Yamato

Constant Temperature Precision Oven
(High Accuracy Fine Oven)
DF412/612
DH412/612

Instruction Manual

First Edition

- **Thank you for choosing DF/DH series Precision Ovens from Yamato Scientific Co., Ltd.**
- **This product is not designed for medical applications. For laboratory drying sterilization only.**
- **For proper equipment operation, please read this instruction manual thoroughly 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

Contents

1. SAFETY PRECAUTIONS

Explanation of Symbols

A Word Regarding Symbols

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

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

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

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

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

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

Symbol Meanings

Signifies warning or caution.
Specific explanation will follow symbol.

Signifiies restriction.
Specific restrictions will follow symbol.

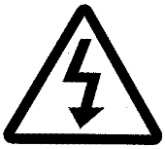
Signifies an action or actions which operator must undertake.
Specific instructions will follow symbol.

1. SAFETY PRECAUTIONS

Symbol Glossary

Warning

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 Required

Disconnect Power

Inspect Regularly

1. SAFETY PRECAUTIONS

⚠ Warning

NEVER operate equipment near combustible gases/fumes.

Do not install or operate DF/DH series unit near flammable or explosive gases/fumes. Unit is NOT fire or blast resistant. Negligent use could cause a fire/explosion.
See “List of Hazardous Substances” (P.67)

ALWAYS ground equipment.

Always ground equipment properly to avoid electric shock.

DO NOT operate equipment when abnormalities are detected.

If smoke or unusual odors begin emitting from unit, or if any other abnormalities are detected, terminate operation immediately, turn off main power switch (Earth Leakage Breaker - “ELB”) and disconnect power cable. Continued operation under such conditions may result in fire or electric shock.

DO NOT operate equipment with bundled or tangled power cable.

Operating unit with the power cable bundled or otherwise tangled may cause power cable to overheat and/or catch fire.

DO NOT damage power cable.

Damaging the power cable by forcibly bending, pulling or twisting may cause fire or electric shock to the operator.

NEVER process explosive or combustible substances.

Attempting to process/use explosive or combustible substances in/near unit may cause explosion or fire. See “List of Hazardous Substances” (P.67)

NEVER disassemble or modify equipment.

Attempting to dismantle or modify unit in any way, may cause malfunction, fire or electric shock.

DO NOT touch hot surfaces.

Some surfaces on this unit become extremely hot during operation. Exercise vigilance in order to avoid getting burned.

⚠ Caution

DO NOT operate equipment during thunderstorms.

In the event of a thunderstorm, terminate operation and turn off main power switch (ELB) immediately. A direct lightning strike may cause damage to equipment, or result in fire or electric shock.

2. PRE-OPERATION PROCEDURES

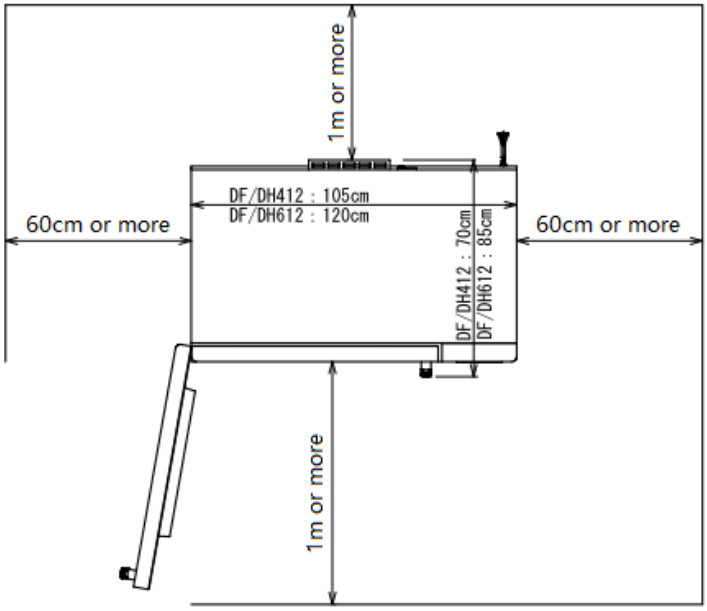
Installation Precautions & Procedures

1. Choose an appropriate installation site.

DO NOT install unit:

- where flammable or corrosive gases/fumes will be generated.
- where ambient temperature will exceed 35ºC, will fall below 5ºC or will fluctuate.
- in excessively humid or dusty locations.
- where there is constant vibration.
- where power supply is erratic.
- in direct sunlight or outdoors.

Install DF/DH series unit in a location with sufficient space, as specified as below.



2. Install on an even surface.

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

Approximate weights**:**
DF/DH412: approx.112kg, DF/DH612: approx.156kg
Handle unit with care. Transportation and installation should always be done by two or more people.

3. Install in a safe location.

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. Check stability.

Unit may tip over or fall, causing injury or death during an earthquake or other unforseen incident. Be sure to stabilize unit properly (adjustable leveling feet securely positioned, etc.) to assure safe operation and a safe work area.

5. Install in a well-ventilated area.

Install unit so that side panel heat vents (see “Unit Exterior” on P.8 for location) are unobstructed and allowed to sufficiently diffuse heat. Failure to do so may result in excessive temperatures inside the unit control panel, causing possible degraded CPU board performance, malfunction or fire. See installation specifications above.

6. Install in a dry location.

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

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

Never install near flammables or explosives. Unit is NOT fire or blast resistant. Simply switching the main power switch (ELB) “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.67).

8. Connect to a proper power supply terminal.

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

Power requirements:	DF412	220V AC single phase	50/60Hz	12.5A (ELB capacity: 15A)
	DF612	220V AC single phase	50/60Hz	17.5A (ELB capacity: 20A)
	DH412	220V AC single phase	50/60Hz	15.5A (ELB capacity: 20A)
	DH612	220V AC single phase	50/60Hz	21.5A (ELB capacity: 30A)

Standard test conditions with no load should be as follows. Operational voltage range: ±10%, Voltage range at which specified performance is guaranteed: ±5%, Frequency rating: ±1%, Atmospheric pressure range: 86kPa ~ 06kPa, Ambient temperature: 23±5: Humidity: 65±5%.

ⓘ Check the line voltage on outlet or terminal to be used and properly evaluate whether to utilize a line being shared by other equipment. If the unit is not activated by turning on the main power switch (ELB), take an appropriate course of action, such as connecting the unit to a dedicated power source.

ⓘ Multiple power cables connected to a single outlet may cause unit input voltage to drop, resulting in degraded heating and temperature control performance.

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

Confim that the facility main breaker is OFF before connecting the round terminals from the power cable. No power plugs or connectors of any kind are included with DN411H/611H. Where required, purchase an appropriate plug and properly connect using the round terminals.

Color	Facility
Black	Live side
White	Neutral side
Green	Ground

10. Handle power cable with care.

Never operate unit with power cable bundled or tangled; and do not modifiy, bend, forcibly twist or pull on power cable. Doing so may cause fire and/or electrical 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 electrical 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.

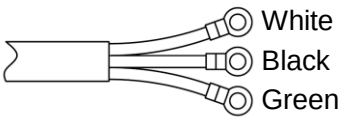
Turn off main power switch (ELB) immediately and disconnect from facility terminal or outlet, if power cable becomes partially severed or damaged in any way. Failure to do so may result in fire or electric shock. Contact a local dealer or Yamato sales office for assistance in replacing power cable if it is damaged.

Always connect power cable to appropriate facility outlet or terminal.

11. Ground wire MUST be connected properly.

- Grounding to Electrical Equipment Technical Standards, Section 19, class D (Grounding Resistance Max. 100Ω) is required in Japan when no grounding terminal is provided. Contact a local dealer, electrician, or Yamato Sales office for location-specific electrical requirements.
- Connect terminals securely to facility terminal or to an appropriate connector.
- Plugs and connectors are not included with this unit. Ground unit properly to facility outlet or terminal as required.
-

Single phase 220V AC



Wire Color	Facility Supply
White	Ground side
Black	Live side
Green	Ground

Never connect ground wire to gas lines, water pipes, telephone grounding lines or lightning rods. Doing so may result in fire or electrical shock.

12. DO NOT disassemble or modify.

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

13. Chamber rack installation and sample placement.

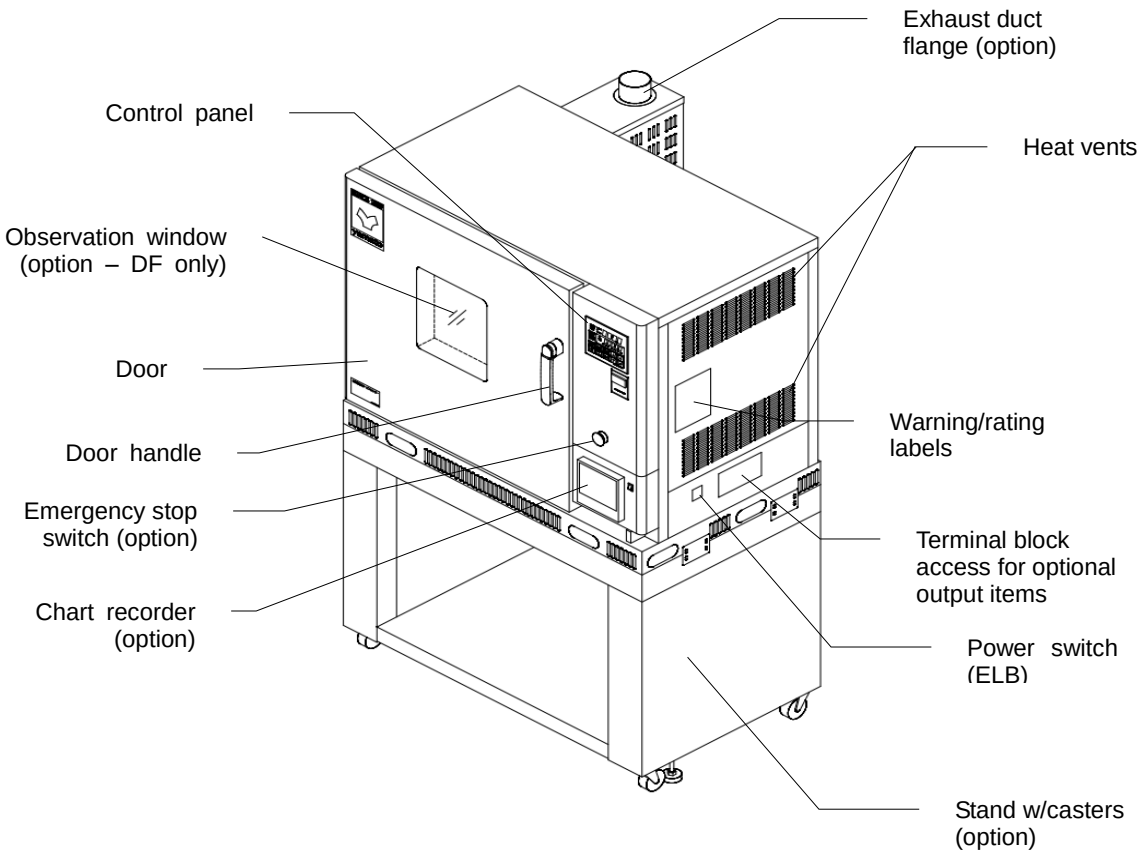
Install rack guides in desired position inside chamber before initial use.
Placing samples directly on bottom chamber surface may overheat samples, cause spills or lead to other mishaps. Temperature control may likewise become inaccurate, causing malfunction, fire or other equipment damage.
Always place samples on supplied chamber racks only; never on bottom chamber surface.
Use optional basket-type racks for processing smaller items. See Accessory Options, P.62.

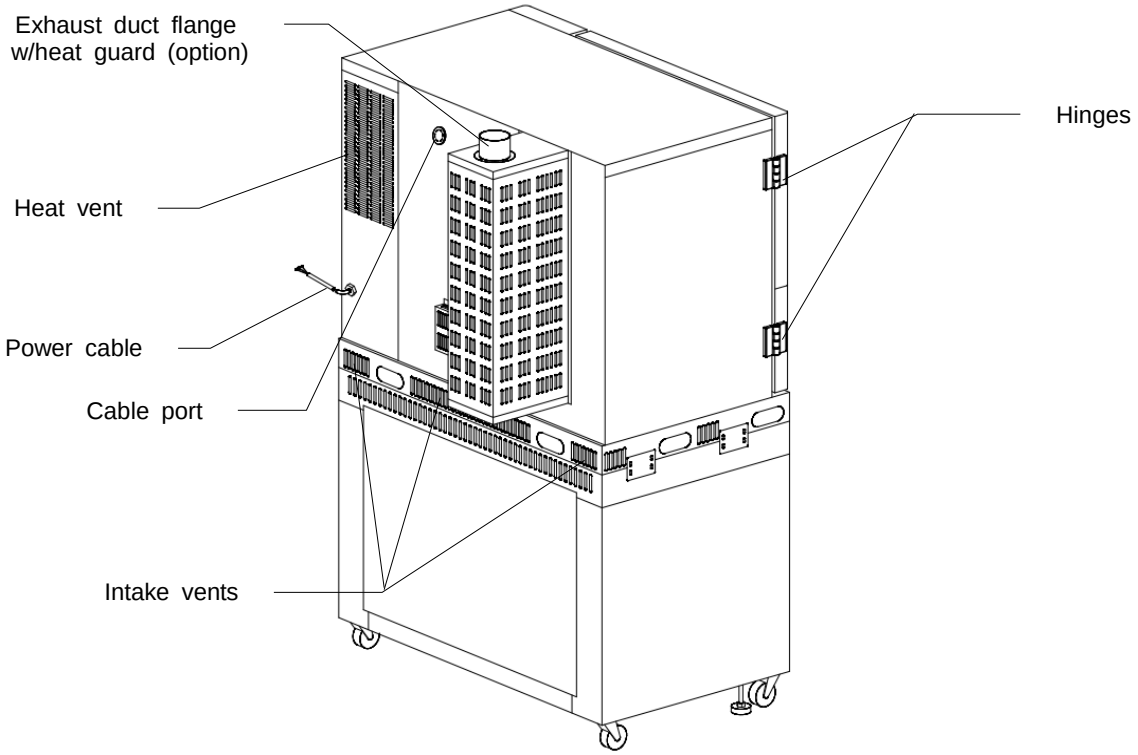
14. Exhaust precautions.

Before using exhaust damper for ventilated operation, take proper measures to assure adequate work area ventilation. Failure to do so may cause excessive work area temperatures due to exhaust heat. Likewise, smoke and other harmful fumes may be emitted into work area from samples in process. Implement proper ventillation, such as by installing an exhaust hood or by running a proper duct from the exhaust port.
Contact Yamato regarding ventilation options for DF/DH series units. Also see Accessory Options on P.62.

3. COMPONENT NAMES AND FUNCTIONS

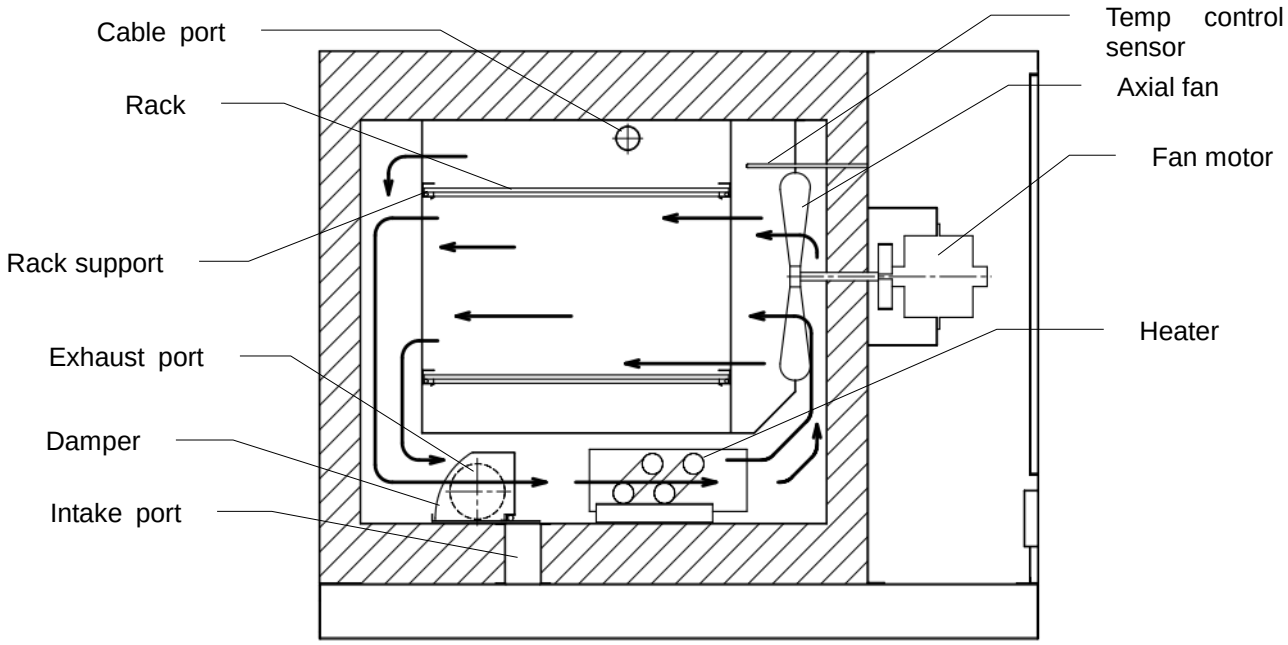
Unit Exterior



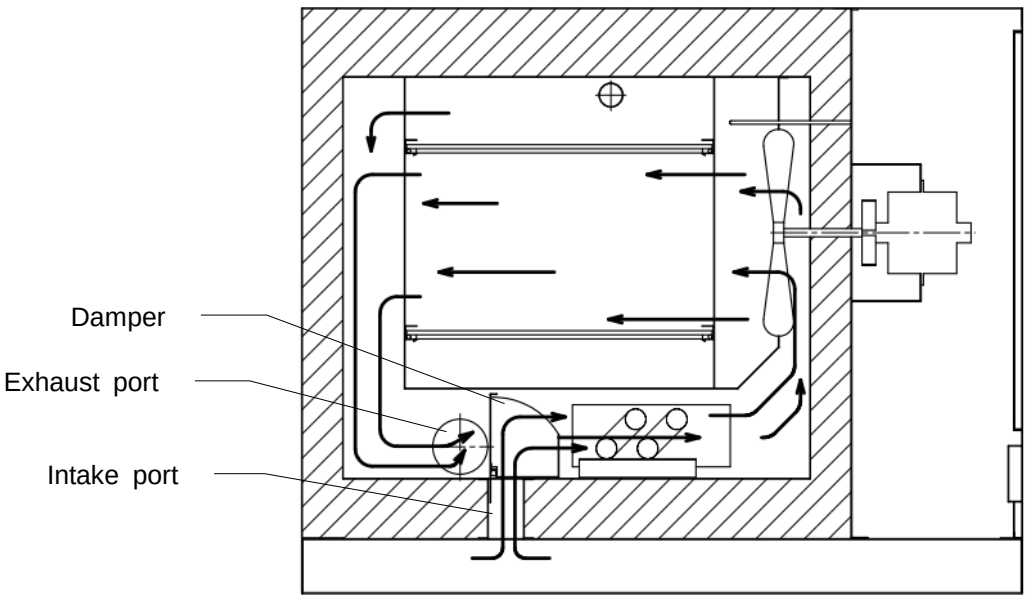


3. COMPONENT NAMES AND FUNCTIONS

Interior Structure & Configuration



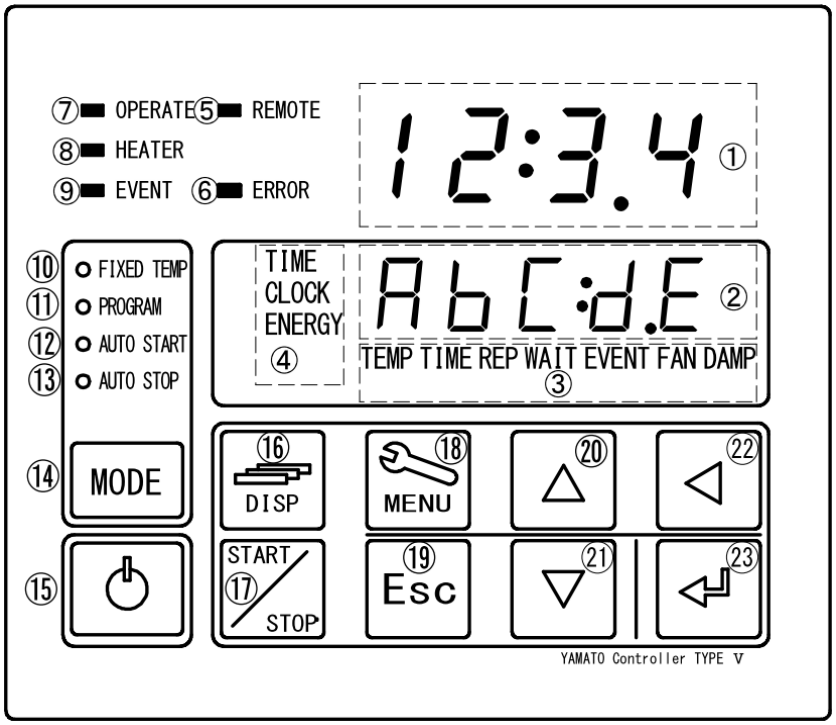
Damper fully closed



Damper fully open

3. COMPONENT NAMES AND FUNCTIONS

Control Panel



No.	Panel Item	Description
1	Upper Display	Readout for chamber temperature, error code, etc.
2	Lower Display	Readout for temperature setting, clock, timer, etc
3	Function Indicator Lamps	Illuminates (one or more) to show which function is currently running or active
4	Mode Indicator Lamps	Illuminates (one at a time) to show which mode is currently running.
5	REMOTE Indicator Lamp	Illuminates while remote comm (optional item) transmission is in progress.
6	ERROR Indicator Lamp	Illuminates when an error has occured.
7	OPERATE Indicator Lamp	Illuminates while in operation. Flashes in operation standby mode.
8	HEATER Indicator Lamp	Illuminates when heaters are on and drawing power.
9	EVENT Indicator Lamp	Illuminates when event output (optional item) is transmitted.
10	FIXED TEMP Indicator Lamp	Illuminates while constant temperature operation is in progress.
11	PROGRAM Indicator Lamp	Illuminates while programmed operation is in progress. Flashes while entering program settings.
12	AUTO START Indicator Lamp	Illuminates while auto start operation is in progress.
13	AUTO STOP Indicator Lamp	Illuminates while auto stop operation is in progress.
14	MODE key	Press to switch between operation modes, ⑩~⑬ on control panel.
15	POWER key	Press and hold to switch between unit idle and unit standby.
16	DISPLAY key	Press to switch between monitoring options in lower display.
17	START/STOP key	Press to start or stop an operation.
18	MENU key	Press to switch between setting options.
19	Escape key	Press to return to previous menu without finalizing settings
20	▲(Up) key	Press to increase setting value incrementally. Press and hold to increase perpetually.
21	▼(Down) key	Press to decrease setting value incrementally. Press and hold to decrease perpetually
22	◄ key	Press to move cursor left.
23	ENTER key	Press to finalize setting items

4. OPERATION PROCEDURE

Prior Confirmation

1. Check power supply and ground wire.

Confirm unit power cable is connected to a proper power source and grounded.

2. Check main power switch (ELB).

Confirm that ELB functions properly.
See “Maintenance Procedure” (P.54).
Check ELB performance once a month or before extended perpetual operation.

- ✶ Current time shows in control panel lower display when ELB is ON (|).

3. Check Independent Overheat Prevention device.

Confirm that IOPD temperature is set 20ºC above unit temperature setting.
Check IOPD performance before extended operations. See “Independent Overheat Prevention Device” P.47.

4. Check exhaust damper aperture.

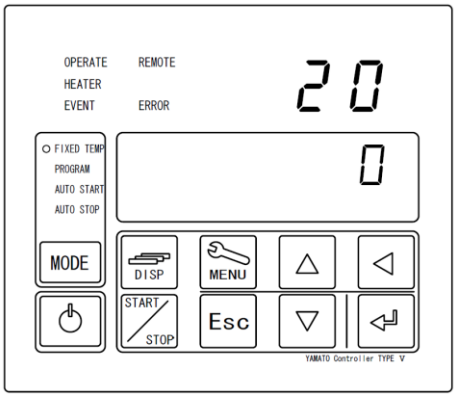
Confirm that damper aperture is set properly. Close exhaust damper completely if ventilation is not required.

The backup battery installed in DF/DH series units, is a wear item and has an estimated life of approximately 5 years. Replacing battery within the 5-year lifespan is recommended.

ⓘContact a local dealer or Yamato sales office to request a replacement battery. If unit has program data in memory, make a data backup file before replacing backup battery. See “Data Backup” (P.44) in this section for details.

To set the current date & time subsequent to backup battery replacement, follow the steps below.

1 **Turn on power.**

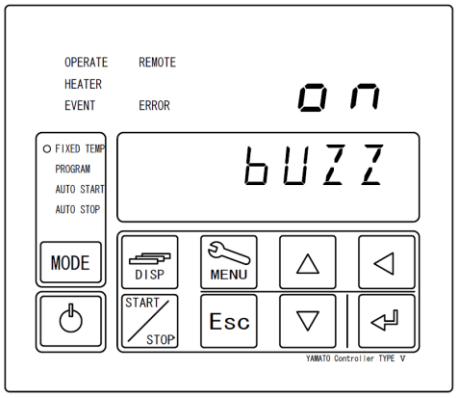


Turn ON the main power switch (ELB), located on the right panel of the DF/DH series units.
Lower display on the control panel will show the time.
This indicates that the machine is in “idle”.

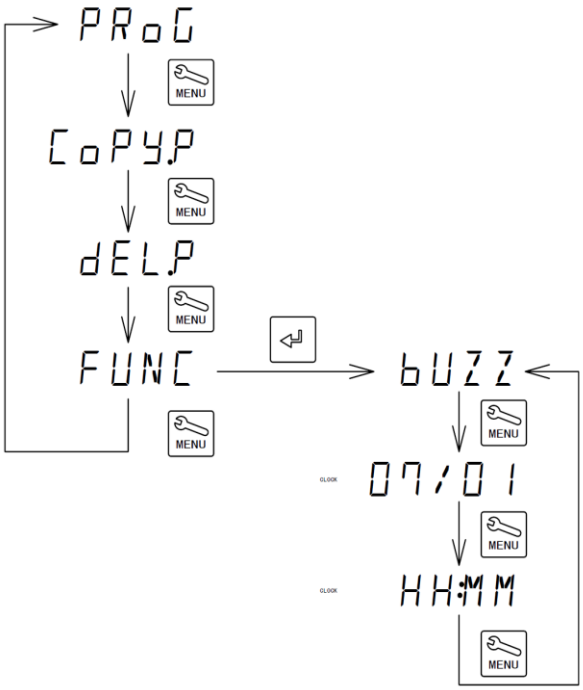
Press and hold [⏻] to display the standby screen.
Upper display shows current temperature in the chamber, while lower display shows current temperature setting.
This indicates that machine is in “standby”.

Fan begins running (runs when door is closed and stops whenever door is opened).

2 **Go to date/time setting menu.**



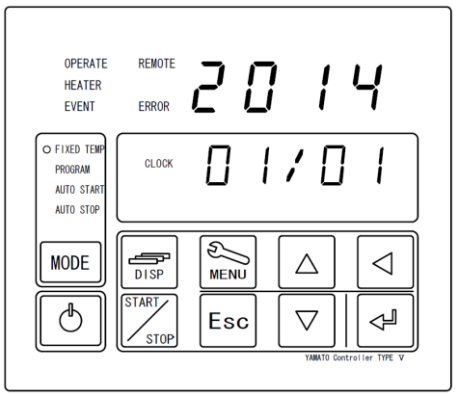
1) Press [MENU] repeatedly until FUNC is shown in lower display. Press [↵].
2) Press [MENU] to bring up year in upper display and month/day/time in lower display. Clock indicator lamp flashes.



4. OPERATION PROCEDURE

Setting Date & Time

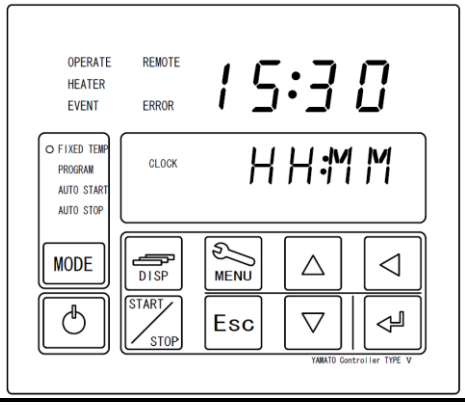
3 Set the date.



1) Press [↵].
2) Set the current year using [△] [▽] and press [↵].
3) Set month/date using [△] [▽] and press [↵].

✶ Press [◁] to move cursor position.

4 Set clock.



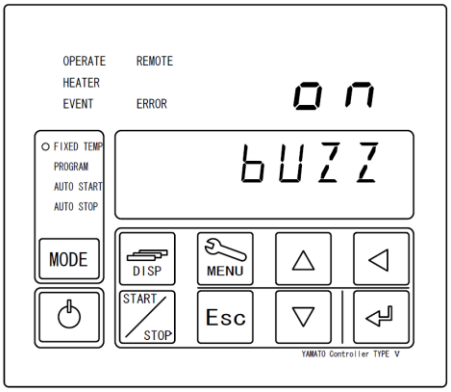
1) Press [MENU].
2) Press [↵] and set clock using [△] [▽]. Press [↵].

✶ Enter time using 24-hour (military time) system.
✶ Press [◁] to move cursor position.

3) Press [Esc] twice to restore initial screen once setting is completed.

Keypad Tone Setting

1 Go to keypad tone setting menu.



1) Press [MENU] repeatedly until FUNC is shown, then press [↵] to bring up bUZZ in the lower display. Press [↵]. on begins flashing in upper display.
2) Select one of three buzzer functions using [△] [▽] and press [↵].

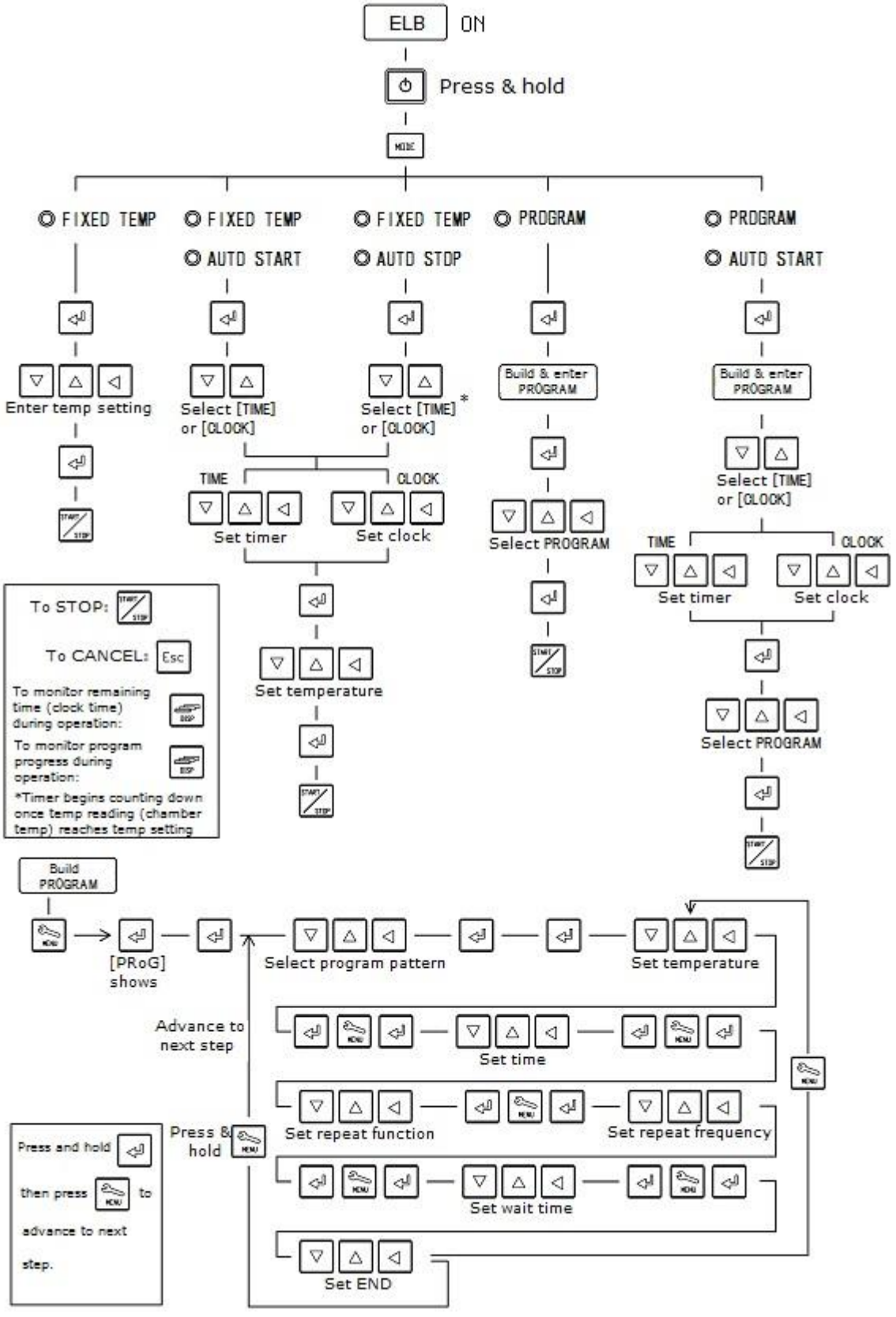
on: Activates tone for all keys. (factory default).
CLR: Activates tone for POWER and ENTER keys only.
oFF: Deactivates tone for all keys.

✶ **An alert tone will sound when an error occurs regardless of tone setting.**

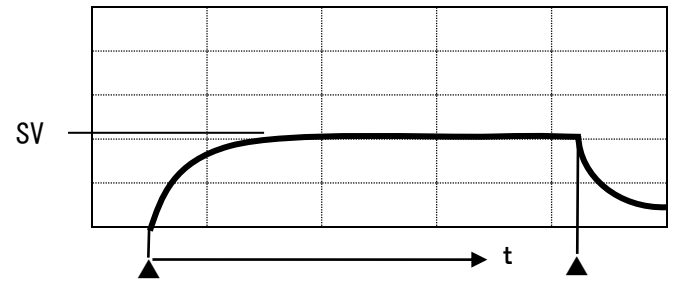
✶ Press [Esc] key twice to return to initial screen after completion of those settings.

4. OPERATION PROCEDURE

Operation & Function Flow



FIXED TEMP (constant temperature) mode runs DF/DH unit at a constant selected temperature until START/STOP key is pressed, manually terminating operation.

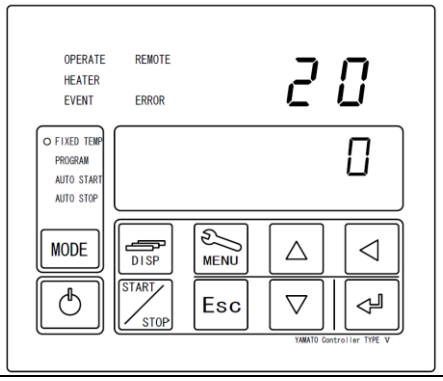


Operation start (manual) Operation stop (manual)

SV: Set Value (temperature setting), t : Time

Setting constant temperature mode.

1 Turn on power

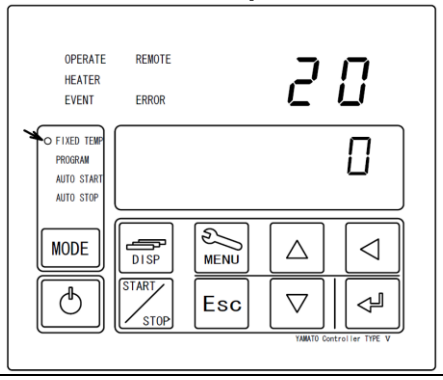


Turn ON (|) main power switch (ELB) (idle).

Press and hold [⏻] to turn on control panel power. (Standby)

Current temperature reading is shown in upper display, Temperature setting is shown in lower display.
Fan begins running (runs when door is closed and stops whenever door is opened).

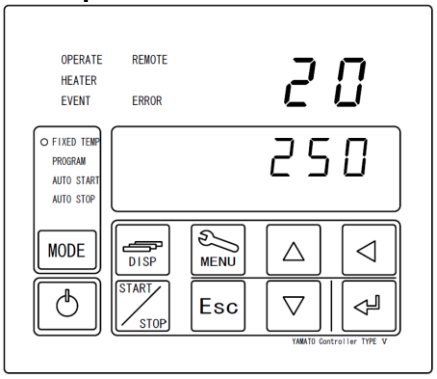
2 Select constant temperature mode.



Press [MODE] (repeatedly if needed) until FIXED TEMP lamp lights.

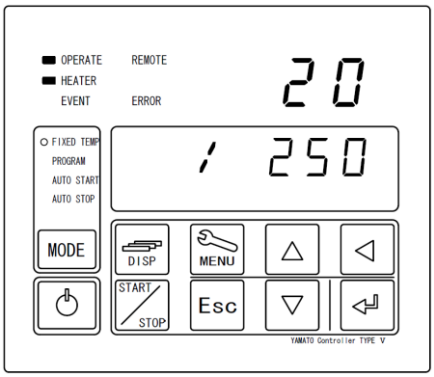
✶ Fixed Temperature mode is factory default. Once mode has been changed, the last mode run will be selected on subsequent startups.

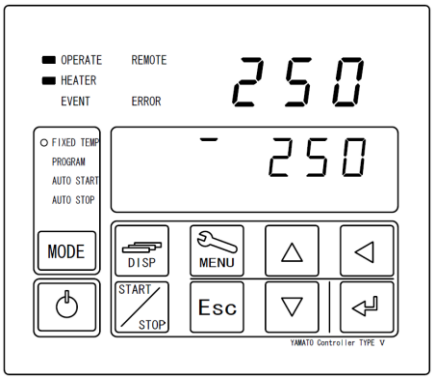
3 Set temperature.



1) Press [↵]. Changeable digits flash in lower display.
2) Change digit positions using [◁] and increase or decrease value using [△] [▽].
   Operating temperature ranges:
   DF412/612: 0～270ºC
   DH412/612: 0～370ºC
3) Press [↵] when temperature setting has been entered.

4 **Start operation.**

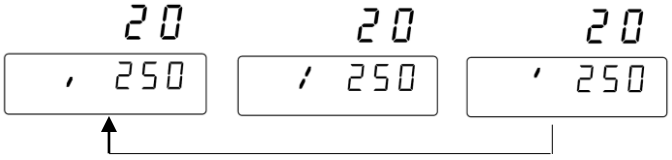




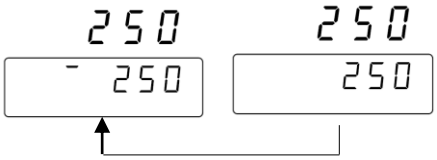
Press START/STOP to start operation.

OPERATE and HEATER lamps light and temperature begins building.

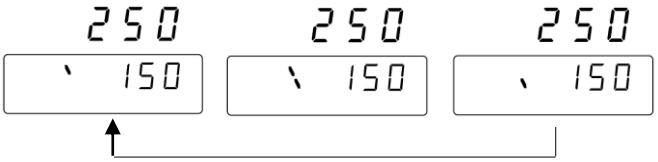
✶ Lower display in heat build phase:



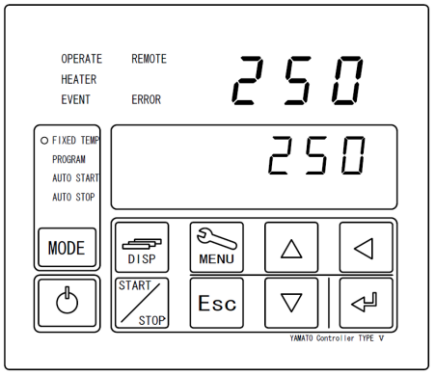
✶ Lower display in temperature stabilization:



✶ Lower display in cooling phase:



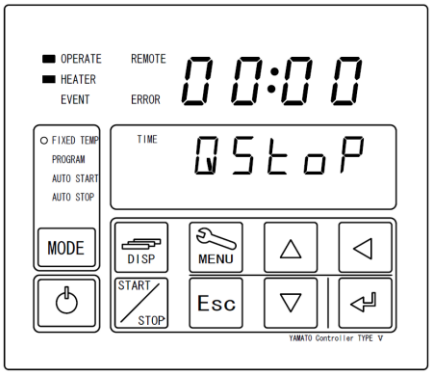
5 **Pause/stop operation**

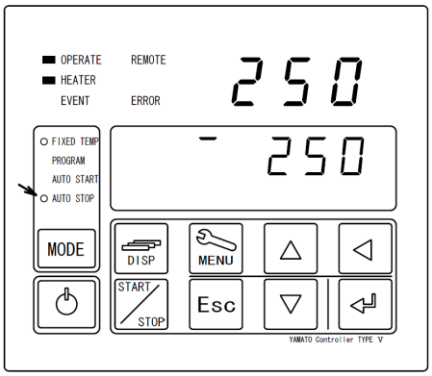


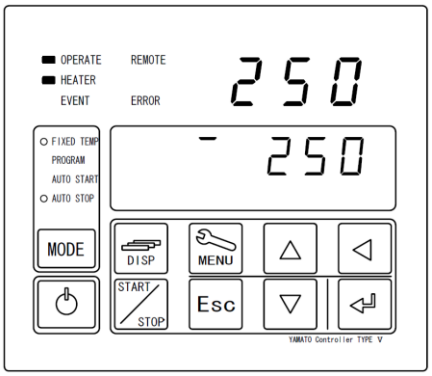
Press START/STOP to manually terminate operation. Start screen will be restored. Press START/STOP to begin operation once again, if desired**.**

✶ Fan motor continues running regardless of wheter operation is stopped. Press and hold ⏻ to turn off control panel and stop fan.

6 Set timer



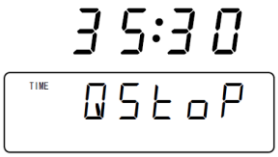




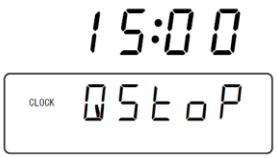
The quick auto stop function is used to automatically stop constant temperature operation at a certain time (by clock) or after a desired duration (by timer). **(decided during operation).**

1) Press [MODE] with constant temperature operation in progress.
2) QStoP is shown in lower display. "TIME" lamp (top-left in lower display) flashes.
3) Select TIME (timer) or CLOCK using [△] [▽] and press [↵].
4) Set TIME (setting range: 0~99hr：59min) or CLOCK (24-hour time system) in upper display and press [↵].

Example 1. Quick Auto Stop function set to timer:
Operation stops automatically 35 hours and 30 minutes **after temperature setting is reached**.



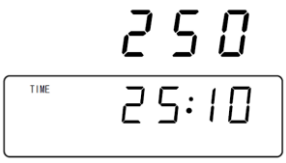
Example 2. Quick Auto Stop function set to clock:
Operation stops automatically at 15:00 (3:00PM).



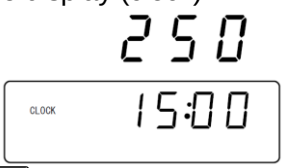
5) AUTO STOP lamp lights and Auto Stop function begins.

✶ Press [DISP] at any time during operation to monitor remaining time in the lower display.

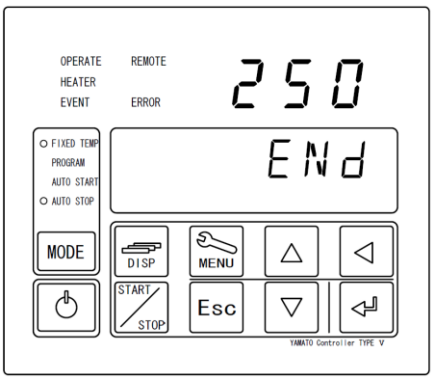
✶ Remaining time display (timer):

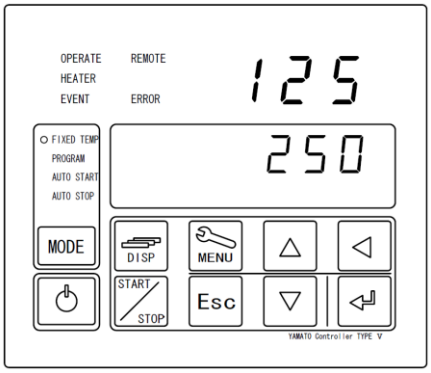


✶ Stop time display (clock):



✶ Press [DISP] again or wait about 10 seconds for screen to return to initial screen.





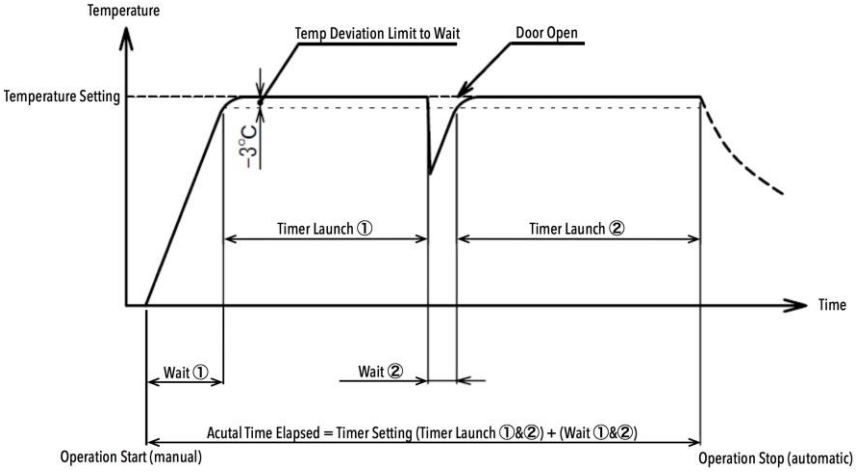
6) When timer runs out or when stop time is reached operation stops, lower display reads END.
7) Press START/STOP to clear END from display.

✶ When operation stops and END is cleared, start screen is restored.

✶ Fan motor continues running regardless of whether operation is stopped. Press and hold ⏻ to turn off control panel and stop fan motor.

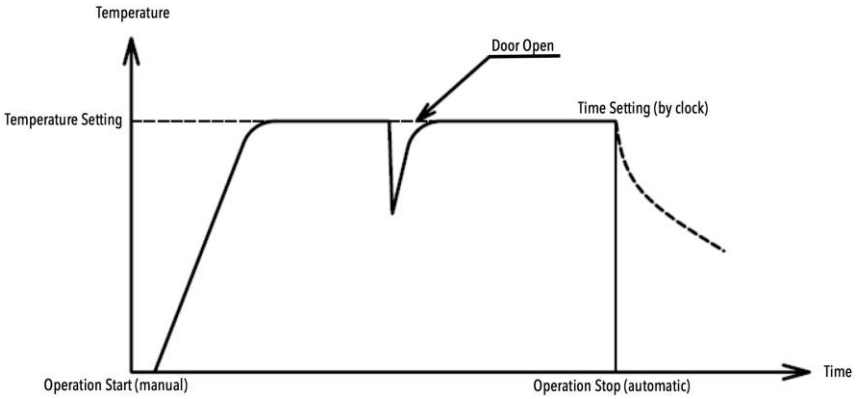
AUTO STOP (Automatic Stop) utilizes timer or clock to automatically stop an operation. Operation must be started manually. See below.

Auto stop mode set to timer:



When auto stop mode is set to the timer, unit enters a wait period, and remains “waiting” without counting down time until chamber temperature is within a set deviation range (-3°C ~ +6°C) of the temperature setting.
Countdown begins once chamber temperature is within the deviation range.
If temperature drops below or exceeds the deviation range afer stabilzing, such as when door is opened, allowing heat to escape; countdown stops and unit again enters a wait period until heat builds to within the deviation range, at which point timer begins counting down once again.

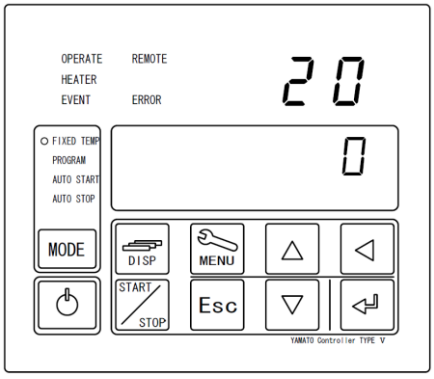
Auto stop mode set to clock:



Wait function does not operate when auto stop mode is set to the clock. Operation stops as soon as clock and set time agree, regardless of when temperature setting is reached.
If a power failure occurs while auto stop mode is set to clock, unit will recover operation automatically when power is restored and run until the set stop time.

Set auto stop mode

1 Turn on power

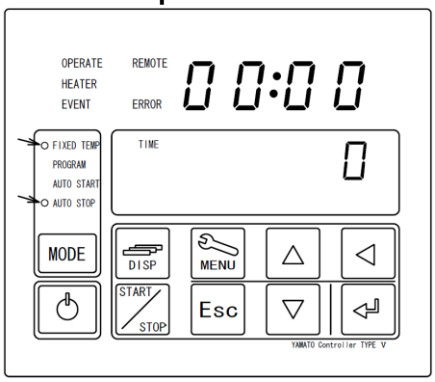


Turn on (|) main power switch (ELB) (idle).

Press and hold ⏻ to turn on control power (standby).

Current temperature reading is shown in upper display, Temperature setting is shown in lower display.
Fan begins running (runs when door is closed and stops whenever door is opened).

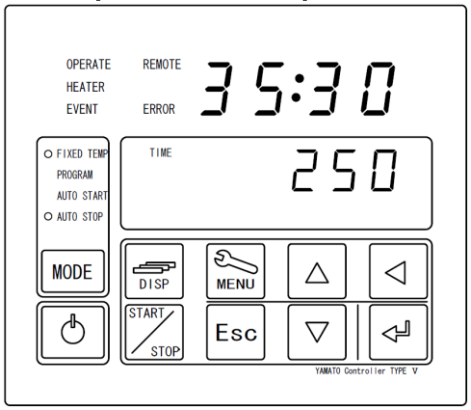
2 Select auto stop mode



Press [MODE] key repeatedly until both FIXED TEMP and AUTO STOP lamps light.

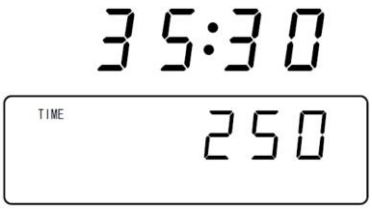
✶ Fixed Temperature mode is factory default. Once mode has been changed, the last mode run will be selected on subsequent startups.

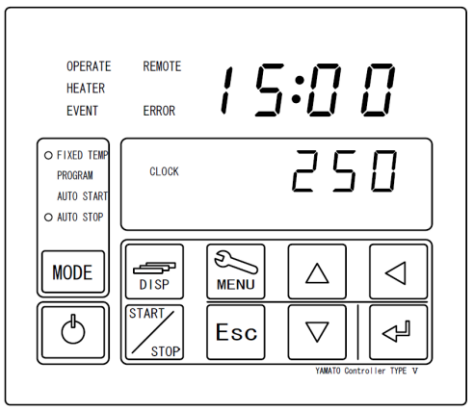
3 Set temperature and stop timer/clock



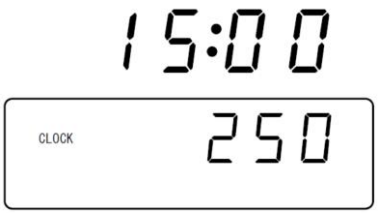
1) Press [↵].
2) Select stop TIME or CLOCK (lamp in upper-left of lower display) using [△] [▽] and press [↵].
3) Set TIME (setting range: 0～99hr：59min) or CLOCK (24-hour time system) in upper display and press [↵].
4) Set temperature in lower display and press [↵].

Example 1. Auto Stop mode set to timer:
Operation stops automatically 35 hours and 30 minutes after 250℃ temperature setting is reached.

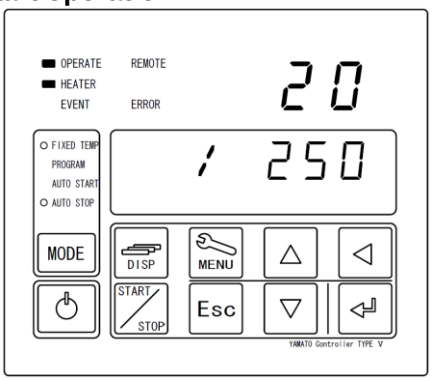


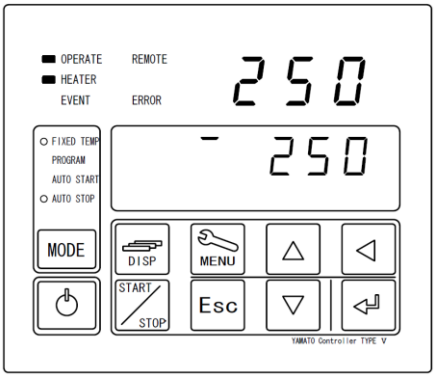


Example 2. Auto Stop mode set to clock:
Operation stops automatically at 15:00 (3:00PM).



4 Start operation

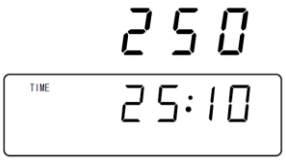




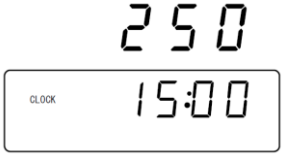
Press START/STOP to start operation.

OPERATE and HEATER lamps light and temperature begins building.

- ✶ Press DISP at any time during operation to monitor remaining time in the lower display.
- ✶ Remaining time display (timer):

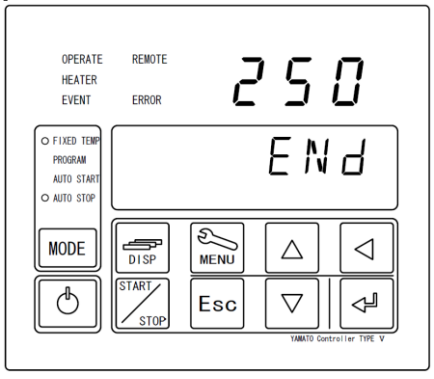


- ✶ Stop time display (clock):

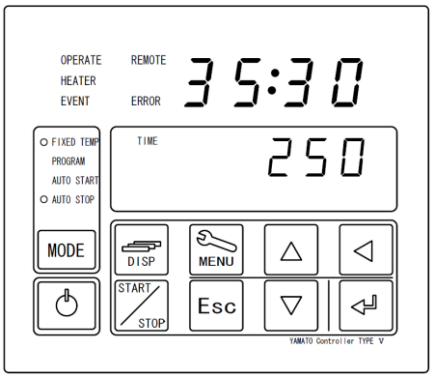


- ✶ Press DISP again or wait about 10 seconds for screen to return to normal reading.

5 Operation end.

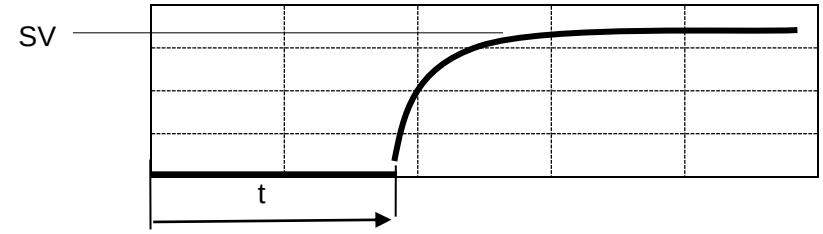


1) When timer runs out or when stop time is reached operation stops, lower display reads End.
2) Press START/STOP to clear End from display.



- ✶ When operation stops, and End is cleared start screen is restored.
- ✶ Fan continues running regardless of whether operation is stopped. Press and hold ⏻ to turn off control panel and stop fan.

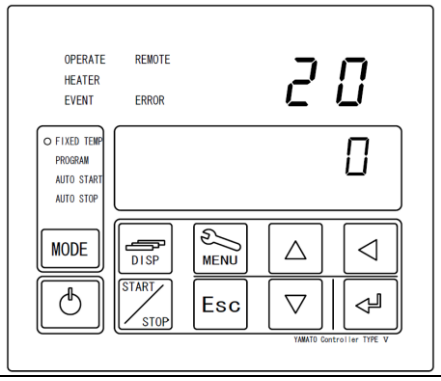
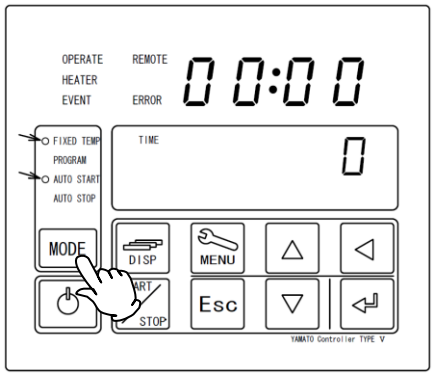
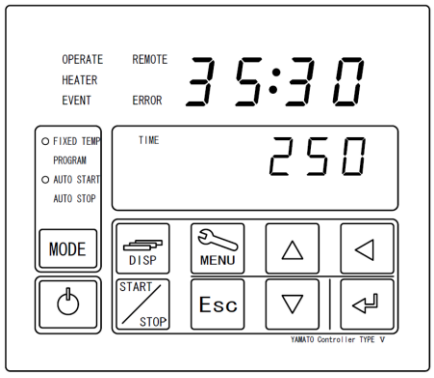
AUTO START (Automatic Start) mode utilizes timer or clock to automatically begin an operation. Operation must be stopped manually.

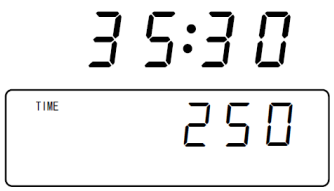
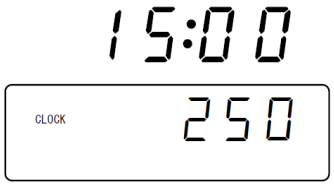
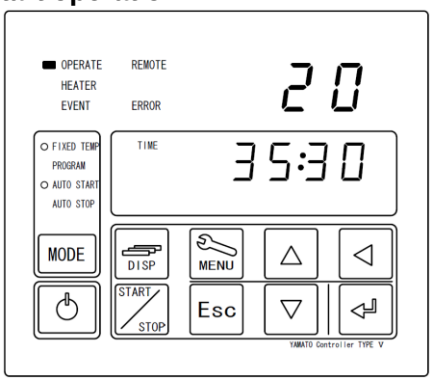
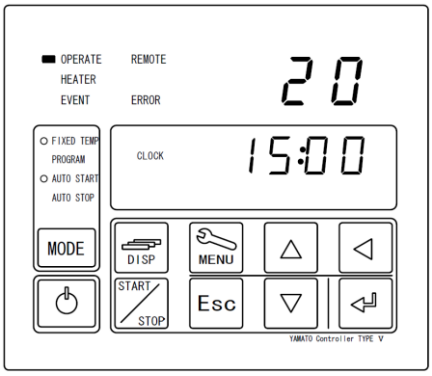
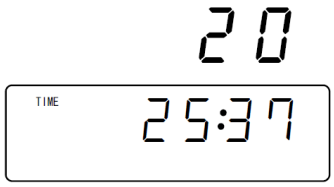
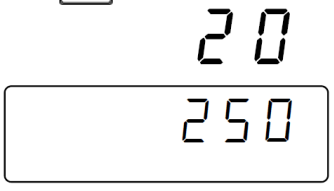


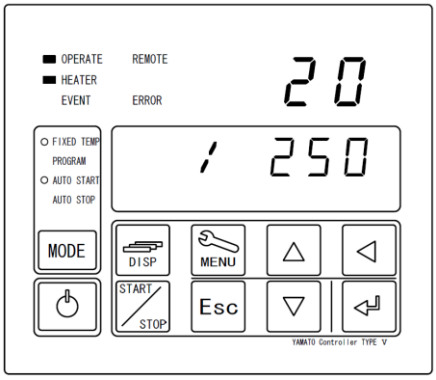
Timer launch Operation start (automatic)

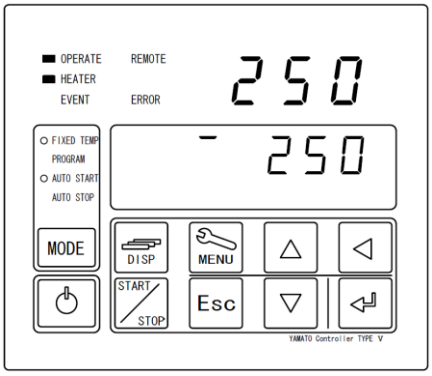
SV: Temperature setting, t: Auto start time (time)

Set Auto Start mode

1	**Turn on power.** 	Turn ON (|) main power switch (ELB) located on lower-right side panel of unit. (idle) Press and hold ⏻ to turn on control power. (standby) Current temperature reading is shown in upper display, Temperature setting is shown in lower display. Fan begins running (runs when door is closed and stops whenever door is opened).
2	**Select Automatic Start mode** 	Press MODE repeatedly until both FIXED TEMP and AUTO START lamps light. ✶ Constant Temperature mode (FIXED TEMP) is factory default. Once mode has been changed, the last mode run will be selected on subsequent startups.
3	**Set temperature and start timer/ clock.** 	1) Press ↵. 2) Select start TIME or CLOCK (lamp in upper-left of lower display) using △ ▽ and press ↵. 3) Set TIME (range: 0～99hr : 59min) or CLOCK (24-hour time system) in upper display and press ↵. 4) Set temperature in lower display and press ↵.

		Example 1. Auto Start mode set to timer: Operation automatically begins 35 hours and 30 minutes after [START/STOP] is pressed.  **Example 2.** Auto Start mode set to clock: Press [START/STOP] and operation begins automatically at 15:00 (3:00PM). 
4	**Start operation**  	1) Press [START/STOP] to enter standby mode (wait) until operation begins at the selected time. 2) The OPERATE lamp flashes and lower display will show remaining time until start or time at which operation will start. ✶ Upper display shows current chamber temperature, while lower shows remaining wait duration or operation start time. When timer is selected, a countdown to operation begins:  ✶ Temperature setting may be confirmed by pressing [DISP]:  ✶ Press [DISP] once more to go back to viewing remaining wait duration.

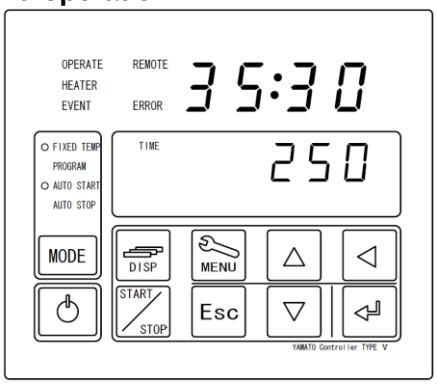




3) When start timer runs out or when clock and start time agree, the OPERATE lamp changes from flashing to lighted; HEATER lamp lights and temperature begins building.

✶ The quick auto stop function is inoperable during auto start mode.

5 End operation



Press START/STOP to manually end operation. Initial screen is restored.

✶ Fan continues running regardless of whether operation is stopped. Press and hold ⏻ to turn off control panel and stop fan.

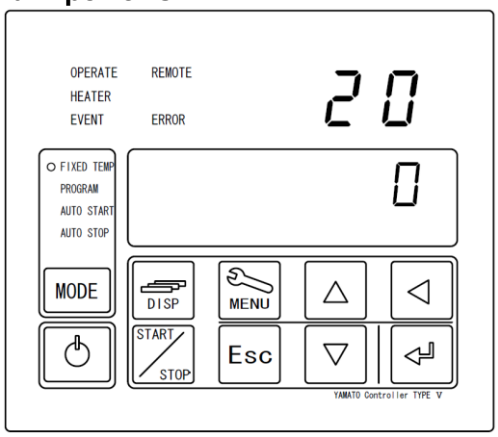
4. OPERATION PROCEDURE

Variable Fan Speed

The variable fan speed function is beneficial for changing circulation speed to match ventilation flow using 10 different fan motor speeds.
Fan speed is the same between settings 1 (about 650rpm) and 9 (about 1400rpm), regardless of whether unit is operating at 50Hz or 60Hz. Frequency affects setting 10 only, which operates at approximately 1420rpm at 50Hz, and approximately 1600rpm at 60Hz.

Set fan speed

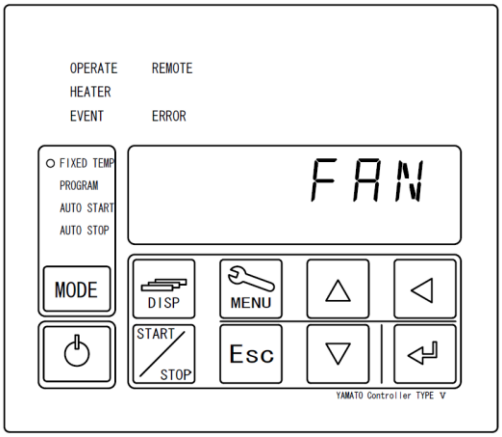
1 Turn power ON



Turn main power switch ON (|) (idle).
Press and hold [⏻] to turn control panel power on (standby).

Current temperature reading is shown in upper display. Temperature setting is shown in lower display.
Fan begins running (runs while door is closed and stops whenever door is opened).

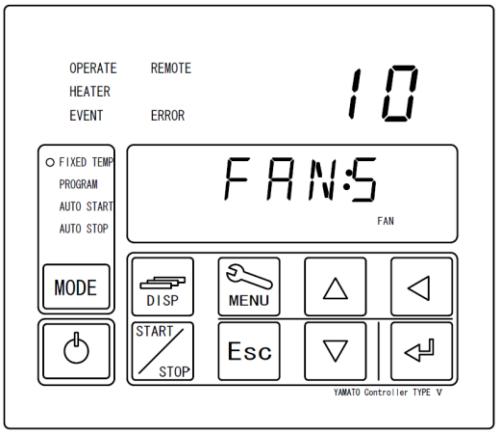
2 Navigate to fan speed setting menu



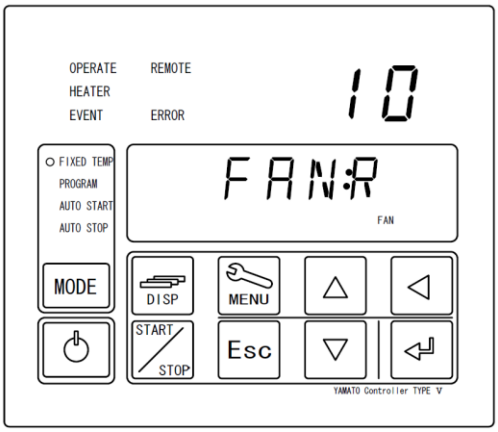
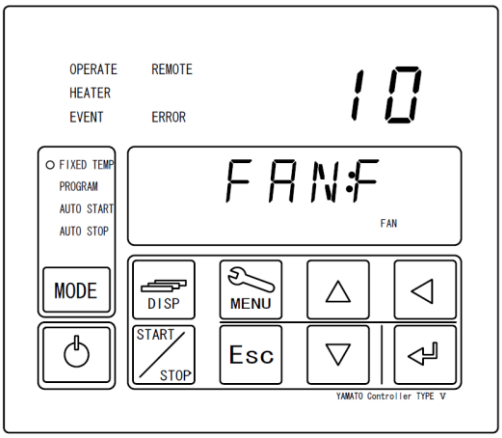
Press [MENU] repeatedly until "FAN" shows in lower display.

✶ Fan speed may be set while operation is in progress.

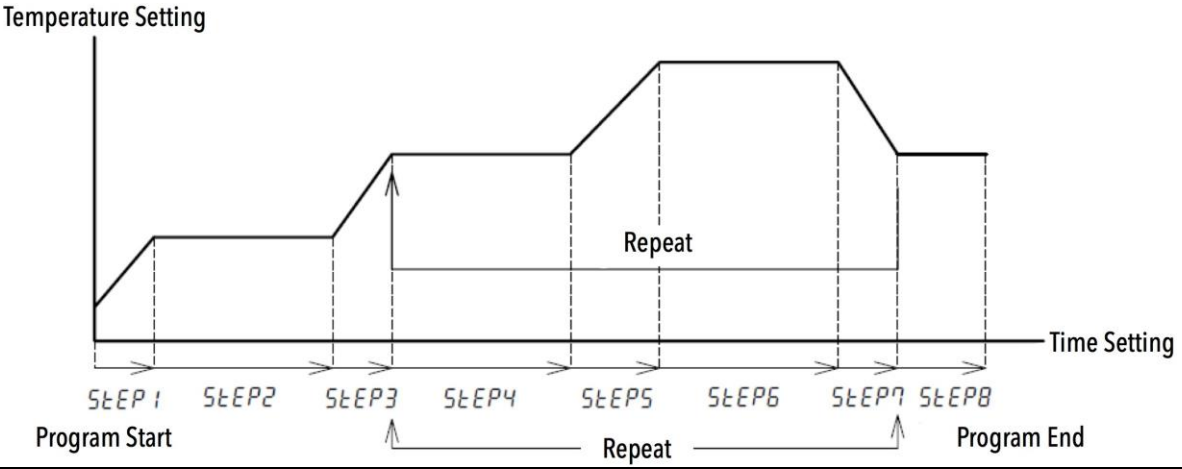
3 Setting fan speed in standby



1) Press [↵] so that "FAN:5" appears with the "5" flashing in the lower display.
2) Press [↵] again so that current speed setting, (1~10) shows flashing in the upper display.
3) Using [△] [▽], set speed and finalize by pressing [↵].

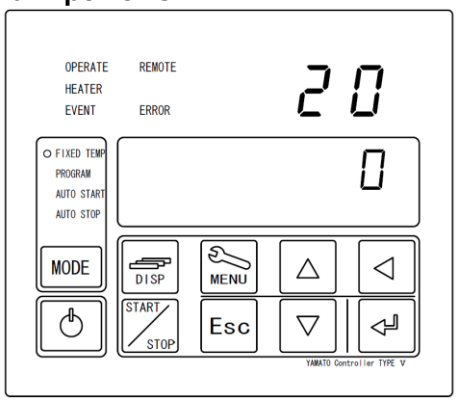
4	**Setting fan speed during operation** 	1) From **3**-1 above, press MENU so that "FAN:R" appears with the "R" flashing in the lower display. 2) Press ↵ so that current speed setting (1～10) shows flashing in the upper display. 3) Using △ ▽, and set speed and finalize by pressing ↵.
5	**Setting fan speed at end of operation** 	1) From **3**-1 above, press MENU so that "FAN:F" appears with the "F" flashing in the lower display. 2) Press ↵ so that current speed setting (1～10) shows flashing in the upper display. 3) Using △ ▽, set speed and finalize by pressing ↵. To return to the standby or operation screens press Esc twice.
6	**Setting fan speed during programmed operation**	Fan speeds may be set for each program step while building programs. See "Programming Procedure" P.30.

PROGRAM mode runs a combination of times and temperatures in a series of programmed steps as one operation. See below.



Running programs

1 Turn power ON



Turn main power switch ON (|) (idle).
Press and hold ⏻ to turn control panel power on (standby).

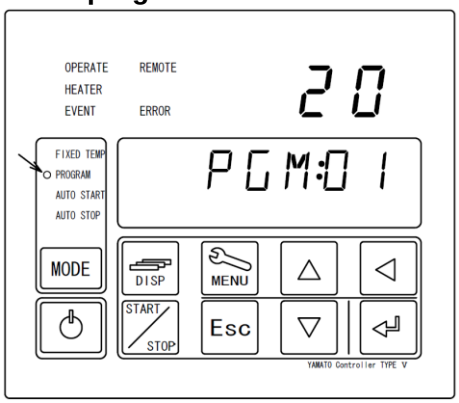
Current temperature reading is shown in upper display, Temperature setting is shown in lower display.
Fan begins running (Runs while door is closed and stops whenever door is opened).

! Programs must be entered prior to starting a programmed operation run.

For details on entering programs, see “Programming Procedure” on P.30

Create as many as 99 programs and steps in total (i.e. 11 programs with a maximum of 9 steps each). Step repeats are not counted in this total.

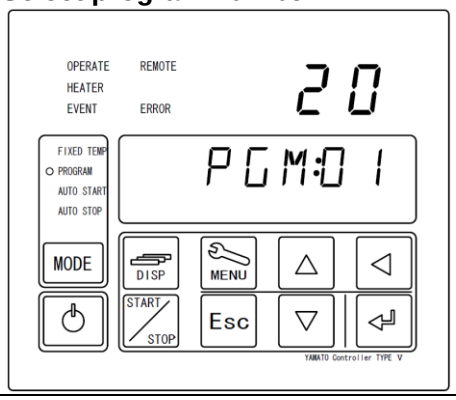
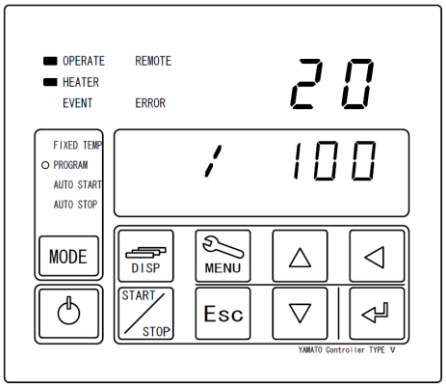
2 Select program mode



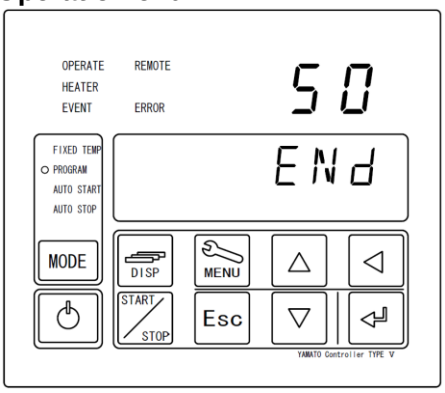
Press MODE repeatedly until PROGRAM lamp lights.

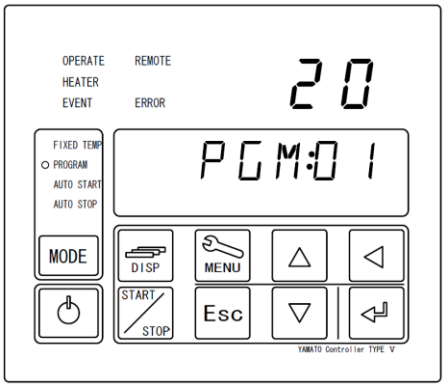
Lower display shows “PGM:XX” (“XX” signifies program number last used. Factory default is “01”).

✶ Constant Temperature (FIXED TEMP) is factory default mode. Once mode has been changed, the last mode run will be selected on subsequent startups.

3	**Select program number** 	Press ↵. The program number in lower display will begin flashing. Select desired program number using △ ▽ and press ↵.
4	**Start programmed operation** 	Press START/STOP to start programmed operation. ✶ Do not attempt to run a cycle if END has not been set at the end step in a program. Confirm whether END has been set, if program cycle does not start. ✶ Operation cannot be started by pressing START/STOP for program numbers which have not been entered. ✶ The program pattern number, current step number or remaining operation time may be monitored in the lower display by pressing DISP repeatedly at any time during operation. ✶ Program pattern monitoring screen: 68 PtN:01 ✶ Current program step monitoring screen: 68 StP:01 ✶ Remaining time monitoring screen: 68 1:00 TIME

5 Operation end





1) When selected program cycle ends, lower display shows END and operation stops.

2) Clear END by pressing START/STOP.

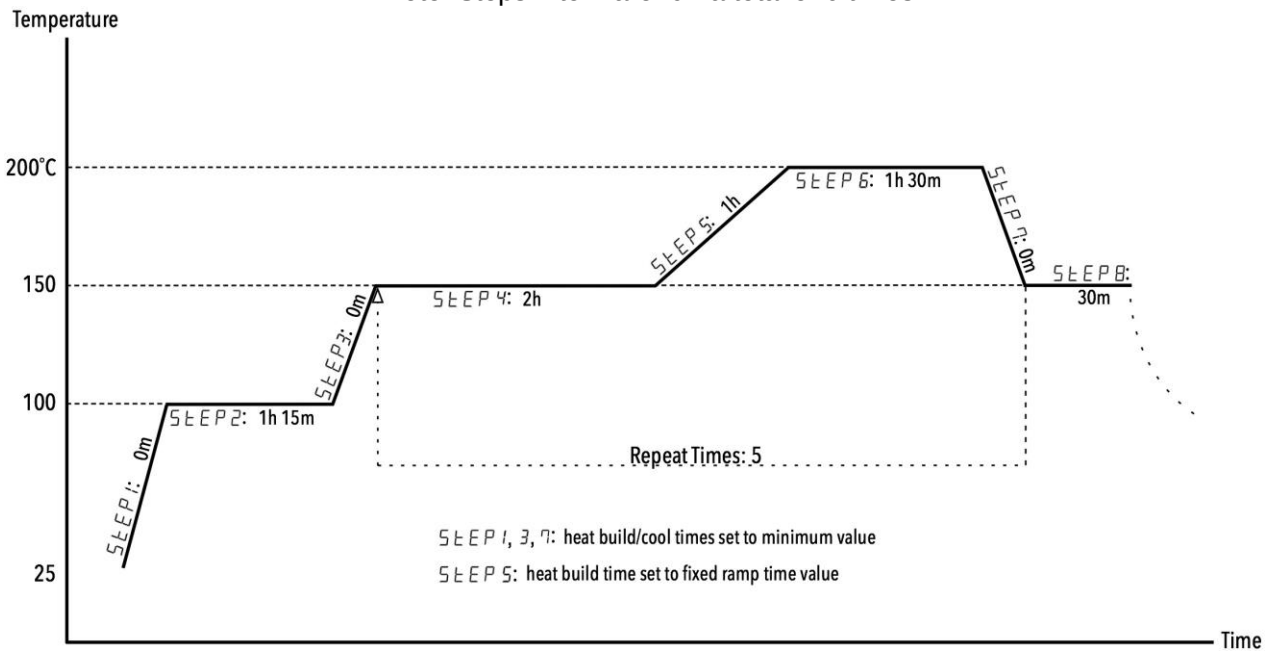
✶ Initial screen is restored.

✶ Fan continues running regardless of whether operation is stopped. Press and hold ⏻ to turn off control panel and stop fan.

4. OPERATION PROCEDURE

Programming Procedure

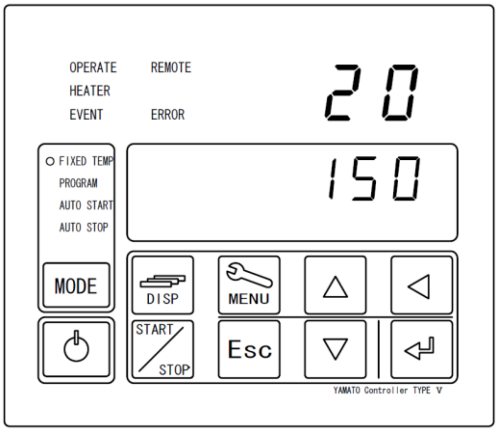
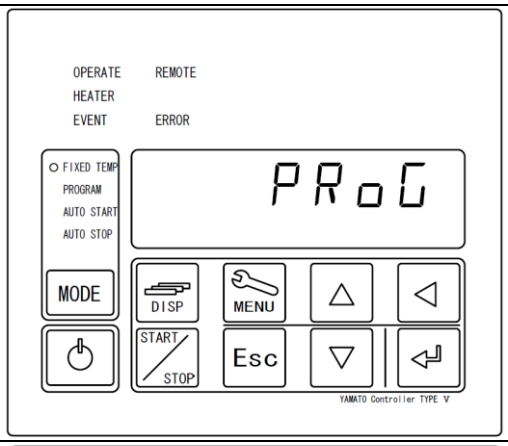
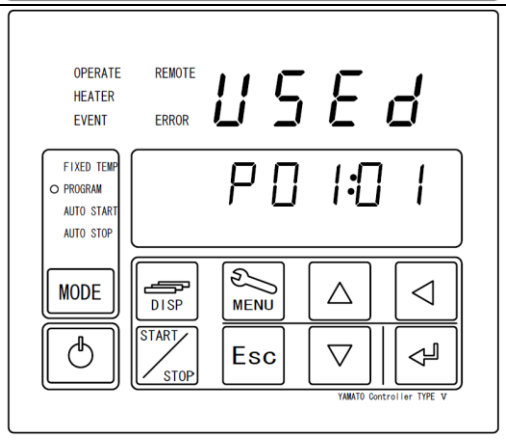
Sample program In this example, there are 8 steps in program pattern 2. Steps from 4 to 7 are repeated 5 times and the program ends with step 8.
Note: Steps 4 to 7 are run a total of 6 times.



Pattern No	Step	Set temp.	Set time	Repeat dstn.	Repeat No.	Wait	Variable fan speed	End
P＊＊:01	**P02: ＊＊**	TEMP	TIME	REP(**STEP**)	REP(**COUNT**)	WAIT	FAN	**ENDST**
02	**01**	**100**	**00:00**	**0**	**0**	**ON**	**10**	**OFF**
	02	**100**	**01:15**	**0**	**0**	**OFF**	**10**	**OFF**
	03	**150**	**00:00**	**0**	**0**	**ON**	**10**	**OFF**
	04	**150**	**02:00**	**0**	**0**	**OFF**	**10**	**OFF**
	05	**200**	**01:00**	**0**	**0**	**ON**	**10**	**OFF**
	06	**200**	**01:30**	**0**	**0**	**OFF**	**10**	**OFF**
	07	**150**	**00:00**	**4**	**5**	**ON**	**10**	**OFF**
	08	**150**	**00:30**	**0**	**0**	**OFF**	**3**	**ON**

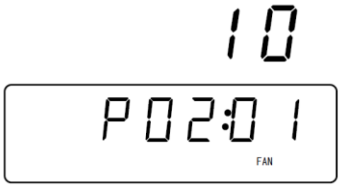
- ✶ When time settings on heat building or cooling steps are beyond the heating or cooling capacity (0 minutes in steps 1, 3 & 7 above) of the unit, it will operate at full power for a short time in wait (**ON**) mode until temperature setting has been reached. With wait set to **OFF**, unit will proceed to the next step regardless of whether temperature setting has been reached. Use caution when setting short heating/cooling times.
- ✶ When the time setting on heat building or cooling steps is set longer than unit normally takes build heat or cool, unit will adjust itself to do so within the set timeframe regardles of whether wait is set to **ON** or **OFF**. Operation proceeds to the next step once temperature setting is reached.
- ✶ Once a step temperature has been set with wait **ON**, unit will enter wait mode whenever temperature in the chamber drops below (or exceeds) the temperature deviation range, due to instances such as opening the chamber door, until temperature builds back to within the deviation range (-3~6°C of temp setting). If wait 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 chamber.
- ✶ When using the repeat function, programming the operation so that chamber temperature is identical to destination step temperature setting before the repeat executes, is recommeded to facilitate smoother transition.
- ✶ Unit heating and cooling capacities may vary depending on environmental and operating conditions. Taking these factors in to consideration before programming is therefore recommended.

The following outlines the procedure for building the example program on P.30:
(This procedure assumes unit is set to factory defaults)

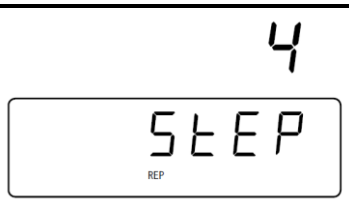
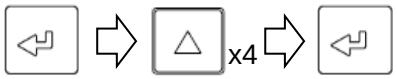
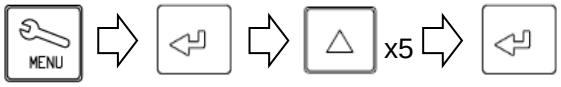
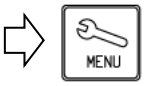
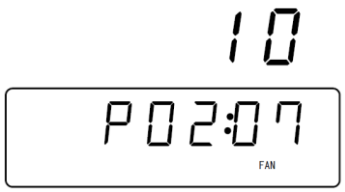
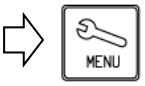
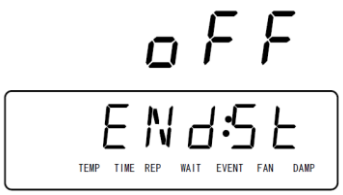
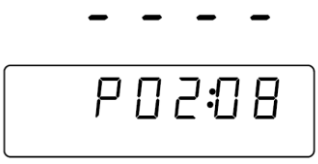
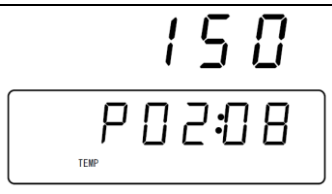
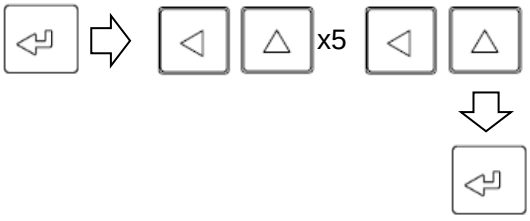
	Screen status	Procedure
I.		
II.		PROG flashes. 
III.		PROGRAM lamp flashes.  - "USEd" appearing in upper display indicates that steps for selected program have already been entered and finalized.  - Last "1" in P01:01 flashes.  - First "1" in P01:01 flashes.  - Changes "P01:01" to "P02:01".
1-1	Enter program pattern 02, STEP 01. - - - - P02:01	"2" in P02:01 flashes and upper display shows "- - - -", signifying that program steps have not yet been entered.

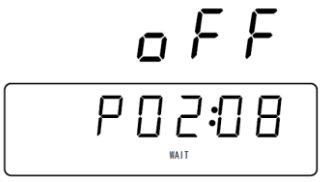
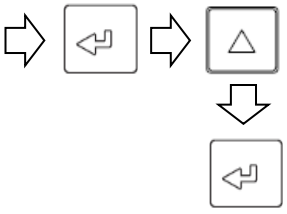
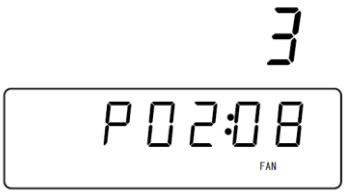
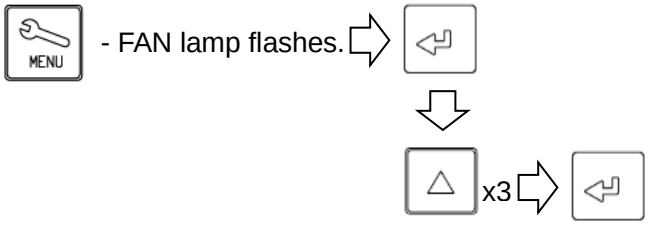
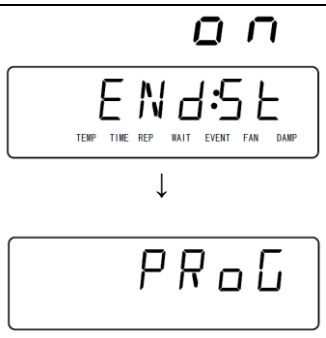
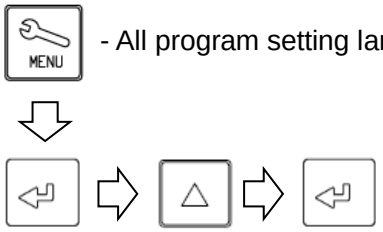
4. OPERATION PROCEDURE

Programming Procedure

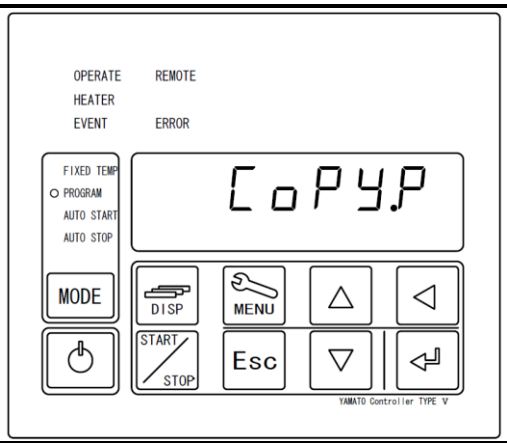
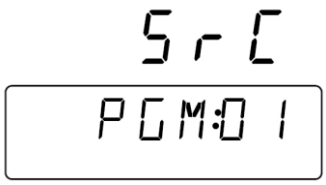
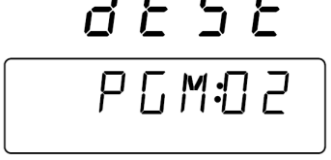
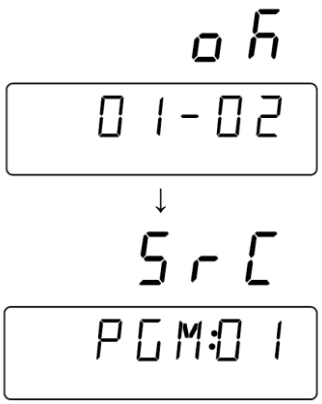
1-2		Enter program pattern 02, StEP 01. - TEMP flashes in bottom left of lower display.
1-3		Enter 100 (°C). - Last "0" in "000" flashes.
1-4		Enter "00:00" (0 hours and 0 minutes - default). - TIME flashes in bottom left of lower display.
1-5		Enter "0" (no repeat destination - default). REP flashes in bottom left of lower display.
1-6		Enter "0" (no repeats - default). REP lamp flashes.
1-7		Turn wait function "on". ("waits" until chamber temp is within -3°C ~ +6°C of temp setting before beginning time countdown - default). WAIT lamp flashes.
1-8		Set variable fan speed to "10" (Max - default) FAN lamp flashes.

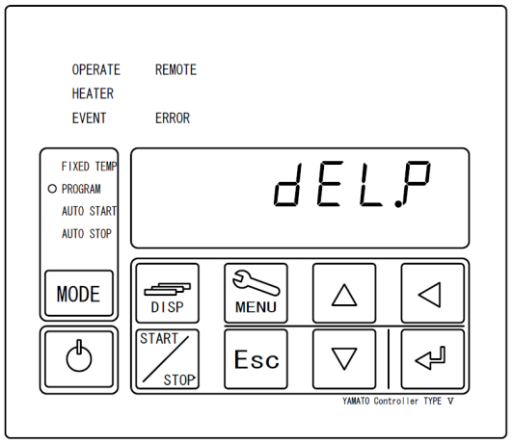
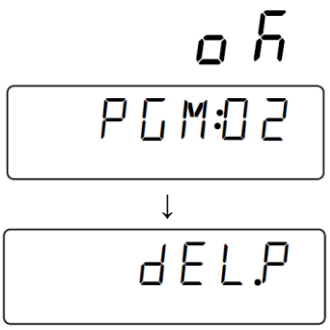
1-9	oFF END:St TEMP TIME REP WAIT EVENT FAN DAMP	Set "End" setting to oFF (default). (to program next step, set to oFF; to enter current step as final, set to on) All program lamps flash. ⇩
1-10	StEP 01 setting complete.	Press and hold MENU.
2-1	- - - - P02:02	Input program pattern 02, StEP 02. ↵
STEP02 ≀ **STEP03** ≀ **STEP04** ≀ **STEP05** ≀ **STEP06**	Enter parameters for STEPS 2 ~ 6 in the same manner as STEP 1 above. Use ◁ to change cursor position and △ or ▽ to change parameter values.	✶ Press DISP any time while entering program to view remaining available steps. (RESt.P will show in lower display. Remaining steps will show in upper display.)
7-1	- - - - P02:07	Enter program pattern 02, StEP 07. ↵ - TEMP lamp flashes.
7-2	150 P02:07 TEMP	Enter 150 (°C). ↵ ⇨ ◁ △ x5 ◁ △ ⇩ ↵
7-3	00:00 P02:07 TIME	Enter "00:00" (00 hour 00 minute). Time lamp flashes. ⇨ MENU

7-4		Enter "4" (repeat begins at STEP 4) 
7-5		Enter "5" (repeats steps 4 ~ 7 five times) ✶ Repeat count may be set between 1 and 99 or to indefinite setting, "1nF" (infinity). 
7-6		Turn wait function " on ". WAIT lamp flashes. 
7-7		Set variable fan speed to "10" (Max). FAN lamp flashes. 
7-8		Set "End" setting to oFF. All setting lamps flash. Press and hold  .
8-1		Enter program pattern 02, STEP 08.  - TEMP flashes.
8-2		Enter "150" (°C). 

8-3		Enter "00:30" (0 hours, 30 minutes) ✶ Entering "InF" on final step makes time setting indefinite (must be stopped manually). 
8-4		Enter "0" (No repeat destination) 
8-5		Enter "0" (No repeats) 
8-6		Set wait function to oFF. Wait lamp flashes. 
8-7		Set fan speed to 3 (Low) 
8-8		Set "End" setting to on.  ✶ Always set End to on in the final step of programs. Programs without End set to on will not be recognized as a complete program and will not run.

✶ Duplicating and using program planning sheet on P.71. of this manual is recommended.

1-1		✶ Copying programs Press MENU repeatedly until CoPY.P appears, flashing in lower display. Press ↵.
1-2		PGM:01 shows with the "01" flashing in lower display. Enter the program number to be copied using ▽ △ and press ↵.
1-3		"dESt" flashes in upper display. while the lowest available program number (i.e. PGM:07) shows with the number flashing in lower display. Enter desired copy destination using ▽ △ and press ↵. Copied program has been replicated to the selected destination.
1-4		Upper display shows " oK" (OK) with lower display showing [source program number - copy destination number] (i.e. 01-02), and initial copy screen is automatically restored; indicating program has been copied and pasted successfully.

2-1		✶ Deleting programs Press MENU repeatedly until dELP shows, flashing in lower display. Press ↵.
2-2		PGM:01 shows with the "01" flashing in lower display. Select a pattern number to delete using ▽ △, or select AL (ALL) using ◁, then press and hold ↵.
2-3		When "dEL" begins flashing in upper display, confirm and finalize by pressing ↵.
2-4		Upper display shows "oh" (OK) with lower display flashing the deleted program number (i.e. PGM:02), and initial delete screen is automatically restored; indicating program has been deleted successfully.

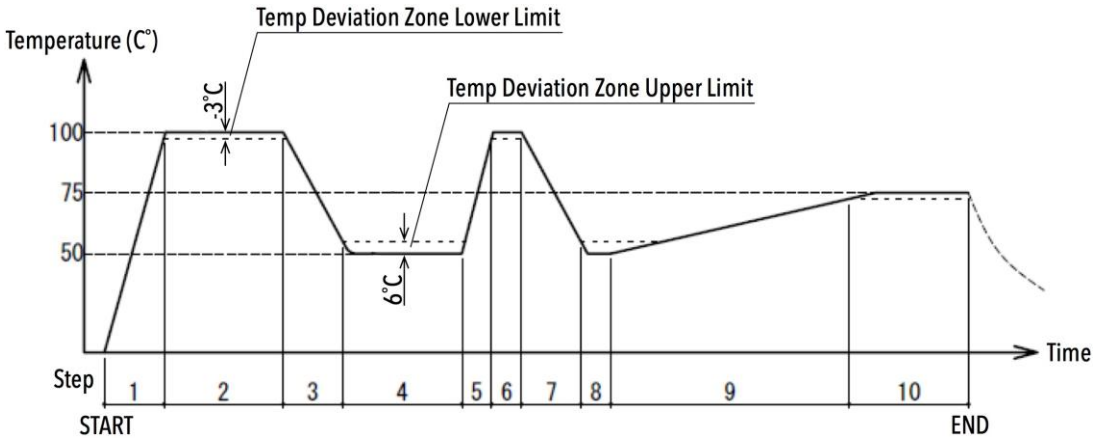
Examples of estimated heating/cooling times with settings designated to WAIT "ON" and WAIT "OFF".

Step	1	2	3	4	5	6	7	8	9	10
Set temp(°C)	100	100	50	50	100	100	50	50	75	75
Set time	0 min	30 min	0 min	30 min	0 min	5 min	0min	5 min	2 hr	30 min
	Heating and cooling times for steps (1), (3), (5) and (7) are set to 0 min. (full power).									
	Heating time for step (9) is set beyond capacity.									

【Example operation with wait function "ON"】

When the wait function is set to ON, the system "waits", without counting down time, until chamber temperature (reading) is within the deviation zone of between -3°C and +6°C of the temperature setting. When time is set to 0 minutes, the system will build heat at full power to reach setting as quickly as possible. When time is set longer than system normally takes to heat or cool to selected temperature, unit will automatically control heating and cooling so that temperature setting is reached (staying within the deviation range) at the time setting.

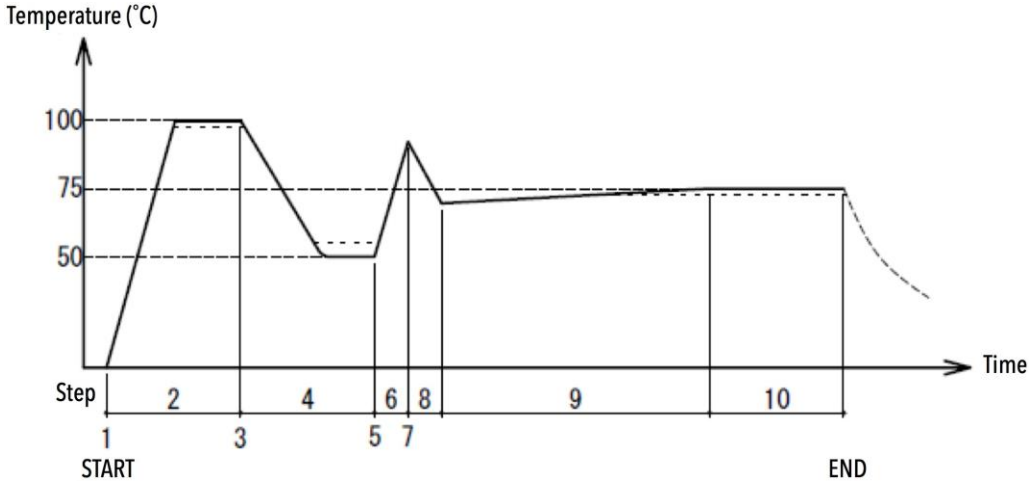
If chamber temperature drops during temperature stabilization, such as when opening chamber door, system will "wait" and pause countdown time if deviation zone's upper or lower limit is exceeded.



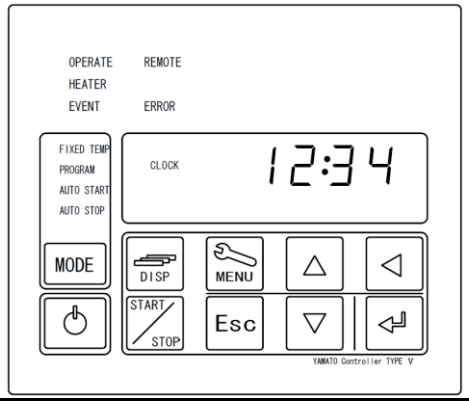
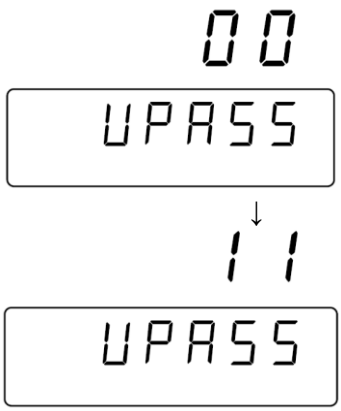
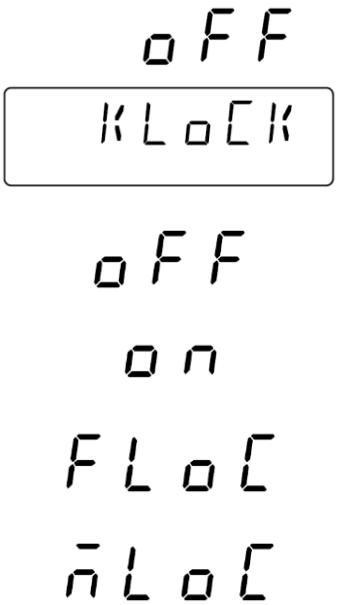
【Example operation with wait function "OFF"】

When wait function is set to OFF, the system proceeds to next step when time setting is reached regardless of whether temperature setting is reached or whether chamber temperature falls below or exceeds the deviation zone.

When time is set beyond unit capacity to heat or cool (e.g. too short), unit proceeds to next step before temperature setting is reached. Wait function should be set to ON for short ramp (build) times.



✶ Set keypad lock.

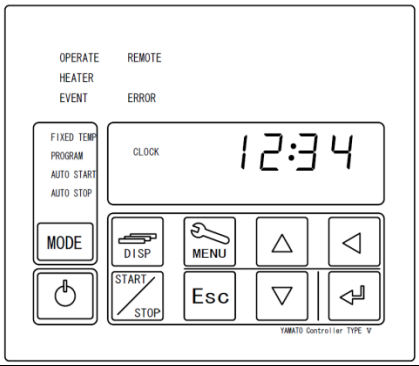
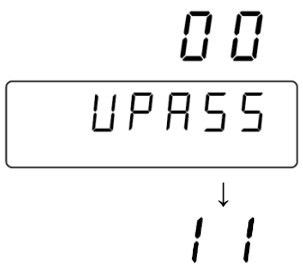
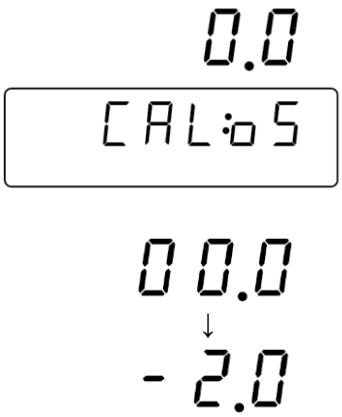
1	**Turn control power off (idle)** 	Turn main power switch ON (|). Lower display shows current time. If unit is in standby, press and hold [⏻] to turn control panel power off (idle).
2	**Enter password** 	1) Press and hold [MENU]. UPASS shows in lower display while 00 flashes in upper display. 2) Using [△][▽] and [◁], enter password "1 1" into upper display and press [↵] (password is set at "11" and cannot be modified).
3	**Set keypad lock mode** 	1) Lower display shows KLoCK while upper display shows oFF. This is the factory default setting. 2) Use [△][▽] to select lock mode and finalize by pressing [↵]. Keypad lock modes are as follows: oFF: Key lock function disabled (factory default) on: All keys except [⏻] and [START/STOP] are disabled. FLoC: [MENU] only is disabled. nLoC: [MODE] only is disabled. Press and hold [⏻] to return unit to idle.

The calibration offset feature makes it possible to compensate for any difference between temperature reading on the control panel and actual chamber temperature (taken manually). This enables parallel compensation in either direction (+ or -) over the entire temperature setting range on all DF/DH series units.

Example

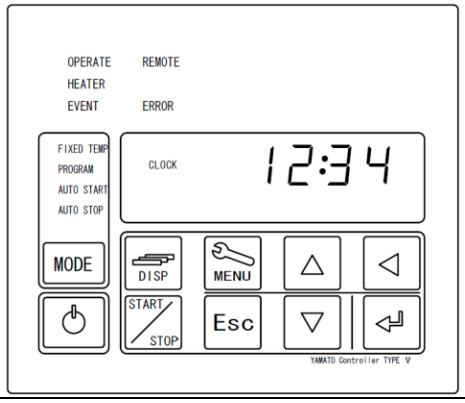
Actual chamber temperature is lower than control panel temperature reading by 2°C:
Temperature reading can be calibrated by entering a calibration offset value of -2.0 to compensate against the actual temperature deficiency of 2°C.
If the initial temperature reading was 200°C, it will read 198°C after offset calibration, and be brought into agreement with actual chamber temperature.

- ✶ **The -2°C calibration in the example above is applied over the entire temperature setting range (DF412/612: 0～260°C, DH412/612: 0～360°C). Note that offset values may change slightly depending on sample/specimen arrangement in the chamber and/or temperature setting.**

1	**Turn control panel off (idle)** 	Turn main power switch ON (|). Lower display shows current time. If unit is in standby, press and hold ⏻ to turn control panel power off (idle).
2	**Enter password.** 	1) Press and hold MENU. UPASS shows in lower display while 00 flashes in upper display. 2) Using △ ▽ and ◁, enter password "11" into upper display and press ↵ (password is set at "11" and cannot be modified).
3	**Set Calibration Offset value.** 	1) Press MENU. CALoS is shown in lower display and 0.0 in upper display. Press ↵. Right-most digit flashes. 2) Enter offset value using △ ▽, ◁ and press ↵. Example Temperature reading: 200°C, actual chamber temperature (manually taken): 198°C ⟶Offset input value: -2.0°C Press and hold ⏻ to return to initial idle screen.

✶ Select recovery mode for the event of a power failure.

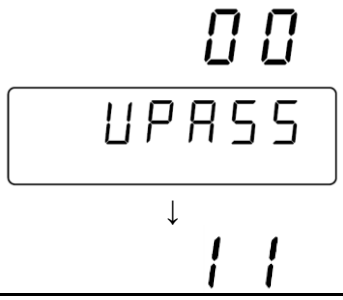
1 Turn control panel off (idle)



Turn main power switch ON (|). Lower display shows the current time.

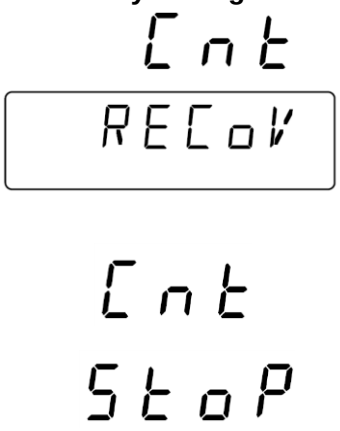
If unit is in standby, press and hold ⏻ to turn control panel power off (idle).

2 Enter password



1) Press and hold MENU. UPASS shows in lower display while 00 flashes in upper display.
2) Using △ ▽ and ◁, enter password "11" into upper display and press ↵ (password is set at "11" and cannot be modified).

3 Select recovery setting



1) Press MENU repeatedly until RECoV shows in lower display and press ↵.
2) Use △ ▽ to select recovery mode and press ↵.

Recovery modes are as follows:

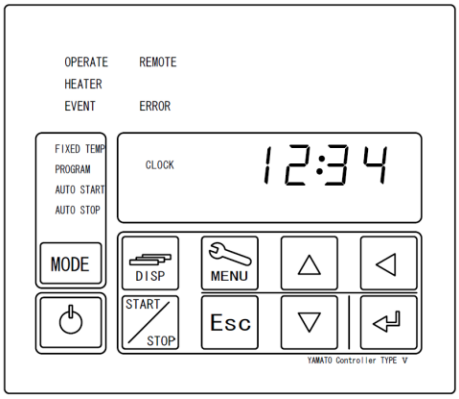
Cnt: Operation resumes where it left off when power failure occurred.

StoP: Operation is terminated and unit goes into idle when power is restored.

Press and hold ⏻ to return to initial idle screen.

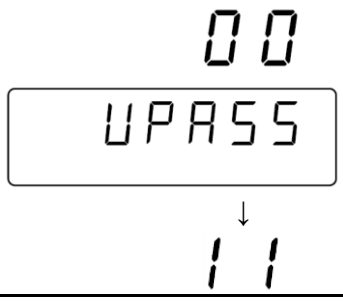
✶ Setting CO_2 conversion factor & resetting total CO_2 emissions/power consumption.

1 Turn control panel power off



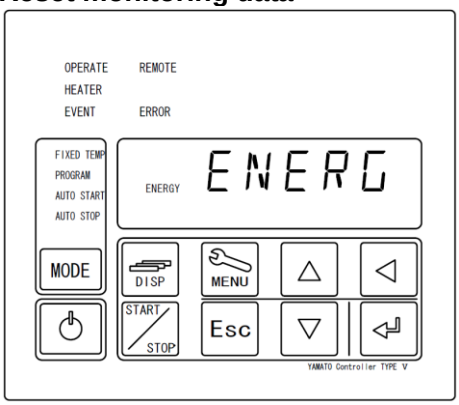
Turn main power switch ON (|). Lower screen shows current time.
If unit is in standby, press and hold ⏻ to turn control panel power off (idle).

2 Enter password.

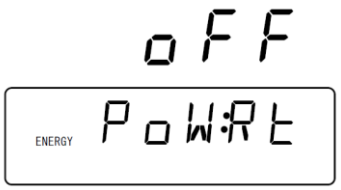


1) Press and hold MENU. UPASS shows in lower display while 00 flashes in upper display.
2) Using △ ▽ and ◁, enter password "11" into upper display and press ↵ (password is set at "11" and cannot be modified).

3 Reset monitoring data

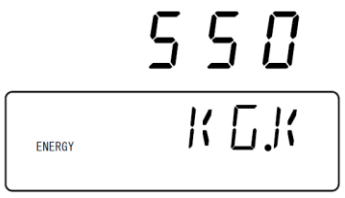


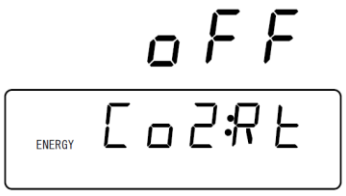
1) Press MENU repeatedly until ENERG shows flashing in lower display, along with ENERGY indicator lamp.
2) Press ↵ to enter set/reset menu.
3) Press MENU scroll through the items in lower display and press ↵ to select one.



PoWRt: Accumulated power consumption
Press ↵ to change oFF (constant) to rUn (flashing).
Press ↵ to reset accumulated power consumption.
Press Esc to return.

4





KGJK: CO_2 emission factor.

The factory default setting of **550** (0.000550t CO_2/kWh) reflects the Environmental Ministry Press Release on 6 November 6, 2013.

Applicable value varies by utility company. Contact the servicing utility authority to confirm what value should be used.

Press [↵] to change 550 (constant) to 0550 with last "0" flashing.

Change the emission factor using [△] [▽] [◁].

Press [↵] to finalize.

Press [Esc] to go return.

Co2RE: Integrated CO_2 Emission

Press [↵] to change upper display from oFF (constant) to rUn (flashing).

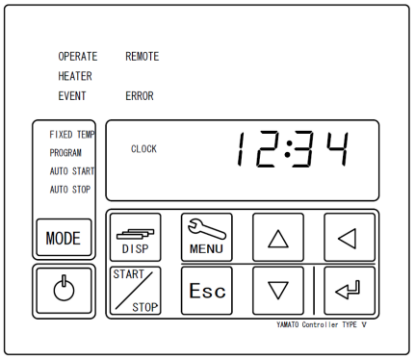
Press [↵] to reset CO_2 emission data.

Press [Esc] to return.

Press and hold [⏻] to go back to initial idle screen.

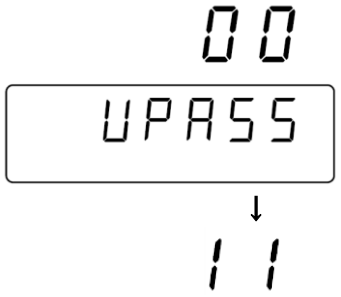
✶ Back up data, recover data from backup or reset data to factory default.

1 Turn control panel off



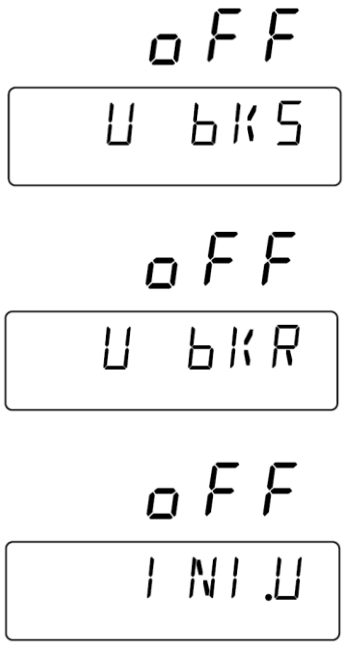
Turn main power switch ON (|). Lower screen shows the current time.
If unit is in standby, press and hold ⏻ to turn control panel power off (idle).

2 Enter password.



1) Press and hold MENU.
   UPASS shows in lower display while 00 flashes in upper display.
2) Using △ ▽ and ◁, enter password "11" into upper display and press ↵ (password is set at "11" and cannot be modified).

3 Back up, restore or reset data.



Press MENU repeatedly to scroll through the following items in lower display, respectively:

U bKS backs up settings for the event of backup battery failure or accidental reset.
Press ↵ to change oFF (constant) to rUn (flashing), then press ↵ again to back up.
Press Esc to return to U bKS menu.

U bKR: restores cleared or reset data from backup.
As above→ ↵ →oFF to rUn→ ↵ →restore

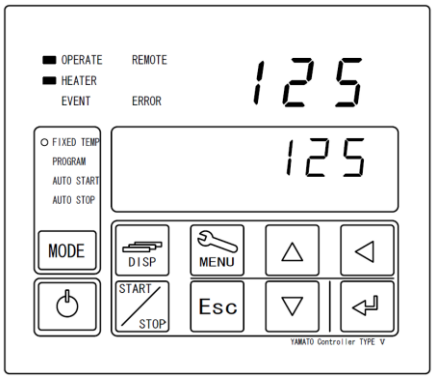
INI.U: Resets all settings to factory default.
As above→ ↵ →oFF to rUn→ ↵ →reset

Backup items include programs entered, temperature offset values and other data, such as keypad lock modes, power recovery modes, etc. These may be recovered if INI.U function is executed in error or if backup battery fails.

Press and hold ⏻ to return to idle screen.

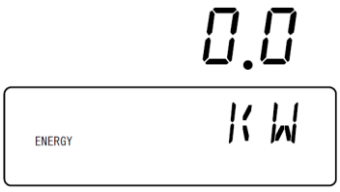
Current power consumption, accumulated hours of operation, etc. may be viewed by using the data monitoring feature.
Setting information shown in upper display cannot be modified.

1 Applicable value shows in upper display

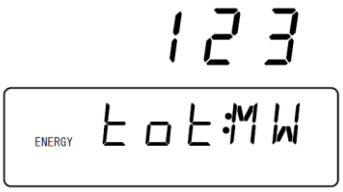


Monitoring items may be viewed in standby or while operation is in progress.

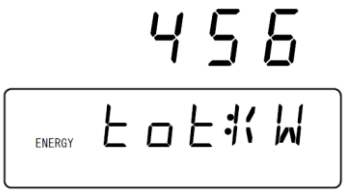
Press and Hold DISP.
Monitor items display screen activates and current item is shown in upper display.
Press DISP to scroll thru items and back to standby screen:



kW: Current power consumption (in kW) is power consumed from moment of activation, and calculated in hourly increments.
Shown as 0.0 in standby. May be shown as 0.0 or 3.6 during temperature stabilization.

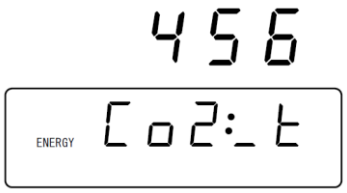


totMW Accumulated power consumption (in MWh). Shown in three-digits up to 999.

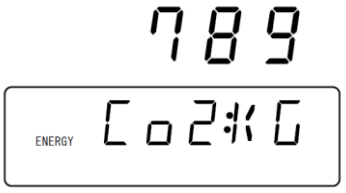


totkW Accumulated power consumption (in kWh). Shown in three-digits up to 999.

Example
If total kilowatt hours is 123,456, “123” (being in thousands of kW) will be shown in the totMW screen, while “456” is shown in the next totkW screen.

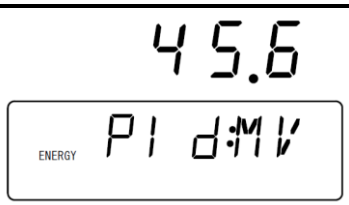


Co2:_t: CO_2 emissions volume (in t - “tons”). Shown in three digits up to 999.
CO_2 emissions is calculated by multiplying the power consumption by an emissions coefficient. Obtain an applicable coefficient from the servicing utility authority. Initial value is calculated on the factory default setting of 0.550 (k-CO2/kWh). See “Setting and resetting the monitor indication, P.43.



Co2:kG CO_2 emissions volume (in kg). Shown in three digits up to 999.

Example
If total CO_2 emissions volume is 456,789kg, “456” (being in thousands of kg) will be shown in the Co2:_t screen, while “456” is shown in the next Co2:kG screen.

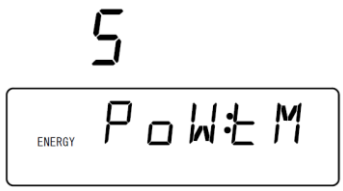


PId:MV Heater Output

Heater output shows heater power output ratio in a percentage of rated capacity. Output is controlled by a PID operation value between 100 and 0% until temperature setting is reached.

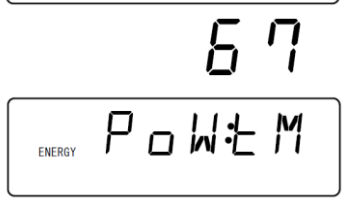
Example

If upper display shows 45.6, ouput is at 45.6% of rated heater capacity.



PoWtM Accumulated power-on time (in hours). First digit of 5 shown (0xxxx)

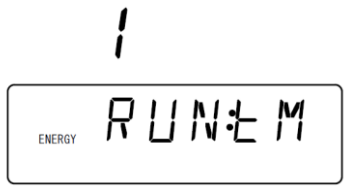
Power-on time is elapsed time between turning main power swtich (ELB) ON (|) and OFF (○).



PoWtM Accumulated power-on time (in hours). Last four digits of 5 shown (x0000)

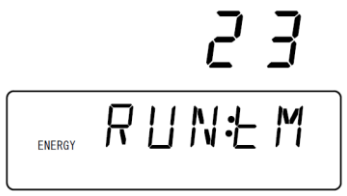
Example

If accumulated power-on time is 50,067 hours the first PoWtM screen will show 5 and next PoWtM screen will show 67. Maximum total for this indicator is 65,535.



RUNtM Accumulated operation run time (in hours). First digit of 5 shown (0xxxx)

Accumulated operation run time is the sum total of hours aggregated between the start and end of operation runs.



RUNtM: Accumulated operation run time (in hours). Last four digits of 5 shown (x0000)

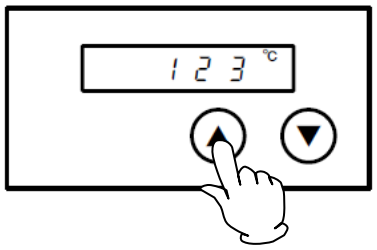
Example

If accumulated operation run time is 10,023 hours, the first RUNtM screen will show 1 and next RUNtM screen will show 23. Maximum total for this indicator is 65,535.

4. OPERATION PROCEDURE

Independent Overheat Prevention Device

DF/DH series units feature redundant safety devices: 1) The internal automatic overheat prevention (automatic reset) feature, and 2) the Independent Overheat Prevention Device (IOPD) with discrete power supply, circuit and sensor; completely independent of the CPU board.
The IOPD main relay functions to activate and cut power to the heater when chamber temperature goes too far beyond objective temperature.
These functions are enabled while the main power switch (ELB) is ON.

Setting Independent Overheat Prevention Device (IOPD) activation temperature 	※Set temperature with ▼▲ keys on IOPD panel.

Operation may be terminated by Independent Overheat Prevention Device (IOPD) activation, when IOPD temperature setting and target temperature are less than 20°C apart.
IOPD temperature should be set at least 20°C higher than target temperature.

Note: main function of IOPD is to keep DF/DH unit from overheating, NOT to protect test samples from damage. Likewise, it is NOT intended for protection against accident or injury resulting from the negligent use of explosives and flammables.

Factory defaults and setting ranges are shown below:

Model	Factory default setting	Setting range
DF412	280ºC	0℃～300ºC
DF612	280ºC	0℃～300ºC
DH412	380ºC	0℃～400ºC
DH612	380ºC	0℃～400ºC

To confirm whether IOPD functions as intended, set chamber temperature to any value within unit specification range and allow temperature to stabilize. Gradually lower IOPD temperature setting. If IOPD activates within 10°C of temperature setting, it is functioning normally.
Note: it normally takes 5 (five) seconds for IOPD to activate. Waiting 5 seconds each time temperature is lowered in the confirmation test above, is therefore recommended. When IOPD activates, error code Er07 shows in main unit display and operation is terminated.
When changing the IOPD temperature setting, a few seconds are needed for changes to finalize. For this reason, wait 5 seconds after entering change before turning main unit off.

5. HANDLING PRECAUTIONS

⚠ Warning

1. DO NOT process hazardous or harmful substances.

Never process explosive or flammable items. Fire or explosion causing serious injury or death may result. See “List of Hazardous Substances” (P.67) for more information on these items.

2. Use extreme caution when heating resin containers.

Confirm temperature tolerance before using resin containers or vessels. Heating resin beyond capacity to withstand temperature will cause resin to melt and may result in a fire or explosion.

3. DO NOT operate equipment when abnormalities are detected.

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

4. DO NOT insert foreign objects into openings.

Never insert metal or combustible objects into unit openings, ventilation ports or exhaust ports. Fire or electric shock, causing serious burns, injury or death may result.

In the event that a foreign object accidentally falls inside, turn off main power (ELB) immediately, disconnect power cable and contact a local dealer, or Yamato sales office for assistance. Continuing to operate unit without removing object may cause fire or electric shock resulting in serious injury or death.

5. Use extreme caution in handling samples following high temperature operation.

Sample/process items are HOT! Do not touch upon removal from chamber, following high temperature operation. Use heat-resistant gloves and exercise extreme care in order to avoid getting burned.

6. Use extreme caution when opening unit door during high temperature operation.

When necessity dictates opening door during high temperature operations, maintain a safe distance until hot air, expelled from chamber, has dissipated. DO NOT touch internal door or other heated interior surfaces. Severe burns may result.
Likewise, DO NOT touch exterior door surface, cable ports, exhaust port or any other surface areas which are likely to become hot during operation. Burns may result.

Be advised that if a fire/smoke alarm is installed in close proximity to unit, it may be set off when chamber door is opened and hot air or smoke is expelled.

5. HANDLING PRECAUTIONS

⚠ Caution

1. DO NOT climb on equipment.

Do not attempt to climb onto unit or substitute it for a proper step ladder. Units are not designed to support bodily weight and damage may result. In addition, unit may become unstable and tip over or fall resulting in equipment damage, serious injury or death.

2. DO NOT place items on equipment.

Do not place any objects on unit. Doing so may cause unit to become unstable and tip over, resulting in possible equipment damage, injury or death.

3. DO NOT operate equipment during thunderstorms.

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

4. DO NOT leave chamber door open.

Do not leave DF/DH unit door open (i.e. to cool test samples while in chamber, etc.) following an operation run. Heat from chamber may damage and/or deform control panel, causing control board malfunction or failure. Always remove processed test samples and close chamber door.

5. DO NOT process corrosive items.

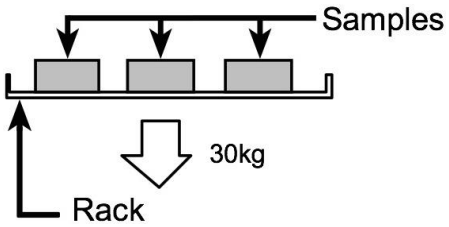
Do not process items containing corrosive chemicals of any kind. Despite stainless steel chamber structure, damage may nonetheless occur from exposure to strong chemicals.

6. ALWAYS run equipment within specified temperature range.

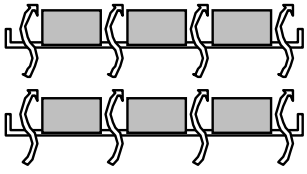
Working temperature range is room temperature +15°C～260°C (DF412/612) and +15°C～360°C (DH412/612).
Never attempt to operate unit outside of specification range. Equipment malfunction or damage may result.

7. Arrange test samples appropriately.

Weight capacity for one chamber rack is approximately 30kg. Test sample load total for each rack should not exceed this specification.
Arrange test samples evenly on racks, leaving as much space between them as possible.



Do not place too many test samples on rack at once. Doing so may hinder proper temperature control in chamber. Test samples should be managed in the following way; 1. Install the supplied chamber racks, 2. Leave as much space between test samples as possible, 3. As a general rule, leave 30% or more of the total space on each rack unoccupied



Leave 30% of total rack space open.

⚠ Caution

8. DO NOT place items on bottom surface of chamber.

Operating unit with test samples placed directly on bottom surface of chamber may cause unit to perform poorly. Likewise, chamber temperature may become excessive, causing malfunction or damage. Always use the supplied chamber racks, supported on the standard supports, and avoid placing any items on bottom surface. Do not allow test samples to contact chamber walls.

9. Power outages.

In the event of a power loss during operation, one of the following will occur when power is restored, depending on what settings have been selected:

- Continued operation: if power recovery settings have been set to continue (factory default), pressing START/STOP, after power is restored, will allow operation will pick up where it left off with the power failure.
- Stop operation: if recovery settings have been set to stop, operation will be terminated and unit will go into idle when power is restored.

See “Recovery Modes” (P.41) for details.

10. Chamber door seal.

Chamber door seals are manufactured from silicon rubber. Benzoic acid, oil, and other components used during the silicone rubber manufacturing process may be emitted during operation, spoiling incompatible test samples. If test samples, sensitive to silicone rubber by-products, are to be processed; specially formulated fluoro-rubber seals are available upon request.

Note that acids, alkaline, and halogenated solvents are corrosive to rubber.

[CAUTION]

Substances which cause corrosion or damage to the silicon or fluoro rubber used in chamber door seals are shown in the Table 5.1.
Do not process test samples which contain any of the substances shown in this table.
For further assistance, contact a Yamato sales office or dealer.

Table 5.1 - Substances harmful to chamber door seal

Material / Classification	Silicon Rubber	Fluoro rubber
Hydrocarbons	Butane, Isooctane, Benzine, Toluene, Xylene, Styrene, Diphenyl, Pinene, Kerosene	Propane
Halogen, Haloid Hydrocarbon	Methyl Chloride, Methylene Chloride, Chloroform, Carbon Tetrachloride, Trichloroethylene, Phlorobenzene, Monochloronaphthalene, R-11、R-12、R-21、R-22、R-113、R-114、Bromine	R-21、R-22
Ketone, Aldehyde	Methyl Ethyl Ketone, Diisopropyl Ketone, Diclohexanon, Acetophenone	Acetone, Methyl Ethyl Ketone, Methyl Isobutyl Ketone, Diisopropyl Ketone, Diclohexanon, Acetophenone
Ester	Methyl Acetate, Ethyl Acetate, Propyl Acetate, Butyl Acetate, Amyl Acetate, Methyl Acetoacetate, Butyl Acrylate, Ethyl Methacrylate	Methyl Acetate, Ethyl Acetate, Propyl Acetate, Isopropyl Acetate, Butyl Acetate, Amyl Acetate, Ethyl Acetoacetate, Ethyl Acrylate, Butyl Acrylate, Ethyl Methacrylate

⚠ Caution

Material / Classification	Silicon Rubber	Fluoro-rubber
Ether	Diethyl Ether, Dibutyl Ether, Ethylene Oxide, Dioxane, Epichlorohydrin, Tetrahydrofuran	Diethyl Ether, Isopropyl Ether, Dibutyl Ether, Dibenzyl Ether, Ethylene Oxide、Dioxane, Epichlorohydrin, Furfural, Tetrahydrofuran
Alcohol	Amyl alcohol	
Multiple Alcohol Derivative		Cellosolve Acetate, Butyl Cellosolve, Triacetin
Fatty Acid, Phenol	Acetic Anhydride, Oleic Acid, Phenol Palmitate	Formic Acid、Acetic Anhydride, Hydroquinone
Nitrogen Chemical Compounds	Nitromethane, Nitroethane, Nitropropane	Nitromethane, Nitroethane, Nitropropane, Ethylenediamine, Dimethylaniline, Ethanol amine, Hydrazine, Triethanol Amine, Dimethyl Formamide, Pyridine, Piperidine
Sulfur and phosphorus compounds	Hydrosulfuric	Hydrosulfuric, Tributyl Phosphate
Other Chemical Compounds	Nickel Acetate, Lead Acetate, Zinc Acetate, Tetraethyl Lead, Vegetable Oil, Silicon Oil	Calcium Acetate, Nickel Acetate, Lead Acetate, Zinc Acetate
Inorganic Solvent	Hydrochloric Acid, Nitric Acid, Sulfuric Acid, Hydrobromic Acid, Phosphoric Acid, Hypochlorous Acid, Chromic Acid, Perchloric Acid, Sodium Hydrate	Sodium Hydrate, Aqueous Ammonia

5. HANDLING PRECAUTIONS

⚠ Caution

11. Temperature control.

⚠ The temperature sensor for this unit is installed on the inside wall of the chamber and used to control chamber temperature. Chamber temperature reading, as detected by the sensor, may not always agree with the temperature of test specimens. More often than not, chamber and test sample temperatures will differ largely immediately after opening or closing chamber door.

12. Inspect equipment regularly.

❗ The main power switch (ELB) and the Independent Overheat Prevention Device (IOPD), in particular, are key devices in maintaining DF/DH series unit safety, and must be inspected/maintained regularly.

☞ See “Inspection & Maintenance” (P.54) for details.

13. Always set Independent Overheat Prevention Device temperature.

❗ Activation temperature for the Independent Overheat Prevention Device (IOPD) must be set in order to protect unit from damage, if overheating occurs.
Note that temperature on the IOPD should be set to 20°C higher than objective temperature.

☞ See “Independent Overheat Prevention Device” (P.47) for more on setting up this device and for other warnings.

14. Open exhaust damper when processing moistened samples.

❗ When processing moistened samples, open the exhaust damper to increase heat and disperse moisture. If moisture is allowed to collect and become trapped inside unit, malfunction or electric shock may result.

🚫 Do not attempt to process dripping wet or liquid samples.

15. Samples/specimens needing special attention.

❗ Use caution when processing samples/specimens, which contain powder or small particles, so they are not disbursed by sudden movements or abrupt air pressure changes. Allowing flammable or metallic items to contact the heater assembly may cause a fire or shock hazard.

⚠ Be advised that more time may be requred for chamber temperature to rise when processing a larger amount of samples/specimens or those with a higher heat load capacity. Do not process more samples than necessary. Further note that temperature reading may not be consistent when processing heat-generating specimens.

16. Check damper aperture before operation.

⚠ Comfirm that damper is at the required aperture before operation. If damper is left fully open, during high temperature operation, unit may be unable to reach maximum temperature.

⚠ Caution

17. Cable port precaution.

Whenever a manual temperature gauging sensor or probe is inserted through the cable port, close the port cover as fully as possible and completely seal any gaps with heat-resistant insulation or sealant. If the seal is inadequate, temperature characteristics or other performance properties will be degraded and inaccurate. Optional silicon plugs are available (DF models only). See Table 11.1 on P.62 for details.

18. Initial operation.

⚠ When operating unit for the first time, organic substances in the heat insulator may burn and produce smoke, which is normal and not a malfunction. An accompanying odor may also be emitted, but will subside with continued operation.

19. DO NOT apply paint thinner, alcohol or other solvents to equipment.

Never attempt to clean DF/DH series units with paint thinner, alcohol or solvents of any kind. Doing so may cause coating to peel, discoloration, superficial damage and deformity to some components.
Note: always turn off main power switch (ELB) prior to cleaning or maintenance.

20. Fan motor.

⚠ Fan continues operating while the ELB is ON(|) and unit is in standby with chamber door closed.
Press ⏻ to turn controls off (idle) and stop fan.

21. Read instruction manual thoroughly before operation.

Always read instruction manual(s) for all equipment, thoroughly, before beginning setup, installation and operation.

Warning

- Be sure that main power switch (ELB) is OFF before daily inspection and maintenance.
- Perform inspections and maintenance when chamber interior is at room temperature.
- Never attempt to disassemble unit.

Caution

- Clean unit using soft damp cloth.
- Never use benzene, paint thinner, scouring powder, scrubbing brush or other abrasives and solvents to clean unit. Superficial damage and/or discoloration, as well as deformity to some components may result.

Inspect monthly.

- Inspect main power switch (ELB) ON and OFF function.
  - ・Prepare unit for inspection by connecting power cable to a facility outlet or terminal.
  - ・Confirm that main switch (ELB) is “OFF” then, turn main switch (ELB) back “ON”.
  - ・With the main switch “ON”, depress the test button on the main switch (ELB) using a ball-point pen or other fine-tipped object. If main switch (ELB) shuts off, it is functioning normally.

- Test Independent Overheat Prevention Device (IOPD).
  - ・Run unit in constant temperture mode and allow temperature to stabilize.
  - ・Set the activation temperature for the IOPD to approximately 5°C below chamber temperature.
  - ・If overheating prevention device is functioning normally, heater will shut off within few seconds and error code “Er07” will appear in the upper display. An alarm will also sound and ERROR lamp will illuminate.

ⓘMain power switch (ELB) and overheat prevention device must be inspected, as prescribed above, prior to every instance of extended or overnight operation.

◆Contact a local dealer or Yamato sales office for further assistance.

7. STORAGE AND DISPOSAL

Extended Storage & Unit Disposal

⚠ Warning	⚠ Caution
If unit will be out of service for an extended period, turn off main power switch (ELB) and disconnect power cable from facility outlet or terminal.	**Unit disposal.** ●Remove door handle and hinges to prevent it from locking. ●Do not leave unit unattended, or in reach of children. ●Dispose of this unit in accordance with local laws and regulations.

Disposal Considerations

Dispose of or recycle this unit in a responsible and environmentally friendly manner.
Yamato Scientific Co., Ltd. strongly recommends disassembling unit, as far as is possible, in order to separate parts and recycle them in contribution to preserving the global environment.

Major components and materials, comprising DF/DH series units are listed in the table below:

Component	Material
Structural	
Exterior	Chrome-free electrogalvanized carbon steel sheet metal, finished in chemical-proof, baked-on coating
Chamber	Stainless steel sheet metal
Heat Insulation	Ceramic fiber + glass wool
Door seal	Silicon rubber
Electrical	
Switches and Relays	Resin composites, copper and other materials
Control Panel	Polycarbonate resin
Printed Circuit Boards	Fiber glass composites and other materials
Heater	Stainless steel tubing
Power Cable	Composites of synthesized rubber coating, copper, nickel and other compound materials
Wires	Fiber glass composites, flame-retardant vinyl, copper, nickel and other materials
Labels	Resin materials
Sensors (K-thermocouple)	Stainless steel and other material

8. TROUBLESHOOTING

Error Codes

All possible error codes are shown in Table 8.1 below.
On DF/DH series units, operation stops and a sounding alarm accompanies occurring errors.
Pressing any key (except ⏻) will pause the alarm. After three minutes alarm will sound again.
Upper display shows error code and error source source appears in lower display. Confirm error code and turn power off immediately.

Table 8.1 - Error Codes

Screen	Source	Causes & Solutions
Er01 SENS	Sensor Failure	● Failure in temperature input circuit. ● Open circuit in temperature sensor line. ● Temperature out of specification range. Call for service
Er02 tRI AC	TRIAC Short Circuit	● Electrical short in TRIAC circuit. ● Faulty current transformer (CT) sensor. Call for service
Er03 HEAt	Faulty or Disconnected Heater Line	● Heater line faulty or severed. ● Faulty current transformer (CT) sensor. ● Drop in supply voltage. Call for service
Er04 FAN	Fan Motor Failure	● Fan motor malfunction Call for service
Er07 oHEAt	Independent Overheat Prevention Device (IOPD) activated	● Independent Overheat Prevention Device (IOPD) has activated. Turn ELB OFF, then back on ON (reset). Check both chamber temperature and IOPD temperature setting. If unit does not function normally after ELB reset, call for service.
Er 10 RELAY	Main Relay Contact Damaged	Turn ELB OFF, then back ON (reset) and confirm: ● whether contact point on main relay is damaged. ● whether current transformer (CT) sensor(s) has failed. Call for service.

8. TROUBLESHOOTING

Error Codes

Error Display	Error Code Name	Causes and their solutions
Er 14 RAM	RAM Failure, backup battery capacity reduced or dead	Turn ELB OFF, then back ON (reset) and confirm whether backup battery capacity is decreased or is dead. ● Replace backup battery If error cannot be cleared by ELB reset or battery replacement, call for service.
Er 15 EPRoM	EEPROM Failure	Turn ELB OFF, then back ON (reset) and confirm whether there is a change in data code on EEPROM. ● Change data code on EEPROM. ● Replace backup battery Call for service if this error cannot be cleared after completing above items.
dooR	Door Open	Door is open. ● NOT a malfunction. "dooR" flashes in lower display, and heater/fan motor are shut off to maintain operator safety while door is open. Closing the door clears the flashing "dooR" indicator and normal operation resumes. Keeping door open for more than 2 minutes will activate an alarm. Pressing any key (except ⏻) pauses alarm. Alarm will sound again for every additional 2 minutes the door is left open.

Troubleshooting Guide

Table 8.2 - Troubleshooting Guide

Symptom	Possible Causes	Possible Solutions
Unit does not turn on/operate when main power switch (ELB) is turned “ON”. (no current time in lower display)	・ No power from power supply ・ ELB failure ・ Control board failure	・ Check connection to power supply and confirm power supply voltage. ・ Replace ELB. (*) ・ Replace control board. (*)
Displays are blank when control panel is powered on (unit in standby)	・ Power supply failure (must be within ±10% voltage rating) ・ Control board failure	・ Connect to adequate power supply ・ Replace control board (*)
Fan does not operate when control panel is powered on (unit in standby)	・ Fan motor malfunction ・ Door open.	・ Replace fan motor (*****) ・ Close door.
Temperature in chamber does build	・ IOPD and/or built–in self-diagnosis function has shut heater circuit down (error code displayed).	・ Refer to Table 8.1, this section (*)
Temperature reading is erratic	・ Heavily fluctuating ambient temperature ・ Power supply failure (must be ±10% of voltage rating) ・ Temperature affected by test samples ・ Control board failure ・ Temperature sensor failure	・ Re-evaluate installation site ・ Connect to adequate power supply ・ Reduce test sample load ・ Replace CPU board (*) ・ Replace temperature sensor (*) ・ See P.53, “Samples/specimens needing special attention”.

(*) Call for service

If problem(s) persists, turn off power immediately, disconnect power cable from outlet or terminal and contact a local dealer or Yamato sales office for further assistance.

9. SERVICE AND REPAIR

Requests for Repair

When a problem occurs, terminate operation immediately, turn off main power switch (ELB) and disconnect power cable.
Contact a local dealer or Yamato sales office for assistance.

The following information is required for all repairs.
- Model name
- Serial Number
- Date (year/month/day) of purchase
- Description of problem in as much detail as possible

Guaranteed Supply Period for Repair Parts

Guaranteed maximum supply period for repair parts is 7 (seven) years from date of discontinuation for DF/DH series ovens. “Repair parts” is defined as components which, when installed, allow for continued unit operation.

10. SPECIFICATIONS

Specification Table

Product Name		Precision Oven			
Model Name		DF412	DF612	DH412	DH612
System		Forced air circulation and ventilation			
Working ambient temperature range		5°C～35°C			
Power supply		Single-phase 220V AC 12.5A	Single-phase 220V AC 17.5A	Single-phase 220V AC 15.5A	Singe-phase 220V AC 21.5A
		50/60Hz, voltage variation tolerance: ±10%			
Performance *1	Temperature Control Range	Room temp. +15°C～260°C		Room temp. +15°C～360°C	
	Temperature control precision	±0.1°C (at 260°C) JTM K05		±0.2°C (at 360°C) JTM K05	
	Temperature variance *2	±0.5°C (at 260°C) JIS C60068		±1.0°C (at 360°C) JIS C60068	
	Temperature distribution precision	±1.5°C (at 260°C) JTM K05		±2.5°C (at 360°C) JTM K05	
	Temperature gradient	10°C (at 260°C) JIS C60068		12°C (at 360°C) JIS C60068	
	Temperature build time (to max temp)	Approx. 40min.		Approx. 50min.	
Configuration	Exterior	Chrome-free electro-galvanized steel sheet metal Chemical-proof baked-on finish			
	Chamber	Stainless steel sheet metal			
	Insulation Material	Glass wool			
	Door	Single swivel (left swing)			
	Heater	Stainless steel tube heater with metal cooling fins			
	Heater capacity	2.1kW	3.0kW	2.7kW	3.75kW
	Fan (motor)	Stainless steel axial fan (capacitor motor 20W)			
	Cable port	I.D. :φ33mm (rear panel)			
	Exhaust port	Automatic exhaust damper I.D. φ80mm (rear panel)			
Control Devices & Functions	Type	Model V (5) controller			
	Temperature control system	PID, Z control			
	Temperature setting system	Digital setting with ▲/▼ keys.			
	Temperature display system	Upper display (Chamber): Green 4-digit LED Digital Display (Resolution: 1°C) Lower display: Orange 5-digit LED Digital Display (Resolution: 1°C)			
	Other displays	LEDs indicating temperature patterns for heating/stablization/cooling			
	Timer	Configurable from 1 minute to 99 hours 59 minutes: timer operation 24 hour time system: clock operation			
	Operation modes	Fixed temperature operation Programmed operation（Maximum 99 steps or 99 patterns, with repeat operation function） Timer or clock operation function (Fixed temperature operation w/ auto start/auto stop/quick auto stop, programmed operation auto start）			

10. SPECIFICATIONS

Specifications Table (continued from previous page)

	Model Name	DF412	DF612	DH412	DH612
Control Devices & Functions	Additional functions	Variable Air Flow Function Power-on Time and Operation Time Accumulation Monitor (up to 65,535 hours); Calibration Offset; Monitoring Display for Accumulated Power Consumption, Total CO2 Emissions, and Heater Operation Output; Power Recovery Mode; Setting Data Backup and Recovery			
	Heater Control	Triac with Zero-cross Control			
	Sensor	K type Thermocouple double sensor (for temperature control and independent overheat prevention device)			
Safety Device	Control Board	Self-diagnosis Functions (Detection for Temp. Sensor Failure, TRIAC Short Circuit, Heater Line Disconnect, Fan Motor Failure, Main Relay Contact Damage and Overheating), Key Lock Function			
	Earth Leakage Breaker (ELB)	15A	20A	20A	30A
		Leak Current/Short Circuit/Over-current Protection, Rated Current Sensitivity 30mA			
	Independent Overheat Prevention Device (IOPD)	Temperature Setting Range: 0～300°C		Temperature Setting Range: 0～400°C	
	Door switch	Door open: fan motor and heater circuit OFF Door close: fan motor and heater circuit ON			
Standard Weights & Measurements	Interior Dimensions Width Depth Height *3	450mm 450mm 450mm	600mm 600mm 600mm	450mm 450mm 450mm	600mm 600mm 600mm
	Overall Dimensions Width Depth Height *3	1050mm 630mm 850mm	1200mm 780mm 1000mm	1050mm 630mm 850mm	1200mm 780mm 1000mm
	Internal Capacity	91ℓ	216ℓ	91ℓ	216ℓ
	Weight	Approx. 112kg	Approx.156kg	Approx.112kg	Approx.156kg
	Number of tiers/ rack support pitch	9 tiers/45mm	9 tiers /60mm	9 tiers /45mm	9 tiers /60mm
	Chamber Rack Load Capacity	Approx. 30kg / rack	Approx.30kg /rack	Approx.30kg /rack	Approx.30kg /rack
Included Items	Chamber Racks / Rack Supports	2/4	3/6	2/4	3/6
	Instruction Manual	1 copy			
Notes	*1 Performance based on rated source voltage, single phase 220V±5%, room temperature 23°C ±5°C, 65%RH±20% humidity, 86kPa to 106kPa atmospheric pressure, exhaust damper closed, no sample load. *2 Value calculated by dividing JIS measurement by 2. *3 Protrusions excluded.				

11. ACCESSORY OPTIONS

Accessory Item List

DF412/612, DH412/612 Precision Ovens are compatible with a wide variety of available options, shown in Tables 11.1, 11.2.1 and 11.2.2.
Options listed in Table 11.2.1 and 11.2.2 are required to be installed at the Yamato manufacturing facility or to be retrofitted by a qualified technician.

Table 11.1 Options List (factory installation not required)

Option	Product Code No.	Option Model No.	Compatible Models	Description
Chamber Rack (stainless steel wire) with supports	211063	-	DF/DH412	Same as standard racks; available for additional purchase.
	211064	-	DF/DH612	
Chamber Rack (perforated stainless steel) with supports Capacity: approx. 30kg/ea.	211098	-	DF/DH412	Perforated stainless steel chamber racks.
	211099	-	DF/DH612	
Basket Style Rack Containter (stainless steel mesh) Capacity: approx.15kg/ea.	212924	ODT12	DF/DH412	30mm deep rack container constructed from stainless steel mesh (3 mesh panels); for processing smaller samples/specimens. Designed to be stacked on standard stainless steel wire racks.
	212925	ODT14	DF/DH612	
Stand (no casters)	415464	OP43	DF/DH412	Stand for DF/DH series ovens.
	415465	OP63	DF/DH612	
Stand (with casters)	415466	OP46	DF/DH412	Stand for DF/DH series ovens with the addition of four caster wheels and two leveling feet on front.
	415467	OP66	DF/DH612	
Stacking hardware	213700	ODF48	All	Hardware for securing an upper and lower DF/DH412, DF/DH612 units by stacking them them vertically. Hardware may be used for stacking DF/DH412 with previous model DF/DH4xx and DF/DH612 with previous model DF/DH6xx. Be advised that newer models should be stacked in the top position
Sheath Sensor (K thermocouple)	212946	ODT48	All	Additional temperature sensor for confirming temperature in chamber or temperature of samples. May be connected to optional memory recorder.
Silicon Plug (for 1 opening)	212947	ODT52	DF models only	Silicon rubber plug for sealing gaps caused by sensors inserted into cable port. φ2mm opening in center.

11. ACCESSORY OPTIONS

Accessory Item List

Table 11.2 List of options (retrofit required)

Option	Product Code No.	Option Model No.	Compatible Models	Description
Remote Communications Terminal (RS485)	213712	ODF72	All	Terminal installed on main unit for controlling and monitoring operation status from remote PC workstation.
External Communications Adaptor Kit	211880	OIN90	All	Adapter kit for connecting unit to remote PC workstation. Option ODH44 required. Software supplied with kit.
Temperature Output Terminal (4-20mA)	213713	ODF74	All	Terminal outputting a 4 – 20 milli ampere analog signal for external temperature sensor.
External Alarm Output Terminal	213714	ODF76	All	Terminal allowing alarm signals accompanying unit errors to be output externally.
Time-up Output Terminal	213715	ODF78	All	Termmal allowing a signal, indicating “END” of Auto Stop Operation and/or Programmed Operation, to be ouput externally.
Operation Signal Output Terminal	213716	ODF80	All	Terminal allowing signal, indicating operation in progress, to be output externally.
Event Output Terminal	213717	ODF82	All	Terminal allowing ON-OFF signals, indicating unit status, such as standby, operating, operation end, and program steps, to be output externally.

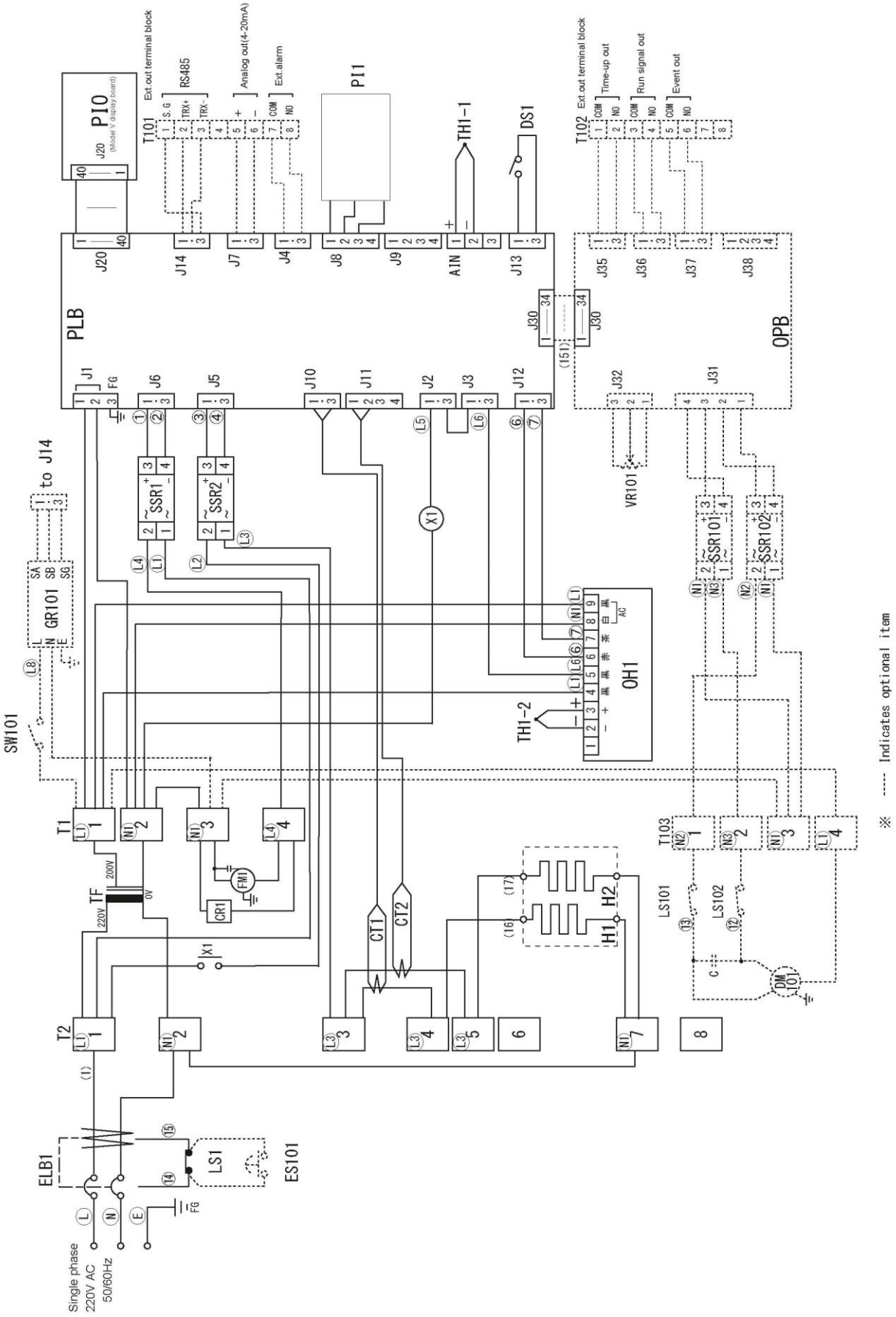
11. ACCESSORY OPTIONS

Accessory Item List

Emergency Stop Button	213708	ODF64	DF/DH412	Button to shut main power off in the event of an emergency.
	213709	ODF66	DF/DH612	
Chart Recorder	213707	ODF62	All	Integrated into main unit. Paperless (inputs: 6), sensor optional (may be used with ODT48). The following three parameters may be monitored: temperature as measured by unit main controller (PV), objective temperature while in operation (SV), heater output ratio (MV).
Power Cable (8m)	213710	ODF68	DF/DH412	8m substitution power cable for main unit. No plug included.
	213711	ODF70	DF/DH612	
Auto Damper	213707	ODF62	All	Electronic damper allowing exhaust port aperture and air flow to be controlled automatically by motor and control circuit in five stages.
Upward facing exhaust duct flange w/heat shield	213703	ODF54	DF/DH412	Duct directs exhaust emissions up and out. Optional exhaust port flange (ODF46) is required with this option.
	213704	ODF56	DF/DH612	
Rear-facing exhaust duct flange	281069	ODF46	All	Flange for connecting exhaust port exhaust duct ODH34 (O.D. :φ80mm). Installed on back of unit.
Additional Cable Port (φ25mm)	211075	ODH66	All	Cable ports of different inner diameters may be installed in in left and right panels. confirm position and number of required ports before placing order.
Additional Cable Port (φ50mm)	211076	ODH68		

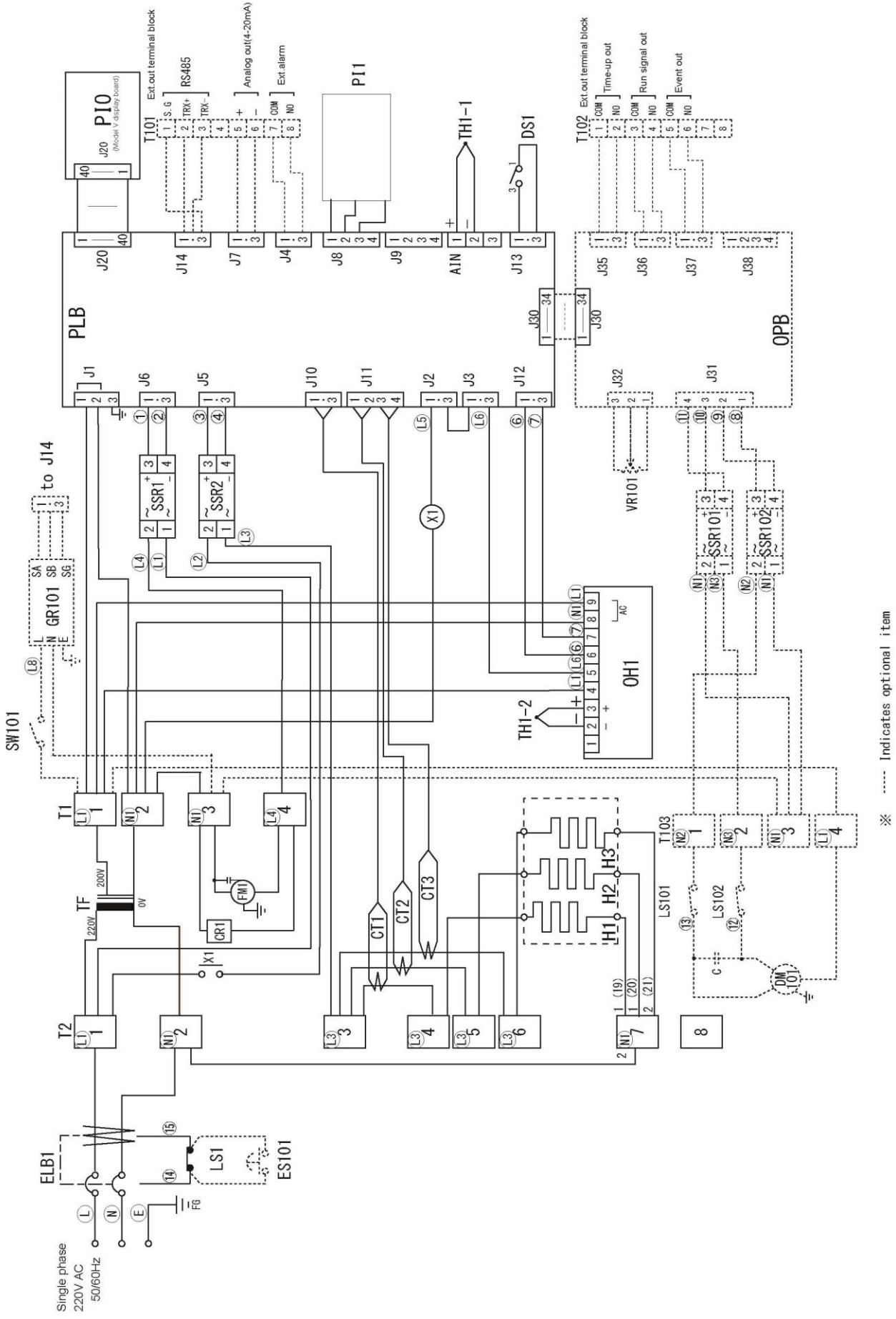
12. WIRING DIAGRAMS

DF412/612 Wiring Diagram



12. WIRING DIAGRAMS

DH412/612 Wiring Diagram



12. WIRING DIAGRAMS

Wiring Diagram Glossary

Symbol	Component	Symbol	Component
ELB1	Earth Leakage Breaker (ELB)	PLB	Model V Motherboard
T1	Wiring Terminal Block	PIO	Model Display Board
T2	Wiring Terminal Block	OH1	Independent Overheat Prevention Device
SSR1,2	Solid State Relay	PI1	Photo Coupler
H1,2,3	Heater	DS1	Door Switch
CT1,2,3	Current Sensing Element	TH1-1	Temperature Sensor
X1	Main Relay	TH1-2	Independent Overheat Prevention Device Sensor
FM1	Fan Motor		
CR1	Spark Eliminator		
LS1	Control box switch		

Optional portion

Symbol	Component	Symbol	Component
T101,102	External Output Terminal Block	T103	Automatic Damper Terminal Block
OPB	Model V Option Board	DM101	Automatic Damper Motor
ES101	Emergency Stop Switch	LS101、102	Automatic Damper Limit Switch
GR101	Chart Recorder	SSR101、102	Automatic Damper Solid State Relay
SW101	Chart Recorder Switch	VR101	Automatic Damper Variable Resistor

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	㊀Ethyl Ether, Gasoline, Acetaldehyde, Propylene Chloride, Carbon Disulfide, and other substances with ignition point of 30 degrees or more below zero.
	②n-hexane, Ethylene Oxide, Acetone, Benzene, Methyl Ethyl Ketone and other substances with ignition point between 30 degrees below zero and less than zero.
	③Methanol, Ethanol, Xylene, Pentyl n-acetate, (a.k.a.amyl n-acetate) and other substances with ignition point between zero and less than 30 degrees.
	④Kerosene, Light Oil, Terebinth Oil, Isopenthyl Alcohol(a.k.a. Isoamyl Alcohol), Acetic Acid and other substances with ignition point between 30 degrees and less than 65 degrees.
Combustible Gases	Hydrogen, Acetylene, Ethylene, Methane, Ethane, Propane, Butane and other gases combustible at 15℃ at one air pressure.

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

14. SETUP CHECKLIST

* Setup DF/DH series units using the following procedure:

Model	Serial number	Installation Date	Installed by (company or personnel)	Installation approved by	Assessed by

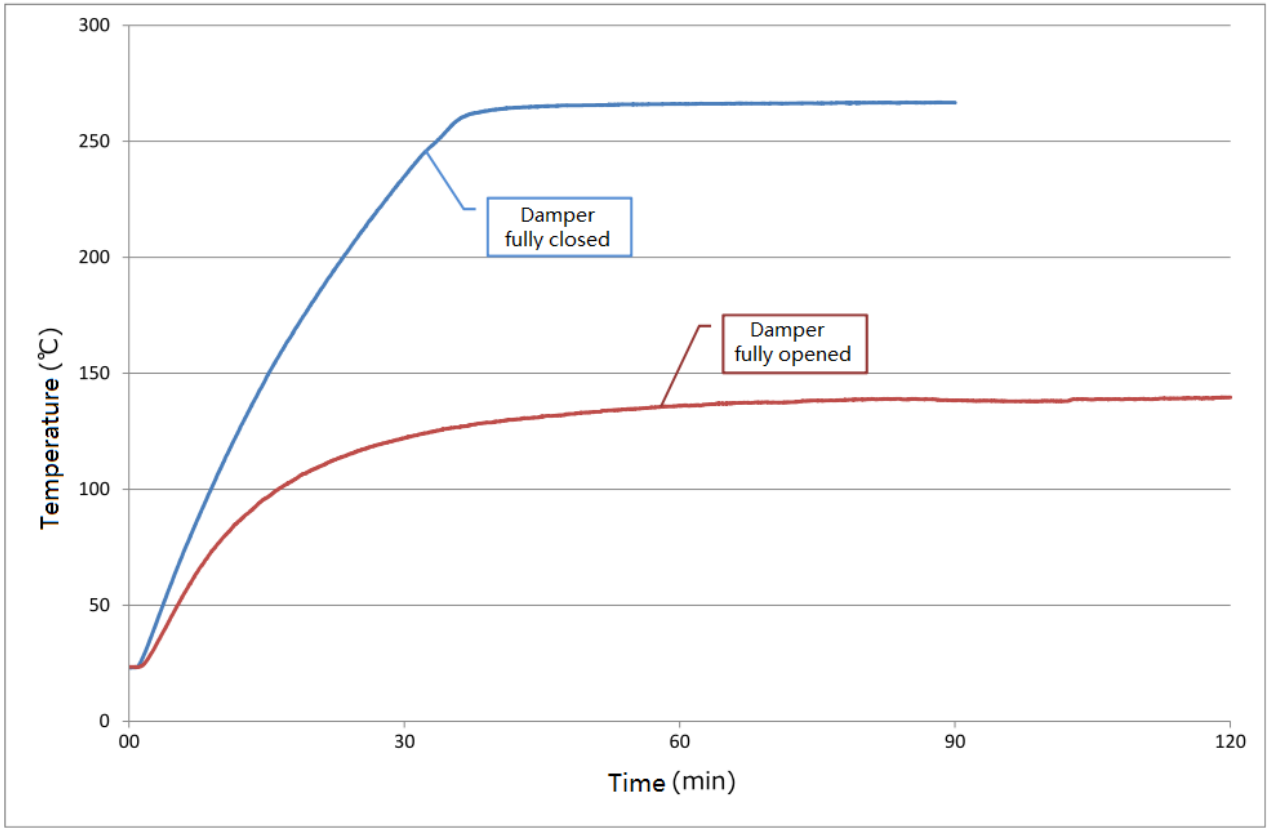
No.	Item	Procedure	Section & Reference Page	Assessed by
Specifications				
1	Accessories	Verify inlcuded accessories against accessories column.	10. Specifications 60~61	
2	Installation	・Check site visually. Caution: check for hazards	2. Pre-operation Procedures 1. Choose Appropriate Site for Installation. 4~7	
		・Prepare installation space.		
		・Install chamber racks	5. Handling Precautions 7. Arranging test samples 49	
Equipment Operation				
1	Power Source Voltage	・Measure line voltage (facility power outlet or terminal) with voltmeter. ・Measure line voltage during operation. (Must meet required voltage rating) Caution: confirm facility power source rating meets unit requirements	2. Pre-operation Procedures 5 7. Connect power cable to proper power supply 6 9. Ground wire must be connected 7 10.Specifications Power Supply (Required) 60	
2	Operation	・Start operation.	2. Pre-operation procedures 4~7 Installation Precautions 4. Operation procedure Setting Time & Date ~ Service & Repair 12~59	
Description				
1	Operation	Explain function of each component as written in instruction manual.	4. Operation Procedure Setting Time & Date 12 1. Safety Precautions ~ 3~ 14. List of Hazardous Substances 67	
2	Error codes	Explain error codes and reset procedures as written in instruction manual.	8. Error Codes ~ 56~ 15. Setup Checklist 68	
3	Maintenance and inspection	Explain function of each component as written in instruction manual.	6. Maintenance Procedures Inspection & Maintenance 54	
4	Setup checklist completion	・Fill in installation date and name of installing personnel or company on unit “OK and Service Sticker”. ・Explain how to contact technician.	9. Service & Repair 59	

Appendix 1

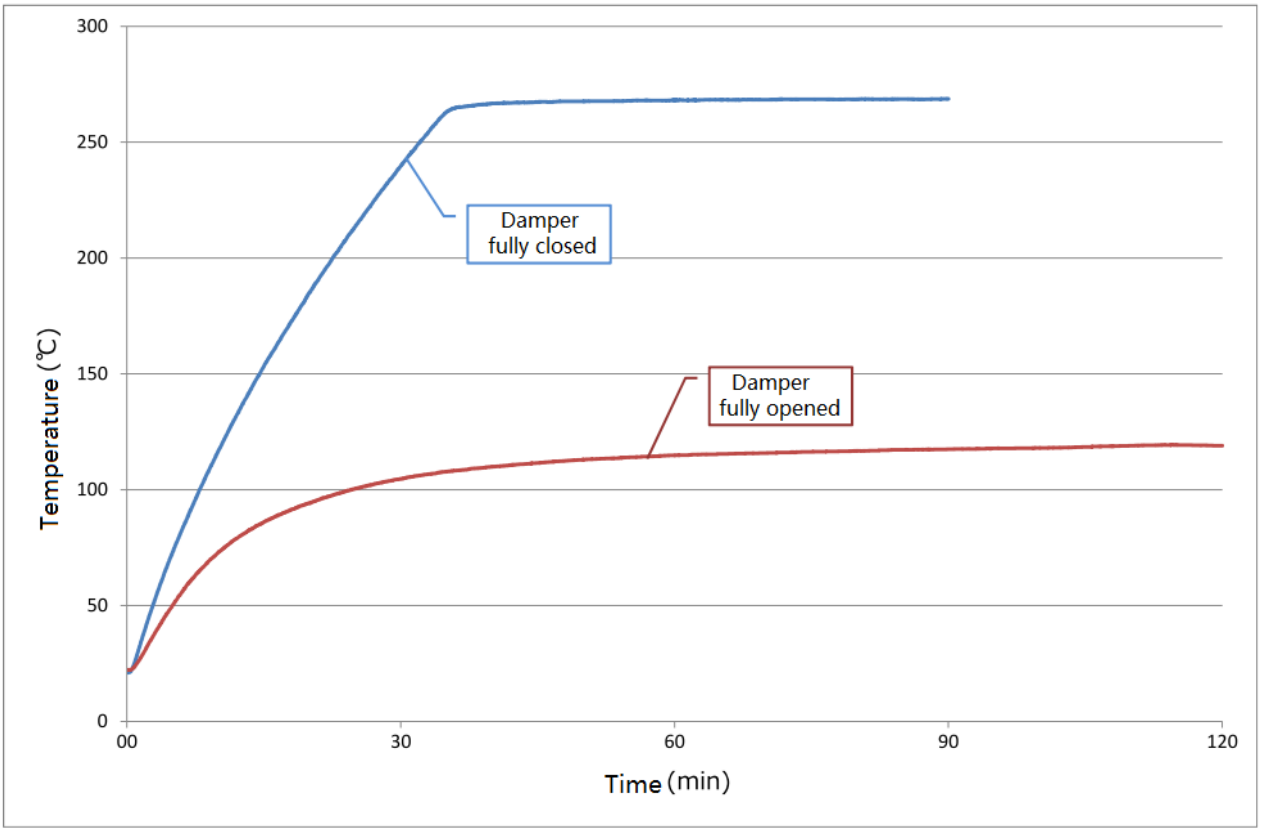
Temperature Build Times By Model

✶ Data shown below is for reference only. Individual results may vary.

1. DF412



2. DF612

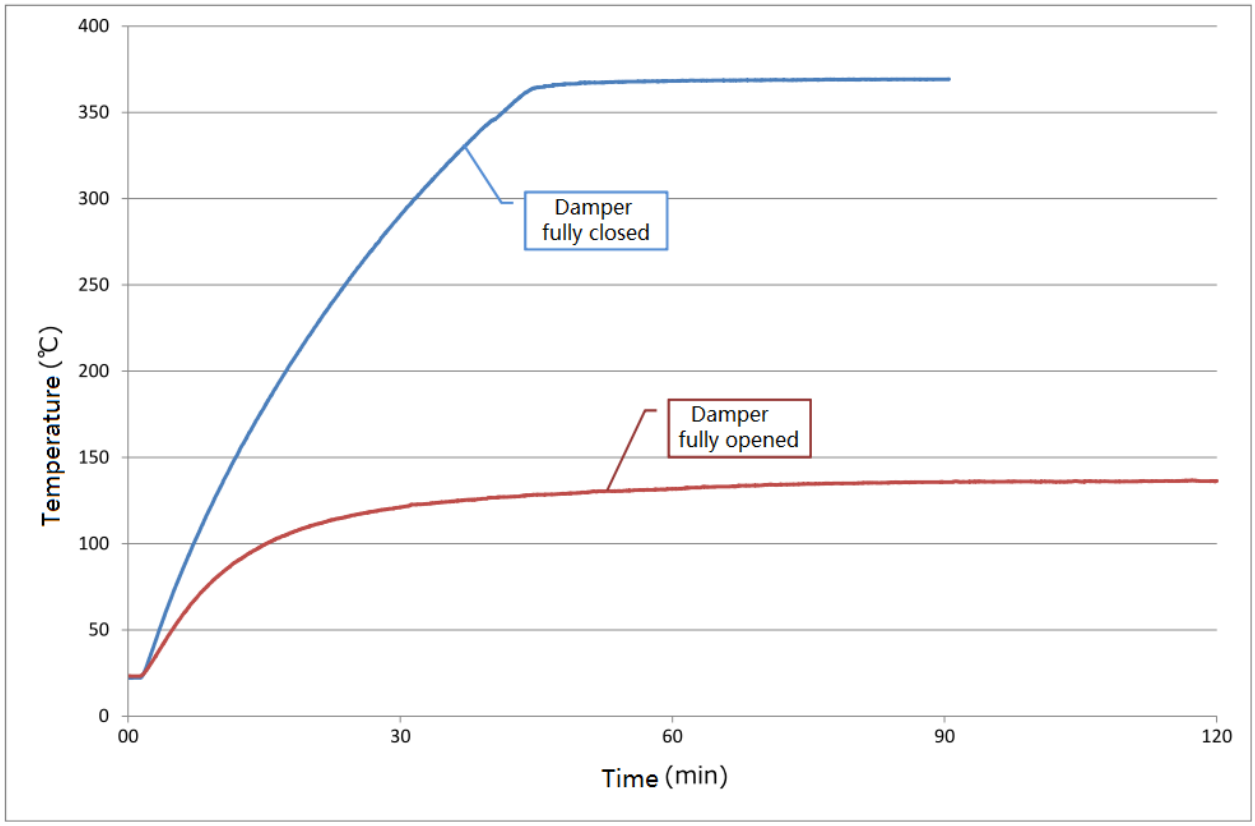


Appendix 1

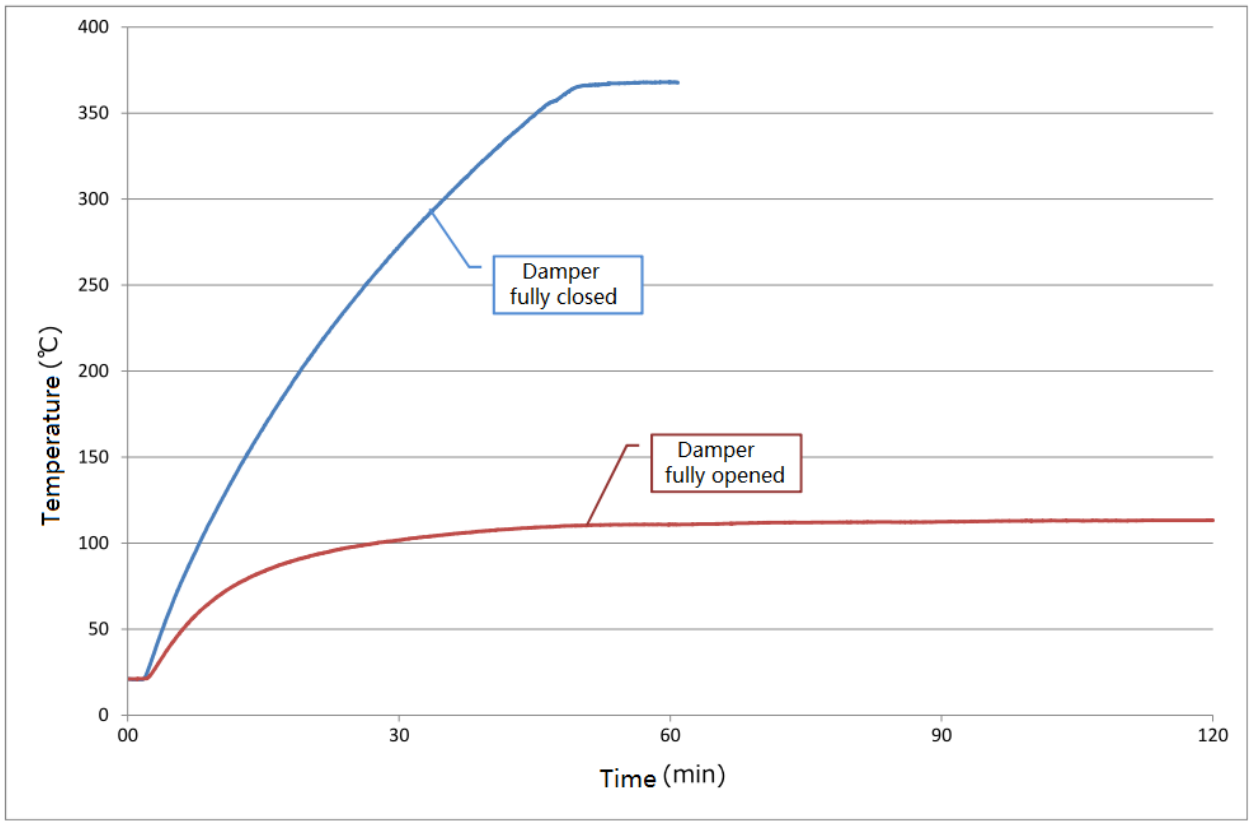
Temperature Build Times By Model

✶ Data shown below is for reference only. Individual results may vary

3. DH412



4. DH612

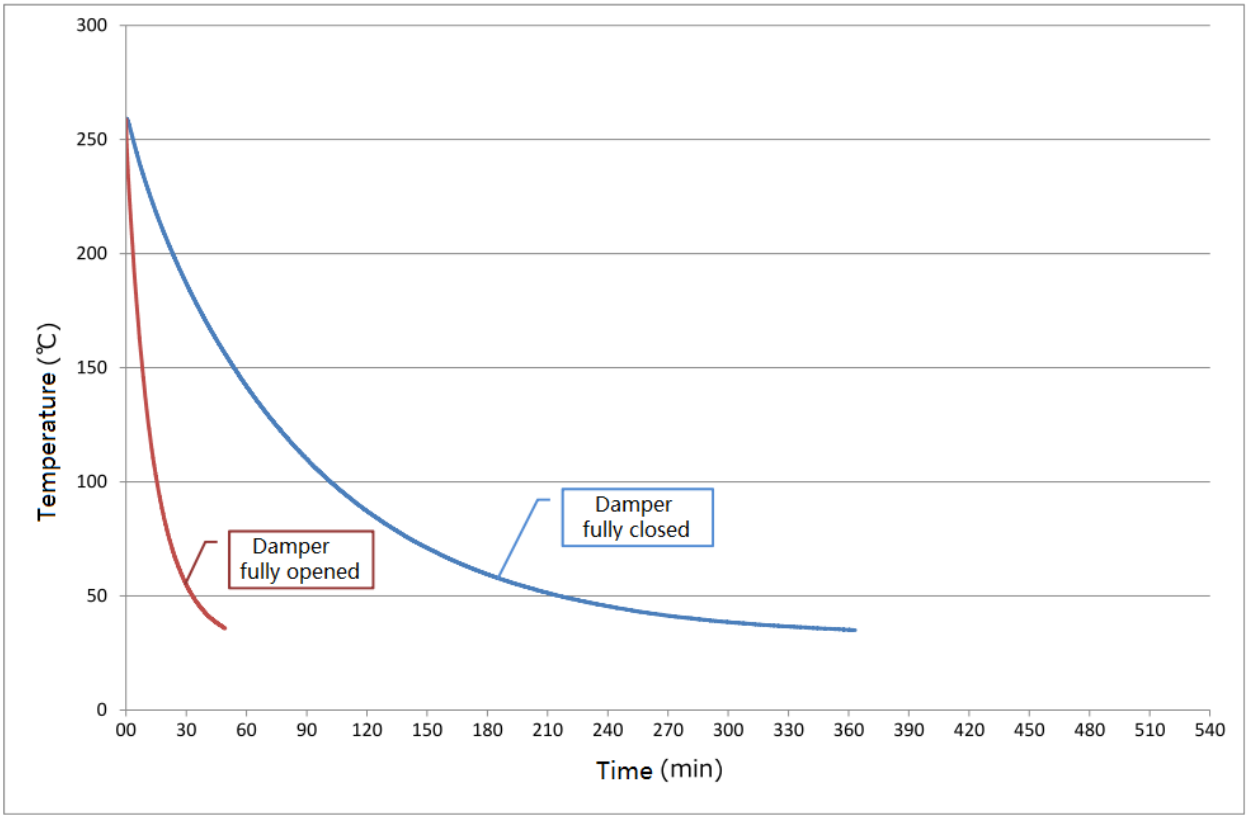


Appendix 2

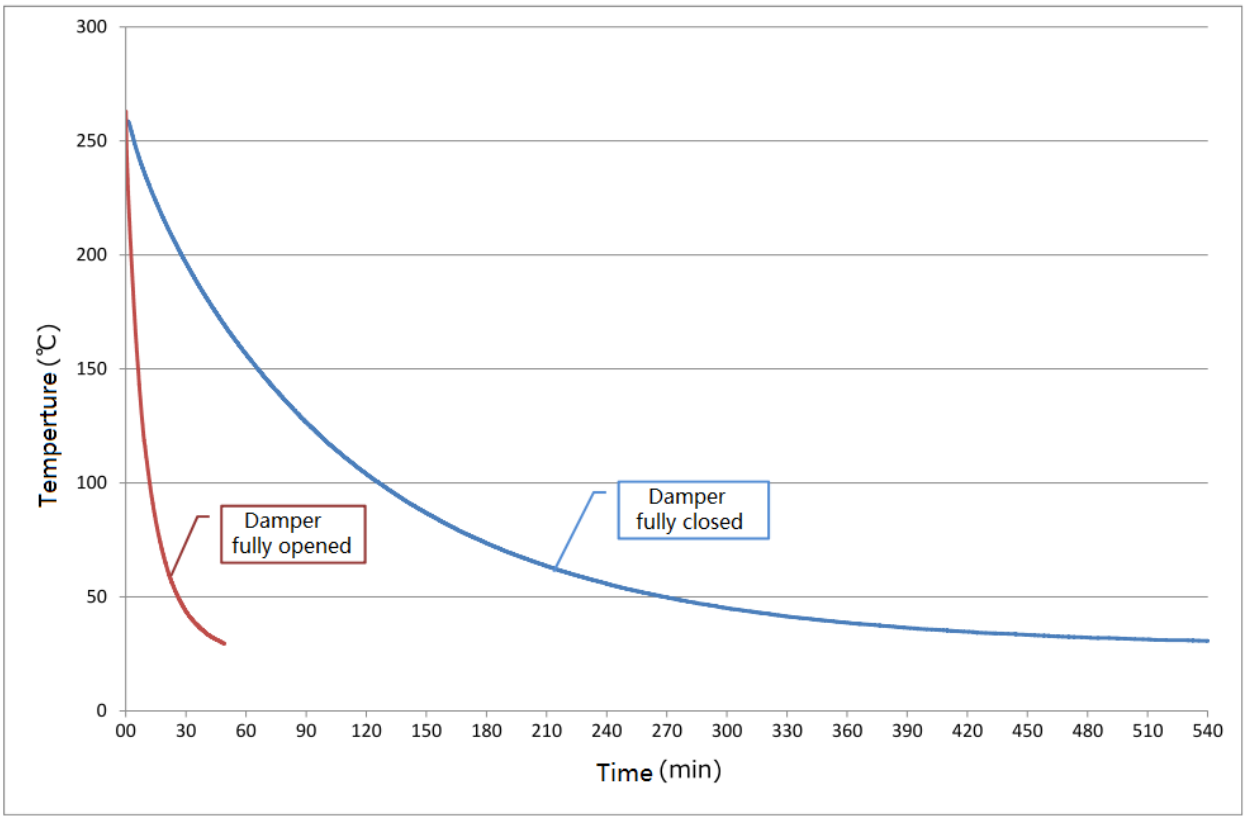
Temperature Fall Times By Model

✶ Data shown below is for reference only. Individual results may vary

1. DF412



2. DF612

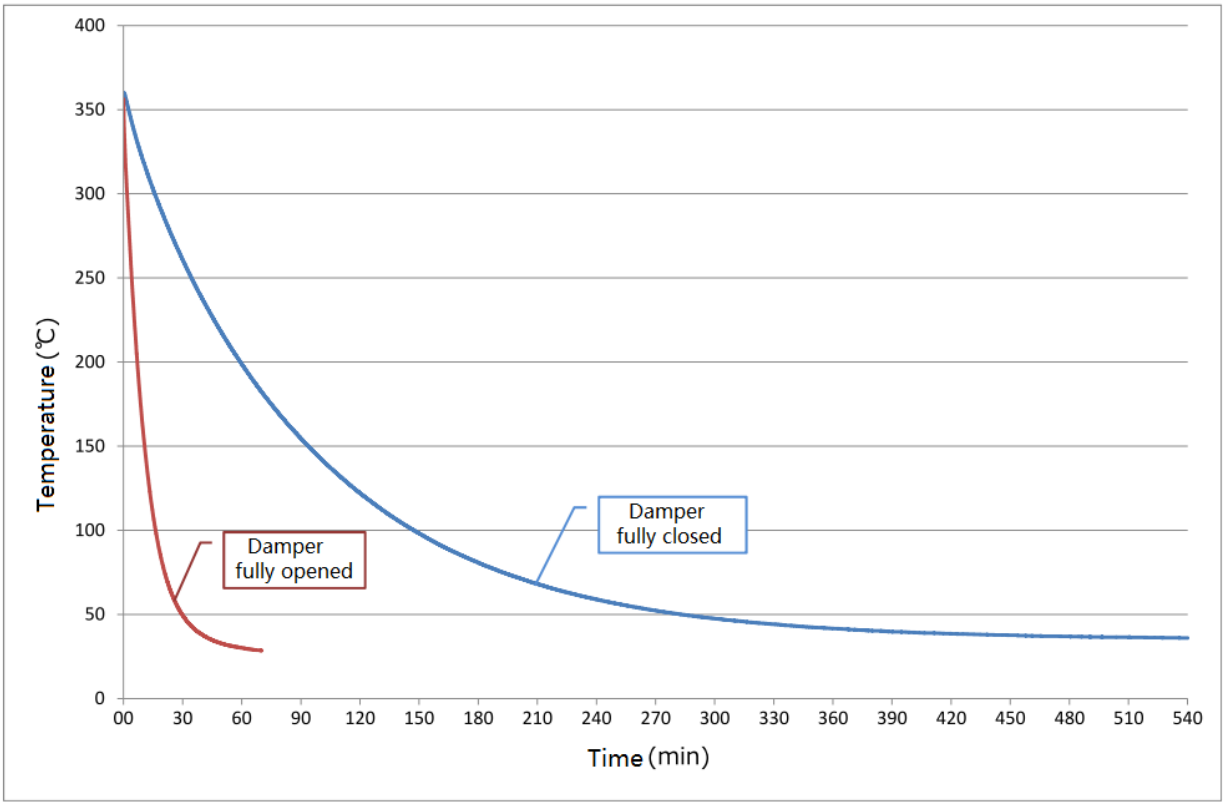


Appendix 2

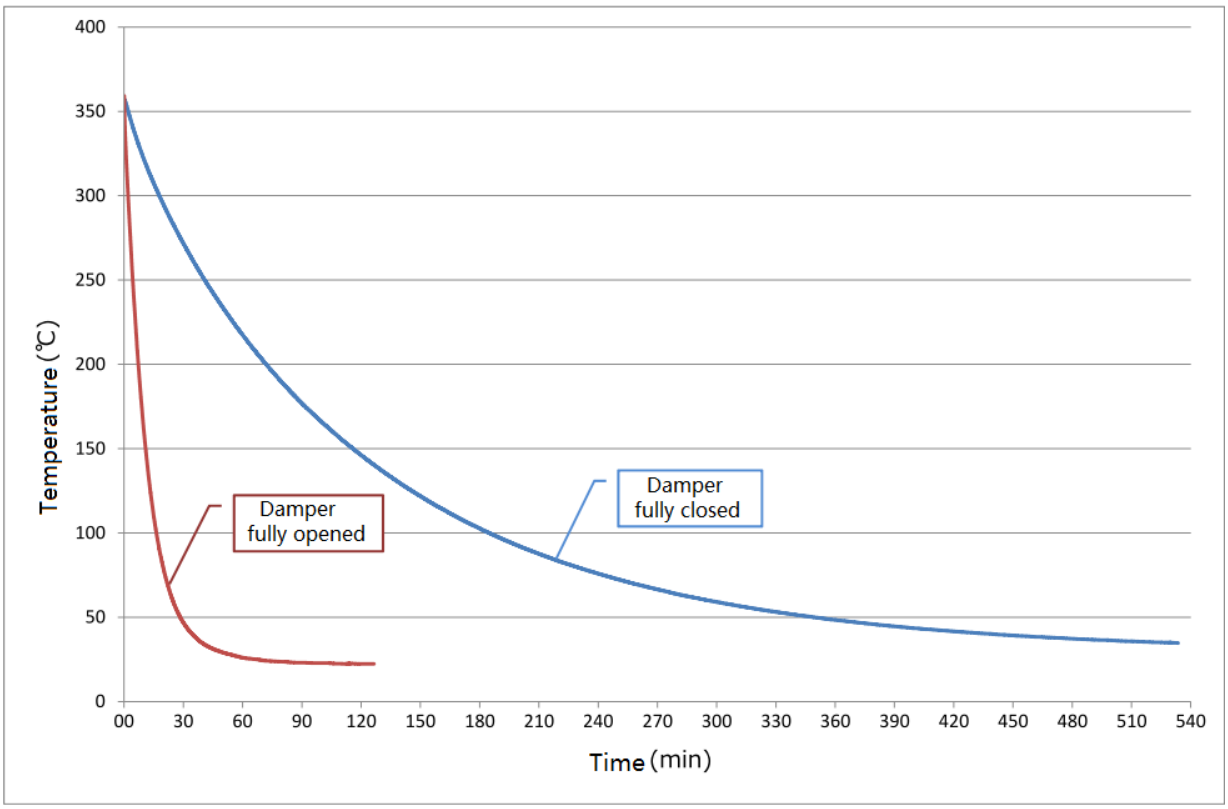
Temperature Fall Times By Model

✶ Data shown below is for reference only. Individual results may vary

3. DH412



4. DH612



Appendix 3

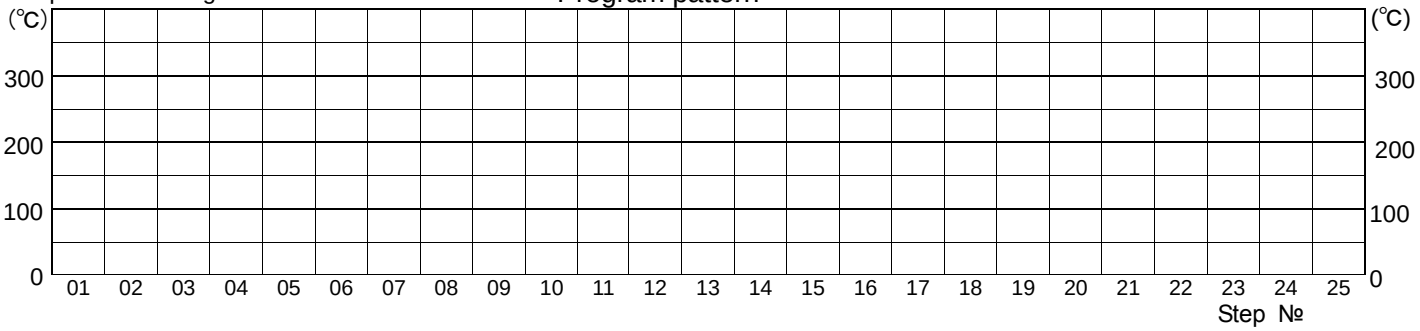
Program Planning Worksheet

Control No.

Model name		Preparation date	(Y) (M) (D)
Program number		Prepared by	

Temperature setting

Program pattern



Program No.	Step	Temperature Setting	Time	Repeat Dstn	Repetition Count	Wait	*Event			Fan Speed	*Damper Aperture	End
P : 00**	**P02 : ****	TEMP (°C)	TIME Hr : Min	REP **STEP**	REP **COUNT**	WAIT **ON/OFF**	EVENT 1	2	3	FAN 1~10	DAMP %	**END:ST**
	01		:									
	02		:									
	03		:									
	04		:									
	05		:									
	06		:									
	07		:									
	08		:									
	09		:									
	10		:									
	11		:									
	12		:									
	13		:									
	14		:									
	15		:									
	16		:									
	17		:									
	18		:									
	19		:									
	20		:									
	21		:									
	22		:									
	23		:									
	24		:									
	25		:									
Remarks												

*Optional items.

Feel free to duplicate and utilize this worksheet.

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 DF/DH 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.**

Instruction Manual
Precision Oven
DF412/612
DH412/612
First Edition April 9, 2015
Revised