



Muffle Furnace

Model

FP 100/300/310/410

Instruction Manual

- Fourth Edition -

- Thank you for purchasing " Muffle Furnaces, FP Series" of Yamato Scientific Co., Ltd.
- To use this unit properly, read this "Instruction Manual" thoroughly before using this unit.
Keep this instruction manual around this unit for referring at anytime.

 **WARNING!**

Carefully read and thoroughly understand the important warning items described in this manual before using this unit.

Yamato Scientific Co. LTD.,

This paper has been printed on recycled paper.

Contents

◆ Cautions in Using with Safety	1
• Explanation.....	1
• Table of Illustrated Symbols	2
• Fundamental Matters of “WARNING!” and “CAUTION!”	3
◆ Before Using this unit	4
• Requirements for Installation.....	4
◆ Description and Function of Each Part	7
• Main Unit	7
• Control Panel.....	8
◆ Operation Method	9
• Preparation.....	9
• Selecting operation mode.....	12
• Fixed Temperature Operation.....	13
• Auto Start Operation.....	15
• Auto Stop Operation	18
• Program Operation.....	21
• Operating instructions for program menu.....	24
• Create New Program.....	26
• Edit Program	27
• Delete Program	34
• Function menu.....	35
• Calibration Offset Function.....	45
• Independent overheating prevention device	46
• Temperature Rise/Fall (Reference Data).....	47
◆ Handling Precautions	48
◆ Maintenance Method	50
• Daily Inspection and Maintenance	50
◆ Long storage and disposal	51
• When not using this unit for long term / When disposing	51
◆ In the Event of Failure	52
• Error Display.....	52
• Function of safety devices.....	53
• Troubleshooting.....	54
◆ After Service and Warranty	55
◆ Specification	56
◆ Wiring Diagram	57
◆ Replacement Parts Table	59
◆ Reference	62
• List of Dangerous Substances	62

Explanation

MEANING OF ILLUSTRATED SYMBOLS

Illustrated Symbols

Various symbols are used in this safety manual in order to use the unit without danger of injury and damage of the unit. A list of problems caused by ignoring the warnings and improper handling is divided as shown below. Be sure that you understand the warnings and cautions in this manual before operating the unit.

 **WARNING!** If the warning is ignored, there is the danger of a problem that may cause a serious accident or even fatality.

 **CAUTION!** If the caution is ignored, there is the danger of a problem that may cause injury/damage to property or the unit itself.

Meaning of Symbols



This symbol indicates items that urge the warning (including the caution). A detailed warning message is shown adjacent to the symbol.



This symbol indicates items that are strictly prohibited. A detailed message is shown adjacent to the symbol with specific actions not to perform.



This symbol indicates items that should be always performed. A detailed message with instructions is shown adjacent to the symbol.

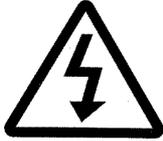
Cautions in Using with Safety

Table of Illustrated Symbols

Warning



Warning,
generally



Warning,
high voltage



Warning,
high temperature



Warning,
drive train



Warning,
explosive

Caution



Caution,
generally



Caution,
electrical shock



Caution,
scald



Caution,
no road heating



Caution,
not to drench



Caution,
water only



Caution,
deadly poison

Prohibit



Prohibit,
generally



Prohibit,
inflammable



Prohibit,
to disassemble



Prohibit,
to touch

Compulsion



Compulsion,
generally



Compulsion,
connect to the
grounding
terminal



Compulsion,
install on a flat
surface



Compulsion,
disconnect the
power plug



Compulsion,
periodical
inspection

Cautions in Using with Safety

Fundamental Matters of “WARNING!” and “CAUTION!”

WARNING!

Do not use this unit in an area where there is flammable or explosive gas

Never use this unit in an area where there is flammable or explosive gas. This unit is not explosion-proof. An arc may be generated when the power switch is turned on or off, and fire/explosion may result. (Refer to page62 “List of Dangerous Substances”.)

Always ground this unit

Always ground this unit on the power equipment side in order to avoid electrical shock due to a power surge.

If a problem occurs

If smoke or strange odor should come out of this unit for some reason, turn off the power key right away, and then turn off the circuit breaker and the main power. Immediately contact a service technician for inspection. If this procedure is not followed, fire or electrical shock may result. Never perform repair work yourself, since it is dangerous and not recommended.

Do not use the power cord if it is bundled or tangled

Do not use the power cord if it is bundled or tangled. If it is used in this manner, it can overheat and fire may be caused.

Do not process, bend, wring, or stretch the power cord forcibly

Do not process, bend, wring, or stretch the power cord forcibly. Fire or electrical shock may result.

Substances that can not be used

Never use explosive substances, flammable substances and substances that include explosive or flammable ingredients in this unit. Explosion or fire may occur.

Do not disassemble or modify this unit

Do not disassemble or modify this unit. Fire or electrical shock or failure may be caused.

Do not touch high-temperature parts

The inside of the body or the door may become hot during and after an operation. It may cause burns.

CAUTION!

During a thunder storm

During a thunderstorm, turn off the power key immediately, then turn off the circuit breaker and the main power. If this procedure is not followed, fire or electrical shock may be caused.

Requirements for Installation

WARNING!

1. Always ground this unit



- Connect the power plug to a receptacle with grounding connectors.
- Do not forget to ground this unit, to protect you and the unit from electrical shock in case of power surge. Choose a receptacle with grounding connectors as often as possible.
- Do not connect the grounding wire to a gas pipe, or by means of a lightning rod or telephone line. A fire or electrical shock will occur.
- Though FP300 model is the 100V single phase model, this model has the large electric capacity as 26A. Be sure to prepare the power switchboard with the specific grand earth or specific receptacle.
- FP310/410 model is the 200V single phase mode. Be sure to connect this model to the specific power switchboard or receptacle for 200V.



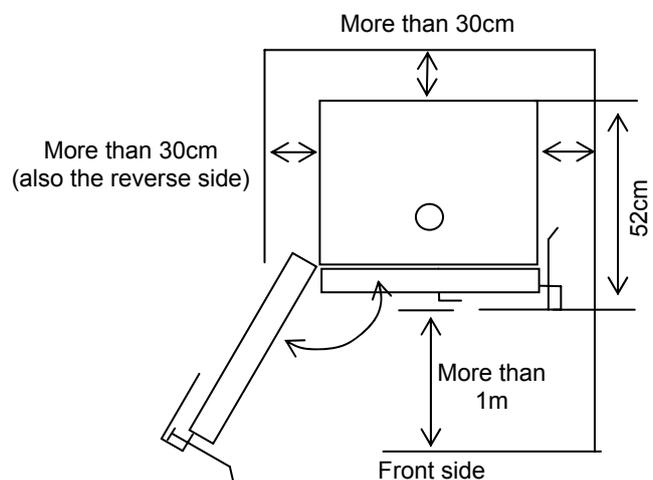
2. Choose a proper place for installation



- Do not install this unit in a place where:
 - ◆ Rough or dirty surface.
 - ◆ Flammable gas or corrosive gas is generated.
 - ◆ Ambient temperature exceeds 35°C.
 - ◆ Ambient temperature fluctuates violently.
 - ◆ There is direct sunlight.
 - ◆ There is excessive humidity and dust.
 - ◆ There is a constant vibration.



- Install this unit on a stable place with the space as shown right. This unit should be installed horizontally by using adjusters on the four corners.

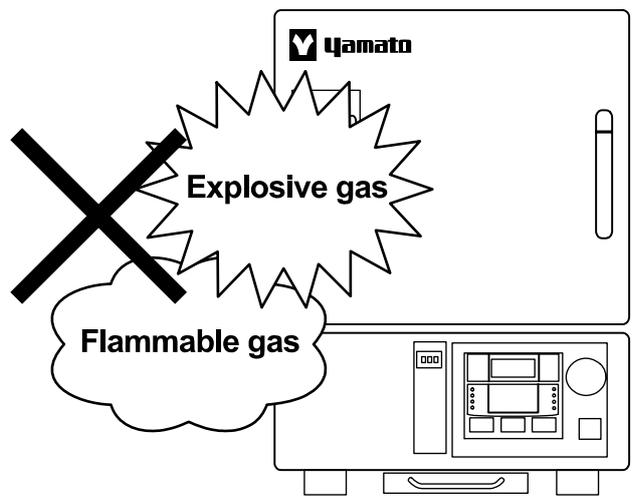


Requirements for Installation

3. Do not use this unit in an area where there is flammable or explosive gas



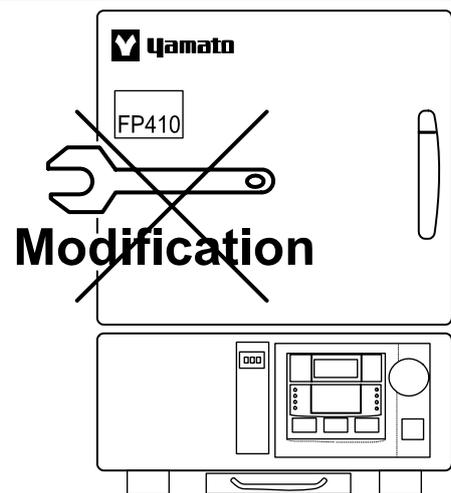
- Never use this unit in an area where there is flammable or explosive gas. This unit is not explosion-proof. An arc may be generated when the power switch is turned ON or OFF, and fire/explosion may result. (Refer to page 62 “List of Dangerous Substances”.)



4. Do not modify



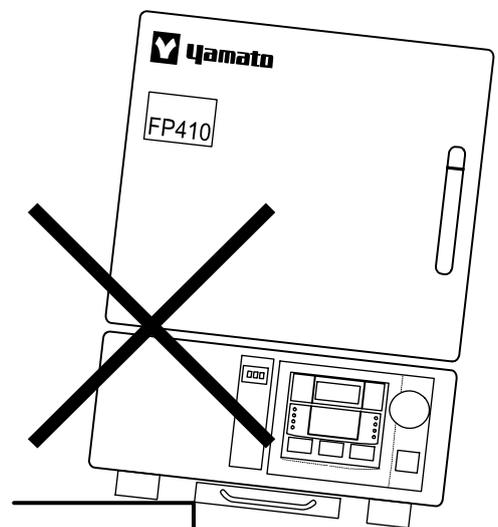
- Modification of this unit is strictly prohibited. This could cause a failure.



5. Installation on horizontal surface



- Set this unit to the flattest place. Not setting this unit with its legs contacted to the setting place surface evenly could cause the vibration or noise, or cause the unexpectible trouble or malfunction.



Requirements for Installation



6. Choose a correct power distribution board or receptacle



- Choose a correct power distribution board or receptacle that meets the unit's rated electric capacity.

Electric capacity:

FP100:	AC100 V, 13A
FP300:	AC100 V, 26A
FP310:	AC200 V (Single phase), 13A
FP410:	AC200V (Single phase), 17.5A

NOTE)

There could be the case that the unit does not run even after turning ON the power. Inspect whether the voltage of the main power is lowered than the specified value, or whether other device(s) uses the same power line of this unit. If the phenomena might be found, change the power line of this unit to the other power line.

Power cord/terminal treatment

Model	Specification for power cord (Nominal cross-sectional area of conductor)	Terminal treatment on power source
FP100	3 cores, 2.0 mm ²	Attachment plug
FP300	3 cores, 5.5 mm ²	Round pressure terminal φ 5mm
FP310	3 cores, 3.5 mm ²	
FP410	3 cores, 3.5 mm ²	

7. Before/after installing



- It may cause injure to a person if this unit falls down or moves by the earthquake and the impact. etc.. To prevent, take measures that the unit cannot fall down, and not install to busy place.
- Touching the unit may cause a burn during and after the operation. To prevent, take measures that putting up a notice of operating, making an enclosure etc..

8. Handling of power code



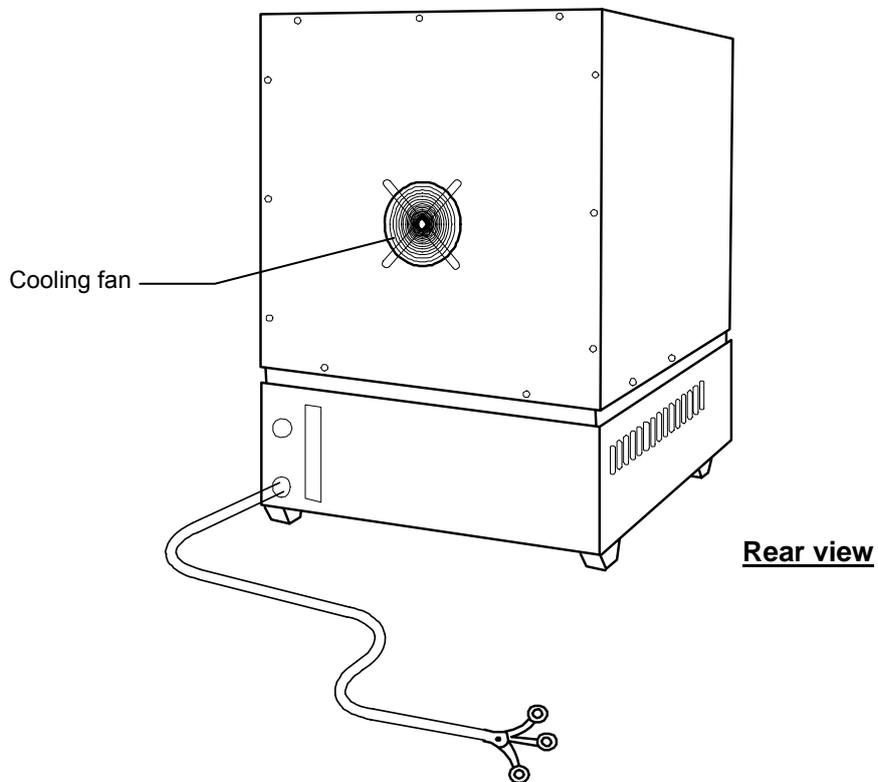
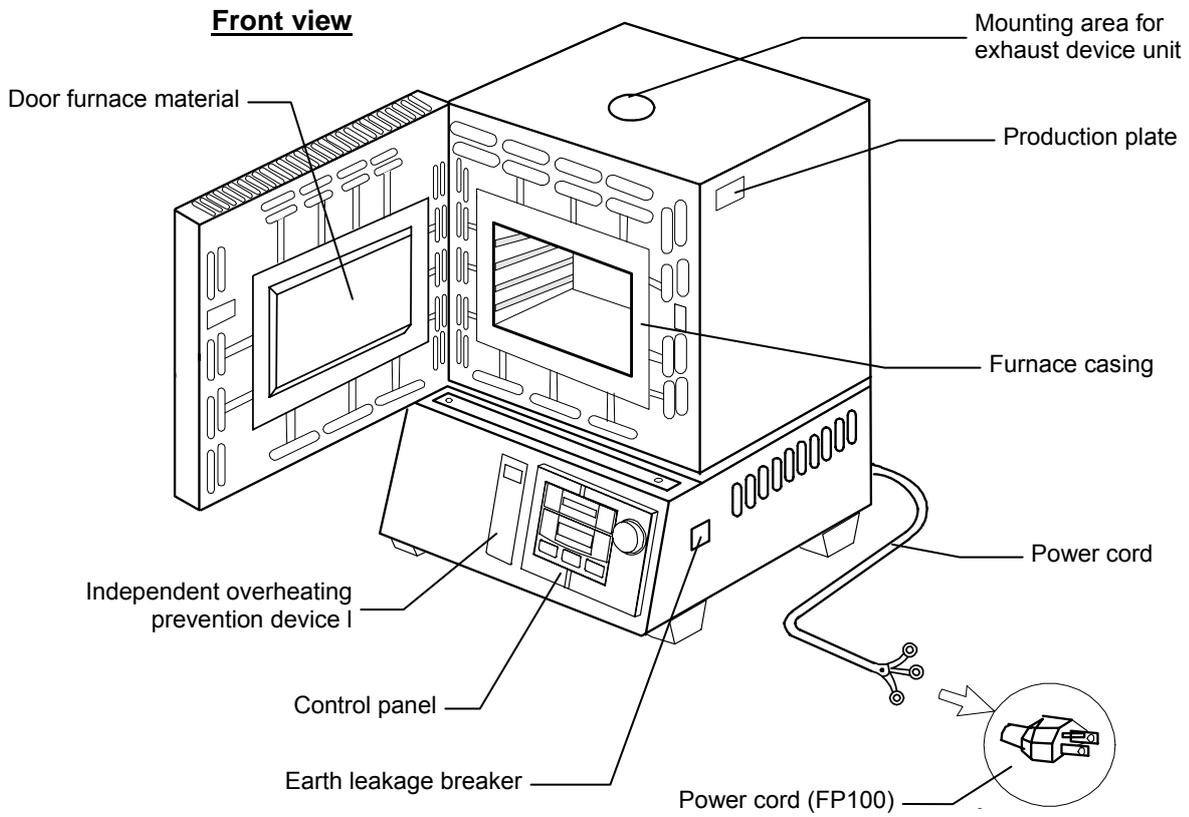
- Do not entangle the power cord. This will cause overheating and possibly a fire.
- Do not bend or twist the power cord, or apply excessive tension to it. This may cause a fire and electrical shock.
- Do not lay the power cord under a desk or chair, and do not allow it to be pinched in order to prevent it from being damaged and to avoid a fire or electrical shock.
- Keep the power cord away from any heating equipment such as a room heater. The cord's insulation may melt and cause a fire or electrical shock.



- If the power cord becomes damaged (wiring exposed, breakage, etc.), immediately turn off the power at the rear of this unit and shut off the main supply power. Then contact your nearest dealer for replacement of the power cord. Leaving it may cause a fire or electrical shock.
- Connect the power plug to the outlet which is supplied appropriate power and voltage.

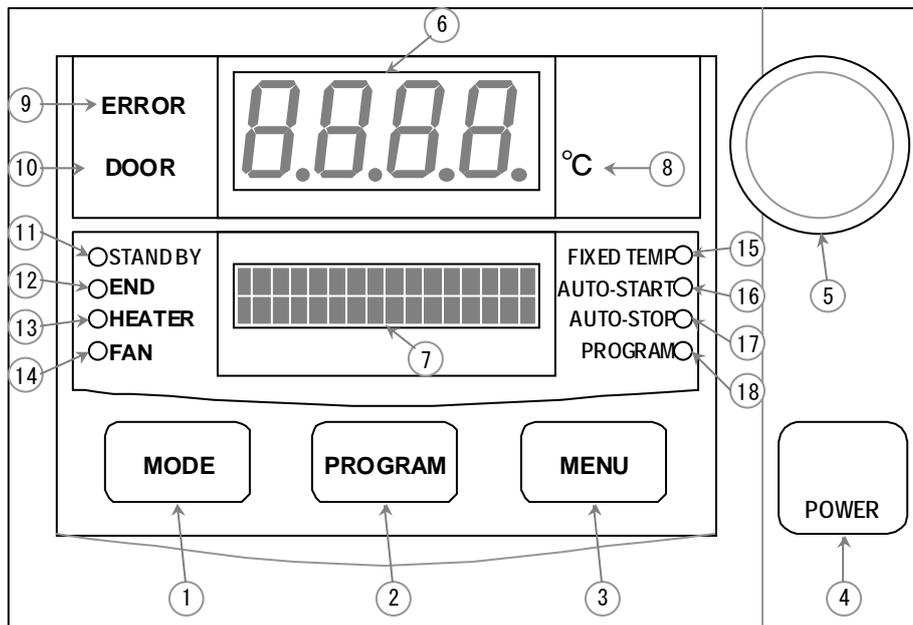
Description and Function of Each Part

Main Unit



Description and Function of Each Part

Control Panel



①	Mode Key	Starts/releases the function menu.
②	Program Key	Starts/releases the program menu.
③	Menu Key	Starts/releases the operation menu.
④	Power Key	Turns ON/OFF the power.
⑤	Jog Dial	Selects menu item and edit parameters.
⑥	Main Indicator	Indicates in-furnace temperature and error number.
⑦	Sub Indicator	Indicates various conditions of device with characters.
⑧	°C Lamp	Lights on while in-furnace temperature is indicated on the main indicator.
⑨	Error Lamp	Blinks when any trouble occurs.
⑩	Door Lamp	Lights on while the door is open (not provided on this unit).
⑪	Standby Lamp	Lights on while the device is in standby condition. Blinks while it is in startup wait state.
⑫	End Lamp	Blinks at autostop or end of the program operation.
⑬	Heater Lamp	Lights on while the heater is active.
⑭	Fan Lamp	Lights on while the fan is active.
⑮	Fixed Temp Lamp	Lights on during the fixed temperature operation. Blinks when selecting operation mode.
⑯	Auto Start Lamp	Lights on during the auto start operation. Blinks when selecting operation mode.
⑰	Auto Stop Lamp	Lights on during the auto stop operation. Blinks when selecting operation mode.
⑱	Program Lamp	Lights on during the program operation. Blinks when selecting operation mode.

Preparation

Connect power plug rightly

The FP series has two specifications; for 100V and 200V depending on the electric capacity used. Make sure that a proper power terminal/power plug is plugged into an adequate distribution board/socket depending on the electric capacity. Refer to Page 6, “Choose a correct power distribution board or receptacle” for the electric capacity.

Set temperature of independent overheating prevention device

Set temperature of independent overheating prevention device. Use the projections on the right side of respective digits on the dial digital switch to set the temperature. The device of FP series works in ten times of the set value. For example, it works at the temperature of 1010°C if the dial is set to “101”, and 1110°C if set to “111”.



- In case there is a small difference between the set values of temperature for independent overheating prevention device and that of controller, the independent overheating prevention device may be activated when the temperature reaches to the set value of controller. Set the temperature of independent overheating prevention device so it be at least 100°C or more higher than that of controller.
(When the setting temperature is lower, there is a case that overshoot occurs because this unit is high temperature type furnace. This independent overheating prevention device should be used for protect the unit.)
- The default value of the independent overheating prevention device at factory shipment is 1200°C.

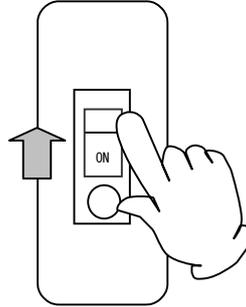
Set samples rightly

Do not load too much samples. Leave a certain space in the furnace.

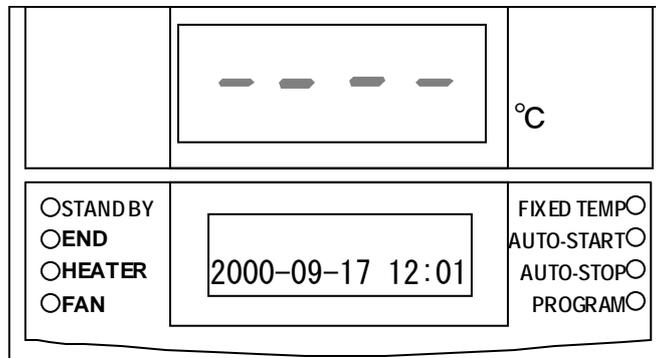
Preparation

Turn on earth leakage breaker

- Turn on the earth leakage breaker at the right side of device.



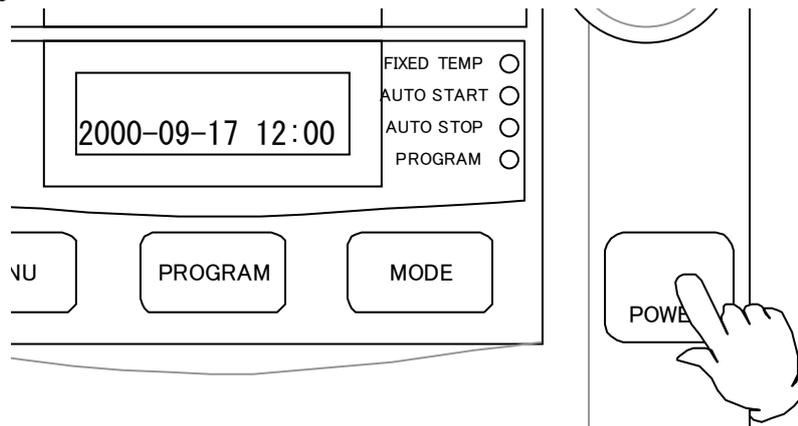
- The main indicator indicates “- - - -”, and after five seconds the sub indicator indicates the current date and time, e.g. “2000-09-17 12:01”, the fan rotates and the fan lamp lights on.



NOTE)

The clock on device is not set at the factory shipment. Set the date and time referring to the instruction shown on Page 42 “Put clock right”.

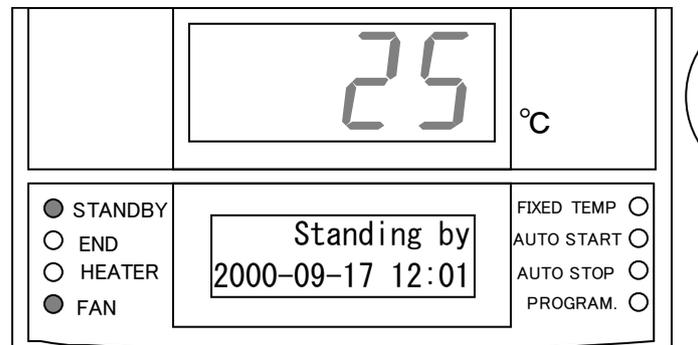
Press power key



- Pressing the power key turns on the power with pip sound.

Preparation

(Continued)

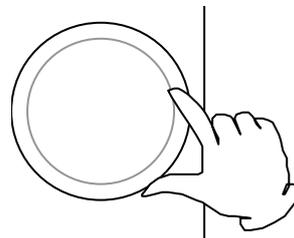


- The main indicator indicates the in-furnace temperature and the °C lamp lights on.
- The sub indicator displays “standing by” and the standby lamp lights on. This state is called the “standby state”.
- Pressing the power key again turns off the power.

Setting with jog dial

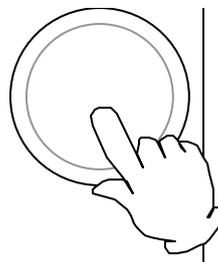
Jog dial is used to select the operation mode or to set temperature and clock.

Turn jog dial



- Turning to clockwise: plus
- Turning to counterclockwise: minus

Press jog dial



- Pressing the jog dial determines the setting and shows the next input window.

Selecting operation mode

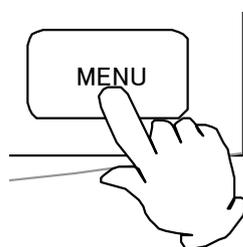
The following four operation modes are used.

No.	Operation mode	Function	Page
1	Fixed Temperature Operation	The device controls the constant temperature.	13
2	Auto Start Operation	The device starts operation at the specified time.	15
3	Auto Stop Operation	The device stops operation at the specified time.	18
4	Program Operation	The device starts programmed operation at the specified time.	21

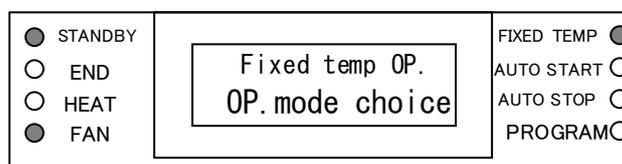
Operation Selecting Method

NOTE) Make sure that the power is on.

- Press the menu key.



- The sub indicator indicates operation mode selection window.



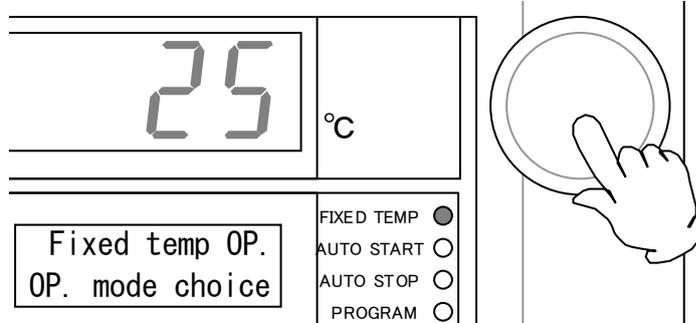
- The operation mode on the sub indicator blinks and the corresponding lamp blinks. The indication can be changed in the order of "Fixed temperature operation" → "Auto start" → "Auto stop" → "program operation" by turning the jog dial to the right. The corresponding lamp also blinks.
- Press the menu key again to cancel the selection.
- The operation mode can be selected from the table below.

No.	Operation mode	Mode Lamp (blink)	Sub Indication (The hatching area is blinking.)
1	Fixed Temperature Operation	Fixed Temp Lamp	Fixed temp OP. OP. mode choice
2	Auto Start Operation	Auto Start Lamp	Auto-start OP. OP. mode choice
3	Auto Stop Operation	Auto Stop Lamp	Auto-stop OP. OP. mode choice
4	Program Operation	Program Lamp	Program OP. OP. mode choice

Fixed Temperature Operation

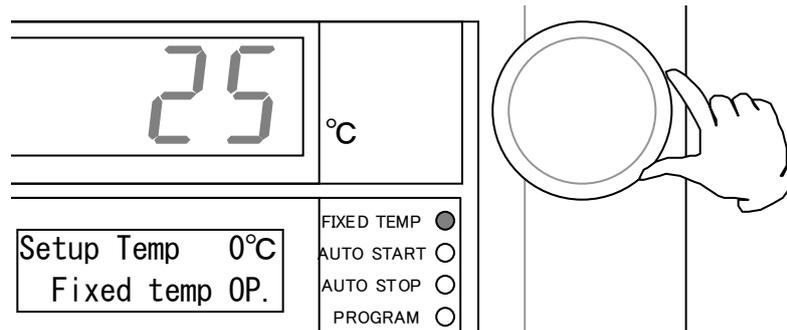
Select operation mode

- Press the menu key. Turn the jog dial to indicate “Fixed temp OP.” on the sub indicator and then press the dial.



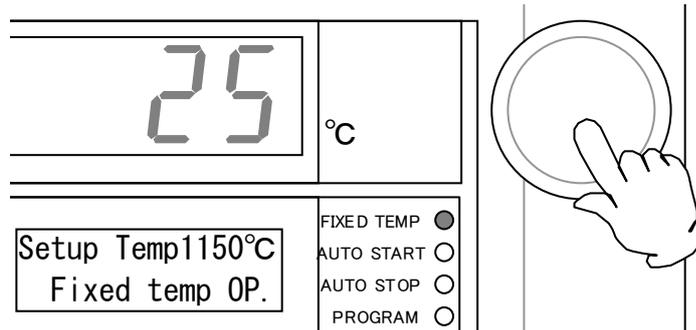
Set temperature

- The screen displays the window to set temperature after the fixed temperature operation is determined.
- The sub indicator indicates “Setup Temp”. The numerical characters that indicate temperature blink. Indicate the desired temperature.



Start operation

- Pressing the jog dial determines the set temperature and starts the operation.

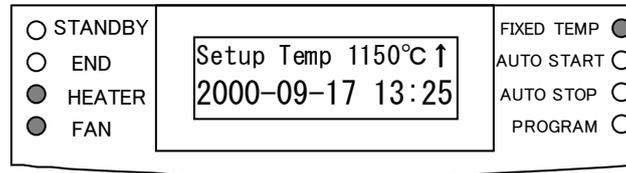


- The heater lamp lights on and the blinking “Fixed temp” lamp lights on.

Fixed Temperature Operation

Observe temperature during operation

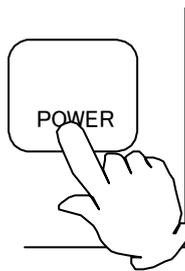
- The main indicator indicates the in-furnace temperature.



- The current state of temperature control is shown with the indications below at the right end of sub indicator.
↑ : rising
↓ : falling
→ : stable (within ± 2.5)

Stop operation

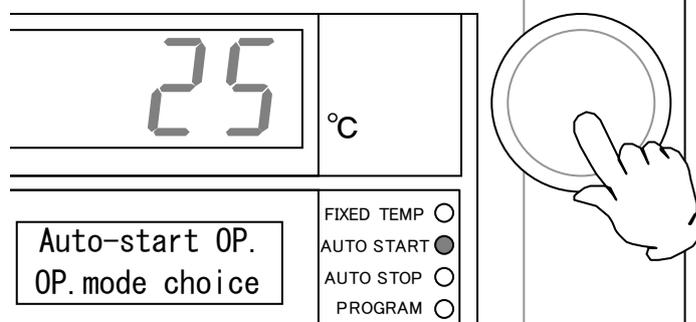
- Press the power key to stop the operation.



Auto Start Operation

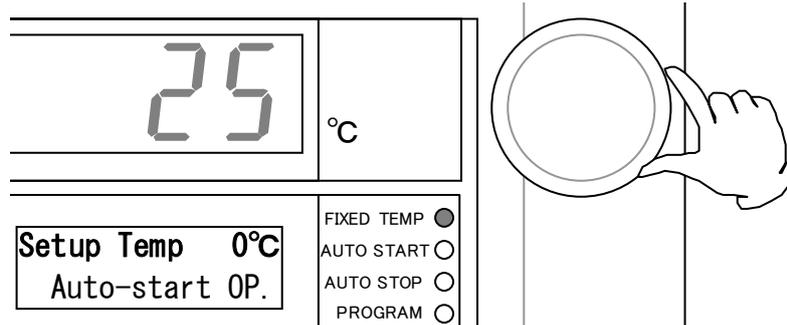
Select operation mode

- Press the menu key. Turn the jog dial to display “Auto-start OP.” on the sub indicator, then press the dial.

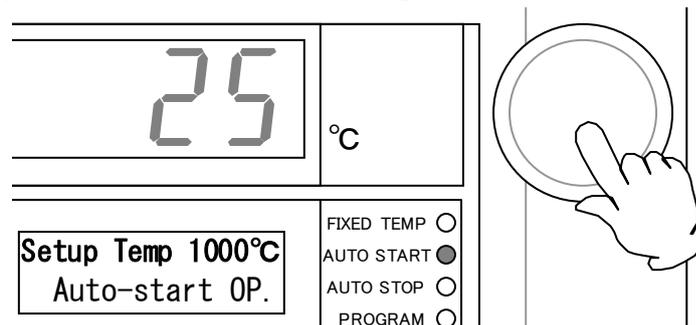


Set temperature

- The screen displays the window to set temperature after the auto start is determined.
- The sub indicator indicates “Setup Temp”. The numerical characters that indicate temperature blink. Indicate the desired temperature.



- Press the jog dial to determine the set temperature.



Auto Start Operation

Set time

- The screen displays the window to set wait time to operate (period) or start time (the hour) after the set temperature is determined.
When timer mode is set to "Time": wait time can be input.
When timer mode is set to "Clock": start time can be input.

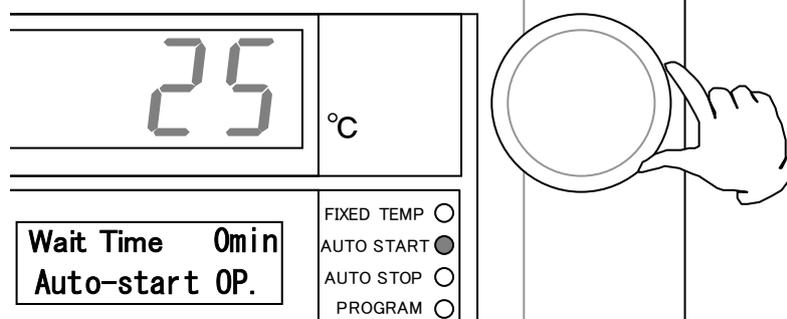
NOTE) The default setting is "Time". Refer to Page 37 "Select timer mode".

Wait time input window	<table border="1"> <tr> <td>Wait Time</td> <td>30min</td> </tr> <tr> <td colspan="2">Auto-start OP.</td> </tr> </table>	Wait Time	30min	Auto-start OP.	
Wait Time	30min				
Auto-start OP.					
Start time input window	<table border="1"> <tr> <td>Start Time</td> <td>13:00</td> </tr> <tr> <td colspan="2">Auto-start OP.</td> </tr> </table>	Start Time	13:00	Auto-start OP.	
Start Time	13:00				
Auto-start OP.					

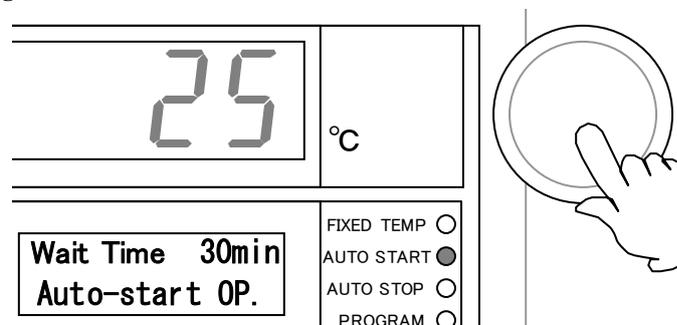
- For the input of startup wait time, the indication varies as shown below depending on the time range to be indicated.

Time Range	Indication
0minute to 59minutes	0min to 59min
1hour to 99hours59minutes	1h00m to 99h59m
100hours to 999hours	100hr to 999hr

- Turn the jog dial to set the desired time.

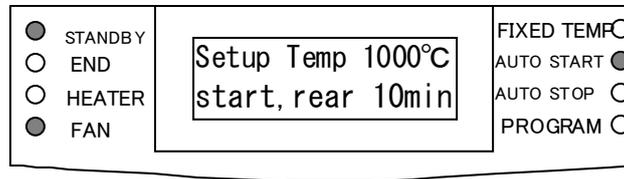


- Press the jog dial to determine the time set above.



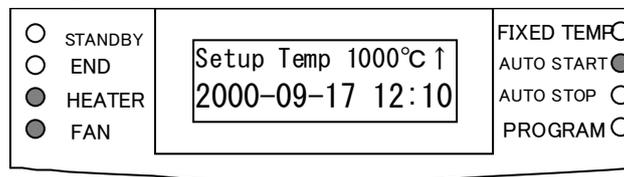
Auto Start Operation

- After the wait time or start time is determined, the blinking auto start lamp lights on and the standby lamp blinks instead in startup wait state on auto start mode. The sub indicator shows the set temperature and remaining time.



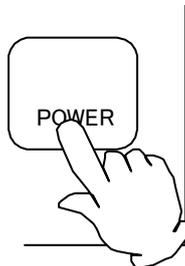
Start operation

- The device starts fixed operation when the remaining time shows "0". The standby lamp lights off when the operation is started. The sub indicator shows the same indication as in the fixed temperature operation.



Stop operation

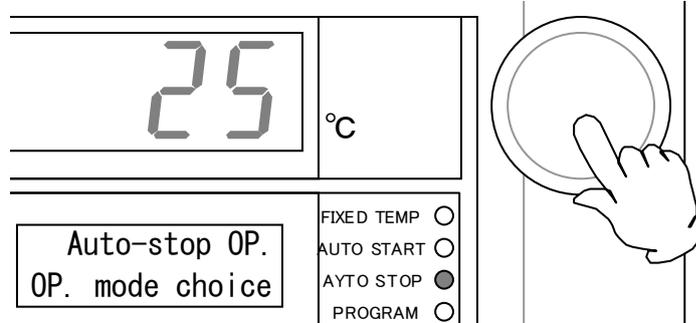
- Press the power key to stop the operation.



Auto Stop Operation

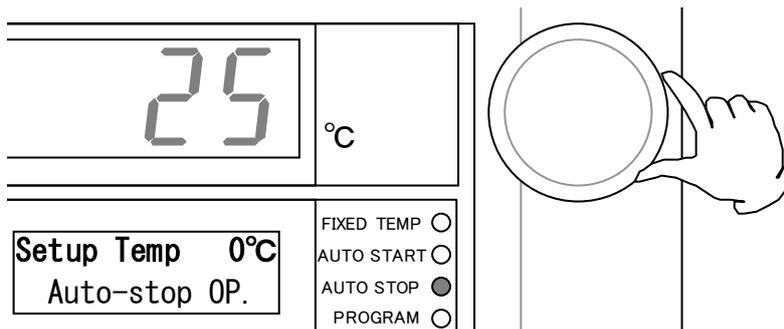
Select operation mode

- Press the menu key. Turn the jog dial to indicate the “Auto-stop OP.” on the sub indicator, then press the dial.

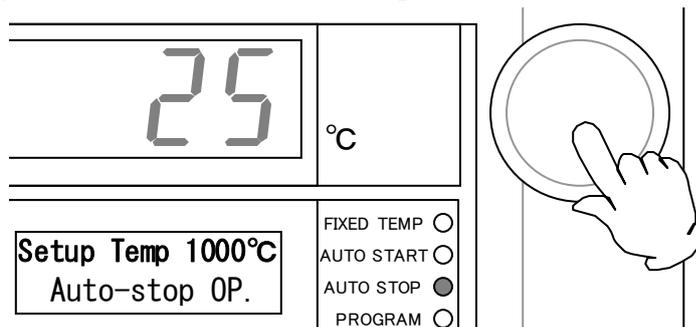


Set temperature

- The screen displays the window to set temperature after the auto stop is determined.
- The sub indicator indicates “Setup Temp” and the numerical characters that indicate temperature blinks.



- Press the jog dial to determine the set temperature.



Auto Stop Operation

Set time

- The screen displays the window to set operation time or operation stop hour after the set temperature is determined.
When timer mode is set to "Time": operation time can be input.
When timer mode is set to "Clock": operation stop hour be input.

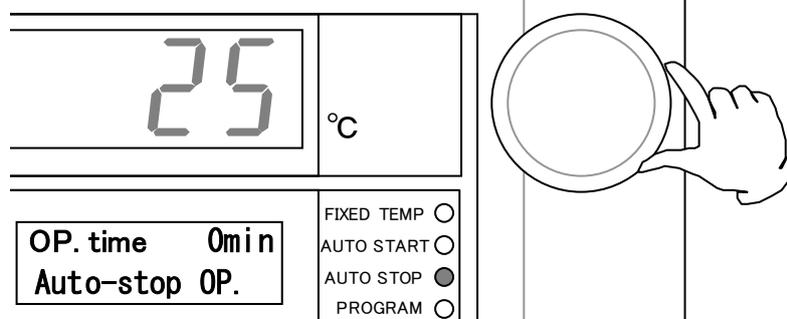
NOTE) The default setting is "Time". Refer to Page 37 "Select timer mode".

Operation time input window	<table border="1"> <tr> <td>Stop time</td> <td>30min</td> </tr> <tr> <td colspan="2">Auto-stop OP.</td> </tr> </table>	Stop time	30min	Auto-stop OP.	
Stop time	30min				
Auto-stop OP.					
Operation stop hour input window	<table border="1"> <tr> <td>Stop time</td> <td>13:00</td> </tr> <tr> <td colspan="2">Auto-stop OP.</td> </tr> </table>	Stop time	13:00	Auto-stop OP.	
Stop time	13:00				
Auto-stop OP.					

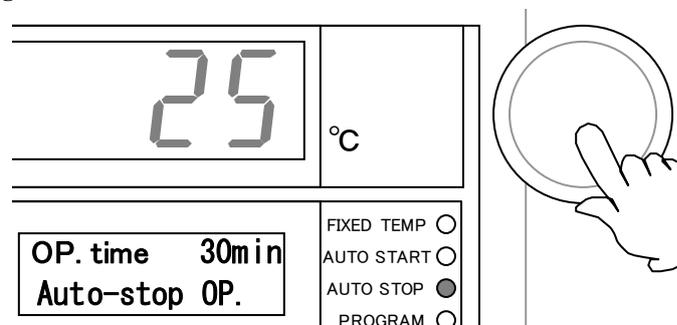
- For the input of operation time, the indication varies as shown below depending on the time range to be indicated.

Time Range	Indication
0minute to 59minutes	0min to 59min
1hour to 99hours59minutes	1h00m to 99h59m
100hours to 999hours	100hr to 999hr

- Turn the jog dial to set the desired time.



- Press the jog dial to determine the time set above.



Auto Stop Operation

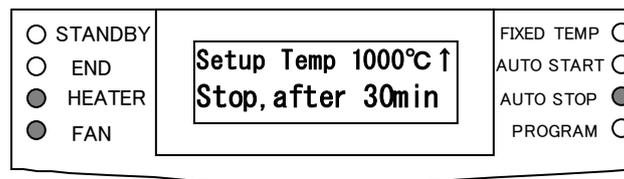
Select "Wait Function"

- The screen changes to the window to select "Wait Function" after the time/hour is set.
- Turning on the function temporarily stops the countdown of timer if the in-furnace temperature is lower than set temperature by 3°C or more, or higher by 6°C or more.
- The function is available only when the timer mode is set to "Time". When it is set to "Clock", go to the next step.
- Turn the jog dial to select "ON" or "OFF" and then press it to determine.

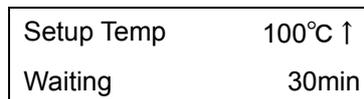


Start operation

- The auto stop operation starts after the wait function is determined. Blinking auto stop lamp lights on and the sub indicator shows the set temperature and remaining time before operation stop.

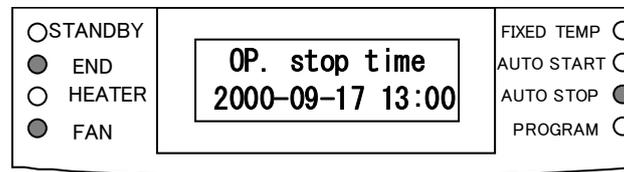


- If the wait function is set, the sub indicator indicates "Waiting" with blinking if the in-furnace temperature is lower than set temperature by 3°C or more, or higher by 6°C or more.



Stop operation

- The device stops operation when the remaining time shows "0". The end lamp blinks when the operation is stopped. The sub indicator shows the operation end time.



Cancel operation

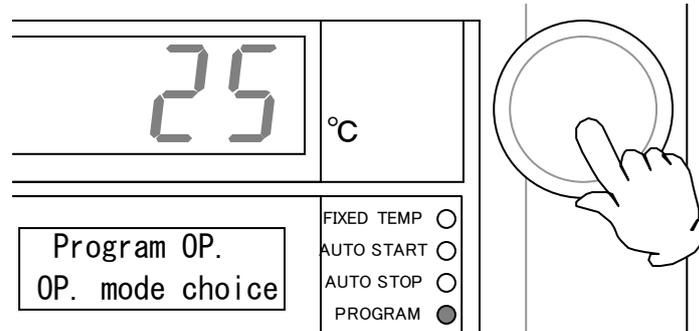
- Press the power key to cancel the operation.

Program Operation

Register the programs with the program menu before starting the program operation. Refer to the Page 26 “Create New Program” for the registration of programs.

Select program mode

- Press the menu key. Turn the jog dial to indicate “Program OP.” on the sub indicator and then press the dial.

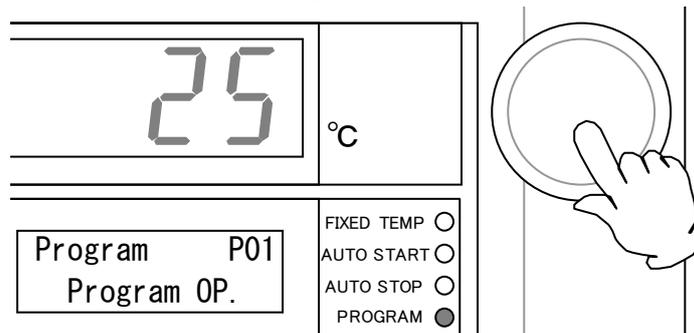


- If no program is set to the device, the buzzer sounds and the sub indicator indicates a message.
- In this case, register a program with “Create New Program” (refer to the Page 26) and try registration again.

A program isn't
Registered

Select program mode number

- Select the program number with the jog dial and then press it to determine.



Program Operation

Wait time / start time for operation

- The screen changes to the window to edit wait time (period)/start time (the hour) after the program is determined.
When timer mode is set to "Time": wait time can be edited.
When timer mode is set to "Clock": start time can be edited.

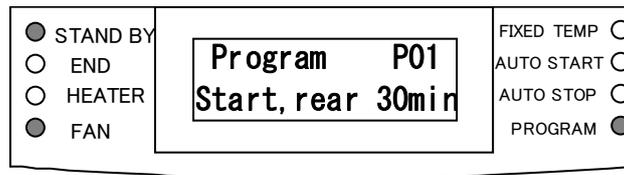
NOTE) The default setting is "Time". Refer to Page 37 "Select timer mode".

- Set the desired time by turning the jog dial.

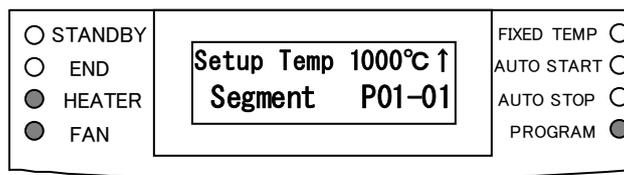
Wait time input window	Wait Time 30min Program OP.
Start time input window	Start Time 13:00 Program OP.

Startup wait / startup

- The device is in the startup wait state of program operation mode after the wait time/ start time is determined. In this situation the blinking program lamp changes to lighting and the standby lamp blinks instead. The sub indicator shows the program number and remaining time to startup.



- The device starts operation when the remaining time shows "0". The standby lamp lights off when the operation is started. The sub indicator shows the segment number currently being executed and the set temperature.



- During the ramp operation, the segment number and remaining time are indicated alternately.

Segment number currently being executed	Setup Temp 100°C ↑ Segment P01-01
↓ ↑	
Remaining time of ramp time	Setup Temp 100°C ↑ Ramp after 30min

Program Operation

Display during soak operation

- During the soak operation, the segment number and the remaining time of soak time are indicated alternately. In the case the device is in the waiting state, a message "Waiting" is indicated with blinking.

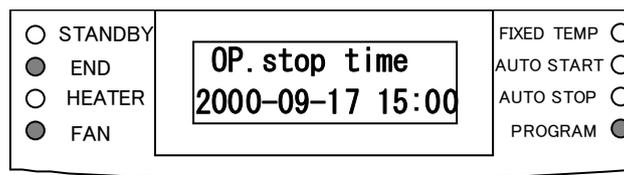
Segment number currently being executed	<table border="1"> <tr> <td>Setup Temp</td> <td>100°C ↑</td> </tr> <tr> <td>Segment</td> <td>P01-01</td> </tr> </table>	Setup Temp	100°C ↑	Segment	P01-01
Setup Temp	100°C ↑				
Segment	P01-01				
↓ ↑					
Remaining time of soak operation	<table border="1"> <tr> <td>Setup Temp</td> <td>100°C ↑</td> </tr> <tr> <td>Soak after</td> <td>30min</td> </tr> </table>	Setup Temp	100°C ↑	Soak after	30min
Setup Temp	100°C ↑				
Soak after	30min				
Waiting state	<table border="1"> <tr> <td>Setup Temp</td> <td>100°C ↑</td> </tr> <tr> <td>Waiting</td> <td>30min</td> </tr> </table>	Setup Temp	100°C ↑	Waiting	30min
Setup Temp	100°C ↑				
Waiting	30min				

- When a segment in repeating section is executed, the segment number and the remaining repeating time are indicated alternately.

Remaining repeating time	<table border="1"> <tr> <td>Setup Temp</td> <td>100°C ↑</td> </tr> <tr> <td>Rep. rest</td> <td>10</td> </tr> </table>	Setup Temp	100°C ↑	Rep. rest	10
Setup Temp	100°C ↑				
Rep. rest	10				

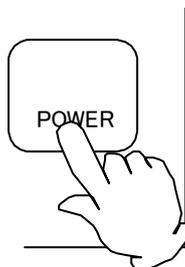
Complete operation

- The end lamp blinks when the operation is completed. The sub indicator shows the operation end time.



Stop operation

- Press the power key to release the waiting state or cancel the program operation.



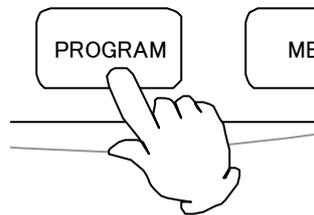
Operating instructions for program menu

The program menu has the three functions listed below.

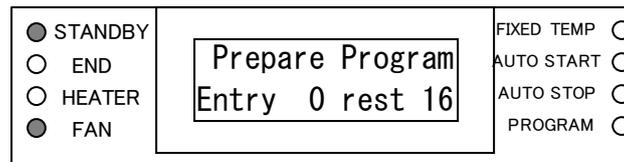
No.	Name	Function	Page
1	Prepare Program	Create a new program and register it.	26
2	Edit Program	Edits or checks the registered program.	27
3	Delete Program	Deletes the registered program.	34

Select function of program menu

- Make sure that the power is turned on.
- Press the program key.



- The program menu is activated and the screen changes to the function selecting window.

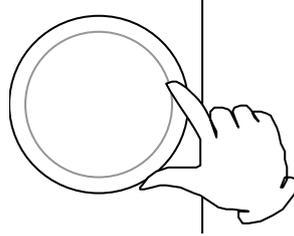


- The sub indicator indicates the number of programs already registered and the remaining number of segments. Also the function name currently selected is indicated with blinking.

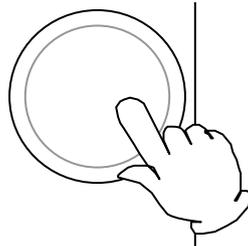
Prepare Program	<div style="border: 1px solid black; padding: 5px; width: fit-content;"> Prepare Program Entry 0 rest 16 </div>
Edit Program	<div style="border: 1px solid black; padding: 5px; width: fit-content;"> Edit Program Entry 0 rest 16 </div>
Delete Program	<div style="border: 1px solid black; padding: 5px; width: fit-content;"> Delete Program Entry 0 rest 16 </div>

Operating instructions for program menu

- Turn the jog dial to select the desired program menu.



- Press the dial to determine menu.
- The screen changes to the menu input window.



Cancel operation

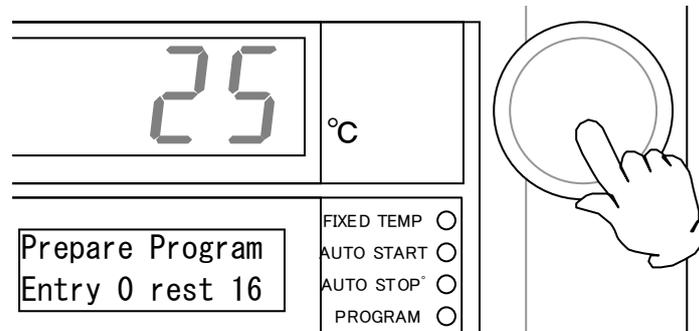
- Press the program key to cancel the program menu selected.



Create New Program

Select the “Prepare Program” menu

- Make sure that the remaining number of segment is not ‘0’. If not, delete one of the registered programs before creating a new program.
- Select the “Prepare Program” on the function selecting window in the program menu and then press the jog dial.



Select program number

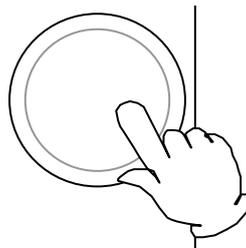
- The screen changes to the program number selecting window. The sub indicator indicates “Prepare” and the number in the screen, which shows the program number, blinks. Turn the jog dial to select the desired program number from P01 to P99.

NOTE) The program numbers already registered is not indicated here.

Program number
selecting window

Prepare	P01
Entry 0	rest 16

- Press the jog dial to determine the number selected above.

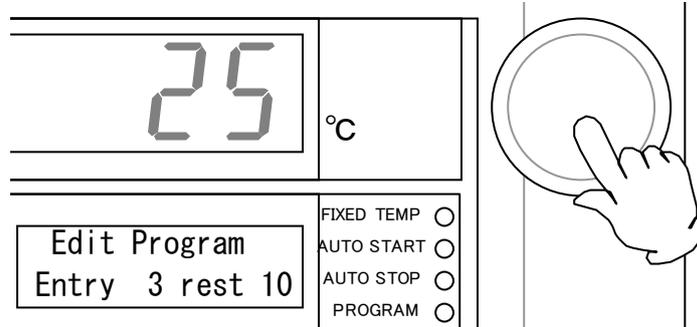


- The screen changes to the “Edit segment” window after the program number is determined. Go to Page 28 “Edit segment” to edit the segment.

Edit Program

Select "Edit Program" menu

- Make sure that any program(s) is (are) registered.



- Select the "Edit Program" on the function selecting window in the program menu and then press the jog dial.

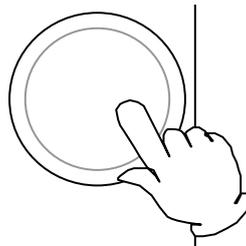
Select program number

- The screen changes to the program number selection window. The sub indicator indicates "Editing" and the number in the screen, which shows the program number, blinks. Turn the jog dial to select the desired program number to be edited. The segment number the selected program uses and remaining numbers of segment are indicated at the bottom of sub indicator.

Program number
selecting window

Editing	P01
Use 5	rest 10

- Press the jog dial to determine the number selected above.



- The screen changes to the "Edit segment" window after the program number is determined. Go to Page 28 "Edit segment" to edit the segment.

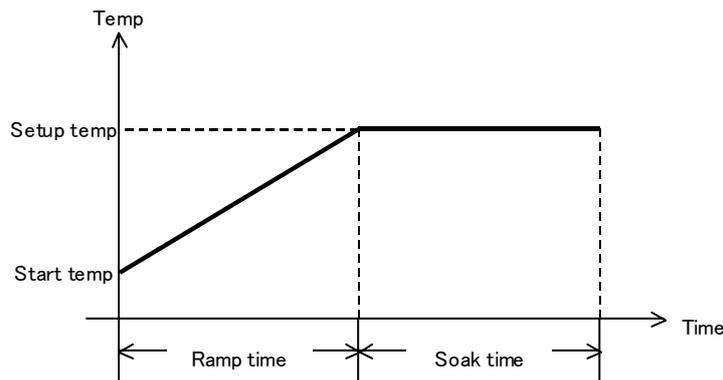
Edit Program

Edit segment

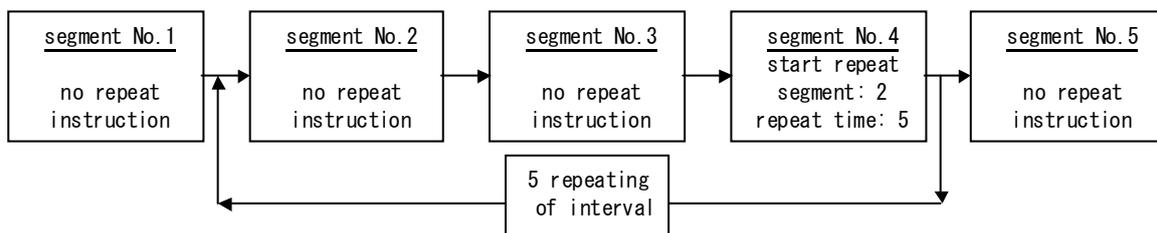
One segment has ten kinds of set item. (*:Optional function)

No.	Name	Setting range
1	Ramp time	Step, 1 minute to 999 hours, end
2	Set temperature	Within the range of set temperature for the device
3	Soak time	0 minute to 999 hours, hold
4	Wait mode	OFF, ON
5	Repeat starting segment	None, registered segment number 1 to 16
6	Repeat time	1 to 999, infinite

The conception of a segment is shown in the figure below. The “Initial Temperature” means the in-furnace temperature when executing segment No. 1 just after the program operation is started, and also means the set temperature of segment executed last in the case other than mentioned above.



The conception of a repeat is shown in the figure below. The first execution of the repeat interval is not counted as a repeating time.



Edit Program

Select set item

The screen changes to the item selecting window after the program number is determined in the “Prepare Program” or “Edit Program”.

Ramp time	Ramp time ▶ 30min P01-01 rest 10
Set temperature	Setup temp ▶ 100°C P01-01 rest 10
Soak time	Soak time ▶ 30min P01-01 rest 10
Wait mode	Wait ▶ OFF P01-01 rest 10
Repeat start segment	Rep. start ▶ S01 P01-01 rest 10
Repeat count	Rep.count ▶ 9999 P01-01 rest 10
Segment addition	Append seg. P01-01 rest 10
Program end	Program End P01-01 rest 10

NOTE)

The program number and segment number under edition, and remaining number of segment are displayed at the bottom of sub indicator. Turning the jog dial shows the details for all segments registered. The two items, “Segment Addition” and “Program End” are shown after the detail for the last segment number is displayed.

Edit Program

Some set items are not indicated depending on the condition as shown in the list below, which means that the items are invalid in that condition.

Item	Indication
Ramp Time	Always indicated.
Set Temperature	Not indicated when the ramp time is in "End".
Soak Time	Not indicated when the ramp time is in "End".
Wait Mode	Not indicated when the ramp time is in "End" or soak time is in "Hold".
Repeat Starting Segment	Not indicated when the ramp time is in "End" or soak time is in "Hold". Not indicated when it is between the repeat intervals specified with the other segments.
Repeat Time	Not indicated when the repeat starting segment is not indicated or in "None".
Segment Addition	Not indicated when the ramp time is in "End" or soak time is in "Hold".

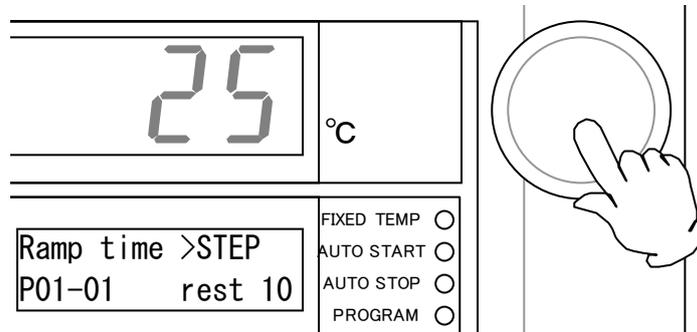
NOTE)

The content of program under operation is impossible to be changed. The "▶" (cursor) does not appear on the item selecting window. Only checking the program is available during operation.

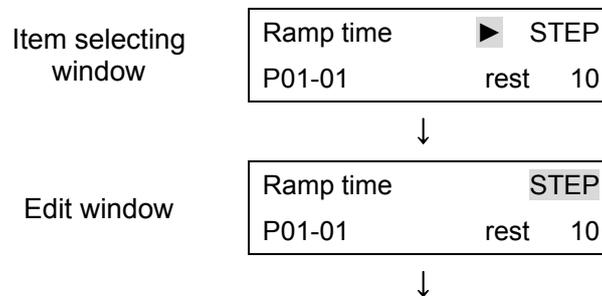
Edit Program

Edit segment

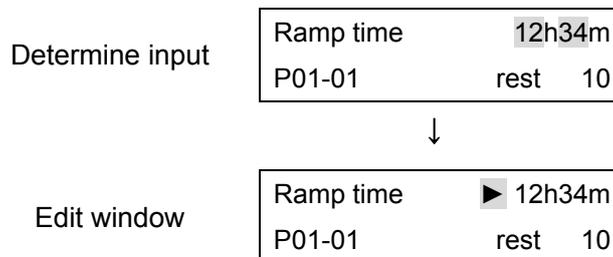
The segment is edited to the program number determined in Page 27 “Select program number”.



- Select the set item and press the jog dial. The blinking "▶" (cursor) disappears and the set value starts to blink.

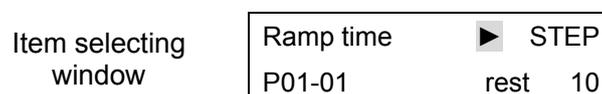


- Turn the jog dial to indicate the desired set item then press it to determine the value and go back to the item selecting.



Cancel setting

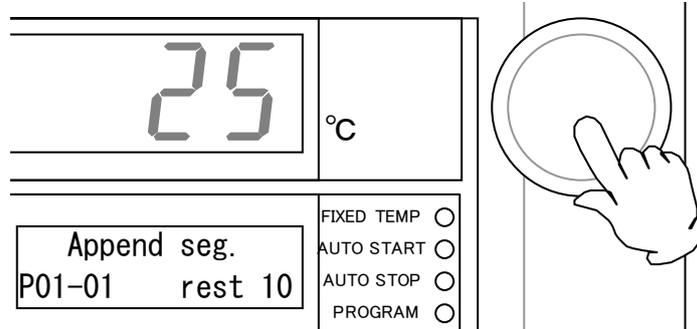
- Press the program key to cancel the setting. The input value is cancelled and the screen goes back to the item selecting window.



Edit Program

Add segment

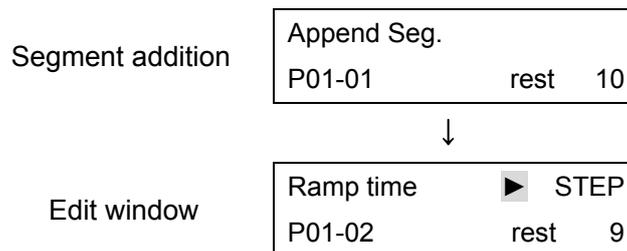
- Select the "Append seg" on the item selecting window and then press the jog dial.



NOTE)

The "Append seg" is not indicated in the following conditions; the ramp time for the last segment number is in "end", the soak time is in "hold", the repeat time is in "limitless", the key lock mode is in "on", or the program under edition is being executed.

- One segment number is added and one remaining number of segment decreases. The screen goes back to the item selecting and the ramp time corresponding to the added segment number is indicated.



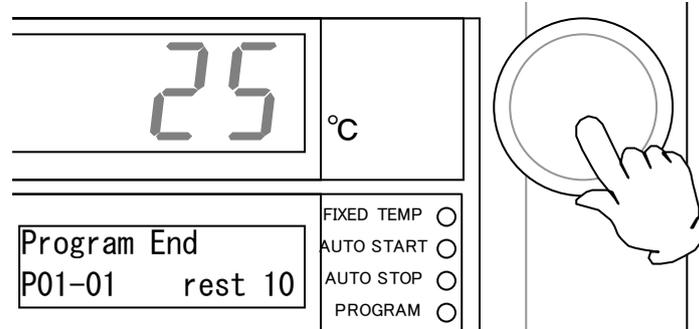
- The initial settings of newly added segment are listed below. The settings of first segment when creating new program are the same as them.

Item	Initial value	Note
Ramp Time	step	
Set Temperature	0°C	
Soak Time	hold	
Wait Function	OFF	Not available because the soak time is in "hold".
Repeat Starting Segment	none	Not available because the soak time is in "hold".
Repeat Time	infinite	Not available because the repeat starting segment is not available.

Edit Program

End program edition

- Select the “Program End” on the items selecting window and then press the jog dial.



NOTE) Pressing the program key on the item selecting window is also possible.

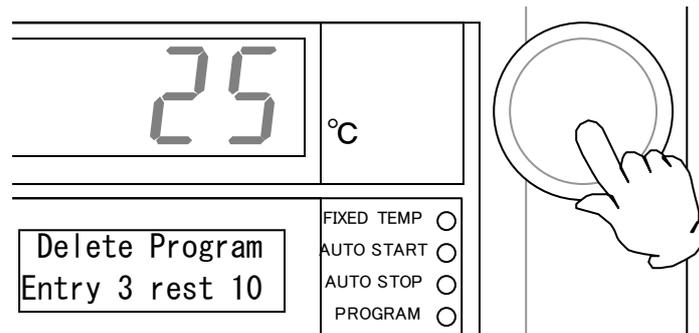
Delete Program

NOTE)

- Make sure that any program(s) is (are) registered.
- Deleting the program under operation is impossible.

Select “Delete Program”

- Select the “Delete Program” on the function selecting window in the program menu and then press the jog dial.



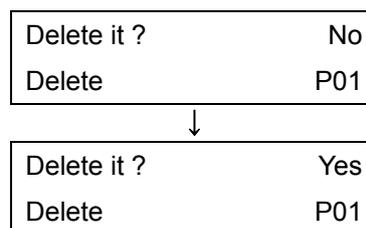
Select program number

- The screen changes to the program number selecting window. Turn the jog dial to select the desired program number to be deleted, then press it.



Check the number and select “Yes”

- The screen changes to the window to check the program number. Make sure that the correct program number to be deleted is indicated and then press “Yes”.



NOTE) Press the “No” or program key to cancel the deletion.

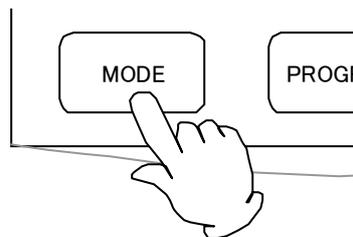
Function menu

The function menu has the seven functions listed below. (*:Optional function)

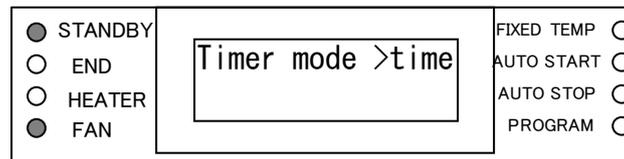
No.	Name	Function	Page
1	Timer Mode	Sets the timer mode	37
2	Key Lock Mode	Sets the key lock mode.	38
3	Buzzer Mode	Sets the buzzer mode.	39
4	Calibration Offset	Sets the calibration offset temperature.	40
5	Total Operating Hours	Indicates the total operating hours.	41
6	Date/Time	Sets the date and time.	42
7	Communication Lock out Mode (*)	Sets the communication lock out mode.	44

Select item from function menu

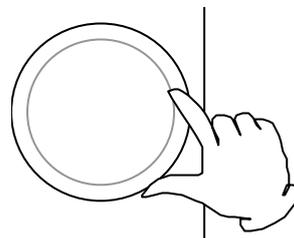
- Make sure that the power is on.
- Press the mode key.



- The function menu is activated and the item selection window appears.



- Turning the jog dial indicates the mode.



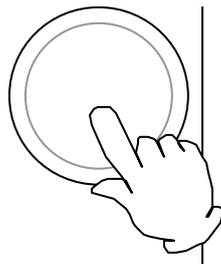
Function menu

Select function

- Turn the jog dial to select the item indicated on the sub indicator.

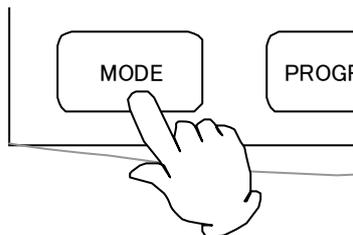
Timer mode	Timer mode ▶time
Key lock mode	Key lock mode ▶OFF
Buzzer mode	Buzzer mode ▶ON
Calibration offset	Calibrate ▶±0°C
Total operating hours	Acc. time 49999hr
Date/Time	Date ▶2000-12-31 Time 23:59
Communication lock out mode	Comm. Lockout ▶OFF

- Press the jog dial to select the function with the mode indicated.



Cancel function setting

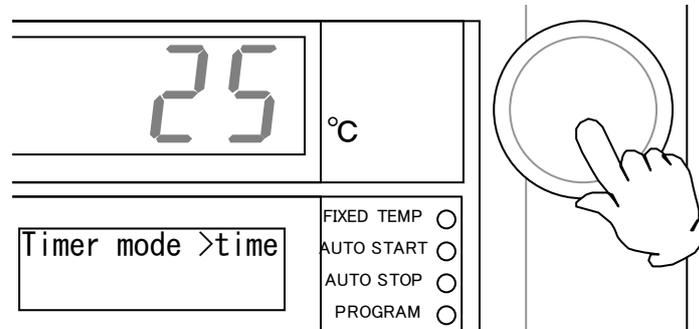
- Press the mode key again to cancel the item selection.



Function menu

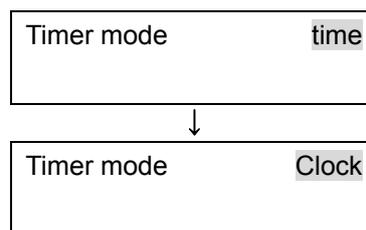
Select timer mode

- Indicate the “Timer mode” on the item selection window in function menu and then press the jog dial.



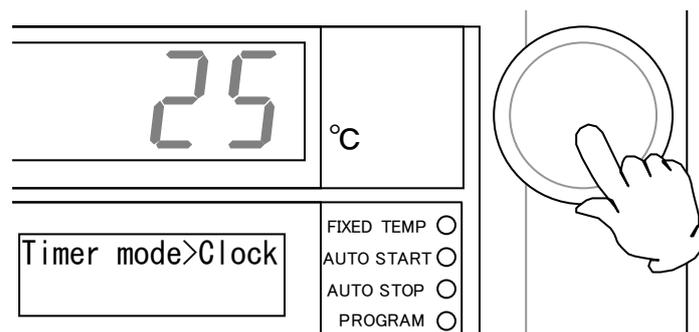
Select “Time” / “Clock”

- The “▶” (cursor) disappears and the current mode blinks. Turn the jog dial to indicate “time” or “Clock”.



Determine mode

- Press the jog dial.

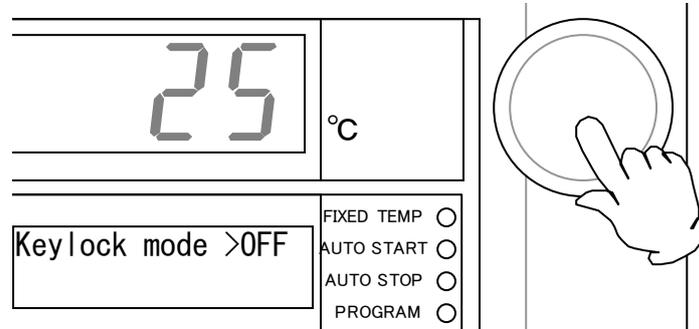


- The timer mode is determined and the screen goes back to the item selection window in function menu.

Function menu

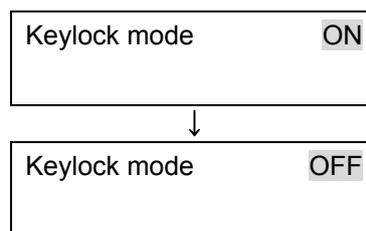
Select key lock mode

- Indicate the “KeyLock mode” on the item selection window in function menu and then press the jog dial.



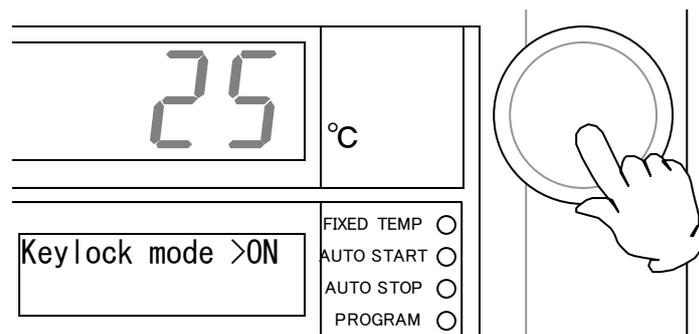
Select “ON” / “OFF”

- The “▶” (cursor) disappears and the current mode blinks. Turn the jog dial to indicate “ON” or “OFF”.



Determine mode

- Press the jog dial.

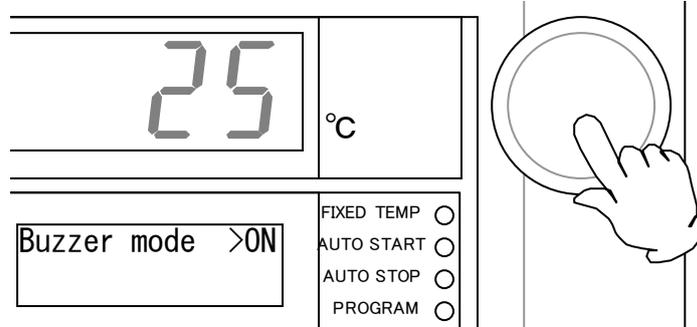


- The keylock mode is determined and the screen goes back to the item selection window in function menu.

Function menu

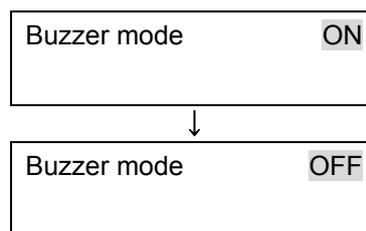
Select buzzer mode

- Indicate the “Buzzer mode” on the item selection window in function menu and then press the jog dial.



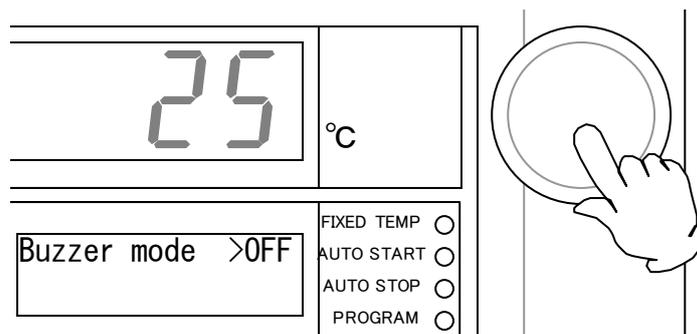
Select “ON” / “OFF”

- The “▶” (cursor) disappears and the current mode blinks. Turn the jog dial to indicate “ON” or “OFF”.



Determine mode

- Press the jog dial.

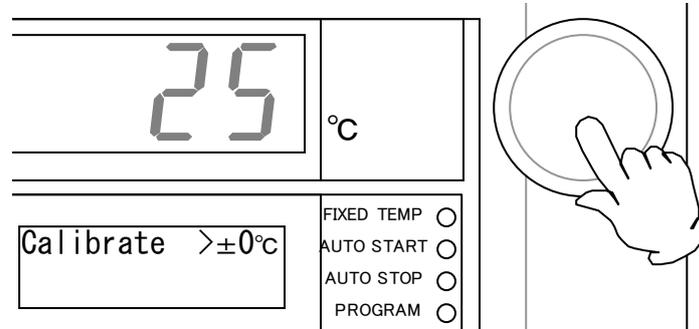


- The buzzer mode is determined and the screen goes back to the item selection window in function menu.

Function menu

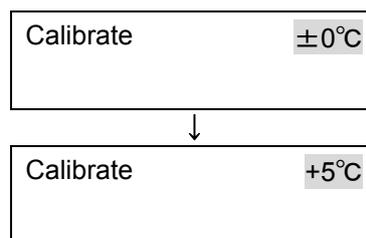
Select calibration offset mode

- Indicate the “Calibrate” on the item selection window in function menu and then press the jog dial.



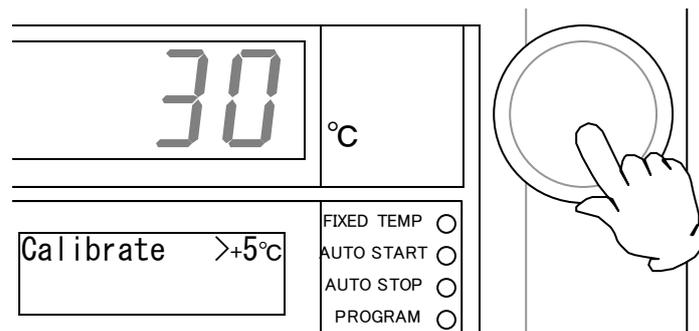
Input offset temperature

- The “▶” (cursor) disappears and the current offset temperature blinks. Turn the jog dial to indicate desired temperature.



Determine mode

- Press the jog dial.



- The calibration offset temperature is determined and the screen goes back to the item selection window in function menu.

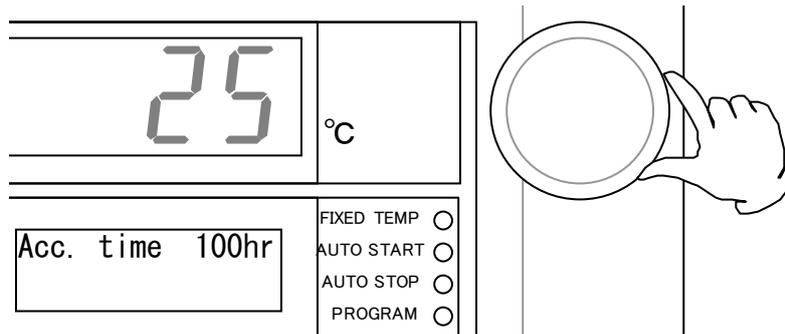
Function menu

Select "Acc. Time"

NOTE)

The "Acc. Time" is a function to check the total operating hour of device. The content cannot be changed.

- Turn the jog dial on the item selection window to indicate the "Acc. Time".



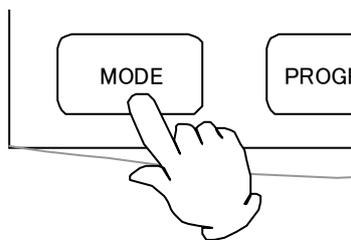
- The total operating hour from the factory shipment to the current time is indicated.



NOTE)

The total operating hour means the total lapsed time when the power of device is not off. Standby state, startup wait state, and operation end state are included in it.

- Press the mode key to cancel the function menu when the check is completed.



Function menu

Put clock right

NOTE)

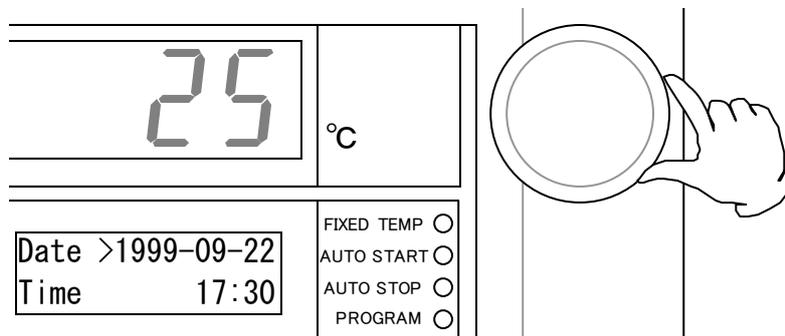
The time indicated on the clock is not correct at factory shipment. Before operating this unit, put the clock right.

NOTE)

The setting of clock cannot be changed at the startup wait state on auto start mode and under operation state on program mode.

Press the “Power key” to stop the operation and reset the clock.

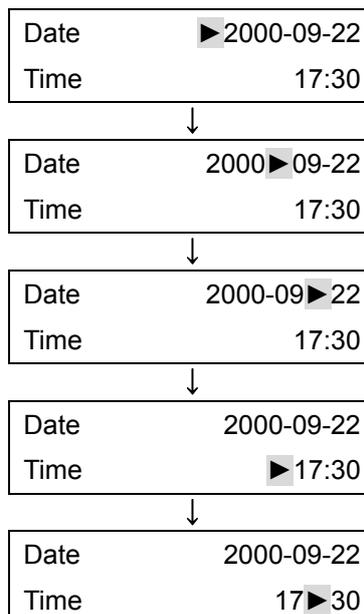
- Turn the jog dial on the item selection window in function menu to indicate the “Date” and “Time”.



- The window indicates the current date and time.



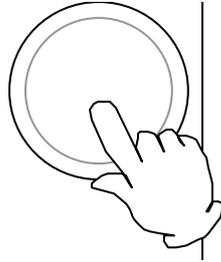
- Turning the jog dial moves the “▶” (cursor) on the window in the order of “Year”, “Month”, “Date”, “Hour” and “Minute”.



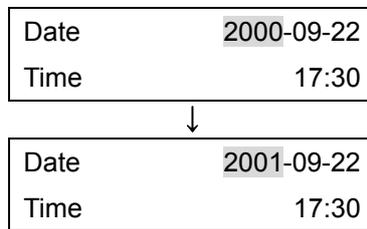
Function menu

(continued)

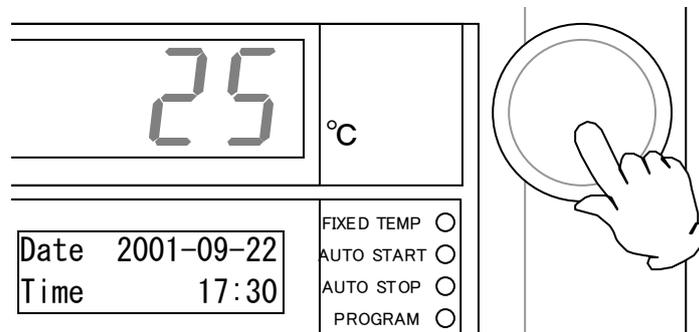
- Select the desired item and press the jog dial.



- The “▶” (cursor) disappears and the current set value blinks. Turn the jog dial to change the value.



Press the jog dial.

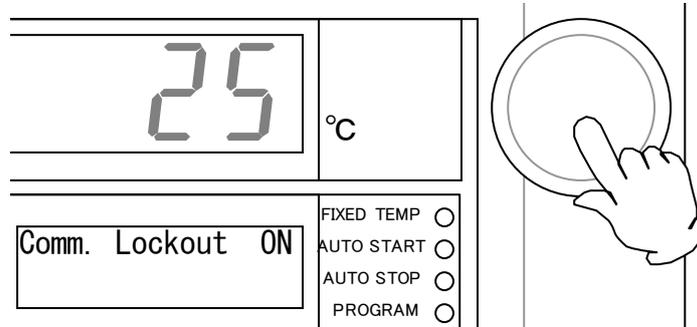


- The setting is determined and the window goes back to the item selection window in function menu.

Function menu

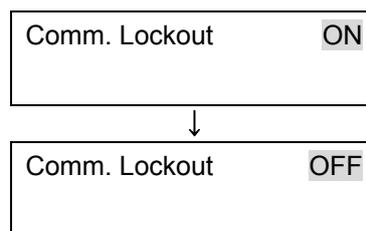
Select communication lockout mode

- Indicate the “Comm. Lockout” on the item selection window in function menu and then press the jog dial.



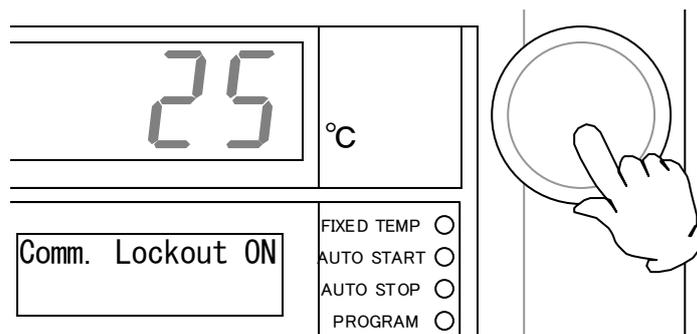
Select “ON” / “OFF”

- The “▶” (cursor) disappears and the current mode blinks. Turn the jog dial to indicate “ON” or “OFF”.



Determine mode

- Press the jog dial.



- The communication lockout mode is determined and the screen goes back to the item selection window in function menu.

Calibration Offset Function

Description

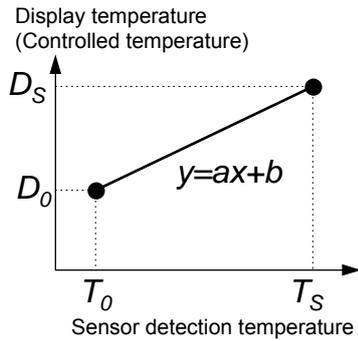


Fig. 1

In the controller, the relationship between the temperature T detected by the sensor and the display temperature of the operation panel D is expressed by the equation of the line which passes the two points (T_0, D_0) and (T_S, D_S) shown in **Fig.1**.

Here, T_0 is the sensor detecting temperature when the chamber central temperature becomes the zero adjusting temperature (normally room temperature is adopted) D_0 at the time of no load, T_S is the sensor detecting temperature when the chamber central temperature becomes the span adjustment temperature (normally working maximum temperature is adopted) D_S at the time of no load in the same way.

As it is clear from the facts above, conforming of the chamber central temperature and the display temperature is guaranteed

only when there is no load and at two points shown above. In other words, it is possible for a temperature measured at a point in the chamber does not conform to the display temperature of the operation panel at a voluntary temperature without load.

This is the function to move the line which passes above two points to the Y axis direction in parallel (increase or decrease y intercept of the line). The parallel movement amount including a sign is defined as the calibration offset. This function can conform the display temperature of the operation panel to the measurement temperature of a voluntary point in the chamber at a voluntary temperature.

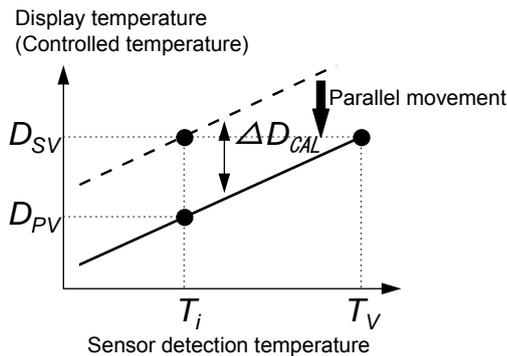


Fig.2

In **Fig.2**, D_{SV} is a display temperature of the operation panel under the condition that the temperature in the chamber is constant for a set temperature. It is natural to say that this value is equal to the target set temperature. D_{PV} is a measurement temperature of a voluntary point in the chamber under this condition. The difference between D_{PV} and D_{SV} including the sign is defined as the calibration offset. Therefore offset is shown as below.

$$\Delta D_{CAL} = D_{PV} - D_{SV} \quad \text{Equation 1}$$

In **Fig. 2**, ΔD_{CAL} becomes the negative value since the target set temperature D_{SV} is larger than the actually measured temperature D_{PV} . In order to conform the display temperature to the actually measured temperature, let the controller to recognize that the temperature in the chamber differs from the target set temperature by ΔD_{CAL} .

NOTE)

The setting tolerance of calibration offset is $\pm 58^\circ\text{C}$. The offset value at factory shipment is 0°C .

<Example>

The fixed temperature operation with a target set temperature of 1000°C is started. After plenty time has passed from the time the indication on operation panel has reached to 1000°C , the temperature of a certain point in the chamber is measured with a thermometer. The result is 970°C . The indication on the panel is to be equal to the measured temperature (970°C) with the calibration offset function.

In this case the calibration offset ΔD_b is expressed with (“measured temperature” — “indicated temperature”) by **Equation 1**.

Therefore, $\Delta D_b : 970^\circ\text{C} - 1000^\circ\text{C} = -30^\circ\text{C}$

Independent overheating prevention device

There are two safety devices in this unit: the auto-overheating preventive function of the controller (automatic recovery) and the independent overheating prevention device (manual recovery). Circuits and sensors that are independent from the controller configure them. These safety devices for the temperature overheating prevention protect the instrument in a fail-safe method.

Setting the Temperature Range and Function

Setting Temperature Range:	10 to 1990°C
Input Method:	Three integer digital switch. Turn the dial of each column and set the desired value. The first integer as the left can only be from 0 to 3 for the hundred columns. The device of FP series works in ten times of the set value. For example, it works at the temperature of 1010°C if the dial is set to “101” ,and 1110°C if set to “111” .
Function:	Heater output is cut off when the measured temperature gets higher than the set temperature of the independent overheating prevention device. The function is active when the earth leakage breaker is ON. When the independent overheating prevention device is activated, Er.07 blinks on the main indicator with the ERROR lamp blinks.

Activation/Setting Method

- Usually, set the temperature 100°C higher than the set temperature of the controller.
- In the case of the program operation, set it at least 100°C higher than the maximum set value of the temperature pattern of the program.
- When the independent overheating prevention device is activated improperly by the next reasons, changing the setting of the device lower than the internal temperature, or by continuing operation when the setting of the device is too low, turn off the earth leakage breaker to reset the main unit and perform the setting again. If it is activated by another reason, refer to the Page 53 “Function of safety devices”.

CAUTION!

Precautions

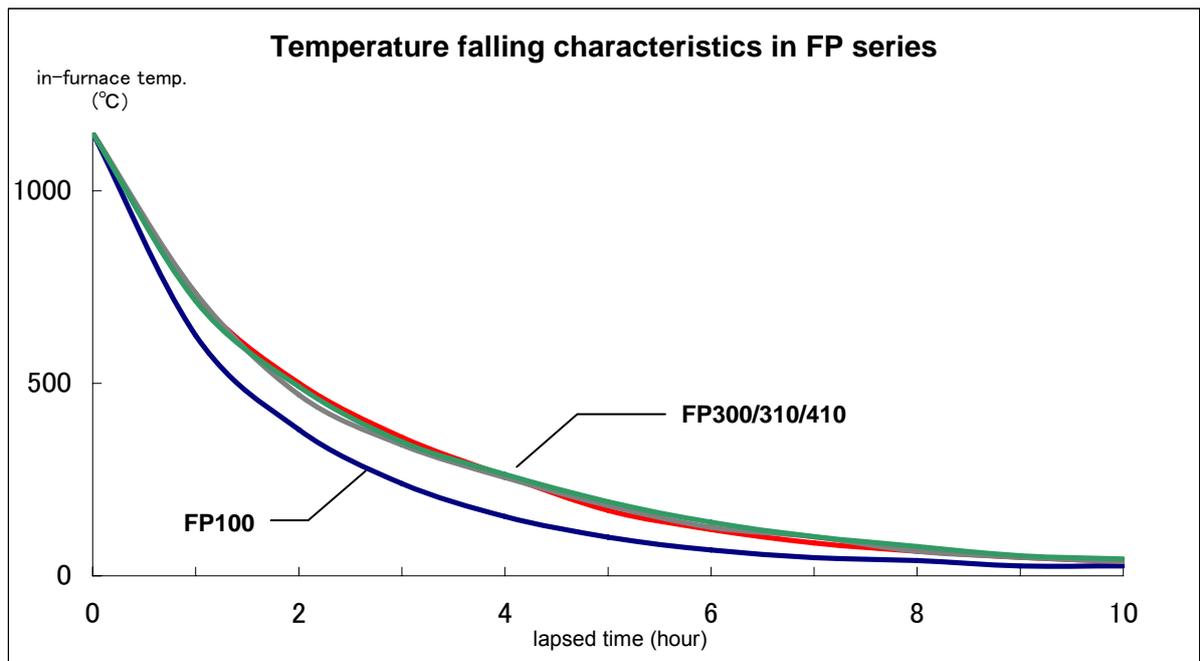
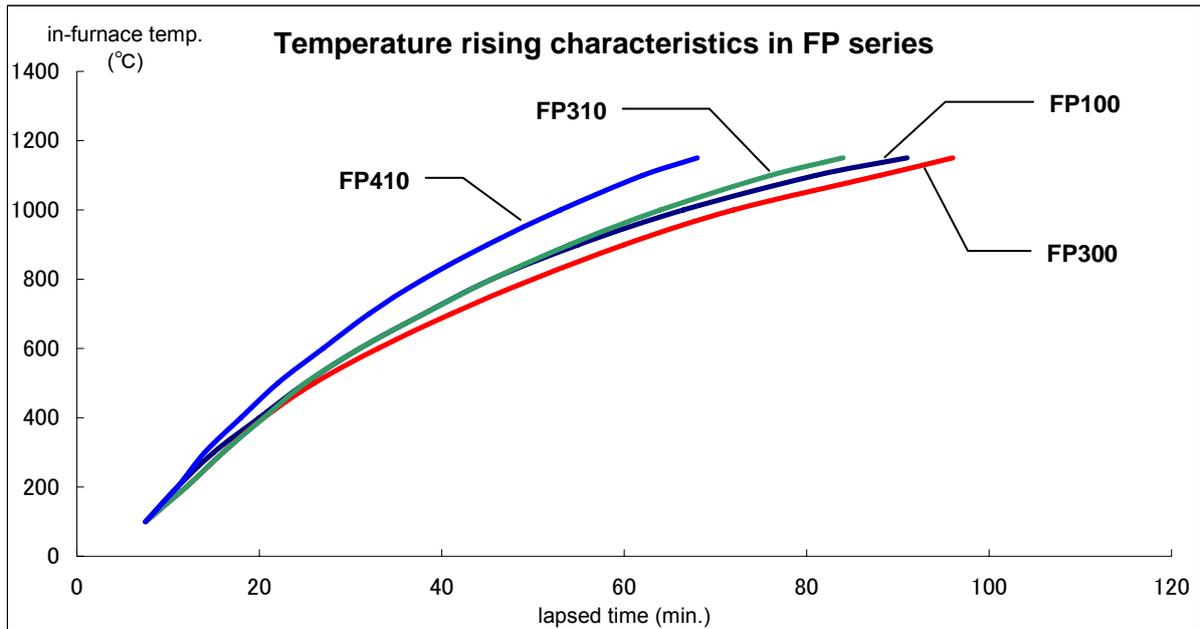
- Only 0 to 3 can be set for the column of hundreds of the digital switch by the stop mechanism; however, if forced to change it to a value higher than 3, it will damage the unit. (Actually, The first integer as the left is a value of thousand.)
- Set temperature can change by touching the dial when cleaning. Always confirm that the set temperature is correct after cleaning or before operation.

Temperature Rise/Fall (Reference Data)



The following graph shows the data for temperature rise/fall of respective device types. The data shown is only reference because these values vary depending on the quantity of sample or an ambient temperature.

Use the data for temperature rise/fall when creating programs.



WARNING!

If a problem occurs

-  If smoke or strange odor should come out of this unit for some reason, turn off the power key right away, and then turn off the circuit breaker and the main power. Immediately contact a service technician for inspection. If this procedure is not followed, fire or electrical shock may result. Never perform repair work yourself, since it is dangerous and not recommended.

Substances that cannot be used

-  Never use explosive substances, flammable substances and substances that include explosive or flammable ingredients in this unit. Explosion or fire may occur. (Refer to page62 "List of Dangerous Substances")

CAUTION!

Do not step on this unit

-  Do not step on this unit. It will cause injury if this unit fall down or break.

Do not put anything on this unit

-  Do not put anything on this unit. It will cause injury if fall.

Prevention of a burn

-  After an operation, the oven unit and the inside of door, samples have a high temperature for a while. For prevent a burn, be careful that do not touch to the parts in the above when handling samples.

During a thunder storm

-  During a thunderstorm, turn off the power key immediately, then turn off the circuit breaker and the main power. If this procedure is not followed, fire or electrical shock may be caused.

About the amount of samples

-  If the excessive amount of sample is set, it could be impossible to control the temperature normally. To keep the temperature control accuracy, do not use this unit in overload.

Return after power failure

-  When power is supplied after a power failure, the device automatically starts operation again with the same state as just before the power failure. It is danger that the device starts unattached operation after a power failure. We recommend for you to turn off the switch of this unit if a power failure occurs during operation.

In-furnace temperature

-  This unit uses a cooling fan to prevent an over temperature of its outer surface during operation when the earth leakage breaker is turned ON. Do not turn OFF the interrupter, or do not disconnect the power supply plug directly when the in-furnace temperature is 600°C or more after operation, except in the case of emergency.

Provide ventilation at the first operation

-  This unit exhausts smoke and smell due to burning of organic matters in the furnace when it is used for the first time. This is not abnormal, but ventilating inside the room should be done.

Furnace may be cracked



Though the furnace may be cracked when it is used with high temperature, this does not affect the use or performance of this unit.

Open/close door in high temperature affects the device



Do not open/close the door as possible at the in-furnace temperature of 500°C or more, which affects the lives of sensor, oven and heater. Quickly open/close it after operation if necessary.

Do not leave door open for a long time at high temperature



Leaving the door open for long time at high temperature may cause a radiation heat, which could result in breakdown on the operation panel or controller.

Fine powder may fly



This unit uses an iron chrome heater. Fine powder from its protective film (oxide film) is possible to be flown during operation. Protect the sample with a cover if needed.

Make protective film on heater



The heater used on this unit forms a protective film on its surface under high temperature. Make the film by operating this unit for ten hours at the temperature of 1050°C when using it under the temperature of 700°C or less.

Heater corrosion



The heater used on this unit can be corroded with halogen elements such as chlorine, fluorinate or alkali metals such as sodium or potassium. Do not contact these materials to the heater.

Sensor deterioration



The sensor on this unit (R thermocouple) is very sensitive. Do not contact it to samples when loading or unloading them. Do not touch the sensor with bare hands, which may cause the degradation.

Sensor corrosion



The sensor used on this unit can be corroded at high temperature with reducing substances such as alkali metal, metal steam, metal oxide, carbon monoxide, carbon, phosphorus, selenium or arsenicum or other reducing ambiances. Do not use these materials.

When using N2 gas...



Under the Atmosphere of N2 gas, high temperature nitrates the surface of heater, which prevents the formation of protective film on it. Upper limit temperature for use is, therefore, lower than that under atmospheric air. Use the temperature within the range of 100 to 900°C when operating this unit under N2 gas.

Notes for the independent overheating prevention device



In case there is a small difference between the set values of temperature for the independent overheating prevention device and that of controller, the overheating prevention device may be activated with displaying **Er.07** when the temperature reaches to the set value of controller. Set the temperature of overheating prevention device so it be at least 100°C or more higher than that of controller. (When the setting temperature is lower, there is a case that overshoot occurs because this unit is high temperature type furnace. This overheating prevention device should be used for protect the unit.) The default value of the overheating prevention device at factory shipment is 1200°C.

Exhaust device unit



Connect the ground lead to the exhaust device unit with the main body chassis when it installed.

Daily Inspection and Maintenance

WARNING!

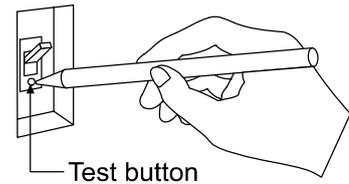
- Disconnect the power cable from the power source when doing an inspection or maintenance unless needed.
- Perform the daily inspection and maintenance after returning the temperature of this unit to the normal one.
- Do not disassemble this unit.

CAUTION!

- Use a well-drained soft cloth to wipe dirt on this unit. Do not use benzene, thinner or cleanser for wiping. Do not scrub this unit. Deformation, deterioration or color change may result in.
- Keep the cooling fan clean. Being covered with dust lowers cooling performance.

Monthly maintenance

- Check the earth leakage breaker function.
 1. Connect the power cord.
 2. Turn the breaker on.
 3. Push the red test switch by a ballpoint pen etc.
 4. If there is no problem, the earth leakage breaker will be turned off.



- Check the movement of overheating prevention device.

Perform the fixed temperature operation of device with certain preset temperature. Then set the operation temperature of overheating prevention device to the value approximately 5°C lower than the preset temperature of device.

In normal condition, the overheating prevention device shuts off the heating circuit in a few seconds, at the same time the alarm lamp lights on and the Er07 is indicated accompanied with a warning buzzer.
- ❖ Be sure to check the movement of earth leakage breaker malfunction and overheating prevention device mentioned above before a long-term continuous operation or unmanned night operation.

For any questions, contact the dealer who you purchased this unit from, or the nearest sales division in our company.

When not using this unit for long term / When disposing

CAUTION!

When not using this unit for long term...

- Turn off the power and disconnect the power cord.

WARNING!

When disposing...

- Keep out of reach of children.
- Remove the door and driving parts.
- Treat as large trash.

Environmental protection should be considered

We request you to disassemble this unit as possible and recycle the reusable parts considering to the environmental protection. The feature components of this unit and materials used are listed below.

Component Name	Material
Main body	
Body	Steel, Melamine, Epoxy composite resin coating, Stainless steel, SUS304
Furnace and Door	Ceramic fiber
Plates	Polyethylene (PET) resin film
Electrical Parts	
Switch, Relays	Resin, Copper, and other composites
Operation panel	Alkyl benzene sulfide (ABS)
Board	Glass fiber and other composites
Heater	Iron chrome wire
Power code	Synthetic rubber coating, Copper, Nickel
Wiring	Glass fiber, Flame resistance plastic, Copper, Nickel
Seals	Resin material
Sensor (R thermocouple)	Platinum element

Error Display

When an error occurs, the buzzer sounds and the ERROR lamp blinks. The main indicator indicates the error number and the sub indicator indicates the detail of error and its corrective actions.

Error No.	Error Name	Main indicator	Sub indicator
Er00	Communication error	Er.00	Communication Er Ex a connection
Er.01	Temperature sensor error	Er.01	Sensor Error Calls a service
Er.02	TRIAC short-circuit	Er.02	SSR Error Calls a service
Er.03	Heater disconnection	Er.03	Heat Error Calls a service
Er.07	Independent overheating protection device is activated.	Er.07	Overheat Error Calls a service
Er.08	Timer element error	Er.08	Controller Er Calls a service
Er.10	Main relay error	Er.10	Main relay Er Calls a service
Er.14	RAM error	Er.14	Controller Er Calls a service
Er.15	EEP ROM error	Er.15	Controller Er Calls a service

Function of safety devices

Safety device	Function	Action	Indication	Possible cause / corrective action
Over current earth leakage breaker	Prevents over current and electric leakage.	Power source is cut off. All indications lights off.	None	Check the cause by contacting to our service division.
Thermal fuse	Prevents overtemperature of device surface	Heater circuit is cut off. Warning buzzer	Combined with heater cutoff detector	Contact to our service division.
Independent overheating prevention device	Prevents overtemperature	Heater circuit is cut off. Warning buzzer	ERROR lamp lights on. Er.07 is indicated.	Overheating prevention device trouble. Contact to our service division.
Sensor abnormality detector	Prevents overtemperature due to sensor abnormality	Heater circuit is cut off. Warning buzzer	ERROR lamp lights on. Er.01 is indicated.	Sensor disconnection. Contact to our service division.
Heater disconnection detector	Gives a warning against temperature uncontrollability	Heater circuit is cut off. Warning buzzer	ERROR lamp lights on. Er.03 is indicated.	Heater or thermal fuse disconnection. Contact to our service division.
Triac short circuit detector	Prevents overtemperature due to heater uncontrollability	Heater circuit is cut off. Warning buzzer	ERROR lamp lights on. Er.02 is indicated.	Triac short circuit. Contact to our service division.
Main relay defect detector	Gives a warning against incapability	Heater circuit is cut off. Warning buzzer	ERROR lamp lights on. Er.10 is indicated.	Main relay trouble. Contact to our service division.
POST function (*)	Checks electronic circuit	Heater circuit is cut off. Warning buzzer	ERROR lamp lights on. Er.08 or Er.14 is indicated.	Contact to our service division.
Automatic overheating prevention	Prevents overtemperature	Heater circuit is cut off. (in-furnace temperature: rising)	None	High fever of sample. Contact to our service division.
Key lock	Prevents wrong operation	Input impossible in key lock state except the mode key	None	Activate during operation to prevent discontinuance due to wrong operation. Refer to the Page 38 to set/release the function.
Memory backup circuit	Stores memory in case of power failure		None	

*: The POST (Power On Self Test) function checks the microprocessor, memory, peripheral LSI and peripheral circuit on the controller every time the power is turned on. It checks the existence of fatal error on the controller before operation.

Troubleshooting

Problem	Possible Cause	Solution
The sub indicator does not indicate current date and time when the electric leakage breaker is turned on.	Power is not supplied.	Check the connection and turn on electricity.
	Bad condition of the earth leakage breaker	Replace the part (*)
	Bad condition of the controller	
The cooling fan does not move when the electric leakage breaker is turned on.	Bad condition of the cooling fan	Replace the part (*)
The operation panel indicates none when the power key is pressed.	Problem in power source	Connect to the appropriate power source.
	Bad condition of the controller	Replace the part (*)
Temperature does not rise.	Heater circuit is interrupted by self-diagnosis function (Error code is indicated)	Refer to the Page 53 "Function of safety devices".
	Heater deterioration	Replace the part (*)
Instable indication of temperature	Variable ambient temperature	Change the installation location.
	Too much samples loaded	Reduce the quantity of sample.
	Bad condition of the controller	Replace the part (*)
	Bad condition of the sensor	
Noisy	Cooling fan deterioration	Replace the part (*)

: Please contact to the shop of your purchase or nearest branch office of Yamato Science for the troubleshooting of items with the "" mark.

When an error occurs...

- In case these error code mentioned above is displayed, recode the error code and shut off the power immediately.
- In case "Er14" is displayed, once turn off a circuit breaker. Then, after more than 30seconds, turn on the breaker again. In case "Er14" is still displayed even after the breaker is turned on, then contact us.

When power failure occurs...

- When power is supplied after a power failure, the device automatically starts operation again with the same state as just before the power failure. It is danger that the device starts unattached operation after a power failure.
- We recommend for you to turn off the switch of device if a power failure occurs during operation.

In the case if the error other than listed above occurred, turn off the power switch and primary power source immediately. Contact the shop of your purchase or nearest Yamato Scientific Service Office.

In Case of Request for Repair

If the failure occurs, stop the operation, turn OFF the power switch, and unplug the power plug. Please contact the sales agency that this unit was purchased, or the Yamato Scientific's sales office.

< Check following items before contact >

- ◆ Model Name of Product
 - ◆ Production Number
 - ◆ Purchase Date
 - ◆ About Trouble (in detail as possible)
- } See the production plate attached to this unit.

Minimum Retention Period of Performance Parts for Repair

The minimum retention period of performance parts for repair of this unit is 7 years after discontinuance of this unit.

The "performance part for repair" is the part that is required to maintain this unit.

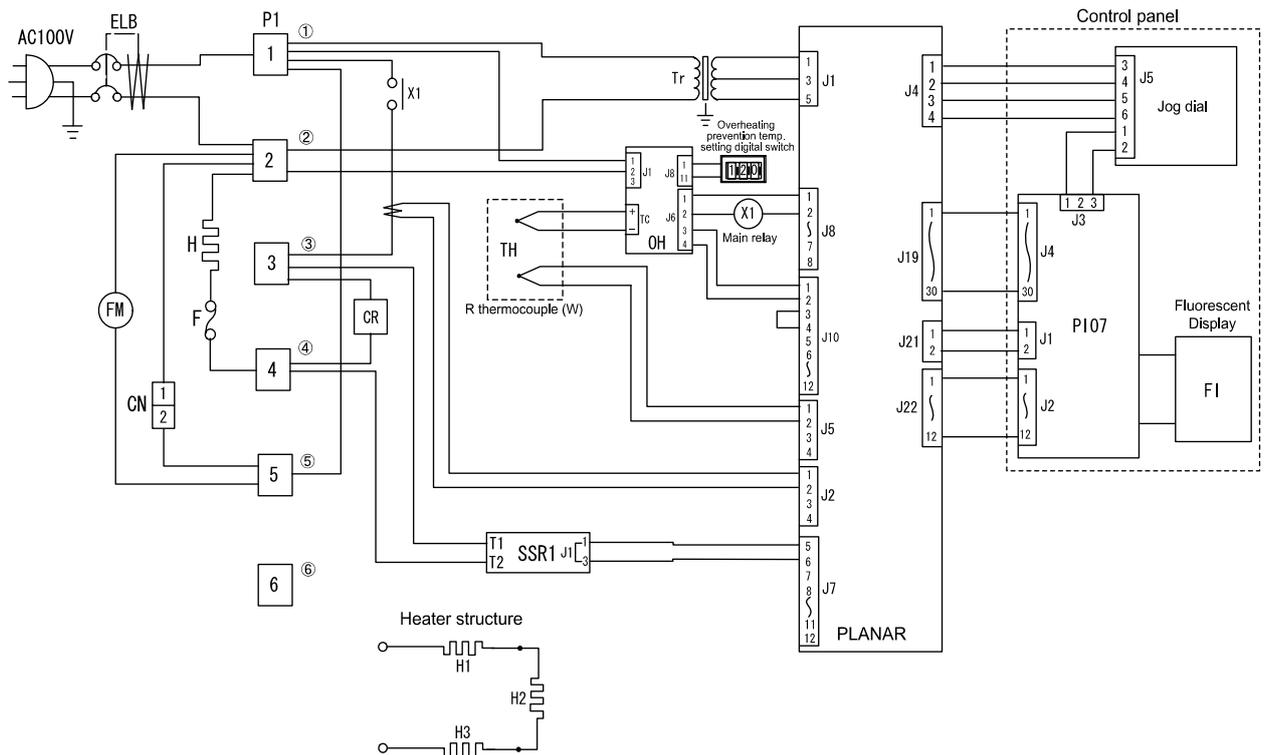
	FP100	FP300	FP310	FP410
Operating temperature range (*1)	100 to 1150°C			
Temperature adjustment accuracy (*1)	±1.5°C (@1150°C)			
Time required to reach highest temperature (*1)	Approx. 80min. (@1150°C)			
Temperature control system	PID control by micro computer			
Temperature / time setting system	Digital setting by jog dial			
Temperature display system	Digital display by green LED			
Other indications	Fluorescent character display of function			
Functions for Operation	Fixed temperature operation, Auto start operation, Auto stop operation, Program operation (max. of 16 segments, repeat operation, Ramp operation, etc.)			
Additional function	Timer, Clock, Total operating hours counter (max. of 49999h), Calibration offset			
Safety device	Earth leakage breaker, Thermal fuse, Independent overheating prevention device, Key lock function, Self-diagnostic functions (Sensor error, Memory error, Heater disconnection, Triac short circuit, Automatic overheating prevention)			
Sensor	R thermocouple (W sensor)			
Heater	Pyromax			
Nominal capacity of heater	1.1KW	2.4KW	2.4KW	3.25KW
Cooling fan	Condenser motor 14W			
Exhaust opening	Internal diameter ϕ 18			
Furnace casing	Single piece vacuum ceramic fiber			
Internal dimensions (W × D × H mm)	Approx. 100 × 150 × 100	Approx. 200 × 250 × 150	Approx. 200 × 250 × 150	Approx. 300 × 250 × 150
External dimensions (*2) (W × D × H mm)	Approx. 346 × 405 × 516	Approx. 446 × 505 × 566	Approx. 446 × 505 × 566	Approx. 506 × 505 × 626
Internal capacity	Approx. 1.5L	Approx. 7.5L	Approx. 7.5L	Approx. 11.3L
Power supply(50/60Hz)	100V AC single phase		200V AC single phase	
	13A	26A	13A	17.5A
Weight	Approx. 24Kg	Approx. 42Kg	Approx. 42Kg	Approx. 48Kg
Attached accessories	Instruction manual, Warranty, Thermal fuse			
Optional accessories	Exhaust device unit, Sample tray, N2 gas leading device, External alarm, Temperature output terminal, Outer communication adapter, Time-up output terminal, Cooling fan automatic stopper			

*1: The value under the condition of the ambient temperature of 23°C±5°C, the humidity of 65%±20%, and without load.

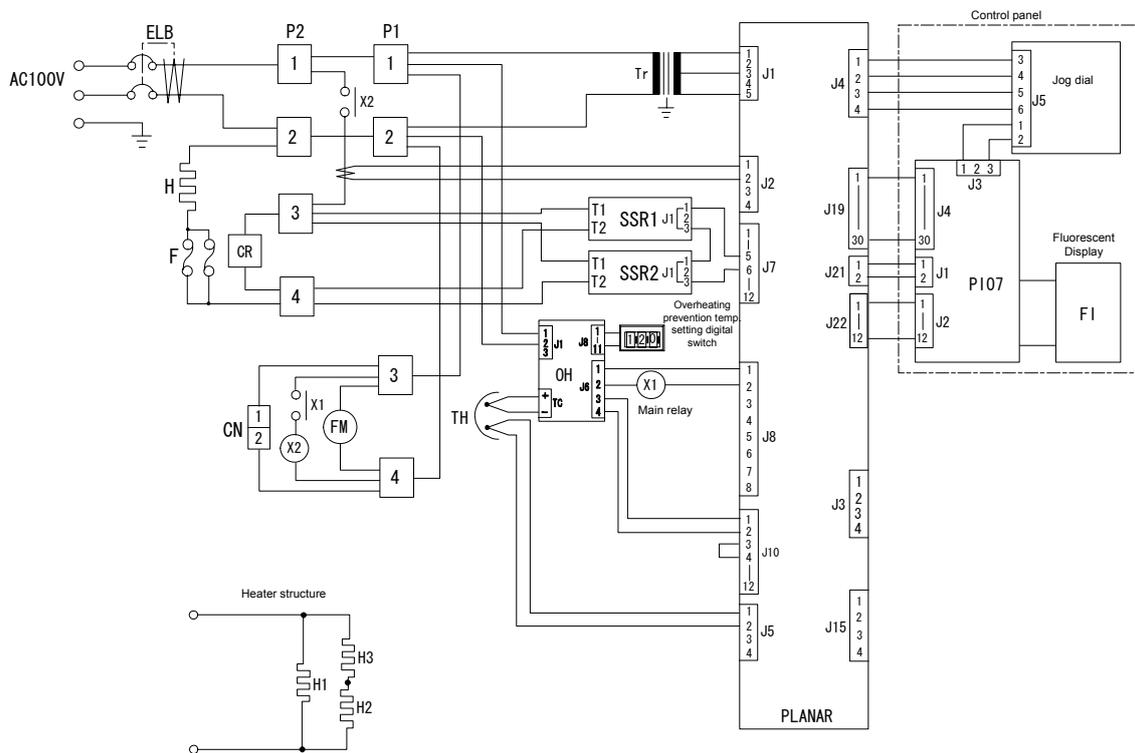
*2: The projection is not included.

Wiring Diagram

FP100



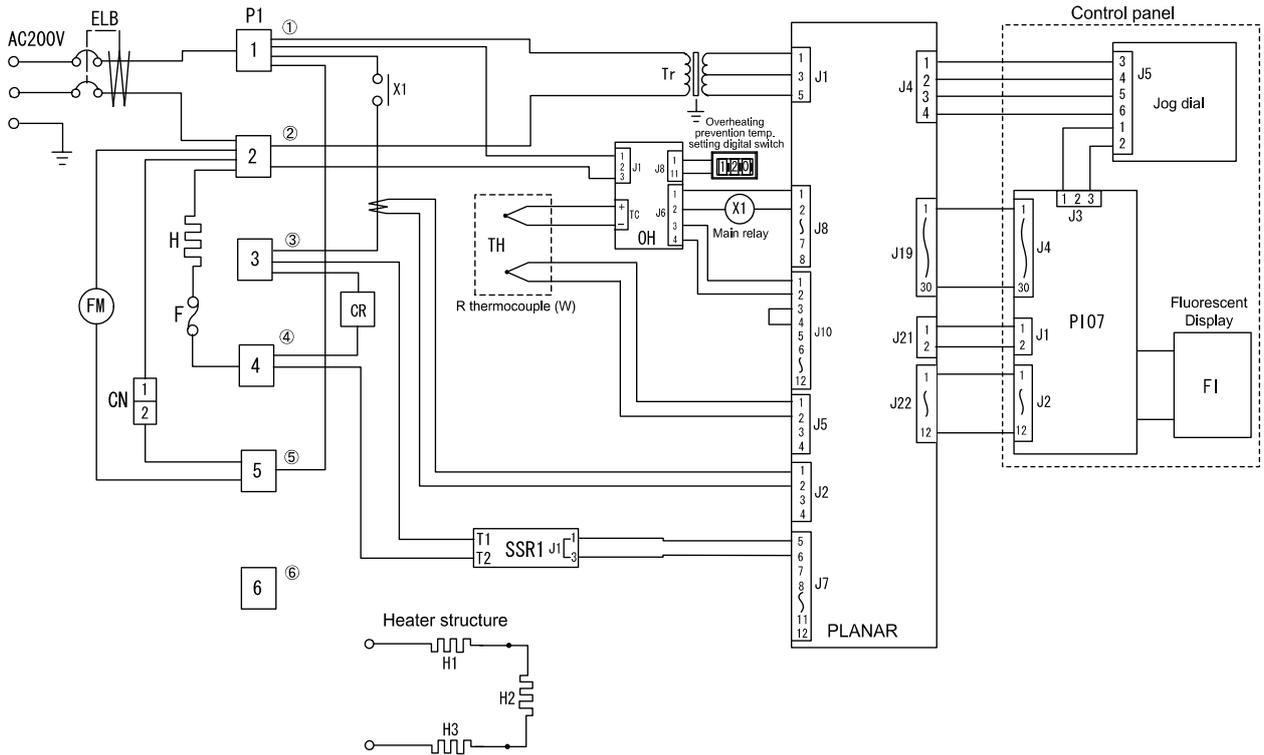
FP300



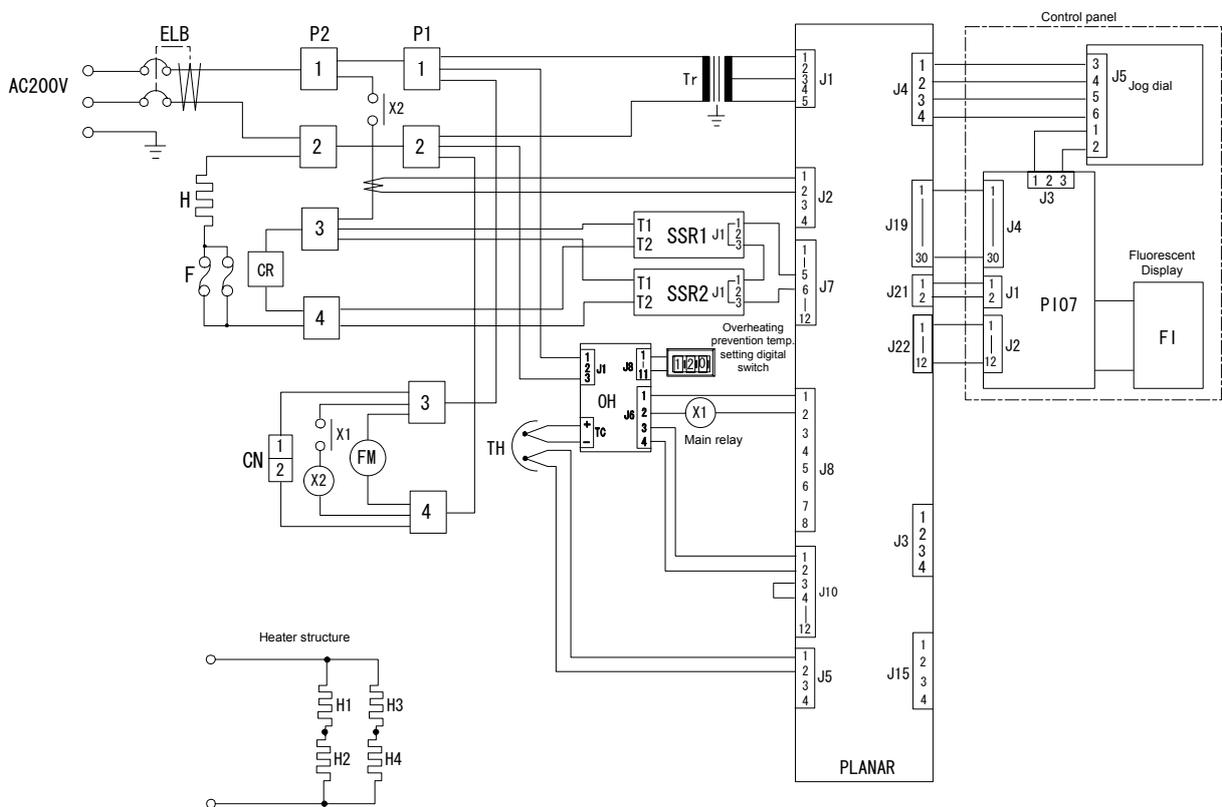
Symbol	Part name	Symbol	Part name
ELB	Earth leakage breaker	P1	Terminal block
FM	Fan motor	X1	Relay
CN	Connector	Tr	Transformer
F	Fuse	OH	Independent overheating prevention device

Wiring Diagram

FP310



FP410



Symbol	Part name	Symbol	Part name
ELB	Earth leakage breaker	P1	Terminal block
FM	Fan motor	X1	Relay
CN	Connector	Tr	Transformer
F	Fuse	OH	Independent overheating prevention device

Replacement Parts Table

Common Use Parts

Part Name	Code No.	Specification	Manufacturer
Control board (HITEC IV CR11)	1240000120		Yamato Scientific
Display circuit board (PIO7)	1240000084		Yamato Scientific
Tough card	1130000007	0-8370-307-000-800	Japan Autonics
CT sensor	2170010002	CTL-6-S-4-H	Yamato Scientific
Relay(X1)	2050000013	AHN36006	Matsushita
Thermal fuse	LT00031819	25A 250V E8A50184C	EMERSON
Independent overheating prevention device	1240000100	IV-LE type	Fuji Denki
Degi-switch	2010100002	For IV-LE	Fuji Denki
W sensor	1016007002	R-thermocouple	Yamato Scientific
Fan guard	4370010003	A-30-F	Minebea
Fiber for heater (6 pieces)	FP21S41451		Yamato Scientific

FP100

Part Name	Code No.	Specification	Manufacturer
SSR	LT00028423	SSR-01	Yamato Scientific
Power code	LT00008924	T2-3c	Yamato Scientific
Earth leakage breaker	LT00029774	NV-L22GR 15A	Mitsubishi
Transformer	2180000040	IVCR2 100V	Yamato Scientific
Fan motor	2150000010	UF12A10BTH	FULLTECH
Heater (A)	LT00032208		Hachikou Syoji
Heater (B) (2 pieces)	LT00032209		Hachikou Syoji
Door furnace material	FP10030120	FP100 type	Nichiasu
Furnace material	FP21S22010	FP100 type	Nichiasu
Furnace port material	FP21S40311	FP100 type	Nichiasu
Furnace front plate	FP21S32040	FP100 type	Kurata Taika
Fiber for ceiling	FP22S40220		Yamato Scientific
Fiber for the side (2 pieces)	FP21S40261		Yamato Scientific
Fiber for the bottom	LT00017249		Yamato Scientific
Fiber for the rear	LT00008757		Yamato Scientific
Terminal block	LT00031663	TFD250ABC-6P	Terminal

Replacement Parts Table

FP300

Part Name	Code No.	Specification	Manufacturer
SSR1	LT00028427	SSR-01A	Yamato Scientific
SSR2	LT00028425	SSR-01B	Yamato Scientific
Power code	2130010010	T3-3e	Yamato Scientific
Earth leakage breaker	LT00029777	NV-L22GR 30A	Mitsubishi
Relay(X2)	LT00005140	AHE1274	Matsushita
Transformer	2180000040	IVCR2 100V	Yamato Scientific
Fan motor	2150000010	UF12A10BTH	FULLTECH
Heater (A)	LT00032206		Hachikou Syoji
Heater (B) (2 pieces)	LT00032207		Hachikou Syoji
Door furnace material	FP30030100	FP300 type	Nichiasu
Furnace material	FP31S20080	FP300 type	Nichiasu
Furnace port material	FP31S40171	FP300 type	Nichiasu
Furnace front plate	FP31S30170	FP300 type	Kurata Taika
Fiber for ceiling	FP32S40110		Yamato Scientific
Fiber for the side (2 pieces)	FP32S40120		Yamato Scientific
Fiber for the bottom	LT00017253		Yamato Scientific
Fiber for the rear	LT00008758		Yamato Scientific
Terminal block	LT00031661	TFD250ABC-4P	Terminal

FP310

Part Name	Code No.	Specification	Manufacturer
SSR	LT00028423	SSR-01	Yamato Scientific
Power code	2130010010	T3-3d	Yamato Scientific
Earth leakage breaker	Lt00039774	NV-L22GR 15A	Mitsubishi
Transformer	2180000042	IVCR2 200V	Yamato Scientific
Fan motor	2150040007	4715PS-20T- b 30-100	Minebea
Heater (A)	LT00032206		Hachikou Syoji
Heater (B) (2 pieces)	LT00032207		Hachikou Syoji
Door furnace material	FP30030100	FP300 type	Nichiasu
Furnace material	FP31S20080	FP300 type	Nichiasu
Furnace port material	FP31S40171	FP300 type	Nichiasu
Furnace front plate	FP31S30170	FP300 type	Kurata Taika
Fiber for ceiling	FP32S40110		Yamato Scientific
Fiber for the side (2 pieces)	FP32S40120		Yamato Scientific
Fiber for the bottom	LT00017257		Yamato Scientific
Fiber for the rear	LT00008759		Yamato Scientific
Terminal block	LT00031663	TFD250ABC-6P	Terminal

Replacement Parts Table

FP410

Part Name	Code No.	Specification	Manufacturer
SSR1	LT00028427	SSR-01A	Yamato Scientific
SSR2	LT00028425	SSR-01B	Yamato Scientific
Power code	2130010010	T3-3d	Yamato Scientific
Earth leakage breaker	LT00029777	NV-L22GR 30A	Mitsubishi
Relay(X2)	LT00005140	AHE1274	Matsushita
Transformer	2180000042	IVCR2 200V	Yamato Scientific
Fan motor	2150040007	4715PS-20T- b 30-100	Minebea
Heater (C)	LT00032203		Hachikou Syoji
Heater (D)	LT00032204		Hachikou Syoji
Heater (E) (2 pieces)	LT00032205		Hachikou Syoji
Door furnace material	FP41030110	FP400 type	Nichiasu
Furnace material	FP41S20090	FP400 type	Nichiasu
Furnace port material	FP41S30171	FP400 type	Nichiasu
Furnace front plate	FP41S30160	FP400 type	Kurata Taika
Fiber for ceiling	FP42S40150		Yamato Scientific
Fiber for the side (2 pieces)	FP32S40120		Yamato Scientific
Fiber for the bottom	LT00017257		Yamato Scientific
Fiber for the rear	LT00008759		Yamato Scientific
Terminal block	LT00031661	TFD250ABC-4P	Terminal

List of Dangerous Substances



Never use explosive substances, flammable substances and substances that include explosive or flammable ingredients in this unit.

EXPLOSIVE

EXPLOSIVE:	Ethylene glycol dinitrate (nitro glycol), Glycerin trinitrate (nitroglycerine), Cellulose nitrate (nitrocellulose), and other explosive nitrate esters
	Trinitrobenzene, Trinitrotoluene, Trinitrophenol (picric acid), and other explosive nitro compounds
	Acetyl hidroperoxide (peracetic acid), Methyl ethyl ketone peroxide, Benzyl peroxide, and other organic peroxides

FLAMMABLE

IGNITING:	Lithium (metal), Potassium (metal), Sodium (metal), Yellow phosphorus, Phosphorus sulfide, Red phosphorus, Celluloid compounds, Calcium carbide, Lime phosphate, Magnesium (powder), Aluminum (powder), Powder of metals other than magnesium and aluminum, Sodium hydrosulfite
OXIDIZING:	Potassium chlorate, Sodium chlorate, Ammonium chlorate, and other chlorate
	Potassium perchlorate, Sodium perchlorate, Ammonium perchlorate, and other perchlorate
	Potassium peroxide, Sodium peroxide, Barium peroxide, and other inorganic peroxide
	Potassium nitrate, Sodium nitrate, Ammonium nitrate, and other nitrate
	Sodium chlorite and other chlorites
	Calcium hypochlorite and other hypochlorites
INFLAMMABLE LIQUID:	Ethyl ether, Gasoline, Acetaldehyde, Propylene chloride, Carbon disulfide, and other flammable substances having a flash point of lower than -30°C
	Normal hexane, ethylene oxide, acetone, benzene, methyl ethyl ketone, and other flammable substances having a flash point of -30°C or higher but lower than 0°C
	Methanol, Ethanol, Xylene, Pentyl acetate (amyl acetate), and other flammable substances having a flash point of 0°C or higher but lower than 30°C
	Kerosene, Light oil (gas oil), Oil of turpentine, Isopentyl alcohol (isoamyl alcohol), Acetic acid, and other flammable substances having a flash point of 30°C or higher but lower than 65°C
FLAMMABLE GAS:	Hydrogen, Acetylene, Ethylene, Methane, Propane, Butane, and other flammable substances which assume a gaseous state at 15°C and 1 atm

(Source: Appendix Table 1 of Article 6 of the Industrial Safety and Health Order in Japan)

Responsibility

Please follow the instructions in this document when using this unit. Yamato Scientific has no responsibility for the accidents or breakdown of device if it is used with a failure to comply. Never conduct what this document forbids. Unexpected accidents or breakdown may result in.

Note

- ◆ The contents of this document may be changed in future without notice.
- ◆ Any books with missing pages or disorderly binding may be replaced.

Instruction Manual for

Muffle Furnace

Model FP100/300/310/410

Fourth Edition Oct. 7, 2009

Revised Feb. 24, 2012

Yamato Scientific Co., Ltd.

2-1-6 Nihonbashi Honcho, Chuo-ku,
Tokyo, 103-8432, Japan

Customer Support Center
(toll-free) 0120-405525

<http://www.yamato-net.co.jp>