



Operation Manual

Communication Functions

PRODUCT NAME

THERMO CHILLER

MODEL / Series / Product Number

**Air-cooled
refrigerated type**
HRSC012-A*-20-*
HRSC018-A*-20-*
HRSC024-A*-20-*
HRSC030-A*-20-*
HRSC040-A*-20-*
HRSC050-A*-20-*
HRSC060-A*-20-*

**Water-cooled
refrigerated type**
HRSC012-W*-20-*
HRSC018-W*-20-*
HRSC024-W*-20-*
HRSC030-W*-20-*
HRSC040-W*-20-*
HRSC050-W*-20-*
HRSC060-W*-20-*

SMC Corporation

To Users,

Thank you for purchasing SMC's Thermo chiller (hereinafter referred to as the "product").

For safety and long life of the product, be sure to read this operation manual (hereinafter referred to as the "manual") and clearly understand the contents.

- Be sure to read and follow all instructions noted with "Warning" or "Caution" in this manual.
- This manual is intended to explain the installation and operation of the product. Only people who understand the basic operation of the product through this manual or who performs installation and operation of or have basic knowledge about industrial machines are allowed to work on the product.
- This manual and other documents attached to the product do not constitute a contract, and will not affect any existing agreements or commitments.
- It is strictly prohibited to copy this manual entirely or partially for the use by the third party without prior permission from SMC.

Note: This manual is subject to possible change without prior notice.

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Chapter 1 Read before using

The communication of this device consists of contact input/output communication and serial communication.

MODBUS communication and simple communication protocol can be selected as the serial communication protocol. Depending on the customer's specification, communication can be changed to contact input/output communication or serial communication.

Table 1-1 Communication method

Contact input/output communication		This product is equipped with a terminal which runs/stops the product by remote control and a terminal which can pick up alarm signals. The terminals can be changed depending on the customer's application.
Serial communication	MODBUS standard protocol	Serial communication (RS-485/RS232C) enables remote control of run/start of the product, temperature setting, and details of product condition and alarm condition can be obtained.
	Simple communication protocol	Serial communication (RS-485/RS232C) enables remote control of temperature setting. This protocol complies with SMC thermo-chiller HRS series (thermo-cooler HRG, HRGC series). (We recommend using the MODBUS protocol if you are unfamiliar with using the communication function.) There are two ways to start and stop by simple communication protocol. The customer can choose between operation using the Operation display panel (simple communication protocol 1) and remote control using the contact input (simple communication protocol 2).

●If using contact input/output communication, refer to chapter 2.

●If using serial communication MODBUS, refer to chapter 3 for serial communication specifications first, then refer to chapter 4 for protocol specifications.

●If using simple communication protocol for serial communication, refer to chapter 3 for serial communication specifications first, then refer to chapter 5 for protocol specifications.

1.1 Communication mode and operation method

LOCAL, DIO and SERIAL are available as the communication modes. Table 1.1-1 explains the communication modes. The default setting is LOCAL.

The operation method depends on the communication mode. Table 1.1-2 shows how the communication mode and method of operation are related.

The operation of the product functions depends on the communication mode. Table 1.1-3 shows how the communication mode and functions of this product are related.

Table 1.1-1 Communication modes

Communication mode	Explanation
LOCAL	Mode allowing the product to be operated by the operation panel.
DIO	Mode allowing the product to be operated by the contact input/output communication. When the communication mode is "DIO", operation mode automatically becomes "DIO REMOTE". "DIO REMOTE" and "DIO LOCAL" can be selected by DIO communication signal. Contact input/output communication takes control of the operation of the product. The [REMOTE] lamp on the operation panel turns on. DIO REMOTE : Operation control of the product is the same as that of LOCAL. DIO LOCAL : The [REMOTE] lamp on the operation panel turns off.
SERIAL	Mode allowing the product to be operated by serial communication. MODBUS/simple communication protocol can be selected.

Table 1.1-2 Communication mode and operation

	LOCAL	DIO		SERIAL		
		DIO LOCAL	DIO REMOTE	MODBUS	Simple communication protocol pattern	
					1	2
Run/Stop control with operation display panel	○	○	×	×	○	×
Circulating fluid supply temperature setting control with operation display panel	○	○	○	×	×	
Except above with operation display panel	○	○	○	○	○	
Condition reading with operation display panel	○	○	○	○	○	
Run/Stop operation by contact input/output communication	×	×	○	×	×	○
Condition reading by contact input/output communication	○	○	○	○	○	
Reading of the external switch	○	×	○ ^{*1}	○	○	○ ^{*1}
Run/Stop operation by serial communication.	×	×	×	○	×	
Circulating fluid supply temperature setting control by serial communication.	×	×	×	○	○	
Condition reading by serial communication.	○	○	○	○	○	

*1: Only one external switch can be installed.

○ : Applicable

×

Table 1.1-3 Communication mode and product functions

	LOCAL	DIO		SERIAL		
		DIO LOCAL	DIO REMOTE	MODBUS	Simple communication protocol pattern	
					1	2
Run timer	○	○	×	×	○	×
Stop timer	○	○	×	×	○	×
Recovery from power failure	○	○	×	×	○	×
Anti-freezing	○	○	○	○	○	○
Pump accumulated operating time reset	○	○	×	×	○	×

○ : Applicable

×

1.2 Communication port

The communication port at the back of the product is used for communication. Figure 1.2-1 shows the location of the communication port.

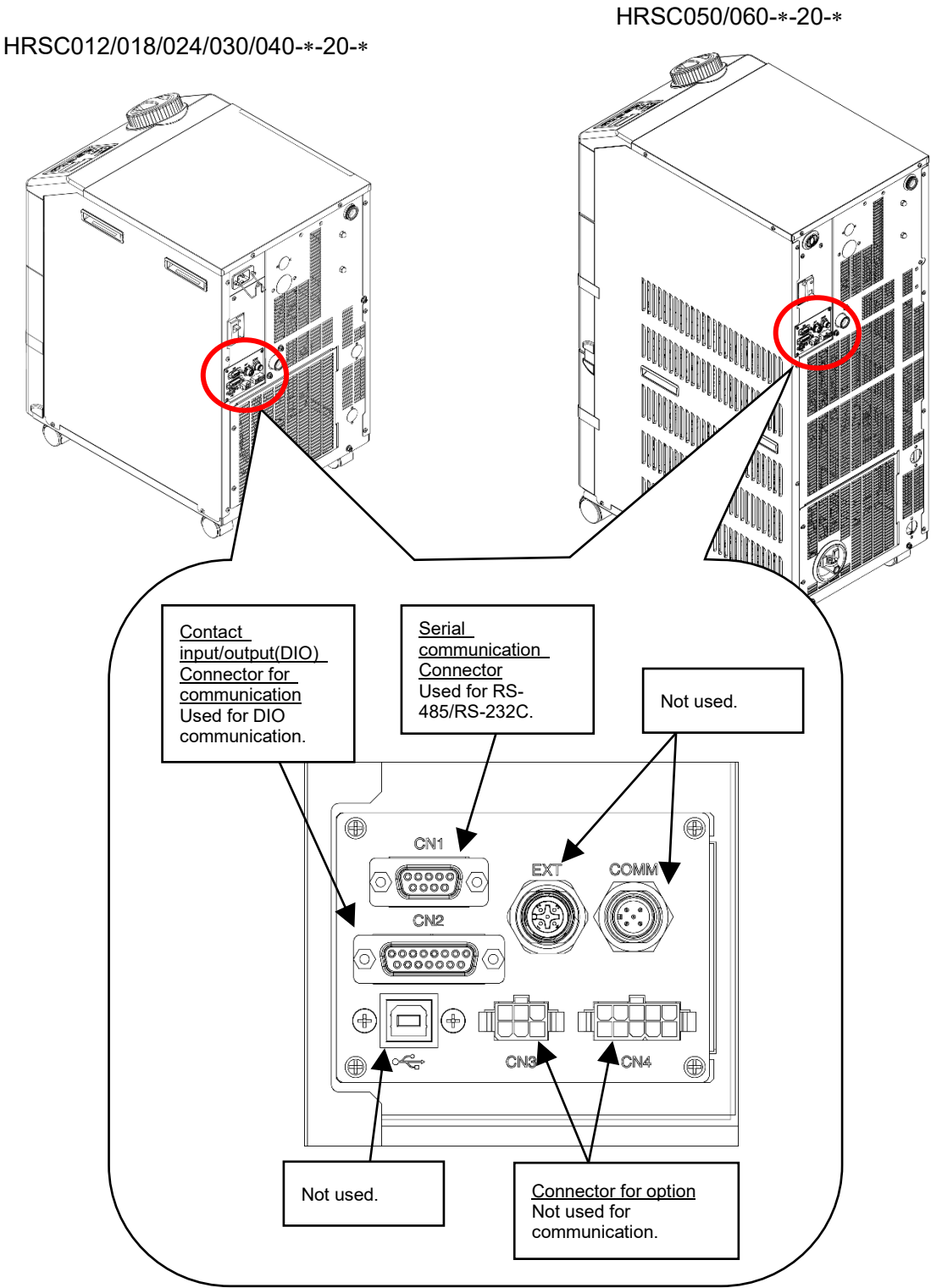


Figure 1.2-1 Communication port

1.3 Key operations

Figure 1.3-1 "Key operation(1/2)" and

Figure 1.3-2 "Key operation(2/2)" show the operation of keys of the thermo-chiller. This manual explains the "Communication setting menu".

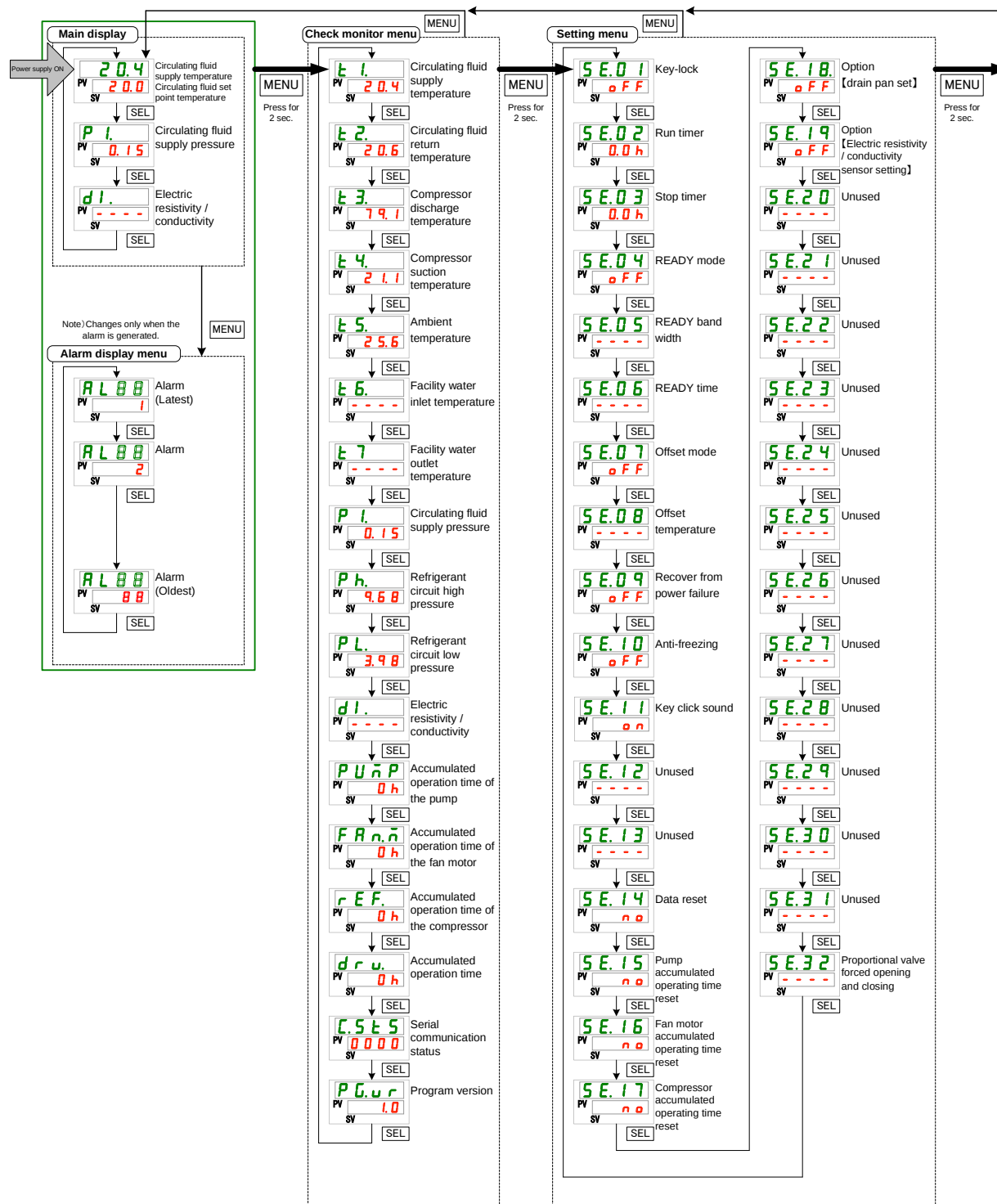


Figure 1.3-1 Key operation(1/2)

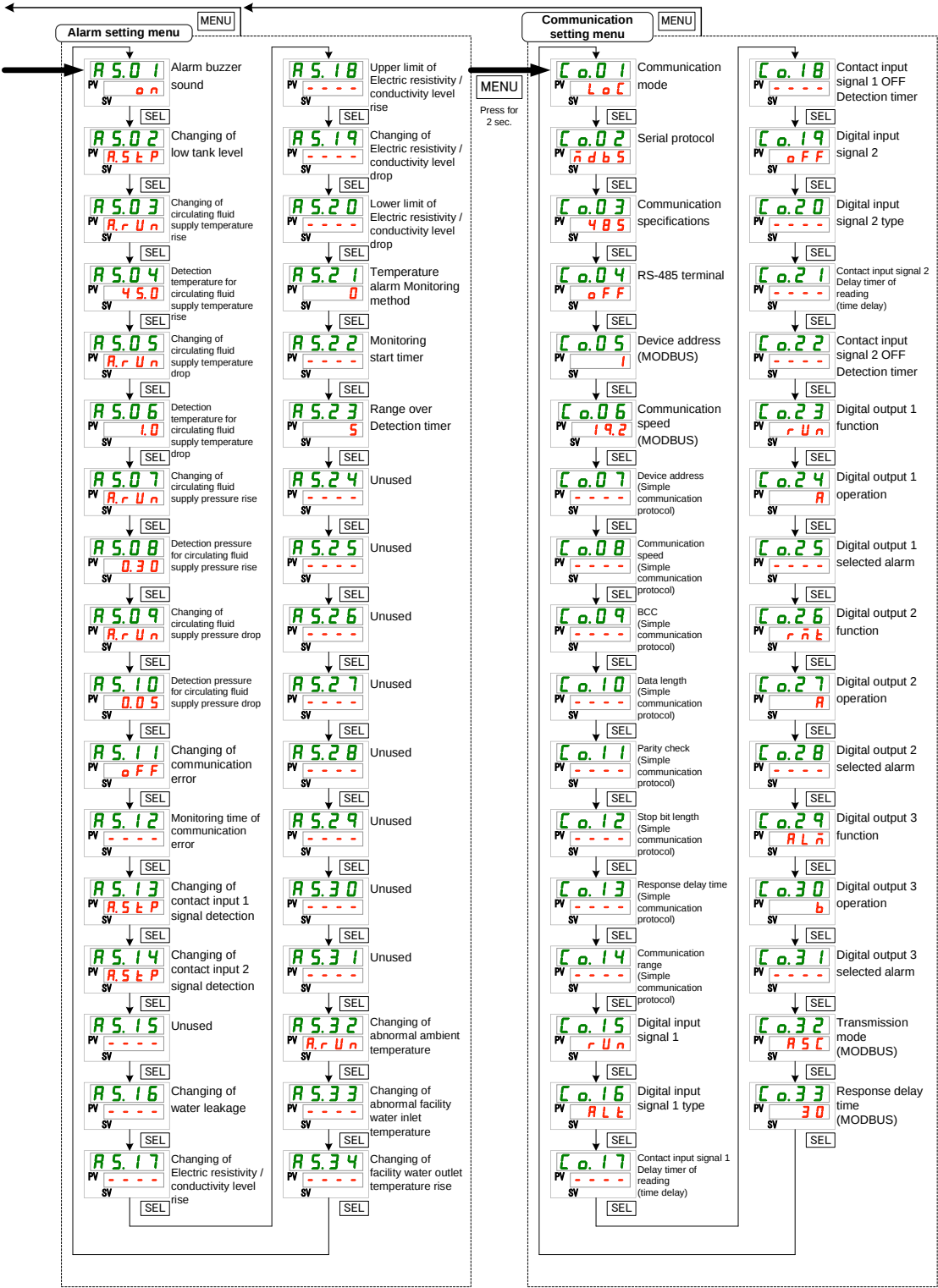


Figure 1.3-2 Key operation(2/2)

1.4 Parameters

Table 1.4-1 “Parameters” explains the parameters of the 「communication setting menu」.

Table 1.4-1 Parameters

Display	Item		Default setting	Reference page	Category	
[0.01]	Communication mode		LOC	2.4 4.3 5.3	Communication setting menu	
[0.02]	Serial communication	Serial protocol	MDBS	4.3 5.3		
[0.03]		Communication specifications	485	4.3 5.3		
[0.04]		RS-485 terminal	OFF	4.3 5.3		
[0.05]		Mod bus	Device address	1		4.3
[0.06]			Communication speed	19.2		
[0.32]			Transmission mode	ASC		
[0.33]			Response delay time	30		
[0.07]		Simple communication protocol	Device address	1		5.3
[0.08]			Communication speed	9.6		
[0.09]			BCC	ON		
[0.10]			Data length	8BIT		
[0.11]			Parity check	NON		
[0.12]			Stop bit length	2BIT		
[0.13]			Response delay time	0		
[0.14]			Communication range	RW		
[0.15]	Contact input/output communication	Contact input signal 1	RUN	2.4		
[0.16]		Contact input signal 1 type	ALT			
[0.17]		Contact input signal 1 delay timer (time delay) of reading	0			
[0.18]		Contact input signal 1 OFF detection timer	0			
[0.19]		Contact input signal 2	OFF			
[0.20]		Contact input signal 2 type	ALT			
[0.21]		Contact input signal 2 delay timer (time delay) of reading	0			
[0.22]		Contact input signal 2 OFF detection timer	0			
[0.23]		Contact output 1 function	RUN			
[0.24]		Contact output 1 operation	A			
[0.25]		Selected for contact output 1	AL.01			
[0.26]		Contact output 2 function	RMT			
[0.27]		Contact output 2 operation	A			
[0.28]		Selected for contact output 2.	AL.01			
[0.29]		Contact output 3 function	ALM			
[0.30]		Contact output 3 operation	B			
[0.31]		Selected for contact output 3	AL.01			

Chapter 2 Contact input/output communication

The device is equipped with a terminal which runs/stops the product. It is also equipped with a terminal which picks up operation signals, alarm signals and setting condition.

The device starts contact input/output communication according to the setting of the operation display panel. Contact input/output communication can be customized by changing the settings. Table 2-1 "Customizable content" shows the contents which can be changed by the operation display panel.

Table 2-1 Customizable content

Signal	Can be changed
Contact input/output signal (2pcs.)	Signal configuration (Alternate/Momentary)
Contact input/output signal (3pcs.)	Type of signal, signal operation (N.O type / N.C type)

2.1 Precautions for communication

2.1.1 Precautions wiring communication

○Communication wiring

A communication cable that connects the product and customer system is not included with the product. Please prepare a cable, referring to "2.3 Connection explanation". In order to avoid malfunction, do not connect to any place other than those shown in "2.3 Connection explanation".

○Power supply

To use the power of the product, the total load current must be 500mA or less.

2.1.2 Precautions after wiring and before communication

○Check or set the communication mode by the operation display panel.

- Communication mode shall be DIO.

Other modes can perform reading, but only DIO mode can issue instructions.

2.2 Communication specification

Table 2.2-1 DIO Communication specification

Item		Specification
Connector type (for this product)		Dsub 15P type female connector
Contact input signal	Insulation system	Photo coupler
	Rated input voltage	DC24V
	Used input voltage	DC24V±10%
	Rated input current	5mA TYP
	Input signal	4.7kΩ
Contact output signal	Rated load voltage	AC48V or less/DC30V or less
	Maximum load current	AC/DC 500mA (Resistance load)
	Minimum load current	DC5V 10mA
DC24V output voltage		DC24V±10% 0.5A MAX (It can not be used for inductive load)

2.3 Connection explanation

This part explains the port of the contact input/output communication. A communication cable that connects the product and customer system is not included with the product. Prepare a cable, referring to Table 2.3-1.

Table 2.3-1 Contact input/output pin number

Terminal no	Application	Division	Default setting	Setting available
1	DC 24V output	Output		
2	DC 24V output	Output		
3	DC 24V output	Output		
4	Contact input signal 1	Input	Run/Stop signal (Alternate)	○
5	Common of contact output signal 1	Output		
6	Common of contact output signal 2	Output		
7	Common of contact output signal 3	Output		
8	None	-		
9	24V COM output	Output		
10	24V COM output	Output		
11	Common of contact input signal	Output		
12	Contact input signal 2	Input	None	○
13	Contact output signal 1	Output	Run status signal (N.O type)	○
14	Contact output signal 2	Output	Remote signal (N.O type)	○
15	Contact output signal 3	Output	Alarm signal (N.C type)	○

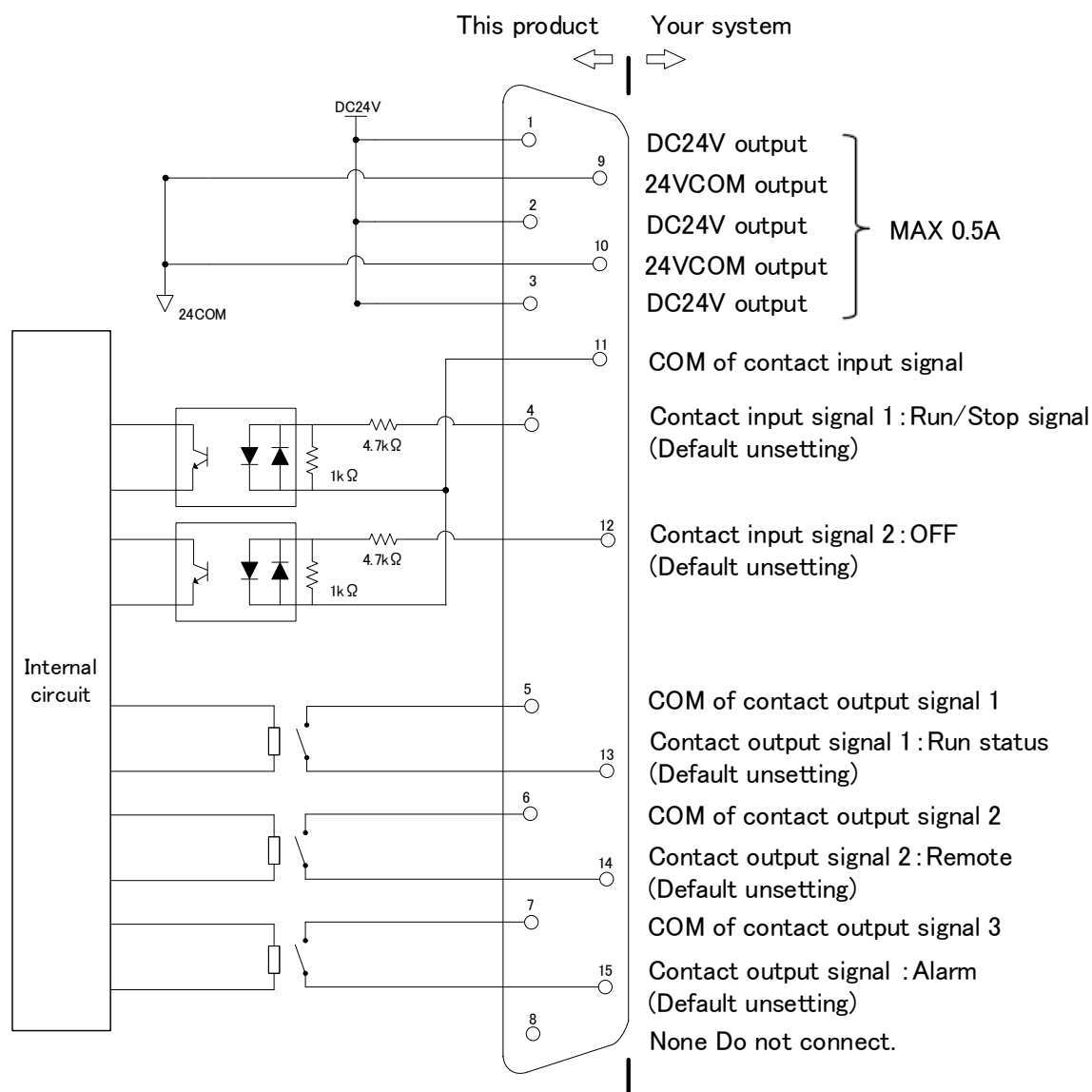


Figure 2.3-1 Contact input/output circuit

2.4 Setting and checking

2.4.1 Setting and checking

The table below explains the setting items of the contact input/output signal and the initial values.

Table 2.4-1 List of set communication items

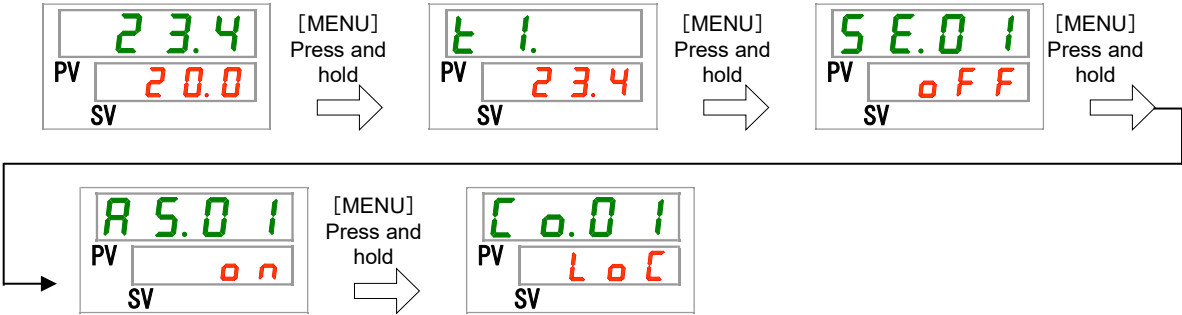
Display	Item	Contents	Default setting
[0.01]	Communication mode	Sets communication mode of this product.	LOC
[0.15]	Contact input signal 1	Setting contact input signal 1 of the contact input/output communication.	RUN
[0.16]	Contact input signal 1 type	Setting input type of contact input signal 1 of the contact input/output communication. [----] is displayed when the setting of contact input signal 1 is OFF.	ALT
[0.17]	Contact input signal 1 delay timer of reading	Sets the delay timer of reading of contact input signal 1 of the contact input/output communication. Used when the setting of the contact input signal 1 is SW_A or SW_B. [----] is displayed when the setting of the contact input signal 1 is not SW_A or SW_B.	-
[0.18]	Contact input signal 1 OFF Detection timer	Sets the OFF detection timer of contact input signal 1 of the contact input/output communication. Used when the setting of the contact input signal 1 is SW_A or SW_B. [----] is displayed when the setting of the contact input signal 1 is not SW_A or SW_B.	-
[0.19]	Contact input signal 2	Setting contact input signal 2 of the contact input/output communication.	OFF
[0.20]	Contact input signal 2 type	Setting input type of contact input signal 2 of the contact input/output communication. [----] is displayed when the setting of contact input signal 2 is OFF.	ALT
[0.21]	Contact input signal 2 delay timer of reading	Sets the delay timer of reading of contact input signal 2 of the contact input/output communication. Used when the setting of the contact input signal 2 is SW_A or SW_B. [----] is displayed when the setting of the contact input signal 2 is not SW_A or SW_B.	-
[0.22]	Contact input signal 2 OFF Detection timer	Sets the OFF detection timer of contact input signal 2 of the contact input/output communication. Used when the setting of the contact input signal 2 is SW_A or SW_B. [----] is displayed when the setting of the contact input signal 2 is not SW_A or SW_B.	-
[0.23]	Contact output 1 function	Setting output signal function of contact output 1 of the contact input/output communication.	RUN
[0.24]	Contact output 1 operation	Setting output signal operation of contact output 1 of the contact input/output communication.	A
[0.25]	Contact output 1 selected alarm	Setting selected alarm of contact output 1 of the contact input/output communication. [----] is displayed when the setting of the output signal of contact output1 is not selected alarm signal.	AL.01
[0.26]	Contact output 2 function	Setting output signal function of contact output 2 of the contact input/output communication.	RMT
[0.27]	Contact output 2 operation	Setting output signal operation of contact output 2 of the contact input/output communication.	A
[0.28]	Contact output 2 selected alarm	Setting selected alarm of contact output 2 of the contact input/output communication. [----] is displayed when the setting of the output signal of contact output2 is not selected alarm signal.	AL.01
[0.29]	Contact output 3 function	Setting output signal function of contact output 3 of the contact input/output communication.	ALM
[0.30]	Contact output 3 operation	Setting output signal operation of contact output 3 of the contact input/output communication.	B
[0.31]	Contact output 3 selected alarm	Setting selected alarm of contact output 3 of the contact input/output communication. [----] is displayed when the setting of the output signal of contact output3 is not selected alarm signal.	AL.01

2.4.2 Setting and checking

Communication mode Setting and checking

1. Press and hold the [MENU] key for 2 sec.

Repeat pressing the key until the setting screen for communication mode [C o.0 1] appears on the digital display.



2. Select [LOC] from the [▼] key , and confirm by pressing [SEL] key.

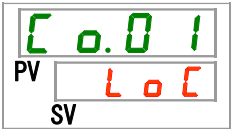


Table 2.4-2 Set values

Set values	Explanation	Default setting
L o C	Sets LOCAL mode.	○
d I o	Sets DIO mode.*1	
S E r	Sets SERIAL mode.*2	

*1 : When the setting of the contact input 1 is “External switch signal”, “DIO mode” cannot be set.

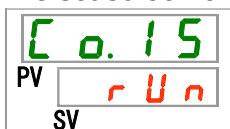
*2 : If the serial protocol is “Simple communication protocol 2” and the contact input 1 is “external switch signal” or contact input 2 is “remote signal”, “SERIAL mode” cannot be set.

CAUTION



If the communication mode is set to [DIO] first while the operating signal is input, the product will start and feed the circulating fluid before the details are set.
For safety, set the communication mode to [DIO] after carrying out the setting below.

- 3.** Display the screen of contact input signal 1 by pressing the [SEL] key several times.
The set screen of contact input signal 1 is displayed on the digital display.



- 4.** Select contact input signal 1 from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 2.4-3 Set Values

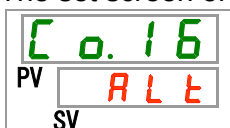
Set values	Explanation	Default setting
	Without input signal	
	Input of Run/Stop signal	○
	External switch signal input(N.O. type)*3,*4	
	External switch signal input (N.C. type)*3,*4	

*3: When the setting of the communication mode is "DIO mode", "External switch signal" cannot be set.

*4: When the setting of the communication mode is "SEIRAL mode" and the protocol setting is "Simplified communication protocol 2", "External switch signal" cannot be set.

- 5.** Press the [SEL] key once.

The set screen of contact input signal 1 type is displayed on the digital display.



- 6.** Select contact input signal 1 type from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 2.4-4 Set values

Set values	Explanation	Default setting
	Setting/checking are not available if the setting of contact input signal 1 is OFF.	
	Alternate signal	○
	Momentary signal*5	

*5: Can be set when the setting of contact input signal 1 is "Run/Stop signal input".

Contact input signal 1 delay timer of reading Setting and checking

7. Press the [SEL] key once.

The set screen of the contact input signal 1 delay timer of reading is displayed on the digital display.

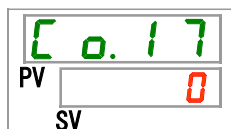
**8.** Select contact input signal 1 delay timer of reading from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 2.4-5 Set values

Set value	Explanation	Default setting
---	Setting and checking are not available unless contact input signal 1 is external switch signal input (N.O. type or N.C. type).	
0 to 300	Setting of contact input signal 1 delay timer of reading. Set range is 0 to 300 sec.	0

Contact input signal 1 OFF detection timer Setting and checking

9. Press the [SEL] key once.

The set screen of the contact input signal 1 OFF detection timer is displayed on the digital display.

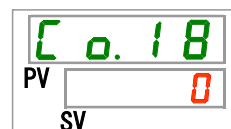
**10.** Select contact input signal 1 OFF detection timer from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 2.4-6 Set values

Set value	Explanation	Default setting
---	Setting and checking are not available unless contact input signal 1 is external switch signal input (N.O. type or N.C. type).	
0 to 10	Setting of contact input signal 1 OFF detection timer Set range is 0 to 10sec.	0

11. Press the [SEL] key once.

The set screen of contact input signal 2 is displayed on the digital display.

**12.** Select contact input signal 2 from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 2.4-7 Set values

Set values	Explanation	Default setting
0 F F	Without input signal	○
r U n	Input of Run/Stop signal	
S H - A	External switch signal input(N.O. type)	
S H - b	External switch signal input (N.C. type)	
r n t	Remote signal*6	

*6: When the setting of the serial protocol is "Simplified communication protocol 2", "Remote signal" cannot be set.

13. Press the [SEL] key once.

The set screen of contact input signal 2 type is displayed on the digital display.

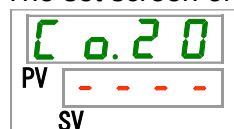
**14.** Select contact input signal 2 type from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 2.4-8 Set values

Set values	Explanation	Default setting
---	Setting/checking are not available if the setting of contact input signal 2 is OFF.	
A L t	Alternate signal	○
n t	Momentary signal*7	

*7: Can be set when the setting of contact input signal 2 is "Run/Stop signal input" or "Remote signal"

15. Press the [SEL] key once.

The set screen of contact input signal 2 delay timer of reading is displayed on the digital display.

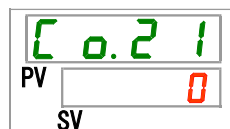
**16.** Select contact input signal 2 delay timer of reading from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 2.4-9 Set values

Set values	Explanation	Default setting
----	Setting and checking are not available unless contact input signal 2 is external switch signal input(N.O. type or N.C. type).	
0 to 300	Setting of contact input signal 2 delay timer of reading. Set range is 0 to 300 sec.	0

17. Press the [SEL] key once.

The set screen of contact input signal 2 OFF detection timer is displayed on the digital display.

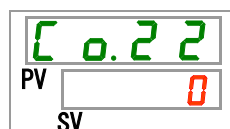
**18.** Select contact input signal 2 OFF detection timer from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 2.4-10 Set values

Set values	Explanation	Default setting
----	Setting and checking are not available unless contact input signal 2 is external switch signal input(N.O. type or N.C. type).	
0 to 10	Setting of contact input signal 2 OFF detection timer. Set range is 0 to 10 sec.	0

19. Press the [SEL] key once.

The set screen of contact output signal 1 function is displayed on the digital display.

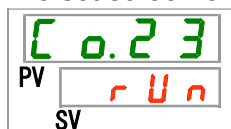
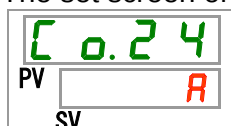
**20.** Select contact output signal 1 function from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 2.4-11 Set values

Set values	Explanation	Default setting
OFF	Without output signal	
run	Signal of operating status is output	○
rn	Signal of remote status is output	
rdy	Signal for completion of preparation (TEMP READY)	
ASTP	Signal for the status of the operation stop alarm is output	
ArUn	Signal for the status of the operation continue alarm is output	
ALn	Signal for the alarm status is output	
ASEL	Signal for selected alarm status is output	
on.tn	Signal for Run timer set status is output	
oF.tn	Signal for Stop timer set status is output	
PrSt	Signal for the recovery from power failure is output	
F.P.	Signal for anti-freezing setting is output	
IP1	Pass through signal of contact input signal 1	
IP2	Pass through signal of contact input signal 2	
AFIL	Signal output during automatic fluid filling	

21. Press the [SEL] key once.

The set screen of contact output signal 1 operation is displayed on the digital display.



- 22.** Select contact output signal 1 operation from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

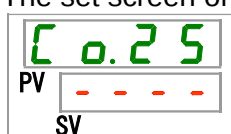
Table 2.4-12 Set values

Set values	Explanation	Default setting
A	N.O type	○
b	N.C type	

Contact output 1 selected alarm Setting and checking

- 23.** Press the [SEL] key once.

The set screen of digital output 1 selected alarm is displayed on the digital display.



- 24.** Select contact output 1 selected alarm from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

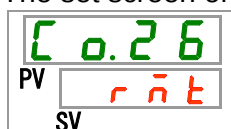
Table 2.4-13 Set values

Set values	Explanation	Default setting
- - - -	Setting/checking are not available unless the function setting of contact output 1 is selected alarm status signal.	
AL.01 to AL.63	Sets selection alarm. Set range is AL.01 to AL.63.	AL.01

Contact output 2 function Setting and checking

- 25.** Press the [SEL] key once.

The set screen of contact output 2 function is displayed on the digital display.



- 26.** Select contact output 2 function from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

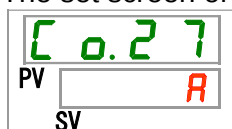
Table 2.4-14 Set values

Set values	Explanation	Default setting
	Without output signal	
	Signal of operating status is output	
	Signal of remote status is output	○
	Signal for completion of preparation (TEMP READY)	
	Signal for the status of the operation stop alarm is output	
	Signal for the status of the operation continue alarm is output	
	Signal for the alarm status is output	
	Signal for selected alarm status is output	
	Signal for Run timer set status is output	
	Signal for Stop timer set status is output	
	Signal for the recovery from power failure is output	
	Signal for anti-freezing setting is output	
	Pass through signal of contact input signal 1	
	Pass through signal of contact input signal 2	
	Signal output during automatic fluid filling	

Contact output 2 operation Setting and checking

- 27.** Press the [SEL] key once.

The set screen of contact output 2 operation is displayed on the digital display.



- 28.** Select contact output 2 operation from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 2.4-15 Set values

Set values	Explanation	Default setting
	N.O type	○
	N.C type	

29. Press the [SEL] key once.

The set screen of contact output 2 selected alarm is displayed on the digital display.



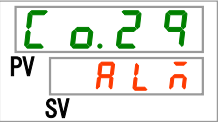
30. Select contact output 2 selected alarm from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 2.4-16 Set values

Set values	Explanation	Default setting
	Setting/checking are not available unless the function setting of contact output 2 is selected alarm status signal.	
	Sets selection alarm. Set range is AL.01 to AL.63.	

31. Press the [SEL] key once.

The set screen of contact output 3 function is displayed on the digital display.



- 32.** Select contact output 3 function from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

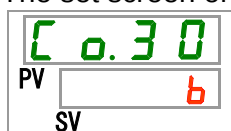
Table 2.4-17 Set values

Set values	Explanation	Default setting
o F F	Without output signal	
r U n	Signal of operating status is output	
r n t	Signal of remote status is output	
r d y	Signal for completion of preparation (TEMP READY)	
R. S t P	Signal for the status of the operation stop alarm is output	
R. r U n	Signal for the status of the operation continue alarm is output	
A L n	Signal for the alarm status is output	○
R. S E L	Signal for selected alarm status is output	
o n t n	Signal for Run timer set status is output	
o F. t n	Signal for Stop timer set status is output	
P. r S t	Signal for the recovery from power failure is output	
F. P.	Signal for anti-freezing setting is output	
I n P 1	Pass through signal of contact input signal 1	
I n P 2	Pass through signal of contact input signal 2	
R. F I L	Signal output during automatic fluid filling	

Contact output 3 operation Setting and checking

- 33.** Press the [SEL] key once.

The set screen of contact output 3 operation is displayed on the digital display.



- 34.** Select contact output 3 operation from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 2.4-18 Set values

Set values	Explanation	Default setting
A	N.O type	
b	N.C type	○

35. Press the [SEL] key once.

The set screen of contact output 3 selected alarm is displayed on the digital display.

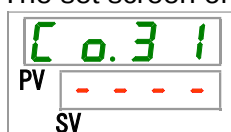
**36.** Select contact output 3 selected alarm from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 2.4-19 Set values

Set values	Explanation	Default setting
---	Setting/checking are not available unless the function setting of contact output 1 is selected alarm status signal.	
AL.01 to AL.63	Sets selection alarm. Set range is AL.01 to AL.63.	AL.01

37. Press the [SEL] key once.

The set screen of communication mode is displayed on the digital display.

**38.** Select communication mode [DIO] from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 2.4-20 Set values

Set value	Explanation	Default setting
LoC	Sets LOCAL mode.	○
dIo	Sets DIO mode.	
SEr	Sets SERIAL mode.	

2.5 Contact input signal

There are two contact input signals. As the default condition, contact input signal 1 is used for Run/Stop signal (signal type: alternate), and contact input signal 2 is not used. The input signals can be customized depending on the customer's application.

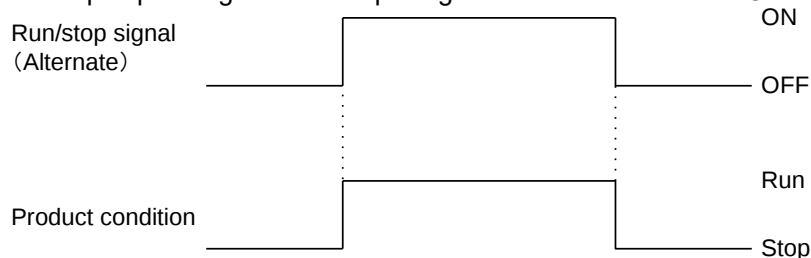
Table 2.5-1 Contact input signal

	Class of signal		Signal configuration		Timer		Default setting
	Description	Display	Description	Display	Delay timer of reading	OFF detection	
Contact input signal 1	Run/Stop signal	RUN	Alternate	ALT	-	-	○
			Momentary	MT	-	-	
	External switch signal input (N.O)	SW_A	Alternate	ALT	Used	Used	
	External switch signal input (N.C)	SW_B	Alternate	ALT	Used	Used	
Contact input signal 2	Without input signal	OFF	—	—	-	-	
	Run/Stop signal	RUN	Alternate	ALT	-	-	
			Momentary	MT	-	-	
	External switch signal input (N.O)	SW_A	Alternate	ALT	Used	Used	
	External switch signal input (N.C)	SW_B	Alternate	ALT	Used	Used	
	Remote signal	RMT	Alternate	ALT	-	-	
			Momentary	MT	-	-	
	Without input signal	OFF	—	—	-	-	○

2.5.1 Run/Stop signal • Remote signal

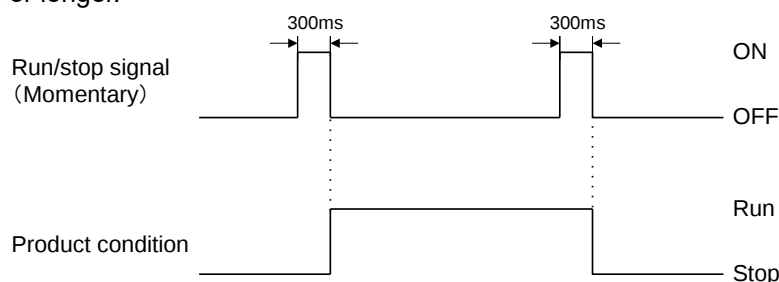
1) Run/Stop signal (Signal type: Alternate)

The product keeps operating while the input signal from the customer is ON.



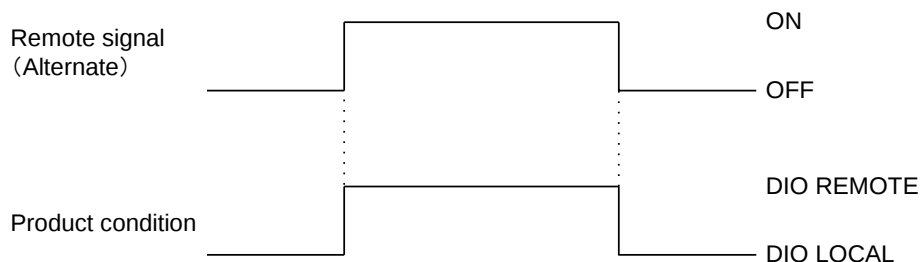
2) Run/Stop signal (Signal type: Momentary)

The state changes when the input signal from the customer goes OFF. This signal operates while the product is stopped, and stops while the product is being operated. Maintain the ON condition for 300ms or longer.



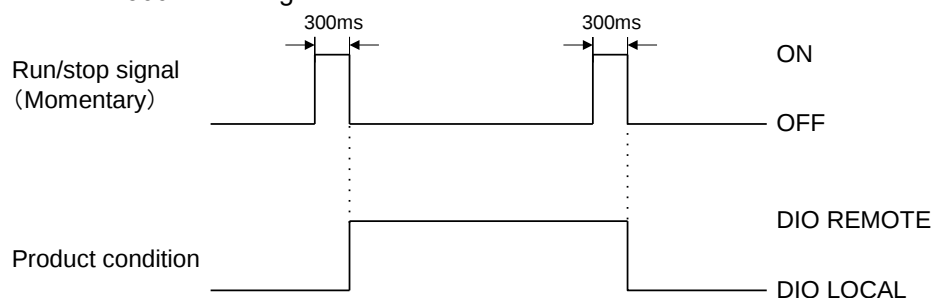
3) Remote signal (Signal type: Alternate)

The product becomes DIO REMOTE while the input signal from the customer is ON.



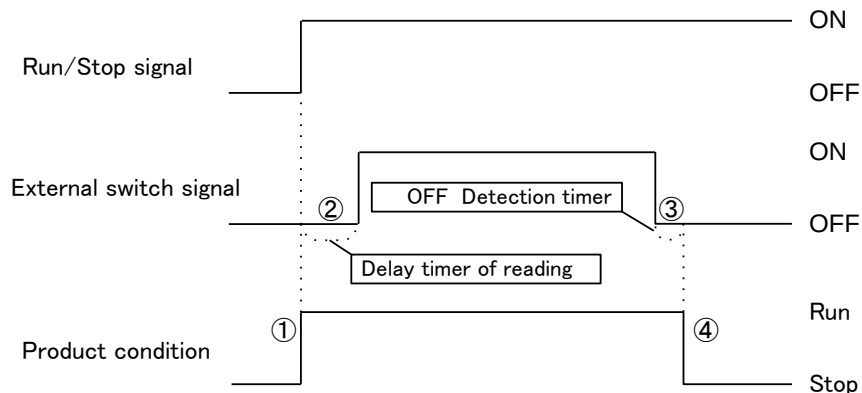
4) Remote signal (Signal type: Momentary)

The state changes when the input signal from the customer goes OFF. If DIO LOCAL is set, it is switched to DIO REMOTE. If DIO REMOTE, it is switched to DIO LOCAL. Maintain the ON condition for 300ms or longer.



5) Digital input signal 1 is for Run/Stop signal (Signal type: Alternate), digital input signal 2 is for external switch signal (N.O. type)

Refer to Chapter for details of the external switch.



- ① The product starts operation when the Run/Stop signal from the user is turned on.
 - ② It reads the signal of the external switch signal (N.O type) after the time which has been set for the delay timer of reading.
The factory default setting of the delay timer of reading is 0sec. Refer to 2.4.2 for setting. .
 - ③ When the external switch signal (N.O. type) has been turned off for the time set for OFF detection timer, it is recognized as OFF.
The factory default setting of the OFF detection timer is 0sec. Refer to 2.4.2 for setting.
 - ④ AL32 contact input 2 signal detection alarm is generated. The operation of the product stops.
"Operation stop" is the default setting for AL32. The product can be set to continue operation or not to detect the alarm. Refer to the "Installation / Operation" manual for details.
- * The product stops operation when the Run/Stop signal is turned off during operation. Afterwards, the alarm is not generated even if the external switch signal (N.O type) is turned off.
- 6) Input signal is not connected to either contact input signal 1 or contact input signal 2.
This product cannot be controlled by the contact input.

2.5.2 Signal of the external switch

This product can be monitored during operation by reading the signal of the external switch prepared by the customer.

The product stops monitoring when it stops operation.

This product generates an alarm and stops operating when a problem is detected from the external switch.

Select the external switch 1 or 2 or both depending on the customer's system. Refer to 2.4.2 for setting.

The number of monitored external switches depends on the communication mode. Refer to Table 2.5-2.

In the communication mode in which the external switches 1 and 2 are available, two products can be monitored simultaneously. If a problem is detected by one or both external switches, an alarm is generated and the operation stops.

You can set the product to continue operation or not to detect the alarm. Refer to the "Installation / Operation" manual for details.

Table 2.5-2 Cross reference of communication modes and external switch monitoring

	LOCAL	DIO		SERIAL		
		DIO LOCAL	DIO REMOTE	MODBUS	Simple communication protocol pattern	
					1	2
External switch 1	○	×	×	○	○	×
External switch 2	○	×	○	○	○	○

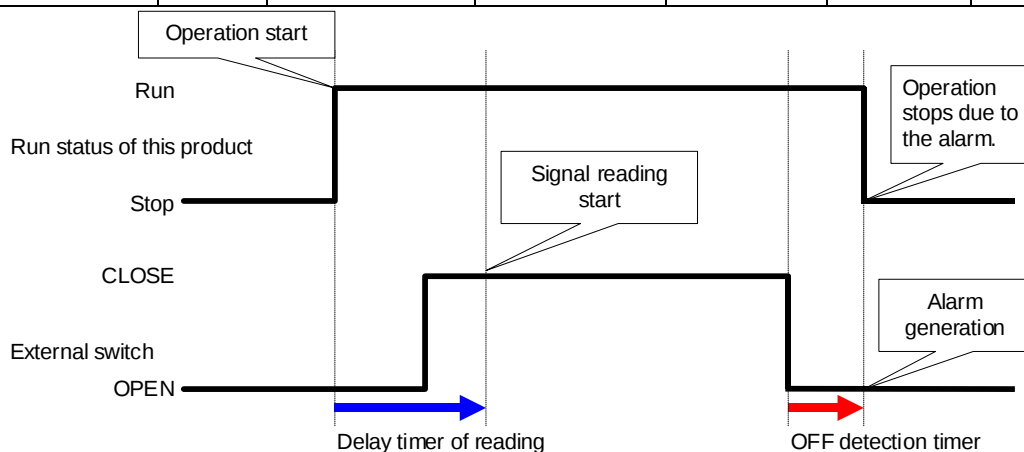


Figure 2.5-1 Timing chart of external switch monitoring

■ Delay timer of reading

If the signal of the external switch prepared by the customer is not closed instantly when the product is operated, set the delay timer for reading. By setting this timer, the external switch monitoring starts after the time set by the delay time of reading since the operation start.

"0" is the default setting. Set a time which is suitable for your environment.

Example} When using a flow switch

When operation is started, it takes time for the fluid to reach the piping and the flow switch to detect the flow. Set the time for the flow switch to start.

■ OFF detection timer

If you do not want the alarm to be generated instantly when the external switch prepared by the customer is in open status, but instead want the alarm to be generated after the switch has been open for a specific time (continuous open status), set the OFF detection timer.

This timer enables the alarm to be generated when the time set for OFF detection time passes after the switch is in OPEN status.

The default setting is 0 sec. Set a time which is suitable for your application.

■ Contact input

N.O type or N.C. type can be selected for the external switch. Set the signal which is suitable for the external switch prepared by the customer.

2.6 Contact output signal

There are three contact output signals. As the default setting, contact output signal 1 is for operating condition (N.O type), contact output signal 2 is for remote signal (N.O type), and contact output signal 3 is for alarm signal (N.C type). Refer to Table 2.6-1. Depending on the product condition, contact output signal is turned on (closed) or turned off (open).

The signals can be customized depending on the customer's application. The Table 2.6-2 shows operation of contact output signal.

(Tips)

All contact output signals are turned off (open) when the power is not supplied.

Table 2.6-1 Contact output signal (Default setting)

	Class of signal		Signal configuration		Remarks
	Description	Display	Description	Display	
Contact output signal 1	Run status signal	RUN	N.O type	A	
Contact output signal 2	Remote signal	RMT	N.O type	A	
Contact output signal 3	Alarm signal	ALM	N.C type	B	

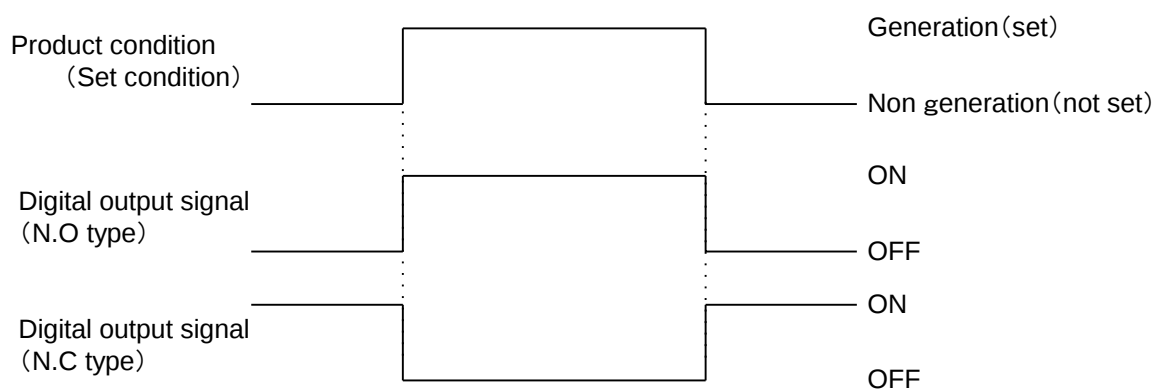


Table 2.6-2 Operation of contact output signal

Class of signal			Operation of contact output signal
Display	Function	Operation	
OFF	Without output	N.O type	Normally, output signal is OFF (open)
		N.C type	Normally, output signal is ON (close)
RUN	Run status signal	N.O type	When the product operates, signal turns on.
		N.C type	When the product operates, signal turns off.
RMT	Remote status signal	N.O type	When the product becomes DIO REMOTE, signal turns on.
		N.C type	When the product becomes DIO REMOTE, signal turns off.
RDY	Signal for completion of preparation (TEMP READY)	N.O type	When the product becomes completion of preparation (TEMP READY), signal turns on.
		N.C type	When the product becomes completion of preparation (TEMP READY), signal turns off.
A.STP	Signal for operation stop alarm	N.O type	When operation stop alarm occurs, signal turns on.
		N.C type	When operation stop alarm occurs, signal turns off.
A.RUN	Signal for continuing operation alarm	N.O type	When continuing operation alarm occurs, signal turns on.
		N.C type	When continuing operation alarm occurs, signal turns off.
ALM	Alarm status signal	N.O type	When alarm occurs, signal turns on.
		N.C type	When alarm occurs, signal turns off.
A.SEL	Signal for selection alarm	N.O type	The signal is turned ON when the selected alarm goes off.
		N.C type	The signal is turned OFF when the selected alarm goes off.
ON.TM	Signal for operation start timer setting	N.O type	The signal is turned ON when the run timer is set.
		N.C type	The signal is turned OFF when the run timer is set.
OF.TM	Signal for operation stop timer setting	N.O type	The signal is turned ON when the stop timer is set.
		N.C type	The signal is turned OFF when the stop timer is set.
P.RST	Signal for power recovery setting	N.O type	The signal is turned ON when the power recovery is set.
		N.C type	The signal is turned OFF when the power recovery is set.
F.P.	Signal for anti-freezing setting	N.O type	The signal is turned ON when the anti-freezing is set.
		N.C type	The signal is turned OFF when the anti-freezing is set.
INP1*1	Pass through signal of contact input signal 1	N.O type	Outputs the signal which is input to the contact input signal 1. Input signal is ON → Output signal is ON
		N.C type	Outputs the reverse of the signal which is input to the contact input signal 1. Input signal is OFF → Output signal is ON
INP2*1	Pass through signal of contact input signal 2	N.O type	Outputs the signal which is input to the contact input signal 2. Input signal is ON → Output signal is ON
		N.C type	Outputs the reverse of the signal which is input to the contact input signal 2. Input signal is OFF → Output signal is ON
A.F.	Signal output during automatic fluid filling	N.O type	Signal is turned ON during automatic fluid filling.*2
		N.C type	Signal is turned OFF during automatic fluid filling.*2

*1: The signal of the product without an option [Automatic filling] also changes.

*2: Signal changes even when option J [Automatic fluid filling] is not selected.

Chapter 3 Serial communication

Serial communication (RS-485/RS232C) enables the remote control of run/start of the product, temperature setting and details of product condition, and alarm condition can be obtained.

The operating state of the product (Run/Stop) and the temperature setting can be monitored by sending a request message made by the program of the host computer (e.g. PC).

MODBUS communication and simple communication protocol can be selected as the serial communication protocol. This chapter illustrates the common specifications of serial communication. Chapter 4 and 5 illustrate each protocol.

3.1 Precautions wiring communication

○Communication wiring

A communication cable that connects the product and customer system is not included with the product. Please prepare a cable, referring to "3.3 Connected explanation". In order to avoid malfunction, do not connect to any place other than those shown in "3.3 Connected explanation".

3.2 Communication specification

Table 3.2-1 Serial communication specification

Item	Specification
Connector type (for the product)	D-sub9P type Female connector(Mounting screw: M2.6×0.45)
Standard	Select from EIA RS-485 / RS-232C
Circuit type Half duplex	Half duplex
Transmission type	Start-stop
Protocol	MODBUS terminal*1 / Simple communication protocol
Terminal resistance	Select from with terminal resistance (120Ω) / Without terminal resistance

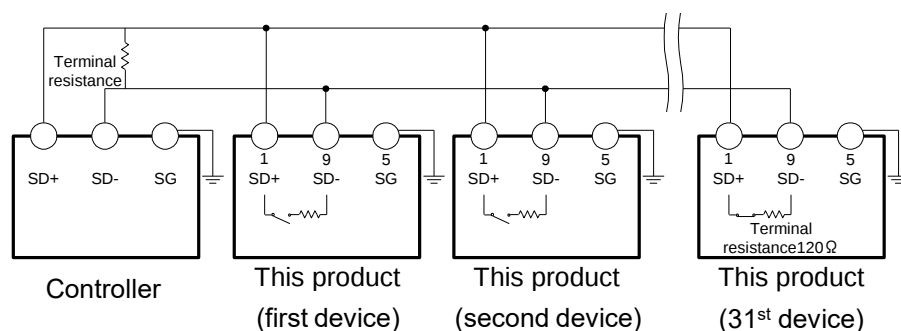
□ : Default setting

*1 : Refer to Modicon Co. protocol specifications "PI-MBUS-300 Rev.J".

3.3 Connected explanation

Figure 3.3-1 shows the wiring when RS-485 is selected as the communication standard. Figure 3.3-2 shows the wiring when RS-232C is selected.

A communication cable that connects the product and customer system is not included with the product. Prepare a cable, referring to Figure 3.3-1 or Figure 3.3-2.

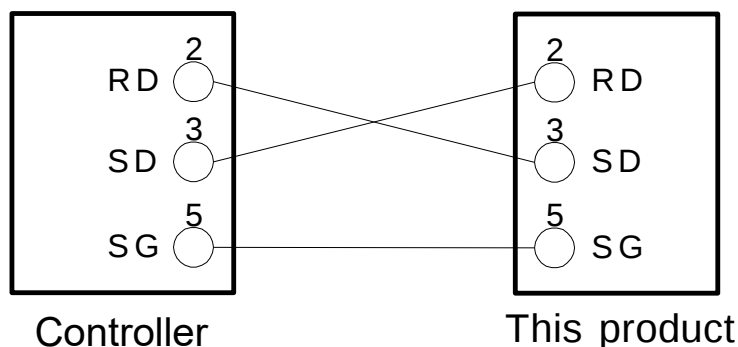


Do not connect any wire to other PIN numbers.

Figure 3.3-1 RS-485 connector connection

[Tips]

- 1 controller : 1 product, or 1 controller : N products.
In the latter case, up to 31 products can be connected.
- Both ends of the communication connection (the end nodes) need to be connected to the higher level computer.
- The terminal resistance of this product can be set by the operation display panel. Refer to "4.3.2 Setting and checking", "5.3.2 Setting and checking".



Do not connect any wire to other PIN numbers.

Figure 3.3-2 RS-232C connector connection

Chapter 4 MODBUS communication function

MODBUS protocol is a communication protocol developed by Modicon. It is used to communicate with a PC or PLC.

Register content is read and written by this communication protocol.

This communication has the following features.

- Controls Run/Stop.
- Sets and reads the circulating fluid set point temperature.
- Reads the circulating fluid supply temperature.
- Reads the condition of the product.
- Reads the alarm generating condition of the product.

Refer to “4.11 Register map” for the register of the product.

4.1 Precautions for communication

4.1.1 Precautions after wiring and before communication

○ Check or set the each communication setting by the operation display panel.

- The communication specification shall be the customer's communication standard.
- The serial protocol shall be the MODBUS.
- The communication mode shall be the SERIAL mode.

Other modes can perform reading, but only SERIAL mode can perform writing.

○ Check or set the communication parameters using the operation display panel.

Check or set the communication speed so that the product synchronizes with the host computer (controller) prepared by the customer.

○ Check the device address by the operation display panel.

No response is returned when a request message is sent from a device address other than those set in the product.

4.1.2 Precautions for communicating

○Allow a suitable interval between requests.

To send request messages in series, wait for 100 msec. or longer after receiving a response message from the product before sending the next message.

○Retry (resend request message).

The response may not be returned due to noise. If no message is returned 1sec. after sending a request message, resend the request message.

○If necessary send a read request message to check if it was written correctly.

Message to notify the completion of the process is returned when the action for the written request message is completed.

Send a read request message to confirm if the setting was written as requested.

○Setting limit of circulating fluid temperature

When the circulating fluid set temperature is written by communication, the data is stored in FRAM. When the product restarts, it restarts with the value which was set before the restart. The number of times it is possible to overwrite FRAM is limited. Data is only stored in FRAM when it receives a circulating fluid set temperature which is different from the previous temperatures. Please check how many times it is possible to overwrite FRAM, and avoid unnecessary changes of the circulating fluid set temperature during communication

4.2 Communication specification

Table 4.2-1 Communication specification of MODBUS communication function

Item	Specification
Standard	Select from EIA RS-485 / RS-232C
Communication speed	Select from 9600bps / 19200bps
Data · bit length	7bit(ASCII) / 8bit(RTU)
Stop · bit length	1bit
Data transfer direction	LSB
Parity	Even parity
Letter code	ASCII character string (ASCII) / Binary data(RTU)
Device address set range	Select from 1 to 99 address
Error check	LRC method (ASCII) / CRC method (RTU)

 : Default setting

4.3 Setting and checking

4.3.1 Setting and checking items

The table below explains the setting items of the MODBUS communication function and the initial values.

Table 4.3-1 Communication setting items

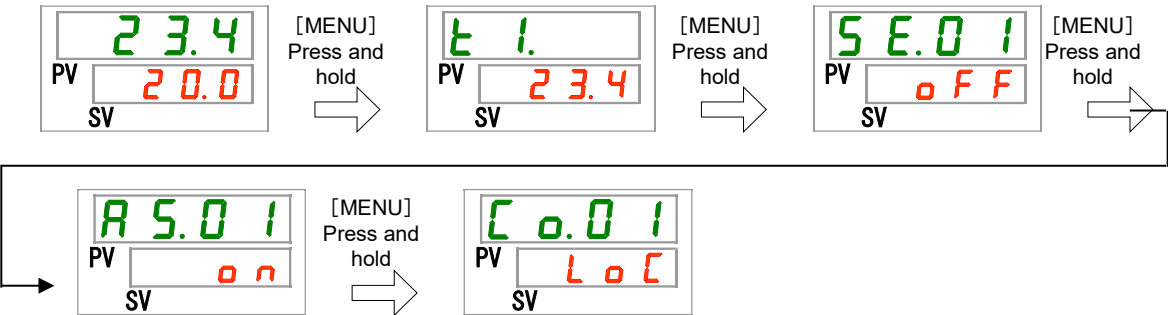
Display	Item	Contents	Default setting
[0.01]	Communication mode	Sets communication mode of this product.	LOC
[0.02]	Serial protocol	Sets serial communication protocol.	MODBUS
[0.03]	Communication specification	Sets standard of the serial communication.	485
[0.04]	RS-485 terminal	Sets of the terminal of RS-485.	OFF
[0.05]	Device address (MODBUS)	Sets device address of MODBUS protocol. [----] is displayed when the setting of serial protocol is not MODBUS.	1
[0.06]	Communication speed (MODBUS)	Sets communication speed of MODBUS protocol. [----] is displayed when the setting of serial protocol is not MODBUS.	19.2
[0.32]	Transmission mode (MODBUS)	Sets transmission mode of MODBUS protocol. [----] is displayed when the setting of serial protocol is not MODBUS.	ASC
[0.33]	Response delay time (MODBUS)	Sets time to delay the response message of MODBUS protocol. [----] is displayed when the setting of serial protocol is not MODBUS protocol.	30

4.3.2 Setting and checking

Communication Setting and checking

1. Press and hold the [MENU] key for 2 sec.

Repeat pressing the key until the setting screen for communication mode [C o.0 1] appears on the digital display.



2. Select “SER” from the table below with the [▲]key, and confirm with [SEL] key.



Table 4.3-2 Set values

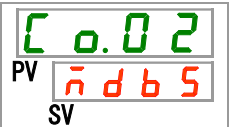
Set values	Explanation	Default setting
L o C	Sets LOCAL mode.	○
d i o	Sets DIO mode.	
S E r	Sets SERIAL mode. *1	

*1: If the serial protocol is “Simple communication protocol 2” and the contact input 1 is “external switch signal” or contact input 2 is “remote signal”, “SERIAL mode” cannot be set.

Serial protocol Setting and checking

3. Press the [SEL] key once.

The set screen of serial protocol is displayed on the digital display.



4. Select serial protocol from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 4.3-3 Set values

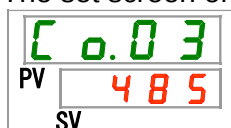
Set values	Explanation	Default setting
MODBUS	MODBUS protocol	○
PRO1	Simple communication protocol 1	
PRO2	Simple communication protocol 2*2	

*2: When the setting of the contact input 2 is "Remote signal", "Simple communication protocol 2" cannot be set.

Communication specification Setting and checking

5. Press the [SEL] key once.

The set screen of communication specification is displayed on the digital display.



6. Select communication specification from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

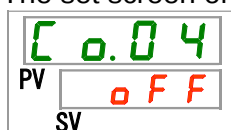
Table 4.3-4 Set values

Set values	Explanation	Default setting
232C	RS-232C standard	
485	RS-485 standard	○

RS-485 terminal Setting and checking

7. Press the [SEL] key once.

The set screen of RS-485 terminal is displayed on the digital display.



8. Select RS-485 terminal from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 4.3-5 Set values

Set values	Explanation	Default setting
OFF	Without terminal	○
ON	With terminal	

9. Press the [SEL] key once.

The set screen of device addresses (MODBUS) is displayed on the digital display.

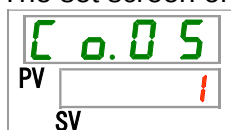
**10.** Select device addresses (MODBUS) from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 4.3-6 Set values

Set values	Explanation	Default setting
---	Setting/checking are not available unless the serial protocol setting is MODBUS.	
1 to 99	Sets of device addresses for MODBUS. Set range is 1 to 99.	1

11. Press the [SEL] key once.

The set screen of communication speed (MODBUS) is displayed on the digital display.

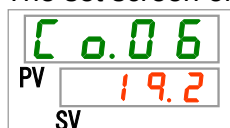
**12.** Select communication speed (MODBUS) from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

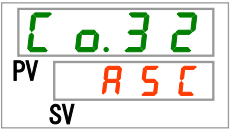
Table 4.3-7 Set values

Set values	Explanation	Default setting
---	Setting/checking are not available unless the serial protocol setting is MODBUS.	
9.6	9600bps	
19.2	19200bps	○

Transmission mode (MODBUS) Setting and checking

13. Display the screen of the transmission mode by pressing the [SEL] key 26 times.

The set screen of transmission mode (MODBUS) is displayed on the digital display.



14. Select changing of operation when transmission mode from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

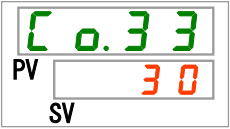
Table 4.3-8 Set values

Set values	Explanation	Default setting
----	Setting/checking are not available unless the serial protocol setting is MODBUS.	
ASC	ASCII mode	○
RTU	RTU mode	

Response delay time (MODBUS) Setting and checking

15. Press the [SEL] key once.

The set screen of response delay time (MODBUS) is displayed on the digital display.



16. Select response delay time (MODBUS) from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 4.3-9 Set values

Set values	Explanation	Default setting
----	Setting/checking are not available unless the serial protocol setting is simple communication protocol.	
0 to 250	Sets of response delay time Set range is 0 to 250msec.	30

4.4 Serial communication status

It is a function to display the status of serial communication. Display the relevant content regarding communication nonconformities, such as device address mismatches or accessing outside the range of this product's register map.

Display	Contents
8001	Normal message being received.
4801	An abnormal number of data has been sent from the customer equipment.
4401	This product is trying to access to the outside address of the register map that support. Or trying to write to read-only address.
4201	Function code that this product does not support is being sent from the customer's equipment.
0081	The device addresses set for this product and customer's equipment are different.
0041	CRC* ¹ does not match in the RTU settings.
0021	LRC* ¹ does not match in the ASCII settings.
00XX* ²	Mismatched communication settings(Baud Rate, parity, number of data bits, etc.)or very short message intervals from customer equipment.
0000* ³	Bad wiring or no message sent from customer equipment.

*1 : Refer to "4.8.1 LRC(ASCII)" , "4.8.2 CRC(RTU)"

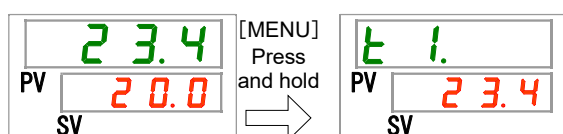
*2 : "XX" means that it is undefined.

*3 : Initial state or after the outgoing message is received from the customer, and displays it in case the message is a state that can not be received was continued for 30 seconds.

4.4.1 How to check

1. Press and hold the [MENU] key for 2 sec.

Circulating fluid supply temperature [**E 1.**] is displayed on the digital display.



Serial communication status How to check

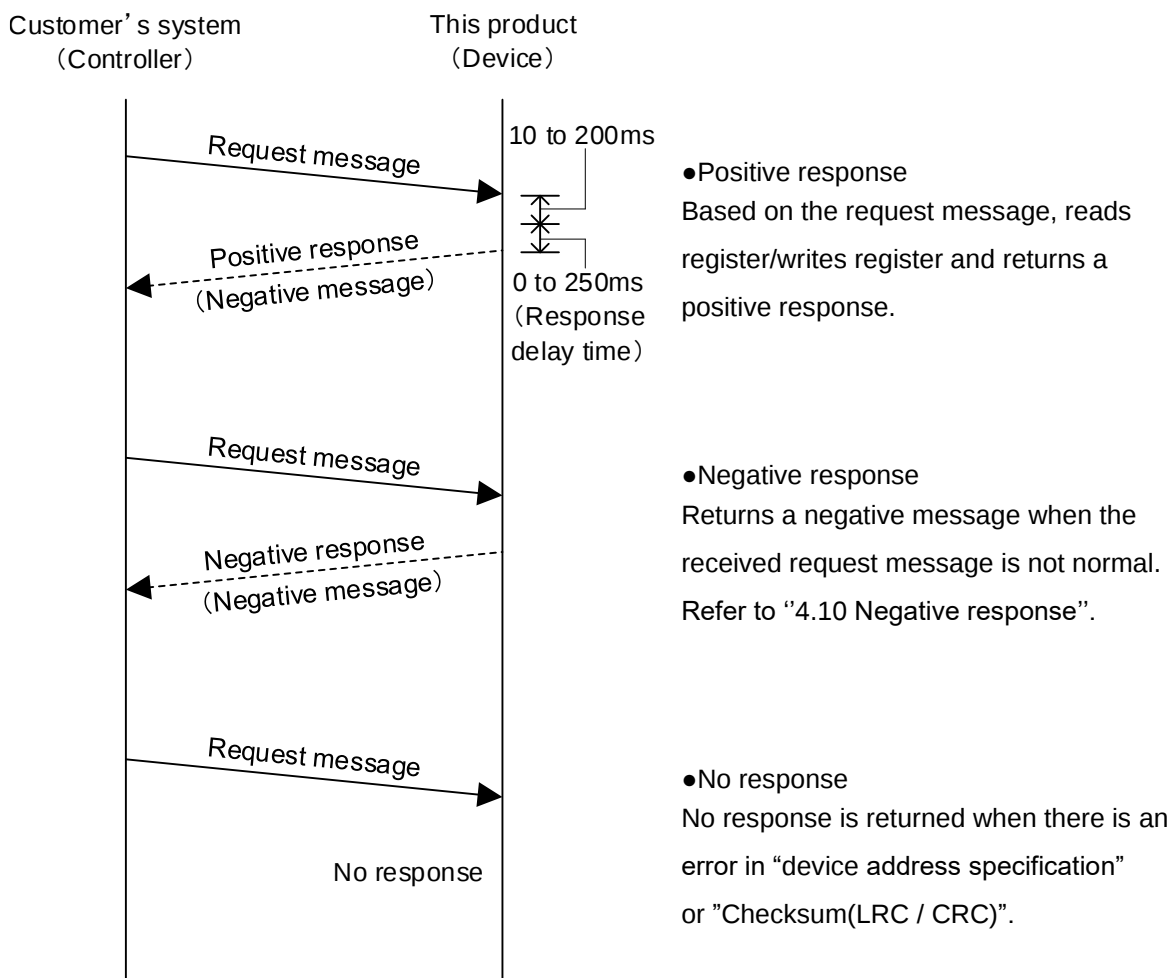
2. Display the screen of the serial communication status by pressing the [SEL] key 15 times.

Serial communication status is displayed on the digital display.



4.5 Communication sequence

Starts with a request message from the customer's system (controller), and finishes with a response message from the product (device). This product operates as a device. It does not send any requests.



4.6 Message configuration

4.6.1 Message frame

The message configuration is shown below. The communication of this product uses 2 transmission modes, ASCII or RTU.

1) ASCII mode frame

For ASCII mode, the message starts with ASCII characters ":"(3Ah) and ends with "CR/LF"(0Dh,0Ah). A response message will not be returned unless the request includes ":" and [CR][LF]. This product clears all previously received code when ":" is received.

a)Start	b)Device Address	c)Function	d)Data	e) Checksum (LRC)	f)End
[:]	XX	XX	XX ~ XX	XX	[CR] [LF]

a) Start

The start of the message. [:](3Ah) (ASCII)

b) Device Address

This is a number to identify this product. "1" is the default setting. This can be changed by the operation display panel.

c) Function(Refer to "4.7 Function code")

Command is assigned.

d) Data

Depending on the function, the address and the number of the register, the value of reading/writing are assigned.

e) LRC

LRC method

Refer to "4.8.1 LRC(ASCII)".

f) End

The end of the message. [CR](0Dh)+[LF](0Ah)

2) RTU mode frame

RTU mode starts from and ends with at least 3.5 characters of silent interval.
Silent interval is indicated by T1-T2-T3-T4.

a)Start	b)Device Address	c)Function	d)Data			e) Checksum (CRC)		f)End
T1-T2-T3-T4	XX	XX	XX	~	XX	XX	XX	T1-T2-T3-T4

a) Start

In Modbus RTU mode, message frames are separated by a silent interval (non-communication time). At least 3.5 characters of silent interval are necessary at the beginning and the end of the communication frame.

b) Device Address

This is a number to identify this product. "1" is the default setting. This can be changed by the operation display panel.

c) Function(Refer to "4.7 Function code")

Command is assigned.

d) Data

Depending on the function, the address and the number of the register, the value of reading/writing are assigned.

e) CRC

CRC method

Refer to "4.8.2 CRC(RTU)".

f) End

3.5 characters of silent interval indicates the end of a message.

4.7 Function code

Table 4.7-1 shows function codes to read or write register. Refer to "4.9 Explanation of function codes".

Table 4.7-1 Function codes

NO	Code	Name	Function
1	03(03h)	Read holding registers	Reading multiple registers
2	04(04h)	Read input registers	Reading multiple registers
3	06(06h)	Preset single register	Writing registers
4	16(10h)	Preset multiple registers	Writing multiple registers
5	23(17h)	Read/write 4x registers	Reading/writing multiple registers

4.8 Checksum calculation method

4.8.1 LRC(ASCII)

LRC checks the content of the message other than [.] of START and [CR][LF] of END. The sending side calculates and sets. The receiving side calculates based on the received message, and compares the calculation result with the received LRC. The received message is deleted if the calculation result and received LRC do not match.

Add up the byte number of the message consisting of 8 consecutive bits. The result except the carry (overflow) is converted to 2's complement.

■ Communication example

Example) Change circulating fluid set temperature 25.4 ° C

Sending data 0106000B00FE

○Device Address: No.1

○Function: No.06

○Writing address: 000Bh

○Writing data: 00FEh

No	Classification	Contents	calculation result
1	LRC message for calculation	0106000B00FE	-
2	Calculation	Added for each 8bit 01h+06h+00h+0Bh+00h+FEh=110h	10h
3		complement of 2 10h→EFh→F0h	F0h(LRC)
4	Sending message	[.]0106000B00FEF0[CR][LF]	-

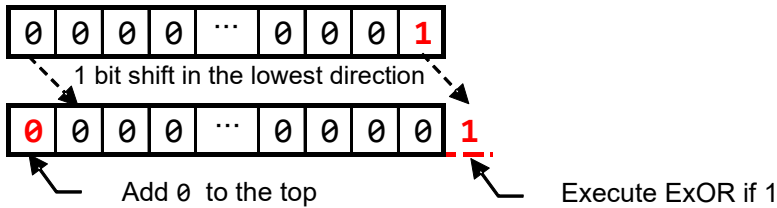
4.8.2 CRC(RTU)

CRC checks the content of the message. The sending side calculates the data every 2 bytes (16bits). The receiving side calculates CRC based on the received message, and compares the calculation result with the received CRC. The received message is deleted if the calculation CRC is different from the received CRC.

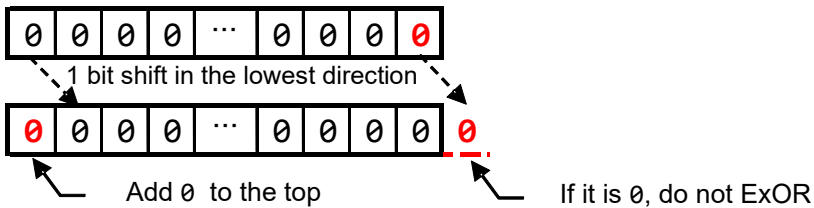
■ Calculation procedure

- (1) Preload "FFFFh" (set 0xFFFF as initial value).
- (2) Exclusive OR the first byte of the transmitted message with the value in (1).
- (3) Shift the result of (2) by one bit toward the least significant bit, and fill a zero into the most significant bit position.
- (4) If the least significant bit was a 1, exclusive OR the result of (3) with "A001h". (Example 1). If the least significant bit was a 0, no exclusive OR takes place.
- (5) Repeat (3) to (4) until eight shifts have been performed.
- (6) After eight shifts, exclusive OR the result of (5) with the next 1-byte (2nd. byte).
- (7) The processes (3) to (6) are repeated for all the remaining bytes of the message.
- (8) The 2-byte data of the result of (7) is the CRC value.

(Example 1) The least significant bit was a 1.



(Example 2) The least significant bit was a 0.



■ Calculation example

Example) Change circulating fluid set temperature 25.4 °C

Sending data 0106000B00FE

○Device Address: No.1

○Function: No.06

○Writing address: 000Bh

○Writing data: 00FEh

Data No.	1st value	2nd value	3rd value	4th value	5th value	6th value
Data contents	0001h	0006h	0000h	000Bh	0000h	00FEh

No	Classification	Contents	Result
1	CRC message for calculation	0106000B00FE	-
2	Calculation	Perform (1) to (4) for the 1st value (0001h) and then, perform (5).	807Eh
3		Perform (6) for 2nd value (0006h) and then, perform (5).	2280h
4		Perform (6) for 3rd. value (0000h) and then, perform (5).	A023h
5		Perform (6) for 4th value (000Bh) and then, perform (5).	1EA0h
6		Perform (6) for 5th value (0000h) and then, perform (5).	781Eh
7		Perform (6) for 6th value (00FEh) and then, perform (5).	8879h (CRC)
8	Addition to the sent message	0106000B00FE7988*1	-

*1 When incorporating it into the message, set it in order of low byte and high byte.

4.9 Explanation of function codes

4.9.1 Function code:03 Reading multiple registers

Register data of assigned points from assigned address is read.

■ Communication example

○Device Address : No.1

○Read seven consecutive data from register 0000h.

(Read circulating fluid supply temperature, circulating fluid supply pressure, status information, alarm information)

Request message 010300000007			
Field name	Example (HEX)	ASCII mode character data	RTU mode binary data
Header	-	“.”	None
Device Address	0x01	“0”, “1”	0x01
Function	0x03	“0”, “3”	0x03
Head address of specified register	0x0000	“0”, “0”, “0”, “0”	0x00, 0x00
Quantity of register to read	0x0007	“0”, “0”, “0”, “7”	0x00, 0x07
Checksum ASCII:LRC RTU:CRC	-	“F”, “5”	0x04, 0x08
Trailer	-	CR/LF	None
	Total quantity of byte	17	8

Response message 01030E00D40000000D0000020100000000			
Field name	Example (HEX)	ASCII mode character data	RTU mode binary data
Header	-	“.”	None
Device Address	0x01	“0”, “1”	0x01
Function	0x03	“0”, “3”	0x03
Quantity of bytes to read	0x0E	“0”, “E”	0x0E
Information of 0000h (Circulating fluid supply temperature)	0x00D4	“0”, “0”, “D”, “4”	0x00, 0xD4
Information of 0001h (Reserved)	0x0000	“0”, “0”, “0”, “0”	0x00, 0x00
Information of 0002h (Circulating fluid supply pressure)	0x000D	“0”, “0”, “0”, “D”	0x00, 0x0D
Information of 0003h (Electric resistivity/conductivity of the circulating fluid)	0x0000	“0”, “0”, “0”, “0”	0x00, 0x00
Information of 0004h (Status flag 1)	0x0201	“0”, “2”, “0”, “1”	0x02, 0x01
Information of 0005h (Alarm flag 1)	0x0000	“0”, “0”, “0”, “0”	0x00, 0x00
Information of 0006h (Alarm flag 2)	0x0000	“0”, “0”, “0”, “0”	0x00, 0x00
Checksum ASCII:LRC RTU:CRC	-	“0”, “A”	0xBA, 0xB2
Trailer	-	CR/LF	None
	Total quantity of byte	39	19

4.9.2 Function code:04 Reading multiple registers

Register data of assigned points from assigned address is read.

■ Communication example

○Device Address : No.1

○Read seven consecutive data from register 0000h.

(Read circulating fluid supply temperature, circulating fluid supply pressure, status information, alarm information)

Request message 010400000007			
Field name	Example (HEX)	ASCII mode character data	RTU mode binary data
Header	-	"0"	None
Device Address	0x01	"0", "1"	0x01
Function	0x04	"0", "4"	0x04
Head address of specified register	0x0000	"0", "0", "0", "0"	0x00, 0x00
Quantity of register to read	0x0007	"0", "0", "0", "7"	0x00, 0x07
Checksum ASCII:LRC RTU:CRC	-	"F", "4"	0xB1, 0xC8
Trailer	-	CR/LF	None
	Total quantity of byte	17	8

Response message 01040E00D40000000D0000020100000000			
Field name	Example (HEX)	ASCII mode character data	RTU mode binary data
Header	-	"0"	None
Device Address	0x01	"0", "1"	0x01
Function	0x04	"0", "4"	0x04
Quantity of bytes to read	0x0E	"0", "E"	0x0E
Information of 0000h (Circulating fluid supply temperature)	0x00D4	"0", "0", "D", "4"	0x00, 0xD4
Information of 0001h (Reserved)	0x0000	"0", "0", "0", "0"	0x00, 0x00
Information of 0002h (Circulating fluid supply pressure)	0x000D	"0", "0", "0", "D"	0x00, 0x0D
Information of 0003h (Electric resistivity/conductivity of the circulating fluid)	0x0000	"0", "0", "0", "0"	0x00, 0x00
Information of 0004h (Status flag 1)	0x0201	"0", "2", "0", "1"	0x02, 0x01
Information of 0005h (Alarm flag 1)	0x0000	"0", "0", "0", "0"	0x00, 0x00
Information of 0006h (Alarm flag 2)	0x0000	"0", "0", "0", "0"	0x00, 0x00
Checksum ASCII:LRC RTU:CRC	-	"0", "9"	0xF8, 0x80
Trailer	-	CR/LF	None
	Total quantity of byte	39	19

4.9.3 Function code:06 Writing registers

Write data to assigned address.

■ Communication example

○Device Address : No.1

○Write data to register 000Ch.
(Commands to run)

Request message 0106000C0001			
Field name	Example (HEX)	ASCII mode character data	RTU mode binary data
Header	-	“.”	None
Device Address	0x01	“0”, “1”	0x01
Function	0x06	“0”, “6”	0x06
Head address of specified register	0x000C	“0”, “0”, “0”, “C”	0x00, 0x0C
Information written to 000Ch (Run/Stop flag)	0x0001	“0”, “0”, “0”, “1”	0x00, 0x01
Checksum ASCII:LRC RTU:CRC	-	“E”, “C”	0x88, 0x09
Trailer	-	CR/LF	None
	Total quantity of byte	17	8

Response message 0106000C0001			
Field name	Example (HEX)	ASCII mode character data	RTU mode binary data
Header	-	“.”	None
Device Address	0x01	“0”, “1”	0x01
Function	0x06	“0”, “6”	0x06
Address of register to write	0x000C	“0”, “0”, “0”, “C”	0x00, 0x0C
Information of register to write	0x0001	“0”, “0”, “0”, “1”	0x00, 0x01
Checksum ASCII:LRC RTU:CRC	-	“E”, “C”	0x88, 0x09
Trailer	-	CR/LF	None
	Total quantity of byte	17	8

4.9.4 Function code:16 Writing multiple registers

Register content of assigned points of assigned address is written.

■ Communication example

○Device Address : No.1

○Write two consecutive data from register 000Bh.

(Commands to change of circulating fluid set point temperature <39.9 °C> and run)

Request message 0110000B000204018F0001			
Field name	Example (HEX)	ASCII mode character data	RTU mode binary data
Header	-	“.”	None
Device Address	0x01	“0”, “1”	0x01
Function	0x10	“1”, “0”	0x10
Head address of specified register	0x000B	“0”, “0”, “0”, “B”	0x00, 0x0B
Quantity of register to write	0x0002	“0”, “0”, “0”, “2”	0x00, 0x02
Quantity of byte to read	0x04	“0”, “4”	0x04
Information written to 000Bh (Circulating fluid set point temperature)	0x018F	“0”, “1”, “8”, “F”	0x01, 0x8F
Information written to 000Ch (Run/Stop flag)	0x0001	“0”, “0”, “0”, “1”	0x00, 0x01
Checksum ASCII:LRC RTU:CRC	-	“4”, “D”	0x43, 0xCB
Trailer	-	CR/LF	None
	Total quantity of byte	27	13

Response message 0110000B0002			
Field name	Example (HEX)	ASCII mode character data	RTU mode binary data
Header	-	“.”	None
Device Address	0x01	“0”, “1”	0x01
Function	0x10	“1”, “0”	0x10
Head address of register to write	0x000B	“0”, “0”, “0”, “B”	0x00, 0x0B
Quantity of register to write	0x0002	“0”, “0”, “0”, “2”	0x00, 0x02
Checksum ASCII:LRC RTU:CRC	-	“E”, “2”	0x30, 0x0A
Trailer	-	CR/LF	None
	Total quantity of byte	17	8

4.9.5 Function code:23 Reading/Writing multiple registers

Register content of assigned points of assigned address is read. Write the register data from the specified address with specified points simultaneously.

■ Communication example

○Device Address : No.1

○Read three consecutive data from register 0004h, and write two consecutive data from register 000Bh.

(Commands to change of circulating fluid set point temperature <15.5 °C> and run, and read status and alarm information.)

Request message 011700040003000B000204009B0001			
Field name	Example (HEX)	ASCII mode character data	RTU mode binary data
Header	-	“:”	None
Device Address	0x01	“0”, “1”	0x01
Function	0x17	“1”, “7”	0x17
Head address of specified register	0x0004	“0”, “0”, “0”, “4”	0x00, 0x04
Quantity of register to read	0x0003	“0”, “0”, “0”, “3”	0x00, 0x03
Head address of specified register	0x000B	“0”, “0”, “0”, “B”	0x00, 0x0B
Quantity of register to write	0x0002	“0”, “0”, “0”, “2”	0x00, 0x02
Quantity of byte to write	0x04	“0”, “4”	0x04
Information written to 000Bh (Circulating fluid set point temperature)	0x009B	“0”, “0”, “9”, “B”	0x00, 0x9B
Information written to 000Ch (Run/Stop flag)	0x0001	“0”, “0”, “0”, “1”	0x00, 0x01
Checksum ASCII:LRC RTU:CRC	-	“3”, “4”	0x96, 0xD6
Trailer	-	CR/LF	None
	Total quantity of byte	35	17

Response message 011706000000000000			
Field name	Example (HEX)	ASCII mode character data	RTU mode binary data
Header	-	“:”	None
Device Address	0x01	“0”, “1”	0x01
Function	0x17	“1”, “7”	0x17
Quantity of bytes to read	0x06	“0”, “6”	0x06
Information of 0004h (Status flag 1)	0x0000	“0”, “0”, “0”, “0”	0x00, 0x00
Information of 0005h (Alarm flag 1)	0x0000	“0”, “0”, “0”, “0”	0x00, 0x00
Information of 0006h (Alarm flag 2)	0x0000	“0”, “0”, “0”, “0”	0x00, 0x00
Checksum ASCII:LRC RTU:CRC	-	“E”, “2”	0x21, 0x8A
Trailer	-	CR/LF	None
	Total quantity of byte	23	11

4.10 Negative response

A negative response is returned when the following request message is received.

- 1) When unspecified function code is used.
- 2) An address out of range is specified.
- 3) The data field is not normal.

■ Negative response message (Device to Controller)

- 1) Negative acknowledgment message frame in ASCII mode.

Start	Device Address	1)Function	2)Error Code			Checksum (LRC)	End	
[:]	XX	XX	XX	~	XX	XX	[CR]	[LF]

- 2) Negative acknowledgment message frame in RTU mode.

Start	Device Address	1)Function	2)Error Code			Checksum (CRC)		End
T1-T2-T3-T4	XX	XX	XX	~	XX	XX	XX	T1-T2-T3-T4

1) Function

Assign the value consisting of the request function code (hexadecimal value) plus 80h.

Example 1) ASCII mode

Received function code: "04"(0000 0100) ASCII code 30h, 34h

Abnormal function code: "84"(1000 0100) ASCII code 38h, 34h

Example 2) RTU mode

Receive function code: "04" (0000 0100)

Abnormal function code: "84" (1000 0100)

2) Error Code

Assign error code below.

- 01 : Function code of a command is outside the standard.
- 02 : The specified address of register is outside the range.
- 03 : Data field of a command is not normal.

■ Communication example

○Device Address : No.1

○Read seven consecutive data from register 0100h which is out of range.

Request message 010301000007			
Field name	Example (HEX)	ASCII mode character data	RTU mode binary data
Header	-	“.”	None
Device Address	0x01	“0”, “1”	0x01
Function	0x03	“0”, “3”	0x03
Head address of specified register	0x0100	“0”, “1”, “0”, “0”	0x01, 0x00
Quantity of register to read	0x0007	“0”, “0”, “0”, “7”	0x00, 0x07
Checksum ASCII:LRC RTU:CRC	-	“F”, “4”	0x05, 0xF4
Trailer	-	CR/LF	None
	Total quantity of byte	17	8

Response message 018302			
Field name	Example (HEX)	ASCII mode character data	RTU mode binary data
Header	-	“.”	None
Device Address	0x01	“0”, “1”	0x01
Function (03h+80h)	0x83	“8”, “3”	0x83
Error Code (Specified register address is out of range.)	0x02	“0”, “2”	0x02
Checksum ASCII:LRC RTU:CRC	-	“7”, “A”	0xC0, 0xF1
Trailer	-	CR/LF	None
	Total quantity of byte	11	5

4.11 Register map

Table 4.11-1 Register map1

Address	Bit Format																R/W
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
0000h	Circulating fluid supply temperature -110.0 to 220.0℃ = FBB4h to 898h (0.1℃ /dig)																R
0001h	Reserved																
0002h	Circulating fluid supply pressure 0.00 to 1.00MPa = 0h to 64h (0.01MPa/dig)																
0003h	Electric resistivity/conductivity of the circulating fluid 0 to 4.5MΩ·cm=0h to 2Dh (0.1MΩ·cm /dig) 2.0 to 48.0μS/cm=14h to 1E0h (0.1μS/cm /dig)																
0004h	Status flag 1																
0005h	Alarm flag 1																
0006h	Alarm flag 2																
0007h	Alarm flag 3																
0008h	Alarm flag 4																
0009h	Status flag 2																
000Ah	Reserved																
000Bh	Circulating fluid set point temperature 5.0 to 40.0℃ = 32h to 190h (0.1℃ /dig)																R/W
000Ch	Reserved															*1	
000Dh	Reserved																
000Eh	Reserved																
000Fh	Reserved																

*1 : Commands to run

4.11.1 Circulating fluid supply temperature

Read the circulating fluid supply temperature. Read the circulating fluid supply temperature which is displayed on the operation display panel PV. (Offset temperature is displayed if offset function is set).

4.11.2 Circulating fluid supply pressure

Read the circulating fluid supply pressure.

4.11.3 Electric resistivity/conductivity of the circulating fluid

Electric resistivity/conductivity of the circulating fluid is informed. The value is 0 [MΩ·cm/dig] / 0 [μS/cm/dig] when the optional [Electric resistivity/conductivity sensor] is invalid.

4.11.4 Status flag

The status of the product is read by the following assignment.

Status flag 1

Name	Status flag 1															
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Name	Explanation
0	Run flag	Run status (Include the independent operation of the pump) 0= Stop 1= Run
1	Operation stop alarm flag	Operation stop alarm given off status 0= Not occurred 1= Operation stop alarm given off
2	Operation continued alarm flag	Operation continued alarm given off status 0= Not occurred 1= Operation continued alarm given off
3	Unused	
4	Unused	
5	Remote status flag	Remote status 0= Other than SERIAL mode 1= SERIAL mode
6	Unused	
7	Unused	
8	Unused	
9	Completion of preparation (TEMP READY) flag	Completion of preparation (TEMP READY) status 0= Condition isn't formed 1= Condition is formed
10	Unused	
11	Run timer flag	Run timer set status 0= Not set 1= Set
12	Stop timer flag	Stop timer set status 0= Not set 1= Set
13	Reset after power failure flag	Reset after power failure set status 0= Not set 1= Set
14	Anti-freezing flag	Anti-freezing set status 0= Not set 1= Set
15	Automatic fluid filling flag	Automatic fluid filling condition 0= Stop 1= Fluid * The signal of the product without an option [Automatic filling] also changes.

Status flag 2

Name	Status flag 2															
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Name	Explanation
0	Electric resistivity/conductivity setting flag	Electric resistivity/conductivity setting status 0= Not set 1= Electric resistivity is set
1		2= Electric conductivity is set
2~15	Unused	

4.11.5 Alarm flag

Each type of alarm which occurs in the product is read with the following assignment.

Name	Alarm flag 1															
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Name	Alarm flag 2															
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Name	Explanation
Alarm flag 1	0 Low level in tank	Alarm given off status 0= Not occurred 1= Occurred
	1 Circulating fluid supply temperature high	
	2 Circulating fluid supply temperature rise	
	3 Circulating fluid supply temperature drop	
	4 Circulating fluid return temperature high	
	5 Circulating fluid supply pressure high	
	6 Pump operation abnormality	
	7 Circulating fluid supply pressure rise	
	8 Circulating fluid supply pressure drop	
	9 Compressor suction temperature high	
	10 Compressor suction temperature low	
	11 Superheat temperature low	
	12 Compressor discharge pressure high (sensor)	
	13 Compressor discharge pressure high (switch)	
	14 Refrigeration circuit pressure (high pressure side) drop	
	15 Refrigeration circuit pressure (low pressure side) rise	
Alarm flag 2	0 Refrigeration circuit pressure (low pressure side) drop	
	1 Compressor overload	
	2 Communication error	
	3 Memory error	
	4 Unused	
	5 Circulating fluid supply temperature sensor abnormality	
	6 Circulating fluid return temperature sensor abnormality	
	7 Compressor suction temperature sensor abnormality	
	8 Circulating fluid supply pressure sensor abnormality	
	9 Compressor discharge pressure sensor abnormality	
	10 Compressor suction pressure sensor abnormality	
	11 Pump Maintenance	
	12 Fan motor maintenance	
	13 Compressor maintenance	
	14 Contact input 1 signal detected	
	15 Contact input 2 signal detected	

Name	Alarm flag 3															
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Name	Alarm flag 4															
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Name	Explanation
Alarm flag 3	0 Fluid leakage	Alarm given off status 0= Not occurred 1= Occurred
	1 Electrical resistivity / conductivity rise	
	2 Electrical resistivity / conductivity drop	
	3 Electrical resistivity / conductivity sensor abnormality	
	4 Compressor discharge temperature sensor abnormality	
	5 Compressor discharge temperature rise	
	6 Unused	
	7 Unused	
	8 Unused	
	9 Unused	
	10 Unused	
	11 Unused	
	12 Unused	
	13 Compressor inverter error	
	14 Unused	
	15 Unused	
Alarm flag 4	0 Unused	
	1 Unused	
	2 Unused	
	3 Ambient temperature abnormality	
	4 Facility water inlet temperature abnormality	
	5 Facility water inlet temperature high	
	6 Facility water outlet temperature rise	
	7 Facility water outlet temperature high	
	8 Ambient temperature sensor abnormality	
	9 Facility water inlet temperature sensor abnormality	
	10 Facility water outlet temperature sensor abnormality	
	11 Internal communication error	
	12 Power supply abnormality	
	13 Compressor inverter parameter error	
	14 Compressor inverter communication error	
	15 Unused	

- The current alarm flag bit assignment will be changed in the future due to the addition of optional functions.
- Unused bit is fixed to 0.

4.11.6 Circulating fluid set point temperature

The circulating fluid set point temperature can be set by specifying the circulating fluid set point temperature during SERIAL mode.

If the temperature exceeds the upper limit of the circulating fluid set point temperature range, the circulating fluid set point temperature is changed to the upper limit value. If it is lower than the lower limit, the circulating fluid set point temperature is changed to the lower limit value.

4.11.7 Operation start command

The operation can be controlled by sending the operation start command during SERIAL mode.

0=Run stop 1=Run start

Table 4.11-2 Register map2

Address	Bit Format																R/W
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
5110h	Alarm flag 1*1																R
5111h	Alarm flag 2*1																
5112h	Alarm flag 3*1																
5113h	Alarm flag 4*1																
5114h to 51FFh	Reserved																
5200h	Circulating fluid supply temperature*1								-110.0 to 220.0°C = FBB4h to 898h (0.1 °C / dig)								
5201h	Circulating fluid return temperature								-110.0 to 220.0°C = FBB4h to 898h (0.1 °C / dig)								
5202h	Reserved																
5203h	Reserved																
5204h	Circulating fluid supply pressure*1								0.00 to 1.00MPa = 0h to 64h (0.01MPa / dig)								
5205h	Reserved																
5206h	Refrigerant circuit high pressure								0.00 to 15.00MPa = 0h to 5DCh (0.01MPa / dig)								
5207h	Refrigerant circuit low pressure								0.00 to 15.00MPa = 0h to 5DCh (0.01MPa / dig)								
5208h	Ambient temperature (product internal temperature)								-30.0 to 105.0°C = FED4h to 41Ah (0.1 °C / dig)								
5209h	Reserved																
520Ah	Compressor discharge temperature								-30.0 to 150.0°C = FED4h to 5DCh (0.1 °C / dig)								
520Bh	Compressor suction temperature								-50.0 to 150.0°C = FE0Ch to 5DCh (0.1 °C / dig)								
520Ch to 5213h	Reserved																
5214h	Compressor output ratio								0 to 100% = 0h to 64h (1% / dig)								
5215h	Reserved																
5216h	Reserved																
5217h	Compressor output power								0.0 to 100.0kW = 0h to 3E8h (0.1kW / dig)								
5218h to 521Eh	Reserved																
521Fh	Facility water inlet temperature								-110.0 to 220.0°C = FBB4h to 898h (0.1 °C / dig)								
5220h	Facility water outlet temperature								-50.0 to 150.0°C = FE0Ch to 5DCh (0.1 °C / dig)								

Table 4.11-3 Register map3

Table 4-17-5 Register maps																	
Address	Bit Format																R/W
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
5221h	Reserved																R
5222h	Reserved																
5223h	Reserved																
5224h	Electric resistivity/conductivity of the circulating fluid*1								0 to 4.5MΩ·cm=0h to 2Dh (0.1MΩ·cm / dig) 2.0 to 48.0μS/cm=14h to 1E0h (0.1μS/cm / dig)								
5225h to 53FFh	Reserved																
5400h	Circulating fluid set point temperature*1								5.0 to 40.0 °C = 32h to 190h (0.1 °C / dig)								
5401h	Reserved																
5402h	Reserved																
5403h	Reserved																
5404h	Circulating fluid supply temperature upper limit alarm set								5.0 to 48.0 °C = 32h to 1E0h (0.1 °C / dig)								
5405h	Circulating fluid supply temperature lower limit alarm set								1.0 to 39.0 °C = Ah to 186h (0.1 °C / dig)								
5406h	READY band width								0.0 to 5.0 °C = 0h to 32h (0.1 °C / dig)								
5407h	Offset mode								0:OFF, 1:MODE1, 2:MODE2, 3:MODE3								
5408h	Offset temperature								-20.0 to 20.0 °C = FF38h to C8h (0.1 °C / dig)								
5409h	Electric resistivity/conductivity of the circulating fluid set point								0.2 to 4.0MΩ·cm=2h to 28h (0.1MΩ·cm / dig) 5.0 to 45.0μS/cm=32h to 1C2h (0.1μS/cm / dig)								
540Ah	Electric resistivity/conductivity of the circulating fluid hysteresis								0.1 to 0.9MΩ·cm=1h to 9h (0.1MΩ·cm / dig) 2.0 to 10.0μS/cm=14h to 64h (0.1μS/cm / dig)								
540Bh	Electric resistivity/conductivity of the circulating fluid lower limit alarm set								0.2 to 2.0MΩ·cm=2h to 14h (0.1MΩ·cm / dig) 5.0 to 45.0μS/cm=32h to 1C2h (0.1μS/cm / dig)								
540Ch to 55FFh	Reserved																
5600h to 5601h	Accumulated operation time								0 to 999999hour = 0h to F423Fh (1hour / dig)								
5602h to 5603h	Accumulated operation time of the compressor								0 to 999999hour = 0h to F423Fh (1hour / dig)								
5604h	Reserved																
5605h	Reserved																
5606h	Reserved																
5607h	Reserved																
5608h to 5609h	Accumulated operation time of the pump								0 to 999999hour = 0h to F423Fh (1hour / dig)								
560Ah	Reserved																
560Bh	Reserved																
560Ch	Reserved																
560Dh	Reserved																
560Eh to 560Fh	Accumulated time of DI filter water flowing								0 to 999999hour = 0h to F423Fh (1hour / dig)								

*1 : Same content as Table 4.11-1 Register map1

4.11.8 Circulating fluid return temperature

Read the circulating fluid return temperature.

4.11.9 Refrigerant circuit high pressure

Read the refrigerant circuit high pressure.

4.11.10 Refrigerant circuit low pressure

Read the refrigerant circuit low pressure.

4.11.11 Ambient temperature (product internal temperature)

Read the ambient temperature (product internal temperature). The value is 0, when the water-cooled type is selected.

4.11.12 Compressor discharge temperature

Read the compressor discharge temperature.

4.11.13 Compressor suction temperature

Read the compressor suction temperature.

4.11.14 Compressor output ratio

Read the compressor output ratio.

4.11.15 Compressor output power

Read the compressor output power.

4.11.16 Facility water inlet temperature

Read the facility water inlet temperature. The value is 0, when the air-cooled type is selected.

4.11.17 Facility water outlet temperature

Read the facility water outlet temperature. The value is 0, when the air-cooled type is selected.

4.11.18 Circulating fluid supply temperature upper limit alarm set

Read the circulating fluid supply temperature upper limit set.

4.11.19 Circulating fluid supply temperature lower limit alarm set

Read the circulating fluid supply temperature lower limit set.

4.11.20 READY band width

Read the READY band width.

4.11.21 Offset mode

Read the offset mode.

4.11.22 Offset temperature

Read the offset temperature.

4.11.23 Electric resistivity/conductivity of the circulating fluid set point

Electric resistivity/conductivity of the circulating fluid set point is informed. The value is 0, when the optional [Electric resistivity/conductivity sensor] is invalid.

4.11.24 Electric resistivity/conductivity of the circulating fluid hysteresis

Electric resistivity/conductivity of the circulating fluid hysteresis is informed. The value is 0, when the optional [Electric resistivity/conductivity sensor] is invalid.

4.11.25 Electric resistivity/conductivity of the circulating fluid lower limit alarm set

Electric resistivity/conductivity of the circulating fluid lower limit alarm set is informed. The value is 0, when the optional [Electric resistivity/conductivity sensor] is invalid.

4.11.26 Accumulated operation time

Read the accumulated operation time. If the time is 100000 hours (186A0h), the output is as follows.

5600h=0001h, 5601h=86A0h

4.11.27 Accumulated operation time of the compressor

Read the accumulated operation time of the compressor. If the time is 100000 hours (186A0h), the output is as follows.

5602h=0001h, 5603h=86A0h

4.11.28 Accumulated operation time of the pump

Read the accumulated operation time of the pump. If the time is 100000 hours (186A0h), the output is as follows.

5608h=0001h, 5609h=86A0h

4.11.29 Accumulated time of DI filter water flowing

Read the accumulated time of DI filter water flowing. If the time is 100000 hours (186A0h), the output is as follows.

560Eh=0001h, 560Fh=86A0h

The value is 0, when the optional [Electric resistivity/conductivity sensor] is invalid.

Chapter 5 Simple communication protocol function

Data can be read / written by this communication protocol. This protocol complies with SMC thermo-cooler HRG, HRGC series.

This communication has the following features.

- Sets and reads the circulating fluid set point temperature.
- Reads the circulating fluid supply temperature.

5.1 Precautions for communication

5.1.1 Precautions after wiring and before communication

○ Check or set each communication setting by the operation display panel.

• The communication specification shall be the customer's communication standard.

- The serial protocol shall be the simple communication protocol 1 or 2.

Simple communication protocol 1: Operation display panel controls the start and stop of the product.

Simple communication protocol 2: Controls the start and stop of the product remotely.

Refer to chapter 2.4 for remote setting when this protocol is selected.

- The communication mode shall be the SERIAL mode.

Other modes can perform reading, but only SERIAL mode can perform writing of values.

○ Check or set the communication parameters using the operation display panel.

Check or set the communication speed, the presence of BCC, data length, parity check, stop bit length, response delay time, and communication range (RO or RW) to synchronize the product with the host computer (controller) prepared by the customer.

○ Check the device address of this product.

No response is returned when a request message is sent from a device address other than those set in the product.

5.1.2 Precautions for communicating

○Check the data digit number and the decimal point location when requesting to write the set value.

○Allow a suitable interval between requests.

To send request messages in series, wait for 100msec. or longer after receiving a response message from the product before sending the next message.

○No response is returned for a request message of a command which is not supported by the product.

○Retry (resend request message).

The response may not be returned due to noise. If no message is returned after 1sec. of sending a request message, resend the request message.

○If necessary send a read request message to check if it was written correctly.

Message to notify the completion of the process is returned when the action for the written request message is completed.

5.1.3 Precautions after the completion of the communication

○Send the data storage request (STR) if necessary.

Data which is set by communication is stored in RAM. Set values stored in RAM are deleted when the power supplied to the product is cut. When the power is supplied again, operation starts with the values set before communication (values stored in FRAM of the product).

Store the values set by communication in FRAM (rewrite FRAM) by sending a data storage request message (STR) before cutting the power supply to the product.

Please check how many times it is possible to write to FRAM, and avoid unnecessary rewriting of the data during communication

5.2 Communication specification

Table 5.2-1 Communication specification of simple communication protocol

Item	Specification
Standard	Select from EIA RS-485/RS-232C
Communication speed	Select from 1200bps/2400bps/4800bps/9600bps/19200bps
Data · bit length	Select from 7bit/8bit
Stop · bit length	Select from 1bit/2bit
Parity	Select from without parity ,odd number ,even number
Letter code	ASCII mode
Device address set range	Select from 1 to 99
Response delay time setting	Select from 0 to 250[msec]
Communication range	RO(Can read data only), Select from RW(can read and write data)
BCC	Select from with BCC , without BCC
Error check	EXOR algorithm of all data from STX to ETX is read only when BCC is selected.

□ : Default setting

5.3 Setting and checking

5.3.1 Setting and checking items

The table below explains the setting items of the simple communication protocol function and the initial values.

Table 5.3-1 Communication setting items

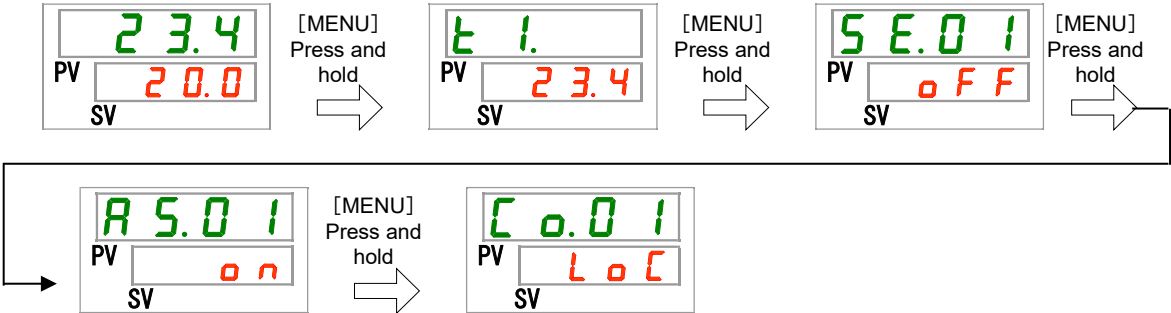
Display	Item	Contents	Default setting
[0.01]	Communication mode	Sets communication mode.	LOC
[0.02]	Serial protocol	Sets serial communication protocol.	MDBS
[0.03]	Communication specification	Sets standard of the serial communication.	485
[0.04]	RS-485 terminal	Sets of the terminal of RS-485.	OFF
[0.07]	Device address (Simple communication protocol)	Sets device address of simple communication protocol. [----] is displayed when the setting of serial protocol is not simple communication protocol.	1
[0.08]	Communication speed (Simple communication protocol)	Sets communication speed of simple communication protocol. [----] is displayed when the setting of serial protocol is not simple communication protocol.	9.6
[0.09]	BCC (Simple communication protocol)	Sets error detection code of communication of simple communication protocol. [----] is displayed when the setting of serial protocol is not simple communication protocol.	ON
[0.10]	Data length (Simple communication protocol)	Sets data length. [----] is displayed when the setting of serial protocol is not simple communication protocol.	8BIT
[0.11]	Parity check (Simple communication protocol)	Sets parity check. [----] is displayed when the setting of serial protocol is not simple communication protocol.	NON
[0.12]	Stop bit length (Simple communication protocol)	Sets bit length. [----] is displayed when the setting of serial protocol is not simple communication protocol.	2BIT
[0.13]	Response delay time (Simple communication protocol)	Sets time to delay the response message of simple communication protocol. [----] is displayed when the setting of serial protocol is not simple communication protocol.	0
[0.14]	Communication range (Simple communication protocol)	Sets communication range of simple communication protocol. [----] is displayed when the setting of serial protocol is not simple communication protocol.	RW

5.3.2 Setting and checking

Communication mode Setting and checking

1. Press and hold the [MENU] key for 2 sec.

Repeat pressing the key until the setting screen for communication mode [C 0.0 1] appears on the digital display.



2. Select “SER” from the table below with the [▲] key, and confirm with [SEL] key.

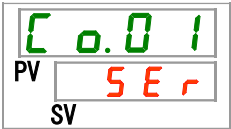


Table 5.3-2 Set values

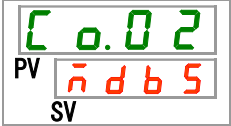
Set values	Explanation	Default setting
L o C	Sets LOCAL mode	○
d I o	Sets DIO mode	
S E r	Sets SERIAL mode*1	

*1: If the serial protocol is “Simple communication protocol 2” and the contact input 1 is “external switch signal” or contact input 2 is “remote signal”, “SERIAL mode” cannot be set.

Serial protocol Setting and checking

3. Press the [SEL] key once.

The set screen of serial protocol is displayed on the digital display.



4. Select serial protocol from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 5.3-3 Set values

Set values	Explanation	Default setting
Modbus	MODBUS protocol	○
Pr01	Simple communication protocol 1	
Pr02	Simple communication protocol 2*2,*3	

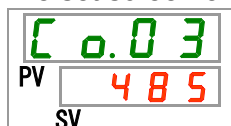
*2: When the setting of the contact input 2 is "Remote signal", "Simple communication protocol 2" cannot be set.

*3: Refer to chapter 2.4 for remote setting when the communication mode is SERIAL and the simple communication protocol 2 is selected as the serial protocol.

Communication specification Setting and checking

5. Press the [SEL] key once.

The set screen of communication specification is displayed on the digital display.



6. Select communication specification from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

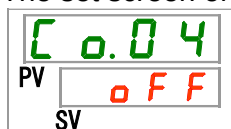
Table 5.3-4 Set values

Set values	Explanation	Default setting
232C	RS-232C Standard	
485	RS-485 Standard	○

RS-485 terminal Setting and checking

7. Press the [SEL] key once.

The set screen of RS-485 terminal is displayed on the digital display.



8. Select RS-485 terminal from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 5.3-5 Set values

Set values	Explanation	Default setting
0FF	Without terminal	○
0n	With terminal	

9. Press the [SEL] key 3 times.

The set screen of device addresses (simple communication protocol) is displayed on the digital display.

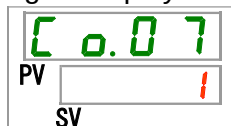
**10.** Select device addresses (simple communication protocol) from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 5.3-6 Set values

Set values	Explanation	Default setting
----	Setting/checking are not available unless the serial protocol setting is simple communication protocol.	
to 99	Sets of device addresses for simple communication protocol. Set range is 1 to 99.	

11. Press the [SEL] key once.

The set screen of communication speed (simple communication protocol) is displayed on the digital display.

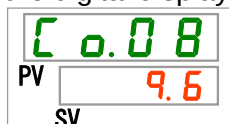
**12.** Select communication speed (simple communication protocol) from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 5.3-7 Set values

Set values	Explanation	Default setting
----	Setting/checking are not available unless the serial protocol setting is simple communication protocol.	
1.2	1200bps	
2.4	2400bps	
4.8	4800bps	
9.6	9600bps	○
19.2	19200bps	

13. Press the [SEL] key once.

The set screen of BCC (simple communication protocol) is displayed on the digital display.

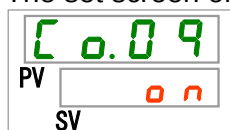
**14.** Select BCC (simple communication protocol) from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 5.3-8 Set values

Set values	Explanation	Default setting
----	Setting/checking are not available unless the serial protocol setting is simple communication protocol.	
0FF	Without BCC	
0n	With BCC	○

15. Press the [SEL] key once.

The set screen of data length (simple communication protocol) is displayed on the digital display.

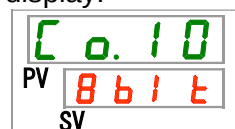
**16.** Select data length (simple communication protocol) from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 5.3-9 Set values

Set values	Explanation	Default setting
----	Setting/checking are not available unless the serial protocol setting is simple communication protocol.	
7bit	7 bit	
8bit	8 bit	○

Parity check (simple communication protocol) Setting and checking

17. Press the [SEL] key once.

The set screen of parity check (simple communication protocol) is displayed on the digital display.

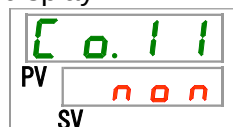
**18.** Select parity check (simple communication protocol) from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 5.3-10 Set values

Set values	Explanation	Default setting
----	Setting/checking are not available unless the serial protocol setting is simple communication protocol.	
non	None	○
odd	Odd number	
Even	Even number	

Stop bit (simple communication protocol) Setting and checking

19. Press the [SEL] key once.

The set screen of stop bit (simple communication protocol) is displayed on the digital display.

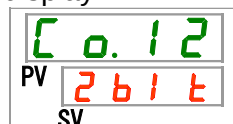
**20.** Select stop bit (simple communication protocol) from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 5.3-11 Set values

Set values	Explanation	Default setting
----	Setting/checking are not available unless the serial protocol setting is simple communication protocol.	
1bit	1 bit	
2bit	2 bit	○

21. Press the [SEL] key once.

The set screen of response delay time (simple communication protocol) is displayed on the digital display.

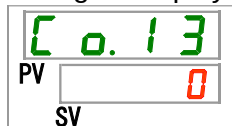
**22.** Select response delay time (simple communication protocol) from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 5.3-12 Set values

Set values	Explanation	Default setting
	Setting/checking are not available unless the serial protocol setting is simple communication protocol.	
 to 	Sets of response delay time Set range is 0 to 250msec.	

23. Press the [SEL] key once.

The set screen of communication range (simple communication protocol) is displayed on the digital display.

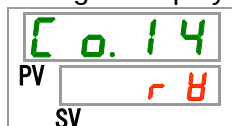
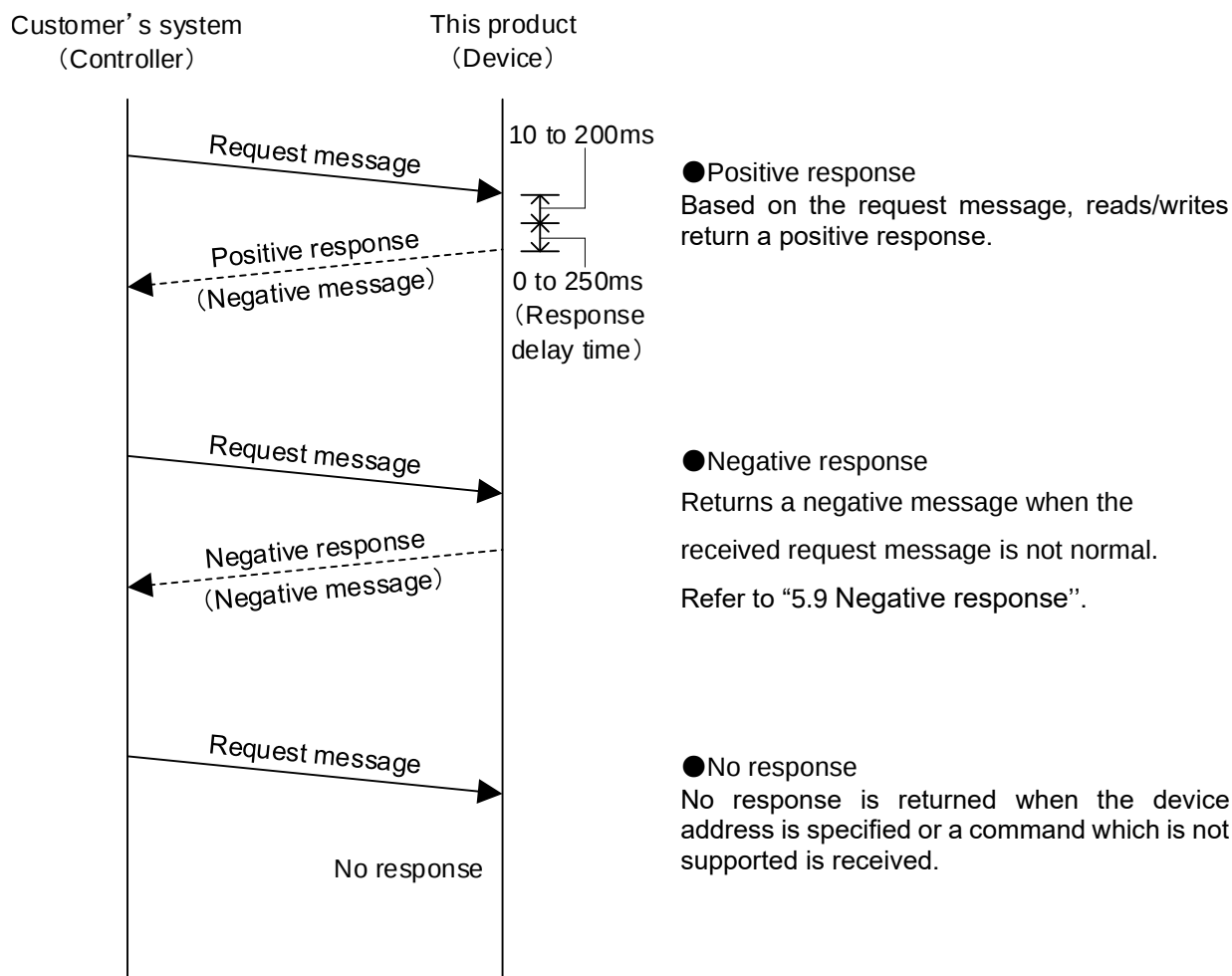
**24.** Select communication range (simple communication protocol) from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Table 5.3-13 Set values

Set values	Explanation	Default setting
	Setting/checking are not available unless the serial protocol setting is simple communication protocol.	
	Only reading is available	
	Reading and writing are available	○

5.4 Communication sequence

Starts with a request message from the customer's system (controller), and finishes with a response message from the product (device). This product operates as a device. It does not send any requests.



5.5 Message configuration

The message configuration is shown in the following. The explanation of data in message is shown in the Table 5.5-1.

This product communicates in ASCII mode. ASCII mode is used from STX to ETX. Hexadecimal value is used for BCC.

5.5.1 Message format

1) Request message format

1-1) Request message (Request to read)

STX	Device Address		Request	Command			ETX	BCC
[STX]	XX	XX	[R]	XX	XX	XX	[ETX]	XX

1-2) Request message (Request to write)

STX	Device Address		Request	Command			Writing data					ETX	BCC
[STX]	XX	XX	[W]	XX	XX	XX	XX	XX	XX	XX	XX	[ETX]	XX

1-3) Request message (Request to store the data)

STX	Device Address		Request	Command			ETX	BCC
[STX]	XX	XX	[W]	XX	XX	XX	[ETX]	XX

2) Response message format

2-1) Response message (Normal response to request to write)

STX	Device Address		ACK	Command			Reading data					ETX	BCC
[STX]	XX	XX	[ACK]	XX	XX	XX	XX	XX	XX	XX	XX	[ETX]	XX

2-2) Response message (Normal response to request to write or store the data)

STX	Device Address		ACK	ETX	BCC
[STX]	XX	XX	[ACK]	[ETX]	XX

2-3) Response message (Response when a receiving error occurred)

STX	Device Address		NAK		ETX	BCC
[STX]	XX	XX	[NAK]	XX	[ETX]	XX

Exception code

Response is not returned unless STX and ETX (BCC) are included in the request. This product clears all previously received code when STX is received.

Table 5.5-1 Format data

Table 5.5-1 Format data

NO	Item	Explanation																				
1	STX(02h)	Start text The code to specify the head of the message. Added to the head of the characters to be sent.																				
2	ETX(03h)	End text The code to specify the end of the message. Added to the end of the characters to be sent. Other than BCC.																				
3	Device Address	Device address which is set to each product. Can be changed by setting. The address to identify the device.																				
4	Request	Request identifier. R (reading) or W (writing)																				
5	Command	Command to reading or writing.																				
6	Writing Reading	To request writing, write the data in this area to the object data. To request reading, set the object data in this area.																				
7	BCC	EXOR algorithm of all characters from STX to ETX is read with the check code for error detection. This code (BCC) is not included in "response" if BCC check is not selected when setting the communication.																				
8	ACK(06h)	Acknowledge code. This is included in the response from the product when there is no error in the received request.																				
9	NAK(15h)	Negative acknowledge code. This is included in the response from the product when there is an error in the received request.																				
10	Exception code	Error content is included in the response when there is an error in the received request. Refer to the table below for exception codes. <table><tr><th>Exception code</th><th>Exception</th></tr><tr><td>0</td><td>Equipment malfunction Memory error</td></tr><tr><td>1</td><td>Out of set range Value data is out of "set range specified independently by set parameter"</td></tr><tr><td>2</td><td>Setting not allowed. Changing of requested communication parameter is prohibited. Or communication parameter to read does not exist. Writing of the communication mode is requested while the communication mode change is set to RO (read only) Writing to PV (measured value) is requested.</td></tr><tr><td>3</td><td>Abnormal code ASCII code other than numerical data is requested (specified) to the location for numerical data. ASCII code other than "0" or "-" is requested (specified) to the location for symbol.</td></tr><tr><td>4</td><td>Format error</td></tr><tr><td>5</td><td>BCC error</td></tr><tr><td>6</td><td>Overrun error</td></tr><tr><td>7</td><td>Fleming error</td></tr><tr><td>8</td><td>Parity error</td></tr></table> *1 : Exception code "0" is included in the response regardless of the presence of the request error because memory error is present. *2 : The exception with the highest number is included in the response when two or more errors have occurred.	Exception code	Exception	0	Equipment malfunction Memory error	1	Out of set range Value data is out of "set range specified independently by set parameter"	2	Setting not allowed. Changing of requested communication parameter is prohibited. Or communication parameter to read does not exist. Writing of the communication mode is requested while the communication mode change is set to RO (read only) Writing to PV (measured value) is requested.	3	Abnormal code ASCII code other than numerical data is requested (specified) to the location for numerical data. ASCII code other than "0" or "-" is requested (specified) to the location for symbol.	4	Format error	5	BCC error	6	Overrun error	7	Fleming error	8	Parity error
Exception code	Exception																					
0	Equipment malfunction Memory error																					
1	Out of set range Value data is out of "set range specified independently by set parameter"																					
2	Setting not allowed. Changing of requested communication parameter is prohibited. Or communication parameter to read does not exist. Writing of the communication mode is requested while the communication mode change is set to RO (read only) Writing to PV (measured value) is requested.																					
3	Abnormal code ASCII code other than numerical data is requested (specified) to the location for numerical data. ASCII code other than "0" or "-" is requested (specified) to the location for symbol.																					
4	Format error																					
5	BCC error																					
6	Overrun error																					
7	Fleming error																					
8	Parity error																					

5.5.2 Message example

The example shows communication with the conditions below.

○Device Address : No.1

○Read seven consecutive data from register 0000h.

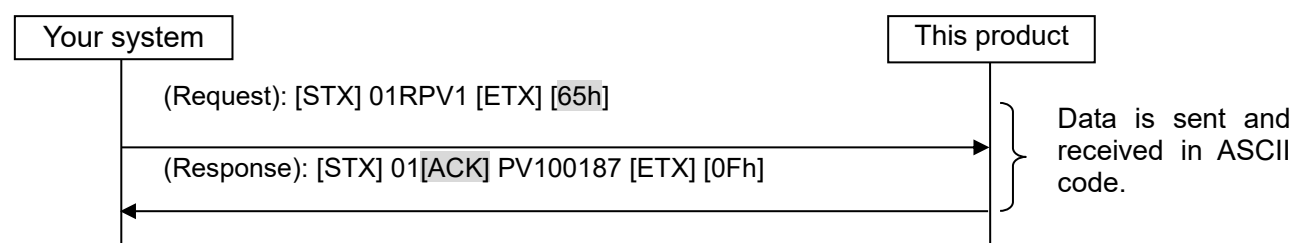
(Read circulating fluid supply temperature.)

■ Communication example

CAUTION



The communication example is expressed in hexadecimal value with []. The actual communication is performed with ASCII code. Refer to the request / response message in this section.



Request message		Response message	
Code	Contents	Code	Contents
01	Device Address	01	Device Address
R	Request message to read	[ACK]	Normal response message
PV1	Circulating fluid supply temperature	PV1	Circulating fluid supply temperature
[65h]	BCC value	00187	Read information
		[0Fh]	BCC value

■ Request message (Controller to Device)

STX	Device Address		Request	Command			ETX	BCC
02	30	31	52	50	56	31	03	65

■ Response message (Device to Controller)

STX	Device Address		ACK	Command			Reading data					ETX	BCC
02	30	31	06	50	56	31	30	30	31	38	37	03	0F

5.6 BCC

EXOR algorithm of all characters from STX to ETX is read with the check code for error detection.

This BCC is not included in “response” if BCC check is not selected when setting the communication.

Displayed in one digit of ASCII code in the message frame.

■ Calculation example

- Message for BCC
[STX] 01RPV1 [ETX]
- Calculation

ASCII	HEX
[STX]	02
'0'	30
'1'	31
'R'	52
'P'	50
'V'	56
'1'	31
[ETX]	03
'e'	65

←Code for EXOR from STX to ETX is BCC.

- Sending message
[STX] 01RPV1 [ETX] e

5.7 Command

Table 5.7-1 shows the commands which are supported by the product.

No response is returned for a request message of a command which is not in Table 5.7-1.

Table 5.7-1 Command list

NO	Command	Name	R/W	Explanation
1	PV1	Circulating fluid supply temperature	R	Read the circulating fluid supply temperature. The circulating fluid supply temperature (offset temperature if offset setting is selected) which is displayed on the operation display panel PV part. e.g. In case of 19.8°C 00198
2	SV1	Circulating fluid set point temperature	R/W	Write/read the circulating fluid set point temperature. Writing is available only in serial mode. e.g. In case of 35.8°C 00358
3	LOC	Key-lock setting	R/W	Write and read the key-lock setting. 00000 : Unlocked 00001 : All locked 00002 : Setting mode value is locked 00003 : Key lock other than for set temp. Key-lock setting of this product just receives the command. This command does not actually lock the keys. This function is to make this product interchangeable with the communication specifications of SMC's HRG/HRGC series thermo coolers. When not using this product as a replacement for HRG/HRGC, this function is not needed.
4	STR	Store the data	W	Store the data to the product (Write to FRAM)

5.8 Command explanation

5.8.1 Command:PV1 Circulating fluid supply temperature

Read the circulating fluid supply temperature. The circulating fluid supply temperature (offset temperature if offset setting is selected) which is displayed on the operation display panel PV part.

■ Request message <Normal> (Controller to Device)

STX	Device Address		Request	Command			ETX	BCC
[STX]	XX	XX	[R]	[P]	[V]	[1]	[ETX]	XX

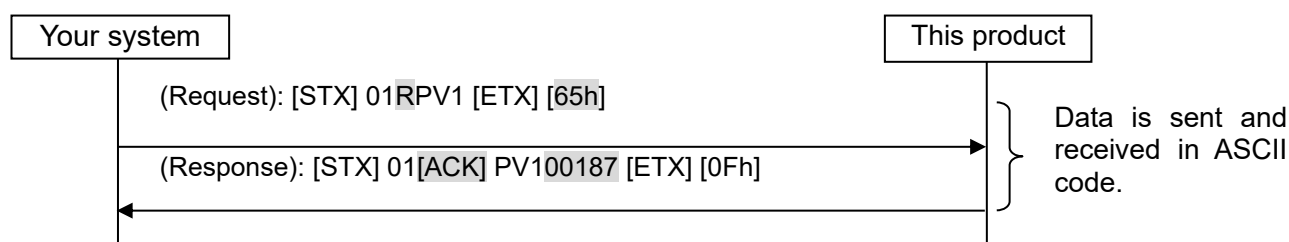
■ Response message <Normal> (Device to Controller)

STX	Device Address		ACK	Command			Reading data					ETX	BCC
[STX]	XX	XX	[ACK]	[P]	[V]	[1]	XX	XX	XX	XX	XX	[ETX]	XX

■ Communication example

○Device Address : No 1

○With BCC



Request message		Response message	
Code	Contents	Code	Contents
01	Device Address	01	Device Address
R	Request message to read	[ACK]	Normal response message
PV1	Circulating fluid supply temperature	PV1	Circulating fluid supply temperature
[65h]	BCC value	00187	Read information (18.7°C)
		[0Fh]	BCC value

5.8.2 Command:SV1 Circulating fluid set point temperature (R)

Read the circulating fluid set point temperature.

Request message <Normal> (Controller to Device)

STX	Device Address		Request	Command			ETX	BCC
[STX]	XX	XX	[R]	[S]	[V]	[1]	[ETX]	XX

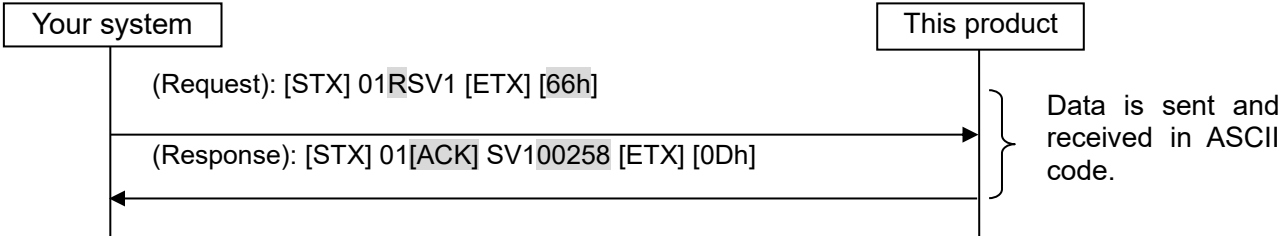
Response message <Normal> (Device to Controller)

STX	Device Address		ACK	Command			Reading data					ETX	BCC
[STX]	XX	XX	[ACK]	[S]	[V]	[1]	XX	XX	XX	XX	XX	[ETX]	XX

Communication example

ODevice Address : No 1

OWith BCC



Request message		Response message	
Code	Contents	Code	Contents
01	Device Address	01	Device Address
R	Request message to read	[ACK]	Normal response message
SV1	Circulating fluid set point temperature	SV1	Circulating fluid set point temperature
[66h]	BCC value	00258	Read information (25.8°C)
		[0Dh]	BCC value

5.8.3 Command:SV1 Circulating fluid set point temperature (W)

Set the circulating fluid set point temperature.

■ Request message <Normal> (Controller to Device)

STX	Device Address		Request	Command			Writing data					ETX	BCC
[STX]	XX	XX	[W]	[S]	[V]	[1]	XX	XX	XX	XX	XX	[ETX]	XX

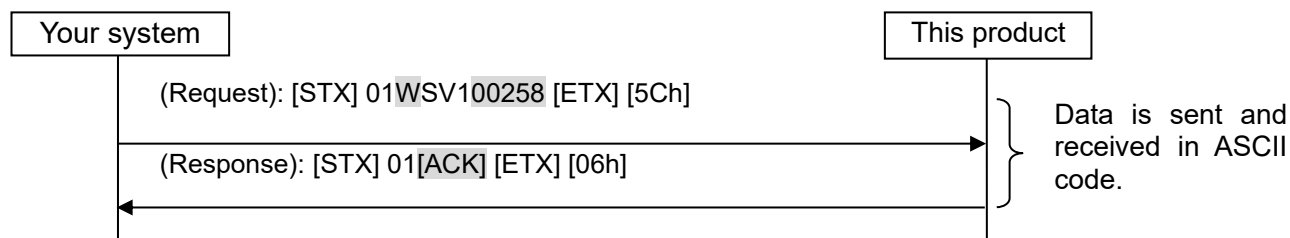
■ Response message <Normal> (Device to Controller)

STX	Device Address		ACK	ETX	BCC
[STX]	XX	XX	[ACK]	[ETX]	XX

■ Communication example

○Device Address : No 1

○With BCC



Request message		Response message	
Code	Contents	Code	Contents
01	Device Address	01	Device Address
W	Request message to write	[ACK]	Normal response message
SV1	Circulating fluid set point temperature	[06h]	BCC value
00258	Write information (25.8 °C)		
[5Ch]	BCC value		

5.8.4 Command:LOC Key-lock setting (R)

Read the key-lock condition set in 5.8.5 "Command: LOC".

It is different from the key-lock information which is set by the operation display panel.

■ Request message <Normal> (Controller to Device)

STX	Device Address		Request	Command			ETX	BCC
[STX]	XX	XX	[R]	[L]	[O]	[C]	[ETX]	XX

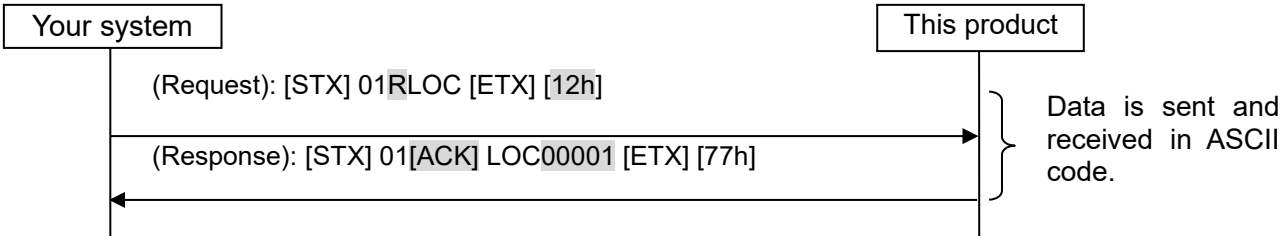
■ Response message <Normal> (Device to Controller)

STX	Device Address		ACK	Command			Reading data					ETX	BCC
[STX]	XX	XX	[ACK]	[L]	[O]	[C]	XX	XX	XX	XX	XX	[ETX]	XX

■ Communication example

○Device Address : No 1

○With BCC



Request message		Response message	
Code	Contents	Code	Contents
01	Device Address	01	Device Address
R	Request message to read	[ACK]	Normal response message
LOC	Key-lock setting	LOC	Key-lock setting
[12h]	BCC value	00001	Read information(00001:All locked)
		[77h]	BCC value

5.8.5 Command:LOC Key-lock setting (W)

Sets key-lock of this product. This setting is different from the key-lock information which is set by the operation display panel.

Key-lock setting of this product just receives the command. This command does not actually lock the keys.

This function is to make this product interchangeable with the communication specifications of SMC's HRG/HRGC series thermo coolers. When not using this product as a replacement for HRG/HRGC, this function is not needed.

■ Request message <Normal> (Controller to Device)

STX	Device Address		Request	Command				Writing data					ETX	BCC
[STX]	XX	XX	[W]	[L]	[O]	[C]		XX	XX	XX	XX	XX	[ETX]	XX

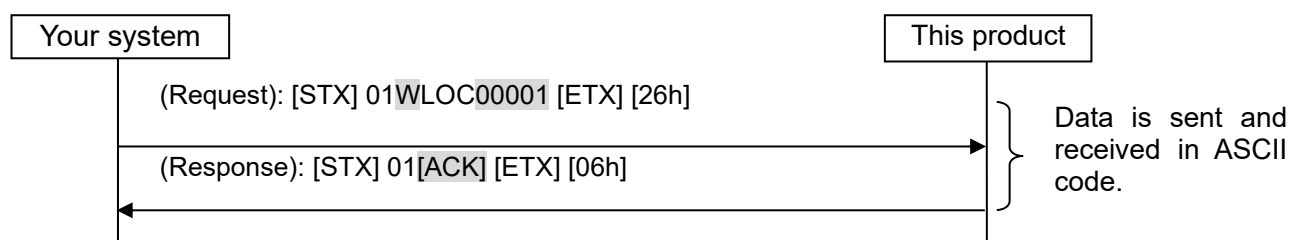
■ Response message <Normal> (Device to Controller)

STX	Device Address		ACK	ETX	BCC
[STX]	XX	XX	[ACK]	[ETX]	XX

■ Communication example

○Device Address : No 1

○With BCC



Request message		Response message	
Code	Contents	Code	Contents
01	Device Address	01	Device Address
W	Request message to write	[ACK]	Normal response message
LOC	Key-lock setting	[06h]	BCC value
00001	Read information (00001 : All locked)		
[26h]	BCC value		

5.8.6 Command:STR Saves data

Store the circulating fluid set point temperature set in 5.8.3 "Command:SV1 Circulating fluid set point temperature (W)". Key-lock set data which is set in 5.8.5 "Command:LOC Key-lock setting (W)" is not the object to store.

■ Request message <Normal> (Controller to Device)

STX	Device Address		Request	Command			ETX	BCC
[STX]	XX	XX	[W]	[S]	[T]	[R]	[ETX]	XX

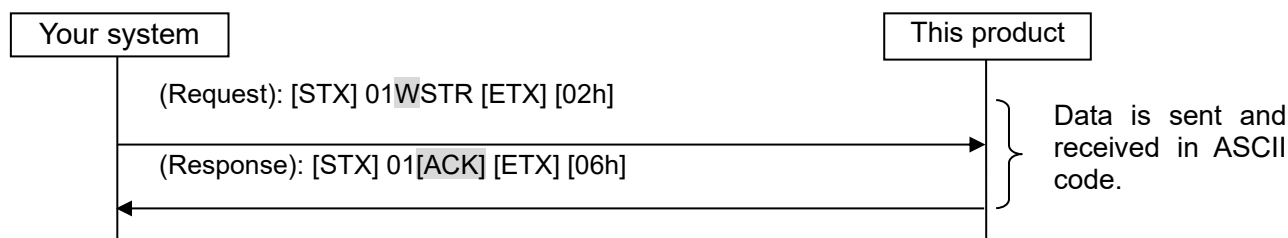
■ Response message <Normal> (Device to Controller)

STX	Device Address		ACK	ETX	BCC
[STX]	XX	XX	[ACK]	[ETX]	XX

■ Communication example

○Device Address : No 1

○With BCC



Request message		Response message	
Code	Contents	Code	Contents
01	Device Address	01	Device Address
W	Request message to write	[ACK]	Normal response message
STR	Saves data	[06h]	BCC value
[02h]	BCC value		

5.9 Negative response

If the request is not normal when receiving the request, or the request cannot be received due to the state of the product, a negative response is returned. Refer to the exception codes in Table 5.5-1 for exceptions.

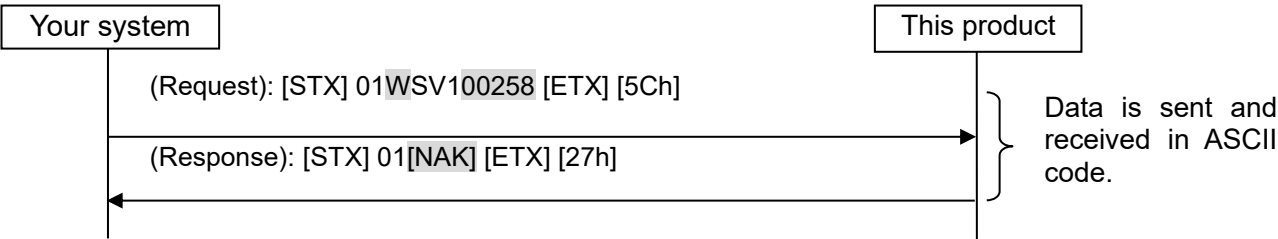
■ Response message <Abnormal> (Device to Controller)

STX	Device Address		NAK		ETX	BCC
[STX]	XX	XX	[NAK]	XX	[ETX]	XX

Exception code

■ Communication example

- Device Address : No 1
- Writing of the circulating fluid set temperature when the communication range setting is RO (read only).



Request message		Response message	
Code	Contents	Code	Contents
01	Device Address	01	Device Address
W	Request message to write	[NAK]	Negative response message
SV1	Circulating fluid set point temperature	2	Exception code for setting is prohibited
00258	Write information (25.8 °C)	[27h]	BCC value
[5Ch]	BCC value		

Chapter 6 Communication alarm function

Monitors whether the serial communication is sent/received properly between the product and the customer's device. This feature is only valid when the communication mode is set to SERIAL mode.

Abnormal signals or disconnection of the communication cable can be notified immediately by setting the alarm function to match the interval at which messages are sent from the customer device. When the communication is restored, the alarm is automatically reset.

Do not use this function when the customer device does not send messages regularly.

The default setting of this function is "off".

6.1 Communication alarm occurs

Figure 6.1-1 shows when an alarm occurs. Refer to 6.3 "Setting and checking" for the setting method.

- Changing of communication error

Operation continues when an alarm occurs.

- Time for monitoring the communication error

180 sec

When the customer's device is sending messages every 60sec, if the communication cable is disconnected and no message is received for 180sec, the product generates AL19 communication error alarm to notify the error.

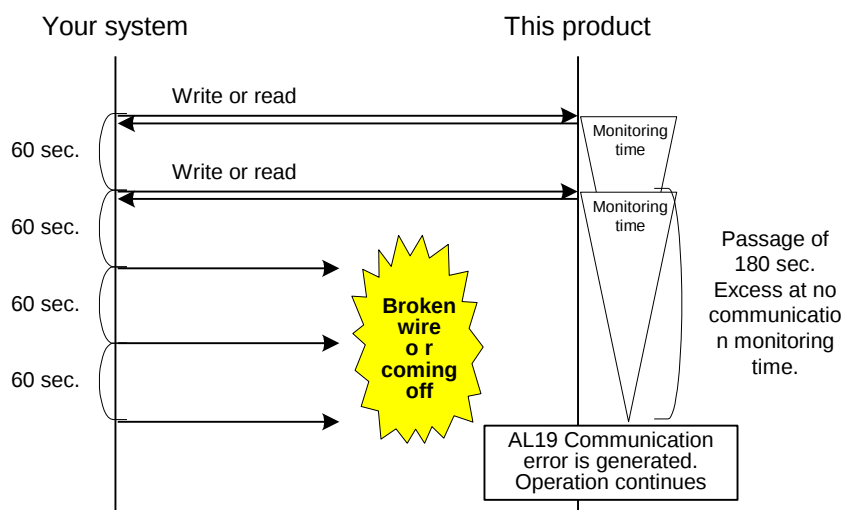


Figure 6.1-1 Communication alarm example

6.2 Communication alarm reset

When AL19 communication error has been generated, the alarm is automatically reset when the disconnection of the communication cable is fixed, and the message from the customer is received. If operation is set to stop when a communication alarm occurs, restart the operation if necessary.

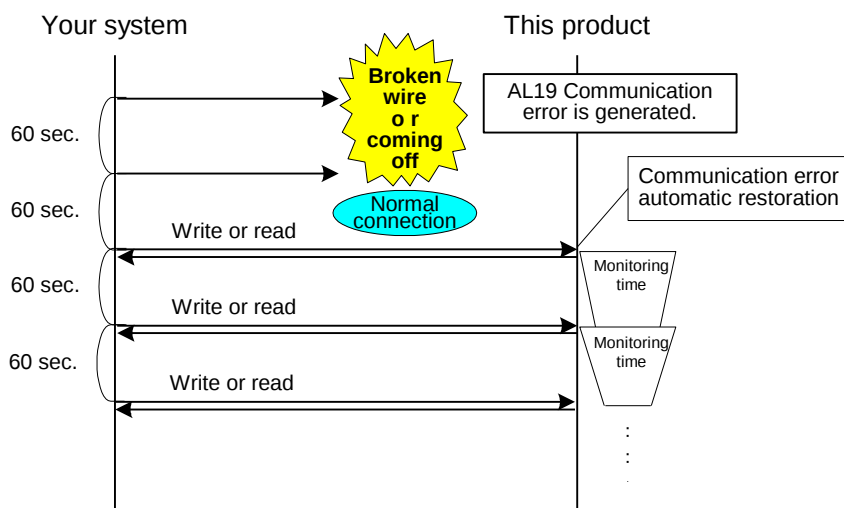


Figure 6.2-1 Communication alarm restoration example

6.3 Setting and checking

6.3.1 Setting and checking items

The table below explains the setting items of the communication alarm function and default values.

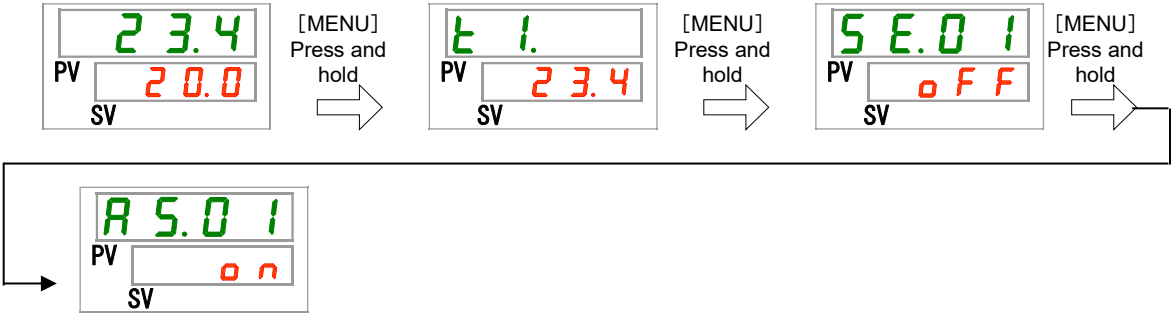
Table 6.3-1 Communication setting item

Display	Item	Contents	Default setting
A 5.11	Changing of communication error	Set the operation when the alarm No. AL19 "Communication error" is generated.	OFF
A 5.12	Monitoring time of communication error	Set the alarm monitoring time when the alarm No. AL19 "Communication error" is generated. Alarm signal is generated when the monitoring time is exceeded. Setting unit is 1 sec. [----] is displayed when the communication error setting is OFF.	30

6.3.2 Setting and checking

1. Press and hold the [MENU] key for 2 sec.

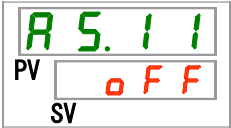
Repeat pressing the key until the setting screen for alarm buzzer sound [**A 5.0 1**] appears on the digital display.



Changing of communication error Setting and checking

2. Display the screen of the communication error by pressing the [SEL] key 10 times.

The set screen of “changing of communication error” is displayed on the digital display.



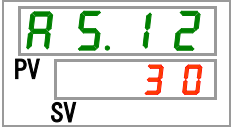
3. Select changing of operation when communication error from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Set values	Explanation	Default setting
0 F F	This alarm signal is not detected.	○
R. r U n	Operation continues when this communication error is generated.	
R. S t P	Operation is stopped when this communication error is generated.	

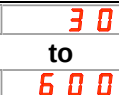
The monitoring time of communication error Setting and checking

4. Press the [SEL] key once.

The set screen of the “monitoring time of communication error” is displayed on the digital display.



- 5.** Select the monitoring time of communication error from the table below with [▲] key or [▼] key, and confirm by pressing [SEL] key.

Set values	Explanation	Default setting
	Setting/checking are not available if the setting of the changing of communication error is OFF.	
	Sets monitoring time of communication error Setting range is 30 to 600 sec.	

Revision history

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Note: Specifications are subject to change without prior notice and any obligation on the part of the manufacturer.
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