Ramp/Soak Controller

PZ400/PZ900

Host Communication Instruction Manual
This manual assumes that the reader has a fundamental knowledge of the principles of electricity, process control, computer technology and communications.

- The figures, diagrams and numeric values used in this manual are only for explanation purpose.
- RKC is not responsible for any damage or injury that is caused as a result of using this instrument, instrument failure or indirect damage.
- RKC is not responsible for any damage and/or injury resulting from the use of instruments made by imitating this instrument.
- Periodic maintenance is required for safe and proper operation of this instrument. Some components have a limited service life, or characteristics that change over time.
- Every effort has been made to ensure accuracy of all information contained herein. RKC makes no warranty, expressed or implied, with respect to the accuracy of the information. The information in this manual is subject to change without prior notice.
- No portion of this document may be reprinted, modified, copied, transmitted, digitized, stored, processed or retrieved through any mechanical, electronic, optical or other means without prior written approval from RKC.
Pictorial Symbols (safety symbols)

Various pictorial symbols are used in this manual to ensure safe use of the product, to protect you and other people from harm, and to prevent damage to property. The symbols are described below. Be sure you thoroughly understand the meaning of the symbols before reading this manual.

![WARNING](image)

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

![CAUTION](image)

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

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

WARNING

- To prevent injury to persons, damage to the instrument and the equipment, a suitable external protection device shall be required.
- All wiring must be completed before power is turned on to prevent electric shock, fire or damage to the instrument and the equipment.
- This instrument must be used in accordance with the specifications to prevent fire or damage to the instrument and the equipment.
- This instrument is not intended for use in locations subject to flammable or explosive gases.
- Do not touch high-voltage connections such as power supply terminals, etc. to avoid electric shock.
- RKC is not responsible if this instrument is repaired, modified or disassembled by other than factory-approved personnel. Malfunction may occur and warranty is void under these conditions.
This product is intended for use with industrial machines, test and measuring equipment. (It is not designed for use with medical equipment and nuclear energy plant.)

This is a Class A instrument. In a domestic environment, this instrument may cause radio interference, in which case the user may be required to take additional measures.

This instrument is protected from electric shock by reinforced insulation. Provide reinforced insulation between the wire for the input signal and the wires for instrument power supply, source of power and loads.

Be sure to provide an appropriate surge control circuit respectively for the following:
- If input/output or signal lines within the building are longer than 30 meters.
- If input/output or signal lines leave the building, regardless the length.

This instrument is designed for installation in an enclosed instrumentation panel. All high-voltage connections such as power supply terminals must be enclosed in the instrumentation panel to avoid electric shock to operating personnel.

All precautions described in this manual should be taken to avoid damage to the instrument or equipment.

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

All wiring must be in accordance with local codes and regulations.

To prevent instrument damage as a result of failure, protect the power line and the input/output lines from high currents with a suitable overcurrent protection device with adequate breaking capacity such as a fuse, circuit breaker, etc.

A malfunction in this product may occasionally make control operations impossible or prevent alarm outputs, resulting in a possible hazard. Take appropriate measures in the end use to prevent hazards in the event of malfunction.

Prevent metal fragments or lead wire scraps from falling inside instrument case to avoid electric shock, fire or malfunction.

Tighten each terminal screw to the specified torque found in the manual to avoid electric shock, fire or malfunction.

For proper operation of this instrument, provide adequate ventilation for heat dissipation.

Do not connect wires to unused terminals as this will interfere with proper operation of the instrument.

Turn off the power supply before cleaning the instrument.

Do not use a volatile solvent such as paint thinner to clean the instrument. Deformation or discoloration may occur. Use a soft, dry cloth to remove stains from the instrument.

To avoid damage to the instrument display, do not rub with an abrasive material or push the front panel with a hard object.

For Proper Disposal

When disposing of each part used for this instrument, always follows the procedure for disposing of industrial wastes stipulated by the respective local community.
Symbols

■ Pictorial Symbols (safety symbols)

- **NOTE**: This mark indicates important information on installation, handling and operating procedures.

- : This mark indicates supplemental information on installation, handling and operating procedures.

- : This mark indicates where additional information may be located.

■ Character Symbols

11-segment character

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7-segment character

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</table>
### Abbreviation symbols

These abbreviations are used in this manual:

<table>
<thead>
<tr>
<th>Abbreviation symbols</th>
<th>Name</th>
<th>Abbreviation symbols</th>
<th>Name</th>
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<tbody>
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<td>PV</td>
<td>Measured value</td>
<td>TC (input)</td>
<td>Thermocouple (input)</td>
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<td>SV</td>
<td>Set value</td>
<td>RTD (input)</td>
<td>Resistance temperature detector (input)</td>
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<tr>
<td>MV</td>
<td>Manipulated output value</td>
<td>V (input)</td>
<td>Voltage (input)</td>
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<td>AT</td>
<td>Autotuning</td>
<td>I (input)</td>
<td>Current (input)</td>
</tr>
<tr>
<td>ST</td>
<td>Startup tuning</td>
<td>HBA (1, 2)</td>
<td>Heater break alarm (1, 2)</td>
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<tr>
<td>OUT (1 to 3)</td>
<td>Output (1 to 3)</td>
<td>CT (1, 2)</td>
<td>Current transformer (1, 2)</td>
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<tr>
<td>DI (1 to 6)</td>
<td>Digital input (1 to 6)</td>
<td>LBA</td>
<td>Control loop break alarm</td>
</tr>
<tr>
<td>DO (1 to 4)</td>
<td>Digital output (1 to 4)</td>
<td>LBD</td>
<td>LBA deadband</td>
</tr>
<tr>
<td>FBR</td>
<td>Feedback resistance</td>
<td></td>
<td></td>
</tr>
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</table>
There are six manuals pertaining to this product. Please be sure to read all manuals specific to your application requirements.

The following manuals can be downloaded from the official RKC website: https://www.rkcinst.com/english/manual_load.htm.

<table>
<thead>
<tr>
<th>Manual</th>
<th>Manual Number</th>
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<tr>
<td>PZ400/PZ900 Installation Manual</td>
<td>IMR03B01-E</td>
<td>This manual is enclosed with instrument. This manual explains the mounting and wiring.</td>
</tr>
<tr>
<td>PZ400/PZ900 Quick Operation Manual</td>
<td>IMR03B02-E</td>
<td>This manual is enclosed with instrument. This manual explains the basic key operation, mode menu, and data setting.</td>
</tr>
<tr>
<td>PZ400/PZ900 Parameter List</td>
<td>IMR03B03-E</td>
<td>This manual is enclosed with instrument. This list is a compilation of the parameter data of each mode.</td>
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<tr>
<td>PZ400/PZ900 Instruction Manual</td>
<td>IMR03B05-E</td>
<td>This manual describes installation, wiring, operation of each function, and troubleshooting.</td>
</tr>
<tr>
<td>PZ400/PZ900 Host Communication Instruction Manual</td>
<td>IMR03B06-E</td>
<td>This manual you are reading now. This manual explains RKC communication protocol (ANSI X3.28-1976) and Modbus relating to communication parameters setting.</td>
</tr>
<tr>
<td>PZ400/PZ900 PLC Communication Instruction Manual</td>
<td>IMR03B07-E</td>
<td>This manual describes how to set up the instrument for communication with a programmable controller (PLC).</td>
</tr>
</tbody>
</table>

📖 Read this manual carefully before operating the instrument. Please place the manual in a convenient location for easy reference.
This manual consists of 8 chapters and an appendix. If you are looking for topics concerning the host communication, you may be able to find one in the following table.

<table>
<thead>
<tr>
<th>What do you want to do?</th>
<th>See the following section for more details</th>
</tr>
</thead>
<tbody>
<tr>
<td>I want to know the features of the host communication</td>
<td>1. OUTLINE</td>
</tr>
<tr>
<td>I want to know how to connect to the host computer</td>
<td>2. WIRING</td>
</tr>
<tr>
<td>I want to know how to connect to the loader communication device</td>
<td>2. WIRING</td>
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<tr>
<td>I want to know how to set up the communication parameters</td>
<td>3. PARAMETER SETTING</td>
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<td>I want to know the content of RKC communication protocol</td>
<td>4. RKC COMMUNICATION PROTOCOL</td>
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<td>I want to know the content of Modbus protocol</td>
<td>5. MODBUS PROTOCOL</td>
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<td>I want to know how to use Modbus data mapping</td>
<td>5. MODBUS PROTOCOL</td>
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<td>I want to check the data map structure</td>
<td>6. COMMUNICATION DATA LIST</td>
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<td>I want to know how to read the table</td>
<td>6. COMMUNICATION DATA LIST</td>
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<td>I want to check RKC communication/Modbus (double word) [data register address, data attribute, data range and factory set values]</td>
<td>6. COMMUNICATION DATA LIST</td>
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<tr>
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<td>6. COMMUNICATION DATA LIST</td>
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<tr>
<td>I want to know how to cope with errors</td>
<td>7. TROUBLESHOOTING</td>
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<tr>
<td>I want to know the specification of the host communication</td>
<td>8. SPECIFICATIONS</td>
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<tr>
<td>I want to see the table of ASCII/JIS 7-bit code</td>
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This chapter describes the host communication of PZ400/900.
The communication function makes it possible to monitor and set the data of the Temperature Controller PZ400/900 from a host computer. The PZ400/900 interfaces with the host computer via Modbus or RKC communication (ANSI X3.28-1976 subcategories 2.5 and A4) protocols. Communication function is available only when optional communication function has been specified at the time of ordering.
In addition, the controller PZ400/900 is equipped standard with a loader communication connector. Therefore, loader communication is possible. For reference purposes, the Modbus protocol identifies the host computer as master, the controller as slave.

**Host communication (RKC communication, Modbus) [Optional]**

Communication interface: RS-485, RS-422A

- **Multi-drop connection**
  One host computer (master) can communicate with up to 31 PZ400/900s.

![Diagram of multi-drop connection](image)

- **Communication data type**
  There are such data as shown below for the communication with the computer.
  Communication data type can be selected at Input data type (INdT).
  For the Input data type, refer to **3.2 Selection of Communication Data Type (P. 3-5)**.

  - **RKC communication**
    - 7 digits data
    - 6 digits data

  - **Modbus**
    - Double word
    - Single word
**Loader communication**

Loader communication allows PZ400/900 data to be set from a personal computer. By saving the data that was set using our Communication Tool PROTEM2 to a computer, the data can be transferred to other PZ400/900s, allowing setup to be accomplished much more quickly than when the data is set in each PZ400/900 using the front panel keys. RKC USB communication converter COM-K2 (sold separately) is required for the loader communication.

![Diagram of communication setup](image)

**NOTE**

- The Loader port is only for parameter setup. Not used for data logging during operation.
- Loader communication can be used on a PZ400/900 even when the Communication function (optional) is not installed.
- The loader communication corresponds to the RKC communication protocol “Based on ANSI X3.28-1976 subcategories 2.5 and A4.”
- A previous version of COM-K (version 1) can be also used. However, if communication tool PROTEM2 is used using a COM-K, the PROTEM2 will not be supported by Windows 8 or later.

**Communication Tool PROTEM2**

PROTEM2 is an integrated configuration support software to manage parameter setting and measured values of our controllers (including PZ400/900). The PROTEM2 can be downloaded from the official RKC website: [https://www.rkcinst.com](https://www.rkcinst.com)

Check our website for more details and operating environment of the PROTEM2.

- PROTEM2 can be used with RKC communication protocol and Modbus protocol.
- PROTEM2 can also be used for loader communication and a host communication.
This chapter describes how to connect to the host computer.

2.1 Wiring Cautions

2.2 Wiring for Host Communication
   2.2.1 Connection to the RS-485 port of PZ400/900
   - Communication terminal number and signal details
   - Connection to the RS-485 port of the host computer (master)
   - Connection to the RS-232C port of the host computer (master)
   - Connection to the USB of the host computer (master)
   2.2.2 Connection to the RS-422A port of PZ400/900
   - Communication terminal number and signal details
   - Connection to the RS-422A port of the host computer (master)
   - Connection to the RS-232C port of the host computer (master)
   - Connection to the USB of the host computer (master)

2.3 Connections for Loader Communication
   - Position of loader communication connector
   - Wiring method
2. WIRING

2.1 Wiring Cautions

- To avoid noise induction, keep communication wire away from instrument power line, load lines and power lines of other electric equipment.
- Use the solderless terminal appropriate to the screw size.
  Screw size:  M3×7 (with 5.8×5.8 square washer)
  Recommended tightening torque:  0.4 N·m [4 kgf·cm]
  Applicable wire:  Solid/twisted wire of 0.25 to 1.65 mm²
  Specified dimension:
    Refer to Fig. at the right
  Specified solderless terminal:
    Manufactured by J.S.T MFG CO., LTD.
    Circular terminal with isolation V1.25-MS3
- Make sure that during field wiring parts of conductors cannot come into contact with adjacent conductive parts.
- If solderless terminal lugs other than the recommended dimensions are used, terminal screws may not be tightened. In that case, bend each solderless terminal lug before wiring. If the terminal screw is forcibly tightened, it may be damaged.
- Up to two solderless terminal lugs can be connected to one terminal screw. The requirements of reinforced insulation can be still complied with in this condition. When actually doing this, place one solderless terminal lug over the other as illustrated below.

- When tightening a screw of the instrument, make sure to fit the screwdriver properly into the screw head mounted tilted or flat as shown in the right figure. Tightening the screw with excessive torque may damage the screw thread.
2.2 Wiring for Host Communication

Host communication is used for a connection to a host computer via RS-485 or RS-422A.

2.2.1 Connection to the RS-485 port of PZ400/900

<table>
<thead>
<tr>
<th>Communication terminal number and signal details</th>
</tr>
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</table>

PZ400/900 rear terminals

| 1 | 25 | 13 |
| 2 | 26 | 14 |
| 3 | 27 | 15 |
| 4 | 28 | 16 |
| 5 | 29 | 17 |
| 6 | 30 | 18 |
| 7 | 31 | 19 |
| 8 | 32 | 20 |
| 9 | 33 | 21 |
| 10 | 34 | 22 |
| 11 | 35 | 23 |
| 12 | 36 | 24 |

RS-485

<table>
<thead>
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<th>PZ400/900 terminal No.</th>
<th>Symbol</th>
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<td>34</td>
<td>SG</td>
<td>Signal ground</td>
</tr>
<tr>
<td>35</td>
<td>T/R (A)</td>
<td>Send data/Receive data</td>
</tr>
<tr>
<td>36</td>
<td>T/R (B)</td>
<td>Send data/Receive data</td>
</tr>
</tbody>
</table>
2. WIRING

- **Connection to the RS-485 port of the host computer (master)**

- **Wiring example**

  The communication cable and termination resistor(s) must be provided by the customer.

  The communication cable and termination resistor(s) must be provided by the customer.
Connection to the RS-232C port of the host computer (master)

Use a RS-232C/RS-485 converter with an automatic send/receive transfer function.

Wiring example

The communication cable and termination resistor(s) must be provided by the customer.
## Connection to the USB of the host computer (master)

Connect the USB communication converter between the host computer and the PZ400/900.

### Wiring example

- **USB communication converter COM-K2** *(RKC product)*
- **Shielded twisted pair wire**
- **RS-485**

---

The communication cable and termination resistor(s) must be provided by the customer.

Recommended USB communication converter: **COM-K2 (RKC product)**

For the COM-K2, refer to the **COM-K2 Instruction Manual**.

A previous version of COM-K (version 1) can be also used. However, if communication tool PROTEM 2 is used using a COM-K, the PROTEM2 will not be supported by Windows 8 or later.
2.2.2 Connection to the RS-422A port of PZ400/900

- Communication terminal number and signal details

<table>
<thead>
<tr>
<th>PZ400/900 terminal No.</th>
<th>Symbol</th>
<th>Signal name</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>R (A)</td>
<td>Receive data</td>
</tr>
<tr>
<td>33</td>
<td>R (B)</td>
<td>Receive data</td>
</tr>
<tr>
<td>34</td>
<td>SG</td>
<td>Signal ground</td>
</tr>
<tr>
<td>35</td>
<td>T (A)</td>
<td>Send data</td>
</tr>
<tr>
<td>36</td>
<td>T (B)</td>
<td>Send data</td>
</tr>
</tbody>
</table>

RS-422A
2. WIRING

- Connection to the RS-422A port of the host computer (master)
- Wiring example

The cable and termination resistor(s) must be provided by the customer.
Connection to the RS-232C port of the host computer (master)

A RS-232C/RS-422A converter is required.

Wiring example

The cable and termination resistor(s) must be provided by the customer.

W-BF-01 or W-BF-28 communication cable (RKC product) can be used as communication cable (sold separately). If noise is a factor, customer should use a twisted pair cable (not included) or something to that effect.

Recommended RS-232C/RS-422A converter: COM-A (RKC product)
For the COM-A, refer to the COM-A/COM-B Instruction Manual.
Connection to the USB of the host computer (master)

Connect the USB communication converter between the host computer and the PZ400/900.

Wiring example

The communication cable and termination resistor(s) must be provided by the customer.

Recommended USB communication converter: **COM-K2 (RKC product)**
For the COM-K2, refer to the **COM-K2 Instruction Manual**.

A previous version of COM-K (version 1) can be also used. However, if communication tool PROTEM 2 is used using a COM-K, the PROTEM2 will not be supported by Windows 8 or later.
2.3 Connections for Loader Communication

■ Position of loader communication connector

The loader communication connector can be found on the front of the instrument. In the following picture the connector cover is open.

■ Wiring method

Connect the PZ400/900, COM-K2, and personal computer using a USB cable and a loader communication cable. Make sure the connectors are oriented correctly when connecting.

**NOTE**
The Loader port is only for parameter setup. Not used for data logging during operation.

- **Communication Tool PROTEM2**
  Software operation environment: Consult the manual that you downloaded
  Communication settings on the computer (The following values are all fixed)
  - Communication speed: 38400 bps
  - Start bit: 1
  - Data bit: 8
  - Parity bit: Without
  - Stop bit: 1

- **Communication port of host computer**
  USB port: Based on USB Ver. 2.0

- **Recommended USB communication converter:**
  **COM-K2 (RKC product)**
  For the COM-K2, refer to the **COM-K2 Instruction Manual**.

When using the loader communication, USB driver for COM-K2 must be installed on the personal computer.
The USB driver for COM-K2 can be downloaded from the official RKC website:
https://www.rkcinst.com

A previous version of COM-K (version 1) can be also used. However, if communication tool PROTEM 2 is used using a COM-K, the PROTEM2 will not be supported by Windows 8 or later.
When the instrument is powered off, power can be supplied to the instrument from COM-K2 (or COM-K version 1). This function is exclusive for parameter setting, and the instrument functions as follows.

- Control is stopped (Output is off, relay remains open).
- Host communication is stopped.
- The PV/SV monitor shows “LoAd” for the PV display and “----” for the SV display. The LCD backlight is partially turned off.

While the instrument is powered by COM-K2 (or COM-K version 1), if power is applied to the instrument, the instrument will be reset and starts for normal operation.

When the instrument is normally powered, the host communication can be used simultaneously.
This chapter describes how to set up parameters necessary for the host communication.

3.1 Setting of Communication Parameter .............................................. 3-2
   3.1.1 Description of each parameter.................................................... 3-2
   3.1.2 Setting procedure .................................................................. 3-4

3.2 Selection of Communication Data Type ........................................... 3-5
   3.2.1 Communication data type .......................................................... 3-5
   3.2.2 Description of each parameter .................................................... 3-6
   3.2.3 Setting procedure .................................................................. 3-7

3.3 Communication Requirements ......................................................... 3-8
   - Processing times during data send/receive .................................... 3-8
   - RS-485 (2-wire system) send/receive timing (RKC communication) .... 3-9
   - Fail-safe .................................................................................... 3-9
### 3.1 Setting of Communication Parameter

#### 3.1.1 Description of each parameter

To establish communication between host computer (master) and PZ400/900 (slave), it is necessary to set the following parameters. The communication related parameters can be found in the Function block No. 60: communication (SCI) of Engineering mode.

The communication status can be monitored at “Communication response monitor.”

#### Function block No. 60: Communication (SCI)

<table>
<thead>
<tr>
<th>No.</th>
<th>Symbol</th>
<th>Name</th>
<th>Data range</th>
<th>Description</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fn60</td>
<td>Function block No. 60</td>
<td></td>
<td>This is the first parameter symbol of Function block No. 60.</td>
<td>—</td>
</tr>
<tr>
<td>236</td>
<td>CMPS</td>
<td>Communication protocol</td>
<td>0: RKC communication</td>
<td>Select the communication protocol type.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1: Modbus</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Order of data transfer: high-order word to low-order word)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2: Modbus</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Order of data a transfer: low-order word to high-order word)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3: PLC communication</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>* (MITSUBISHI MELSEC series special protocol QnA-compatible 3C frame [format 4])</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Do not set for the host communication.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>237</td>
<td>Add</td>
<td>Device address</td>
<td>RKC communication: 0 to 99</td>
<td>Do not use the same device address for more than one PZ400/900 in multi-drop connection. Each PZ400/900 must have a unique address in multi-drop connection.</td>
<td>RKC communication: 0 Modbus: 1 PLC communication: 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Modbus: 1 to 99</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>PLC communication: 0 to 30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>238</td>
<td>bPS</td>
<td>Communication speed</td>
<td>0: 2400 bps</td>
<td>Set the same communication speed for both the PZ400/900 (slave) and the host computer (master).</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1: 4800 bps</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2: 9600 bps</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3: 19200 bps</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4: 38400 bps</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5: 57600 bps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>239</td>
<td>blT</td>
<td>Data bit configuration</td>
<td>0 to 11</td>
<td>Set the same data bit configuration for both the PZ400/900 (slave) and the host computer (master).</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Refer to Data bit configuration table (P. 3-3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>240</td>
<td>IT</td>
<td>Interval time</td>
<td>0 to 250 ms</td>
<td>The Interval time is the waiting time between the receipt of the message from the host computer and the transmission of the reply message from PZ400/900. Adjust the interval time when the switchover between send and receive is not appropriate.</td>
<td>10</td>
</tr>
<tr>
<td>241</td>
<td>CMRM</td>
<td>Communication response monitor</td>
<td>Refer to Communication response monitor (P. 3-3)</td>
<td>Displays the communication state.</td>
<td>—</td>
</tr>
</tbody>
</table>
### Data bit configuration table

<table>
<thead>
<tr>
<th>Set value</th>
<th>Data bit</th>
<th>Parity bit</th>
<th>Stop bit</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>8</td>
<td>Without</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>8</td>
<td>Without</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>Even</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>Even</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>Odd</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>Odd</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set value</th>
<th>Data bit</th>
<th>Parity bit</th>
<th>Stop bit</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>7</td>
<td>Without</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>Without</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>7</td>
<td>Even</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>7</td>
<td>Even</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>7</td>
<td>Odd</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>7</td>
<td>Odd</td>
<td>2</td>
</tr>
</tbody>
</table>

* : Not settable for Modbus

---

**Interval time:**

The interval time for the PZ400/900 should be set to provide a time for host computer to finish sending all data including stop bit and to switch the line to receive status for the host. If the interval time between the two is too short, the PZ400/900 may send data before the host computer is ready to receive it. In this case, communication transmission cannot be conducted correctly.

**The communication protocol, device address (slave address), communication speed, data bit configuration, and interval time can also be set by loader communication using PROTEM2. It can also be set by host communication.**

---

### Communication response monitor

- Communication response monitor
  - 0: Normal response
  - 1: Overrun error
  - 2: Parity error
  - 4: Framing error
  - 8: Receive buffer overflow
  - If two or more errors occur, the error values are summed up.
  - Errors are displayed in the hexadecimal format (0 to F).

- Reception status monitor
  - Each time signal is received, 0 and 1 are displayed in turns.

- Transmission status monitor
  - Each time signal is sent, 0 and 1 are displayed in turns.

- Lights off

---

**CMRM**

- SV display unit
3.1.2 Setting procedure

The communication related parameters can be found in the Function block No. 60: Communication (SCI) of Engineering mode.

**NOTE**
After all the communications parameters are set, perform one of the following steps to make settings valid:
- The power is turned on again after turning it off once.
- The Operation mode is changed to Program control mode (RUN), the Fixed set point control mode (FIX) or the Manual control mode (MAN) from Reset mode (RESET) again after changing it to Reset mode (RESET) once.

### Set value change and registration
- The flashing digit indicates which digit can be set. Press **MODE** key to go to a different digit.
- To store a new value for the parameter, always press the **SET** key. The display changes to the next parameter and the new value will be stored. The modified data will not be stored only by operating the **△** and **▼** keys.
- In case no operation is performed within 60 seconds after the change of the setting, the mode will return to the PV/SV monitor. The modified data will not be registered in this case.

### Setting procedure

To enter the Engineering mode

1. Press the **RESET** key first to stop the control.

2. Press the **SET** key until Parameter setting mode is displayed.

3. Keep pressing without releasing your finger from the key to enter the Setting lock mode.

4. Press the **MONI** or **RESET** (4 seconds ***) key.

5. Press the **MODE** key + **(2 seconds)**.

6. Function block No. 00

7. Function block No. 60

8. Communication protocol

9. Device address

- Next parameter is displayed.
- Press **MONI** key or **RESET** key to return to the PV/SV monitor screen.
- Select lock on the Set data unlock/lock transfer.
3.2 Selection of Communication Data Type

3.2.1 Communication data type

There are such data as shown below for the communication with the computer. Communication data type can be selected at Input data type (INdT).

- For the Input data type, refer to the 3.2.2 Description of each parameter (P. 3-6).

### RKC communication

<table>
<thead>
<tr>
<th>Communication data type</th>
<th>Set value of Input data type</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 digits data</td>
<td>0</td>
</tr>
<tr>
<td>6 digits data</td>
<td>1</td>
</tr>
</tbody>
</table>

- For the data map of RKC communication, 6.3.1 Communication data [RKC communication identifier/Modbus double word] (P. 6-8).

### Modbus

<table>
<thead>
<tr>
<th>Communication data type</th>
<th>Set value of Input data type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double word</td>
<td>0</td>
</tr>
<tr>
<td>Single word</td>
<td>1</td>
</tr>
</tbody>
</table>

- For details, refer to the 6.3.1 Communication data [RKC communication identifier/Modbus double word] (P. 6-8).
- For details, refer to the 6.4.1 Communication data [Modbus single word] (P. 6-86).
3.2.2 Description of each parameter

Communication data type can be selected at Input data type (\(\text{INdT}\)). The Input data type can be found in the Function block No. 21: Input (\(\text{InP}\)) of Engineering mode.

### Function block No. 21: Input (\(\text{InP}\))

<table>
<thead>
<tr>
<th>No.</th>
<th>Symbol</th>
<th>Name</th>
<th>Data range</th>
<th>Description</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(\text{Fn21})</td>
<td>Function block No. 21</td>
<td>This is the first parameter symbol of Function block No. 21</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 145 | \(\text{INdT}\) | Input data type | 0: Number of measured value digits: 5  
Number of RKC communication data digits: 7  
PLC communication data: Double word  
(System data: Single word)  
1: Number of measured value digits: 4  
Number of RKC communication data digits: 6  
PLC communication data: Single word  
When changing the Input data type from 0 to 1 and when the present Input range has 5 digits (example: Input range high: 1372.0), you need to configure the Input range to have 4 digits beforehand. | Select the input data type. | Depends on the input range code specified at the time of order. |

The communication data type can be checked at Input data type of the host communication.

**Input data type**

- RKC communication identifier: SE (Refer to P. 6-35)
- Modbus Double word: 013EH, 013FH (Refer to P. 6-35)
- Modbus Single word: 009FH (Refer to P. 6-89)
3.2.3 Setting procedure

The Input data type can be found in the Function block No. 21: Input (InP) of Engineering mode.

**NOTE**

After all the communications parameters are set, perform one of the following steps to make settings valid:
- The power is turned on again after turning it off once.
- The Operation mode is changed to Program control mode (RUN), the Fixed set point control mode (FIX) or the Manual control mode (MAN) from Reset mode (RESET) again after changing it to Reset mode (RESET) once.

**Set value change and registration**

- The flashing digit indicates which digit can be set. Press \[MODE\] key to go to a different digit.
- To store a new value for the parameter, always press the \[Set\] key. The display changes to the next parameter and the new value will be stored. The modified data will not be stored only by operating the \[Up\] and \[Down\] keys.
- In case no operation is performed within 60 seconds after the change of the setting, the mode will return to the PV/SV monitor. The modified data will not be registered in this case.

### Setting procedure

To enter the Engineering mode

Press the RESET key first to stop the control.

Monitor & Program setting mode
PV/SV monitor (Reset mode)

[Set data unlock/lock transfer]

LOCK on

[Lock state]

LOCK off

[Unlock state]

Press the \[Set\] key until Parameter setting mode is displayed. Keep pressing without releasing your finger from the key to enter the Setting lock mode.

**MODE**

(2 seconds)

Engineering mode
Function block No. 00
[Program]

Twice

FUNCTION

(4 seconds *)

Lock state

Unlock state

Function block No. 21
[Input]

Several times

Input data type

Set the Input data type

Twice

Several times

3. PARAMETER SETTING
3.3 Communication Requirements

- **Processing times during data send/receive**

When the host computer is using either the polling or selecting procedure for communication, the following processing times are required for PZ400/900 to send data:
- Response wait time after PZ400/900 sends BCC in polling procedure
- Response wait time after PZ400/900 sends ACK or NAK in selecting procedure

Response send time is time when interval time is set at 0 ms.

<table>
<thead>
<tr>
<th>RKC communication (Polling procedure) processing times</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response send time after PZ400/900 receives ENQ</td>
<td>4.48 ms max.</td>
</tr>
<tr>
<td>Response send time after PZ400/900 receives ACK</td>
<td>4.64 ms max.</td>
</tr>
<tr>
<td>Response send time after PZ400/900 receives NAK</td>
<td>4.64 ms max.</td>
</tr>
<tr>
<td>Response send time after PZ400/900 sends BCC</td>
<td>304 μs max.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RKC communication (Selecting procedure) processing times</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response send time after PZ400/900 receives BCC</td>
<td>318 ms max.</td>
</tr>
<tr>
<td>Response wait time after PZ400/900 sends ACK</td>
<td>276 μs max.</td>
</tr>
<tr>
<td>Response wait time after PZ400/900 sends NAK</td>
<td>276 μs max.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Modbus processing times</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read holding registers [03H]</td>
<td>19.5 ms max.</td>
</tr>
<tr>
<td>Response send time after the slave receives the query message</td>
<td></td>
</tr>
<tr>
<td>Preset single register [06H]</td>
<td>160 ms max.</td>
</tr>
<tr>
<td>Response send time after the slave receives the query message</td>
<td></td>
</tr>
<tr>
<td>Diagnostics (loopback test) [08H]</td>
<td>14.8 ms max.</td>
</tr>
<tr>
<td>Response send time after the slave receives the query message</td>
<td></td>
</tr>
<tr>
<td>Preset multiple registers (Write multiple registers) [10H]</td>
<td>312 ms max.</td>
</tr>
<tr>
<td>Response send time after the slave receives the query message</td>
<td></td>
</tr>
</tbody>
</table>
RS-485 (2-wire system) send/receive timing (RKC communication)

RS-485 communication is conducted through two wires, therefore, the transmission and reception of data requires precise timing.

### Polling procedure

<table>
<thead>
<tr>
<th>Host computer</th>
<th>Send data (Possible/Impossible)</th>
<th>Possible</th>
<th>Impossible</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sending status**

<table>
<thead>
<tr>
<th>Host computer</th>
<th>Send data (Possible/Impossible)</th>
<th>Possible</th>
<th>Impossible</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sending status**

- a: Response send time after the PZ400/900 receives [ENQ] + Interval time
- b: Response send time after the PZ400/900 sends BCC
- c: Response send time after the PZ400/900 receives [ACK] + Interval time or Response send time after the PZ400/900 receives [NAK] + Interval time

### Selecting procedure

<table>
<thead>
<tr>
<th>Host computer</th>
<th>Send data (Possible/Impossible)</th>
<th>Possible</th>
<th>Impossible</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sending status**

<table>
<thead>
<tr>
<th>Host computer</th>
<th>Send data (Possible/Impossible)</th>
<th>Possible</th>
<th>Impossible</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sending status**

- a: Response send time after the PZ400/900 receives BCC + Interval time
- b: Response wait time after the PZ400/900 sends ACK or Response wait time after the PZ400/900 sends NAK

To switch the host computer from transmission to reception, send data must be on line.

The following processing times are required for the PZ400/900 to process data:
- In polling procedure, Response wait time after the PZ400/900 sends BCC
- In selecting procedure, Response wait time after the PZ400/900 sends ACK or NAK

### Fail-safe

A transmission error may occur if the transmission line is disconnected, shorted or set to the high-impedance state. In order to prevent the above error, it is recommended that the fail-safe function be provided on the receiver side of the host computer. The fail-safe function can prevent a framing error from its occurrence by making the receiver output stable to the MARK (1) when the transmission line is in the high-impedance state.
This chapter describes the RKC communication protocol.

4.1 Polling .............................................................................................. 4-2
   4.1.1 Polling procedures ......................................................................... 4-3
   4.1.2 Polling procedure example .......................................................... 4-9
4.2 Selecting ........................................................................................ 4-11
   4.2.1 Selecting procedures .................................................................... 4-11
   4.2.2 Selecting procedure example ...................................................... 4-15
The RKC communication uses the Polling/Selecting method to establish a data link. The basic procedure follows ANSI X3.28-1976 subcategories 2.5 and A4 basic mode data transmission control procedure (Fast selecting is the selecting method used in this controller).

In this chapter PZ400/900 are called controllers.

- The Polling/Selecting procedures are a centralized control method where the host computer controls the entire process. The host computer initiates all communication so the controller responds according to queries and commands from the host.

- The code used in communication is 7-bit ASCII code including transmission control characters. The transmission control characters are EOT (04H), ENQ (05H), ACK (06H), NAK (15H), STX (02H) and ETX (03H). The figures in the parentheses indicate the corresponding hexadecimal number.

Data send/receive state (communication data monitoring and setting) of RKC communication can be checked by using the following software:

Communication Tool “PROTEM2”

The software can be downloaded from the official RKC website:
https://www.rkcinst.com

### 4.1 Polling

Polling is the action where the host computer requests one of the connected controllers to transmit data. An example of the polling procedure is shown below:
4. RKC COMMUNICATION PROTOCOL

4.1.1 Polling procedures

(1) Data link initialization

Host computer sends EOT to the controllers to initiate data link before polling sequence.

(2) Data sent from host computer - Polling sequence

The host computer sends the polling sequence in the following two types of formats:
- Format when Extended identifier is not required.
- Format when Extended identifier is required.
Extended identifiers are used when a parameter requires “Pattern & Segment group,” “Pattern group,” “PID group” or “PLC item group.”

- When Extended identifier is not required

<table>
<thead>
<tr>
<th>1.</th>
<th>3.</th>
<th>4.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address</td>
<td>Identifier</td>
<td>ENQ</td>
</tr>
</tbody>
</table>

Example: Measured value (PV)

| 0 | 1 | M | 1 | ENQ |

Identifier: M1

- When Extended identifier is required

<table>
<thead>
<tr>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address</td>
<td>Extended identifier</td>
<td>Identifier</td>
<td>ENQ</td>
</tr>
</tbody>
</table>

Example: Proportional band in the PID group 1

| 0 | 1 | K | 0 | P | 1 | ENQ |

Identifier: P1

Extended identifier: K
PID group number: 01

1. Address (2 digits)

The device address specifies the controller to be polled and each controller must have its own unique device address.
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 3.1 Setting of Communication Parameter (P. 3-2).

The polling address which transmitted a message once becomes effective so long as data link is not initialized by transmit and receive of EOT.
2. Extended identifier

Extended identifiers are used when a parameter requires “Pattern & Segment group,” “Pattern group,” “PID group” or “PLC item group.” There are 4 types of Extended identifiers.

- To specify data with Pattern & Segment group (6 to 8 digits)

```
P N □ □ S N □ □ □
```

Specify Segment number from 00 to 16.
Specify Pattern number from 00 to 16.

- To specify data with Pattern group (3 or 4 digits)

```
P N □ □ □
```

Specify Pattern number from 00 to 16.

- To specify data with PID group (Level PID) (2 or 3 digits)

```
K □ □
```

Specify PID group number from 00 to 08*.

* When the Level PID action selection is “0: No Level PID”, PID group numbers 02 to 08 are invalid and the response is NAK (Negative Acknowledge).

**Level PID action selection**

7RKC communication identifier: PP  (Refer to P. 6-47)
Modbus Double word: 01D6H, 01D7H  (Refer to P. 6-47)
Modbus Single word: 00EBH  (Refer to P. 6-91)

- To specify data with PLC item group (2 or 3 digits)

Monitor item selection

```
M □ □ □ R 6
```

Identifier of Monitor item selection: R6
Specify PLC item group number from 01 to 03.

Setting item selection

```
M □ □ □ R E
```

Identifier of Setting item selection: RE
Specify PLC item group number from 01 to 27.

- The data being used is specified upon when setting “00” for group number.
- The upper digits of the display can be zero-suppressed.
- When specifying a parameter which does not have Extended identifier, the specified Extended identifier is ignored.
3. Identifier (2 digits)
   The identifier specifies the type of data that is requested from the controller. Always attach the ENQ code to the end of the identifier.
   
   For details, refer to 6.3 RKC Communication/Modbus (Double Word) Data (P. 6-8).

4. ENQ
   The ENQ is the transmission control character that indicates the end of the polling sequence.
   The ENQ must be attached to the end of the identifier.
   The host computer then must wait for a response from the controller.
(3) Data sent from the controller

If the polling sequence is received correctly, the controller sends data in the following two types of formats:

- Format when Extended identifier is not required.
- Format when Extended identifier is required.

Extended identifiers are used when a parameter requires “Pattern & Segment group,” “Pattern group,” “PID group” or “PLC item group.”

**When Extended identifier is not required**

<table>
<thead>
<tr>
<th>1.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
<th>6.</th>
</tr>
</thead>
<tbody>
<tr>
<td>STX</td>
<td>Identifier</td>
<td>Data</td>
<td>ETX</td>
<td>BCC</td>
</tr>
</tbody>
</table>

**When Extended identifier is required**

<table>
<thead>
<tr>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
<th>6.</th>
</tr>
</thead>
<tbody>
<tr>
<td>STX</td>
<td>Extended identifier</td>
<td>Identifier</td>
<td>Data</td>
<td>ETX</td>
<td>BCC</td>
</tr>
</tbody>
</table>

When specifying the data belonging to “Pattern & Segment group,” “Pattern group,” “PID group” and “PLC item group,” if you have omitted extended identifier(s), the data used at that moment will be specified, and Pattern No., Segment No., and Group No. will be “00.”

**Example: Segment level in the Pattern & Segment group**

```
STX P N 0 0 S N 0 0 L E Data ETX BCC
```

Extended identifier: PN
Pattern number: 00
Extended identifier: SN
Segment number: 00
Identifier: LE

**Example: Proportional band in the PID group**

```
STX K 0 0 P 1 Data ETX BCC
```

Extended identifier: K
PID group number: 00
Identifier: P1

1. **STX**

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

2. **Extended identifier**

   Extended identifiers are used when a parameter requires “Pattern & Segment group,” “Pattern group,” “PID group” or “PLC item group.”

   - For details, refer to **(2) Data sent from host computer - Polling sequence, 2. Extended identifier (P. 4-4)**.

   - When specifying a parameter which does not have Extended identifier, the specified Extended identifier is ignored.

3. **Identifier (2 digits)**

   The identifier indicates the type of data (measured value, status and set value) sent to the host computer.

   - For details, refer to **6.3 RKC Communication/Modbus (Double Word) Data (P. 6-8)**.
4. Data (7 or 6 digits)
Data which is indicated by an identifier of the controller. It is expressed in decimal ASCII code including a minus sign (−) and a decimal point. Data is not zero-suppressed.

The following items have the data length (in digits) as follows.
- Instrument serial number monitor (Identifier RX): 10 digits
- Model code monitor (Identifier ID): 32 digits

The time data is described as shown below:
- Segment remaining time, Segment time, Pattern end output time, Time signal start/end time and Segment time in progress
  When data range is 0 hours 00 minutes to 199 hours 59 minutes or 0 minutes 00 seconds to 199 minutes 59 seconds:
  Data range is 0:00 to 199:59, punctuation of time unit is expressed in colon “:” (3AH).
- Pattern remaining time monitor
  When data range is 0 hours 00 minutes to 999 hours 59 minutes or 0 minutes 00 seconds to 999 minutes 59 seconds:
  Data range is 0:00 to 999:59, punctuation of time unit is expressed in colon “:” (3AH).
- AT remaining time monitor
  When data range is 0 hours 00 minutes to 48 hours 00 minutes:
  Data range is 0:00 to 48:00, punctuation of time unit is expressed in colon “:” (3AH).

The data length in RKC communication (7 or 6 digits) can be set at Input data type.
For the Input data type, refer to 3.2 Selection of Communication Data Type (P. 3-5).

5. ETX
ETX is a transmission control character used to indicate the end of text transmission.

6. BCC
BCC (Block Check Character) detects error by using horizontal parity (even number).

Calculation method of BCC: Exclusive OR all data and characters from STX through ETX, not including STX.

Example:

<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>0</th>
<th>.</th>
<th>0</th>
<th>ETX</th>
<th>BCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>4DH</td>
<td>31H</td>
<td>30H</td>
<td>30H</td>
<td>31H</td>
<td>30H</td>
<td>30H</td>
<td>2EH</td>
<td>30H</td>
<td>03H</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BCC = 4DH ⊕ 31H ⊕ 30H ⊕ 30H ⊕ 31H ⊕ 30H ⊕ 30H ⊕ 30H ⊕ 30H ⊕ 2EH ⊕ 30H ⊕ 03H = 50H
( ⊕: Exclusive OR)
Value of BCC becomes 50H.

(4) EOT sent from the controller (Ending data transmission from the controller)
In the following cases, the controller sends EOT to terminate the data link:
- When the specified identifier (Extended identifier) is invalid
- When there is an error in the data type
- When data is not sent from the host computer even if the data link is initialized
- When all the data has been sent
(5) No response from the controller
The controller will not respond if the polling address is not received correctly. It may be necessary for the host computer to take corrective action such as a time-out.

(6) ACK (Acknowledgment)
An acknowledgment ACK is sent by the host computer when data received is correct. When the controller receives ACK from the host computer, the controller will send any remaining data of the next identifier without additional action from the host computer.

For the identifier, refer to 6.3 RKC Communication/Modbus (Double Word) Data (P. 6-8).

When the host computer determines to terminate the data link, EOT is sent from the host computer.

(7) NAK (Negative acknowledge)
If the host computer does not receive correct data from the controller, it sends a negative acknowledgment NAK to the controller. The controller will re-send the same data when NAK is received. This cycle will go on continuously until either recovery is achieved or the data link is corrected at the host computer.

(8) No response from host computer
When the host computer does not respond within approximately three seconds after the controller sends data, the controller sends EOT to terminate the data link. (Time out: 3 seconds)

(9) Indefinite response from host computer
The controller sends EOT to terminate the data link when the host computer response is indefinite.

(10) EOT (Data link termination)
The host computer sends EOT message when it is necessary to suspend communication with the controller or to terminate the data link due to lack of response from the controller.
4.1.2 Polling procedure example

(1) When polling items which does not have Extended identifier

Example: Read Measured value (PV) from the controller

- **Normal transmission**

  ![Diagram of normal transmission](image)

- **Error transmission**

  ![Diagram of error transmission](image)

(2) When polling items which requires Extended identifier

Example: Read data of Segment 1 level of Pattern 1 from controller

- **Normal transmission**

  ![Diagram of normal transmission](image)
4. RKC COMMUNICATION PROTOCOL

- Error transmission

Host computer send

Error data

Controller send

Host computer send

Controller re-send

Error data
4.2 Selecting

Selecting is the action where the host computer requests one of the connected controllers to receive data. An example of the selecting procedure is shown below:

4.2.1 Selecting procedures

(1) Data link initialization

Host computer sends EOT to the controllers to initiate data link before selecting sequence.

(2) Sending selecting address from the host computer

Host computer sends selecting address for the selecting sequence.

- Address (2 digits)

  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 3.1 Setting of Communication Parameter (P. 3-2).

  As long as the data link is not initialized by sending or receiving EOT, the selecting address once sent becomes valid.
(3) Data sent from the host computer

The host computer sends data for the selecting sequence with the following format:

- **When Extended identifier is not required**

<table>
<thead>
<tr>
<th>2.</th>
<th>3.</th>
</tr>
</thead>
<tbody>
<tr>
<td>STX</td>
<td>Identifier</td>
</tr>
</tbody>
</table>

- **When Extended identifier is required**

<table>
<thead>
<tr>
<th>1.</th>
<th>2.</th>
<th>3.</th>
</tr>
</thead>
<tbody>
<tr>
<td>STX</td>
<td>Extended identifier</td>
<td>Identifier</td>
</tr>
</tbody>
</table>

  For the STX, ETX and BCC, refer to 4.1 Polling (P. 4-2).

1. **Extended identifier**

   Extended identifiers are used when a parameter requires “Pattern & Segment group,” “Pattern group,” “PID group” or “PLC item group.”

   For details, refer to (2) Data sent from host computer - Polling sequence, 2. Extended identifier (P. 4-4).

   When specifying a parameter which does not have Extended identifier, the specified Extended identifier is ignored.

2. **Identifier (2 digits)**

   The identifier specifies the type of data that is requested from the controller, such as set value.

   For details, refer to 6.3 RKC Communication/Modbus (Double Word) Data (P. 6-8).

3. **Data**

   Data which is indicated by an identifier of the controller is expressed in decimal ASCII code including a minus sign (−) and a decimal point. The channel number can be zero-suppressed.

   The number of digits varies depending on the type of identifier. (7 or 6 digits)

   The time data is described as shown below:
   - Segment remaining time, Segment time, Pattern end output time, Time signal start/end time and Segment time in progress:
     When data range is 0 hours 00 minutes to 199 hours 59 minutes or 0 minutes 00 seconds to 199 minutes 59 seconds:
     Data range is 0:00 to 199:59, punctuation of time unit is expressed in colon “:” (3AH).”
   - Pattern remaining time monitor:
     When data range is 0 hours 00 minutes to 999 hours 59 minutes or 0 minutes 00 seconds to 999 minutes 59 seconds:
     Data range is 0:00 to 999:59, punctuation of time unit is expressed in colon “:” (3AH).”
   - AT remaining time monitor:
     When data range is 0 hours 00 minutes to 48 hours 00 minutes:
     Data range is 0:00 to 48:00, punctuation of time unit is expressed in colon “:” (3AH).”

   In addition to above, when minute and second data are set in more than 60, become as the following:

   Example: 1:65 (1 hour 65 minutes) → 2:05 (2 hours 05 minutes)
   0:65 (0 minute 65 seconds) → 1:05 (1 minute 05 seconds)

   The data length in RKC communication (7 or 6 digits) can be set at Input data type. For the Input data type, refer to 3.2 Selection of Communication Data Type (P. 3-5).
4. RKC COMMUNICATION PROTOCOL

- **About numerical data**

  **Receivable data**

  The controller can receive zero-suppressed data and whole number data (data without decimal fraction).
  
  **<Example>** For example, even if the data −1.5 is sent by the host as −001.5, −01.5, −1.5, −1.50, −1.500, the controller receives the data as −1.5.

  - When the host computer sends data containing a decimal point to the item without a decimal point, the controller receives a message with the value that is cut off below the decimal point.
  
  **<Example>** When setting range is 0 to 200, the controller will receive as follows:

  | Send data | 0.5 | 100.5 |
  | Receive data | 0 | 100 |

  - The controller receives a value truncated to a specified number of decimal places. The digits smaller than that will be cut off.
  
  **<Example>** When setting range is −10.00 to +10.00, the controller will receive as follows:

  | Send data | −.5 | −.058 | .05 | −0 |
  | Receive data | −0.50 | −0.05 | 0.05 | 0.00 |

  **Unreceivable data**

  The controller sends NAK when received a following data.

  | + | Plus sign and data with a plus sign |
  | − | Only minus sign (without a number) |
  | . | Only decimal point (period) |
  | −. | Only minus sign and a decimal point |

  **(4) ACK (Acknowledgment)**

  An acknowledgment ACK is sent by the controller when data received is correct. When the host computer receives ACK from the controller, the host computer will send any remaining data. If there is no more data to be sent to the controller, the host computer sends EOT to terminate the data link.

  **(5) NAK (Negative acknowledge)**

  If the controller does not receive correct data from the host computer, it sends a negative acknowledgment NAK to the host computer. Corrections, such as re-send, must be made at the host computer. The controller will send NAK in the following cases:

  - When an error occurs on communication the line (parity, framing error, etc.)
  - When a BCC check error occurs
  - When the specified identifier (Extended identifier) is invalid
  - When receive data exceeds the setting range
  - When receive data is the identifier of RO (read only)
(6) **No response from controller**

The controller does not respond when it cannot receive the selecting address, STX, ETX or BCC.

(7) **EOT (Data link termination)**

The host computer sends EOT when there is no more data to be sent from the host computer or there is no response from the controller.
4. RKC COMMUNICATION PROTOCOL

4.2.2 Selecting procedure example

(1) When selecting items which does not have Extended identifier

Example: Write Level PID setting 1 to the controller

- **Normal transmission**

  ```
<table>
<thead>
<tr>
<th>Address</th>
<th>Identifier</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>4   0</td>
<td>01</td>
<td>00</td>
</tr>
<tr>
<td>0   0</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>EOT</td>
<td>ACK</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>00</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>4   0</td>
<td>01</td>
<td>00</td>
</tr>
<tr>
<td>0   0</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>EOT</td>
<td>ACK</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>00</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>4   0</td>
<td>01</td>
<td>00</td>
</tr>
<tr>
<td>0   0</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>EOT</td>
<td>ACK</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>00</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>4   0</td>
<td>01</td>
<td>00</td>
</tr>
<tr>
<td>0   0</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>EOT</td>
<td>ACK</td>
<td></td>
</tr>
</tbody>
</table>
  ```

- **Error transmission**

  ```
<table>
<thead>
<tr>
<th>Address</th>
<th>Identifier</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>4   0</td>
<td>01</td>
<td>00</td>
</tr>
<tr>
<td>0   0</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>EOT</td>
<td>EOT</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>00</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>4   0</td>
<td>01</td>
<td>00</td>
</tr>
<tr>
<td>0   0</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>EOT</td>
<td>EOT</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>00</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>4   0</td>
<td>01</td>
<td>00</td>
</tr>
<tr>
<td>0   0</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>EOT</td>
<td>EOT</td>
<td></td>
</tr>
</tbody>
</table>
  ```

(2) When selecting items which requires Extended identifier

Example: Write data of Segment 1 level of Pattern 1 to controller

- **Normal transmission**

  ```
<table>
<thead>
<tr>
<th>Address</th>
<th>Extended identifier</th>
<th>Identifier</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>00</td>
<td>01</td>
<td>00</td>
</tr>
<tr>
<td>0   0</td>
<td>01</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>0   0</td>
<td>00</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>EOT</td>
<td>ACK</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>00</td>
<td>00</td>
<td>01</td>
<td>00</td>
</tr>
<tr>
<td>0   0</td>
<td>01</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>0   0</td>
<td>00</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>EOT</td>
<td>ACK</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
  ```

- **Error transmission**

  ```
<table>
<thead>
<tr>
<th>Address</th>
<th>Extended identifier</th>
<th>Identifier</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>00</td>
<td>01</td>
<td>00</td>
</tr>
<tr>
<td>0   0</td>
<td>01</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>0   0</td>
<td>00</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>EOT</td>
<td>NAK</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
  ```
This chapter describes the Modbus protocol.

5.1 Message Format ................................................................. 5-2
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5.7 Caution for Handling Communication Data ....................... 5-13
5.8 How to Use Modbus Data Mapping ................................. 5-15
In this chapter a host computer is called Master and PZ400/900 is called Slave.
The master controls communication between master and slave. A typical message consists of a request (query message) sent from the master followed by an answer (response message) from the slave. When master begins data transmission, a set of data is sent to the slave in a fixed sequence. When it is received, the slave decodes it, takes the necessary action, and returns data to the master.

Data send/receive state (communication data setting) of Modbus can be checked by using the following software:
- Communication Tool “PROTEM2”
The software can be downloaded from the official RKC website: https://www.rkcinst.com

5.1 Message Format

The message consists of four parts: slave address, function code, data, and error check code which are always transmitted in the same sequence.

<table>
<thead>
<tr>
<th>Slave address</th>
<th>Function code</th>
<th>Data</th>
<th>Error check (CRC-16)</th>
</tr>
</thead>
</table>

**Slave address**

The slave address is a number from 1 to 99 manually set at the front key panel of the PZ400/900.

- Master does not communicate with the slave when the address is set to “0.”
- For details, refer to 3.1 Setting of Communication Parameter (P. 3-2).

Although all connected slave units receive the query message sent from the master, only the slave with the slave address coinciding with the query message will accept the message.

**Function code**

The function codes are the instructions set at the master and sent to the slave describing the action to be executed. The function codes are included when the slave responds to the master.

- For details, refer to 5.2 Function Code (P. 5-3).

**Data**

The data to execute the function specified by the function code is sent to the slave and corresponding data returned to the master from the slave.

- For details, refer to 5.6 Register Read and Write (P. 5-8) and 6. COMMUNICATION DATA LIST (P. 6-1).

**Error check**

An error checking code (CRC-16: Cyclic Redundancy Check) is used to detect an error in the signal transmission.

- For details, refer to 5.5 Calculating CRC-16 (P. 5-5).
5.2 Function Code

Function code contents

<table>
<thead>
<tr>
<th>Function code (Hexadecimal)</th>
<th>Function</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>03H</td>
<td>Read holding registers</td>
<td>Measured (PV) value monitor, Event state monitor, etc.</td>
</tr>
<tr>
<td>06H</td>
<td>Preset single register</td>
<td>Set value (SV), Event set value, PID constants, PV bias, etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Write single data)</td>
</tr>
<tr>
<td>08H</td>
<td>Diagnostics (loopback test)</td>
<td>loopback test</td>
</tr>
<tr>
<td>10H</td>
<td>Preset multiple registers</td>
<td>Set value (SV), Event set value, PID constants, PV bias, etc.</td>
</tr>
<tr>
<td></td>
<td>(Write multiple registers)</td>
<td>(Write multiple consecutive data)</td>
</tr>
</tbody>
</table>

Message length of each function (Unit: byte)

<table>
<thead>
<tr>
<th>Function code (Hexadecimal)</th>
<th>Function</th>
<th>Query message</th>
<th>Response message</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>03H</td>
<td>Read holding registers</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>06H</td>
<td>Preset single register</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>08H</td>
<td>Diagnostics (loopback test)</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>10H</td>
<td>Preset multiple registers</td>
<td>11</td>
<td>255</td>
</tr>
<tr>
<td></td>
<td>(Write multiple registers)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.3 Communication Mode

Signal transmission between the master and slaves is conducted in Remote Terminal Unit (RTU) mode.

<table>
<thead>
<tr>
<th>Items</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data bit length</td>
<td>8-bit (Binary)</td>
</tr>
<tr>
<td>Start mark of message</td>
<td>Unused</td>
</tr>
<tr>
<td>End mark of message</td>
<td>Unused</td>
</tr>
<tr>
<td>Message length</td>
<td>Refer to 5.2 Function Code</td>
</tr>
<tr>
<td>Data time interval</td>
<td>Less than 24-bit time *</td>
</tr>
<tr>
<td>Error check</td>
<td>CRC-16 (Cyclic Redundancy Check)</td>
</tr>
</tbody>
</table>

* When sending a command message from the master, set intervals of data configuring one message to time shorter than the 24-bit time. If time intervals become time longer than the 24-bit time the relevant slave assumes that message sending from the master is terminated and there is no response.
5.4 Slave Responses

(1) Normal response

- In the response message of the Read Holding Registers, the slave returns the read out data and the number of data items with the same slave address and function code as the query message.
- In the response message of the Preset Single Register, the slave returns the same message as the query message.
- In the response message of the Diagnostics (Loopback test), the slave returns the same message as the query message.
- In the response message of the Preset Multiple Registers (Write Multiple Registers), the slave returns the slave address, the function code, starting number, and number of holding registers in the multi-query message.

(2) Defective message response

- If the query message from the master is defective, except for transmission error, the slave returns the error response message without any action.
- If the self-diagnostic function of the slave detects an error, the slave will return an error response message to all query messages.
- The function code of each error response message is obtained by adding 80H to the function code of the query message.

<table>
<thead>
<tr>
<th>Error code</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Function code error (An unsupported function code was specified)</td>
</tr>
<tr>
<td>2</td>
<td>When the mismatched address is specified.</td>
</tr>
<tr>
<td>3</td>
<td>• The maximum number (Read from a read holding register or write to Preset multiple registers) has been exceeded.</td>
</tr>
<tr>
<td></td>
<td>• The setting of the number of data (the number of requested byte) is not set to a double of the requested number of data at the time of “Preset multiple registers (Write multiple registers)”</td>
</tr>
<tr>
<td>4</td>
<td>Self-diagnostic error response</td>
</tr>
</tbody>
</table>

(3) No response

The slave ignores the query message and does not respond when:

- The slave address in the query message does not coincide with any slave address settings.
- The CRC code of the master does not coincide with that of the slave.
- Transmission error such as overrun, framing, parity etc., is found in the query message.
- Data time interval in the query message from the master exceeds 24-bit time.
5.5 Calculating CRC-16

The Cyclic Redundancy Check (CRC) is a 2 byte (16-bit) error check code. After constructing the data message, not including start, stop, or parity bit, the master calculates a CRC code and appends this to the end of the message. The slave will calculate a CRC code from the received message, and compare it with the CRC code from the master. If they do not coincide, a communication error has occurred and the slave does not respond.

The CRC code is formed in the following sequence:

1. Load FFFFh to a 16-bit CRC register.
2. Exclusive OR (⊕) the first byte (8 bits) of the message with the CRC register. Return the result to the CRC register.
3. Shift the CRC register 1 bit to the right.
4. If the carry flag is 1, exclusive OR the CRC register with A001 hexadecimal and return the result to the CRC register. If the carry flag is 0, repeat step 3.
5. Repeat step 3 and 4 until there have been 8 shifts.
6. Exclusive OR the next byte (8 bits) of the message with the CRC register.
7. Repeat step 3 through 6 for all bytes of the message (except the CRC).
8. The CRC register contains the 2 byte CRC error code. When they are appended to the message, the low-order byte is appended first, followed by the high-order byte.
The flow chart of CRC-16

The ⊕ symbol indicates an exclusive OR operation. The symbol for the number of data bits is \( n \).
Example of a CRC calculation in the ‘C’ language

This routine assumes that the data types ‘uint16’ and ‘uint8’ exist. These are unsigned 16-bit integer (usually an ‘unsigned short int’ for most compiler types) and unsigned 8-bit integer (unsigned char). ‘z_p’ is a pointer to a Modbus message, and ‘z_message_length’ is its length, excluding the CRC. Note that the Modbus message will probably contain NULL characters and so normal C string handling techniques will not work.

```c
uint16 calculate_crc (byte *z_p, unit16 z_message_length)
{
    uint16 CRC = 0xffff;
    uint16 next;
    uint16 carry;
    uint16 n;
    uint8 crch, crcl;

    while (z_message_length--) {
        next = (uint16) *z_p;
        CRC ^= next;
        for (n = 0; n < 8; n++) {
            carry = CRC & 1;
            CRC >>= 1;
            if (carry) {
                CRC ^= 0xA001;
            }
        }
        z_p++;
    }
    crch = CRC / 256;
    crcl = CRC % 256
    z_p[z_message_length++] = crcl;
    z_p[z_message_length] = crch;
    return CRC;
}
```
5.6 Register Read and Write

■ Read holding registers [03H]

The query message specifies the starting register address and quantity of registers to be read.
The contents of the holding registers are entered in the response message as data, divided into two parts: the high-order 8-bit and the low-order 8-bit, arranged in the order of the register numbers.

Example: The contents of the four holding registers from 0000H to 0003H are read out from slave address 2.

● Double word

Query message

<table>
<thead>
<tr>
<th>Slave address</th>
<th>02H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function code</td>
<td>03H</td>
</tr>
<tr>
<td>Starting number</td>
<td>High 00H  Low 00H</td>
</tr>
<tr>
<td>Quantity</td>
<td>High 00H  Low 04H</td>
</tr>
<tr>
<td>CRC-16</td>
<td>High 44H  Low 3AH</td>
</tr>
</tbody>
</table>

Normal response message

<table>
<thead>
<tr>
<th>Slave address</th>
<th>02H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function code</td>
<td>03H</td>
</tr>
<tr>
<td>Number of data</td>
<td>08H</td>
</tr>
<tr>
<td>First holding register contents</td>
<td>High 00H  Low 62H</td>
</tr>
<tr>
<td>Next holding register contents</td>
<td>High 00H  Low 00H</td>
</tr>
<tr>
<td>Next holding register contents</td>
<td>High 00H  Low 14H</td>
</tr>
<tr>
<td>Next holding register contents</td>
<td>High 00H  Low 00H</td>
</tr>
<tr>
<td>CRC-16</td>
<td>High 99H  Low 51H</td>
</tr>
</tbody>
</table>

Error response message

<table>
<thead>
<tr>
<th>Slave address</th>
<th>02H</th>
</tr>
</thead>
<tbody>
<tr>
<td>80H + Function code (+ denotes a logical add)</td>
<td>83H</td>
</tr>
<tr>
<td>Error code</td>
<td>03H</td>
</tr>
<tr>
<td>CRC-16</td>
<td>High F1H  Low 31H</td>
</tr>
</tbody>
</table>

First holding register address

The setting must be between 1 (0001H) and 62 (003EH).

Number of holding registers × 2
### Single word

#### Query message

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slave address</td>
<td>02H</td>
</tr>
<tr>
<td>Function code</td>
<td>03H</td>
</tr>
<tr>
<td>Starting number</td>
<td>High 00H, Low 00H</td>
</tr>
<tr>
<td>Quantity</td>
<td>High 00H, Low 04H</td>
</tr>
<tr>
<td>CRC-16</td>
<td>High 44H, Low 3AH</td>
</tr>
</tbody>
</table>

#### Normal response message

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slave address</td>
<td>02H</td>
</tr>
<tr>
<td>Function code</td>
<td>03H</td>
</tr>
<tr>
<td>Number of data</td>
<td>08H</td>
</tr>
<tr>
<td>First holding register contents (First data)</td>
<td>High 00H, Low 62H</td>
</tr>
<tr>
<td>Next holding register contents (Next data)</td>
<td>High 00H, Low 14H</td>
</tr>
<tr>
<td>Next holding register contents (Next data)</td>
<td>High 00H, Low 00H</td>
</tr>
<tr>
<td>Next holding register contents (Next data)</td>
<td>High 00H, Low 00H</td>
</tr>
<tr>
<td>CRC-16</td>
<td>High E9H, Low 56H</td>
</tr>
</tbody>
</table>

#### Error response message

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slave address</td>
<td>02H</td>
</tr>
<tr>
<td>80H + Function code (+ denotes a logical add)</td>
<td>83H</td>
</tr>
<tr>
<td>Error code</td>
<td>03H</td>
</tr>
<tr>
<td>CRC-16</td>
<td>High F1H, Low 31H</td>
</tr>
</tbody>
</table>

First holding register address
The setting must be between 1(0001H) and 125 (007DH).

Number of holding registers $\times 2$
**Preset single register [06H]**

The query message specifies data to be written into the designated holding register. The write data is arranged in the query message with high-order 8-bit first and low-order 8-bit next. Only R/W holding registers can be specified.

Example: Data is written into the holding register 0072H of slave address 1.

<table>
<thead>
<tr>
<th>Query message</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slave address</td>
</tr>
<tr>
<td>Function code</td>
</tr>
<tr>
<td>Holding register number</td>
</tr>
<tr>
<td>High</td>
</tr>
<tr>
<td>Low</td>
</tr>
<tr>
<td>Write data</td>
</tr>
<tr>
<td>High</td>
</tr>
<tr>
<td>Low</td>
</tr>
<tr>
<td>CRC-16</td>
</tr>
<tr>
<td>High</td>
</tr>
<tr>
<td>Low</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Normal response message</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slave address</td>
</tr>
<tr>
<td>Function code</td>
</tr>
<tr>
<td>Holding register number</td>
</tr>
<tr>
<td>High</td>
</tr>
<tr>
<td>Low</td>
</tr>
<tr>
<td>Write data</td>
</tr>
<tr>
<td>High</td>
</tr>
<tr>
<td>Low</td>
</tr>
<tr>
<td>CRC-16</td>
</tr>
<tr>
<td>High</td>
</tr>
<tr>
<td>Low</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Error response message</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slave address</td>
</tr>
<tr>
<td>80H + Function code (+ denotes a logical add)</td>
</tr>
<tr>
<td>Error code</td>
</tr>
<tr>
<td>CRC-16</td>
</tr>
<tr>
<td>High</td>
</tr>
<tr>
<td>Low</td>
</tr>
</tbody>
</table>

In the case of double word, writing to high-order word register only is not possible. The attempt ends with a normal message, but the write will not be done.

In the case of double word, writing to high-order word register only is not possible. The attempt ends with a normal message, but the write will not be done.
## Diagnostics (Loopback test) [08H]

The master’s query message will be returned as the response message from the slave. This function checks the communication system between the master and slave.

Example:  Loopback test for slave address 1

**Query message**

<table>
<thead>
<tr>
<th>Slave address</th>
<th>01H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function code</td>
<td>08H</td>
</tr>
<tr>
<td>Test code</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>00H</td>
</tr>
<tr>
<td>Low</td>
<td>00H</td>
</tr>
<tr>
<td>Data</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>1FH</td>
</tr>
<tr>
<td>Low</td>
<td>34H</td>
</tr>
<tr>
<td>CRC-16</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>E9H</td>
</tr>
<tr>
<td>Low</td>
<td>ECH</td>
</tr>
</tbody>
</table>

Test code must be set to “00.”  
Any pertinent data

**Normal response message**

<table>
<thead>
<tr>
<th>Slave address</th>
<th>01H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function code</td>
<td>08H</td>
</tr>
<tr>
<td>Test code</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>00H</td>
</tr>
<tr>
<td>Low</td>
<td>00H</td>
</tr>
<tr>
<td>Data</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>1FH</td>
</tr>
<tr>
<td>Low</td>
<td>34H</td>
</tr>
<tr>
<td>CRC-16</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>E9H</td>
</tr>
<tr>
<td>Low</td>
<td>ECH</td>
</tr>
</tbody>
</table>

Contents will be the same as query message data.

**Error response message**

<table>
<thead>
<tr>
<th>Slave address</th>
<th>01H</th>
</tr>
</thead>
<tbody>
<tr>
<td>80H + Function code (+ denotes a logical add)</td>
<td>88H</td>
</tr>
<tr>
<td>Error code</td>
<td>03H</td>
</tr>
<tr>
<td>CRC-16</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>06H</td>
</tr>
<tr>
<td>Low</td>
<td>01H</td>
</tr>
</tbody>
</table>
### Preset multiple registers (Write multiple registers) [10H]

The query message specifies the starting register address and quantity of registers to be written. The write data is arranged in the query message with high-order 8-bit first and low-order 8-bit next. Only R/W holding registers can be specified.

Example: Data is written into the two holding registers from 0070H to 0071H of slave address 1.

#### Query message

<table>
<thead>
<tr>
<th>Slave address</th>
<th>01H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function code</td>
<td>10H</td>
</tr>
</tbody>
</table>
| Starting number | High 00H  
                    Low 70H |
| Quantity      | High 00H  
                  Low 02H |
| Number of data | 04H |
| Data to first register | High 00H  
                          Low 01H |
| Data to next register   | High 00H  
                             Low 00H |
| CRC-16         | High A5H  
                    Low 4BH |

#### Normal response message

<table>
<thead>
<tr>
<th>Slave address</th>
<th>01H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function code</td>
<td>10H</td>
</tr>
</tbody>
</table>
| Starting number | High 00H  
                    Low 70H |
| Quantity      | High 00H  
                  Low 02H |
| CRC-16         | High 40H  
                    Low 13H |

#### Error response message

<table>
<thead>
<tr>
<th>Slave address</th>
<th>01H</th>
</tr>
</thead>
<tbody>
<tr>
<td>80H + Function code (+ denotes a logical add)</td>
<td>90H</td>
</tr>
<tr>
<td>Error code</td>
<td>02H</td>
</tr>
</tbody>
</table>
| CRC-16        | High CDH  
                    Low C1H |
5.7 Caution for Handling Communication Data

- The numeric range of data used in Modbus protocol is 0000H to FFFFH. Only the set value within the setting range is effective.
  
  FFFFH represents −1.

- The Modbus protocol does not recognize data with decimal points during communication.

  **Example 1:** When Manipulated output value monitor [heat-side] is 5.0 %, 5.0 is processed as 50,
  
  \[50 = 0032H.\]

  Manipulated output value monitor [heat-side] | High | 00H | Low | 32H |

  **Example 2:** When Set value (SV) in Fixed set point control mode is −20.0 °C, −20.0 is processed as −200,
  
  \[-200 = 0000H – 00C8H = FF38H.\]

  Set value (SV) in Fixed set point control mode | High | FFH | Low | 38H |

- In our communication a variable is handled as a double word or a single word.
  
  Switchover between the single word and the double word can be done at Input data type. For the Input data type, refer to 3.2 Selection of Communication Data Type (P. 3-5).

  **[Double word]**
  
  - The variable is handled as 4 bytes data.
  - One variable use two register addresses (Address of high-order word, Address of low-order word).
  - To Read/Write two-word data is implemented from the low-order word to the high-order word or from the high-order word to the low-order word.

    The data transfer sequence is selectable at “Communication protocol” in the Engineering mode. For the Communication protocol, refer to 3.1 Setting of Communication Parameter (P. 3-2).

    The following constraint in writing data in order to treat the variable as 4 bytes data.
  
    - It is not possible to write only of high-order word. The communication response becomes normal response, but do not writing.
    - A writing only of low-order word does sign extend and does it.

      **Example 1:** When did a writing only of “0020H” in low-order word.
      
      The controller interprets high-order word as “0000H.”

      **Example 2:** When did a writing only of “FFFFH (−1)” in low-order word.
      
      The controller interprets high-order word as “FFFH.”

  **[Single word]**
  
  - A variable is handled as a two-byte data.
  - Each variable occupies one register address.
• If data (holding register) exceeding the accessible address range is accessed, an error response message is returned.

• Read data of unused item is “0.”

• Any attempt to write to an unused item is not processed as an error. Data cannot be written into an unused item.

• If data range error occurs during data writing (Write Action), it is not processed as an error. Normal data is written in data register but data with error is not written; therefore, it is recommended to confirm data of changed items after the data setting.

• Communication items not existing in the product because of the specifications are handled as “0” when the data is read in. If write action to this item is performed, no error message is indicated and no data is written.

• Commands should be sent at time intervals of 24 bits after the master receives the response message.
5.8 How to Use Modbus Data Mapping

Data mapping function is a function that enables the data that needs to be constantly monitored to be mapped into the specified address area.

Up to 32 communication data can be assigned to the register address in the following table used to actually read the data from/write the data to.

Communication data allocation can be performed in “Register address specifying the mapping data.”

(HEX: Hexadecimal number   DEC: Decimal number)

<table>
<thead>
<tr>
<th>Double word</th>
<th>Single word</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEX: 0500H to 053FH</td>
<td>HEX: 0500H to 051FH</td>
</tr>
<tr>
<td>DEC: 1280 to 1343</td>
<td>DEC: 1280 to 1311</td>
</tr>
<tr>
<td>HEX: 1000H to 103FH</td>
<td>HEX: 1000H to 101FH</td>
</tr>
<tr>
<td>DEC: 4096 to 4159</td>
<td>DEC: 4096 to 4127</td>
</tr>
</tbody>
</table>

— For the data mapping address list, refer to the 6.3.2 Data mapping address [Modbus double word] (P. 6-56), 6.4.2 Data mapping address [Modbus single word] (P. 6-93).

Example 1: When the data is read in double-word

Data to be mapped: Measured value (PV), Manipulated output value monitor [heat-side], Event 1 state monitor, Event 2 state monitor

1. Write 0000H to the low-order word of Register address setting 1 to 4 (see table of “Register address for data designation”). Write register address of the data to be mapped (either low-order word or high-order word) to the high-order word.

Data to be mapped

<table>
<thead>
<tr>
<th>Name</th>
<th>Low-order</th>
<th>High-order</th>
<th>Low-order</th>
<th>High-order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value (PV)</td>
<td>0000</td>
<td>0001</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Manipulated output value monitor [heat-side]</td>
<td>0004</td>
<td>0005</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Event 1 state monitor</td>
<td>0022</td>
<td>0023</td>
<td>34</td>
<td>35</td>
</tr>
<tr>
<td>Event 2 state monitor</td>
<td>0024</td>
<td>0025</td>
<td>36</td>
<td>37</td>
</tr>
</tbody>
</table>

Register address for data designation

<table>
<thead>
<tr>
<th>Name</th>
<th>Low-order</th>
<th>High-order</th>
<th>Low-order</th>
<th>High-order</th>
<th>Setting data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Register address setting 1 [Read/write address: Low-order word 1000H, high-order word 1001H]</td>
<td>0500</td>
<td>0501</td>
<td>1280</td>
<td>1201</td>
<td>Low-order word: 0000H  High-order word: 0000H or 0001H</td>
</tr>
<tr>
<td>Register address setting 2 [Read/write address: Low-order word 1002H, high-order word 1003H]</td>
<td>0502</td>
<td>0503</td>
<td>1202</td>
<td>1203</td>
<td>Low-order word: 0000H  High-order word: 0004H or 0005H</td>
</tr>
<tr>
<td>Register address setting 3 [Read/write address: Low-order word 1004H, high-order word 1005H]</td>
<td>0504</td>
<td>0505</td>
<td>1204</td>
<td>1205</td>
<td>Low-order word: 0000H  High-order word: 0022H or 0023H</td>
</tr>
<tr>
<td>Register address setting 4 [Read/write address: Low-order word 1006H, high-order word 1007H]</td>
<td>0506</td>
<td>0207</td>
<td>1206</td>
<td>1207</td>
<td>Low-order word: 0000H  High-order word: 0024H or 0025H</td>
</tr>
</tbody>
</table>
The table below shows the assignment of read/write register addresses 1000H to 1007H by the above mapping.

<table>
<thead>
<tr>
<th>Register address</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low-</td>
</tr>
<tr>
<td></td>
<td>order</td>
</tr>
<tr>
<td>1000</td>
<td>1001</td>
</tr>
<tr>
<td>1002</td>
<td>1003</td>
</tr>
<tr>
<td>1004</td>
<td>1005</td>
</tr>
<tr>
<td>1006</td>
<td>1007</td>
</tr>
</tbody>
</table>

2. Reads out the mapping data by following order message.

<table>
<thead>
<tr>
<th>Slave address</th>
<th>02H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function code</td>
<td>03H</td>
</tr>
<tr>
<td>Starting number</td>
<td>High 10H</td>
</tr>
<tr>
<td></td>
<td>Low 00H</td>
</tr>
<tr>
<td>Quantity</td>
<td>High 00H</td>
</tr>
<tr>
<td></td>
<td>Low 04H</td>
</tr>
<tr>
<td>CRC-16</td>
<td>High 40H</td>
</tr>
<tr>
<td></td>
<td>Low FAH</td>
</tr>
</tbody>
</table>

Example 2: When the data is read in a single word of data mapped.

Data to be mapped: Measured value (PV), Manipulated output value monitor [heat-side], Event 1 state monitor, Event 2 state monitor

1. Write register addresses of mapping data to register address setting from 1 to 4 (Register address for data designation).

Data to be mapped

<table>
<thead>
<tr>
<th>Name</th>
<th>Register address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value (PV)</td>
<td>0000 0</td>
</tr>
<tr>
<td>Manipulated output value monitor</td>
<td>0002 2</td>
</tr>
<tr>
<td>Event 1 state monitor</td>
<td>0011 17</td>
</tr>
<tr>
<td>Event 2 state monitor</td>
<td>0012 18</td>
</tr>
</tbody>
</table>

Register address for data designation

<table>
<thead>
<tr>
<th>Name</th>
<th>Register address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Register address setting 1</td>
<td>0500 1280</td>
</tr>
<tr>
<td>[Read/write address: 1000H]</td>
<td></td>
</tr>
<tr>
<td>Register address setting 2</td>
<td>0501 1281</td>
</tr>
<tr>
<td>[Read/write address: 1001H]</td>
<td></td>
</tr>
<tr>
<td>Register address setting 3</td>
<td>0502 1282</td>
</tr>
<tr>
<td>[Read/write address: 1002H]</td>
<td></td>
</tr>
<tr>
<td>Register address setting 4</td>
<td>0503 1283</td>
</tr>
<tr>
<td>[Read/write address: 1003H]</td>
<td></td>
</tr>
</tbody>
</table>
The table below shows the assignment of read/write register addresses 1000H to 1003H by the above mapping.

<table>
<thead>
<tr>
<th>Register address</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEX</td>
<td>DEC</td>
</tr>
<tr>
<td>1000</td>
<td>4096</td>
</tr>
<tr>
<td>1001</td>
<td>4097</td>
</tr>
<tr>
<td>1002</td>
<td>4098</td>
</tr>
<tr>
<td>1003</td>
<td>4099</td>
</tr>
</tbody>
</table>

2. Reads out the mapping data by following order message.

<table>
<thead>
<tr>
<th>Slave address</th>
<th>Function code</th>
<th>Starting number</th>
<th>Quantity</th>
<th>CRC-16</th>
</tr>
</thead>
<tbody>
<tr>
<td>02H</td>
<td>03H</td>
<td>High 10H</td>
<td>High 00H</td>
<td>High 40H</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low 00H</td>
<td>Low 04H</td>
<td>Low FAH</td>
</tr>
</tbody>
</table>

First holding register address (1000H)  
Number of data (4)
This chapter describes communication data.

6.1 Data Map Structure................................................................. 6-2
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   6.1.2 Structure of Modbus (Single Word) data map ............................. 6-4

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   6.3.2 Data mapping address [Modbus double word] .................................. 6-56
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   6.4.2 Data mapping address [Modbus single word] .................................. 6-93
   6.4.3 PID group (Level PID) data [Modbus single word] ........................ 6-97
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   6.4.5 Pattern group data [Modbus single word] ..................................... 6-105
6. COMMUNICATION DATA LIST

6.1 Data Map Structure

This chapter contains two types of data maps.

- **RKC Communication/Modbus (Double Word) data map**
- **Modbus (Single word) data map**

The data length in RKC communication (7 or 6 digits) or the communication data type in Modbus (single word/double word) can be set at Input data type (INdT).

For the Input data type, refer to the **3.2 Selection of Communication Data Type (P. 3-5)**.

6.1.1 Structure of RKC Communication/Modbus (Double Word) data map

This part describes identifiers in RKC communication and register addresses in Modbus data (double word). The structure of RKC communication/Modbus (double word) is as follows.

- **Continuous [ACK (Acknowledgment)] polling**
  - Continuous [ACK (Acknowledgment)] polling stops between the monitor item and the set item.
  - In the case of groups (Pattern & Segment group, Pattern group, PID group, and PLC items group), communication data of the group is sent sequentially, and after completion of this, communication data in the next group is transmitted.

Example: Pattern & Segment group and Pattern group

- When Group zero is specified or when there is no specification of the group, communication data is sent from all groups starting with group 1 after sending communication data of groups now in operation.
## Modbus (Double word)

<table>
<thead>
<tr>
<th>Register address</th>
<th>HEX</th>
<th>DEC</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low-order</td>
<td>High-order</td>
<td>Low-order</td>
</tr>
</tbody>
</table>
| 0000             | 0001 | 0 | 1 | Normal setting data  
                  |     |   |   | Refer to 6.3.1 Communication data [RKC communication identifier/Modbus double word] (P. 6-8). |
| 0118             | 0119 | 280 | 281 | Data in the Engineering mode  
                  |     |   |   | Refer to 6.3.1 Communication data [RKC communication identifier/Modbus double word] (P. 6-8). |
| 011A             | 011B | 282 | 283 |                   |
| 027E             | 027F | 638 | 639 |                   |
| 0280             | 0281 | 640 | 641 | Unused |
| 04FE             | 04FF | 1278 | 1279 |                   |
| 0500             | 0501 | 1280 | 1281 | Mapping setting (32)  
                  |     |   |   | Refer to □ Register address for data designation of 6.3.2 Data mapping address [Modbus double word] (P. 6-56). |
| 053E             | 053F | 1342 | 1343 |                   |
| 0540             | 0541 | 1344 | 1345 | Unused |
| 0FFE             | 0FFF | 4094 | 4095 |                   |
| 1000             | 1001 | 4096 | 4097 | Mapping data (32)  
                  |     |   |   | Refer to □ Register address for data read/write of 6.3.2 Data mapping address [Modbus double word] (P. 6-59). |
| 103E             | 103F | 4158 | 4159 |                   |
| 1040             | 1041 | 4160 | 4161 | Unused |
| 14FE             | 14FF | 5374 | 5375 |                   |
| 1500             | 1501 | 5376 | 5377 | PID group (Level PID) data  
                  |     |   |   | Refer to 6.3.3 PID group (Level PID) data [Modbus double word] (P. 6-61). |
| 161E             | 161F | 5562 | 5563 |                   |
| 1620             | 1621 | 5564 | 5565 |                   |
| 2FFE             | 2FFF | 12286 | 12287 | Unused |
| 3000             | 3001 | 12288 | 12289 | Pattern & Segment group data  
                  |     |   |   | Refer to 6.3.4 Pattern & Segment group data [Modbus double word] (P. 6-65). |
| 35FE             | 35FF | 13822 | 13823 |                   |
| 3600             | 3601 | 13824 | 13825 |                   |
| 4FFE             | 4FFF | 20478 | 20479 | Unused |
| 5000             | 5001 | 20480 | 20481 | Pattern group data  
                  |     |   |   | Refer to 6.3.5 Pattern group data [Modbus double word] (P. 6-75). |
| 537E             | 537F | 21374 | 21375 |                   |

□ For the Data mapping, refer to the 5.8 How to Use Modbus Data Mapping (P. 5-15).
### 6.1.2 Structure of Modbus (Single Word) data map

This part describes register addresses of Modbus data (single word). The structure of the data map of Modbus (single word) is as follows.

<table>
<thead>
<tr>
<th>HEX</th>
<th>DEC</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>0</td>
<td>Normal setting data items</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Refer to 6.4.1 Communication data [Modbus single word] (P. 6-86).</td>
</tr>
<tr>
<td>008C</td>
<td>140</td>
<td>Data in the Engineering mode</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Refer to 6.4.1 Communication data [Modbus single word] (P. 6-86).</td>
</tr>
<tr>
<td>008D</td>
<td>141</td>
<td>Normal setting data items</td>
</tr>
<tr>
<td>013F</td>
<td>319</td>
<td>Data in the Engineering mode</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Refer to 6.4.1 Communication data [Modbus single word] (P. 6-86).</td>
</tr>
<tr>
<td>0140</td>
<td>320</td>
<td>Unused</td>
</tr>
<tr>
<td>04FF</td>
<td>1279</td>
<td>Unused</td>
</tr>
<tr>
<td>0500</td>
<td>1280</td>
<td>Mapping setting (32)</td>
</tr>
<tr>
<td>051F</td>
<td>1311</td>
<td>Refer to ▲ Register address for data designation of 6.4.2 Data mapping address [Modbus single word] (P. 6-93).</td>
</tr>
<tr>
<td>0520</td>
<td>1312</td>
<td>Unused</td>
</tr>
<tr>
<td>0FFF</td>
<td>4095</td>
<td>Unused</td>
</tr>
<tr>
<td>1000</td>
<td>4096</td>
<td>Mapping data (32)</td>
</tr>
<tr>
<td>101F</td>
<td>4127</td>
<td>Refer to ▲ Register address for data read/write of 6.4.2 Data mapping address [Modbus single word] (P. 6-95).</td>
</tr>
<tr>
<td>1020</td>
<td>4128</td>
<td>Unused</td>
</tr>
<tr>
<td>14FF</td>
<td>5375</td>
<td>Unused</td>
</tr>
<tr>
<td>1500</td>
<td>5376</td>
<td>PID group (Level PID) data</td>
</tr>
<tr>
<td>158F</td>
<td>5519</td>
<td>Refer to 6.4.3 PID group (Level PID) data [Modbus single word] (P. 6-97).</td>
</tr>
<tr>
<td>1590</td>
<td>5520</td>
<td>Unused</td>
</tr>
<tr>
<td>2FFF</td>
<td>12287</td>
<td>Unused</td>
</tr>
<tr>
<td>3000</td>
<td>12288</td>
<td>Pattern &amp; Segment group data</td>
</tr>
<tr>
<td>32FF</td>
<td>13055</td>
<td>Refer to 6.4.4 Pattern &amp; Segment group data [Modbus single word] (P. 6-99).</td>
</tr>
<tr>
<td>3300</td>
<td>13056</td>
<td>Unused</td>
</tr>
<tr>
<td>4FFF</td>
<td>20479</td>
<td>Unused</td>
</tr>
<tr>
<td>5000</td>
<td>20480</td>
<td>Pattern group data</td>
</tr>
<tr>
<td>51BF</td>
<td>20927</td>
<td>Refer to 6.4.5 Pattern group data [Modbus single word] (P. 6-105).</td>
</tr>
</tbody>
</table>

For the Data mapping, refer to the 5.8 How to Use Modbus Data Mapping (P. 5-15).
6. COMMUNICATION DATA LIST

6.2 How to Read the Table

■ Data map of RKC communication identifiers/Modbus double word

This part describes how to read the data map of 6.3.1 Communication data [RKC communication identifier/Modbus double word] (P. 6-8).

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Identifier</th>
<th>Digits</th>
<th>Register address (HEX: Hexadecimal number DEC: Decimal number)</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Measured value (PV)</td>
<td>M1</td>
<td>7 or 6</td>
<td>0000 0001 0 1 RO</td>
<td>Input range low = (Input 1.5 % of input span or more) to Input range high = (Input 1.5 % of input span or more)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Set value (SV) monitor</td>
<td>MS</td>
<td>7 or 6</td>
<td>0002 0003 2 3 RO</td>
<td>Setting limiter low to Setting limiter high</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

(1) No.: Communication data number
(2) Name: Communication data name
(3) Identifier: Identifier for RKC communication
(4) Digits: Number of digits for RKC communication
(5) Register address: Register address for Modbus communication
(6) Attribute: A method of how communication data items are read or written when viewed from the host computer is described.
RO: Read only data
R/W: Read and Write data

(7) Data range: Read or write range of communication data

- **ASCII code data (RKC communication)**

```
Most significant digit  Least significant digit
```

The data length in RKC communication (7 or 6 digits) can be set at Input data type (P. 3-6).

- **16-bit data (Modbus)**

```
Bit 15 ........................................ Bit 0
```

(8) Factory set value: Factory set value of communication data
The communication data include “Normal setting data” and “Data in the Engineering mode.”

- **Normal setting data:** No. 1 to 144
- **Data in the Engineering mode:** No. 145 to 325

The attributes of parameters in the Engineering mode are RO (Read only) in the Program control mode (RUN), the Fixed set point control mode (FIX) or the Manual control mode (MAN).

---

**WARNING**

Communication data in the Engineering mode should be set according to the application before setting any parameter related to operation. Once the communication data in the Engineering mode are set correctly, no further changes need to be made to parameters for the same application under normal conditions. If they are changed unnecessarily, it may result in malfunction or failure of the instrument. RKC will not bear any responsibility for malfunction or failure as a result of improper changes in the Engineering mode.

---

**NOTE**

Make sure to be in the Reset mode (RESET) before conducting parameter setting in the Engineering mode. However, only checking can be made even in the Program control mode (RUN), the Fixed set point control mode (FIX) and the Manual control mode (MAN).
# Data map of Modbus single word

This part describes how to read the data map of 6.4.1 Communication data [Modbus single word] (P. 6-86).

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Register address</th>
<th>Reference No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Measured value (PV)</td>
<td>0000 0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Set value (SV) monitor</td>
<td>0001 1</td>
<td>2</td>
</tr>
</tbody>
</table>

**No.:** Communication data number  
**Name:** Communication data name  
**Register address:** Register address for Modbus communication (HEX: Hexadecimal number DEC: Decimal number)  
**6.3.1 Reference No.:** Refer to 6.3.1 Communication data [RKC communication identifier/Modbus double word] (P. 6-8) for communication data numbers.

Find the same number in the data map 6.3.1 Communication data [RKC communication identifier/Modbus double word], and use the attribute, the data range and the factory set value obtained there.

The communication data include “Normal setting data” and “Data in the Engineering mode.”

- **Normal setting data:** No. 1 to 141  
- **Data in the Engineering mode:** No. 142 to 320

The attributes of parameters in the Engineering mode are RO (Read only) in the Program control mode (RUN), the Fixed set point control mode (FIX) or the Manual control mode (MAN).

⚠️ **WARNING**

Communication data in the Engineering mode should be set according to the application before setting any parameter related to operation. Once the communication data in the Engineering mode are set correctly, no further changes need to be made to parameters for the same application under normal conditions. If they are changed unnecessarily, it may result in malfunction or failure of the instrument. RKC will not bear any responsibility for malfunction or failure as a result of improper changes in the Engineering mode.

⚠️ **NOTE**

Make sure to be in the Reset mode (RESET) before conducting parameter setting in the Engineering mode. However, only checking can be made even in the Program control mode (RUN), the Fixed set point control mode (FIX) and the Manual control mode (MAN).
### 6.3 RKC Communication/Modbus (Double Word) Data

The following table shows communication identifiers of RKC communication and double word register address of Modbus.

*In case of Input data type “0,” Modbus double word.*

Switchover between the single word and the double word can be done at Input data type.

For the Input data type, refer to the [3.2 Selection of Communication Data Type (P. 3-5)](#).

#### 6.3.1 Communication data [RKC communication identifier/Modbus double word]

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Identifier</th>
<th>Digits</th>
<th>Register address</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Attribute</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>HEX Low-order</strong></td>
<td><strong>High-order</strong></td>
</tr>
<tr>
<td>1</td>
<td>Measured value (PV)</td>
<td>M1</td>
<td>7 or 6</td>
<td>0000</td>
<td>0001 RO Input range low – (5 % of input span or more) to Input range high + (5 % of input span or more) [Varies with the setting of the Decimal point position.]</td>
<td>—</td>
</tr>
<tr>
<td>2</td>
<td>Set value (SV) monitor</td>
<td>MS</td>
<td>7 or 6</td>
<td>0002</td>
<td>0003 RO Setting limiter low to Setting limiter high [Varies with the setting of the Decimal point position.]</td>
<td>—</td>
</tr>
<tr>
<td>3</td>
<td>Manipulated output value monitor [heat-side]</td>
<td>O1</td>
<td>7 or 6</td>
<td>0004</td>
<td>0005 RO −5.0 to +105.0 %</td>
<td>—</td>
</tr>
<tr>
<td>4</td>
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<td>Time signal state</td>
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<td>RKC communication&lt;br&gt;The Time signal state is assigned as a bit image in binary numbers.&lt;br&gt;Bit 0: Time signal 1&lt;br&gt;Bit 1: Time signal 2&lt;br&gt;Bit 2: Time signal 3&lt;br&gt;Bit 3: Time signal 4&lt;br&gt;Bit 4 to Bit 7: Unused&lt;br&gt;Data 0: OFF 1: ON</td>
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* When the Digital input (DI) for the Reset mode (RESET) setting, or the Hold function is closed, this setting is invalid and response is NAK.
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<td>When multiple items are applicable, they are summed up.</td>
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</tr>
<tr>
<td>31</td>
<td>PID group</td>
<td>PC</td>
<td>7 or 6</td>
<td>003C 003D</td>
<td>RO</td>
<td>Switching by Set value (SV): 1 to 8&lt;br&gt;Switching by Measured value (PV): 1 to 8&lt;br&gt;[Which PID group can be used depends on the setting of the Level PID action selection.]</td>
<td>—</td>
</tr>
<tr>
<td>32</td>
<td>Peak hold monitor</td>
<td>HQ</td>
<td>7 or 6</td>
<td>003E 003F</td>
<td>RO</td>
<td>Input range low – (5 % of input span) to Input range high + (5 % of input span)&lt;br&gt;[Varies with the setting of the Decimal point position.]</td>
<td>—</td>
</tr>
<tr>
<td>33</td>
<td>Bottom hold monitor</td>
<td>FQ</td>
<td>7 or 6</td>
<td>0040 0041</td>
<td>RO</td>
<td>Input range low – (5 % of input span) to Input range high + (5 % of input span)&lt;br&gt;[Varies with the setting of the Decimal point position.]</td>
<td>—</td>
</tr>
<tr>
<td>34</td>
<td>AT remaining time monitor</td>
<td>AN</td>
<td>7 or 6</td>
<td>0042 0043</td>
<td>RO</td>
<td>RKC communication&lt;br&gt;0 hours 00 minutes to 48 hours 00 minutes&lt;br&gt;Modbus&lt;br&gt;0 to 2880 minutes</td>
<td>—</td>
</tr>
<tr>
<td>No.</td>
<td>Name</td>
<td>Identifier</td>
<td>Digits</td>
<td>Register address</td>
<td>Attribute</td>
<td>Data range</td>
<td>Factory set value</td>
</tr>
<tr>
<td>-----</td>
<td>-----------------------------</td>
<td>------------</td>
<td>--------</td>
<td>------------------</td>
<td>-----------</td>
<td>----------------------------------------------------------------------------</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>AT/ST status monitor</td>
<td>AP</td>
<td>7 or 6</td>
<td>0044 0045 68 69</td>
<td>RO</td>
<td>−4 to +2&lt;br&gt;0: AT/ST complete&lt;br&gt;+1: AT running now&lt;br&gt;+2: ST running now&lt;br&gt;−1: Aborted. Setting changed.&lt;br&gt;−2: Aborted. Abnormal input.&lt;br&gt;−3: Aborted. Timeout.&lt;br&gt;−4: Aborted. Abnormal calculated values.</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>Error code</td>
<td>ER</td>
<td>7 or 6</td>
<td>0046 0047 70 71</td>
<td>RO</td>
<td>0 to 71&lt;br&gt;0: Normal&lt;br&gt;+1: Adjustment data error&lt;br&gt;+2: Data back-up error&lt;br&gt;+4: A/D conversion error&lt;br&gt;+64: Display units error&lt;br&gt;(Temperature compensation error included)&lt;br&gt;When multiple items are applicable, they are summed up.</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>Integrated operating time</td>
<td>UT</td>
<td>7 or 6</td>
<td>0048 0049 72 73</td>
<td>RO</td>
<td>0 to 65535 hours&lt;br&gt;When multiple items are applicable, they are summed up.</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>Peak hold monitor of ambient temperature</td>
<td>HP</td>
<td>7 or 6</td>
<td>004A 004B 74 75</td>
<td>RO</td>
<td>−120 to +120 °C</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>ROM version</td>
<td>VR</td>
<td>7 or 6</td>
<td>—</td>
<td>RO</td>
<td>Version of ROM built in the instrument</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>Model code monitor</td>
<td>ID</td>
<td>32</td>
<td>—</td>
<td>RO</td>
<td>Model code</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>Instrument number monitor</td>
<td>RX</td>
<td>10</td>
<td>—</td>
<td>RO</td>
<td>Instrument serial number</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Name</td>
<td>Identifier</td>
<td>Digits</td>
<td>Register address</td>
<td>Data range</td>
<td>Factory set value</td>
<td></td>
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<td>------------------</td>
<td>------------</td>
<td>------------------</td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>Retransmission output 1 decimal point position</td>
<td>— —</td>
<td>004C 004D</td>
<td>004C 004D</td>
<td>0: No decimal place</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3: Three decimal places</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1: One decimal place</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4: Four decimal places</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2: Two decimal places</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>When the type of retransmission output is as follows:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Varies with the setting of the Decimal point position.</td>
<td></td>
<td></td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>No retransmission output</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td>Measured value (PV)</td>
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<td></td>
<td>Segment level or Set value (SV) in Fixed set point control</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>mode</td>
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<tr>
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<td></td>
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<td></td>
<td>SV monitor value</td>
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<td></td>
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<td></td>
<td>Deviation</td>
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<td></td>
<td></td>
<td></td>
<td>When the type of retransmission output is as follows:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 (One decimal place)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Manipulated output value [heat-side]</td>
<td></td>
<td></td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Manipulated output value [cool-side]</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Current transformer 1 (CT1) input value</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Current transformer 2 (CT2) input value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>Retransmission output 2 decimal point position</td>
<td>— —</td>
<td>004E 004F</td>
<td>004E 004F</td>
<td>0: No decimal place</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>Retransmission output 3 decimal point position</td>
<td>— —</td>
<td>0050 0051</td>
<td>0050 0051</td>
<td>0: No decimal place</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3: Three decimal places</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1: One decimal place</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4: Four decimal places</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2: Two decimal places</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>When the event type is No event, Deviation, Process, or SV:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Varies with the setting of the Decimal point position.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>When the event type is Manipulated output value:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 (One decimal place)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>Event 1 decimal point position</td>
<td>— —</td>
<td>0052 0053</td>
<td>0052 0053</td>
<td>0: No decimal place</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>Event 2 decimal point position</td>
<td>— —</td>
<td>0054 0055</td>
<td>0054 0055</td>
<td>0: No decimal place</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>Event 3 decimal point position</td>
<td>— —</td>
<td>0056 0057</td>
<td>0056 0057</td>
<td>0: No decimal place</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>Event 4 decimal point position</td>
<td>— —</td>
<td>0058 0059</td>
<td>0058 0059</td>
<td>0: No decimal place</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>Execution pattern selection</td>
<td>ZA</td>
<td>7 or 6 005A</td>
<td>005A 005B</td>
<td>0 to 16</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

RKC communication
Settable only in the RESET mode (RESET)
In Program control mode (RUN), Fixed set point control mode (FIX), and Manual control mode (MAN), the Pattern number now in execution will be displayed.

Modbus
Settable only in the RESET mode (RESET)
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Identifier</th>
<th>Digits</th>
<th>Register address</th>
<th>Hex</th>
<th>Dec</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>Peak/Bottom hold reset</td>
<td>CQ</td>
<td>7 or 6</td>
<td>005C 005D 92 93</td>
<td>R/W</td>
<td>0: Hold</td>
<td>1: Reset</td>
<td>Returns to Hold state automatically after reset</td>
<td>0</td>
</tr>
<tr>
<td>51</td>
<td>Bottom suppression start signal</td>
<td>S8</td>
<td>7 or 6</td>
<td>005E 005F 94 95</td>
<td>R/W</td>
<td>0 to 1</td>
<td>0: No forced ON</td>
<td>1: Bottom suppression action Forced ON</td>
<td>0</td>
</tr>
<tr>
<td>52</td>
<td>Operation mode transfer</td>
<td>XM</td>
<td>7 or 6</td>
<td>0060 0061 96 97</td>
<td>R/W</td>
<td>0: Reset mode (RESET)</td>
<td>1: Program control mode (RUN)</td>
<td>2: Fixed set point control mode (FIX)</td>
<td>3: Manual control mode (MAN)</td>
</tr>
<tr>
<td>53</td>
<td>Step function</td>
<td>SK</td>
<td>7 or 6</td>
<td>0062 0063 98 99</td>
<td>R/W</td>
<td>0: Normal state</td>
<td>1: Step</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>Autotuning (AT)</td>
<td>G1</td>
<td>7 or 6</td>
<td>0064 0065 100 101</td>
<td>R/W</td>
<td>0: PID control</td>
<td>1: Start Autotuning</td>
<td>When the Autotuning (AT) is finished, the control will automatically return to “0.”</td>
<td>0</td>
</tr>
<tr>
<td>55</td>
<td>Overall level autotuning (AT)</td>
<td>TT</td>
<td>7 or 6</td>
<td>0066 0067 102 103</td>
<td>R/W</td>
<td>0: Overall level autotuning (AT) OFF</td>
<td>1: Overall level autotuning (AT) ON</td>
<td>When the Overall level autotuning (AT) is finished, the control will automatically return to “0.”</td>
<td>0</td>
</tr>
<tr>
<td>56</td>
<td>Startup tuning (ST)</td>
<td>ST</td>
<td>7 or 6</td>
<td>0068 0069 104 105</td>
<td>R/W</td>
<td>0: ST unused</td>
<td>1: Execute once *</td>
<td>2: Execute always</td>
<td>* When the ST is finished, the control will automatically return to “0.”</td>
</tr>
<tr>
<td>57</td>
<td>Interlock release</td>
<td>IL</td>
<td>7 or 6</td>
<td>006A 006B 106 107</td>
<td>R/W</td>
<td>0: Interlock release</td>
<td>1: Interlock state</td>
<td>“1: Interlock state” is for monitoring the interlocked state. Do not write “1.”</td>
<td>0</td>
</tr>
<tr>
<td>58</td>
<td>Set value (SV) in Fixed set point control mode</td>
<td>S1</td>
<td>7 or 6</td>
<td>006C 006D 108 109</td>
<td>R/W</td>
<td>Setting limiter low to Setting limiter high</td>
<td>[Varies with the setting of the Decimal point position.]</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

1 When the Digital input (DI) for the Reset mode (RESET) setting is closed, this setting is invalid and the response is NAK [Negative Acknowledge].
2 When the Digital input (DI) for the Reset mode (RESET) setting, or the Hold function is closed, this setting is invalid and response is NAK [Negative Acknowledge].
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Identifier</th>
<th>Digits</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>59</td>
<td>Segment level</td>
<td>LE</td>
<td>7 or 6</td>
<td>006E 006F 110 111</td>
<td>R/W</td>
<td>Setting limiter low to Setting limiter high [Varies with the setting of the Decimal point position.]</td>
<td>0</td>
</tr>
<tr>
<td>60</td>
<td>Segment time</td>
<td>TM</td>
<td>7 or 6</td>
<td>0070 0071 112 113</td>
<td>R/W</td>
<td>RKC communication 0 hours 00 minutes to 199 hours 59 minutes or 0 minutes 00 seconds to 199 minutes 59 seconds</td>
<td>RKC communication: 0:00 (0 hour 00 minutes) Modbus: 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>200:00: Continuous (Settable only in Soak segments * of segment 2 to 16)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>* When the segment that is set to continuous becomes no longer a soak segment, the Segment time is automatically set to 199 hours 59 minutes or 199 minutes 59 seconds. [Time unit depends on the time unit of the setting]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>RKC communication: 0:00 (0 hour 00 minutes) Modbus: 0</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Modbus 0 to 11999 minutes 0 to 11999 seconds 12000: Continuous (Settable only in Soak segments * of segment 2 to 16)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>* When the segment that is set to continuous becomes no longer a soak segment, the Segment time is automatically set to 11999 minutes or 11999 seconds. [Time unit depends on the time unit of the setting]</td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>Pattern end number</td>
<td>PE</td>
<td>7 or 6</td>
<td>0072 0073 114 115</td>
<td>R/W</td>
<td>1 to 16 (Segment number)</td>
<td>16</td>
</tr>
<tr>
<td>62</td>
<td>Number of repeating patterns</td>
<td>RR</td>
<td>7 or 6</td>
<td>0074 0075 116 117</td>
<td>R/W</td>
<td>1 to 1000 times 1000: Continuous operation</td>
<td>1</td>
</tr>
<tr>
<td>63</td>
<td>Pattern link number</td>
<td>LP</td>
<td>7 or 6</td>
<td>0076 0077 118 119</td>
<td>R/W</td>
<td>0 to 16 0: No link</td>
<td>0</td>
</tr>
</tbody>
</table>

Data belonging to [PN, SN]: Pattern & Segment group [Extended identifier: PN (Pattern), SN (Segment) Number of patterns: 16, Number of segments: 16]
Data belonging to [PN]: Pattern group [Extended identifier: PN Number of patterns: 16]
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Identifier</th>
<th>Register address</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
</table>
| 64  | Event 1 set value (EV1) When Event 1 type is either high or low limit with individual setting Event 1 set value (EV1) [high] [PN] | A1 | 7 or 6 0078 0079 120 121 | R/W | Deviation:  
- Input span to + Input span  
[Varies with the setting of the Decimal point position.]  
Input value or Set value:  
Input range low to Input range high  
[Varies with the setting of the Decimal point position.]  
Manipulated output value:  
-5.0 to +105.0 % | TC/RTD inputs:  
-10  
V/I inputs:  
5 % of input span  
Manipulated output value:  
50.0 |
| 65  | Event 1 set value (EV1') [low] [PN] | BT | 7 or 6 007A 007B 122 123 | R/W | Deviation:  
- Input span to + Input span  
[Varies with the setting of the Decimal point position.]  
Input value:  
Input range low to Input range high  
[Varies with the setting of the Decimal point position.] | TC/RTD inputs:  
-10  
V/I inputs:  
-5 % of input span |
| 66  | Event 2 set value (EV2) When Event 2 type is either high or low limit with individual setting Event 2 set value (EV2) [high] [PN] | A2 | 7 or 6 007C 007D 124 125 | R/W | Same as Event 1 set value (EV1)/Event 1 set value (EV1) [high] |
| 67  | Event 2 set value (EV2') [low] [PN] | BU | 7 or 6 007E 007F 126 127 | R/W | Same as Event 1 set value (EV1') [low] |
| 68  | Event 3 set value (EV3) When Event 3 type is either high or low limit with individual setting Event 3 set value (EV3) [high] [PN] | A7 | 7 or 6 0080 0081 128 129 | R/W | Same as Event 1 set value (EV1)/Event 1 set value (EV1) [high] |
| 69  | Event 3 set value (EV3') [low] [PN] | BV | 7 or 6 0082 0083 130 131 | R/W | Same as Event 1 set value (EV1') [low] |

Data belonging to [PN]: Pattern group [Extended identifier: PN Number of patterns: 16]
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Identifier</th>
<th>Digits</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>Event 4 set value (EV4)</td>
<td>A8</td>
<td>7 or 6</td>
<td>0084</td>
<td>0085</td>
<td>132</td>
<td>133</td>
</tr>
<tr>
<td></td>
<td>When Event 4 type is either high or low limit with individual setting Event 4 set value (EV4) [high] [PN]</td>
<td></td>
<td></td>
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<tr>
<td>71</td>
<td>Event 4 set value (EV4') [low] [PN]</td>
<td>BW</td>
<td>7 or 6</td>
<td>0086</td>
<td>0087</td>
<td>134</td>
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<tr>
<td>72</td>
<td>Time signal 1 start segment number [PN]</td>
<td>SA</td>
<td>7 or 6</td>
<td>0088</td>
<td>0089</td>
<td>136</td>
<td>137</td>
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<tr>
<td>73</td>
<td>Time signal 1 start time [PN]</td>
<td>T5</td>
<td>7 or 6</td>
<td>008A</td>
<td>008B</td>
<td>138</td>
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<tr>
<td>74</td>
<td>Time signal 1 end segment number [PN]</td>
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<td>7 or 6</td>
<td>008C</td>
<td>008D</td>
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<td>141</td>
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<td>75</td>
<td>Time signal 1 end time [PN]</td>
<td>T9</td>
<td>7 or 6</td>
<td>008E</td>
<td>008F</td>
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Data belonging to [PN]: Pattern group [Extended identifier: PN Number of patterns: 16]
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<td>76</td>
<td>Time signal 2 start segment number</td>
<td>SB</td>
<td>7 or 6</td>
<td>0090 0091</td>
<td>R/W</td>
<td>Same as Time signal 1 start segment number</td>
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<td>77</td>
<td>Time signal 2 start time</td>
<td>T6</td>
<td>7 or 6</td>
<td>0092 0093</td>
<td>R/W</td>
<td>Same as Time signal 1 start time</td>
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<td>78</td>
<td>Time signal 2 end segment number</td>
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<td>7 or 6</td>
<td>0094 0095</td>
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<td>79</td>
<td>Time signal 2 end time</td>
<td>TA</td>
<td>7 or 6</td>
<td>0096 0097</td>
<td>R/W</td>
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<td>80</td>
<td>Time signal 3 start segment number</td>
<td>SC</td>
<td>7 or 6</td>
<td>0098 0099</td>
<td>R/W</td>
<td>Same as Time signal 1 start segment number</td>
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<td>81</td>
<td>Time signal 3 start time</td>
<td>T7</td>
<td>7 or 6</td>
<td>009A 009B</td>
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<td>Time signal 3 end segment number</td>
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<td>009C 009D</td>
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<td>83</td>
<td>Time signal 3 end time</td>
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<td>Time signal 4 start segment number</td>
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<td>Time signal 4 start time</td>
<td>T8</td>
<td>7 or 6</td>
<td>00A2 00A3</td>
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Data belonging to [PN]: Pattern group [Extended identifier: PN Number of patterns: 16]
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<td>SR</td>
<td>7 or 6</td>
<td>00A4 00A5 164 165</td>
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<td>87</td>
<td>Time signal 4 end time</td>
<td>TC</td>
<td>7 or 6</td>
<td>00A6 00A7 166 167</td>
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<td>Same as Time signal 1 end time</td>
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<td>88</td>
<td>Pattern end output time</td>
<td>ET</td>
<td>7 or 6</td>
<td>00A8 00A9 168 169</td>
<td>R/W</td>
<td>RKC communication: 0:00 (0 hour 00 minute) Modbus: 0</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Modbus: 0 to 11999 minutes 0 to 11999 seconds 0: Output remains on</td>
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<td>[Time unit depends on the time unit of the setting]</td>
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<td>89</td>
<td>Proportional band [heat-side]</td>
<td>P1</td>
<td>7 or 6</td>
<td>00AA 00AB 170 171</td>
<td>R/W</td>
<td>TC/RTD inputs: 30 V/I inputs: 3.0</td>
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<td>[K]</td>
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<td>0 (0.0, 0.00): ON/OFF action</td>
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<td>[Varies with the setting of the Decimal point position.]</td>
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<td>90</td>
<td>Integral time [heat-side]</td>
<td>I1</td>
<td>7 or 6</td>
<td>00AC 00AD 172 173</td>
<td>R/W</td>
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<td>[K]</td>
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<td></td>
<td>PID control or Heat/Cool PID control</td>
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<td></td>
<td></td>
<td>0 to 3600 seconds, 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>0 (0.0, 0.00): PD action</td>
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<td></td>
<td></td>
<td>Position proportioning PID control</td>
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<td></td>
<td></td>
<td></td>
<td>1 to 3600 seconds, 0.1 to 3600.0 seconds or 0.01 to 360.00 seconds</td>
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<tr>
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<td></td>
<td>[Varies with the setting of the Integral/Derivative time decimal point position.]</td>
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<td>No.</td>
<td>Name</td>
<td>Identifier</td>
<td>Digits</td>
<td>Register address</td>
<td>Attribute</td>
<td>Data range</td>
<td>Factory set value</td>
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</tr>
<tr>
<td>91</td>
<td>Derivative time [heat-side]</td>
<td>D1</td>
<td>7 or 6</td>
<td>00AE 00AF</td>
<td>R/W</td>
<td>0 to 3600 seconds, 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds or 0 (0.0, 0.00): PI action [Varies with the setting of the Integral/Derivative time decimal point position.]</td>
<td>60</td>
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<tr>
<td>92</td>
<td>Control response parameter</td>
<td>CA</td>
<td>7 or 6</td>
<td>00B0 00B1</td>
<td>R/W</td>
<td>0: Slow 1: Medium 2: Fast [When the P or PD action is selected, this setting becomes invalid]</td>
<td>2</td>
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<tr>
<td>93</td>
<td>Proactive intensity</td>
<td>ZP</td>
<td>7 or 6</td>
<td>00B2 00B3</td>
<td>R/W</td>
<td>0 to 4 0: No function</td>
<td>2</td>
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<tr>
<td>94</td>
<td>Manual reset</td>
<td>MR</td>
<td>7 or 6</td>
<td>00B4 00B5</td>
<td>R/W</td>
<td>−100.0 to +100.0 %</td>
<td>0.0</td>
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<tr>
<td>95</td>
<td>FF amount</td>
<td>F3</td>
<td>7 or 6</td>
<td>00B6 00B7</td>
<td>R/W</td>
<td>−100.0 to +100.0 %</td>
<td>0.0</td>
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<tr>
<td>96</td>
<td>Output limiter high [heat-side]</td>
<td>OH</td>
<td>7 or 6</td>
<td>00B8 00B9</td>
<td>R/W</td>
<td>Output limiter low [heat-side] to 105.0 %</td>
<td>105.0</td>
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<tr>
<td>97</td>
<td>Output limiter low [heat-side]</td>
<td>OX</td>
<td>7 or 6</td>
<td>00BA 00BB</td>
<td>R/W</td>
<td>−5.0 % to Output limiter high [heat-side]</td>
<td>−5.0</td>
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<tr>
<td>98</td>
<td>Control loop break alarm (LBA) time</td>
<td>A5</td>
<td>7 or 6</td>
<td>00BC 00BD</td>
<td>R/W</td>
<td>0 to 7200 seconds 0: No function</td>
<td>LBA function is specified: 480 LBA function is not specified: 0</td>
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<tr>
<td>99</td>
<td>LBA deadband (LBD)</td>
<td>A6</td>
<td>7 or 6</td>
<td>00BE 00BF</td>
<td>R/W</td>
<td>0 to Input span [Varies with the setting of the Decimal point position.]</td>
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<tr>
<td>100</td>
<td>Unused</td>
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<td>00C0 00C1</td>
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Data belonging to [K]: PID group (Level PID) [Extended identifier: K Number of groups: 8]
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<th>Data range</th>
<th>Factory set value</th>
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<tr>
<td>101</td>
<td>Proportional band [cool-side]</td>
<td>P2</td>
<td>7 or 6</td>
<td>00C2 00C3</td>
<td>R/W</td>
<td>TC/RTD inputs: 1 (0.1, 0.01) to Input span (Unit: °C [°F]) [Varies with the setting of the Decimal point position.] Voltage (V)/Current (I) inputs 0.1 to 1000.0 % of Input span</td>
<td>TC/RTD inputs: 30 V/I inputs: 3.0</td>
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<td></td>
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<td></td>
<td>194 195</td>
<td></td>
<td>Voltage (V)/Current (I) inputs 0.1 to 1000.0 % of Input span</td>
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<td>102</td>
<td>Integral time [cool-side]</td>
<td>I2</td>
<td>7 or 6</td>
<td>00C4 00C5</td>
<td>R/W</td>
<td>0 to 3600 seconds, 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds 0 (0.0, 0.00): PD action [Varies with the setting of the Integral/Derivative time decimal point position.]</td>
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<td>196 197</td>
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<td>[Varies with the setting of the Integral/Derivative time decimal point position.]</td>
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<tr>
<td>103</td>
<td>Derivative time [cool-side]</td>
<td>D2</td>
<td>7 or 6</td>
<td>00C6 00C7</td>
<td>R/W</td>
<td>0 to 3600 seconds, 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds 0 (0.0, 0.00): PI action [Varies with the setting of the Integral/Derivative time decimal point position.]</td>
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<td>198 199</td>
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<td>[Varies with the setting of the Integral/Derivative time decimal point position.]</td>
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<td>104</td>
<td>Overlap/Deadband</td>
<td>V1</td>
<td>7 or 6</td>
<td>00C8 00C9</td>
<td>R/W</td>
<td>TC/RTD inputs: − Input span to + Input span (Unit: °C [°F]) [Varies with the setting of the Decimal point position.] Voltage (V)/Current (I) inputs −100.0 to +100.0 % of Input span Minus (−) setting results in Overlap. However, the overlapping range is within the proportional range.</td>
<td>TC/RTD inputs: 0 V/I inputs: 0.0</td>
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<td>200 201</td>
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<td>Same data as RKC communication identifier OX</td>
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<td>105</td>
<td>Output limiter high [cool-side]</td>
<td>OL</td>
<td>7 or 6</td>
<td>00CA 00CB</td>
<td>R/W</td>
<td>Heat/Cool PID control Output limiter low [cool-side] to 105.0 %</td>
<td>105.0</td>
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<td>Output limiter low [heat-side]</td>
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<td>202 203</td>
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<td>PID control or Position proportioning PID control −5.0 % to Output limiter high [heat-side] Same data as RKC communication identifier OX</td>
<td>−5.0</td>
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<td>106</td>
<td>Output limiter low [cool-side]</td>
<td>OY</td>
<td>7 or 6</td>
<td>00CC 00CD</td>
<td>R/W</td>
<td>−5.0 % to Output limiter high [cool-side]</td>
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Data belonging to [K]: PID group (Level PID) [Extended identifier: K Number of groups: 8]
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<th>Attribute</th>
<th>Data range</th>
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<tr>
<td>107</td>
<td>Automatic level PID setting</td>
<td>LV</td>
<td>7 or 6</td>
<td>00CE 00CF 206 207</td>
<td>R/W</td>
<td>−1: Restore setting before change&lt;br&gt;0: Automatic setting OFF&lt;br&gt;1: Automatic setting ON</td>
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<td>108</td>
<td>Level PID setting 1 *</td>
<td>Q4</td>
<td>7 or 6</td>
<td>00D0 00D1 208 209</td>
<td>R/W</td>
<td>Input range low to Input range high&lt;br&gt;[Varies with the setting of the Decimal point position.]</td>
<td>Input range high</td>
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<td>Level PID setting 2 *</td>
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<td>Same as Level PID setting 1</td>
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<td>Level PID setting 4 *</td>
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<td>7 or 6</td>
<td>00D6 00D7 214 215</td>
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<td>Level PID setting 5 *</td>
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<td>Level PID setting 6 *</td>
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<td>00DA 00DB 218 219</td>
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<td>Level PID setting 7 *</td>
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<td>00DC 00DD 220 221</td>
<td>R/W</td>
<td>Same as Level PID setting 1</td>
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<tr>
<td>115</td>
<td>Wait zone high</td>
<td>ZW</td>
<td>7 or 6</td>
<td>00DE 00DF 222 223</td>
<td>R/W</td>
<td>TC/RTD inputs&lt;br&gt;0 (0.0, 0.00) to Input span (Unit: °C [°F])&lt;br&gt;[Varies with the setting of the Decimal point position.]&lt;br&gt;Voltage (V)/Current (I) inputs&lt;br&gt;0.0 to 100.0 % of Input span&lt;br&gt;0 (0.0, 0.00): Wait zone high OFF</td>
<td>0</td>
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</table>

*Level PID settings 1 to 7 of Input 1 always maintain the following relation.<br>(Level PID setting 1) ≤ (Level PID setting 2) ≤ (Level PID setting 3) ≤ (Level PID setting 4) ≤ (Level PID setting 5) ≤ (Level PID setting 6) ≤ (Level PID setting 7)*
<table>
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<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
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<td>Wait zone low</td>
<td>ZX</td>
<td>7 or 6</td>
<td>00E0 00E1</td>
<td>R/W</td>
<td>TC/RTD inputs</td>
<td>0</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Input span to 0 (0.0, 0.00) (Unit: °C [°F])</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>[Varies with the setting of the Decimal point position.]</td>
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<td></td>
<td></td>
<td>Voltage (V)/Current (I) inputs</td>
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<td></td>
<td></td>
<td></td>
<td>-100.0 to 0.0 % of Input span</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>0 (0.0, 0.00): Wait zone low OFF</td>
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<tr>
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<td>SV selection at program start</td>
<td>SV</td>
<td>7 or 6</td>
<td>00E2 00E3</td>
<td>R/W</td>
<td>0: Zero start</td>
<td>0</td>
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<td>1: PV start</td>
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<td>118</td>
<td>Hot/Cold start</td>
<td>XN</td>
<td>7 or 6</td>
<td>00E4 00E5</td>
<td>R/W</td>
<td>0: Hot start 1</td>
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<td></td>
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<td>1: Hot start 2</td>
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<td>2: Cold start</td>
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<td>3: Reset start</td>
<td></td>
</tr>
<tr>
<td>119</td>
<td>Control action at pattern end</td>
<td>X1</td>
<td>7 or 6</td>
<td>00E6 00E7</td>
<td>R/W</td>
<td>PID control, Heat/Cool PID control or Position proportioning PID control (With FBR input):</td>
<td>0</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>0: Control continued</td>
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<td>1: Control stop</td>
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<td></td>
<td>Position proportioning PID control (When there is no FBR input or the FBR input is break):</td>
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<td></td>
<td></td>
<td></td>
<td>0: Control continued</td>
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<td></td>
<td></td>
<td>1: Open-side output OFF, Close-side output OFF</td>
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<td>2: Open-side output OFF, Close-side output ON</td>
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<td></td>
<td>3: Open-side output ON, Close-side output OFF</td>
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<tr>
<td>120</td>
<td>Output action at pattern end</td>
<td>X2</td>
<td>7 or 6</td>
<td>00E8 00E9</td>
<td>R/W</td>
<td>0 to 7</td>
<td>7</td>
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<td>0: OFF</td>
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<td></td>
<td>+1: Logic calculation output: Action continues</td>
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<td></td>
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<td>+2: Retransmission output: Action continues</td>
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<td></td>
<td></td>
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<td>+4: Instrument status output: Action continues</td>
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<td></td>
<td>To select two or more functions, sum each value.</td>
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<tr>
<td>121</td>
<td>Display update cycle</td>
<td>HE</td>
<td>7 or 6</td>
<td>00EA 00EB</td>
<td>R/W</td>
<td>1: 50 ms</td>
<td>1</td>
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<td>6: 300 ms</td>
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<td>2: 100 ms</td>
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<td></td>
<td></td>
<td>7: 350 ms</td>
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<td>3: 150 ms</td>
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<td>8: 400 ms</td>
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<td>4: 200 ms</td>
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<td>9: 450 ms</td>
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<td>5: 250 ms</td>
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<td>10: 500 ms</td>
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<td>Data range</td>
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<tr>
<td>122</td>
<td>PV bias</td>
<td>PB</td>
<td>7 or 6</td>
<td>00EC 00ED</td>
<td>R/W - Input span to + Input span [Varies with the setting of the Decimal point position.]</td>
<td>0</td>
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<tr>
<td>123</td>
<td>PV digital filter</td>
<td>F1</td>
<td>7 or 6</td>
<td>00EE 00EF</td>
<td>R/W 0.0 to 100.0 seconds 0.0: Filter OFF</td>
<td>0.0</td>
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<tr>
<td>124</td>
<td>PV ratio</td>
<td>PR</td>
<td>7 or 6</td>
<td>00F0 00F1</td>
<td>R/W 0.500 to 1.500 1.000</td>
<td>1.000</td>
<td></td>
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<tr>
<td>125</td>
<td>PV low input cut-off</td>
<td>DP</td>
<td>7 or 6</td>
<td>00F2 00F3</td>
<td>R/W 0.00 to 25.00 % of Input span</td>
<td>0.00</td>
<td></td>
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<tr>
<td>126</td>
<td>OUT1 proportional cycle time</td>
<td>T0</td>
<td>7 or 6</td>
<td>00F4 00F5</td>
<td>R/W 0.1 to 100.0 seconds</td>
<td>Relay contact output: 20.0 Voltage pulse output, Transistor output: Note1</td>
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<tr>
<td>127</td>
<td>OUT2 proportional cycle time</td>
<td>T1</td>
<td>7 or 6</td>
<td>00F6 00F7</td>
<td>R/W 0.1 to 100.0 seconds</td>
<td>Relay contact output: 20.0 Voltage pulse output, Transistor output: Note2</td>
<td></td>
</tr>
<tr>
<td>128</td>
<td>OUT3 proportional cycle time</td>
<td>T2</td>
<td>7 or 6</td>
<td>00F8 00F9</td>
<td>R/W 0.1 to 100.0 seconds</td>
<td>Voltage pulse output: Note3</td>
<td></td>
</tr>
</tbody>
</table>

**Note1:** In case OUT1 function selection is “Control output [cool-side]” and Control action is “Brilliant II Heat/Cool PID control [air cooling] or [water cooling]”: 20.0 Other cases: 2.0

**Note2:** In case OUT2 function selection is “Control output [cool-side]” and Control action is “Brilliant II Heat/Cool PID control [air cooling] or [water cooling]”: 20.0 Other cases: 2.0

**Note3:** In case OUT3 function selection is “Control output [cool-side]” and Control action is “Brilliant II Heat/Cool PID control [air cooling] or [water cooling]”: 20.0 Other cases: 2.0
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<thead>
<tr>
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<th>Digits</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>129</td>
<td>OUT1 minimum ON/OFF time of proportional cycle</td>
<td>OP</td>
<td>7 or 6</td>
<td>00FA 00FB</td>
<td>R/W</td>
<td>0 to 1000 ms</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>250 251</td>
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<tr>
<td>130</td>
<td>OUT2 minimum ON/OFF time of proportional cycle</td>
<td>OQ</td>
<td>7 or 6</td>
<td>00FC 00FD</td>
<td>R/W</td>
<td>0 to 1000 ms</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>252 253</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>131</td>
<td>OUT3 minimum ON/OFF time of proportional cycle</td>
<td>OR</td>
<td>7 or 6</td>
<td>00FE 00FF</td>
<td>R/W</td>
<td>0 to 1000 ms</td>
<td>0</td>
</tr>
<tr>
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<td>254 255</td>
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<tr>
<td>132</td>
<td>Heater break alarm 1 (HBA1) set value</td>
<td>A3</td>
<td>7 or 6</td>
<td>0100 0101</td>
<td>R/W</td>
<td>0.0 to 100.0 A</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td>256 257</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>133</td>
<td>Number of heater break alarm 1 (HBA1) delay times</td>
<td>TH</td>
<td>7 or 6</td>
<td>0102 0103</td>
<td>R/W</td>
<td>0 to 255 times</td>
<td>5</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>258 259</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>134</td>
<td>Heater break alarm 2 (HBA2) set value</td>
<td>A4</td>
<td>7 or 6</td>
<td>0104 0105</td>
<td>R/W</td>
<td>0.0 to 100.0 A</td>
<td>0.0</td>
</tr>
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<td></td>
<td>260 261</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>135</td>
<td>Number of heater break alarm 2 (HBA2) delay times</td>
<td>TI</td>
<td>7 or 6</td>
<td>0106 0107</td>
<td>R/W</td>
<td>0 to 255 times</td>
<td>5</td>
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<td></td>
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<td></td>
<td>262 263</td>
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<td>No.</td>
<td>Name</td>
<td>Identifier</td>
<td>Digits</td>
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<td>Attribute</td>
<td>Data range</td>
<td>Factory set value</td>
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</tbody>
</table>
| 137 | Event selection of the Segment [PN, SN] | **AS** | 7 or 6 | 0108 0109 264 265 | R/W       | RKC communication  
  The Event selection of the Segment is assigned as a bit image in binary numbers.  
  Bit 0: Event 1  
  Bit 1: Event 2  
  Bit 2: Event 3  
  Bit 3: Event 4  
  Bit 4 to Bit 7: Unused  
  Data 0: Unused  
  1: Used  
  0 to 15  
  0: OFF  
  +1: Event 1 is enabled  
  +2: Event 2 is enabled  
  +4: Event 3 is enabled  
  +8: Event 4 is enabled  
  To select two or more functions, sum each value. |
| 136 | Manual manipulated output value | **ON** | 7 or 6 | 010A 010B 266 267 | R/W       | PID control, Position proportioning PID control  
  Output limiter low [heat-side] to Output limiter high [heat-side]  
  Heat/Cool PID control *  
  −(Output limiter high [cool-side]) to + (Output limiter high [heat-side])  
  PID control, Position proportioning PID control: −5.0  
  Heat/Cool PID control: 0.0 |

Data belonging to [PN, SN]: Pattern & Segment group [Extended identifier: PN (Pattern), SN (Segment) Number of patterns: 16, Number of segments: 16]

* In case of Heat/Cool PID control, the data range has such exceptional conditions as shown below.

1. Output limiter high [cool-side] is ≤ 0.0 %
   - Output limiter low [heat-side] is ≤ 0.0 %: 0.0 % to +(Output limiter high [heat-side])
   - Output limiter low [heat-side] is > 0.0 %: Output limiter low [heat-side] to Output limiter high [heat-side]

2. Output limiter high [heat-side] is ≤ 0.0 %
   - Output limiter low [cool-side] is ≤ 0.0 %: −(Output limiter high [cool-side]) to 0.0 %
   - Output limiter low [cool-side] is > 0.0 %: −(Output limiter high [cool-side]) to −(Output limiter low [cool-side])

3. Fixed at 0.0 % in the following cases: Output limiter high [cool-side] ≤ 0.0 %, and Output limiter high [heat-side] ≤ 0.0 %
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Identifier</th>
<th>Digits</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>138</td>
<td>ON/OFF action differential gap (upper)</td>
<td>IV</td>
<td>7 or 6</td>
<td>010C 010D</td>
<td>R/W</td>
<td>TC/RTD inputs 0 (0.0, 0.00) to Input span (Unit: °C [°F])</td>
<td>TC/RTD inputs: I</td>
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<tr>
<td></td>
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<td></td>
<td>268 269</td>
<td></td>
<td>[Varies with the setting of the Decimal point position.]</td>
<td>V/I inputs: 0.1</td>
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<tr>
<td></td>
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<td></td>
<td>Voltage (V)/Current (I) inputs 0.0 to 100.0 % of Input span</td>
<td></td>
</tr>
<tr>
<td>139</td>
<td>ON/OFF action differential gap (lower)</td>
<td>IW</td>
<td>7 or 6</td>
<td>010E 010F</td>
<td>R/W</td>
<td>TC/RTD inputs 0 (0.0, 0.00) to Input span (Unit: °C [°F])</td>
<td>TC/RTD inputs: I</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>270 271</td>
<td></td>
<td>[Varies with the setting of the Decimal point position.]</td>
<td>V/I inputs: 0.1</td>
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<tr>
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<td></td>
<td>Voltage (V)/Current (I) inputs 0.0 to 100.0 % of Input span</td>
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</tr>
<tr>
<td>140</td>
<td>AT bias</td>
<td>GB</td>
<td>7 or 6</td>
<td>0110 0111</td>
<td>R/W</td>
<td>Input span to + Input span [Varies with the setting of the Decimal point position.]</td>
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<tr>
<td>141</td>
<td>Open/Close output neutral zone</td>
<td>V2</td>
<td>7 or 6</td>
<td>0112 0113</td>
<td>R/W</td>
<td>0.1 to 10.0 % of output [Varies with the setting of the Decimal point position.]</td>
<td>2.0</td>
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<tr>
<td>142</td>
<td>Open/Close output differential gap</td>
<td>VH</td>
<td>7 or 6</td>
<td>0114 0115</td>
<td>R/W</td>
<td>0.1 to 5.0 % of output [Varies with the setting of the Decimal point position.]</td>
<td>1.0</td>
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<td>143</td>
<td>FF amount learning</td>
<td>G7</td>
<td>7 or 6</td>
<td>0116 0117</td>
<td>R/W</td>
<td>0 to 1 0: No learning +1: Learn Input [Varies with the setting of the Decimal point position.]</td>
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<tr>
<td>144</td>
<td>Determination point of external disturbance</td>
<td>G8</td>
<td>7 or 6</td>
<td>0118 0119</td>
<td>R/W</td>
<td>Input span to + Input span [Varies with the setting of the Decimal point position.]</td>
<td>-1</td>
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</tbody>
</table>
Items 145o 325 are data in the Engineering mode.

**WARNING**

Communication data the Engineering mode should be set according to the application before setting any parameter related to operation. Once the communication data in the Engineering mode are set correctly, no further changes need to be made to parameters for the same application under normal conditions. If they are changed unnecessarily, it may result in malfunction or failure of the instrument. RKC will not bear any responsibility for malfunction or failure as a result of improper changes in the Engineering mode.

**NOTE**

Make sure to be in the RESET mode before conducting parameter setting in the Engineering mode. However, only checking can be made even in the Program control mode (RUN), the Fixed set point control mode (FIX) and the Manual control mode (MAN).

<table>
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<td>Time unit of the setting</td>
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<td>011A 011B 282 283</td>
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<td>1: Minute : Second</td>
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<td>0: Minute</td>
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<td>Segment setting change type</td>
<td>SG</td>
<td>7 or 6</td>
<td>011C 011D 284 285</td>
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<td>0: Change type 1</td>
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<td>147</td>
<td>Store segment setting change</td>
<td>SJ</td>
<td>7 or 6</td>
<td>011E 011F 286 287</td>
<td>R/W</td>
<td>0</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>0: Store setting</td>
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<td>1: Do not store setting</td>
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<td>Digits</td>
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<td>Data range</td>
<td>Factory set value</td>
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<td>ALM lamp lighting condition</td>
<td>LY</td>
<td>7 or 6</td>
<td>0120 0121 288 289</td>
<td>R/W 0 to 511</td>
<td>0: OFF</td>
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<td>+2: Event 2</td>
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<td>+4: Event 3</td>
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<td>+8: Event 4</td>
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<td>+16: Heater break alarm 1 (HBA1)</td>
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<td>+32: Heater break alarm 2 (HBA2)</td>
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<td>+64: Control loop break alarm (LBA)</td>
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<td>+128: Input error high</td>
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<td>+256: Input error low</td>
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<td>To select two or more functions, sum each value.</td>
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<td>149</td>
<td>PV flashing display at input error</td>
<td>DU</td>
<td>7 or 6</td>
<td>0122 0123 290 291</td>
<td>R/W 0: Flashing display</td>
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<td>1: Non-flashing display</td>
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<td>150</td>
<td>Select hide items in Monitor mode</td>
<td>LN</td>
<td>7 or 6</td>
<td>0124 0125 292 293</td>
<td>R/W 0 to 31</td>
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<td>0: Show all</td>
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<td>+1: Number of repeating patterns monitor</td>
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<td>+2: Pattern remaining time monitor</td>
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<td>+4: Manipulated output value (MV) monitor</td>
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<td>+8: Current transformer (CT) input value monitor</td>
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<td>+16: Comprehensive event state</td>
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<td>To select two or more functions, sum each value.</td>
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<td>151</td>
<td>Select hide items in Operation transfer mode</td>
<td>LM</td>
<td>7 or 6</td>
<td>0126 0127 294 295</td>
<td>R/W 0 to 31</td>
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<td>0: Show all</td>
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<td>+1: Operation mode transfer</td>
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<td>+2: Step function</td>
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<td>+4: Autotuning (AT)</td>
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<td>+8: Overall level autotuning (AT)</td>
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<td>+16: Startup tuning (ST)</td>
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<td>To select two or more functions, sum each value.</td>
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<td>Data range</td>
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<td>Low-order</td>
<td>High-order</td>
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<td>152</td>
<td>Input type</td>
<td>XI</td>
<td>7 or 6</td>
<td>0128 0129 296 297</td>
<td>R/W</td>
<td>0: TC input K 1: TC input J 2: TC input R 3: TC input S 4: TC input B 5: TC input E 6: TC input N 7: TC input T 8: TC input W5Re/W26Re 9: TC input PLII 10: TC input U 11: TC input L 12: TC input PR40-20</td>
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<td>153</td>
<td>Display unit</td>
<td>PU</td>
<td>7 or 6</td>
<td>012A 012B 298 299</td>
<td>R/W</td>
<td>0: °C 1: °F</td>
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<td>154</td>
<td>Decimal point position</td>
<td>XU</td>
<td>7 or 6</td>
<td>012C 012D 300 301</td>
<td>R/W</td>
<td>0: No decimal place 1: One decimal place 2: Two decimal places 3: Three decimal places 4: Four decimal places TC inputs: W5Re/W26Re, PR40-20: 0 (fixed) Thermocouples other than those shown above: 0 or 1 RTD inputs: 0 to 2 Voltage (V)/Current (I) inputs: In case of Input data type 0: 0 to 4 In case of Input data type 1: 0 to 3</td>
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<td>155</td>
<td>Input range high</td>
<td>XV</td>
<td>7 or 6</td>
<td>012E 012F 302 303</td>
<td>R/W</td>
<td>(Input range low + 1 digit) to Maximum value of input range [Varies with the setting of the Decimal point position.]</td>
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<tr>
<td>No.</td>
<td>Name</td>
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<td>High-order</td>
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<td>156</td>
<td>Input range low</td>
<td>XW</td>
<td>7 or 6</td>
<td>0130</td>
<td>0131</td>
<td>304</td>
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<tr>
<td>157</td>
<td>Input error determination point (high)</td>
<td>AV</td>
<td>7 or 6</td>
<td>0132</td>
<td>0133</td>
<td>306</td>
</tr>
<tr>
<td>158</td>
<td>Input error determination point (low)</td>
<td>AW</td>
<td>7 or 6</td>
<td>0134</td>
<td>0135</td>
<td>308</td>
</tr>
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<td>159</td>
<td>Temperature compensation calculation</td>
<td>R0</td>
<td>7 or 6</td>
<td>0136</td>
<td>0137</td>
<td>310</td>
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<tr>
<td>160</td>
<td>Burnout direction</td>
<td>BS</td>
<td>7 or 6</td>
<td>0138</td>
<td>0139</td>
<td>312</td>
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<tr>
<td>161</td>
<td>Square root extraction</td>
<td>XH</td>
<td>7 or 6</td>
<td>013A</td>
<td>013B</td>
<td>314</td>
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<tr>
<td>162</td>
<td>Inverting input</td>
<td>IB</td>
<td>7 or 6</td>
<td>013C</td>
<td>013D</td>
<td>316</td>
</tr>
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<td>No.</td>
<td>Name</td>
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<td>Register address</td>
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<td>163</td>
<td>Input data type</td>
<td>SE</td>
<td>7 or 6</td>
<td>013E 013F</td>
<td>R/W</td>
<td>0: Number of measured value digits: 5&lt;br&gt;1: Number of measured value digits: 4&lt;br&gt;Number of RKC communication data digits: 7&lt;br&gt;Modbus data: Double word&lt;br&gt;PLC communication data: Double word (System data: Single word) When changing the Input data type from 0 to 1 (or 2) and when the present Input range has 5 digits (example: Input range high: 1372.0), you need to configure the Input range to have 4 digits beforehand.</td>
</tr>
<tr>
<td>164</td>
<td>DI1 function selection</td>
<td>H2</td>
<td>7 or 6</td>
<td>0140 0141</td>
<td>R/W</td>
<td>0: No function&lt;br&gt;1: Reset mode (RESET) setting&lt;br&gt;2: Program control mode (RUN) setting&lt;br&gt;3: Step function&lt;br&gt;4: Hold function&lt;br&gt;5: Interlock release&lt;br&gt;6: Peak/Bottom hold reset&lt;br&gt;7: Autotuning (AT)&lt;br&gt;8: Set data unlock/lock transfer&lt;br&gt;9: Direct/Reverse action transfer</td>
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<tr>
<td>165</td>
<td>DI2 function selection</td>
<td>H3</td>
<td>7 or 6</td>
<td>0142 0143</td>
<td>R/W</td>
<td>0 to 9&lt;br&gt;Same as DI1 function selection (0 to 9)</td>
</tr>
<tr>
<td>166</td>
<td>DI3 function selection</td>
<td>H4</td>
<td>7 or 6</td>
<td>0144 0145</td>
<td>R/W</td>
<td>0 to 9&lt;br&gt;Same as DI1 function selection (0 to 9)</td>
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<tr>
<td>167</td>
<td>DI4 function selection</td>
<td>H5</td>
<td>7 or 6</td>
<td>0146 0147</td>
<td>R/W</td>
<td>0 to 9&lt;br&gt;Same as DI1 function selection (0 to 9)</td>
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<tr>
<td>168</td>
<td>DI5 function selection</td>
<td>H6</td>
<td>7 or 6</td>
<td>0148 0149</td>
<td>R/W</td>
<td>0 to 9&lt;br&gt;Same as DI1 function selection (0 to 9)</td>
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<td>169</td>
<td>DI6 function selection</td>
<td>H7</td>
<td>7 or 6</td>
<td>014A 014B 330 331</td>
<td>R/W</td>
<td>0 to 9</td>
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<td>Same as DI1 function selection (0 to 9)</td>
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<td>170</td>
<td>DI logic invert</td>
<td>D0</td>
<td>7 or 6</td>
<td>014C 014D 332 333</td>
<td>R/W</td>
<td>0 to 3</td>
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<td>0: No logic invert</td>
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<td>+1: Set data unlock/lock transfer</td>
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<td>+2: Direct/Reverse action transfer</td>
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<td>To select two or more functions, sum each value.</td>
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<td>171</td>
<td>OUT1 function selection</td>
<td>E0</td>
<td>7 or 6</td>
<td>014E 014F 334 335</td>
<td>R/W</td>
<td>0: No assignment</td>
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<td>1: Control output [heat-side] or [open-side]</td>
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<td>2: Control output [cool-side] or [close-side]</td>
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<td>3: Retransmission output</td>
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<td>4: Logic calculation output (Event, HBA, LBA, Input error)</td>
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<td>5: Output of Program control mode (RUN) state</td>
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<td>6: Output of Manual control mode (MAN) state</td>
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<td>7: Autotuning (AT) state output</td>
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<td>8: Output of the communication monitoring result</td>
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<td>9: FAIL output (Permanently configured to be de-energized)</td>
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<td>Based on Model code</td>
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<td>172</td>
<td>OUT2 function selection</td>
<td>E2</td>
<td>7 or 6</td>
<td>0150 0151 336 337</td>
<td>R/W</td>
<td>Same as OUT1 function selection</td>
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<td>Based on Model code</td>
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<td>173</td>
<td>OUT3 function selection</td>
<td>E3</td>
<td>7 or 6</td>
<td>0152 0153 338 339</td>
<td>R/W</td>
<td>Same as OUT1 function selection</td>
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<td>174</td>
<td>OUT1 logic calculation selection</td>
<td>W0</td>
<td>7 or 6</td>
<td>0154 0155 340 341</td>
<td>R/W</td>
<td>0 to 511</td>
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<td>0: OFF</td>
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<td>+1: Event 1</td>
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<td>+2: Event 2</td>
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<td>+4: Event 3</td>
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<td>+8: Event 4</td>
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<td>+16: Heater break alarm 1 (HBA1)</td>
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<td>+32: Heater break alarm 2 (HBA2)</td>
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<td>+64: Control loop break alarm (LBA)</td>
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<td>+128: Input error high</td>
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<td>+256: Input error low</td>
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<td>To select two or more functions, sum each value.</td>
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<td>OUT2 logic calculation selection</td>
<td>W2</td>
<td>7 or 6</td>
<td>0156 0157 342 343</td>
<td>R/W</td>
<td>Same as OUT1 logic calculation selection</td>
</tr>
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<td>176</td>
<td>OUT3 logic calculation selection</td>
<td>W3</td>
<td>7 or 6</td>
<td>0158 0159 344 345</td>
<td>R/W</td>
<td>Same as OUT1 logic calculation selection</td>
</tr>
<tr>
<td>177</td>
<td>Energized/De-energized selection</td>
<td>NA</td>
<td>7 or 6</td>
<td>015A 015B 346 347</td>
<td>R/W</td>
<td>0 to 127</td>
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<td>0: All outputs are energized</td>
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<td>+1: OUT1 de-energized</td>
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<td>+2: OUT2 de-energized</td>
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<td>+4: OUT3 de-energized</td>
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<td>+8: DO1 de-energized</td>
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<td>+16: DO2 de-energized</td>
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<td>+32: DO3 de-energized</td>
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<td>+64: DO4 de-energized</td>
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<td>To select two or more functions, sum each value.</td>
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<td>178</td>
<td>Interlock selection</td>
<td>LF</td>
<td>7 or 6</td>
<td>015C 015D 348 349</td>
<td>R/W</td>
<td>0 to 511</td>
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<td>0: Unused</td>
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<td>+2: Event 2</td>
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<td>+8: Event 4</td>
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<td>+64: Control loop break alarm (LBA)</td>
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<td>+128: Input error high</td>
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<td>+256: Input error low</td>
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<td>179</td>
<td>Output action in Reset mode</td>
<td>SS</td>
<td>7 or 6</td>
<td>015E 015F 350 351</td>
<td>R/W</td>
<td>0 to 7</td>
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<td>+1: Logic calculation output: Action continues</td>
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<td>+2: Retransmission output: Action continues</td>
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<td>+4: Instrument status output: Action continues</td>
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<td>To select two or more functions, sum each value.</td>
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</table>
| 180 | Universal output type selection (OUT3)    | **XO**     | 7 or 6 | 0160 0161 352 353 | R/W       | 0: Voltage pulse output  
1: Current output (4 to 20 mA DC)  
2: Current output (0 to 20 mA DC) | 1                 |
| 181 | Retransmission output 1 type              | **LA**     | 7 or 6 | 0162 0163 354 355 | R/W       | 0: No retransmission output  
1: Measured value (PV)  
2: Segment level or Set value (SV) in Fixed set point control mode  
3: SV monitor value  
4: Deviation  
5: Manipulated output value [heat-side]  
6: Manipulated output value [cool-side]  
7: Current transformer 1 (CT1) input value *  
8: Current transformer 2 (CT2) input value *  
* Setting will be ignored if Current transformer (CT) input is not specified at the time of order. | 0                 |
| 185 | Retransmission output 1 scale high        | **HV**     | 7 or 6 | 0164 0165 356 357 | R/W       | No retransmission output, Measured value (PV), Segment level,  
Set value (SV) in Fixed set point control mode and SV monitor value  
Input range low to Input range high  
[Varies with the setting of the Decimal point position.]  
Deviation  
– Input span to + Input span  
[Varies with the setting of the Decimal point position.]  
Manipulated output value  
–5.0 to +105.0 %  
Current transformer (CT) input value  
0.0 to 100.0 % | No retransmission output,  
Measured value (PV),  
Segment level, Set value (SV) in Fixed set point control mode and SV monitor value:  
Input range high  
Deviation:  
+ Input span  
Manipulated output value, and Current transformer (CT) input value: | 100.0             |
<table>
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<th>No.</th>
<th>Name</th>
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<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
</table>
| 183 | Retransmission output 1 scale low         | HW         | 7 or 6 | 0166 0167        | Low-order | No retransmission output, Measured value (PV), Segment level, Set value (SV) in Fixed set point control mode and SV monitor value: 
|     |                                           |            |        |                  | High-order | Input range low to Input range high 
|     |                                           |            |        |                  | Low-order  | [Varies with the setting of the Decimal point position.] Deviation 
|     |                                           |            |        |                  | High-order | – Input span to + Input span 
|     |                                           |            |        |                  | Low-order  | [Varies with the setting of the Decimal point position.] Manipulated output value 
|     |                                           |            |        |                  | High-order | –5.0 to +105.0 % 
<p>|     |                                           |            |        |                  |            | Current transformer (CT) input value 0.0 to 100.0 %                                                                                                                                                    |                                                                                  |
| 184 | Retransmission output 2 type              | LB         | 7 or 6 | 0168 0169        | Low-order | Same as Retransmission output 1 type                                                                                                                                                                    | Based on Model code                                                             |
| 185 | Retransmission output 2 scale high        | CV         | 7 or 6 | 016A 016B        | Low-order | Same as Retransmission output 1 scale high                                                                                                                                                             |                                                                                  |
| 186 | Retransmission output 2 scale low         | CW         | 7 or 6 | 016C 016D        | Low-order | Same as Retransmission output 1 scale low                                                                                                                                                             |                                                                                  |
| 187 | Retransmission output 3 type              | LC         | 7 or 6 | 016E 016F        | Low-order | Same as Retransmission output 1 type                                                                                                                                                                    | Based on Model code                                                             |
| 188 | Retransmission output 3 scale high        | EV         | 7 or 6 | 0170 0171        | Low-order | Same as Retransmission output 1 scale high                                                                                                                                                             |                                                                                  |
| 189 | Retransmission output 3 scale low         | EW         | 7 or 6 | 0172 0173        | Low-order | Same as Retransmission output 1 scale low                                                                                                                                                             |                                                                                  |</p>
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<th>Attribute</th>
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<td>Low-order</td>
<td>High-order</td>
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<td>190</td>
<td>DO1 function selection</td>
<td>E4</td>
<td>7 or 6</td>
<td>0174 0175</td>
<td>372 373</td>
<td>R/W</td>
<td>0: No assignment</td>
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<td>1: Logic calculation output (Event, HBA, LBA, Input error)</td>
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<td>2: Output of Program control mode (RUN) state</td>
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<td>3: Output of Manual control mode (MAN) state</td>
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<td>4: Autotuning (AT) state output</td>
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<td>5: Output of the communication monitoring result</td>
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<td>6: FAIL output (Permanently configured to be deenergized)</td>
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<td>7: Time signal</td>
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<td>8: Pattern end signal</td>
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<td>7 or 6</td>
<td>0176 0177</td>
<td>374 375</td>
<td>R/W</td>
<td>Same as DO1 function selection</td>
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<td>192</td>
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<td>E6</td>
<td>7 or 6</td>
<td>0178 0179</td>
<td>376 377</td>
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<td>Same as DO1 function selection</td>
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<td>E7</td>
<td>7 or 6</td>
<td>017A 017B</td>
<td>378 379</td>
<td>R/W</td>
<td>Same as DO1 function selection</td>
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<td>017C 017D</td>
<td>380 381</td>
<td>R/W</td>
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<td>+1: Event 1</td>
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<td>+2: Event 2</td>
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<td>+8: Event 4</td>
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<td>+64: Control loop break alarm (LBA)</td>
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<td>+128: Input error high</td>
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<td>+256: Input error low</td>
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<td>To select two or more functions, sum each value.</td>
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<td>017E 017F</td>
<td>382 383</td>
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<td>Same as DO1 logic calculation selection</td>
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<td>Based on Model code</td>
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<td>W6</td>
<td>7 or 6</td>
<td>0180 0181</td>
<td>Low-order: 384 High-order: 385 R/W Same as DO1 logic calculation selection</td>
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<td>7 or 6</td>
<td>0182 0183</td>
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<td>DO1 time signal selection</td>
<td>DJ</td>
<td>7 or 6</td>
<td>0184 0185</td>
<td>Low-order: 388 High-order: 389 R/W RKC communication</td>
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<td>The DO1 time signal selection is assigned as a bit image in binary numbers.</td>
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<td>Bit 0: Time signal 1</td>
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<td>Bit 1: Time signal 2</td>
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<td>Bit 2: Time signal 3</td>
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<td>Bit 3: Time signal 4</td>
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<td>Bit 4 to Bit 7: Unused</td>
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<td>Data 0: Unused</td>
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<td>0: OFF</td>
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<td>+1: Time signal 1 is enabled</td>
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<td>+2: Time signal 2 is enabled</td>
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<td>+4: Time signal 3 is enabled</td>
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<td>+8: Time signal 4 is enabled</td>
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<td>To select two or more functions, sum each value.</td>
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<td>DO2 time signal selection</td>
<td>DK</td>
<td>7 or 6</td>
<td>0186 0187</td>
<td>Low-order: 390 High-order: 391 R/W Same as DO1 time signal selection</td>
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<td>DO3 time signal selection</td>
<td>DL</td>
<td>7 or 6</td>
<td>0188 0189</td>
<td>Low-order: 392 High-order: 393 R/W Same as DO1 time signal selection</td>
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<td>DO4 time signal selection</td>
<td>DM</td>
<td>7 or 6</td>
<td>018A 018B</td>
<td>Low-order: 394 High-order: 395 R/W Same as DO1 time signal selection</td>
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<td>Data range</td>
<td>Factory set value</td>
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</table>
| 202 | Event 1 type | XA | 7 or 6 | 018C 018D 396 397 | R/W | 0: None  
1: Deviation high (Using SV monitor value)  
2: Deviation low (Using SV monitor value)  
3: Deviation high/low (Using SV monitor value)  
4: Band (Using SV monitor value)  
5: Deviation high/low (Using SV monitor value) [High/Low individual setting]  
6: Band (Using SV monitor value) [High/Low individual setting]  
7: SV high (Using SV monitor value)  
8: SV low (Using SV monitor value)  
9: Process high  
10: Process low  
11: Deviation high (Using segment level)  
12: Deviation low (Using segment level)  
13: Deviation high/low (Using segment level)  
14: Band (Using segment level)  
15: Deviation high/low (Using segment level) [High/Low individual setting]  
16: Band (Using segment level) [High/Low individual setting]  
17: SV high (Using segment level)  
18: SV low (Using segment level)  
19: MV high [heat-side]  
20: MV low [heat-side]  
21: MV high [cool-side]  
22: MV low [cool-side]  
23: Process high/low [High/Low individual setting]  
24: Process band [High/Low individual setting]  |
|     |      |            |        |                  |           |            |                 |

If the Event type is specified by the Digital output function selection of initial setting code when ordering, that Event type will be the factory set value.  
If the Event type is not specified by the Digital output function selection of initial setting code: 1

Event hold and re-hold action is available.  
Event hold action is available.  
When the instrument is specified as position proportioning PID control with feedback resistance, this item becomes Feedback resistance (FBR) input.
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Identifier</th>
<th>Digits</th>
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<th>Hex Low-order</th>
<th>Dec Low-order</th>
<th>Hex High-order</th>
<th>Dec High-order</th>
<th>Attribute</th>
<th>Data range</th>
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<td>Event 1 hold action</td>
<td>WA</td>
<td>7 or 6</td>
<td>7 or 6</td>
<td>018E 018F</td>
<td>398 399</td>
<td>R/W</td>
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<td>0: Hold action OFF 1: Hold action ON 2: Re-hold action ON Setting hold or re-hold action on the event that is not available with hold and re-hold actions will just be ignored.</td>
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<tr>
<td>204</td>
<td>Event 1 differential gap</td>
<td>HA</td>
<td>7 or 6</td>
<td>7 or 6</td>
<td>0190 0191</td>
<td>400 401</td>
<td>R/W</td>
<td></td>
<td>Deviation, Process and SV: 0 to Input span [Varies with the setting of the Decimal point position.] MV: 0.0 to 110.0 % Deviation, Process and SV: TC/RTD inputs: 2 V/I inputs: 0.2 % of Input span MV: 0.2</td>
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<tr>
<td>205</td>
<td>Event 1 timer</td>
<td>TD</td>
<td>7 or 6</td>
<td>7 or 6</td>
<td>0192 0193</td>
<td>402 403</td>
<td>R/W</td>
<td></td>
<td>0.0 to 600.0 seconds</td>
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<tr>
<td>206</td>
<td>Event 2 type</td>
<td>XB</td>
<td>7 or 6</td>
<td>7 or 6</td>
<td>0194 0195</td>
<td>404 405</td>
<td>R/W</td>
<td>Same as Event 1 type</td>
<td>Same as Event 1 type If the Event type is not specified by the Digital output function selection of initial setting code: 2</td>
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<tr>
<td>207</td>
<td>Event 2 hold action</td>
<td>WB</td>
<td>7 or 6</td>
<td>7 or 6</td>
<td>0196 0197</td>
<td>406 407</td>
<td>R/W</td>
<td>Same as Event 1 hold action</td>
<td></td>
<td></td>
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<tr>
<td>208</td>
<td>Event 2 differential gap</td>
<td>HB</td>
<td>7 or 6</td>
<td>7 or 6</td>
<td>0198 0199</td>
<td>408 409</td>
<td>R/W</td>
<td>Same as Event 1 differential gap</td>
<td></td>
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<tr>
<td>209</td>
<td>Event 2 timer</td>
<td>TG</td>
<td>7 or 6</td>
<td>7 or 6</td>
<td>019A 019B</td>
<td>410 411</td>
<td>R/W</td>
<td>Same as Event 1 timer</td>
<td></td>
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<tr>
<td>210</td>
<td>Event 3 type</td>
<td>XC</td>
<td>7 or 6</td>
<td>7 or 6</td>
<td>019C 019D</td>
<td>412 413</td>
<td>R/W</td>
<td>Same as Event 1 type</td>
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If the Event type is specified by the Digital output function selection of initial setting code when ordering, the factory set value of Event hold action differs depending on the Event type. If the Event type is not specified by the Digital output function selection of initial setting code: 0
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<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Identifier</th>
<th>Digits</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
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<td>211</td>
<td>Event 3 hold action</td>
<td>WC</td>
<td>7 or 6</td>
<td>019E 019F 414 415</td>
<td>R/W</td>
<td>Same as Event 1 hold action</td>
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<td>212</td>
<td>Event 3 differential gap</td>
<td>HC</td>
<td>7 or 6</td>
<td>01A0 01A1 416 417</td>
<td>R/W</td>
<td>Same as Event 1 differential gap</td>
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<td>213</td>
<td>Event 3 timer</td>
<td>TE</td>
<td>7 or 6</td>
<td>01A2 01A3 418 419</td>
<td>R/W</td>
<td>Same as Event 1 timer</td>
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<td>214</td>
<td>Event 4 type</td>
<td>XD</td>
<td>7 or 6</td>
<td>01A4 01A5 420 421</td>
<td>R/W</td>
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<td>215</td>
<td>Event 4 hold action</td>
<td>WD</td>
<td>7 or 6</td>
<td>01A6 01A7 422 423</td>
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<td>216</td>
<td>Event 4 differential gap</td>
<td>HD</td>
<td>7 or 6</td>
<td>01A8 01A9 424 425</td>
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<td>Same as Event 1 differential gap</td>
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<td>217</td>
<td>Event 4 timer</td>
<td>TF</td>
<td>7 or 6</td>
<td>01AA 01AB 426 427</td>
<td>R/W</td>
<td>Same as Event 1 timer</td>
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<td>218</td>
<td>CT1 assignment</td>
<td>ZF</td>
<td>7 or 6</td>
<td>01AC 01AD 428 429</td>
<td>R/W</td>
<td>0: None 1: OUT1 2: OUT2 3: OUT3</td>
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<tr>
<td>219</td>
<td>CT1 type</td>
<td>YE</td>
<td>7 or 6</td>
<td>01AE 01AF 430 431</td>
<td>R/W</td>
<td>0: CTL-6-P-N 1: CTL-12-SS6-10L-N 2: CTL-6-P-Z</td>
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<tr>
<td>220</td>
<td>CT1 ratio</td>
<td>XS</td>
<td>7 or 6</td>
<td>01B0 01B1 432 433</td>
<td>R/W</td>
<td>0 to 9999 When the CT type is changed, the following value will be automatically set.</td>
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</tbody>
</table>

If the Event type is not specified by the Digital output function selection of initial setting code: 0
If the Current transformer (CT) input is specified by the Option 1 type when ordering: 1
If the Current transformer (CT) input is not specified: 0
If CTL-6-P-N or CTL-6-P-Z is specified for the Current transformer (CT) type: 800
If CTL-12-SS6-10L-N is specified for the Current transformer (CT) type: 1000
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<tr>
<th>No.</th>
<th>Name</th>
<th>Identifier</th>
<th>Digits</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
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<td>221</td>
<td>CT1 low input cut-off</td>
<td>M5</td>
<td>7 or 6</td>
<td>01B2 01B3</td>
<td>R/W</td>
<td>0.0 to 1.0 A</td>
<td>0.0</td>
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<tr>
<td>222</td>
<td>CT2 assignment</td>
<td>ZG</td>
<td>7 or 6</td>
<td>01B4 01B5</td>
<td>R/W</td>
<td>0: None</td>
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<td>2: OUT2</td>
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<td>3: OUT3</td>
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<tr>
<td>223</td>
<td>CT2 type</td>
<td>YF</td>
<td>7 or 6</td>
<td>01B6 01B7</td>
<td>R/W</td>
<td>0: CTL-6-P-N</td>
<td>Based on Model code</td>
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<td>1: CTL-12-S56-10L-N</td>
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<td>2: CTL-6-P-Z</td>
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<td>224</td>
<td>CT2 ratio</td>
<td>XT</td>
<td>7 or 6</td>
<td>01B8 01B9</td>
<td>R/W</td>
<td>0 to 9999</td>
<td>If CTL-6-P-N or CTL-6-P-Z is specified for the Current transformer (CT) type: 800 If CTL-12-S56-10L-N is specified for the Current transformer (CT) type: 1000</td>
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<td>CT2 low input cut-off</td>
<td>M7</td>
<td>7 or 6</td>
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<td>R/W</td>
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<td>226</td>
<td>Manual manipulated output value selection</td>
<td>OT</td>
<td>7 or 6</td>
<td>01BC 01BD</td>
<td>R/W</td>
<td>0: The last manipulated output value (Balanceless-bumpless function)</td>
<td>0</td>
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<td>1: Manual manipulated output value</td>
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<td>227</td>
<td>Integral/Derivative time decimal point position</td>
<td>PK</td>
<td>7 or 6</td>
<td>01BE 01BF</td>
<td>R/W</td>
<td>0: No decimal place</td>
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<td>1: One decimal place</td>
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<td>2: Two decimal places</td>
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<td>228</td>
<td>ST start condition</td>
<td>SU</td>
<td>7 or 6</td>
<td>01C0 01C1</td>
<td>R/W</td>
<td>0: Activate the Startup tuning (ST) function when the power is turned on; when transferred from RESET to RUN/FIX; or when the Set value (SV) is changed.</td>
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<td>1: Activate the Startup tuning (ST) function when the power is turned on; when transferred from RESET to RUN/FIX</td>
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<td>2: Activate the Startup tuning (ST) function when the Set value (SV) is changed.</td>
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<td>Digits</td>
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<td>Attribute</td>
<td>Data range</td>
<td>Factory set value</td>
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<tr>
<td>229</td>
<td>Time signal selection</td>
<td>TS</td>
<td>7 or 6</td>
<td>01C2 01C3</td>
<td>R/W</td>
<td>The time signal selection is assigned as a bit image in binary numbers.</td>
<td>Based on Model code</td>
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<td>Bit 0: Time signal 1</td>
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<td>Bit 1: Time signal 2</td>
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<td>Bit 2: Time signal 3</td>
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<td>Bit 3: Time signal 4</td>
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<td>Bit 4 to Bit 7: Unused</td>
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<td>Data 0: Unused</td>
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<td>Modbus 0 to 15</td>
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<td>0: OFF</td>
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<td>+1: Time signal 1 is enabled</td>
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<td>+2: Time signal 2 is enabled</td>
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<td>+4: Time signal 3 is enabled</td>
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<td>+8: Time signal 4 is enabled</td>
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<td>To select two or more functions, sum each value.</td>
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<td>230</td>
<td>Pattern end signal selection</td>
<td>EP</td>
<td>7 or 6</td>
<td>01C4 01C5</td>
<td>R/W</td>
<td>0: Unused</td>
<td>Based on Model code</td>
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<td>231</td>
<td>Control action</td>
<td>XE</td>
<td>7 or 6</td>
<td>01C6 01C7</td>
<td>R/W</td>
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<td>Control action specified at the time of order.</td>
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<td>1: Brilliant II PID control (reverse action)</td>
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<td>2: Brilliant II Heat/Cool PID control [water cooling]</td>
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<td>3: Brilliant II Heat/Cool PID control [air cooling]</td>
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<td>4: Brilliant II Heat/Cool PID control [cooling linear type]</td>
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<td>5: Brilliant II Position proportioning PID control (reverse action)</td>
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<td>6: Brilliant II Position proportioning PID control (direct action)</td>
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<td>Decimal</td>
<td>Attribute</td>
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<tr>
<td>232</td>
<td>Output change rate limiter (up) [heat-side]</td>
<td>PH</td>
<td>7 or 6</td>
<td>01C8 01C9 456 457</td>
<td>01C8</td>
<td>01C9</td>
<td>R/W</td>
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<tr>
<td>233</td>
<td>Output change rate limiter (down) [heat-side]</td>
<td>PL</td>
<td>7 or 6</td>
<td>01CA 01CB 458 459</td>
<td>01CA</td>
<td>01CB</td>
<td>R/W</td>
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<td>234</td>
<td>Action (high) input error</td>
<td>WH</td>
<td>7 or 6</td>
<td>01CC 01CD 460 461</td>
<td>01CC</td>
<td>01CD</td>
<td>R/W</td>
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<td>235</td>
<td>Action (low) input error</td>
<td>WL</td>
<td>7 or 6</td>
<td>01CE 01CF 462 463</td>
<td>01CE</td>
<td>01CF</td>
<td>R/W</td>
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<td>236</td>
<td>Manipulated output value at input error</td>
<td>OE</td>
<td>7 or 6</td>
<td>01D0 01D1 464 465</td>
<td>01D0</td>
<td>01D1</td>
<td>R/W</td>
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<td>237</td>
<td>Manipulated output value in Reset mode [heat-side]</td>
<td>OF</td>
<td>7 or 6</td>
<td>01D2 01D3 466 467</td>
<td>01D2</td>
<td>01D3</td>
<td>R/W</td>
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<td>238</td>
<td>Start determination point</td>
<td>SX</td>
<td>7 or 6</td>
<td>01D4 01D5 468 469</td>
<td>01D4</td>
<td>01D5</td>
<td>R/W</td>
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<tr>
<td>239</td>
<td>Level PID action selection</td>
<td>PP</td>
<td>7 or 6</td>
<td>01D6 01D7 470 471</td>
<td>01D6</td>
<td>01D7</td>
<td>R/W</td>
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<td>240</td>
<td>Level PID differential gap</td>
<td>LS</td>
<td>7 or 6</td>
<td>01D8 01D9 472 473</td>
<td>01D8</td>
<td>01D9</td>
<td>R/W</td>
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<tr>
<td>241</td>
<td>Unused</td>
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<td>—</td>
<td>01DA 01DB 474 475</td>
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<td>No.</td>
<td>Name</td>
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<td>Attribute</td>
<td>Data range</td>
<td>Factory set value</td>
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</table>
| 242 | Action at feedback resistance (FBR) input error                     | SY         | 7 or 6 | 01DC 01DD        | R/W       | 0: Action depending on the Valve action in Reset mode  
1: Control action continued | 0        |
| 243 | Feedback adjustment                                                  | FV         | 7 or 6 | 01DE 01DF        | R/W       | 0: Adjustment end            
1: During adjustment on the open-side  
2: During adjustment on the close-side  
3: Adjustment error                 | 0        |
| 244 | Control motor time                                                   | TN         | 7 or 6 | 01E0 01E1        | R/W       | 5 to 1000 seconds            | 10                |
| 245 | Integrated output limiter                                            | OK         | 7 or 6 | 01E2 01E3        | R/W       | 0.0 to 200.0 % of control motor time  
0.0: No function | 150.0 |
| 246 | Valve action in Reset mode                                           | VS         | 7 or 6 | 01E4 01E5        | R/W       | 0: Close-side output OFF, Open-side output OFF  
1: Close-side output ON, Open-side output OFF  
2: Close-side output OFF, Open-side output ON | 0        |
| 247 | Action at saturated output                                           | UZ         | 7 or 6 | 01E6 01E7        | R/W       | 0: Invalid (The close-side [or open-side] output turns to OFF when the valve position is fully closed [or opened]).  
1: Valid (The close-side [or open-side] output remains ON state when the valve position is fully closed [or opened]). | 0        |
| 248 | Output change rate limiter (up) [cool-side]                          | PM         | 7 or 6 | 01E8 01E9        | R/W       | 0.0 to 1000.0 %/seconds of manipulated output  
0.0: OFF | 0.0        |
| 249 | Output change rate limiter (down) [cool-side]                        | PN         | 7 or 6 | 01EA 01EB        | R/W       | 0.0 to 1000.0 %/seconds of manipulated output  
0.0: OFF | 0.0        |
| 250 | Manipulated output value in Reset mode [cool-side]                   | OG         | 7 or 6 | 01EC 01ED        | R/W       | −5.0 to +105.0 %              | −5.0              |
| 251 | Undershoot suppression factor                                        | KB         | 7 or 6 | 01EE 01EF        | R/W       | 0.000 to 1.000               | Water cooling: 0.100  
Air cooling: 0.250  
Cooling linear: 1.000 | 0.0        |
<p>| 252 | Overlap/Deadband reference point                                     | UY         | 7 or 6 | 01F0 01F1        | R/W       | 0.0 to 1.0                   | 0.0                |</p>
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<th>No.</th>
<th>Name</th>
<th>Identifier</th>
<th>Digits</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
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<td>253</td>
<td>Bottom suppression function</td>
<td>G6</td>
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<td>01F2 01F3 498 499</td>
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<td>0: No function 1: FF amount is added by level 2: FF amount is forcibly added</td>
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<td>01F4 01F5 500 501</td>
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<td>0: RKC communication 1: Modbus (Order of data transfer: high-order word to low-order word) 2: Modbus (Order of data transfer: low-order word to high-order word) 3: PLC communication (MITSUBISHI MELSEC series special protocol QnA compatible 3C frame [Format 4])</td>
<td>When the communication protocol is specified at the time of order, the specified communication protocol will be the factory set value. With communication, communication protocol not specified: 0</td>
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<td>RKC communication: 0 Modbus: 1 PLC communication: 0</td>
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<td>01F8 01F9 504 505</td>
<td>R/W</td>
<td>0: 2400 bps 1: 4800 bps 2: 9600 bps 3: 19200 bps 4: 38400 bps 5: 57600 bps</td>
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<td>258</td>
<td>Interval time</td>
<td>IT</td>
<td>7 or 6</td>
<td>01FC 01FD</td>
<td>R/W</td>
<td>0 to 250 ms</td>
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<td>0: D register (data register)</td>
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<td>1: R register (file register)</td>
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<td>2: W register (link register)</td>
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<td>3: ZR register</td>
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<td>(Method of specifying consecutive numbers when 32767 of R register is exceeded.)</td>
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<td>Slave register bias</td>
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<td>270</td>
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<td>For details, refer to PLC communication manual.</td>
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<td>Setting item selection [M]</td>
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<td>R/W</td>
<td>0 to 65535</td>
<td>For details, refer to PLC communication manual.</td>
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Data belonging to [M]: PLC item group [Extended identifier: M Number of groups of Monitor item selection: 3 Number of groups of Setting item selection: 27]
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<td>7 or 6</td>
<td>0252 0253</td>
<td>Low-order High-order</td>
<td>Setting limiter low to Input range high</td>
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<td>Setting limiter low</td>
<td>SL</td>
<td>7 or 6</td>
<td>0254 0255</td>
<td>Low-order High-order</td>
<td>Setting limiter low to Input range high</td>
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<td>305</td>
<td>Initialization</td>
<td><strong>DC</strong></td>
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<td>0256 0257 598 599</td>
<td>R/W</td>
<td>1225: Start initialization Other values: Set values are maintained After the initialization, this instrument is restarted. This setting will automatically go back to zero.</td>
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<tr>
<td>306</td>
<td>Set data unlock/lock transfer</td>
<td><strong>LU</strong></td>
<td>7 or 6</td>
<td>0258 0259 600 601</td>
<td>R/W</td>
<td>0: Unlock state 1: Lock state</td>
<td>0</td>
</tr>
<tr>
<td>307</td>
<td>Set lock level</td>
<td><strong>LK</strong></td>
<td>7 or 6</td>
<td>025A 025B 602 603</td>
<td>R/W</td>
<td>RKC communication The Set lock level is assigned as a bit image in binary numbers. Bit 0: Program setting mode + Parameter select mode Bit 1: Operation transfer mode Bit 2: Parameter setting mode Bit 3 Setup setting mode Bit 4 Engineering mode Bit 5 to Bit 7: Unused Data 0: Unlock 1: Lock Modbus 0 to 31 0: Unlock +1: Program setting mode + Parameter select mode +2: Operation transfer mode +4: Parameter setting mode +8: Setup setting mode +16: Engineering mode To select two or more functions, sum each value.</td>
<td>00000</td>
</tr>
<tr>
<td>308</td>
<td>Select Blind function</td>
<td><strong>BQ</strong></td>
<td>7 or 6</td>
<td>025C 025D 604 605</td>
<td>R/W</td>
<td>0: Blind function: OFF 1: Blind function: ON</td>
<td>0</td>
</tr>
<tr>
<td>No.</td>
<td>Name</td>
<td>Identifier</td>
<td>Digits</td>
<td>Register address</td>
<td>Attribute</td>
<td>Data range</td>
<td>Factory set value</td>
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</table>
| 309 | Parameter select direct registration | **LD**     | 7 or 6 | 025E 025F       | R/W       | 0: Direct registration: OFF  
1: Direct registration: ON | 0 |
| 310 | Parameter select setting 1       | **BA**     | 7 or 6 | 0260 0261       | R/W       | 0 to 253 (Screen No.)  
0: No registration | 0 |
| 311 | Parameter select setting 2       | **BB**     | 7 or 6 | 0262 0263       | R/W       | 0 to 253 (Screen No.)  
0: No registration | 0 |
| 312 | Parameter select setting 3       | **BC**     | 7 or 6 | 0264 0265       | R/W       | 0 to 253 (Screen No.)  
0: No registration | 0 |
| 313 | Parameter select setting 4       | **BD**     | 7 or 6 | 0266 0267       | R/W       | 0 to 253 (Screen No.)  
0: No registration | 0 |
| 314 | Parameter select setting 5       | **BE**     | 7 or 6 | 0268 0269       | R/W       | 0 to 253 (Screen No.)  
0: No registration | 0 |
| 315 | Parameter select setting 6       | **BF**     | 7 or 6 | 026A 026B       | R/W       | 0 to 253 (Screen No.)  
0: No registration | 0 |
| 316 | Parameter select setting 7       | **BG**     | 7 or 6 | 026C 026D       | R/W       | 0 to 253 (Screen No.)  
0: No registration | 0 |
| 317 | Parameter select setting 8       | **BH**     | 7 or 6 | 026E 026F       | R/W       | 0 to 253 (Screen No.)  
0: No registration | 0 |
| 318 | Parameter select setting 9       | **BI**     | 7 or 6 | 0270 0271       | R/W       | 0 to 253 (Screen No.)  
0: No registration | 0 |
| 319 | Parameter select setting 10      | **BJ**     | 7 or 6 | 0272 0273       | R/W       | 0 to 253 (Screen No.)  
0: No registration | 0 |
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Identifier</th>
<th>Digits</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
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<tr>
<td>320</td>
<td>Parameter select setting 11</td>
<td>BK</td>
<td>7 or 6</td>
<td>0274 0275</td>
<td>R/W</td>
<td>0 to 253 (Screen No.) 0: No registration</td>
<td>0</td>
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<tr>
<td>321</td>
<td>Parameter select setting 12</td>
<td>BL</td>
<td>7 or 6</td>
<td>0276 0277</td>
<td>R/W</td>
<td>0 to 253 (Screen No.) 0: No registration</td>
<td>0</td>
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<tr>
<td>322</td>
<td>Parameter select setting 13</td>
<td>BM</td>
<td>7 or 6</td>
<td>0278 0279</td>
<td>R/W</td>
<td>0 to 253 (Screen No.) 0: No registration</td>
<td>0</td>
</tr>
<tr>
<td>323</td>
<td>Parameter select setting 14</td>
<td>BN</td>
<td>7 or 6</td>
<td>027A 027B</td>
<td>R/W</td>
<td>0 to 253 (Screen No.) 0: No registration</td>
<td>0</td>
</tr>
<tr>
<td>324</td>
<td>Parameter select setting 15</td>
<td>BO</td>
<td>7 or 6</td>
<td>027C 027D</td>
<td>R/W</td>
<td>0 to 253 (Screen No.) 0: No registration</td>
<td>0</td>
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<tr>
<td>325</td>
<td>Parameter select setting 16</td>
<td>BP</td>
<td>7 or 6</td>
<td>027E 027F</td>
<td>R/W</td>
<td>0 to 253 (Screen No.) 0: No registration</td>
<td>0</td>
</tr>
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### 6.3.2 Data mapping address [Modbus double word]

Necessary data can be read/written at one time by assigning any desired data (max. 32) continuously.

For the Data mapping, refer to the [5.8 How to Use Modbus Data Mapping (P. 5-15)](#).

#### Register address for data designation

<table>
<thead>
<tr>
<th>No.</th>
<th>Register address setting</th>
<th>Name</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
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<td>Low-order</td>
<td>High-order</td>
<td>Low-order</td>
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<td>HEX</td>
<td>DEC</td>
<td>Low-order</td>
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<tr>
<td>1</td>
<td>Register address setting 1</td>
<td>[Read/write address: Low-order word 1000H, high-order word 1001H]</td>
<td>0500 0501 1280 1281</td>
<td>R/W</td>
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<tr>
<td>2</td>
<td>Register address setting 2</td>
<td>[Read/write address: Low-order word 1002H, high-order word 1003H]</td>
<td>0502 0503 1282 1283</td>
<td>R/W</td>
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<tr>
<td>3</td>
<td>Register address setting 3</td>
<td>[Read/write address: Low-order word 1004H, high-order word 1005H]</td>
<td>0504 0505 1284 1285</td>
<td>R/W</td>
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<tr>
<td>4</td>
<td>Register address setting 4</td>
<td>[Read/write address: Low-order word 1006H, high-order word 1007H]</td>
<td>0506 0507 1286 1287</td>
<td>R/W</td>
<td>Set the register address of data to be assigned to 1000H to 103FH</td>
<td>–1</td>
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<tr>
<td>5</td>
<td>Register address setting 5</td>
<td>[Read/write address: Low-order word 1010H, high-order word 1011H]</td>
<td>0510 0511 1296 1297</td>
<td>R/W</td>
<td>Decimal number: –1 to 32767 (–1: Without mapping)</td>
<td>–1</td>
</tr>
<tr>
<td>6</td>
<td>Register address setting 6</td>
<td>[Read/write address: Low-order word 1012H, high-order word 1013H]</td>
<td>0512 0513 1298 1299</td>
<td>R/W</td>
<td>Hexadecimal numeral: FFFFH to 7FFFH (FFFFH: Without mapping)</td>
<td>–1</td>
</tr>
<tr>
<td>7</td>
<td>Register address setting 7</td>
<td>[Read/write address: Low-order word 1014H, high-order word 1015H]</td>
<td>0514 0515 1300 1301</td>
<td>R/W</td>
<td>The register addresses for data designation (0500H to 053FH) and read/write (1000H to 103FH) will be invalid (without mapping), even if set.</td>
<td>–1</td>
</tr>
<tr>
<td>8</td>
<td>Register address setting 8</td>
<td>[Read/write address: Low-order word 1016H, high-order word 1017H]</td>
<td>0516 0517 1302 1303</td>
<td>R/W</td>
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</table>

 FTC Communication/Modbus (Double Word) [Data Mapping]
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
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<td>Low-order</td>
<td>High-order</td>
<td>Low-order</td>
<td>High-order</td>
</tr>
<tr>
<td>13</td>
<td>Register address setting 13 [Read/write address: Low-order word 1018H, high-order word 1019H]</td>
<td>0518 0519</td>
<td>1304 1305</td>
<td>R/W</td>
<td>–1</td>
</tr>
<tr>
<td>14</td>
<td>Register address setting 14 [Read/write address: Low-order word 101AH, high-order word 101BH]</td>
<td>051A 051B</td>
<td>1306 1307</td>
<td>R/W</td>
<td>–1</td>
</tr>
<tr>
<td>15</td>
<td>Register address setting 15 [Read/write address: Low-order word 101CH, high-order word 101DH]</td>
<td>051C 051D</td>
<td>1308 1309</td>
<td>R/W</td>
<td>–1</td>
</tr>
<tr>
<td>16</td>
<td>Register address setting 16 [Read/write address: Low-order word 101EH, high-order word 101FH]</td>
<td>051E 051F</td>
<td>1310 1311</td>
<td>R/W</td>
<td>–1</td>
</tr>
<tr>
<td>17</td>
<td>Register address setting 17 [Read/write address: Low-order word 1020H, high-order word 1021H]</td>
<td>0520 0521</td>
<td>1312 1313</td>
<td>R/W</td>
<td>–1</td>
</tr>
<tr>
<td>18</td>
<td>Register address setting 18 [Read/write address: Low-order word 1022H, high-order word 1023H]</td>
<td>0522 0523</td>
<td>1314 1315</td>
<td>R/W</td>
<td>–1</td>
</tr>
<tr>
<td>19</td>
<td>Register address setting 19 [Read/write address: Low-order word 1024H, high-order word 1025H]</td>
<td>0524 0525</td>
<td>1316 1317</td>
<td>R/W</td>
<td>–1</td>
</tr>
<tr>
<td>20</td>
<td>Register address setting 20 [Read/write address: Low-order word 1026H, high-order word 1027H]</td>
<td>0526 0527</td>
<td>1318 1319</td>
<td>R/W</td>
<td>–1</td>
</tr>
<tr>
<td>21</td>
<td>Register address setting 21 [Read/write address: Low-order word 1028H, high-order word 1029H]</td>
<td>0528 0529</td>
<td>1320 1321</td>
<td>R/W</td>
<td>–1</td>
</tr>
<tr>
<td>22</td>
<td>Register address setting 22 [Read/write address: Low-order word 102AH, high-order word 102BH]</td>
<td>052A 052B</td>
<td>1322 1323</td>
<td>R/W</td>
<td>–1</td>
</tr>
<tr>
<td>23</td>
<td>Register address setting 23 [Read/write address: Low-order word 102CH, high-order word 102DH]</td>
<td>052C 052D</td>
<td>1324 1325</td>
<td>R/W</td>
<td>–1</td>
</tr>
<tr>
<td>24</td>
<td>Register address setting 24 [Read/write address: Low-order word 102EH, high-order word 102FH]</td>
<td>052E 052F</td>
<td>1326 1327</td>
<td>R/W</td>
<td>–1</td>
</tr>
<tr>
<td>25</td>
<td>Register address setting 25 [Read/write address: Low-order word 1030H, high-order word 1031H]</td>
<td>0530 0531</td>
<td>1328 1329</td>
<td>R/W</td>
<td>–1</td>
</tr>
<tr>
<td>26</td>
<td>Register address setting 26 [Read/write address: Low-order word 1032H, high-order word 1033H]</td>
<td>0532 0533</td>
<td>1330 1331</td>
<td>R/W</td>
<td>–1</td>
</tr>
<tr>
<td>27</td>
<td>Register address setting 27 [Read/write address: Low-order word 1034H, high-order word 1035H]</td>
<td>0534 0535</td>
<td>1332 1333</td>
<td>R/W</td>
<td>–1</td>
</tr>
<tr>
<td>No.</td>
<td>Name</td>
<td>Register address</td>
<td>Attribute</td>
<td>Data range</td>
<td>Factory set value</td>
</tr>
<tr>
<td>-----</td>
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</tr>
<tr>
<td>28</td>
<td>Register address setting 28 [Read/write address: Low-order word 1036H, high-order word 1037H]</td>
<td>0536 0537 1334 1335</td>
<td>R/W</td>
<td>Set the register address of data to be assigned to 1000H to 103FH</td>
<td>–1</td>
</tr>
<tr>
<td>29</td>
<td>Register address setting 29 [Read/write address: Low-order word 1038H, high-order word 1039H]</td>
<td>0538 0539 1336 1337</td>
<td>R/W</td>
<td>Decimal number: –1 to 32767 (–1: Without mapping) Hexadecimal numeral: FFFFH to 7FFFH (FFFFH: Without mapping)</td>
<td>–1</td>
</tr>
<tr>
<td>30</td>
<td>Register address setting 30 [Read/write address: Low-order word 103AH, high-order word 103BH]</td>
<td>053A 053B 1338 1339</td>
<td>R/W</td>
<td>The register addresses for data designation (0500H to 053FH) and read/write (1000H to 103FH) will be invalid (without mapping), even if set.</td>
<td>–1</td>
</tr>
<tr>
<td>31</td>
<td>Register address setting 31 [Read/write address: Low-order word 103CH, high-order word 103DH]</td>
<td>053C 053D 1340 1341</td>
<td>R/W</td>
<td></td>
<td>–1</td>
</tr>
<tr>
<td>32</td>
<td>Register address setting 32 [Read/write address: Low-order word 103EH, high-order word 103FH]</td>
<td>053E 053F 1342 1343</td>
<td>R/W</td>
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<td>–1</td>
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### Register address for data read/write

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<th>Data range</th>
<th>Factory set value</th>
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<td>(Low-order word 0500H, high-order word 0501H)</td>
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<td>(Low-order word 0502H, high-order word 0503H)</td>
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*Based on the data specified at 0500H to 053FH.*
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<th>Factory set value</th>
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<td>Data specified Register address setting 20</td>
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<td>1032 1033 4146 4147</td>
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<td>Data specified Register address setting 27</td>
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<td>32</td>
<td>Data specified Register address setting 32</td>
<td>103E 103F 4158 4159</td>
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</table>

Based on the data specified at 0500H to 053FH.
### 6.3.3 PID group (Level PID) data [Modbus double word]

Register addresses 1500H to 161FH are used to check and change set values belonging to the PID group (Level PID).

#### PID group 1 data

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
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<tbody>
<tr>
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<td>HEX</td>
<td>DEC</td>
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</tr>
<tr>
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<td></td>
<td></td>
<td>Low-order</td>
<td>High-order</td>
<td></td>
</tr>
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<td></td>
<td>Low-order</td>
<td>High-order</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Proportional band [heat-side]</td>
<td>1500 1501</td>
<td>5376</td>
<td>5377</td>
<td>R/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TC/RTD inputs</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0 (0.0, 0.00) to Input span (Unit: °C [°F])</td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
<td>Voltage (V)/Current (I) inputs</td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>0.0 to 1000.0 % of Input span</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0 (0.0, 0.00): ON/OFF action</td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>TC/RTD inputs: 30</td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td>V/I inputs: 3.0</td>
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</tr>
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<td>2</td>
<td>Integral time [heat-side]</td>
<td>1502 1503</td>
<td>5378</td>
<td>5379</td>
<td>R/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>PID control or Heat/Cool PID control</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0 to 3600 seconds, 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0 (0.0, 0.00): PD action</td>
<td></td>
</tr>
<tr>
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<td></td>
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<td></td>
<td>Position proportioning PID control</td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td>1 to 3600 seconds, 0.1 to 360.0 seconds or 0.01 to 360.00 seconds</td>
<td></td>
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<tr>
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<td>[Varies with the setting of the Integral/Derivative time decimal</td>
<td>240</td>
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<tr>
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<td></td>
<td></td>
<td>point position.]</td>
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</tr>
<tr>
<td>3</td>
<td>Derivative time [heat-side]</td>
<td>1504 1505</td>
<td>5380</td>
<td>5381</td>
<td>R/W</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>0 to 3600 seconds, 0.0 to 3600.0 seconds or 0.00 to 360.00 seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 (0.0, 0.00): PI action</td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
<td>Position proportioning PID control</td>
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<td></td>
<td></td>
<td>1 to 3600 seconds, 0.1 to 360.0 seconds or 0.01 to 360.00 seconds</td>
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<td>[Varies with the setting of the Integral/Derivative time decimal</td>
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<tr>
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<td>Control response parameter</td>
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<td>5382</td>
<td>5383</td>
<td>R/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0: Slow 1: Medium 2: Fast</td>
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<td></td>
<td>[When the P or PD action is selected, this setting becomes</td>
<td>2</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>invalid]</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Proactive intensity</td>
<td>1508 1509</td>
<td>5384</td>
<td>5385</td>
<td>R/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 to 4</td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0: No function</td>
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<td></td>
</tr>
<tr>
<td>6</td>
<td>Manual reset</td>
<td>150A 150B</td>
<td>5386</td>
<td>5387</td>
<td>R/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>−100.0 to +100.0 %</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>FF amount</td>
<td>150C 150D</td>
<td>5388</td>
<td>5389</td>
<td>R/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>−100.0 to +100.0 %</td>
<td>0.0</td>
<td></td>
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<tr>
<td>8</td>
<td>Output limiter high [heat-side]</td>
<td>150E 150F</td>
<td>5390</td>
<td>5391</td>
<td>R/W</td>
</tr>
<tr>
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<td></td>
<td>Output limiter low [heat-side] to 105.0 %</td>
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<tr>
<td>9</td>
<td>Output limiter low [heat-side]</td>
<td>1510 1511</td>
<td>5392</td>
<td>5393</td>
<td>R/W</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>−5.0 % to Output limiter high [heat-side]</td>
<td>−5.0</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Name</td>
<td>Register address</td>
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<td>Data range</td>
<td>Factory set value</td>
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<td>-----</td>
<td>-----------------------------------</td>
<td>------------------</td>
<td>-----------</td>
<td>------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Low-order</td>
<td>High-order</td>
<td>Low-order</td>
</tr>
<tr>
<td>10</td>
<td>Control loop break alarm (LBA) time</td>
<td>1512 1513</td>
<td>5394</td>
<td>5395</td>
<td>R/W</td>
</tr>
<tr>
<td>11</td>
<td>LBA deadband (LBD)</td>
<td>1514 1515</td>
<td>5396</td>
<td>5397</td>
<td>R/W</td>
</tr>
<tr>
<td>12</td>
<td>Unused</td>
<td>1516 1517</td>
<td>5398</td>
<td>5399</td>
<td>—</td>
</tr>
<tr>
<td>13</td>
<td>Proportional band [cool-side]</td>
<td>1518 1519</td>
<td>5400</td>
<td>5401</td>
<td>R/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Integral time [cool-side]</td>
<td>151A 151B</td>
<td>5402</td>
<td>5403</td>
<td>R/W</td>
</tr>
<tr>
<td>15</td>
<td>Derivative time [cool-side]</td>
<td>151C 151D</td>
<td>5404</td>
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<td>R/W</td>
</tr>
<tr>
<td>16</td>
<td>Overlap/Deadband</td>
<td>151E 151F</td>
<td>5406</td>
<td>5407</td>
<td>R/W</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Output limiter high [cool-side]</td>
<td>1520 1521</td>
<td>5408</td>
<td>5409</td>
<td>R/W</td>
</tr>
<tr>
<td>18</td>
<td>Output limiter low [heat-side]</td>
<td></td>
<td></td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td></td>
<td>Output limiter low [cool-side]</td>
<td>1522 1523</td>
<td>5410</td>
<td>5411</td>
<td>R/W</td>
</tr>
</tbody>
</table>
### PID group 2 to 5 data

Register address for PID group 2 to 5.

For details of attribute, data range and factory set values, refer to the same line No. in **PID group 1 data** (P.6-61).

When the Level PID action selection is "0: No Level PID", PID group numbers 02 to 08 are invalid and the response is NAK (Negative Acknowledge).

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
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<th>PID group 3</th>
<th>PID group 4</th>
<th>PID group 5</th>
</tr>
</thead>
<tbody>
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<td>Register address</td>
<td>Register address</td>
<td>Register address</td>
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<td>HEX</td>
<td>DEC</td>
<td>HEX</td>
<td>DEC</td>
</tr>
<tr>
<td>1</td>
<td>Proportional band [heat-side]</td>
<td>1524   1525</td>
<td>5412  5413</td>
<td>1548  1549</td>
<td>5448  5449</td>
</tr>
<tr>
<td>2</td>
<td>Integral time [heat-side]</td>
<td>1526   1527</td>
<td>5414  5415</td>
<td>154A  154B</td>
<td>5450  5451</td>
</tr>
<tr>
<td>3</td>
<td>Derivative time [heat-side]</td>
<td>1528   1529</td>
<td>5416  5417</td>
<td>154C  154D</td>
<td>5452  5453</td>
</tr>
<tr>
<td>4</td>
<td>Control response parameter</td>
<td>152A   152B</td>
<td>5418  5419</td>
<td>154E  154F</td>
<td>5454  5455</td>
</tr>
<tr>
<td>5</td>
<td>Proactive intensity</td>
<td>152C   152D</td>
<td>5420  5421</td>
<td>1550  1551</td>
<td>5456  5457</td>
</tr>
<tr>
<td>6</td>
<td>Manual reset</td>
<td>152E   152F</td>
<td>5422  5423</td>
<td>1552  1553</td>
<td>5458  5459</td>
</tr>
<tr>
<td>7</td>
<td>FF amount</td>
<td>1530   1531</td>
<td>5424  5425</td>
<td>1554  1555</td>
<td>5460  5461</td>
</tr>
<tr>
<td>8</td>
<td>Output limiter high [heat-side]</td>
<td>1532  1533</td>
<td>5426  5427</td>
<td>1556  1557</td>
<td>5462  5463</td>
</tr>
<tr>
<td>9</td>
<td>Output limiter low [heat-side]</td>
<td>1534  1535</td>
<td>5428  5429</td>
<td>1558  1559</td>
<td>5464  5465</td>
</tr>
<tr>
<td>10</td>
<td>Control loop break alarm (LBA) time</td>
<td>1536  1537</td>
<td>5430  5431</td>
<td>155A  155B</td>
<td>5466  5467</td>
</tr>
<tr>
<td>11</td>
<td>LBA deadband (LBD)</td>
<td>1538   1539</td>
<td>5432  5433</td>
<td>155C  155D</td>
<td>5468  5469</td>
</tr>
<tr>
<td>12</td>
<td>Unused</td>
<td>153A   153B</td>
<td>5434  5435</td>
<td>155E  155F</td>
<td>5470  5471</td>
</tr>
<tr>
<td>13</td>
<td>Proportional band [cool-side]</td>
<td>153C  153D</td>
<td>5436  5437</td>
<td>1560  1561</td>
<td>5472  5473</td>
</tr>
<tr>
<td>14</td>
<td>Integral time [cool-side]</td>
<td>153E   153F</td>
<td>5438  5439</td>
<td>1562  1563</td>
<td>5474  5475</td>
</tr>
<tr>
<td>15</td>
<td>Derivative time [cool-side]</td>
<td>1540   1541</td>
<td>5440  5441</td>
<td>1564  1565</td>
<td>5476  5477</td>
</tr>
<tr>
<td>16</td>
<td>Overlap/Deadband</td>
<td>1542   1543</td>
<td>5442  5443</td>
<td>1566  1567</td>
<td>5478  5479</td>
</tr>
<tr>
<td>17</td>
<td>Output limiter high [cool-side]</td>
<td>1544  1545</td>
<td>5444  5445</td>
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<tr>
<td>18</td>
<td>Output limiter low [heat-side]</td>
<td>1546  1547</td>
<td>5446  5447</td>
<td>156A  156B</td>
<td>5482  5483</td>
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</tbody>
</table>
### PID group 6 to 8 data

Register address for PID group 6 to 8.

For details of attribute, data range and factory set values, refer to the same line No. in [PID group 1 data (P.6-61)].

When the Level PID action selection is “0: No Level PID”, PID group numbers 02 to 08 are invalid and the response is NAK (Negative Acknowledge).

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>PID group 6</th>
<th>PID group 7</th>
<th>PID group 8</th>
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<td>Register address</td>
<td>Register address</td>
</tr>
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<td>Low: Low-order</td>
<td>High: High-order</td>
<td>Low: Low-order</td>
<td>High: High-order</td>
</tr>
<tr>
<td>1</td>
<td>Proportional band [heat-side]</td>
<td>15B4 HE 15B5 DEC 5556 DEC 5557</td>
<td>15D8 HE 15D9 DEC 5592 DEC 5593</td>
<td>15FC HE 15FD DEC 5628 DEC 5629</td>
</tr>
<tr>
<td>2</td>
<td>Integral time [heat-side]</td>
<td>15B6 HE 15B7 DEC 5558 DEC 5559</td>
<td>15DA HE 15DB DEC 5594 DEC 5595</td>
<td>15FE HE 15FF DEC 5630 DEC 5631</td>
</tr>
<tr>
<td>3</td>
<td>Derivative time [heat-side]</td>
<td>15B8 HE 15B9 DEC 5560 DEC 5561</td>
<td>15DC HE 15DD DEC 5596 DEC 5597</td>
<td>1600 HE 1601 DEC 5632 DEC 5633</td>
</tr>
<tr>
<td>4</td>
<td>Control response parameter</td>
<td>15BA HE 15BB DEC 5562 DEC 5563</td>
<td>15DE HE 15DF DEC 5598 DEC 5599</td>
<td>1602 HE 1603 DEC 5634 DEC 5635</td>
</tr>
<tr>
<td>5</td>
<td>Proactive intensity</td>
<td>15BC HE 15BD DEC 5564 DEC 5565</td>
<td>15E0 HE 15E1 DEC 5600 DEC 5601</td>
<td>1604 HE 1605 DEC 5636 DEC 5637</td>
</tr>
<tr>
<td>6</td>
<td>Manual reset</td>
<td>15BE HE 15BF DEC 5566 DEC 5567</td>
<td>15E2 HE 15E3 DEC 5602 DEC 5603</td>
<td>1606 HE 1607 DEC 5638 DEC 5639</td>
</tr>
<tr>
<td>7</td>
<td>FF amount</td>
<td>15C0 HE 15C1 DEC 5568 DEC 5569</td>
<td>15E4 HE 15E5 DEC 5604 DEC 5605</td>
<td>1608 HE 1609 DEC 5640 DEC 5641</td>
</tr>
<tr>
<td>8</td>
<td>Output limiter high [heat-side]</td>
<td>15C2 HE 15C3 DEC 5570 DEC 5571</td>
<td>15E6 HE 15E7 DEC 5606 DEC 5607</td>
<td>160A HE 160B DEC 5642 DEC 5643</td>
</tr>
<tr>
<td>9</td>
<td>Output limiter low [heat-side]</td>
<td>15C4 HE 15C5 DEC 5572 DEC 5573</td>
<td>15E8 HE 15E9 DEC 5608 DEC 5609</td>
<td>160C HE 160D DEC 5644 DEC 5645</td>
</tr>
<tr>
<td>10</td>
<td>Control loop break alarm (LBA) time</td>
<td>15C6 HE 15C7 DEC 5574 DEC 5575</td>
<td>15EA HE 15EB DEC 5610 DEC 5611</td>
<td>160E HE 160F DEC 5646 DEC 5647</td>
</tr>
<tr>
<td>11</td>
<td>LBA deadband (LBD)</td>
<td>15C8 HE 15C9 DEC 5576 DEC 5577</td>
<td>15EC HE 15ED DEC 5612 DEC 5613</td>
<td>1610 HE 1611 DEC 5648 DEC 5649</td>
</tr>
<tr>
<td>12</td>
<td>Unused</td>
<td>15CA HE 15CB DEC 5578 DEC 5579</td>
<td>15EE HE 15EF DEC 5614 DEC 5615</td>
<td>1612 HE 1613 DEC 5650 DEC 5651</td>
</tr>
<tr>
<td>13</td>
<td>Proportional band [cool-side]</td>
<td>15CC HE 15CD DEC 5580 DEC 5581</td>
<td>15F0 HE 15F1 DEC 5616 DEC 5617</td>
<td>1614 HE 1615 DEC 5652 DEC 5653</td>
</tr>
<tr>
<td>14</td>
<td>Integral time [cool-side]</td>
<td>15CE HE 15CF DEC 5582 DEC 5583</td>
<td>15F2 HE 15F3 DEC 5618 DEC 5619</td>
<td>1616 HE 1617 DEC 5654 DEC 5655</td>
</tr>
<tr>
<td>15</td>
<td>Derivative time [cool-side]</td>
<td>15D0 HE 15D1 DEC 5584 DEC 5585</td>
<td>15F4 HE 15F5 DEC 5620 DEC 5621</td>
<td>1618 HE 1619 DEC 5656 DEC 5657</td>
</tr>
<tr>
<td>16</td>
<td>Overlap/Deadband</td>
<td>15D2 HE 15D3 DEC 5586 DEC 5587</td>
<td>15F6 HE 15F7 DEC 5622 DEC 5623</td>
<td>161A HE 161B DEC 5658 DEC 5659</td>
</tr>
<tr>
<td>17</td>
<td>Output limiter high [cool-side]</td>
<td>15D4 HE 15D5 DEC 5588 DEC 5589</td>
<td>15F8 HE 15F9 DEC 5624 DEC 5625</td>
<td>161C HE 161D DEC 5660 DEC 5661</td>
</tr>
<tr>
<td>18</td>
<td>Output limiter low [heat-side]</td>
<td>15D6 HE 15D7 DEC 5590 DEC 5591</td>
<td>15FA HE 15FB DEC 5626 DEC 5627</td>
<td>161E HE 161F DEC 5662 DEC 5663</td>
</tr>
</tbody>
</table>
### 6.3.4 Pattern & Segment group data [Modbus double word]

Register addresses 3000H to 35FFH are used to check and change set values belonging to the Pattern & Segment group.

#### Data description (Name, Attribute, Data range, Factory set value)

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Segment level</td>
<td>R/W</td>
<td>Setting limiter low to Setting limiter high</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[Varies with the setting of the Decimal point position.]</td>
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### Register address for Segment 1 to 16 of Pattern 1 to 4

Register address for Segment 1 to 16 of Pattern 1 to 4. For details of attribute, data range and factory set values, refer to the same line No. in Data description (Name, Attribute, Data range, Factory set value) (P.6-65).

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### Register address for Segment 1 to 16 of Pattern 5 to 8

Register address for Segment 1 to 16 of Pattern 5 to 8. For details of attribute, data range and factory set values, refer to the same line No. in **Data description (Name, Attribute, Data range, Factory set value)** (P.6-65).

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Register address for Segment 1 to 16 of Pattern 9 to 12

Register address for Segment 1 to 16 of Pattern 9 to 12. For details of attribute, data range and factory set values, refer to the same line No. in Data description (Name, Attribute, Data range, Factory set value) (P.6-65).

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### Register address for Segment 1 to 16 of Pattern 13 to 16

Register address for Segment 1 to 16 of Pattern 13 to 16. For details of attribute, data range and factory set values, refer to the same line No. in Data description (Name, Attribute, Data range, Factory set value) (P.6-65).

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RKC communication: 0:00 (0 hour 00 minute)

Modbus: 0 to 11999 minutes
0 to 11999 seconds
0: Output remains on

[Time unit depends on the time unit of the setting]
## Pattern 2 to 5 data

Register address for Pattern 2 to 5.

For details of attribute, data range and factory set values, refer to the same line No. in **Pattern 1 data (P.6-75).**

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# Pattern 6 to 9 data

Register address for Pattern 6 to 9.

For details of attribute, data range and factory set values, refer to the same line No. in # Pattern 1 data (P.6-75).

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## Pattern 10 to 13 data

Register address for Pattern 10 to 13.

For details of attribute, data range and factory set values, refer to the same line No. in **Pattern 1 data** (P.6-75).

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### Pattern 14 to 16 data

Register address for Pattern 14 to 16

For details of attribute, data range and factory set values, refer to the same line No. in **Pattern 1 data (P.6-75)**.

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### 6.4 Modbus (Single Word) Data

#### 6.4.1 Communication data [Modbus single word]

The following table shows single word register address of Modbus. For attribute, data range, and factory set values, refer to 6.3.1 Communication data [RKC communication identifier/Modbus double word] (P. 6-8).

When Input data type is set to “1,” the communication data will be Modbus single word.

Switch over between the single word and the double word can be done at Input data type. For the Input data type, refer to the 3.2 Selection of Communication Data Type (P. 3-5).

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Items 142 to 320 are data in the Engineering mode.

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**WARNING**

Communication data the Engineering mode should be set according to the application before setting any parameter related to operation. Once the communication data in the Engineering mode are set correctly, no further changes need to be made to parameters for the same application under normal conditions. If they are changed unnecessarily, it may result in malfunction or failure of the instrument. RKC will not bear any responsibility for malfunction or failure as a result of improper changes in the Engineering mode.

---

**NOTE**

Make sure to be in the Reset mode (RESET) before conducting parameter setting in the Engineering mode. However, only checking can be made even in the Program control mode (RUN), the Fixed set point control mode (FIX) and the Manual control mode (MAN).

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<tr>
<td>320</td>
<td>Parameter select setting 16</td>
<td>013F 319</td>
<td>325</td>
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</tbody>
</table>
6.4.2 Data mapping address [Modbus single word]

Necessary data can be read/written at one time by assigning any desired data (max. 32) continuously.

For the Data mapping, refer to the 5.8 How to Use Modbus Data Mapping (P. 5-15).

### Register address for data designation

<table>
<thead>
<tr>
<th>No.</th>
<th>Register address setting</th>
<th>Name</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
</table>
| 1   | Register address setting 1 | [Read/write address: 1000H] | 0500 | 1280 | R/W | Set the register address of data to be assigned to 1000H to 101FH
| 2   | Register address setting 2 | [Read/write address: 1001H] | 0501 | 1281 | R/W | Decimal number: -1 to 32767
| 3   | Register address setting 3 | [Read/write address: 1002H] | 0502 | 1282 | R/W | (-1: Without mapping)
| 4   | Register address setting 4 | [Read/write address: 1003H] | 0503 | 1283 | R/W | Hexadecimal numeral: FFFFH to 7FFFH
| 5   | Register address setting 5 | [Read/write address: 1004H] | 0504 | 1284 | R/W | (FFFFH: Without mapping)
| 6   | Register address setting 6 | [Read/write address: 1005H] | 0505 | 1285 | R/W | -1
| 7   | Register address setting 7 | [Read/write address: 1006H] | 0506 | 1286 | R/W | -1
| 8   | Register address setting 8 | [Read/write address: 1007H] | 0507 | 1287 | R/W | -1
| 9   | Register address setting 9 | [Read/write address: 1008H] | 0508 | 1288 | R/W | -1
| 10  | Register address setting 10 | [Read/write address: 1009H] | 0509 | 1289 | R/W | -1
| 11  | Register address setting 11 | [Read/write address: 100AH] | 050A | 1290 | R/W | -1
| 12  | Register address setting 12 | [Read/write address: 100BH] | 050B | 1291 | R/W | -1
| 13  | Register address setting 13 | [Read/write address: 100CH] | 050C | 1292 | R/W | -1
| 14  | Register address setting 14 | [Read/write address: 100DH] | 050D | 1293 | R/W | -1
| 15  | Register address setting 15 | [Read/write address: 100EH] | 050E | 1294 | R/W | -1
| 16  | Register address setting 16 | [Read/write address: 100FH] | 050F | 1295 | R/W | -1
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Register address setting</th>
<th>HEX</th>
<th>DEC</th>
<th>Attribute</th>
<th>Data range</th>
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</thead>
<tbody>
<tr>
<td>17</td>
<td>Register address setting 17</td>
<td>[Read/write address: 1010H]</td>
<td>0510</td>
<td>1296</td>
<td>R/W</td>
<td>Set the register address of data to be assigned to 1000H to 101FH</td>
</tr>
<tr>
<td>18</td>
<td>Register address setting 18</td>
<td>[Read/write address: 1011H]</td>
<td>0511</td>
<td>1297</td>
<td>R/W</td>
<td>Decimal number: –1 to 32767&lt;br&gt;(–1: Without mapping)</td>
</tr>
<tr>
<td>19</td>
<td>Register address setting 19</td>
<td>[Read/write address: 1012H]</td>
<td>0512</td>
<td>1298</td>
<td>R/W</td>
<td>Hexadecimal numeral: FFFFH to 7FFFH&lt;br&gt;(FFFFH: Without mapping)</td>
</tr>
<tr>
<td>20</td>
<td>Register address setting 20</td>
<td>[Read/write address: 1013H]</td>
<td>0513</td>
<td>1299</td>
<td>R/W</td>
<td>The register addresses for data designation (0500H to 051FH) and read/write (1000H to 101FH) will be invalid (without mapping), even if set.</td>
</tr>
<tr>
<td>21</td>
<td>Register address setting 21</td>
<td>[Read/write address: 1014H]</td>
<td>0514</td>
<td>1300</td>
<td>R/W</td>
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<tr>
<td>22</td>
<td>Register address setting 22</td>
<td>[Read/write address: 1015H]</td>
<td>0515</td>
<td>1301</td>
<td>R/W</td>
<td>–1</td>
</tr>
<tr>
<td>23</td>
<td>Register address setting 23</td>
<td>[Read/write address: 1016H]</td>
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<td>24</td>
<td>Register address setting 24</td>
<td>[Read/write address: 1017H]</td>
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<td>26</td>
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<td>[Read/write address: 1019H]</td>
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<tr>
<td>27</td>
<td>Register address setting 27</td>
<td>[Read/write address: 101AH]</td>
<td>051A</td>
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<tr>
<td>28</td>
<td>Register address setting 28</td>
<td>[Read/write address: 101BH]</td>
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<td>1307</td>
<td>R/W</td>
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<tr>
<td>29</td>
<td>Register address setting 29</td>
<td>[Read/write address: 101CH]</td>
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<td>1308</td>
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<tr>
<td>30</td>
<td>Register address setting 30</td>
<td>[Read/write address: 101DH]</td>
<td>051D</td>
<td>1309</td>
<td>R/W</td>
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<tr>
<td>31</td>
<td>Register address setting 31</td>
<td>[Read/write address: 101EH]</td>
<td>051E</td>
<td>1310</td>
<td>R/W</td>
<td>–1</td>
</tr>
<tr>
<td>32</td>
<td>Register address setting 32</td>
<td>[Read/write address: 101FH]</td>
<td>051F</td>
<td>1311</td>
<td>R/W</td>
<td>–1</td>
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### Register address for data read/write

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<th>No.</th>
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<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
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<tbody>
<tr>
<td>1</td>
<td>Data specified Register address setting 1 (0500H)</td>
<td>1000 4096</td>
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<td>2</td>
<td>Data specified Register address setting 2 (0501H)</td>
<td>1001 4097</td>
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<td>3</td>
<td>Data specified Register address setting 3 (0502H)</td>
<td>1002 4098</td>
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<td>4</td>
<td>Data specified Register address setting 4 (0503H)</td>
<td>1003 4099</td>
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<td>5</td>
<td>Data specified Register address setting 5 (0504H)</td>
<td>1004 4100</td>
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<tr>
<td>6</td>
<td>Data specified Register address setting 6 (0505H)</td>
<td>1005 4101</td>
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<td>7</td>
<td>Data specified Register address setting 7 (0506H)</td>
<td>1006 4102</td>
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<td>8</td>
<td>Data specified Register address setting 8 (0507H)</td>
<td>1007 4103</td>
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<td>9</td>
<td>Data specified Register address setting 9 (0508H)</td>
<td>1008 4104</td>
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<td>1009 4105</td>
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<td>11</td>
<td>Data specified Register address setting 11 (050AH)</td>
<td>100A 4106</td>
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<td>12</td>
<td>Data specified Register address setting 12 (050BH)</td>
<td>100B 4107</td>
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<td>13</td>
<td>Data specified Register address setting 13 (050CH)</td>
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<td>14</td>
<td>Data specified Register address setting 14 (050DH)</td>
<td>100D 4109</td>
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<td>15</td>
<td>Data specified Register address setting 15 (050EH)</td>
<td>100E 4110</td>
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<td>16</td>
<td>Data specified Register address setting 16 (050FH)</td>
<td>100F 4111</td>
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<td>17</td>
<td>Data specified Register address setting 17 (0510H)</td>
<td>1010 4112</td>
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<td>18</td>
<td>Data specified Register address setting 18 (0511H)</td>
<td>1011 4113</td>
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<td>19</td>
<td>Data specified Register address setting 19 (0512H)</td>
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<tr>
<td>20</td>
<td>Data specified Register address setting 20 (0513H)</td>
<td>1013 4115</td>
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<tr>
<td>21</td>
<td>Data specified Register address setting 21 (0514H)</td>
<td>1014 4116</td>
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<tr>
<td>22</td>
<td>Data specified Register address setting 22 (0515H)</td>
<td>1015 4117</td>
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</table>

*Based on the data specified at 0500H to 051FH.*
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>Data specified Register address setting 23 (0516H)</td>
<td>1016</td>
<td>DEC</td>
<td>4118</td>
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</tr>
<tr>
<td>24</td>
<td>Data specified Register address setting 24 (0517H)</td>
<td>1017</td>
<td>DEC</td>
<td>4119</td>
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</tr>
<tr>
<td>25</td>
<td>Data specified Register address setting 25 (0518H)</td>
<td>1018</td>
<td>DEC</td>
<td>4120</td>
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<td>26</td>
<td>Data specified Register address setting 26 (0519H)</td>
<td>1019</td>
<td>DEC</td>
<td>4121</td>
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</tr>
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<td>27</td>
<td>Data specified Register address setting 27 (051AH)</td>
<td>101A</td>
<td>DEC</td>
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<td>28</td>
<td>Data specified Register address setting 28 (051BH)</td>
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<td>DEC</td>
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</tr>
<tr>
<td>29</td>
<td>Data specified Register address setting 29 (051CH)</td>
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<td>30</td>
<td>Data specified Register address setting 30 (051DH)</td>
<td>101D</td>
<td>DEC</td>
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<td>31</td>
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<td>32</td>
<td>Data specified Register address setting 32 (051FH)</td>
<td>101F</td>
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</table>

*Based on the data specified at 0500H to 051FH.*
6.4.3 PID group (Level PID) data [Modbus single word]

Register addresses 1500H to 158FH are used to check and change set values belonging to the PID group (Level PID). For the details of attribute, data range and factory set values, refer to **PID group 1 data (P.6-61), 6.3.3 PID group (Level PID) data [Modbus double word].**

When the Level PID action selection is “0: No Level PID”, PID group numbers 02 to 08 are invalid and the response is NAK (Negative Acknowledge).

**■ PID group 1 to 6 data**

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>PID group 1</th>
<th>PID group 2</th>
<th>PID group 3</th>
<th>PID group 4</th>
<th>PID group 5</th>
<th>PID group 6</th>
<th>6.3.3 Reference No.</th>
</tr>
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<td>DEC</td>
<td>HEX</td>
<td>DEC</td>
<td>HEX</td>
<td>DEC</td>
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<tr>
<td>1</td>
<td>Proportional band [heat-side]</td>
<td>1500</td>
<td>5376</td>
<td>1512</td>
<td>5394</td>
<td>1524</td>
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<td>1536</td>
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<td>2</td>
<td>Integral time [heat-side]</td>
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<td>5377</td>
<td>1513</td>
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<td>1525</td>
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<td>Derivative time [heat-side]</td>
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<td>1526</td>
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<td>4</td>
<td>Control response parameter</td>
<td>1503</td>
<td>5379</td>
<td>1515</td>
<td>5397</td>
<td>1527</td>
<td>5415</td>
<td>1539</td>
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<td>Proactive intensity</td>
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<td>5380</td>
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<td>5398</td>
<td>1528</td>
<td>5416</td>
<td>153A</td>
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<td>6</td>
<td>Manual reset</td>
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<td>5381</td>
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<td>5399</td>
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<td>5417</td>
<td>153B</td>
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<td>5400</td>
<td>152A</td>
<td>5418</td>
<td>153C</td>
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<td>8</td>
<td>Output limiter high [heat-side]</td>
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<td>5383</td>
<td>1519</td>
<td>5401</td>
<td>152B</td>
<td>5419</td>
<td>153D</td>
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<td>9</td>
<td>Output limiter low [heat-side]</td>
<td>1508</td>
<td>5384</td>
<td>151A</td>
<td>5402</td>
<td>152C</td>
<td>5420</td>
<td>153E</td>
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<td>10</td>
<td>Control loop break alarm (LBA)</td>
<td>1509</td>
<td>5385</td>
<td>151B</td>
<td>5403</td>
<td>152D</td>
<td>5421</td>
<td>153F</td>
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<td>11</td>
<td>LBA deadband (LBD)</td>
<td>150A</td>
<td>5386</td>
<td>151C</td>
<td>5404</td>
<td>152E</td>
<td>5422</td>
<td>1540</td>
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<td>151D</td>
<td>5405</td>
<td>152F</td>
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<td>Proportional band [cool-side]</td>
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<td>Overlap/Deadband</td>
<td>150F</td>
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### PID group 7 to 8 data

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<th>Reference No.</th>
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<td>HEX  DEC</td>
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<td>156E 5486</td>
<td>1580 5504</td>
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<td>1581 5505</td>
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<td>1570 5488</td>
<td>1582 5506</td>
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<td>1584 5508</td>
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<td>1586 5510</td>
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<td>Control loop break alarm (LBA) time</td>
<td>1575 5493</td>
<td>1587 5511</td>
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</tr>
<tr>
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6.4.4 Pattern & Segment group data [Modbus single word]

Register addresses 3000H to 31FFH are used to check and change set values belonging to the Pattern & Segment group.
For the details of attribute, data range and factory set values, refer to Data description (Name, Attribute, Data range, Factory set value) (P.6-65), 6.3.4 Pattern & Segment group data [Modbus double word].

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### 6.4.5 Pattern group data [Modbus single word]

Register addresses 5000H to 51BFH are used to check and change set values belonging to the Pattern group.

For the details of attribute, data range and factory set values, refer to ■ Pattern 1 data (P.6-75), 6.3.5 Pattern group data [Modbus double word].

■ Pattern 1 to 6 data

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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>7</td>
<td>Event 2 set value (EV2’) [low]</td>
<td>5156</td>
<td>20822</td>
<td>5172</td>
<td>20850</td>
<td>518E</td>
</tr>
<tr>
<td>8</td>
<td>Event 3 set value (EV3)</td>
<td>5157</td>
<td>20823</td>
<td>5173</td>
<td>20851</td>
<td>518F</td>
</tr>
<tr>
<td></td>
<td>When Event 3 type is either high or low limit with individual setting</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Event 3 set value (EV3) [high]</td>
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</tr>
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<td>9</td>
<td>Event 3 set value (EV3’) [low]</td>
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<tr>
<td>10</td>
<td>Event 4 set value (EV4)</td>
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<td>20825</td>
<td>5175</td>
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<tr>
<td></td>
<td>When Event 4 type is either high or low limit with individual setting</td>
<td></td>
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<td>No.</td>
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<td>Pattern 14</td>
<td>Pattern 15</td>
<td>Pattern 16</td>
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<td>------------------------------------</td>
<td>------------</td>
<td>------------</td>
<td>------------</td>
<td>------------</td>
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<tr>
<td></td>
<td></td>
<td>Register address</td>
<td>Register address</td>
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<td>Register address</td>
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<td>DEC</td>
<td>HEX</td>
<td>DEC</td>
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<td>20840</td>
<td>5184</td>
<td>20868</td>
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<tr>
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<td>20841</td>
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<td>Time signal 4 end time</td>
<td>516A</td>
<td>20842</td>
<td>5186</td>
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<td>51A2</td>
</tr>
<tr>
<td>28</td>
<td>Pattern end output time</td>
<td>516B</td>
<td>20843</td>
<td>5187</td>
<td>20871</td>
<td>51A3</td>
</tr>
</tbody>
</table>
This chapter describes how to cope with errors during the communication.

7.1 RKC Communication ................................................................. 7-3
7.2 Modbus .................................................................
7. TROUBLESHOOTING

WARNING

- To prevent electric shock or instrument failure, always turn off the system power before replacing the instrument.
- To prevent electric shock or instrument failure, always turn off the power before mounting or removing the instrument.
- To prevent electric shock or instrument failure, do not turn on the power until all wiring is completed. Make sure that the wiring is correct before applying power to the instrument.
- To prevent electric shock or instrument failure, do not touch the inside of the instrument.
- All wiring must be performed by authorized personnel with electrical experience in this type of work.

CAUTION

All wiring must be completed before power is turned on to prevent electric shock, instrument failure, or incorrect action. The power must be turned off before repairing work for input break and output failure including replacement of sensor, contactor or SSR, and all wiring must be completed before power is turned on again.
This section lists some of the main causes and solutions for communication problems. If you cannot solve a problem, please contact RKC sales office or the agent, on confirming the type name and specifications of the product.

### 7.1 RKC Communication

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>No response</td>
<td>Wrong connection, no connection or disconnection of the communication cable</td>
<td>Confirm the connection method or condition and connect correctly</td>
</tr>
<tr>
<td></td>
<td>Breakage, wrong wiring, or imperfect contact of the communication cable</td>
<td>Confirm the wiring or connector and repair or replace the wrong one</td>
</tr>
<tr>
<td></td>
<td>Mismatch of the setting data of communication speed and data bit configuration with those of the host computer</td>
<td>Confirm the settings and set them correctly</td>
</tr>
<tr>
<td>Wrong address setting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error in the data format</td>
<td></td>
<td>Re-examine the communication program</td>
</tr>
<tr>
<td>Transmission line is not set to the receive state after data send (for RS-485)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication protocol setting is wrong</td>
<td></td>
<td>Set “0: RKC communication” at Communication protocol referring to 3.1 Setting of Communication Parameter (P. 3-2).</td>
</tr>
<tr>
<td>EOT return</td>
<td>The specified identifier is invalid</td>
<td>Confirm the identifier is correct or that with the correct function is specified. Otherwise correct it</td>
</tr>
<tr>
<td>Error in the data format</td>
<td></td>
<td>Reexamine the communication program</td>
</tr>
<tr>
<td>NAK return</td>
<td>Error occurs on the line (parity bit error, framing error, etc.)</td>
<td>Confirm the cause of error, and solve the problem appropriately. (Confirm the transmitting data, and resend data)</td>
</tr>
<tr>
<td>BCC error</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The data exceeds the setting range</td>
<td></td>
<td>Confirm the setting range and transmit correct data</td>
</tr>
<tr>
<td>The specified identifier is invalid</td>
<td></td>
<td>Confirm the identifier is correct or that with the correct function is specified. Otherwise correct it</td>
</tr>
</tbody>
</table>
## 7.2 Modbus

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>No response</td>
<td>Wrong connection, no connection or disconnection of the communication cable</td>
<td>Confirm the connection method or condition and connect correctly</td>
</tr>
<tr>
<td></td>
<td>Breakage, wrong wiring, or imperfect contact of the communication cable</td>
<td>Confirm the wiring or connector and repair or replace the wrong one</td>
</tr>
<tr>
<td></td>
<td>Mismatch of the setting data of communication speed and data bit configuration with those of the host computer</td>
<td>Confirm the settings and set them correctly</td>
</tr>
<tr>
<td>Wrong address setting</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A transmission error (overrun error, framing error, parity error or CRC-16 error) is found in the query message</td>
<td>Re-transmit after time-out occurs or verify communication program</td>
</tr>
<tr>
<td></td>
<td>The time interval between adjacent data in the query message is too long, exceeding 24-bit time</td>
<td></td>
</tr>
<tr>
<td>Communication protocol setting is wrong</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Set “1” or “2” at Communication protocol referring to 3.1 Setting of Communication Parameter (P. 3-2).**

1: Modbus
   (Order of data transfer: high-order word to low-order word)

2: Modbus
   (Order of data transfer: low-order word to high-order word)

<table>
<thead>
<tr>
<th>Error code</th>
<th>Function code error</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Error code 1</td>
<td>Function code error (Specifying nonexistent function code)</td>
<td>Confirm the function code</td>
</tr>
<tr>
<td>Error code 2</td>
<td>When the mismatched address is specified.</td>
<td>Confirm the address of holding register</td>
</tr>
<tr>
<td>Error code 3</td>
<td>When the specified number of data items in the query message exceeds the maximum number of data items available</td>
<td>Confirm the setting data</td>
</tr>
<tr>
<td>Error code 4</td>
<td>Self-diagnostic error</td>
<td>Turn off the power to the instrument. If the same error occurs when the power is turned back on, please contact RKC sales office or the agent.</td>
</tr>
</tbody>
</table>
This chapter describes the specification of the host communication.

8.1 RKC Communication............................................................... 8-2
8.2 Modbus ............................................................................... 8-3
8.3 Loader Communication........................................................... 8-4
8. SPECIFICATIONS

8.1 RKC Communication

Interface: Based on RS-485, EIA standard
Based on RS-422A, EIA standard

Connection method: 2-wire system, half-duplex multi-drop connection

Synchronous method: Start/Stop synchronous type

Communication speed: 2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps

Protocol: ANSI X3.28-1976 subcategories 2.5 and A4
Polling/Selecting type

Data bit configuration: Start bit: 1
Data bit: 7 or 8
Parity bit: Without, Odd or Even
Stop bit: 1 or 2

Error control: Vertical parity (With parity bit selected)
Horizontal parity (BCC check)

Communication code: ASCII 7-bit code

Termination resistor: Externally terminal connected (120 Ω 1/2 W)

Xon/Xoff control: None

Maximum connections: Up to 31 controllers

Signal logic: RS-485/RS-422A

<table>
<thead>
<tr>
<th>Signal logic</th>
<th>Logic</th>
</tr>
</thead>
<tbody>
<tr>
<td>V (A) – V (B) ≥ 1.5 V</td>
<td>0 (SPACE)</td>
</tr>
<tr>
<td>V (A) – V (B) ≤ −1.5 V</td>
<td>1 (MARK)</td>
</tr>
</tbody>
</table>

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

Maximum transmission distance: 1.2 km (This is the maximum value specified in the standard and actual value depends on the product specification.)
8.2 Modbus

Interface: Based on RS-485, EIA standard
Based on RS-422A, EIA standard

Connection method: 2-wire system, half-duplex multi-drop connection

Synchronous method: Start/Stop synchronous type

Communication speed: 2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps

Data bit configuration:
- Start bit: 1
- Data bit: 8
- Parity bit: Without, Odd or Even
- Stop bit: 1 or 2

Protocol: Modbus

Signal transmission mode: Remote Terminal Unit (RTU) mode

Function code:
- 03H (Read holding registers)
- 06H (Preset single register)
- 08H (Diagnostics: loopback test)
- 10H (Preset multiple registers [Write multiple registers])

Error check method: CRC-16

Error code:
1: Function code error
2: When the mismatched address is specified.
3: • The maximum number (Read from a read holding resistor or write to
   Preset multiple resistors [Write multiple registers]) has been exceeded.
   • The setting of the number of data (the number of requested byte) is not set
eq to a double of the requested number of data at the time of “Preset multiple
resistors (Write multiple registers)”
4: Self-diagnostic error response

Termination resistor: Externally terminal connected (Example: 120 Ω 1/2 W)

Maximum connections: Up to 31 controllers

Signal logic: RS-485/RS-422A

<table>
<thead>
<tr>
<th>Signal logic</th>
<th>Logic</th>
</tr>
</thead>
<tbody>
<tr>
<td>V (A) – V (B) ≥ 1.5 V</td>
<td>0 (SPACE)</td>
</tr>
<tr>
<td>V (A) – V (B) ≤ −1.5 V</td>
<td>1 (MARK)</td>
</tr>
</tbody>
</table>

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

Maximum transmission distance:
1.2 km (This is the maximum value specified in the standard and actual value
depends on the product specification.)
8.3 Loader Communication

**Protocol:**
For RKC communication protocol only
(ANSI X3.28-1976 subcategories 2.5 and A4)

**Synchronous method:**
Start/Stop synchronous type

**Communication speed:**
38400 bps

**Data bit configuration:**
- Start bit: 1
- Data bit: 8
- Parity bit: Without
- Stop bit: 1
- Number of communication data digits: 7(fixed)

**Maximum connections:**
1 point (COM-K2 only)

**Connection method:**
COM-K2 loader cable (W-BV-05)

**Interval time:**
10 ms

When the instrument is powered off, power can be supplied to the instrument from COM-K2 (or COM-K version 1). This function is exclusive for parameter setting, and the instrument functions as follows.
- Control is stopped (Output is off, relay remains open).
- Host communication is stopped.
- The PV/SV monitor shows “LoAd” for the PV display and “----” for the SV display. The LCD backlight is partially turned off.

While the instrument is powered by COM-K2 (or COM-K version 1), if power is applied to the instrument, the instrument will be reset and starts for normal operation.

When the instrument is normally powered, the host communication can be used simultaneously.
A.1 ASCII 7-Bit Code Table..............................................................A-2
### A.1 ASCII 7-Bit Code Table

This table is only for use with RKC communication.

<table>
<thead>
<tr>
<th>b5 to b7</th>
<th>b4</th>
<th>b3</th>
<th>b2</th>
<th>b1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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<tbody>
<tr>
<td>0 0 0 0 0</td>
<td>NUL</td>
<td>DLE</td>
<td>SP</td>
<td>0</td>
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<td>P</td>
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<tr>
<td>0 0 0 1 1</td>
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<td>!</td>
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<td>A</td>
<td>Q</td>
<td>a</td>
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<td>2</td>
<td>B</td>
<td>R</td>
<td>b</td>
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<td>#</td>
<td>3</td>
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<td>1 0 0 1 9</td>
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<td>1 1 0 0 C</td>
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<tr>
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