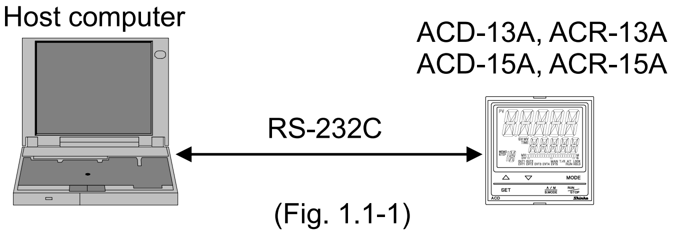
No. ACDR1CE7 2013.07

This manual contains instructions for communication functions of the ACD-13A, ACR-13A, ACD-15A and ACR-15A.

Serial communication and Console communication cannot be used together.
When performing Serial communication, remove the exclusive cable (CMB) from the USB port of the PC and console connector of the ACD/R-13A, ACD/R-15A.
When performing Console communication, it is not required to remove the Serial communication cables.
However, do not send a command from the master side.

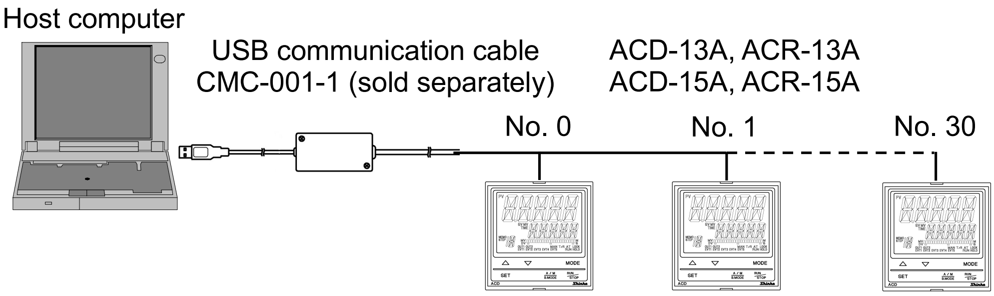
# 1. System configuration

### 1.1 RS-232C (C option)

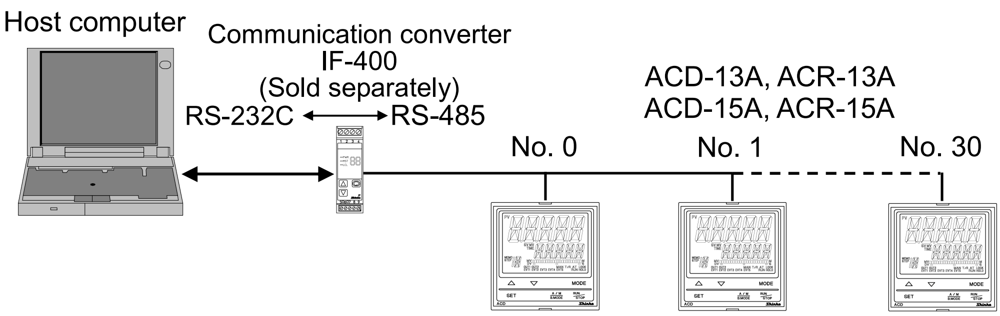



(Fig. 1.1-1)

### 1.2 RS-485 Multi-drop connection communication (C5 option)




(Fig. 1.2-1)

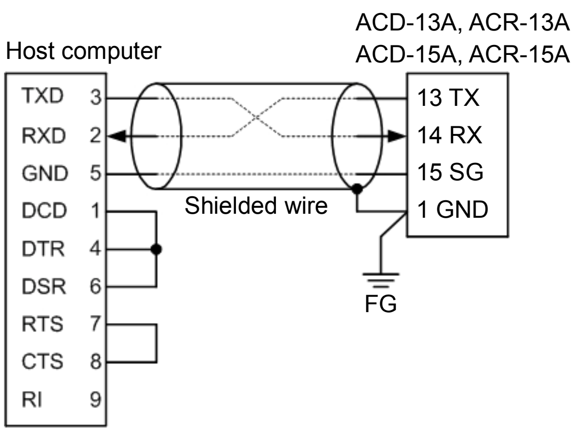



(Fig. 1.2-2)

# 2. Wiring

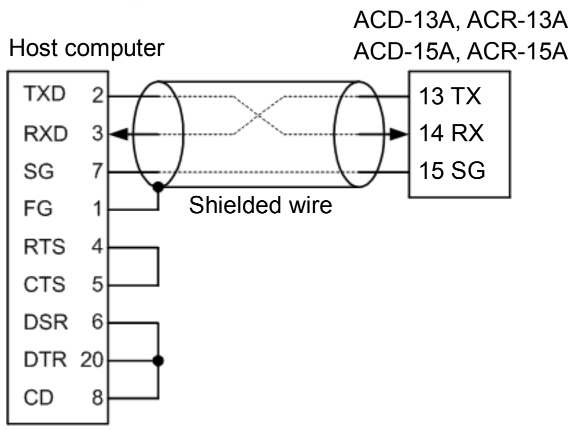
### 2.1 RS-232C (C option)

**• D-sub 9-pin connector**




(Fig. 2.1-1)

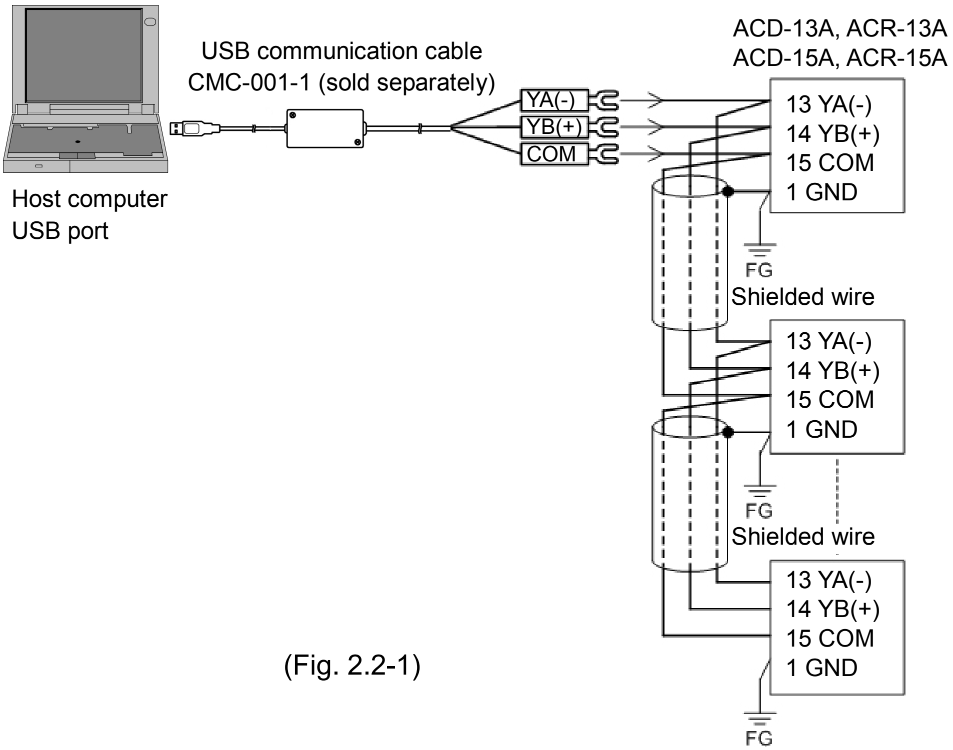
**• D-sub 25-pin connector**




(Fig. 2.1-2)

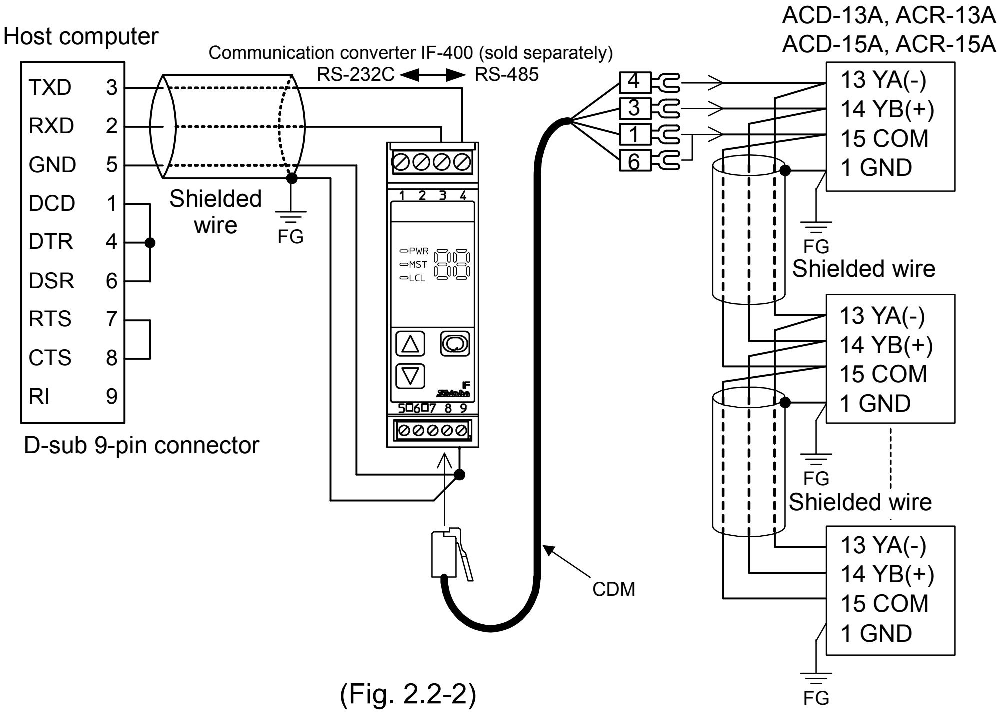
## 2.2 RS-485 (C5 option)

**• When using USB communication cable CMC-001-1 (sold separately)**




(Fig. 2.2-1)

**• When using communication converter IF-400 (sold separately)**




(Fig. 2.2-2)

**Shielded wire**

Connect only one end of the shielded wire to the FG or GND terminal so that current cannot flow to the shielded wire. If both ends of the shielded wire are connected to the FG or GND terminal, the circuit will be closed between the shielded wire and the ground. As a result, current will run through the shielded wire and this may cause noise.
Be sure to ground FG or GND terminal.
Recommended cable: OTSC-VB 2PX0.5SQ (made by Onamba Co., Ltd.) or equivalent (Use a twisted pair cable.)

**Terminator (Terminal resistor)**

Communication converter IF-400 (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 terminator with the communication line because each ACD/R-13A, ACD/R-15A has built-in pull-up and pull-down resistors instead of a terminator.

# 3. Communication parameter settings

Set each communication parameter following the procedures below.

(1) G_ENG Set the SET key 4 times in the PV/SV display mode.
The unit will enter the Engineering group.

(2) E_INP Press the MODE key once. The unit will proceed to the Input group.

(3) E_coM Press the SET key several times until characters of the Communication group appear.

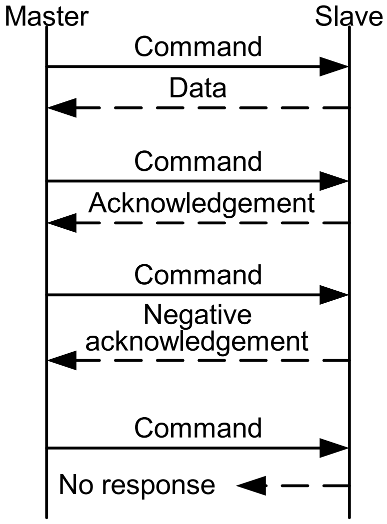
(4) cMSL NoML Press the MODE key once.
The unit will proceed to the Communication protocol selection.

- To set each setting item, use the △ or ▽ key.
- If the MODE key is pressed, the set value is registered, and the unit proceeds to the next setting item.
  If the MODE key is pressed at the SVTC bias setting, the unit proceeds to the Communication protocol selection.
- Pressing the A/M B.MODE key reverts to the previous setting item.
- Pressing the A/M B.MODE key for 1 sec reverts to the previous setting level (reverts from setting item to each group).
- If the MODE key is pressed for 3 sec in any setting mode, the unit will revert to the PV/SV display mode.

| Character | Name, Function, Setting range | Factory Default |
|---|---|---|
| cMSL NoML | **Communication protocol**<br>• Selects the communication protocol.<br>• NoML: Shinko protocol<br>ModA: Modbus ASCII mode<br>ModR: Modbus RTU mode | Shinko protocol |
| cMNo 0 | **Instrument number**<br>• Sets the instrument number of this unit. (The instrument numbers should be set one by one when multiple instruments are connected in Serial communication, otherwise communication is impossible.)<br>• Setting range: 0 to 95 | 0 |
| cMSP 96 | **Communication speed**<br>• Selects a communication speed equal to that of the host computer.<br>When using IF-400 communication converter (sold separately), select 9600bps or 19200bps.<br>• 96 : 9600bps<br>192 : 19200bps<br>384 : 38400bps | 9600bps |
| cMFT 7EVN | **Data bit/Parity**<br>• Selects data bit and parity.<br>• 8NoN : 8 bits/No parity<br>7NoN : 7 bits/No parity<br>8EVN : 8 bits/Even<br>7EVN : 7 bits/Even<br>8odd : 8 bits/Odd<br>7odd : 7 bits/Odd | 7 bits/Even |
| SToP 1 | **Stop bit**<br>• Selects the stop bit.<br>• 1 : 1<br>2 : 2 | 1 |
| SV_b 0 | **SVTC bias**<br>• By connecting to Shinko programmable controllers [PC-900 and PCD-33A with SVTC (Set value digital transmission) option], digital set values via the SVTC command can be received from programmable controllers. See Section 8 (pp.22, 23).<br>• Control desired value (SV) adds SVTC bias value to the value received by the SVTC command.<br>• Available only when Shinko protocol is selected during communication protocol selection.<br>• Setting range: Converted value of ±20% of the input span<br>DC voltage, current input: ±20% of the scaling span (The placement of the decimal point follows the selection.) | 0℃ |

# 4. Communication procedure

Communication starts with command transmission from the host computer (hereafter Master) and ends with the response of the ACD/R-13A, ACD/R-15A (hereafter Slave).



(Fig.4-1)

- **Response with data**
  When the master sends the reading command, the slave responds with the corresponding set 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 a non-existent command or value out of the setting range, the slave returns a negative acknowledgement.
- **No response**
  The slave will not respond to the master in the following cases:
  - Global address (Shinko protocol) is set.
  - Broadcast address (Modbus protocol) is set.
  - Communication error (framing error, parity error)
  - Checksum error (Shinko protocol), LRC discrepancy (Modbus ASCII mode), CRC-16 discrepancy (Modbus RTU mode)

**Communication timing of the RS-485**

**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 has received the response.
If a response to the command is not returned due to communication errors, set the Retry Processing to send the command again. (Retry twice or more is recommended.)

**Slave side**

When the slave starts transmission through a 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 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.

# 5. Shinko protocol

## 5.1 Transmission mode

Shinko protocol is composed of ASCII.
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 (8bits) Selectable
Parity : Even (Odd, No parity) Selectable
Stop bit : 1 bit (2 bits) Selectable

Error detection: Checksum

## 5.2 Command configuration

All commands are composed of ASCII.
The data (set value, decimal number) is represented by hexadecimal numbers.
The negative numbers are represented in 2's complement.
Numerals written below the command represent number of characters.

**(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 |

**(2) Reading command**

| Header (02H) | Address | Sub address (20H) | Command type (20H) | Data item | Checksum | Delimiter (03H) |
|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 4 | 2 | 1 |

**(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 |

**(4) Acknowledgement**

| Header (06H) | Address | Checksum | Delimiter (03H) |
|---|---|---|---|
| 1 | 1 | 2 | 1 |

**(5) Negative acknowledgement**

| Header (15H) | Address | Error code | Checksum | Delimiter (03H) |
|---|---|---|---|---|
| 1 | 1 | 1 | 2 | 1 |

**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

**Instrument number (Address)**: Numbers by which the master discerns each slave.
Instrument number 0 to 94 and Global address 95.
ASCII codes (20H to 7FH) are used by adding 20H to instrument numbers 0 to 95 (00H to 5FH).
95 (7FH) is called Global address, which is used when the same command is sent to all the slaves connected. However, the 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, using ASCII.
(Refer to "7. Communication command table".)

**Data** : The contents of data (set value) differs depending on the setting command.
Composed of hexadecimal 4 digits, using ASCII.
(Refer to "7. Communication command table".)

**Checksum** : 2-character data to detect communication errors. (Refer to "5.3 Checksum calculation".)

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

**Error code** : Represents an error type with ASCII codes.
1 (31H)-----Non-existent command
2 (32H)-----Not used
3 (33H)-----Setting outside the setting range
4 (34H)-----Status unable to be 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 communication errors can be checked.

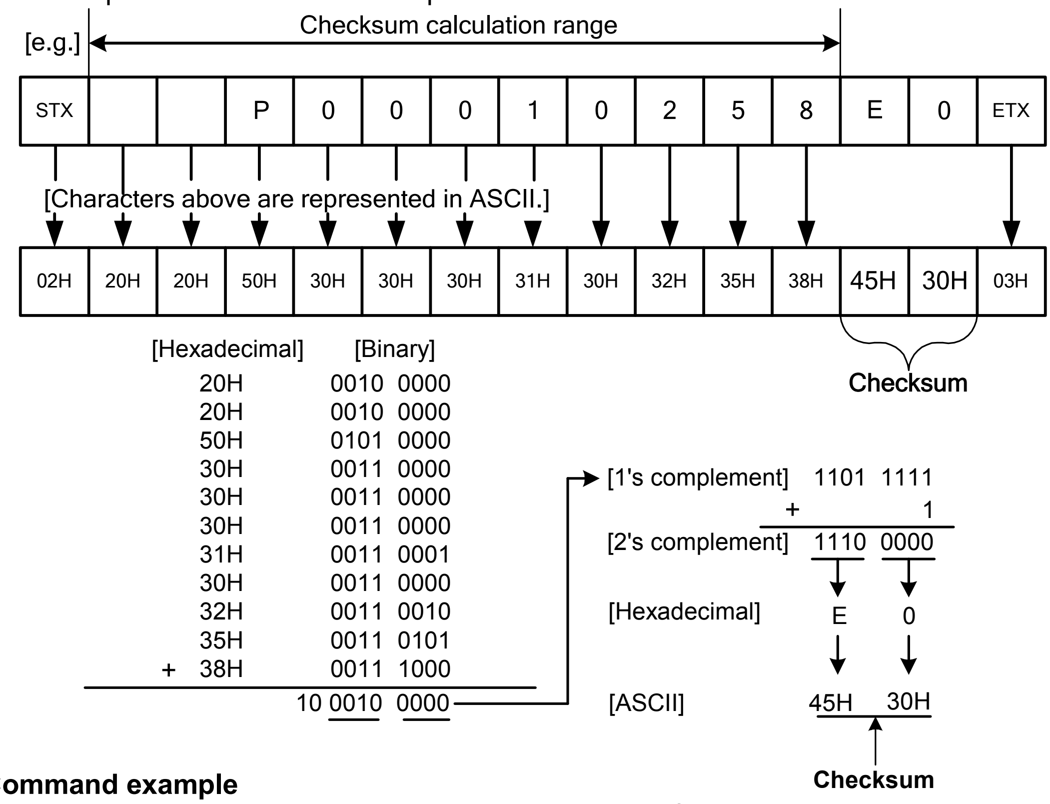
The ASCII code (hexadecimal) corresponding to the characters which range from the address to that before the checksum is converted to binary notation, and the total value is calculated.
The lower 2-digits of the total value are converted to 2's complement, and then to hexadecimal figures, that is, ASCII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

**Checksum calculation example**

SV: 600℃ (0258H)

Address (instrument number): 0 (20H)

- 1's complement: Reverse each binary bit. 0 will become 1 and vice versa.
- 2's complement: Add 1 to 1's complement.




## 5.4 Command example

Numerals written below the command represent number of characters.

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

- Reading command from the master

| Header (02H) | Address (21H) | Sub address (20H) | Command type (20H) | Data item [0A00H] (30H 41H 30H 30H) | Checksum (43H 45H) | Delimiter (03H) |
|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 4 | 2 | 1 |

- A response from the slave in normal status [When PV=600℃ (0258H)]

| Header (06H) | Address (21H) | Sub address (20H) | Command type (20H) | Data item [0A00H] (30H 41H 30H 30H) | Data [0258H] (30H 32H 35H 38H) | Checksum (46H 46H) | Delimiter (03H) |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 4 | 4 | 2 | 1 |

**(2) Reading (Address 1, SV)**

- Reading command from the master

| Header (02H) | Address (21H) | Sub address (20H) | Command type (20H) | Data item [0001H] (30H 30H 30H 31H) | Checksum (44H 45H) | Delimiter (03H) |
|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 4 | 2 | 1 |

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

| Header (06H) | Address (21H) | Sub address (20H) | Command type (20H) | Data item [0001H] (30H 30H 38H 30H) | Data [0258H] (30H 32H 35H 38H) | Checksum (30H 46H) | Delimiter (03H) |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 4 | 4 | 2 | 1 |

**(3) Setting (Address 1, SV)** [when setting SV to 600℃ (0258H)]

- Setting command from the master

| Header (02H) | Address (21H) | Sub address (20H) | Command type (50H) | Data item [0001H] (30H 30H 30H 31H) | Data [0258H] (30H 32H 35H 38H) | Checksum (44H 46H) | Delimiter (03H) |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 4 | 4 | 2 | 1 |

- A response from the slave in normal status

| Header (06H) | Address (21H) | Checksum (44H 46H) | Delimiter (03H) |
|---|---|---|---|
| 1 | 1 | 2 | 1 |

# 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 command is transmitted as ASCII characters.

Data format    Start bit : 1 bit
Data bit : 7 bits (8 bits)  Selectable
Parity  : Even (Odd, No parity)  Selectable
Stop bit : 1 bit (2 bits)  Selectable

Error detection : LRC (Longitudinal Redundancy Check)

Data interval  : 1 second or less (Max.1 sec of interval between characters)

#### (1) Message configuration

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

| Header (:) | Slave address | Function Code | Data | Error check LRC | Delimiter (CR) | Delimiter (LF) |
|---|---|---|---|---|---|---|

**Slave address**

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

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 0 (00H, broadcast address) can identify all the slaves connected. However slaves do not respond.

**Function code**

The function code is the command code for the slave to undertake the following action types.

| Function code | Contents |
|---|---|
| 03 (03H) | Reading the set 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 the function code by mistake, slave returns 90H by setting the MSB to 1, because the former is an illegal function.

For negative acknowledgement, the exception codes below are set to the data of the response message and returned to the master in order to inform it of what kind of error has occurred.

| Exception 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) | Shinko protocol error code 4 (Status unable to be set, e.g. AT is performing) |
| 18 (12H) | Shinko protocol error code 5 (During setting mode by keypad operation) |

**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 the number of bytes, data and exception codes in negative acknowledgements. The number of data to be dealt with in one message is “1”.

Therefore the number of data is fixed as (30H)(30H)(30H)(31H).

Effective range of data is -32768 to 32767 (8000H to 7FFFH).

**Error check**: 2-character data to detect communication errors.
Refer to “(2) Error check of ASCII mode”. (p.8)

**(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 message.

**How to calculate LRC**

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**

Numerals written below the command represent the number of characters.

① **Reading (Slave address 1, PV)**

• A request message from the master

Amount of data means how many data items are to be read. It is fixed as 1 (30H 30H 30H 31H).

| Header | Slave address | Function code | Data item [0A00H] | Amount of data [0001H] | Error check LRC | Delimiter CR+LF |
|---|---|---|---|---|---|---|
| (3AH) | (30H 31H) | (30H 33H) | (30H 41H 30H 30H) | (30H 30H 30H 31H) | (46H 31H) | (0DH 0AH) |
| 1 | 2 | 2 | 4 | 4 | 2 | 2 |

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

The number of response bytes means the number of bytes of data which have been read.
It is fixed as 2 (30H 32H).

| Header | Slave address | Function code | Number of response bytes [02H] | Data [0258H] | Error check LRC | Delimiter CR+LF |
|---|---|---|---|---|---|---|
| (3AH) | (30H 31H) | (30H 33H) | (30H 32H) | (30H 32H 35H 38H) | (41H 30H) | (0DH 0AH) |
| 1 | 2 | 2 | 2 | 4 | 2 | 2 |

② **Reading (Slave address 1, SV)**

• A request message from the master

Amount of data means how many data items are to be read. It is fixed as 1 (30H 30H 30H 31H).

| Header | Slave address | Function code | Data item [0001H] | Amount of data [0001H] | Error check LRC | Delimiter CR+LF |
|---|---|---|---|---|---|---|
| (3AH) | (30H 31H) | (30H 33H) | (30H 30H 30H 31H) | (30H 30H 30H 31H) | (46H 41H) | (0DH 0AH) |
| 1 | 2 | 2 | 4 | 4 | 2 | 2 |

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

The number of response bytes means the number of bytes of data which have been read.
It is fixed as 2 (30H 32H).

| Header | Slave address | Function code | Number of response bytes [02H] | Data [0258H] | Error check LRC | Delimiter CR+LF |
|---|---|---|---|---|---|---|
| (3AH) | (30H 31H) | (30H 33H) | (30H 32H) | (30H 32H 35H 38H) | (41H 30H) | (0DH 0AH) |
| 1 | 2 | 2 | 2 | 4 | 2 | 2 |

• Response message from the slave in exception (error) status (When a data item has been mistaken)

The function code MSB is set to 1 for the response message in exception (error) status [83H (38H 33H)].
The exception code 02H (30H 32H: Non-existent data address) is returned (error).

| Header | Slave address | Function code | Exception code [02H] | Error check LRC | Delimiter CR+LF |
|---|---|---|---|---|---|
| (3AH) | (30H 31H) | (38H 33H) | (30H 32H) | (37H 41H) | (0DH 0AH) |
| 1 | 2 | 2 | 2 | 2 | 2 |

③ **Setting (Slave address 1, SV)** [When setting SV to 600℃ (0258H)]

• A request message from the master

| Header | Slave address | Function code | Data item [0001H] | Data [0258H] | Error check LRC | Delimiter CR+LF |
|---|---|---|---|---|---|---|
| (3AH) | (30H 31H) | (30H 36H) | (30H 30H 30H 31H) | (30H 32H 35H 38H) | (39H 45H) | (0DH 0AH) |
| 1 | 2 | 2 | 4 | 4 | 2 | 2 |

• Response message from the slave in normal status

| Header | Slave address | Function code | Data item [0001H] | Data [0258H] | Error check LRC | Delimiter CR+LF |
|---|---|---|---|---|---|---|
| (3AH) | (30H 31H) | (30H 36H) | (30H 30H 30H 31H) | (30H 32H 35H 38H) | (39H 45H) | (0DH 0AH) |
| 1 | 2 | 2 | 4 | 4 | 2 | 2 |

• Response message from the slave in exception (error) status (When a value out of the setting range is set)
The function code MSB is set to 1 for the response message in exception (error) status [86H (38H 36H)].
The exception code 03H (30H 33H: Value out of the setting range) is returned (error).

| Header<br><br>(3AH) | Slave address<br>(30H 31H) | Function code<br>(38H 36H) | Exception code [03H]<br>(30H 33H) | Error check LRC<br>(37H 36H) | Delimiter CR+LF<br>(0DH 0AH) |
|---|---|---|---|---|---|
| 1 | 2 | 2 | 2 | 2 | 2 |

## 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 : No parity (Even, Odd) Selectable
Stop bit : 1 bit (2 bits) Selectable

Error detection : CRC-16 (Cyclic Redundancy Check)

Data interval : 3.5 character transmission times or less
To transmit continuously, an interval between characters which consist of one message, must be within 3.5 character transmission times.

### (1) Message configuration

RTU mode is configured to start after idle time is processed for more than 3.5 character transmissions, and end after idle time is processed for more than 3.5 character transmissions.

| 3.5 idle characters | Slave address | Function Code | Data | Error check CRC-16 | 3.5 idle characters |
|---|---|---|---|---|---|

**Slave address**

Slave address is an individual instrument number on the slave side, and is set within the range 0 to 95 (00H to 5FH).
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 0 (00H, broadcast address) can identify all the slaves connected. However slaves do not respond.

**Function code**

The function code is the command code for the slave to undertake the following action types.

| Function code | Contents |
|---|---|
| 03 (03H) | Reading the set 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 the function code by mistake, slave returns 90H by setting the MSB to 1, because the former is an illegal function.
For negative acknowledgement, the exception codes below are set to the data of the response messages and returned to the master in order to inform it of what kind of error has occurred.

| Exception 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) | Shinko protocol error code 4 (Status unable to be set, e.g. AT is performing) |
| 18 (12H) | Shinko protocol error code 5 (During setting mode by keypad operation) |

**Data**

Data differs depending on the function code.
A request message from the master side is composed of data item, amount of data and setting data.
A response message from the slave side is composed of the number of bytes, data and exception codes in negative acknowledgements.
The number of data to be dealt with in one message is “1”. Therefore the number of data is fixed as (0001H).
The number of response bytes is (02H).
Effective range of data is –32768 to 32767 (8000H to 7FFFH).

**Error check**: 16 bit data to detect communication errors. Refer to “(2) Error check of RTU mode”. (p.10)

**(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 to calculate CRC-16**

In the CRC-16 system, the information is divided by polynomial series. The remainder is added to the end of the information and transmitted. The generation of polynomial series is as follows.
(Generation of polynomial series: $X^{16} + X^{15} + X^{2} + 1$)

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 the message in sequence from low order to high order.

**(3) Message example of RTU mode**

Numerals written below the command represent number of characters.

① **Reading (Slave address 1, PV)**

• A request message from the master
Amount of data means the data item to be read, and it is fixed as 1 (0001H).

| 3.5 idle characters | Slave address (01H) | Function code (03H) | Data item (0A00H) | Amount of data (0001H) | Error check CRC-16 (87D2H) | 3.5 idle characters |
|---|---|---|---|---|---|---|
| | 1 | 1 | 2 | 2 | 2 | |

• Response message from the slave in normal status [When PV=600℃ (0258H)]
The number of response bytes means the number of bytes of data which have been read.
It is fixed as 2 (02H).

| 3.5 idle characters | Slave address (01H) | Function code (03H) | Number of response bytes (02H) | Data (0258H) | Error check CRC-16 (B8DEH) | 3.5 idle characters |
|---|---|---|---|---|---|---|
| | 1 | 1 | 1 | 2 | 2 | |

② **Reading (Slave address 1, SV)**

• A request message from the master
Amount of data means the data item to be read, and it is fixed as 1 (0001H).

| 3.5 idle characters | Slave address (01H) | Function code (03H) | Data item (0001H) | Amount of data (0001H) | Error check CRC-16 (D5CAH) | 3.5 idle characters |
|---|---|---|---|---|---|---|
| | 1 | 1 | 2 | 2 | 2 | |

• Response message from the slave in normal status [When SV=600℃ (0258H)]
The number of response bytes means the number of bytes of data which have been read. It is fixed as 2 (02H).

| 3.5 idle characters | Slave address (01H) | Function code (03H) | Number of response bytes (02H) | Data (0258H) | Error check CRC-16 (B8DEH) | 3.5 idle characters |
|---|---|---|---|---|---|---|
| | 1 | 1 | 1 | 2 | 2 | |

• Response message from the slave in exception (error) status (When data item is mistaken)
The function code MSB is set to 1 for the response message in exception (error) status (83H).
The exception code (02H: Non-existent data address) is returned (error).

| 3.5 idle characters | Slave address (01H) | Function code (83H) | Exception code (02H) | Error check CRC-16 (C0F1H) | 3.5 idle characters |
|---|---|---|---|---|---|
| | 1 | 1 | 1 | 2 | |

③ **Setting (Slave address 1, SV)** [When setting SV to 600℃ (0258H)]

• A request message from the master

| 3.5 idle characters | Slave address (01H) | Function code (06H) | Data item (0001H) | Data (0258H) | Error check CRC-16 (D890H) | 3.5 idle characters |
|---|---|---|---|---|---|---|
| | 1 | 1 | 2 | 2 | 2 | |

• Response message from the slave in normal status

| 3.5 idle characters | Slave address (01H) | Function code (06H) | Data item (0001H) | Data (0258H) | Error check CRC-16 (D890H) | 3.5 idle characters |
|---|---|---|---|---|---|---|
| | 1 | 1 | 2 | 2 | 2 | |

• Response message from the slave in exception (error) status (When a value out of the setting range is set)
The function code MSB is set to 1 for the response message in exception (error) status (86H).
The exception code (03H: Value out of the setting range) is returned (error).

| 3.5 idle characters | Slave address (01H) | Function code (86H) | Exception code (03H) | Error check CRC-16 (0261H) | 3.5 idle characters |
|---|---|---|---|---|---|
| | 1 | 1 | 1 | 2 | |

# 7. Communication command table

● **Data**

**Notes about setting, reading command**

• [13A] is entered in the Data item for the exclusive commands of the ACD/R-13A.
[15A] is entered in the Data item for the exclusive commands of the ACD/R-15A.
[13A] or [15A] is not entered in the Data item for common commands to ACD/R-13A, ACD/R-15A.
Be sure to use exclusive commands correctly as described above, otherwise actions will not be guaranteed.

• The data (set value, decimal) is converted to hexadecimal figures. A negative number is represented in 2's complement.

• When connecting multiple slaves, the address (instrument number) must not be duplicated.

• Use specified Data items only. If unspecified Data items are entered, negative acknowledgement will be returned or communication errors may occur.

• Modbus protocol uses Holding Register addresses. The Holding Register addresses are created as follows.
A Shinko command data item is converted to decimal number, and the offset of 40001 is added. The result is the Holding Register address.
Using Data item 0001H SV [Set value memory number 1 (SM1)] as an example: Data item in the sending message is 0001H, however, Modbus protocol Holding Register address is 40002 (1 + 40001).

**Setting command**

• Up to 1,000,000 (one million) entries can be stored in non-volatile IC memory.
If the number of settings exceeds the limit, the data will not be saved. So, do not change the set values frequently via communication. (If the value set via communication is the same as the value before the setting, the value will not be written in non-volatile IC memory.)

• Setting range of each item is the same as that of keypad operation.

• When the data (set value) has a decimal point, a whole number (hexadecimal) without a decimal point is used.

• If the alarm type is changed during Event output EVT1 allocation (0060H) to Event output EVT5 allocation (0064H), the alarm value will default to “0”. Also Alarm output status will be initialized.

• Settings via software communication are possible while in Set value lock status.

• Even if options are not ordered, setting or reading via software communication will be possible.
However, their command contents will not function.

• The Instrument Numbers and Communication Speed of the slave cannot be set by software communication.

• When sending a command by Global address [95 (7FH), Shinko protocol] or Broadcast address [0 (00H) Modbus protocol], the same command is sent to all the slaves connected. However, the response is not returned.

**Reading command**

• When the data (set value) has a decimal point, a whole number (hexadecimal) without a decimal point is used for a response.

● **Negative acknowledgement**

**The slave will return Error code 1 (31H, Shinko protocol) or Exception code 1 (01H, Modbus protocol) in the following cases.**

• If AT/Auto-reset (0010H) is selected while control is in PI control or in ON/OFF control action.
• When Manual MV (00D3H) is read during automatic control.

**The slave will return Error code 4 (34H, Shinko protocol) or Exception code 17 (11H, Modbus protocol) in the following cases.**

• When SV (00D0H) of current Set value memory number is set during AT or program control.
• When manual MV (00D3H) is set during automatic control.

| Shinko Command type | Modbus Function code | | Data item | Data |
|---|---|---|---|---|
| 20H/50H | 03H/06H | 0001H | SV [Set value memory number 1(SM1)] | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 0002H | EVT1 alarm value (SM1) | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 0003H | EVT1 high limit alarm value (SM1) | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 0004H | EVT2 alarm value (SM1) [13A] | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 0005H | EVT2 high limit alarm value (SM1) [13A] | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 0006H | EVT3 alarm value (SM1) [13A] | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 0007H | EVT3 high limit alarm value (SM1) [13A] | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 0008H | EVT4 alarm value (SM1) | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 0009H | EVT4 high limit alarm value (SM1) | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 000AH | EVT5 alarm value (SM1) | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 000BH | EVT5 high limit alarm value (SM1) | Set value, Decimal point ignored |
| | | | **Note:**<br>If Independent alarms such as High/Low limits independent, High/Low limit range independent and High/Low limits with standby independent are selected during EVT1 to EVT5 allocation (0060H to 0064H), the EVT1 to EVT5 alarm value (SM1) matches the low limit side, and EVT1 to EVT5 high limit alarm value (SM1) matches the high limit side.<br>Set values of the Set value memory numbers (SM1 to SM15) are common to those of step numbers (1 to 15) of the Program control command. (Pages 19, 20)<br>For Set value memory numbers (SM2 to SM15), use step numbers (2 to 15) of the Program control command. | |
| 20H/50H | 03H/06H | 0010H | AT/Auto-reset | 0000H: Cancel<br>0001H: Perform |
| 20H/50H | 03H/06H | 0011H | AT bias | Set value |
| | | | | |
| 20H/50H | 03H/06H | 0020H | OUT1 proportional band (Zone 1) [13A]<br>Proportional band (Zone 1) [15A] | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 0021H | OUT2 proportional band (Zone 1) [13A] | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 0022H | Integral time (Zone 1) | Set value |
| 20H/50H | 03H/06H | 0023H | Derivative time (Zone 1) | Set value |
| 20H/50H | 03H/06H | 0024H | ARW (Zone 1) | Set value |
| 20H/50H | 03H/06H | 0025H | Manual reset (Zone 1) | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 0026H | OUT1 rage-of-change (Zone 1) [13A]<br>MV rage-of-change (Zone 1) [15A] | Set value |
| | | | **Note:**<br>Set values from Zone 1 to Zone 5 are common to those of Zone 1 to Zone 5 of the PID zone command. (Pages 20, 21)<br>For Zone 2 to Zone 5, use Zone 2 to Zone 5 of the PID zone command. | |
| 20H/50H | 03H/06H | 0030H | Input type | 0000H: K -200 to 1370℃<br>0001H: K -200.0 to 400.0℃<br>0002H: J -200 to 1000℃<br>0003H: R 0 to 1760℃<br>0004H: S 0 to 1760℃<br>0005H: B 0 to 1820℃<br>0006H: E -200 to 800℃<br>0007H: T -200.0 to 400.0℃<br>0008H: N -200 to 1300℃<br>0009H: PL-Ⅱ 0 to 1390℃<br>000AH: C(W/Re5-26) 0 to 2315℃<br>000BH: Pt100 -200.0 to 850.0℃<br>000CH: JPt100 -200.0 to 500.0℃<br>000DH: Pt100 -200 to 850℃<br>000EH: JPt100 -200 to 500℃ |

| Shinko Command type | Modbus Function code | Data item | | Data |
|---|---|---|---|---|
| | | | | 000FH: Pt100 -100.0 to 100.0℃<br>0010H:JPt100 -100.0 to 500.0℃ |
| | | | | 0011H: K -328 to 2498℉<br>0012H: K -328.0 to 752.0℉<br>0013H: J -328 to 1832℉<br>0014H: R 32 to 3200℉<br>0015H: S 32 to 3200℉<br>0016H: B 32 to 3308℉<br>0017H: E -328 to 1472℉<br>0018H: T -328.0 to 752.0℉<br>0019H: N -328 to 2372℉<br>001AH: PL-Ⅱ 32 to 2534℉<br>001BH: C(W/Re5-26) 32 to 4199℉<br>001CH: Pt100 -328.0 to 1562.0℉<br>001DH: JPt100 -328.0 to 932.0℉<br>001EH: Pt100 -328 to 1562℉<br>001FH: JPt100 -328 to 932℉<br>0020H: Pt100 -148.0 to 212.0℉<br>0021H: JPt100 -148.0 to 932.0℉ |
| | | | | 0022H: 4 to 20mA DC -2000 to 10000<br>0023H: 0 to 20mA DC -2000 to 10000<br>0024H: 0 to 10mV DC -2000 to 10000<br>0025H: -10 to 10mV DC -2000 to 10000<br>0026H: 0 to 50mV DC -2000 to 10000<br>0027H: 0 to 100mV DC -2000 to 10000<br>0028H: 0 to 1V DC -2000 to 10000<br>0029H: 0 to 5V DC -2000 to 10000<br>002AH: 1 to 5V DC -2000 to 10000<br>002BH: 0 to 10V DC -2000 to 10000 |
| | | | **Note:**<br>When responding to the command of Input type selection, it takes approx. 2 sec due to internal processing. Therefore set the Time-out time for communication to 2 sec or more when executing this command. | |
| 20H/50H | 03H/06H | 0031H | Scaling high limit | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 0032H | Scaling low limit | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 0033H | Decimal point place | 0000H: xxxxx<br>0001H: xxxx.x<br>0002H: xxx.xx<br>0003H: xx.xxx<br>0004H: x.xxxx |
| 20H/50H | 03H/06H | 0034H | PV filter time constant | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 0035H | Sensor correction | Set value, Decimal point ignored |
| | | | | |
| 20H/50H | 03H/06H | 0040H | OUT1 proportional cycle [13A] | Set value |
| 20H/50H | 03H/06H | 0041H | OUT2 proportional cycle [13A] | Set value |
| 20H/50H | 03H/06H | 0042H | OUT1 high limit [13A]<br>MV high limit [15A] | Set value |
| 20H/50H | 03H/06H | 0043H | OUT1 low limit [13A]<br>MV low limit [15A] | Set value |
| 20H/50H | 03H/06H | 0044H | OUT1 ON/OFF hysteresis [13A]<br>ON/OFF hysteresis [15A] | Set value, Decimal point ignored |

| Shinko Command type | Modbus Function code | Data item | | Data |
|---|---|---|---|---|
| 20H/50H | 03H/06H | 0045H | OUT2 action mode [13A] | 0000H: Air cooling<br>0001H: Oil cooling<br>0002H: Water cooling |
| 20H/50H | 03H/06H | 0046H | OUT2 high limit [13A] | Set value |
| 20H/50H | 03H/06H | 0047H | OUT2 low limit [13A] | Set value |
| 20H/50H | 03H/06H | 0048H | Overlap/Dead band [13A] | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 0049H | OUT2 ON/OFF hysteresis [13A] | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 004AH | Direct/Reverse action | 0000H: Reverse action<br>0001H: Direct action |
| 20H/50H | 03H/06H | 004BH | OUT1 preset output [13A] | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 004CH | OUT2 preset output [13A] | Set value, Decimal point ignored |
| | | | | |
| 20H/50H | 03H/06H | 0050H | Event input EVI1 allocation | 0000H: No event<br>0001H: Set value memory<br>0002H: Control ON/OFF<br>0003H: Direct/Reverse control action<br>0004H: Timer Start/Stop<br>0005H: PV display; PV holding<br>0006H: PV display;<br>PV peak value holding<br>0007H: Preset output 1<br>0008H: Auto/Manual control<br>0009H: Remote/Local<br>000AH: Program mode; RUN/STOP<br>000BH: Program mode;<br>Holding/Not holding<br>000CH: Program mode;<br>Advance function<br>000DH: Integral action holding<br>000EH: Preset output 2 |
| 20H/50H | 03H/06H | 0051H | Event input EVI2 allocation | The same as those of the Event input EVI1 allocation |
| 20H/50H | 03H/06H | 0052H | Event input EVI3 allocation | The same as those of the Event input EVI1 allocation |
| 20H/50H | 03H/06H | 0053H | Event input EVI4 allocation | The same as those of the Event input EVI1 allocation |
| | | | | |

| Shinko Command type | Modbus Function code | | Data item | Data |
|---|---|---|---|---|
| 20H/50H | 03H/06H | 0060H | Event output EVT1 allocation | 0000H: No event<br>0001H: High limit alarm<br>0002H: Low limit alarm<br>0003H: High/Low limits alarm<br>0004H: H/L limits independent<br>0005H: H/L limit range alarm<br>0006H: H/L limit range independent<br>0007H: Process high alarm<br>0008H: Process low alarm<br>0009H: High limit with standby<br>000AH: Low limit with standby<br>000BH: H/L limits with standby<br>000CH: H/L limits with standby independent<br>000DH: Timer output Interlocked with Event input<br>000EH: Timer output Interlocked with Event input. Control ON during timer operation. Control OFF after time is up.<br>000FH: Heater burnout alarm output<br>0010H: Loop break alarm output<br>0011H: Time signal output<br>0012H: Output during AT<br>0013H: Pattern end output |
| 20H/50H | 03H/06H | 0061H | Event output EVT2 allocation [13A] | The same as those of the Event output EVT1 allocation |
| 20H/50H | 03H/06H | 0062H | Event output EVT3 allocation [13A] | The same as those of the Event output EVT1 allocation |
| 20H/50H | 03H/06H | 0063H | Event output EVT4 allocation | The same as those of the Event output EVT1 allocation |
| 20H/50H | 03H/06H | 0064H | Event output EVT5 allocation | The same as those of the Event output EVT1 allocation |
| 20H/50H | 03H/06H | 0065H | EVT1 Alarm hysteresis | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 0066H | EVT1 Alarm action delay timer | Set value |
| 20H/50H | 03H/06H | 0067H | EVT1 Alarm Energized/De-energized | 0000H: Energized<br>0001H: De-energized |
| 20H/50H | 03H/06H | 0068H | EVT2 Alarm hysteresis [13A] | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 0069H | EVT2 Alarm action delay timer [13A] | Set value |
| 20H/50H | 03H/06H | 006AH | EVT2 Alarm Energized/De-energized [13A] | 0000H: Energized<br>0001H: De-energized |
| 20H/50H | 03H/06H | 006BH | EVT3 Alarm hysteresis [13A] | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 006CH | EVT3 Alarm action delay timer [13A] | Set value |
| 20H/50H | 03H/06H | 006DH | EVT3 Alarm Energized/De-energized [13A] | 0000H: Energized<br>0001H: De-energized |
| 20H/50H | 03H/06H | 006EH | EVT4 Alarm hysteresis | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 006FH | EVT4 Alarm action delay timer | Set value |
| 20H/50H | 03H/06H | 0070H | EVT4 Alarm Energized/De-energized | 0000H: Energized<br>0001H: De-energized |
| 20H/50H | 03H/06H | 0071H | EVT5 Alarm hysteresis | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 0072H | EVT5 Alarm action delay timer | Set value |

| Shinko Command type | Modbus Function code | Data item | | Data |
|---|---|---|---|---|
| 20H/50H | 03H/06H | 0073H | EVT5 Alarm Energized/De-energized | 0000H: Energized<br>0001H: De-energized |
| 20H/50H | 03H/06H | 0074H | Timer output delay action | 0000H: ON delay timer<br>0001H: OFF delay timer<br>0002H: ON/OFF delay timer |
| 20H/50H | 03H/06H | 0075H | Timer output time unit | 0000H: Minute<br>0001H: Second |
| 20H/50H | 03H/06H | 0076H | OFF delay timer time | Set value |
| 20H/50H | 03H/06H | 0077H | ON delay timer time | Set value |
| 20H/50H | 03H/06H | 0078H | Heater rated current [13A] | 0000H: 20A<br>0001H: 100A |
| 20H/50H | 03H/06H | 0079H | Heater burnout alarm 1 [13A] | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 007AH | Heater burnout alarm 2 [13A] | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 007BH | Loop break alarm time | Set value |
| 20H/50H | 03H/06H | 007CH | Loop break alarm span | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 007DH | Time signal output step | Set value |
| 20H/50H | 03H/06H | 007EH | Time signal output OFF time | Set value |
| 20H/50H | 03H/06H | 007FH | Time signal output ON time | Set value |
| | | | **Note:**<br>For Time Signal output OFF/ON time setting, the smaller unit value of Step time unit (0091H) is calculated, and is converted to hexadecimal figures.<br>00:00 to 99:59 (0 to 5999)<br>(e.g.) When time unit is set to “Hour:Minute”:<br>1 hour 30 minutes ➡ 90 minutes ➡ 005AH<br>15 hours 50 minutes ➡ 950 minutes ➡ 03B6H | |
| | | | | |
| 20H/50H | 03H/06H | 0090H | Fixed value control/Program control | 0000H: Fixed value control<br>0001H: Program control |
| 20H/50H | 03H/06H | 0091H | Step time unit | 0000H: Hour:Minute<br>0001H: Minute:Second |
| 20H/50H | 03H/06H | 0092H | Power restore action | 0000H: Stops (Standby) after power restoration<br>0001H: Continues after power restoration<br>0002H: Suspended (On hold) after power restoration |
| 20H/50H | 03H/06H | 0093H | Program start temperature | Set value, Decimal point ignored |
| | | | | |
| 20H/50H | 03H/06H | 00A0H | Remote/Local | 0000H: Local<br>0001H: Remote |
| 20H/50H | 03H/06H | 00A1H | External setting input high limit | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 00A2H | External setting input low limit | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 00A3H | Remote bias | Set value, Decimal point ignored |
| | | | | |
| 20H/50H | 03H/06H | 00B0H | Transmission output | 0000H: PV transmission<br>0001H: SV transmission<br>0002H: MV transmission<br>0003H: DV transmission |
| 20H/50H | 03H/06H | 00B1H | Transmission output high limit | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 00B2H | Transmission output low limit | Set value, Decimal point ignored |
| | | | | |

| Shinko Command type | Modbus Function code | | Data item | Data |
|---|---|---|---|---|
| 20H/50H | 03H/06H | 00C0H | Set value lock | 0000H: Unlock<br>0001H: Lock 1<br>0002H: Lock 2<br>0003H: Lock 3<br>0004H: Lock 4 |
| | | | | |
| 20H/50H | 03H/06H | 00C1H | PID zone function | 0000H: Not used<br>0001H: Used |
| 20H/50H | 03H/06H | 00C2H | SV rise rate | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 00C3H | SV fall rate | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 00C4H | Indication when output OFF | 0000H: OFF indication<br>0001H: No indication<br>0002H: PV indication<br>0003H: PV indication + Any event from EVT1 to EVT5 output effective |
| 20H/50H | 03H/06H | 00C5H | Backlight selection | 0000H: All are backlit<br>0001H: Only PV display is backlit<br>0002H: Only SV display is backlit<br>0003H: Only Action indicators are backlit<br>0004H: PV+SV displays are backlit<br>0005H: PV+ Action indicators are backlit<br>0006H: SV+ Action indicators are backlit |
| 20H/50H | 03H/06H | 00C6H | PV color | 0000H: Green<br>0001H: Red<br>0002H: Orange<br>0003H: EVT1 to EVT5 ON: Green→Red<br>0004H: EVT1 to EVT5 ON: Orange→Red<br>0005H: PV continuous change<br>0006H: PV continuous change + EVT1 to EVT5 ON: Red |
| 20H/50H | 03H/06H | 00C7H | PV color range | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 00C8H | Backlight time | Set value |
| 20H/50H | 03H/06H | 00C9H | Bar graph | 0000H: MV indication<br>0001H: DV indication<br>0002H: No indication<br>0003H: Degree of valve opening is indicated. [15A] |
| 20H/50H | 03H/06H | 00CAH | Deviation unit | Set value, Decimal point ignored. |
| | | | | |
| 20H/50H | 03H/06H | 00D0H | SV of Current Set value memory number | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 00D1H | Control output OFF function or RUN/STOP selection | Fixed value control:<br>0000H: ON<br>0001H: OFF<br>Program control:<br>0000H: STOP<br>0001H: RUN |
| 20H/50H | 03H/06H | 00D2H | Auto/Manual control | 0000H: Automatic control<br>0001H: Manual control |
| 20H/50H | 03H/06H | 00D3H | Manual MV | Set value |
| 20H/50H | 03H/06H | 00D4H | Key (setting operation) Allowed/Prohibited | 0000H: Allowed<br>0001H: Prohibited |
| | | | **Note**:<br>If power to the controller is turned ON again after the key has been set to “Prohibited”, the key will be set to “allowed”. | |
| | | | | |

| Shinko Command type | Modbus Function code | | Data item | Data |
|---|---|---|---|---|
| 20H/50H | 03H/06H | 00E0H | FBP Yes/No [15A] | 0000H: FBP Yes<br>0001H: FBP No |
| 20H/50H | 03H/06H | 00E1H | Open/Closed output dead band [15A] | Set value |
| 20H/50H | 03H/06H | 00E2H | Open/Closed output hysteresis [15A] | Set value |
| 20H/50H | 03H/06H | 00E3H | Open output time [15A] | Set value |
| 20H/50H | 03H/06H | 00E4H | Closed output time [15A] | Set value |
| 20H/50H | 03H/06H | 00E5H | Error detection during FBP adjustment [15A] | 0000H: Error detection Yes<br>0001H: Error detection No |
| | | | | |
| 50H | 06H | 00F0H | Key operation change flag clearing | 0000H: No action<br>0001H: Clear all |
| | | | | |
| 20H | 03H | 0A00H | PV (process variable) | Decimal point ignored |
| 20H | 03H | 0A01H | OUT1 MV [13A]<br>Output MV [15A] | Decimal point ignored |
| 20H | 03H | 0A02H | OUT2 MV [13A] | Decimal point ignored |
| 20H | 03H | 0A03H | Current SV | Decimal point ignored |
| 20H | 03H | 0A04H | Remaining time when program runs | Remaining time |
| 20H | 03H | 0A05H | Program running step | Running step (SM) number |
| 20H | 03H | 0A06H | Status flag 1 | |

0000 0000 0000 0000

- $2^0$: OUT1 0: OFF, 1: ON [13A]
  (Direct current output type: Not fixed)
  Open output 0: OFF, 1: ON [15A]
- $2^1$: OUT2 0: OFF, 1: ON [13A]
  (Direct current output type: Not fixed)
  Closed output 0: OFF, 1: ON [15A]
- $2^2$: EVT1 output 0: OFF, 1: ON
- $2^3$: EVT2 output 0: OFF, 1: ON [13A]
  Not used, Always 0 [15A]
- $2^4$: EVT3 output 0: OFF, 1: ON [13A]
  Not used, Always 0 [15A]
- $2^5$: EVT4 output 0: OFF, 1: ON
- $2^6$: EVT5 output 0: OFF, 1: ON
- $2^7$: Heater burnout alarm output 0: OFF, 1: ON [13A]
  (When sensor burnout, 0: OFF)
  Not used, Always 0 [15A]
- $2^8$: Loop break alarm output 0: OFF, 1: ON
- $2^9$: Overscale 0: OFF, 1: ON
- $2^{10}$: Underscale 0: OFF, 1: ON
- $2^{11}$: PV/SV display mode/Standby mode
  0: PV/SV display mode, 1: Standby mode
- $2^{12}$: PV/SV display mode/Setting mode
  0: PV/SV display mode, 1: Setting mode
- $2^{13}$: AT/Auto-reset
  0: OFF, 1: During AT/Auto-reset
- $2^{14}$: Warm-up
  0: Finished, 1: During warm-up
- $2^{15}$: Change in key operation
  0: No, 1: Yes

| Shinko Command type | Modbus Function code | | Data item | Data |
|---|---|---|---|---|
| 20H | 03H | 0A07H | Status flag 2 | |
| | | | 0000 0000 0000 0000<br>$2^0$: EVT1 input 0: OFF, 1: ON<br>$2^1$: EVT2 input 0: OFF, 1: ON<br>$2^2$: EVT3 input 0: OFF, 1: ON<br>$2^3$: EVT4 input 0: OFF, 1: ON<br>$2^4$: Not used, Always 0<br>$2^5$: Not used, Always 0<br>$2^6$: Not used, Always 0<br>$2^7$: Not used, Always 0<br>$2^8$: Not used, Always 0<br>$2^9$: Not used, Always 0<br>$2^{10}$: Not used, Always 0<br>$2^{11}$: Auto/Manual control<br>0: Automatic control, 1: Manual control<br>$2^{12}$: Control mode<br>0: Fixed value control, 1: Program control<br>$2^{13}$: Program control<br>0: Standby, 1: Program control run<br>$2^{14}$: Wait function<br>0: OFF, 1: During Wait<br>$2^{15}$: Not used, Always 0 | |
| 20H | 03H | 0A08H | CT1 current value [13A] | Decimal point ignored |
| 20H | 03H | 0A09H | CT2 current value [13A] | Decimal point ignored |
| 20H | 03H | 0A0AH | Degree of valve opening [15A] | Returns “0.0 to 100.0%” as a Fully Closed/Fully Open position of FBP. (Without FBP: Not fixed) |

**Program control command**

| Shinko Command type | Modbus Function code | | Data item | Data |
|---|---|---|---|---|
| 20H/50H | 03H/06H | 1110H | Step 1 SV | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 1111H | Step 1 time | Set value |
| | | | **Note:**<br>For Step time setting, the smaller unit value of Step time unit (0091H) is calculated, and is converted to hexadecimal figures.<br>00:00 to 99:59 (0 to 5999)<br>(e.g) When time unit is set to “Hour:Minute”:<br>1 hour 30 minutes ➡ 90 minutes ➡ 005AH<br>15 hours 50 minutes ➡ 950 minutes ➡ 03B6H | |
| 20H/50H | 03H/06H | 1112H | Step 1 wait value | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 1113H | Step 1 EVT1 alarm value | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 1114H | Step 1 EVT1 high limit alarm value | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 1115H | Step 1 EVT2 alarm value [13A] | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 1116H | Step 1 EVT2 high limit alarm value [13A] | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 1117H | Step 1 EVT3 alarm value [13A] | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 1118H | Step 1 EVT3 high limit alarm value [13A] | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 1119H | Step 1 EVT4 alarm value | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 111AH | Step 1 EVT4 high limit alarm value | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 111BH | Step 1 EVT5 alarm value | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 111CH | Step 1 EVT5 high limit alarm value | Set value, Decimal point ignored. |

| Shinko Command type | Modbus Function code | Data item | | Data |
|---|---|---|---|---|
| | | | **Note:** If Independent alarms such as High/Low limits independent, High/Low limit range independent and High/Low limits with standby independent are selected during EVT1 to EVT5 allocation (0060H to 0064H), Step 1 EVT1 to EVT5 alarm value matches the low limit side, and Step 1 EVT1 to EVT5 high limit alarm value matches the high limit side. | |
| | | | One step data includes from Step 1 SV to Step 1 EVT5 high limit alarm value. It is possible to set up to Step 15. | |
| 20H/50H | 03H/06H | 11F0H | Step 15 SV | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 11F1H | Step 15 time | Set value |
| 20H/50H | 03H/06H | 11F2H | Step 15 wait value | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 11F3H | Step 15 EVT1 alarm value | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 11F4H | Step 15 EVT1 high limit alarm value | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 11F5H | Step 15 EVT2 alarm value [13A] | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 11F6H | Step 15 EVT2 high limit alarm value [13A] | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 11F7H | Step 15 EVT3 alarm value [13A] | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 11F8H | Step 15 EVT3 high limit alarm value [13A] | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 11F9H | Step 15 EVT4 alarm value | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 11FAH | Step 15 EVT4 high limit alarm value | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 11FBH | Step 15 EVT5 alarm value | Set value, Decimal point ignored |
| 20H/50H | 03H/06H | 11FCH | Step 15 EVT5 high limit alarm value | Set value, Decimal point ignored |

**Data item**:

$16^3$ digit: 0: Fixed value control, 1: Program control
$16^2$ digit: Pattern number (1, fixed) for Program control
$16^1$ digit: Step number [1 to 15(FH)] for Program control
$16^0$ digit: One step data item code for Program control

Set values (from Step 2 to Step 15) of the Program control command are common to those of the Set value memory number (from SM2 to SM15). (P.12)

**PID zone command**

| Shinko Command type | Modbus Function code | Data item | | Data |
|---|---|---|---|---|
| 20H/50H | 03H/06H | 2010H | PID zone value 1 (Zone 1) | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 2011H | OUT1 proportional band (Zone 1) [13A]<br>Proportional band (Zone 1) [15A] | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 2012H | OUT2 proportional band (Zone 1) [13A] | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 2013H | Integral time (Zone 1) | Set value |
| 20H/50H | 03H/06H | 2014H | Derivative time (Zone 1) | Set value |
| 20H/50H | 03H/06H | 2015H | ARW (Zone 1) | Set value |
| 20H/50H | 03H/06H | 2016H | Manual reset (Zone 1) | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 2017H | OUT1 rate-of-change (Zone 1) [13A]<br>MV rate-of change (Zone 1) [15A] | Set value |
| | | | If "0001H: Used" is selected during PID zone function selection (00C1H), it is possible to set up to 5 zones [One block data includes from PID zone value 1 (Zone 1) to OUT1 rate-of-change (Zone 1) [13A] / MV rate-of-change (Zone 1) [15A]. | |
| 20H/50H | 03H/06H | 2050H | PID zone value 5 (Zone 5) | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 2051H | OUT1 proportional band (Zone 5) [13A]<br>Proportional band (Zone 5) [15A] | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 2052H | OUT2 proportional band (Zone 5) [13A] | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 2053H | Integral time (Zone 5) | Set value |
| 20H/50H | 03H/06H | 2054H | Derivative time (Zone 5) | Set value |

| | | | | |
|---|---|---|---|---|
| 20H/50H | 03H/06H | 2055H | ARW (Zone 5) | Set value |
| 20H/50H | 03H/06H | 2056H | Manual reset (Zone 5) | Set value, Decimal point ignored. |
| 20H/50H | 03H/06H | 2057H | OUT1 rate-of-change (Zone 5) [13A]<br>MV rate-of-change (Zone 5) [15A] | Set value |

**Data item**:

$16^3$ digit: 0: Fixed value control, 2: PID zone
$16^2$ digit: Not used (0, fixed)
$16^1$ digit: PID zone number (1 to 5)
$16^0$ digit: One zone data item code
Set values (from Zone 1 to Zone 5) of the PID zone command are common to set values from Zone 1 to Zone 5. (p.12)

● **Notes on programming monitoring software**

**How to speed up the scan time**

When monitoring multiple units of the controller, set the program so that the requisite minimum pieces of data such as PV (0A00H), OUT1 MV [13A] / Output MV[15A] (0A01H), Status flag 1 (0A06H), etc. can be read.
For other data, set the program so that they can be read only when their set value has changed.
This will speed up the scan time.

**How to read the set value changes made by front keypad operation**

If any set value is changed by the keypad operation, the controller sets the [Status flag 1 (0A06H) $2^{15}$: Change in key operation] to [Yes (1)].
There are 2 methods of reading the set value changes made by front keypad as follows.

**Reading method 1**

(1) On the software side, check that [Status flag 1 (0A06H) $2^{15}$: Change in key operation] has been set to [Yes (1)], then read all set values.

(2) Clear the [Status flag 1 (0A06H) $2^{15}$: Change in key operation], by setting the [Key operation change flag clearing (00F0H)] to [Clear all (0001H)].
If [Key operation change flag clearing (00F0H)] is set to [Clear all (0001H)] during the setting mode of the controller, Error code 5 (35H, Shinko protocol) or Exception Code 18 (12H, Modbus protocol) will be returned as a negative acknowledgement. And [Status flag 1 (0A06H) $2^{15}$: Change in key operation] cannot be cleared.
Set a program so that all set values can be read until acknowledgement is returned.

(3) Read all set values again after acknowledgement is returned.

**Reading method 2**

(1) On the software side, check that [Status flag 1 (0A06H) $2^{15}$: Change in key operation] has been set to [Yes (1)], then set the [Key operation change flag clearing (00F0H)] to [Clear all (0001H)].

(2) Set the program depending on the acknowledgement or negative acknowledgement as follows.
When acknowledgement is returned;
Consider it as settings completed, and read all set values.
When Error code 5 (35H, Shinko protocol) or Exception code 18 (12H, Modbus protocol) is returned as a negative acknowledgement;
Consider it as still in setting mode, and read the requisite minimum pieces of data such as PV (0A00H), OUT1 MV [13A] / Output MV [15A] (0A01H), Status flag 1 (0A06H), etc. then return to step (1).

Thus, programs which do not affect the scan time can be created using the methods described above, even if set values on the monitoring software will not be updated until settings are complete.

**How to read PID parameters after AT finishes**

The controller sets [Status flag 1 (0A06H) $2^{13}$: AT/Auto-reset] to [During AT/Auto-reset (1)] while AT is performing.
After AT is finished, PID parameters are updated.
On the software side, read the parameters such as P, I, D, ARW after checking that [Status flag 1 (0A06H) $2^{13}$: AT/Auto-reset] has been set to [OFF (0)].

**Note when sending all set values simultaneously**

• When changing alarm types in [Event output EVT1 allocation (0060H)] to [Event output EVT5 allocation (0064H)], alarm value will revert to “0”. First, send the selected alarm type, then send the alarm value.

• When changing input types in [Input type selection (0030H)], set values such as SV, OUT1 proportional band [13A] / Proportional band [15A], Alarm 1 value, etc. will be initialized.
First, send the selected input type (0030H), then send other set values.
When responding to the command of Input type selection, it takes approx. 2 sec due to internal processing.
Therefore set the Time-out time for communication to 2 sec or more when executing this command.

● **When communicating with a PLC**

To communicate with a PLC, use a Shinko PLC Interface Unit SIF-600.
No programming is needed for connection.

**PLCs corresponding to the SIF-600**:

| PLC manufacturer | PLC model | Host link unit model |
|---|---|---|
| Mitsubishi Electric Corp. | MELSEC<br>Q, QnA series (*) | AJ71UC24, A1SJ71UC24-R2/R4/PRF<br>A1SJ71C24-R2/R4/PRF, QJ71C24 |
| | MELSEC FX series (*) | ―――― |
| Omron Corp. | SYSMAC CJ series | CS1W-SCU21-V1<br>CJ1W-SCU21, CJ1W-SCU41 |
| Keyence Corp. | KV | KV-L20V |
| Yokogawa Electric Corp. | FA-M3 | F3LC11-2N, F3LC11-1F, F3LC12-1F |
| Fuji Electric Co., Ltd. | MICREX-SX series | NP1L-RS1, NP1L-RS2, NP1L-RS3, NP1L-RS4 |

(*) Models with compatible QR/QW communication commands.

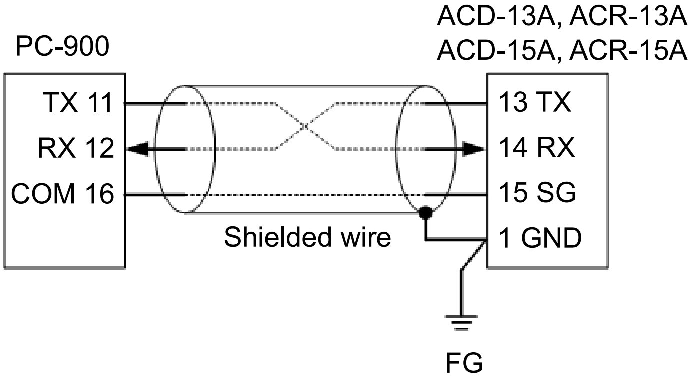
# 8. Set value digital transmission

By connecting to Shinko programmable controllers [PC-900 or PCD-33A with the SVTC (Set value digital transmission) option], digital set values via the SVTC command can be received from programmable controllers.

## 8.1 Wiring

**RS-232C (only PC-900)**:

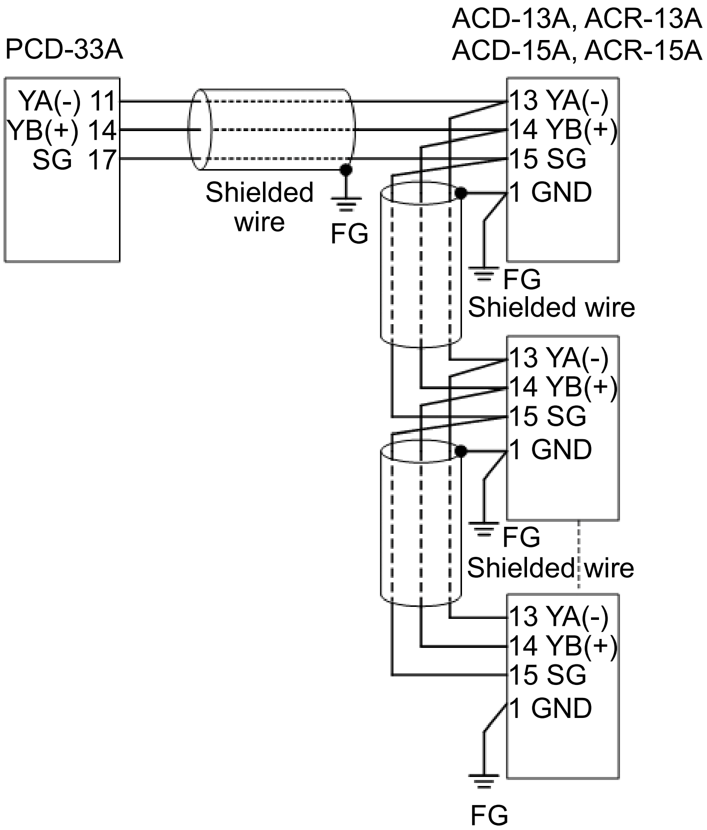
Connect TX (PC-900) to RX (ACD/R-13A, ACD/R-15A), RX (PC-900) to TX (ACD/R-13A, ACD/R-15A) and COM (PC-900) to SG (ACD/R-13A, ACD/R-15A) terminal.
The following shows connection example between the PC-900 and ACD/R-13A, ACD/R-15A.




(Fig. 8.1-1)

**RS-485**:

For the PC-900, connect YA(-) to YA(-), YB(+) to YB(+),COM to SG terminal respectively.
For the PCD-33A, connect YA(-) to YA(-), YB(+) to YB(+),SG to SG terminal respectively.
Up to 31 units of the ACD/R-13A or ACD/R-15A can be connected.
The following shows a connection example of PCD-33A and ACD/R-13A, ACD/R-15A.




(Fig. 8.1-2)

**8.2 Setting method of programmable controllers (PC-900, PCD-33A) and ACD/R-13A, ACD/R-15A**

**(1) Setting the PC-900 or PCD-33A**

If SVTC option is added, none of the settings are required.
PC-900: Check that Set value digital transmission (SVTC) is selected in [Communication mode, CMSL].
PCD-33A: Check that Set value digital transmission (SVTC) is selected in [Communication protocol, CMSL] in Auxiliary function setting mode 1.

**(2) Setting the ACD/R-13A, ACD/R-15A**

Check the following items in the Communication group. (Refer to “3. Communication parameter setting”.)
(a) Shinko protocol has been selected in [Communication protocol].
(b) Communication speed of the ACD/R-13A or ACD/R-15A is equal to that of the PC-900 or PCD-33A (9600bps or 19200bps).

**(3) Starting Set value digital transmission**

Enter the program set values to the PC-900 or PCD-33A.
If the program is executed by pressing the RUN Key, the set values of the PC-900 or PCD-33A will be sent to the ACD/R-13A, ACD/R-15A.
During program standby, “0” will be sent to the ACD/R-13A, ACD/R-15A.

# 9. Specifications

Cable length: RS-232C: 10m (Max.), RS-485: 1.2km (Max.)
Cable resistance: Within 50Ω (Terminators are not necessary, but if used, use 120Ω or more on one side.)
Communication interface: EIA RS-232C, EIA RS-485
Communication method: Half-duplex communication
Communication speed: 9600/19200/38400bps (Selectable by keypad) (Default: 9600bps)
Synchronization method: Start-stop synchronization
Code form: ASCII, binary
Data bit/Parity: 7, 8/Even, Odd, No parity (Selectable by keypad) (Default: 7/Even)
Stop bit: 1, 2 (Selectable by keypad) (Default: 1)
Communication protocol: Shinko protocol/ Modbus ASCII/ Modbus RTU (Selectable by keypad) (Default: Shinko protocol)
Data format

| Communication protocol | Shinko protocol | Modbus ASCII | Modbus RTU |
|---|---|---|---|
| Start bit | 1 | | 1 |
| Data bit | 7 or 8 | | 8 |
| Parity | Yes (Even, Odd), No parity | | Yes (Even, Odd), No parity |
| Stop bit | 1 or 2 | | 1 or 2 |

Number of connectable units: RS-232C: 1 unit, RS-485: Max 31 units to 1 host computer
Error correction: Command request repeat system
Communication error detection: Parity, checksum(Shinko protocol), LRC(Modbus ASCII), CRC-16(Modbus RTU)
Digital external setting: Receives digital set values via the SVTC command from Shinko programmable controllers (PC-900, PCD-33A with the SVTC option)

# 10. Troubleshooting

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

• **Problem: Communication failure**

| **Check the following** |
|---|
| Make sure that the communication connector is securely connected. |
| Check that wiring of the communication connector is correct.<br>Refer to “2. Wiring”. |
| Burnout or imperfect contact on the communication cable and the connector. |
| Communication speed of the slave does not match that of the master.<br>Refer to “3. Communication parameter settings”. |
| The data bit, parity and stop bit of the master do not correspond to those of the slave.<br>Refer to “3. Communication parameter settings”. |
| The instrument number (address) of the slave does not correspond to that of the command.<br>Refer to “3. Communication parameter settings”. |
| The instrument numbers (addresses) are duplicated in multiple slaves.<br>Refer to “3. Communication parameter settings”. |
| Make sure that the program is appropriate for the transmission timing.<br>Refer to “4. Communication procedure”. |

• **Problem: Although communication is occurring, the response is 'NAK'.**

| **Check the following** |
|---|
| A non-existent command code has been sent. |
| The setting command data exceeds the setting range of the slave. |
| The controller cannot be set when functions such as AT are performing. |
| The ACD/R-13A or ACD/R-15A is in the front keypad operation setting mode. |

For all other malfunctions, please contact our main office or dealers.