

This manual contains instructions for communication functions of the KT4R.

To prevent accidents arising from the misuse of this controller, please ensure the operator receives this manual.
For model number and basic operation, please read the User's Manual for the KT4R.



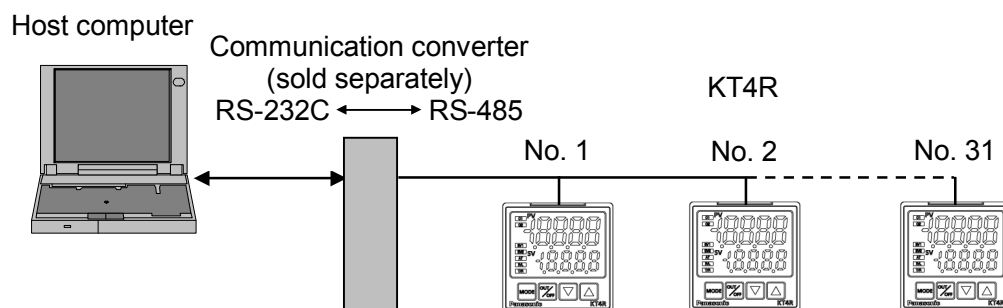
Warning

Turn the power supply to the instrument off before wiring or checking.

Working on or touching the terminal with the power switched on may result in severe injury or death due to electric shock.

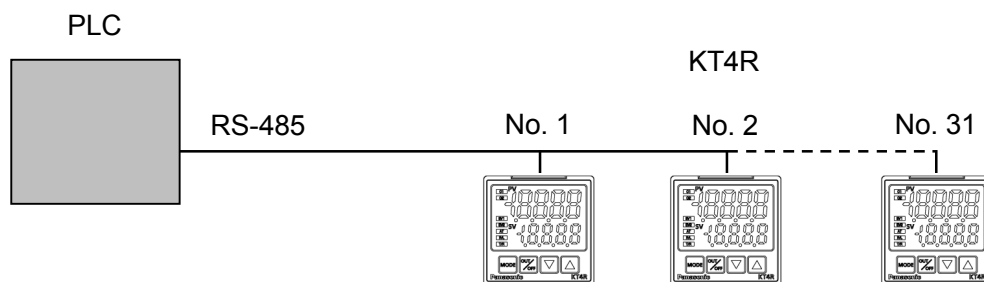
1. System Configuration

1.1 When Using Communication Converter (sold separately)



(Fig. 1.1-1)

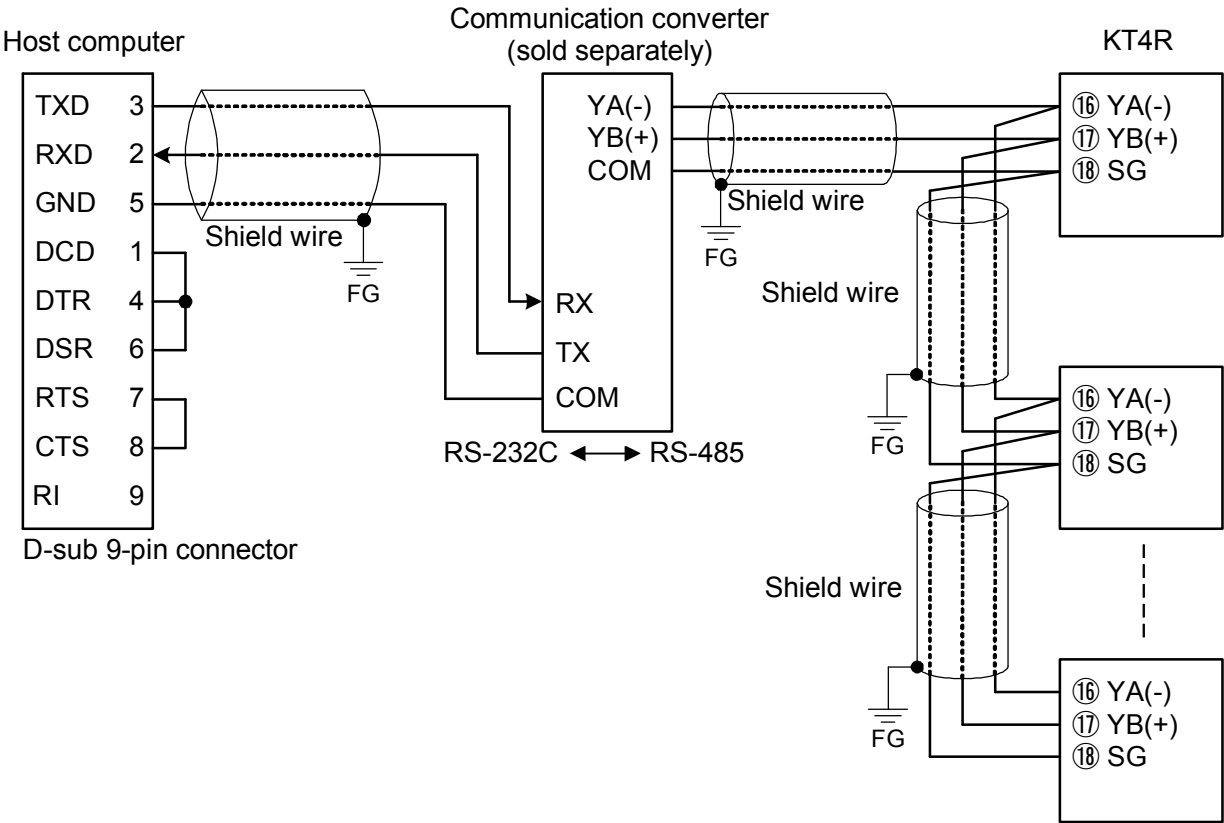
1.2 When Using a PLC



(Fig. 1.2-1)

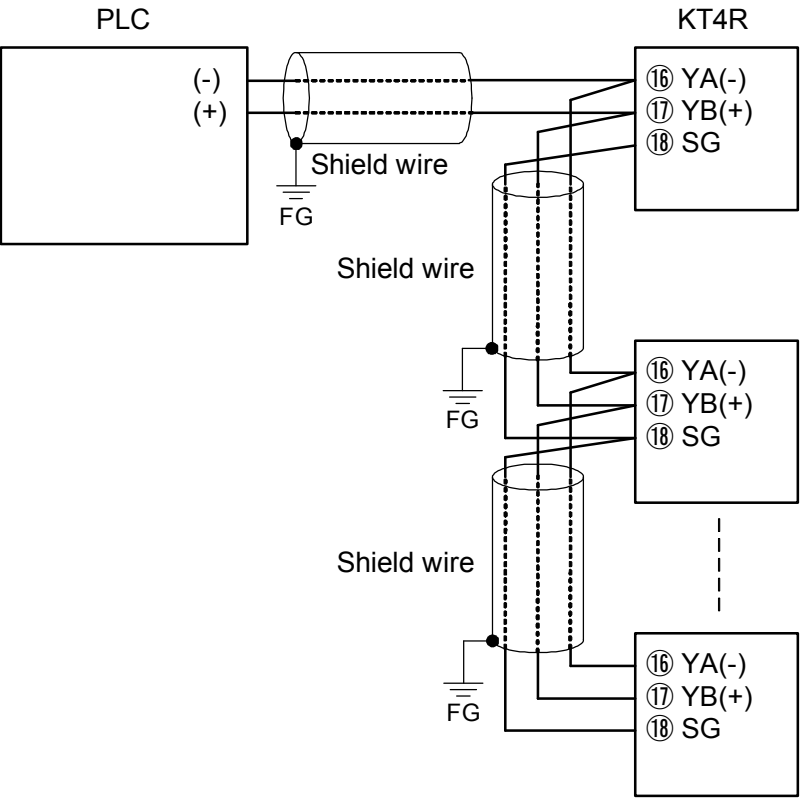
2. Wiring

2.1 When Using Communication Converter (sold separately)



(Fig. 2.1-1)

2.2 When Using a PLC (RS-485)



(Fig. 2.2-1)

Shield wire

Connect only one end of the shield wire to the FG terminal so that current cannot flow to the shield wire.

If both ends of the shield wire are connected to the FG terminal, the circuit will be closed between the shield wire and the ground. As a result, current will run through the shield wire, and this may cause noise.

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)

The terminator is mounted at the end of the wire when connecting a personal computer to multiple peripheral devices. The terminator prevents signal reflection and disturbance.





It is not necessary to connect a terminator to the communication line because the KT4R has built-in pull-up and pull-down resistors.

For communication between the PLC and KT4R, terminators are not necessary. However, to reduce the risk of reflection, connect a terminator to the PLC side.

Use a terminator of 120 Ω or more.

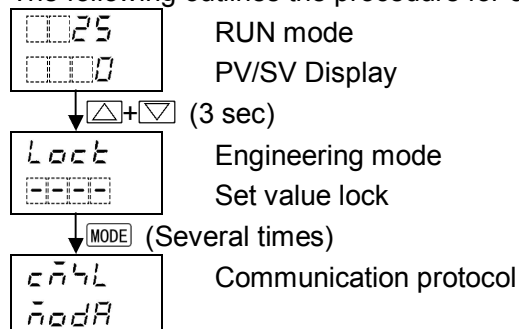
3. Setting Communication Parameters

Set communication parameters in Engineering mode.

To enter Engineering mode, press and hold the  and  keys (in that order) for approx. 3 seconds in RUN mode. Use the  or  key for settings (or selections).

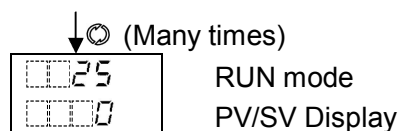
To register the set data, use the  key.

The following outlines the procedure for communication parameter setting.



Characters, Factory Default	Setting Item, Function, Setting Range	
cñ4L ñodr	Communication protocol	
	<ul style="list-style-type: none"> Selects the communication protocol. Selection item: 	
	ñEÜΓ	MEWTOCOL
	ñodr	Modbus ASCII
	ñodr	Modbus RTU
	ēñdr	Modbus ASCII (KT4 command allocation)
cñno 001	Instrument number	
	<ul style="list-style-type: none"> Sets the instrument number. The instrument numbers should be set one by one when multiple instruments are connected in Serial communication, otherwise communication is not possible. Setting range: 1 to 95 [Do not use 0 (zero) – 0 cannot be used as an instrument number.] 	
cñ4P 096	Communication speed	
	<ul style="list-style-type: none"> Selects a communication speed equal to that of the host computer. Selection item: 	
	096	9600 bps
	092	19200 bps
cñFΓ 7EÜn	Data bit/Parity	
	<ul style="list-style-type: none"> Selects the data bit and parity. Selection item: 	
	8non	8 bits/No parity
	7non	7 bits/No parity
	8EÜn	8 bits/Even
	7EÜn	7 bits/Even
	8odd	8 bits/Odd
	7odd	7 bits/Odd

Characters, Factory Default	Setting Item, Function, Setting Range	
	Stop bit	
	<ul style="list-style-type: none"> • Selects the stop bit. • Selection item: 	
		1 bit
		2 bits
	Response delay time <ul style="list-style-type: none"> • Response from the controller can be delayed after receiving command from the host computer. • Setting range: 0 to 1000 ms 	



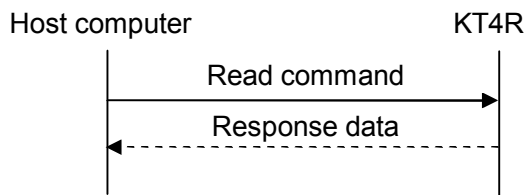
Now, settings are complete.

4. MEWTOCOL

4.1 Communication Procedure

Communication starts with command transmission from the host computer, and ends with the response of the KT4R (controller).

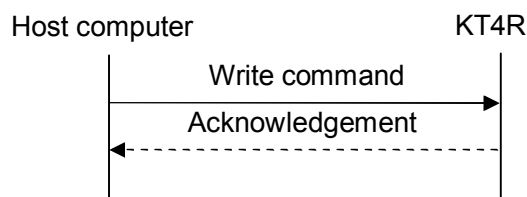
4.1.1 Response with Data



(Fig. 4.1.1-1)

When the host computer sends the Read command, the KT4R responds with the corresponding set value or current status.

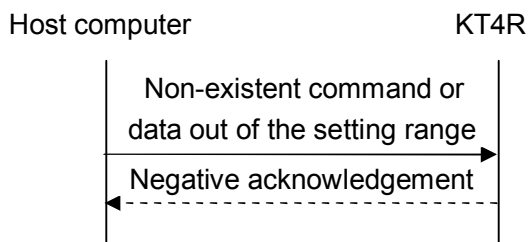
4.1.2 Acknowledgement



(Fig. 4.1.2-1)

When the host computer sends the Write command, the KT4R responds by sending acknowledgement after processing is terminated.

4.1.3 Negative Acknowledgement



(Fig. 4.1.3-1)

When the host computer sends a non-existent command or value out of the setting range, the KT4R returns a negative acknowledgement.

4.2 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 character or more 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 a 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 (p.5.)] within a range of 0 to 1000 ms.

4.3 Data Format

Data format is shown below.

Start bit	B1	B2	B3	B4	B5	B6	B7	B8	Parity	Stop bit
-----------	----	----	----	----	----	----	----	----	--------	----------

Start bit	1 bit
Data bit	7 bits/8 bits
Parity	Even parity/Odd parity/No parity
Stop bit	1 bit/2 bits

4.4 Command Structure

All commands are composed of ASCII, and have the following structures.

Numerals written above the command represent the number of characters.

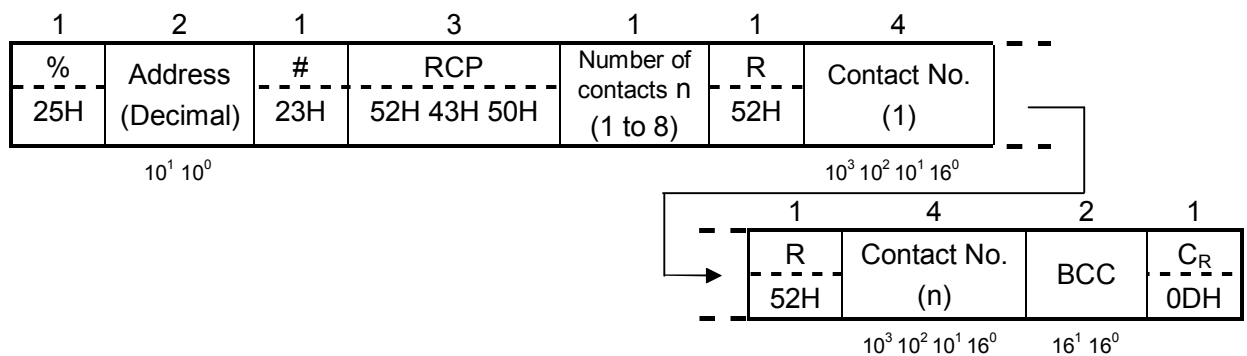
4.4.1 RCP Command Structure

Contact Area Read

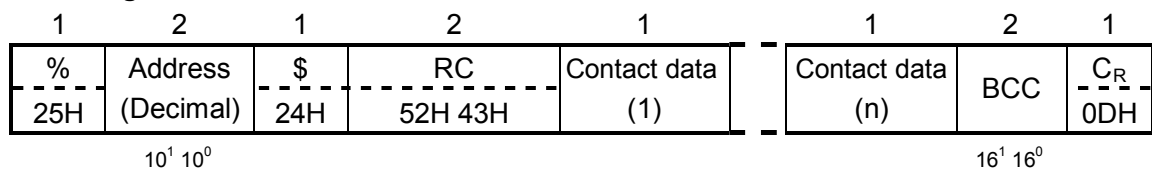
Reads ON/OFF status of multiple contacts (R only).

8 points to 1 command can be specified.

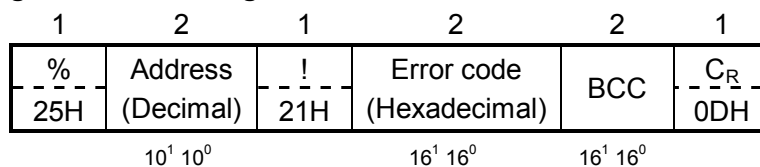
Command



Acknowledgement



Negative acknowledgement



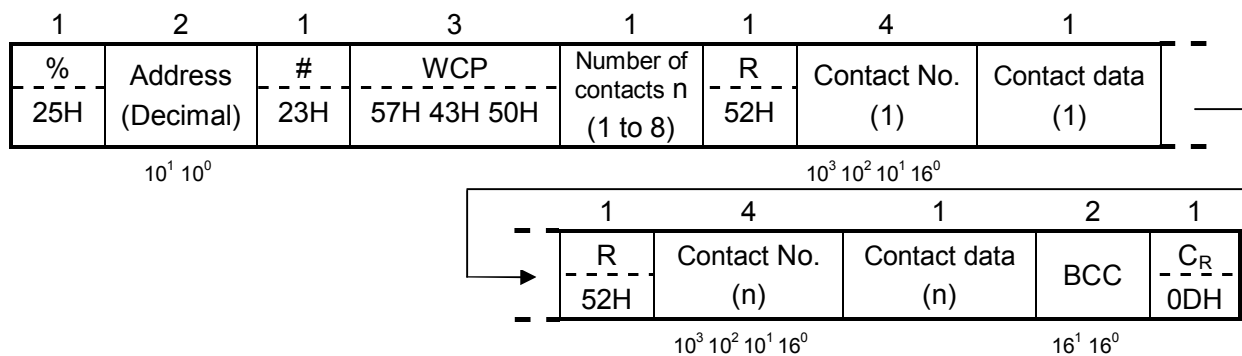
4.4.2 WCP Command Structure

Contact Area Write

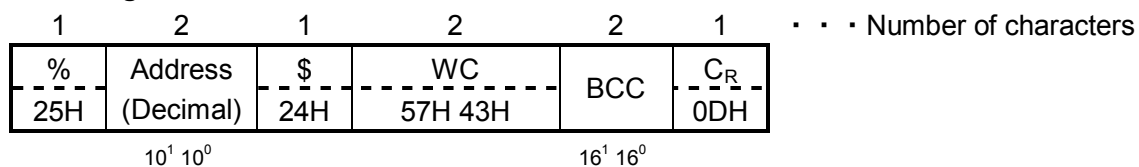
Multiple contacts (R only) are set to ON/OFF.

8 points to 1 command can be specified.

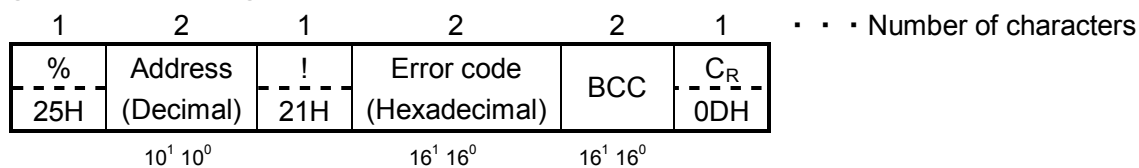
Command



Acknowledgement



Negative acknowledgement

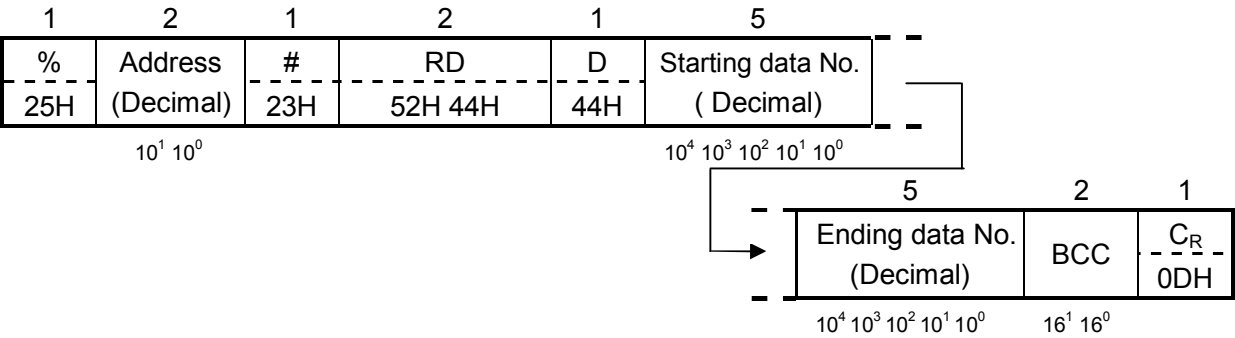


4.4.3 RD Command Structure

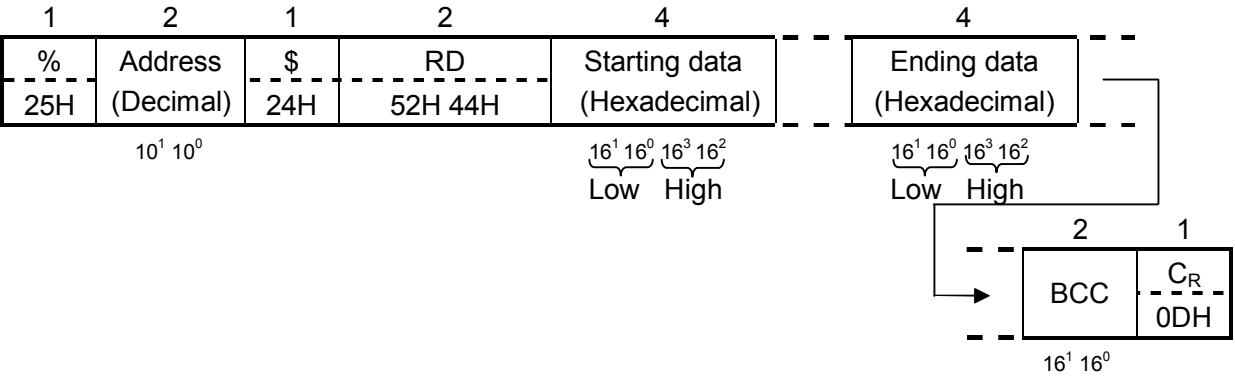
Data Area Read

Reads contents of data area (DT area only).
16 pieces of data to 1 command can be specified.

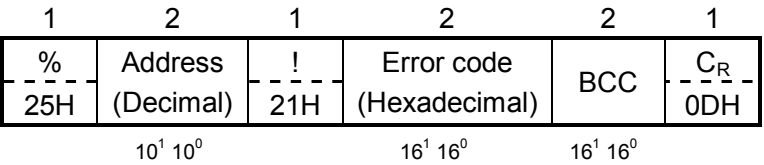
Command



Acknowledgement



Negative acknowledgement



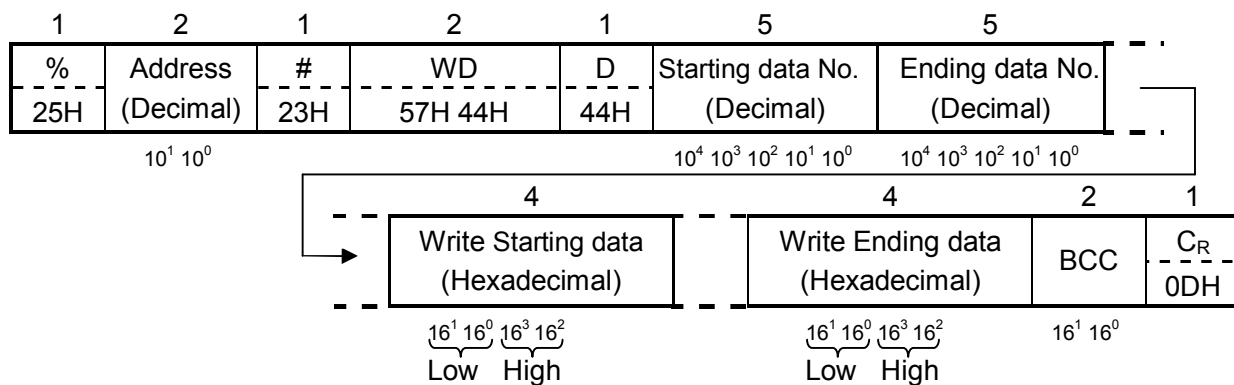
4.4.4 WD Command Structure

Data Area Write

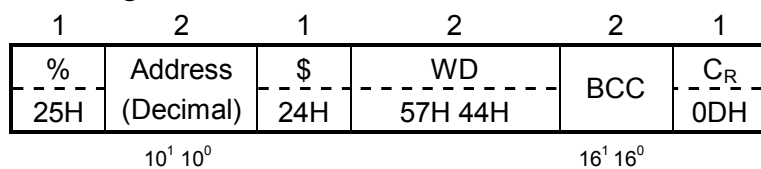
Writes data to data area (DT area only).

16 pieces of data to 1 command can be specified.

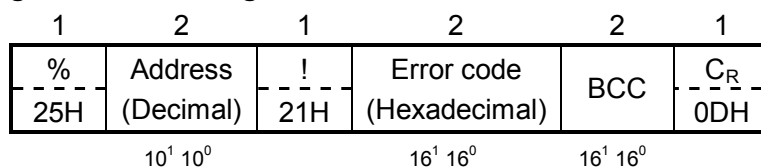
Command



Acknowledgement



Negative acknowledgement



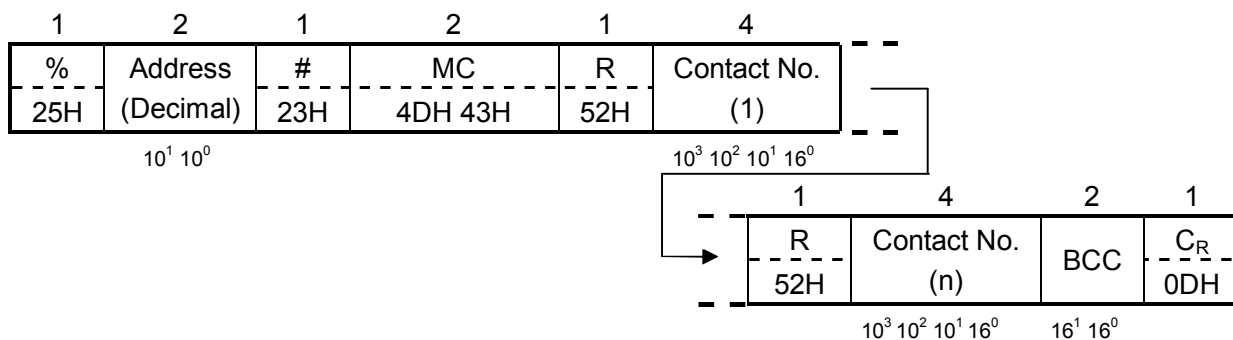
4.4.5 MC Command Structure

Monitor Contact Register/Reset

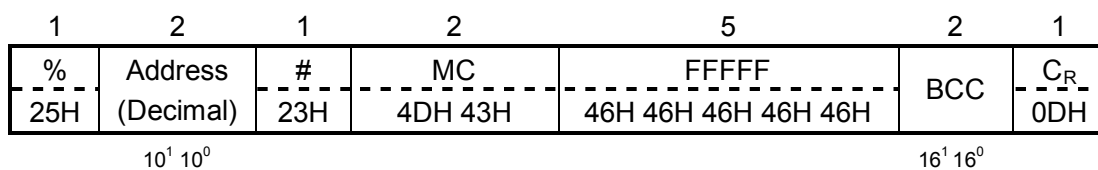
Registers contact (R only) to be monitored.

Up to 16 contacts can be registered.

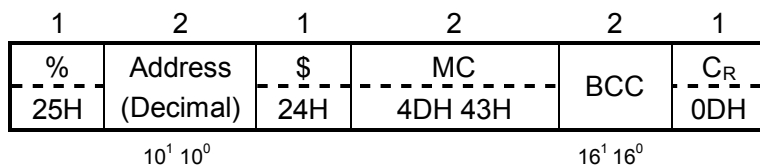
Command



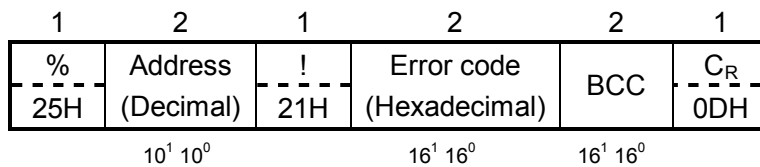
Reset



Acknowledgement



Negative acknowledgement



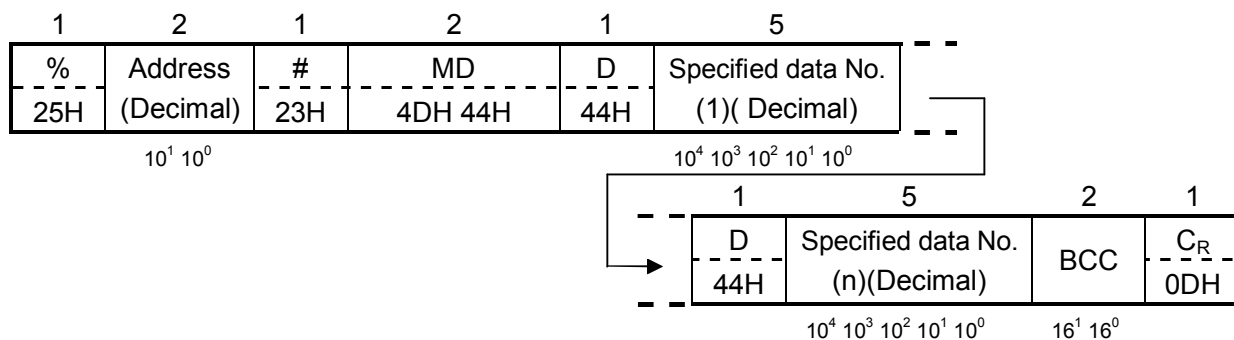
4.4.6 MD Command Structure

Monitor Data Register/Reset

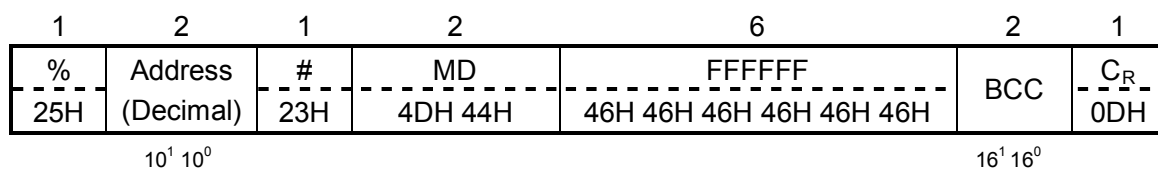
Registers data (DT only) to be monitored.

Up to 16 pieces of data can be registered.

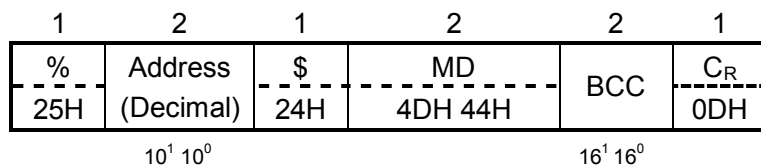
Command



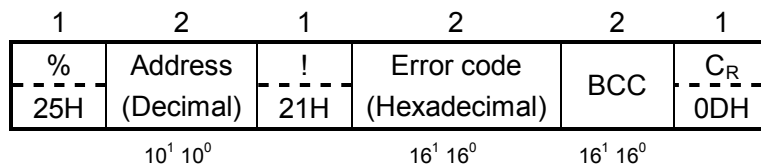
Reset



Acknowledgement



Negative acknowledgement

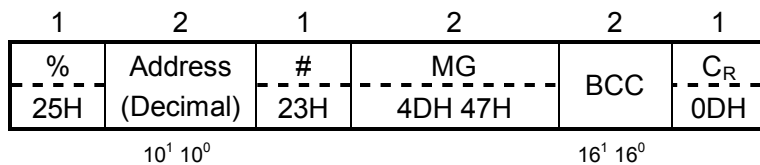


4.4.7 MG Command Structure

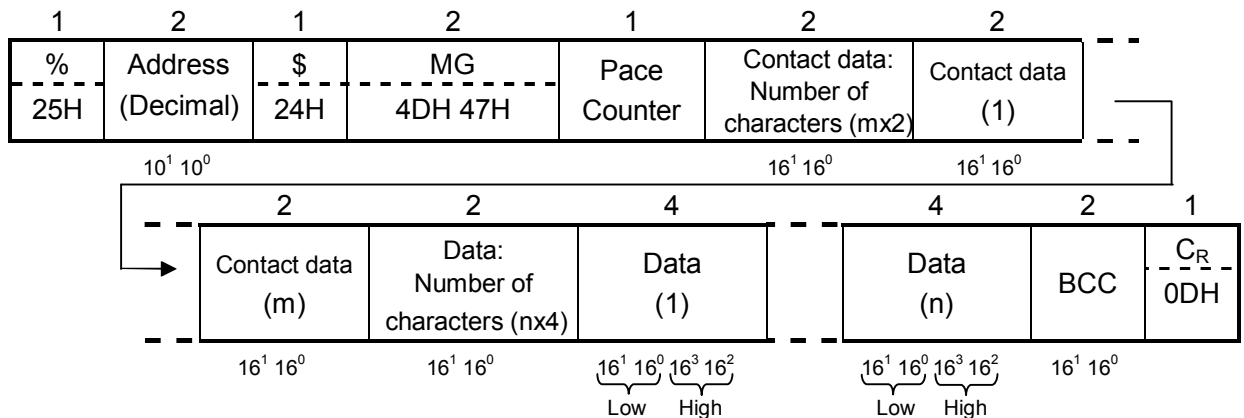
Monitor Data Execute

Monitors registered contacts or data.

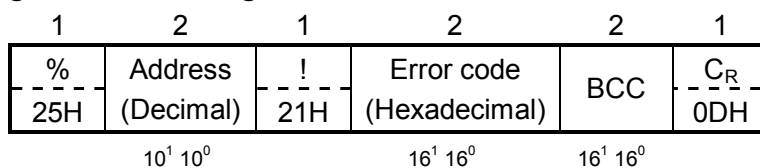
Command



Acknowledgement



Negative acknowledgement



Notice

To execute Monitor data with the MG command, register the Monitor contact and Monitor data using the MC command (Monitor contact register) and the MD command (Monitor data register) beforehand.

If Monitor data is not registered and is executed with the MG command, it will result in negative acknowledgement, and Error code 62H will be returned.

Header: Represents the beginning of the command and the response.
ASCII % (25H) is used.

Address (Instrument number): Numbers by which the master discerns each slave.

Instrument numbers 1 to 95 (2-digit decimal) and Global addresses EE and FF are used.
By using the Global address, the same command can be sent to all connected slaves.
For the Global address EE, EE is appended to the address of response command.
For the Global address FF, a response is not returned.

Command: Codes to discern message are described below.

ASCII	Name	Description
#(23H)	Command	Represents command message.
\$(24H)	Response (normal)	Represents normal response message.
!(21H)	Response (error)	Represents response message when an error has occurred.

Command code: 4 types of command code are listed below.

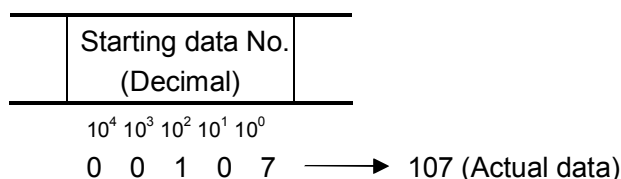
Command Code	Contents	Description
RCP	Contact Area Read (multiple points)	Reads ON/OFF status of multiple contacts (R only). Up to 8 points to 1 command can be specified.
WCP	Contact Area Write (multiple points)	Multiple contacts (R only) are set to ON/OFF. Up to 8 points to 1 command can be specified.
RD	Data Area Read	Reads the contents of data area (DT area only). Up to 16 pieces of data to 1 command can be specified.
WD	Data Area Write	Writes data to data area (DT area only). Up to 16 pieces of data to 1 command can be specified.
MC	Monitor Contact Register/Reset	Registers contact (R only) to be monitored. Up to 16 contacts can be registered.
MD	Monitor Data Register/Reset	Registers data (DT only) to be monitored. Up to 16 pieces of data can be registered.
MG	Monitor Data Execute	Monitors registered contact or data.

Data code: Specifies data register DT.
ASCII D (44H) is used.

Data: Composed of 5-digit decimal, 4-digit hexadecimal, or '3-digit decimal+1-digit hexadecimal', expressed using ASCII.
Negative numbers are represented in 2's complement.

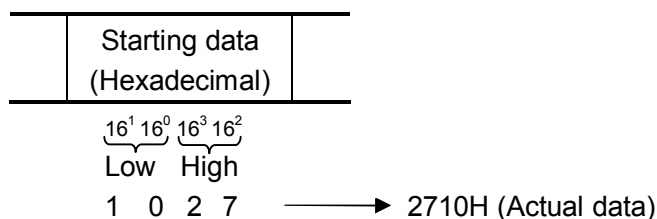
Decimal data

(e.g.) Starting data No. of Data area Read (RD) command



Hexadecimal data

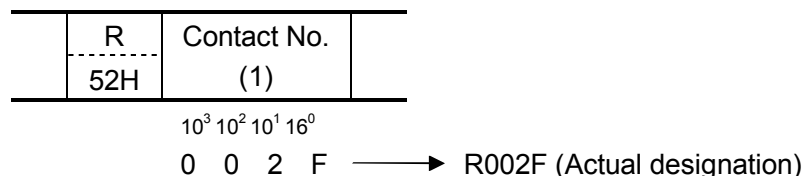
(e.g.) Starting data of Data area Read (RD) acknowledgement



Decimal + Hexadecimal data

For the Contact No. of the contact (R), the least significant digit is expressed in hexadecimal, and other higher digits are expressed in decimal.

(e.g.) Specifying Contact No. of Contact area Read (RCP) command



BCC: BCC (Block check code) is a code to detect transmission errors.
Using horizontal parity, XOR is calculated from the header through the last text character, and is expressed in ASCII.

Terminator: Represents the end of command.
ASCII C_R(0DH) is used.

Error code: Represents an error type using ASCII.

Error code	Description
40H	BCC error
41H	Format error, #, non-existent data item
42H	Not-support command
43H	Procedure error, Delimiter (&) error
60H	Any data code except D, Any contact except R
61H	Data error (data item is not correct)
62H	Registration error
63H	Mode error

4.5 Example of BCC (Block Check Code) Calculation

(e.g.) % 01 # RD D 00101 00107

%	25H
0	30H
1	31H
#	23H
R	52H
D	44H
D	44H
0	30H
0	30H
1	31H
0	30H
1	31H
0	30H
0	30H
1	31H
0	30H
7	37H

53H (Exclusive OR)



Converts to ASCII. BCC (H) = 5 (35H), BCC (L) = 3 (33H)



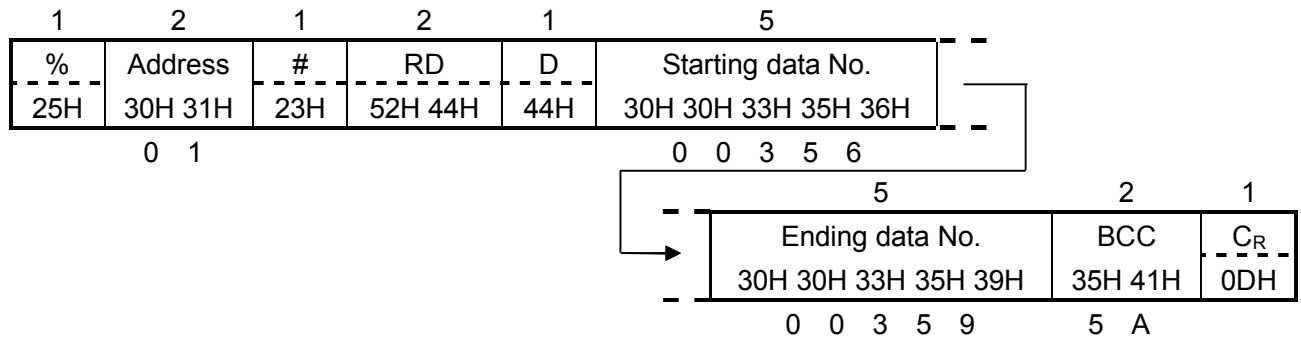
% 01 # RD D 00101 00107 53 C_R

4.6 Command Example

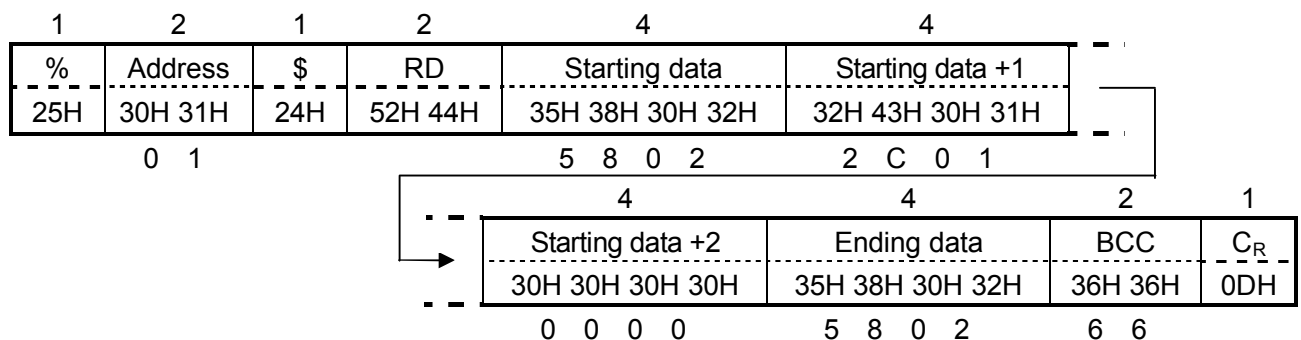
Numerals written above the command represent the number of characters.

4.6.1 Read (Address 1, PV, OUT1 MV, OUT2 MV, Current SV)

• Read command from the master

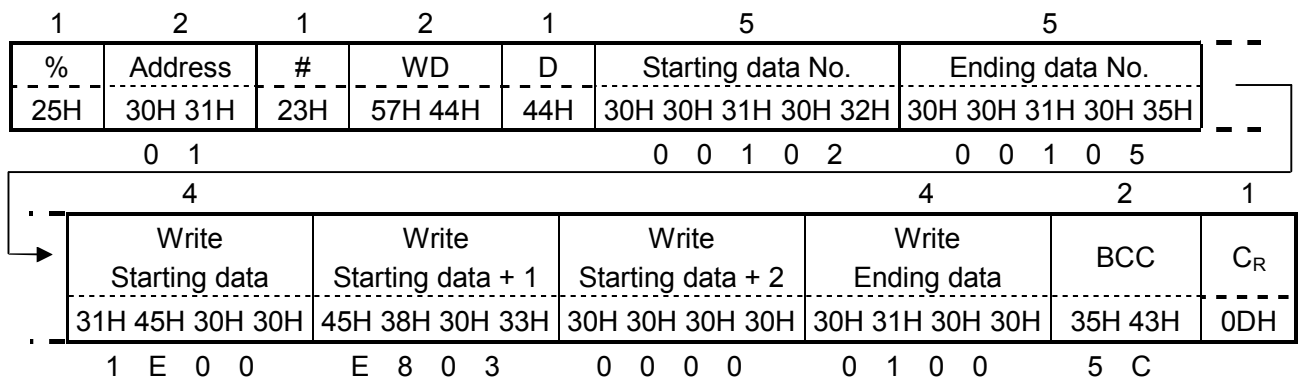


• A response from the slave in normal status [PV: 600°C (0258H), OUT1 MV: 30.0% (012CH), OUT2 MV: 0.0% (0000H), Current SV: 600°C (0258H)]

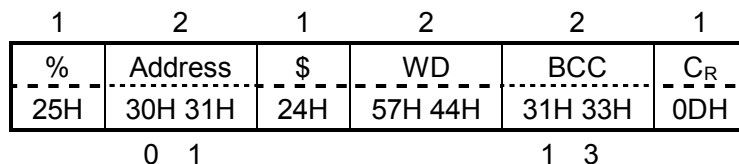


4.6.2 Write (Address 1, Input type, Scaling high limit, Scaling low limit, Decimal point place)

• Write command from the master [Input type: 4 to 20 mA DC (001EH), Scaling high limit: 1000 (03E8H), Scaling low limit: 0 (0000H), Decimal point place: 1 digit after decimal point (0001H)]

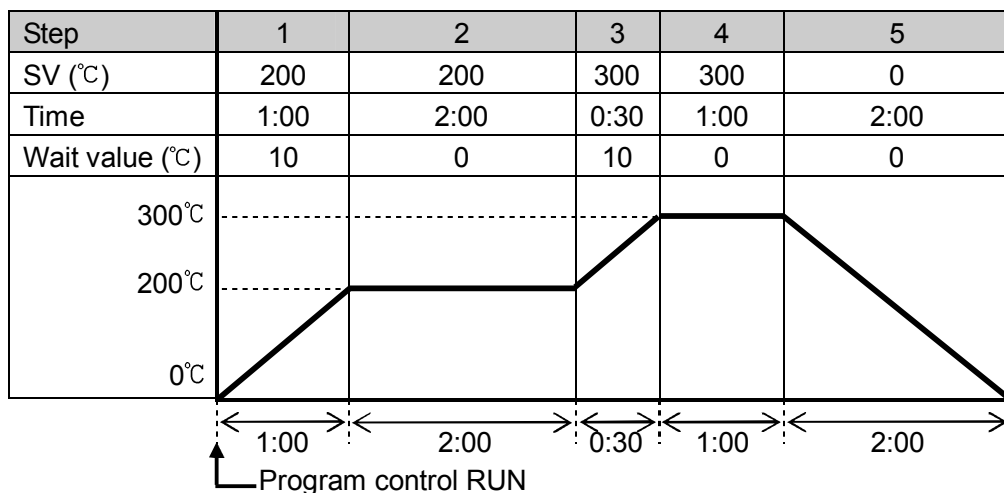


• A response from the slave in normal status



4.6.3 Write (Address 1, Program pattern data)

Program pattern setting example



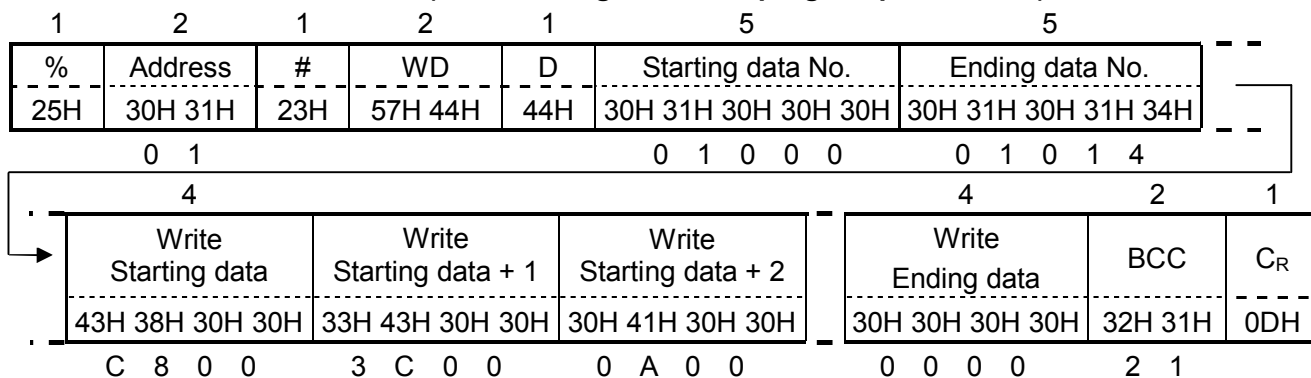
(Fig. 4.6.3-1)

When writing the above program pattern, command data section converts to the following.

Data: Data in the following table is converted to Hexadecimal.

MEWTOCOL	Data Item	Data	Data (Converted to Hexadecimal)
DT01000	1000H Step 1 SV	200°C	00C8H
DT01001	1001H Step 1 time	60 minutes (1:00)	003CH
DT01002	1002H Step 1 wait value	10°C	000AH
DT01003	1003H Step 2 SV	200°C	00C8H
DT01004	1004H Step 2 time	120 minutes (2:00)	0078H
DT01005	1005H Step 2 wait value	0°C	0000H
DT01006	1006H Step 3 SV	300°C	012CH
DT01007	1007H Step 3 time	30 minutes (0:30)	001EH
DT01008	1008H Step 3 wait value	10°C	000AH
DT01009	1009H Step 4 SV	300°C	012CH
DT01010	100AH Step 4 time	60 minutes (1:00)	003CH
DT01011	100BH Step 4 wait value	0°C	0000H
DT01012	100CH Step 5 SV	0°C	0000H
DT01013	100DH Step 5 time	120 minutes (2:00)	0078H
DT01014	100EH Step 5 wait value	0°C	0000H

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

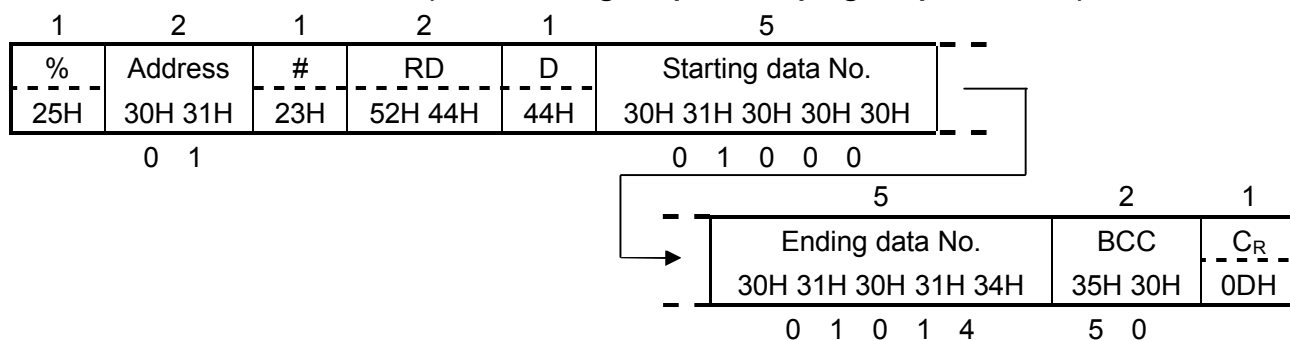


• Response from the slave in normal status

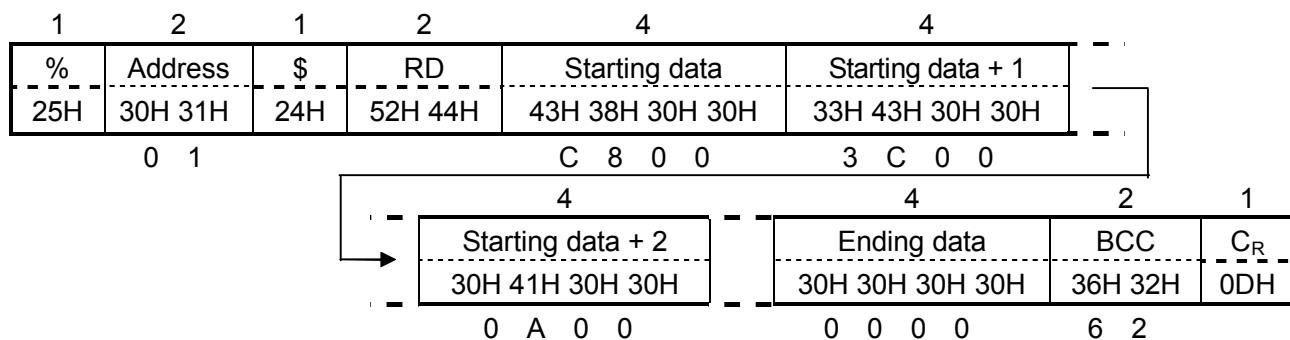
1		2		1		2		2		1	
%	Address	\$	WD	BCC		C _R					
25H	30H 31H	24H	57H 44H	31H 33H		0DH					
0 1				1 3							

4.6.4 Read (Address 1, program pattern data)

- Read command from the master (when reading the previous program pattern data)



- Response from the slave in normal status



Response data section converts to the following.

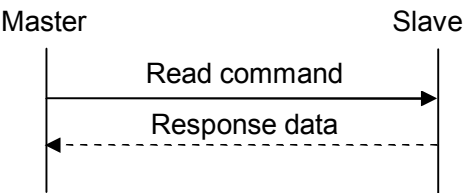
MEWTOCOL	Data Item		Data	Data (Converted to Hexadecimal)
DT01000	1000H	Step 1 SV	200°C	00C8H
DT01001	1001H	Step 1 time	60 minutes (1:00)	003CH
DT01002	1002H	Step 1 wait value	10°C	000AH
DT01003	1003H	Step 2 SV	200°C	00C8H
DT01004	1004H	Step 2 time	120 minutes (2:00)	0078H
DT01005	1005H	Step 2 wait value	0°C	0000H
DT01006	1006H	Step 3 SV	300°C	012CH
DT01007	1007H	Step 3 time	30 minutes (0:30)	001EH
DT01008	1008H	Step 3 wait value	10°C	000AH
DT01009	1009H	Step 4 SV	300°C	012CH
DT01010	100AH	Step 4 time	60 minutes (1:00)	003CH
DT01011	100BH	Step 4 wait value	0°C	0000H
DT01012	100CH	Step 5 SV	0°C	0000H
DT01013	100DH	Step 5 time	120 minutes (2:00)	0078H
DT01014	100EH	Step 5 wait value	0°C	0000H

5. Modbus Protocol

5.1 Communication Procedure

Communication starts with command transmission from the host computer (master), and ends with the response of the KT4R (slave).

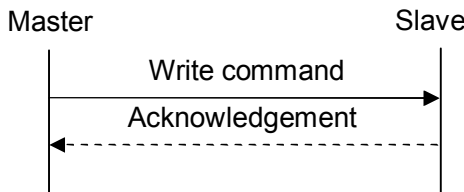
5.1.1 Response with Data



(Fig. 5.1.1-1)

When the master sends the Read command, the slave responds with the corresponding set value or current status.

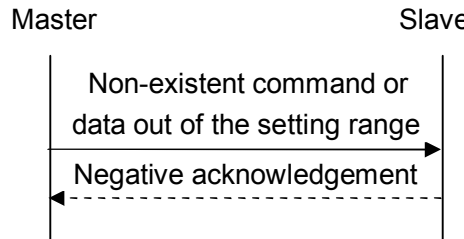
5.1.2 Acknowledgement



(Fig. 5.1.2-1)

When the master sends the Write command, the slave responds by sending acknowledgement after processing is terminated.

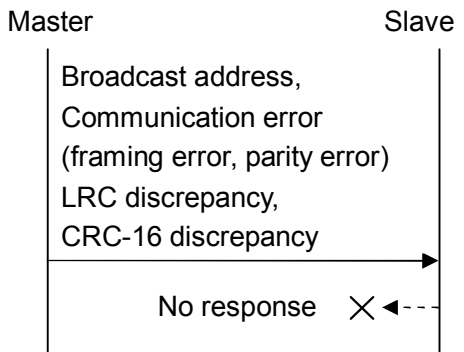
5.1.3 Negative Acknowledgement



(Fig. 5.1.3-1)

When the master sends a non-existent command or value out of the setting range, the slave returns negative acknowledgement.

5.1.4 No Response



(Fig. 5.1.4-1)

The slave will not respond to the master in the following cases:

- Broadcast address
- Communication error (framing error, parity error)
- LRC discrepancy (Modbus ASCII mode)
- CRC-16 discrepancy (Modbus RTU mode)

5.2 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 character or more 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 a response to ensure synchronization on the receiving side.

The slave is arranged so as to disconnect the transmitter from the communication line within 1 character transmission period, after sending the response.

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

5.3 Transmission Mode

There are 2 transmission modes (ASCII and RTU) in Modbus protocol, which have the following structure.

5.3.1 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 (Odd, No parity) Selectable
 Stop bit: 1 bit (2 bits) Selectable
Error detection: LRC (Longitudinal Redundancy Check)

5.3.2 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)

5.4 Data Communication Interval

5.4.1 ASCII Mode

No communication interval limit between characters

5.4.2 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 μ s)

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 KT4R assumes that transmission from the master is finished, which results in a communication error, and will not return a response.

5.5 Message Configuration

5.5.1 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)
---------------	------------------	------------------	------	--------------------	-------------------	-------------------

5.5.2 RTU Mode

RTU mode is configured to start after idle time is processed for more than 3.5 character transmissions, and end after idle time is processed for more than 3.5 character transmissions. (Communication speed 9600 bps, 19200 bps: 1.5 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 Field

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.

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

(2) Function Code Field

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)	Status unable to be written. [(e.g.) AT is performing.]
18 (12H)	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 a number of bytes, 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.35 to 51).

(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.

5.6 Message Example

5.6.1 ASCII Mode

Numerals written below the command represent the number of characters.

(1) Read [Slave address 1, PV]

- A request message from the master

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

- Response message from the slave in normal status [When PV is 600°C (0258H)]

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

(2) Write (Slave address 1, SV1)

- A request message from the master [When SV1 is set to 600°C (0258H)]

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

- Response message from the slave in normal status

Header	Slave address	Function code	Data item	Data	Error check	Delimiter
(3AH)	(30H 31H)	(30H 36H)	[0001H] (30H 30H 30H 31H)	[0258H] (30H 32H 35H 38H)	LRC (39H 45H)	CR+LF (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, and [86H (38H, 36H)] is returned. Exception code 03H [(30H, 33H, Value out of the setting range) is returned (error).

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

(3) Read (Slave address 1, SV1)

- A request message from the master

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

- Response message from the slave in normal status [When SV1 is 600°C (0258H)]

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

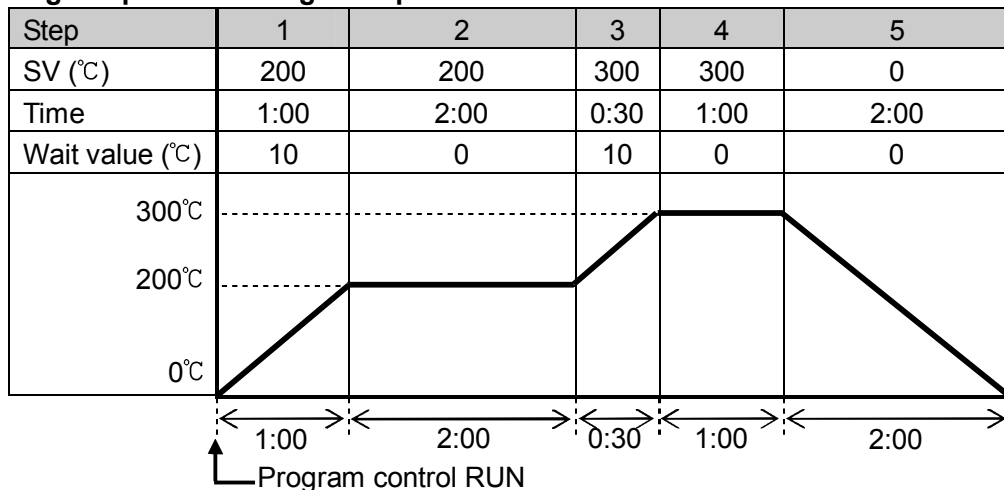
- Response message from the slave in exception (error) status (When a data item is misread)

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

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

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

Program pattern setting example



(Fig. 5.6.1-1)

When writing the above program pattern, message data section converts to the following.

Amount of data: 15 (000FH)

Number of bytes: 30 (1EH)

Data: Data in the following table is converted to Hexadecimal.

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

• 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 (32H 45H)	Delimiter CR+LF (0DH 0AH)
2	2

- Response message from the slave in normal status

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

(5) Read (Slave address 1, Multiple pieces of program pattern data)

- A request message from the master (When reading the previous program pattern data)

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

- Response message from the slave in normal status

Header (3AH)	Slave address (30H 31H)	Function code (30H 33H)	Number of response bytes [1EH] (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 (35H 41H)	Delimiter CR+LF (0DH 0AH)
2	2

Response message data section converts to the following.

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

5.6.2 RTU Mode

Numerals written below the command represent the number of characters.

(1) Read (Slave address 1, PV)

- 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°C (0258H)]

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

(2) Write (Slave address 1, SV1)

- A request message from the master [When SV1 is set to 600°C(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.

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]

- 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°C (0258H)]

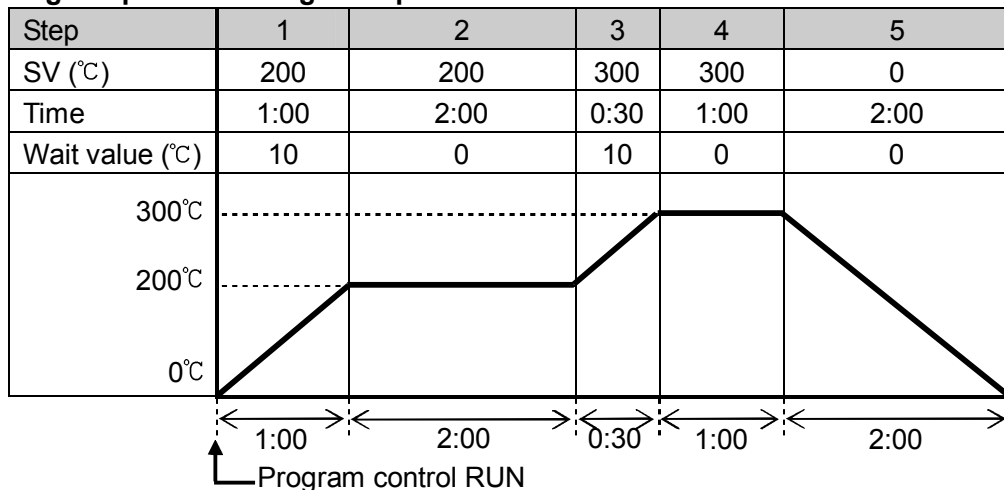
3.5 idle characters	Slave address (01H)	Function code (03H)	Number of response bytes (02H)	Data (0258H)	Error check CRC-16 (B8DEH)	3.5 idle characters
	1	1	1	2	2	

- Response message from the slave in exception (error) status (When a data item is misread)
The function code MSB is set to 1 for the response message in exception (error) status, and 83H is returned. 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, multiple pieces of program pattern data)

Program pattern setting example



(Fig. 5.6.2-1)

When writing the above program pattern, message data section converts to the following.

Amount of data: 15 (000FH)

Number of bytes: 30 (1EH)

Data: Data in the following table is converted to Hexadecimal.

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

- 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, Multiple pieces of program pattern data)

- Request message from the master (when reading the previous program pattern data)

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)	Number of response bytes (1EH)
	1	1	1

Data
(00C8003C000A00C800780000012C001E000A012C003C0000000000780000H)
30

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

Response message data section converts to the following.

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

5.7 Self-diagnostic Function

In Modbus protocol, the following Self-diagnostic functions are included.

- Echoes back the request message.
- Reads device identification information.

5.7.1 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 Field

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.

The Self-diagnostic function does not work for Broadcast address 0 (00H).

(2) Function Code Field

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

Type	Function Code	Sub-Function Code	Contents
Diagnostics	08 (08H)	00 (0000H)	Echoes back a request message.
	43 (2BH)	14 (0EH)	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 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 Function code 08 (08H), the request message from the master 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 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	01/04H	
Object ID	1 byte	00	Vendor name (company name) Panasonic Industrial Devices SUNX Co., Ltd.
		01	Product code (model number) (e.g.) AKT4R1111001
		02	Version (Major Minor Revision) (e.g.) 010000

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

Function code		1 byte	2BH
Sub-function code (MEI type)		1 byte	0EH
Data	Read Device ID code	1 byte	01/04H
	Conformity level	1 byte	01/81H
	More Follows	1 byte	00/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	

(4) Error Check

16-bit data to detect communication errors

Refer to Section “5.5 Message Configuration (4) Error Check” (p.23),

5.7.2 Message Example

Message example in RTU mode is 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 (company 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 (Panasonic Industrial Devices SUNX Co., Ltd.)

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

	Data
	(0481000001002B50616E61736F6E696320496E647573747269616C
	50

	Data (Continued)	Error check CRC-16 (21CDH)	3.5 idle characters
	20446576696365732053554E5820436F2E2C204C74642EH)	2	

Data in the response message becomes the following.

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	43 (2BH)
	List of Object value	Object length	P (50H)
			a (61H)
			n (6EH)
			a (61H)
			s (73H)
			o (6FH)
			n (6EH)
			l (69H)
			c (63H)
			(20H)
			l (49H)
			n (6EH)
			d (64H)
			u (75H)
			s (73H)
			t (74H)
			r (72H)
			l (69H)
			a (61H)
			l (6CH)
			(20H)
			D (44H)
			e (65H)
			v (76H)
			l (69H)
			c (63H)
			e (65H)
			s (73H)
			(20H)
			S (53H)
			U (55H)
			N (4EH)
			X (58H)
			(20H)
			C (43H)
			o (6FH)
			. (2EH)
			, (2CH)
			(20H)
			L (4CH)
			t (74H)
			d (64H)
			. (2EH)

(3) Read [Slave address 1, Device identification information: Product code (model number)]

- 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 (AKT4R1111001)

3.5 idle characters	Slave address (01H)	Function code (2BH)	Sub-function code (0EH)			
	1	1	1			
				Data (0481000001010C414B54345231313131303031H)	Error check CRC-16 (8870H)	3.5 idle characters
				19	2	

Data in the response message becomes the following.

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	12 (0CH)
	List of Object value	Object length	A (41H)
			K (4BH)
			T (54H)
			4 (34H)
			R (52H)
			1 (31H)
			1 (31H)
			1 (31H)
			1 (31H)
			0 (30H)
			0 (30H)
			1 (31H)

- Response message from the slave in exception (error) status [when Sub-function code (MEI type) is not correct]

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	

6. Communication Command Table

Communication command can be selected in [Communication protocol].

If $\overline{MEWTOCOL}$ (MEWTOCOL), $\overline{Modbus\ ASCII}$ (Modbus ASCII) or $\overline{Modbus\ RTU}$ (Modbus RTU) is selected, communication commands on pages 35 to 47 can be used.

If $\overline{Modbus\ ASCII\ (KT4\ command\ allocation)}$ or $\overline{Modbus\ RTU\ (KT4\ command\ allocation)}$ is selected, KT4 command on pages 48 to 51 can be used.

6.1 MEWTOCOL/Modbus ASCII/Modbus RTU

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

MEWTOCOL	Modbus Function Code	Data Item		Data
DT00101	03/06/10H	0001H	SV1	Set value, Decimal point ignored
DT00102	03/06/10H	0002H	Input type	0000H : K -200 to 1370°C 0001H : K -200.0 to 400.0°C 0002H : J -200 to 1000°C 0003H : R 0 to 1760°C 0004H : S 0 to 1760°C 0005H : B 0 to 1820°C 0006H : E -200 to 800°C 0007H : T -200.0 to 400.0°C 0008H : N -200 to 1300°C 0009H : PL-Ⅱ 0 to 1390°C 000AH : C(W/Re5-26) 0 to 2315°C 000BH : Pt100 -200.0 to 850.0°C 000CH : JPt100 -200.0 to 500.0°C 000DH : Pt100 -200 to 850°C 000EH : JPt100 -200 to 500°C 000FH : K -328 to 2498°F 0010H : K -328.0 to 752.0°F 0011H : J -328 to 1832°F 0012H : R 32 to 3200°F 0013H : S 32 to 3200°F 0014H : B 32 to 3308°F 0015H : E -328 to 1472°F 0016H : T -328.0 to 752.0°F 0017H : N -328 to 2372°F 0018H : PL-Ⅱ 32 to 2534°F 0019H : C(W/Re5-26) 32 to 4199°F 001AH : Pt100 -328.0 to 1562.0°F 001BH : JPt100 -328.0 to 932.0°F 001CH : Pt100 -328 to 1562°F 001DH : JPt100 -328 to 932°F 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
DT00103	03/06/10H	0003H	Scaling high limit	Set value, Decimal point ignored
DT00104	03/06/10H	0004H	Scaling low limit	Set value, Decimal point ignored
DT00105	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

MEWTOCOL	Modbus Function Code	Data Item		Data
DT00106	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: Reserved 000EH: Loop break alarm output 000FH: Time signal output 0010H: Output during AT 0011H: Pattern end output 0012H: Output by communication command
DT00107	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: Reserved 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
DT00108	03/06/10H	0008H	Reserved (*2)	
:	:	:	:	
DT00113	03/06/10H	000DH	Reserved (*2)	

MEWTOCOL	Modbus Function Code	Data Item		Data
DT00114	03/06/10H	000EH	SV1	Set value, Decimal point ignored
DT00115	03/06/10H	000FH	SV2	Set value, Decimal point ignored
DT00116	03/06/10H	0010H	SV3	Set value, Decimal point ignored
DT00117	03/06/10H	0011H	SV4	Set value, Decimal point ignored
DT00118	03/06/10H	0012H	EV1 alarm value (*1)	Set value, Decimal point ignored
DT00119	03/06/10H	0013H	EV1 high limit alarm value (*1)	Set value, Decimal point ignored
DT00120	03/06/10H	0014H	EV2 alarm value (*1)	Set value, Decimal point ignored
DT00121	03/06/10H	0015H	EV2 high limit alarm value (*1)	Set value, Decimal point ignored
DT00122	03/06/10H	0016H	Reserved (*2)	
:	:	:	:	
DT00129	03/06/10H	001DH	Reserved (*2)	
DT00130	03/06/10H	001EH	Loop break alarm time	Set value
DT00131	03/06/10H	001FH	Loop break alarm span	Set value, Decimal point ignored
DT00132	03/06/10H	0020H	Reserved (*2)	
:	:	:	:	
DT00135	03/06/10H	0023H	Reserved (*2)	
DT00136	03/06/10H	0024H	EV1 alarm value 0 Enabled/Disabled	0000H : Disabled 0001H : Enabled
DT00137	03/06/10H	0025H	EV1 alarm hysteresis	Set value, Decimal point ignored
DT00138	03/06/10H	0026H	EV1 alarm delay time	Set value
DT00139	03/06/10H	0027H	EV1 alarm Energized/De-energized	0000H : Energized 0001H : De-energized
DT00140	03/06/10H	0028H	EV2 alarm value 0 Enabled/Disabled	0000H : Disabled 0001H : Enabled
DT00141	03/06/10H	0029H	EV2 alarm hysteresis	Set value, Decimal point ignored
DT00142	03/06/10H	002AH	EV2 alarm delay time	Set value
DT00143	03/06/10H	002BH	EV2 alarm Energized/De-energized	0000H : Energized 0001H : De-energized
DT00144	03/06/10H	002CH	Reserved (*2)	
:	:	:	:	
DT00159	03/06/10H	003BH	Reserved (*2)	
DT00160	03/06/10H	003CH	OUT1 proportional band	Set value, Decimal point ignored
DT00161	03/06/10H	003DH	Integral time	Set value
DT00162	03/06/10H	003EH	Derivative time	Set value
DT00163	03/06/10H	003FH	ARW	Set value
DT00164	03/06/10H	0040H	Manual reset	Set value, Decimal point ignored
DT00165	03/06/10H	0041H	OUT1 proportional cycle	Set value
DT00166	03/06/10H	0042H	OUT1 ON/OFF hysteresis	Set value, Decimal point ignored
DT00167	03/06/10H	0043H	OUT1 high limit	Set value
DT00168	03/06/10H	0044H	OUT1 low limit	Set value
DT00169	03/06/10H	0045H	OUT1 rate-of-change	Set value
DT00170	03/06/10H	0046H	OUT2 cooling method	0000H : Air cooling 0001H : Oil cooling 0002H : Water cooling
DT00171	03/06/10H	0047H	OUT2 proportional band	Set value, Decimal point ignored
DT00172	03/06/10H	0048H	OUT2 proportional cycle	Set value
DT00173	03/06/10H	0049H	OUT2 ON/OFF hysteresis	Set value, Decimal point ignored
DT00174	03/06/10H	004AH	OUT2 high limit	Set value
DT00175	03/06/10H	004BH	OUT2 low limit	Set value
DT00176	03/06/10H	004CH	Overlap band/Dead band	Set value, Decimal point ignored

MEWTOCOL	Modbus Function Code	Data Item		Data
DT00177	03/06/10H	004DH	Direct/Reverse action	0000H : Reverse action 0001H : Direct action
DT00178	03/06/10H	004EH	Set value lock	0000H : Unlock 0001H : Lock 1 0002H : Lock 2 0003H : Lock 3 0004H : Lock 4 0005H : Lock 5
DT00179	03/06/10H	004FH	Sensor correction coefficient	Set value, Decimal point ignored
DT00180	03/06/10H	0050H	Sensor correction	Set value, Decimal point ignored
DT00181	03/06/10H	0051H	PV filter time constant	Set value, Decimal point ignored
DT00182	03/06/10H	0052H	Response delay time	Set value
DT00183	03/06/10H	0053H	Reserved (*2)	
:	:	:	:	
DT00186	03/06/10H	0056H	Reserved (*2)	
DT00187	03/06/10H	0057H	SV Rise/Fall rate start type	0000H : SV start 0001H : PV start
DT00188	03/06/10H	0058H	SV rise rate	Set value, Decimal point ignored
DT00189	03/06/10H	0059H	SV fall rate	Set value, Decimal point ignored
DT00190	03/06/10H	005AH	Indication when control output OFF	0000H : OFF indication 0001H : No indication 0002H : PV indication 0003H : PV indication + Any Alarm active
DT00191	03/06/10H	005BH	AT bias	Set value, Decimal point ignored
DT00192	03/06/10H	005CH	Output status when input errors occur	0000H : Output OFF 0001H : Output ON
DT00193	03/06/10H	005DH	Auto/Manual after power interruption	0000H : Automatic control 0001H : Manual control
DT00194	03/06/10H	005EH	Indication time	Set value
DT00195	03/06/10H	005FH	Reserved (*2)	
DT00196	03/06/10H	0060H	Reserved (*2)	
DT00197	03/06/10H	0061H	Reserved (*2)	
:	:	:	:	
DT00208	03/06/10H	006CH	Reserved (*2)	
DT00209	03/06/10H	006DH	Step time unit	0000H : Hours:Minutes 0001H : Minutes:Seconds
DT00210	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.
DT00211	03/06/10H	006FH	Program start temperature	Set value, Decimal point ignored
DT00212	03/06/10H	0070H	Program control start type	0000H : PV start 0001H : PVR start 0002H : SV start
DT00213	03/06/10H	0071H	Number of repetitions	Set value
DT00214	03/06/10H	0072H	TS1 output step number	Set value
DT00215	03/06/10H	0073H	TS1 OFF time (*12)	Set value
DT00216	03/06/10H	0074H	TS1 ON time (*12)	Set value
DT00217	03/06/10H	0075H	TS2 output step number	Set value
DT00218	03/06/10H	0076H	TS2 OFF time (*12)	Set value
DT00219	03/06/10H	0077H	TS2 ON time (*12)	Set value

MEWTOCOL	Modbus Function Code	Data Item		Data
DT00220	03/06/10H	0078H	Reserved (*2)	
:	:	:	:	
DT00240	03/06/10H	008CH	Reserved (*2)	
DT00241	03/06/10H	008DH	Control method	0000H : Usual PID 0001H : 2DOF PID
DT00242	03/06/10H	008EH	Proportional gain 2DOF coefficient (α)	Set value
DT00243	03/06/10H	008FH	Integral 2DOF coefficient (β)	Set value
DT00244	03/06/10H	0090H	Not used (*3)	
:	:	:	:	
DT00323	03/06/10H	00DFH	Not used (*3)	
DT00324	03/06H	00E0H	OUT/OFF key function	0000H : Control output OFF function 0001H : Auto/Manual control 0002H : Program control
DT00325	03/06H	00E1H	Reserved (*2)	
DT00326	03/06H	00E2H	Control output OFF function Auto/Manual control Program control RUN/STOP	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
DT00327	03/06H	00E3H	Program control Holding/Not holding	0000H : Not holding 0001H : Holding
DT00328	03/06H	00E4H	Output by communication command	B0 EV1 output 0: OFF, 1: ON B1 EV2 output 0: OFF, 1: ON
DT00329	03/06H	00E5H	Manual control MV (*4)	Set value
DT00330	03/06H	00E6H	AT/Auto-reset Perform/Cancel	0000H : AT/AT on startup/ Auto-reset Cancel 0001H : AT/Auto-reset Perform 0002H : AT on startup Perform
DT00331	03/06H	00E7H	Controller/Converter	0000H : Controller 0001H : Converter
DT00332	03/06H	00E8H	AT gain	Set value, Decimal point ignored

6.1.2 A Single Piece of Data Write Command

MEWTOCOL	Modbus Function Code	Data Item		Data
DT00333	06H	00E9H	Program control Advance function (*5)	0001H : Advance Perform
DT00334	06H	00EAH	Not used (*3)	
:	:	:	:	
DT00353	06H	00FDH	Not used (*3)	
DT00354	06H	00FEH	Data clear (*6)	1234H : Clear data
DT00355	06H	00FFH	Key operation change flag clearing (*7)	0001H : Clear key operation change flag

6.1.3 Read Command

MEWTOCOL	Modbus Function Code	Data Item		Data
DT00356	03/04H	0100H	PV	Read value, Decimal point ignored
DT00357	03/04H	0101H	OUT1 MV	Read value, Decimal point ignored
DT00358	03/04H	0102H	OUT2 MV	Read value, Decimal point ignored
DT00359	03/04H	0103H	Current SV	Read value, Decimal point ignored
DT00360	03/04H	0104H	Reserved (*2)	
DT00361	03/04H	0105H	Remaining time when program control runs	Read value
DT00362	03/04H	0106H	Reserved (*2)	
DT00363	03/04H	0107H	Step number when program control runs	Read value
DT00364	03/04H	0108H	Number of repetitions when program control runs	Read value
DT00365	03/04H	0109H	Reserved (*2)	
DT00366	03/04H	010AH	Reserved (*2)	
DT00367	03/04H	010BH	Reserved (*2)	
DT00368	03/04H	010CH	Key operation changed item	Data item changed by key operation
DT00369	03/04H	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 Stop/Perform 0: Stop 1: Perform B10: AT/Auto-reset, AT on startup 0: AT/ Auto-reset 1: AT on startup B11: Reserved B12: Loop break alarm 0: OFF 1: ON B13: Overscale 0: OFF 1: ON B14: Underscale 0: OFF 1: ON B15: Change in key operation 0: No 1: Yes
DT00370	03/04H	010EH	Status flag 2	B0: Reserved B1: Reserved 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: Completed 1: Warm-up B8: USB connection 0: Usual 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 control 1: Manual control 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 output 0: OFF 1: ON

6.1.4 A Single/Multiple Piece(s) of Data Read/Write Command (for Program Control)

MEWTOCOL	Modbus Function Code	Data Item		Data
DT01000	03/06/10H	1000H	Step 1 SV(*10)	Set value, Decimal point ignored
DT01001	03/06/10H	1001H	Step 1 time (*12)	Set value, Decimal point ignored
DT01002	03/06/10H	1002H	Step 1 wait value	Set value, Decimal point ignored
DT01003	03/06/10H	1003H	Step 2 SV(*11)	Set value, Decimal point ignored
DT01004	03/06/10H	1004H	Step 2 time (*12)	Set value, Decimal point ignored
DT01005	03/06/10H	1005H	Step 2 wait value	Set value, Decimal point ignored
DT01006	03/06/10H	1006H	Step 3 SV(*11)	Set value, Decimal point ignored
DT01007	03/06/10H	1007H	Step 3 time (*12)	Set value, Decimal point ignored
DT01008	03/06/10H	1008H	Step 3 wait value	Set value, Decimal point ignored
DT01009	03/06/10H	1009H	Step 4 SV(*11)	Set value, Decimal point ignored
DT01010	03/06/10H	100AH	Step 4 time (*12)	Set value, Decimal point ignored
DT01011	03/06/10H	100BH	Step 4 wait value	Set value, Decimal point ignored
DT01012	03/06/10H	100CH	Step 5 SV	Set value, Decimal point ignored
DT01013	03/06/10H	100DH	Step 5 time (*12)	Set value, Decimal point ignored
DT01014	03/06/10H	100EH	Step 5 wait value	Set value, Decimal point ignored
DT01015	03/06/10H	100FH	Step 6 SV	Set value, Decimal point ignored
DT01016	03/06/10H	1010H	Step 6 time (*12)	Set value, Decimal point ignored
DT01017	03/06/10H	1011H	Step 6 wait value	Set value, Decimal point ignored
DT01018	03/06/10H	1012H	Step 7 SV	Set value, Decimal point ignored
DT01019	03/06/10H	1013H	Step 7 time (*12)	Set value, Decimal point ignored
DT01020	03/06/10H	1014H	Step 7 wait value	Set value, Decimal point ignored
DT01021	03/06/10H	1015H	Step 8 SV	Set value, Decimal point ignored
DT01022	03/06/10H	1016H	Step 8 time (*12)	Set value, Decimal point ignored
DT01023	03/06/10H	1017H	Step 8 wait value	Set value, Decimal point ignored
DT01024	03/06/10H	1018H	Step 9 SV	Set value, Decimal point ignored
DT01025	03/06/10H	1019H	Step 9 time (*12)	Set value, Decimal point ignored
DT01026	03/06/10H	101AH	Step 9 wait value	Set value, Decimal point ignored
DT01027	03/06/10H	101BH	Reserved (*2)	
:	:	:	:	
DT01047	03/06/10H	102FH	Reserved (*2)	

6.1.5 Contact No.

Contact No.	Read/Write	Contents of Data	Data Section
R0000	R/W	EV1 alarm Energized/De-energized	0000H : Energized (OFF) 0001H : De-energized (ON)
R0001	R/W	EV1 alarm value 0 Enabled/Disabled	0000H : Disabled (OFF) 0001H : Enabled (ON)
R0002	R/W	EV2 alarm Energized/De-energized	0000H : Energized (OFF) 0001H : De-energized (ON)
R0003	R/W	EV2 alarm value 0 Enabled/Disabled	0000H : Disabled (OFF) 0001H : Enabled (ON)
R0004	R/W	Direct/Reverse action	0000H : Reverse action (OFF) 0001H : Direct action (ON)
R0005	R/W	SV Rise/Fall rate start type	0000H : SV start (OFF) 0001H : PV start (ON)
R0006	R/W	Output status when input errors occur	0000H : Output OFF(OFF) 0001H : Output ON(ON)
R0007	R/W	Auto/Manual after power interruption	0000H : Automatic control (OFF) 0001H : Manual control (ON)
R0008	R/W	Step time unit	0000H : Hours:Minutes (OFF) 0001H : Minutes:Seconds (ON)
R0009	R/W	Control method	0000H : Usual PID (OFF) 0001H : 2DOF PID (ON)
R000A	R/W	Reserved (*2)	Always 0000H
R000B	R/W	Control output OFF function, Auto/Manual control, Program control RUN/STOP	When Control output OFF function is selected: 0000H: Control output ON (OFF) 0001H: Control output OFF (ON) When Auto/Manual control is selected: 0000H: Automatic control (OFF) 0001H: Manual control (ON) When Program control is selected: 0000H: Program control STOP (OFF) 0001H: Program control RUN (ON)
R000C	R/W	Program control Holding/Not holding	0000H : Not holding (OFF) 0001H : Holding (ON)
R000D	W	Program control Advance (*5)	0001H : Advance Perform (ON)
R000E	R/W	Controller/Converter	0000H : Controller (OFF) 0001H : Converter (ON)
R000F	R/W	EV1 output by communication command	0000H : OFF 0001H : ON
R0010	R/W	EV2 output by communication command	0000H : OFF 0001H : ON
R0011	R/W	AT/Auto-reset Perform/Cancel	0000H : AT/Auto-reset Cancel (OFF) 0001H : AT/Auto-reset Perform (ON)
R0012	R/W	AT on startup Perform/Cancel	0000H : AT on startup Cancel(OFF) 0001H : AT on startup Perform(ON)
R0013	W	Key operation change flag clearing (*7)	0001H : Clear key operation change flag (ON)
R0014	R/W	Reserved (*2)	Always 0000H
R0015	R/W	Reserved (*2)	Always 0000H
R0016	R/W	Reserved (*2)	Always 0000H

Contact No.	Read/Write	Contents of Data	Data Section
R0017	R/W	Reserved (*2)	Always 0000H
R0018	R/W	Reserved (*2)	Always 0000H
R0019	R/W	Reserved (*2)	Always 0000H
R001A	R/W	Reserved (*2)	Always 0000H
R001B	R/W	Reserved (*2)	Always 0000H
R001C	R/W	Reserved (*2)	Always 0000H
R001D	R/W	Reserved (*2)	Always 0000H
R001E	R/W	Reserved (*2)	Always 0000H
R001F	R/W	Reserved (*2)	Always 0000H
R0020	R	OUT1 output status	0000H : OFF 0001H : ON
R0021	R	OUT2 output status	0000H : OFF 0001H : ON
R0022	R	EV1 output status	0000H : OFF 0001H : ON
R0023	R	EV2 output status	0000H : OFF 0001H : ON
R0024	R	Reserved (*2)	Always 0000H
R0025	R	Reserved (*2)	Always 0000H
R0026	R	Reserved (*2)	Always 0000H
R0027	R	Reserved (*2)	Always 0000H
R0028	R	Reserved (*2)	Always 0000H
R0029	R	AT/Auto-reset, AT on startup status	0000H : Stop (OFF) 0001H : Perform (ON)
R002A	R	AT/AT on startup status (*13)	0000H : AT is performing (OFF) 0001H : AT on startup is performing (ON)
R002B	R	Reserved (*2)	Always 0000H
R002C	R	Loop break alarm	0000H : OFF 0001H : ON
R002D	R	Overscale	0000H : OFF 0001H : ON
R002E	R	Underscale	0000H : OFF 0001H : ON
R002F	R	Change in key operation	0000H : Not changed (OFF) 0001H : Changed (ON)
R0030	R	Reserved (*2)	Always 0000H
R0031	R	Reserved (*2)	Always 0000H
R0032	R	Reserved (*2)	Always 0000H
R0033	R	Reserved (*2)	Always 0000H
R0034	R	Reserved (*2)	Always 0000H
R0035	R	Unit status 1	0000H : Standby (OFF) 0001H : Program control RUN (ON)
R0036	R	Unit status 2	0000H : PV/SV Display (OFF) 0001H : Setting mode (ON)
R0037	R	Warm-up	0000H : Completed (OFF) 0001H : Warm-up (ON)
R0038	R	Reserved (*2)	Always 0000H
R0039	R	Control output OFF	0000H : Control output ON (OFF) 0001H : Control output OFF (ON)
R003A	R	Auto/Manual control	0000H : Automatic control (OFF) 0001H : Manual control (ON)

Contact No.	Read/Write	Contents of Data	Data Section
R003B	R	Control mode	0000H : Fixed value control (OFF) 0001H : Program control (ON)
R003C	R	Program control	0000H : Standby (OFF) 0001H : RUN (ON)
R003D	R	Wait function	0000H : OFF 0001H : ON
R003E	R	Hold function	0000H : OFF 0001H : ON
R003F	R	Pattern end output	0000H : OFF 0001H : ON
R0040	R	Error 01	0000H : OFF 0001H : ON
R0041	R	Error 02	0000H : OFF 0001H : ON
R0042	R	Reserved (*2)	Always 0000H
R0043	R	Reserved (*2)	Always 0000H
R0044	R	Error 05	0000H : OFF 0001H : ON
R0045	R	Error 06	0000H : OFF 0001H : ON
R0046	R	Error 07	0000H : OFF 0001H : ON
R0047	R	Reserved (*2)	Always 0000H
R0048	R	Reserved (*2)	Always 0000H
R0049	R	Error 10	0000H : OFF 0001H : ON
R004A	R	Reserved (*2)	Always 0000H
R004B	R	Reserved (*2)	Always 0000H
R004C	R	Reserved (*2)	Always 0000H
R004D	R	Reserved (*2)	Always 0000H
R004E	R	Reserved (*2)	Always 0000H
R004F	R	Reserved (*2)	Always 0000H
R0050	R	Reserved (*2)	Always 0000H
R0051	R	Reserved (*2)	Always 0000H
R0052	R	Reserved (*2)	Always 0000H
R0053	R	Error 20	0000H : OFF 0001H : ON
R0054	R	Reserved (*2)	Always 0000H
R0055	R	Reserved (*2)	Always 0000H
R0056	R	Reserved (*2)	Always 0000H
R0057	R	Reserved (*2)	Always 0000H
R0058	R	Reserved (*2)	Always 0000H
R0059	R	Reserved (*2)	Always 0000H
R005A	R	Reserved (*2)	Always 0000H
R005B	R	Reserved (*2)	Always 0000H
R005C	R	Reserved (*2)	Always 0000H
R005D	R	Reserved (*2)	Always 0000H
R005E	R	Reserved (*2)	Always 0000H
R005F	R	Reserved (*2)	Always 0000H
R0060	R	Reserved (*2)	Always 0000H

Contact No.	Read/Write	Contents of Data	Data Section
R0061	R	EV2 output Enabled/Disabled	0000H : Disabled (OFF) 0001H : Enabled (ON)
R0062	R	Reserved (*2)	Always 0000H
R0063	R	Reserved (*2)	Always 0000H
R0064	R	Reserved (*2)	Always 0000H
R0065	R	Reserved (*2)	Always 0000H
R0066	R	Reserved (*2)	Always 0000H
R0067	R	Communication function Enabled/Disabled	0000H : Disabled (OFF) 0001H : Enabled (ON)
R0068	R	Heating/Cooling control function Disabled/Enabled	0000H : Disabled (OFF) 0001H : Enabled (ON)
R0069	R	Reserved (*2)	Always 0000H
R006A	R	Reserved (*2)	Always 0000H
R006B	R	Reserved (*2)	Always 0000H
R006C	R	Reserved (*2)	Always 0000H
R006D	R	Reserved (*2)	Always 0000H
R006E	R	Reserved (*2)	Always 0000H
R006F	R	Reserved (*2)	Always 0000H
R0070	R	Unit model: AKT9R	0001H : Specified model
R0071	R	Unit model: AKT8R	0001H : Specified model
R0072	R	Reserved (*2)	Always 0000H
R0073	R	Unit model: AKT4R	0001H : Specified model
R0074	R	Reserved (*2)	Always 0000H
R0075	R	Reserved (*2)	Always 0000H
R0076	R	OUT1 output type: Relay contact output	0001H : Specified model
R0077	R	OUT1 output type: Non-contact voltage output (for SSR drive)	0001H : Specified model
R0078	R	OUT1 output type: Direct current output	0001H : Specified model
R0079	R	OUT2 output type : Relay contact output	0001H : Specified model
R007A	R	Reserved (*2)	Always 0000H
:	:	:	:
R009F	R	Reserved (*2)	Always 0000H

R/W: Both Read and Write can be executed.

R: Read can be executed. If Write is executed, data will be discarded, and acknowledgement will be returned.
If Data larger than Contact No. R0100 is read or written, Error code 61H will be returned.
If Data larger than DT10000 is read or written, Error code 61H will be returned.

(*1) If any action is changed in [Event output EV1 allocation] or in [Event output EV2 allocation], EV1 alarm value and EV2 alarm value, etc. will revert to factory default value.

For the items to be initialized: Refer to Section "6.6 Items to Be Initialized by Changing Settings" (p.55).

(*2) If reserved items and reserved Contact No. are read, acknowledgement will be returned (but data is 0).

If they are written, data will be discarded, and acknowledgement will be returned.

(*3) If 'Not used' items are read or written, the following data will be returned depending on the communication protocol.

For MEWTOCOL, if 'Not used' items are read, acknowledgement will be returned (but data is 0). If they are written, data will be discarded, and acknowledgement will be returned.

For Modbus, Exception code 2 (02H) will be returned.

(*4) For Manual control MV, if the following are written, Error code 61H (MEWTOCOL) or Exception code 3 (03H, Modbus) will be returned.

- When control action is 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, and Cooling side OUT2 low limit/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/OUT1 high limit value, and Cooling side OUT2 low limit/OUT2 high limit value - are written.

- (*5) If "Program control Advance" is read, acknowledgement (data 0, MEWTOCOL) or Exception code 2 (02H, Modbus) will be returned.
If any value except 0001H (Advance Perform) is written, Error code 61H (MEWTOCOL) or Exception code 3 (03H, Modbus) will be returned.
- (*6) If "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 "Data clear" is read, acknowledgement (data 0, MEWTOCOL) or Exception code 2 (02H, Modbus) will be returned.
If any value except 1234H (Clear data) is written, Error code 61H (MEWTOCOL) or Exception code 3 (03H, Modbus) will be returned.
- (*7) If "Key operation change flag clearing" is read, acknowledgement (data 0, MEWTOCOL) or Exception code 2 (02H, Modbus) will be returned.
If any value except 0001H (Clear key operation change flag) is written, Error code 61H (MEWTOCOL) or Exception code 3 (03H, Modbus) will be returned.
- (*8) Contents of error code are shown below.

Error Code	Contents
Error 01	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) Data item:
16³ digit: 0: Fixed value control, 1: Program control
16² to 16⁰ digits: Data item code (serial number) for each step
- (*10) Step 1 SV corresponds to SV1 (0001H) and SV1 (000EH).
- (*11) Step 2 SV to Step 4 SV correspond to SV2 to SV4 (000FH to 0011H).
- (*12) For TS1 OFF/ON time, TS2 OFF/ON time, and Steps 1 to 9 time:
Calculate the step time using the smaller time unit at Sep 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 → 1 x 60+00=60 → 003CH
1:30 → 1 x 60+30=90 → 005AH
FFFFH: Step time is held, and Fixed value control is enabled.
- (*13) Only when R0029 (AT/Auto-reset, AT on startup status) is ON (0001H), R002A (AT/AT on startup status) can be read.
When R0029 (AT/Auto-reset, AT on startup status) is OFF (0000H), and if R002A (AT/AT on startup status) is read, acknowledgement (data is 0) will be returned.

6.2 KT4 Command Table

If Modbus ASCII [Modbus ASCII (KT4 command allocation)] or Modbus RTU [Modbus RTU (KT4 command allocation)] is selected in [Communication protocol], the following KT4 command can be used.

6.2.1 A Single Piece of Data Read/Write Command

Modbus Function Code	Data Item		Data
03/06H	0001H	SV1	Set value, Decimal point ignored
03/06H	0002H	Not used (*1)	
03/06H	0003H	AT/Auto-reset Perform/Cancel	0000H : AT/ Auto-reset Cancel 0001H : AT/ Auto-reset Perform
03/06H	0004H	OUT1 proportional band	Set value, Decimal point ignored
03/06H	0005H	OUT2 proportional band (*2)(*3)	Set value, Decimal point ignored
03/06H	0006H	Integral time	Set value
03/06H	0007H	Derivative time	Set value
03/06H	0008H	OUT1 proportional cycle	Set value
03/06H	0009H	OUT2 proportional cycle	Set value
03/06H	000AH	Not used (*1)	
03/06H	000BH	EV1 alarm value (*4)	
03/06H	000CH	EV2 alarm value (*4)	
03/06H	000DH	Not used (*1)	
03/06H	000EH	Not used (*1)	
03/06H	000FH	Not used (*1)	
03/06H	0010H	Loop break alarm time	Set value
03/06H	0011H	Loop break alarm span	Set value, Decimal point ignored
03/06H	0012H	Set value lock	0000H : Unlock 0001H : Lock 1 0002H : Lock 2 0003H : Lock 3 0004H : Lock 4 0005H : Lock 5
03/06H	0013H	SV high limit	Set value, Decimal point ignored
03/06H	0014H	SV low limit	Set value, Decimal point ignored
03/06H	0015H	Sensor correction	Set value, Decimal point ignored
03/06H	0016H	Overlap band/Dead band	Set value, Decimal point ignored
03/06H	0017H	Not used (*1)	
03/06H	0018H	Scaling high limit	Set value, Decimal point ignored
03/06H	0019H	Scaling low limit	Set value, Decimal point ignored
03/06H	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
03/06H	001BH	PV filter time constant	Set value, Decimal point ignored
03/06H	001CH	OUT1 high limit	Set value
03/06H	001DH	OUT1 low limit	Set value
03/06H	001EH	OUT1 ON/OFF hysteresis	Set value, Decimal point ignored
03/06H	001FH	OUT2 cooling method	0000H : Air cooling 0001H : Oil cooling 0002H : Water cooling
03/06H	0020H	OUT2 high limit	Set value
03/06H	0021H	OUT2 low limit	Set value
03/06H	0022H	OUT2 ON/OFF hysteresis	Set value, Decimal point ignored

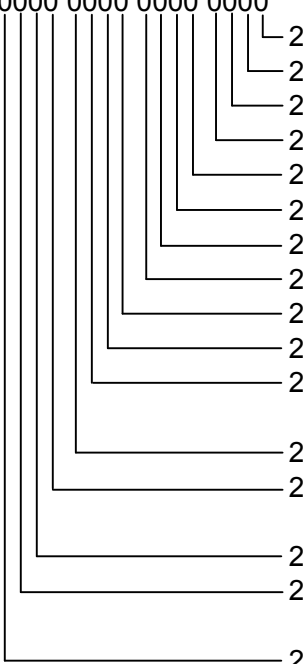
Modbus Function Code	Data Item		Data
03/06H	0023H	Event output EV1 allocation (*2)(*5)	0000H : No event 0001H : Alarm output, High limit alarm 0002H : Alarm output, Low limit alarm 0003H : Alarm output, High/Low limits alarm 0004H : Alarm output, High/Low limit range alarm 0005H : Alarm output, Process 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
03/06H	0024H	Event output EV2 allocation (*2)(*5)	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
03/06H	0025H	EV1 alarm hysteresis	Set value, Decimal point ignored
03/06H	0026H	EV2 alarm hysteresis	Set value, Decimal point ignored
03/06H	0027H	Not used (*1)	
03/06H	0028H	Not used (*1)	
03/06H	0029H	EV1 alarm delay time	Set value
03/06H	002AH	EV2 alarm delay time	Set value
03/06H	002BH	Not used (*1)	
03/06H	002CH	Not used (*1)	
03/06H	002DH	Not used (*1)	
03/06H	002EH	Not used (*1)	
03/06H	002FH	Not used (*1)	
03/06H	0030H	Not used (*1)	
03/06H	0031H	Not used (*1)	
03/06H	0032H	Not used (*1)	
03/06H	0033H	Not used (*1)	
03/06H	0034H	Not used (*1)	
03/06H	0035H	Not used (*1)	
03/06H	0036H	Not used (*1)	
03/06H	0037H	Control output OFF function (*6)	0000H : Control output ON 0001H : Control output OFF
03/06H	0038H	Auto/Manual control (*7)	0000H : Automatic control 0001H : Manual control
03/06H	0039H	Manual control MV (*8)	Set value
03/06H	003AH	Not used (*1)	
03/06H	003BH	Not used (*1)	
03/06H	003CH	Not used (*1)	
03/06H	003DH	Not used (*1)	
03/06H	003EH	Not used (*1)	
03/06H	003FH	Not used (*1)	

Modbus Function Code	Data Item		Data
03/06H	0040H	EV1 alarm Energized/De-energized	0000H : Energized 0001H : De-energized
03/06H	0041H	EV2 alarm Energized/De-energized	0000H : Energized 0001H : De-energized
03/06H	0042H	Not used (*1)	
03/06H	0043H	Not used (*1)	
03/06H	0044H	Input type	0000H : K -200 to 1370°C 0001H : K -200.0 to 400.0°C 0002H : J -200 to 1000°C 0003H : R 0 to 1760°C 0004H : S 0 to 1760°C 0005H : B 0 to 1820°C 0006H : E -200 to 800°C 0007H : T -200.0 to 400.0°C 0008H : N -200 to 1300°C 0009H : PL-II 0 to 1390°C 000AH : C(W/Re5-26) 0 to 2315°C 000BH : Pt100 -200.0 to 850.0°C 000CH : JPt100 -200.0 to 500.0°C 000DH : Pt100 -200 to 850°C 000EH : JPt100 -200 to 500°C 000FH : K -328 to 2498°F 0010H : K -328.0 to 752.0°F 0011H : J -328 to 1832°F 0012H : R 32 to 3200°F 0013H : S 32 to 3200°F 0014H : B 32 to 3308°F 0015H : E -328 to 1472°F 0016H : T -328.0 to 752.0°F 0017H : N -328 to 2372°F 0018H : PL-II 32 to 2534°F 0019H : C(W/Re5-26) 32 to 4199°F 001AH : Pt100 -328.0 to 1562.0°F 001BH : JPt100 -328.0 to 932.0°F 001CH : Pt100 -328 to 1562°F 001DH : JPt100 -328 to 932°F 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
03/06H	0045H	Direct/Reverse action	0000H : Reverse action 0001H : Direct action
03/06H	0046H	Not used (*1)	
03/06H	0047H	AT bias	Set value, Decimal point ignored
03/06H	0048H	ARW	Set value
03/06H	006FH	Reserved (*9)	

6.2.2 A Single Piece of Data Write Command

Modbus Function Code	Data Item		Data
06H	0070H	Key operation change flag clearing (*10)	0001H : Clear key operation change flag

6.2.3 Read Command

Modbus Function Code	Data Item		Data
03H	0080H	PV	Read value, Decimal point ignored
03H	0081H	OUT1 MV	Read value, Decimal point ignored
03H	0082H	OUT2 MV	Read value, Decimal point ignored
03H	0083H	Not used (*1)	
03H	0084H	Not used (*1)	
03H	0085H	Status flag	
		0000 0000 0000 0000 	<div> <div>2⁰ OUT1 output</div> <div>2¹ OUT2 output</div> <div>2² EV1 output</div> <div>2³ EV2 output</div> <div>2⁴ Not used, Always 0</div> <div>2⁵ Not used, Always 0</div> <div>2⁶ Not used, Always 0</div> <div>2⁷ Loop break alarm</div> <div>2⁸ Overscale</div> <div>2⁹ Underscale</div> <div>2¹⁰ Control output OFF function</div> <div>2¹¹ AT/Auto-reset, Perform/Cancel</div> <div>2¹² OUT/OFF key function</div> <div>2¹³ Not used, Always 0</div> <div>2¹⁴ Auto/Manual control</div> <div>2¹⁵ Change in key operation</div> </div> <div> <div>0: OFF</div> <div>0: OFF</div> <div>0: OFF</div> <div>0: OFF</div> <div>0: OFF</div> <div>0: OFF</div> <div>0: OFF</div> <div>0: OFF</div> <div>0: OFF</div> <div>0: Control output ON</div> <div>0: Cancel, 1: Perform</div> <div>0: Control output OFF function</div> <div>0: Automatic control</div> <div>0: No</div> </div> <div> <div>1: ON</div> <div>1: ON</div> <div>1: ON</div> <div>1: ON</div> <div>1: ON</div> <div>1: ON</div> <div>1: ON</div> <div>1: ON</div> <div>1: ON</div> <div>1: Control output OFF</div> <div>1: Auto/Manual control</div> <div>1: Manual control</div> <div>1: Yes</div> </div>

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

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

(*3) For writing OUT2 proportional band, write the multiplied value (0.0 to 10.0 times) of OUT1 proportional band.

For reading OUT2 proportional band, the controller internally calculates the value using OUT1 and OUT2 proportional bands, and returns the result as response data.

Even if the multiplied value exceeds 10.0 times, the exceeding value will be returned as response data.

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

(*5) If any action is changed in [Event output EV1 allocation] or [Event output EV2 allocation], the EV1 alarm value, EV2 alarm value, etc. will revert to factory default value.

For the items to be initialized: Refer to Section "6.6 Items to Be Initialized by Changing Settings" (p.56).

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, Time signal output, Output during AT, Pattern end output, Output via communication command, Heating/Cooling control relay contact output (EV2 only)

(*6) For Control output OFF, if Control output OFF function is not selected in [OUT/OFF key function], Exception code 2 (02H) will be returned.

(*7) For Auto/Manual control, if Auto/Manual control is not selected in [OUT/OFF key function], Exception code 2 (02H) will be returned.

(*8) For Manual control MV, if Write is executed during automatic control, Exception code 2 (02H) will be returned.

If the following are written, Exception code 3 (03H) will be returned.

- When OUT1 is 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, and Cooling side OUT2 low limit/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/OUT1 high limit value, and Cooling side OUT2 low limit/OUT2 high limit value – are written.

(*9) If Reserved items are read, acknowledgement will be returned (but data is 0).

If Reserved items are written, data will be discarded, and acknowledgement will be returned.

(*10) If "Key operation change flag clearing" is read, Exception code 2 (02H) will be returned.

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

6.3 Data

6.3.1 Notes about Write/Read Command

- The data (set value, decimal) is converted to hexadecimal numbers. 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 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 Holding Register address is 40002 (1 + 40001).

6.3.2 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 in [Event output EV1 allocation] or [Event output EV2 allocation], the EV1 alarm value, EV2 alarm value, etc. will revert to factory default value.
For the items to be initialized: Refer to Section "6.6 Items to Be Initialized by Changing Settings" (pp. 55, 56).
- Writings via software communication are possible while in Set value lock status.
- Even if options are not ordered, writing via software communication will be possible. However, their command contents will not function.
- The Instrument Numbers and Communication Speed of the slave cannot be set by software communication. They can only be set via the keypad.
- When sending a command by Global address FF (MEWTOCOL) or Broadcast address 00H (Modbus), the same command is sent to all the slaves connected. However, the response is not returned.

6.3.3 Read Command

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

6.4 Negative Acknowledgement

- When non-existent data item is read or written:
For MEWTOCOL, if the data item is read, acknowledgement (data is 0) will be returned.
If the data item is written, the data will be discarded, and acknowledgement will be returned.
(If Data larger than DT 10000 is read or written, Error code 61H will be returned.)
For Modbus, Exception code 2 (02H) will be returned.
- When a value out of the setting range is written:
The slave will return Error code 61H (MEWTOCOL) or Exception code 3 (03H, Modbus).

The slave will return Error code 63H (MEWTOCOL) or Exception code 17 (11H, Modbus) in the following cases:

- When AT/Auto-reset Perform or AT on startup Perform is written during PI control or ON/OFF control action
- While AT is performing in Fixed value control, if any item – except AT/AT on startup/Auto-reset Cancel, Control output OFF function, Direct/Reverse action – is written
(If AT/AT on startup/Auto-reset Cancel, Control output OFF function, or Direct/Reverse action is written, AT will stop.)
- While AT is performing in Program control, if any item – except AT/AT on startup/Auto-reset Cancel, Program control STOP, Direct/Reverse action, Program control Advance Perform, Program control Holding/Not holding, Key operation change flag clearing – is written
(If AT/AT on startup/Auto-reset Cancel, Program control STOP, Direct/Reverse action, Program control Advance Perform, or Key operation change flag clearing is written, AT will stop.
If Program control Holding/Not holding is written, AT will continue.)
- When Manual control MV is written during automatic control
- When the OUT/OFF key function is written while in Control output OFF status
- When the OUT/OFF key function is written during manual control
- When the OUT/OFF key function is written while program control is performing

The slave will return Error code 63H (MEWTOCOL) or Exception code 18 (12H, Modbus) in the following case.

- During setting mode by keypad operation, if any item – except Control output OFF function, Program control RUN/STOP, Program control Advance Perform, Program control Holding/Not holding, Key operation change flag clearing – is written

6.5 Notes on Programming Monitoring Software

6.5.1 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 PV, OUT1 MV, Status flag 1, and Status flag 2 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.

6.5.2 How to Read the Set Value Changes Made by the Front Keypad Operation

If any set value is changed by the keypad operation, the controller sets [Status flag 1: B15 (Change in key operation)] to 1 (Yes).

There are 2 methods of reading the set value changes made by the front keypad.

(1) Reading Method 1

- ① On the monitoring software side, check that [Status flag 1: B15 (Change in key operation)] has been set to 1 (Yes), then read all set values.
- ② Clear [Status flag 1: B15 (Change in key operation)], by writing “Key operation change flag clearing” to 0001H (Clear key operation change flag).
If “Key operation change flag clearing” is written to 0001H (Clear key operation change flag) during setting mode of the controller, Error code 63H (MEWTOCOL) or Exception Code 18 (12H, Modbus) will be returned as negative acknowledgement. And [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 [Status flag 1: B15 (Change in key operation)] has been set to 1 (Yes), then write the “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 63H (MEWTOCOL) or Exception code 18 (12H, Modbus) is returned as a negative acknowledgement;
 Consider it as still in setting mode, and read the requisite minimum pieces of data such as PV OUT1 MV, Status flag 1, Status flag 2, 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.

6.5.3 How to Read PID Parameters after AT or AT on Startup is Complete

While AT or AT on startup is performing, this controller sets [Status flag 1: B9 (AT/Auto-reset, AT on startup Perform/Cancel)] to 1 (Perform).

After AT or AT on startup is complete, PID parameters are updated.

On the monitoring software side, check that [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.

6.5.4 Notes When Sending All Set Values Simultaneously

- When changing alarm types in [Event output EV1/EV2 allocation], EV1 alarm value, EV2 alarm value, etc. will revert to factory default value.
First, send the selected alarm type, then send each alarm value.
For the items to be initialized: Refer to Section “6.6 Items to Be Initialized by Changing Settings” (pp. 55, 56).
- When changing input type in [Input type], values such as SV1, OUT1 proportional band, EV1 Alarm value will be initialized.
First, send the selected input type, then send other set values.

6.6 Items to Be Initialized by Changing Settings

6.6.1 MEWTOCOL/Modbus ASCII/Modbus RTU

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

Yes: Initialized

No: Not initialized

Setting item to be changed Item to be Initialized	Input Type (0002H)	Event output EV1 allocation (0006H)	Event output EV2 allocation (0007H)	Transmission output (000BH)
SV1 to SV9 (1000 to 1018H)	Yes	No	No	No
Steps 1 to 9 wait value (1002 to 101AH)	Yes	No	No	No
AT bias (005BH)	Yes	No	No	No
OUT1 proportional band (003CH)	Yes	No	No	No
Manual reset (0040H)	Yes	No	No	No
SV rise rate (0058H)	Yes	No	No	No
SV fall rate (0059H)	Yes	No	No	No
Scaling high limit (0003H)	Yes	No	No	No
Scaling low limit (0004H)	Yes	No	No	No
Program start temperature (006FH)	Yes	No	No	No
EV1 alarm value (0012H)	Yes	Yes	No	No
EV1 high limit alarm value (0013H)	Yes	Yes	No	No
Loop bread alarm time (001EH)	Yes	No	No	No
Loop bread alarm span (001FH)	Yes	No	No	No
SVTC bias (0053H)	Yes	No	No	No
Remote bias (0056H)	Yes	No	No	No
EV2 alarm value (0014H)	Yes	No	Yes	No
EV2 high limit alarm value (0015H)	Yes	No	Yes	No
Transmission output high limit (000CH)	Yes	No	No	Yes
Transmission output low limit (000DH)	Yes	No	No	Yes
OUT2 proportional band (0047H)	Yes	No	No	No
EV1 alarm value 0 Enabled/Disabled (0024H)	No	Yes	No	No
EV1 alarm hysteresis (0025H)	No	Yes	No	No
EV1 alarm delay time (0026H)	No	Yes	No	No
EV1 alarm Energized/De-energized (0027H)	No	Yes	No	No
EV2 alarm value 0 Enabled/Disabled (0028H)	No	No	Yes	No
EV2 alarm hysteresis (0029H)	No	No	Yes	No
EV2 alarm delay time (002AH)	No	No	Yes	No
EV2 alarm Energized/De-energized (002BH)	No	No	Yes	No
Sensor correction coefficient (004FH)	Yes	No	No	No
Sensor correction (0050H)	Yes	No	No	No
External setting input high limit (0054H)	Yes	No	No	No
External setting input low limit (0055H)	Yes	No	No	No

6.6.2 KT4 Command

For KT4 command, if settings are changed, the following items will be initialized.

Yes: Initialized

No: 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)	Yes	No	No
AT bias (0047H)	Yes	No	No
OUT1 proportional band (0004H)	Yes	No	No
Scaling high limit (0018H)	Yes	No	No
Scaling low limit (0019H)	Yes	No	No
EV1 alarm value (000BH)	Yes	Yes	No
Loop bread alarm time (0010H)	Yes	No	No
Loop bread alarm span (0011H)	Yes	No	No
EV2 alarm value (000CH)	Yes	No	Yes
OUT2 proportional band (0005H)	Yes	No	No
EV1 alarm hysteresis (0025H)	No	Yes	No
EV1 alarm delay time (0029H)	No	Yes	No
EV1 alarm Energized/De-energized (0040H)	No	Yes	No
EV2 alarm hysteresis (0026H)	No	No	Yes
EV2 alarm delay time (002AH)	No	No	Yes
EV2 alarm Energized/De-energized (0041H)	No	No	Yes
Sensor correction (0015H)	Yes	No	No

7. Specifications

Cable length	1.2 km (Max.), Cable resistance: Within 50 Ω (Terminators are not necessary, but if used, use 120 Ω or more on both sides.)		
Communication interface	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	Data bit: 7, 8, Parity: Even/Odd/No parity (Selectable by keypad)		
Stop bit	1, 2 (Selectable by keypad)		
Communication protocol	MEWTOCOL/Modbus ASCII/Modbus RTU/ Modbus ASCII (KT4 command allocation)/ Modbus RTU (KT4 command allocation) (Selectable by keypad)		
Data format	Data format is different depending on the communication protocol.		
		MEWTOCOL	Modbus ASCII
			Modbus RTU
	Start bit	1	1
	Data bit	7 or 8	8
	Parity	Yes (Even, Odd), No parity	Yes (Even, Odd), No parity
	Stop bit	1 or 2	1 or 2
Number of connectable units	Max 31 units to 1 host computer		
Error correction	Command request repeat system		
Error detection	Parity check, BCC (MEWTOCOL), LRC (Modbus ASCII), CRC-16 (Modbus RTU)		

8. 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	The communication connector is not securely connected.	Make sure that the communication connector is securely connected.
	Incorrect wiring of the communication connector	Check the communication cable and connector. Refer to Section "2. Wiring" (pages 2, 3).
	Burnout or imperfect contact on the communication cable and the connector.	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" (pages 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" (pages 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" (pages 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" (pages 4, 5).
	Make sure that the program is appropriate for the transmission timing.	Check the program. Refer to Sections "4.2 and 5.2 Communication Timing of the RS-485" (pages 6, 21).
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 status of slave.
	The KT4R is in front keypad operation setting mode.	Return the controller to RUN mode.

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

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