
*High Resolution
Temperature Controller*

REX-F9000

***Communication
Instruction Manual***


- MELSEC : MITSUBISHI product
- C200HS: OMRON product
- Company names and product names used in this manual are the trademarks or registered trademarks of the respective companies.


Thank you for purchasing the **RKC** product.

Before operating this instrument, please carefully read this manual and fully understand its contents.

And always keep it around you to make it available easily anytime.

SYMBOL

 : If there are possible dangers such as electric shock, fire (burns), etc. which may result in operator's loss of life or injury, precautions to avoid such dangers are described.

 : In case instrument damages may be caused if operating procedures are not strictly followed, precautions to avoid such damages are described.



: This mark is used when great care is needed especially for safety.



: This mark is used when careful operation or handling is especially needed.



: This mark is used when a supplemental description of operation or handling is needed.



: This mark is used when detailed or related information needs to be referred to.



WARNING

- 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.
- Do not turn on the power supply until all of the wiring is completed. Otherwise electric shock, fire or malfunction may result.
- Use this instrument within the scope of its specifications. Otherwise fire or malfunction may result.
- Do not use this instrument in the places subject to flammable or explosive gas.
- Do not touch high-voltage blocks such as power supply terminals, etc. Otherwise electric shock may result.
- Never disassemble, repair or modify the instrument. This may cause electric shock, fire or malfunction.

CAUTION

- This is a Class A instrument. In a domestic environment this instrument may cause radio interference, in which case the user is required to take adequate measures.
- This instrument is protected from electric shock by reinforced insulation. So please arrange reinforced insulation to the wire for input signal against the wires for instrument power supply, source of power and loads as far as possible.
- This instrument is manufactured on the assumption that it is used in the condition of being mounted on the instrumentation panel. Therefore, take the necessary measures on the equipment side mounted with this instrument so that the operator or other personnel are not accessible to high-voltage blocks in this instrument such as power supply terminals, etc.
- Always observe precautions described in this manual. Otherwise serious injury or accident may result.
- Conduct all of the wiring in accordance with the local codes and regulations.
- Install a protection device such as a fuse, etc. in the power supply, input or output line, if necessary.
- Do not allow metal fragments or lead wire scraps to fall inside this instrument. This may cause electric shock, fire or malfunction.
- Firmly tighten each terminal screw at the specified torque. Otherwise electric shock or fire may result.
- Do not place any obstacle around this instrument in order not to impede radiation of heat. And do not close ventilation holes.
- Do not connect wires to unused terminals.
- Before cleaning the instrument, always turn off the power supply.
- Remove stains from this instrument using a soft, dry cloth. Do not use a volatile solvent such as thinner in order to avoid deformation or discoloration.
- Do not rub nor strike the display unit of this instrument with a hard object.

NOTICE

- This manual is prepared especially for readers who already have a fundamental knowledge of electricity, control, computer and communication.
- 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.
- This manual may not be reproduced or copied in whole or in part without **RKC**'s prior consent.
- **RKC** assumes no responsibility for any of the following damage which the user or third party may suffer.
 - Damage incurred as a result of using this product.
 - Damage caused by product failure which cannot be predicted by **RKC**.
 - Other indirect damage.
- In order to use this instrument continuously and safely, periodic maintenance is required. Some of components and parts used in this instrument have a limited service life, or deteriorate over time.
- This manual is carefully prepared. However, if any mistake or omission is found, please contact **RKC**.

CONTENTS

	Page
1. SPECIFICATION	1
2. CONNECTION.....	3
3. SETTING FOR COMMUNICATION	6
3.1 Preparation for setting communication parameters	6
3.2 Transfer to parameter group 24 (PG24)	7
3.3 Communication parameter selection	8
3.4 Device address setting	9
3.5 Communication speed setting	11
3.6 Communication data configuration setting	13
3.7 Interval time setting	15
3.8 Protocol setting.....	17
3.9 Cautions for communicatin.....	19
4. RKC STANDARD COMMUNICATION.....	22
4.1 Communication protocol.....	22
4.1.1 Polling.....	22
4.1.2 Selecting.....	27
4.2 Communication identifier.....	31
5. LADDER COMMUNICATION.....	36
5.1 Communication protocol	36
5.1.1 Communication data configuration	36
5.1.2 Data format.....	38
5.1.3 Data read.....	39
5.1.4 Data write	40
5.1.5 Reversal of read/write data bytes.....	41
5.1.6 REX-F9000 no response	43
5.1.7 Example of text sent by PLC.....	43

	Page
5.2 Communication identifier	44
5.3 Example of sequence program	46
5.3.1 MELSEC Series (MITSUBISHI)	46
5.3.2 C200HS (OMRON)	48
6. TROUBLESHOOTING	50
7. ASCII 7-BIT CODE TABLE	52

1. SPECIFICATION

- (1) Interface : Based on EIA standard RS-485
- (2) Connection method : 2-wire system, half-duplex multidrop connection
- (3) Communication distance : 1 km (max.)
* However, the maximum communication distance varies slightly with the surroundings such as cables etc.
- (4) Synchronous method : Start/stop synchronous type
- (5) Communication speed : 1200 bps, 2400 bps, 4800 bps, 9600 bps, 19200 bps
- (6) Data type : RKC standard communication :
Start bit : 1
Data bit : 7 or 8
Parity bit : Unused or Used (Odd number or even number)
Stop bit : 1 or 2
Ladder communication :
Start bit : 1
Data bit : 8 (Fixed)
Parity bit : None
Stop bit : 1
- (7) Protocol : RKC standard communication :
ANSI X3.28 subcategory 2.5, A4
Polling/selecting type
Ladder communication :
Non-protocol type
- (8) Error control (Only RKC standard communication) :
Vertical parity (With parity bit selected)
Horizontal parity (BCC check)
- (9) Maximum connection : RKC standard communication :
32 sets including a host computer
Ladder communication :
32 sets including a programmable controller

1. SPECIFICATIONS

(10)Communication code : RKC standard communication :
ASCII 7-bit code
Ladder communication :
Text : BCD code
Control code : STX(02H), CR(0DH), LF(0AH)
* Code in brackets () are in hexadecimal.

(11)Terminal resister : 100 Ω or more (Externally connected)

(12)Xon/Xoff control : None

(13)Signal logic :

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

2. CONNECTION



WARNING

In order to prevent electric shock or instrument failure, turn off power for this instrument and peripheral equipment before connecting or disconnecting.

Up to 32 REX-F9000 including the host computer (or programmable controller [hereinafter, the "PLC"]) can be connected if multidrop connected by RS-485.

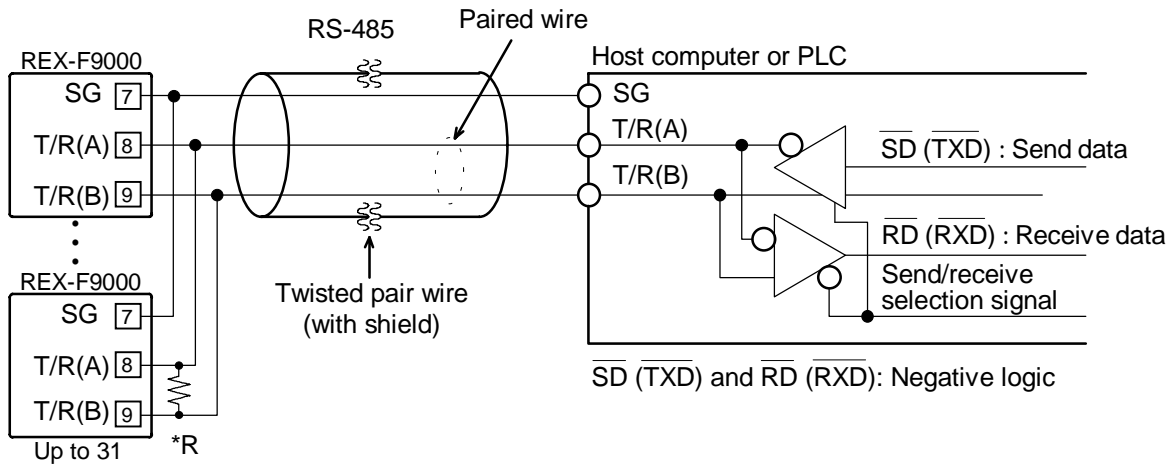
■ Terminal No. and signal details

Terminal No.	Signal name	Name	Signal direction	
			REX-F9000	Host computer or PLC
7	SG	Signal ground	_____	
8	T/R(A)	Send data/Receive data	←—————→	
9	T/R(B)	Send data/Receive data	←—————→	

■ Connecting method

● When RS-485 is used as a host computer or PLC interface

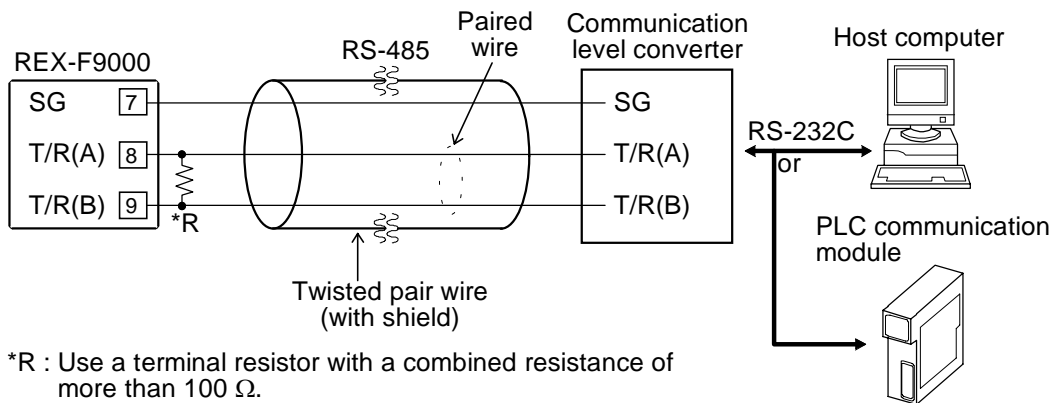
It is necessary that a circuit to transfer send and receive be built-in the host computer (or PLC).



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

● When RS-232C is used as a host computer or PLC interface

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



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

CAUTION

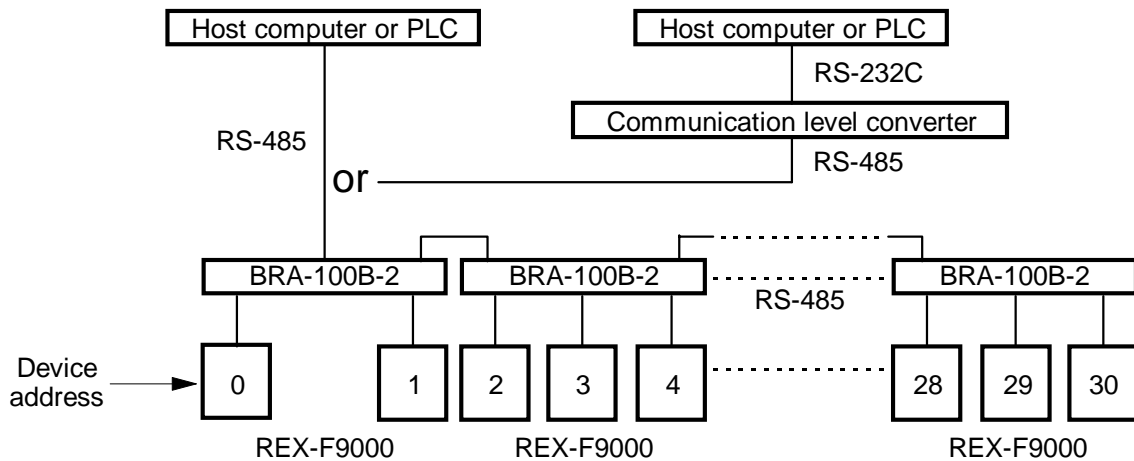
When the host computer is for Windows 95/NT, use a communication level converter of the automatic send/receive select type.

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

■ Connection example

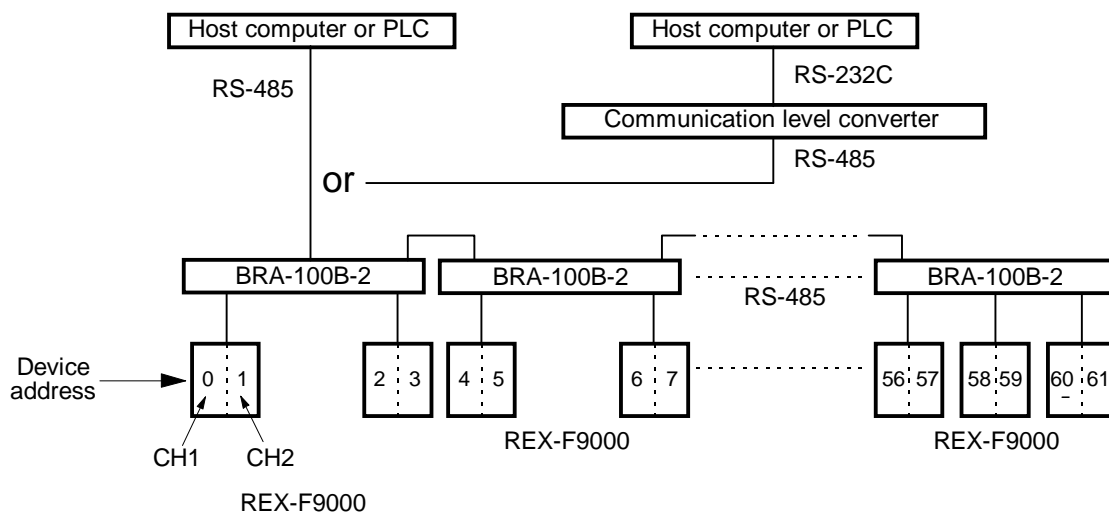
● 1-channel type


When up to 32 REX-F9000 controllers including host computer (or PLC) are connected.



● 2-channel type

For the 2-channel type REX-F9000 controller, set independent device addresses to CH1 and CH2.



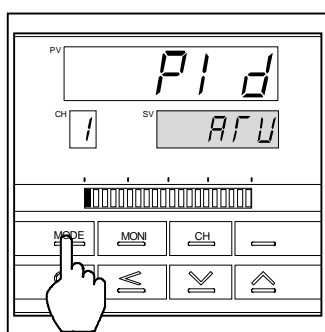
 For details of the communication level converter and junction branch box BRA-100B-2, see each Instruction Manual.

3. SETTING FOR COMMUNICATION

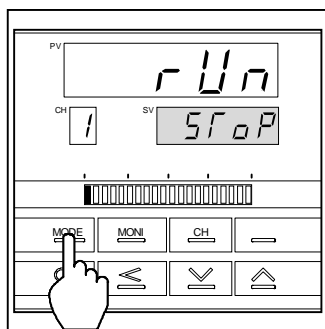
In order to make communication between the REX-F9000 and the host computer (or PLC), it is necessary to set the device address, communication speed, communication data configuration, interval time and protocol. Communication settings are made in parameter group 24 (PG24).

3.1 Preparation for setting communication parameters

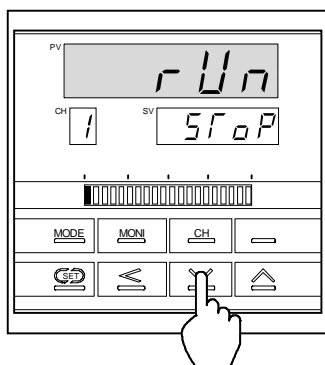
The setting of parameter group 24 (PG24) can be changed only in control stop mode. Before the SETUP mode is selected, it is necessary to set the mode selection of "Control RUN/STOP" to "STOP."



① Press the MODE key to set the instrument to the mode transfer.



② Press the MODE key to display "Control RUN/STOP."

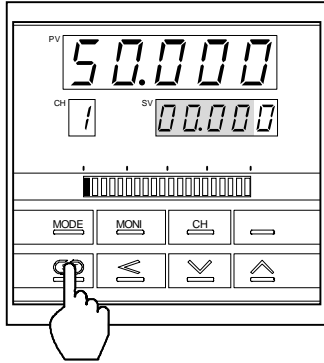


③ Press the DOWN key to control is changed from execution (RUN) to STOP.

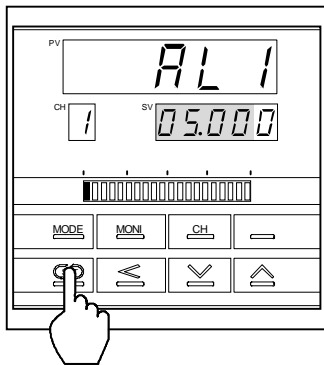
 : Bright lighting

 : Dim lighting

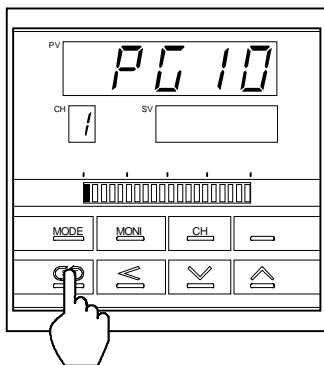
3.2 Transfer to parameter group 24 (PG24)



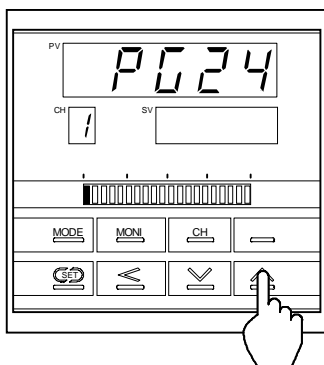
① Press the SET key to set the instrument to the SV setting mode.



② Press the SET key for more than 5 sec in SV setting mode to set the instrument to operator set mode.



③ Press the SET key for more than 5 sec in operator set mode to set the instrument to setup mode.



④ Press the UP key a few times to display "PG24."

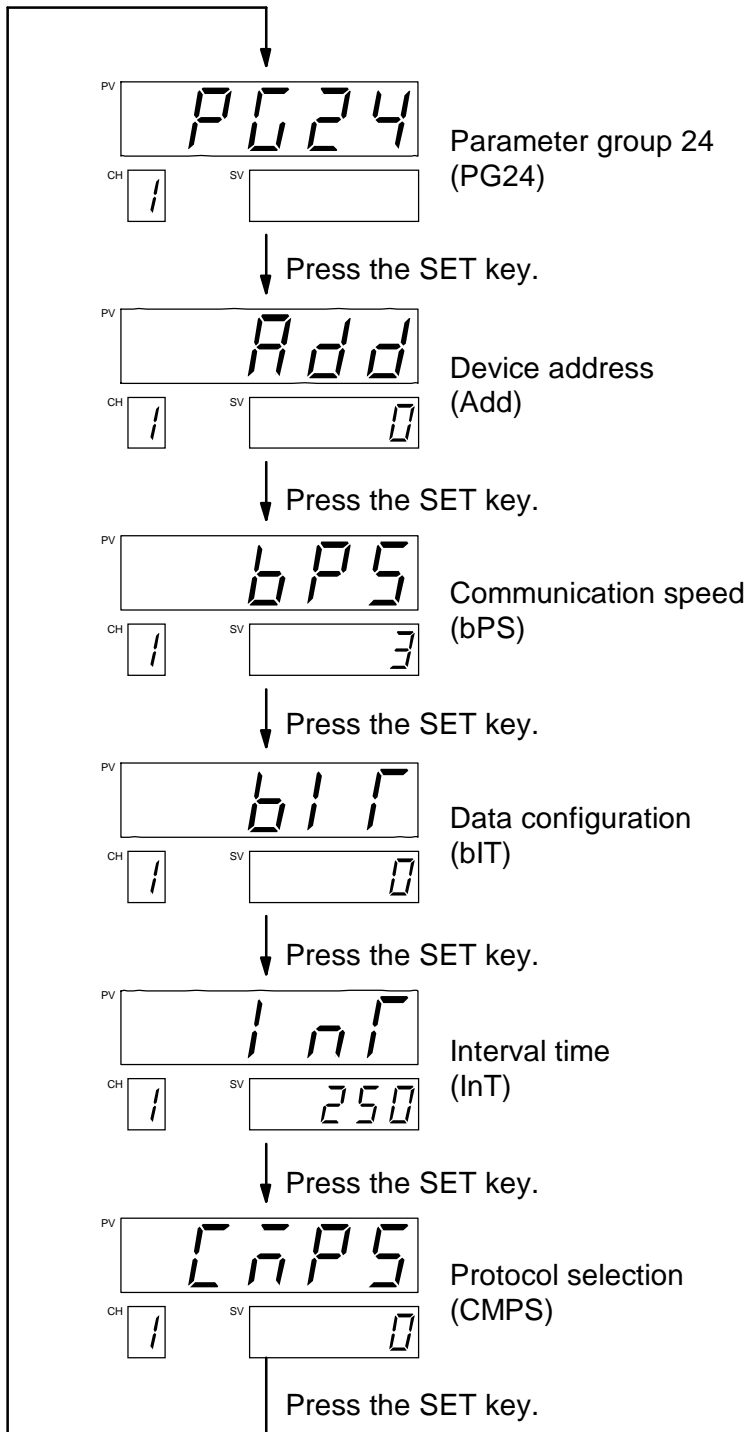
 : Bright lighting

 : Dim lighting

3.3 Communication parameter selection

Communication parameter in parameter group 24 (PG24) are selected in the order of device address (Add), communication speed (bPS), communication data configuration (bIT), interval time (InT) and protocol selection (CMPS). Each communication parameter is selected by pressing the SET key.

■ Display sequence



In order to set the CH2 monitor, communication parameter, press the CH key to change CH1 to CH2. The setting procedure is the same as the CH1 setting.

3.4 Device address setting

Set the desired device address by using the corresponding numeric value from 0 to 99.

Press the UP or DOWN key to change the numeral, and also press the SHIFT key to shift the digit.

■ Symbol and symbol name

Add (Add) : Device address

■ Setting range

Range : 0 to 99

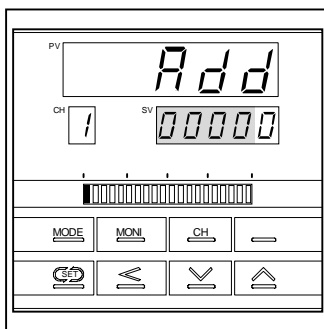
Factory set value : 0

■ Setting procedure

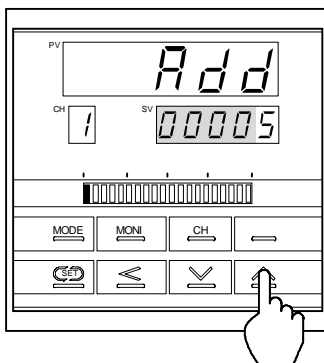
CAUTION

For the 2-channel type REX-F9000, set independent device addresses to CH1 and CH2.

Example : When setting device address to 15.



① Change the controller to parameter group 24 (PG24), and then display the device address (See P.8).

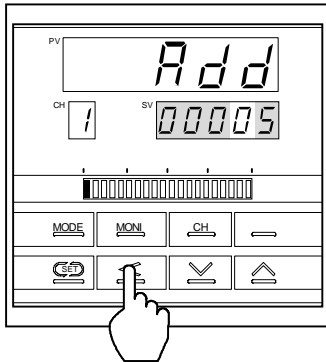


② Set the device address. Press the UP key to enter "5" in the lowest digit.

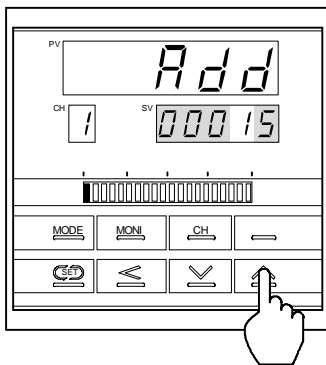
 : Bright lighting

 : Dim lighting

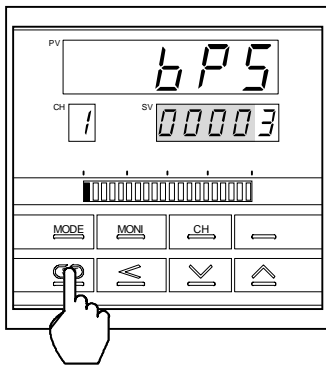
3. SETTING FOR COMMUNICATION



③ Press the SHIFT 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.

 : Bright lighting

 : Dim lighting

 For the 1-channel type, if the key is not operated for more than 1 minute, the present display automatically returns to the PV/SV display.

 For the 2-channel type, if the key is not operated for more than 1 minute, the present display automatically returns to the CH1PV/CH2PV display.

3.5 Communication speed setting

Set a communication speed of 1200 bps, 2400 bps, 4800 bps, 9600 bps or 19200 bps by using numerals from 0 to 4. Press the UP or DOWN key to change the numeral.

■ Symbol and symbol name

bPS (bPS) : Communication speed

■ Setting items

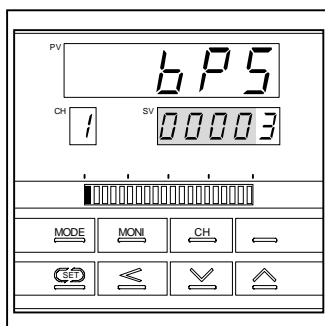
Set value	Communication speed	Factory set value
0	1200 bps	3
1	2400 bps	
2	4800 bps	
3	9600 bps	
4	19200 bps	

■ Setting procedure

CAUTIONS

- Set the same communication speed to both the REX-F9000 and connecting host computer (or PLC).
- For the 2-channel type REX-F9000, set the communication speed to CH1 and CH2.

Example : When setting communication speed to "2 : 4800 bps."

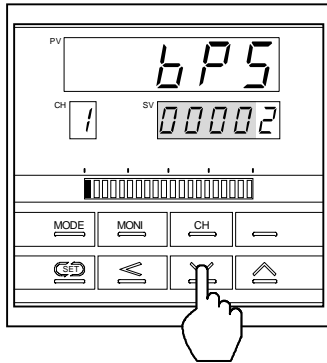


① Select the communication speed display. (See P.8.)

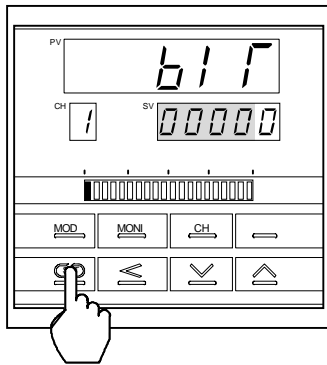
: Bright lighting

: Dim lighting



3. SETTING FOR COMMUNICATION





② Press the DOWN key to enter "2" 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.

 : Bright lighting
 : Dim lighting

-  For the 1-channel type, if the key is not operated for more than 1 minute, the present display automatically returns to the PV/SV display.
-  For the 2-channel type, if the key is not operated for more than 1 minute, the present display automatically returns to the CH1PV/CH2PV display.

3.6 Communication data configuration setting

Set the data configuration during communication. Press the UP or DOWN key to change the numeral.

■ Symbol and symbol name



(bIT) : Communication data configuration

■ Setting items

- **RKC standard communication** : Set the desired numeric value from 0 to 11.

Set value	Parity bit	Data bit	Stop bit	Factory set value
0	None	8	1	0
1	None	8	2	
2	Even	8	1	
3	Even	8	2	
4	Odd	8	1	
5	Odd	8	2	
6	None	7	1	
7	None	7	2	
8	Even	7	1	
9	Even	7	2	
10	Odd	7	1	
11	Odd	7	2	

- **Ladder communication** : The following numeric value is fixed.

Parity bit : None
Data bit : 8
Stop bit : 1



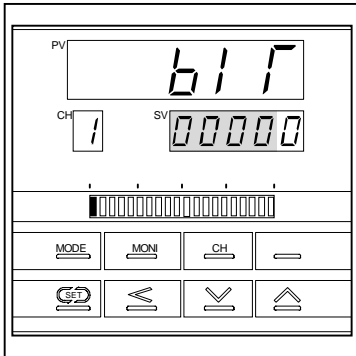
If the protocol is for ladder communication, it becomes invalid even when the communication data bit configuration is selected.

■ Setting procedure

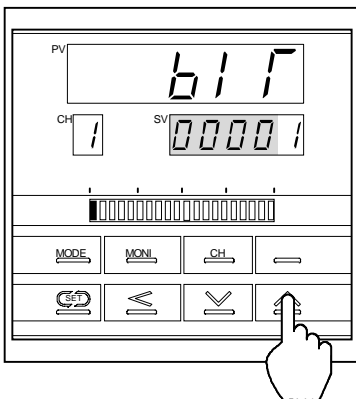
CAUTION

For the 2-channel type REX-F9000, set the same communication data configuration to CH1 and CH2.

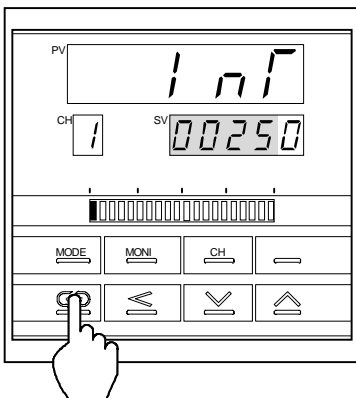
Example : When setting communication data configuration to "1 : 8 data bits, no parity bit and 2 stop bits."



① Select the data configuration during communication. (See P.8.)




② Press the UP key to enter "1" in the lowest digit. As a result, communication data 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 communication data configuration is registered.

 : Bright lighting

 : Dim lighting


 For the 1-channel type, if the key is not operated for more than 1 minute, the present display automatically returns to the PV/SV display.

 For the 2-channel type, if the key is not operated for more than 1 minute, the present display automatically returns to the CH1PV/CH2PV display.

3.7 Interval time setting

Set the interval time. Press the UP or DOWN key to change the numeral, and press the SHIFT key to shift the digit.

■ Symbol and symbol name

 (InT) : Interval time

■ Setting range

Range : 0 to 250 ms

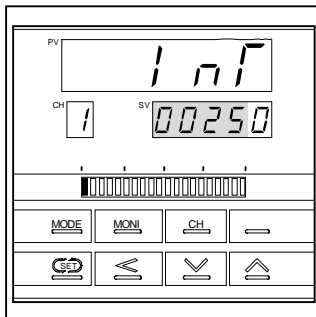
Factory set value : 250

■ Setting procedure

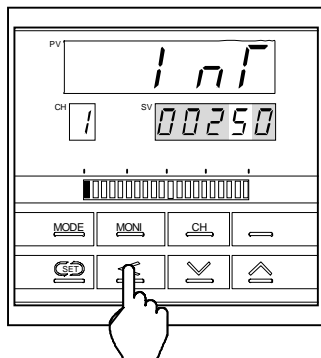
CAUTION

For the 2-channel type REX-F9000, set the same interval time to CH1 and CH2.

Example : When setting interval time to 200 ms.



① Select the interval time display. (See P.8.)

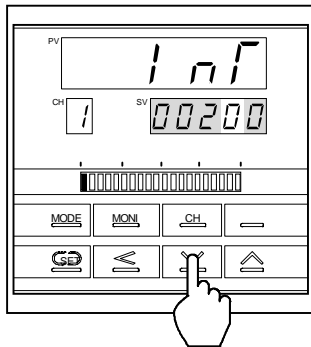


② Press the SHIFT key to brightly light the tens digit.

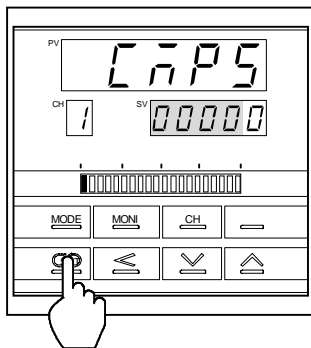
 : Bright lighting

 : Dim lighting

3. SETTING FOR COMMUNICATION




③ Press the DOWN key to enter "0" in the tens digit.




④ Press the SET key to change to the next communication parameter. As a result, the set interval time is registered.

 : Bright lighting

 : Dim lighting

 For the 1-channel type, if the key is not operated for more than 1 minute, the present display automatically returns to the PV/SV display.

 For the 2-channel type, if the key is not operated for more than 1 minute, the present display automatically returns to the CH1PV/CH2PV display.

3.8 Protocol setting

The protocol is selected. Either RKC standard communication or ladder communication is selected.

Press the UP or DOWN key to change the numeral.

■ Symbol and symbol name

CAPS (CMPS) : Protocol selection

■ Setting items

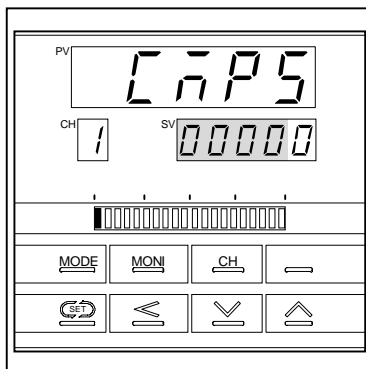
Set value	Protocol type	Factory set value
0	RKC standard communication	0
1	Ladder communication	

■ Setting procedure

CAUTION

For the 2-channel type REX-F9000, set same protocol selection to CH1 and CH2.

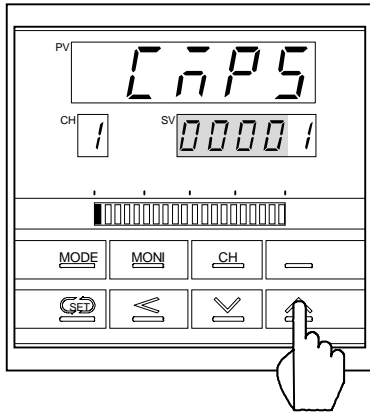
Example : When setting protocol to "1 : Ladder communication."



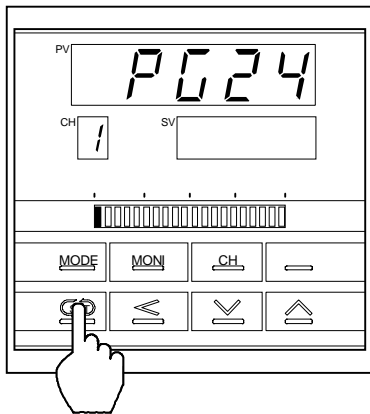
① Select the protocol selection display. (See P.8.)

 : Bright lighting

 : Dim lighting





② Setting a numeric value of "1" by pressing the UP key changes the protocol to ladder communication.



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

□ : Bright lighting
 ■ : Dim lighting

 For the 1-channel type, if the key is not operated for more than 1 minute, the present display automatically returns to the PV/SV display.

 For the 2-channel type, if the key is not operated for more than 1 minute, the present display automatically returns to the CH1PV/CH2PV display.

3.9 Cautions for communication

■ Send/receive selection

● 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 REX-F9000 side secures the maximum time until the transmission line changes to the data receiving side (until the REX-F9000 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 REX-F9000 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.

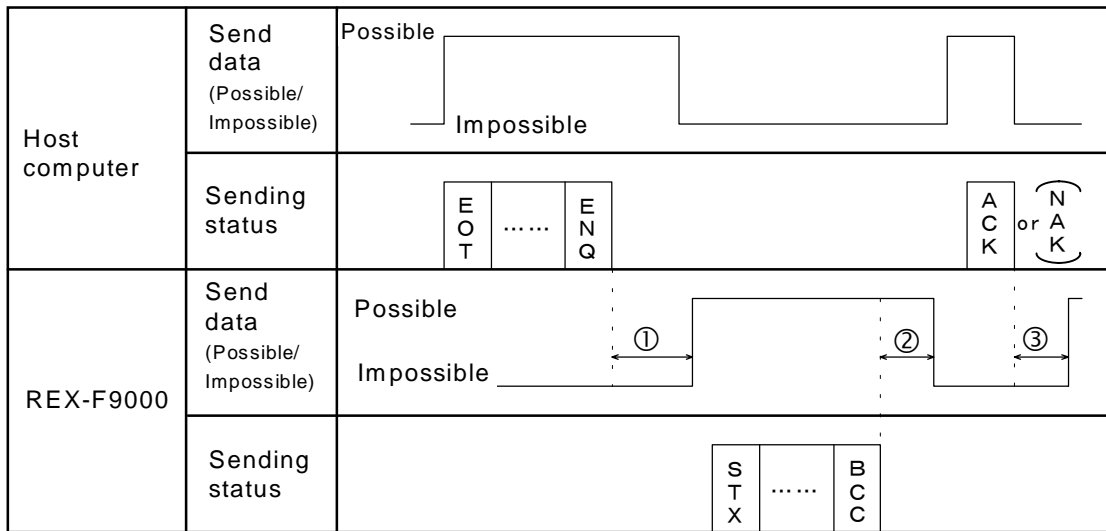
● When host computer is selected from data receiving to data sending

Polling procedure "Response wait time after BCC send" or selecting procedure "Response wait time after [ACK] or [NAK] send" is processing time required during REX-F9000 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 21.

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

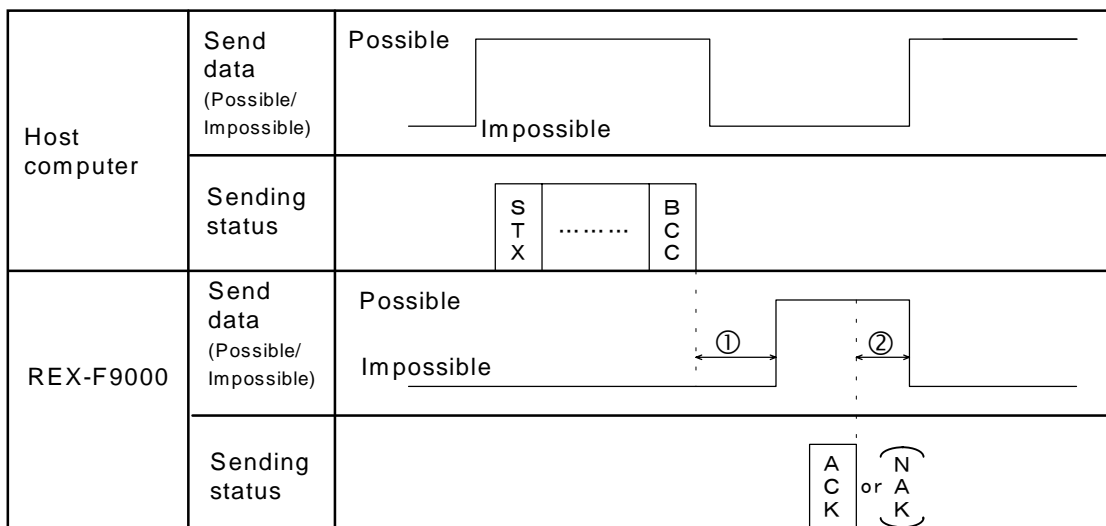
The transmission and reception of RS-485 communication are operated by a transmitting wire. Therefore, the timing of switching should be acted correctly. Send/receive example in the host computer and REX-F9000 is show in the following.

● **Polling procedure**



- ① (Response send time after calling [ENQ] receive) + (Interval time)
- ② Response send time after BCC send
- ③ (Response send time after acknowledgment [ACK] receive + (Interval time) or
(Response send time after negative acknowledge [NAK] receive + (Interval time))

● **Selecting procedure**



- ① (Response send time after BCC receive) + (Interval time)
- ② Response wait time after acknowledgment [ACK] send or
Response wait time after negative acknowledge [NAK] send

■ Send/receive processing times

The processing time shown in the following is required for the REX-F9000 during data sending and receiving.

● Polling procedure

Procedure details	Time (ms)		
	MIN	TYP	MAX
Response send time after calling [ENQ] receive	-	-	7.0
Response send time after acknowledgment [ACK] receive	-	-	7.0
Response send time after negative acknowledge [NAK] receive	-	-	7.0
Response send time after BCC send	-	-	1.0

* Data link is terminated sending [EOT], if no response within about 3 sec after BCC send.
Response wait time is the time when the interval time is set to 0 ms.

● Selecting procedure

Procedure details	Time (ms)		
	MIN	TYP	MAX
Response send time after BCC receive	2.0	3.0	7.0
Response wait time after acknowledgment [ACK] send	-	-	1.0
Response wait time after negative acknowledge [NAK] send	-	-	1.0

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

4. RKC STANDARD COMMUNICATION

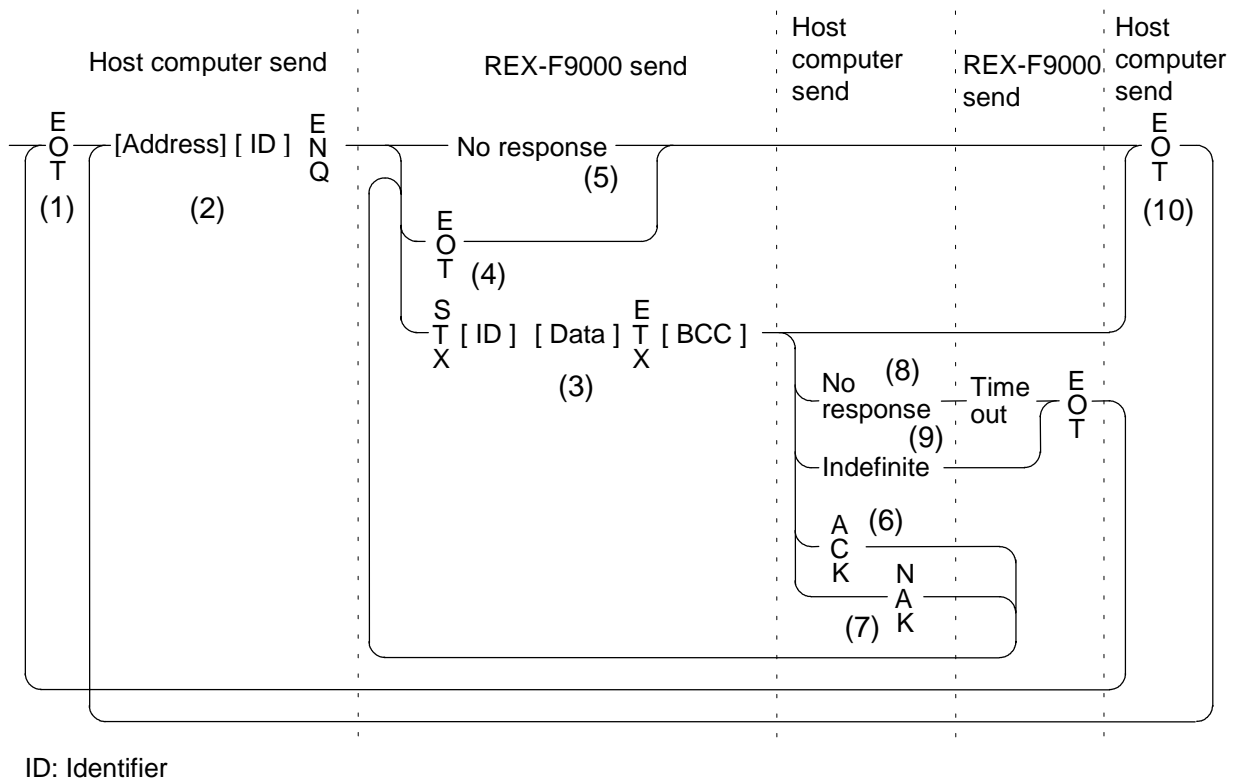
4.1 Communication protocol

The REX-F9000 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 REX-F9000 is controlled completely by the host computer is permitted. Since the host computer invites information message sending from and receiving to the REX-F9000, 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.

4.1.1 Polling

Polling is an action that host computer requesting one of the REX-F9000 which selected among multidrop connected, to transmit the data. The procedure is as the following.



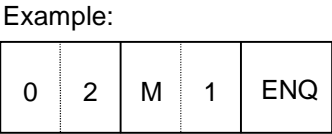
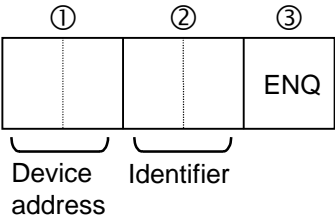
■ Polling procedure

(1) Initialize of data link

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

(2) Polling sequence send

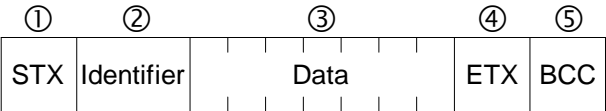
Host computer sends polling sequence with a format shown below.



- ① **Device address [Number of digits: 2]**
This data is a device address of the REX-F9000 for polled and must be the same as the device address set value in item "3.4 Device address setting" (P. 9).
- ② **Identifier [Number of digits : 2] (See P. 31.)**
This is for identifying data requested for the REX-F9000. 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 REX-F9000.

(3) REX-F9000 data send

If the polling sequence is received correctly, the REX-F9000 sends data in the following format.



- ① **[STX]**
This is the transmission control character which indicates the start of the text (identifier and data).

Continued on the next page.

② Identifier [Number of digits: 2] (See P. 31.)

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

③ Data [Number of digits: 7]

Data indicated by the identifier belonging to the REX-F9000. 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 exclusive "OR" of all character from next [STX] through [ETX].
Not including [STX].

Example:

In the case of the data are :

S T X	M	1	0	2	3	.	0	0	0	E T X	BCC
	4DH	31H	30H	32H	33H	2EH	30H	30H	30H	03H	50H

In the parenthesis are indicated with hexadecimal number.

$BCC = 4DH \oplus 31H \oplus 30H \oplus 32H \oplus 33H \oplus 2EH \oplus 30H \oplus 30H \oplus 30H \oplus 03H = 50H$
Value of BCC becomes 50H

(4) REX-F9000 data send end (EOT send)

If the following cases, the REX-F9000 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.

(5) REX-F9000 no response

The REX-F9000 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 REX-F9000 sends the identifier data following the identifier just sent in succession shown in "■ Communication identifier list" (P. 31).

If data send from the REX-F9000 is suspend, send [EOT] to terminate the data link.

(7) Negative acknowledge [NAK]

If the host computer cannot receive send data correctly from the REX-F9000, it sends [NAK] to the controller. Then, the REX-F9000 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 REX-F9000 sends data, the REX-F9000 sends [EOT] as time-out processing to terminate the data link (time-out time : approx. 3 sec).

(9) Indefinite response from host computer

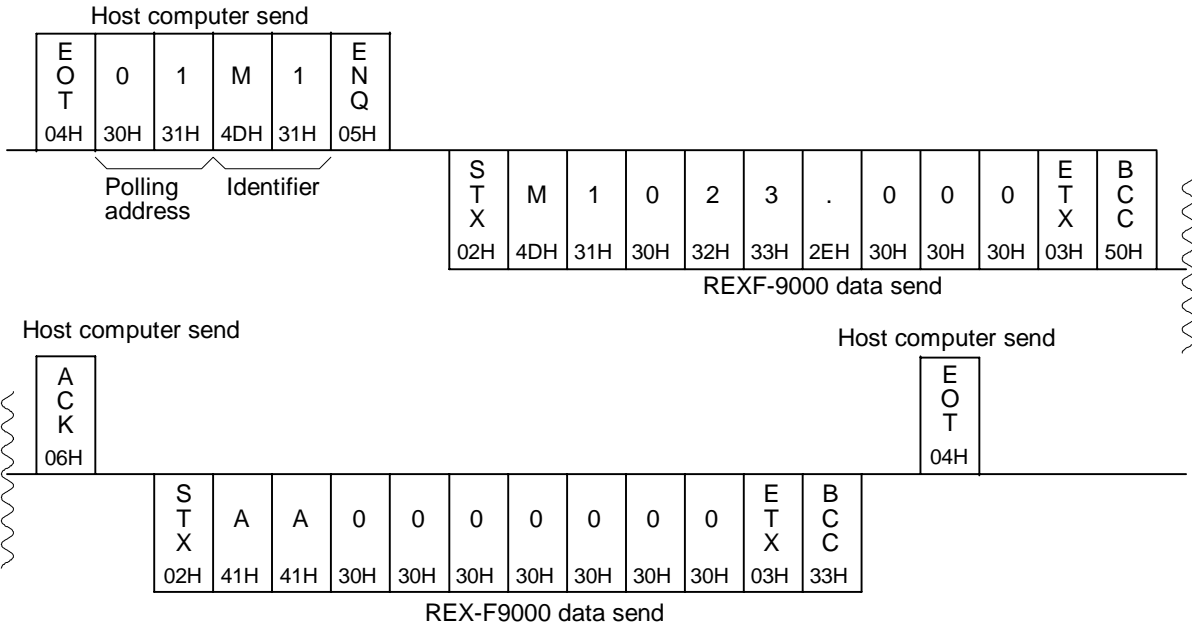
When the response from the host computer is indefinite, the REX-F9000 sends [EOT] to terminate the data link.

(10) Data link termination [EOT]

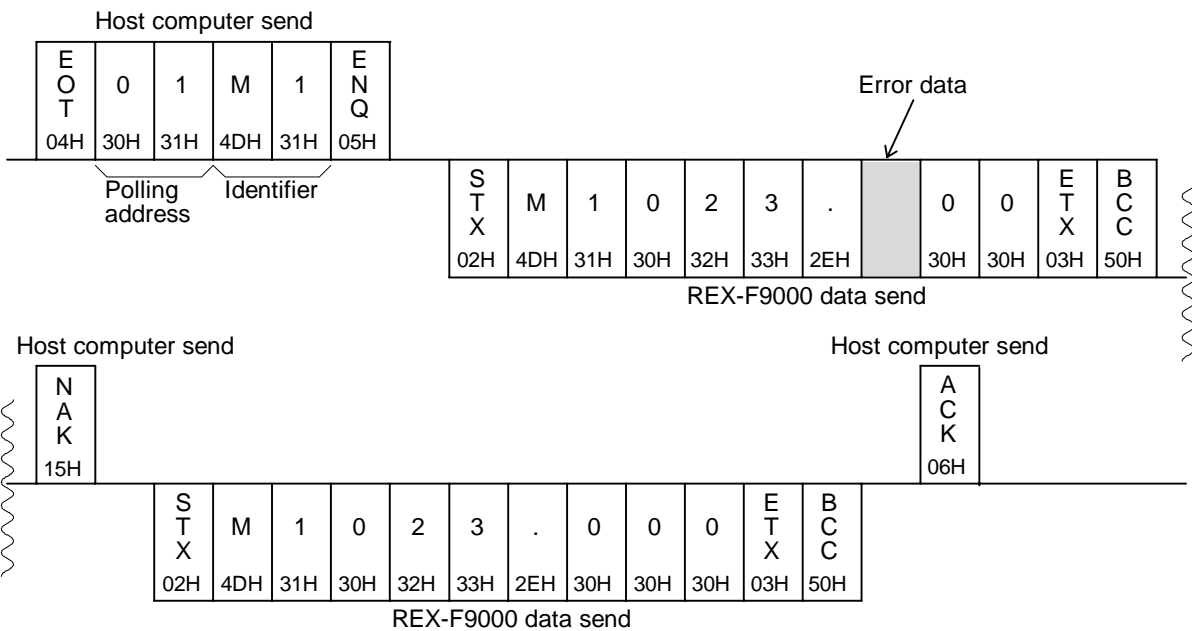
If it is necessary to suspend communication with the REX-F9000 or to terminate the data link due to no response from the controller, the host computer sends [EOT].

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

● **Normal transmission**

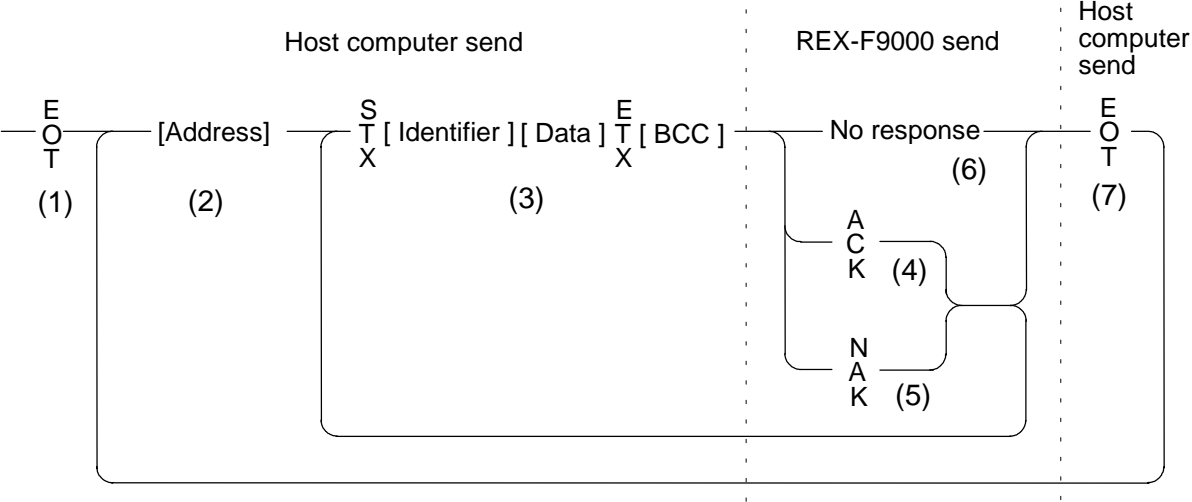


● **For the presence of error in data**



4.1.2 Selecting

Selecting is an operation in which the host computer selects one from among the REX-F9000s multidrop connected and then of recommending data receive. The procedure is as the following. Due to adopted fast selecting in REX-F9000s therefore becomes the type to send the data which connected to selecting sequence.



■ 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 REX-F9000 to be selected and must be the same as the device address set value in item "3.4 Device address setting" (P. 9).

(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 "4.1.1 Polling" (P. 22).

① Identifier [Number of digits : 2] (See P. 31.)

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

② Data [Number of digits : 7]

This is the data indicated by the identifier of the REX-F9000. 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 7).

Example : When data is -1.5

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

In addition, the REX-F9000 determines the receive data during selecting as follows.

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

When data is receivable:	When data is not receivable:
-.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) Acknowledgment [ACK]

If the REX-F9000 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 REX-F9000 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 7.
- When normally receive data exceeds the setting range.

(6) No response

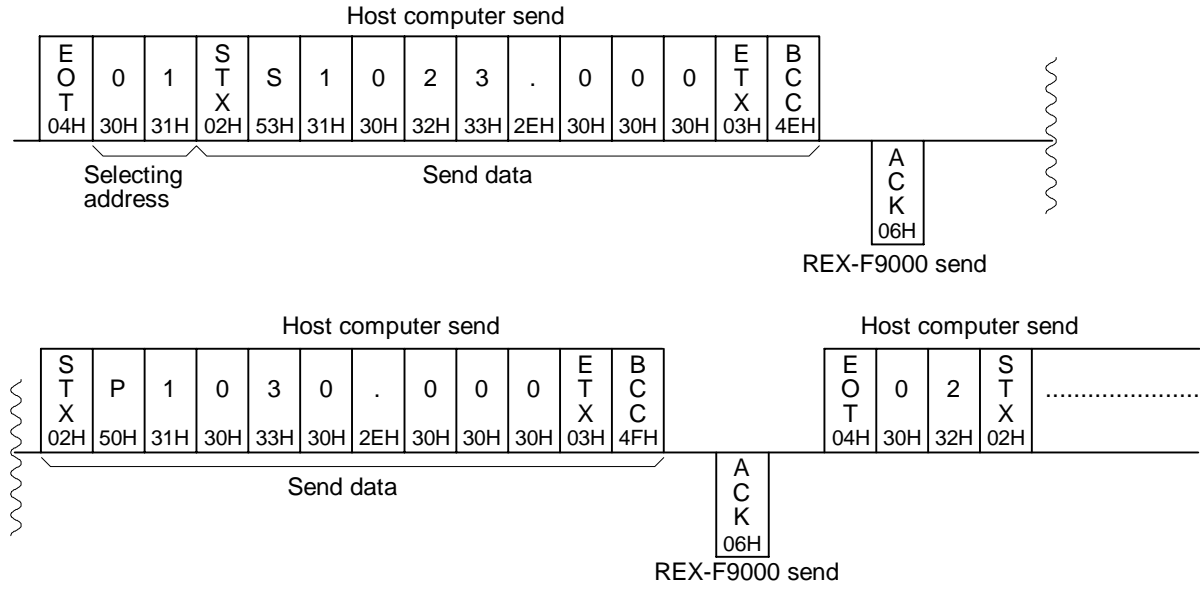
If the selecting address is not received correctly, the REX-F9000 is set to no response, if [STX], [ETX] and [BCC] is not received correctly, the REX-F9000 is also set to no response.

(7) Data link termination [EOT]

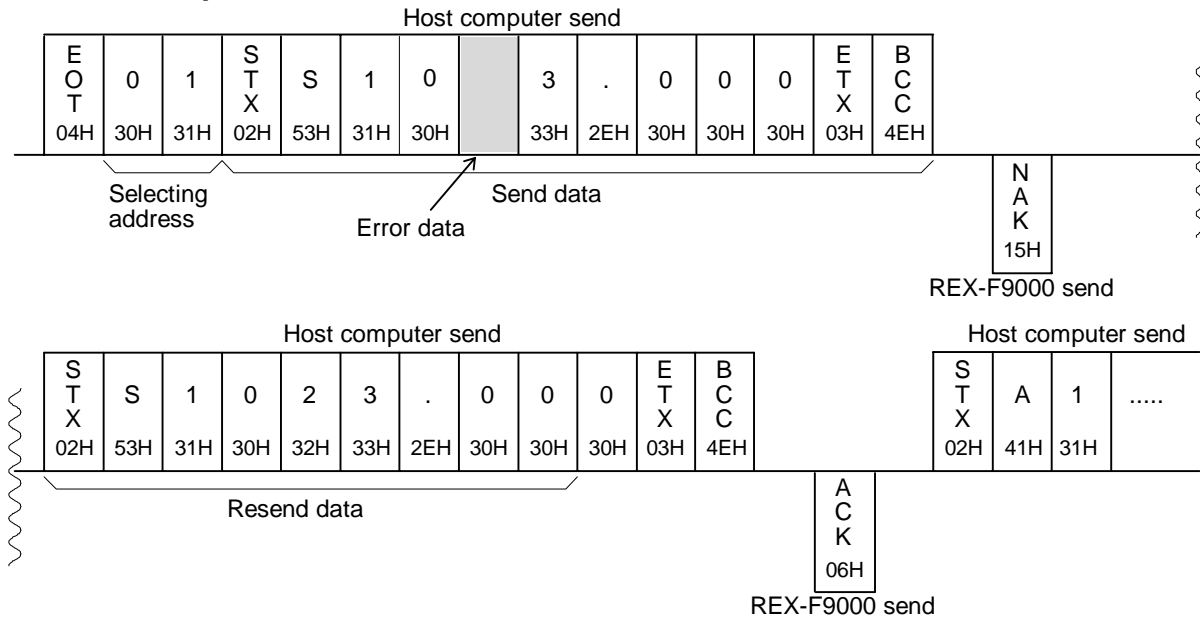
When terminating the data link because there was no more to be sent on the host computer side or the REX-F9000 was set to no response, send [EOT] from the host computer.

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

● **Normal transmission**





● **For the presence of error in data**



4.2 Communication identifier

■ Communication identifier list

 Before changing data corresponding to the identifiers from "XI (input type)" to "WB (alarm 2 hold action selection)," always turn the "Control RUN/STOP" mode to "STOP."

 The number of digits is 7 for all data. [Except for model code (ID)]

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

Name	Identifier	Data range	Attribute	Factory set value
Model code	ID	----	RO	----
Measured value (PV)	M1	----	RO	----
Alarm 1 output *1	AA	0: OFF 1: ON	RO	----
Alarm 2 output *2	AB	0: OFF 1: ON	RO	----
Manipulated output value (MV)	O1	-5.0 to +105.0%	RO	----
Burnout	B1	0: OFF 1: ON	RO	----
Error code	ER	0 to 255	RO	----
PID/AT transfer	G1	0 : PID 1 : AT	R/W	0
AUTO/MANUAL transfer	J1	0 : AUTO 1 : MANUAL	R/W	0
Control RUN/STOP	SR	0 : RUN 1 : STOP	R/W	0
Set value (SV)	S1	Setting limiter (low limit) to setting limiter (high limit)	R/W	0.000
Alarm 1 setting	A1	Process alarm : 0.000 to 50.000 °C	R/W	5.000
Alarm 2 setting	A2	Deviation alarm : -19.999 to +19.999 °C		
Proportional band	P1	0.001 to 50.000 °C * 0.000 can't be set.	R/W	30.000
Integral time	I1	0.1 to 3600.0 sec * 0.0 can't be set.	R/W	240.0
Derivative time	D1	0.0 : Derivative action OFF 0.1 to 3600.0 sec	R/W	60.0

Continued on the next page.

4. RKC STANDARD COMMUNICATION

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

Name	Identifier	Data range	Attribute	Factory set value
Control response parameter	CA	0 : Slow 1 : Medium 2 : Fast	R/W	0
PV bias	PB	-19.999 to +19.999 °C	R/W	0.000
Sensor bias	PC	-1.9999 to +1.9999 Ω	R/W	0.0000
Digital filter	F1	0.0 : OFF 0.1 to 100.0 sec	R/W	0.0
Output limiter (high limit)	OH	Output limiter (low limit) to +105.0 %	R/W	100.0
Output limiter (low limit)	OL	-5.0 % to output limiter (high limit)	R/W	0.0
AT bias	GB	-19.999 to +19.999 °C	R/W	0.000
Alarm 1 differential gap *1	HA	0.000 to 50.000 °C	R/W	2.000
Alarm 1 timer setting *1	TD	0 to 600 sec	R/W	0
Alarm 2 differential gap *2	HB	0.000 to 50.000 °C	R/W	2.000
Alarm 2 timer setting *2	TG	0 to 600 sec	R/W	0
Analog output specification selection *4	LA	0 : Measured value (PV) 1 : Deviation (DEV) 2 : Set value (SV) *5 4 : Manipulated output value(MV)	R/W	0
Analog output scale high *4	HV	*6	R/W	50.000
Analog output scale low *4	HW		R/W	0.000
Bar-graph display selection	DA	0 : Manipulated output value(MV) [1 dot : 5 %] 1 : Deviation (DEV) [0.01 °C/dot] 2 : Deviation (DEV) [0.1 °C/dot]	R/W	0

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Continued on the next page.

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

Name	Identifier	Data range	Attribute	Factory set value
Input type	XI	0 : Pt100 Ω (3-wire system) 1 : Pt100 Ω (4-wire system) 2 : JPt100 Ω (3-wire system) 3 : JPt100 Ω (4-wire system)	R/W See *7	0
Decimal point position selection	XU	0 : No digit below decimal-point 1 : 1 digit below decimal-point 2 : 2 digits below decimal-point 3 : 3 digits below decimal-point	R/W See *7	3
Power supply frequency	JT	0 : 50 Hz 1 : 60 Hz 2 : Auto setting	R/W See *7	0
Setting limiter (high limit)	SH	Setting limiter (low limit) to 50.000 °C	R/W See *7	50.000
Setting limiter (low limit)	SL	0.000 °C to setting limiter (high limit)	R/W See *7	0.000
Output cycle time	T0	0.1 to 100.0 sec	R/W See *7	0.1
Direct/reverse action selection	XE	0 : Direct action 1 : Reverse action	R/W See *7	1
Power feed forward	PF	0 : OFF 1 : ON	R/W See *7	1
Alarm 1 type selection	XA	See *8	R/W See *7	0
Alarm 1 energize/de-energize selection	NA	0 : Energize 1 : De-energize	R/W See *7	0
Alarm 1 action selection at abnormality	OA	0 : Normal action 1 : Forced alarm output ON	R/W See *7	0
Alarm 1 hold action selection	WA	See *9	R/W See *7	0
Alarm 2 type selection	XB	See *8	R/W See *7	0
Alarm 2 energize/de-energize selection	NB	0 : Energize 1 : De-energize	R/W See *7	0
Alarm 2 action selection at abnormality	OB	0 : Normal action 1 : Forced alarm output ON	R/W See *7	0

Continued on the next page.

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

Name	Identifier	Data range	Attribute	Factory set value
Alarm 2 hold action selection	WB	See *9	R/W See *7	0
Set data lock level selection	LK	See *10	R/W	0
Mode lock level selection	LM	See *11	R/W	0

*1 : This is an identifier which enables communication when there is an alarm 1.

*2 : This is an identifier which enables communication when there is an alarm 2.

*3 : Any number other than "0" indicates errors (RAM write error, etc.) detected by the REX-F9000 self-diagnosis function. If two or more errors occur simultaneously, the sum total of all error Nos. is sent.

Contact your nearest RKC sales agent or RKC sales office.

Error code	Details
-	MCU abnormality
-	MCU power supply voltage abnormality
-	Software abnormality
16	Input circuit abnormality
8	EEPROM error
4	Adjusted data destruction
2	Sensor break
1	Other abnormality

*4 : This is an identifier which enables communication when there is an analog output.

*5 : Do not set "3."

*6 : Analog scale range : The analog output scale differs depending on the analog output specification.

Analog output specification	Analog output scale range
0 : When measured value (PV) is selected.	0.000 to 50.000 °C
1 : When deviation (DEV) is selected.	-19.999 to +19.999 °C
2 : When set value (SV) is selected.	0.000 to 50.000 °C
3 : When manipulated output (MV) is selected.	-5.0 to +105.0%

*7 : Data can be written only in STOP mode.

*8 : Alarm type

Set value	Type
0	No alarm
1	Set value high alarm
2	Set value low alarm
3	Process high alarm
4	Process low alarm
5	Deviation high alarm
6	Deviation low alarm
7	Deviation high/low alarm (Absolute value setting)
8	Band alarm (Absolute value setting)

Continued on the next page.

*9 : Hold action type

Set value	Type
0	No hold action
1	Hold action is taken when the power is turned on.
2	Hold action is taken when the power is turned on or the setting changed.

*10 : Set data lock level

Set value	Set data lock level
0	Set value (SV) and parameter can't be set.
1	Only set value (SV) can be set.
2	Only parameter group (PG) can't be set.

*11 : Mode lock level

Set value	PID/AT	AUTO/MANUAL	Control RUN/STOP
0	×	×	×
1	×	-	×
2	-	×	×
3	-	-	×
4	×	×	-
5	×	-	-
6	-	×	-
7	-	-	-

- : Unsettable (Mode lock)

× : Settable (Mode unlock)

5. LADDER COMMUNICATION

5.1 Communication protocol

Ladder communication is a communication means provided for connecting with the PLC. The REX-F9000 uses the ignored process for the ladder communication protocol.

- Definition of protocol

Read : Based on a data request from the PLC, data is sent to the PLC from the REX-F9000.

Write : Based on a data request from the PLC, data is received by the REX-F9000.

5.1.1 Communication data configuration

■ PLC → REX-F9000 (During data send from PLC)

	①	②	③	④	⑤	⑥	⑦
Number of bytes	1	1	2	2	2	1	1
Number of BCD digits	2	2	4	4	4	2	2
Details	STX (02H)	ADR	ID	CMD	DAT	CR (0DH)	LF (0AH)

■ REX-F9000 → PLC (During data receive by PLC)

	①	②	③	④	⑤	④	⑤	.....	⑥	⑦
Number of bytes	1	1	2	2	2	2	2	.....	1	1
Number of BCD digits	2	2	4	4	4	4	4	.....	2	2
Details	STX (02H)	ADR	ID	CMD	DAT	CMD	DAT	.....	CR (0DH)	LF (0AH)

① STX

This is the transmission control character which indicates the start of the text (identifier and data). Set to STX (02H) fixed.

② ADR [Device address]

This data corresponds to the device address to select one REX-F9000 from among many REX-F9000s to which the PLC is multi-drop-connected. This should be the same as the device address set value in "3.4 Device address setting" (P.9).

③ ID [Identifier]

These are numbers used for the PLC to identify data to be requested or set to the REX-F9000.

These are numbers of four figures in the communication identifier list (P.44).

④ CMD [Command]

These are commands used for the PLC to identify the details of processing and the data sing to be requested to the REX-F9000.

PLC → REX-F9000 (During data send from PLC)

Command (CMD)	Details	Identifier transfer order
(0000) 0001	Read request	Upper byte → Lower byte
0010	Write request, write data +(Positive)	
0011	Write request, write data - (Negative)	
0100	Read request (Byte inversion)	Lower byte → Upper byte
1000	Write request, write data +(Positive)	
1100	Write request, write data - (Negative)	
Other	Usage inhibited	

REX-F9000 → PLC (During data receive by PLC)

Command (CMD)	Details	Identifier transfer order
0000	Read response, read data +(Positive)	*1
0001	Read response, read data - (Negative)	Upper byte → Lower byte
0010	Write response, write result data + (Positive)	
0011	Write response, write result data - (Negative)	Lower byte → Upper byte
0100	Read response, read data - (Negative)	
1000	Read request, write result data + (Positive)	
1100	Read request, write result data - (Negative)	
Other	Abnormal response	

*1 : Data transfer order is in accordance with the command from the PLC connected to the REX-F9000.

⑤ DAT [Data]

Details of processing by PLC	Communication direction	Details of send/receive data
Polling *For data read	PLC → REX-F9000	Number of read data (Maximum 30)
	REX-F9000 → PLC	Read data *Data such as measured value (PV), etc.
Selecting *For data write	PLC → REX-F9000	Write data
	REX-F9000 → PLC	Data after write execution

⑥, ⑦ CR, LF [Delimit]

Control characters to indicate the end of a text. The REX-F9000 judges that the text ends if it receives CR (0DH) and LF (0AH) in succession.

5.1.2 Data format

The data (DAT) format is expressed as internal data excluding the decimal point.

Example :

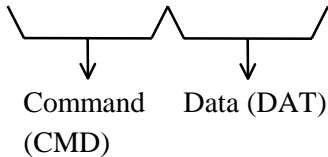
Data name	Actual data	Internal data
Manipulated output value (MV)	-5.0 to +105.0	-0050 to +1050
Proportional band	0.001 to 50.000	0001 to 5000
PV bias	-19.999 to +19.999	-1999 to +1999
Alarm 1 setting	Process alarm : 0.000 to 50.000	Process alarm : 0000 to 5000
	Deviation alarm : -19.999 to +19.999	Deviation alarm : -1999 to +1999

5.1.3 Data read

Reads identifiers requested from the PLC by the corresponding number of data items. A response from REX-F9000 is returned as 4-digit BCD data excluding the sign data and decimal point. Number of data which can be read at a time : 1 to 30.

PLC send data

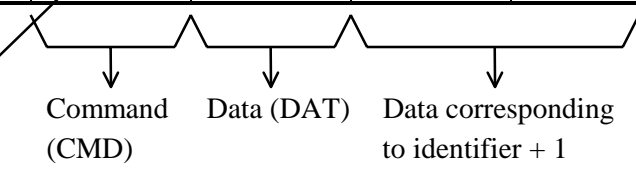
Number of bytes	1	1	2	2	2	1	1
Number of BCD digits	2	2	4	4	4	2	2
Details	STX (02H)	Device address (ADR)	Identifier (ID)	0001	Read data	CR (0DH)	LF (0AH)



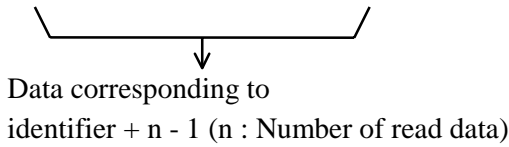
REX-F9000 response under normal operation

Number of bytes	1	1	2	2	2	2	2	.....
Number of BCD digits	2	2	4	4	4	4	4	.....
Details	STX (02H)	Device address (ADR)	Identifier (ID)	0000	ddd1	0000	ddd2	.....

This numeric value changes depending on the data sign (+ or -). (0 or 1)



.....	2	2	1	1
.....	4	4	2	2
.....	0000	dddn	CR	LF



 If there is no identifier requested by the PLC, the REX-F9000 returns the "0000" data.

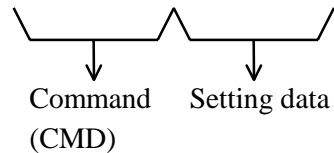
5.1.4 Data write

Writes the specified data in the specified identifier. Write data is specified by 4-digit BCD data excluding the sign data and decimal point.

The number of data which can be written at a time is 1.

PLC send data

Number of bytes	1	1	2	2	2	1	1
Number of BCD digits	2	2	4	4	4	2	2
Details	STX (02H)	Device address (ADR)	Identifie r (ID)	0010 or 0011	dddd	CR (0DH)	LF (0AH)



REX-F9000 response

Number of bytes	1	1	2	2	2	1	1
Number of BCD digits	2	2	4	4	4	2	2
Details	STX	Device address (ADR)	Identifie r (ID)	0010 or 0011	dddd	CR	LF



The original data is returned by ignoring data write for either of the following cases.

- The data range is exceeded, or
- a write inhibit identifier is specified.

5.1.5 Reversal of read/write data bytes

There are two methods of sending word data : One is to send the data from the upper byte and the other is to send the data from the lower byte.

The following two items can be inverted : Identifier (ID) and data (DAT).

Only the data (DAT) can also be inverted by setting.

Number of bytes	1	1	2	2	2	1	1
Number of BCD digits	2	2	4	4	4	2	2
Details	STX (02H)	Device addresses (ADR)	Identifier (ID)	Command (CMD)	Data (DAT) ↑	CR (0DH)	LF (0AH)

These two items can be inverted.

■ Inverting method

Reversal of Identifier (ID) and data (DAT)

The usual data transfer order is reversed by the command (CMD).

PLC → REX-F9000 (During data send from PLC)

Command (CMD)	Details	Identifier transfer order
(0000) 0001	Read request	Upper byte → Lower byte
0010	Write request, write data + (Positive)	
0011	Write request, write data - (Negative)	
0100	Read request (Byte inversion)	Lower byte → Upper byte
1000	Write request, write data + (Positive)	
1100	Write request, write data - (Negative)	
Other	Usage inhibited	

Continued on the next page.

REX-F9000 → PLC (During data receive by PLC)

Command (CMD)	Details	Identifier transfer order
0000	Read response, Read data + (Positive)	*1
0001	Read response, Read data - (Negative)	Upper byte → Lower byte
0010	Write response, Write result data + (Positive)	
0011	Write response, Write result data - (Negative)	Lower byte → Upper byte
0100	Read response, Read data - (Negative)	
1000	Write request, Write result data + (Positive)	
1100	Write request, Write result data - (Negative)	
Other	Abnormal response	

*1 : Data transfer order is in accordance with the command from the PLC connected to the REX-F9000.

■ Only data is inverted

Change can be made by specifying "0011" to the data number (ID) and setting data on "0 : High order→Low order " or "Other than 0 : Low order→High order."

Number of bytes	1	1	2	2	2	1	1
Number of BCD digits	2	2	4	4	4	2	2
Details	STX (02H)	Device addresses (ADR)	0011	Command (CMD)	Set 0 or any number other than 0.	CR (0DH)	LF (0AH)

↓
Identifier (ID)

↓
Data (DAT)

[Example] The following procedure is executed for send/receive data of 1234h.

- When sending data from the upper byte
 When REX-F9000 sends data : Sends data in order of 12h and 34h.
 When REX-F9000 receives data : When REX-F9000 receives data in order of 12h and 34h, it recognizes the data as 1234h.
- When sending data from the lower byte
 When REX-F9000 sends data : Sends data in order of 34h and 12h.
 When REX-F9000 receives data : When REX-F9000 receives data in order of 12h and 34h, it recognizes the data as 3412h.

*This setting is held even if the power is turned on again.

5.1.6 REX-F9000 no response

The REX-F9000 issues no-response for any of the following cases.

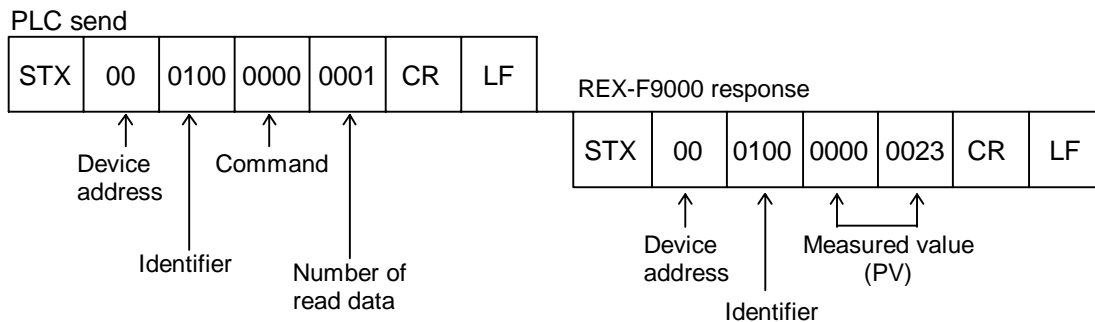
- The device address sent from the PLC does not match the device address of the REX-F9000.
- "CR" and "LF" can't be normally received.
- When there is an error in the data type.
- When a communication error occurs.

5.1.7 Example of text sent by PLC

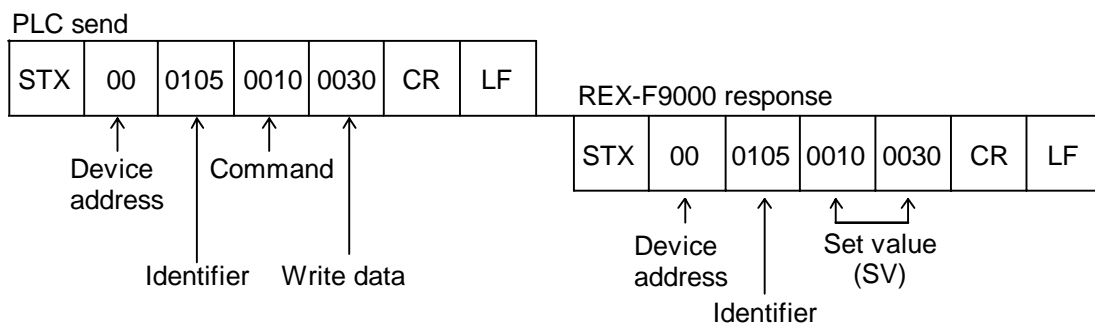
■ Example of text

It is assumed that the address No. is 00 and that data notation is hexadecimal.

● When reading measured value (PV)



● When writing set value (PV)



5.2 Communication identifier

In RKC standard communication described above, each item is expressed by an identifier combined with a number and a letter (M1, S1 ...) but in ladder communication, each item is expressed only by a number.

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

Item	Identifier		Details of data	#1	#2	Factory set value
	Upper	Lower				
Measured value (PV)	01	00	Within input range	1/100 °C	RO	----
Undefined	01	01	-----	-----	----	----
Manipulated output value (MV)	01	02	-0050 to +1050	1/10 %	RO	----
Undefined	01	03	-----	-----	----	----
Alarm 1 output	01	04	*1	-----	RO	----
Alarm 2 output						
Burnout (Measured value)						
Set value (SV)	01	05	Setting limiter (low limit) to setting limiter (high limit)	1/100 °C	R/W	0000
Alarm 1 setting	01	06	Process alarm : 0.000 to 50.000	1/100 °C	R/W	0500
Alarm 2 setting	01	07	Deviation alarm : -19.999 to +19.999			
Undefined	01	08	-----	-----	----	----
	01	09				
Proportional band	01	10	0001 to 5000	°C	R/W	3000
Undefined	01	11	-----	-----	----	----
Integral time	01	12	0001 to 3600	sec	R/W	0240
Derivative time	01	13	0000 to 3600	sec	R/W	0060
PID/AT transfer	01	14	0 : PID 1 : AT (Autotuning)	-----	R/W	0000
AUTO/MANUAL transfer	01	15	0 : AUTO 1 : MANUAL	-----	R/W	0000
The amount of manual output	01	16	Output limiter (low limit) to output limiter (high limit)	1/10 %	R/W *2	----

#1 : Engineering unit

#2 : Attribute

Continued on the next page.

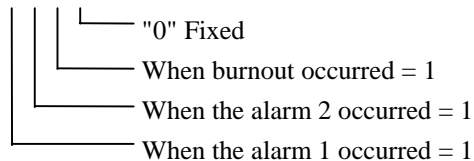
(Attributes RO: Read only, R/W: Read/Write)

Item	Identifier		Details of data	#1	#2	Factory set value
	Upper	Lower				
PV bias	01	17	-1999 to +1999	1/100 °C	R/W	0000
Undefined	01 to 01	18 to 99	-----	-----	----	----
Control RUN/STOP	00	00	0 : RUN 1 : STOP	-----	R/W	0000
Reversing the usual data transfer order *3	00	11	0: Upper byte→Lower byte Any number other than 0 : Lower byte→Upper byte	-----	R/W	0000

#1 : Engineering unit

#2 : Attribute

*1 : 0 0 0 0



*2 : Data can be written only in manual mode.

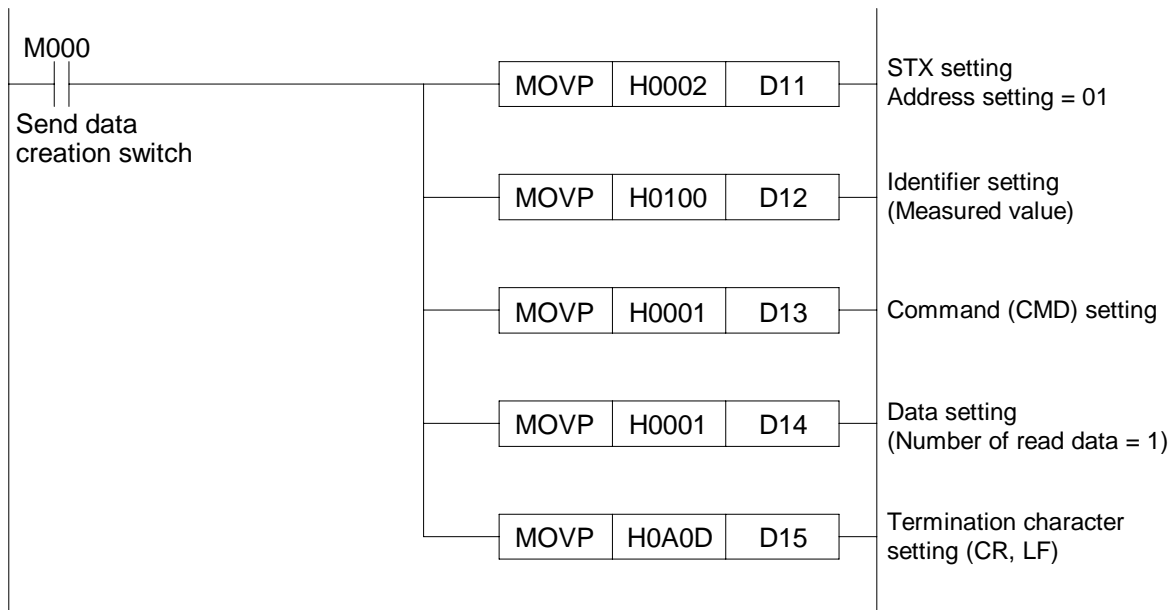
*3 : Specified when only the data (DAT) block is inverted. If the inversion of transfer order is specified by the command (CMD), this setting becomes invalid.

5.3 Example of sequence program

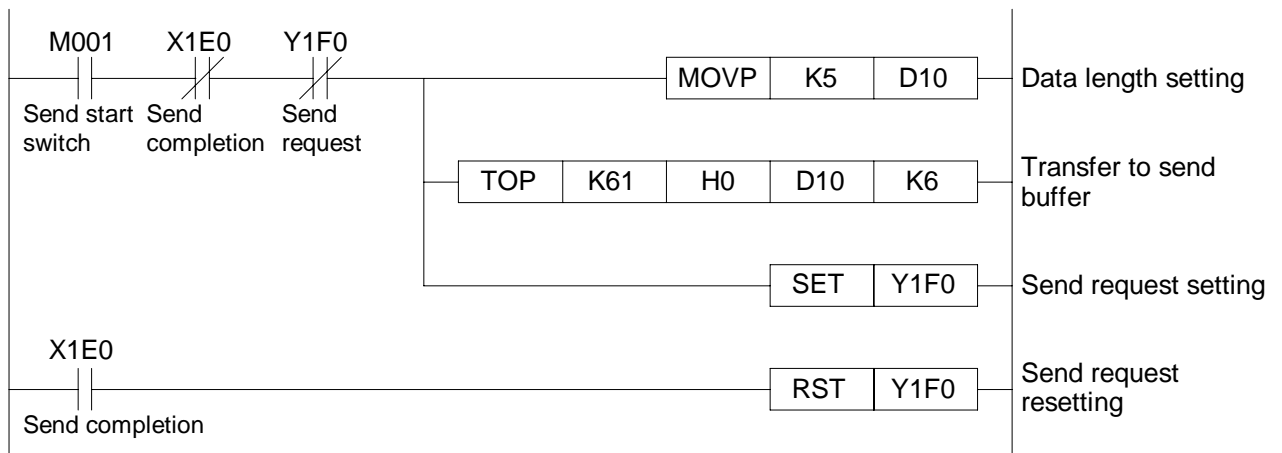
5.3.1 MELSEC Series (MITSUBISHI)

The ladder communication send/receive program using the MITSUBISHI MELSEC Series (A2CCPU24) is described below.

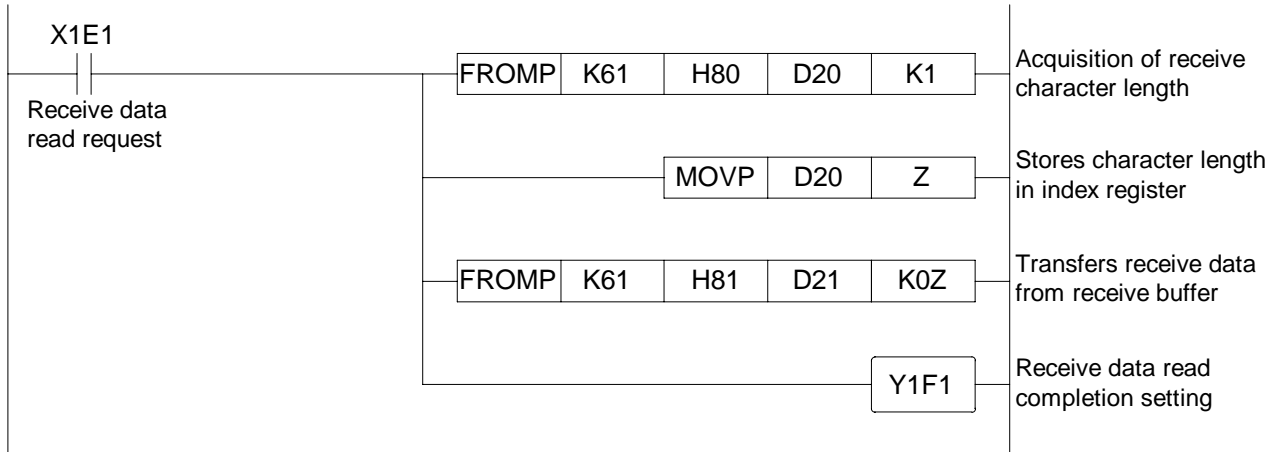
■ Send data creation program (example)





■ Send program (example)



■ Receive program (example)



 X1E0, X1E1, Y1F0, Y1F1 and K61 in the above program differ depending on the programmable controller used to communication module address.

 For details on setting the PLC, see the manual for "MITSUBISHI MELSEC Series."

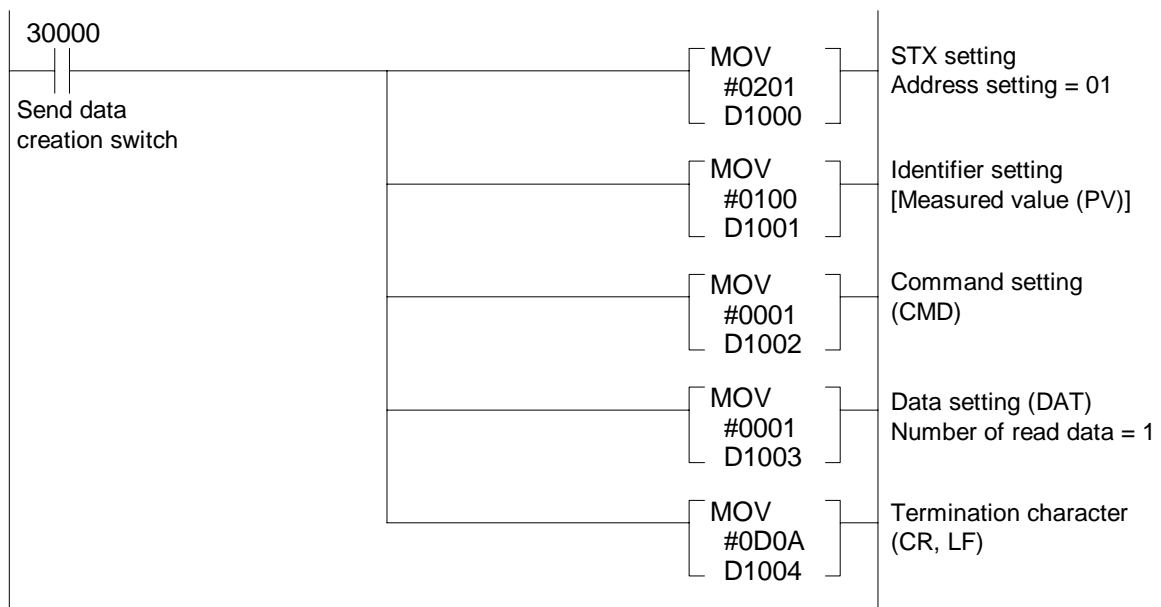
5.3.2 C200HS (OMRON)

The communication send/receive program using the OMRON C200HS is described below.

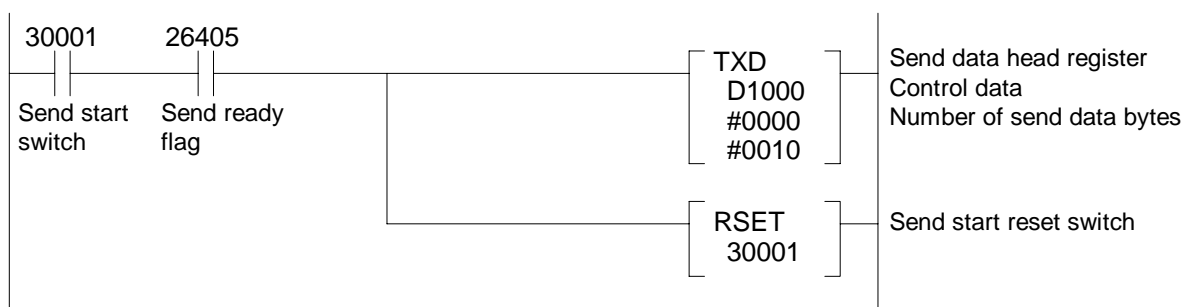
The following types of OMRON C200HS with the built-in RS-232C post can perform non-protocol communication.

- C200HS-CPU21
- C200HS-CPU23
- C200HS-CPU31
- C200HS-CPU33

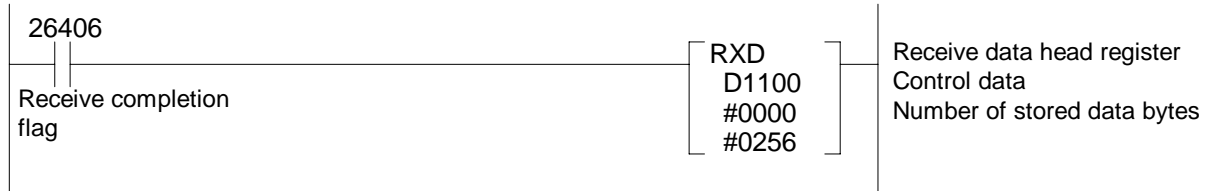
■ Send data creation program (example)



■ Send program (example)



■ Receive program (example)



☞ For details on setting the PLC, see the manual for "OMRON C200HS."

6. 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.

■ RKC standard communication

Details	Cause	Measures
No response	Trouble with and imperfect contact of communication cable and connector	Check communication cables and connectors.
	Device address designation differs	Make reassignment after checking the device address by referring to "3.4 Device address setting" (P.9).
	Incorrect communication speed	Set the communication speed suitable for the host computer by referring to "3.5 Communication speed setting" (P.11).
	Incorrect data configuration setting	Make reassignment after checking the data configuration by referring to "3.6 Data configuration setting" (P.13).
	Transmission line is not set to the receive state after data send	Check a program on the host computer side.
EOT return	Incorrect identifier	Make re-setting after checking the identifier by referring to "■Communication identifier list" (P.31).
	The identifier of a function not added to the REX-F9000 is specified	
NAK return	BCC error	Check BCC of the transmission data.
	Data exceeds the setting range	Check a data range.
	The identifier of a function not added to the REX-F9000 is specified	Make re-setting after checking the identifier by referring to "■Communication identifier list" (P.31).

■ Ladder communication

Details	Cause	Measures
No response	Trouble wit and imperfect contact communication cable and connector	Check communication cables and connectors.
	Device address designation differs	Make reassignment after checking the device address by referring to "3.4 Device address setting" (P.9).
	Incorrect communication speed	Set the communication speed suitable for the PLC by referring to "3.5 Communication speed setting" (P.11).
	Incorrect data configuration setting	Make reassignment after checking the data configuration by referring to "3.6 Data configuration setting" (P.13).
	Transmission line is not set to the receive state after data send	Check the program on the PLC side.
	The specified identifier is not defined.	Check the identifier.
	The number of read data exceeds the specified number.	Check the number of data.
	No command length is correct *Command length must be 10 bytes including CR and LF.	Check the PLC side program.
No settings are written	Write data is out of the range	Check a setting range.
	An unsettable identifier (measured value, etc.) was specified.	Check whether they are identifiers corresponding to settable items.
All return characters other than STX, device address, identifier, CR and LF are set to F.	Characters other than BCD codes (0 to 9) were used for communication data (excluding STX, CR and LF)	Make conversion to BCD coded characters.

7. ASCII 7-BIT CODE TABLE

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



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