Low Temperature Constant-Temperature Chamber

Model IL602

Instruction Manual

First edition

●**Thank you very much for purchasing this Yamato IL602 low temperature constant-temperature chamber.**

●**Please read the "Operating Instructions" and "Warranty" before operating this unit to assure proper operation. After reading these documents, be sure to store them securely together with the "Warranty" at a handy place for future reference.**

⚠**Warning**: **Before operating the unit, be sure to read carefully and fully understand important warnings in the operating instructions.**

Yamato Scientific Co., Ltd.

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1. Safety precautions

Explanation of pictograms

About pictograms

A variety of pictograms are indicated in this operating instruction and on products for safe operation. Possible results from improper operation ignoring them are as follows.
Be sure to fully understand the descriptions below before proceeding to the text.

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

Caution Indicates a situation which may result in minor injury (Note 2) and property damages (Note 3.)

（Note 1）Serious injury means a wound, an electrical shock, a bone fracture or intoxication that may leave after effects or require hospitalization or outpatient visits for a long time.

（Note 2）Minor injury means a wound or an electrical shock that does not require hospitalization or outpatient visits for a long time.

（Note 3）Property damage means damage to facilities, devices and buildings or other properties.

Meanings of pictograms

This pictogram indicates a matter that encourages the user to adhere to warning (“caution” included).
Specific description of warning is indicated near this pictogram.

This pictogram indicates prohibitions
Specific prohibition is indicated near this pictogram.

This pictogram indicates matters that the user must perform
Specific instruction is indicated near this pictogram.

1. Safety precautions

List of symbols

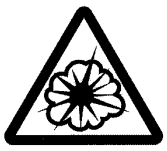
Warning

General warnings

Danger!: High voltage

Danger!: High temperature

Danger!: Moving part



Danger!: Hazard of explosion

Caution

General cautions

Electrical shock!

Burning!

Caution for no liquid heating!

Caution for water leak!

For water only

Poisonous material

Prohibitions

General bans

Fire ban

Do not disassemble

Do not touch

Compulsions

General compulsions

Connect ground wire

Install levelly

Pull out the power plug

Regular inspection

1. Safety precautions

Warning・Cautions

⚠ Warning

Never operate the unit in an atmosphere containing flammable or explosive gas

Never operate the unit in an atmosphere containing flammable or explosive gas.
Otherwise, an explosion or a fire may result since the unit is not explosion-proof.
See section “13. List of dangerous materials” on page 55.

Be sure to connect the ground wire.

Be sure to connect the ground wire correctly. Otherwise, electrical leak may result and cause an electrical shock or a fire.

Ban on operation when an abnormality occurs

When a smoke or an unusual odor is seen or sensed, immediately turn the ELB on the main unit off and pull out the power plug. A fire or an electrical shock may result.

Never use electrical power cords bundled.

When these are used bundled, they might overheat causing a fire.

Take care not to damage electrical power cords.

Avoid tightly bend, pull with a strong force or twist to prevent electrical power cords from damaging. A fire or an electrical shock may result.

Never use an explosive or a flammable material with this unit.

Never use an explosive material, a flammable material or a material containing them. An explosion or an electrical shock may result.
See section “13. List of dangerous materials” on page 55.

Never try to touch a hot part.

Some parts of the unit are hot during and immediately after operation. Take special care for possible burning.

Never try to disassemble or alter the unit.

Never try to disassemble or alter the unit. A malfunction, a fire or an electrical shock may result.

⚠ Caution

When a thunder is heard.

When a thunder is heard, turn the main power off immediately. A malfunction, fire or an electrical shock may result.

2. Before operating the unit

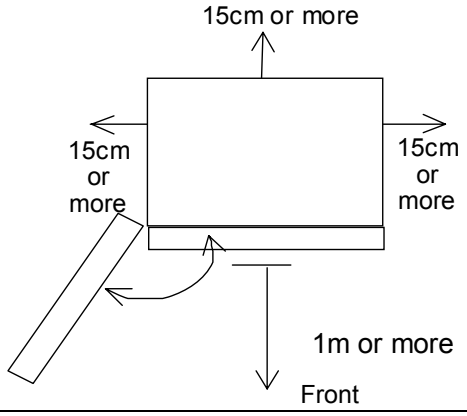
Precautions when installing the unit

1. Carefully select an installation site.

Take special care not to install the unit at a place described below:

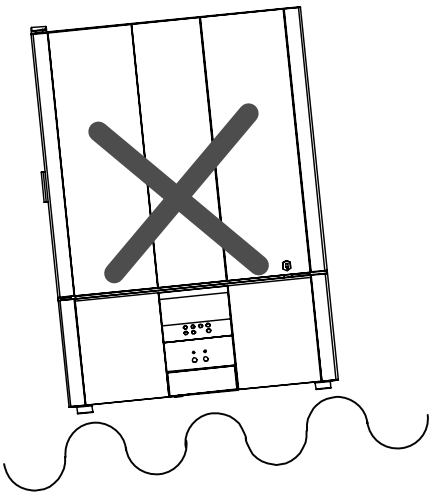
- Uneven surfaces or dirty surfaces
- Where flammable gas or corrosive gas exists
- Where the ambient temperature is 35℃ or more
- Where temperature changes severely
- Where humidity is high
- Where subject to direct sunlight
- Where vibration is severe

Install this unit at a place with spaces shown below.



2. Install the unit on a level surface.

Install the unit on a level surface. If the whole bottom surface of the unit does not contact the surface evenly, vibrations or noises may result. This might cause unexpected troubles or malfunctions.



The unit weight is approx. 90 kg.
When lifting the unit for transportation and installation, carefully handle it by at least two people.

3. Installation

The unit might fall down or move by an earthquake or an impact resulting a personal injury. We recommend making safety measures such as to avoid installing the unit at a place other than busy places.

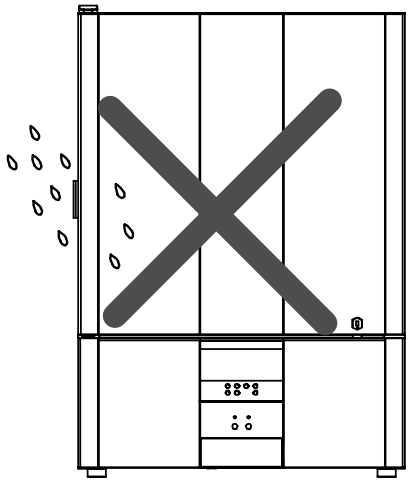
2. Before operating the unit

4. Secure sufficient ventilation for the unit.

Do not operate the unit when its side panels and vent holes are blocked.
Internal temperature of the unit will rise degrading the performance and an accident, a malfunction or a fire may result.

5. Do not operate the unit at such a place that may subject to splash.

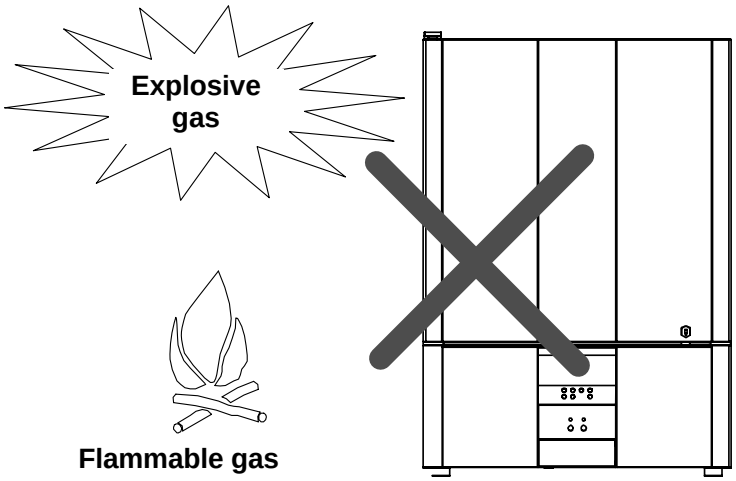
Do not operate the unit at such a place that may subject to splash. Liquid entering the inside may cause an accident, a malfunction, an electrical shock or a fire.



6. Never operate the unit in an atmosphere containing flammable or explosive gas.

Never operate the unit in an atmosphere containing flammable or explosive gas. Since the unit is not explosion-proof, an arc is discharged when switching the ELB “ON” and “OFF” and during operation and a fire or an explosion may result.

See the section “13. List of dangerous materials” on page 55 for flammable and explosive gases.



2. Before operating the unit

Precautions when installing the unit

7. Be sure to connect the power plug to the dedicated power distribution panel or a wall outlet.

Use a power distribution panel or a wall outlet that meets the electrical capacity of the unit.

Electrical capacity: IL602 AC100V 13A

* When the unit will not start even when you turn the Electric Leakage Breaker to “ON”, check for low main voltage or if the unit is connected to the same power supply line as other devices and connect it to another line if necessary.

Avoid connecting too many devices using a branching outlet or extending a wire with a cord reel or refrigerating function and temperature controlling function may degrade due to voltage drop.

Do not connect the unit to any parts or lines other than a correct power supply line such as a gas pipe, a water pipe or a telephone line.
Otherwise, an accident or a malfunction may result.

8. Handling of a power cord

Never use electrical power cords bundled. When these are used bundled, they might overheat causing a fire.

Do not convert, forcibly bend, twist or pull the power cord. Otherwise, a fire or an electrical shock may result.

Do not place the power cord under a desk or a chair, or sand between objects to avoid it from being damaged.
Otherwise, a fire or an electrical shock may result.
Do not place the power cord close to a stove or other heat generating device. Sheath of the cord may burn and result in a fire or an electrical shock.

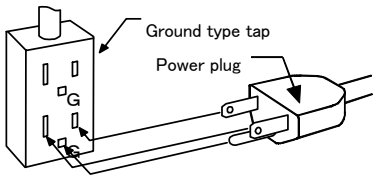
If the power cord should be damaged (exposure of core wire or disconnection), immediately turn the ELB off, turn the power supply off and ask your dealer to replace the cord. If the unit is operated with a damaged power cord, a fire or an electrical shock may result.

Connect the power cord to an appropriate wall outlet.

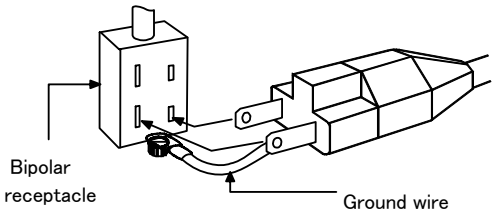
9. Be sure to connect the ground wire.

- When the unit has no ground terminal, class D grounding work is necessary and please consult your dealer or our customer service center.
- Securely connect to an outlet.

We recommend use of a ground type outlet tap.



When a bipolar type outlet tap is used



When there is no ground terminal.
In this case, class D grounding work is necessary and please consult your dealer or our customer service center.

Insert the ground adaptor included as an option, into a power plug confirming the polarity of the outlet. Connect the grounding wire (green) of the ground adaptor to the ground terminal on the power supply equipment.

Do not connect the grounding wire to any parts or lines other than a correct grounding terminal such as a gas pipe, a water pipe or a telephone line.
Otherwise, an accident or a malfunction may result.

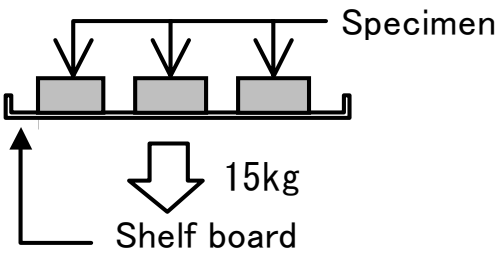
2. Before operating the unit

Installation procedures/precautions

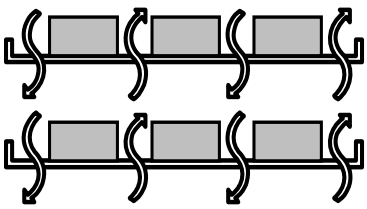
(1) Select an installation site.
Make sure that the four feet completely sit on a flat surface.

(2) ・Install a drain pan.
During defrosting, water will come out of the drain hose. Make sure that a drain pan is put inside the punch panel on the left side.
Be sure to stop the unit before attaching or removing the drain pan.
Be sure to empty the drain pan before moving the unit.

(3) Install shelf boards.
- Install shelf pegs at heights you want on the right and left shelf posts in the internal bath of the main body.
- Completely push shelf boards by sliding to the end.
  *Take care to put each shelf board on correct pairs of right and left shelf pegs.
- Make sure that shelf boards will not fall nor rattle.
- Withstand load of each shelf board is 15 kg in even loading. When putting specimens, arrange them as dispersed as possible.



- Put specimens with appropriate spaces between them. Too many specimens may prevent proper temperature control. To assure proper temperature control, put specimens with a space at least 30% of the shelf board area.



Assure at least 30% of space

(4) Do not put an specimen on the bottom of the internal bath.

・Operating the unit with a specimen directly put on the bottom of the internal bath might degrade its temperature characteristics. This also may cause corrosion, damage or rust of the internal bath. Never put any specimen on the bottom surface.

・When putting specimens, take care not to allow them touching the wall on which the heater, the sensor or other devices are installed. Put specimens on the shelf board included with the unit.

(5) Take special care for specimens including:

①Specimen that contains a flammable or explosive component.

・This unit is not explosion-proof. Never attempt to dry or process a specimen that contains a flammable or explosive component.

②Corrosive specimen

・Take care for handling a corrosive specimen. Although SUS304 stainless steel is used for major components of this unit, they might corrode if they are subject to strong acid. Also note that packing may corrode with acid, alkaline substances, oil, or organic solvent.

③Specimen that contains much moisture

・While operating the unit at a lower temperature, cooling capacity of the evaporator may be degraded and the set temperature may not be maintained due to too much frost on the evaporator. When frost is confirmed through the frost observation window at the bottom of the bath in the unit, perform defrosting.

④Operation with devices of higher heat load introduced

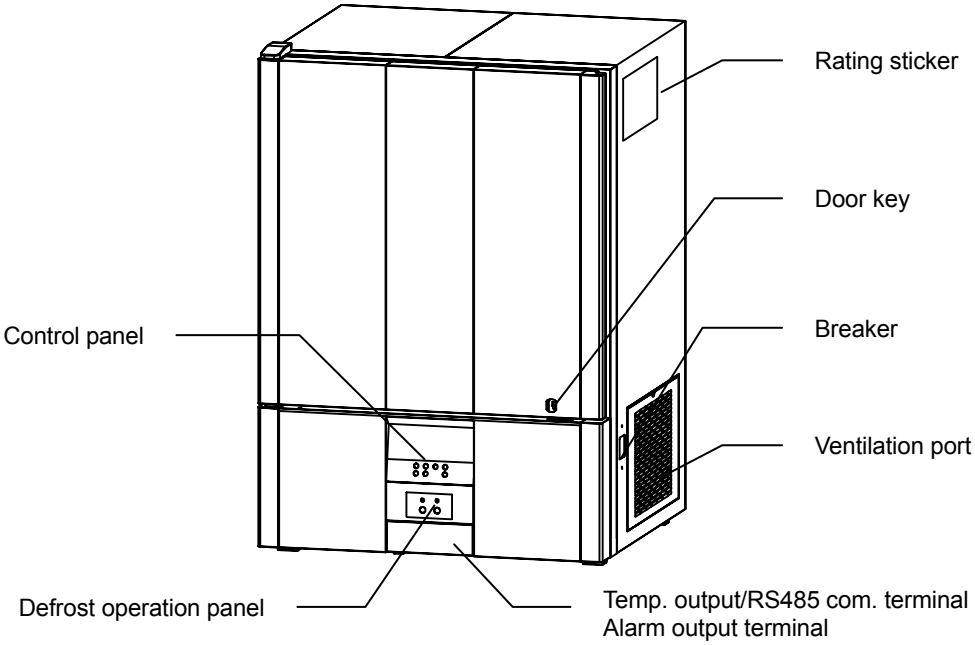
・By leading a power cable from the cable port, you can operated devices in the unit. Note, however, that you cannot use devices with higher heat load because they will raise temperature in the unit.

※Refer to the cooling capacity graph.

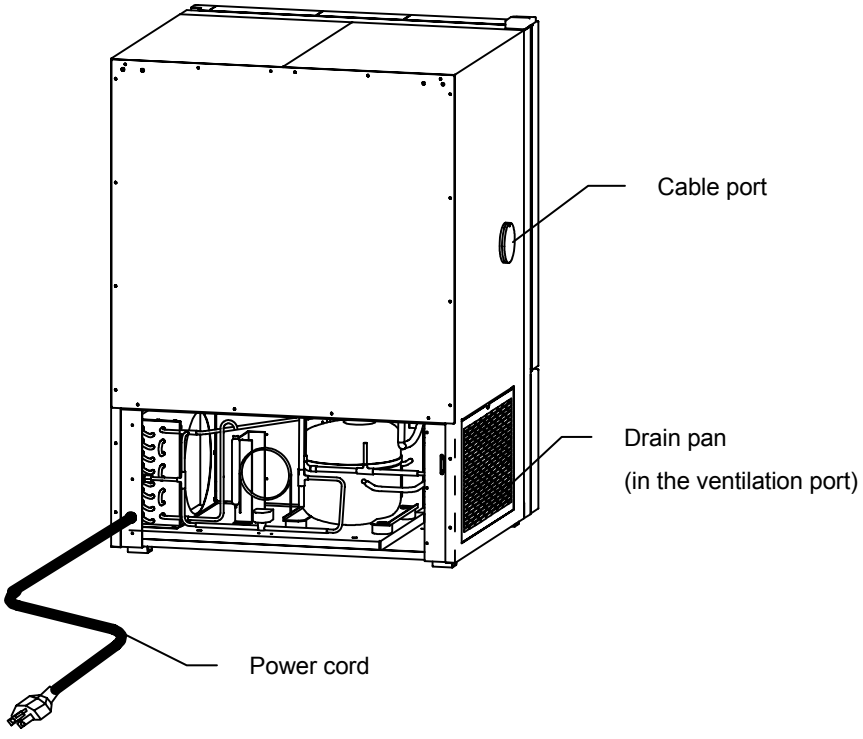
3. Names and functions of parts

Main unit

Front view

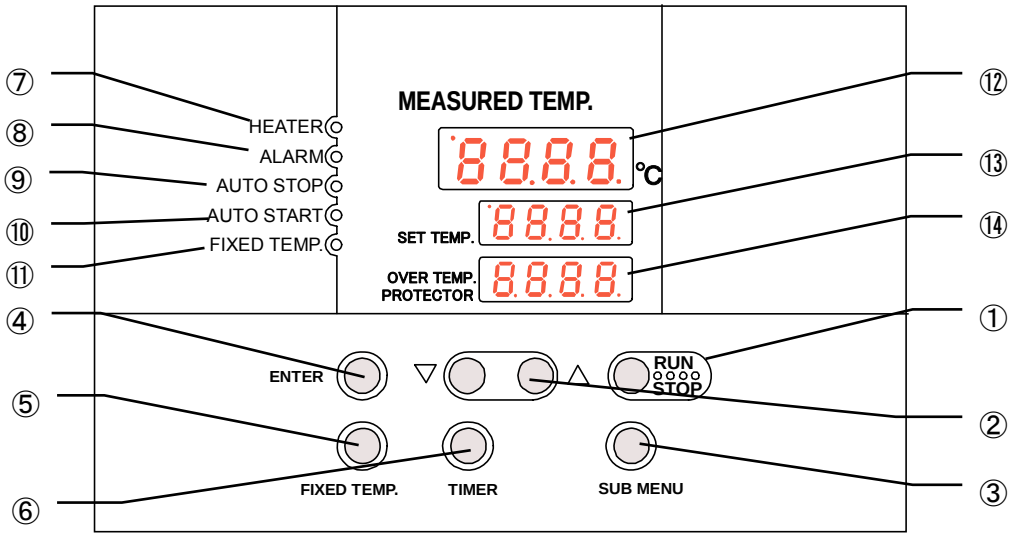


Rear view



3. Names and functions of parts

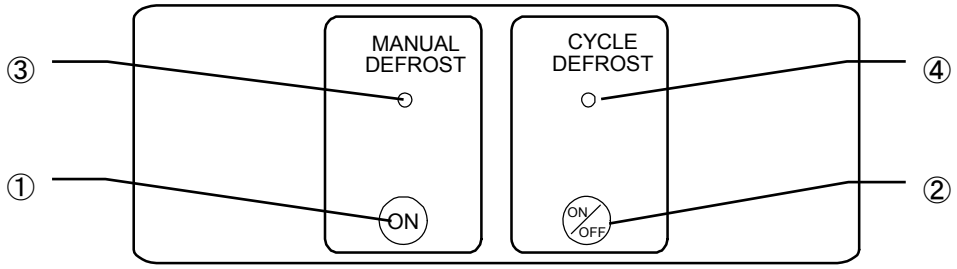
Operation panel



No.	Name	Function
①	RUN/STOP Key :	Starts/stops the operation.
②	▲▼ Key :	Uses for rising UP/lowering DOWN the setting value.
③	SUB MENU Key :	Uses for setting the overheating prevention temperature, calibration offset temperature, or key lock function.
④	ENTER Key :	Settles the inputted value.
⑤	FIXED TEMP Key :	Chooses the fixed temperature operation.
⑥	TIMER Key :	Chooses the timer operation (Quick Auto Stop/Auto Stop/Auto Start).
⑦	HEATER Lamp :	Lights while the heater works.
⑧	ALARM Lamp :	Lights up when an error occurs. (Buzzer sounds simultaneously.)
⑨	AUTO STOP Lamp :	Blinks while setting quick auto stop timer or auto stop timer. Lights while quick auto stop timer or auto stop timer is running.
⑩	AUTO START Lamp :	Blinks while setting auto start timer. Lights while auto start timer is running.
⑪	FIXED TEMP Lamp :	Blinks while setting fixed temperature operation. Lights while fixed temperature operation is running.
⑫	Measurement Temperature Display :	Displays the measured temperature, setting character, alarm information.
⑬	Setting Temperature Display :	Displays the setting temperature, setting value for timer mode, remaining time.
⑭	Overheating Prevention Temperature Display :	Displays the setting temperature for overheating prevention device.

3. Names and functions of parts

Control panel



No.	Name	Operation／Function
①	MANUAL DEFROST key	Used to activate the manual defrost function.
②	CYCLE DEFROST key	Used to activate the cycle defrost function.
③	Manual defrost lamp	Lights while the manual defrost function is active.
④	Cycle defrost lamp	Ligts while the cycle defrost function is active AND defrosting is active and flashes while the cycle defrost function is active AND defrosting is stopped.

3. Names and functions of parts

Characters of the Controller

The characters controller shows are as follows:

Character	Identifier	Name	Purpose
	**FiX**	Fixed Temperature Setting Mode	Used for setting the fixed temperature operation.
	**Sv**	Temperature Setting	Used for setting the temperature.
	**AStP**	Auto Stop Setting	Used for setting the auto stop operation.
	**AStr**	Auto Start Setting	Used for setting the auto start operation.
	**tim**	Time Setting	Used for setting the time.
	**End**	Time-up	Displayed when timer operation is ended. Refer to Pages 21 and 23
	**cAL**	Calibration Offset Setting	Used for inputting the calibration offset temperature. (Refer to Page 27 "Calibration Offset Function".)
	**oH**	Overheating Prevention Setting	Used for setting temperature for overheating prevention device. (Refer to Page 18 "Setting of Overheating Prevention Device ".)
	**LocK**	Key Lock	Locks the keys on control panel to protect from unnecessary operation. (Refer to Page 28 "Lock Function".)
 	**rEFr** **Fcnt**	Freezer Operation Mode Function Setting	Used when you prefer more effective prevention of frosting on the evaporator. See “Using the freezer operation mode function” on P.29

* Also refer to Page 17 "Operation Mode, Function Setting Key, and Characters".

4. Operation Method

Operation Mode and Function List

The operation modes of this unit are as follows;

No.	Name	Description	Page
1	Fixed Temperature Operation	Pressing the FIXED TEMP key enters into the fixed temperature operation setting mode. Pressing it again enters into the temperature setting mode. The "▲▼" are used to set temperature. Pressing the RUN/STOP key starts or stops operation.	19
2	Quick Auto Stop Operation	This operation is used to specify the period up to automatic stop during operation. The period up to operation stop can be set by pressing the TIMER key during fixed temperature operation. The "▲▼" are used to set the time. Pressing the RUN/STOP key starts the quick auto stop operation, activates the timer function and stops the operation automatically after specified period.	21
3	Auto Stop Operation	This operation is used to specify the automatic stop time in the fixed temperature operation. Pressing the TIMER key displays "AStP". The setting temperature "Sv" can be set by pressing the ENTER key. The operation time "tim" can be set by pressing it again. Pressing the RUN/STOP key starts the auto stop operation.	23
4	Auto Start Operation	This operation is used to specify the period up to automatic start after power on. Pressing the TIMER key displays "AS t r". The setting temperature "Sv" can be set by pressing the ENTER key. The operation time "tim" can be set by pressing it again. Pressing the RUN/STOP key starts the auto start operation.	25

NOTE) This unit is impossible to be changed the mode during the operation. If the mode requires to be changed, stop the operation.

4. Operation Method

Operation Mode and Function List

The operation functions of this unit are as follows;

No.	Name		Description	Page
1	Overheating prevention function	Auto overheating prevention function	This function is set to be automatically activated (auto reset) when the temperature exceeds the setting temperature by 6℃.	18
		Independent overheating prevention device	Though the device shares power source, display, and key input with the controller, it has independent temperature measurement circuit, CPU, sensor and output circuit. Overheating prevention temperature can be set using the operation panel. The unit stops operation when the device is activated. The unit starts operation again when the SUB MENU key is pressed again (manual reset).	
2	Calibration offset function		This calibration offset function is for calibrating the difference occurred between the required in- bath temperature and control temperature (sensor temperature) of the controller. This unit can be calibrated toward either plus side or minus side of the whole temperature range. Press SUB MENU kes to set this function.	27
3	Setting value locking		This function locks the established operation status. It can be set and cancelled with the SUB MENU key. Press SUB MENU kes to set this function.	28
4	Temperature Output Terminal		Transmits and outputs the measured temperature of the controller at 4 to 20 mA.	30
5	RS485 Communication Function		The function to allow communication between the VS3 controller and a personal computer or another unit. An optional RS485-RS232C conversion adapter is required for external communication. A sample program is uploaded on our website. http://www.yamato-net.co.jp/support/program/index.htm	32

Operation Mode and Function List

No.	Name	Description
6	Defrost function	When a lot of frost sticks to the evaporator during operation at a lower temperature, its cooling capacity may be compromised and cannot keep the set temperature. The model IL602 has an observation window inside the bath to allow the operator to check how much the evaporator is frosted. The frosting speed will differ depending on the actual conditions. (1) Operating temperature : Operation at a lower temperature will tend to cause more frost. (2) External temperature/ humidity : Operation at a higher temperature and a humidity will tend to cause more frost. (3) Inside the bath : Higher in-bath temperature will tend to cause more frost. （For example, when the water content of the specimen is high.） The model IL602 supports operation modes below to prevent frosting and select an operation mode suited to the operating conditions. You can enable these operation modes by pressing the DEFROST key at the defrost control assembly below the unit controller independently from the fixed-temperature operation settings. 1. Manual defrost operation（Operation is started manually and stopped automatically.） Perform defrost operation when you have found that a lot of frost on the evaporator through the frost observation window. Note that temperature control will be paused during defrost operation. Although you need to start defrost operation manually, it will automatically stop after about five minutes with the internal timer. 2. Cycle defrost operation （Both starting and stopping operation are automatic.） It is effective to set the cycle defrost operation when you are going to start a long time operation. Cycle repeats cycle defrost operation → noromal operation → cycle defrost operation→normal operation→ and 24 hours comprises of five minutes for cycle defrost operation and 23 hours 55 minutes for normal operation. ⚠ **Although it depends on the specific operating conditions, the in-bath temperature will rise beyond the set temperature during defrost operation and take care for possible adverse effects on the specimen. At this time, the temperature on the gauge may rise by 10℃ or more.** **（The increase margin will differ depending on the set temperature, the specimen, or the external temperature.）** **※Reference data：Temperature increase is withing about 4℃ when set temperature is at 37℃ and the external temperature is 20℃.）**

4. Operation Method

Operation Mode and Function List

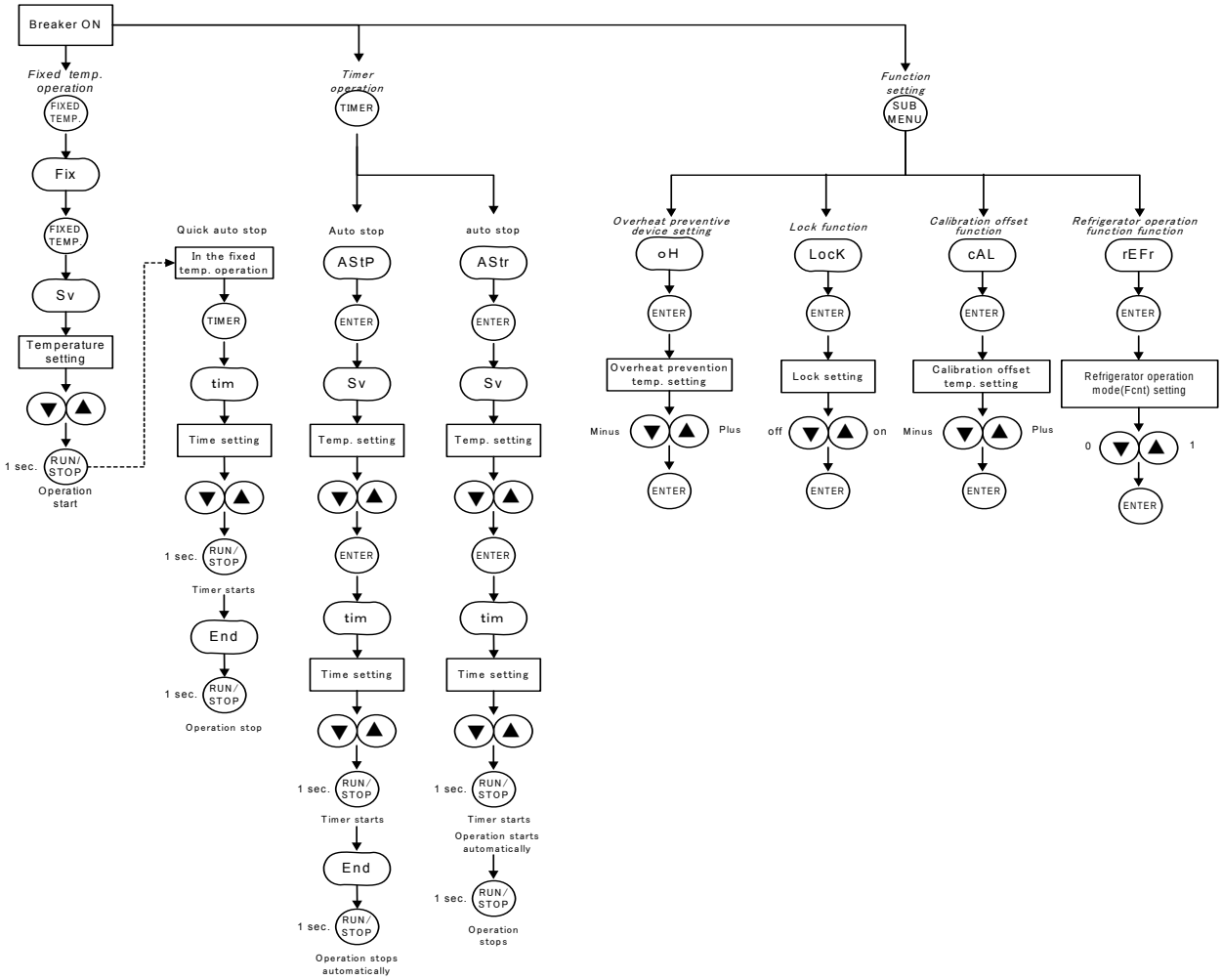
<table>
<tr><th>No.</th><th>Name</th><th>Description</th></tr>
<tr><td>7</td><td>Freezer operation mode</td><td>
There are two freezer operation modes: continuous operation and cycle operation and you can select an operation mode you want by setting the freezer operation mode function.
See “Using the freezer operation mode function” on P.29.
・ When the set temperature is 10℃ or lower, the operation mode will be the continuous operation automatically even if you set to the cycle operation.
・ When the set temperature is 44.1℃ or higher, the freezer will stop automatically irrespective of the current operation mode setting.
・ When the stop is set, the freezer will not operate irrespective of the set temperature. Thus when the set temperature is low, that temperature may not be attained.

Continuous operation : The freezer will operate continuously. Select this when you think temperature control precision is important. Note, however, that frosting will likely to occur on the evaporator and more frequent defrosting will be needed.
Cycle operation : The freezer repeats operation（about 12 minutes）→stop（about 8 minutes）→operation→stop. This can minimize frosting onto the evaporator. Select this operation mode when you think suppressing frost is important. Note that the temperature control precision will be slightly compromised.
</td></tr>
</table>

4. Operation Method

Operation Mode, Function Setting Key, and Characters

The operation mode setting and function setting use the key operation and characters show in the following figure.



4. Operation Method

Setting of Overheating Prevention Device

The unit has the overheating prevention device (manual reset) that consists of independent temperature measurement circuit, CPU, sensor and output circuit (it shares power source, display, and key input with the controller) in addition to the automatic overheating prevention function (auto reset) in the controller.

Setting range/function

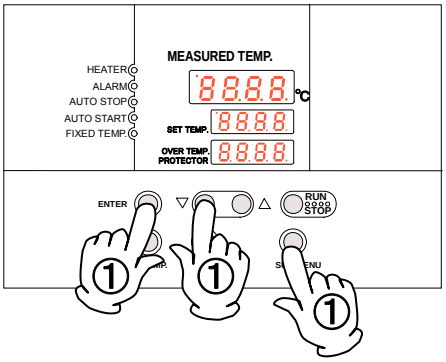
The unit has failsafe functions against overheating. One of them is built in the controller and previously set at factory shipment so to be automatically activated when the temperature exceeds the setting temperature of temperature controller by 4℃, where the heater turns off.
The other is united with the controller, which can be set by operating the keys on the controller.

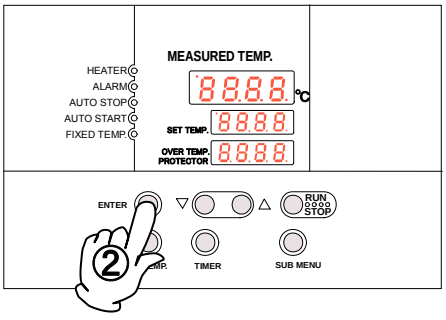
The setting range of latter is from 0℃ to 50℃.

In case the temperature in bath exceeds the setting temperature of controller to reach to that of overheating prevention device, the circuit is shut off and "Er19" is displayed with blinking on the screen of controller with buzzer sound.

If the device is once activated,"Er19"continues to be displayed until the power is newly turned on.

Temperature setting procedure





1. Turn on the power (turn on the breaker in front)

The default value is displayed for about four seconds after turning on the power. The screen then displays the initial setting. The current temperature in bath, operation mode character and setting temperature of overheating prevention device are displayed on respective screens.

2. Set the temperature for overheating prevention

①Press the SUB MENU key. Press the "▼▲" several times to select the setting character of overheating prevention temperature 

. Press the ENTER key. The current setting temperature is displayed with blinking on the setting temperature screen.

Note: To prevent improper operation, set the value 10℃ or more over the setting temperature of controller.

②Select the value using the "▼▲"and then press the ENTER key. This completes the setting.

⚠ Caution

① The standard setting temperature of device is "the maximum setting temperature of unit plus 5℃" or "setting temperature plus 5℃". If the unit performs improper operation, increase it 5℃ more.

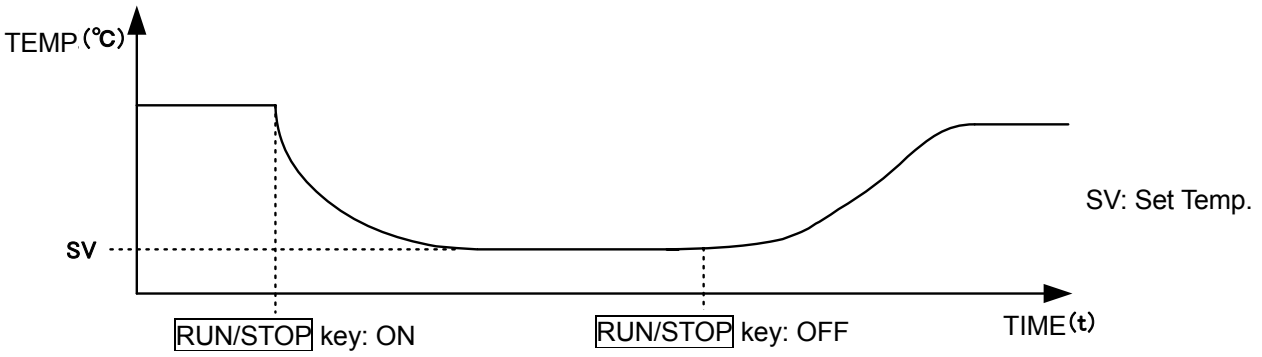
② The setting range of overheating prevention device is from 0℃ to 50℃. Improper setting of temperature may cause inoperative of unit, malfunction of device, e.g. it is activated during increasing in temperature in bath, or unexpected accidents such as fire disaster. To prevent such matters, set a proper value.
The temperature is set to 60℃ at factory shipment.

③ The purpose of overheating prevention device is to protect the unit from overheating. It does not intend to protect the samples, or to protect them from the accident caused by the use of explosive or inflammability.

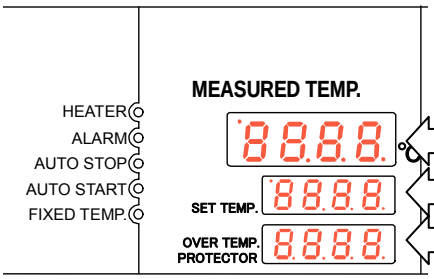
4. Operation Method

Fixed Temperature Operation

In this mode, the unit starts to operate by pressing RUN/STOP key and continues operating at the set temperature until RUN/STOP key is re-pressed, as shown in the figure below.



Fixed temperature operation procedure



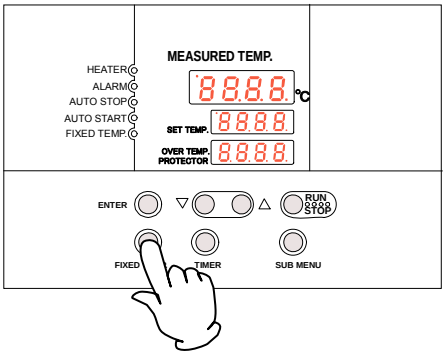
1. Turn on the power (turn on the breaker in front)

Current version of the software is displayed for about four seconds after turning on the power. The screen then displays the initial setting. The current temperature in bath, operation mode character and setting temperature of overheating prevention device are displayed on respective screens.。

Measurement temperature screen:
Displays the current temperature in bath.

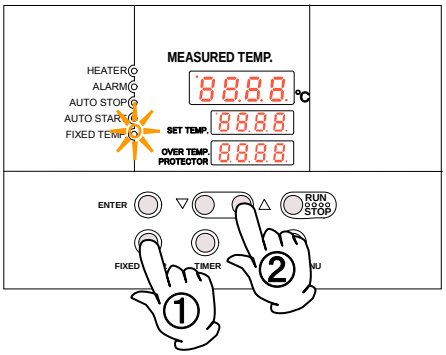
Setting temperature screen:
Displays the operation mode character.

Overheating prevention screen:
Displays the setting temperature of overheating prevention device



2. Select the operation mode

Press the FIXED TEMP key to display "FIX"  , which indicates the fixed temperature operation, on the center display screen.



3. Set the temperature

①Press the FIXED TEMP key again.

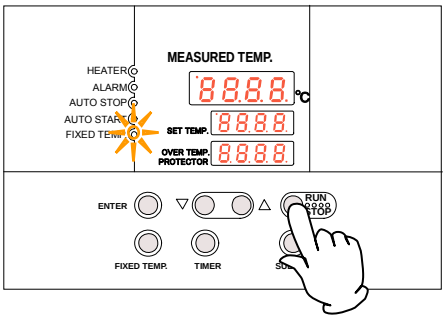
The setting temperature screen displays the character "Sv"  which indicates the temperature setting. Also it displays the current setting temperature with blinking. The FIXED TEMP lamp blinks, too.

②Set the temperature by pressing the "▼▲".

The temperature can be set to the first decimal place.

4. Operation Method

Fixed Temperature Operation



4. Start operation

Press the orange RUN/STOP key for about one second. The unit starts operation and the blinking FIXED TEMP lamp lights on

5. Stop operation

Press the orange RUN/STOP key for about one second. The unit stops operation and the FIXED TEMP lamp lights off. The screen returns to the initial setting screen.

To correct or check setting…

Press the FIXED TEMP key again to correct or check the setting.

Changing the setting temperature during operation is also possible by pressing the FIXED TEMP key.

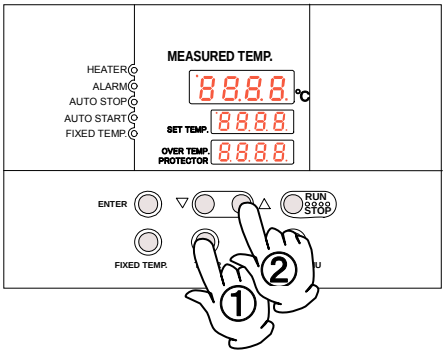
Press the ENTER key after changing the setting.

4. Operation Method

Quick Auto Stop Operation

This operation is used to specify the period up to automatic stop, i.e., sets the auto stop timer during operation.

Quick auto stop operation procedure



1. Set the time up to stop during fixed temperature operation

①Check that the FIXED TEMP lamp lights on and that the unit is under operation. Press the TIMER key.

The measurement temperature display screen displays the character "tim"  , which indicates the timer setting.

The setting temperature display screen displays the current setting time with blinking.

②Select the time by pressing the "▼▲".

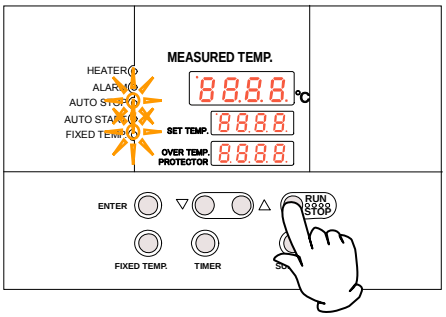
Timer function:

The maximum setting time is "999 hours and 50 minutes".

The time can be set in increments of a minute under 99 hours and 59 minutes.

It can be set in increment of ten minutes over 100 hours.

The "▼▲"can change the setting time quickly when it is pressed continuously. Press them discontinuously when fine adjustment is needed.

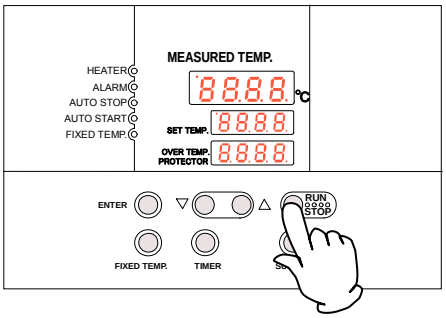


2. Start timer operation

Press the RUN/STOP key for one second after deciding the time.

Timer operation starts with the FIXED TEMP and AUTO STOP lamps lighting on.

The timer is activated at the point when the RUN/STOP key is pressed.



3. Stop/terminate timer operation

The operation stops automatically at setting time.

Buzzer continues to sound for about five minutes at operation stop.

The setting temperature screen displays the character "End"  , which indicates termination of operation, with the FIXED TEMP and AUTO STOP lamps lighting on. Press the RUN/STOP key to terminate the timer operation mode. The screen returns to the initial setting screen.

To correct or check setting…

Changing the setting temperature during operation is possible by pressing the FIXED TEMP key. Press the ENTER key after changing the setting.

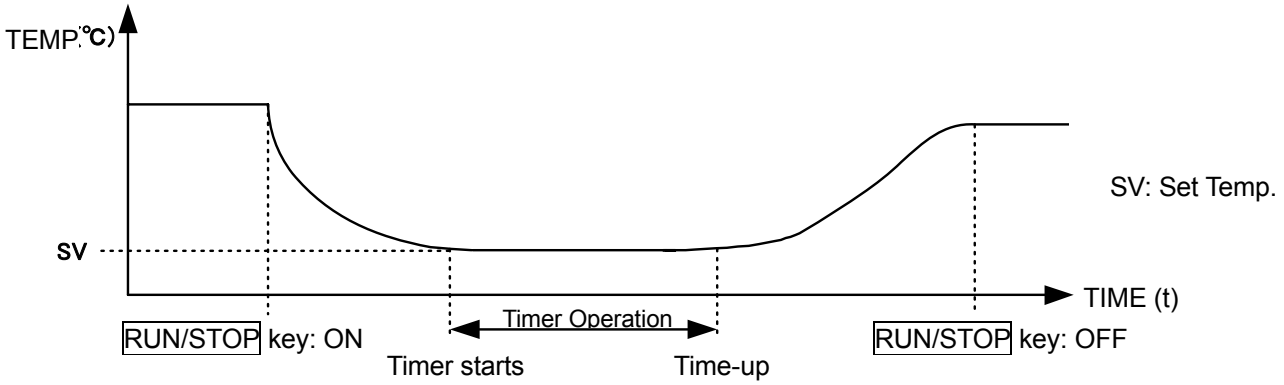
Changing the setting time during operation is possible by pressing the TIMER key. Note that the time setting is required using the value calculated by adding a new additional time to the already passed time in this case. Press the RUN/STOP key after changing the setting.

Press the ▼ key to display the setting temperature, operation mode and residual time on the setting temperature screen.

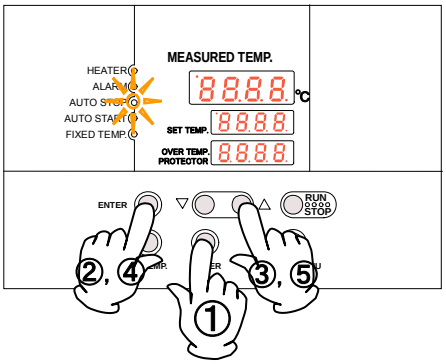
4. Operation Method

Auto Stop Operation

In this mode, the unit automatically comes to a stop after the set period passes away from the start of fixed-value operation according to timer setting, as shown in the figure below.



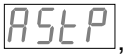
Auto stop operation procedure



This operation is used to specify the automatic stop time in the fixed temperature operation.

1. Set stop time

①Press the TIMER key on the initial screen.

The setting temperature display screen displays the character "AstP"  , which indicates the auto stop operation, with blinking.

②Press the ENTER key.

The measurement temperature screen displays the character "SV"  , which indicates the temperature setting. The setting temperature screen displays the current setting temperature with blinking. The AUTO STOP lamp blinks, too.

③Set the temperature using the "▼▲".

The temperature can be set to the first decimal place.

④Press the ENTER key again.

The measurement temperature display screen displays the character "tim"  , which indicates the timer setting. The setting temperature display screen displays the current setting time with blinking.

⑤Set the time using the "▼▲".

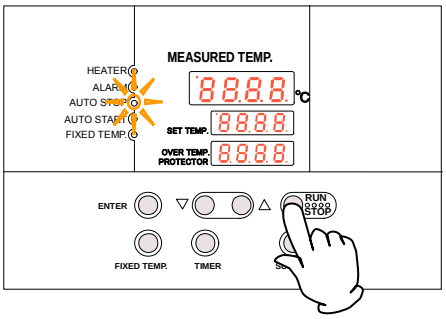
Timer function:

The maximum setting time is "999 hours and 50 minutes".

The time can be set in increments of a minute under 99 hours and 59 minutes.

It can be set in increment of ten minutes over 100 hours.

The "▼▲"can change the setting time quickly when it is pressed continuously. Press them discontinuously when fine adjustment is needed.

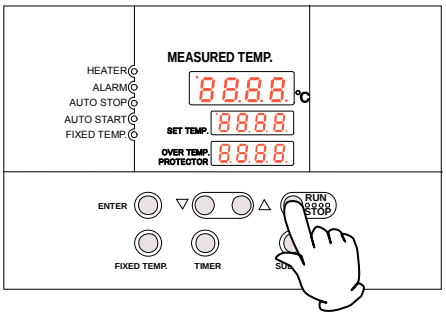


2. Start timer operation

Press the RUN/STOP for one second after deciding the time.

Timer operation starts with the AUTO STOP lamp lighting on.

The timer is activated at the point when the temperature in bath (measurement temperature) reaches to the setting temperature.



3. Stop/terminate timer operation

The operation stops automatically at setting time.

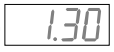
Buzzer continues to sound for about five minutes at operation stop.

The setting temperature screen displays the character "End"  , which indicates termination of operation, with the FIXED TEMP and AUTO STOP lamps lighting on. Press the RUN/STOP to terminate the timer operation mode. The screen returns to the initial setting screen.

To correct or check setting…

Changing the setting temperature or time during operation is possible by pressing the TIMER key. Use the "▼▲" to change the setting value. Press the ENTER key respectively after changing the setting. Note that the time setting is required using the value calculated by adding a new additional time to the already passed time in this case.

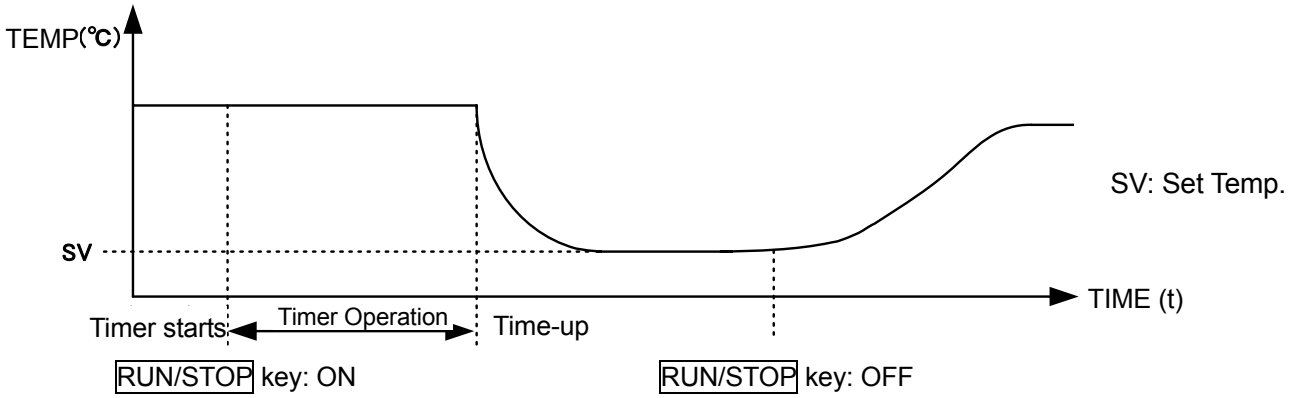
Press the "▼" to display the setting temperature, operation mode and residual time on the setting temperature screen.

When the dot is blinked, the indicator of the remaining time e.g."1.30"  indicates the countdown. When the dot is lit, the unit is under waiting (that is, the unit is under increasing or decreasing toward setting temperature), and the timer stop s counting.

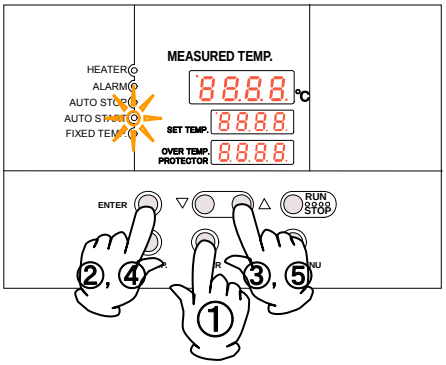
4. Operation Method

Auto Start Operation

In this mode, the unit automatically starts to operate after the set period passes away from the start of fixed-value operation according to timer setting, as shown in the figure below. However, it does not automatically come to a stop and must be manually deactivated.

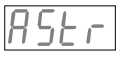


Auto start operation procedure

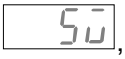


1. Set start time

①Press the TIMER key on the initial screen.

The setting temperature display screen displays the character "Astr"  , which indicates the auto start operation, with blinking.

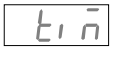
②Press the ENTER key.

The measurement temperature screen displays the character "SV"  , which indicates the temperature setting. The setting temperature screen displays the current setting temperature with blinking. The AUTO START lamp blinks, too.

③Set the temperature using the "▼▲".

The temperature can be set to the first decimal place.

④Press the ENTER key again.

The measurement temperature display screen displays the character "tim"  , which indicates the timer setting. The setting temperature display screen displays the current setting time with blinking.

⑤Set the time using the "▼▲".

Timer function:

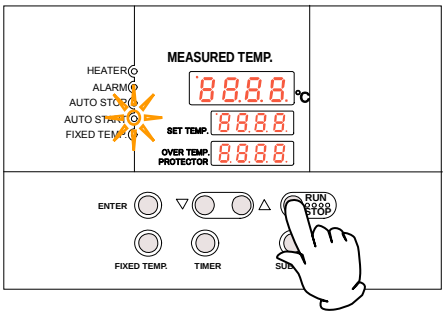
The maximum setting time is "999 hours and 50 minutes".

The time can be set in increments of a minute under 99 hours and 59 minutes.

It can be set in increment of ten minutes over 100 hours.

The "▼▲"can change the setting time quickly when it is pressed continuously. Press them discontinuously when fine adjustment is needed.

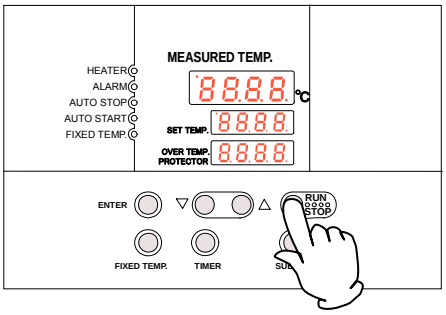
Auto Start Operation



2. Start timer operation

Press the RUN/STOP for one second after deciding the time.

Timer operation starts with the AUTO START lamp lighting on.



3. Stop/terminate timer operation

The operation starts automatically at setting time.

Press the RUN/STOP for one second to stop or terminate operation. The screen returns to the timer setting screen.

To correct or check setting…

Changing the setting temperature or time during operation is possible by pressing the TIMER key. Use the "▼▲" to change the setting value. Press the ENTER key respectively after changing the setting. (Note that the time setting is required using the value calculated by adding a new additional time to the already passed time in this case.)

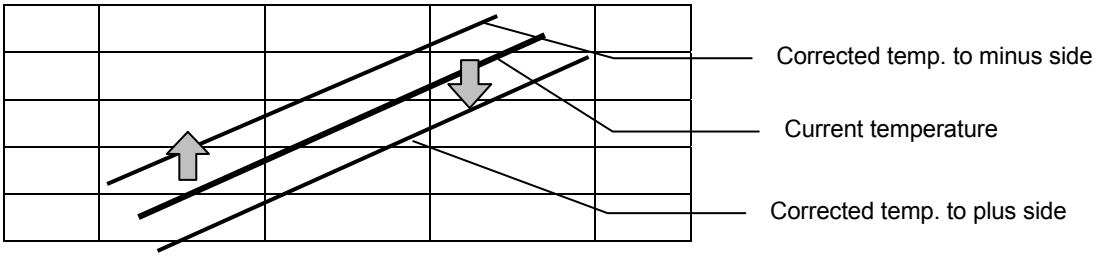
Press the "▼" to display the setting temperature, operation mode and residual time on the setting temperature screen.

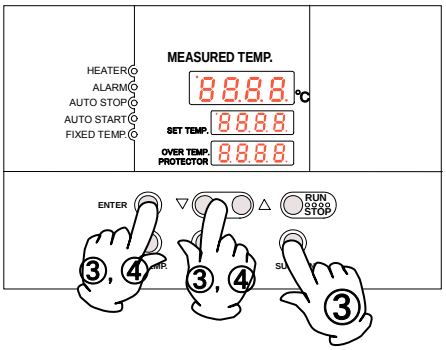
Note that the setting condition is impossible to change once starting the operation after passing the auto start operation time. In this case, stop the operation by pressing RUN/STOP, and reset to initial status.

To use Calibration Offset Function

Calibration offset is a function which corrects the difference between the temperature in bath and that of controller (sensor temperature) if arises. The function parallel corrects the difference either to the plus or minus side within the whole temperature range of unit. The function can be set or cancelled by the SUB MENU key.

The offset value is set to 0 before shipment.





①Start operation with the target setting temperature. Check the temperature in bath with a thermograph after it is stabilized.

②Check the difference between the setting temperature and that in bath.

③Press the SUB MENU key. Select the character "cAL"  , which indicates the calibration offset, using the "▲▼", and then press the ENTER key.

④Input the difference using the "▲▼" and then press the ENTER key. This completes the setting.

* You can set an offset compensation temperature to either + or – side.
When it is set to the minus side, the temperature on the measurement temperature display screen falls by the setting temperature, while the temperature on bath rises.
When it is set to the minus side, the temperature on the measurement temperature display screen rises by the setting temperature, while the temperature on bath falls.

* When you want to enter a correction value that might be too large, consult a nearest sales office first. Enter too large a correct value may cause difference between the actual and indicated temperatures and cause a danger.

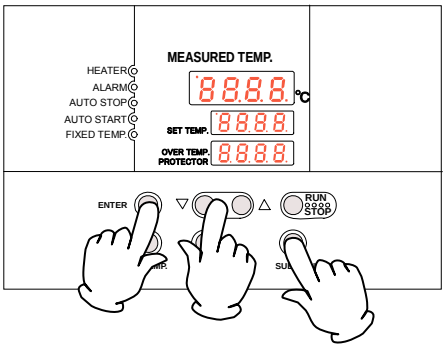
* The unit has two-point correction function, which performs offset between low-temperature zone and high-temperature zone.

* Please consult our local branch office when carrying out validation of temperature controller.

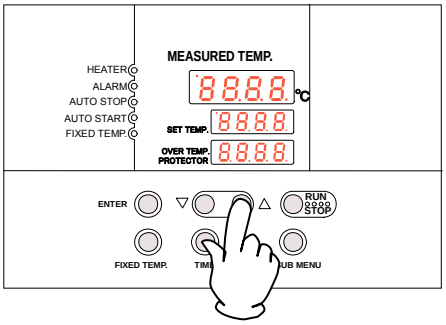
To use lock function

This function locks the operation status previously set.

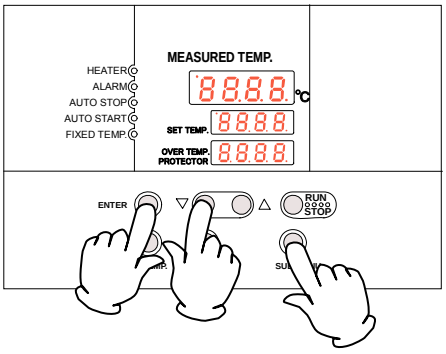
This function is set to OFF before shipment.



①Press the SUB MENU key. Select the character" "Lock" LocH, which indicates the lock of setting value, using the "▲▼", and then press the ENTER key.



②The setting temperature screen displays "oFF". The setting value is locked when it is turned to "on" using the "▲".



③Press the SUB MENU key again to cancel the lock. Select the character" "Lock" LocH, which indicates the lock of setting value, using the "▲▼", and then press the ENTER key. Select "oFF" with the "▼" and then press the ENTER key to cancel the function.

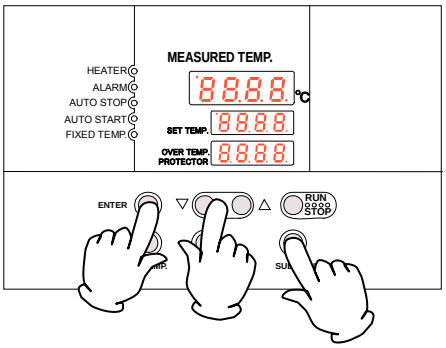
∗ All keys other than the RUN/STOP and SUB MENU keys are lock when the lock function is on.

4. Operation Method

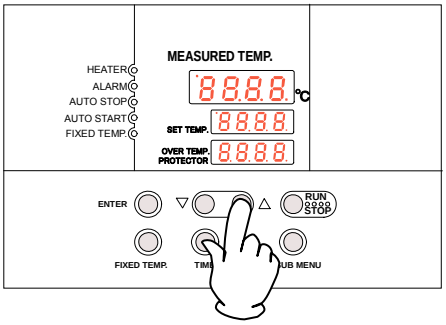
Freezer operation mode function

Using the freezer operation mode function

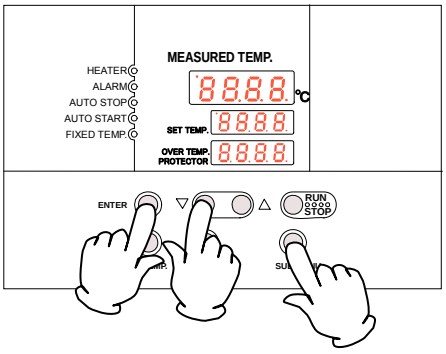
This function enables you to set the freezer to continuous operation or to cycle operation.



① Press the SUB MENU key and select the character rEFr  which indicates the freezer operation mode using the "▼▲" keys and then press the ENTER key.



②The setting temperature screen displays "0". You can switch to the freezer cycle operation by changing the value to "1" with the "▲" key.



③When you want to set the freezer to continous operation, press the SUB MENU key again to select the character Fcnt  which indicates the freezer operation mode using the "▼▲" keys and then press the ENTER key.
Select "0" with the "▼" key and press the ENTER key.

4. Operation Method

Precautions

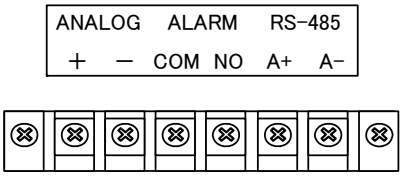
❗	Operate this product according to the procedure described in this Operation Manual. Failure to follow the operation procedure described herein may result in a problem. The guarantee will not apply if you operate the product in the wrong manner.

⚠CAUTION!

❗	1 Turn off the breaker before connecting the cables.
	2 Connect a recorder or another appliance of 600 Ω or less in input impedance to the temperature output terminal.
	3 Securely fasten all connections with the screws attached to the terminal block.

Connection procedure

❗	Connect the cables to the appropriate terminals.
	When using temperature output, use a shielded wire for the cable to be connected to prevent noise.



Connection terminal

Specification

Temperature Output (ANALOG)	• The curent (mA) corresponding to the measured temperature is output. • Output temperature range: -5～55℃ • Output voltage: 4～20mA • Load impedance: 600Ω or less • Resolution:±1℃ • Connection: M4 screw terminal block
Alarm Output （ALARM）	• Output when an abnormality is detected （See “Safety device and error codes “ on P.48 for description of a specific error.） • a contact（Relay contact） • Contact capacity：AC250V 3A ：DC30V 3A • Connect to ：M4 screw terminal block （common）

Temperature（℃）	Output current（mA）
-5	4.00
5	6.67
15	9.33
25	12.00
35	14.67
45	17.33
55	20.00

1. Settings Relating to Communication

1.1 Communication Settings

Before starting communication with the VS3 controller (hereinafter called the "unit"), set communication parameters on the personal computer.

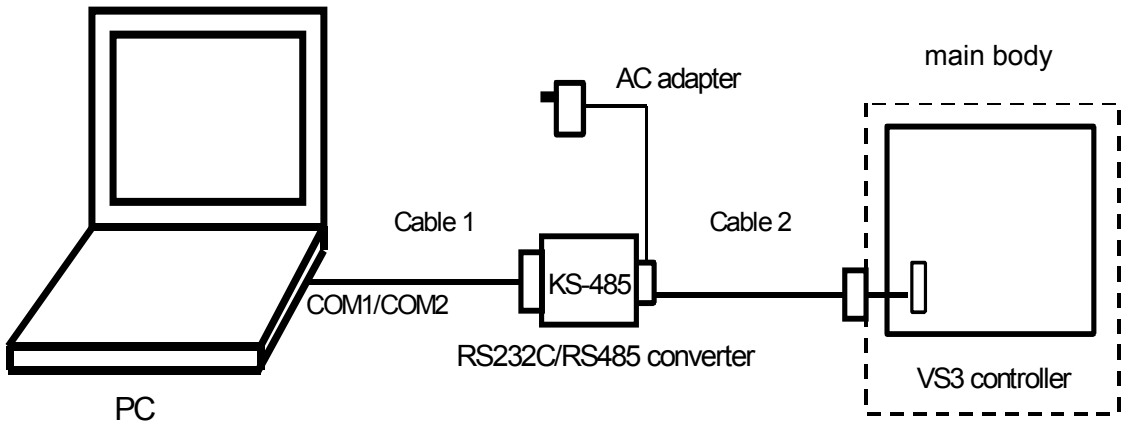
	Item	Communication setting
1	Data length	8 bits
2	Stop bit length	2 bits
3	Parity	Disabled
4	BCC check	Enabled
5	Baud rate	4800BPS
6	Response delay time	0msec

1.2 Communication Connections

■ Personal computer
- Use channel 1 (COM1/COM2 port) of the RS232C interface.

■ RS232C/RS485 converter
- For the converter, System Sacom's KS-485 is recommended.
- Our optional accessory "external communication adapter (RS485-232C) ODK18" permits the connections described in Note 1) below (except the personal computer).

■ Communication cable for connection



Note 1)

The optional accessory "external communication adapter (RS485-232C) ODK18" comprises the following:

① Communication cable 1: One-meter-long RS-232C cable with a connector (for IBM nine-pin appliance connection) to the personal computer and System Sacom's CBL16 connector (Dsub 25-pin male) to the KS-485

② Communication cable 2: Three-meter-long UL2464TASB two-core AWG20 cable with a connector (Dsub nine-pin male) to the KDS-485 and a Y-terminal (with a 100W terminating resistor) to the unit

③ RS-232C <=> KS-485 conversion unit: System Sacom's KS-485 with an AC adapter

2. Data Transmission Method

Item	Specification
Communication standard	EIA standard, complying with RS-485
Synchronization method	Asynchronous communication method
Communication method	Half-duplex communication
Transmission code	ASCII code
Baud rate	1200/2400/4800/9600BPS
Communication distance	Max. 500 m (It depends on the effect of the ambient environment.)
Network	Multi-drop method (up 1:31 stations)
Signal wire	Two wires for transmission and receipt
Stop bit length	1/2bits
Data length	7/8bits
Parity	None/Odd/Even
BCC check	Enabled/Disabled
Response delay time	0 to 250msec
Communication address	1 to 99 stations (however, 1:31 stations at maximum)
Communication mode switching	RO/RW

Note) The shading indicates the initial setting of the unit.

3. Transmission Control Characters

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

Note)

R: Read (command to read settings or measured values)

W: Write (command to write set values)

R commands can be communicated at all times in all modes.

W commands can be communicated in regular mode only, and the parameters that can be set depend on the operation state (during operation). See "7. List of Identifiers/Commands."

4. Transmission Control Procedures

4.1 Communication Procedure

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

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

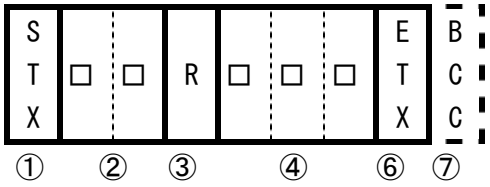
4.2 Message Types

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

4.3 Request Message Structures (transmission from the host computer to the unit)

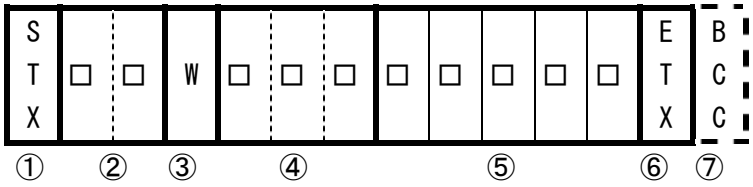
4.3.1 Structure of Read Request Messages

①	Start code
②	Address
③	Request (read)
④	Identifier
⑤	-
⑥	End code
⑦	BCC data



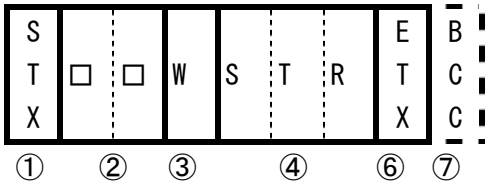
4.3.2 Structure of Write Request Messages

①	Start code
②	Address
③	Request (write)
④	Identifier
⑤	Numeric data
⑥	End code
⑦	BCC data



4.3.3 Structure of Storage Request Messages

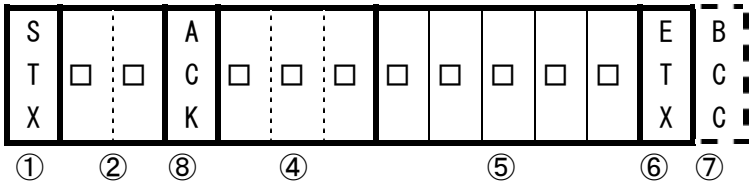
①	Start code
②	Address
③	Request (write)
④	Identifier
⑤	-
⑥	End code
⑦	BCC data



4.4 Reply Message Structures

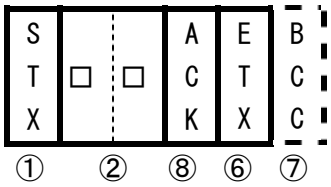
4.4.1 Reply Messages to Read Request Messages

①	Start code
②	Address
④	Identifier
⑤	Numeric data
⑥	End code
⑦	BCC data
⑧	Acknowledgement code



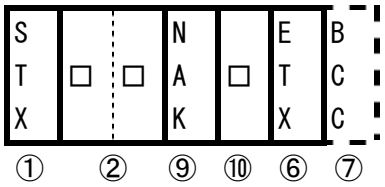
4.4.2 Reply Messages to Write Request/Storage Request Messages

①	Start code
②	Address
⑥	End code
⑦	BCC data
⑧	Acknowledgement code



4.4.3 Reply Messages In Case of an Error

①	Start code
②	Address
⑥	End code
⑦	BCC data
⑨	Negative acknowledgement code
⑩	ERR type



4.5 Description of Codes

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

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

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

① STX

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

② Address

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

③ Request

Enter the symbol "R" or "W."

R: To read data from the unit
W: To write data to the unit or save it in the unit

④ Identifier

This is the classification symbol (identifier) of the data to be read or written and represented by a three-digit alphanumeric ASCII code. See "7. List of Identifiers/Commands."

⑤ Numeric data

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

Negative data: The symbol "-" is at the highest digit.

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

Example) The meaning of the five-digit numeric data ００１０１ is shown in the table below.

Example		Meaning of numeric data
Set temperature (SV1)	When the temperature sensor is a thermocouple	→ 101℃
	When the temperature sensor is platinum	→ 10.1℃
Set time (TIM)		→ One hour and one minute

⑥ ETX

This code is required for the receiving side to detect the end of the message. Add it at the end of the character string to be transmitted (except BCC).

⑦ BCC

This is the check code for error detection and takes the exclusive OR (EX-OR) of all characters from STX to ETX. When "Enabled" is selected for BBC check among the communication settings for the unit, this code (BCC) will not be included in the reply message.

⑧ ACK

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

⑨ NAK

This is a negative acknowledgement code and included and returned in the "reply message" from the unit when there is an error in the "request message" received by the unit.

⑩ ERR type

If there is an error in the "request message" received by the unit, this code is included in the "reply message" from the unit after "(9) NAK" to report the type of the error.

This is a communication-related error, and details of display are omitted.

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

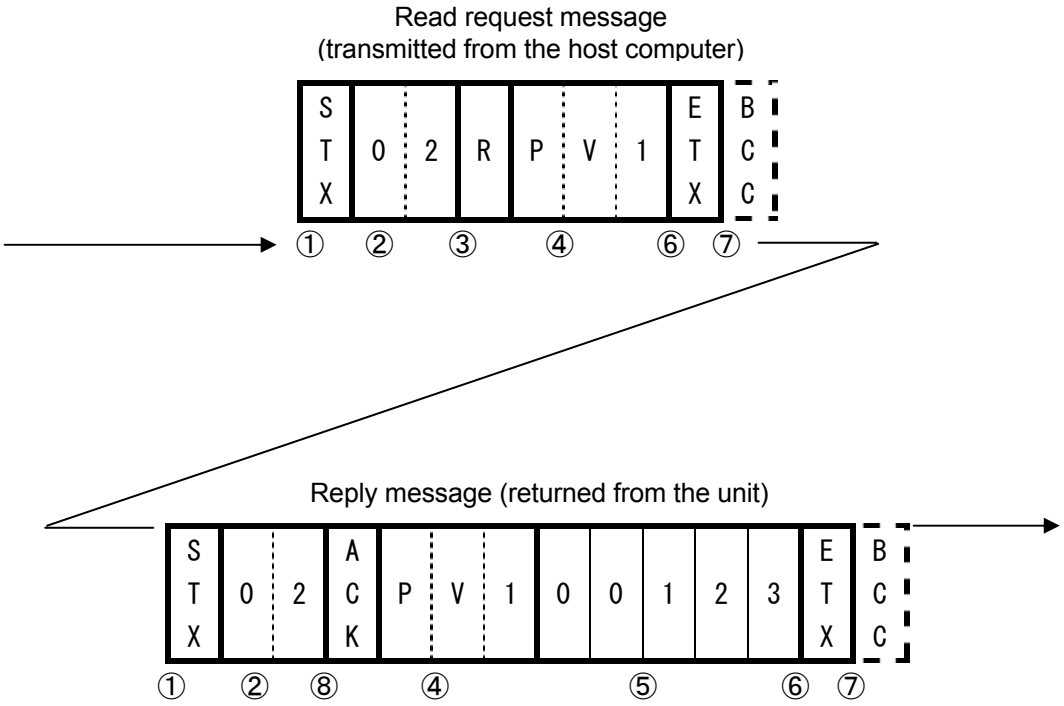
5. Communication Examples

5.1 Read communication example

Example) Request message:

A request for reading PV is transmitted to the unit set at address 02.

Reply message from the unit to this request message: The data of PV (00123) is returned.



Code		Symbol/Data	ASCII code *2
① Start Code		STX	02H
② Address		02	30H 32H
③ Request (Read)		R	52H
④ Identifier *1		PV1	50H 56H 31H
⑤ Numeric Data		00123	30H 30H 31H 32H 33H
⑥ End Code		ETX	03H
⑦ BCC data	Request		61H
	Reply		02H
⑧ Acknowledgement code		ACK	06H

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

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

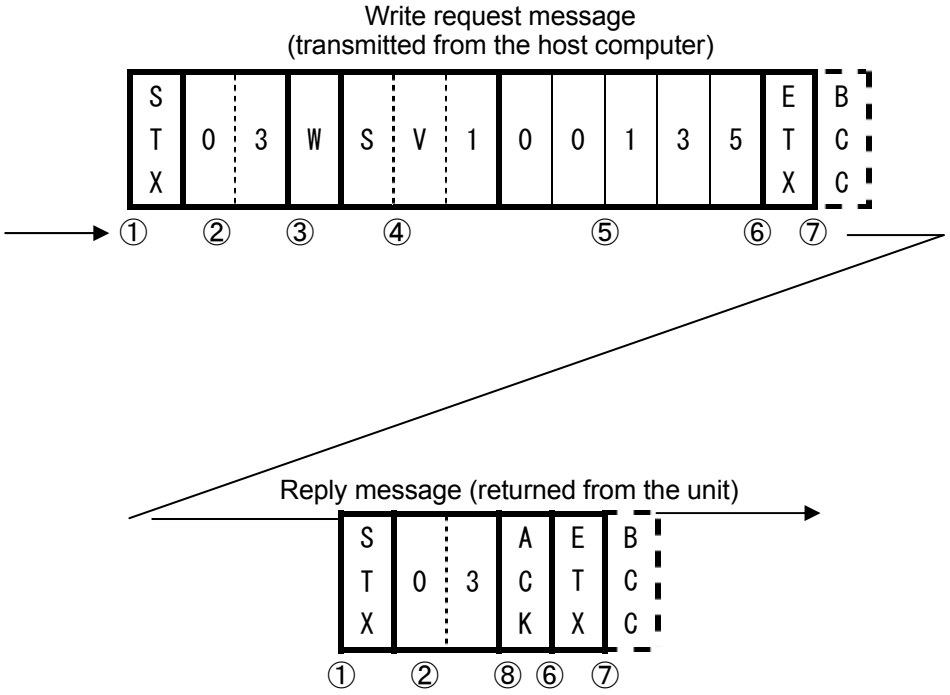
5.2 Write communication example

Example) Request message:

A request for setting "SV to 135" (writing 135) is transmitted to the unit set at address 03.

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

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



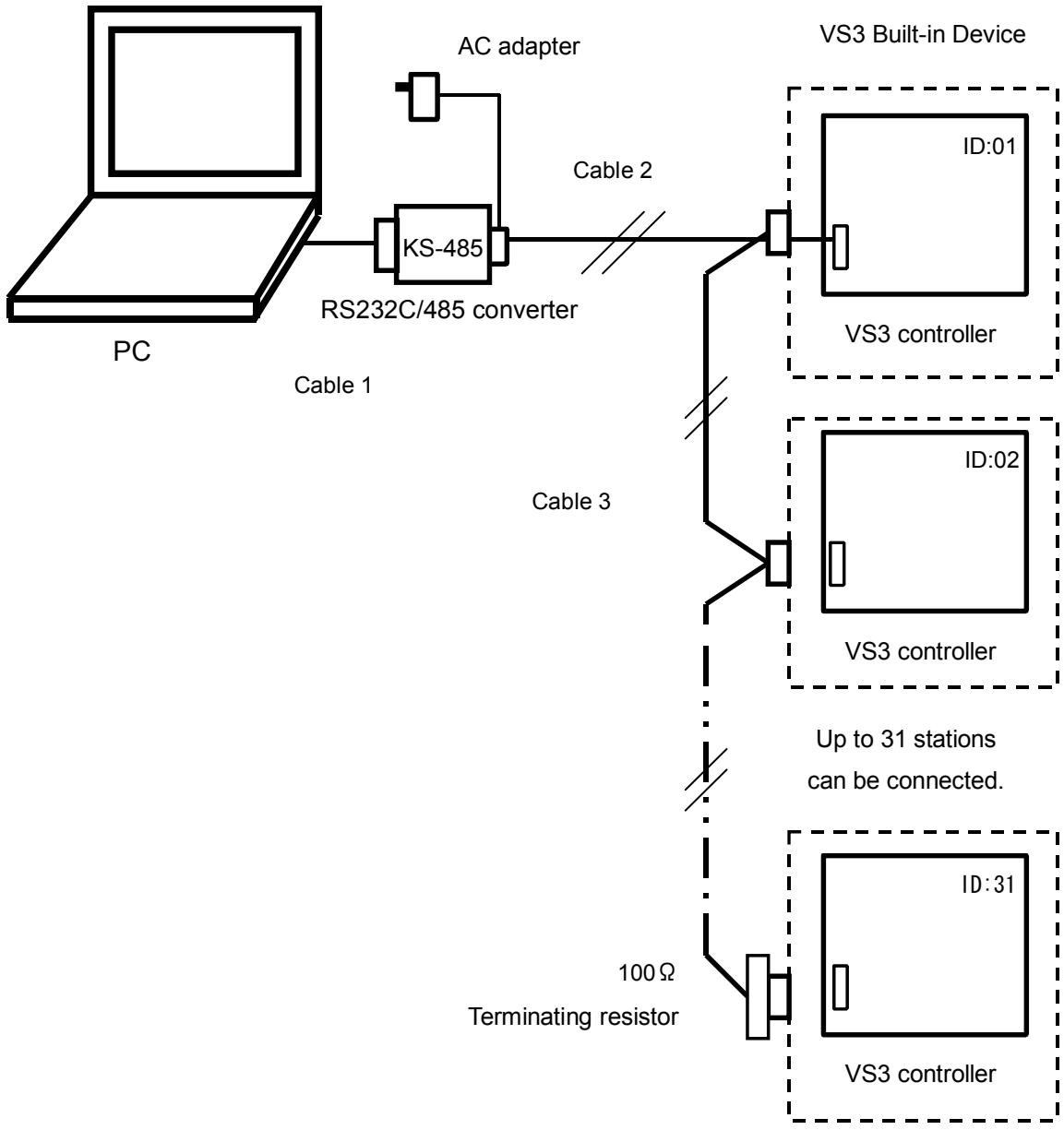
Code		Symbol/Data	ASCII code *2
① Start Code		STX	02H
② Address		03	30H 33H
③ Request (Write)		W	57H
④ Identifier *1		PV1	53H 56H 31H
⑤ Numeric Data		00135	30H 30H 31H 33H 35H
⑥ End Code		ETX	03H
⑦ BCC data	Request		56H
	Reply		04H
⑧ Acknowledgement code		ACK	06H

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

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

6. Wire Connection

Shown below is an example of multi-drop wire connection.



Note 1) Communication cable 1: One-meter-long RS-232C cable with a connector (for IBM nine-pin appliance connection) to the personal computer and System Sacom's CBL16 connector (Dsub 25-pin male) to the KS-485

Note 2) Communication cables 2 and 3: Custom-made items.

Note 3) Terminating resistor: Custom-made item. If you prepare a terminating resistor yourself, connect a fixed resistor of 100 Ω and 1/4 W or over to the last cable appliance terminal block.

7. List of Identifiers/Commands

<Identifiers and set values>

*1: "_" means a space.

*2: The setting range depends on other parameters. (See the table shown below.)

*3: A parameter with which a W command is valid during each operation (valid during operation in regular mode).

Fixed-value operation parameters

Name	Identifier	Command	Set value
Temperature setting	SV1	R/W	SLL～SLH : Set value limiter lower limit - set value limiter upper limit ℃ (*2, *3)

Store command

Name	Identifier	Command	Set value
Store set value	SV1	R/W	None (This command is required to store temperature and time settings.)

Other Parameters

Name	Identifier	Command	Setting Value
Key lock	LOC	R/W	00000 : Key lock released 00001 : Key lock
Operation start/stop	RUN	R/W	00000 : Stop (*3) 00001 : Start
Operation type selection	RST	R/W	00000 : Fixed temperature operation selected (*3)
Remaining hour monitor	_TI	R	00000 : Time-up (*1) 00001～09950 : 0 hours and a minute to 999 hours and 50 minutes
Output monitor	OM1	R	00000 : First digit = Heater output Second digit = Refrigerator output Third digit = Main output Fourth digit = Time-up or alarm output Fifth digit = Overheat prevention output ※ Output state: 0 = Output OFF, 1 = Output ON
Error monitor 1	ER1	R	00000 : First digit = Memory error Second digit = Sensor error Third digit = AT error Fourth digit = Heater wire disconnection error Fifth digit = SSR short error ※ Error state: 0 = No error exists., 1 = An error exists.
Error monitor 2	ER2	R	00000 : First digit = Boil-dry error Second digit = Overheating prevention 1 error Third digit = Overheating prevention 2 error Fourth digit = Internal communication/Temperature input circuit error Fifth digit = Unused *Error state: 0 = No error exists., 1 = An error exists.
Measured temperature monitor	PV1	R	(Example) 00100= 100°C (when the temperature sensor is a thermocouple input) 01000= 100.0°C (when the temperature sensor is a platinum input) HHHHH = Measured temperature over-scale (input common) LLLLL = Measured temperature under-scale (input common) *The measured temperature resolution of the platinum input is ten times that of the thermocouple input.

8. List of ASCII Codes

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

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

ASCII code	2DH	20H								
Numeric	ー (minus)	SP (space)								

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

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

ASCII コード	55H	56H	57H	58H	59H	5AH	20H			
Symbol	U	V	W	X	Y	Z	SP (space)			

5. Cautions on handling

⚠ Warning

1. About handling of flammable or combustible solution

The unit is not explosion proof. Take special care for handling specimens that contain on which explosive materials, combustible materials. Flammable or combustible solution will evaporate when left at a room temperature (or at a lower temperature for some types of solutions) and may be ignited and explode from switches, lights and other ignitable sources. Be sure to assure sufficient ventilation when using these materials.
See section “13. List of dangerous materials” on page 55.

2. Ban on use/countermeasures when an error occurs

If smoke is emerges on the unit or an odd odor is felt, immediately turn the ELB on the main unit off, turn the power supply off and contact your dealer, a Yamato sales office or our customer service center for inspection. Otherwise, a fire or an electrical shock may result. The user shall never attempt to repair the unit to avoid any possible dangers.

3. Secure sufficient ventilation for the unit.

Do not operate the unit when its side panels and vent holes are blocked.
Internal temperature of the unit will rise degrading the performance and an accident, a malfunction or a fire may result.

4. Do not allow liquid to spill over the unit.

Do not allow liquid to spill over the unit. Pay special attention not to allow liquid to enter into the vent holes in the side and rear panel of the unit. If liquid is spilt over or into the unit, do not try to operate it any further. Otherwise, an accident, a malfunction, a fire or an electrical shock may result.

5. Do not allow a metal piece to fall into the unit.

Do not allow a clip, a staple, a screw or other metal pieces to fall into the unit.
Stop operating the unit if a metal piece has dropped into the unit.
Otherwise, an accident, a malfunction, a fire or an electrical shock may result.

6. Do not open the cabinet.

Do not open panels or covers fixed on the unit, or do not operate the unit with any of those open. Other wise, an accident, a malfunction, or an electrical shock may result.

7. Do not attempt to operate the unit without the vent hole filter.

Do not attempt to operate the unit without the vent hole filter.
Otherwise, an accident, a malfunction, or an electrical shock may result.

8. Do not attempt to modify the unit.

The user shall never try to modify the unit; other wise, an accident, a malfunction, a fire or an electrical shock may result.

5. Cautions on handling

⚠ Caution

1. Do not step on the unit.

Do not step on the unit. Otherwise, the unit may trip over or be damaged resulting a personal injury or a malfunction.

2. Do not put or drop an object on the unit.

Do not put or drop an object on the unit. Since the unit contains high precision devices, vibrations or shock may cause a malfunction.

3. When a thunder is heard.

When a thunder is heard, turn the ELB on the main unit off then turn the main power off immediately. Otherwise, a lightning strike may result and cause a fire.

4. During night and not to be operated for a long period of time.

During the night and when you want to stop the unit for a longer period of time, turn the ELB to “off” and pull out the power cord from the power supply.

5. About recovery from power outage.

When the power is applied again after the unit has stopped due to power outage, the unit will automatically return to the status immediately before the power outage and resumes operation. If you do not want to resume operation by automatic recovery, turn the ELB off.

6. Abnormal refrigerator pressure

If the refrigerator operates in a high-temperature range, the refrigerator overload relay protecting circuit may work to stop the refrigerator.

7. When opening or closing the door

When opening or closing the door, do not put your hand or face close to the area the door moves (space).

8. Do not operate the unit with the door open.

When the unit is operated with the door open, proper temperature control is not possible and the heater may overheat causing a possible danger. Be sure to operate the unit with the door closed.

9. About installation of shelf boards and specimens

Correctly place shelf boards and specimens according to section “Installation procedures/precautions” on page 7. If these are not placed correctly, the unit will be unable to perform correctly as well as an accident or a malfunction may result.

10. Do not attempt to do anything other than specified in this operation manual.

Do not attempt to do anything other than specified in this operation manual. Otherwise, an unexpected accident may result.

6. Maintenance procedures

Daily inspection/maintenance

Be sure to perform daily inspection and maintenance to assure reliable operation of the unit.

⚠ Warning

- Be sure to pull out the power cord unless necessary before trying to do inspection and maintenance works.
- Start these works after the device has returned to the normal temperature.
- Never try to disassemble the unit.

⚠ Caution

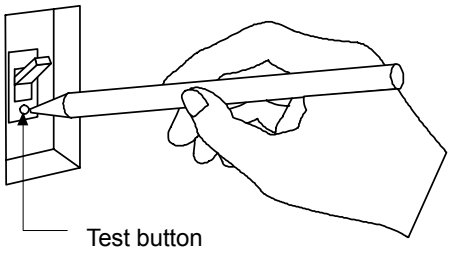
- Wipe off any dirt with a tightly wrung soft cloth. Never try to clean the unit with benzene, thinner or scouring powder, or rub with a scrubbing brush. Deformation, degradation or discoloration may result.

Every month

Inspect the functions of the ELB.

Test shall be performed with the power cord connected and power is being supplied to the unit.

- First turn the ELB to “off.”
- Then, turn the ELB “on” and press the test button on the device with a ball-point pen to check whether it is turned off to indicate that it is in the normal state.



Maintenance of the internal bath

Stop operation and turn the ELB to OFF. Pull out the power cord off the distribution board and the wall outlet. Confirm the temperature in the device and remove shelf boards and clamps.

The internal bath, shelf boards and shelf clamps are made of SUS304 stainless steel, acrylic board for the frost observation window and reinforced glass for inner door. To clean these items, thoroughly wipe with a cloth moistened with cleaning alcohol then wipe gently with a dry cloth.

Never use acid detergent, alkaline detergent, oil or organic solvent, which may cause corrosion or damage to the products.

⚠ **There are sharp protrusions inside the internal bath, shelf boards and shelf pillars and shall be handled with special care to avoid personal injury. Be sure to wear gloves since handling with bare hands may present danger.**

6. Maintenance procedures

Maintenance of the filter

A clogged filter will degrade cooling performance. It may also cause a refrigerator malfunction. The extent and speed of clogging depends on the environment and operation period. Regularly clean the filter according to the specific operating conditions.

Pull the filter attaching plate on the right side of the unit toward you. The plate is fixed with magnets so you can remove simply by pulling it.

Remove the filter on the filter attaching plate and wash or remove dusts with an electric cleaner.

There are condenser fins behind the ventilation port plate.
Never touch them with bare hands to avoid injury.
After cleaning, install it by performing the procedures above in the reversed order.

◆If you have questions, immediately contact your dealer, one of Yamato sales offices or our customer service center.

7. When the unit is not to be used for a long time or when disposing

When the unit is not to be used for a long time or when disposing

⚠ Caution	⚠ Warning
When the unit is not going to be used for a long time ●Turn the ELB to off and pull out the power cord.	When disposing the unit ●The Unit employs substitutive CFC. Ask disposal to a professional company.

Notes about disposition

Always pay attention to the preservation of the global environment.

- We highly recommend taking the unit apart as far as possible for separation or recycling to contribute to the preservation of the global environment. Major components and materials for the unit are as follows:

Names of major parts	Major materials
Major components of the outer finish	
Outer finish	Bonderized steel sheet, melamine resin baking finish
Internal bath	SUS304 stainless steel
Packing	Vinyl chloride
Nameplate	Polyethylene（PET）resin film
Major electric parts	
Switches and relays	Resin, copper
Board	Fiber glass
Heater	Chrome iron
Power cord	Synthetic rubber coating, copper, nickel
Refrigerator	Iron, copper
Major piping parts	
Hoses	Silicon rubber
Drain hose	Silicon
Hose clamp	66 nylon
Piping heat insulation hose	Polyurethane sponge
Piping parts	SUS304
Condenser	Iron, copper, aluminum
Refrigerator encapsulated refrigerant	
Refrigerant	HFC-R134a

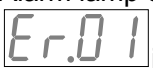
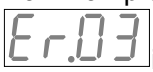
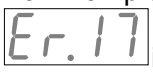
8. Troubleshooting

Safety device and error codes

The unit has the self diagnostic function with a controller and a separate safety device.
Table below shows possible causes and measures when the safety device is triggered.

[Error codes]

When a functional or mechanical abnormality occurs, the alarm lamp will illuminate on the control panel, an error code will be displayed on the control panel and the alarm busser will sound. When an abnormality occurs, confirm the error code and immediately stop operation.

Safety device	Symptom	Possible causes and measures
Sensor error	Alarm lamp on  indication	● Error in the temperature input circuit ● Disconnection or other errors in the temperature sensor ● Measured temperature is outside the displayable range Contact our customer service center.
SSR short circuit	Alarm lamp on  indication	● SSR short circuit Contact our customer service center.
Detection of heater disconnection	Alarm lamp on  indication	● Heater disconnection Contact our customer service center.
Memory error	Alarm lamp on  indication	● Memory setting error Contact our customer service center.
Internal communication error	Alarm lamp on  indication	● Internal communication circuit and temperature input circuit error Contact our customer service center.
Overheat	Alarm lamp on  indication	● Activation of overheat protector First reset the power supply and check the temperature in the bath and the set temperature for the overheat protector. If the unit does not reset, contact our customer service center.
Measurement temperature error	Alarm lamp on －－－－ －－－－indication	● Measurement value is out of display range. Contact our customer service center

8. Troubleshooting

When a malfunction is suspected

If any of the symptoms below occurs

Symptom	Check
Turning the ELB to on will not activate the unit.	● If the power cord is connected to the power supply securely. ● If power outage is occurring..
Alarm lamp lights	● Check the error code. Check the error code in “Safety device and error codes” on P. 49.
Temperature does not rise.	● If the set temperature is below that in the bath. ● If the power supply voltage has declined. ● If the ambient temperature is outside the usable environmental temperature range. ● If cooling load for inside the bath is large.
Temperature does not go down	● If the set temperature is higher than that in the bath. ● If supply voltage is low. ● If the environmental temperature is high. ● If heat load in the bath is large. ● If the ventilation port is covered. ● If the condenser filter is dirty. ● If the condenser fins are clogged.
Temperature fluctuates during operation.	● If the set temperature is appropriate. ● If the power supply voltage has declined. ● IF fluctuation of the environmental temperature has become large. ● If load for inside the bath is large.
The refrigerator does not start	● Refrigerator is overloaded. Turn the ELB off immediately and make check in the column “Temperature does not go down” above, wait for a while and turn the breaker on again. ● If the condenser filter is dirty that is installed at the lower part of the front of the main unit. ● If the room temperature is high. ● If the in-bath temperature is 45℃ or higher.
Displayed temperature differs from the measurement.	● If the calibration offset setting is other than “0”. Set it to “0.” ● Confirm the settings described in P-27 “To use Calibration Offset Function”.

If power outage occurs

When the power is applied again after the unit has stopped due to power outage, the unit will automatically return to the status immediately before the power outage and resumes operation.
Turn the ELB off if you do not want to resume operation by automatic recovery.

◆If the symptom does not match any of the above, immediately turn the ELB on the main unit off, pull out the power cord from the power supply and contact your dealer or one of our sales offices.

9. After sales service and warranty

When requesting a repair

If any trouble occurs, immediately stop operation, turn the ELB off, pull out the power plug and contact your dealer, our sales office or our customer service center.

Information necessary for requesting a repair

- Model name of the product
- Serial number
- Date (y/m/d) of purchase

See the warranty card or the nameplate on the unit.
See the section “3. Names and functions of parts” on page 9.

- Description of trouble (as in detail as possible)

Be sure to indicate the warranty card to our service representative.

Warranty card (attached separately)

●Your dealer or one of our sales office will give you a warranty card. Please fill “dealer name, date of purchase” and other necessary matters and send it to the customer service center(FAX:03-3231-6523). Save the warranty card at a safe place.

●Warranty period is one full year from the date of purchase. Repair service for free is available according to the conditions written on the warranty card.

●For repairs after the warranty period consult your dealer, our sales office or our customer service center. Paid repair service is available on your request when the product’s functionality can be maintained by repair.

Minimum holding period of repair parts

The minimum holding period of repair parts for this product is seven years after end of production. Repair parts here refer to parts necessary for maintaining performance of the product.

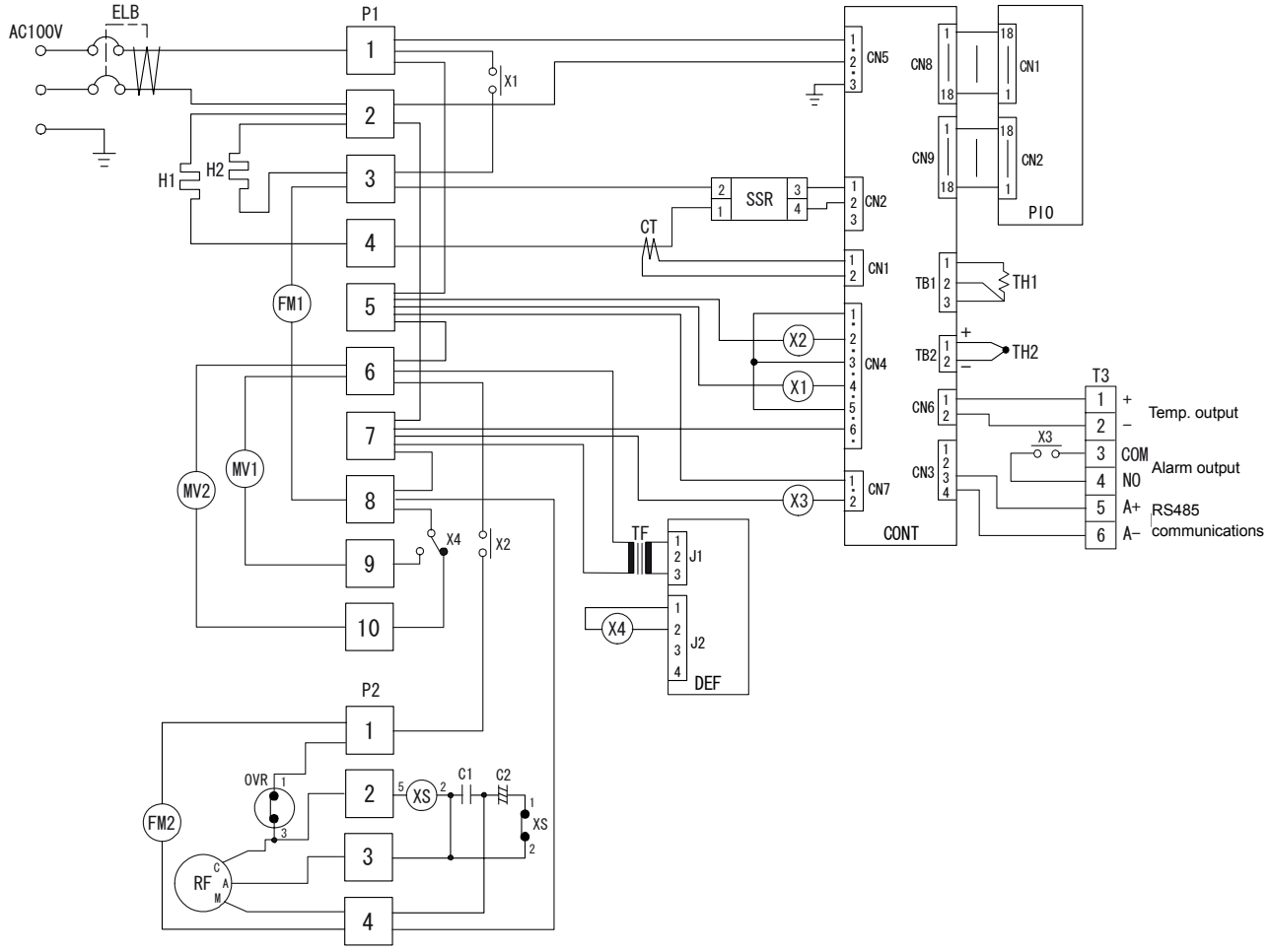
10. Specifications

Product name		Low temperature constant-temperature chamber
Model		IL602
System		Natural convection with air jacket
Performance	Operating temp. range	0℃～50℃
	Set temp. range	-5℃～55℃
	Temp. adjustment precision※1	During continuous operation of refrigerator ±0.3℃（Set at 37℃, no load） During ON/OFF operation of refrigerator ±1.0℃（Set at 37℃, no load）
	Temperature distribution precision ※1	During continuous operation of refrigerator ±1.0℃（Set at 37℃, no load）
	Refrigerator operating range	Below set temp.44.0℃:ON; 44.1℃ or above: OFF
	Operating ambient temperature	5℃～35℃
Configuration	Internal finish material	SUS304 stainless steel
	Frost observation window	Frost observation window: transparent acrylic plate
	Inner door	Reinforced glass:5 ㎜
	Temp. control	PID control with a micro computer
	Sensor	Pt100Ω（for temp. control）+ K-thermocouple（for overheat protection）
	Temperature set/display	Digital setting/digital indication
	Heater	Chrome iron wire heater:800W
	Refrigerator	Air-cooled fully closed compressor:300W（reciprocal type）
	Refrigerant/amount	HFC R134a 280g
	Defrosting mechanism	Hot gas bypass system Manual defrost（manual ON, automatic OFF）, cycle defrost
	Cable port	I.D.50 ㎜ Left side on the main unit
Safety functions		Over-current ELB, overheat protector, delay timer for refrigerator protection, refrigerator overload relay circuit, self-diagnosis function（sensor error, heater disconnection, SSR short circuit, automatic overheat protection）
Other functions		Key lock function, calibration offset function, temperature output terminal, RS485 communication function, alarm output terminal, condenser filter
Standard	Internal dimensions (w × d × h mm)	600 × 530 × 500
	Outer dimensions※2 (w × d × h mm)	710 × 645 × 1008
	Number of steps for shelf boards/ withstand load	12 steps 15 kg/board
	Shelf peg pitch	30 ㎜
	Capacity	159 litters
	Power（50/60Hz）	AC100V 13A
	Weight	Approx. 90 kg
Accessories		Shelf boards:3, shelf peg:3 sets, door key:2, operation manual, warranty card

※1 Temperature adjustment precision and temperature distribution precision are possible values at the environmental temperature 23℃±5℃.

※2 Outer dimensions do not include protrusions.

11. Wiring diagram



Symbol	Part name	Symbol	Part name
ELB	Electric Leakage Breaker	X4	Relay（swtiching solenoid valve）
T1	Terminal block	C1	Operation condenser
T2	Terminal block	C2	Start condenser
T3	Terminal block	TH	Temp. sensor (twin)
H1	Heater（in the unit）	CT	Current sensor
H2	Heater（door）	XS	Start relay
FM1	Fan motor（in the unit）	RF1	Refrigerator
FM2	Fan motor（refrigerator）	CONT	Planar board
MV1	Solenoid valve（defrost）	PIO	Display board
MV2	Solenoid valve（return tube）	DEF	Defrost board
X1	Relay（heater in the unit）	OVR	Overload relay
X2	Relay（refrigerator）	SSR1	Solid state relay
X3	Relay（alarm output）	TF	Transformer

12. Replacement parts list

Replacement parts

Symbol	Part name	Code №.	Specifications	Maker
PIO	Display board	1020000051	For VS-3	TOHO Electronics
CONT	Planar board	LT00009401	VS-3PL	TOHO Electronics
DEF	Defrost board	1240000122		Ryowa Electronics
TH1	Temp. sensor	1160030038	Pt100Ω	NIHONDENSOKU
TH2	Temp. sensor	LT00009502	K-thermocouple	NIHONDENSOKU
RF	Compressor	LT00009463	AA134C24TA00-A0FS 300W	Panasonic
FM1	Cross flow fan	2150270001	FM-05035-AAB	Royal
FM2	Fan motor	3010060006	SW4-C041NP	Sanyo
H1	Heater	IL72S-40100	100V 800W	Yamato Scientific
H2	Cord heater	IN81S-40480	100V 54W	Yamato Scientific
ELB	Electric leakage breaker	LT00029774	NV-L22GR 15A	Mitsubishi
MV1	Solenoid valve	3020060003	SEV-502DXF	Saginomiya
MV2	Solenoid valve	3020060004	NEV-603DXF	Saginomiya
X1,X3	Relay	2050000030	JR1a-TM	Panasonic
X2	Relay	2050000026	G2R-1-1 DC6V	Omron
X4	Relay	2050000056	G7L-1A-TUB 100V	Omron
SSR	SSR	2160000035	TRS5225	TOHO Electronics
CT	Current sensor	2170010005	CTL-6-S-H	URD
P1	Terminal block	LT00031665	TFD250ABC-10P	Terminal
P2	Terminal block	LT00031661	TFD250ABC-4P	Terminal
P3	Terminal block	LT00009399	MF10-4AX 6P, For cover	Toyo Giken
-	Power cord	LT00008924	TS-3C 3m	Yamato Scientific
TF	Transformer	2180000044	ⅣFR type, for 100V	Autonics

13. List of dangerous materials

Never use an explosive substance a flammable substance or a substance containing them for this device.

Explosive substance	Explosive substance	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
Flammable substances	Explosive substances	Metal “lithium”, metal “potassium”, metal “natrium”, yellow phosphorus, phosphorus sulfide, red phosphorus, celluloids, calcium carbide (a.k.a, carbide), lime phosphide, magnesium powder, aluminum powder, metal powder other than magnesium and aluminum powder, sodium dithionous acid (a.k.a., hydrosulphite)
	Oxidizing substances	①Potassium chlorate, sodium chlorate, ammonium chlorate, and other chlorates
		② Potassium perchlorate, sodium perchlorate, ammonium perchlorate, and other perchlorates
		③ Potassium peroxide, sodium peroxide, barium peroxide, and other inorganic peroxides
		④Potassium nitrate, sodium nitrate, ammonium nitrate, and other nitrates
		⑤Sodium chlorite and other chlorites
		⑥Calcium hypochlorite and other hypochlorites
	Flammable substances	①Ethyl ether, gasoline, acetaldehyde, propylene chloride, carbon disulfide, and other substances with ignition point at a degree 30 or more degrees below zero.
		② n-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 acetate, (a.k.a.amyl acetate) and other substances with ignition point between zero and less than 30 degrees.
		④Kerosene, light oil, terebinth oil, isopenthyl alcohol(a.k.a. isoamyl alcohol), acetic acid and other substances with ignition point between 30 degrees and less than 65 degrees.
	Combustible gas	Hydrogen, acetylene, ethylene, methane, ethane, propane, butane and other gases combustible at 15℃ at one air pressure.

(Quoted from the separate table 1 in Article 6, the enforcement order of the Industrial Safety and Health Law)

14. Standard installation manual

*Install the product according to the following: (Confirm separately for optional items or special specifications)

Model	Serial number	Date	Installation mgr.(company name)	Installation mgr.	Judgment

No.	Item	Implementation method	TOC No. Reference page of the operating instruction manual	Judgment
Specifications				
1	Accessories	Check for number of accessories on the basis of the column for accessories.	10. Specifications field P.52	
2	Installation	・ Visual check of environmental conditions Caution: Take care for environment	2. Before operating the unit ・ On the installation site P.4	
		・ Securing a space		
		・ Placement of shelf boards and specimens	2.Before operating the unit P.7～ ・ Installation procedure 8	
Operation-related matters				
1	Source voltage	・ Measure the user side voltage (distribution board, outlet, etc.) with a tester ・ Measure voltage during operation (shall meet the specifications) Caution: Always use a plug that meets the specification for attaching to the ELB.	2. Before operating the unit ・ Be sure to connect the ground wire. P.6 ・ Power supply is …. P.6 10.Specifications ・ Specification-power supply P. 52	
2	Operation start	・ Start operation. Set to a temperature about five to 5℃ lower than the room temperature and check that cooling time and temperature is stable at the setting.	2. Before operating the unit P.7～8 ・ Installation procedures 4. Operating method P.13～43	
Description				
1	Operational descriptions	Explain operations of each component according to the operational instructions	4. Operating method P.13～43 1. Safety precautions ～13. List of dangerous materials P. 1 ～P.55	
2	Error codes	Explain the customer about error codes and procedures for release according to the operational instructions	8. Troubleshooting ～9. After sales service and warranty P.49～51	
3	Maintenance and inspection	Explain operations of each component according to the operational instructions	6. Maintenance procedures ・ Daily inspection/ maintenance P. 46	
4	Completion of installation Entries	・ Fill in the installation date and the installation mgr. on the nameplate of the main unit ・ Fill in necessary information to the warranty card and hand it over to the customer ・ Explanation of the route for after-sales service	9. After sales service and warranty P.51	

Limited liability

Be sure to use the unit strictly following the handling and operating instructions in this operating instruction.
Yamato Scientific Co., Ltd. assumes no responsibility for an accident or a malfunction caused by use of this product in any way not specified in this operating instruction.
Never attempt to perform matters prohibited in this operation instruction.
Otherwise, an unexpected accident may result.

Notice

- **Descriptions in this operating instruction are subject to change without notice.**
- **We will replace a manual with a missing page or paging disorder.**

Instruction Manual
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IL602
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