# Oil Bath (Large Capacity)

## Model BOA201 / 311

# Instruction Manual

- First Edition –

**Thank you for purchasing "Constant Temperature Oil Bath, BOA201/311" of Yamato Scientific Co., Ltd.**

**●For proper equipment operation, please read and become thoroughly familiar with this instruction manual before use. Always keep equipment documentation safe and close at hand for convenient future reference.**

**⚠ WARNING: Read instruction manual warnings and cautions carefully and completely before proceeding.**

**Yamato Scientific Co. Ltd.**

**Printed on recycled paper**

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# 1. SAFETY PRECAUTIONS

## Explanation of Symbols

### A Word Regarding Symbols

Various symbols are provided throughout this text and on equipment to ensure safe operation. Failure to comprehend the operational hazards and risks associated with these symbols may lead to adverse results as explained below. Become thoroughly familiar with all symbols and their meanings by carefully reading the following text regarding symbols before proceeding

**⚠ Warning** Signifies a situation which may result in serious injury or death (Note 1.)

**⚠ Caution** Signifies a situation which may result in minor injury (Note 2) and/or property damage (Note 3.)

(Note 1) Serious injury is defined as bodily wounds, electrocution, bone breaks/fractures or poisoning, which may cause debilitation requiring extended hospitalization and/or outpatient treatment.

(Note 2) Minor injury is defined as bodily wounds or electrocution, which will not require extended hospitalization or outpatient treatment.

(Note 3) Property damage is defined as damage to facilities, equipment, buildings or other property.

### Symbol Meanings

Signifies warning or caution.
Specific explanation will follow symbol.

Signifiies restriction.
Specific restrictions will follow symbol.

Signifies an action or actions which operator must undertake.
Specific instructions will follow symbol.

# 1. SAFETY PRECAUTIONS

**Symbol Glossary**

**WARNING / CAUTION**

General

Danger!: High Voltage

Danger!: High Temperature

Danger!: Moving Parts

Danger!: Blast Hazard


Caution: Water Only

Caution: Shock Hazard!

Caution: Burn Hazard!

Caution: Do Not Heat Without Water!

Caution: May Leak Water!

Caution: Toxic Chemicals

**RESTRICTION**

General Restriction

No Open Flame

Do Not Disassemble

Do Not Touch

**ACTION**

General Action Required

Connect Ground Wire


Level Installation

Disconnect Power

Inspect Regularly

# 1. SAFETY PRECAUTIONS

**WARNING / CAUTION**

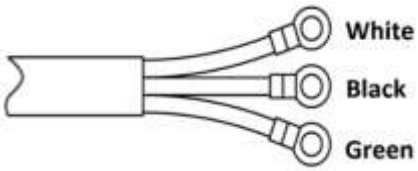
## WARNING

### Install in a location free of flammables and explosives.

Never install or operate unit in a flammable or explosive gas atmosphere. This unit is NOT fire or blast resistant. Simply switching earth leakage breaker (ELB) "ON" or "OFF" can produce a spark, which can then be relayed during operation, causing fire or explosion when near flammable or explosive fluids, chemicals or gases/fumes. See "LIST OF HAZARDOUS SUBSTANCES" (P.) for information on flammable and explosive gases.

### Ground wire MUST be connected properly

If there is no ground terminal, contact original dealer of purchase for location-specific electrical requirements. Securely connect to a distribution board.
No power plugs or connectors of any kind are included with this unit. When using a power plug, use a plug that meets the voltage and electrical capacity.




| Core color | Wiring on distribution board |
|---|---|
| White | Neutral |
| Black | Live |
| Green | Ground |

Never connect ground wire to gas lines, water pipes, telephone grounding lines, or lightning conductor rods. Malfunction, electric shock, fire, or other accident may result.

### Turn OFF (○) ELB immediately when an abnormality occurs.

If unit begins emitting smoke or abnormal odors for reasons unknown, turn OFF (○) ELB immediately, disconnect power cable from power supply, and contact original dealer of purchase for assistance. Continuing to operate without addressing abnormalities may cause fire or electric shock, resulting in serious injury or death. Never attempt to disassemble or repair unit. Repairs should always be performed by a certified technician.

### DO NOT disassemble or modify equipment

Never attempt to disassemble or modify unit. Doing so may cause malfunction, fire, electric shock, or personal injury. Note that any malfunction resulting from unauthorized modifications or customizations to unit will void the warranty.

# 1. SAFETY PRECAUTIONS

## WARNING / CAUTION

### Handle power cable with care.

- Do not operate unit with power cable bundled or tangled. Operating unit with the power cable bundled or otherwise tangled, may cause power cable to overheat and/or catch fire.
- Do not modifiy, bend, forcibly twist or pull on power cable. Fire or electric shock may result.
- Do not risk damage to power cable by positioning it under desks or chairs, or by allowing it to be pinched in between objects. Fire or electric shock may result.
- Do not place power cable near kerosene/electric heaters or other heat-generating devices. Doing so may cause power cable insulation to overheat, melt and/or catch fire, which may result in electric shock.
- Turn off (○) ELB immediately and disconnect from facility terminal or outlet, if power cable becomes partially severed or damaged in any way. Contact original dealer of purchase for information about replacing power cable. Continuing to operate without addressing abnormalities may cause fire or electric shock, resulting in serious injury or death.

-Connect the power cord to the appropriate distribution board.

### DO NOT touch hot surfaces.

Do not touch the vicinity of the oil bath during operation or immediately after operation. Burn injury may result.

### DO NOT climb or place any objects on top of equipment.

Personal injury or equipment malfunction may result.
Do not place any products other than those specified as options on top of unit.
Personal injury or equipment malfunction may result.

## CAUTION

### DO NOT operate equipment during thunderstorms

In the event of a thunderstorm, turn OFF (○) ELB and disconnect power cable immediately. A direct lightning strike may cause equipment damage, fire or electric shock, resulting in serious injury or death.

### Turn OFF (○) ELB in case of power failure.

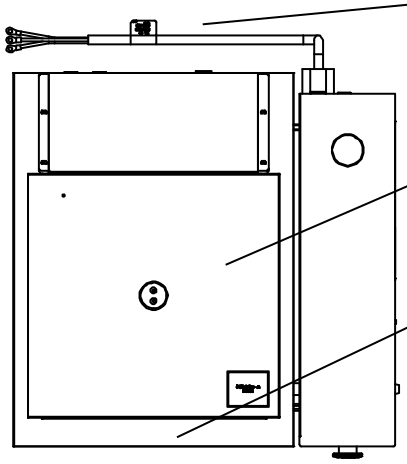
Operation stops when power failures occur. For added safety however, turn OFF (○) ELB in the event of a power failure.

# 1. SAFETY PRECAUTIONS

## Residual Risk Map

**These figures indicate positions of caution labels.**
**The numbers shown in the figure indicate the numbers listed in the "List of Residual Risks" in this manual.**
**For details of individual residual risks, see the List of Residual Risks.**

【BOA201】



| Power cable | |
|---|---|
| ⚠ WARNING | No.8, 9, 10, 29, 32 |

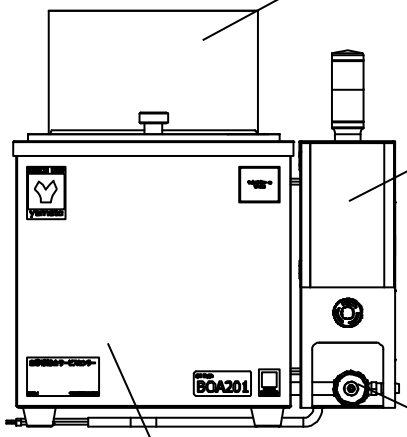
| lid | |
|---|---|
| ⚠ WARNING | No.19 |

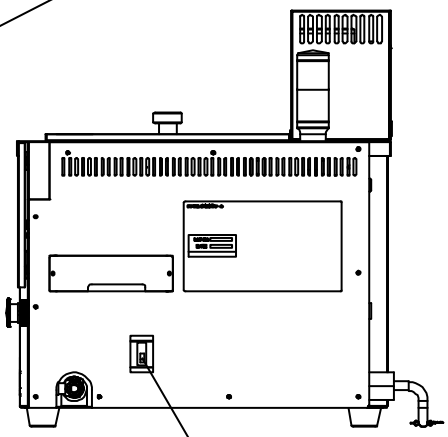
| Bath | |
|---|---|
| ⚠ WARNING | No.19, 24, 26, 27 |

| Housing box | |
|---|---|
| ⚠ WARNING | No.19 |

| Controller | |
|---|---|
| ⚠ CAUTION | No.17, 23, 28 |

* Overhead view



| Exterior | |
|---|---|
| ⚠ WARNING | No.19 |

| Drain valve | |
|---|---|
| ⚠ CAUTION | No.18 |

| Earth leakage breaker | |
|---|---|
| ⚠ WARNING | No.15, 22, 32 |

| Residual risks of unspecified location on equipment | |
|---|---|
| ⚠ WARNING | No.2, 5, 6, 7, 11, 13, 14, 16, 20, 21, 25, 30 |
| ⚠ CAUTION | No.1, 3, 4, 12, 33 |

***Contact original dealer of purchase if the nameplates and caution labels have come off, or become illegible. New nameplates are available at cost.**

# 1. SAFETY PRECAUTIONS

## List of Residual Risks

### List of residual risks (instructions for risk avoidance)

This list summarizes residual risks to avoid personal injuries or damages to properties during or related to the use of equipment.

**Be sure to fully understand or receive instructions on how to use, maintain and inspect equipment before starting operation.**

| | Loading/Installation | | | |
|---|---|---|---|---|
| No. | Degree of risks | Risk description | Protective measures taken by the user | Relevant page |
| 1 | CAUTION | Injury | Always use cargo-handling equipment to move or install unit. Transport unit with sufficient number of people and an appropriate work method when carrying out manually. | P.13 |
| 2 | WARNING | Fire/Electric shock | Choose an appropriate installation site. | P.12 |
| 3 | CAUTION | Injury | Install unit on a level surface. | P.13 |
| 4 | CAUTION | Injury | Take appropriate safety measures when installing. | P.13 |
| 5 | WARNING | Fire | Install equipment in a well-ventilated place | P.14 |
| 6 | WARNING | Fire/Electric shock | Install in a dry location. | P.14 |
| 7 | WARNING | Explosion/fire | Install in a location free of flammables and explosives. | P.3 |
| 8 | WARNING | Fire/Electric shock | Always connect power cable to appropriate facility outlet or terminal. | P.13 |
| 9 | WARNING | Fire/Electric shock | Handle power cable with care. | P.4 |
| 10 | WARNING | Fire/Electric shock | Ground wire MUST be connected properly | P.3 |
| 11 | WARNING | Fire/Electric shock | DO NOT disassemble or modify equipment. | P.3 |
| 12 | CAUTION | Injury/Fire | Implement proper fire extinguishing and ventilation measures. | P.14 |

# 1. SAFETY PRECAUTIONS

## List of Residual Risks

| | Use | | | |
|---|---|---|---|---|
| No. | Degree of risks | Risk description | Protective measures taken by the user | Relevant page |
| 13 | WARNING | Explosion/fire | DO NOT process explosive or flammable substances | P.61 |
| 14 | WARNING | Fire/Burn | Never move unit while in operation. | P.17 |
| 15 | WARNING | Fire/Electric shock | Turn OFF (○) ELB immediately when an abnormality occurs. | P.3 |
| 16 | WARNING | Fire/Electric shock<br>Burn | Take care not to drop test samples or objects into the inside unit. | P.61 |
| 17 | CAUTION | Fire | In the event of a power failure with Auto-resume mode “ON”, unit automatically reverts to status just before power loss and begin operation once again from that point. Be sure to confirm the state of unit when the power is supplied again. | P.62 |
| 18 | CAUTION | Burn | Do not operate the drain valve until the oil temperature drops below 45 ° C. | P.17 |
| 19 | WARNING | Burn | DO NOT touch hot surfaces | P.4 |
| 20 | WARNING | Fire | Never operate unmanned at high temperatures as it is dangerous. | P.17 |
| 21 | WARNING | Injury | DO NOT climb or place any objects on top of equipment. | P.4 |
| 22 | WARNING | Fire | DO NOT operate equipment during thunderstorms | P.4 |
| 23 | CAUTION | Burn<br>Injury | ALWAYS run equipment within specified temperature range. | P.62 |
| 24 | WARNING | Burn | Pay attention to internal temperature after operation. | P.61 |
| 25 | WARNING | Fire/Electric shock | Carefully handle test samples. | P.61 |
| 26 | WARNING | Injury/Fire | The media that can be used with this product are water (ion-exchanged water, distilled water) and silicone oil. | P.17 |
| 27 | WARNING | Burn<br>Injury, fire | Since silicone oil has a large thermal expansion, the maximum supply amount should be up to 28ℓ. | P.18 |
| 28 | WARNING | Fire | Set the overheat prevention activation temperature. | P.61 |

# 1. SAFETY PRECAUTIONS

## List of Residual Risks

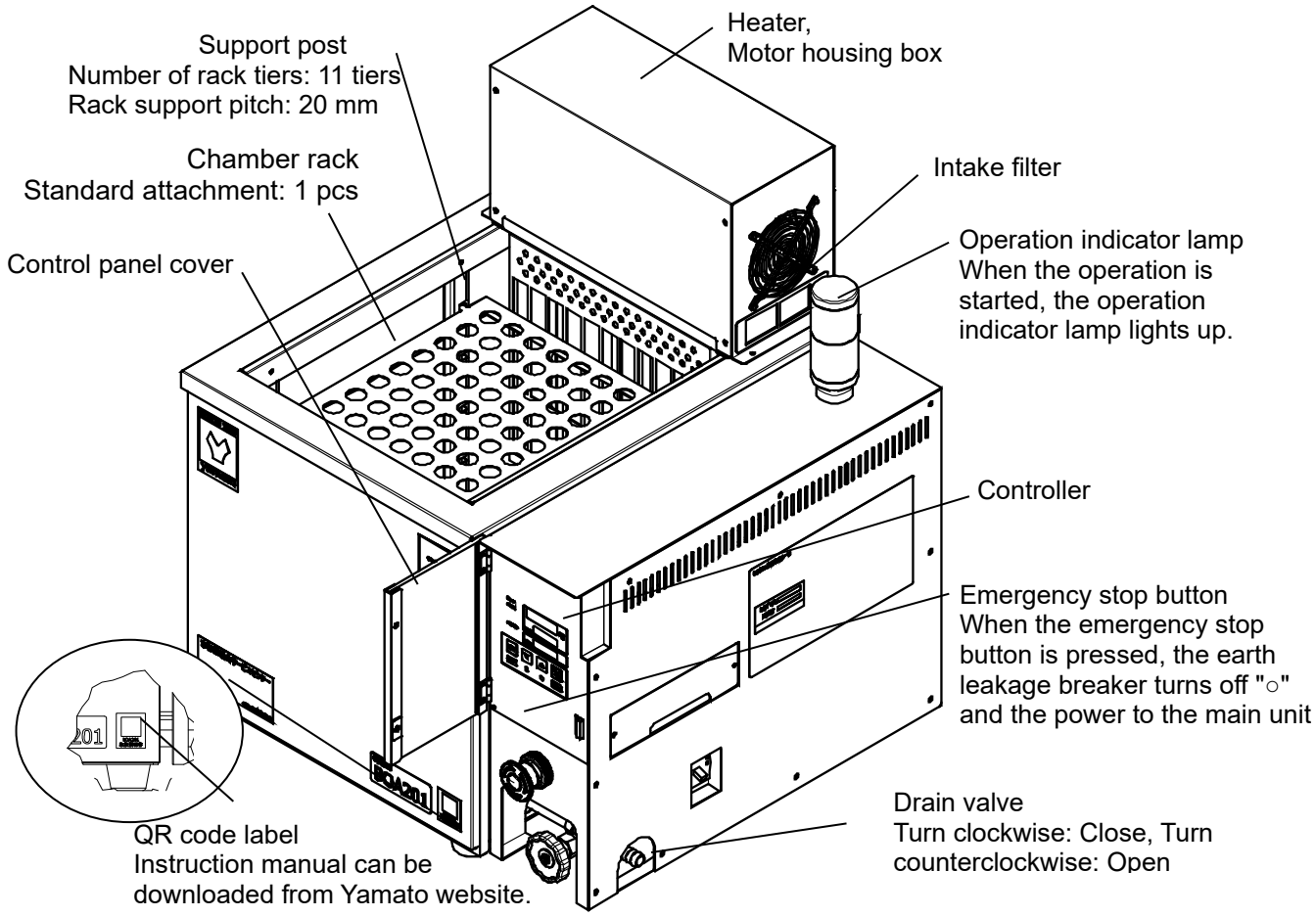
| | Daily inspection/maintenance | | | |
|---|---|---|---|---|
| No. | Degree of risks | Risk description | Protective measures taken by the user | Relevant page |
| 29 | WARNING | Fire/Electric shock | Be sure to disconnect power cable before daily inspection and maintenance. | P.64 |
| 30 | WARNING | Burn | Perform inspections and maintenance when unit is at room temperature. | P.64 |
| 31 | WARNING | Fire/Electric shock | DO NOT disassemble or modify equipment. | P.3 |

| | Extended storage/disposal | | | |
|---|---|---|---|---|
| No. | Degree of risks | Risk description | Protective measures taken by the user | Relevant page |
| 32 | WARNING | Fire/Electric shock | Turn OFF (○) ELB and disconnect power cable from facility outlet or terminal. | P.66 |
| 33 | CAUTION | Injury | Do not leave unit in a location where children may have access | P.66 |

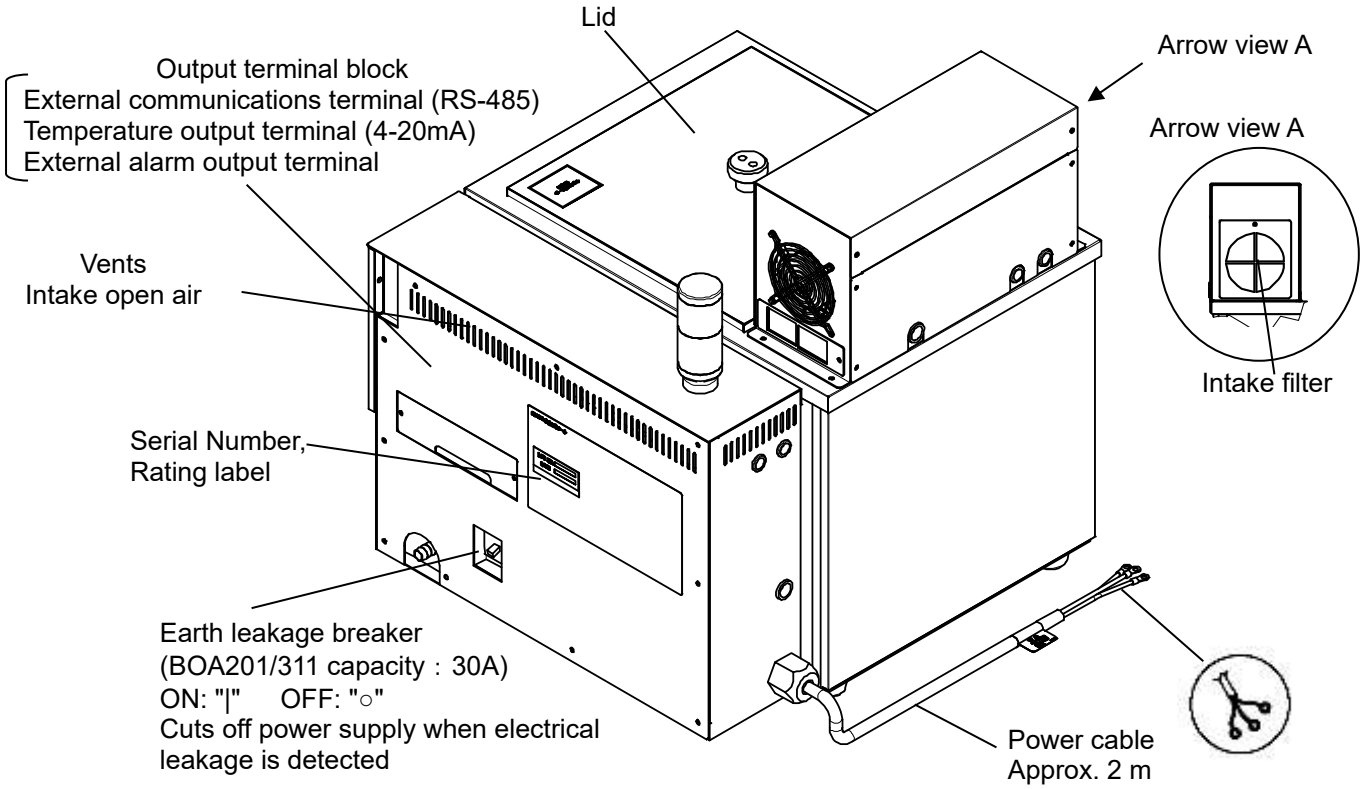
# 2. COMPONENT NAMES AND FUNCTIONS

## Main Unit (BOA201/311)

### ◆ BOA201 / 311 Front view

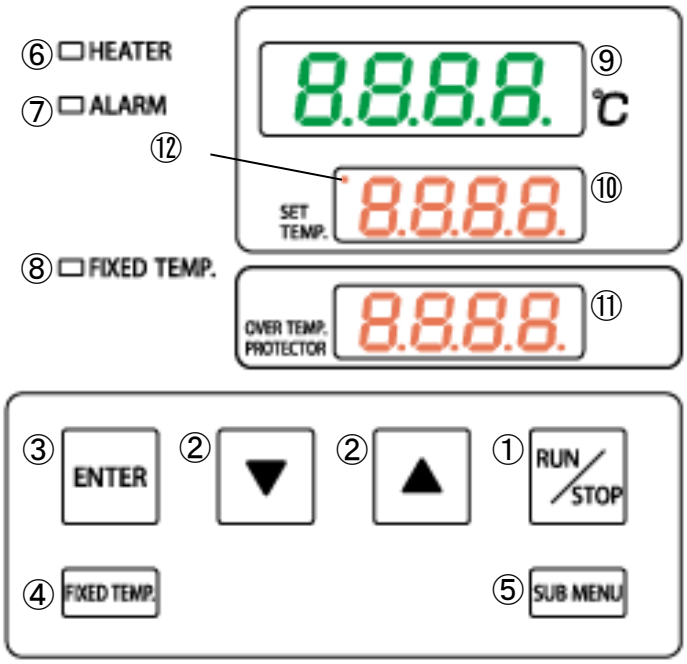



### ◆ BOA201 / 311 Rear view



# 2. COMPONENT NAMES AND FUNCTIONS

## Control panel

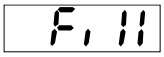
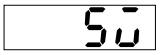
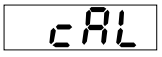
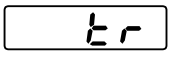
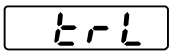
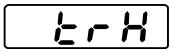
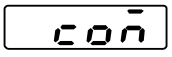
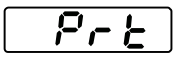
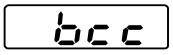
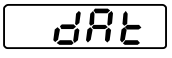
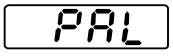
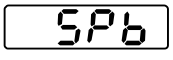
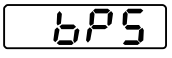
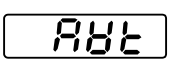



| No | Panel Item | Description |
|---|---|---|
| ① | RUN/STOP Key | Press one second to start or stop a constant temperature operation. |
| ② | ▼▲keys | Press to increase or decrease the setting value. |
| ③ | ENTER key | Press to finalize setting. |
| ④ | FIXED TEMP Key. | It is a key to set the constant temperature for fixed value operation. |
| ⑤ | SUB MENU Key | Press and hold for two seconds to enter Submenu. Overheat Prevention Device Setup, Calibration offset, Keypad lock, Auto-resume mode select, Temperature output Scaling setting, Remote comm parameter setting (option) may be set. |
| ⑥ | HEATER lamp | Illuminates when heater is on and drawing power. |
| ⑦ | ALARM lamp | Illuminates when an error occurs. |
| ⑧ | FIXED TEMP. Lamp | Illuminates while fixed temperature operation is in progress. Flashes while setting. |
| ⑨ | Temperature reading display | Shows current chamber temperature, setting characters, and error codes. |
| ⑩ | Temperature setting display | Displays the set temperature, Fix indicating the constant temperature operation mode, etc. |
| ⑪ | Overheat prevention display | Shows overheat prevention temperature setting |
| ⑫ | Communication lamp | Lights when the remote operation mode is set by communication, and blinks synchronously during communication. |

# 2. COMPONENT NAMES AND FUNCTIONS

## Display Characters

All characters displayed when making settings and during operation are defined as follows:

| Character | Letters | Panel Item | Purpose |
|---|---|---|---|
|  | Fix | Fixed temperature operation | Appears during Fixed temperature operation |
|  | Sv | Temperature setting | Appears while entering temperature settings for Fixed temperature operation. |
|  | oH | Overheat prevention | Appears while setting activation temperature for overheat prevention device<br>See “Overheat Prevention Device Setup” (P.19) |
|  | cAL | Calibration Offset function | Appears while entering offset temperature values<br>See “Other Functions: Calibration Offset” (P.23) |
|  | Lock | Keypad lock | Appears while setting Keypad lock function<br>See “Other Functions: Keypad Lock” (P.24) |
|  | Pon | Auto-resume mode select | Appears while setting Auto-resume function<br>See “Other Functions: Auto-resume Function” (P.25) |
|  | tr | Temperature output scaling settings | Displayed when the temperature output scaling of the temperature output terminal is set.<br>P.28 Refer to "How to set the temperature output terminal output range". |
|  | trL | Temperature output range Lower limit setting | Displayed when the lower limit of the temperature output range is set. |
|  | trH | Temperature output range Upper limit setting | Displayed when the upper limit of the temperature output range is set. |
|  | coM | Remote communication parameter setting (option) | Displayed when setting communication parameters.<br>P.30 Refer to "Communication parameter setting method" |
|  | Prt | Communication protocol setting | Displayed when setting the communication protocol |
|  | bcc | BCC check settings | Displayed when BCC check is set for communication. |
|  | dAt | Data length setting | Displayed when setting the communication data length |
|  | PAL | Parity setting | Displayed when setting communication parity. |
|  | SPb | Stop bit setting | Displayed when the communication stop bit is set. |
|  | bPS | Communication rate setting | Displayed when setting the communication speed. |
|  | Adr | Avxiliary address setting | Displayed when setting the communication avxiliary address. |
|  | AWt | Response delay time setting | Displayed when setting the communication response delay time. |
|  | Mod | Communication mode setting | Displayed when setting the communication mode. |
|  | rEMt | Remote display | Displayed when remote operation mode is selected by communication. |

* For more information about key operation flow, see "Mode & Function Flow" (P.16)

# 3. PRE-OPERATION PROCEDURES

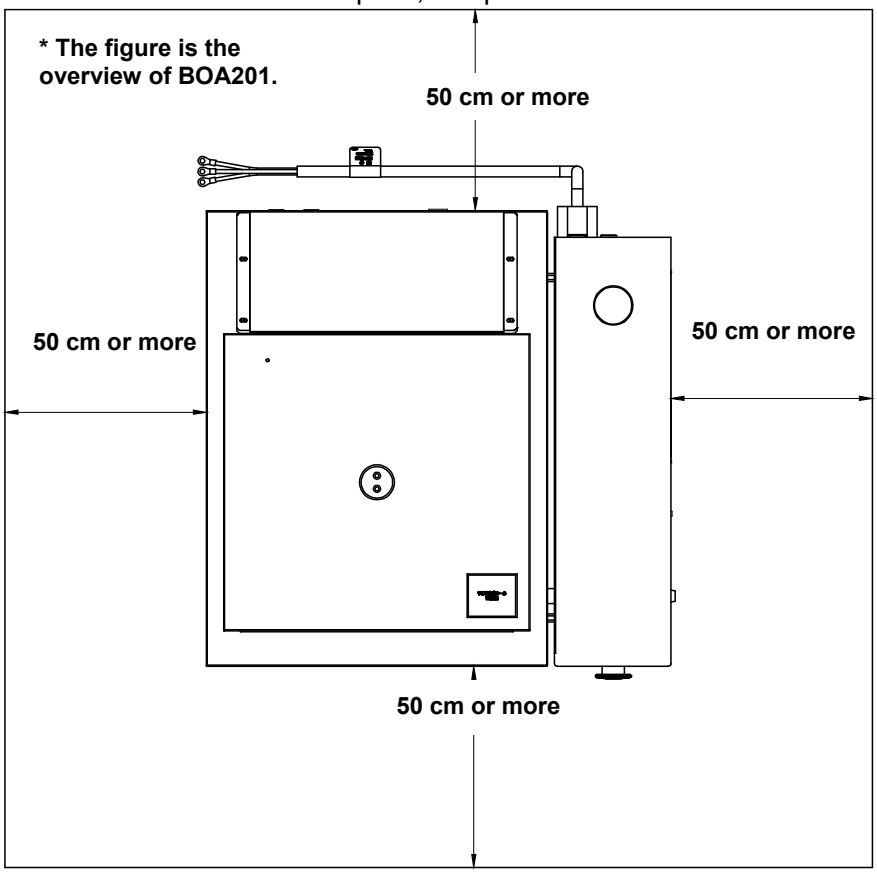
## Installation Precautions

### Choose an appropriate installation site.

DO NOT install unit:

- where installation surface is not completely level, not even or not clean.
- where flammable or corrosive gases/fumes may be present.
- where external temperature will exceed 35 °C, will fall below 5 °C or will fluctuate largely.
- where liquid is assumed to splash on unit.
- A place with a large temperature difference.
- in excessively humid or dusty locations.
- in direct sunlight or outdoors.
- where there is constant vibration.
- in direct contact with the outside air.
- where power supply is erratic.
- where there is combustible material nearby.
- in the proximity of, particularly right bellow a fire alarm.
- where there is a risk of freezing or condensation.
- where exposed to a strong wind.

Install unit in a location with sufficient space, as specified below.




Leave 60 cm or more space above unit.

The recommended space is described in reference to the Tokyo Fire Prevention Ordinance.
Install unit as stipulated by the ordinance of each prefecture.

# 3. PRE-OPERATION PROCEDURES

## Installation Precautions

### Use cargo-handling equipment for transportation and installation.

Always use cargo-handling equipment to move or install unit. If it is necessary to transport unit by man power, be sure to carry out with more than two people, and an appropriate work method.

Approx. weight: BOA201/311: 37kg


### Install unit on a level surface.

Install unit on level and even surface. Failure to do so may cause abnormal vibrations or noise, possibly resulting in complications and/or malfunction.

### Take appropriate safety measures when installing.

Implement appropriate safety measures for the installation environment. Unit may tip over or fall, causing injury or death during an earthquake or other unforeseen incident.

### Always connect power cable to appropriate facility outlet or terminal.

Connect power cable to a suitable facility outlet or terminal, according to the electrical requirements.

Electrical requirements:
BOA201:115 V AC single phase 50/60 Hz 18.5 A (ELB capacity 30 A)
:220 V AC single phase 50/60 Hz 10A (ELB capacity 15 A)
BOA311:115 V AC single phase 50/60 Hz 40.5A (ELB capacity 50 A)
:220 V AC single phase 50/60 Hz 21A (ELB capacity 30 A)

Operational voltage range is ±10 % of power rating, performance guarantee voltage range is ±5 %, and frequency is ±1 %.

* Check the line voltage on distribution board and properly evaluate whether to utilize a line being shared by other equipment. If unit is not activated by turning on ELB, take an appropriate course of action, such as connecting unit to a dedicated power source.

Extension cords may cause a drop in voltage, which may affect performance, resulting in failure to control or maintain proper temperature.

# 3. PRE-OPERATION PROCEDURES

## Installation Precautions

### Observe wire color designation when connecting to facility terminal.

Confirm that the facility main breaker is OFF before connecting the round terminals from the power cable. No power plugs or connectors of any kind are included with this unit. See table on the right and select a plug or terminal that meets the voltage and electrical capacity.

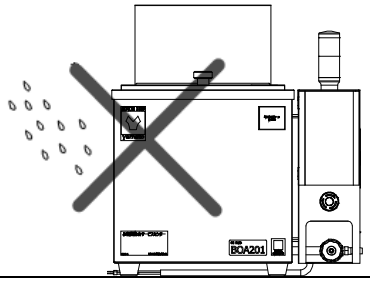
| Core color | Wiring on distribution board |
|---|---|
| Black | Live |
| White | Neutral |
| Green | Ground |

### Install equipment in a well-ventilated place

Install unit so that side and rear panel vents are unobstructed and allowed to sufficiently diffuse heat.
Doing so may result in excessive temperatures inside the unit control panel, causing possible degraded CPU board performance, malfunction or fire.
See "COMPONENT NAMES AND FUNCTIONS" (P.9) for location.

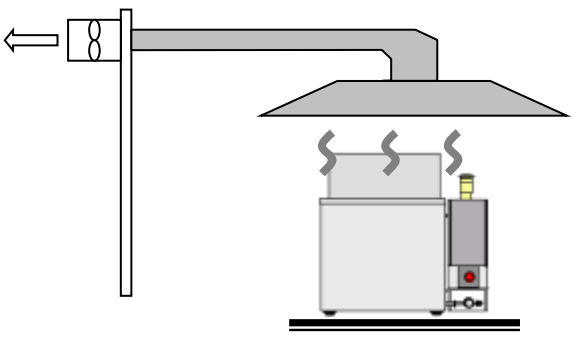
### Install in a dry location.

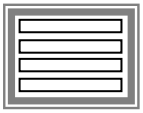
Install unit where it will be free from liquid spray and other moisture.
Failure to do so may result in control mechanisms becoming wet, causing malfunction, electrical shock and/or fire.



### Implement proper fire extinguishing and ventilation measures.

The oily smoke and steam generated from heating silicon oil is flammable and may cause a fire hazard.
Silicon oil also emits harmful gases when heated to high temperatures.
A ventilation hood must be installed above unit, with a fire extinguisher in close proximity.





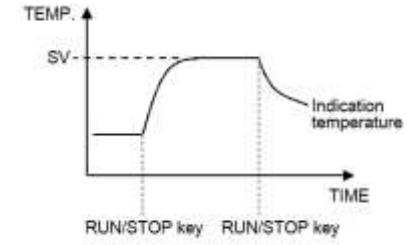
Installation of exhaust system and ventilation system

Installation of fire extinguisher

# 4. PRE-OPERATIVE PREPARATIONS

## Operation Modes and Functions

Operation modes for this unit are defined in the table below:

| Description | Page |
|---|---|
| **Fixed temperature operation**<br>It is an operation mode of "continuous operation at a constant selected temperature".<br>  | P.20 |

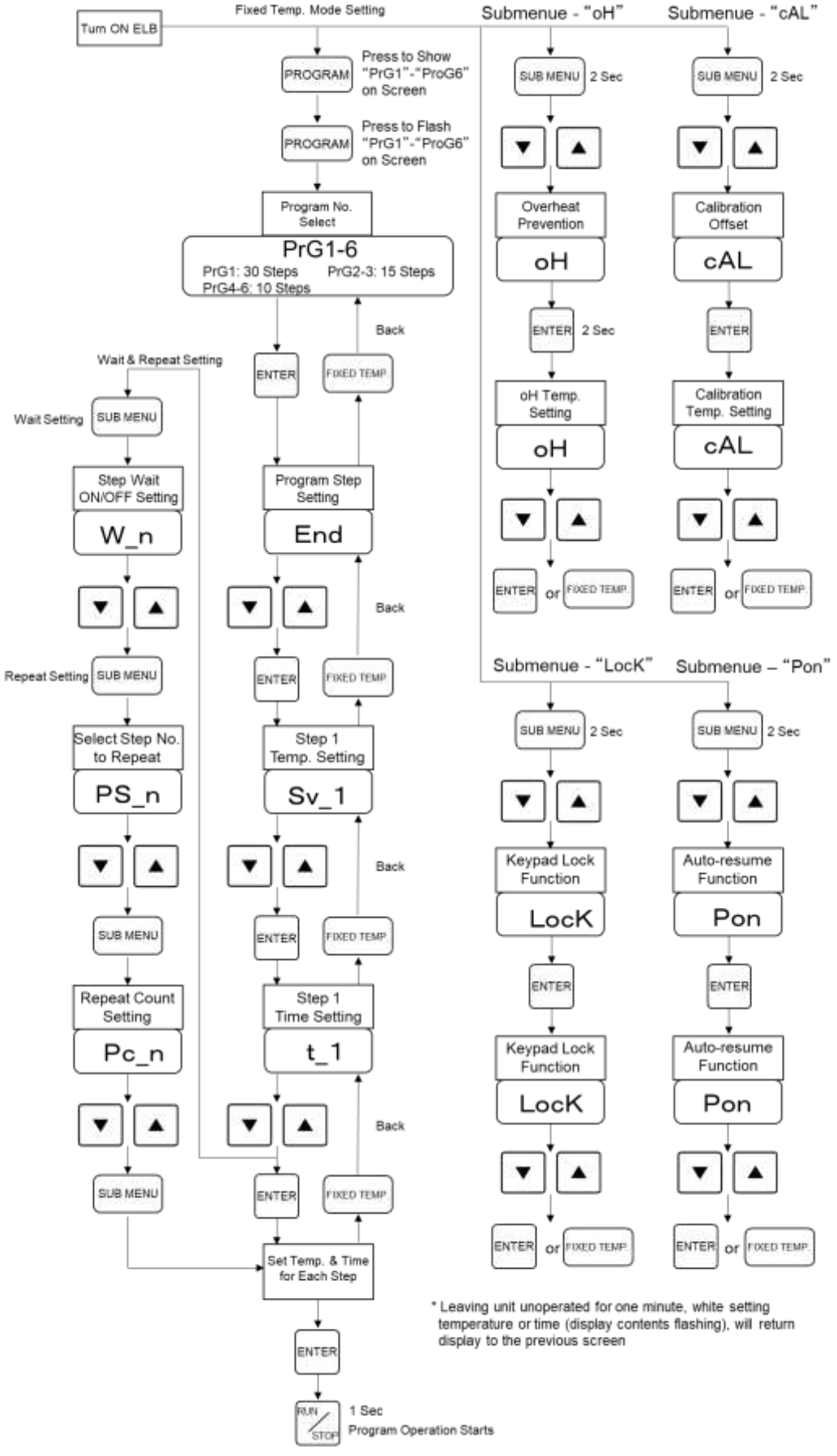
Operation functions for this unit are defined in the table below:

| Description | Page |
|---|---|
| **Automatic overheat prevention**<br>This function is set to automatically activate when chamber temperature exceeds the temperature setting by 6 °C.<br>Unit will restart heater control when chamber temperature comes within temperature setting +6 °C.<br>(Error code is not displayed) | — |
| **Overheat prevention device (oH)**<br>Although this device uses the same power source, display, and keypad as the control panel, it has an independent temperature monitoring circuit and sensor.<br>When chamber temperature exceeds temperature setting of the overheat prevention device, power supply to heater is shut off and error lamp illuminates. Operation may be restarted when ELB is switched off (wait 5 seconds), then back on again. (manual reset)<br>This setting can be made from Submenu. | P.19 |
| **Calibration offset (cAL)**<br>Calibration offset function is to compensate for differences in the temperature reading (as taken by unit sensor) and actual chamber temperature (as taken manually with a thermograph).<br>Unit can be offset to either the positive or negative side of temperature line for entire temperature range of unit<br>This setting can be made from Submenu. | P.23 |
| **Overheat prevention temperature calibration function**<br>The temperature specified for the overheat prevention device is automatically recalibrated when temperature reading is corrected with Calibration offset. | — |
| **Keypad lock (Lock)**<br>This function locks all the keys that may change setting values.<br>This setting can be made from Submenu. | P.24 |
| **Auto-resume mode select (Pon)**<br>This is to select whether unit remain standby or resume operation at the time of recovery from power failure.<br>Unit can begin operation again with the same settings (in memory) as before the power failure occurred.<br>This setting can be made from Submenu. | P.25 |
| **Independent overheat prevention device**<br>The BOA201 type has a built in independent overheating prevention device that is fixedly set at 230 ° C and the BOA311 type at 300 ° C. It will be activated if the above automatic overheating prevention device and overheating prevention device do not work. | P.22 |

# 4. PRE-OPERATIVE PREPARATIONS

## Mode & Function Flow

The following chart illustrates operation flow of Constant temperature operation and Submenu.




* Leaving unit unoperated for one minute, white setting temperature or time (display contents flashing), will return display to the previous screen

# 4. PRE-OPERATIVE PREPARATIONS

## PRE-OPERATIVE PREPARATIONS

### operation precautions

Exercise caution in regard to the following.

① Connect unit to a power distribution board having sufficient capacity.
② Never move unit while in operation.
③ Take sufficient measures against burns, such as using thick leather gloves.
④ During and after use, the chamber interior and the device are hot. Do not touch it with bare hands. In particular, the edge of the bath is hot, so do not touch it.
⑤ Do not operate the drain valve until the oil temperature drops below 45 °C.
⑥ Do not leave unit unattended during operation.
⑦ The medium that can be used with this product is water (ion-exchanged water / distilled water) when used as a water bath, and silicone oil when used as an oil bath. Never use any liquid other than water or silicone oil.
⑧ Please refrain from using the water bath and oil bath together as it may cause an unexpected accident and is dangerous.
⑨ Do not place or operate unit outdoors.

### About the medium liquid to be used.

**When used as an aquarium**

This product can be used as an aquarium from room temperature to around 95 °C. When using it as a water bath, it is recommended to use ion-exchanged water or distilled water to prevent the can stones from adhering to the heater and the bath. However, the temperature setting at the time of shipment is optimally set for the oil bath, and when water is used, the temperature control accuracy and temperature distribution accuracy will deteriorate.

**When silicone oil is used as an oil bath**

Use heat-resistant dimethyl silicon oil for open system heat transfer only, and Kinematic viscosity of 100mm2/s (cSt) or less.

**Recommended silicon oil:**

Temperature for use Below 200 °C Toshiba Silicone Co.,Ltd. TSF458-50
Temperature for use 200 °C ～ 270 °C Toshiba Silicone Co.,Ltd. TSF458-100

| | Manufacturer | Toshiba Silicone | Toshiba Silicone |
|---|---|---|---|
| Characteristics of silicone oil | Recommended temperature | 200 °C or less | 200 °C～270 °C |
| | Product name | TSF458-50 | TSF458-100 |
| | Unit Overview | Light yellow transparent | Light yellow transparent |
| | Relative density (25 °C) | 0.961 | 0.963 |
| | Viscosity (25 °C) mm2 / s (cSt) | 50 | 100 |
| | Volatile content (150 °C, 24h)% | 0.3 | 0.3 |
| | Viscosity temperature coefficient | 0.59 | 0.59 |
| | Flash point (°C) | 325 | 342 |
| | Pour point (°C) | -50 °C or less | -50 °C or less |
| | Viscosity increase rate (300 °C, 168h)% | 40 | 35 |

The deterioration rate (viscosity change) of silicone oil varies depending on the temperature used.
Especially in the case of TSF485-100 used at a temperature exceeding 200 °C, as a guide, almost no change in viscosity is seen at 200 °C, but it is about 1000 hours at 250 °C and 100 hours at 270 °C.
For details, please contact the silicone oil manufacturer at the time of purchase.

# 4. PRE-OPERATIVE PREPARATIONS

## PRE-OPERATIVE PREPARATIONS

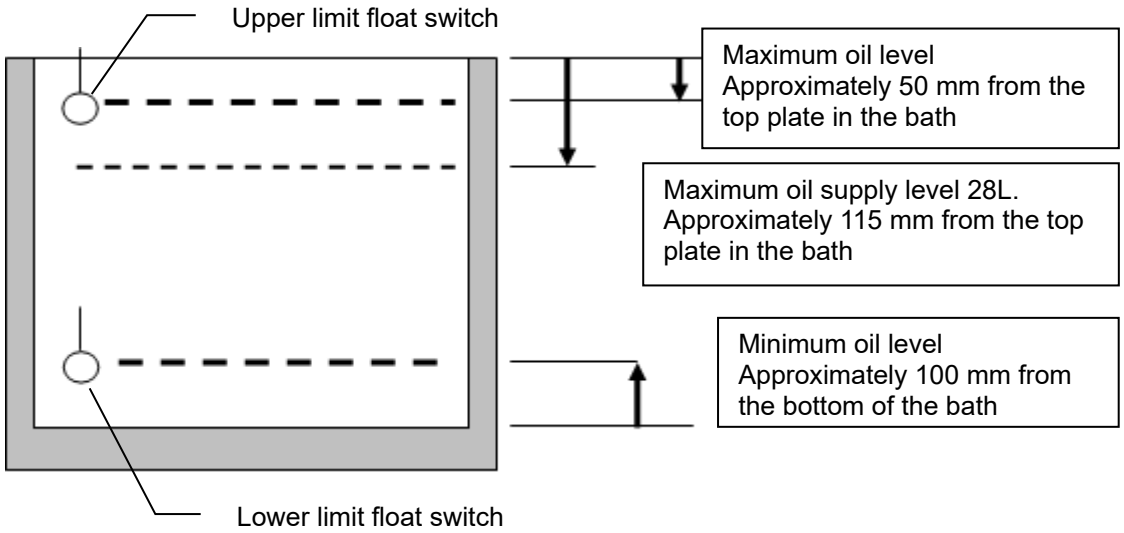
### About the amount of oil and water supplied to the bath.

Make sure that the maximum amount of silicone oil and water is 50 mm or less from the upper end of the bath.
Also, make sure that the minimum amount of liquid is 100 mm or more from the bottom of the bath.
For safety, this product has a function to detect the upper and lower limit levels and turn off the heater.
Please note that if the supply amount is too large or too small, the level detection switch will operate, stopping the device and not heating it.

**Pay attention to the amount of silicone oil supplied.**
Silicon oil has a broad thermal expansion capacity and may overflow from oil bath when heated.
When putting oil in the oil bath, it is necessary to deduct the expansion amount in advance and refuel.

Example):When using TSF485-100, the formula for calculating the amount of refueling is as follows.
Oil increase = (Temperature setting - Current temperature) x oil amount x 0.00098
When the set temperature is 270 °C, the current oil temperature is 23 °C, and the amount of oil is 37 L.
(270 °C -23 °C) × 37 × 0.00098 = 8.965 L.
Therefore, in the case of the above example, it is sufficient to supply 28 L of oil in advance.

The relationship between the amount of oil supplied and the liquid level of BOA201 / 311 is as follows.



# 4. Preparation for operation

## Overheat Prevention Device Setup

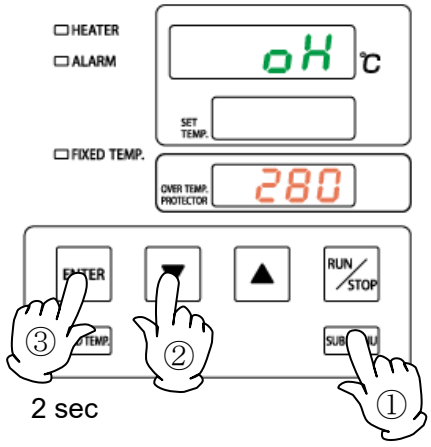
### Setting range/function

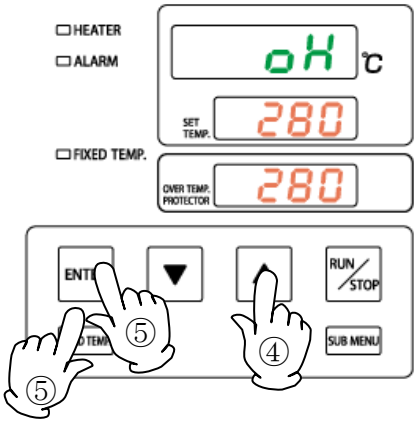
The overheat prevention device temperature setting range is from 0 °C to 20 °C (BOA201 : 220 °C, BOA311 : 290 °C)beyond the maximum temperature setting of this unit.

When chamber temperature exceeds objective temperature setting and reaches that of the overheat prevention device, the heater circuit is shut off and error code "Er19" is shown flashing in the control panel display, accompanied by a sounding alarm.

Once activated, "Er19" continues to be displayed until ELB is turned off, then back on.

### ·Setting temperature for overheat prevention




**1. Turn ON (|) ELB**

Initial values will be shown for about five seconds after power-on, then displays will switch to the initial settings screen, showing current chamber temperature (top), operation mode character (center) and overheat prevention setting (bottom).

**2. Set temperature for overheat prevention**

① Press the SUB MENU key for about two seconds. Character in top display will flash.

② Press the ▼▲ keys several times until oH shows in top display.

③ Press the confirm key for about 2 seconds to display the current temperature indicator.

Note: To prevent false errors, set the value 10 °C or more above the main temperature setting.

④ Set the temperature using the ▼▲ keys.

⑤ Press the ENTER key or the FIXED TEMP. key to finalize the setting.

* Setting change can also be made during operation.

## ⚠ CAUTION

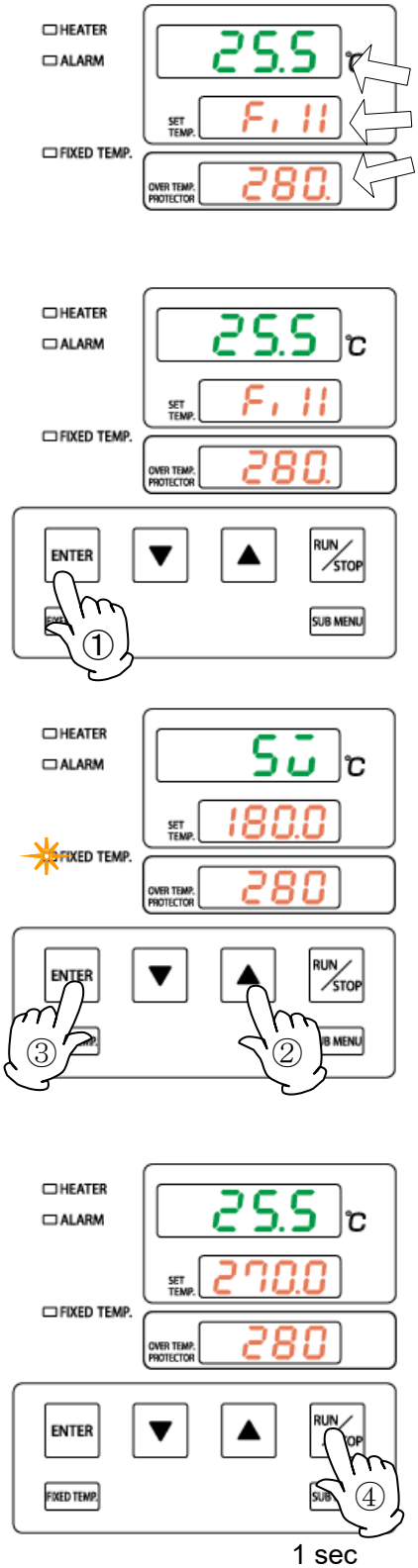
① Overheat prevention device is designed to protect unit against overheating, to prevent damage to human body, not to protect test samples against damage caused by overheating, nor to protect against injury or death resulting from negligence from processing explosives, inflammables or other hazardous substances in this unit.

② Operation may be terminated by overheat prevention device activation, when overheat prevention device temperature setting and unit target temperature are less than 10 °C apart. **The default settings are BOA201: 210 ° C and BOA311: 280 ° C.**

# 5. OPERATION PROCEDURES

## Fixed Temperature Operation

### Run a Fixed temperature operation




1 sec

**1. Turn ON (|) power (ELB)**

Initial values will be shown for about five seconds after power-on, then displays will switch to the initial settings screen, showing current chamber temperature (top), operation mode character (center) and overheat prevention setting (bottom).

Top: Shows current temperature in the chamber and other setting information.
Center: Shows temperature setting and other setting information.
Bottom: Displays the temperature setting of overheat prevention device.

For more on mode and setting characters, see "Display Characters" (P.11).

**2. Set the temperature**

① Press the FIXED TEMP. key

F, 11, signifying Fixed temperature operation, will show in center display.

50, signifying temperature setting, will show in top display. Current temperature will flash in center display. FIXED TEMP lamp also flashes.

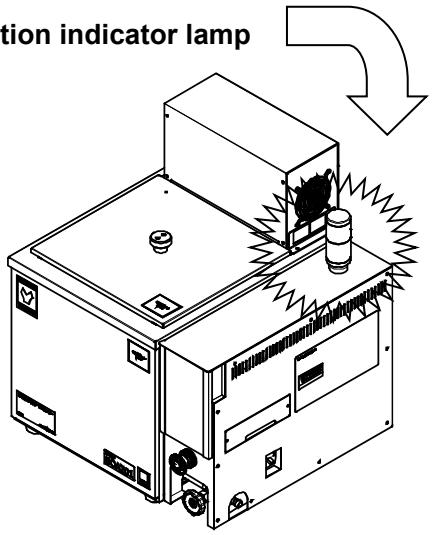
② Set the temperature using the ▼▲ keys.

③ Press the ENTER key to finalize the setting.

**3. Start operation**

④ Press the RUN/STOP key for about one second.
The operation has started, and it is installed in the fixed value operation lamp and the main body control unit.

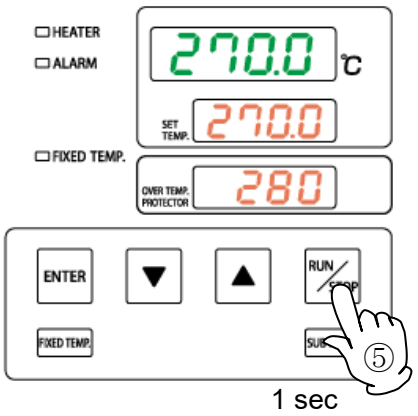
**Operation indicator lamp**



The operation indicator lamp turns on when you press the RUN/STOP key on the controller and starts operation, and turns off when you stop operation.

# 5. OPERATION PROCEDURES

## Fixed Temperature Operation




**4. Stop operation**

⑤ Press the RUN/STOP key for about one second. Operation will stop (terminate) and the FIXED TEMP lamp and the operation indicator lamp installed in the main unit control unit will go out. Control panel reverts to initial settings screen.

**・Setting value loop function**

When setting temperature by the ▼ or ▲ key, the setting value cycles in the setting range; when it reaches the maximum settable value, it returns to minimum and goes up again.

**・Editing and confirming settings**

Changing Temperature during operation is possible by pressing the FIXED TEMP key. Use the ▼▲ keysto change the setting values. Press the ENTER key when changes have been entered.

# 5. OPERATION PROCEDURES

## Independent overheat prevention device function

This product has a built-in hydraulic overheating prevention device that is independent of the controller. The operating temperature is about 230 °C (fixed) for BOA201 and about 300 °C (fixed) for BOA311. Even if the temperature inside the bath rises due to a controller malfunction, it will automatically reach about 230 °C or 300 °C. Turn off the breaker (○) to cut off the power supply to the main unit.
After the temperature inside the bath returns to below the operating temperature (230 °C or 300 °C), turn on the breaker (|) to restore the power.

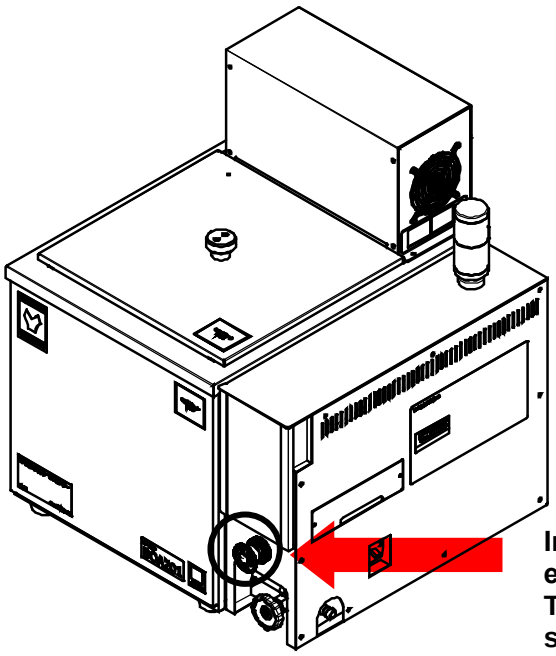
This product has a triple overheating prevention function due to the automatic overheating prevention function, overheating prevention function and the above independent overheating prevention device.

> ⚠ If the independent overheating protector is activated, the circuit may be defective. Immediately disconnect the power cord and make a service call to your local dealer, our sales office, or the customer service center.

## Emergency stop switch function

This product is equipped as standard with an emergency stop switch in case of a fire.
When the emergency stop button is pressed, the breaker is automatically turns off (○) and the power to the main unit is cut off.

> ⚠ During normal operation, do not use the emergency stop switch to stop the operation.



**In an emergency, press the emergency stop press strongly. To release it, turn the emergency stop switch to the right and turn on (|) the breaker.**

# 5. OPERATION PROCEDURES

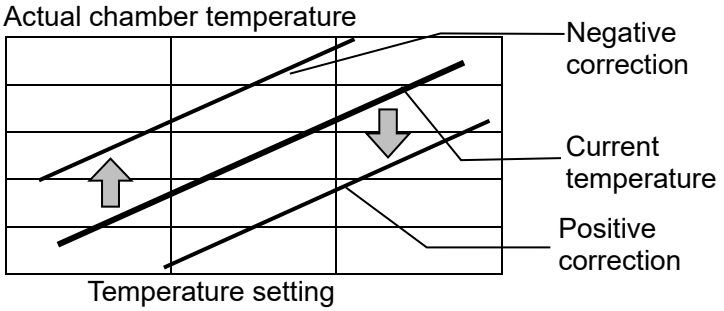
## Other Functions: Calibration Offset

### Use the calibration offset function

The calibration offset function is a function that corrects the measured temperature of the controller.

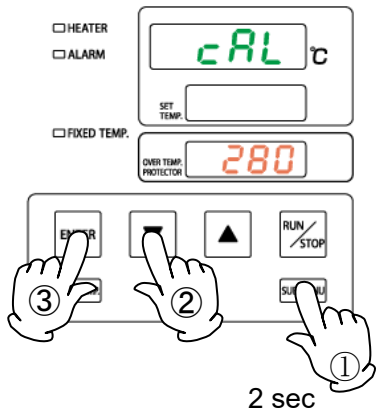
Offset function can correct to either the positive or negative side of the entire unit temperature range. Offset function can be set or cancelled with the SUBMENU key.

Default setting is “0.0 °C”, and setting range is “-15.0 to +15.0 °C”




・Run unit in Fixed temperature operation. When temperature stabilizes, gauge chamber temperature with a thermograph.

・Check the differences between display temperature and bath temperature.



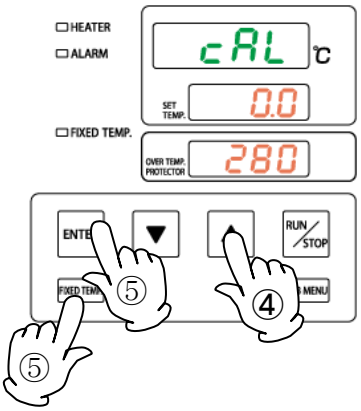

① Press the SUB MENU key for about two seconds.

② Select cAL, signifying calibration offset, using the ▲▼ keys.

③ Press the ENTER key.

④ Enter a value that brings temperature display (top display) and chamber temperature into agreement, using the ▲▼ keys.

⑤ Press the ENTER key or the FIXED TEMP. key to finalize the setting.



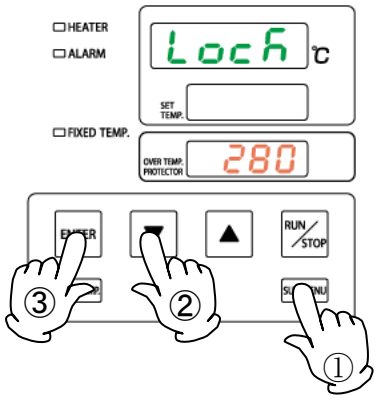

- Setting change can also be made during operation.
- Calibration offset can be set either the positive or negative side of 0. Setting calibration offset to the negative side of 0 increases actual temperature by the negative value entered (i.e. entering a value of -3 increases actual temperature by 3°C).
  Setting calibration offset to the positive side of 0 decreases actual temperature by positive value entered (i.e entering +3 decreases actual temperature by 3°C
- Entering excessive compensation values may cause a precariously large discrepancy between actual temperature and temperature reading.
- In addition to the calibration offset function, this unit has a two-point offset function built in, which has some compensating effects in low and high temperature zones. These offsets have already been entered at the factory.
- Contact original dealer of purchase when it becomes necessary to validate temperature controller.

# 5. OPERATION PROCEDURES

## Other Functions: Keypad Lock

### ·Using keypad lock

This function locks all the keys that may change setting values. With the keypad lock function ON, all keys become unresponsive except the RUN/STOP and SUBMENU keys. ( will show in top display)




2 sec

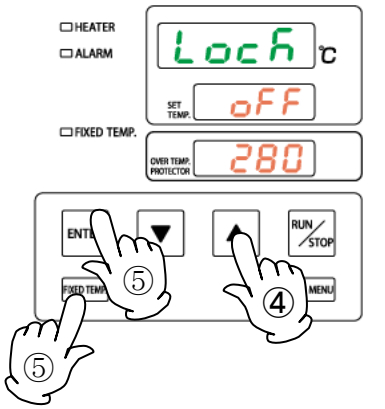
Default setting is “oFF”.

① Press the SUB MENU key for about two seconds.

② Select LocK, signifying Keypad lock function, using the ▲▼.

③ Press the ENTER key.

④ Center display will read "oFF" or “on”. Use the ▼▲ keys to change the setting.




⑤ Press the ENTER key or the FIXED TEMP. key to finalize the setting.

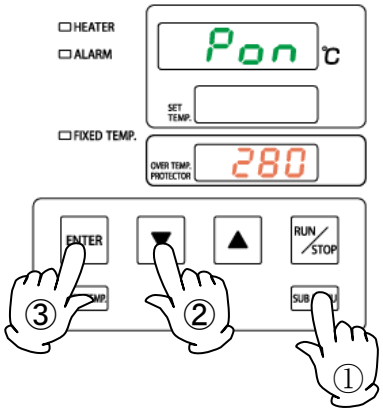
* Setting change can also be made during operation.

# 5. OPERATION PROCEDURES

## Other Functions: Auto-resume Function

### ·Auto-resume mode select

Unit may restart operation or may be switched into standby state after power failure, by selecting “on” or “oFF” of this mode.
With this setting “on” unit automatically resume operation, and remain standby when set to “oFF”.
Default setting is “oFF”.




2 sec

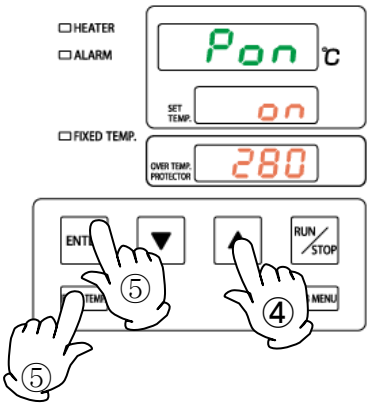
① Press the SUB MENU key for about two seconds.

② Select Pon, signifying Auto-resume function, using the ▲▼ keys.

③ Press the ENTER key.

④ Center display will read "oFF" or “on”. Use the ▼▲ keys to change the setting.

⑤ Press the ENTER key or the FIXED TEMP. key to finalize the setting.




* Settings cannot be changed during operation.
nG ,indicating that the setting cannot be changed, will show in STEP ④.

* If "on" is set and the breaker is turned on (|) after the emergency stop switch is turned on during the fixed operation or after the independent overheating prevention device is activated, the fixed value operation is restored. Set “on” appropriately.

# 5. OPERATION PROCEDURES

## Various output terminal functions

### ・Before use

Operate this unit according to the procedure described in this Instruction manual. Failure to follow the operation procedure described herein may result in a problem. The guarantee will not apply if you operate the unit in a wrong manner.

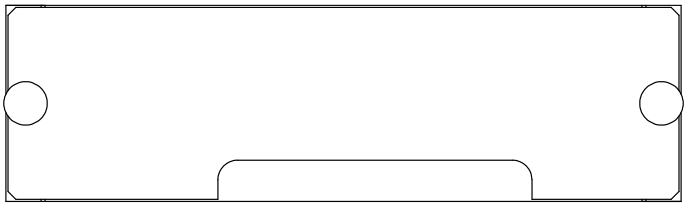
## ⚠CAUTION

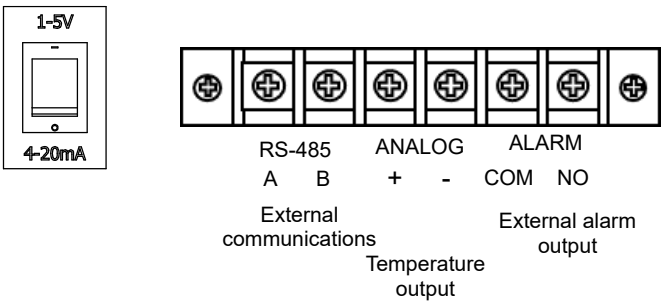
| |
|---|
| 1. Turn OFF (◯) ELB before connecting the cables. |
| 2. For external alarm output, ensure that the input current is no greater than contact capacity shown in the specification table. |
| 3. Connect a recorder or another appliance of 600Ω or less in input impedance to the temperature output terminal. |
| 4. Securely fasten all connections with the screws attached to the terminal block. |
| 5. For the external alarm output, the non-voltage a contact from the terminal block becomes "ON = closed" when an error (Er ** display) occurs. |
| 6. Use a shielded wire for the cable to be connected to prevent noise. |

### Connection instructions

Remove the two screws that secure the sheet metal cover in the figure below, and remove the clear cover that comes with the terminal block.

Connect the external communication terminals to RS-485 A and B of the terminal block, the temperature output terminals to ANALOG + and-, and the external alarm output to ALARM COM and NO (M4 screw), respectively.



# 5. OPERATION PROCEDURES

## Various output terminal functions

### ・Specifications

| | |
|---|---|
| External alarm output terminal (ALARM) | • While some error occurs and the error code is displayed (Er ** is displayed), the non-voltage a contact is output as "ON = closed". Even if you mute the alarm buzzer on the main unit, the external alarm output continues as long as the error code is displayed.<br>See “Reading Error Codes” (P.67) for details on errors.<br>• Contact configuration : No voltage a contact (relay contact)<br>• Contact capacity: AC250V 3A (resistive load), DC30V 3A (resistive load)<br>Ensure that the input current is no greater than contact capacity shown above.<br>• Connection: M4 screw terminal block |
| External communications terminal (RS-485) | • Connection: M4 screw terminal block<br>* Refer to P.29 "Overview of external communication terminals" and subsequent pages for an overview of specifications. |
| Temperature output terminal (ANALOG) | • Outputs the current or voltage corresponding to the measured temperature.<br>• Temperature output range: 0 to 200 ° C (BOA201), 0 to 270 ° C (BOA311)<br>* The above is the temperature output range at the time of initial setting, and the range can be changed.<br>• Output current: 4-20mA, output voltage: 1-5V<br>* Current or voltage output can be selected with the changeover switch.<br>• Output accuracy: ±2 °C<br>• Connection: M4 screw terminal block |

**Temperature output terminal Temperature vs. Output Current conversion table**

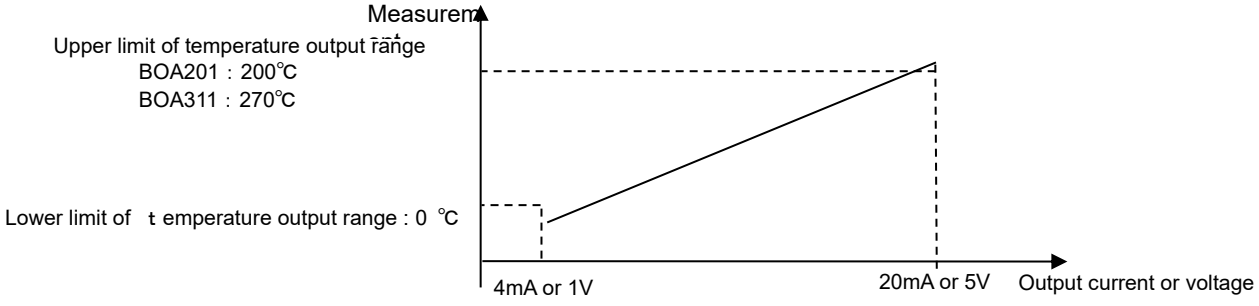
| BOA201 Temperature (°C) | BOA311 Temperature (°C) | Output Current (mA) Changeover switch 4-20mA side | Output voltage (V) Changeover switch 1-5V side |
|---|---|---|---|
| 0 | 0 | 4.0 | 1.0 |
| 50 | 67.5 | 8.0 | 2.0 |
| 100 | 135 | 12.0 | 3.0 |
| 150 | 202.5 | 16.0 | 4.0 |
| 200 | 270 | 20.0 | 5.0 |

* The temperature in the table is the output range at the time of initial setting and can be changed. See next page for how to change.

**Temperature Output TerminalOutput current value and voltage value calculation formula**

Output current mA = ((20mA-4mA) x current measured temperature) / (Temperature output range upper limit-Temperature output range lower limit) + 4mA

Output voltage V = ((5V-1V) x current measured temperature) / (Temperature output range upper limit-Temperature output range lower limit) + 1V



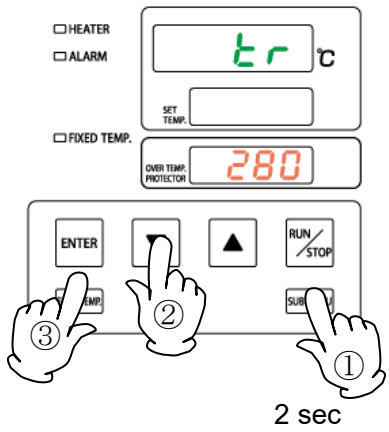
# 5. OPERATION PROCEDURES

## How to set the temperature output terminal output range

### · How to set the temperature output range

The temperature output terminal can set the temperature output range arbitrarily between -100.0 and 300.0 °C.

The default settings are BOA 201: 0 to 200 °C and BOA 311: 0 to 270 °C.

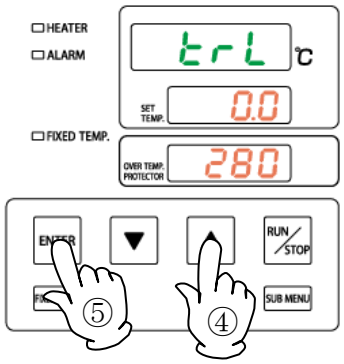



① Press the SUB MENU key for about two seconds.
Character in top display will flash.

② Press the ▼▲ keys to select the character tr that represents the temperature output scaling setting.

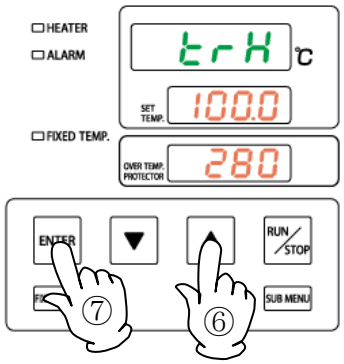
③ Press the ENTER key.

④ Top display will show , indicating that the lower limit of t emperature output range can be set. Current setting will flash in center display.
Use the ▼▲ keys to set the desired lower limit of the temperature output range.
* Press the fixed temperature key during display to confirm the set value and return to the initial screen.




⑤ Press the ENTER key.

⑥ Top display will show , indicating that the upper limit of temperature output range can be set. Current setting will flash in center display.
Use the ▼ ▲ keys to set the desired upper limit of the temperature output range.
* Press the fixed temperature key during display to confirm the set value and return to the display.




⑦ Press the confirm key to return to the initial screen.

* Settings cannot be changed during operation. , indicating that the setting cannot be changed, will show in STEP ④ and ⑥.
* Both trL and trH can be set to any value in the setting range: -100.0 to 300.0 ° C.
* If both trL and trH are set to the same setting such as 0.0 ° C, the output will be fixed at 4mA.
Also, for example, if trL: 0.0 ° C and trH: -0.1 ° C are set, the output of about 1mA will continue.
To release it, set trH to 0.0 ° C or higher, and then turn the breaker OFF (○) / ON ( | ).
Depending on the setting, the output may be 1mA as described above, so pay close attention to the setting value.

# 5. OPERATION PROCEDURES

## Overview of external communication terminals

Introduction

RS-485 allows to set or monitor data of the controller of this unit by building a program on host computer.

Communication specifications

| Item | Communication settings |
|---|---|
| Communication interface standard | EIA standard, based on RS-485 |
| Synchronous method | asynchronous communication method |
| Communication method | Two-wire half-duplex |
| Transmission code | ASCII |
| Communication rate | 2400/4800/9600/19200/38400bps |
| Communication range | Up to 500 m (results may vary depending on the environment) |
| Network | Multi-drop method (max 31 hosts to each node) |
| Stop bit length | 1/2bits |
| Data length | 7/8bits |
| Parity bit | None/Odd/Even |
| Error detection | ・Toho : BCC ・Modbus-RTU : CRC-16 ・Modbus-ASCII : LRC |
| Response delay time | 0 to 250 msec |

Note: [ ] is default setting.

Connection

■ PC

・A USB interface is used

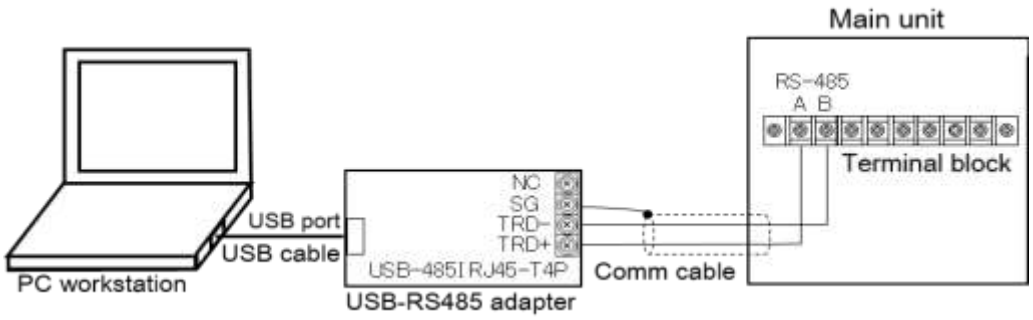
■ USB-RS485 converter unit

・ For the converter, System Sacom's USB-485 is applicable.

・ Optional accessory "External communications adapter (RS485-USB) OA017" permits the following connections.

(PC not included)

Sample program → http://www.yamato-net.co.jp/support/program/index.htm




USB-RS485 converter unit: System Sacom USB-485I RJ45-T4P

Communication cable: UL2464TASB 2-lead AWG20 cable 3 m, with Y terminal on main unit side.

USB cable: 1.8 m, included with USB-485I

* It may be effective to use a commercial braided shield USB cable for noise resistance.

# 5. OPERATION PROCEDURES

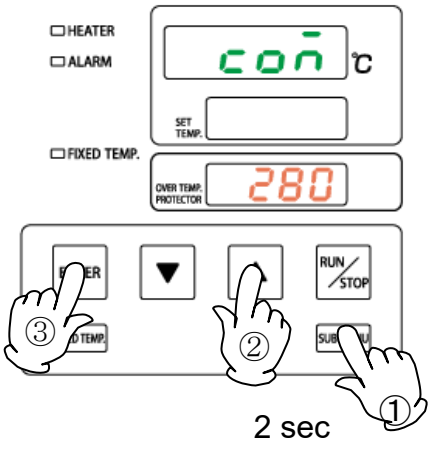
## Communication settings

Setting items and parameters for this controller is defined in the table below.

| | Item | Communication settings | Default values |
|---|---|---|---|
| 1 | Communication protocol | Toho (0)/Modbus-RTU (1)/ Modbus-ASCII (2) | Toho (0) |
| 2 | BCC check | Enable (b)/Disable (n) | Enable (b) |
| 3 | Data length | 7/8 bits | 8 bits |
| 4 | Parity bit | None (n)/odd (o)/even (E) | None (n) |
| 5 | Stop bit length | 1/2 bits | 2 bits |
| 6 | Communication rate | 2400 (24)/4800 (48)/ 9600 (96)/19200 (192)/ 38400 (384) bps | 4800（48） bps |
| 7 | Auxiliary address | 1-99 units (1:31 stations at maximum) | 1 |
| 8 | Response delay time | 0-250 msec | 0 msec |
| 9 | Communication mode | Read only (ro)/ Read/Write (rW) | Read/Write (rW) |

* For how to change the communication settings on the product side, refer to "Communication parameter setting method" below.

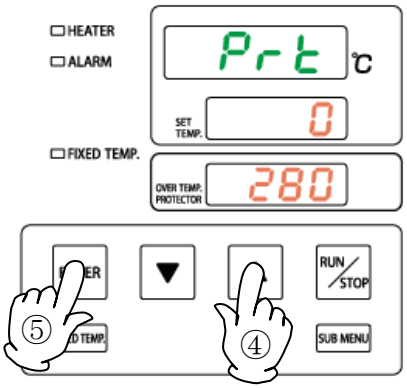
## Remote communication parameter setting (option)




① Press the SUB MENU key for about two seconds.
Character in top display will flash.

② Press the ▼▲ keys to display the communication parameter settings.
Select coM.

③ Press the ENTER key.




④ The character Prt indicating the communication protocol setting is displayed on the measured temperature display, and the current protocol setting is displayed blinking on the set temperature display.

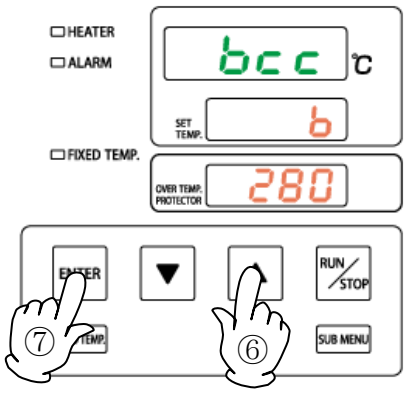
Use the ▼▲ keys to set the desired settings.
「0」: Toho／「1」: Modbus-RTU／「2」: Modbus-ASCII

⑤ Press the ENTER key.

*Press the fixed temperature key during display to confirm the set value and return to the initial screen.

# 5. OPERATION PROCEDURES

## Remote communication parameter setting (option)

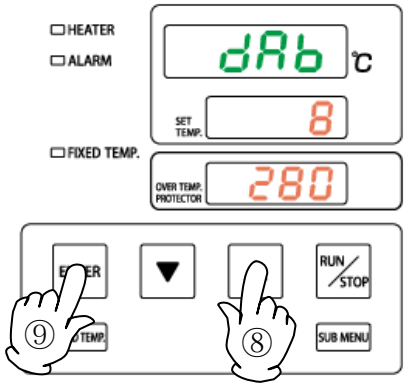



⑥ The character bcc indicating the BCC check setting is displayed on the measurement temperature display, and the current setting is displayed blinking on the set temperature display.

Use the ▼▲ keys to set the desired settings.
"N": None / "b": Yes

⑦ Press the ENTER key.

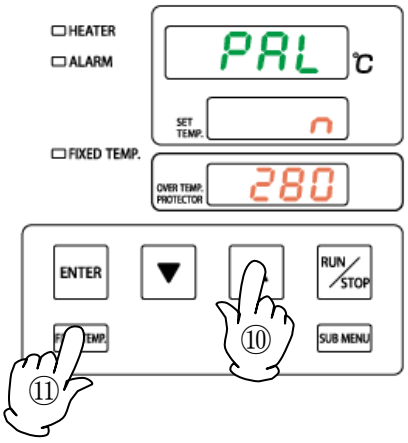
* Press the fixed temperature key during display to confirm the set value and return to the display.




⑧ The character dAt indicating the date length setting is displayed on the measurement temperature display, and the current setting is displayed blinking on the set temperature display.
Use the ▼▲ keys to set the desired settings.
"7": 7 bits /: "8" 8 bits

⑨ Press the ENTER key.

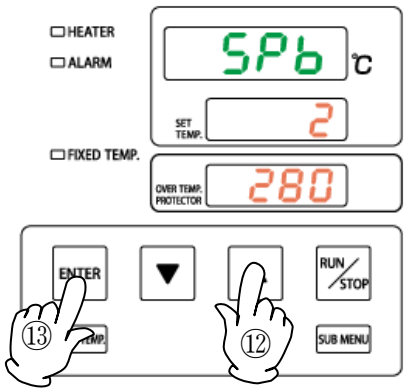
* Press the fixed temperature key during display to confirm the set value and return to the display.




⑩ The character PAL indicating the parity setting is displayed on the measurement temperature display, and the current setting is displayed blinking on the set temperature display.
Use the ▼▲ keys to set the desired settings.
None (n)/odd (o)/even (E)

⑪ Press the ENTER key.

* Press the fixed temperature key during display to confirm the set value and return to the display.



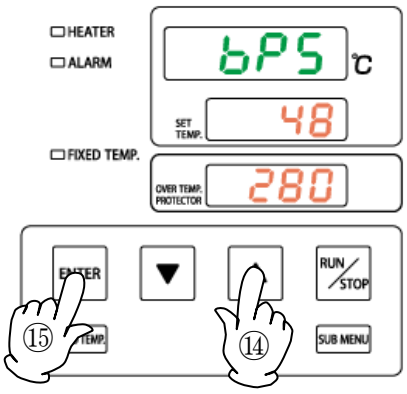

⑫ The character SPb indicating the stop bit setting is displayed on the measurement temperature display, and the current setting is displayed blinking on the set temperature display.
Use the ▼▲ keys to set the desired settings.
"1": 1 bit / "2": 2 bits

⑬ Press the ENTER key.

* Press the fixed temperature key during display to confirm the set value and return to the display.

# 5. OPERATION PROCEDURES

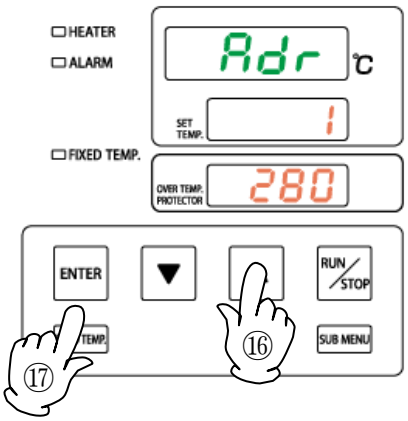
## Remote communication parameter setting (option)




⑭ The character bPS indicating the communication rate setting is displayed on the measurement temperature display, and the current setting is displayed blinking on the set temperature display.
Use the ▼▲ keys to set the desired settings.
「24」: 2400bps／「48」: 4800bps／「96」: 9600bps／「192」: 19200bps／「384」: 38400bps

⑮ Press the ENTER key.

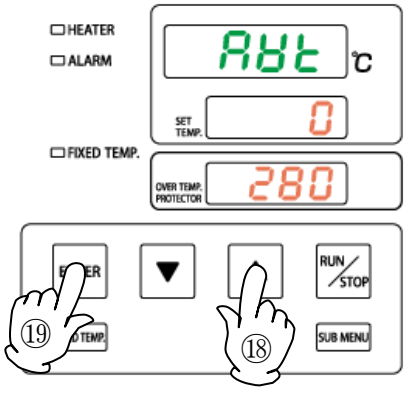
* Press the fixed temperature key during display to confirm the set value and return to the display.




⑯ The character Adr indicating the avxiliary address setting is displayed on the measurement temperature display, and the current setting is displayed blinking on the set temperature display.
Use the ▼▲ keys to set the desired settings.
Setting range: 1 to 99 (stations), but up to 1 to 31 stations

⑰ Press the ENTER key.

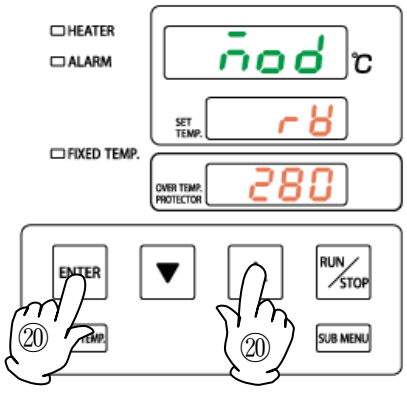
* Press the fixed temperature key during display to confirm the set value and return to the display.




⑱ The character AWt indicating the response delay time setting is displayed on the measurement temperature display, and the current setting is displayed blinking on the set temperature display.
Use the ▼▲ keys to set the desired settings. Setting range: 0 to 250 msec

⑲ Press the ENTER key.

* Press the fixed temperature key during display to confirm the set value and return to the display.




⑭ The character Mod indicating the mode setting is displayed on the measurement temperature display, and the current setting is displayed blinking on the set temperature display.
Use the ▼▲ keys to set the desired settings.
"Ro": read-only / "rW": read / write

㉑ Press the confirm key to return to the initial screen.

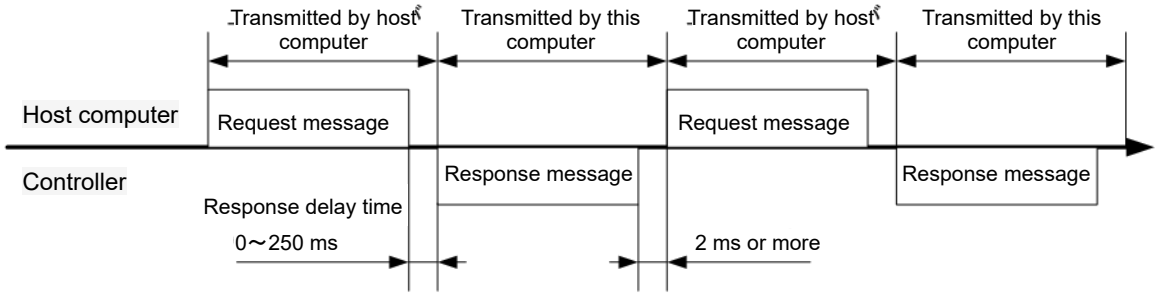
* Press the fixed temperature key during display to confirm the set value and return to the display.

# 5. OPERATION PROCEDURES

## Communication procedure

This unit returns a "reply message" to a "request message" from the host computer but does not start transmission.

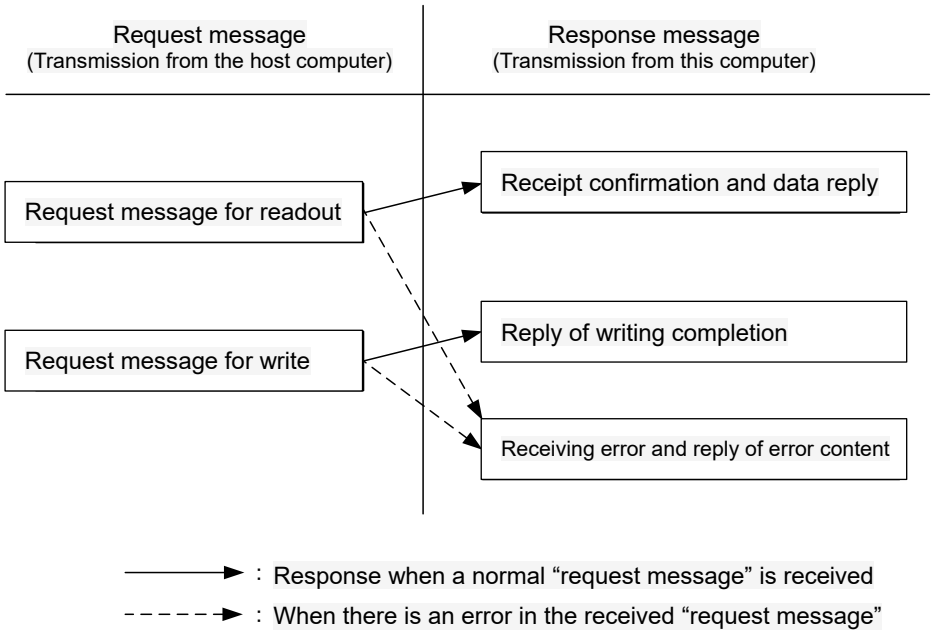
- This unit does not start communication (no reply) for about five seconds after the power is turned on. Set a delay until communication begins after the power is turned on.



# 5. OPERATION PROCEDURES

## Communication message type

The types of communication messages can be broadly divided as follows.




: Response when a normal “request message” is received

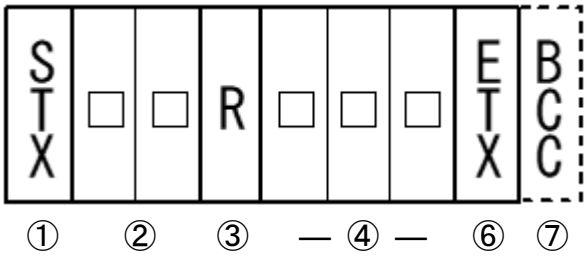
: When there is an error in the received “request message”

# 5. OPERATION PROCEDURES

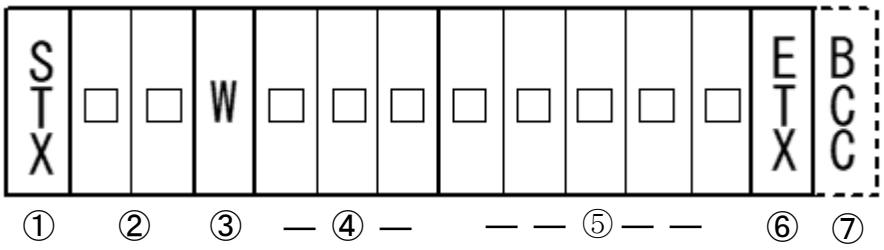
**Configuration of Toho protocol request message (sending from host compute r to this product)**

■ For the codes from ① to ⑦, refer to P.37 "Explanation of Toho Protocol Codes".
■ Refer to P.40 "Toho Protocol Read Communication Example" and P.41 "Toho Protocol Write Communication Example" for specific request message examples.

Structure of read request message




Structure of write request message



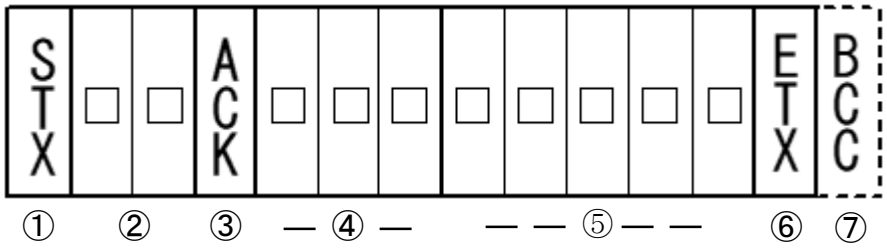

① Start code
② Avxiliary address
③ Request
④ Indentifier
⑤ Numeric data
⑥ End code
⑦ BCC code

# 5. OPERATION PROCEDURES

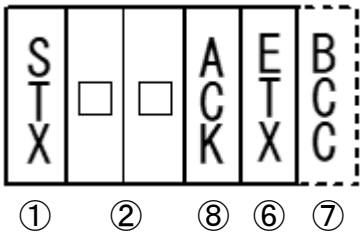
## Configuration of Toho protocol response message (sending from this produc t to host computer)

■ For the codes from ① to ⑩, refer to next page "Explanation of Toho Protocol Codes".
■ Refer to P.40 "Toho Protocol Read Communication Example" and P.41 "Toho Protocol Write Communication Example" for specific request message examples.

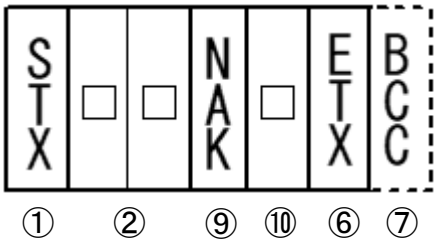
Response message to read request message




Response message to read request message




Response message when there is an error




① Start code
② Avxiliary address
③ Request
④ Indentifier
⑤ Numeric data
⑥ End code
⑦ BCC code
⑧ Positive code
⑨ Negative code
⑩ Errer code

# 5. OPERATION PROCEDURES

## Code description for the Toho protocol

■ The following codes ① STX address to ⑩ error type are represented by ASCII codes.

■ For ASCII codes, p.59 "List of ASCII Codes."

■ Refer to P.40 "Toho Protocol Read Communication Example" and P.41 "Toho Protocol Write Communication Example" for conversion to ASCII code.

① STX

This code is required for the receiving side to detect the beginning of the message. Add it to the beginning of the character string to be sent.

② スレーブアドレス

This is the avxiliary address of the unit with which the host computer communicates. The avxiliary address within a reply message from the unit indicates the unit that has transmitted the message.

③ Request details

Enter the symbol "R" or "W."

R: To read data from the unit

W: When writing data to this product

④ Identifier

This is the classification symbol (identifier) of the data to be read or written and represented by a three-digit alphanumeric ASCII code.

Refer to the various commands on P. ~.

⑤ Numerical data

This is the data to be read or written and always represented by five digits, irrespective of the type.

Negative data: The symbol "-" symbol to the 5th digit.

Position of decimal point: Five-digit data does not include any decimal point.

Example) The meaning of the five-digit numeric data 00123 is shown in the table below.

| example | Meaning of numbers |
|---|---|
| Set temperature SV1 (with decimal point) | 12.3℃ |

Example2) The meaning of the five-digit numeric data -0004 is shown in the table below.

| example | Meaning of numbers |
|---|---|
| Measurement temperature PV1 (with decimal point) | -0.4℃ |

⑥ ETX

This code is required for the receiving side to detect the end of the message. Add it to the final of the character string to be sent. (If there is BCC, before BCC)

## Code description for the Toho protocol

⑦ BCC

This is the check code for error detection and takes the exclusive OR (EX-OR) of all characters from STX to ETX.

When "Disabled" is selected for BBC check among the communication settings for the unit, this code (BCC) will not be included in the reply message.

⑧ ACK

Positive code. This is an included and returned in the "reply message" from the unit when no error is found in the received message.

⑨ NAK

Negative code. This is an included and returned in the "reply message" from the unit when error is found in the received message.

⑩ Error number

If there is an error in the "request message" received by this product, the error number (number in the table below) is included after "⑨NAK" in the "response message".

When there is a compound error, the error number with the higher number is included.

| Error number | Details of the error in the "request message" received by this product |
|---|---|
| 1 | Numerical data was out of the "setting range individually specified by the setting item" |
| 2 | Change of requested item is prohibited or there is no item to read |
| 3 | ASCII code other than numerical data was specified in the place of numerical data<br>An ASCII code other than a number or "-" was specified at the sign position. |
| 4 | Format error |
| 5 | BCC error |
| 6 | Overrun error |
| 7 | Framing error |
| 8 | Parity error |

# 5. OPERATION PROCEDURES

## Precautions for Toho protocol communication

(1) Transmission / reception timing

When using communication, set a sufficient response delay time to ensure that the host computer switches from transmission to reception.

Refer to the figure on page 33 “Communication procedure”.

(2) Request interval

When sending a "request message" continuously from a host computer, wait at least 2 msec after receiving the "response message" from this product before sending.

(3) Response conditions

This product will not reply to the "response message" unless STX and ETX (BCC) are included in the "request message".

Therefore, even if there is an error in the "request message", the "response message" (error reply) containing NAK and error number will not be returned unless the above conditions are met.

Therefore, if the host computer does not return the "response message" within an appropriate time after sending the "request message", send the required "request message" again.

When this product receives STX, all the codes received before that will be cleared.

(4) Error specifying avxiliary address

This product does not respond to any "request message" that specifies a avxiliary address other than the one set for itself. Therefore, if there is an error in the avxiliary address part in the "request message", the "response message" will not be returned.

Therefore, if the host computer does not return the "response message" within an appropriate time after sending the "request message", send the required "request message" again.

When this product receives STX, all the codes received before that will be cleared.

(5) Operation when the power is turned on

This unit does not start communication (no reply) for about five seconds after the power is turned on.

Set a delay until communication begins after the power is turned on.

(6) Decimal point of temperature data

This product does not add a decimal point or data suggesting a decimal point to the temperature data.

Please convert the data on the computer side.

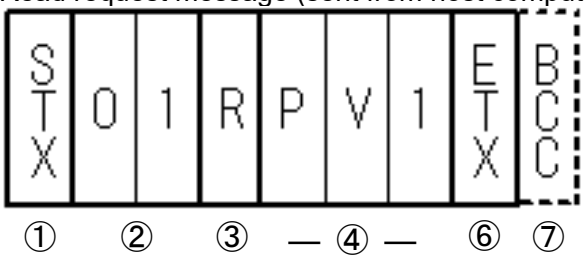
# 5. OPERATION PROCEDURES

## Toho protocol read communication example

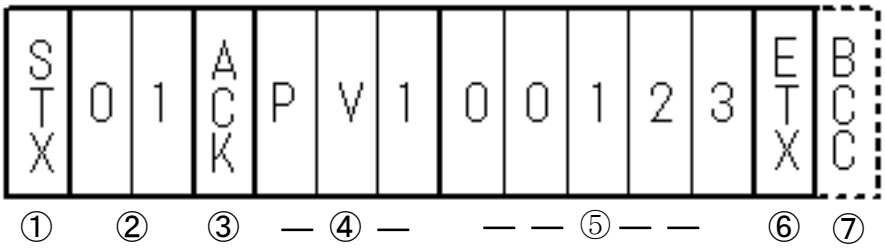
Request message: Requests "measurement temperature read" to the product set to the avxiliary address "01".

Response message: Return the measured temperature data "12.3 °C (00123)".

Read request message (sent from host computer)




Response message (response from this product)



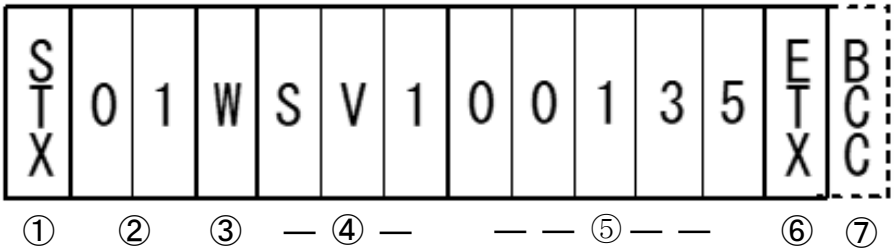

| code | Symbol / data | ASCII code |
|---|---|---|
| ① Start code | STX | 02h |
| ② Avxiliary address | 01 | 30h 31h |
| ③ Request contents (reading) | R | 52h |
| ④ Identifier | PV1 | 50h 56h 31h |
| ⑤ Numerical data | 00123 | 30h 30h 31h 32h 33h |
| ⑥ End code | ETX | 03h |
| ⑦ BCC data Request | | 65h |
| Response | | 01h |
| ⑧ Positive code | ACK | 06h |

# 5. OPERATION PROCEDURES

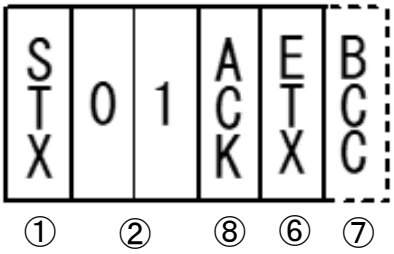
## Toho protocol write communication example

Request message: Requests "write to set temperature 13.5 °C (00135)" for this product set to avxiliary address "01".
Reply message from the unit to this request message: Information that the request message has been received is returned.
Confirm that the data has been properly written by reading it separately.

Write request message (sent from host computer)




Response message (response from this product)




| code | Symbol / data | ASCII code |
|---|---|---|
| ① Start code | STX | 02h |
| ② Avxiliary address | 01 | 30h 31h |
| ③ Request contents (writing) | W | 57h |
| ④ Identifier | SV1 | 53h 56h 31h |
| ⑤ Numerical data | 00135 | 30h 30h 31h 33h 35h |
| ⑥ End code | ETX | 03h |
| ⑦ BCC data Request | | 54h |
| Response | | 06h |
| ⑧ Positive code | ACK | 06h |

# 5. OPERATION PROCEDURES

## Modbus-RTU request message configuration (sending from host computer to this product)

■ For the codes from a) to g), refer to P.44 "Explanation of Modbus-RTU Code".

Structure of read request message

| | | | (example) | |
|---|---|---|---|---|
| a) | Avxiliary address | | **01h** | |
| b) | Function code | | **03h** | |
| c) | Register address | Top | **10h** | Register address |
| | | Lower level | **00h** | |
| d) | Number of registers | Top | **00h** | Two are fixed |
| | | Lower level | **02h** | |
| e) | CRC-16 | Lower level | **C0h** | |
| | | Top | **CBh** | |

Structure of write request message

| | | | (example) | |
|---|---|---|---|---|
| a) | Avxiliary address | | **01h** | |
| b) | Function code | | **10h** | |
| c) | Register address | Top | **10h** | Register address |
| | | Lower level | **00h** | |
| d) | Number of registers | Top | **00h** | Two are fixed |
| | | Lower level | **02h** | |
| f) | Number of bytes | | **04h** | Number of registers x 2 |
| g) | Data to the first register (Lower word) | Top | **00h** | ③ |
| | | Lower level | **00h** | ④ |
| | Data to the first register (Upper word) | Top | **00h** | ① |
| | | Lower level | **00h** | ② |
| e) | CRC-16 | Lower level | **3Eh** | |
| | | Top | **6Fh** | |

The data structure is ①②③④ h.
(① represents 1 byte)

# 5. OPERATION PROCEDURES

## Modbus-RTU response message configuration (sending from this product to host computer)

■ For the codes from a) to h), refer to next page "Explanation of Modbus-RTU Code".

Response message to read request message

(example)

| | | | | |
|---|---|---|---|---|
| a) | Avxiliary address | | **01h** | |
| b) | Function code | | **03h** | |
| f) | Number of bytes | | **04h** | Number of registers x 2 |
| g) | Data to the first register (Lower word) | Top | **00h** | ③ |
| | | Lower level | **64h** | ④ |
| | Data to the first register (Upper word) | Top | **00h** | ① |
| | | Lower level | **00h** | ② |
| e) | CRC-16 | Lower level | **BBh** | |
| | | Top | **ECh** | |

The data structure is ①②③④ h.
(① represents 1 byte)

Response message to read request message

(example)

| | | | | |
|---|---|---|---|---|
| a) | Avxiliary address | | **01h** | |
| b) | Function code | | **10h** | |
| c) | Register address | Top | **10h** | |
| | | Lower level | **00h** | First register address |
| d) | Number of registers | Top | **00h** | |
| | | Lower level | **02h** | Two are fixed |
| e) | CRC-16 | Lower level | **45h** | |
| | | Top | **08h** | |

Response message when there is an error

(example)

| | | | | |
|---|---|---|---|---|
| a) | Avxiliary address | | **01h** | |
| b) | Function code | | **83h** | ← In case of error, the value of function + 80 h of the request message is entered. |
| h) | Error Codes | | **02h** | |
| e) | CRC-16 | Lower level | **C0h** | |
| | | Top | **F1h** | |

# 5. OPERATION PROCEDURES

## Modbus-RTU code description

■ The following a) avxiliary address to h) error code are expressed in 8-bit binary.

a) Avxiliary address

This is the avxiliary address of the other party (this product) with which the high level computer communicates.
The avxiliary address in the response message from this product indicates the source of the response message.

b) Function code

Please enter the code for 03h or 10h.
03h: When reading data from this product / 10h: When writing data to this product

c) Register address

Specify the position of the data to be read or written in 2 bytes.
For the address of each command, refer to the various commands on page P. 50～58
The data is stored in the holding register.

d) Number of registers

Specifies the number of registers to write. Since the number of registers of this product is fixed at 2, specify 0002h.

e) CRC-16

This is an error check code for detecting an error in a message. Send CRC-16 (Cyclic Redundancy Code).

The CRC-16 generation polynomial used in this product is $X^{16} + X^{15} + X^2 + 1$.
If you want to add it to the end of the message as an error code, add it in the order of the lower byte and the upper byte of CRC.

f) Number of bytes

Specify the number of registers to read and write x 2. Since the number of registers of this product is fixed at 2, 04h is specified here.

g) Data

Specifies the data to write to the register. The data is fixed at 4 bytes.
If the data has a decimal point, write the data without the decimal point.
Also, when reading data, determine the presence or absence of a decimal point on the computer side.
The data in parentheses is the value when actually used for the transmitted message.
For details, refer to P.48 "Modbus-RTU Request Message Configuration (Sending from the high level computer to this product)".

■ For numerical data with a decimal point

| Communication content | HEX data |
|---|---|
| Measurement temperature = 10.5 | 00000069h (00690000) |
| Measurement temperature = -10.5 | FFFFFF97h (FF97FFFF) |

h) Error code

If there is an error in the message from the high level computer, "Response message" from this product.

When there is a compound error, the error number with the higher number is included.
The details and classification of the errors are as shown in the table below.

| Error number | Details of the error in the "request message" received by this product |
|---|---|
| 01 | Irregular/incorrect function code received |
| 02 | Received an address other than the specified address |
| 03 | Numerical data was out of the "setting range individually specified by the setting item" |

# 5. OPERATION PROCEDURES

## Modbus-RTU Code Communication Precautions

(1) Transmission timing

When using communication, set a sufficient response delay time to ensure that the host computer switches from transmission to reception.

Refer to the figure on page 33 “Communication procedure”.

(2) Request interval

When sending a "request message" continuously from a high level computer, wait at least 2 msec after receiving the "response message" from this product before sending.

(3) Response conditions

If the time interval between the data that make up the "request message" is 3.5 characters or more, this product cannot be recognized as one "request message" and will not return the "response message".

Therefore, even if there is an error in the "request message", the "response message" (error reply) containing error code will not be returned unless the above conditions are met.

Therefore, if the host computer does not return the "response message" within an appropriate time after sending the "request message", send the required "request message" again.

When this product opens a time interval of 3.5 characters or more, all codes received before that will be cleared.

(4) Error specifying avxiliary address

This product does not respond to any "request message" that specifies a avxiliary address other than the one set for itself.

Therefore, if there is an error in the avxiliary address part in the "request message", the "response message" will not be returned.

Therefore, if the host computer does not return the "response message" within an appropriate time after sending the "request message", send the required "request message" again.

(5) Number of digits of data and position of decimal point

See P.51 "Modbus-RTU Code Description g) Data".

(6) Operation when the power is turned on

This unit does not start communication (no reply) for about five seconds after the power is turned on.

Set a delay until communication begins after the power is turned on.

(7) Decimal point of temperature data

This product does not add a decimal point or data suggesting a decimal point to the temperature data.

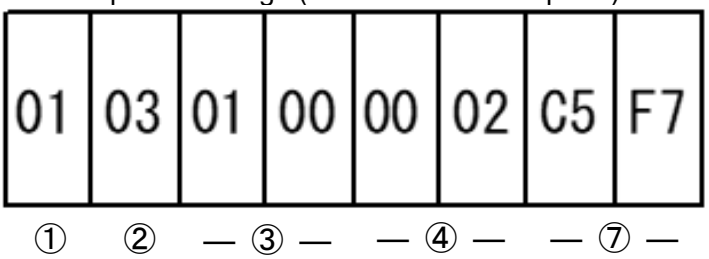
Please convert the data on the computer side.

# 5. OPERATION PROCEDURES

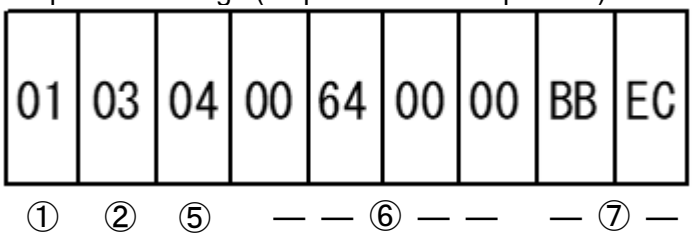
## Modbus-RTU read communication example

Request message: Requests "measurement temperature read" to the product set to the avxiliary address "01".
Response message: Return the measured temperature data "10.0 ° C".

Read request message (sent from host computer)




Response message (response from this product)




| code | Symbol / data | ASCII code |
|---|---|---|
| ① Avxiliary address | 01 (0x01) | 01h |
| ② Function code | 03 (0x03) | 03h |
| ③ Register address | 0x0100 | 01h 00h |
| ④ Number of registers | 2 fixed (0002) | 00h 02h |
| ⑤ Number of bytes | 4 fixed (04) | 04h |
| ⑥ Numerical data | 100 (00000064h) | 00h 00h 00h 64h |
| ⑦ CRC-16 Request | | F7h C5h |
| Response | | ECh BBh |

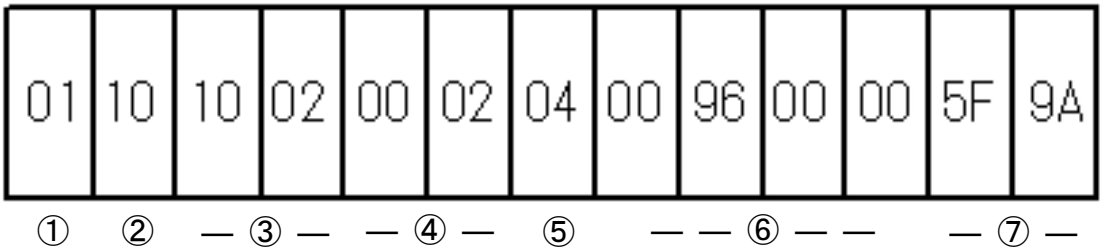
# 5. OPERATION PROCEDURES

## Modbus-RTU write communication example

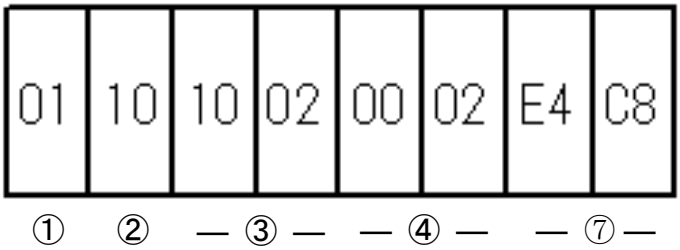
Request message: Requests "write to set temperature 15.0 ° C" for this product set to avxiliary address "01".

Reply message from the unit to this request message: Information that the request message has been received is returned.
Confirm that the data has been properly written by reading it separately.

Write request message (sent from host computer)




Response message (response from this product)




| code | Symbol / data | ASCII code |
|---|---|---|
| ① Avxiliary address | 01 (0x01) | 01h |
| ② Function code | 10 (0x10) | 10h |
| ③ Register address | 0x1002 | 10h 02h |
| ④ Number of registers | 2 fixed (0002) | 00h 02h |
| ⑤ Number of bytes | 4 fixed (04) | 04h |
| ⑥ Numerical data | 150 (00000096h) | 00h 00h 00h 96h |
| ⑦ CRC-16 Request | | 9Ah 5Fh |
| Response | | C8h E4h |

# 5. OPERATION PROCEDURES

## Modbus-ASCII request message configuration (sending from host computer to this product)

■ For the codes from a) to i), refer to P.50 "Explanation of Modbus-ASCII Code".

Structure of read request message

| | | | | |
|---|---|---|---|---|
| a) | Start code | | **':'** | |
| b) | Avxiliary address | | **'0','1'** | |
| c) | Function code | | **'0','3'** | |
| d) | Register address | Top | **'1','0'** | First register address |
| | | Lower level | **'0','0'** | |
| e) | Number of registers | Top | **'0','0'** | Two are fixed |
| | | Lower level | **'0','2'** | |
| f) | LRC | | **'E','A'** | |
| g) | End code | | **CR, LF** | |

Structure of write request message

| | | | | |
|---|---|---|---|---|
| a) | Start code | | **':'** | |
| b) | Avxiliary address | | **'0','1'** | |
| c) | Function code | | **'1','0'** | |
| d) | Register address | Top | **'1','0'** | First register address |
| | | Lower level | **'0','0'** | |
| e) | Number of registers | Top | **'0','0'** | Two are fixed |
| | | Lower level | **'0','2'** | |
| h) | Number of bytes | | **'0','4'** | Register x 2 |
| i) | First register data (Lower word) | Top | **'0','0'** | ③ |
| | | Lower level | **'0','0'** | ④ |
| | First register data (Upper word) | Top | **'0','0'** | ① |
| | | Lower level | **'0','0'** | ② |
| f) | LRC | | **'D','9'** | |
| g) | End code | | **CR, LF** | |

The data structure is ①②③④h.
(① represents 1 byte)

# 5. OPERATION PROCEDURES

## Modbus-ASCII request message configuration (sending from this product to host computer)

■ For the codes from a) to j), refer to next page "Explanation of Modbus-ASCII Code".

Response message to read request message

| | | | | |
|---|---|---|---|---|
| a) | Start code | | **':'** | |
| b) | Avxiliary address | | **'0','1'** | |
| c) | Function code | | **'0','3'** | |
| h) | Number of bytes | | **'0','4'** | Register x 2 |
| i) | First register data (Lower word) | Top | **'0','0'** | ③ |
| | | Lower level | **'0','0'** | ④ |
| | First register data (Upper word) | Top | **'0','0'** | ① |
| | | Lower level | **'0','0'** | ② |
| f) | LRC | | **'F','8'** | |
| g) | End code | | **CR, LF** | |

The data structure is ①②③④h.
(① represents 1 byte)

Response message to read request message

| | | | | |
|---|---|---|---|---|
| a) | Start code | | **':'** | |
| b) | Avxiliary address | | **'0','1'** | |
| c) | Function code | | **'1','0'** | |
| d) | Register address | Top | **'1','0'** | |
| | | Lower level | **'0','0'** | First register address |
| e) | Number of registers | Top | **'0','0'** | |
| | | Lower level | **'0','2'** | Two are fixed |
| f) | LRC | | **'D','D'** | |
| g) | End code | | **CR, LF** | |

Response message when there is an error

| | | | |
|---|---|---|---|
| a) | Start code | | **':'** |
| b) | Avxiliary address | | **'0','1'** |
| c) | Function code | | **'8','3'** |
| j) | Error Codes | | **'0','2'** |
| f) | LRC | | **'7','A'** |
| g) | End code | | **CR, LF** |

← In case of error, the value of function + 80h of the request message is entered.

# 5. OPERATION PROCEDURES

## Modbus-ASCII code description

■ The following a) start code to j) error code are expressed in ASCII code.
■ For ASCII codes, p.59 "List of ASCII Codes."
■ Refer to P.40 "Modbus-ASCII Read Communication Example" and P.41 "Modbus-ASCII Write Communication Example" for conversion to ASCII code.

a) Start code
This code is required for the receiving side to detect the beginning of the message. Add it to the beginning of the character string to be sent.

b) Avxiliary address
This is the avxiliary address of the other party (this product) with which the high level computer communicates.
The avxiliary address in the response message from this product indicates the source of the response message.

c) Function code
Please enter the code for 03h or 10h.
03h: When reading data from this product / 10h: When writing data to this product

d) Register address
Specify the position of the data to be read or written in 2 bytes.
For the address of each command, refer to the various commands on page P. 50～58

e) Number of registers
Specifies the number of registers to write. Since the number of registers of this product is fixed at 2, specify 0002h.

f) LRC
This is an error check code for detecting an error in a message. I will send you an LRC.
The LRC used in this product is the data part excluding the start code and end code of the message.
It is a two's complement of the answer, added without a carry.
The parts represented by "1" and "B" in the data part are considered as "1Bh".
If 12h is calculated as an error code, add "1" and "2" after the message.

g) End code
This code is required for the receiving side to detect the end of the message. Add CR (0Dh) and LF (0Ah) to the end of the character string to be sent.

h) Number of bytes
Specify the number of registers to read and write x 2. Since the number of registers of this product is fixed at 2, 04h is specified here.

## Modbus-ASCII code description

g) Data

Specifies the data to write to the register. The data is fixed at 4 bytes.
If the data has a decimal point, write the data without the decimal point.
Also, when reading data, determine the presence or absence of a decimal point on the computer side.
The data in parentheses is the value when actually used for the transmitted message.
For details, refer to P.48 "Modbus-ASCII Request Message Configuration (Sending from the high level computer to this product)".

■ For numerical data with a decimal point

| Communication content | HEX data |
|---|---|
| Measurement temperature = 10.5 | 00000069h (00690000) |
| Measurement temperature = -10.5 | FFFFFF97h (FF97FFFF) |

h) Error code

If there is an error in the message from the high level computer, "Response message" from this product.

When there is a compound error, the error number with the higher number is included.
The details and classification of the errors are as shown in the table below.

| Error number | Details of the error in the "request message" received by this product |
|---|---|
| 01 | Irregular/incorrect function code received |
| 02 | Received an address other than the specified address |
| 03 | Numerical data was out of the "setting range individually specified by the setting item" |
| 04 | Instrument failure (when equipment abnormality occurs) |

# 5. OPERATION PROCEDURES

## Modbus-ASCII communication notes

(1) Transmission timing

When using communication, set a sufficient response delay time to ensure that the host computer switches from transmission to reception.
Refer to the figure on page 33 “Communication procedure”.

(2) Request interval

When sending a "request message" continuously from a high level computer, wait at least 2 msec after receiving the "response message" from this product before sending.

(3) Response conditions

This product will not return the "response message" unless the start code and end code are included in the "request message".
Therefore, even if there is an error in the "request message", the "response message" (error reply) containing error code will not be returned unless the above conditions are met.
Therefore, if the host computer does not return the "response message" within an appropriate time after sending the "request message", send the required "request message" again.

When this product receives start code, all the codes received before that will be cleared.

(4) Error specifying avxiliary address

This product does not respond to any "request message" that specifies a avxiliary address other than the one set for itself.

Therefore, if there is an error in the avxiliary address part in the "request message", the "response message" will not be returned.

Therefore, if the host computer does not return the "response message" within an appropriate time after sending the "request message", send the required "request message" again.

When this product receives start code, all the codes received before that will be cleared.

(5) Number of digits of data and position of decimal point

See P.51 "Modbus-ASCII Code Description g) Data".

(6) Operation when the power is turned on

This unit does not start communication (no reply) for about five seconds after the power is turned on.
Set a delay until communication begins after the power is turned on.

(7) Decimal point of temperature data

This product does not add a decimal point or data suggesting a decimal point to the temperature data.
Please convert the data on the computer side.

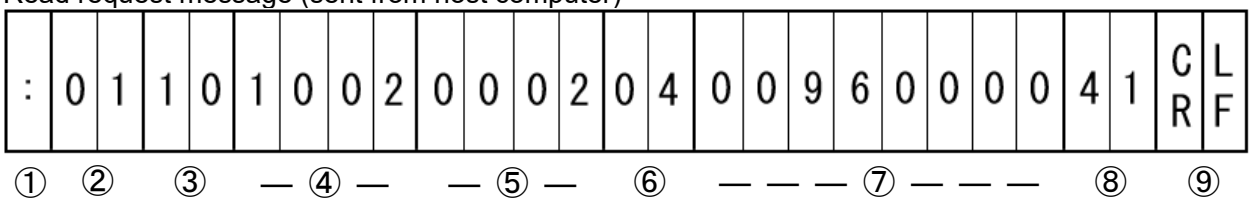
# 5. OPERATION PROCEDURES

## Modbus-ASCII read communication example

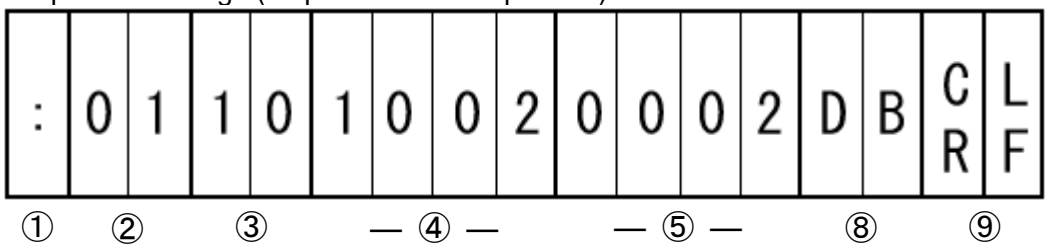
Request message: Requests "measurement temperature read" to the product set to the avxiliary address "01".

Response message: Return the measured temperature data "10.0 ° C".

Read request message (sent from host computer)




Response message (response from this product)




| code | Symbol / data | ASCII code |
|---|---|---|
| ① Start code | : | 3Ah |
| ② Avxiliary address | 01 (0x01) | 30h 31h |
| ③ Function code | 03 (0x03) | 30h 33h |
| ④ Register address | 0x0100 | 30h 31h 30h 30h |
| ⑤ Number of registers | 2 fixed (0002) | 30h 30h 30h 32h |
| ⑥ Number of bytes | 4 fixed (04) | 30h 34h |
| ⑦ Numerical data | 100 (00000064h) | 30h 30h 30h 30h 30h 30h 36h 34h |
| ⑧ LRC Request | F9 | 46h 39h |
| Response | 94 | 39h 34h |
| ⑨ Encode | CR, LF | 0Dh 0Ah |

# 5. OPERATION PROCEDURES

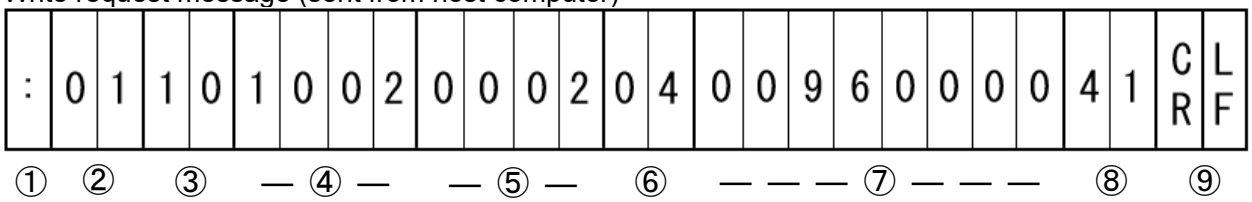
## Modbus-ASCII write communication example

Request message: Requests "write to set temperature 15.0 ° C" for this product set to avxiliary address "01".

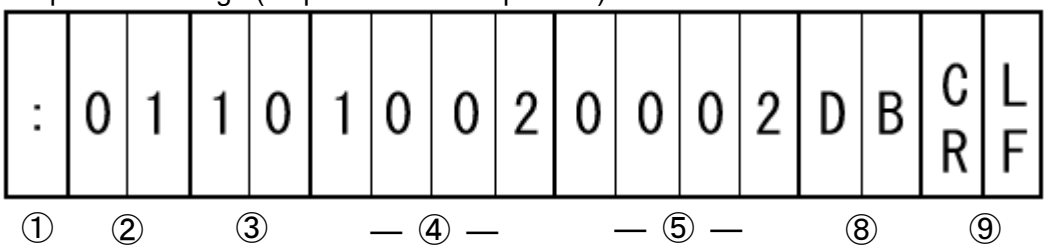
Reply message from the unit to this request message: Information that the request message has been received is returned.

Confirm that the data has been properly written by reading it separately.

Write request message (sent from host computer)




Response message (response from this product)




| code | Symbol / data | ASCII code |
|---|---|---|
| ① Start code | : | 3Ah |
| ② Avxiliary address | 01 (0x01) | 30h 31h |
| ③ Function code | 10 (0x10) | 31h 30h |
| ④ Register address | 0x1002 | 31h 30h 30h 32h |
| ⑤ Number of registers | 2 fixed (0002) | 30h 30h 30h 32h |
| ⑥ Number of bytes | 4 fixed (04) | 30h 34h |
| ⑦ Numerical data | 150 (00000096h) | 30h 30h 30h 30h 30h 30h 39h 36h |
| ⑧ LRC Request | 41 | 34h 31h |
| Response | DB | 44h 42h |
| ⑨ Encode | CR, LF | 0Dh 0Ah |

# 5. OPERATION PROCEDURES

## Precautions for setting by communication

- The W command is disabled when some setting screen is displayed by operating the keys on the product.
- During communication, the communication lamp on the upper left of the set temperature indicator on the operation panel of the product blinks.

Refer to the figure below for the communication lamp.

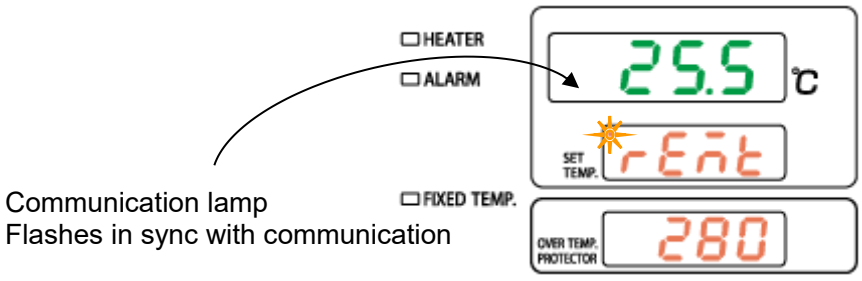
## Operation setting command

| Panel item | Letters | Modbus Address | Command | Setting value |
|---|---|---|---|---|
| Fixed value operation start / stop | RUN | 0x1502 | R / W | 00000: Stop<br>00001: Start ※ |
| Remote operation mode | RMT | 0x1506 | R / W | 00000: Stop<br>00001: Remote operation mode |
| Signifies temperature setting mode | SV1 | 0x1002 | R / W | Lower limit of set temperature to upper limit of set temperature ※ |

※ The W command is a valid parameter during fixed-value operation.

About remote operation mode

- When "1" is written in the remote operation mode when the product is stopped, the communication lamp on the upper left of the set temperature indicator on the operation panel lights up, and the communication lamp blinks in synchronization with the communication.
  Refer to the figure below for the communication lamp.
- All key operations on the product are disabled during remote operation, and the remote character rEmt is always displayed on the set temperature display on the operation panel when operation is stopped, and any key operation is performed during fixed-value operation.
  Display rEmt. Refer to the figure below for the display of rEmt.
- To cancel the remote operation mode, write "0" or turn off (○) / ON ( | ) the breaker and restart.
- If the remote operation mode is not set, the parameters can be changed by both key operation and communication, and there is a risk of double changes. Therefore, it is recommended to switch to the remote operation mode when rewriting the parameters.



# 5. OPERATION PROCEDURES

## Submenu command

| Panel item | Letters | Modbus Address | Command | Setting value |
|---|---|---|---|---|
| Signifies overheat prevention setting mode | _OH | 0x2004 | R / W | Overheating prevention set temperature range ※1 ※2 |
| Calibration Offset temperature setting | PVS | 0x2722 | R / W | Calibration offset set temperature range ※1 |
| Set keypad lock | LOC | 0x1500 | R / W | 00000: Set value lock OFF ※1<br>00001: Set value lock ON |
| Signifies auto-resume function setting | PON | 0x2618 | R / W | 00000: Power outage compensation OFF<br>00001: Power outage compensation ON |
| Lower limit of t emperature output range | TRL | 0x2804 | R / W | -1000(-100.0 °C)～03000(300.0 °C) |
| Upper limit of temperature output range | TRH | 0x2806 | R / W | -1000(-100.0 °C)～03000(300.0 °C) |

※1 The W command is a valid parameter during fixed-value operation.
※2 The identifier _ means a space (ASCII: 20h).

Refer to P.58 "Communication Parameter Command" for communication parameters.

## Monitor command

| Panel item | Letters | Modbus Address | Command | Setting value |
|---|---|---|---|---|
| Measurement temperature monitor | PV1 | 0x0100 | R | (example)<br>Toho / Modbus / —<br>01000 / 000003E8h / 100.0 °C (with decimal point)<br>HHHHH / 7FFFFFFFh / Measurement temperature overscale<br>LLLLL / 80000000h / Measurement temperature under scale |
| Output monitor 1 | OM1 | 0x0204 | R | 00000<br>└ 1st digit: Heater output<br>└ 2nd digit: Do not use.<br>└ 3rd digit: Main relay output<br>└ 4th digit: Do not use.<br>└ 5th digit: Overheating prevention device output (normally ON)<br>* Output status 0: Output OFF / 1: Output ON<br>Example) Overheating prevention device output ON, main relay output ON<br>Toho: 10100<br>Modbus: 00002774h |
| Output monitor 2 | OM2 | 0x0206 | R | 00000<br>└ 1st digit: External alarm output<br>* Output status 0: Output OFF / 1: Output ON |

# 5. OPERATION PROCEDURES

## Monitor command

| Panel item | Letters | Modbus Address | Command | Setting value |
|---|---|---|---|---|
| Abnormal alarm | ER1 | 0x020A | R | 00000<br>1st digit: Memory abnormality (Er15)<br>2nd digit: Sensor error (Er01)<br>3rd digit: Do not use.<br>4th digit: Heater disconnection (Er03)<br>5th digit: SSR short circuit (Er02)<br>※Abnormal state 0: No abnormality / 1: Abnormal<br>Example) Sensor abnormality, heater disconnection<br>Toho: 01010<br>Modbus: 000003F2h |
| Abnormal alarm | ER2 | 0x020C | R | 00000<br>1st digit: Water level error (Er20)<br>2nd digit: Do not use.<br>3rd digit: Overheating preventer activated (Er19)<br>4th digit: Internal communication error (Er17)<br>5th digit: Do not use.<br>※Abnormal state 0: No abnormality / 1: Abnormal |
| Abnormal alarm | ER3 | 0x020E | R | 00000<br>1st digit: Main relay contact short circuit error (Er10)<br>2nd digit: Do not use.<br>3rd digit: Do not use.<br>4th digit: Do not use.<br>5th digit: Do not use.<br>※Abnormal state 0: No abnormality / 1: Abnormal |
| Operation status | RNM | 0x0216 | R | 00000<br>1st digit: Fixed value operation is stopped (waiting)<br>2nd digit: Do not use.<br>3rd digit: During fixed price operation<br>4th digit: Do not use.<br>5th digit: Do not use.<br>* Fixed value operation: Stopped = 0, operating = 3rd digit "1" |

# 5. OPERATION PROCEDURES

## Communication parameter command

| Panel item | Letters | Modbus Address | Command | Setting value |
|---|---|---|---|---|
| Protocol settings | PRT | 0x2500 | R / W | 00000: Toho<br>00001: Modbus-RTU<br>00002: Modbus-ASCII |
| BCC check | BCC | 0x2502 | R / W | Toho<br>____N: None ____B: Yes ※<br>Modbus<br>0x00: None 0x01: Yes |
| Data length | DAT | 0x2504 | R / W | Toho<br>____ 7: 7 bits ____ 8: 8 bits ※<br>Modbus<br>0x07: 7 bits 0x08: 8 bits |
| Parity bit | PAL | 0x2506 | R / W | Toho<br>None (n)/Odd (o)/Even (E)<br>Modbus<br>0x00: None 0x01: Odd 0x02: Even |
| Stop bit | SPB | 0x2508 | R / W | Toho<br>____ 1: 1 bits ____ 2: 2 bits ※<br>Modbus<br>0x01: 1 bit 0x02: 2 bits |
| Communication rate | BPS | 0x250A | R / W | Toho<br>「2400」：2400bps ／ 「4800」：4800bps ※<br>「9600」：9600bps／「19200」：19200bps<br>「38400」：34800bps<br>Modbus<br>0x01：2400bps 0x02：4800bps<br>0x03：9600bps 0x04：19200bps<br>0x05：38400bps |
| Avxiliary address | ADR | 0x250C | R / W | Toho：1～99 Modbus：0x01～0x63 |
| Response delay time | AWT | 0x250E | R / W | 0-250 msec |
| Communication mode switching | MOD | 0x2510 | R / W | Toho<br>___RO: Lead only ___RW: Lead light ※<br>Modbus<br>0x00: Lead only 0x01: Lead light |

※Setting value _ means a space (ASCII: 20h).

**About external communication**

When using external remote communication option on any unit, access by anything other than the above-mentioned reference addresses, may cause equipment malfunction. Do not attempt to use any reference address, code or utility other than those given above or as recommended by Yamato Scientific Co., Ltd.

# 5. OPERATION PROCEDURES

## ASCII code table

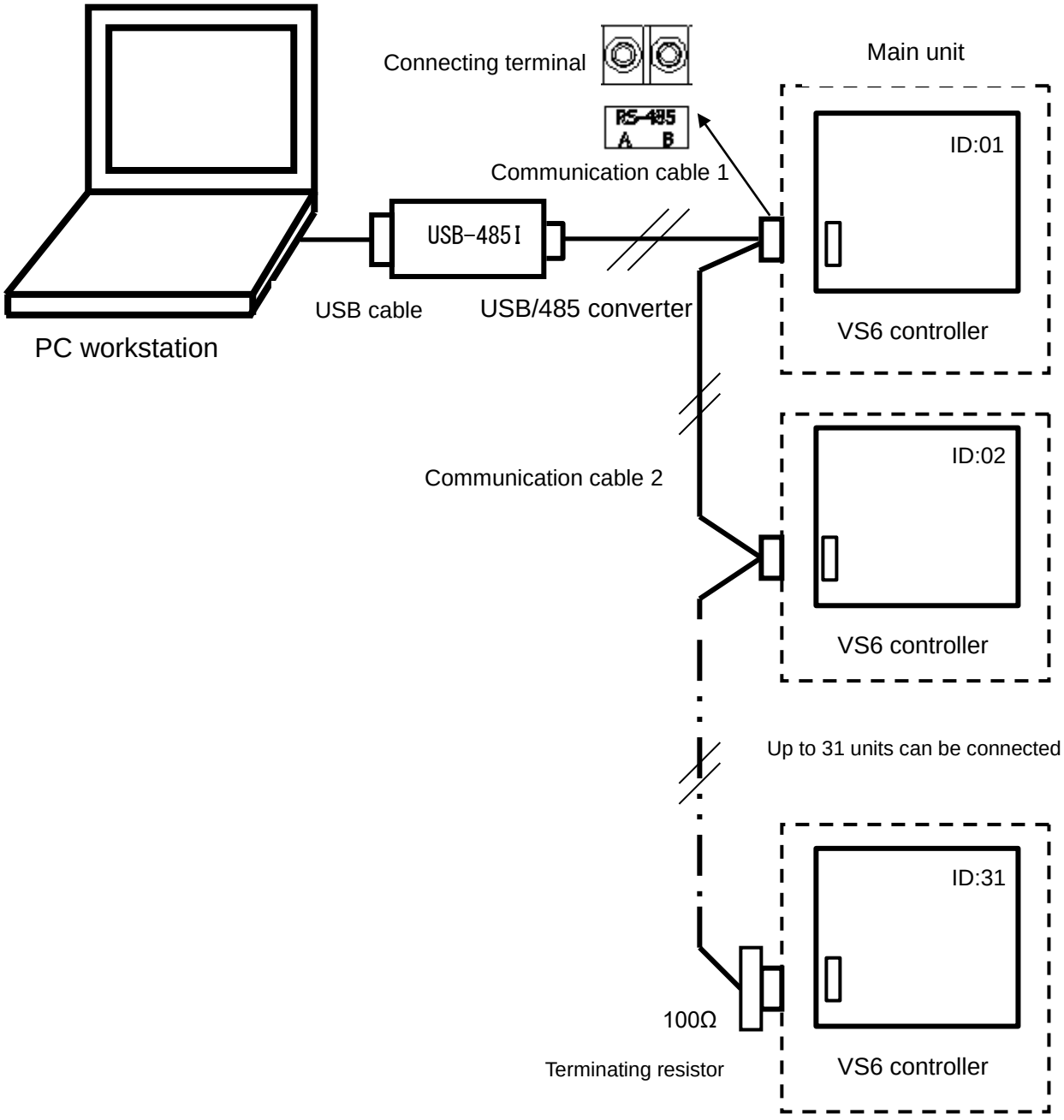
| Top / Lower level | 00h | 10h | 20h | 30h | 40h | 50h | 60h | 70h |
|---|---|---|---|---|---|---|---|---|
| 00h | **NUL** | **DEL** | **Space** | **0** | **@** | **P** | **`** | **p** |
| 01h | **SOH** | **DC1** | **!** | **1** | **A** | **Q** | **a** | **q** |
| 02h | **STX** | **DC2** | **"** | **2**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

※How to read ASCII code table
(ASCII code) = (TOP) + (LOWER)
Example 1) In the case of "5": (35h) = (30h) + (05h)
Example 2) In the case of "A": (41h) = (40h) + (01h)

# 5. OPERATION PROCEDURES

## Multi-drop connection example

This is an example of the multi-drop wiring method using the optional "external communication adapter (RS485-USB conversion) OA017".




USB-RS485 converter unit: System Sacom USB-485I RJ45-T4P

USB cable: 1.8 m, included with USB-485I

Communication cable 1: UL2464TASB 2-lead AWG20 cable 3 m, with Y terminal on main unit side.

Communication cable 2: Custom-made items.

Terminating resistor: Custom-made item. If you prepare a terminating resistor yourself, connect a fixed resistor of 100 Ω and 1/4 W or over to the last cable appliance terminal block.

# 6. HANDLING PRECAUTIONS

**Warnings and Cautions**

## WARNING

### NEVER process explosive or flammable substances

Never attempt to process explosives, flammables or any items which contain explosives or flammables. Fire or explosion may result.
See " LIST OF HAZARDOUS SUBSTANCES" (P.72)

### DO NOT insert foreign objects into unit openings.

In the event that a foreign object accidentally falls inside, turn OFF(○) ELB immediately, disconnect power cable and contact original dealer of purchase for assistance. Failure to do so may result in fire or electric shock.

### Carefully handle test samples following high temperature operation.

Bath and sample/process items are hot during operation and for some time after operation. Be careful with hot items in order to avoid burn injury. Always wear protective equipment when handling test samples during operation or right after operation.

### Do not operate unattended.

Do not leave unit unattended during operation of equipment using oil.
There is a risk of fire such as ignition of oil smoke.

### Implement proper fire extinguishing and ventilation measures.

There is a risk of fire. Implement proper fire extinguishing and ventilation measures. Devices which heat silicon oil present a fire hazard and may emit harmful fumes at 150℃ or higher. Always be sure that a ventilation hood is installed over such devices, with a fire extinguisher in close proximity.
Implement proper fire extinguishing and ventilation measures.

### Check overheat prevention device.

Confirm that overheat prevention device temperature is set 10 °C above unit temperature setting.
Check overheat prevention device performance before extended operations.
See “Overheat Prevention Device Setup” (P.19)

# 6. HANDLING PRECAUTIONS

**Warnings and Cautions**

## ⚠ CAUTION

### DO NOT process corrosive items.

Do not process items containing corrosive chemicals of any kind. Potent acids may corrode the reservoir despite stainless steel construction. Note that acids, alkaline, and halogenated solvents are corrosive to rubber.

### Wash the bath before use.

The bath has been cleaned at the time of shipment. However, when unit is used for the first time or has been in storage for a long period of time, thoroughly wash the bath before operation.

### Supply water and oil with care

Do not overflow the bath or spill water and oil on the unit exterior when adding water. Also, if you accidentally get it on the electrical components such as the operation panel, wipe it off well.
Electrical leakage and/or electric shock may result.

### DO NOT operate equipment without water.

This unit employs float switch to prevent unit from running with the bath empty. However, always pay attention to the water level and maintain it at the proper level whenever operating this unit.

### ALWAYS run equipment within specified temperature range

Operate unit within the temperature setting range specified in the specifications. Never attempt to operate unit outside of the specified temperature range. Equipment malfunction or accident may result.

### Power loss recovery

In the event of a power loss, unit automatically reverts to status just before power loss and begin operation once again from that point. This function may be turned off through Submenu.

If "on" is set and the breaker is turned on (|) after the emergency stop switch is turned on during the fixed operation or after the independent overheating prevention device is activated, the fixed value operation is restored. Confirm the setting before starting an fixed temperature operation.

### Overnight and extended storage.

When stopping the device at night or for a long time, turn the breaker "OFF (○)".

# 6. HANDLING PRECAUTIONS

## Warnings and Cautions

### Use only water and oil for this equipment

Never use it with any liquid other than the specified silicone oil.
(Refer to P.17 "About the medium liquid used".)
Periodically change oil and wash the bath container. In particular, impurities adhering to the heater significantly accelerate the deterioration of the heater. Please frequent cleaning.
When used as an aquarium, use ion-exchanged water or distilled water to prevent the accumulation of scale and can stones. Do not use tap water or well water as it not only pollutes the inside of the bath but also reduces the heater efficiency and heater life.

### Use calibration offset function to correct temperature reading.

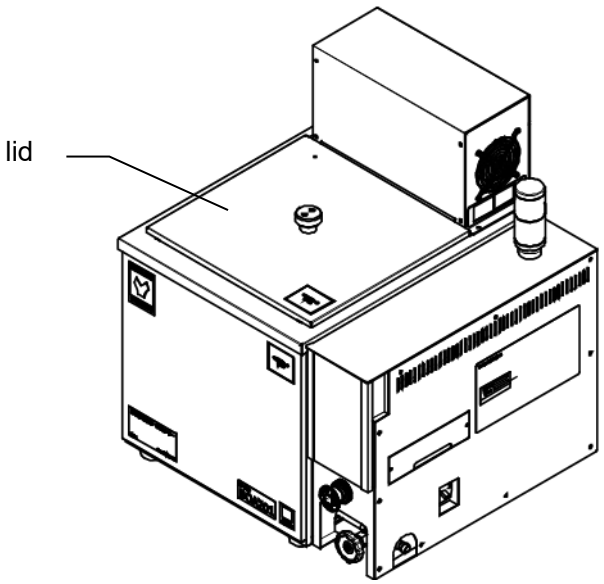
If there is a discrepancy between temperature reading and actual chamber temperature, refer to "Calibration Offset" (P.23) to perform temperature correction.

### Inspect regularly.

Circuit breakers and overheating prevention devices are important security devices. Inspect regularly. See "Maintenance and Inspection" (P.64) for detailed instructions.

### Using lid

- Ensure that the bath is filled with water or oil before placing the lid on the bath.
- Do not touch the lid other than its handle. The whole lid except the handle becomes hot during high temperature operation.
- When taking off the lid, lift it evenly a little, then slide frontward.
  If you remove it all at once or lift the front side, there is a risk of getting burned by steam.



# 7. MAINTENANCE PROCEDURES

## Precautions before Inspection

## ⚠WARNING

- Be sure to disconnect power cable before daily inspection and maintenance.
- Perform inspections and maintenance when unit is at room temperature. (Make sure that the water and oil in the bath are below 45 ° C.)
- Never attempt to disassemble unit.

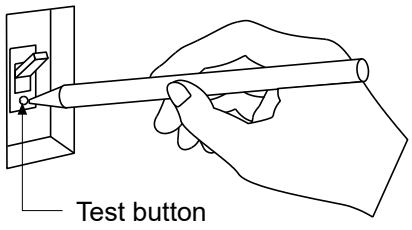
## Precautions in Daily Maintenance

## ⚠CAUTION

- Clean unit using soft damp cloth. Never use benzene, paint thinner, scouring powder, scrubbing brush or other abrasives and solvents to clean unit. Superficial damage and/or discoloration, as well as deformity to some components may result.
- Wipe off any dirt in the bath with a dry cloth. Be careful not to damage the heater.

## Maintenance and Inspection

- Inspect ELB ON and OFF function.
  - Prepare unit for inspection by connecting power cable to a facility outlet or terminal.
  - Turn ON(|) ELB.
  - Press the test button on ELB using a ball-point pen or other fine-tipped object. If ELB shuts OFF (○), it is functioning normally.




- Check overheat prevention device.
  - Set the overheat prevention device temperature 10 °C higher than the unit objective temperature.
  - Operate unit in Fixed temperature mode and wait until chamber temperature becomes stable.
  - Lower the overheat prevention device temperature by 1 °C.
  - If overheat prevention device is functioning normally, heater will shut off within few seconds and error code “Er19” will appear in top display. An alarm will also sound and ALARM lamp will illuminate.
- Check terminals at the cable end for abnormalities
  - Visually check the terminals for dust and dirt. If there is dust or dirt on it, remove it.
  - Visually check the terminals for deformation. Replace if bent or damaged.
  - Check the terminals for discoloration or abnormal heat generation. If there is discoloration or abnormal heating, the internal contact of the distribution board may be faulty.

* ELB and overheat prevention device must be inspected, as prescribed above, prior to every instance of extended or overnight operation.

◆ Contact original dealer of purchase, if further questions arise concerning maintenance procedures.

# 7. MAINTENANCE PROCEDURES

## Maintenance and Inspection

● Please clean the inside of the bath.

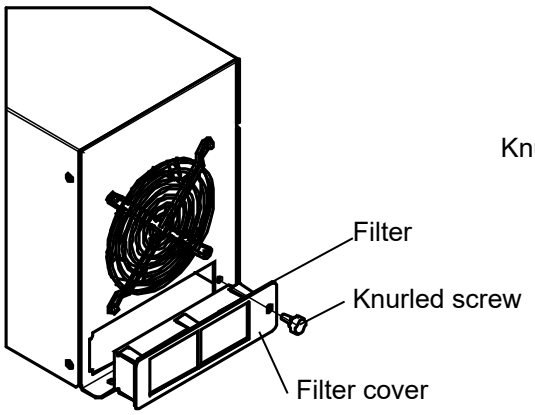
- As distillation continues, water in boiler will be concentrated, accelerating the accumulation of boiler scale.
  When scale build up in the bath, discharge water and clean the bath interior.
  We recommend using ion-exchanged water or distilled water.When operating with silicone oil, it deteriorates according to the operating temperature / time.
- Replace oil regularly.
  (Refer to P.17 "About the medium liquid used".)

◆ Contact original dealer of purchase, if further questions arise concerning maintenance procedures.

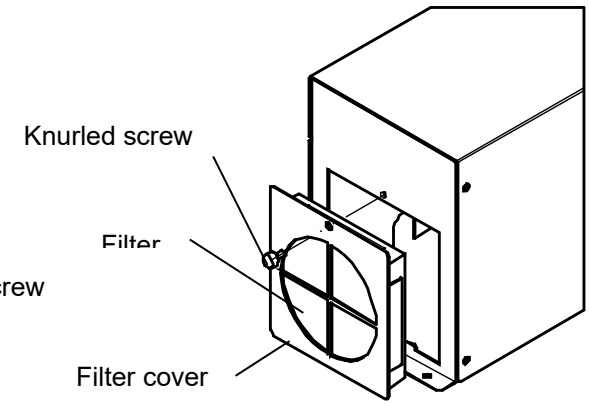
## Cleaning the intake filter

● Clean the intake filter.

- If the operation is continued, dust and dirt will adhere to the intake filter. If it becomes clogged, the performance of the cooling fan inside the housing box will deteriorate.
  Cleaning intervals will vary depending on usage frequency and operating environment. Be sure to clean condenser fins periodically.
- Remove the knurled screws on the left and right of the storage box and remove the intake filter from the filter cover.
- ･Remove the dust from the intake filter with a vacuum cleaner, etc., and put it back into unit.




Intake filter (right)




Intake filter (left)

# 8. EXTENDED STORAGE AND DISPOSAL.

## Extended storage

| ⚠WARNING | ⚠CAUTION |
|---|---|
| Extended storage<br>● Turn OFF (○) ELB and disconnect power cable from facility outlet or terminal. | Unit disposal<br>● Do not leave unit in a location where children may have access.<br>Contact original dealer of purchase if there are any questions. |

## Disposal Considerations

Dispose of this unit in accordance with local laws and regulations.Dispose of or recycle this unit in a responsible and environmentally friendly manner.

Yamato Scientific Co., Ltd. strongly recommends disassembling unit, as far as is possible, in order to separate parts and recycle them in contribution to preserving the global environment. Major components and materials, comprising this unit are listed in the table below.

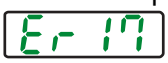
| **Component Name** | **Material** |
|---|---|
| **Main Unit Components** | |
| Exterior | Chromium-free electrogalvanized steel sheet, baked-on finish |
| Chamber interior | Stainless steel sheet metal |
| Heat insulator | Gypsum board, ceramic fiber |
| Rubber legs | Chloroprene rubber |
| **Electrical Parts** | |
| Switches and relays | Composite of resin, copper and other materials |
| Motor | Composite of steel plate, copper wire, resin coated wiring materials and other compounds |
| Circuit boards | Boards: epoxy resin, fiber glass<br>Boards are equipped with capacitors, resistors, transformers, etc. |
| Tube heater | Stainless steel SUS316, nichrome and other composites |
| Power cable | Composite of synthesized rubber coating, copper, nickel and other compounds |
| Wiring material | Composites of fiber glass, fire-retardant vinyl, copper, nickel and other compounds |
| Seals | Resin material |
| Sensor | Stainless steel etc. |

# 9. TROUBLESHOOTING

## Reading Error Codes

Unit has a self-diagnostic function built into the CPU board. The table below shows possible causes when safety function is triggered. If unit does not reset by turning OFF (◯) and ON (|) ELB, contact original dealer of purchase.

[Error Codes]
When an operational error or malfunction occurs, ALARM lamp on the control panel illuminates, an error code is displayed, and an alarm sounds. Press any key to stop the alarm.
When an error occurs, confirm the error code and terminate operation immediately. For abnormal temperature reading, the controller shows only "----" on display (no lamps go on, and no alarm sounds).

| Safety functions | Symptom | Possible causes |
|---|---|---|
| Sensor failure | ALARM lamp ON  on screen | ● Failure in temperature input circuit of the controller<br>● Temperature control sensor disconnection/short circuit |
| SSR short circuit | ALARM lamp ON  on screen | ● Short circuit in SSR |
| Heater line disconnection | ALARM lamp ON  on screen | ● Heater interruption or disconnection<br>● Current sensing element failure, disconnection<br>● Drop in power supply voltage |
| Main relay Main relay contact short circuit | ALARM lamp ON  on screen | ● Main relay contact short circuit |
| Memory error | ALARM lamp ON  on screen | ● Error in CPU storage setting on the controller. |
| Internal communication error | ALARM lamp ON  on screen | ● Internal communication error, temperature input circuit failure |
| Overheating | ALARM lamp ON  on screen | ● Turn off the ELB for which the overheat protection device is not set properly, and then turn it back on. Check both bath temperature and temperature setting for overheat prevention. If unit does not reset, it may be a result from sensor disconnection.<br>● Temperature sensor for overheat prevention is interrupted or disconnected<br>● Failure in temperature input circuit of the controller |
| Abnormal water level | ALARM lamp ON  on screen | ● Water level is insufficient or rising<br>See P.18<br>● Float switch failure |
| Abnormal temperature reading |  on screen | ● Temperature reading is out of display range (-110 to 310 °C) |

# 9. TROUBLESHOOTING

## Troubleshooting Guide

### Troubles

| Symptom | Possible causes |
|---|---|
| Unit does not turn on when main power switch is turned "ON" | ● Power cable is not connected securely to power terminal or outlet.<br>● Power failure in progress<br>● No power from power supply, or supply voltage is low. |
| Temperature does not rise. | ● Temperature setting is inappropriate<br>● Power supply voltage has dropped<br>● The ambient temperature is out of operable temperature range<br>Operating ambient temperature range for this unit is between 5 °C and 35 °C<br>● The amount of test samples is excessive |
| Temperature fluctuates during operation | ● Temperature setting is inappropriate<br>● Power supply voltage is unstable<br>● The ambient temperature is heavily fluctuating |
| Temperature reading differs from manually measured temperature | ● Calibration offset value is inappropriate.<br>**P.**23 **・Using calibration offset**<br>Check the set value. |

**◆ If none of the above applies, immediately turn off the breaker of this product to "OFF (○)" to see if it is a power supply facility.**

Contact original dealer of purchase or Yamato sales office for assistance.

# 10. SERVICE & REPAIR

## Requests for Repair

### Warranty card (attached separately)

Warranty card will be handed by dealer or Yamato personnel upon delivery and installation, or will be attached to equipment if no one from dealer or Yamato is to be present at delivery and installation.

Register warranty card at https://www.yamato-net.co.jp/support/warranty.htm
https://www.yamato-net.co.jp/support/warranty.htm

- Keep warranty card safe.

### Requests for Repair

If abnormalities remain after confirming "Troubleshooting Guide", terminate operation, turn off controller and ELB, and disconnect power cable. Contact original dealer of purchase or Yamato sales
office for assistance.

The following information is required for all repairs.

- product name
- Model
- Serial number
- Date (year/month/day) of Delivery

} Refer to warranty card.

- Description of problem in as much detail as possible

- Repair this equipment for free of charge according to the contents on warranty card. Warranty period is 1 (one) year from date of purchase.

- Consult with original dealer of purchase or Yamato sales office for any repair after warranty ended. Charged repair service of this equipment will be available on customer's request when it can be maintained functional by its repair.

*Be sure to present warranty card to the service representative.

### Guaranteed Supply Period for Repair Parts

Guaranteed maximum supply period for repair parts is 7 (seven) years from date of discontinuation for this equipment.
"Repair parts" is defined as components which, when installed, allow for continued equipment operation.

# 11. SPECIFICATIONS

| Model | | | BOA201 | BOA311 |
|---|---|---|---|---|
| System | | | Jet agitation | |
| Operating ambient temperature range | | | 5 to 35 °C | |
| Temperature setting range | | | 0 to 200 °C | 0 to 270 °C |
| Performance ※1 | Temperature control range | | Room temp +10 °C to 200 °C | Room temp +10 °C to 270 °C |
| | Temperature control accuracy | | ± 0.1 °C (at 200 °C Silicone Oil JTM K05) | |
| | Temperature fluctuation | | 0.2 °C (at 200 °C Silicone Oil JIS) | |
| | Temperature distribution accuracy | | ± 0.2 °C (at 200 °C Silicone Oil JTM K05) | |
| | Temperature gradient | | 0.5 °C (at 200 °C Silicone Oil JIS) | |
| | Temperature rise time | | Approx. 120 minutes | Approx. 70 minutes |
| Configuration | Exterior | | Chromium-free electrogalvanized steel sheet, baked-on finish | |
| | Bath | | Stainless steel sheet metal | |
| | Heat insulator | | Ceramic fiber | |
| | Heater | Type | SUS316 pipe heater | |
| | | Capacity | 2 kW | 4.5 kW |
| | Agitator | Type | Vertical propeller agitation, induction motor | |
| | | Capacity | 25 W | |
| Controller | Temperature control system | | PID control by microcomputer | |
| | Temperature setting system | | Digital setting with menu keys and the ▼▲ keys | |
| | Temperature display system | | Temperature reading display: Green 4-digit LED digital display<br>Temperature setting display: Red 4-digit LED digital display | |
| | Temperature resolution | | 0.1 °C | |
| | Operation modes | | Fixed value operation (with operation indicator lamp) | |
| | Additional functions | | Drain valve / operation indicator lamp / external alarm output terminal / temperature output terminal (with 1-5V, 4-20mA changeover switch) / external communication function (RS485) / calibration offset function / set value lock function / power failure recovery mode selection function | |
| | Output terminal block | | External communication terminal (RS-485), Temperature output terminal (with 4-20mA / 1-5V changeover switch) External alarm output terminal | |
| | Sensor | | Platinum sensor Pt100Ω (for temperature control), type-K thermocouple (for overheat prevention) | |

※1 Performance data above based on 23 ±5 °C room temperature, 65%RH ±20% humidity, and no process load.
Temperature control accuracy, temperature fluctuation, temperature distribution accuracy, and temperature gradient are the values measured using Toshiba Silicone TSF485-50.

Performance varies depending on the environmental temperature, the type of medium (water, silicone oil) used, and the operating temperature.

# 11. SPECIFICATIONS

| Model | | BOA201 | BOA311 |
|---|---|---|---|
| Safety devices | | Self-diagnostic functions (Automatic overheat prevention, Temperature sensor failure, Heater disconnection, SSR short circuit,main relay failure, memory error, internal communication error, abnormal temperature reading,Abnormal water level), overcurrent leakage breaker, overheating protector, independent overheating preventer, Emergency stop button | |
| Standard | External dimensions ※2 (W × D × H) mm | 531 x 520 x 578 (height in the bath: 397) | |
| | Inner bath dimensions ※2 (W × D × H) mm | 312 x 440 x 320 | |
| | Effective inner bath dimensions (W × D × H) mm | 296 x 340 x 270 (height when the lowest shelf board is installed from the upper edge in the bath) | |
| | Bath capacity | Approximately 37L (when the amount of oil is up to 50mm from the upper edge of the bath) | |
| | Effective bath capacity | Approximately 31.9L (when the bottom shelf board is installed) | |
| | Power supply (50/60 Hz) ※3 Rated current (ELB capacity) | AC115V 18.5A (30A)<br>AC220V 10A (15A) | AC220V 21A (30A) |
| | Approx. weight | 37 kg | |
| Accessories | | Chamber rack, lid, Instruction manual, Warranty card | |
| Optional | | External communication adapter (RS485-USB conversion)<br>Product code: 281146 Model: OA017 | |

※2 Dimensions do not include protrusions.

※3 BOA311 with external transformer

・For product improvement, above specifications are subject to change without notice.

# 12. LIST OF HAZARDOUS SUBSTANCES

Never attempt to process explosives, flammables or any items which contain explosives or flammables.

Table 13.1 List of hazardous substances

| | |
|---|---|
| Explosive substances | ①Trinitrobenzen, Trinitrotoluene, Picric Acid and other explosive nitro compounds |
| | ②Trinitrobenzen, Trinitrotoluene, Picric Acid and other explosive nitro compounds |
| | ③Acetyl Hydroperoxide, Methyl Ethyl Ketone Peroxide, Benzoyl Peroxide and other organic peroxides |
| | ④Metallic Azide, including Sodium Azide, etc. |
| Combustible substances | ① Metal "lithium" ② metal "potassium" ③ metal "sodium" ④ yellow phosphorus ⑤ phosphorus sulfide ⑥ red phosphorus ⑦ celluloids ⑧ calcium carbide (aka ka -baid) ⑨ phosphorized lime ⑩ magnesium powder ⑪ aluminum powder ⑫ metal powder other than magnesium powder and aluminum powder ⑬ Sodium subthionate (also known as hydrosulfite) |
| Oxidizing Substances | ①Potassium Chlorate, Sodium Chlorate, Ammonium Chlorate, and other chlorates |
| | ②Potassium Perchlorate, Sodium Perchlorate, Ammonium Perchlorate, and other perchlorates |
| | ③Potassium Peroxide, Sodium Peroxide, Barium Peroxide, and other inorganic peroxides |
| | ④Potassium Nitrate, Sodium Nitrate, Ammonium Nitrate, and other nitrates |
| | ⑤Sodium Chlorite and other chlorites |
| | ⑥Calcium Hypochlorite and other hypochlorites |
| Flammable Substances | ①Ethyl Ether, Gasoline, Acetaldehyde, Propylene Chloride, Carbon Disulfide, and other substances with ignition point at 30 or more degrees below zero. |
| | ②n-hexane, Ethylene Oxide, Acetone, Benzene, Methyl Ethyl Ketone and other substances with ignition point between 30 degrees below zero and less than zero. |
| | ③Methanol, Ethanol, Xylene, Pentyl n-acetate, (a.k.a.amyl n-acetate) and other substances with ignition point between zero and less than 30 degrees. |
| | ④Kerosene, Light Oil, Terebinth Oil, Isopenthyl Alcohol(a.k.a. Isoamyl Alcohol), Acetic Acid and other substances with ignition point between 30 degrees and less than 65 degrees. |
| Combustible gas | hydrogen, acetylene, ethylene, methane, ethane, propane, butane and other flammable objects that are gases at 1 atm and 1 atm |

Excerpt from Table 1, Hazardous Substances, of Cabinet Order of the Occupational Safety and Health Law (substances related to Articles 1, 6, and 9)

# 13. STANDARD INSTALLATION MANUAL

※ Please install according to the following items. (Please check separately for options and special specifications)

| Model | Serial number | Installation Date | Charged Personnel or Company Name for Installation | Installation proved by | Judgment |
|---|---|---|---|---|---|
| | | | | | |

| № | Item | Implementation method | Chapter No. & Reference page of instruction manual | Judgment |
|---|---|---|---|---|
| Specifications | | | | |
| 1 | Accessories | Quantity check according to the accessories column | 11. SPECIFICATIONS P.70 | |
| 2 | Installation | -Securing a space<br>-Visual check of surrounding conditions<br>Note: Pay attention to the surrounding environment, exhaust system, ventilation system, fire extinguisher, type of oil used, and amount of refueling. | 3. PRE-OPERATION PROCEDURES<br>-Choose an appropriate･･･ P.12<br>-Implement proper･･･ P.14<br>4. PRE-OPERATIVE PREPARATIONS P.17-18 | |
| Operation-related matters | | | | |
| 1 | Power supply voltage | ・Customer voltage with tester Measure (power supply equipment)<br>-Measure line voltage during operation (must meet required voltage)<br>Caution:Use a compliant device to install on a plug or an ELB. | 1. SAFETY PRECAUTIONS<br>-Ground wire MUST be ... P.3<br>3. PRE-OPERATION PROCEDURES P.13<br>-Always connect power cable to ... P.70<br>11. SPECIFICATIONS<br>-Standard-Power Supply | |
| 2 | Starting operation | -Start operation<br>Lubricate with silicone oil, set to 100 ° C and check the stable condition. | 3. PRE-OPERATION PROCEDURES P.12-19<br>-4. PRE-OPERATIVE PREPARATIONS P.20-60<br>5. OPERATION PROCEDURES<br>-Operation procedure | |
| Description | | | | |
| 1 | Operational descriptions | Explain about maintenance of equipment and each component according to instruction manual. | 5. OPERATION PROCEDURES P.20-60<br>-Operation procedure P.1-72<br>1. SAFETY PRECAUTIONS<br>-12. LIST OF HAZARDOUS SUBSTANCES | |
| 2 | error code | To customers according to instruction manual<br>Error code explanation / cancellation method | 9. TROUBLESHOOTING<br>-10. SERVICE & REPAIR P.67-69 | |
| 3 | Maintenance and Inspection | Explain about maintenance of equipment and each component according to instruction manual. | 7. MAINTENANCE PROCEDURES P.64<br>-Inspection and Maintenance | |
| 4 | Completion of installation Matters to be Stated | - Enter the date of installation and name of the charged personnel in the main unit nameplate<br>- Write necessary information on warranty card and hand it over to customer<br>- Explain how to contact service personnel | 10. SERVICE & REPAIR P.69 | |

## Limited Liability

**Always operate equipment in strict compliance to the handling and operation procedures set forth by this instruction manual.**
**In the unlikely event that it is used with contents other than those described in the instruction manual, an accident or failure may occur.**

**Never attempt to disassemble, repair or perform any procedure which are not expressly mandated by this manual.**
**Doing so may result in equipment malfunction, serious personal injury or death.**

## Notice

**● Instruction manual descriptions and specifications are subject to change without notice.**
**● Yamato Scientific Co., Ltd. will replace flawed instruction manuals (pages missing, pages out of order, etc.) upon request.**

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Oil Bath (Large Capacity)
BOA201/311
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