

Service Manual

Bench-Top Type Temperature and Humidity Chamber

SH-221, 241, 261, 641, 661

SU-221, 241, 261, 641, 661

4009205000330



This Service Manual has been compiled specifically for service-people trained or certified by ESPEC ENGINEERING CORP. Because of the dangers involved, service described herein should not be performed by other persons.

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Introduction

This Service Manual explains how to service Bench-Top Type Temperature and Humidity Chambers (SH/SU-221/241/261/641/661) in the event of trouble during usage. In particular, it organizes troubleshooting procedures into operation matrixes to help you quickly identify the cause of trouble, and provides criteria for making evaluations with each item. It also contains precise procedures on replacing parts. If troubles cannot be corrected as explained herein, contact the place of purchase or the headquarters of ESPEC ENGINEERING CORP. Make note of the following conventions used in this manual before reading it.

Safety Symbols

The following safety symbols are used throughout this manual.

■ Degree of DANGER

 VERY DANGEROUS	This mark means extremely dangerous consequences may arise, with the possibility of death or serious injury to the user, if the equipment is handled incorrectly.
 DANGER	This mark means dangerous consequences may arise, with the possibility of death or serious injury to the user, if the equipment is handled incorrectly.
 CAUTION	This mark means dangerous consequences may arise, with the possibility of somewhat serious injury to the user and/or damage to equipment and facilities, if the equipment is handled incorrectly.

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Read this section BEFORE servicing the equipment.

Chapter 1 For Your Safety

This chapter explains safety precautions to be observed when servicing the equipment. Read this section BEFORE servicing the equipment to prevent accidents to you, users, specimens or the user's equipment. These precautions are written for all models of environmental chambers, therefore some of them may not apply to the specific chamber.

1.1 Who May Service the Equipment

 **DANGER**

- **This Service Manual was written for persons trained and certified by ESPEC ENGINEERING CORP. or servicepeople with the same knowledge and skill. Because of the dangers involved, persons untrained in service procedures should never perform servicing described herein.**

1.2 Being Prepared

 **DANGER**

- **Anyone servicing the equipment as explained in this manual is exposed to various forms of danger.**

For your safety and that of others, read this chapter thoroughly BEFORE servicing the equipment. The first dangers that come to mind are as follows. In all cases, the serviceman can be killed or seriously injured.

- Electric shock → Always ground the equipment when servicing the equipment.
- Toxic gas poisoning → Always wear a safety mask when servicing the equipment.
- Mechanical dangers → Always wear protective gear when servicing the equipment.

In servicing the equipment, always remember the safety first principle, follow procedures to the letter, and use tools as specified. Always obtain the customer's permission BEFORE using open flames, and obey all safety requirements enforced by the customer.

1.3 Clothing and Safety Gear for Servicepeople

Always be appropriately dressed when servicing the equipment.
With the exception of clean room work, regular work clothes should be worn for all types of work.

Type of work	Serviceman clothing requirements
Regular work	Work-specific clothes and safety shoes
Wiring & circuit checks	No metallic objects exposed on the side facing the equipment
Welding	Shaded safety goggles, gloves and long sleeve shirt
Solvent use (e.g. refrigeration water circuit cleaning)	Dust-proof mask, safety goggles, gloves and long sleeve shirt
Glass wool insulating	Dust-proof mask and gloves
Piercing	Dust-proof goggles
Quick-bonding agent use	Dust-proof goggles and vinyl gloves (or of similar material)
Work in high places	Helmet and safety belt
Lifting or handling metallic parts	Leather gloves
Inside clean rooms	Clean room suit (Check with customer in advance.)

1.4 Reporting Accidents and Trouble

If personnel is lost, property is damaged or work is shut down (more specifically, if a life-endangering accident, damaged specimens, fire, water pollution, or other serious situation occurs) because of trouble attributable to the product itself or service thereto or if the possibility thereof is foreseen;

- Servicemen from ESPEC ENGINEERING CORP. should report the situation as explained in the “PL Complaint Report Manual”.
- Servicemen from authorized dealers should report the situation to the headquarters of ESPEC ENGINEERING CORP. or International Business Headquarters of ESPEC CORP.

1.5 Precautions in Service

Before Starting

- To prevent electric shock, check the equipment is properly and effectively grounded.
- Test the leakage breaker and check it is functioning properly.

Troubleshooting, Checks and Adjustments

Because power is ON (live parts) when troubleshooting or when making checks and adjustments, precautions are listed separate of those for repair work.

(1) Prerun checks

- ① Check no inflammables or explosives have been loaded inside the equipment as specimens.
- ② If the customer charges specimens in testing, check specimen power supply control terminals are properly wired.
- ③ Have the customer remove specimens and wiring from inside the equipment before starting the equipment.

(2) Precautions in usage

- ① Do not touch exposed live terminals.
- ② Watch out for rotating parts such as fans.
- ③ Do not disable safety circuit when running the equipment.
If however unavoidable, restore the safety circuit and check tripping after servicing the equipment.
- ④ Door opening-closing during high temperature, high humidity operations
 - Do not suddenly open the door.
 - Use extreme caution when opening the door if fire alarm is located directly above the equipment.
- ⑤ Door opening-closing during high temperature, high pressure operation
Do not open the door when the chamber is pressurized on the inside.

Repair Work

Turn power to the equipment OFF before replacing parts or making other repairs. Also, take measures to prevent power from being turned ON accidentally.

(1) Precautions in electric wiring work

- Use spring washers with screw-locked circuits and coat with locking paint to prevent loosening.

(2) Precautions in refrigeration circuit work

Keep combustible refrigerant and additives away from potential sources of fire.

Perform welding and work in which required to handle refrigerant and solvents outdoors where possible, or in a well-ventilated place.

If any of the following situations occur when handling chemicals and refrigerants, take the prescribed action immediately.

Contact with eyes: Flush with clean water for at least 15 minutes and consult a physician.

Contact with skin: Flush affected area abundantly with water.

Inhaled chemical vapors: Seek fresh air, and where necessary, consult a physician.

Always keep a dry chemical fire extinguisher and bucket of water nearby when welding or using open flames.

Also, do not weld or use open flames where prohibited or in the vicinity of hazardous, ignitable or flammable substances.

Observe the following points with water-cooled refrigerators.

- Set an adequate drain pan in dew forming spots before shutting off the water circuit.
- Use adequate couplings and sealant when connecting water circuit pipes.
- After cleaning the water circuit, dilute drainage to the accepted level with fresh water before discharging it into the public sewer system.

(3) Precautions in water circuit work

Set an adequate drain pan in dew forming spots before shutting off the water circuit.

Use adequate couplings and sealant when connecting water circuit pipes.

(4) Precautions in air circuit work

Disconnect tubes and release air inside the circuit before removing air circuit parts.

- (5) Precautions in using solvents
Perform work in which required to handle refrigerant and solvents outdoors where possible, or in a well-ventilated place.
- (6) Precautions in working in high places
Take measures to prevent tools and supplies from dropping to below.
Use adequate step ladders or other means for climbing to high places.
- (7) Precautions in moving heavy objects
Have other persons help you as needed. Also, wear leather gloves to keep your hands from slipping.
- (8) Precautions in using quick-bonding agents
Wear a dust-proof goggles and vinyl gloves (or of similar material).
Be careful not to touch the bonding agent with hands when oozing from applied areas.
- (9) Special precautions in servicing incubators
Wash hands and tools with alcohol before servicing the incubator.
- (10) Other
Take measures to keep the door from accidentally closing when working inside the equipment.
Perform work in which required to use auxiliary cooling gas outdoors where possible, or in a well-ventilated place, to prevent local accumulation or asphyxiation.
Avoid prolonged contact with cold parts. Show extreme caution when detaching the cooler and cold accumulator.
Wear leather gloves when handling sheet metal.

After Servicing the Equipment

- (1) Clean and tidy up the work area. Especially check inside the equipment to make sure you haven't forgotten tools, rags, etc.
- (2) Restore the customer's operation pattern. Check the overheat protector is properly set.
- (3) Check screw-locked terminals in load circuit are tight.
- (4) Check for leaks.
Check around the equipment for leaking water.
Check for deterioration in cooling water circuit tubes and pressure-proof hoses.
Check the drain hose is securely connected to the building's drain convergence line.

Chapter 2

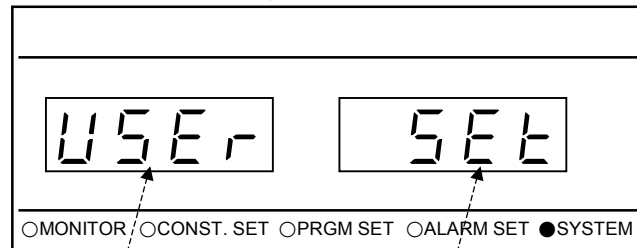
Precautions in Operation

This chapter responds to frequently asked questions on operation.

2.1 How to Unlock Keys (Protection)

If settings cannot be changed because the key lock (protection) is ON, release the key lock as follows. For more information, see 6.2 in the Reference Manual.

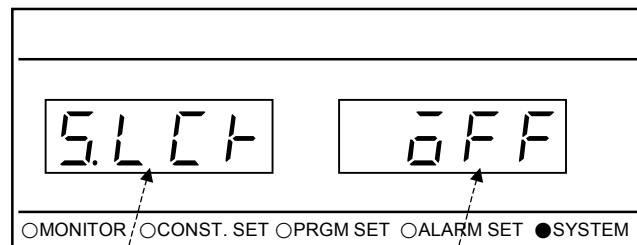
1. Set the main power supply (breaker) in the ON position and press the **POWER** key.
2. From the monitor mode, press the **SET** key 5 times until getting the user setup top display of the test environment setup mode.



Stands for.
"User"

Stands for.
"Set"

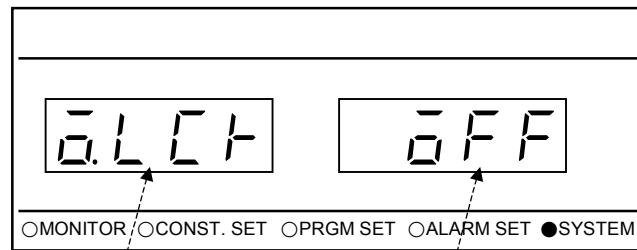
3. Press the **NEXT** key to display the setup key lock ON/OFF setting.
4. Using the **DOWN** key, change the setting from ON ($\bar{a}n$) to OFF ($\bar{a}FF$) and press the **ENT** key. This is how the setting can be changed.



Stands for
"Set Lock"

Lock status
 $\bar{a}n$: Key lock is ON.
 $\bar{a}FF$: Key lock is OFF.

5. Press the (NEXT) key to display the operation key lock ON/OFF setting.
6. Using the (▽) key, change the setting from ON (ON) to OFF (OFF) and press the (ENT) key. This is how the setting can be changed.



Stands for
"Operation Lock"

Lock status
ON: Key lock is ON.
OFF: Key lock is OFF.

7. Press the (SET) key until returning the display to the monitor mode.

2.2 Adjustments Required When the Chamber Is Relocated in a Different Frequency Area

Because the chamber does not incorporate an integrating hour meter, there are no adjustments related to power supply frequency.

2.3 Test Resume Status If Power Is Lost While Running a Program

Test resume status after a power outage depends on whether the user selects “r S E t” or “C n t i” for the power recovery mode in the test environment setup.

- When “r S E t” is selected: Control power remains OFF after power is restored from an outage.
- When “C n t i” is selected: Operation resumes from the point it was interrupted by the power outage once the power is restored. The timer resumes counting from the point the power outage occurred.

<Example>: When “C n t i” is selected

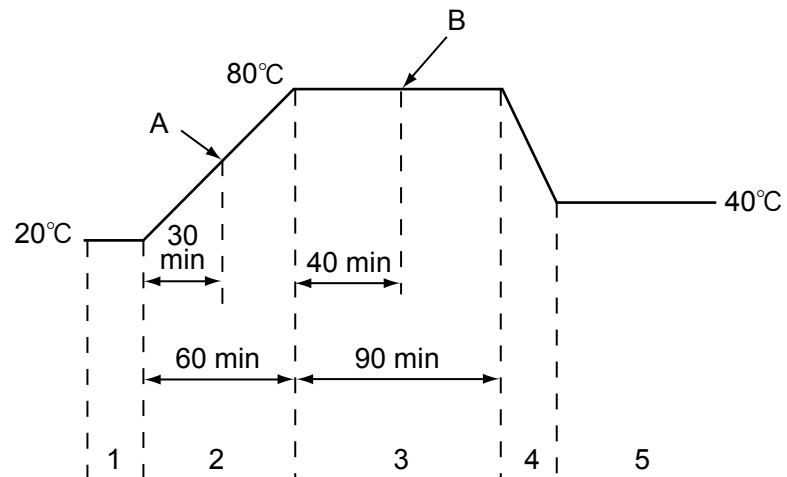


Fig. 2.1 Program pattern

If power is lost at points A and B during the above program, the program resumes running from point A and subsequently from point B once power is restored in those separate instances. However, because of the effects of the power outage, test area temperature does not follow the program pattern, as shown in Fig. 2.2.

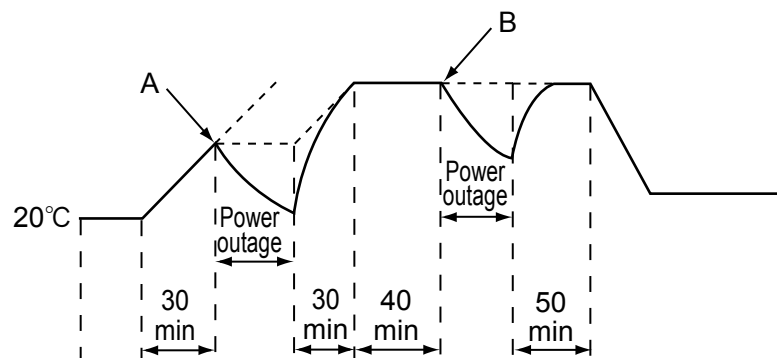


Fig. 2.2 Test area temperature after power outage

Chapter 3

Troubleshooting

This chapter explains what to check and how when trouble occurs during chamber use, as well as what remedial action should be taken to correct the trouble. Explanations are presented as check lists.

3.1 Troubles Not Displayed as Alarms

The display does not light up when the **POWER** key is pressed.

NO.	Check item	Check method	What to do
1	Power check	Check primary power source and that rated primary power is supplied to main power switch (LB1). • Rated power supply voltage $\pm 10\%$	Supply rated voltage.
2	Main power switch trip	Check main power switch (LB1) can be set in ON position. • If switch's button has popped out, circuit insulation may have broken down (current leak). • If switch's button has not popped out, an overload or overcurrent (short-circuit) in the circuit may have occurred. • If main power switch trips even when secondary wires are disconnected, trouble is in switch itself.	Locate insulation breakdown. Locate overcurrent. Replace switch (LB1). See "5.1 Electric Parts Compartment".
3	Fuse check	Check if fuse (F1) in electrical compartment has blown or not. • If fuse blows in short amount of time (instantly), trouble may be overcurrent caused by short-circuiting in either load or load circuit wiring. • If not blown to the eye, check with tester. If not continuous, more often than not fuse is at end of service-life. • If fuse blows soon after replacing, trouble is in fuse holder or caused by faulty contact such as a loose cap.	Replace fuse (F1). See "5.1 Electric Parts Compartment". Reconnect properly.
4	Thermal fuse check	Check for faulty contact and disconnection. • Check if thermal fuse (MF1) has blown. • Check continuity across wires Nos. 10 and 11. If not continuous, fuse is blown.	Replace fuse.
5	DC power supply check	Check voltage is impressed on DC power supply unit (SPS1) and 24V DC is output. • Check rated voltage is impressed across wires Nos. 11 and 12. If not, check fuse (F1) and thermal fuse (MF1). • Check 24V DC is output from wires Nos. 5C (+) and 6C (-).	Replace power supply unit.
6	Connector check	Check for faulty contact and disconnection. • Check connectors of wires Nos. 1 and 9 inside control console. • Check connectors of wires Nos. 10 and 11 inside mechanical parts compartment.	Reconnect properly.
7	Display board harness check	Check if harness from CN10 of temperature (humidity) controller to display board is disconnected.	Reconnect properly.

The main power switch (leakage breaker) trips.

NO.	Check item	Check method	What to do
1	Main power switch button has popped out.	Check for poor insulation along circuit.	Search for cause of poor insulation.
2	Main power switch button has not popped out.	Check for overload and overcurrent along circuit.	Search for cause of overcurrent.
3	Main power switch trips even when secondary side wires are disconnected.	Check for trouble in main power switch itself.	Replace switch.

Temperature does not rise.

NO.	Check item	Check method	What to do
1	Target temperature	Check if target temperature is wrongly set.	Remake setting.
2	Heater output check	Check heater output from temperature (humidity) controller. • Check heater output 1 in the channel monitoring mode of the service mode.	Initialize or replace temperature controller.
		Check SSR operation (ignition). • Check for voltage on SSR input side. If not detected and temperature (humidity) controller is outputting signal, trouble is in SSR. • Check for SSR output.	Replace SSR.
3	Heater check	• Check if voltage is impressed on heater. If not, check SSR. • Check continuity of heater. If not continuous, heater needs replacing.	Replace heater.

Temperature does not lower.

NO.	Check item	Check method	What to do
1	Target temperature	Check if target temperature is wrongly set.	Change setting. → Check refrigerator operation.
2	Door sealing when shut	Check for gapping in door packing.	Adjust door packing contact.
3	Specimens	• Check whether specimen arrangement is blocking air flow. • Check whether specimens are generating high heat load.	Rearrange specimens. Reduce specimen quantity.
4	Heater output status check	Check heater output from temperature (humidity) controller. • Check heater output 1 in the channel monitor setup of service mode.	Initialize or replace temperature controller. In temperature pull-down, 0 - few % is displayed.
		Check for SSR short-circuit. • Disconnect one wire on SSR output side and measure resistance across terminals. If 100 kΩ or more, OK.	Replace SSR.
5	Refrigerator operation	Check refrigerator operation.	If refrigerator doesn't work, see "The refrigerator does not work."
6	Solenoid valve operation check	Check if solenoid valve is wired incorrectly.	Repair wiring.
		Check if voltage is impressed on solenoid valve. See "Table 4.4".	If solenoid valve does not work despite voltage, replace solenoid. If voltage is not detected, check if temperature controller relay is closed. If open, replace temperature controller.

Humidity does not rise.

NO.	Check item	Check method	What to do
1	Humidifying tray water supply	(If water supplied to humidifying tray) Check humidifying tray water level detection switch operation. Switch (LS3) should be OFF when float is above red line. It should be ON when float is 2 mm or more below red line.	If water not supplied, see ALARM/TROUBLE: AL26 (If WATER lamp is out and continuous buzzer sounds) Water circuit trouble (Water supply). Replace water level detection switch.
		Check water level.	Regulate water level.
2	Heater output check	Check heater output from temperature (humidity) controller. • Check humidifying heater output in monitor mode.	Initialize and/or replace heater.
		Check SSR operation (ignition). • Check for 12V DC on SSR input side. If not detected, trouble is in temperature (humidity) controller. • Check for SSR output.	Replace SSR.
3	Heater check	Check if voltage is impressed on heater. If not, check SSR. Check continuity of heater.	Replace SSR and/or heater.
4	Door sealing when shut	Check for gapping in door packing.	Adjust door packing contact.

Humidity does not lower.

NO.	Check item	Check method	What to do
1	Wick wetness	• Check wick pan water supply. Check humidifying tray water supply. • Check if wick is dry.	Replace wick.
2	Door sealing when shut	• Check door packing contact. • Check for gapping in door packing.	Adjust door packing contact.
3	Specimens	• Check whether specimen arrangement is blocking air flow. • Check whether specimens are generating high heat load.	Rearrange specimens. Reduce heat load. Reduce specimen quantity.
4	Heater output status check	• Check heater output from temperature (humidity) controller. Check heater output 2 in monitor mode. In temperature pull-down, heater output should be 0 to few%.	Initialize and/or replace heater.
		• Check for SSR short-circuit. Disconnect one wire on SSR output side and measure resistance across terminals. If 100 kΩ or more, OK.	Replace SSR.
5	Humidifying tray water supply	Check humidifying tray water level. Check if tray is overflowing and floor is wet.	Regulate water level. See 4.1.

The refrigerator (high temperature side) does not work.

NO.	Check item	Check method	What to do
1	AL08 trigger	See "AL08".	See "AL08".
2	Voltage impression	<ul style="list-style-type: none"> • Check if voltage is impressed on refrigerator. • Check if temperature (humidity) control relay (RL103) works in refrigerator operating range (see "Operation Matrix Table"). 	Reset or replace temperature (humidity) controller.
		<ul style="list-style-type: none"> • Check for faulty contact or incorrect wiring at terminals. 	Repair wiring.

The refrigerator (low temperature side) does not work.

*** SH/SU-261/641/661 only**

NO.	Check item	Check method	What to do
1	AL08 trigger	See "AL08".	See "AL08".
2	Voltage impression	<ul style="list-style-type: none"> • Check if voltage is impressed on refrigerator. • Check if power relay (X51) works in refrigerator operating range (see "Operation Matrix Table"). 	Replace power relay.
		<ul style="list-style-type: none"> • Check for faulty contact or incorrect wiring at terminals. 	Repair wiring.

Water circuit: High water consumption

NO.	Check item	Check method	What to do
1	Water leak from water supply tank, auxiliary water tank, tubing or water level sensor container	Check for leak in water supply tank, auxiliary water tank, tubing and water level sensor container. (Check around chamber and floor underneath water circuit parts for water.) Check for disconnected tubes. • Check water level sensor container lid is correctly attached. (If spacer is missing, gapping occurs between lid and container. Then, when water is supplied to auxiliary water tank, sensor container can overflow. Check spacer is installed and container-lid contact is sealed, as shown in Fig. 5.18.)	Replace supply tank, auxiliary water tank, tubing or container. If spacer missing from sensor container, correctly install. See “5.3 (2) Water circuit Parts (Water Level Sensor Container and Pump)”.
2	Overflow from water level sensor container	Check if water is overflowing from water level sensor container and not draining from drain pipe on left edge of chamber rear. • Check chamber is level by placing level on test area floor.	Correctly install spacer to preventing gapping between container and lid.
3	Overflow from humidifying tray	Check if water overflowing from humidifying tray is not draining from test area drain port. • Check chamber is level by placing level on test area floor. • Check water flow is regulated to correct level. (Check water is at WATER LEVEL mark on wick pan regulator, and humidifying tray and wick pan are at reference water level. Reference water level is less than 4 mm from test area floor. • Check if wick pan regulator float is stuck below water level despite presence of water. Also, check float rises/lowers smoothly. • Wick pan regulator float (reed switch) operation test Disconnect relay connector (CN23) of wick pan regulator and measure resistance at reed switch terminals [5] and [6] (5A and 6A). At or above reference water level: $\infty\Omega$ (OFF) Below reference water level: 0Ω (ON)	Level chamber. See 5.3 in Basic Operation manual. Regulate water level. See “5.3 (2) Water circuit Parts (Water Level Sensor Container and Pump)” and Fig. 4.6. Clean wick pan regulator. Replace wick pan regulator reed switch (LS3). See “5.3 (1) Wick Pan Regulator”.
4	Vapor leak from test area	Check if vapor is leaking from test area. • Check if cable port caps and plugs are attached. • Check packing sealing. (If vapor leaks, shut sheet of paper in chamber door and try pulling out. Paper must not come free.)	Attach cable port caps and plugs. Adjust door packing contact. (Reposition door hinges and lock catch pin.) See Fig. 5.7.

Water circuit: The humidifying tray does not drain.

NO.	Check item	Check method	What to do
1	Clogging or trapped air in humidifying tray supply and drain pipes	Check for clogging or trapped air in humidifying tray supply and drain pipes.	Disconnect tube and clear clog/trapped air.
2	Humidifying tray drain plug (Quick coupling)	Check for clogging in humidifying tray drain plug (quick coupling). • If water does not drain even though there is no clogging, trouble may be in plug (quick coupling).	Replace plug (quick coupling).
3	Freezing of humidifying tray supply and drain pipes	If above 1 and 2 are not cause and draining stopped after running chamber at or below 0°C, humidifying tray supply and drain pipes may have froze.	Thaw ice by running chamber at 70°C, humidity control OFF and refrigerator capacity control OFF.

Water circuit: Water is not supplied from the auxiliary water tank (option).

Even though the WATER lamp is flashing, water is not supplied from the auxiliary water tank.

NO.	Check item	Check method	What to do																		
1	Timers 1/2 setting of auxiliary water tank board	<p>Check DIP switch setting for timers 1/2 on auxiliary water tank board. If timer 1 \geq timer 2, water is not supplied.</p> <p>Initial values</p> <table border="1"> <thead> <tr> <th></th> <th>Set time (min)</th> <th>DIP. SW1</th> <th>DIP. SW2</th> <th>DIP. SW3</th> <th>DIP. SW4</th> </tr> </thead> <tbody> <tr> <td>Timer 1</td> <td>0</td> <td>OFF</td> <td>OFF</td> <td>OFF</td> <td>OFF</td> </tr> <tr> <td>Timer 2</td> <td>1</td> <td>ON</td> <td>OFF</td> <td>OFF</td> <td>OFF</td> </tr> </tbody> </table>		Set time (min)	DIP. SW1	DIP. SW2	DIP. SW3	DIP. SW4	Timer 1	0	OFF	OFF	OFF	OFF	Timer 2	1	ON	OFF	OFF	OFF	Restore initial values, or set timer 1 < timer 2.
	Set time (min)	DIP. SW1	DIP. SW2	DIP. SW3	DIP. SW4																
Timer 1	0	OFF	OFF	OFF	OFF																
Timer 2	1	ON	OFF	OFF	OFF																
2	Auxiliary water tank	<ul style="list-style-type: none"> Check if tank is empty or, if fitted with cock, cock is closed. 	Add deionized water and/or open cock.																		
3	Situation prior to operation	<ul style="list-style-type: none"> Check if timer 2 tripped and shut OFF water supply in previous operation. See below "Water circuit: Water is not supplied from the auxiliary water tank (option)". 	Eliminate cause of water supply trouble and restart chamber.																		

Water circuit: Water is not supplied from the auxiliary water tank (option).

Timer 2 tripped, forcefully shutting OFF water supply.

NO.	Check item	Check method	What to do																		
1	Tank location, low water pressure	<p>Check if auxiliary water tank is 400 mm or more higher than water supply circuit filter.</p> <p>Correct height: 400 to 2000 mm higher than water supply circuit filter</p> <p>Correct water supply pressure range: 4.9 to 19.6 kPa (At gauge)</p>	Reposition tank and/or correct water pressure.																		
2	Timers 2 setting of auxiliary water tank board	<p>Check timer 2 set time is shorter than time needed to fill water level sensor container from auxiliary water tank.</p> <p>Initial values</p> <table border="1"> <thead> <tr> <th></th> <th>Set time (min)</th> <th>DIP. SW1</th> <th>DIP. SW2</th> <th>DIP. SW3</th> <th>DIP. SW4</th> </tr> </thead> <tbody> <tr> <td>Timer 1</td> <td>0</td> <td>OFF</td> <td>OFF</td> <td>OFF</td> <td>OFF</td> </tr> <tr> <td>Timer 2</td> <td>1</td> <td>ON</td> <td>OFF</td> <td>OFF</td> <td>OFF</td> </tr> </tbody> </table>		Set time (min)	DIP. SW1	DIP. SW2	DIP. SW3	DIP. SW4	Timer 1	0	OFF	OFF	OFF	OFF	Timer 2	1	ON	OFF	OFF	OFF	Set timer 2 to initial value or higher.
	Set time (min)	DIP. SW1	DIP. SW2	DIP. SW3	DIP. SW4																
Timer 1	0	OFF	OFF	OFF	OFF																
Timer 2	1	ON	OFF	OFF	OFF																
3	Full sensor (LS4, located in water level tank of auxiliary water tank [option] water supply circuit)	<p>Check full sensor works.</p> <p>When tank is full: $\infty\Omega$ contact resistance</p> <p>When tank is not full: 0 to 10Ω</p>	Replace full sensor (LS4).																		
4	Filter clogging	Check if auxiliary water tank water supply circuit filter is clogged. Filter is accessible from chamber rear panel.	Clean filter.																		
5	Auxiliary water tank	Check if tank is empty or, if fitted with cock, cock is closed.	Add deionized water and/or open cock.																		
6	Solenoid valve (SV50)	<p>Check 100V AC is impressed across solenoid terminals (wires Nos. 250 and 2).</p> <ul style="list-style-type: none"> If voltage is not impressed, trouble is in auxiliary water tank board, board wiring or connections. If voltage is impressed but water is not supplied to water level sensor container, trouble is in solenoid valve. <p>Correct operation --- When low or empty water level detected by water level sensor container, 100V AC is impressed on solenoid valve (wires Nos. 250 and 2) and valve opens.</p>	Replace auxiliary water tank board or solenoid valve.																		

3.2 Alarms with Displayed Codes

TROUBLE: AL00

CH□□

Disconnection or broken wire in temperature sensor

NO.	Check item	Check method	What to do
1	Temperature sensor connection check (CH01/02)	Check temperature controller terminals (CH01/02) for looseness and faulty contact. CH01: Dry-bulb input CH02: Wet-bulb input * SH chambers only	Tighten as necessary.
2	Temperature sensor disconnection check (CH01/02)	Disconnect indicated temperature sensor from temperature controller and measure resistance across both lead ends. If about 10 Ω, OK. If high or short-circuited, sensor is NG.	Replace sensor.
3	Resistance thermometer sensor check (CH00)	Check temperature controller terminals (RTD) for looseness and faulty contact. CH00: Room temperature compensation input	Tighten as necessary. If sensor is broken, replace temperature controller.
4	Temperature controller initialization (resetting)	If no trouble occurs when the above checks are done, initialize temperature controller and watch situation.	Initialize temperature controller.
			If initialization does not restore system, replace temperature controller.

ALARM: AL01

Upper deviation temperature alarm

Test area temperature exceeded the upper deviation temperature setting.

NO.	Check item	Check method	What to do
1	Specimen heat generation check	<p>Check specifications. * Example: Allowed heat generation for standard door and cable ports ($\phi 25$ mm on both sides) SH/SU-221: 56 W (-20°C) SH/SU-241: 35 W (-40°C) SH/SU-261: 100 W (-60°C) SH/SU-641: 180 W (-40°C) SH/SU-661: 90 W (-60°C)</p>	Reduce quantity of specimens and/or heat load.
2	Upper deviation temperature alarm setting check	<p>With temperature monitor displayed, press (SET) key 3 times to display high absolute temperature alarm setting (H.tE). Press (NEXT) key twice to display upper deviation temperature alarm setting (Ud.tE). Check setting. Normally, set to 10°C</p>	Correct setting as necessary. Normally, set to 10°C.
3	Refrigerator running check	<p>Listen for strange sounds with refrigerator running.</p> <p>Check refrigerator control status. Example: Constant setup mode With temperature monitor displayed, press (SET) key once to get constant mode and press (NEXT) key 3 times. Check status (rEF.S) in auto/manual control.</p> <p>“OFF”: Refrigerator is OFF. “ON”: Manual refrigerator capacity control “AUTO”: Auto refrigerator capacity control</p>	Set to auto control.
4	Temperature control status check	<p>Run chamber at 60°C and check control. • Check SSR with heater ON and temperature control OFF.</p>	Disconnect SSR LOAD terminals and measure resistance twice with tester, switching polarity between LOAD terminals. If approx. 100 k Ω or higher, OK.
5	Refrigerator capacity check	<p>Check if temperature pull-down rate satisfies specifications. SH/SU-221: Within 20 min (+20 to -20°C) SH/SU-241: Within 50 min (+20 to -40°C) SH/SU-261: Within 70 min (+20 to -60°C) SH/SU-641: Within 60 min (+20 to -40°C) SH/SU-661: Within 90 min (+20 to -60°C)</p>	Repair refrigeration circuit as necessary.
6	Temperature controller initialization (resetting)	<p>If no trouble occurs when the above checks are done, initialize temperature controller and watch performance.</p>	<p>Initialize temperature controller.</p> <p>If initialization does not restore system, replace temperature controller.</p>

TROUBLE: AL02

Absolute high temperature alarm

Test area temperature exceeded the absolute high temperature setting.

NO.	Check item	Check method	What to do
1	Specimen heat generation check	<p>Check specifications.</p> <p>* Example: Allowed heat generation for standard door and cable ports ($\phi 25$ mm on both sides)</p> <p>SH/SU-221: 56 W (-20°C) SH/SU-241: 35 W (-40°C) SH/SU-261: 100 W (-60°C) SH/SU-641: 180 W (-40°C) SH/SU-661: 90 W (-60°C)</p>	Reduce quantity of specimens and/or heat load.
2	Absolute high temperature alarm setting check	With temperature monitor displayed, press (SET) key 3 times to display high absolute temperature alarm setting (H.tE). Check setting. Normally, set 10 to 20°C higher than target temperature.	Correct setting as necessary. Normally, set 10 to 20°C higher than target temperature.
3	Refrigerator running check	Listen for strange sounds with refrigerator running.	Set to auto control.
		<p>Check refrigerator control status. Example: Constant mode</p> <p>With temperature monitor displayed, press (SET) key once to get constant mode and press (NEXT) key 3 times. Check status (rEF.S) in auto/manual control.</p> <p>“OFF”: Refrigerator is OFF. “ON”: Manual refrigerator capacity control “AUTO”: Auto refrigerator capacity control</p>	
4	Temperature control status check	<p>Run chamber at 60°C and check control.</p> <p>• Check SSR with heater ON and temperature control OFF.</p>	Disconnect SSR LOAD terminals and measure resistance twice with tester, switching polarity between LOAD terminals. If approx. 100 k Ω or higher, OK.
5	Refrigerator capacity check	<p>Check if temperature pull-down rate satisfies specifications.</p> <p>SH/SU-221: Within 20 min (+20 to -20°C) SH/SU-241: Within 50 min (+20 to -40°C) SH/SU-261: Within 70 min (+20 to -60°C) SH/SU-641: Within 60 min (+20 to -40°C) SH/SU-661: Within 90 min (+20 to -60°C)</p>	Repair refrigeration circuit as necessary.
6	Temperature controller initialization (resetting)	If no trouble occurs when the above checks are done, initialize temperature controller and watch performance.	Initialize temperature controller.
			If initialization does not restore system, replace temperature controller.

TROUBLE: AL03

Absolute low temperature alarm

Test area temperature exceeded the absolute low temperature setting.

NO.	Check item	Check method	What to do
1	Absolute low temperature alarm setting check	With temperature monitor displayed, press (SET) key 3 times to display high absolute temperature alarm setting (H.tE). Press (NEXT) key once to display absolute low temperature alarm setting (LoTE). Check setting.	Correct setting as necessary. Set 5°C or more lower than target temperature.
2	Temperature control status check	Run chamber at 60°C and check control. • Check SSR with heater and temperature control OFF.	Disconnect SSR LOAD terminals and measure resistance twice with tester, switching polarity between LOAD terminals. If approx. 10 Ω or lower, OK.
3	Heater check	• Check if voltage is impressed on heater. If not, check SSR. • Check continuity of heater. If not continuous, heater needs replacing.	Replace SSR and/or heater.

TROUBLE: AL08

Refrigerator trouble

NO.	Check item	Check method	What to do
1	Power supply voltage check	Check power supply voltage is correct. ±10% of power supply voltage listed on rating plate	Supply rated voltage. Check power cable and wiring, and replace as necessary.
2	Compressor wiring check	Check if compressor power supply wiring terminal is loose and properly wired.	Repair wiring.
3	Compressor control relay check	Check operation of high temperature side relay (X100) and low temperature side relay (X101) on electric parts chassis. * SH/SU-261/641/661 only • Check if 100V AC impressed on relay coil when refrigerator is ON. • Check operation of contact.	Supply rated power supply. Check relay wiring, and repair as necessary. Replace relay.
4	Refrigeration circuit check	Check status (temperature, pressure and electric current) of refrigeration circuit.	Repair refrigeration circuit as necessary.
		Check operation of solenoid valves. • See "Table 4.4". • Test output of SV11 to 14 from operating panel.	Repair refrigeration circuit as necessary.



TROUBLE: AL12

Overheat/Overcool trouble and air circulator trouble

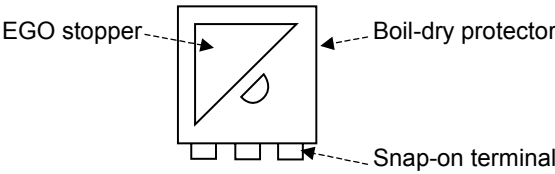
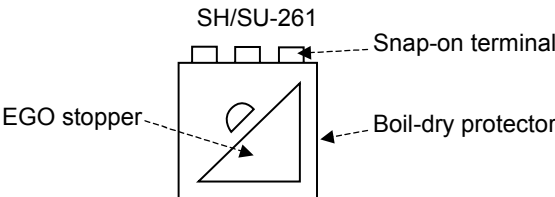
NO.	Check item	Check method	What to do
1	Overheat (Overcool) protector setting check	Check overheat protector is set 10°C or more higher than highest target temperature and higher than room temperature. Check overcool protector is set 5°C or more lower than lowest target temperature and lower than room temperature.	Correct setting as necessary.
2	Overheat (Overcool) protector operation check	Change overheat (overcool) protector setting and check devices trip around test area temperature. If devices do not trip, do the following. <ul style="list-style-type: none">• Check overheat (overcool) protector wiring.• Check temperature sensor. (See No. 3.)	Repair wiring.
		<ul style="list-style-type: none">• If above checks do not correct trouble, replace overheat (overcool) protector.	Replace device and check operation.
3	Overheat (Overcool) protector temperature sensor check	Disconnect temperature sensor terminals and measure resistance across both lead ends. If about 10 Ω, OK. If high or short-circuited, sensor is NG.	Replace sensor.
4	Temperature trip check	Run test again and check alarm occurs.	See "AL01" and "AL03".
5	Air circulator fan operation check	Check air circulator fan operation and rotation. Check fan motor is not generating strange noises.	Replace air circulator fan motor.
		Check for foreign matter or interference with fan mount.	Remove foreign matter. Reposition fan mount.
6	Air circulator fan motor temperature switch check	Check contact of temperature switch. Check contact is closed at room temperature.	Replace air circulator fan motor.

ALARM: AL13

Door open detection

NO.	Check item	Check method	What to do
1	Alarm state clearing	When chamber door is shut, chamber resumes operation. Clear alarm with  and  keys.	If alarm does not clear, check No. 2 and below.
2	Door switch check	Check operation of door switch magnet by moving it close to chamber frame switch. If OK, do the following. <ul style="list-style-type: none">• Check if door has lowered.	Reposition door and/or magnet.
		If NG, do the following. <ul style="list-style-type: none">• Check for faulty contact in connector (CN300) on electric parts chassis.• Check for faulty contact in temperature controller connector.	Repair connector wiring as necessary.
		<ul style="list-style-type: none">• Check operation of door switch with tester.	Replace door switch.
3	Temperature controller initialization (resetting)	If no trouble occurs when the above checks are done, initialize temperature controller and watch performance.	Initialize temperature controller.
			If initialization does not restore system, replace temperature controller.

TROUBLE: AL21 Humidifier boil-dry

NO.	Check item	Check method	What to do
1	Chamber level check	Check chamber is level. Incline may be within 1°.	Adjust level from adjustable feet.
2	Humidifying heater check	Check if dirt, scale or silica are adhering to humidifying heater.	Clean humidifying heater.
3	Humidifying tray water level check	Check humidifying heater is submerged.	Regulate humidifying tray water level.
		Check if humidifying tray is out of water.	See "AL26".
4	Boil-dry protector check	Check boil-dry protector setting. • Check setting dial shaft stopper (triangular plate) is not loose.	Anchor stopper.
		Check boil-dry protector operation. • Disconnect crimping terminals and check continuity with tester. Should be continuous at room temperature and not continuous when boil-dry detected.	Replace boil-dry protector.
		Check wiring and connectors. Check for faulty contact and other trouble in wiring and connectors between boil-dry protector and temperature controller.	Repair wiring and connectors as necessary.
		Check EGO stopper is correctly installed. SH/SU-221, 241, 641, 661  SH/SU-261 	Install stopper correctly.
5	Temperature controller initialization (resetting)	If no trouble occurs when the above checks are done, initialize temperature controller and watch performance.	Initialize temperature controller.
			If initialization does not restore system, replace temperature controller.

ALARM: AL22

Absolute high humidity alarm

Test area humidity exceeded the absolute high humidity setting.

NO.	Check item	Check method	What to do
1	Absolute high humidity alarm setting check	Check absolute high humidity alarm setting.	Correct setting. Set 10%rh higher than target humidity. See 5.3 in Basic Operation manual.
2	Wet-bulb wick status	Check if wet-bulb wick is dry or contaminated.	Replace wick. Check if wick pan is out of water. Add if necessary.
3	Refrigerator capacity switching solenoid valve check	<p>Check ON/OFF operation of refrigerator capacity switching solenoid valves (SV11 to 13).</p> <p>If following resistance is not obtained, trouble is in temperature controller board (TC1).</p> <p>At 100% refrigerator capacity: 0 to 10 Ω across pins 7 and 8, 9 and 10, and 11 and 12 of CN4.</p> <p>At 71 to 99% refrigerator capacity: Alternating between 0 to 10 Ω and $\infty\Omega$ across pins 7 and 8 of CN4. 0 to 10 Ω across pins 9 and 10, and 11 and 12 of CN4.</p> <p>At 70% refrigerator capacity: $\infty\Omega$ across pins 7 and 8 of CN4. 0 to 10 Ω across pins 9 and 10, and 11 and 12 of CN4.</p> <p>At 41 to 69% refrigerator capacity: $\infty\Omega$ across pins 7 and 8 of CN4. Alternating between 0 to 10 Ω and $\infty\Omega$ across pins 9 and 10 of CN4. 0 to 10 Ω across pins 11 and 12 of CN4.</p> <p>At 40% refrigerator capacity: $\infty\Omega$ across pins 7 and 8, and 9 and 10 of CN4. 0 to 10 Ω across pins 11 and 12 of CN4. (However, with SH/SU-261, $\infty\Omega$ across pins 7 and 8.)</p> <p>Check solenoid valve output as shown in "Table 4.4". If refrigerant does not flow on secondary side of solenoid valves (SV11 to 13), trouble is in solenoid valves.</p>	Replace solenoid valves (SV11 to 13).
4	Temperature controller board (TC1) check	<p>If following resistance is not obtained, trouble is in temperature controller board (TC1).</p> <p>At 100% refrigerator capacity: 0 to 10 Ω across pins 7 and 8, 9 and 10, and 11 and 12 of CN4.</p> <p>At 71 to 99% refrigerator capacity: Alternating between 0 to 10 Ω and $\infty\Omega$ across pins 7 and 8 of CN4. 0 to 10 Ω across pins 9 and 10, and 11 and 12 of CN4.</p> <p>At 70% refrigerator capacity: $\infty\Omega$ across pins 7 and 8 of CN4. 0 to 10 Ω across pins 9 and 10, and 11 and 12 of CN4.</p> <p>At 41 to 69% refrigerator capacity: $\infty\Omega$ across pins 7 and 8 of CN4. Alternating between 0 to 10 Ω and $\infty\Omega$ across pins 9 and 10 of CN4. 0 to 10 Ω across pins 11 and 12 of CN4.</p> <p>At 40% refrigerator capacity: $\infty\Omega$ across pins 7 and 8, and 9 and 10 of CN4. 0 to 10 Ω across pins 11 and 12 of CN4. (However, with SH/SU-261, $\infty\Omega$ across pins 7 and 8.)</p>	Replace temperature controller board.
5	Humidity control status check	Run chamber at 20°C/60%rh and check control. Check SSR with humidifying heater ON and humidity control OFF.	Replace SSR.

ALARM: AL23

Absolute low humidity alarm

Test area humidity exceeded the absolute low humidity setting.

NO.	Check item	Check method	What to do
1	Absolute low humidity alarm setting check	Check absolute low humidity alarm setting.	Correct setting. Set 10%rh lower than target humidity. See 5.3 in Basic Operation manual.

ALARM/TROUBLE: AL26

(If WATER lamp flashes or is lit and continuous buzzer sounds)

Water tank water level is low or the tank is empty.

NO.	Check item	Check method	What to do												
1	Water tank water level check	Check if WATER lamp on operating panel is flashing or is lit. If water level is about 30 mm or higher, lamp neither flashes or lights up solidly.	Add water to tank.												
2	Water tank – Coupler connection	Check water tank and coupler are properly connected. Coupler cannot be properly connected if middle bracket is out of place. See Fig. 5.17.	Install connection parts correctly.												
3	Foreign matter or air pocket in coupler or tubes	Check for foreign matter and air pockets in coupler or tubes between water tank and water level sensor container.	Free line of foreign matter and air pockets.												
4	Water level sensor container lid	Check water level sensor container lid is correctly attached. If raised, sensor cannot properly detect water level.	Install correctly. See “5.3 (2) Water Circuit Parts (Water Level Sensor Container and Pump)”.												
5	Water level sensor container float operation check	Check if water level sensor container float is stuck below water level despite presence of water. Also, check float rises/lowers smoothly.	Clean water level sensor container. See “5.3 (2) Water Circuit Parts (Water Level Sensor Container and Pump)”.												
6	Water level sensor container float (reed switch) operation check	<p>Disconnect relay connector (CN21) of water level sensor container and measure resistance at reed switch low level detection terminals and (1A and 2A) and empty detection terminals and (3A and 4A).</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>Low level detection (LS1)</th> <th>Empty detection (LS2)</th> </tr> </thead> <tbody> <tr> <td></td> <td>CN5 (1A, 2A)</td> <td>CN5 (3A, 4A)</td> </tr> <tr> <td>At or above reference water level</td> <td>$\infty\Omega$ (OFF)</td> <td>0Ω (ON)</td> </tr> <tr> <td>Below reference water level</td> <td>0Ω (ON)</td> <td>$\infty\Omega$ (OFF)</td> </tr> </tbody> </table> <p>For details, see “4.1 Water Circuit”.</p>		Low level detection (LS1)	Empty detection (LS2)		CN5 (1A, 2A)	CN5 (3A, 4A)	At or above reference water level	$\infty\Omega$ (OFF)	0 Ω (ON)	Below reference water level	0 Ω (ON)	$\infty\Omega$ (OFF)	Replace water level sensor. See “5.3 (2) Water Circuit Parts (Water Level Sensor Container and Pump)”.
	Low level detection (LS1)	Empty detection (LS2)													
	CN5 (1A, 2A)	CN5 (3A, 4A)													
At or above reference water level	$\infty\Omega$ (OFF)	0 Ω (ON)													
Below reference water level	0 Ω (ON)	$\infty\Omega$ (OFF)													

ALARM/TROUBLE: AL26

(If WATER lamp is out and continuous buzzer sounds)

Water circuit trouble (Water supply)

NO.	Check item	Check method	What to do				
1	Chamber level check	Check chamber is level. * Chamber is designed so that water does not overflow and run out when chamber is inclined 1° (12.7 mm high-low difference).	Adjust level from adjustable feet. See 5.3 in Basic Operation manual.				
2	Water level check	Check water is at WATER LEVEL mark on wick pan regulator, and humidifying tray and wick pan are at reference water level. Reference water level is less than 4 mm from test area floor. (Particularly, humidifying heater must be completely submerged. Humidifying tray must not overflow.)	Regulate water level. See "Regulating Humidifying Tray and Wick Pan Water Level" in 4.1 Water Circuit.				
3	Wick pan regulator float operation check	Check if wick pan regulator float is stuck below water level despite presence of water. Also, check float rises/lowers smoothly.	Clean wick pan regulator. See "5.3 (1) Wick Pan Regulator".				
4	Wick pan regulator float (reed switch) operation test	Check continuity of wick pan regulator reed switch (LS3). Disconnect relay connector (CN5) from temperature controller board (TC1) and measure resistance at reed switch terminals [5] and [6] (5A and 6A). At or above reference water level: ∞Ω (OFF) Below reference water level: 0Ω (ON)	Replace wick pan regulator reed switch (LS3). See "5.3 (1) Wick Pan Regulator".				
5	Electromagnetic pump (P1) power supply check	Check voltage across electromagnetic pump (P1) terminals (wires Nos. 2 and 18) in drive state. Normal: Approx. 32 to 35V DC If abnormal, diode requires checking. (* Electromagnetic pump runs on 100V AC, but diode rectifies supply to half wave.)	Replace pump (P1). See "5.3 (2) Water circuit Parts (Water Level Sensor Container and Pump)".				
6	Diode (D1)	Detach diode and check continuity with applicable tester. <table border="1" data-bbox="545 1178 1171 1379"> <tr> <td>Touch tester positive side to diode primary (wires No. 17) and negative side to diode secondary (wires No. 18).</td> <td>Continuous</td> </tr> <tr> <td>Touch tester positive side to diode primary (wires No. 17) and negative side to diode secondary (wires No. 18).</td> <td>Not continuous</td> </tr> </table>	Touch tester positive side to diode primary (wires No. 17) and negative side to diode secondary (wires No. 18).	Continuous	Touch tester positive side to diode primary (wires No. 17) and negative side to diode secondary (wires No. 18).	Not continuous	Replace diode (D1). * Insulate inside electric parts compartment with heat shrink tube.
Touch tester positive side to diode primary (wires No. 17) and negative side to diode secondary (wires No. 18).	Continuous						
Touch tester positive side to diode primary (wires No. 17) and negative side to diode secondary (wires No. 18).	Not continuous						
7	Pump drive output from temperature controller board (TC1)	If terminals ⑬ and ⑭ of temperature controller board connector (CN4) are not continuous when electromagnetic pump is in drive state, trouble is in temperature controller board. Disconnect power line from terminals ⑬ and ⑭ before measurement. For electromagnetic pump drive state, see Fig. 4.2.	Replace temperature controller board (TC1). See "5.1 (3) Temperature Controller Board (ROM): Electric Parts Compartment".				
8	Temperature controller initialization (resetting)	Initialize temperature controller and check system is restored.	For initialization, see "6.2 Temperature (Humidity) Controller Initialization".				
9	Water tubing	Check water tubing is not clogged.	Clear clog and eliminate cause.				

TROUBLE: AL31

Program data setting is out of range.

NO.	Check item	Check method	What to do
1	Program data setting	Check if temperature or humidity setting in program data is in the range of absolute high or low limit.	Set program data within the range of absolute high or low limit, or change the absolute high or low limit setting.
2	Power restarting	Set main power switch in ON position and watch situation.	
3	Temperature controller initialization (resetting)	If no trouble occurs when the above checks are done, initialize temperature controller and watch situation.	Initialize temperature controller. If initialization does not restore system, replace temperature controller.

TROUBLE: AL99

Communication error

NO.	Check item	Check method	What to do
1	Power restarting	Set main power switch in ON position and watch situation.	
2	Temperature controller initialization (resetting)	If no trouble occurs when the above checks are done, initialize temperature controller and watch situation.	If initialization does not restore system, replace temperature controller.

Chapter 4

Checks and Adjustments

This chapter explains how to make adjustments and identify faulty parts. For temperature controller checks and adjustments, see “Chapter 6 Temperature (Humidity) Controller Adjustments”.

4.1 Water Circuit

Operation and Configuration

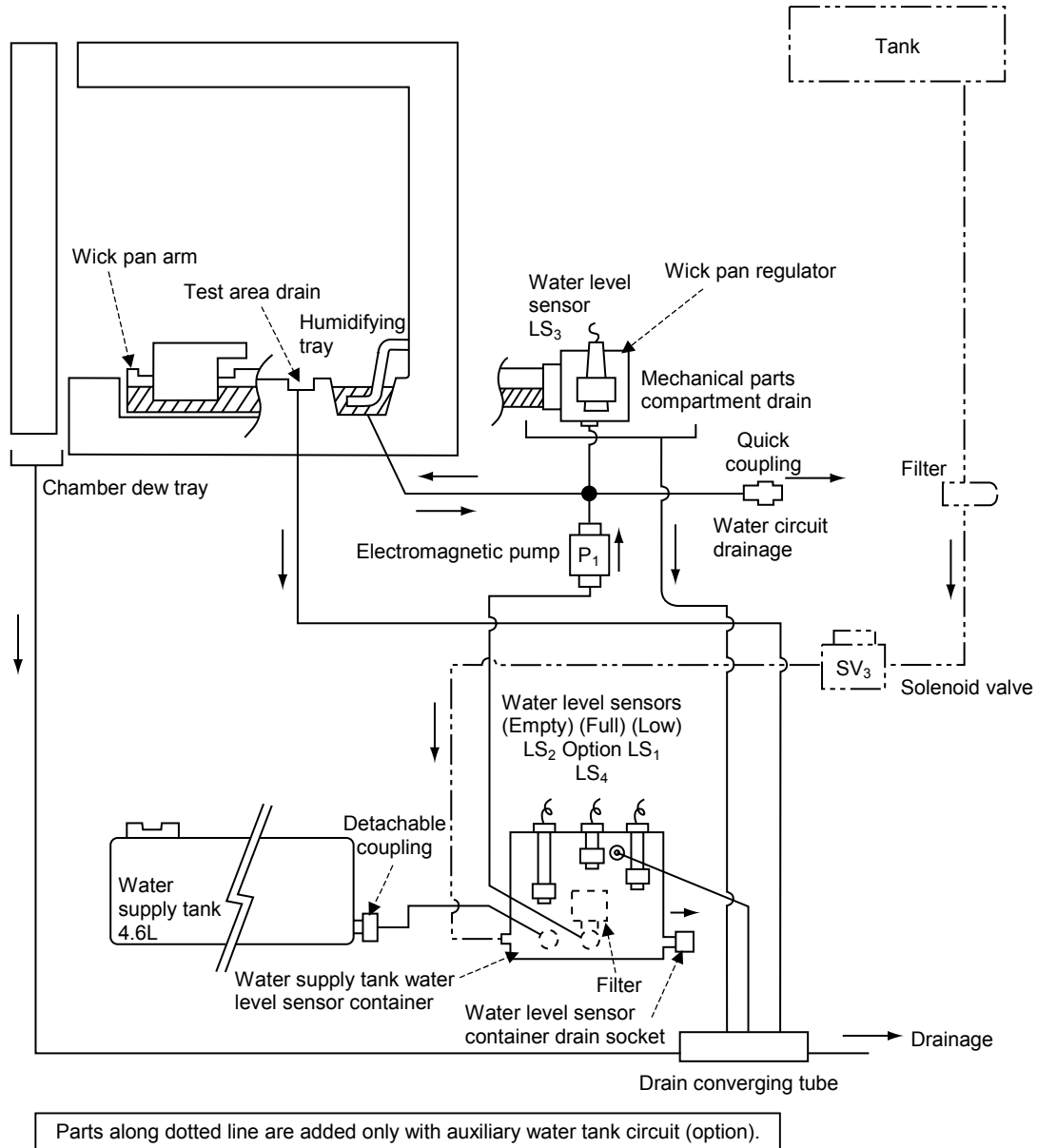


Fig. 4.1 Water circuit configuration

■ Water Circuit Operation (At start of humidity-controlled operation)

- When the water supply tank is filled with deionized water and set in the water circuit compartment underneath the chamber, water is supplied to the water supply tank water level sensor container.
- When temperature and humidity-controlled operations start, the electromagnetic pump pumps water from the water supply tank water level sensor container to the wick pan regulator. (The pump repeated turns ON for 5 sec and OFF for 10 sec.)
- When the wick pan regulator reaches the reference level, the electromagnetic pump stops pumping water. Three sec after the reference water level has been reached, humidifying heater charging starts.

- Water level is controlled by the float in the wick pan regulator. Water in the wick pan and humidifying tray are controlled to the same level.

■ Control (In normal humidity-controlled operation)

- When the water level in the wick pan regulator drops, the electromagnetic pump turns ON. The pump repeatedly turns ON for 1 sec and OFF for 30 sec, until water in the wick pan regulator reaches the reference level.
- If the water supply tank water level sensor container becomes empty and the water level in the wick pan regulator drops below the reference level, the humidifying heater is forcefully shut OFF until water in the wick pan regulator reaches the reference level.

■ Drainage (Manual)

- Before running temperature-only operations or cleaning the humidifying tray, connect the humidifying tray drain hose (included) to the water circuit drain plug on the chamber rear and drain the humidifying tray.
- Before cleaning the pump filter in the water supply tank water level sensor container or draining the water circuit, connect the water level sensor container drain hose (included) to the water level sensor container drain socket on the chamber rear and drain the water level sensor container.

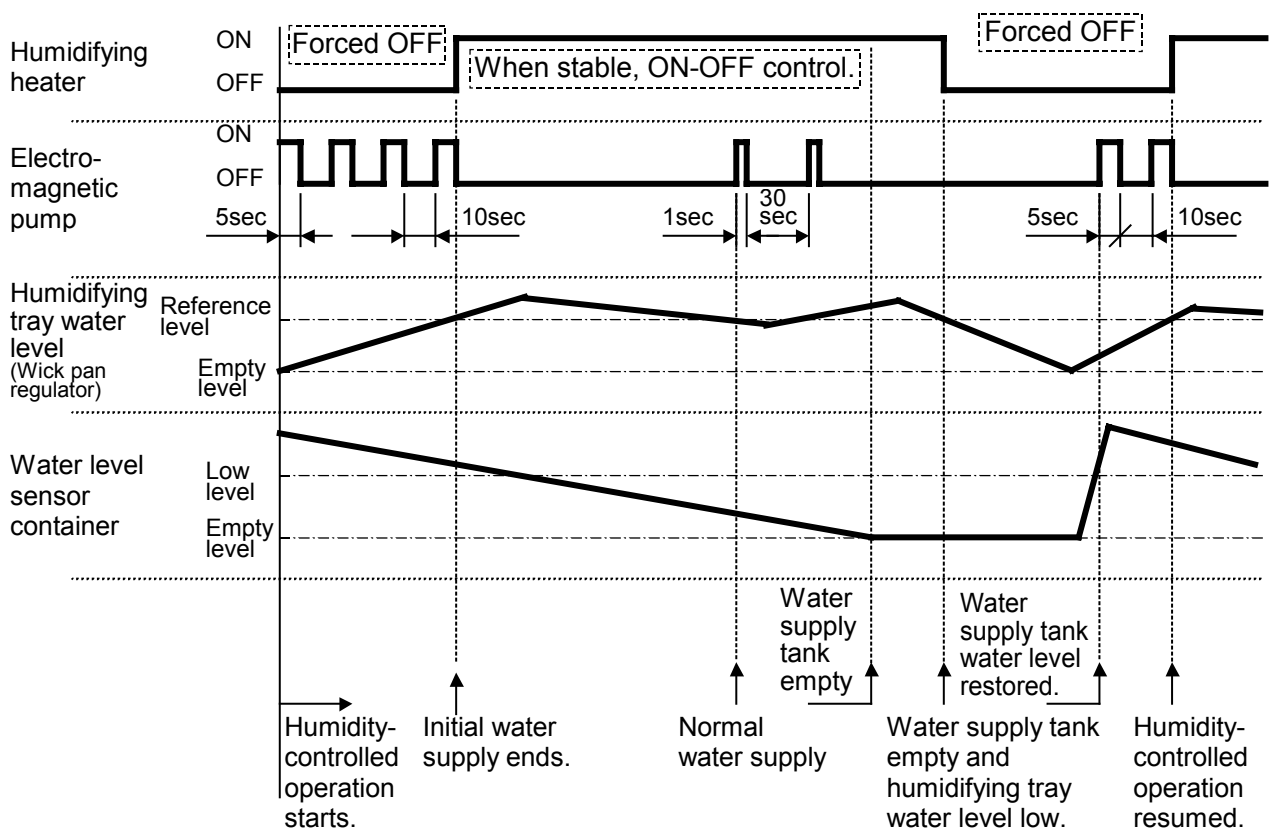
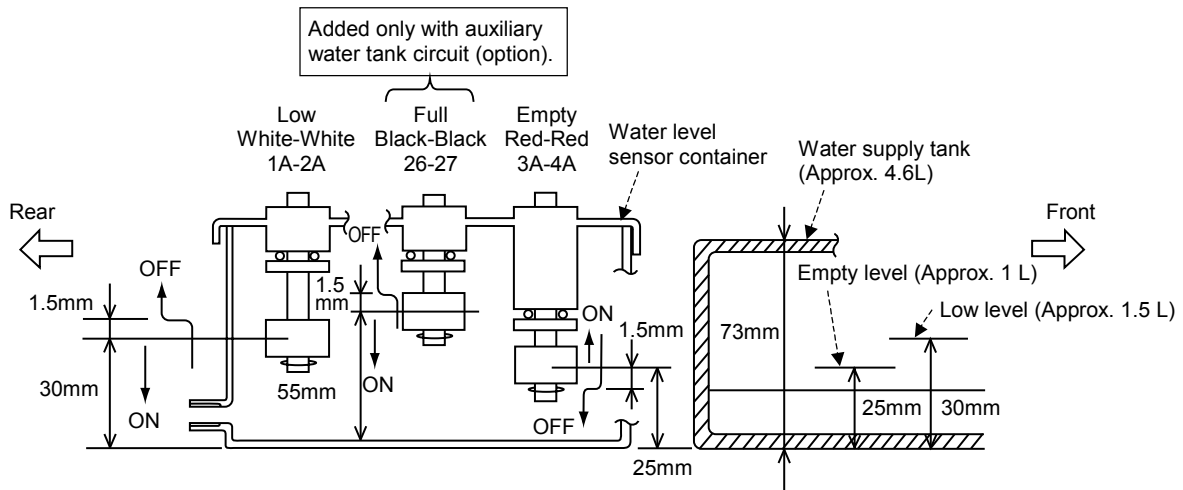


Fig. 4.2 Temperature-Humidity control in normal operation

Alarm Operation



* When the chamber is equipped with the auxiliary water tank circuit (option), water level in the water level sensor container and the water supply tank are not always the same. (The water supply tank cap contains a check valve that seals it airtight, but also makes it hard for water to enter the tank.)

Fig. 4.3 Water level relationship between level switch operation and water supply tank

Table 4.1 Relationship of water supply tank water level to indications and operations

Water supply tank water level	Trip condition	Displayed indication/Buzzer	Remarks
Above low level		[No alarm displayed] [Buzzer not sounded] [WATER lamp out]	
At low water level (30 mm mark in tank/Approx. 1.5 L)	If water level drops to low level trip position, 1A-2A of low level switch (LS1) turn ON. ON condition held for 10 sec. (During normal water supply)	["AL26" displayed] [Intermittent buzzer emitted] [WATER flashes]	Temperature-Humidity control continues and water is supplied to tank. When 1A-2A turns OFF, "AL26" goes out and intermittent buzzer stops. Temperature and humidity control continue as is. However, displayed code and buzzer are not released until an operating panel key is pressed.
At empty level (25 mm mark in tank/Approx. 1 L)	If water level drops to empty level trip position, 3A-4A of empty level switch (LS2) turn OFF. OFF condition held for 10 sec. (During normal water supply)	["AL26" displayed] [Intermittent buzzer emitted] [WATER lit solidly]	Temperature and humidity control continue as long as humidifying tray water level is within reference level range. If humidifying tray water level drops below reference level, reed switch (LS3) of wick pan regulator turns ON, and humidifying heater and electromagnetic pump stop.

Fig. 4.2 Relationship of humidifying tray water level to indications and operations

Water supply tank water level	Trip condition	Displayed indication/ Buzzer	Remarks
Wick pan regulator at or below reference level	<u>At humidity-controlled operation start</u> Even though electromagnetic pump drive enable continues for 10 min, humidifying tray does not rise to reference level. Reed switch (LS3) does not turn OFF.	["AL26" displayed] [Continuous buzzer emitted]	Humidifying heater and electromagnetic pump stop. However, if backup mode in test environment setup is OFF, heater, test area air circulator and refrigerator turn OFF, too.
	<u>During normal humidity-controlled operation</u> Even though electromagnetic pump drive enable continues for 40 min, humidifying tray does not rise to reference level. Reed switch (LS3) does not turn OFF.		

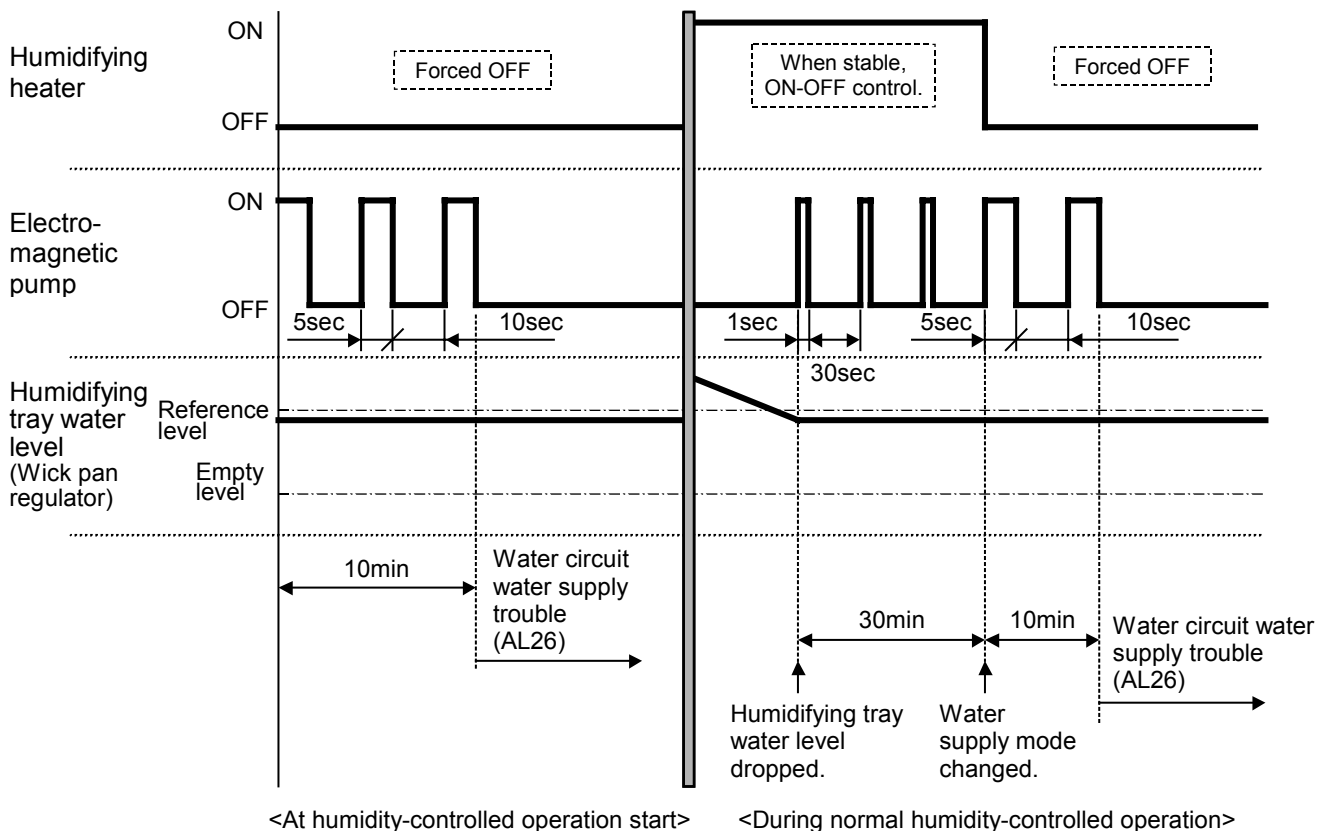


Fig. 4.4 Temperature-Humidity control when water circuit trouble occurs

Regulating Humidifying Tray and Wick Pan Water Level

■ Preparations

1. Container for collecting water. Water may be drained depending on water level.

■ Checking Humidifying Tray and Wick Pan Water Level

1. Shut power OFF at the main power switch.
2. Open the chamber door. Remove the screws that lock down the top and bottom test area partitions and detach the partitions. (See Fig. 5.26.)
3. Remove the screw that locks the water level check panel to the chamber rear panel and detach the check panel.

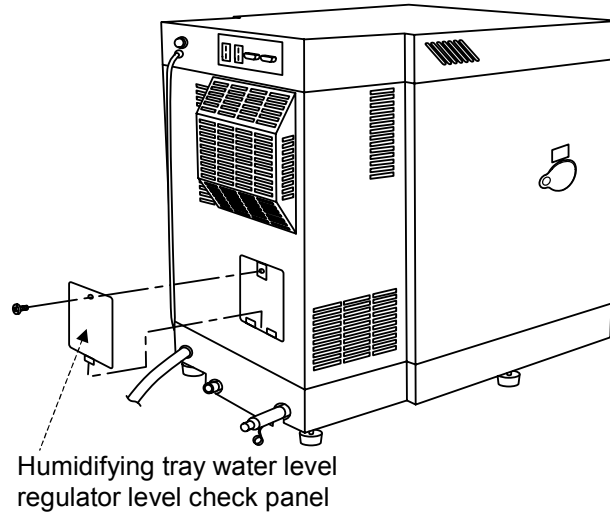


Fig. 4.5 Detaching the humidifying tray water level regulator level check panel

4. Check that water in the wick pan regulator is at the WATER LEVEL line and that water in the humidifying tray and wick pan is at the reference level (4 mm below test area floor). (In particular, make sure the humidifying heater is completely submerged and that water in the humidifying tray is not overflowing.)

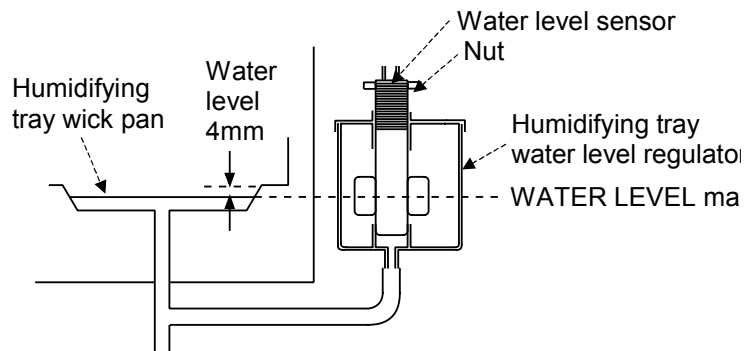


Fig. 4.6 Relationship of the humidifying tray water level regulator to humidifying tray and wick pan

Regulating Humidifying Tray and Wick Pan Water Level

Water can drop below or rise above the reference level for the following reasons.

- When the water supply tank is not properly connected to the water circuit compartment
(Water is not supplied to the humidifying tray [wick pan] regulator.)
- When the chamber is not level
- When water in the humidifying tray (wick pan) regulator is not at the reference level

If the water supply tank is not properly connected to the water circuit compartment, press it inward until hearing it catch so as to securely connect it to the water circuit compartment.

If the chamber is not level, adjust height from the adjustable feet. Place a level in the test area to check level.

If water in the humidifying tray (wick pan) regulator is not at the reference level, regulate water level as follows.

When water level is too low

Perform the below procedure with the test area top and bottom partitions and the water level check panel detached.

1. Reaching in from the water level check panel opening, loosen the nut on top of the wick pan regulator, turn the water level sensor counterclockwise as seen from above until water level is high enough, and then retighten the nut.
2. Turn power ON at the main power switch and press the **POWER** key. Run the chamber to 30°C/40%rh and check if an alarm is triggered.
3. Check if water in the humidifying tray and wick pan are the proper level.
4. If water is at the proper level, press the **POWER** key and shut power OFF at the main power switch.

Once power has been shut OFF at the main power switch, reattach the test area top and bottom partitions and the water level check panel. This completes the procedure.

If water is not at the proper level, repeat steps 1 through 4.

When water level is too high

Perform the below procedure with the test area top and bottom partitions and the water level check panel detached.

1. Reaching in from the water level check panel opening, loosen the nut on top of the wick pan regulator, turn the water level sensor clockwise as seen from above until water level is low enough, and then retighten the nut.

2. Connect the included humidifying tray drain hose as shown in Fig. 5.14 and drain the humidifying tray and wick pan as necessary.
3. Turn power ON at the main power switch and press the **POWER** key.
Run the chamber to 30°C/40%rh and check if an alarm is triggered.
4. Check if water in the humidifying tray and wick pan are the proper level.
5. If water is at the proper level, press the **POWER** key and shut power OFF at the main power switch.

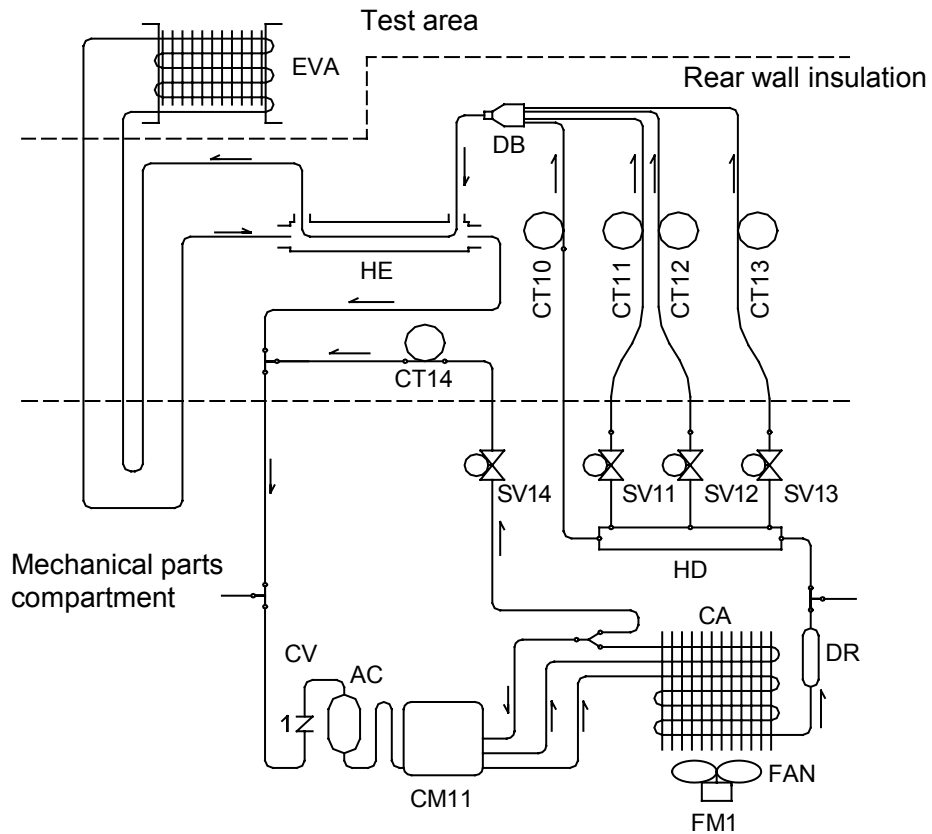
Once power has been shut OFF at the main power switch, reattach the test area top and bottom partitions and the water level check panel and disconnect the humidifying tray drain hose. This completes the procedure.

If water is not at the proper level, repeat steps 1 through 5.

4.2 Refrigerator

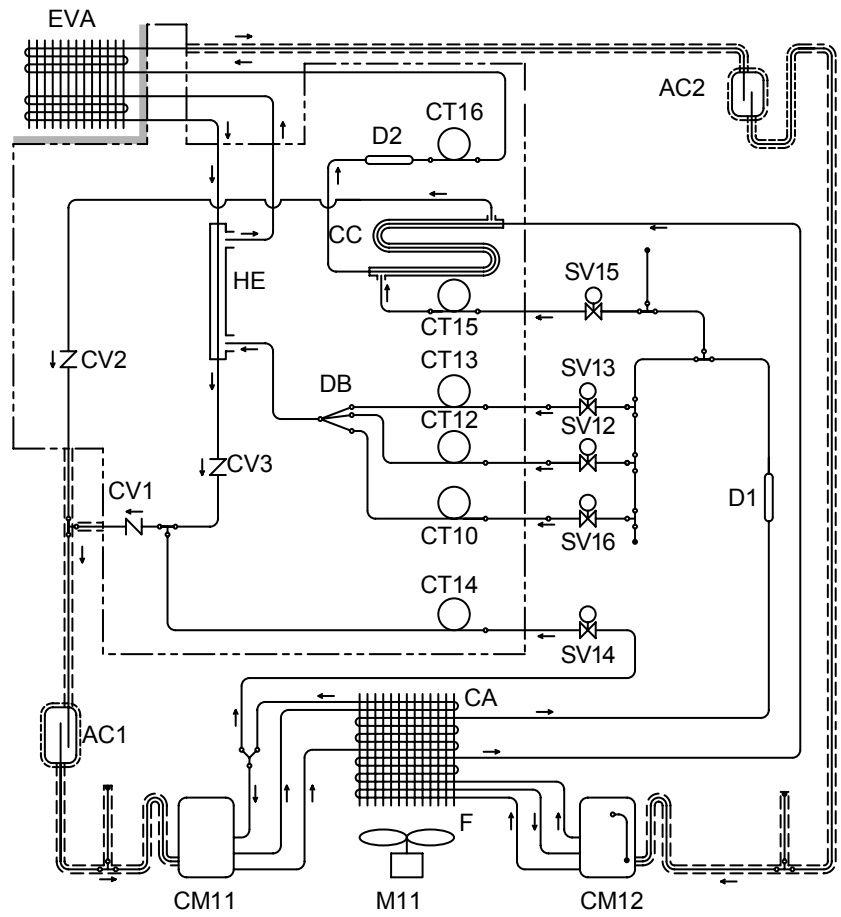
Refrigerator Diagnostics and Precautions

■ Refrigeration Circuit



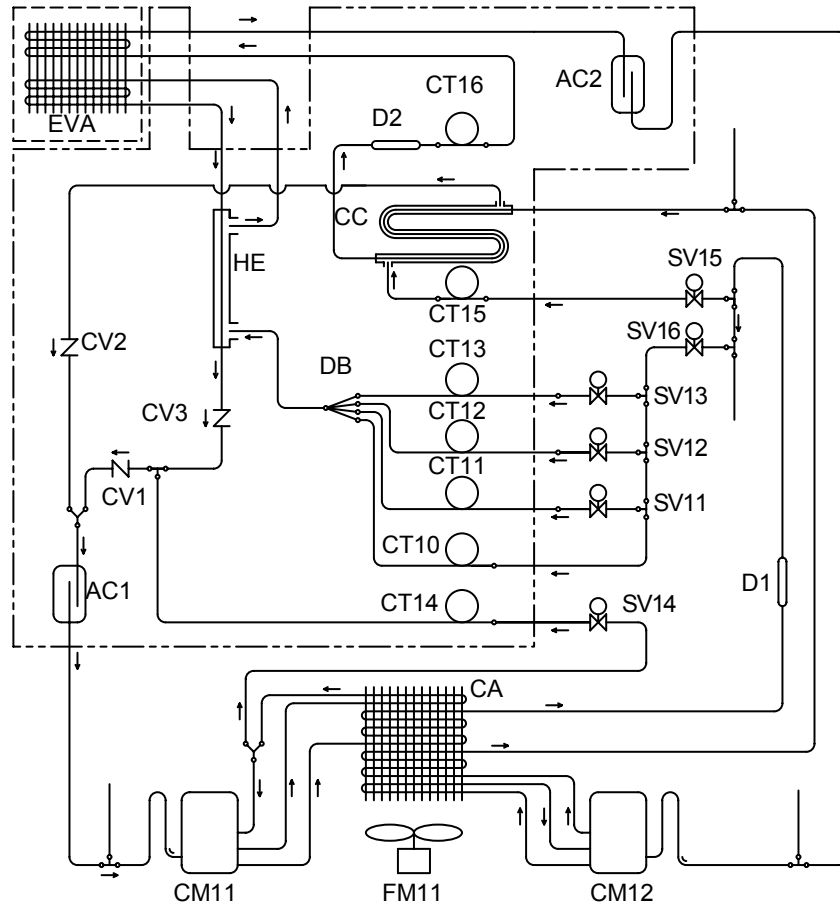
Use specified copper pipe and observe bend radius.

Fig. 4.7 Refrigeration circuit (SH/SU-221/241)



* Double-dashed lines indicate urethane foam insulation.

Fig. 4.8 Refrigeration circuit (SH/SU-261)



* Double-dashed lines indicate urethane foam insulation.

Fig. 4.9 Refrigeration circuit (SH/SU-641, 661)

Table 4.3 Major differences from older refrigeration circuit

	Current	Old
Type of refrigerator unit	Single-stage unit (SH/SU-221/241) Cascade unit (SH/SU-261/641/661)	Single-stage unit only
Piping diameter	1/4" and 3/16"	1/4" and 3/8"
Piping bend radius	12.5 mm	1/4" pipe → 9/16" R 3/8" pipe → 15/16" R
Compressor	Silent type (C-2SN400L0V)	C-2SN400L0W
Refrigerator capacity control system	Time-sharing control using solenoid valves Multi-step control between 10 and 100%	Rapid cooling, SAVE-H, SAVE-L
Compressor cooling system	Liquid-gas heat exchanger	Suction bypass system (SAVE-H)
Subcooler for compressor	With built-in condenser	Self-standing type (Coil)
Other	Installation of hot gas bypass	—

■ Refrigerator Operating Mode Selection

- ON: The refrigerator is ON in all temperature and humidity zones. Solenoid valve output is fixed. (SV12 and SV13 ON)
- OFF: The refrigerator is OFF.
- AUTO: The refrigerator can run in all temperature and humidity zones. Capacity is controlled by time-sharing control using solenoid valves. The refrigerator is OFF only in temperature-only operation when the target temperature is 62.6°C (72.6°C for SH/SU-641/661) or higher and the temperature controller judges that cooling is unnecessary. (In humidity operations, the refrigerator does not turn OFF.)

Table 4.4 Solenoid valve output in refrigerator auto mode

	Refrigerator capacity	SV11 (Not equipped on SH/SU-261)	SV12	SV13	SV14	SV15 (Not equipped on SH/SU-221/241)	SV16 (Not equipped on SH/SU-221/241)
Single-stage refrigeration	100%	ON	ON	ON	ON *1	OFF	ON
	99 to 71%	ON/OFF	ON	ON			
	70%	OFF	ON	ON			
	69% to 41%	OFF	ON/OFF	ON			
	40%	OFF	OFF	ON			
	39% to 11%	OFF	OFF	ON/OFF			
	10%	OFF	OFF	OFF			
*2 Cascade refrigeration		OFF	OFF	OFF	OFF	ON	OFF

*1 The refrigerator turns OFF when the target temperature is set to -20°C and below.

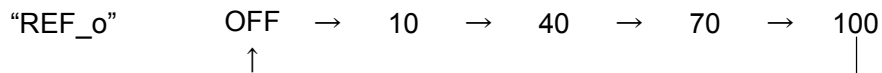
*2 Cascade refrigeration is only for the SH/SU-261/641, 661.

Cascade refrigeration is used in temperature pull-down when the test area temperature is less than 0°C and the target temperature is less than -17.5°C.

Cascade refrigeration is used in temperature heat-up when the test area temperature is less than -25°C and the target temperature is less than -17.5°C.

■ Solenoid Valve Fixed Output Mode (Service Mode)

Get the test environment setup mode from the operating panel. Then, press the (SET) key 3 times and the (NEXT) key 6 times so that “REF_o” is displayed.



Refrigeration circuit status can be diagnosed from the heater output value when this output is stable.

Table 4.5 Heater output value at 20°C test area temperature and 23°C room temperature (50/60 Hz)

- The refrigerator stops if the target temperature and/or test area temperature are less than 0°C or higher than 60°C.

Fixed output mode	Solenoid valve output				Heater output		
	SV11	SV12	SV13	SV14	SH/SU-221/241	SH/SU-261	SH/SU-641/661
REF_o 10	OFF	OFF	OFF	ON	0% to 5%	0% to 5%	5% to 10%
REF_o 40	OFF	OFF	ON	ON	20% to 30%	25% to 35%	15% to 20%
REF_o 70	OFF	ON	ON	OFF	40% to 50%	60% to 70%	25% to 35%
REF_o 100 (100% not available for SH/SU-261)	ON	ON	ON	OFF	60% to 70%	—	40% to 50%

Example: If measurement results are:

REF_o 10 → 5%

REF_o 40 → 25%

REF_o 70 → 45%

REF_o 100 → 45%

→ SV11 is malfunctioning or CT 11 is clogged.

Refrigerator Adjustment Data and Operation Matrixes

■Notes

1. Refrigerant

The chamber uses an HFC refrigerant of 0 ozone depletion factor. Both this HFC refrigerant and the refrigerator machine oil despise moisture. Moisture in the air can hydrolyze these substances. Accordingly, in order to prevent them from absorbing moisture from the air, keep the refrigerator circuit open and exposed to the atmosphere no more than 15 min.

2. Refrigerant adjustment data

Refrigerant level can change. The below serves only as a reference.

Table 4.6 Refrigerant adjustment data (For reference only) (SH/SU-221/241)

60Hz

Condition	Target test area temperature	150°C	-40°C	20°C	-40°C
	Monitored test area temperature (°C)	146.7	-40.2	19.9	-40.0
	Refrigerator setting	ON	AUTO	AUTO	AUTO
	Room temperature (°C)	43.2	23.0	23.0	5.5
Measured value	Compressor surface temperature (Oil) (°C)	86.9	53.9	64.7	37.7
	Compressor surface temperature (Motor) (°C)	90.4	58.5	69.7	42.9
	Subcooler inlet temperature (°C)	110.0	64.2	74.4	47.0
	Subcooler outlet temperature (°C)	75.2	36.1	34.4	16.6
	Discharge pipe temperature (°C)	93.0	56.4	60.3	40.5
	Condensing temperature (°C)	55.7	32.6	25.2	13.7
	Vapor temperature (°C)	-30.9	-42.4	-48.7	-44.6
	Intake pipe temperature (°C)	48.4	-29.3	-3.4	-33.3
	High pressure (MPa)	2.62	1.53	1.26	0.91
	Low pressure (MPa)	0.18	0.10	0.07	0.09
	Current (A)	4.63	2.20	1.46	1.71

50Hz

Condition	Target test area temperature	20°C	-40°C	-40°C	20°C	-40°C
	Monitored test area temperature (°C)	19.6	-38.0	-40.2	19.9	-40.2
	Refrigerator setting	AUTO	AUTO	AUTO	AUTO	AUTO
	Room temperature (°C)	34.7	34.7	23.1	23.1	0.9
Measured value	Compressor surface temperature (Oil) (°C)	70.8	62.2	52.1	62.5	28.8
	Compressor surface temperature (Motor) (°C)	76.8	67.1	58.0	69.2	33.5
	Subcooler inlet temperature (°C)	87.7	76.1	61.4	71.5	37.2
	Subcooler outlet temperature (°C)	51.9	52.1	36.0	34.6	11.2
	Discharge pipe temperature (°C)	75.0	66.5	55.9	60.2	31.3
	Condensing temperature (°C)	40.3	42.7	32.2	25.5	8.6
	Vapor temperature (°C)	-28.4	-37.0	-41.8	-47.8	-44.7
	Intake pipe temperature (°C)			-33.4	-2.3	-33.9
	High pressure (MPa)	1.85	1.96	1.51	1.27	0.78
	Low pressure (MPa)	0.20	0.14	0.11	0.08	0.09
	Current (A)	3.54	3.29	2.68	2.32	2.20

Table 4.7 Refrigerant adjustment data (For reference only) (SH/SU-261)

60Hz

Condition	Target temperature (°C)	150	-60	20	-60
	Test area temperature (°C)	150	-60	20	-60
	Operating mode (Single-stage/Cascade)	Single-stage	Cascade	Single-stage	Cascade
	Room temperature (°C)	40.3	23.6	22.9	4.7
Measured value	High temperature side compressor surface temperature (Oil) (°C)	82.8	49.4	54.1	27.3
	High temperature side compressor surface temperature (Coil) (°C)	91.2	55.2	60.9	32.4
	High temperature side compressor subcooler inlet temperature (°C)	102.7	65.0	68.3	41.5
	High temperature side compressor subcooler outlet temperature (°C)	64.6	38.6	31.9	16.1
	High temperature side compressor discharge pipe temperature (°C)	88.6	55.0	50.9	32.0
	High temperature side condensing temperature (°C)	47.7	33.8	25.4	14.2
	High temperature side condenser outlet temperature (°C)	45.2	34.0	25.2	11.7
	High temperature side vapor temperature (°C)	-28.8	—	-49.0	—
	High temperature side heat exchanger inlet temperature (°C)	12.2	—	-47.7	—
	High temperature side evaporator outlet temperature (°C)	33.9	—	-1.1	—
	High temperature side heat exchanger outlet temperature (°C)	32.1	—	-41.5	—
	High temperature side cascade condenser inlet temperature (°C)	74.9	-29.3	—	-36.2
	High temperature side cascade condenser outlet temperature (°C)	73.5	-20.7	—	-37.4
	High temperature side accumulator temperature (°C)	34.4	-16.4	-4.7	-32.9
	High temperature side return pipe temperature (°C)	35.6	-13.6	3.0	-29.4
	High temperature side high pressure (MPa)	2.2	1.6	1.21	0.91
	High temperature side low pressure (MPa)	0.1	0.07	-0.02	0.03
	High temperature side compressor current (A)	4.5	3.18	2.13	2.52
	Low temperature side compressor surface temperature (Oil) (°C)	—	55.0	—	38.9
	Low temperature side compressor surface temperature (Coil) (°C)	—	60.9	—	44.3
	Low temperature side compressor subcooler inlet temperature (°C)	—	69.0	—	52.1
	Low temperature side compressor subcooler outlet temperature (°C)	—	34.4	—	13.3
	Low temperature side compressor discharge pipe temperature (°C)	—	58.7	—	42.0
	Low temperature side cascade condenser inlet temperature (°C)	—	34.3	—	14.6
	Low temperature side cascade condenser outlet temperature (°C)	—	-27.9	—	-34.3
	Low temperature side vapor temperature (°C)	—	-75.5	—	-77.0
	Low temperature side evaporator outlet temperature (°C)	—	-59.1	—	-62.0
	Low temperature side accumulator temperature (°C)	—	-56.2	—	-59.3
	Low temperature side return pipe temperature (°C)	—	-42.0	—	-47.1
	Low temperature side high pressure (MPa)	—	1.11	1.52	0.88
	Low temperature side low pressure (MPa)	—	0.13	1.52	0.11
	Low temperature side compressor current (A)	—	2.7	—	2.49

50Hz

Condition	Target temperature (°C)	20	-60	-60	20	-60
	Test area temperature (°C)	20	-60	-60	20	-60
	Operating mode (Single-stage/Cascade)	Single-stage	Cascade	Cascade	Single-stage	Cascade
	Room temperature (°C)	34.5	35.5	23.6	22.9	0.3
Measured value	High temperature side compressor surface temperature (Oil) (°C)	65.2	65.9	47.5	52.3	22.2
	High temperature side compressor surface temperature (Coil) (°C)	73.5	72.7	53.9	60.5	31.7
	High temperature side compressor subcooler inlet temperature (°C)	80.8	82.0	60.4	64.8	33.7
	High temperature side compressor subcooler outlet temperature (°C)	46.0	53.4	37.6	30.2	11.7
	High temperature side compressor discharge pipe temperature (°C)	64.7	72.3	53.8	50.1	31.6
	High temperature side condensing temperature (°C)	37.5	46.1	33.8	25.3	10.2
	High temperature side condenser outlet temperature (°C)	37.4	47.5	33.9	25.3	6.5
	High temperature side vapor temperature (°C)	-41.0	—	—	-47.0	1.1
	High temperature side heat exchanger inlet temperature (°C)	-39.9	—	—	-45.8	-11.8
	High temperature side evaporator outlet temperature (°C)	4.2	—	—	-1.9	-8.5
	High temperature side heat exchanger outlet temperature (°C)	-33.9	—	—	-40.2	-6.4
	High temperature side cascade condenser inlet temperature (°C)	—	-25.0	-28.5	—	-35.7
	High temperature side cascade condenser outlet temperature (°C)	—	-1.6	-25.7	—	-36.8
	High temperature side accumulator temperature (°C)	2.2	1.8	-20.9	-7.4	-37.5
	High temperature side return pipe temperature (°C)	8.7	4.3	-17.3	0.9	-33.2
	High temperature side high pressure (MPa)	1.67	2.17	1.58	1.2	0.79
	High temperature side low pressure (MPa)	0.0	0.12	0.09	-0.03	0.04
	High temperature side compressor current (A)	3.23	4.21	3.64	3.15	4.5
	Low temperature side compressor surface temperature (Oil) (°C)	—	65.1	53.7	—	36.6
	Low temperature side compressor surface temperature (Coil) (°C)	—	73.1	61.2	—	46.4
	Low temperature side compressor subcooler inlet temperature (°C)	—	78.8	67.7	—	49.1
	Low temperature side compressor subcooler outlet temperature (°C)	—	48.6	35.0	—	10.3
	Low temperature side compressor discharge pipe temperature (°C)	—	70.4	58.0	—	43.7
	Low temperature side cascade condenser inlet temperature (°C)	—	46.9	34.0	—	10.8
	Low temperature side cascade condenser outlet temperature (°C)	—	-23.2	-27.3	—	-33.5
	Low temperature side vapor temperature (°C)	—	-73.4	-75.0	—	-75.2
	Low temperature side evaporator outlet temperature (°C)	—	-57.4	-58.9	—	-61.0
	Low temperature side accumulator temperature (°C)	—	-54.2	-54.9	—	-59.4
	Low temperature side return pipe temperature (°C)	—	-38.4	-41.1	—	-48.4
	Low temperature side high pressure (MPa)	1.63	1.3	1.13	1.45	0.80
Low temperature side low pressure (MPa)	1.62	0.15	0.14	1.45	0.04	
Low temperature side compressor current (A)	—	3.45	3.23	—	4.4	

Table 4.8 Refrigerant adjustment data (For reference only) (SH/SU-641, 661)

60Hz

Condition	Target temperature (°C)	150	-60
	Test area temperature (°C)	150	-60
	Operating mode (Single-stage/Cascade)	Single-stage	Cascade
	Room temperature (°C)	41.2	6.5
Measured value	High temperature side compressor surface temperature (Oil) (°C)	81.1	34.9
	High temperature side compressor surface temperature (Coil) (°C)	89.7	39.5
	High temperature side compressor subcooler inlet temperature (°C)	64.0	13.4
	High temperature side compressor subcooler outlet temperature (°C)	101.1	46.9
	High temperature side compressor discharge pipe temperature (°C)	90.1	40.2
	High temperature side condensing temperature (°C)	50.2	11.3
	High temperature side condenser outlet temperature (°C)	/	/
	High temperature side vapor temperature (°C)	-14.6	—
	High temperature side heat exchanger inlet temperature (°C)	/	—
	High temperature side evaporator outlet temperature (°C)	136.4	—
	High temperature side heat exchanger outlet temperature (°C)	/	—
	High temperature side cascade condenser inlet temperature (°C)	—	-45.7
	High temperature side cascade condenser outlet temperature (°C)	—	-11.9
	High temperature side accumulator temperature (°C)	/	/
	High temperature side return pipe temperature (°C)	46.8	14.8
	High temperature side high pressure (MPa)	2.44	0.87
	High temperature side low pressure (MPa)	0.32	0.08
	High temperature side compressor current (A)	4.33	2.00
	Low temperature side compressor surface temperature (Oil) (°C)	—	45.5
	Low temperature side compressor surface temperature (Coil) (°C)	—	51.9
	Low temperature side compressor subcooler inlet temperature (°C)	—	16.0
	Low temperature side compressor subcooler outlet temperature (°C)	—	68.9
	Low temperature side compressor discharge pipe temperature (°C)	—	51.5
	Low temperature side cascade condenser inlet temperature (°C)	—	/
	Low temperature side cascade condenser outlet temperature (°C)	—	/
	Low temperature side vapor temperature (°C)	—	/
	Low temperature side evaporator outlet temperature (°C)	—	-57.0
	Low temperature side accumulator temperature (°C)	—	/
	Low temperature side return pipe temperature (°C)	—	-28.2
	Low temperature side high pressure (MPa)	—	1.80
	Low temperature side low pressure (MPa)	—	0.12
	Low temperature side compressor current (A)	—	3.15

50Hz

Condition	Target temperature (°C)	20	-60	-60	20	-60
	Test area temperature (°C)	20	-60	-60	20	-60
	Operating mode (Single-stage/Cascade)	Single-stage	Cascade	Cascade	Single-stage	Cascade
	Room temperature (°C)	36.0	40.1	23.7	22.9	6.6
Measured value	High temperature side compressor surface temperature (Oil) (°C)	59.3	68.7	43.0	45.0	29.7
	High temperature side compressor surface temperature (Coil) (°C)	65.9	76.4	47.1	52.1	34.8
	High temperature side compressor subcooler inlet temperature (°C)	49.1	57.3	33.4	34.1	15.2
	High temperature side compressor subcooler outlet temperature (°C)	72.6	85.1	55.7	58.1	43.7
	High temperature side compressor discharge pipe temperature (°C)	66.5	77.8	48.8	52.8	37.6
	High temperature side condensing temperature (°C)	42.3	50.9	31.8	28.1	13.3
	High temperature side condenser outlet temperature (°C)	/	/	/	/	-
	High temperature side vapor temperature (°C)	-22.7	-	-	-29.8	-
	High temperature side heat exchanger inlet temperature (°C)	/	-	-	/	-
	High temperature side vapor outlet temperature (°C)	18.5	-	-	17.8	-
	High temperature side heat exchanger outlet temperature (°C)	/	-	-	/	-34.7
	High temperature side cascade condenser inlet temperature (°C)	-	-18.0	-27.9	-	-22.6
	High temperature side cascade condenser outlet temperature (°C)	-	-15.9	-26.9	-	/
	High temperature side accumulator temperature (°C)	/	/	/	/	7.7
	High temperature side return pipe temperature (°C)	2.00	17.6	-5.20	-5.3	0.94
	High temperature side high pressure (MPa)	2.01	2.44	1.55	1.44	0.15
	High temperature side low pressure (MPa)	0.23	0.28	0.19	0.18	3.09
	High temperature side compressor current (A)	3.56	4.44	3.22	3.22	38.4
	Low temperature side compressor surface temperature (Oil) (°C)	-	69.0	49.9	-	46.4
	Low temperature side compressor surface temperature (Coil) (°C)	-	79.9	57.4	-	16.0
	Low temperature side compressor subcooler inlet temperature (°C)	-	52.1	32.7	-	56.9
	Low temperature side compressor subcooler outlet temperature (°C)	-	88.5	66.8	-	48.4
	Low temperature side compressor discharge pipe temperature (°C)	-	83.7	59.9	-	/
	Low temperature side cascade condenser inlet temperature (°C)	-	/	/	-	/
	Low temperature side cascade condenser outlet temperature (°C)	-	/	/	-	/
	Low temperature side vapor temperature (°C)	-	/	/	-	-61.6
	Low temperature side evaporator outlet temperature (°C)	-	-57.1	-59.3	-	/
	Low temperature side accumulator temperature (°C)	-	/	/	-	-36.4
	Low temperature side return pipe temperature (°C)	/	-23.5	-28.0	-	1.29
	Low temperature side high pressure (MPa)	/	1.59	1.12	-	0.15
Low temperature side low pressure (MPa)	-	0.17	0.14	-	3.5	
Low temperature side compressor current (A)	-	4.13	2.97	-	/	

Table 4.9 Refrigerator operation matrix (SH/SU-221/241)

Chamber model		Compressor	Condenser fan	Solenoid valve				
				For capacity control	For capacity control	For capacity control	For hot gas bypass	
SH/SU-221, 241 SH/SU-221, 241		CM11	FM11	SV11	SV12	SV13	SV14	
Operation stopped state	Main power switch in OFF position	OFF	In synch with CM11	OFF	OFF	OFF	OFF	
	Main power switch in ON position	OFF		OFF	OFF	OFF	OFF	
	Main power switch in ON position (Standby state)	OFF		OFF	OFF	OFF	OFF	
Local operating mode	Refrigerator stopped	OFF		OFF	OFF	OFF	OFF	
	Refrigerator in auto mode	Start processing in course		ON	OFF	ON	ON	ON
		Normal (temperature-only) operation at SV 62.6°C or higher		OFF (1)	OFF (2)	OFF (3)	OFF (4)	OFF (5)
		Normal (temperature-only) operation at SV 62.5°C or lower		ON	ON (1)	ON (2)	ON (3)	ON (4)
		Humidity-controlled operation		ON	ON (1)	ON (2)	ON (3)	ON (4)
	Refrigerator ON	ON		OFF	ON	ON	OFF	
	Refrigerator OFF	OFF		OFF	OFF	OFF	OFF	
Remote operating mode		Same operation as in local operating mode						

Table 4.10 Operation details

OFF(1)	Normally OFF. However, turns ON in the constant mode when the test area temperature is 10°C or more higher than the target temperature and, in ramp control, when the test area temperature is 1°C or more higher than the target temperature. Turns OFF when refrigerator is running at minimum capacity and the temperature controller judges that temperature can be maintained even if the refrigerator is OFF.
OFF(2)	Normally OFF. However, turns ON when CM11 is ON and the temperature controller calculates 100% refrigerator capacity is required for operation, and turns ON/OFF at a set cycle determined by the specific refrigerator capacity when CM11 is ON and refrigerator is running at 71 to 99% capacity.
OFF(3)	Normally OFF. However, turns ON when CM11 is ON and the temperature controller calculates 70 to 100% refrigerator capacity is required for operation, and turns ON/OFF at a set cycle determined by the required refrigerator capacity when CM11 is ON and the temperature controller calculates 41 to 69% refrigerator capacity is required for operation.
OFF(4)	Normally OFF. However, turns ON when CM11 is ON and the temperature controller calculates 40 to 100% refrigerator capacity is required for operation, and turns ON/OFF at a set cycle determined by the required refrigerator capacity when CM11 is ON and the temperature controller calculates 11 to 39% refrigerator capacity is required for operation.
OFF(5)	Normally OFF. However, turns ON when CM11 is ON.
ON(1)	ON when the temperature controller calculates 100% refrigerator capacity is required for operation, and turns ON/OFF at a set cycle determined by the required refrigerator capacity when and the temperature controller calculates 71 to 99% refrigerator capacity is required for operation.
ON(2)	ON when the temperature controller calculates 70 to 100% refrigerator capacity is required for operation, and turns ON/OFF at a set cycle determined by the required refrigerator capacity when and the temperature controller calculates 41 to 69% refrigerator capacity is required for operation.
ON(3)	ON when the temperature controller calculates 40 to 100% refrigerator capacity is required for operation, and turns ON/OFF at a set cycle determined by the required refrigerator capacity when and the temperature controller calculates 11 to 39% refrigerator capacity is required for operation.
ON(4)	ON when the target temperature is set to -20°C or higher, or when the target temperature is set to -20°C or lower and the temperature controller calculates 40% refrigerator capacity or less is required for operation. Always ON during humidity-controlled operation.

Table 4.11 Refrigerator operation matrix (SH/SU-261, 641, 661)

Chamber model		Compressor		Condenser fan		
		CM11	CM12	FM11		
SH/SU-261		○	○	○		
SH/SU-641/661		○	○	○		
Main power switch in OFF position		OFF	OFF	OFF		
Main power switch in ON position		OFF	OFF	OFF		
Standby state		OFF	OFF	OFF		
When refrigerator running in auto mode	Temperature-only operation	(Min. 62.6°C) *1	OFF (2)	OFF	OFF (2)	
		(0.0°C to 62.5°C) *1	ON	ON	OFF	
		(-17.5°C to -0.1°C)	ON	OFF (3)	ON	
		(-17.6°C to -24.9°C)	ON	ON (3)	ON	
	(Max. -25.0°C)	ON	ON (3)	ON		
Temperature and humidity operation		ON	OFF	ON		
When refrigerator running in ON mode	Temperature-only operation	(62.5°C or more) *1	ON	OFF	ON	
		(0.0°C to 62.4°C) *1	ON	OFF	ON	
		(-17.5°C to -0.1°C)	ON	OFF (3)	ON	
		(-17.6°C to -24.9°C)	ON	ON (3)	ON	
	(-25.0°C or less)	ON	ON (3)	ON		
Temperature and humidity operation		ON	OFF	ON		
When safety device trip	Instrumentation trouble		OFF	OFF	OFF	
	Room temperature compensation circuit burn-out		OFF	OFF	OFF	
	Dry-bulb input burn-out		OFF	OFF	OFF	
	Wet-bulb input burn-out		OFF	OFF	OFF	
	Absolute high temperature alarm		OFF	OFF	OFF	
	Absolute low temperature alarm		OFF	OFF	OFF	
	Upper deviation temperature alarm		—	—	—	
	Absolute high humidity alarm		—	OFF	—	
	Absolute low humidity alarm		—	OFF	—	
	Overheat/Overcool trouble and air circulator trouble		OFF	OFF	OFF	
	Blown thermal fuse		OFF	OFF	OFF	
	Boil-dry protection		—(1)	OFF	—(1)	
	Door open detection	Within alarm hold time		—	—	—
		Alarm hold time elapsed		—(2)	OFF	—(2)
	Refrigeration circuit trouble CM11		OFF	OFF	OFF	
	Water circuit trouble (WATER lamp out)		—(1)	OFF	—(1)	
	Water supply tank (WATER lamp flashing)		—	OFF	—	
Water supply tank (EMPTY lamp lit solidly)		—	OFF	—		

Solenoid valve					
SV15	SV11	SV12	SV13	SV14	SV16
○		○	○	○	○
○	○	○	○	○	○
OFF	OFF	OFF	OFF	OFF	OFF
OFF	OFF	OFF	OFF	OFF (0)	OFF
OFF	OFF	OFF	OFF	OFF (1)	OFF
OFF	OFF (2)	OFF (2)	OFF (2)	OFF (2)	OFF (2)
OFF	ON/OFF (1)	ON/OFF (2)	ON/OFF (3)	ON	ON
OFF (3)	ON/OFF (4)	ON/OFF (5)	ON/OFF (6)	ON (1)	ON (2)
ON (3)	OFF	OFF (4)	OFF (4)	OFF (5)	OFF (5)
ON (3)	OFF	OFF	OFF	OFF (5)	OFF
OFF	ON/OFF (1)	ON/OFF (2)	ON/OFF (3)	ON	ON
OFF	OFF	ON	ON	ON	ON
OFF	OFF	ON	ON	ON	ON
OFF (3)	OFF	ON (2)	ON (2)	ON	ON (2)
ON (3)	OFF	OFF (4)	OFF (4)	OFF (5)	OFF (5)
ON (3)	OFF	OFF	OFF	OFF(5)	OFF
OFF	OFF	ON	ON	ON	ON
OFF	OFF	OFF	OFF	OFF	OFF
OFF	OFF	OFF	OFF	OFF	OFF
OFF	OFF	OFF	OFF	OFF	OFF
OFF	OFF	OFF	OFF	OFF	OFF
OFF	OFF	OFF	OFF	OFF	OFF
OFF	OFF	OFF	OFF	OFF	OFF
—	—	—	—	—	—
OFF	—	—	—	—	—
OFF	—	—	—	—	—
OFF	OFF	OFF	OFF	OFF	OFF
OFF	OFF	OFF	OFF	OFF	OFF
OFF	—(1)	—(1)	—(1)	—(1)	—(1)
—	—	—	—	—	—
OFF	OFF	OFF	OFF	—(2)	—(2)
OFF	OFF	OFF	OFF	OFF	OFF
OFF	—(1)	—(1)	—(1)	—(1)	—(1)
OFF	—	—	—	—	—
OFF	—	—	—	—	—

Table 4.12 Operation details

*1	Unit_2: 62.5 → 77.5, 62.6 → 77.6
OFF (0)	Normally OFF. Turns ON for 15 sec when the main power switch is set in the ON position.
OFF (1)	Normally OFF. Turns ON for 15 sec when the CM11 turns ON.
OFF (2)	Normally OFF. Turns ON when the test area requires cooling of 10°C or more (1°C or more in ramp control). OFF when the refrigerator is running at 10% capacity.
OFF (3)	Normally OFF. Turns ON when the target temperature is set to –17.6°C or lower, or when the final target temperature in ramp control is set to –17.6°C or lower.
OFF (4)	Normally OFF. Turns ON after a set period of time when the target temperature is set to –17.5°C or higher, or when the final target temperature in ramp control is set to –17.5°C or higher.
OFF (5)	Normally OFF. Turns ON when the target temperature is set to –17.5°C or higher, or when the final target temperature in ramp control is set to –17.5°C or higher.
ON (1)	Normally ON. Turns OFF when the refrigerator switches to cascade operation.
ON (2)	Normally ON. Turns OFF after a set period of time when the refrigerator switches to cascade operation.
ON (3)	Normally ON. Turns OFF when the target temperature is set to –17.5°C or higher.
ON/OFF (1)	ON when the refrigerator is running at 100% capacity. Turns ON/OFF for a set period of time when the refrigerator is running at 71 to 99% capacity. OFF when the refrigerator is running at 70% capacity and below.
ON/OFF (2)	ON when the refrigerator is running at 70 to 100% capacity. Turns ON/OFF for a set period of time when the refrigerator is running at 41 to 69% capacity. OFF when the refrigerator is running at 40% capacity and below.
ON/OFF (3)	ON when the refrigerator is running at 40 to 100% capacity. Turns ON/OFF for a set period of time when the refrigerator is running at 11 to 39% capacity. OFF when the refrigerator is running at 10% capacity and below.
ON/OFF (4)	Same as ON/OFF (1). And, turns OFF when the refrigerator switches to cascade operation.
ON/OFF (5)	Same as ON/OFF (2). And, turns OFF after a set period of time when the refrigerator switches to cascade operation.
ON/OFF (6)	Same as ON/OFF (3). And, turns OFF after a set period of time when the refrigerator switches to cascade operation.
–(1)	Normally operation continues. OFF when the backup mode in test environment setup is OFF.
–(2)	Normally operation continues. However, turns OFF if CM12 is ON. Turns OFF when a safety device input continues for 15 min.

Chapter 5

Replacement of Parts

This chapter explains how to replace parts. It contains both replacement procedures and replacement part codes.

 **DANGER**

- **Shut OFF power supply at the main power switch BEFORE replacing parts.**
- **Wear gloves and be careful of sharp edges and corners when detaching metal parts such as panels.**

Note | Parts codes contained in this chapter are subject to change. Always confirm the latest part code when replacing parts.

5.1 Electric Parts Compartment (Chamber and Instrumentation Panel)

(1) Display Panel, Display Board, Overheat Protector and Door Switch (Instrumentation Frame)

■ Preparations

Check part codes as parts may have been changed.

Part code	Part	Specification/Model
2180580001300	Display board (Bench-Top Type Temperature and Humidity Chamber)	ES102DU-S
2041901012600	Rubber-capped switch board	2041901012600
2041901012710	Display panel	2041901012710 (SH)
2041901013600	Display panel	2041901013600 (SU)
2191080000200	Overheat protector	AB-Y (-199 to +199) L=700
2170801044700	Door switch	EK369

■ Replacement Procedure

1. Shut power OFF at the main power switch (leakage breaker) on the chamber right panel.
2. Detach the electric parts compartment rear panel and top panel (on chamber top). (Remove the screws A [x 6].)
3. Disconnect wiring to the instrumentation frame.
(Temperature controller board, overheat protector and door switch)
4. Detach the instrumentation frame.
(Remove screws B [x 3] from the front and screws C [x 4] on the lower half of the instrumentation frame.)

Reference

If the electric parts compartment top panel does not come off, disconnect wiring connectors on the rear panel, removes screws D [x 2] and screws C (x4, on instrumentation frame), and pull the electric parts compartment to the front. However, there is no stopper to prevent the chassis from being pulled out, therefore do not pull the chassis out more than 45 cm. Pulling it out farther than 45 cm can break the harness and dry/wet-bulb sensor leads.

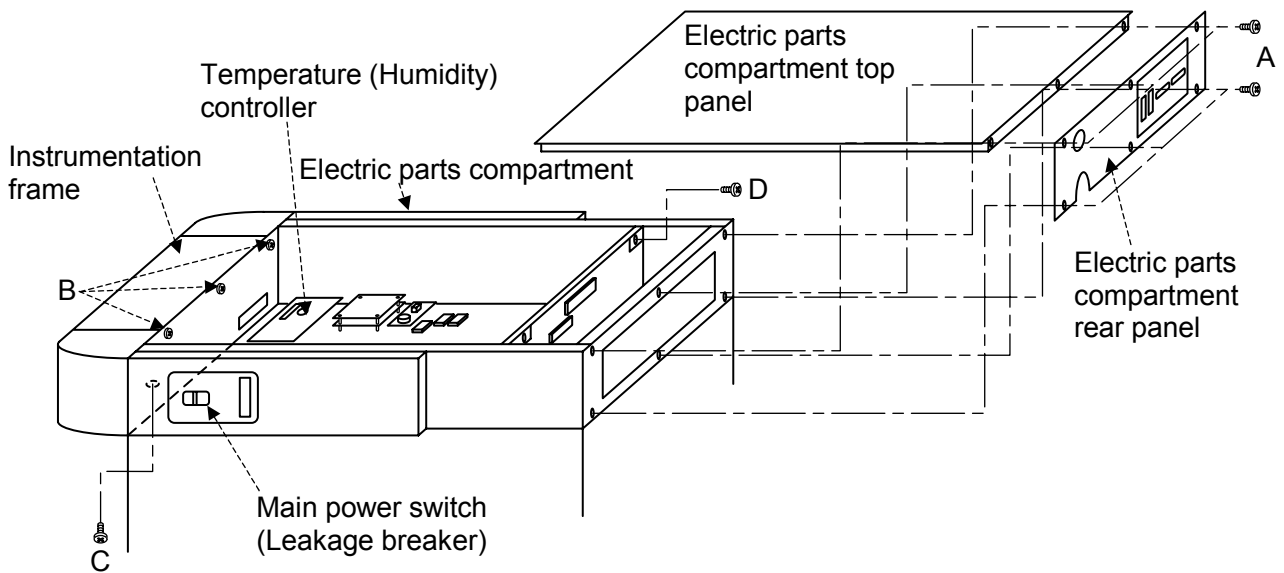


Fig. 5.1 Removing electric parts compartment panels

5. Detach the instrumentation frame mounting plate.
(Remove screws F [x 7].)
6. Detach the small anchoring parts such as hexagon supports and pipe spacers, of the display panel and display board, and replace the display panel and board.
7. Depress the tabs of the overheat protector with a slotted screwdriver or other means, and replace the protector.
8. Detach the instrumentation frame bottom panel and replace the door switch. (Remove screws E [x 4].)

* Install the door switch so that the arrow (↑) mark on the switch faces to the front of the chamber.

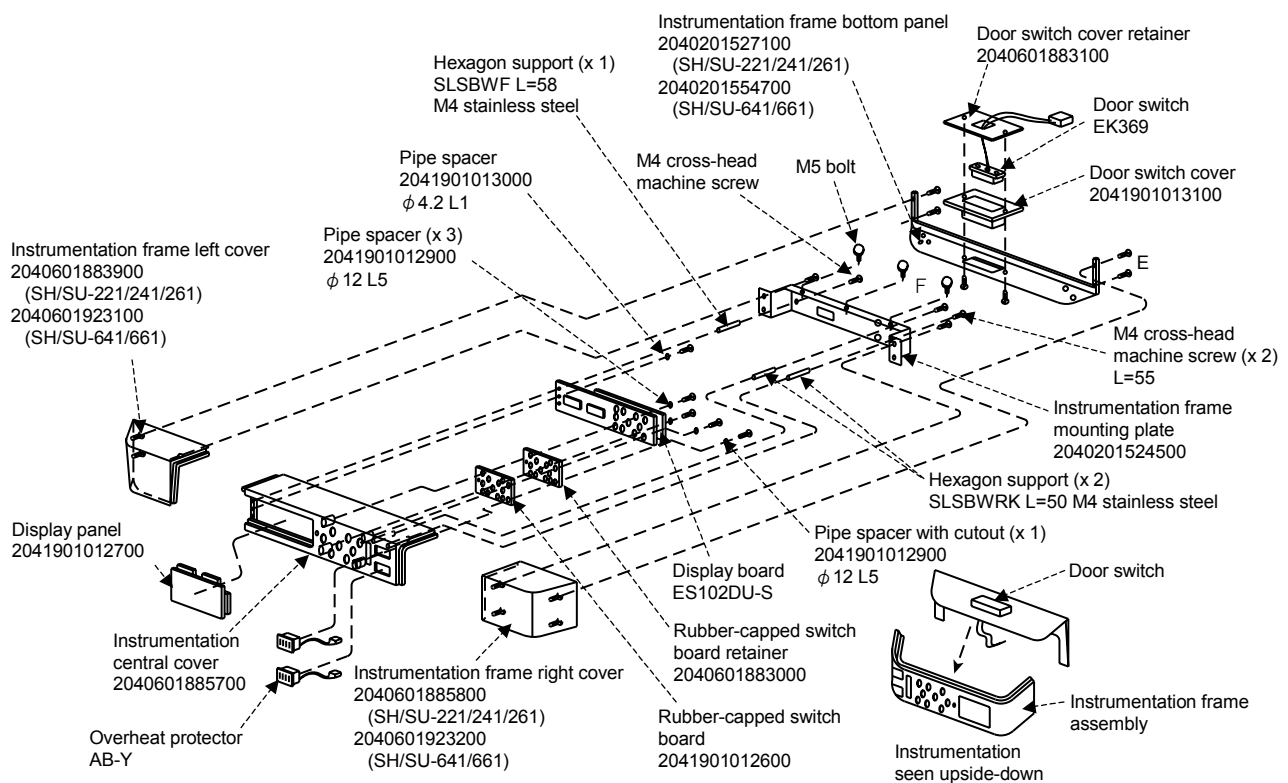


Fig. 5.2 Instrumentation frame assembly

(2) Main Power Switch (Leakage Breaker): Electric Parts Compartment/Chamber

■ Preparations

Check part codes as parts may have been changed.

Part code	Part	Specification/Model	Chamber
2170101000410	Leakage breaker	BJ5_153_100/220V AC_15A	SU-221/241
2170101000610	Leakage breaker	BJ5_203_2P_20A_100V/200V AC	SH-221/241 SH/SU-261 SH/SU-641/661

■ Replacement Procedure

1. Shut power OFF at the main power switch (leakage breaker) on the chamber right panel.
2. Detach the electric parts compartment top panel (on chamber top). (Remove the screws [x 3] from electric parts compartment rear panel.)
3. Remove the breaker panel and leakage breaker. (Remove screws [x 2].)
4. Detach the leakage breaker from the breaker panel, and replace the leakage breaker.
5. The breaker cover is held in place by the breaker panel, but if it rattles, fit a washer underneath the breaker panel to hold it firmly in place.

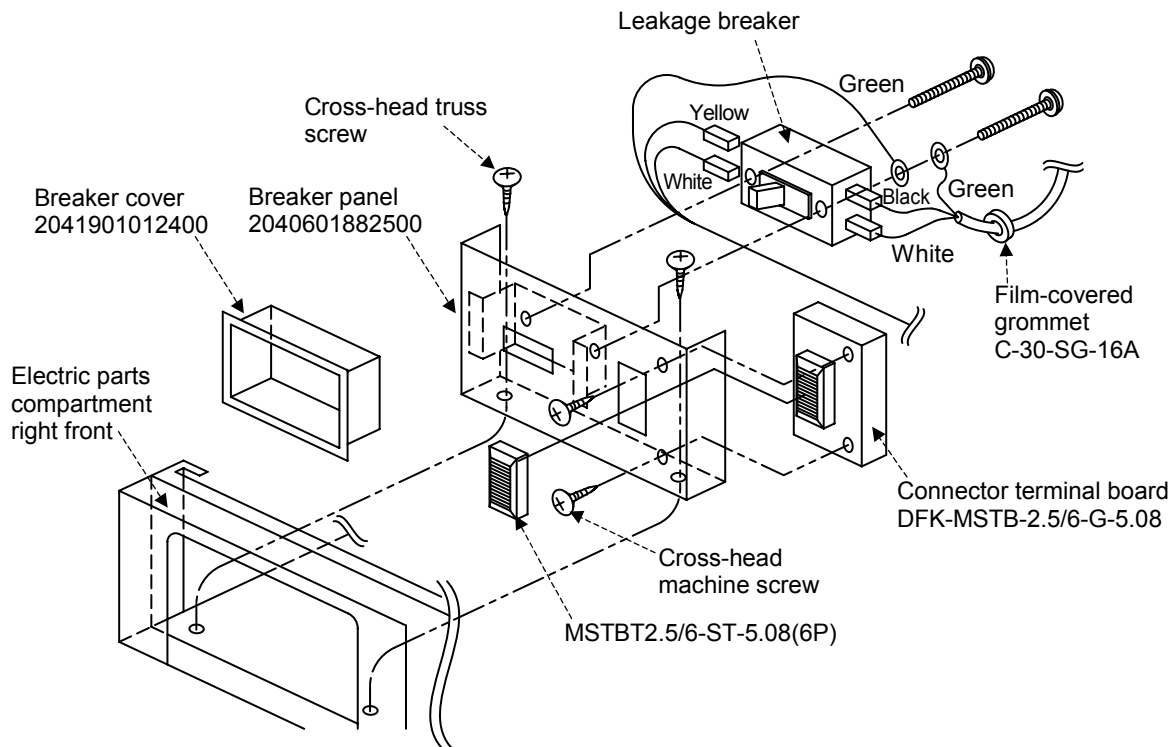


Fig. 5.3 Leakage breaker assembly

(3) Temperature Controller Board (ROM): Electric Parts Compartment

■ Preparations

Check part codes as parts may have been changed.

Part code	Part	Specification/Model	Remarks
2180101041210	Temperature (Humidity) controller	ES102C-T2-7-1	
2181180000100	Communication adapter board (Bench-top type Temperature and Humidity Chamber)	ES-102 (RS485)	Standard equipment

■ Replacement Procedure

1. Shut power OFF at the main power switch (leakage breaker) on the chamber right panel.
2. Detach the electric parts compartment top panel (on chamber top).
(See 5.1 [1].)
3. Disconnect all connectors and wiring from the temperature controller board, replace the old board with a new board, and reconnect connectors and wiring as before. If the old board is equipped with an option board, detach it from the old board and install it on the new board.
4. Replace the ROM only after replacing the temperature controller board.
5. Turn ON power at the main power switch and check that LED201 on the temperature controller board lights up. If LED202 (red) lights up instead, the ROM or flat cable may not be properly mounted, therefore check.
6. After replacement, initialize the temperature controller ROM and set parameters. See “Chapter 6 Temperature (Humidity) Controller Adjustments”.

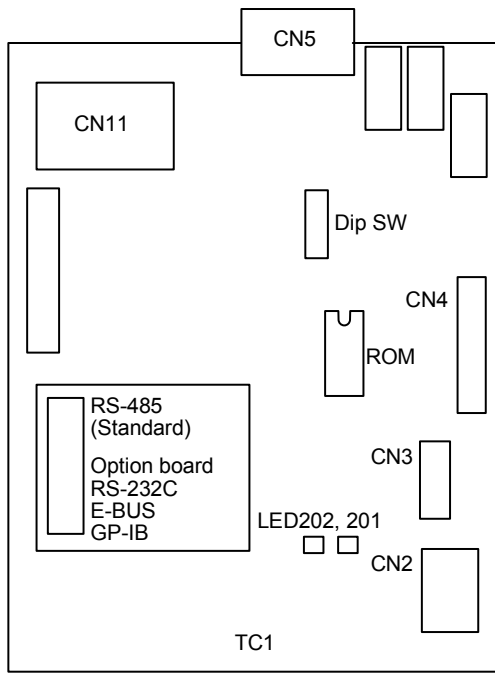


Fig. 5.4 Temperature controller board (ROM) with communication board

(4) Instrumentation Parts and Overheat Protector: Electric Parts Compartment

Preparations

Check part codes as parts may have been changed.

Part code	Part	Specification/Model	Circuit code
2180101041210	Temperature (Humidity) controller	ES102C-T2-7-1	TC1
2180101000300	Overheat protector board and unit	HCP-T -199 to 199	OHP1, OCP1
2191080000200	Overheat protector	AB-Y (-199 to +199) L=700	
2200201000100	Switching power supply unit	LDA30F-24	SPS1
2170401023900	Relay	MY-1F_Coil voltage: 100/110V AC, 5A	X100, 101
2170401024000	Relay	MY-3F_Coil voltage: 100/110V AC, 5A	X20
2170601011500	Solid state relay	SS201C-3Z-D4 (85-264V AC/12V DC) 20A	SSR1, 2
2170401025500	Relay	MY-2F_Coil voltage: 24V AC	X21
2170401025400	Relay	G4B-112T1_Coil voltage: 100V AC	X51 (261/6**)
2170401025100	Relay	HH53S_110/120V AC	X20, 100 (115V AC specification)
2170401025800	Relay	HH52S_110/120V AC	X101 (115V AC specification)
2170401025700	Relay	HH53S_200/220V AC	X20, 100 (200V AC specification)
2170401025900	Relay	HH52S_200/220V AC	X101 (200V AC specification)
2170401024900	Relay	HH53S_220/240V AC	X20, 100 (220/230V AC specification)
2170401026000	Relay	HH52S_220/240V AC	X101 (220/230V AC specification)
2200501000200	Noise filter	ZGB2203-01U 250V AC, 3A	NF1
2200101059500	Power supply transformer	BSW200D-46007	TF1 (100V AC specification for 221/241 with optional viewing window and 220/230V specification for 221/241)
2200101059600	Power supply transformer	BSW200D-56004	TF1 (115V AC specification for 221/241, 100V AC specification for 261/6**)
2200101059700	Power supply transformer	BSW300D-46075	TF1 (200V AC specification for 6**)
2200101059800	Power supply transformer	BSW300D-46062	TF1 (220/230V AC specification for 261/6**)
2200101039100	Power supply transformer	BSW200D-61022	TF1 (230V AC specification [CE spec.] for 221/241)
2200101039200	Power supply transformer	BSW300D-61042	TF1 (230V AC specification [CE spec.] for 261/6**)

Cont.

Part code	Part	Specification/Model	Circuit code
2170701009900	Fuse holder	F-7111-1P	
2170701003000	Fuse holder	F-7111-3P	
2170701000200	Cartridge fuse	3 A (FGAO, Class A, 250 V)	F1
2170701013700	Cartridge fuse	4 A (FGAO, Class A, 250 V)	See electric circuit diagrams.
2170701013600	Cartridge fuse	5 A (FGAO, Class A, 250 V)	See electric circuit diagrams.
2170701013800	Cartridge fuse	6 A (FGAO, Class A, 250 V)	See electric circuit diagrams.
2170701001300	Cartridge fuse	10 A (FGAO, Class A, 250 V)	See electric circuit diagrams.

Replacement Procedure

1. Shut power OFF at the main power switch (leakage breaker) on the chamber right panel.
2. Detach the electric parts compartment top panel (on chamber top).
(See 5.1 [1].)
3. Identify parts against locations on Fig. 5.5 below, and replace parts.
4. Coat the underside of the solid state relays SSR1 and 2 are on the underside with heat sinker.

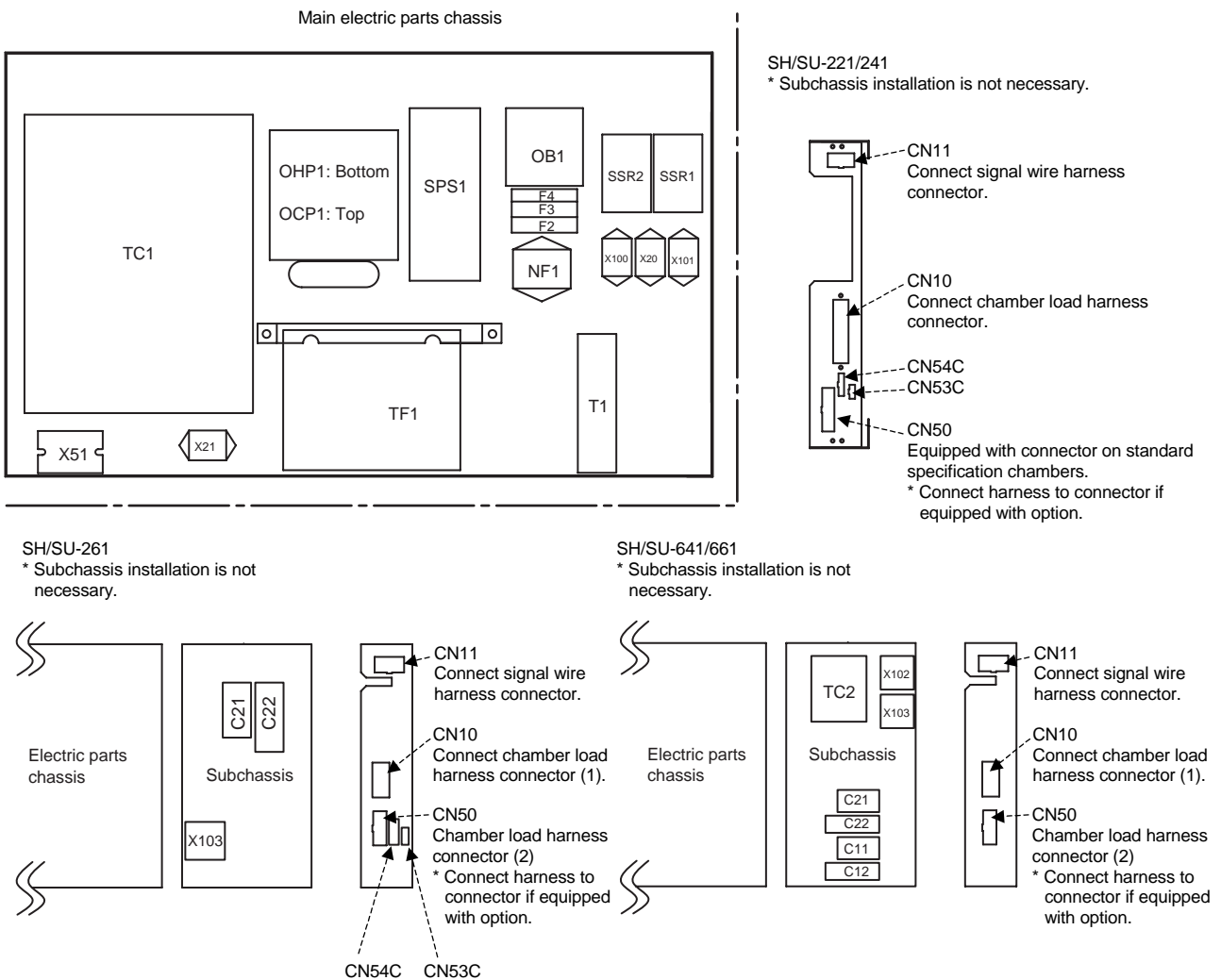


Fig. 5.5 Electric parts chassis layout

5.2 Door

(1) Door Packing

■ Preparations

Check part codes as parts may have been changed.

Part code	Part	Specification/Model	Remarks
2041301027500	Door outer packing	Black/Z830-H8	SH/SU-221/241/261 2m SH/SU-641/661 2.3m
2041301110410	Chamber-side packing	02041301110410	SH/SU-221/241/261 1250mm
2041301113400	Chamber-side packing	02041301113400	SH/SU-641/661

■ Replacement Procedure

Door Outer Packing

1. Shut power OFF at the main power switch (leakage breaker) on the chamber right panel, and open the door.
2. Pull the door packing off.
3. Attach a new door packing. (Position the packing so that the seam comes to the location shown in Fig. 5.6.)

Chamber-side Packing

1. Shut power OFF at the main power switch (leakage breaker) on the chamber right panel, and open the door.
2. Pull the chamber-side packing off.
3. Attach a new door packing. (Position the packing so that the seam comes to the location shown in Fig. 5.6.)

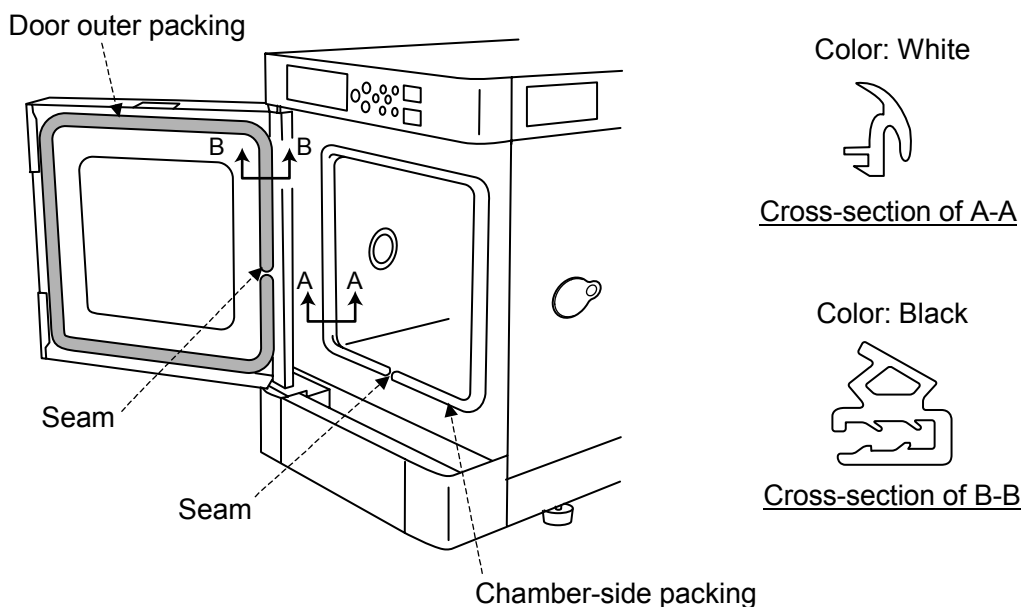


Fig. 5.6 Packing replacement

(2) Door Lock (Lock mechanism, Lock catch), Door

■ Preparations

Check part codes as parts may have been changed.

Part code	Part	Specification/Model	Remarks
2040801064610	Top lock catch	2040801064610	
2040801064210	Bottom lock catch	2040801064210	
2170801044700	Door switch	EK369	Magnet (Replace magnet cover sheet when replacing door switch.)
2040801063900	Door hinge shaft	2040801063900	Same on top/bottom
2040802000610	Lock mechanism	2040802000610	SH/SU-221/241/261
2040801066500	Lock mechanism	2040801066500	SH/SU-641/661
2040501360220	Magnet cover sheet	2040501360220	
2041901018600	Dual lock fastener	SJ-4570 (50×25)	

■ Replacement Procedure

Numbers in () are for parts shown in Fig. 5.7.

Top/Bottom Lock Catch

1. Shut power OFF at the main power switch (leakage breaker) on the chamber right panel, and open the door.
2. Remove the screw (8) (16) that locks down the top (4)/bottom (15) lock catch, and detach the lock catch.
3. Install a new lock catch.

Door Switch (Door side: Magnet)

1. Shut power OFF at the main power switch (leakage breaker) on the chamber right panel, and open the door.
2. Peel off the magnet cover sheet (19) from the top face of the door.
3. Remove the two screws (6) that lock down the door switch magnet (2), and detach the magnet.
4. Install a new magnet in the opposite order that the old one was detached.
5. Affix a new magnet cover sheet.

Door (Standard)

1. Shut power OFF at the main power switch (leakage breaker) on the chamber right panel, and open the door slightly.
2. Remove the two screws (5) that lock the door hinge shaft (1) to the top face of the door.
3. Pull the top outward and detach.

4. Prepare a new door. Attach the magnet mounting plate (3) to the top face of the door with M3 round head screws (7). Then, on top of that, attach the door switch magnet with M3 round head screws (6).
5. Attach the door front panel with six binder screws (22).
6. Attach the dual lock fasteners to the door front panel (18) and decorative panel (21), and then attach the decorative panel to door front panel.
7. Affix a magnet sheet cover (19) to cover the square hole on the top face of the door.
8. Attach the new door in the opposite order that the old door was detached.

Reference

The aforementioned procedure requires you to prepare the magnet mounting plate, door switch magnet and magnet cover sheet in advance. If you already have these parts, detach the door as explained in “Door Switch (Door side: Magnet)”. However, use a new magnet cover sheet.

Door (Option: Door with viewing window or for SH/SU-261/641/661)

1. Shut power OFF at the main power switch (leakage breaker) on the chamber right panel, and open the door slightly.
2. Remove the two screws (5) that lock the door hinge shaft (1) to the top face of the door.
3. Pull the top outward.
4. Cut the door viewing window heater wires (24) with nippers, and detach the door. (Cut the wire near the door side.)
5. Prepare a new door. Attach the magnet mounting plate (3) to the top face of the door with M3 round head screws (7). Then, on top of that, attach the door switch magnet with M3 round head screws (6).
6. Wire the viewing window heater of the new door as before, and connect to the door with bar caps (25).
7. Attach the dual lock fasteners to the door front panel (18) and decorative panel (21), and then attach the decorative panel to door front panel.
8. Lock down the door front panel (18) with binder screws.
9. Affix a magnet sheet cover (19) to cover the square hole on the top face of the door.

Reference

The aforementioned procedure requires you to prepare the magnet mounting plate, door switch magnet and magnet cover sheet in advance. If you already have these parts, detach the door as explained in “Door Switch (Door side: Magnet)”. However, use a new magnet cover sheet.

Lock Mechanism

1. Pull the decorative panel (21) outward and detach it. (Dual lock fasteners (20) are attached to the left and right edges on the backside of the decorative panel.)
2. Remove the screws (22) that lock down the door front panel (18), and detach the front panel.
3. Remove the screws (12) that lock down the handle (11), and detach the handle.
4. Remove the screws (9) that lock down the lock mechanism (14), and detach the lock mechanism.
5. Install a new lock mechanism in the opposite order that the old was detached.

Part codes are the same for left-opening doors.

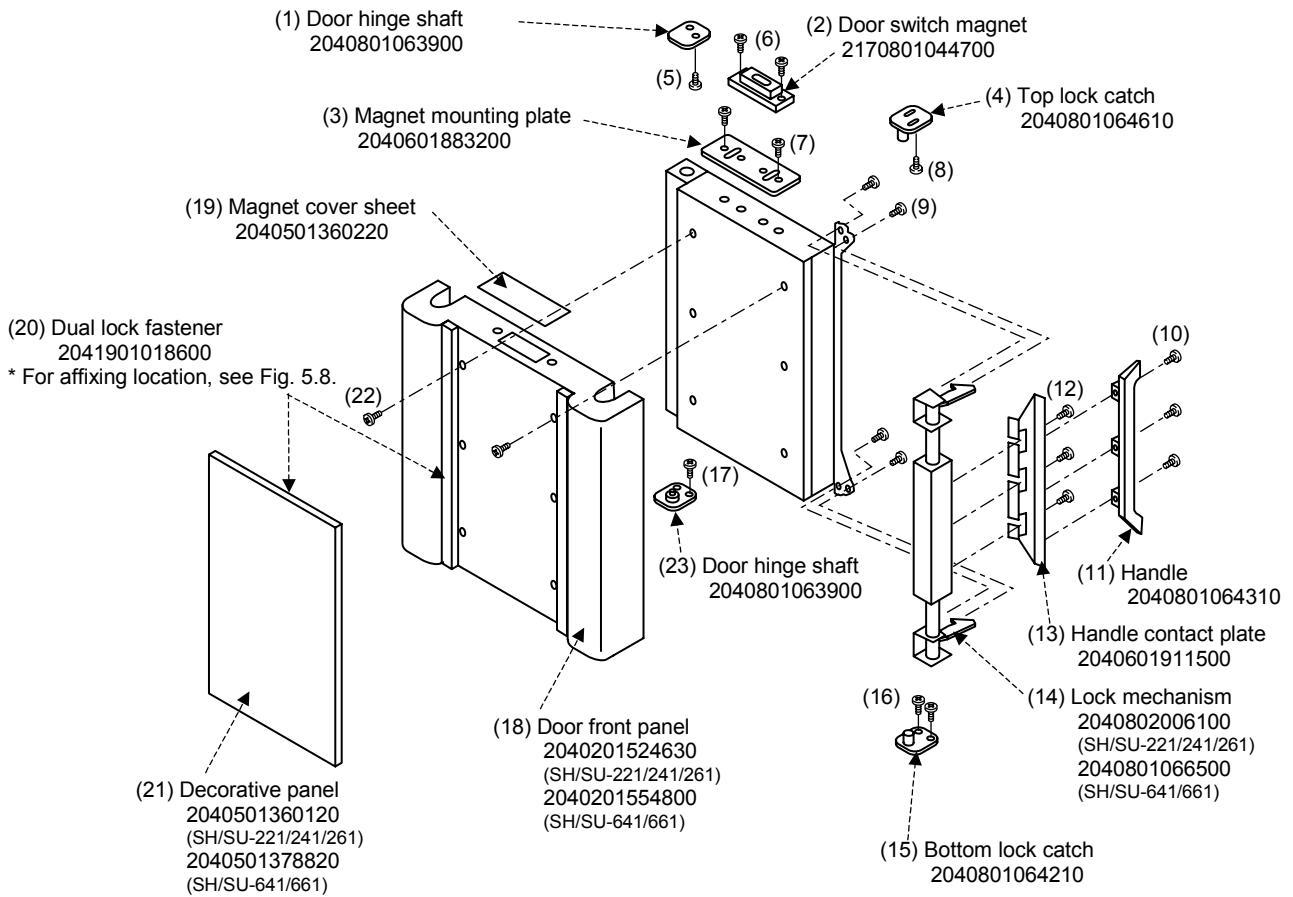
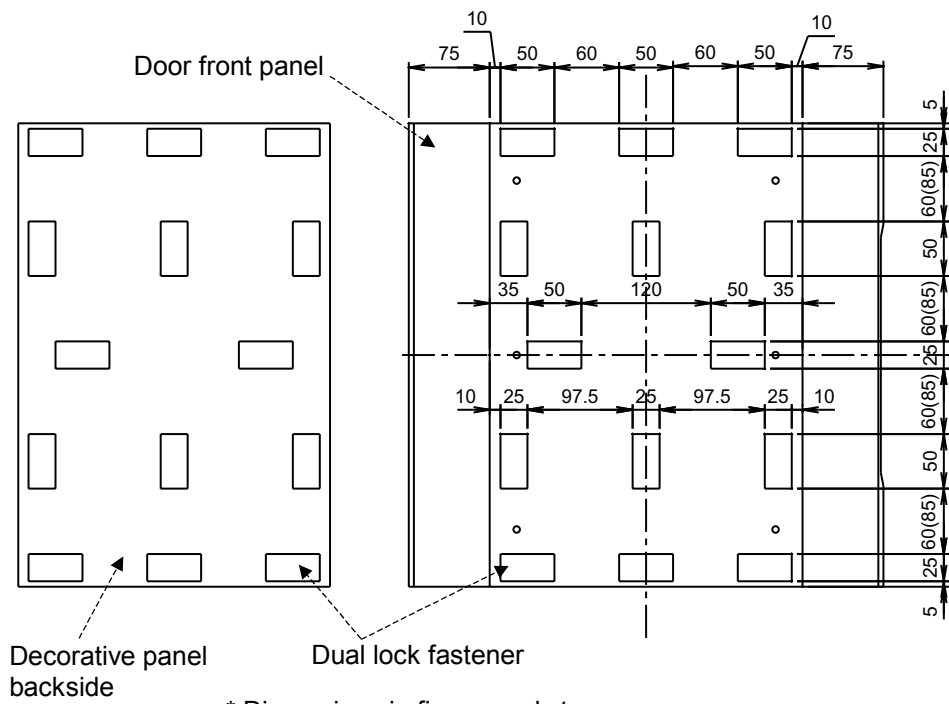


Fig. 5.7 Door lock parts (Standard door)



* Dimensions in figure apply to SH/SU-221/241/261. However, dimensions in () are for SH/SU-641/661.

Fig. 5.8 Affixing location of dual lock fasteners (Standard door)

Parts codes in figures are subject to change. Always use parts of the latest part code.
 Part codes are the same for left-opening doors, except lock catches; top lock catch is located on bottom, and bottom lock catch is located on top.

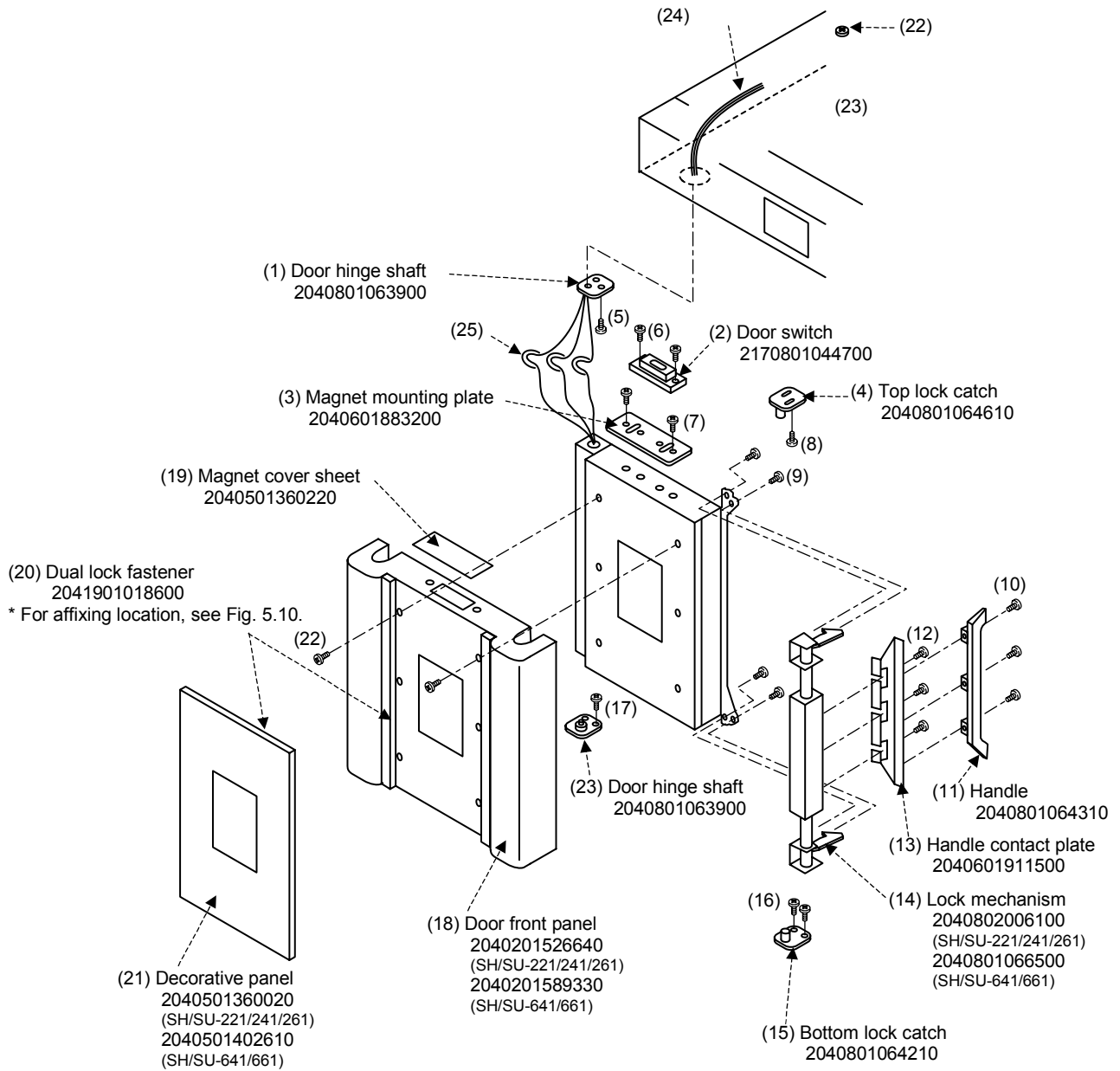


Fig. 5.9 Door lock parts (Option door with viewing window)

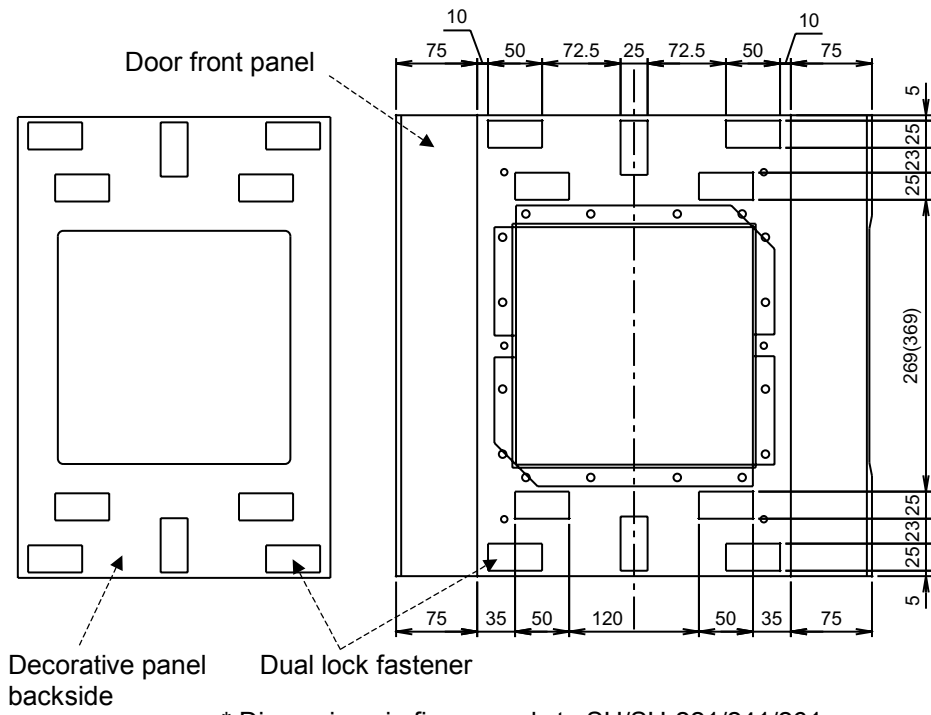


Fig. 5.10 Affixing location of dual lock fasteners (Option door with viewing window)

5.3 Water Circuit

(1) Wick Pan Regulator

■ Preparations

Supplies: Silicon sealant: KE-45 Clear by Shinetsu Chemical Co., Ltd. or similar

After adjustments, make the adjustments in “Regulating Humidifying Tray and Wick Pan Water Level” in 4.1 Water Circuit.

Check part codes as parts may have been changed.

* Replace the regulator unit as a whole, not individual parts.

Part code	Part	Specification/Model	Remarks
2000000009400	Wick pan regulator unit		For assembly and parts, see Fig. 5.12. Replace dry/wet-bulb sensor lid packing at same time.
2000000009300	Wick pan arm unit		For assembly and parts, see Fig. 5.12. Replace dry/wet-bulb sensor lid packing at same time.
2041301110510	Dry/Wet-bulb sensor lid packing		SH/SU-221/241
2041301113500	Dry/Wet-bulb sensor lid packing		SH/SU-261/641/661

■ Replacement Procedure

Wick Pan Regulator Unit

1. Shut power OFF at the main power switch (leakage breaker) on the chamber right panel.
2. Connect the included humidifying tray drain hose to the humidifying tray drain plug on the rear of the water circuit compartment, drain the humidifying tray and wick pan regulator.
3. Remove the screws that lock down the mechanical parts compartment rear panel and detach the panel.
4. Remove the screw that locks down the regulator bracket and detach the bracket.
5. Pinch open the crescent clamp underneath the wick pan regulator with needle nose pliers or other means, and pull the tube downward and out.
6. While holding up the wick pan arm, pull the wick pan regulator unit out the rear of the mechanical parts compartment.

* Before attaching the regulator bracket, coat screws with sealant.

Wick Pan Arm Unit

1. Detach the wick pan regulator unit as explained above. Then, remove the screws that lock down the dry/wet-bulb sensor stoppers and pull

the dry and wet-bulb sensors out from the mechanical parts compartment.

2. Remove the screws that lock down the top and bottom dry/wet-bulb sensor backing plates, and detach the backing plates.
3. Slide the dry/wet-bulb sensor packing towards the rear of the mechanical parts compartment, over the end of the wick pan arm and out the chamber. (As a rule, do not use the same packing. Always replace it with new packing.)
4. Remove the glass wool.
5. Remove the screws that lock down the wick pan arm and pull the wick pan arm out from the mechanical parts compartment.
6. Prepare a new wick pan arm, wick pan arm flange packing, O-ring (P32), and dry/wet-bulb sensor backing plate packing.
7. Coat the wick pan arm flange and flange packing with sealant, and attach to each other.
8. Coat sealant also on the front face of the flange packing, hold it against the rear wall of the test area and lock in place with M4 truss screws.
 - * Remove any old sealant that still adheres to the test area rear wall and degrease the area, as old sealant can prevent proper sealing.
 - * When ready to tighten the screws, hold the wick pan arm tip down with tape or other means so that the wings of the arm do not rise more than 3 mm above of the test area floor.
 - * Seal around truss screws on both the sides of the test area rear wall.
9. Attach the glass wool and carefully open a hole in the wick pan arm backing plate packing for feeding over the wick pan arm. Then, fit the packing over the arm from the end. When doing this, be careful not to widen the hole. Also, fit an O-ring (P32) on the end of the wick pan arm.
10. Tighten down the top and bottom dry/wet-bulb sensor backing plates together with the screws, and coat the seam between the backing plates and around the wick pan arm with sealant (KE-45 Clear or similar).
11. Install the dry/wet-bulb sensors as explained in “5.4 (5)”.
12. After that, reinstall parts in the opposite order in which they were detached.

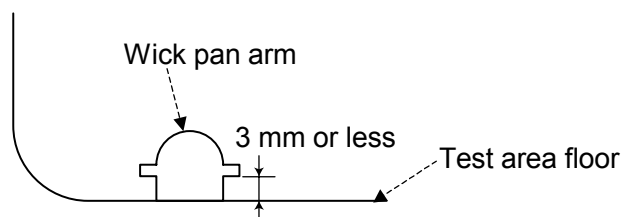


Fig. 5.11 Wick pan arm positioning in test area
(Test area seen from chamber front)

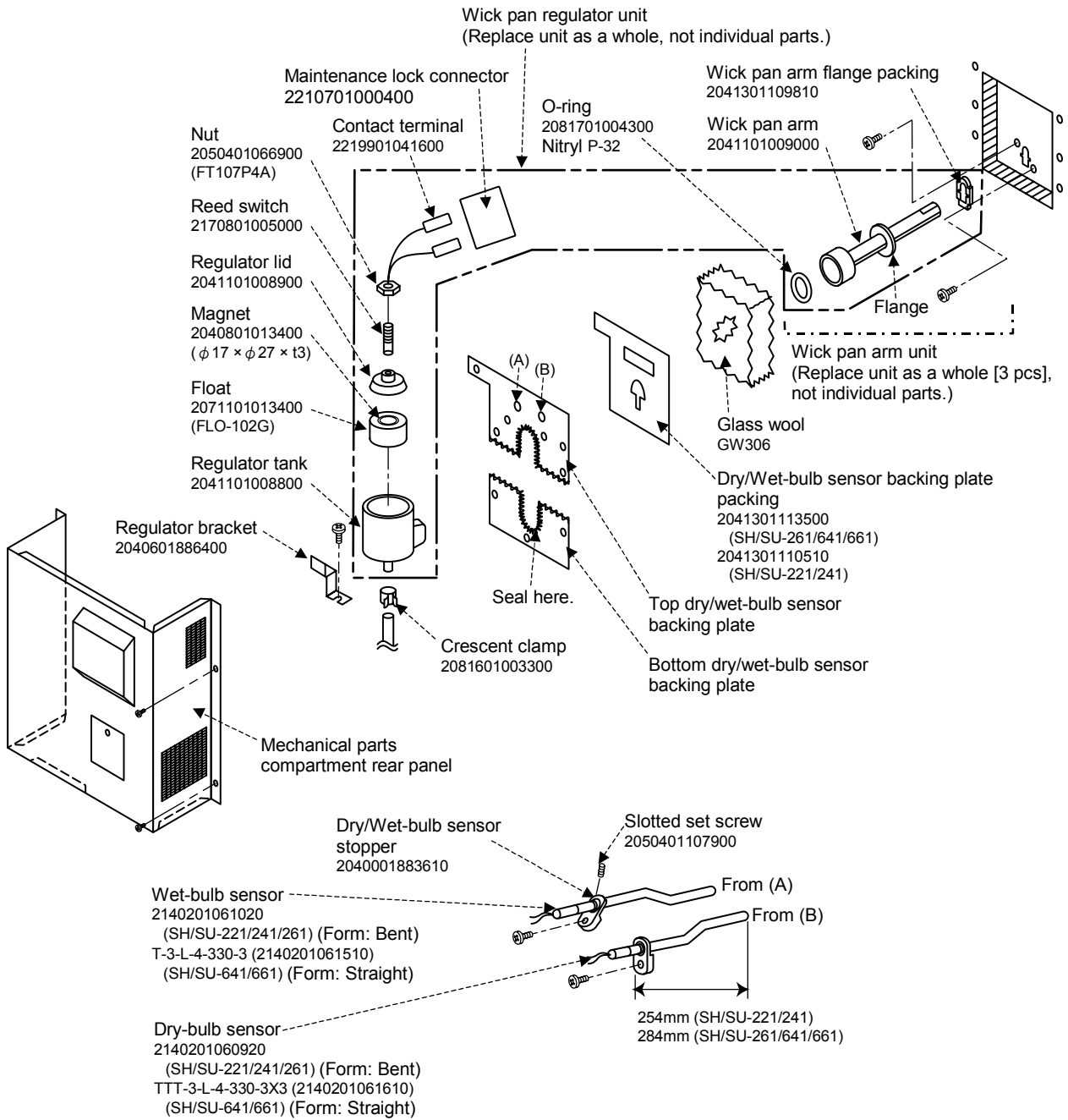


Fig. 5.12 Wick pan regulator parts

(2) Water Circuit Parts (Water Level Sensor Container and Pump)

■ Preparations

Check part codes as parts may have been changed.

* Replace the unit as a whole, not individual parts.

Part code	Part	Specification/Model
0200000000920000	Water level sensor container unit	For assembly and parts, see Fig. 5.18.
207070100040000	Pump	SR6W (B-2)
0200000000950000	Water supply tank unit	For connection details, see Fig. 5.17.

■ Replacement Procedure

Preparation

1. Shut power OFF at the main power switch (leakage breaker) on the chamber right panel.
2. Pull the water supply tank in the water circuit compartment out the front of the chamber.
3. Remove the screws that lock down the water circuit compartment rear panel and detach the panel. (Pull outward then upward.)

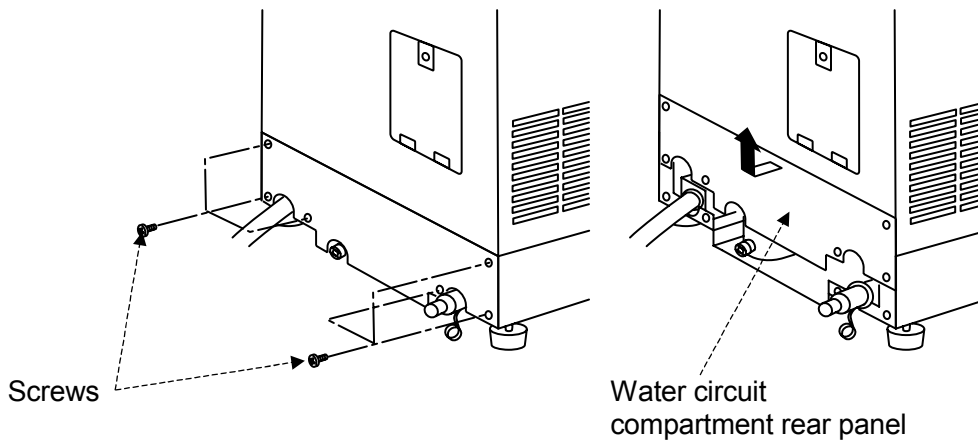


Fig. 5.13 Water circuit compartment rear panel detaching

4. Connect the included humidifying tray drain hose and water level sensor container drain hose, and drain the water circuit.

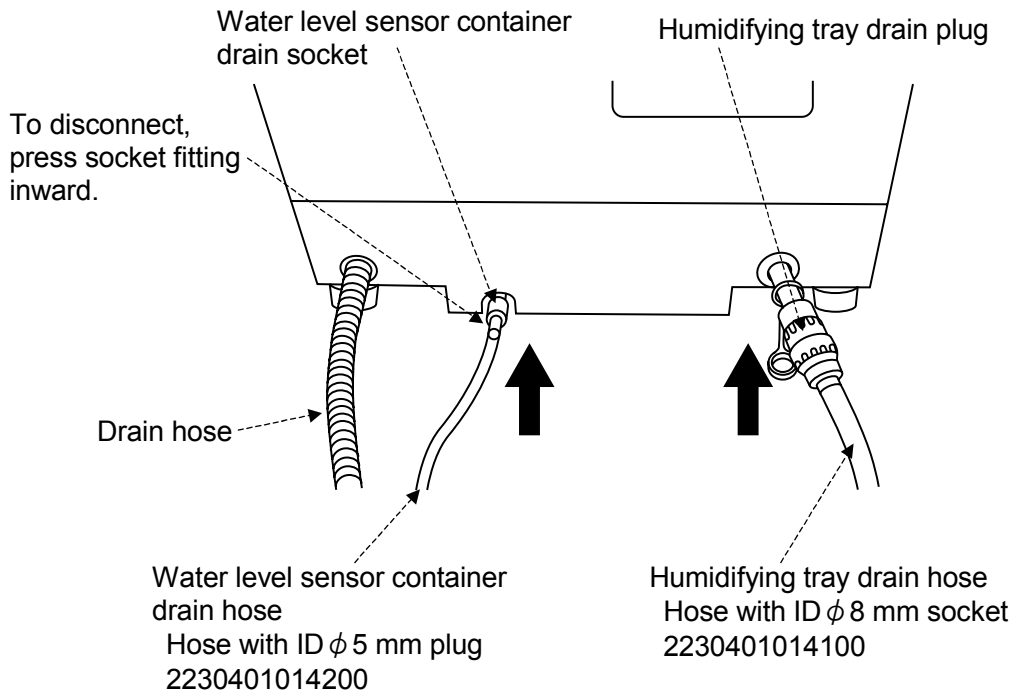


Fig. 5.14 Drain hose connections

Water Level Sensor Container Replacement

1. Remove the screws that lock down the water level sensor container.
2. Loosen crescent clamps 1 – 4 on the water circuit with needle nose pliers or other means, and separate tubes from parts. (Crescent clamp 4 is for the auxiliary water tank [option] and is not provided on standard chambers.)

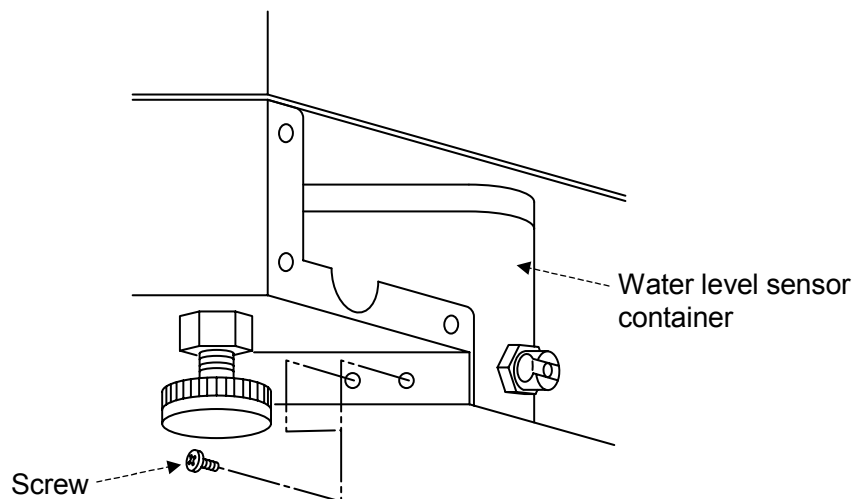


Fig. 5.15 Water level sensor container screws

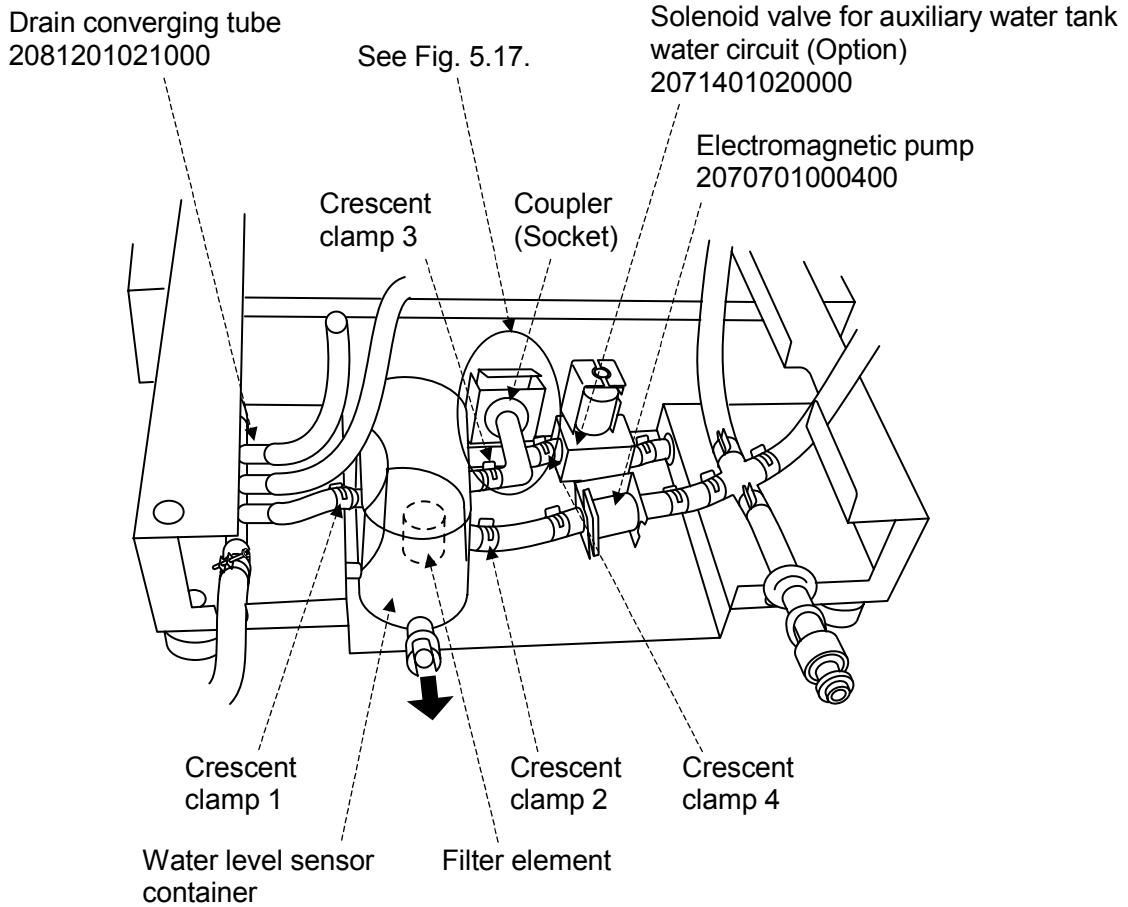


Fig. 5.16 Water level sensor container detaching

3. Pull the water level sensor container toward the rear and out the water circuit compartment, and disconnect the tube from it.
4. Install a new water level sensor container in the opposite order in which the old container was detached.
5. Disconnect the two drain hoses and reattach the water circuit compartment rear panel.

Water supply tank unit (Replace unit as a whole, not individual parts.)
 (2000000009500)

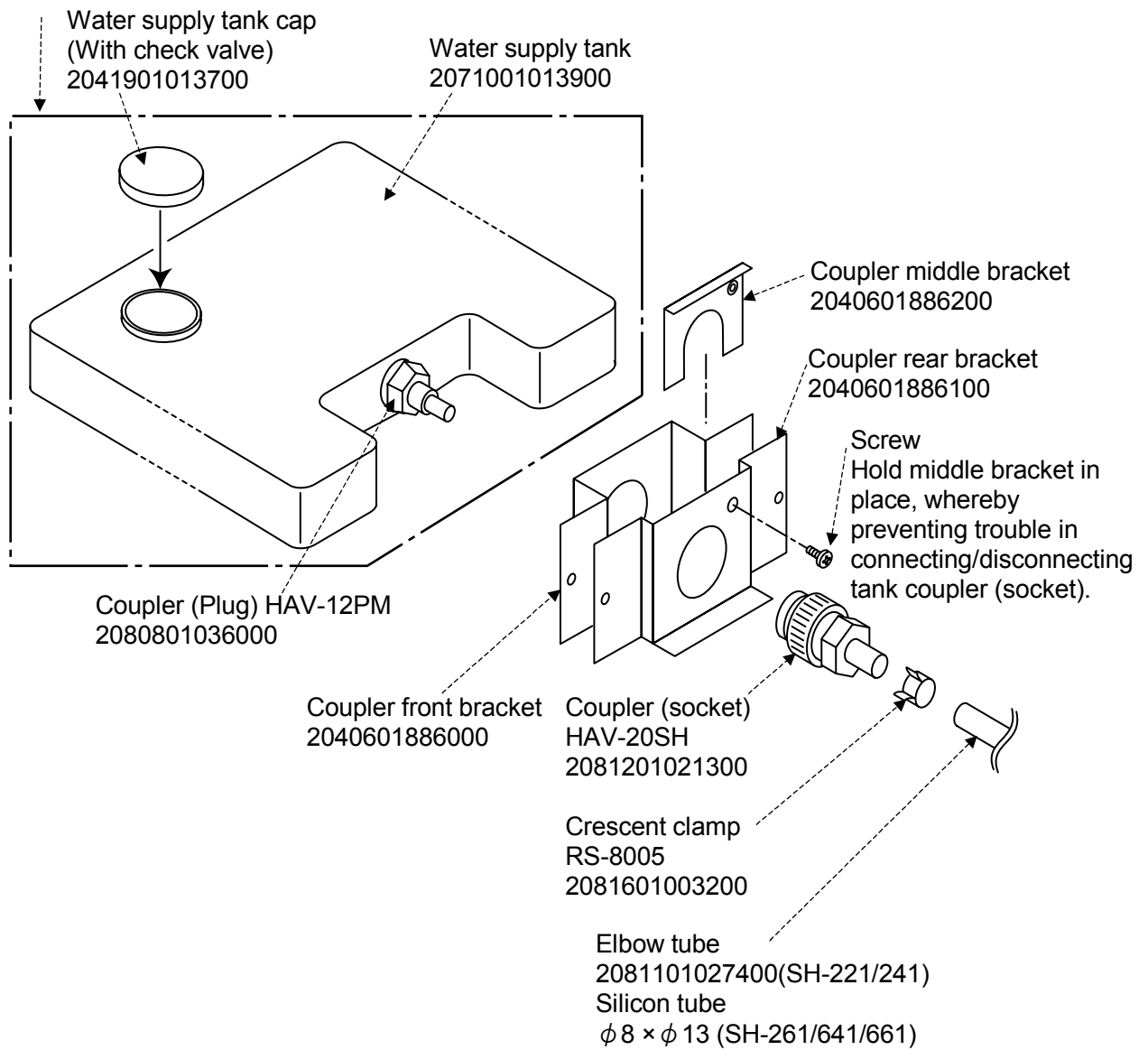


Fig. 5.17 Water supply tank connection parts

Water Level Sensor Container Unit Parts Assembly

Refer to Fig. 5.18 when performing the below procedure.

1. Screw the water level sensors into the water level sensor container lid.
Before screwing in the water level sensors, fit them with a nitril O-ring (P9). Screw the sensors into the container lid until the O-ring contacts the lid. Do not use sealant tape on the sensors. The white sensor goes on the short embossed side of the lid, while the red sensor goes on the long embossed side of the lid.
(If equipped with the auxiliary water tank circuit [option], cleanly cut the film on the top side of the middle embossing of the lid with a cutter knife or other means, and install the water level sensor (LS11R-1A, black wiring) and nitril O-ring (P9) in the same manner.
2. Screw the coupling (body) into the Rc 1/8 threaded nipple on the backside of the water level sensor container with sealant tape. Orient the coupling (body) fitting as shown in Fig. 5.19.
* Tightening torque: 1.5 N·m
3. Fit the vinyl cap on the water level sensor container and fit the filter element over the projection at the center of the container bottom with the filter element hole facing downward.
Fit the water level sensor container spacer into the container with the projection on the spacer matched to the cutout on the container lid.
4. Attach the lid to the water level sensor container.
Be careful the lid does not tilt or dislodge the spacer when attaching.

Water Supply Tank Unit Parts Installation

1. Fit the coupler over the water supply tank plug until the O-ring (attached to coupler) makes contact. Sealant tape or other type of sealing is not necessary.
2. Tighten the screw on the water supply tank cap (with check valve) to attach securely.

Replace the below unit as a whole, not individual parts.

Water level sensor container lid
2041101008700

Nitril O-ring (P9)
2081701009100

Water level sensor
2140601004500
Wiring color: White (Includes more parts than O-ring shown at right.)

Water level sensor container spacer
2041101009500

Filter element
2071101068200
OSS-3M (25 × 20L)

Coupling (Body)
PMCD1002BSPT
2081201021500

This water level sensor is not included in unit. To add auxiliary water tank circuit (option), prepare below parts.
Water level sensor
LS11R-1A, 2140601004700
Wiring color: Black
Nitril O-ring P9, 2081701009100

Nitril O-ring (P9)
2081701009100

Water level sensor
2140601004600
* Includes more parts than O-ring shown at left. Wiring color: red. Sealant tape or other sealant not needed to screw in. Screw in directly until O-ring makes contact.

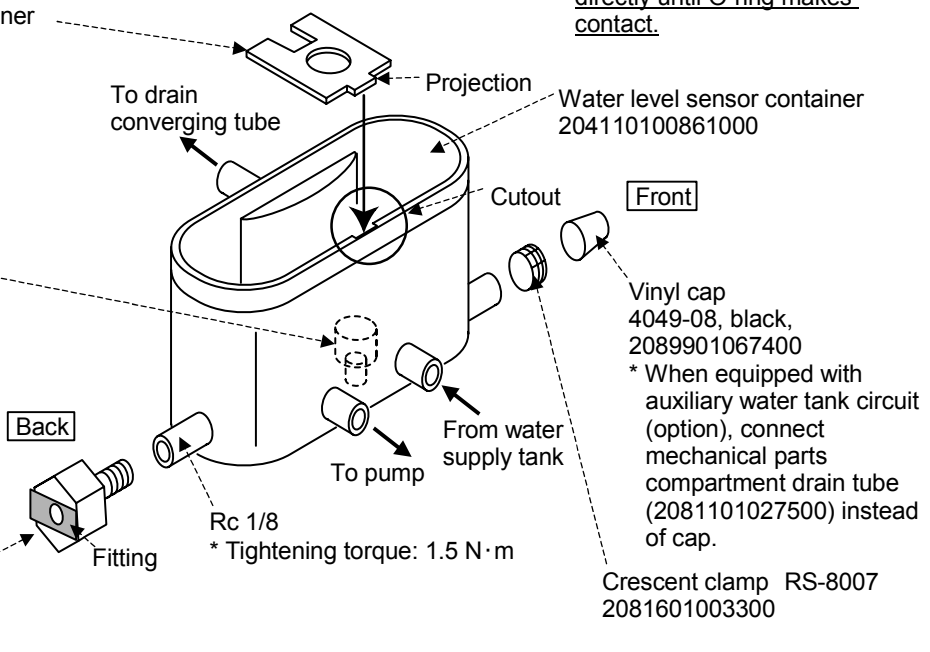


Fig. 5.18 Water level sensor container unit parts

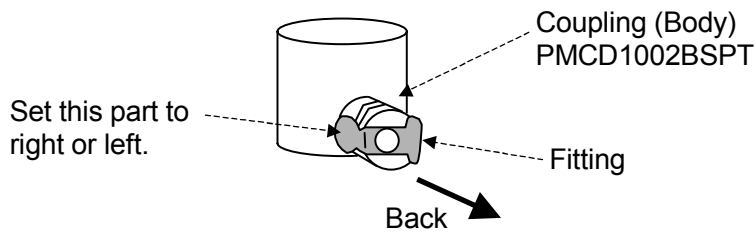


Fig. 5.19 Coupling (Body) orientation

Electromagnetic Pump Replacement

After making the aforementioned preparations and draining the water circuit, perform the following procedure.

1. Disconnect leads from the electromagnetic pump. (To also replace the leads, note that a diode [ERD29-02] is connected to them, therefore connect the same kind of diode as before. The diode is located roughly in the center of the chassis.)
2. Loosen the crescent clamps on both ends of the electromagnetic pump with pliers, and separate tubes from the pump.
3. Remove the screws that lock down the electromagnetic pump and detach the pump.
4. Install a new electromagnetic pump in the opposite order in which the old pump was detached. (Be careful to orient terminals to the angle shown in the figure.)

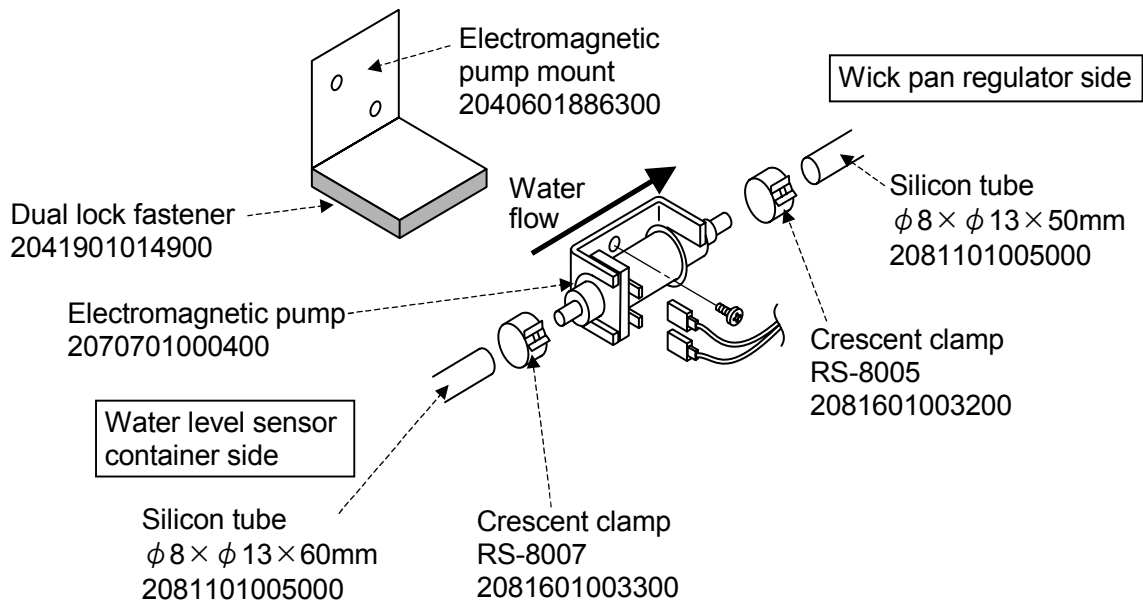


Fig. 5.20 Electromagnetic pump replacement (Seen from chamber rear)

5.4 Test Area

(1) Heater Unit

SH/SU-221/241/261

■ Preparation

Silicon sealant (KE-45)

Check part codes as parts may have been changed.

Part code	Part	Specification/Model	Use
2060801084100	Heater	2060801084100	
2040101427330	Heater protective sheet	2040101427300	
2041001008900	Rubber bushing	X-15-148	For test area leads

■ Replacement Procedure

1. Shut power OFF at the main power switch (leakage breaker) on the chamber right panel.
2. Open the chamber door and detach the test area shelf, shelf brackets and partition.
3. Detach the heater unit. (Remove the screws on the left and right.)
4. Lock a new heater unit to the heater protective sheet.
5. Disconnect heater leads from the old unit and connect them to the new unit.
6. Fill the screw holes used to anchor the heater unit with silicon sealant.
7. Lock the heater unit down as before. (Keep the heater leads from contacting the evaporator.)
8. Reattach the test area partition, shelf brackets and shelf.

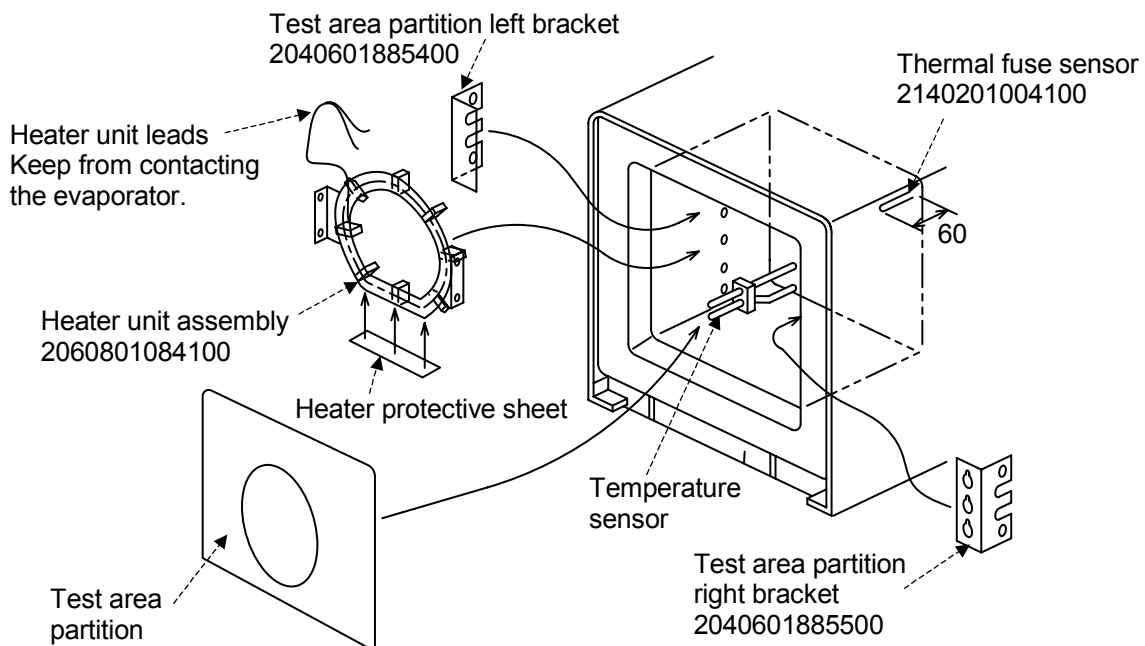


Fig. 5.21 Heater unit (SH/SU-221/241/261)

■ Preparations

Check part codes as parts may have been changed.

Part code	Part	Specification/Model	Use
2060801085920	Heater	2060801085920	
2040101427330	Heater protective sheet	2040101427330	
2041001008900	Rubber bushing	X-15-148	For test area leads

■ Replacement Procedure

1. Shut power OFF at the main power switch (leakage breaker) on the chamber right panel.
2. Open the chamber door and detach the test area partition.
3. Detach the heater unit. (Remove the screws that lock the heater to the evaporator.)
4. Lock a new heater unit to the heater protective sheet.
5. Disconnect heater leads from the old unit and connect them to the new unit.
6. Lock the heater unit down as before. (Keep the heater leads from contacting the evaporator.)
7. Reattach the test area partition.

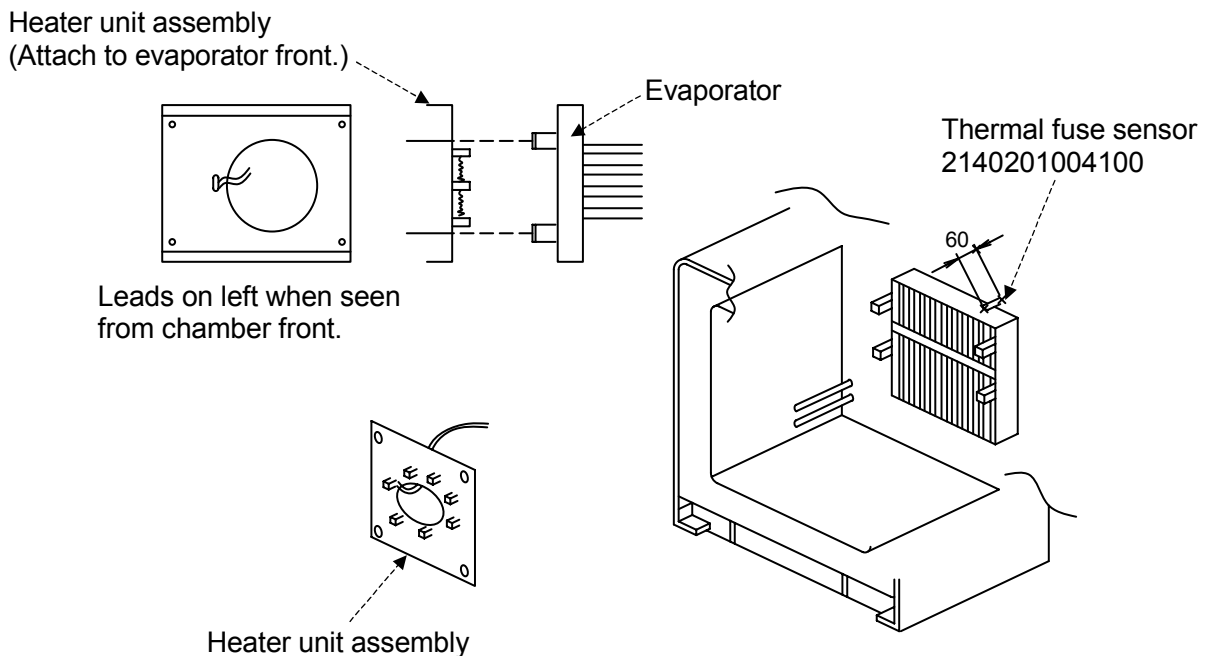


Fig. 5.22 Heater unit (SH/SU-641, 661)

(2) Air Circulator Fan and Motor

■ Preparations

Silicon sealant (KE-45), hex key (width across flat 2 mm)

Check part codes as parts may have been changed.

Part code	Part	Specification/Model	Use
2060101048100	Motor	M81X20SP2L1 100V AC, 50/60Hz	SH/SU-221/241/261
2060601006700	Axial fan propeller	P6-150R, Suction 8A	SH/SU-221/241/261
2081701013300	O-ring	P9 (JIS B2401), silicon	
2060101052900	Motor	M81X40SP2L1 100V AC, 50/60Hz	SH/SU-641/661
2060601006800	Axial fan propeller	P6-180R, Suction 8A	SH/SU-641/661
2230201056800	Arrow adhesive mark	NO.X-16-400	

■ Replacement Procedure

1. Shut power OFF at the main power switch (leakage breaker) on the chamber right panel.
2. Open the chamber door and detach the test area shelf, shelf brackets and partition.
3. Detach the heater unit. (Remove the screws on the left and right. See 5.4 [1].)
4. Detach the air circulator fan. (This will require a hex key (width across flat 2 mm).)
5. Detach the mechanical parts compartment rear panel and detach the condenser fan motor and mount.
6. Detach the air circulator fan motor and capacitor.
7. Affix the arrow adhesive mark to the new air circulator fan motor and fit the O-ring over the motor shaft and position 0.3 mm from the motor body.
8. Lock down the fan motor with the motor lead hole facing downward. Make sure the motor shaft does not contact either the front or back of the air circulator shaft flange.
9. Attach the air circulator fan to the motor shaft from the test area side.
10. Fill the screw holes used to anchor the capacitor with silicon sealant.
11. Lock down the new capacitor.
12. Connect wires as before.
13. Reattach the condenser fan motor, heater unit and other parts as before.

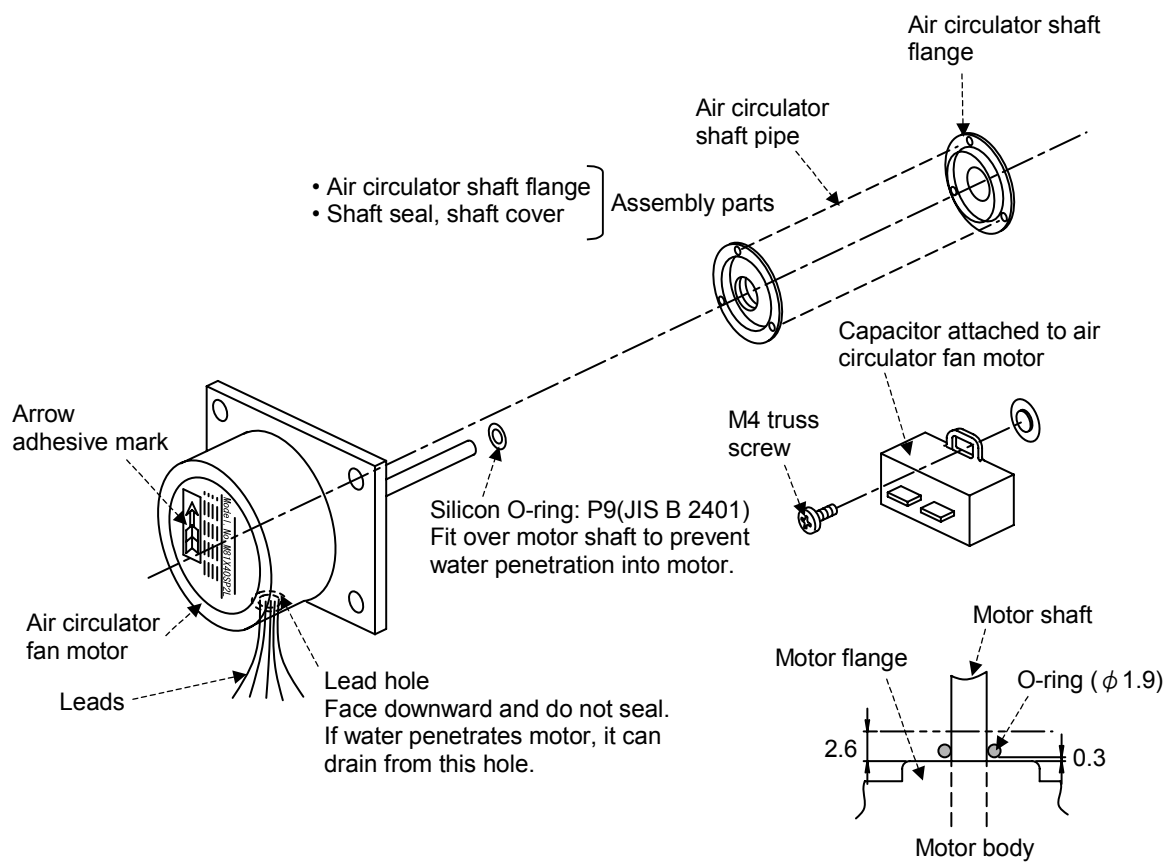


Fig. 5.23 Air circulator motor installation

(3) Thermal Fuse Sensor

■ Preparations

Check part codes as parts may have been changed.

Part code	Part	Specification/Model	Use
2140201004100	Thermal fuse sensor	FT-192-30C (NO.15275H1385P4A)	

■ Replacement Procedure

1. Shut power OFF at the main power switch (leakage breaker) on the chamber right panel.
2. Detach the mechanical parts compartment rear panel.
3. Open the chamber door and detach the test area shelf, shelf brackets and partition.
4. Press the thermal fuse sensor inward with your finger from the test area side and pull it out from the thermal fuse replacement hole on the mechanical parts compartment side.
5. Insert a new thermal fuse sensor from the mechanical parts compartment side far enough into the test area side to grab with your fingers, and position so that the tip is 60 mm from the test area wall.
6. Connect wires and reattach detached parts as before.

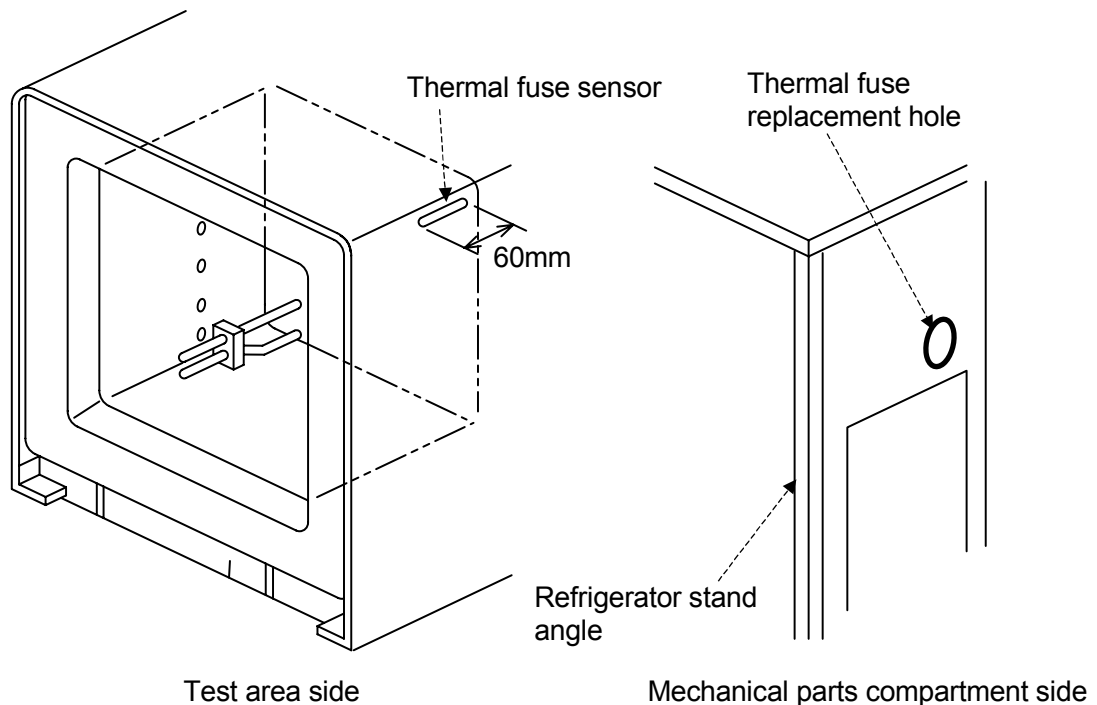


Fig. 5.24 Thermal fuse sensor

(4) Humidifying Heater and Boil-dry Protector (Temperature Switch)

■ Preparations

Supplies: Silicon sealant: KE-45 Clear by Shinetsu Chemical Co., Ltd. or similar

Check part codes as parts may have been changed.

Part code	Part	Specification/Model	Remarks
2000000009600	Humidifying heater unit		Humidifying heater (2060801084000)+ Humidifying heater packing (2041301109710)
2140201014300	Temperature switch (Boil-dry protector)	T55-1326901	Set temperature: 155°C

■ Replacement Procedure

Humidifying Heater

1. Shut power OFF at the main power switch (leakage breaker) on the chamber right panel.
2. Remove the screws that lock down the mechanical parts compartment rear panel and detach the panel. (See Fig. 5.25.)
3. Cut humidifying heater leads with nippers or other means.
4. Open the chamber door. Remove the screws that lock down the top and bottom test area partitions and detach the partitions. (See Fig. 5.26.)
5. Remove the screws that lock down the EGO clamp and detach the bracket.
(A screwdriver cannot be used with the EGO clamp as installed. Turn the bracket 90° to the front so that screw head faces front.)
6. Remove the screws that lock down the humidifying heater, and pull the humidifying heater and humidifying heater packing to the front and out.
7. Feed the leads of the new humidifying heater through the humidifying heater packing.
8. Coat both ends of the new humidifying heater packing with sealant and feed the humidifying heater leads from the front to the mechanical parts compartment.
9. Coat humidifying heater screws with sealant and lock down the humidifying heater. Lock down the temperature switch with the humidifying heater bracket and the EGO clamp. (See Fig. 5.27.)
After tightening the EGO clamp screw, turn the bracket 90° toward the rear. (See Fig. 5.28.)
10. Crimp the humidifying heater leads and the cut leads in the mechanical parts compartment with an insulated crimping sleeve.

Boil-dry Protector

1. Shut power OFF at the main power switch (leakage breaker) on the chamber right panel.
2. Remove the screws that lock down the mechanical parts compartment rear panel and detach the panel. (See Fig. 5.25.)
3. Remove the screws that lock down the boil-dry protector bracket and the screws that lock down the temperature switch, and detach the temperature switch.
4. Open the chamber door. Remove the screws that lock down the top and bottom test area partitions and detach the partitions. (See Fig. 5.26.)
5. Remove the screws that lock down the EGO clamp and detach the bracket.
(A screwdriver cannot be used with the EGO clamp as installed. Turn the bracket 90° to the front so that screw head faces front.)
6. Detach the boil-dry sensor from the humidifying heater bracket and pull out to the mechanical parts compartment side. (Do not cut. Because of fluid pressure, fluid will spray if the sensor line is cut.)
7. Install a new boil-dry protector to the chamber with the EGO stopper and boil-dry protector bracket. (Seal screws.)
Installing the EGO stopper as shown in the figure enables setter installation. (See Fig. 5.25.)
8. Insert the boil-dry protector sensor from the rear. With the SH/SU-221/241, the sensor is inserted at about a 20° angle.
9. Coil the EGO capillary tube and bind in two places.
10. Lock down the boil-dry protector sensor as shown in Fig. 5.27.

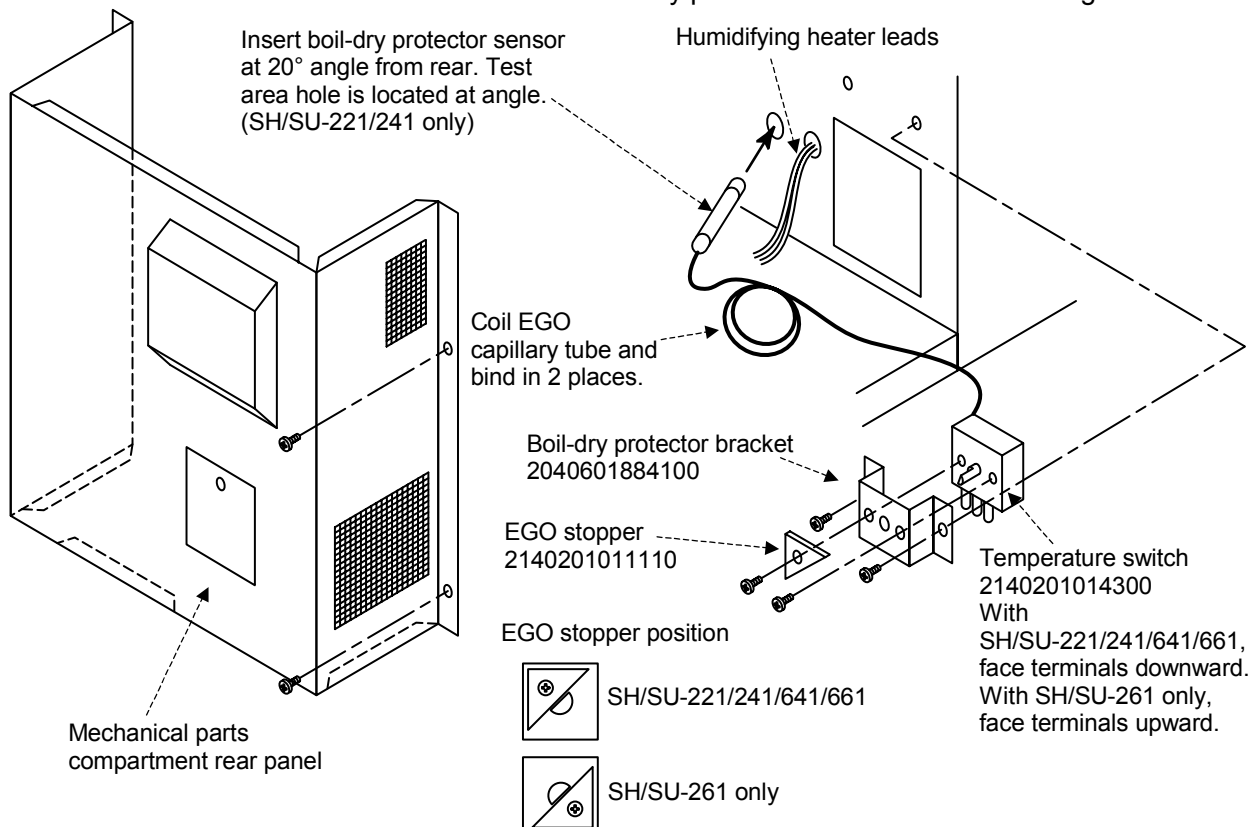


Fig. 5.25 Boil-dry protector replacement

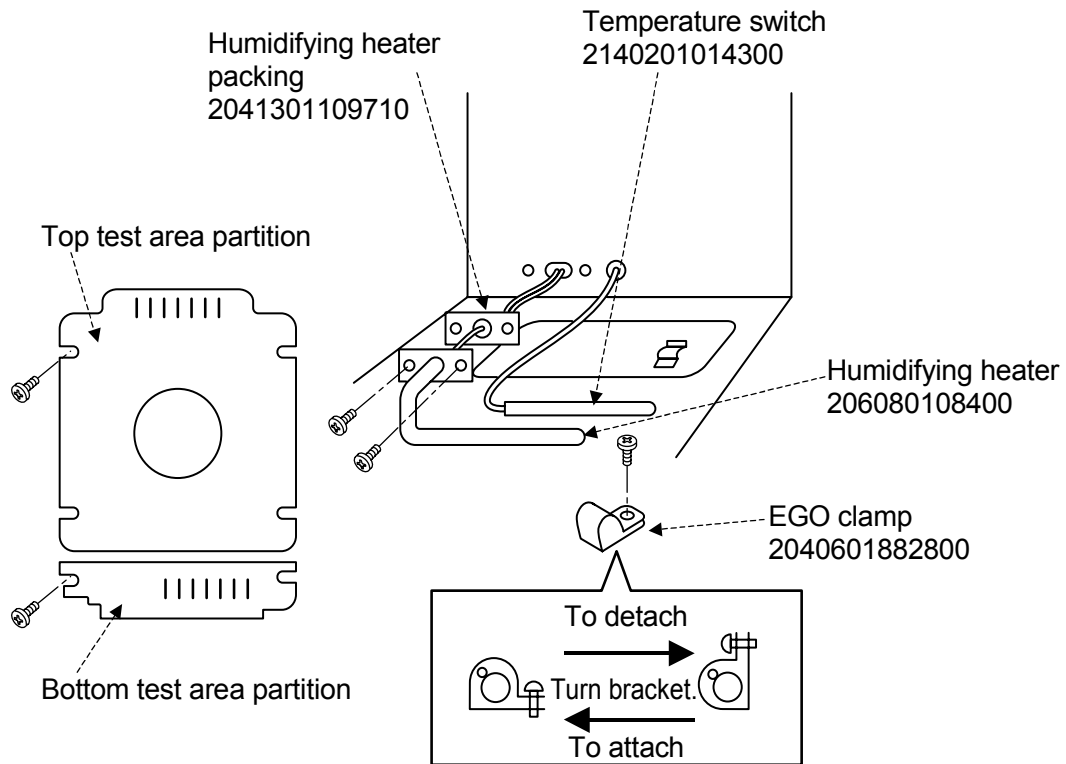


Fig. 5.26 Humidifying heater replacement

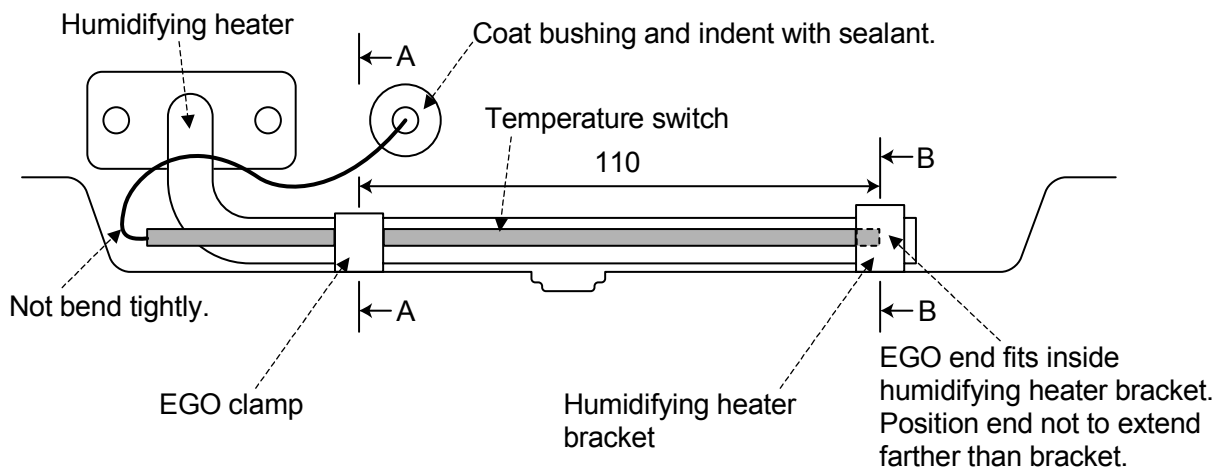


Fig. 5.27 Humidifying heater installation

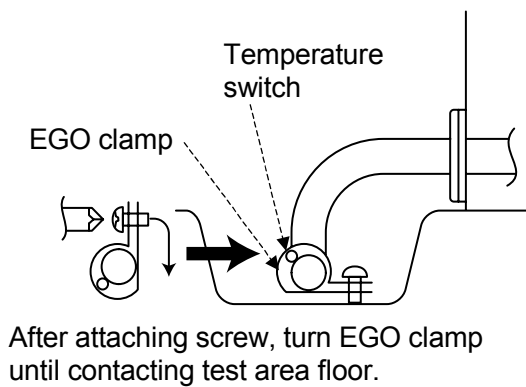


Fig. 5.28 Cross-view at A-A

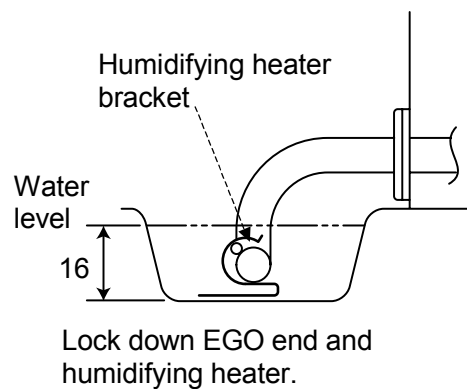


Fig. 5.29 Cross-view at B-B

(5) Dry/Wet-bulb Sensors

■ Preparations

Supplies: Silicon sealant: KE-45 Clear by Shinetsu Chemical Co., Ltd. or similar

Check part codes as parts may have been changed.

Part code	Part	Specification/Model	Chamber
0214020106092000	Dry-bulb sensor	Thermocouple type T (Copper/Copper-Nickel), 4 ϕ , triple (bent)	SH/SU-221/241/261
0214020106161000	Dry-bulb sensor	TTT-3-L-4-330-3 \times 3	SH/SU-641
0214020106102000	Wet-bulb sensor	Thermocouple type T (Copper/Copper-Nickel), 4 ϕ , single (bent)	SH-221/241/261
0214020106150000	Wet-bulb sensor	T-3-L-4-330-3	SH-641/661

■ Replacement Procedure

Dry/Wet-bulb Sensors

1. Shut power OFF at the main power switch (leakage breaker) on the chamber right panel.
2. Remove the screws that lock down the electric parts compartment top panel and detach the panel. (See 5.1.[1].)
3. Disconnect the dry/wet-bulb sensor leads from CN1 on the temperature controller board. (See 5.1 [3].)
4. Open the chamber door. Remove the screws that lock down the top and bottom test area partitions and detach the partitions.
5. Pull the dry/wet-bulb sensor positioning plate out from the front. (SH-221, 241, 261 only)

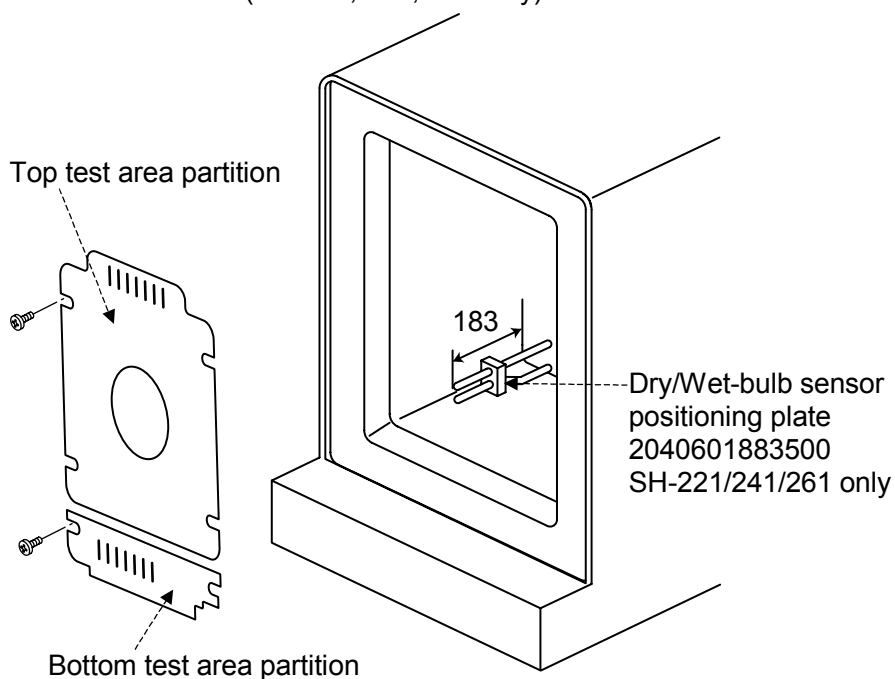


Fig. 5.30 Dry/Wet-bulb sensors seen from test area front

6. Remove the screws that lock down the mechanical parts compartment rear panel and detach the panel. (See Fig. 5.31.)
7. Loosen the screws that lock down the dry/wet-bulb sensor stoppers and pull the stoppers and sensors out from the rear.
(If the wick pan regulator is in the way, detach the regulator bracket and move the regulator slightly to the side or detach it entirely.)
* Coat screws with sealant when reattaching the wick pan regulator bracket.
8. Loosen the screws (slotted set screws) that lock down the dry/wet-bulb sensor and pull the sensors out.
9. Install new dry/wet-bulb sensors in the opposite order in which the old sensors were detached.
However, note that the dry-bulb sensor and wet-bulb sensor are different parts. (For dimensions and form, see Fig. 5.34.) The dry/wet-bulb sensors are bent (SH/SU-221/241/261 only; sensors are straight on SH/SU-641/661), therefore be careful of which end goes in first. (For position and orientation, see Figs. 5.32 and 5.33.) Seal the insertion hole bushings.

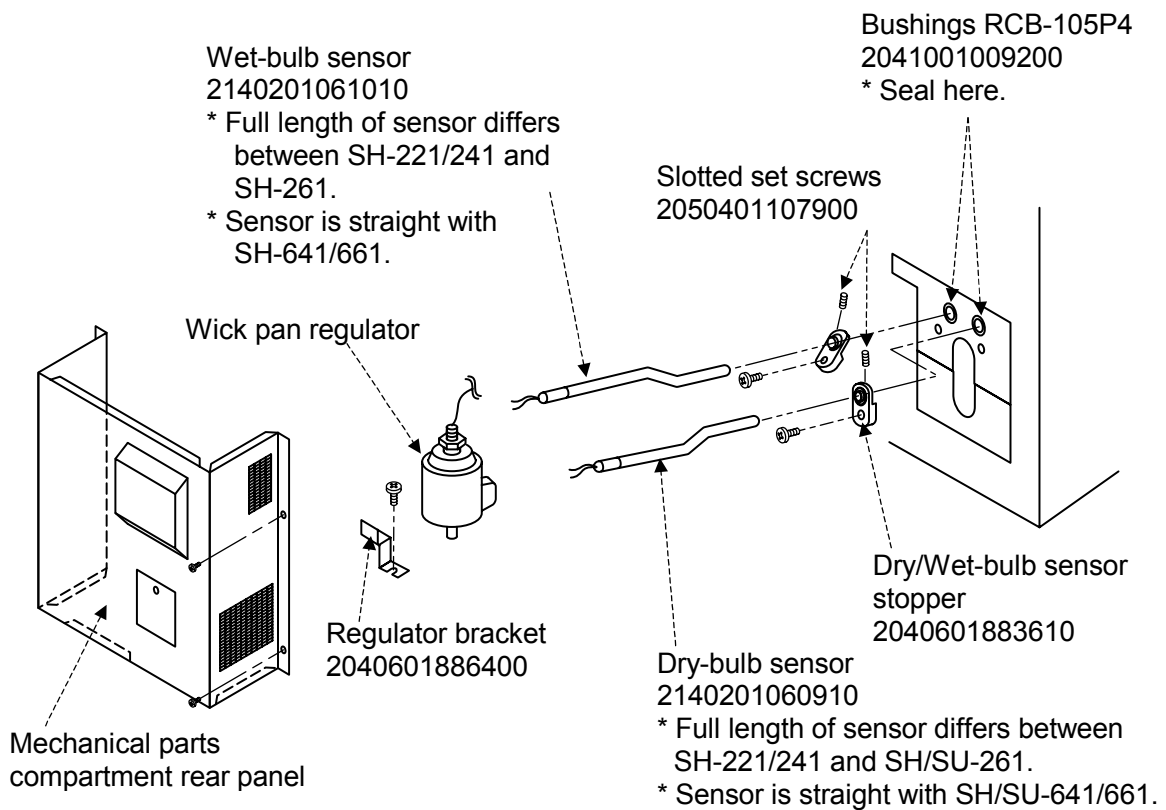


Fig. 5.31 Dry/Wet-bulb sensors seen from mechanical parts compartment

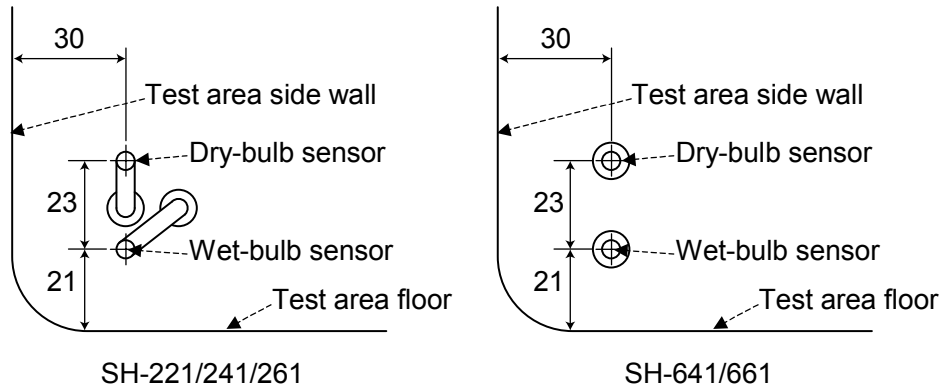


Fig. 5.32 Dry/Wet-bulb sensors seen from test area

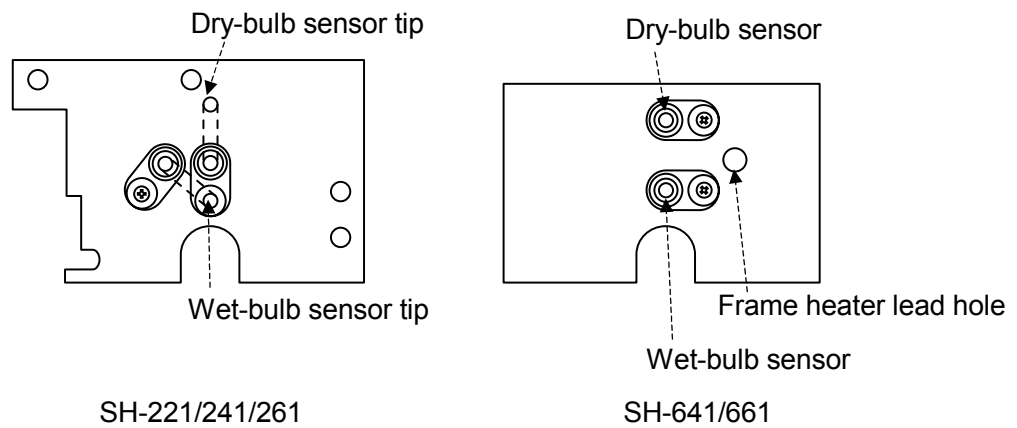
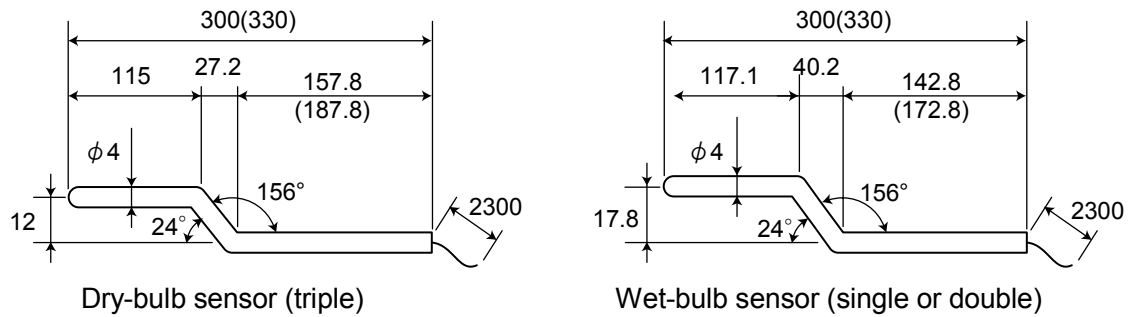


Fig. 5.33 Dry/Wet-bulb sensors seen from rear



Figures in () for SH/SU-261.

Fig. 5.34 Dimensions and form of dry/wet-bulb sensors (SH/SU-221/241/261 only)

5.5 Refrigerator

(1) Condenser Fan and Fan Motor

■ Preparations

Check part codes as parts may have been changed.

Part code	Part	Specification/Model	Use
2060101003000	Condenser fan motor	FE4-041N (P)	For condenser fan drive (SH/SU-221/241)
2060101006400	Condenser fan motor	FE-11L	For condenser fan drive (For SH/SU-261/641/661)
2060101009800	Fan (Condenser)	φ 196, ABS resin	For SH/SU-221/241
2060101002900	Fan (Condenser)	φ 230 FRP	For SH/SU-261/641/661
2040201527011	Condenser fan motor mount	2040201527011	For SH/SU-221/241
2040201569400	Condenser fan motor mount	2040201569400	For SH/SU-261
2040201555400	Condenser fan motor mount	2040201555400	For SH/SU-641/661
2230201056800	Arrow adhesive mark (Rotation direction indication)	No.X-16-400	

■ Replacement Procedure

1. Shut power OFF at the main power switch (leakage breaker) on the chamber right panel.
2. Remove the screws that lock down the mechanical parts compartment rear panel.
3. Remove the screws (4) that lock down the condenser fan motor mount and detach the fan motor and mount.
4. Detach the fan from the fan motor. (Loosen the hexagon bolts.)
5. Detach the condenser fan motor from the condenser fan motor mount.
6. Attach the condenser fan motor and condenser fan to the condenser fan motor mount (be careful of which side they are attached to) and reattach the condenser fan motor mount as before. Affix the arrow adhesive mark to the new condenser fan motor.

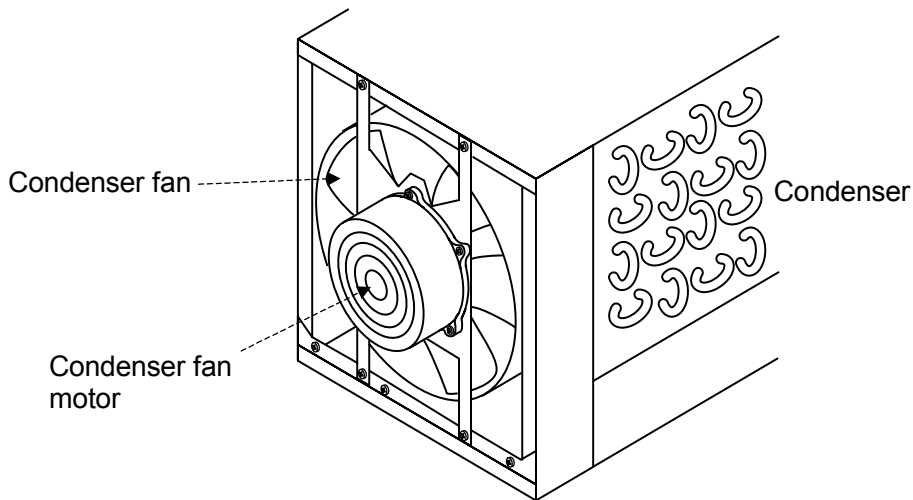
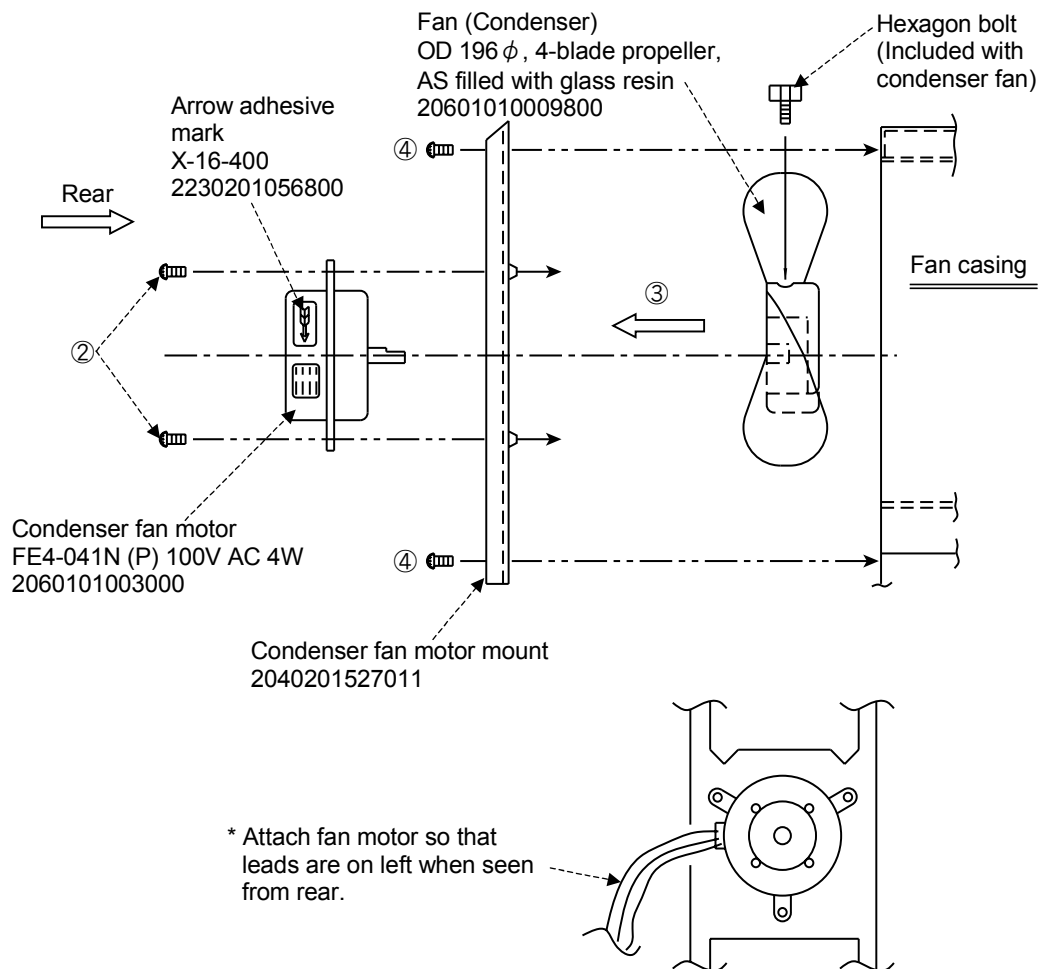
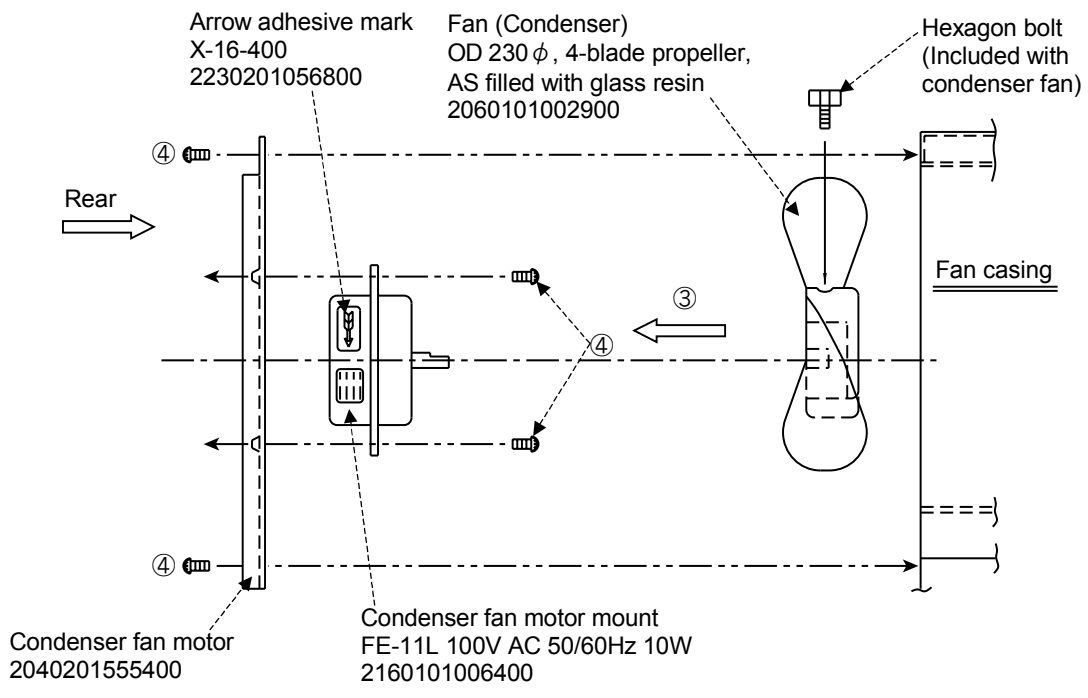


Fig. 5.35 Condenser fan and fan motor

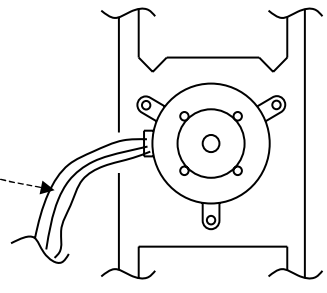


* After installing, spin propeller by hand and check for interference.

Fig. 5.36 Condenser fan motor installation (SH/SU-221/241)



* Attach fan motor so that leads are on left when seen from rear.



* After installing, spin propeller by hand and check for interference.

Fig. 5.37 Condenser fan motor installation (SH/SU-261/641/661)

(2) Refrigerator Unit

The following information is for single-stage refrigerators.

■ Preparations

- The refrigerant pipes are smaller than normally used copper pipe at 3/16". Use a pipe bender to bend pipes. Bend pipes to a 12.5 mm radius. Even refrigerant adjustments cannot correct performance lost to improperly bent pipes. Before performing maintenance, see "5.5 (3) Precautions in Maintenance".
- Supplies: Silicon sealant: KE-45 Clear by Shinetsu Chemical Co., Ltd. or similar, long shaft driver
- If replacing the refrigerator because of a refrigerant leak, replace the cooling unit.

Check part codes as parts may have been changed.

	Part code	Part	Specification/Model	Use
	2070202000100	Cooling unit	GM-G77R1UVA	Includes parts ① to ⑬.
①	2070501015500	Compressor	C-2SN400L0V	Refrigerant compression
②	2070901039000	Fin condenser	2070901039000	Refrigerant condensing
③	2070203002100	Dryer	2070203002100	Refrigerant moisture removal
④	2071401019900	Solenoid valve	HCS-TB-1	Refrigerant control
⑤	2070203004310	Capillary insert pipe		
⑥	2071401015600	Solenoid valve	SB18P-TB	
⑦	2060501005900	Heat exchanger	HE0.5	
⑧	2070203002200	Header		
⑨	2070203002400	Distributor		
⑩	2071901011000	Check valve	YCV5-2	
⑪	2070203002000	Accumulator		
⑫	2070901038800	Fin evaporator		Refrigerant evaporation
⑬	—	Capillary tube	—	Refrigerant expansion

■ Replacement Procedure

* Before performing work, unplug the power cable and drain refrigerant from the refrigeration circuit.

1. Open the chamber door and detach the test area shelf and partition.
2. Detach the heater and the test area shelf bracket supports. (See 5.4.)
3. Detach the air circulator fan. (This will require a hex key (width across flat 2 mm).)
4. Detach the mechanical parts compartment rear panel, temperature (humidity) sensor and thermal fuse. (See 5.4.)
5. Disconnect all wires in the mechanical parts compartment. (Cut heater and humidifying heater wires in the mechanical parts compartment with nippers.)
6. Detach the condenser fan motor and mount from the mechanical parts compartment.
7. Detach the air circulator fan motor and capacitor.

8. Remove the screws that lock the electric parts compartment to the chamber (x 4 in electric parts compartment bottom panel) and the screws that lock down the instrumentation frame (x 4 on lower half of instrumentation frame), and separate the electric parts compartment from the chamber.
 9. Cut the refrigerating connection pipe between the test area and mechanical parts compartment with a gas burner or other means, and detach the connection pipes.
- * Shield other pipes and parts against heat when using the gas burner.

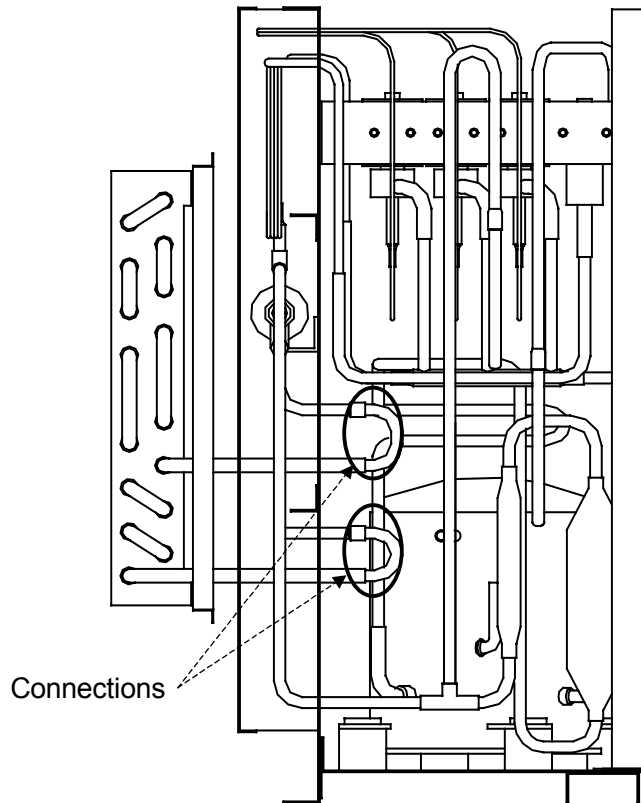


Fig. 5.38 Evaporator connection pipe connections

10. From the test area side, remove screws A (screws B for cascade units) that lock down the evaporator and remove seals B.

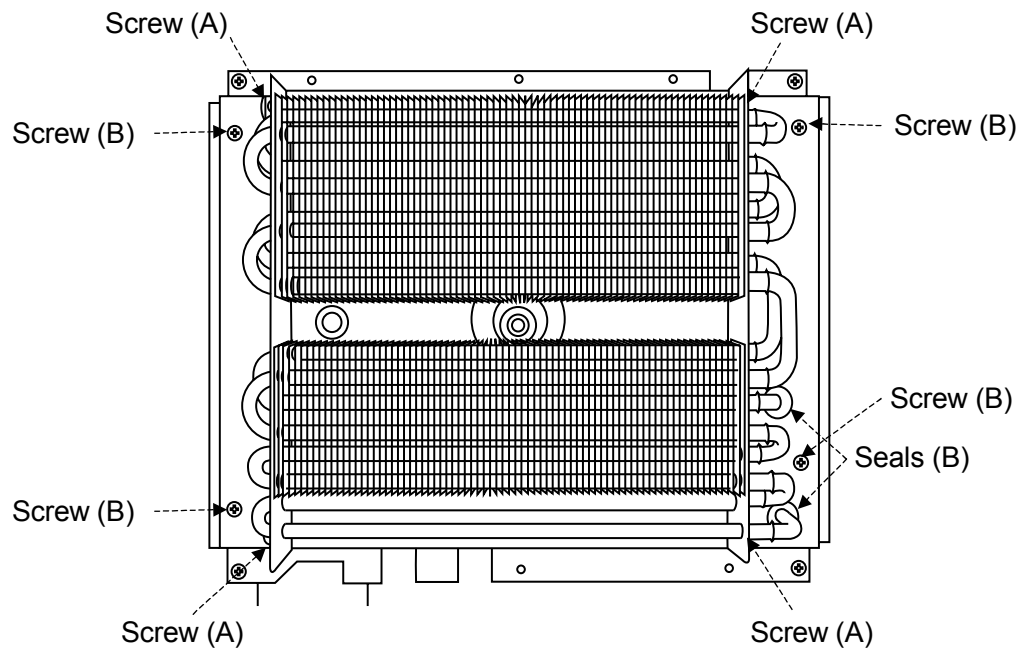


Fig. 5.39 Evaporator

11. Pull the evaporator towards the chamber front and out.
12. Removes screws A and B that lock down the chamber top panel and refrigerator unit left and right legs.

Screw (B)
(Also found on opposite side.) Screw (A)

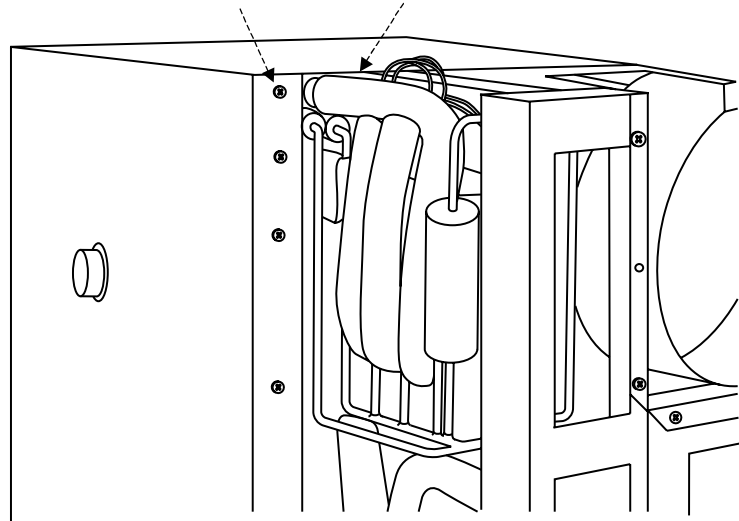


Fig. 5.40 Refrigerator unit

13. Remove the seal between the chamber and refrigerator unit, and pull the refrigerator unit out.
14. Install a new refrigerator unit (and evaporator) in the opposite order in which the old refrigerator unit was detached.

■ **Note**

Be careful of the following when installing a new refrigerator unit.

- Remove any seals leftover in step 10 and 13, and seal anew.
- Replace the air circulator shaft pipe with a new pipe.
- When tightening screws A of Fig. 5.40, do not introduce drills of 1 cm or larger into the refrigerator unit. (Refrigerator unit insulation contains capillary tubes.)
- Replace the evaporator connection pipe with a new pipe.
- Newly seal all holes and bushings on both sides.
- With SH chambers, be careful not to damage water supply and drain tubes when connecting the refrigerator unit.
- After docking the refrigerator unit, check for water leaks.

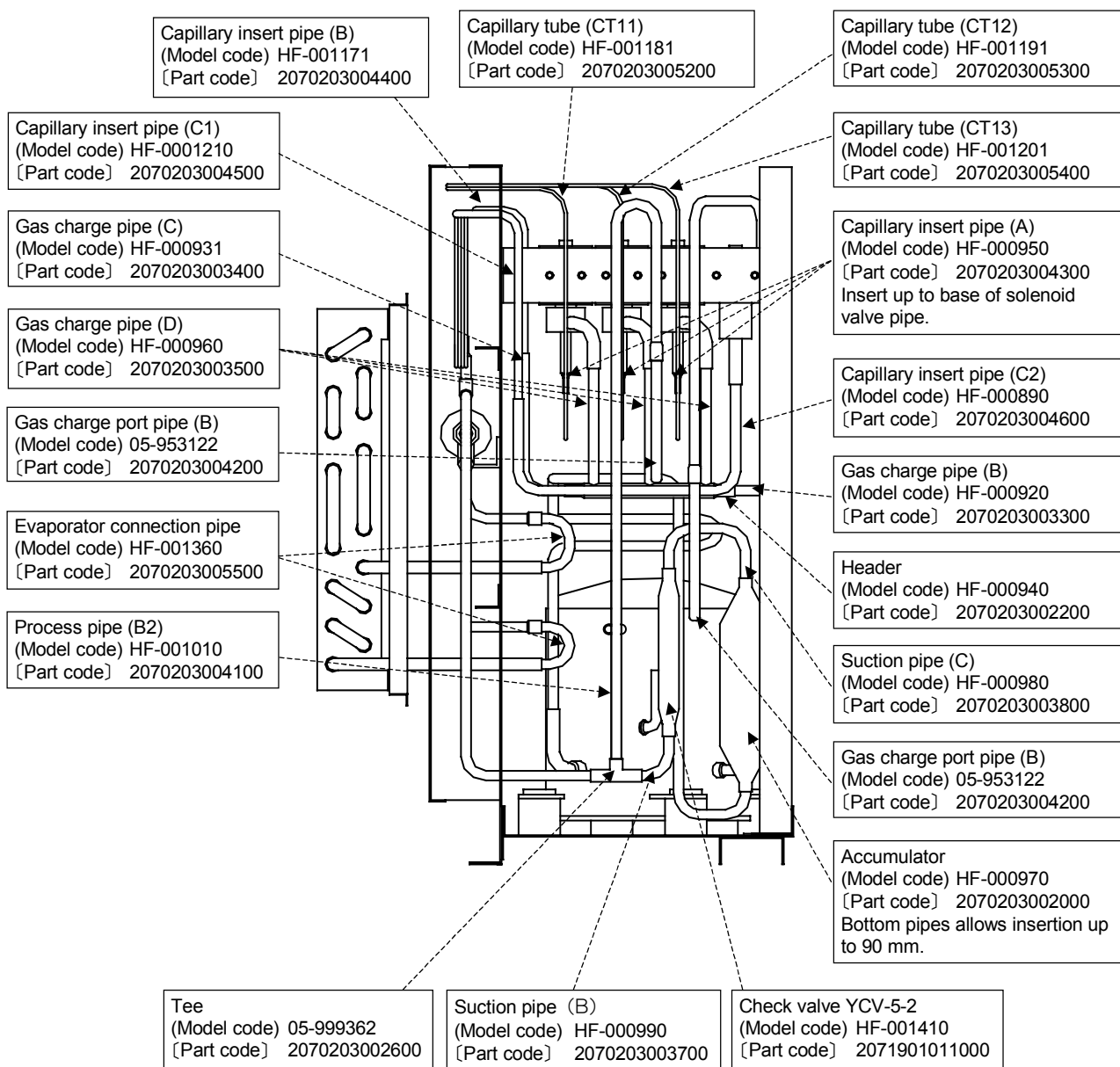


Fig. 5.41 Refrigerator piping

(3) Precautions in Maintenance

■ Compressor

- Do not use old compressors. (On the outside, they look exactly the same as new compressors.)
→ New compressors use a different model of overload relay.
- When replacing pipes connected to the compressor, replace the entire pipe without using inserts, etc.
→ Unless the proper size, pipes can burst.

■ Evaporator

- Detach the evaporator connection pipes on the rear and pull them out from the test area side.

■ High Durability Solenoid Valve

SV11/12/13..... SH/SU-221/241/641/661

SV12/13/16..... SH/SU-261

- Install as follows.
→ If not sufficiently inserted, control can destabilize.

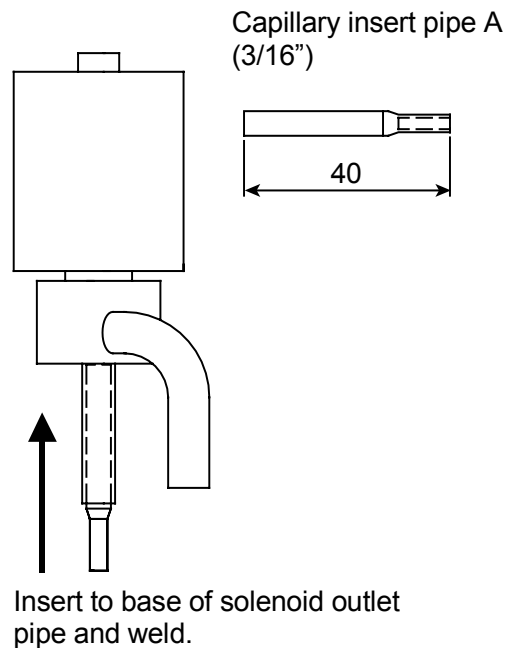


Fig. 5.42 High durability solenoid valve installation

Chapter 6

Temperature (Humidity) Controller Adjustments

This chapter explains how to initialize the temperature (humidity) controller and offset sensors.



DANGER

- **Shut OFF power supply at the main power switch BEFORE replacing parts.**
- **Wear gloves and be careful of sharp edges and corners when detaching metal parts such as panels.**

6.1 ROM Replacement

Basically, it is not necessary to initialize the ROM when replaced. If the ROM is upgraded, initialization is needed because of software structure, but in that case, you will be notified by a release notice.

ROM initialization returns all settings to their initial values, therefore care is needed. (See “6.2 Temperature [Humidity] Controller Initialization”.)

■ Replacement Procedure

1. Shut power OFF at the main power switch (leakage breaker) on the chamber right panel.
2. Detach the electric parts compartment top panel. (See “5.1 [1]”.)

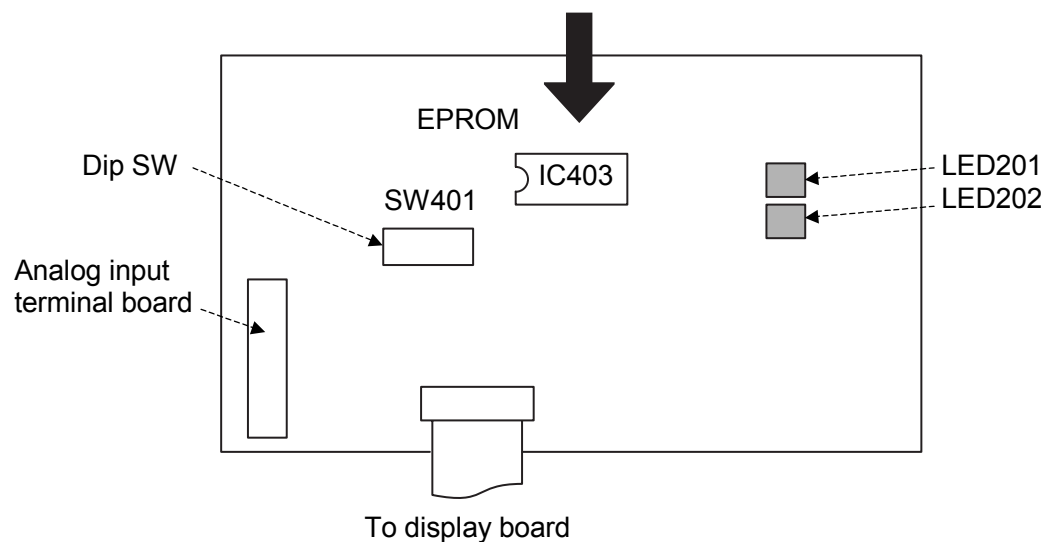


Fig. 6.1 Conceptual view of control board

3. Replace the temperature (humidity) controller ROM.
4. Turn ON power at the main power switch and check that LED201 on the temperature controller board lights up. If LED202 (red) lights up instead, the ROM may not be properly mounted, therefore check.
5. Set the **POWER** key on the operating panel in the ON position and, when the monitor mode appears on the display, check the ROM version. If the displayed version matches the label on the ROM chip, replacement is completed.

From the monitor mode, press the **SET** key 5 or 6 times until getting the top display “USER 545” of the system environment monitor mode. Then, press the **NEXT** key and check the chamber model, ROM version and ladder software version in that order. (See the Basic Operation manual.)

6. Reattach the electric parts compartment top panel.

6.2 Temperature (Humidity) Controller Initialization

When Initialization Is Needed

The temperature (humidity) controller must be initialized in the following cases.

- When software is not compatible with ROM upgrades (The chamber will not function properly after replacing the ROM.)
- When the chamber does not function properly for unknown reason and resetting the system can help.




1. Make preparations.

When the temperature (humidity) controller is initialized, all data except calibration data is defaulted. If service mode settings have been made specially for user's system, those settings will have to be remade after initializing the temperature (humidity) controller. If that is the case with their system, keep a record of important service mode settings. You do not need to record all settings. To find out which, see "Special Notes". Also, keep a record of user setup mode settings.

2. Initialize the temperature (humidity) controller.

- ① Set the leakage breaker in the OFF position.
- ② Detach the electric parts compartment top panel. (See "5.1 [1]").)
- ③ Set temperature (humidity) controller dip switches Nos. 1 and 4 in the ON position.
- ④ Set the leakage breaker in the ON position.
- ⑤ Wait 10 seconds.
- ⑥ Press the **POWER** key and check the temperature (humidity) controller has been initialized from the monitor mode.
- ⑦ Set the leakage breaker in the OFF position and return dip switches as before.
- ⑧ Reattach the electric parts compartment top panel.

3. Remake the chamber model code setting and service mode settings.

- Initialization sets the chamber model code to SU-221. Change as necessary.
- ① From the normal monitor mode, press the **SET** key 6 times until the (USER 545) top display of system environment monitor mode appears. Then, hold down the ,  and  keys simultaneously for at least 4 seconds.

- ② The display will change to the channel input value (CH - 0). Press the (SET) key once.
 - ③ The display will change to the chamber model code setting (TYPE 51). Select the code for the chamber you are servicing with the (▲) and (▼) keys, and press the (ENT.) key.
 - ④ Press the (NEXT) key to get the numerical half of the model code (10 2 2 1). Set the code for the chamber you are servicing with the (▲) and (▼) keys, and press the (SET) and (ENT.) key.
 - ⑤ Set the leakage breaker in the OFF position.
 - ⑥ If servicing a chamber with special features, repeat step ① and get special settings referring to 6.6 Display Transition Diagrams. Remake settings with the (▲) and (▼) keys, and press the (SET) and (ENT.) key. Once all settings have been made, set the leakage breaker in the OFF position.
4. If user setup mode settings have to be remade, do so. See the User's Manual.

Special Notes

1. Service mode settings that may need setting after initialization are given here following. ① and ② are definitely necessary, whereas the others are for customized chambers. Settings are blocked off into groups as they appear in the service mode. Pressing the (SET) key moves you to the next group. Some settings are not displayed or cannot be set depending on the type of chamber and ROM version.
 - ① Chamber model code 1 (Alphabetical code)
 - ② Chamber model code 2 (Numerical code)
 - ③ Maximum/Minimum allowed temperatures
 - Maximum allowed temperature
 - Minimum allowed temperature
 - ④ Temperature (Humidity) high/low temperature alarms
 - Absolute high temperature alarm
 - Absolute low temperature alarm
 - Upper deviation temperature alarm
 - Lower deviation temperature alarm
 - Absolute high humidity alarm (For humidity type chambers)
 - Absolute low humidity alarm (For humidity type chambers)
 - Upper deviation humidity alarm (For humidity type chambers)
 - Lower deviation humidity alarm (For humidity type chambers)

Temperature (Humidity) attainment setup

- Temperature attainment range
- Temperature holding time
- Humidity attainment range
- Humidity holding time

Output settings

- Trouble output
- Analog output
- Recorder output
- Analog output range maximum
- Analog output range minimum
- Startup control
- Backup mode

Time signal 1

Time signal 2

PID settings

- P setting (Loop1/Loop2)
- I setting (Loop1/Loop2)
- D setting (Loop1/Loop2)
- X setting (Loop1/Loop2)
- Measured value filter
- Filter value

2. When model code is changed, the Maximum/Minimum allowed temperatures and PID coefficients are automatically changed. However, if using added specification values that differ from standard values, make those settings again.
3. After installing a communication board (RS-485, E-BUS, RS-232C or GPIB) to the temperature (humidity) controller, initialize them.

6.3 Temperature (Humidity) Controller Switches and LEDs

Control Board (Temperature [Humidity] Controller)

The control board has one DIP switch array and two LEDs. Their names and functions are explained here following.

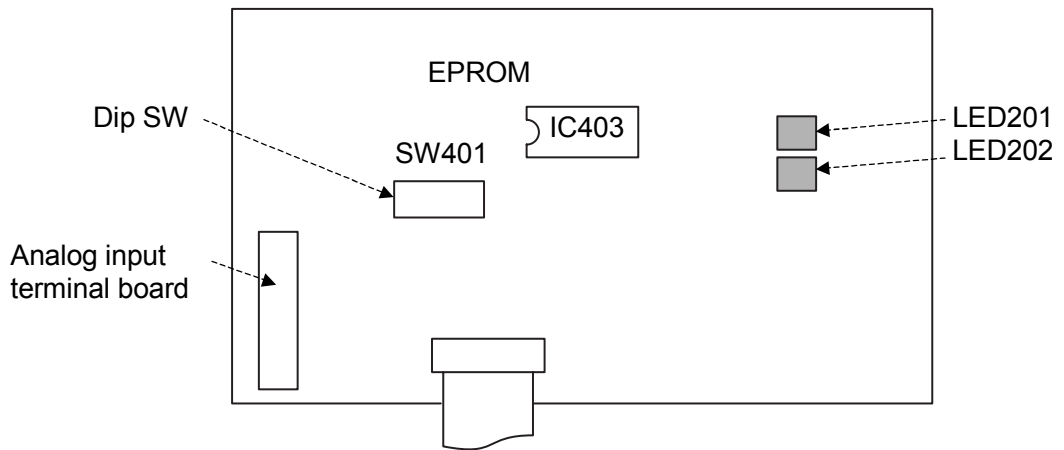


Fig. 6.2 Conceptual view of control board

- LED201/202 indicate the following.

Table 6.1 LED201/202 functions

Lighting			Function
LED	Name	Color when lit	
LED201	POWER	Green	Lit while power supply is ON.
LED202	FAIL	Red	Lights when CPU trouble occurs.

DIP switches have the following functions.

- ① Setting Nos. 1 and 4 in the ON position initializes the ROM when the main power switch is set in the ON position.
- ② Setting No. 3 in the ON position enables maintenance communications using the RS-232C communication board.
- ③ Setting No. 4 in the ON position stops sequence control.

Communication Board (Option)

RS-485, RS-232C, GPIB and E-BUS communication boards all have LED1/2.

- LED1/2 indicate the following.

Table 6.2 LED1/2 functions

Lighting			Function
LED	Name	Color when lit	
LED1	RXD	Yellow	Lit while receiving data.
LED2	TXD	Yellow	Lit while receiving data.

6.4 Sensor Offset

■ Dry-bulb Temperature Offset

From the monitor mode, pressing the (SET) key 5 times gets the top display of the system environment monitor mode. Then, pressing the (NEXT) key 16 times (14 times on SU chambers) gets the dry-bulb temperature offset setting. This setting enables you to set the amount of offset to apply to the dry-bulb sensor reading.

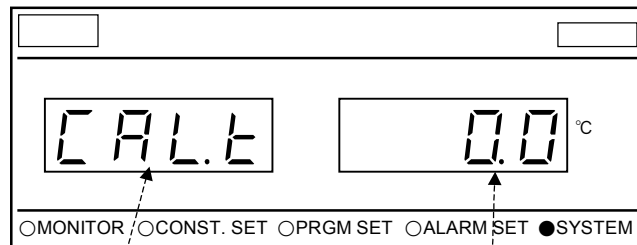
It can be set in the below range.

$$-5.0^{\circ}\text{C} \leq \text{offset} \leq 5.0^{\circ}\text{C}$$

For example, if the chamber is run at 60°C and “60.0°C” appears on the display as the monitored test area temperature, changing the dry-bulb temperature offset from 0.0°C to -0.2°C, displays the monitored test area temperature as 59.8°C.

The following procedure displays the current dry-bulb temperature.

Press the (◀) key 2 to 3 times. When the active digit returns to the far right column, the dry-bulb temperature (test area temperature) is displayed for 1 to 2 sec.



Stands for
“Calibration Temperature”

Dry-bulb temperature offset setting

(▲) (▼) : For changing the displayed value

(◀) : For selecting the active digit

(ENT) : For entering changed settings

■ Wet-bulb Temperature Offset (SH chambers only)

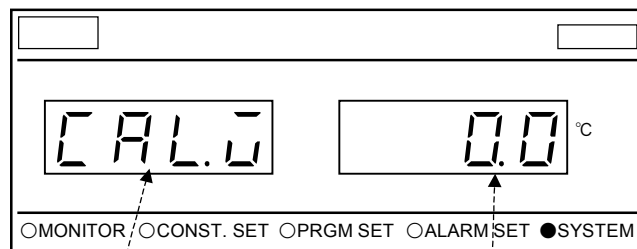
With the dry-bulb temperature offset setting on the display, pressing the **(NEXT)** key once displays the wet-bulb temperature offset setting. This setting enables you to set the amount of offset to apply to the wet-bulb sensor reading.

It can be set in the below range.

$$-5.0^{\circ}\text{C} \leq \text{offset} \leq 5.0^{\circ}\text{C}$$

The following procedure displays the current wet-bulb temperature.

Press the **(◀)** key 2 to 3 times. When the active digit returns to the far right column, the wet-bulb temperature is displayed for 1 to 2 sec.



Stands for
“Calibration
Wet Temperature”

Wet-bulb temperature offset setting
(▲) **(▼)** : For changing the
displayed value
(◀) : For selecting the active digit
(ENT.) : For entering changed settings

6.5 Running Time Integration

Running Time Integration Feature

The SH/SU-221/241/261/641/661 do away with the resettable integrating hour meter found on earlier S1 chambers. Instead, running time can be checked and reset from the operating panel display.

Display Explanation

Figure 6.3 shows the integrating running time display. In this example, the chamber has run 1,111 h 59 min.

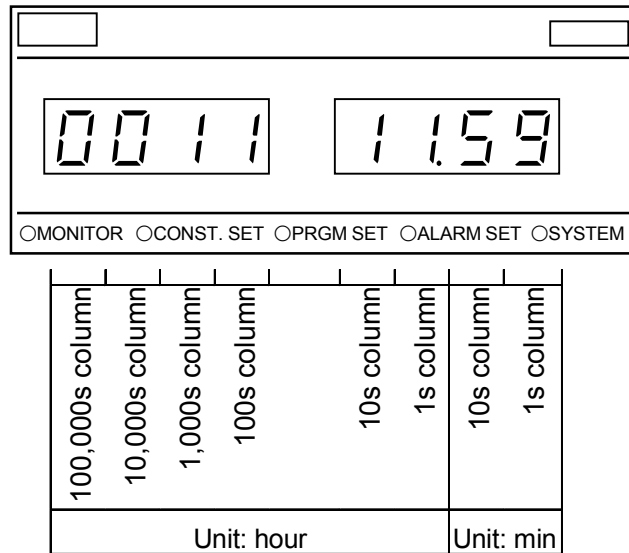


Fig. 6.3 Integrating running time display

Specifications

1. Running time is integrated only while the chamber is running normally.
2. Integrating running time is paused while primary power is OFF, control power is OFF and alarms are active.
3. The integrating running time is reset when the temperature controller is initialized.
4. If integrating running time exceeds "999999 h 59 min", the display returns to "000000 h 00 min".

How to Display Integrating Running Time

Integrating running time is displayed as follows.

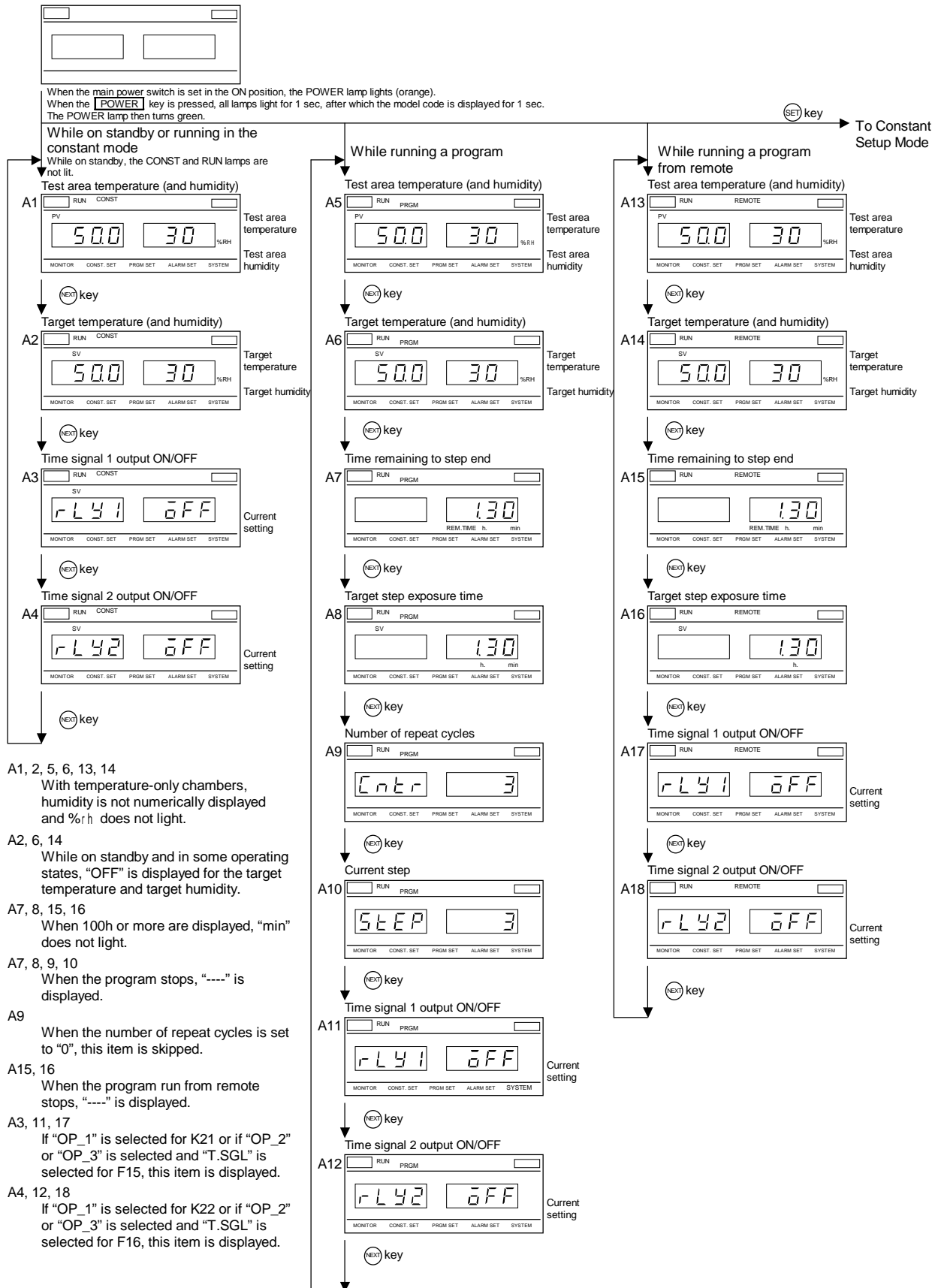
1. Set the main power switch and press the **POWER** key to get the monitor mode.
2. From the monitor mode, press the **SET** key 6 times until getting the top display (*U S E r 5 4 5*) of the system environment monitor mode. Then, hold down the **◀**, **▲** and **▼** keys simultaneously for 4 sec.
3. The display will change to (*┌ H - ┐*), therefore press the **NEXT** key 6 or 7 times. The integrating running time will appear on the display.

When the Temperature Controller Is Replaced

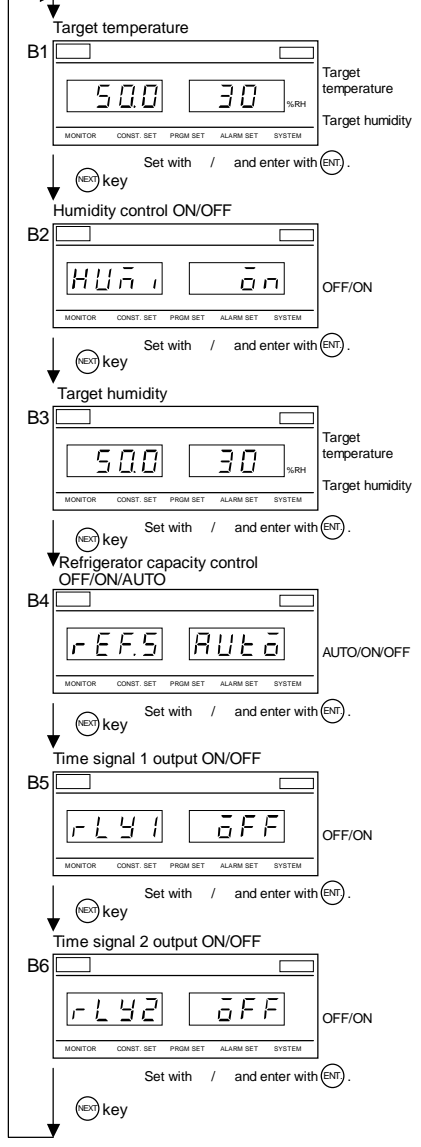
In the initial settings of the temperature controller, the integrating running time is "000000 h 00 min". Accordingly, it is possible to set the integrating running time so as to continue counting from the current running time if the temperature controller is replaced.

1. Check the integrating running time before replacing the temperature controller. (For the check procedure, see "How to Display Integrating Running Time".)
2. Replace the temperature controller and display the integrating running time.
3. Press the **◀** key 6 sec or more.
4. The far right column will flash, therefore input the integrating running time with the **◀**, **▲** and **▼**, and press the **ENT** key.
(The setting is not activated unless the **ENT** key is pressed.)
5. Press the **NEXT** key to return (*┌ H - ┐*) to the display.

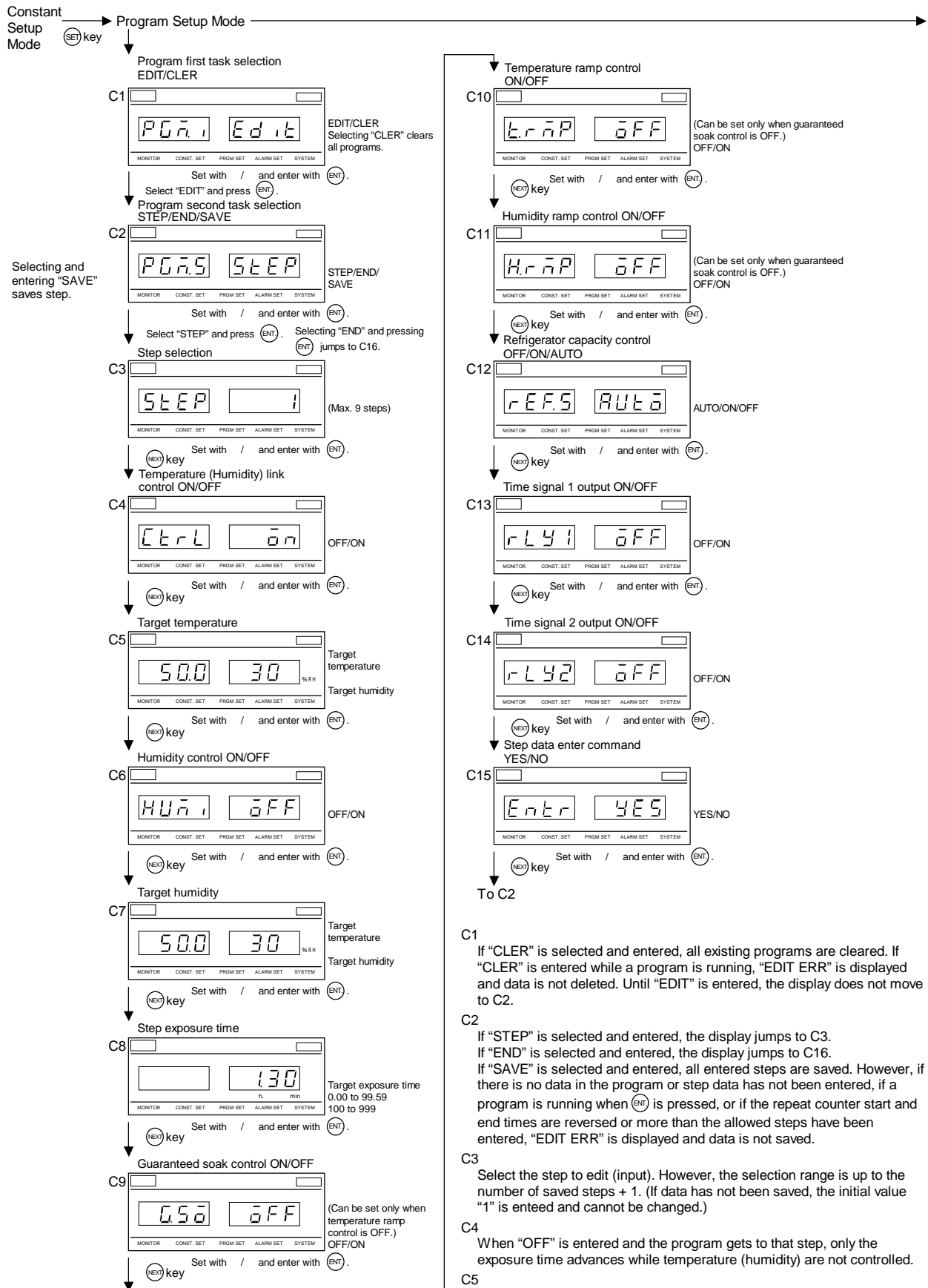
6.6 Display Transition Diagrams



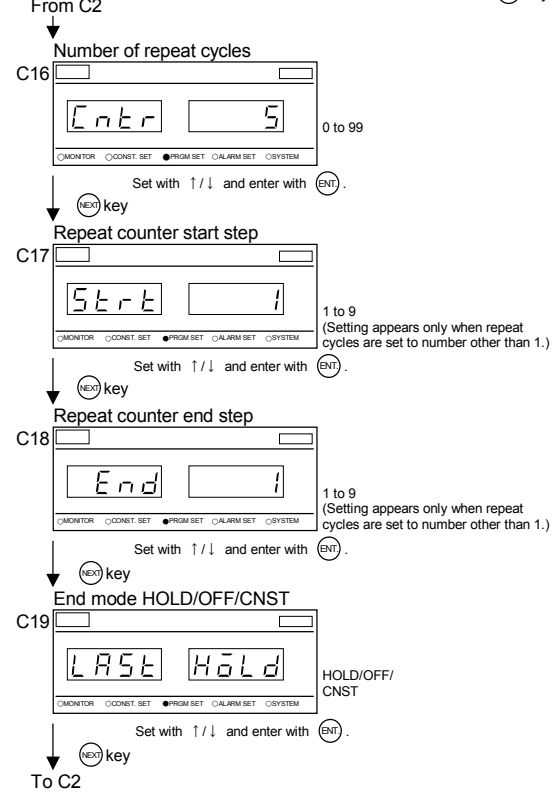
- A1, 2, 5, 6, 13, 14
 With temperature-only chambers, humidity is not numerically displayed and %RH does not light.
- A2, 6, 14
 While on standby and in some operating states, "OFF" is displayed for the target temperature and target humidity.
- A7, 8, 15, 16
 When 100h or more are displayed, "min" does not light.
- A7, 8, 9, 10
 When the program stops, "----" is displayed.
- A9
 When the number of repeat cycles is set to "0", this item is skipped.
- A15, 16
 When the program run from remote stops, "----" is displayed.
- A3, 11, 17
 If "OP_1" is selected for K21 or if "OP_2" or "OP_3" is selected and "T.SGL" is selected for F15, this item is displayed.
- A4, 12, 18
 If "OP_1" is selected for K22 or if "OP_2" or "OP_3" is selected and "T.SGL" is selected for F16, this item is displayed.



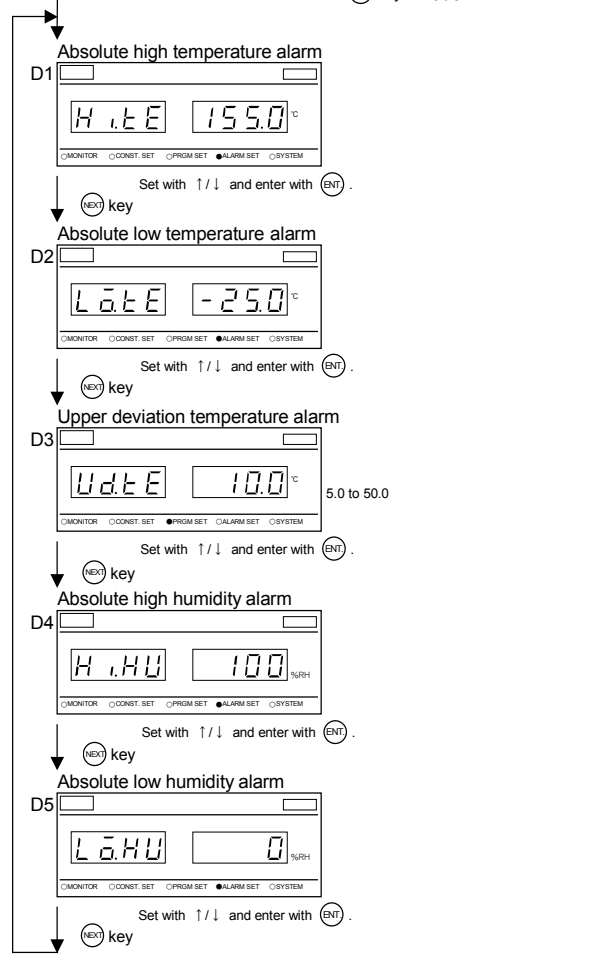
- B1** With temperature-only chambers, humidity is not numerically displayed and %RH does not light.
When humidity control is turned OFF, "OFF" is displayed.
- B2, 3** With temperature-only chambers, this item is skipped. Also, when B2 is turned OFF, B3 is skipped.
- B4** When anything other than "NON" is selected for K6 and "TYP2" is selected for K8, this item is displayed.
- B5** When "OP_1" is selected for K21 or if "OP_2" or "OP_3" is selected and "T.SGL" is selected for F15, this item is displayed.
- B6** When "OP_1" is selected for K22 or if "OP_2" or "OP_3" is selected and "T.SGL" is selected for F16, this item is displayed.



* If "OFF" is selected for C4, C5, 6, 7, 9, 10, 11, 12, 13 and 14 are skipped.



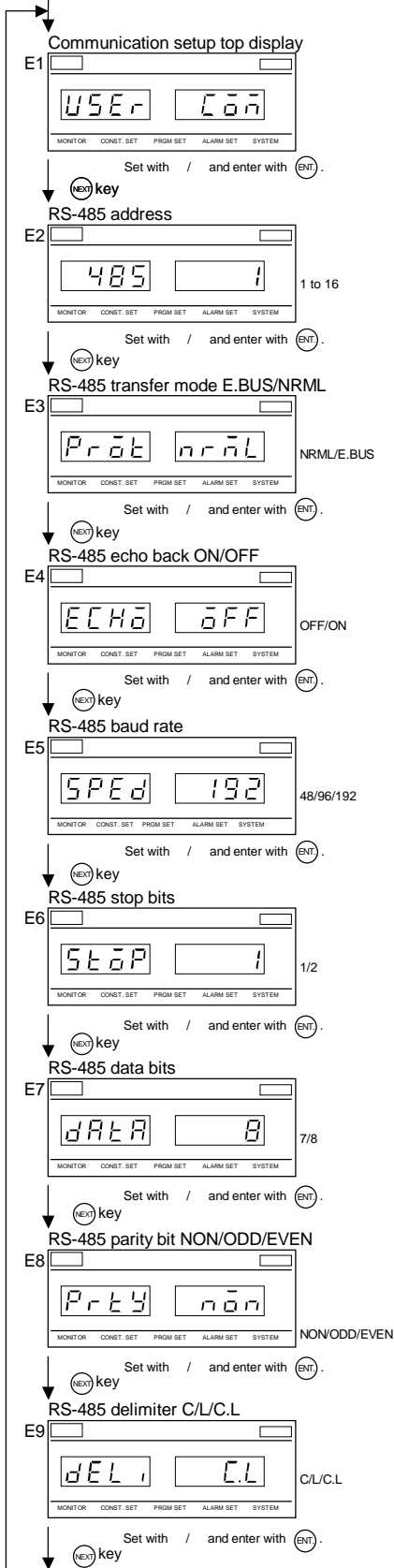
- C6, 7 With temperature-only chambers, this setting is skipped.
- C8 When 100 h or more are displayed, "min" does not light.
- C9 When temperature ramp control or humidity ramp control is ON, this setting is skipped.
- C10, 11 When ramp control is ON, this setting is skipped. Also, C11 appears only with temperature and humidity chambers.
- C12 If anything other than "NON" is selected for K6 and "TYP2" is selected for K8, this setting is displayed.
- C13 When "OP_1" is selected for K21 or if "OP_2" or "OP_3" is selected and "T.SGL" is selected for F15, this setting is displayed.
- C14 When "OP_1" is selected for K22 or if "OP_2" or "OP_3" is selected and "T.SGL" is selected for F16, this setting is displayed.
- C15 If "YES" is selected and entered, step data is entered. Also, input is enabled for the next step in C3.
- C17,18 When the number of repeat cycles in C16 is greater than 0, this setting is displayed.



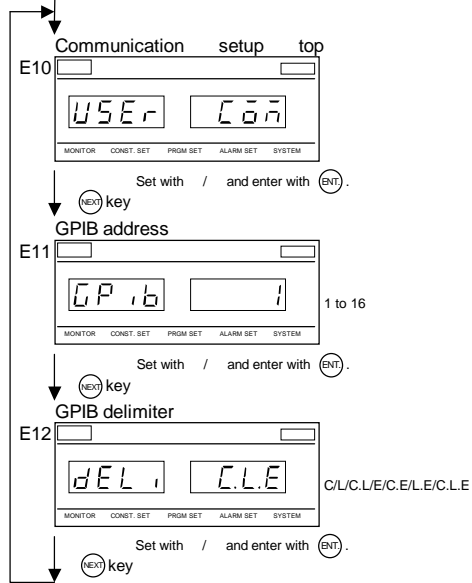
- D1 If the absolute high temperature alarm is turned OFF in the service mode, this setting is skipped.
- D2 If the absolute low temperature alarm is turned OFF in the service mode, this setting is skipped.
- D3 If the upper deviation temperature alarm is turned OFF in the service mode, this setting is skipped.
- D4 If the absolute high humidity alarm is turned OFF in the service mode, this setting is skipped.
- D5 If the absolute low humidity alarm is turned OFF in the service mode, this setting is skipped.



When equipped for RS-485 communications

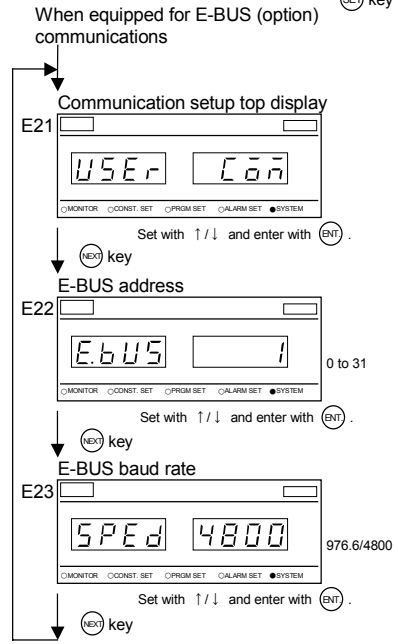
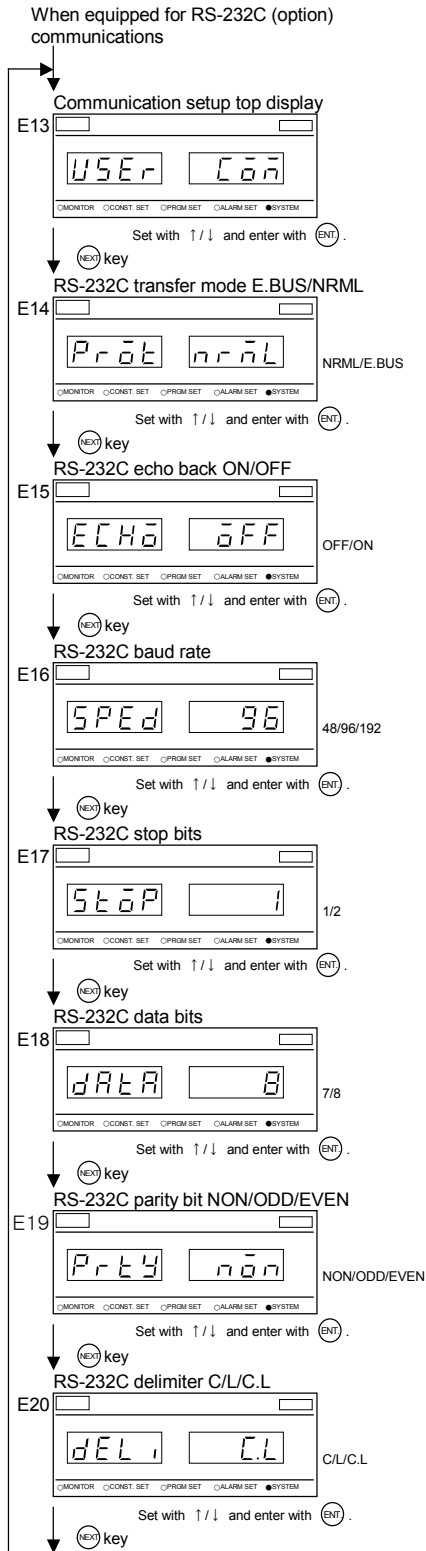


When equipped for GPIB (option) communications

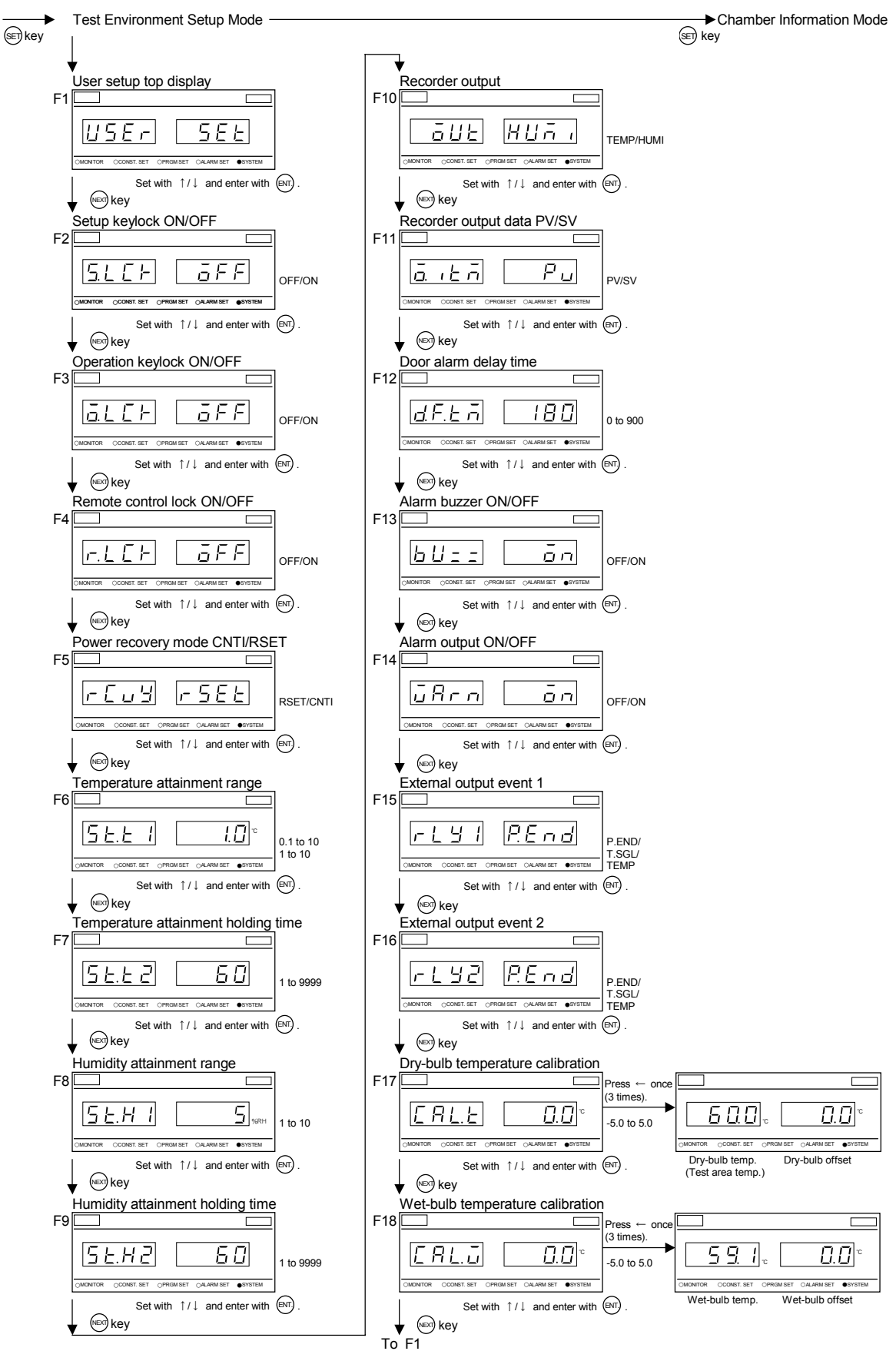


- E4 When "E.BUS" is selected in E3, this setting is displayed.
- E9, 20 CR and LF are expressed by only the first letter. By combining the 2 parameters, up to 3 patterns can be set.
- E12 CR, LF and EOI are expressed by only the first letter. By combining the 3 parameters, up to 7 patterns can be set.
- E15 When "E.BUS" is selected in E14, this setting is displayed.

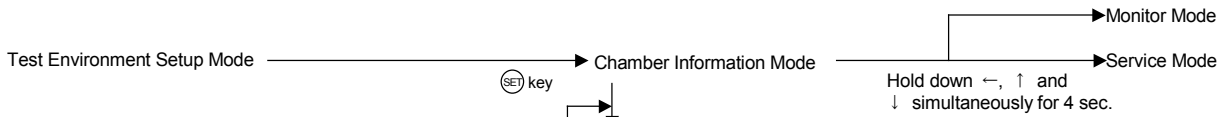
The setting transition changes automatically depending on the type of communication board (option).



Communication Setup Mode



F11
When "SV.PV" is selected for K10, this setting is displayed.



F2 When turned ON, the (ENT) does not respond to touch on settings other than F2, 3 and 4.

F3 When turned ON, the CONST. OPER./STOP key, PRGM. OPER./STOP key (programmable chambers only) and POWER key do not respond to touch the OFF setting.

F4 When turned ON, operations other than monitoring are not accepted from remote.

F8, 9, 18 With temperature-only chambers, this setting is skipped.

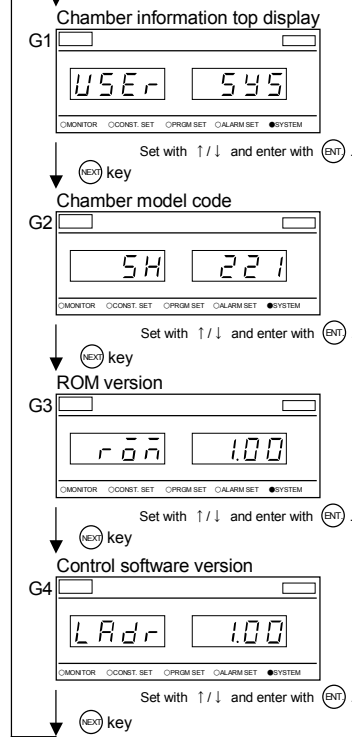
F10 With temperature and humidity chambers, when "REC" is selected for K9, this setting is displayed.

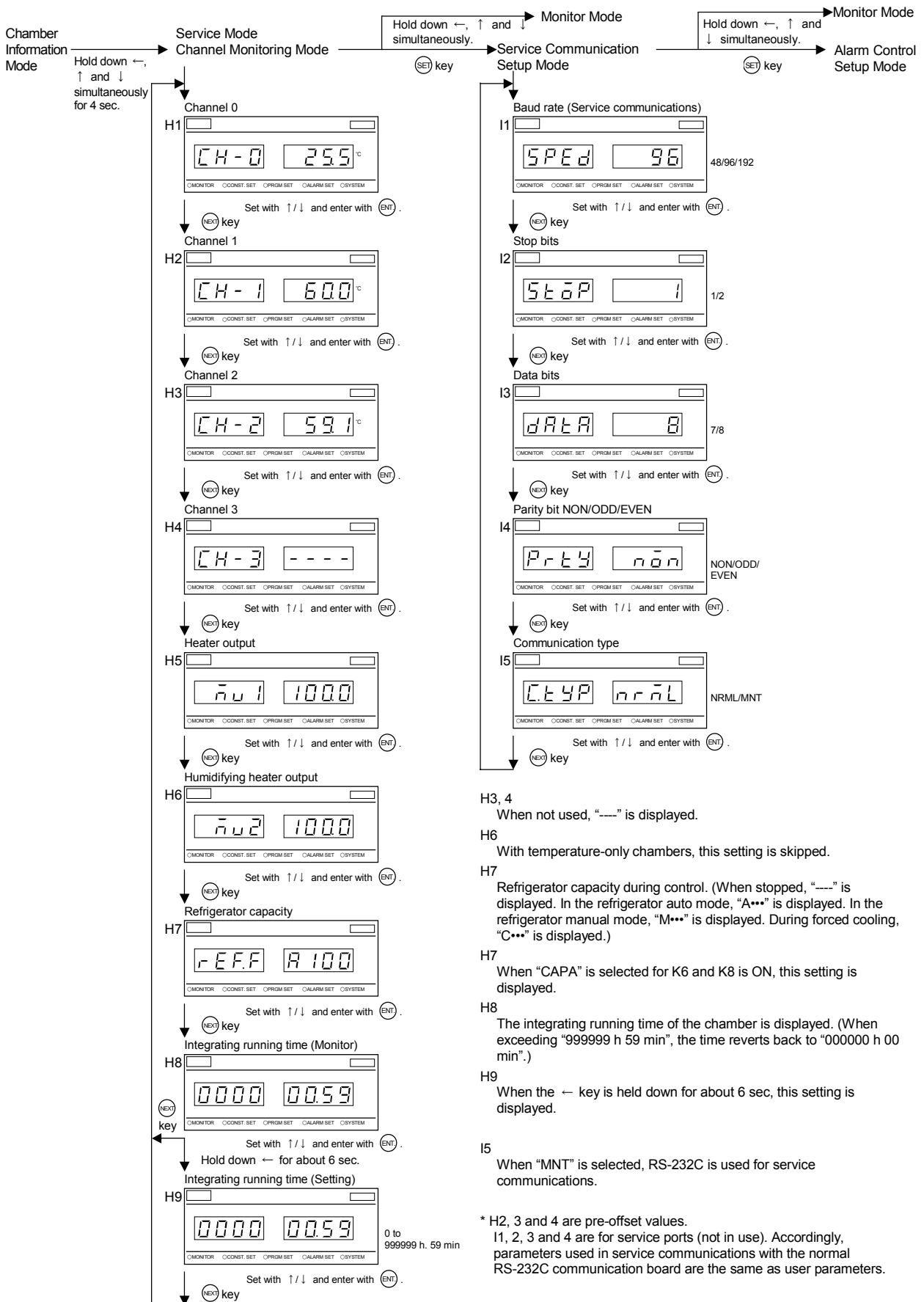
F11 In addition to the condition set in F10, when [SV.PV] is selected for K10, this setting is displayed.

F14 When K5 is ON, this setting is displayed.

F17 When the active digit returns to the far right column (selected with ←), the dry-bulb temperature is displayed for 1 to 2 sec.

F18 When the active digit returns to the far right column (selected with ←), the wet-bulb temperature is displayed for 1 to 2 sec. However, this setting is displayed only on temperature and humidity chambers.





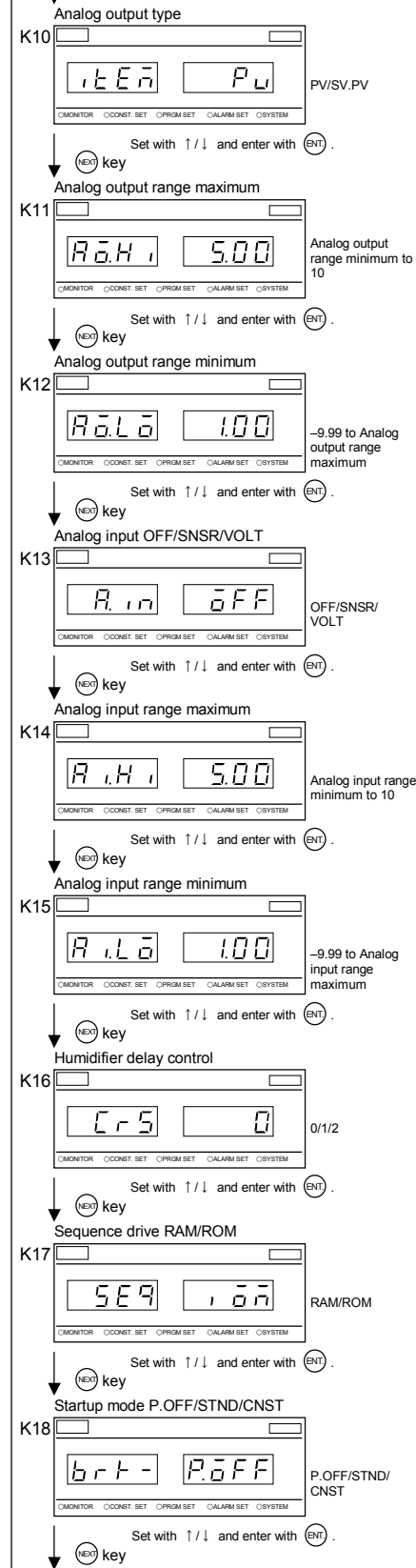
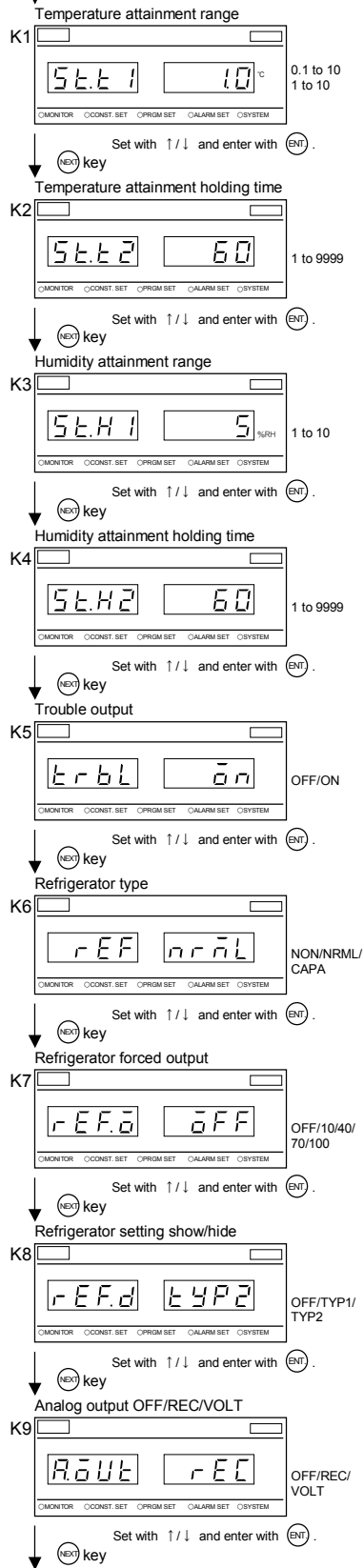
- H3, 4 When not used, "----" is displayed.
- H6 With temperature-only chambers, this setting is skipped.
- H7 Refrigerator capacity during control. (When stopped, "----" is displayed. In the refrigerator auto mode, "A**" is displayed. In the refrigerator manual mode, "M**" is displayed. During forced cooling, "C**" is displayed.)
- H7 When "CAPA" is selected for K6 and K8 is ON, this setting is displayed.
- H8 The integrating running time of the chamber is displayed. (When exceeding "999999 h 59 min", the time reverts back to "000000 h 00 min".)
- H9 When the ← key is held down for about 6 sec, this setting is displayed.
- I5 When "MNT" is selected, RS-232C is used for service communications.

* H2, 3 and 4 are pre-offset values.
 I1, 2, 3 and 4 are for service ports (not in use). Accordingly, parameters used in service communications with the normal RS-232C communication board are the same as user parameters.

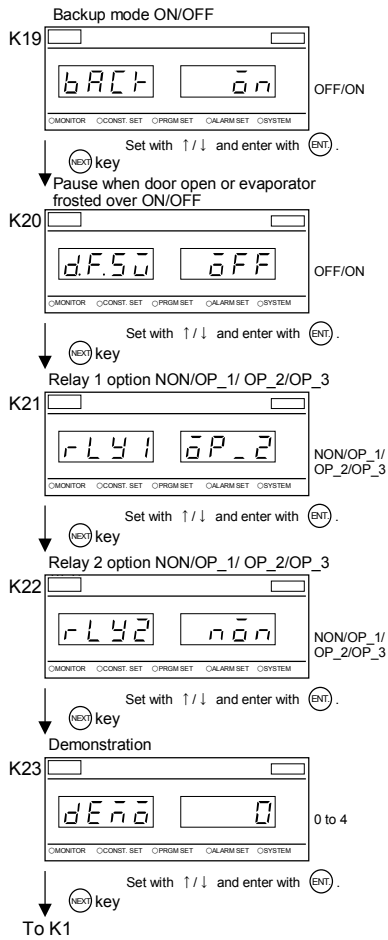
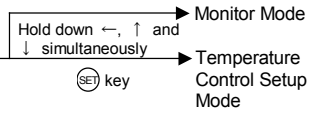
Alarm Control Setup Mode

Sequence Setup Mode

(SET) key



To K19



K3, 4

With temperature-only chambers, this setting is skipped.

K23

If set, a still picture is displayed when the main power switch is set in the ON position.

- 0: Normal mode (Picture is not displayed.)
- 1: Demo mode 1 (Picture 1 is displayed.)
- 2: Demo mode 2 (Picture 2 is displayed.)
- 3: Demo mode 3 (Picture 3 is displayed.)
- 4: Demo mode 4 (Picture 4 is displayed.)

K10, 11, 12

When "REC" is selected for K9, this setting is displayed. (Even when "VOLT" is selected for K11 and 12, this setting is displayed.)

K14, 15

When "REC" is selected for K13, this setting is displayed. (Even when "VOLT" is selected, this setting is displayed.)

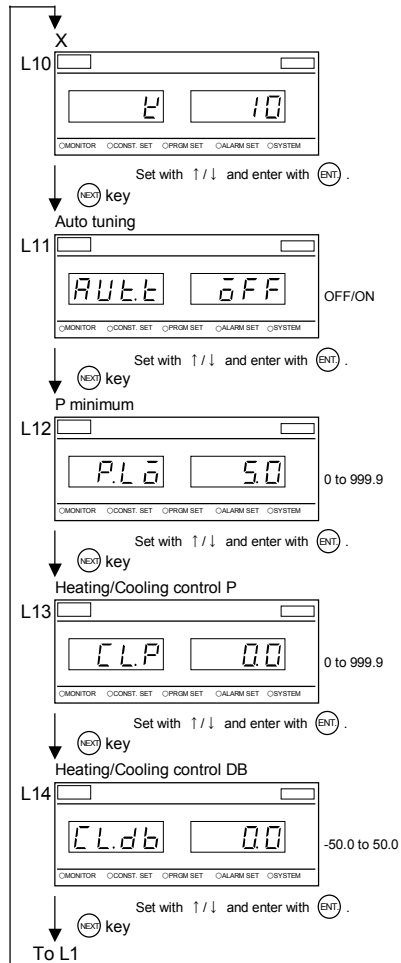
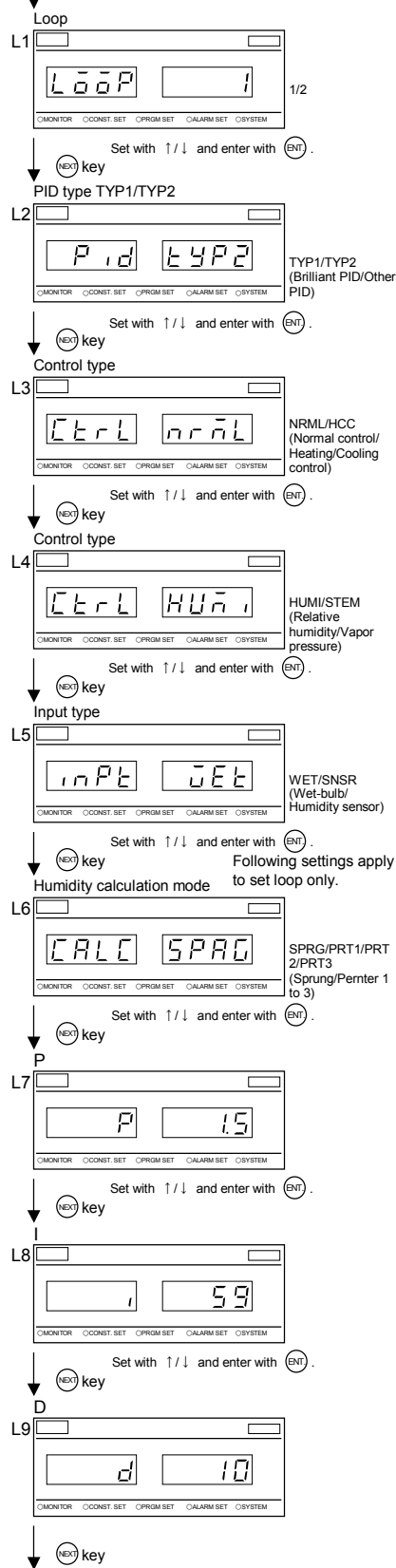
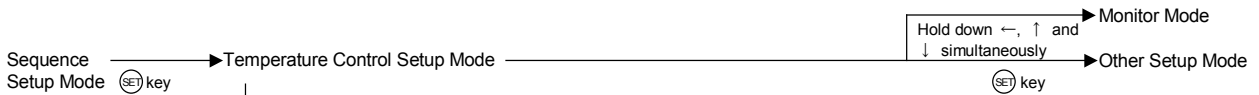
* When "NON" is selected for K21, A3, 11, 17, B5, C13 and F15 are skipped.

When "OP_1" is selected for K21, A3, 11, 17, B5 and C13 can be displayed.

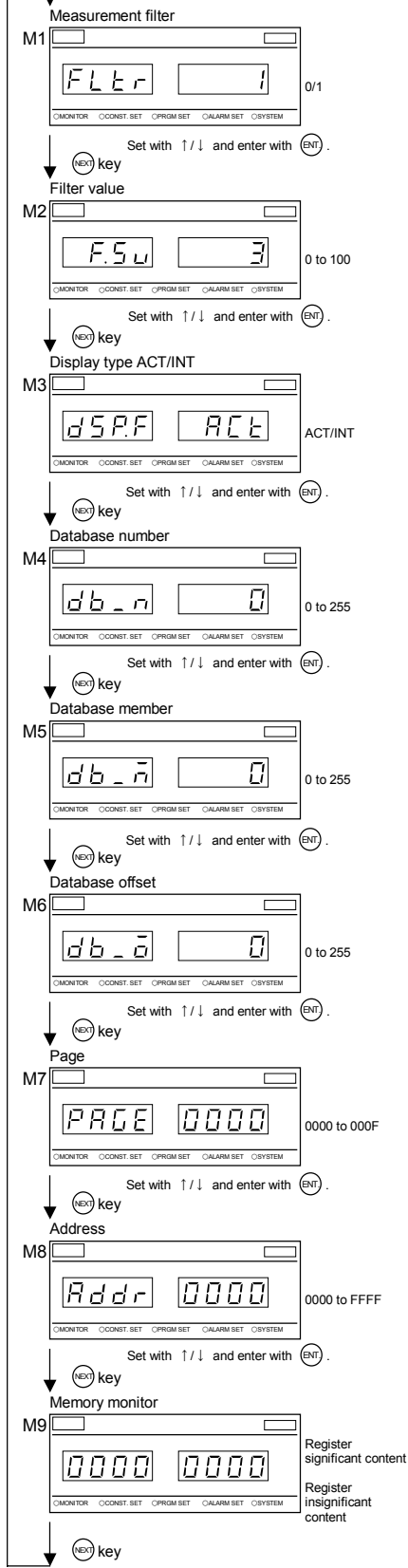
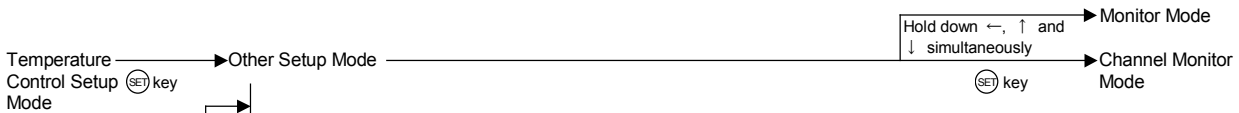
When "OP_2" is selected for K21, F15 can be displayed. Furthermore, when "T.SGL" is selected for F15, A3, 11, 17, B5 and C13 can be displayed.

When "OP_3" is selected for K21, "HUMI", "S_END" and "STRT" can be selected for F15. However, "HUMI" is for temperature and humidity chambers only. (OP_3 is not supported at present.)

(K22 has the same specifications as K21, however settings apply to relay 2.)



- To L1
- L1** Sets the control loop. This setting is reflected on L2, 7, 8, 9 and 10.
 - L2** Selects a PID module. (Brilliant PID/Other PID)
 - L3** Selects between standard control and heating/cooling control. When "1" is selected for L1 and "TYP1" for L2, this setting is displayed.
 - L4, 5** When "2" is selected for L1, this setting is displayed.
 - L10** Fourth parameter in brilliant PID. When "TYP1" is selected for L2, this setting is displayed. Input range is 0.0 to 1.0, but set to 0.0, 0.5 or 1.0.
0.0: Slow control response speed (Overshoot [Undershoot] control)
0.5: Medium control response speed
1.0: Fast control response speed (Arrival speed is prioritized.)
 - L11** When "TYP1" is selected for L2, this setting is displayed. When turned ON, auto tuning starts. When auto tuning ends, the setting turns OFF automatically.
 - L12** When "TYP2" is selected for L2, this setting is displayed. This is the minimum variable P in terms of variable gain.
 - L13** Cooling P coefficient in heating/cooling control. When "1" is selected for L1, "TYP1" for L2 and "HCC" for L3, this setting is displayed.
 - L14** Cooling DB coefficient in heating/cooling control. When "1" is selected for L1, "TYP1" for L2 and "HCC" for L3, this setting is displayed.



- M1** Using the measurement filter produces averages.
0: OFF 1: ON
- M2** Inputs the coefficient used with the measurement filter. When "1" is set for M1, this setting is displayed.
- M3** Selects whether to show/hide the decimal point in temperature and humidity values. The initial value varies according to chamber model.
ACT: Active (Decimal point shown)
INT: Integer (Decimal point not shown)
- M4** Sets the database access number.
- M5** Sets the database access member.
- M6** Sets the database offset.
- M7** Displays the page of the database address calculated from M4, 5 and 6. Any page can be set.
- M8** Displays the database address calculated from M4, 5 and 6. Any address can be set.
- M9** Displays the content of the address entered with M7 and 8.

Because of the relationship amongst values, some values cannot be entered for M4, 5 and 6. "0000" and "0004" to "0009" are prohibited access areas and cannot be entered with M7.

Chapter 7

Specifications and Performance Data

This chapter gives specifications required for servicing and performance data that customers frequently inquire about.

7.1 Major Specifications

Table 7.1 Major specifications (SH/SU-221, 241)

Model		SH-221	SH-241	SU-221	SU-241
Temperature/humidity control system		Balanced temperature and humidity control system (BTHC system)		Balanced temperature control system (BTC system)	
Power supply		100V AC 1 50/60Hz Option: 115V AC 1 60Hz 220V AC 1 50/60Hz 230V AC 1 50Hz			
Maximum current (A) *1		12.5A (100V AC)		10.0A (100V AC)	
Ambient temperature		Allowable operating range: +5 to +35			
Performance *2	Temperature control range	-20 to +150	-40 to +150	-20 to +150	-40 to +150
	Humidity control range	30 to 95%rh See temperature-humidity control range diagram. *3			
	Temperature constancy	± 0.3 (-20 to +100)	± 0.3 (-40 to +100)	± 0.3 (-20 to +100)	± 0.3 (-40 to +100)
		± 0.5 (+100.1 to +150)	± 0.5 (+100.1 to +150)	± 0.5 (+100.1 to +150)	± 0.5 (+100.1 to +150)
	Humidity constancy	± 3%rh			
	Temperature uniformity	± 0.5 (-20 to +100)	± 0.5 (-40 to +100)	± 0.5 (-20 to +100)	± 0.5 (-40 to +100)
		± 0.8 (+100.1 to +150)	± 0.8 (+100.1 to +150)	± 0.8 (+100.1 to +150)	± 0.8 (+100.1 to +150)
	Humidity uniformity	± 3%rh			
	Temperature heat-up rate	Within 55 min from -20 to +150	Within 60 min from -40 to +150	Within 55 min from -20 to +150	Within 60 min from -40 to +150
	Temperature pull-down rate	Within 20 min from +20 to -20	Within 50 min from +20 to -40	Within 20 min from +20 to -20	Within 50 min from +20 to -40
Lowest attainable temperature	-20	-40	-20	-40	
Temperature (Humidity) indicator-controller	Operation modes	Program + Constant setting			
	Setter	Mechanical key input			
	Program memory capacity	1 program with 9 steps (Repeat cycles: 1 to 99)			
	Control principle	PID control			
	Communications	RS-485, E-BUS (option), GPIB (option), RS-232C (option)			
Functions	Input burnout detection function, upper and lower temperature limit alarm function, self-diagnostic function (watchdog timer), alarm indication function, power cut protection function, timer function (automatic start/stop), refrigerator capacity auto control				

Table 7.2 Major specifications (SH/SU-261)

Model		SH-261	SU-261
Temperature/humidity control system		Balanced temperature and humidity control system (BTHC system)	Balanced temperature control system (BTC system)
Power supply		100V AC 1 2W 50/60Hz Option: 115V AC 1 2W 60Hz 220V AC 1 2W 50/60Hz 230V AC 1 2W 50Hz	
Maximum current (A) *1		13.5A (100V AC)	
Ambient temperature		Allowable operating range: +5 to +35	
Performance *2	Temperature control range	-60 to +150	-60 to +150
	Humidity control range	30 to 95%rh See temperature-humidity control range diagram. *3	
	Temperature constancy	± 0.3 (-60 to +100)	± 0.3 (-60 to +100)
		± 0.5 (+100.1 to +150)	± 0.5 (+100.1 to +150)
	Humidity constancy	$\pm 3\%rh$	
	Temperature uniformity	± 0.5 (-60 to +100)	± 0.5 (-60 to +100)
		± 0.8 (+100.1 to +150)	± 0.8 (+100.1 to +150)
	Humidity uniformity	$\pm 3\%rh$	
	Temperature heat-up rate	Within 70 min from -60 to +150	Within 70 min from -60 to +150
	Temperature pull-down rate	Within 70 min from +20 to -60	Within 70 min from +20 to -60
Lowest attainable temperature	-60	-60	
Temperature (Humidity) indicator-controller	Operation modes	Program + Constant setting	
	Setter	Mechanical key input	
	Program memory capacity	1 program with 9 steps (Repeat cycles: 1 to 99)	
	Control principle	PID control	
	Communications	RS-485, E-BUS (option), GPIB (option), RS-232C (option)	
Functions	Input burnout detection function, upper and lower temperature limit alarm function, self-diagnostic function (watchdog timer), alarm indication function, power cut protection function, timer function (automatic start/stop), refrigerator capacity auto control		

Table 7.3 Major specifications (SH/SU-641, 661)

Model		SH-641	SH-661	SU-641	SU-661
Temperature/humidity control system		Balanced temperature and humidity control system (BTHC system)		Balanced temperature control system (BTC system)	
Power supply		100V AC 1 2W 50/60Hz Option: 200V AC 1 50/60Hz 220V AC 1 50/60Hz 230V AC 1 50Hz			
Maximum current (A) *1		18.0A (100V AC)			
Ambient temperature		Allowable operating range: +5 to +35			
Performance *2	Temperature control range	-40 to +150	-60 to +150	-40 to +150	-60 to +150
	Humidity control range	30 to 95%rh See temperature-humidity control range diagram. *3			
	Temperature constancy	± 0.3 (-40 to +100)	± 0.3 (-60 to +100)	± 0.3 (-40 to +100)	± 0.3 (-60 to +100)
		± 0.5 (+100.1 to +150)	± 0.5 (+100.1 to +150)	± 0.5 (+100.1 to +150)	± 0.5 (+100.1 to +150)
	Humidity constancy	$\pm 3\%rh$			
	Temperature uniformity	± 0.5 (-40 to +100)	± 0.5 (-60 to +100)	± 0.5 (-40 to +100)	± 0.5 (-60 to +100)
		± 0.8 (+100.1 to +150)	± 0.8 (+100.1 to +150)	± 0.8 (+100.1 to +150)	± 0.8 (+100.1 to +150)
	Humidity uniformity	$\pm 3\%rh$			
	Temperature heat-up rate	Within 70 min from -40 to +150	Within 80 min from -60 to +150	Within 70 min from -40 to +150	Within 80 min from -60 to +150
	Temperature pull-down rate	Within 60 min from +20 to -40	Within 90 min from +20 to -60	Within 60 min from +20 to -40	Within 90 min from +20 to -60
Lowest attainable temperature	-40	-60	-40	-60	
Temperature (Humidity) indicator-controller	Operation modes	Program + Constant setting			
	Setter	Mechanical key input			
	Program memory capacity	1 program with 9 steps (Repeat cycles: 1 to 99)			
	Control principle	PID control			
	Communications	RS-485, E-BUS (option), GPIB (option), RS-232C (option)			
Functions	Input burnout detection function, upper and lower temperature limit alarm function, self-diagnostic function (watchdog timer), alarm indication function, power cut protection function, timer function (automatic start/stop), refrigerator capacity auto control				

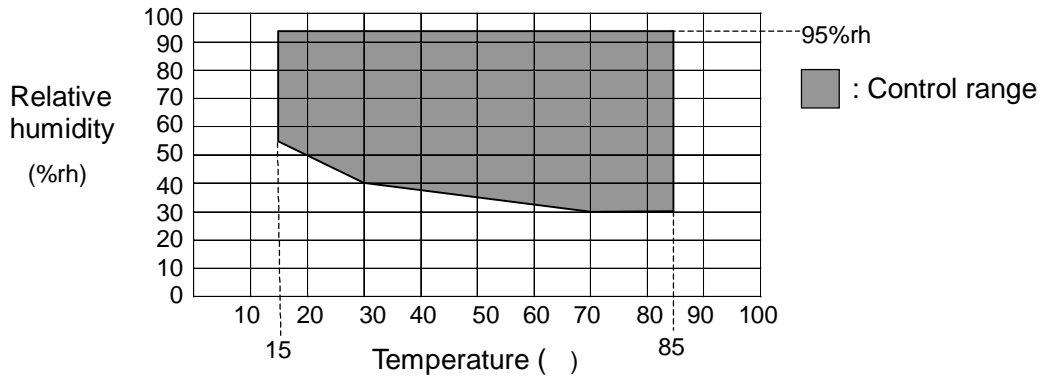
*1 At ambient temperature of +23 , rated voltage.

*2 • At ambient temperature of +23 , rated voltage and no specimens inside test area.

However, the lowest attainable temperature is for a maximum ambient temperature of +30 .

- Performance figures are based on JTM K 01-1998 (Humidity chambers-test and indications method for performance by Japan Testing Machinery Association).

*3 Temperature-Humidity control range (SH chambers only)



7.2 Performance Data

This performance data is only an example and can vary from chamber to chamber, therefore use it only for reference.

(1) Exhaust Rate

50 Hz: 230 m³/h
 60 Hz: 276 m³/h
 (SH/SU-221/241)

(2) Heat Exhaust Rate

3,500 kJ/h (SH/SU-221/241)

Heat load generated per hour during operation at maximum temperature and an ambient temperature of +23°C (Refrigerator set to manual mode)

(3) Noise Emission

	Rear	Front	Side
SH/SU-221, 241	Max. 57.0 dB	Max. 55.0dB	Max. 55.0dB
SH/SU-261	Max. 60.5dB	Max. 58.0dB	Max. 59.0dB
SH/SU-641, 661	Max. 64.5dB	Max. 61.0dB	Max. 62.5dB

Measurements were performed in a soundproof room of low echo at a height 1.2 m from the floor (Characteristic A) and a distance of 1 m from the chamber. Depending on the installation environment, noise emission can be high because of nearby reverberation.

(4) Water Consumption

	Consumption rate	Hours of continuous use
SH-221, 241	20.0mL/hour	Approx. 205 h
SH-261	29.5mL/hour	Approx.138
SH-641, 661	16.0mL/hour	Approx.256

* When target temperature of 85°C, target humidity of 85%rh and refrigerator set to AUTO.

(5) Test Area Air Flow Rate

	50Hz	60Hz
SH/SU-221, 241	1.9m/S	2.4m/S
SH-261	1.9m/S	2.4m/S
SH/SU-641, 661	2.3m/S	2.4m/S

(6) Power Consumption

Target setting	SH/SU-241	SH/SU-261	SH/SU-641, 661
-40°C	480 Wh	1010 Wh	—
-20°C	400 Wh	1110 Wh	1180 Wh
20°C	350 Wh	—	480 Wh
60°C	350 Wh	330 Wh	—
85°C/85%	400 Wh	—	—
-60°C	—	890 Wh	—

Chapter 8

Replacement Parts

This chapter lists parts that require periodic replacement in order to maintain chamber performance and features.

8.1 Replacement Parts List

The below parts require periodic replacement. When time for replacement, promptly replace the part.

Table 8.1 Consumables and replacement parts

Part	Replacement interval	Replacement procedure
Wet-bulb wick	After temperature operation and once a month	See "5.1" in User's manual.
Door packing	Every 3 years	See "5.2 (1)" in this manual.

Chapter 9

Options and Remodeling

This chapter explains parts and remodeling procedures when options are added after chamber delivery.

9.1 Auxiliary Water Tank Circuit (Option)

■ Introduction

This section explains how to retrofit chambers with the automatic water supply circuit on-site. The automatic water supply system uses the optional “auxiliary water tank circuit”, “auxiliary water tank” and “auxiliary water tank vat”. Though each of these options is sold separately, for explanatory purposes, it will be explained how to install all three.

Auxiliary water tank circuit: This is the circuit that enables automatic water supply. The option package consists of all piping and fittings from the filter to the water level tank.

Auxiliary water tank: This additional tank provides a supplemental supply of water to that in the standard water supply tank. The option package consists of tubing from the tank and crescent clamps for anchoring tubing.

Auxiliary water tank vat: This vat prevents water from the auxiliary water tank from leaking into the room where the auxiliary water tank is used. The option package consists of tubing from the vat and crescent clamps for anchoring tubing and coupled lines from the user’s equipment.

■ Required Documents and Tools

For retrofitting procedures, see “5.3 (2) Water Circuit Parts (Water Level Sensor Container and Pump)” in addition to the information here following. Also, required tools are as follows.

- Philips screwdriver (For installing solenoid valves, filters, etc.)
- Crimping tool (For connecting maintenance lock connector of full water level switch)
- Pliers or needle nose pliers (For installing crescent clamps)
- Tube cutter (For cutting tubing)

■ Before Performing Work

- If using a water tank of greater capacity than the auxiliary water tank, install a separate leak detector and adequate drainage system as a preemptive measure for containing leaks.
- The auxiliary water tank circuit alone does not include a water supply tank.

- Use deionized water of an electrical conductivity of 0.1 to 10 $\mu\text{s}/\text{cm}$.
 - * Do not use super deionized water as its strong solvent power can deform chamber water circuit parts.
- Locate the water supply tank in a position higher than the water supply connection port on the chamber.
- Do not use sources or setups that apply high hydraulic pressure on the water supply tank, such as tap water. (Supply pressure range: 4.9 to 19.6 kPa [At gauge])
- When installing the auxiliary water tank on top of the chamber, use the auxiliary water tank vat (option) as a preemptive measure for containing leaks.

■ Required Parts

The same numbers given under “No.” are used in Fig. 9.1.

Table 9.1 Required parts for on-site retrofitting of auxiliary water tank circuit

No	Part code	Part	Specification	221/241	261	641/661	Remarks	OP
1	2041901013700	Water supply tank cap (With check valve)	2041901013700	1	1	1		Auxiliary water tank
2	2071001013900	Water supply tank	2071001013900	1	1	1		
3	2080801036000	Coupler (Plug)	HAV-12PM	1	1	1		
4	2040601886700	Auxiliary water tank stand	2040601886700	1	1	1		
5	2081201021300	Coupler (Socket)	HAV-20SH	1	1	1		
6, 8	2081601003300	Crescent clamp	RS-8007	2	2	2		
7	2081101004800	Soft flexible tubing	1044-14 (ϕ 11.5 \times ϕ 8)	2 m	2 m	2 m	Units: m	
	4009204006300	Auxiliary water tank installation manual		1	1	1		Auxiliary water tank vat
9	2041101009200	Auxiliary water tank vat	2041101009200	1	1	0		
9	2041101010600	Auxiliary water tank vat	2041101010600	0	0	1		
10	2081601003300	Crescent clamp	RS-8007	1	1	1		Auxiliary water tank circuit
11	2081101004800	Soft flexible tubing	1044-14 (ϕ 11.5 \times ϕ 8)	2 m	2 m	2 m	Units: m	
13	2181801000600	Auxiliary water tank water supply board	ES-102 (WATER)	1	1	1		
14	2191001001900	Spacer	MSPLS-3U	4	4	4		
15	2081701009100	Nitril O-ring	P9	1	1	1		
16	2140601004700	Level sensor	LS11R-1A	1	1	1		
17/19/24/26/28/30	2081601003300	Crescent clamp	RS-8007	6	6	6		
18	2081101027510	Mechanical parts compartment drain tube	2081101027510	1	0	0		
18	2081101005000	Silicon tube	ϕ 8 \times ϕ 13	0	17	27	Units: cm	
20	2071401020000	Solenoid valve	J241-804	1	1	1		
21,31	2220401004700	Recessed cross-head truss screw	M4 \times 6_SUSXM7	4	4	4		
22	2040601003910	Solenoid bracket	2040601003910	1	1	1		
23	2220401005600	Recessed cross-head truss screw	M5 \times 6_SUSXM7	2	2	2		
25	2081101027400	Water circuit elbow tube	2081101027400	1	1	1		
27	2081201022300	Tube connector PP	S-2 (2002-02)	1	1	1		
19	2081101004900	TOALONG-G TUBING	1045-14 (ϕ 11.5 \times ϕ 8)	20 cm	30 cm	40 cm	Units: cm	
32	2071101018100	Filter	WS-00IAM (100 mesh)	1	1	1		
	2210101368800	Additional chamber load harness	2210101368800	1	0	0		
	2210101409600	Additional chamber load harness	2210101409600	0	1	0		
	2210101409500	Additional chamber load harness	2210101409500	0	0	1		
	2210101376100	Additional signal wire harness	19305H1246P3	1	1	0		
	2210101409700	Additional signal wire harness	2210101409700	0	0	1		
	2210101368700	Additional chassis harness	2210101368700	1	0	0	100V	
	2210101409200	Additional chassis harness	2210101409200	0	1	1	100V	
	2210101409000	Additional chassis harness	2210101409000	0	0	1	100V	
	2210101389400	Additional chassis harness	2210101389400	1	0	-	115V	
	2210101409300	Additional chassis harness	2210101409300	0	1	-	115V	
	2210101388500	Additional chassis harness	2210101388500	1	0	0	200/220/230V	
	2210101409400	Additional chassis harness	2210101409400	0	1	0	200/220/230V	
	2210101409100	Additional chassis harness	2210101409100	0	0	1	200/220/230V	
	2210701000400	Maintenance lock connector	170924-1 (2P, cap)	1	1	1		
	2210701028100	Contactora	60620-1 ON	2	2	2		

■ Installation Procedure

1. Shut power OFF at the main power switch (leakage breaker) on the chamber right panel.
2. Detach the water circuit compartment rear panel, drain the water circuit and detach the water level sensor container. (For details, see “5.3 [2] Water Circuit Parts [Water Level Sensor Container and Pump]”.)
3. Detach the water level sensor container lid and cleanly cut the film on the top side of the middle embossing of the lid with a cutter knife or other means, and screw in the level sensor ⑩ (black wiring) already fitted with a nitril O-ring ⑮ until the contacts the lid. Do not use sealant tape on the sensor.
4. Reattach the lid to the water level sensor container.
Be careful the lid does not tilt or dislodge the spacer when attaching.
5. In the standard setup, there is a black vinyl cap attached to the water level sensor container where the crescent clamp ⑰ is located.
Remove this cap and rig the line as follows. (The auxiliary water tank circuit does not require this crescent clamp.)
6. Rig the auxiliary water tank circuit line as shown in Fig. 9.1. Lock the solenoid valve ⑳ to the solenoid bracket ㉒ before locking the bracket to the water circuit compartment.
7. Detach the electric parts compartment rear panel and top panel (on top of the chamber).
8. Fit the spacers ⑭ (for circuit board) into the bottom of the electric parts compartment, and install the auxiliary water tank water supply board ⑬.
9. Disconnect level switch relay connectors CN56P and CN56C and connect as shown in Fig. 9.2. (See also Fig. 9.5.) Fit the leads of the full level detection level switch (LS4) with the maintenance lock connector and contactors.
10. Reattach the electric parts compartment top panel and screw down tight.
11. Install the auxiliary water tank (separately sold option) as follows.
The auxiliary water tank is separately sold option, but it is the same as the water supply tank.
* Screw the coupler (plug) ③ into the water supply tank ② until the O-ring (included with coupler) contacts the tank. (Sealant tape or other form of sealing is not needed.) Screw down the water supply tank cap (with check valve) ①.
12. Set the auxiliary water tank vat ⑨ (separately sold option) on the electric parts compartment and set the auxiliary water tank stand ④ (included with tank) in the vat.
(If the water supply tank ② is set directly in the vat ⑨, the tube will contact the side wall of the vat, therefore the stand gives the tank enough height for the tube to clear the wall. Also, the stand does not

require anchoring by screw. Simply set it flat in the vat.)

13. Fit the hole in the water supply tank ② over the L-plate on the auxiliary water tank stand ④ to prevent the tank from slipping.
14. Bind the coupler (socket) ⑤ and 2 m soft flexible tubing ⑦ included with the auxiliary water tank using a crescent clamp ⑥ and connect the coupler to the tank.
15. Cut the soft flexible tubing ⑦ to the appropriate length and connect it to the pump filter ③② (included with the auxiliary water tank circuit).
16. Bind the soft flexible tubing ①① (included with the auxiliary water tank vat) for draining the auxiliary water tank vat ⑨ to the vat with a crescent clamp ⑩. Keep the end of this soft flexible tubing open to the atmosphere and run into the user's drainage system.
17. Check operation.
Check that the water circuit functions as explained in "■ Operation".

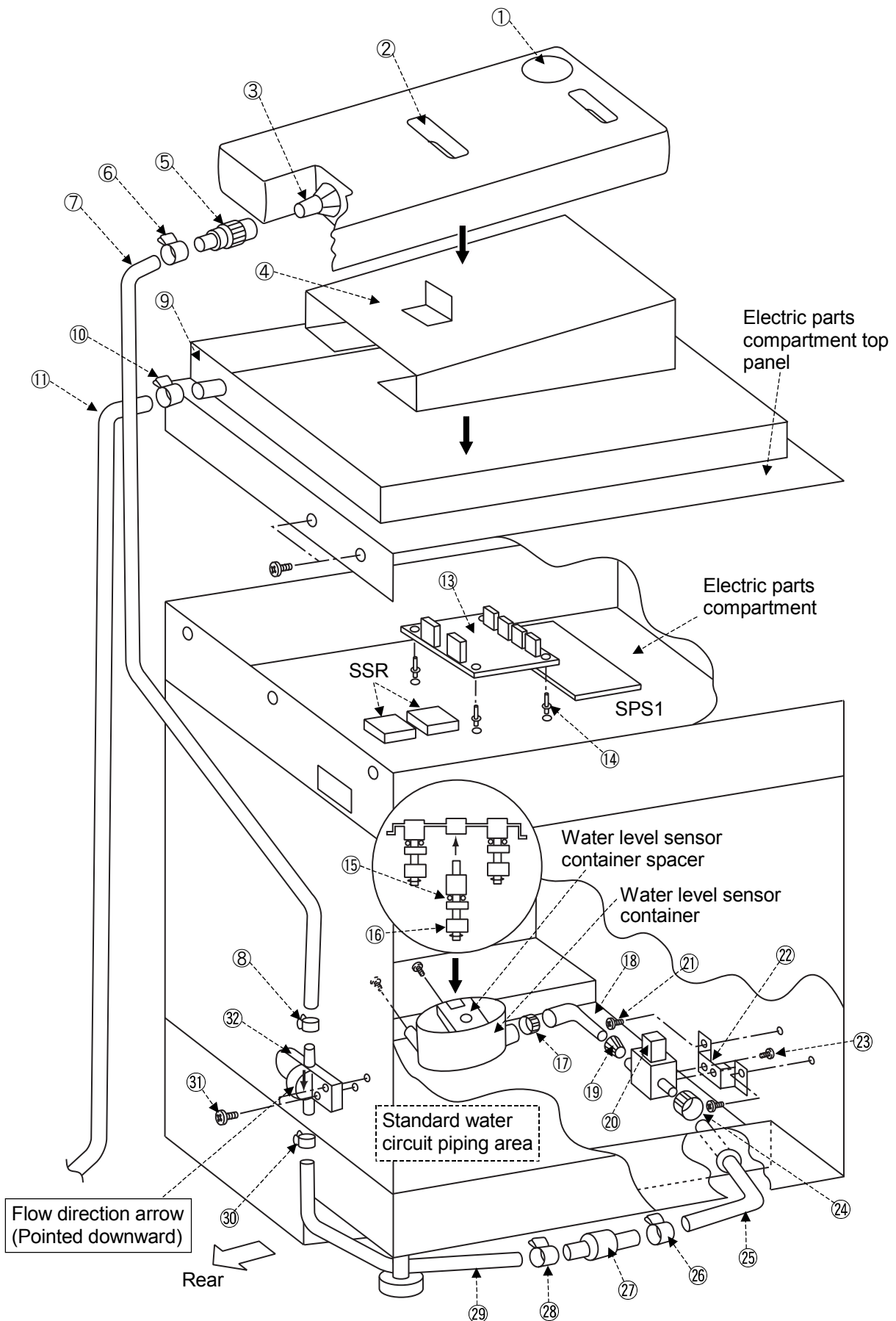


Fig. 9.1 Piping for auxiliary water tank circuit (option)

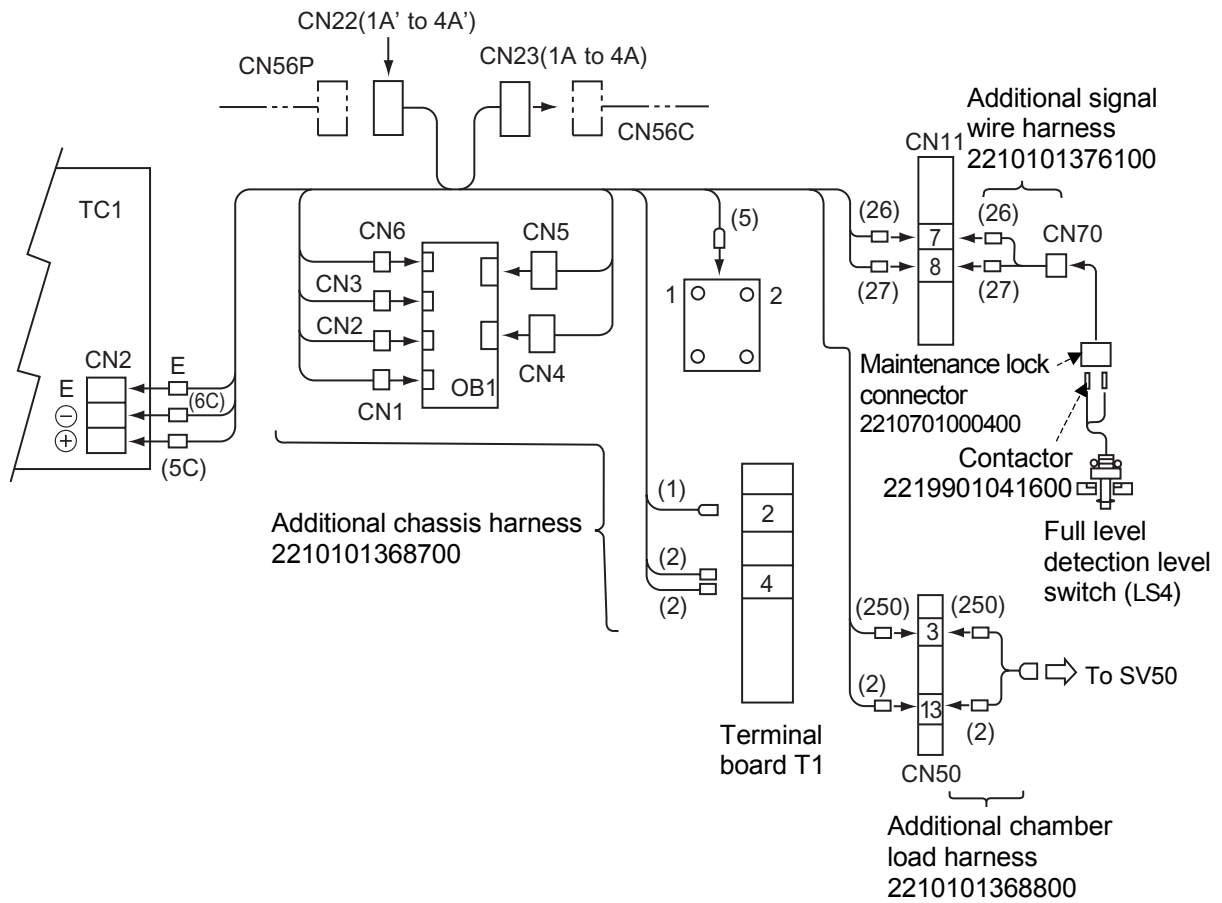
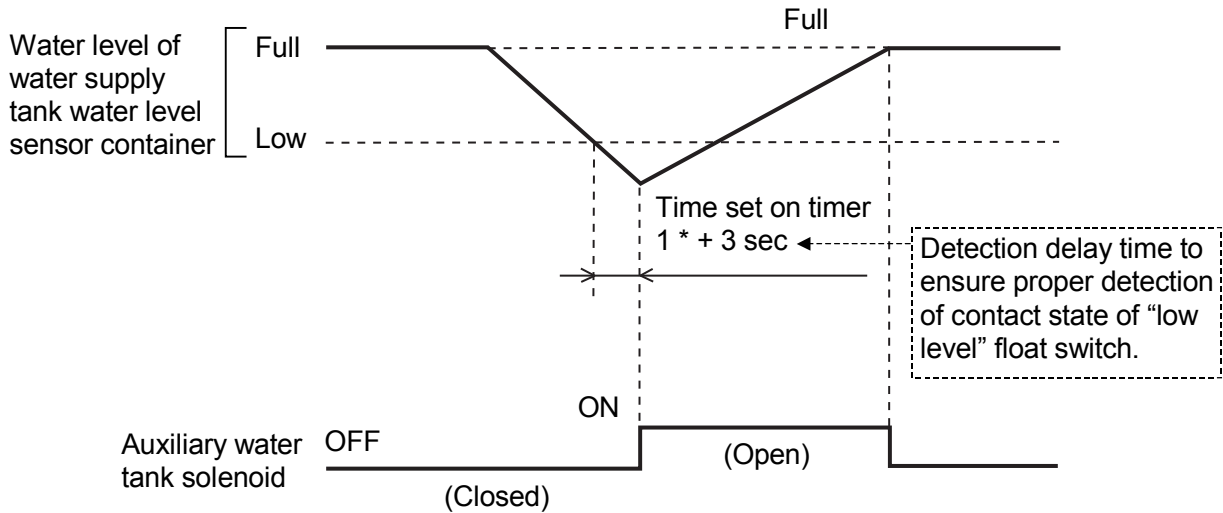


Fig. 9.2 Chassis wiring for auxiliary water tank circuit (option)

■ Operation

Normal Operation and Forced OFF

- When the water level sensor container of the auxiliary water tank detects a low water level or empty, the WATER lamp starts flashing (lights solidly if the tank is empty). Three sec after that, the auxiliary water tank solenoid turns ON whereby starting water supply. When the water level sensor container detects a full water level, the auxiliary water tank solenoid turns OFF and water supply stops.



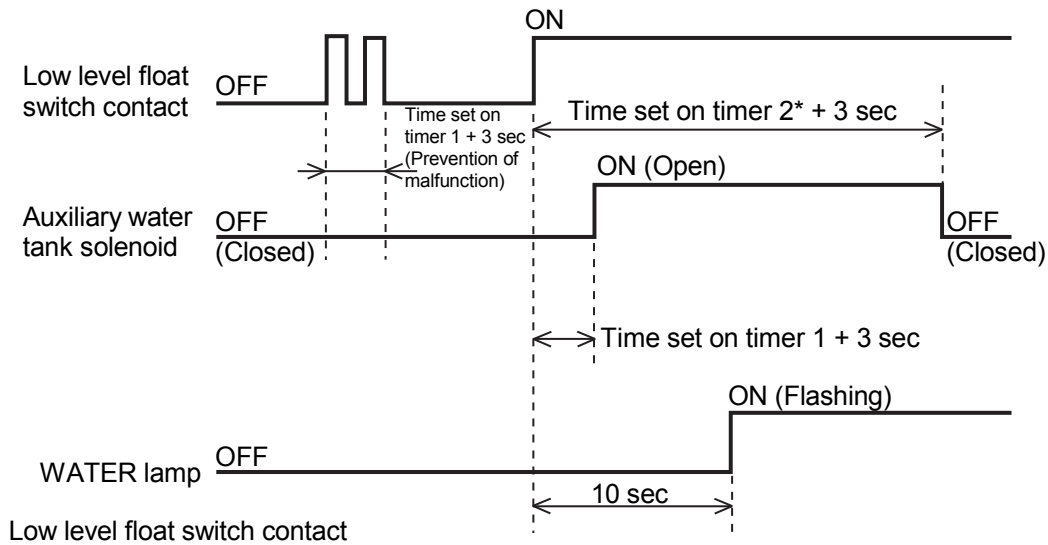
* Timer 1

This timer determines the time from when the water level sensor container of the water supply tank detects a low (or empty) level until the solenoid turns ON.

The timer can be set between 0 to 15 min (minimal unit: 1 min) from the TIMER 1 DIP switches on the ES-102 (WATER) auxiliary water tank circuit board. The timer is set to 0 min when shipped (Setting DIP switches Nos. 1 to 4 to the OFF position sets the timer to 0 min.)

Fig. 9.3 Auxiliary water tank circuit (option) operation

If the full water level is not detected for some reason, timer 2 will close the solenoid (forced OFF).



Low level float switch contact

OFF When water level in the water supply tank water level sensor container is higher than the low water level

ON When water level in the water supply tank water level sensor container is lower than the low water level

* Timer 2

This timer determines the time from when the water level sensor container of the water supply tank detects a low (or empty) level until the solenoid is forcefully turned OFF.

The timer can be set between 0 to 15 min (minimal unit: 1 min) from the TIMER 2 DIP switch on the ES-102 (WATER) auxiliary water tank circuit board. The timer is set to 1 min when shipped (Setting DIP switch No. 1 to the ON position and DIP switches Nos. 2 to 4 to the OFF position sets the timer to 1 min.)

Fig. 9.4 Solenoid forced OFF operation of auxiliary water tank circuit (option)

Table 9.2 DIP switch settings on auxiliary water tank board

DIP switch setting				Set time (min)
1	2	3	4	
OFF	OFF	OFF	OFF	0
ON	OFF	OFF	OFF	1
OFF	ON	OFF	OFF	2
ON	ON	OFF	OFF	3
OFF	OFF	ON	OFF	4
ON	OFF	ON	OFF	5
OFF	ON	ON	OFF	6
ON	ON	ON	OFF	7
OFF	OFF	OFF	ON	8
ON	OFF	OFF	ON	9
OFF	ON	OFF	ON	10
ON	ON	OFF	ON	11
OFF	OFF	ON	ON	12
ON	OFF	ON	ON	13
OFF	ON	ON	ON	14
ON	ON	ON	ON	15

Chapter 10

Technical Information

10.1 Operation Matrix – Normal Operation

Operating state		Heater circuit output		Humidifying circuit output		Refrigerator control output						
		Heater relay	Heater SSR	Humidifying heater relay	Humidifying heater SSR	Compressor (High temperature side)	Compressor (Low temperature side)	Condenser fan	Solenoid No. 1	Solenoid No. 2	Solenoid No. 3	Solenoid No. 4
		RL101		RL102		RL103	RL105 X51	RL103	RL107	RL151	RL152	RL153
		H1	SSR1	H2	SSR2	CM11	CM12	M11	SV11	SV12	SV13	SV14
Main power switch in OFF position		OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Main power switch in ON position		OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Standby state		OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Local operating mode	Temperature-only operation	ON	ON (1)	OFF	OFF	See Tables 4.9 to 4.12.						
	Temperature and humidity-controlled operation	ON	ON (1)	ON (9)	ON (2)							
Remote operating mode		Same operation as in local operating mode										

1. ON (1): The heater SSR turns ON when the temperature controller inputs the signal to the SSR.

2. ON (2): The heater SSR turns ON when the temperature controller inputs the signal to the SSR.

However, signal input from the temperature controller to the heater SSR is forced OFF in the following cases.

① If the humidifying tray is detected at the low water level at the start of a humidity-controlled operation, SSR signal input is kept OFF until the humidifying tray reaches the high water level.

Three sec after the humidifying tray reaches the high water level, heater charging starts.

② If humidifying tray water level remains low 30 sec after electromagnetic pump drive has been enabled during ordinary humidity-controlled operation

③ If the monitored test area temperature or target temperature is equal to or less than 5°C, or equal to or greater than 100°C

④ If wet-bulb temperature is 0°C or less

3. ON (3) operation is detailed as follows.

① When the humidifying tray is detected at the low water level, the electromagnetic pump drive is enabled. If the humidifying tray is detected at the high water level while the electromagnetic pump drive is enabled, the electromagnetic pump turns OFF.

② The electromagnetic pump drive enable allows the following two drives depending on the state of humidity operations.

- At the start of ordinary humidity-controlled operation ... Repeatedly turns ON for 5 sec and OFF for 10 sec until the humidifying tray reaches the high water level.

- During ordinary humidity-controlled operation

- i) Repeatedly turns ON for 1 sec and OFF for 30 sec until the humidifying tray reaches the high water level.

- ii) Switches to the drive given in iii if the humidifying tray does not reach the high water level after driving for 30 min as described in i.

- iii) Repeatedly turns ON for 5 sec and OFF for 10 sec until the humidifying tray reaches the high water level. (If the humidifying tray still does not reach the high water level after driving for 10 min, an alarm is triggered.)

③ The electromagnetic pump is forced OFF if the monitored test area temperature or target temperature is equal to or less than 5°C, or equal to or greater than 100°C.

④ The electromagnetic pump is forced OFF if wet-bulb temperature is 0°C or less.

		Air circulator control output	Water circuit control output	Other control output								
Solenoid No. 5	Solenoid No. 6	Motor	Electromagnetic pump	Specimen power supply control terminal	External alarm terminal	External output terminal			POWER lamp	Frame heater (Chamber)	Frame heater (Door)	Viewing window heater
RL105	RL106	RL101	RL154	RL101	RL155	Program end output	Time signal	Temperature attainment output		—	—	Option
SV15	SV16	M1	P1			RL156			LED1	H7	H8	H3
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON (Orange)	OFF	OFF	OFF
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON (Green)	OFF	OFF	OFF
		ON	OFF	ON	ON (4)	ON (5)	ON (6)	ON (7)	ON (Green)	ON (8)	ON (8)	ON (8)
		ON	ON (3)	ON	ON (4)	ON (5)	ON (6)	ON (7)	ON (Green)	ON (8)	ON (8)	ON (8)

* Humidifying tray low water level must be held for 1 sec to be attained.

Humidifying tray high water level is attained the instant that the high level mark is reached.

Water supply tank empty water level must be held for 10 sec to be attained.

4. ON (4) operation is as detailed in “10.2 Operation Matrix – Safety Device Trip”.

5. ON (5) operation is detailed as follows.

Program end output turns ON for 3 sec at the end of a programmed operation when “P.END” is selected as the external output event in the test environment setup.

6. ON (6) operation is detailed as follows.

① In both the constant mode and program mode, the time signal can be set, provided “T.SGL” is selected as the external output event in the test environment setup.

② When “T.SGL” is selected as the external output event in the test environment setup, the time signal then turns ON when the set condition is satisfied during operation, provided time signal output is ON in the test environment setup.

7. ON (7) operation is detailed as follows.

① Temperature attainment output turns ON and stays ON when test area temperature satisfies the conditions (temperature attainment range and temperature attainment holding time) in the test environment setup, provided “TEMP” is selected as the external output event in the test environment setup.

8. ON (8) operation is detailed as follows.

The chamber frame heater turns ON when test area temperature is 88.45°C and below. It turns OFF if temperature rises to 90.45°C and higher.

9. ON (9): The humidifying heater relay is forced OFF if the below conditions are satisfied.

① If the monitored test area temperature or target temperature is equal to or less than 5°C, or equal to or greater than 100°C

② If wet-bulb temperature is 0°C or less

10. The following control output does not apply to SU chambers.

① Humidifying circuit output

② Water circuit control output

11. Shaded areas do not apply to SH/SU-221/241.

10.2 Operation Matrix – Safety Device Trip

Safety input	Alarm No.	Displayed code	Potential trigger period of alarm	Buzzer	Operation recovery action	Heater circuit output		Humidifying circuit output		Refrigerator control output			
						Heater relay	Heater SSR	Humidifying heater relay	Humidifying heater SSR	Compressor (High temp. side)	Compressor (Low temp. side)	Condenser fan	Solenoid No. 1
						RL101		RL102		RL103	RL105 X51	RL103	RL107
						H1	SSR1	H2	SSR2	CM11	CM12	M11	SV11
Instrumentation trouble	See "Chapter 3 Troubleshooting" for details.				Main power SW OFF → ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Room temperature compensation circuit burn-out	136	AL00 (CH00)	During operation	A	POWER key OFF → ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Dry-bulb input burn-out	129	AL00 (CH01)	During operation	A	POWER key OFF → ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
<u>Wet-bulb input burn-out</u>	130	AL00 (CH02)	During operation	A	POWER key OFF → ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Absolute high temperature alarm	161	AL02	During operation	A	POWER key OFF → ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Absolute low temperature alarm	162	AL03	During operation	A	POWER key OFF → ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Upper deviation temperature alarm	163	AL01	During operation	B	Auto reset	–	OFF	–	OFF	–	–	–	–
<u>Absolute high humidity alarm</u>	177	AL22	During operation	B	Auto reset	–	–	OFF	OFF	–	–	–	–
<u>Absolute low humidity alarm</u>	178	AL23	During operation	B	Auto reset	–	–	–	–	–(B)	OFF	–(B)	–(B)
Overheat/Overcool trouble and air circulator trouble	225	AL12	During operation	A	POWER key OFF → ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Blown thermal fuse	–	–	During operation During standby	–	Fuse replacement	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
<u>Boil-dry protection</u>	227	AL21	During operation	A	POWER key OFF → ON	–(A)	–(A)	OFF	OFF	–(A)	–(A)	–(A)	–(A)
Door open detection	Within alarm hold time	–	–	–	–	–	–	–	–	–	–	–	–
	Alarm hold time elapsed	232	AL13	During operation	B	Auto reset	OFF	OFF	OFF	–(2)	–(B)	OFF	–(B)
Refrigerator 1 trouble	235	AL08	During operation	A	POWER key OFF → ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Refrigerator 2 trouble	235	AL08	During operation	A	POWER key OFF → ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
<u>Water circuit trouble (WATER lamp out)</u> *1		AL26	During operation	A	POWER key OFF → ON	–(A)	–(A)	OFF	OFF	–(A)	–(A)	–(A)	–(A)
<u>Water supply tank (WATER lamp flashing)</u> *2	145	AL26	During operation	B	Auto reset	–	–	–	–	–	–	–	–
<u>Water supply tank (EMPTY lamp lit solidly)</u> *3	146	AL26	During operation	B	Auto reset	–	–	–	–(1)	–	–	–	–

					Air circulator control output	Water circuit control output	Water circuit control output								
Solenoid No. 2	Solenoid No. 3	Solenoid No. 4	Solenoid No. 5	Solenoid No. 6	Motor	Electro-magnetic pump	Specimen power supply control terminal	External alarm terminal	External output terminal			POWER lamp	Frame heater (Chamber)	Frame heater (Door)	Viewing window heater
RL151	RL152	RL153	RL105	RL106	RL101	RL154	RL101	RL155	Program end output	Time signal	Temp. attainment output		—	—	Option
SV12	SV13	SV14	SV15	SV16	M1	P1			RL156			LED1	H7	H8	H3
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	* 1	OFF	OFF	OFF
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	—	OFF	ON (Green)	OFF	OFF	OFF
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	—	OFF	ON (Green)	OFF	OFF	OFF
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	—	OFF	ON (Green)	OFF	OFF	OFF
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	—	OFF	ON (Green)	OFF	OFF	OFF
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	—	OFF	ON (Green)	OFF	OFF	OFF
—	—	—	—	—	—	—	—	ON (2)	—	—	—	ON (Green)	—	—	—
—	—	—	—	—	—	—	—	ON (2)	—	—	—	ON (Green)	—	—	—
—(B)	—(B)	—(B)	OFF	OFF	—	—	—	ON (2)	—	—	—	ON (Green)	—	—	—
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	—	OFF	ON (Green)	OFF	OFF	OFF
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
—(A)	—(A)	—(A)	—(A)	—(A)	—(A)	OFF	—(A)	ON	OFF	—	—(A)	ON (Green)	—(A)	—(A)	—(A)
—	—	—	—	—	—	—	—	—	—	—	—	ON (Green)	—	—	—
—(B)	—(B)	—(B)	OFF	OFF	OFF	OFF	OFF	ON (2)	—	—	—	ON (Green)	OFF	OFF	OFF
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	—	OFF	ON (Green)	OFF	OFF	OFF
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	—	OFF	ON (Green)	OFF	OFF	OFF
—(A)	—(A)	—(A)	—(A)	—(A)	—(A)	OFF	—(A)	ON	OFF	—	—(A)	ON (Green)	—(A)	—(A)	—(A)
—	—	—	—	—	—	—	—	ON (2)	—	—	—	ON (Green)	—	—	—
—	—	—	—	—	—	OFF	—	ON (2)	—	—	—	ON (Green)	—	—	—

1. Buzzer details are as follows.
 - A..... Continuous buzzer
 - B..... Intermittent buzzer

2. Attainment conditions for “Water circuit trouble (WATER lamp out) *1” are as follows.

Trouble is judged when the following conditions are satisfied while the electromagnetic pump is enabled.

 - At the start of ordinary humidity-controlled operation:
 - If the humidifying tray does not reach the high water level after driving the electromagnetic pump for 10 min
 - During ordinary humidity-controlled operation:
 - If the humidifying tray does not reach the high water level after driving the electromagnetic pump for 40 min

Humidifying tray low water level must be held for 1 sec to be attained.

3. “-(1)” operation is detailed as follows.
 - ① The humidifying heater SSR is forced OFF if the water supply tank is detected at the empty level and the humidifying tray is detected at the low water level. Humidifying heater SSR input remains OFF even after the alarm has been cleared, until the humidifying tray reaches the high water level.

4. “-(2)” operation is detailed as follows.

The humidifying heater SSR is forced OFF if the door open alarm is triggered and the humidifying tray is detected at the low water level. Humidifying heater SSR input remains OFF even after the alarm has been cleared, until the humidifying tray reaches the high water level.

5. Attainment conditions for “Water supply tank (WATER lamp flashing) *2” are as follows.

The WATER lamp on the operating panel starts flashing if the water level in the water supply tank drops below the low level during a humidity-controlled operation. The low level is attained as follows.

 - At the start of ordinary humidity-controlled operation:
 - If not “Water supply tank (EMPTY lamp lit solidly)” and if continued for 30 sec
 - During ordinary humidity-controlled operation:
 - If continued for 10 sec

6. Attainment conditions for “Water supply tank (EMPTY lamp lit solidly) *3” are as follows.

The EMPTY lamp on the operating panel lights up solidly if the water level in the water supply tank drops below the empty level during a humidity-controlled operation. The empty level is attained as follows.

 - At the start of ordinary humidity-controlled operation:
 - If continued for 60 sec
 - During ordinary humidity-controlled operation:
 - If continued for 10 sec

7. The following control output does not apply to SU chambers.
 - ① Humidifying circuit output
 - ② Water circuit control output

8. Safety devices underlined in "Safety input" are not detected with SU chambers.
9. ON (2) operation depends on the alarm output setting in the test environment setup.
10. Operation for "-(A)" is indicated for when the backup mode in the service mode is activated.
* When the backup mode is OFF, "-(A)" is OFF.
11. Operation for "-(B)" is indicated for when the refrigerator is running at minimum capacity. If this situation continues for 15 min, the refrigerator stops.
12. Operation for *1 is not specified.
(POWER lamp lighting is output from the instrumentation. Operation cannot be specified in the event of instrumentation trouble.)
13. Shaded areas do not apply to SH/SU-221/241.

10.3 Initial Values

Mode	Displayed setting	Model				
		SU				
		221	241	261	641	661
Constant	Target temperature (humidity)	0.0	0.0	0.0	0.0	0.0
	Humidity control ON/OFF	—	—	—	—	—
	Target humidity	—	—	—	—	—
	Refrigerator capacity control OFF/ON/AUTO	AUTO	AUTO	AUTO	AUTO	AUTO
	Time signal 1 output ON/OFF	OFF	OFF	OFF	OFF	OFF
Program setup	Program first task selection EDIT/CLER	EDIT	EDIT	EDIT	EDIT	EDIT
	Program second task selection STEP/END/SAVE	STEP	STEP	STEP	STEP	STEP
	Step selection	1	1	1	1	1
	Temperature (Humidity) link control ON/OFF	ON	ON	ON	ON	ON
	Target temperature	0.0	0.0	0.0	0.0	0.0
	Humidity control ON/OFF	—	—	—	—	—
	Target humidity	—	—	—	—	—
	Step exposure time	0:00	0:00	0:00	0:00	0:00
	Guaranteed soak control ON/OFF	OFF	OFF	OFF	OFF	OFF
	Temperature ramp control ON/OFF	OFF	OFF	OFF	OFF	OFF
	Humidity ramp control ON/OFF	—	—	—	—	—
	Refrigerator capacity control OFF/ON/AUTO	AUTO	AUTO	AUTO	AUTO	AUTO
	Time signal 1 output ON/OFF	OFF	OFF	OFF	OFF	OFF
	Step data enter command YES/NO	YES	YES	YES	YES	YES
	Number of repeat cycles	0	0	0	0	0
	Repeat counter start step	1	1	1	1	1
Repeat counter end step	1	1	1	1	1	
End mode HOLD/OFF/CNST	END HOLD	END HOLD	END HOLD	END HOLD	END HOLD	
Alarm setup	Absolute high temperature alarm	155.0	155.0	155.0	155.0	155.0
	Absolute low temperature alarm	-25.0	-45.0	-65.0	-45.0	-65.0
	Upper deviation temperature alarm	10.0	10.0	10.0	10.0	10.0
	Absolute high humidity alarm	—	—	—	—	—
	Absolute low humidity alarm	—	—	—	—	—

SH					Remarks
221	241	261	641	661	
0.0	0.0	0.0	0.0	0.0	
OFF	OFF	OFF	OFF	OFF	Displayed with SH chambers.
0	0	0	0	0	Displayed with SH chambers when humidity control is ON.
AUTO	AUTO	AUTO	AUTO	AUTO	Displayed when refrigerator capacity is shown in constant mode setting (TYP1/TYP2).
OFF	OFF	OFF	OFF	OFF	Displayed when "OP_1" is selected for relay 1 option and "T.SGL" is selected for external output event 1.
EDIT	EDIT	EDIT	EDIT	EDIT	
STEP	STEP	STEP	STEP	STEP	
1	1	1	1	1	
ON	ON	ON	ON	ON	When set to OFF, only step exposure time and step data enter command can be set.
0.0	0.0	0.0	0.0	0.0	
OFF	OFF	OFF	OFF	OFF	Displayed with SH chambers.
0	0	0	0	0	Displayed with SH chambers when humidity control is ON.
0:00	0:00	0:00	0:00	0:00	
OFF	OFF	OFF	OFF	OFF	Displayed when temperature (humidity) ramp control are OFF.
OFF	OFF	OFF	OFF	OFF	Displayed when guaranteed soak control is OFF.
OFF	OFF	OFF	OFF	OFF	Displayed with SH chambers when guaranteed soak control is OFF.
AUTO	AUTO	AUTO	AUTO	AUTO	Displayed when refrigerator capacity is shown in constant mode setting (TYP1/TYP2).
OFF	OFF	OFF	OFF	OFF	Displayed when "OP_1" is selected for relay 1 option and "T.SGL" is selected for external output event 1.
YES	YES	YES	YES	YES	
0	0	0	0	0	
1	1	1	1	1	Displayed when number of repeat cycles is 1 or higher.
1	1	1	1	1	Displayed when number of repeat cycles is 1 or higher.
END HOLD	END HOLD	END HOLD	END HOLD	END HOLD	
155.0	155.0	155.0	155.0	155.0	Displayed when absolute high temperature alarm control is not OFF.
-25.0	-45.0	-65.0	-45.0	-65.0	Displayed when absolute low temperature alarm control is not OFF.
10.0	10.0	10.0	10.0	10.0	Displayed when upper deviation temperature alarm control is not OFF.
100	100	100	100	100	Displayed when absolute high humidity alarm control is not OFF.
0	0	0	0	0	Displayed when absolute low humidity alarm control is not OFF.

Mode	Displayed setting	Model				
		SU				
		221	241	261	641	661
USERCOM	E-BUS address	0	0	0	0	0
	E-BUS baud rate	4800	4800	4800	4800	4800
	GPIB address	1	1	1	1	1
	GPIB delimiter C/L/CL	C.L.E	C.L.E	C.L.E	C.L.E	C.L.E
	RS-232C transfer mode E.BUS/ NRML	NRML	NRML	NRML	NRML	NRML
	RS-232C echo back ON/OFF	OFF	OFF	OFF	OFF	OFF
	RS-232C baud rate	96	96	96	96	96
	RS-232C stop bits	1	1	1	1	1
	RS-232C data bits	8	8	8	8	8
	RS-232C parity bit NON/ODD/EVEN	NON	NON	NON	NON	NON
	RS-232C delimiter C/L/CL	C.L.	C.L.	C.L.	C.L.	C.L.
	RS-485 address	1	1	1	1	1
	RS-485 transfer mode E.BUS/NRML	NRML	NRML	NRML	NRML	NRML
	RS-485 echo back ON/OFF	OFF	OFF	OFF	OFF	OFF
	RS-485 baud rate	192	192	192	192	192
	RS-485 stop bits	1	1	1	1	1
	RS-485 data bits	8	8	8	8	8
	RS-485 parity bit NON/ODD/EVEN	NON	NON	NON	NON	NON
	RS-485 delimiter C/L/CL	C.L.	C.L.	C.L.	C.L.	C.L.
USERSET	Setup keylock ON/OFF	OFF	OFF	OFF	OFF	OFF
	Operation keylock ON/OFF	OFF	OFF	OFF	OFF	OFF
	Remote control keylock ON/OFF	OFF	OFF	OFF	OFF	OFF
	Power recovery mode CNT/RSET	RSET	RSET	RSET	RSET	RSET
	Temperature attainment range	1.0	1.0	1.0	1.0	1.0
	Temperature attainment holding time	60	60	60	60	60
	Humidity attainment range	-	-	-	-	-
	Humidity attainment holding time	-	-	-	-	-
	Recorder output	-	-	-	-	-
	Door alarm delay time	180	180	180	180	180
	Alarm buzzer ON/OFF	ON	ON	ON	ON	ON
	Alarm output ON/OFF	ON	ON	ON	ON	ON
	External output event 1	P.END	P.END	P.END	P.END	P.END
	Dry-bulb temperature calibration	0.0	0.0	0.0	0.0	0.0
	Wet-bulb temperature calibration	-	-	-	-	-

SH					Remarks
221	241	261	641	661	
0	0	0	0	0	Displayed when chamber equipped with E-BUS communications (option).
4800	4800	4800	4800	4800	Displayed when chamber equipped with E-BUS communications (option).
1	1	1	1	1	Displayed when chamber equipped with GPIB communications (option).
C.L.E	C.L.E	C.L.E	C.L.E	C.L.E	Displayed when chamber equipped with GPIB communications (option).
NRML	NRML	NRML	NRML	NRML	Displayed when chamber equipped with RS-232C communications (option).
OFF	OFF	OFF	OFF	OFF	Displayed when chamber equipped with RS-232C communications (option).
96	96	96	96	96	Displayed when chamber equipped with RS-232C communications (option).
1	1	1	1	1	Displayed when chamber equipped with RS-232C communications (option).
8	8	8	8	8	Displayed when chamber equipped with RS-232C communications (option).
NON	NON	NON	NON	NON	Displayed when chamber equipped with RS-232C communications (option).
C.L	C.L	C.L	C.L	C.L	Displayed when chamber equipped with RS-232C communications (option).
1	1	1	1	1	
NRML	NRML	NRML	NRML	NRML	
OFF	OFF	OFF	OFF	OFF	
192	192	192	192	192	
1	1	1	1	1	
8	8	8	8	8	
NON	NON	NON	NON	NON	
C.L	C.L	C.L	C.L	C.L	
OFF	OFF	OFF	OFF	OFF	
OFF	OFF	OFF	OFF	OFF	
OFF	OFF	OFF	OFF	OFF	
RSET	RSET	RSET	RSET	RSET	
1.0	1.0	1.0	1.0	1.0	
60	60	60	60	60	
5	5	5	5	5	Displayed with SH chambers.
60	60	60	60	60	Displayed with SH chambers.
HUMI	HUMI	HUMI	HUMI	HUMI	Displayed when "REC" is set for analog output.
180	180	180	180	180	
ON	ON	ON	ON	ON	
ON	ON	ON	ON	ON	
P.END	P.END	P.END	P.END	P.END	Displayed when "OP_1" selected for relay 1 option.
0.0	0.0	0.0	0.0	0.0	
0.0	0.0	0.0	0.0	0.0	Displayed with SH chambers.

Mode	Displayed setting	Model				
		SU				
		221	241	261	641	661
Service 2	Baud rate (Service communications)	96	96	96	96	96
	Stop bits (Service communications)	1	1	1	1	1
	Data bits (Service communications)	8	8.0	8.0	8	8
	Parity bit (Service communications) NON/ODD/EVEN	NON	NON	NON	NON	NON
	Communication type NRML/MNT	NRML	NRML	NRML	NRML	NRML
Service 3	Chamber model code	SU	SU	SU	SU	SU
	Chamber type code	221	241	261	641	661
	Refrigerator capacity adjustment	1	1	0	0	0
	Highest allowed temperature	160.0	160.0	160.0	160.0	160.0
	Lowest allowed temperature	-30.0	-50.0	-70.0	-50.0	-70.0
	Absolute high temperature alarm control OFF/WARN/ERR	ERR	ERR	ERR	ERR	ERR
	Absolute low temperature alarm control OFF/WARN/ERR	ERR	ERR	ERR	ERR	ERR
	Upper deviation temperature alarm control OFF/WARN/ERR	WARN	WARN	WARN	WARN	WARN
	Lower deviation temperature alarm control OFF/WARN/ERR	OFF	OFF	OFF	OFF	OFF
	Absolute high humidity alarm control OFF/WARN/ERR	—	—	—	—	—
	Absolute low humidity alarm control OFF/WARN/ERR	—	—	—	—	—
	Upper deviation humidity alarm control OFF/WARN/ERR	—	—	—	—	—
	Lower deviation humidity alarm control OFF/WARN/ERR	—	—	—	—	—
Service 4	Temperature attainment range	1.0	1.0	1.0	1.0	1.0
	Temperature attainment holding time	60	60	60	60	60
	Humidity attainment range	—	—	—	—	—
	Humidity attainment holding time	—	—	—	—	—
	Trouble output	ON	ON	ON	ON	ON
	Refrigerator type NON/NRML/CAPA	CAPA	CAPA	CAPA	CAPA	CAPA
	Refrigerator forced output	OFF	OFF	OFF	OFF	OFF
	Refrigerator setting show/hide	TYP2	TYP2	TYP2	TYP2	TYP2
	Analog output OFF/REC/VOLT	OFF	OFF	OFF	OFF	OFF
	Analog output type	PV	PV	PV	PV	PV
	Analog output range maximum	5.00	5.00	5.00	5.00	5.00
	Analog output range minimum	1.00	1.00	1.00	1.00	1.00
	Analog input OFF/SNSR/VOLT	OFF	OFF	OFF	OFF	OFF
	Analog input range maximum	5.00	5.00	5.00	5.00	5.00
	Analog input range minimum	1.0	1.0	1.0	1.0	1.0
	Humidifier delay control	0	0	0	0	0
	Sequence drive RAM/ROM	ROM	ROM	ROM	ROM	ROM
Startup mode P.OFF/STND/CNST	P.OFF	P.OFF	P.OFF	P.OFF	P.OFF	

SH					Remarks
221	241	261	641	661	
96	96	96	96	96	
1	1	1	1	1	
8	8	8	8	8	
NON	NON	NON	NON	NON	
NRML	NRML	NRML	NRML	NRML	
SH	SH	SH	SH	SH	
221	241	261	641	661	
1	1	0	0	0	
160.0	160.0	160.0	160.0	160.0	
-30.0	-50.0	-70.0	-50.0	-70.0	
ERR	ERR	ERR	ERR	ERR	
ERR	ERR	ERR	ERR	ERR	
WARN	WARN	WARN	WARN	WARN	
OFF	OFF	OFF	OFF	OFF	
WARN	WARN	WARN	WARN	WARN	Displayed with SH chambers.
WARN	WARN	WARN	WARN	WARN	Displayed with SH chambers.
OFF	OFF	OFF	OFF	OFF	Displayed with SH chambers.
OFF	OFF	OFF	OFF	OFF	Displayed with SH chambers.
1.0	1.0	1.0	1.0	1.0	
60	60	60	60	60	
5	5	5	5	5	Displayed with SH chambers.
60	60	60	60	60	Displayed with SH chambers.
ON	ON	ON	ON	ON	
CAPA	CAPA	CAPA	CAPA	CAPA	
OFF	OFF	OFF	OFF	OFF	
TYP2	TYP2	TYP2	TYP2	TYP2	
REC	REC	REC	REC	REC	
PV	PV	PV	PV	PV	Displayed when "REC" is set for analog output.
5.00	5.00	5.00	5.00	5.00	Displayed when analog output is set to other than "OFF".
1.00	1.00	1.00	1.00	1.00	Displayed when analog output is set to other than "OFF".
OFF	OFF	OFF	OFF	OFF	
5.00	5.00	5.00	5.00	5.00	Displayed when analog input is set to other than "OFF".
1.0	1.0	1.0	1.0	1.0	Displayed when analog input is set to other than "OFF".
0	0	0	0	0	
ROM	ROM	ROM	ROM	ROM	
P.OFF	P.OFF	P.OFF	P.OFF	P.OFF	

Mode	Displayed setting	Model				
		SU				
		221	241	261	641	661
Service 4	Backup mode ON/OFF	ON	ON	ON	ON	ON
	Pause when door open or evaporator frosted over ON/OFF	OFF	OFF	OFF	OFF	OFF
	Relay 1 option NON/OP_1/OP_2/OP_3	OP_2	OP_2	OP_2	OP_2	OP_2
	Relay 2 option NON/OP_1/OP_2/OP_3	NON	NON	NON	NON	NON
	Demonstration	0	0	0	0	0
Service 5	Loop	1	1	1	1	1
	PID type TYP1/TYP2 (Brilliant PID/Y type)	TYP2	TYP2	TYP2	TYP2	TYP2
	Control type NRML/HCC (Normal control/Heating/Cooling control)	NRML	NRML	NRML	NRML	NRML
	Control type HUMI/STEM (Relative humidity/Vapor pressure)	HUMI	HUMI	HUMI	HUMI	HUMI
	Input type WET/SNSR (Wet-bulb/Humidity sensor)	WET	WET	WET	WET	WET
	Humidity calculation mode SPRG/PRT1/PRT2/PRT3 (Sprung/Pernter 1 to 3)	SPRG	SPRG	SPRG	SPRG	SPRG
	P (Loop 1: Temperature)	1.5	1.5	1.5	1.5	1.5
	I (Loop 1: Temperature)	68	68	68	68	68
	D (Loop 1: Temperature)	17	17	17	17	17
	P (Loop 2: Humidity)	0.0	0.0	0.0	0.0	0.0
	I (Loop 2: Humidity)	0	0	0	0	0
	D (Loop 2: Humidity)	0	0	0	0	0
P.LO (Loop 2: Humidity): Variable gain minimum	0.0	0.0	0.0	0.0	0.0	
Service 6	Measurement filter	1	1	1	1	1
	Filter value	3	3	3	3	3
	Display type ACT/INT	ACT	ACT	ACT	ACT	ACT
	Database number	0	0	0	0	0
	Database member	0	0	0	0	0
	Database offset	0	0	0	0	0
	Page	—	—	—	—	—
	Address	—	—	—	—	—

SH					Remarks
221	241	261	641	661	
ON	ON	ON	ON	ON	For SH chambers. Backs up temperature operation if humidity alarm occurs.
OFF	OFF	OFF	OFF	OFF	Does not pause.
OP_2	OP_2	OP_2	OP_2	OP_2	
NON	NON	NON	NON	NON	Not used with Bench-top Type Temperature and Humidity Chamber.
0	0	0	0	0	
1	1	1	1	1	
TYP2	TYP2	TYP2	TYP2	TYP2	OFF when loop 2 selected with SU chambers
NRML	NRML	NRML	NRML	NRML	When loop 1 selected.
HUMI	HUMI	HUMI	HUMI	HUMI	When loop 2 selected.
WET	WET	WET	WET	WET	When loop 2 selected.
SPRG	SPRG	SPRG	SPRG	SPRG	When loop 2 selected.
1.5	1.5	1.5	1.5	1.5	
68	68	68	68	68	
17	17	17	17	17	
1.0	1.0	1.0	1.0	1.0	
156	156	156	156	156	
39	39	39	39	39	
6.0	6.0	6.0	6.0	6.0	
1	1	1	1	1	
3	3	3	3	3	
ACT	ACT	ACT	ACT	ACT	
0	0	0	0	0	
0	0	0	0	0	
0	0	0	0	0	
—	—	—	—	—	Value varies depending on version.
—	—	—	—	—	Value varies depending on version.

Service Manual

**Bench-Top Type Temperature
and Humidity Chamber**

SH-221, 241, 261, 641, 661
SU-221, 241, 261, 641, 661

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