

---

---

---

---

---

*Digital Controller*

***CB100/CB400***  
***CB500/CB700***  
***CB900***

***Communication***  
***Instruction Manual***




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


## SYMBOLS

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

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

**NOTE** : Extra noted or precautions are added to operating procedures and explanations.

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

 : This mark is used to add extra notes, precautions or supplementary explanations to table and figures.



### WARNING

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

## **CAUTION**

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

## **NOTICE**

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

# CONTENTS

---

	Page
<b>1. SPECIFICATIONS</b> .....	<b>1</b>
<b>2. WIRING</b> .....	<b>2</b>
<b>3. SETTING FOR COMMUNICATION</b> .....	<b>5</b>
3.1 Transfer to communication setting mode.....	5
3.2 Communication parameter selection .....	6
3.3 Device address setting .....	7
3.4 Communication speed setting .....	9
3.5 Data bit configuration setting .....	11
3.6 Interval time setting.....	13
3.7 Notes under communication .....	16
<b>4. COMMUNICATION PROTOCOL</b> .....	<b>19</b>
4.1 Polling .....	19
4.1.1 Polling procedure.....	20
4.1.2 Polling procedure example (When the host computer requests data).....	23
4.2 Selecting .....	24
4.2.1 Selecting procedure.....	24
4.2.2 Selecting procedure example (When the host computer sends a set value).....	27
<b>5. COMMUNICATION IDENTIFIER</b> .....	<b>28</b>
<b>6. TROUBLESHOOTING</b> .....	<b>34</b>
<b>7. ASCII 7-BIT CODE TABLE (Reference)</b> .....	<b>35</b>

# **MEMO**

# 1. SPECIFICATIONS

---

- Interface:** Based on RS-485, EIA standard
- Connection method:** 2-wire system, half-duplex multi-drop connection
- Communication distance:** 1 km max.  
The maximum communication distance will be affected by the surrounding conditions.
- Synchronous method:** Start/stop synchronous type
- Communication speed:** 2400 bps, 4800 bps, 9600 bps, 19200 bps
- Data bit configuration:** Start bit: 1  
Data bit: 7 or 8  
Parity bit: Without, Odd or Even  
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)
- Communication code:** ASCII 7-bit code
- Termination resistor:** Externally connected
- Xon/Xoff control:** None
- Maximum connections:** 32 instruments maximum including a host computer
- Signal logic:** RS-485

Signal voltage	Logic
$V(A) - V(B) \geq 2\text{ V}$	0 (SPACE)
$V(A) - V(B) \leq -2\text{ V}$	1 (MARK)

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

## 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 **CB100/CB400/CB500/CB700/CB900** digital controller (hereinafter, the "controller") including the host computer can be connected if multidrop connected by RS-485.

#### ■ Terminal No. and signal details

##### CB100/CB400/CB500/CB900

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	←————→	

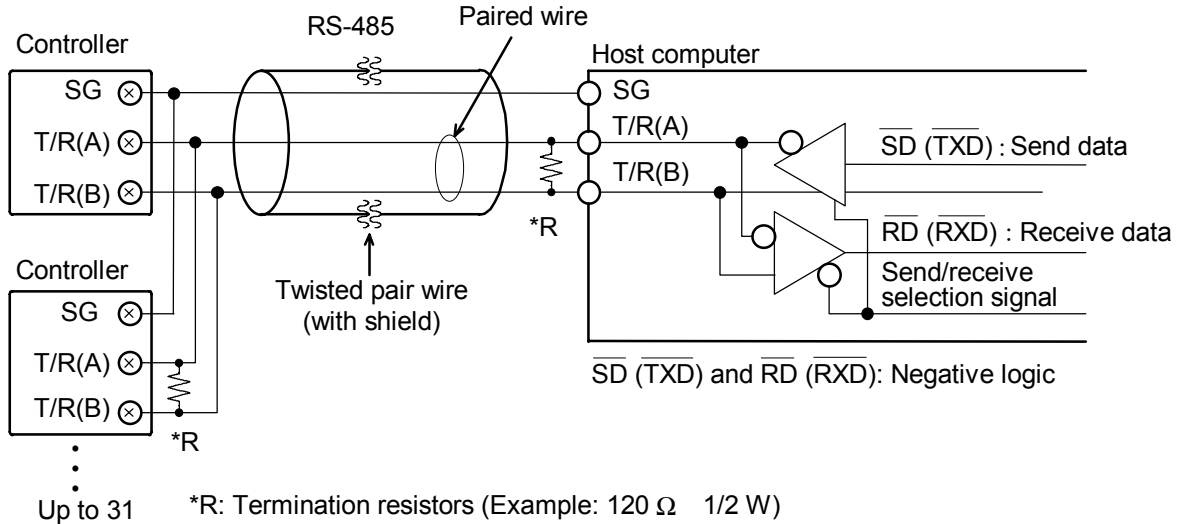
##### CB700

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	←————→	



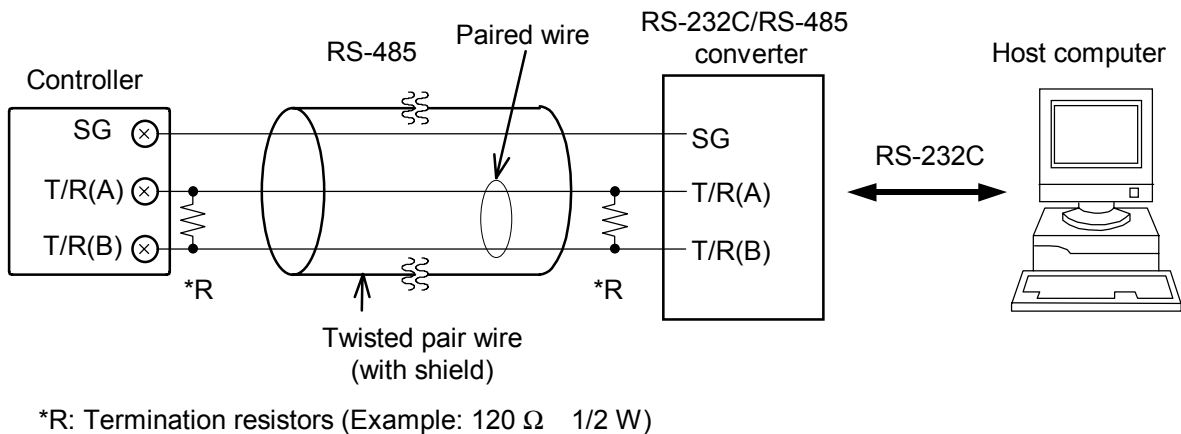
■ When host computer interface is RS-485

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



■ When host computer interface is RS-232C

RS-232C/RS-485 converter is required.

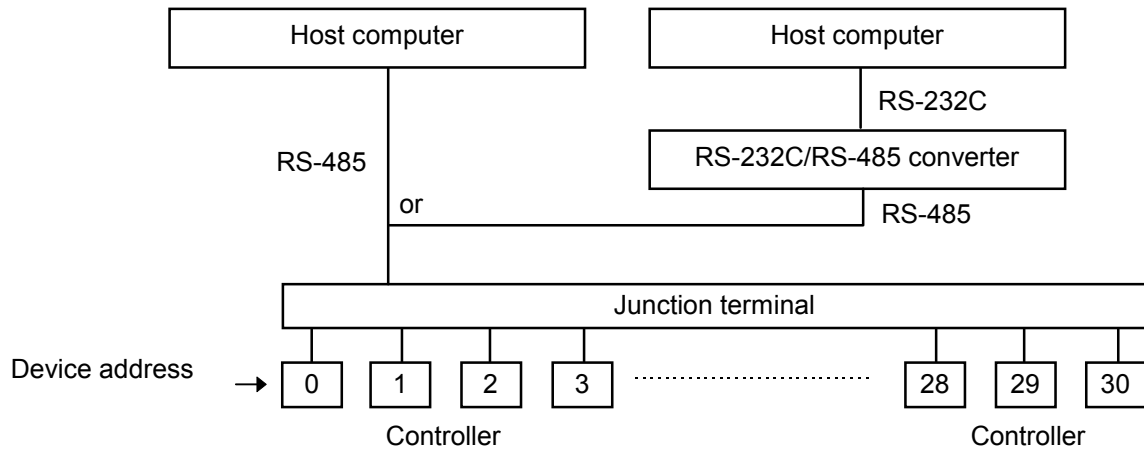


**CAUTION**

When the host computer use Windows 95/98/NT, use a RS-232C/RS-485 converter with an automatic send/receive transfer function.

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

■ **Connection example**  
**(Connection with up to 31 controllers and one host computer)**



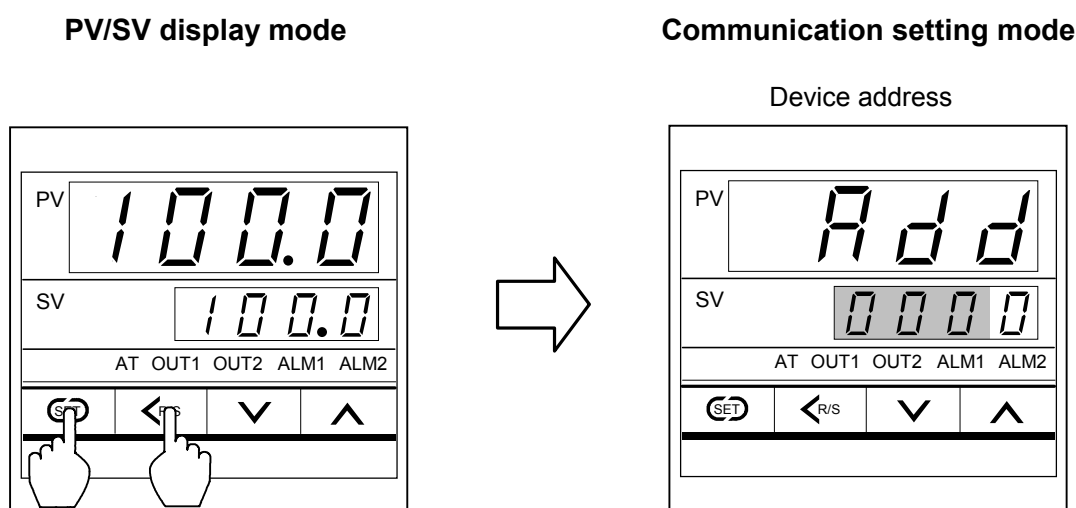
# 3. SETTING FOR COMMUNICATION

In order to make communication between the **CB100/CB400/CB500/CB700/CB900** 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 **CB900**. 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.



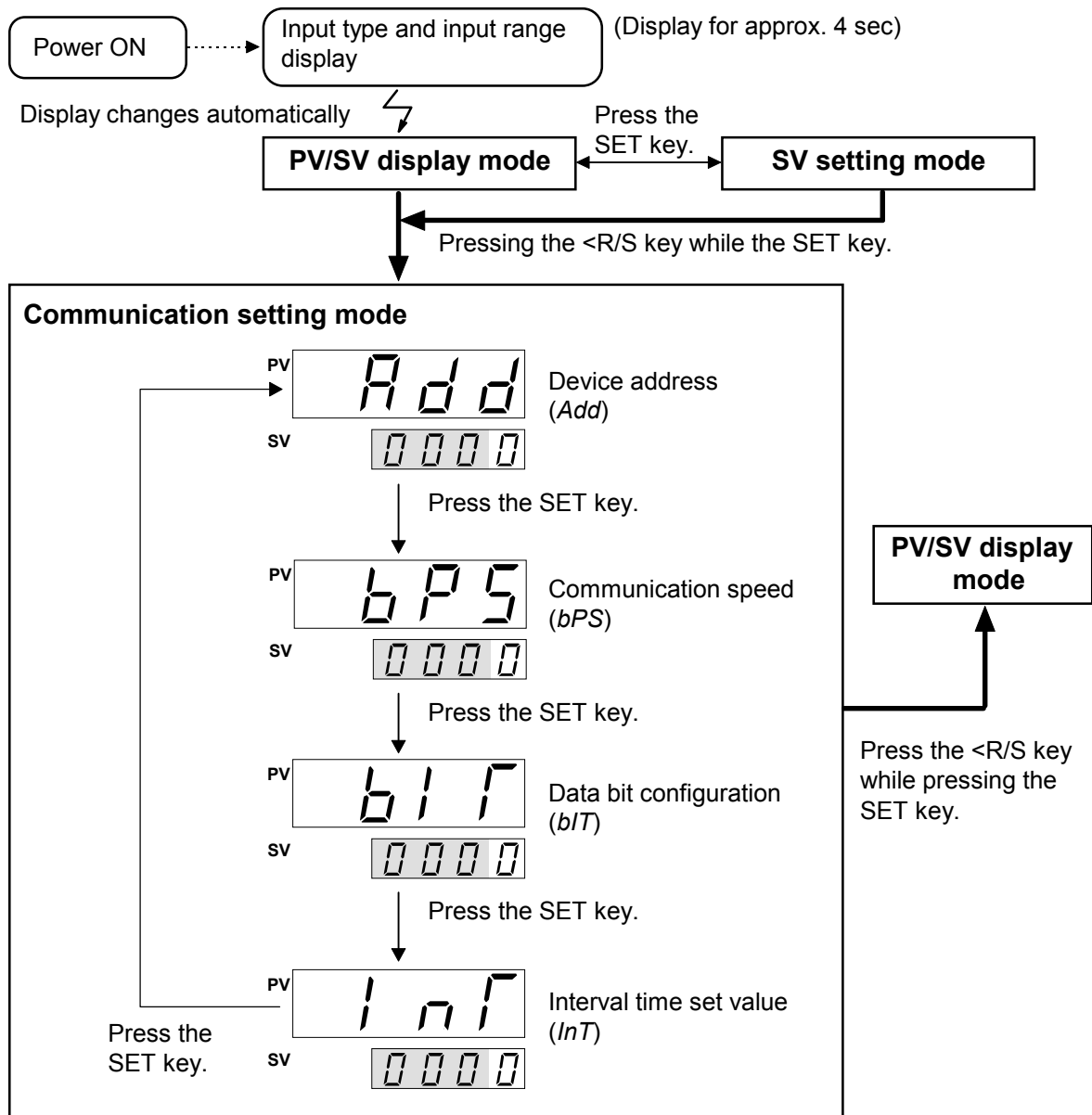
### NOTES

- 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

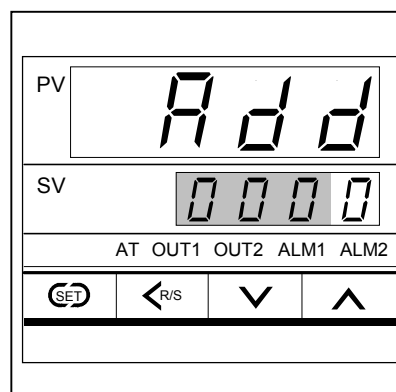
- When the communication parameter was changed, always turn on the power again. Otherwise, no communication is performed by using the changed value.
- If key operation is not performed for more than 1 minute without pressing the SET key after the device address is set, the controller is automatically 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).

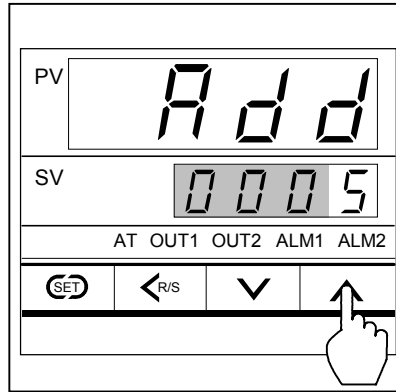
Device address



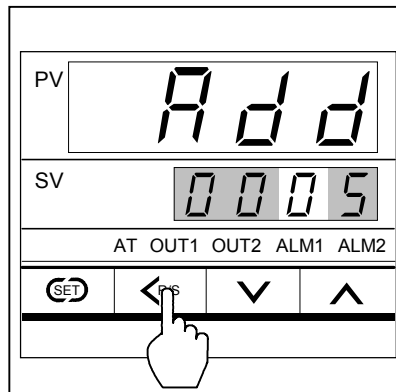
### 3. SETTING FOR COMMUNICATION

---

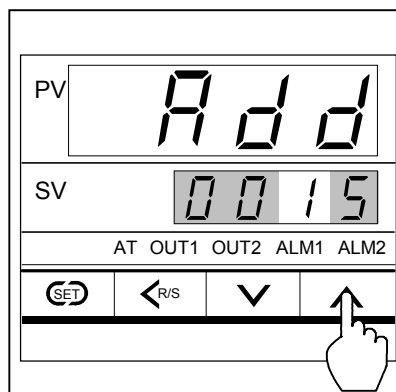
2. Set the device address. Press the UP key to enter "5" in the lowest digit.



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		

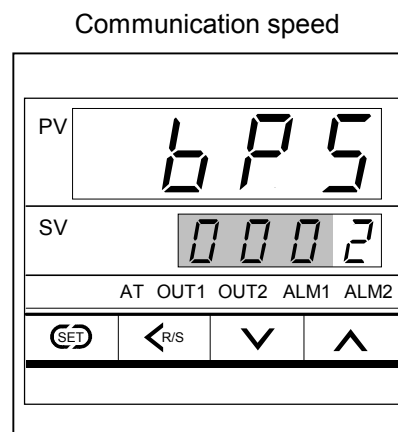
#### CAUTIONS

- 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 communication speed 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."

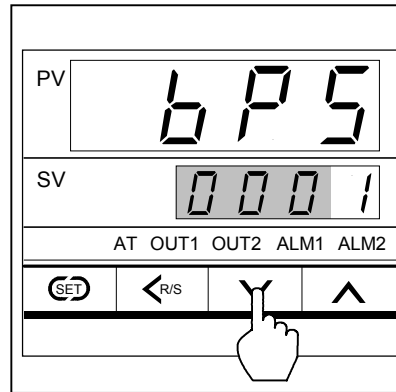
1. Change the controller to communication setting mode, and then display the communication speed (See P. 5, 6).



### 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 bit configuration setting

Set the data bit configuration 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 bit configuration	0 to 5 See *A	Selects data bit configuration during communication.	0
<b>bIT</b>				

\*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

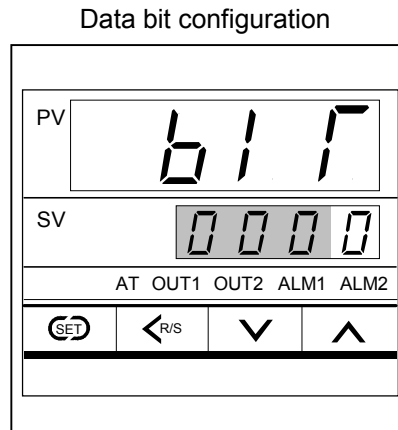
#### CAUTIONS

- Set the same data bit configuration 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 data bit configuration is set, the controller is automatically changed to PV/SV display mode. In this case, the set data bit configuration returns to the value before the setting is changed.

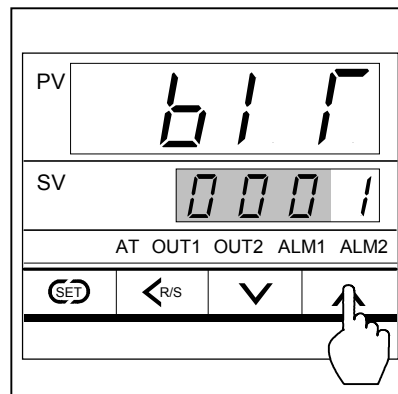
■ **Setting procedure**

Example: When setting data bit configuration 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 bit configuration (See P. 5, 6).



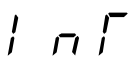
2. Press the UP key to enter "1" in the lowest digit. As a result, data bit configuration is set to "8 data bits, no parity bit and 2 stop bits."



3. Press the SET key to change to the next communication parameter. As a result, the set data bit configuration 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 :

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

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

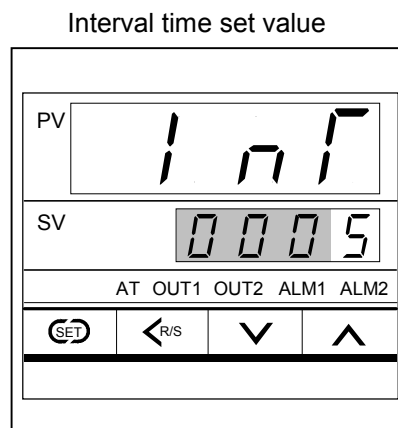
#### CAUTIONS

- 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 interval time set value 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).



### 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:

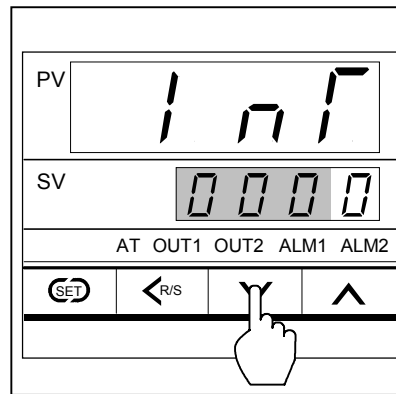
$$250 \text{ ms} \div 1.666 \text{ ms} \approx 150 \text{ (Round to the nearest whole number.)}$$

Interval time:

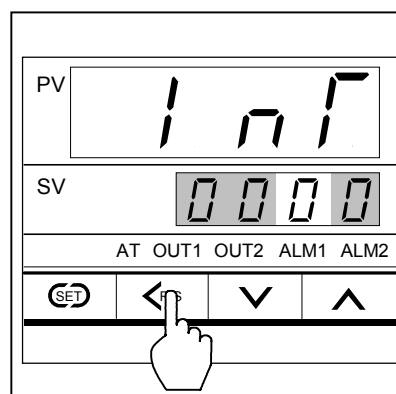
$$150 \times 1.666 \text{ ms} \approx 249.9 \text{ (Approx. 250 ms)}$$

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.

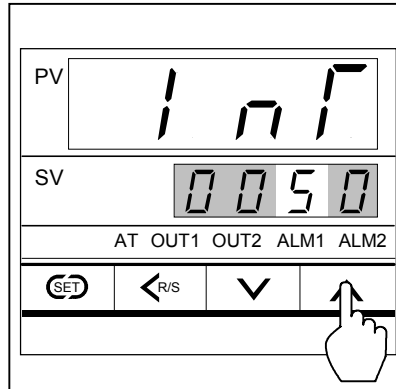
- Press the DOWN key to enter "0" in the lowest digit.



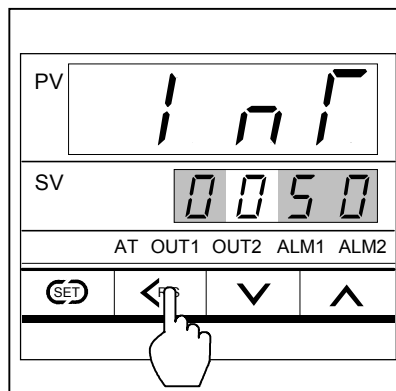
- Press the <R/S key to brightly light the tens digit.



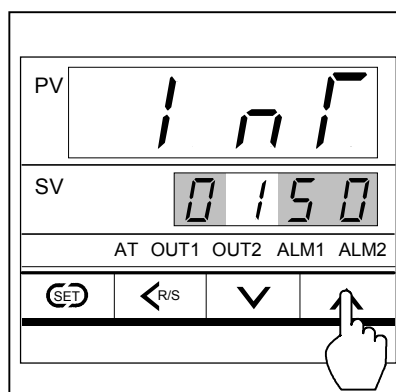
5. Press the UP key to enter "5" in the tens digit.



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

#### NOTES

- Data-link is terminated sending [EOT], if no response within about 3 sec after BCC send.
- Response send time is the time at having set interval time in 0 ms.

#### 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

#### NOTE

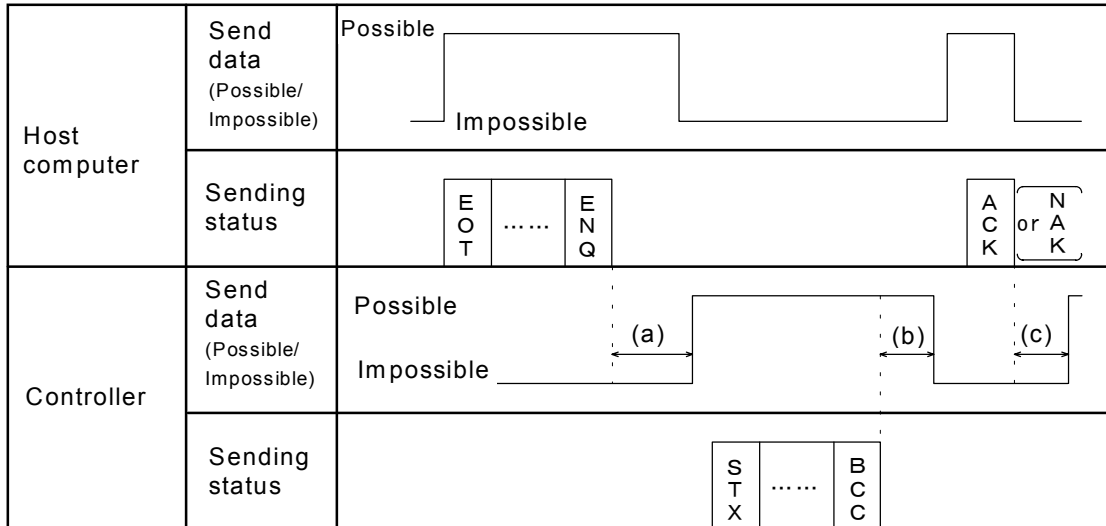
- Response send time is the time at having set interval time in 0 ms.

■ 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.

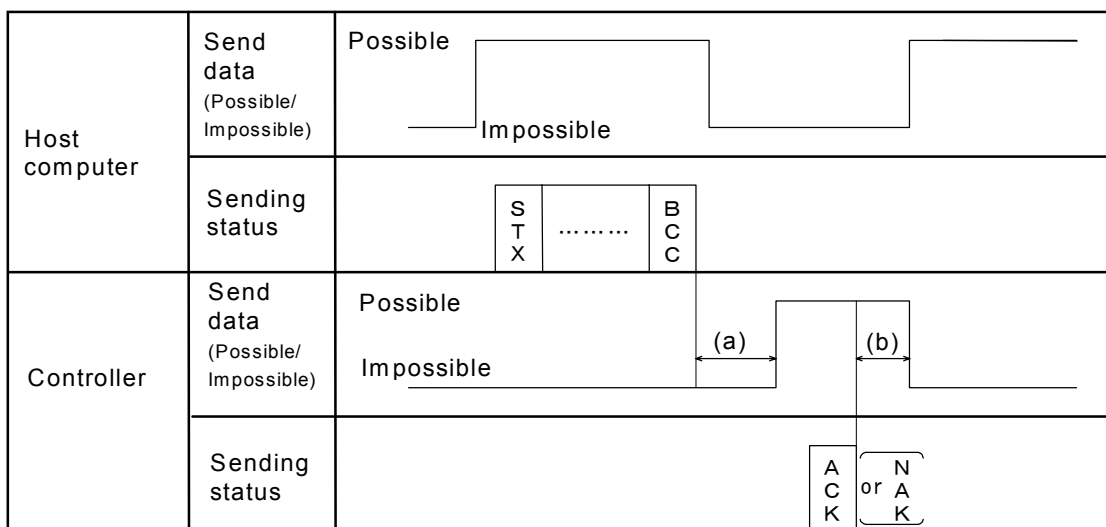
Send/receive example in the host computer and controller is show in the following.

**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))

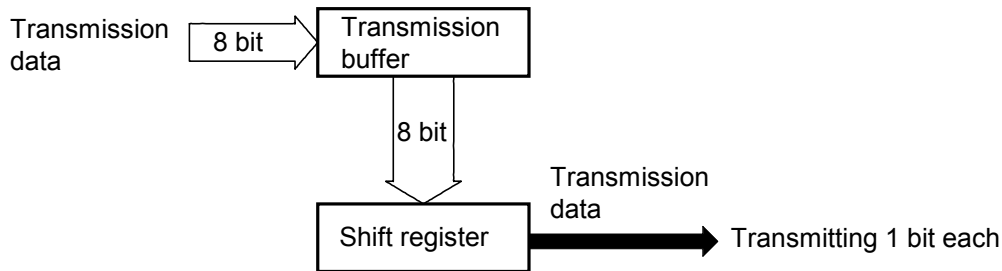
**Selecting procedure**



- (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) 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.
- (5) The nonvolatile memory (EEPROM) for data backup has limitations on the number of memory rewrite times (approx. 100,000 times). Avoid using the memory to frequently change the set value via communication.



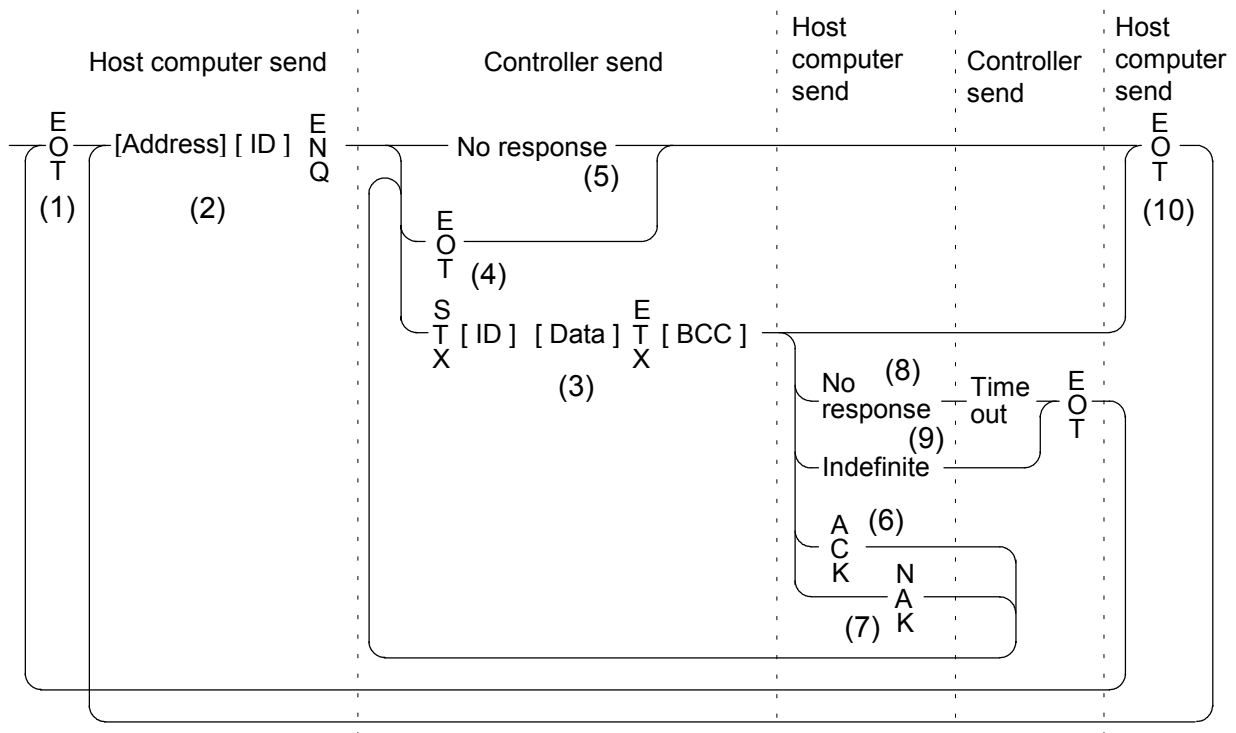
# 4. COMMUNICATION PROTOCOL

The **CB100/CB400/CB500/CB700/CB900** 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.



##### 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.)

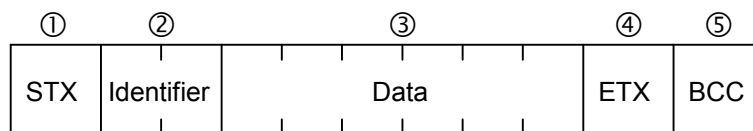
This is for identifying data requested for the controller. Always attach the [ENQ] code to the end of the identifier.

##### 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.
- When 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**

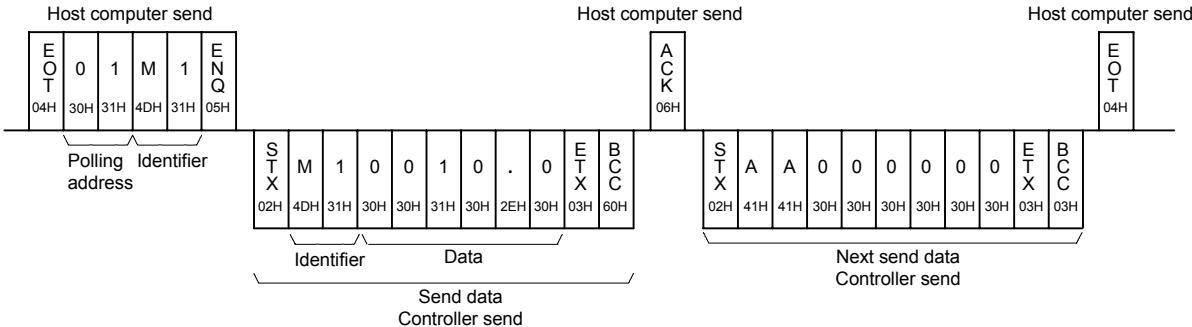
When the response from the host computer is indefinite, the controller sends [EOT] to terminate the data link.

### **(10) Data link termination [EOT]**

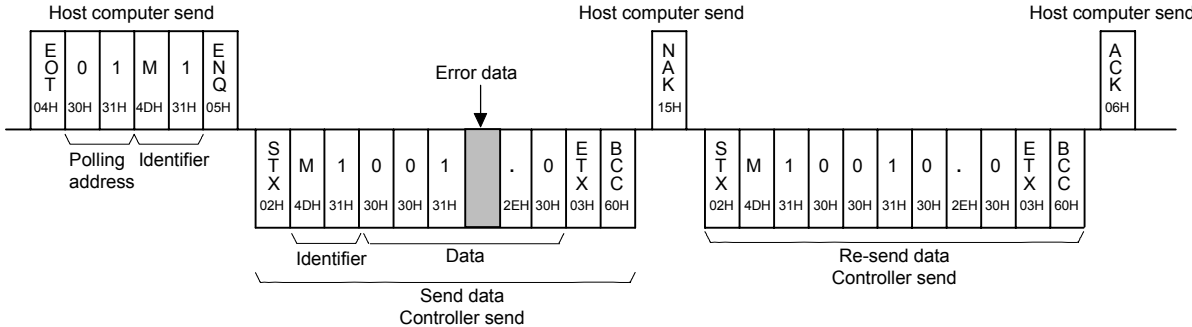
If it is necessary to suspend communication with the controller or to terminate the data link due to no response from the controller, the host computer sends [EOT].

### 4.1.2 Polling procedure example (When the host computer requests data)

■ Normal transmission



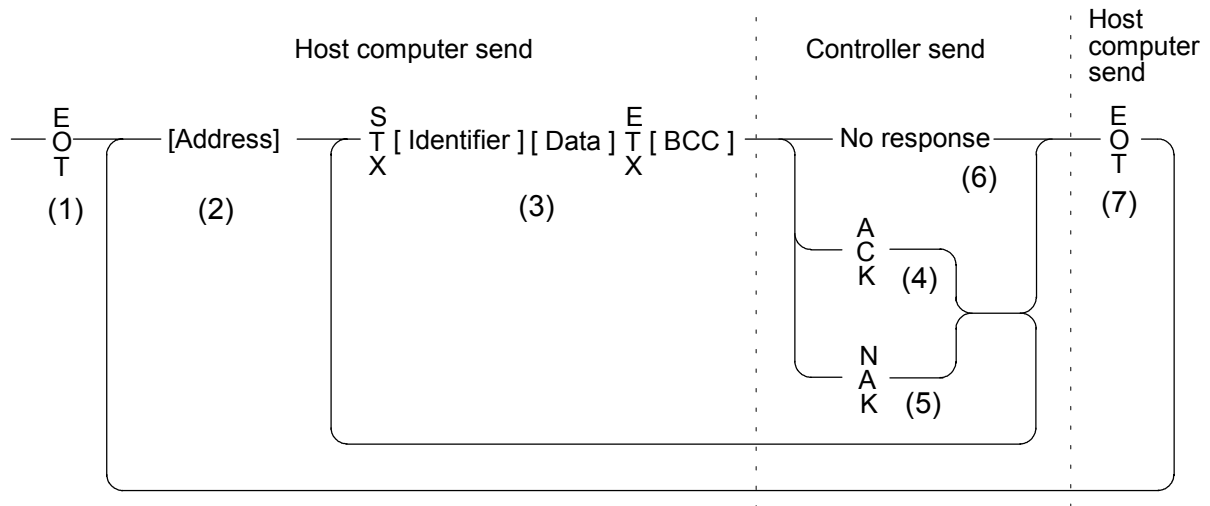
■ For the presence of error in data



## 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]**

Data is the information being sent to the controller. It is expressed in decimal ASCII code including a minus sign (-) and a decimal point (period).

**● 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.  
 <Example> When data send with -001.5, -01.5, -1.5, -1.50, -1.500 at the time of -1.5, controller can receive a data.

- When the host computer send data with decimal point to item of without decimal point, controller receives a message with the value which cut off below the decimal point.

<Example> When setting range is 0 to 200, controller receives as a following.

<b>Send data</b>	0.5	100.5
<b>Receive data</b>	0	100

- Controller 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, controller receives as a following.

<b>Send data</b>	-.5	-.058	.05	-0
<b>Receive data</b>	-0.50	-0.05	0.05	0.00

The data that receipt of letter is impossible

Controller sends NAK when received a following data.

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

### **(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.

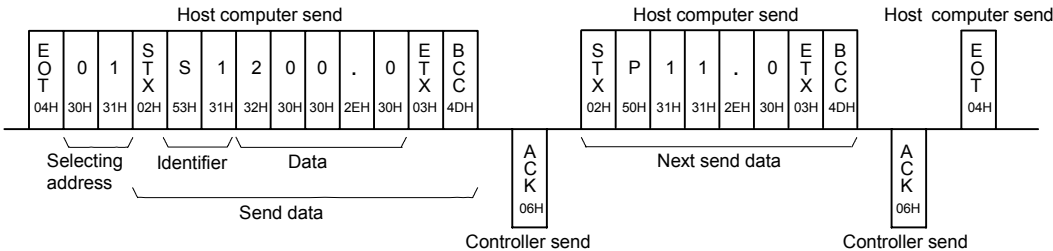
### **(7) Data link termination [EOT]**

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.

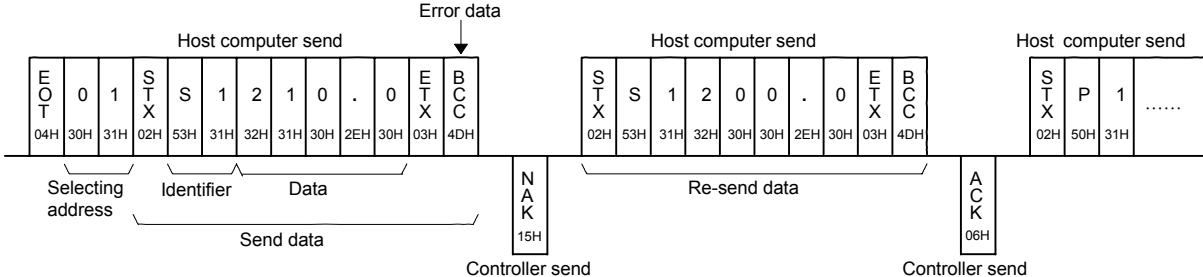


### 4.2.2 Selecting procedure example (When the host computer sends a set value)

■ Normal transmission



■ For the presence of error in data



# 5. COMMUNICATION IDENTIFIER

## ■ Communication identifier list

### NOTES

- Communication is not possible when an identifier is specified that the controller can not recognize.
- 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)	<b>M1</b>	Within input range	----	RO
Current transformer input 1 See *1.	<b>M2</b>	0.0 to 100.0 A	----	RO
Current transformer input 2 See *2.	<b>M3</b>	0.0 to 100.0 A	----	RO
Alarm 1 status See *3.	<b>AA</b>	0: OFF 1: ON	----	RO
Alarm 2 status See *1.	<b>AB</b>	0: OFF 1: ON	----	RO
Burnout	<b>B1</b>	0: OFF 1: ON	----	RO
Error code	<b>ER</b>	0 to 255 See *4.	----	RO
RUN/STOP transfer	<b>SR</b>	0: RUN 1: STOP	0	R/W
Set value (SV)	<b>S1</b>	Within input range	0	R/W
Alarm 1 setting See *3.	<b>A1</b>	<b>Temperature input</b> 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.	<b>A2</b>	<b>Voltage/ current inputs</b> Deviation alarm: -span to +span (Within 9999) Process alarm, SV alarm: Within input range	Voltage/ current inputs: 5.0	

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 (LBA) setting See *1, *3.	A5	0.1 to 200.0 min.	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	<b>D1</b>	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	<b>W1</b>	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	<b>T0</b>	1 to 100 sec (Not set if the control output is current output.)	See *6.	R/W
Cool-side proportional band See *7.	<b>P2</b>	1 to 1000 % of heat-side proportional band	100	R/W
Overlap/deadband See *7.	<b>V1</b>	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.	<b>T1</b>	1 to 100 sec (Not set if the control output is current output.)	See *8.	R/W
PV bias	<b>PB</b>	-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	<b>LK</b>	0 to 7 See *9.	0	R/W
EEPROM storage mode See *10.	<b>EB</b>	0: Backup mode (Set values are store to the EEPROM when set values are changed.) 1: Buffer mode (Not set values are store to the EEPROM when set values are changed.)	0	R/W
EEPROM storage state See *11.	<b>EM</b>	0: The content of the EEPROM does not coincide with that of the RAM. 1: The content of the EEPROM coincides with that of the RAM.	----	RO

\*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. Please contact RKC sales office or the agent.

- \*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.

**\*10:** The non-volatile memory (EEPROM) has limitations on the number of memory rewrite times. If the buffer mode is selected as an EEPROM storage mode, all of the set values changed are not written to the EEPROM and thus a problem of limitations on the number of memory rewrite times can be solved. When the memory is used to frequently change the set value via communication, select the buffer mode.

When selecting any EEPROM storage mode, take notice of the following.

- If power failure occurs while the buffer mode is selected, the set value returns to the value before the storage mode is selected.
- If the buffer mode is changed to the backup mode, all of the set values at that time are stored to the EEPROM. If necessary to backup the final value of each set item, select the backup mode.
- When the power is turned on, the backup mode is always set.

**\*11:** The contents of the buffer memory and those of the EEPROM can be checked.

When data is 0: The contents of the buffer memory do not match with those of the EEPROM.

- As data is being written to the EEPROM in backup mode, do not turn the power off. If turned off, no set values are stored.
- If the set value is changed after the backup mode is changed to the buffer mode, 0 is set (mismatch). As the set value changed is not backup, select the backup mode if necessary.

When data is 1: The contents of the buffer memory match with those of the EEPROM.  
(Data write to the EEPROM is completed.)

## ■ 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
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	0.0 100.0 % to	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 751 °F: Accuracy is not guaranteed.

\*2: -199.9 to -100.0 °C/-199.9 to -148.0 °F : Accuracy is not guaranteed.

## 6. TROUBLESHOOTING

This section lists some of the main causes and solutions for communication problems.

If you can not solve a problem, please contact RKC sales office or the agent, on confirming the type name and specifications of the product.

<b>Problem</b>	<b>Probable cause</b>	<b>Solution</b>
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 bit configuration	Make reassignment after checking the data bit configuration by referring to "3.5 Data bit configuration 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
	The identifier of a function not added to the controller is specified	"■Communication identifier list" (P. 28).
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](mailto:info@rkcinst.co.jp)

FAX: 03-3751-8585 (+81 3 3751 8585)