Temperature controller with fuzzy function

**R E X - D S E R I E S**

COMMUNICATION INSTRUCTION MANUAL

RKC INSTRUMENT INC.
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.

● The contents of this manual are copy righted; all rights are reserved by RKC INSTRUMENT INC. It is prohibited to reprint or reproduce the whole or a part of this manual without the prior of RKC INSTRUMENT INC.

● "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

<table>
<thead>
<tr>
<th>Date of revision</th>
<th>Manual number</th>
<th>Reason of revision</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994.10.07</td>
<td>IMDRE03-E1</td>
<td>The First edition issue</td>
</tr>
<tr>
<td>1994.12.16</td>
<td>IMDRE03-E2</td>
<td>Addition of the item : terminal resistor</td>
</tr>
</tbody>
</table>
| 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 |
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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)

<table>
<thead>
<tr>
<th>Terminal No.</th>
<th>Signal name</th>
<th>Signal direction Controller ↔ HOST</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>D400 18, D700 23, D900 18</td>
<td>SG</td>
<td></td>
<td>Signal ground</td>
</tr>
<tr>
<td>D400 14, D700 19, D900 14</td>
<td>T(A)</td>
<td>➔</td>
<td>Send data</td>
</tr>
<tr>
<td>D400 15, D700 20, D900 15</td>
<td>T(B)</td>
<td>➔</td>
<td>Send data</td>
</tr>
<tr>
<td>D400 16, D700 21, D900 16</td>
<td>R(A)</td>
<td>←</td>
<td>Receive data</td>
</tr>
<tr>
<td>D400 17, D700 22, D900 17</td>
<td>R(B)</td>
<td>←</td>
<td>Receive data</td>
</tr>
</tbody>
</table>

② RS-485 (2-wire system)

<table>
<thead>
<tr>
<th>Terminal No.</th>
<th>Signal name</th>
<th>Signal direction Controller ↔ HOST</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>D100 18, D400 23, D700 18</td>
<td>SG</td>
<td></td>
<td>Signal ground</td>
</tr>
<tr>
<td>D100 14, D400 16, D700 21, D900 16</td>
<td>T/R(A)</td>
<td>←➔</td>
<td>Send data/Receive data</td>
</tr>
<tr>
<td>D100 13, D400 17, D700 22, D900 17</td>
<td>T/R(B)</td>
<td>←➔</td>
<td>Send data/Receive data</td>
</tr>
</tbody>
</table>
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

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

Up to 31

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

<table>
<thead>
<tr>
<th>Signal name</th>
<th>REX-D400</th>
<th>REX-D700</th>
<th>REX-D900</th>
</tr>
</thead>
<tbody>
<tr>
<td>SG</td>
<td>18</td>
<td>23</td>
<td>18</td>
</tr>
<tr>
<td>T(A)</td>
<td>14</td>
<td>19</td>
<td>14</td>
</tr>
<tr>
<td>T(B)</td>
<td>15</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>R(A)</td>
<td>16</td>
<td>21</td>
<td>16</td>
</tr>
<tr>
<td>R(B)</td>
<td>17</td>
<td>22</td>
<td>17</td>
</tr>
</tbody>
</table>
(2) When host computer interface is RS-232C
Our converter COM-104C is used.

**REX-D series controller**

**RS-422A**

**COM-104C**

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

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

<table>
<thead>
<tr>
<th>Signal name</th>
<th>REX-D400</th>
<th>REX-D700</th>
<th>REX-D900</th>
</tr>
</thead>
<tbody>
<tr>
<td>SG</td>
<td>18</td>
<td>23</td>
<td>18</td>
</tr>
<tr>
<td>T(A)</td>
<td>14</td>
<td>19</td>
<td>14</td>
</tr>
<tr>
<td>T(B)</td>
<td>15</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>R(A)</td>
<td>16</td>
<td>21</td>
<td>16</td>
</tr>
<tr>
<td>R(B)</td>
<td>17</td>
<td>22</td>
<td>17</td>
</tr>
</tbody>
</table>

*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

- **Host computer**
- **RS-232C**
- **COM-104C** (RS-232C ↔ RS-422A converter)
- **Device address example**
  - **REX-D series controller**
    - **BRA-100B**
      - 0 1
  - **REX-D series controller**
    - **BRA-100B**
      - 2 3
  - **REX-D series controller**
    - **BRA-100B**
      - 28 29 30
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.

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

<table>
<thead>
<tr>
<th>Signal name</th>
<th>REX−D100</th>
<th>REX−D400</th>
<th>REX−D700</th>
<th>REX−D900</th>
</tr>
</thead>
<tbody>
<tr>
<td>SG</td>
<td></td>
<td>18</td>
<td>23</td>
<td>18</td>
</tr>
<tr>
<td>T/R(A)</td>
<td>14</td>
<td>16</td>
<td>21</td>
<td>16</td>
</tr>
<tr>
<td>T/R(B)</td>
<td>13</td>
<td>17</td>
<td>22</td>
<td>17</td>
</tr>
</tbody>
</table>

* For the REX−D100, no SG wiring is required.
(2) When host computer interface is RS-232C

Our converter COM-103C is used.

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

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

<table>
<thead>
<tr>
<th>Signal name</th>
<th>Terminal No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SG</td>
<td>18, 23, 18</td>
</tr>
<tr>
<td>T/R(A)</td>
<td>14, 16, 16</td>
</tr>
<tr>
<td>T/R(B)</td>
<td>13, 17, 17</td>
</tr>
</tbody>
</table>

* 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]

- Host computer
- RS-232C
- COM-103C (RS-232C ↔ RS-485 converter)
- Device address 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 or key to set the instrument to the PV/SV display/set mode.

② Call up engineer set mode
Press the 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 or 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 \( \text{[P G B]} \) key is pressed. The final item returns to the "PG" display.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Name</th>
<th>Setting range</th>
<th>Description</th>
<th>Initial value prior to shipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>PG8</td>
<td>Parameter group</td>
<td></td>
<td>The first characters of parameter group (PG8).</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>① bPS</td>
<td>Communication speed</td>
<td>0:1200bps 3: 9600bps</td>
<td>Selects communication speed.</td>
<td>3</td>
</tr>
<tr>
<td>bPS</td>
<td></td>
<td>1:2400bps 4:19200bps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>② bIT</td>
<td>Communication data bit configuration</td>
<td>See *A</td>
<td>Selects data bit configuration during communication.</td>
<td>0</td>
</tr>
</tbody>
</table>

* A …

<table>
<thead>
<tr>
<th>Setting</th>
<th>Data bit [bit]</th>
<th>Parity bit</th>
<th>Stop bit [bit]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>8</td>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>8</td>
<td>None</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>Even</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>Even</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td>Odd</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td>Odd</td>
<td>2</td>
</tr>
</tbody>
</table>

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 \[ ] 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 \[ ] 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 \[ \text{SEL} \] and \[ \text{F2} \] keys simultaneously to call up SETUP set mode.
First, "Input type selection (InP)" is displayed

② Set to "Device address (Add)"
Press the \[ \text{SEL} \] key.
The measured-value (PV) display unit shows "Add", and
the set-value (SV) display unit shows the address number.

③ Change the address number
Press the \[ \text{SEL} \] or \[ \text{SEL} \] key to change the number shown on
the set-value (SV) display unit to the desired number.
Then press the \[ \text{SEL} \] key to validate it.

* Keep pressing the \[ \text{SEL} \] or \[ \text{SEL} \] key to increase the speed
with which the numeric value changes.

④ Setting end
After the setting is completed, press the \[ \text{SEL} \] or \[ \text{SEL} \] key to
set the instrument to the desired mode.
(Figure on the left: PV/SV display/set mode)

(2) The contents of device address

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Name</th>
<th>Setting range</th>
<th>Description</th>
<th>Initial value prior to shipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add</td>
<td>Device address</td>
<td>0 to 99</td>
<td>Set device address of this instrument.</td>
<td>0</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Selection time</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approx. 0.8msec</td>
<td>Approx. 1.8msec</td>
<td>Approx. 2.4msec</td>
<td></td>
</tr>
</tbody>
</table>

Sent with the circuit set to high impedance

**REX—D series controller sending data**

Circuit state

**REX—D series controller sending direction**

HiZ

Selection time

Receivable
☆ 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.

![Diagram](image-url)

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.

```
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

(Example)
```
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Q</td>
</tr>
</tbody>
</table>
```

Device  Identifier  address

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.

```
<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

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.
③ [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:

<table>
<thead>
<tr>
<th>S</th>
<th>T</th>
<th>M</th>
<th>1</th>
<th>0</th>
<th>2</th>
<th>5</th>
<th>0</th>
<th>.</th>
<th>0</th>
<th>E</th>
<th>T</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>4DH</td>
<td>31H</td>
<td>30H</td>
<td>32H</td>
<td>35H</td>
<td>30H</td>
<td>2EH</td>
<td>30H</td>
<td>03H</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In the parenthesis are indicated with hexadecimal number.

\[
\text{BCC} = 4\text{DH} \oplus 31\text{H} \oplus 30\text{H} \oplus 32\text{H} \oplus 35\text{H} \oplus 30\text{H} \oplus 2\text{EH} \oplus 30\text{H} \oplus 03\text{H} = 66\text{H} \quad (\oplus \text{ indicates EX - OR})
\]

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>

Host computer send

<table>
<thead>
<tr>
<th>EOT</th>
<th>G</th>
<th>I</th>
<th>M</th>
<th>I</th>
<th>ENQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>04H</td>
<td>31H</td>
<td>31H</td>
<td>40H</td>
<td>31H</td>
<td>05H</td>
</tr>
</tbody>
</table>

Polling identifier address

<table>
<thead>
<tr>
<th>STX</th>
<th>M</th>
<th>0</th>
<th>1</th>
<th>0</th>
<th>1</th>
<th>0</th>
<th>O</th>
<th>E</th>
<th>B</th>
<th>T</th>
<th>X</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>02H</td>
<td>40H</td>
<td>31H</td>
<td>30H</td>
<td>30H</td>
<td>31H</td>
<td>02H</td>
<td>30H</td>
<td>03H</td>
<td>02H</td>
<td>03H</td>
<td>02H</td>
<td>03H</td>
</tr>
</tbody>
</table>

DEX-D series controller data send

Host computer send

<table>
<thead>
<tr>
<th>ACK</th>
<th>OEH</th>
</tr>
</thead>
</table>

<For the presence of error in data>

Host computer send

<table>
<thead>
<tr>
<th>EOT</th>
<th>G</th>
<th>I</th>
<th>M</th>
<th>I</th>
<th>ENQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>04H</td>
<td>31H</td>
<td>31H</td>
<td>40H</td>
<td>31H</td>
<td>05H</td>
</tr>
</tbody>
</table>

Polling identifier address

<table>
<thead>
<tr>
<th>STX</th>
<th>M</th>
<th>1</th>
<th>0</th>
<th>0</th>
<th>1</th>
<th>1</th>
<th>O</th>
<th>E</th>
<th>B</th>
<th>T</th>
<th>X</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>02H</td>
<td>40H</td>
<td>31H</td>
<td>30H</td>
<td>31H</td>
<td>2EH</td>
<td>30H</td>
<td>03H</td>
<td>02H</td>
<td>03H</td>
<td>02H</td>
<td>03H</td>
<td>02H</td>
</tr>
</tbody>
</table>

DEX-D series controller data send

Host computer send

<table>
<thead>
<tr>
<th>NAK</th>
<th>15H</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>STX</th>
<th>M</th>
<th>1</th>
<th>0</th>
<th>0</th>
<th>1</th>
<th>0</th>
<th>O</th>
<th>E</th>
<th>B</th>
<th>T</th>
<th>X</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>02H</td>
<td>40H</td>
<td>31H</td>
<td>30H</td>
<td>31H</td>
<td>2EH</td>
<td>30H</td>
<td>03H</td>
<td>02H</td>
<td>03H</td>
<td>02H</td>
<td>03H</td>
<td>02H</td>
</tr>
</tbody>
</table>

DEX-D series controller data send
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 "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
   −01.5 → Receivable
   −1.5 → Receivable
   −1.50 → Receivable
   −1.500 → Receivable
   −1.5000 → Receivable

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

   **Example:** When setting data is between −10.00 to 10.00

<table>
<thead>
<tr>
<th>When data is receivable</th>
<th>When data is not receivable</th>
</tr>
</thead>
<tbody>
<tr>
<td>−.5 → −0.5</td>
<td>− → Not receivable (NAK answer)</td>
</tr>
<tr>
<td>−.058 → −0.05</td>
<td>. → Not receivable (NAK answer)</td>
</tr>
<tr>
<td>.03 → 0.03</td>
<td>−. → Not receivable (NAK answer)</td>
</tr>
<tr>
<td>+0 → Not receivable (NAK answer)</td>
<td></td>
</tr>
</tbody>
</table>

3. **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.

4. **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.

5. **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.

6. **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 transmission>

<For the presence of error in data>
## 5. COMMUNICATION DATA

### Communication identifier list

<table>
<thead>
<tr>
<th>Name</th>
<th>Identifier</th>
<th>Number of digits</th>
<th>Data range</th>
<th>Initial value</th>
<th>User setting value</th>
<th>R/W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured-value (PV)</td>
<td>M1</td>
<td>6</td>
<td>Scaling low-limit to scaling high-limit</td>
<td></td>
<td></td>
<td>R/O</td>
</tr>
<tr>
<td>First current transformer input value (CT1)</td>
<td>M2</td>
<td>6</td>
<td>0.0 to 100.0A</td>
<td></td>
<td></td>
<td>R/O</td>
</tr>
<tr>
<td>Second current transformer input value (CT2)</td>
<td>M3</td>
<td>6</td>
<td>0.0 to 100.0A</td>
<td></td>
<td></td>
<td>R/O</td>
</tr>
<tr>
<td>First alarm output</td>
<td>AA</td>
<td>6</td>
<td>0 : OFF 1 : ON</td>
<td></td>
<td></td>
<td>R/O</td>
</tr>
<tr>
<td>Second alarm output</td>
<td>AB</td>
<td>6</td>
<td>0 : OFF 1 : ON</td>
<td></td>
<td></td>
<td>R/O</td>
</tr>
<tr>
<td>Heater break alarm output 1</td>
<td>AC</td>
<td>6</td>
<td>0 : OFF 1 : ON</td>
<td></td>
<td></td>
<td>R/O</td>
</tr>
<tr>
<td>Heater break alarm output 2</td>
<td>AD</td>
<td>6</td>
<td>0 : OFF 1 : ON</td>
<td></td>
<td></td>
<td>R/O</td>
</tr>
<tr>
<td>Control loop break alarm</td>
<td>AE</td>
<td>6</td>
<td>0 : OFF 1 : ON</td>
<td></td>
<td></td>
<td>R/O</td>
</tr>
<tr>
<td>Burnout</td>
<td>B1</td>
<td>6</td>
<td>0 : OFF 1 : ON</td>
<td></td>
<td></td>
<td>R/O</td>
</tr>
<tr>
<td>Manipulated output 1 (Heating-side)</td>
<td>O1</td>
<td>6</td>
<td>-5.0 to 105.0%</td>
<td></td>
<td></td>
<td>R/O</td>
</tr>
<tr>
<td>Manipulated output 2 (Cooling-side)</td>
<td>O2</td>
<td>6</td>
<td>-5.0 to 105.0%</td>
<td></td>
<td></td>
<td>R/O</td>
</tr>
<tr>
<td>Set-value (SV) monitoring</td>
<td>MS</td>
<td>6</td>
<td>Scaling low-limit to scaling high-limit</td>
<td></td>
<td></td>
<td>R/O</td>
</tr>
<tr>
<td>Error data</td>
<td>ER</td>
<td>6</td>
<td>0 to 255</td>
<td></td>
<td></td>
<td>R/O</td>
</tr>
<tr>
<td>AUTO/MAX transfer</td>
<td>J1</td>
<td>6</td>
<td>0 : AUTO mode 1 : MAX mode</td>
<td>AUTO mode</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>RUN/STOP transfer</td>
<td>SR</td>
<td>6</td>
<td>0 : RUN 1 : STOP</td>
<td>RUN</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>PID/Auto-tuning transfer</td>
<td>G1</td>
<td>6</td>
<td>0 : PID control 1 : Auto-tuning</td>
<td>PID control</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Set-value (SV1)</td>
<td>S1</td>
<td>6</td>
<td>Scaling low-limit to scaling high-limit</td>
<td></td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Manipulated output value (MV)</td>
<td>ON</td>
<td>6</td>
<td>Low-limit output range to high-limit output range</td>
<td>-5.0</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Step-set-value (SV2)</td>
<td>S2</td>
<td>6</td>
<td>Scaling low-limit to scaling high-limit</td>
<td>0(0.0)</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>First alarm setting</td>
<td>A1</td>
<td>6</td>
<td>-1999 to 9999 (The decimal-point position is the same as that of PV)</td>
<td>50(50.0)</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Second alarm setting</td>
<td>A2</td>
<td>6</td>
<td>-1999 to 9999 (The decimal-point position is the same as that of PV)</td>
<td>-50(-50.0)</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>First heater break alarm setting</td>
<td>A3</td>
<td>6</td>
<td>0.0 to 100.0A 0.0 : HBA1 OFF</td>
<td>0.0</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Second heater break alarm setting</td>
<td>A4</td>
<td>6</td>
<td>0.0 to 100.0A 0.0 : HBA2 OFF</td>
<td>0.0</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>PV bias</td>
<td>P3</td>
<td>6</td>
<td>Temperature input : -1999 (-199.9) to -9999 (999.9)°C (°F)</td>
<td>0(0.0)</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Voltage input : -1999 to 9999 (The decimal-point position is the same as that of PV)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SV change rate limit</td>
<td>HH</td>
<td>6</td>
<td>Temperature input : 0(0.0) to input span (or 9999 (999.9)°C (°F)) /min</td>
<td>0(0.0)</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Voltage input : 0.0 to 100.0% /min of span</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First alarm action selection</td>
<td>XA</td>
<td>6</td>
<td>0 to 14</td>
<td>5</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>First alarm differential gap</td>
<td>HA</td>
<td>6</td>
<td>Temperature input : 0(0.0) to 100(100.0)°C (°F) /min</td>
<td></td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Voltage input : 0.0 to 10.0% /min of span</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First alarm timer setting</td>
<td>TD</td>
<td>6</td>
<td>0 to 600 sec</td>
<td>0</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Control loop break alarm setting</td>
<td>A5</td>
<td>6</td>
<td>0 to 7200 sec 0 : LBA OFF</td>
<td>0</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>LBA deadband</td>
<td>V3</td>
<td>6</td>
<td>Temperature input : 0 to 9999 °C (°F)</td>
<td>0</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Voltage input : 0 to 100% of span</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second alarm action selection</td>
<td>XB</td>
<td>6</td>
<td>0 to 14</td>
<td>6</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Second alarm differential gap</td>
<td>HB</td>
<td>6</td>
<td>Temperature input : 0(0.0) to 100(100.0)°C (°F)</td>
<td>Temperature input : 0(0.0) to 100(100.0)°C (°F)</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Voltage input : 0.0 to 10.0% /min of span</td>
<td>Voltage input : 0.0 to 10.0% /min of span</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R/O (read-only)  R/W (read-write)
<table>
<thead>
<tr>
<th>Name</th>
<th>Identifier</th>
<th>Number of digits</th>
<th>Data range</th>
<th>Initial value</th>
<th>User setting value</th>
<th>R/W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second alarm timer setting</td>
<td>TG</td>
<td>6</td>
<td>0 to 600 sec</td>
<td>0</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>HBA delay timer</td>
<td>TH</td>
<td>6</td>
<td>0 to 600 sec</td>
<td>3</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Proportional band (Heating-side)</td>
<td>P1</td>
<td>6</td>
<td>Temperature input: 0(0,0) to input span (for 999,999,999)</td>
<td>Temperature input: 0(0,0)</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Voltage input: 0.0 to 100.0% of span</td>
<td>Voltage input: 3.0</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Integral time</td>
<td>T1</td>
<td>6</td>
<td>0 to 3600 sec (0: Integral action OFF)</td>
<td>240</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Derivative time</td>
<td>D1</td>
<td>6</td>
<td>0 to 3600 sec (0: Derivative action OFF)</td>
<td>60</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Anti-reset windup (AWW)</td>
<td>W1</td>
<td>6</td>
<td>1 to 100% of proportional band</td>
<td>100</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Cooling-side proportional band</td>
<td>P2</td>
<td>6</td>
<td>1 to 3000% of proportional band</td>
<td>100</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Overlap/deadband</td>
<td>V1</td>
<td>6</td>
<td>Temperature input: -10(10.0) to 10(10.0)²</td>
<td>Temperature input: 0(0.0)</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Voltage input: -10.0 to 10.0% of span</td>
<td>Voltage input: 0.0</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>ON/OFF action differential gap</td>
<td>MH</td>
<td>6</td>
<td>Temperature input: 0(0.0) to 50(50.0)%</td>
<td>Temperature input: 0(0.0)</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Voltage input: 0.0 to 10.0% of span</td>
<td>Voltage input: 0.2</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Manual reset</td>
<td>MX</td>
<td>6</td>
<td>-50.0 to 50.0% (Heating/cooling -100.0 to 100.0%)</td>
<td>0</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Fuzzy</td>
<td>XP</td>
<td>6</td>
<td>0: OFF 1: ON</td>
<td>ON</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Proportioning cycle (OVT1)</td>
<td>T0</td>
<td>6</td>
<td>1 to 100 sec</td>
<td>29</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Output limit (High-limit)</td>
<td>CH</td>
<td>6</td>
<td>Low limit output range to 105.0% (Heating/cooling)</td>
<td>105.0</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Output limit (Low-limit)</td>
<td>CL</td>
<td>6</td>
<td>-5.0% to high limit output range</td>
<td>-0.0</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Direct/reverse action selection</td>
<td>XE</td>
<td>6</td>
<td>0: Direct action 1: Reverse action</td>
<td>1</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Proportioning cycle (OVT2)</td>
<td>T1</td>
<td>6</td>
<td>1 to 100 sec</td>
<td>29</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Output limit (high-limit) (OVT2)</td>
<td>CI</td>
<td>6</td>
<td>0.0 to 105.0% (Cooling-side output)</td>
<td>105.0</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Analog output specification selection</td>
<td>LA</td>
<td>6</td>
<td>0 to 4 (See page 24.)</td>
<td>0</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>High limit analog output range</td>
<td>HV</td>
<td>6</td>
<td>(See page 23.)</td>
<td></td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Low limit analog output range</td>
<td>HW</td>
<td>6</td>
<td>(See page 23.)</td>
<td></td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Input type selection</td>
<td>XI</td>
<td>6</td>
<td>0 to 37 (See page 24.)</td>
<td>0</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Scaling high-limit</td>
<td>XV</td>
<td>6</td>
<td>Scaling low-limit to 9999</td>
<td>999.9</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Scaling low-limit</td>
<td>XW</td>
<td>6</td>
<td>-1999 to scaling high-limit</td>
<td>-1999.9</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Biplane-point position selection</td>
<td>XU</td>
<td>6</td>
<td>0 to 3</td>
<td>1</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>AUTO/MAN function selection</td>
<td>PQ</td>
<td>6</td>
<td>0: Not provided 1: Provided</td>
<td>0</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Control KUN/STOP display selection</td>
<td>DH</td>
<td>6</td>
<td>0: Not provided 1: Provided</td>
<td>0</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Current transformer type selection</td>
<td>XR</td>
<td>6</td>
<td>0: CTL-6-3-P-W 1: CTL-12-566-10L-W</td>
<td>0</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Air cooling/water cooling selection</td>
<td>XQ</td>
<td>6</td>
<td>0: Air cooling 1: Water cooling (H/C)</td>
<td>0</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Auto-tuning (AT) differential gap</td>
<td>GH</td>
<td>6</td>
<td>0 to 3600 sec</td>
<td>10</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Action selection at input abnormality</td>
<td>WH</td>
<td>6</td>
<td>0: No alarm action when abnormal input</td>
<td>0</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1: Output OFF 2: Output ON</td>
<td></td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>Universal output selection</td>
<td>XD</td>
<td>6</td>
<td>0: Relay contact output 1: Voltage pulse output 2: Continuous current output</td>
<td>0</td>
<td></td>
<td>R/W</td>
</tr>
</tbody>
</table>

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  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
  8 : Band alarm
  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

<table>
<thead>
<tr>
<th>Analog output selection</th>
<th>Scaling setting range</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 : Measured—value (PV)</td>
<td>Scaling low—limit to scaling high—limit</td>
</tr>
<tr>
<td>1 : Deviation</td>
<td>− span (−1999) to span (9999)</td>
</tr>
<tr>
<td>2 : Set—value (SV)</td>
<td>Scaling low—limit to scaling high—limit</td>
</tr>
<tr>
<td>3 : Control output (Heating—side)</td>
<td>0.0 to 100.0 %</td>
</tr>
<tr>
<td>4 : Heater current value (CT1)</td>
<td>0.0 to 100.0 A</td>
</tr>
</tbody>
</table>

* 8  As REX-D100 has no universal output, no identifier appears.
### Input range table

#### 1. Thermocouple input

<table>
<thead>
<tr>
<th>Data</th>
<th>Input type</th>
<th>Input range</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>K(₄')</td>
<td>-199.9 to 999.9 °C</td>
</tr>
<tr>
<td>1</td>
<td>K(₄')</td>
<td>-200 to 1372 °C</td>
</tr>
<tr>
<td>2</td>
<td>J(₄)</td>
<td>-199.9 to 999.9 °C</td>
</tr>
<tr>
<td>3</td>
<td>J(₄)</td>
<td>-200 to 1200 °C</td>
</tr>
<tr>
<td>4</td>
<td>T(₄)</td>
<td>-199.9 to 400.0 °C</td>
</tr>
<tr>
<td>5</td>
<td>R(₄)</td>
<td>0 to 1769 °C</td>
</tr>
<tr>
<td>6</td>
<td>S(₅)</td>
<td>0 to 1769 °C</td>
</tr>
<tr>
<td>7</td>
<td>B(₅)</td>
<td>0 to 1820 °C</td>
</tr>
<tr>
<td>8</td>
<td>E(₅)</td>
<td>-200 to 1000 °C</td>
</tr>
<tr>
<td>9</td>
<td>N(₆)</td>
<td>0 to 1300 °C</td>
</tr>
<tr>
<td>10</td>
<td>PL II (P)</td>
<td>0 to 1390 °C</td>
</tr>
<tr>
<td>11</td>
<td>W5Re / W26Re(ω)</td>
<td>0 to 2320 °C</td>
</tr>
<tr>
<td>12</td>
<td>U(J)</td>
<td>0 to 600 °C</td>
</tr>
<tr>
<td>13</td>
<td>L(L)</td>
<td>0 to 900 °C</td>
</tr>
<tr>
<td>14</td>
<td>K(₄')</td>
<td>-199.9 to 999.9 °F</td>
</tr>
<tr>
<td>15</td>
<td>K(₄')</td>
<td>-330 to 2500 °F</td>
</tr>
<tr>
<td>16</td>
<td>J(₄)</td>
<td>-199.9 to 999.9 °F</td>
</tr>
<tr>
<td>17</td>
<td>J(₄)</td>
<td>-330 to 2192 °F</td>
</tr>
<tr>
<td>18</td>
<td>T(₄)</td>
<td>-199.9 to 752.0 °F</td>
</tr>
<tr>
<td>19</td>
<td>R(₄)</td>
<td>0 to 3216 °F</td>
</tr>
<tr>
<td>20</td>
<td>S(₅)</td>
<td>0 to 3216 °F</td>
</tr>
<tr>
<td>21</td>
<td>B(₅)</td>
<td>0 to 3308 °F</td>
</tr>
<tr>
<td>22</td>
<td>E(₅)</td>
<td>-330 to 1832 °F</td>
</tr>
<tr>
<td>23</td>
<td>N(₆)</td>
<td>0 to 2372 °F</td>
</tr>
<tr>
<td>24</td>
<td>PL II (P)</td>
<td>0 to 2534 °F</td>
</tr>
<tr>
<td>25</td>
<td>W5Re / W26Re(ω)</td>
<td>0 to 4208 °F</td>
</tr>
<tr>
<td>26</td>
<td>U(J)</td>
<td>0 to 1100 °F</td>
</tr>
<tr>
<td>27</td>
<td>L(L)</td>
<td>0 to 1600 °F</td>
</tr>
</tbody>
</table>

#### 2. RTD input

<table>
<thead>
<tr>
<th>Data</th>
<th>Input type</th>
<th>Input range</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>Pt100 (JIS)</td>
<td>-199.9 to 510.0 °C</td>
</tr>
<tr>
<td>29</td>
<td>Pt100 (JIS/IEC)</td>
<td>-199.9 to 660.0 °C</td>
</tr>
<tr>
<td>30</td>
<td>JPt100 (Conforming to JIS)</td>
<td>-199.9 to 950.0 °F</td>
</tr>
<tr>
<td>31</td>
<td>JPt100 (Conforming to JIS/IEC)</td>
<td>-199.9 to 999.9 °F</td>
</tr>
</tbody>
</table>

#### 3. DC voltage (Low) input

<table>
<thead>
<tr>
<th>Data</th>
<th>Input type</th>
<th>Input range</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>0 to 10 mV DC</td>
<td>Programmable scale</td>
</tr>
<tr>
<td>33</td>
<td>0 to 100 mV DC</td>
<td>The range is determined from the decimal–point position.</td>
</tr>
<tr>
<td>34</td>
<td>0 to 1 V DC</td>
<td></td>
</tr>
</tbody>
</table>

#### 4. DC voltage (High) input *1

<table>
<thead>
<tr>
<th>Data</th>
<th>Input type</th>
<th>Input range</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>0 to 5 V DC</td>
<td>Programmable scale</td>
</tr>
<tr>
<td>36</td>
<td>1 to 5 V DC</td>
<td>The range is determined from the decimal–point position.</td>
</tr>
<tr>
<td>37</td>
<td>0 to 10 V DC</td>
<td></td>
</tr>
</tbody>
</table>

*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: (Parity bit: Absence, Data bit: 8, Stop bit: 1)
  * Device address: (A 1 D) : 0
  * Communication speed: (b P 5) : 3 (9600bps) Match communication speed to that of the host computer.

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

```basic
1000 '==============================================
1010 ' TEST PROGRAM of COMMUNICATION
1020 ' (For PC-9801 NEC)
1030 '==============================================
1040 ' Initial setting
1050 '
1060 CMS="8N1NN" 'Initial setting for communication
1070 ADDS="00" 'Designation of address
1080 '
1090 STX$=CHR$(&H2) : EOTS=CHR$(&H4) : ENGS=CHR$(&H5)
1100 ACK$=CHR$(&H6) : NAK$=CHR$(&H15) : ETX$=CHR$(&H3)
1110 '
1120 ' RS-232C Port open
1130 '
1140 OPEN "COM1:"="CMS 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$=EOTS$+ADDS$+"S1"+ENGS$ 'S1' Transmission
1260 GOSUB #TEXT 'Clear of buffer
1270 GOSUB #RXDT 'Clear of buffer
1280 #J10
1290 J=0
1300 #IF
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 #ETRX ' ETX
1350 IF K$=NAK$ THEN PRINT " RX DATA = NAK ":END ' NAK
1360 IF K$=EOTS$ 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 #ETRX
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 " Rejection data = ":DT$ ' Display of Reception data
```

- 25 -
1510 *SEL
1520 PRINT
1530 PRINT "SELECTING TRANSACTION for RECEPTION TIME OUT"
1540 PRINT
1550 "DTS$=EOT$+ADD$+DT$"
1560 PRINT "Transmission data =";DT$ 'Display of Transmission data
1570 GOSUB *BCCCH
1580 DT$=DT$+CHR$(BCC)
1590 GOSUB *TEXT
1600 GOSUB *RXDT
1610 'Clear of buffer
1620 J=0
1630 *IF2
1650 IF LOC(1)=0 THEN J=J+1: IF J<500 THEN *IF2 ELSE PRINT "Time out": END
1660 .
1670 K$=INPUT$(1,1)
1680 IF K$=NAK$ THEN PRINT " RX DATA = NAK": END
1690 IF K$=ACK$ THEN PRINT " RX DATA = ACK": END
1700 DT$=DT$+K$
1710 PRINT "DATA ERROR"
1720 .
1730 GOTO *J20
1740 .
1750 'BCC CHECK : ERROR
1760 .
1770 .
1780 .
1790 *NAKTX
1800 PRINT "BCC Check error"
1810 DT$=NAK$
1820 GOSUB *TEXT
1830 RETURN
1840 .
1850 'RECEPTION ROUTINE
1860 .
1870 .
1880 .
1890 *RXDT
1900 DT$=""
1910 RETURN
1920 .
1930 'TRANSMISSION ROUTINE DT$ --> TEXT
1940 .
1950 .
1960 .
1970 *TEXT
1980 PRINT #1, DT$:
1990 RETURN
2000 .
2010 'BCC CHECK
2020 .
2030 .
2040 .
2050 *BCCCH
2060 FOR II=1 TO LEN(DT$)
2070 BCCAS=MID$(DT$,II,1)
2080 IF BCCAS=STX$ THEN BCC=0: GOTO *I1NEXT 'IF BCCAS=STX$, BCC=0
2090 BCC=BCC XOR ASC(BCC$)
2100 *I1NEXT
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 ' Initial setting
1040 ' 1050 COM.PORT=AH32          ' 0251 command port address
1060 CM$="N1NN"                  ' Initial setting for communication
1070 ADDR$="00"                  ' Designation of address
1080 TXON=AH37                  ' TXOFF=AH17
1090 ' RS-232C Port open
1100 ' OPEN "COM1:"+CM$ AS #1 : OUT COM.PORT,TXOFF
1110 CONSOLE,,,1
1120 COLOR 7:CLS 3              ' Clear of display
1130 '-----------------------------------------------
1140 ' MAIN PROGRAM LOOP
1150 '-----------------------------------------------
1160 *POL
1170 PRINT
1180 PRINT " POLLING TRANSACTION for RECEIPTION TIME OUT "
1190 PRINT
1200 DTS=ETX$+ADD$+"S1"+ENQ$     ' "S1" Transmission
1210 GO SUB *TEXT
1220 GO SUB *RXT
1230 J=0
1240 IF LOC(1)=0 THEN J=J+1:IF J<500 THEN *IF1 ELSE PRINT " Time out ":END
1250 '-----------------------------------------------
1260 *IF1
1270 K$=INPUT$(1,1)              ' Reception of one letter
1280 IF K$=ETX$ THEN PRINT " RX DATA = ETX ":GOTO *ETXRX  ' ETX
1290 IF K$=NAK$ THEN PRINT " RX DATA = NAK ":END     ' NAK
1300 IF K$=EOT$ THEN PRINT " RX DATA = EOT ":END     ' EOT
1310 IF K$=ACK$ THEN PRINT " RX DATA = ACK ":END     ' ACK
1320 '-----------------------------------------------
1330 DT$=DTS+K$                  ' BCC Check : Reception
1340 GOTO *J10
1350 '-----------------------------------------------
1360 *ETXRX
1370 DT$=DTS+K$
1380 BCCRX$=INPUT$(1,1)     ' BCC Check : Reception
1390 BCCRX$=ASC(BCCRX$)
1400 GO SUB *BCCCH
1410 IF BCC$>BCCRX$ THEN GOSUB *NARLX     ' BCC Check:Right?
1420 IF BCC$<BCCRX$ THEN GOSUB *RXDT: GOTO *J10     ' NEXT TRANSACTION
1430 '-----------------------------------------------
1440 PRINT " Reception data = ":DT$     ' Display of Reception data
1450 *SEL
1460 PRINT
1470 PRINT " SELECTING TRANSACTION for RECEIPTION TIME OUT "
1480 PRINT
1490 DTS=EOT$+ADD$+DT$          ' Transmission data = ":DT$ ' Display of Transmission data
1500 GOSUB *BCCCH
1510 GO SUB *TEXT
1520 GOSUB *RXDT
1530 ' "S1+data" Transmission
1540 ' Clear of buffer
1550 '-----------------------------------------------
1560 *J20
1570 J=0
1580 *IF2
IF LOC(1)=0 THEN J=J+1:IF J<500 THEN *IF2 ELSE PRINT "Time out":END

K$=INPUT$(1..1) 'Reception of one letter
IF K$=NAK$ THEN PRINT "RX DATA = NAK":END 'NAK
IF K$=ACK$ THEN PRINT "RX DATA = ACK":END 'ACK
DTS=DTS+K$
PRINT "DATA ERROR"
GOTO *J20

---------------------------------------------------------------------
BCC CHECK: ERROR
---------------------------------------------------------------------

*NAKTX
PRINT "BCC Check error" 'Error display
DTS=NAK$ "NAK" data set
GOSUB *TEXT
RETURN

---------------------------------------------------------------------
RECEPTION ROUTINE
---------------------------------------------------------------------

*RXDT
DTS="" 'Clear of buffer
RETURN

---------------------------------------------------------------------
TRANSMISSION ROUTE DTS --> TEXT
---------------------------------------------------------------------

*TEXT
OUT COM.PORT,TXON 'Change to Transmission
PRINT #1,DTS; 'Data Transmission
IF3
OUT NOT INP(COM.PORT) AND &H4 THEN *IF3 'Transmission is end?
OUT COM.PORT,TXOFF 'Change to Reception
RETURN

---------------------------------------------------------------------
BCC CHECK
---------------------------------------------------------------------

*BCCCH
FOR II=1 TO LEN(DTS$)
BCCAS=MID$(DTS$,II,1)
IF BCCAS=STX$ THEN BCC=0:GOTO *LINEXT 'IF BCCAS=STX$, BCC=0
BCC=BCC XOR ASC(BCCAS)
*LINEXT
NEXT II
RETURN

---------------------------------------------------------------------
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>
<thead>
<tr>
<th>Details</th>
<th>Cause</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>No- response</td>
<td>Trouble occurring in the controller</td>
<td>Contact our agent</td>
</tr>
<tr>
<td></td>
<td>Trouble with and imperfect contact of</td>
<td>Check communication cables</td>
</tr>
<tr>
<td></td>
<td>communication cable</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Incorrect communication speed</td>
<td>Set the communication speed suitable for the host computer by referring</td>
</tr>
<tr>
<td></td>
<td></td>
<td>to &quot;3.1 Communication speed and Data type setting&quot; (Page 8).</td>
</tr>
<tr>
<td></td>
<td>Device address designation differs</td>
<td>Make reassignment after checking the device address by referring to &quot;3.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Device address setting&quot; (Page 10).</td>
</tr>
<tr>
<td></td>
<td>Incorrect data configuration</td>
<td>Make reassignment after checking the data configuration by referring to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;3.1 Communication speed and Data type setting&quot; (Page 8).</td>
</tr>
<tr>
<td></td>
<td>Transmission line is not set to high</td>
<td>Program check on the host computer side.</td>
</tr>
<tr>
<td></td>
<td>impedance after data send</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Specification conforming to RS-485</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2-wire system)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EOT return</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Incorrect identifier</td>
<td>Make re-setting after checking the identifier by referring to &quot;Communication identifier list&quot; (Page 21).</td>
</tr>
<tr>
<td></td>
<td>The identifier of a function not added</td>
<td></td>
</tr>
<tr>
<td></td>
<td>to the instrument is specified</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BCC error</td>
<td>Data check and re-setting</td>
</tr>
<tr>
<td></td>
<td>Data exceeds the setting range</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The identifier of a function not added</td>
<td>Identifier check</td>
</tr>
<tr>
<td></td>
<td>to the instrument is specified</td>
<td></td>
</tr>
</tbody>
</table>
8. **JIS/ASCII 7-bit CODE TABLE** (For reference)

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