COMMUNICATION INSTRUCTION MANUAL

PCD-33A (C5, SVTC)

No.PCD3CE1 2003.02

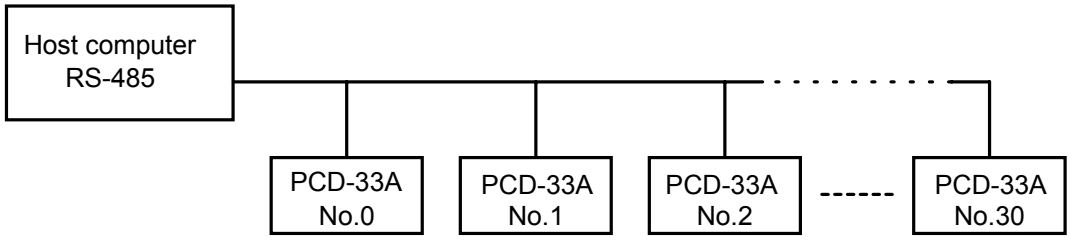
To prevent accidents arising from the misuse of this controller, please ensure the operator using it receives this manual.

⚠ Warning

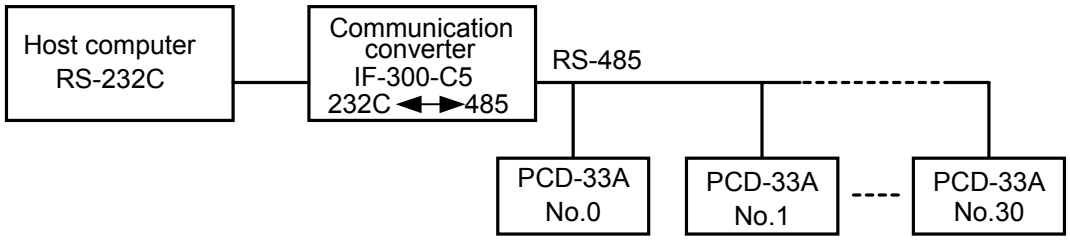
Turn the power supply to the instrument off before wiring or checking it.
Working or touching the terminal with the power switched on may result in severe injury or death due to Electric Shock.

1. System configuration

RS-485 multi-drop connection communication (Option: C5)



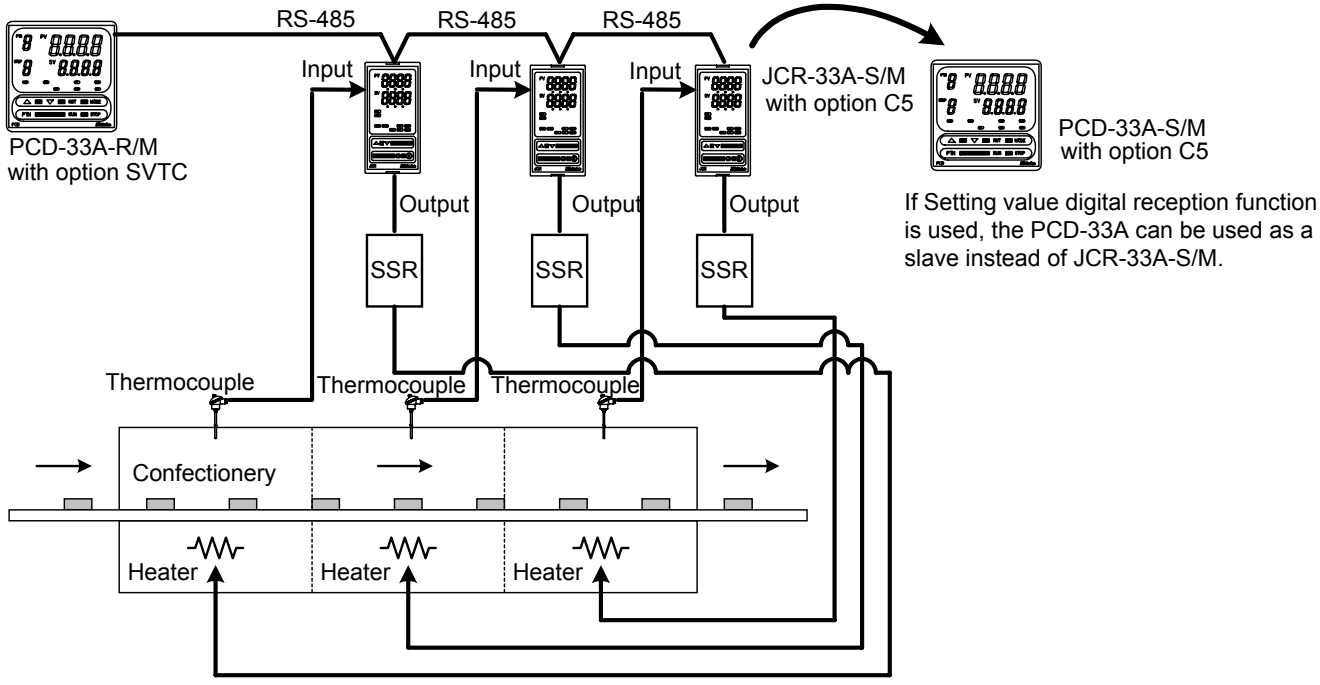
(Fig. 1-1)



(Fig. 1-2)

Note: When communication converter IF-300-C5 is used, Modbus protocol is not available. For the Modbus protocol, use a commercially available communication converter.

Setting value digital transmission (option SVTC) application example



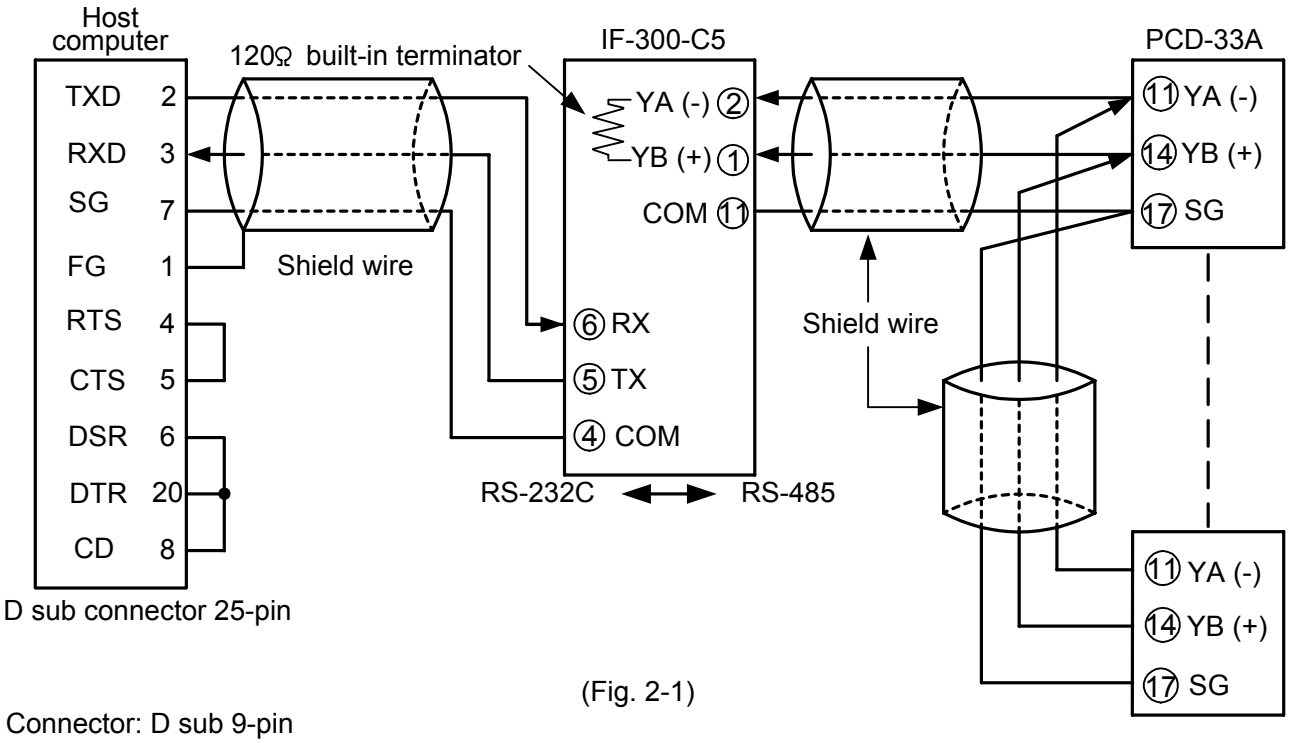
(Fig. 1-3)

2. Wiring connection

Serial communication (option C5)

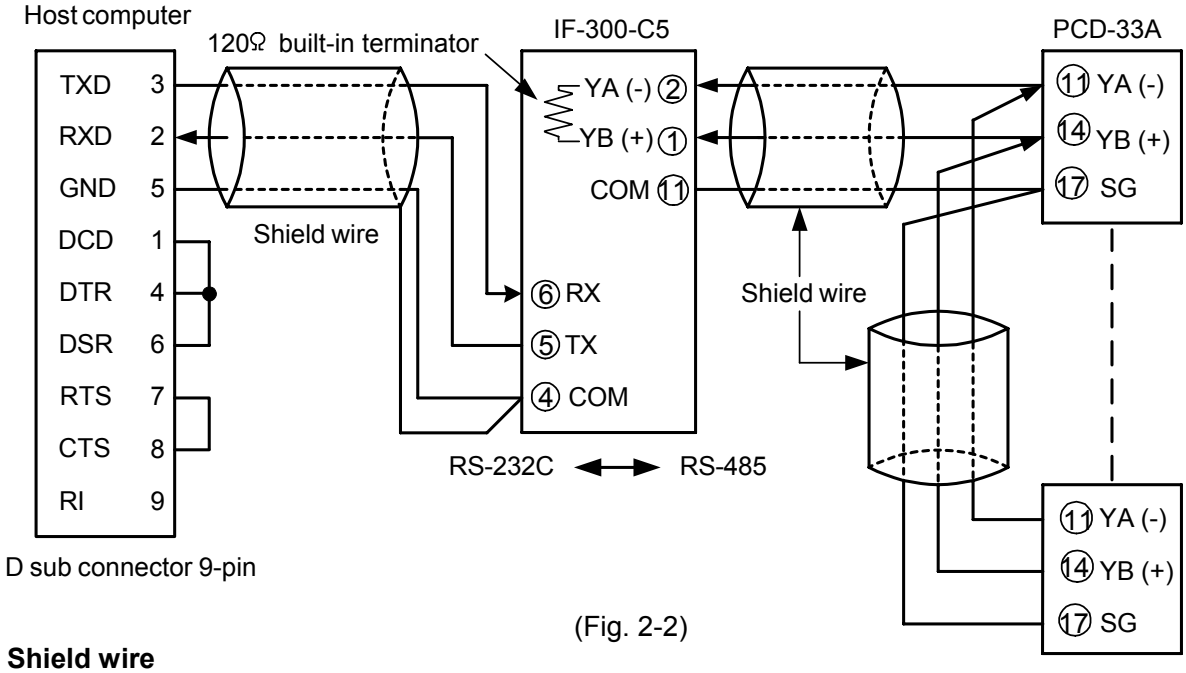
When using communication converter IF-300-C5

• Connector: D sub 25-pin
Connection: RS-232C ◄——► RS-485 (Communication speed: 2400, 4800, 9600, 19200bps)



(Fig. 2-1)

• Connector: D sub 9-pin
Connection: RS-232C ◄——► RS-485 (Communication speed: 2400, 4800, 9600, 19200bps)



(Fig. 2-2)

Shield wire

Connect only one side of the shield wire to the FG or GND terminal so that current cannot flow to the shield wire.
(If both sides of the shield wire are connected to the FG or GND terminal, the circuit will be closed between the shield wire and the ground. As a result, current will run through the shield wire and this may cause noise.)
Never fail to ground FG and GND terminals.

Terminator (Terminal resistor)

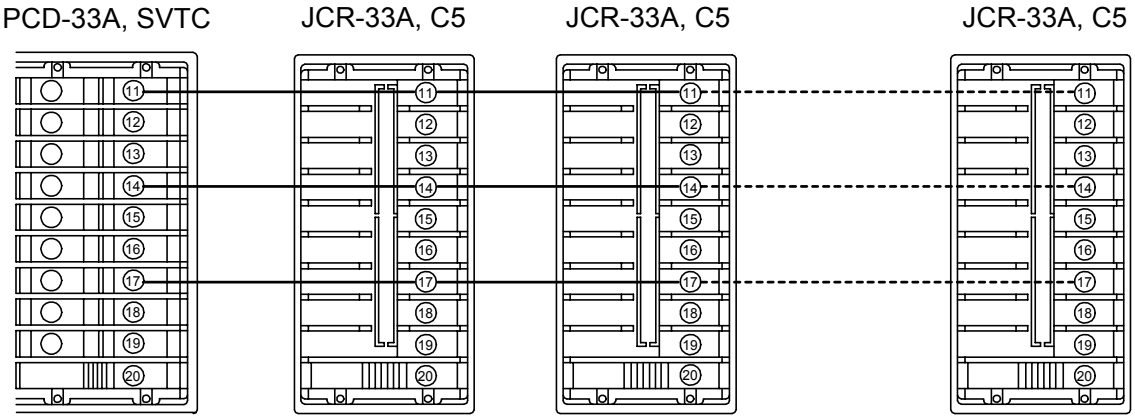
Communication converter IF-300-C5 (sold separately) has a built-in terminator.
The terminator is mounted at the end of the wire when connecting a personal computer with multiple peripheral devices. The terminator prevents signal reflection and disturbance.
Do not connect a terminator with the communication line because the PCD-33A has built-in pull-up and pull-down resistors instead of a terminator.

Setting value digital transmission (option SVTC)

With the wiring of the Setting value digital transmission, connect YA (-) with YA (-), YB (+) with YB (+) and COM with COM respectively.

A maximum of 31 units of the JCR-33A can be connected.

The following shows an example of connection when using setting value digital transmission function between the PCD-33A and JCR-33A



(Fig. 2-3)

3. Setup of the PCD-33A

• **Serial communication** (option C5)

It is necessary to set an instrument number individually to the PCD-33A when communicating by connecting plural units.

Select a communication speed for the PCD-33A according to that of the host computer.

• **Setting value digital transmission** (option SVTC)

When Setting value digital transmission and Setting value digital reception are used, select a communication protocol as follows.

Procedure for Setting value digital transmission between PCD-33A and JCR-33A

(1) Setting to PCD-33A

If the option SVTC is applied, it is not necessary to set any item.

Check if Setting value digital transmission [SVT□] is selected from Communication protocol selection [COMM] in Auxiliary function setting mode 1.

(2) Setting to JCR-33A

Check if the communication speed in Auxiliary function setting mode 1 of the JCR-33A is identical with that of PCD-33A.

(3) Setting value digital transmission starts.

Input program setting value to the PCD-33A.

If the program is initiated by pressing the RUN key, PCD-33A setting values are transmitted to the JCR-33A.

During program standby mode, “0” is sent to the JCR-33A

Procedure for Setting value digital transmission between PCD-33As

(1) Setting to the PCD-33A with Setting value digital transmission

If the option SVTC is added, it is not necessary to set any item.

Check if Setting value digital transmission [SVT□] is selected from Communication protocol selection [COMM] in Auxiliary function setting mode 1.

(2) Setting to the PCD-33A with Setting value digital reception

Check if Setting value digital reception [SVTr] is selected from Communication protocol selection [COMM] in Auxiliary function setting mode 1.

Check if the communication speed in Auxiliary function setting mode 1 is identical with that of PCD-33A with Setting value digital transmission.

(3) Setting value digital transmission starts.

Input program setting value to the PCD-33A with Setting value digital transmission.

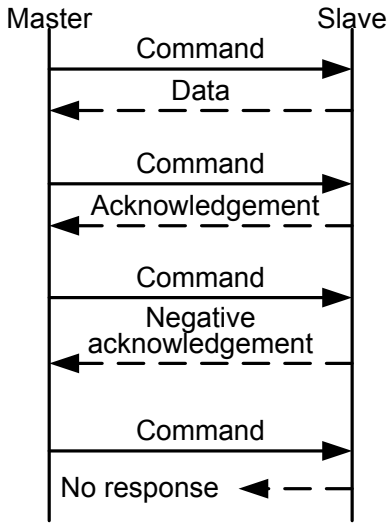
If the program is initiated by pressing the RUN key, setting values of the PCD-33A with Setting value digital transmission are transmitted to the PCD-33A with Setting value digital reception.

During program standby mode, “0” is sent to the PCD-33A.

• For the Communication protocol and Communication speed selection, refer to the Instruction manual for the PCD-33A.

4. Communication procedure

Communication starts with command transmission from the host computer (hereafter Master) and ends with the response of the PCD-33A (hereafter Slave).



(Fig.4-1)

- **Response with data**
  When the master sends the reading command, the slave responds with the corresponding setting value or current status.
- **Acknowledgement**
  When the master sends the setting command, the slave responds by sending the acknowledgement after the processing is terminated.
- **Negative acknowledgement**
  When the master sends non-existent command or value out of the setting range, the slave returns the negative acknowledgement.
- **No response**
  The slave will not respond to the master when global address is set, or when there is a framing error or checksum error (for Shinko protocol), or when LRC discrepancy (for Modbus protocol ASCII mode) or CRC discrepancy (for Modbus protocol RTU mode) is detected.

Communication timing of the RS-485 (option C5)

Slave side

When the slave starts transmission to RS-485 communication line, the slave is arranged so as to provide an idle status (mark status) **transmission period of 1 or more characters** before sending the response to ensure the synchronization on the receiving side.
The slave is arranged so as to disconnect the transmitter from the communication line **within a 1 character transmission period** after sending the response.

Master side (Notice on programming)

Set the program so that the master can disconnect the transmitter from the communication line **within a 1 character transmission period** after sending the command in preparation for reception of the response from the slave.
To avoid the collision of transmissions between the master and the slave, send the next command after carefully checking that the master received the response.

Note:

When the master communicates with the slave through the line converter (IF-300-C5), it is not required to manage the transmission timing described above, because the converter automatically sets the transmission timing interpreting the protocol.

5. Shinko protocol

5.1 Transmission mode

Shinko protocol is composed of ASCII codes.
Hexadecimal (0 to 9, A to F), which is divided into high order (4-bit) and low order (4-bit) out of 8-bit binary data in command is transmitted as ASCII characters.

Data format	Start bit	: 1 bit
	Data bit	: 7 bits
	Parity	: Even
	Stop bit	: 1 bit
	Error detection	: Checksum

5.2 Command configuration

All commands are composed of ASCII. The data (setting value, decimal number) is represented by hexadecimal figures, and ASCII code is used.
The negative numbers are represented by 2's complement.

(1) Setting command

Header (02H)	Address	Sub address (20H)	Command type (50H)	Data item	Data	Checksum	Delimiter (03H)	
1	1	1	1	4	4	2	1	← Number of characters

(Fig. 5.2-1)

(2) Reading command

Header (02H)	Address	Sub address (20H)	Command type (20H)	Data item	Checksum	Delimiter (03H)
1	1	1	1	4	2	1 ← Number of characters

(Fig. 5.2-2)

(3) Response with data

Header (06H)	Address	Sub address (20H)	Command type (20H)	Data item	Data	Checksum	Delimiter (03H)
1	1	1	1	4	4	2	1 ← Number of characters

(Fig. 5.2-3)

(4) Acknowledgement

Header (06H)	Address	Checksum	Delimiter (03H)
1	1	2	1 ← Number of characters

(Fig. 5.2-4)

(5) Negative acknowledgement

Header (15H)	Address	Error code	Checksum	Delimiter (03H)
1	1	1	2	1 ← Number of characters

(Fig. 5.2-5)

Header : Control code to represent the beginning of the command or the response
ASCII codes are used.
Setting command, Reading command : STX(02H) fixed
Response with data, Acknowledgement: ACK(06H) fixed
Negative acknowledgement : NAK(15H) fixed

Address : Numbers by which the master discerns each slave.
Instrument number 0 to 94 (00H to 5EH) and Global address 95 (5FH)
The numbers (20H to 7EH) are used by giving 20H of bias.
95 (7FH) is called **Global address**, which is used when the same command is sent to all the slaves connected. However, a response is not returned.

Sub address : (20H) fixed

Command type : Code to discern Setting command (50H) and Reading command (20H)

Data item : Data classification of the command object
Composed of hexadecimal 4 digits (Refer to the Communication command table)

Data : The contents of data (setting value) differs depending on the setting command.
Composed of hexadecimal 4 digits (Refer to the Communication command table)

Checksum : 2-character data to detect communication errors

Delimiter : Control code to represent the end of command
(03H) fixed

Error code : Represents an error type. Composed of hexadecimal 1 digit.
1 (31H)-----Non-existent command
2 (32H)-----Not used
3 (33H)-----Setting value outside the setting range
4 (34H)-----Status unable to set (e.g. AT is performing)
5 (35H)-----During setting mode by keypad operation

5.3 Checksum calculation

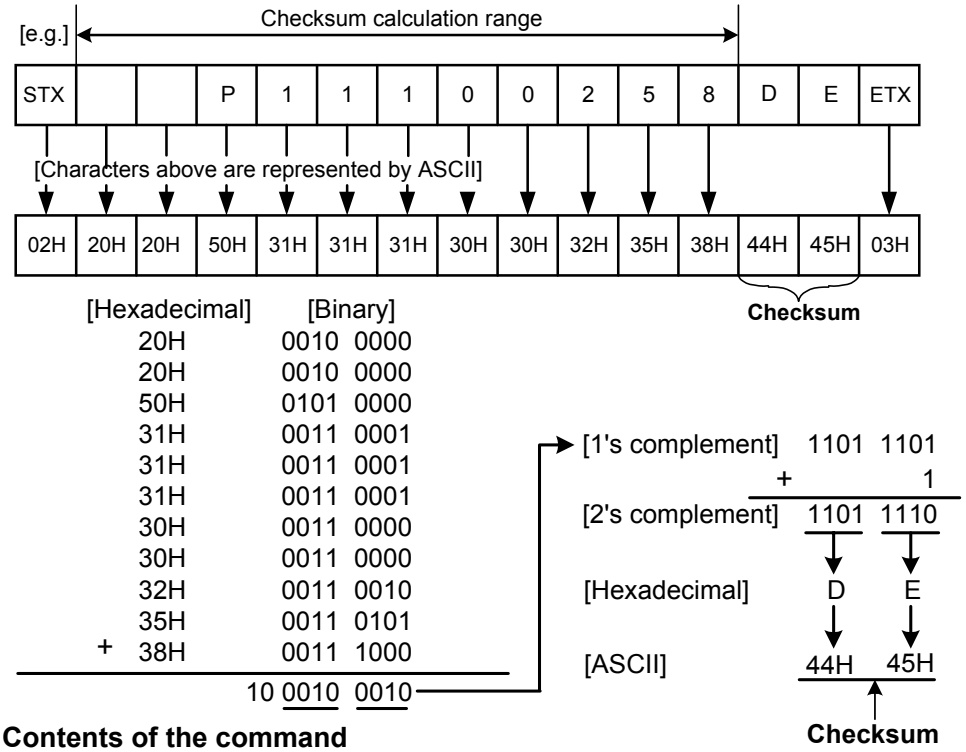
Checksum is used to detect receiving errors in the command or data.
Set the program for the master side as well to calculate the checksum of the response data from the slaves so that the communication errors can be checked.

The ASCII code (hexadecimal) corresponding to the characters which range from the address to that before the checksum is converted to binary notation, and the total value is calculated. The lower 2-digits of the total value are converted to 2's complements and then to hexadecimal figures, that is, ASCII code for the checksum.

Checksum calculation example

Pattern 1, Step 1, step SV: 600℃ (0258H)
Address (instrument number): 0 (20H)

- 1's complement: Make each bit of binary 0 and 1 reverse.
- 2's complement: Add 1 to 1's complement.



5.4 Contents of the command

Notes on the setting command and reading command

- It is possible to set the setting value by setting command of the communication function even if the setting value is locked.
- Although the options are not applied, setting the optional items is possible by the setting command. However, they will not function.

- The memory can store up to 1,000,000 (one million) entries. If the number of setting times exceeds the limit, it cannot memorize the data. So frequent transmission via communication is not recommended.
- When connecting plural slaves, the address (instrument number) must not be duplicated.
- When sending a command by Global address [95 (7FH)], the same command is sent to all the slaves connected. However, the response is not returned.
- The instrument number and communication speed of the slave cannot be set by communication.

Setting command

- The settable range is the same as the one by keypad operation. For communication command, refer to the communication command table of this manual.
- All commands are composed of ASCII.
- The data (setting value, decimal) is converted to hexadecimal figures, and ASCII is used. Negative numbers are represented by 2's complement. When the data (setting value) has a decimal point, the whole number without a decimal point is used.

Reading command

- All commands are composed of ASCII.
- The data (setting value, decimal) is converted to hexadecimal figures, and ASCII is used. Negative numbers are represented by 2's complement. When the data (setting value) has a decimal point, the response is returned as a whole number without a decimal point.

5.5 Command example

(1) **Reading (Address 1, PV)**

- Reading command from the master

Header (02H)	Address (20H)	Sub address (20H)	Command type (20H)	Data item (30H 30H 38H 30H)	Checksum (44H 38H)	Delimiter (03H)
1	1	1	1	4	2	1

Number of characters

(Fig. 5.5-1)

- Response from the slave in normal status [When PV=25℃ (0019H)]

Header (06H)	Address (20H)	Sub address (20H)	Command type (20H)	Data item (30H 30H 38H 30H)	Data (30H 30H 31H 39H)	Checksum (30H 45H)	Delimiter (03H)
1	1	1	1	4	4	2	1

Number of characters

(Fig. 5.5-2)

(2) **Reading (Address 1, Pattern 1, Step 1 step SV)**

• Reading command from the master

Header (02H)	Address (20H)	Sub address (20H)	Command type (20H)	Data item (31H 31H 31H 30H)	Checksum (44H 44H)	Delimiter (03H)
1	1	1	1	4	2	1 ← Number of characters

(Fig. 5.5-3)

• Response from the slave in normal status [When SV=600℃ (0258H)]

Header (06H)	Address (20H)	Sub address (20H)	Command type (20H)	Data item (31H 31H 31H 30H)	Data (30H 32H 35H 38H)	Checksum (30H 45H)	Delimiter (03H)
1	1	1	1	4	4	2	1 ← Number of characters

(Fig. 5.5-4)

(3) **Setting (Address 1, Pattern 1, Step 1 step SV)** [When step SV is set to 600℃(0258H)]

• Setting command from the master

Header (02H)	Address (20H)	Sub address (20H)	Command type (50H)	Data item (31H 31H 31H 30H)	Data (30H 32H 35H 38H)	Checksum (44H 45H)	Delimiter (03H)
1	1	1	1	4	4	2	1 ← Number of characters

(Fig. 5.5-5)

• Response from the slave in normal status

Header (06H)	Address (20H)	Checksum (45H 30H)	Delimiter (03H)
1	1	2	1 ← Number of characters

(Fig. 5.5-6)

6. Modbus protocol

6.1 Transmission mode

There are 2 transmission modes (ASCII and RTU) in Modbus protocol.

6.2 ASCII mode

Hexadecimal (0 to 9, A to F), which is divided into high order (4-bit) and low order (4-bit) out of 8-bit binary data in the command is transmitted as ASCII characters.

Data format
- Start bit : 1 bit
- Data bit : 7 bits
- Parity : Even/No/Odd (Selectable)
- Stop bit : 1 bit/2 bits (Selectable)
- Error detection: LRC (Longitudinal Redundancy Check)
- Data interval : 1 second or less

(1) Message configuration

ASCII mode message is configured to start by [: (colon)(3AH)] and end by [CR (carriage return) (0DH) + LF (Line feed)(0AH)]. (See Fig. 6.2-1)

Header (:)	Slave address	Function code	Data	Error check LRC	Delimiter (CR)	Delimiter (LF)

(Fig. 6.2-1)

Slave address

Slave address is an individual instrument number on the slave side and is set within the range 00H to 5FH (0 to 95).

The master identifies slaves by the slave address of the requested message.

The slave informs the master which slave is responding to the master by placing its own address in the response message.

[Slave address 00H (broadcast address) can identify all the slaves. However slaves do not respond.]

Function code

The function code is the command code for the slave to undertake the following action types (Table 6.2-1).

(Table 6.2-1)

Function code	Contents
03 (03H)	Reading the setting value and information from slaves
06 (06H)	Setting to slaves

Function code is used to discern whether the response is normal (acknowledgement) or if any error (negative acknowledgement) has occurred when the slave returns the response message to the master.
When acknowledgement is returned, the slave simply returns the original function code.
When negative acknowledgement is returned, the MSB of the original function code is set as 1 for the response.
(For example, when the master sends a request message setting 10H to function code by mistake, slave returns 90H by setting the MSB to 1, because the former is an illegal function.)
For negative acknowledgement, abnormal code (Table 6.2-2) below is set to the data of response message and returned to the master in order to inform it that what kind of error has occurred.

(Table 6.2-2)

Abnormal code	Contents
1 (01H)	Illegal function (Non-existent function)
2 (02H)	Illegal data address (Non-existent data address)
3 (03H)	Illegal data value (Value out of the setting range)
17 (11H)	Illegal setting (Unsettable status)
18 (12H)	Illegal setting (During setting mode by keypad operation, etc)

Data

Data differs depending on the function code.
A request message from the master is composed of data item, number of data and setting data.
A response message from the slave is composed of number of bytes, data and abnormal code in negative acknowledgement. Effective range of data is –32768 to 32767 (8000H to 7FFFH).

(2) Error check of ASCII mode

After calculating LRC (Longitudinal Redundancy Check) from the slave address to the end of data, the calculated 8-bit data is converted to two ASCII characters and are appended to the end of the message.

How LRC is calculated

① Create a message in RTU mode.
② Add all the values from the slave address to the end of data. This is assumed as X.
③ Make a complement for X (bit reverse). This is assumed as X.
④ Add a value of 1 to X. This is assumed as X.
⑤ Set X as an LRC to the end of the message.
⑥ Convert the whole message to ASCII characters.

(3) Message example of ASCII mode

① Reading (Address 1, PV)

• A request message from the master
The number of data indicates the data item to be read and it is fixed as (30H 30H 30H 31H).

Header	Slave address	Function code	Data item	Number of data	Error check LRC	Delimiter	
(3AH)	(30H 31H)	(30H 33H)	(30H 30H 38H 30H)	(30H 30H 30H 31H)	(37H 42H)	(0DH 0AH)	Number of characters
1	2	2	4	4	2	2	←

(Fig. 6.2-2)

• A response message from the slave in normal status [When PV=25℃ (0019H)]
The number of response bytes indicates the number of bytes of the data which has been read, and it is fixed as (30H 32H).

Header	Slave address	Function code	Number of response bytes	Data	Error check LRC	Delimiter	
(3AH)	(30H 31H)	(30H 33H)	(30H 32H)	(30H 30H 31H 39H)	(45H 31H)	(0DH 0AH)	Number of characters
1	2	2	2	4	2	2	←

(Fig.6.2-3)

② **Reading (Address 1, Pattern 1, Step 1 step SV)**

• Request message from the master

The number of the data indicates the data item to be read and it is fixed as (30H 30H 30H 31H).

Header	Slave address	Function code	Data item	Number of data	Error check LRC	Delimiter	
(3AH)	(30H 31H)	(30H 33H)	(31H 31H 31H 30H)	(30H 30H 30H 31H)	(44H 41H)	(0DH 0AH)	
1	2	2	4	4	2	2	← Number of characters

(Fig. 6.2-4)

• A response message from the slave in normal status [When SV=600℃ (0258H)]

The number of response bytes indicates the number of bytes of the data which has been read, and it is fixed as (30H 32H).

Header	Slave address	Function code	Number of response bytes	Data	Error check LRC	Delimiter	
(3AH)	(30H 31H)	(30H 33H)	(30H 32H)	(30H 32H 35H 38H)	(41H 30H)	(0DH 0AH)	
1	2	2	2	4	2	2	← Number of characters

(Fig. 6.2-5)

• A response message from the slave in abnormal status (When non-existent data item is sent)

The function code MSB is set to 1 for the response message in abnormal status (83H).
If an abnormal code (02H: Non-existent data address) is returned, the error can be determined by reading this code.

Header	Slave address	Function code	Abnormal code	Error check LRC	Delimiter	
(3AH)	(30H 31H)	(38H 33H)	(30H 32H)	(37H 41H)	(0DH 0AH)	
1	2	2	2	2	2	← Number of characters

(Fig. 6.2-6)

③ **Setting (Address 1, Pattern 1, Step 1 step SV)**

When step SV is set to 600℃ (0258H)

• A request message from the master

Header	Slave address	Function code	Data item	Data	Error check LRC	Delimiter	
(3AH)	(30H 31H)	(30H 36H)	(31H 31H 31H 30H)	(30H 32H 35H 38H)	(37H 45H)	(0DH 0AH)	
1	2	2	4	4	2	2	← Number of characters

(Fig. 6.2-7)

• A response message from the slave in normal status

Header	Slave address	Function code	Data item	Data	Error check LRC	Delimiter	
(3AH)	(30H 31H)	(30H 36H)	(31H 31H 31H 30H)	(30H 32H 35H 38H)	(37H 45H)	(0DH 0AH)	
1	2	2	4	4	2	2	← Number of characters

(Fig. 6.2-8)

• A response message from the slave in abnormal status (When a value out of the setting range is set.)

The function code MSB is set to 1 for the response message in abnormal status (86H).
If an abnormal code (03H: Value out of the setting range) is returned, the error can be determined by reading this code.

Header	Slave address	Function code	Abnormal code	Error check LRC	Delimiter	
(3AH)	(30H 31H)	(38H 36H)	(30H 33H)	(37H 36H)	(0DH 0AH)	
1	2	2	2	2	2	← Number of characters

(Fig. 6.2-9)

6.3 RTU mode

8-bit binary data in command is transmitted as it is.

Data format
- Start bit : 1 bit
- Data bit : 8 bits
- Parity : Even/No/Odd (Selectable)
- Stop bit : 1 bit/2 bits (Selectable)
- Error detection : CRC-16 (Cyclic Redundancy Check)
- Data interval : 3.5 characters transmission time or less

(1) Message configuration

RTU mode is configured to start after idle time is processed for more than 3.5 characters transmission and end after idle time is processed for more than 3.5 characters transmission. (See Fig. 6.3-1)

3.5 idle characters	Slave address	Function code	Data	Error check CRC	3.5 idle characters

(Fig. 6.3-1)

Slave address

Slave address is an individual instrument number on the slave side and is set within the range 00H to 5FH (0 to 95).

The master identifies slaves by the slave address of the requested message.

The slave informs the master which slave is responding to the master by placing its own address in the response message.

[Slave address 00H (broadcast address) can identify all the slaves. However slaves do not respond.]

Function code

The function code is the command code for the slave to undertake the following action types (Table 6.3-1).

(Table 6.3-1)

Function code	Contents
03 (03H)	Reading the setting value and information from slaves
06 (06H)	Setting to slaves

Function code is used to discern whether the response is normal (acknowledgement) or if any error (negative acknowledgement) has occurred when the slave returns the response message to the master.

When acknowledgement is returned, the slave simply returns the original function code.

When negative acknowledgement is returned, the MSB of the original function code is set as 1 for the response.

(For example, when the master sends request message setting 10H to function code by mistake, slave returns 90H by setting the MSB to 1, because the former is an illegal function.)

For negative acknowledgement, abnormal code (Table 6.3-2) below is set to the data of response message and returned to the master in order to inform it that what kind of error has occurred.

(Table 6.3-2)

Abnormal code	Contents
1 (01H)	Illegal function (Non-existent function)
2 (02H)	Illegal data address (Non-existent data address)
3 (03H)	Illegal data value (Value out of the setting range)
17 (11H)	Illegal setting (Unsettable status)
18 (12H)	Illegal setting (During setting mode by keypad operation, etc)

Data

Data differs depending on the function code.

A request message from the master side is composed of data item, number of data and setting data.

A response message from the slave side is composed of number of bytes, data and abnormal code in negative acknowledgement. Effective range of data is –32768 to 32767 (8000H to 7FFFH).

(2) Error check of RTU mode

After calculating CRC-16 (Cyclic Redundancy Check) from the slave address to the end of data, the calculated 16-bit data is appended to the end of message in sequence from low order to high order.

How CRC is calculated

In the CRC system, the information is divided by the polynomial. The remainder is added to the end of the information and transmitted. The generation of polynomial is as follows.

(Generation of polynomial: $X^{16} + X^{15} + X^2 + 1$)

① Initialize the CRC-16 data (assumed as X) (FFFFH).
② Calculate exclusive OR (XOR) with the 1st data and X. This is assumed as X.
③ Shift X one bit to the right. This is assumed as X.
④ When a carry is generated as a result of the shift, XOR is calculated by X of ③ and the fixed value (A001H). This is assumed as X. If a carry is not generated, go to step ⑤.
⑤ Repeat steps ③ and ④ until shifting 8 times.
⑥ XOR is calculated with the next data and X. This is assumed as X.
⑦ Repeat steps ③ to ⑤.
⑧ Repeat steps ③ to ⑤ up to the last data.
⑨ Set X as CRC-16 to the end of message in sequence from low order to high order.

(3) Message example of RTU mode

① **Reading (Address 1, PV)**

• Request message from the master

The number of data indicates the data item to be read, and it is fixed as (0001H).

3.5 idle characters	Slave address (01H)	Function code (03H)	Data item (0080H)	Number of data (0001H)	Error check CRC (85E2H)	3.5 idle characters
	1	1	2	2	2 ←	Number of characters

(Fig. 6.3-2)

• Response message from the slave in normal status [When PV=25℃ (0019H)]

The number of response bytes indicates number of bytes of the data which has been read, and it is fixed as (02H).

3.5 idle characters	Slave address (01H)	Function code (03H)	Number of response bytes (02H)	Data (0019H)	Error check CRC (798EH)	3.5 idle characters
	1	1	1	2	2 ←	Number of characters

(Fig. 6.3-3)

② **Reading (Address 1, Pattern 1, Step 1 step SV)**

• Request message from the master

The number of data indicates the data item to be read, and it is fixed as (0001H).

3.5 idle characters	Slave address (01H)	Function code (03H)	Data item (1110H)	Number of data (0001H)	Error check CRC (80F3H)	3.5 idle characters
	1	1	2	2	2 ←	Number of characters

(Fig. 6.3-4)

• Response message from the slave in normal status [SV=600℃ (0258H)]

The number of response bytes indicates number of bytes of the data which has been read, and it is fixed as (02H).

3.5 idle characters	Slave address (01H)	Function code (03H)	Number of response bytes (02H)	Data (0258H)	Error check CRC (B8DEH)	3.5 idle characters
	1	1	1	2	2 ←	Number of characters

(Fig. 6.3-5)

• Response message from the slave in abnormal status (When data item is mistaken)

The function code MSB is set to 1 for the response message in abnormal status (83H).
If an abnormal code (02H: Non-existent data address) is returned, the error can be determined by reading this code.

3.5 idle characters	Slave address (01H)	Function code (83H)	Abnormal code (02H)	Error check CRC (C0F1H)	3.5 idle characters
	1	1	1	2 ←	Number of characters

(Fig. 6.3-6)

③ Setting (Address 1, Pattern 1, Step 1 step SV)

When setting the step SV to 600℃ (0258H)

• Request message from the master

3.5 idle characters	Slave address (01H)	Function code (06H)	Data item (1110H)	Data (0258H)	Error check CRC 8DA9H	3.5 idle characters
	1	1	2	2	2 ←	Number of characters

(Fig. 6.3-7)

• Response message from the slave in normal status

3.5 idle characters	Slave address (01H)	Function code (06H)	Data item (1110H)	Data (0258H)	Error check CRC 8DA9H	3.5 idle characters
	1	1	2	2	2 ←	Number of characters

(Fig. 6.3-8)

• Response message from the slave in abnormal status (When a value out of the setting range is set)
The function code MSB is set to 1 for the response message in abnormal status (86H).
If an abnormal code (03H: Value out of the setting range) is returned, the error can be determined by reading this code.

3.5 idle characters	Slave address	Function code	Abnormal code	Error check CRC	3.5 idle characters
	(01H)	(86H)	(03H)	(0261H)	
	1	1	1	2 ←	Number of characters

(Fig. 6.3-9)

7. Communication command table

Shinko command type	Modbus function code	Data item	Data
20H/50H	03H/06H	1xx0H: Step SV setting (*1)	Setting value
20H/50H	03H/06H	1xx1H: Step time setting (*1)	Setting value
20H/50H	03H/06H	1xx2H: Wait Used/Not used (*1)	0000H: Not used 0001H: Used
20H/50H	03H/06H	1x13H: Wait value setting (*2)	Setting value
20H/50H	03H/06H	1x14H: Alarm 1 (A1) action point (*2)	Setting value
20H/50H	03H/06H	1x15H: Alarm 2 (A2) action point (*2)	Setting value
20H/50H	03H/06H	1x16H: Time signal OFF time setting (*2)	Setting value
20H/50H	03H/06H	1x17H: Time signal ON time setting (*2)	Setting value
20H/50H	03H/06H	0001H: Not used	
20H/50H	03H/06H	0002H: proportional band setting	Setting value
20H/50H	03H/06H	0003H: Integral time setting	Setting value
20H/50H	03H/06H	0004H: Derivative time setting	Setting value
20H/50H	03H/06H	0005H: Anti-reset windup (ARW)	Setting value
20H/50H	03H/06H	0006H: Not used	
20H/50H	03H/06H	0007H: Not used	
20H/50H	03H/06H	0008H: Not used	
20H/50H	03H/06H	0009H: Not used	
20H/50H	03H/06H	000AH: Not used	
20H/50H	03H/06H	000BH: Not used	
20H/50H	03H/06H	000CH: Not used	
20H/50H	03H/06H	000DH: Not used	
20H/50H	03H/06H	000EH: PID auto-tuning Perform/Cancel	0000H: Cancel 0001H: Perform
20H/50H	03H/06H	000FH: Alarm 1 (A1) action selection 0010H: Alarm 2 (A2) action selection	0000H: No alarm action 0001H: High limit alarm 0002H: Low limit alarm 0003H: High/Low limits alarm 0004H: High/Low limit range alarm 0005H: Process high alarm 0006H: Process low alarm 0007H: High limit alarm with standby 0008H: Low limit alarm with standby 0009H: High/Low limits alarm with standby
20H/50H	03H/06H	0011H: Alarm 1 (A1) hysteresis	Setting value
20H/50H	03H/06H	0012H: Alarm 2 (A2) hysteresis	Setting value
20H/50H	03H/06H	0013H: Not used	
20H/50H	03H/06H	0014H: Not used	
20H/50H	03H/06H	0015H: Alarm 1 (A1) action delayed timer	Setting value
20H/50H	03H/06H	0016H: Alarm 2 (A2) action delayed timer	Setting value
20H/50H	03H/06H	0017H: Not used	
20H/50H	03H/06H	0018H: Not used	
20H/50H	03H/06H	0019H: Not used	
20H/50H	03H/06H	001AH: Not used	
20H/50H	03H/06H	001BH: Proportional cycle setting	Setting value
20H/50H	03H/06H	001CH: Control output high limit	Setting value
20H/50H	03H/06H	001DH: Control output low limit	Setting value

20H/50H	03H/06H	001EH: Control output ON/OFF action hysteresis setting	Setting value
20H/50H	03H/06H	001FH: Not used	
		0020H: Not used	
		0021H: Not used	
20H/50H	03H/06H	0022H: Not used	
20H/50H	03H/06H	0023H: Not used	
20H/50H	03H/06H	0024H: Not used	
20H/50H	03H/06H	0025H: Not used	
20H/50H	03H/06H	0026H: Not used	
20H/50H	03H/06H	0027H: SV high limit	Setting value
20H/50H	03H/06H	0028H: SV low limit	Setting value
20H/50H	03H/06H	0029H: Not used	
20H/50H	03H/06H	002AH: Not used	
		002BH: Not used	
		002CH: Scaling high limit setting	Setting value
		002DH: Scaling low limit setting	Setting value
		002EH: Decimal point place selection	0000H: XXXX (No decimal point) 0001H: XXX.X (1 digit after decimal point) 0002H: XX.XX (2 digits after decimal point) 0003H: X.XXX (3 digits after decimal point)
20H/50H	03H/06H	002FH: Sensor correction setting	Setting value
20H/50H	03H/06H	0030H: PV filter time constant setting	Setting value
20H/50H	03H/06H	0031H: Setting value lock selection	0000H: Unlock 0001H: Lock
20H/50H	03H/06H	0032H: Step SV setting when control starts	Setting value
20H/50H	03H/06H	0033H: Program control start form	0000H: PV start 0001H: SV start
20H/50H	03H/06H	0034H: Not used	
20H/50H	03H/06H	0035H: Step time unit selection	0000H: Hour:Minute 0001H: Minute:Second
20H/50H	03H/06H	0036H: Not used	
20H/50H	03H/06H	0037H: Not used	
20H/50H	03H/06H	0038H: Pattern end output time setting	Setting value
20H/50H	03H/06H	0039H: Not used	
20H/50H	03H/06H	003AH: Not used	
20H/50H	03H/06H	003BH: Event output function selection	0000H: Time signal output 0001H: Pattern end output 0002H: Run output
20H/50H	03H/06H	003CH: Not used	
20H/50H	03H/06H	003DH: Not used	
20H/50H	03H/06H	003EH: Not used	
20H/50H	03H/06H	003FH: Running pattern number selection	1 to 9
20H/50H	03H/06H	0040H: Not used	
20H/50H	03H/06H	0041H: Not used	
50H	06H	0042H: Program running Perform/Stop	0000H: Stop 0001H: Perform
50H	06H	0043H: Advance function Perform	0001H: Perform
20H/50H	03H/06H	0044H: Input type selection	0000H: K [–200 to 1370℃] 0001H: K [–199.9 to 400.0℃] 0002H: J [–200 to 1000℃] 0003H: R [0 to 1760℃] 0004H: S [0 to 1760℃] 0005H: B [0 to 1820℃] 0006H: E [–200 to 800℃] 0007H: T [–199.9 to 400.0℃] 0008H: N [–200 to 1300℃] 0009H: PL-Ⅱ [0 to 1390℃]

			000AH: C (W/Re5-26) [0 to 2315℃] 000BH: Pt100 [–199.9 to 850.0℃] 000CH: JPt100 [–199.9 to 500.0℃] 000DH: Pt100 [–200 to 850℃] 000EH: JPt100 [–200 to 500℃] 000FH: K [–320 to 2500℉] 0010H: K [–199.9 to 750.0℉] 0011H: J [–320 to 1800℉] 0012H: R [0 to 3200℉] 0013H: S [0 to 3200℉] 0014H: B [0 to 3300℉] 0015H: E [–320 to 1500℉] 0016H: T [–199.9 to 750.0℉] 0017H: N [–320 to 2300℉] 0018H: PL-Ⅱ [0 to 2500℉] 0019H: C (W/Re5-26) [0 to 4200℉] 001AH: Pt100 [–199.9 to 999.9℉] 001BH: JPt100 [–199.9 to 900.0℉] 001CH: Pt100 [–300 to 1500℉] 001DH: JPt100 [–300 to 900℉] 001EH: 4 to 20mA DC[–1999 to 9999] 001FH: 0 to 20mA DC[–1999 to 9999] 0020H: 0 to 1V DC [–1999 to 9999] 0021H: 0 to 5V DC [–1999 to 9999] 0022H: 1 to 5V DC [–1999 to 9999] 0023H: 0 to 10V DC [–1999 to 9999]
20H/50H	03H/06H	0045H: Direct/Reverse action selection	0000H: Heating (Reverse action) 0001H: Cooling (Direct action)
20H/50H	03H/06H	0046H: Not used	
20H/50H	03H/06H	0047H: Not used	
20H/50H	03H/06H	0048H: Alarm 1 (A1) action Energized/Deenergized	0000H: Energized 0001H: Deenergized
20H/50H	03H/06H	0049H: Alarm 2 (A2) action Energized/Deenergized	0000H: Energized 0001H: Deenergized
50H	06H	0070H: Key operation change flag clearing	0000H: No action 0001H: All clearing
20H	03H	0080H: PV (input value) reading	Current PV
20H	03H	0081H: Control output MV (manipulated variable) reading	Control output MV
20H	03H	0082H: Not used	
20H	03H	0083H: Current SV reading	Current SV
20H	03H	0084H: Running step remaining time reading	Remaining time
20H	03H	0085H: Running pattern, step number reading	16^0: Pattern number 16^1: Step number 16^2: Not used (Always 0) 16^3: Not used (Always 0)
20H	03H	0086H: Instrument status reading	2^{15} to 2^0 0000 0000 0000 0000 2^0 digit: Control output (OUT) 0: OFF 1: ON (For current output, Not decided) 2^1 digit: Not used (Always 0) 2^2 digit: Alarm 1 (A1) output 0: OFF 1: ON 2^3 digit: Alarm 2 (A2) output 0: OFF 1: ON 2^4 digit: Event output 0: OFF 1: ON 2^5 digit: Not used (Always 0) 2^6 digit: Not used (Always 0)

			2^7 digit: Overscale 0: OFF 1: ON 2^8 digit: Underscale 0: OFF 1: ON 2^9 digit: During Run 0: OFF 1: Run 2^{10} digit: During Wait 0: OFF 1: Wait 2^{11} digit: During AT 0: OFF 1: AT 2^{12} digit: During Hold 0: OFF 1: Hold 2^{13} digit: Not used (Always 0) 2^{14} digit: Not used (Always 0) 2^{15} digit: Key operation change 0: No 1: Yes
20H	03H	0087H: Not used	
20H	03H	0088H: Not used	
20H	03H	00A0H: Not used	
20H	03H	00A1H: Instrument information reading	2^{15} to 2^0 0000 0000 0000 0000 2^0 digit: Not used (Always 0) 2^1 digit: Alarm 2 (A2) function 0: Not applied 1: Applied 2^2 digit: Communication function 0: Not applied 1: Applied 2^3 to 2^{15} digit: Not used (Always 0)
20H	03H	00A3H: Reading if any item changed by keypad operation exists or not	Changed item command

Data item:

(*1) 16^1: Step 1 to Step 9
16^2: Pattern 1 to Pattern 9

(*2) 16^2: Pattern 1 to Pattern 9

Data:

- When the data (setting value) has a decimal point, remove the decimal point and represent it as a whole number, then express it in hexadecimal figures.
- When the alarm action type is changed, the alarm setting value returns to the default value. The alarm output status is also initialized.

Note

The settings by the front key operation and by communication function differ as follows.

- When data is changed by front keypad operation, the data that is related to the changed item is also changed automatically as shown in Example 1 below.
- When the data is changed by communication function, the related data does not change as shown in Example 2 below. (Only the changed data is altered.)

(Example 1) SV high limit: 1370℃
Step SV : 1000℃
When SV high limit is changed to 800℃ by the front keypad operation, both SV high limit and Step SV are changed to 800℃.

(Example 2) SV high limit: 1370℃
Step SV : 1000℃
When SV high limit is changed to 800℃ by communication function, SV high limit is changed to 800℃, however, Step SV is maintained at the same temperature 1000℃.

8. Specifications

Cable length	: Maximum communication distance 1.2km Cable resistance: Within 50Ω (The terminator is not necessary or 120Ω or greater on one side.)
Communication line	: Based on EIA RS-485
Communication	: Half-duplex
Communication speed	: 9600bps (2400, 4800, 9600, 19200bps) Selectable by keypad operation
Synchronous system	: Start-stop synchronous
Code form	: ASCII, binary
Error correction	: Command request repeat system
Error detection	: Parity check, Checksum (LRC), CRC
Data format	Start bit : 1 Data bit : 7, 8 Parity : Even, Odd, No parity Stop bit : 1, 2

9. Troubleshooting

If any malfunctions occur, refer to the following items after checking the power supply to the master and the slave.

- **Problem: If it is unable to communicate**

Check the following
The connection or wiring of communication is not secure.
Burnout or imperfect contact on the communication cable and the connector.
Communication speed of the slave does not coincide with that of the master.
The data bit, parity and stop bit of the master do not accord with those of the slave.
The instrument number (address) of the slave does not coincide with that of the command.
The instrument numbers (addresses) are duplicated in multiple slaves.
When communicating without using Shinko communication converter (IF-300-C5), make sure that the program is appropriate for the transmission timing.

- **Problem: Though it is able to communicate, the response is 'NAK'**.

Check the following
Check whether a non-existent command code has been sent or not.
The setting command data goes outside the setting range of the slave.
The controller cannot be set when functions such as AT is performing.
The operation mode is under the front keypad operation setting mode.

If you have any inquiries, please consult our agency or the shop where you purchased the unit.

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