
Digital Controller

CD101/CD401
CD501/CD701
CD901

Communication
Instruction Manual

CAUTIONS

- This manual is subject to change without prior notice.
- Examples of figures, diagrams and numeric values used in this manual are only for a better understanding of the text, but not for assuring the result of operation.
- This manual may not be reproduced or copied in whole or in part without RKC's prior written consent.
- This instrument and manual are manufactured, prepared, then shipped under strict quality control. However, if any defect is found, please contact your nearest RKC sales office or agent from which you bought the system.
- RKC assumes no responsibility for any of the following damage which the user or third party may suffer.
 - (1) Damage incurred as a result of using this instrument.
 - (2) Damage caused by the failure of the instrument, which cannot be predicted by RKC.
 - (3) Other indirect damage.

INTRODUCTION

Before using this instrument, please carefully read this manual for its correct use. In addition, after reading the manual keep it available easily anytime.

USERS OF THIS MANUAL

This manual is prepared for all personnel who use **CD101/CD401/CD501/CD701/CD901**. However, it is desirable that they have a fundamental knowledge of electrical engineering, process control and communication.



WIRING PRECAUTIONS

- If failure or error of this instrument could result in a critical accident of the system, install an external protection circuit to prevent such an accident.
- In order to prevent instrument damage or failure, protect the power line and the input/output lines from high currents by using fuses with appropriate ratings.

POWER SUPPLY

- In order to prevent instrument damage or failure, supply power of the specified rating.
- In order to prevent electric shock or instrument failure, do not turn on the power supply until all of the wiring is completed.

INSTALLATION ENVIRONMENT

- In order to prevent fire, explosion or instrument damage, never use this instrument at a location where flammable or explosive gases or vapor exist.
- This is a Class A instrument. In a domestic environment this instrument may cause radio interference, in which case the user is required to take adequate measures.

NEVER TOUCH THE INSIDE OF THE INSTRUMENT

In order to prevent electric shock or burns, never touch the inside of the instrument. Only RKC service engineers can touch the inside of the instrument to check the circuit or to replace parts. High voltage and high temperature sections inside the instrument are extremely dangerous.

NEVER MODIFY THE INSTRUMENT.

In order to prevent accident or instrument failure, never modify the instrument.

MAINTENANCE

- In order to prevent electric shock, burns or instrument failure, only RKC service engineers may replace parts.
- In order to use this instrument continuously and safely, conduct periodic maintenance. Some parts used in this instrument have a limited service life and may deteriorate over time.

INSTRUMENT SAFETY CAUTIONS

- This instrument is designed to be mounted on instrumentation panels. It is therefore manufactured as part of the final product to facilitate wiring. This means that unauthorized personnel can easily access the high-voltage sections in this instrument such as power terminals, etc. Therefore, when this instrument is installed on the final product, the user should take the necessary measures for the final product to ensure that unauthorized personnel cannot access the high-voltage sections, etc.
- In order to use this instrument correctly and safely, always observe the cautions described in this manual when performing operations and maintenance. RKC assumes no responsibility for any injury or accident resulting from not following these cautions.

NOTES ON INDICATIONS

The following indications are used in this manual to ensure the safe, correct use of the CD101/CD401/CD501/CD701/CD901.

SIGNAL WORDS

-  : Where there are possible dangers such as electric shock, fire (burns), etc. which could cause loss of life or injury, precautions to avoid such dangers are described.
-  : These describe precautions to be taken in case unit damage may result if operating procedures are not strictly followed.
-  : Extra noted or nrecautions are added to operating procedures and explanations.

SYMBOL MARKS

-  : This mark is used when great care is needed especially for safety.
-  : This mark is used to add extra notes, precautions or supplementary explanations to table and figures.

CAUTIONS PRIOR TO USE

- This instrument is intended to be used under the following environmental conditions. **(IEC1010)** [OVERVOLTAGE CATEGORY II, POLLUTION DEGREE 2]
- To the instrument with power supply of 24 V, please be sure to supply the power from SELV circuit.
- Before cleaning the instrument, check that the power is turned off.
- Remove stains on the display unit using a soft cloth or tissue paper.
- As the display unit is easily scratched, do not scrub or touch it with a hard object.
- The stains on the housing shall be wiped off by the cloth which is dipped into the neutral cleanser diluted by water and wrung tightly, and finish it by a dried cloth.
- This instrument is protected from electric shock by reinforced insulation. So please arrange reinforced insulation to the wire for input signal against the wires for instrument power supply, source of power and loads as far as possible.

Name and number of this instruction manual :

Name : **Digital Controller CD101/CD401/CD501/CD701/CD901
Communication Instruction Manual**

Manual number : **IMCD06-E2**

■ Revisions

| Date of revision | Manual number | Reason for revision |
|-------------------------|----------------------|-------------------------------|
| October 27, 1998 | IMCD06-E1 | The first edition issue |
| July 7, 1999 | IMCD06-E2 | Addition of controller types. |
| | | |

CONTENTS

| | Page |
|---|-----------|
| 1. SPECIFICATIONS | 1 |
| 2. WIRING | 2 |
| 3. SETTING FOR COMMUNICATION | 4 |
| 3.1 Transfer to communication setting mode | 4 |
| 3.2 Communication parameter selection | 5 |
| 3.3 Device address setting | 6 |
| 3.4 Communication speed setting | 8 |
| 3.5 Data construction setting | 10 |
| 3.6 Interval time setting | 12 |
| 3.7 Notes under communication..... | 15 |
| 4. COMMUNICATION PROTOCOL | 18 |
| 4.1 Polling..... | 18 |
| 4.1.1 Polling procedure | 19 |
| 4.1.2 Polling procedure example (When the host computer requests data) | 22 |
| 4.2 Selecting..... | 23 |
| 4.2.1 Selecting procedure | 23 |
| 4.2.2 Selecting procedure example (When the host computer sends a set value) | 26 |
| 5. COMMUNICATION IDENTIFIER | 27 |
| 6. TROUBLESHOOTING | 31 |
| 7. ASCII 7-BIT CODE TABLE (Reference) | 32 |

1. SPECIFICATIONS

- Interface:** Based on EIA standard RS-485
- Connection method:** 2-wire system, half-duplex multidrop connection
- Communication distance:** 1 km (max.)
* However, the maximum communication distance varies slightly with the surroundings such as cables etc.
- Synchronous method:** Start/stop synchronous type
- Communication speed:** 2400 bps, 4800 bps, 9600 bps, 19200 bps
- Data type:**
Start bit: 1
Data bit: 7 or 8
Parity bit: Unused or Used (Odd number or even number)
Stop bit: 1 or 2
- Protocol:** ANSI X3.28 subcategory 2.5, A4
Polling/selecting type
- Error control:** Vertical parity (With parity bit selected)
Horizontal parity (BCC check)
- Maximum connection:** 32 sets including a host computer
- Communication code:** ASCII 7-bit code
- Termination resistor:** 100 Ω or more (Externally connected)
- Xon/Xoff control:** None

Signal logic:

| Signal voltage | Logic |
|----------------|------------------|
| V (A) > V (B) | 0 (Space status) |
| V (A) < V (B) | 1 (Mark status) |

2. WIRING



WARNING

In order to prevent electric shock or instrument failure, do not turn on the power until all the wiring is finished.

Up to 32 **CD101/CD401/CD501/CD701/CD901** digital controller (hereinafter, the "controller") including the host computer can be connected if multidrop connected by RS-485.

■ Terminal No. and signal details

CD101/CD401/CD501/CD901

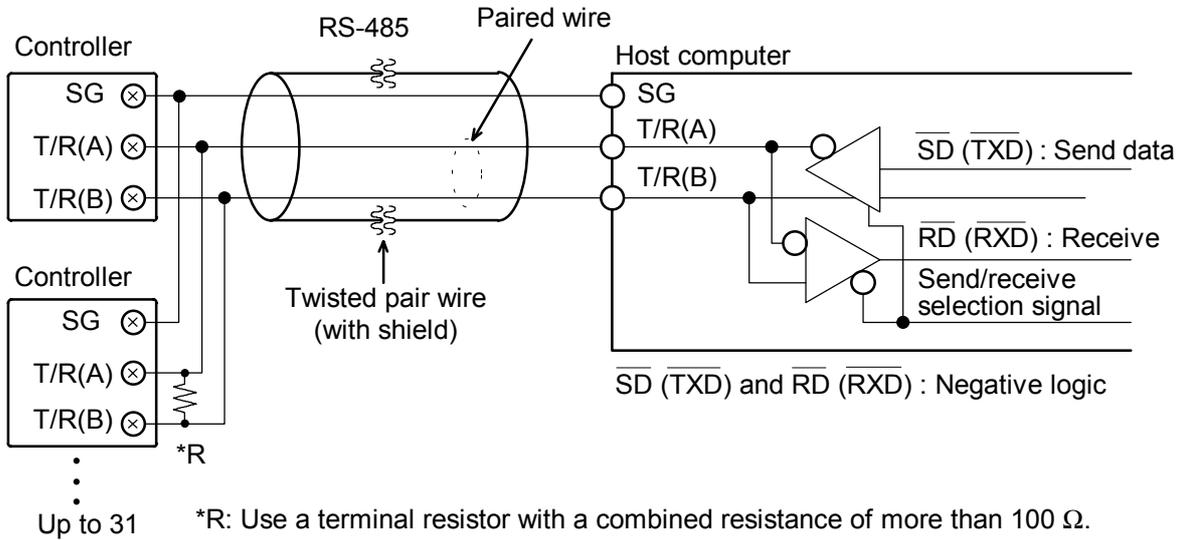
| Terminal No. | Signal name | Name | Signal direction | |
|--------------|-------------|------------------------|------------------|---------------|
| | | | Controller | Host computer |
| 13 | SG | Signal ground | ————— | |
| 14 | T/R(A) | Send data/Receive data | ←————→ | |
| 15 | T/R(B) | Send data/Receive data | ←————→ | |

CD701

| Terminal No. | Signal name | Name | Signal direction | |
|--------------|-------------|------------------------|------------------|---------------|
| | | | Controller | Host computer |
| 7 | SG | Signal ground | ————— | |
| 8 | T/R(A) | Send data/Receive data | ←————→ | |
| 9 | T/R(B) | Send data/Receive data | ←————→ | |

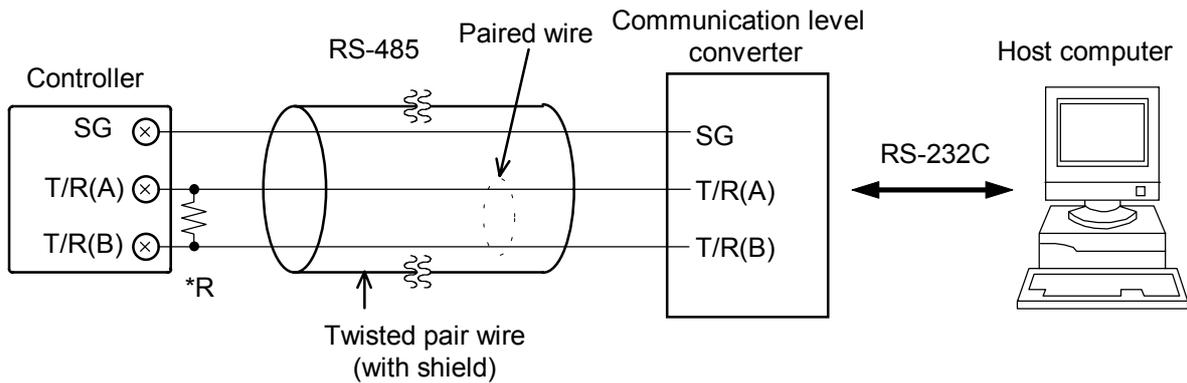
■ When host computer interface is RS-485

It is necessary that a circuit to transfer send and receive be built-in the host computer.



■ When host computer interface is RS-232C

Communication level converter (RS-232C/RS-485) is used.



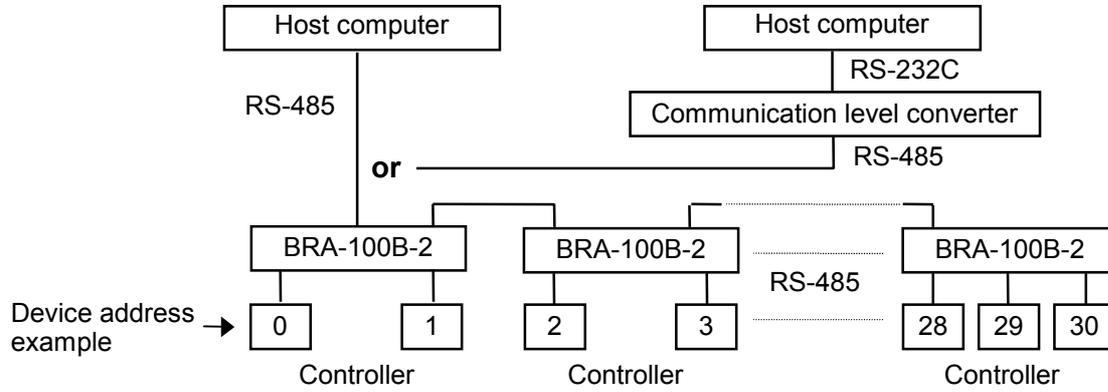
*R: Use a terminal resistor with a combined resistance of more than 100 Ω.

CAUTION

When the host computer is for Windows 95/NT, use a communication level converter of the automatic send/receive select type.

Recommended: CD485, CD485/V manufactured by Data Link, Inc. or equivalent.

■ **Connection example**
(When up to 32 controllers including host computer are connected)



NOTE

For details of the communication level converter and junction branch box **BRA-100B-2**, see each Instruction Manual.

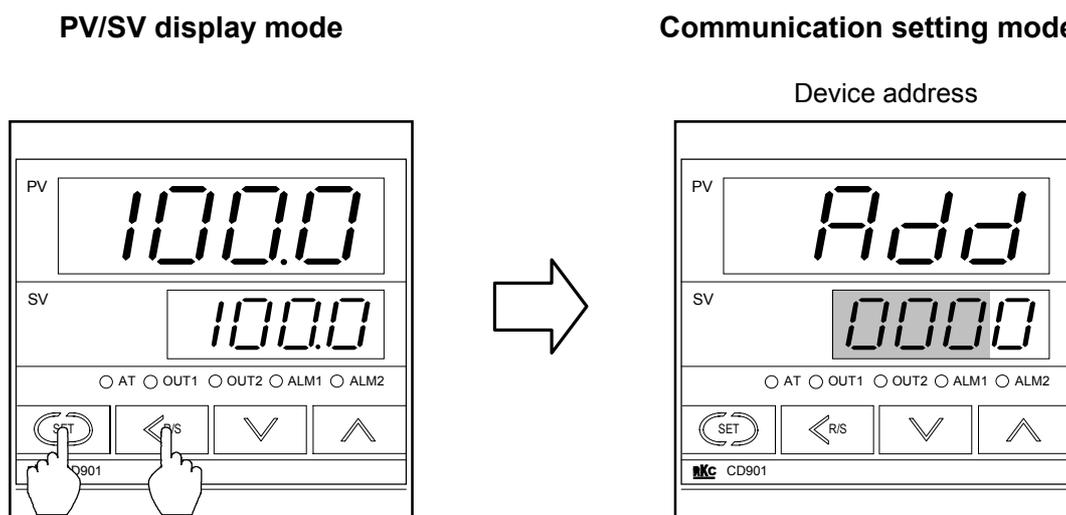
3. SETTING FOR COMMUNICATION

In order to make communication between the **CD101/CD401/CD501/CD701/CD901** digital controller (hereinafter, the "controller") and the host computer, it is necessary to set the device address, communication speed, data construction and interval time. Communication settings are made in communication setting mode.

The following pictures used for explanation are for **CD901**. However, the same operation also applies to other controllers. The section in each picture is dimly lit.

3.1 Transfer to communication setting mode

1. Turn on the power to this controller. Thus, the input type, input range and PV/SV display mode change in this order.
2. Pressing the <R/S key while the SET key is being pressed when PV/SV display mode is being displayed selects communication setting mode. In this mode, device address "Add" are displayed in the first place.



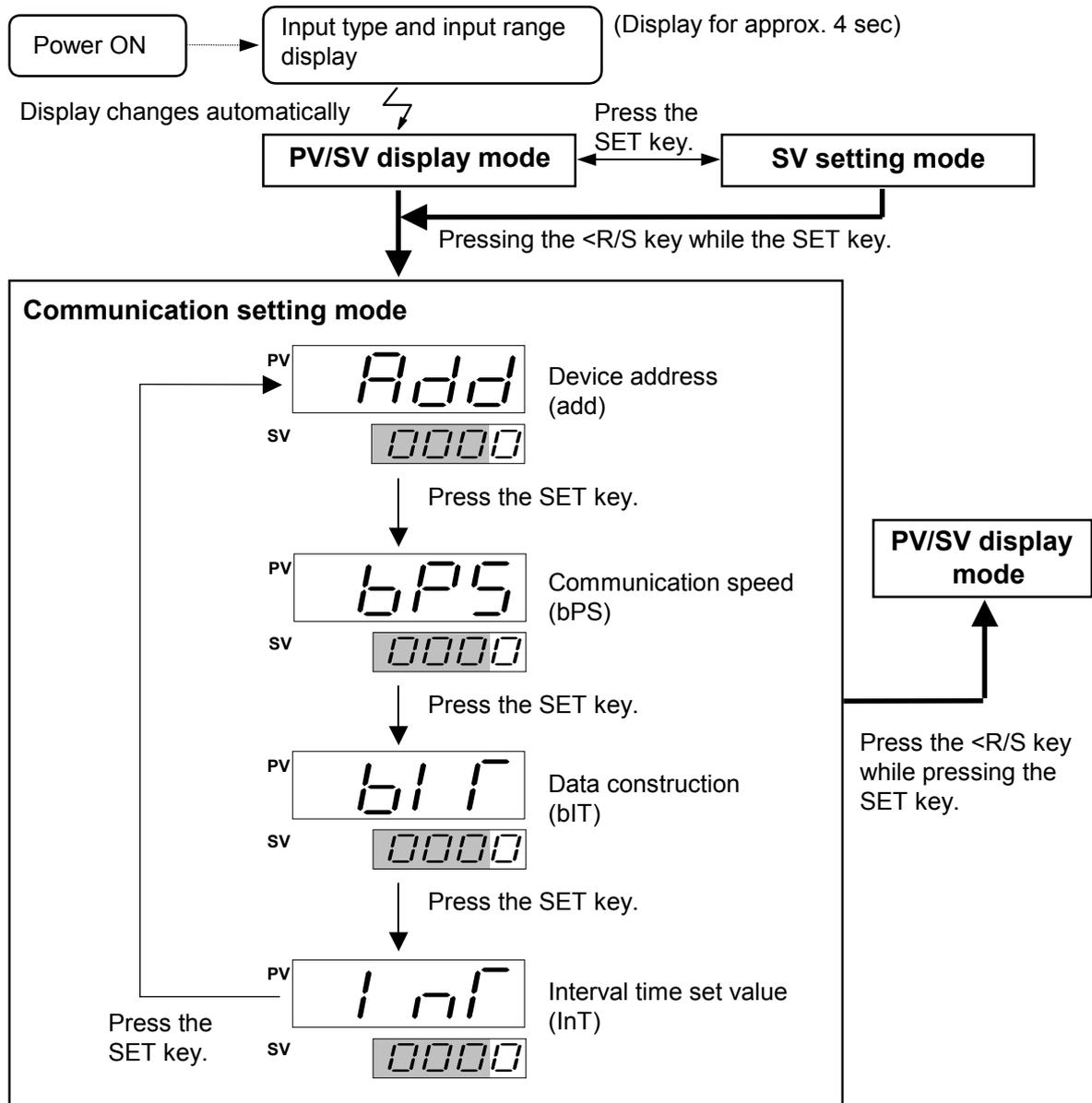
NOTES

- The communication setting mode can be selected anytime when the SV setting mode.
- In order to terminate the communication setting mode, press the <R/S key while pressing the SET key. After the communication setting mode terminates, the display changes to the PV/SV display mode.

3.2 Communication parameter selection

Parameters in communication setting mode are selected in the order of device address "Add," communication speed "bPS," data construction "bIT" and interval time set value "InT." Each parameter is selected by pressing the SET key.

■ Display flowchart



3.3 Device address setting

Set the device address by using numerals from 0 to 99. Press the UP or DOWN key to change the numeral, and also press the <R/S key to shift the digit.

| Symbol | Name | Setting range | Description | Factory set value |
|--------|----------------|---------------|-------------------------------------|-------------------|
| Add | Device address | 0 to 99 | Sets the controller device address. | 0 |
| Add | | | | |

CAUTIONS

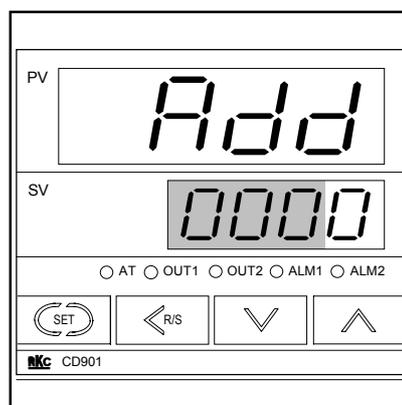
- When the communication parameter was changed, always turn on the power again. Otherwise, no communication is performed by using the changed value.
- If key operation is not performed for more than 1 minute without pressing the SET key after the device address is set, the controller is automatically changed to PV/SV display mode. In this case, the set device address returns to the value before the setting is changed.

■ Setting procedure

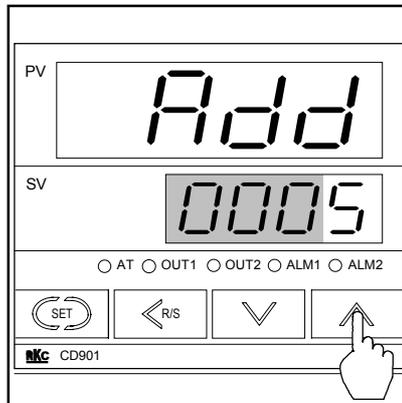
Example: When setting device address to 15.

1. Change the controller to communication setting mode, and then display the device address (See P. 5, 6).

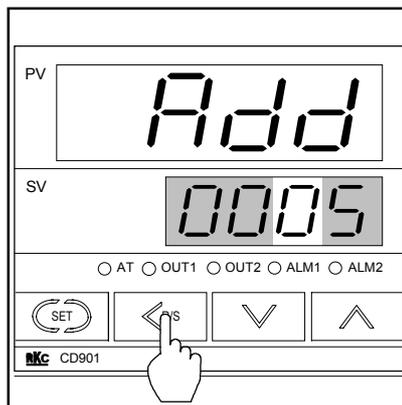
Device address



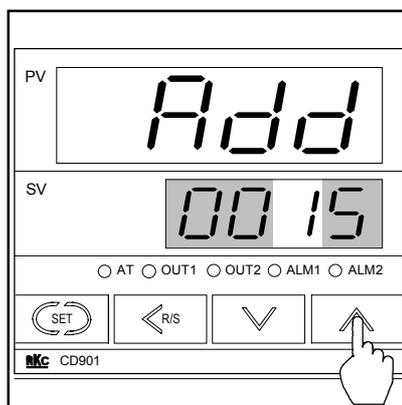
2. Set the device address. Press the UP key to enter "5" in the lowest digit.



3. Press the <R/S key to brightly light the tens digit.



4. Press the UP key to enter "1" in the tens digit.



5. Press the SET key to select the next communication parameter. As a result, the set device address is registered.

3.4 Communication speed setting

Set a communication speed of 2400 bps, 4800 bps, 9600 bps or 19200 bps by using numerals from 0 to 3. Press the UP or DOWN key to change the numeral.

| Symbol | Name | Setting range | Description | Factory set value |
|--------|---------------------|---|----------------------------------|-------------------|
| bPS | Communication speed | 0 : 2400 bps | Selects the communication speed. | 2 |
| bPS | | 1 : 4800 bps 2 : 9600 bps 3 : 19200 bps | | |

CAUTIONS

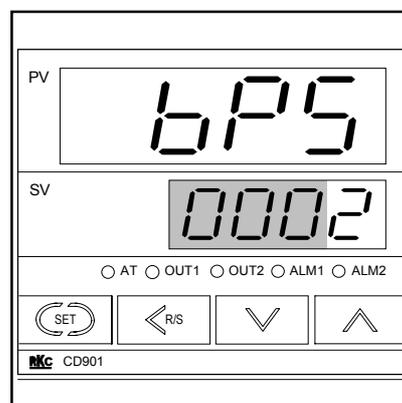
- Set the same communication speed to both the controller and connecting host computer.
- When the communication parameter was changed, always turn on the power again. Otherwise, no communication is performed by using the changed value.
- If key operation is not performed for more than 1 minute without pressing the SET key after the device address is set, the controller is automatically changed to PV/SV display mode. In this case, the set communication speed returns to the value before the setting is changed.

■ Setting procedure

Example: When setting communication speed to "1: 4800 bps."

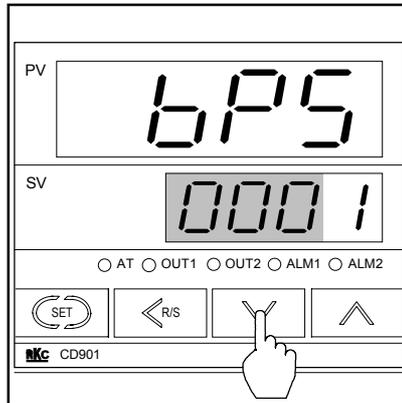
1. Change the controller to communication setting mode, and then display the communication speed (See P. 5, 6).

Communication speed



3. SETTING FOR COMMUNICATION

2. Press the DOWN key to enter "1" in the lowest digit. As a result, a communication speed of 4800 bps is set.



3. Press the SET key to change to the next communication parameter. As a result, the set communication speed is registered.

3.5 Data construction setting

Set the data bit construction during communication by using numerals from 0 to 5. Press the UP or DOWN key to change the numeral.

| Symbol | Name | Setting range | Description | Factory set value |
|------------|-------------------|------------------|---|-------------------|
| <i>bIT</i> | Data construction | 0 to 5 See *A | Selects data construction during communication. | 0 |
| bIT | | | | |

*A

| Setting | Data bit [bit] | Parity bit | Stop bit [bit] |
|---------|----------------|------------|----------------|
| 0 | 8 | None | 1 |
| 1 | 8 | None | 2 |
| 2 | 7 | Even | 1 |
| 3 | 7 | Even | 2 |
| 4 | 7 | Odd | 1 |
| 5 | 7 | Odd | 2 |

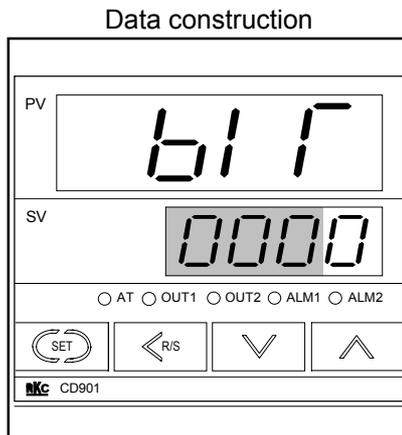
CAUTIONS

- Set the same data construction to both the controller and connecting host computer.
- When the communication parameter was changed, always turn on the power again. Otherwise, no communication is performed by using the changed value.
- If key operation is not performed for more than 1 minute without pressing the SET key after the device address is set, the controller is automatically changed to PV/SV display mode. In this case, the set data construction returns to the value before the setting is changed.

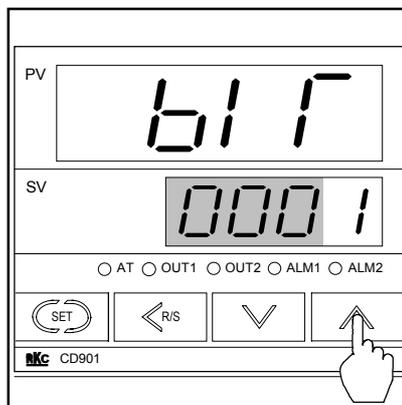
■ **Setting procedure**

Example: When setting data construction to "1: 8 data bits, no parity bit and 2 stop bits."

1. Change the controller to communication setting mode, and then display the data construction (See P. 5, 6).



2. Press the UP key to enter "1" in the lowest digit. As a result, data construction is set to "8 data bits, no parity bit and 2 stop bits."



3. Press the SET key to change to the next communication parameter. As a result, the set data construction is registered.

3.6 Interval time setting

Set the interval time. Press the UP or DOWN key to change the numeral, and press the <R/S key to shift the digit.

| Symbol | Name | Setting range | Description | Factory set value |
|---|-------------------------|----------------|--|-------------------|
|  | Interval time set value | 0 to 150 *A | Sets the value to set the interval time. | 5 |
| InT | | | | |

*A : Can be set up to 250 ms if converted to interval time.

Equations for calculating interval time and interval time set value

Equations :

$$\text{Interval time} = \text{Interval time set value} \times 1.666 \text{ ms}$$

$$\text{Interval time set value} = \text{Interval time} \div 1.666 \text{ ms}$$

CAUTIONS

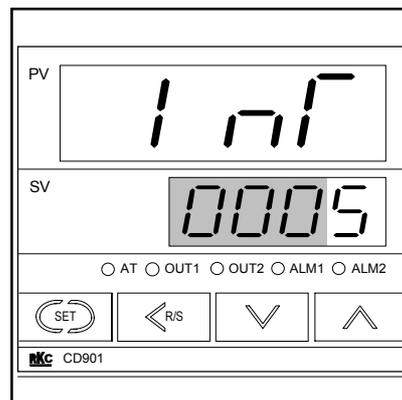
- When the communication parameter was changed, always turn on the power again. Otherwise, no communication is performed by using the changed value.
- If key operation is not performed for more than 1 minute without pressing the SET key after the device address is set, the controller is automatically changed to PV/SV display mode. In this case, the set interval time set value returns to the value before the setting is changed.

■ Setting procedure

Example: When setting interval time to 250 ms.

1. Change the controller to communication setting mode, and then display the interval time set value (See P. 5, 6).

Interval time set value



3. SETTING FOR COMMUNICATION

- Here, as an interval time of 250 ms needs to be set, calculate the interval time set value using the equation (See P. 13).

Interval time set value:

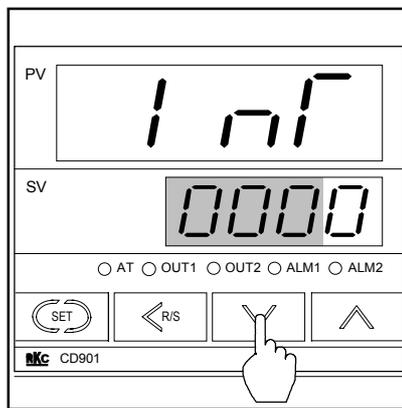
$$250 \text{ ms} \div 1.666 \text{ ms} \approx 150 \text{ (Round to the nearest whole number.)}$$

Interval time:

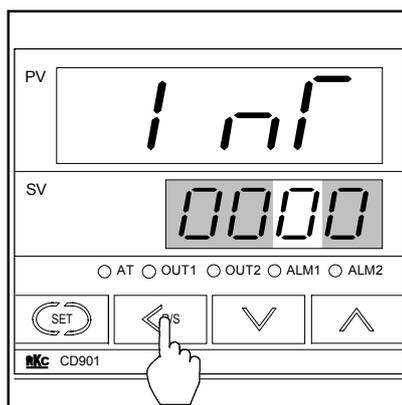
$$150 \times 1.666 \text{ ms} \approx 249.9 \text{ (Approx. 250 ms)}$$

Thus, enter an interval time set value of 150 calculated from the above by pressing the UP or DOWN key at the front of the controller.

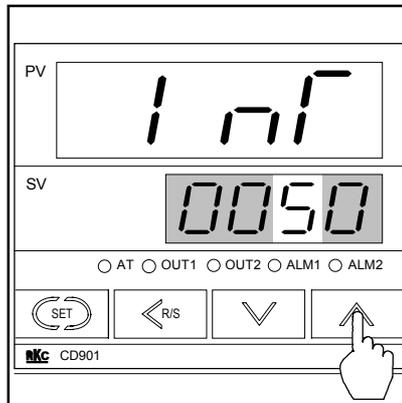
- Press the DOWN key to enter "0" in the lowest digit.



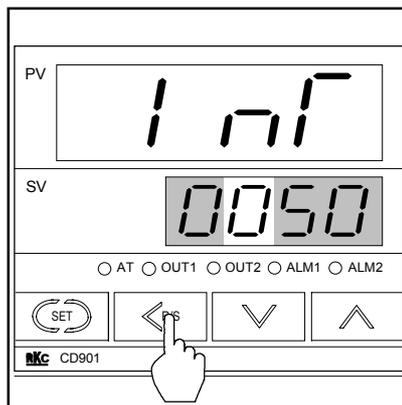
- Press the <R/S key to brightly light the tens digit.



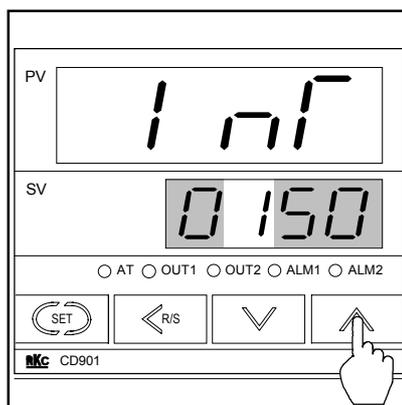
5. Press the UP key to enter "5" in the tens digit.



6. Press the <R/S key to brightly light the hundreds digit.



7. Press the UP key to enter "1" in the hundreds digit.



8. Press the SET key to change to the next communication parameter. As a result, the set interval time set value is registered.

3.7 Notes under communication

- (1) If polling is made by specifying the identifier of the function which is not added to the controller, the controller sends [EOT]. In addition, if selecting is made, the controller sends [NAK].
- (2) When the communication parameter was changed, always turn on the power again. Otherwise, no communication is performed by using the changed value.
- (3) Send/receive timing

The controller requires the following processing times during data send/receive.

Polling procedure

| Procedure details | Time (ms) | | |
|---|-----------|-----|-----|
| | MIN | TYP | MAX |
| Response send time after calling [ENQ] receive | 1.5 | 2.0 | 3.0 |
| Response send time after acknowledgment [ACK] receive | 1.5 | 2.0 | 3.5 |
| Response send time after negative acknowledge [NAK] receive | 1.0 | 1.5 | 3.0 |
| Response send time after BCC send | / | 0.7 | 1.0 |

* Data-link is terminated sending [EOT], if no response within about 3 sec after BCC send.

Selecting procedure

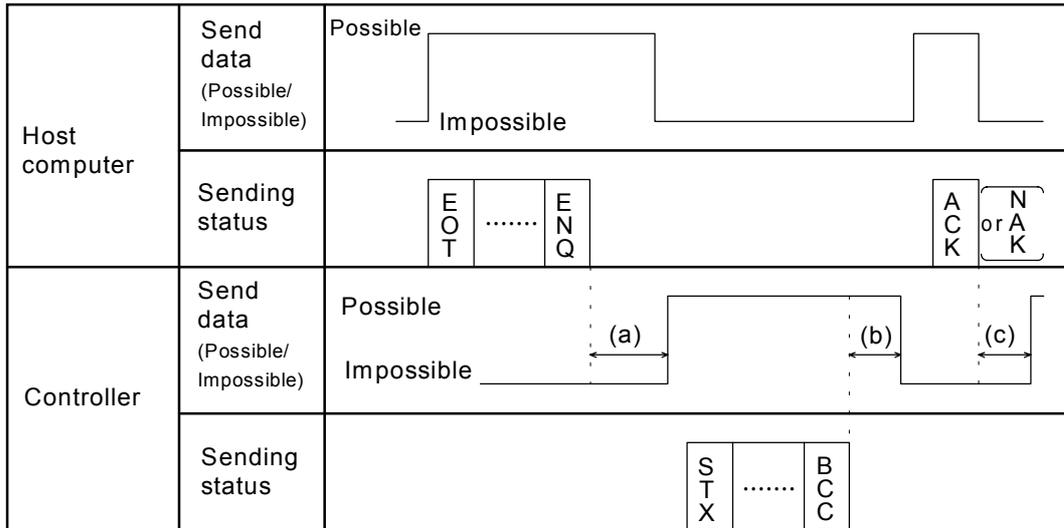
| Procedure details | Time (ms) | | |
|--|-----------|-----|-----|
| | MIN | TYP | MAX |
| Response send time after BCC receive | 2.0 | 3.0 | 4.0 |
| Response wait time after acknowledgment [ACK] send | / | 0.7 | 1.0 |
| Response wait time after negative acknowledge [NAK] send | / | 0.7 | 1.0 |

* Response wait time is the time when the interval time is set to 0 ms.

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

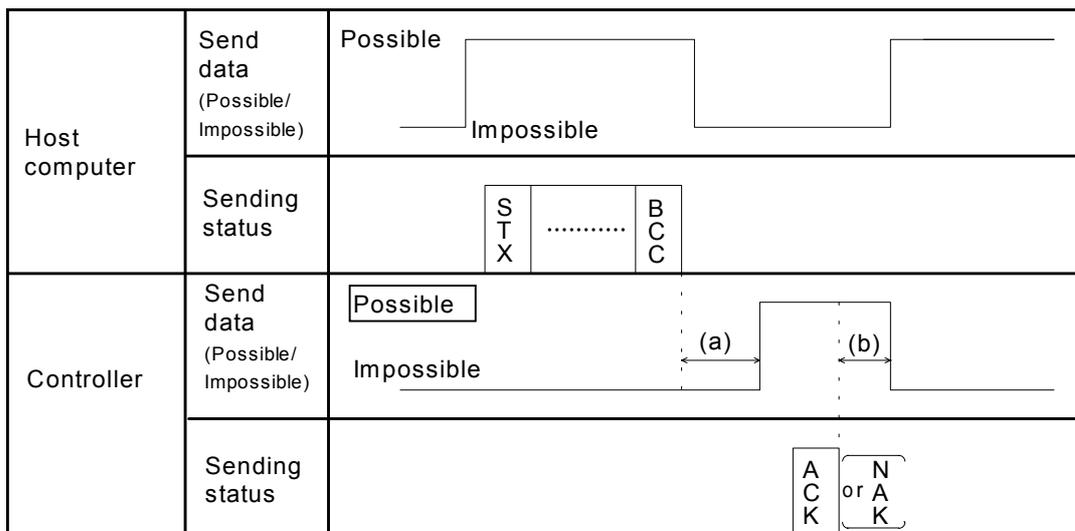
The transmission and reception of RS-485 communication are operated by a transmitting wire. Therefore, the timing of switching should be acted correctly. Send/receive example in the host computer and controller is show in the following.

Polling procedure



- (a): (Response send time after calling [ENQ] receive) + (Interval time)
- (b): Response send time after BCC send
- (c): (Response send time after acknowledgment [ACK] receive + (Interval time) or
(Response send time after negative acknowledge [NAK] receive + (Interval time))

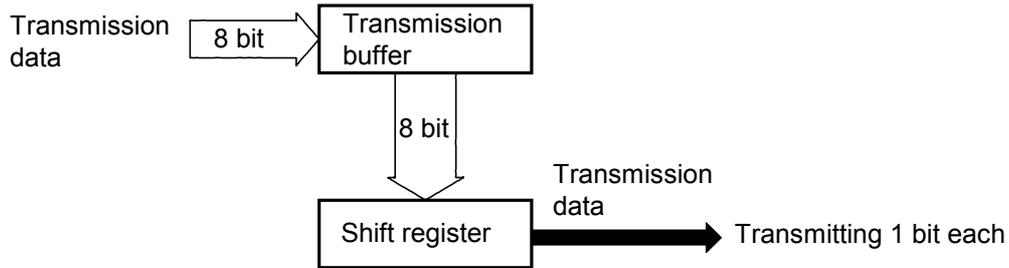
Selecting procedure



- (a): (Response send time after BCC receive) + (Interval time)
- (b): Response wait time after acknowledgment [ACK] send or
Response wait time after negative acknowledge [NAK] send

■ **When host computer is selected from data sending to data receiving**

When switching the host computer into reception from transmission, it must be confirmed that the data was surely put on line. This is not observe the transmission buffer of host computer itself, but confirming with shift register.



Next, the controller side secures the maximum time until the transmission line changes to the data receiving side (until the controller is ready to send data) after the host computer has received the stop bit corresponding to the final character. This maximum time corresponds to interval time.

If no interval time is set, the controller side may be set to the send state even when the host computer side is not set to the receive state. As a result, no communication is conducted correctly. In addition, set the interval time so as to match the host computer.

■ **When host computer is selected from data receiving to data sending**

Polling procedure "Response wait time after BCC send" or selecting procedure "Response wait time after [ACK] or [NAK] send" is processing time required during controller data sending. Therefore, select the host computer from receiving to sending after the lapse of the above time.

As for the necessary processing time, refer to the table of page 16.

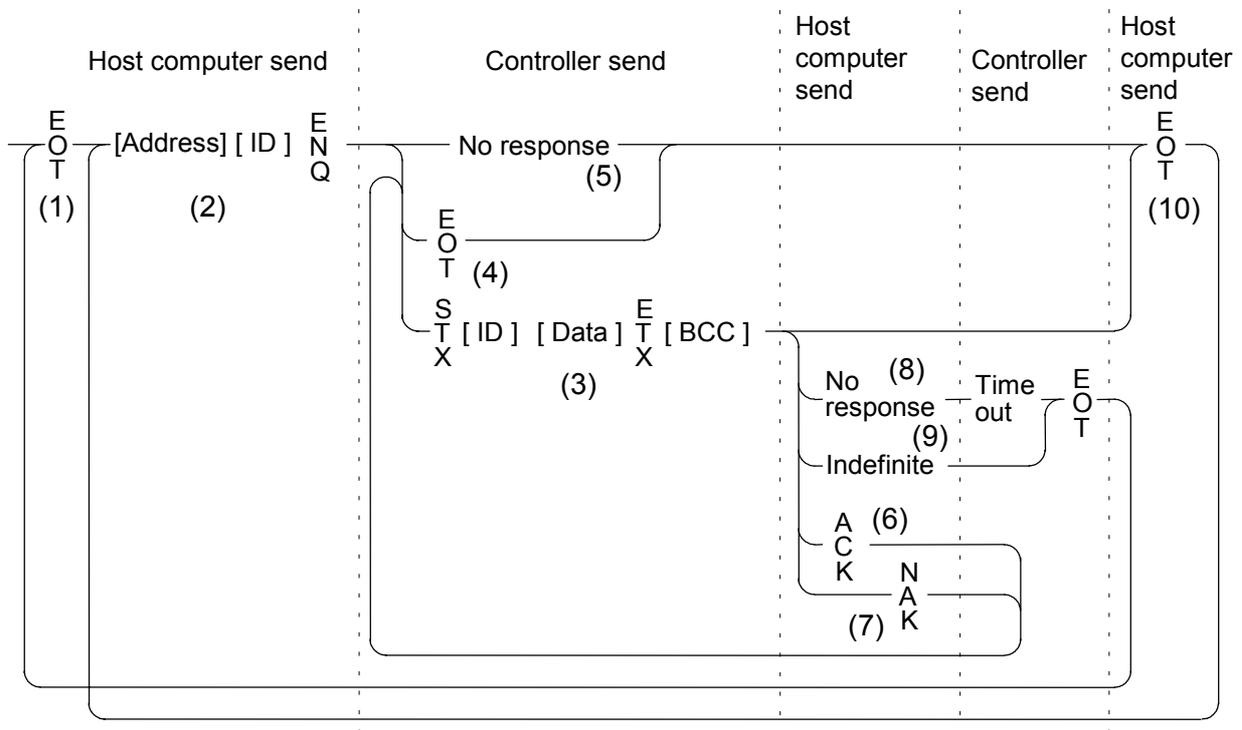
4. COMMUNICATION PROTOCOL

The CD101/CD401/CD501/CD701/CD901 digital controller (hereinafter, the "controller") uses the polling/selecting method to establish a data link. The basic procedure is followed ANSI X3.28 subcategory 2.5, A4 basic mode data transmission control procedure (Fast selecting is established for selecting).

- In the polling/selecting method, the controller is controlled completely by the host computer is permitted. Since the host computer invites information message sending from and receiving to the controller, send the data in accordance with the polling or selecting procedure. (Centralized control method)
- The code use in communication is 7-bit ASCII code including transmission control character. The transmission control characters are [EOT] (04H), [ENQ] (05H), [ACK] (06H), [NAK] (15H), [STX] (02H) and [ETX] (03H). The figure in the parenthesis is indicating hexadecimal number.

4.1 Polling

Polling is an action that host computer requesting one of the controller which selected among multidrop connected, to transmit the data. The procedure is as the following.



ID: Identifier

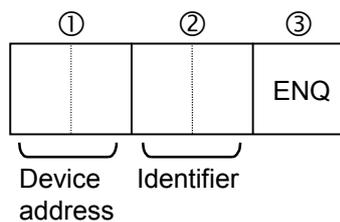
4.1.1 Polling procedure

(1) Initialize of data link

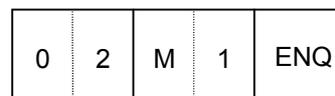
Host computer sends [EOT] for initializing of data link before polling sequence.

(2) Polling sequence send

Host computer sends polling sequence with a format shown below.



Example:



① Device address [Number of digits: 2]

This data is a device address of the controller for polled and must be the same as the device address set value in item "3.3 Device address setting" (P. 7).

② Identifier [Number of digits : 2] (See P. 28.)

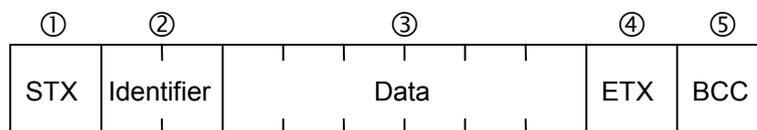
This is for identifying data requested for the controller. Always attach the [ENQ] code to the end of the identifier.

③ [ENQ]

This is the transmission control character which indicates the end of the polling sequence. Then, the host computer waits for response from the controller.

(3) Controller data send

If the polling sequence is received correctly, the controller sends data in the following format.



① [STX]

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

② Identifier [Number of digits: 2] (See P. 28.)

This is for identifying data (measured value, status and set value) sent to the host computer.

③ Data [Number of digits: 6]

Data indicated by the identifier belonging to the controller. It is expressed in decimal ASCII code including a minus sign (-) and a decimal point. No zero suppression is made.

④ [ETX]

A transmission control character used to indicate text end.

⑤ [BCC]

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

<Algorithm>

Take off EX-OR (exclusive "or") of all character from next [STX] through [ETX].
Not including [STX].

Example:

In the case of the data are :

| | | | | | | | | | | |
|-----|---|---|---|---|---|---|---|---|-----|-----|
| STX | M | 1 | 0 | 0 | 0 | 5 | 0 | 0 | ETX | BCC |
|-----|---|---|---|---|---|---|---|---|-----|-----|

4DH 31H 30H 30H 30H 35H 30H 30H ←

In the parenthesis are indicated with hexadecimal number.

$$\text{BCC} = 4\text{DH} \oplus 31\text{H} \oplus 30\text{H} \oplus 30\text{H} \oplus 30\text{H} \oplus 35\text{H} \oplus 30\text{H} \oplus 30\text{H} \oplus 03\text{H} = 7\text{AH}$$

Value of BCC becomes 7AH.

(4) Controller data send end (EOT send)

If the following cases, the controller sends [EOT] to terminate the data link.

- When there is no specified identifier.
- When there is an error in the data type.
- After all the data has been sent.
- When a identifier not added to the controller is specified.

(5) Controller no response

The controller is set to no response when the polling sequence is not received correctly. If necessary, take time out recovery etc. for the host computer.

(6) Acknowledgment [ACK]

Send [ACK] when the host computer could receive data items correctly.

Next, the controller sends the identifier data following the identifier just sent in succession shown in "■Communication identifier list" (P. 28).

If data send from the controller is suspend, send [EOT] to terminate the data link.

(7) Negative acknowledge [NAK]

If the host computer cannot receive send data correctly from the controller, it sends [NAK] to the controller. Then, the controller re-sends the same data to the host computer.

As the number of re-send times is not specified, take the necessary measures on the host computer side if no recovery is made.

(8) No response from host computer

When the host computer is set to no response after the controller sends data, the controller sends [EOT] as time-out processing to terminate the data link (time-out time : about 3 sec).

(9) Indefinite response from host computer

When the response from the host computer is indefinite, the controller sends [EOT] to terminate the data link.

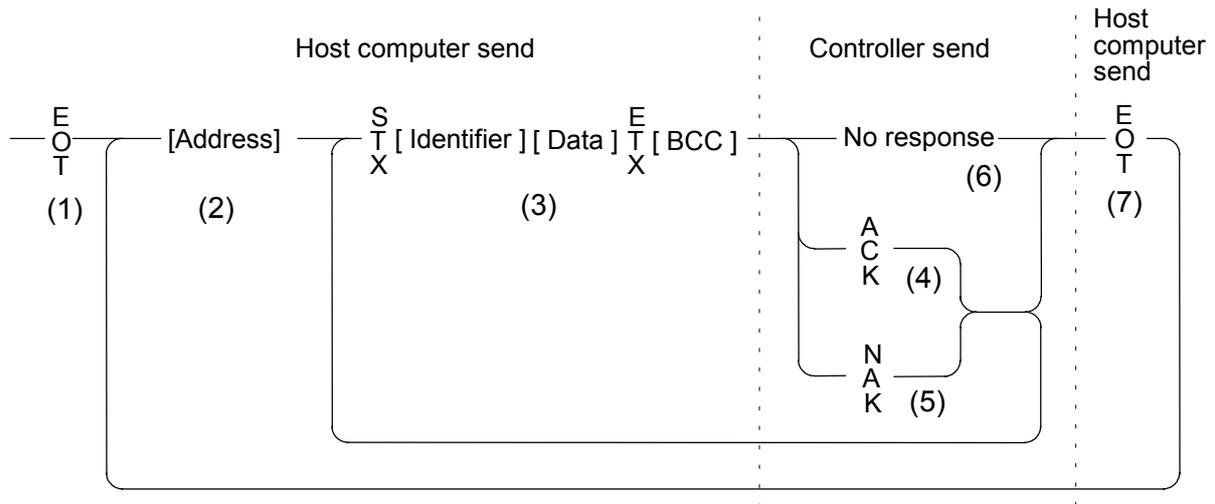
(10) Data link termination [EOT]

If it is necessary to suspend communication with the controller or to terminate the data link due to no response from the controller, the host computer sends [EOT].

4.2 Selecting

Selecting is an operation in which the host computer selects one from among the controllers multidrop connected and then of recommending data receive. The procedure is as the following.

Due to adopted fast selecting in controllers therefore becomes the type to send the data which connected to selecting sequence.



4.2.1 Selecting procedure

(1) Initialize of data link

Host computer sends [EOT] for initializing of data link before selecting sequence.

(2) Selecting address send

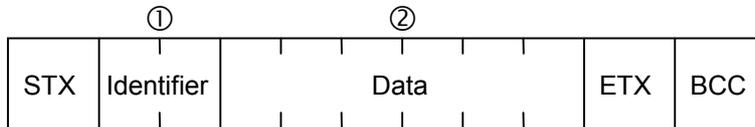
Send the selecting address selected as the selecting sequence from the host computer.

[Device address] (Number of digits : 2)

This data is a device address of the controller to be selected and must be the same as the device address set value in item "3.3 Device address setting" (P. 7).

(3) Data send

Host computer to send the data with a format indicated below continuing the selecting sequence.



* For [STX], [ETX] and [BCC], see item "4.1 Polling" (P. 19).

① Identifier [Number of digits : 2] (See P. 28.)

This identifies the data (set value) which is sent by the host computer.

② Data [Number of digits : 6]

This is the data indicated by the identifier of the controller. It is expressed in decimal ASCII code including a minus sign (-) and a decimal point. Even zero suppressed data or data whose figures below the decimal point are omitted can be received (However, the maximum number of digits is 6).

Example : When data is -1.5

| | |
|---------------------|---------------------|
| -001.5 → Receivable | -1.50 → Receivable |
| -01.5 → Receivable | -1.500 → Receivable |
| -1.5 → Receivable | |

In addition, the controller determines the receive data during selecting as follows.

Example : When setting data is between -10.00 to +10.00

| | |
|--------------------------|----------------------------------|
| When data is receivable: | When data is not receivable: |
| -0.5 → -0.5 | - → Not receivable (NAK answer) |
| -0.058 → -0.05 | . → Not receivable (NAK answer) |
| .03 → 0.03 | -. → Not receivable (NAK answer) |
| | +0 → Not receivable (NAK answer) |

(4) Acknowledgment [ACK]

If the controller correctly received data sent from the host computer, send [ACK]. Then, if there is data to be sent next on the host computer side, send the data.

After the data has been sent, send [EOT] to terminate the data link.

(5) Negative acknowledge [NAK]

The controller sends [NAK] in the following cases. Then the appropriate recovery processing steps, such as data resend on the host computer side should be taken.

- When an error occurs on the line (parity, framing error, etc.).
- When a BCC check error occurs.
- When there is no identifier.
- When receive data is not in the specified configuration (Text is not in the "Identifier + data construction.")
- When the number of receive data digits exceeds 6.
- When normally receive data exceeds the setting range.
- When the identifier not added to the controller is specified.

(6) No response

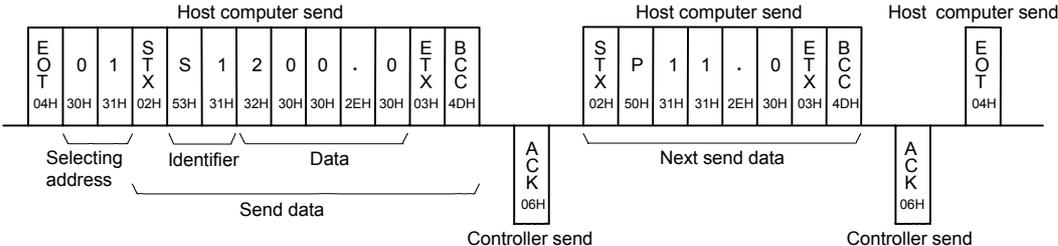
If the selecting address is not received correctly, the controller is set to no response, if [STX], [ETX] and [BCC] is not received correctly, the controller is also set to no response.

(7) Data link termination [EOT]

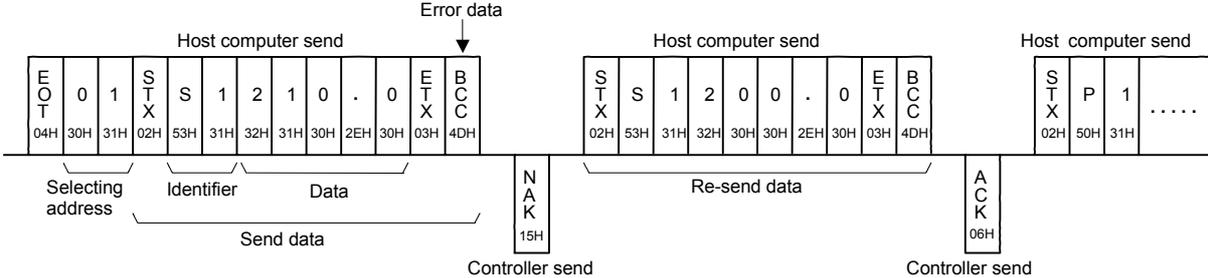
When terminating the data link because there was no more to be sent on the host computer side or the controller was set to no response, send [EOT] from the host computer.

4.2.2 Selecting procedure example (When the host computer sends a set value)

■ Normal transmission



■ For the presence of error in data



5. COMMUNICATION IDENTIFIER

■ Communication identifier list

NOTES

- Note that there are identifiers which indicate that communication is not possible depending on the specification.
- The number of digits is 6 for all data.

(Attributes RO: Read only, R/W: Read/Write)

| Name | Identifier | Data range | Factory set value | Attribute |
|--|------------|--|----------------------------------|-----------|
| Measured value (PV) | M1 | Within input range | ---- | RO |
| Current transformer input 1 See *1. | M2 | 0.0 to 100.0 A | ---- | RO |
| Current transformer input 2 See *2. | M3 | 0.0 to 100.0 A | ---- | RO |
| Alarm 1 status See *3. | AA | 0: OFF 1: ON | ---- | RO |
| Alarm 2 status See *1. | AB | 0: OFF 1: ON | ---- | RO |
| Burnout | B1 | 0: OFF 1: ON | ---- | RO |
| Error code | ER | 0 to 255 See *4. | ---- | RO |
| RUN/STOP function | SR | 0: RUN 1: STOP | 0 | R/W |
| Set value (SV) | S1 | Within input range | 0 | R/W |
| Alarm 1 setting See *3. | A1 | Temperature input Process alarm, deviation alarm, SV alarm: -1999 to +9999 °C [°F] or -199.9 to +999.9 °C [°F] | Temperature input: 50 or 50.0 | R/W |
| Alarm 2 setting See *1. | A2 | Voltage/ current inputs Deviation alarm: -span to +span (Within 9999) Process alarm, SV alarm: Within input range | Voltage/ current inputs: 5.0 | R/W |

Continued on the next page.

| Name | Identifier | Data range | Factory set value | Attribute |
|---|------------|--|--|-----------|
| Heater break alarm 1 setting See *1. | A3 | 0.0 to 100.0 A | 0.0 | R/W |
| Heater break alarm 2 setting See *2. | A4 | 0.0 to 100.0 A | 0.0 | R/W |
| Control loop break alarm setting See *1, *3. | A5 | 0.1 to 200.0 min. (0.0 can not be set.) | 8.0 | R/W |
| LBA deadband See *1, *3. | A6 | Temperature input: 0 to 9999 °C [°F] Voltage/current inputs: 0 to 100 % of span | 0 | R/W |
| Autotuning (AT) | G1 | 0: Autotuning (AT) end or suspension 1: Autotuning (AT) start *Change to "0" automatically at the end of Autotuning. | 0 | R/W |
| Self-tuning (ST) See *5. | G2 | 0: Self-tuning (ST) suspension 1: Self-tuning (ST) start | 0 | R/W |
| Heat-side proportional band | P1 | Temperature input: 1 (0.1) to span or 9999 (999.9) °C [°F] Voltage/current inputs : 0.1 to 100.0 % of span (ON/OFF action control when set to 0 or 0.0.) *Cannot be set while the self-tuning (ST) function is activated. Only polling can be made. | Temperature input: 30 (30.0) Voltage/current inputs: 3.0 | R/W |
| Integral time | I1 | 1 to 3600 sec (0: PD control) *Cannot be set while the self-tuning (ST) function is activated. Only polling can be made. | 240 | R/W |

Continued on the next page.

5. COMMUNICATION IDENTIFIER

| Name | Identifier | Data range | Factory set value | Attribute |
|--|------------|---|-------------------|-----------|
| Derivative time | D1 | 1 to 3600 sec (0: PI control) *Cannot be set while the self-tuning (ST) function is activated. Only polling can be made. | 60 | R/W |
| Anti-reset windup | W1 | 1 to 100 % of heat-side proportional band. (0: integral action OFF) *Cannot be set while the self-tuning (ST) function is activated. Only polling can be made. | 100 | R/W |
| Heat-side proportioning cycle | T0 | 1 to 100 sec (0 can not be set.) (Not set if the control output is current output.) | See *6. | R/W |
| Cool-side proportional band See *7. | P2 | 1 to 1000 % of heat-side proportional band (0 can not be set.) | 100 | R/W |
| Deadband See *7. | V1 | Temperature input: -10 to +10 °C [°F] or -10.0 to +10.0 °C [°F] Voltage/current inputs: -10.0 to +10.0 % of span | 0 or 0.0 | R/W |
| Cool-side proportioning cycle See *7. | T1 | 1 to 100 sec (0 can not be set.) (Not set if the control output is current output.) | See *8. | R/W |
| PV bias | PB | -span to +span However, temperature input: -1999 to +9999 °C [°F] or -199.9 to +999.9 °C [°F] | 0 or 0.0 | R/W |
| Set data lock function | LK | 0 to 7 See *9. | 0 | R/W |

*1: The communicable identifier differs depending on the alarm type specified in alarm 2.

– : Communication is impossible × : Communication is possible

| Name | Identifier | The alarm type specified in alarm 2 | | | | | |
|----------------------------------|------------|-------------------------------------|---------------|-------|--------|----------|----------|
| | | Deviation alarm | Process alarm | LBA * | HBA ** | SV alarm | No alarm |
| Current transformer input 1 | M2 | – | – | – | × | – | – |
| Alarm 2 status | AB | × | × | × | × | × | – |
| Alarm 2 setting | A2 | × | × | – | – | × | – |
| Heater break alarm 1 setting | A3 | – | – | – | × | – | – |
| Control loop break alarm setting | A5 | – | – | × | – | – | – |
| LBA deadband | A6 | – | – | × | – | – | – |

As control loop break alarm, only either the alarm 1 or alarm 2 is specified.

*LBA: Control loop break alarm **HBA: Heater break alarm

*2: This is an identifier which enables communication when specifying to the Z-168 specification.

*3: The communicable identifier differs depending on the alarm type specified in alarm 1.

– : Communication is impossible × : Communication is possible

| Name | Identifier | The alarm type specified in alarm 1 | | | | |
|----------------------------------|------------|-------------------------------------|---------------|-------|----------|----------|
| | | Deviation alarm | Process alarm | LBA * | SV alarm | No alarm |
| Alarm 1 status | AA | × | × | × | × | – |
| Alarm 1 setting | A1 | × | × | – | × | – |
| Control loop break alarm setting | A5 | – | – | × | – | – |
| LBA deadband | A6 | – | – | × | – | – |

As control loop break alarm, only either the alarm 1 or alarm 2 is specified.

*LBA: Control loop break alarm

*4: Any number other than "0" indicates errors (RAM write error, etc.) detected by the controller self-diagnosis function. Contact your nearest RKC sales agent or RKC sales office.

***5:** •*In a controlled system in which ripples may be contained by the application of periodic disturbances, use this instrument with the self-tuning function turned off.*

- This is an identifier which enables communication at PID action with autotuning (Reverse action/Direct action).

***6:** Relay contact output: 20 sec

Voltage pulse output, Trigger output for triac driving, Triac output: 2 sec

***7:** This is an identifier which enables communication at heat/cool PID action with autotuning (Water cooling/Air cooling).

***8:** Relay contact output: 20 sec Voltage pulse output, Triac output: 2 sec

***9:** Details of set data lock level selection.

– : Unsettable (Data locked) ×: Settable (Data unlocked)

| Set data | Set value | Alarm setting (Alarm 1, Alarm 2) | *A Other setting items |
|----------|-----------|-------------------------------------|---------------------------|
| 0 | × | × | × |
| 1 | × | × | – |
| 2 | × | – | × |
| 3 | × | – | – |
| 4 | – | × | × |
| 5 | – | × | – |
| 6 | – | – | × |
| 7 | – | – | – |

*A: All setting items other than set value and alarm settings (alarm 1 or alarm 2).

NOTE

The set data lock function is effective only for the setting performed by key operation. Setting items in the data lock state cannot be set by key operation, but can always be selected via communication.

■ Input range table

Thermocouple input

| Input type | Code | |
|-----------------|------------------------|-------|
| | Input | Range |
| K | 0 to 200 °C | K 01 |
| | 0 to 400 °C | K 02 |
| | 0 to 600 °C | K 03 |
| | 0 to 800 °C | K 04 |
| | 0 to 1000 °C | K 05 |
| | 0 to 1200 °C | K 06 |
| | 0 to 1372 °C | K 07 |
| | 0 to 100 °C | K 13 |
| | 0 to 300 °C | K 14 |
| | 0 to 450 °C | K 17 |
| | 0 to 500 °C | K 20 |
| | 0 to 800 °F | K A1 |
| | 0 to 1600 °F | K A2 |
| | 0 to 2502 °F | K A3 |
| | 20 to 70 °F | K A9 |
| J | 0 to 200 °C | J 01 |
| | 0 to 400 °C | J 02 |
| | 0 to 600 °C | J 03 |
| | 0 to 800 °C | J 04 |
| | 0 to 1000 °C | J 05 |
| | 0 to 1200 °C | J 06 |
| | 0 to 450 °C | J 10 |
| | 0 to 800 °F | J A1 |
| | 0 to 1600 °F | J A2 |
| | 0 to 2192 °F | J A3 |
| | 0 to 400 °F | J A6 |
| 0 to 300 °F | J A7 | |
| R | 0 to 1600 °C *1 | R 01 |
| | 0 to 1769 °C *1 | R 02 |
| | 0 to 1350 °C *1 | R 04 |
| | 0 to 3200 °F *1 | R A1 |
| | 0 to 3216 °F *1 | R A2 |
| S | 0 to 1600 °C *1 | S 01 |
| | 0 to 1769 °C *1 | S 02 |
| | 0 to 3200 °F *1 | S A1 |
| | 0 to 3216 °F *1 | S A2 |
| B | 400 to 1800 °C | B 01 |
| | 0 to 1820 °C *1 | B 02 |
| | 800 to 3200 °F | B A1 |
| | 0 to 3308 °F *1 | B A2 |
| E | 0 to 800 °C | E 01 |
| | 0 to 1000 °C | E 02 |
| | 0 to 1600 °F | E A1 |
| | 0 to 1832 °F | E A2 |
| N | 0 to 1200 °C | N 01 |
| | 0 to 1300 °C | N 02 |
| | 0 to 2300 °F | N A1 |
| | 0 to 2372 °F | N A2 |
| T | -199.9 to +400.0 °C *2 | T 01 |
| | -199.9 to +100.0 °C *2 | T 02 |
| | -100.0 to +200.0 °C | T 03 |
| | 0.0 to 350.0 °C | T 04 |
| | -199.9 to +752.0 °F *2 | T A1 |
| | -100.0 to +200.0 °F *2 | T A2 |
| | -100.0 to +400.0 °F *2 | T A3 |
| 0.0 to 450.0 °F | T A4 | |
| 0.0 to 752.0 °F | T A5 | |
| W5Re/ W26Re | 0 to 2000 °C | W 01 |
| | 0 to 2320 °C | W 02 |
| | 0 to 4000 °F | W A1 |

| Input type | Code | |
|------------|------------------------|-------|
| | Input | Range |
| PL II | 0 to 1300 °C | A 01 |
| | 0 to 1390 °C | A 02 |
| | 0 to 1200 °C | A 03 |
| | 0 to 2400 °F | A A1 |
| | 0 to 2534 °F | A A2 |
| U | -199.9 to +600.0 °C *2 | U 01 |
| | -199.9 to +100.0 °C *2 | U 02 |
| | 0.0 to 400.0 °C | U 03 |
| | -199.9 to +999.9 °F *2 | U A1 |
| | -100.0 to +200.0 °F *2 | U A2 |
| | 0.0 to 999.9 °F | U A3 |
| L | 0 to 400 °C | L 01 |
| | 0 to 800 °C | L 02 |
| | 0 to 800 °F | L A1 |
| | 0 to 1600 °F | L A2 |

RTD input

| Input type | Code | |
|------------|---------------------|-------|
| | Input | Range |
| Pt100 | -199.9 to +649.0 °C | D 01 |
| | -199.9 to +200.0 °C | D 02 |
| | -100.0 to +50.0 °C | D 03 |
| | -100.0 to +100.0 °C | D 04 |
| | -100.0 to +200.0 °C | D 05 |
| | 0.0 to 50.0 °C | D 06 |
| | 0.0 to 100.0 °C | D 07 |
| | 0.0 to 200.0 °C | D 08 |
| | 0.0 to 300.0 °C | D 09 |
| | 0.0 to 500.0 °C | D 10 |
| | -199.9 to +999.9 °F | D A1 |
| | -199.9 to +400.0 °F | D A2 |
| | -199.9 to +200.0 °F | D A3 |
| | -100.0 to +100.0 °F | D A4 |
| | -100.0 to +300.0 °F | D A5 |
| | 0.0 to 100.0 °F | D A6 |
| | 0.0 to 200.0 °F | D A7 |
| | 0.0 to 400.0 °F | D A8 |
| | 0.0 to 500.0 °F | D A9 |
| JPt100 | -199.9 to +649.0 °C | P 01 |
| | -199.9 to +200.0 °C | P 02 |
| | -100.0 to +50.0 °C | P 03 |
| | -100.0 to +100.0 °C | P 04 |
| | -100.0 to +200.0 °C | P 05 |
| | 0.0 to 50.0 °C | P 06 |
| | 0.0 to 100.0 °C | P 07 |
| | 0.0 to 200.0 °C | P 08 |
| | 0.0 to 300.0 °C | P 09 |
| | 0.0 to 500.0 °C | P 10 |

Voltage input and Current input

| Input type | Code | |
|----------------|----------------|-------|
| | Input | Range |
| 0 to 5 V DC | 0.0 to 100.0 % | 4 01 |
| 0 to 10 V DC * | | 5 01 |
| 1 to 5 V DC | | 6 01 |
| 0 to 20 mA DC | | 7 01 |
| 4 to 20 mA DC | | 8 01 |
| | | |

* Z-1010 specification

*1: 0 to 399 °C/0 to 799 °F: Accuracy is not guaranteed.

*2: -199.9 to -100.0 °C/-199.9 to -158.0 °F : Accuracy is not guaranteed.

6. TROUBLE SHOOTING

The causes of and measures to be used for faulty controller status during communication are described in the following. For trouble other than the below, contact us or your nearest RKC agent after confirming Model No. and specifications.

| Details | Cause | Measures |
|-------------|---|--|
| No response | Trouble with and imperfect contact of communication cable | Check communication cables and connectors. |
| | Incorrect communication speed | Set the communication speed suitable for the host computer by referring to "3.4 Communication speed setting" (P. 9). |
| | Device address designation differs | Make reassignment after checking the device address by referring to "3.3 Device address setting" (P. 7). |
| | Incorrect data construction | Make reassignment after checking the data construction by referring to "3.5 Data construction setting" (P. 11). |
| | Transmission line is not set to the receive state after data send | Check a program on the host computer side. |
| EOT return | Incorrect identifier | Make re-setting after checking the identifier by referring to "■Communication identifier list" (P. 28). |
| | The identifier of a function not added to the controller is specified | |
| NAK return | BCC error | Check BCC of the transmission data. |
| | Data exceeds the setting range | Check a data range. |
| | The identifier of a function not added to the controller is specified | Make re-setting after checking the identifier by referring to "■Communication identifier list" (P. 28). |

7. ASCII 7-BIT CODE TABLE (REFERENCE)

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

MEMO



RKC INSTRUMENT INC.

HEADQUARTERS: 16-6, KUGAHARA 5-CHOME, OHTA-KU TOKYO 146-8515
JAPAN

PHONE: 03-3751-9799 (+81 3 3751 9799)

E-mail: info@rkcinst.co.jp