MITSUBISHI ELECTRIC

HOT WATER HEAT PUMP

Changes for the Better

2015

R407C

Service Handbook

Model

CAHV-P500YB-HPB

Safety Precautions

- Thoroughly read the following safety precautions prior to use.
- Observe these precautions carefully to ensure safety.

⚠ WARNING	Indicates a risk of death or serious injury
⚠ CAUTION	Indicates a risk of injury or structural damage
⚠ IMPORTANT	Indicates a risk of damage to the unit or other components in the system

> **All electric work must be performed by personnel certified by Mitsubishi Electric.**

General

⚠ WARNING

Do not use refrigerant other than the type indicated in the manuals provided with the unit and on the nameplate.

- Doing so may cause the unit or pipes to burst, or result in explosion or fire during use, during repair, or at the time of disposal of the unit.
- It may also be in violation of applicable laws.
- MITSUBISHI ELECTRIC CORPORATION cannot be held responsible for malfunctions or accidents resulting from the use of the wrong type of refrigerant.

Do not install the unit in a place where large amounts of oil, steam, organic solvents, or corrosive gases, such as sulfuric gas, are present or where acidic/alkaline solutions or sprays containing sulfur are used frequently.

These substances can compromise the performance of the unit or cause certain components of the unit to corrode, which can result in refrigerant leakage, water leakage, injury, electric shock, malfunctions, smoke, or fire.

Do not try to defeat the safety features of the unit or make unauthorized setting changes.

Forcing the unit to operate the unit by defeating the safety features of the devices such as the pressure switch or the temperature switch, making unauthorized changes to the switch settings, or using accessories other than the ones recommended by Mitsubishi Electric may result in smoke, fire, or explosion.

To reduce the risk of fire or explosion, do not use volatile or flammable substances as a heat carrier.

To reduce the risk of burns or electric shock, do not touch exposed pipes and wires.

To reduce the risk of shorting, current leakage, electric shock, malfunctions, smoke, or fire, do not splash water on electric parts.

To reduce the risk of electric shock, malfunctions, smoke or fire, do not operate the switches/buttons or touch other electrical parts with wet hands.

To reduce the risk of electric shock and injury from the fan or other rotating parts, stop the operation and turn off the main power before cleaning, maintaining, or inspecting the unit.

To reduce the risk of burns or frost bites, do not touch the refrigerant pipes or refrigerant circuit components with bare hands during and immediately after operation.

Before cleaning the unit, switch off the power.
(Unplug the unit, if it is plugged in.)

To reduce the risk of injury, keep children away while installing, inspecting, or repairing the unit.

Children should be supervised to ensure that they do not play with the appliance.

This appliance is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety.

Keep the space well ventilated. Refrigerant can displace air and cause oxygen starvation.

If leaked refrigerant comes in contact with a heat source, toxic gas may be generated.

Always replace a fuse with one with the correct current rating.

The use of improperly rated fuses or a substitution of fuses with steel or copper wire may result in fire or explosion.

If any abnormality (e.g., burning smell) is noticed, stop the operation, turn off the power switch, and consult your dealer.

Continuing the operation may result in electric shock, malfunctions, or fire.

Properly install all required covers and panels on the terminal box and control box to keep moisture and dust out.

Dust accumulation and water may result in electric shock, smoke, or fire.

Consult an authorized agency for the proper disposal of the unit

Refrigerant oil and refrigerant that may be left in the unit pose a risk of fire, explosion, or environmental pollution.

⚠ CAUTION

To reduce the risk of fire or explosion, do not place flammable materials or use flammable sprays around the unit.

Do not operate the unit without panels and safety guards properly installed.

To reduce the risk of injury, do not sit, stand, or place objects on the unit.	**To prevent environmental pollution, dispose of brine in the unit and cleaning solutions according to the local regulations.**
Do not connect the makeup water pipe directly to the potable water pipe. Use a cistern tank between them.	It is punishable by law not to dispose of them according to the applicable laws.
Connecting these pipes directly may cause the water in the unit to migrate into the potable water and cause health problems.	**The water heated by the heat pump is not suitable for use as drinking water or for cooking.**
To reduce the risk of adverse effects on plants and animals, do not place them where they are directly exposed to discharge air from the unit.	It may cause health problems or degrade food.
Do not install the unit on or over things that are vulnerable to water damage.	**In areas where temperature drops to freezing during the periods of non-use, blow the water out of the pipes or fill the pipes with anti-freeze solution.**
Condensation may drip from the unit.	Not doing so may cause the water to freeze, resulting in burst pipes and damage to the unit or the furnishings.
The model of heat pump unit described in this manual is not intended for use to preserve food, animals, plants, precision instruments, or art work.	In areas where temperature drops to freezing, use an anti-freeze circuit and leave the main power turned on to prevent the water in the water circuit from freezing and damaging the unit or causing water leakage and resultant damage to the furnishings.
To reduce the risk of injury, do not touch the heat exchanger fins or sharp edges of components with bare hands.	**Use clean tap water.**
Do not place a container filled with water on the unit.	The use of acidic or alkaline water or water high in chlorine may corrode the unit or the pipes, causing water leakage and resultant damage to the furnishings.
If water spills on the unit, it may result in shorting, current leakage, electric shock, malfunction, smoke, or fire.	**In areas where temperature can drop low enough to cause the water in the pipes to freeze, operate the unit often enough to prevent the water from freezing.**
Always wear protective gears when touching electrical components on the unit.	Frozen water in the water circuit may cause the water to freeze, resulting in burst pipes and damage to the unit or the furnishings.
Several minutes after the power is switched off, residual voltage may still cause electric shock.	**Periodically inspect and clean the water circuit.**
To reduce the risk of injury, do not insert fingers or foreign objects into air inlet/outlet grills.	Dirty water circuit may compromise the unit's performance or corrodes the unit or cause water leakage and resultant damage to the furnishings.
To reduce the risk of injury, wear protective gear when working on the unit.	
Do not release refrigerant into the atmosphere. Collect and reuse the refrigerant, or have it properly disposed of by an authorized agency.	
Refrigerant poses environmental hazards if released into the air.	

Transportation

⚠ WARNING

Lift the unit by placing the slings at designated locations. Support the outdoor unit securely at four points to keep it from slipping and sliding.
If the unit is not properly supported, it may fall and cause personal injury.

⚠ CAUTION

To reduce the risk of injury, do not carry the product by the PP bands that are used on some packages.	To reduce the risk of injury, products weighing 20 kg or more should be carried by two or more people.

Installation

⚠ WARNING

Do not install the unit where there is a risk of leaking flammable gas.	**Properly dispose of the packing materials.**
If flammable gas accumulates around the unit, it may ignite and cause a fire or explosion.	Plastic bags pose suffocation hazard to children.

The unit should be installed only by personnel certified by Mitsubishi Electric according to the instructions detailed in the Installation/Operation Manual.	Any additional parts must be installed by qualified personnel. Only use the parts specified by Mitsubishi Electric.
Improper installation may result in refrigerant leakage, water leakage, injury, electric shock, or fire.	Take appropriate safety measures against wind gusts and earthquakes to prevent the unit from toppling over and causing injury.
Periodically check the installation base for damage.	Be sure to install the unit horizontally, using a level.
If the unit is left on a damaged base, it may fall and cause injury.	If the unit is installed at an angle, it may fall and cause injury or cause water leakage.
Remove packing materials from the unit before operating the unit. Note that some accessories may be taped to the unit. Properly install all accessories that are required.	The unit should be installed on a surface that is strong enough to support its weight.
Failing to remove the packing materials or failing to install required accessories may result in refrigerant leakage, oxygen starvation, smoke, or fire.	As an anti-freeze, use ethylene glycol or propylene glycol diluted to the specified concentration.
Consult your dealer and take appropriate measures to safeguard against refrigerant leakage and resultant oxygen starvation. An installation of a refrigerant gas detector is recommended.	The use of other types of anti-freeze solution may cause corrosion and resultant water leakage. The use of flammable anti-freeze may cause fire or explosion.

⚠ CAUTION

Do not install the unit on or over things that are vulnerable to water damage.	All drainage work should be performed by the dealer or qualified personnel according to the instructions detailed in the Installation Manual.
When the indoor humidity exceeds 80% or if the drain water outlet becomes clogged, condensation may drip from the indoor unit onto the ceiling or floor.	Improper drainage work may cause rain water or drain water to enter the buildings and damage the furnishings.

Pipe installation

⚠ WARNING

To prevent explosion, do not heat the unit with refrigerant gas in the refrigerant circuit.	Check for refrigerant leakage at the completion of installation.
	If leaked refrigerant comes in contact with a heat source, toxic gas may be generated.

⚠ CAUTION

Check that no substance other than the specified refrigerant (R407C) is present in the refrigerant circuit.	Piping work should be performed by the dealer or qualified personnel according to the instructions detailed in the Installation Manual.
Infiltration of other substances may cause the pressure to rise abnormally high and cause the pipes to explode.	Improper piping work may cause water leakage and damage the furnishings.
To keep the ceiling and floor from getting wet due to condensation, properly insulate the pipes.	

Electrical wiring

To reduce the risk of wire breakage, overheating, smoke, and fire, keep undue force from being applied to the wires.	All electric work must be performed by a qualified electrician according to the local regulations, standards, and the instructions detailed in the Installation Manual.
Properly secure the cables in place and provide adequate slack in the cables so as not to stress the terminals.	Capacity shortage to the power supply circuit or improper installation may result in malfunction, electric shock, smoke, or fire.
Improperly connected cables may break, overheat, and cause smoke or fire.	To reduce the risk of electric shock, smoke, or fire, install an inverter circuit breaker on the power supply to each unit.
To reduce the risk of injury or electric shock, switch off the main power before performing electrical work.	Use properly rated breakers and fuses (inverter breaker, Local Switch <Switch + Type-B fuse>, or no-fuse breaker).
	The use of improperly rated breakers may result in malfunctions or fire.

To reduce the risk of current leakage, overheating, smoke, or fire, use properly rated cables with adequate current carrying capacity.

Keep the unsheathed part of cables inside the terminal block.

If unsheathed part of the cables come in contact with each other, electric shock, smoke, or fire may result.

Proper grounding must be provided by a licensed electrician. Do not connect the grounding wire to a gas pipe, water pipe, lightning rod, or telephone wire.

Improper grounding may result in electric shock, smoke, fire, or malfunction due to electrical noise interference.

⚠ CAUTION

To reduce the risk of current leakage, wire breakage, smoke, or fire, keep the wiring out of contact with the refrigerant pipes and other parts, especially sharp edges.

To reduce the risk of electric shock, shorting, or malfunctions, keep wire pieces and sheath shavings out of the terminal block.

Transportation and repairs

⚠ WARNING

The unit should be moved, disassembled, or repaired only by qualified personnel. Do not alter or modify the unit.

Improper repair or unauthorized modifications may result in refrigerant leakage, water leakage, injury, electric shock, or fire.

After disassembling the unit or making repairs, replace all components as they were.

Failing to replace all components may result in injury, electric shock, or fire.

If the supply cord is damaged, it must be replaced by the manufacturer, its service agent or similarly qualified persons in order to avoid a hazard.

⚠ CAUTION

To reduce the risk of shorting, electric shock, fire, or malfunction, do not touch the circuit board with tools or with your hands, and do not allow dust to accumulate on the circuit board.

IMPORTANT

To avoid damage to the unit, use appropriate tools to install, inspect, or repair the unit.

To reduce the risk or malfunction, turn on the power at least 12 hours before starting operation, and leave the power turned on throughout the operating season.

Recover all refrigerant from the unit.

It is punishable by law to release refrigerant into the atmosphere.

Do not unnecessarily change the switch settings or touch other parts in the refrigerant circuit.

Doing so may change the operation mode or damage the unit.

To reduce the risk of malfunctions, use the unit within its operating range.

Do not switch on or off the main power in a cycle of shorter than 10 minutes.

Short-cycling the compressor may damage the compressor.

To maintain optimum performance and reduce the risk of malfunction, keep the air pathway clear.

To ensure proper operation of the unit, periodically check for proper concentration of anti-freeze.

Inadequate concentration of anti-freeze may compromise the performance of the unit or cause the unit to abnormally stop.

Take appropriate measures against electrical noise interference when installing the air conditioners in hospitals or facilities with radio communication capabilities.

Inverter, high-frequency medical, or wireless communication equipment as well as power generators may cause the air conditioning system to malfunction. Air conditioning system may also adversely affect the operation of these types of equipment by creating electrical noise.

Check the water system, using a relevant manual as a reference.

Using the system that does not meet the standards (including water quality and water flow rate) may cause the water pipes to corrode.

To reduce the risk of power capacity shortage, always use a dedicated power supply circuit.

This appliance is intended to be used by expert or trained users in shops, in light industry and on farms, or for commercial use by lay persons.

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I Read Before Servicing

[1] Read Before Servicing

1. **Check the type of refrigerant used in the system to be serviced.**
   Refrigerant Type
   Hot water Heat pump CAHV-P500YB-HPB:R407C

2. **Check the symptoms exhibited by the unit to be serviced.**
   Refer to this service handbook for symptoms relating to the refrigerant cycle.

3. **Thoroughly read the safety precautions at the beginning of this manual.**

4. **Preparing necessary tools: Prepare a set of tools to be used exclusively with each type of refrigerant.**
   Refer to "Necessary Tools and Materials" for information on the use of tools.(page 4)

5. **If there is a leak of gaseous refrigerant and the remaining refrigerant is exposed to an open flame, a poisonous gas hydrofluoric acid may form. Keep workplace well ventilated.**

⚠ **CAUTION**
 ◆Install new pipes immediately after removing old ones to keep moisture out of the refrigerant circuit.
 ◆The use of refrigerant that contains chloride, such as R22, will cause the refrigerating machine oil to deteriorate.

[2] Necessary Tools and Materials

Prepare the following tools and materials necessary for servicing the unit.

Tools for use with R407C (Adaptability of tools that are for use with R22 or R410A)

1. To be used exclusively with R407C (not to be used if used with R22 or R410A)

Tools/Materials	Use	Notes
Gauge Manifold	Evacuation and refrigerant charging	Higher than 4.82MPa on the high-pressure side
Charging Hose	Evacuation and refrigerant charging	
Refrigerant Recovery Cylinder	Refrigerant recovery	
Refrigerant Cylinder	Refrigerant charging	The refrigerant type is indicated. The cylinder is Gray
Charging Port on the Refrigerant Cylinder	Refrigerant charging	

2. Tools and materials that may be used with R407C with some restrictions

Tools/Materials	Use	Notes
Gas Leak Detector	Gas leak detection	The ones for use with HFC refrigerant may be used.
Vacuum Pump	Vacuum drying	May be used if a check valve adapter is attached.
Refrigerant Recovery Equipment	Refrigerant recovery	May be used if compatible with R407C.

3. Tools and materials that are used with R22 or R410A that may also be used with R407C

Tools/Materials	Use	Notes
Vacuum Pump with a Check Valve	Vacuum drying	
Bender	Bending pipes	
Torque Wrench	Tightening water pipes	
Pipe Cutter	Cutting pipes	
Welder and Nitrogen Cylinder	Welding pipes	
Refrigerant Charging Meter	Refrigerant charging	
Vacuum Gauge	Vacuum level check	

4. Tools and materials that must not be used with R407C

Tools/Materials	Use	Notes
Charging Cylinder	Refrigerant charging	Prohibited to use

Tools for R407C must be handled with special care to keep moisture and dust from infiltrating the cycle.

[3] Brazing

No changes have been made in the brazing procedures. Perform brazing with special care to keep foreign objects (such as oxide scale, water, and dust) out of the refrigerant system.

Example: Inside the brazed connection

Use of oxidized solder for brazing
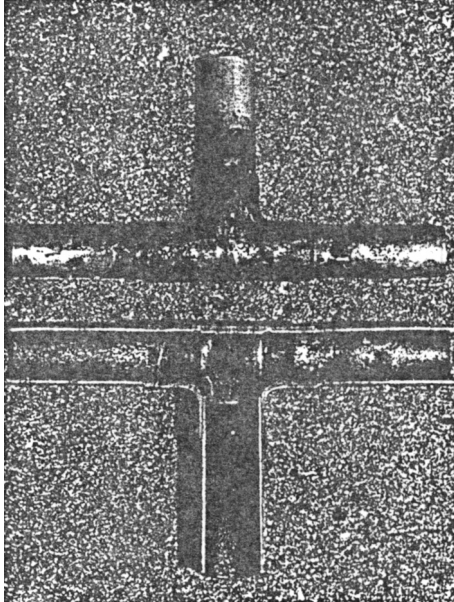
Use of non-oxidized solder for brazing
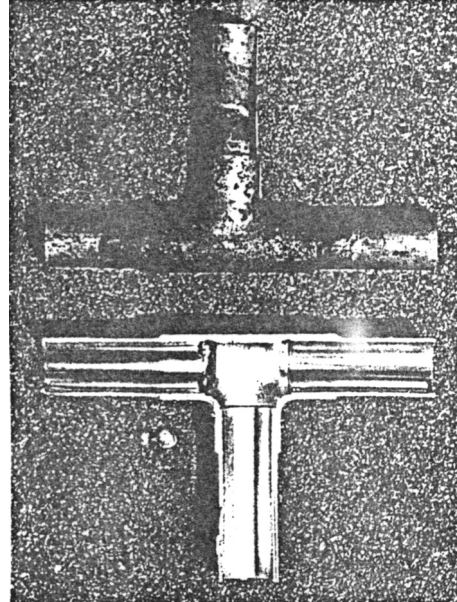
1. **Items to be strictly observed**
   - Do not conduct refrigerant piping work outdoors if raining.
   - Use non-oxidized solder.
   - Use a brazing material (BCuP-3) that requires no flux when brazing between copper pipes or between a copper pipe and copper coupling.
   - If installed refrigerant pipes are not immediately connected to the equipment, then braze and seal both ends.

2. **Reasons**
   - The new refrigerating machine oil is 10 times as hygroscopic as the conventional oil and is more likely to cause unit failure if water infiltrates into the system.
   - Flux generally contains chloride. Residual flux in the refrigerant circuit will cause sludge to form.

3. **Notes**
   Do not use commercially available antioxidants because they may cause the pipes to corrode or refrigerating machine oil to deteriorate.

[4] Air Tightness Test

No changes have been made in the detection method. Note that a refrigerant leak detector for R22 will not detect an R407C leak.
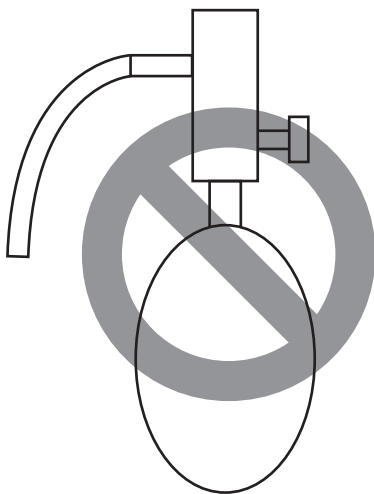
Halide torch
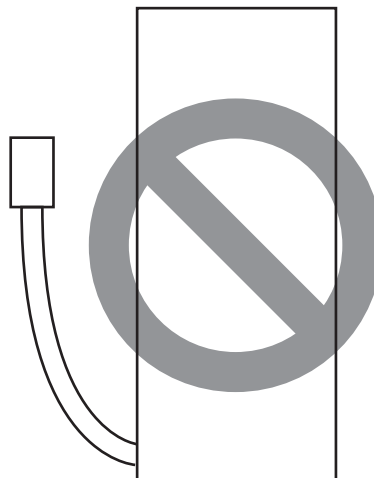
R22 leakage detector

1. **Items to be strictly observed**
   - Pressurize the equipment with nitrogen up to the design pressure (3.85MPa), and then judge the equipment's air tightness, taking temperature variations into account.
   - Refrigerant R407C must be charged in its liquid state (vs. gaseous state).

2. **Reasons**
   - Oxygen, if used for an air tightness test, poses a risk of explosion. (Only use nitrogen to check air tightness.)
   - Refrigerant R407C must be charged in its liquid state. If gaseous refrigerant in the cylinder is drawn out first, the composition of the remaining refrigerant in the cylinder will change and become unsuitable for use.

3. **Notes**
   Procure a leak detector that is specifically designed to detect an HFC leak. A leak detector for R22 will not detect an HFC(R407C) leak.

[5] Vacuum Drying (Evacuation)

(Photo1) 15010H

(Photo2) 14010

Recommended vacuum gauge:
ROBINAIR 14010 Thermistor Vacuum Gauge

1. **Vacuum pump with a reverse-flow check valve (Photo1)**
   To prevent the vacuum pump oil from flowing into the refrigerant circuit during power OFF or power failure, use a vacuum pump with a reverse-flow check valve.
   A reverse-flow check valve may also be added to the vacuum pump currently in use.

2. **Standard of vacuum degree (Photo 2)**
   Use a vacuum pump that attains 0.5Torr(65Pa) or lower degree of vacuum after 5 minutes of operation, and connect it directly to the vacuum gauge. Use a pump well-maintained with an appropriate lubricant. A poorly maintained vacuum pump may not be able to attain the desired degree of vacuum.

3. **Required precision of vacuum gauge**
   Use a vacuum gauge that registers a vacuum degree of 5Torr(650Pa) and measures at intervals of 1Torr(130Pa). (A recommended vacuum gauge is shown in Photo2.)
   Do not use a commonly used gauge manifold because it cannot register a vacuum degree of 5Torr(650Pa).

4. **Evacuation time**
   ♦After the degree of vacuum has reached 5Torr(650Pa), evacuate for an additional 1 hour. (A thorough vacuum drying removes moisture in the pipes.)
   ♦Verify that the vacuum degree has not risen by more than 1Torr(130Pa) 1hour after evacuation. A rise by less than 1Torr(130Pa) is acceptable.
   ♦If the vacuum is lost by more than 1Torr(130Pa), conduct evacuation, following the instructions in section 6. Special vacuum drying.

5. **Procedures for stopping vacuum pump**
   To prevent the reverse flow of vacuum pump oil, open the relief valve on the vacuum pump side, or draw in air by loosening the charge hose, and then stop the operation.
   The same procedures should be followed when stopping a vacuum pump with a reverse-flow check valve.

6. **Special vacuum drying**
   ♦When 5Torr(650Pa) or lower degree of vacuum cannot be attained after 3 hours of evacuation, it is likely that water has penetrated the system or that there is a leak.
   ♦If water infiltrates the system, break the vacuum with nitrogen. Pressurize the system with nitrogen gas to 0.5kgf/cm^{2}G(0.05MPa) and evacuate again. Repeat this cycle of pressurizing and evacuation either until the degree of vacuum below 5Torr(650Pa) is attained or until the pressure stops rising.
   ♦Only use nitrogen gas for vacuum breaking. (The use of oxygen may result in an explosion.)

7. **Notes**
   ♦**To evacuate air only from the outdoor units**
   Apply a vacuum through the check joints on the low pressure sides.
   ♦**Evacuating the system from the high-pressure side may damage the compressor.**

[6] Refrigerant Charging

Cylinder with a siphon   Cylinder without a siphon
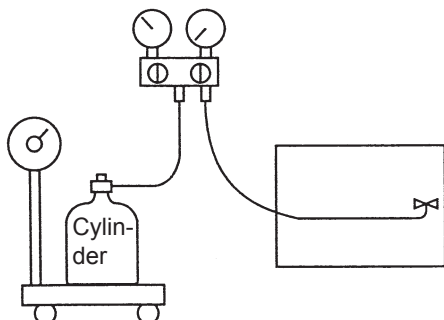
Cylinder color R407C is Gray.   Refrigerant charging in the liquid state
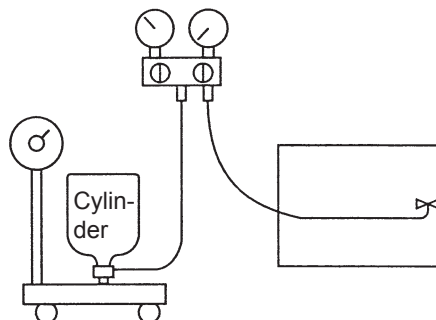
Valve   Valve
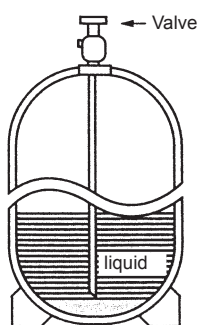
Charge refrigerant through the   Charging refrigerant through the
check joint on the high-pressure side.   check joint on the low-pressure side
                                          will create reverse pressure,
                                          resulting in compressor malfunctions.

1. **Reasons**

   R407C is a mixture of 3 refrigerants, each with a different evaporation temperature. Therefore, if the equipment is charged with R407C gas, then the refrigerant whose evaporation temperature is closest to the outside temperature is charged frist while the rest of refrigerants remain in the cylinder.

2. **Notes**

   When using a cylinder with a siphon, refrigerant is charged in the liquid state without the need for turning it upside down. Check the type of the cylinder on the label before use.

[7] Remedies to be taken in case of a Refrigerant Leak

If the refrigerant leaks out, all of the remaining refrigerant must be replaced with a new charge to maintain the proper composition of the refrigerant. Repair the leak, and then charge the system with the specified amount of refrigerant (5.5 kg). (Charge refrigerant in the liquid state.)
Refer to "IX [4] Refrigerant Leak."(page 146)

[8] Characteristics of the Conventional and the New Refrigerants

1. **Chemical property**
   As with R22, the new refrigerant (R407C) is low in toxicity and chemically stable nonflammable refrigerant.
   However, because the specific gravity of vapor refrigerant is greater than that of air, leaked refrigerant in a closed room will accumulate at the bottom of the room and may cause hypoxia.
   If exposed to an open flame, refrigerant will generate poisonous gases. Do not perform installation or service work in a confined area.

	New Refrigerant (HFC type)		Conventional Refrigerant (HCFC type)
	R410A	R407C	R22
	R32/R125	R32/R125/R134a	R22
Composition (wt%)	(50/50)	(23/25/52)	(100)
Type of Refrigerant	Pseudo-azeotropic Refrigerant	Non-azeotropic Refrigerant	Single Refrigerant
Chloride	Not included	Not included	Included
Safety Class	A1/A1	A1/A1	A1
Molecular Weight	72.6	86.2	86.5
Boiling Point (°C/°F)	-51.4/-60.5	-43.6/-46.4	-40.8/-41.4
Steam Pressure (25°C,MPa/77°F,psi) (gauge)	1.557/226	0.9177/133	0.94/136
Saturated Steam Density (25°C,kg/m^3/77°F,psi)	64.0	42.5	44.4
Flammability	Nonflammable	Nonflammable	Nonflammable
Ozone Depletion Coefficient (ODP)[1]	**0**	**0**	**0.055**
Global Warming Coefficient (GWP)[2]	1975	1653	1700
Refrigerant Charging Method	Refrigerant charging in the liquid state	Refrigerant charging in the liquid state	Refrigerant charging in the gaseous state
Replenishment of Refrigerant after a Refrigerant Leak	Available	Available	Available

*1 When CFC11 is used as a reference
*2 When CO_2 is used as a reference

2. **Pressure characteristics**
   The pressure in the system using R407C is 1.1 times as great as that in the system using R22.

Temperature (°C/°F)	Saturation Pressure (gauge)		
	R410A	R407C	R22
	MPa/psi	MPa/psi	MPa/psi
-20/-4	0.30/44	0.18/26	0.14/20
0/32	0.70/102	0.47/68	0.40/58
20/68	1.34/194	0.94/136	0.81/117
40/104	2.31/335	1.44/209	1.44/209
60/140	3.73/541	2.43/354	2.33/338
65/149	4.17/605	2.74/399	2.60/377

[9] Notes on Refrigerating Machine Oil

1. **Refrigerating machine oil in the HFC refrigerant system**

   HFC type refrigerants use a refrigerating machine oil different from that used in the R22 system.
   Note that the ester oil used in the system has properties that are different from commercially available ester oil.

Refrigerant	Refrigerating machine oil
R22	Mineral oil
R407C	Ester oil
R410A	Ester oil

2. **Effects of contaminants[*1]**

   Refrigerating machine oil used in the HFC system must be handled with special care to keep contaminants out.
   The table below shows the effect of contaminants in the refrigerating machine oil on the refrigeration cycle.

3. **The effects of contaminants in the refrigerating machine oil on the refrigeration cycle.**

Cause		Symptoms		Effects on the refrigerant cycle
Water infiltration			Frozen expansion valve and capillary tubes	Clogged expansion valve and capillary tubes Poor cooling performance Compressor overheat Motor insulation failure Burnt motor Coppering of the orbiting scroll Lock Burn-in on the orbiting scroll
		Hydrolysis	Sludge formation and adhesion Acid generation Oxidization Oil degradation	
Air infiltration			Oxidization	
Infiltration of contaminants	Dust, dirt	Adhesion to expansion valve and capillary tubes		Clogged expansion valve, capillary tubes, and drier Poor cooling performance Compressor overheat
		Infiltration of contaminants into the compressor		Burn-in on the orbiting scroll
	Mineral oil etc.	Sludge formation and adhesion		Clogged expansion valve and capillary tubes Poor cooling performance Compressor overheat
		Oil degradation		Burn-in on the orbiting scroll

*1. Contaminants is defined as moisture, air, processing oil, dust/dirt, wrong types of refrigerant, and refrigerating machine oil.

II Restrictions

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[1] System Configuration

Schematic Diagrams of Individual and Multiple Systems

(1) Individual system

*Each unit is operated individually by connecting a dry contact switch/relay to each unit.
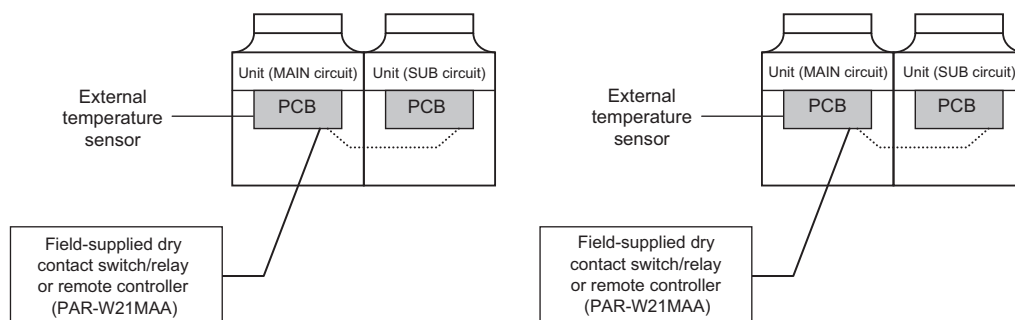
Refer to the sections "Switch Types and the Factory Settings" (page 18) and "System configuration procedures: Individual system" (page 21) for further details.

(2) Multiple system (2-16 units)

*A group of unit that consists of one main unit and up to 15 sub units is operated collectively by connecting an external water temperature sensor and a dry contact switch/relay to the main unit.
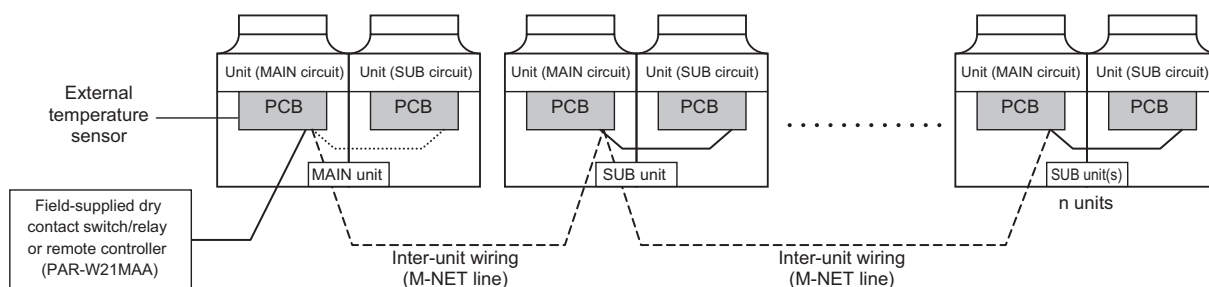
Refer to the sections "Switch Types and the Factory Settings" (page 18) and "System configuration procedures: Multiple system" (page 22) for further details.

[2] Types and Maximum allowable Length of Cables

Wiring work

(1) Notes

1) Have all electrical work performed by an authorized electrician according to the local regulations and instructions in this manual.

2) Install external transmission cables at least 5cm [1-31/32"] away from the power supply cable to avoid noise interference. (Do not put the control cable and power supply cable in the same conduit tube.)

3) Provide grounding for the outdoor unit as required.

4) Run the cable from the electric box of the outdoor unit in such way that the box is accessible for servicing.

5) Do not connect power supply wiring to the terminal block for transmission line. Doing so will damage the electronic components on the terminal block.

6) Use 2-core shielded cables as transmission cables.

   Use a separate 2-core control cable for each refrigerant system. Do not use a single multiple-core cable to connect units that belong to different refrigerant systems. The use of a multiple-core cable may result in signal transmission errors and malfunctions.
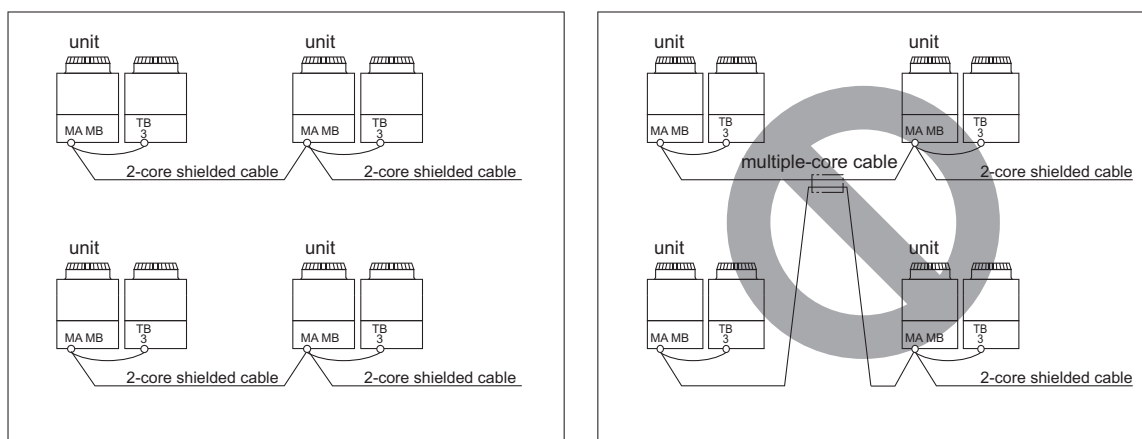
TB3: Terminal block for transmission line

(2) Control wiring

Different types of control wiring are used for different systems.

Types and maximum allowable length of cables

Control lines are categorized into 2 types: transmission line and remote controller line.

Use the appropriate type of cables and observe the maximum allowable length specified for a given system. If a given system has a long transmission line or if a noise source is located near the unit, place the unit away from the noise source to reduce noise interference.

[3] Main Power Supply Wiring and Switch Capacity

Schematic Drawing of Wiring (Example)

Ⓐ : Switch (with current breaking capability)

Ⓑ : Current leakage breaker

Ⓒ : Outdoor unit

Ⓓ : Pull box

Ⓔ : Indoor unit
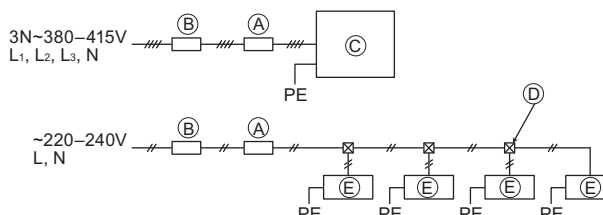
Main power supply wire size, switch capacities, and system impedance

Model	Minimum wire thickness (mm²)			Current leakage breaker	Local swtich (A)		No-fuse breaker (A)	Max. Permissive System Impedance
	Main cable	Branch	Ground		Capacity	Fuse		
CAHV-P500YB-HPB	25	-	25	75 A 100 mA 0.1 sec. or less	75	75	75	0.28 Ω

1. **Use a dedicated power supply for each unit. Ensure that each unit is wired individually.**

2. **When installing wiring, consider ambient conditions (e.g., temperature, sunlight, rain).**

3. **The wire size is the minimum value for metal conduit wiring. If voltage drop is a problem, use a wire that is one size thicker.**
   Make sure the power-supply voltage does not drop more than 10%.

4. **Specific wiring requirements should adhere to the wiring regulations of the region.**

5. **Power supply cords of appliances for outdoor use shall not be lighter than polychloroprene sheathed flexible cord (design 60245 IEC57).**

6. **A switch with at least 3 mm contact separation in each pole shall be provided by the Air Conditioner installer.**

7. **Do not install a phase advancing capacitor on the motor. Doing so may damage the capacitor and result in fire.**

⚠ **Warning:**
- **Be sure to use specified wires and ensure no external force is imparted to terminal connections. Loose connections may cause overheating and fire.**
- **Be sure to use the appropriate type of overcurrent protection switch. Note that overcurrent may include direct current.**

⚠ **Caution:**
- **Some installation sites may require an installation of an earth leakage breaker for the inverter. If no earth leakage breaker is installed, there is a danger of electric shock.**
- **Only use properly rated breakers and fuses. Using a fuse or wire of the wrong capacity may cause malfunction or fire.**

Note:
- **This device is intended for the connection to a power supply system with a maximum permissible system impedance shown in the above table at the interface point (power service box) of the user's supply.**
- **Ensure that this device is connected only to a power supply system that fulfills the requirements above. If necessary, consult the public power supply company for the system impedance at the interface point.**
- **This equipment complies with IEC 61000-3-12 provided that the short-circuit power S_{SC} is greater than or equal to S_{SC} (*2) at the interface point between the user's supply and the public system. It is the responsibility of the installer or user of the equipment to ensure, in consultation with the distribution network operator if necessary, that the equipment is connected only to a supply with a short-circuit power S_{SC} greater than or equal to S_{SC} (*2).**

S_{SC} (*2)

S_{SC} (MVA)
4.11

Control cable specifications

Remote controller cable	Size	0.3 - 1.25 mm² (Max. 200 m total)*2
	Recommended cable types	CVV
M-NET cable between units	Size	Min. 1.25 mm² (Max. 120 m total)
*1	Recommended cable types	Shielded cable CVVS, CPEVS or MVVS
External input wire size		Min. 0.3 mm²
External output wire size		1.25 mm²

*1 Use a CVVS or CPEVS cable (Max. total length of 200 m) if there is a source of electrical interference near by (e.g., factory) or the total length of control wiring exceeds 120 m.
*2 When the wiring length exceeds 10 m, use wire of 1.25 mm².

<1> Schematic Diagram of a Unit and Terminal Block Arrangement

To remove the front panel of the control box, unscrew the four screws and pull the panel forward and then down.
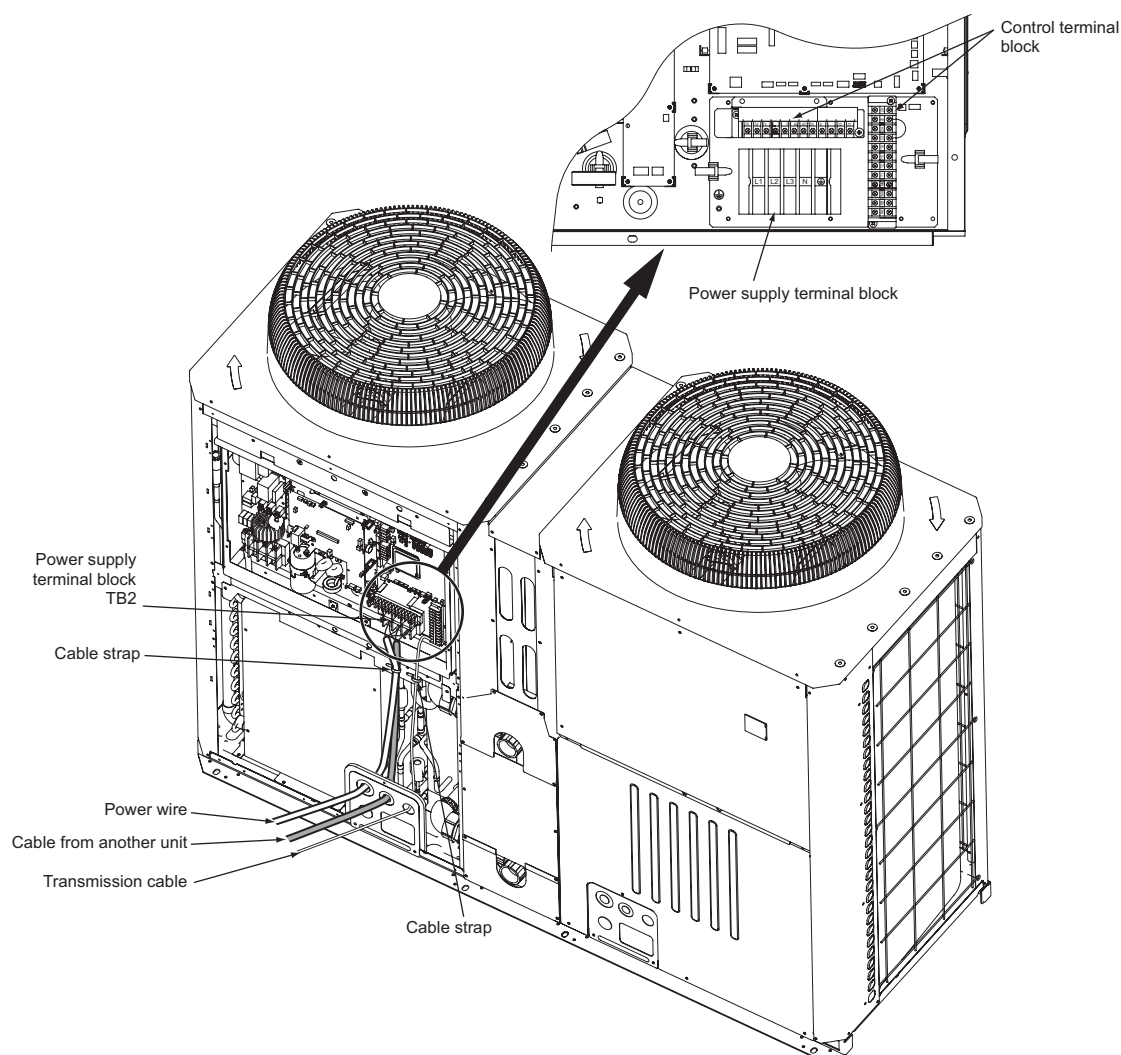
Important: Power supply cables larger than 25 mm² in diameter are not connectable to the power supply terminal block (TB2). Use a pull box to connect them.

<2> Installing the conduit tube

- Punch out the knockout hole for wire routing at the bottom of the front panel with a hammer.
- When putting wires through knockout holes without protecting them with a conduit tube, deburr the holes and protect the wires with protective tape.
- If damage from animals is a concern, use a conduit tube to narrow the opening.
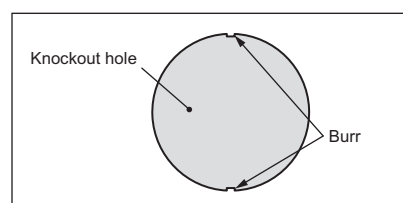
[4] Sample Installation

(1) Individual system

*Each unit is operated individually by connecting a dry contact switch/relay to each unit.
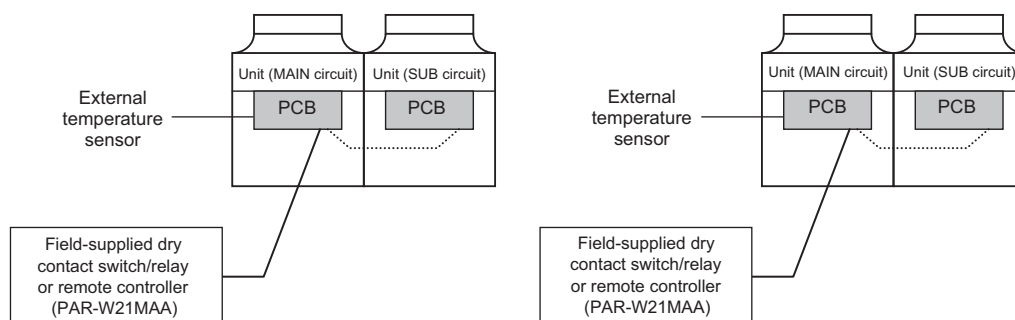
(2) Multiple system (2-16 units)

*A group of unit that consists of one main unit and up to 15 sub units is operated collectively by connecting an external water temperature sensor and a dry contact switch/relay to the main unit.
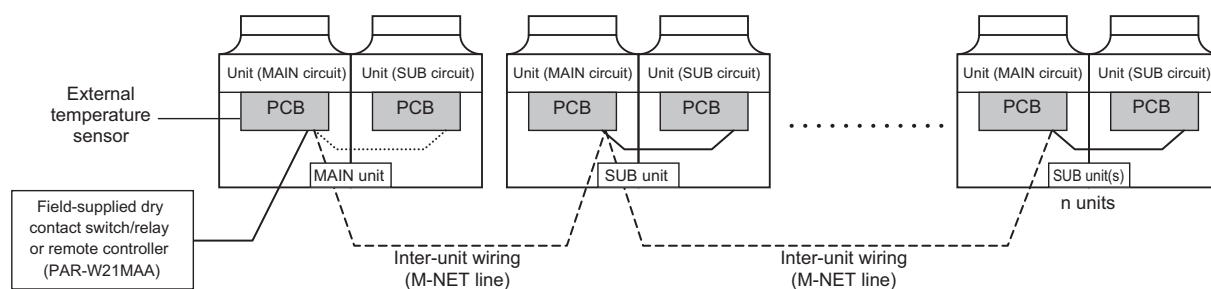
[5] Switch Types and the Factory Settings

(1) Switch names and functions
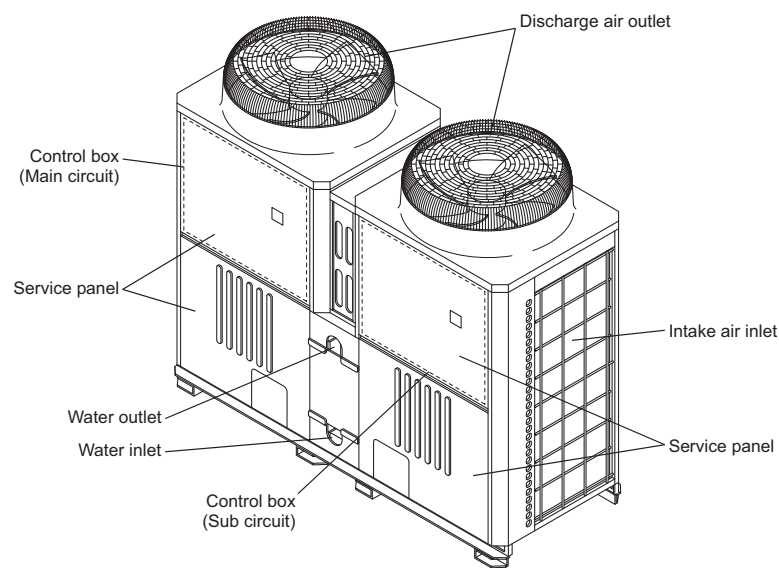
There are four main ways to set the settings as follows:
  ① Dip switches (SW1 - SW3)
  ② Dip switches used in combination with the push switches
  ③ Rotary switches
  ④ Slide switches
See below for how these switches are used to set certain items.

(2) Different types of switches on the PCB

[Entire view of a PCB]

[Enlarged view of the switches]

Rotary switch (SWU3) (0-F)

Rotary switch (SWU2) (0-9)

Rotary switch (SWU1) (0-9)

Slide switch (SWS1)
(LOCAL, OFF, and REMOTE
from the top)

Slide switch (SWS2)
(A and B from the top)

Push switch (SWP1) "UP"

Push switch (SWP2) "DOWN"

Push switch (SWP3) "ENTER"

LED display

Dip switch (SW1)

Dip switch (SW2)

Dip switch (SW3)

		Initial Setting	
		MAIN circuit	SUB circuit
Rotary switch (SWU1)	Sets the 10's digit of the unit address (Multiple system).	"0"	"5"
Rotary switch (SWU2)	Sets the 1's digit of the unit address (Multiple system).	"1"	"1"
Rotary switch (SWU3)	Starts up or resets the system (when set to F).	"0"	"0"
Slide switch (SWS1)	LOCAL OFF REMOTE The action that the switch takes when set to a certain position depends on the type of system configuration (e.g., individual or multiple system)	REMOTE	REMOTE
Slide switch (SWS2)	Unused	A	A
Push switch (SWP1)	Switches the display between the item code and the current value for a specific item. Increases value.	-	-
Push switch (SWP2)	Switches the display between the item code and the current value for a specific item. Decreases value.	-	-
Push switch (SWP3)	Advances the item code. Saves the changed value.	-	-
Dip switches (SW1-3)	Switches the LED display contents.		

Slide the dip
switches; do not
push down the
switches.
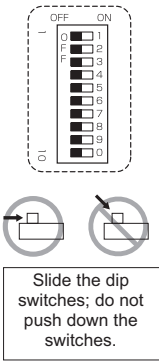
[6] Configuring the Settings

The settings must be set only by a qualified personnel.

Making the settings

Use the LED display and the three push switches (SWP1 (↑), SWP2 (↓), and SWP3 (Enter)) to change the current settings on the circuit board and to monitor various monitored values.

(1) Setting procedures

Take the following steps to set the push switches SWP1 through SWP3. These switches must be set after the dip switches SW2 and SW3 have been set.
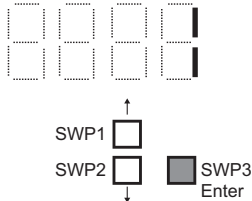
① Normally an item code appears on the display.

(The figure at left shows the case where item code 1 is displayed.) Press SWP3 (Enter) to advance the item code.

↓

Press SWP3 (Enter) until the item code appears that corresponds to the item to change or monitor its value.
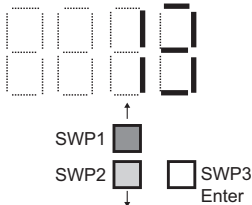
② The left figure shows a display example (Code 13 Built-in thermistor temperature setting 2).

↓

Press either SWP1 (↑) or SWP2 (↓) to display the value that corresponds to the selected item.
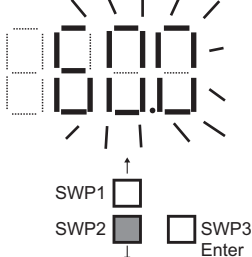
③ The current setting value will blink.

↓

The left figure shows that the current setting value is "60.0."
To decrease this value to 58.0, for example, press SWP2 (↓).
Press SWP1 (↑) to increase the value.

④ **\<To change the settings\>**
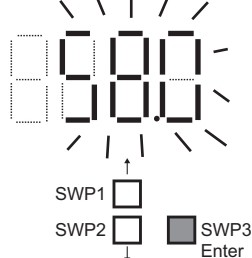
When the desired value is displayed (58.0 in the example at left), press SWP3 (Enter).

↓

The displayed value will stop blinking and stay lit.
A lit LED indicates that the new setting has been saved.

*Pressing SWP1 (↑) or SWP2 (↓) will change the blinking setting value, but the change will not be saved until SWP3 (Enter) is pressed.
If SWP3 is not pressed within one minute, the change will not be saved and the display will return to the item code display mode.
Press and hold SWP1 (↑) or SWP2 (↓) for one second or longer to fast forward through the numbers.

\<To view the monitored data\>

Press SWP3 (Enter) while the LED display is blinking (see step 3 above) to stop the blinking.

*The values of the items that can only be monitored will not change when SWP1 (↑) or SWP2 (↓) is pressed.

The display will stop blinking and stay lit after a minute, and the display will automatically return to the item code display regardless of the type of values displayed.

To change the values of other items, repeat the steps from step 2 above.

(2) Table of settings items

Set the dip switches SW2 and SW3 as shown in the table below to set the value for the items in the "Setting item" column.

SW2 and SW3 settings				Setting Item	Item Code	Default	Notes
SW2-1	SW3-8	SW3-9	SW3-10				
OFF	OFF	ON	OFF	Maximum peak-demand capacity	2	100%	
				Peak-demand control start time	3	13:00	
				Peak-demand control end time	4	13:00	
				Remote water temperature input signal type	21	0	0: 4-20 mA; 1: 0-10V; 2: 0-5 V; 3: 2-10V
				Setting temp D,E for analog input	11 13	D=45ºC, E=65ºC	When SW2-7 is set to ON
				Setting temp A (Heating mode)	11	45ºC	Range 25-70
				Setting temp B (Hot water mode)	13	65ºC	Range 25-70
				Heating ECO mode/2-point system or Curve	20	1	0: 2-point system 1: Curve
				Setting temp C1,C2,C3,C4,C5,C6 for Setting temp C for Heating ECO mode	22-25	C1=60ºC; C2=0ºC C3=35ºC; C4=25ºC C5=47.5ºC; C6=12.5ºC	
				Enable/disable schedule setting	5	0	Set to "1" to enable scheduled operation.
				ON-time 1 (schedule mode without remote)	6	0:00	
				OFF-time 1 (schedule mode without remote)	7	0:00	
				ON-time 2 (schedule mode without remote)	8	0:00	
				OFF-time 2 (schedule mode without remote)	9	0:00	
				ON-time 3 (schedule mode without remote)	18	0:00	
				OFF-time 3 (schedule mode without remote)	19	0:00	
				Current time	1		Set the current time.
				TWL1	1057	40	Water temperature 1 for emergency signal 1
				TAL1	1058	-10	Outside temperature 1 for emergency signal 1
				TWL2	1059	30	Water temperature 2 for emergency signal 2
				TAL2	1060	-15	Outside temperature 2 for emergency signal 2
				Drain pan heater/Defrost signal	1056	0	Selects between drain pan output and defrost output for MAIN circuit board (CN512 5-7) output.
				Water temperature/Capacity control	1051	0	0: Water temperature input 4-20 mA 1: Capacity control input 4-20 mA 2: Water temperature input IT terminal 3: Capacity control input IT terminal
OFF	ON	OFF	OFF	Setting temp selection 1 (ON-time 1-OFF-time 1)	1218	A (1)	A=1; B=2; C=3
				Setting temp selection 2 (ON-time 2-OFF-time 2)	1219	A (1)	A=1; B=2; C=3
				Setting temp selection 3 (ON-time 3-OFF-time 3)	1220	A (1)	A=1; B=2; C=3
				Control Sensor selection (Target Setting temp A)	1215	TH14	Selectable from TH14 or TH15
				Control Sensor selection (Target Setting temp B)	1216	TH14	Selectable from TH14 or TH15
				Control Sensor selection (Target Setting temp C)	1217	TH14	Selectable from TH14 or TH15
				Thermo differential 2	1016	2.0	Range 0-8
				Multiple System Thermo-ON/OFF prohibition periods	1020	1	Range 1-5
				Outdoor temperature input source selection	1080	0	0: Outdoor temperature sensor (TH9) 1: IT terminal

(3) System configuration procedures: Individual system

1. Set the dip switches on the MAIN circuit board.

Switch settings on the MAIN circuit

Set the dip switches (labeled A in the figure at right) that correspond to the items below, according to the local system.

- Water temperature control based on the external water temperature reading
- Water temperature control based on the inlet water temperature

Refer to "Dip switch settings table" (page 67) for further details.
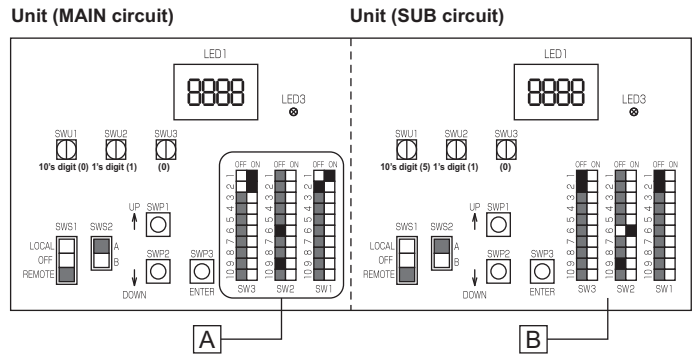
Unit (MAIN circuit) **Unit (SUB circuit)**

2. Switch on the power to the unit.

Check for loose or incorrect wiring, and then switch on the power to the unit.

When the power is switched on, the following codes will appear on the LED:

- [EEEE] will appear on LED1 in the MAIN circuit board (labeled A in the figure at right).
- [9999] will appear on LED1 in the SUB circuit board (labeled B in the figure at right).

Unit (MAIN circuit) **Unit (SUB circuit)**

3. Set the preset values with the switches on the MAIN circuit board.

(1) Press either one of the push switches SWP1, 2, or 3 (labeled A in the figure at right) on the MAIN circuit board.

   *[EEEE] will disappear, and an item code ([101]) will appear on LED1 (labeled B in the figure at right).

(2) Use SWP3 to toggle through the item codes and select an item code to change its current value. (The item codes will appear in the following order: [101]→[102]→[104]→[105]→ [107]→[101] (back to the beginning)).

(3) Use SWP1 to increase the value and SWP2 to decrease the value.

(4) Press SWP3 to save the changed value.

Following the steps above, set the value for the following items as necessary.

[101] Not used
[102] Not used
[104] Not used
[105] Not used
[107] Total number of units in the system (Default = 1) (Leave it as it is.)
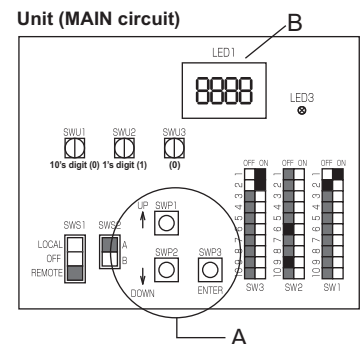
Unit (MAIN circuit)

4. Perform an initial setup. (MAIN circuit side)

(1) Set the rotary switch SWU3 (labeled A in the figure at right) to "F."
   [EEEE] will appear in LED1 (labeled B in the figure at right). *1

(2) Press and hold the push switch (SWP3) (labeled C in the figure at right) for one second or longer.
   • While the system is starting up [9999] will appear on LED1 (labeled B in the figure at right).
   • When start-up is complete, a control property [0012] will appear.
   • Then five seconds later [FFFF] will appear.

(3) Set the rotary switch SWU3 (labeled A in the figure at right) back to "0."
   The start-up process is complete, and the settings for such items as clock, peak-demand control, schedule, and thermistor settings can now be made.

Unit (MAIN circuit)

*1 If the start-up process has already been completed, [FFFF] (instead of [EEEE]) will appear when the rotary switch SWU3 is set to "F."

(4) System configuration procedures : Multiple system

1. Set the dip switches and rotary switches.
   (Switches on the MAIN circuit on the main unit* AND the MAIN and SUB circuits on all sub units)

System configuration diagram

* The main unit is the unit to which an external water temperature sensor is connected.
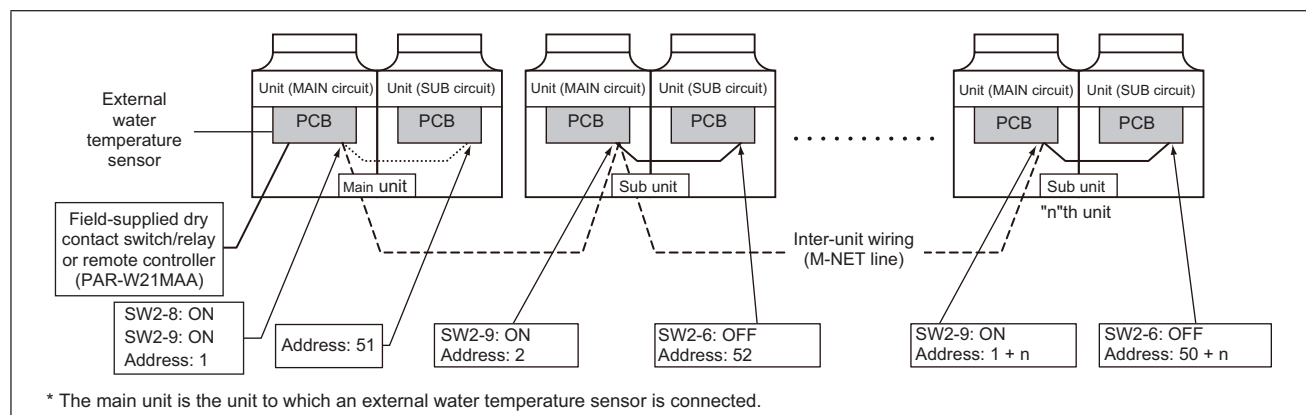
Setting the switches on the main unit

MAIN circuit

(1) Set the dip switch SW2-8 to ON. (an external water temperature sensor) (labeled A in the figure at right)

(2) Set the dip switch SW2-9 to ON. (multiple unit control)(labeled A in the figure at right)

SUB circuit

Nothing needs to be changed.

Refer to "Dip switch settings table" (page 67) for further details.
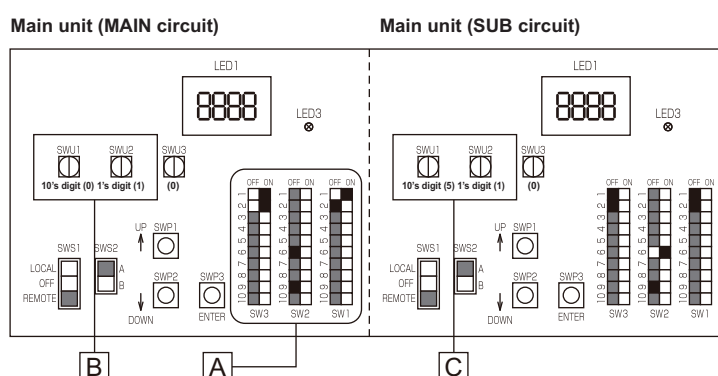
Make sure the address of the MAIN circuit on the main unit is set to "1" (labeled B in the figure above) and that the address of the SUB circuit on the main unit is set to "51" (labeled C in the figure above).

The address of each SUB circuit should equal the sum of the MAIN circuit address on the same unit and 50.

Setting the switches on all sub units

MAIN circuit

(1) Set the dip switch SW2-9 to ON. (multiple unit control) (labeled A in the figure at right)

(2) Set the MAIN circuit addresses with the rotary switches. (labeled B in the figure at right). Set the 10's digit with SWU1, and set the 1's digit with SWU2. Assign sequential addresses to the MAIN circuit on all sub units starting with 2.

SUB circuit

(3) Set the dip switch SW2-6 to OFF. (power supply to communication circuit) (labeled C in the figure at right)

(4) Set the SUB circuit addresses with the rotary switches (labeled D in the figure above). Set the 10's digit with SWU1, and set the 1's digit with SWU2. Assign sequential addresses to the SUB circuit on all sub units starting with 52.
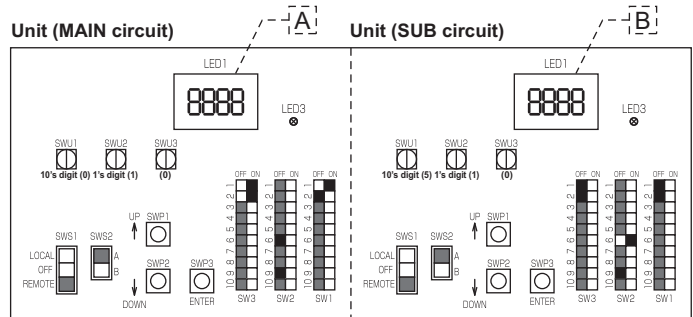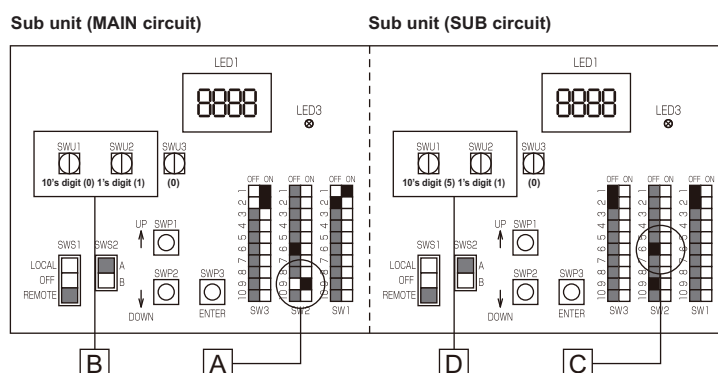
2. Switch on the power to the unit.

Check for loose or incorrect wiring, and then switch on the power to all units.

When the power is switched on, the following codes will appear on the LED:

- [EEEE] will appear on LED1 in the MAIN circuit board.
- [9999] will appear on LED1 in the SUB circuit board on the main unit and both MAIN and SUB circuits on the sub units.

Main unit (MAIN circuit)

Main unit (SUB circuit)
Sub unit (MAIN and SUB circuits)

[EEEE]

[9999]

3. Set the preset values with the switches on the MAIN circuit board.

(1) Press either one of the push switches SWP1, 2, or 3 (labeled A in the figure at right) on the MAIN circuit board.

*[EEEE] will disappear, and an item code ([101]) will appear on LED1 (labeled B in the figure at right).

(2) Use SWP3 to toggle through the item codes, and select an item code to change its current value. (The item codes will appear in the following order: [101] →[102]→[104]→[105]→[107]→[101] (back to the beginning).)

(3) Use SWP1 to increase the value and SWP2 to decrease the value.

(4) Press SWP3 to save the changed value.
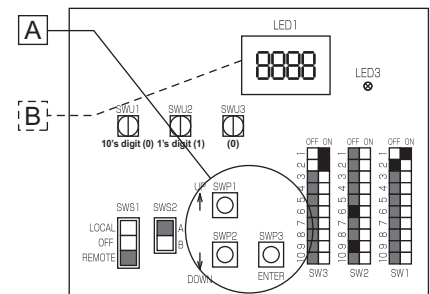
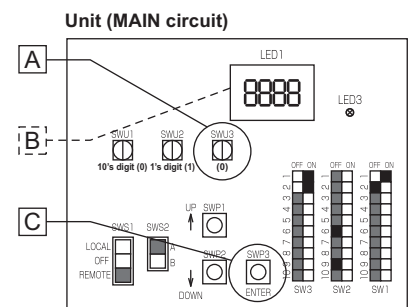Following the steps above, set the value for the following items with the switches on the MAIN circuit as necessary. Item [107] must be set when multiple units are connected to a system.

[101] Not used
[102] Not used
[104] Not used
[105] Not used
[107] Total number of the main and sub units in the system

4. Perform an initial setup on the MAIN circuit on the main unit

(1) Set the rotary switch SWU3 on the MAIN circuit on the main unit (labeled A in the figure at right) to "F."

[EEEE] will appear in LED1 (labeled B in the figure at right). *1

(2) Press and hold the push switch (SWP3) (labeled C in the figure at right) for one second or longer.

- While the system is starting up [9999] will appear on LED1 (labeled B in the figure at right).
- When start-up is complete, a control property [0012] will appear.
- Then, five seconds later, [FFFF] will appear.

(3) Set the rotary switch SWU3 (labeled A in the figure at right) back to "0." The start-up process is complete, and the settings for such items as clock, peak-demand control, schedule, and thermistor settings can now be made.

Main unit (MAIN circuit)

*1 If the start-up process has already been completed, [FFFF] (instead of [EEEE]) will appear when the rotary switch SWU3 is set to "F."

(5) Re-initializing the system

When the settings for the items below have been changed, the system will require re-initialization.
- Dip switch SW2-8 (use or non-use of an external water temperature sensor) (Re-initialization is required only for the Multiple system.)
- Dip switch SW2-9 (multiple unit control)
- Dip switch SW3-3 (water temperature control method)
- External signal input setting [107] (total number of units in the system)
- Rotary switches (SWU1 and SWU2) (unit address)

Take the following steps to re-initialize the system:

(1) Set the rotary switch SWU3 to "F."
    [FFFF] will appear in the LED1.

(2) Press and hold the push switch SWP3 for one second or longer.
- While the system is starting up [9999] will appear on LED1.
- When start-up is complete, a control property [0012] will appear.
- Then, five seconds later, [FFFF] will appear.

(3) Press and hold the push switch SWP3 again for one second or longer.
- While the system is starting up [9999] will appear on LED1.
- When start-up is complete, a control property [0012] will appear.
- Then, five seconds later, [FFFF] will appear.

(4) Set the rotary switch SWU3 back to "0."

(6) Resetting the system (MAIN and SUB circuits)

Take the following steps to reset the system. An error can also be reset by taking the steps below.
Note that the errors on the MAIN unit must be reset through the MAIN circuit, and the errors on the sub unit must be reset through the SUB circuit.
When an error on the MAIN unit is reset, all sub units will stop.

(1) Set the rotary switch SWU3 to "F."
    [FFFF] will appear in the LED1.

(2) Press and hold the push switch SWP3 for one second or longer.
- While the system is starting up [9999] will appear on LED1.
- When start-up is complete, a control property [0012] will appear.
- Then, five seconds later, [FFFF] will appear.

(3) Set the rotary switch SWU3 back to "0."

[7] Water Pipe Installation

1. Schematic Piping Diagram and Piping System Components

①	Union joints/flange joints	Required to allow for a replacement of equipment.
②	Thermometer	Required to check the performance and monitor the operation of the units.
③	Water pressure gauge	Recommended for checking the operation status.
④	Valve	Required to allow for a replacement or cleaning of the flow adjuster.
⑤	Flexible joint	Recommended to prevent the noise and vibration from the pump from being transmitted.
⑥	Drain pipe	Install the drain pipe with a downward inclination of between 1/100 and 1/200. To prevent drain water from freezing in winter, install the drain pipe as steep an angle as practically possible and minimize the straight line. For cold climate installation, take an appropriate measure (e.g., drain heater) to prevent the drain water from freezing.
⑦	Pump	Use a pump that is large enough to compensate for the total water pressure loss and supply sufficient water to the unit.
⑧	Air vent valve	Install air venting valves to the places where air can accumulate. Automatic air vent valves (such as ⑧') are effective.
⑨	Expansion tank	Install an expansion tank to accommodate expanded water and to supply water.
⑩	Water pipe	Use pipes that allow for easy air purging, and provide adequate insulation.
⑪	Drain valve	Install drain valves so that water can be drained for servicing.
⑫	Strainer	Install a strainer near the unit to keep foreign materials from entering the water-side head exchanger (supplied).
⑬	Flow switch	Required to protect the unit.

2. Notes on pipe corrosion

Water treatment and water quality control

Poor-quality circulating water can cause the water-side heat exchanger to scale up or corrode, reducing heat-exchange performance. Properly control the quality of the circulating water.

• Removing foreign objects and impurities in the pipes
  During installation, keep foreign objects, such as welding and sealant fragments and rust, out of the pipes.

• Water Quality Control

(1) Poor-quality water can corrode or scale up the heat exchanger. Regular water treatment is recommended.

Water circulation systems using open heat storage tanks are particularly prone to corrosion.

When using an open heat storage tank, install a water-to-water heat exchanger, and use a closed-loop circuit on the air-conditioner side. If a water supply tank is installed, keep contact with air to a minimum, and keep the level of dissolved oxygen in the water no higher than 1 mg/ℓ.

(2) Water quality standard

Items		Lower mid-range temperature water system Water Temp. ≤ 60ºC		Higher mid-range temperature water system Water Temp. > 60ºC		Tendency	
		Recirculating water	Make-up water	Recirculating water	Make-up water	Corrosive	Scale-forming
Standard items	pH (25°C)	7.0 ~ 8.0	7.0 ~ 8.0	7.0 ~ 8.0	7.0 ~ 8.0	○	○
	Electric conductivity (mS/m) (25°C)	30 or less	30 or less	30 or less	30 or less	○	○
	(µs/cm) (25°C)	[300 or less]	[300 or less]	[300 or less]	[300 or less]		
	Chloride ion (mg Cl$^-$/ℓ)	50 or less	50 or less	30 or less	30 or less	○	
	Sulfate ion (mg SO4^{2-}/ℓ)	50 or less	50 or less	30 or less	30 or less	○	
	Acid consumption (pH4.8) (mg CaCO$_3$/ℓ)	50 or less	50 or less	50 or less	50 or less		○
	Total hardness (mg CaCO$_3$/ℓ)	70 or less	70 or less	70 or less	70 or less		○
	Calcium hardness (mg CaCO$_3$/ℓ)	50 or less	50 or less	50 or less	50 or less		○
	Ionic silica (mg SiO$_2$/ℓ)	30 or less	30 or less	30 or less	30 or less		○
Reference items	Iron (mg Fe/ℓ)	1.0 or less	0.3 or less	1.0 or less	0.3 or less	○	○
	Copper (mg Cu/ℓ)	1.0 or less	1.0 or less	1.0 or less	1.0 or less	○	
	Sulfide ion (mg S^{2-}/ℓ)	Not to be detected	Not to be detected	Not to be detected	Not to be detected	○	
	Ammonium ion (mg NH$_4$$^+$/ℓ)	0.3 or less	0.1 or less	0.1 or less	0.1 or less	○	
	Residual chlorine (mg Cl/ℓ)	0.25 or less	0.3 or less	0.1 or less	0.3 or less	○	
	Free carbon dioxide (mg CO$_2$/ℓ)	0.4 or less	4.0 or less	0.4 or less	4.0 or less	○	
	Ryzner stability index	—	—	—	—	○	○

Reference: Guideline of Water Quality for Refrigeration and Air Conditioning Equipment. (JRA GL02E-1994)

(3) Please consult with a water quality control specialist about water quality control methods and water quality calculations before using anti-corrosive solutions for water quality management.

(4) When replacing an air conditioner (including when only the heat exchanger is replaced), first analyze the water quality and check for possible corrosion.

Corrosion can occur in water systems in which there has been no signs of corrosion. If the water quality level has dropped, adjust the water quality before replacing the unit.

(5) Suspended solids in the water

Sand, pebbles, suspended solids, and corrosion products in water can damage the heating surface of the heat exchanger and cause corrosion. Install a good quality strainer (20 mesh or better) at the inlet of the unit to filter out suspended solids.

Removing foreign substances from the water system

Consider installing a settlement tank or a bypass strainer to remove foreign substances from the water system. Select a strainer capable of handling two to three percent of the circulating water. The figure below shows a sample system with a bypass strainer.
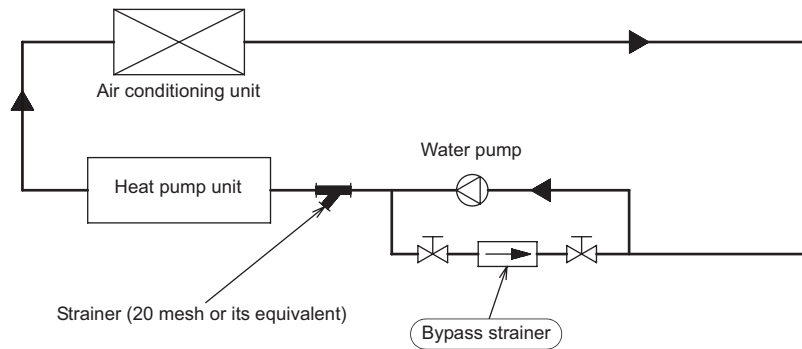
(6) Connecting pipes made from different materials

If different types of metals are placed in direct contact with each other, the contact surface will corrode. Install an insulating material between pipes that are made of different materials to keep them out of direct contact with each other.

(7) In the case that the unit is installed in higher than storage tank

Note the following. Air pockets inside of heat exchanger will cause to corrode or scale up.
(Refer to the lower diagram.)
1) Provide air vent valve at the unit outlet to let the air certainly go through.
2) Keep the height differences between the unit and storage tank within 7 m.
3) Note the following not to become negative pressure.
   a) Continuously operate the pump not to become negative pressure.
     (Reference Boiling point : -70 kPaG, 70°C)
     When the pump is not continuously operated, provide pressure holding valve to prevent air mixing.
   b) Provide vacuum valve or use sealed tank not to become negative pressure.
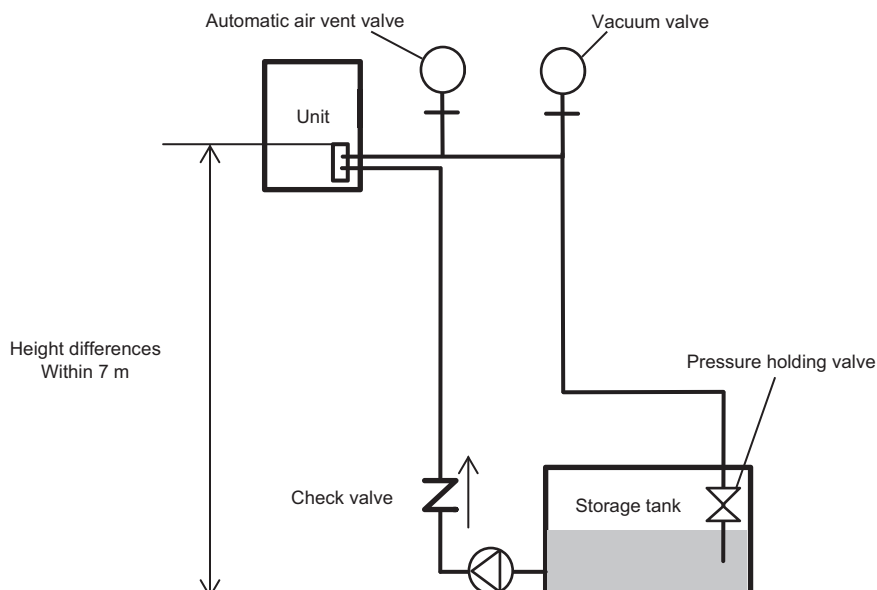
3. Installing the strainer and flow switch

(1) Installing the strainer

Install the supplied strainer on the inlet water pipe near the unit to filter out suspended solids and prevent clogging or corrosion of the heat exchanger.

Install the strainer in a way that allows for easy access for cleaning, and instruct the user to clean it regularly.

Operating the units with a clogged strainer may cause the units to make an abnormal stop.

Select a location to install a strainer, taking into consideration the installation angle, insulation thickness, and maintenance space.

* The dimensions given below indicate the amount of space necessary when screwing in a Y-shaped strainer.

<Unit: mm>

Sample installation 1

Sample installation 2
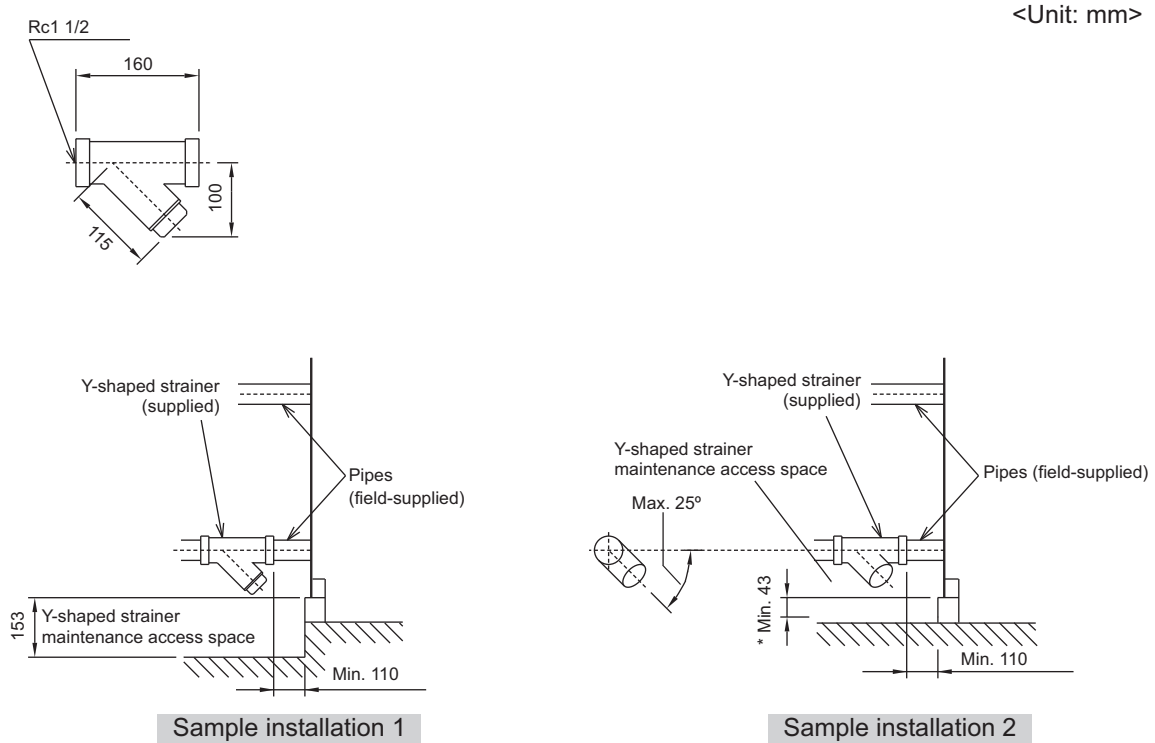
(2) Installing a flow switch

Install a flow switch that meets the following specifications on the water pipe.

Connect the flow switch to the flow switch contact on the unit.

Minimum flow rate= 7.5 m³/h (125 L/min)
Unit usage range (water flow rate): 7.5 - 15.0 m³/h

4. Water pipe hole size and location
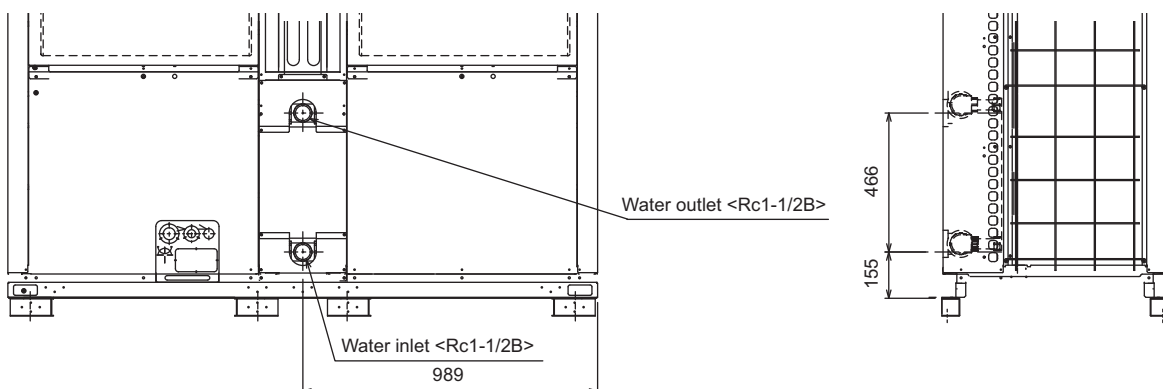
5. Minimum and maximum water flow rates

A low flow rate will not only compromise the performance of the unit but also increase the water temperature difference between the periods when the unit is in operation and when the unit is stopped. A high flow rate will cause the pipes to corrode. Adjust the circulating flow rate so that the difference between the inlet and outlet temperatures will be between 3 ºC and 5 ºC. Refer to the table below for the standard, minimum, and maximum flow rates.

Standard, Minimum, and Maximum flow rates   Unit: m³/h

	Standard flow rate (50Hz)	Minimum allowable flow rate	Maximum allowable flow rate
	Heating		
CAHV-P500YB-HPB	7.74	7.5	15.0

The flow rate will be considered appropriate if the difference between the inlet and outlet water temperatures is between 3 ºC and 5 ºC.

⬩If the temperature difference is less than 3 ºC
Decrease the flow rate.

⬩If the temperature difference is more than 5 ºC
Increase the flow rate. Check the pipes for air pockets, and make sure that the pump has enough capacity to sustain appropriate water pressure in a given water circuit.

6. Maintaining the appropriate amount of water in the water circuit.

(1) Amount of water in the water circuit

Shortage of water in the circulating water circuit may shorten the operation time of the unit or cause large fluctuations of water temperature. It also causes the unit not to operate properly during the defrost cycle. The table below shows the minimum allowable amount of water in the water circuit. If the piping length is too short to secure this amount, install a cushion tank to ensure that the circuit has enough water in it.

Model	Minimum allowable amount of water (ℓ)
CAHV-P500YB-HPB	360

(2) Calculating the amount of water in the circuit

The amount of water in the circuit can be obtained using the following formula.
Amount of water in the water circuit = Amount of water in the water piping + Amount of water in the heat source unit + and Amount of water in the load-side unit

The table below shows the amount of water in the water piping per 1 m

Amount of water in the piping

	Pipe size					
	3/4B (20A)	1B (25A)	1 1/4B (32A)	1 1/2B A(40A)	2B (50A)	1 1/2B (65A)
Internal volume per meter (ℓ/m)	0.37	0.60	0.99	1.36	2.20	3.62

The table below shows the amount of water in the heat-source unit.

Amount of water in the heat-source unit

	CAHV-P500YB-HPB
Amount of water in the heat-source unit (ℓ)	14

7. Sizes and the material types of the inlet and outlet pipes on the unit

The table below shows the sizes of the inlet and outlet pipes.

Inlet and outlet pipe sizes

	Inlet pipe	Outlet pipe
CAHV-P500YB-HPB	R1-1/2 female thread pipe <SUS304>	R1-1/2 female thread pipe <SUS304>

III Unit Components

[1] Unit Components and Refrigerant Circuit

1. Unit Components

(1) Front view

Frame assy L

Fin guard LR

Panel assy FU

Fan guard

Panel TOP

Pillar LF Pillar RF

Pillar F(L)

Pillar F(R)

Frame assy R

H screw.
WFT screw

Frame F.
Frame FB

Pillar RF

Pillar LF

Frame
assy MU

Panel
assy F

Frame
assy MB

Panel 1

Panel
assy FB

Panel assy FBL   Cover piping   Panel B

Attachment leg

Panel M

(2) Rear view

Fin guard B Frame assy B

Pillar B

Guard fixed plate

Guard fixed plate

Pillar B (L)   Pillar B (R)

(3) Fan

Upset screw

Fan

Motor

Base fan

Box nut

2. Refrigerant circuit

Receiver   Strainer   Water side HEX.   Water side HEX.   Strainer   Receiver

Heat exchanger

Four way valve

Pressure switch

Pressure sensor HP

Check joint (HP)   Thermistor (TH4)   Pressure sensor LP

Thermistor (TH1)   Check joint (LP)   Thermistor. Sensor holder (TH9)

Heat exchanger

Four way valve

Pressure sensor LP

Thermistor (TH8)   Pressure sensor HP   Thermistor (TH5)   Check joint (LP)

Pressure switch   Check joint (HP)

Linear expansion valve   Thermistor (TH16,TH12)   Strainer

Thermistor (TH16,TH12)   Linear expansion valve

Strainer

Solenoid coil

Solenoid coil   Strainer UL

Strainer UL   Check valve   Solenoid valve. Solenoid coil

Solenoid valve. Solenoid coil   Thermistor (TH11,TH13)   Solenoid valve. Solenoid coil

Solenoid valve. Solenoid coil   Compressor

Thermistor (TH2)   Rubber mount   Thermistor (TH3)   Compressor   Strainer UL   Belt heater   Check valve   Expansion valve. Solenoid coil CAM

Check valve   Strainer UL   Expansion valve. Solenoid coil CAM   Thermistor (TH6)   Rubber mount   Thermistor (TH7)   Belt heater

Strainer

[2] Control Box of the Unit

1. Main circuit control box

Rush current protection resister
Capacitor   Fan board   INV board   Control board

DC reactor
(DCL)

Electromagnetic relay
(72C)

Noise filter

Terminal block
(TB1)

Control terminal block1

Control terminal block2

Note.1

Terminal block for power supply
L1,L2,L3,N,⏚
(TB2)

2. Sub circuit control box

Rush current protection resister
Capacitor   Fan board   Control board

DC reactor
(DCL)

Electromagnetic relay
(72C)

Noise filter

Terminal block
(TB4)

Note.1

M-NET board

Note
1) Exercise caution not to damage the bottom and the front panel of the control box. Damage to these parts affect the waterproof and dust proof properties of the control box and may result in damage to its internal components.
2) Faston terminals have a locking function. Make sure the cable heads are securely locked in place. Press the tab on the terminals to remove them.

[3] Unit Circuit Board

1. Control board (MAIN board)

CNDC
Bus voltage input
① P
② N

CN2
① Serial communication signal input
⑤ GND
⑦ Output 17VDC

CN801
Pressure switch connection

CN332
① Output 18VDC
② GND(Fan board)

CN4
① GND
② Serial communication signal output

LEV driving output

CN3A
Remote controller

LED1
Digital display

LED3
Energization status

Dip switch
SW1-3

Push switch
SWP1-3

Sensor input

CN105
IT TERMINAL

Dip switch
SW421

Voltage output at the dry contact

Rotary switch
SWU1-3

Slide switch
SWS1-2

Actuator driving output

CNAC
200 VAC input
① R
② S

F01
Fuse
250V/3.15A

External signal input
(contact input)

LED2
Lit during normal
CPU operation

CN102
③-④ outdoor transmission line input/output
(30VDC)

CNS2
Transmission line input/output
for centralized control system

CNIT
① Output 12VDC
② GND
③ Output 5VDC
④ RX (Power supply detection input)
⑤ TX (Power supply ON/OFF signal output)

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2. M-NET board

3. INV board

Note

1) Before inspecting the inside of the control box, turn off the power, keep the unit off for at least 10 minutes, and confirm that the voltage between FT-P and FT-N on INV Board has dropped to DC20V or less.
It takes about 10 minutes to discharge electricity after the power supply is turned off.

4. Fan board

CN18V
① Input 18VDC
② GND

LED3
Lit during normal
CPU operation

CN4
① GND
③ Serial communication signal output

CN5
① GND(Control board)
② Serial communication signal output

CN21
① Serial communication signal output
③ GND(INV board)
④ Input 17VDC

CN22
① GND(INV board)
② Input 5VDC
③ Serial communication signal input
⑤ GND(INV board)
⑥ Output 17VDC

LED1
Inverter in normal operation
LED2
Inverter error

CNVDC
Bus voltage input
① N
④ P

CNINV
Inverter output
① W
④ V
⑦ U

R630,R631
Overcurrent detection
resistor

DIP IPM（Rear）

5. Noise Filter

CN4
Output
(Rectified L2-N current)
① P
③ N

CN2
① Surge absorber circuit
③ Surge absorber circuit
⑤ Short circuit
⑥ Short circuit

F1,F2,F3,F4
Fuse
250VAC 6.3A

Grounding

CN1A
Input
① N
③ L1

CN1B
Input
① L3
④ L2

CN5
Output
(Rectified L2-N current)
① P
③ N

Grounding

CN3
Output
① L1
③ N

TB21
Input/output(L1)

TB22
Input/output(L2)

TB23
Input/output(L3)

TB24
Input(N)

IEC/UL AC250V 6.3A T

CAUTION FOR HIGH VOLTAGE

高電圧注意

solder

30PYTST4C7
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IV Remote Controller

[1] Using the Remote Controller

<1> Starting and Stopping Operation and Changing the Operation Mode

Set Temperature buttons ③

Mode (BACK) button ②
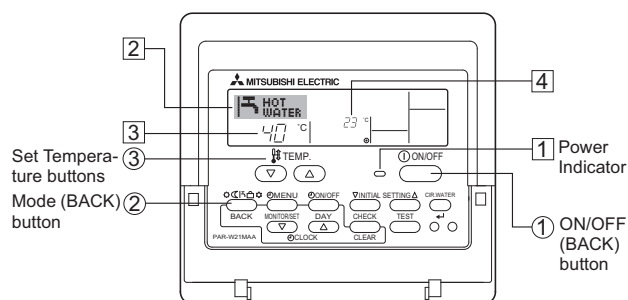
To Start Operation

1. Press the ON/OFF (BACK) button ①.

   The power indicator 1 and the display will light up.

To Stop Operation

1. Press the ON/OFF (BACK) button ① while the unit is in operation.

   The power indicator 1 and the display will light off.
   The remote controller will remember the last mode and temperature settings when turned off.

To select the Mode

1. With the power turned on, press the Mode (BACK) button ② until the desired mode appears.

   • Each press changes the operation mode in the following sequence (see notes *1 and *2 below):
   Heating→Heating ECO→Hot water→Anti-freeze→Cooling →Back to Heating.

   The currently selected mode will appear in the area labeled 2.

*1 The available modes vary depending on the model.

*2 Refer to [4]-2. (2) (page 49) for how to change the settings for a specific function.

<2> Setting the Water Temperature

The current water temperature will appear in the area labeled ③.

How to Change the Temperature Setting

1. To lower the water temperature setting
   Press the ▽ Set Temperature button ③.
2. To raise the water temperature setting
   Press the △ Set Temperature button ③.
   • Each press increases or decreases the temperature by 1 °C (1 °F).
     The current setting will appear in the area labeled ③ in the figure on the previous page.
   • The settable ranges for the "Hot Water" and "Heating" modes are as follows. *1, *2

Hot Water	Heating
25 °C - 70 °C	25 °C - 55 °C
77 °F - 158 °F *3	77 °F - 131 °F *3

Note:

*1 Available ranges vary depending on the type of unit connected.

*2 If the temperature ranges are restricted from the remote controller, the settable ranges may be narrower than shown above. If an attempt is made to set a value outside of the restricted range, the display will show a message indicating that the range is currently restricted.
For information about how to set and clear the restrictions, refer to [4]–2. (3) (page 49).

*3 Temperatures can be displayed in Celsius or Fahrenheit (factory setting: Fahrenheit). For information about how to select °C or °F , refer to [4]–4. (1) (page 49).

*4 If the target water temperature setting for the Heating mode has been set to a temperature outside of the remote controller's setting range (above 55°C) from the circuit board, any signal from the remote controller to change the temperature setting will be ignored. If this happens, disconnect the remote controller, set the target temperature to 55°C or below from the circuit board, reconnect the remote controller, and then change the temperature setting from the remote controller.

   • Water temperature can be controlled based on the inlet or outlet temperature.

   * The water temperature range that can be displayed is between 0 °C to 100 °C. Outside this range, the display flashes either 0 °C or 100 °C.

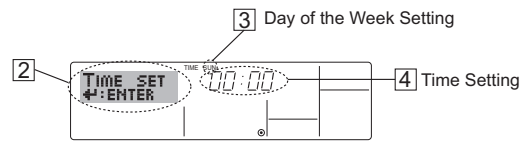## <3> Setting the Day of the Week and Time

Use this screen to set and change the current day of the week and time settings.

Note:
The day and time will not appear if the clock display is disabled from the remote controller on the Function Selection menu.

1 Day of the Week & Time display
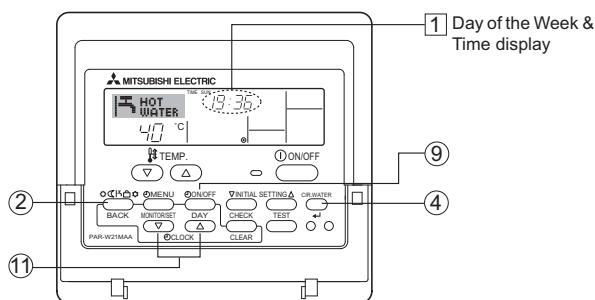
How to Set the Day of the Week and Time

3 Day of the Week Setting
4 Time Setting

1. Press the ▽ or △ Set Time button ⑪ to bring up TIME SET ↵:ENTER in the area labeled ②.

2. Press the TIMER ON/OFF (SET DAY) button ① to set the day (labeled ③ in the figure).
   * Each press advances the day.

3. Press the Set Time button ⑪ as necessary to set the time.
   * When the button is held down, the time (at ④) will increment first in one-minute intervals, then in ten-minute intervals, and then in one-hour intervals.

4. After making the appropriate settings in Steps 2 and 3, press the CIR.WATER ↵ button ④ to save the values.

Note:
The changes will be lost unless the Mode (BACK) button ② is pressed before the CIR.WATER ↵ button ④ is pressed.

5. Press the Mode (BACK) button ② to complete the setting procedure and return the display to the normal operation screen. The new day and time will appear in the area labeled ③.

<4> Using the Timer

Three types of timers are available as follows: ① Weekly timer, ② Simple timer, or ③ Auto-Off timer. The timer type can be selected from the remote controller on the Function Selection menu.
For information about how to use the Function Selection menu on the remote controller, refer to [4]–3. (3) (page 49).

Using the Weekly Timer

1. The weekly timer can be used to schedule up to six events for each day of the week.
   • Each operation event can consist of any of the following: ON/OFF time together with a temperature setting, ON/OFF time only, or temperature setting only.
   • When the timer reaches the preset time, the schedule event will take place.
2. The time can be set to the nearest minute.
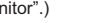
Note:

*1 The Weekly, Simple, and Auto-Off timers cannot be used concurrently.

*2 The weekly timer will not operate when any of the following conditions is met.
The timer is off; the system is in error; a test run is in progress; the remote controller is performing self-check or remote controller check; the timer, function, day, or time is being set. If the ON/OFF status and/or the temperature setting is centrally controlled, their settings cannot be changed according to a schedule that was set from the remote controller.

Operation No.
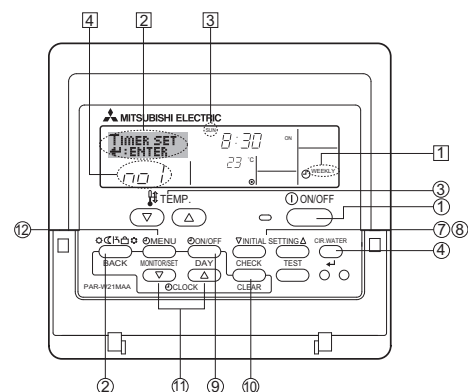
How to Set the Weekly Timer

1. On the Normal Operation screen, make sure that the weekly timer icon 1 is displayed.
2. Press the TIMER MENU button ⑫, so that the "Set Up" appears on the screen (2). (Each press toggles between "Set Up" and "Monitor".)
3. Press the TIMER ON/OFF (SET DAY) button ⑨ to set the day. Each press advances the day, which appears in the area labeled 3 .
4. Press the ▽ or △ INITIAL SETTING button (⑦ or ⑧) to select a desired operation pattern number (1 through 6) 4 .
   * (The remote-controller display on the previous page shows how the display would appear if operation #1 for Sunday were set to the values shown below.)

Setup Matrix

Op No.	Sunday	Monday	⋯	Saturday	
No. 1	• 8:30 • ON • 23 °C (73 °F)				<Operation 1 settings for Sunday> Start the unit at 8:30, with the temperature set to 23 °C (73 °F).
No. 2	• 10:00 • OFF	• 10:00 • OFF	• 10:00 • OFF	• 10:00 • OFF	<Operation 2 settings for every day> Turn off the unit at 10:00.
⋯					
No. 6					

Note:
By selecting the day to "Sun Mon Tues Wed Thurs Fri Sat", the same action can be carried out at the same time every day.
(Example: In Operation #2 above, the unit is scheduled to be turned off at 10:00 every day.)

Time setting 5   6 Selection operation (ON or OFF)
* Does not appear if actions are scheduled.

7 Temperature setting
* Does not appear if no temperature changes are scheduled.

5. Press the Set Time button ⑪ to set the time (5).
   * Time will first increment in one-minute intervals, then in ten-minute intervals, and then in one-hour intervals.
6. Press the ON/OFF button ① to select the desired operation (ON or OFF), at 6 .
   * Each press toggles through the following options:
     No display (no setting) → "ON" → "OFF"
7. Press the Set Temperature button ③ to set the temperature (7).
   * Each press:
     No display (no setting) ↔ 5 (41) ↔ 6 (43) ↔ ... ↔ 89 (192) ↔ 90 (194) ↔ No display. (Available temperature range: The temperature display range is between 5 °C (41 °F) and 90 °C (194 °F). The actual range which the temperature can be controlled will vary according to the type of the connected unit.)
8. To clear the current values for the selected operation, press and quickly release the CHECK (CLEAR) button ⑩ once.
   * The displayed time setting will change to "—:—", and the ON/OFF and temperature settings will disappear.
     (To clear all weekly timer settings at once, hold down the CHECK (CLEAR) button ⑩ for two seconds or more. The display will begin flashing, indicating that all settings have been cleared.)
9. After making the appropriate settings in Steps 5, 6. and 7, press the CIR.WATER ↵ button ④ to save the values.

Note:
The changes will not be saved unless the Mode (BACK) button ② is pressed before the CIR.WATER ↵ button ④ is pressed.
If two or more different operation patterns have been scheduled for exactly the same time, only the operation with the highest Operation No. will be carried out.

10. Repeat Steps 3 through 9 as necessary to add more settings.
11. Press the Mode (BACK) button ② to return to complete the setting procedure and return to the Normal Operation screen.
12. To activate the timer, press the TIMER ON/OFF button ⑨, so that the "Timer Off" icon (10) disappears.
   * If no timer settings have been made, the "Timer Off" icon will flash on the screen.

How to View the Weekly Timer Settings
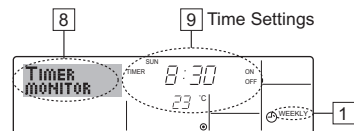
8   9 Time Settings

1. Make sure that "WEEKLY" is displayed (1).
2. Press the TIMER MENU button ⑫ so that "Monitor" appears on the screen (8).
3. Press the TIMER ON/OFF (SET DAY) button ⑨ to select the desired day.
4. Press the ▽ or △ INITIAL SETTING (⑦ or ⑧) to toggle through the settings (9).
   * Each press will advance the display to the next timer operation in order of time.
5. To close the monitor display and return to the Normal Operation screen, press the Mode (BACK) button ②.

To Turn Off the Weekly Timer

Press the TIMER ON/OFF button ⑨ so that "Timer Off" appears at 10 .
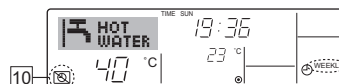
To Turn On the Weekly Timer

Press the TIMER ON/OFF button ⑨ so that the "Timer Off" icon (10) disappears.
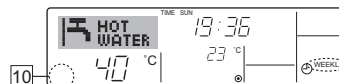
Using the Simple Timer

1. The simple timer can be set in any of the following three ways.
   • Start time only   The unit starts when the set time has elapsed.
   • Stop time only   The unit stops when the set time has elapsed.
   • Start & stop times   The unit starts and stops at the respective elapsed times.
2. The simple timer can be set to start and stop the unit only once each within a 72-hour period.
   The time setting can be made in one-hour increments.

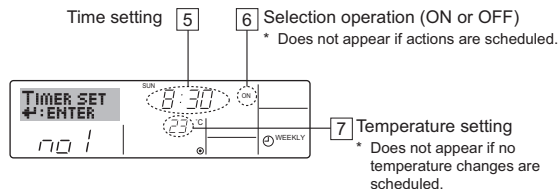**Note:**
*1 Weekly, Simple, and AUTO-off timers cannot be used concurrently.
*2 The simple timer will not operate when any of the following conditions is met. The timer is disabled; the system is in error; a test run is in progress; the remote controller is performing self-check or remote controller check; or a function or the timer is being set. If the ON/OFF status and/or the temperature setting is centrally controlled, their settings cannot be changed according to the schedule that was set from the remote controller.
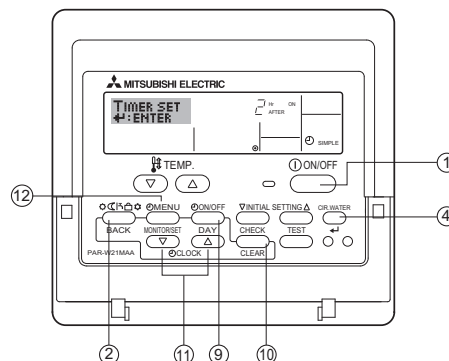
How to Set the Simple Timer
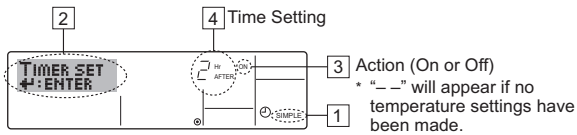
1. On the normal operation screen, make sure that the simple timer icon is displayed (1). If anything other than "SIMPLE" is displayed, select the simple timer by referring to 4.[4]-3(3) (page 49).
2. Press the TIMER MENU button ⑫, so that "Set Up" appears (2). (Each press toggles between "Set Up" and "Monitor".)
3. Press the ON/OFF button ① to display the current ON or OFF setting. Each press toggles between the time remaining until the unit turns on or off. ("ON" or "OFF" will appear in the area labeled 3.)
   • ON timer   The unit will start operation when the specified hours have elapsed.
   • OFF timer   The unit will stop operation when the specified hours have elapsed.
4. With "ON" or "OFF" displayed on the screen (3), press the Set Time button ⑪ to set the hours until the unit turns on or off (4).
   • Available Range: 1 to 72 hours
5. To set both the ON and OFF times, repeat Steps 3 and 4.
   * Note that ON and OFF times cannot be set to the same value.
6. To clear the current ON or OFF setting: Display the ON or OFF setting (see step 3) and then press the CHECK (CLEAR) button ⑩ so that "-" appears where the remaining time was. To use only the ON-timer or the OFF-timer, make sure that the time setting for the timer that will not be used is set to "-".
7. After completing steps 3 through 6 above, press the CIR.WATER ↵ button ④ to save the value.

Note:
The changes will not be saved unless the Mode (BACK) button ② is pressed before the CIR.WATER ↵ button ④ is pressed.

8. Press the Mode (BACK) button ② to return to the Normal Operation screen.
9. Press the TIMER ON/OFF button ⑨ to start the timer countdown. When the timer is running, the remaining time should appear on the screen. **Make sure that the remaining time is displayed on the screen and that it is correct.**

Viewing the Current Simple Timer Settings
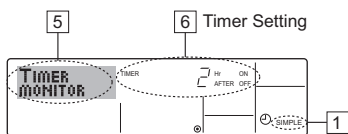
1. Make sure that "SIMPLE" is displayed (1).
2. Press the TIMER MENU button ⑫, so that "Monitor" appears on the screen (5).
   • If the ON or OFF simple timer is running, the current timer value will appear in the area labeled 6.
   • If ON and OFF values have both been set, the two values will appear alternately.
3. Press the Mode (BACK) button ② to close the monitor display and return to the Normal Operation screen.

To Turn Off the Simple Timer

Press the TIMER ON/OFF button ⑨ so that the timer setting no longer appears on the screen (at 7).
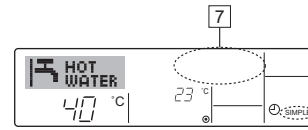
To Turn On the Simple Timer

Press the TIMER ON/OFF button ⑨ so that the timer setting appears in the area labeled 7.
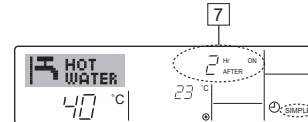
Examples
The two examples below show how the screen will appear when both the ON- and Off- timers have been set.

Example 1:
The ON-timer is set to 3 hours, and the OFF-timer is set to 7 hours.

When the timer starts	The display will show the remaining hours until the unit will turn off.
2 hours after the timer started	The display will show the remaining hours until the unit will turn on. OFF setting (7 hours) - ON setting (3 hours) = 4 hours.
7 hours after the timer started	The unit will turn off and stay off until restarted.
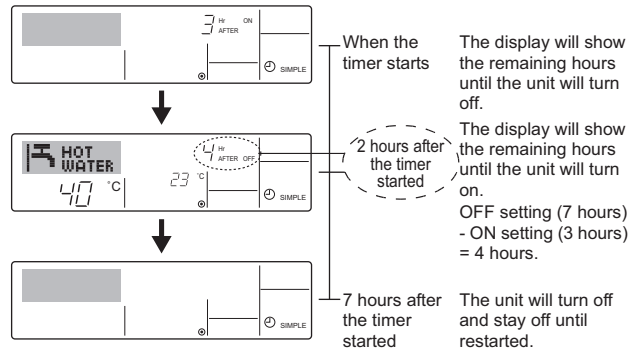
Example 2:
The ON-timer is set to 5 hours, and the OFF-timer is set to 2 hours.

When timer starts	The display will show the ramaining hours until the unit will turn off.
2 hours after the timer started	The display will show the remaining hours until the unit will turn on. ON-setting (5 hours) - OFF-setting (2 hours) = 3 hours.
5 hours after the timer started	The unit will turn on and stay on until turned off.
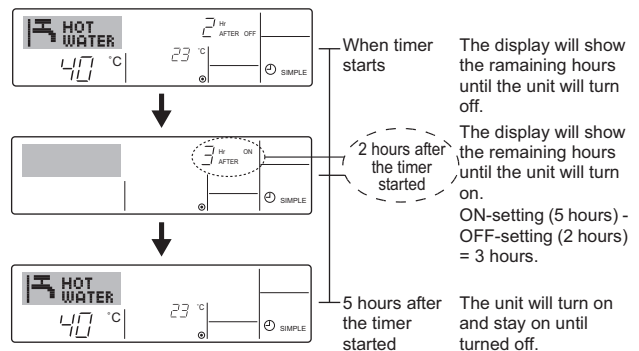
Using the Auto-Off Timer

1. This timer begins countdown when the unit starts, and shuts the unit off when the set time has elapsed.
2. Available settings range from 30 minutes to 4 hours in 30-minute intervals.

Note:

*1 Weekly Timer/Simple Timer/Auto Off Timer cannot be used at the same time.

*2 The Auto Off timer will not operate when any of the following conditions is in effect.
The timer is off; the system is in error; a test run is in progress; the remote controller is performing self-check or remote controller check; or a function or the timer is being set. If the ON/OFF status and/or the temperature setting is centrally controlled, their settings cannot be changed according to the schedule that was set from the remote controller.
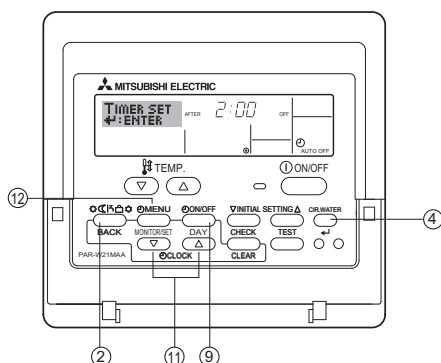
How to Set the Auto-Off TIMER
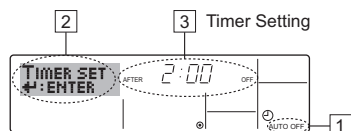
1. On the Normal Operation screen, make sure that "AUTO OFF" is displayed (1).
   If anything other than "AUTO OFF" is displayed, select the Auto-OFF timer by referring to [4]-3(3) (page 49).
2. Press and hold the TIMER MENU button 12 for **3 seconds**, so that "Set Up" appears on the screen (2).
   (Each press toggles between "Set Up" and "Monitor".)
3. Press the Set Time button 11 to set the OFF time (3).
4. Press the CIR.WATER ↵ button 4 to save the setting.

Note:
The changes will not be saved unless the Mode (BACK) button 2 is pressed before the CIR.WATER ↵ button 4 is pressed.

5. Press the Mode (BACK) button 2 to complete the setting procedure and return to the Normal Operation screen.
6. If the unit is already running, the timer will start counting down immediately.
   Make sure that the remaining time is displayed on the screen and that it is correct.

Checking the Current Auto-Off Timer Setting
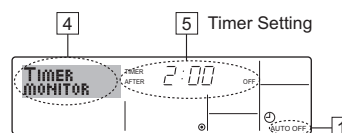
1. Make sure that "AUTO OFF" is displayed (1).
2. Press and hold the TIMER MENU button 12 for **3 seconds** so that "Monitor" appears (4).
   • The time remaining until the unit will turn off will appear in the area labeled 5.
3. To close the monitor display and return to the Normal Operation screen, press the Mode (BACK) button 2.

To Turn Off the Auto-Off Timer

• Press and hold the TIMER ON/OFF button 9 for **3 seconds** so that "Timer Off" appears (6) and the timer value (7) disappears.
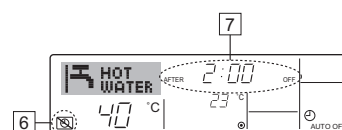
• Alternatively, turn off the unit itself. The timer value (7) will disappear from the screen.
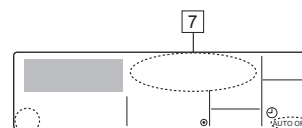
To Turn On the Auto-Off Timer

• Press and hold the TIMER ON/OFF button 9 for **3 seconds**. The "Timer Off" will disappear (6), and the timer setting will appear on the display (7).

• Alternatively, turn on the unit. The timer value will appear in the area labeled 7.
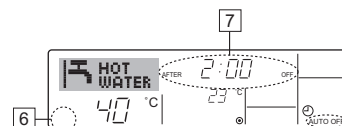
[2] Function Settings

The settings for the following remote controller functions can be changed using the remote controller function selection mode. Change the settings as necessary.

Item 1	Item 2	Item 3 (Setting content)
1. Display language setting ("CHANGE LANGUAGE")	Display language selection	• Use to select the display language from available languages.
2. Function lock settings ("FUNCTION SELECTION")	(1) Function lock ("LOCKING FUNCTION")	• Use to lock functions.
	(2) Operation mode skip setting ("SELECT MODE").	• Use to show or hide specific modes.
	(3) Temperature range limit setting ("LIMIT TEMP FUNCTION")	• Use to restrict the temperature range.
3. Basic function settings ("MODE SELEC-TION")	(1) Remote controller main/sub setting ("CONTROLLER MAIN/SUB")	• Use to designate the remote controller as Main or Sub. *When two remote controllers are connected to one group, one controller must be set to sub.
	(2) Use of clock setting ("CLOCK")	• Use to enable or disable the clock.
	(3) Timer function setting ("WEEKLY TIMER")	• Use to select a timer type.
	(4) Contact number setting ("CALL.")	• Use to show or hide, or enter the emergency contact number.
	(5) Temp offset setting ("TEMP OFF SET FUNCTION")	• Use to show or hide the offset value.
4. Display options ("DISP MODE SETTING")	(1) Temperature unit °C/°F setting ("TEMP MODE °C/°F")	• Use to show or hide the temperature unit (°C or °F).
	(2) Water temperature display setting ("WATER TEMP DISP SELECT")	• Use to show or hide the water temperature.

Function setting flowchart

[1] Stop the unit and go into the remote controller function selection mode. → [2] Select from item 1. → [3] Select from item 2. → [4] Make the setting. → [5] Return to the Normal Operation screen.
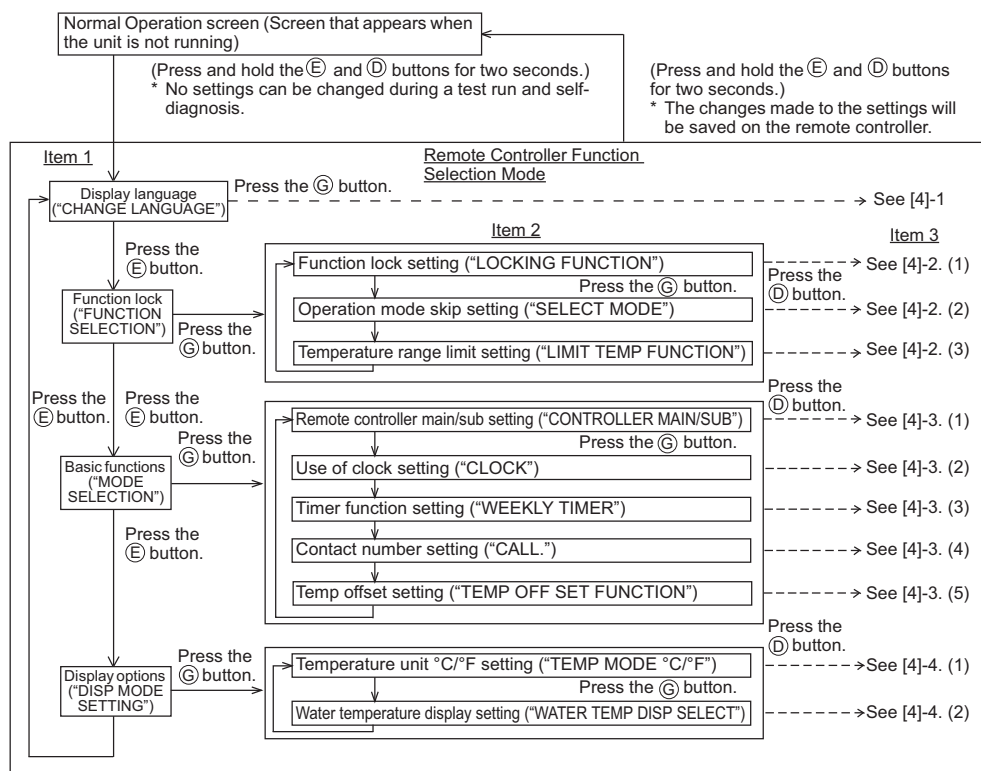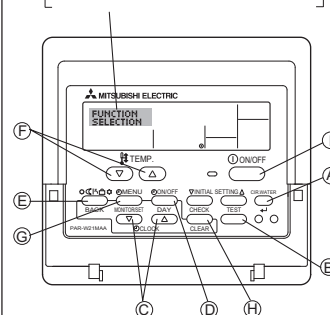
Settings details

[4]-1. Display language setting

The display language can be selected from the languages listed below.

- Press the [⏱ MENU] button to change the language.
  ①English (GB), ②German (D), ③ Spanish (E), ④ Russian (RU),
  ⑤Italian (I), ⑥ French (F),⑦ Swedish (SW)

[4]-2. Function lock settings

(1) Function lock

- Press the [⏱ ON/OFF] button to toggle through the following options.

  ① no1: All buttons except the [① ON/OFF] button will be locked.
  ② no2: All buttons will be locked.
  ③ OFF (Default): No buttons will be locked.

* Press and hold the [CIR.WATER] and [① ON/OFF] buttons simultaneously for two seconds on the Normal Operation screen to enable the button-lock function.

(2) Operation mode skip setting

The following modes can be made available for selection or can be hidden.

- Press the [⏱ ON/OFF] button to toggle through the following options.
  ① Heating mode
  ② Heating ECO mode
  ③ Hot Water mode
  ④ Anti-freeze mode
  ⑤ Cooling mode
  ⑥ OFF (Default): All modes will be available for selection.

* The mode that is not supported on the connected unit will not be available, even if the mode is available for selection on the display.

(3) Temperature range limit setting

The temperature range for the following modes can be restricted. Once the range has been restricted, the preset temperature can only be set to a value within the restricted range.

- Press the [⏱ ON/OFF] button to toggle through the following options.
  ① LIMIT TEMP HEATING MODE
  ② LIMIT TEMP HOT WATER MODE
  ③ LIMIT TEMP ANTI-FREEZE MODE
  ④ LIMIT TEMP COOLING MODE
  ⑤ OFF (Default) : The temperature ranges are not active.

- To increase or decrease the temperature, press the [🌡 TEMP. ▽ or ▵] button.
- Settable range

  Hot Water mode : Lower limit: 25 ~70 °C (77 ~158 °F)
  Upper limit: 70 ~25 °C (158 ~ 77 °F)

  Heating mode : Lower limit: 25 ~55 °C (77 ~131 °F)
  Upper limit: 55 ~25 °C (131 ~ 77 °F)

* The settable range varies depending on the type of unit to be connected.

[4]-3. Basic functions

(1) Remote controller main/sub setting

- Press the [⏱ ON/OFF] button Ⓓ to toggle between the following options.
  ① Main   The controller will be designated as the main controller.
  ② Sub   The controller will be designated as the sub controller.

(2) Use of clock setting

- Press the [⏱ ON/OFF] button Ⓓ to toggle between the following options.
  ① ON   The clock function.
  ② OFF   The clock function.

(3) Timer function setting

- Press the [⏱ ON/OFF] button Ⓓ to toggle through the following options.
  ① WEEKLY TIMER (Default)
  ② SIMPLE TIMER
  ③ AUTO OFF TIMER
  ④ TIMER MODE OFF

* When the use of clock setting is set to OFF, the "WEEKLY TIMER" cannot be used.

(4) Contact number setting

- Press the [⏱ ON/OFF] button Ⓓ to toggle through the following options.
  ① CALL OFF   The contact number will not be displayed when a problem occurs.
  ② CALL **** *** ****   The contact number will be displayed when a problem occurs.
     CALL_   Use this option to enter the contact number.

- Setting the contact number
  To set the contact number, follow the following procedures.
  Press the [🌡 TEMP. ▽ or ▵] button Ⓕ to move the cursor to the right (left). Press the [⏱ CLOCK ▽ or ▵] button Ⓒ to set the contact number.

(5) Temp offset setting

- Press the [⏱ ON/OFF] button Ⓓ to toggle between the following options.
  ① ON   The offset value will be displayed under the water temperature initial setting mode.
  ② OFF   The offset value will not be displayed.

[4]-4. Display options

(1) Temperature unit °C/°F setting

- Press the [⏱ ON/OFF] button Ⓓ to toggle between the following options.
  ① °C   Celcius
  ② °F   Fahrenheit

(2) Water temperature display setting

- Press the [⏱ ON/OFF] button Ⓓ to toggle between the following options.
  ① ON   The water temperature will be displayed.
  ② OFF   The water temperature will not be displayed.

- 50 -

Ⅴ Electrical Wiring Diagram

- 51 -

- 52 -

[1] Electrical Wiring Diagram

Note1. Single-dotted lines indicate field wiring.
Note2. Faston terminals have a locking function.
        Check that the terminals are securely locked
        in place after insertion.
        Press the tab in the middle of the terminals to
        remove them.

Note 3. The symbols used for different types of terminals are as follows:
         ○: Terminal block
         ✕: Cut the short-circuit wire, and connect field wiring
         □: Bullet terminal (field supply: male ø3.96)

Note 4. To switch between "Capacity priority" and "COP priority,"
         short-circuit wire on terminal 23 and CN142-6.

Note 5. The broken lines indicate the optional parts, field-supplied parts, and
         field work.

Note 6. Be sure to connect the wires from terminals 11 and 12 to the interlock
         contact on the pump.
         A short-circuit may cause abnormal stop or malfunctions.

Note 7. Operation signals can be received from the remote controller or through
         the dry contact. The temperature setting can be changed by a signal
         received through the dry contact or by using the schedule setting.

Note 8. Leave a space of at least 5 cm between the low voltage external wiring
         (no-voltage contact input and remote controller wiring) and wiring of 100
         V or greater. Do not place them in the same conduit tube or cabtyre
         cable as this will damage the circuit board.

Note 9. The voltage/current applied to the dry contact should not exceed 12
         VDC/5 mA.

Note 10. When cabtyre cable is used for the control cable wiring, use a separate
          cabtyre cable for the following wiring.
          Using the same cabtyre cable may cause malfunctions and damage to
          the unit.
          (a) Optional remote controller wiring
          (b) No-voltage contact input wiring
          (c) No-voltage contact output wiring
          (d) Remote water temp. setting

Note 11. Selects either Drain pan signal or Defrost signal by SW2 and SW3
          settings. (Item code 1056)

Note 12. Selects either Water temperature setting input signal or Capacity control
          input signal by SW2 and SW3 settings. (Item code 1051)

Note 13. Use a 4-20 mA signal output device with insulation.
          Feeding 30 mA or more current may damage the circuit board.

Note 1. Single-dotted lines indicate field wiring.
Note 2. Faston terminals have a locking function. Check that the terminals are securely locked in place after insertion.
Press the tab in the middle of the terminals to remove them.

Symbol explanation

	Symbol	explanation
	CH	Crankcase heater(for heating the compressor)
	CT12	Ac current sensor
	CT22	
	CT3	
	C100	Capacitor(Electrolysis)
	DCL	DC reactor
	F01	Fuse
	F02	
	F03	
	F04	
	F05	
	F06	
MAIN BOX and SUB BOX	LEV1	Electronic expansion valve(Main circuit)
	LEV2	Electronic expansion valve(Injection)
	M	Fan motor
	MS	Compressor motor
	R1	Electrical resistance
	R5	
	SV1	Solenoid valve(Injection circuit)
	SV2	Solenoid valve(Hot gas circuit)
	THHS	IGBT temperature
	Z21	Function setting connector
	21S4	4-way valve
	63HS	High pressure sensor
	63H1	High pressure switch
	63LS	Low pressure sensor
	72C	Electromagnetic relay(Inverter main circuit)
MAIN BOX	TH1~4	Thermistor
	TH9,11	
	TH14~16	
SUB BOX	TH5~8	Thermistor
	TH12,13	
Field-supplied	<ELB1,2>	Earth leakage breaker
	<F2>	Fuse
	<H20>	Emergency signal (for extra heater)
	<H21>	Drain pan heater
	<MP>	Pump motor
	<51P>	Overcurrent relay(Pump)
	<52P>	Electromagnetic contactor(Pump)

Note

1. Make sure to connect a pump interlock contact.
   A short-circuit may cause abnormal stop or malfunctions.

2. The preset temperature setting can be switched from the no-voltage contact or by setting time ranges.

3. Use a contact that takes 12VDC 5mA for no-voltage contact input.

When using a local controller, refer to the table below for the types of input/output signals that are available and the operations that correspond to the signals.

External Input/Output

Input type	Dry contact		ON (Close)	OFF (Open)	Terminal block/connector
	(a)UNIT OPERATION	Run/Stop	The unit will go into operation when the water temperature drops below the preset temperature.	The unit will stop except when the unit is in the Anti-Freeze mode.	TB6 15-16
	(b)MODE CHANGE 2	Heating Eco/Heating	The unit will go into operation when the water temperature drops below the temperature setting for "Water Temp Setting C" (Heating ECO mode)	The unit will go into operation when the water temperature drops below the temperature setting for "Water Temp Setting A." (Heating mode)	CN142A 3-4
	(c)PRIORITY MODE	COP/ Capacity	The unit will operate in the energy-efficient mode (COP priority mode).	The unit will operate at the maximum capacity setting (Capacity priority mode).	CN142C 2-6
	(d)MODE CHANGE 1	Hot water/Heating	The unit will go into operation when the water temperature drops below the temperature setting for "Water Temp Setting B."	The unit will go into operation when the water temperature drops below the temperature setting for "Water Temp Setting A." (Heating mode)	CN142D 1-5
	(e)ANTI FREEZE	On/Off	The unit will operate in the Anti-Freeze mode (with the target temperature between 25-35ºC) when the contact status of (a) "Unit Operation" is "Stop" OR the ON/OFF button on the remote controller is turned off.	The unit will operate according to the status of the "Unit Operation" contact (item (a) above) or the ON/OFF command from the remote controller.	TB6 23-24
	(f)FAN MODE	Forced/ Normal	The fan will remain in operation after the compressor has stopped (including when the OPERATION status is "STOP").	The fan will stop when the compressor stops.	TB5 19-20
	(g)FLOW SWITCH	Normal/Error	The unit is allowed to operate.	The unit will not operate.	CN142D 2-6
	(h)PUMP INTERLOCK	Normal/Error	The unit is allowed to operate.	The unit will not operate.	TB5 11-12
	(i)PEAK-DEMAND CONTROL	On/Off	The unit will operate at or below the maximum capacity level that was set for the Peak-demand control setting. (If the maximum capacity setting for item (c) above "Priority mode" is below the setting for the Peak-demand control setting, the unit will operate at whichever capacity is the smaller.)	The unit will operate at or below the maximum capacity setting for either "Capacity Priority Mode" or "COP Priority Mode" that was selected for item (c) "Priority Mode" above.	CN142C 1-4
	Analog				**Terminal block/connector**
	Input type		**Action**		
	(j)WATER TEMP SETTING/CAPACITY CONTROL		Water temperature or capacity control can be set by using the external analog input to the CN421 on the MAIN circuit board. One analog input type can be selected from the following types: 4-20 mA, 1-5 V, 0-10 V, or 2-10 V. Selection between drain pan output and defrost output can be made using the item code 1051. Note: Use a 4-20 mA signal output device with insulation.		CN421 2(+)-3(-)
	(k)EXTERNAL WATER SENSOR (optional)		-		TB6 T1-T2
	(l)EXTERNAL WATER SENSOR (optional)		-		TB6 T3-T4
Output type	Contact type		Conditions in which the contact closes (turns on)	Conditions in which the contact opens (turns off)	Terminal block/connector
	(m)ERROR INDICATOR	Close/Open	The unit has made an abnormal stop.	During normal operation	TB5 74-75
	(n)OPERATION INDICATOR	Close/Open	The "Unit Operation" contact (item (a) above) or the ON/OFF button on the remote controller is ON.	The "Unit Operation" contact (item (a) above) or the ON/OFF button on the remote controller is OFF.	TB5 72-73
	(o)PUMP OPERATION COMMAND	Close/Open	(1)When SW2-8 is set to ON The pump will operate according to the Thermo-ON/OFF status of the unit. (2)When SW2-8 is set to OFF The pump will operate according to the status of the "Unit Operation" contact or the ON/OFF button on the remote controller button.	Under all conditions other than the ones listed on the left	TB5 70-71
	(p)EMERGENCY SIGNAL	Close/Open	Water temperature has dropped below the Booster Heater Operation Water Temperature (TWL1 value) (Item code 1057) and the outside temperature (TAL1 value) (Item code 1058).	Water temperature is at or above "TWL1+2ºC" or the outside temperature is at or above "TAL1+2ºC".	MAIN circuit CN512 1-3
	(q)DRAIN PAN HEATER SIGNAL/ DEFROST SIGNAL Selects either the drain pan signal or defrost signal by Item code 1056	Close/Open	In case of the defrost signal when item code 1056 is "1", at least one of the circuits is in defrost mode.	In case of the drain pan signal when item code 1056 is "0", the outside temperature is above 1ºC or the outside temperature has risen above 3ºC after the conditions has been met under which the contact turns on. In case of the defrost signal when item code 1056 is "1", both circuits are not in defrost mode.	MAIN circuit CN512 5-7
	(r)DRAIN PAN HEATER SIGNAL	Close/Open	-	When item code 1056 is "1", the outside temperature is above 1ºC or the outside temperature has risen above 3ºC after the conditions has been met under which the contact turns on.	SUB circuit CN512 5-7
	(s)EMERGENCY SIGNAL 2	Close/Open	Water temperature has dropped below the Booster Heater Operation Water Temperature (TWL2 value) (Item code 1059) or the outside temperature (TAL2 value) (Item code 1060)	Water temperature is at or above "TWL2+2ºC" or the outside temperature is at or above "TAL2+2ºC".	SUB circuit CN512 1-3
RC/M-NET	REMOTE CONTROLLER	PAR-W21MAA			TB6 RA-RB
	M-NET		-		TB6 MA-MB

TB6

24	ANTI FREEZE ON/OFF
23	
16	UNIT OPERATION RUN/STOP
15	
T4	External Water Temperature Sensor (optional) TH15
T3	
T2	External Water Temperature Sensor (optional) TH14
T1	
MB	M-NET
MA	
RA	REMOTE CONTROLLER
RB	

TB5

75 74 73 72 71 70 66 62 20 19 12 11

L1 L2 L3 N ⏚

PUMP INTERLOCK Normal/Error

FAN MODE FORCED/NORMAL

230 V VOLTAGE

PUMP OPERATION COMMAND

OPERATION INDICATOR

ERROR INDICATOR

VI Refrigerant Circuit
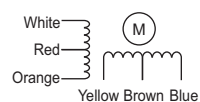
[1] Refrigerant Circuit Diagram

Note 1: Each unit has two circuits like the one in the diagram below.

← Refrigerant flow direction (during heating)
⇐ Refrigerant flow direction (during defrost)

Table of symbols and circuit components

Symbol		Component
MAIN circuit	SUB circuit	
LEV1	LEV1	Linear expansion valve (Main circuit)
LEV2	LEV2	Linear expansion valve (Injection)
63HS	63HS	High-pressure sensor
63LS	63LS	Low-pressure sensor
SV1	SV1	Solenoid valve (Injection circuit)
SV2	SV2	Solenoid valve (Hot gas circuit)
21S4	21S4	4-way valve
63H1	63H1	High-pressure switch
TH9	—	Outside temperature sensor
TH16	TH12	Inlet water temperature sensor
TH11	TH13	Outlet water temperature sensor
TH1	TH5	Compressor discharge temperature sensor
TH2	TH6	Compressor suction temperature sensor
TH4	TH8	Air-side heat exchanger inlet refrigerant temperature sensor
TH3	TH7	Compressor shell temperature

[2] Principal Parts and Functions

Outdoor unit

Part name	Symbols (functions)	Notes	Usage	Specifications	Check method
Compressor	MS (Comp)		Adjusts the amount of circulating refrigerant by adjusting the operating frequency based on the operating pressure data	Low-pressure shell scroll compressor Wirewound resistance 20°C[68°F] : 0.092 ohm	
High pressure sensor	63HS		1) Detects high pressure 2) Regulates frequency and provides high-pressure protection	63HS Connector Pressure 0~3.85 MPa Vout 0.5~3.3V 0.071V/0.098 MPa Pressure [MPa] =1.38 x Vout [V]-0.69 Pressure =(1.38 x Vout [V] - 0.69) x 145 1 GND (Black) 2 Vout (White) 3 Vcc (DC5V) (Red)	
Low pressure sensor	63LS		1) Detects low pressure 2) Provides low-pressure protection	63LS Connector Pressure 0~1.7 MPa Vout 0.5~3.5V 0.173V/0.098 MPa Pressure [MPa] =0.566 x Vout [V] - 0.283 Pressure =(0.566 x Vout [V] - 0.283) x 145 1 GND (Black) 2 Vout (White) 3 Vcc (DC5V) (Red)	
Pressure switch	63H1		1) Detects high pressure 2) Provides high-pressure protection	3.85MPa OFF setting	
Thermistor	TH4 (Discharge)		1) Detects discharge air temperature 2) Provides high-pressure protection 0°C[32°F] :698kohm 10°C[50°F] :413kohm 20°C[68°F] :250kohm 30°C[86°F] :160kohm 40°C[104°F] :104kohm 50°C[122°F] : 70kohm 60°C[140°F] : 48kohm 70°C[158°F] : 34kohm 80°C[176°F] : 24kohm 90°C[194°F] :17.5kohm 100°C[212°F] :13.0kohm 110°C[230°F] : 9.8kohm	Degrees Celsius R_{120} = 7.465kΩ $R_{25/120}$ = 4057 $R_t =$ $7.465\exp\{4057(\frac{1}{273+t} - \frac{1}{393})\}$	Resistance check

Part name	Symbols (functions)	Notes	Usage	Specifications	Check method
Thermistor	TH3 (Pipe temperature)		Controls defrosting during heating operation	Degrees Celsius $R_0 = 15k\Omega$ $R_{0/80} = 3385$ $R_t = 15\exp\{3385\,(\frac{1}{273+t} - \frac{1}{273})\}$ 0°C[32°F] :15kohm 10°C[50°F] :9.7kohm 20°C[68°F] :6.5kohm 25°C[77°F] :5.3kohm 30°C[86°F] :4.4kohm 40°C[104°F] :3.0kohm	Resistance check
	TH7 (Outdoor temperature)		1) Detects outdoor air temperature 2) Controls fan operation		
	TH5		Fan operated on the 63LS and TH5 values.		
	TH6		Controls defrosting during heating operation		
	THHS Inverter heat sink temperature		Controls inverter cooling fan based on THHS temperature	Degrees Celsius $R_{50} = 17k\Omega$ $R_{25/120} = 4016$ $R_t = 17\exp\{4016\,(\frac{1}{273+t} - \frac{1}{323})\}$ 0°C[32°F] :161kohm 10°C[50°F] :97kohm 20°C[68°F] :60kohm 25°C[77°F] :48kohm 30°C[86°F] :39kohm 40°C[104°F] :25kohm	
Solenoid valve	SV1 INJ control		Turns on/off the injection	AC220 - 240V Open while being powered/closed while not being powered	Continuity check with a tester
	SV2 Heat exchanger capacity control		Controls defrost cycle	AC220 - 240V Open while being powered/closed while not being powered	
Heater	CH		Heats the refrigerant in the compressor	Cord heater ohm 45W	Resistance check
4-way valve	21S4		Changeover between heating and defrost	AC220-240V Dead: defrost cycle Live: heating cycle	Continuity check with a tester
Fan motor	FAN motor		Regulates the heat exchanger capacity by adjusting the operating frequency and operating the propeller fan based on the operating pressure.	AC342V, 50.5Hz, 920W	
Linear expansion valve	LEV2 (INJ control)		Adjusts the amount of bypass flow from the liquid pipe on the outdoor unit during heating	DC12V Opening of a valve driven by a stepping motor 0-480 pulses (direct driven type)	Refer to the section "Continuity Test with a Tester". Continuity between white, brown, and orange. Continuity between yellow, red, and blue.
	LEV1a LEV1b (Refrigerant flow adjustment)		Adjusts refrigerant flow during heating	DC12V Opening of a valve driven by a stepping motor 2000 pulses	Refer to the section "Continuity Test with a Tester". Continuity between white, red, and orange. Continuity between yellow, brown, and blue. White ⌐ Red ⌐ (M) Orange ⌐ Yellow Brown Blue

VII Control

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[1] Functions and Factory Settings of the Dip switches

1. Factory Switch Settings (Dip switch settings table)

SW		Function	Usage	Factory setting MAIN circuit	Factory setting SUB circuit	OFF setting	ON setting	Setting timing
SW1	1	Model setting		Depends on the unit	-	Leave the setting as it is.		At a reset
	2							
	3							
	4							
	5							
	6							
	7	Fan output mode	Selects ON or OFF depending on the external static pressure.	OFF	OFF	When the external static pressure drops below 10Pa, select OFF.	When the external static pressure exceeds 10Pa, select ON. (The fan output increases.)	At a reset
	8	Model setting		Depends on the unit	-	Leave the setting as it is.		At a reset
	9							
	10	Model setting		OFF	-	Leave the setting as it is.		At a reset
SW2	1	Freeze-up protection setting		OFF	-	Starts the pump when both the outside and water temperatures drop to prevent water pipe freeze up.	Same as when set to OFF	At a reset
	2	Scheduled operation display	Turns on and off the remote display during scheduled operation.	OFF	-	Leaves the operation display on during the period in which the unit is scheduled to be stopped.	Turns off the operation display during the period in which the unit is scheduled to be stopped.	At a reset
	3	Model setting		OFF	-	Leave the setting as it is.		At a reset
	4	Model setting		OFF	OFF	Leave the setting as it is.		At a reset
	5	Recovery conditions after forced stoppage	Selects what the operation restoration condition will be based on after the unit was forced to stop based on the external thermistor reading (water outlet temperature).	OFF	-	External thermistor	Built-in thermistor	At a reset
	6	Power supply option to the communication circuit	Switches between supplying or not supplying power to the communication circuit.	-	ON	Does not supply power to the communication circuit.	Supplies power to the communication circuit.	Any time
	7	Remote water-temperature setting	Allows or disallows the water temperature to be set using analog signals from a remote location.	OFF	-	Disallows the water temperature to be set using external analog signals.	Allows the water temperature to be set using external analog signals.	At a reset
	8	Water-temperature control option	Selects either the external water temperature sensor or the built-in sensor to be used to control water temperature.	OFF	-	Built-in sensor on the unit	External water temperature sensor	At a reset
	9	Individual/Multiple system	Selects between individual and Multiple system	OFF	-	Individual system	Multiple system	At a reset
	10	Display mode switch 7	This switch is used in combination with dip switches SW3-5 through 3-10 and push switches SWP 1, 2, and 3 to configure or view the settings when performing a test run or changing the system configuration.	OFF	OFF	Changes the 7-segment LED display mode.		Any time
SW3	1	Remote reset	Enables or disables the error to be reset from a remote location.	ON	-	Disables the error to be reset from a remote location.	Enables the error to be reset from a remote location.	At a reset
	2	Auto restart after power failure	Enables or disables the automatic restoration of operation after power failure (in the same mode as the unit was in before a power failure).	ON	-	An alarm will be issued when power is restored after a power outage. The alarm will be reset when the power is turned off and then turned back on.	Automatically restores operation after power failure.	At a reset
	3	Water-temperature control	Switches between inlet-water-temperature-based control and outlet-water-temperature-based control.	OFF	-	Outlet-water-temperature-based control	Inlet-water-temperature-based control	At a reset
	4	Pump-thermistor interlock setting	Interlocks or does not interlock the operation of the pump with the external thermistor. (Effective only when SW2-8 is set to ON.)	OFF	-	The pump turns on when the operation switch is turned on regardless of the Thermo-ON/Thermo-OFF status.	Interlocks the operation of the pump with the Thermo-ON/Thermo-OFF status.	At a reset
	5	Display mode switch 1	These switches are used in combination with dip switches SW2-5 and push switches SWP 1, 2, and 3 to configure or view the settings when performing a test run or changing the system configuration.	OFF	OFF	Changes the 7-segment LED display mode.		Any time
	6	Display mode switch 2		OFF	OFF	Changes the 7-segment LED display mode.		Any time
	7	Display mode switch 3		OFF	OFF	Changes the 7-segment LED display mode.		Any time
	8	Display mode switch 4		OFF	OFF	Changes the 7-segment LED display mode.		Any time
	9	Display mode switch 5		OFF	OFF	Changes the 7-segment LED display mode.		Any time
	10	Display mode switch 6		OFF	OFF	Changes the 7-segment LED display mode.		Any time

"-" in the table indicates that the function in the corresponding row will be disabled regardless of the actual switch setting.
The factory setting for these items is OFF.
Refer to page 24 for how to reset errors.

2. Slide switch (SWS1) settings

Individual system

SWS1 Setting		Unit Operation	
MAIN circuit	SUB circuit	MAIN circuit	SUB circuit
LOCAL	LOCAL	Follows the input signal of the MAIN circuit	Follows the input signal of the sub circuit
	OFF		Ignores the signal input
	REMOTE		Follows the input signal of the sub circuit
OFF	LOCAL	Ignores the signal input	Ignores the signal input
	OFF		
	REMOTE		
REMOTE	LOCAL	Follows the input signal fed through a dry contact interface	Follows the input signal of the MAIN circuit
	OFF		Ignores the signal input
	REMOTE		Follows the input signal of the MAIN circuit

Multiple system (SWS1 in the SUB circuit on both the main and sub units will be ineffective.)

SWS1 Setting		Unit Operation			
Main unit MAIN circuit	Sub unit MAIN circuit	Main unit MAIN circuit	Main unit SUB circuit	Sub unit MAIN circuit	Sub unit SUB circuit
LOCAL	LOCAL	Follows the input signal of the MAIN circuit on the Main unit	Follows the input signal of the MAIN circuit on the Main unit	Follows the input signal of the MAIN circuit on the Sub unit	Follows the input signal of the MAIN circuit on the Sub unit
	OFF			Ignores the signal input	
	REMOTE			Follows the input signal of the MAIN circuit on the Sub unit	
OFF	LOCAL	Ignores the signal input		Ignores the signal input	
	OFF				
	REMOTE				
REMOTE	LOCAL	Follows the input signal fed through a dry contact interface		Follows the input signal of the MAIN circuit on the Main unit	
	OFF			Ignores the signal input	
	REMOTE			Follows the input signal of the MAIN circuit on the Main unit	

Priority order of the water-temperature-setting-input-signal sources

Water temperature can be controlled by using the signals from the four types of input sources listed below. The setting for the item with higher priority will override the settings for the items with lower priorities. The water temperature will be controlled according to the temperature setting in the "Target water temperature" column that corresponds to a specific combination of the settings for the four items.

Priority 1	Priority 2	Priority 3		Priority 4			Target water temperature	Sensor that becomes active (when SW2-8 is set to ON)(*1)
Analog input	Main board on the unit	Dry contact input		Centralized controller AG-150A Remote controller PAR-W21MAA				
	Schedule setting	Mode Change 1	Mode Change 2	No remote controller	Manual setting	Schedule setting		
SW2-7: ON	Ineffective	Ineffective	Ineffective	-	Ineffective	Ineffective	Temperature setting for the analog signal input	TH14
SW2-7: OFF	When schedule has been set	Ineffective	Ineffective	-	Ineffective	Ineffective	Selectable from temperature settings A through C	Selectable from TH14 or TH15
	When no schedule has been set	ON (Heating Eco)	ON (Hot water)	-	Ineffective	Ineffective	Temperature setting B (Hot water mode)	Selectable from TH14 or TH15
		ON (Heating Eco)	OFF (Heating)	-	Ineffective	Ineffective	Temperature setting C (Heating Eco mode)	Selectable from TH14 or TH15
		OFF (Heating)	ON (Hot water)	-	Ineffective	Ineffective	Temperature setting B (Hot water mode)	Selectable from TH14 or TH15
		OFF (Heating)	OFF (Heating)	When no RC is used	-	-	Temperature setting A (Heating mode)	Selectable from TH14 or TH15
				-	Hot water mode	-	Temperature setting B (Hot water mode)	Selectable from TH14 or TH15
				-	Heating ECO mode	-	Temperature setting C (Heating Eco mode)	Selectable from TH14 or TH15
				-	Heating	-	Temperature setting A (Heating mode)	Selectable from TH14 or TH15
				-	-	When schedule has been set	Target water temp is controlled according to the setting on the remote controller.	TH14

*1 If SW2-8 is set to OFF, water temperature will be controlled by the built-in thermistors TH11~13 and TH16 on the unit.

Water-temperature setting

Different water temperature settings can be set for different modes. Use item codes 11, 13, 22, 23, 24, 25, 26, or 27 to set the water temperatures.

(1) Setting procedures

Set the dip switches on the circuit board as follows before making the settings for the items described in this section.

Step 0 Set the ON/OFF switch (SWS1) to OFF.	Set SWS1 to OFF from the remote controller or with the local switch. Most settings (other than item codes 11 and 13 (water temperature setting)) cannot be changed unless the ON/OFF setting is set to OFF. *

> * Settings can be changed from the optional remote controller, regardless of the ON/OFF status of the operation switch.

Step 1

Outdoor temperature input source selection

SW2	SW3					
-10	5	6	7	8	9	10
OFF	OFF	OFF	OFF	ON	OFF	OFF

Items that can be set	Item code	Initial value	Unit	Setting			Note	Setting change from an optional remote controller
				Increments	Lower limit	Upper limit		
Outdoor temperature input source selection	1080	0		1	0	1		Not possible

0: Outdoor temperature sensor (TH9)
1: IT terminal

Step 2

Set the dip switches SW2 and SW3.

SW2	SW3					
-10	5	6	7	8	9	10
OFF	OFF	OFF	OFF	OFF	ON	OFF

Step 3

Select the desired item with the push switch SWP3.

Item codes 11, 13, 22, 23, 24, 25, 26, and 27 relate to water-temperature setting.
Press the push switch SWP3 to select an item code.
Press the push switches SWP1 and SWP2 to change the value of the selected item.
The value will keep blinking while it is being changed.

Step 4

Press the push switches SWP1 (↑) or SWP2 (↓) to increase or decrease the value.

Settings table

Settable item	Item code	Initial value	
Heating ECO mode/ 2-point system or Curve	20	1	2-point system: 0 Curve: 1

Items that can be set	Item code	Initial value	Unit	Setting			Setting change from an optional remote controller (PAR-W21MAA)
				Increments	Lower limit	Upper limit	
Water temp. setting A (Heating mode)	11	45	°C	0.1°C	25	70	Possible
Water temp. setting B *1 (Hot water mode)	13	65	°C	0.1°C	25	70	Possible
Heating ECO mode/ Water temp. setting C1 *2	22	60	°C	0.1°C	25	70	Not possible
Heating ECO mode/ Outside temp. setting C2 *2	23	0	°C	0.1°C	-20	50	Not possible
Heating ECO mode/ Water temp. setting C3 *2	24	35	°C	0.1°C	25	70	Not possible
Heating ECO mode/ Outside temp. setting C4 *2	25	25	°C	0.1°C	-20	50	Not possible
Heating ECO mode/ Water temp. setting C5	26	47.5	°C	0.1°C	25	70	Not possible
Heating ECO mode/ Outside temp. setting C6	27	12.5	°C	0.1°C	-20	50	Not possible
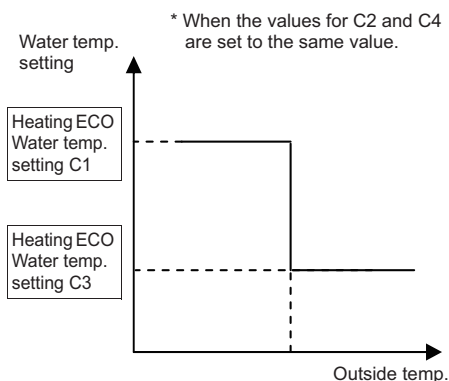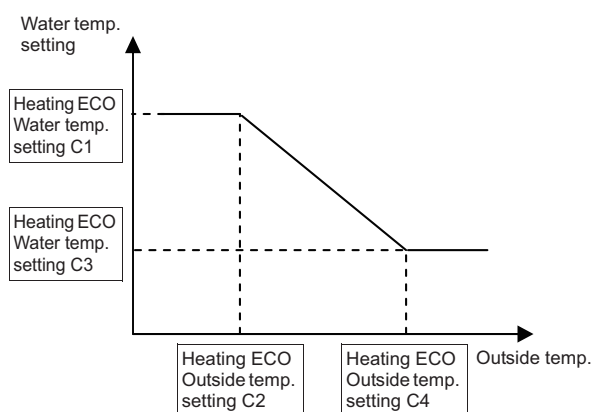
* When the values for C2 and C4 are set to the same value.

Heating ECO (Curve)
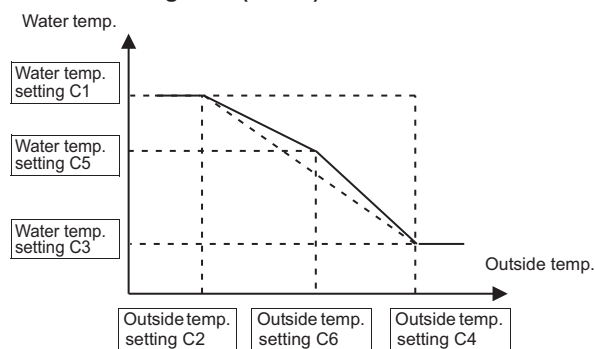
*   Always use a value for setting C6 that is between setting values C2 and C4, and for setting C5 that is between setting values C1 and C3.

*1 These items need not be set when only a single water temperature setting is used.
When a signal through a dry contact is used to switch between the three modes, the water temperature setting is selected as follows.

*2 The setting ranges for the water temperature setting A, B, C1, C3, and C5 are shown in the table below.

Water-temperature control	Lower limit	Upper limit
Outlet-water-temperature-based control	25.0°C	70.0°C
Inlet-water-temperature-based control	25.0°C	65.0°C

* When the outside temperature is -5ºC or below and the water temperature is set as follows, the unit may operate at a higher preset temperature than the preset temperature: Outlet temperature 35ºC/Inlet temperature 30ºC.

Step 5 Press the push switch SWP3 to save the change.	Press SWP3 once within one minute of changing the setting with SWP1 or SWP2 to save the setting. Once the new setting is saved, the display will stop blinking and stay lit. The display will, then, return to the item code display mode. If SWP3 is not pressed within one minute, the change will not be saved and the display will return to the item code display mode.

(2) Scheduled operation

Up to three sets of start/end times can be assigned for each day.

To operate the units according to the schedule, set the item code 5 to "1", and set the time for item codes 1, 6 through 9, 18 and 19.

Note	The operation schedule function will operate only when SWS1 is set to "REMOTE."

Setting procedures

Step 0 Set the ON/OFF switch (SWS1) to OFF.	Set SWS1 to OFF from the remote controller or with the local switch. Settings cannot be changed unless the ON/OFF setting is set to OFF.

Step 1 Set the dip switches SW2 and SW3.	Set the dip switches on the circuit board as follows before making the settings for the items described in this section.

SW2	SW3					
-10	5	6	7	8	9	10
OFF	OFF	OFF	OFF	OFF	ON	OFF

Step 2 Select the desired item with the push switch SWP3.	Item codes 1, 5 through 9, 18, and 19 relate to scheduled operation setting. Set the item code to 1, and set the time for each of the relevant items. Press the push switch SWP3 to select an item code. Use the push switches SWP1 and SWP2 to change the value of the selected item. The value will keep blinking while it is being changed.

Step 3 Press the push switches SWP1 (↑) or SWP2 (↓) to increase or decrease the value.	**Settings table**

Settable item	Item code	Initial value	Unit	Limits and increments		
				Increments	Lower limit	Upper limit
Current time	1	0000	Hour: minute	1 minute	0000	2359
Enable or disable scheduled operation (ON/OFF)	5	0	Enable: 1 Disable: 0	1	0	1
Operation start time 1	6	0000	Hour: minute	1 minute	0000	2359
Operation end time 1	7	0000	Hour: minute	1 minute	0000	2359
Operation start time 2	8	0000	Hour: minute	1 minute	0000	2359
Operation end time 2	9	0000	Hour: minute	1 minute	0000	2359
Operation start time 3	18	0000	Hour: minute	1 minute	0000	2359
Operation end time 3	19	0000	Hour: minute	1 minute	0000	2359

Step 4 Press the push switch SWP3 to save the change.	Press SWP3 once within one minute of changing the setting with SWP1 or SWP2 to save the setting. Once the new setting is saved, the display will stop blinking and stay lit. The display will, then, return to the item code display mode. If SWP3 is not pressed within one minute, the change will not be saved and the display will return to the item code display mode.

Note	A mode (preset temperatures) can be selected for each operation time period. See the next page for how to make the settings.

Note	If Code 5 is set to "1," lock the remote controller's schedule function.

[When the operation Start/End times do not overlap]

Operation Period 1

Operation Period 2

Operation Period 3

Target water temp.　　Item code 1219 setting　　Item code 1220 setting　　Item code 1218 setting

Operation command signal　　ON　　ON　　ON

If "Start time1 - End time 1", "Start time 2 - End time 2", "Start time 3 - End time 3" overlap, the settings for the period with a larger number will be ineffective.

[When operation period 1 and 2 overlap]

Operation Period 1

Operation Period 2

Operation Period 3

Set temp.　　Item code 1218 setting　　Item code 1220 setting

Operation command signal　　ON　　ON
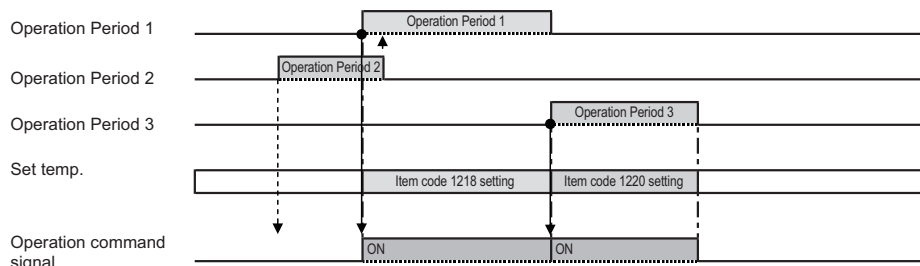
If two or more operation periods overlap, the settings for the period with a larger number will be ineffective.
If Start time 1 and start time 3 are set to the same value, the setting for Start time 3 will be ineffective.
Set the setting for Start time 3 to a time at least one minute after End time 1.
(Once the compressor stops when End time 1 comes, the 3-minute restart delay function will keep the compressor from restarting for three minutes. Because of this, even if Start 3 time is set to a time within three minutes after End time 1, the compressor will not start right away.)

[When operation periods 1 and 3 overlap]
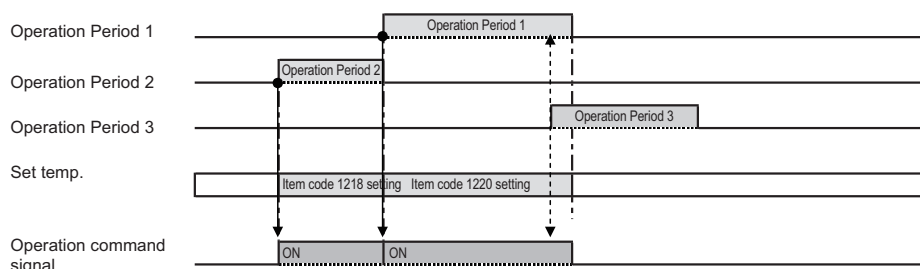
Operation Period 1

Operation Period 2

Operation Period 3

Set temp.　　Item code 1218 setting　　Item code 1220 setting

Operation command signal　　ON　　ON

[When operation periods 2 and 3 overlap]

Operation Period 1

Operation Period 2

Operation Period 3

Set temp.　　Item code 1218 setting　　Item code 1219 setting

Operation command signal　　ON　　ON

[When operation periods 2 and 3 overlap]

Operation Period 1

Operation Period 2

Operation Period 3

Set temp.　　Item code 1218 setting

Operation command signal　　ON
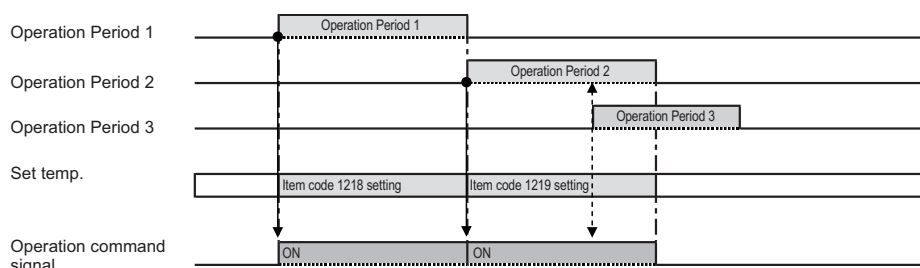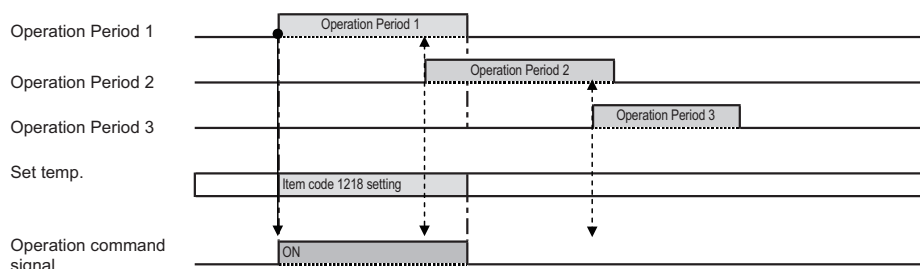
(*) Refer to the section on how to select the preset water temperatures on the next page.

(3) Selecting the preset temperature for different operation periods

Setting procedures

| **Step 0**
Set the ON/OFF switch (SWS1) to OFF. | Set SWS1 to OFF from the remote controller or with the local switch.
Settings cannot be changed unless the ON/OFF setting is set to OFF. |

| **Step 1**
Set the dip switches SW2 and SW3. | Set the dip switches on the circuit board as follows before making the settings for the items described in this section. |

SW2	SW3					
-10	5	6	7	8	9	10
OFF	OFF	OFF	OFF	ON	OFF	OFF

| **Step 2**
Select the desired item with the push switch SWP3. | Item codes 1215 through 1220 relate to scheduled operation setting.
Set the item code to 1, and set the time for each of the relevant items.
Press the push switch SWP3 to select an item code.
Use the push switches SWP1 and SWP2 to change the value of the selected item.
The value will keep blinking while it is being changed. |

Step 3

Press the push switches SWP1 (↑) or SWP2 (↓) to increase or decrease the value.

Settings table

Items that can be set	Item code	Initial value	Unit	Setting			Note	Setting change from an optional remote controller
				Increments	Lower limit	Upper limit		
Preset temp. 1 (Heating)	1215	14	TH	1	14	15		Not possible
Preset temp. 1 (Hot Water)	1216	14	TH	1	14	15		Not possible
Preset temp. 1 (Heating ECO)	1217	14	TH	1	14	15		Not possible
Start/End time setting 1 (ON/OFF) water temp. setting	1218	1		1	1	3	*	Not possible
Start/End time setting 2 (ON/OFF) water temp. setting	1219	1		1	1	3	*	Not possible
Start/End time setting 3 (ON/OFF) water temp. setting	1220	1		1	1	3	*	Not possible

*1: Preset temp. A (Heating)
 2: Preset temp. B (Hot Water)
 3: Preset temp. C (Heating ECO)

| **Step 4**
Press the push switch SWP3 to save the change. | Press SWP3 once within one minute of changing the setting with SWP1 or SWP2 to save the setting.
Once the new setting is saved, the display will stop blinking and stay lit. The display will, then, return to the item code display mode.
If SWP3 is not pressed within one minute, the change will not be saved and the display will return to the item code display mode. |

Selecting the preset temperature for different operation periods

When operating the units on schedule, preset temperatures can be selected from A, B, or C for time periods 1 through 3.

Item code 1218: Operation time setting 1

Item code 1219: Operation time setting 2

Item code 1220: Operation time setting 3

Item code 1215: Preset temp. 1 (Item code 11: Heating)

Item code 1216: Preset temp. 2 (Item code 13: Hot Water)

Item code 1217: Preset temp. 3 (Item codes: 22-27: Heating ECO)

Preset temperature selection for different time periods

			Example 1	Example 2	Example 3
<1> <2>	Start time 1 End time 1	Operation 1 (Preset temperature is selectable from A, B, or C.)	Heating	Heating	Hot Water
<3> <4>	Start time 2 End time 2	Operation 2 (Preset temperature is selectable from A, B, or C.)	Hot Water	Hot Water	Heating ECO
<5> <6>	Start time 3 End time 3	Operation 2 (Preset temperature is selectable from A, B, or C.)	Heating ECO	Heating	Hot Water
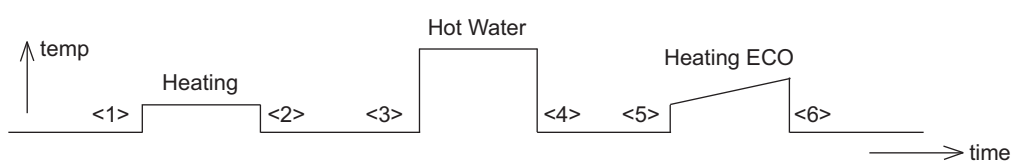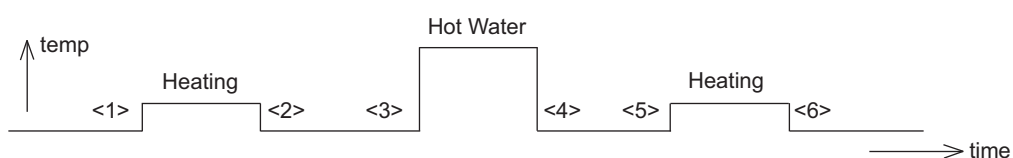
Example 1

Example 2

Example 3
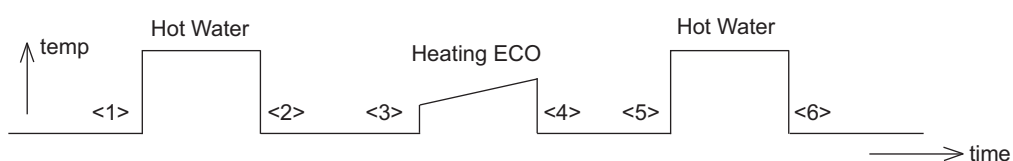
(4) Peak-demand control operation

Peak-demand control is a function used to control the power consumptions of the units during peak-demand hours.

The number of units in operation and the compressor's maximum operating frequency will be controlled according to the peak-demand control signal.

Individual system control	Multiple system control
Individual unit control Maximum frequency = Maximum capacity under peak-demand control	Depending on the peak-demand control setting that is made on the main unit, the number of units in operation and the maximum operating frequency of the units in operation will be adjusted.

Setting procedures

Set the maximum capacity setting on the circuit board.

Step 0 Set the ON/OFF switch (SWS1) to OFF.	Set SWS1 to OFF from the remote controller or with the local switch. Settings cannot be changed unless the ON/OFF setting is set to OFF.

Step 1 Set the dip switches SW2 and SW3.	Set the dip switches on the circuit board as follows before making the settings for the items described in this section.

SW2	SW3					
-10	5	6	7	8	9	10
OFF	OFF	OFF	OFF	OFF	ON	OFF

Step 2 Select the desired item with the push switch SWP3.	Press the push switch SWP3 to select item code 2. Press the push switches SWP1 or SWP2 to change the value of the selected item. The value will keep blinking while it is being changed.

Step 3 Press the push switches SWP1 (↑) or SWP2 (↓) to increase or decrease the value.	**Settings table**

Items that can be set	Item code	Initial value	Unit	Setting			Setting change from an optional remote controller
				Increments	Lower limit	Upper limit	
Maximum capacity setting	2	100	%	5%	0	100	Not possible
Peak-demand control start time	3	1300	Hour: minute	1	0000	2359	Not possible
Peak-demand control end time	4	1300	Hour: minute	1	0000	2359	Not possible

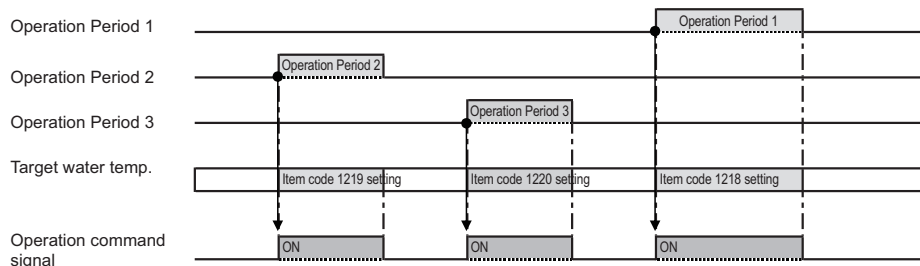| **Step 4** Press the push switch SWP3 to save the change.	Press SWP3 once within one minute of changing the setting with SWP1 or SWP2 to save the setting. Once the new setting is saved, the display will stop blinking and stay lit. The display will, then, return to the item code display mode. If SWP3 is not pressed within one minute, the change will not be saved and the display will return to the item code display mode. (*) If the peak-demand control contact is ON, units will operate at the maximum capacity that was set in the steps above.

(5) Setting the total number of units for a multiple system

| **Step 0**
Set the ON/OFF switch (SWS1) to OFF. | Set SWS1 to OFF from the remote controller or with the local switch.
Settings cannot be changed unless the ON/OFF switch is set to OFF. |

| **Step 1**
Set the dip switches SW2 and SW3. | Set the dip switches on the circuit board as follows to select how external inputs are received. |

SW2	SW3					
-10	5	6	7	8	9	10
OFF	OFF	OFF	OFF	ON	ON	ON

| **Step 2**
Select the desired item with the push switch SWP3. | The item codes shown in the table below will appear in order every time the push switch SWP3 is pressed.
Use the push switches SWP1 and SWP2 to change the value of the selected item.
The value will keep blinking while it is being changed. |

| **Step 3**
Press the push switches SWP1 (↑) or SWP2 (↓) to increase or decrease the value. | **Setting thetotal number of units** |

	Item code	Increments	Lower limit	Upper limit	Initial value
Total number of units in the system*1	107	1	1	16	1

*1 Enter the total number of units including the main unit. Applicable only to the main unit.

| **Step 4**
Press the push switch SWP3 to save the change. | Press SWP3 once within one minute of changing the setting with SWP1 or SWP2 to save the setting.
Once the new setting is saved, the display will stop blinking and stay lit. The display will, then, return to the item code display mode.
If SWP3 is not pressed within one minute, the change will not be saved and the display will return to the item code display mode. |

| **Step 5**
Turn the power back on.
Reset the system. | After changing the settings, re-initialize the system according to the procedures detailed on page 24.

Note   **The new setting will not be saved unless a reset is performed.** |

Setting the unit addresses

Refer to "System configuration procedures: Multiple system" (page 22).

(6) Selecting the item that normally appears on the LED

SW2	SW3						Display content
-10	5	6	7	8	9	10	
OFF	OFF	OFF	ON	OFF	OFF	OFF	Displays the operation mode.(*1)
OFF	OFF	ON	ON	OFF	OFF	OFF	Displays the operation mode.(*2)
OFF	ON	ON	OFF	OFF	OFF	OFF	Displays the current water temperature.
OFF	ON	OFF	OFF	OFF	OFF	OFF	Displays the water-temperature setting.
OFF	OFF	OFF	OFF	OFF	OFF	OFF	Displays the high and low refrigerant pressures.

(*1)

The dot lights up when the operation signal is on.
The dot lights off when the operation signal is off.

"A" will be displayed while the compressor is in operation.
"S" will be displayed while the compressor is stopped.

"S" will be displayed while the fan is forced to operate.
"-" will be displayed when this function is disabled.

"d" will be displayed when the peak-demand control function is enabled.
"-" will be displayed when this function is disabled.

Displays the operation mode.
"H" will be displayed during water-heating operation.
"d" will be displayed during a defrost cycle.
"F" will be displayed while the pump is being operated to prevent freeze-up.

(*2)

Displays the system control mode.
"S" will be displayed when the multiple system control option is used.
"A" will be displayed when the individual system control option is used.

(7) Remote water temperature setting input signal type

By setting SW2-7 to ON, external analog signals can be used to set the water temperatures.

Analog input type can be selected from the following four types:

  "0": 4-20 mA
  "1": 0-10 V
  "2": 1-5 V
  "3": 2-10 V

Select item code 21 to set the type of analog input signal to be used to set the water temperature from a remote location.

Setting procedures

Set the dip switches on the circuit board as follows to change the settings.

Step 1
Set dip switches SW2, SW3,
SW421-1, and SW421-2.

	SW421-1	SW421-2
4-20 mA	ON	ON
0-10 V	OFF	OFF
1-5 V	OFF	ON
2-10 V	OFF	OFF

	SW2	SW3					
	-10	5	6	7	8	9	10
Switch settings	OFF	OFF	OFF	OFF	OFF	ON	OFF

Step 2
Select the item to be set with
push switch SWP3.

Select the type of analog input signal to be used to set the water temperature from a remote location.

Step 3
Change the values with push
switches SWP1 (↑) or SWP2 (↓).

Press push switch SWP3 to select the item code.

Change the values with push switches SWP1 and SWP2.

Until the changed values are saved, the values will blink.

Items that can be set	Item code	Initial value	Unit	Setting			Note	Setting change from an optional remote controller
				Incre-ments	Lower limit	Upper limit		
Water temperature setting input signal type	21	0		1	0	3		Not possible

Step 4
Press push switch SWP3 to save
the changed value.

Press SWP3 once within one minute of changing the settings to save the change.

When the new setting is saved, the display will stop blinking and stay lit. The display will, then, return to the item code display mode.

If SWP3 is not pressed within one minute, the change will not be saved, and the display will return to the item code display mode.

(8) Setting the water temperature using analog signal input
Select the analog input format

	SW2	SW3					
	-10	5	6	7	8	9	10
Switch settings	OFF	OFF	OFF	OFF	OFF	ON	OFF

Items that can be set	Item code	Initial value	Unit	Setting			Note	Setting change from an optional remote controller
				Incre-ments	Lower limit	Upper limit		
Select the analog input format	1051	0		1	0	3		Not possible

Select "0"

0: Water temperature input 4-20 mA
1: Capacity control input 4-20 mA
2: Water temperature input IT terminal
3: Capacity control input IT terminal

- When dip switch SW2-7 is set to ON (Enable external input), the target water temperature varies with the preset temperatures A and B and the type of analog input signal.
  - When the water temperature setting input signal type is set to 0 (4-20 mA)

  - External analog input signal of 5.9 mA: Preset temp. A (Item code 11)
  - External analog input signal of 18.3 mA: Preset temp. B (Item code 13)
  - External analog input signal of between 5.9 and 18.3 mA: the preset temperature will be linearly interpolated.
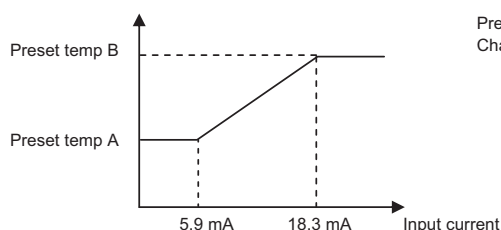
Preset temperature = (B - A) * (Input current - 5.9 mA) / 12.4 mA + A
Change of 0.12 mA or less is not recognized.

- When the water temperature setting input signal type is set to 1 (0-10 V)

  - External analog input signal of 1.0 V: Preset temp. A (Item code 11)
  - External analog input signal of 9.1 V: Preset temp. B (Item code 13)
  - External analog input signal of between 1.0 and 9.1 V: the preset temperature will be linearly interpolated.
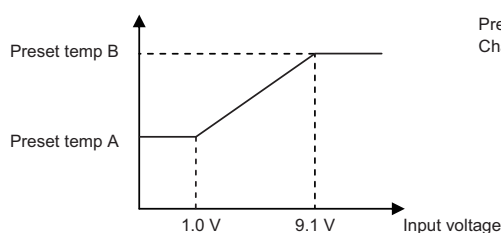
Preset temperature = (B - A) * (Input voltage - 1.0 V) / 8.1 V + A
Change of 59 mV or less is not recognized.

- When the water temperature setting input signal type is set to 2 (1-5 V)

  - External analog input signal of 1.5 V: Preset temp. A (Item code 11)
  - External analog input signal of 4.5 V: Preset temp. B (Item code 13)
  - External analog input signal of between 1.5 and 4.5 V: the preset temperature will be linearly interpolated.
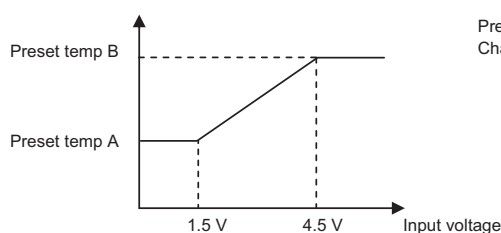
Preset temperature = (B - A) * (Input voltage - 1.5 V) / 3.0 V + A
Change of 29 mV or less is not recognized.

- When the water temperature setting input signal type is set to 3 (2-10 V)

  - External analog input signal of 2.9 V: Preset temp. A (Item code 11)
  - External analog input signal of 9.1 V: Preset temp. B (Item code 13)
  - External analog input signal of between 2.9 and 9.1 V: the preset temperature will be linearly interpolated.

Preset temperature = (B - A) * (Input voltage - 2.9 V) / 6.2 V + A
Change of 59 mV or less is not recognized.
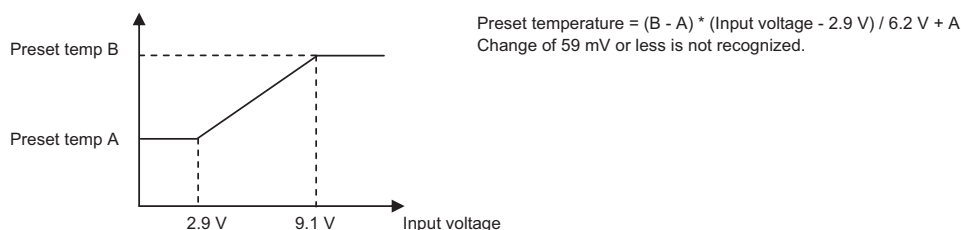
(9) Setting the capacity control ratio using analog signal input
Select the analog input format

	SW2	SW3					
	-10	5	6	7	8	9	10
Switch settings	OFF	OFF	OFF	OFF	OFF	ON	OFF

Items that can be set	Item code	Initial value	Unit	Setting			Note	Setting change from an optional remote controller
				Incre-ments	Lower limit	Upper limit		
Select the analog input format	1051	0		1	0	3		Not possible

Select "1"

0: Water temperature input 4-20 mA
1: Capacity control input 4-20 mA
2: Water temperature input IT terminal
3: Capacity control input IT terminal

- When dip switch SW2-7 is set to ON (Enable external input), the capacity control ratio varies with the type of analog input signal.
  - When the water temperature setting input signal type is set to 0 (4-20 mA)

    - External analog input signal of 5.9 mA: 0%
    - External analog input signal of 18.3 mA: 100%
    - External analog input signal of between 5.9 and 18.3 mA: the percent will be linearly interpolated.
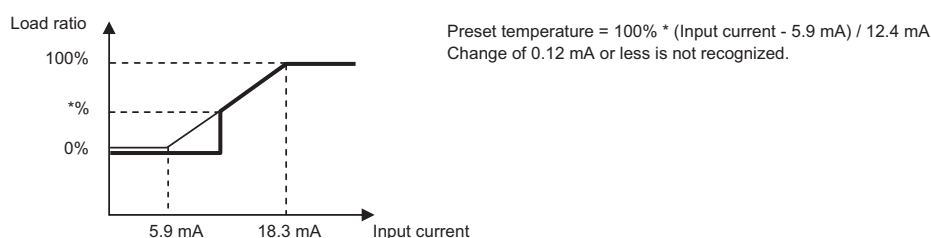
Preset temperature = 100% * (Input current - 5.9 mA) / 12.4 mA
Change of 0.12 mA or less is not recognized.

- When the water temperature setting input signal type is set to 1 (0-10 V)

  - External analog input signal of 1.0 V: 0%
  - External analog input signal of 9.1 V: 100%
  - External analog input signal of between 1.0 and 9.1 V: the percent will be linearly interpolated.
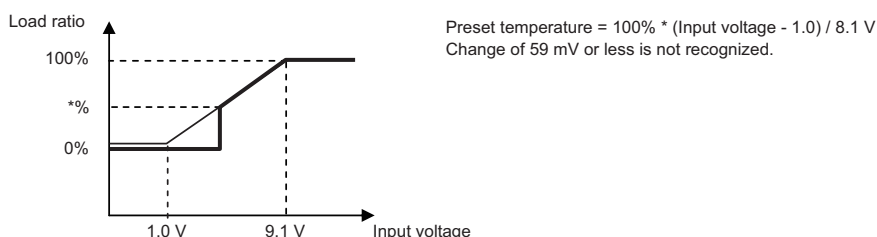
Preset temperature = 100% * (Input voltage - 1.0) / 8.1 V
Change of 59 mV or less is not recognized.

• When the water temperature setting input signal type is set to 2 (1-5 V)

  • External analog input signal of 1.5 V: 0%
  • External analog input signal of 4.5 V: 100%
  • External analog input signal of between 1.5 and 4.5 V: the percent will be linearly interpolated.
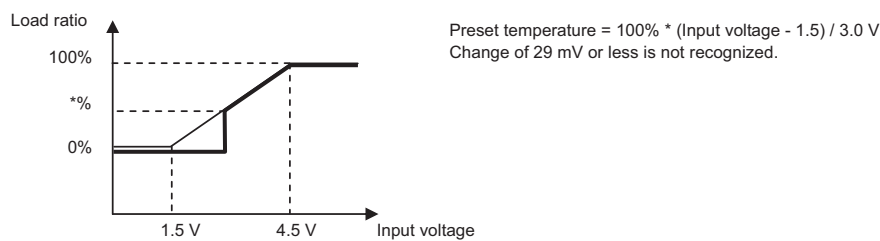
Preset temperature = 100% * (Input voltage - 1.5) / 3.0 V
Change of 29 mV or less is not recognized.

• When the water temperature setting input signal type is set to 3 (2-10 V)

  • External analog input signal of 2.9 V: 0%
  • External analog input signal of 9.1 V: 100%
  • External analog input signal of between 2.9 and 9.1 V: the percent will be linearly interpolated.

Preset temperature = 100% * (Input voltage - 2.9 V) / 6.2 V
Change of 59 mV or less is not recognized.
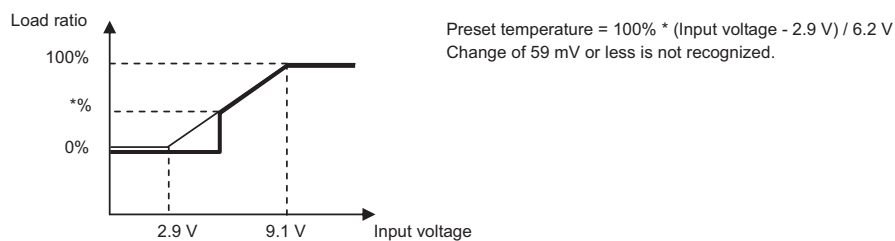
*%: When the compressor frequency drops below 30 Hz, the compressor stops.
    The frequency value that causes the compressor to stop varies depending on the outside temperature and water temperature.

(10) Setting the booster heater 1 operation conditions

A temperature at which the booster heater 1 will go into operation (TWL) can be selected.

Select item code 1057 and 1058 to set the threshold temperature (TWL1 and TAL1) for booster heater operation.

Booster heater 1 operation conditions

•Individual system

The operation command signal is ON and at least one of the following two conditions is met.

1　Water-temperature control option is set to OFF, the water temperature drops below TWL1, and the outside temperature drops below TAL1.

2　Water-temperature control option is set to ON, the external water temperature sensor reading drops below TWL1, and the outside temperature drops below TAL1.

The booster heater 1 signal of the MAIN circuit comes on.

•Multiple system

The operation command signal is ON and the following condition is met.

External water temperature sensor readings (TH14 and TH15) drop below TWL1, and the reading of the outside temperature sensor connected to the MAIN circuit of the main unit drops below TWL1.

The booster heater 1 signal of the MAIN circuit comes on.

Booster heater 1 operation-stop conditions

The operation command signal is OFF or all of the following two conditions are met.

1　The water temperature is at or above TWL1+2°C or the outside temperature is at or above TAL1+2°C.

2　External water temperature sensor readings (TH14 and TH15) are at or above TWL1+2°C, or the reading of the outside temperature sensor (TH9) connected to the MAIN circuit of the main unit exceeds TAL1+2°C.

(*)Unit's inlet water temperature: Average value between the water temperature settings of the MAIN and SUB circuits

Setting procedures

Set the dip switches on the circuit board as follows to change the settings.

Step 1
Outdoor temperature input source selection

	SW2	SW3					
	-10	5	6	7	8	9	10
Switch settings	OFF	OFF	OFF	OFF	ON	OFF	OFF

Items that can be set	Item code	Initial value	Unit	Setting			Note	Setting change from an optional remote controller
				Incre-ments	Lower limit	Upper limit		
Outdoor temperature input source selection	1080	0		1	0	1		Not possible

0: Outdoor temperature sensor (TH9)
1: IT terminal

Step 2
Set dip switches
SW2 and SW3.

	SW2	SW3						
	-10	5	6	7	8	9	10
Switch settings	OFF	OFF	OFF	OFF	OFF	ON	OFF

Step 3
Select the item to be set with
push switch SWP3.

Step 4
Change the values with push
switches SWP1 (↑) or SWP2 (↓).

Select item code 1057 and 1058 to set the operation temperature (TWL1 and TAL1) for the booster heater 1.

Press push switch SWP3 to select the item code.

Change the values with push switches SWP1 and SWP2.

Until the changed values are saved, the values will blink.

Items that can be set	Item code	Initial value	Unit	Setting			Note	Setting change from an optional remote controller
				Increm-ents	Lower limit	Upper limit		
Booster heater 1 operation water temperature (TWL1)	1057	40	°C	0.1	0	70		Not possible
Booster heater 1 operation outside temperature (TAL1)	1058	-10		0.1	-30	50		

Press and hold push switches SWP1 and SWP2 to fast forward the numbers.

Step 5
Press push switch SWP3 to save
the changed value.

Press SWP3 once within one minute of changing the settings to save the change.

When the new setting is saved, the display will stop blinking and stay lit. The display will, then, return to the item code display mode.

If SWP3 is not pressed within one minute, the change will not be saved, and the display will return to the item code display mode.

(11) Setting the booster heater 2 operation conditions
A temperature at which the booster heater 2 will go into operation (TWL) can be selected.
Select item code 1059 and 1060 to set the threshold temperature (TWL2 and TAL2) for booster heater operation.

Booster heater 2 operation conditions

•Individual system
The operation command signal is ON and at least one of the following two conditions is met.

1 Water-temperature control option is set to OFF, the water temperature drops below TWL2, and the outside temperature drops below TAL2.
2 Water-temperature control option is set to ON, the external water temperature sensor reading drops below TWL2, and the outside temperature drops below TAL2.

The booster heater 2 signal of the MAIN circuit comes on.

•Multiple system
The operation command signal is ON and the following condition is met.

External water temperature sensor readings (TH14 and TH15) drop below TWL2, and the reading of the outside temperature sensor connected to the MAIN circuit of the main unit drops below TWL2.

The booster heater 2 signal of the MAIN circuit comes on.

Booster heater 2 operation-stop conditions

The operation command signal is OFF or all of the following two conditions are met.

1 The water temperature is at or above TWL2+2°C or the outside temperature is at or above TAL2+2°C.
2 External water temperature sensor readings (TH14 and TH15) are at or above TWL2+2°C, or the reading of the outside temperature sensor (TH9) connected to the MAIN circuit of the main unit exceeds TAL2+2°C.

(*)Unit's inlet water temperature: Average value between the water temperature settings of the MAIN and SUB circuits

Setting procedures
Set the dip switches on the circuit board as follows to change the settings.

Step 1
Outdoor temperature input source selection

	SW2	SW3					
	-10	5	6	7	8	9	10
Switch settings	OFF	OFF	OFF	OFF	ON	OFF	OFF

Items that can be set	Item code	Initial value	Unit	Setting			Note	Setting change from an optional remote controller
				Incre-ments	Lower limit	Upper limit		
Outdoor temperature input source selection	1080	0		1	0	1		Not possible

0: Outdoor temperature sensor (TH9)
1: IT terminal

Step 2

Set dip switches
SW2 and SW3.

	SW2	SW3					
	-10	5	6	7	8	9	10
Switch settings	OFF	OFF	OFF	OFF	OFF	ON	OFF

Step 3

Select the item to be set with
push switch SWP3.

Step 4

Change the values with push
switches SWP1 (↑) or SWP2 (↓).

Select item code 1059 and 1060 to set the operation temperature (TWL2 and TAL2) for the booster heater 2.

Press push switch SWP3 to select the item code.

Change the values with push switches SWP1 and SWP2.

Until the changed values are saved, the values will blink.

Items that can be set	Item code	Initial value	Unit	Setting			Note	Setting change from an optional remote controller
				Increm-ents	Lower limit	Upper limit		
Booster heater 2 operation water temperature (TWL2)	1059	30	°C	0.1	0	70		Not possible
Booster heater 2 operation outside temperature (TAL2)	1060	-15		0.1	-30	50		

Press and hold push switches SWP1 and SWP2 to fast forward the numbers.

Step 5

Press push switch SWP3 to save
the changed value.

Press SWP3 once within one minute of changing the settings to save the change.

When the new setting is saved, the display will stop blinking and stay lit. The display will, then, return to the item code display mode.

If SWP3 is not pressed within one minute, the change will not be saved, and the display will return to the item code display mode.

[2] Operating characteristics and Control Capabilities

-1- Operating characteristics

Function	Component		Symbol	Control/ Detection	Action	Unit	Trigger condition
Unit protection	Pressure switch	High-pressure switch	63H1	HP 63H1	ON	MPa	(2.95)
					OFF	MPa	3.85 $^{+0}_{-0.15}$
		High-pressure sensor	63HS	HP 63HS	OFF	MPa	-
		Low-pressure sensor	63LS	LP 63LS	OFF	MPa	♦The low pressure has dropped below 0.06 MPa within 30 seconds of compressor start-up. ♦The low pressure has dropped below 0.06 MPa within 30 seconds of a defrost cycle. ♦During water heating, the low pressure has dropped by 0.02 MPa after the air-side heat exchanger inlet temperature has reached -31ºC. ♦During water heating, the low pressure has dropped by 0.02 MPa after the air-side suction pipe temperature has reached -33ºC. ♦The outside temperature of 10ºC or above has been detected for 20 minutes and the low pressure has dropped below 0.06 MPa during water heating.
	Compressor overcurrent relay			Compressor current	OFF	A	33
	Built-in thermistor on the fan motor (Stops the motor)			Built-in thermistor on the fan motor	ON	ºC	90±15
					OFF	ºC	145±5
	Thermistor	Discharge refrigerant temp. (Discharge temp. overrise protection)	TH1 TH5	Discharge gas temp.	OFF	ºC	♦A discharge gas temperature of 120ºC or above has been detected for 30 seconds while the compressor is in operation. (Preliminary abnormal stop) If this happens three times, the unit will make an abnormal stop. ♦If a discharge gas temperature of 125ºC or above was detected, the unit will make an abnormal stop.
		Air-side HEX inlet temp. (vacuum protection)	TH4 TH8	Air-side HEX inlet temp.	OFF	ºC	A heat-side heat exchanger inlet temperature of -33ºC was detected.
		Suction temp. (vacuum and freeze-up protection)	TH2 TH6	Suction gas temp.	OFF	ºC	A suction gas temperature of -36ºC was detected.
		Compressor shell temp. (compressor floodback protection)	TH3 TH7	Comp. shell temp.	OFF	ºC	A shell bottom SH temperature of 10ºC or below has been detected for 40 minutes while the compressor is in operation.
		Inverter heatsink temp	THHS	INV. heatsink temp.	OFF	ºC	A temperature of 80ºC or above has been detected for 10 minutes or a temperature of 90ºC or above was detected.
Refrigerant circuit control	Liquid injection circuit		LEV2 SV2	Discharge gas temp.		ºC	Injection is controlled by referencing the discharge gas temperature.
Pump control	Inlet (freeze-up protection)		TH16 TH12	Water inlet	ON	ºC	3
					OFF	ºC	5
	Outside temperature thermistor		TH9	Outside temp.	ON	ºC	1
					OFF	ºC	3
	Freeze-up protection circuit						The pump turns on when the water inlet temperature has reached below the "ON" threshold AND the outside temperature has reached below the "ON" threshold when the compressor is stopped.

-2- Initial control

- When the power is turned on, the initial processing of the microcomputer is given top priority.
- During the initial processing, processing of the operation signal is suspended and is resumed after the initial processing is completed.
  (Initial processing involves data processing by the microcomputer and initial setup of the LEV opening. This process takes up to two minutes.)
- During the initial processing ” 9999 ” will appear on the LED monitor on the MAIN board.

-3- Compressor frequency

- The upper limit of frequency during the first 30 seconds of operation is 48 Hz.
- The upper limit of frequency during the first 90 seconds of operation is 60 Hz.
- If the water temperature is controlled based on the outlet water temperature (SW3-3 is set to OFF.), for 90 seconds after the startup, the compressor will be controlled every 30 seconds so that the frequency fluctuation will be kept within ± 5 Hz.
- If the water temperature is controlled based on the external water temperature sensor reading or the inlet water temperature (SW3-3 is set to ON.), for 90 seconds after the startup, the compressor will be controlled every 30 seconds so that the frequency fluctuation will be kept within ± 10 Hz.
  (The above does not apply when the high-pressure is suppressed to protect the system or when the defrost operation is in progress.)
- The amount of frequency change is controlled to approximate the target value that are determined based on the temperature difference between the current and the preset water temperatures.
- The minimum operating frequency is 30 Hz.
- The maximum frequency will be determined based on the relationship between the water temperature and the outside temperature as well as the ON/OFF status of the Energy-save/Maximum capacity contact.
  (The values not on listed in the table are interpolated.)

"Energy-save/Maximum capacity" contact is ON.

(Maximum frequency of the compressor　Hz)

		Outside temp. °C										
		− 20	− 15	− 5	0	5	10	15	20	25	30	35 or above
Water temperature °C	35	100	100	100	100	77	65	57	53	49	46	43
	45	100	100	100	100	82	69	60	55	51	48	44
	60	100	100	100	100	88	76	69	63	58	53	49
	70	100	100	100	100	95	84	75	68	62	57	50

"Energy-save/Maximum capacity" contact is OFF.

(Maximum frequency of the compressor　Hz)

		Outside temp. °C										
		− 20	− 15	− 5	0	5	10	15	20	25	30	35 or above
Water temperature °C	35	100	100	100	100	100	91	85	81	76	71	66
	45	100	100	100	100	100	94	88	83	78	73	67
	60	100	100	100	100	100	100	93	87	81	75	69
	70	100	100	100	100	100	100	96	90	83	77	71

-4- Defrost operation

1. Defrost start

The defrost cycle will start when one of the following conditions 1 through 3 is met.
Defrost operation will be performed individually in the circuit that meets the defrost-start condition below. Defrost operations will not be performed simultaneously in multiple circuits.

Defrost-start conditions 1
1) Three minutes have passed since the compressor started up.
2) Forty-five minutes have passed since the unit received an operation command signal.
3) Cumulative compressor operation time after the completion of the last defrost cycle has reached 45 minutes.
4) The air-side heat exchanger inlet temperature is equal to or below the defrost-start temperature. (See the figure at right.)
5) Inlet water temperature is above 18ºC.
6) No other circuits are in the defrost cycle.
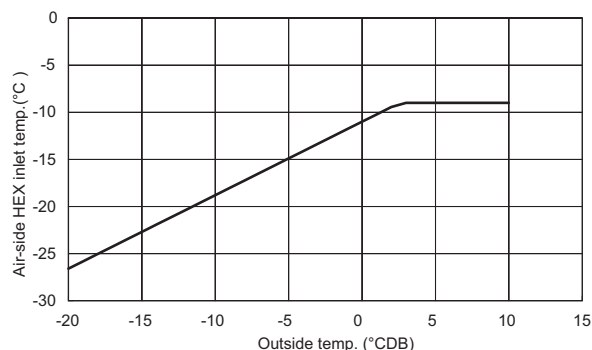
Defrost-start conditions 2
1) Twenty minutes have passed since the unit received an operation command signal.
2) Cumulative compressor operation time after the completion of the last defrost cycle has reached 20 minutes.
3) Air-side heat exchanger inlet temperature is below -31ºC.
4) Inlet water temperature is above 18ºC.

Defrost-start conditions 3
1) Three minutes have passed since the compressor started up.
2) Forty-five minutes have passed since the unit received an operation command signal.
3) Cumulative compressor operation time after the completion of the last defrost cycle has reached 240 minutes.
4) Air-side heat exchanger inlet temperature is equal to or below 0 ºC.
5) Inlet water temperature is above 18 ºC.
6) No other circuits are in the defrost cycle.

2. Defrost end

The defrost cycle will end when one of the following conditions is met.
Whether the defrost-end condition is met is determined individually for each circuit.
1) An air-side heat exchanger inlet temperature of 15ºC or above has been detected for 120 seconds.
2) An air-side heat exchanger inlet temperature of 25ºC or above was detected.
3) Ten seconds have passed since the beginning of the defrost cycle or later, the high-pressure has reached 3.0 MPa or above.
4) The inlet or outlet water temperature has dropped below the value obtained by the following formula: Compressor frequency during operation × 0.5 - 22 (ºC).
5) Twelve minutes have passed since the beginning of the defrost start (20 minutes, if the defrost operation is performed at the defrost-start setting 2).
6) When the operation command signal is off.
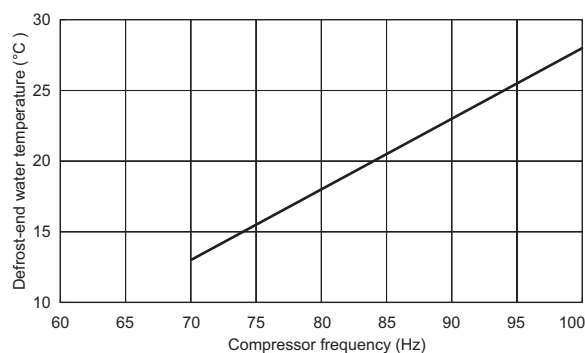
-5- Outdoor unit fan

The fan's rotation speed will be controlled to approximate the values in the table below that are obtained based on the outside temperature and the low pressure.
(Pressures and temperatures will be monitored, and the fan frequency will change accordingly in three steps.)

Fan rotation speed (rpm)	Frequency (Hz)	Outdoor temp.(A) (°C)	Fan rotation speed (rpm)	Frequency (Hz)	Outdoor temp.(A) (°C)
270	31	37 < A ≤ 40	450	50	12 < A ≤ 17
300	34	32 < A ≤ 37	490	55	7 < A ≤ 12
330	37	27 < A ≤ 32	550	60	2 < A ≤ 7
370	41	22 < A ≤ 27	600	66	0 < A ≤ 2
410	45	17 < A ≤ 22	670	73	A ≤ 0

-6- Injection LEV

Operating range of the LEV
Opening range: 50-480 (fully open)
LEV operation speed
◆Open   133 plus/sec
◆Close   200 plus/sec

At startup
◆For one minute after startup, the valve will be fixed to Initial Setting 1.
◆Between one and five minutes after startup, the valve will be fixed to Initial Setting 2.

During operation
◆Five or more minutes after startup, LEV2 (Injection LEV) opening will be controlled every 30 seconds to approximate the discharge SH to the target value according to the changes in high pressure and discharge gas temperature.
(Refer to the table below for the target discharge SH values.)

Target discharge SH (Item code c31: Discharge gas temp. - discharge pressure saturation temperature)
Refer to Chapter IX [1] 2. "Checking the sensor status." (page 115)

Outlet water temperature (B) (°C)	Outside temp.(A) (°C)				
	≤ -20	-20< A ≤ -17	-17< A ≤ -14	-14< A ≤ -11	-11< A ≤ -8
B ≤ 45	20-35*	20-35*	20-35*	20-35*	35
45 < B ≤50	20-30*	20-30*	20-30*	20-30*	30
50 < B ≤55	20-25*	20-25*	20-25*	20-25*	25
55 < B ≤60	20	20	20	20	20
60 < B ≤65	20	20	20	20	20
65 < B	20	20	20	20	20

Outlet water temperature (B) (°C)	Outside temp.(A) (°C)				
	-8< A ≤ -5	-5< A ≤ -2	-2< A ≤ 1	1< A ≤ 5	5< A
B ≤ 45	40	45	50	55	close
45 < B ≤50	35	40	45	50	close
50 < B ≤55	30	35	40	45	close
55 < B ≤60	25	30	35	40	close
60 < B ≤65	23	26	30	35	close
65 < B	20	23	27	32	close

*The target discharge SH will vary, depending on the operating frequency of the compressor.

-7- LEV in the main circuit

Operating range of the LEV
The opening range of the LEV is between 100 and 2000 (fully open).
LEV operation speed
♦Open   133 plus/sec
♦Close   200 plus/sec

At startup
♦For one minute and thirty seconds after startup, the valve will be fixed to the Initial Setting.
During operation
♦Ninety or more seconds after startup, the LEV opening will be controlled every 30 seconds according to the changes in compressor frequency, pressure, and temperature.
♦The LEV will be controlled to keep the shell bottom SH in the range between 20 and 25K.
♦If the outside temperature reaches 17ºC or above, the MOP function will be triggered to keep the low pressure from rising too high.
(The LEV opening will be decreased to keep the low pressure at or below 1 MPa.)
♦When the outside temperature is high and the water temperature is low (water temperature below 35ºC), the function to keep the low pressure from rising too high will trip.
(The LEV opening will be decreased so that the compression ratio of 1.5 or above will be maintained.)

-8- Operation during power failure

Duration of power failure		20 ms or shorter	20 ~ 200ms	200 ms or longer
Detection of power failure		Undetectable	Instantaneous power failure	Detection of power failure
Operation during power failure		Normal operation	During an instantaneous power failure, the unit will be controlled according to the input status of the circuit board immediately before the instantaneous power failure.	All outputs will be turned off immediately after power failure.
Operation after power is restored	Automatic restoration after power failure is set to "Enabled" (SW3-2 is set to ON.)	Normal operation	The circuit board will start receiving input.	The unit will be controlled according to the input status of the circuit board immediately before the power failure, except that the input status of the dry contact after the power is restored will override the one before the power failure. For three minutes after the power is restored, the unit will not operate.
	Automatic restoration after power failure is set to "Disabled" (SW3-2 is set to OFF.)			The unit will stop, displaying the error code for power failure. The error will be cleared when the operation command signal is off.

-9- Anti-short-cycling protection

The unit has a 3-minute restart-delay function to protect the compressor from short-cycling. This function is effective even after a power failure.

3-minute restart delay function

The 3-minite restart-delay function will be triggered in the following situations: (1) The setting for the SWS1 (Local, Off, Remote) was changed, or (2) after a power failure.

Compressor

ON

OFF

Min. 3 minutes

Time
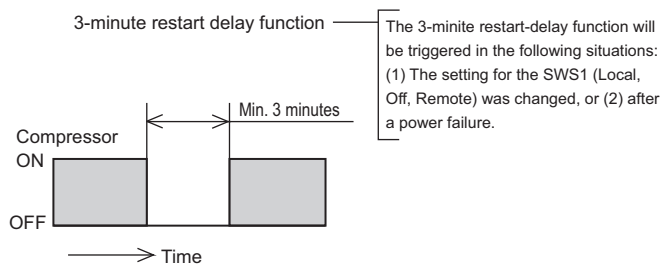
The unit has a function to keep the compressor from short-cycling when the amount of circulating water is low or when the load is light. After the compressor cycles off, it will not restart for 10 minutes.

Min. 10 minutes | 15 minutes | 10 minutes

ON for 7 minutes | 3 minutes | ON for 12 minutes | 3 minutes | ON for 4 minutes | ON for 6 minutes

Compressor

ON

OFF

Time
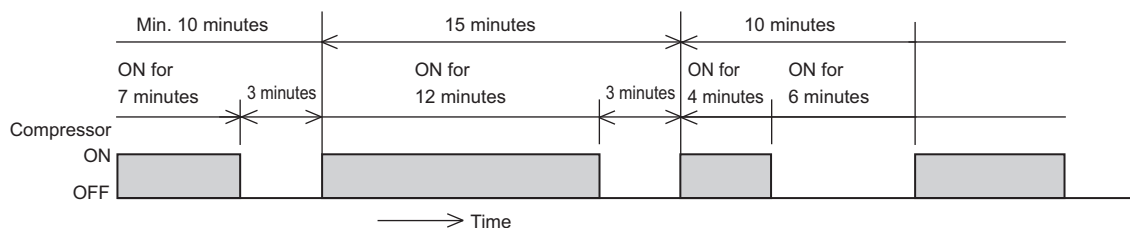
-10- Peak-demand control

General idea about demand control in the system with a combination of a heat pump and a combustion-type hot water boiler.
→During peak-demand hours, the operation of the air conditioning units is given higher priority than that of the heat pump units.

1. Individual system

The peak-demand control function is a function that restricts the maximum capacity of the units. The maximum operation capacities of the units are restricted to specific levels relative to the maximum capacity of the units (= the compressors are operating at the maximum rotation speed (100 Hz on the unit described in this manual)) being set as 100%.

80%
Preset value   100% (100Hz)   ⇒   The compressor will operate at the maximum rotation speed of 80 Hz.
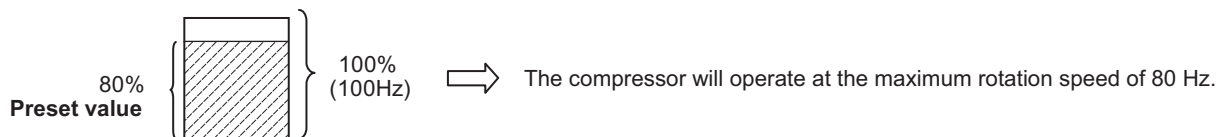
2. Peak-demand control in a multiple system

The peak-demand control function is a function that restricts the maximum capacity of the units. The maximum operation capacities of the units are restricted to specific levels relative to the maximum capacity of all units (= the compressors are operating at the maximum rotation speed (100 Hz on the unit described in this manual)) being set as 100%.

Standard operation

The units are designed to operate in the patterns as shown below to optimize operation efficiency.

a. Maximum capacity setting (D%) ≥ 70% → All units will be operated at D Hz.

The maximum capacity of each unit is set as 100%.
(The figures in the angle brackets indicate the total capacity in the entire system.)

400%<100%>
320%
<80%>
Preset value

Entire system   No. 1 unit   No. 2 unit   No. 3 unit   No. 4 unit
Distribution of capacity
80%   100%
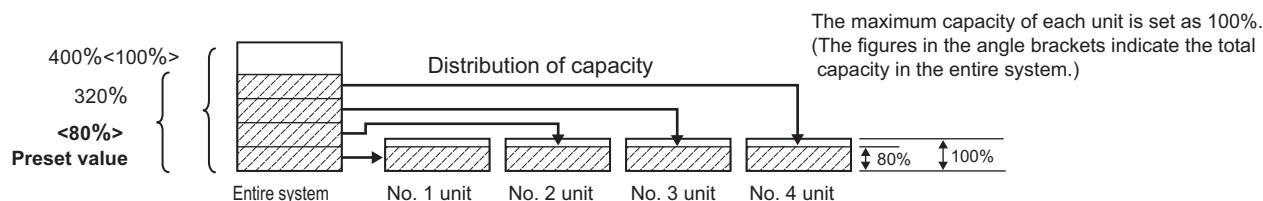
b. Maximum capacity setting D% < 70% → The number of units "N" and the capacity at which the units operate "α" will be determined so that either the condition (1) or (2) below is met.

1) D × M = 70% × (N-1) + α × 1 (40 % ≤ α < 70 %)
(N-1) units will be operated at 70 Hz, and one unit will be operated at α Hz.

400% <100%>
200%
<50%>
Preset value

Entire system   No. 1 unit   No. 2 unit   No. 3 unit   No. 4 unit
70%   70%   60 %   0 %
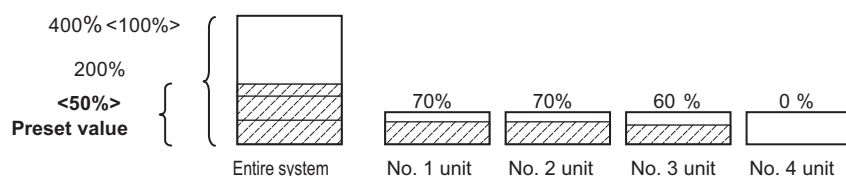
2) D × M = α× N   70% ≤ α, The α value will be set to a value as close to 70 Hz as possible.
N units will be operated at α Hz.

400% <100%>
200%
<50%>
Preset value

No. 1 unit   No. 2 unit   No. 3 unit   No. 4 unit
70%   70%   70 %   α :30% < 40 %

Re-distribution of capacity

Re-distribution of capacity

400% <100%>
240%
<60%>
Preset value

80%   80%   80 %   0%
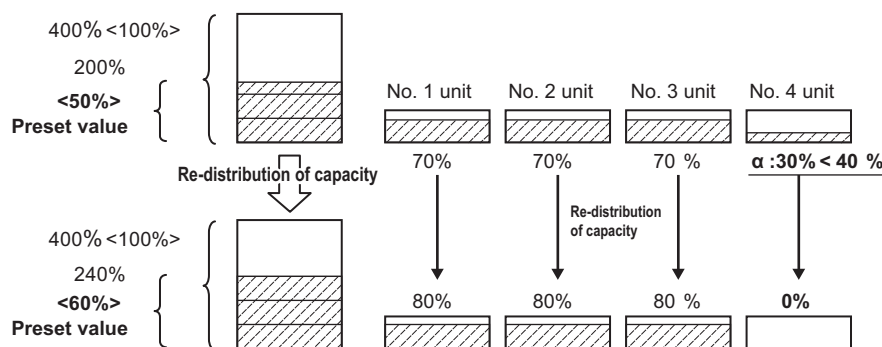
Nomenclature

D %	Maximum capacity setting: The capacity of the system when all units are operated at 100 Hz will be set as 100%.
M	Total number of units
N	No. of units in operation (calculated value)
α % (α Hz)	Operating capacity (calculated value)

note. During the heating season, the unit will not be operated at 100 Hz to save energy consumption in the first place, so the unit's performance may not be affected even if the maximum capacity setting is changed.

3. Operating characteristics (w/o maximum capacity setting)

Maximum operating frequency of the compressor
(outlet water temperature: 65ºC)
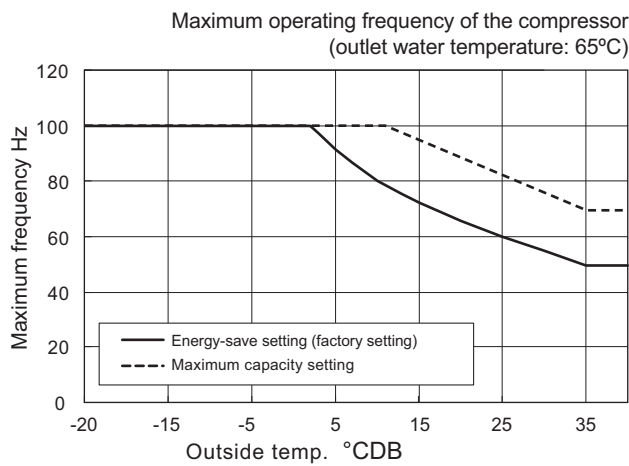
-11- Multiple system control

1. Electrical wiring diagram
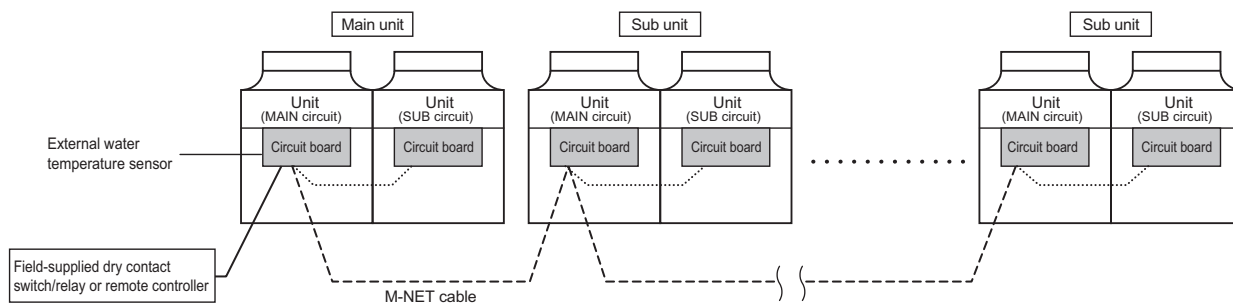
(*) Main/Sub units and switch settings

	SW2-8 (Use of external water temperature sensor)	SW2-9 (Multiple system)
Main unit (Unit to which the external water temperature sensor is connected.)	ON	ON
Sub unit	OFF	ON

2. Water piping system configuration

The main unit will determine the Tshs (the target outlet water temperature) for each sub unit as well as the number of units to put into operation as explained under item a below.

Preset water temperature (tshs)

External water temperature sensor (ex) Attached to the outlet

The target outlet water temperature of each unit will be set as Tshs, and the water temperature is controlled based on the compressor frequency. (See item b below.)

a. Changing the number of units to go into operation and changing the startup sequence of the units (controlled by the main unit)

Check interval : Variable between 1 and 5
DIFF2 : Differential (Variable between 0 and 8 K)

1) One unit will stop when the external water temperature meets the following formula: External water temperature ≤ [Set temperature (Tshs)] + [DIFF 2 value divided by 2].

If two or more units are operating at the same frequency, the one with more hours of cumulative operation hours will be stopped first.

2) One unit will go into operation when the external water temperature meets the following formula: External water temperature ≤ [Set temperature (Tshs)] - [DIFF 2 value divided by 2].

The unit with shorter cumulative operation hours will go into operation first.

The cumulative operation hours of a given unit is determined by the cumulative operation hours of the compressor with more hours than the other compressor.

b. Operation control based on the compressor frequency (Each unit controls its own frequency.)

Each unit increases or decreases the compressor frequency based on the difference between the preset and the current water temperatures.

The frequency of the compressor is adjusted to a range between 50 and 70 Hz to optimize operation efficiency.

Only when all units are under the Thermo-ON condition, the operating frequency may exceed 70 Hz.

-12- Automatic operation of pump for freeze-up protection

1. Purpose

This is a function to protect the water circuit from freezing up in winter.

2. Pump wire connection
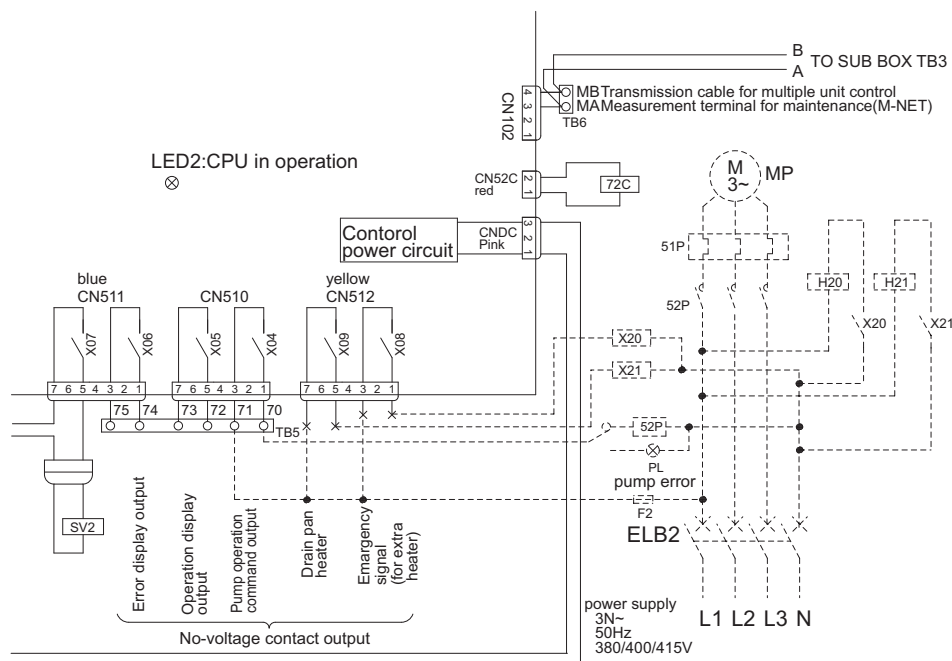
3. Natural freeze-up protection

The units will operate according to the dip switch SW2-1 on the control board as shown in the table below.

Dip switch settings		SW2-1 OFF	SW2-1 ON
Control method		Natural freeze-up protection based on both the outside temperature and the water temperature	Natural freeze-up protection based on both the outside temperature and the water temperature
Details	Pump start conditions	"Outside temperature is within ±1 ºC of 1 ºC" OR "Inlet water temperatureis within ±1 of 3 ºC "	Same as left
	Pump stop conditions	"Outside temperature is more than ±1ºC of 3 ºC" OR "Inlet water temperature is more than ±1ºC of 5 ºC"	Same as left

-13- Water-temperature control

Water temperature can be controlled in the following three ways. Select one that works best.

	Switch	Factory setting
Outlet-water-temperature-based control	SW3-3	OFF
Inlet-water-temperature-based control		-
Water temperature control based on the external water temperature reading	SW2-8	OFF

	SW3-3	SW2-8
Outlet-water-temperature-based control	OFF	OFF
Inlet-water-temperature-based control	ON	OFF
Water temperature control based on the external water temperature reading	Arbitrary[*1]	ON

*1 When dip switch SW2-8 is set to ON, the ON/OFF operation of the units is controlled based on the external water temperature sensor reading.
How the operating frequency of the compressor is controlled depends on the SW3-3 setting (outlet-/inlet-based control option).
(Sub units will be controlled based on the water-temperature control method that has been selected for the Main unit.)

1. **When the units are restarted after stopping for under a condition other than Thermo-OFF**
   Conditions for the units to stop other than the Thermo-OFF condition
   •The control option was changed from built-in thermistor reading based control to the external thermistor reading based control.
   •Pump interlock is off.
   •When one of the units in a set is forced to stop
   •When the Capacity priority/Cop priority setting was changed.
   •When the units were stopped under the following conditions:
     1. Tmax has reached 65ºC (when the outside temperature ≤ -10ºC) or
     2. Tmax has reached 70ºC (when the outside temperature > -10ºC.

   DIFF1 = 2 ºC (Initial setting): "1015" Digitally set value
   DIFF2 = 2 ºC (Initial setting): "1016" Digitally set value
   Tmax (Outside temperature ≤ -10 ºC: 65ºC, Outside temperature > -10 ºC : 70ºC)

Single/Multiple system	sensor	Control method	Thermo-ON conditions
Individual system	Built-in thermistor	Inlet-water-tempera-ture-based control	Outlet water temperatures < (Preset water temperature - DIFF1ºC) AND Inlet water temperatures < (Preset water temperature - DIFF1ºC)
		Outlet-water-temper-ature-based control	Outlet water temperatures < (Preset water temperature - DIFF1ºC) AND Inlet water temperatures < (Preset water temperature - DIFF1ºC) AND Average outlet water temperature ≤ (Preset water temperature+ DIFF2ºC)
	Representative water temperature	Representative water temperature	Representative water temperature < (Preset water temperature - DIFF1ºC)
Multiple system	Representative water temperature	Representative water temperature	Representative water temperature < (Preset water temperature - DIFF2/2) AND The number of units to run an optimal operation will be determined by the main unit. (The unit with the least amount of cumulative operation hours will go into operation first.)

2. Normal Thermo-ON/OFF operations

DIFF1 = 2 ºC (Initial setting): "1015" Digitally set value
DIFF2 = 2 ºC (Initial setting): "1016" Digitally set value
Tmax (Outside temperature ≦ -10 ºC: 65ºC, Outside temperature > -10 ºC : 70ºC)

Single/Multiple system	sensor	Thermo-ON conditions	Thermo-ON conditions	Thermo-OFF conditions
Individual system	Built-in thermistor	Inlet-water-temperature-based control	Inlet water temperatures is lower than the "Inlet temperature at Thermo-OFF - DIFF2ºC" and the system is not in the short-cycling protection mode.	Inlet water temperatures are greater than the "set temperature + DIFF2 value (ºC)" AND at least 60 seconds have passed since the last Thermo-ON.
		Outlet-water-temperature-based control	Inlet temperatures are below the "Inlet temperature at Thermo-OFF - DIFF2ºC"AND the average outlet temperature is at or below "Preset temperature + DIFF2ºC" AND the system is not in the short-cycling protection mode.	Average outlet water temperature is greater than the "set temperature + DIFF2 value (ºC)" AND at least 60 seconds have passed since the last Thermo-ON.
	Representative water temperature	Water temperature control based on the external water temperature reading	Inlet water temperatures is lower than the "Inlet temperature at Thermo-OFF - DIFF2ºC"	External water temperature sensor reading is greater than the "set temperature * DIFF2 value (ºC)" AND at least 60 seconds have passed since the last Thermo-ON.
Multiple system	Representative water temperature	Water temperature control based on the external water temperature reading	External water temperature thermistor reading < Set temperature - DIFF 2 value (ºC) AND the anti-short-cycling protection function is not been triggered. The number of units to run an optimal operation will be determined by the main unit. (The unit with the least amount of cumulative operation hours will go into operation first.)	External water temperature sensor reading is greater than the "set temperature * DIFF2/2 value (ºC)" AND at least 60 seconds have passed since the last Thermo-ON. The number of units to run an optimal operation will be determined by the main unit. (The unit with the least amount of cumulative operation hours will go into operation first.)

1) Thermo-ON/OFF temperature conditions

♦**Intlet-temperature-based water temperature control in an individual system (with the external water temperature sensor setting being set to ON and the Inlet-/outlet-based control option being set to inlet)**
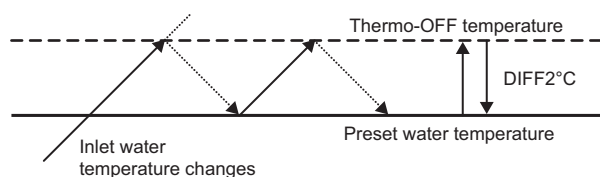
When the water temperature is controlled based on the inlet temperature, compressor frequency will be controlled as described in section -3- "Compressor frequency" (page 89). (Automatic operation according to the preset temperature)

♦**Outlet-temperature-based water temperature control in an individual system (with the external water temperature sensor setting being set to ON and the Inlet-/outlet-based control option being set to outlet)**
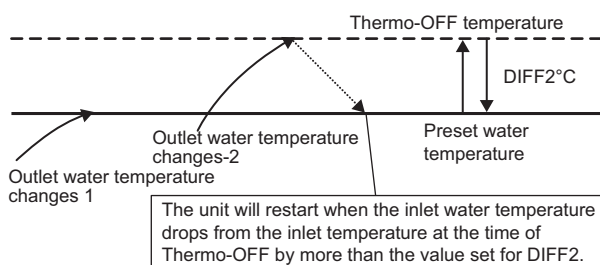
When the water temperature is controlled based on the external water temperature sensor reading (outlet water temperature), compressor frequency will be controlled in the way that the target water temperature will be maintained. If there is a sudden increase in water temperature and the unit did not stop at the preset temperature, the unit will stop when the temperature that equals "the preset temperature + the value set for DIFF2" is reached.

♦Multiple system control (inlet-water-temperature-based control)
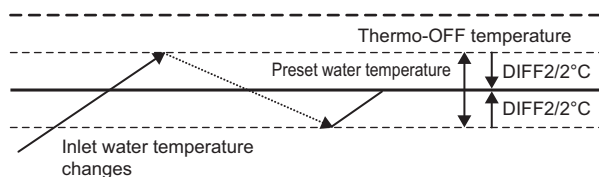
When the water temperature is controlled based on the representative inlet temperature, compressor frequency will be controlled as described in section -3-"Compressor frequency" (page 89). (Automatic operation according to the preset temperature)

♦Multiple system control (outlet-water-temperature-based control)
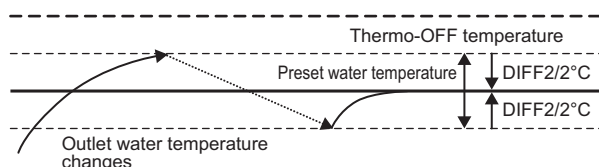
When the water temperature is controlled based on the external water temperature sensor reading (outlet water temperature), compressor frequency will be controlled in the way that the target water temperature will be maintained. The number of units to be in operation will be determined by the main unit to maintain the proper operating frequency of each unit.

2) Thermo-ON/OFF conditions (time)
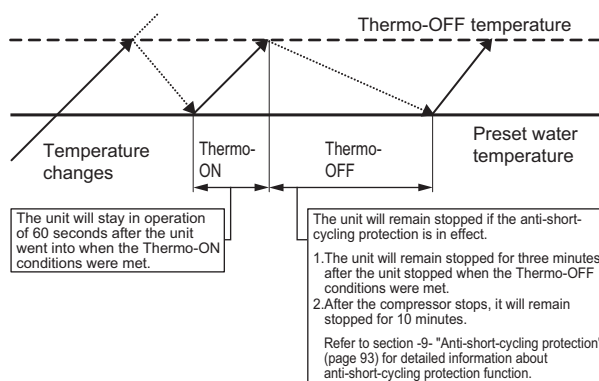
When the water temperature is controlled based on the inlet temperature, compressor frequency will be controlled as described in section -3- "Compressor frequency" (page 89). (Automatic operation according to the preset temperature)

3. When the units are stopped after the water temperature has reached the upper limit setting

DIFF1 = 2 ºC (Initial setting): "1015" Digitally set value
DIFF2 = 2 ºC (Initial setting): "1016" Digitally set value
Tmax (Outside temperature ≦ -10 ºC: 65ºC, Outside temperature > -10 ºC : 70ºC)

Individual system	sensor	Control method	Thermo-ON conditions	Thermo-OFF conditions
Refer to the section on individual system.	Built-in thermistor External water temperature	Inlet-water-temperature-based control Outlet-water-temperature-based control Water temperature control based on the external water temperature reading	When SW2-5 (operation restoration after forced stoppage) is set to ON Inlet water temperatures are lower than the "Inlet temperature at Thermo-OFF DIFF2ºC" AND outlet temperatures are lower than "Tmax - DIFF1ºC." When SW2-5 (operation restoration after forced stoppage) is set to OFF Inlet temperatures are lower than "Tmax - DIFF1ºC" AND outlet temperatures are lower than "Tmax - DIFF1ºC."	"External water temperature of each unit > Tmax" or "Inlet water temperature of each unit > Tmax"

-14- Controlling the operation of unit using external water temperature sensors

The water temperature can be controlled using the built-in sensor on the unit or a separately sold external water temperature sensor.
The factory setting for the sensor option is "built-in sensor on the unit." (SW2-8: OFF)
To control the water temperature with an external water temperature sensor, set SW2-8 to ON.
(Note) If the settings for the dip switches are changed while the power to the circuit board is being supplied, reset the unit according to the instructions in [6] (5) "Re-initializing the system" (page 24).
A separately sold water temperature sensor "TW-TH16" will be required to control the water temperature based on the external water temperature reading.
It is possible to switch between two external water temperature sensors. Refer to the installation manual for how to set the sensors.
Install the external water temperature sensor and wiring according to the instructions on the next page.

-15- Remote water temperature setting input signal type

By setting SW2-7 to ON, external analog signals can be used to set the water temperatures.
Analog input type can be selected from the following four types:
"0": 4-20 mA
"1": 0-10 V
"2": 1-5 V
"3": 2-10 V

External water temperature sensor TW-TH16

1. Parts that are required to install an external water temperature sensor

 (1) External water temperature sensor

 (2) Wiring to connect the sensor and the unit*

 (3) Wiring terminals to connect the wiring to the sensor and the terminal block on the unit

   (Four for M4 screws)*
   *Items (1) and (2) are field supplied.

Wire specifications

Wire size	2-core cable Min. 1.25 mm^2
Type	CVVS or CPEVS
Maximum length	20 m

2. Installing the external water temperature sensor

   ♦Install the external water temperature sensor where the water pipes merge or on the load-side tank as shown in the figure at right.
   ♦Install horizontally or vertically on top of the pipe.
   ♦When installing horizontally, make sure the wire faces down.
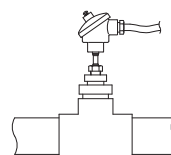
Vertical installation   Horizontal installation
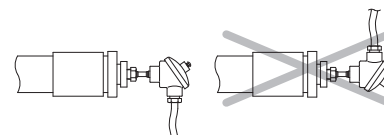
3. Wiring the external water temperature sensor

   Connect the external temperature sensor wiring to the terminal block in the control box on the unit as shown in the figure below.

External water temperature sensor

12-pin terminal block in the control box on the unit

(Note)
Run the sensor wiring at least 5 cm away from any wire that carries a voltage of 100 V or more, and do not put the sensor wiring in the same conduit tube with it.

T1 T2

Sensor wire

Control box   Unit

Note

157   42   54

20 12

Ø6   Ø10

Sensor
Sensor properties

R 1/2

48

· Resistance: R=15KΩ±3% (0 °C)
· B-constant: 3460K

A

M4 screws × 3
Terminal screws

50

⑥   ⑤

Terminal block for connection to the sensor

Connect the sensor wiring to terminals T1 and T2 of the 12-pin terminal block in the control box on the unit.

Connect the shield to the earth terminal.

Thread the wire to the external water temperature sensor through parts ② through ④ as shown in the figure at right. Attach M4 terminals (field-supplied) to the wires, and connect them to ⑤ and ⑥ (terminals A and B).

Cut the shield wire. Do not connect it to the terminal. (Connect the shield on the unit side to the ground terminal.)

After the wire is connected, securely tighten the tightening screw ④ , and then caulk the gap between the wire ① and the tightening screw to keep water from entering.

②Water-sealing rubber
(Internal diameter ø11)

③Washer (Internal diameter ø12)

④Tightening screw
(Internal diameter ø15)

Shield (to be cut)

①Field-supplied wire
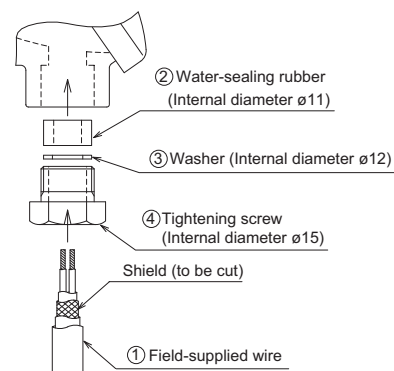
Detailed view of the area labeled "A" in the figure above

VIII Test Run Mode

[1] Items to be checked before a Test Run

(1) Check for refrigerant leak and loose cables and connectors.

(2) Measure the insulation resistance between the power supply terminal block and the ground with a 500V megger and make sure it reads at least 1.0Mohm.

Note
  ♦ Do not operate the unit if the insulation resistance is below 1.0Mohm.
  ♦ Do not apply megger voltage to the terminal block for transmission line. Doing so will damage the controller board.
  ♦ Never measure the insulation resistance of the transmission terminal block for the RA,RB,MA,MB(TB3). Do not attempt to measure the insulation resistance of TB7.
  ♦ The insulation resistance between the power supply terminal block and the ground could go down to close to 1Mohm immediately after installation or when the power is kept off for an extended period of time because of the accumulation of refrigerant in the compressor.
  ♦ If insulation resistance reads at least 1Mohm, by turning on the main power and powering the belt heater for at least 12 hours, the refrigerant in the compressor will evaporate and the insulation resistance will go up.
  ♦ Do not measure the insulation resistance of the terminal block for transmission line for the unit remote controller.

Note
  Securely tighten the cap.

(3) Check the phase order of the 3-phase power source and the voltage between each phase.

Note
  Open phase or reverse phase causes the emergency stop of test run. (A471,4152 error)

(4) When a power supply unit is connected to the transmission line for centralized control, perform a test run with the power supply unit being energized.

(5) Pre-energize the compressor.

A.	A case heater is attached to the bottom of the compressor to prevent the refrigerant oil from foaming when starting up. Switch on the power to the case heater and keep it turned on for **at least 12 hours** before starting a test run. (Compression of liquid refrigerant that may happen if the unit is started up without pre-energizing the compressor may damage the valve or cause other problems. When foaming is happening, the compressor will make cracking sounds for a few seconds at the beginning of operation.)

  B. Supply water to the water circuit before operating the pump. Operating the pump without water may damage the shaft seal.

(6) Check the pressure.

Translate the pressure readings into saturating temperatures, and make sure these values fall into the ranges specified in the table below.

Condensing and evaporating temperatures during operation

Saturation pressure equivalent to refrigerant pressure	Heating (outside temperature: between -20 °C and +40 °C)	
	At the initial stage of heating water (Before water has been heated up)	During normal operation
Condensing temperature	Outlet water temperature + (0 - 10 °C)	Outlet water temperature + (0 - 5 °C)
Evaporating temperature	Outside temp. - (5 - 13 °C)	Outside temp. - (3 - 8 °C)*

* To maintain proper compression ratio, when the outside temperature exceeds 17 °C, evaporating temperature may drop below "(Outside temperature) - 8 °C"

(7) Check that the correct voltage is applied.

Check that the voltage that is applied while the unit is stopped and the load-side voltage of the solenoid contactor in the relay box during operation are within the voltage ranges. Check the voltage in all phases (L1, L2, and L3), and make sure that the voltage imbalance between the phases is 2% or less.

(8) Check either the power supply current or the compressor current.

Check the compressor current in all phases (L1, L2, and L3).

(9) Check for short-cycling of discharge air.

Check that the intake air temperature is not unusually higher or lower than the outside temperature. During operation, the difference between the heat exchanger inlet temperature and outside temperature should be 1 °C or less.

(10) Check for proper circulating water flow rate.

Measure the circulating water flow rate, if possible. If it is not, check that the temperature difference between the outlet and inlet temperatures is between 3 and 5 ºC. A temperature difference of 6ºC or more indicates not enough water flow. Check for air pockets in the pipe, and make sure that the pump has the appropriate capacity for the circuit.

(11) Check that the unit is operating properly according to the temperature adjustment function.

When a pull-down operation is completed, check that the hot water temperature adjustment function will come on and that the unit will automatically go on and off. Make sure the ON/OFF cycle (beginning of an operation until the next) is at least 10 minutes. (The unit features an anti-short-cycling protection.)

Notes on temperature adjustment function
The water temperature can be controlled based on the inlet or the outlet temperature sensor reading. Select one to use. Refer to "VII [1]1.Factory Switch Settings (Dip switch settings table)(page 67) and "(1)Setting procedures"(page 71) for how to select the water temperature control method and how to set the water temperature.

Do not disconnect the power wire to the compressor in an attempt to keep the compressor from going into operation during test run. (If it is done, the control board will not sense that the compressor is stopped, and the water temperature will not be controlled properly and the unit may come to an abnormal stop.)

(12) Connect the pump-interlock wire to the appropriate contacts.

1) Connecting the pump-interlock wire
Connect the pump-interlock wire to the pump-interlock circuit (Terminal block ⑪ and ⑫). The unit will not operate unless this circuit is complete.

2) Notes on connecting the pump-interlock wire
  ♦Connect an NO relay (solenoid switch) for the pump.
  ♦This circuit is a low-voltage circuit. Keep the pump-interlock wire at least 5 cm away from any wire that carries a voltage of 100 V or above to avoid damage to the circuit board.
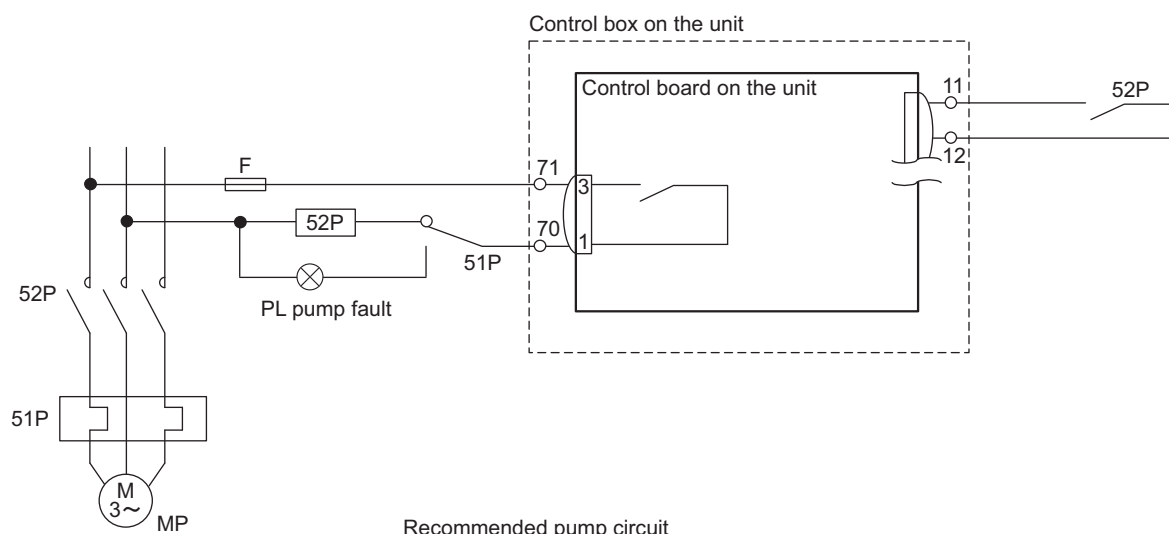
Recommended pump circuit

(13) Checking the rotation direction of the pump

Check that the circulating water pump is rotating in the correct direction. If the pump is rotating in the wrong direction, disconnect the pump wiring from the solenoid switch, and reconnect them so that the pump will rotate in the correct direction.

[2] Test Run Method

① [Set Temperature] buttons (▽ Down/△ Up buttons)
② [TIMER MENU] button (MONITOR/SET button)
③ [Mode] button (BACK button)
④ [Set Time] buttons (▽ Back/△ Ahead buttons)
⑤ [TIMER ON/OFF] button (DAY button)
⑥ [CHECK] button (CLEAR button)
⑦ [TEST RUN] button
⑧ Not available
⑨ [CIR. WATER] button (↵ <Enter> button)
⑩ [INITIAL SETTING] button (▽ Down/△ Up buttons)
⑪ [ON/OFF] button
* Opening the lid.
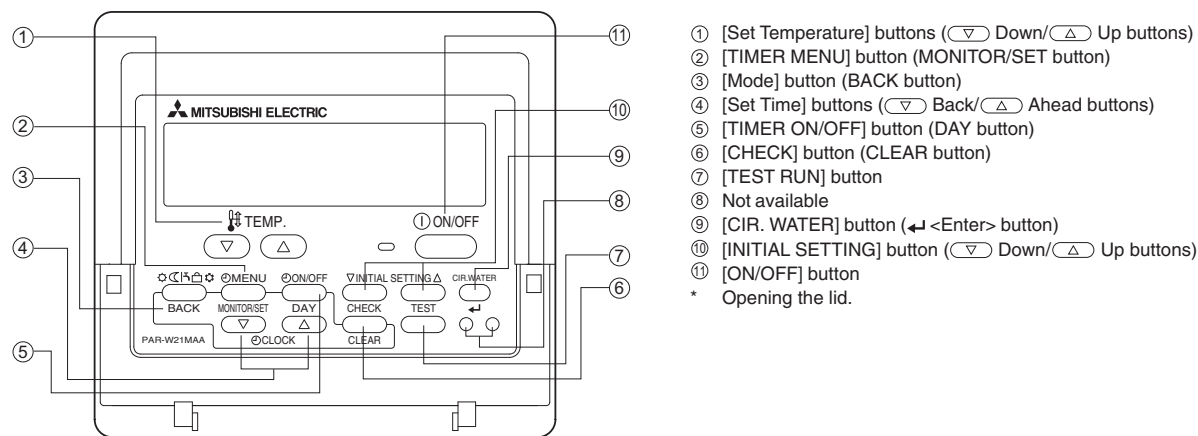
Operation procedures	
Turn on the main power.	→ "PLEASE WAIT" appears on the LCD for up to five minutes.
Set the water temperature to a temperature at least 5 ºC above the current settings. Press the ⑪ ON/OFF button to start operation.	→ Run
To stop the operation, press the ⑪ ON/OFF button.	→ Stop
Note 1: Refer to the following pages if an error code appears on the remote controller or when the unit malfunctions.	

[3] Operating the Unit

1. Initial Operation

(1) Make sure the Run/Stop switch that controls the unit on the local control panel is switched off.

(2) Switch on the main power.

(3) Leave the main power switched on for at least 12 hours before turning on the Run/Stop switch that controls the unit on the on-site control panel to warm up the compressor.

(The compressor will not be warmed up if initial settings have not been made. Make sure to make initial settings.)

(4) Switch on the Run/Stop switch that controls the unit on the on-site control panel.

2. Daily Operation

To start an operation

Switch on the Run/Stop switch that controls the unit on the local control panel, or press the ON/OFF button on the remote controller. (*1)

Note

The unit described in this manual features a circuit that protects the compressor from short-cycling. Once the compressor stops, it will not start up again for up to 10 minutes. If the unit does not start when the ON/OFF switch is turned on, leave the switch turned on for 10 minutes. The unit will automatically start up within 10 minutes.

To stop an operation

Switch off the Run/Stop switch that controls the unit on the on-site control panel, or press the ON/OFF button on the remote controller. (*1)

Refer to the following pages for how to use the remote controller.

IMPORTANT

• Keep the main power turned on throughout the operating season, in which the unit is stopped for three days or shorter (e.g., during the night and on weekends).

• Unless in areas where the outside temperature drops to freezing, switch off the main power when the unit will not be operated for four days or longer. (Switch off the water circulating pump if the pump is connected to a separate circuit.)

• When resuming operation after the main power has been turned off for a full day or longer, follow the steps under "Initial Operation" above.

• If the main power was turned off for six days or longer, make sure that the clock on the unit is correct.

3. Operating the unit from the control board on the unit.

(1) To start the unit
Set the switch SWS1 on the circuit board to "LOCAL."

(2) To stop the unit
Set the switch SWS1 on the circuit board to "OFF."

[4] Refrigerant

Unit type	CAHV-P500YB-HPB
Refrigerant type	R407C
Refrigerant charge	5.5kg × 2

[5] Symptoms that do not Signify Problems

Symptom	Remote controller display	Cause
Fan does not stop while stopping operation.	**Extinguished**	If terminals 19 and 20 on TB5 are short-circuited, the fan will be forced to operate even after the compressor has stopped.
The display shown right will appear on the unit remote controller for about 5 minutes when the main power source is turned on.	**"PLEASE WAIT" ("HO")** **blinking display**	The system is under starting up. Operate the remote controller after the blinking of "PLEASE WAIT" ("HO") is disappeared.

[6] Standard operating characteristics (Reference data)

Reference data

Space requirements	DB	°C	7	16
Ambient temperature	WB	°C	6	12.4
Temperature	Discharge refrigerant	°C	75	72
	Suction refrigerant	°C	6	10
	Shell temperature	°C	20	35
	Air-side heat exchanger inlet	°C	1	7
	Outside temperature	°C	7	16
	Inlet water temperature	°C	40	40
	Outlet water temperature	°C	45	45
Pressure	High pressure	MPa	1.72	1.72
	Low pressure	MPa	0.38	0.47
LEV opening	Main circuit	pulse	550	870
	Injection	pulse	60	60
Compressor	Frequency	Hz	73	59
Fan	Frequency	Hz	55	50

IX Troubleshooting

[1] Maintenance items

1. Checking the error history
   Take the following steps to view the last six error histories (error codes).

Setting procedure

| **Step 1**
Set the dip switches
SW2 and SW3. | Set the dip switches on the circuit board as follows to view error histories. |

SW2	SW3					
10	5	6	7	8	9	10
OFF	OFF	OFF	OFF	OFF	ON	ON

| **Step 2**
Select the desired
item with the push
switch SWP3. | Press the push switch SWP3 to toggle through the item codes listed below.
Select an item code from 1 through 18, and press either of the push switches SWP1 or SWP2 to display the error history (error code) in blinking form. |

| **Step 3**
Press the push
switches SWP1 (↑) or
SWP2 (↓) to increase
or decrease the value. | Refer to "Error history item list" on the next page for the types of errors that appear on error history. |

| **Step 4**
Press the push switch
SWP3 to save the
change. | Press SWP3 to stop the blinking and return to the item code display. |

Error history item list

Item	Item code	LED display	Unit and circuit type				Notes
			Main unit		Sub unit		
			MAIN circuit	SUB circuit	MAIN circuit	SUB circuit	
Error history 1	1	Error Code	○	○	○	○	
Error history 1 details (Inverter error)	2	Error Code	○	○	○	○	
Error history 1/Occurrence time	3	Time	○	○	○	○	
Error history 2	4	Error Code	○	○	○	○	
Error history 2 details (Inverter error)	5	Error Code	○	○	○	○	
Error history 2/Occurrence time	6	Time	○	○	○	○	
Error history 3	7	Error Code	○	○	○	○	
Error history 3 details (Inverter error)	8	Error Code	○	○	○	○	
Error history 3/Occurrence time	9	Time	○	○	○	○	(Note1) (Note2) (Note3)
Error history 4	10	Error Code	○	○	○	○	
Error history 4 details (Inverter error)	11	Error Code	○	○	○	○	
Error history 4/Occurrence time	12	Time	○	○	○	○	
Error history 5	13	Error Code	○	○	○	○	
Error history 5 details (Inverter error)	14	Error Code	○	○	○	○	
Error history 5/Occurrence time	15	Time	○	○	○	○	
Error history 6	16	Error Code	○	○	○	○	
Error history 6 details (Inverter error)	17	Error Code	○	○	○	○	
Error history 6/Occurrence time	18	Time	○	○	○	○	
Inlet water temp (Twi) (* Sub circuit: TH12)	c01	First decimal place	○	○	○	○	
Outlet water temperature (Two)	c02	First decimal place	○	○	○	○	
Discharge refrigerant temperature 1 TH1 / Discharge refrigerant temperature 2 TH5	c03	First decimal place	○	○	○	○	
Suction refrigerant temperature 1 TH2 / Suction refrigerant temperature 2 TH6	c04	First decimal place	○	○	○	○	
Shell temperature 1 TH3 / Shell temperature 2 TH7	c05	First decimal place	○	○	○	○	
Air-side heat exchanger inlet refrigerant temperature 1 TH4 / Air-side heat exchanger inlet refrigerant temperature 2 TH8	c06	First decimal place	○	○	○	○	
Outside temperature TH9	c07	First decimal place	○	○	○	○	
Inlet water temperature 1 TH16 / Inlet water temperature 2 TH12	c08	First decimal place	○	○	○	○	
Outlet water temperature 1 TH11 / Outlet water temperature 2 TH13	c09	First decimal place	○	○	○	○	
Representative water temperature 1 TH14	c10	First decimal place	○	Fixed to 0	Fixed to 0	Fixed to 0	
Representative water temperature 2 TH15	c11	First decimal place	○	Fixed to 0	Fixed to 0	Fixed to 0	
High pressure 1 HP1 / High pressure 2 HP2	c12	Second decimal place	○	○	○	○	
Low pressure 1 LP1 / Low pressure 2 LP2	c13	Second decimal place	○	○	○	○	
Heatsink temperature (THHS)	c14	First decimal place	○	○	○	○	
Water temperature setting using an external analog input (4-20 mA Current input)	c15	First decimal place	(Note5)	Fixed to 0	Fixed to 0	Fixed to 0	
I u(U-phase current)(Compressor)	c16	First decimal place	○	○	○	○	
I w(W-phase current)(Compressor)	c17	First decimal place	○	○	○	○	(Note4)
I dc(Bus current)(Compressor)	c18	First decimal place	○	○	○	○	
Vdc(Bus voltage)(Compressor)	c19	Integer	○	○	○	○	
I u(U-phase current)(Fan)	c20	First decimal place	○	○	○	○	
I w(W-phase current)(Fan)	c21	First decimal place	○	○	○	○	
I dc(Bus current)(Fan)	c22	First decimal place	○	○	○	○	
Vdc(Bus voltage)(Fan)	c23	Integer	○	○	○	○	
Suction SH (target)	c24	First decimal place	○	○	○	○	
Compressor frequency (actual frequency)	c25	Integer	○	○	○	○	
Suction SH	c26	First decimal place	○	○	○	○	
Shell bottom SH	c27	First decimal place	○	○	○	○	
Operating frequency of the fan (actual frequency)	c28	Integer	○	○	○	○	
Opening of the LEV on the main circuit	c29	Integer	○	○	○	○	
Injection LEV opening	c30	Integer	○	○	○	○	
Discharge SH (target)	c31	First decimal place	○	○	○	○	
Discharge SH	c32	First decimal place	○	○	○	○	
Target water temperature	c33	First decimal place	○	○	○	○	
Water temperature setting using an external analog input (0-10 V or 2-10 V Voltage input)	c35	First decimal place	(Note5)	Fixed to 0	Fixed to 0	Fixed to 0	
Water temperature setting using an external analog input (1-5 V Voltage input)	c36	First decimal place	(Note5)	Fixed to 0	Fixed to 0	Fixed to 0	

(Note1) Item codes 1 through 18 indicate error histories. Each history has the error code, error detail code, and time as a set.
(Note2) Error histories are displayed from the newest to the oldest. (Each history has the error code, error detail code, and time as a set.)
          Up to the past six histories can be displayed. (The older ones will be deleted.)
(Note3) If the error history is empty, "----" will blink.
(Note4) Refer to section "2. Checking the sensor status" for details. (page 115)
(Note5) When the input type is selected
          When the input type is not selected = 0

2. Checking the sensor status

Setting procedure

| **Step 1**
Set the dip switches
SW2 and SW3. | Set the dip switches on the circuit board as follows to check temperatures and pressures. |

SW2	SW3					
10	5	6	7	8	9	10
OFF	OFF	OFF	OFF	OFF	ON	ON

| **Step 2**
Select the desired
item with the push
switch SWP3. | Press the push switch SWP3 to toggle through the item codes listed below.
Select an item code from c01 through c36, and press either of the push switches SWP1 or SWP2 to display the current temperature, pressure, and electrical current in blinking form. |

| **Step 3**
Press the push
switches SWP1 (↑) or
SWP2 (↓) to increase
or decrease the value. | Refer to "Sensors and item code list" on the next page for the types of errors that appear on error history. |

| **Step 4**
Press the push switch
SWP3 to save the
change. | Press SWP3 to stop the blinking and return to the item code display. |

Sensors and item code list

Item		Item code	LED display	Unit and circuit type				Notes
MAIN circuit	SUB circuit			Main unit		Sub unit		
				MAIN circuit	SUB circuit	MAIN circuit	SUB circuit	
Error history 1		1	Error Code	○	○	○	○	
Error history 1 details (Inverter error)		2	Error Code	○	○	○	○	
Error history 1/Occurrence time		3	Time	○	○	○	○	
Error history 2		4	Error Code	○	○	○	○	
Error history 2 details (Inverter error)		5	Error Code	○	○	○	○	
Error history 2/Occurrence time		6	Time	○	○	○	○	
Error history 3		7	Error Code	○	○	○	○	
Error history 3 details (Inverter error)		8	Error Code	○	○	○	○	
Error history 3/Occurrence time		9	Time	○	○	○	○	
Error history 4		10	Error Code	○	○	○	○	(Note1)
Error history 4 details (Inverter error)		11	Error Code	○	○	○	○	
Error history 4/Occurrence time		12	Time	○	○	○	○	
Error history 5		13	Error Code	○	○	○	○	
Error history 5 details (Inverter error)		14	Error Code	○	○	○	○	
Error history 5/Occurrence time		15	Time	○	○	○	○	
Error history 6		16	Error Code	○	○	○	○	
Error history 6 details (Inverter error)		17	Error Code	○	○	○	○	
Error history 6/Occurrence time		18	Time	○	○	○	○	
Inlet water temp (Twi)	Inlet water temp 2 TH12	c01	First decimal place	○	○	○	○	(Note2)
Outlet water temperature (Two)		c02	First decimal place	○	○	○	○	(Note2)
Discharge refrigerant 1 TH1	Discharge refrigerant 2 TH5	c03	First decimal place	○	○	○	○	(Note2)
Suction refrigerant 1 TH2	Suction refrigerant 2 TH6	c04	First decimal place	○	○	○	○	(Note2)
Shell temperature 1 TH3	Shell temperature 2 TH7	c05	First decimal place	○	○	○	○	(Note2)
Air-side heat exchanger inlet 1 TH4	Air-side heat exchanger inlet 2 TH8	c06	First decimal place	○	○	○	○	(Note2)
Outside temperature TH9	Outside temperature TH9	c07	First decimal place	○	○	○	○	(Note2)
Inlet water temperature 1 TH16	Inlet water temperature 2 TH12	c08	First decimal place	○	○	○	○	(Note2)
Outlet water temperature 1 TH11	Outlet water temperature 2 TH13	c09	First decimal place	○	○	○	○	(Note2)
Representative water temperature 1 TH14	-	c10	First decimal place	○	Fixed to 0	Fixed to 0	Fixed to 0	(Note2)
Representative water temperature 2 TH15	-	c11	First decimal place	○	Fixed to 0	Fixed to 0	Fixed to 0	(Note2)
High pressure 1 HP1	High pressure 2 HP2	c12	Second decimal place	○	○	○	○	(Note3)
Low pressure 1 LP1	Low pressure 2 LP2	c13	Second decimal place	○	○	○	○	(Note3)
Heatsink temperature(THHS)		c14	First decimal place	○	○	○	○	(Note2)
Water temperature setting using an external analog input (4-20 mA Current input)	-	c15	First decimal place	(Note13)	Fixed to 0	Fixed to 0	Fixed to 0	(Note4)
I u(U-phase current)(Compressor)		c16	First decimal place	○	○	○	○	(Note4)
I w(W-phase current)(Compressor)		c17	First decimal place	○	○	○	○	(Note4)
I dc(Bus current)(Compressor)		c18	First decimal place	○	○	○	○	(Note4)
Vdc(Bus voltage)(Compressor)		c19	Integer	○	○	○	○	(Note5)
I u(U-phase current)(Fan)		c20	First decimal place	○	○	○	○	(Note4)
I w(W-phase current)(Fan)		c21	First decimal place	○	○	○	○	(Note4)
I dc(Bus current)(Fan)		c22	First decimal place	○	○	○	○	(Note4)
V dc(Bus voltage)(Fan)		c23	Integer	○	○	○	○	(Note5)
Suction SH (target)		c24	First decimal place	○	○	○	○	(Note6)
Compressor frequency (actual frequency)		c25	Integer	○	○	○	○	(Note7)
Suction SH		c26	First decimal place	○	○	○	○	(Note8)
Shell bottom SH		c27	First decimal place	○	○	○	○	(Note9)
Operating frequency of the fan (actual frequency)		c28	Integer	○	○	○	○	(Note10)
Opening of the LEV on the main circuit		c29	Integer	○	○	○	○	(Note11)
Injection LEV opening		c30	Integer	○	○	○	○	(Note11)
Discharge SH (target)		c31	First decimal place	○	○	○	○	(Note6)
Discharge SH		c32	First decimal place	○	○	○	○	(Note12)
Target water temperature		c33	First decimal place	○	○	○	○	(Note6)
Water temperature setting using an external analog input (0-10 V or 2-10 V Voltage input)		c35	First decimal place	(Note13)	Fixed to 0	Fixed to 0	Fixed to 0	(Note14)
Water temperature setting using an external analog input (1-5 V Voltage input)		c36	First decimal place	(Note13)	Fixed to 0	Fixed to 0	Fixed to 0	(Note14)

(Note1)   Refer to the section "1. Checking the error history" for further information. (Page 113)
(Note2)   Codes c01 through C11 and c14 indicate temperature sensors.
(Note3)   Codes c12 and c13 indicate pressure sensors.
(Note4)   Codes c15 through c18 and c20 through 22 indicate current sensors.
(Note5)   Codes c19 and c23 indicate voltage sensors.
(Note6)   Codes c24, c31, and c33 indicate target values.
(Note7)   Code c25 indicates compressor's operating frequency.
(Note8)   Code c26 indicates superheat that was calculated based on the low pressure and suction refrigerant temperature.
(Note9)   Code c27 indicates superheat that was calculated based on the low pressure and shell temperature.
(Note10) Code c28 indicates the operating frequency of the fan.
(Note11) Codes c29 and c30 indicate the degree of LEV opening.
(Note12) Code c32 indicates superheat that was calculated based on high pressure and discharge refrigerant temperature.
(Note13) When the input type is selected. When the input type is not selected = 0.
(Note14) c35 and c36 show the external analog input values (water temperature settings)

3.   Operation status before error

Setting procedure

<table>
<tr>
<td>
Step 1
Set the dip switches
SW2 and SW3.
</td>
<td>
Set the dip switches on the circuit board as follows to view the operation status before error.

SW2	SW3					
10	5	6	7	8	9	10
ON	OFF	OFF	OFF	OFF	OFF	OFF
</td>
</tr>
<tr>
<td>
Step 2
Select the desired
item with the push
switch SWP3.
</td>
<td>
Press the push switch SWP3 to toggle through the item codes listed below.
</td>
</tr>
<tr>
<td>
Step 3
Press the push
switches SWP1 (↑) or
SWP2 (↓) to increase
or decrease the value.
</td>
<td>
Select an item code, and press either of the push switches SWP1 or SWP2 to display the data acquisition time (operation data before error; 0 minute before = error occurrence time) and data type. They will appear alternately at one-second intervals.
Every time SWP2 is pressed, the time will go back by one minute, and the time and the temperature (or pressure) will appear alternately at one-second intervals.
Each time SWP1 is pressed, the time will advance by one minute, and the time and the temperature (or pressure) will appear alternately at one-second intervals.
The time immediately before the occurrence of error is defined as 0, and the time can go back up to 19 minutes in one-minute increments.
Up to 20 collections of data can be viewed for each operation data.

Refer to "Time of data storage before error" on the next page for the types of errors that appear on error history.
</td>
</tr>
<tr>
<td>
Step 4
Press the push switch
SWP3 to save the
change.
</td>
<td>
Press SWP3 to stop the blinking and return to the item code display.
</td>
</tr>
</table>

Time of data storage before error

Item		Item code	LED display	Unit and circuit type			
				Main unit		Sub unit	
MAIN circuit	SUB circuit			MAIN circuit	SUB circuit	MAIN circuit	SUB circuit
Inlet water temp (Twi)	Inlet water temp 2 TH12	c01	First decimal place	○	○	○	○
Outlet water temperature (Two)		c02	First decimal place	○	○	○	○
Discharge refrigerant temperature 1 TH1	Discharge refrigerant temperature 2 TH5	c03	First decimal place	○	○	○	○
Suction refrigerant temperature 1 TH2	Suction refrigerant temperature 2 TH6	c04	First decimal place	○	○	○	○
Shell temperature 1 TH3	Shell temperature 2 TH7	c05	First decimal place	○	○	○	○
Air-side heat exchanger inlet refrigerant temperature 1 TH4	Air-side heat exchanger inlet refrigerant temperature 2 TH8	c06	First decimal place	○	○	○	○
Outside temperature TH9	Outside temperature TH9	c07	First decimal place	○	○	○	○
Inlet water temperature 1 TH16	Inlet water temperature 2 TH12	c08	First decimal place	○	○	○	○
Outlet water temperature 1 TH11	Outlet water temperature 2 TH13	c09	First decimal place	○	○	○	○
Representative water temperature 1 TH14		c10	First decimal place	○	Fixed to 0	Fixed to 0	Fixed to 0
Representative water temperature 2 TH15		c11	First decimal place	○	Fixed to 0	Fixed to 0	Fixed to 0
High pressure 1 HP1	High pressure 2 HP2	c12	Second decimal place	○	○	○	○
Low pressure 1 LP1	Low pressure 2 LP2	c13	Second decimal place	○	○	○	○
Heatsink temperature(THHS)		c14	First decimal place	○	○	○	○
Water temperature setting using an external analog input (4-20 mA Current input)		c15	First decimal place	(Note3)	Fixed to 0	Fixed to 0	Fixed to 0
I u(U-phase current)(Compressor)		c16	First decimal place	○	○	○	○
I w(W-phase current)(Compressor)		c17	First decimal place	○	○	○	○
I dc(Bus current)(Compressor)		c18	First decimal place	○	○	○	○
V dc(Bus voltage)(Compressor)		c19	Integer	○	○	○	○
I u(U-phase current)(Fan)		c20	First decimal place	○	○	○	○
I w(W-phase current)(Fan)		c21	First decimal place	○	○	○	○
I dc(Bus current)(Fan)		c22	First decimal place	○	○	○	○
V dc(Bus voltage)(Fan)		c23	Integer	○	○	○	○
Suction SH (target)		c24	First decimal place	○	○	○	○
Compressor frequency (actual frequency)		c25	Integer	○	○	○	○
Suction SH		c26	First decimal place	○	○	○	○
Shell bottom SH		c27	First decimal place	○	○	○	○
Operating frequency of the fan (actual frequency)		c28	Integer	○	○	○	○
Opening of the LEV on the main circuit		c29	Integer	○	○	○	○
Injection LEV opening		c30	Integer	○	○	○	○
Discharge SH (target)		c31	First decimal place	○	○	○	○
Discharge SH		c32	First decimal place	○	○	○	○
Target water temperature		c33	First decimal place	○	○	○	○
Water temperature setting using an external analog input (0-10 V or 2-10 V Voltage input)		c35	First decimal place	(Note3)	Fixed to 0	Fixed to 0	Fixed to 0
Water temperature setting using an external analog input (1-5 V Voltage input)		c36	First decimal place	(Note3)	Fixed to 0	Fixed to 0	Fixed to 0

(Note1) Each circuit board displays error data of its own unit and not other units.
(Note2) "Before error" is defined as the period between 19 minutes before the occurrence of an error up to immediately before the occurrence of the error.
(Note3) When the input type is selected. When the input type is not selected = 0

4. Maintenance setting 1

This category includes items that are set during test run and maintenance.

Setting procedure

<table>
<tr><td>**Step 1**
Set the dip switches SW2 and SW3.</td><td>Set the dip switches on the circuit board as follows.</td></tr>
</table>

SW2	SW3					
10	5	6	7	8	9	10
OFF	OFF	OFF	OFF	ON	OFF	OFF

Note

By setting SW3-9 to ON after setting the dip switches SW2 and SW3 as shown left, the setting values can be checked.
(The settings cannot be changed.)

Step 2
Select the desired item with the push switch SWP3.

Press the push switch SWP3 to toggle through the item codes listed below.
Press the push switches SWP2 and SWP3 to change the value of the selected item.

Step 3
Press the push switches SWP1 (↑) or SWP2 (↓) to increase or decrease the value.

Refer to "Maintenance item (1) list" on the next page for information about the items that can be set.

Step 4
Press the push switch SWP3 to save the change.

Press SWP3 once within one minute of changing the setting with SWP1 or SWP2 to save the setting.
Once the new setting is saved, the display will stop blinking and stay lit. The display will, then, return to the item code display mode.
If SWP3 is not pressed within one minute, the change will not be saved, and the display will return to the item code display mode.

Maintenance item (1) list

	Item code	Incre-ments	Lower limit	Upper limit	Default	Switch setting timing	Unit type				Notes
							Main unit		Sub unit		
							MAIN circuit	SUB circuit	MAIN circuit	SUB circuit	
Forcing the units in a specific system to stop	1004	1	0	3	0	When unit is stopped	○	-	○	-	(Note1)
Outlet water temperature sensor correction (hot water)TH11	1009	-	-	-	-	-	○	-	○	-	(Note2)
Outlet water temperature sensor correction (hot water)TH13	1010	-	-	-	-	-	-	○	-	○	
Inlet water temperature sensor correction (hot water)TH16	1011	-	-	-	-	-	○	-	○	-	
Inlet water temperature sensor correction (hot water)TH12	1012	-	-	-	-	-	-	○	-	○	
Representative water temperature sensor correction (hot water)TH14	1013	-	-	-	-	-	○	-	-	-	
Representative water temperature sensor correction (hot water)TH15	1014	-	-	-	-	-	○	-	-	-	
Built-in thermistor differential DIFF1	1015	-	-	-	-	-	○	○	○	○	(Note3)
Built-in thermistor differential DIFF2	1016	-	-	-	-	-	○	○	○	○	
Cumulative operation time of the compressor	1017	-	-	-	-	Can be reset only when unit is stopped	○	○	○	○	(Note4) (Note5) (Note6)
Cumulative operation time of the compressor (Unit: 10,000 hours)	1018	-	-	-	-	Can be reset only when unit is stopped	○	○	○	○	(Note4) (Note5) (Note6) (Note7)
Temperature data collection interval (S seconds)	1019	1 second	1	9999	60	When unit is stopped	○	○	○	○	(Note8)
Multiple system Thermo-ON/OFF status check interval	1020	1 minute	1	5	1	When unit is stopped	○	-	-	-	(Note9)
Representative water temperature thermistor while the "Temperature shift (Setting temperature A)" function is enabled.	1215	1	14	15	14	When unit is stopped	○	-	-	-	(Note10)
Representative water temperature thermistor while the "Temperature shift (Setting temperature B)" function is enabled.	1216	1	14	15	14	When unit is stopped	○	-	-	-	
Representative water temperature thermistor while the "Temperature shift (Setting temperature C)" function is enabled.	1217	1	14	15	14	When unit is stopped	○	-	-	-	
Start/End time setting 1 Water temp setting	1218	1	1	3	1	When unit is stopped	○	-	-	-	(Note11)
Start/End time setting 2 Water temp setting	1219	1	1	3	1	When unit is stopped	○	-	-	-	
Start/End time setting 3 Water temp setting	1220	1	1	3	1	When unit is stopped	○	-	-	-	

(Note1) Do not use this item. (Stop the units in a given system by setting the slide switch SWS1 to OFF.)
(Note2) Consult your nearest Mitsubishi representative if the sensors go off below the preset values.
(Note3) Consult your nearest Mitsubishi representative.
(Note4) These items can only be displayed. (Their settings cannot be changed.)
(Note5) The cumulative time between 1 and 9999 hours will be displayed in four digits. (unit: hour)
(Note6) Pressing the push switches SW01 and SW02 simultaneously while the time is displayed will reset (initialize) the data to 0.
(Note7) The cumulative time between 10,000 and 99,990,000 hours will be displayed in four digits (unit: 10000 hours)
(Note8) Set the data collection interval by referring to section "3. Operation status before error". (Page 117)
(Note9) The Thermo-ON/OFF status check interval can be adjusted to optimize the ON/OFF operation when the piping length to the load side is long and the detection of changes in water temperature tends to lag behind.
(Note10) Set these settings when using both external thermistors TH14 and TH15 and switching between the two according to the preset water temperature.
(Heating temperature = A°C, Hot water temperature = B °C, Heating ECO temperature = C °C)
(Note11) Set these settings when changing the temperature settings for the units by using the schedule function of the control board.
(Heating temperature: 1 Hot water temperature: 2, Heating ECO temperature: 3)

[2] Troubleshooting

1. If a problem occurs, please check the following. If a protection device has tripped and brought the unit to stop (when an error code is blinking on the LED), resolve the cause of the error before resuming operation.
   Resuming operation without removing the causes of an error may damage the unit and its components.

Problem	Check item	Cause		Solution
The unit does not operate.	The fuse in the control box is not blown.	The power lamp on the circuit board is not lit.	The main power is not turned on.	Switch on the power.
		The power lamp on the circuit board is lit.	The pump interlock circuit is not connected.	Connect the pump interlock circuit wiring to the system.
			The flow switch wiring is not connected.	Connect the flow switch wiring to the system.
	The fuse in the control box is blown.	Measure the circuit resistance and the earth resistance.	Short-circuited circuit or ground fault	Resolve the cause, and replace the fuse.
	The compressor does not operate.	Protection devices have not tripped.	INV board problem	Repair or replace the INV board.
			Noise filter board problem	Repair or replace the noise filter board.
		High-pressure cutout switch has tripped. AHP1	Abnormal high pressure / Dirty condenser (scaling formation)	Clean the condenser.
			Air in the refrigerant circuit	Vacuum the refrigerant circuit, and charge it with refrigerant.
			Water flow shortage	Secure enough water flow rate.
		The discharge temperature thermistor has tripped. AC61	LEV fault in the main circuit	Replace the LEV in the main circuit.
			Injection LEV fault	Replace the injection LEV.
			Injection solenoid valve fault	Replace the solenoid valve.
			Refrigerant gas leakage	Leakage test
			Refrigerant undercharge	Repair the cause of refrigerant shortage, evacuate the system, and charge the refrigerant circuit with refrigerant.
		A thermistor error was detected. 5101~5115	Broken or short-circuited thermistor wiring	Check the thermistor wiring for broken connections or short circuit. Replace the thermistor.
		Overcurrent passed through the compressor. 4250	Compressor motor	Replace the compressor.
			Overload operation	Check the operation patterns.
			Seized compressor shaft	Replace the compressor.
		The pump interlock has tripped.	The pump interlock circuit is not connected.	Connect the pump interlock wiring.
			The water pump is not operating.	Operate the pump.
			Problem with the solenoid contactor for the pump	Replace the solenoid contactor.
		The flow switch has tripped.	The flow switch wiring is not connected.	Connect the flow switch wiring to the system.
			Water flow shortage	Increase the water flow rate.
			Flow switch contact failure	Polish the contact point.
		Automatic Start/Stop thermistor has tripped.	The water temperature has reached above the preset temperature.	Normal
		The motor whines, but will not turn.	Contact failure at a connector terminal	Polish the contact point.
			Loose wire connection	Tighten the wire connection.
			Seized compressor or fan bearing	Disassemble the compressor or the fan, and repair as necessary.
			High-pressure is too high.	Check the operation patterns.
		A momentary overcurrent was detected.	Burned, short-circuited, or ground faulted motor	Replace the compressor, and clean the refrigerant circuit.

Problem	Check item		Cause	Solution
The unit has stopped during operation and does not restart.	Automatic Start/Stop thermistor has tripped.	Water temperature is high.		Normal
		Water temperature is low.	The setting for the automatic Start/Stop thermistor is too low.	Change the setting for the automatic Start/Stop thermistor.
	The high-pressure switch has tripped. AHP1	Water temperature is not high.	Dirty condenser	Clean the condenser.
			Refrigerant overcharge	Evacuate the system, and charge the system with refrigerant.
			Air in the refrigerant circuit	Evacuate the system, and charge the system with refrigerant.
			Water flow shortage	Secure enough water flow rate.
	The vacuum protection has tripped. 1303	Outside temperature is not low.	Refrigerant undercharge, refrigerant gas leakage	Perform a leakage test, repair the leaks, evacuate the system, and charge the refrigerant circuit with refrigerant.
			Dirty evaporator	Clean the evaporator.
			Air flow shortage	Check the evaporator fan for proper operation, and replace it if necessary.
			LEV fault in the main circuit	Replace the LEV in the main circuit.
			Clogged strainer	Replace the strainer.
			Clogged check valve	Replace the check valve.
			Excessive frosting	Install a snow hood to keep snow from accumulating on the unit.
	The discharge temperature thermistor has tripped. AC61	Suction gas is overheated.	Refrigerant undercharge, refrigerant gas leakage	Perform a leakage test, repair the leaks, evacuate the system, and charge the refrigerant circuit with refrigerant.
			LEV fault in the main circuit	Replace the LEV in the main circuit.
			Injection LEV actuation failure	Replace the injection LEV.
			Injection solenoid valve fault	Replace the injection solenoid valve.
			Clogged strainer	Replace the strainer.
			The cooling fan is stopped.	Check the evaporator fan for proper operation, and replace it if necessary.
			High pressure is too high.	Check the items above and make necessary adjustments so that the suction gas temperature falls within the specified temperature range.
The unit has stopped during operation and does not restart.	Overcurrent passed through the compressor. 4250	Outside temperature is high.	Overload operation Burnt motor Seized compressor	Reduce the operation load, and check the operation patterns. Replace the compressor.
	A water supply cutoff was detected. AFSA	The pump is operating normally.	Water flow shortage	Increase the water flow rate.
			Flow switch fault	Replace the flow switch.
		The pump does not operate.	Problem with the solenoid contactor for the pump	Replace the electromagnetic contactor.
			Pump fault	Replace the pump.
	The freeze-up protection function has tripped. AFL1	Water flow shortage	Plate heat exchanger freeze-up during the defrost cycle	Increase the water flow rate.
		The water flow rate is sufficient.	4-way valve fault	Replace the 4-way valve.
The unit is in operation, but the water does not heat up.	Water temperature is low.	The water inlet/outlet temperature differential is normal.	The water-heating load is too high.	Install more units
			Low refrigerant charge due to a leak.	Perform a leakage test, repair the leaks, evacuate the system, and charge the refrigerant circuit with refrigerant.
		The water inlet/outlet temperature differential is small.	LEV fault in the main circuit	Replace the LEV in the main circuit.
			Compressor failure	Replace the compressor.
			High pressure is too high, or low pressure is too low.	Operate the units within the specified pressure range.
	Water temperature is high.		Water flow shortage	Increase the water flow rate.
			Problem with the external devices	Repair the devices.
The unit is making a great deal of vibrations and noise.	The compressor is being flooded.		LEV fault in the main circuit	Replace the LEV.

2. Error code list

*Preliminary error codes will not appear on the 7-segment LED.

Error Type	Cause (problem with the installation environment/setting error)	Cause (component problem)	Error code*1 (PCB*2 RC M-NET)	Resetting the error*3 Unit side (PCB) [SWS1]	Resetting the error*3 Remote [Operation SW]
Errors have not been reset. *6	Some of the errors have not been reset.	• Twenty-one or more errors occurred, and only the latest 20 errors have been cleared. (Resetting more than 20 errors all at once requires a power reset.)	A000	—	—
Power failure *4 • A power interruption of 200 ms or longer was detected.	• There was a power failure while the ON/OFF switch was on.		A-P0	◎	◎
Water-supply cutoff (Flow switch) • The flow switch goes off and stays off for three seconds or longer during Thermo-ON.	• Water flow rate has dropped below the threshold of the flow switch. • Water outage	• Open-circuited flow switch • Broken flow switch wiring	AFSA	○	○
High-pressure fault • The high pressure switch SW (63H) tripped after one second has passed since the operation command was turned on.	• Water depletion • Water outage	• Electronic expansion valve fault • High-pressure sensor fault	AHP1	○	○
Liquid refrigerant floodback • A shell bottom temperature of 10°C or below has been detected for 40 minutes while the compressor is in operation. • A discharge temperature of 10°C or below has been detected for 40 minutes while the compressor is in operation. Note: Shell bottom SH = (Shell temp. - Evaporation temp.) Note: Discharge SH = (Discharge refrigerant temp. - condensation temp.)		• Fan motor error/broken motor wire • Low-pressure sensor fault • Shell temperature thermistor fault • High-pressure sensor fault • Discharge refrigerant temperature thermistor fault • Electronic expansion valve fault • Broken electronic expansion valve wiring • Solenoid valve fault in the hot gas circuit	AdSH	○	○
Vacuum protection • The low pressure has dropped below 0.06 MPa within 30 seconds of compressor start-up. • The low pressure has dropped below 0.06 MPa within 30 seconds of the start of a defrost cycle. • During water heating, the low pressure has dropped by 0.02 MPa after the air-side heat exchanger inlet temperature has reached -31°C. • During water heating, the low pressure has dropped by 0.02 MPa after the air-side suction pipe temperature has reached -33°C. • The outside temperature of 10°C or above has been detected for 20 minutes and the low pressure has dropped below 0.06 MPa during water heating.	• Outside temperature is below the minimum usage temperature. • Sudden frosting or heavy snow has clogged the heat exchanger.	• Low-pressure sensor fault • Air-side HEX inlet thermistor detection error • Suction refrigerant temperature thermistor fault • Electronic expansion valve bypass check valve fault on the main circuit • Electric expansion valve fault on the main circuit • Fan motor error/broken motor wire • Refrigerant shortage (gas leakage)	1303	○	○
Abnormal compressor shell temperature • A shell bottom temperature of 80°C or above has been detected for 20 seconds while the compressor is in operation.	• Outside temperature is above the maximum usage temperature. • Excessive refrigerant oil	• Shell temperature thermistor fault • Electric expansion valve fault on the main circuit	1103	○	○
Thermistor fault — Outside temperature (TH9) • A temperature of -50°C or below OR 80°C or above has been detected for 20 seconds or longer while the operation command is on.		• Broken or short-circuited thermistor wiring (Thermistor fault, pinched lead wire, missing pins on the connectors) • Thermistor input circuit fault on the control board	5109	○	○
Water inlet temperature (TH16 MAIN circuit) Water inlet temperature (TH12 SUB circuit) • A temperature of -10°C or below OR 80°C or above has been detected for 20 seconds or longer while the operation command is on.		• Broken or short-circuited thermistor wiring (Thermistor fault, pinched lead wire, missing pins on the connectors) • Thermistor input circuit fault on the control board	5116 5112	○	○
Water outlet temperature (TH11 MAIN circuit) Water outlet temperature (TH13 SUB circuit) • A temperature of -10°C or below OR 80°C or above has been detected for 20 seconds or longer while the operation command is on.		• Broken or short-circuited thermistor wiring (Thermistor fault, pinched lead wire, missing pins on the connectors) • Thermistor input circuit fault on the control board	5111 5113	○	○
Compressor shell temperature (TH3 MAIN circuit) Compressor shell temperature (TH7 SUB circuit) • A temperature of -50°C or below OR 100°C or above has been detected for 20 seconds or longer while the operation command is on.		• Broken or short-circuited thermistor wiring (Thermistor fault, pinched lead wire, missing pins on the connectors) • Thermistor input circuit fault on the control board	5103 5107	○	○
Discharge temperature (TH1 MAIN circuit) Discharge temperature (TH5 SUB circuit) • A discharge temperature of -20°C or below OR 200°C or above has been detected for 20 seconds while the operation command is on. (on the open-circuited side, this error is detected only after two minutes have passed after compressor startup.)		• Broken or short-circuited thermistor wiring (Thermistor fault, pinched lead wire, missing pins on the connectors) • Thermistor input circuit fault on the control board	5101 5105	○	○

*Preliminary error codes will not appear on the 7-segment LED.

Error Type	Cause (problem with the installation environment/setting error)	Cause (component problem)	Error code[1] (PCB[2] RC M-NET)	Resetting the error[3] Unit side (PCB) SWS1 / Operation SW	Resetting the error[3] Remote (Operation SW)
Thermistor fault — Suction refrigerant thermistor fault (TH2 MAIN circuit) / Suction refrigerant thermistor fault (TH6 SUB circuit) •A temperature of -50°C or below OR above 80°C or above has been detected for 20 seconds or longer while the operation command is on.		•Broken or short-circuited thermistor wiring (Thermistor fault, pinched lead wire, missing pins on the connectors) •Thermistor input circuit fault on the control board	5102 5106	○	○
Air-side heat exchanger inlet thermistor fault (TH4 MAIN circuit) / Air-side heat exchanger inlet thermistor fault (TH8 SUB circuit) •A temperature of -50°C or below OR above 80°C or above has been detected for 20 seconds or longer while the operation command is on.		•Broken or short-circuited thermistor wiring (Thermistor fault, pinched lead wire, missing pins on the connectors) •Thermistor input circuit fault on the control board	5104 5108	○	○
Representative water temperature thermistor (TH14) •A temperature of -50°C or below OR above 80°C or above has been detected for 20 seconds or longer while the operation command is on.		•Broken or short-circuited thermistor wiring (Thermistor fault, pinched lead wire, missing pins on the connectors) •Thermistor input circuit fault on the control board	5114	○	○
High-pressure sensor fault, High-pressure fault •When the operation signal is ON A high-pressure of -0.1 MPa or below (open-circuit) or 4.0 MPa or above (short-circuit) has been detected for 20 seconds.		•Broken or shorted high-pressure sensor wiring (High-pressure sensor fault, broken sheath, missing connector pins) •High-pressure input circuit fault on the control board	5117	○	○
Low-pressure sensor fault, Low-pressure fault •When the operation signal is ON A high-pressure of -0.1 MPa or below (open-circuit) or 2.0 MPa or above (short-circuit) has been detected for 20 seconds.		•Broken or shorted low-pressure sensor wiring (Low-pressure sensor fault, broken sheath, missing connector pins) •Low-pressure input circuit fault on the control board •Pressure drop due to refrigerant leakage	5118	○	○
Model setting error 1 •SW1-1, 1-2, 1-3, or 1-4 (model setting) is set to the setting that corresponds to a model that is not on the model list while the power is turned on.	•Dip switches on the circuit board were set incorrectly at the time of servicing.		7113	×	×
Model setting error 2 •SW1-1, 1-2, 1-3, or 1-4 (model setting) is set to the setting that corresponds to a model that is not on the model list while the power is turned on.		•Resistor Z21 fault (connected to CNTYP1 on the Main control board) •Resistor fault (connected to CNTYP2 on the INV board) •Incorrect SW1 setting on the control board	7117	×	×
Power supply frequency fault When power is turned on •Power supply frequency is determined based on the number of zero crossings (N) per second (timed on a 5 msec timer and calculated in 20 msec increments). The error detection process will be terminated when one of the conditions ① or ② is met wit win one minute. If the error persists for longer than one minute, it will be regarded as a power supply frequency fault. ① 95 times N≦105 times [50 Hz] ② 115 times ≦N≦125 times [60 Hz] ③ N<95 times or N>125 times or 105 times<N<115 times [Power supply frequency error]	•The power supply frequency is at a frequency other than 50 Hz.	•Broken wiring between power supply terminal block TB2 and TB1/TB4. •Broken coil (L1, L2, or L3) •Noise filter fault (Voltage measured at CN3 connector is below 180 V.) •Blown fuse F01, F02, or F03 on the noise filter board •Blown fuse F06 on the control board •Control board fault (If the items above are normal)	4115	×	×
Open phase •An open phase of three seconds or longer has been detected when the power was turned on or when the power is on.	•L1, L2, or L3-phase is open. •Power supply fault •Power supply voltage drop	•Broken wiring between power supply terminal block TB2 and TB1/TB4. •Broken coil (L1, L2, or L3) •Noise filter fault (Voltage measured at CN3 connector is below 180 V.) •Blown fuse F01, F02, or F03 on the noise filter board •Broken wiring between CN3 on the noise filter board and CNAC on the control board (MAIN board) •Voltage drop (180 V or below) at CNAC on the control board (Main board) •Faulty attachment of ACCT3 (The wiring that connects TB23 on the noise filter board and the SC-T on the INV boards does not pass through ACCT3.) •ACCT3 fault (if A471 appears after the compressor has gone into operation) •MAIN board fault (If the items above are normal)	A471 (Preliminary error code 4152 will appear if the T-phase is open.)	×	×

[IX Troubleshooting]

*Preliminary error codes will not appear on the 7-segment LED.

Error Type	Cause (problem with the installation environment/setting error)	Cause (component problem)	Error code*1 (PCB*2 RC M-NET)	Resetting the error*3 Unit side (PCB) SWS1	Resetting the error*3 Remote Operation SW
Power supply fault ●After a power reset, if nomal power suppy is not detected five consecutive times at 20 ms intervals, this will be regarded as an error. *8		●Transmission power supply output fault / Wiring fault / Detection of overcurrent in the transmission power supply / Transmission power supply fault / Transmission voltage detection circuit fault / Transmission power supply power reception fault / In a multiple unit system, one unit started supplying power, but the other units have not.	4106 (Details : 255)	—	—
Active filter fault	●Incorrect dip switch setting ●Incorrect SW2-4 setting		4121 (Preliminary : 4171)	◎	◎
Discharge temperature fault ●Preliminary : A discharge temperature of 120°C or above has been detected for 30 seconds while the compressor is in operation. ●Error : The above preliminary error was detected three times. ●Error : A discharge temperature of 125°C or above was detected momentarily.	●Water depletion ●Abrupt water temperature change (5K/min or greater) ●Pump fault	●High-pressure sensor fault ●Discharge refrigerant thermistor fault ●Linear expansion valve fault (Main circuit LEV, injection LEV) ●Injection solenoid valve fault ●Fan motor error ●Fan inverter fault ●Refrigerant shortage (gas leakage) ●Thermistor input circuit fault on the control board	AC61 (Preliminary AC71)	○	○
Heat exchanger freeze up ●A suction temperature of -2°C or below has been detected for 10 seconds during the defrost cycle and 30 seconds after the initiation of the defrost cycle. *7	●Drop in water flow or water outage during defrost ●Water temperature drop during defrost	●4-way valve switching failure	1104	○	○
Inverter fault — Current-related problem during normal operation — IPM error ●30 seconds after the compressor has started up ●An overcurrent was detected by the overcurrent detection resistor (RSH) on the INV board. ●An IPM error signal was detected.		●INV board fault ●Ground fault of the compressor or fan motor ●Coil fault on the compressor or fan motor ●IPM fault (loose terminal screws, cracks due to swelling) ●Items in the "Heatsink overheat protection" row in the "Cause" column.	4250 4255 (Preliminary : 4350) (Preliminary : 4355) (Details : 101)	○	○
ACCT overcurrent ●30 seconds after the compressor has started up ●A peak current of at or above 56A or 33 Arms was detected by the current sensor.		●INV board fault ●Compressor ground fault ●Coil failure ●IPM fault (loose terminal screws, cracks due to swelling)	4250 4255 (Preliminary : 4350) (Preliminary : 4355) (Details : 102)	○	○
DCCT overcurrent ●30 seconds after the compressor has started up ●A peak current of at or above 56A or 33 Arms was detected by the current sensor.			4250 4255 (Preliminary : 4350) (Preliminary : 4355) (Details : 103)	○	○
Overcurrent relay trip (effective value) (During normal operation) ●30 seconds after the compressor has started up ●A current of at or adove 33 Arms was detected by the current sensor.			4250 4255 (Preliminary : 4350) (Preliminary : 4355) (Details : 107)	○	○

*Preliminary error codes will not appear on the 7-segment LED.

Error Type		Cause (problem with the installation environment/setting error)	Cause (component problem)	Error code*1 (PCB*2 RC M-NET)	Resetting the error*3 Unit side (PCB) SWS1	Resetting the error*3 Remote Operation S/W
Inverter fault	Current-related problem during normal operation	Overcurrent relay trip (momentary value) (During normal operation) • 30 seconds after the compressor has started up • A current of at or adove 56 A peak was detected by the current sensor.			4250 4255 (Preliminary : 4350) (Preliminary : 4355) (Details : 106)	○	○
		Short-circuited IPM/ground fault (During normal operation) • A short-circuited IPM or a ground fault on the load side was detected.		• Compressor ground fault • IPM fault (loose terminal screws, cracks due to swelling)	4250 4255 (Preliminary : 4350) (Preliminary : 4355) (Details : 104)	○	○
		Overload short circuit (During normal operation) • A ground fault of the compressor or fan motor was detected.	• Power supply voltage drop (Inter-phase voltage of 342 V or below)	• Compressor ground fault • Short-circuited output signal wire	4250 4255 (Preliminary : 4350) (Preliminary : 4355) (Details : 105)	○	○
	Current-related problem at startup	IPM error At startup • Occurred 30 seconds after the compressor has started up. • An overcurrent was detected by the overcurrent detection resistor (RSH) on the INV board. • An IPM error signal was detected.		• INV board fault • Ground fault of the compressor or fan motor • Coil failure • IPM fault (loose terminal screws, cracks due to swelling) • Items in the "Heatsink overheat protection" row in the "Cause" column.	4250 4255 (Preliminary : 4350) (Preliminary : 4355) (Details : 101)	○	○
		ACCT overcurrent At startup • Occurred 30 seconds after the compressor has started up. • A peak current of at or above 56A or 33 Arms was detected by the current sensor.		• INV board fault • Compressor ground fault • Coil failure • IPM fault (loose terminal screws, cracks due to swelling)	4250 4255 (Preliminary : 4350) (Preliminary : 4355) (Details : 102)	○	○
		DCCT overcurrent At startup • Occurred 30 seconds after the compressor has started up. • A peak current of at or above 56A or 33 Arms was detected by the current sensor.			4250 4255 (Preliminary : 4350) (Preliminary : 4355) (Details : 103)	○	○
		Overcurrent relay trip (effective value) At startup • Occurred 30 seconds after the compressor has started up. • A current of at or adove 33 Arms was detected by the current sensor.			4250 4255 (Preliminary : 4350) (Preliminary : 4355) (Details : 107)	○	○
		Overcurrent relay trip (momentary value) At startup • Occurred 30 seconds after the compressor has started up. • A current of at or adove 33 Arms was detected by the current sensor.			4250 4255 (Preliminary : 4350) (Preliminary : 4355) (Details : 106)	○	○

*Preliminary error codes will not appear on the 7-segment LED.

Inverter fault

Error Type	Cause (problem with the installation environment/setting error)	Cause (component problem)	Error code*1 (PCB*2 RC M-NET)	Resetting the error*3 — Unit side (PCB) SWS1	Resetting the error*3 — Remote (Operation SW)
Voltage-related problem during normal operation — Bus voltage drop protection trip	● Momentary power failure and power failure ● Power supply voltage drop (Inter-phase voltage of 342 V or below) ● Voltage drop	● CNDC2 wiring connection fault on the INV board ● INV board fault ● 72C fault ● Diode stack failure	4220 4225 (Preliminary : 4320) (Preliminary : 4325) (Details: 108)	○	○
Voltage-related problem during normal operation — BUS voltage rise up	● Wrong power supply voltage	● INV board fault	4220 4225 (Preliminary : 4320) (Preliminary : 4325) (Details: 109)	○	○
Voltage-related problem during normal operation — Logic error	Malfunction due to external electrical noise ● Faulty grounding ● Faulty transmission and external wiring (use of non-shield wire) ● Contact between low-voltage signal wiring and high-voltage wiring (Placement of multiple power supply wires in the same conduit.)	● INV board fault	4220 4225 (Preliminary : 4320) (Preliminary : 4325) (Details: 111)	○	○
Voltage fault at startup ● BUS voltage drop protection trip at startup (detected on the Main side)	● Power supply voltage drop	● Circuit board fault	4220 4225 (Preliminary : 4320) (Preliminary : 4325) (Details: 131)	○	○
Heatsink fault ● Heatsink overheat protection	● Power supply voltage drop (Inter-phase voltage of 342 V or below) ● Blocked cooling air passage (heatsink)	● Fan motor error ● Inverter board fan output fault ● THHS sensor fault ● IPM fault (loose terminal screws, cracks due to swelling)	4230 4235 (Preliminary : 4330) (Preliminary : 4335)	○	○
Overload protection trip	● Short-cycling of air (air flow drop) ● Blocked cooling air passage (heatsink) ● Power supply voltage drop (Inter-phase voltage of 342 V or below)	● THHS sensor fault ● Electric current sensor fault ● Inverter board fan output fault ● Inverter circuit fault ● Compressor fault	4240 4245 (Preliminary : 4340) (Preliminary : 4345)	○	○
ACCT sensor fault		● INV board fault ● Compressor ground fault and IPM fault	5301 5305 (Preliminary : 4301) (Preliminary : 4305) (Details: 115)	○	○
DCCT sensor fault		● Compressor ground fault and IPM fault	5301 5305 (Preliminary : 4300) (Preliminary : 4305) (Details: 116)	○	○
ACCT sensor/circuit fault		● ACCT sensor fault	5301 5305 (Preliminary : 4300) (Preliminary : 4305) (Details: 117)	○	○

*Preliminary error codes will not appear on the 7-segment LED.

Error Type		Cause (problem with the installation environment/setting error)	Cause (component problem)	Error code*1 (PCB*2 RC M-NET)	Resetting the error*3 Unit side (PCB) SWS1	Resetting the error*3 Remote Operation SW
Inverter fault	DCCT sensor/circuit fault		●DCCT sensor fault ●INV board fault	5301 5305 (Preliminary : 4300) (Preliminary : 4305) (Details : 118)	○	○
	Open-circuited IPM/Disconnected ACCT sensor		●ACCT sensor fault ●Broken compressor wiring ●Inverter circuit fault (IPM fault)	5301 5305 (Preliminary : 4300) (Preliminary : 4305) (Details : 119)	○	○
	Incorrect wiring		●ACCT sensor fault	5301 5305 (Preliminary : 4300) (Preliminary : 4305) (Details : 120)	○	○
	THHS sensor/circuit fault		●THHS sensor fault (Thermistor fault, pinched lead wire, missing pins on the connectors) ●Thermistor input circuit fault on the circuit board ●INV board fault	5110 (Preliminary : 1214) (Details COMP : 01) (Details FAN : 05)	○	○
	Serial communication error		●Communication error between control board and INV board (noise interference, broken wiring)	0403 (Preliminary : 4300) (Preliminary : 4305) (Details COMP : 01) (Details FAN : 05)	○	○
	IPM system error	●INV board switch setting error	●Wiring or connector connection failure between connectors on IPM-driven power supply circuit ●INV board fault	- (Preliminary : 4300)	○	○
Remote controller error (incl. remote controller wiring fault)	Address overlap	●There are two or more of the same address.		6830	×	×
	Non-consecutive address, system error	●Address setting error (Non-consecutive address)		7105	×	×
	Remote controller signal reception error 1	●Remote controller cables are not connected. ●Broken wiring	●Broken remote controller wiring ●Communication circuit fault on the control board	6831	—	—
	Remote controller signal transmission error	●Communication error due to external noise interference	●Communication circuit fault on the control board	6832	×	×
	Remote controller over current	●Remote controller cable is short		6833	×	×
	Remote controller signal reception error 2	●Communication error due to external noise interference	●Communication circuit fault on the control board	6834	—	—
Multiple unit system error	Address setting error	●Address setting error (Non-consecutive address)		7105	×	×
	Incompatible combination of units	●Different types of units are connected to the same system.		7130	×	×
	No.-of-connected-unit setting is incorrect	●No.-of-connected-unit setting is incorrect (Main unit)		7102	×	×
	Analog input error (Control board (MAIN) CN421)	●Analog input type fault See item code 21	●Broken or open 4-20mA signal output device wiring (CN421)	4126 1001	○	○
	Communication error between Main & Sub units Communication error between the MAIN and SUB circuits		●Connector contact failure at CN102 on the control board ●Contact failure at the MA-MB terminal block on the MAIN circuit or terminal block TB3 on the SUB circuit.	6500	—	—

*Preliminary error codes will not appear on the 7-segment LED.

Error Type	Cause (problem with the installation environment/setting error)	Cause (component problem)	Error code*1 (PCB*2 RC M-NET)	Resetting the error*3 Unit side (PCB) SWS1	Resetting the error*3 Remote Operation SW
Transmission line power supply PCB fault Communication error between the main and sub units (Multiple system mode) *5	Communication error due to external noise interference	Broken wiring to the transmission power supply circuit board (between the main and sub units)	6600	×	×
			6602		
		Transmission power supply PCB communication circuit fault	6603	—	—
			6606		
		Broken M-NET line	6607		
			6608		

*1. The codes in the parentheses in the "Error code" column indicate error detail codes.
*2. If an error occurs, error codes shown above will blink in the 4-digit digital display on the PCB.
*3. Definition of symbols in the "Error reset" column
     ◎ ···· Errors that can be reset regardless of the switch settings
     ○ ···· Errors that cannot be reset if the remote reset setting on the unit is set to "Enable" (factory setting)
           Errors that cannot be reset if the remote reset setting on the unit is set to "Disable"
     × ···· Errors that cannot be reset
     — ···· Errors that will be automatically cancelled once its cause is removed
*4. Power failure will be detected as an error only when the "Automatic recovery after power failure" setting on the unit is set to "Disable."
     (The default setting for the "Automatic recovery after power failure" setting is "Enable.")
*5. Depending on the system configuration, if transmission power supply board fault lasts for 10 minutes or longer, units will make an abnormal stop.
     This error can be reset by turning off and then back on the unit's power.
*6. This error code will appear when multiple errors occur that are reset in different ways and when one or more of these errors have not been reset.
     This error can be reset by turning off and then back on the unit's power.
*7. Before resetting this error, remove its causes.
     Resuming operation without removing the causes of heat exchanger freeze up will cause heat exchanger damage.

[3] Troubleshooting Principal Parts

-1- High-Pressure Sensor (63HS)

1. Compare the pressure that is detected by the high pressure sensor, and the high-pressure gauge pressure to check for failure.

Error history, temperature and pressure readings of the sensor, and LEV opening

SW2	SW3					
10	5	6	7	8	9	10
OFF	OFF	OFF	OFF	OFF	OFF	OFF

High pressure and low pressure will appear alternately on the 7-segment LED at P-second intervals (Default: 3 seconds). See below for how they are displayed.

Decimal delimiter

A dot will appear when the compressor is in operation. No dot will appear when the compressor is stopped.

Indicates that the high pressure is displayed

Indicates that the low pressure is displayed

(1) While the sensor is stopped, compare the gauge pressure and the pressure displayed on self-diagnosis LED1.

1) When the gauge pressure is between 0 and 0.098MPa, internal pressure is caused due to gas leak.
2) When the pressure displayed on self-diagnosis LED1 is between 0 and 0.098MPa, the connector may be defective or be disconnected. Check the connector and go to (4).
3) When the pressure displayed on self-diagnosis LED1 exceeds 3.85MPa, go to (3).
4) If other than 1), 2) or 3), compare the pressures while the sensor is running. Go to (2).

(2) Compare the gauge pressure and the pressure displayed on self-diagnosis LED1 while the sensor is running. (Compare them by MPa unit.)

1) When the difference between both pressures is within 0.098MPa, both the high pressure sensor and the control board are normal.
2) When the difference between both pressures exceeds 0.098MPa, the high pressure sensor has a problem. (performance deterioration)
3) When the pressure displayed on self-diagnosis LED1 does not change, the high pressure sensor has a problem.

(3) Remove the high pressure sensor from the control board to check the pressure on the self-diagnosis LED1.

1) When the pressure displayed on self-diagnosis LED1 is between 0 and 0.098MPa , the high pressure sensor has a problem.
2) When the pressure displayed on self-diagnosis LED1 is approximately 3.85MPa, the control board has a problem.
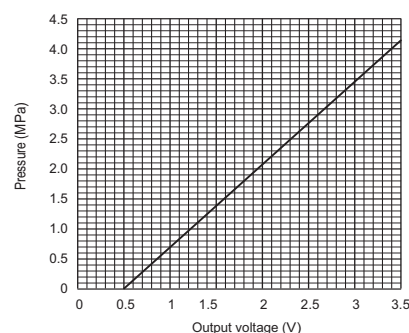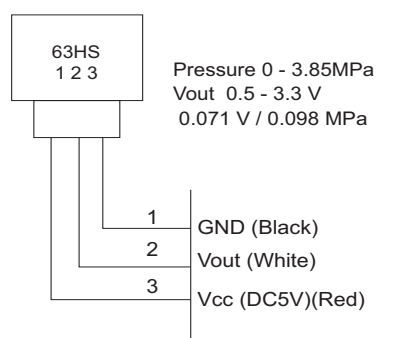
(4) Remove the high pressure sensor from the control board, and short-circuit between the No.2 and 3 connectors (63HS:CN63HS) to check the pressure with self-diagnosis LED1.

1) When the pressure displayed on the self-diagnosis LED1 exceeds 3.85MPa, the high pressure sensor has a problem.
2) If other than 1), the control board has a problem.

2. Pressure sensor configuration

The high pressure sensor consists of the circuit shown in the figure below. If DC 5V is applied between the red and the black wires, voltage corresponding to the pressure between the white and the black wires will be output, and the value of this voltage will be converted by the microcomputer. The output voltage is 0.071V per 0.098MPa.

	Control board side
Vcc	Pin 3
Vout	Pin 2
GND	Pin 1

63HS
1 2 3

Pressure 0 - 3.85MPa
Vout 0.5 - 3.3 V
0.071 V / 0.098 MPa

1 GND (Black)
2 Vout (White)
3 Vcc (DC5V)(Red)

-2- Low-Pressure Sensor (63LS)

1. Compare the pressure that is detected by the low pressure sensor, and the low pressure gauge pressure to check for failure.

Error history, temperature and pressure readings of the sensor, and LEV opening

SW2	SW3					
10	5	6	7	8	9	10
OFF	OFF	OFF	OFF	OFF	OFF	OFF

High pressure and low pressure will appear alternately on the 7-segment LED at P-second intervals (Default: 3 seconds). See below for how they are displayed.

Decimal delimiter
A dot will appear when the compressor is in operation.
No dot will appear when the compressor is stopped.

Indicates that the high pressure is displayed

Indicates that the low pressure is displayed

(1) While the sensor is stopped, compare the gauge pressure and the pressure displayed on self-diagnosis LED1.
1) When the gauge pressure is between 0 and 0.098MPa, internal pressure is caused due to gas leak.
2) When the pressure displayed on self-diagnosis LED1 is between 0 and 0.098MPa , the connector may be defective or be disconnected. Check the connector and go to (4).
3) When the pressure displayed on self-diagnosis LED1 exceeds 1.7MPa, go to (3).
4) If other than 1), 2) or 3), compare the pressures while the sensor is running. Go to (2).

(2) Compare the gauge pressure and the pressure displayed on self-diagnosis LED1 while the sensor is running.(Compare them by MPa unit.)
1) When the difference between both pressures is within 0.03MPa, both the low pressure sensor and the control board are normal.
2) When the difference between both pressures exceeds 0.03MPa, the low pressure sensor has a problem. (performance deterioration)
3) When the pressure displayed on the self-diagnosis LED1 does not change, the low pressure sensor has a problem.

(3) Remove the low pressure sensor from the control board to check the pressure with the self-diagnosis LED1 display.
1) When the pressure displayed on the self-diagnosis LED1 is between 0 and 0.098MPa, the low pressure sensor has a problem.
2) When the pressure displayed on self-diagnosis LED1 is approximately 1.7MPa, the control board has a problem.
  ◆When the outdoor temperature is 40°C or less, the control board has a problem.
  ◆When the outdoor temperature exceeds 40°C, go to (5).

(4) Remove the low pressure sensor from the control board, and short-circuit between the No.2 and 3 connectors (63LS:CN63LS) to check the pressure with the self-diagnosis LED1.
1) When the pressure displayed on the self-diagnosis LED1 exceeds 1.7MPa, the low pressure sensor has a problem.
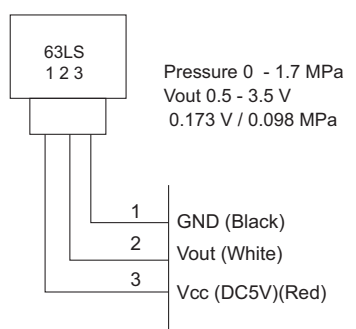2) If other than 1), the control board has a problem.

(5) Remove the high pressure sensor (63HS) from the control board, and insert it into the connector for the low pressure sensor (63LS:CN63LS) to check the pressure with the self-diagnosis LED1.
1) When the pressure displayed on the self-diagnosis LED1 exceeds 1.7MPa, the control board has a problem.
2) If other than 1), the control board has a problem.

2. Low-pressure sensor configuration
The low pressure sensor consists of the circuit shown in the figure below. If DC5V is applied between the red and the black wires, voltage corresponding to the pressure between the white and the black wires will be output, and the value of this voltage will be converted by the microcomputer. The output voltage is 0.173V per 0.098MPa.

	Control board side
Vcc	Pin 3
Vout	Pin 2
GND	Pin 1

63LS
1 2 3
Pressure 0 - 1.7 MPa
Vout 0.5 - 3.5 V
0.173 V / 0.098 MPa

1 GND (Black)
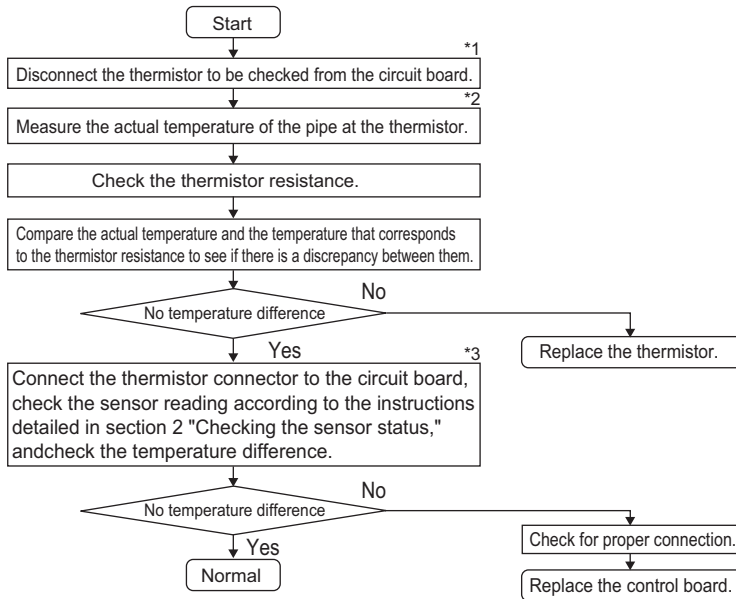2 Vout (White)
3 Vcc (DC5V)(Red)
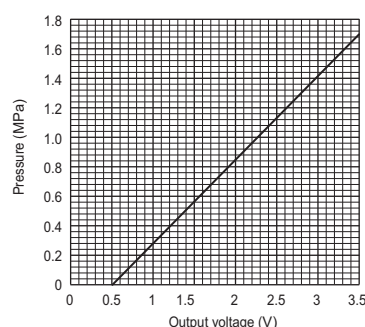
-3- Temperature sensor

Use the flowchart below to troubleshoot the temperature sensor.

Troubleshooting the thermistor

(1)Thermistor <Heatsink temperature> :THHS

Thermistor R_{50} = 17 kΩ±2 %

$R_t = 17\exp\{4016(\dfrac{1}{273+t} - \dfrac{1}{323})\}$

* 1   The table below shows the thermistor numbers and their corresponding connectors.
Check each sensor by disconnecting the corresponding connector.

TH1 · TH5	CN401	
TH3 · TH7	CN402	3-4
TH2 · TH6	CN402	1-2
TH4 · TH8	CN404	

TH9	CN405	
TH16 · TH12	CN407	1-2
TH11 · TH13	CN407	3-4

* 2   · Pull out the sensor connector from the I/O board.
         Do not pull on the lead wire.
       · Measure the resistance with a tester.
       · If the measured value is within ± 10% of the value as shown in the table below, the circuit sensor is normal.

* 3   Use the dip switches and push switches to view the sensor reading on the LED.
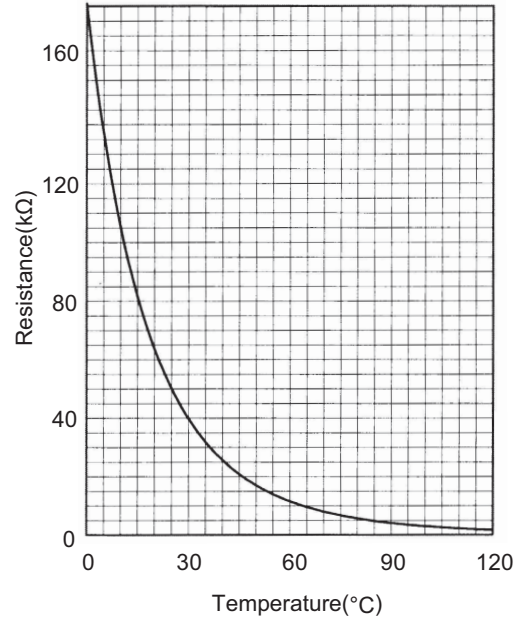
(2) Low-temperature-range thermistor
     : TH2,3,4,6,7,8,9,11,12,13,16

Thermistor R_0 = 15kΩ±3%

$R_t = 15\exp\{3385(\dfrac{1}{273+t} - \dfrac{1}{273})\}$
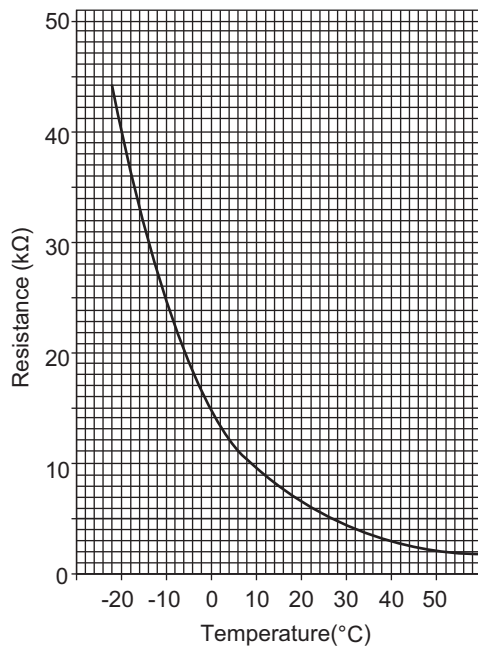
(3) High-temperature-range thermistor: TH1,TH5

Thermistor R_{120} = 7.465kΩ±2%

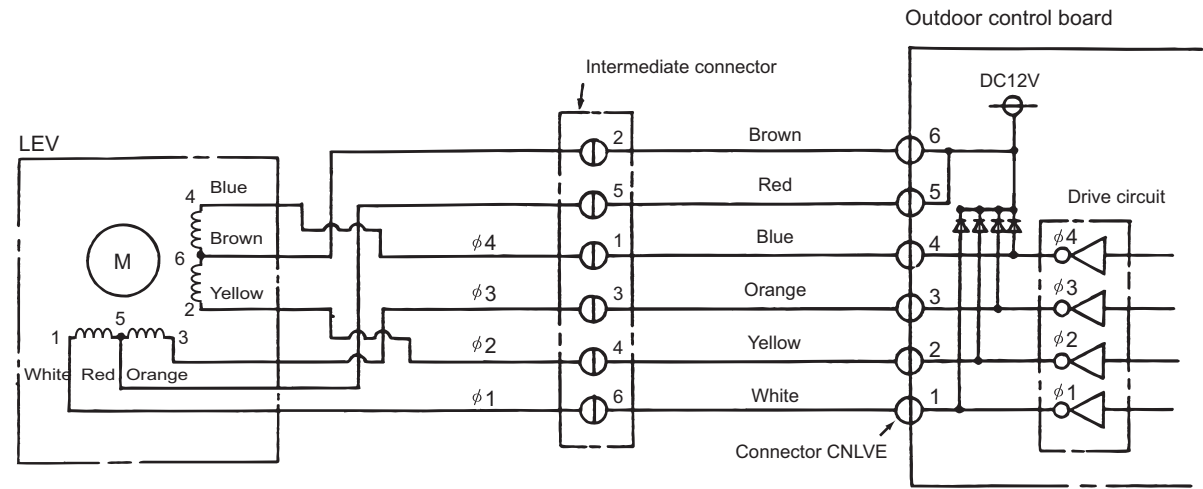$R_t = 7.465\exp\{4057(\dfrac{1}{273+t} - \dfrac{1}{393})\}$
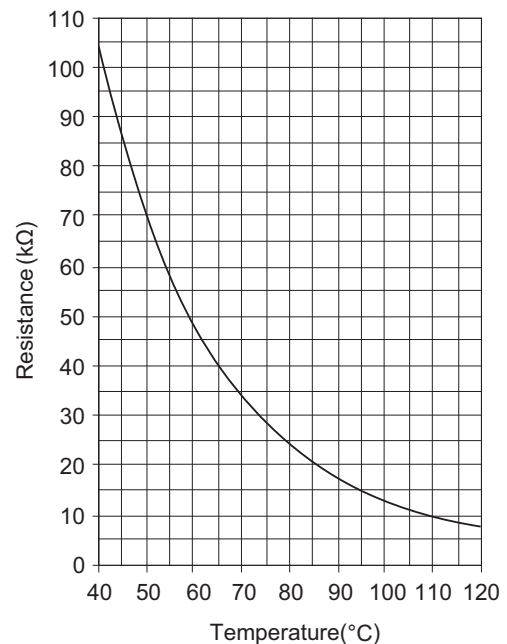
-4- LEV

1. General descriptions of the operation of the LEV in the main circuit

LEV1 is driven by the pulse signal from the circuit board and is controlled by a stepping motor.

The valve opening changes according to the number of pulses

1) Control board and LEV

Note. The connector numbers on the intermediate connector and the connector on the control board differ. Check the color of the lead wire to judge the number.

2) Pulse signal output and valve operation

Output (phase) number	Output state			
	1	2	3	4
$\phi 1$	ON	OFF	OFF	ON
$\phi 2$	ON	ON	OFF	OFF
$\phi 3$	OFF	ON	ON	OFF
$\phi 4$	OFF	OFF	ON	ON

Output pulses change in the following orders when the
  Valve is closed; 1 → 2 → 3 → 4 → 1
  Valve is open; 4 → 3 → 2 → 1 → 4

*1. When the LEV opening angle does not change,
   all the output phases will be off.
*2. When the output is open phase or remains ON,
   the motor cannot run smoothly, and rattles and vibrates.

3) LEV valve closing and opening operatio
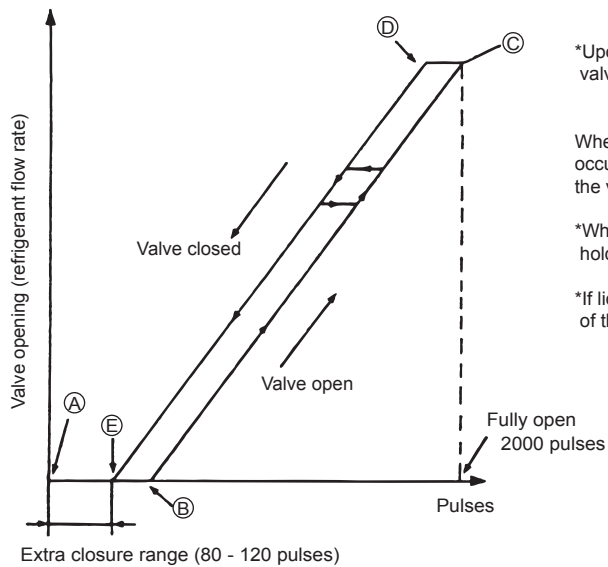
*Upon power on, a 2260 pulse signal is sent to the LEV to determine the
 valve position and bring the valve to the position indicated by " Ⓐ " in the diagram

When the valve operates smoothly, no sound from LEV or no vibration
occurs, however, when the pulses change from Ⓔ to Ⓐ in the chart or
the valve is locked, a big sound occurs.

*Whether a sound is generated or not can be determined by
 holding a screwdriver against it, then placing your ear against the handle.

*If liquid refrigerant is present in the LEV, it may make the operating sound
 of the LEV difficult to detect.

2. General descriptions of injection LEV operation

The valve opening changes according to the number of pulses.

1) Control board and LEV

Connector CNLVE
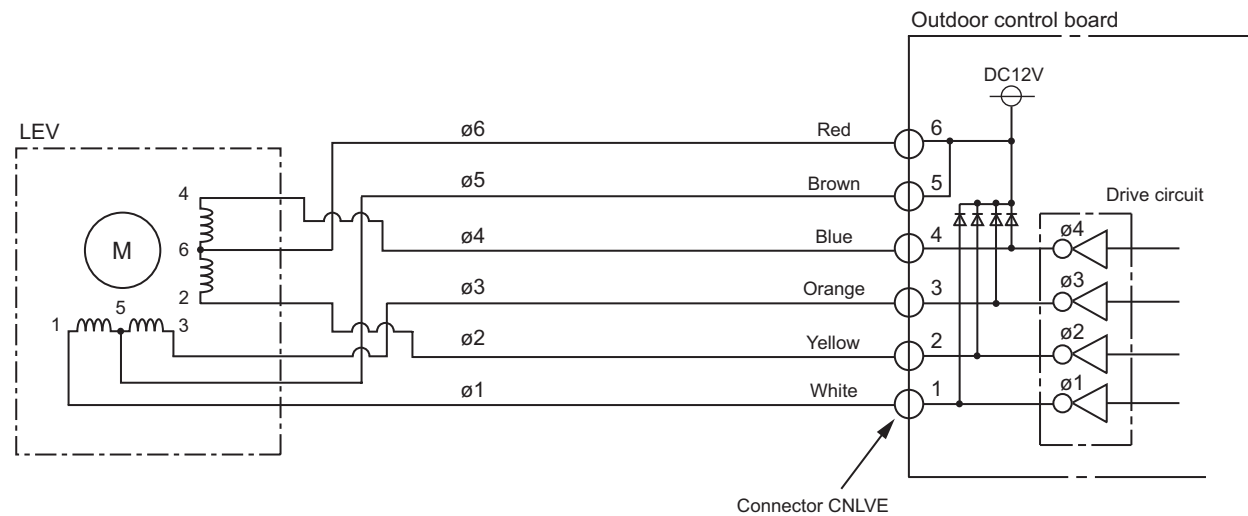
2) Pulse signal output and valve operation

Output (phase) number	Output state							
	1	2	3	4	5	6	7	8
$\phi 1$	ON	OFF	OFF	OFF	OFF	OFF	ON	ON
$\phi 2$	ON	ON	ON	OFF	OFF	OFF	OFF	OFF
$\phi 3$	OFF	OFF	ON	ON	ON	OFF	OFF	OFF
$\phi 4$	OFF	OFF	OFF	OFF	ON	ON	ON	OFF

Output pulses change in the following orders when the

Valve is open; $1 \rightarrow 2 \rightarrow 3 \rightarrow 4 \rightarrow 5 \rightarrow 6 \rightarrow 7 \rightarrow 8 \rightarrow 1$

Valve is closed; $8 \rightarrow 7 \rightarrow 6 \rightarrow 5 \rightarrow 4 \rightarrow 3 \rightarrow 2 \rightarrow 1 \rightarrow 8$

*1. When the LEV opening angle does not change, all the output phases will be off.

*2. When the output is open phase or remains ON, the motor cannot run smoothly, and rattles and vibrates.
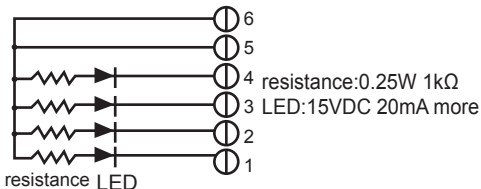
3) LEV valve closing and opening operatio
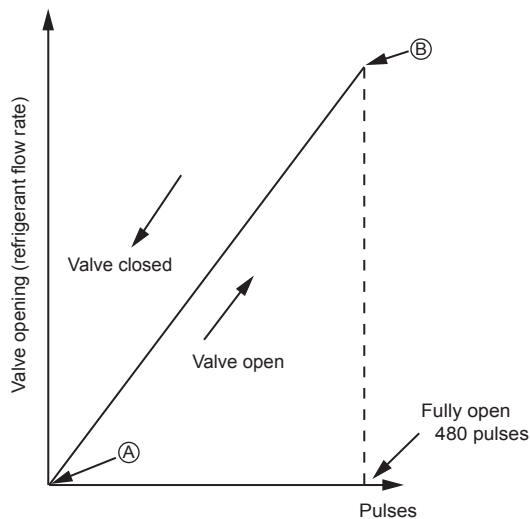
*Upon power on, a 520 pulse signal is sent to the LEV to determine the valve position and bring the valve to the position indicated by "Ⓐ" in the diagram. (Pulse signal is output for approximately 17 seconds.)

The LEV is free of noise and vibration when it is functioning properly, but it makes a noise when it becomes locked.

*Whether a sound is generated or not can be determined by holding a screwdriver against it, then placing your ear against the handle.

*If liquid refrigerant is present in the LEV, it may make the operating sound of the LEV difficult to detect.

(1) Judgment methods and possible failure mode

| Malfunction mode	Judgment method	Remedy
Microcomputer driver circuit failure	Disconnect the control board connector and connect the check LED as shown in the figure below. resistance:0.25W 1kΩ LED:15VDC 20mA more resistance LED Pulse signal is output for 17 seconds when the main power is turned on. If there is any LED that remains unlit or remains lit, there is a problem with the drive circuit.	When the drive circuit has a problem, replace the control board.
LEV mechanism is locked	If the LEV is locked, the drive motor runs idle, and makes a small clicking sound. When the valve makes a closing and opening sound, the valve has a problem.	Replace the LEV.
Disconnected or short-circuited LEV motor coil	Measure resistance between the coils (red - white, red -orange, brown - yellow, brown - blue) using a tester. They are normal if resistance is 150ohm ± 10%.	Replace the LEV coils.
	Measure resistance between the coils (red - white, red -orange, brown - yellow, brown - blue) using a tester. They are normal if resistance is 46ohm ± 3%.	Replace the LEV coils.
Faulty wire connections in the connector or faulty contact	1. Check for loose pins on the connector and check the colors of the lead wires visually 2. Disconnect the control board's connector and conduct a continuity check using a tester.	Check the continuity at the points where an error occurs.

3. Injection LEV coil removal procedure

The LEV consists of a coil and a valve body that can be separated from each other.

Coils
Stopper
Body
Lead wire
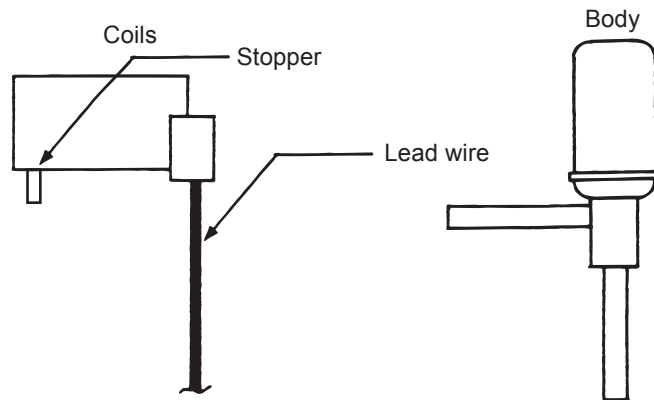
(1) Removing the coils

Fasten the body tightly at the bottom (Part A in the figure) so that the body will not move, then pull out the coils toward the top.If the coils are pulled out without the body gripped, undue force will be applied and the pipe will be bent.
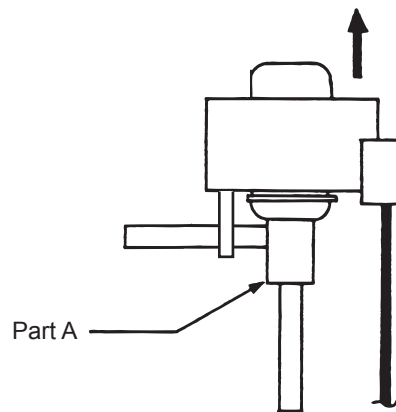
Part A

(2) Installing the coils

Fix the body tightly at the bottom (Part A in the figure) so that the body will not move, then insert the coils from the top, and insert the coil stopper securely in the pipe on the body. Hold the body when pulling out the coils to prevent so that the pipe will not be bent.
If the coils are pushed without the body gripped, undue force will be applied and the pipe will be bent. Hold the body when pulling out the coils to prevent so that the pipe will not be bent.

Part A
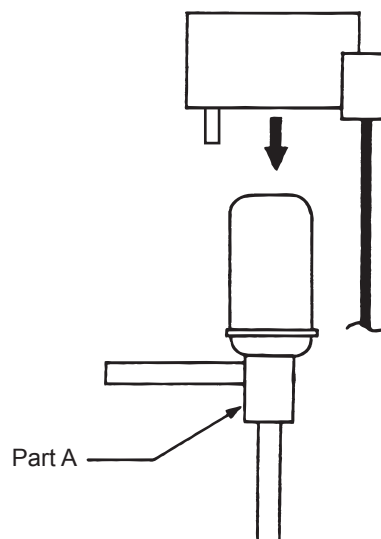
-5- Inverter

- ⋆<u>Replace only the compressor</u> if only the compressor is found to be defective.
- ⋆<u>Replace only the fan motor</u> if only the fan motor is found to be defective.
- ⋆Replace the defective components if the inverter is found to be defective.
- ⋆If both the compressor and the inverter are found to be defective, replace the defective component(s) of both devices.

(1) Inverter-related problems: Troubleshooting and remedies

1) The INV board has a large-capacity electrolytic capacitor, in which residual voltage remains even after the main power is turned off, posing a risk of electric shock. Before inspecting the inside of the control box, turn off the power, keep the unit off for at least 10 minutes, and confirm that the voltage between FT-P and FT-N on INV Board has dropped to DC20V or less. (It takes about 10 minutes to discharge electricity after the power supply is turn off.)

2) The IPM on the inverter becomes damaged if there are loose screws are connectors. If a problem occurs after replacing some of the parts, mixed up wiring is often the cause of the problem. Check for proper connection of the wiring, screws, connectors, and Faston terminals.

3) To avoid damage to the circuit board, do not connect or disconnect the inverter-related connectors with the main power turned on.

4) Faston terminals have a locking function. Make sure the terminals are securely locked in place after insertion.

Press the tab on the terminals to remove them.
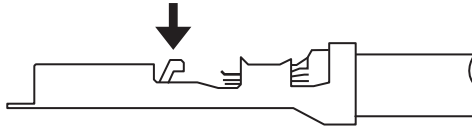
5) When the IPM or IGBT is replaced, apply a thin layer of heat radiation grease that is supplied evenly to these parts. Wipe off any grease that may get on the wiring terminal to avoid terminal contact failure.

6) Faulty wiring to the compressor damages the compressor. Connect the wiring in the correct phase sequence.

		Error display/failure condition	Measure/inspection item
[1]		Inverter related errors 4250, 4255, 4220, 4225, 4230, 4235, 4240, 4245, 5301, 5305, 5110, 0403	Check the details of the inverter error in the error log at [1] Error history item list.(page 114) Take appropriate measures to the error code and the error details in accordance with [2] 2.Error code list.(page 123)
[2]		Main power breaker trip	Refer to "(3) Trouble treatment when the main power breaker is tripped".(page 141)
[3]		Main power earth leakage breaker trip	Refer to "(4) Trouble treatment when the main power earth leakage breaker is tripped".(page 141)
[4]		Only the compressor does not operate.	Check the inverter frequency on the LED monitor and proceed to (2) -[4] if the compressor is in operation.(page 140)
[5]		The compressor vibrates violently at all times or makes an abnormal sound.	See (2)-[4].(page 140)
[6]		Only the fan motor does not operate.	Check the inverter frequency on the LED monitor and proceed to (2)-[6] if the fan motor is in operation.(page 140)
[7]		The fan motor shakes violently at all times or makes an abnormal sound.	Check the inverter frequency on the LED monitor and proceed to (2)-[6] if the fan motor is in operation.(page 140)
[8]		Noise is picked up by the peripheral device	<1> Check that power supply wiring of the peripheral device does not run close to the power supply wiring of the outdoor unit.
			<2> Check if the inverter output wiring is not running parallel to the power supply wiring and the transmission lines.
			<3> Check that the shielded wire is used as the transmission line when it is required, and check that the grounding work is performed properly on the shielded wire.
			<4> Meg failure for electrical system other than the inverter
			<5> Attach a ferrite core to the inverter output wiring. (Contact the factory for details of the service part settings.)
			<6> Provide separate power supply to the air conditioner and other electric appliances.
			<7> If the error occurred suddenly, a ground fault of the inverter output can be considered. See (2)-[4].(page 140)
			*Contact the factory for cases other than those listed above.
[9]		Sudden malfunction (as a result of external noise.)	<1> Check that the grounding work is performed properly.
			<2>Check that the shielded wire is used as the transmission line when it is required, and check that the grounding work is performed properly on the shielded wire.
			<3>Check that neither the transmission line nor the external connection wiring does not run close to another power supply system or does not run through the same conduit pipe.
			* Contact the factory for cases other than those listed above.

(2) Inverter output related troubles

	Items to be checked		Phenomena	Remedy
[1] Check the INV board error detection circuit.	(1)	Disconnect the inverter output wire from the terminals of the INV board (SC-U, SC-V, SC-W).	1) Overcurrent error (4250 Detail code No. 101, 104, 105, 106, and 107)	Replace the INV board.
	(2)	Put the outdoor unit into operation.	2) Logic error (4220 Detail code No. 111)	Replace the INV board.
			3) ACCT sensor circuit failure (5301 Detail code No.117)	Replace the INV board.
			4) IPM open (5301 Detail code No.119)	Normal
[2] Check for compressor ground fault or coil error.	Disconnect the compressor wiring, and check the compressor Meg, and coil resistance.		1) Compressor Meg failure Error if less than 1 Mohm.	Check that there is no liquid refrigerant in the compressor. If there is none, replace the compressor.
			2) Compressor coil resistance failure Coil resistance value of 0.092 ohm (20°C)	Replace the compressor.
[3] Check whether the inverter is damaged. (No load)	(1)	Disconnect the inverter output wire from the terminals of the INV board (SC-U, SC-V, SC-W).	1) Inverter-related problems are detected.	Connect the short-circuit connector to CN6, and go to section [1].
	(2)	Disconnect the short-circuit connector from CN6 on the INV board.	2) Inverter voltage is not output at the terminals (SC-U, SC-V, and SC-W)	Replace the INV board.
	(3)	Put the outdoor unit into operation. Check the inverter output voltage after the inverter output frequency has stabilized.	3) There is an voltage imbalance between the wires. Greater than 5% imbalance or 5V	Replace the INV board.
			4) There is no voltage imbalance between the wires.	Normal *Reconnect the short-circuit connector to CN6 after checking the voltage.

	Items to be checked	Phenomena	Remedy
[4] Check whether the inverter is damaged. (During compressor operation)	Put the outdoor unit into operation. Check the inverter output voltage after the inverter output frequency has stabilized.	1) Overcurrent-related problems occur immediately after compressor startup. Error code : 4250 Detail code : 101, 106, 107	a. Check items [1] through [3] for problems. b. Check that high and low pressures are balanced. c. Check that no liquid refrigerant is present in the compressor. →Go to "d." when the problem persists after compressor startup was repeated several times. If normal operation is restored, check the crankcase heater for problems. d. Check that there is a pressure difference between high and low pressures after compressor startup. →Check the high pressure with LED monitor for changes. Replace the compressor if there is no pressure difference. (the compressor may be locked.)
		2) There is a voltage imbalance between the wires after the inverter output voltage is stabilized. Greater than the larger of the following values: imbalance of 5% or 5V	Replace the INV board if there is a voltage imbalance. Check the crankcase heater for problems if there is no voltage imbalance. →When the error occurred, liquid refrigerant may have been present in the compressor.
[5] Check the fan motor ground fault or the winding.	Remove the wire for the outdoor fan motor, and check the fan motor megger and the winding resistance.	1) Fan motor megger failure Failure when the megger is 1Mohm or less.	Replace the fan motor.
		2) Fan motor disconnection Standard: The winding resistance is approximately several ohm. (It varies depending on the temperature, or while the inner thermo is operating, it will be ∞ ohm)	
[6] Check the fan inverter board failure.	(1) Check the fan output wiring.	Connector contact failure •Board side (CNINV) •Fan motor side	Connect the connector.
	(2) Check the connector CN-VDC connection.	Cnnector contact failure	Connect the connector.
	(3) Check the FAN board failure.	1) The voltage imbalance among each motor wiring during operation (The voltage imbalance is greater than the larger of the values represented by 5% or 5V.)	Replace the FAN board.
		2) The same error occurs even after the operation is restarted.	

(3) Trouble treatment when the main power breaker is tripped

	Items to be checked	Phenomena	Remedy
[1]	Check the breaker capacity.	Use of a non-specified breaker	Replace it with a specified breaker.
[2]	Perform Meg check between the terminals on the power terminal block TB4.	Zero to several ohm, or Meg failure	Check each part and wiring. *Refer to (5) "Simple checking procedure for individual components of main inverter circuit".(page 142) ◆IGBT module ◆Rush current protection resistor ◆Electromagnetic relay ◆DC reactor
[3]	Turn on the power again and check again.	1) Main power breaker trip	
		2) No remote control display	
[4]	Turn on the outdoor unit and check that it operates normally.	1) Operates normally without tripping the main breaker.	a) The wiring may have been short-circuited. Search for the wire that short-circuited, and repair it.
		2) Main power breaker trip	b) If item a) above is not the cause of the problem, refer to (2)-[1]-[6].(page 139)

(4) Trouble treatment when the main power earth leakage breaker is tripped

	Items to be checked	Phenomena	Remedy
[1]	Check the earth leakage breaker capacity and the sensitivity current.	Use of a non-specified earth leakage breaker	Replace with a regulation earth leakage breaker.
[2]	Check the resistance at the power supply terminal block with a megger.	Failure resistance value	Check each part and wiring. *Refer to (5) "Simple checking procedure for individual components of main inverter circuit".(page 142) ◆IGBT module ◆Rush current protection resistor ◆Electromagnetic relay ◆DC reactor
[3]	Disconnect the compressor wirings and check the resistance of the compressor with a megger.	Failure compressor if the insulating resistance value is not in specified range. Failure when the insulating resistance value is 1 Mohm or less.	Check that there is no liquid refrigerant in the compressor. If there is none, replace the compressor.
[4]	Disconnect the fan motor wirings and check the resistance of the fan motor with a megger.	Failure fan motor if the insulating resistance value is not in specified range. Failure when the insulating resistance value is 1 Mohm or less.	Replace the fan motor.

Note

The insulation resistance could go down to close to 1Mohm after installation or when the power is kept off for an extended period of time because of the accumulation of refrigerant in the compressor. If the earth leakage breaker is triggered, please use the following procedure to take care of this.
◆Disconnect the wires from the compressor's terminal block.
◆If the resistance is less than 1 Mohm, switch on the power for the outdoor unit with the wires still disconnected.
◆Leave the power on for at least 12 hours.
◆Check that the resistance has recovered to 1 Mohm or greater.

Earth leakage current measurement method
◆For easy on-site measurement of the earth leakage current, enable the filter with a measurement instrument that has filter functions as below, clamp all the power supply wires, and measure.
Recommended measurement instrument: CLAMP ON LEAK HiTESTER 3283 made by HIOKI E.E. CORPORATION
◆When measuring one device alone, measure near the device's power supply terminal block.

(5) Simple checking procedure for individual components of main inverter circuit

Note

Before inspecting the inside of the control box, turn off the power, keep the unit off for at least 10 minutes, and confirm that the voltage between FT-P and FT-N on INV Board has dropped to DC20V or less.

Part name	Judgment method
IGBT module	See "Troubleshooting for IGBT Module ". (IX [3] -5- (6))(page 142)
Rush current protection resistor R1, R5	Measure the resistance between terminals R1 and R5: 22 ohm $\pm$ 10%
Electromagnetic relay 72C	Note This electromagnetic relay is rated at DC12V and is driven by a coil. Check the resistance between terminals <table><tr><td></td><td>Check point</td><td>Checking criteria(W)</td></tr><tr><td>Coil</td><td>Between Terminals 5 and 6</td><td>Not to be short-circuited (Center value 75 ohm)</td></tr><tr><td rowspan="2">Contact</td><td>Between Terminals 1 and 2</td><td>∞</td></tr><tr><td>Between Terminals 3 and 4</td><td>∞</td></tr></table>
DC reactor DCL	Measure the resistance between terminals: 1ohm or lower (almost 0 ohm) Measure the resistance between terminals and the chassis: ∞

(6) Troubleshooting for IGBT Module

Measure the resistances between each pair of terminals on the IGBT with a tester, and use the results for troubleshooting. The terminals on the INV board are used for the measurement.

1) Notes on measurement

♦Check the polarity before measuring. (On the tester, black normally indicates plus.)
♦Check that the resistance is not open (∞ ohm) or not shorted (to 0 ohm).
♦The values are for reference, and the margin of errors is allowed.
♦The result that is more than double or half of the result that is measured at the same measurement point is not allowed.
♦Disconnect all the wiring connected the INV board, and make the measurement.

2) Tester restriction

♦Use the tester whose internal electrical power source is 1.5V or greater
♦Use the dry-battery-powered tester.

Note

(The accurate diode-specific resistance cannot be measured with the button-battery-powered card tester, as the applied voltage is low.)

♦Use a low-range tester if possible. A more accurate resistance can be measured.

Judgment value (reference)

		Black (+)				
		SC-P1	FT-N	SC-L1	SC-L2	SC-L3
Red (-)	SC-P1	-	-	5 - 200 ohm	5 - 200 ohm	5 - 200 ohm
	FT-N	-	-	∞	∞	∞
	SC-L1	∞	5 - 200 ohm	-	-	-
	SC-L2	∞	5 - 200 ohm	-	-	-
	SC-L3	∞	5 - 200 ohm	-	-	-

		Black (+)				
		SC-P2	FT-N	SC-U	SC-V	SC-W
Red (-)	SC-P2	-	-	5 - 200 ohm	5 - 200 ohm	5 - 200 ohm
	FT-N	-	-	∞	∞	∞
	SC-U	∞	5 - 200 ohm	-	-	-
	SC-V	∞	5 - 200 ohm	-	-	-
	SC-W	∞	5 - 200 ohm	-	-	-

INV board external diagram

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-6- Control Circuit

Troubleshooting transmission power circuit of outdoor unit
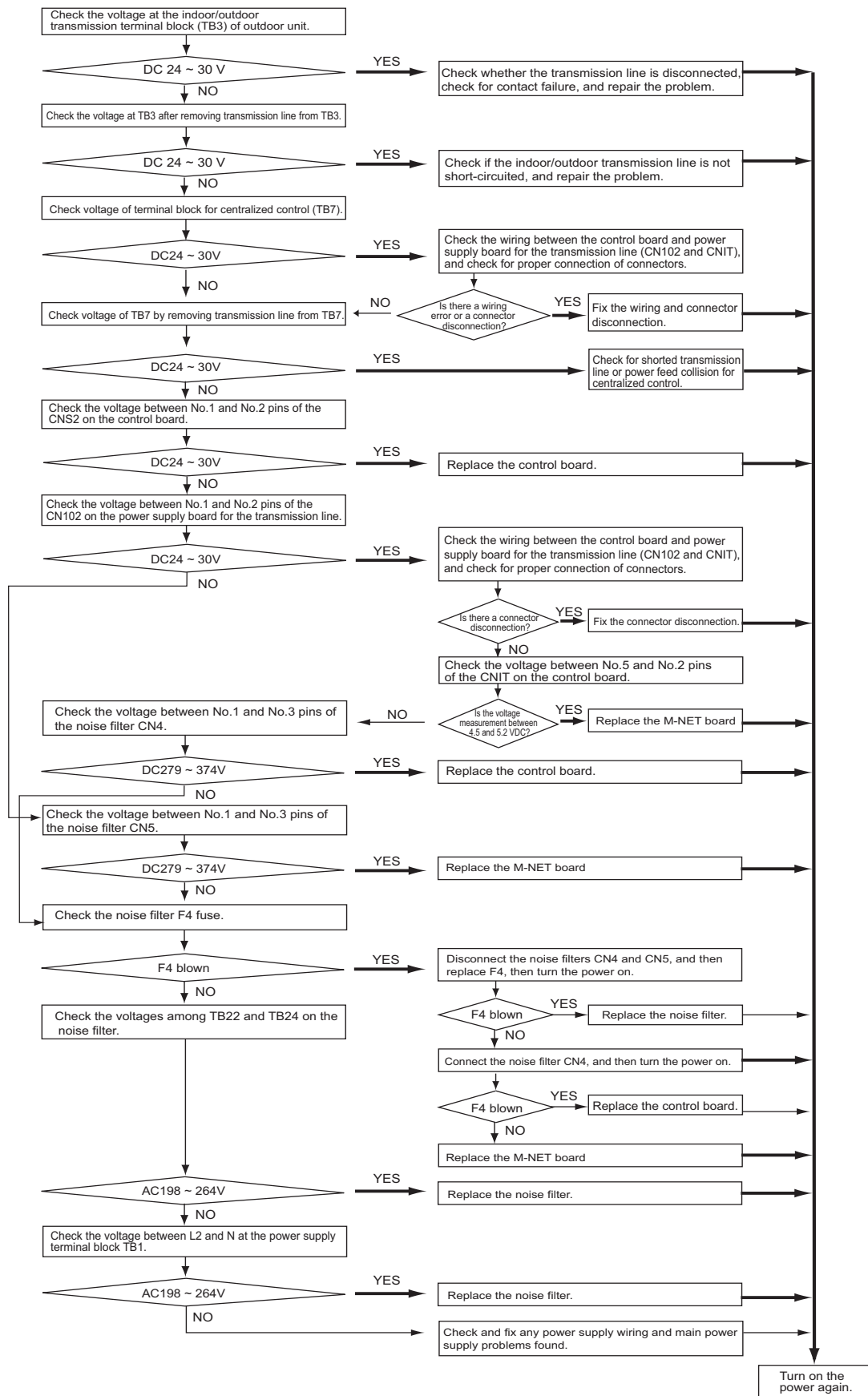
-7- Fan

The rotation speed of the fan is controlled by the inverter. Check the inverter output status on the LED to check the rotation speed. The maximum rotation speed of the fan is approximately 670 rpm. Make appropriate settings on the display function to get the output to be displayed [%]. Refer to section 2 "Checking the sensor status" for how to use the display function (page 115). 73% indicates that the fan is operating at full speed, and 0% indicates that the fan is stopped.

The rotation speed of the fan changes according to the number of units in operation. If the fan does not operate or if it vibrates, FAN INV board problem or fan motor error is suspected. Refer to section -5-(2) [5] "Check the fan motor ground fault or the winding." (page 140) and section [6] "Check the fan inverter board failure." (page 140)

-8- Troubleshooting

1. Important notes

If the unit or its refrigerant circuit components experience malfunctions, take the following steps to prevent recurrence.

(1) Diagnose the problem and find the cause.

(2) Before repairing leaks on the brazed sections on the pipes, recover the refrigerant. Braze under nitrogen purge to prevent oxidation.

(3) If any component (including the compressor) malfunctions, only replace the affected parts; it is not necessary to replace the entire unit.

(4) Be sure to recover the refrigerant from the unit before disposing of the unit.

(5) If the cause of the problem cannot be identified, contact the service desk with the following information: unit model, serial number, and the nature of the problem.

2. Before replacing the fan

(1) Before replacing the fan, turn off the main power of the unit.

(2) The motor connectors are on the FAN INV board in the control box and can be accessed by removing the service panel and the fan guard.

(3) Install the fan wires as they were, using the same route and all required clamps.

[4] Refrigerant Leak

⚠ **WARNING**

Do not use refrigerant other than the type indicated in the manuals provided with the unit and on the nameplate.
• Doing so may cause the unit or pipes to burst, or result in explosion or fire during use, during repair, or at the time of disposal of the unit.   • It may also be in violation of applicable laws.   • MITSUBISHI ELECTRIC CORPORATION cannot be held responsible for malfunctions or accidents resulting from the use of the wrong type of refrigerant.

1. **Leak spot: In the case of outdoor unit (Heating season)**
1) Collect the refrigerant in the entire system (outdoor unit).Do not discharge refrigerant into the atmosphere when it is collected.
2) Repair the leak.
3) Repair the leak, and evacuate the air from the entire system [*1].
   Charge the system with 5.5 kg of R407C.

*1. Refer to Chapter I [5] Vacuum Drying (Evacuation) for detailed procedure. (page 7)

## [5] Parts Replacement Procedures

⚠ **WARNING**

Do not use refrigerant other than the type indicated in the manuals provided with the unit and on the nameplate.

- Doing so may cause the unit or pipes to burst, or result in explosion or fire during use, during repair, or at the time of disposal of the unit.
- It may also be in violation of applicable laws.
- MITSUBISHI ELECTRIC CORPORATION cannot be held responsible for malfunctions or accidents resulting from the use of the wrong type of refrigerant.
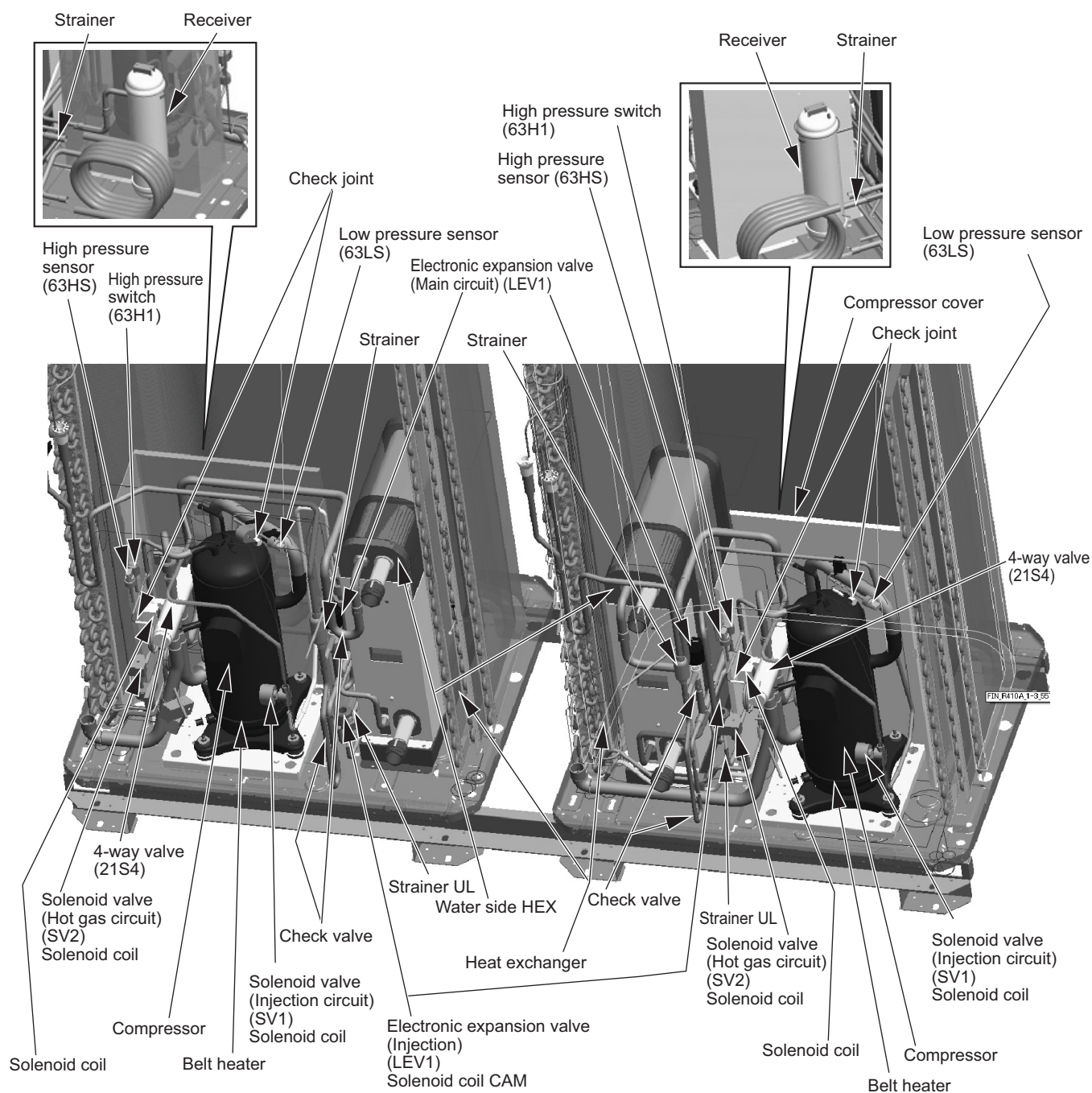
1. Compressor Replacement instructions

Follow the procedures below (Step 1 through 6) to remove the compressor components and replace the compressor. Reassemble them in the reverse order after replacing the compressor.
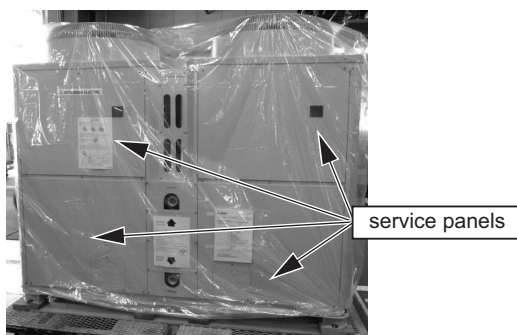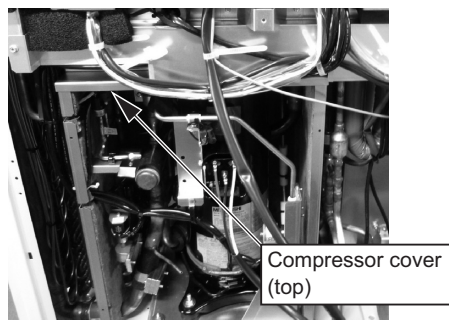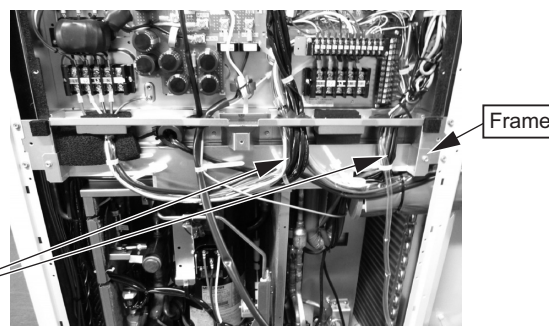

service panels

1. Remove both the top and bottom service panels. (front panels)

control boxes
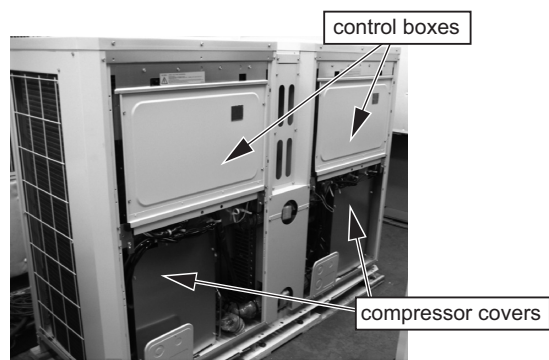
compressor covers

2. Remove the control box and the compressor cover. (front)

Electric wirings
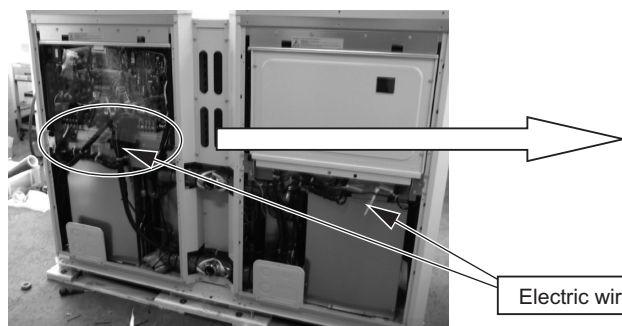
Frame

3. Remove the wires that are secured to the frames, and remove the frames.

Compressor cover (top)

4. Remove the compressor cover. (top)

Compressor covers (right and left) The inside of the compressor cover is insulation material.
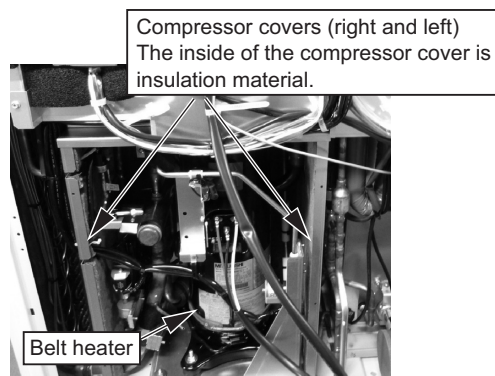
Belt heater

5. Remove the compressor wires, compressor covers (right and left), and belt heater.


Suction pipe

Protection for the compressor cover
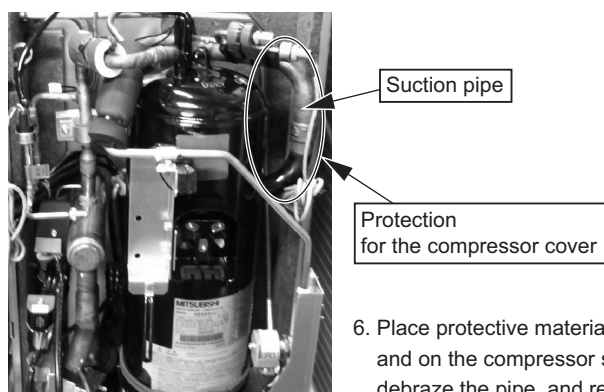
6. Place protective materials on the insulation lining compressor cover and on the compressor suction pipe to protect them from the torch flame, debraze the pipe, and replace the compressor.

Attachment instructions for INJ pipe fixing plate

INJ pipe fixing plate

Butyl rubber

INJ pipe fixing plate

attachment   Temporary tightening
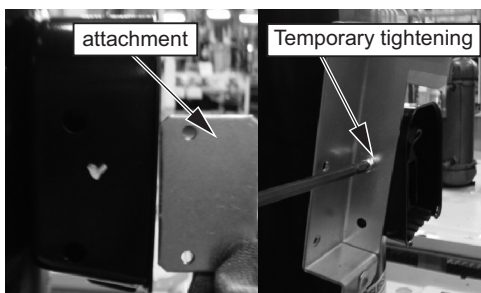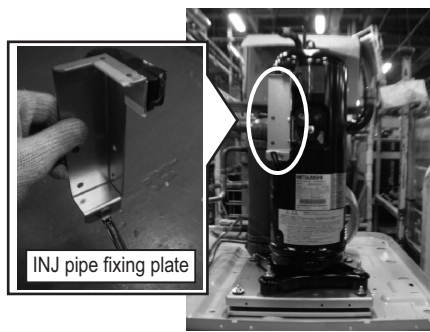
1. Hold the attachment and INJ pipe fixing plate against the terminal box, aligning the holes with the hole on the terminal box, and then temporarily screw in the top screw to hold them in place.
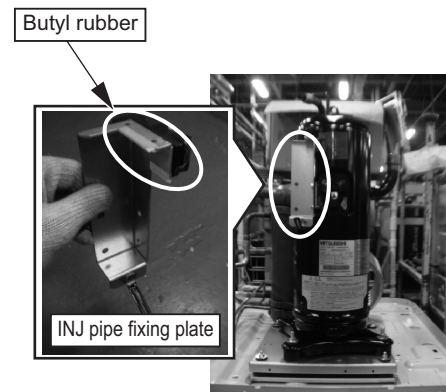
2. Press the butyl rubber on the fixing plate against the compressor shell.

Final tightening

Final tightening
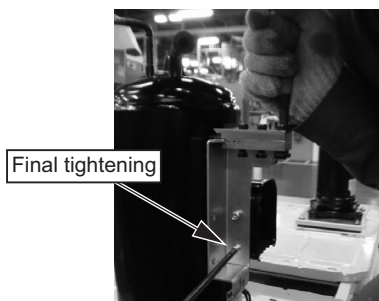
3. Tighten the fixing screw at the bottom.
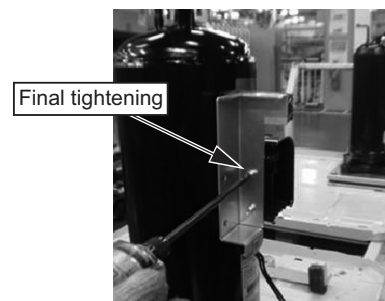
4. Tighten the fixing screw at the top.

Finished state   Parallel

Final check
Make sure that the side edge of the fixing plate and the vertical edge of the terminal box are parallel to each other.

5. Check for proper attachment.

2. Check valve Replacement instructions
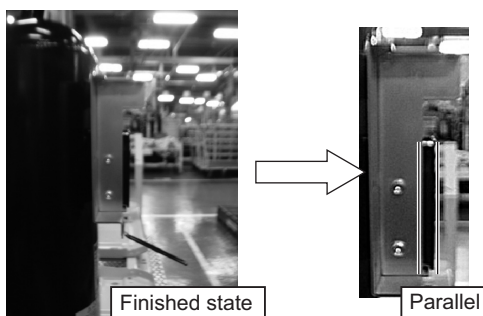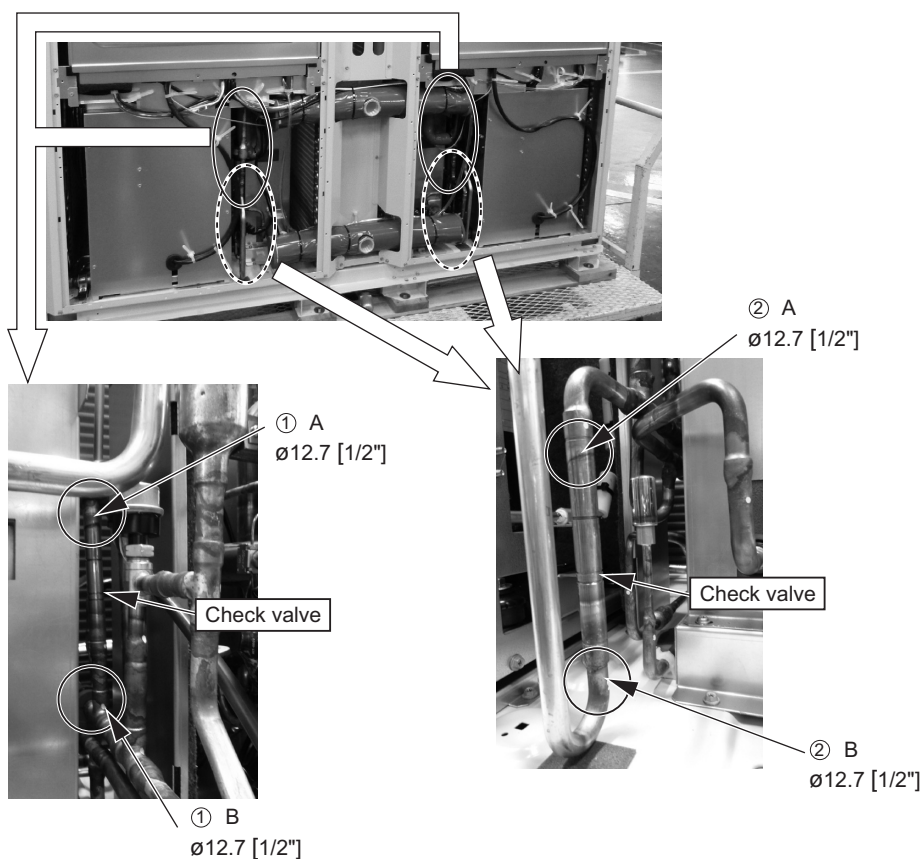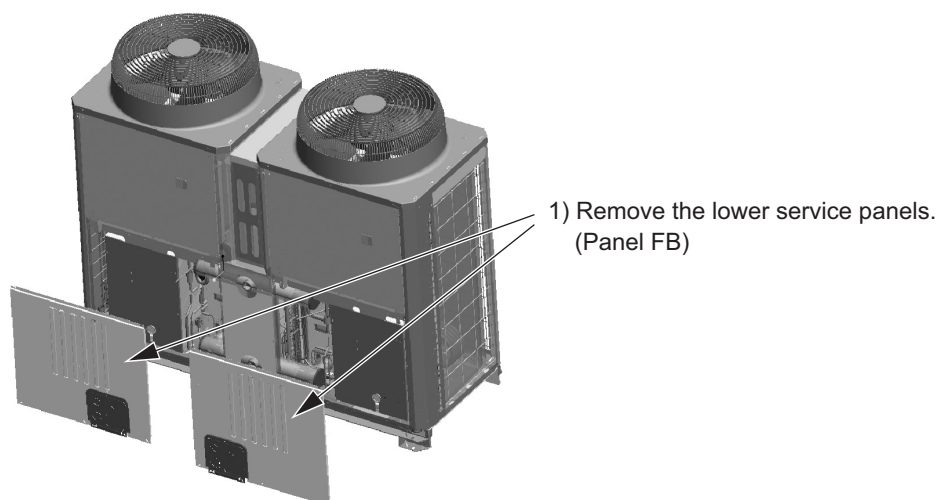
1) Remove the lower service panels.
   (Panel FB)

② A
ø12.7 [1/2"]

① A
ø12.7 [1/2"]

Check valve

Check valve

② B
ø12.7 [1/2"]

① B
ø12.7 [1/2"]

1. Debraze A-B parts (total 2 places), and remove the Check valve .
2. Replace the Check valve to be serviced while it is removed from the unit.

Precautions for replacing Check valve
·Be sure to perform no-oxidation brazing when brazing.
·Place a wet towel on the Check valve when heating pipes to keep the temperature of the valve from exceeding
  120°C [248°F].
·After brazing , check the condition around the brazing. After confirming no leakage, evacuate the air inside. *1
·Perform carefully with the flame direction so that it does not burn cables and plates etc. in the unit.

*1 Refer to Chapter I [5] Vacuum Drying (Evacuation) for detailed procedure. (page 7)

3. LEV replacement instructions

2) Remove the cables from the
   Frame Assy MU (top) and MB (bottom),
   and remove the Frame assy MU and MB.

1) Remove the upper and
   lower service panels.
   (Panel FU and FB)

Work procedure

(1) Remove the service panel. (See figure at above)
(2) Replace the LEV in trouble.

LEV 1

LEV 2

4. Thermistor replacement instructions (liquid pipe/gas pipe/water temperature detection)

1) Remove the service panel.
2) Remove the lead wire of the piping sensor from the control board.
3) Pull out the temperature sensor from the tenperature sensor housing, and replace the temperature sensor with the new one.
4) Connect the lead wire of the temperature sensor securely on the control board.

> Special care must be taken when replacing heavy parts.

TH9

TH11, TH13

TH4, TH8

TH16, TH12

TH2, TH6

TH1, TH5

TH3,TH7

No.1 CIRCUIT	No.2 CIRCUIT
TH1	TH5
TH2	TH6
TH3	TH7
TH4	TH8
TH9	-
TH16	TH12
TH11	TH13

5. Solenoid valve replacement instructions

2) Remove the cables from the
   Frame Assy MU (top) and MB (bottom),
   and remove the Frame assy MU and MB.

1) Remove the upper and
   lower service panels.
   (Panel FU and FB)

(1) Remove the service panel. (See figure at above)
(2) Remove the connector of the solenoid valve in the trouble.
(3) Remove the solenoid valve coil.

SV 2

SV 1
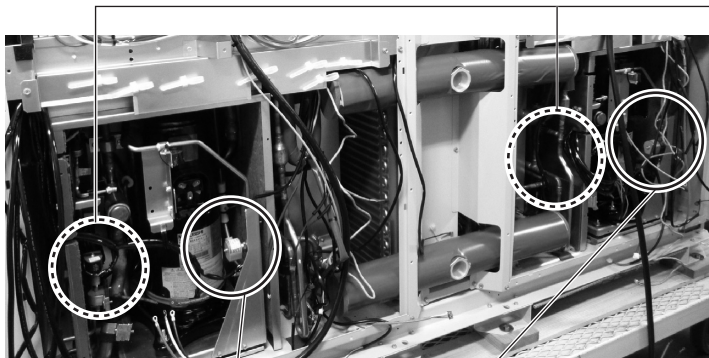
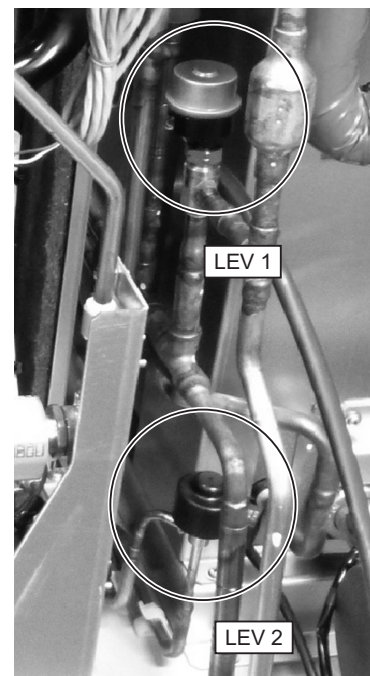**6. 4-way valve replacement instructions**
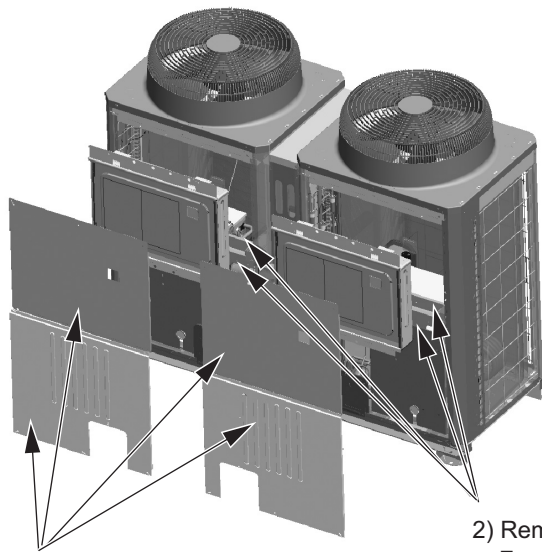
1) Remove the upper and
   lower service panels.
   (Panel FU and FB)

2) Remove the cables from the
   Frame Assy MU (top) and MB (bottom),
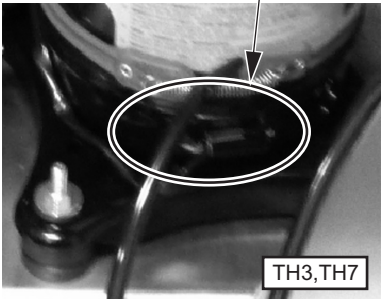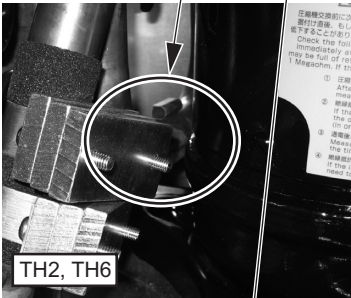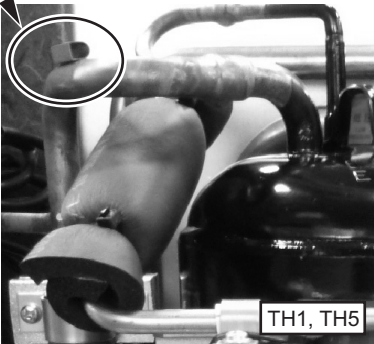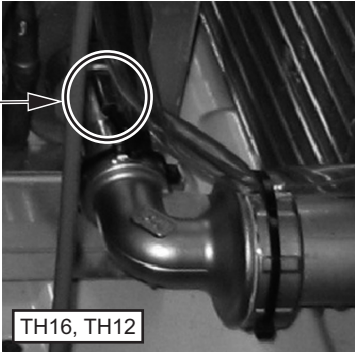   and remove the Frame assy MU and MB.

(1) Remove the service panel. (See figure at above)
(2) Remove the connector of the 4-way valve in the trouble.
(3) Remove the 4-way valve coil.

21S4
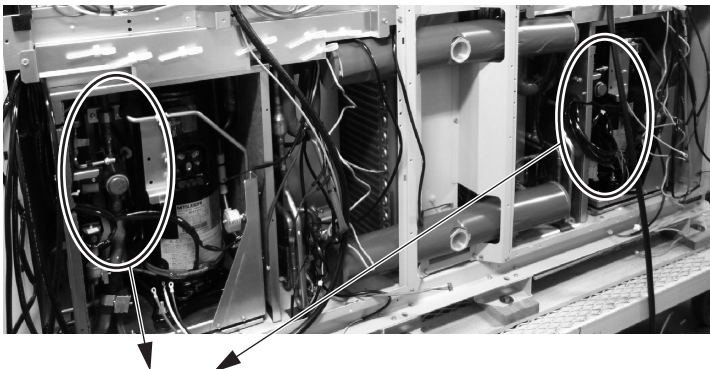
[6] Water piping configuration in the unit and how to connect the piping

(1) Water piping configuration in the unit

The pipe that connects the two plate heat exchangers are connected to each heat exchanger with a joint with ferrules. Note that the tightening torque for these joints are different than the ones for screw-in joints. Refer to the table below and tighten them to the appropriate torque.

Water outlet pipe   (Connection to field-installed piping)
Screw-in type Rc1-1/2
Tightening torque 150 N·m

Connection to plate heat exchanger
Screw-in type Rc1
Tightening torque 100 N·m

1-inch pipe
Ferrule on the joint
Tightening torque
169 N·m

Water inlet pipe   (Connection to field-installed piping)
Screw-in type Rc1-1/2
Tightening torque 150 N·m

1-inch pipe
Ferrule on the joint
Tightening torque 169 N·m

2-inch pipe
Ferrule on the joint
Tightening torque 217 N·m

(2) Replacing the plate exchanger and connecting water piping

|		Steps
1	Connecting parts of the 2-inch pipe Ferrule on the joint	① Remove the 2-inch pipe in the front of the unit.
2	Connection to refrigerant piping Plate heat exchanger Plate heat exchanger mounting plate	① Unscrew the fixing screws on the plate heat exchanger mounting plate. ② De-braze the refrigerant pipe from the unit. ③ Pull out the plate heat exchanger.
3	Connection to plate heat exchanger Screw-in type Rc1 Tightening torque 100 N·m Connection to 1-inch pipe Ferrule on the joint Tightening torque 169 N·m	① Disconnect the 1-inch pipe from the heat exchanger. ② Retighten the ferrule on the 1-inch pipe to a torque of 169 N·m. ③ Screw the 1-inch pipe into the new heat exchanger and tighten to a torque of 100 N·m. (Wrap sealing tape around the pipe connection to the plate heat exchanger four to five times.)
4	Connecting parts of the 2-inch pipe Ferrule on the joint Tightening torque 217 N·m	① Install the plate heat exchanger, and connect the refrigerant pipe to it by brazing. ② Tighten the 2-inch pipe in the front of the unit to 217 N·m. Finish

Ⅹ Attachments

[1] R407C saturation temperature table

Saturation pressure	Saturating temperature °C		Saturation pressure	Saturating temperature °C		Saturation pressure	Saturating temperature °C		Saturation pressure	Saturating temperature °C		Saturation pressure	Saturating temperature °C	
MPa(gauge)	Saturated liquid	Saturated gas	MPa(gauge)	Saturated liquid	Saturated gas	MPa(gauge)	Saturated liquid	Saturated gas	MPa(gauge)	Saturated liquid	Saturated gas	MPa(gauge)	Saturated liquid	Saturated gas
0.00	-43.63	-36.63	0.80	15.05	20.79	1.60	38.87	43.81	2.40	55.36	59.54	3.20	68.30	71.63
0.01	-41.65	-34.69	0.81	15.43	21.16	1.61	39.11	44.04	2.41	55.54	59.71	3.21	68.45	71.77
0.02	-39.81	-32.88	0.82	15.81	21.53	1.62	39.35	44.27	2.42	55.72	59.88	3.22	68.59	71.90
0.03	-38.08	-31.18	0.83	16.19	21.89	1.63	39.58	44.50	2.43	55.90	60.04	3.23	68.74	72.03
0.04	-36.46	-29.59	0.84	16.56	22.25	1.64	39.82	44.72	2.44	56.08	60.21	3.24	68.88	72.17
0.05	-34.92	-28.08	0.85	16.93	22.61	1.65	40.05	44.95	2.45	56.26	60.38	3.25	69.03	72.30
0.06	-33.46	-26.65	0.86	17.30	22.97	1.66	40.29	45.17	2.46	56.43	60.55	3.26	69.17	72.43
0.07	-32.07	-25.28	0.87	17.66	23.32	1.67	40.52	45.40	2.47	56.61	60.71	3.27	69.32	72.57
0.08	-30.75	-23.98	0.88	18.02	23.67	1.68	40.75	45.62	2.48	56.78	60.88	3.28	69.46	72.70
0.09	-29.47	-22.73	0.89	18.38	24.02	1.69	40.98	45.84	2.49	56.96	61.05	3.29	69.61	72.83
0.10	-28.25	-21.53	0.90	18.73	24.36	1.70	41.21	46.06	2.50	57.14	61.21	3.30	69.75	72.96
0.11	-27.08	-20.38	0.91	19.09	24.70	1.71	41.44	46.28	2.51	57.31	61.37	3.31	69.89	73.09
0.12	-25.94	-19.27	0.92	19.44	25.04	1.72	41.67	46.50	2.52	57.48	61.54	3.32	70.03	73.22
0.13	-24.85	-18.20	0.93	19.78	25.38	1.73	41.90	46.71	2.53	57.66	61.70	3.33	70.18	73.35
0.14	-23.79	-17.16	0.94	20.13	25.72	1.74	42.12	46.93	2.54	57.83	61.86	3.34	70.32	73.48
0.15	-22.77	-16.15	0.95	20.47	26.05	1.75	42.35	47.15	2.55	58.00	62.03	3.35	70.46	73.61
0.16	-21.77	-15.18	0.96	20.81	26.38	1.76	42.57	47.36	2.56	58.17	62.19	3.36	70.60	73.74
0.17	-20.81	-14.23	0.97	21.15	26.71	1.77	42.79	47.57	2.57	58.35	62.35	3.37	70.74	73.87
0.18	-19.87	-13.31	0.98	21.49	27.03	1.78	43.02	47.79	2.58	58.52	62.51	3.38	70.88	74.00
0.19	-18.96	-12.42	0.99	21.82	27.35	1.79	43.24	48.00	2.59	58.69	62.67	3.39	71.02	74.13
0.20	-18.07	-11.55	1.00	22.15	27.68	1.80	43.46	48.21	2.60	58.86	62.83	3.40	71.17	74.26
0.21	-17.20	-10.70	1.01	22.48	27.99	1.81	43.68	48.42	2.61	59.03	62.99	3.41	71.31	74.38
0.22	-16.36	-9.87	1.02	22.80	28.31	1.82	43.90	48.63	2.62	59.20	63.15	3.42	71.44	74.51
0.23	-15.53	-9.07	1.03	23.13	28.62	1.83	44.11	48.84	2.63	59.36	63.31	3.43	71.58	74.64
0.24	-14.73	-8.28	1.04	23.45	28.94	1.84	44.33	49.05	2.64	59.53	63.47	3.44	71.72	74.76
0.25	-13.94	-7.50	1.05	23.77	29.25	1.85	44.55	49.25	2.65	59.70	63.62	3.45	71.86	74.89
0.26	-13.17	-6.75	1.06	24.09	29.56	1.86	44.76	49.46	2.66	59.87	63.78	3.46	72.00	75.02
0.27	-12.41	-6.01	1.07	24.41	29.86	1.87	44.98	49.66	2.67	60.04	63.94	3.47	72.14	75.14
0.28	-11.67	-5.29	1.08	24.72	30.17	1.88	45.19	49.87	2.68	60.20	64.09	3.48	72.28	75.27
0.29	-10.95	-4.58	1.09	25.03	30.47	1.89	45.41	50.07	2.69	60.37	64.25	3.49	72.41	75.39
0.30	-10.24	-3.88	1.10	25.34	30.77	1.90	45.62	50.28	2.70	60.53	64.40	3.50	72.55	75.52
0.31	-9.54	-3.20	1.11	25.65	31.07	1.91	45.83	50.48	2.71	60.70	64.56	3.51	72.69	75.64
0.32	-8.85	-2.53	1.12	25.96	31.36	1.92	46.04	50.68	2.72	60.86	64.71	3.52	72.83	75.76
0.33	-8.18	-1.87	1.13	26.26	31.66	1.93	46.25	50.88	2.73	61.03	64.87	3.53	72.96	75.89
0.34	-7.52	-1.22	1.14	26.56	31.95	1.94	46.46	51.08	2.74	61.19	65.02	3.54	73.10	76.01
0.35	-6.87	-0.59	1.15	26.86	32.24	1.95	46.67	51.28	2.75	61.35	65.17	3.55	73.23	76.13
0.36	-6.23	0.04	1.16	27.16	32.53	1.96	46.88	51.48	2.76	61.52	65.33	3.56	73.37	76.26
0.37	-5.60	0.65	1.17	27.46	32.82	1.97	47.08	51.67	2.77	61.68	65.48	3.57	73.51	76.38
0.38	-4.98	1.26	1.18	27.76	33.10	1.98	47.29	51.87	2.78	61.84	65.63	3.58	73.64	76.50
0.39	-4.37	1.85	1.19	28.05	33.39	1.99	47.50	52.07	2.79	62.00	65.78	3.59	73.78	76.62
0.40	-3.77	2.44	1.20	28.34	33.67	2.00	47.70	52.26	2.80	62.16	65.93	3.60	73.91	76.74
0.41	-3.18	3.01	1.21	28.63	33.95	2.01	47.91	52.46	2.81	62.33	66.08	3.61	74.04	76.86
0.42	-2.60	3.58	1.22	28.92	34.23	2.02	48.11	52.65	2.82	62.49	66.23	3.62	74.18	76.99
0.43	-2.03	4.14	1.23	29.21	34.51	2.03	48.31	52.84	2.83	62.65	66.38	3.63	74.31	77.11
0.44	-1.46	4.70	1.24	29.50	34.78	2.04	48.51	53.04	2.84	62.81	66.53	3.64	74.45	77.23
0.45	-0.91	5.24	1.25	29.78	35.06	2.05	48.71	53.23	2.85	62.97	66.68	3.65	74.58	77.35
0.46	-0.36	5.78	1.26	30.06	35.33	2.06	48.92	53.42	2.86	63.12	66.83	3.66	74.71	77.46
0.47	0.19	6.31	1.27	30.34	35.60	2.07	49.12	53.61	2.87	63.28	66.98	3.67	74.85	77.58
0.48	0.72	6.83	1.28	30.62	35.87	2.08	49.31	53.80	2.88	63.44	67.12	3.68	74.98	77.70
0.49	1.25	7.34	1.29	30.90	36.14	2.09	49.51	53.99	2.89	63.60	67.27	3.69	75.11	77.82
0.50	1.77	7.85	1.30	31.18	36.41	2.10	49.71	54.18	2.90	63.76	67.42	3.70	75.24	77.94
0.51	2.29	8.36	1.31	31.45	36.67	2.11	49.91	54.37	2.91	63.91	67.56	3.71	75.37	78.06
0.52	2.80	8.85	1.32	31.73	36.94	2.12	50.11	54.55	2.92	64.07	67.71	3.72	75.51	78.17
0.53	3.30	9.34	1.33	32.00	37.20	2.13	50.30	54.74	2.93	64.22	67.85	3.73	75.64	78.29
0.54	3.80	9.83	1.34	32.27	37.46	2.14	50.50	54.92	2.94	64.38	68.00	3.74	75.77	78.41
0.55	4.29	10.31	1.35	32.54	37.72	2.15	50.69	55.11	2.95	64.54	68.14	3.75	75.90	78.52
0.56	4.77	10.78	1.36	32.81	37.98	2.16	50.89	55.29	2.96	64.69	68.29	3.76	76.03	78.64
0.57	5.25	11.25	1.37	33.07	38.24	2.17	51.08	55.48	2.97	64.85	68.43	3.77	76.16	78.76
0.58	5.73	11.71	1.38	33.34	38.49	2.18	51.27	55.66	2.98	65.00	68.58	3.78	76.29	78.87
0.59	6.20	12.17	1.39	33.60	38.75	2.19	51.46	55.84	2.99	65.15	68.72	3.79	76.42	78.99
0.60	6.66	12.62	1.40	33.87	39.00	2.20	51.66	56.02	3.00	65.31	68.86	3.80	76.55	79.10
0.61	7.12	13.07	1.41	34.13	39.25	2.21	51.85	56.21	3.01	65.46	69.00	3.81	76.68	79.22
0.62	7.58	13.51	1.42	34.39	39.50	2.22	52.04	56.39	3.02	65.61	69.14	3.82	76.81	79.33
0.63	8.03	13.95	1.43	34.65	39.75	2.23	52.23	56.57	3.03	65.77	69.29	3.83	76.94	79.44
0.64	8.47	14.39	1.44	34.91	40.00	2.24	52.42	56.75	3.04	65.92	69.43	3.84	77.07	79.56
0.65	8.91	14.82	1.45	35.16	40.25	2.25	52.60	56.93	3.05	66.07	69.57	3.85	77.19	79.67
0.66	9.35	15.24	1.46	35.42	40.49	2.26	52.79	57.10	3.06	66.22	69.71	3.86	77.32	79.78
0.67	9.78	15.66	1.47	35.67	40.74	2.27	52.98	57.28	3.07	66.37	69.85	3.87	77.45	79.89
0.68	10.21	16.08	1.48	35.92	40.98	2.28	53.17	57.46	3.08	66.52	69.99	3.88	77.58	80.01
0.69	10.63	16.49	1.49	36.18	41.22	2.29	53.35	57.63	3.09	66.67	70.13	3.89	77.71	80.12
0.70	11.05	16.90	1.50	36.43	41.46	2.30	53.54	57.81	3.10	66.82	70.26	3.90	77.83	80.23
0.71	11.47	17.30	1.51	36.68	41.70	2.31	53.72	57.99	3.11	66.97	70.40	3.91	77.96	80.34
0.72	11.88	17.71	1.52	36.92	41.94	2.32	53.91	58.16	3.12	67.12	70.54	3.92	78.09	80.45
0.73	12.29	18.10	1.53	37.17	42.18	2.33	54.09	58.33	3.13	67.27	70.68	3.93	78.22	80.56
0.74	12.70	18.50	1.54	37.42	42.42	2.34	54.27	58.51	3.14	67.42	70.82	3.94	78.34	80.67
0.75	13.10	18.89	1.55	37.66	42.65	2.35	54.46	58.68	3.15	67.57	70.95	3.95	78.47	80.78
0.76	13.50	19.27	1.56	37.91	42.89	2.36	54.64	58.85	3.16	67.71	71.09	3.96	78.59	80.89
0.77	13.89	19.66	1.57	38.15	43.12	2.37	54.82	59.02	3.17	67.86	71.22	3.97	78.72	81.00
0.78	14.28	20.04	1.58	38.39	43.35	2.38	55.00	59.20	3.18	68.01	71.36	3.98	78.85	81.11
0.79	14.67	20.41	1.59	38.63	43.58	2.39	55.18	59.37	3.19	68.16	71.50	3.99	78.97	81.22

[X Attachments]

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