Temperature controller with fuzzy function

REX－D SERIES

COMMUNICATION INSTRUCTION MANUAL

RKC INSTRUMENT INC.

IMDRE03－E3

INTRODUCTION

Thank you very much purchasing our "*REX−D series*". This manual describes the "*REX−D series*" communication function. Please read this manual carefully before using the instruments.
Before using the unit, carefully read this instruction manual. Also keep this manual with much care for future reference.

USERS OF THIS MANUAL

This manual is prepared for all personnel who use "*REX−D series*". However, it is desirable that they have a fundamental knowledge of electrical engineering and communication.

CAUTIONS

- This manual is subject to change without prior notice.
- Examples of figures, diagrams and numeric values used in this manual are for a better understanding of the text, but not for assuring the resultant operation.
-
- "*REX−D series*" and this manual are manufactured and prepared under strict quality control before delivery. However, if any problems arise, please contact us directly or your nearest our sales agent.
- RKC assumes no responsibility for any of the following damages which the user or third party may suffer.

  ① Damage incurred as a result of using this product.
  ② Damage caused by product failure which cannot be predicted by RKC.
  ③ Other indirect damages.

★ For safe operation of "REX−D series"

1 . "*REX−D series*" must be used under the following conditions.
"*REX−D series*" is a component type and is used after mounting on an instrument panel.
It is thus manufactured as a component destined for the final product, so its high−voltage blocks such as the power terminals are uncovered.
Therefore, after it is installed on the final product, the final product supplier must take the necessary measures for the user to prevent touching directly the high−voltage blocks.

2 . For correct and safe operation of "*REX−D series*", always observe the safety precautions described in this manual when performing operations, maintenance and repair work.
RKC neither assures responsibility nor provides warranty for problems or accidents occurring if these precautions are not observed.

● For safe operation of "*REX−D series*", the following "Signal Words and Symbol Marks" are used in this manual.

< Signal Words >

WARNING : 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.

CAUTION : These describe precautions to be taken if unit damage may result if operating procedures are not strictly followed.

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

< Symbol Mark >

⚠ : 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.

⚠ WARNING

● 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 unit all of the wiring is completed.

● Never use the instrument near inflammable gases

- In order to prevent fire, explosion or instrument damage, never use this instrument at a location where inflammable or explosive gases or vapour exist.

● 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.

Name and number of this instruction manual:

Name : **REX- D** SERIES COMMUNICATION INSTRUCTION MANUAL
Manual number : IMDRE03-E3

■ Revisions

Date of revision	Manual number	Reason of revision
1994.10.07	IMDRE03-E1	The First edition issue
1994.12.16	IMDRE03-E2	Addition of the item : terminal resistor
1997.01.14	IMDRE03-E3	2. WIRING EXAMPLES : Addition of notes 3. SETTING FOR COMMUNICATION : Addition of **CAUTION** 5. COMMUNICATIN DATA : Correction of clerical errors

CONTENTS

1. SPECIFICATIONS

(1) **Interface** : ① EIA standard Based on RS-422A (Other than REX-D100)
② EIA standard Based on RS-485

(2) **Connection method** : ① 4-wire system, half-duplex multi-drop connection (Other than REX-D100) ＊1
② 2-wire system, half-duplex multi-drop connection ＊2

＊1 Specification conforming to RS-422A
＊2 Specification conforming to RS-485

(3) **Communication distance** : ① RS-422A : 1km (max)
② RS-485 : 1km (max)
＊ However, communication distance varies slightly with the surroundings such as cables, etc.

(4) **Synchronous method** : Start/stop synchronous type

(5) **Communication speed** : 1200bps, 2400bps, 4800bps, 9600bps, 19200bps

(6) **Data type** : ① Start bit : 1
② Data bit : 7 or 8
③ Parity bit : None (Odd number or even number)
④ Stop bit : 1 or 2

(7) **Transmission control procedure** : ANSI X3.28 subcategory 2.5, A4
Polling / selection type

(8) **Error control** : ① Vertical parity (With parity bit selected)
② Horizontal parity (BCC check)

(9) **Block length** : Within 16 bytes

(10) **Maximum connection** : ① RS-422A : 32 sets including a host computer
(However, 32 sets may not always be connected depending on host computer driver performance.)
② RS-485 : 32 sets including a host computer

(11) Communication code : JIS/ASCII 7-bit code

(12) Details of terminals :

① **RS-422A (4-wire system)**

Terminal No.			Signal name	Signal direction Controller ↔ HOST	Remarks
D400	D700	D900			
18	23	18	SG	————	Signal ground
14	19	14	T(A)	————→	Send data
15	20	15	T(B)	————→	Send data
16	21	16	R(A)	←————	Receive data
17	22	17	R(B)	←————	Receive data

② **RS-485 (2-wire system)**

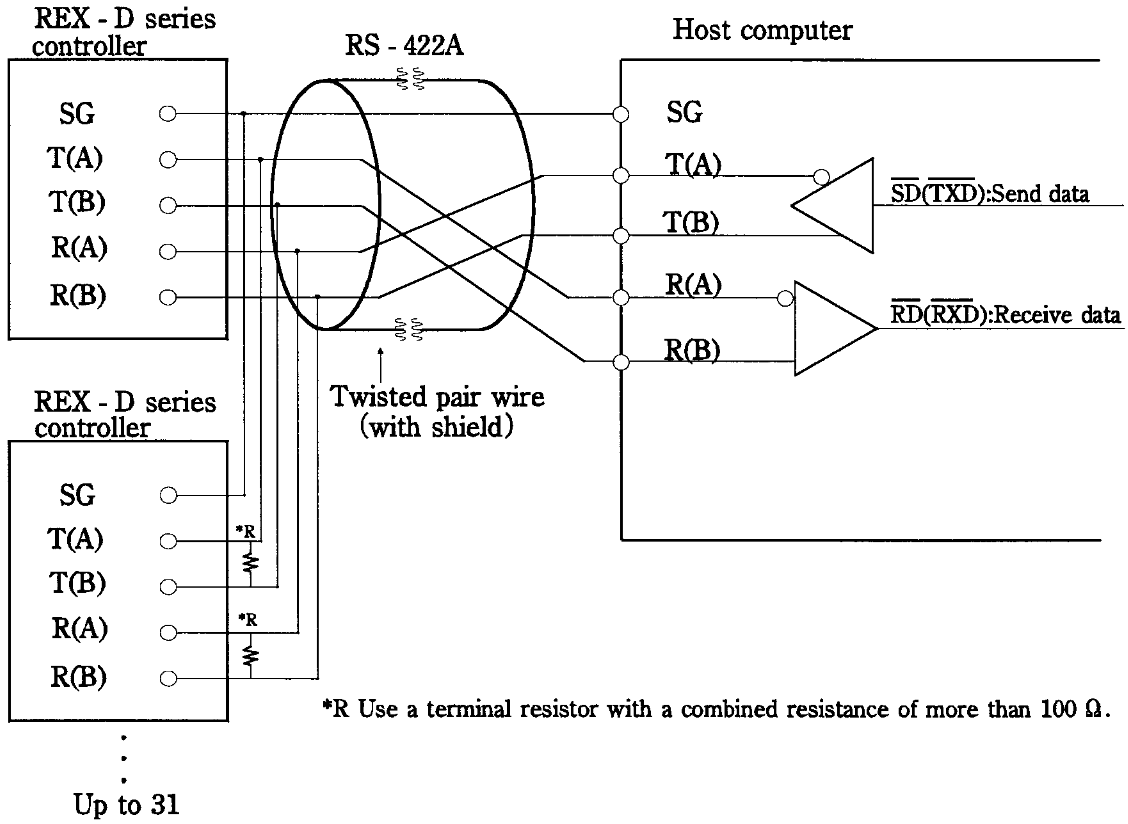
Terminal No.				Signal name	Signal direction Controller ↔ HOST	Remarks
D100	D400	D700	D900			
	18	23	18	SG	————	Signal ground
14	16	21	16	T/R(A)	←————→	Send data/Receive data
13	17	22	17	T/R(B)	←————→	Send data/Receive data

2. WIRING EXAMPLES

Up to 32 *REX–D series controllers* including a host computer can be connected by multi–drop connection via the RS–422A or RS–485. However, for the RS–422A, 32 sets may not always be connected depending on host computer driver performance. Conduct wiring suitable for customer's use by referring to the following wiring examples.

2.1 Specifications conforming to RS–422A

(1) When host computer interface is RS–422A



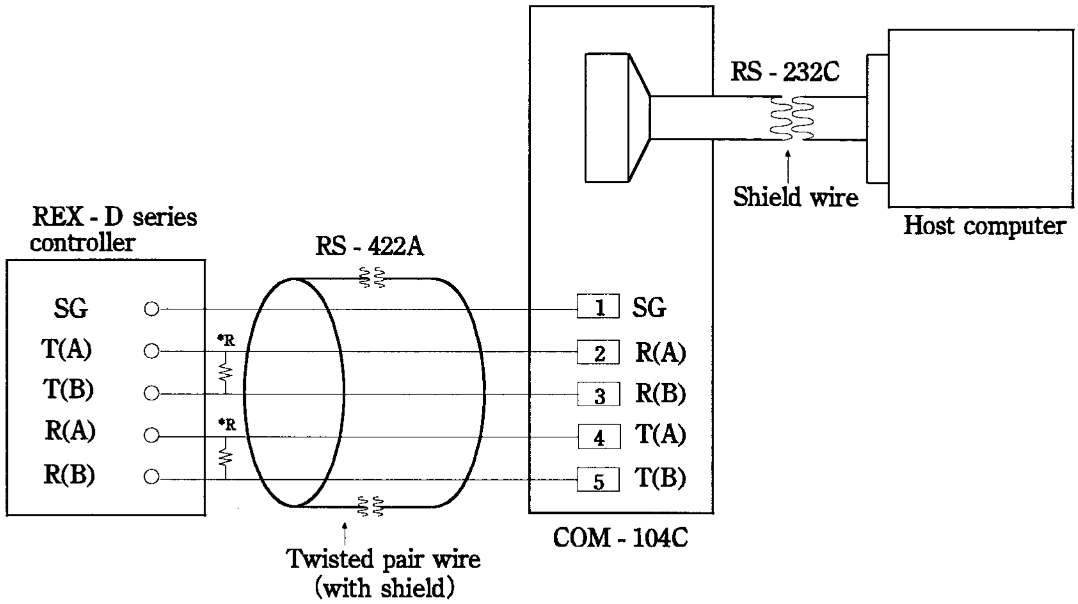
*R Use a terminal resistor with a combined resistance of more than 100 Ω.

REX–D series controller terminal Nos.
used for RS–422A

Signal name	Terminal No.		
	REX–D400	REX–D700	REX–D900
SG	18	23	18
T(A)	14	19	14
T(B)	15	20	15
R(A)	16	21	16
R(B)	17	22	17

(2) **When host computer interface is RS-232C**

Our converter COM-104C is used.



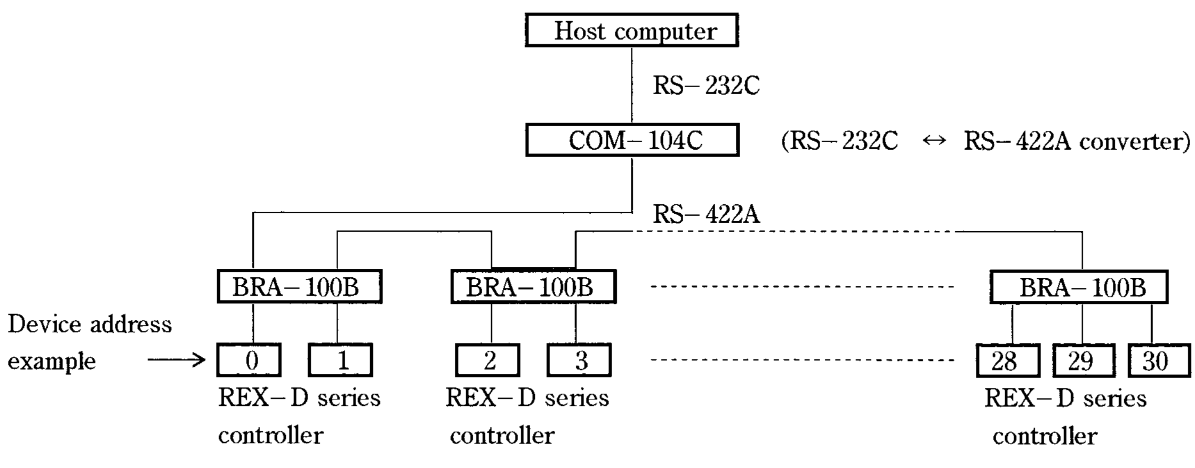
***R Use a terminal resistor with a combined resistance of more than 100 Ω.**

REX-D series controller terminal Nos. used for RS-422A

Signal name	Terminal No.		
	REX-D400	REX-D700	REX-D900
SG	18	23	18
T(A)	14	19	14
T(B)	15	20	15
R(A)	16	21	16
R(B)	17	22	17

* In the RS-422A specification, up to 32 *REX-D series controllers* including a host computer can be connected. However, 32 sets may not always be connected depending on host computer driver performance.

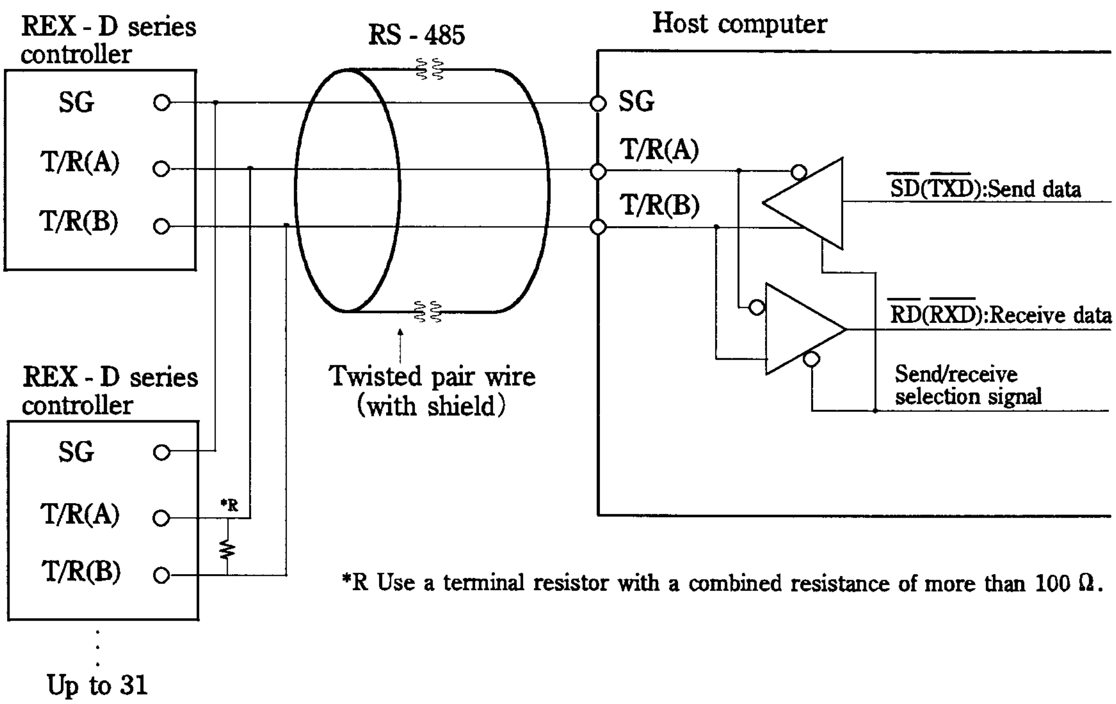
〔**Connection example**〕



2.2 Specifications conforming to RS-485

(1) When host computer interface is RS-485

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



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

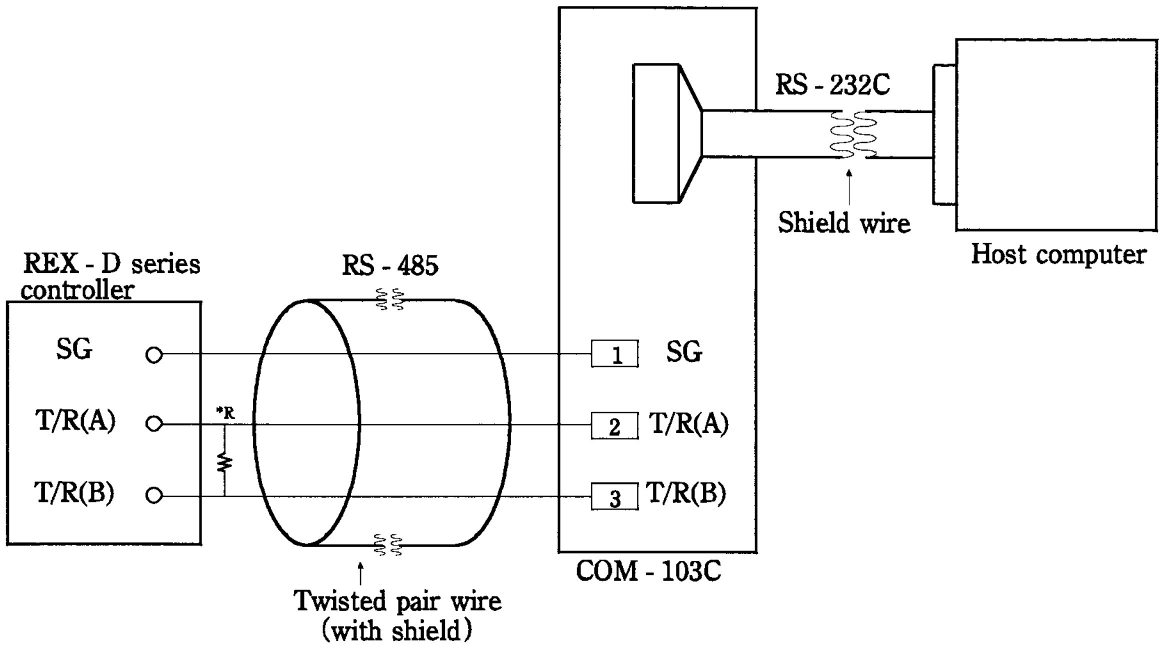
REX-D series controller terminal Nos.
used for RS-485

Signal name	Terminal No.			
	REX-D100	REX-D400	REX-D700	REX-D900
SG		18	23	18
T/R(A)	14	16	21	16
T/R(B)	13	17	22	17

＊ For the REX-D100, no SG wiring is required.

(2) **When host computer interface is RS-232C**

Our converter COM-103C is used.



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

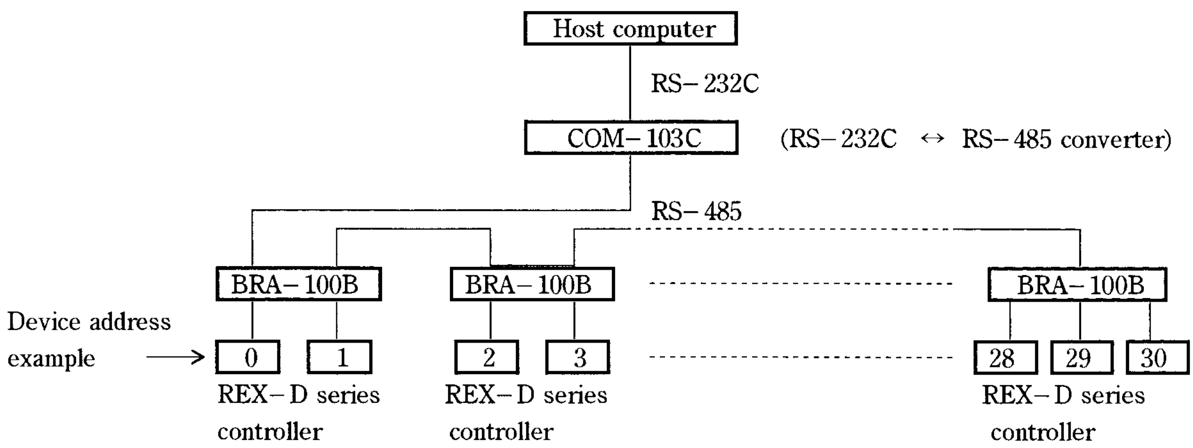
REX-D series controller terminal Nos.
used for RS-485

Signal name	Terminal No.			
	REX-D100	REX-D400	REX-D700	REX-D900
SG		18	23	18
T/R(A)	14	16	21	16
T/R(B)	13	17	22	17

* For the REX-D100, no SG wiring is required.

* In the RS-485 specification, up to 32 *REX-D series controllers* including a host computer can be connected.

〔**Connection example**〕

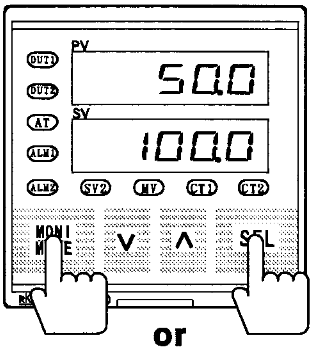


3. SETTING FOR COMMUNICATION

Engineer setting mode and SETUP mode are set for communication. The picture in the following is for REX−D100, but the same operation also applies to other *REX−D series controllers.*

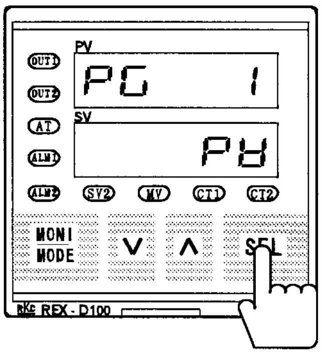
3.1 Communication speed and Data type setting

(1) Calling up communication parameter (PG8)



① **Set the instrument to the PV/SV display/set mode**

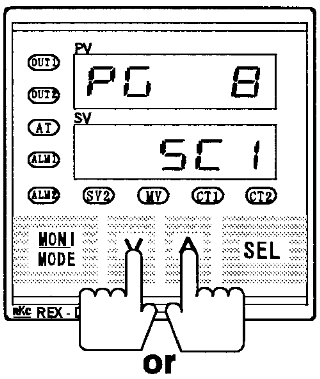
If the instrument is set to another mode, press the MONI MODE or SEL key to set the instrument to the PV/SV display/set mode.



② **Call up engineer set mode**

Press the SEL key for 2 sec. with the controller set to PV/SV display/set mode to call up engineer set mode.

First, "Parameter group (PG1)" is displayed.



③ **Set to parameter group (PG8)**

Press the Λ or V key to call up the parameter group (PG8).

(2) The contents of parameter group (PG8)

Each item shown in the following changes to the next item every time the [SEL] key is pressed.
The final item returns to the "P G 8" display.

	Symbol	Name	Setting range	Description	Initial value prior to shipment
	P G 8 PG8	Parameter group 8		The first characters of parameter group (PG8).	
①	b P S bPS	Communication speed	0:1200bps 3: 9600bps 1:2400bps 4:19200bps 2:4800bps	Selects communication speed.	3
②	b I T bIT	Communication data bit configuration	See ∗A	Selects data bit configuration during communication.	0

∗A ···

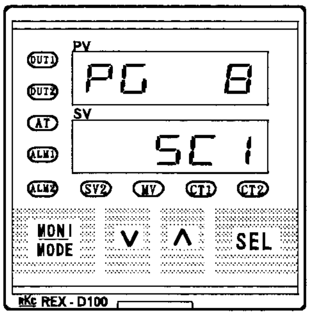
Setting	Data bit [bit]	Parity bit	Stop bit [bit]
0	8	None	1
1	8	None	2
2	7	Even	1
3	7	Even	2
4	7	Odd	1
5	7	Odd	2

① Select communication speed to meet the host computer.

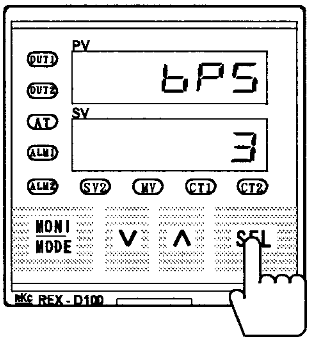
② Select bit configuration meeting the host computer.

(3) Communication speed setting

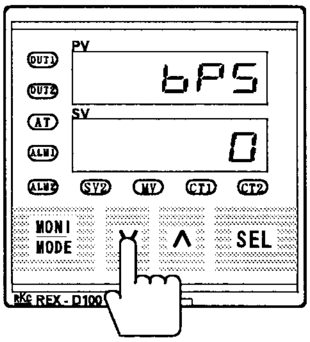
〔Example〕 When communication speed is set to 1200bps.



① **Set to parameter group (PG8)**
Call up the parameter group (PG8) by referring to "(1) Calling up communication parameter (PG8)" (Page 7).



② **Set to "Communication speed (bps)"**
Press the SEL key.
Thus, the measured−value (PV) display unit shows "b P S", and the set−value (SV) display unit shows the numeric value.



③ **Communication speed setting**
Press the ∨ key to set "0". Thus, a communication speed of 1200bps is set.
Press the SEL key.

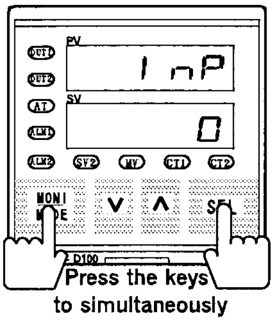
* For the communication speed codes, see "(2) The contents of parameter group (PG8)".

CAUTION

● The settings (communication speed and communication data bit configuration) are not established if the power is not turned on again after turned off once.

3.2 Device address setting

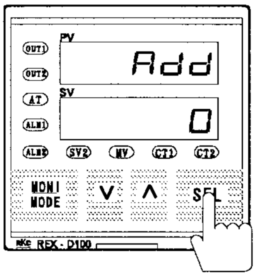
(1) Device address setting



① **Call up SETUP set mode**

Press the MONI MODE and SEL keys simultaneously to call up SETUP set mode.

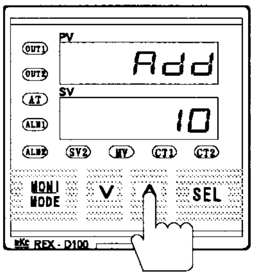
First, "Input type selection (InP)" is displayed



② **Set to "Device address (Add)"**

Press the SEL key.

The measured-value (PV) display unit shows "A d d", and the set-value (SV) display unit shows the address number.

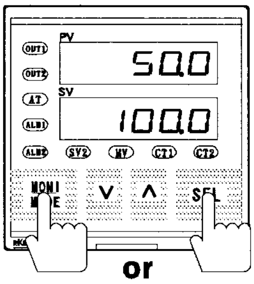


③ **Change the address number**

Press the Λ or V key to change the number shown on the set-value (SV) display unit to the desired number.

Then press the SEL key to validate it.

* Keep pressing the Λ or V key to increase the speed with which the numeric value changes.



④ **Setting end**

After the setting is completed, press the MONI MODE or SEL key to set the instrument to the desired mode.

(Figure on the left : PV/SV display/set mode)

(2) The contents of device address

Symbol	Name	Setting range	Description	Initial value prior to shipment
A d d Add	Device address	0 to 99	Set device address of this instrument.	0

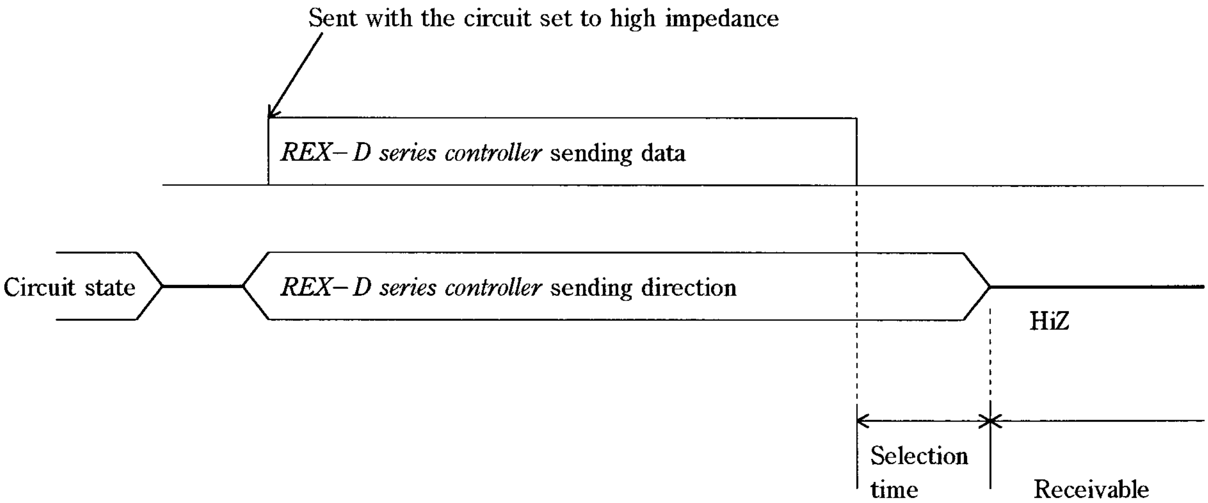
3.3 Notes under communication

(1) When the operation mode (Operation execution (RUN)/STOP) is set to the operation execution (RUN) status from the operation stop status, the *REX–D series controller* becomes reset status temporarily. Therefore, it may become to the no–response state.

(2) If polling is made by specifying the identifier of the function not added to the instrument, the *REX–D series controller* sends [EOT]. In addition, if selecting is made the *REX–D series controller* sends [NAK].

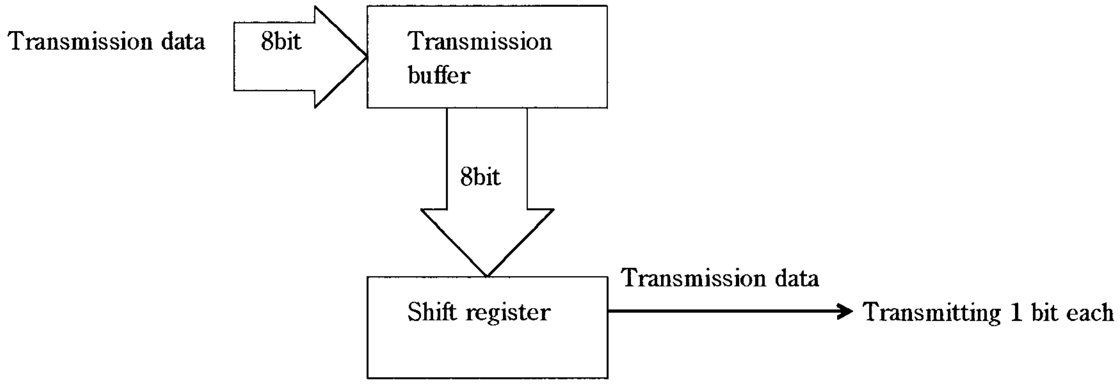
(3) Send/receive timing
The times until which data can be received from the host computer after the *REX–D series controller* sends data to the host computer is as follows.

Selection time	MIN	TYP	MAX
	Approx. 0.8msec	Approx. 1.8msec	Approx. 2.4msec



☆ When host computer is changed 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.
Switched to "Receive" after confirming that the shift register is empty.



☆ When host computer is selected from data receiving to 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 *REX−D series controller* data sending.
Therefore, select the host computer from receiving to sending after the lapse of the above time.

4. COMMUNICATION PROTOCOL

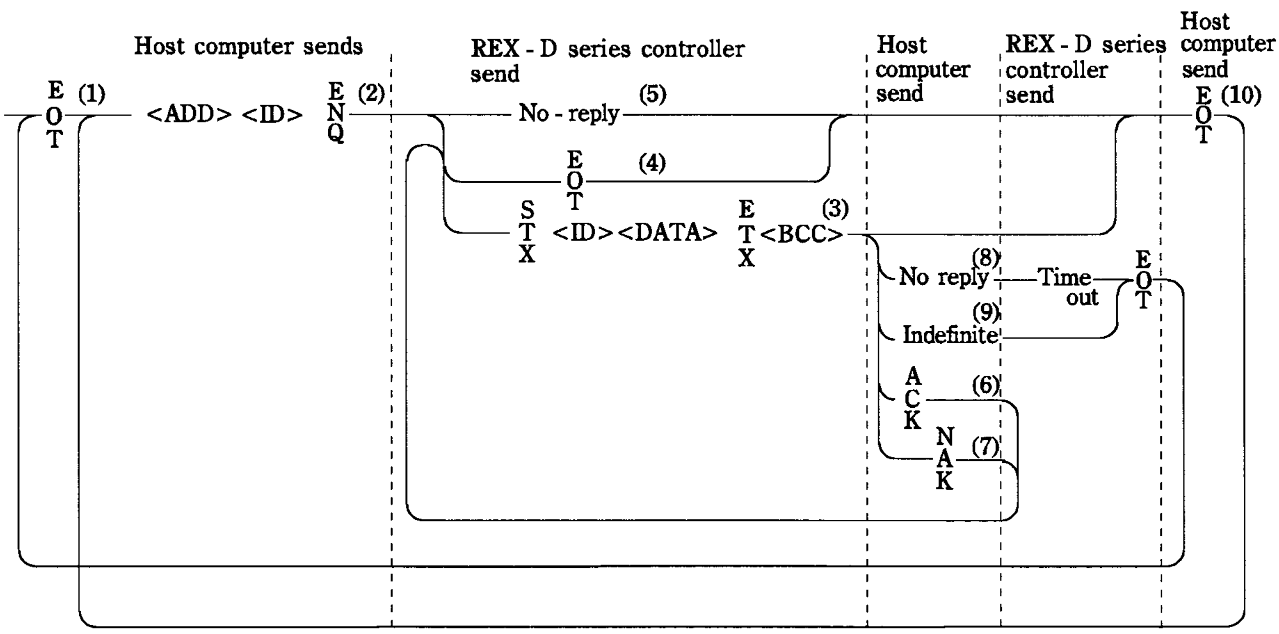
REX– D series (hereinafter called the controller) adopted polling/selection type for the method of establish data link. The basic procedure is followed ANSI X3.28 subcategory 2.5, A4 and JIS basic mode data transmission control procedure (Fast selecting is established for selection).

- The polling/selection method is such that all controllers are controlled by the host computer and controllers is permitted. In order to force controller to send and receive data messages, send the message from the host computer according to the polling or selection procedure.
  (Centralized control method)

- The code use in communication is 7– bit JIS/ASCII code including transmission control character.
  The transmission control characters are [EOT] (04H), [ENQ] (05H), [ACK] (06H), [NAK] (15H), [STX] (02H), [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 multiconnected, to send the data. The procedure is as the following.



ADD : Address
ID : Identifier

◎ 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		②		③
				ENQ
Device address		Identifier		

(Example)

0	2	M	1	ENQ

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 "3.2 Device address setting" (Page 10).

② **Identifier 〔Number of digits : 2〕**

This is for identifying data required to send to the controller.
(For details, refer to "5. COMMUNICATION DATA", page 21.)
The identifier is expressed as an alphanumeric ASCII code.

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	②			③					④	⑤
STX									ETX	BCC
	Identifier		Data							

① **[STX]**

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

② **Identifier 〔Number of digits : 2〕**

This is for identifying data (measured-value, status and set-value) sent to the host computer.
(For details, refer to "5.COMMUNICATION DATA", page 21.)
The identifier is expressed as an alphanumeric ASCII code.

③ **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. No zero suppression is made.

④ **[ETX]**

This is the transmission control character which indicates the end of the text.

⑤ **[BCC]**

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

<Algorithm>

[BCC] is the result calculated using EX − OR (exclusive "or") of all characters from the character next to [STX] to [ETX]. Not including [STX].

− Example −

In the case of the data are :

STX	M	1	0	2	5	0	.	0	ETX	BCC
	4DH	31H	30H	32H	35H	30H	2EH	30H	03H	

In the parenthesis are indicated with hexadecimal number.

BCC = 4DH ⊕ 31H ⊕ 30H ⊕ 32H ⊕ 35H ⊕ 30H ⊕ 2EH ⊕ 30H ⊕ 03H = 66H ("⊕" indicates EX − OR)

Value of BCC becomes 66H.

(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 instrument 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) Acknowledgement [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" (Page 21). If data send from the controller is suspend, send [EOT] to terminate the data link.

(7) Negative acknowledgement [NAK]

If the host computer cannot receive data correctly, [NAK] is sent. Then, controller resends the send data. However, since the number of resend times is not specified, take the appropriate recovery measures on the host computer side if it does not recover.

(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

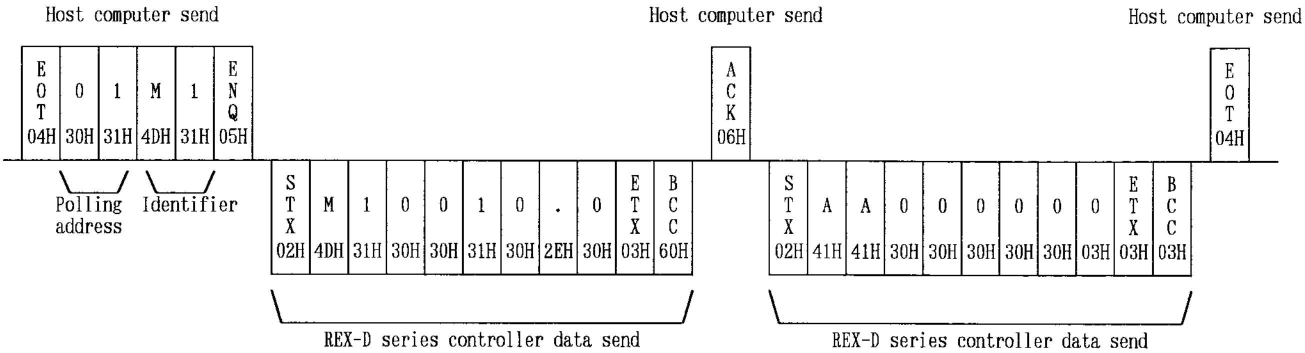
When the response from the host computer is indefinite, the controller sends [EOT] to terminate the data link.

(10) Data link termination [EOT]

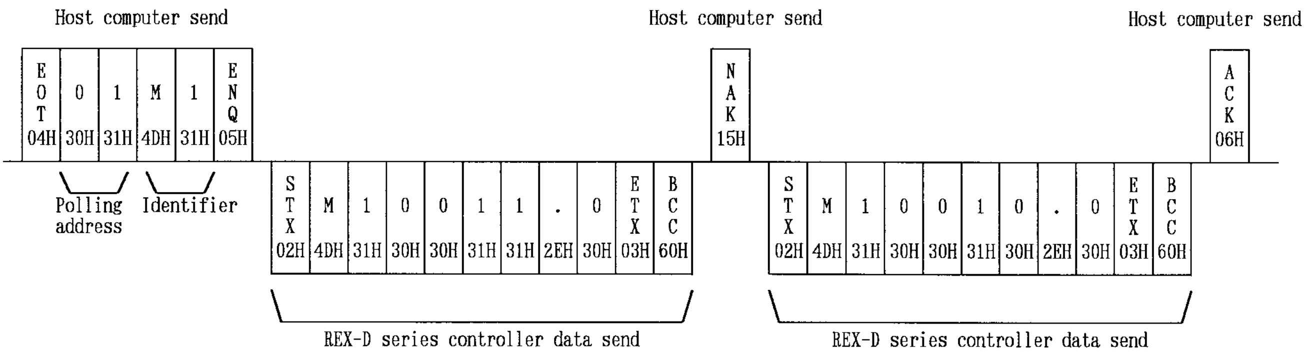
If it is necessary to suspend communication with the controller or to terminate the data link due to no– response from the controller, the host computer sends [EOT].

◎ Polling procedure example (when the host computer requests data)

<Normal transmission>

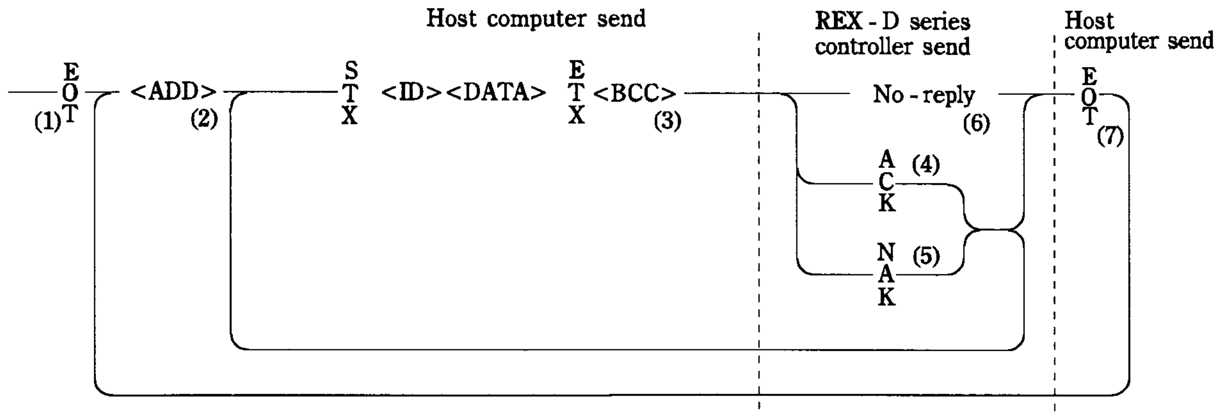


<For the presence of error in data>



4.2 Selection

Selection is an operation in which the host computer selects one set from among the controllers multiconnected and then of recommending data receive. The procedure is as the following.
Due to adopted first selecting in controllers therefore becomes the type to send the data which connected to selection sequence.



ADD : Address
ID : Identifier

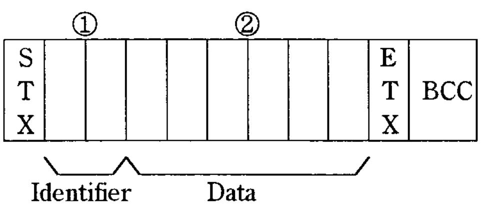
◎ Selection procedure

(1) Initialize of data link
Host computer sends [EOT] for initializing of data link before selection sequence.

(2) Selection sequence send
Send the selection address selected as the selection 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 "3.2 Device address setting" (Page 10).

(3) Data send
Host computer to send the data with a format indicated below continuing the selection sequence.



＊ For [STX], [ETX] and [BCC], see item "4.1 Polling" (Page 13).

① **Identifier 〔Number of digits : 2〕**

This is for identifying data (measured−value, status and set−value) sent to the host computer.
(See "5. COMMUNICATION DATA" on page 21.)
The identifier is expressed as an alphanumeric ASCII code.

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 selection as follows.

Example : When setting data is between − 10.00 to 10.00

When data is receivable	When data is not receivable
−.5 → − 0.5	− → Not receivable(NAK answer)
−.058 → − 0.05	. → Not receivable(NAK answer)
.03 → 0.03	−. → Not receivable(NAK answer)
	+ 0 → Not receivable(NAK answer)

(4) Acknowledgement [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 acknowledgement [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" configuration.)
- When the number of receive data digits exceeds 6.
- When normally receive data exceeds the setting range.
- When the identifier not added to the instrument is specified.

(6) No−reply

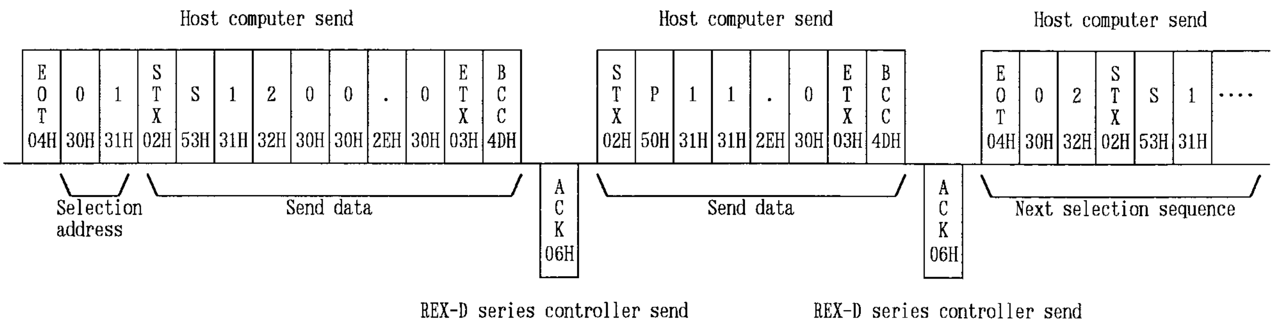
If the selection address is not received correctly, the controller is set to no−reply, if [STX], [ETX] and [BCC] is not received correctly, the controller is also set to no−reply.

(7) Data link termination [EOT]

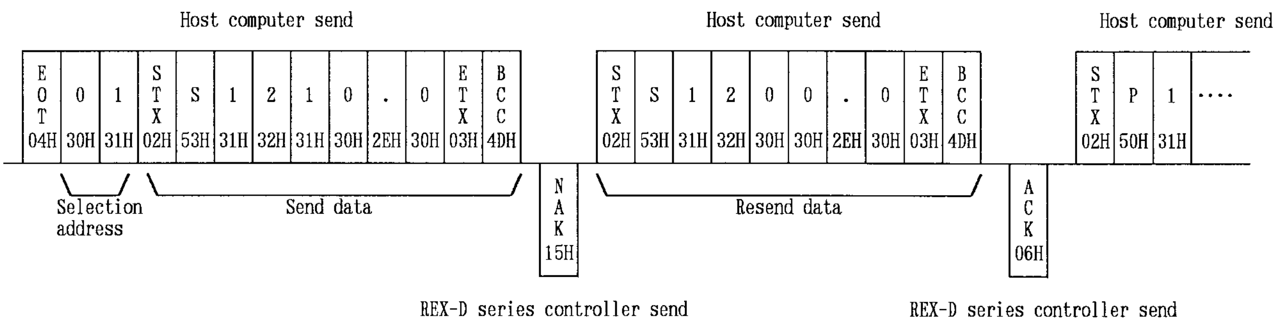
When terminating the data link because there was no more to be sent on the host computer side or the controller was set to no−reply, send [EOT] from the host computer.

◎ Selection procedure example (When the host computer sends a set－value)

<Normal transmisson>



<For the presence of error in data>



5. COMMUNICATION DATA

■ Communication identifier list

NOTE Note that there are identifiers which indicate that communication is not possible depending on the specification.

Name	Identifier	Number of digits	Data range	Initial value	User setting value	R/W	
Measured-value(PV)	M1	6	Scaling low-limit to scaling high-limit	———		R/O	
First current transformer input value (CT1)	M2	6	0.0 to 100.0A	———		R/O	
Second current transformer input value (CT2)	M3	6	0.0 to 100.0A	———		R/O	*1
First alarm output	AA	6	0 : OFF 1 : ON	———		R/O	
Second alarm output	AB	6	0 : OFF 1 : ON	———		R/O	
Heater break alarm output 1	AC	6	0 : OFF 1 : ON	———		R/O	
Heater break alarm output 2	AD	6	0 : OFF 1 : ON	———		R/O	
Control loop break alarm	AE	6	0 : OFF 1 : ON	———		R/O	
Burnout	B1	6	0 : OFF 1 : ON	———		R/O	
Manipulated output 1 (Heating-side)	O1	6	-5.0 to 105.0%	———		R/O	
Manipulated output 2 (Cooling-side)	O2	6	-5.0 to 105.0%	———		R/O	
Set-value (SV) monitoring	MS	6	Scaling low-limit to scaling high-limit	———		R/O	
Error data	ER	6	0 to 255	———		R/O	
AUTO/MAN transfer	J1	6	0 : AUTO mode 1 : MAN mode	AUTO mode		R/W	*2
RUN/STOP transfer	SR	6	0 : RUN 1 : STOP	RUN		R/W	*3
PID/Auto-tuning transfer	G1	6	0 : PID control 1 : Auto-tuning	PID control		R/W	
Set-value (SV1)	S1	6	Scaling low-limit to scaling high-limit	0(0.0)		R/W	
Manipulated output value (MV)	ON	6	Low-limit output range to high-limit output range	-5.0		R/W	*2
Step set-value (SV2)	S2	6	Scaling low-limit to scaling high-limit	0(0.0)		R/W	
First alarm setting	A1	6	-1999 to 9999 (The decimal-point position is the same as that of PV)	50(50.0)		R/W	
Second alarm setting	A2	6	-1999 to 9999 (The decimal-point position is the same as that of PV)	-50(-50.0)		R/W	
First heater break alarm setting	A3	6	0.0 to 100.0A (0.0 : HBA1 OFF)	0.0		R/W	
Second heater break alarm setting	A4	6	0.0 to 100.0A (0.0 : HBA2 OFF)	0.0		R/W	*1
PV bias	PB	6	Temperature input : -1999 (-199.9) to 9999 (999.9)°C [°F] Voltage input : -1999 to 9999 (The decimal-point position is the same as that of PV)	0(0.0)		R/W	
SV change rate limit	HH	6	Temperature input : 0(0.0) to input span (or 9999 [999.9])°C [°F] /min Voltage input : 0.0 to 100.0%/min of span	0(0.0)		R/W	
First alarm action selection	XA	6	0 to 14	5		R/W	*6
First alarm differential gap	HA	6	Temperature input : 0(0.0) to 100(100.0)°C [°F] Voltage input : 0.0 to 10.0% of span	Temperature input:2(2.0) Voltage input :0.2		R/W	
First alarm timer setting	TD	6	0 to 600 sec	0		R/W	
Control loop break alarm setting	A5	6	0 to 7200 sec (0 : LBA OFF)	0		R/W	
LBA deadband	V3	6	Temperature input : 0 to 9999 °C [°F] (0 : LBA OFF) Voltage input : 0 to 100% of span	0		R/W	
Second alarm action selection	XB	6	0 to 14	6		R/W	*6
Second alarm differential gap setting	HB	6	Temperature input : 0(0.0) to 100(100.0)°C [°F] Voltage input : 0.0 to 10.0% of span	Temperature input:2(2.0) Voltage input :0.2		R/W	

R/O:(read-only) R/W:(read-write)

Name	Identifier	Number of digits	Data range	Initial value	User setting value	R/W	
Second alarm timer setting	TG	6	0 to 600 sec	0		R/W	
HBA delay timer	TH	6	0 to 600 sec	3		R/W	
Proportional band (Heating-side)	P1	6	Temperature input : 0(0.0) to input span (or 9999[999.9])°C 〔°F〕 Voltage input : 0.0 to 100.0% of span	Temperature input 30(30.0) Voltage input 3.0		R/W	
Integral time	I1	6	0 to 3600 sec (0:Integral action OFF)	240		R/W	
Derivative time	D1	6	0 to 3600 sec (0:Derivative action OFF)	60		R/W	
Anti-reset windup (ARW)	W1	6	1 to 100% of proportional band	100		R/W	
Cooling-side proportional band	P2	6	1 to 3000% of proportional band	100		R/W	
Overlap/deadband	V1	6	Temperature input : -10(-10.0)to 10(10.0)°C 〔°F〕 Voltage input : -10.0 to 10.0% of span	0(0.0)		R/W	
ON/OFF action differential gap	MH	6	Temperature input : 0(0.0) to 50(50.0)°C 〔°F〕 Voltage input : 0.0 to 10.0% of span	Temperature input 2(2.0) Voltage input 0.2		R/W	
Manual reset	MR	6	-50.0 to 50.0% (Heating/cooling -100.0 to 100.0%)	0.0		R/W	
Fazzy	XP	6	0 : OFF 1 : ON	ON		R/W	
Proportioning cycle (OUT1)	T0	6	1 to 100 sec	20		R/W	*4
Output limit (High-limit)	OH	6	Low limit output range to 105.0% (Heating/cooling 0.0 to 105.0%)	105.0		R/W	
Output limit (Low-limit)	OL	6	-5.0% to high limit output range	-5.0		R/W	
Direct/reverse action selection	XE	6	0 : Direct action 1 : Reverse action	1		R/W	
Proportioning cycle (OUT2)	T1	6	1 to 100 sec	20		R/W	*4
Output limit[high-limit](OUT2)	OI	6	0.0 to 105.0% (Cooling-side output)	105.0		R/W	
Analog output specification selection	LA	6	0 to 4 (See page 24.)	0		R/W	*7
High limit analog output range	HV	6	(See page 23.)	———		R/W	*7
Low limit analog output range	HW	6	(See page 23.)	———		R/W	*7
Input type selection	XI	6	0 to 37 (See page 24.)	0		R/W	
Scaling high-limit	XV	6	Scaling low-limit to 9999	999.9		R/W	
Scaling low-limit	XW	6	-1999 to scaling high-limit	-199.9		R/W	
Decimal-point position selection	XU	6	0 to 3	1		R/W	*5
AUTO/MAN function selection	PQ	6	0 : Not provided 1 : Provided	0		R/W	
Control RUN/STOP display selection	DH	6	0 : Not provided 1 : Provided	0		R/W	
Current transformer type selection	XR	6	0 : CTL-6-P-N 1 : CTL-12-S56-10L-N	0		R/W	
Air cooling/water cooling selection	XQ	6	0 : Air cooling 1 : Water cooling (H/C)	0		R/W	
Auto-tuning (AT) differential gap	GH	6	0 to 3600 sec	10		R/W	
Action selection at input abnormality	WH	6	0 : No alarm action when abnormal input 1 : Output OFF 2 : Output ON	0		R/W	
Universal output selection	XO	6	0 : Relay contact output 1 : Voltage pulse output 2 : Continuous current output	0		R/W	*8

H/C : Heating/cooling PID action with auto-tuning　　R/O:(read-only)　R/W:(read-write)

It is recommended that each value set by the customer be entered in the respective column of "User setting value".
Even if the data is lost for any reason, it can be re-set by referring to that entered in the column.

＊1 REX−D100 only

＊2 This identifier appears when the "AUTO/MAN transfer" function is selected.
Manual output value becomes R/O (read−only) in AUTO mode.

＊3 This identifier appears when the "Selection of operation STOP function" function is selected.

＊4 This identifier appears when time proportioning output is selected in "Control output type selection".

＊5 This identifier appears when voltage input is selected in "Input type selection".

0 No digit below decimal−point
1 : 1 digit below decimal−point
2 : 2 digits below decimal−point
3 : 3 digits below decimal−point

＊6 Alarm type selection

0 : Alarm OFF
1 : High−limit SV alarm
2 : Low−limit SV alarm
3 : High−limit PV alarm
4 : Low−limit PV alarm
5 : Deviation high alarm
6 : Deviation low alarm
7 : Deviation high/low alarm
(Absolute−value setting)
8 : Band alarm
(Absolute−value setting)
9 : High−limit PV alarm (With hold function)
10 : Low−limit PV alarm (With hold function)
11 : Deviation high alarm (With hold function)
12 : Deviation low alarm (With hold function)
13 : Deviation high/low alarm (With hold function)
(Absolute−value setting)
14 : FAIL alarm

＊7 Selection of analog output specifications and scaling setting range

Analog output selection	Scaling setting range
0 : Measured−value (PV)	Scaling low−limit to scaling high−limit
1 : Deviation	−span(−1999) to span(9999)
2 : Set−value (SV)	Scaling low−limit to scaling high−limit
3 : Control output (Heating−side)	0.0 to 100.0 %
4 : Heater current value (CT1)	0.0 to 100.0 A

＊8 As REX−D100 has no universal output, no identifier appears.

■ Input range table

① Thermocouple input

Data	Input type	Input range
0	K(K)	-199.9 to 999.9 ℃
1	K(K)	-200 to 1372 ℃
2	J(J)	-199.9 to 999.9 ℃
3	J(J)	-200 to 1200 ℃
4	T(T)	-199.9 to 400.0 ℃
5	R(r)	0 to 1769 ℃
6	S(S)	0 to 1769 ℃
7	B(b)	0 to 1820 ℃
8	E(E)	-200 to 1000 ℃
9	N(n)	0 to 1300 ℃
10	PL II(P)	0 to 1390 ℃
11	W5Re／W26Re(w)	0 to 2320 ℃
12	U(U)	0 to 600 ℃
13	L(L)	0 to 900 ℃
14	K(K)	-199.9 to 999.9 ℉
15	K(K)	-330 to 2500 ℉
16	J(J)	-199.9 to 999.9 ℉
17	J(J)	-330 to 2192 ℉
18	T(T)	-199.9 to 752.0 ℉
19	R(r)	0 to 3216 ℉
20	S(S)	0 to 3216 ℉
21	B(b)	0 to 3308 ℉
22	E(E)	-330 to 1832 ℉
23	N(n)	0 to 2372 ℉
24	PL II(P)	0 to 2534 ℉
25	W5Re／W26Re(w)	0 to 4208 ℉
26	U(U)	0 to 1100 ℉
27	L(L)	0 to 1600 ℉

② RTD input

Data	Input type	Input range
28	JPt100 (JIS)	-199.9 to 510.0 ℃
29	Pt100 (JIS/IEC)	-199.9 to 660.0 ℃
30	JPt100 (Conforming to JIS)	-199.9 to 950.0 ℉
31	Pt100 (Conforming to JIS/IEC)	-199.9 to 999.9 ℉

③ DC voltage (Low) input

Data	Input type	Input range
32	0 to 10 mV DC	Programmable scale
33	0 to 100 mV DC	(The range is determined from
34	0 to 1 V DC	the decimal-point position.)

④ DC voltage (High) input *1

Data	Input type	Input range
35	0 to 5 V DC *2	Programmable scale
36	1 to 5 V DC *2	(The range is determined from
37	0 to 10 V DC	the decimal-point position.)

*1 If voltage (high) input is used, the internal switch needs to be switched.

*2 If voltage (high) input is used as current input 〔Option〕

- If a current input of 0 to 20mA is used, select a voltage (high) input of 0 to 5V, then connect an external resistor of 250 Ω ± 10PPM, more than 0.25W.
- If a current input of 4 to 20mA is used, select a voltage (high) input of 1 to 5V, then connect an external resistor of 250 Ω ± 10PPM, more than 0.25W.

6. SAMPLE PROGRAM

A sample program (language : BASIC) for NEC PC−9801 used as a host computer is shown below.
Note, however, that the language may vary slightly with the computer type and contact our agent for a sample program.

∗ Setting conditions relating to *REX−D series controller* communication during execution of the following sample programs. (For setting procedure, see "3. SETTING FOR COMMUNICATION" on page 7.)

- Communication data bit configuration 〔bIF〕 : 0 (Parity bit : Absence, Data bit : 8, Stop bit : 1)
- Device address 〔Add〕 : 0
- Communication speed 〔bPS〕 : 3 (9600bps) Match communication speed to that of the host computer.

(1) For specifications conforming to RS−422A (4−wire system)

```
1000 '==========================================================================
1010 '         TEST PROGRAM of COMMUNICATION      (For PC-9801  NEC)
1020 '==========================================================================
1030 '
1040 '         Initial setting
1050 '
1060      CM$="N81NN"                         ' Initial setting for communication
1070      ADD$="00"                           ' Designation of address
1080 '
1090      STX$=CHR$(&H2)  : EOT$=CHR$(&H4)   : ENQ$=CHR$(&H5)
1100      ACK$=CHR$(&H6)  : NAK$=CHR$(&H15)  : ETX$=CHR$(&H3)
1110 '
1120 '         RS-232C Port open
1130 '
1140      OPEN "COM1:"+CM$  AS #1
1150      CONSOLE ,,,1
1160      COLOR 7:CLS 3                       ' Clear of display
1170 '
1180 '--------------------------------------------------------------------------
1190 '                    MAIN PROGRAM LOOP
1200 '--------------------------------------------------------------------------
1210 *POL
1220      PRINT
1230      PRINT "      POLLING TRANSACTION for RECEPTION TIME OUT "
1240      PRINT
1250      DT$=EOT$+ADD$+"S1"+ENQ$
1260      GOSUB *TEXT                         ' "S1" Transmission
1270      GOSUB *RXDT                         ' Clear of buffer
1280 *J10
1290      J=0
1300 *IF1
1310      IF LOC(1)=0 THEN J=J+1:IF J<500 THEN *IF1 ELSE PRINT " Time out ":END
1320 '
1330      K$=INPUT$(1,#1)                     ' Reception of one letter
1340           IF K$=ETX$ THEN PRINT "      RX DATA = ETX ":GOTO *ETXRX     ' ETX
1350           IF K$=NAK$ THEN PRINT "      RX DATA = NAK ":END             ' NAK
1360           IF K$=EOT$ THEN PRINT "      RX DATA = EOT ":END             ' EOT
1370           IF K$=ACK$ THEN PRINT "      RX DATA = ACK ":END             ' ACK
1380 '
1390      DT$=DT$+K$
1400      GOTO *J10
1410 '
1420 *ETXRX
1430      DT$=DT$+K$
1440           BCCRX$=INPUT$(1,#1)            ' BCC Check : Reception
1450           BCCRX=ASC(BCCRX$)
1460           GOSUB *BCCCH
1470     IF BCC<>BCCRX THEN GOSUB *NAKTX                ' BCC Check:Right?
1480     IF BCC<>BCCRX THEN GOSUB *RXDT : GOTO *J10     ' NEXT TRANSACTION
1490 '
1500      PRINT "      Reception data = ":DT$      ' Display of Reception data
```

```
1510 *SEL
1520      PRINT
1530      PRINT "      SELECTING TRANSACTION for RECEPTION TIME OUT "
1540      PRINT
1550      DT$=EOT$+ADD$+DT$
1560      PRINT "      Transmission data = ";DT$  ' Display of Transmission data
1570      GOSUB *BCCCH
1580      DT$=DT$+CHR$(BCC)
1590      GOSUB *TEXT                         ' "S1+data" Transmission
1600      GOSUB *RXDT                         ' Clear of buffer
1610
1620 *J20
1630      J=0
1640 *IF2
1650      IF LOC(1)=0 THEN J=J+1:IF J<500 THEN *IF2 ELSE PRINT " Time out ":END
1660 '
1670      K$=INPUT$(1,#1)                     ' Reception of one letter
1680           IF K$=NAK$ THEN PRINT "      RX DATA = NAK ":END             ' NAK
1690           IF K$=ACK$ THEN PRINT "      RX DATA = ACK ":END             ' ACK
1700      DT$=DT$+K$
1710      PRINT "      DATA ERROR "
1720 '
1730      GOTO *J20
1740 '
1750 '-----------------------------------------------------------------------------------
1760 '                   BCC CHECK : ERROR
1770 '-----------------------------------------------------------------------------------
1780 '
1790 *NAKTX
1800      PRINT "      BCC Check error "      ' Error display
1810      DT$=NAK$                            ' "NAK" data set
1820           GOSUB *TEXT
1830      RETURN
1840 '
1850 '-----------------------------------------------------------------------------------
1860 '                   RECEPTION ROUTINE
1870 '-----------------------------------------------------------------------------------
1880 '
1890 *RXDT
1900      DT$=""                              ' Clear of buffer
1910      RETURN
1920 '
1930 '-----------------------------------------------------------------------------------
1940 '                   TRANSMISSION ROUTINE   DT$ --> TEXT
1950 '-----------------------------------------------------------------------------------
1960 '
1970 *TEXT
1980      PRINT #1,DT$;                       ' Data Transmission
1990      RETURN
2000 '
2010 '-----------------------------------------------------------------------------------
2020 '                   BCC CHECK
2030 '-----------------------------------------------------------------------------------
2040 '
2050 *BCCCH
2060      FOR II=1 TO LEN(DT$)
2070           BCCA$=MID$(DT$,II,1)
2080           IF BCCA$=STX$ THEN BCC=0 : GOTO *IINEXT ' IF BCCA$=STX$ , BCC=0
2090           BCC=BCC XOR ASC(BCCA$)
2100 *IINEXT
2110      NEXT II
2120 '
2130      RETURN
2140 '-----------------------------------------------------------------------------------
2150 END
```

(2) **For specifications conforming to RS−485 (2−wire system)**

```
1000 '=========================================================================
1010 '        TEST PROGRAM of COMMUNICATION      (For PC-9801  NEC)
1020 '=========================================================================
1030 '
1040 '        Initial setting
1050 '
1060     COM.PORT=&H32                        ' 8251 command port address
1070     CM$="N81NN"                          ' Initial setting for communication
1080     ADD$="00"                            ' Designation of address
1090     TXON=&H37       : TXOFF=&H17
1100 '
1110     STX$=CHR$(&H2) : EOT$=CHR$(&H4)  : ENQ$=CHR$(&H5)
1120     ACK$=CHR$(&H6) : NAK$=CHR$(&H15) : ETX$=CHR$(&H3)
1130 '
1140 '        RS-232C Port open
1150 '
1160     OPEN "COM1:"+CM$  AS #1 : OUT COM.PORT,TXOFF
1170     CONSOLE ,,,1
1180     COLOR 7:CLS 3                        ' Clear of display
1190 '
1200 '-------------------------------------------------------------------------
1210 '                  MAIN PROGRAM LOOP
1220 '-------------------------------------------------------------------------
1230 *POL
1240     PRINT
1250     PRINT "     POLLING TRANSACTION for RECEPTION TIME OUT "
1260     PRINT
1270     DT$=EOT$+ADD$+"S1"+ENQ$
1280     GOSUB *TEXT                          ' "S1" Transmission
1290     GOSUB *RXDT                          ' Clear of buffer
1300 *J10
1310     J=0
1320 *IF1
1330     IF LOC(1)=0 THEN J=J+1:IF J<500 THEN *IF1 ELSE PRINT " Time out ":END
1340 '
1350     K$=INPUT$(1,#1)                      ' Reception of one letter
1360          IF K$=ETX$ THEN PRINT "     RX DATA = ETX ":GOTO *ETXRX      ' ETX
1370          IF K$=NAK$ THEN PRINT "     RX DATA = NAK ":END              ' NAK
1380          IF K$=EOT$ THEN PRINT "     RX DATA = EOT ":END              ' EOT
1390          IF K$=ACK$ THEN PRINT "     RX DATA = ACK ":END              ' ACK
1400 '
1410     DT$=DT$+K$
1420     GOTO *J10
1430 '
1440 *ETXRX
1450     DT$=DT$+K$
1460          BCCRX$=INPUT$(1,#1)             ' BCC Check : Reception
1470          BCCRX=ASC(BCCRX$)
1480          GOSUB *BCCCH
1490    IF BCC<>BCCRX THEN GOSUB *NAKTX                 ' BCC Check:Right?
1500    IF BCC<>BCCRX THEN GOSUB *RXDT : GOTO *J10      ' NEXT TRANSACTION
1510 '
1520     PRINT "      Reception data = ";DT$      ' Display of Reception data
1530 *SEL
1540     PRINT
1550     PRINT "     SELECTING TRANSACTION for RECEPTION TIME OUT "
1560     PRINT
1570     DT$=EOT$+ADD$+DT$
1580     PRINT "      Transmission data = ";DT$  ' Display of Transmission data
1590     GOSUB *BCCCH
1600     DT$=DT$+CHR$(BCC)
1610     GOSUB *TEXT                          ' "S1+data" Transmission
1620     GOSUB *RXDT                          ' Clear of buffer
1630
1640 *J20
1650     J=0
1660 *IF2
```

```
1670     IF LOC(1)=0 THEN J=J+1:IF J<500 THEN *IF2 ELSE PRINT " Time out ":END
1680 '
1690     K$=INPUT$(1,#1)                        ' Reception of one letter
1700           IF K$=NAK$ THEN PRINT "      RX DATA = NAK ":END             ' NAK
1710           IF K$=ACK$ THEN PRINT "      RX DATA = ACK ":END             ' ACK
1720     DT$=DT$+K$
1730     PRINT "       DATA ERROR "
1740 '
1750     GOTO *J20
1760 '
1770 '-------------------------------------------------------------------------
1780 '                     BCC CHECK : ERROR
1790 '-------------------------------------------------------------------------
1800 '
1810 *NAKTX
1820     PRINT "       BCC Check error "       ' Error display
1830     DT$=NAK$                              ' "NAK" data set
1840          GOSUB *TEXT
1850     RETURN
1860 '
1870 '-------------------------------------------------------------------------
1880 '                     RECEPTION ROUTINE
1890 '-------------------------------------------------------------------------
1900 '
1910 *RXDT
1920     DT$=""                                ' Clear of buffer
1930     RETURN
1940 '
1950 '-------------------------------------------------------------------------
1960 '                     TRANSMISSION ROUTINE   DT$ --> TEXT
1970 '-------------------------------------------------------------------------
1980 '
1990 *TEXT
2000     OUT COM.PORT,TXON                               ' Change to Transmission
2010     PRINT #1,DT$;                                   ' Data Transmission
2020 *IF3
2030     IF NOT INP(COM.PORT) AND &H4 THEN *IF3          ' Transmission is end ?
2040     OUT COM.PORT,TXOFF                              ' Change to Reception
2050     RETURN
2060 '
2070 '-------------------------------------------------------------------------
2080 '                     BCC CHECK
2090 '-------------------------------------------------------------------------
2100 '
2110 *BCCCH
2120     FOR II=1 TO LEN(DT$)
2130          BCCA$=MID$(DT$,II,1)
2140          IF BCCA$=STX$ THEN BCC=0 : GOTO *IINEXT ' IF BCCA$=STX$ , BCC=0
2150          BCC=BCC XOR ASC(BCCA$)
2160 *IINEXT
2170     NEXT II
2180 '
2190     RETURN
2200 '-------------------------------------------------------------------------
2210 END
```

7. TROUBLESHOOTING

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.

<table>
<tr><th>Details</th><th>Cause</th><th>Measures</th></tr>
<tr><td rowspan="6">No-response</td><td>Trouble occurring in the controller</td><td>Contact our agent</td></tr>
<tr><td>Trouble with and imperfect contact of communication cable</td><td>Check communication cables</td></tr>
<tr><td>Incorrect communication speed</td><td>Set the communication speed suitable for the host computer by referring to "3.1 Communication speed and Data type setting" (Page 8).</td></tr>
<tr><td>Device address designation differs</td><td>Make reassignment after checking the device address by referring to "3.2 Device address setting" (Page 10).</td></tr>
<tr><td>Incorrect data configuration</td><td>Make reassignment after checking the data configuration by referring to "3.1 Communication speed and Data type setting" (Page 8).</td></tr>
<tr><td>Transmission line is not set to high impedance after data send
〔Specification conforming to RS-485 (2-wire system)〕</td><td>Program check on the host computer side.</td></tr>
<tr><td rowspan="2">EOT return</td><td>Incorrect identifier</td><td rowspan="2">Make re-setting after checking the identifier by referring to "■ Communication identifier list" (Page 21).</td></tr>
<tr><td>The identifier of a function not added to the instrument is specified</td></tr>
<tr><td rowspan="3">NAK return</td><td>BCC error</td><td rowspan="2">Data check and re-setting</td></tr>
<tr><td>Data exceeds the setting range</td></tr>
<tr><td>The identifier of a function not added to the instrument is specified</td><td>Identifier check</td></tr>
</table>

8. JIS/ASCII 7-bit CODE TABLE (For reference)

				D7	0	0	0	0	0	0	0	0
				D6	0	0	0	0	1	1	1	1
				D5	0	0	1	1	0	0	1	1
				D4	0	1	0	1	0	1	0	1
D3	D2	D1	D0		0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	DLE		0	@	P	`	p
0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
0	0	1	0	2	STX	DC2	"	2	B	R	b	r
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
0	1	0	0	4	EOT	DC4	$	4	D	T	d	t
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
0	1	1	0	6	ACK	SYM	&	6	F	V	f	v
0	1	1	1	7	BEL	ETB	'	7	G	W	g	w
1	0	0	0	8	BS	CAN	(	8	H	X	h	x
1	0	0	1	9	HT	EM	)	9	I	Y	i	y
1	0	1	0	A	LF	SUB	*	:	J	Z	j	z
1	0	1	1	B	VT	ESC	+	;	K	[	k	{
1	1	0	0	C	FF	FS	,	<	L	¥	l	|
1	1	0	1	D	CR	GS	−	=	M	]	m	}
1	1	1	0	E	SO	RS	.	>	N	^	n	-
1	1	1	1	F	SI	US	/	?	O	_	o	DEL

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