This manual contains instructions for communication functions of the BCD2, BCR2, BCS2.

Serial communication and Console communication cannot be used together.
When performing Serial communication, remove the tool cable (CMD-001) from the USB port of the PC and console connector of the BCD2, BCR2, BCS2.
When performing Console communication, it is not required to remove the Serial communication cables.
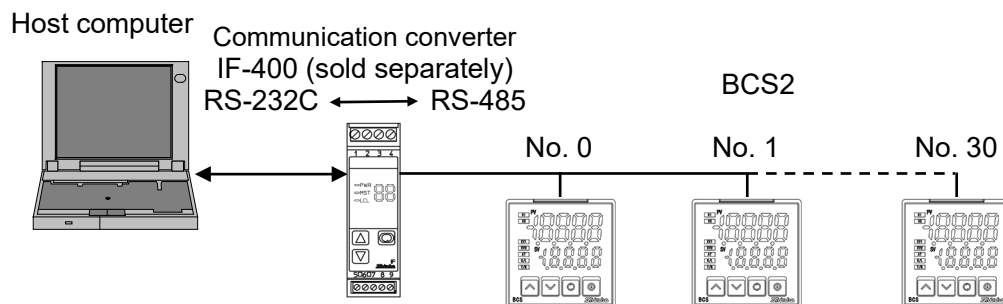However, do not send a command from the master side.

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1. System Configuration

1.1 When Using USB Communication Cable CMC-001-1 (sold separately)
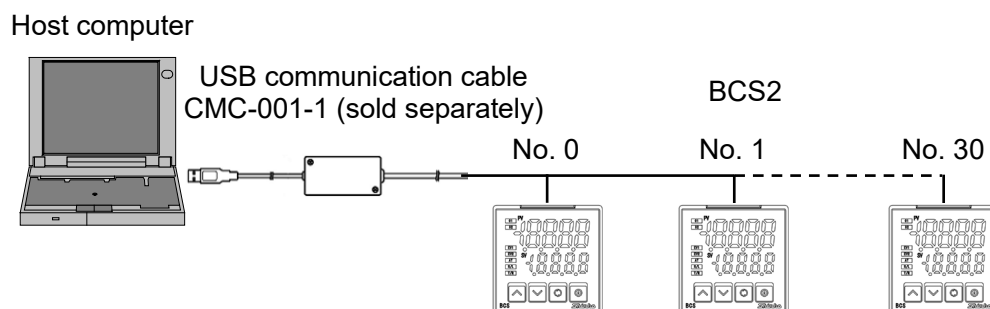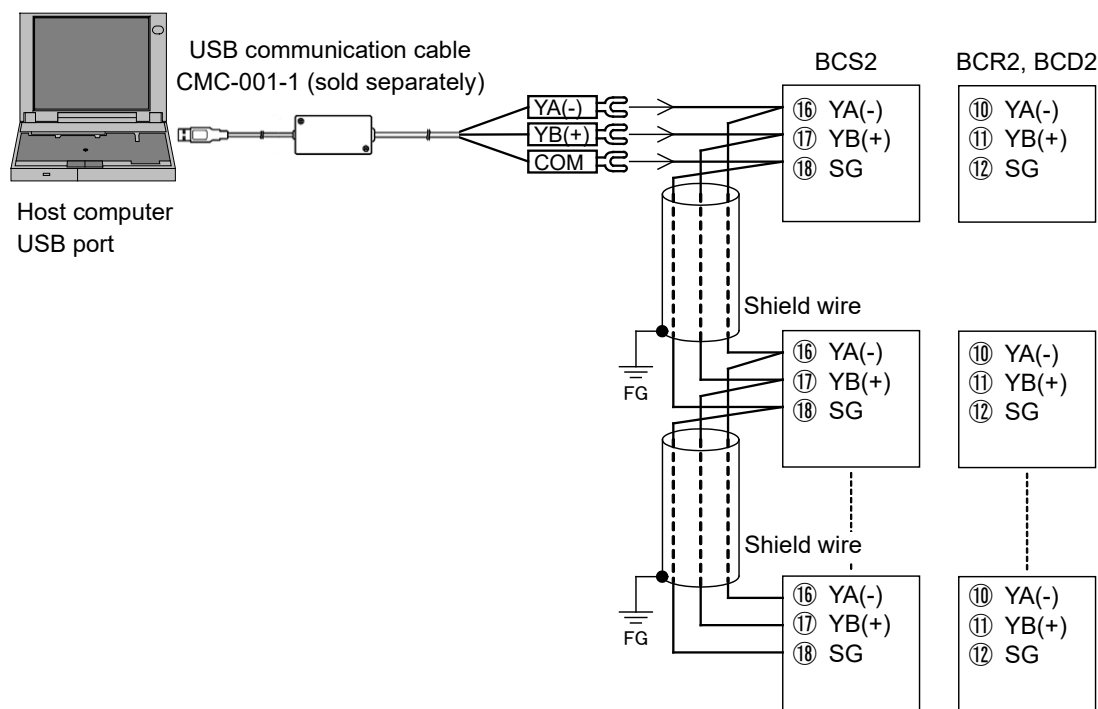

(Fig. 1.1-1)

1.2 When Using Communication Converter IF-400 (sold separately)

(Fig. 1.2-1)

2. Wiring

2.1 When Using USB Communication Cable CMC-001-1 (sold separately)

(Fig. 2.1-1)

2.2 When Using Communication Converter IF-400 (sold separately)
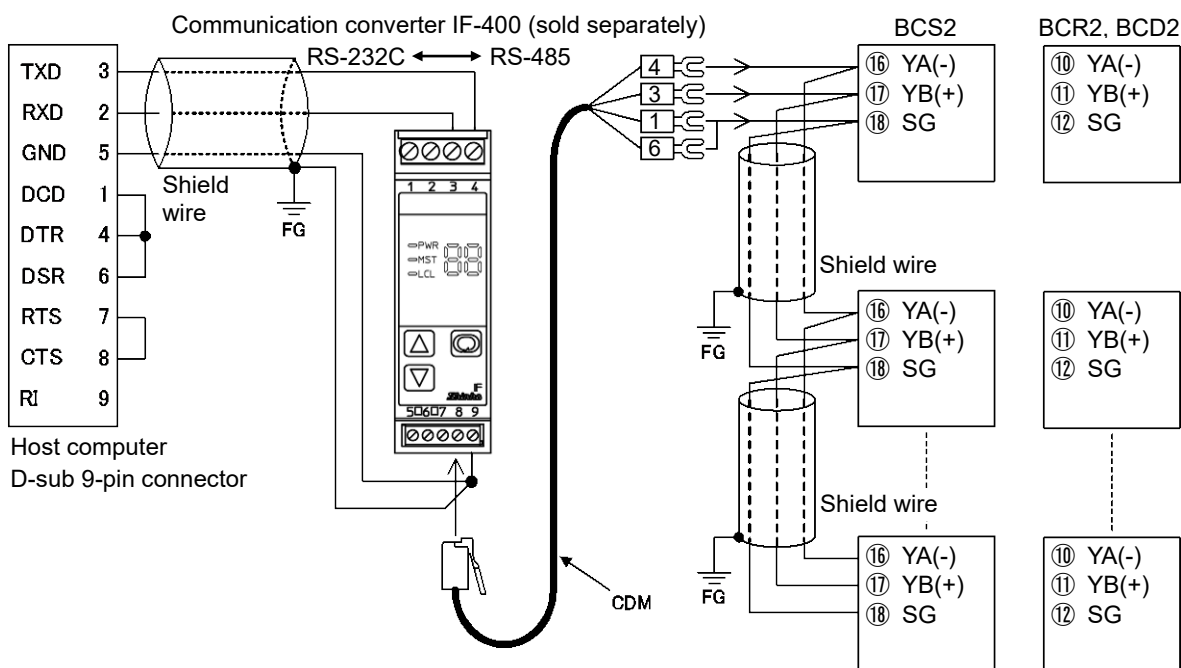
(Fig. 2.2-1)

Shield wire

Connect only one end of the shield to the FG to avoid a ground loop. If both ends of the shield wire are connected to the FG, the circuit will be closed, resulting in a ground loop. This may cause noise. Be sure to ground the FG 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 multiple peripheral devices to a personal computer. The terminator prevents signal reflection and disturbance.

Do not connect a terminator to the communication line because each BCD2, BCR2, BCS2 has built-in pull-up and pull-down resistors.
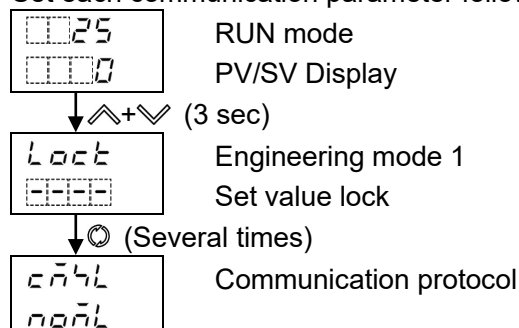
3. Setting Communication Parameters

Set communication parameters in Engineering mode 1.

To enter Engineering mode 1, press and hold the ⋀ and ⋁ keys (in that order) together for approx. 3 seconds in RUN mode.

Use the ⋀ or ⋁ key for settings (or making a selection).

To register the set data, use the ◯ key.

Set each communication parameter following the procedure below.

Display	Description
`25` / `0`	RUN mode / PV/SV Display
↓ ⋀+⋁ (3 sec)	
`Lock` / `----`	Engineering mode 1 / Set value lock
↓ ◯ (Several times)	
`cЛ4L` / `noЛL`	Communication protocol

Characters, Factory Default	Setting Item, Function, Setting Range	
`cЛ4L` `noЛL`	**Communication protocol** • Selects communication protocol. • Selection item:	
	`noЛL`	Shinko protocol
	`ЛodA`	MODBUS ASCII
	`Лodr`	MODBUS RTU
	`JnЛL`	Shinko protocol (JC command allocated)
	`JЛdA`	MODBUS ASCII (JC command allocated)
	`JЛdr`	MODBUS RTU (JC command allocated)
`cЛno` `0`	**Instrument number** • Sets the instrument number. The instrument numbers should be set one by one when multiple instruments are connected in Serial communication, otherwise communication is impossible. • Setting range: 0 to 95	
`cЛ4P` `96`	**Communication speed** • Selects a communication speed equal to that of the host computer. • Selection item:	
	`96`	9600 bps
	`192`	19200 bps
	`384`	38400 bps
`cЛFr` `7EЬn`	**Data bit/Parity** • Selects data bit and parity. • Selection item:	
	`Bnon`	8 bits/No parity
	`7non`	7 bits/No parity
	`BEЬn`	8 bits/Even
	`7EЬn`	7 bits/Even
	`Bodd`	8 bits/Odd
	`7odd`	7 bits/Odd

| Characters, Factory Default	Setting Item, Function, Setting Range	
c̄o̅5̄r̄ ☐☐☐1	**Stop bit** • Selects the stop bit. • Selection item:	
	☐☐☐1	1 bit
	☐☐☐2	2 bits
c̄o̅d̄5̄ ☐☐10	**Response delay time** • Response from the controller can be delayed after receiving command from the host computer. • Setting range: 0 to 1000 ms	

5̄8̄_b̄
☐☐☐0
	SVTC bias
	• Step SV can be received from the connected Shinko programmable controllers PCA1 or PCB1. (Select 'SV digital transmission' in [Communication protocol] on the PCA1 or PCB1.)
	  Refer to Section '8. SV Digital Transmission' on p.46.
	• SV adds SVTC bias value to the step SV.
	• Setting range: ±20% of input span
	  DC voltage, current inputs: ±20% of scaling span (*)
	  Available only when Shinko protocol is selected in [Communication protocol].	

(*) The placement of the decimal point follows the selection.

↓◎ (Multiple times)

☐☐25	RUN mode
☐☐☐0	PV/SV Display
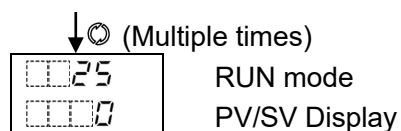
Settings are now complete.

4. Communication Procedure

Communication starts with command transmission from the host computer (hereafter Master) and ends with the response of the BCx2 (hereafter Slave).
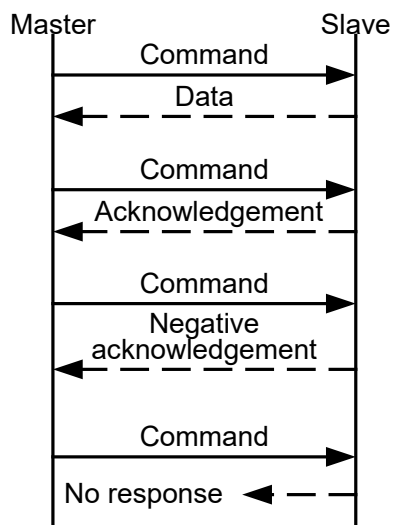
(Fig. 4-1)

- **Response with data**
  When the master sends the Read command, the slave responds with the corresponding set value or current status.
- **Acknowledgement**
  When the master sends the Write 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 (Take note while programming)

When the master starts transmission through the RS-485 communication line, the master is arranged so as to provide an idle status (mark status) transmission period of 1 or more characters before sending the command to ensure synchronization on the receiving side.

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 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. (It is recommended to execute Retry twice or more.)

Slave Side

When the slave starts transmission through the RS-485 communication line, the slave is arranged so as to provide an idle status (mark status) transmission period of 1 ms or more (*) 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.

(*) Can be set in [Response delay time] within a range of 0 to 1000 ms. (See p.5.)

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 (8 bits)   Selectable

                     Parity: Even (No parity, Odd)   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 a hexadecimal number.

The negative numbers are represented in 2's complement.

Numerals written below the command represent number of characters.

(1) Write command

• Write a single piece of data

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

• Write multiple pieces of data

Header (02H)	Address	Sub address (20H)	Command type (54H)	Data item	Data	Checksum	Delimiter (03H)
1	1	1	1	4	4 x n	2	1

n: Amount of data

(2) Read command

• Read a single piece of data

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

• Read multiple pieces of data

Header (02H)	Address	Sub address (20H)	Command type (24H)	Data item	Amount of Read data n	Checksum	Delimiter (03H)
1	1	1	1	4	4	2	1

(3) Response with data

• Response to 'Read a single piece of data'

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

• Response to 'Read multiple pieces of data'

Header (06H)	Address	Sub address (20H)	Command type (24H)	Data item	Data	Checksum	Delimiter (03H)
1	1	1	1	4	4 x n	2	1

n: Amount of data

(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 is used.

Write command, Read 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 (20H to 7FH) is 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 Write command and Read command.

Command Type	Contents	Description
20H	Read a single piece of data	Reads a single piece of data.
24H	Read multiple pieces of data	Reads consecutive multiple pieces of data. (Amount of data: Max. 100)
50H	Write a single piece of data	Writes a single piece of data.
54H	Write multiple pieces of data	Writes consecutive multiple pieces of data. (Amount of data: Max. 100)

Notes about Reading/Writing multiple pieces of data

When reading/writing multiple pieces of data, as it takes time until slave sends response data, the master determines no response time based on timeout period below after sending a command.

Timeout period calculation: 6 ms x Amount of data + Response delay time (*)

(*) Refer to Response delay time on p.5.

Data item: Classification of the command object.

Composed of 4-digit hexadecimal numbers, using ASCII.

Refer to '7. Communication Command Table'. (pp. 26 to 40)

Data: The contents of data (values) differ depending on the Write command.

Composed of 4-digit hexadecimal numbers, using ASCII.

Refer to '7. Communication Command Table'. (pp. 26 to 40)

Checksum: 2-character data to detect communication errors.

Refer to '5.3 Checksum Calculation' on p.9.

Delimiter: Control code to represent the end of command.

ASCII code ETX (03H) fixed

Error code: Represents an error type using ASCII.

Error Code	Contents
1 (31H)	Non-existent command
2 (32H)	Not used
3 (33H)	Value outside the setting range
4 (34H)	Status unable to be written (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.
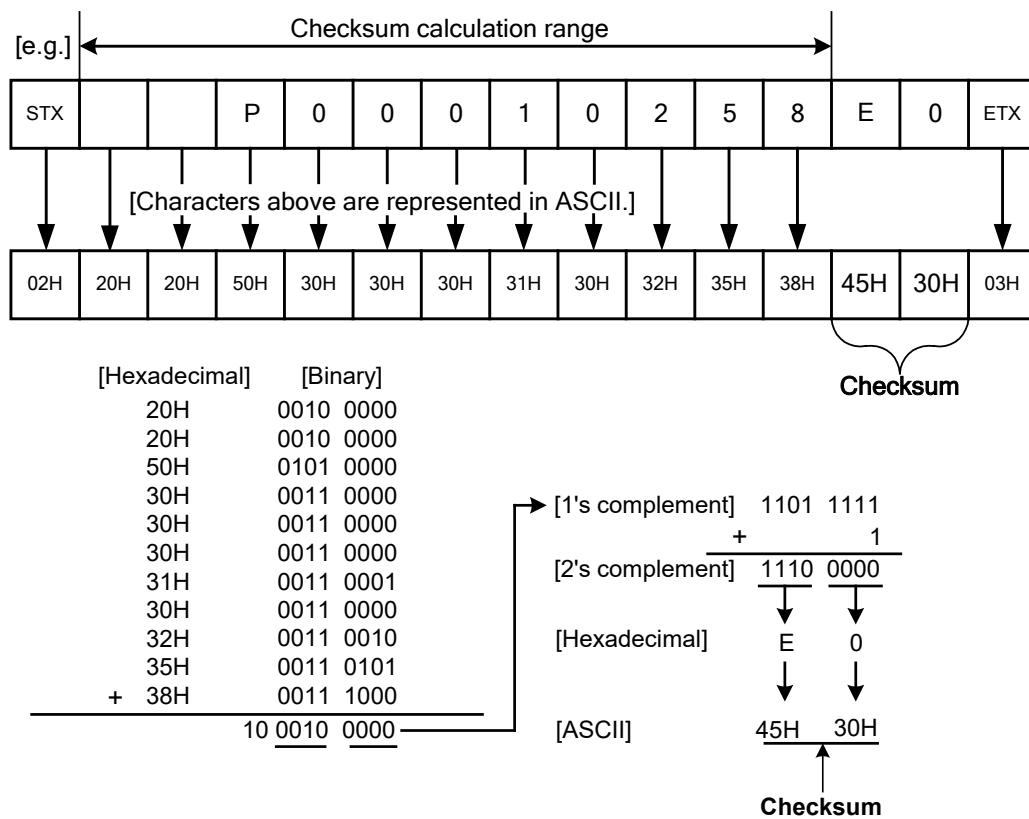The lower one byte of the total value is converted to 2's complement, and then to hexadecimal numbers, that is, ASCII code for the checksum.

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

[Example of checksum calculation]

SV1 (0001H): 600℃ (0258H)
Address (instrument number): 0 (20H)

(Fig. 5.3-1)

5.4 Command Example

Numerals written below the command represent number of characters.

(1) Read [Address 1, PV (0100H)]

• Read command from the master

Header	Address	Sub address	Command type	Data item [0100H]	Checksum	Delimiter
(02H)	(21H)	(20H)	(20H)	(30H 31H 30H 30H)	(44H 45H)	(03H)
1	1	1	1	4	2	1

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

Header	Address	Sub address	Command type	Data item [0100H]	Data [0258H]	Checksum	Delimiter
(06H)	(21H)	(20H)	(20H)	(30H 31H 30H 30H)	(30H 32H 35H 38H)	(30H 46H)	(03H)
1	1	1	1	4	4	2	1

(2) Write [Address 1, SV1 (0001H)]

• Write command from the master [when writing SV1 to 600℃ (0258H)]

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

• A response from the slave in normal status

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

(3) Read [Address 1, SV1 (0001H)]

• Read command from the master

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

• A response from the slave in normal status [When SV1=600℃ (0258H)]

Header	Address	Sub address	Command type	Data item [0001H]	Data [0258H]	Checksum	Delimiter
(06H)	(21H)	(20H)	(20H)	(30H 30H 30H 31H)	(30H 32H 35H 38H)	(30H 46H)	(03H)
1	1	1	1	4	4	2	1

(4) Write (Address 1, Program pattern data) (Write multiple pieces of data)

Example of program pattern setting

Step	1	2	3	4	5
SV (℃)	200	200	300	300	0
Time	1:00	2:00	0:30	1:00	2:00
Wait value (℃)	10	0	10	0	0
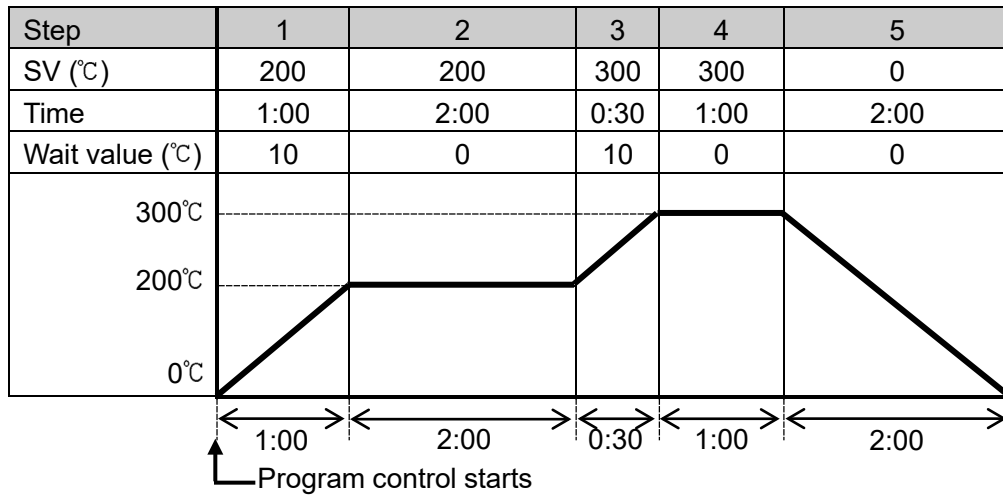
(Fig. 5.4-1)

When writing the above program pattern, Command data in the message becomes as follows.

Data is converted to hexadecimal.

Data Item		Data	Data (Converted to Hexadecimal)
1000H	Step 1 SV	200℃	00C8H
1001H	Step 1 time	60 minutes (1:00)	003CH
1002H	Step 1 wait value	10℃	000AH
1003H	Step 2 SV	200℃	00C8H
1004H	Step 2 time	120 minutes (2:00)	0078H
1005H	Step 2 wait value	0℃	0000H
1006H	Step 3 SV	300℃	012CH
1007H	Step 3 time	30 minutes (0:30)	001EH
1008H	Step 3 wait value	10℃	000AH
1009H	Step 4 SV	300℃	012CH
100AH	Step 4 time	60 minutes (1:00)	003CH
100BH	Step 4 wait value	0℃	0000H
100CH	Step 5 SV	0℃	0000H
100DH	Step 5 time	120 minutes (2:00)	0078H
100EH	Step 5 wait value	0℃	0000H

• Write command from the master (When writing the above program pattern data)

Header	Address	Sub address	Command type	Data item [1000H]
(02H)	(21H)	(20H)	(54H)	(31H 30H 30H 30H)
1	1	1	1	4

Data [00C8003C000A00C800780000012C001E000A012C003C0000000000780000H] (30H 30H 43H 38H 30H30H 33H 43H ・・・・・30H 30H 37H 38H 30H 30H 30H 30H)
60 (4 x 15)

Checksum	Delimiter
(38H 36H)	(03H)
2	1

• Response from the slave in normal status

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

(5) Read (Address 1, Program pattern data) (Read multiple pieces of data)

• Read command from the master [Amount of data: 15 (000FH), when reading the program pattern data on p.11]

Header	Address	Sub address	Command type	Data item [1000H]	Amount of read data 15 [000FH]	Checksum	Delimiter
(02H)	(21H)	(20H)	(24H)	(31H 30H 30H 30H)	(30H 30H 30H 46H)	(30H 34H)	(03H)
1	1	1	1	4	4	2	1

• Response from the slave in normal status

Header	Address	Sub address	Command type	Data item [1000H]	
(06H)	(21H)	(20H)	(24H)	(31H 30H 30H 30H)	
1	1	1	1	4	

Data [00C8003C000A00C800780000012C001E000A012C003C0000000000780000H]
(30H 30H 43H 38H 30H30H 33H 43H ･････ 30H 30H 37H 38H 30H 30H 30H 30H)
60 (4 x 15)

Checksum	Delimiter
(42H 36H)	(03H)
2	1

Response data becomes as follows.

Data Item		Data	Data (Converted to Hexadecimal)
1000H	Step 1 SV	200℃	00C8H
1001H	Step 1 time	60 minutes (1:00)	003CH
1002H	Step 1 wait value	10℃	000AH
1003H	Step 2 SV	200℃	00C8H
1004H	Step 2 time	120 minutes (2:00)	0078H
1005H	Step 2 wait value	0℃	0000H
1006H	Step 3 SV	300℃	012CH
1007H	Step 3 time	30 minutes (0:30)	001EH
1008H	Step 3 wait value	10℃	000AH
1009H	Step 4 SV	300℃	012CH
100AH	Step 4 time	60 minutes (1:00)	003CH
100BH	Step 4 wait value	0℃	0000H
100CH	Step 5 SV	0℃	0000H
100DH	Step 5 time	120 minutes (2:00)	0078H
100EH	Step 5 wait value	0℃	0000H

6. MODBUS Protocol

6.1 Transmission Mode

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

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

Error detection : LRC (Longitudinal Redundancy Check)

6.1.2 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)

6.2 Data Communication Interval

6.2.1 ASCII Mode

No communication interval limit between characters

6.2.2 RTU Mode

1.5 character transmission times or less
(Communication speed 9600 bps, 19200 bps: 1.5 character transmission times,
Communication speed 38400 bps: 750 μs)
To transmit continuously, an interval between characters which consist of one message, must be within 1.5 character transmission times.
If an interval lasts longer than 1.5 character transmission times, the BCx2 assumes that transmission from the master is finished, which results in a communication error, and will not return a response.

6.3 Message Configuration

6.3.1 ASCII Mode

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

Data section: Max. 2 x 252 characters

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

6.3.2 RTU Mode

RTU mode message 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.
(Communication speed 9600 bps, 19200 bps: 3.5 character transmission times,
Communication speed 38400 bps: 1.75 ms)

Data section: Max. 252 bytes

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

(1) 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.

(2) Function Code

The function code is the command code for the slave to undertake one of the following actions.

Type	Function Code	Sub-Function Code	Contents
Data access	03 (03H)		Reads a single or multiple piece(s) of data from slave(s).
	04 (04H)		Reads information from slave(s).
	06 (06H)		Writes a single piece of data to slave(s).
	16 (10H)		Writes multiple pieces of data to slave(s).
Diagnostics	08 (08H)	00	Echoes back the request message.
	43 (2BH)	14	Reads device identification information.

The 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, if the master sends request message setting 13H to the function code by mistake, slave returns 93H 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 written. (e.g.) AT is performing.)
18 (12H)	Shinko protocol error code 5 (During setting mode by keypad operation)

(3) Data

Data differs depending on the function code.

A request message from the master is composed of a data item, amount of data and setting data.

A response message from the slave is composed of the byte count, data and exception codes in negative acknowledgements, corresponding to the request message.

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

Refer to Section "7. Communication Command Table" (pp.26 to 40).

(4) Error Check

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.

RTU Mode

After calculating CRC-16 (Cyclic Redundancy Check) from the slave address to the end of the 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 the polynomial series. The remainder is added to the end of the information and transmitted. The generation of a 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 final data.

⑨ Set X as CRC-16 to the end of message in sequence from low order to high order.

6.4 Message Example
6.4.1 ASCII Mode

Numerals written below the command represent the number of characters.

(1) Read [Slave address 1, PV (0100H)]

• A request message from the master

Header	Slave address	Function code	Data item [0100H]	Amount of data [0001H]	Error check LRC	Delimiter CR+LF
(3AH)	(30H 31H)	(30H 33H)	(30H 31H 30H 30H)	(30H 30H 30H 31H)	(46H 41H)	(0DH 0AH)
1	2	2	4	4	2	2

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

Header	Slave address	Function code	Response byte count [02H] (30H 32H)	Data [0258H]	Error check LRC	Delimiter CR+LF
(3AH)	(30H 31H)	(30H 33H)		(30H 32H 35H 38H)	(41H 30H)	(0DH 0AH)
1	2	2	2	4	2	2

(2) Write [Slave address 1, SV1 (0001H)]

• A request message from the master [When writing SV1 to 600℃ (0258H)]

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

(3) Read [Slave address 1, SV1 (0001H)]

• A request message from the master

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 SV1=600℃ (0258H)]

Header	Slave address	Function code	Response byte count [02H] (30H 32H)	Data [0258H]	Error check LRC	Delimiter CR+LF
(3AH)	(30H 31H)	(30H 33H)		(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 data item is incorrect)

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

(4) Write (Slave address 1, Program pattern data) (Write Multiple pieces of data)

Example of program pattern setting

Step	1	2	3	4	5
SV (℃)	200	200	300	300	0
Time	1:00	2:00	0:30	1:00	2:00
Wait value (℃)	10	0	10	0	0

Program control starts
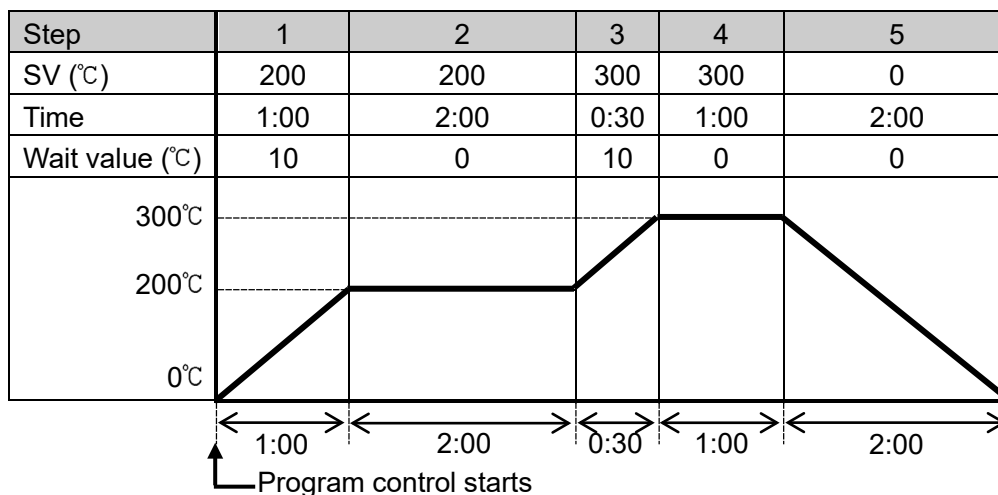
(Fig. 6.4.1-1)

When writing the above program pattern, Data in the message becomes as follows.

Amount of data: 15 (000FH)

Byte count: 30 (1EH)

Data is converted to hexadecimal.

	Data Item	Data	Data (Converted to Hexadecimal)
1000H	Step 1 SV	200℃	00C8H
1001H	Step 1 time	60 minutes (1:00)	003CH
1002H	Step 1 wait value	10℃	000AH
1003H	Step 2 SV	200℃	00C8H
1004H	Step 2 time	120 minutes (2:00)	0078H
1005H	Step 2 wait value	0℃	0000H
1006H	Step 3 SV	300℃	012CH
1007H	Step 3 time	30 minutes (0:30)	001EH
1008H	Step 3 wait value	10℃	000AH
1009H	Step 4 SV	300℃	012CH
100AH	Step 4 time	60 minutes (1:00)	003CH
100BH	Step 4 wait value	0℃	0000H
100CH	Step 5 SV	0℃	0000H
100DH	Step 5 time	120 minutes (2:00)	0078H
100EH	Step 5 wait value	0℃	0000H

• A request message from the master (When writing the above program pattern data)

Header	Slave address	Function code	Data item [1000H]
(3AH)	(30H 31H)	(31H 30H)	(31H 30H 30H 30H)
1	2	2	4

Data
[000F1E00C8003C000A00C800780000012C001E000A012C003C0000000000780000H]
(30H 30H 30H 46H 31H 45H 30H 30H ・・・・・・30H 30H 37H 38H 30H 30H 30H 30H)
66

Error check LRC	Delimiter CR+LF
(32H 45H)	(0DH 0AH)
2	2

• A response message from the slave in normal status

Header	Slave address	Function code	Data item [1000H]	Data [000FH]	Error check LRC	Delimiter CR+LF
(3AH)	(30H 31H)	(31H 30H)	(31H 30H 30H 30H)	(30H 30H 30H 46H)	(44H 30H)	(0DH 0AH)
1	2	2	4	4	2	2

(5) Read (Slave address 1, Program pattern data) (Read multiple pieces of data)

• A request message from the master (When reading the program pattern data on p.17)

Header	Slave address	Function code	Data item [1000H]	Amount of data [000FH]	Error check LRC	Delimiter CR+LF
(3AH)	(30H 31H)	(30H 33H)	(31H 30H 30H 30H)	(30H 30H 30H 46H)	(44H 44H)	(0DH 0AH)
1	2	2	4	4	2	2

• Response message from the slave in normal status

Header	Slave address	Function code	Response byte count [1EH]
(3AH)	(30H 31H)	(30H 33H)	(31H 45H)
1	2	2	2

Data [00C8003C000A00C800780000012C001E000A012C003C0000000000780000H]
(30H 30H 43H 38H 30H 30H 33H 43H · · · · · · 30H 30H 37H 38H 30H 30H 30H 30H)
60

Error check LRC	Delimiter CR+LF
(35H 41H)	(0DH 0AH)
2	2

Data in the response message becomes as follows.

	Data Item	Data	Data (Converted to Hexadecimal)
1000H	Step 1 SV	200℃	00C8H
1001H	Step 1 time	60 minutes (1:00)	003CH
1002H	Step 1 wait value	10℃	000AH
1003H	Step 2 SV	200℃	00C8H
1004H	Step 2 time	120 minutes (2:00)	0078H
1005H	Step 2 wait value	0℃	0000H
1006H	Step 3 SV	300℃	012CH
1007H	Step 3 time	30 minutes (0:30)	001EH
1008H	Step 3 wait value	10℃	000AH
1009H	Step 4 SV	300℃	012CH
100AH	Step 4 time	60 minutes (1:00)	003CH
100BH	Step 4 wait value	0℃	0000H
100CH	Step 5 SV	0℃	0000H
100DH	Step 5 time	120 minutes (2:00)	0078H
100EH	Step 5 wait value	0℃	0000H

6.4.2 RTU Mode

Numerals written below the command represent number of characters.

(1) Read [Slave address 1, PV (0100H)]

• A request message from the master

3.5 idle characters	Slave address (01H)	Function code (03H)	Data item (0100H)	Amount of data (0001H)	Error check CRC-16 (85F6H)	3.5 idle characters
	1	1	2	2	2	

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

3.5 idle characters	Slave address (01H)	Function code (03H)	Response byte count (02H)	Data (0258H)	Error check CRC-16 (B8DEH)	3.5 idle characters
	1	1	1	2	2	

(2) Write [Slave address 1, SV1 (0001H)]

• A request message from the master [When SV1 is written to 600℃ (0258H)]

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, and 86H is returned.
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	

(3) Read [Slave address 1, SV1 (0001H)]

• A request message from the master

3.5 idle characters	Slave address (01H)	Function code (03H)	Data item (0001H)	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 SV1 is 600℃ (0258H)]

3.5 idle characters	Slave address (01H)	Function code (03H)	Response byte count (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 incorrect)
The function code MSB is set to 1 for the response message in exception (error) status, and 83H is returned. 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	

(4) Write (Slave address 1, Program pattern data) (Write multiple pieces of data)

Program pattern setting example

Step	1	2	3	4	5
SV (℃)	200	200	300	300	0
Time	1:00	2:00	0:30	1:00	2:00
Wait value (℃)	10	0	10	0	0
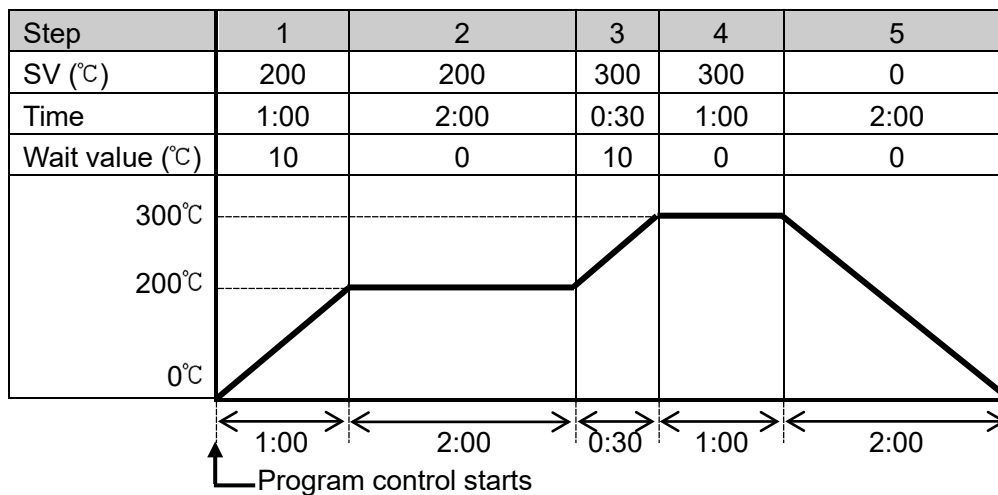
(Fig. 6.4.2-1)

When writing the above program pattern, Data in the message becomes as follows.

Amount of data: 15 (000FH)

Byte count: 30 (1EH)

Data is converted to hexadecimal.

	Data Item	Data	Data (Converted to Hexadecimal)
1000H	Step 1 SV	200℃	00C8H
1001H	Step 1 time	60 minutes (1:00)	003CH
1002H	Step 1 wait value	10℃	000AH
1003H	Step 2 SV	200℃	00C8H
1004H	Step 2 time	120 minutes (2:00)	0078H
1005H	Step 2 wait value	0℃	0000H
1006H	Step 3 SV	300℃	012CH
1007H	Step 3 time	30 minutes (0:30)	001EH
1008H	Step 3 wait value	10℃	000AH
1009H	Step 4 SV	300℃	012CH
100AH	Step 4 time	60 minutes (1:00)	003CH
100BH	Step 4 wait value	0℃	0000H
100CH	Step 5 SV	0℃	0000H
100DH	Step 5 time	120 minutes (2:00)	0078H
100EH	Step 5 wait value	0℃	0000H

• A request message from the master (When writing the above program pattern data)

3.5 idle characters	Slave address (01H)	Function code (10H)	Data item (1000H)	
	1	1	2	

Data
(000F1E00C8003C000A00C800780000012C001E000A012C003C0000000000780000H)
33

Error check CRC-16 (13EEH)	3.5 idle characters
2	

20

• Response message from the slave in normal status

3.5 idle characters	Slave address (01H)	Function code (10H)	Data item (1000H)	Data (000FH)	Error check CRC-16 (84CDH)	3.5 idle characters
	1	1	2	2	2	

(5) Read (Slave address 1, Program pattern data) (Read multiple pieces of data)

• A request message from the master (When reading the program pattern data on p.20)

3.5 idle characters	Slave address (01H)	Function code (03H)	Data item (1000H)	Amount of data (000FH)	Error check CRC-16 (010EH)	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 (03H)	Response byte count (1EH)
	1	1	1

Data (00C8003C000A00C800780000012C001E000A012C003C0000000000780000H)
30

Error check CRC-16 (F340H)	3.5 idle characters
2	

Data in the response message becomes as follows.

Data Item		Data	Data (Converted to Hexadecimal)
1000H	Step 1 SV	200℃	00C8H
1001H	Step 1 time	60 minutes (1:00)	003CH
1002H	Step 1 wait value	10℃	000AH
1003H	Step 2 SV	200℃	00C8H
1004H	Step 2 time	120 minutes (2:00)	0078H
1005H	Step 2 wait value	0℃	0000H
1006H	Step 3 SV	300℃	012CH
1007H	Step 3 time	30 minutes (0:30)	001EH
1008H	Step 3 wait value	10℃	000AH
1009H	Step 4 SV	300℃	012CH
100AH	Step 4 time	60 minutes (1:00)	003CH
100BH	Step 4 wait value	0℃	0000H
100CH	Step 5 SV	0℃	0000H
100DH	Step 5 time	120 minutes (2:00)	0078H
100EH	Step 5 wait value	0℃	0000H

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6.5 Diagnostics Function

MODBUS protocol has the following diagnostics functions.
- Echoes back the request message.
- Reads device identification information.

6.5.1 Message Configuration

ASCII mode

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

RTU mode

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

(1) Slave address:

Slave address is an individual instrument number on the slave side, and is set within the range 1 to 95 (01H 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.
Diagnostics function is disabled for the Slave address 0 (00H, broadcast address).

(2) Function code:

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

Type	Function Code	Sub-function Code	Contents
Diagnostics	08 (08H)	00 (0000H)	Echoes back the request message.
	43 (2BH)	14 (0EH)	Reads device identification information.

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 0FH to the sub-function code by mistake, slave returns ABH by setting the MSB to 1, because the former is a non-existent sub-function code.

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) Sub-function code is not correct.
2 (02H)	Illegal data address (Non-existent data address) For function code 43: Object ID is any value other than 00, 01, 02.
3 (03H)	Illegal data value (Value out of the setting range) For function code 08: Data is less than 1, or has exceeded 100. For function code 43: Read Device ID code is any value other than 01, 04.

(3) Data

Data differs depending on the function code.
For the Function code 08 (08H), a request message from the master side is composed of 'Sub-function code 2 Bytes (0000H)' and 'Data n x 2 Bytes'.
[n: Amount of data (Max. 100)]
In normal status, a response message from the slave side is the same as the request message.

Function code	1 Byte	08H
Sub-function code	1 Byte	0000H fixed
Data	n x 2 Bytes	Random value (Max. 100)

For Function code 43 (2BH), the request message from the master side is composed of Sub-function code 14 (0EH), Read Device ID code and Object ID.

Function code	1 Byte	2BH	
Sub-function code (MEI type)	1 Byte	0EH	
Read Device ID code (Corresponds to Basic category)	1 Byte	01H/04H	
Object ID	1 Byte	00	Vendor name SHINKO TECHNOS CO., LTD.
		01	Product code (model) (e.g.) BCS2R00-00
		02	Version number (D, T, MP) (e.g.) Dxx-xxxx-xx, MPxxxx-xx

Response message from the slave is composed of Sub-function code 14 (0EH) (for request), Read Device ID code and Object ID.

Function code		1 Byte	2BH
Sub-function code (MEI type)		1 Byte	0EH
Data	Read Device ID code	1 Byte	01H/04H
	Conformity level	1 Byte	01H/81H
	More Follows	1 Byte	00H/FFH
	Next Object ID	1 Byte	Object ID number
	Number of Objects	1 Byte	
	List of Object ID	1 Byte	
	List of Object length	1 Byte	
	List of Object value	Object length	

For the response message (negative acknowledgement), an exception code is set and returned.

Function code	1 Byte	ABH
Exception code	1 Byte	01H/02H/03H

(4) Error check:
16-bit data to detect communication errors.
Refer to Section '6.3 Message Configuration (4) Error Check (pp.14, 15).

6.5.2 Message Example
Message example in RTU mode are shown below.
Numerals written below the command represent the number of characters.

(1) Echo back Slave address 1, Request message
• A request message from the master [Test data 200 (00C8H), 60 (003CH), 10 (000AH)]

3.5 idle characters	Slave address (01H)	Function code (08H)	Sub-function code (0000H)	Data (00C8003C000AH)	Error check CRC-16 (E7D9H)	3.5 idle characters
	1	1	2	n x 2	2	

• Response message from the slave in normal status (Echoes back the same message.)

3.5 idle characters	Slave address (01H)	Function code (08H)	Sub-function code (0000H)	Data (00C8003C000AH)	Error check CRC-16 (E7D9H)	3.5 idle characters
	1	1	2	n x 2	2	

(2) Read Slave address 1, Device identification information (Vendor name)

• A request message from the master

3.5 idle characters	Slave address (01H)	Function code (2BH)	Sub-function code (0EH)	Data (0400H)	Error check CRC-16 (7327H)	3.5 idle characters
	1	1	1	2	2	

• Response message from the slave in normal status (SHINKO TECHNOS CO., LTD.)

3.5 idle characters	Slave address (01H)	Function code (2BH)	Sub-function code (0EH)	
	1	1	1	

Data
(048100000100185348494E4B4F20544543484E4F5320434F2E2C204C54442EH)
31

Error check CRC-16 (1C54H)	3.5 idle characters
2	

Data in the response message becomes as follows.

Data	Read Device ID code	1 Byte	04H
	Conformity level	1 Byte	81H
	More Follows	1 Byte	00H
	Next Object ID	1 Byte	00H
	Number of Objects	1 Byte	01H
	List of Object ID	1 Byte	00H
	List of Object length	1 Byte	24(18H)
	List of Object value	Object length	S(53H)
			H(48H)
			I(49H)
			N(4EH)
			K(4BH)
			O(4FH)
			(20H)
			T(54H)
			E(45H)
			C(43H)
			H(48H)
			N(4EH)
			O(4FH)
			S(53H)
			(20H)
			C(43H)
			O(4FH)
			.(2EH)
			,(2CH)
			(20H)
			L(4CH)
			T(54H)
			D(44H)
			.(2EH)

(3) Read Slave address 1, Device identification information (Product code)

• A request message from the master

3.5 idle characters	Slave address (01H)	Function code (2BH)	Sub-function code (0EH)	Data (0401H)	Error check CRC-16 (B2E7H)	3.5 idle characters
	1	1	1	2	2	

• Response message from the slave in normal status (BCD2R00-01)

3.5 idle characters	Slave address (01H)	Function code (2BH)	Sub-function code (0EH)	
	1	1	1	

Data (0481000001010A424344325230302D3031H)	Error check CRC-16 (FDEEH)	3.5 idle characters
17	2	

Data in the response message becomes as follows.

Data	Read Device ID code	1 Byte	04H
	Conformity level	1 Byte	81H
	More Follows	1 Byte	00H
	Next Object ID	1 Byte	00H
	Number of Objects	1 Byte	01H
	List of Object ID	1 Byte	01H
	List of Object length	1 Byte	10(0AH)
	List of Object value	Object length	B(42H)
			C(43H)
			D(44H)
			2(32H)
			R(52H)
			0(30H)
			0(30H)
			-(2DH)
			0(30H)
			1(31H)

• Response message from the slave in exception (error) status [when Sub-function code (MEI type) is incorrect]

The function code MSB is set to 1 for the response message in exception (error) status, and ABH is returned.

Exception code 01H (Non-existent function) is returned (error).

3.5 idle characters	Slave address (01H)	Function code (ABH)	Exception code (01H)	Error check CRC-16 (9EF0H)	3.5 idle characters
	1	1	1	2	

7. Communication Command Table

Communication command can be selected in [Communication protocol].

If ⎍⎍⎍⎍ (Shinko protocol), ⎍⎍⎍⎍ (MODBUS ASCII) or ⎍⎍⎍⎍ (MODBUS RTU) is selected, communication commands (pp. 26 to 35) can be used.

If ⎍⎍⎍⎍ (Shinko protocol, JC command allocated), ⎍⎍⎍⎍ (MODBUS ASCII, JC command allocated) or ⎍⎍⎍⎍ (MODBUS RTU, JC command allocated) is selected, JC command (pp. 36 to 40) can be used.

7.1 Shinko Protocol / MODBUS ASCII / MODBUS RTU

7.1.1 A Single / Multiple Piece(s) of Data Read / Write Command

(20/24/50/54H: 20H/24H/50H/54H,   03/06/10H: 03H/06H/10H)

Shinko Command Type	MODBUS Function Code	Data Item		Data
20/24/50/54H	03/06/10H	0001H	SV1	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0002H	Input type	0000H: K -200 to 1370℃ 0001H: K -200.0 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 -200.0 to 400.0℃ 0008H: N -200 to 1300℃ 0009H: PL-Ⅱ 0 to 1390℃ 000AH: C(W/Re5-26) 0 to 2315℃ 000BH: Pt100 -200.0 to 850.0℃ 000CH: JPt100 -200.0 to 500.0℃ 000DH: Pt100 -200 to 850℃ 000EH: JPt100 -200 to 500℃ 000FH: K -328 to 2498℉ 0010H: K -328.0 to 752.0℉ 0011H: J -328 to 1832℉ 0012H: R 32 to 3200℉ 0013H: S 32 to 3200℉ 0014H: B 32 to 3308℉ 0015H: E -328 to 1472℉ 0016H: T -328.0 to 752.0℉ 0017H: N -328 to 2372℉ 0018H: PL-Ⅱ 32 to 2534℉ 0019H: C(W/Re5-26) 32 to 4199℉ 001AH: Pt100 -328.0 to 1562.0℉ 001BH: JPt100 -328.0 to 932.0℉ 001CH: Pt100 -328 to 1562℉ 001DH: JPt100 -328 to 932℉ 001EH: 4 to 20 mA DC -2000 to 10000 001FH: 0 to 20 mA DC -2000 to 10000 0020H: 0 to 1 V DC -2000 to 10000 0021H: 0 to 5 V DC -2000 to 10000 0022H: 1 to 5 V DC -2000 to 10000 0023H: 0 to 10 V DC -2000 to 10000
20/24/50/54H	03/06/10H	0003H	Scaling high limit	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0004H	Scaling low limit	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0005H	Decimal point place	0000H: No decimal point 0001H: 1 digit after decimal point 0002H: 2 digits after decimal point 0003H: 3 digits after decimal point

Shinko Command Type	MODBUS Function Code	Data Item		Data
20/24/50/54H	03/06/10H	0006H	Event output EV1 allocation (*1)	0000H: No event 0001H: Alarm output, High limit alarm 0002H: Alarm output, Low limit alarm 0003H: Alarm output, High/Low limits alarm 0004H: Alarm output, High/Low limits independent alarm 0005H: Alarm output, High/Low limit range alarm 0006H: Alarm output, High/Low limit range independent alarm 0007H: Alarm output, Process high alarm 0008H: Alarm output, Process low alarm 0009H: Alarm output, High limit with standby alarm 000AH: Alarm output, Low limit with standby alarm 000BH: Alarm output, High/Low limits with standby alarm 000CH: Alarm output, High/Low limits with standby independent alarm 000DH: Heater burnout alarm output 000EH: Loop break alarm output 000FH: Time signal output 0010H: Output during AT 0011H: Pattern end output 0012H: Output by communication command
20/24/50/54H	03/06/10H	0007H	Event output EV2 allocation (*1)	0000H: No event 0001H: Alarm output, High limit alarm 0002H: Alarm output, Low limit alarm 0003H: Alarm output, High/Low limits alarm 0004H: Alarm output, High/Low limits independent alarm 0005H: Alarm output, High/Low limit range alarm 0006H: Alarm output, High/Low limit range independent alarm 0007H: Alarm output, Process high alarm 0008H: Alarm output, Process low alarm 0009H: Alarm output, High limit with standby alarm 000AH: Alarm output, Low limit with standby alarm 000BH: Alarm output, High/Low limits with standby alarm 000CH: Alarm output, High/Low limits with standby independent alarm 000DH: Heater burnout alarm output 000EH: Loop break alarm output 000FH: Time signal output 0010H: Output during AT 0011H: Pattern end output 0012H: Output by communication command 0013H: Heating/Cooling control relay contact output
20/24/50/54H	03/06/10H	0008H	Reserved (*2)	
:	:	:	:	
20/24/50/54H	03/06/10H	000AH	Reserved (*2)	

Shinko Command Type	MODBUS Function Code		Data Item	Data
20/24/50/54H	03/06/10H	000BH	Transmission output type	0000H: PV transmission 0001H: SV transmission 0002H: MV transmission 0003H: DV transmission
20/24/50/54H	03/06/10H	000CH	Transmission output high limit	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	000DH	Transmission output low limit	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	000EH	SV1	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	000FH	SV2	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0010H	SV3	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0011H	SV4	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0012H	EV1 alarm value (*1)	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0013H	EV1 high limit alarm value (*1)	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0014H	EV2 alarm value (*1)	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0015H	EV2 high limit alarm value (*1)	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0016H	Reserved (*2)	
⋮	⋮	⋮	⋮	
20/24/50/54H	03/06/10H	001BH	Reserved (*2)	
20/24/50/54H	03/06/10H	001CH	Heater burnout alarm 1 value	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	001DH	Heater burnout alarm 2 value	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	001EH	Loop break alarm time	Set value
20/24/50/54H	03/06/10H	001FH	Loop break alarm band	Set value (Decimal point ignored)

20/24/50/54H	03/06/10H	0020H	Event input DI1 allocation	0000H: No event
				0001H: Set value memory
				0002H: Control ON/OFF
				0003H: Direct/Reverse action
				0004H: Preset output 1 ON/OFF
				0005H: Preset output 2 ON/OFF
				0006H: Auto/Manual control
				0007H: Remote/Local
				0008H: Program control RUN/STOP
				0009H: Program control
				      Holding/Not holding
				000AH: Program control
				      Advance function
				000BH: Integral action Holding

20/24/50/54H	03/06/10H	0021H	Event input DI2 allocation	Same as Event input DI1 allocation
20/24/50/54H	03/06/10H	0022H	Reserved (*2)	
20/24/50/54H	03/06/10H	0023H	Reserved (*2)	
20/24/50/54H	03/06/10H	0024H	EV1 alarm value 0 Enabled/Disabled	0000H: Disabled 0001H: Enabled
20/24/50/54H	03/06/10H	0025H	EV1 alarm hysteresis	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0026H	EV1 alarm delay time	Set value
20/24/50/54H	03/06/10H	0027H	EV1 alarm Energized/De-energized	0000H: Energized 0001H: De-Energized
20/24/50/54H	03/06/10H	0028H	EV2 alarm value 0 Enabled/Disabled	0000H: Disabled 0001H: Enabled
20/24/50/54H	03/06/10H	0029H	EV2 alarm hysteresis	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	002AH	EV2 alarm delay time	Set value
20/24/50/54H	03/06/10H	002BH	EV2 alarm Energized/De-energized	0000H: Energized 0001H: De-Energized

Shinko Command Type	MODBUS Function Code		Data Item	Data
20/24/50/54H	03/06/10H	002CH	Reserved (*2)	
:	:	:	:	
20/24/50/54H	03/06/10H	003BH	Reserved (*2)	
20/24/50/54H	03/06/10H	003CH	OUT1 proportional band	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	003DH	Integral time	Set value
20/24/50/54H	03/06/10H	003EH	Derivative time	Set value
20/24/50/54H	03/06/10H	003FH	ARW	Set value
20/24/50/54H	03/06/10H	0040H	Manual reset	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0041H	OUT1 proportional cycle	Set value
20/24/50/54H	03/06/10H	0042H	OUT1 ON/OFF hysteresis	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0043H	OUT1 high limit	Set value
20/24/50/54H	03/06/10H	0044H	OUT1 low limit	Set value
20/24/50/54H	03/06/10H	0045H	OUT1 rate-of-change	Set value
20/24/50/54H	03/06/10H	0046H	OUT2 cooling method	0000H: Air cooling 0001H: Oil cooling 0002H: Water cooling
20/24/50/54H	03/06/10H	0047H	OUT2 proportional band	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0048H	OUT2 proportional cycle	Set value
20/24/50/54H	03/06/10H	0049H	OUT2 ON/OFF hysteresis	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	004AH	OUT2 high limit	Set value
20/24/50/54H	03/06/10H	004BH	OUT2 low limit	Set value
20/24/50/54H	03/06/10H	004CH	Overlap band/Dead band	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	004DH	Direct/Reverse action	0000H: Reverse (Heating) action 0001H: Direct (Cooling) action
20/24/50/54H	03/06/10H	004EH	Set value lock	0000H: Unlock 0001H: Lock 1 0002H: Lock 2 0003H: Lock 3 0004H: Lock 4 0005H: Lock 5
20/24/50/54H	03/06/10H	004FH	Sensor correction coefficient	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0050H	Sensor correction	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0051H	PV filter time constant	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0052H	Response delay time	Set value
20/24/50/54H	03/06/10H	0053H	SVTC bias	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0054H	External setting input high limit	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0055H	External setting input low limit	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0056H	Remote bias	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0057H	SV Rise/Fall rate start type	0000H: SV start 0001H: PV start
20/24/50/54H	03/06/10H	0058H	SV rise rate	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0059H	SV fall rate	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	005AH	Indication when control output OFF	0000H: OFF indication 0001H: No indication 0002H: PV indication 0003H: PV indication + Any Alarm active
20/24/50/54H	03/06/10H	005BH	AT bias	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	005CH	Output status when input errors occur	0000H: Output OFF 0001H: Output ON
20/24/50/54H	03/06/10H	005DH	Auto/Manual after power ON	0000H: Automatic control 0001H: Manual control

Shinko Command Type	MODBUS Function Code		Data Item	Data
20/24/50/54H	03/06/10H	005EH	Indication time	Set value
20/24/50/54H	03/06/10H	005FH	OUT1 MV preset value	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0060H	OUT2 MV preset value	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0061H	Reserved (*2)	
:	:	:	:	
20/24/50/54H	03/06/10H	006CH	Reserved (*2)	
20/24/50/54H	03/06/10H	006DH	Step time unit	0000H: Hours:Minutes 0001H: Minutes:Seconds
20/24/50/54H	03/06/10H	006EH	Power restore action	0000H: Stops after power is restored. 0001H: Continues (resumes) after power is restored. 0002H: Suspends (on hold) after power is restored.
20/24/50/54H	03/06/10H	006FH	Program start temperature	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	0070H	Program control start type	0000H: PV start 0001H: PVR start 0002H: SV start
20/24/50/54H	03/06/10H	0071H	Number of repetitions	Set value
20/24/50/54H	03/06/10H	0072H	TS1 output step number	Set value
20/24/50/54H	03/06/10H	0073H	TS1 OFF time (*12)	Set value
20/24/50/54H	03/06/10H	0074H	TS1 ON time (*12)	Set value
20/24/50/54H	03/06/10H	0075H	TS2 output step number	Set value
20/24/50/54H	03/06/10H	0076H	TS2 OFF time (*12)	Set value
20/24/50/54H	03/06/10H	0077H	TS2 ON time (*12)	Set value
20/24/50/54H	03/06/10H	0078H	Reserved (*2)	
:	:	:	:	
20/24/50/54H	03/06/10H	008CH	Reserved (*2)	
20/24/50/54H	03/06/10H	008DH	Not used (*3)	
:	:	:	:	
20/24/50/54H	03/06/10H	00DFH	Not used (*3)	

7.1.2 A Single Piece of Data Read/Write Command

Shinko Command Type	MODBUS Function Code		Data Item	Data
20H/50H	03H/06H	00E0H	OUT/OFF key function	0000H: Control output OFF function 0001H: Auto/Manual control 0002H: Program control
20H/50H	03H/06H	00E1H	Remote/Local	0000H: Local 0001H: Remote

20H/50H	03H/06H	00E2H	Control output OFF function, Auto/Manual control, Program control	When control output OFF function is selected:
				  0000H: Control output ON
				  0001H: Control output OFF
				When Auto/Manual control is selected:
				  0000H: Automatic control
				  0001H: Manual control
				When Program control is selected:
				  0000H: Program control STOP
				  0001H: Program control RUN

20H/50H	03H/06H	00E3H	Program control Holding/Not holding	0000H: Not holding 0001H: Holding
20H/50H	03H/06H	00E4H	Output by communication command	B0 EV1 output 0：OFF, 1:ON B1 EV2 output 0：OFF, 1:ON
20H/50H	03H/06H	00E5H	Manual control MV (*4)	Set value
20H/50H	03H/06H	00E6H	AT/Auto-reset Perform/Cancel	0000H: AT/AT on startup/ Auto-reset Cancel 0001H: AT/Auto-reset Perform 0002H: AT on Startup Perform
20H/50H	03H/06H	00E7H	Controller/Converter	0000H: Controller 0001H: Converter
20H/50H	03H/06H	00E8H	AT gain	Set value (Decimal point ignored)

7.1.3 A Single Piece of Data Write Command

Shinko Command Type	MODBUS Function Code		Data Item	Data
50H	06H	00E9H	Program control Advance function (*5)	0001H: Advance Perform
50H	06H	00EAH	Not used (*3)	
:	:	:	:	
50H	06H	00FDH	Not used (*3)	
50H	06H	00FEH	Data clear (*6)	1234H: Clear data
50H	06H	00FFH	Key operation change flag clearing (*7)	0001H: Clear key operation change flag

7.1.4 Read Command

Shinko Command Type	MODBUS Function Code	Data Item		Data	
20H/24H	03H/04H	0100H	PV	Read value (Decimal point ignored)	
20H/24H	03H/04H	0101H	OUT1 MV	Read value (Decimal point ignored)	
20H/24H	03H/04H	0102H	OUT2 MV	Read value (Decimal point ignored)	
20H/24H	03H/04H	0103H	Current SV	Read value (Decimal point ignored)	
20H/24H	03H/04H	0104H	Set value memory number	Read value	
20H/24H	03H/04H	0105H	Remaining time when program control runs	Read value	
20H/24H	03H/04H	0106H	Reserved (*2)		
20H/24H	03H/04H	0107H	Step number when program control runs	Read value	
20H/24H	03H/04H	0108H	Number of repetitions when program control runs	Read value	
20H/24H	03H/04H	0109H	CT1 current value	Read value (Decimal point ignored)	
20H/24H	03H/04H	010AH	CT2 current value	Read value (Decimal point ignored)	
20H/24H	03H/04H	010BH	Reserved (*2)		
20H/24H	03H/04H	010CH	Key operation changed item	Data item changed by key operation	

20H/24H	03H/04H	010DH	Status flag 1	B0: OUT1 output 0: OFF 1: ON
				B1: OUT2 output 0: OFF 1: ON
				B2: EV1 output 0: OFF 1: ON
				B3: EV2 output 0: OFF 1: ON
				B4: Reserved
				      :
				B8: Reserved
				B9: AT/ Auto-reset, AT on startup Perform/Cancel
				     0: Cancel 1: Perform
				B10: AT/Auto-reset, AT on startup
				     0: AT/Auto-reset 1: AT on startup
				B11: Heater burnout alarm (*9) 0: OFF 1: ON
				B12: Loop break alarm 0: OFF 1: ON
				B13: Overscale (*9) 0: OFF 1: ON
				B14: Underscale (*9) 0: OFF 1: ON
				B15: Change in key operation 0: No 1: Yes	

20H/24H	03H/04H	010EH	Status flag 2	B0: DI1 input 0: OFF 1: ON
				B1: DI2 input 0: OFF 1: ON
				B2: Reserved
				B3: Reserved
				B4: Not used, Always 0
				B5: Unit status 1 (Program control)
				     0: Standby 1: Program control RUN
				B6: Unit status 2 (Fixed value control)
				     0: PV/SV Display 1: Setting mode
				B7: Warm-up 0: Finished 1: Warm-up
				B8: USB connection
				     0: Standard connection 1: USB connection
				B9: Control output OFF (Fixed value control)
				     0: Control output ON 1: Control output OFF
				B10: Auto/Manual control 0: Automatic 1: Manual
				B11: Control mode
				     0: Fixed value control 1: Program control
				B12: Program control 0: Standby 1: RUN
				B13: Wait function 0: OFF 1: ON
				B14: Hold function 0: OFF 1: ON
				B15: Pattern end function 0: OFF 1: ON	

Shinko Command Type	MODBUS Function Code	Data Item		Data
20H/24H	03H/04H	010FH	Error status flag 1 (*8)	B0: Error 01 0: OFF 1: ON B1: Error 02 0: OFF 1: ON B2: Reserved B3: Reserved B4: Error 05 0: OFF 1: ON B5: Error 06 0: OFF 1: ON B6: Error 07 0: OFF 1: ON B7: Reserved B8: Reserved B9: Error 10 0: OFF 1: ON B10: Reserved : B15: Reserved
20H/24H	03H/04H	0110H	Error status flag 2 (*8)	B0: Reserved B1: Reserved B2: Reserved B3: Error 20 0: OFF 1: ON B4: Reserved : B15: Reserved

20H/24H	03H/04H	0112H	Unit model information 1	B0: Event input Enabled/Disabled
				        0: Disabled 1: Enabled
				B1: Event output EV2 Enabled/Disabled
				        0: Disabled 1: Enabled
				B2: Reserved
				:
				B4: Reserved
				B5: Heater burnout alarm output
				   Enabled/Disabled
				        0: Disabled 1: Enabled
				B6: Heater burnout alarm output rated current
				        0: 20.0 A 1: 100.0 A
				B7: Serial communication Enabled/Disabled
				        0: Disabled 1: Enabled
				B8: Heating/Cooling control Enabled/Disabled
				        0: Disabled 1: Enabled
				B9: Transmission output Enabled/Disabled
				        0: Disabled 1: Enabled
				B10: External setting input Enabled/Disabled
				        0: Disabled 1: Enabled
				B11: Insulated power output Enabled/Disabled
				        0: Disabled 1: Enabled
				B12 to B15: Not used, Always 0

20H/24H	03H/04H	0113H	Unit model information 2	B0 to B2: Model 0: xxD
				                      1: xxR (Vertical type)
				                      2: xxM
				                      3: xxS
				                      4: xxL
				                      5: xxR (Horizontal type)
				B3 to B4: OUT1 output type
				                      0: R (Relay contact)
				                      1: S (Non-contact voltage)
				                      2: A (Direct current)
				B5 to B6: OUT2 output type
				                      0: DR (Relay contact)
				                      1: DS (Non-contact voltage)
				                      2: DA (Direct current)
				B7 to B15: Not used, Always 0

7.1.5 A Single/Multiple Piece(s) of Data Read/Write Command (for Program Control)
(20/24/50/54H: 20H/24H/50H/54H,   03/06/10H: 03H/06H/10H)

Shinko Command Type	MODBUS Function Code	Data Item (*10)		Data
20/24/50/54H	03/06/10H	1000H	Step 1 SV (*11)	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	1001H	Step 1 time (*13)	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	1002H	Step 1 wait value	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	1003H	Step 2 SV (*12)	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	1004H	Step 2 time (*13)	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	1005H	Step 2 wait value	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	1006H	Step 3 SV (*12)	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	1007H	Step 3 time (*13)	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	1008H	Step 3 wait value	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	1009H	Step 4 SV (*12)	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	100AH	Step 4 time (*13)	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	100BH	Step 4 wait value	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	100CH	Step 5 SV	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	100DH	Step 5 time (*13)	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	100EH	Step 5 wait value	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	100FH	Step 6 SV	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	1010H	Step 6 time (*13)	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	1011H	Step 6 wait value	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	1012H	Step 7 SV	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	1013H	Step 7 time (*13)	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	1014H	Step 7 wait value	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	1015H	Step 8 SV	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	1016H	Step 8 time (*13)	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	1017H	Step 8 wait value	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	1018H	Step 9 SV	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	1019H	Step 9 time (*13)	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	101AH	Step 9 wait value	Set value (Decimal point ignored)
20/24/50/54H	03/06/10H	101BH	Reserved (*2)	
:	:	:	:	
20/24/50/54H	03/06/10H	102FH	Reserved (*2)	

(*1) If any action is changed at 0006H (Event output EV1 allocation) or 0007H (Event output EV2 allocation), EV1 alarm value, EV2 alarm value, etc. will revert to factory default value.
　　For the items to be initialized: Refer to Section '7.7 Items to be Initialized by Changing Settings' (p.44).
(*2) For 'Reserved' items, if a single/multiple piece(s) of data Read is/are executed, acknowledgement will be returned (but data is 0).
　　If a single/multiple piece(s) of data is/are written, data will be discarded, and acknowledgement will be returned.
(*3) For 'Not used' items, if a single/multiple piece(s) of data Read/Write is/are executed, Error code 1 (31H, Shinko protocol) or Exception code 2 (02H, MODBUS protocol) will be returned.
(*4) For 00E5H (Manual control MV), if the following is written, Error code 3 (33H, Shinko protocol) or Exception code 3 (03H, MODBUS protocol) will be returned.
　• When OUT1 is in ON/OFF control, and if any items except OUT1 low limit and OUT1 high limit values are written.
　• When Heating side (of Heating/Cooling control) is in ON/OFF control, and if any items – except Heating side OUT1 low limit, OUT1 high limit value, Cooling side OUT2 low limit and OUT2 high limit value – are written.
　• When Cooling side (of Heating/Cooling control) is in ON/OFF control, and if any items – except Heating side OUT1 low limit to OUT1 high limit value, Cooling side OUT2 low limit and OUT2 high limit value – are written.
(*5) If 00E9H (Program control Advance function) is read, Error code 1 (31H, Shinko protocol) or Exception code 2 (02H, MODBUS protocol) will be returned.
　　If any value except 0001H (Advance Perform) is written, Error code 3 (33H, Shinko protocol) or Exception code 3 (03H, MODBUS protocol) will be returned.
(*6) If 00FEH (Data clear) is executed, all values will revert to factory default values.
　　If communicating using parameters which are unequal to the factory default, it will be impossible to communicate.
　　Set the communication parameters again.
　　(Refer to Section '3. Setting Communication Parameters'.)
　　If 00FEH (Data clear) is read, Error code 1 (31H, Shinko protocol) or Exception code 2 (02H, MODBUS protocol) will be returned.
　　If any value except 1234H (Clear data) is written, Error code 3 (33H, Shinko protocol) or Exception code 3 (03H, MODBUS protocol) will be returned.

(*7) If 00FFH (Key operation change flag clearing) is read, Error code 1 (31H, Shinko protocol) or Exception code 2 (02H, MODBUS protocol) will be returned.

If any value except 0001H (Clear key operation change flag) is written, Error code 3 (33H, Shinko protocol) or Exception code 3 (03H, MODBUS protocol) will be returned.

(*8) Contents of error code are shown below.

Error Code	Contents
Error 01	Internal non-volatile IC memory is defective.
Error 02	Data writing (in non-volatile IC memory) error when power failure occurs.
Error 05	Overscale. PV has exceeded Input range high limit value (Scaling high limit value for DC voltage, current inputs).
Error 06	Underscale. PV has dropped below Input range low limit value (Scaling low limit value for DC voltage, current inputs).
Error 07	Input burnout or disconnection. Input value is outside of the Indication range and control range.
Error 10	Hardware malfunction
Error 20	AT or AT on startup has not been completed even if approx. 4 hours has elapsed since starting. For AT on startup, PV slope and delay time cannot be measured normally for P, I, D calculation.

(*9) If B13 or B14 is "1: ON", B11 will also be "1: ON".

(*10) Data item

16^3 digit: 0: Fixed value control,   1: Program control

16^2 to 16^0 digits: Data item code (serial number) for each step

(*11) Step 1 SV (1000H) corresponds to SV1 (0001H) and SV1 (000EH).

(*12) Step 2 SV to Step 4 SV (1003H, 1006H, 1009H) correspond to SV2 to SV4 (000FH, 0010H, 0011H).

(*13) For TS1 OFF time (0073H), TS1 ON time (0074H), TS2 OFF time (0076H), TS2 ON time (0077H), and Steps 1 to 9 time (1001H, 1004H, 1007H, 100AH, 100DH, 1010H, 1013H, 1016H, 1019H):

Calculate the step time using the smaller time unit at 006DH (Step time unit), then convert it to hexadecimal numbers.

Use hexadecimal numbers for settings as follows.

Setting range: 00:00 to 99:59 (0 to 5999)   (e.g.) When 'Hours:Minutes' is selected in [Step time unit].

1:00 $\longrightarrow$ 1 x 60 + 00=60 $\longrightarrow$ 003CH

1:30 $\longrightarrow$ 1 x 60 + 30=90 $\longrightarrow$ 005AH

FFFFH: The step time is held, and Fixed value control is performed.

7.2 JC Command Table

If ⨰⨰⨰⨰ (Shinko protocol, JC command allocated), ⨰⨰⨰⨰ (MODBUS ASCII, JC command allocated) or ⨰⨰⨰⨰ (MODBUS RTU, JC command allocated) is selected in [Communication protocol], the following JC command can be used.

7.2.1 A Single Piece of Data Read/Write Command

Shinko Command Type	MODBUS Function Code		Data Item	Data
20H/50H	03H/06H	0001H	SV1	Set value (Decimal point ignored)
20H/50H	03H/06H	0002H	Not used (*1)	
20H/50H	03H/06H	0003H	AT/Auto-reset Perform/Cancel	0000H: AT/ Auto-reset Cancel 0001H: AT/ Auto-reset Perform
20H/50H	03H/06H	0004H	OUT1 proportional band	Set value (Decimal point ignored)
20H/50H	03H/06H	0005H	OUT2 proportional band (*2)(*3)	Set value (Decimal point ignored)
20H/50H	03H/06H	0006H	Integral time	Set value
20H/50H	03H/06H	0007H	Derivative time	Set value
20H/50H	03H/06H	0008H	OUT1 proportional cycle	Set value
20H/50H	03H/06H	0009H	OUT2 proportional cycle	Set value
20H/50H	03H/06H	000AH	Not used (*1)	
20H/50H	03H/06H	000BH	EV1 alarm value (*4)	Set value (Decimal point ignored)
20H/50H	03H/06H	000CH	EV2 alarm value (*4)	Set value (Decimal point ignored)
20H/50H	03H/06H	000DH	Not used (*1)	
20H/50H	03H/06H	000EH	Not used (*1)	
20H/50H	03H/06H	000FH	Heater burnout alarm value	Set value (Decimal point ignored)
20H/50H	03H/06H	0010H	Loop break alarm time	Set value
20H/50H	03H/06H	0011H	Loop break alarm band	Set value (Decimal point ignored)
20H/50H	03H/06H	0012H	Set value lock (*2)(*5)	0000H: Unlock 0001H: Lock 1 0002H: Lock 2 0003H: Lock 3
20H/50H	03H/06H	0013H	SV high limit (*6)	Set value (Decimal point ignored)
20H/50H	03H/06H	0014H	SV low limit (*6)	Set value (Decimal point ignored)
20H/50H	03H/06H	0015H	Sensor correction	Set value (Decimal point ignored)
20H/50H	03H/06H	0016H	Overlap/Dead band	Set value (Decimal point ignored)
20H/50H	03H/06H	0017H	Not used (*1)	
20H/50H	03H/06H	0018H	Scaling high limit	Set value (Decimal point ignored)
20H/50H	03H/06H	0019H	Scaling low limit	Set value (Decimal point ignored)
20H/50H	03H/06H	001AH	Decimal point place	0000H: No decimal point 0001H: 1 digit after decimal point 0002H: 2 digits after decimal point 0003H: 3 digits after decimal point
20H/50H	03H/06H	001BH	PV filter time constant	Set value (Decimal point ignored)
20H/50H	03H/06H	001CH	OUT1 high limit	Set value
20H/50H	03H/06H	001DH	OUT1 low limit	Set value
20H/50H	03H/06H	001EH	OUT1 ON/OFF hysteresis	Set value (Decimal point ignored)
20H/50H	03H/06H	001FH	OUT2 cooling method	0000H: Air cooling 0001H: Oil cooling 0002H: Water cooling
20H/50H	03H/06H	0020H	OUT2 high limit	Set value
20H/50H	03H/06H	0021H	OUT2 low limit	Set value
20H/50H	03H/06H	0022H	OUT2 ON/OFF hysteresis	Set value (Decimal point ignored)
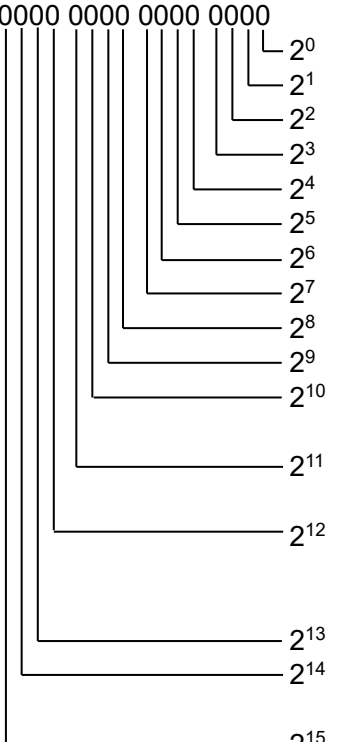
Shinko Command Type	MODBUS Function Code		Data Item	Data
20H/50H	03H/06H	0023H	Event output EV1 allocation (*2)(*7)	0000H: No event 0001H: Alarm output, High limit alarm 0002H: Alarm output, Low limit alarm 0003H: Alarm output, High/Low limits alarm 0004H: Alarm output, High/Low limit range alarm 0005H: Alarm output, Process high alarm 0006H: Alarm output, Process low alarm 0007H: Alarm output, High limit with standby alarm 0008H: Alarm output, Low limit with standby alarm 0009H: Alarm output, High/Low limits with standby alarm
20H/50H	03H/06H	0024H	Event output EV2 allocation (*2)(*7)	0000H: No event 0001H: Alarm output, High limit alarm 0002H: Alarm output, Low limit alarm 0003H: Alarm output, High/Low limits alarm 0004H: Alarm output, High/Low limit range alarm 0005H: Alarm output, Process high alarm 0006H: Alarm output, Process low alarm 0007H: Alarm output, High limit with standby alarm 0008H: Alarm output, Low limit with standby alarm 0009H: Alarm output, High/Low limits with standby alarm
20H/50H	03H/06H	0025H	EV1 alarm hysteresis	Set value (Decimal point ignored)
20H/50H	03H/06H	0026H	EV2 alarm hysteresis	Set value (Decimal point ignored)
20H/50H	03H/06H	0027H	Not used (*1)	
20H/50H	03H/06H	0028H	Not used (*1)	
20H/50H	03H/06H	0029H	EV1 alarm delay time	Set value
20H/50H	03H/06H	002AH	EV2 alarm delay time	Set value
20H/50H	03H/06H	002BH	Not used (*1)	
20H/50H	03H/06H	002CH	Not used (*1)	
20H/50H	03H/06H	002DH	Not used (*1)	
20H/50H	03H/06H	002EH	Not used (*1)	
20H/50H	03H/06H	002FH	Not used (*1)	
20H/50H	03H/06H	0030H	Not used (*1)	
20H/50H	03H/06H	0031H	Not used (*1)	
20H/50H	03H/06H	0032H	Not used (*1)	
20H/50H	03H/06H	0033H	Not used (*1)	
20H/50H	03H/06H	0034H	Not used (*1)	
20H/50H	03H/06H	0035H	Not used (*1)	
20H/50H	03H/06H	0036H	Not used (*1)	
20H/50H	03H/06H	0037H	Control output OFF (*8)	0000H: Control output ON 0001H: Control output OFF
20H/50H	03H/06H	0038H	Auto/Manual control (*9)	0000H: Automatic control 0001H: Manual control
20H/50H	03H/06H	0039H	Manual control MV (*10)	Set value
20H/50H	03H/06H	003AH	Not used (*1)	
20H/50H	03H/06H	003BH	Not used (*1)	
20H/50H	03H/06H	003CH	Not used (*1)	

Shinko Command Type	MODBUS Function Code		Data Item	Data
20H/50H	03H/06H	003DH	Not used (*1)	
20H/50H	03H/06H	003EH	Not used (*1)	
20H/50H	03H/06H	003FH	Not used (*1)	
20H/50H	03H/06H	0040H	EV1 alarm Energized/De-energized	0000H: Energized 0001H: De-energized
20H/50H	03H/06H	0041H	EV2 alarm Energized/De-energized	0000H: Energized 0001H: De-energized
20H/50H	03H/06H	0042H	Not used (*1)	
20H/50H	03H/06H	0043H	Not used (*1)	
20H/50H	03H/06H	0044H	Input type	0000H: K -200 to 1370℃ 0001H: K -200.0 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 -200.0 to 400.0℃ 0008H: N -200 to 1300℃ 0009H: PL-Ⅱ 0 to 1390℃ 000AH: C(W/Re5-26) 0 to 2315℃ 000BH: Pt100 -200.0 to 850.0℃ 000CH: JPt100 -200.0 to 500.0℃ 000DH: Pt100 -200 to 850℃ 000EH: JPt100 -200 to 500℃ 000FH: K -328 to 2498℉ 0010H: K -328.0 to 752.0℉ 0011H: J -328 to 1832℉ 0012H: R 32 to 3200℉ 0013H: S 32 to 3200℉ 0014H: B 32 to 3308℉ 0015H: E -328 to 1472℉ 0016H: T -328.0 to 752.0℉ 0017H: N -328 to 2372℉ 0018H: PL-Ⅱ 32 to 2534℉ 0019H: C(W/Re5-26) 32 to 4199℉ 001AH: Pt100 -328.0 to 1562.0℉ 001BH: JPt100 -328.0 to 932.0℉ 001CH: Pt100 -328 to 1562℉ 001DH: JPt100 -328 to 932℉ 001EH: 4 to 20 mA DC -2000 to 10000 001FH: 0 to 20 mA DC -2000 to 10000 0020H: 0 to 1 V DC -2000 to 10000 0021H: 0 to 5 V DC -2000 to 10000 0022H: 1 to 5 V DC -2000 to 10000 0023H: 0 to 10 V DC -2000 to 10000
20H/50H	03H/06H	0045H	Direct/Reverse action	0000H: Reverse action 0001H: Direct action
20H/50H	03H/06H	0046H	Not used (*1)	
20H/50H	03H/06H	0047H	AT bias	Set value (Decimal point ignored)
20H/50H	03H/06H	0048H	ARW	Set value
20H/50H	03H/06H	006FH	Key lock (*11)	0000H: Key lock Disabled (Front keys Enabled) 0001H: Key lock Enabled (Front keys Disabled)

7.2.2 A Single Piece of Data Write Command

Shinko Command Type	MODBUS Function Code		Data Item	Data
50H	06H	0070H	Key operation change flag clearing (*12)	0001H: Clear key operation change flag

7.2.3 Read Command

Shinko Command Type	MODBUS Function Code		Data Item	Data
20H	03H	0080H	PV	Read value (Decimal point ignored)
20H	03H	0081H	OUT1 MV	Read value (Decimal point ignored)
20H	03H	0082H	OUT2 MV	Read value (Decimal point ignored)
20H	03H	0083H	Not used (*1)	
20H	03H	0084H	Not used (*1)	
20H	03H	0085H	Status flag	

0000 0000 0000 0000

- 2^0 OUT1 output (*13)   0: OFF   1: ON
- 2^1 OUT2 output (*13)   0: OFF   1: ON
- 2^2 EV1 output   0: OFF   1: ON
- 2^3 EV2 output   0: OFF   1: ON
- 2^4 Not used, Always 0
- 2^5 Not used, Always 0
- 2^6 Heater burnout alarm   0: OFF   1: ON
- 2^7 Loop break alarm   0: OFF   1: ON
- 2^8 Overscale   0: OFF   1: ON
- 2^9 Underscale   0: OFF   1: ON
- 2^{10} Control output OFF function
  - 0: Control output ON   1: Control output OFF
- 2^{11} AT/Auto-reset, Perform/Cancel
  - 0: Cancel   1: Perform
- 2^{12} OUT/OFF key function
  - 0: Control output OFF function
  - 1: Auto/Manual control
- 2^{13} Not used, Always 0
- 2^{14} Auto/Manual control
  - 0: Automatic control   1: Manual control
- 2^{15} Change in key operation   0: No   1: Yes

(*1) For 'Not used' items, if a single piece of data Read/Write is executed, Error code 1 (31H, Shinko protocol) or Exception code 2 (02H, MODBUS protocol) will be returned.

(*2) The Read/Write range of setting values is different from that of keypad operation.

(*3) For writing 0005H (OUT2 proportional band), write the multiplied value (0.0 to 10.0) of OUT1 proportional band.
For reading 0005H (OUT2 proportional band), the controller internally calculates the multiplied value using OUT1 and OUT2 proportional bands, and returns the result as response data.
Even if the multiplied value exceeds 10.0, the exceeding value will be returned as response data.

(*4) If 000BH (EV1 alarm value) or 000CH (EV2 alarm value) is changed, EVT1 high limit alarm value or EVT2 high limit alarm value will be automatically changed to the same value.

(*5) For 0012H (Set value lock), Lock 4 and Lock 5 can be selected, which is the same as 004EH (Set value lock) of the BCx2 (p.29).

(*6) If 0013H (SV high limit) or 0014H (SV low limit) is changed, Scaling high limit or Scaling low limit will be automatically changed to the same value.

(*7) If any action is changed at 0023H (Event output EV1 allocation) or at 0024H (Event output EV2 allocation), EV1 alarm value, EV2 alarm value, etc. will revert to factory default value.
For the items to be initialized, refer to Section "7.7 Items to Be Initialized by Changing Settings" (p.44).
The following items cannot be selected via software communication (They can only be set via the keypad):
High/Low limits independent alarm, High/Low limit range independent alarm, High/Low limits with standby independent alarm, Loop break alarm output, Time signal output, Output during AT, Pattern end output, Output via communication command, Heating/Cooling control relay contact output (EV2 only)

(*8) For 0037H (Control output OFF), if Control output OFF function is not selected in [OUT/OFF key function], Error code 1 (31H, Shinko protocol) or Exception code 2 (02H, MODBUS protocol) will be returned.

(*9) For 0038H (Auto/Manual control), if Auto/Manual control is not selected in [OUT/OFF key function], Error code 1 (31H, Shinko protocol) or Exception code 2 (02H, MODBUS protocol) will be returned.

(*10) For 0039H (Manual control MV), if Write is executed during automatic control, Error code 1 (31H, Shinko protocol) or Exception code 2 (02H, MODBUS protocol) will be returned.

If the following are written, Error code 3 (33H, Shinko protocol) or Exception code 3 (03H, MODBUS protocol) will be returned.

- When OUT1 is in ON/OFF control, and if any items except OUT1 low limit and OUT1 high limit values are written.
- When Heating side (of Heating/Cooling control) is in ON/OFF control, and if any items – except Heating side OUT1 low limit, OUT1 high limit value, Cooling side OUT2 low limit and OUT2 high limit value – are written.
- When Cooling side (of Heating/Cooling control) is in ON/OFF control, and if any items – except Heating side OUT1 low limit to OUT1 high limit value, Cooling side OUT2 low limit and OUT2 high limit value – are written.

(*11) Key lock Enabled/Disabled can be selected.

If Key lock Enabled (Front keys Disabled) is selected, front keys cannot be used. However, if the power to the BCx2 is turned OFF, then ON again, the Key lock will be cancelled, and front keys can be used.

(*12) If 0070H (Key operation change flag clearing) is read, Error code 1 (31H, Shinko protocol) or Exception code 2 (02H, MODBUS protocol) will be returned.

If any value except 0001H (Clear key operation change flag) is written, Error code 3 (33H, Shinko protocol) or Exception code 3 (03H, MODBUS protocol) will be returned.

(*13) For direct current output, data is not fixed.

7.3 Data

7.3.1 Notes about Write/Read Command

- The data (set value, decimal) is converted to a hexadecimal number.
  Negative numbers are represented in 2's complement.
- When connecting multiple slaves, the address (instrument number) must not be duplicated.
- Do not use undefined Data items. If they are used, negative acknowledgement will be returned or a random value will be written or read, resulting in malfunction.
- 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 (SV1) as an example: Data item in the sending message is 0001H, however, MODBUS protocol Holding Register address is 40002 (1 + 40001).

7.3.2 Write 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 software communication. (If a value set via software 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 data (set value) has a decimal point, a whole number (hexadecimal) without a decimal point is used.
- If any action is changed at 0006H (Event output EV1 allocation) or at 0007H (Event output EV2 allocation), the following values will revert to the factory default value:
  EV1 alarm value (0012H), EV2 alarm value (0014H), etc.
  For the items to be initialized, refer to Section "7.7 Items to Be Initialized by Changing Settings" (p.44).
- Writings via software communication are possible while in Set value lock status.
- Even if options are not ordered, writing or reading via software communication will be possible.
  However, their command contents will not function.
- Communication parameters such as Instrument Number, Communication Speed of the slave cannot be set by software communication. They can only be set via the keypad. See pages 4, 5.
- When Write is executed using the Global address [95 (7FH), Shinko protocol] command or Broadcast address [(00H) MODBUS protocol] command, the command is sent to all the connected slaves. However, a response is not returned.

7.3.3 Read Command

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

7.4 Negative Acknowledgement

7.4.1 Error code 1 (31H, Shinko protocol) or Exception code 2 (02H, MODBUS protocol)

The slave will return Error code 1 (31H, Shinko protocol) or Exception code 2 (02H, MODBUS protocol) in the following case.

• When non-existent data item is read or written.

7.4.2 Error code 3 (33H, Shinko protocol) or Exception code 3 (03H, MODBUS protocol)

The slave will return Error code 3 (33H, Shinko protocol) or Exception code 3 (03H, MODBUS protocol) in the following case.

• When a value out of the setting range is written.

7.4.3 Error code 4 (34H, Shinko protocol) or Exception code 17 (11H, MODBUS protocol)

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

• When 0001H (AT/Auto-reset Perform) or 0002H (AT on startup Perform) is written at 00E6H (AT/Auto-reset Perform/Cancel) during PI control or ON/OFF control action.
• While AT is performing during Fixed value control, if 0001H (AT/Auto-reset Perform) or 0002H (AT on startup Perform) is written at 00E6H (AT/Auto-reset Perform/Cancel).
  While AT is performing in Fixed value control, and if 00E0H (OUT/OFF key function) is written.
• While AT is performing during Program control, if 0001H (AT/Auto-reset Perform) or 0002H (AT on startup Perform) is written at 00E6H (AT/Auto-reset Perform/Cancel).
  While AT is performing during Program control, and if 00E0H (OUT/OFF key function) is written.
• When 00E5H (Manual control MV) is written during automatic control

7.4.4 Error code 5 (35H, Shinko protocol) or Exception code 18 (12H, MODBUS protocol)

The slave will return Error code 5 (35H, Shinko protocol) or Exception code 18 (12H, MODBUS protocol) in the following case.

• During setting mode by keypad operation

7.5 Notes on Programming Monitoring Software

7.5.1 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 Data item 0100H (PV), Data item 0101H (OUT1 MV), Data item 010DH (Status flag 1), 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.

7.5.2 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 [010DH (Status flag 1) B15: Change in key operation] to 1 (Yes).
There are 2 methods of reading the set value changes made by front keypad.

(1) Reading method 1

① On the monitoring software side, check that [010DH (Status flag 1) B15: Change in key operation] has been set to 1 (Yes), then read all set values.

② Clear [010DH (Status flag 1) B15: Change in key operation], by writing Data item 00FFH (Key operation change flag clearing) to 0001H (Clear key operation change flag).
If 00FFH (Key operation change flag clearing) is written to 0001H (Clear key operation change flag) 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 [010DH (Status flag 1) B15: Change in key operation] cannot be cleared.
Set a program so that all set values can be read when a negative acknowledgement is returned.

③ Read all set values again after acknowledgement is returned.

(2) Reading method 2

① On the monitoring software side, check that [010DH (Status flag 1) B15: Change in key operation] has been set to 1 (Yes), then write the 00FFH (Key operation change flag clearing) to 0001H (Clear key operation change flag).

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 0100H (PV) 0101H (OUT1 MV), 010DH (Status flag 1), 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.

7.5.3 How to Read PID Parameters after AT or 'AT on Startup' Finishes

While AT or 'AT on startup' is performing, this controller sets [010DH (Status flag 1) B9: AT/Auto-reset, AT on startup Perform/Cancel] to 1 (Perform).
After AT or 'AT on startup' is finished, PID parameters are updated.
On the monitoring software side, check that [010DH (Status flag 1) B9: AT/Auto-reset, AT on startup Perform/Cancel] has been set to 0 (Cancel), then read parameters such as P, I, D, ARW.

7.5.4 Note When Sending All Set Values Simultaneously

• When changing alarm types at 0006H (Event output EV1 allocation) or at 0007H (Event output EV2 allocation), the following values will revert to 0 (zero).
　　EV1 alarm value (0012H), EV2 alarm value (0014H)
First, send the selected alarm type, then send each alarm value.
Refer to Section '7.7 Items to be Initialized by Changing Settings'. (p.44)

• When changing input types at 0002H (Input type), values such as SV1, OUT1 proportional band, EV1 Alarm value, etc. will be initialized.

First, send the selected input type, then send other set values.

7.6 When Communicating with a PLC

To communicate with a PLC, use a Shinko PLC Interface Unit SIF-600.

No programming is needed for connection.

Shinko protocol 24H (Multiple pieces of data read command) and 54H (Multiple pieces of data write command) are not available.

PLCs corresponding to the SIF-600, its manufacturer and host link units:

PLC Manufacturer	PLC Model, Series Name	Host Link Unit Model
Mitsubishi Electric Corp.	MELSEC Q, QnA series (*)	AJ71UC24, A1SJ71UC24-R2/R4/PRF A1SJ71C24-R2/R4/PRF, QJ71C24
	MELSEC FX series (*)	
Omron Corp.	SYSMAC CJ series	CS1W-SCU21-V1 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 (MC protocol 1C Format 4).

7.7 Items to be Initialized by Changing Settings
7.7.1 Shinko protocol / MODBUS ASCII / MODBUS RTU

If settings are changed, the following items will be initialized.

●: Initialized

x: Not initialized

Item to be initialized \ Setting item to be changed	Input type (0002H)	Event output EV1 allocation (0006H)	Event output EV2 allocation (0007H)	Transmission output (000BH)
SV1 to SV9 (1000H to 1018H)	●	X	X	X
Steps 1 to 9 wait value (1002H to 101AH)	●	X	X	X
AT bias (005BH)	●	X	X	X
OUT1 proportional band (003CH)	●	X	X	X
Manual reset (0040H)	●	X	X	X
SV rise rate (0058H)	●	X	X	X
SV fall rate (0059H)	●	X	X	X
Scaling high limit (0003H)	●	X	X	X
Scaling low limit (0004H)	●	X	X	X
Program start temperature (006FH)	●	X	X	X
EV1 alarm value (0012H)	●	●	X	X
EV1 high limit alarm value (0013H)	●	●	X	X
Loop break alarm time (001EH)	●	X	X	X
Loop break alarm band (001FH)	●	X	X	X
SVTC bias (0053H)	●	X	X	X
Remote bias (0056H)	●	X	X	X
EV2 alarm value (0014H)	●	X	●	X
EV2 high limit alarm value (0015H)	●	X	●	X
Transmission output high limit (000CH)	●	X	X	●
Transmission output low limit (000DH)	●	X	X	●
OUT2 proportional band (0047H)	●	X	X	X
EV1 alarm value 0 Enabled/Disabled (0024H)	X	●	X	X
EV1 alarm hysteresis (0025H)	X	●	X	X
EV1 alarm delay time (0026H)	X	●	X	X
EV1 alarm Energized/De-energized (0027H)	X	●	X	X
EV2 alarm value 0 Enabled/Disabled (0028H)	X	X	●	X
EV2 alarm hysteresis (0029H)	X	X	●	X
EV2 alarm delay time (002AH)	X	X	●	X
EV2 alarm Energized/De-energized (002BH)	X	X	●	X
Sensor correction coefficient (004FH)	●	X	X	X
Sensor correction (0050H)	●	X	X	X
External setting input high limit (0054H)	●	X	X	X
External setting input low limit (0055H)	●	X	X	X

7.7.2 JC Command

For the JC command, the following items will be initialized when settings are changed.

●: Initialized

X: Not initialized

| Setting item to be changed / Item to be initialized	Input type (0044H)	Event output EV1 allocation (0023H)	Event output EV2 allocation (0024H)
SV1 (0001H)	●	X	X
AT bias (0047H)	●	X	X
OUT1 proportional band (0004H)	●	X	X
Scaling high limit (0018H)	●	X	X
Scaling low limit (0019H)	●	X	X
EV1 alarm value (000BH)	●	●	X
Loop break alarm time (0010H)	●	X	X
Loop break alarm band (0011H)	●	X	X
EV2 alarm value (000CH)	●	X	●
OUT2 proportional band (0005H)	●	X	X
EV1 alarm hysteresis (0025H)	X	●	X
EV1 alarm delay time (0029H)	X	●	X
EV1 alarm Energized/De-energized (0040H)	X	●	X
EV2 alarm hysteresis (0026H)	X	X	●
EV2 alarm delay time (002AH)	X	X	●
EV2 alarm Energized/De-energized (0041H)	X	X	●
Sensor correction (0015H)	●	X	X

8. SV Digital Transmission

Step SV can be received from the connected Shinko programmable controllers PCA1 or PCB1. (Select 'SV digital transmission' in [Communication protocol] on the PCA1 or PCB1.)

8.1 Wiring

For the SV digital transmission, connect YA (-) to YA (-), YB (+) to YB (+), SG to SG terminal respectively in the same way as Serial communication (RS-485).
Up to 31 units of the BCS2 / BCR2 / BCD2 can be connected.

The following shows a connection example of PCB1 and BCS2 / BCR2 / BCD2.
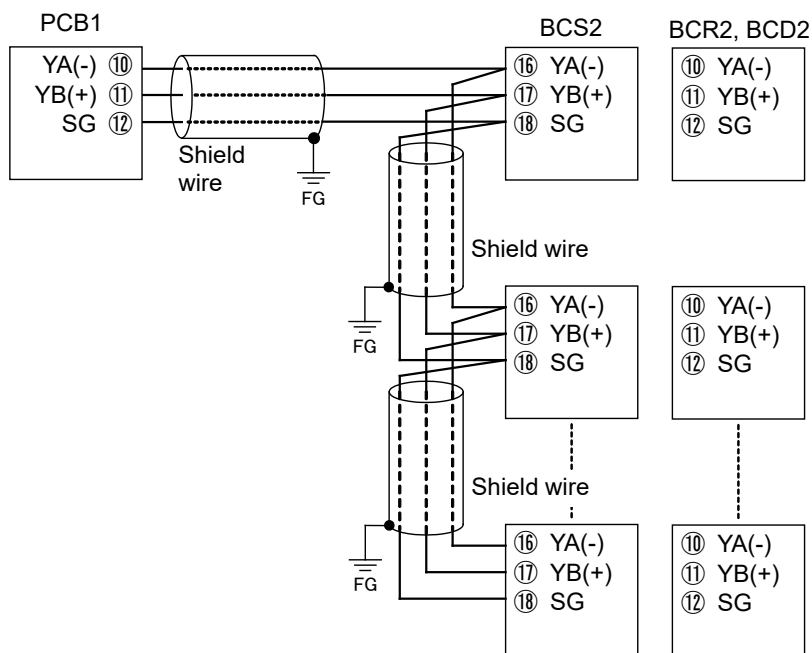
(Fig. 8.1-1)

8.2 Setting Method of PCA1, PCB1 and BCx2

(1) Setting the PCA1 or PCB1

Select 'SV digital transmission' in [Communication protocol].

(2) Setting the BCx2

Check the following in Engineering mode 1.
Refer to Section '3. Setting Communication Parameters'. (pp. 4, 5)
• 'Shinko protocol' has been selected in [Communication protocol].
• Communication speed of the BCx2 is equal to that of the PCA1 or PCB1 (9600 bps, 19200 bps or 38400 bps).

(3) Starting 'SV digital transmission'

Enter the program set values on the PCA1, PCB1.
If the program is executed by pressing the RUN Key, Step SV of the PCA1 or PCB1 will be sent to the BCx2.
During program Standby, 0 (zero) will be sent to the BCx2.

9. Specifications

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

Communication Protocol	Shinko Protocol	MODBUS ASCII	MODBUS RTU
Start bit	1	1	1
Data bit	7 (8) Selectable	7 (8) Selectable	8
Parity	Even (No parity, Odd) Selectable	Even (No parity, Odd) Selectable	No parity (Even, Odd) Selectable
Stop bit	1 (2) Selectable	1 (2) Selectable	1 (2) Selectable

Number of connectable units	Max 31 units to 1 host computer
Error correction	Command request repeat system
Error detection	Parity, checksum (Shinko protocol), LRC (MODBUS ASCII), CRC-16 (MODBUS RTU)
Digital external setting	Step SV can be received from the connected Shinko programmable controllers PCA1 or PCB1. (Select 'SV digital transmission' in [Communication protocol] on the PCA1 or PCB1.)

10. Troubleshooting

Check that power is being supplied to the master and slave that customers use. If communication failure still occurs, check the following.

Problem	Possible Cause	Solution
Communication failure	Communication cable is not securely connected, or is disconnected/defective.	Check the communication cable and connector.
	Incorrect wiring of the communication cable and/or connector	Check the communication cable and connector. Refer to Section '2. Wiring' (pp. 2, 3).
	Imperfect contact between the communication cable and the connector, or between the communication connector and instrument port	Check the communication cable and connector.
	Communication speed of the slave does not match that of the master.	Set the same communication speed on the master and the slave. Refer to Section '3. Setting Communication Parameters' (pp. 4, 5).
	The data bit, parity and stop bit of the master do not correspond to those of the slave.	Set the same data bit, parity and stop bit on the master and the slave. Refer to Section '3. Setting Communication Parameters' (pp. 4, 5).
	The instrument number (address) of the slave does not correspond to that of the command.	Check the instrument number (address) of the slave and the command. Refer to Section '3. Setting Communication Parameters' (pp. 4, 5).
	The instrument numbers (addresses) are duplicated in multiple slaves.	Check that each slave has a different instrument number (address). Refer to Section '3. Setting Communication Parameters' (pp. 4, 5).
	Make sure that the program is appropriate for the transmission timing.	Check the program. Refer to Section '4. Communication Procedure' (p.6).
Although communication is occurring, the response is negative acknowledgement.	A non-existent command code has been sent.	Check the command code.
	The Write command data exceeds the setting range of the slave.	Check the setting range of the slave.
	The controller cannot be written when functions such as AT are performing.	Check the slave status.
	The BCx2 is in front keypad operation setting mode.	Return the controller to RUN mode.

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