	Set value
001	Number of channel to use PV	4
002	Number of channel to use SV	4

The values for Sub-Index number 003 and subsequent numbers remain 65535 (0xFFFF) as they will not be used.

Click



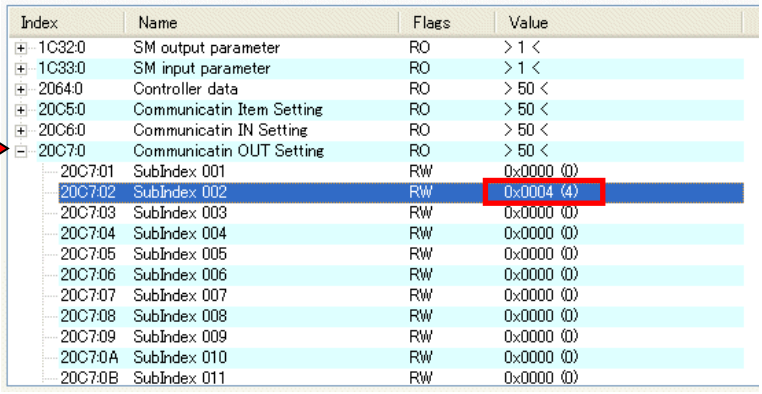
8. Set the number of communication item to be used for setting via PDO communication at 0x20C7 [Number of setting data items (OUT)] by following the same procedure described at No. ***6***.

[Setting contents]

Sub-Index number	Setting contents	Set value
002	Number of channel to use SV	4

The values for Sub-index number 001, 003 and subsequent numbers remain 65535 (0xFFFF) as they are not used.

Click



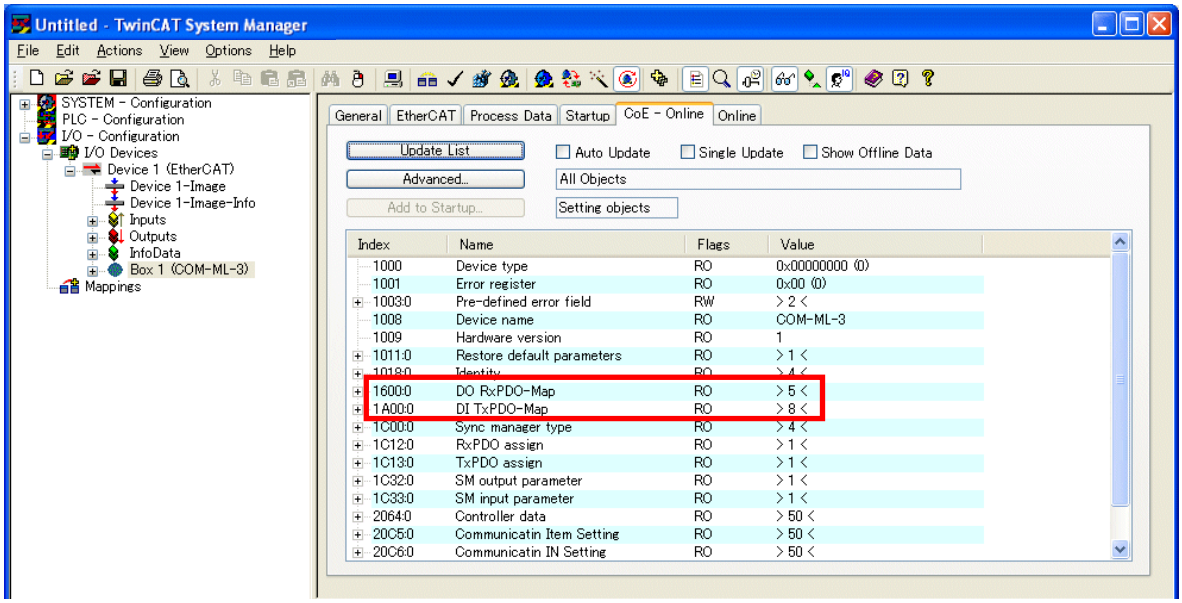
Regardless of the setting of 0x20C7, “setting state selection” is assigned to the first-word of the setting data item (OUT).

9. To validate the setting, turn OFF first and restore COM-ML.

10. Confirm the data length of PDO communication at 0x1600 and 0x1A00.

1600:0 DO RxPDO-Map (Receive PDO mapping):
Data length of setting data items (OUT): 5 words (10 bytes)

1A00:0 DI TxPDO-Map (Transmit PDO mapping):
Data length of measured data items (IN): 8 words (16 bytes)

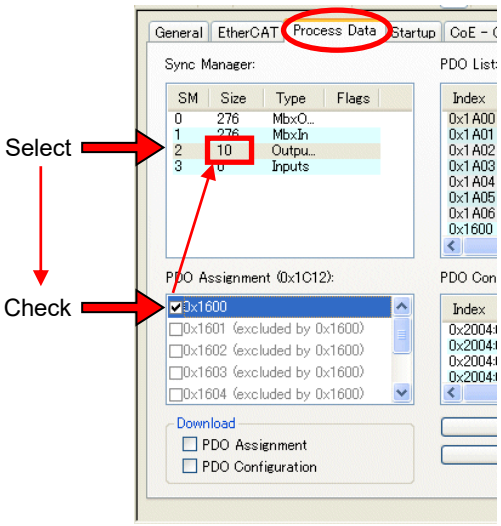


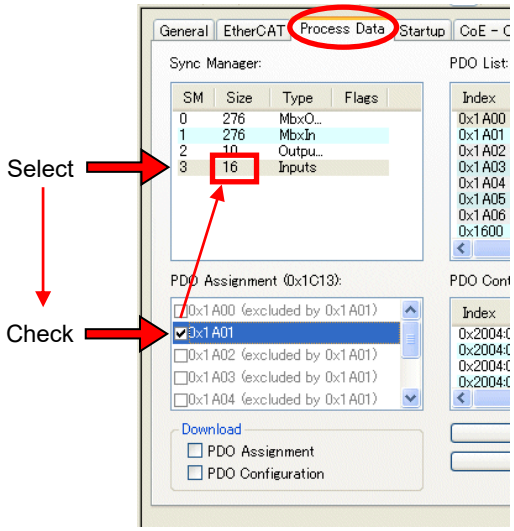
11. Select “Process Data” tab and set Process data length for Outputs and Inputs at “Sync Manager.”

Output: Data length of setting data items (OUT): 10 bytes

Input: Data length of measured data items (IN): 16 bytes

- Select Outputs at “Sync Manager” and check “0x1600” at “PDO Assignment (0x1C12)” to set 10 (bytes) for the size of Outputs.
- Select Inputs at “Sync Manager” and check “0x1A01” at “PDO Assignment (0x1C13)” to set 16 (bytes) for the size of Inputs.

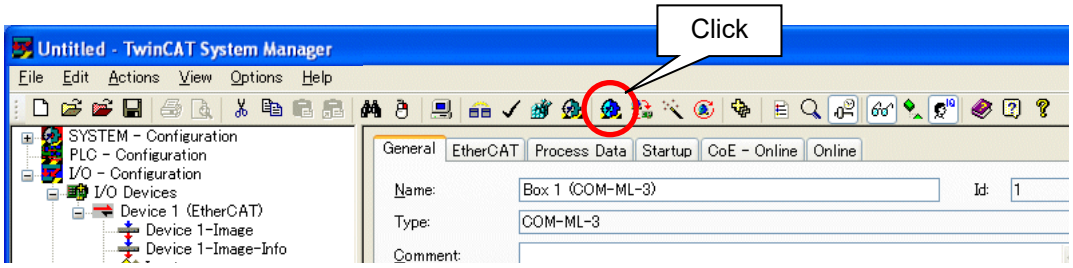




10.6 PDO Communication

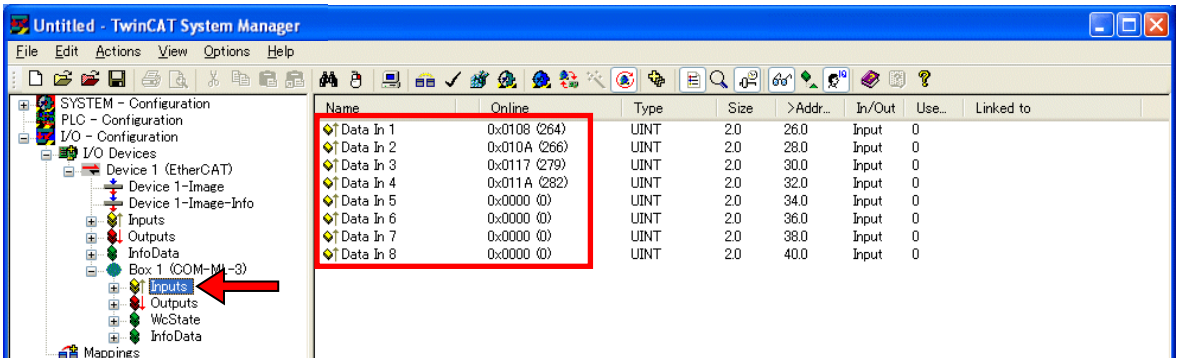
To monitor and set data via PDO communication.

1. Click “Set/Reset TwinCAT to Config Mode” information icon and restart in the Config Mode.

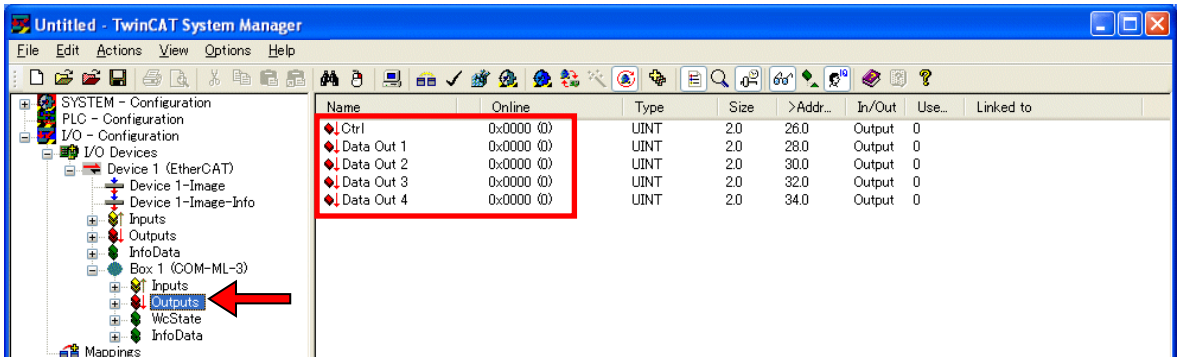


2. Click “OK” at each dialog being displayed to establish the connection between COM-ML and TwinCAT.

3. Select “Inputs” at “Box 1 (COM-ML-3)” in the treeview at the left side of the screen to read out the value of Measured data item of PDO communication at the right side of the screen.



4. Select “Outputs” at “Box 1 (COM-ML-3)” in the treeview at the left side of the screen to read out the value of Setting data items of PDO communication at the right side of the screen.

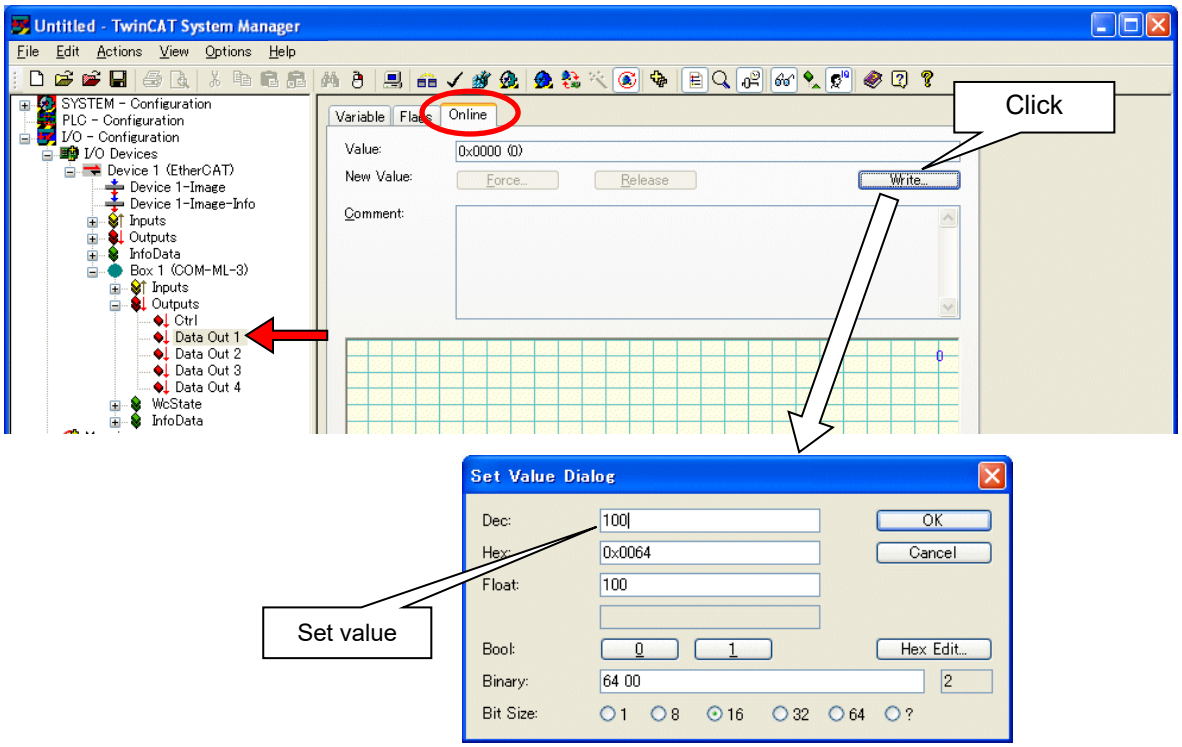


Ctrl at the first word of setting data item is “Setting state selection.”

5. Set each data of setting data items (OUT) to the value described below.

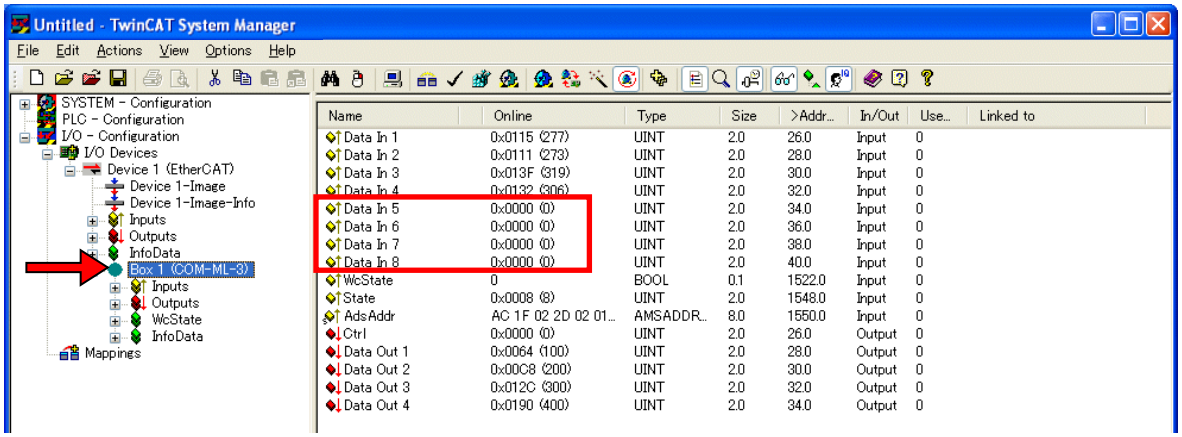
Setting items	Setting value
Channel 1 Set value (SV)	100
Channel 2 Set value (SV)	200
Channel 3 Set value (SV)	300
Channel 4 Set value (SV)	400

- Channel 1 Set value (SV) setting
  Select “Data Out 1” at “Outputs” of “Box 1 (COM-ML-3)” in the treeview at the left side of the screen. Then select “Online” tab to display the screen where Set value (SV) can be input. Click “Write” to display “Set Value Dialog” and input “100” for the Set value (SV) of channel 1.

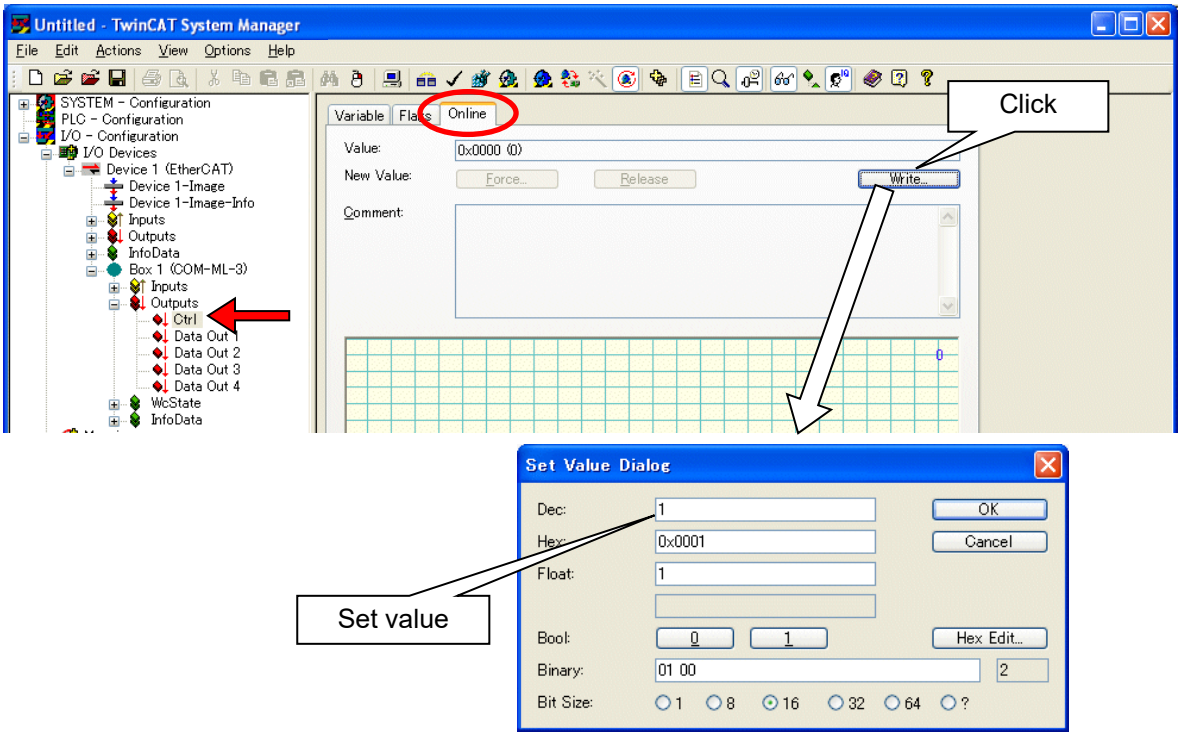


Follow the same procedure to set SV of channel 2 to 4.

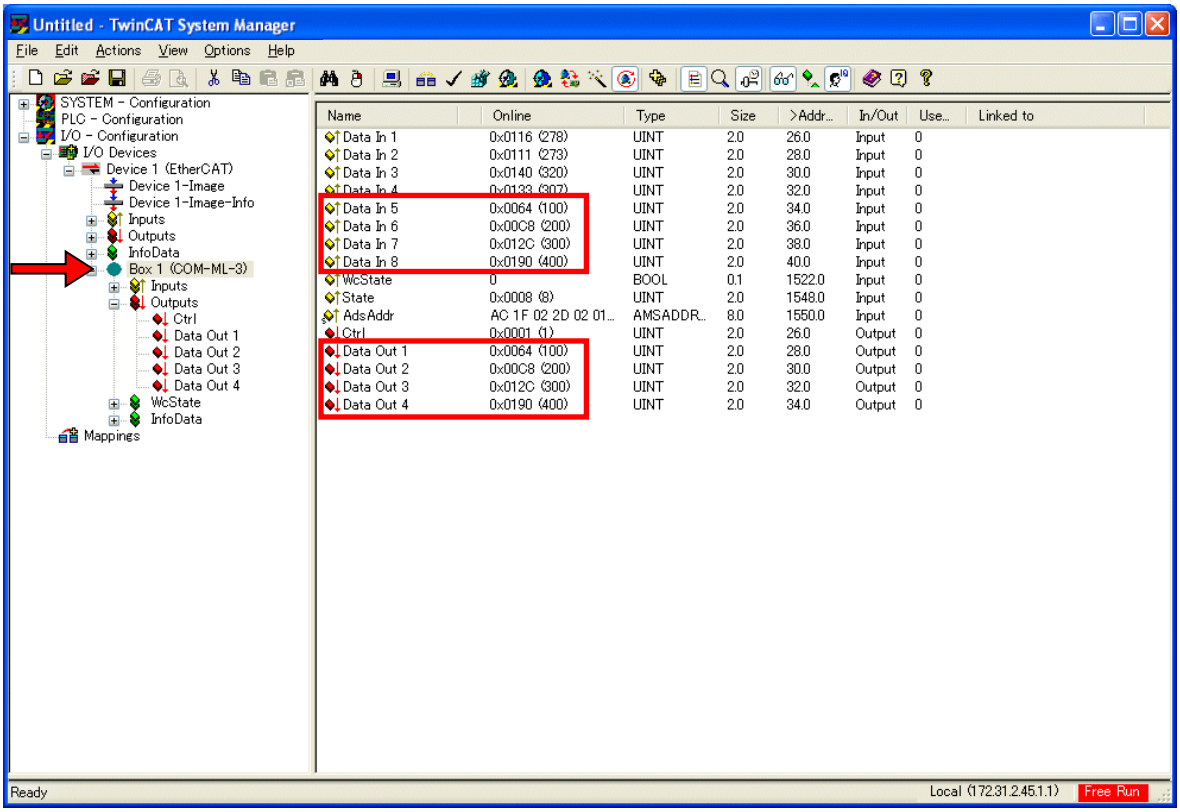
6. Select “Box 1 (COM-ML-3)” in the treeview at the left side of the screen to read out the values of Measured data item and Setting data item of PDO communication at the right side of the screen.
The monitor value of Set value (SV) is “0” as writing SV is not authorized at this stage (Setting state selection: Ctrl = 0).



7. To authorize writing Set value (SV) (Setting state selection: Ctrl =1).
Select “Ctrl” at “Outputs” of “Box 1 (COM-ML-3)” in the treeview at the left side of the screen and open “Online” tab at the right side of the screen. Click “Write” to display Set Value Dialog and change the value of Setting state selection (Dec:) into 1.



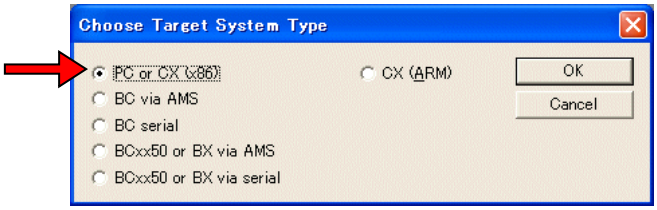
8. Select “Box 1 (COM-ML-3)” in the treeview at the left side of the screen again to read out the values of Measured data item and Setting data item of PDO communication at the right side of screen.
The data written for Set value (SV) displays as monitor value.



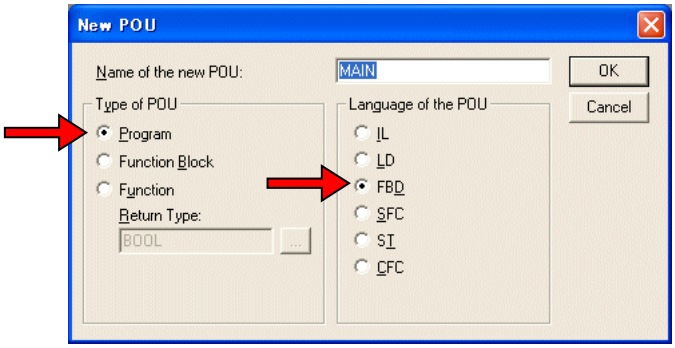
10.7 SDO Communication

To compose program and set data for SDO communication

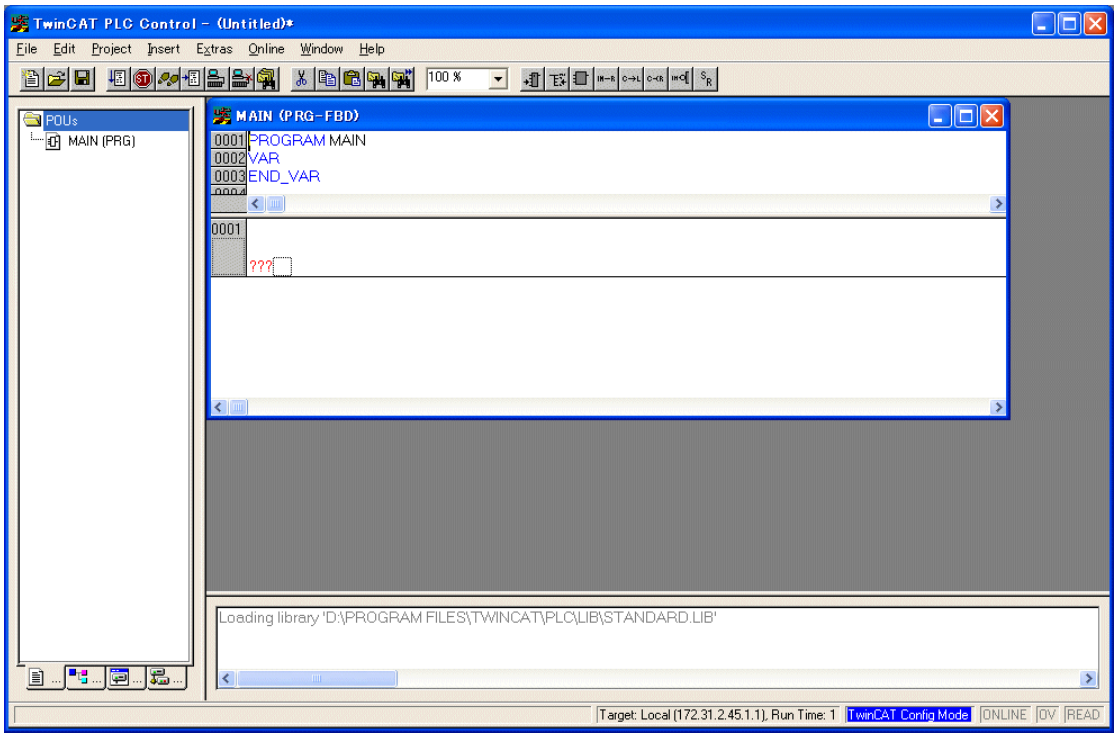
1. Startup “TwinCAT PLC Control” and compose new project.
Open “File” in the Menu bar and select “New” to display “Choose Target System Type.” Then select “PC or CX 8x86.”



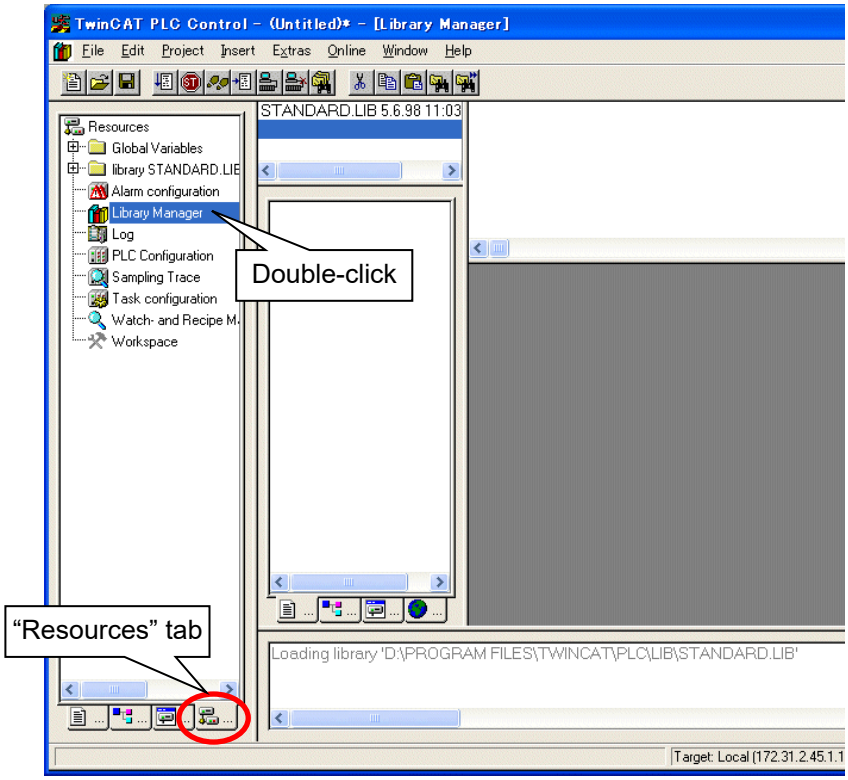
2. Select “Program” and “FBD” in the “New POU” box.



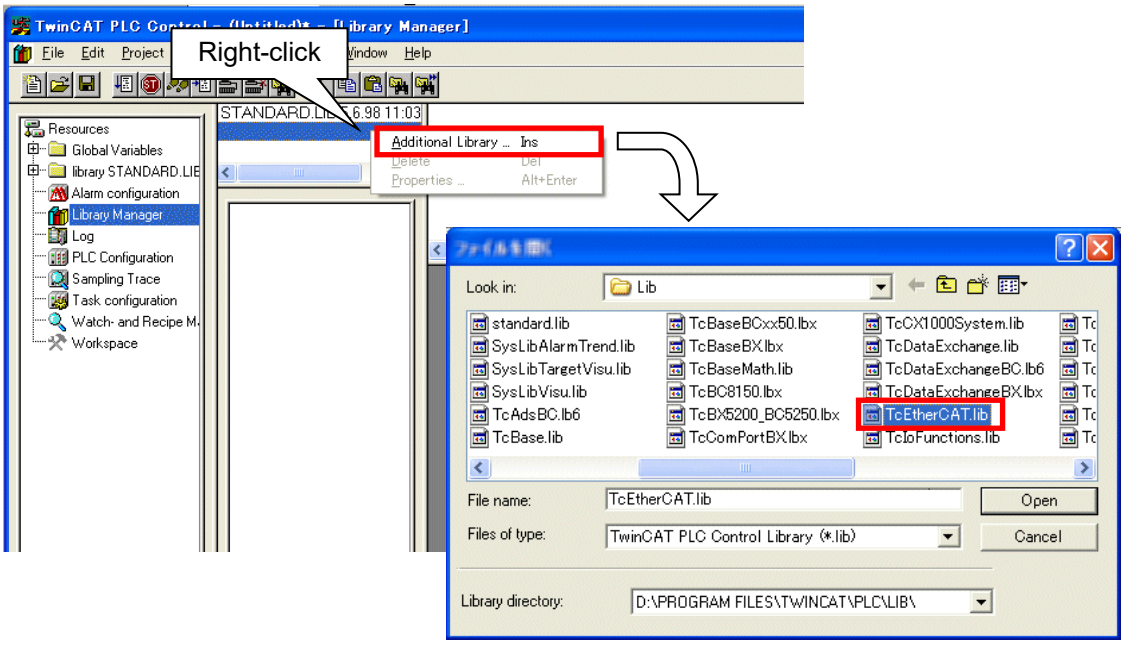
3. The display for new project opens.



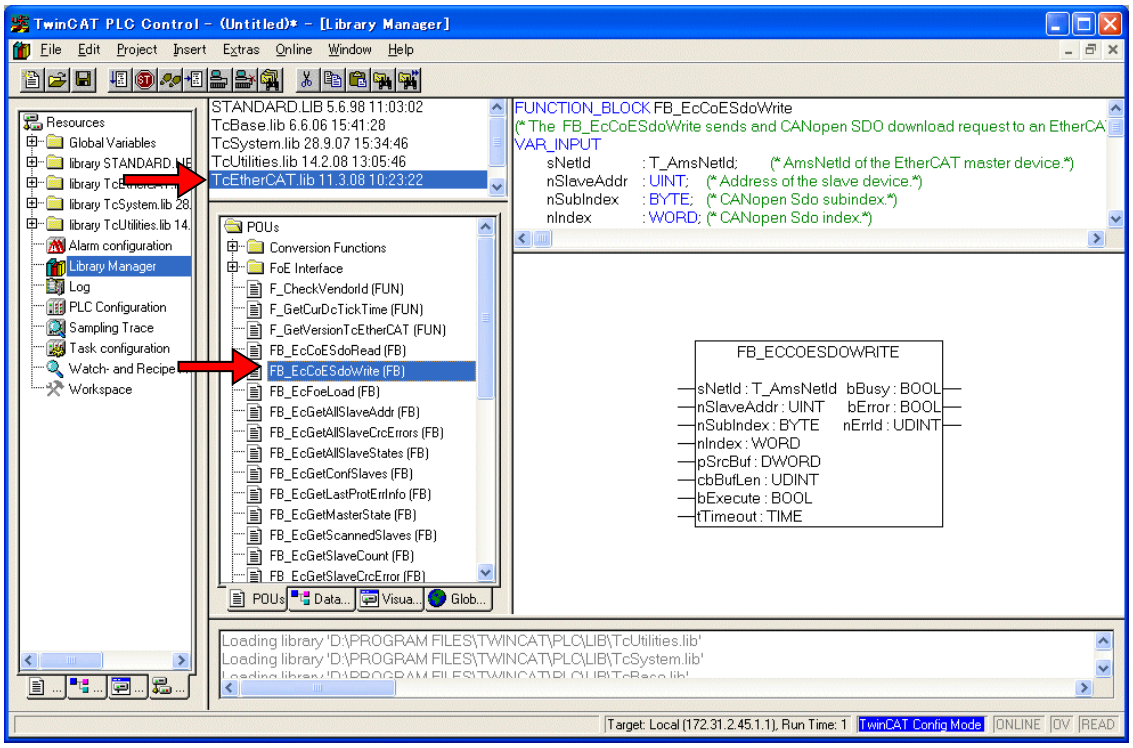
4. Select “Resources” tab in the treeview at the left side of the screen. Then double-click “Library Manager” to display Library Manager screen.



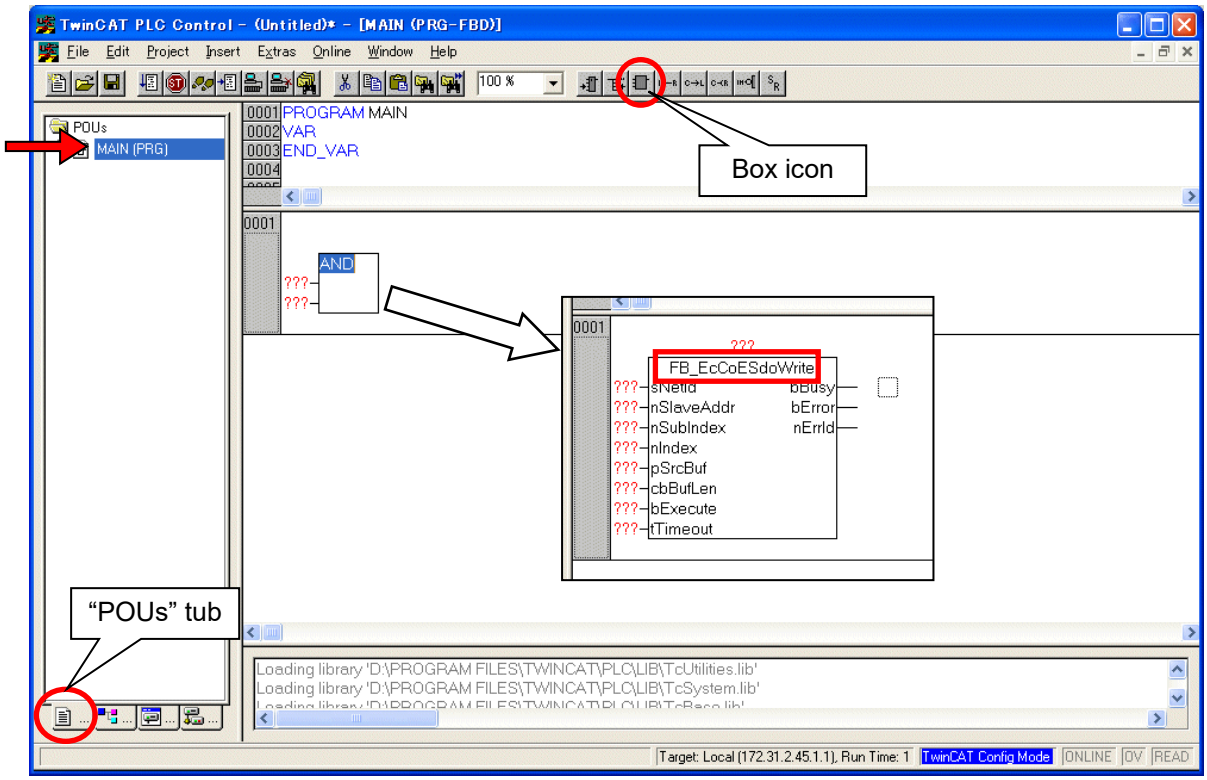
5. Right-click at the central upper side of the screen and select “Additional Library.” Then select “TcEtherCAT.lib” in the displayed library.



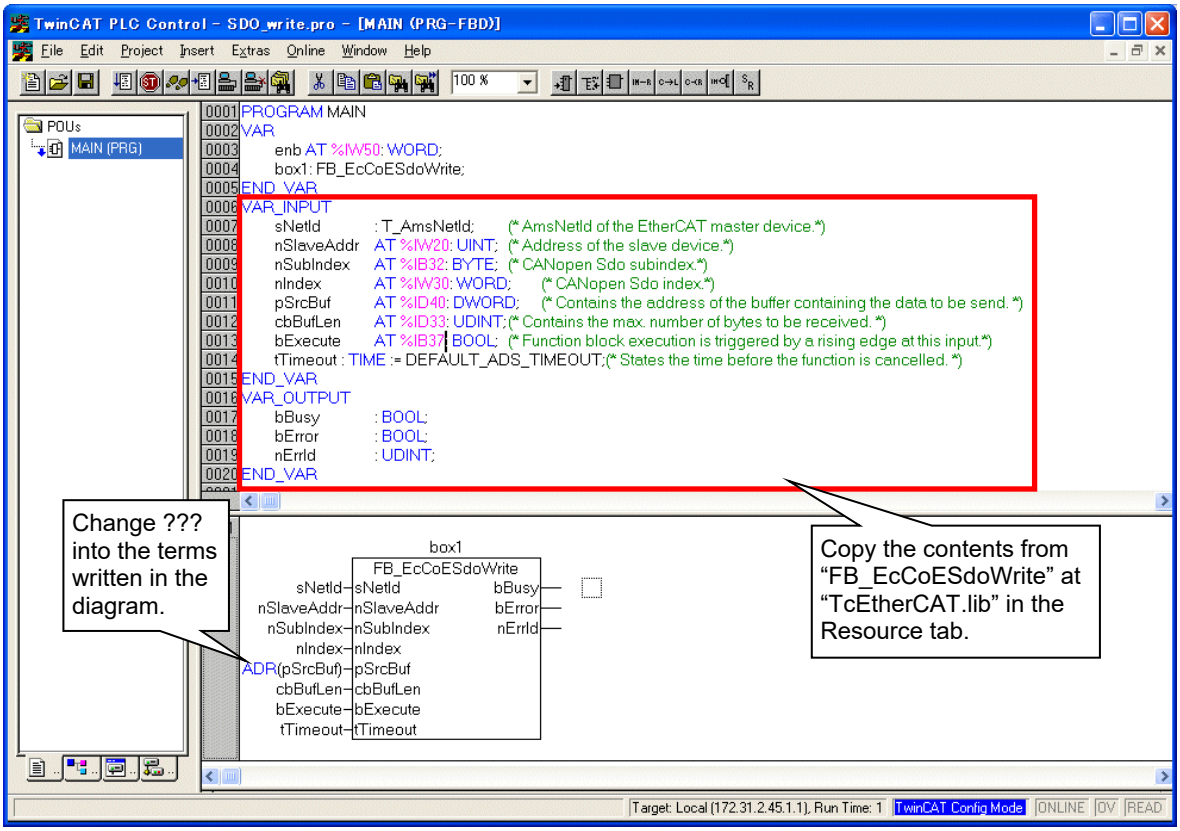
6. Read out the function block for writing of SDO communication.
Select function block “FB_EcCoESdoWrite” from “TcEtherCAT.lib.”



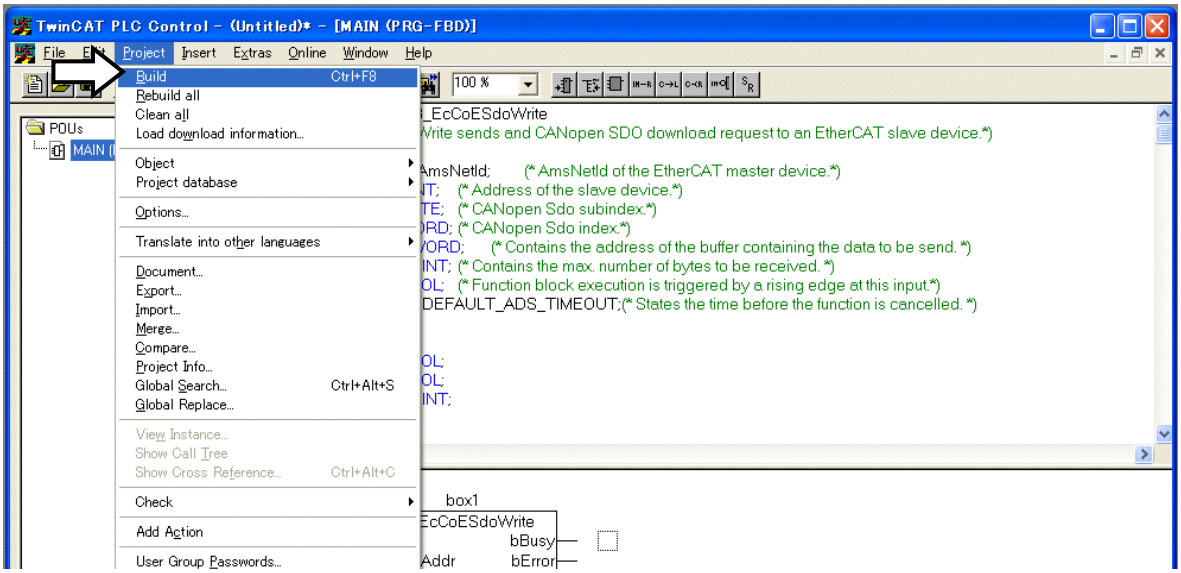
7. Select “POUs” tab in the treeview at the bottom left side of the screen to display “Main (PRG).” Click the Box icon and display “AND” at the right side of the screen. Then change “AND” into “FB_EcCoESdoWrite” by typing the letters.



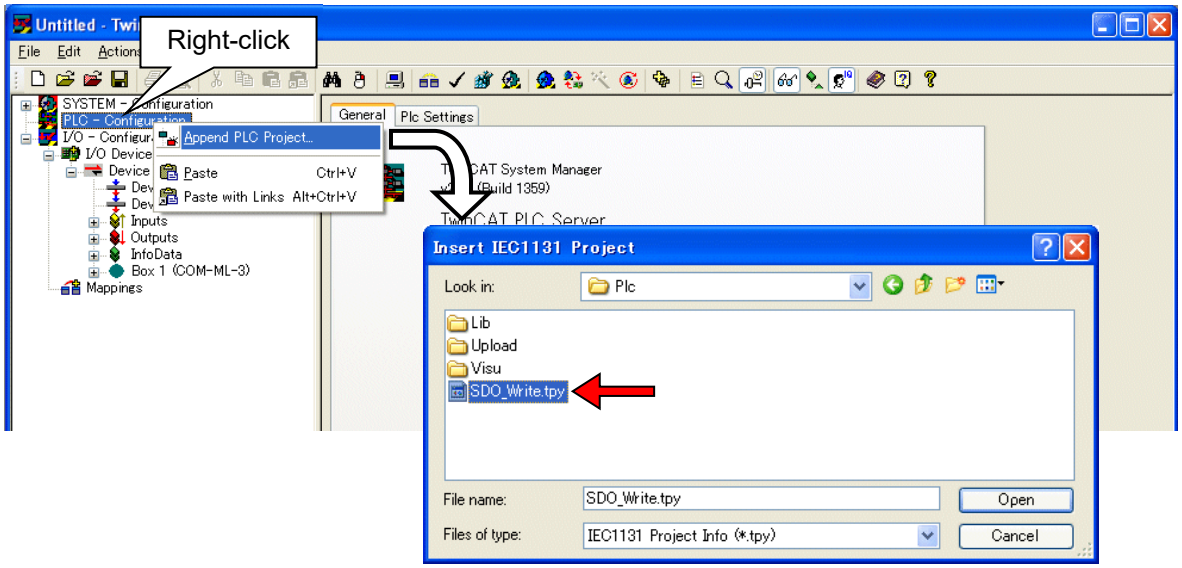
8. Input data as described below by using “FB_EcCoESdoWrite” block. The data at the right side of the screen is the same as the data written at “FB_EcCoESdoWrite” in “TcEtherCAT.lib.”



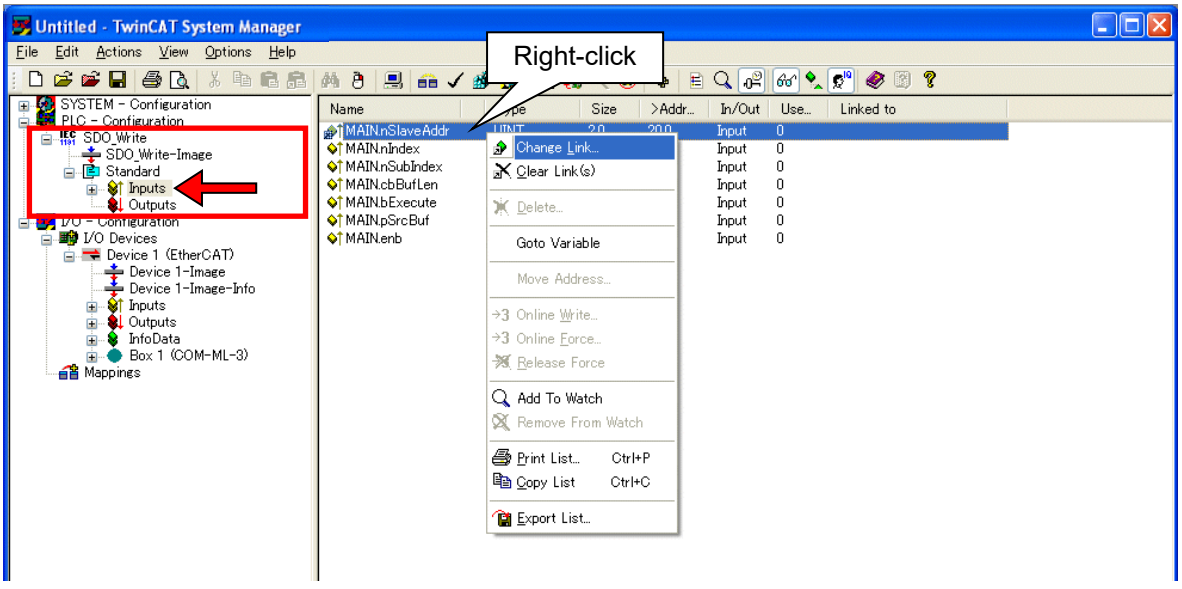
9. When data input is done, name and store the project. (File → Save as)
Then open “Project” in the Menu bar and click “Build” to build the project.



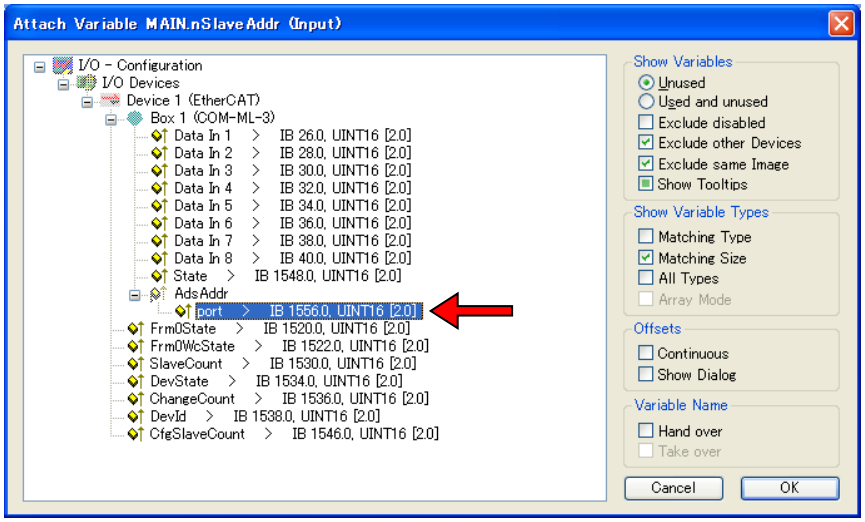
10. Open the file of "TwinCAT system Manager" initialized for COM-ML and add the program just composed.
Right-click "PLC-Configuration" in the treeview at the left side of the screen and select "Append PLC Project."
Select the file with an extension "tpy" at the place where TwinCAT is installed. (The file is composed by building the project described at procedure No. ***9***.)
Example: Destination of the file to save in C drive: C: \TwinCAT\Plc



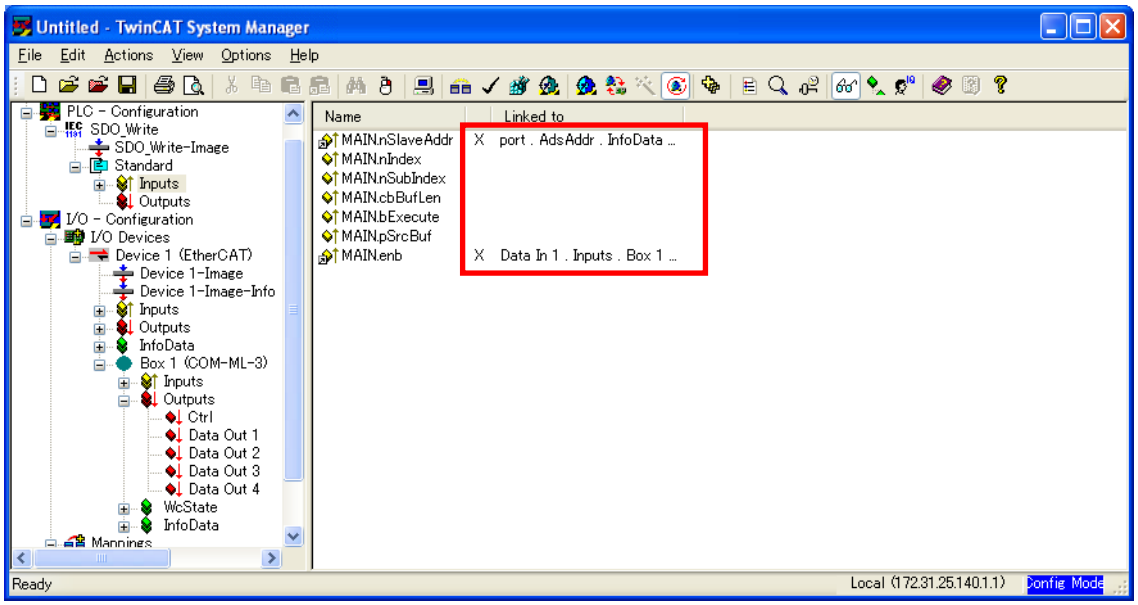
11. Link the data to the parameters being used for the added program. Select "Inputs" at "SDO_Write" in the treeview at the left side of the screen. Then right-click the file name at the right side of the screen and select "Change Link…"
(The image below is for data link to slave address.)



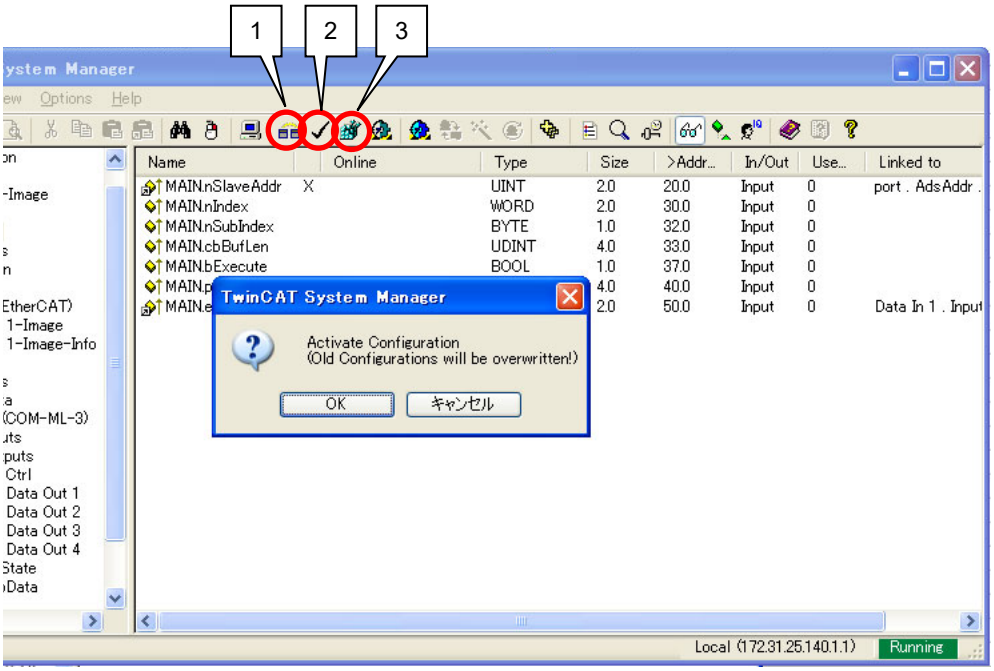
12. When selecting “Change Link…,” the window below displays. Select the destination to link.



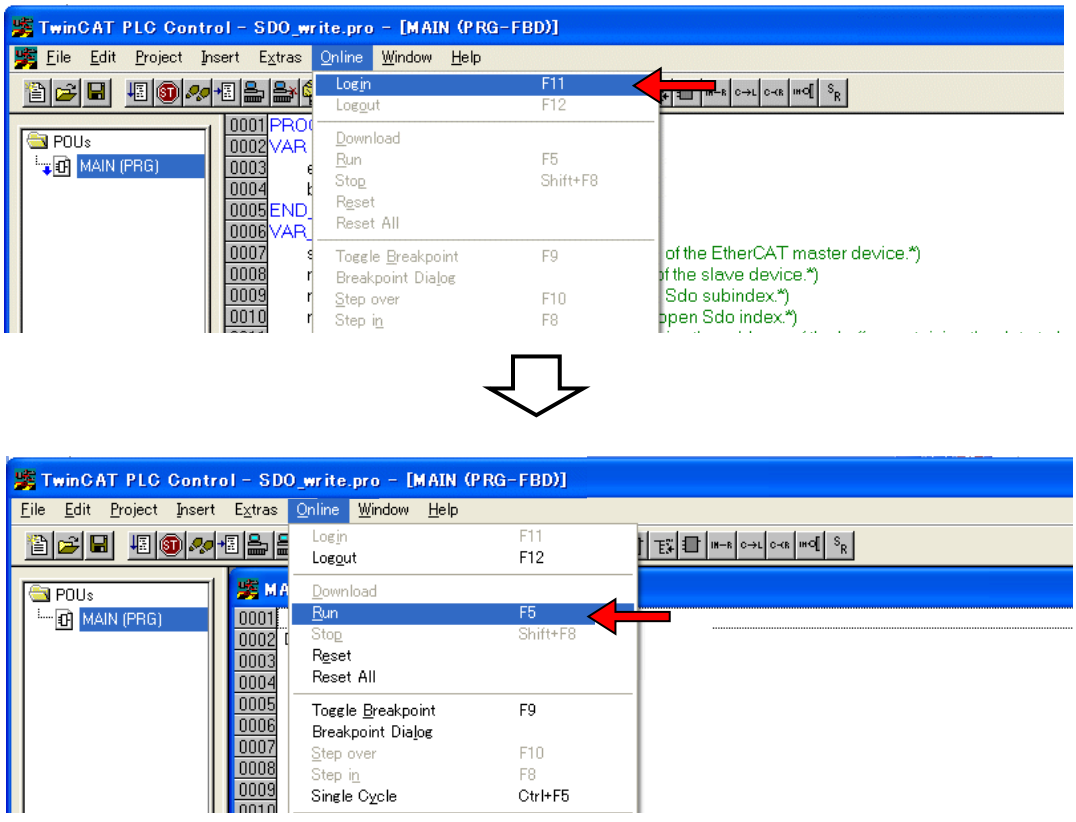
Set as follows for this example.



13. After Data link is completed, click the information icons from 1 to 3 by turns to active the configuration.



14. Go back to TwinCAT PLC Control and execute the program.
Go to “Online” in the Menu bar and select “Login.” Then reopen “Outline” to select “Run.”

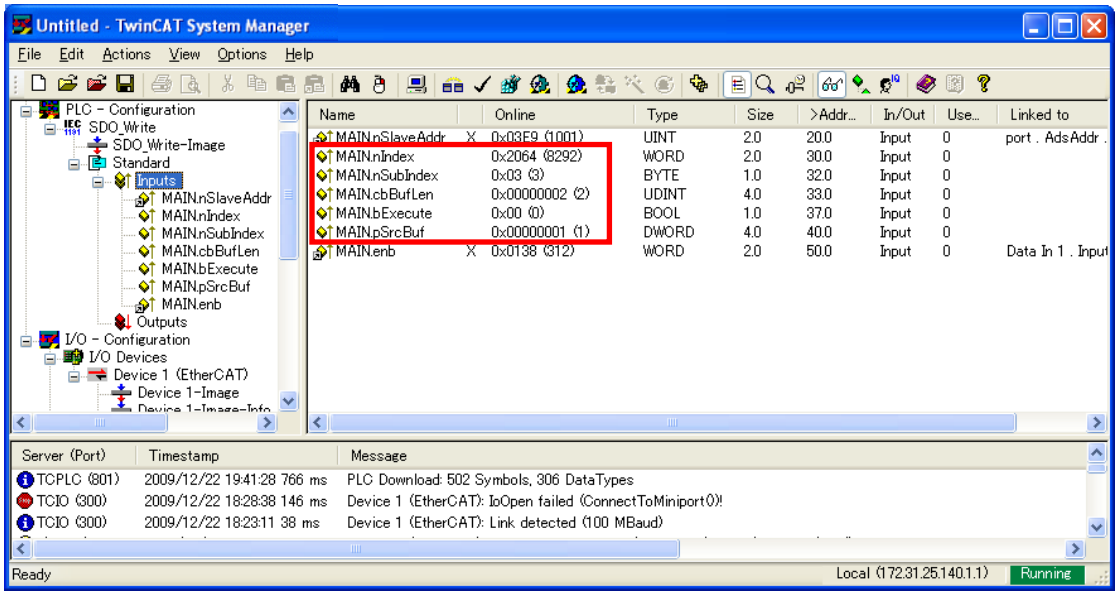


15. After executing the program, go back to TwinCAT System Manager and set parameters.

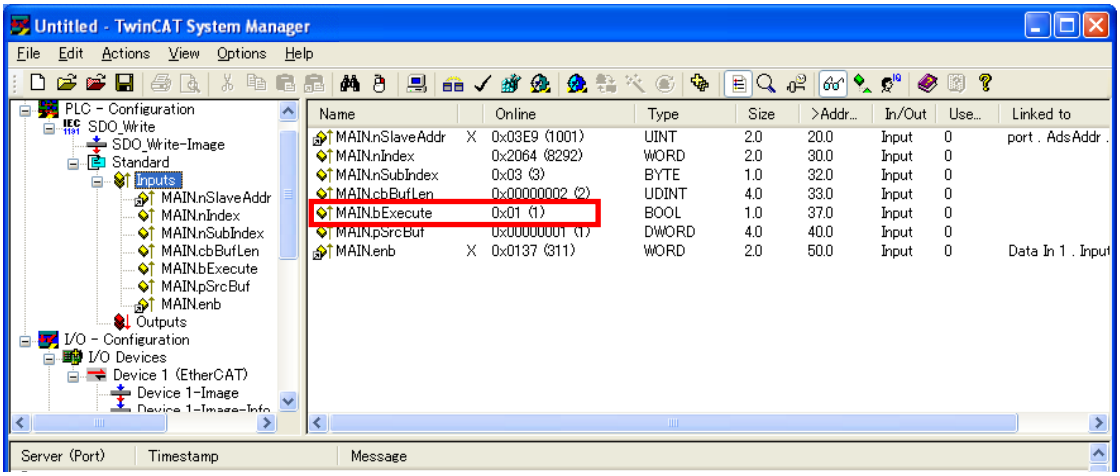
- **Execution example: Switch RUN/STOP from STOP to RUN.**

  Set data of communication item to be used in SDO communication at 0x2064 of the Object dictionary. As RUN/STOP transfer is assigned to Sub-Index003, the setting data is described as follows for this example. (Refer to P. 84.)

  MAIN.nIndex: 0x2064 (Object dictionary: Controller Data)
  MAIN.nSubIndex: 0x03 (Sub-Index number of RUN/STOP transfer)
  MAIN.cbBufLen: 0x00000002 (Data length: 2 bytes)
  MAIN.bExecute: 0x00 (Instruction execution bit: execute at 0 → 1.)
  MAIN.pSrcBuf: 0x00000001 (Set value of RUN/STOP transfer: 0: STOP, 1: RUN)



Start writing via SDO communication when changing the value from 0 to 1 for “MAIN.bExecute.”

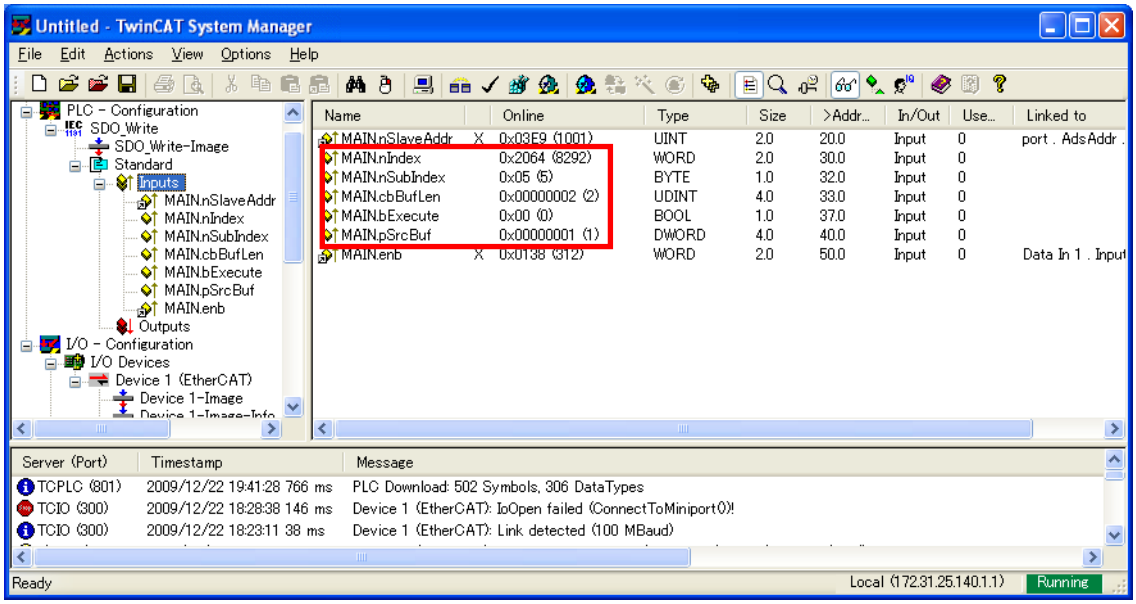


- **Execution example 2: Conduct Autotuning (AT) at Channel 2.**

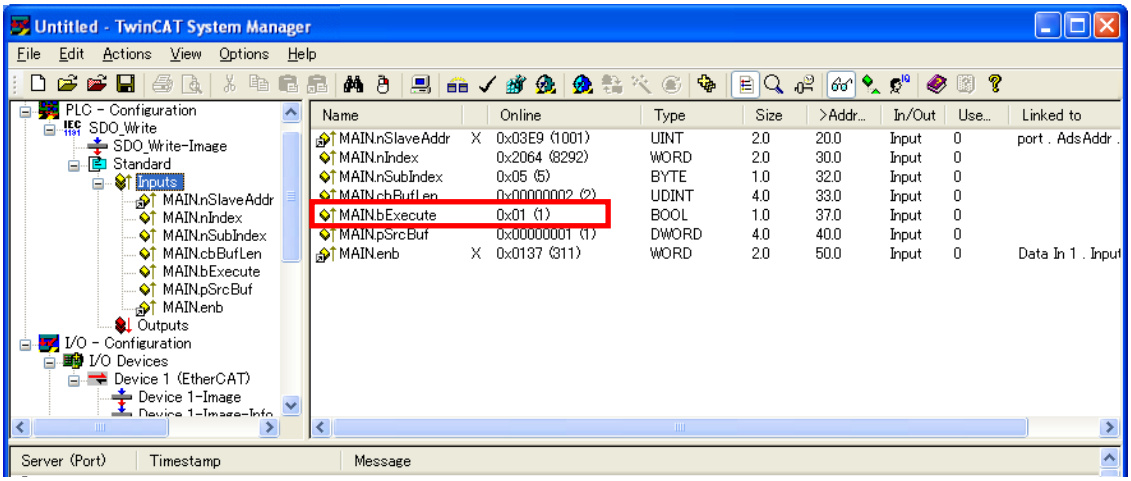
  Set data of communication item to be used in SDO communication at 0x2064 of the Object dictionary. As PID/AT transfer is assigned to Sub-Index005, the setting date is described as follows for this example. (Refer to P. 84.)

  "MAIN.bExecute" should remain "0" at setting change.

  MAIN.nIndex: 0x2064 (Object dictionary: Controller Data)
  MAIN.nSubIndex: 0x05 (Sub-Index number of PID/AT transfer at channel 2)
  MAIN.cbBufLen: 0x00000002 (Data length: 2 bytes)
  MAIN.bExecute: 0x00 (Instruction execution bit: execute at 0 → 1.)
  MAIN.pSrcBuf: 0x00000001 (PID/AT transfer at channel 2: 0: PID, 1: AT)



Start writing via SDO communication when changing the value from 0 to 1 for "MAIN.bExecute."



11. TROUBLESHOOTING

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

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 wiring is completed. Make sure that the wiring is correct before applying power to the instrument.
- 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.

NOTE

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.

■ COM-ML

Problem	Possible cause	Solution
FAIL/RUN lamp does not light up	Power not being supplied	Check external breaker etc.
	Appropriate power supply voltage not being supplied	Check the power supply
	Power supply terminal contact defect	Retighten the terminals
	Power supply section defect	Replace COM-ML
The FAIL/RUN lamp flashes (green): Recoverable fault occur	Data backup error (Error code 2) EEPROM read/write error	Turn off the power to the instrument. If the same error occurs when the power is turned back on, please contact RKC sales office or the agent.
	Stack overflow (Error code 64) Runaway of the program, etc.	
	Network module error (Error code 512) Operational failure of the network module in the COM-ML	Confirm the wiring, remove the noise, and turn off the power to the instrument. If the same error occurs when the power is turned back on, please contact RKC sales office or the agent.
The FAIL/RUN lamp flashes (red): Major fault occur	RAM value abnormal Power suooly voltage monitoring error Watchdog timer error	Turn off the power to the instrument. If the same error occurs when the power is turned back on, please contact RKC sales office or the agent.

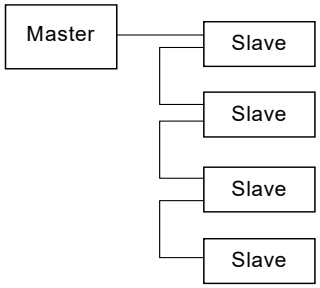
■ EtherCAT

Problem	Possible 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
Link/Activity lamp: OFF	Link has not been established. Destination is not on Ethernet.	Confirm that the power supply is ON and the Ethernet cable is connected correctly. Then permit the connection of the destination device.
ERR lamp: Flashs (red)	PDO data length is not matched.	Confirm the setting at Communication Item Setting (20C5h). For details, refer to **7.1 EtherCAT Communication Settings (P. 26)**.
		Confirm the setting at Communication IN Setting (20C6h). For details, refer to**7.1 EtherCAT Communication Settings (P. 26)** and **10.5.3 COM-ML initial setting (P. 81)**.

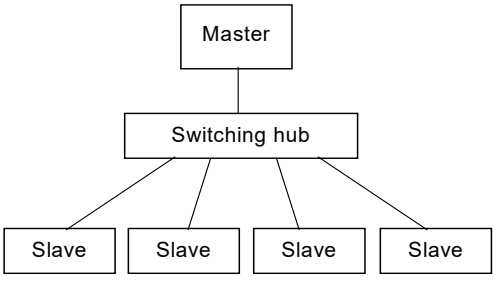
Problem	Possible cause	Solution
ERR lamp: Flashs (red)	PDO data length is not matched.	Confirm the setting at Communication OUT Setting (20C7h). For details, refer to**7.1 EtherCAT Communication Settings (P. 26)** and **10.5.3 COM-ML initial setting (P. 81)**.
ERR lamp: Double flashing (red)	Application watchdog timeout occurs with the Network module.	Turn OFF first and then restore the power supply. If the operation does not recover normally, replace the COM-ML.
ERR lamp: ON (red)	PDI watchdog timeout occurs with the Network module.	Turn OFF first and then restore the power supply. If the operation does not recover normally, replace the COM-ML.
Data cannot be read out via PDO communication.	Reading invalidates data.	Set the value written in the data map as Modbus address at Communication Item Setting (20C5h). For details, refer to **9. COMMUNICATION DATA LIST (P. 36)**.
		Confirm the setting at Communication IN Setting (20C6h). For details, refer to **7.1 EtherCAT Communication Settings (P. 26)**.
		Put the data items into order from the SubIndex being assigned for reading (in ascending order). The maximum number of settable reading data is 128 (2 bytes data × 128 = 256 bytes). For details, refer to **7.1 EtherCAT Communication Settings (P. 26)** and **13. OBJECT DICTIONARY (P.109)**.
Data cannot be written via PDO communication.	Writing invalidates data.	To set data, change the value to “1” at first word of the setting item being assigned with “Setting state selection.” Data cannot be set when the value is other than “1.” For details, refer **13. OBJECT DICTIONARY (P. 109)**.
		Set the value written in the data map as Modbus address at Communication Item Setting (20C5h). For details, refer to **9. COMMUNICATION DATA LIST (P. 36)**.
		Confirm the setting at Communication OUT Setting (20C7h). For details, refer to**7.1 EtherCAT Communication Settings (P. 26)**.

Problem	Possible cause	Solution
Data cannot be written via PDO communication.	Writing invalidates data.	Put the data items into order from the SubIndex being assigned for writing (in ascending order). The maximum number of settable writing data is 127 (2 bytes data × 127 + Setting state selection = 256 bytes). For details, refer to **7.1 EtherCAT Communication Settings (P. 26)** and **13. OBJECT DICTIONARY (P. 109)**.
Data cannot be read out via SDO communication.	Reading invalidates data.	Set the value written in the data map as Modbus address at Communication Item Setting (20C5h). For details, refer to **9. COMMUNICATION DATA LIST (P. 36)**.
Data cannot be written via SDO communication.	Writing invalidates data.	Set the value written in the data map as Modbus address at Communication Item Setting (20C5h). For details, refer to **9. COMMUNICATION DATA LIST (P. 36)**.
		Data cannot be written when the attribute of the access object is Read only.
Some devices cannot access data in daisy-chained connection.	Communication fails at the slave device connected to the master device (by failure, power supply OFF, cable breakage etc.).	Disconnect the failed device from the Daisy chain or change the wiring configuration into Star connection.
		Change the wiring configuration into dual-redundant system by making a new route from the OUT port of the end device to the master device.
Data cannot be sent or written by following the PDO communication cycle.	The performance of the switch is slow or PDO data access route is complicated.	Replace with a high-speed switch.
		Change the wiring configuration into Daisy-chained connection.
		Change configuration of the Star connection. (Partially configure Star connection.)
		Change the PDO communication cycle of the master device.

[Daisy-chained connection]



[Star connection]



■ RKC communication

Problem	Possible 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 computer	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	
EOT return	The specified identifier is invalidated	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 block data length of the transmission exceeds 136 bytes	Divide the block using ETB before sending it
	The specified identifier is invalidated	Confirm the identifier is correct or that with the correct function is specified. Otherwise correct it

■ Modbus

Problem	Possible 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 computer	Confirm the settings and set them correctly
	Wrong address setting	
	There is length of query message exceeds set range	
	A transmission error (overrun error, framing error, parity error or CRC-16 error) is found in the query message	Re-transmit after time-out occurs or verify communication program
	The time interval between adjacent data in the query message is too long, exceeding 24 bit's time	
Error code 1	Function cod error (Specifying nonexistent function code)	Confirm the function code
Error code 2	When the mismatched address is specified	Confirm the address of holding register
Error code 3	• When the specified number of data items in the query message exceeds the maximum number of data items available • When the data written exceeds the setting range	Confirm the setting data
Error code 4	Self-diagnostic error	Turn off the power to the instrument. If the same error occurs when the power is turned back on, please contact RKC sales office or the agent.

12. SPECIFICATIONS

■ EtherCAT communication

Physical layer: 100BASE-TX

User layer: EtherCAT

Corresponding protocol: CANopen over EtherCAT (CoE)

Communication object: Service data objects (SDO),
Process data objects (PDO)

Connector type: RJ-45 × 2 ports

■ Host communication

Interface: Based on EIA, RS-485 standard
Based on EIA, RS-422A standard

Protocol:
- RKC communication
  Based on ANSI X3.28-1976 subcategories 2.5 and 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 of data items available
  4: Self-diagnostic error response

Synchronous method: Start/stop synchronous type

Connection method: RS-485: 2-wire system, half-duplex multi-drop connection
RS-422A: 4-wire system, half-duplex multi-drop connection

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

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

Interval time: 0 to 250 ms

Maximum connections: 16 SRZ units per communication port of host computer

Connection method: Modular juck (6-pin)

Termination resistor: External connection is necessary (Example: 120 Ω, 1/2 W)

■ Loader communication

Interface: Connection with a loader communication cable for our USB converter COM-K2 (sold separately).

Protocol: RKC communication (Based on ANSI X3.28-1976 subcategories 2.5 and B1)

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

Maximum connections: One SRZ unit

■ Self-diagnostic function

● Major fault

Action stop: RAM value abnormal
Power supply voltage monitoring error
Watchdog timer error

Instrument status: Display: A red lamp (FAIL/RUN) is on
Host communication:
Receive mode
Network communication:
Receive mode

Error recovery: Recovery by device power restart after cause of error is removed

● Recoverable fault

Data backup error: Display: A green lamp (FAIL/RUN) frashes
Status: Error code 2

Stack overflow: Display: A green lamp (FAIL/RUN) frashes
Status: Error code 64

Network module error: Display: A green lamp (FAIL/RUN) frashes
Status: Error code 512

■ General specifications

Power supply voltage: 21.6 to 26.4 V DC [Including power supply voltage variation]
(Rating 24 V DC)

Power consumption (at maximum load):
120 mA max. (at 24 V DC)

Rush current: 12 A or less

Insulation resistance: Between power supply terminal and grounding:
20 MΩ or more at 500 V DC
Between host communication terminal and grounding:
20 MΩ or more at 500 V DC
Between power supply terminal and host communication terminal:
20 MΩ or more at 500 V DC
Between power supply terminal and network communication terminal:
20 MΩ or more at 250 V DC

Withstand voltage: Refer to table shown below

Time: 1 min.	①	②	③
① Grounding terminal			
② Power supply terminal	750 V AC		
③ Host communication terminal	750 V AC	750 V AC	
④ Network communication terminal	750 V AC	250 V AC	750 V AC

Power failure: A power failure of 4 ms or less will not affect the control action.

Memory backup: Backed up by non-volatile memory
Number of writing: Approx. 1,000,000 times
Data storage period: Approx. 10 years

Vibration: Equivalent to JIS C1805-3 Clause 7 conformance test
Frequency range: 10 to 150 Hz
Amplitude: < 0.075 mm
Acceleration: < 9.8 m/s^2
Each direction of XYZ axes

Shock: Free fall: Height 50 mm or less
Each direction of XYZ axes (de-energized state)

Allowable ambient temperature:
−10 to +50 °C (14 to 122 °F)

Allowable ambient humidity: 5 to 95 % RH
(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

Operating environment: Avoid the following conditions when selecting the mounting location.
- Rapid changes in ambient temperature which may cause condensation.
- Corrosive or inflammable gases.
- Water, oil, chemicals, vapor or steam splashes.
- Direct air flow from an air conditioner.
- Exposure to direct sunlight.
- Excessive heat accumulation.

Weight: Approx. 130 g

Dimensions: 30.0 × 100.0 × 81.6 mm (W×H×D) (Not including protruding parts)

■ Standard

Safety standards:	UL: UL 61010-1 cUL: CAN/CSA-C22.2 No.61010-1
CE marking:	LVD: EN61010-1 POLLUTION DEGREE 2, Class II (Reinforced insulation) EMC: EN61326-1
RCM:	EN55011

13. OBJECT DICTIONARY

Object dictionary defines the parameters for EtherCAT.

Index	Index Name	Sub-Index	Description	Type	Access	Notes
1000H	Device Type	00H	Device Type	U32	RO	0000 0000h (No profile)
1001H	Error register	00H	Error register	U8	RO	—
1003H	Pre-defined error field	00H	Number of errors	U8	RW	—
		01H ⋮ 05H	Error field	U32	RO	—
1008H	Manufacturer device name	00H	Manufacturer device name	Visible string	RO	COM-ML-3
1009H	Manufacturer hardware version	00H	Manufacturer hardware version	Visible string	RO	1
1011H	Restore parameters	00H	Largest sub index supported	U8	RO	01h
		01H	Restore all default parameters	U32	RW	—
1018H	Identity object	00H	Number of entries	U8	RO	Number of entries
		01H	Vendor ID	U32	RO	0000 0563h
		02H	Product Code	U32	RO	1
		03H	Revision Number	U32	RO	1
		04H	Serial Number	U32	RO	Unique number
1600H	Receive PDO mapping	00H	Number of mapped application objects in PDO	U8	RO	Number of mapped objects (0 to 128)
		01H	Mapped object 1	U32	RO	—
		02H	Mapped object 2	U32	RO	—
		⋮	⋮	⋮	⋮	⋮
		NNH	Mapped object NN	U32	RO	—
1A00H	Transmit PDO mapping	00H	Number of mapped application objects in PDO	U8	RO	Number of mapped objects (0 to 128)
		01H	Mapped object 1	U32	RO	—
		02H	Mapped object 2	U32	RO	—
		⋮	⋮	⋮	⋮	⋮
		NNH	Mapped object NN	U32	RO	—
1C00H	Sync Manager Communication Type	00H	Number of entries	U8	RO	4
		01H	Mailbox wr	U8	RO	1
		02H	Mailbox rd	U8	RO	2
		03H	Process Data out	U8	RO	3
		04H	Process Data in	U8	RO	4
1C12H	Sync Manager Rx PDO Assign	00H	Number of assigned PDOs	U8	RO	1
		01H	Assigned PDO	U16	RO	1600h
1C13H	Sync Manager Tx PDO Assign	00H	Number of assigned PDOs	U8	RO	1
		01H	Assigned PDO	U16	RO	1A00h
1C32H	SM output parameter	00H	Number of entries	U8	RO	1
		01H	Sync mode	U16	RO	0 (FREE_RUN)
1C33H	SM input parameter	00H	Number of entries	U8	RO	1
		01H	Sync mode	U16	RO	0 (FREE_RUN)

Index	Index Name	Sub-Index	Description	Type	Access	Notes
2064H	Controller Data	00H	Number of entries	U8	RO	50
		01H	Data 1	U16	RW	The Modbus register address data specified in the index 20C5H. (Only data used for SDO communication are validated.) When an RO item is written to, the value reverts to the original value several seconds later. Items that are not used are RO, and the data is 0.
		02H	Data 2			
		⋮	⋮			
		32H	Data 50			
20C5H	Communication Item Setting	00H	Number of entries	U8	RO	50
		01H	Item setting of Data 1	U16	RW	Set Modbus resister address of communication item. If not used, set 0xFFFF.
		02H	Item setting of Data 2			
		⋮	⋮			
		32H	Item setting of Data 50			
20C6H	Communication IN Setting	00H	Number of entries	U8	RO	50
		01H	Number of times to use Data 1 as measured data items (IN)	U16	RW	0: Unused, 1 to 128 [a]
		02H	Number of times to use Data 2 as measured data items (IN)			
		⋮	⋮			
		32H	Number of times to use Data 50 as measured data items (IN)			
20C7H	Communication OUT Setting	00H	Number of entries	U8	RO	50
		01H	Number of times to use Data 1 as setting data items (OUT)	U16	RW	0: Unused, 1 to 127 [b]
		02H	Number of times to use Data 2 as setting data items (OUT)			
		⋮	⋮			
		32H	Number of times to use Data 50 as setting data items (OUT)			

[a] A cumulative number of data items of up to 128 from Sub-Index 01H is validated. A setting above this will be disregarded.

[b] A cumulative number of data items of up to 127 from Sub-Index 01H is validated. A setting above this will be disregarded.

Regardless of the setting of Index 20C7H (Communication OUT Setting), “Setting state selection” is assigned to the first-word of the setting data item (OUT).

	Description	Type	Access	Notes
First-word of setting data item (OUT)	Setting state selection	U16	RW	Bit data Bit 0: Data setting disabled/enabled 0: Setting disable 1: Setting enable Bit 1 to Bit 15: Unused

APPENDIX.
HOST COMMUNICATION PROTOCOL

A.1 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 SRZ unit to send data:
- Response wait time after SRZ unit sends BCC in polling procedure
- Response wait time after SRZ unit sends ACK or NAK in selecting procedure

RKC communication (Polling procedure)

Procedure details	Time
Response send time after controller receives ENQ	60 ms max.
Response send time after controller receives ACK	60 ms max.
Response send time after controller receives NAK	60 ms max.
Response send time after controller sends BCC	2 ms max.

RKC communication (Selecting procedure)

Procedure details	Time
Response send time after controller receives BCC	60 ms max. *
Response wait time after controller sends ACK	2 ms max.
Response wait time after controller sends NAK	2 ms max.

Modbus

Procedure details	Time
Read holding registers [03H] Response send time after the slave receives the query message	60 ms max.
Preset single register [06H] Response send time after the slave receives the query message	100 ms max.
Diagnostics (loopback test) [08H] Response send time after the slave receives the query message	30 ms max.
Preset multiple registers [10H] Response send time after the slave receives the query message	100 ms max. *

* In the case of RKC communication (selecting procedure), the time will be "the time after BCC reception until an acknowledgement [ACK] is sent."
- When successive changes are made to the setting of the same item
  [Example] Successive changes to a Set value (SV), control by manual manipulated output value, etc.
- When successive changes are made to multiple items
  [Example] Configuring initial settings

Processing times (Varies with the function module types.)

Function module (When connected maximum connection number)	Time
Setting items of the Z-TIO module	750 ms max.
Setting items of the Z-DIO module	2000 ms max.

■ Caution for selecting

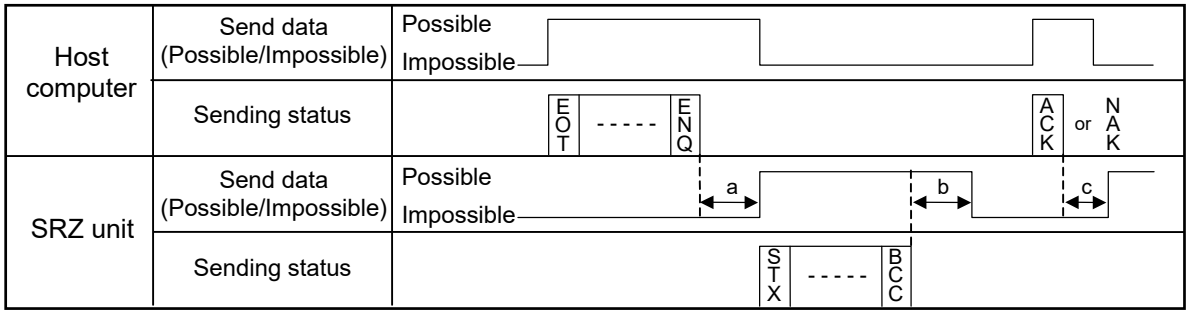
When selecting of the following communication data of a Z-TIO module is performed, the next selecting procedure for the changed Z-TIO module will not be possible for 4 to 6 seconds.
For this reason, when there are many channels to be changed, do not perform selecting for each channel individually; perform selecting for all channels at once. Note that if the communication data exceeds 136 bytes, the data will be separated into blocks by ETB.

- Input type
- Decimal point position
- Integral/derivative time decimal point position

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

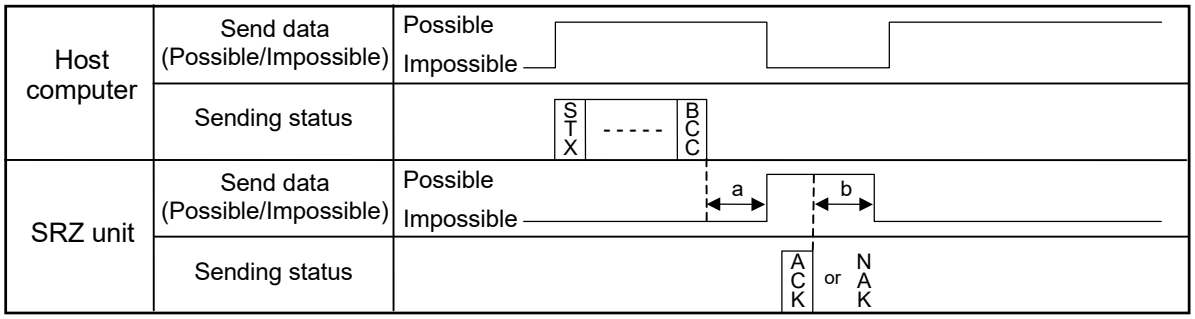
RS-485 communication is conducted through two wires, therefore the transmission and reception of data requires precise timing.

● Polling procedure



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

● Selecting procedure



a: Response send time after the controller receives BCC + Interval time
b: Response wait time after the controller sends ACK or Response wait time after the controller sends NAK

To switch the host computer from transmission to reception, send data must be on line.

The following processing times are required for the SRZ unit to process data.
- In Polling procedure, Response wait time after the SRZ unit sends BCC
- In Selecting procedure, Response wait time after the SRZ unit sends ACK or NAK

■ 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.

A.2 RKC Communication Protocol

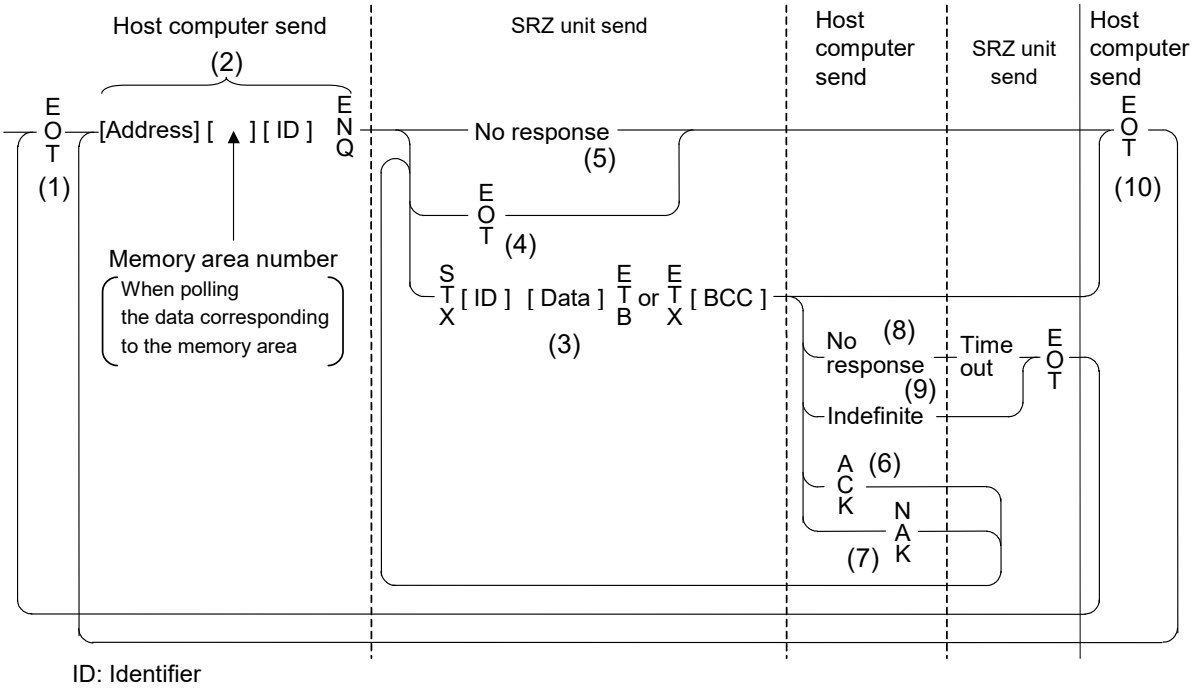
RKC communication uses the Polling/Selecting method to establish a data link. The basic procedure is followed ANSI X3.28-1976 subcategories 2.5 and B1 basic mode data transmission control procedure (Fast selecting is the selecting method used in SRZ unit).

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

A.2.1 Polling procedures

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



(1) Data link initialization

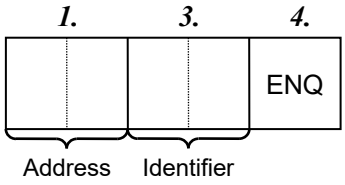
Host computer sends EOT to the controllers to initiate data link before polling sequence.

(2) Data sent from host computer - Polling sequence

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

- When no Memory area number is specified

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

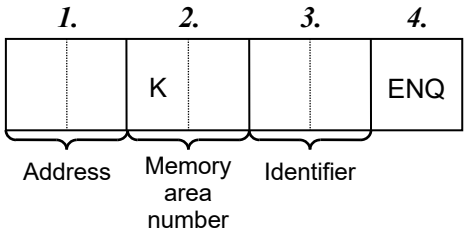


Example:

0	1	M	1	ENQ

- When the Memory area number is specified

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



Example:

0	1	K	1	S	1	ENQ

1. Address (2 digits)
This data is a unit address of the SRZ for polled and must be the same as the unit address set value in item **5.1 Address Setting (P. 21)**.


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

2. Memory area number (2 digits)
This is the identifier to specify the Memory area number. It is expressed by K1 to K8 to each Memory area number (from 1 to 8). If the Memory area number is assigned with K0, this represents that Control area is specified.


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


If the Memory area number is not specified when polling the identifier corresponding to the memory area, this represents that the Control area is specified.


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

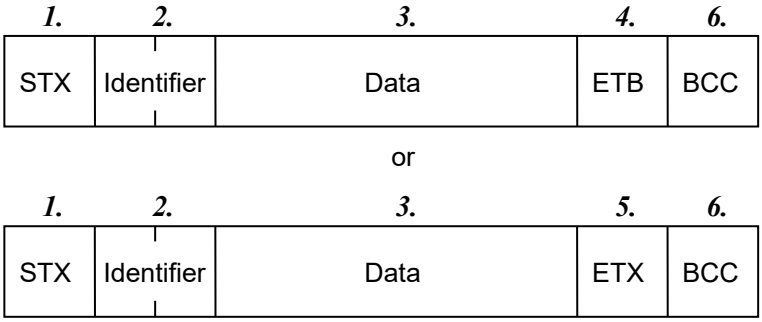
3. Identifier (2 digits)
The identifier specifies the type of data that is requested from the SRZ unit. Always attach the ENQ code to the end of the identifier.


Refer to **9. COMMUNICATION DATA LIST (P. 36)**.

4. 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 SRZ unit.

(3) Data sent from the SRZ unit

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



📖 If the length of send data (from STX to BCC) exceeds 136 bytes, it is divided into blocks by ETB. In this case, the succeeding divided data is sent after STX.

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

2. Identifier (2 digits)
The identifier indicates the type of data (measured value, status and set value) sent to the host computer.

☞ For the communication data, refer to **9. COMMUNICATION DATA LIST (P. 36)**.

3. Data
Data which is indicated by an identifier of SRZ unit, consisting of channel numbers, data, etc. Each channel number and data are delimited by a space (20H). The data and the next channel number are delimited by a comma (2CH).

- Channel number: 3-digit ASCII code, not zero-suppressed. Channels without channel numbers may exist depending on the type of identifier.
- Data: ASCII code, zero-suppressed with spaces (20H). The number of digits varies depending on the type of identifier.

📖 Memory area soak time monitor and Area soak time become the following data:
- When data range is 0 hour 00 minute to 99 hours 59 minutes:
  Data range is 0:00 to 99:59, punctuation of time unit is expressed in colon ": (3AH)."
- When data range is 0 minute 00 second to 199 minutes 59 seconds:
  Data range is 0:00 to 199:59, punctuation of time unit is expressed in colon ": (3AH)."

📖 "0" (without a decimal point) is sent for unused channels and for data that is invalidated due to the function selection.

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).

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

Example:

STX	M	1	0	0	1				1	5	0	.	0	ETX	BCC
	4DH	31H	30H	30H	31H	20H	20H	20H	31H	35H	30H	2EH	30H	03H	←

Hexadecimal numbers

BCC = 4DH ⊕ 31H ⊕ 30H ⊕ 30H ⊕ 31H ⊕ 20H ⊕ 20H ⊕ 20H ⊕ 31H ⊕ 35H ⊕ 30H ⊕ 2EH ⊕ 30H ⊕ 03H = 44H

(⊕: *Exclusive OR*)

Value of BCC becomes 44H

(4) EOT send (Ending data transmission from the SRZ unit)

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

- When the specified identifier is invalidated
- When there is an error in the data format
- When all the data has been sent
- When the module that relates to the identifier is not connected

(5) No response from the SRZ unit

The SRZ unit 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 SRZ unit receives ACK from the host computer, the SRZ unit will send any remaining data of the next identifier without additional action from the host computer. When host computer determines to terminate the data link, EOT is sent from the host computer.

- When ACK is received after ETX and BCC are sent, the next identifier data is sent according to the order of the communication data list.
- When ACK is received after ETB and BCC are sent, the data after ETB is sent.

(7) NAK (Negative acknowledge)

If the host computer does not receive correct data from the SRZ unit, it sends a negative acknowledgment NAK to the SRZ unit. The SRZ unit 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.
The format of the data that an SRZ unit re-sends is as follows.

STX	Identifier	Data	ETB or ETX	BCC

(8) No response from host computer

When the host computer does not respond within approximately three seconds after the SRZ unit sends data, the SRZ unit sends EOT to terminate the data link (time-out time: about 3 seconds).

(9) Indefinite response from host computer

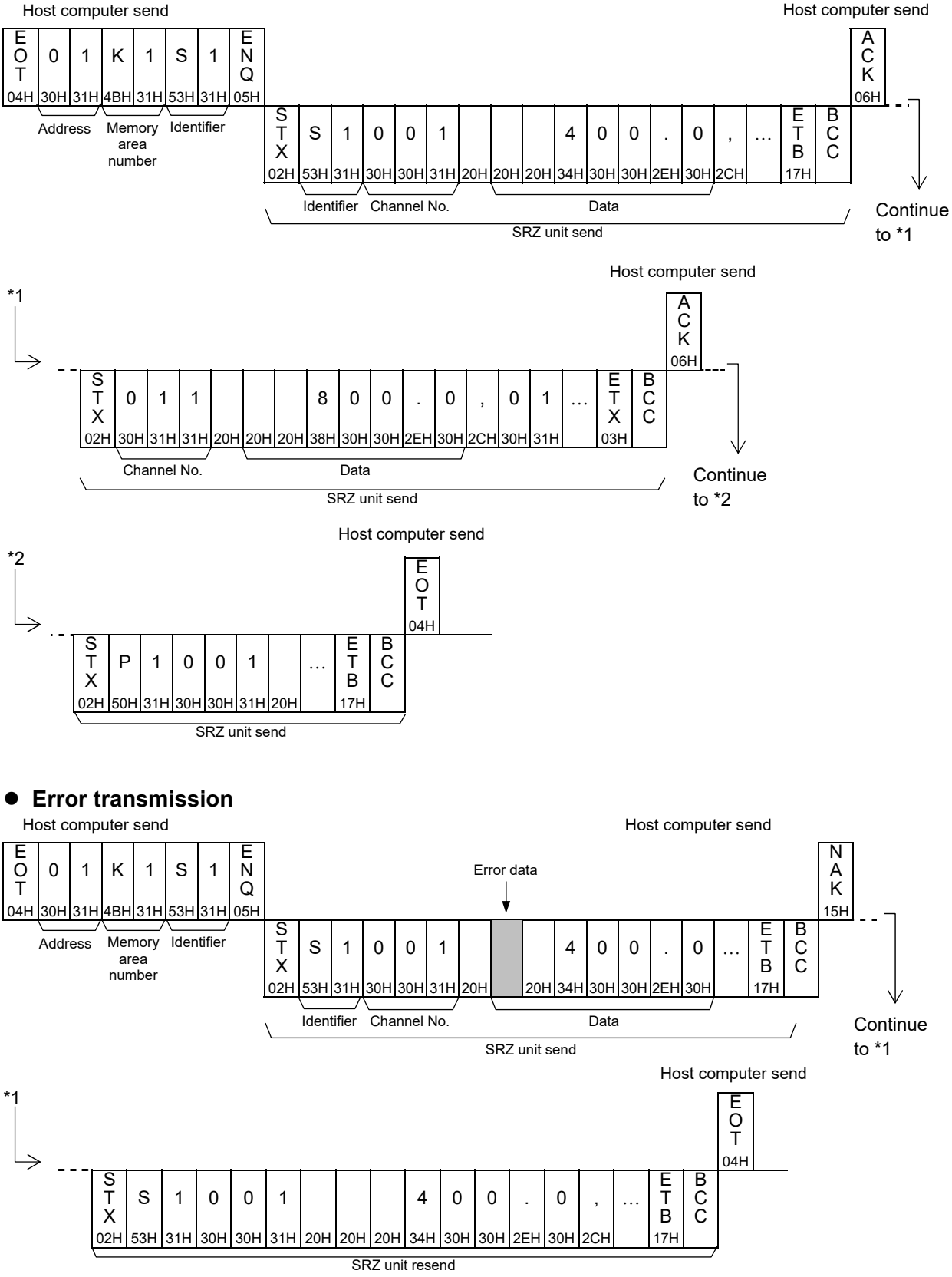
The SRZ unit sends EOT to terminate the data link when the host computer response is indefinite.

(10) EOT (Data link termination)

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

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

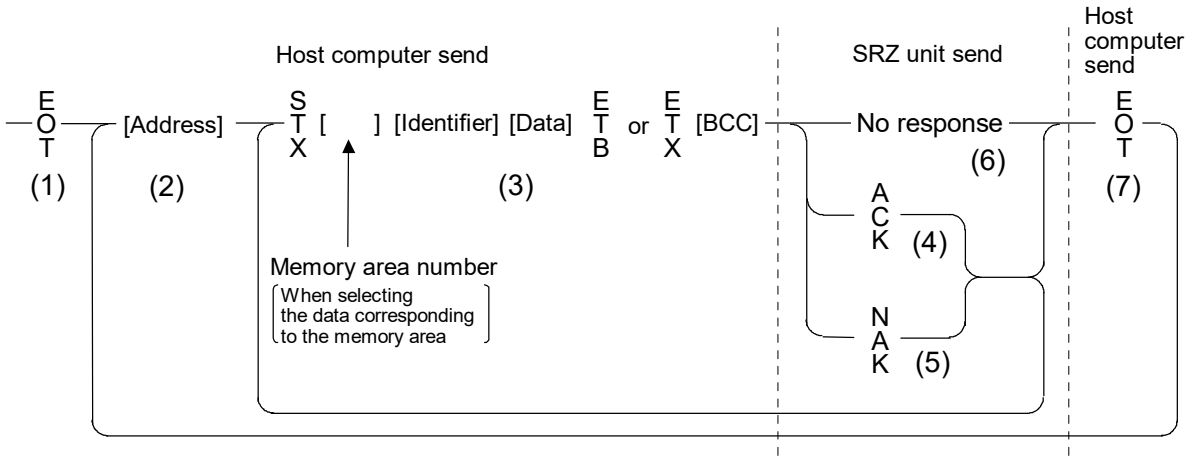
● Normal transmission



● Error transmission

A.2.2 Selecting procedures

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



(1) Data link initialization

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

(2) Sending selecting address from the host computer

Host computer sends selecting address for the selecting sequence.

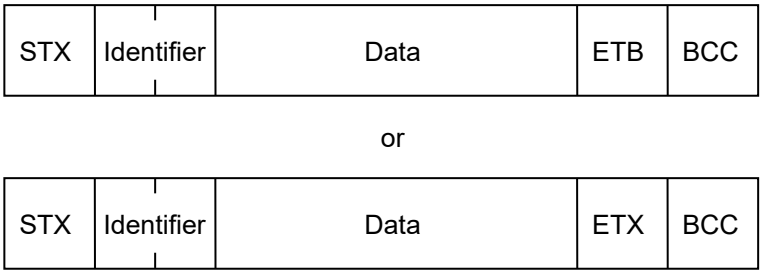
Address (2 digits):
This data is a unit address of the SRZ to be selected and must be the same as the unit address set value in item **5.1 Address setting (P. 21)**.

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

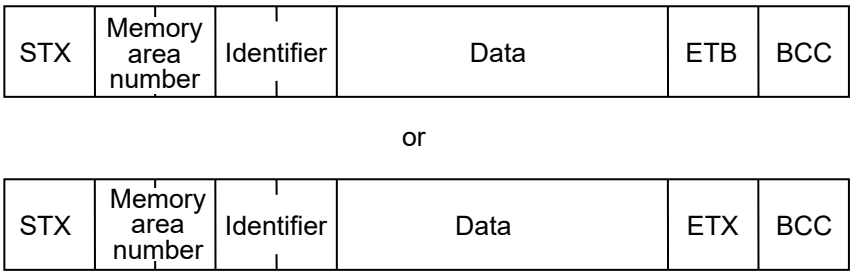
(3) Data sent from the host computer

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

- When no memory area number is specified



- When the memory area number is specified



☞ For the STX, Memory area number Identifier, Data, ETB, ETX and BCC, refer to **A.2.1 Polling procedures (P. 113)**.

📖 If the length of send data (from STX to BCC) exceeds 136 bytes, it is divided into blocks by ETB. In this case, the succeeding divided data is sent after STX.

📖 Area soak time set data as the following:

- When data range is 0 hour 00 minute to 99 hours 59 minutes:
  Data range is 0:00 to 99:59, punctuation of time unit is expressed in colon ": (3AH)."
- When data range is 0 minute 00 second to 199 minutes 59 seconds:
  Data range is 0:00 to 199.59, punctuation of time unit is expressed in colon ": (3AH)."

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

Example: 1:65 (1 hour 65 minutes) → 2:05 (2 hours 05 minutes)
0:65 (0 minute 65 seconds)→ 1:05 (1 minute 05 seconds)

- **About numerical data**

[The data that receipt of letter is possible]

- Data with numbers below the decimal point omitted or zero-suppressed data can be received.
  (Number of digits: Within 7 digits)
  <Example>
  When data send with −001.5, −01.5, −1.5, −1.50, −1.500 at the time of −1.5, SRZ unit can receive a data.

- When the host computer sends data with decimal point to item of without decimal point, the SRZ unit receives a message with the value that cut off below the decimal point.
  <Example>
  When setting range is 0 to 200, the SRZ unit receives as a following.

Send data	0.5	100.5
Receive data	0	100

- The SRZ unit receives value in accordance with decided place after the decimal point. The value below the decided place after the decimal point is cut off.
  <Example>
  When setting range is −10.00 to +10.00, the controller receives as a following.

Send data	−.5	−.058	.05	−0
Receive data	−0.50	−0.05	0.05	0.00

If the host computer sends “decimal point only (.)” or “minus sign and decimal point only (-.),” the SRZ unit receives this as “0.” However, the decimal point position will be the same as the decimal point position of the transmitted data item.

[The data that receipt of letter is impossible]

The SRZ unit sends NAK when received a following data.

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

(4) ACK (Acknowledgment)

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

(5) NAK (Negative acknowledge)

If the SRZ unit 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 send conditions of NAK (after reception of ETX or BCC)

- When an error occurs on communication the line (parity, framing error, etc.)
- When a BCC check error occurs
- When the specified identifier is invalidated
- When receive data exceeds the setting range
- When receive data is the identifier of RO (read only)
- When the module related to the identifier received by the SRZ is not connected

The send conditions of NAK (after reception of ETB or BCC)

- When a BCC check error occurs

(6) No response from SRZ unit

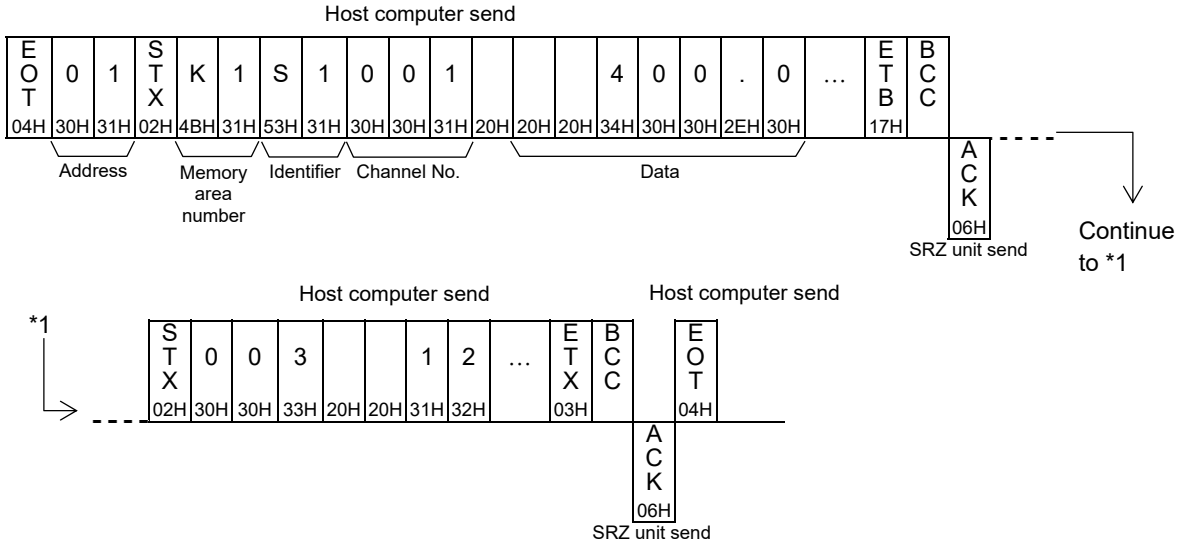
The SRZ unit does not respond when it can not receive the selecting address, STX, ETB, ETX or BCC.

(7) EOT (Data link termination)

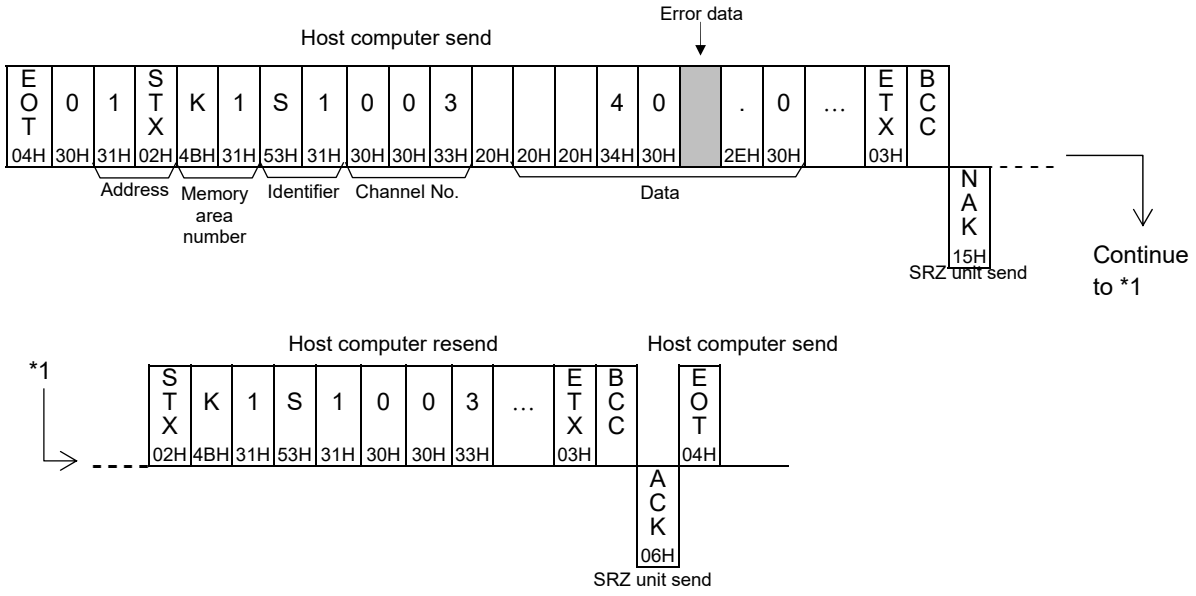
The host computer sends EOT when there is no more data to be sent from the host computer or there is no response from the SRZ unit.

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

● Normal transmission



● Error transmission



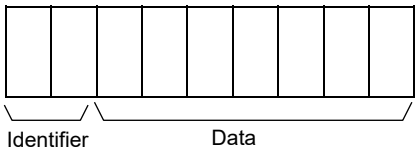
A.2.3 Communication data structure

■ Data description

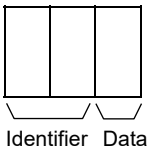
Part of the data above is shown below.

● Data for each unit (Without channel)

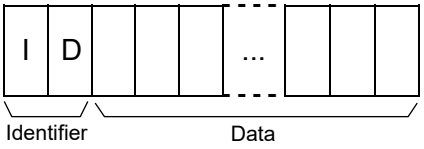
Data length 7 digits



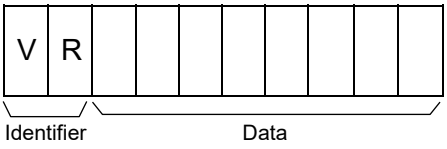
Data length 1 digit



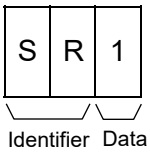
Data length 32 digits (Model code)



Data length 8 digits (ROM version)

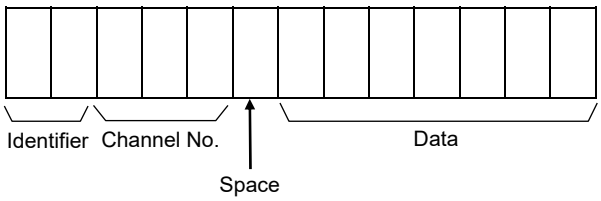


Example) Data structure for control RUN/STOP switching in each SRZ unit

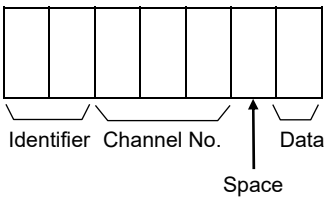


● Data for each module

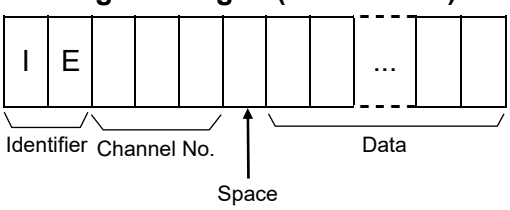
Data length 7 digits



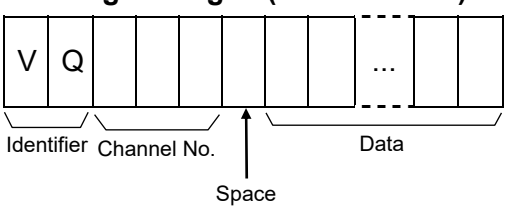
Data length 1 digit



Data length 32 digits (Model code)

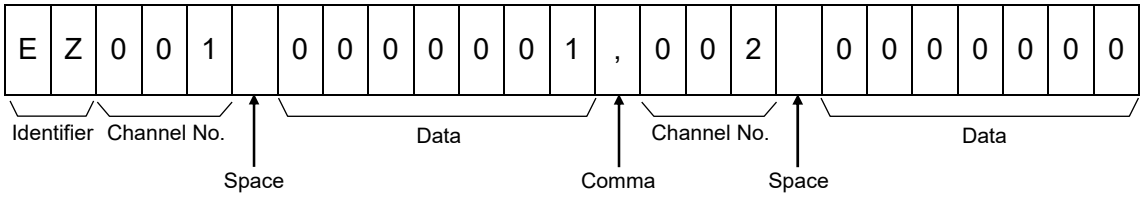


Data length 8 digits (ROM version)



Continued on the next page.

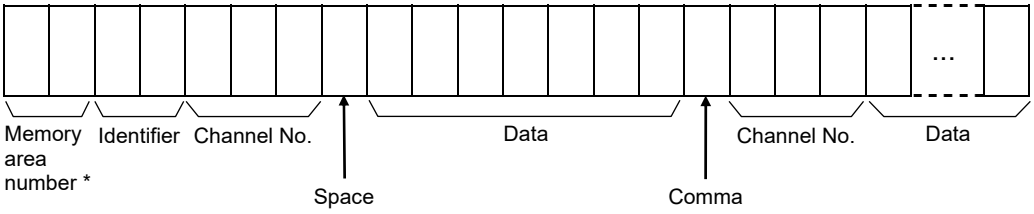
Example) Data structure of error codes of Z-TIO, Z-DIO and Z-CT modules



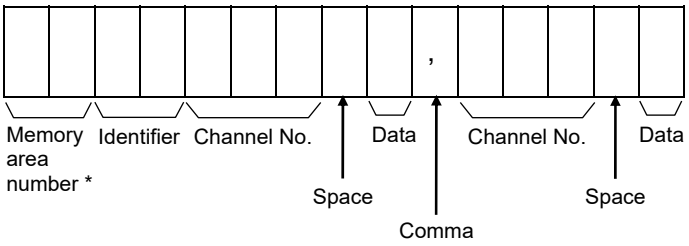
☞ For the calculation method of the channel number, refer to **6.2 Temperature Control Channel of the SRZ (P. 24)** and **6.3 Digital Input/Output Channel of Z-DIO Module (P. 25)**.

- **Data for each channel**

Data length 7 digits

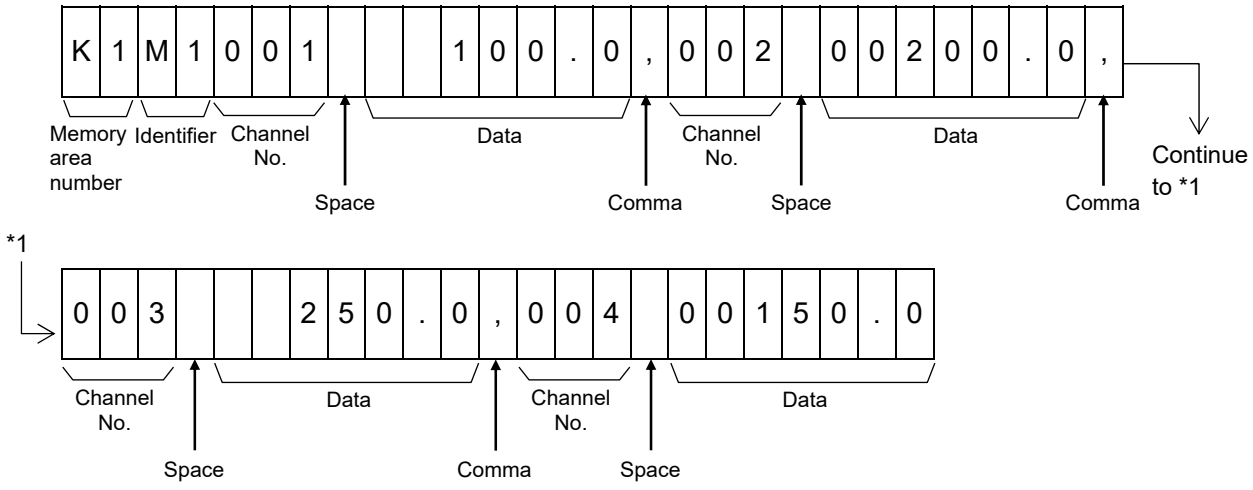


Data length 1 digit



* To select data corresponding to a memory area, specify the number of the appropriate memory area.
If a memory area number is specified for data that does not correspond to a memory area, the specification will be invalidated.

Example) Data configuration of measured value (PV) of Z-TIO module



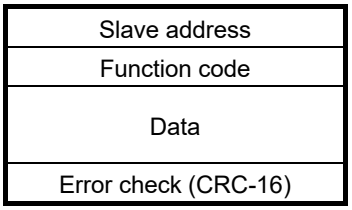
☞ For the calculation method of the channel number, refer to **6.2 Temperature Control Channel of the SRZ (P. 24)** and **6.3 Digital Input/Output Channel of Z-DIO Module (P. 25)**.

A.3 Modbus 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 (SRZ unit). 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.

A.3.1 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 F manually set at the address setting switch located at the front of Z-COM module.

☞ For details, refer to **5.1 Address Setting (P. 21)**.

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, refer to **A.3.2 Function code (P. 127)**.

■ 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, refer to **A.3.6 Register read and write (P. 132)**, **A.3.7 Data processing precautions (P. 136)** and **9. COMMUNICATION DATA LIST (P. 36)**.

■ Error check

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

☞ For details, refer to **A.3.5 Calculating CRC-16 (P. 129)**.

A.3.2 Function code

- **Function code contents**

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

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

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

A.3.3 Communication mode

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

Items	Contents
Data bit length	8-bit (Binary)
Start mark of message	Unused
End mark of message	Unused
Message length	Refer to **A.3.2 Function code**
Data time interval	Less than 24-bit 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-bit time. If time intervals become time longer than the 24-bit time 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.3.4 Slave responses

(1) Normal response

- In the response message of the Read Holding Registers, the slave returns the read out data and the number of data items with the same slave address and function code as the query message.
- In the response message of the Preset Single Register, the slave returns the same message as the query message.
- In the response message of the Diagnostics (Loopback test), the slave returns the same message as the query message.
- In the response message of the Preset Multiple Registers, the slave returns the slave address, the function code, starting number, and number of holding registers in the multi-query message.

(2) Defective message response

- If the query message from the master is defective, except for transmission error, the slave (SRZ unit) returns the error response message without any action.

  Example: If there is a problem in the data range of CH3 when writing data of four channels, the data of CH1 and CH2 will be written. The data of CH3 and CH4 will be disregarded and an error response message will be returned.

Slave address
Function code
Error code
Error check CRC-16

Error response message

- If the self-diagnostic function of the slave (SRZ unit) detects an error, the slave (SRZ unit) will return an error response message to all query messages.
- The function code of each error response message is obtained by adding 80H to the function code of the query message.

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

(3) No response

The slave (SRZ unit) ignores the query message and does not respond when:

- The slave address in the query message does not coincide with any slave address settings.
- The CRC code of the master does not coincide with that of the slave.
- Transmission error such as overrun, framing, parity and etc., is found in the query message.
- Data time interval in the query message from the master exceeds 24-bit time.

A.3.5 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 bits) of the message with the CRC register. Return the result to the CRC register.

3. Shift the CRC register 1 bit to the right.

4. If the carry flag is 1, *exclusive OR* the CRC register with A001 hex and return the result to the CRC register. If the carry flag is 0, repeat step ***3***.

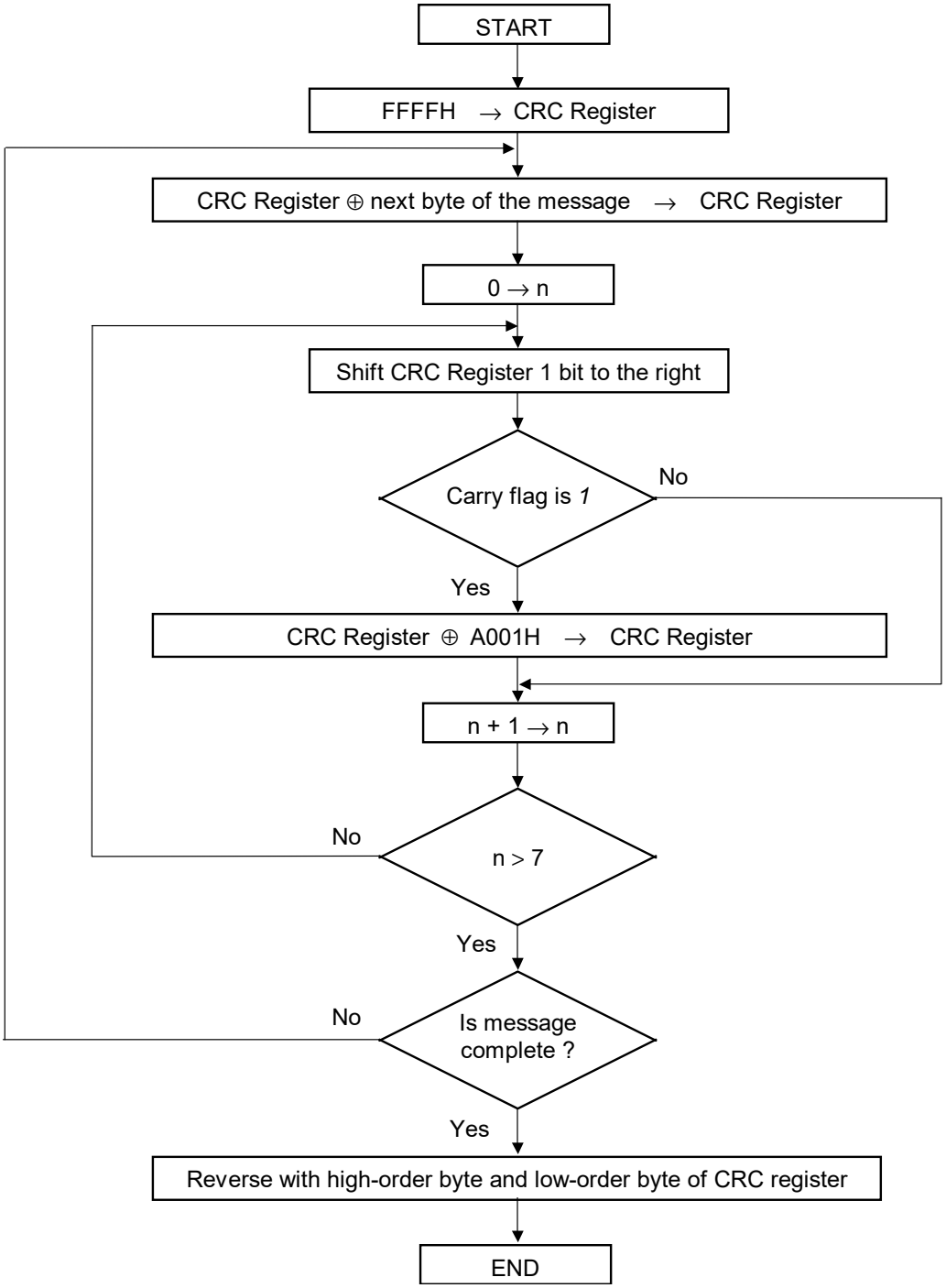
5. Repeat step ***3*** and ***4*** until there have been 8 shifts.

6. *Exclusive OR* the next byte (8 bits) of the message with the CRC register.

7. Repeat step ***3*** through ***6*** for all bytes of the message (except the CRC).

8. The CRC register contains the 2 byte CRC error code. When they are appended to the message, the low-order byte is appended first, followed by the high-order byte.

■ The flow chart of CRC-16



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

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

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

uint16 calculate_crc（byte *z_p, unit16 z_message_length）

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

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

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

A.3.6 Register read and write

■ Read holding registers [03H]

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

Example: The contents of the four holding registers from 01FCH to 01FFH are the read out from slave address 2.

Query message

Slave address		02H	
Function code		03H	
Starting number	High	01H	First holding register address
	Low	FCH	
Quantity	High	00H	The setting must be between 1 (0001H) and 125 (007DH).
	Low	04H	
CRC-16	High	85H	
	Low	F6H	

Normal response message

Slave address		02H	
Function code		03H	
Number of data		08H	→ Number of holding registers × 2
First holding register contents	High	01H	
	Low	24H	
Next holding register contents	High	01H	
	Low	1BH	
Next holding register contents	High	01H	
	Low	2BH	
Next holding register contents	High	01H	
	Low	22H	
CRC-16	High	AAH	
	Low	F3H	

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 0ADCH of slave address 1.

Query message

Slave address		01H
Function code		06H
Holding register number	High	0AH
	Low	DCH
Write data	High	00H
	Low	64H
CRC-16	High	4AH
	Low	03H

} Any data within the range

Normal response message

Slave address		01H
Function code		06H
Holding register number	High	0AH
	Low	DCH
Write data	High	00H
	Low	64H
CRC-16	High	4AH
	Low	03H

} Contents will be the same as query message

Error response message

Slave address		01H
80H + Function code		86H
Error code		02H
CRC-16	High	C3H
	Low	A1H

■ Diagnostics (Loopback test) [08H]

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

Example: Loopback test for slave address 1

Query message

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

Normal response message

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

Error response message

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

■ 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 0ADCH to 0ADDH of slave address 1.

Query message

Slave address		01H	
Function code		10H	
Starting number	High	0AH	First holding register address
	Low	DCH	
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	Any pertinent data
	Low	64H	
Data to next register	High	00H	
	Low	64H	
CRC-16	High	C0H	
	Low	32H	

Normal response message

Slave address		01H
Function code		10H
Starting number	High	0AH
	Low	DCH
Quantity	High	00H
	Low	02H
CRC-16	High	83H
	Low	EAH

Error response message

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

A.3.7 Data processing precautions

- 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.

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

  Example1: When Heater break alarm (HBA) set value is 20.0 A, 20.0 is processed as 200, 200 = 00C8H

Heater break alarm (HBA) set value	High	00H
	Low	C8H

  Example2: When "Set value (SV)" is −20.0 °C, −20.0 is processed as −200, −200 = 0000H − 00C8H = FF38H

Set value (SV)	High	FFH
	Low	38H

- In this communication, the data that memory area includes handles different address with for Control area and for setting area.
- If data (holding register) exceeding the accessible address range is accessed, an error response message is returned.
- Read data of unused item is a default value.
- Any attempt to write to an unused item is not processed as an error. Data cannot be written into an unused item.
- If an error (data range error or address error) is detected in the data writing process, an error is returned. Writing is aborted at and after the addresses where an error occurred. After having completed the setting, check to see if the data was properly written.
- An attribute of the item for functions which are not in the controller is RO (read only). If read action to this item is performed, the read data will be "0." If write action to this item is performed, no error message is indicated and no data is written.

  For details, refer to **9. COMMUNICATION DATA LIST (P. 36)**.

- Commands should be sent at time intervals of 24 bits after the master receives the response message.

A.3.8 How to use memory area data

Memory area function can store up to 8 individual sets of SVs and parameters. One of the areas is used for control, and the currently selected area is Control area.
Memory area data can be used to check and change settings that belong to memory areas other than the Control area. Reading and writing of memory area data is performed by channel.

■ Read and write of memory area data

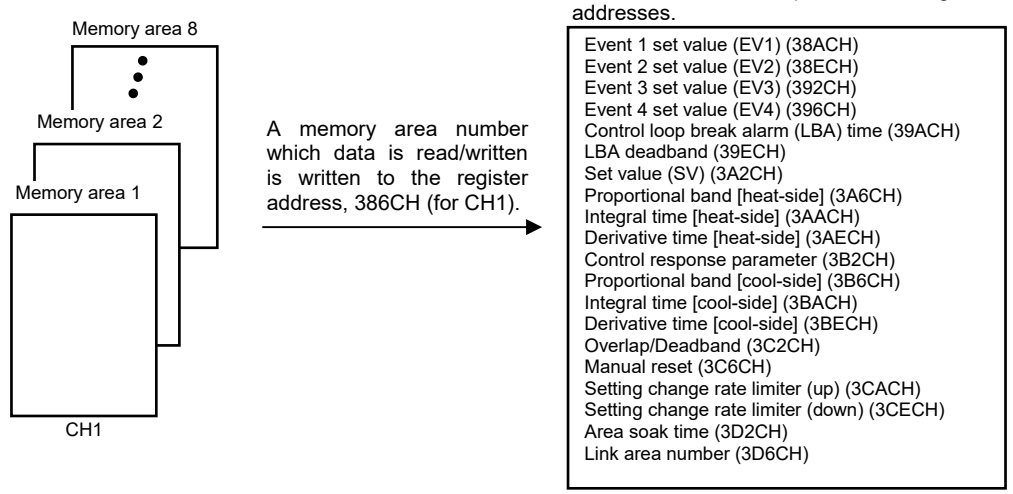
If any Memory area number to perform data read and write is specified by the Setting memory area number (386CH to 38ABH), data corresponding to the specified memory area number is called up to the register addresses from 38ACH to 3DABH. By using these register addresses from 38ACH to 3DABH, it becomes possible to read and write data in any memory area.

	Register address			
	CH1	CH2	·····	CH64
Setting memory area number	386CH	386DH	·····	38ABH
Event 1 set value (EV1)	38ACH	38ADH	·····	38EBH
Event 2 set value (EV2)	38ECH	38EDH	·····	392BH
Event 3 set value (EV3)	392CH	392DH	·····	396BH
Event 4 set value (EV4)	396CH	396DH	·····	39ABH
Control loop break alarm (LBA) time	39ACH	39ADH	·····	39EBH
LBA deadband	39ECH	39EDH	·····	3A2BH
Set value (SV)	3A2CH	3A2DH	·····	3A6BH
Proportional band [heat-side]	3A6CH	3A6DH	·····	3AABH
Integral time [heat-side]	3AACH	3AADH	·····	3AEBH
Derivative time [heat-side]	3AECH	3AEDH	·····	3B2BH
Control response parameter	3B2CH	3B2DH	·····	3B6BH
Proportional band [cool-side]	3B6CH	3B6DH	·····	3BABH
Integral time [cool-side]	3BACH	3BADH	·····	3BEBH
Derivative time [cool-side]	3BECH	3BEDH	·····	3C2BH
Overlap/Deadband	3C2CH	3C2DH	·····	3C6BH
Manual reset	3C6CH	3C6DH	·····	3CABH
Setting change rate limiter (up)	3CACH	3CADH	·····	3CEBH
Setting change rate limiter (down)	3CECH	3CEDH	·····	3D2BH
Area soak time	3D2CH	3D2DH	·····	3D6BH
Link area number	3D6CH	3D6DH	·····	3DABH

← Register address to specify memory area

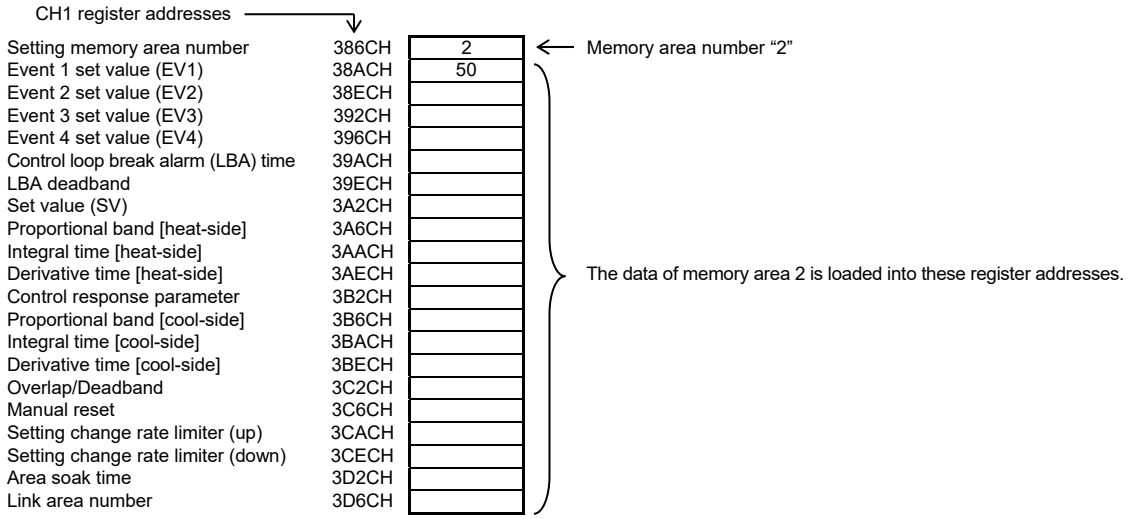
Register address of memory area data

☞ For the Memory area data list, refer to **9.4 Memory Area Data Address of Z-TIO Module (P. 64)**.



[Example 1] When data on the Event 1 set value in Memory area 2 of CH1 is read

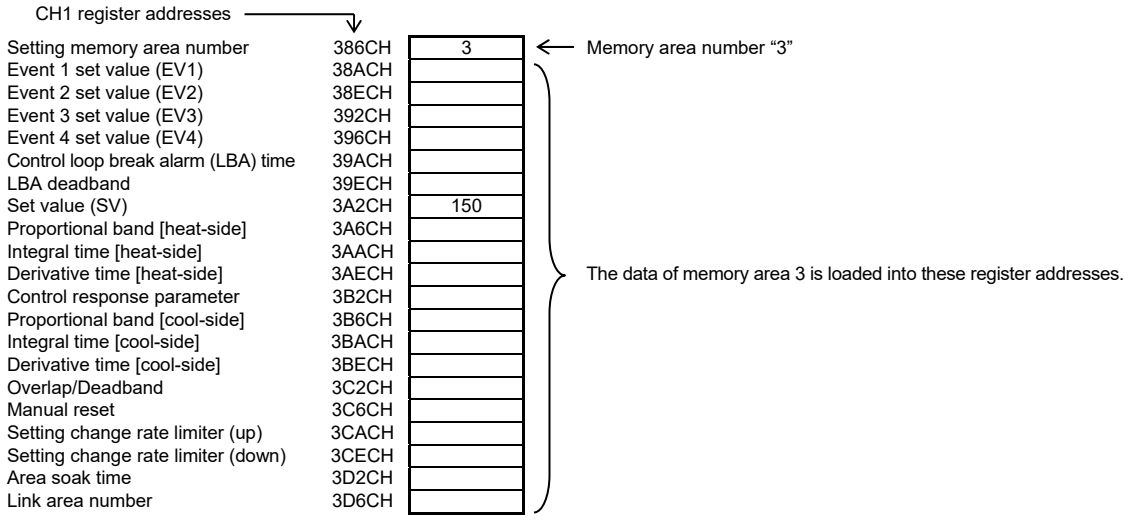
1. The Memory area number, "2" is written to the CH1 Setting memory area number (386CH). Data in Memory area 2 is called up to the CH1 register addresses.



2. Data "50" on Event 1 set value (38ACH) is read.

[Example 2] When the Set value (SV) in Memory area 3 of CH1 is changed to 200

1. The Memory area number, "3" is written to the CH1 Setting memory area number (386CH). Data in Memory area 3 is called up to the CH1 register addresses.



2. "200" is written to the Set value (SV) (3A2CH).

■ Control area transfer

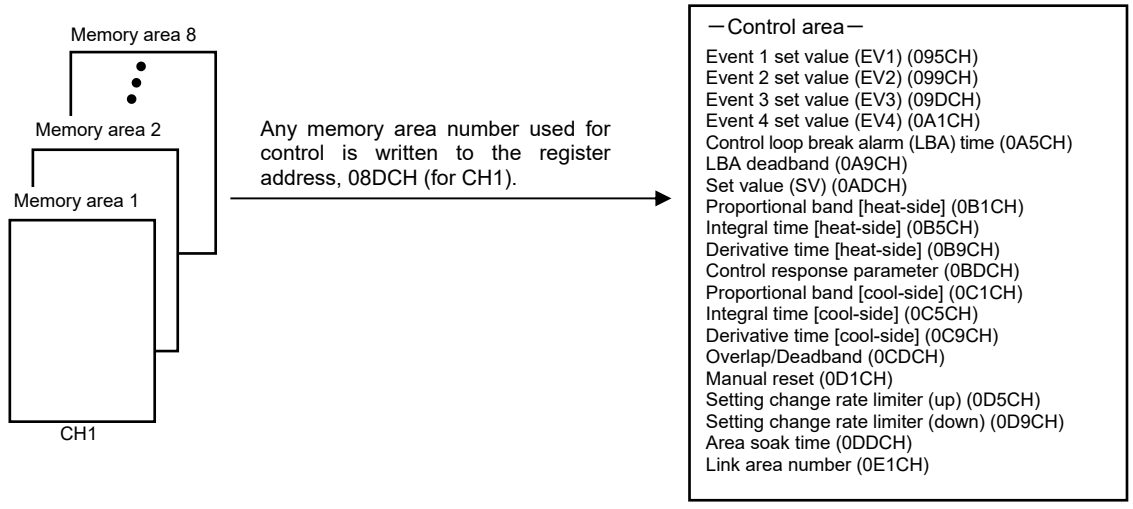
Any memory area used for control is specified by the Memory area transfer (08DCH to 091BH). The area (095CH to 0E5BH) now used for control is called Control area.

The Memory area number (Control area) can be changed at either RUN or STOP.

	Register address			
	CH1	CH2	·····	CH64
Memory area transfer	08DCH	08DDH	·····	091BH
Event 1 set value (EV1)	095CH	095DH	·····	099BH
Event 2 set value (EV2)	099CH	099DH	·····	09DBH
Event 3 set value (EV3)	09DCH	09DDH	·····	0A1BH
Event 4 set value (EV4)	0A1CH	0A1DH	·····	0A5BH
Control loop break alarm (LBA) time	0A5CH	0A5DH	·····	049BH
LBA deadband	0A9CH	0A9DH	·····	0ADBH
Set value (SV)	0ADCH	0ADDH	·····	0B1BH
Proportional band [heat-side]	0B1CH	0B1DH	·····	0B5BH
Integral time [heat-side]	0B5CH	0B5DH	·····	0B9BH
Derivative time [heat-side]	0B9CH	0B9DH	·····	0BDBH
Control response parameter	0BDCH	0BDDH	·····	0C1BH
Proportional band [cool-side]	0C1CH	0C1DH	·····	0C5BH
Integral time [cool-side]	0C5CH	0C5DH	·····	0C9BH
Derivative time [cool-side]	0C9CH	0C9DH	·····	0CDBH
Overlap/Deadband	0CDCH	0CDDH	·····	0CDCH
Manual reset	0D1CH	0D1DH	·····	0D5BH
Setting change rate limiter (up)	0D5CH	0D5DH	·····	0D9BH
Setting change rate limiter (down)	0D9CH	0D9DH	·····	0DDBH
Area soak time	0DDCH	0DDDH	·····	0E1BH
Link area number	0E1CH	0E1CH	·····	0E5BH

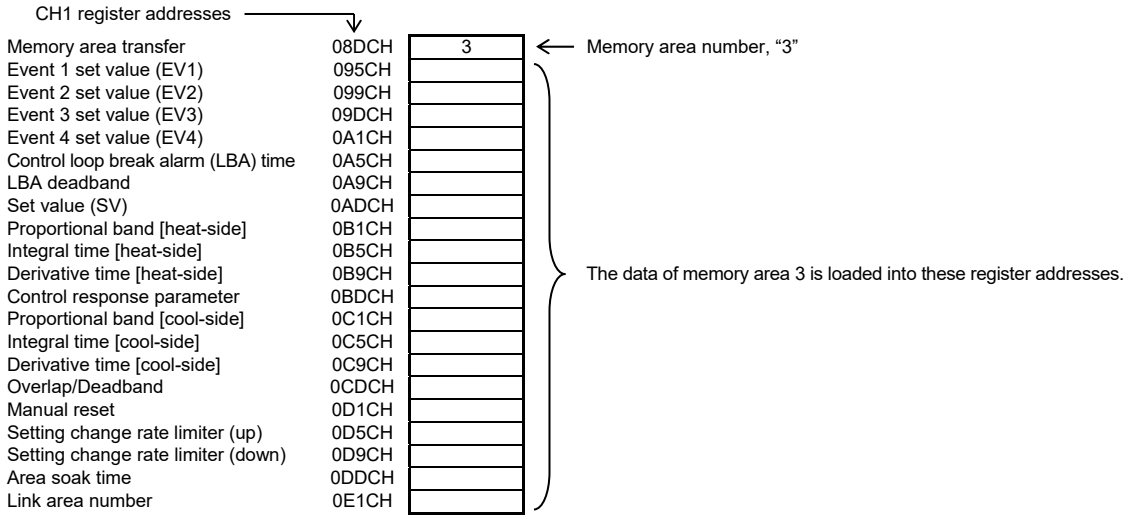
← Register address to specify Control area

Register address of memory area data



[Example] When performing control by calling up data in Memory area 3 of CH1

1. The memory area number, "3" is written to the memory area transfer (08DCH).
Data in Memory area 3 is called up to the CH1 register addresses.



2. Control of CH1 is performed by using data in the register addresses.

If the Memory area transfer (08DCH to 091BH) and the Setting memory area number (386CH to 38ABH) are set to the same Memory area number, the respective data can be synchronized.

- Values in the Control areas (095CH to 0E5BH) and the setting memory area number (38ACH to 3DABH) are set to the same memory area number, the respective data can be synchronized.
- If data in the Control area is changed, data in the memory area is also changed.
- If data in the memory area is changed, data in the Control area is also changed.

■ Data mapping function

When using a COM-ML joined to function modules, the data mapping function cannot be used.

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