Yamato

Immersion Constant Temperature Device

Thermomate®

model BF201/401/501/601

Instruction Manual

First Edition

- ● Thank you for choosing BF series Immersion Constant Temperature Device Thermomate® from 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 America Inc.
Santa Clara, CA

Printed on recycled paper

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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.

Warning

General Warning
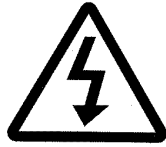
Danger!: High Voltage

Danger!: Extremely Hot

Danger!: Moving Parts

Danger!: Blast Hazard

Caution

General Caution

Caution: Shock Hazard!

Caution: Burn Hazard!

Caution: Do Not Heat Without Water!

Caution: May Leak Water!

Caution: Water Only

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
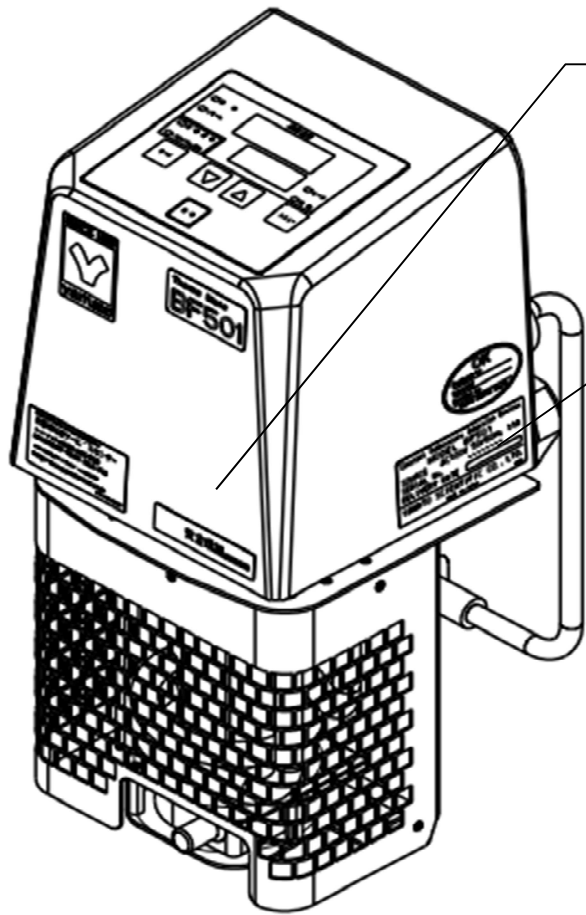
[Safety plates]
Burn hazard
Moving parts
Regular inspection
Ground connection

[Rating & Serial number label]
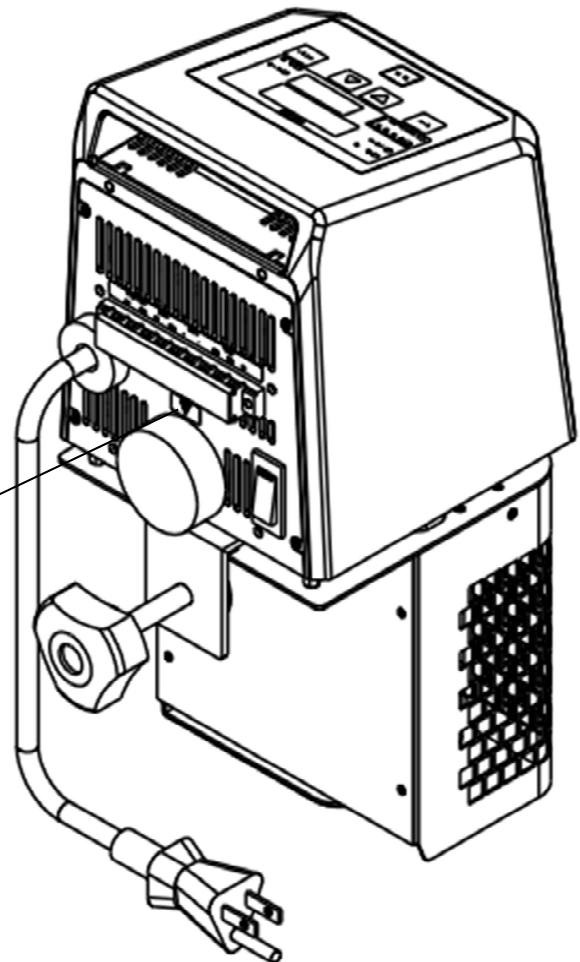
[Overheat prevention device label]

Contact us if the caution signs are no more visible because nameplate is peeled off or texts are eliminated. We will send you a new nameplate. (for charge)

Warnings and Cautions

List of residual risks (instructions for risk aversion)

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.**

|			[During installation]	
No.	Degree of risks	Risk description	Protective measures taken by the user	Relevant sections
①	WARNING	Fire/Electric shock	Carefully select an installation site.	2.1
②	CAUTION	Injury	Install unit on a level surface.	2.2
③	CAUTION	Injury	Take appropriate safety measures when installing.	2.3
④	WARNING	Explosion/Fire	Install in a location free of flammables and explosives.	2.4
⑤	WARNING	Fire/Electric shock	Always ground equipment.	2.5
⑥	WARNING	Fire/Electric shock	Handle power cable with care.	2.6
⑦	WARNING	Fire/Electric shock	Always connect power cable to appropriate facility outlet or terminal.	2.7
⑧	WARNING	Fire/Toxic gas	Install exhaust, ventilation unit, and fire extinguisher.	2.8
⑨	WARNING	Fire/Electric shock	DO NOT disassemble or modify.	2.9
⑩	CAUTION	Injury	Properly tighten BF unit fixing knob.	2.10
⑪	WARNING	Fire/Electric shock	Install in a dry location.	2.11
⑫	WARNING	Burn	When using oil, pay due attention to the admixture of moisture.	2.13

			[In use]	
No.	Degree of risks	Risk description	Protective measures taken by the user	Relevant sections
⑬	WARNING	Explosion/Fire	Never process explosive or flammable substances.	5.1
⑭	WARNING	Fire/Electric shock	When any abnormalities are detected, terminate operation immediately, turn off power switch and disconnect power cable.	5.2
⑮	WARNING	Fire/Toxic gas	A ventilation hood must be installed above unit, with a fire extinguisher in close proximity.	5.3
⑯	WARNING	Burn	Handle main unit, sample container and water/oil with care after operating unit at high temperature.	5.4
⑰	WARNING	Burn	Be extremely careful with hot air and steam from unit openings during operation.	5.5
⑱	WARNING	Fire	DO NOT heat without appropriate fluid in the bath.	5.6
⑲	WARNING	Fire	Do not leave unit unattended during operation.	5.7
⑳	CAUTION	Burn	Exercise caution not to trip over power cable possibly causing unit to tip over.	5.8
㉑	CAUTION	Injury/Fire	Do not place any objects on or around unit.	5.9

Warnings and Cautions

			[In use]	
No.	Degree of risks	Risk description	Protective measures taken by the user	Relevant sections
㉒	WARNING	Fire	In the event of a thunderstorm, turn off power switch and disconnect power cable immediately.	5.10
㉓	CAUTION	Burn/iInjury	Always run equipment within specified temperature range.	5.12
㉔	WARNING	Fire/Electric shock	Be sure not to overflow or spill fluid on or around unit when supplying.	5.15

			[Daily inspection/maintenance]	
No.	Degree of risks	Risk description	Protective measures taken by the user	Relevant sections
㉕	WARNING	Fire/Electric shock	Disconnect power cable from facility outlet before daily inspection and maintenance.	6
㉖	WARNING	Burn	Perform inspections and maintenance when inside of chamber is returned to room temperature.	6
㉗	WARNING	Fire/Electric shock	Never attempt to disassemble unit	6

			Extended storage/disposal	
No.	Degree of risks	Risk description	Protective measures taken by the user	Relevant sections
㉘	WARNING	Fire/Electric shock	Turn off power switch and disconnect power cable.	7
㉙	CAUTION	Injury	Do not leave unit in a location where children may have access	7

1. 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 ambient temperature will exceed 35℃, will fall below 5℃
- where liquid is assumed to splash on unit
- where ambient temperature will fluctuate
- in excessively humid or dusty locations
- in direct sunlight
- where there is constant vibration
- outdoors
- where power supply is erratic

❗ Ensure that there is no flammable substances around unit, and provide sufficient space as specified below.

5cm or more

5cm or more ← **Testing bath** **B** → 10cm or more

5cm or more
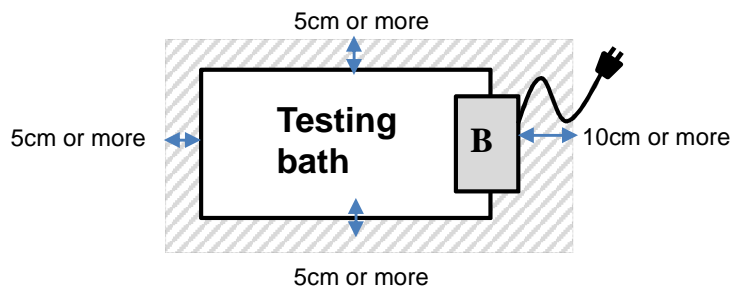
2. Install unit on a level surface.

In order to maintain the testing bath horizontal, install unit in a level and stable location.

3. Take appropriate safety measures when installing

❗ In the event of an earthquake or other unforeseen incident, equipment may unexpectedly shift or fall, causing injury. Taking preventative steps to install unit in a safe location, away from room access doors and out of harm's way, is strongly recommended.

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

🚫⚠️ NEVER install or operate unit in a flammable or explosive gas atmosphereUnit is NOT fire or blast resistant. Simply switching the main power switch "RESET(ON)" or "OFF" can produce a spark, which could relay during operation, causing a fire or explosion when near flammable or explosive fluids, chemicals or gases/fumes.
See "List of Hazardous Substances" (P.84)

5. ALWAYS ground equipment. （with external transformer for AV115V）
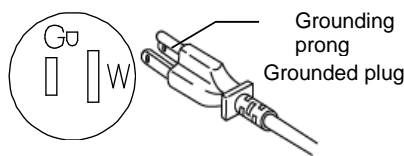
- Ground wire must be connected to a proper grounding line or terminal in order to prevent electric shock.
- Never connect ground wire to gas lines or water pipes. Operating unit ungrounded may cause accident or equipment malfunction.
- Never connect ground wire to telephone grounding lines or to lightning conductor rods. Doing so may result in fire or electric shock.
- Never insert multiple plugs into a single outlet. Doing so may result in power cable overheating, fire or drop in voltage.

Connect to grounded outlet

Grounding prong
Grounded plug

Grounded outlet

Use ground adapter for ungrounded outlets

Ungrounded outlet
(2-prong outlet)

Ground adapter

Grounded plug

Ground wire

Ground adapter

When no ground terminal is found
- Contact original dealer of purchase, a local electrician or Yamato sales office for location-specific electrical requirements.
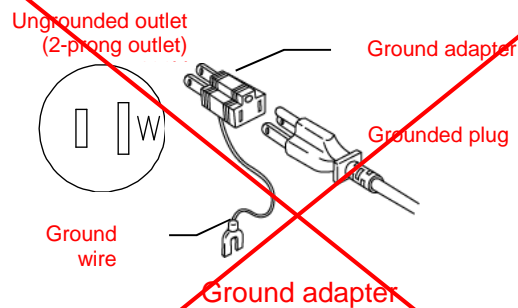
- Insert grounded plug into ground adapter. Connect grounding wire (green) from ground adapter to a ground terminal.

要確認

（with external transformer for AC220V）

Require to ground by Electrical Equipment Technical Standards Section 19-calss D(Grounding Resistance Max. 100Ω) in Japan, if grounding terminal is not provided. Please contact with local dealer, local electrician, or Yamato Customer Service Center.
Connect the terminals firmly to switch board of facilities or appropriate power plug.
Power plug itself will not be included as an accessory of this Equipment. Connect to the power supply facilities that meet the electric capacity.

White
Black
Green

Core color	Wiring on the distribution board
White	Ground side
Black	Voltage side
Green	Earth

- Never connect grounding wire to gas line pipe, water line pipe or telephone grounding wire due to fire or electric shock.

6. Handle power cable with care.

- DO NOT operate equipment 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. Doing so may cause fire and/or electric shock.
- Do not risk damage to power cable by positioning it under desks or chairs, or by allowing it to be pinched in between objects. Doing so may cause fire and/or electric shock.
- Do not place power cable near kerosene/electric heaters or other heat-generating devices. Doing so may cause power cable insulation to overheat, be damaged and/or catch fire, which may result in electric shock.

- Turn off power switch immediately, disconnect from facility outlet and contact original dealer of purchase, if power cable becomes partially severed or damaged in any way. Continued use may result in fire or electric shock.
- Always connect power cable to appropriate facility outlet or terminal.

7. Connect to a proper power source

Use a dedicated power supply that matches electrical capacity.

Electrical capacity: **Single phase 100V with external transformer for 115V or 220V**
(BF201) 115VAC 50/60Hz 10A   220VAC 50/60Hz 5A
(BF401) 100VAC 50/60Hz 10A   220VAC 50/60Hz 5A
(BF501) 100VAC 50/60Hz 10A   220VAC 50/60Hz 5A
(BF601) 100VAC 50/60Hz 11.5A   220VAC 50/60Hz 6A

8. Install exhaust, ventilation unit, and fire extinguisher.

Ventilation hood and fire extinguisher must be installed when operating unit enclosed.

*Using silicon oil (BF601)
The oily smoke and steam generated from heating silicon oil is flammable and may cause a fire hazard. Silicon oil also emits harmful gases (e.g. small amount of formaldehyde) when heated to high temperatures.
A ventilation hood must be installed above unit, with a fire extinguisher in close proximity.

9. DO NOT disassemble or modify.

Attempting to disassemble or modifiy this unit in any way may result in malfunction, fire or electric shock.

10. Secure BF unit properly with the fixing knob.

Overtightening the knob may damage or deform the testing bath. On the other hand, too weak tightening may cause unit to tip over or affect the performance. Carefully tighten BF unit fixing knob with proper tightening force.

11. 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, electric shock and/or fire.

12. Operation precautions (when water is used)・・・BF201/401/501/601

Exercise caution in regard to the following.
- Usable medium for this unit is water. Using tap water may cause mineral deposit accumulation or increasing chlorine concentration, resulting in damage and/or corrosion to the heater, or cracking of the water bath. Distilled water or ion exchange water, therefore, is recommended. If only tap water is being employed as coolant, frequently change water entirely.
- Heat-resistance temperature of included the testing bath is 80℃ (the lower limit temperature is –5℃). Always operate unit at 80℃ or less. Employ stainless-steel bath for use above 80℃.
- If unit is emitting large amounts of water vapor, cover the bath to prevent condensation on the main unit.
- Do not operate unit with water temperature of above 80℃ or while water is boiling (BF601).
- Connect unit to a power outlet having sufficient capacity.
- Do not move unit while in operation.
- Exercise caution not to get burned during operation.
- Unit and water bath may be hot during operation or right after operation. Do not touch hot surfaces with bare hands or fingers.
- Do not drain until water temperature falls below 45℃.
- Be sure not to spill water on or around unit while adding water. Fire or leakage of current may result.
- Do not leave unit unattended during operation.
- Do not place or operate unit outdoors.
- Do not heat without adding required fluid.

13. Operation precautions (when oil is used)...BF601

Exercise caution in regard to the following.
- Usable medium for this unit is silicon oil. Use ONLY silicon oil for bath fluid. (vegetable oil and mineral oil may catch fire)
- If moisture is formed in the oil, the oil can be vigorously dispersed since the moisture evaporates explosively from the oil. Exercise caution not to let moisture mixed in the oil in order to avoid burn injury.
- NEVER use water and oil alternately without thorough washing.
- Connect unit to a power outlet having sufficient capacity.
- Do not move unit while in operation.
- Exercise caution not to get burned during operation.
- Unit and oil bath may be hot during operation or right after operation. Do not touch hot surfaces with bare hands or fingers.
- Do not drain unit oil temperature falls below 45℃.
- Be sure not to spill oil on or around unit while adding. Fire or leakage of current may result.
- Do not leave unit unattended during operation.
- Be careful not to allow oil to overflow while heating.
- Do not place or operate unit outdoors.
- Do not heat without adding required fluid.

14. Using silicon oil (BF601)

⚠ The only unit which can use silicon oil is BF601 and maximum operating temperature is 180 ℃.
Use heat-resistant dimethyl silicon oil for open system heat transfer only, and Kinematic viscosity
of 50mm2/s (cSt).

Recommended: KF-96-50cs silicon oil by Shinetsu Science Industries Co., Ltd.

Silicon oil characteristic	Appearance	Colorless, transparent
	Kinematic viscosity (25℃)	50mm2/s
	Specific gravity (25℃)	0.960
	Volatile matter (150℃/24 h)	0.5% or less
	Viscosity temperature coefficient (V.T.C)	0.59
	Pour point	-50℃ or less
	Flash Point	310℃ or more
	Specific heat (25℃)	1.5J/g·℃
	Thermal conductivity (25℃)	0.15W/m·℃
	Expansion coefficient (25-150℃)	0.00096cc/cc/℃

❗ * Silicon oil when heated at more than 150℃ in air atmosphere will gradually generate trace
amount of formaldehyde. Therefore, when heating silicon oil at 150℃ or above under an
atmosphere of air, ensure sufficient ventilation and use of protective equipment.
* The degradation rate of silicon oil (viscosity change) depends on the operating temperature.
Contact the silicon oil manufacturer for details at the time of purchase.
* Select KF-96-50cs silicon oil from Shinetsu Science Industries Co., Ltd or equivalent products.
KF-96 series comprise products with various viscousity. Note that low-viscosity type cannot be
used at high temperature, and high-viscosity type, on the other hand, may cause heater to
partialy overheat, resulting in fire.

15. Filling level of water/oil bath

❗

* The minimum of fluid quantity is approximately 3.5 liters irrespective of water or silicon oil, which
should cover the tip of tenperature sensor by 2cm or above.
Insufficient fluid level may result in inaccurate or erratic temperature readings or inability to
control temperature, which may cause overheating and fire hazards.
* The highest level of fluid during heating should be 4cm below the upper end of the bath with a
sample container immersed. Use caution not to overflow when filling the bath.
* Silicon oil has a broad thermal expansion capacity and may overflow from the bath when heated.
Expansion should be subtracted prior to supply silicon oil to the bath.

Example) Calculate the oil supply amount based on the following formula (where KF-96-50cs is
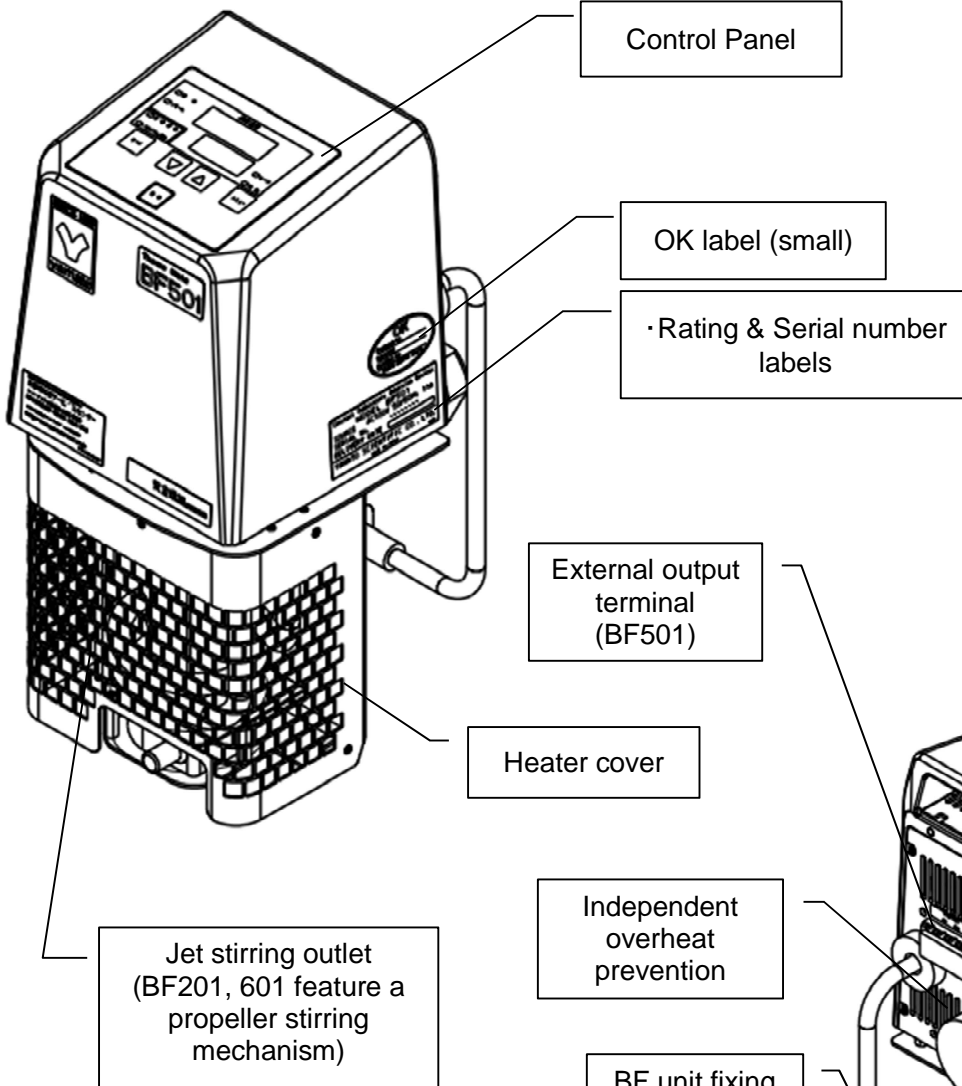used).
Oil increment = (target temperature-measured temperature) × amount of silicon oil x 0.00096
With target temp. 180℃, current measured temp. 23℃ and required amount of silicon oil 4.5L,
increase amount of the oil will be: (180℃-23℃) ×4.5L × 0.00096 = 0.68L. Thus, 3.8L of silicon
oil needs to be prepared in the case of example above.

[External view (front)] *Figure is BF501

Control Panel

OK label (small)

·Rating & Serial number labels

External output terminal (BF501)

[External view (rear)]
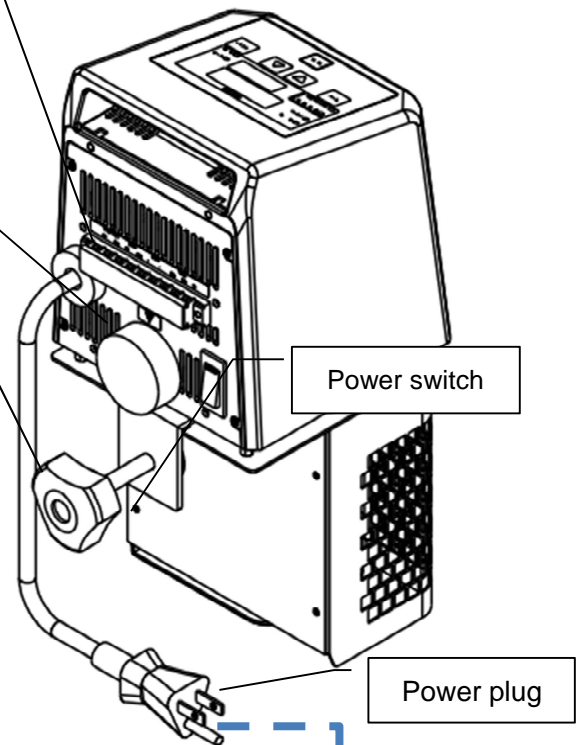
Heater cover

Independent overheat prevention

Power switch

Jet stirring outlet (BF201, 601 feature a propeller stirring mechanism)

BF unit fixing knob

[External transformer]

Power switch

For 115V

Connect

Power plug

Power cable for 220V

Power switch

11
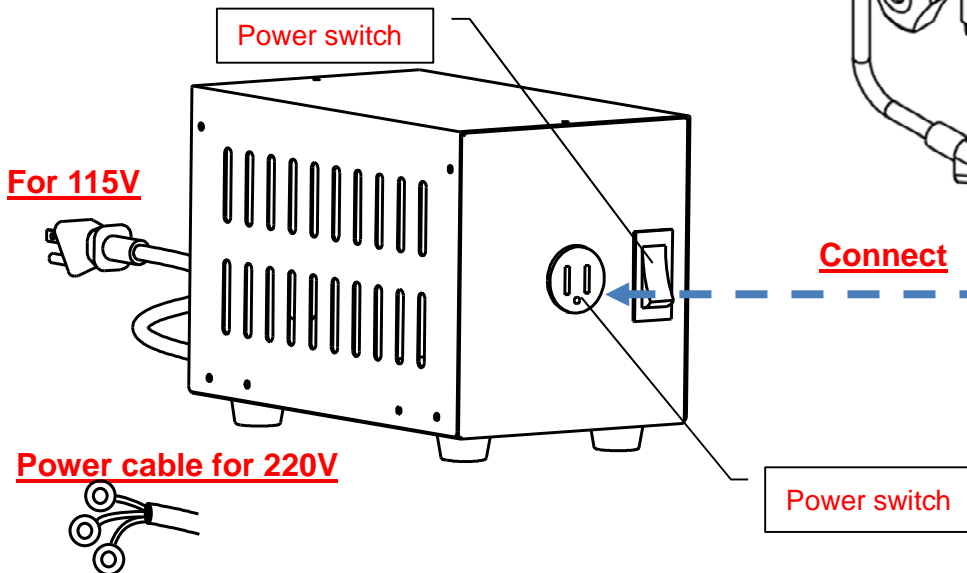
[Heater cover internal diagram]   *Figure is BF501

| Temperature sensor |

| Independent overheat prevention device-sensor |

| Float sensor |

| Heater |

●Jet stirring outlet
BF401, 501 can change the direction of outlet.

Propeller for stirring supplied.
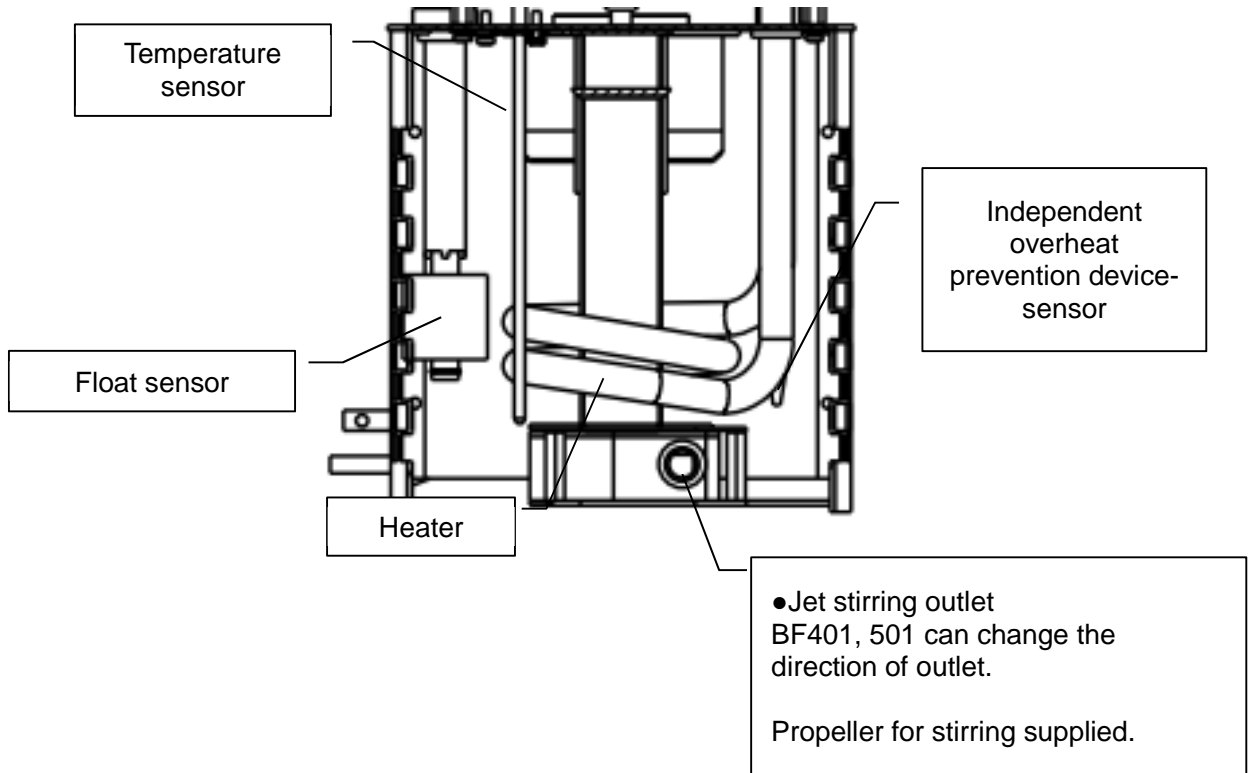
[BF401,501] Jet Stirring Mechanism

The jet stirring mechanism of BF401/501 can change the angle manually by approximately 10 degrees (see the figure below). Set in suitable position.
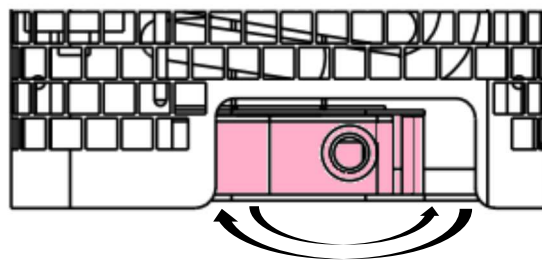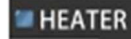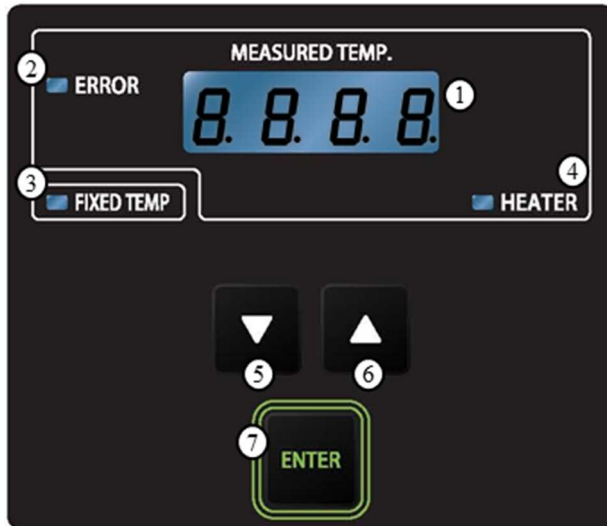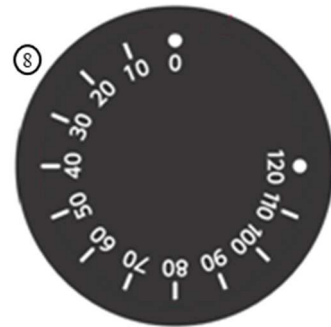
[BF201] Control Panel

Control panel

Independent overheat prevention setting knob

 HEATER

The figure on the left (lamp is outlined) illustrates that the indicator lamp in the control panel is ON in the following sections.

 HEATER

The figure on the left (lamp is solid filled) illustrates that the indicator lamp in the control panel is OFF in the following sections.
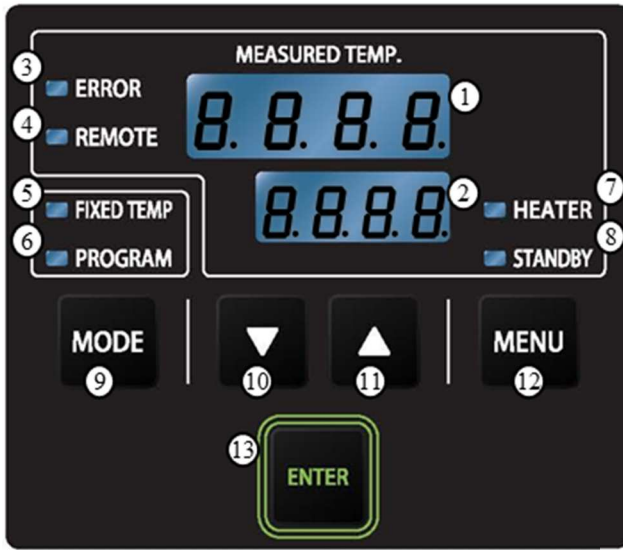
 HEATER

The figure on the left illustrates that the indicator lamp or main display in the control panel is flashing in the following sections.

No.	Panel Item	Description
1	Main display	Displays measured temperature/target temperature/errors/setting character and other information.
2	ERROR lamp	Illuminates when abnormality occurs.
3	FIXED TEMP Indicator Lamp	Illuminates during operation.
4	HEATER Indicator Lamp	Illuminates while heater is ON
5	DOWN key	Press to decrease setting value.
6	UP key	Press to increase setting value.
7	Enter key	Press to finalize setting values and modes.
8	Independent overheat prevention setting knob	Changes setting temperature of independent overheat prevention device. (Settable temperature range: 0-120℃)

3. COMPONENT NAMES AND FUNCTIONS

Control panel

Independent overheat prevention setting knob

⑭

BF401/501   BF601

■ HEATER

The figure on the left (lamp is outlined) illustrates that the indicator lamp in the control panel is ON in the following sections.

■ HEATER

The figure on the left (lamp is solid filled) illustrates that the indicator lamp in the control panel is OFF in the following sections.

■ HEATER

The figure on the left illustrates that the indicator lamp or main display in the control panel is flashing in the following sections.

No.	Panel Item	Description
1	Main display	Displays measured temperature/setting character and other information.
2	Sub display	Displays target temperature/errors/remaining time and other information.
3	ERROR indicator lamp	Illuminates when abnormality occurs.
4	REMOTE indicator lamp	Illuminates when unit is in remote operation mode.
5	FIXED TEMP Indicator Lamp	Illuminates while fixed temperature operation is in progress. Flashes during standby.
6	PROGRAM Indicator Lamp	Illuminates while programmed operation or auto stop operation is in progress. Flashes while selecting program or setting timer.
7	HEATER Indicator Lamp	Illuminates while heater is ON
8	STANDBY indicator lamp	Illuminates during standby. (flashes during standby for program operation)
9	MODE key	Changes operation modes or stops operation (press & hold for 2 seconds).
10	DOWN key	Press to decrease setting value.
11	UP key	Press to increase setting value.
12	MENU key	Press to enter/cancel function setting mode.
13	Enter key	Press to finalize setting values and modes.
14	Independent overheat prevention setting knob	Changes setting temperature of independent overheat prevention device. [BF401/501] (settable temperature 0-120 ℃) [BF601] (settable temperature 0-230 ℃)

*For BF601, measured temperature in the main display and target temperature in the sub display are represented by integer number.

Operation Mode

No.	Name	Description

1	Fixed Temperature Operation (BF201,401,501,601) See P20 for details on BF201, P24 on BF401,501,601.	Fixed Temperature Operation runs unit at a constant selected temperature.
		
		Select value using the ▼▲ keys and press the ENTER key to begin operation.
		To stop operation, press the MODE key for two seconds. Unit stops operation and shifts to the standby state.
		BF201 does not have the MODE key on control panel. Turn off main power switch to terminate operation.
		*Setting temperature range:
		    -20 to 90℃ (BF201/401/501)
		    0 to 200℃ (BF601).

2	Quick Auto Stop Mode (BF401,501, 601) See P.25 for details	This mode is used to specify when unit should terminate fixed temperature operation. Press the MODE key during fixed temperature operation, select 「A.STP」 using the ▲▼ keys, and press the ENTER key. Set the timer using the ▲▼ keys, and press the ENTER key to begin operation in quick auto stop mode. *1 PROGRAM lamp illuminates during quick auto stop operation. *2 The time can be set in increments of one minute, under 99 hours and 59 minutes. Setting increments are one hour, after 100 hours.
3 4	Programmed Operation Auto Start Mode (BF401,501, 601) See P.29 for details	Program mode runs a combination of times and temperatures in a series of programmed steps as one operation. (see P.44 for details) Auto Start Mode can automatically begin operation after a specified period has passed. Press the MODE key during stanby or fixed temperature operation. Select PR.1-PR.3 (program number 1-3) using the ▲▼ keys, and press the ENTER key. Setting start time using the ▲▼ keys, and press the ENTER key to begin programmed operation or auto start operation. *1 With the set time of 00: 00, programmed operation begins instantly, and with other values, programmed auto-start operation starts. *2 PROGRAM lamp illuminates during auto start mode, STANDBY lamp also begin flashing. *3 The time can be set in increments of one minute, under 99 hours and 59 minutes. Setting increments are one hour, after 100 hours.

Safety functions

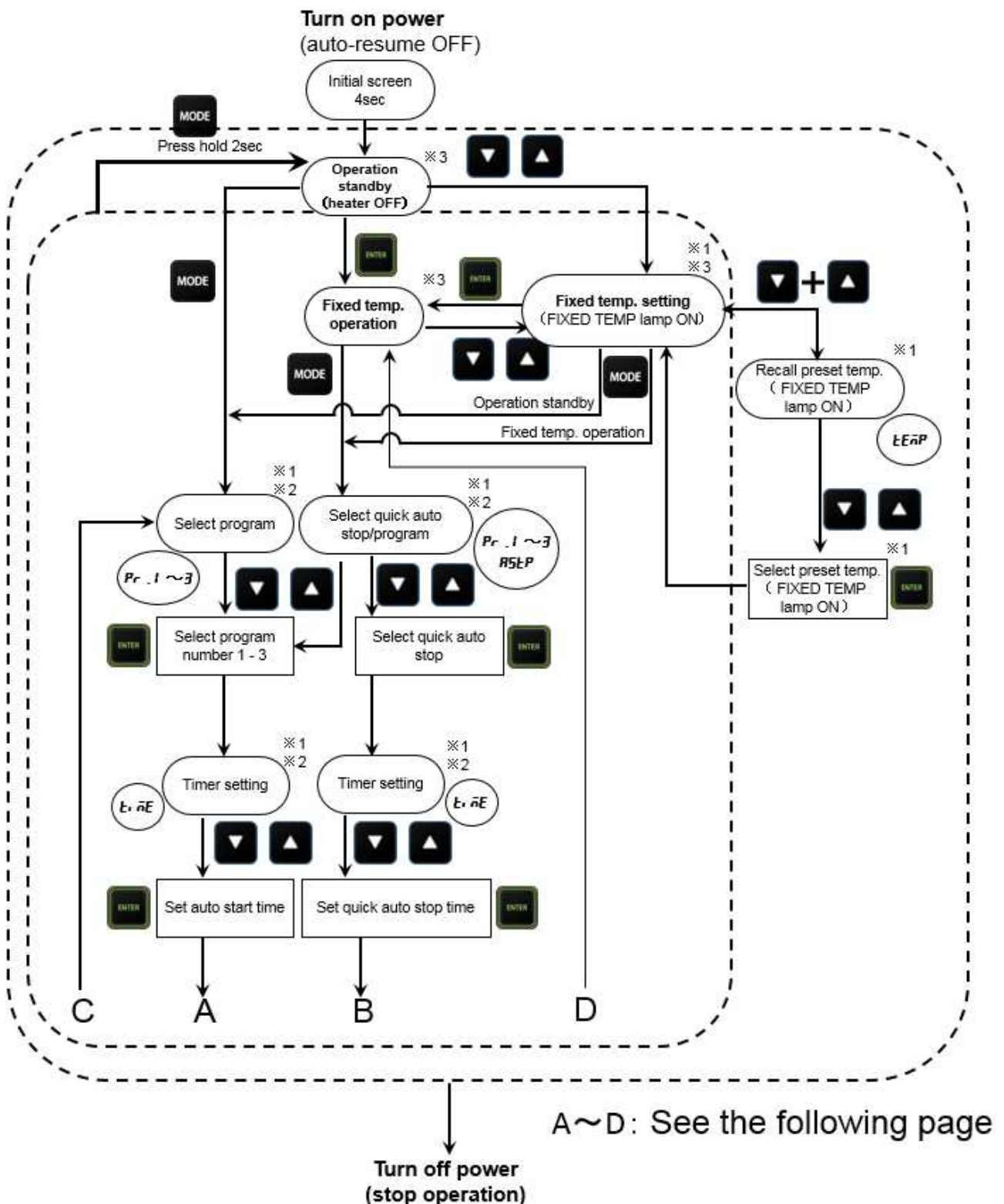| No.	Name	Description
1	Circuit protector	Circuit protector is installed as the power supply switch in rear panel of unit. In the event of an electrical surge or current overload, the circuit protector activates to shut off power supply. If activated, contact original dealer of purchase or Yamato sales office for assistance.
2	Independent overheat prevention	This device comprises a circuit, power supply, and a sensor, independent of the unit controller. An overheat prevention temperature can be manually specified using the round knob in the rear of main unit. When fluid temperature in the bath exceeds overheat prevention temperature, power supply to the heater-circuit is cut off. When overheat prevention device activates, "ER.03" flashes in the display. In this case, immediately turn off the main power switch. Lower setting temperature or increase overheat prevention temperature, and then reset main power switch to cancel "ER.03". If problem persists, contact original dealer of purchase or Yamato sales office for assistance.

The following chart illustrates the flow of modes and functions.

Turn on power

Initial screen
4sec

Measured temp. display
Start fixed temp. operation
(previous target temperature)

ENTER

▼ + ▲

Set target
temperature

Recall preset
temp.

▼ ▲

▼ ▲

ENTER

Change target
temperature

Select preset
temperature

ENTER

ENTER
Press twice

Measured temp. display
Start fixed temp. operation
(new target temperature)

ENTER
Press twice

Enter preset temp.

Turn off power
(stop operation)

Turn on power
(auto-resume OFF)

Initial screen 4sec

MODE
Press hold 2sec

Operation standby (heater OFF) ※3

▼ ▲

MODE

Fixed temp. operation ※3

ENTER

ENTER

Fixed temp. setting (FIXED TEMP lamp ON) ※1 ※3

▼+▲

MODE

▼ ▲

MODE
Operation standby
Fixed temp. operation

Recall preset temp. (FIXED TEMP lamp ON) ※1

tEñP

▼ ▲

Select program ※1 ※2

Pr.1～3

▼ ▲

Select quick auto stop/program ※1 ※2

▼ ▲

Pr.1～3
ASEP

Select preset temp. (FIXED TEMP lamp ON) ※1

ENTER

ENTER

Select program number 1 - 3

Select quick auto stop

ENTER

Timer setting ※1 ※2

t.ñE

▼ ▲

Timer setting ※1 ※2

▼ ▲

t.ñE

ENTER

Set auto start time

Set quick auto stop time

ENTER

C　　A　　B　　D

A～D: See the following page

Turn off power
(stop operation)

The chart above illustrates the flow of modes and functions.
*1 Display will return to initial setting screen if the controller is not operated for one minute on each screen.
*2 Pressing the MODE key on each screen cancels settings and the display will return to initial setting screen.
*3 Pressing the MENU key on each screen will show function menu (see P.34).
Display returns to initial setting screen when pressing the MENU key again in function menu.
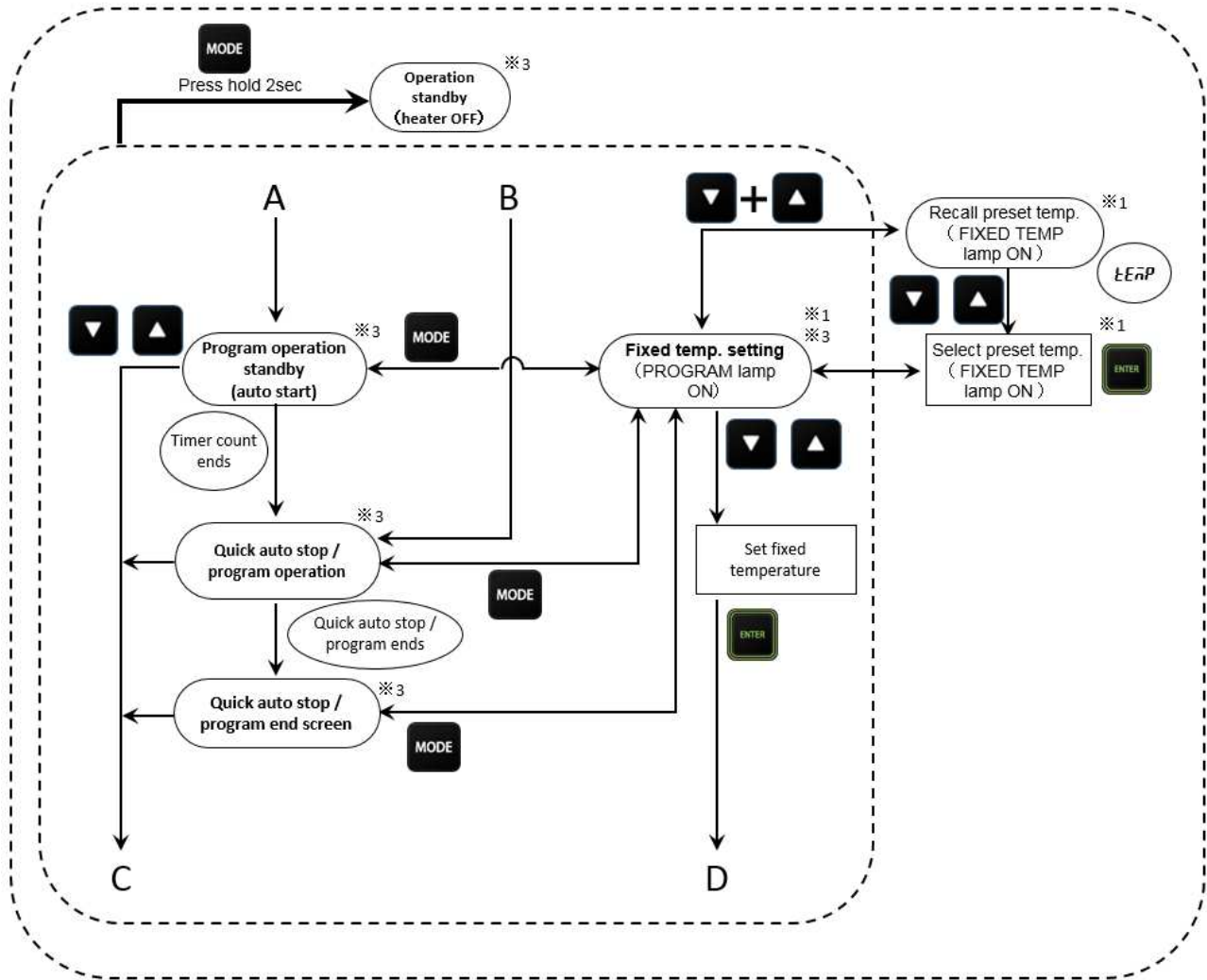
The chart above illustrates the flow of modes and functions.

*1 Display will return to initial setting screen if the controller is not operated for one minute in each screen.

*2 Pressing the MODE key in each screen cancels settings and the display will return to initial setting screen.

*3 Pressing the MENU key on each screen will show function menu (see P.34).

Display returns to initial setting screen when pressing the MENU key again in function menu.

Fixed Temperature Operation runs unit at a constant selected temperature. BF201 automatically begins fixed temperature operation when main power switch is turned on.

Temp

SV: target temperature
PV: measured temperature

SV

PV

Time

Start
(main power switch "ON")

Stop
(main power switch "OFF")
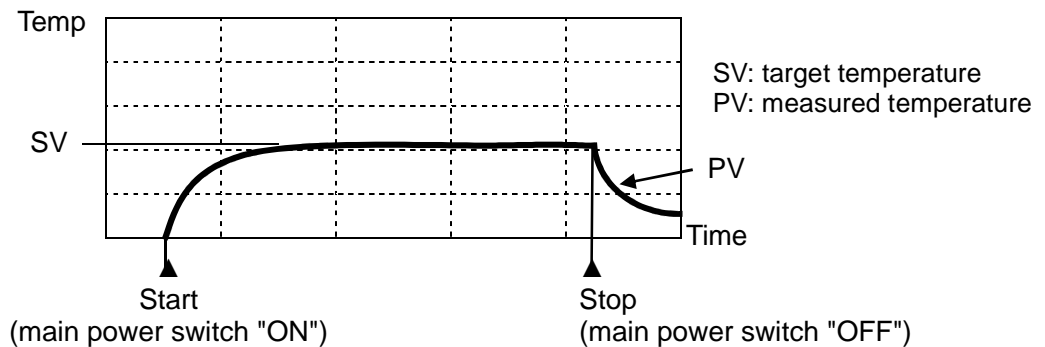
Fixed temperature operation (example: operate in fixed temp. mode at 56 ℃)

1	Turn on main power switch.	

MEASURED TEMP.

ERROR

2 5. 0

FIXED TEMP   HEATER

ENTER
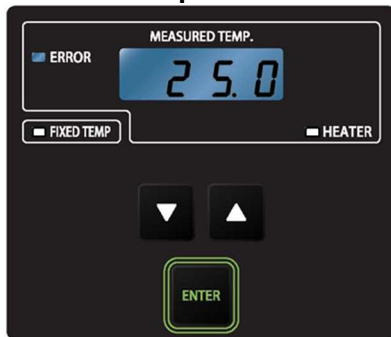
Initial screen is displayed after turning on power. Fixed temperature operation screen will then show in the display. Automatically start operation at previously set temperature. Current measured temperature will show in the display.

* HEATER indicator lamp illuminates according to the difference between measured and target temperatures.

2	Change the target temperature	

MEASURED TEMP.

ERROR

3 7. 0

FIXED TEMP   HEATER

ENTER

1

MEASURED TEMP.

ERROR

5 6. 0

FIXED TEMP   HEATER

ENTER

2

3
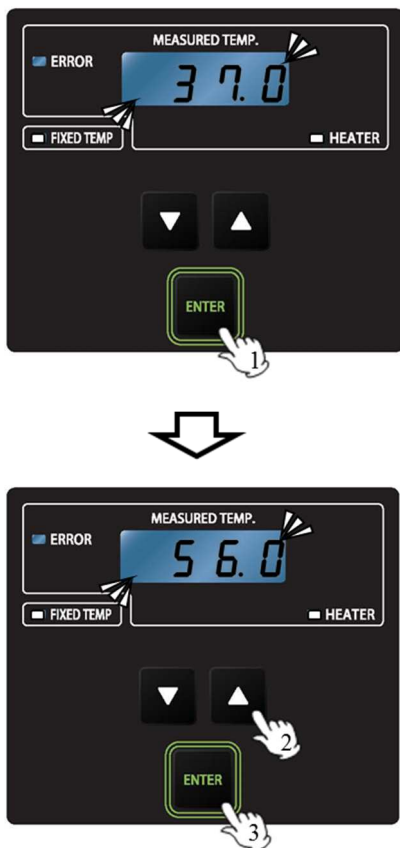
1. Press the ENTER key. Current target temperature flashes in the display, indicating targt temperature settings mode.

2. Set target temperature using the ▲▼ keys (e.g. 56.0℃).

3. Press the ENTER key to confirm.
   Current measured temperature will show in the display and unit will begin fixed temperature operation on new target temperature.

* While target temperature is flashing in the disaplay, press the ▲ and ▼ keys together for about one second to recall preset temperature (see P.23). Select desired temperature using the ▲▼ keys and press the ENTER key to complete setting.
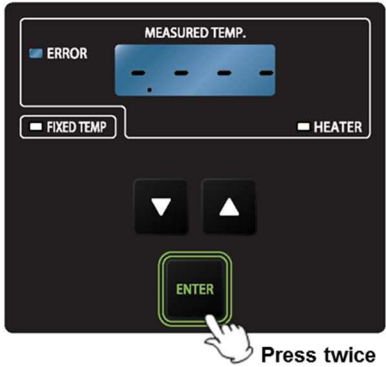
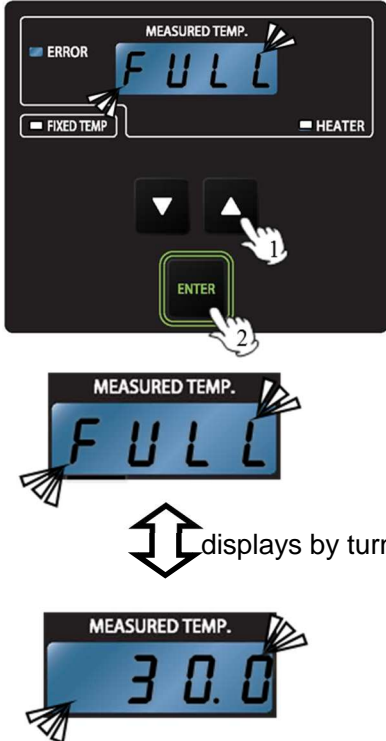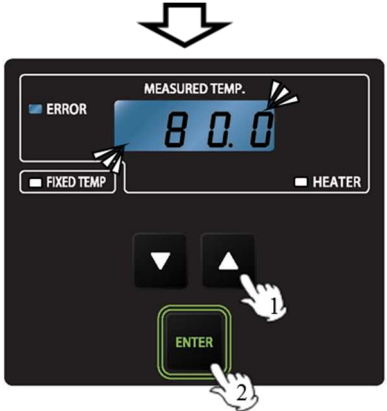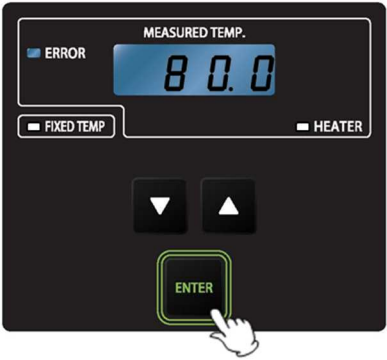|	**Enter preset temperatures**	
•	By presetting the frequently used temperature setting, the entered temperature can be easily called up (max. 10 entries).	
1	Press twice	**Example: enter 80.0℃ as a preset temperature.** Press the ENTER key twice quickly (within 0.3 seconds). "-.---" is shown in the display, indicating the preset temperature screen (if temperatures have already been entered, each value is displayed in turn in every one second.) Press the ENTER key again. * A dot at the left end of the display indicates that unit is on the preset temperature view/entry screen.
2	Where 10 values are already entered (proceed to Step 3 below in case of nine or less)	
	displays by turns	When making new entry while 10 setting values are already entered, select one to be overwritten. 1. Select a preset temperature to be overwritten using the ▲▼ keys while "FULL" and one of the preset values are displayed altenately. 2. Press the Enter key to confirm.
3		"-.---" is shown flashing in the display. *Selected value will flash, following the Step 2 above.
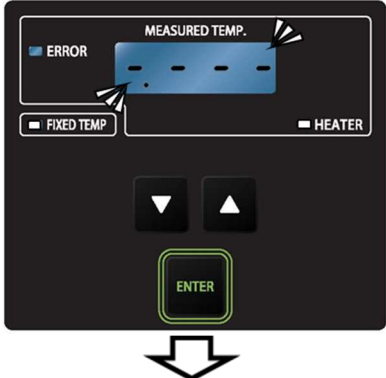
21

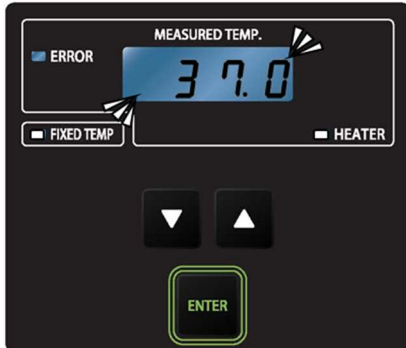| 4		1. Set preset temperature (80.0℃ for the example above) using the ▲ ▼ keys. The set value flashes in the display. 2. Press ENTER to save the preset temperature.

5		Display automatically returns to preset temperature display screen (shown in Step 1 above) when preset temperature is properly entered.
		
		* Following operations
		  A. Press the ENTER key again to continue preset temperature entry.
		  B. Press the ENTER key twice quickly (within 0.3 seconds) to cancel preset temperature entry. Display returns to the fixed temperature operation screen.
		  C. To reset preset temperature, press and hold the ENTER key for about five seconds. All the entries will be deleted.

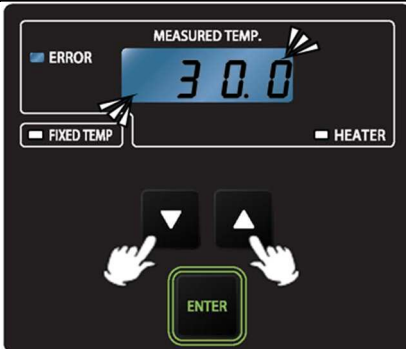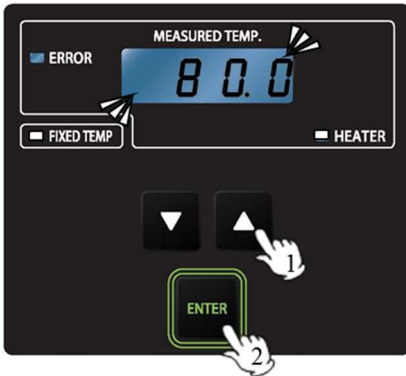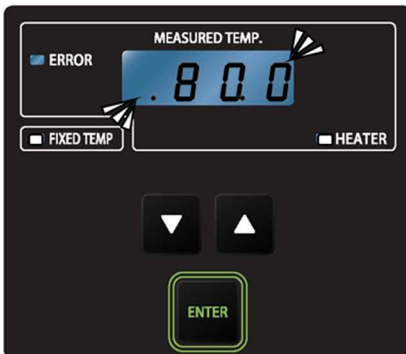|		
Call up preset temperatures		
Stored preset temperature can be recalled and set on target temperature setting screen (Max.10 entries).		
1	MEASURED TEMP. 37.0 ERROR FIXED TEMP HEATER ▼ ▲ ENTER	**Example: Recall a preset temperature and set target temperature at 80.0℃.** Preset temperatures are recalled through target temperature setting screen (see Step 1 & 2 on P.20).
2	MEASURED TEMP. 30.0 ERROR FIXED TEMP HEATER ▼ ▲ ENTER Press together ⬇ MEASURED TEMP. 80.0 ERROR FIXED TEMP HEATER ▼ ▲ 1 ENTER 2	On target temperature setting screen, press the ▲ and ▼ keys together for about one second. Preset temperature flashes in the display. (If no entries found "----" is shown flashing). 1. If multiple preset temperatures are stored, press the ▲▼ keys to select a preset temperature (e.g. 80.0℃) to be set as target temperature. The selected value flashes in the display. 2. Press the ENTER key. * To cancel the preset temperature recall, press the ▲▼ keys together for about one second.
3	MEASURED TEMP. .80.0 ERROR FIXED TEMP HEATER ▼ ▲ ENTER	Display returns to target temperature setting screen and selected preset temperature is reflected in target temperature. * Pressing the ENTER key continues operation in fixed temperature mode at newly set temperature (e.g. 80.0℃).

Fixed temperature operation runs unit at a constant selected temperature. Unit operates at target temperature until manually terminated.

Timer function which automatically terminates operation after specified period of time is available during operation.
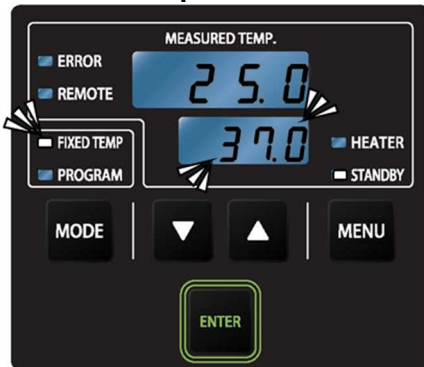
(quick auto stop function)
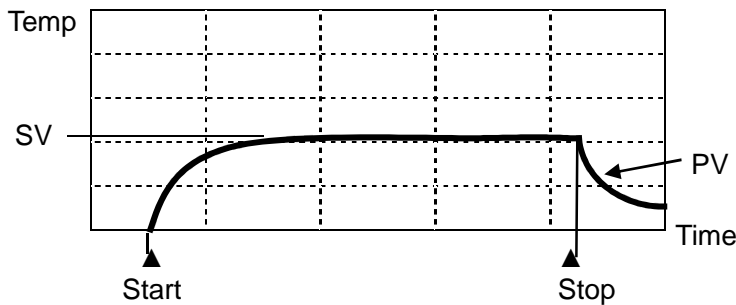
Temp

SV: target temperature
PV: measured temperature

SV

PV

Time

Start   Stop

Fixed temperature operation (example: operate at fixed temperature of 56 ℃)

1	Turn on main power switch	Fixed temperature operation screen is shown in the main display.

Current measured temperature is shown in the main display and target temperature of previous run flashes in the sub display.

*For BF601, measured temperature in the main display and target temperature in the sub display are represented by integer number.

* When turning power off and back on during operation, unit, if the auto-resume function (P.33) is ON, automatically reverts to status just before shutoff and begin operation once again from that point. When the auto-resume function is OFF, unit will not resume operation.
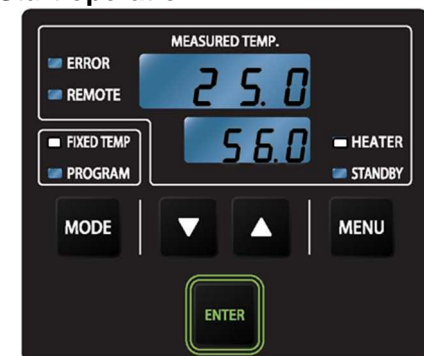
2 Set temperature
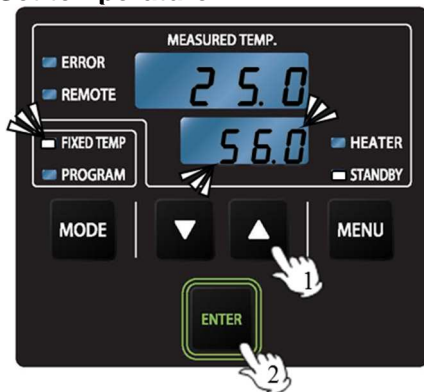
1. Set target temperature in the sub display using the ▲▼ keys (e.g. 56.0 ℃).

2. Press the ENTER key to complete setting. Unit begins fixed temperature operaton.

* Press the ▲ and ▼ keys together for about one second to recall preset temperature (see P.39). Select preset temperature using the ▲▼ keys and press the ENTER key to complete setting.
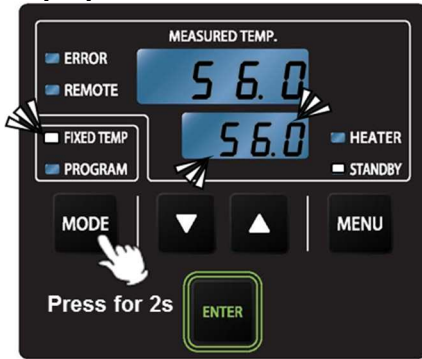
3 Start operation

FIXED TEMP lamp illuminates and STANDBY lamp goes out.

* HEATER indicator lamp illuminates according to the difference between measured and target temperatures.

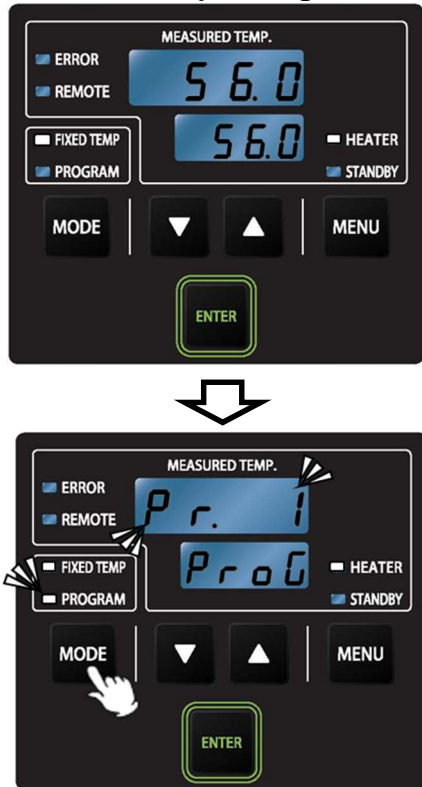| 4	**Stop operation**	
		To stop operation, press the MODE key for two seconds. Unit stops operation and shifts to the standby state.

Quick auto stop mode: automatically stops fixed temperature operation
(example: terminate operation after 2 hours and 30 minutes)

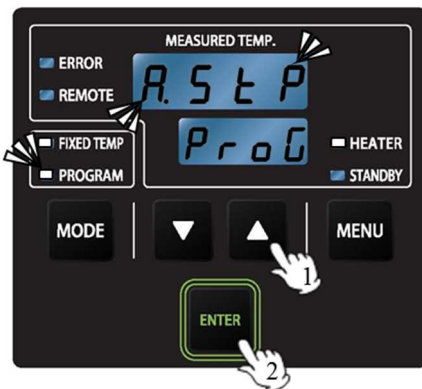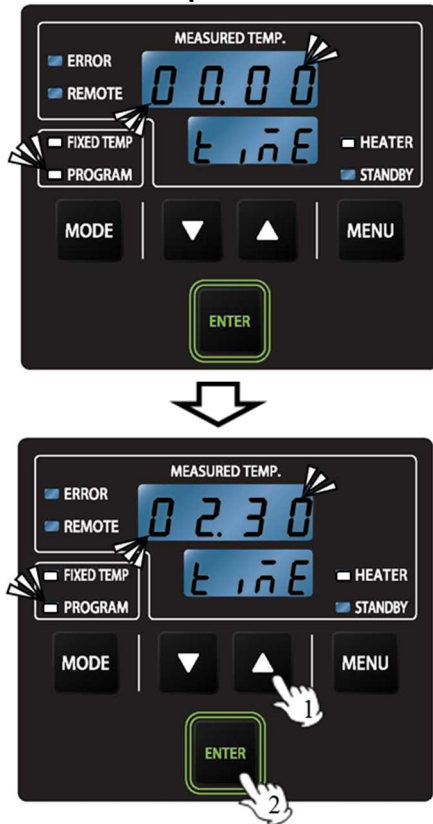| 5	**Quick auto stop setting**	
		Press the MODE key in fixed temperature operation. Display shows program/quick auto stop setting screen. Program number setting flashes in the main display and "PROG" is shown in the sub display. PROGRAM lamp also flashes. (Fixed temperature operation continues while setting quick auto stop mode) * If no program is created, "A.STP" is shown by pressing the MODE key during fixed temperature operation.

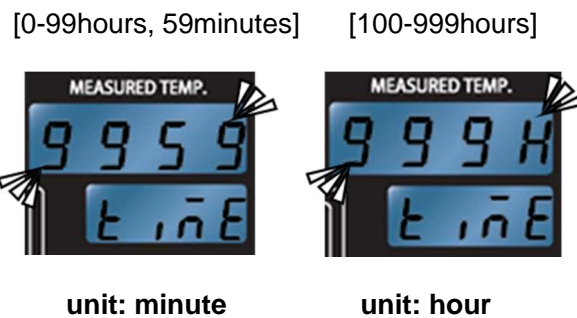| 6	**Select quick auto stop mode**	
		1. Press the ▲▼ keys several times until "A.STP" flashes in the main display. 2. Press the ENTER key to complete setting.

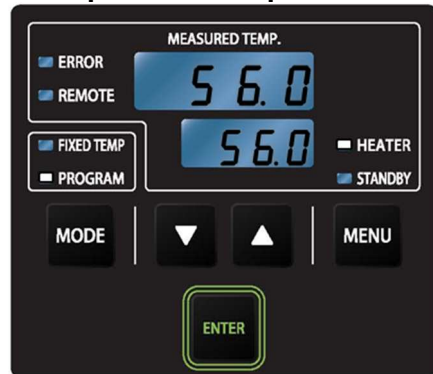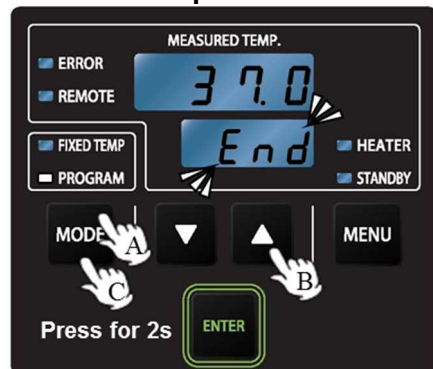| 7	**Specify a time period to the automatic stop time**	"TimE" is shown in the sub display. Set timer for the automatic stop on this screen. 1. Set timer in the main display to desired time using the ▲▼ keys (e.g. 2 hours and 30 minutes). 2. Press the ENTER key to complete the timer setting and unit will switch to operation in quick auto stop mode. --- Setting range of quick auto stop time [0-99hours, 59minutes] [100-999hours] **unit: minute** **unit: hour**
8	**Start quick auto stop mode**	PROGRAM lamp illuminates and FIXED TEMP lamp goes out. *1 HEATER indicator lamp illuminates according to the difference between measured and target temperatures. *2 The sub screen switching function in the function menu allows to switch screen to target temperature, remaining time and quick auto stop. (see the following page for details) *3 Press the MODE key for two seconds to cancel quick auto stop mode and shift to standby state.
9	**Automatic stop**	When a specified time period has passed, "END" is shown in the sub display and unit stops fixed temperature operation. *Following operations A. Pressing the MODE key enters target temperature setting for fixed temperature operation. Set target temperature using the ▲▼ keys and press the ENTER key. Fixed temperature operation begins once again. B. Pressing the ▲▼ keys enters program number select mode (Step 2 on P.29) for programmed operation. C. Pressing the MODE key for two seconds enters fixed temperature standby mode (Step 1 on P.24).

Sub display in quick auto stop mode.
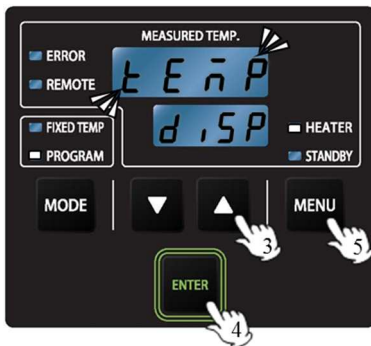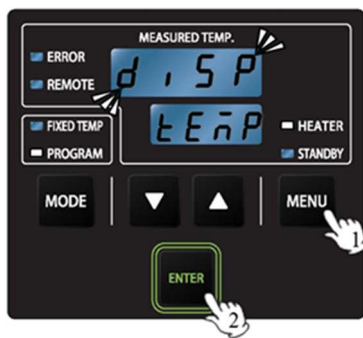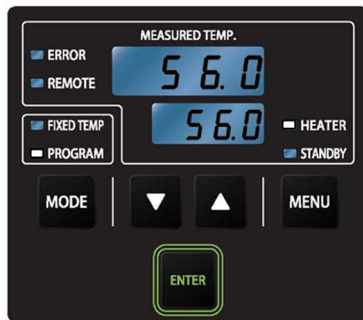
The information shown in the sub display can be changed by the sub screen switching function in the function menu.
The items of sub display are selected from "target temperature", " remaining time of quick auto stop" and "indication that unit is in quick auto stop mode"

1. Press the MENU key during quick auto stop mode to enter the function menu. "DiSP" flashes in the main display and "TEmP" or other characters are shown in the sub display.

2. Select the sub screen switching function by pressing the ENTER key.

3. "TEmP" or other characters will flash in the main display. Select an item using the ▲▼ keys.
   (Refer to the following "*" for setting characters)

4. Press the ENTER key to confirm the selected item.

5. Display reverts to the function menu. Pressing the MENU key returns to operation screen from the function menu.

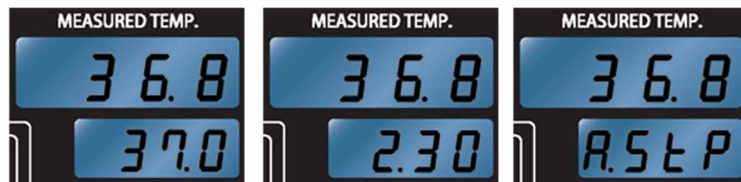
*Setting characters and items of the sub display in the sub screen switching function

Setting characters

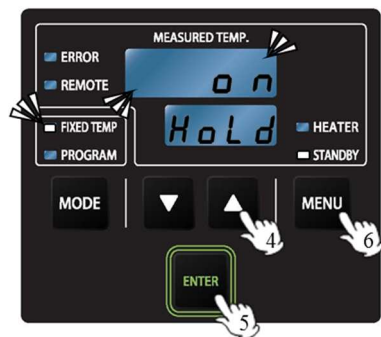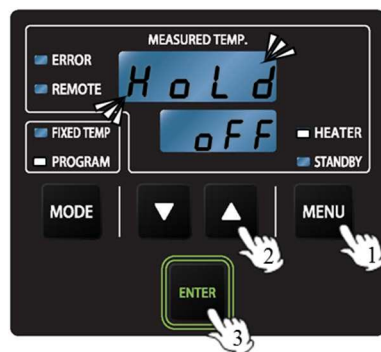| ｔＥｎＰ	ｒＥＳｔ	ＡＳｔＰ
MEASURED TEMP.	MEASURED TEMP.	MEASURED TEMP.
3 6. 8	3 6. 8	3 6. 8
3 7. 0	2.3 0	A.5 t P

Target temperature   remaining time   operating status
(during quick auto stop mode)

Hold function in quick auto stop mode
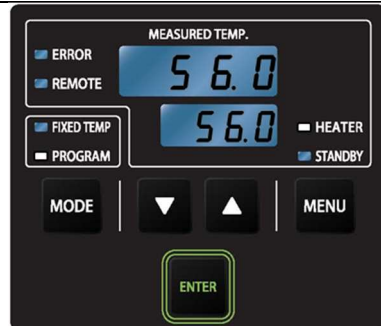
This function temporarily suspends timer for quick auto stop mode and continues operation as in fixed temperature mode, can be found in the function menu.

1. Press the MENU key during quick auto stop mode to enter the function menu.

2. Press the ▲▼ keys several times until "HOLD" is shown in the main display and "OFF" flashes in the sub display.

3. Select the hold function by pressing the ENTER key.

4. "OFF" flashes in the main display. Press the ▲ ▼ keys to switch hold function on (*).

5. Press the ENTER key to confirm.

6. Display reverts to the function menu. Pressing the MENU key returns to operation screen from the function menu.

* To cancel hold function: follow the same procedures above and set the hold function to OFF. Timer count starts once again and unit resumes quick auto stop operation.

[Note]

|	
■To edit or confirm settings	Press the ▲ ▼ keys again to edit or confirm settings. Display will show target temperature.
■To change the target temperature during operation	Changing the target temperature setting during operation is possible using the ▲ ▼ keys. When setting changes have been made, press the ENTER key to complete setting. Unit reflects the changes and continues operation.
■To change the remaining time during quick auto stop operation	To change the remaining time in quick auto stop operation, press the MODE key for two seconds to stop auto stop operation. Follow the procedures on P.25-26 to change the remaining time for quick auto stop mode.

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Program mode runs a combination of times and temperatures in a series of programmed steps as one operation.(See P.45 for editing procedures)

Automatic start time for programmed operation can also be set with auto start mode.
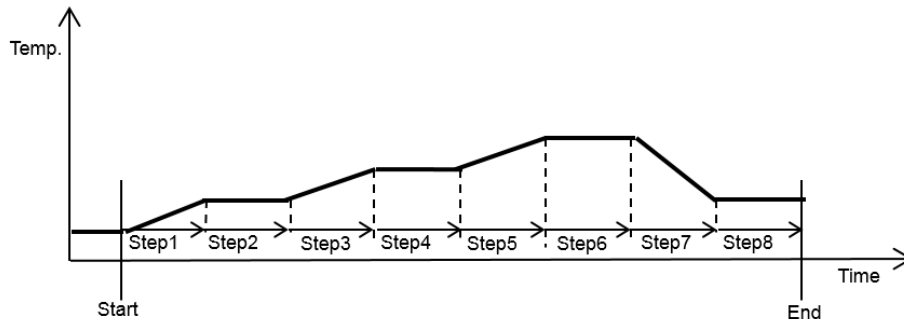
Building programes (Run program number 2 after 2 hours and 30 minutes)
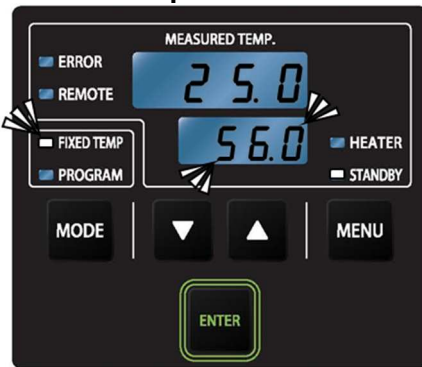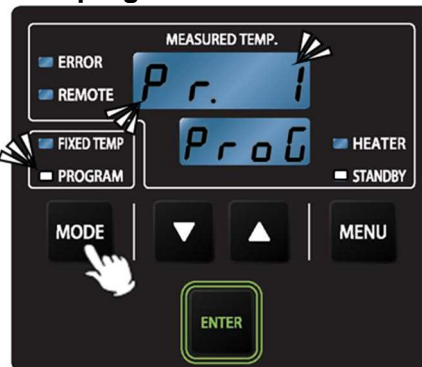
1	Turn on main power switch	Fixed temperature operation screen is shown in the main display. Current measured temperature is shown in the main display and targt temperature of previous run flashes in the sub display. *For BF601, measured temperature in the main display and target temperature in the sub display are represented by integer number. * When turning power off and back on during operation, unit, if the auto-resume function (see P.33) is ON, automatically reverts to status just before shutoff and begins operation once again from that point. When the auto-resume function is OFF, unit will not resume operation.
2	Select programs	Press the MODE key. The display shows program setting screen. Set program number flashes in the main display and "PROG" is shown in the sub display. PROGRAM lamp also illuminates. *1 If no programs have been created, "----" is displayed. *2 Program select screen can be displayed during fixed temperature operation by the same procedures above (see Step 5 on P.25). Select a program to run.
3	Select program number 2	1. Select a program to run using the ▲▼ keys. "PR.2" flashes in the display. 2. Press the ENTER key to confirm program operation.
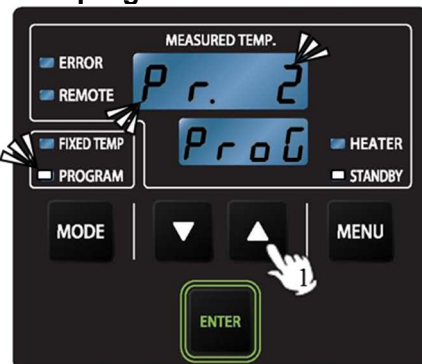
4	**Set operating standby time [Auto start function]**	"TimE" is shown in the sub display. Standby time up to the time that program operation starts can be set on this screen.
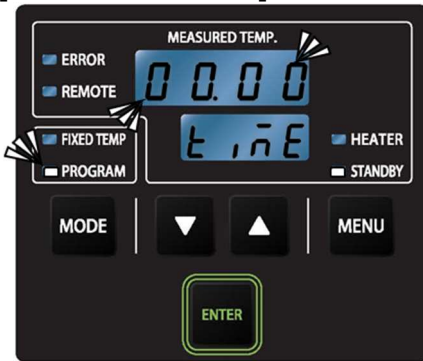
1. Set timer in the main display to desired time using the ▲▼ keys (2 hours 30 minutes "02.30").

2. Press the ENTER key to confirm timer setting and unit begins programmed operation (including 2-hour-30-minute standby).

*Set timer at "00.00" when it becomes necessary to start programmed operation immediately.

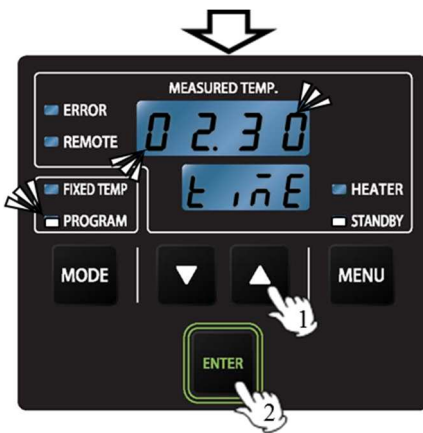---

Setting range of auto start time

[0-99hours, 59minutes]   [100-999hours]
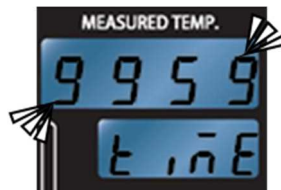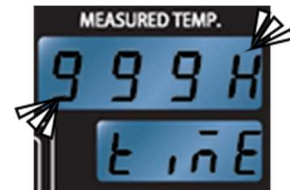
unit: minute   **unit: hour**

5	**Start programmed operation**	
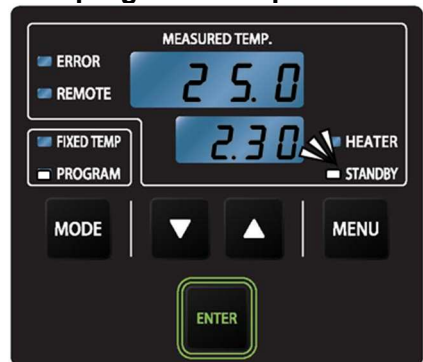
STANDBY lamp illuminates and PROGRAM lamp goes out. Remaining time will show in the sub display.

When a specified time period has passed, STANDBY lamp goes out and unit begins programmed operation.

* HEATER indicator lamp illuminates according to the difference between measured and target temperatures.
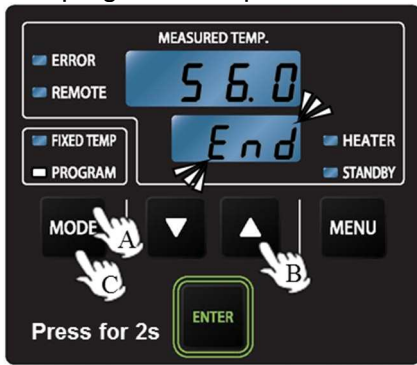
6	End programmed operation	When program ends, "END" is shown in the sub display and unit stops programmed operation.
		Following operations A. Pressing the MODE key enters target temperature setting for fixed temperature operation. Set target temperature using the ▲▼ keys and press the ENTER key. Fixed temperature operation begins. B. Pressing the ▲▼ keys enters program number select mode (P.29) for programmed operation. C. Pressing the MODE key for two seconds enters fixed temperature standby mode (P.24).

Sub screen in programmed operation
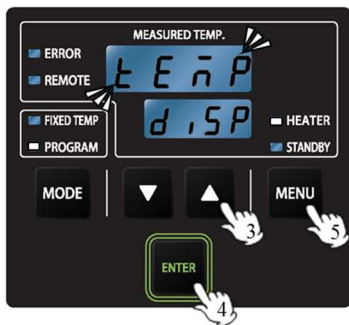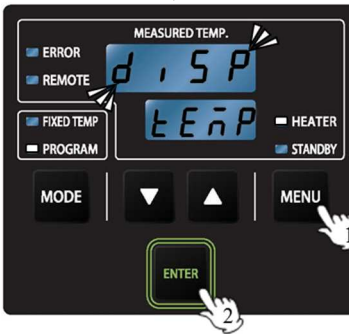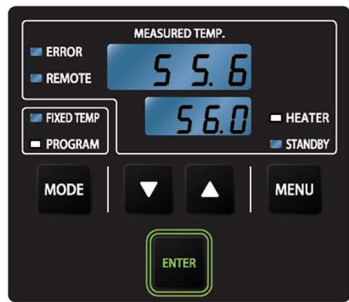
The information shown in the sub display can be changed by the sub screen switching function in the function menu.

The items of sub display are selected from "target temperature of the current step", "the remaining time of the current step", "information on the running program", and "repeat information".

1. Press the MENU key during programmed operation to enter the function menu. "DiSP" flashes in the main display and "TEmP" and other characters are shown in the sub display.
2. Select the sub screen switching function by pressing the ENTER key.
3. "TEmP" and other characters will flash in the main display. Select an item using the ▲▼ keys.
   (Refer to the following "*" for setting characters)
4. Press the ENTER key to confirm the selected item.
5. Display reverts to the function menu. Pressing the MENU key returns to operation screen from the function menu.

*Setting characters and items of the sub display for the sub screen switching function

Setting characters

Target temperature of the current step

Remaining time of the current step

Setting characters

Running program information
(Left: current program number Right: current step number)

Repeat information
(Number of repeat remaining)
*A dot at the right end flashes while repeating.

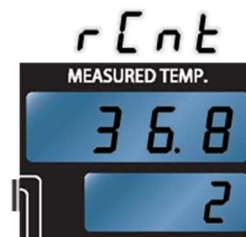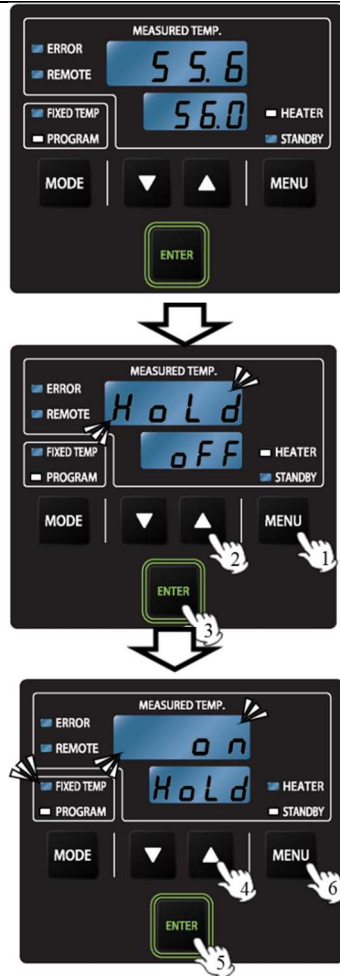| Hold function in programmed operation	
	This function temporarily suspends step timer and continues operation of the current step, can be selected in the function menu. 1. In programmed operation, press the MENU key when operating in the step to be continued. The function menu will show in the display. 2. Press the ▲▼ keys several times until "HOLD" is shown in the main display and "OFF" flashes in the sub display. 3. Select the hold function by pressing the ENTER key. 4. "OFF" will flash in the main display. Switch the hold function to ON with the ▲▼ keys. 5. Press the ENTER key to confirm. 6. Display reverts to the function menu. Pressing the MENU key returns to operation screen from the function menu. *To cancel hold function: follow the same procedures above and set hold function to OFF. Step timer starts counting and unit continues programmed operation.
[Note] ■**To discard selected functions and settings**	Press the MODE key while selecting a program, setting timer or other functions. Settings and functions being selected are canceled and the display returns to the previous screen.
■**To switch to fixed temperature operation from programmed operation in progress**	Press the MODE key during programmed operation or auto start standby. Target temperature setting screen will show in the display. When setting changes have been made by the ▲▼ keys, press the ENTER key to complete setting. Unit continues operation with altered temperature setting. If the MODE key is pressed again instead of pressing the ENTER key, the display will return to programmed operation screen.
■**To change the program number to another during operation.**	Press the ▲▼ keys during programmed operation or auto start standby. Display will show program select screen and the program number can be selected. Select program number using the ▲▼ keys and press the ENTER key, then set auto start timer. (See Step 3 on P.30) If the MODE key is pressed again instead of pressing the ENTER key, the display will return to programmed operation screen.

4. OPERATION PROCEDURES

Independent Overheat Prevention Device

This unit features an overheat prevention device (manual reset) which has a circuit, power supply, and a sensor, independent of the unit controller. This is in addition to the internal automatic overheat prevention function (auto reset), built in for added measure against overheating. Independent overheat prevention device cuts off power supply to the heater when measured temperature exceeds overheat prevention temperature.

If the difference between overheat prevention temperature and target temperature of the controller is small, the device may activate and stop operation. Set overheat prevention temperature at least 10℃ higher than target temperature. (15℃ or higher for BF601)

Overheat prevention device is designed to protect unit against overheating, 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..

The factory default setting and temperature ranges for overheat prevention device are defined as follows.

Model	Factory default setting temperature	Setting temperature range
BF201/401/501	120℃	0℃-120℃
BF601	230℃	0℃-230℃

To activate independent overheat prevention device at a certain temperature, keep unit running at the desired, stable temperature, and gradually decrease overheat prevention temperature. Ensure that the device works at the specified temperature. It takes about 15 seconds for the device to activate. Wait each time temperature setting is adjusted. If activates, "ER.3" is shown in the display and operation stops.

[BF401,501,601] Auto-resume function

BF401, 501, 601 units feature auto-resume function. The function "PON" can be ON/OFF in the function menu, (ON at the factory before shipment). See P.55 for setting change.

When auto-resume function is ON
In the event of a power failure, unit automatically reverts to status just before power failure and begin operation once again from that point. Do not leave unit unattended since unmanned operation may cause unforeseen accidents or complications.

When auto-resume function is OFF
Unit remains in fixed temperature operation standby after the power recovery, regardless of the status before power failure. All timer operations such as quick auto stop, auto start and programmed operations are cancelled.
When it has been confirmed safe to continue operation, manually restart operation.
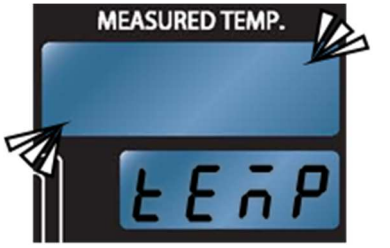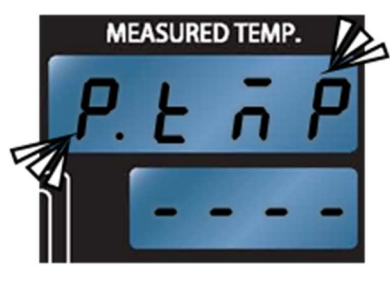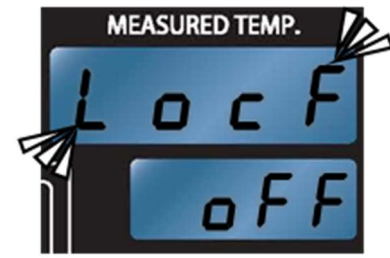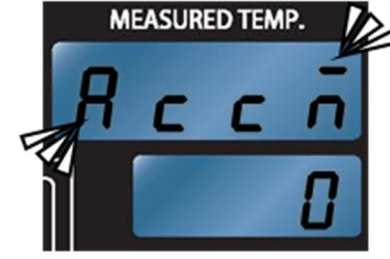
* BF201 does not have operation standby mode with main power switch in RESET(ON) position. Auto-resume function, therefore, is always ON. Note that the function cannot be set to OFF.
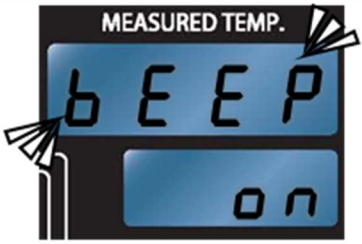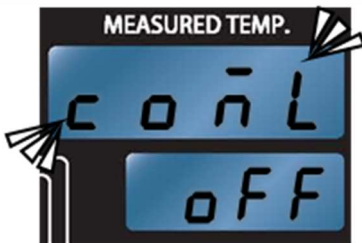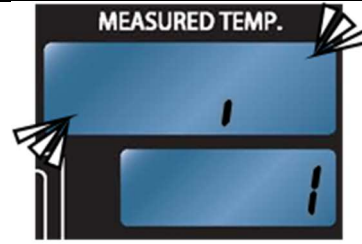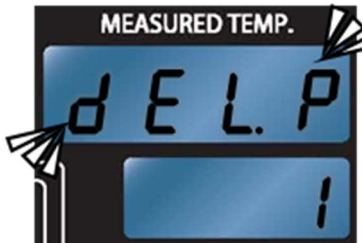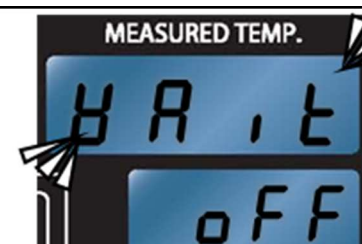
Function menu list

- Press the MENU key and select function using the ▲ ▼ keys while the function menu is displayed.
- Settings of the functions displayed in the function menu can be viewed and changed by pressing the ENTER key.
- Display returns to initial setting screen if the controller is not operated for one minute, or the MENU key is pressed while the function menu is on screen.

1	MEASURED TEMP. ⊾EⁿP	**Sub screen switching function (see P27, P31)** (Displayed in quick auto stop/auto start/programmed operations. ←Displays an item set for the sub display in quick auto stop/auto start/programmed operations.
2	MEASURED TEMP. P.ⱢⁿP ----	**Preset temperature (see P.37)** Displays stored preset temperature (max. 10 entries) in the oreder from lower temperature in every one ←second. (if no entries found, displays "----") Pressing the ENTER key for five seconds resets preset temperatures.
3	MEASURED TEMP. LocF oFF	**Keypad Lock function (see P.40)** ←Displays the ON/OFF status of lock function
4	MEASURED TEMP. Accⁿ 0	**Accumulated power-on time screen (see P.41)** ←Displays the accumulated power on time (in hours, max. 49999 hours)
5	MEASURED TEMP. PUⁿP 10	**Jet strength (see P.41) [BF401,BF501]** ←Displays the set value of jet strength
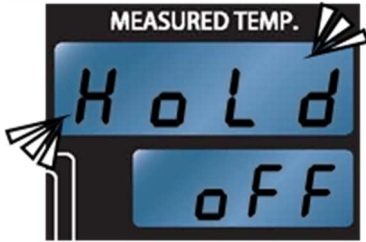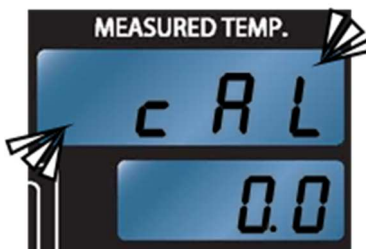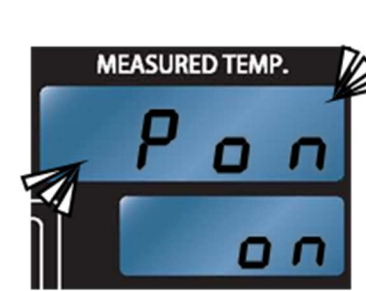
6	MEASURED TEMP. bEEP on	**Beep sound (see P.42)** ←Displays the ON/OFF status of beep sound
7	MEASURED TEMP. conL oFF	**Communication lockout function (see P.43) [BF501]** ←Displays the ON/OFF status of communication lockout function
8	MEASURED TEMP. 1 1	**Communication ID (see P.44) [BF501]** ←Displays communication ID
9	MEASURED TEMP. ProG 1	**Program settings (see P.45)** ←Displays the number of programs entered (If no programs created, displays "0")
10	MEASURED TEMP. dEL.P 1	**Deleting programs (see P.49)** (Shows only when a program is entered) ←Displays the number of programs entered
11	MEASURED TEMP. HAit oFF	**Wait function (see P.50)** ←Displays the ON/OFF status of wait function

12	MEASURED TEMP. HoLd oFF	**Hold function (see P.52)** (Displayed in quick auto stop/programmed operations) ←Displays the ON/OFF status of hold function
13	MEASURED TEMP. cAL 0.0	**Calibration function (see P.53)** ←Displays the set value of calibration offset
14	MEASURED TEMP. Pon on	**Auto-resume function (see P.55)** ←Displays the ON/OFF status of auto-resume function

Enter preset temperatures	
By presetting the frequently used temperature setting, the entered temperatures can be easily called up. (max. 10 entries)	
1	**Example: during operation standby, enter 80.0℃ as a preset temperature.**
	1. Press the MENU key to enter the function menu.
	2. "PTmP" flashes in the main display and "----" is shown in the sub display (if temperatures have already been entered, press the ▲ ▼ keys several times until each value is displayed in turn in every one second).
	3. Select preset temperature entry by pressing the ENTER key.
	* For BF601, temperature can be set in integer values.
2	Where 10 values are already entered (proceed to Step 3 below in case of nine or less)
	When making new entry while 10 setting values are already entered, select one to be overwritten.
	1. While "FULL" is shown in the sub display and the lowest preset value flashes in the main display, select a preset temperature to be overwritten using the ▲▼ keys
	2. Press the Enter key to confirm.
3	
	"PTmP" will show in the sub display and "----" will show flashing in the main display.
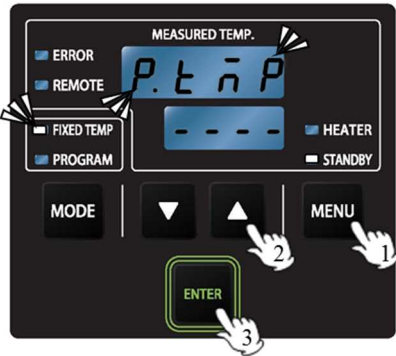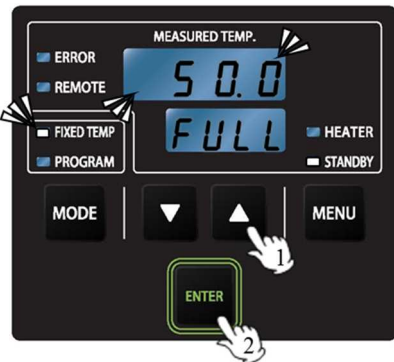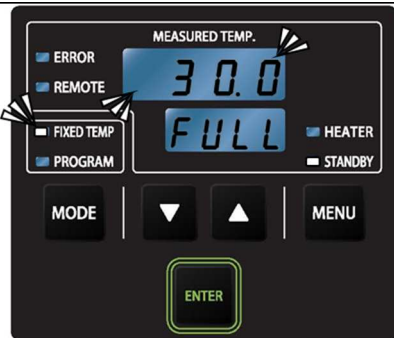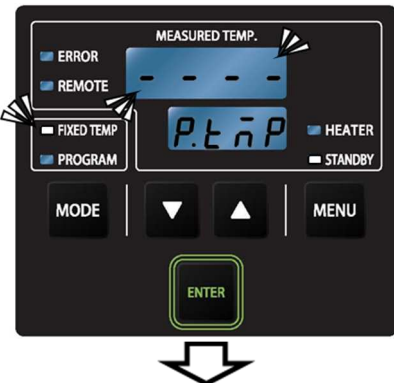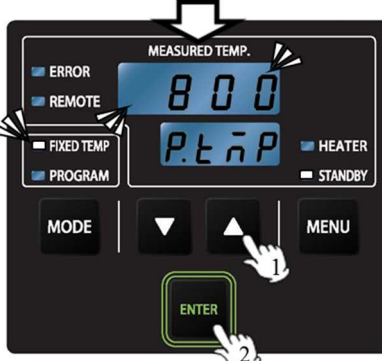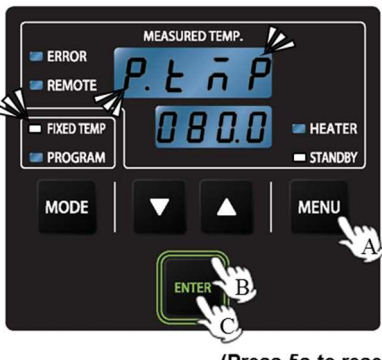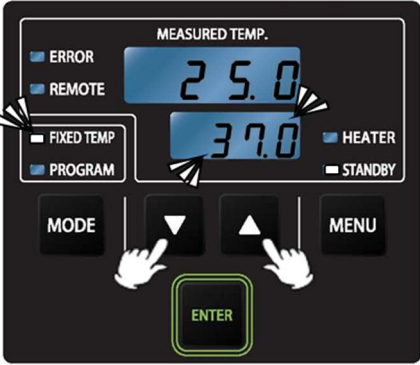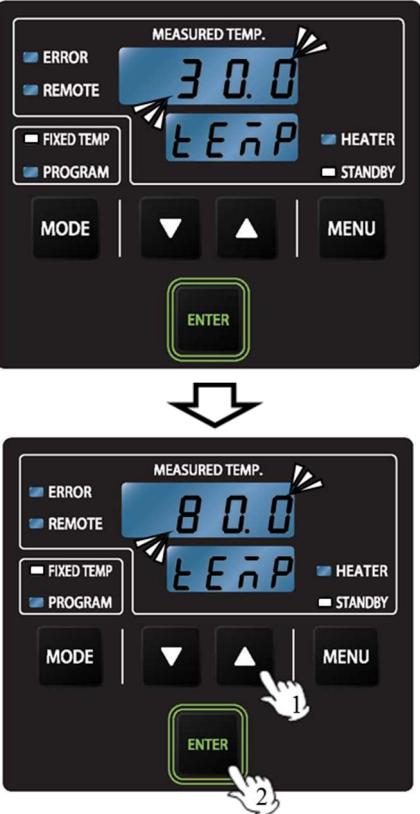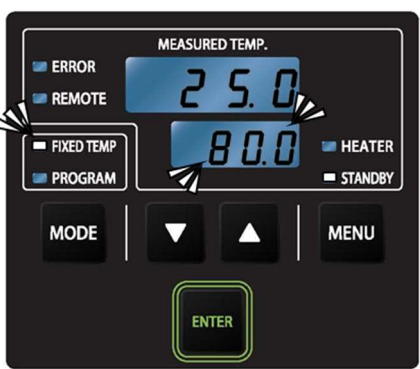
3		1. Set preset temperature (e.g. 80.0℃) using the ▲▼ keys. The set value flashes in the display. 2. Press ENTER to save the preset temperature.
4	 (Press 5s to reset)	Display automatically returns to the function menu (shown in Step 1 above) when preset temperature is properly entered. * Following operations A. Press the MENU key to exit the function menu. B. Press the ENTER key again to continue preset temperature entry C. To reset preset temperature, press and hold the ENTER key for about five seconds. All the entries are deleted.

Call up preset temperatures

Stored preset temperature can be recalled and set on target temperature setting screen.
(max. 10 entries)

1	Press together	**Example: during operation standby, enter 80.0℃ as a preset temperature.** Preset temperature can be called by pressing the ▲ and ▼ keys together for about one second at the following timing. Timing with possible preset temperature invocation - During standby and target temperature setting in fixed temperature operation - During step temperature setting while building a program (See P.46) For BF601, temperature can be set in integer values.
2		"TEmP" is shown in the sub display and preset temperature flashes in the display. (If no entries found "----" is displayed). 1. Select preset temperature to be set as target temperature, using the ▲▼ keys. Preset temperature (80.0℃ for the example above) flashes in the main display. 2. Press the Enter key to confirm. * To cancel the preset temperature recall, press the ▲▼ keys together for about one second.
3		Display returns to the screen before calling up preset temperature, and selected temperature is reflected in target temperature. * When operating at preset temperature (e.g. 80℃) selected during fixed temperature, press the ENTER key to continue operation.

Enable or disable the keypad lock function
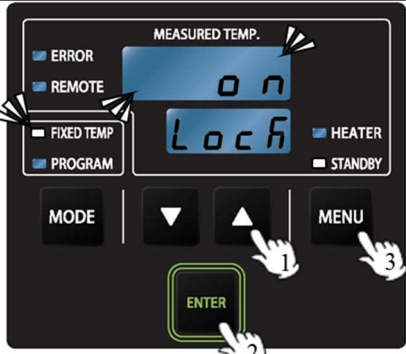
● This function locks keys so that settings cannot be unintentionally changed during operation.
With the keypad lock function ON, all keys become unresponsive except the MENUkey.
(When the MENU key is pressed, only the keypad lock function will show in the display. Other functions will not be displayed)

1		1. Press the MENU key to enter the function menu 2. Press the ▲▼ keys several times until "LOck" flashes in the main display and "OFF" is shown in the sub display. 3. Press the ENTER key to select the keypad lock function.
2		1. "OFF" flashes in the main diplay and "LOck" shows in the sub display. Switch to ON using the ▲▼ keys. 2. Press the ENTER to enable the keypad lock function. 3. Display returns to the function menu after settng. Press the MENU key to exit the function menu.
3		All the keys become unresponsive except the MENUkey while keypad lock is enabled. (when a key other than the MENU key is pressed, the sub display will read "LOck" indicating that keypad lock is enabled.)
4	To disable keypad lock function	
		1. Keypad lock function will show automatically when the MENU key is pressed (any functions other than keypad lock are not displayed even when the ▲▼ keys are pressed). 2. To cancel keypad lock function: follow the same procedures above and set the keypad lock function to OFF. Keypad lock is released and all the keys become functional again.
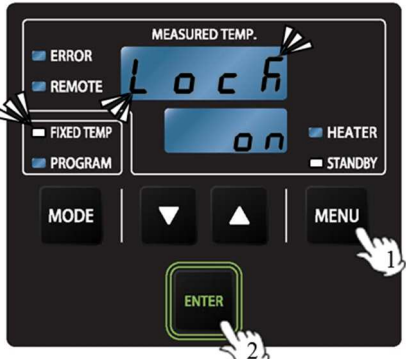
[BF401,501,601] Function Menu (Accumulated Power-on Time)

View accumulated power-on time.	

Check accumulated power-on time.
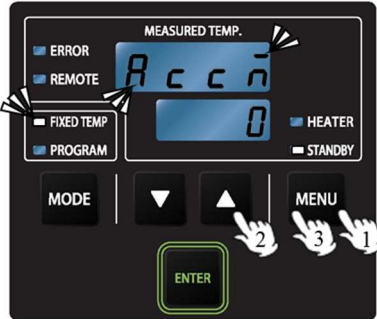
	1. Press the MENU key to enter the function menu. 2. Press the ▲▼ keys several times until "Accm" is shown in the main display. Accumulated power-on time (total time the main power switch is ON) will read in the sub display. 3. Press the MENU key to exit the function menu. * The time cannot be reset.

Accumulated time screen
- Unit displays the time of over 9999 hours using D.P. of each digit.
- Time unit is one hour and the display can show up to 49999 hours (shows 49999 hours thereafter).
Example)

 ←10050 hours   ←20050 hours

 ←30050 hours   ←40050 hours

[BF401,501] Function Menu (Jet Strength Changable Function)

Change the jet strength.	

●   This function adjusts the strength of the jet flow. (10 stages from 1 to 10)
(Note: strength of each stage is determined in advance, and the jet cannot be completely stopped.)
* Performance shown in the specifications based on the setting of 10. With settings of 1-9, there can be some affects on temperature control accuracy.
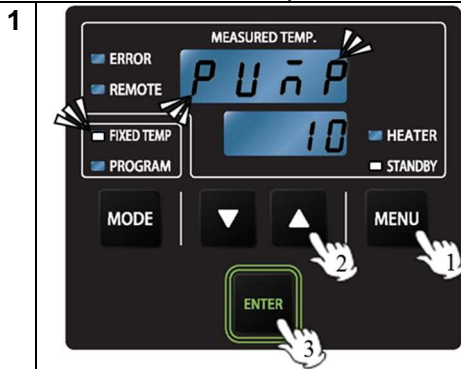
1		**Example: change the jet strength from 10 (maximum output) to 6 during operation standby.** 1. Press the MENU key to enter the function menu. 2. Press the ▲▼ keys several times until "PUmP" flashes in the main display and the current jet strength (initial setting: 10) is shown in the sub display. 3. Select the jet strength changable function by pressing the ENTER key.
2		1. The current jet strength will show flashing in the main display and "PUmP" will show in the sub display. Set the strength (6 for the example above) using the ▲▼ keys. 2. Press the ENTER key to complete setting and the change is applied. 3. Display returns to the function menu after settng. Press the MENU key to exit the function menu.
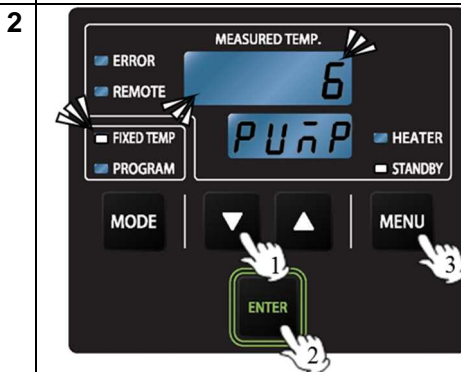
Enable or disable beep for abnormal conditions

● This function switches ON and OFF beep sound for errors.

1		
	MEASURED TEMP. ERROR REMOTE FIXED TEMP PROGRAM **b E E P** **o n** HEATER STANDBY MODE ▼ ▲ MENU ENTER	1. Press the MENU key to enter the function menu. 2. Press the ▲▼ keys several times until "BEEP" flashes in the main display and "ON or OFF" is shown in the sub display. 3. Select beep function by pressing the ENTER key. *1 Setting "ON" is recommended, considering possible error occurrence. *2 Initial setting is "ON".

2		
	MEASURED TEMP. ERROR REMOTE FIXED TEMP PROGRAM **o F F** **b E E P** HEATER STANDBY MODE ▼ ▲ MENU ENTER	1. The current beep function setting (ON or OFF) will show flashing in the main display and "BEEP" will show in the sub display. Switch the setting using the ▲▼ keys. 2. Press the ENTER key to confirm. 3. Display returns to the function menu after settng. Press the MENU key to exit the function menu.

Enable or disable the communication lockout function

● This function chooses whether to pass each parameter or control to a host computer or to refuse response when a communication request is received from the host computer connected to the communication interface.
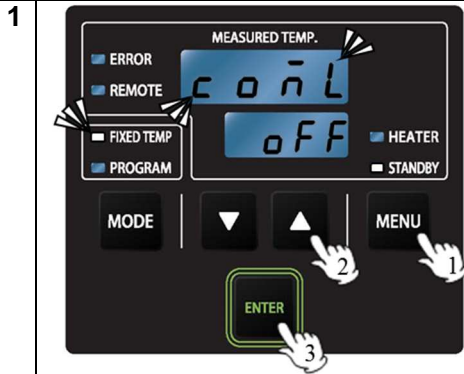
1		1. Press the MENU key to enter the function menu.
		2. Press the ▲▼ keys several times until "cOmL" flashes in the main display and the current setting (ON or OFF) is shown in the sub display.
		3. Select communication lockout function by pressing the ENTER key.
		* Initial setting is "OFF".
2		1. The current setting (ON or OFF) will show flashing in the main display and "cOmL" will show in the sub display. Switch the setting using the ▲▼ keys.
		2. Press the ENTER key to confirm.
		3. Display returns to the function menu after settng. Press the MENU key to exit the function menu.
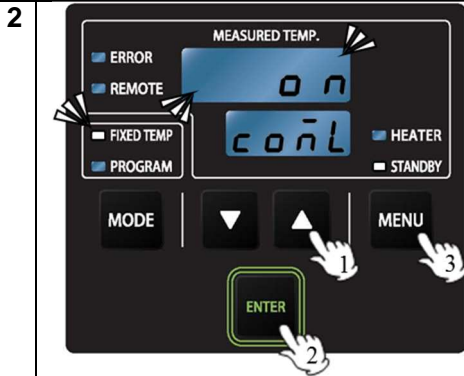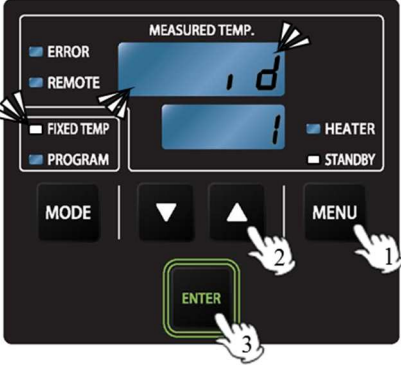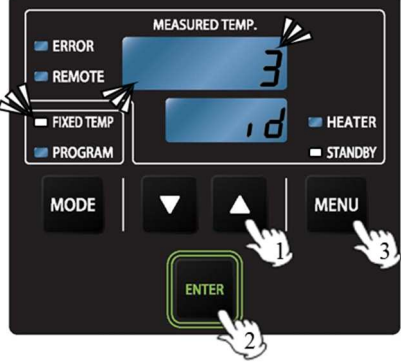
Change the communication address

When connecting multiple BF501 units to a host computer, it is possible to communicate indivisually by assigning communication address (1-99) to each BF unit (see P.58).

Note 1: 1-99 address are available to assign. One host computer, however, can only be connected up to 31 units.

Note 2: if a single address is shared by multiple units, communication cannot be properly established.

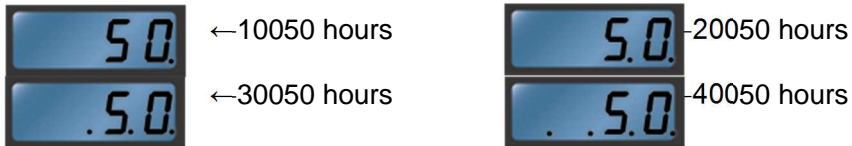| 1		1. Press the MENU key to enter the function menu. 2. Press the ▲▼ keys several times until "iD" flashes in the main display and the current address (1-99) is shown in the sub display. 3. Select communication ID function by pressing the ENTER key.
2		1. The current address (1-99) will show flashing in the main display and "iD" will show in the sub display. Change address using the ▲▼ keys. 2. Press the ENTER key to set address. 3. Display returns to the function menu after settng. Press the MENU key to exit the function menu.

Set a program to be run in programmed operation. (see P.29 for operating procedures)

A maximum of three programs can be entered and each program can include up to 10 steps.
"Wait function" (P50) and "hold function" (P52) are featured as related functions.

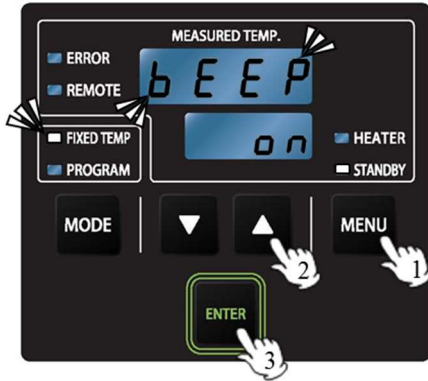**Set the program shown below to program number three. (wait function: ON)**
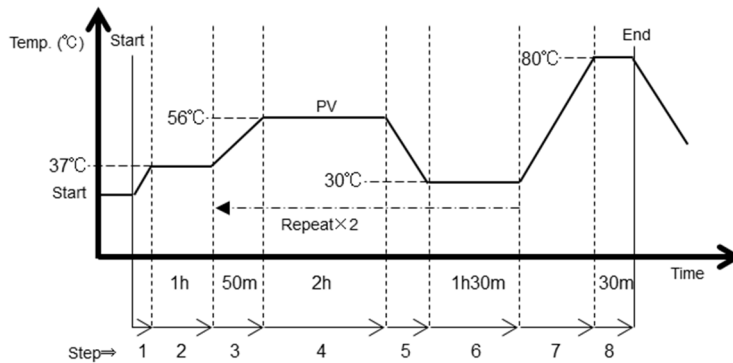
Step1: Set temp. 37℃ 0h00m
Step2: Set temp. 37℃ 1h00m

Step3: Set temp. 56℃ 0h50m
(Temp. rises at fixed rate)
Step4: Set temp. 56℃ 2h00m } Repeat×2
Step5: Set temp. 30℃ 0h00m
Step6: Set temp. 30℃ 1h30m

Step7: Set temp. 80℃ 0h00m
Step8: Set temp. 80℃ 0h30m

※Times for step 1,5 and 7 depend on the ambient conditions.

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* Precautions when building programs (see P.50 for details on wait function)

- When time settings on heat building or cooling steps are beyond the heating or cooling capability of unit (e.g. 0 minutes), unit will keep operating at full power with the wait function ON until measured temperature enters the wait zone. However, with the wait function OFF', the process proceeds to the next step when time setting is reached, regardless of whether or not the target temperature is reached. Wait function should be set to ON for short ramp (build) times.
- If the set time for temperature rise/fall step is long enough for the temperature rise/fall capability of BF units, temperature will rise or fall at the fixed rate irrespective of the the wait function setting.
- With the wait function OFF, compensation action takes priority in the next step if temperature could not reach the step target temperature. This may cause a delay in shifting to stabilized temperature operation.
- Once a temperature in the temperature-constant step has been set with wait function ON, unit will enter wait mode and hold step time count whenever temperature drops below (or exceeds) the wait zone by disturbance or other factors, until temperature returns to within the wait zone.
  If the wait function is set to OFF, however, the process will proceed to the next step after the set time has passed, regardless of any extreme temperature changes occuring in the bath.

Example) Changes of measured temperature when unit runs the program above with the wait function OFF.
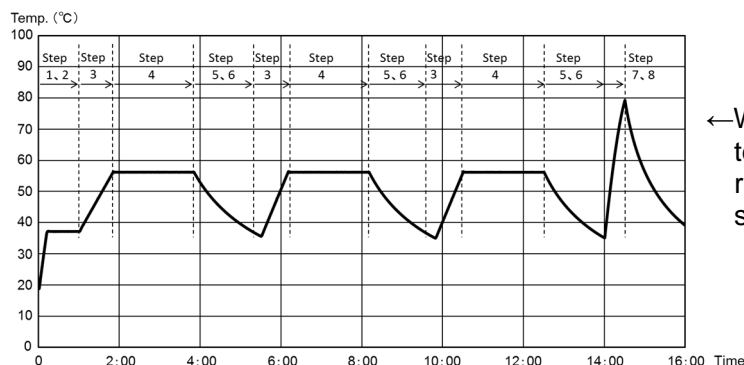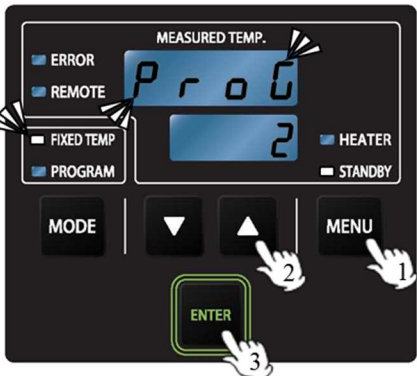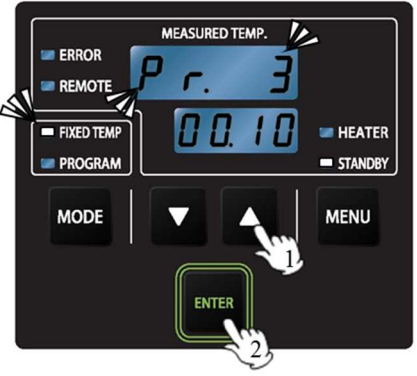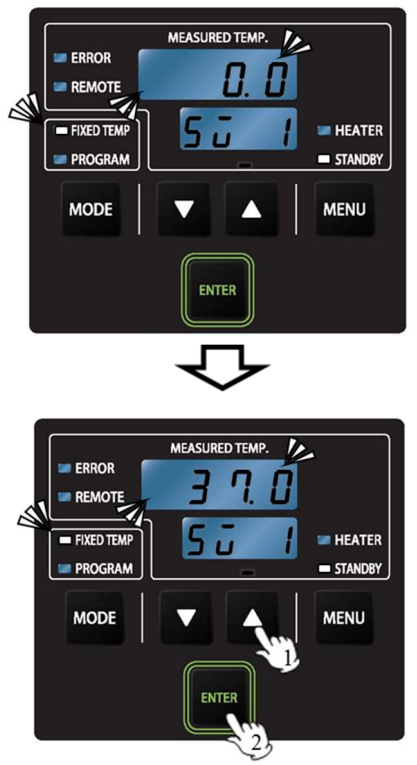
←With the wait function OFF, target temperature of each step may not be reached since unit proceeds to next step when after set time has passed.

*1 The temperature rise and fall times may vary depending on the bath capacity, water/oil volume and other environmental and operating conditions.
*2 Refer to reference data of temperature rise on P87, 88.

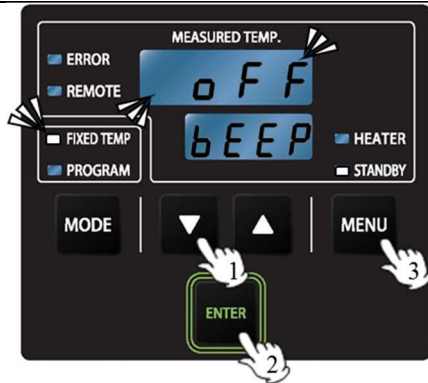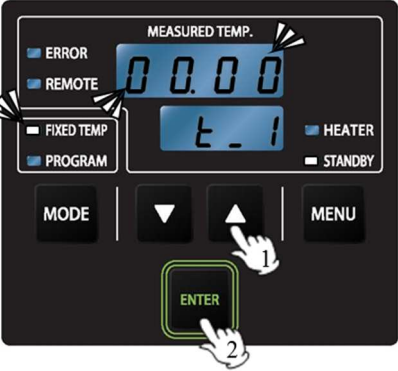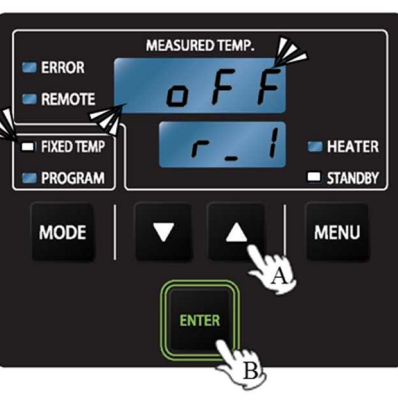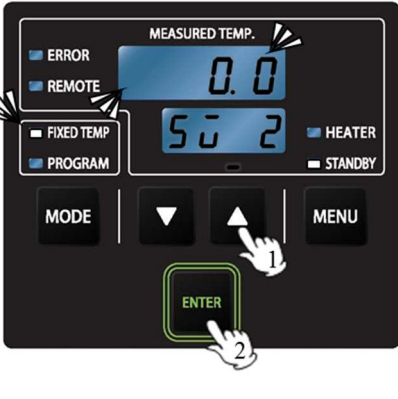| 1		**Set the program shown above to program number three.** 1. Press the MENU key to enter the function menu. 2. Press the ▲▼ keys several times until "PROG" flashes in the main display and the number of programs already entered ("0" when no program is set) is shown in the sub display. 3. Select program setting by pressing the ENTER key.
2		1. Program numbers "PR.1", "PR.2" and "PR.3" will show flashing in the main display and "00.10" etc. will show in the sub display. Select program number to be set using the ▲▼ keys. 2. Press the ENTER key to confirm the program number to be set.
3	**Building a program (temperature setting ⇒ time setting ⇒ repeat setting ⇒ temperature setting ⇒…)**	
		Each program can be set a total of four items (temperature, time, repeat destination and repeat count) Set temperature for step 1. "Sv_1" will show in the sub display and target temperature will show flashing in the main display. 1. Set temperature for step 1 using the ▲▼ keys. (e.g. 37.0℃) Press the ENTER key to confirm. * For BF601, temperature can be set in integer values.
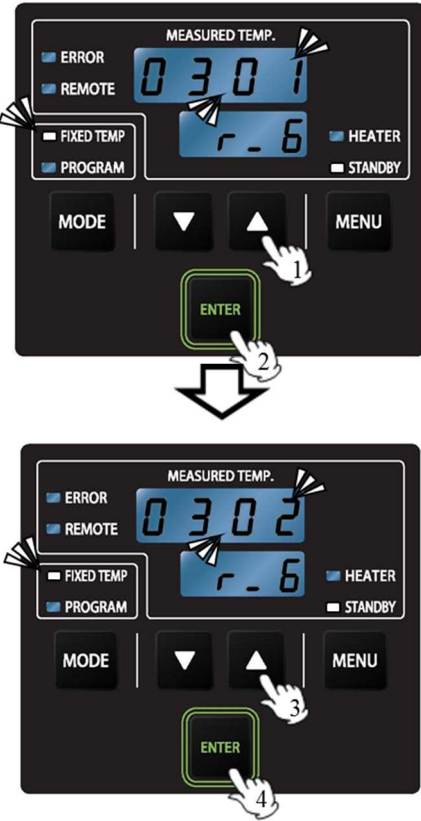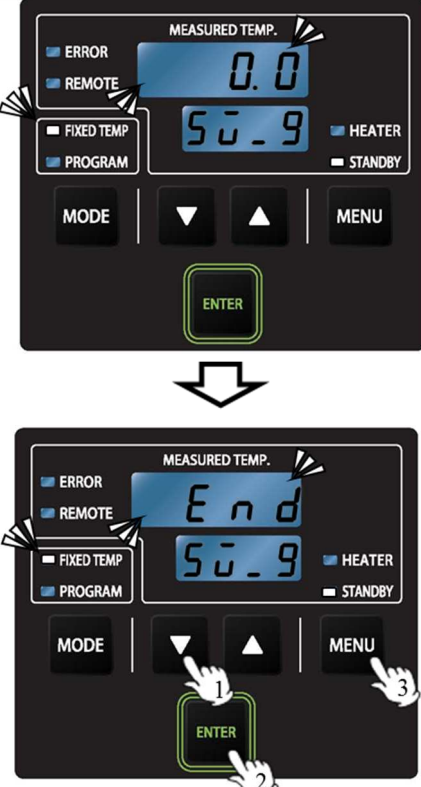
4		Set time for step 1 (0-99 hours, 59 minutes, 100-999 hours). "T_1" will show in the sub display and setting time will show flashing in the main display. 1. Set time for step 1 using the ▲▼ keys. (e.g. 0 minutes) 2. Press the ENTER key to confirm.
5		Set repeat function for step 1. "R_1" will show in the sub display and "OFF" will show flashing in the main display. A. Set the step number to be repeated and the number of times to repeat using the ▲▼ keys. (see Step 7 on the next page) B. Press the ENTER key while "OFF" flashes in the main display If not using the repeat function. This completes all four settings for step 1 and proceeds to step 2 setting. (see Step 6 below)
6	When not using the repeat function	
		Set temperature for step 2. "Sv_2" will show in the sub display and target temperature will show flashing in the main display. 1. Like step 1, set temperature for step 2 using the ▲▼ keys (e.g. 37.0℃). 2. Press the ENTER key to confirm. Operation will proceed to temperature setting, and then repeat setting. As the same procedures as step 1 (Steps 3-5 above), enter settings of step 2 to step 6 (up to time setting).

7	When using the repeat function (example: setting of step 6)	
		Set step number to be repeated after step 6 completes. On repeat function setting for step 6, the character in the main display changes from "OFF" to "01.01" and two digits on the left flashes (indicates repeat destination). 1. In the case of example above, operation returns to the beginning of step 3. Set the value in the main display to "03.01" using the ▲▼ keys. 2. Press the ENTER key to confirm repeat destination. Two digits on the right of the main display now flashes (indicates the number of times to repeat). 3. In the case of example above, operation repeats step 3 twice. Set the value in the main display to "03.02" using the ▲▼ keys. 4. Press the ENTER key to confirm repeat count and proceed to temperature setting of next step. Repeat destination Repeat count * If repeat count is set "00" unit will repeat the step indefinitely
8		As the same procedures as step 1 (see Steps 3-5 of P.46-47), enter settings of step 7 and step 8.
9		After entering the program, the program setting needs to be completed. 1. Press the ▼ key in temperature setting of the next step of the final step (temperature setting of step 9 for the example above). "END" is shown flashing in the main display. 2. Pressing the ENTER key completes the program setting. 3. The display shows a screen to select a program number to be edited (see Step 2 on P.46). Exit the function menu by pressing the MENU key twice. * Unit can set up to 10 steps for each program and automatically completes setting of the program when the repeat function of step 10 is established.

Delete entered program.

● This function chooses and deletes (reset) one of the programs entered.
(Note: if no programs have been created, this function will not be displayed in the function menu)
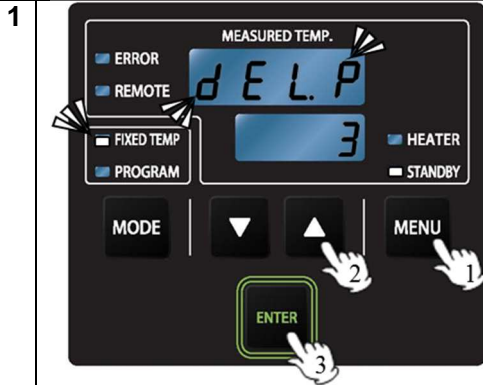
1		
		Example: delete program number 3 1. Press the MENU key to enter the function menu. 2. Press the ▲▼ keys several times until "DEL.P" flashes in the main display and the number of programs already entered is shown in the sub display. 3. Select program delete by pressing the ENTER key.
2		1. Select a program number to be deleted using the ▲▼ keys while "DEL.P" is shown in the sub display and the lowest program number among those currently entered flashes in the main display. 2. Press the ENTER key to confirm. 3. Display reverts to the function menu. Press the MENU key to exit the function menu.
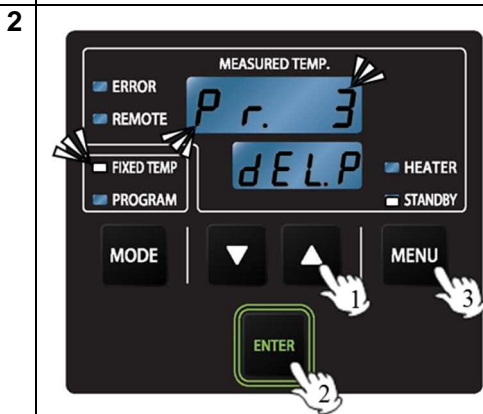
Note: The deleted programs cannot be restored. Perform sufficient confirmation before deleting programs.

Enable or disable the wait function

● This function holds timer count until measured temperature enters the wait zone (upper and lower limits are settable at ±0℃) during quick auto stop operation and programmed operation. Wait timer is adjustable from 1 minute to 1 hour, 59 min. If the timer needs to be held for two hours or longer, set the wait function ON. Unit maintains wait status until temperatue reaches the wait zone.

- **Wait function in quick auto stop operation**
  When either of following condition is satisfied timer of quick auto stop starts counting.
  ① In the beginning of quick auto stop operation, the wait time starts counting. Quick auto stop time will start counting once the wait time reaches "0".
  ② When measured temperature enters the range of the wait zone between lower and upper limits bound on the target temperature, timer count starts.
- **Wait function in programmed operation**
  When either of following condition is satisfied the process shifts to next step.
  ① Wait time starts counting after step time count. The process proceeds to the next step once the wait time reaches "0".
  ② After step time count, unit will wait for measured temperature to enter the range of the wait zone, and then proceed to the next step.
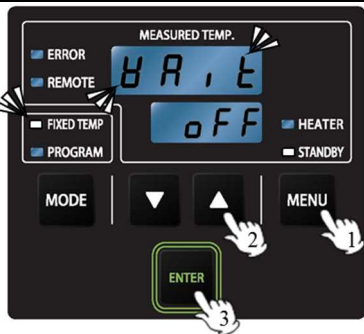
1		1. Press the MENU key to enter the function menu. 2. Press the ▲▼ keys several times until "WAiT" flashes in the main display and the current setting of the wait function (OFF, 00:01-01:59 or ON) is shown in the sub display. 3. Select wait function setting by pressing the ENTER key. * Initial setting is "ON".
2		Set the wait time. 1. The current setting (OFF, 00:01-01:59 or ON) will flash in the main display and "WAiT" will show in the sub display. Change the setting using the ▲▼ keys. 2. Press the ENTER key to confirm. * Wait time setting The set value shown in the main display changes as follows by pressing the ▲▼ keys. Enter desired setting value and confirm.
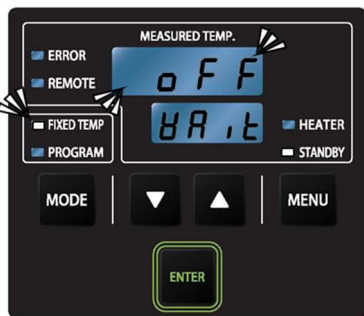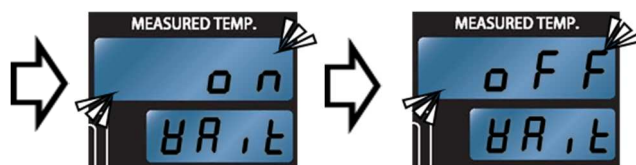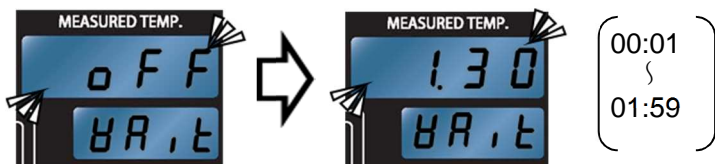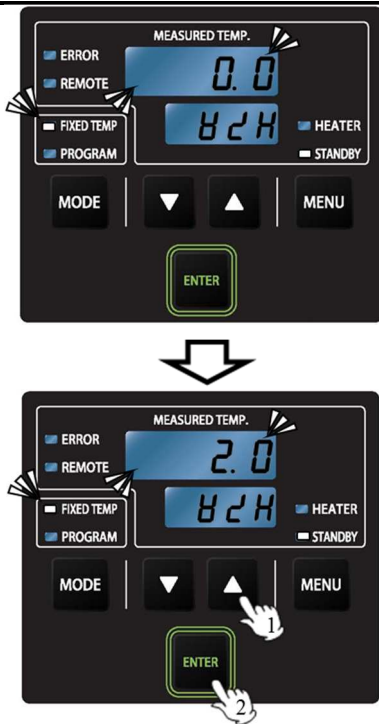
3		Set upper limit of the wait zone. 1. The current setting value will flash in the main display and "WZH" will show in the sub display. Change the setting value using the ▲▼ keys. 2. Press the ENTER key to confirm.
4		Set lower limit of the wait zone. 1. The same as Step 3 above, the current setting value will flash in the main display and "WZL" will show in the sub display. Change the setting value using the ▲▼ keys. 2. Press the ENTER key to confirm. 3. Display reverts to the function menu after the setting of lower limit. Press the MENU key to exit the function menu.
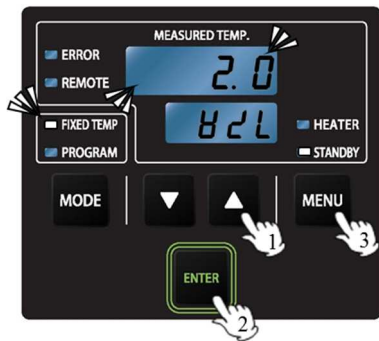
Enable or disable the hold function

This function can be set in programmed operation/auto start standby/quick auto stop operation.
Maintains the operating state at the point the function is set to ON (temporarily stops the timer count).
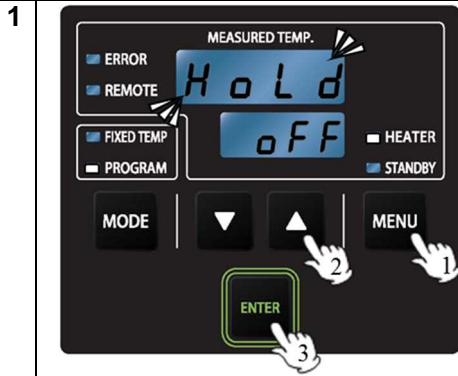
1		1. Press the MENU key to enter the function menu. 2. Press the ▲▼ keys several times until "HOLD" flashes in the main display and the current setting (ON or OFF) is shown in the sub display. 3. Select the hold function by pressing the ENTER key. * Initial setting is "OFF".
2		1. The current setting (ON or OFF) will flash in the main display and "HOLD" will show in the sub display. Switch the setting using the ▲▼ keys. 2. Press the ENTER key to confirm. 3. Display reverts to the function menu. Press the MENU key to exit the function menu.
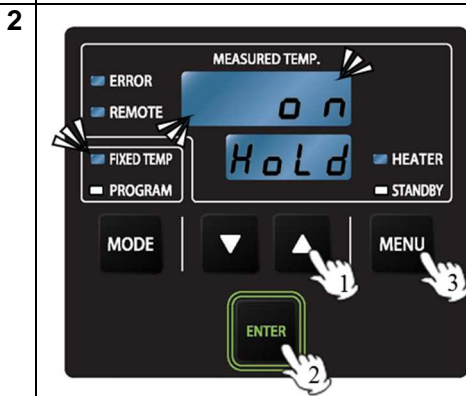
Use calibration offset

● Calibration offset function is to compensate for differences in the temperature reading (as taken by unit sensor) and actual temperature in the testing bath (as taken manually with a thermograph). Offset function can correct to either the positive or negative side of the entire unit temperature range.
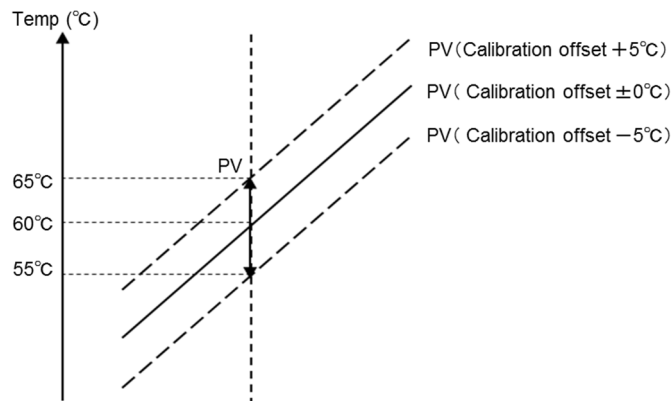
Setting example

When measured temperature is 2℃ lower than display temperature, inputting "calibration offset: -2.0" decreases display temperature by 2℃.

Example: When display temperature is 60 ℃, inputting of offset value "-2.0" corrects display temperature to 58℃

* Corrects -2 ℃ of the entire temperature range of -20-90℃ (BF401, 501) and 0-200℃ (BF601). Note that offset value depends on the target temperature, sample placement and other operating conditions.
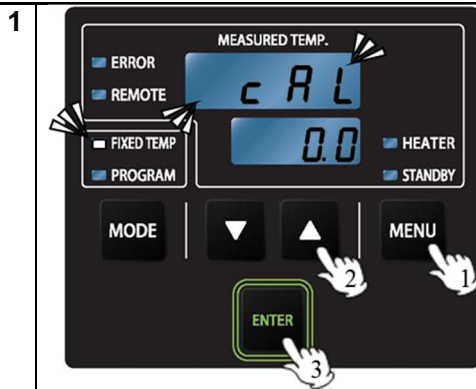
| 1 | | **Example: Set calibration offset -2.0℃.**
(display temperature: 60.0 ℃ → 58.0℃)
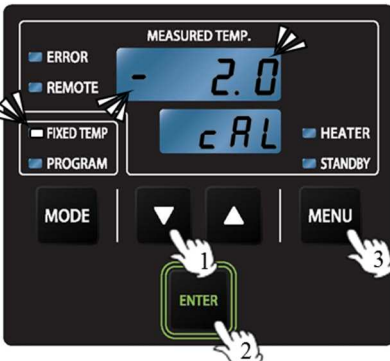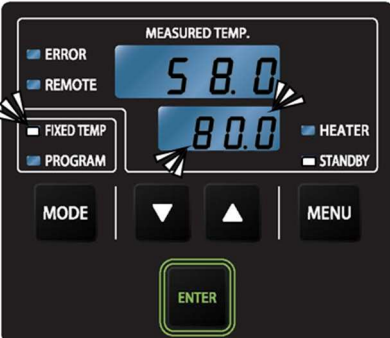
1. Press the MENU key to enter the function menu.
2. Press the ▲▼ keys several times until "cAL" flashes in the main display and the current setting of calibration offset (-5.0 to 5.0℃ for BF401, 501, -10.0 to 10.0℃ for BF601) is shown in the sub display.
3. Select the calibration function by pressing the ENTER key. |
| 2 | | The current setting value (e.g. 0.0℃) will show flashing in the main display and "cAL" will show in the sub display. |

| 3 | | 1. Set offset value using the ▲▼ keys (e.g. -2.0℃).
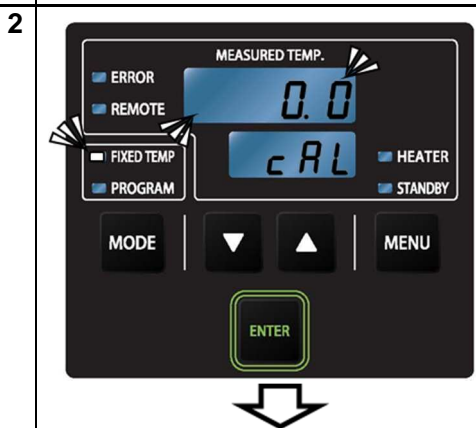
2. Press the ENTER key to confirm.

3. Display reverts to the function menu. Press the MENU key to exit the function menu. |
| 4 | | Display temperature will be corrected by -2.0℃ and the value on screen will change from 60.0℃ to 58.0℃. |

Enable or disable the auto-resume function

● This function switches the mode whether to automatically resume operation or shift to standby mode after power recovery.
Initial setting is "ON". Unit reverts to the status just before power failure.
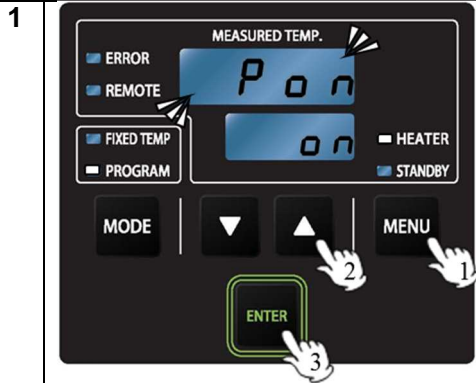
1		1. Press the MENU key to enter the function menu. 2. Press the ▲▼ keys several times until "PON" flashes in the main display and the current setting (ON or OFF) is shown in the sub display. 3. Select the auto-resume function by pressing the ENTER key.
2		1. The current setting (ON or OFF) will show flashing in the main display and "PON" will show in the sub display. Switch the setting using the ▲▼ keys 2. Press the ENTER key to confirm. 3. Display reverts to the function menu. Press the MENU key to exit the function menu.
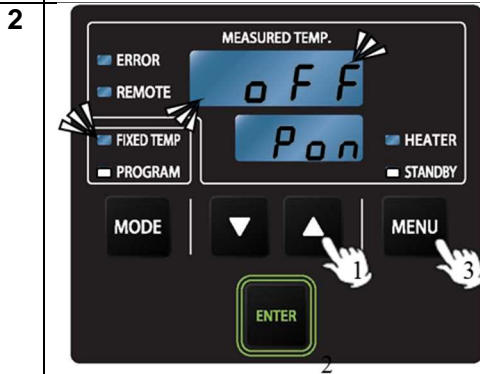
Caution: Never operate unit unattended regardless of "ON", "OFF" setting of auto-resume function.

If power failure occurs during quick auto stop operation or programmed operation, the timer count will be suspended until power is restored. Unit will resume operation for the remaining time after power recovery. Unit will remain hold status if the hold function (see P.52) is ON.

PRE-OPERATION PROCEDURES

❗	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 the power switch before connect the cables.
	2. Connect a recorder or another appliance of 300Ω or less in input impedance to the temperature output terminal.
	3. Securely fasten all connections with the screws attached to the terminal block.

Connection procedure

❗	Connect the cables to the appropriate terminals.
	Use a shielded wire for the cable to be connected to prevent noise.
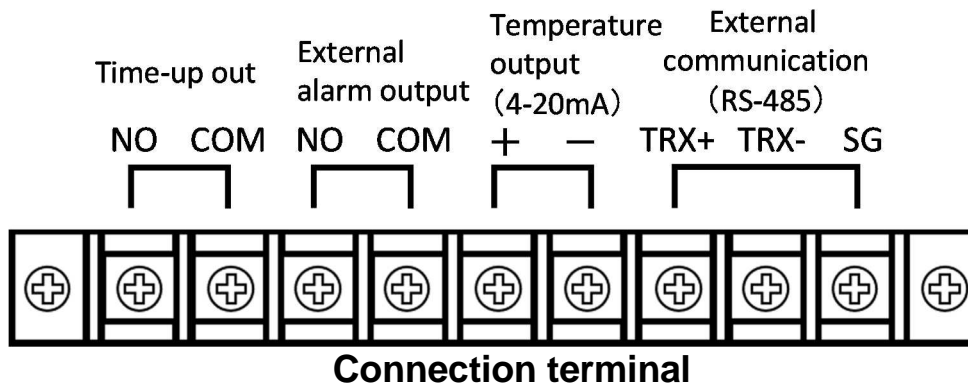
Connection terminal

Specifications

Time-up Output Alarm output	• Time-up Output When a programmed operation or auto stop operation completes, END is displayed on the control panel and no-voltage "a" contact (relay contact) is output. • Alarm output: When abnormality occurs, unit outputs no-voltage "a" contact (relay contact). See P.77 for errors in detail. Contact capacity: 250V AC 1A (resistance load) Minimum load: DC5V 10mA Connection: M3 screw terminal block
External-communication	Connection: M3 screw terminal block Refer to the following pages for details on communication settings.
Temperature output	• Outputs the current (mA) corresponding to the measured temperature Output temperature range: -25℃ to 95℃ Output voltage: 4-20mA DC Load impedance: 300Ω: Precision: ±0.4℃ [under standard environmental condition (23±10℃)] Connection: M3 screw terminal block

Relationship between measured temperature and output current

Measured temperature (℃)	Output current (mA)
-25	4.00
-10	6.00
5	8.00
20	10.00
35	12.00
50	14.00
65	16.00
80	18.00
95	20.00

1. TRANSMISSION SETUP PROCEDURES

1.1 Communication settings

Before starting communication with the BF501 (hereinafter called the "unit"), set communication parameters on the personal computer.

	Item	Communications settings
1	Data length	8 bits
2	Stop bit length	2 bits
3	Parity	None
4	BCC check	Enabled
5	Baud rate	4800 bps
6	Response delay time	3 msec

1.2.1 Communication settings

■ Computer

- Serial communications port (port USB) is used.

■ USB/RS485 converter (available separately)

- For the converter, System Sacom's [KS-485I RJ45-T4P] is recommended.
- Our optional accessory "external communication adapter (model: OBF12, product code: 221871) permits the connections described in below (except the personal computer).

■ Communication cable
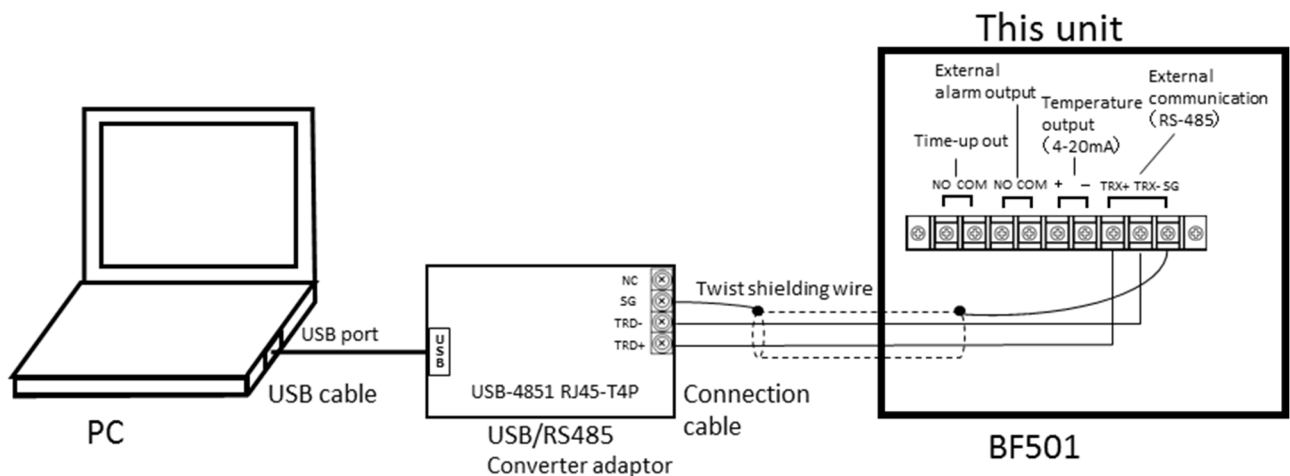
Note: Optional accessory of external communication adapter (model: OBF12, product code: 221871) comprises the following.
  (1) USB cable: USB connector A to the personal computer, USB connector B to the RS485, cable length 1.8 m
  (2) Communication cable: three-meter-long UL2464TASB two-core AWG20 cable to the RS485, Y terminal on unit side.
  (3) USB-RS485 conversion adapter: System Sacom's USB-RS-485I RJ45-TT4P

■Communication sample program
  Visit our web site linked below for sample program.
    http://www.yamato-net.co.jp/support/program/index.htm

2. Data transmission method

Item	SPECIFICATIONS
Communication standard	EIA standard complying with RS-485
Synchronization method	Asynchronous communication method
Communication method	Half-duplex communication
Transmission code	ASCII-code
Baud rate	4800/9600/19200 bps
Communication distance	Max. 500m (it depends on the effect of the ambient environment)
Network	Multi-drop method (up to 1:31 stations)
Signal wire	Two wires for transmission and receipt
Stop bit length	1/2 bits
Data length	7/8 bits
Parity	None/Odd/Even
BCC check	Enabled/Disabled
Response delay time	0 to 250 msec *set value: 3 msec
Communication address	1 to 99 stations (however, 1:31 stations at maximum) *See P.44 for procedures for changing the address
Communication mode switching	RO/RW

The shading part ☐ indicates the initial setting of the unit.

3. Transmission control characters

Symbol	Name	Code	Detail
STX	Start of text	02H	Indicates the start of the text
ETX	End of text	03H	Indicates the end of the text
R	Read	52H	The command to read a request
W	Write	57H	The command to write a request
ACK	Acknowledge Character	06H	Transmits a reply when data is properly received
NAK	Negative Acknowledge	15H	Transmits a replay in case of a receiving error

Note) R: Read (command to read settings or measured values)
 W: Write (command to write set values)
 R commands can be communicated at all times in all modes.
 The parameters for W commands which can be set depend on the operation state (during operation).
 See "7. List of Identifiers/Commands".

4. Transmission control procedures

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

4.2 Message types
■Message types include transmission request messages from the host computer and transmission reply messages from this unit.
■All codes from STY, address, request, identifier to ETX (except BCC) are represented by ASCII-codes.

4.3 Request message structures (transmission from the host computer to the unit)
4.3.1 Structure of read request message

①Start code
②Address
③Request (read)
④Identifier
⑤Numeric data
⑥End code
⑦BCC code
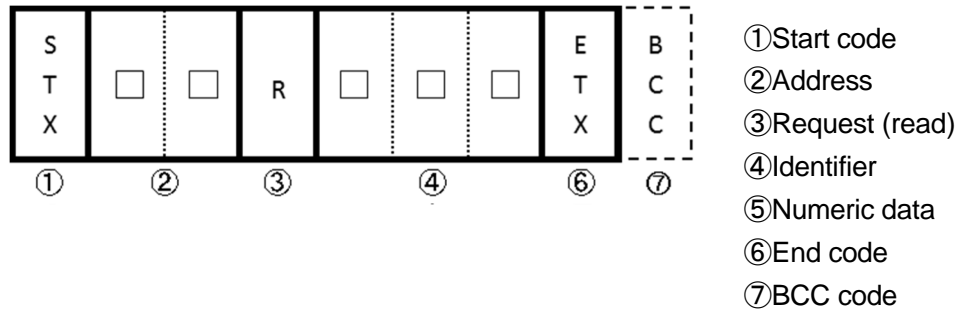
4.3.2 Structure of write request message

①Start code
②Address
③Request (write)
④Identifier
⑤Numeric data
⑥End code
⑦BCC code
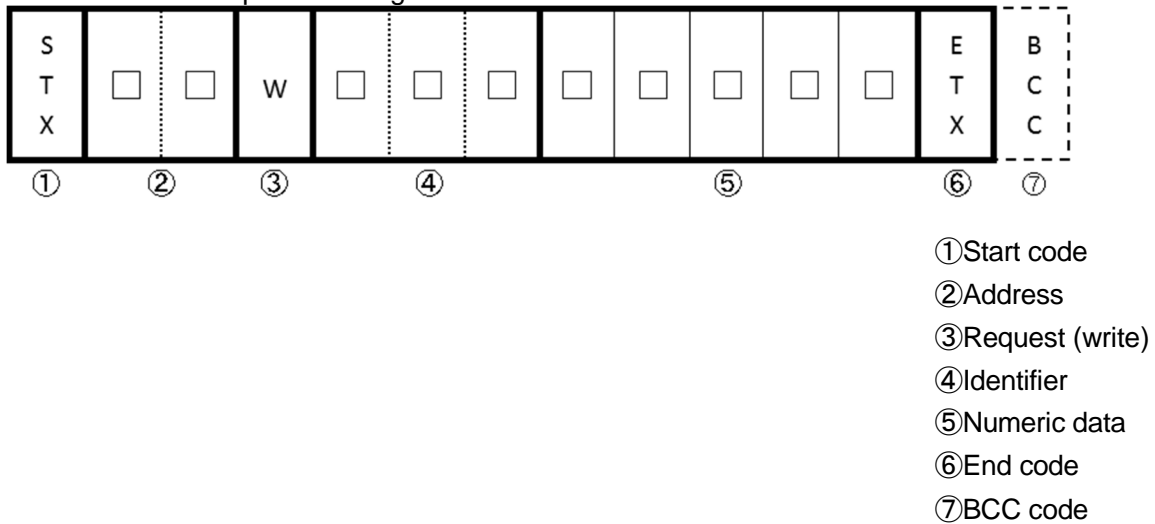
4.4 Reply message structures
4.4.1 Reply message to read request messages

S T X	□	□	W	□	□	□	□	□	□	□	□	E T X	B C C
①		②	③			④				⑤		⑥	⑦
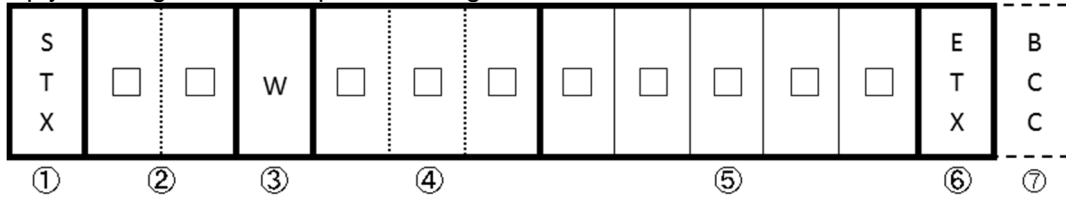
①Start code
②Address
③Request (write)
④Identifier
⑤Numeric data
⑥End code
⑦BCC code

4.4.2 Reply message to write request/storage request messages

S T X	□	□	A C K	E T X	B C C
①		②	⑧	⑥	⑦
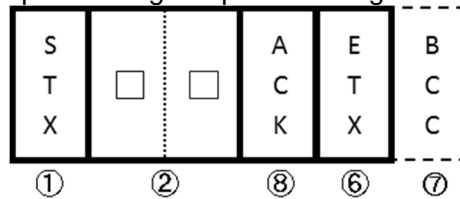
①Start code
②Address
⑥End code
⑦BCC code
⑧Affirmative acknowledge

4.4.3 Reply message in case of an error

S T X	□	□	N A K	□	E T X	B C C
①		②	⑨	⑩	⑥	⑦
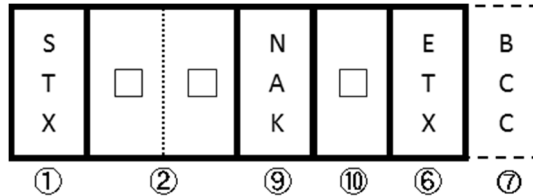
①Start code
②Address
⑥End code
⑦BCC code
⑨Negative acknowledge
⑩Form of error

4.5 Description of codes

■ The following codes from ①STX, ②address to ⑩error type are represented by ASCII codes.

■ For ASCII codes, see "8. List of ASCII Codes."

■ For conversion into ASCII codes, see "5. Communication Examples."

① STX
This code is required for the receiving side to detect the head of a message. Add it at the head of the character string to be transmitted.

② Adress
This is the address of the unit with which the host computer communicates. The address within a reply message from the unit indicates the unit that has transmitted the message.

③ Request contents
Enter the symbol "R" or "W."
R: To read data from the unit
W: To write data to the unit or save it in the unit

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. See "7. List of Identifiers/Commands".

⑤ Numeric Data
This is the data to be read or written and always represented by five digits, irrespective of the type.

Negative data: The symbol "-" is at the highest digit.
Position of decimal point: 5-digit data does not include any decimal point.
Example) The meaning of the five-digit numeric data 00101 is shown in the table below.

Example	Meaning of numeric data
Target temp in fixed temp operation (identifier:SV1)	10.1℃
Time setting for step1 in program No.1 (identifier: 11T)	1 hour 41 minutes (101 minutes)

⑥ ETX
This code, attached to the last character string, is required for the receiving side to detect the end of the message (except BCC).

⑦ BCC
This is the check code for error detection and takes the exclusive OR (EX-OR) of all characters from STX to ETX.

⑧ ACK
   This is an acknowledgement code and included and returned in the "reply message" from the unit when no error is found in the received message.

⑨ NAK
   This is a negative acknowledgement code and included and returned in the "reply message" from the unit when there is an error in the "request message" received by the unit.
   Error description (⑩ERR type) is included in the "reply message" from the unit after NAK when there is an error in the "request message" received by the unit.

⑩ ERR type
   If there is an error in the "request message" received by the unit, this code is included in the "reply message" from the unit after (⑨NAK) to report the type of the error.
   This is a communication-related error, and details of display are omitted.

If STX is not transmitted from the unit within the specified reply wait time after the host computer transmits BCC, it is considered receive time-out.

4.6 COMMUNICATION PRECAUTIONS
① Request intervals
   If "request message" is sent from host computer intermittently, set a delay for at least 2 seconds after "reply message" from the unit is received.

② Reply conditions
   The unit will not send "reply message" unless STX or ETX (BCC) is included in "request message".
   Thus, even if there is an error within "request message", NAK added "reply message" (error report) is not returned unless the conditions dscribed above are fulfilled.

   Even if the course is so the upper computer "request message" appropriate time after transmission, when "reply message" is not send back, again send and, required "request message".

   All the previously received codes are deleted at the time when unit recieves STX.

③ Address setting error
   Unit only responds to "request message" when it is addressed to the unit itself.
   Thus, when there is an error in relation to address in "request message", unit does not return "reply message"
   Even if the course is so the upper computer "request message" appropriate time after transmission, when "reply message" is not sent back, again send and, required "request message".
   All the previously received codes are deleted at the time when unit recieves STX.

④ Starting up
   This unit does not start communication (no reply) for about four seconds after the power is turned on.
   Set a delay until communication begins after the power is turned on.

5. Communication examples

5.1 Read communications example

Example) request message: A request for reading PV1 (measured temp.) is transmitted to the unit set at address 02.

Reply message from the unit to this request message: The data of PV1 "00123"(12.3℃) is returned.

Read request message (transmitted from the host computer)
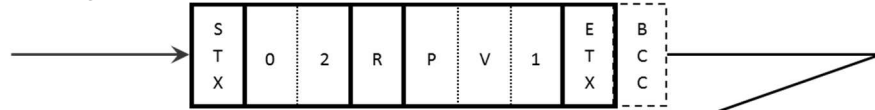
Reply message (receive from the unit)
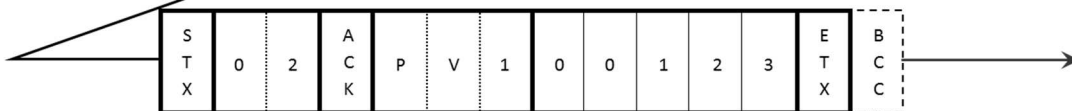
Code	Symbol/Data	ASCII code *2
① Start Code	STX	02H
② Address	02	30H 32H
③ Request (Read)	R (read)	52H
④ Identifier *1	PV1	50H 56H 31H
⑤ Numeric Data	00123	30H 30H 31H 32H 33H
⑥ End Code	ETX	03H
⑦ BCC data Request		66H
Reply		02H
⑧ Acknowledgement Code	ACK	06H

*1): See "7. List of Identifiers/Commands."

*2): For ASCII codes, see "8. List of ASCII Codes."

5.2 Write communications example

Example) request message: A request for setting SV1 (target temperature of fixed mode) to "00800" (80.0℃) is transmitted to the unit set at address 03.

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 (transmitted from the host computer)

| S T X | 0 | 3 | W | S | V | 1 | 0 | 0 | 8 | 0 | 0 | E T X | B C C |

Reply message (receive from the unit)

| S T X | 0 | 3 | A C K | E T X | B C C |
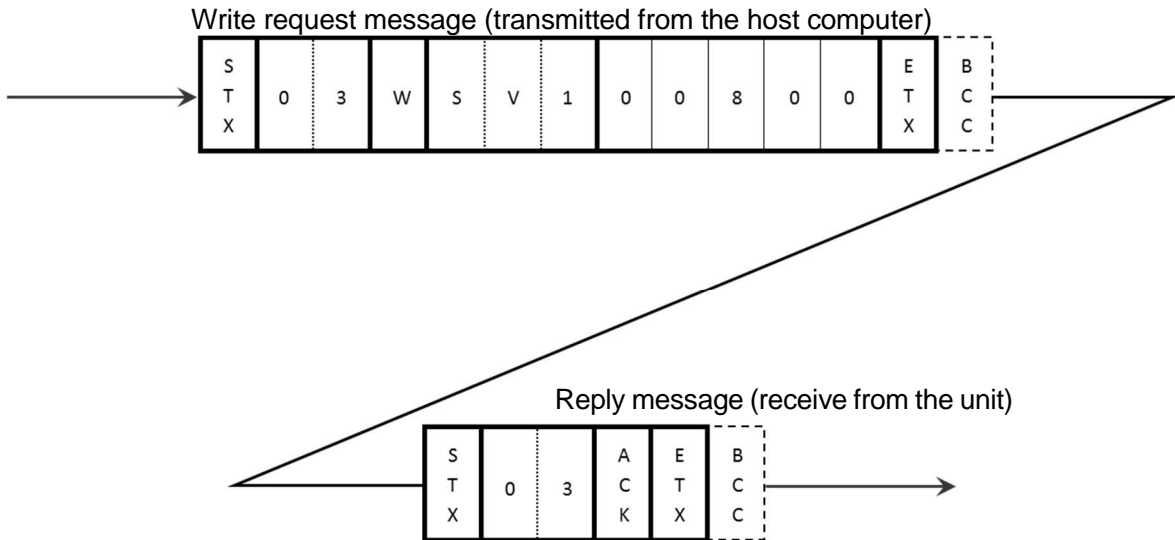
Code	Symbol/data	ASCII Code *2
① Start Code	STX	02H
② Address	03	30H 33H
③ Request (Write)	W (write)	57H
④ Identifier *1	SV1	53H 56H 31H
⑤ Numeric Data	00800	30H 30H 38H 30H 30H
⑥ End Code	ETX	03H
⑦ BCC data Request		59H
Reply		04H
⑧ Acknowledgement Code	ACK	06H

*1): See "7. List of Identifiers/Commands."

*2): For ASCII codes, see "8. List of ASCII Codes."

6. Wire connection
Shown below is an example of multi-drop wire connection.
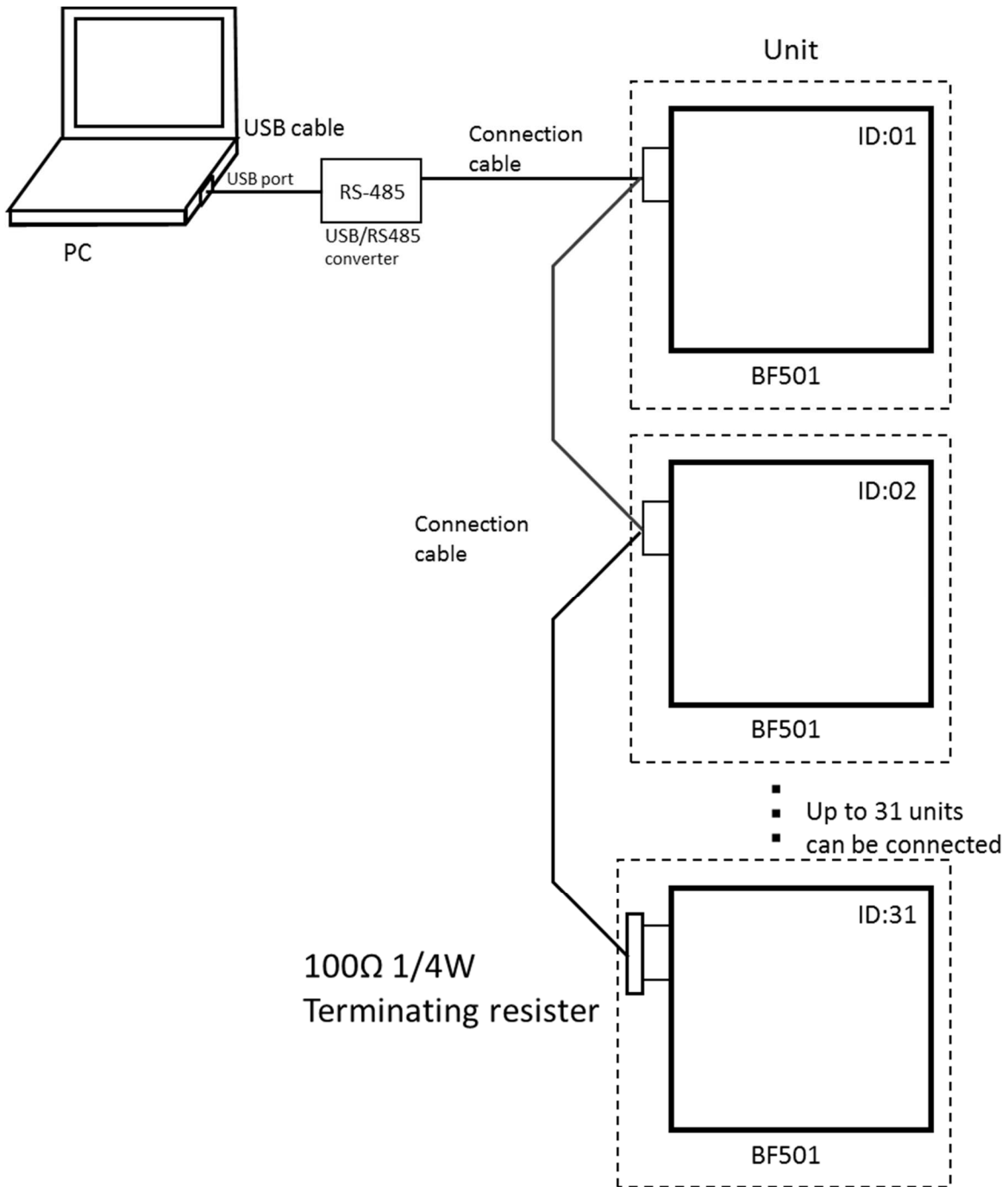
Note) Terminating resistor: Custom-made item. If you prepare a terminating resistor yourself, connect a fixed resistor of 100 Ω and 1/4 W or over to the last cable appliance terminal block (between TRX+ and TRX-).

7. List of Identifiers/Commands

< Identifier and set values >

*1 "A" represents the identifier of step 10 in 11 decimal number.
    (Example: setting target temperature on program number 1: step 1 → 11S, step 5 → 15S, step 10 → 1AS)

*2 through the external communication, time can be set in increments of one minute even over 100 hours.

*3 an identifier "_" signifies a space.

Fixed temperature operation

Name	Identifier	Command	Set value
Measured temperature	PV1	R	Indicates the current measured temperature. (HHHHH: overscale, LLLLL: under-scale)
Target temperature in fixed temperature operation	SV1	R/W	Set value of target temperature in fixed temperature operation. Setting range: -20℃ to 90℃ (-0200-00900)

Programmed operation

Name	Identifier	Command	Set value
Target temperature in current step	SSV	R	Shows target temperature in the current step in programmed operation. (HHHHH: overscale, LLLLL: under-scale)
Current step readout	STP	R	Shows the number of the current step in programmed operation.
Step remaining time readout	STT	R	Shows the remaining time of the current step in programmed operation.
Program number 1 Target temperature (Step 1-10)	11S to 1AS *1	R/W	Signifies the set value of target temperature in step 1 to 10 on program number 1. Setting range: -20℃ to 90℃ (-0200-00900)
Program number 1 Setting time (Step 1-10)	11T to 1AT *1	R/W	Signifies the set value of time in step 1 to 10 on program number 1. Setting range: 0 min- 999hrs: in minutes *2 (00000-59940)
Program number 1 Repeat destination setting (Step 1-10)	11F to 1AF *1	R/W	Signifies repeat destination setting in step 1 to 10 on program number 1. Setting range: OFF-Setting step No. (Max. 10 steps) (10000-00010)
Program number 1 Number of times to repeat (Step 1-10)	11R to 1AR *1	R/W	Signifies the number of times to repeat in step 1 to 10 on program number 1. Setting range: 0: unlimited repetition number 1-99: repetition number (00000-00099)
Program number 2 Target temperature (Step 1-10)	21S to 2AS *1	R/W	Signifies the set value of target temperature in step 1 to 10 on program number 2. Setting range: -20℃ to 90℃ (-0200-00900)
Program number 2 Setting time (Step 1-10)	21T to 2AT *1	R/W	Signifies the set value of time in step 1 to 10 on program number 2. Setting range: 0min- 999hrs: in minutes *2 (00000-59940)

Program operation mode

Name	Identifier	Command	Set value
Program number 2 Repeat destination setting (Step 1-10)	21F to 2AF *1	R/W	Signifies repeat destination setting in step 1 to 10 on program number 2. Setting range: OFF-Setting step No. (max. 10 steps)
Program number 2 Number of times to repeat (Step 1-10)	21R to 2AR *1	R/W	Signifies the number of times to repeat in step 1 to 10 on program number 2. Setting range: 0: unlimited repetition number 1-99: repetition number (00000-00099)
Program number 3 Target temperature (Step 1-10)	31S to 3AS *1	R/W	Signifies the set value of target temperature in step 1 to 10 on program number 3. Setting range: -20℃ to 90℃ (-0200-00900)
Program number 3 Setting time (Step 1-10)	31T to 3AT *1	R/W	Signifies the set value of time in step 1 to 10 on program number 3. Setting range: 0min- 999hrs: in minutes *2 (00000-59940)
Program number 3 Repeat destination setting (Step 1-10)	31F to 3AF *1	R/W	Signifies repeat destination setting in step 1 to 10 on program number 3. Setting range: OFF-Setting step No. (Max. 10 steps) (00000-00010)
Program number 3 Number of times to repeat (Step 1-10)	31R to 3AR *1	R/W	Signifies the number of times to repeat in step 1 to 10 on program number 3. Setting range: 0: unlimited repetition number 1-99: repetition number (00000-00099)
Program 1-3 End step setting	P1S to P3S	R/W	Signifies the set value of final step on program number 1-3. Setting range: 0-10 (00000-00010)

Function menu mode

Name	Identifier	Command	Set value
Preset temperature setting (max. 10 settings)	P01 to P10	R/W	Signifies the set value of preset temperature Setting range: -20℃ to 90℃ (-0200-00900)
Accumulated time display	ACM	R	Displays accumulated power-on time. Display range: 0-49999 (in hours)
Jet strength setting	PMP	R/W	Signifies the set value of jet strength. Setting range: 1-10 (00001-00010)

Function menu mode

Name	Identifier	Command	Set value
Beep output on abnormal setting	BEP	R/W	ON, OFF setting of beep sounds at errors. Setting range: 0(OFF), 1(ON) (00000,00001)
Wait time setting	_WT *3	R/W	Signifies the set value of ON, OFF and time setting for wait function. Setting range: OFF/1min-1hr, 59min/ON (OFF=00000, 00001-00119, ON=00120)
Wait zone upper limit setting	WZH	R/W	Signifies upper limit set value of temperature range (deviation from measured value) which completes wait operations. Setting range: 0.0℃-100.0℃ (00000-01000)
Wait zone lower limit setting	WZL	R/W	Signifies lower limit set value of temperature range (deviation from measured value) which completes wait operations. Setting range: 0.0℃-100.0℃ (00000-01000)
Hold function setting	HLD	R/W	ON, OFF setting of hold function. (works only while unit is in the remote mode) Setting range: 0(OFF),1(ON) (00000,00001)
Calibration offset	CAL	R/W	Signifies the set value of calibration offset. Setting range: -5.0℃ to 5.0℃ (-0050-00050)
Recovery function	PON	R/W	ON, OFF setting of the automatic power recovery function. Setting range: 0(OFF), 1(ON) (00000,00001)

Remote operation mode

Name	Iidentifier	Command	Set value
Remote mode Start/stop	RMT	R/W	Start/stop command for the remote mode. *Unit is operated by following identifiers only when being in the remote mode. In this state, all keys of main unit become unresponsive. (Remote lamp illuminates) Setting range: 0(OFF), 1(ON) (00000,00001)
Fixed temperature operation and Quick auto stop operation	FIX	W	This is a start command of fixed temperature operation and quick auto stop operation. (works only while unit is in the remote mode) Setting range: 0 min (fixed temperature operation) 1min-999hrs (quick auto stop operation) (00000-59940)
Programmed operation and auto start operation (Program number 1-3)	PG1 to PG3	W	This is a start command of programmed operation and auto start operation. (works only while the foma phone is in the remote mode) Setting range: 0 min (programmed operation) 1min-999hrs (auto start mode) (00000-59940)
Standby setting	RST	W	This is a command for unit to standby. Settable range: 1 (operation standby) (00001)

Monitoring function

Name	Identifier	Command	Set value
Output monitor	OM1	R	This is a monitoring function for confirming various outputs. The following is displayed when any item is actually outputted. 00000 ‖ ◄——— Time-up output | ◄——— Alarm output
Error monitor 1	EM1	R	This is a monitoring function for confirming errors. The following is displayed when an error occurs. 00000 ‖‖ ◄——— Controller failure (ER15) ‖ ◄——— Sensor error (ER01) | ◄——— SSR short error(ER2)
Error monitor 2	EM2	R	This is a monitoring function for confirming errors. The following is displayed when an error occurs. 00000 ‖‖‖ ◄——— Main relay error (ER10) ‖‖ ◄——— Independent overheat prevention device error (heater disconnection error) (ER03) | ◄——— Abnormality water level(ER20)
Operating status monitor	RUN	R	This is a monitoring function for confirming current operating state. 0: Operation standby 1: Fixed temperature operation 2: Quick auto stop operation 3: End of quick auto stop 4: Programmed operation 1 standby 5: Programmed operation 1 6: Programmed operation 2 standby 7: Programmed operation 2 8: Programmed operation 3 standby 9: Programmed operation 3 A(10): End of programmed operation (00000-00010)

8. List of ASCII Codes

ASCII-code	02H	03H	06H	15H						
Symbol	STX	ETX	ACK	NAK						

ASCII-code	30H	31H	32H	33H	34H	35H	36H	37H	38H	39H
Numeric	0	1	2	3	4	5	6	7	8	9

ASCII-code	2DH	20H								
Numeric	- Negative	SP Space								

ASCII-code	41H	42H	43H	44H	45H	46H	47H	48H	49H	4AH
Symbol	A	B	C	D	E	F	G	H	I	J

ASCII-code	4BH	4CH	4DH	4EH	4FH	50H	51H	52H	53H	54H
Symbol	K	L	M	N	O	P	Q	R	S	T

ASCII-code	55H	56H	57H	58H	59H	5AH	20H			
Symbol	U	V	W	X	Y	Z	SP Space			

9. Remote operation

To operate unit through external communication (remote operation), enter main unit into remote mode beforehand by identifier "RMT" . In remote mode unit operates as following.

<Remote mode>
- All keys of main unit become unresponsive.
- Fixed temperature operation can be remotely started by Identifier "FIX".
  (Select fixed temperature operation or quick auto stop operation with numeric data. Unit operates in fixed temperature operation with 00000, in quick auto stop operation with a set value at 00001 or more.)
- Programmed operation 1-3 can be remotely started by identifier "PG1" to "PG3".
  (Select programmed operation or auto start operation with numeric data. Unit operates in programmed operation with 00000, in auto start operation with a set value of 00001 or more.)

*1 "FIX", "PG1", "PG2" and "PG3" accept orders only in remote mode.
*2 Unit will maintain the state of operation if remote mode is entered or canceled during operation.
*3 When power supply to main unit is shut off during remote mode, it is not continued after power recovery.

1. DO NOT process hazardous or harmful 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.84)

2. Turn off power swith (circuit protector) immediately if an abnormality occurs.

If unit begins emitting smoke or abnormal odors for reasons unknown, turn off main power switch immediately, disconnect power cable from power supply, and contact original dealer of purchase or Yamato sales office for assistanceContinuing 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 be always be performed by a certified technician.

3. Install exhaust, ventilation unit, and fire extinguisher.

Devices which heat silicon oil present a fire hazard and may emit harmful fumes. Always be sure that a ventilation hood is installed over such devices, with a fire extinguisher in close proximity.

4. Handle main unit, sample container and water/oil with care after operating unit at high temperature.

Main unit, sample container and water/oil are hot for some time after operation. Do not touch upon sample removal from the bath, following high temperature operation. Use heat-resistant gloves and exercise extreme care in order to avoid getting burned.

5. Be extremely careful with hot air and steam from the bath during operation.

When operating unit at high temperature, water produces steam and hot air. Exercise vigilance in order to avoid burn injury.
Do not operate unit with water temperature of above 80℃ or while water is boiling (BF601).
Steam from the bath may damage keypad and/or deform labels on control panel.

6. DO NOT heat without appropriate fluid in the bath.

BF series unit features water level sensor and overheat prevention device to prevent heating with the bath empty. Running unit without fluid will degrade the heating element, affecting the overall life of the heater, and also presents a fire hazard. Confirm that the bath contains water/oil before operation and add if fluid levels are low. As a rule of thumb, fluid quantity should be approximately 80% for the whole bath with sample container is set inside.

7. Do not leave unit unattended during operation.

Operating unit unattended may cause water/oil to continue evaporating during operation, resulting in boil-dry.
Heated oil presents a fire hazard which could result in serious injury or death.

8. Handle power cable with care.

Contacting or tripping over power cable during operation may cause main unit to tip over or fluid to spill, resulting in burn injury. Pay due attention to surroundings when handling power cable.

9. DO NOT place items on top of equipment.

Do not place any objects on top of unit. Such objects may fall, resulting in personal injury. Do not place paper or other flammable objects on or around unit.

10. DO NOT operate equipment during thunderstorms.

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

11. DO NOT process corrosive items.

Acidic samples may cause corrosion to sensor and heater, despite stainless steel construction. Avoid processing corrosive items.

12. ALWAYS run equipment within specified temperature range.

Temperature control range is room temperature +5℃ to 80℃ (BF201/401/501), room temperature +5℃ to 180℃ (BF601).
Never attempt to operate unit outside of specification range. Fire may result, causing serious injury or death.

13. Overnight and extended storage.

Whenever unit is not in operation, stored overnight or put in storage, always turn off main power switch and disconnect power cable.

14. Keep upright

Never tip or place unit on its side while moisture remains in the bath. Moisture may enter from unit openings and cause malfunction. Take fall preventive measures when keep it standing.

15. Supplies of fluids.

Be sure not to spill fluid on or around unit when adding. Fire or leakage of current may result.

16. Water and Silicon oil.

In order to prevent mineral deposit to build up in the bath, using distilled water or ion exchange water is recommended. If only tap water is being employed as coolant, frequently change water entirely.
(Do not continue adding water without changing or washing. Rust and corrosion will result.)
Heater may rupture due to insuficient heat-radiation caused by mineral deposit accumulation.
When using BF601 with an oil-bath, do not use any fluid other than specified silicon oil in the bath.
Always use recommended silicon oil, periodically change oil and wash the testing bath.
See "14. Using silicon oil (BF601)" (P.10)

17. Read instruction manual thoroughly before operation.

Read instruction manual for safe and proper equipment operation.

⚠ **WARNING**

●Be sure that main power switch is OFF and disconnect power cable from facility outlet before daily inspection and maintenance.
●Perform inspections and maintenance when unit is returned to room temperature.
●Clean off any water/oil on or around the control panel with a soft, damp cloth.
●Never attempt to disassemble unit.

⚠ **CAUTION**

●Confirm whether water level of the testing bath is adequate at each use.
●Ensure that there is no abnormal sounds or the degraded jet performance found. (BF401/501)
●Clean unit using a 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 contaminants, excess fluids and oil from the bath with a clean, dry cloth.
●Use caution not to damage heater, sensor and other components.

Inspect Monthly.

●When unit is frequently used at high temperature, mineral deposits accumulate on heater and it may shorten the lifetime. Exercise caution not to bend or damage water level detection sensor and temperature control sensor when removing mineral deposits.
●If operating unit at incubation temperature, check for scale formed on stirring mechanism, heater, water level detection sensor, temperature control sensor and overheat prevention device sensor.
●Frequently change water entirely.
●Dismantle BF unit before washing the testing bath.

◆Contact original dealer of purchase or Yamato sales office for service or questions.

⚠WARNING

Extended storage

● Turn off main power switch and disconnect power cable from outlet.

● When storing BF unit on its side, the moisture in the wetted part must be completely removed.

● Discharge water from the bath. ⇒ Dismantle BF unit before draining.

● Do not let foreign objects be mixed in the silicon oil.

⇒ Cover the testing bath or transfer it to a predetermined container.

Disposal

⚠ CAUTION

● When disposing of the silicon oil, soak a cloth or paper in the oil to absorb it and discard as industrial waste.

● Remove all the silicon oil out of the testing bath used in operation prior to the disposal of unit.

● Place out of reach of children.

Disposal Considerations

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

Component Name	Material
Main unit	
Exterior parts	Polycarbonate, aluminum plate, stainless steel plate
Water bath	Polypropylene
Labels	Resin material
Electrical parts	
Switches and relays	Composite of resin, copper and other materials
Control panel	Polyethylene (PET) resin film
Circuit boards	Composite of fiber glass and other materials
Heater	Stainless Steel., magnesium oxide, nichrome wire etc.
Power cable	Composite of synthesized rubber coating, copper, nickel and other compounds
Wiring material	Fire-retardant vinyl, copper, nickel and other compounds
Sensor (platinum resistance temperature detector)	Stainless Steel etc.

Shuts off heater output when an abnormality occurs.
Error code will show in the main display (in the sub display for BF201) flashing acconpanied by beep sounds. Confirm the error codes and turn off main power switch immediately. Press ENTER key to deactivate only beep sound.

Error codes	Error name	Possible Causes and measures
HZ.ER	Power supply frequency error	• Power supply frequency (50Hz/60Hz) could not be detected . ❖ Reset power supply (re-entry). If unit does not function normally after power reset, call for service.
ER01	Sensor Failure	• Temperture in the bath abnormaly falls ("_____")will show in the main display below-30℃), or rise ("_____") will show in the main display over 220℃). • Temperature sensor disconnected ("_____" will show in the main display) or short circuited ("_____" will show in the main display). BF201 unit does not display "_____" and "_____". • Controller failure ❖ Confirm that temperture in the bath is in the range of -30 to 220℃ taken by separately prepared sensor. If temperature is within the range, temperature sensor or controller may need to be replaced. Contact original dealer of purchase or Yamato sales office for assistance
ER02	SSR short error	• SSR short circuit ❖ SSR replacement is required. Contact original dealer of purchase or Yamato sales office for assistance
ER03	Overheating error or heater interruption	• Independent Overheat Prevention Device (IOPD) activated ❖ Turn main power off, then back on (reset) after checking IOPD temperature setting. If unit does not function normally after power reset, call for service. • Heater interruption ❖ Heater replacement is required. Contact original dealer of purchase or Yamato sales office for assistance
ER10	Main relay error.	• Contact welding on the main relay is detected while unit is initializing. ❖ Reset power supply (re-entry). If unit does not function normally after power reset, call for service.
ER15	Controller failure	• Abnormalities occurred to the controller. ❖ Circuit board repair is required. Contact original dealer of purchase or Yamato sales office for assistance
ER20	Water level error *Only Er20 is shown in the display	• Water level lowered • Float sensor disconnection *Returns when refilled to the specified level. If unit does not function normally after power reset, call for service.

Troubles

Symptom	Check
Nothing is displayed in control panel display(s) when main power switch is turned on.	• Whether power cable is securely connected to outlet. • Whether there is a power supply failure (out of range of power supply voltage ±10%). • Whether a power outage is in progress. • Display(s) may not illuminate if main power switch is repeatedly RESET(ON) and OFF. Wait for several seconds before pressing main power switch to RESET(ON)
Power supply cut off	• Whether water is spilling over unit. • Electrical short circuit(*)
Temperature in the bath does not rise	• Heater interruption (*) • Overheat prevention activates and shuts the heater circuit. (Error code [ER3] displayed) • Whether the ambient temperatures is low.
Temperature fluctuates during operation	• Whether there are large fluctuations in external temperature. • Whether the water level of the testing bath is lowered. • Whether the quantity of test sample is appropriate. • Whether the silicon oil viscosity is too high. (BF601)
Stirring performance is deteriorated.	• Whether foreign substances are blocking in the stirring mechanism. • Whether power supply voltage dropped. • Whether the jet strength setting is at low. (BF401/501)

Note: If an error marked with an asterisk is applicable or the problem does not fall under any of errors above, turn off power immediately, disconnect power cable and contact original dealer of purchase or Yamato sales office for assistance.

Requests for Repair

If problem persists or does not fall under any of errors above, turn off power immediately, disconnect power cable and contact original dealer of purchase or Yamato sales office for assistance.

The following information is required for all repairs.
- Model
- Serial Number
- Date (year/month/day) of purchase

Refer to warranty card or serial no. and rating label on unit.
See "COMPONENT NAMES AND FUNCTIONS" (P.11)

- Description of problem in as much detail as possible

Be sure to present warranty card to Yamato service representative

Keep warranty card with care. (attached separately)

- Warranty card is given by local dealer or one of Yamato sales offices. Date of purchase of this equipment and other information should be filled in warranty card. Please send warranty card to Yamato customer service center by facsimile described Fax number in the left top corner of it. Then, keep the card with good care.

- 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.

Guaranteed Supply Period for Repair Parts

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

Specifications

Model	BF201	BF401	BF501	BF601
Product code	221808	221809	221810	221811
External temperature range	5℃ to 35℃			
Performance — Temperature setting range	-20 to 90℃ *1			0 to 200℃
Temperature control range	Room temp +5 to 80℃ *2			Room temp +5 to 180℃*3
Temperature control accuracy	±0.05/0.1℃ *4	±0.02/0.05℃ *4		±0.05/0.2℃ *5
	Performance based on maximum jet strength of "10", room temp 23℃±5℃, 65%RH±20% humidity, rated power supply voltage,no process load.			
Configuration — Heater	SUS pipe heater			
	1.0kW			1.2kW
Stirring mechanism	Propeller stirring	Water jet stirring		Propeller stirring
Motor	31/27W (shaded‐pole motor)			
Jet strength variable function	Fixied	Variable in 10 stages (variablet angle outlet)		Fixed
Controller — Controller type	T04MT			
Temperature control system	PID control			
Temperature setting system	Digital setting by up/down keys			
Temperature display system	Measured/target temperature display: green 4-digit LED digital display Digital 7 segment display (Res: 0.1℃)	Target temperature display: orange 4-digit LED digital display (Resolution: 0.1℃, 1℃ for BF601) Measured temperature display: green 4 digit LED digital display (Resolution: 0.1℃, 1℃ for BF601)		
Other displays	LED indicator for operation status and erorrs			
Timer/timer Resolution	Time: 1min-99hrs, 59min /1min, 100hrs-999hrs/1hour			
Operation modes	Fixed temperature operation	Fixed temperature, quick auto stop operation Repeat function, auto start function		
		Programmed operation: 3 patterns 10 steps		
Additional functions	Preset temperature function (10 points)	Calibration offset, keypad lock Preset temperature function (10 points) auto-resume function		
External output terminal *6	Not included		Temperature output External Alarm Output Time-up Output External communication	Not included
Heater Control	Triac (SSR) with Zero-cross Control			
Temperature sensor	Platinum resistance temperature detector (Pt100)			

Specifications

Model		BF201	BF401	BF501	BF601
Controller	Safety devices	Self-diagnostics function (power supply frequency error, controller failure detection, Sensor failure detection, heater interruption detection, triac (SSR) short circuit detection, Main relay contact failure, automatic overheat prevention, measured temperature error detection) Independent Overheat Prevention Device (IOPD), circuit protector, float level detection			

Model		BF201	BF401	BF501	BF601
Standard	External dimensions (mm) *7	W140×D138×H312			
	Power supply (50/60 Hz)	**Single phase 100V with external transformer for 115V or 220V**			
	Rated current	**115V / 10A 220V / 5A**			**115V / 11.5A 220V / 6A**
	Weight	Approx. 4kg			
	Maximum thickness to clamp	35mm			
Accessories	water bath	BY100			
	Instruction Manual	1			
	Warranty card	1			
	Advisory	1			

*1 When operating condition is at room temperature +5℃ or less, operate unit in conjunction with a low temperature water bath or BE series immersion cooler Neocool dip.
*2 When the testing bath BY100 is used.
*3 When the testing bath BZ100D and silicon oil with a viscosity of 50cSt are used. Water can not be used at temperature above 80℃.
*4 When set temperature is at 37℃/80℃ and the testing bath BY100 is used.
*5 When set temperature is at 40℃/180℃, and the testing bath BZ100D and silicon oil with a viscosity of 50cSt are used.
*6 output is hybridized 1 output terminal in correspondence.
*7 External dimensions do not include protrusions.

* Power cable length is approx. 2.8m.

Immersion constant temperature devices Thermomate® are compatible with a wide variety of available options as shown in the table below.

List of Options

Product name		Product code	Model	Compatible models	Description
Level controller (automatic water supply unit)		221570	OBF10	All	Maintains constant water level through the use of float level function.
Cooling pipe		221572	OBJ10	All	Use when operating at room temperature +5℃ or less
Bath cover (Machining is partly required when useing together with the optional cooling pipe and external circulation nozzle,)		221578	OBI11	All	Stainless-steel cover for the included the testing bath BY100 (However, the cover cannot be set when the automatic water supply unit, external circulation nozzle, and cooling pipe are mounted).
External circulation nozzle		221573	OBG10	BF401/501	Enables to circulate through external closed systems by connecting to BF401/501 units
Float for microtube (for φ8mm)		221575	OBH10	All	Can be attached up to 24 pcs.
Float for microtube (for φ11mm)		221576	OBH20		
Testing bath	Stainless steel plate	221820	BZ100	All	Suitable for high temperature operation and as an oil bath
		221821	BZ100D		
		221822	BZ200		
		221823	BZ300		
	Polypropylene	221824	BY100		Use within range of -5℃ to 80℃
		221825	BY200		
	Acrylate	221826	BX100		For water only Use below 50℃ Employs transparent acrylate
		221827	BX100D		
		221828	BX200		
External communication adapter		221871	OBF12	BF501	Set up when communicating with PC or other equipment See P.58 for details
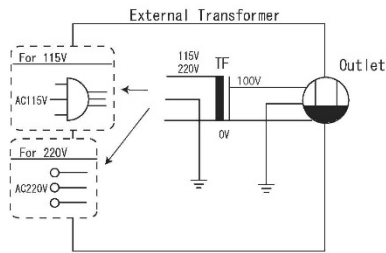
Connect to the Outlet of the External Transformer.

要確認

BF201/601

Symbol	Component
MAIN	Control Circuit Board
DISP	Display Board
CP1	Circuit Protector
T1	Terminal Block
H1	Heater
M1	Motor
X1	Relay
X2	Relay
SSR1	Solid State Relay
CT1	Current Transformer Sensor
FLS1	Float Switch
TH1	Pt Sensor
C1	Condenser
OH1	Independent Overheat Prevention Device
TF	Transformer

* Circled numbers indicate wire markers.
* Dotted lines (———) indicate BF601 wiring.

BF401/501

Symbol	Component
MAIN	Control Circuit Board
DISP	Display Board
CP1	Circuit Protector
T1	Terminal Block
H1	Heater
M1	Motor
X1	Relay
X2	Relay
SSR1	Solid State Relay
CT1	Current Transformer Sensor
FLS1	Float Switch
TH1	Pt Sensor
C1	Condenser
OH1	Independent Overheat Prevention Device
SSR2	Solid State Relay
TF	Transformer

* Circled numbers indicate wire markers.
* Dotted lines (———) indicate BF501 wiring.

13. LIST OF HAZARDOUS SUBSTANCES

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

Explosive substances	①Nitroglycol, Glycerine trinitrate, Cellulose Nitrate and other explosive nitrate esters
	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	①Metal "Lithium" ②Metal "Potassium" ③Metal "Natrium" ④Yellow Phosphorus
	⑤Phosphorus Sulfide ⑥Red Phosphorus⑦Phosphorus Sulfide
	⑧Celluloids, Calcium Carbide (a.k.a, Carbide)⑨Lime Phosphide⑩Magnesium Powder
	⑪Aluminum Powder ⑫Metal Powder other than Magnesium and Aluminum Powder
	⑬Sodium Dithionous Acid (a.k.a., Hydrosulphite)
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 having ignition point of 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 having ignition point of between zero and less than 30 degrees.
	④Kerosene, Light Oil, Terebinth Oil, Isopenthyl Alcohol (a.k.a. Isoamyl Alcohol), Acetic Acid and other substances having ignition point of between 30 degrees and less than 65 degrees.
Combustible gas	Hydrogen, Acetylene, Ethylene, Methane, Ethane, Propane, Butane and other gases combustible at 15°C, ambient air pressure.

14. STANDARD INSTALLATION MANUAL

* Install this equipment according to following format.

Model	Serial Number	Installation Date	Charged Personnel or Company Name for Installation	Installation proved by	Judgment

No.	Item	Implementation method	Chapter No. & Reference page of instruction manual		Judgment
Specification					
1	Accessories	Quantity check according to the accessories column	10. SPECIFICATIONS	P.80	
2	Installation	- Visual check of surrounding conditions Caution: Take care for environment, exhaust unit, fire extinguisher and type of silicon oil	1. SAFETY PRECAUTIONS - Explanation of … 2. PRE-OPERATION PROCEDURES -Installation Precautions	P.1-5 P.6-8	
Operation-related matters					
1	Power supply voltage	- Measure line voltage (power distribution board of facilities, outlet etc.) with a tester. - Measure line voltage during operation (must meet required voltage).	10. SPECIFICATIONS	P.80	
2	Confirmation on operation	- Explain name and function of each component.	3. COMPONENT NAMES AND FUNCTIONS -External View -Control panel	 P.11-12 P.13-14	
Description					
1	Operational descriptions	Explain operations of each component and handling precautions according to instruction manual.	2. PRE-OPERATION PROCEDURES -Operation Preparations 4. OPERATION PROCEDURES - Operation Modes and… - Mode & Function Flow - Fixed Temperature… - Independent Overheat.. - Function Menu… - External Output… 5. HANDLING PRECAUTIONS - Warning - Caution 13. LIST OF HAZARDOUS SUBSTANCES - List of Hazardous Substances	 P.9-10 P.15-16 P.17-19 P.20-32 P.33 P.34-55 P.56-72 P.73 P.74 P.84	
2	Error codes	Explain about error codes and procedures for reset according to instruction manual.	8. TROUBLESHOOTING - Error Codes - Troubleshooting	 P.77 P.78	

3	Maintenance and inspection	Explain about maintenance of equipment and each component according to instruction manual	6. MAINTENANCE PROCEDURES -Daily Inspection and… P.75 7. EXTENDED STORAGE AND DISPOSAL - Extended Storage P.76	
4	Completion of installation Entries	- Fill in Installation Date and Charged Personnel or Company Name on OK and Service label of equipment. - Fill in necessary information to warranty card and hand it over to customer - Explain how to contact with service personnel	9. SERVICE & REPAIR - Requests for Repair P.79	

[BF201,401,501] TemperatureRise [Reference Data]

Regard the data below as reference only since actual numeric results will differ depending on the sample amount, the environmental temperature or other factors.
 *Conditions of data acquisition:
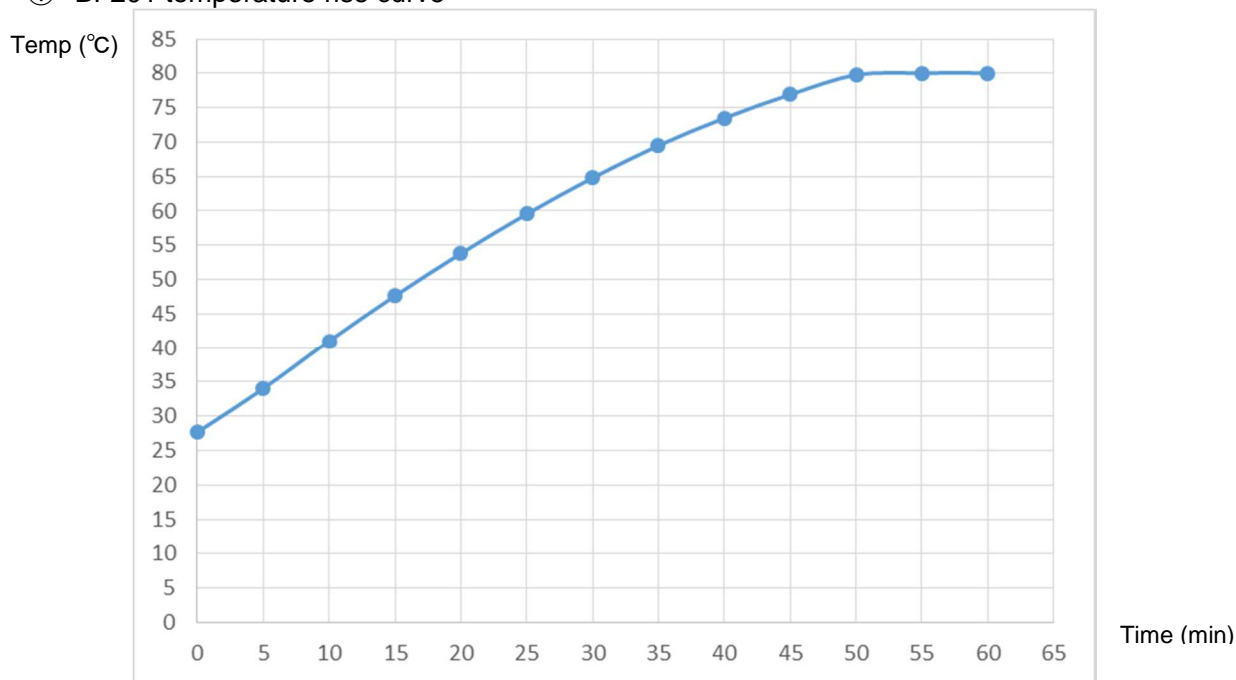 Water bath: BY100 (included) Polypropylene
 Fluid: Approx. 7.2L (Approx. 90% of the bath capacity) of pure water (ion exchange water)
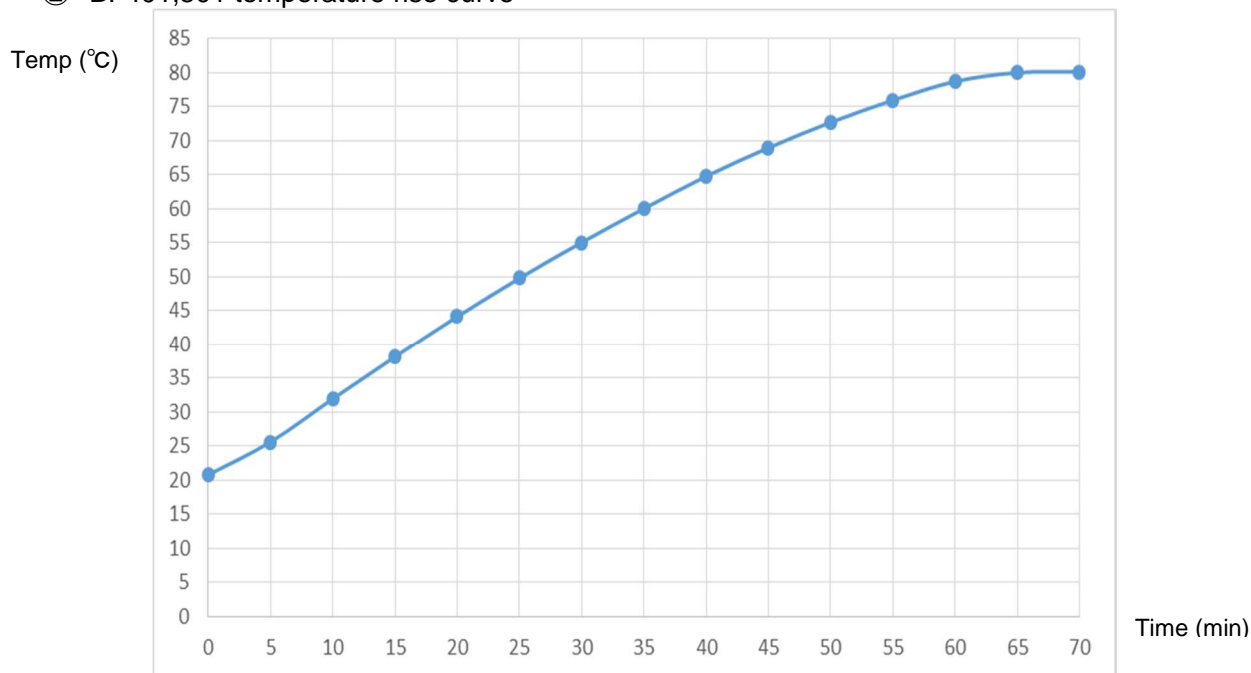 Ambient temperature: 23℃
 Temperature measurement point: Bath center
 Power supply: Commercial power 103V AC 50Hz

 ① BF201 temperature rise curve

Temp (℃)

Time (min)

 ② BF401,501 temperature rise curve

Temp (℃)

Time (min)

 *The water jet strength is set at the highest of "10".

Caution: Conducting tests with the baths filled for 90% of the capacity is due to data
         acquisition. Confirm an appropriate amount which deffers according to the
         operating conditions when actually fill up the baths

[BF601] Temperature Rise [Reference Data]

Regard the data below as reference only since actual numeric results will differ depending on the sample amount, the environmental temperature or other factors..

*Conditions of data acquisition:

Bath: ①BY100 (included) Polypropylene, ②BZ100D (optionally available) Stainless steel

Fluid: ①Pure water (ion exchange water)approx. 7.2L (Approx. 90% of the bath capacity)
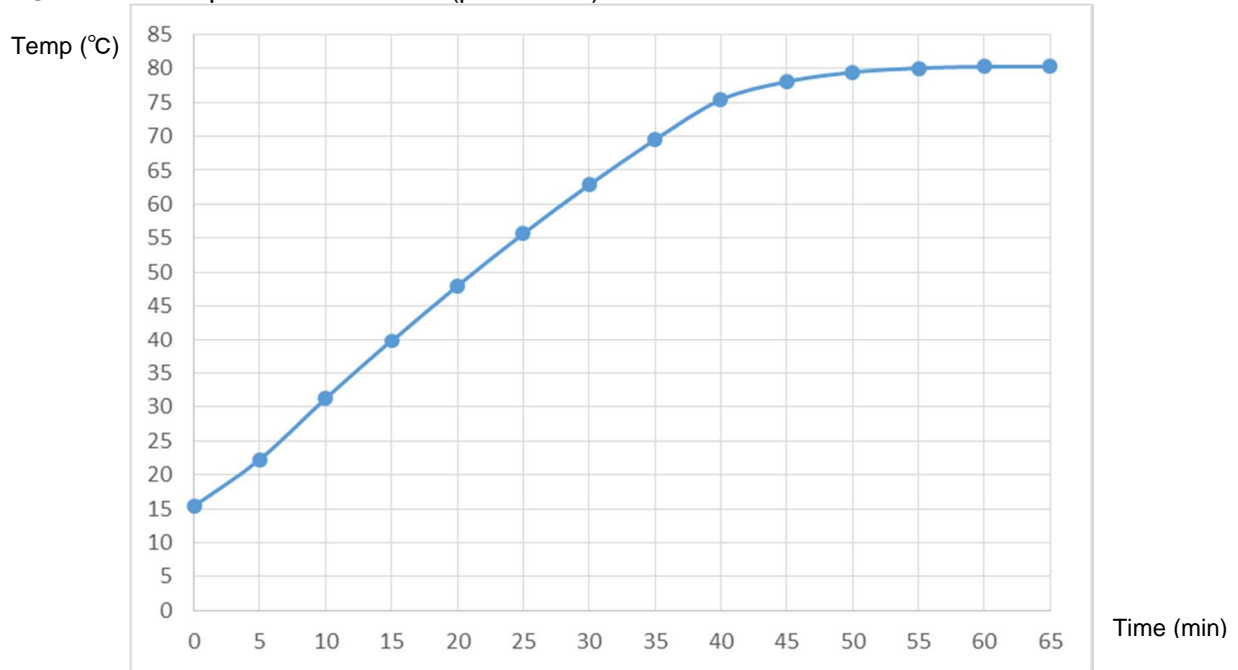②Silicon oil (KF-96-50 cs silicon oil from Shinetsu Science Industries Co., Ltd) approx..11.7L (Approx. 90% of the bath capacity)
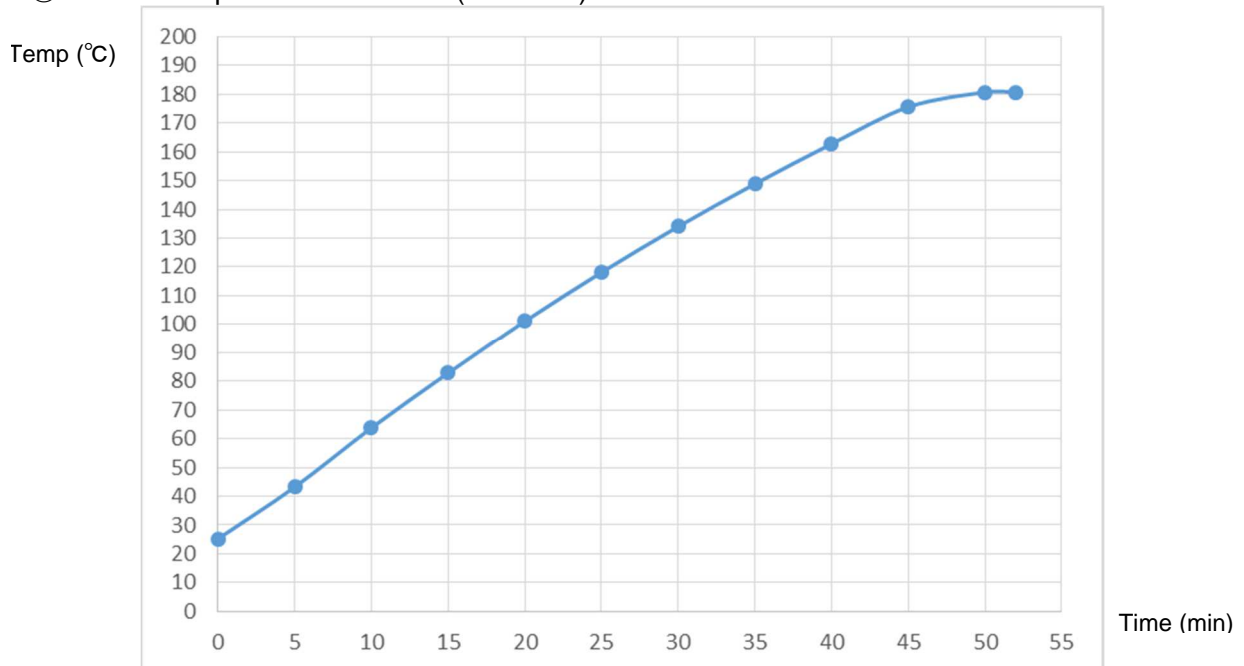
Ambient temperature: 23℃

Temperature measurement point: Bath center

Power supply: Commercial power 103V AC 50Hz

① BF601 temperature rise curve (pure water)

② BF601 temperature rise curve (silicon oil)

Caution: Conducting tests with the baths filled for 90% of the capacity is due to data acquisition. Confirm an appropriate amount which deffers according to the operating conditions when actually fill up the baths

Limited Liability

Always operate equipment in strict compliance to the handling and operation procedures set forth by this instruction manual.

Yamato Scientific Co., Ltd. assumes no responsibility for malfunction, damage, injury or death, resulting from negligent equipment use.

Never attempt to disassemble, repair or perform any procedure on BF series units 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.**