

TOHO ELECTRONICS INC.

Instruction Manual (Communication Edition)
(TOHO Protocol, MODBUS)

Model: TTM-P4W Series
Name: Program Controller

Thank you very much for purchasing the TTM-P4W (with a communication function).
Kindly read this operation manual for proper usage.

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1. Before Using the Product

1.1 About the Operation Manual

This manual explains the communication function of TTM-P4W (hereinafter referred to as "Product").

1.2 Requirements for Communication

The communication function of the product is optional. Therefore, you need to specify the communication option (RS-485) upon purchase.

1.3 Things the Communication Function Can Do

This function allows the user to write and read the items of this product that are described in "8. List of Identifiers," such as "To change, start, or stop items that can be operated through front keys" and "To read the information that can be displayed on the display section."

However, since the RAM of this product is used during the reading/writing of data through ordinary command, data that was written will be replaced by the previous data (data that is saved in the memory element) if the power is turned OFF and then turned ON.

To save the written data into the memory element of this product, execute the save request message.

(See 3.6, 5.6, and 5.10, "Things to Be Noted during the Communication.")

Furthermore, unnecessary setting items, such as items that are related to the unattached option, will not be read and written.

1.4 Position (Priority) of Communication

This product allows the user to change data and parameters through the key even during the operation under communication mode.

1.5 Settings to Be Made Prior to the Communication

Several settings need to be made to this product in order for it to perform a communication function.

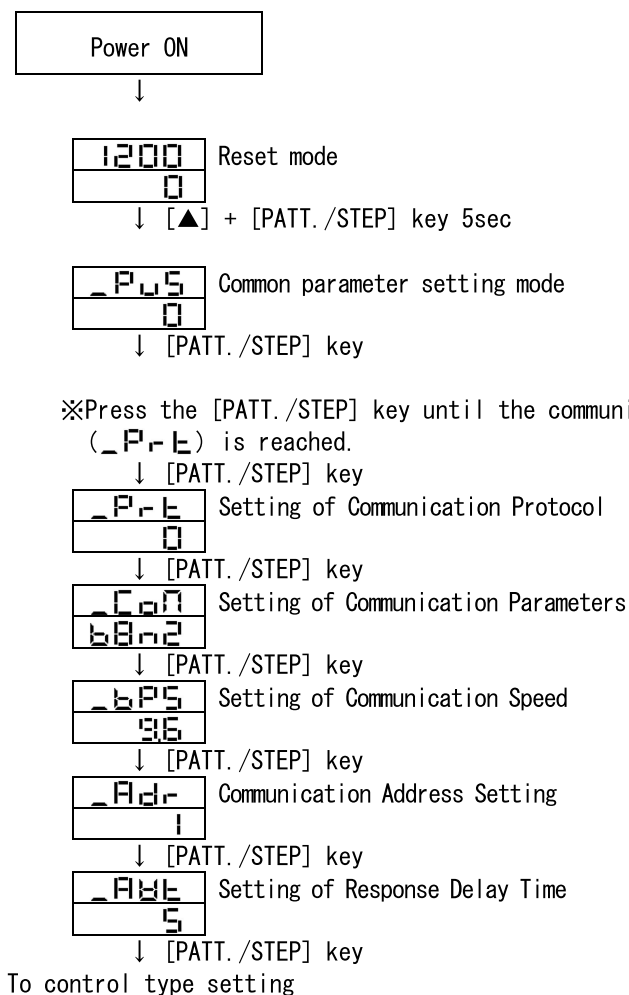
See "2. Setting about TOHO Communication"

2. Setting about TOHO Communication

2.1 Outline

Initial settings need to be made to the product in order for it to perform a communication function. The setting shall be done by keys at the front side.

Follow the procedure shown below to navigate between setting screens. See the User's Manual of this product for details.



When the setting is done, press the [RUN/RESET] key for more than 5 seconds to return to the reset mode.

2.2 Setting of Communication Protocol

Operate the ▲▼ keys on the "Communication Protocol Settings" screen on the previous page to set. The initial value is 0.

_Pr6	
0	

0	TOHO Protocol
1	MODBUS RTU
2	MODBUS ASCII

2.3 Setting of Data Length

2.4 Setting of Stop Bit

2.5 Setting of Parity

2.6 Setting of BCC Checking

Set the value by pressing the ▲▼ keys on the "Setting of Communication Parameters" screen in a previous page. The initial value is 68n2.

_Con	

1	Stop Bit 1
2	Stop Bit 2

n	Without Parity
a	Odd Parity
E	Even Parity

7	Data Length 7 Bits
8	Data Length 8 Bits

n	Without BCC Checking	Hide for MODBUS
b	With BCC Checking	

2.7 Setting of Communication Speed

Set the value by pressing the ▲▼ keys on the "Setting of Communication Speed" screen in a previous page. The initial value is 96.

_bPS	

12	1200 BPS
24	2400 BPS
48	4800 BPS
96	9600 BPS
192	19200 BPS

2.8 Setting of Communication Address

Set the value by pressing the ▲▼ keys on the "Setting of Communication Address" screen in a previous page. The initial value is 1.

_Adr	
1	

Setting Range: 1 to 99 (1 to 247 for MODBUS)

2.9 Setting of Response Delay Time

Set the time to take for the upper computer to complete the receiving of "request message," open the line, and get ready for the next input.

Set the value by pressing the ▲▼ keys on the "Setting of Response Delay Time" screen in a previous page. The initial value is 5.

_RHL	
5	

Setting Range: 0 to 250mSEC

*Communication may not be performed properly if the response delay time is too short.

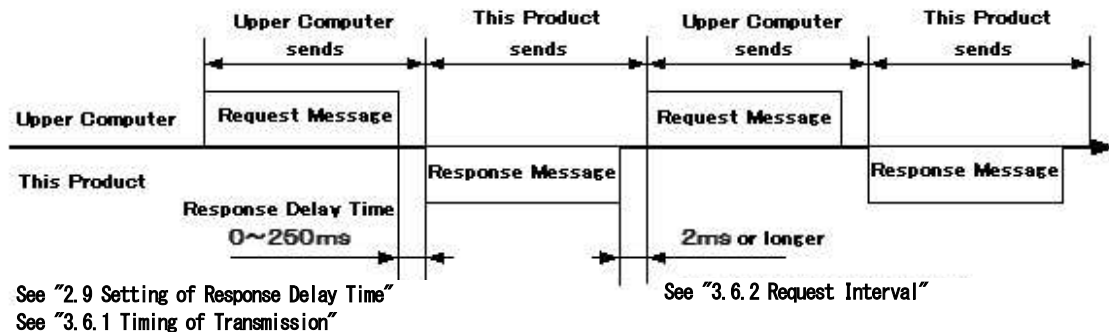
*In actual operation, the processing time of the product will be added to the response delay time.

3. TOHO Communication Control

3.1 Communication Procedures

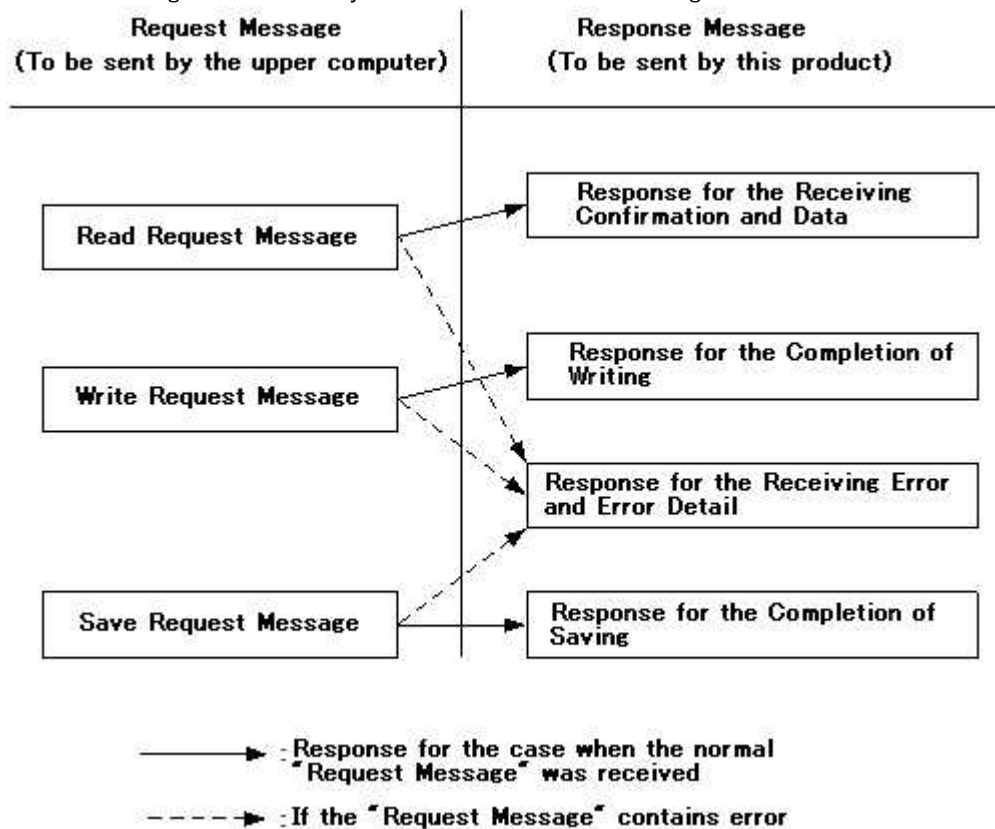
This product returns the "response message" as a reply to the "request message" that will be sent by the upper computer.

Therefore, the transmission will never be initiated by this product.



3.2 Kinds of Message

■ Kinds of message can be briefly classified into the following:



■ In TOHO protocol mode, all codes (excluding BCC) up to ETX, such as STX and data, are represented by ASCII codes.

■ To code the program for the upper computer, see "8. List of Identifiers (Codes)" and "9. List of ASCII Codes" at the end of this document.

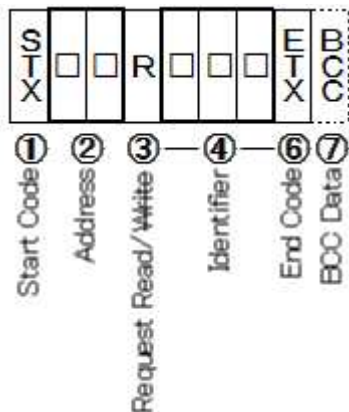
■ This unit does not store data until it receives a save request message.

If you want to retain the data even after power cycle, send a save request message.

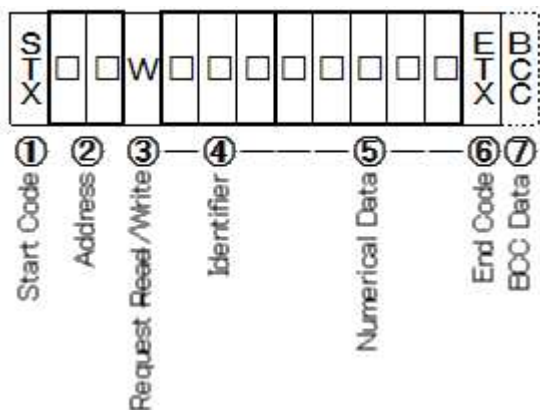
3.3 Structure of Request Message (Data transmission from upper computer to this product)

- See "3.5 Explanation about Codes" for codes from ① to ⑦.
- See "4.1 Sample Communication for Reading" and "4.2 Sample Communication for Writing" for concrete samples of the request message.

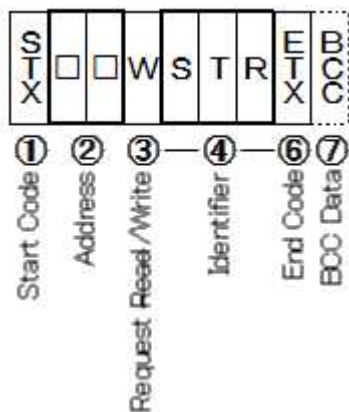
3.3.1 Structure of Read Request Message



3.3.2 Structure of Write Request Message



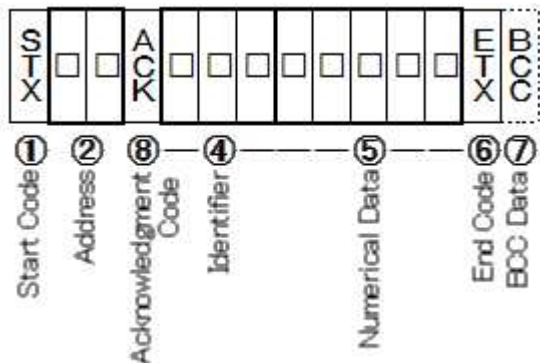
3.3.3 Structure of Save Request Message



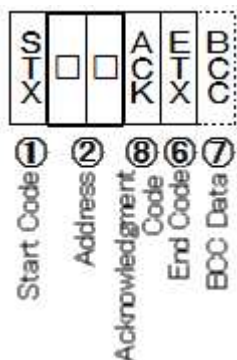
3.4 Structure of Response Message (Data transmission from this product to upper computer)

- See "3.5 Explanation about Codes" for codes from ① to ⑩.
- See "4.1 Sample Communication for Reading" and "4.2 Sample Communication for Writing" for concrete samples of the request message.

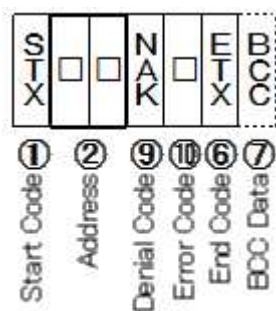
3.4.1 Response Message for Read Request Message



3.4.2 Response Message for Write/Save Request Message



3.4.3 Response Message for the Error



3.5 Explanation about Codes

■ The following ① STX to ⑥ ETX, ⑧ ACK to ⑩ error type codes are represented by ASCII codes.

⑦ BCC is represented by a binary code.

■ See "9. List of ASCII Codes" for the details about ASCII codes.

■ For conversion to ASCII code, refer to "4.1 Sample Communication for Reading" and "4.2 Sample Communication for Writing."

① STX

It is a code that is necessary for the receiving side to detect the start of the message.

It shall be attached to the start of the character string to be sent.

② Address

It is an address of the device that will be communicated by the upper computer (this product).

The address in the response message from this product indicates the source of the response message.

③ Contents of Request

Set the symbol R or W.

R: If the data is to be read from the product

W: If the data is to be written or saved into the product

④ Identifier

It is a classification symbol (identifier) of the data to be read or written that will be expressed by the 3-digit alphanumeric characters.

See "8. List of Identifiers (Codes)."

⑤ Numerical Data

It is a data for reading or writing which will be expressed in 5-digit characters regardless of the data type.

Negative data: The symbol "-" is considered one digit to be displayed at the largest digit.

Position of decimal point: Decimal point will not be included in the 5-digit data.

Example: 5-digit numerical data "-9999" means the following:

Settings		Meaning of Numerical Value
Data whose decimal point position changes depending on the sensor switching setting (SV, etc.)	If the position of decimal point is 0	-9999
	If the position of decimal point is 0.0	-999.9

- ⑥ ETX
It is a code that is necessary for the receiving side to detect the end of the message.
It shall be attached to the end of the character string to be sent (except for BCC).
- ⑦ BCC
Get the Ex-OR of all characters from STX to ETX with the check code for the detection of error.
This code shall not be included in the response message if BCC Check is turned OFF at the communication setting of this product. See "2. Setting about TOHO Communication."
- ⑧ ACK
It is an acknowledge code that will be included in the "response message" to be replied by this product if no error is found in the received message.
- ⑨ NAK
It is a reject code that will be included in the "response message" to be replied by this product if error is found in the received message.
If there is an error in the received "request message," content of error (⑩ Type of ERR) will also be attached (next to NAK) to the "response message" that will be returned by this product.
- ⑩ Error Code
If there is an error in the "request message" that was received by this product, the description of the said error (number in the table shown below) will be attached (next to "⑨ NAK") to the "response message" that will be returned by this product.
For multiple errors, the largest error number will be included.

Contents and classification of error are the following:

Error Number	Description of errors in the "request message" that was received by this product
0	Malfunction of measuring equipment (memory error or A/D conversion error)
1	Numerical value data is out of the "setting range that is specified individually by the setting item"
2	Changing of the requested item is prohibited or no item to read
3	ASCII code that is other than the numeric value has been set to the portion for the numeric value. ASCII code that is other than "0" or "-" has been set to the position for the symbol.
4	Format Error
5	BCC Error
6	Overflow Error
7	Framing Error
8	Parity Error
9	PV abnormality has occurred during AT or AT does not end although 3 hours have lapsed

3.6 Things to Be Noted during the Communication

3.6.1 Timing of Send and Receive

Upon using comm, set enough response delay time to ensure the communication (sending/receiving) with the host computer.

See Figure of "3.1 Communication Procedures."

3.6.2 Request Interval

If the "request message" is to be sent continuously by the upper computer, wait for at least 2msecs. from the arrival of the "response message" from this product before sending the next request message.

3.6.3 Conditions for Response

This product will not return the "response message" if STX and ETX (BCC) are not included in the "request message".

Therefore, although there is an error in the "request message," the "response message" with NAK And ERR will not be returned unless the above condition is met.

Therefore, the upper computer should resend the necessary "request message" if the "response message" is not returned within the reasonable time.

Once STX is received, this product clears all codes that were received prior to the said STX.

3.6.4 Address Specification Error

This product will not respond to any "request message" that specifies the address that is other than the one that has been set to itself.

Therefore, if there is an error in the address section of the "request message," none of the slave stations will return the "response message."

Therefore, the upper computer should resend the necessary "request message" if the "response message" is not returned within the reasonable time.

Once STX is received, this product clears all codes that were received prior to the said STX.

3.6.5 Number of Digits of Data and Position of Decimal Point

See "3.5 Explanation about Codes" ⑤ Numerical Data.

3.6.6 Operation After the Receiving of Save Request Message

This product starts the saving of data once it receives the save request message correctly from the upper computer.

Time that is required to save the data is within 6 seconds.

The product sends a response (ACK) when the saving of data is completed.

Some data may be lost if the product is turned OFF while the saving process is in progress. Do not turn the power of this product OFF for at least 6 seconds after the sending of the save request message.

3.6.7 Upon Turning the Power ON

This product will not perform any communication during the initial processing after turning its power ON (no response).

Make the sufficient delay from power ON to start communication.

3.6.8 Saving the Data Other than Save Request Message

This product saves the parameter into the memory element even without receiving the save request message in case of the following:

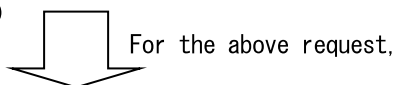
- 1) When a parameter is changed by a key operation, or when a limit is applied to other parameters due to the changed parameter.
- 2) If the auto tuning is activated and ended normally.

4. Example of TOHO Communication

4.1 Sample Communication for Reading

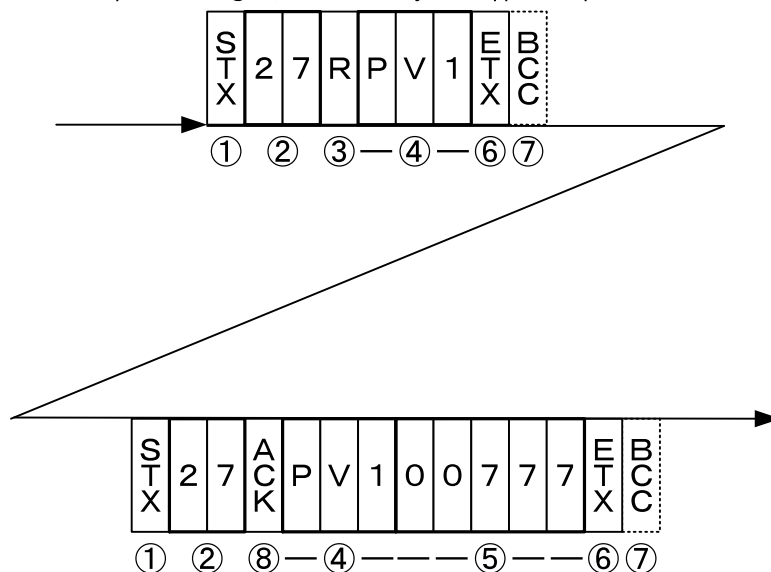
Example:

Request Message: Request this product, with address is set as "10," to read the measured value (PV).
(Upper computer)



Response Message: Returns the data (00100) of the measured value (PV).
(This product)

Read Request Message (to be sent by the upper computer)



Code	Symbol · Data	ASCII Code Note 2)
① Start Code	STX	02H
② Address	10	31H 30H
③ Contents of Request	R	52H
④ Identifier Note 1	PV1	50H 56H 31H
⑤ Numerical Data	00100	30H 30H 31H 30H 30H
⑥ End Code	ETX	03H
⑦ BCC Data Request		65H
Response		00H
⑧ Acknowledgment Code	ACK	06H

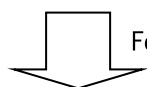
Note 1: See "8. List of Identifiers (Codes)."

Note 2: See "9. List of ASCII Codes" for the details about ASCII codes.

4.2 Sample Communication for Writing

Example:

Request Message: Requests the instrument set at address 01 to write to change the step 1 temperature setting to 50.
(upper computer).

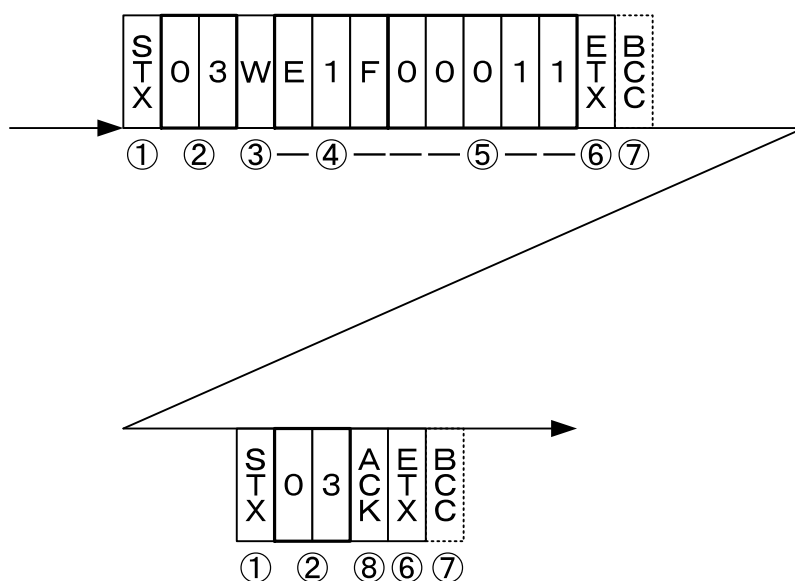


For the above request,

Response Message: Return the message to tell that the request message has been received.
(This product)

☆ Read the data separately to check if the data is written correctly.

Write Request Message (to be sent by the upper computer)



Code	Symbol · Data	ASCII Code Note 2)
① Start Code	STX	02H
② Address	01	30H 31H
③ Contents of Request	W (Write)	57H
④ Identifier Note 1	S01	53H 30H 31H
⑤ Numerical Data	00050	30H 30H 30H 35H 30H
⑥ End Code	ETX	03H
⑦ BCC Data Request		30H
Response		06H
⑧ Acknowledgment Code	ACK	06H

Note 1: See "8. List of Identifiers (Codes)."

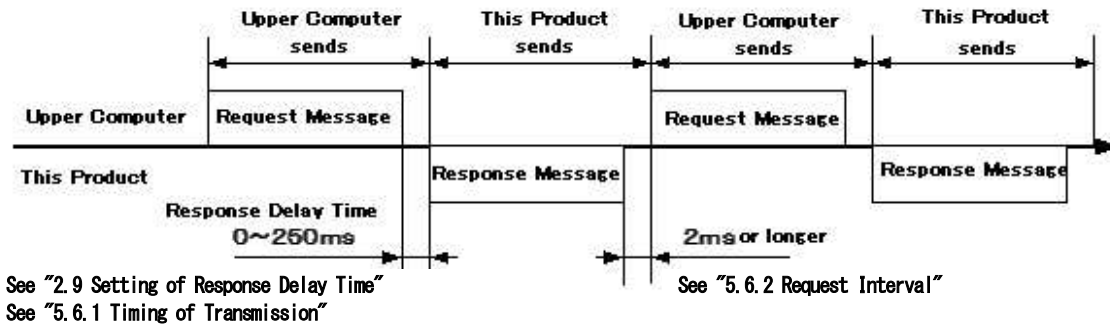
Note 2: See "9. List of ASCII Codes" for the details about ASCII codes.

5. MODBUS Communication Control

5.1 Communication Procedures

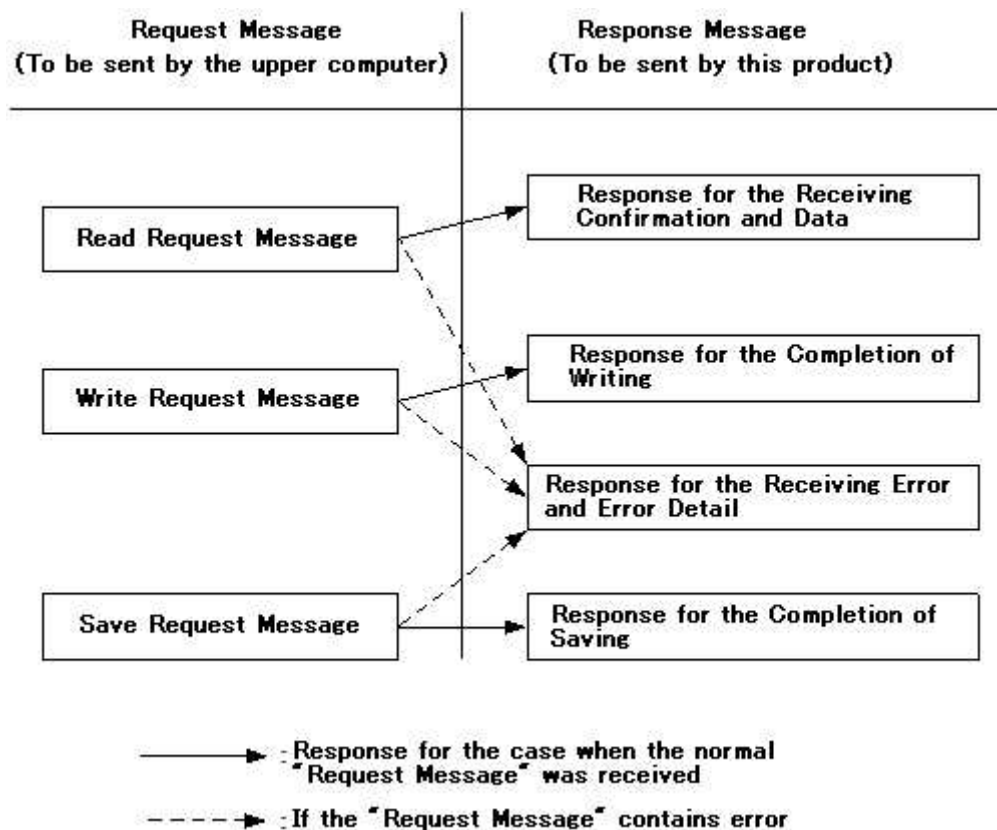
This product returns the "response message" as a reply to the "request message" that will be sent by the upper computer.

Therefore, the transmission will never be initiated by this product.



5.2 Kinds of Message

■ Kinds of message can be broadly classified into the following:



- Data is in binary during MODBUS RTU mode.
- In case of MODBUS ASCII mode, all codes will be expressed in ASCII code.
- To code the program for the upper computer, see "8. List of Identifiers (Codes)" and "9. List of ASCII Codes".
- This unit does not store data until it receives a save request message.
If you want to retain the data even after power cycle, send a save request message.

5.3 Structure of MODBUS RTU Request Message (Data transmission from upper computer to this product)

■ See "5.5 Explanation about MODBUS RTU Codes" for codes from (a) to (g).

5.3.1 Structure of Read Request Message

a)	Slave Address		01H	
b)	Function Code		03H	
c)	Register Address	Upper	00H	First Register Address
		Lower	00H	
d)	No. of Registers	Upper	00H	2pcs. Fixed
		Lower	02H	
e)	CRC-16	Lower	C4H	
		Upper	0BH	

5.3.2 Structure of Write Request Message

a)	Slave Address		01H	
b)	Function Code		10H	
c)	Register Address	Upper	01H	First Register Address
		Lower	00H	
d)	No. of Registers	Upper	00H	2pcs. Fixed
		Lower	02H	
f)	No. of Bytes		04H	No. of Registers x 2
g)	Data to the first register (Lower word)	Upper	00H	③
		Lower	00H	
g)	Data to the first register (Upper word)	Upper	00H	④ Data structure is ①②③④H.
		Lower	00H	
e)	CRC-16	Lower	FEH	① (① indicates 1 byte)
		Upper	3FH	

5.3.3 Structure of Save Request Message

a)	Slave Address		01H	
b)	Function Code		10H	
c)	Register Address	Upper	10H	First Register Address
		Lower	00H	
d)	No. of Registers	Upper	00H	2pcs. Fixed
		Lower	02H	
f)	No. of Bytes		04H	No. of Registers x 2
g)	Data to the first register (Lower word)	Upper	00H	Data of the saving of the setting is optional.
		Lower	00H	
g)	Data to the first register (Upper word)	Upper	00H	
		Lower	00H	
e)	CRC-16	Lower	3EH	
		Upper	6FH	

5.4 Structure of MODBUS RTU Response Message (Data transmission from this product to upper computer)

■ See "5.5 Explanation about MODBUS RTU Codes" for codes from (a) to (h).

5.4.1 Response Message for Read Request Message

a)	Slave Address		01H	
b)	Function Code		03H	
f)	No. of Bytes		04H	No. of Registers x 2
g)	Data to the first register (Lower word)	Upper	0AH	③
		Lower	A1H	④
	Data to the first register (Upper word)	Upper	00H	①
		Lower	00H	②
e)	CRC-16	Lower	A8H	
		Upper	09H	

① Data structure is ①②③④H.
 (① indicates 1 byte)

5.4.2 Response Message for Write/Save Request Message

a)	Slave Address		01H	
b)	Function Code		10H	
c)	Register Address	Upper	01H	First Register Address
		Lower	00H	
d)	No. of Registers	Upper	00H	2pcs. Fixed
		Lower	02H	
e)	CRC-16	Lower	40H	
		Upper	34H	

5.4.3 Response Message for the Error

a)	Slave Address		01H	
b)	Function Code		83H	←In case of error, function code of the request message + 80H will be entered.
h)	Error Code		03H	
e)	CRC-16	Lower	01H	
		Upper	31H	

5.5 Explanation about MODBUS RTU Codes

- The following codes from (a) Slave Address, (b) Function Code, up to (h) Error Code will be expressed in 8-bit binary:

a) Slave Address

It is an address of the device (this product) that the upper computer will communicate with.

The address in the response message from this product indicates the source of the response message.

b) Function Code

Enter the code 03H or 10H.

03H: If the data is to be read from this product

10H: If the data is to be written or saved into this product

c) Register Address

It specifies the position of data to be read or written with two bytes.

See "8. List of Identifiers (Codes)" for the address of each command.

d) Number of Registers

It specifies the number of registers that are to be written. Since the number of registers of this product is fixed to 2, specify "0002H."

e) CRC-16

It is an error checking code for the detection of the possible error in the message. It sends CRC-16 (Cyclic Redundancy Code).

Generating polynomial of CRC-16 that is used in this product is $X^{16} + X^{15} + X^2 + 1$.

Attach this code to the end of message in order of lower byte then upper byte.

f) Number of Bytes

It specifies the number of registers x 2 that read and write. Since the number of registers of this product is 2 (fixed), specify "04H."

g) Data Section

It specifies the data to be written into the register. Data is 4 bytes (fixed).

If the data includes a decimal point, specify numerical value without the decimal point.

The data in parentheses is the value that will actually be used for the transmitted message.

See "5.3 Structure of MODBUS RTU Request Message (Data transmission from upper computer to this product)"

In case of numerical data

Contents of Communication	HEX Data
PV = 1200 (°C)	000004B0h (04B00000)
PV = -10.0 (°C)	FFFFFF9Ch (FF9CFFFF)

ASCII code will be written in case of the character data (□ means space)

Contents of Communication	HEX Data
Communication setting = □8N2	20384E32h (4E322038)

h) Error Code

If there is an error in the message that was sent by the upper computer, the error number will be included in the "response message" of this product for the reply.
For multiple errors, the largest error number will be included.

Contents and classification of error are the following:

Error Number	Description of errors in the "request message" that was received by this product
01	Received an unsupported function code
02	Received an address other than the specified address.
03	Numerical value data is out of the "setting range that is specified individually by the setting item"
04	Malfunction of instruments (memory error or A/D conversion error, AT error)

5.6 Things to be Noted during MODBUS RTU Communication

5.6.1 Timing of Send and Receive

Upon using RS-485, set enough response delay time to ensure the communication (sending/receiving) with the host computer.

See Figure of "5.1 Communication Procedures."

5.6.2 Request Interval

If the "request message" is to be sent successively by the upper computer, before sending the next request message wait for at least 2msec from the time of receiving the "response message" from this product.

5.6.3 Conditions for Response

This product will not return the "response message" if there is a time interval of more than 3.5 characters between data that consist the "request message" since it cannot identify these data as one whole "request message." Therefore, although there is an error in the "request message," the "response message" with ERR will not be returned unless the above condition is met.

Therefore, the upper computer should resend the necessary "request message" if the "response message" is not returned within the reasonable time.

At a time interval of more than 3.5 characters, this product clears all characters that were received prior to the said interval.

5.6.4 Address Specification Error

This product will not respond to any "request message" that specifies the address that is other than the one that has been set to itself.

Therefore, if there is an error in the address section of the "request message," none of the slave stations will return the "response message."

Therefore, the upper computer should resend the necessary "request message" if the "response message" is not returned within the reasonable time.

At a time interval of more than 3.5 characters, this product clears all characters that were received prior to the said interval.

5.6.5 Number of Digits of Data and Position of Decimal Point

See "5.5 Explanation about MODBUS RTU Codes g) Data Section".

5.6.6 Operation After the Receiving of Save Request Message

This product starts the saving of data once it receives the save request message correctly from the upper computer.

Time that is required to save the data is within 6 seconds.

The product sends a message when the saving of data is completed.

Some data may be lost if the product is turned OFF while the saving process is in progress. Do not turn the power of this product OFF for at least 6 seconds after the sending of save request message.

5.6.7 Upon Turning the Power ON

This product will not perform any communication during the initial processing after turning its power ON (no response).

Make the sufficient delay from power ON to start communication.

5.6.8 Saving the Data Other than Save Request Message

This product saves the parameter into the memory element even without receiving the save request message in case of the following:

- 1) When a parameter is changed by a key operation, or when a limit is applied to other parameters due to the changed parameter.
- 2) If the auto tuning is activated and ended normally.

5.7 Structure of MODBUS ASCII Request Message (Data transmission from upper computer to this product)

■ See "5.9 Explanation about MODBUS ASCII Codes" for codes from (a) to (i).

5.7.1 Structure of Read Request Message

a)	Start Code		' :
b)	Slave Address		' 0', ' 1'
c)	Function Code		' 0', ' 3'
d)	Register Address	Upper	' 0', ' 0'
		Lower	' 0', ' 0'
e)	No. of Registers	Upper	' 0', ' 0'
		Lower	' 0', ' 2'
f)	LRC		' F', ' A'
g)	End Code		CR, LF

First Register Address

2pcs. Fixed

5.7.2 Structure of Write Request Message

a)	Start Code		' :
b)	Slave Address		' 0', ' 1'
c)	Function Code		' 1', ' 0'
d)	Register Address	Upper	' 0', ' 1'
		Lower	' 0', ' 0'
e)	No. of Registers	Upper	' 0', ' 0'
		Lower	' 0', ' 2'
h)	No. of Bytes		' 0', ' 4'
i)	Data to the first register (Lower word)	Upper	' 0', ' 0'
		Lower	' 0', ' 0'
i)	Data to the first register (Upper word)	Upper	' 0', ' 0'
		Lower	' 0', ' 0'
f)	LRC		' E', ' 8'
g)	End Code		CR, LF

First Register Address

2pcs. Fixed

No. of Registers x 2

③

④ Data structure is ①②③④H.

① ((① indicates 1 byte)

②

5.7.3 Structure of Save Request Message

a)	Start Code		' :
b)	Slave Address		' 0', ' 1'
c)	Function Code		' 1', ' 0'
d)	Register Address	Upper	' 1', ' 0'
		Lower	' 0', ' 0'
e)	No. of Registers	Upper	' 0', ' 0'
		Lower	' 0', ' 2'
h)	No. of Bytes		' 0', ' 4'
i)	Data to the first register (Lower word)	Upper	' 0', ' 0'
		Lower	' 0', ' 0'
i)	Data to the first register (Upper word)	Upper	' 0', ' 0'
		Lower	' 0', ' 0'
f)	LRC		' D', ' 9'
g)	End Code		CR, LF

First Register Address

2pcs. Fixed

No. of Registers x 2

Data of the saving of the setting is optional.

5.8 Structure of MODBUS ASCII Response Message (Data transmission from this product to upper computer)

■ See "5.9 Explanation about ASCII Codes " for codes from (a) to (j).

5.8.1 Response Message for Read Request Message

a)	Start Code		' :
b)	Slave Address		' 0', ' 1'
c)	Function Code		' 0', ' 3'
h)	No. of Bytes		' 0', ' 4'
i)	Data to the first register (Lower word)	Upper	' 0', ' 0'
		Lower	' 0', ' 0'
	Data to the first register (Upper word)	Upper	' 0', ' 0'
		Lower	' 0', ' 0'
f)	LRC		' F', ' 8'
g)	End Code		CR, LF

No. of Registers x 2

③

④ Data structure is ①②③④H.

① ((① indicates 1 byte)

②

5.8.2 Response Message for Write/Save Request Message

a)	Start Code		' :
b)	Slave Address		' 0', ' 1'
c)	Function Code		' 1', ' 0'
d)	Register Address	Upper	' 0', ' 1'
		Lower	' 0', ' 0'
e)	No. of Registers	Upper	' 0', ' 0'
		Lower	' 0', ' 2'
f)	LRC		' E', ' C'
g)	End Code		CR, LF

First Register Address

2pcs. Fixed

5.8.3 Response Message for the Error

a)	Start Code		' :
b)	Slave Address		' 0', ' 1'
c)	Function Code		' 8', ' 3'
j)	Error Code		' 0', ' 3'
f)	LRC		' 7', ' 9'
g)	End Code		CR, LF

←In case of error, function code of the request message + 80H will be entered.

5.9 Explanation about MODBUS ASCII Codes

- The following codes from (a) Start Code, (b) Slave Address, up to (j) Error Type will be expressed in ASCII code:
- See "9. List of ASCII Codes" for the details about ASCII codes.
- To convert into ASCII code, see the message structure in 5.7 and 5.8.

a) Start Code

It is a code that is necessary for the receiving side to detect the start of the message. It shall be attached to the start of the character string to be sent.

b) Slave Address

It is an address of the device (this product) that the upper computer will communicate with.
The address in the response message from this product indicates the source of the response message.

c) Function Code

Enter the code 03H or 10H.

03H: If the data is to be read from this product

10H: If the data is to be written or saved into this product

d) Register Address

It specifies the position of data to be read or written with two bytes.

See "8. List of Identifiers (Codes)" for the address of each command.

e) Number of Registers

It specifies the number of registers that are to be written. Since the number of registers of this product is fixed to 2, specify "0002H."

f) LRC

It is an error checking code for the detection of the possible error in the message. It sends LRC.

LRC that is used in this product is a value where all data in the message, except for start code and end code, are summed up without performing a carryover and treat the sum total as the complement of 2.

Any portion that is expressed as "1" and "B" shall be considered as "1BH."

If 12H was computed as an error code, attach "1" and "2" at the end of the message.

g) End Code

It is a code that is necessary for the receiving side to detect the end of the message. CR(0DH) and LF(0AH) shall be attached at the end of the character string to be sent.

h) Number of Bytes

It specifies the number of registers that read and write x 2. Since the number of registers of this product is 2 (fixed), set "04H."

i) Data Section

It specifies the data to be written into the register. Data is 4 bytes (fixed).

If the data includes a decimal point, specify numerical value without the decimal point.

The data in parentheses is the value that will actually be used for the transmitted message.

See "5.7 Structure of ASCII Request Message (Data transmission from upper computer to this product)"

In case of numerical data

Contents of Communication	HEX Data
PV = 1200(°C)	000004B0h (04B00000)
PV = -10.0(°C)	FFFFFF9Ch (FF9CFFFF)

ASCII code will be written in case of the character data (□ means space)

Contents of Communication	HEX Data
Communication setting = □8N2	20384E32h (4E322038)

j) Error Code

If there is an error in the message that was sent by the upper computer, the error number will be included in the "response message" of this product for the reply.

For multiple errors, the largest error number will be included.

Contents and classification of error are the following:

Error Number	Description of errors in the "request message" that was received by this product
01	Received an unsupported function code
02	Received an address other than the specified address.
03	Numerical value data is out of the "setting range that is specified individually by the setting item"
04	Malfunction of instruments (memory error or A/D conversion error, AT error)

5.10 Things to Be Noted during MODBUS ASCII Communication

5.10.1 Timing of Send and Receive

Upon using RS-485, set enough response delay time to ensure the communication (sending/receiving) with the host computer.

See Figure of "5.1 Communication Procedures."

5.10.2 Request Interval

If the "request message" is to be sent continuously by the upper computer, wait for at least 2msecs. from the arrival of the "response message" from this product before sending the next request message.

5.10.3 Conditions for Response

This product will not return the "response message" if start code and end code are not included in the "request message."

Therefore, although there is an error in the "request message," the "response message" with error code will not be returned unless the above condition is met.

Therefore, the upper computer should resend the necessary "request message" if the "response message" is not returned within the reasonable time.

Once the start code is received, this product clears all codes that were received prior to the said start code.

5.10.4 Address Specification Error

This product will not respond to any "request message" that specifies the address that is other than the one that has been set to itself.

Therefore, if there is an error in the address section of the "request message," none of the slave stations will return the "response message."

Therefore, the upper computer should resend the necessary "request message" if the "response message" is not returned within the reasonable time.

5.10.5 Number of Digits of Data and Position of Decimal Point

See "5.9 Explanation about MODBUS ASCII Codes i) Data Section".

5.10.6 Operation After the Receiving of Save Request Message

This product starts the saving of data once it receives the save request message correctly from the upper computer. Time that is required to save the data is within 6 seconds.

The product sends a message when the saving of data is completed.

Some data may be lost if the product is turned OFF while the saving process is in progress. Do not turn the power of this product OFF for at least 6 seconds after the sending of save request message.

5.10.7 Upon Turning the Power ON

This product will not perform any communication during the initial processing after turning its power ON (no response).

Make the sufficient delay from power ON to start communication.

5.10.8 Saving the Data Other than Save Request Message

This product saves the parameter into the memory element even without receiving the save request message in case of the following:

- 1) When a parameter is changed by a key operation, or when a limit is applied to other parameters due to the changed parameter.
- 2) If the auto tuning is activated and ended normally.

6. Communication specifications

6.1 Type of Communication Standard: EIA Standard Based on RS-485

6.2 Communication Specifications

6.2.1 Communication Method

- : Network.....Multidrop System (Max 1 to 31 stations)
- : Direction of Information.....Half-Duplex
- : Synchronization System.....Start-Stop Synchronization
- : Transmission Code.....ASCII Code or Binary Code

6.2.2 Interface System

- : Signal Wire.....Two wires for sending and receiving
- : Communication Speed.....1200, 2400, 4800, 9600, 19200BPS
Select and set the above.
- : Communication Distance.....Up to 500m
However, the distance may vary depending on the surrounding environment, such as cable.

6.2.3 Character

1) TOHO Communication Protocol

- : Start Bit Length.....1 bit fixed
- : Stop Bit Length.....Select and set from 1 bit and 2 bits
- : Data Length.....Select and set from 7 bits and 8 bits
- : Parity.....Select and set from none, odd, and even
- : BCC Checking.....Select and set from Yes (with) and No (without)
- : Communication Address.....1 to 99

2) MODBUS (RTU) Communication Protocol

- : Start Bit Length.....1 bit fixed
- : Stop Bit Length.....Select and set from 1 bit and 2 bits
- : Data Length.....8 bits fixed
- : Parity.....Select and set from none, odd, and even
- : CRC-16 Check.....ON fixed
- : Communication Address.....1 to 247

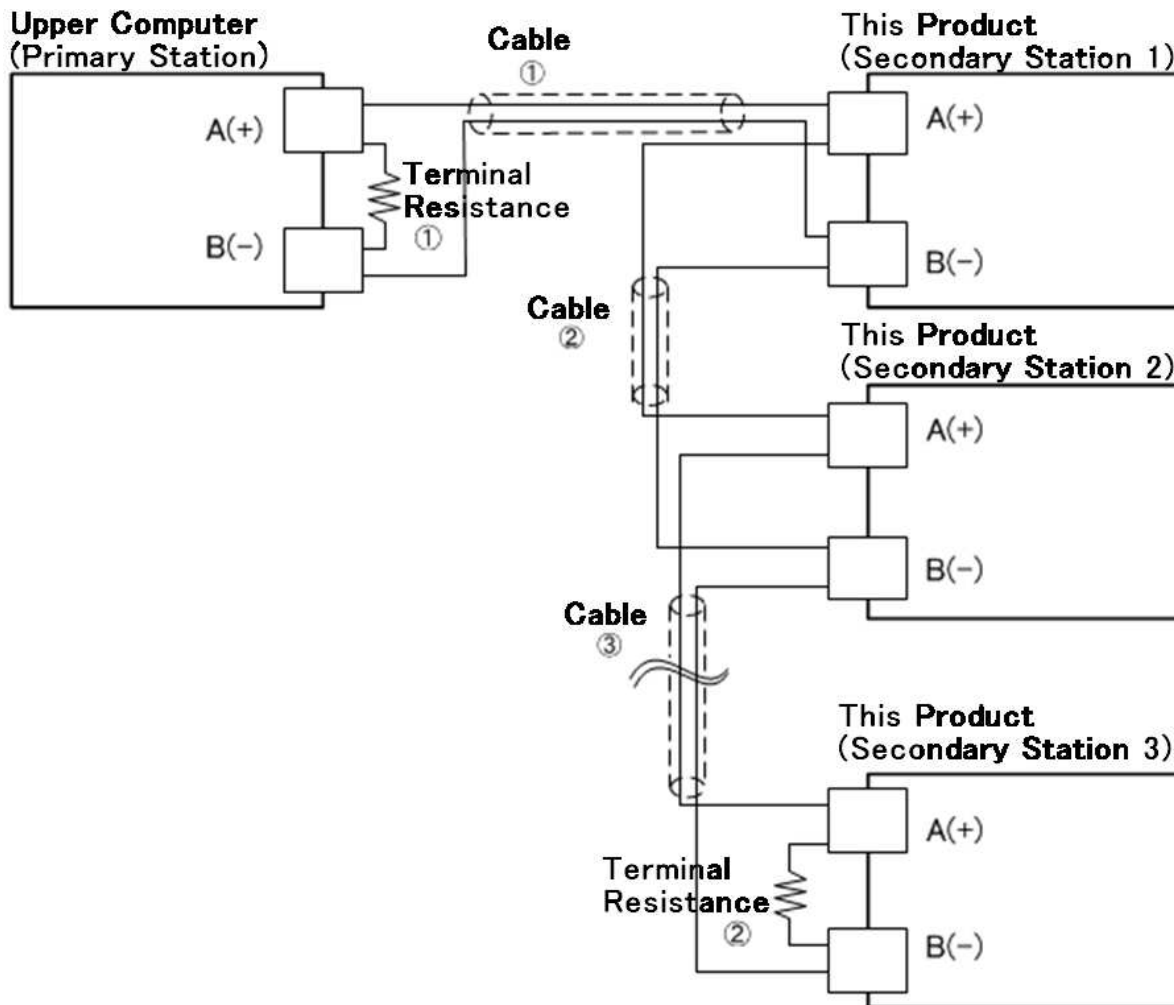
3) MODBUS (ASCII) Communication Protocol

- : Start Bit Length.....1 bit fixed
- : Stop Bit Length.....Select and set from 1 bit and 2 bits
- : Data Length.....Select and set from 7 bits and 8 bits
- : Parity.....Select and set from none, odd, and even
- : LRC Check.....ON fixed
- : Communication Address.....1 to 247

4) MODBUS (RTU/ASCII) Communication Function Code

- : 03H (Read the content of the holding register)
- : 10H (Write the content of multiple holding registers)

7. Wiring



- The figure below shows the example of the case where secondary stations 1-3 (3 stations) will be connected to the primary station.
 - ◇ For cables ①-③, use the cable with the same characteristic impedance.
 - Connect secondary stations 1-3 as slave, as shown in the figure.
 - Use the cable with the same characteristic impedance for the connection between secondary stations as well.
 - ◇ Attach the terminator to both the primary station ① and the farthest secondary station ② (secondary station 3).
 - ◇ Choose the terminator of which $[\text{Characteristic impedance of cables ①-③}] = [\text{Resistance of ①}] = [\text{Resistance of ②}]$.
 - Also, use the cable with characteristic impedance where $[\text{Resistance of ①}] // [\text{Resistance of ②}]$ (parallel combined resistance) is 75Ω or higher.

8. List of Identifiers (Codes)

8.1 Monitor information

Identifier	Absolute Address	Relative Address	Character	Name	Command	Description
PV1	40001	0000		Measuring Value (PV)	R	To be used as a monitor of measuring value (PV) If Over Scale: HHHHH If Under Scale: LLLLL
SV1	40003	0002		Set Value (SV)	R	
MV1	40005	0004		Manipulated Variable of Output 1	R	
MV2	40007	0006		Manipulated Variable of Output 2	R	
DOM	40009	0008		Output monitor	R	00000 |||| |||+ OUT1 (OFF:0/ON:1) ||+ OUT2 (OFF:0/ON:1) |+ EV1 (OFF:0/ON:1) ++ Zero fixed
DIM	40011	000A		Input monitor	R	00000 |||| |||+ DI ||| (Open:0/Close:1) +++ Zero fixed
STA	40013	000C		Step time	R	
PTM	40015	000E		Current pattern	R	
STM	40017	0010		Current step	R	

8.2 Program setting mode

- The pattern currently in operation, the temperature setting and time setting of the step cannot be changed by the write command.

Identifier	Absolute Address	Relative Address	Character	Name	Command	Description
S01	40257	0100	SV 1	Set a step 1 temperature	RW	※1
S02	40259	0102	SV 2	Set a step 2 temperature	RW	
S03	40261	0104	SV 3	Set a step 3 temperature	RW	
S04	40263	0106	SV 4	Set a step 4 temperature	RW	
S05	40265	0108	SV 5	Set a step 5 temperature	RW	
S06	40267	010A	SV 6	Set a step 6 temperature	RW	
S07	40269	010C	SV 7	Set a step 7 temperature	RW	
S08	40271	010E	SV 8	Set a step 8 temperature	RW	
S09	40273	0110	SV 9	Set a step 9 temperature	RW	
S10	40275	0112	SV10	Set a step 10 temperature	RW	
S11	40277	0114	SV11	Set a step 11 temperature	RW	
S12	40279	0116	SV12	Set a step 12 temperature	RW	
S13	40281	0118	SV13	Set a step 13 temperature	RW	
S14	40283	011A	SV14	Set a step 14 temperature	RW	
S15	40285	011C	SV15	Set a step 15 temperature	RW	
S16	40287	011E	SV16	Set a step 16 temperature	RW	
S17	40289	0120	SV17	Set a step 17 temperature	RW	
S18	40291	0122	SV18	Set a step 18 temperature	RW	
S19	40293	0124	SV19	Set a step 19 temperature	RW	
S20	40295	0126	SV20	Set a step 20 temperature	RW	
S21	40297	0128	SV21	Set a step 21 temperature	RW	
S22	40299	012A	SV22	Set a step 22 temperature	RW	
S23	40301	012C	SV23	Set a step 23 temperature	RW	
S24	40303	012E	SV24	Set a step 24 temperature	RW	
S25	40305	0130	SV25	Set a step 25 temperature	RW	
S26	40307	0132	SV26	Set a step 26 temperature	RW	
S27	40309	0134	SV27	Set a step 27 temperature	RW	
S28	40311	0136	SV28	Set a step 28 temperature	RW	
S29	40313	0138	SV29	Set a step 29 temperature	RW	
S30	40315	013A	SV30	Set a step 30 temperature	RW	
S31	40317	013C	SV31	Set a step 31 temperature	RW	

※1 "□" in "Step □ Temperature setting" is calculated by the following formula.

"□" = ("Pattern No." x "Number of steps") + "Step No."

Identifier	Absolute Address	Relative Address	Character	Name	Command	Description
S32	40319	013E	SV32	Set a step 32 temperature	RW	※1
S33	40321	0140	SV33	Set a step 33 temperature	RW	
S34	40323	0142	SV34	Set a step 34 temperature	RW	
S35	40325	0144	SV35	Set a step 35 temperature	RW	
S36	40327	0146	SV36	Set a step 36 temperature	RW	
S37	40329	0148	SV37	Set a step 37 temperature	RW	
S38	40331	014A	SV38	Set a step 38 temperature	RW	
S39	40333	014C	SV39	Set a step 39 temperature	RW	
S40	40335	014E	SV40	Set a step 40 temperature	RW	
S41	40337	0150	SV41	Set a step 41 temperature	RW	
S42	40339	0152	SV42	Set a step 42 temperature	RW	
S43	40341	0154	SV43	Set a step 43 temperature	RW	
S44	40343	0156	SV44	Set a step 44 temperature	RW	
S45	40345	0158	SV45	Set a step 45 temperature	RW	
S46	40347	015A	SV46	Set a step 46 temperature	RW	
S47	40349	015C	SV47	Set a step 47 temperature	RW	
S48	40351	015E	SV48	Set a step 48 temperature	RW	
S49	40353	0160	SV49	Set a step 49 temperature	RW	
S50	40355	0162	SV50	Set a step 50 temperature	RW	
S51	40357	0164	SV51	Set a step 51 temperature	RW	
S52	40359	0166	SV52	Set a step 52 temperature	RW	
S53	40361	0168	SV53	Set a step 53 temperature	RW	
S54	40363	016A	SV54	Set a step 54 temperature	RW	
S55	40365	016C	SV55	Set a step 55 temperature	RW	
S56	40367	016E	SV56	Set a step 56 temperature	RW	
S57	40369	0170	SV57	Set a step 57 temperature	RW	
S58	40371	0172	SV58	Set a step 58 temperature	RW	
S59	40373	0174	SV59	Set a step 59 temperature	RW	
S60	40375	0176	SV60	Set a step 60 temperature	RW	
S61	40377	0178	SV61	Set a step 61 temperature	RW	
S62	40379	017A	SV62	Set a step 62 temperature	RW	
S63	40381	017C	SV63	Set a step 32 temperature	RW	
S64	40383	017E	SV64	Set a step 33 temperature	RW	
T01	40385	0180	T 1	Set a step 1 time	RW	
T02	40387	0182	T 2	Set a step 2 time	RW	
T03	40389	0184	T 3	Set a step 3 time	RW	
T04	40391	0186	T 4	Set a step 4 time	RW	
T05	40393	0188	T 5	Set a step 5 time	RW	

※1 "□" in "Step □ Temperature setting" is calculated by the following formula.

"□" = ("Pattern No." x "Number of steps") + "Step No."

Identifier	Absolute Address	Relative Address	Character	Name	Command	Description
T06	40395	018A	T 6	Set a step 6 time	RW	※1
T07	40397	018C	T 7	Set a step 7 time	RW	
T08	40399	018E	T 8	Set a step 8 time	RW	
T09	40401	0190	T 9	Set a step 9 time	RW	
T10	40403	0192	T10	Set a step 10 time	RW	
T11	40405	0194	T11	Set a step 11 time	RW	
T12	40407	0196	T12	Set a step 12 time	RW	
T13	40409	0198	T13	Set a step 13 time	RW	
T14	40411	019A	T14	Set a step 14 time	RW	
T15	40413	019C	T15	Set a step 15 time	RW	
T16	40415	019E	T16	Set a step 16 time	RW	
T17	40417	01A0	T17	Set a step 17 time	RW	
T18	40419	01A2	T18	Set a step 18 time	RW	
T19	40421	01A4	T19	Set a step 19 time	RW	
T20	40423	01A6	T20	Set a step 20 time	RW	
T21	40425	01A8	T21	Set a step 21 time	RW	
T22	40427	01AA	T22	Set a step 22 time	RW	
T23	40429	01AC	T23	Set a step 23 time	RW	
T24	40431	01AE	T24	Set a step 24 time	RW	
T25	40433	01B0	T25	Set a step 25 time	RW	
T26	40435	01B2	T26	Set a step 26 time	RW	
T27	40437	01B4	T27	Set a step 27 time	RW	
T28	40439	01B6	T28	Set a step 28 time	RW	
T29	40441	01B8	T29	Set a step 29 time	RW	
T30	40443	01BA	T30	Set a step 30 time	RW	
T31	40445	01BC	T31	Set a step 31 time	RW	
T32	40447	01BE	T32	Set a step 32 time	RW	
T33	40449	01C0	T33	Set a step 33 time	RW	
T34	40451	01C2	T34	Set a step 34 time	RW	
T35	40453	01C4	T35	Set a step 35 time	RW	
T36	40455	01C6	T36	Set a step 36 time	RW	
T37	40457	01C8	T37	Set a step 37 time	RW	
T38	40459	01CA	T38	Set a step 38 time	RW	
T39	40461	01CC	T39	Set a step 39 time	RW	
T40	40463	01CE	T40	Set a step 40 time	RW	
T41	40465	01D0	T41	Set a step 41 time	RW	
T42	40467	01D2	T42	Set a step 42 time	RW	
T43	40469	01D4	T43	Set a step 43 time	RW	
T44	40471	01D6	T44	Set a step 44 time	RW	

※1 "□" in "Step □ Temperature setting" is calculated by the following formula.

"□" = ("Pattern No." x "Number of steps") + "Step No."

Identifier	Absolute Address	Relative Address	Character	Name	Command	Description
T45	40473	01D8	T45	Set a step 45 time	RW	※1
T46	40475	01DA	T46	Set a step 46 time	RW	
T47	40477	01DC	T47	Set a step 47 time	RW	
T48	40479	01DE	T48	Set a step 48 time	RW	
T49	40481	01E0	T49	Set a step 49 time	RW	
T50	40483	01E2	T50	Set a step 50 time	RW	
T51	40485	01E4	T51	Set a step 51 time	RW	
T52	40487	01E6	T52	Set a step 52 time	RW	
T53	40489	01E8	T53	Set a step 53 time	RW	
T54	40491	01EA	T54	Set a step 54 time	RW	
T55	40493	01EC	T55	Set a step 55 time	RW	
T56	40495	01EE	T56	Set a step 56 time	RW	
T57	40497	01F0	T57	Set a step 57 time	RW	
T58	40499	01F2	T58	Set a step 58 time	RW	
T59	40501	01F4	T59	Set a step 59 time	RW	
T60	40503	01F6	T60	Set a step 60 time	RW	
T61	40505	01F8	T61	Set a step 61 time	RW	
T62	40507	01FA	T62	Set a step 62 time	RW	
T63	40509	01FC	T63	Set a step 63 time	RW	
T64	40511	01FE	T64	Set a step 64 time	RW	

※1 "□" in "Step □ Temperature setting" is calculated by the following formula.

"□" = ("Pattern No." x "Number of steps") + "Step No."

8.3 Common parameter setting mode

• The parameters of this setting mode cannot be changed by the write command during operation.

Identifier	Absolute Address	Relative Address	Character	Name	Command	Description
PVS	40769	0300	_PVS	Set the PV correction zero point	RW	
PVG	40771	0302	_PVG	Set the PV correction gain	RW	
DIR	40773	0304	_DIR	Forward/reverse switchover	RW	
□IN	40775	0306	_ IN	Sensor switching setting	RW	
SLH	40777	0308	_SLH	SV limiter upper limit	RW	
SLL	40779	030A	_SLL	SV limiter lower limit	RW	
PAT	40781	030C	_PAT	Set the number of patterns	RW	
PSV	40783	030E	PVSV	PV / SV start selection setting	RW	0 : PV1 1 : PV2 2 : SV
PPV	40785	0310	PVPV	SV start temperature setting	RW	
□T1	40787	0312	_ T1	Main control proportional period	RW	
□T2	40789	0314	_ T2	Sub-control proportional period	RW	
□WZ	40791	0316	_ WZ	Wait zone	RW	
□WT	40793	0318	_ WT	Wait time	RW	
AL1	40795	031A	ALF1	Time signal / Event Output 1 type	RW	
AL2	40797	031C	ALF2	Run signal Output / Event Output 2 type	RW	
AD1	40799	031E	AD1	Event Output 1 sensitivity	RW	
AD2	40801	0320	AD2	Event Output 2 sensitivity	RW	
TSN	40803	0322	TSON	Time signal ON delay time	RW	
TSF	40805	0324	TSOF	Time signal OFF delay time	RW	
A01	40807	0326	T□□□	Time signal 1 selection	RW	0 : OFF 1 : ON ※1
A02	40809	0328		Time signal 2 selection	RW	
A03	40811	032A		Time signal 3 selection	RW	
A04	40813	032C		Time signal 4 selection	RW	
A05	40815	032E		Time signal 5 selection	RW	
A06	40817	0330		Time signal 6 selection	RW	
A07	40819	0332		Time signal 7 selection	RW	
A08	40821	0334		Time signal 8 selection	RW	
A09	40823	0336		Time signal 9 selection	RW	
A10	40825	0338		Time signal 10 selection	RW	
A11	40827	033A		Time signal 11 selection	RW	
A12	40829	033C		Time signal 12 selection	RW	
A13	40831	033E		Time signal 13 selection	RW	
A14	40833	0340		Time signal 14 selection	RW	
A15	40835	0342		Time signal 15 selection	RW	
A16	40837	0344		Time signal 16 selection	RW	
A17	40839	0346		Time signal 17 selection	RW	
A18	40841	0348		Time signal 18 selection	RW	

※1 "□" in "Step □ Temperature setting" is calculated by the following formula.

"□" = ("Pattern No." x "Number of steps") + "Step No."

Identifier	Absolute Address	Relative Address	Character	Name	Command	Description
A19	40843	034A	T□□□	Time signal 19 selection	RW	0 : OFF 1 : ON ※1
A20	40845	034C		Time signal 20 selection	RW	
A21	40847	034E		Time signal 21 selection	RW	
A22	40849	0350		Time signal 22 selection	RW	
A23	40851	0352		Time signal 23 selection	RW	
A24	40853	0354		Time signal 24 selection	RW	
A25	40855	0356		Time signal 25 selection	RW	
A26	40857	0358		Time signal 26 selection	RW	
A27	40859	035A		Time signal 27 selection	RW	
A28	40861	035C		Time signal 28 selection	RW	
A29	40863	035E		Time signal 29 selection	RW	
A30	40865	0360		Time signal 30 selection	RW	
A31	40867	0362		Time signal 31 selection	RW	
A32	40869	0364		Time signal 32 selection	RW	
A33	40871	0366		Time signal 33 selection	RW	
A34	40873	0368		Time signal 34 selection	RW	
A35	40875	036A		Time signal 35 selection	RW	
A36	40877	036C		Time signal 36 selection	RW	
A37	40879	036E		Time signal 37 selection	RW	
A38	40881	0370		Time signal 38 selection	RW	
A39	40883	0372		Time signal 39 selection	RW	
A40	40885	0374		Time signal 40 selection	RW	
A41	40887	0376		Time signal 41 selection	RW	
A42	40889	0378		Time signal 42 selection	RW	
A43	40891	037A		Time signal 43 selection	RW	
A44	40893	037C		Time signal 44 selection	RW	
A45	40895	037E		Time signal 45 selection	RW	
A46	40897	0380		Time signal 46 selection	RW	
A47	40899	0382		Time signal 47 selection	RW	
A48	40901	0384		Time signal 48 selection	RW	
A49	40903	0386		Time signal 49 selection	RW	
A50	40905	0388		Time signal 50 selection	RW	
A51	40907	038A		Time signal 51 selection	RW	
A52	40909	038C		Time signal 52 selection	RW	
A53	40911	038E		Time signal 53 selection	RW	
A54	40913	0390		Time signal 54 selection	RW	
A55	40915	0392		Time signal 55 selection	RW	
A56	40917	0394		Time signal 56 selection	RW	

※1 "□" in "Step □ Temperature setting" is calculated by the following formula.

"□" = ("Pattern No." x "Number of steps") + "Step No."

Identifier	Absolute Address	Relative Address	Character	Name	Command	Description
A57	40919	0396	T□□□	Time signal 57 selection	RW	0 : OFF 1 : ON ※1
A58	40921	0398		Time signal 58 selection	RW	
A59	40923	039A		Time signal 59 selection	RW	
A60	40925	039C		Time signal 60 selection	RW	
A61	40927	039E		Time signal 61 selection	RW	
A62	40929	03A0		Time signal 62 selection	RW	
A63	40931	03A2		Time signal 63 selection	RW	
A64	40933	03A4		Time signal 64 selection	RW	
TRN	40935	03A6	_TRN	Transmission output function	RW	
TRH	40937	03A8	_TRH	Transmission output scaling upper limit	RW	
TRL	40939	03AA	_TRL	Transmission output scaling lower limit	RW	
ERU	40941	03AC	ERUN	Select an external operation	RW	0 : OFF 1 : ON
LOC	40943	03AE	_LOC	Key lock setting	RW	0 : OFF 1 : ON
PRT	40945	03B0	_PRT	Communication protocol	R	
COM	40947	03B2	_COM	Communication parameter	R	R / W of communication parameter settings Example) B8N2 ※2
BPS	40949	03B4	_BPS	Communication speed	R	12:1200bps 24:2400bps 48:4800bps 96:9600bps 192:19200bps
ADR	40951	03B6	_ADR	Communication address	R	
AWT	40953	03B8	_AWT	Response delay time	RW	

※1 "□" in "Step □ Temperature setting" is calculated by the following formula.

"□" = ("Pattern No." x "Number of steps") + "Step No."

※2 When the MODBUS protocol (RTU / ASCII mode) is selected, the BCC check is sent as "space (0x20)".

8.4 Control setting mode

Identifier	Absolute Address	Relative Address	Character	Name	Command	Description
CNT	41025	0400	<u>CNT</u>	Control type	RW	
OU1	41027	0402	<u>OUT1</u>	OUT1 function	RW	
OU2	41029	0404	<u>OUT2</u>	OUT2 function	RW	
P11	41031	0406	<u>P11</u>	Main control proportional band low temperature	RW	
P12	41033	0408	<u>P12</u>	Main control proportional band middle temperature	RW	
P13	41035	040A	<u>P13</u>	Main control proportional band high temperature	RW	
□I1	41037	040C	<u>I1</u>	Integration time low temperature	RW	
□I2	41039	040E	<u>I2</u>	Integration time middle temperature	RW	
□I3	41041	0410	<u>I3</u>	Integration time high temperature	RW	
□D1	41043	0412	<u>D1</u>	Differentiation time low temperature	RW	
□D2	41045	0414	<u>D2</u>	Differentiation time middle temperature	RW	
□D3	41047	0416	<u>D3</u>	Differentiation time high temperature	RW	
AS1	41049	0418	<u>AT1</u>	AT set temperature low temperature	RW	
AS2	41051	041A	<u>AT2</u>	AT set temperature middle temperature	RW	
AS3	41053	041C	<u>AT3</u>	AT set temperature high temperature	RW	
AT1	41055	041E	<u>AT1</u>	AT Start/Stop low temperature	RW	0:AT Stop 1:AT Start
AT2	41057	0420	<u>AT2</u>	AT Start/Stop middle temperature	RW	
AT3	41059	0422	<u>AT3</u>	AT Start/Stop high temperature	RW	
PM1	41061	0424	<u>PM1</u>	PID range midpoint 1	RW	
PM2	41063	0426	<u>PM2</u>	PID range midpoint 2	RW	
P21	41065	0428	<u>P21</u>	Sub-control proportional band low temperature	RW	
P22	41067	042A	<u>P22</u>	Sub-control proportional band middle temperature	RW	
P23	41069	042C	<u>P23</u>	Sub-control proportional band high temperature	RW	

Identifier	Absolute Address	Relative Address	Character	Name	Command	Description
□C1	41071	042E	_ C1	Main control ON/OFF sensitivity	RW	
CP1	41073	0430	_CP1	Main control ON/OFF off-point position	RW	
FD1	41075	0432	FDT1	Main control protection OFF timer	RW	
□C2	41077	0434	_ C2	Sub-control ON/OFF sensitivity	RW	
CP2	41079	0436	_DT2	Sub-control ON/OFF off-point position	RW	
FD2	41081	0438	FDT2	Sub-control protection OFF timer	RW	
□DB	41083	043A	_ DB	Dead band	RW	

8.5 Alarm temperature setting mode

Identifier	Absolute Address	Relative Address	Character	Name	Command	Description
AL1	41281	0500	ALL1	Event Output 1 lower limit	RW	
AH1	41283	0502	ALH1	Event Output 1 upper limit	RW	
AL2	41285	0504	ALL2	Event Output 2 lower limit	RW	
AH2	41287	0506	ALH2	Event Output 2 upper limit	RW	

8.6 Other

Identifier	Absolute Address	Relative Address	Character	Name	Command	Description
STR	44097	1000		Store instruction	W	
RUN	44099	1002		Operation command	RW	0:Stop 1:Start ※1

※1 When the external operation selection setting is "ON: external operation", it cannot be changed by the write command.

9. List of ASCII Codes

Upper Lower	00h	10h	20h	30h	40h	50h	60h	70h
00h	NUL	DLE	Space	0	@	P	`	p
01h	SOH	DC1	!	1	A	Q	a	q
02h	STX	DC2	"	2	B	R	b	r
03h	ETX	DC3	#	3	C	S	c	s
04h	EOT	DC4	\$	4	D	T	d	t
05h	ENQ	NAK	%	5	E	U	e	u
06h	ACK	SYN	&	6	F	V	f	v
07h	BEL	ETB	'	7	G	W	g	w
08h	BS	CAN	(	8	H	X	h	x
09h	HT	EM	)	9	I	Y	i	y
0Ah	LF	SUB	*	:	J	Z	j	z
0Bh	VT	ESC	+	;	K	[	k	{
0Ch	FF	FS	,	<	L	¥	l	|
0Dh	CR	GS	-	=	M	]	m	}
0Eh	SO	RS	.	>	N	^	n	~
0Fh	SI	US	/	?	O	_	o	DEL

※How to Use the ASCII Code Table:
 (ASCII Code) = (Upper) + (Lower)

Example 1: If "A": (41h) = (40h) + (01h)

Example 2: If "m": (6Dh) = (60h) + (0Dh)

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