Panasonic

COMMUNICATION INSTRUCTION MANUAL TEMPERATURE CONTROLLER KT2

No. KTC3E5 2013.05

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 at the end of the model number. (For the model number and basic operation, refer to the instruction manual for KT2.)

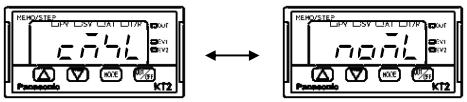
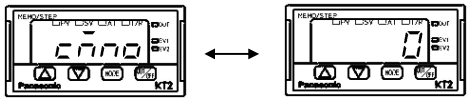
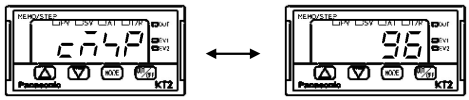
⚠ Warning

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

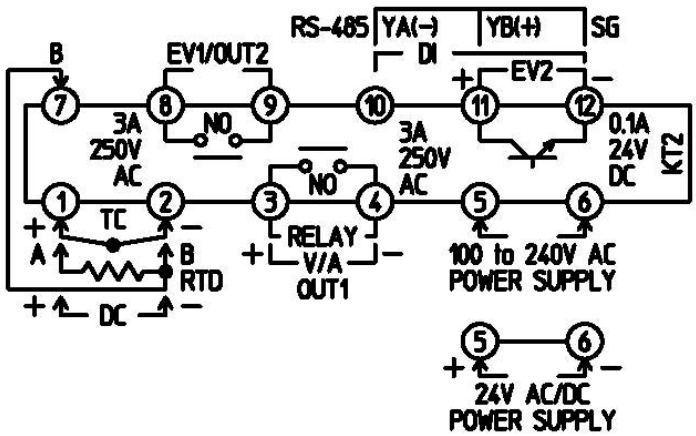
1. Setup of the KT2

Set the items “Communication protocol selection”, “Instrument number setting”, “Communication speed selection” after the “Sensor correction setting” in Auxiliary function setting mode 1.

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

Display	Name, Functions, Setting range	Default value
	**Communication protocol selection** • Selects the communication protocol. • nonL: Unavailable modA: Modbus ASCII mode modr: Modbus RTU mode	Modbus ASCII mode
	**Instrument number setting** • Sets the instrument number individually to each instrument when communicating by connecting plural instruments in serial communication. • Setting range: 0 to 95 (However, number of connectable units: Max. 31 units)	0
	**Communication speed selection** • Selects a communication speed to be equal to the speed of the host computer. • 24: 2400bps 48: 4800bps 96: 9600bps 192: 19200bps	9600bps

2. Terminal arrangement

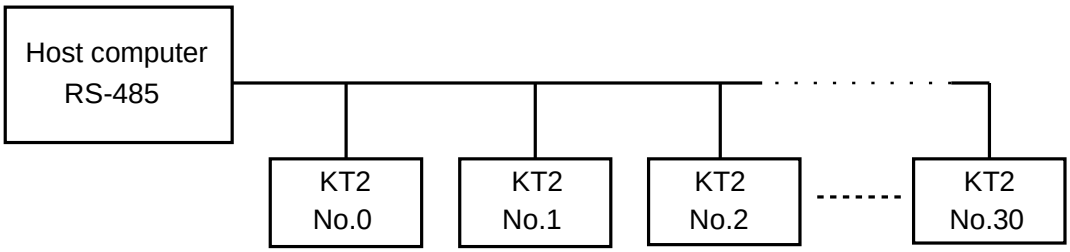


(Fig. 2-1)

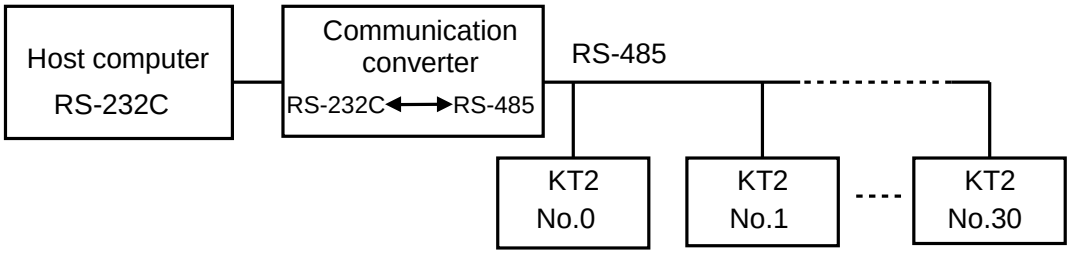
- TC : Thermocouple input terminals
- RTD : RTD input terminals
- DC : DC current, DC voltage input terminals
  For DC current input type, connect 50Ω shunt resistor (sold separately) between input terminals.
- OUT1 : Control output or Heating output (Heating/Cooling control option) terminals
- POWER SUPPLY: Power terminals
- EV1/OUT2: Event output 1 or Cooling output (Heating/Cooling control option) terminals
- EV2 : Event output 2 terminals
- DI : DI (Digital input) terminals
  Three DI functions: SV1/SV2 external selection function, OUT/OFF (RUN/STOP) external selection and Timer function
- RS-485: Serial communication terminals

3. System configuration

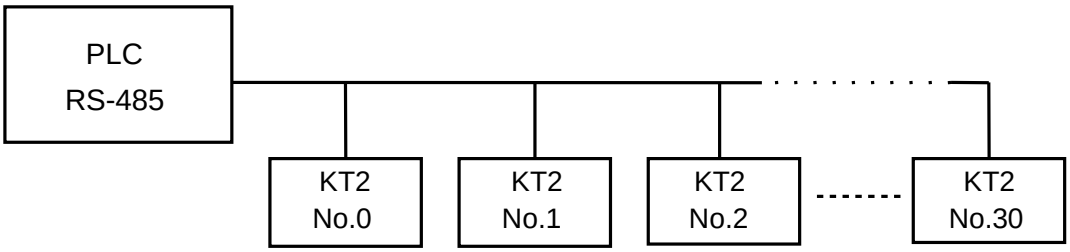
RS-485 multi-drop connection communication



(Fig. 3-1)



(Fig. 3-2)

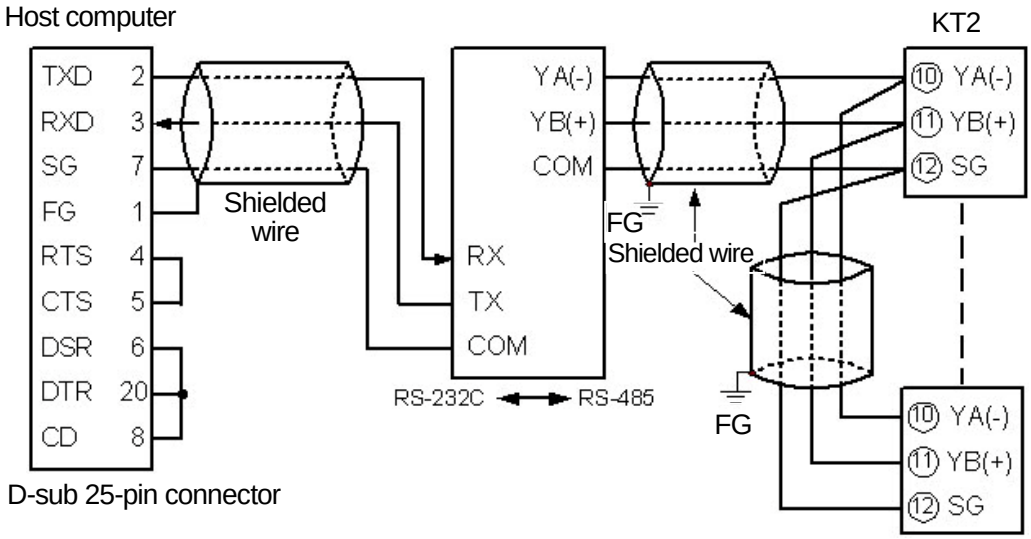


(Fig. 3-3)

4. Wiring

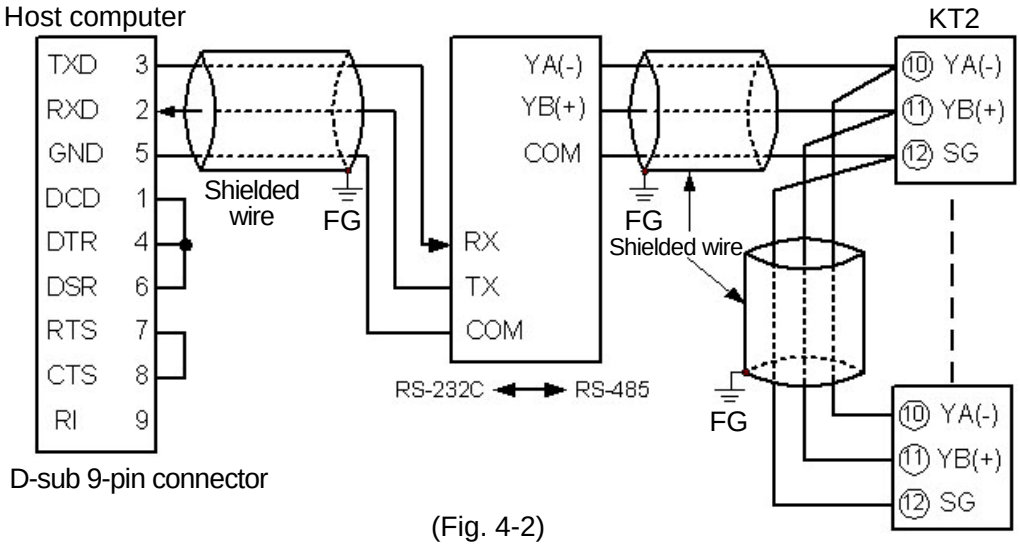
When using a communication converter

• Connector: D-sub 25-pin
Connection: RS-232C ◄——► RS-485 (Communication speed: 2400, 4800, 9600, 19200bps)



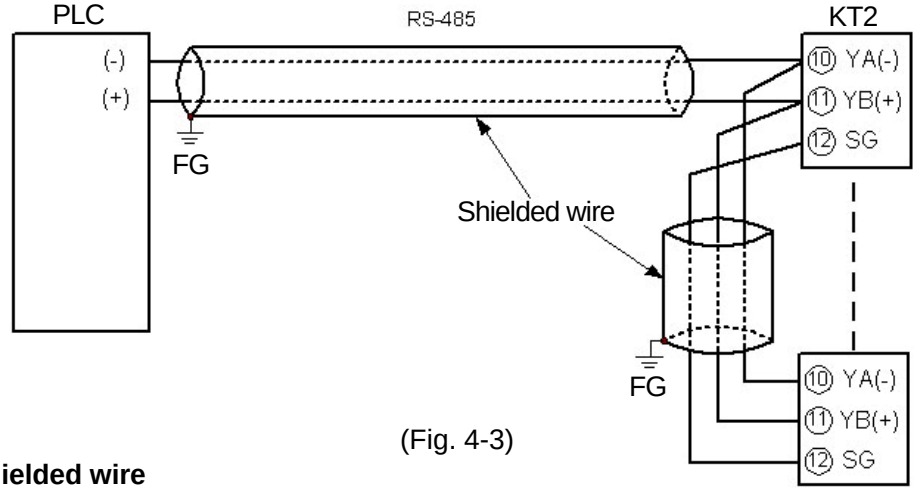
(Fig. 4-1)

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



(Fig. 4-2)

• When connecting PLC (RS-485)
Connection: RS-485 ⟷ RS-485 (Communication speed: 2400, 4800, 9600, 19200bps)



(Fig. 4-3)

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 KT2 has built-in pull-up and pull-down resistors instead of a terminator.
If there is a large distance between the PLC and the KT2, connect the terminator on the PLC side. (Connect a terminator of 120Ω or more resistance.)

Setup of the KT2

• It is necessary to set the instrument number individually to the KT2 when communicating by connecting plural units with serial communication.
Select a communication speed of KT2 in accordance with that of the host computer.
• For instrument number setting and communication speed selection, refer to Chapter “1. Setup of the KT2” or the instruction manual for KT2.

Memory capacity of the KT2

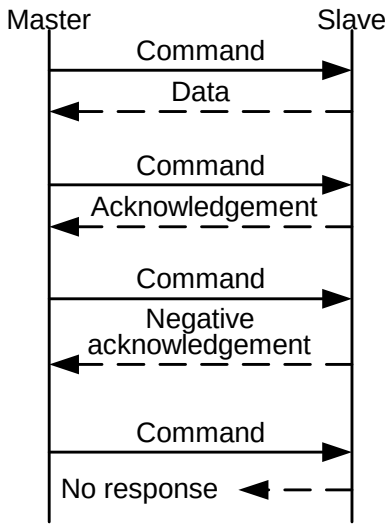
The memory can contain up to 1,000,000 (one million) set value entries. This memory capacity is sufficient when the set value is changed by keypad operation. However, when changing the set value via the communication function, be careful not to exceed the 1,000,000 (one million) capacity limit.
When 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, then 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 function.

SV2 of the KT2.

If communication function is applied to KT2, 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 KT2 (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 status.
- **Acknowledgement**
  When the master sends the setting command, the slave responds by sending an acknowledgement after the processing is terminated.
- **Negative acknowledgement**
  When the master sends a non-existent command or a value outside 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 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 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.

Master side (Notice on programming)

Set the program so that the master can disconnect the transmitter from the communication line **within a 1 character transmission period** after sending the command in preparation for reception of the response from the slave.
To avoid the collision of transmissions between the master and the slave, send the next command after carefully checking that the master 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 the command is transmitted as ASCII characters.

Data format
- Start bit : 1 bit
- Data bit : 7 bits
- Parity : Even
- Stop bit : 1 bit
- 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 that makes 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

A function code is used to discern whether the response is normal (acknowledgement) or if any error (negative acknowledgement) has occurred when the slave returns the response message to the master.
When acknowledgement is returned, the slave simply returns the original function code.
When negative acknowledgement is returned, the MSB of the original function code is set as 1 for the response.
(For example, when the master sends a 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, etc)

(4) Data

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

(5) ASCII mode error check

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 is appended to the end of the 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) ASCII mode message example

① **Reading (Address 1, PV)**

• A request message from the master
The number of data indicates the data item to be read and it is fixed as (30H 30H 30H 31H).

Header	Slave address	Function code	Data item	Number of data	Error check LRC	Delimiter	
(3AH)	(30H 31H)	(30H 33H)	(30H 30H 38H 30H)	(30H 30H 30H 31H)	(37H 42H)	(0DH 0AH)	
1	2	2	4	4	2	2	← Number of characters

(Fig. 6.3-2)

• A response message from the slave in normal status [When PV=600℃ (0258H)]
The number of response bytes indicates the number of bytes of the data which has been read, and it is fixed as (30H 32H).

Header	Slave address	Function code	Number of response bytes	Data	Error check LRC	Delimiter	
(3AH)	(30H 31H)	(30H 33H)	(30H 32H)	(30H 32H 35H 38H)	(41H 30H)	(0DH 0AH)	
1	2	2	2	4	2	2	← Number of characters

(Fig.6.3-3)

• A response message from the slave in exception (error) status (When data item is mistaken)
The function code MSB is set to 1 for the response message in exception (error) status [83H (38H 33H)]. If an exception code [02H (30H 32H): Non-existent data address] is returned, the error can be determined by reading this code.

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

← Number of characters

(Fig.6.3-4)

② **Reading (Address 1, SV1)**

• Request message from the master
The number of the data indicates the data item to be read and it is fixed as (30H 30H 30H 31H).

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)
1	2	2	4	4	2	2

← Number of characters

(Fig. 6.3-5)

• A response message from the slave in normal status [When SV1=600℃ (0258H)]
The number of response bytes indicates the number of bytes of the data which has been read, and it is fixed as (30H 32H).

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

← Number of characters

(Fig. 6.3-6)

• A response message from the slave in exception (error) status (When data item is mistaken)
The function code MSB is set to 1 for the response message in exception (error) status [83H (38H 33H)]. If an exception code [02H (30H 32H): Non-existent data address] is returned, the error can be determined by reading this code.

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

← Number of characters

(Fig. 6.3-7)

③ **Setting (Address 1, SV1)**

• A request message from the master: When setting SV1 to 600℃ (0258H)

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

← Number of characters

(Fig. 6.3-8)

• A 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 32H 35H 38H)	(39H 45H)	(0DH 0AH)
1	2	2	4	4	2	2

← Number of characters

(Fig. 6.3-9)

• A response message from the slave in exception (error) status (When a value out of the setting range is set.)
The function code MSB is set to 1 for the response message in exception (error) status [86H (38H 36H)]. If an exception code [03H (30H 33H): Value out of the setting range] is returned, the error can be determined by reading this code.

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

← Number of characters

(Fig. 6.3-10)

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 : No parity
- Stop bit : 1 bit
- 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 characters transmission and end after idle time is processed for more than 3.5 characters 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 that makes the slave 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

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

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

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

(For example, when the master sends request message setting 10H to 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, etc)

(4) Data

Data differs depending 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) RTU mode error check

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 a polynomial series. The remainder is added to the end of the information and then 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) RTU mode message example

① **Reading (Address 1, PV)**

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

3.5 idle characters	Slave address (01H)	Function code (03H)	Data item (0080H)	Number of data (0001H)	Error check CRC (85E2H)	3.5 idle characters
	1	1	2	2	2 ←	Number of characters

(Fig. 6.4-2)

• Response message from the slave in normal status [When PV=600℃ (0258H)]
The number of response bytes indicates number of bytes of the data which has been read, and it is fixed as (02H).

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

(Fig. 6.4-3)

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

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)

② **Reading (Address 1, SV1)**

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

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. 6.4-5)

• Response message from the slave in normal status [SV1=600℃ (0258H)]
The number of response bytes indicates number of bytes of the data which has been read, and it is fixed as (02H).

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

(Fig. 6.4-6)

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

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. 6.4-7)

③ **Setting (Address 1, SV1)**

• A request message from the master: When setting SV1 to 600℃ (0258H)

3.5 idle characters	Slave address (01H)	Function code (06H)	Data item (0001H)	Data (0258H)	Error check CRC (D890H)	3.5 idle characters
	1	1	2	2	2 ←	Number of characters

(Fig. 6.4-8)

• 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 (D890H)	3.5 idle characters
	1	1	2	2	2 ←	Number of characters

(Fig. 6.4-9)

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

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. 6.4-10)

7. Communication command table

Modbus function code	Data item	Data
03H/06H	1110H: Step 1 SV	Set value, Decimal point ignored
03H/06H	1111H: Step 1 time	Set value, Decimal point ignored
03H/06H	1120H: Step 2 SV	Set value, Decimal point ignored
03H/06H	1121H: Step 2 time	Set value, Decimal point ignored
03H/06H	1130H: Step 3 SV	Set value, Decimal point ignored
03H/06H	1131H: Step 3 time	Set value, Decimal point ignored
03H/06H	1140H: Step 4 SV	Set value, Decimal point ignored
03H/06H	1141H: Step 4 time	Set value, Decimal point ignored
03H/06H	1150H: Step 5 SV	Set value, Decimal point ignored
03H/06H	1151H: Step 5 time	Set value, Decimal point ignored
03H/06H	1160H: Step 6 SV	Set value, Decimal point ignored
03H/06H	1161H: Step 6 time	Set value, Decimal point ignored
03H/06H	1170H: Step 7 SV	Set value, Decimal point ignored
03H/06H	1171H: Step 7 time	Set value, Decimal point ignored
03H/06H	1180H: Step 8 SV	Set value, Decimal point ignored
03H/06H	1181H: Step 8 time	Set value, Decimal point ignored
03H/06H	1190H: Step 9 SV	Set value, Decimal point ignored
03H/06H	1191H: Step 9 time	Set value, Decimal point ignored
03H/06H	0001H: SV1	Set value, Decimal point ignored
	0002H: Not used	
03H/06H	0003H: AT	0000H: Cancel 0001H: Perform
03H/06H	0004H: OUT1 (Heating) proportional band	Set value, Decimal point ignored
03H/06H	0005H: OUT2 (Cooling) proportional band	Set value, Decimal point ignored
03H/06H	0006H: OUT1 (Heating) integral time	Set value
03H/06H	0007H: OUT1 (Heating) derivative time	Set value
03H/06H	0008H: OUT1 (Heating) proportional cycle	Set value
03H/06H	0009H: OUT2 (Cooling) proportional cycle	Set value
03H/06H	000AH: Manual reset	Set value, Decimal point ignored
03H/06H	000BH: A1 value	Set value, Decimal point ignored
03H/06H	000CH: A2 value	Set value, Decimal point ignored
	000DH: Not used	
	⋮	
	0011H: Not used	
03H/06H	0012H: Set value lock (*1)	0000H: Unlock 0001H: Lock 1 0002H: Lock 2 0003H: Lock 3
	0013H: Not used	
	0014H: Not used	
03H/06H	0015H: Sensor correction	Set value, Decimal point ignored
03H/06H	0016H: Overlap band/Dead band	Set value
	0017H: Not used	
03H/06H	0018H: Scaling high limit	Set value, Decimal point ignored
03H/06H	0019H: Scaling low limit	Set value, Decimal point ignored
03H/06H	001AH: Decimal point place	0000H: No decimal point 0001H: 1 digit after decimal point 0002H: 2 digits after decimal point 0003H: 3 digits after decimal point

(*1) If Lock 3 is selected, the set data is not saved in the memory. After the power is turned off, the set value reverts to the value set before Lock 3 was selected.

03H/06H	001BH: PV filter time constant	Set value, Decimal point ignored
03H/06H	001CH: OUT1 (Heating) high limit	Set value
03H/06H	001DH: OUT1 (Heating) low limit	Set value
03H/06H	001EH: OUT1 (Heating) ON/OFF action hysteresis	Set value, Decimal point ignored
	001FH: Not used	
	0020H: Not used	
	0021H: Not used	
03H/06H	0022H: OUT2 (Cooling) ON/OFF action hysteresis	Set value, Decimal point ignored
03H/06H	0023H: A1 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 000AH: Timer function 000BH: Pattern end output
03H/06H	0024H: A2 type (*2)	The same as A1 type selection
03H/06H	0025H: A1 hysteresis	Set value, Decimal point ignored
03H/06H	0026H: A2 hysteresis	Set value, Decimal point ignored
	0027H: Not used	
	0028H: Not used	
03H/06H	0029H: A1 action delayed timer	Set value
03H/06H	002AH: A2 action delayed timer	Set value
	002BH: Not used	
	⋮	
	0036H: Not used	
03H/06H	0037H: OUT/OFF (RUN/STOP)	0000H: OUT(STOP) 0001H: OFF(RUN)
	0038H: Not used	
	⋮	
	0041H: Not used	
03H/06H	0042H: Alarm HOLD function	0000H: Alarm Not Holding 0001H: Alarm Holding
	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℉]

(*2) If the alarm type is changed, the alarm set value reverts to the default value, and alarm output status is also initialized.

		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)
	0046H: Not used	
03H/06H	0047H: AT bias	Set value, Decimal point ignored
03H/06H	0048H: ARW	Set value
03H/06H	006FH: Key lock	0000H: Key enabled 0001H: Key locked
06H	0070H: Key operation change flag clearing	0000H: No action 0001H: All clearing
03H	0080H: PV (input value) reading	Current PV, Decimal point ignored
03H	0081H: OUT1 (Heating) MV reading	OUT1 (Heating) MV (manipulated variable), Decimal point ignored
03H	0082H: OUT2 (Cooling) MV reading	OUT2 (Cooling) MV, Decimal point ignored
03H	0083H: Current SV reading	Current SV, Decimal point ignored
03H	0084H: Running step remaining time reading	Remaining time Decimal point ignored
03H	0085H: Status flag	0000 0000 0000 0000 2^{15} to 2^{0} 2^{0} digit: OUT1 (Heating) output 0: OFF 1: ON (For current output, Not decided) 2^{1} digit: OUT2 (Cooling) output 0: OFF 1: ON 2^{2} digit: A1 output 0: OFF 1: ON 2^{3} digit: A2 output 0: OFF 1: ON 2^{4} to 2^{7} digit: Not used (Always 0) 2^{8} digit: Overscale 0: OFF 1: ON 2^{9} digit: Underscale 0: OFF 1: RUN 2^{10} digit: OUT (STOP)/OFF (RUN) selection 0: OUT (STOP) 1: OFF (RUN) 2^{11} digit: During AT 0: OFF 1: AT 2^{12} digit: OUT/OFF key function selection 0: Control output OUT/OFF function (Fixed value control) 1: Program control function 2^{13} digit: Controller/Converter mode selection 0: Controller 1: Converter 2^{14} digit: Not used (Always 0) 2^{15} digit: Change in key operation 0: No 1: Yes
03H	0086H: Running step	Running step
	0087H: Not used	
	0088H: Not used	
	00A0H: Not used	

03H	00A1H: Instrument information reading	0000 0000 0000 0000 2^{15} to 2^{0} 2^{0} digit: OUT1 (Heating) output 0: OFF 1: ON (For current output, Not decided) 2^{1} digit: Heating/Cooling function option 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} to 2^{15} digit: Not used (Always 0)

8. Specifications

Communication method : Half-duplex
Cable length : Maximum communication distance 1,000m
Cable resistance: Within 50Ω (The terminator is not necessary or 120Ω or more on the PLC side.)
Communication line : EIA RS-485
Number of connectable units: Maximum 31 units
Communication speed : 9600bps (2400, 4800, 9600, 19200bps) Selectable by keypad
Synchronous system : Start-stop synchronous
Instrument number : 0 (0 to 95) Selectable by keypad
Communication protocol : Modbus ASCII (Modbus ASCII, Modbus RTU) Selectable by keypad
Code form : ASCII (Modbus ASCII) , Binary (Modbus RTU) (*)
Error detection : Parity, LRC (Modbus ASCII), CRC (Modbus RTU) (*)
Error correction : Command request repeat system
Data format
Start bit : 1 bit
Data bit : 7 bits (Modbus ASCII), 8 bits (Modbus RTU) (*)
Parity : Even (Modbus ASCII), No parity (Modbus RTU) (*)
Stop bit : 1 bit
(*): Automatically selected upon selecting the communication protocol.

9. Troubleshooting

If any malfunction occurs, 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 the communication cable 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 whether a non-existent command code has been sent or not.
The setting command data exceeds the setting range of the slave.
The controller cannot be set when functions such as AT is performed.
While in setting mode and inputting settings via the front keypad.

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

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