Panasonic®

COMMUNICATION INSTRUCTION MANUAL TEMPERATURE CONTROLLER **KT4, KT8 and KT9**

To prevent accidents arising from the misuse of this controller, please ensure the operator receives this manual. For this product to which communication function has been added, "1" is entered after the heater burnout alarm indication in the model number.
(For the model number and basic operation, refer to the instruction manual for KT4, KT8 and KT9.)

⚠ Warning ....

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

1. Setup of the KT4, KT8 and KT9

Set the items "Communication protocol selection", "Instrument number setting", "Communication speed selection" "Parity selection" and "Stop bit selection" after the "Sensor correction setting" in the Auxiliary function setting mode 1.

To enter Auxiliary function setting mode 1, press the [MODE] key for 3 seconds while holding down the [▽] key.

Character (PV display)	Name, Functions and Setting range	Default (SV display)
⌐ñ�5Ⴑ	Communication protocol selection • Selects the Communication protocol. • Modbus ASCII mode: ñod用 Modbus RTU mode: ñodⴖ ⴖoñL: Not available.	Modbus ASCII
⌐ñⴖo	Instrument number setting • Sets individual instrument number for each unit when communicating by connecting plural controllers in serial communication. Up to 31 units can be connected, however, the instrument number can be set within the range 0 to 95. • 0 to 95	0
⌐ñ5P	Communication speed selection • Selects a communication speed to correspond to that of host computer. • 2400bps: 己Ⴈ, 4800bps: Ⴈ8, 9600bps: 96, 19200bps: I9己	9600bps
⌐ñPⴖ	Parity selection • Selects the parity. • No parity: ⴖoⴖ모, Even parity: 모Ⴘ모ⴖ, Odd parity: odd	Even
⌐ñ5Ⴑ	Stop bit selection • Selects the stop bit. • 1 or 2	1

2. Terminal arrangement

2.1 Terminal arrangement of KT4
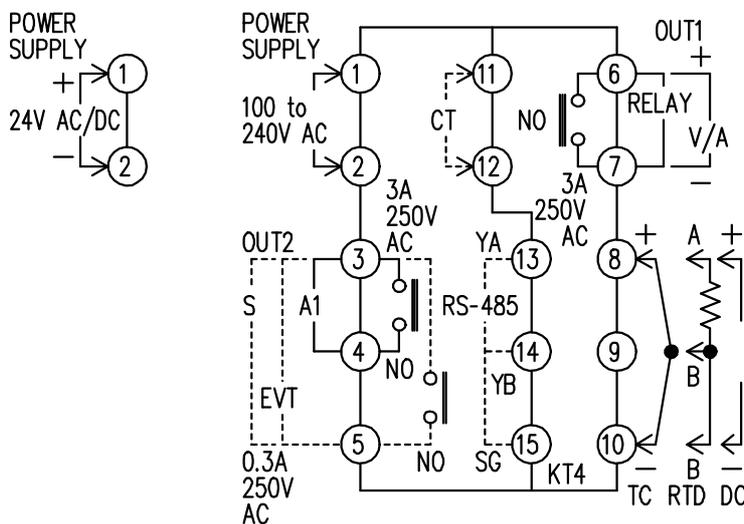
(Fig. 2.1-1)

OUT1 : Control output 1 (Heating output)
OUT2 : Control output 2 (Cooling output)
RELAY : Relay contact output
V/A : DC voltage output /DC current output
S : Non-contact relay output
A1 : Alarm 1 output
EVT : Event output (Comprises A2 output and Heater burnout alarm output)
CT : Current transformer input
TC : Thermocouple
RTD : Resistance Temperature Detector
DC : DC current or DC voltage
RS-485: Serial communication

2.2 Terminal arrangement of KT8 and KT9

OUT1 : Control output 1 (Heating output)
OUT2 : Control output 2 (Cooling output)
RELAY : Relay contact output
V/A   : Non-contact voltage output /DC current output
A1   : Alarm 1 output
A2   : Alarm 2 output
HB   : Heater burnout alarm output
SV2   : 2nd main setting
CT   : Current transformer input
TC   : Thermocouple
RTD   : Resistance Temperature Detector
DC   : DC current or DC voltage
RS-485: Serial communication

(Fig 2.2-1)

3. System configuration

RS-485 multi-drop connection communication


(Fig. 3-1)

(Fig. 3-2)

(Fig. 3-3)

2
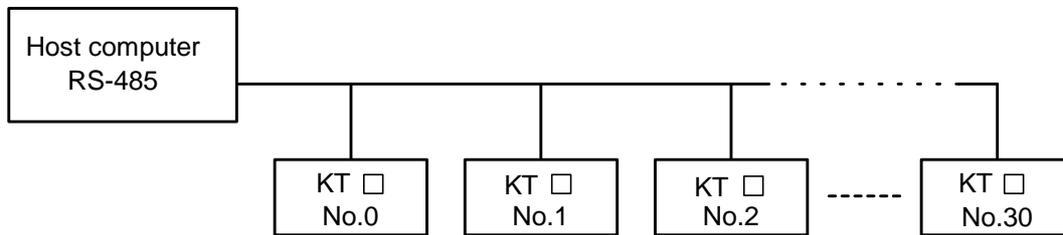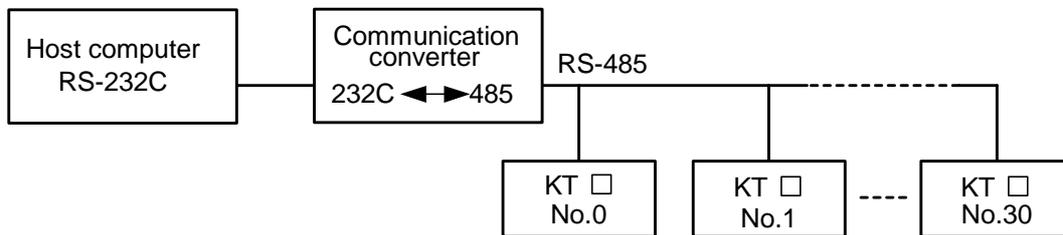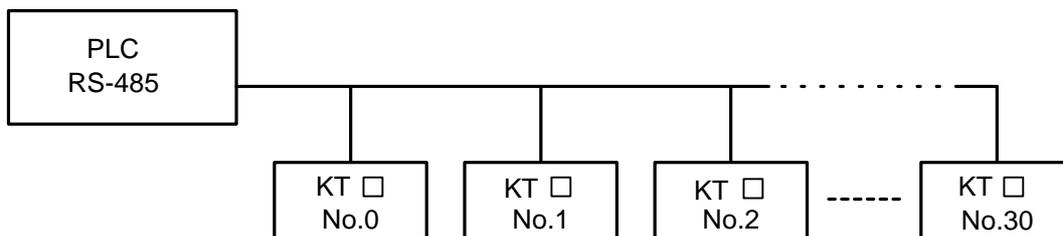
4. Wiring

**When using communication converter (RS-232C)**
• Connector: D-sub 25-pin
  Connection: RS-232C ◄────► RS-485 (Communication speed: 2400, 4800, 9600, 19200bps)

Host computer

TXD	2
RXD	3
SG	7
FG	1
RTS	4
CTS	5
DSR	6
DTR	20
CD	8

Shielded wire

D-sub 25-pin connector

RX
TX
COM

RS-232C ◄────► RS-485

YA(−)
YB(+)
COM

FG

Shielded wire

Shielded wire

FG

KT4 — ⑬YA(−) ⑭YB(+) ⑮SG
KT8, KT9 — ⑪YA(−) ⑭YB(+) ⑰SG

KT4 — ⑬YA(−) ⑭YB(+) ⑮SG
KT8, KT9 — ⑪YA(−) ⑭YB(+) ⑰SG
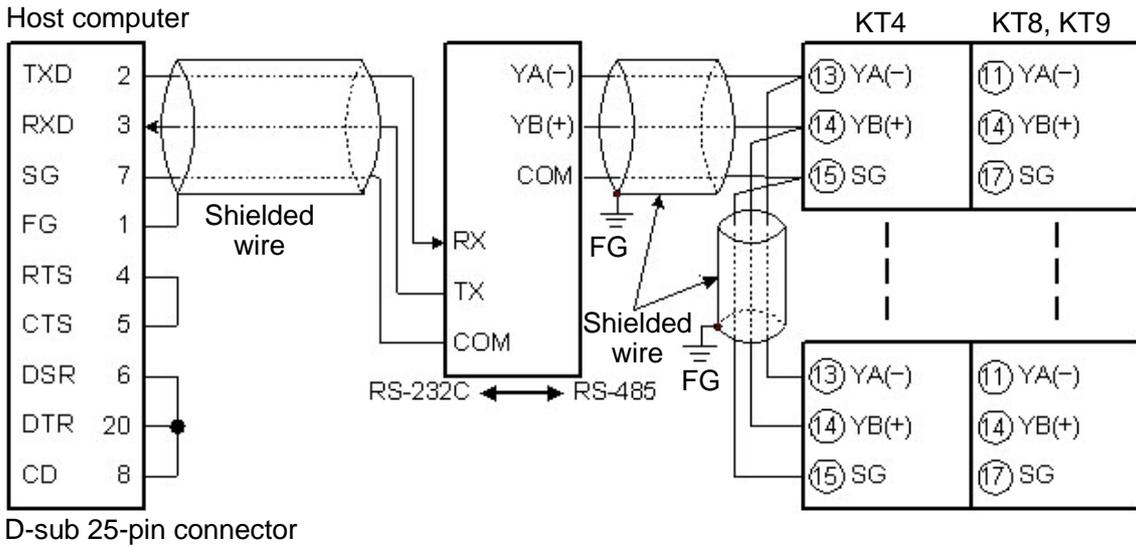
(Fig. 4-1)

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

Host computer

TXD	3
RXD	2
GND	5
DCD	1
DTR	4
DSR	6
RTS	7
CTS	8
RI	9

Shielded wire

FG

D-sub 9-pin connector

RX
TX
COM

RS-232C ◄────► RS-485

YA(−)
YB(+)
COM

FG

Shielded wire

Shielded wire

FG

KT4 — ⑬YA(−) ⑭YB(+) ⑮SG
KT8, KT9 — ⑪YA(−) ⑭YB(+) ⑰SG

KT4 — ⑬YA(−) ⑭YB(+) ⑮SG
KT8, KT9 — ⑪YA(−) ⑭YB(+) ⑰SG
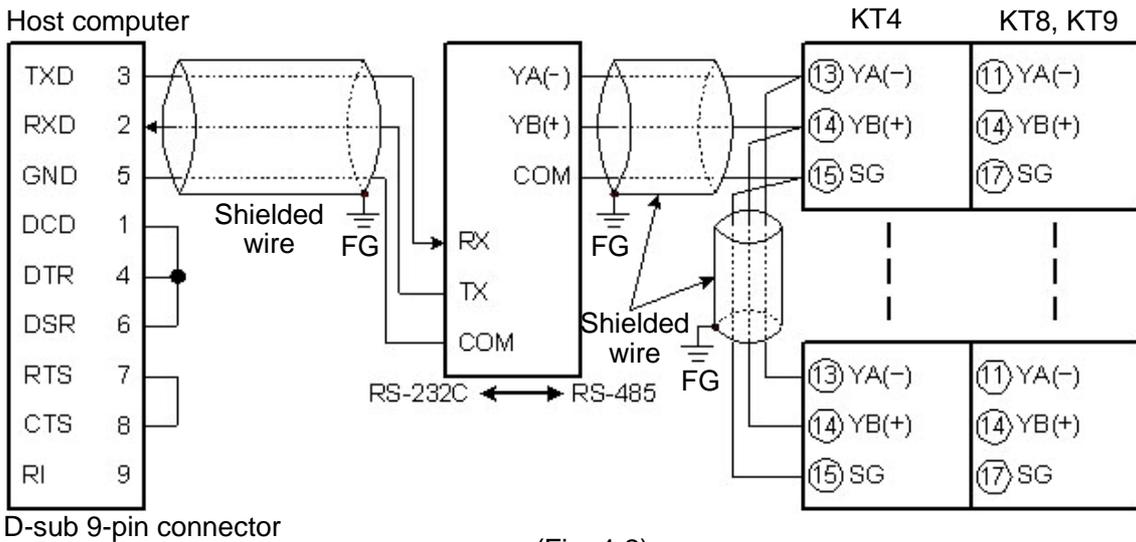
(Fig. 4-2)

When connecting with PLC (RS-485)
Connection: RS-485 ◄────► RS-485 (Communication speed: 2400, 4800, 9600, 19200bps)

PLC

(−)
(+)

RS-485

FG

Shielded wire

FG

KT4 — ⑬YA(−) ⑭YB(+) ⑮SG
KT8, KT9 — ⑪YA(−) ⑭YB(+) ⑰SG

KT4 — ⑬YA(−) ⑭YB(+) ⑮SG
KT8, KT9 — ⑪YA(−) ⑭YB(+) ⑰SG
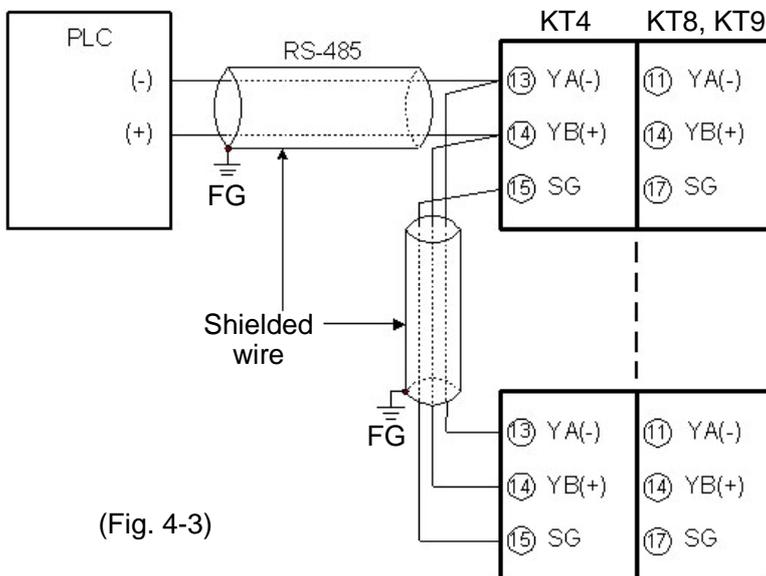
(Fig. 4-3)

3

Shielded wire
Connect only one side of the shielded wire to the FG or GND terminal so that current cannot flow to the shielded wire.
(If both sides of the shielded wire are connected to the FG or GND terminal, the circuit will be closed between the shielded wire and the ground. As a result, current will run through the shielded wire and this may cause noise.)
Be sure to ground FG and GND terminals.

Terminator (Terminal resistor)
Do not connect terminator with the communication line because each KT4, KT8 and KT9 has built-in pull-up and pull-down resistors instead of a terminator.
If there is a large distance between the PLC and the KT4, KT8 and KT9, connect the terminator (120Ω or more resistance) on the PLC side.

Setup of the KT4, KT8, KT9
- It is necessary to set the instrument number individually to the KT4, KT8 and KT9 when communicating by connecting plural units with serial communication.
  Select a communication speed of KT4, KT8 and KT9 in accordance with that of the host computer.
- For instrument number setting and communication speed selection, refer to the instruction manual for KT4, KT8 and KT9.

Memory life of the KT4, KT8, KT9
The memory can contain up to 1,000,000 (one million) set value entries.
This memory life is sufficient when the set value is changed by keypad operation.
However, when changing the set value frequently via the communication function, be careful not to exceed the 1,000,000 (one million) times limit.
When Lock 1 or Lock 2 is used, every time the set value is changed by the communication function, the changed value is written in the non-volatile memory.
If the value changed by the communication function is the same as previous one, it is not written in the non-volatile memory.
When Lock 3 is used and if the set value is changed, the changed value is not written in the non-volatile memory until the power to the controller is turned off. This has no relation to the limit for changes in set value.
**Therefore, be sure to use Lock 3 when changing the set value frequently via communication.**

SV2 of the KT8, KT9
If communication function is applied to KT8 and KT9, SV2 cannot be set by the command.

5. Communication procedure
Communication starts with command transmission from the host computer (hereafter Master) and ends with the response of the KT4, KT8, KT9 (hereafter Slave).

(Fig.5-1)
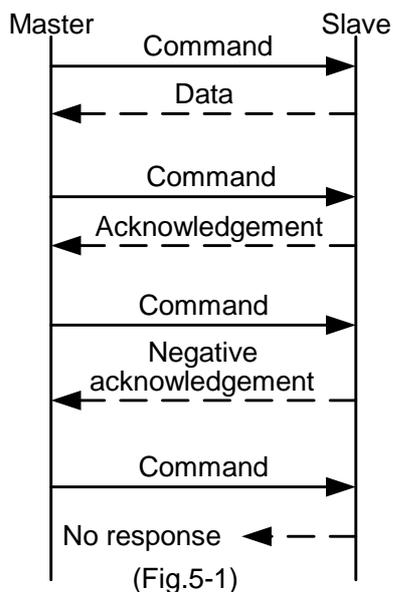
- **Response with data**
  When the master sends the reading command, the slave responds with the corresponding set value or current action status.
- **Acknowledgement**
  When the master sends setting command, the slave responds by sending an acknowledgement after the processing is terminated.
- **Negative acknowledgement**
  When the master sends non-existent command or value out of the setting range, the slave returns a negative acknowledgement.
- **No response**
  The slave will not respond to the master when broadcast address is set, or when there is a communication error (framing error or parity error), or when LRC or CRC discrepancy is detected.

Communication timing of the RS-485
Slave side
When a 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 or more characters** before sending the response to ensure the synchronization on the receiving side.
The slave is arranged so as to disconnect the transmitter from the communication line **within a 1 character transmission period** after sending the response.

4

Master side (Notice on setting a program)

Set the program so that the master can disconnect the transmitter from the communication line **within a 1 character transmission period** after sending the command in preparation for reception of the response from the slave.

To avoid the collision of transmissions between the master and the slave, send the next command after carefully checking that the master received the response.

6. Modbus protocol

6.1 Modbus protocol

Modbus protocol is a communication protocol for the PLC developed by Modicon Inc.

6.2 Transmission mode

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

6.3 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
- Parity　　　　: Even/No/Odd (Selectable)
- Stop bit　　　: 1 bit/2 bits (Selectable)
- Error detection: LRC (Longitudinal Redundancy Check)
- Data interval　: 1 second or less

(1) Message configuration

ASCII mode message is configured to start by [: (colon)(3AH)] and end by [CR (carriage return) (0DH) + LF (Line feed)(0AH)]. (See Fig. 6.3-1)

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

(Fig. 6.3-1)

(2) Slave address

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

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

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

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

(3) Function code

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

(Table 6.3-1)

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

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

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

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

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

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

(Table 6.3-2)

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)	Illegal setting (Unsettable status)
18 (12H)	Illegal setting (During setting mode by keypad operation, etc)

(4) Data

Data depends on the function code.

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

(5) Error check of ASCII mode

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

How LRC is calculated

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

(6) Message example of ASCII mode

① **Reading (Instrument number 1, SV)**

• A request message from the master

Header	Slave address	Function code	Data item	Number of data	Error check LRC	Delimiter	
(3AH)	(30H 31H)	(30H 33H)	(30H 30H 30H 31H)	(30H 30H 30H 31H)	(46H 41H)	(0DH 0AH)	Number of
1	2	2	4	4	2	2 ←	characters
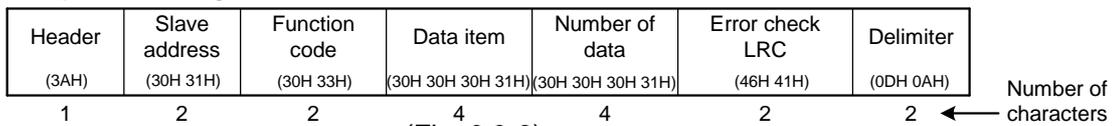
(Fig. 6.3-2)

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

• Response message from the slave in normal status (When SV=100℃)

Header	Slave address	Function code	Number of response bytes	Data	Error check LRC	Delimiter	
(3AH)	(30H 31H)	(30H 33H)	(30H 32H)	(30H 30H 36H 34H)	(39H 36H)	(0DH 0AH)	Number of
1	2	2	2	4	2	2 ←	characters
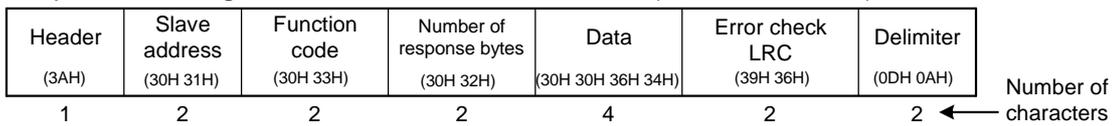
(Fig.6.3-3)

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

• Response message from the slave in exception (error) status (When non-existent data item is sent)

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

(Fig. 6.3-4)

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

② **Setting (Instrument number 1, SV=100℃)**

• A request message from the master

Header	Slave address	Function code	Data item	Data	Error check LRC	Delimiter	
(3AH)	(30H 31H)	(30H 36H)	(30H 30H 30H 31H)	(30H 30H 36H 34H)	(39H 34H)	(0DH 0AH)	Number of
1	2	2	4	4	2	2 ←	characters

(Fig. 6.3-5)

• Response message from the slave in normal status
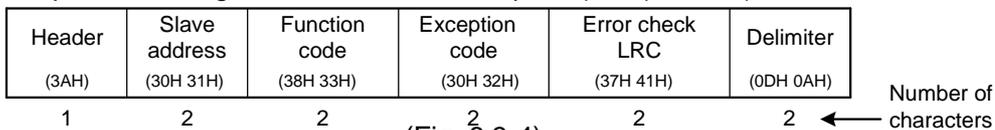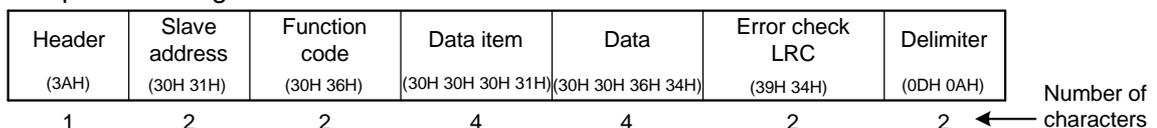
Header	Slave address	Function code	Data item	Data	Error check LRC	Delimiter	
(3AH)	(30H 31H)	(30H 36H)	(30H 30H 30H 31H)	(30H 30H 36H 34H)	(39H 34H)	(0DH 0AH)	Number of
1	2	2	4	4	2	2 ←	characters

(Fig. 6.3-6)

• Response message from the slave in exception (error) status (When a value out of the setting
range is set.)

Header	Slave address	Function code	Exception code	Error check LRC	Delimiter	
(3AH)	(30H 31H)	(38H 36H)	(30H 33H)	(37H 36H)	(0DH 0AH)	Number of
1	2	2	2	2	2 ←	characters
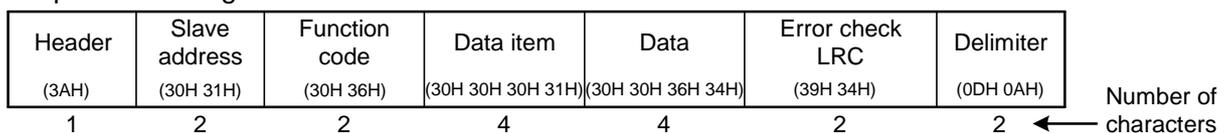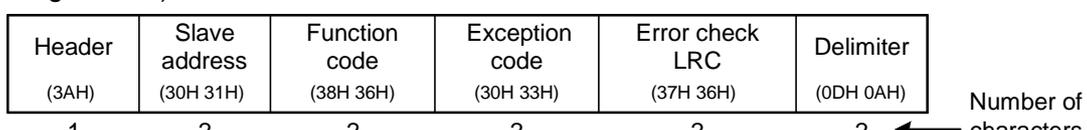
(Fig. 6.3-7)

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

6.4 RTU mode

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

Data format Start bit : 1 bit

       Data bit : 8 bits

       Parity   : Even/No/Odd (Selectable)

       Stop bit : 1 bit/2 bits (Selectable)

       Error detection : CRC-16 (Cyclic Redundancy Check)

       Data interval : 3.5 characters transmission time or less

(1) Message configuration

RTU mode is configured to start after idle time is processed for more than 3.5 character transmission and end after idle time is processed for more than 3.5 character transmission. (See Fig. 6.4-1)

3.5 idle characters	Slave address	Function code	Data	Error check CRC	3.5 idle characters
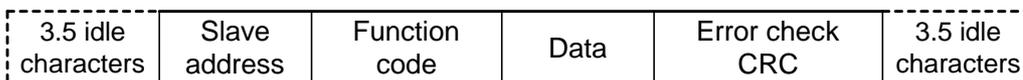
(Fig. 6.4-1)

(2) Slave address

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

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

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

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

(3) Function code

The function code is the command code for the slave to undertake the following action types (Table 6.4-1).

(Table 6.4-1)

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

Function code is used to discern whether the response is normal (acknowledgement) or if any error (negative acknowledgement) is occurred when the slave returns the response message to the master. When acknowledgement is returned, the slave simply returns the original function code.

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

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

For negative acknowledgement, exception code (Table 6.4-2) below is set to the data of response message and returned to the master in order to inform it that what kind of error has occurred.

(Table 6.4-2)

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)	Illegal setting (Unsettable status)
18 (12H)	Illegal setting (During setting mode by keypad operation, etc)

(4) Data

Data depends on the function code.

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

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

(5) Error check of RTU mode

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

How CRC is calculated

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

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

(6) Message example of RTU mode

① Reading (Instrument number 1, SV)

• A request message from the master

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

Number of characters
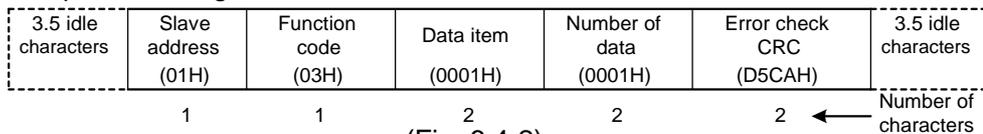
(Fig. 6.4-2)

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

• Response message from the slave in normal status (When SV=100℃)

3.5 idle characters	Slave address (01H)	Function code (03H)	Number of response bytes (02H)	Data (0064H)	Error check CRC (B9AFH)	3.5 idle characters
	1	1	1	2	2	

Number of characters
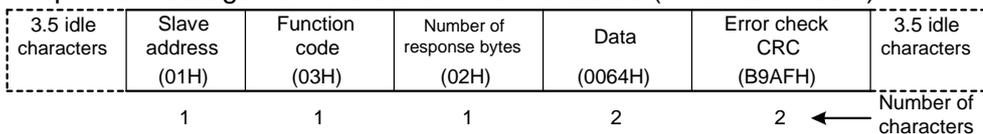
(Fig. 6.4-3)

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

• Response message from the slave in exception (error) status (When non-existent data item is sent)

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

Number of characters

(Fig. 6.4-4)

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

② Setting (Instrument number 1, SV=100℃)

• A request message from the master

3.5 idle characters	Slave address (01H)	Function code (06H)	Data item (0001H)	Data (0064H)	Error check CRC (D9E1H)	3.5 idle characters
	1	1	2	2	2	

Number of characters

(Fig. 6.4-5)

• Response message from the slave in normal status

3.5 idle characters	Slave address (01H)	Function code (06H)	Data item (0001H)	Data (0064H)	Error check CRC (D9E1H)	3.5 idle characters
	1	1	2	2	2	
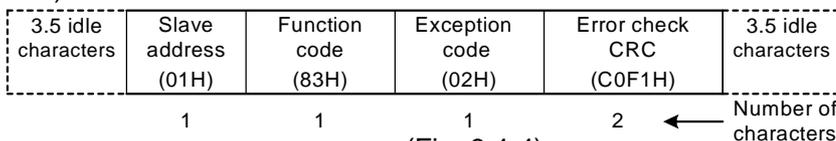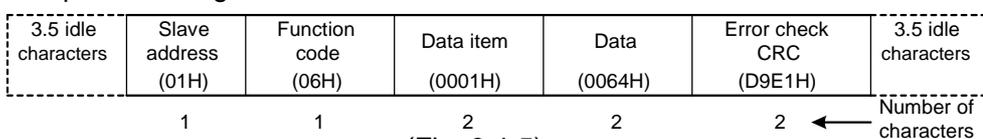
Number of characters

(Fig. 6.4-6)

• Response message from the slave in exception (error) status (When a value out of the setting range is set)

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

Number of characters
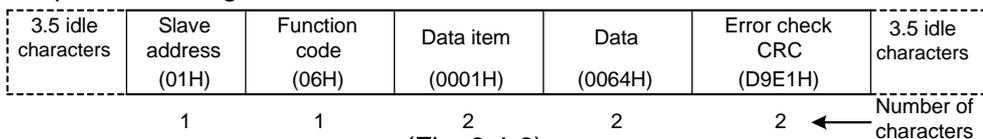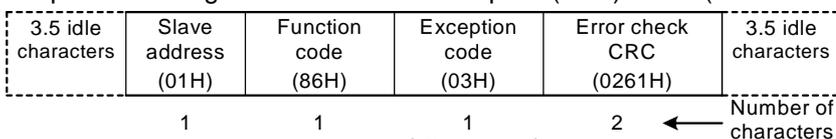
(Fig. 6.4-7)

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

7. Communication command table

When the data (set value) has a decimal point, remove the decimal point and represent it as a whole number, then express it in hexadecimal figures.

Modbus function code	Data item	Data
03H/06H	0001H: SV1	Set value
03H/06H	0002H: Not used	
03H/06H	0003H: AT/Auto-reset	0000H: Cancel 0001H: Perform
03H/06H	0004H: OUT1 proportional band	Set value
03H/06H	0005H: OUT2 proportional band	Set value
03H/06H	0006H: Integral time	Set value
03H/06H	0007H: Derivative time	Set value
03H/06H	0008H: OUT1 proportional cycle	Set value
03H/06H	0009H: OUT2 proportional cycle	Set value
03H/06H	000AH: Not used	
03H/06H	000BH: A1 value	Set value
03H/06H	000CH: A2 value	Set value
03H/06H	000DH: Not used	
03H/06H	000EH: Not used	
03H/06H	000FH: HB (Heater burnout alarm) value	Set value
03H/06H	0010H: LA (Loop break alarm) time	Set value
03H/06H	0011H: LA (Loop break alarm) span	Set value
03H/06H	0012H: Set value lock (*1)	0000H: Unlock 0001H: Lock 1 0002H: Lock 2 0003H: Lock 3
03H/06H	0013H: SV high limit	Set value
03H/06H	0014H: SV low limit	Set value
03H/06H	0015H: Sensor correction value	Set value
03H/06H	0016H: Overlap/Dead band	Set value
03H/06H	0017H: Not used	
03H/06H	0018H: Scaling high limit	Set value
03H/06H	0019H: Scaling low limit	Set value
03H/06H	001AH: Decimal point place	0000H: XXXX (No decimal point) 0001H: XXX.X (1 digit after decimal point) 0002H: XX.XX (2 digits after decimal point) 0003H: X.XXX (3 digits after decimal point)
03H/06H	001BH: PV filter time constant	Set value
03H/06H	001CH: OUT1 high limit	Set value
03H/06H	001DH: OUT1 low limit	Set value
03H/06H	001EH: OUT1 ON/OFF action hysteresis	Set value
03H/06H	001FH: OUT2 action mode	0000H: Air cooling 0001H: Oil cooling 0002H: Water cooling
03H/06H	0020H: OUT2 high limit	Set value
03H/06H	0021H: OUT2 low limit	Set value
03H/06H	0022H: OUT2 ON/OFF action hysteresis	Set value
03H/06H	0023H: A1 type (*2) 0024H: A2 type (*2)	0000H: No alarm action 0001H: High limit alarm 0002H: Low limit alarm 0003H: High/Low limits alarm 0004H: High/Low limit range alarm 0005H: Process high alarm 0006H: Process low alarm 0007H: High limit alarm with standby 0008H: Low limit alarm with standby 0009H: High/Low limits alarm with standby
03H/06H	0025H: A1 hysteresis	Set value
03H/06H	0026H: A2 hysteresis	Set value
03H/06H	0027H: Not used	
03H/06H	0028H: Not used	
03H/06H	0029H: A1 action delayed timer	Set value
03H/06H	002AH: A2 action delayed timer	Set value

03H/06H	002BH: Not used	
⋮	⋮	
03H/06H	0036H: Not used	
03H/06H	0037H: OUT/OFF	0000H: OUT 0001H: OFF
03H/06H	0038H: Auto/Manual control	0000H: Automatic control 0001H: Manual control
03H/06H	0039H: Manual control MV (manipulated variable)	Set value
03H/06H	003AH: Not used	
⋮	⋮	
03H/06H	003FH: Not used	
03H/06H	0040H: A1 action Energized/Deenergized	0000H: Energized 0001H: Deenergized
03H/06H	0041H: A2 action Energized/Deenergized	0000H: Energized 0001H: Deenergized
03H/06H	0042H: Not used	
03H/06H	0043H: Not used	
03H/06H	0044H: Input type	0000H: K [−200 to 1370℃] 0001H: K [−199.9 to 400.0℃] 0002H: J [−200 to 1000℃] 0003H: R [0 to 1760℃] 0004H: S [0 to 1760℃] 0005H: B [0 to 1820℃] 0006H: E [−200 to 800℃] 0007H: T [−199.9 to 400.0℃] 0008H: N [−200 to 1300℃] 0009H: PL-Ⅱ [0 to 1390℃] 000AH: C (W/Re5-26) [0 to 2315℃] 000BH: Pt100 [−199.9 to 850.0℃] 000CH: JPt100 [−199.9 to 500.0℃] 000DH: Pt100 [−200 to 850℃] 000EH: JPt100 [−200 to 500℃] 000FH: K [−320 to 2500℉] 0010H: K [−199.9 to 750.0℉] 0011H: J [−320 to 1800℉] 0012H: R [0 to 3200℉] 0013H: S [0 to 3200℉] 0014H: B [0 to 3300℉] 0015H: E [−320 to 1500℉] 0016H: T [−199.9 to 750.0℉] 0017H: N [−320 to 2300℉] 0018H: PL-Ⅱ [0 to 2500℉] 0019H: C (W/Re5-26) [0 to 4200℉] 001AH: Pt100 [−199.9 to 999.9℉] 001BH: JPt100 [−199.9 to 900.0℉] 001CH: Pt100 [−300 to 1500℉] 001DH: JPt100 [−300 to 900℉] 001EH: 4 to 20mA DC [−1999 to 9999] 001FH: 0 to 20mA DC [−1999 to 9999] 0020H: 0 to 1V DC [−1999 to 9999] 0021H: 0 to 5V DC [−1999 to 9999] 0022H: 1 to 5V DC [−1999 to 9999] 0023H: 0 to 10V DC [−1999 to 9999]
03H/06H	0045H: Direct/Reverse action	0000H: Heating (Reverse action) 0001H: Cooling (Direct action)
03H/06H	0046H: Not used	
03H/06H	0047H: AT bias	Set value
03H/06H	0048H: ARW (anti-reset windup)	Set value
03H/06H	006FH: Key Lock	0000H: Key enabled 0001H:Key Lock
06H	0070H: Key operation change flag clearing	0000H: No action 0001H: All clearing
03H	0080H: PV reading	Present PV (input value)
03H	0081H: OUT1 MV reading	Present MV (manipulated variable)
03H	0082H: OUT2 MV reading	Present MV (manipulated variable)

03H	0083H: Not used	
03H	0084H: Not used	

03H	0085H: OUT status reading	$\begin{array}{cccc}0000 & 0000 & 0000 & 0000\\ 2^{15} & & \text{to} & 2^0\end{array}$
		2^0 digit: OUT1
		    0: OFF 1: ON
		2^1 digit: OUT2
		    0: OFF 1: ON
		2^2 digit: A1 output
		    0: OFF 1: ON
		2^3 digit: A2 output
		    0: OFF 1: ON
		2^4 digit: Not used (Always 0)
		2^5 digit: Not used (Always 0)
		2^6 digit: HB (Heater burnout alarm)
		    output
		    0: OFF 1: ON
		    (When sensor burnout, 0: OFF)
		2^7 digit: LA (Loop break alarm) output
		    0: OFF 1: ON
		2^8 digit: Overscale
		    0: OFF 1: ON
		2^9 digit: Underscale
		    0: OFF 1: ON
		2^{10} digit: OUT/OFF selection
		    0: OUT 1: OFF
		2^{11} digit: AT/Auto-reset
		    0: OFF 1: ON
		2^{12} digit: OUT/OFF key function selection
		    0: OUT/OFF
		    1: Auto/Manual
		2^{13} digit: Not used (Always 0)
		2^{14} digit: Auto/Manual control
		    0: Automatic
		    1: Manual
		2^{15} digit: Key operation change
		    0: No 1: Yes

03H	0086H: Not used	
03H	0087H: Not used	
03H	00A0H: Not used	

03H	00A1H: Instrument information reading	$\begin{array}{cccc}0000 & 0000 & 0000 & 0000\\ 2^{15} & & \text{to} & 2^0\end{array}$
		2^0 digit: Not used (Always 0)
		2^1 digit: Cooling action
		    0: Not applied 1: Applied
		2^2 digit: A1 function
		    0: Not applied 1: Applied
		2^3 digit: A2 function
		    0: Not applied 1: Applied
		2^4 digit: Not used (Always 0)
		2^5 digit: Not used (Always 0)
		2^6 digit: HB (Heater burnout alarm)
		    0: Not applied 1: Applied
		2^7 digit: LA (Loop break alarm)
		    0: Not applied 1: Applied
		2^8 to 2^{15} digit: Not used (Always 0)

(*1) When Lock 3 is designated, the set data is not saved in the memory.
   This is why the set value reverts to the one before Lock 3 when power is turned OFF.
(*2) When alarm type is changed, the alarm set value reverts to the default value and
   alarm output status is also initialized.

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

(Example 1) SV high limit: 1370℃
            SV   : 1000℃

            When SV high limit is changed to 800℃ by the front keypad operation, both SV high limit and SV are changed to 800℃.

(Example 2) SV high limit: 1370℃
            SV   : 1000℃

            When SV high limit is changed to 800℃ by communication function, SV high limit is changed to 800℃, however, SV is maintained at the same temperature 1000℃.

7. Specifications

Communication method   : Half-duplex
Cable length   : Maximum communication distance 1000m
                           Cable resistance: Within 50Ω (Terminator is not necessary or
                                      120Ω or more on PLC side.)
Communication line   : EIA RS-485
Connectable number of units: Maximum 31 units to 1 host computer
Communication speed   : 2400, 4800, 9600, 19200bps (Selectable by keypad operation)
Synchronous system   : Start-stop synchronous
Code form   : ASCII, binary
Error detection   : Parity check, Checksum (LRC, CRC)
Error correction   : Command request repeat system
Data format   Start bit : 1
                            Data bit : 7, 8
                            Parity   : Even, Odd, No parity
                            Stop bit : 1

8. Troubleshooting

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

• **Problem: Communication failure**

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

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

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

For further inquiries, please consult our agency or the shop where you purchased the unit.