

HOT WATER HEAT PUMP

2025
R454C

Service Handbook

Model




CAHV-R136TAU(-BS)

CAHV-R136YAU(-BS)

2nd edition

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.

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.

Do not use means to accelerate the defrosting process or to clean, other than those recommended by the manufacturer.

The appliance shall be stored in a room without continuously operating ignition sources (for example: open flames, an operating gas appliance or an operating electric heater.)

Do not pierce or burn.

Be aware that refrigerants may not contain an odour.

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.

Do not connect the makeup water pipe directly to the potable water pipe. Use a cistern tank between them.

Connecting these pipes directly may cause the water in the unit to migrate into the potable water and cause health problems.

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.

Do not install the unit on or over things that are vulnerable to water damage.

Condensation may drip from the unit.

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.

To reduce the risk of injury, do not touch the heat exchanger fins or sharp edges of components with bare hands.

Do not place a container filled with water on the unit.

If water spills on the unit, it may result in shorting, current leakage, electric shock, malfunction, smoke, or fire.

Always wear protective gears when touching electrical components on the unit.

Several minutes after the power is switched off, residual voltage may still cause electric shock.

To reduce the risk of injury, do not insert fingers or foreign objects into air inlet/outlet grills.

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.

To prevent environmental pollution, dispose of brine in the unit and cleaning solutions according to the local regulations.

It is punishable by law not to dispose of them according to the applicable laws.

The water heated by the heat pump is not suitable for use as drinking water or for cooking.

It may cause health problems or degrade food.

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.

Not doing so may cause the water to freeze, resulting in burst pipes and damage to the unit or the furnishings.

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.

Use clean tap water.

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.

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.

Frozen water in the water circuit may cause the water to freeze, resulting in burst pipes and damage to the unit or the furnishings.

Periodically inspect and clean the water circuit.

Dirty water circuit may compromise the unit's performance or corrodes the unit or cause water leakage and resultant damage to the furnishings.

Ensure that the flow rate of the feed-water is within the permitted range.

If the flow rate exceeds the permitted range, the unit may become damaged due to corrosion. Furniture may become wet due to water leaks.

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.

Observe the restrictions on the maximum weight that a person can lift, which is specified in local regulations.

Installation

WARNING

Do not install the unit where there is a risk of leaking flammable gas.

If flammable gas accumulates around the unit, it may ignite and cause a fire or explosion.

Do not install the unit in an indoor or semi-underground space.

- If the refrigerant leaks, a fire may result.
- The unit must be stored where leaking refrigerant will not accumulate.

Properly dispose of the packing materials.

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.

Improper installation may result in refrigerant leakage, water leakage, injury, electric shock, or fire.

Periodically check the installation base for damage.

If the unit is left on a damaged base, it may fall and cause injury.

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.

Failing to remove the packing materials or failing to install required accessories may result in refrigerant leakage, oxygen starvation, smoke, or fire.

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.

Any additional parts must be installed by qualified personnel. Only use the parts specified by Mitsubishi Electric.

Take appropriate safety measures against wind gusts and earthquakes to prevent the unit from toppling over and causing injury.

Be sure to install the unit horizontally, using a level.

If the unit is installed at an angle, it may fall and cause injury or cause water leakage.

The unit should be installed on a surface that is strong enough to support its weight.

As an anti-freeze, use ethylene glycol or propylene glycol diluted to the specified concentration.

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.

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.

All drainage work should be performed by the dealer or qualified personnel according to the instructions detailed in the Installation Manual.

Improper drainage work may cause rain water or drain water to enter the buildings and damage the furnishings.

Appliances not accessible to the general public.

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 (R454C) is present in the refrigerant circuit.

Infiltration of other substances may cause the pressure to rise abnormally high and cause the pipes to explode.

To keep the ceiling and floor from getting wet due to condensation, properly insulate the pipes.

Piping work should be performed by the dealer or qualified personnel according to the instructions detailed in the Installation Manual.

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.

Do not open the control box cover while charging refrigerant.

- If the refrigerant leaks, a fire may result.

Piping material, pipe routing, and installation shall include protection from physical damage in operation and service, and be in compliance with national and physical damage in operation and service, and be in compliance with national and local codes and standards. All field joints shall be accessible for inspection prior to being covered or enclosed.

Protection devices, piping, and fittings shall be protected as far as possible against adverse environmental effects, such as the danger of water collecting and freezing in relief pipes or the accumulation of dirt and debris.

Piping in refrigeration systems shall be designed and installed to minimize the likelihood of hydraulic shock damaging the system.

Electrical wiring

WARNING

To reduce the risk of wire breakage, overheating, smoke, and fire, keep undue force from being applied to the wires.

Properly secure the cables in place and provide adequate slack in the cables so as not to stress the terminals.

Improperly connected cables may break, overheat, and cause smoke or fire.

To reduce the risk of injury or electric shock, switch off the main power before performing electrical work.

All electric work must be performed by a qualified personnel according to the local regulations, standards, and the instructions detailed in the Installation Manual.

Capacity shortage to the power supply circuit or improper installation may result in malfunction, electric shock, smoke, or fire.

To reduce the risk of electric shock, smoke, or fire, install an earth leakage breaker on the power supply to each unit.

Use properly rated breakers and fuses (an earth leakage breaker, local switch <a switch + fuse that meets local electrical codes>, or overcurrent breaker).

The use of improperly rated breakers may result in electric shock, malfunction, smoke, 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 qualified personnel. 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.

Tighten all terminal screws to the specified torque.

Loose screws and contact failure may result in smoke or fire.

Only use standard power cables of sufficient capacity.

Failure to do so may result in current leakage, overheating, smoke, or fire.

To ensure all-pole-disconnection from the main power supply, make sure to provide a disconnection incorporated in the fixed wiring routed to the unit during installation.

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.

When replacing a fusible plug, torque it to $38.4 \pm 4 \text{ N} \cdot \text{m}$ [$336.3 \pm 35.4 \text{ lbf} \cdot \text{in}$]

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.

Do not open the control box cover while charging refrigerant.

- If the refrigerant leaks, a fire may result.

IMPORTANT

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

To reduce the risk of 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.

To reduce the risk of both the breaker on the product side and the upstream breaker from tripping and causing problems, split the power supply system or provide protection coordination between the earth leakage breaker and no-fuse breaker.

When servicing the refrigerant, open and close the check joint using two spanners, as there is the risk of refrigerant leaking due to damaged piping.



Please build the water circuit so that it is a closed system.

Do not use water directly for showers or other applications. Do not allow other heat source water to mix with the water circuit.

Store the unit in a room large enough to allow clearance in the event of refrigerant leakage.

Refrigerant R454C is flammable. Do not use a naked-flame type detector.

The refrigeration system must be kept clean and free of oil stains or waste matters by the manager and kept accessible to the manager.

The unit shall be properly stored to prevent mechanical damage.

When heating the piping, wrap a wet towel around the refrigerant circuit components to keep their temperature below 120°C [248°F] and the fusible plug temperature below 88°C [190°F].

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[1] Read Before Servicing

1. Check the type of refrigerant used in the system to be serviced.

Refrigerant Type

Hot water Heat pump CAHV-R136TAU(-BS), CAHV-R136YAU(-BS): R454C

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 R454C (Adaptability of tools that are for use with R22 or R410A)

1. To be used exclusively with R454C (not to be used if used with R22 or R410A)

Tools/Materials	Use	Notes
Gauge Manifold	Evacuation and refrigerant charging	Higher than 4.82 MPa [699 psi] 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 White
Charging Port on the Refrigerant Cylinder	Refrigerant charging	

2. Tools and materials that may be used with R454C 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 R454C.

3. Tools and materials that are used with R22 or R410A that may also be used with R454C

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 R454C

Tools/Materials	Use	Notes
Charging Cylinder	Refrigerant charging	Prohibited to use
Tools containing abrasive materials	Pipe cutting, cut edge treatment	Prohibited to use

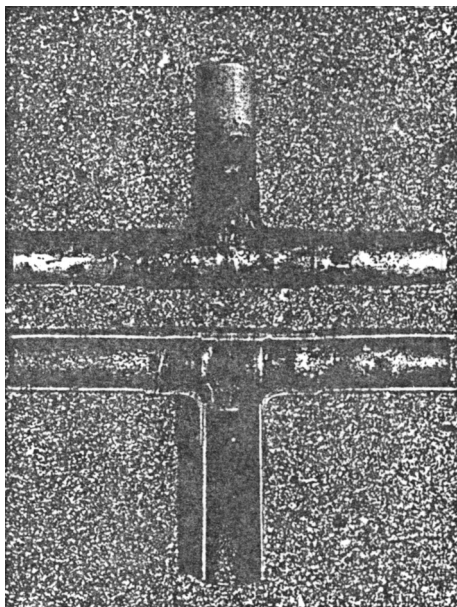
Tools for R454C must be handled with special care to keep moisture and dust from infiltrating the cycle.

[3] Brazing

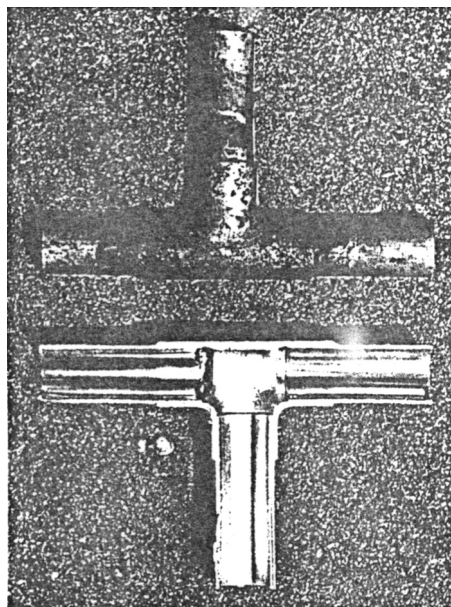
No changes have been made in the brazing procedures. Perform brazing with special care to keep foreign objects (such as oxide scale, water, and dust) out of the refrigerant system.

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

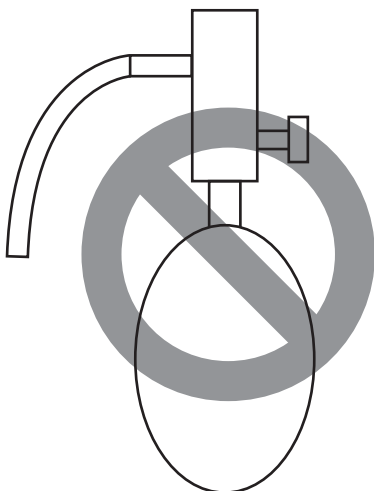
- ♦ The new refrigerating machine oil is hygroscopic and is more likely to cause unit failure if water infiltrates into the system.
- ♦ Flux generally contains chloride. Residual flux in the refrigerant circuit will cause sludge to form.

3. Notes

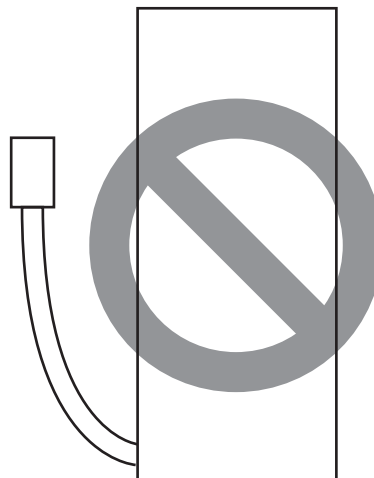
Do not use commercially available antioxidants because they may cause the pipes to corrode or refrigerating machine oil to deteriorate.

[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 R454C leak.



Halide torch



R22 leakage detector

1. Items to be strictly observed

- Pressurize the equipment with nitrogen up to the design pressure (3.85 MPa [558 psi]), and then judge the equipment's air tightness, taking temperature variations into account.
- Refrigerant R454C 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 R454C 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(R454C) 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 0.5 Torr (65 Pa) 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 5 Torr (650 Pa) and measures at intervals of 1 Torr (130 Pa). (A recommended vacuum gauge is shown in Photo2.)

Do not use a commonly used gauge manifold because it cannot register a vacuum degree of 5 Torr (650 Pa).

4. Evacuation time

♦After the degree of vacuum has reached 5 Torr (650 Pa), evacuate for an additional 1 hour. (A thorough vacuum drying removes moisture in the pipes.) When the outside temperature drops below 1°C (34°F) (or when the saturation pressure drops below 656 Pa), continue vacuum drying for another 1 hour after the vacuum degree has reached the saturated vapor pressure of the water (ice) at the outside temperature. When performing vacuum drying at a low outside temperature, use a vacuum gauge appropriate for the temperature range.

Degree of vacuum (reference)

Outdoor temp.	-20°C (-4°F)	-15°C (5°F)	-10°C (14°F)	-5°C (23°F)	0°C (32°F)
Degree of vacuum	0.77 Torr (103 Pa)	1.24 Torr (165 Pa)	1.95 Torr (260 Pa)	3.01 Torr (402 Pa)	4.58 Torr (611 Pa)

* Degrees of vacuum shown above are obtained based on the saturated vapor pressure of ice.

* In a system using water heat exchangers, circulate water to prevent the water in the heat exchangers from freezing during vacuum drying.

♦Verify that the vacuum degree has not risen by more than 1 Torr (130 Pa) 1hour after evacuation. A rise by less than 1 Torr (130 Pa) is acceptable.

♦If the vacuum is lost by more than 1 Torr (130 Pa), 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 5 Torr (650 Pa) 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 368 Torr (0.05 MPa) and evacuate again. Repeat this cycle of pressurizing and evacuation either until the degree of vacuum below 5 Torr (650 Pa) is attained or until the pressure stops rising.

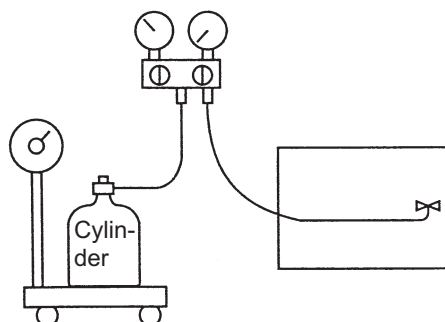
♦Only use nitrogen gas for vacuum breaking. (The use of oxygen may result in an explosion.)

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.
- ♦When dry-vacuumping and recovering refrigerant, let the water circulate to keep the plate heat exchanger from freezing.

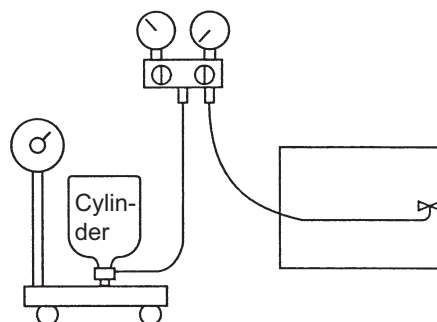
[6] Refrigerant Charging

Cylinder with a siphon

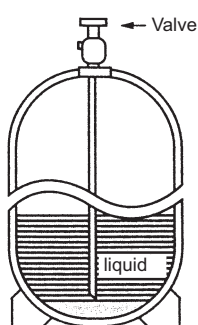


Cylinder color R454C is White.

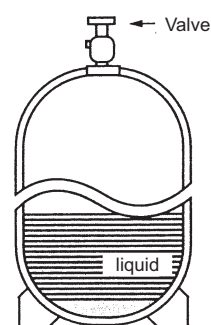
Cylinder without a siphon



Refrigerant charging in the liquid state



Charge refrigerant through the check joint on the high-pressure side.



Charging refrigerant through the check joint on the low-pressure side will create reverse pressure, resulting in compressor malfunctions.

1. Reasons

R454C is a mixture of 2 refrigerants, each with a different evaporation temperature. Therefore, if the equipment is charged with R454C gas, then the refrigerant whose evaporation temperature is closest to the outside temperature is charged first 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 (9.0 kg (19.8 lbs)). (Charge refrigerant in the liquid state.)

Refer to "X [4] Refrigerant Leak."(page 168)

[8] Characteristics of the Conventional and the New Refrigerants

1. Chemical property

As with R22, the new refrigerant (R454C) is low in toxicity and slightly flammable 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	R454C	R22
	R32/R125	R32/R125/R134a	R32/R1234yf	R22
Composition (wt%)	(50/50)	(23/25/52)	(21.5/78.5)	(100)
Type of Refrigerant	Pseudo-azeotropic Refrigerant	Non-azeotropic Refrigerant	Non-azeotropic Refrigerant	Single Refrigerant
Chloride	Not included	Not included	Not included	Included
Safety Class	A1/A1	A1/A1	A2L/A2L	A1
Molecular Weight	72.6	86.2	90.8	86.5
Boiling Point (°C/°F)	-51.4/-60.5	-43.6/-46.4	-45.9/-50.6	-40.8/-41.4
Steam Pressure (25°C, MPa/77°F, psi) (gauge)	1.56/226	0.92/133	0.88/127	0.94/136
Saturated Steam Density (25°C, kg/m ³ /77°F, lb/ft ³)	64.0/4.0	42.5/2.7	44.5/2.8	44.4/2.8
Flammability	Nonflammable	Nonflammable	Slightly flammable	Nonflammable
Ozone Depletion Coefficient (ODP)*¹	0	0	0	0.055
Global Warming Coefficient (GWP)* ²	1920	1624	146	1760
Refrigerant Charging Method	Refrigerant charging in the liquid state	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	Non available	Non available	Available

*1 When CFC11 is used as a reference

*2 When CO₂ is used as a reference

2. Pressure characteristics

The pressure in the system using R454C is 0.9 times as great as that in the system using R22.

Temperature (°C/°F)	Saturation Pressure (gauge)			
	R410A	R407C	R454C	R22
	MPa/psi	MPa/psi	MPa/psi	MPa/psi
-20/-4	0.30/44	0.18/26	0.12/17	0.14/20
0/32	0.70/102	0.47/68	0.35/51	0.40/58
20/68	1.34/194	0.94/136	0.75/108	0.81/117
40/104	2.31/335	1.44/209	1.36/197	1.44/209
60/140	3.73/541	2.43/354	2.27/329	2.33/338
65/149	4.17/605	2.74/399	2.55/370	2.60/377

[9] Precautions for handling equipment using R454C

When handling the units that use R454C refrigerant, observe the following notes. (The notes are based on the precautions regarding R454C refrigerant contained in IEC 60335-2-40.)

1. General

Compliance with national gas regulations shall be observed.

2. Transportation

1) Additional transportation regulations may exist with respect to equipment containing slightly flammable gas.

3. Disposal

1) Follow the local regulations on proper disposal of equipment using R454C.

4. Storage

- 1) Store the unit in a sufficiently large space so that leaked refrigerant will not stagnate in a small confined area.
- 2) The maximum number of pieces of equipment permitted to be stored together will be determined local regulations.

5. Servicing information

1) Checks to the area

Prior to beginning work on systems containing slightly flammable refrigerants, safety checks are necessary to ensure that the risk of ignition is minimised. For repair to the refrigerating system, 3) to 7) shall be completed prior to conducting work on the system.

2) Work procedure

Work shall be undertaken under a controlled procedure so as to minimise the risk of a slightly flammable gas being present while the work is being performed.

3) General work area

All maintenance staff and others working in the local area shall be instructed on the nature of work being carried out. Work in confined spaces shall be avoided. The area around the workspace shall be sectioned off. Ensure that the conditions within the area have been made safe by control of flammable material.

4) Checking for presence of refrigerant

The area shall be checked with an appropriate refrigerant detector prior to and during work, to ensure the technician is aware of potentially slightly flammable atmospheres. Ensure that the leak detection equipment being used is suitable for use with all applicable refrigerants.

5) Presence of fire extinguisher

If any hot work is to be conducted on the refrigeration equipment or any associated parts, appropriate fire extinguishing equipment shall be available to hand. Have a dry powder or CO₂ fire extinguisher adjacent to the charging area.

6) No ignition sources

No person carrying out work, such as brazing, in relation to a refrigeration system which involves exposing any pipe work shall use any sources of ignition in such a manner that it may lead to the risk of fire or explosion. All possible ignition sources, including cigarette smoking, should be kept sufficiently far away from the site of installation, repairing, removing and disposal, during which refrigerant can possibly be released to the surrounding space. Prior to work taking place, the area around the equipment is to be surveyed to make sure that there are no flammable hazards or ignition risks. "No Smoking" signs shall be displayed in a conspicuous place in the work area.

7) Ventilated area

Ensure that the area is in the open or that it is adequately ventilated before replacing parts or conducting any hot work. A degree of ventilation shall continue during the period that the work is carried out. The ventilation should safely disperse any released refrigerant and preferably expel it externally into the atmosphere.

8) Checks to the refrigeration equipment

Where electrical components are being changed, they shall be fit for the purpose and to the correct specification. At all times the MITSUBISHI ELECTRIC's Installation Manual and Service Handbook shall be followed. If in doubt, consult the dealer's technical department for assistance.

The following checks shall be applied to installations using slightly flammable refrigerants:

- the amount of refrigerant charge depends on the size of the area in which products containing refrigerant are to be installed;
- the ventilation machinery and outlets are operating adequately and are not obstructed;
- if an indirect refrigerating circuit is being used, the secondary circuit shall be checked for the presence of refrigerant;
- marking to the equipment continues to be visible and legible. Markings and signs that are illegible shall be corrected;
- refrigeration pipe or components are installed in a position where they are unlikely to be exposed to any substance which may corrode components containing refrigerant, unless the components are constructed of materials which are inherently resistant to being corroded or are suitably protected being so corroded.

9) Checks to electrical devices

Repair and maintenance to electrical components shall include initial safety checks and component inspection procedures. If a fault exists that could compromise safety, then no electrical supply shall be connected to the circuit until it is satisfactorily dealt with. If the fault cannot be corrected immediately but it is necessary to continue operation, an adequate temporary solution shall be used. This shall be reported to the owner of the equipment so all parties are advised.

10) Initial safety checks shall include:

- that capacitors are discharged: this shall be done in a safe manner to avoid possibility of sparking;
- that no live electrical components and wiring are exposed while charging, recovering or purging the system;
- that there is continuity of earth bonding.

6. Repairing sealed components

- 1) During repairs to sealed components, all electrical supplies shall be disconnected from the equipment being worked upon prior to any removal of sealed covers, etc. If it is absolutely necessary to have an electrical supply to equipment during servicing, then a permanently operating form of leak detection shall be located at the most critical point to warn of a potentially hazardous situation.
- 2) Particular attention shall be paid to the following to ensure that by working on electrical components, the casing is not altered in such a way that the level of protection is affected. This shall include damage to cables, excessive number of connections, terminals not made to original specification, damage to seals, incorrect fitting of glands, etc.
- 3) Ensure that the apparatus is mounted securely.
- 4) Ensure that seals or sealing materials have not degraded to the point that they no longer serve the purpose of preventing the ingress of flammable atmospheres. Replacement parts shall be in accordance with the MITSUBISHI ELECTRIC's specifications.
- 5) The use of silicon sealant can inhibit the effectiveness of some types of leak detection equipment. Intrinsically safe components do not have to be isolated prior to working on them.

7. Repair to intrinsically safe components

- 1) Do not apply any permanent inductive or capacitance loads to the circuit without ensuring that this will not exceed the permissible voltage and current permitted for the equipment in use.
- 2) Intrinsically safe components are the only types that can be worked on while live in the presence of a flammable atmosphere.
- 3) The test apparatus shall be at the correct rating.
- 4) Replace components only with parts specified by the manufacturer. Other parts may result in the ignition of refrigerant in the atmosphere from a leak.

8. Cabling

Check that cabling will not be subject to wear, corrosion, excessive pressure, vibration, sharp edges or any other adverse environmental effects. The check shall also take into account the effects of aging or continual vibration from sources such as compressors or fans.

9. Refrigerant leakage detection

The following leak detection methods are deemed acceptable for all refrigerant systems.

- 1) Electronic leak detectors may be used to detect refrigerant leaks but, in the case of slightly flammable refrigerants, the sensitivity may not be adequate, or may need re-calibration. (Detection equipment shall be calibrated in a refrigerant-free area.) Ensure that the detector is not a potential source of ignition and is suitable for the refrigerant used.
- 2) If a leak is suspected, all naked flames shall be removed/extinguished.
- 3) If a leakage of refrigerant is found which requires brazing, all of the refrigerant shall be recovered from the system, or isolated (by means of shut off valves) in a part of the system remote from the leak. Because R454C is slightly flammable, oxygen free nitrogen (OFN) shall be poured through the system both before and during the brazing process to purge R454C.

10. Refrigerant removal and vacuum drying for service

- 1) R454C is slightly flammable. Follow the procedures below to reduce the risk of R454C from catching fire:
 1. Remove refrigerant;
 2. Purge the circuit with inert gas;
 3. Evacuate;
 4. Purge again with inert gas;
 5. Open the circuit by cutting or brazing.
- 2) The charged refrigerant shall be recovered into the recovery cylinders designated for use with R454C. For appliances containing slightly flammable refrigerants, the system shall be "flushed" with OFN to render the unit safe. This process may need to be repeated several times. Compressed air or oxygen shall not be used for purging refrigerant systems.
- 3) Because R454C is slightly flammable, flushing shall be achieved by breaking the vacuum in the system with OFN and continuing to fill until the working pressure is achieved, then venting to atmosphere, and finally pulling down to a vacuum. This process shall be repeated until no refrigerant is within the system. When the final OFN charge is used, the system shall be vented down to atmospheric pressure to enable work to take place. This operation is absolutely vital if brazing operations on the pipework are to take place.
- 4) Ensure that the outlet for the vacuum pump is not close to any ignition sources and that ventilation is available.

11. Charging Procedures

- 1) In addition to conventional charging procedures, the following requirements shall be followed:
 - Ensure that contamination of different refrigerants does not occur when using charging equipment. Hoses or lines shall be as short as possible to minimize the amount of refrigerant contained in them.
 - Cylinders shall be kept upright.
 - Ensure that the refrigeration system is earthed prior to charging the system with refrigerant.
 - Label the system when charging is complete (if not already).
 - Extreme care shall be taken not to overfill the refrigeration system.
- 2) Prior to recharging the system, it shall be pressure-tested with the appropriate purging gas. The system shall be leak tested on completion of charging but prior to commissioning. A follow up leak test shall be carried out prior to leaving the site.

12. Decommissioning

- 1) Before carrying out this procedure, it is essential that the technician is completely familiar with the equipment and all its detail. It is recommended good practice that all refrigerants are recovered safely. Prior to the task being carried out, an oil and refrigerant sample shall be taken in case analysis is required prior to re-use of reclaimed refrigerant. It is essential that electrical power is available before the task is commenced.
- 2) Become familiar with the equipment and its operation.
- 3) Isolate system electrically.
- 4) Before attempting the procedure, ensure that:
 - mechanical handling equipment is available, if required, for handling refrigerant cylinders;
 - all personal protective equipment is available and being used correctly;
 - the recovery process is supervised at all times by a competent person;
 - recovery equipment and cylinders conform to the appropriate standards.

- 5) Pump down refrigerant system, if possible.
- 6) Make sure that cylinder is situated on the scales before recovery takes place.
- 7) Start the recovery machine and operate in accordance with MITSUBISHI ELECTRIC's instructions.
- 8) Do not overfill cylinders. (No more than 80% volume liquid charge)
- 9) Do not exceed the maximum working pressure of the cylinder, even temporarily.
- 10) When the cylinders have been filled correctly and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation Valves on the equipment are closed off.
- 11) Recovered refrigerant shall not be charged into another refrigeration system unless it has been cleaned and checked.

13. Labelling

- 1) Equipment shall be labelled stating that it has been de-commissioned and emptied of refrigerant. The label shall be dated and signed. Because R454C is slightly flammable, ensure that there are labels on the equipment stating the equipment contains flammable refrigerant.

14. Appropriate refrigerant recovery method

- 1) When removing refrigerant from a system, either for repairing or decommissioning, it is recommended good practice that all refrigerants are removed safely.
- 2) When transferring refrigerant into cylinders, ensure that only appropriate refrigerant recovery cylinders are employed. Ensure that the correct number of cylinders for holding the total system charge are available. All cylinders to be used are designated for recovering refrigerant and labelled for that refrigerant (i.e. special cylinders for the recovery of refrigerant). Cylinders shall be complete with pressure-relief valve and associated shut-off valves in good working order. Empty recovery cylinders are evacuated and, if possible, cooled before recovery starts.
- 3) The recovery equipment shall be in good working order with a set of instructions concerning the equipment that is at hand and shall be suitable for the recovery of all appropriate refrigerants including, when applicable, slightly flammable refrigerants. In addition, a set of calibrated weighing scales shall be available and in good working order. Hoses shall be complete with leakfree disconnect couplings and in good condition. Before using the recovery machine, check that it is in satisfactory working order, has been properly maintained and that any associated electrical components are sealed to prevent ignition in the event of a refrigerant release. Consult dealer if in doubt.
- 4) The recovered refrigerant shall be returned to the refrigerant supplier in the correct recovery cylinder, and the relevant waste transfer note arranged. Do not mix refrigerants with different properties in recovery units and especially not in cylinders.
- 5) If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that slightly flammable refrigerant does not remain within the lubricant. The evacuation process shall be carried out prior to returning the compressor to the suppliers. Only electric heating to the compressor body shall be employed to accelerate this process. When oil is drained from a system, it shall be carried out safely.

15. Competence of service personnel

(1) General

Special training additional to usual refrigerating equipment repair procedures is required when equipment with slightly flammable refrigerants are affected.

(2) Training

The training should include the substance of the following:

Information about the explosion potential of slightly flammable refrigerants to show that flammables may be dangerous when handled without care.

(3) Information about the correct working procedures

Commissioning

- 1) Carry out a leak test before charging with refrigerant.
- 2) Check safety equipment before putting into service.

Maintenance

- 1) Portable equipment shall be repaired outside or in a workshop specially equipped for servicing units with slightly flammable refrigerants.
- 2) Ensure sufficient ventilation at the repair place.
- 3) Be aware that malfunction of the equipment may be caused by refrigerant loss and a refrigerant leak is possible.

- 4) Discharge capacitors in a way that won't cause any spark. The standard procedure to short circuit the capacitor terminals usually creates sparks.
- 5) Reassemble sealed enclosures accurately. If seals are worn, replace them.
- 6) Check safety equipment before putting into operation.
- 7) Carry a portable refrigerant-leak sensor when entering a space with a risk of refrigerant leakage.

Repair

- 1) Portable equipment shall be repaired outside or in a workshop specially equipped for servicing units with slightly flammable refrigerants.
- 2) Ensure sufficient ventilation at the repair place.
- 3) Be aware that malfunction of the equipment may be caused by refrigerant loss and a refrigerant leak is possible.
- 4) Discharge capacitors in a way that won't cause any spark.
- 5) When brazing is required, the following procedures shall be carried out in the right order:
 1. Remove the refrigerant. If the recovery is not required by national regulations, drain the refrigerant to the outside. Take care that the drained refrigerant will not cause any danger. In doubt, one person should guard the outlet. Take special care that drained refrigerant will not float back into the building.
 2. Evacuate the refrigerant circuit.
 3. Purge the refrigerant circuit with nitrogen for 5 min.
 4. Evacuate again.
 5. Remove parts to be replaced by cutting, not by flame.
 6. Purge the braze point with nitrogen during the brazing procedure.
 7. Carry out a leak test before charging with refrigerant.
- 6) Reassemble sealed enclosures accurately. If seals are worn, replace them.
- 7) Check safety equipment before putting into operation.

Decommissioning

- 1) If the safety is affected when the equipment is putted out of service, the charged refrigerant shall be removed before decommissioning.
- 2) Ensure sufficient ventilation at the equipment location.
- 3) Be aware that malfunction of the equipment may be caused by refrigerant loss and a refrigerant leak is possible.
- 4) Discharge capacitors in a way that won't cause any spark.
- 5) Remove the refrigerant. If the recovery is not required by national regulations, drain the refrigerant to the outside. Take care that the drained refrigerant will not cause any danger. In doubt, one person should guard the outlet. Take special care that drained refrigerant will not float back into the building.
- 6) Evacuate the refrigerant circuit.
- 7) Purge the refrigerant circuit with nitrogen for 5 min.
- 8) Evacuate again.
- 9) Fill with nitrogen up to atmospheric pressure.
- 10) Put a label on the equipment that the refrigerant is removed.

Disposal

- 1) Ensure sufficient ventilation at the working place.
- 2) Remove the refrigerant. If the recovery is not required by national regulations, drain the refrigerant to the outside. Take care that the drained refrigerant will not cause any danger. In doubt, one person should guard the outlet.
- 3) Evacuate the refrigerant circuit.
- 4) Purge the refrigerant circuit with nitrogen for 5 min.
- 5) Evacuate again.
- 6) Cut out the compressor and drain the oil.

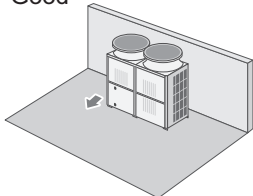
16. Installation restrictions

Do not install the unit where combustible gas may leak.

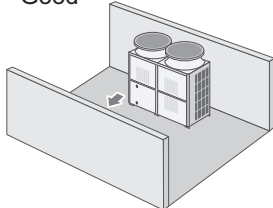
- If combustible gas accumulates around the unit, fire or explosion may result.

- Provide sufficient space around the unit for effective operation, efficient air movement, and ease of access for maintenance.
- All restrictions mentioned in this manual apply not only to new installations but also to relocations and layout changes.
- Refer to the Installation manual for other precautions on installation.
- Do not install the unit inside a building such as the basement or machine room, where the refrigerant may stagnate.
- Install the unit in a place where at least one of four sides is open.

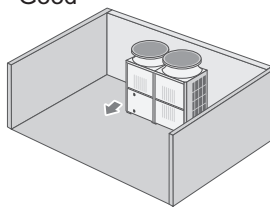
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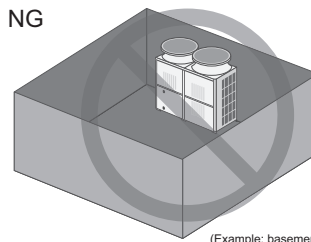
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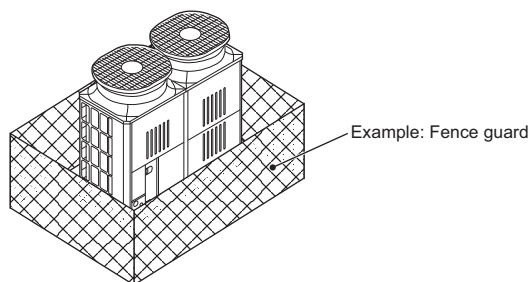
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(Example: basement)

Restricted access

- Appliance shall install to secure d location with restricted access
(e.g. location of not accessible to the general public, like a rooftop and fence guard etc...)

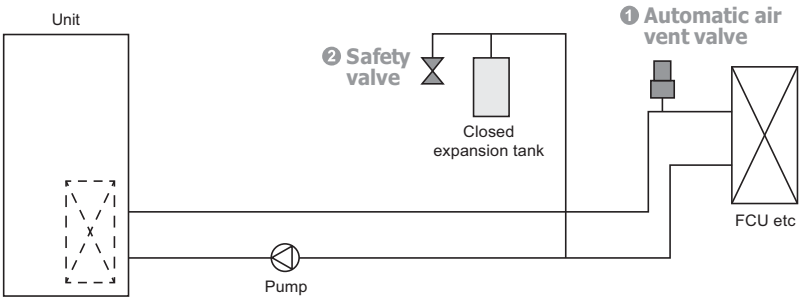


- Provide sufficient space around the unit for effective operation, efficient air movement, and ease of access for maintenance.
- Do not install the unit inside a building such as the basement or machine room, where the refrigerant may stagnate.
- Install the unit in a place where at least one of four sides is open.

17. Regulatory requirements for safety

See below for information on installing a safety device.

- * Safety devices shall be regularly inspected, maintained, and replaced in accordance with relevant laws, regulations, and the instructions of the manufacturers.
- * The requirements listed below were established based on IEC60335-2-40 (Edition 6.0) G.G.6. See the original standards for further information on selecting a safety device.



Required items	Note
① Automatic air vent valve	* In the event of a failure of the waterside heat exchanger in the unit, the refrigerant may leak from the automatic air vent valve, so install it in a place where the refrigerant will not accumulate, such as outdoors.
② Safety valve	* In the event of a failure of the waterside heat exchanger in the unit, the refrigerant may leak from the safety valve, so install it in a place where the refrigerant will not accumulate, such as outdoors.

[10] 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 refrigerants machine oil used in the system has properties that are different from commercially available refrigerants machine oil.

Refrigerant	Refrigerating machine oil
R22	Mineral oil
R407C	Ester oil
R410A	Ester oil
R454C	Polyvinyl ether 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		Freezing	Frozen expansion valve and capillary tubes
		Hydrolysis	Sludge formation and adhesion Acid generation Oxidization Oil degradation
Air infiltration		Oxidization	Clogged expansion valve and capillary tubes Poor cooling performance Compressor overheat Motor insulation failure Burnt motor Coppering of the orbiting parts Burn-in on the orbiting parts
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 parts
	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 parts

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

II Restrictions

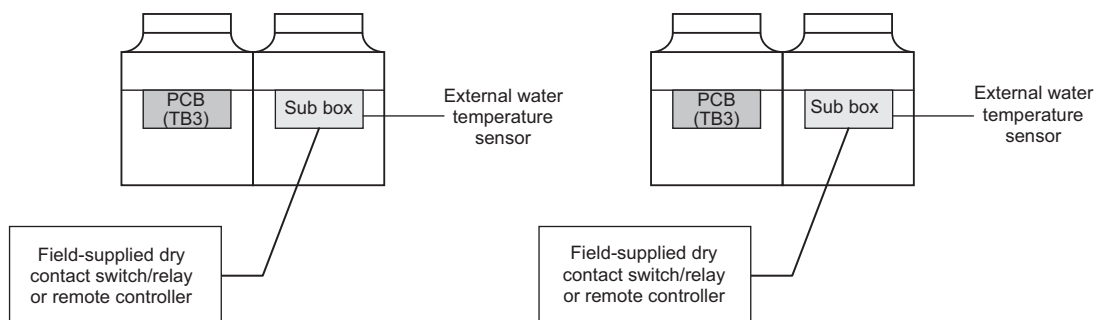
[1]	System Configuration.....	21
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[1] System Configuration

Schematic Diagrams of Individual and Multiple Systems

(1) Individual system

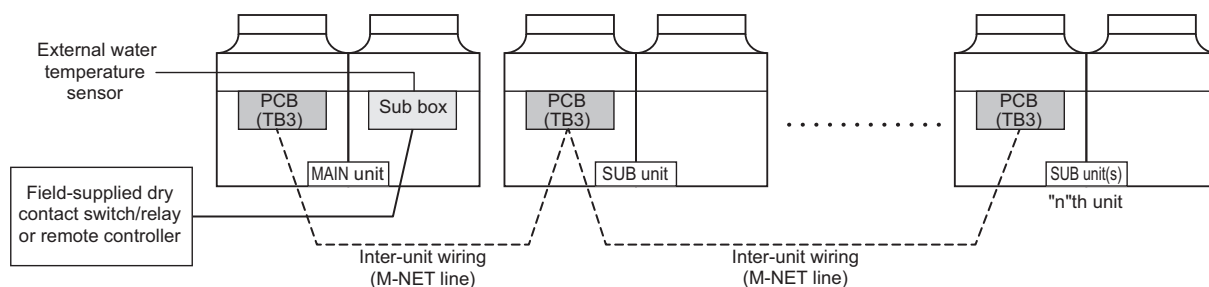
* Each unit is operated individually by connecting a dry contact switch/relay to each unit.



Refer to the sections "Switch Types and the Factory Settings" (page 30) and "System configuration procedures: Individual system" (page 33) 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 30) and "System configuration procedures: Multiple system" (page 34) for further details.

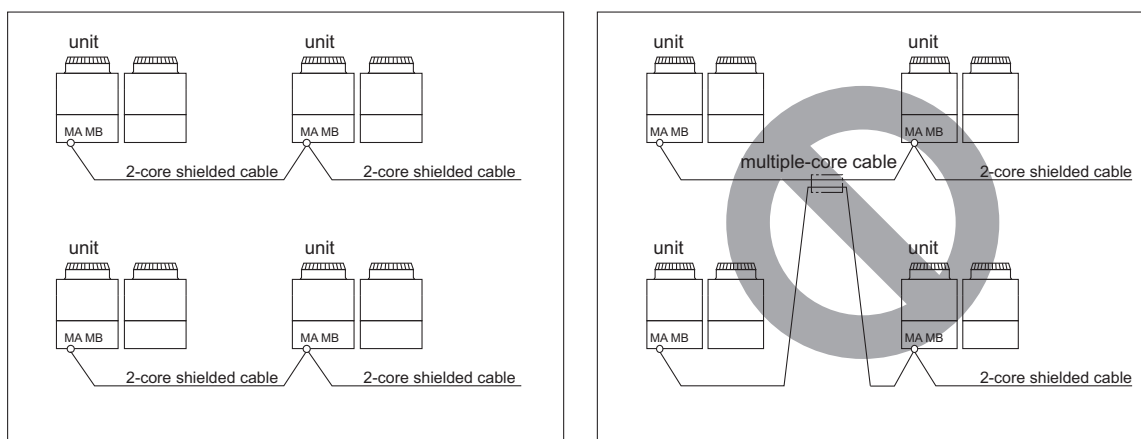
[2] Types and Maximum allowable Length of Cables

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 5 cm [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.



(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.

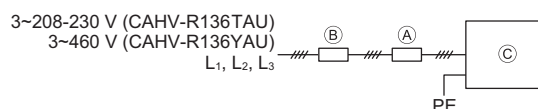
[3] Main Power Supply Wiring and Switch Capacity

Schematic Drawing of Wiring (Example)

(A): Switch (with current breaking capability)

(B): Earth leakage breaker

(C): Outdoor unit



Main power supply wire size, switch capacities, and system impedance

Model	Minimum wire thickness (mm ²)			Earth leakage breaker	Local switch (A)		Overcurrent breaker (A)	MCA (A)	MOP (A)
	Main cable	Branch	Ground		Capacity	Fuse			
CAHV-R136TAU	33.63 mm ² (AWG 2)	-	33.63 mm ² (AWG 2)	110 A 100 mA 0.1 sec. or less	110	110	110	72	110
CAHV-R136YAU	16.77 mm ² (AWG 5)	-	16.77 mm ² (AWG 5)	60 A 100 mA 0.1 sec. or less	60	60	60	41	60

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. Do not install a phase advancing capacitor on the motor. Doing so may damage the capacitor and result in fire.
7. Use the breakers that match the unit capacity (leakage current limit, current breaking threshold, etc.).
8. Select the type of breaker for an inverter circuit as an earth leakage breaker. (Mitsubishi Electric NV-S series or its equivalent)
9. A breaker with at least 3.0mm (0.12 inch) contact separation in each poles shall be provided.
10. When using an earth leakage breaker without an overcurrent breaker, use a local switch and a molded-case circuit breaker in combination.
11. If the power cable is damaged, it must be replaced by qualified personnel in order to avoid a hazard.
12. The appliance shall be installed in accordance with national wiring regulations. However, the local standards and/or regulations is applicable at a higher priority.
13. When the power cable is connected, the grounding wire must be longer than the power wire.

⚠ Warning:

- All electric work must be performed by a qualified electrician according to the local regulations, standards, and the instructions detailed in the Installation Manual.
- Be sure to use specified wires and ensure no external force is imparted to terminal connections. Loose connections may cause overheating and fire.
- Proper grounding must be provided by a qualified personnel. Do not connect the grounding wire to 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.
- Include some slack in the power cables.
- Failure to do so may break or overheat the cables, resulting in smoke or fire.
- Install an earth leakage breaker on the power supply of each unit.
- Failure to do so may result in electric shock or fire.
- Only use properly rated breakers (an earth leakage breaker, local switch <a switch + fuse that meets local electrical codes>, or overcurrent breaker).
- Failure to do so may result in electric shock, malfunction, smoke, or fire.
- Only use standard power cables of sufficient capacity.
- Failure to do so may result in current leakage, overheating, smoke, or fire.
- Tighten all terminal screws to the specified torque.
- Loose screws and contact failure may result in smoke or fire.

⚠ 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.
- If a large electric current flows due to a malfunction or faulty wiring, earth-leakage breakers on the unit side and on the upstream side of the power supply system could both operate. Depending on the importance of the system, separate the power supply system or take protective coordination of breakers.

Control cable specifications

Remote controller cable	Size	0.3 - 1.25 mm ² (AWG 22-16)(Max. 200 m (656 ft) total) *1
	Recommended cable types	CVV
M-NET cable between units	Size	Min. 1.25 mm ² (AWG 16)(Max. 200 m (656 ft) total)
	Recommended cable types	Shielded cable CVVS, CPEVS or MVVS
External input wire size	Size	Min. 0.3 mm ² (AWG 22)
	*1 Recommended cable types	Shielded cable CVVS, CPEVS or MVVS
External output wire size	Size	1.25 mm ² (AWG 16)
	*1 Recommended cable types	Shielded cable CVVS, CPEVS or MVVS

*1 At least 1 mm (0.039 in) thickness of supplementary insulation shall be provided.

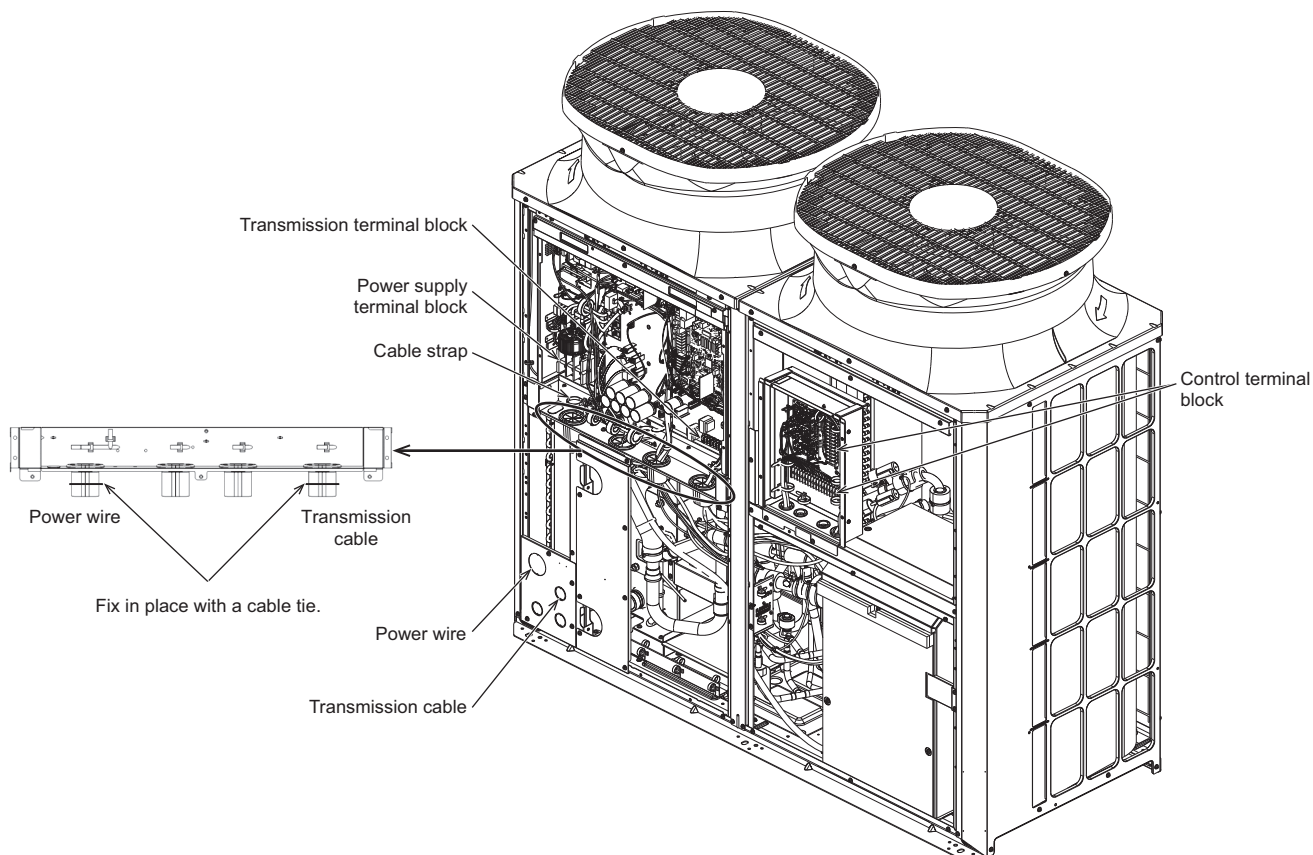
Applicable torque of wiring

Screw	Torque [N · m] (lbf · ft)
M3	0.69 ± 0.1 (0.509 ± 0.074)
M4	1.47 ± 0.15 (1.084 ± 0.111)
M5	2.55 ± 0.2 (1.881 ± 0.147)
M6	2.75 ± 0.3 (2.028 ± 0.222)

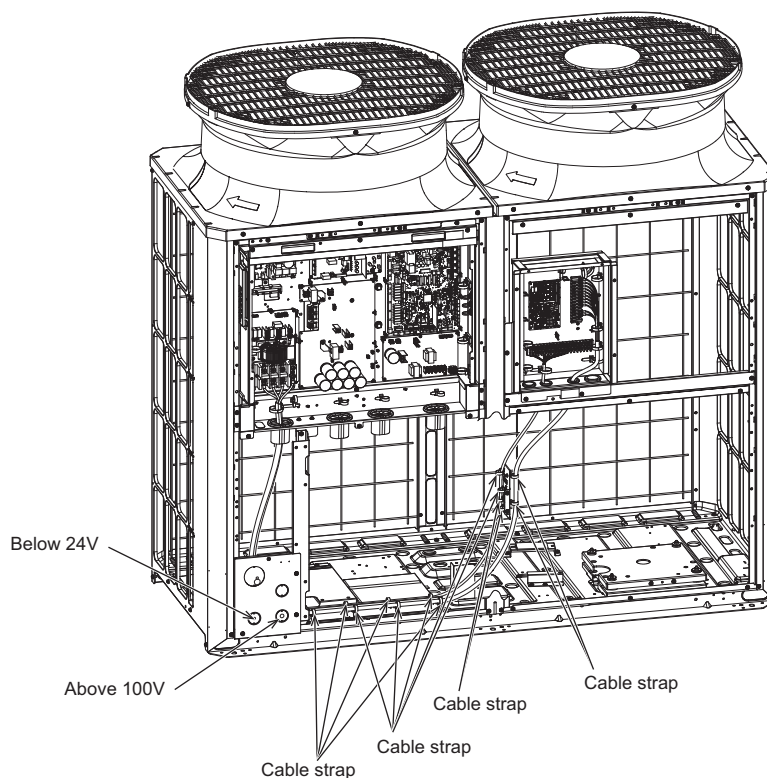
<1> Schematic Diagram of a Unit and Terminal Block Arrangement

To remove the front panel of the control box, unscrew the four screws and pull the panel forward and then down.

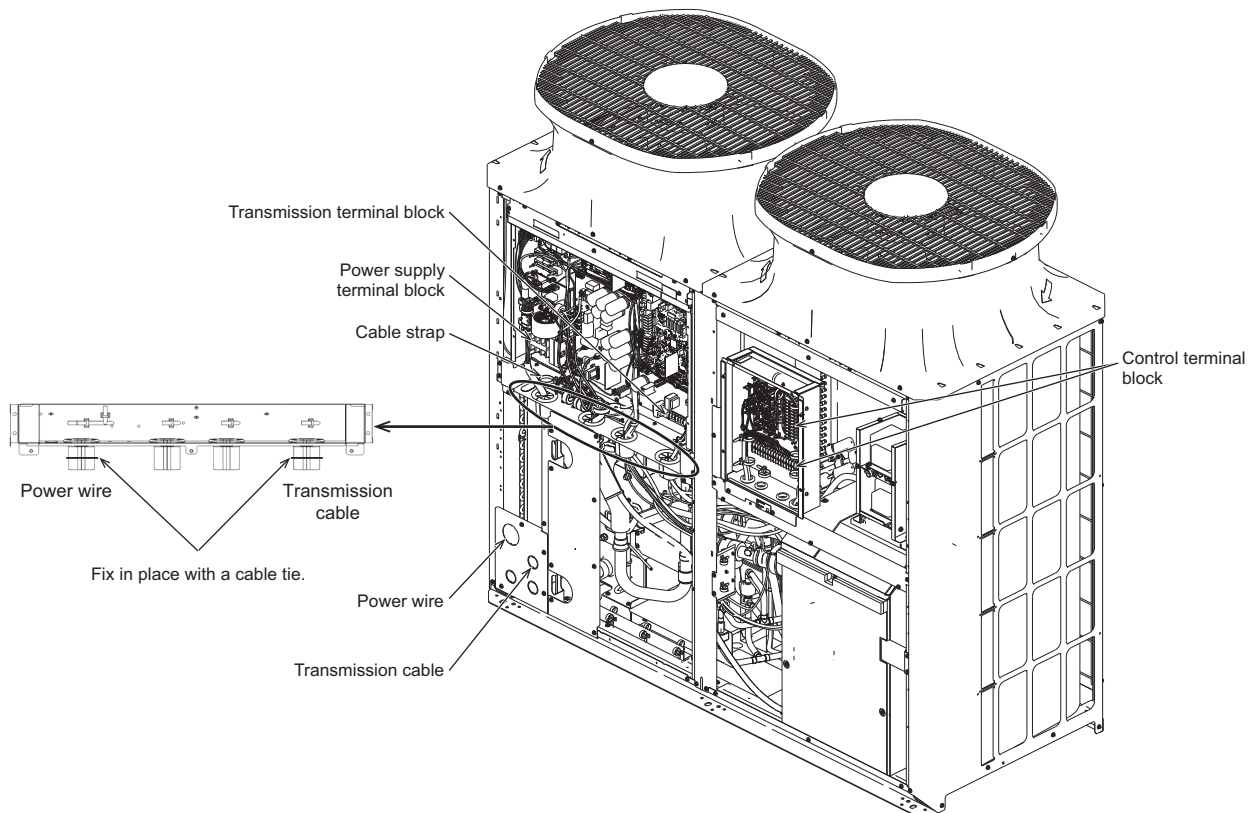
CAHV-R136TAU (-BS)



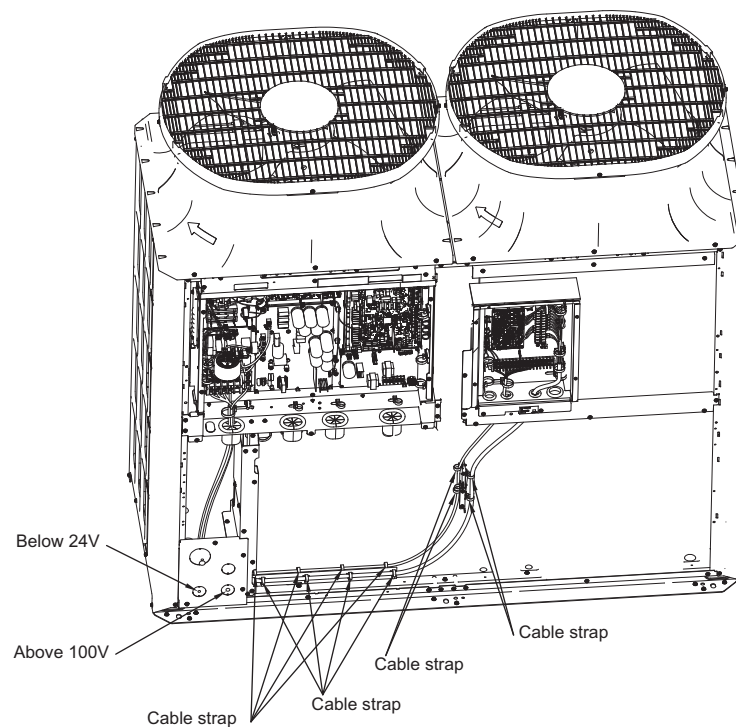
Important: Power supply cables larger than 53.49 mm^2 (AWG 1/0) in diameter are not connectable to the power supply terminal block (TB1). Use a pull box to connect them.



CAHV-R136YAU (-BS)

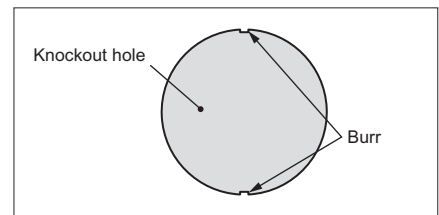


Important: Power supply cables larger than 21.15 mm^2 (AWG 4) in diameter are not connectable to the power supply terminal block (TB1). Use a pull box to connect them.



<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.



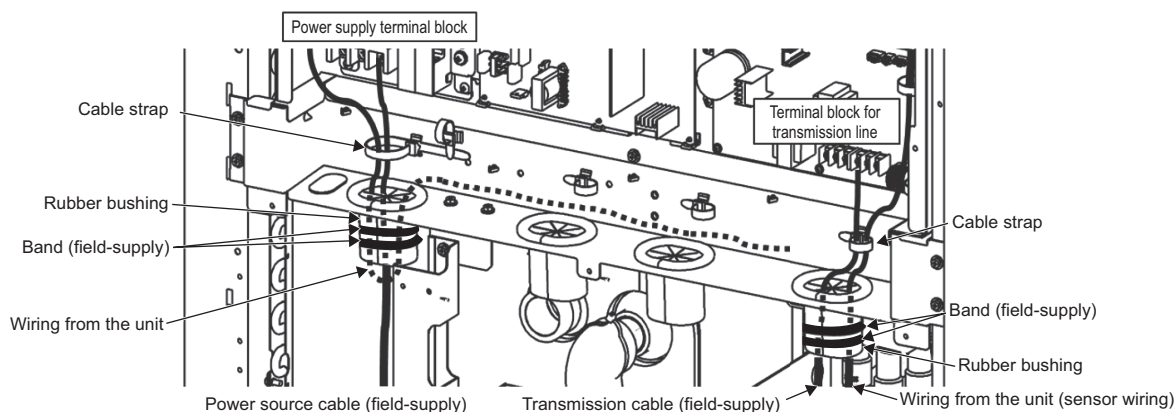
<3> Control box and connecting position of wiring

(1) Preparation for installation

- Check that the main power on the outdoor unit is turned off.
- After turning off the main power, leave it turned off for at least 10 minutes before proceeding the installation work.

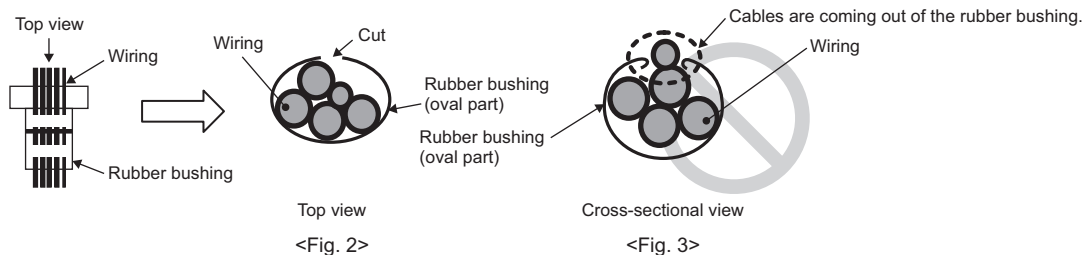
(3) Installation

1. Thread the power source cable through the rubber bushing on the left side. (Refer to Fig. 1, Note 1, and Note 2.)
2. Thread the unit wiring (sensor wiring) and the transmission cable through the rubber bushing on the right side. (Refer to Fig. 1, Note 1, and Note 2.)
3. Hold the power source cable and the transmission cable in place respectively with the cable straps. (Refer to Fig. 1)
4. Connect the cables respectively to the power supply terminal block and the terminal block for transmission line. (Refer to Fig. 1)
5. Secure each rubber bushing with the supplied band. (Refer to Fig. 1 and Note 3)



<Fig. 1>

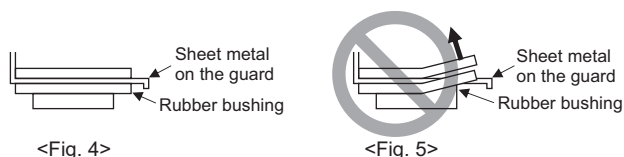
Note 1) Make sure the cables are not coming out of the rubber bushing cut. (Fig. 2 and Fig. 3)



<Fig. 2>

<Fig. 3>

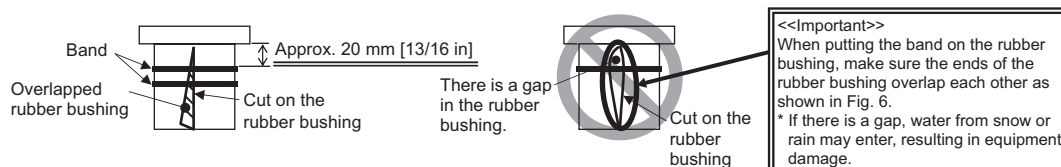
Note 2) When threading the wiring through the rubber bushing, make sure the rubber bushing will not come off the sheet metal on the control box guard. (Fig. 4 and Fig. 5)



<Fig. 4>

<Fig. 5>

Note 3) When tying the supplied band around the rubber bushing, make sure to leave no gap between the ends. (Fig. 6 and Fig. 7)



<Fig. 6: Back of the rubber bushing>

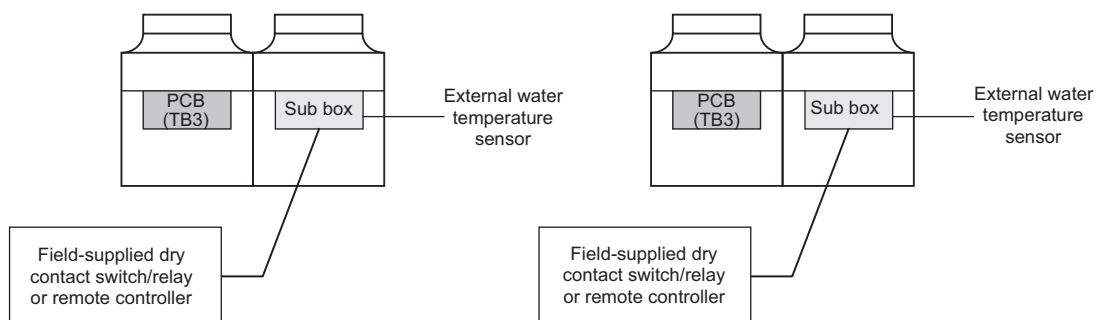
<Fig. 7: Back of the rubber bushing>

<<Important>>
When putting the band on the rubber bushing, make sure the ends of the rubber bushing overlap each other as shown in Fig. 6.
* If there is a gap, water from snow or rain may enter, resulting in equipment damage.

[4] Sample Installation

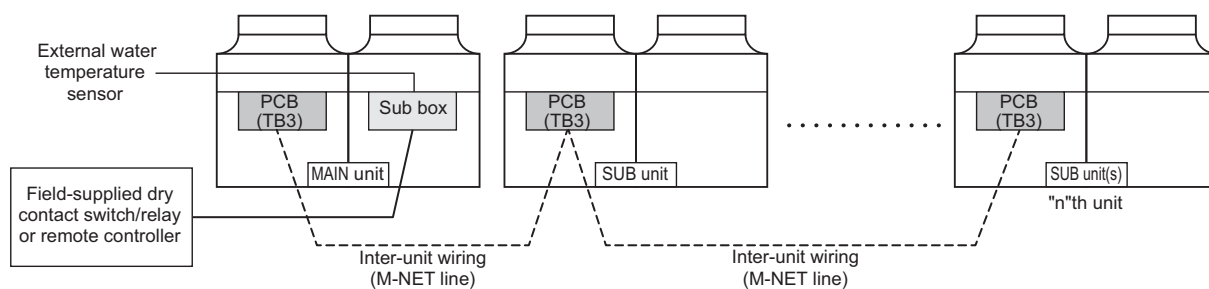
(1) Individual system

*Each unit is operated individually by connecting a dry contact switch/relay to each unit.



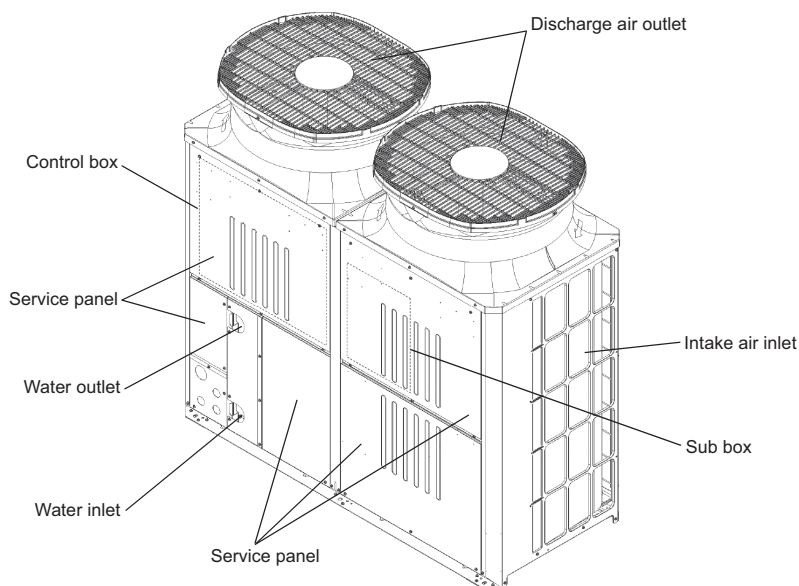
(2) Multiple system (2-16 units)

*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



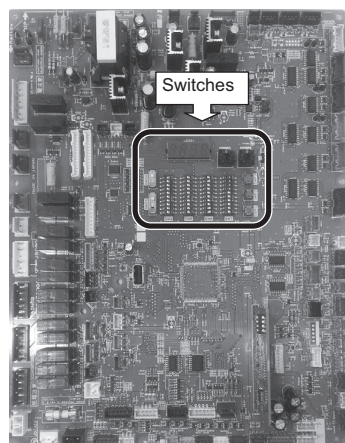
There are four main ways to set the settings as follows:

- ① Dip switches (SW4 - SW7)
- ② Dip switches used in combination with the push switches
- ③ Rotary switches
- ④ Slide switches

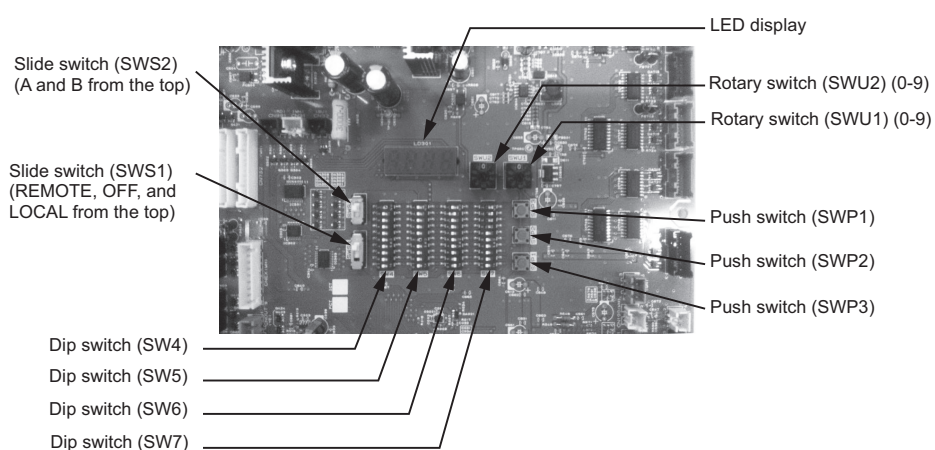
See below for how these switches are used to set certain items.

(2) Different types of switches on the PCB

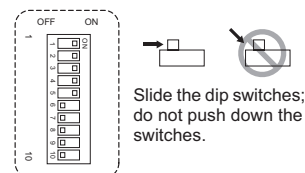
[Entire view of a PCB]



[Enlarged view of the switches]



			Initial Setting
Rotary switch (SWU1)	Sets the 1's digit of the unit address (Multiple system).		"1"
Rotary switch (SWU2)	Sets the 10's digit of the unit address (Multiple system).		"0"
Slide switch (SWS1)	REMOTE OFF LOCAL	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
Slide switch (SWS2)	Unused		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 (SW4-7)	Switches the LED display contents.		



Example: on the upper figure. 1 to 5 are "ON" and 6 to 10 are "OFF".

[6] Configuring the Settings

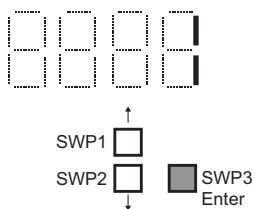
The settings must be set only by a qualified personnel.

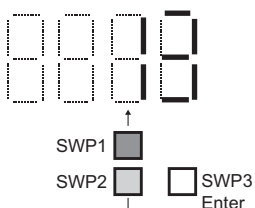
<1> Making the settings

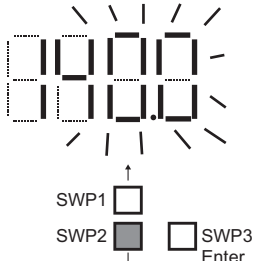
Use the LED display and the three push switches (SWP1 (↑), SWP2 (↓), and SWP3 (Enter)) to change the current settings on the circuit board and to monitor various monitored values.

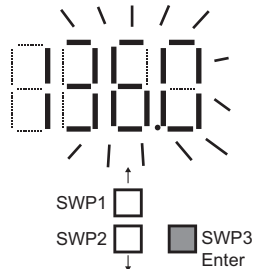
(1) Setting procedures

Take the following steps to set the push switches SWP1 through SWP3. These switches must be set after the dip switches SW5 and SW6 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.
- ↓
- 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 "140.0."
To decrease this value to 140.0, for example, press SWP2 (↓).
Press SWP1 (↑) to increase the value.

- ④
- 
- <To change the settings>**
- When the desired value is displayed (136.0 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 SW5 and SW6 as shown in the table below to set the value for the items in the "Setting item" column.

SW5 and SW6 settings				Setting Item	Item Code	Default	Notes
SW5-1	SW6-8	SW6-9	SW6-10				
OFF	OFF	ON	OFF	Current time	1		Set the current time.
				Maximum peak-demand capacity	2	100%	
				Peak-demand control start time	3	13:00	
				Peak-demand control end time	4	13:00	
				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	
				Setting temp D,E for analog input	11 11 (D) = 45.0°C (113°F) 13 13 (E) = 65.0°C (149°F)		When SW5-7 is set to ON
				Setting temp A (Heating mode)	11	113°F	Range 75-165
				Setting temp B (Hot water mode)	13	149°F	Range 75-165
				Remote water temperature input signal type	21	0	0: 4-20 mA; 1: 0-10 V; 2: 1-5 V; 3: 2-10 V
OFF	ON	OFF	OFF	Setting temp C1,C2,C3,C4 for Setting temp C for Heating Eco mode	22-27	22 (C1) = 34°C (93°F) 23 (C2) = -7°C (19°F) 24 (C3) = 24°C (75°F) 25 (C4) = 12°C (54°F) 26 (C5) = 30°C (86°F) 27 (C6) = 2°C (36°F)	
				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
				Drain pan heater/Defrost signal	1056	0	0: Drain pan signal 1: Defrost signal
				TWL1	1057	40°C (104°F)	Water temperature 1 for emergency signal 1
				TAL1	1058	-10.0°C (14°F)	Outside temperature 1 for emergency signal 1
				Thermo differential 2	1016	2.0°C (4°F)	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
				Control Sensor selection (Target Setting temp A)	1215	14	Selectable from TH14 or TH15
				Control Sensor selection (Target Setting temp B)	1216	14	Selectable from TH14 or TH15
OFF	ON	OFF	OFF	Control Sensor selection (Target Setting temp C)	1217	14	Selectable from TH14 or TH15
				Setting temp selection 1 (ON-time 1-OFF-time 1)	1218	1	1 = A; 2 = B; 3 = C
				Setting temp selection 2 (ON-time 2-OFF-time 2)	1219	1	1 = A; 2 = B; 3 = C
				Setting temp selection 3 (ON-time 3-OFF-time 3)	1220	1	1 = A; 2 = B; 3 = C
				Temperature Unit selection	1271	0	0: Fahrenheit 1: Centigrade

(3) System configuration procedures: Individual system

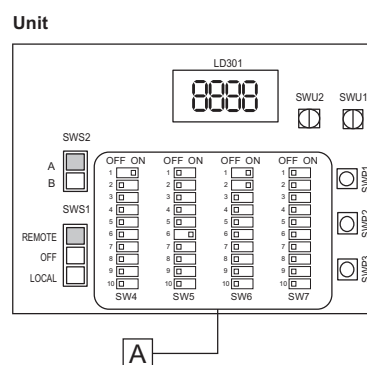
1. Set the dip switches on the control board.

Switch settings on the control board

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 "Factory Switch Settings (Dip switch settings table)" (page 87) for further details.

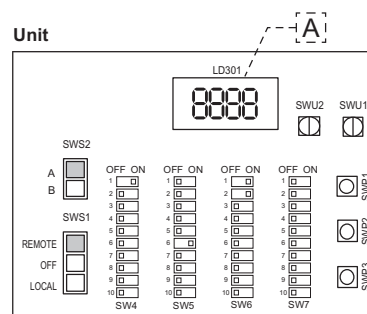


2. Switch on the power to the unit.

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 LD301 in the circuit board (labeled A in the figure at right).



3. Set the preset values with the switches on the control board.

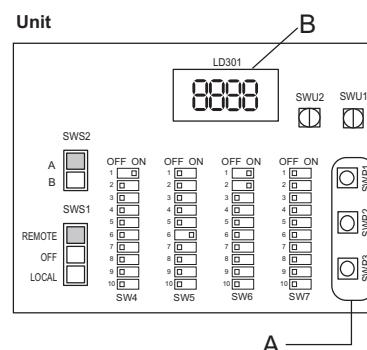
- (1) Press either one of the push switches SWP1, 2, or 3 (labeled A in the figure at right) on the circuit board.

* [EEEE] will disappear, and an item code ([101]) will appear on LD301 (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]→[105]→[107]→[108]→[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

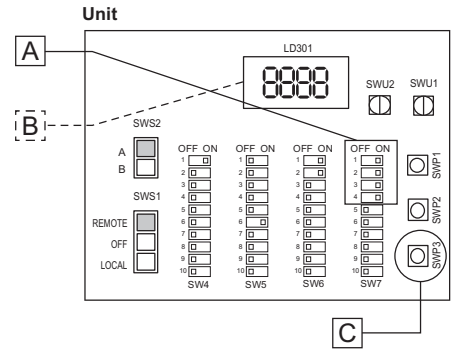
[105] Not used

[107] Total number of units in the system (Default = 1) (Leave it as it is.)

[108] Not used

4. Perform an initial setup.

- (1) Set dip switches SW7-1, -2, -3, and -4 to ON (labeled A in the figure at right).
[EEEE] will appear in LD301 (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 LD301 (labeled B in the figure at right).
- (3) Set dip switches SW7-1, -2, -3, and -4 to OFF (labeled A in the figure at right).
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.

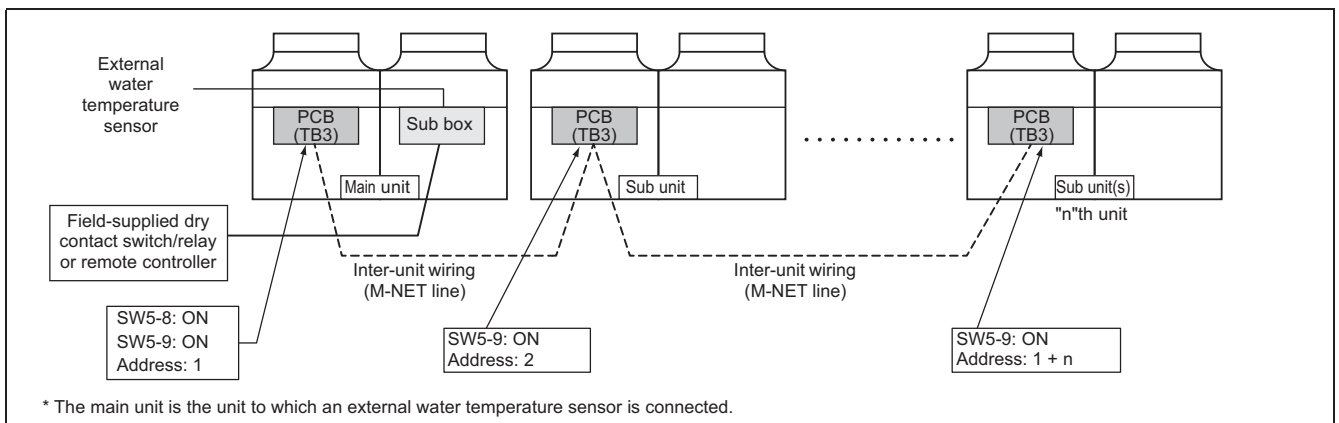


*1 If the start-up process has already been completed, [FFFF] (instead of [EEEE]) will appear when the dip switches SW7-1, 2, 3, 4 are set to ON.

(4) System configuration procedures : Multiple system

1. Set the dip switches and rotary switches.

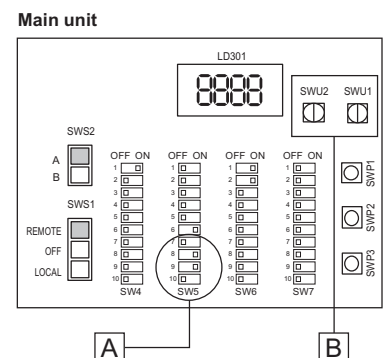
System configuration diagram



Setting the switches on the main unit

- (1) Set the dip switch SW5-8 to ON. (an external water temperature sensor) (labeled A in the figure at right)
- (2) Set the dip switch SW5-9 to ON. (multiple unit control) (labeled A in the figure at right)

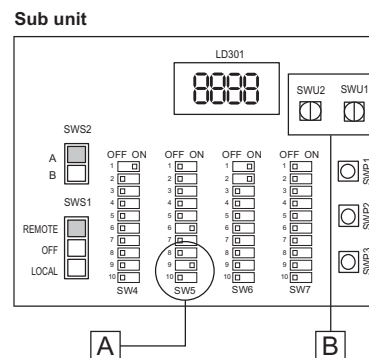
Refer to "Factory Switch Settings (Dip switch settings table)" (page 87) for further details.



Make sure the address on the main unit is set to "1" (labeled B in the figure above).

Setting the switches on all sub units

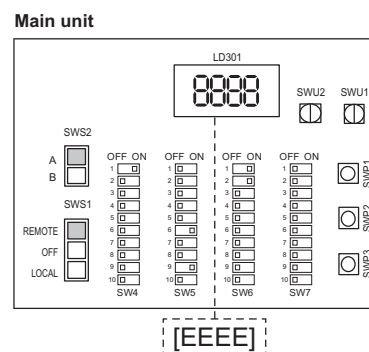
- (1) Set the dip switch SW5-9 to ON. (multiple unit control) (labeled A in the figure at right)
- (2) Set the addresses with the rotary switches. (labeled B in the figure at right). Set the 1's digit with SWU1, and set the 10's digit with SWU2. Assign sequential addresses on all sub units starting with 2.



2. Switch on the power to the unit.

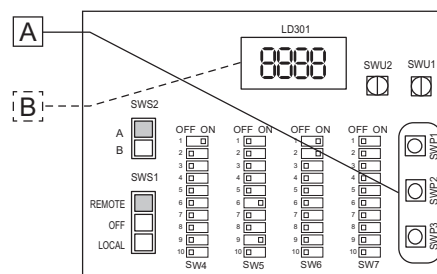
Check for loose or incorrect wiring, and then switch on the power to all units. When the power is switched on, the following codes will appear on the LED:

- [EEEE] will appear on LD301 on the main unit.
- [9999] will appear on LD301 on the sub units.



3. Set the preset values with the switches on the control board.

- (1) Press either one of the push switches SWP1, 2, or 3 (labeled A in the figure at right) on the control board.
* [EEEE] will disappear, and an item code ([101]) will appear on LD301 (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] → [105] → [107] → [108] → [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.

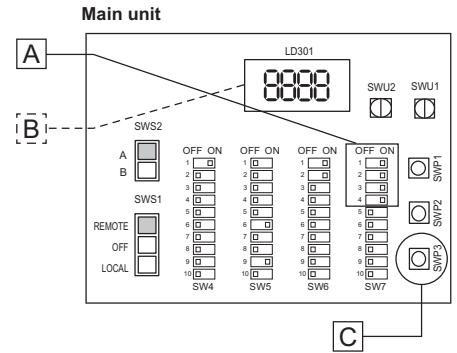


Following the steps above, set the value for the following items with the switches as necessary. Item [107] must be set when multiple units are connected to a system.

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

4. Perform an initial setup on the main unit.

- (1) Set dip switches SW7-1, -2, -3, and -4 to ON (labeled A in the figure at right).
[EEEE] will appear in LD301 (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 LD301 (labeled B in the figure at right).
- (3) Set dip switches SW7-1, -2, -3, and -4 to OFF (labeled A in the figure at right).
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.



*1 If the start-up process has already been completed, [FFFF] (instead of [EEEE]) will appear when the dip switches SW7-1, 2, 3, 4 are set to ON.

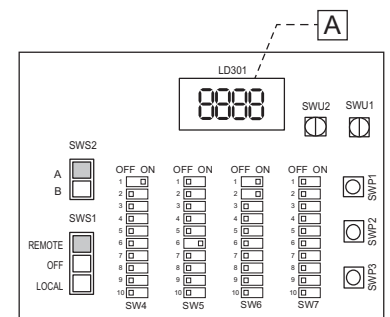
(5) System configuration procedures: Individual system (for FTC connection)

1. Switch on the power to the unit.

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

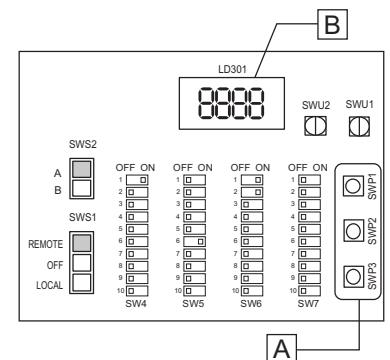
When the power is switched on, the following codes will appear on the LED:

- [EEEE] will appear on LD301 in the circuit board (labeled A in the figure at right).



2. Set the preset values with the switches on the control board.

- (1) Press either one of the push switches SWP1, 2, or 3 (labeled A in the figure at right) on the circuit board.
 - * [EEEE] will disappear, and an item code ([101]) will appear on LD301 (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] → [105] → [107] → [108] → [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.

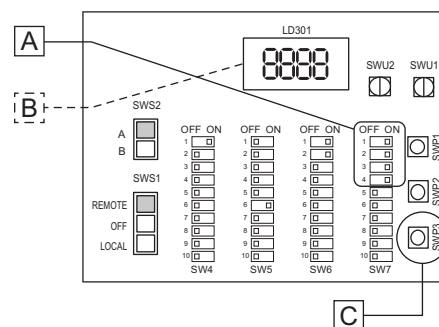


Following the steps above, set the value for the following items as necessary.

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

3. Perform an initial setup.

- (1) Set dip switches SW7-1, -2, -3, and -4 to ON (labeled A in the figure at right).
[EEEE] will appear in LD301 (labeled B in the figure at right).
- (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 LD301 (labeled B in the figure at right).
- (3) Set dip switches SW7-1, -2, -3, and -4 to OFF (labeled A in the figure at right).
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.



(6) Re-initializing the system

When the settings for the items below have been changed, the system will require re-initialization.

- Dip switch SW5-8 (use or non-use of an external water temperature sensor) (Re-initialization is required only for the Multiple system.)
- Dip switch SW5-9 (multiple unit control)
- Dip switch SW6-3 (water temperature control method)
- System 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 dip switches SW7-1, 2, 3, 4 to ON.
[FFFF] will appear in the LD301.
- (2) Press and hold the push switch SWP3 for 5 seconds.
 - While the system is starting up [9999] will appear on LD301.
- (3) Set the dip switches SW7-1, 2, 3, 4 to OFF.

(7) Resetting the system

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.

When an error on the MAIN unit is reset, all sub units will stop.

- (1) Set the dip switches SW7-1, 2, 3, 4 to ON.
[FFFF] will appear in the LD301.
- (2) Press and hold the push switch SWP3 for one second or longer.
 - While the system is starting up [9999] will appear on LD301.
- (3) Set the dip switches SW7-1, 2, 3, 4 to OFF.

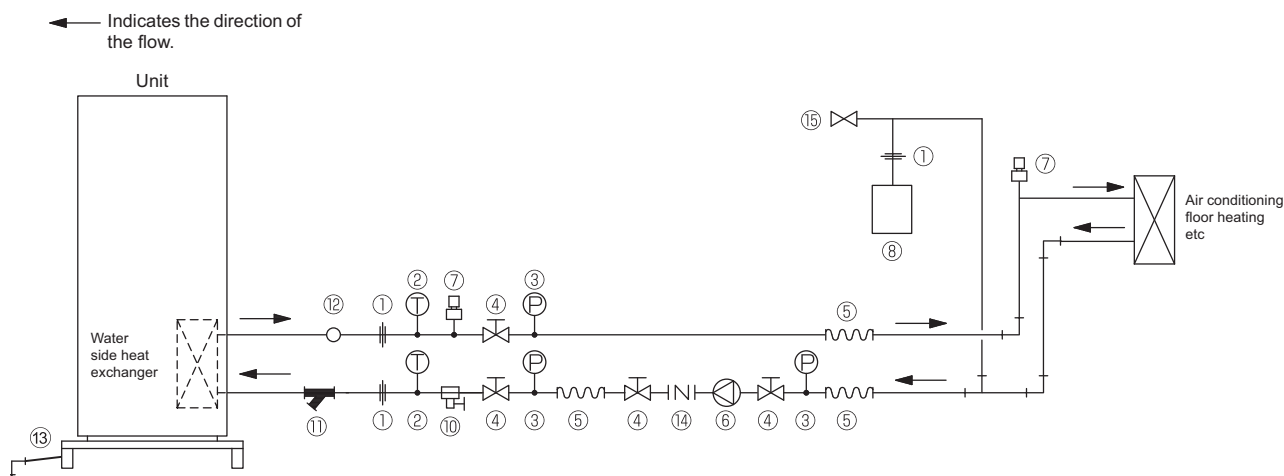
(8) Factory reset

Factory reset the system as follows when necessary. All settings and information on cumulative operation time, etc. will be lost when the system is factory reset. Before resetting the system, be sure to write down the current settings, cumulative operation time, and other necessary information.

- (1) Set SWS1 to OFF.
- (2) Press and hold SWP1, 2, and 3 simultaneously for 5 seconds.
 - While the system is starting up [9999] will appear on LD301.

[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	Pump	Use a pump that is large enough to compensate for the total water pressure loss and supply sufficient water to the unit. The fluctuation of the flow rate must be 10% per minute or less.
⑦	Automatic air vent valve	Install automatic air vent valves where air accumulates. Even in the case of a failure of the water-side heat exchanger in the unit, the refrigerant may leak from the automatic air vent valve. To prevent accidents resulted from refrigerant leakage, install the unit where leaked refrigerant will not accumulate, such as outdoors.
⑧	Closed expansion tank	Install a closed expansion tank to accommodate expanded water and to supply water.
⑨	Water pipe	Use pipes that allow for easy air purging, and provide adequate insulation. Ensure that gaps between water pipe and the unit are filled. e. g. Racking.
⑩	Drain valve	Install drain valves so that water can be drained for servicing.
⑪	Strainer	Install a strainer near the unit to keep foreign materials from entering the water-side heat exchanger.
⑫	Flow switch	Required to protect the unit.
⑬	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.
⑭	Check valve	Required to prevent the backward flow.
⑮	Safety valve	Install a safety valve near the closed expansion tank. Even in the case of a failure of the water-side heat exchanger in the unit, the refrigerant may leak from the safety valve. To prevent accidents resulted from refrigerant leakage, install the unit where leaked refrigerant will not accumulate, such as outdoors.

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 hot water heat pump unit 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. ≤ 60°C (140°F)		Higher mid-range temperature water system Water Temp. > 60°C (140°F)		Tendency	
		Recirculating water	Make-up water	Recirculating water	Make-up water	Corrosive	Scale-forming
Standard items	pH (25°C) (77°F)	7.0 ~ 8.0	7.0 ~ 8.0	7.0 ~ 8.0	7.0 ~ 8.0	○	○
	Electric conductivity (mS/m) (25°C) (77°F)	30 or less	30 or less	30 or less	30 or less	○	○
	(μS/cm) (25°C) (77°F)	[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 SO ₄ 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		○
Reference items	Ionic silica (mg SiO ₂ /ℓ)	30 or less	30 or less	30 or less	30 or less		○
	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	0.1 or less	1.0 or less	0.1 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	○	
Ryznar 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 a hot water heat pump unit (including when only the heat exchanger is replaced), first analyze the water quality and check for possible corrosion.

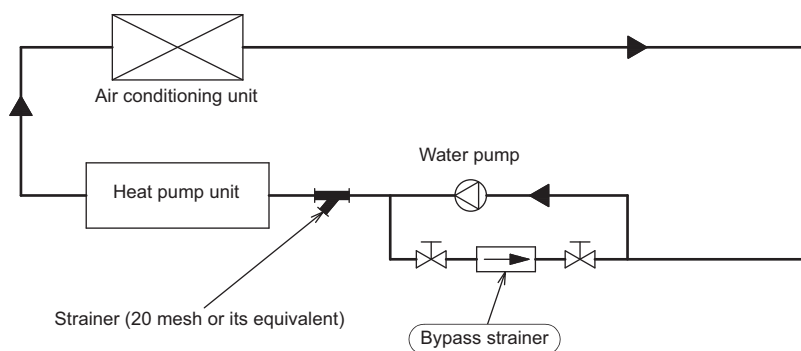
Corrosion can occur in water systems in which there has been no signs of corrosion. If the water quality level has dropped, adjust the water quality before replacing the unit.

(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.

3. Installing the strainer and flow switch

<1> Installing the strainer YS-40A (Optional parts)

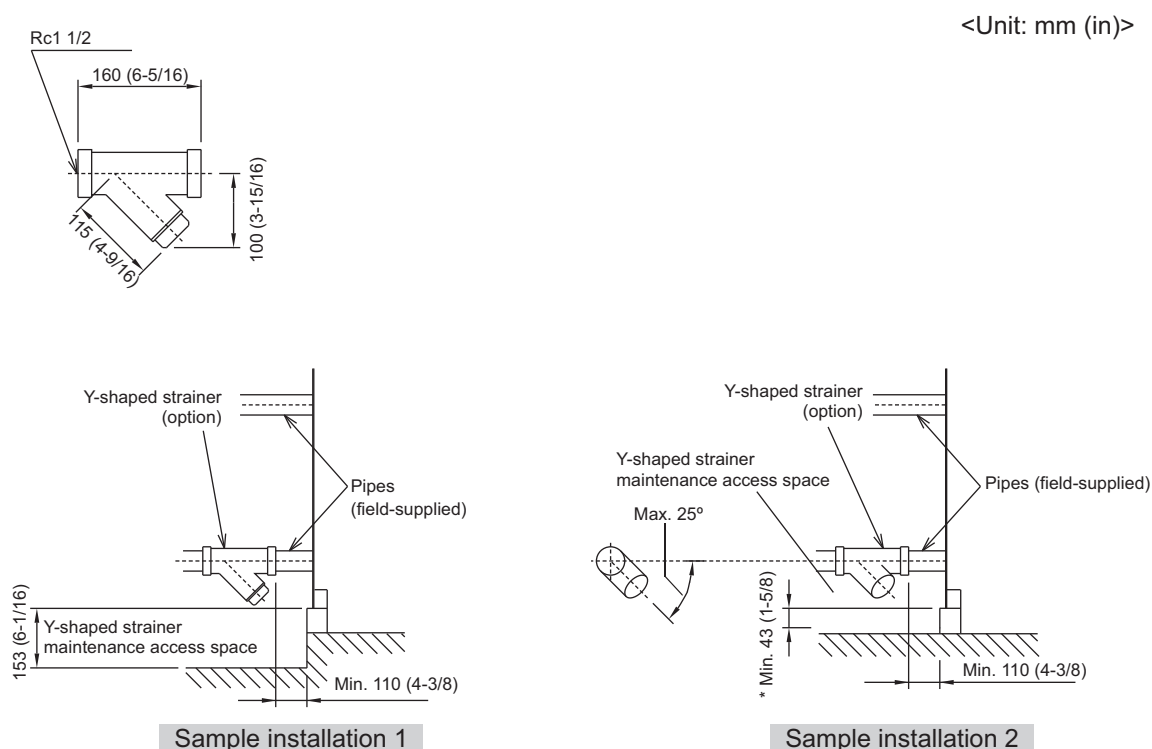
Install the optional strainer on the inlet water pipe near the unit to filter out suspended solids and prevent clogging or corrosion of the heat exchanger.

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.



<2> Installing a flow switch

Install a flow switch (field supplied) that meets the following specifications on the water pipe.

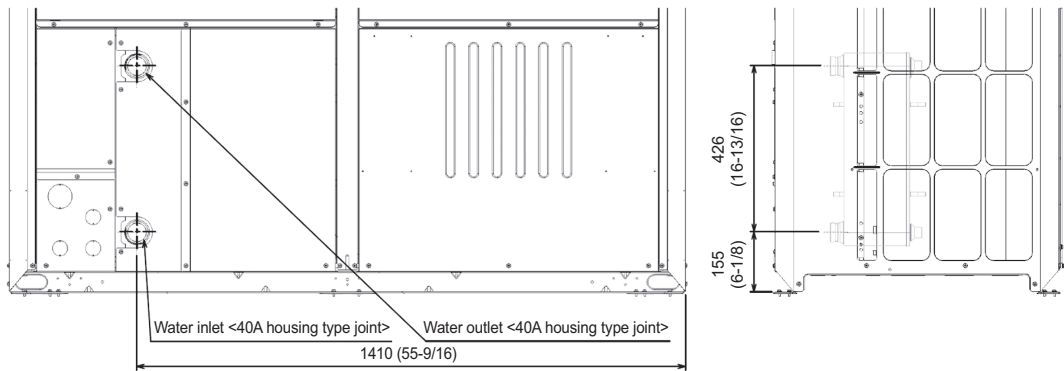
Connect the flow switch to the flow switch contact on the unit.

Minimum flow rate= 4.0 m³/h (66 L/min) (1056.8 G/h (17.6 G/m))

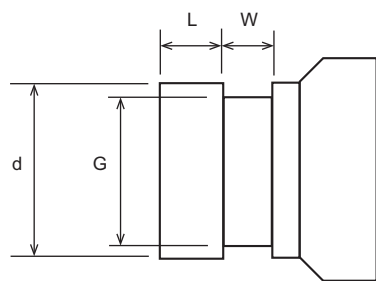
Unit usage range (water flow rate): 4.0 - 15.0 m³/h (1056.8 - 3963.0 G/h)

4. Water pipe hole size and location

<Unit: mm (in)>



Water pipe groove specifications



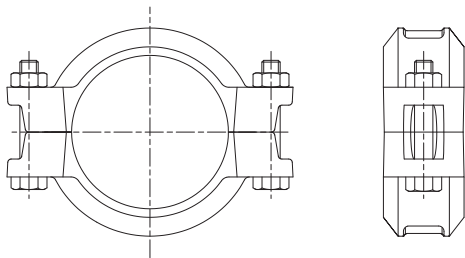
<Unit: mm (in)>

	Pipe size
	1-1/2B (40 A)
d	$\varnothing 48.3 \pm 0.3$ (1-15/16)
G	$\varnothing 45^{+0}_{-0.3}$ (1-13/16)
W	8 ± 0.3 (3/8)
L	15.9 ± 0.3 (11/16)

Housing joint (HJ-40A)

- Use to connect unit to local piping.

For the connection method and other details, refer to the installation instructions supplied with the housing joint (option parts).



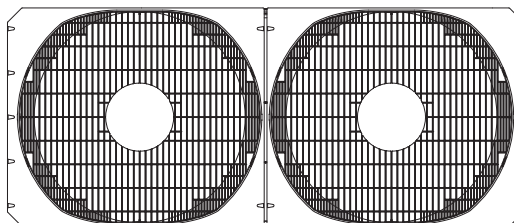
III Unit Components

[1] Unit Components and Refrigerant Circuit	47
[2] Control Box of the Unit.....	49
[3] Unit Circuit Board.....	51

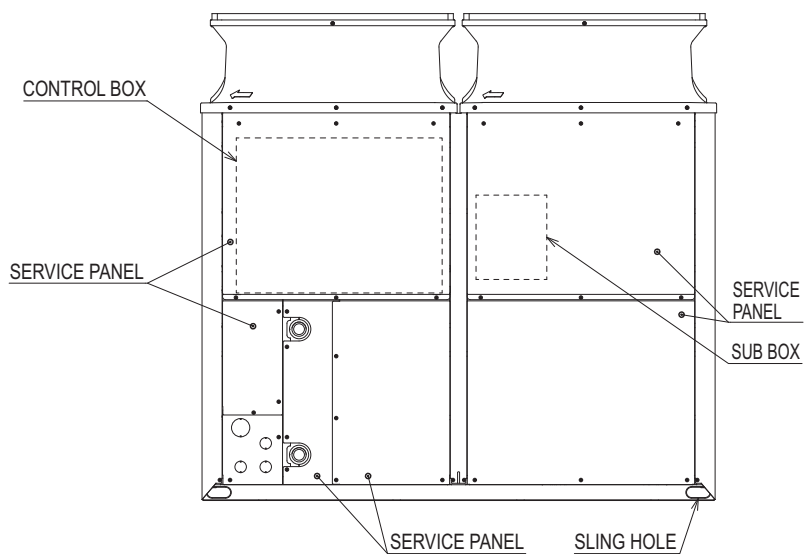
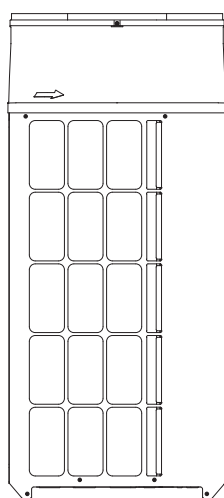
[1] Unit Components and Refrigerant Circuit

1. Unit Components

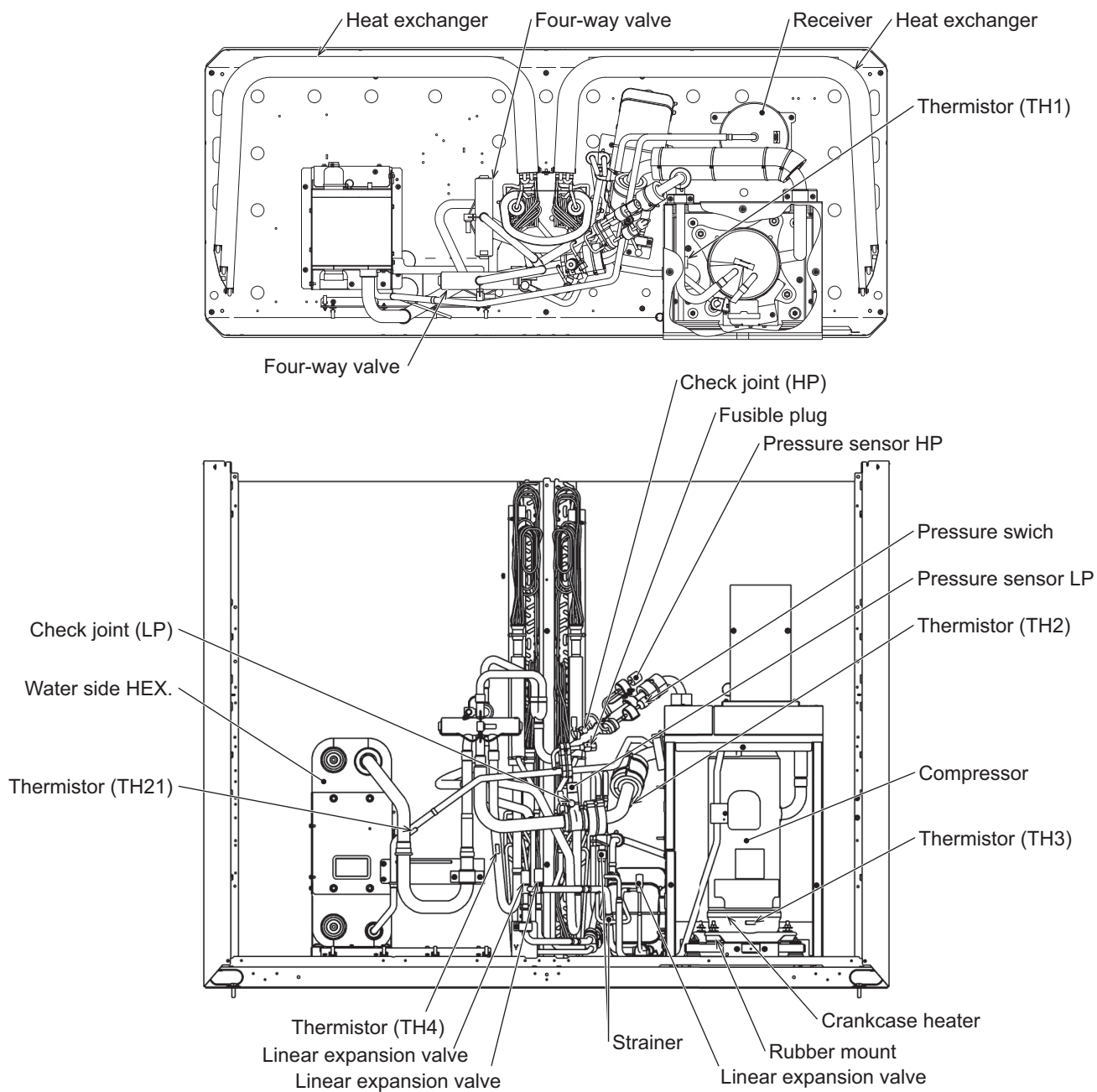
(1) Top view



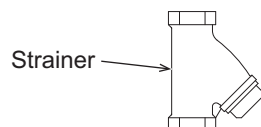
(2) Front and side view



2. Refrigerant circuit



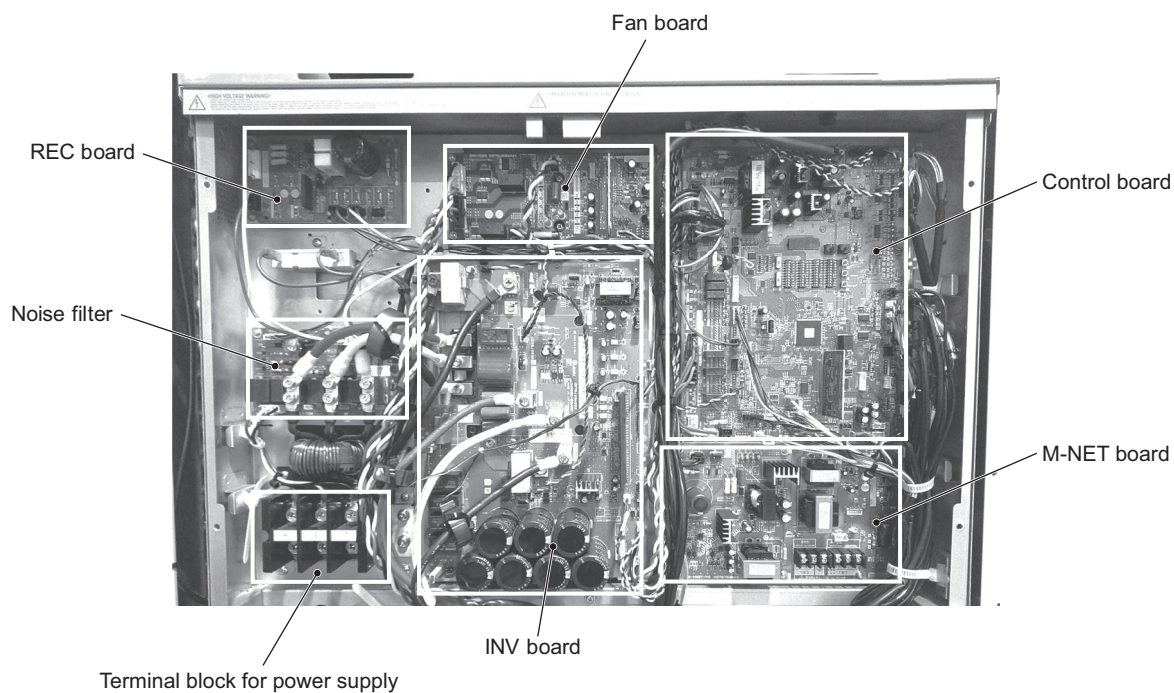
3. Water circuit (option)



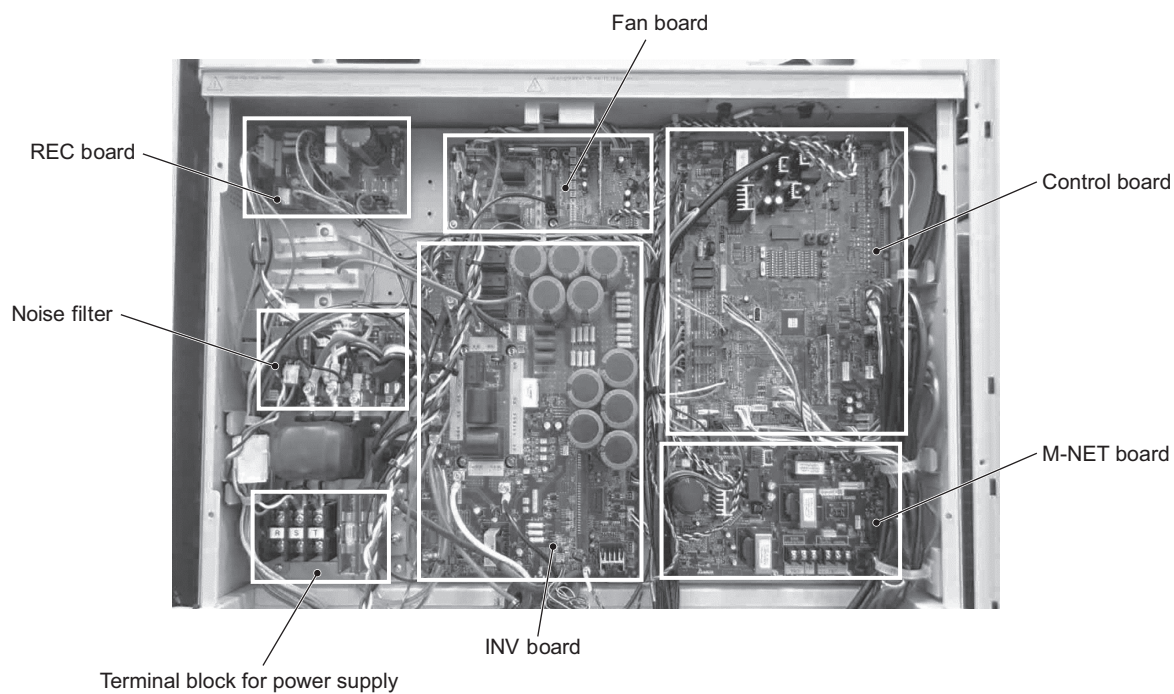
[2] Control Box of the Unit

1. Control box

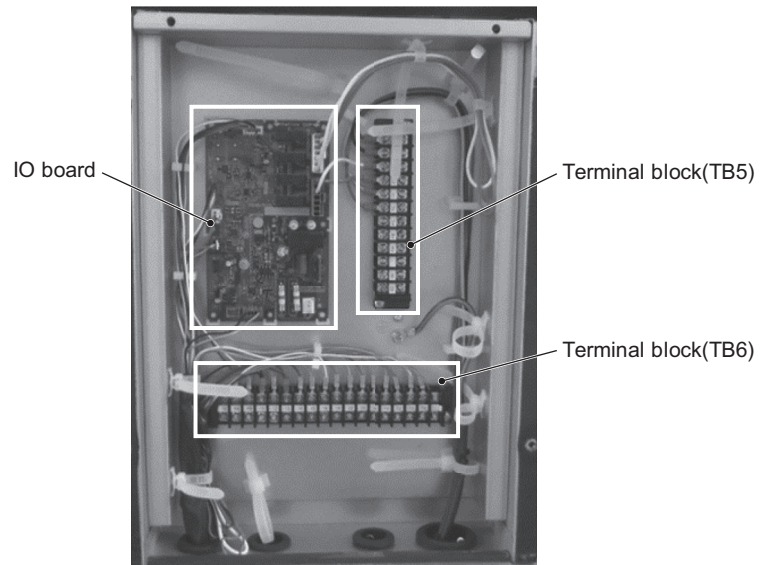
CAHV-R136TAU (-BS)



CAHV-R136YAU (-BS)



2. Sub box

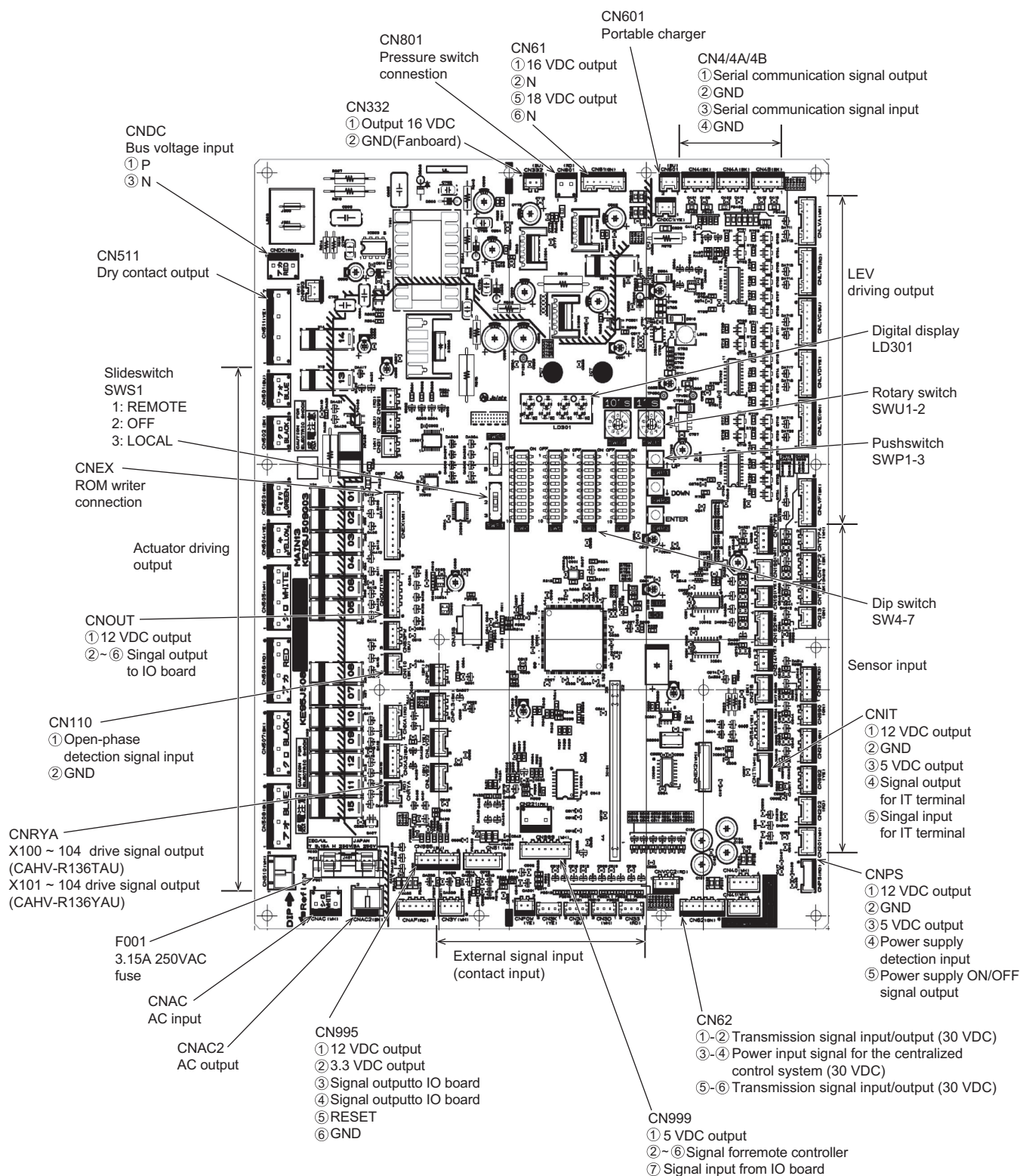


Note

- 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.

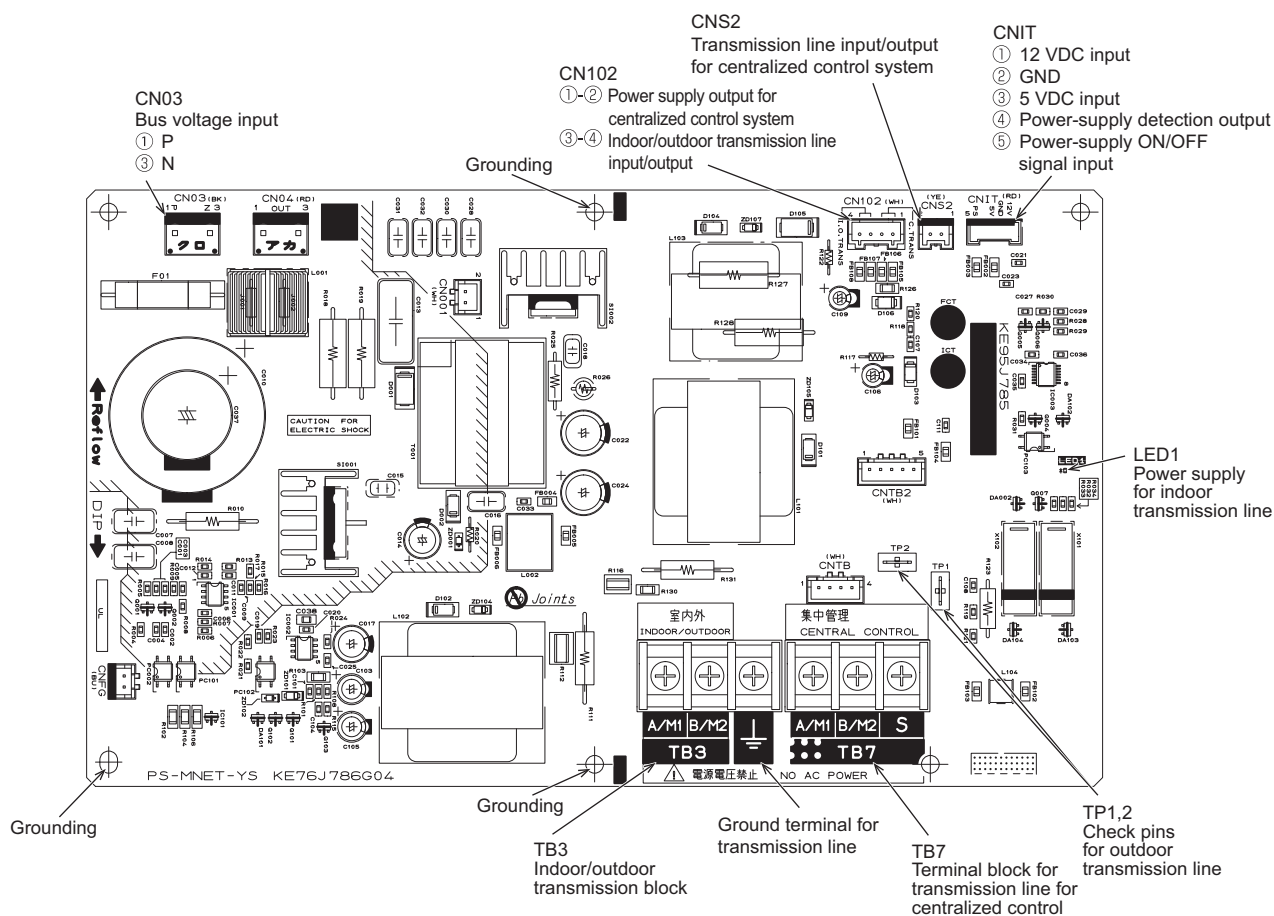
[3] Unit Circuit Board

1. Control board (MAIN board)

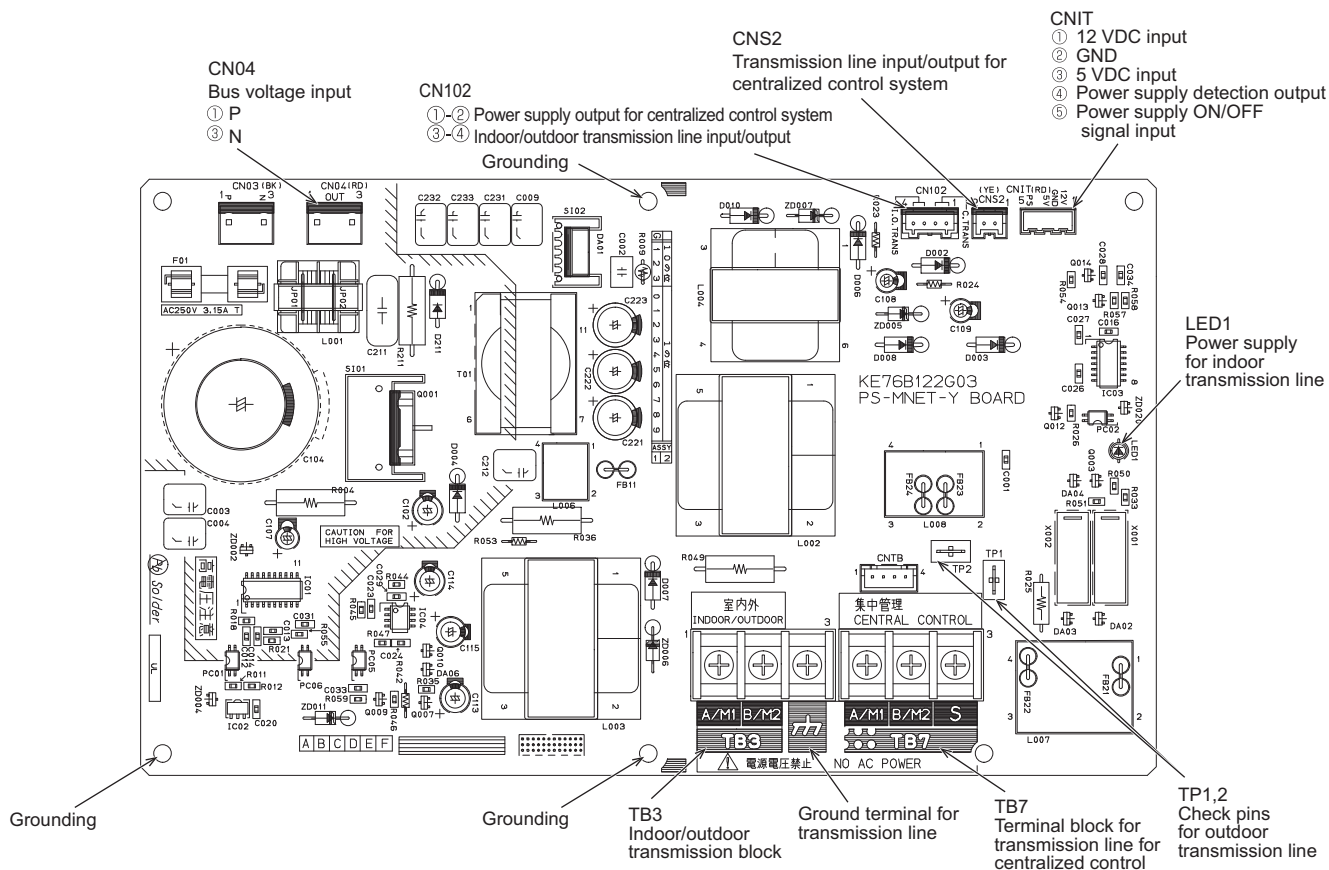


2. M-NET board

CAHV-R136TAU (-BS)

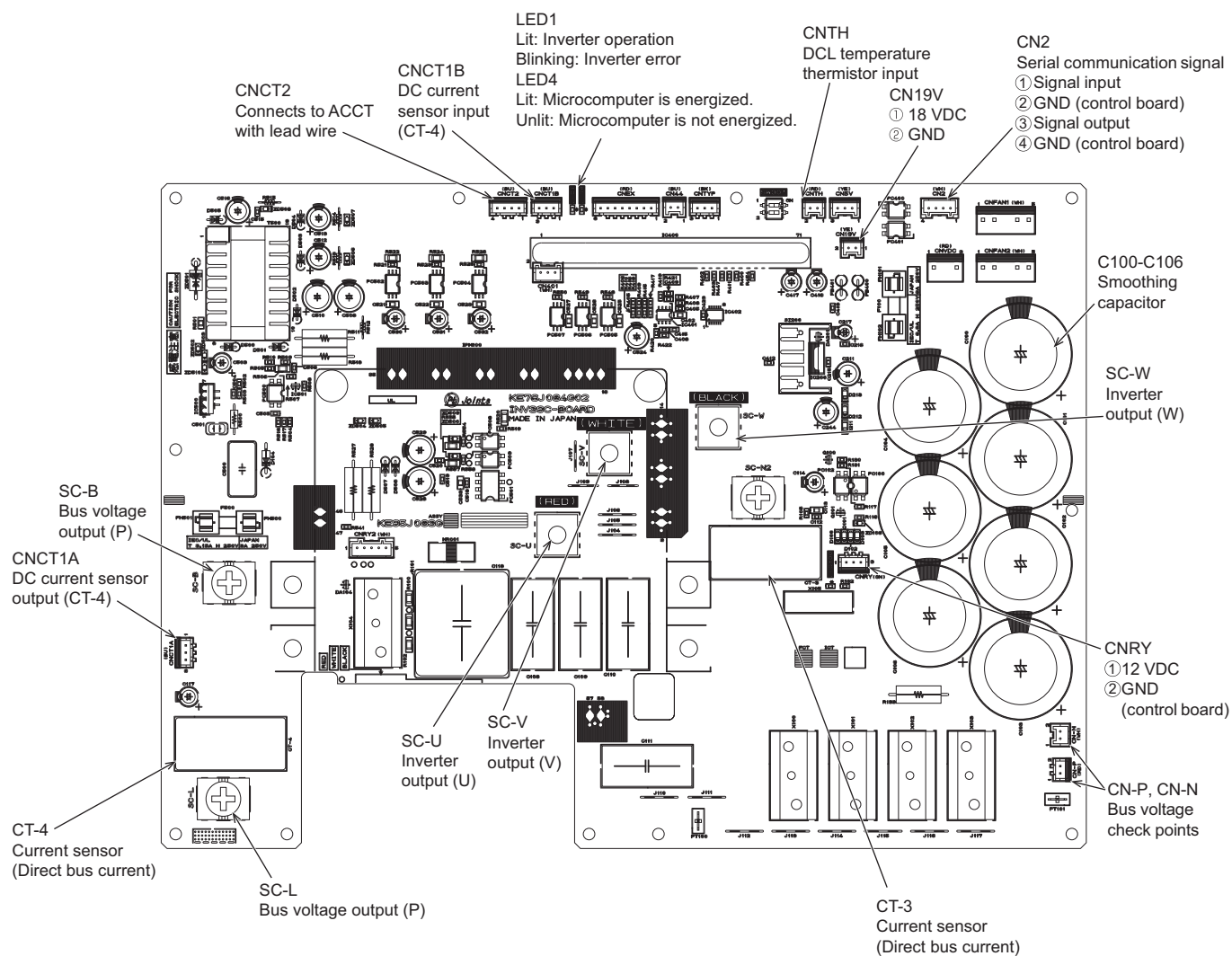


CAHV-R136YAU (-BS)

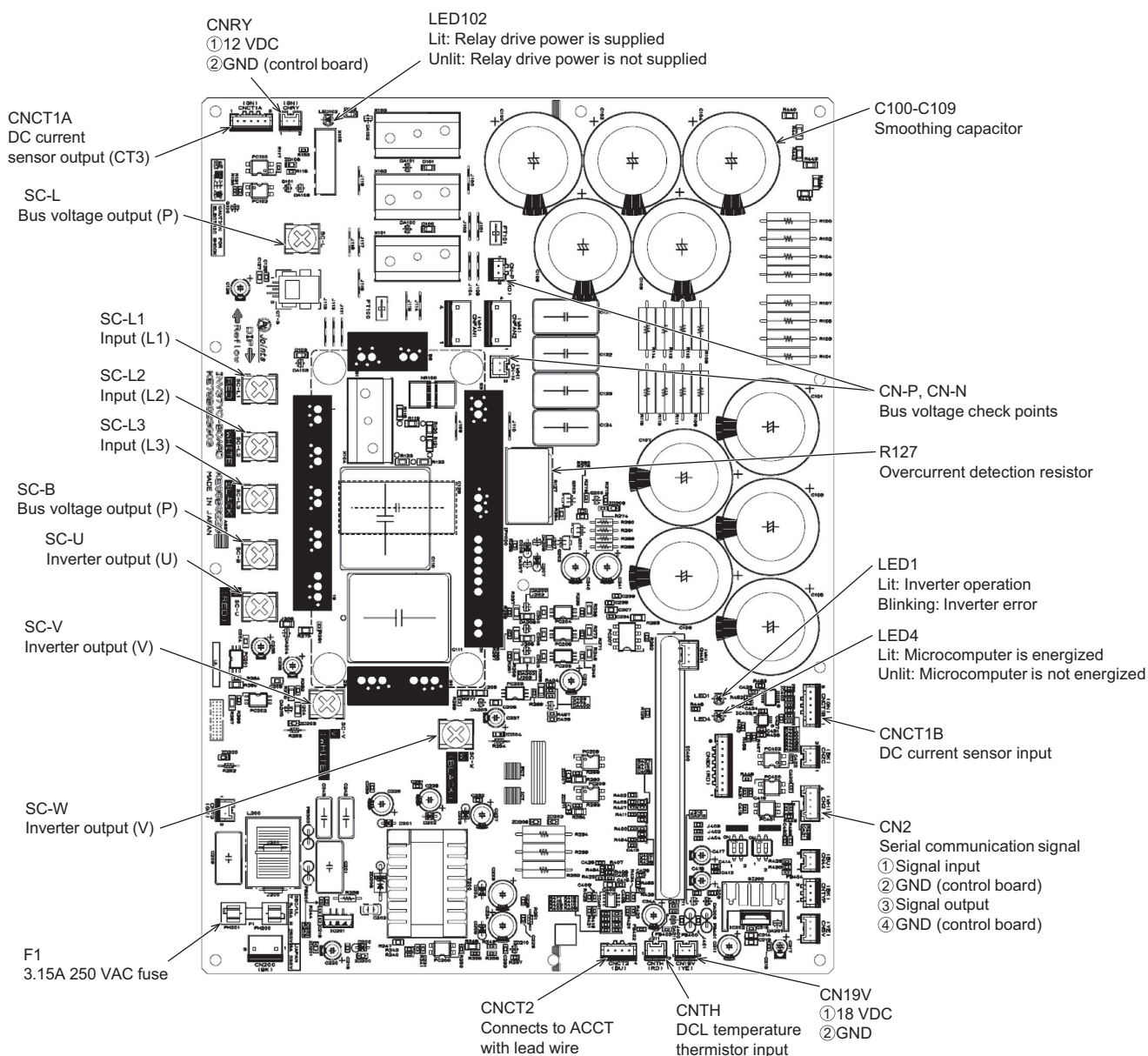


3. INV board

CAHV-R136TAU (-BS)



CAHV-R136YAU (-BS)

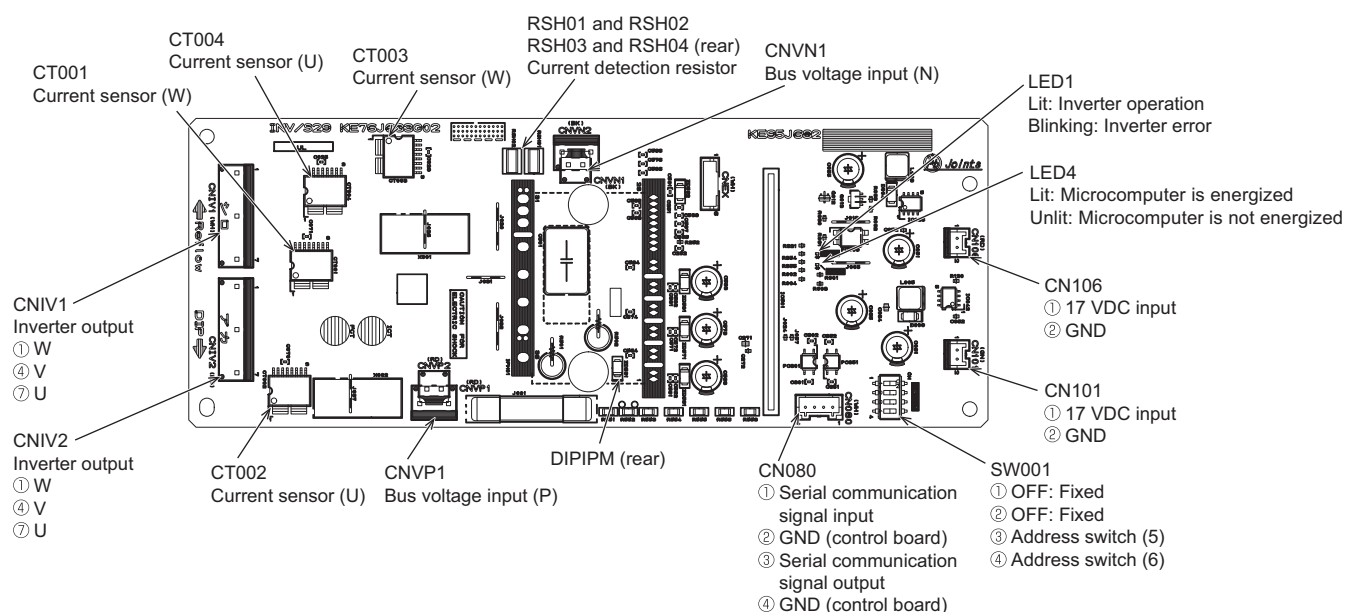


Note

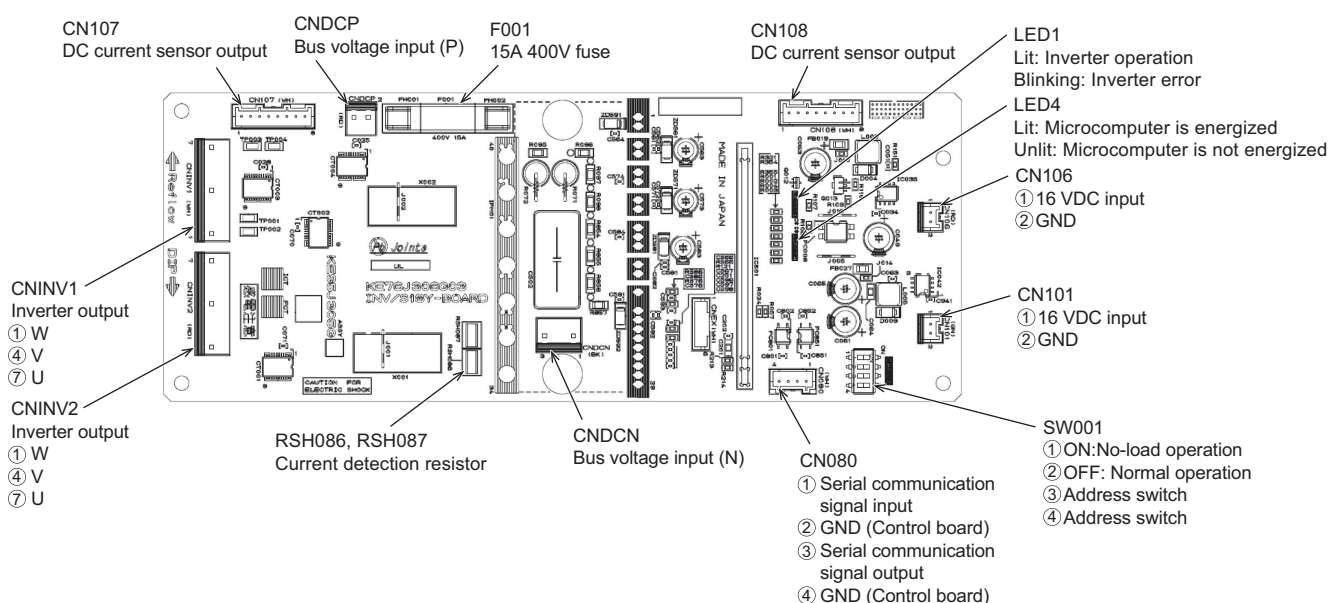
- When opening or closing the front panel of the control box, do not let it come into contact with any of the internal components.
Before inspecting the inside of the control box, turn off the power, keep the unit off for at least 10 minutes, and confirm that the voltage across CN-P and CN-N has dropped to 20 VDC or less. It takes about 10 minutes to discharge electricity after the power supply is turned off.
- A Faston terminal on the inrush current resistor has a locking function. Make sure the cable heads are securely locked in place. Press the tab on the terminals to remove them.
- Control box houses high temperature parts. Be well careful even after turning off the power source.
- Perform the service after disconnecting the connector (CNIV1, CNIV2 (CAHV-R136TAU)/CNINV1, CNINV2 (CAHV-R136YAU)) on the fan board. Before plugging in or unplugging connectors, check that the outdoor unit fan is not rotating and that the voltage across CN-P and CN-N is 20 VDC or less. The capacitor may collect a charge and cause an electric shock when the outdoor unit fan rotates in windy conditions. Refer to the wiring nameplate for details.
- After servicing, reconnect the relay connector (CNIV1, CNIV2 (CAHV-R136TAU)/CNINV1, CNINV2 (CAHV-R136YAU)) on the fan board as it was.
- When the power is turned on, the compressor is energized even while it is not operating. Before turning on the power, disconnect all power supply wires from the compressor terminal block, and measure the insulation resistance of the compressor.
Check the compressor for a ground fault. If the insulation resistance is 1.0 Mohm or below, connect all power supply wires to the compressor and turn on the power to the outdoor unit. The liquid refrigerant in the compressor will evaporate by energizing the compressor.

4. Fan board

CAHV-R136TAU (-BS)



CAHV-R136YAU (-BS)

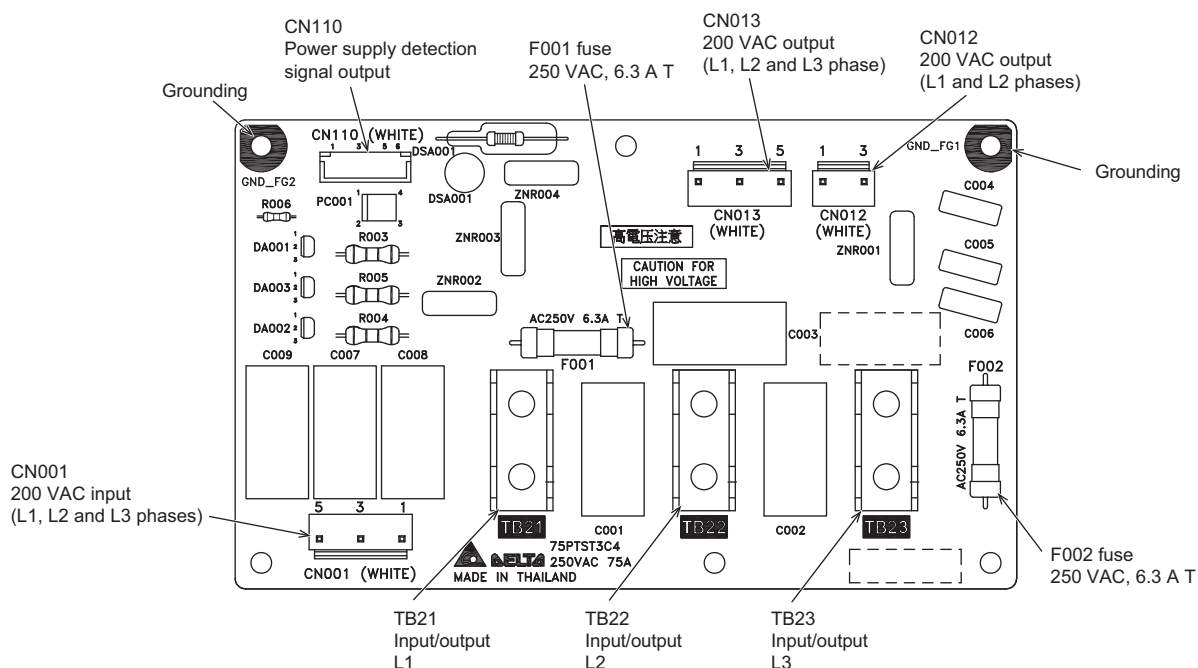


Note

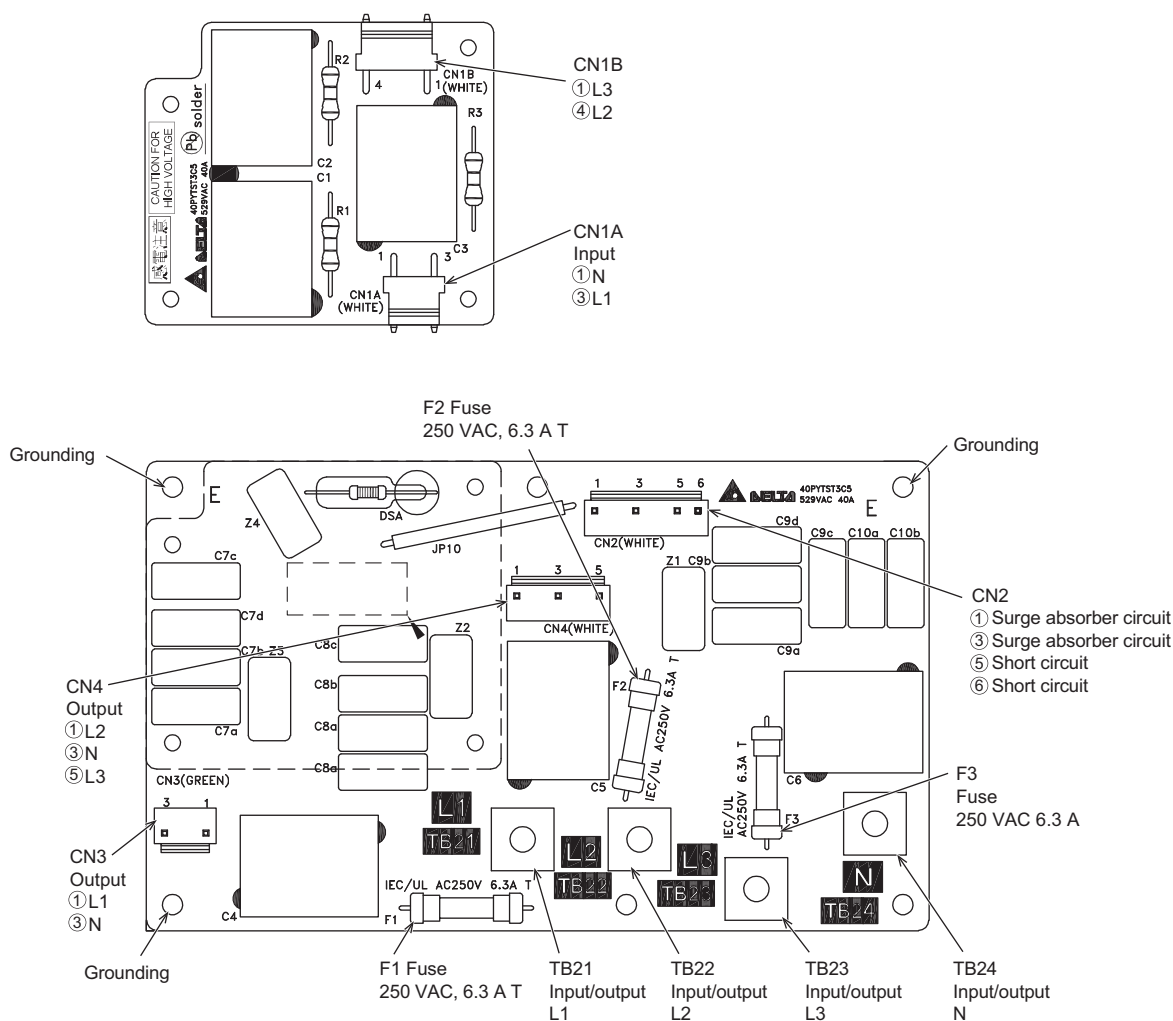
- 1) When opening or closing the front panel of the control box, do not let it come into contact with any of the internal components.
Before inspecting the inside of the control box, turn off the power, keep the unit off for at least 10 minutes, and confirm that the capacitor voltage (inverter main circuit) has dropped to 20 VDC or less. It takes about 10 minutes to discharge electricity after the power supply is turned off.
- 2) Control box houses high temperature parts. Be well careful even after turning off the power source.
- 3) Perform the service after disconnecting the connector (CNIV1, CNIV2 (CAHV-R136TAU)/CNINV1, CNINV2 (CAHV-R136YAU)) on the fan board. Before plugging in or unplugging connectors, check that the outdoor unit fan is not rotating and that the voltage across CN-P and CN-N on the INV board is 20 VDC or less.
The capacitor may collect a charge and cause an electric shock when the outdoor unit fan rotates in windy conditions. Refer to the wiring nameplate for details.
- 4) To connect wiring to TB7, check that the voltage is 20 VDC or below.
- 5) After servicing, reconnect the connector (CNIV1, CNIV2 (CAHV-R136TAU)/CNINV1, CNINV2 (CAHV-R136YAU)) on the fan board as it was.

5. Noise Filter

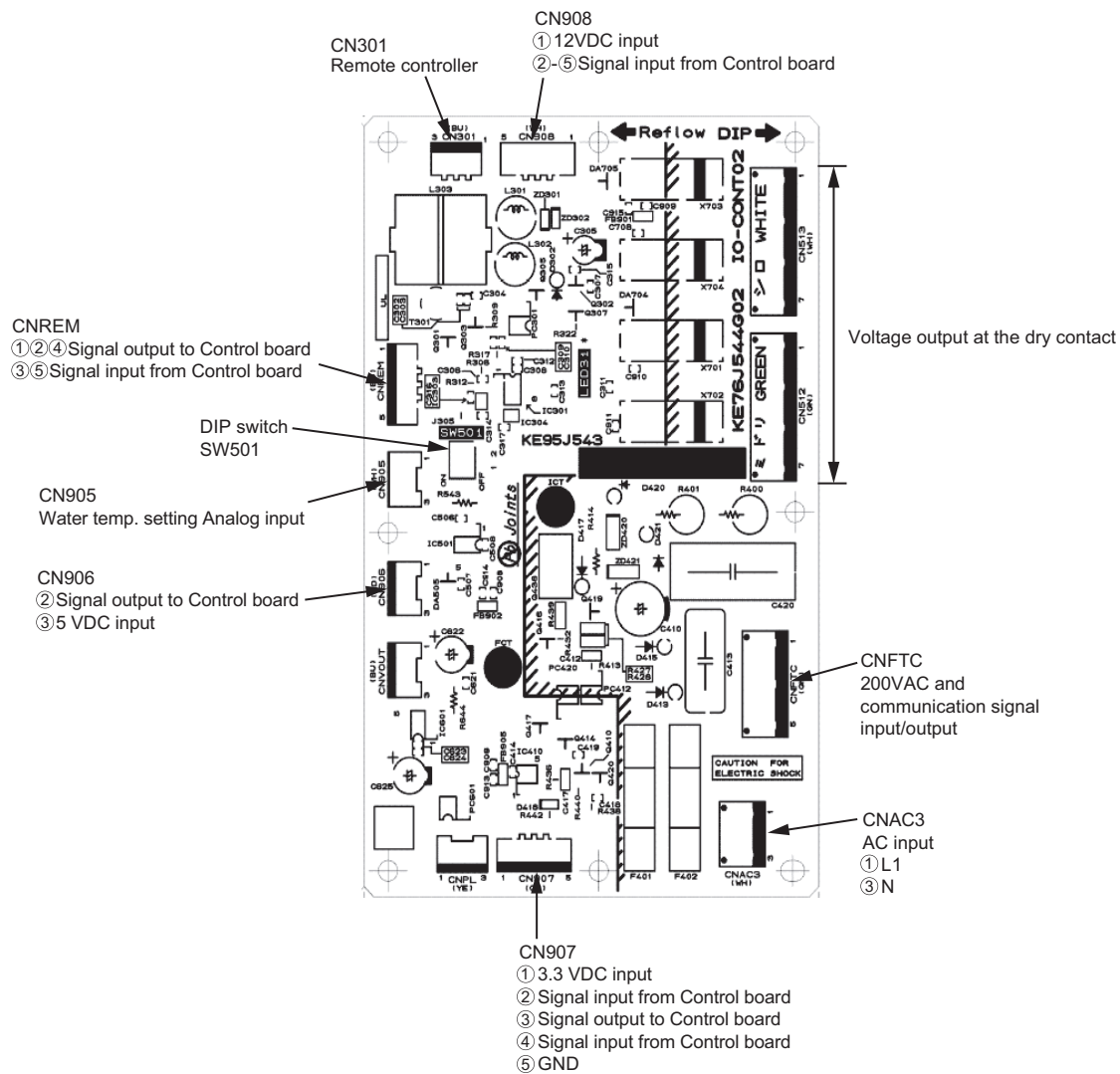
CAHV-R136TAU (-BS)



CAHV-R136YAU (-BS)

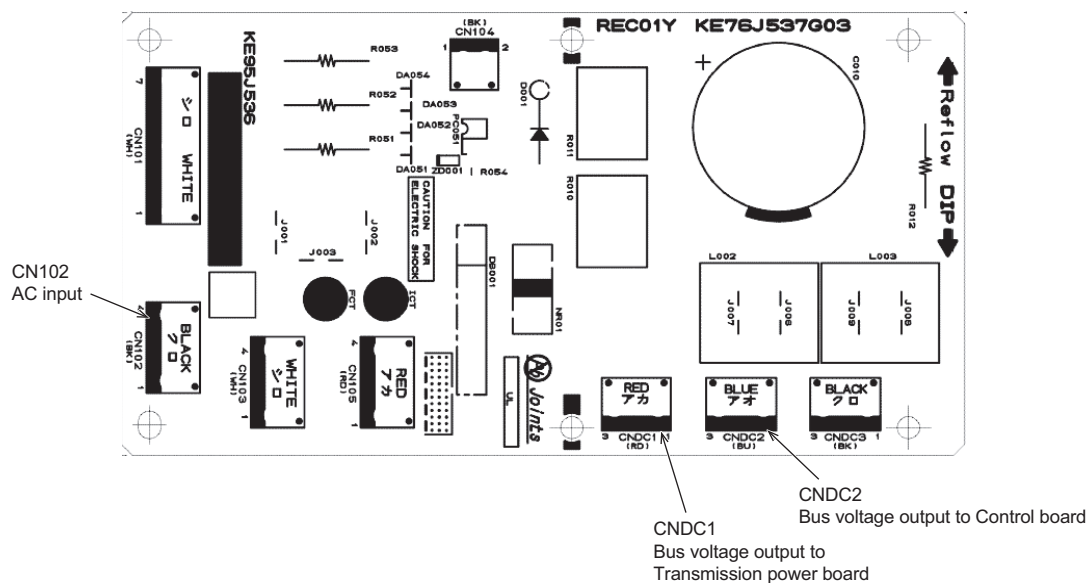


6. IO board

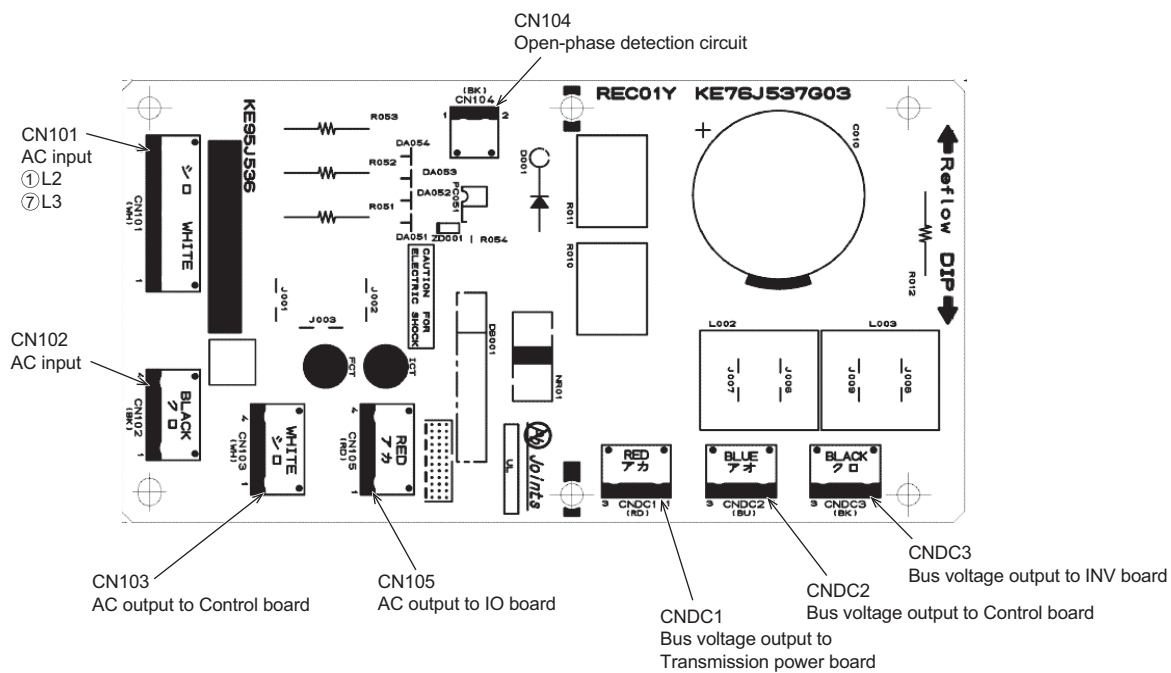


7. REC board

CAHV-R136TAU (-BS)



CAHV-R136YAU (-BS)



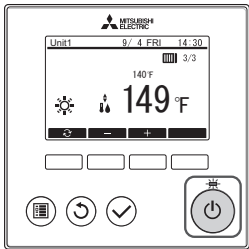
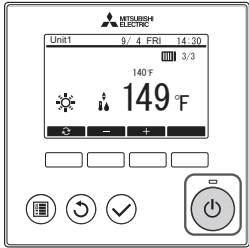
IV Remote Controller

[1] Using the Remote Controller.....	61
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[1] Using the Remote Controller

- Remote controller is sold separately.

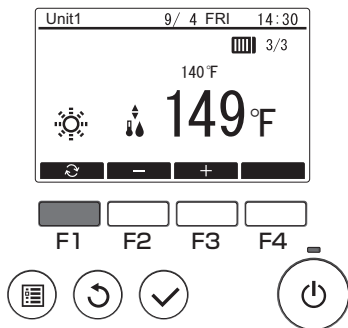
<1> Power ON/OFF

During operation		Press the [ON/OFF] button. The ON/OFF lamp will light up in green, and the operation will start.
During stoppage		Pressing the [ON/OFF] button brings up a confirmation screen. When it appears, press the [F3] button. The ON/OFF lamp will come off, and the operation will stop.

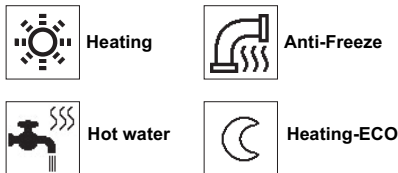
<2> Operation mode and set temperature settings

Operation mode setting

Button operation

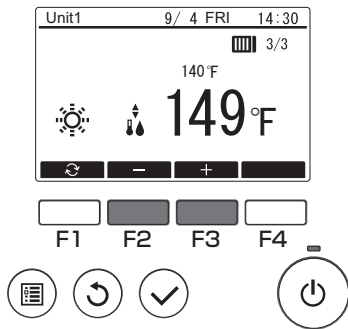


Press the [F1] button to go through the operation modes in the order of "Heating, Anti-Freeze, Hot water, and Heating-ECO."
Select the desired operation mode.



Set temperature setting

Button operation



Press the [F2] button to decrease the set temperature, and press the [F3] button to increase.

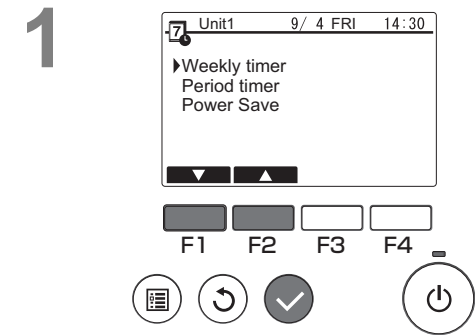
<3> Using Weekly timer

Function description

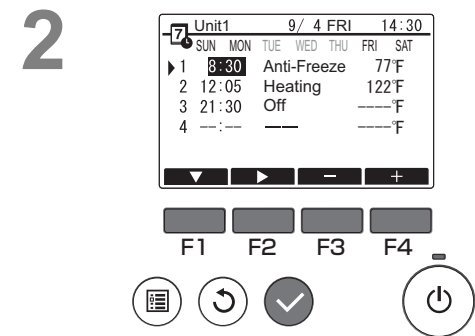
Following settings can be used to change the operating schedule according to the day of the week.

- Set the schedule for ON/OFF, operation mode and set temperature for each day of the week.

Button operation



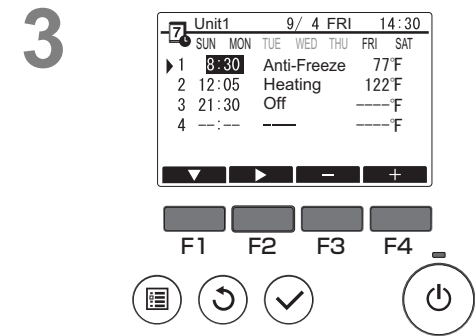
Select "Weekly timer" from the Schedule menu, and press the [Select] button.



The Weekly timer screen will be displayed.

To check the operation settings:
Press the [F1] or [F2] button to check the settings from Monday to Sunday.
The [F4] button displays the following page.

To change the operation settings:
Press the [F1] or [F2] button to select a day and then press the [F3] button to confirm the day to be set. (Multiple days can be selected.)
After selecting the desired day, press the [Select] button.



The pattern setting screen will be displayed.
Press the [F1] button to select a pattern.
Press the [F2] button to select the item you want to change.
Press the [F3] or [F4] button to switch to the desired setting.

Time	Set in 5-minute increments. * Hold down the button to change the value continuously.
Operation mode, Off	The options available vary depending on the connected unit. * If you select an operation mode other than Off, the connected unit will operate.
Set temperature	You can change the set temperature (in 0.5°C (1°F) increments).

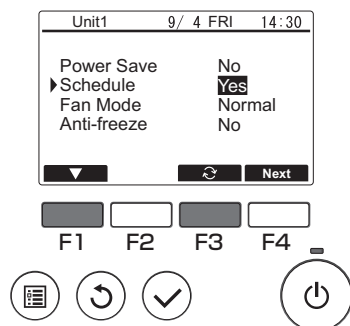
Weekly timer operation is disabled in the following situations:

- When Schedule is disabled
- On days when the period timer is also enabled

Weekly timer operation may not be executed depending on the system configuration.

Navigating through the screens

- To save the settings [Select] button
- To return to the Main display [Menu] button
- To return to the previous screen [Return] button



In the Operation setting screen, press the [F1] button to move the cursor to "Schedule".
Press the [F3] button to select "Yes".

<4> Using Period timer

Function description

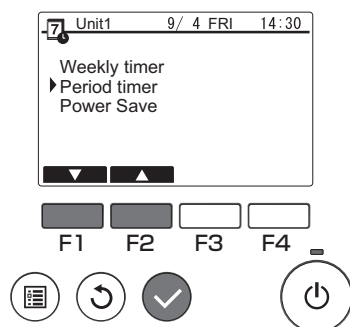
Following settings can be made to change the specified period and daily operating schedule.

- Set the schedule for ON/OFF, operation mode and set temperature.

* If the periods specified in 1 and 2 overlap, only the period specified in 1 will be implemented.

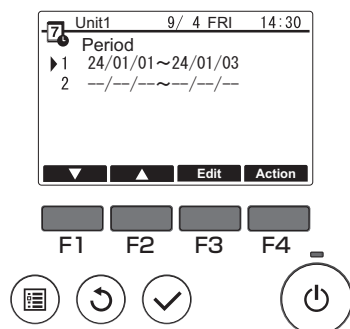
Button operation

1



Select "Period timer" from the Schedule menu, and press the [Select] button.

2



The suitable periods for the period timer will be displayed.

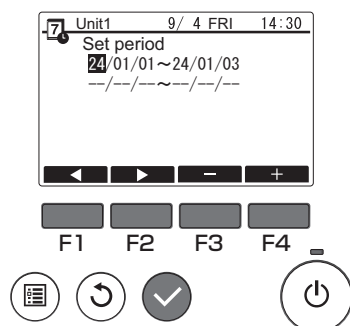
To set the period:

Press the [F1] or [F2] button to select the specified date and then press the [F3] button. ... Move to 3.

To set the operation:

Press the [F1] or [F2] button to select the specified date and then press the [F4] button. ... Move to 4.

3

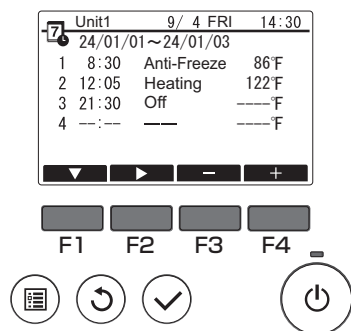


The period setting screen will be displayed.

Press the [F1] or [F2] button to move to the item you want to change.

Press the [F3] or [F4] button to change the start date and end date for the period timer and then press the [Select] button to update the setting.

4



The pattern setting screen will be displayed.

* Refer to the section on Weekly timer for details on using the pattern setting screen.

Weekly timer operation will be disabled in the following situations:

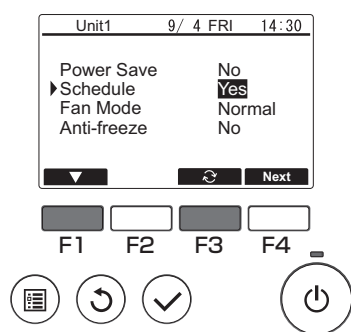
- When Schedule is disabled

When Schedule is disabled with the centralized controller or the connected unit, Schedule settings cannot be made with the remote controller.

After switching to the desired setting, press the [Select] button. A setting confirmation screen will appear.

Navigating through the screens

- To save the settings [Select] button
- To return to the Main display [Menu] button
- To return to the previous screen [Return] button



In the Operation setting screen, press the [F1] button to move the cursor to "Schedule".

Press the [F3] button to select "Yes".

<5> Fan mode

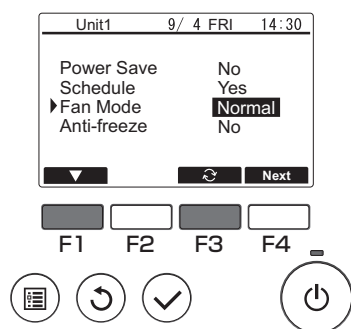
Function description

Spins the fan even when the compressor is stopped to prevent snow buildup on the fan when it snows in regions where there is relatively little snow cover.

Normal: The fan also stops when the compressor is stopped.

Snow: The fan continues to operate even when the compressor is stopped.

Button operation



Select "Fan Mode" from the menu, and press the [F3] button to select "Snow".

<6> Using Power Save

Function description

Power Save is a function that regulates the compressor rotation count either daily or according to a specified period and according to a preset time interval or regulated capacity. Use this function when you want to inhibit electric power use. A typical scenario where Power Save can be used to inhibit the power consumption for water heating would be periods of particularly heavy operating loads for air conditioning and other equipment, such as periods when large numbers of people check in at a hotel or similar accommodation facility.

- Approach to power save intervals and time periods

Specify intervals by using the Day Start Time as the delimiter. Note that this may not match the actual date.

You cannot set a time period that spans the Day Start Time.

Example 1) When the Day Start Time is 22:00 on August 1 and 2 and the time period is 22:00 to 08:00

The shaded (■) periods in the figure below indicate when Power Save is used.

Actual date July 31							Actual date August 1							Actual date August 2							Actual date August 3			
0	4	8	12	16	20		0	4	8	12	16	20		0	4	8	12	16	20		0	4	8	12
Delimiter based on the Day Start Time							July 31							August 1							August 2			

Example 2) When the Day Start Time is 12:00 on August 1 and 2 and the time period is 22:00 to 08:00

The shaded (■) periods in the figure below indicate when Power Save is used.

Actual date July 31							Actual date August 1							Actual date August 2							Actual date August 3			
0	4	8	12	16	20		0	4	8	12	16	20		0	4	8	12	16	20		0	4	8	12
Delimiter based on the Day Start Time							July 31							August 1							August 2			

Power Save will not be implemented in the following situations:

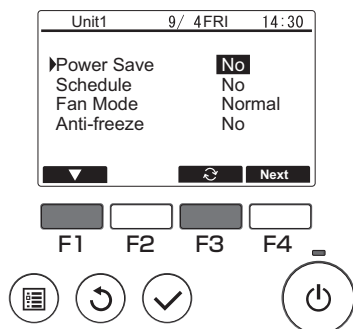
- If a system controller is connected
- While Power Save is disabled

- To use demand control on the connected units, make the settings as shown below.

(a) To use only connected unit demand control (contact input) without using Power Save on the remote controller

Button operation

1



In the Operation setting screen, press the [F1] button to move the cursor to Power Save.

Press the [F3] button to select "No".

* Do not set the Power Save settings on the remote controller.

* Some items are not available for selection on this model.

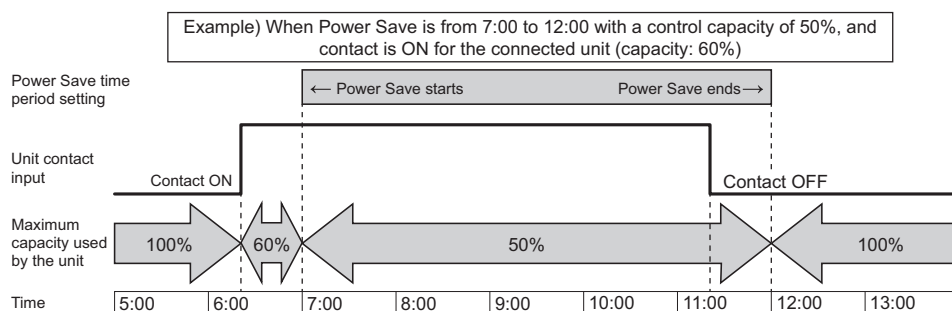
(b) To use both connected unit demand control (contact input) and Power Save on the remote controller

* Exercise control using low values in the demand control settings and Power Save control capacity. When the contact ON and Power Save start times differ, control will be exercised as of the earliest low value. (See the table below.)

Table: Control values when Power Save and demand control are both used

Period	Power Save value	Connected unit demand control value	Control value actually used
12:00-6:30	— (100%)	— (100%)	100%
6:30-7:00	— (100%)	60%	60%
7:00-11:30	50%	60%	50%
11:30-12:00	50%	— (100%)	50%

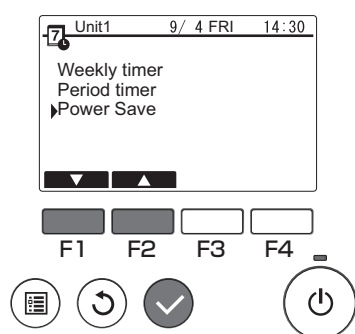
→ Because Power Save is set from 7:00, control begins based on the Power Save setting.



- While the contact is ON or Power Save is being applied, the maximum capacity will be limited to whichever is the lower value of the Power Save and demand control settings.
- While the contact is OFF and Power Save is not applied, control will be exercised with the maximum capacity of 100%.
- The control capacity during periods when Power Save is not set will be 100%.

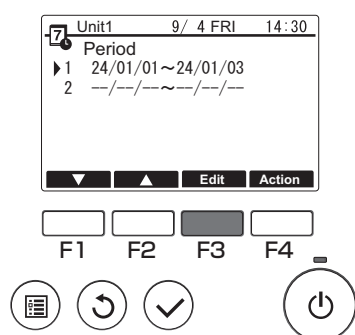
Button operation

1



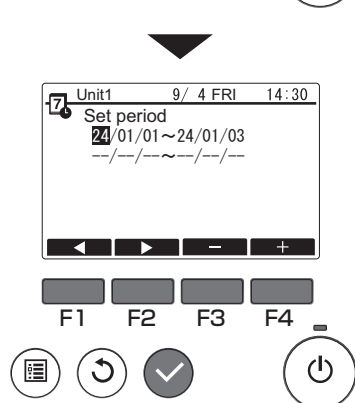
From the Main menu, select "Schedule" > "Power Save" and press the [Select] button.

2



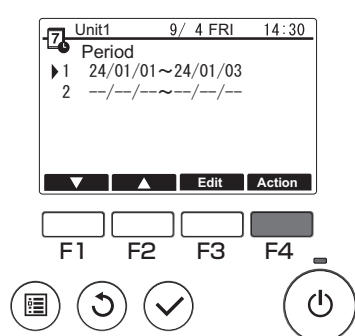
Press the [F3] button to proceed to the settings screen.
You can set 2 types of pattern, as necessary.

* If the periods specified in 1 and 2 overlap, only period specified in 1 will be implemented.



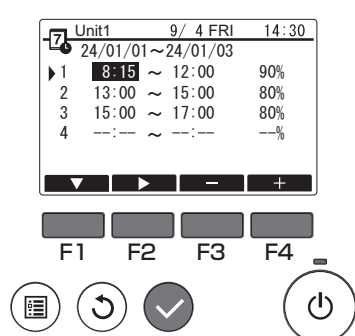
Press the [F1] to [F4] buttons to set the period and then press the [Select] button.

3



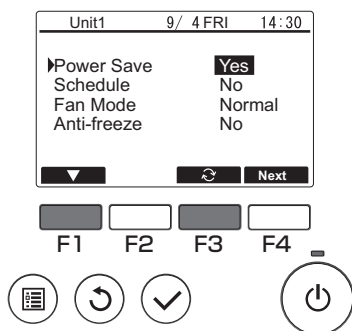
The Power Save screen will be displayed.
Press the [F4] button.

4



Press the [F1] to [F4] buttons to set the Power Save start time, end time and control value.

5



In the Operation setting screen, press the [F1] button to move the cursor to Power Save.
Press the [F3] button to select "Yes".

<7> Function setting

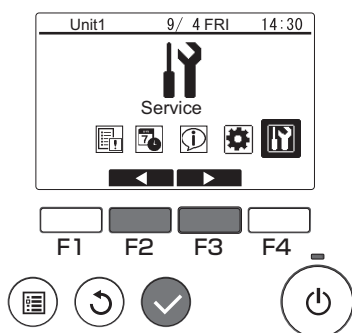
Function description

Sets the functions for each connected unit from the remote controller as required.

- If the function settings change the connected unit functions, all the settings must be managed appropriately, such as by writing them down on paper.

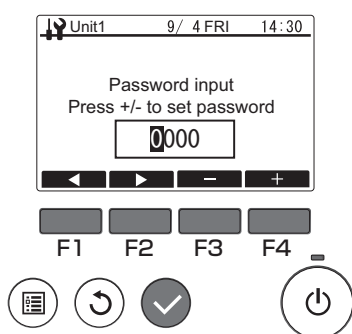
Button operation

1



Select "Service" from the Main menu, and press the [Select] button.

2



A password input screen will be displayed.
Enter the current maintenance password (a 4-digit number).
After entering the 4-digit password, press the [Select] button.
If the password is correct, the Service menu will be displayed.

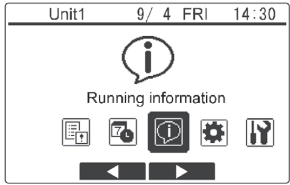
<8> Operation status monitoring

Function description

Check the running information of each unit from the remote controller

Button operation

1

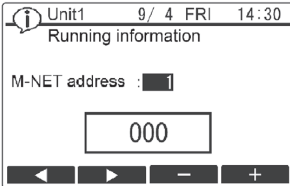


F1 F2 F3 F4

⏮ ⏪ ⏩ ⏭

Select "Running information" from the main menu screen, and press the [Select] button.

2

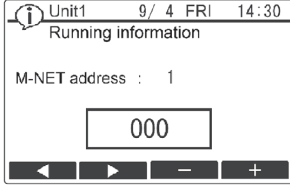


F1 F2 F3 F4

⏮ ⏪ ⏩ ⏭

Set the desired M-NET address with the [F2] and [F3] buttons, and press the [Select] button.

3



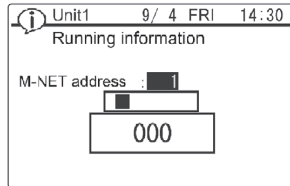
F1 F2 F3 F4

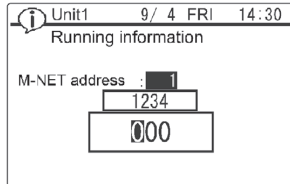
⏮ ⏪ ⏩ ⏭

Enter a 3-digit running information number, and press the [Select] button. The setting information send screen appears.

Running information No.	Description	Remarks
001	Total compressor operation time [× 10 h]	Data of last hot water storage operation
002	Outlet hot water temperature [× 0.1 °F]	Current value
003	Inlet water temperature [× 0.1 °F]	
004	High pressure [× 0.1 MPa]	
005	Low pressure [× 0.1 MPa]	
006	Discharge redrigerant temperature [× 0.1 °F]	
007	Suction refrigerant temperature [× 0.1 °F]	
008	Operating frequency [× 0.1 Hz]	

Example) No. 004
Remote control display: 31
Actual value: 3.1MPa





When the information is sent successfully, the running information values appear in the result display screen. To continue operation, press the [Return] button to return to the screen of step 2. Set other M-NET address and running information number using the same procedure.

Navigating through the screens

■ To return to the Service menu [Menu] button

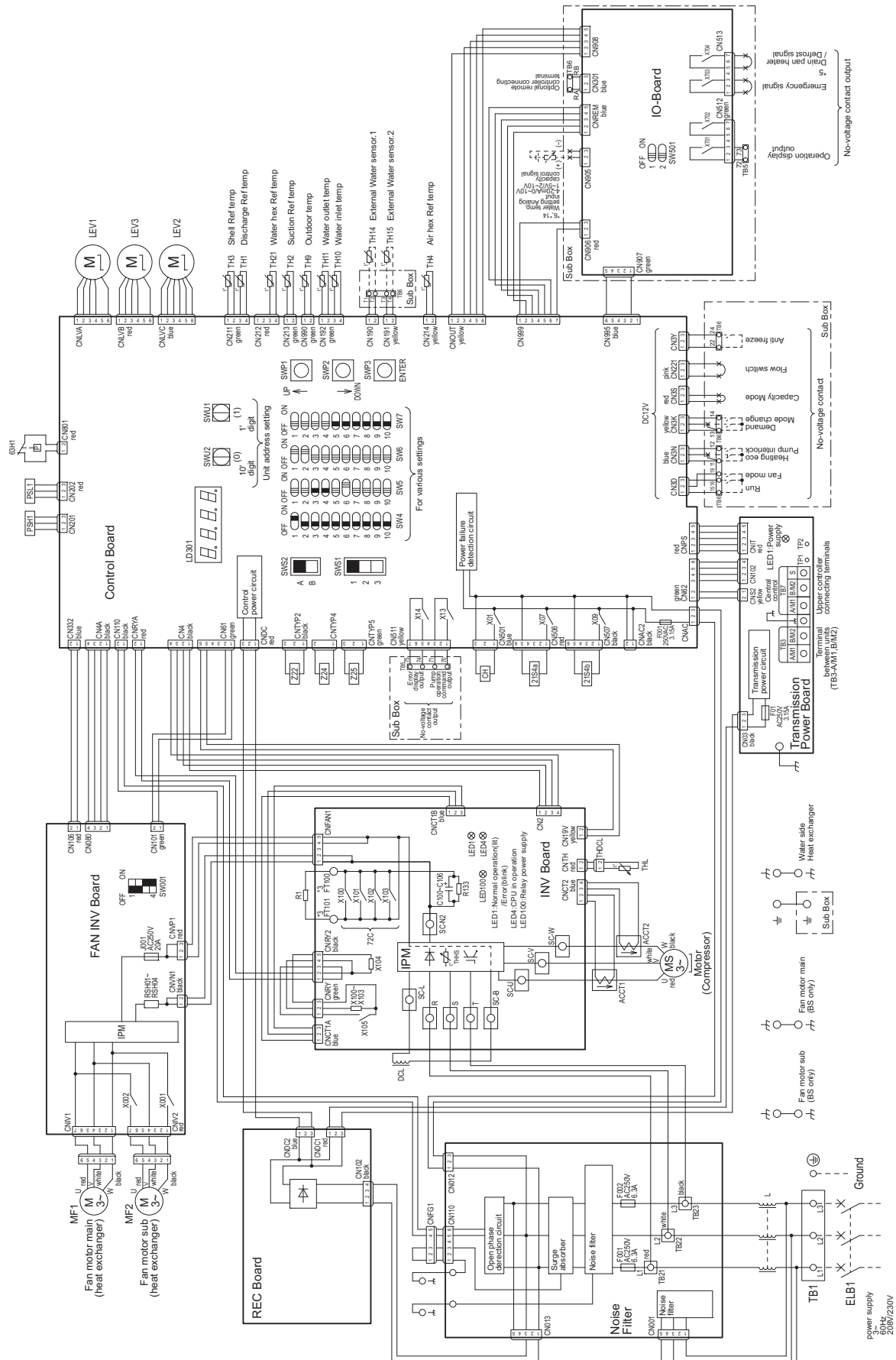
■ To return to the previous screen [Return] button

V Electrical Wiring Diagram

[1] Electrical Wiring Diagram.....	73
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[1] Electrical Wiring Diagram


CAHV-R136TAU (-BS)



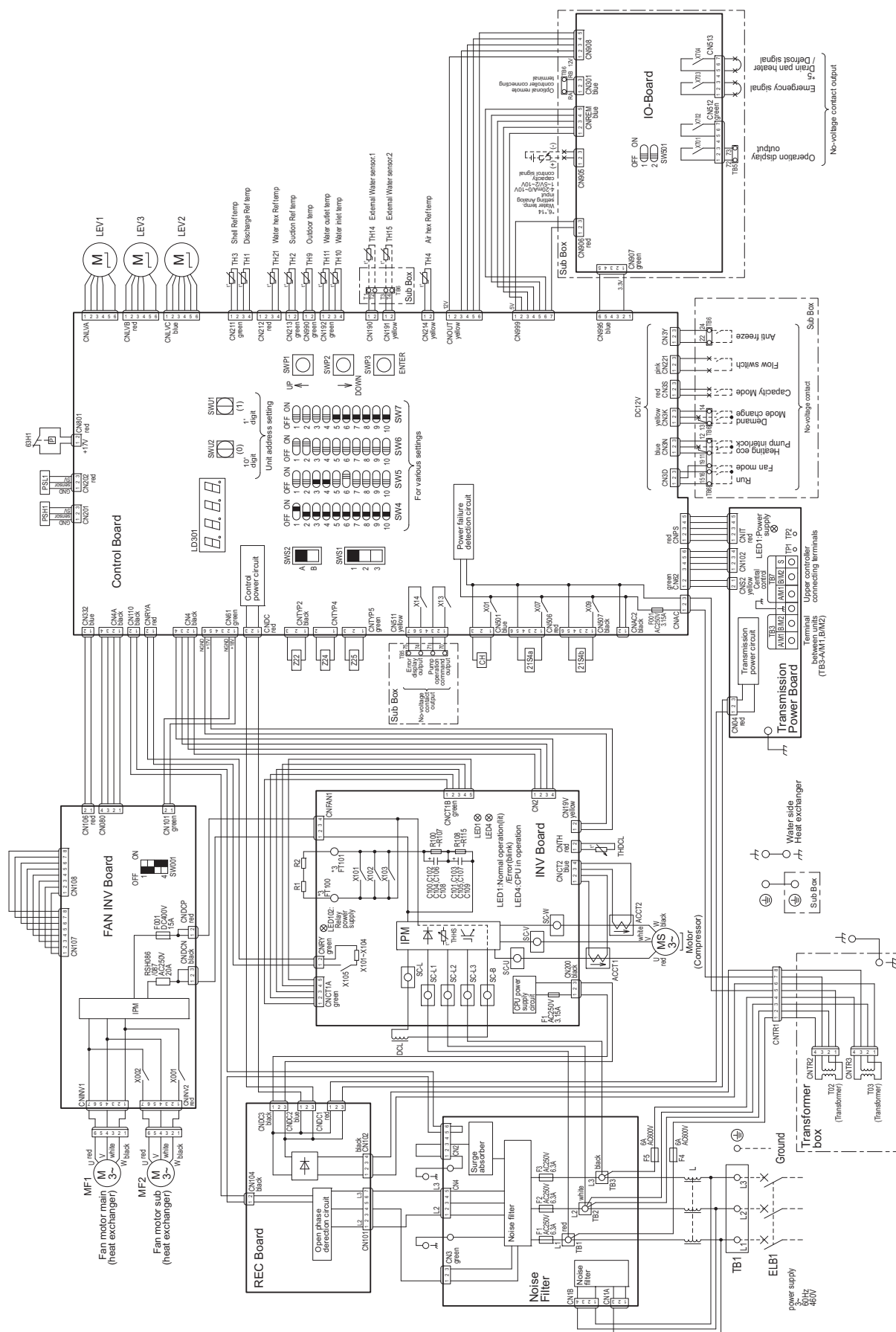
CAHV-R136TAU (-BS)

Symbol explanation	
Symbol	Explanation
ACCT1	AC current sensor
ACCT2	
CH	Crankcase heater (for heating the compressor)
DCL	DC reactor
F001, F002 (Noise Filter)	
F001 (Control Board)	
F01 (Transmission Power Board)	Fuse
LEV1, 3	Electronic expansion valve (Main circuit)
LEV2	Electronic expansion valve (Injection)
MF1, 2	Fan motor
MS	Compressor motor
PSH1	High pressure sensor
PSL1	Low pressure sensor
R1	Electrical resistance
21S4a	
21S4b	4-way valve Cooling/Heating switching
THL	DC reactor temperature
TH1~4, 9~11, 21	Thermistor
Z22, 24, 25	Function setting connector
63H1	High pressure switch
72C	Electromagnetic relay (Inverter main circuit)
*TH14, 15	Thermistor
<ELB1>	Earth leakage breaker

* of symbol item is the optional parts, <> is field-supplied parts.

- Note 1. The broken lines indicate the optional parts, field-supplied parts, and field work.
2. Dashed lines indicate Sub box.
3. Faston terminals have a locking function.
Press the tab in the middle of the terminals to remove them.
Check that the terminals are securely locked in place after insertion.
4. The symbols of the field connecting terminals are as follows.
○ Terminal block X : Connection by cutting the short circuit wire
5. Selects either Drain pan signal or Defrost signal by SW5 and SW6 settings.
(Item code 1056)
6. Selects either Water temperature setting input signal or Capacity control input signal by SW5 and SW6 settings. (Item code 1051)
7. Make sure to connect a pump interlock contact.
A short-circuit may cause abnormal stop or malfunctions.
8. The preset temperature setting can be switched from the no-voltage contact or by setting time ranges.
9. The method of input signal of operation can be either one of optional remote controller or no-voltage input.
10. 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 100V or greater. Do not place them in the same conduit tube or cable tray cable as this will damage the circuit board.
11. When cable tray cable is used for the control cable wiring, use a separate cable tray cable for the following wiring.
Using the same cable tray 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 temperature setting
12. Use a contact that takes 12VDC 1mA for no-voltage contact input.
13. Need to select Water temperature setting input signal.
Set the SW501 as shown in the table below.
- | | |
|---------|---------|
| SW501-1 | SW501-2 |
| 4~20mA | ON |
| 0~10V | OFF |
| 1~5V | ON |
| 2~10V | OFF |
14. Use a 4-20mA signal output device with insulation.
Feeding 30mA or more current may damage the circuit board.
15. The SW4-SW7 switches indicated with  can be set on site.
Do not change the other SW4-SW7 switch settings.


CAHV-R136YAU (-BS)



CAHV-R136YAU (-BS)

Symbol explanation	
Symbol	Explanation
ACCT1	AC current sensor
ACCT2	Crankcase heater(for heating the compressor)
CH	DC reactor
DCL	
F1~3(Noise Filter)	
F4,5(Transformer)	Fuse
F001(FAN INV Board)	
F001(Control Board)	
F1(INV Board)	
LEV1,3	Electronic expansion valve (Main circuit)
LEV2	Electronic expansion valve (Injection)
MF1,2	Fan motor
MS	Compressor motor
PSH1	High pressure sensor
PSL1	Low pressure sensor
R1,R2	Electrical resistance
21S4a	4-way valve Cooling/Heating switching
21S4b	
THL	DC reactor temperature
TH1~4,9~11,21	Thermistor
Z22,24,25	Function setting connector
63H1	High pressure switch
72C	Electromagnetic relay (Inverter main circuit)
*TH14, 15	Thermistor
<ELB1>	Earth leakage breaker

* of symbol item is the optional parts, <> is field-supplied parts.

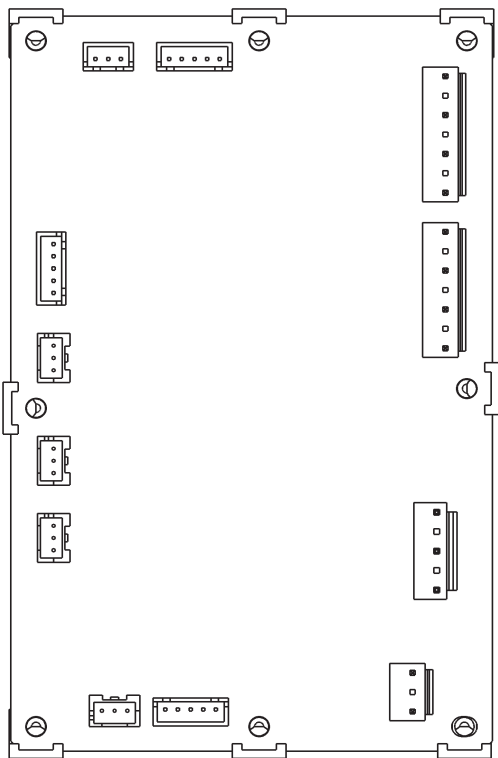
- Note 1. The broken lines indicate the optional parts, field-supplied parts, and field work.
2. Dashed lines indicate Sub box.
3. Faston terminals have a locking function.
Press the tab in the middle of the terminals to remove them.
Check that the terminals are securely locked in place after insertion.
4. The symbols of the field connecting terminals are as follows.
○ Terminal block X: Connection by cutting the short circuit wire
5. Selects either Drain pan signal or Defrost signal by SW5 and SW6 settings.
(Item code 1056)
6. Selects either Water temperature setting input signal or Capacity control input signal by SW5 and SW6 settings. (Item code 1051)
7. Make sure to connect a pump interlock contact.
A short-circuit may cause abnormal stop or malfunctions.
8. The preset temperature setting can be switched from the no-voltage contact or by setting time ranges.
9. The method of input signal of operation can be either one of optional remote controller or no-voltage input.
10. 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 100V or greater. Do not place them in the same conduit tube or cable tray cable as this will damage the circuit board.
11. When cable tray cable is used for the control cable wiring, use a separate cable tray cable for the following wiring.
Using the same cable tray 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 temperature setting
12. Use a contact that takes 12VDC 1mA for no-voltage contact input.
13. Need to select Water temperature setting input signal.
Set the SW501 as shown in the table below.
- | SW501-1 | SW501-2 |
|---------|---------|
| 4~20mA | ON |
| 0~10V | OFF |
| 1~ 5V | ON |
| 2~10V | OFF |
14. Use a 4-20mA signal output device with insulation.
Feeding 30mA or more current may damage the circuit board.
15. The SW4-SW7 switches indicated with  can be set on site.
Do not change the other SW4-SW7 switch settings.

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.

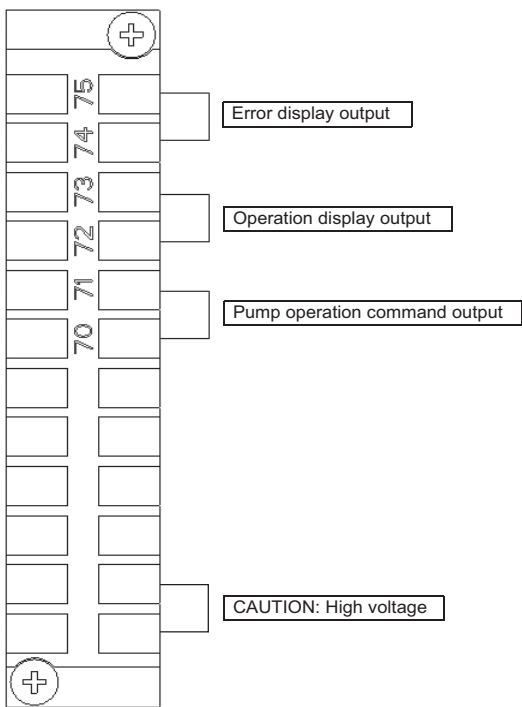
External Input/Output

Input type	Dry contact		ON (Close)	OFF (Open)	Terminal block/connector
(a) RUN	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) HEATING ECO	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)	CN3N 1-2
(c) CAPACITY	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).	CN3S 1-2
(d) MODE CHANGE	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)	TB6 13-14
(e) ANTI FREEZE	On/Off		The unit will operate in the Anti-Freeze mode (with the target temperature 25°C (77°F)) when the contact status of (a) "RUN" is "Stop" OR the ON/OFF button on the remote controller is turned off.	The unit will operate according to the status of the "RUN" contact (item (a) above) or the ON/OFF command from the remote controller.	TB6 22-24
(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.	TB6 15-19
(g) FLOW SWITCH	Normal/Error		The unit is allowed to operate.	The unit will not operate.	CN221 1-3
(h) PUMP INTERLOCK	Normal/Error		The unit is allowed to operate.	The unit will not operate.	TB6 11-12
(i) DEMAND	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 "CAPACITY" 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) "CAPACITY" above.	CN3K 1-2
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 CN905 on the IO-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.			CN905 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 DISPLAY OUTPUT	Close/Open		The unit has made an abnormal stop.	During normal operation	TB5 74-75
(n) OPERATION DISPLAY OUTPUT	Close/Open		The "RUN" contact (item (a) above) or the ON/OFF button on the remote controller is ON.	The "RUN" contact (item (a) above) or the ON/OFF button on the remote controller is OFF.	TB5 72-73
(o) PUMP OPERATION COMMAND OUTPUT	Close/Open		(1) When SW5-8 is set to ON The pump will operate according to the Thermo-ON/OFF status of the unit. (2) When SW5-8 is set to OFF The pump will operate according to the status of the "RUN" 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+2°C (TWL1+3.6°F)" or the outside temperature is at or above "TAL1+2°C (TAL1+3.6°F)".	CN513 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". In case of the drain pan signal when item code 1056 is "0", the outside temperature is above 1°C (34°F) or the outside temperature has risen above 3°C (37°F) after the conditions has been met under which the contact turns on.	-	CN513 5-7
RC/M-NET	REMOTE CONTROLLER	PAR-W31MAA			TB6 RA-RB
	M-NET	Terminal between units			TB3 A/M1-B/M2
	Centralized controller	AE-C400A, TE-C400A, EW-C50A, TW-C50A			TB7 A/M1-B/M2

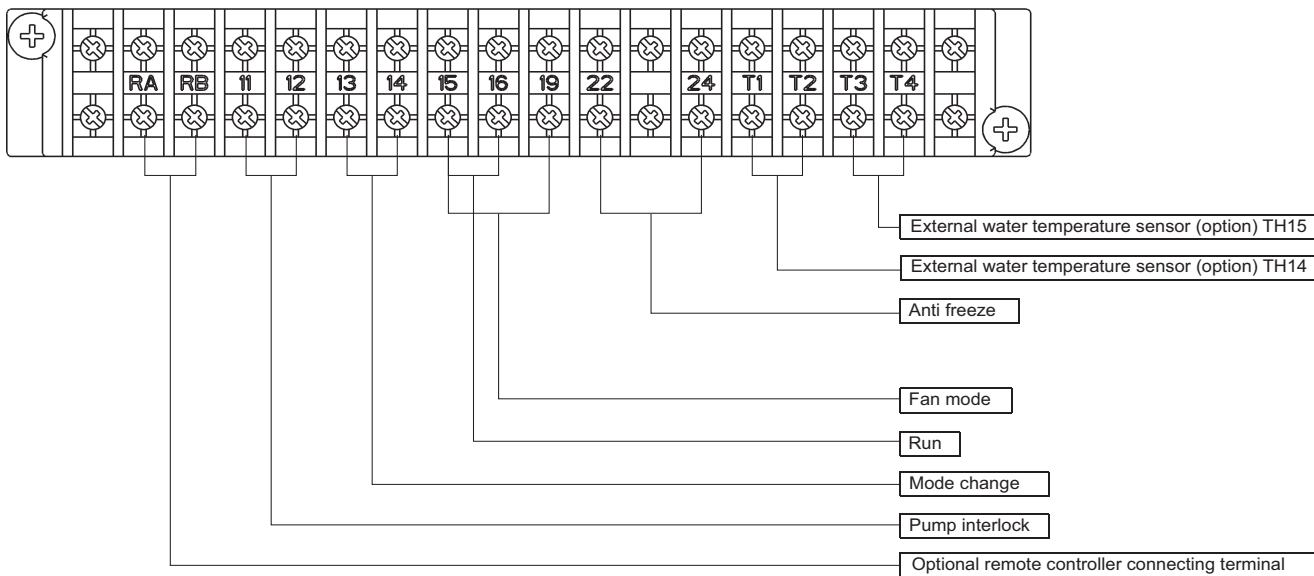
IO Board



TB5



TB6



Wire color

Heating ECO	Black
Demand	Brown
Capacity mode	Blue
Flow switch	White

VI Refrigerant Circuit

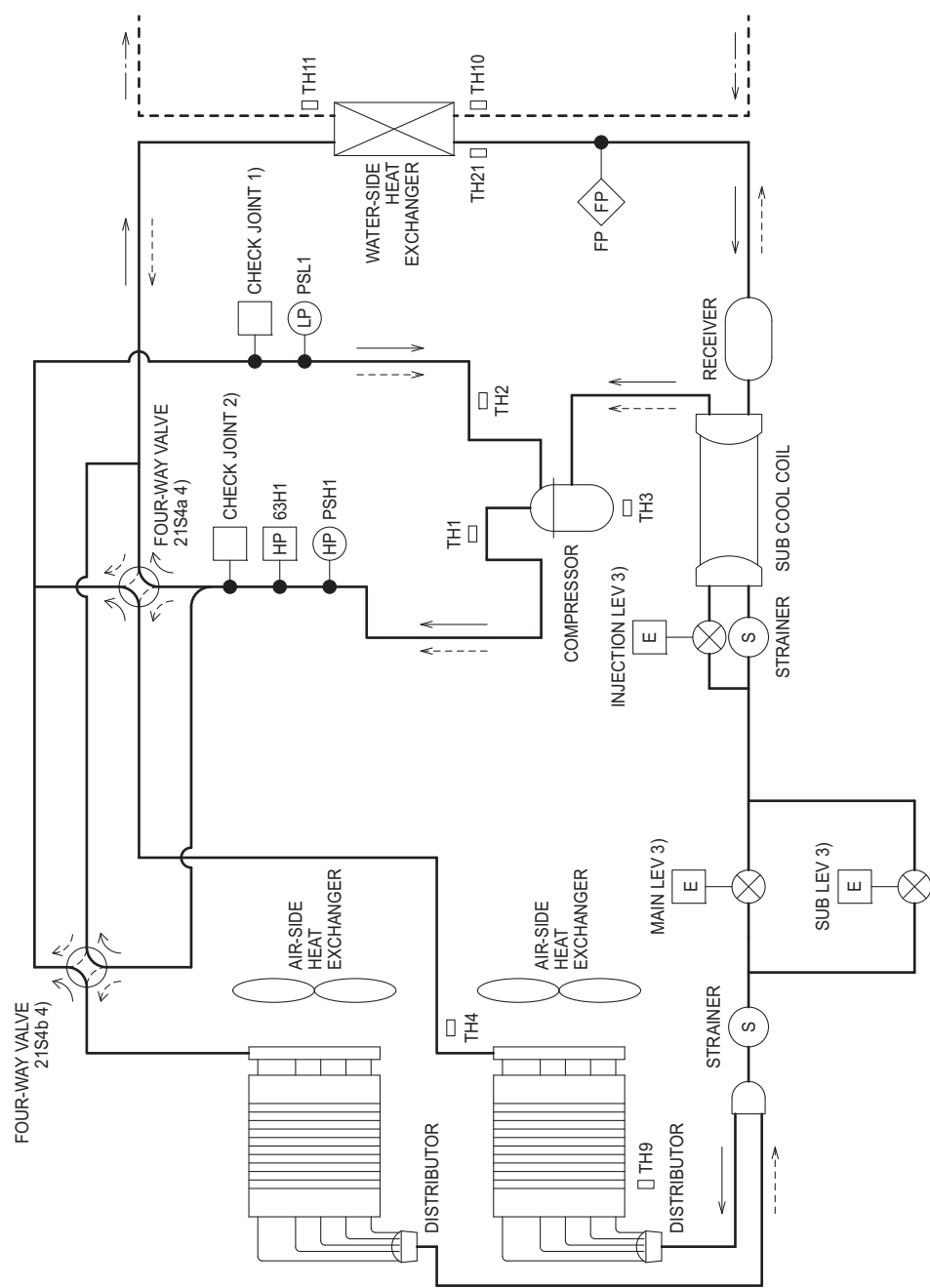
[1] Refrigerant Circuit Diagram	81
[2] Principal Parts and Functions	82

[1] Refrigerant Circuit Diagram

REFRIGERANT FLOW DIRECTION
→ HEATING MODE
--- DEFROST MODE
→ WATER FLOW DIRECTION

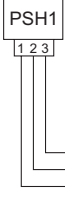
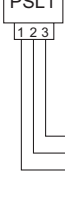
SYMBOL	DESCRIPTION
FP	FUSIBLE PLUG
PSH1	HIGH PRESSURE SENSOR
PSL1	LOW PRESSURE SENSOR
63H1	HIGH PRESSURE SWITCH
TH1	DISCHARGE TEMP.
TH2	SUCTION TEMP.
TH3	COMPRESSOR TEMP.
TH4	HEAT EXCHANGER TEMP.
TH9	OUTDOOR AIR TEMP.
TH10	WATER INLET TEMP.
TH11	WATER OUTLET TEMP.
TH21	WATER HEAT EXCHANGER TEMP.

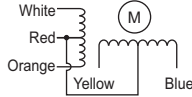
NO.	NAME
1)	CHECK JOINT (LOW PRESSURE EXTRACTION)
2)	CHECK JOINT (HIGH PRESSURE EXTRACTION)
3)	LEV
4)	FOUR-WAY VALVE



[2] Principal Parts and Functions

Outdoor unit

Part name	Symbols (functions)	Notes	Usage	Specifications	Check method
Com-pressor	MS (Comp)		Adjusts the amount of circulating refrigerant by adjusting the operating frequency based on the operating pressure data	Low-pressure shell scroll compressor	
High pressure sensor	PSH1		1) Detects high pressure 2) Regulates frequency and provides high-pressure protection	 <p>Pressure 0~3.85 MPa [558 psi] Vout 0.5 ~ 3.3 V 0.071 V/0.098 MPa [14 psi] Pressure [MPa] =1.38 x Vout [V] - 0.69 Pressure [psi] =(1.38 x Vout [V] - 0.69) x 145</p> <p>1 GND (Black) 2 Vout (White) 3 Vcc (DC5 V) (Red)</p>	
Low pressure sensor	PSL1		1) Detects low pressure 2) Provides low-pressure protection	 <p>Pressure 0~1.7 MPa [247 psi] Vout 0.5 ~ 3.5 V 0.173 V/0.098 MPa [14 psi] Pressure [MPa] =0.566 x Vout [V] - 0.283 Pressure [psi] =(0.566 x Vout [V] - 0.283) x 145</p> <p>1 GND (Black) 2 Vout (White) 3 Vcc (DC5 V) (Red)</p>	
Pressure switch	63H1		1) Detects high pressure 2) Provides high-pressure protection	3.85 MPa [558 psi] OFF setting	
Thermistor	TH1 (Discharge)		1) Detects discharge temperature 2) Provides high-pressure protection	<p>Degrees Celsius</p> $R_{120} = 7.465 \text{ kohm}$ $R_{25/120} = 4057$ $R_t [^{\circ}\text{C}] = 7.465 \exp \left\{ 4057 \left(\frac{1}{273+t} - \frac{1}{393} \right) \right\}$ <p>Rt [°F] =</p> $7.465 \exp \left\{ 4057 \left(\frac{1}{255.2+t(5/9)} - \frac{1}{393} \right) \right\}$ <p>0°C [32°F]: 698 kohm 10°C [50°F]: 413 kohm 20°C [68°F]: 250 kohm 30°C [86°F]: 160 kohm 40°C [104°F]: 104 kohm 50°C [122°F]: 70 kohm 60°C [140°F]: 48 kohm 70°C [158°F]: 34 kohm 80°C [176°F]: 24 kohm 90°C [194°F]: 17.5 kohm 100°C [212°F]: 13.0 kohm 110°C [230°F]: 9.8 kohm</p>	Resistance check

Part name	Symbols (functions)	Notes	Usage	Specifications	Check method
Thermistor	TH2 (Suction)		Detects low pressure drop	Degrees Celsius $R_0 = 15\text{kohm}$ $R_{0/80} = 3385$ $R_t [^\circ\text{C}] = 15 \exp\{3385 (\frac{1}{273+t} - \frac{1}{273})\}$ $R_t [^\circ\text{F}] = 15 \exp\{3385 (\frac{1}{255.2+t(5/9)} - \frac{1}{273})\}$ 0°C [32°F]: 15 kohm 10°C [50°F]: 9.7 kohm 20°C [68°F]: 6.5 kohm 25°C [77°F]: 5.3 kohm 30°C [86°F]: 4.4 kohm 40°C [104°F]: 3.0 kohm	Resistance check
	TH3 (Compressor shell temperature)		Controls defrosting during heating operation		
	TH4 (Air HEX Ref. temperature)		1) Detects low pressure drop 2) Controls defrosting during heating operation		
	TH9 (Outdoor temperature)		1) Detects outdoor air temperature 2) Controls fan operation		
	TH10 (Water inlet)		Controls compressor operation		
	TH11 (water outlet)		Controls compressor operation		
	TH21 (Water heat exchanger)		Detects water heat exchanger temperature		
4-way valve	21S4a 21S4b		Changeover between heating and defrost	AC220-240 V AC208-230 V OFF: defrost cycle ON: 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.	AC415 V, 920 W AC200 V, 920 W	
Linear expansion valve	LEV2 (INJ control)		Adjusts the amount of bypass flow from the liquid pipe on the outdoor unit during heating	DC12 V Opening of a valve driven by a stepping motor 0-480 pulses (direct driven type)	Continuity between white, yellow, and orange. Continuity between blue, brown, and red.
	LEV1 LEV3 (Refrigerant flow adjustment)		Adjusts refrigerant flow during heating	DC12 V Opening of a valve driven by a stepping motor 2000 pulses (LEV1) Opening of a valve driven by a stepping motor 3000 pulses (LEV3)	Continuity between white, red, and orange. Continuity between yellow and blue. 

VII Control

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[1] Functions and Factory Settings of the Dip switches

1. Factory Switch Settings (Dip switch settings table)

			Factory setting				
SW		Function	Usage	Circuit board	OFF setting	ON setting	Setting timing
SW4	1	Model setting		Depends on the unit	Leave the setting as it is.		At a reset
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
SW5	1	Freeze-up protection setting	Starts the pump when both the outside and water temperatures drop to prevent water pipe freeze up.	OFF	The outside temperature condition for Freeze-up protection is 1°C (34°F)	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	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. · Water temperature input IT terminal.	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 SW6-5 through 6-10 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	Changes the 7-segment LED display mode.		Any time
SW6	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.	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 SW5-8 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 SW6-5 through 6-10 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	Changes the 7-segment LED display mode.		Any time
	6	Display mode switch 2		OFF	Changes the 7-segment LED display mode.		Any time
	7	Display mode switch 3		OFF	Changes the 7-segment LED display mode.		Any time
	8	Display mode switch 4		OFF	Changes the 7-segment LED display mode.		Any time
	9	Display mode switch 5		OFF	Changes the 7-segment LED display mode.		Any time
	10	Display mode switch 6		OFF	Changes the 7-segment LED display mode.		Any time

Refer to page 38 for how to reset errors.

				Factory setting			
SW		Function	Usage	Circuit board	OFF setting	ON setting	Setting timing
SW7	1	Initial setup/ Re-initializing the system/ Resetting the system	Used to start up or initialize the unit. (See II. Restrictions for detail.)	OFF	Usual setting	Set to ON only when using the function.	At a reset
	2						
	3						
	4						
	5	Model setting		OFF	Leave the setting as it is.	At a reset	
	6						
	7						
	8						
	9	Software rewrite	Used to rewrite the software using a USB memory stick.	OFF	Does not allow the rewriting of the software using a USB memory stick.	Allows the rewriting of the software using a USB memory stick.	At a reset
	10	Model setting		OFF	Leave the setting as it is.		At a reset

Refer to page 38 for how to reset errors.

2. Slide switch (SWS1) settings

Individual system

SWS1 Setting	Unit Operation
REMOTE	Follows the input signal fed through a dry contact interface or controllers
OFF	Ignores the signal input
LOCAL	Follows the input signal

Multiple system

SWS1 Setting		Unit Operation	
Main unit	Sub unit	Main unit	Sub unit
REMOTE	REMOTE	Follows the input signal fed through a dry contact interface or controllers	Follows the input signal on the Main unit
	OFF		Ignores the signal input
	LOCAL		Follows the input signal on the Main unit
OFF	REMOTE	Ignores the signal input	Ignores the signal input
	OFF		
	LOCAL		
LOCAL	REMOTE	Follows the input signal on the Main unit	Follows the input signal on the Sub unit
	OFF		Ignores the signal input
	LOCAL		Follows the input signal on the Sub unit

(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

SW5	SW6					
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 SW5 and SW6.

SW5	SW6					
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.

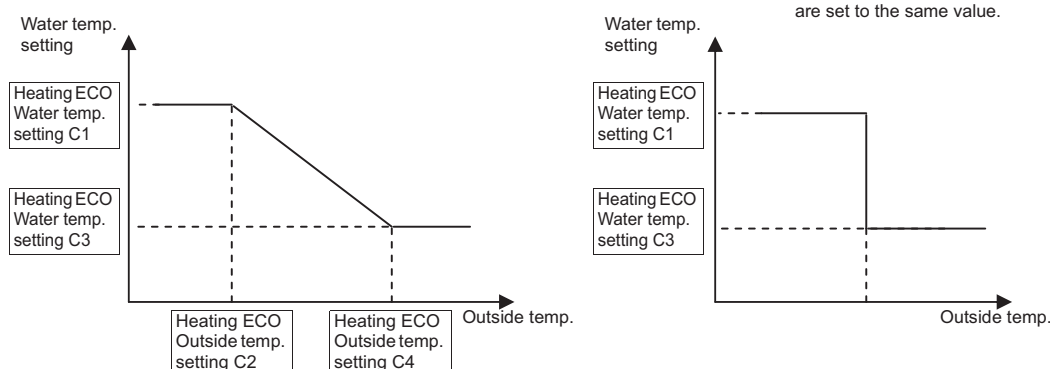
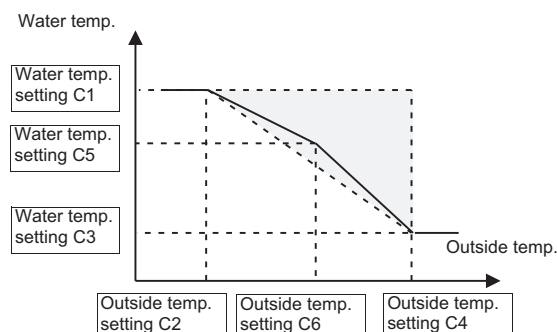
Step 4

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

Settings table

Items that can be set	Item code	Initial value	Unit	Setting			Setting change from an optional remote controller
				Increments	Lower limit	Upper limit	
Water temp. setting A (Heating mode)	11	113	°F	0.2	75	165	Possible
Water temp. setting B (Hot water mode)	13	149	°F	0.2	75	165	Possible
Heating ECO mode/ Water temp. setting C1 *1	22	93	°F	0.2	75	165	Not possible
Heating ECO mode/ Outside temp. setting C2 *1	23	19	°F	0.2	-4	122	Not possible
Heating ECO mode/ Water temp. setting C3 *1	24	75	°F	0.2	75	165	Not possible
Heating ECO mode/ Outside temp. setting C4 *1	25	54	°F	0.2	-4	122	Not possible
Heating ECO mode/ Water temp. setting C5 *1	26	86	°F	0.2	75	165	Not possible
Heating ECO mode/ Outside temp. setting C6 *1	27	36	°F	0.2	-4	122	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 shown in the table below.

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

Water-temperature control	Lower limit	Upper limit
Outlet-water-temperature-based control	24.0°C (75°F)	74.0°C (165°F)
Inlet-water-temperature-based control	24.0°C (75°F)	69.0°C (156°F)

* When the outside temperature is -5°C (23°F) 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 35°C (95°F)/Inlet temperature 30°C (86°F).

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 and 6 through 9.

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 SW5 and SW6.

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

SW5	SW6					
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

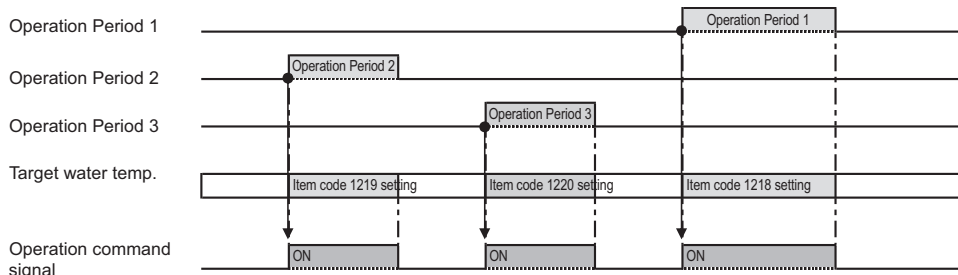
Press the push switch SWP3 to save the change.

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. Refer to page 92 for how to make the settings.

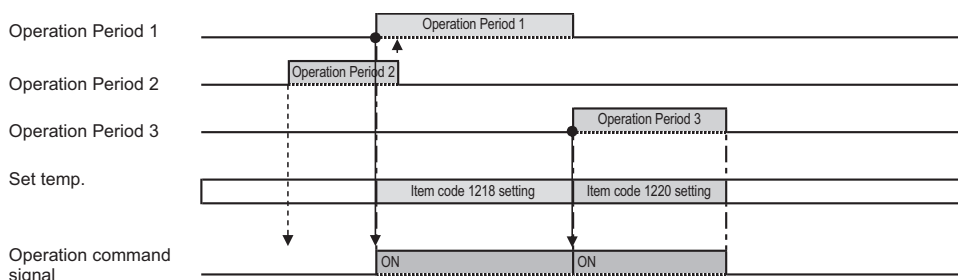
Note If Code 5 is set to "1," lock the remote controller's schedule function.

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



If "Start time 1 - 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]



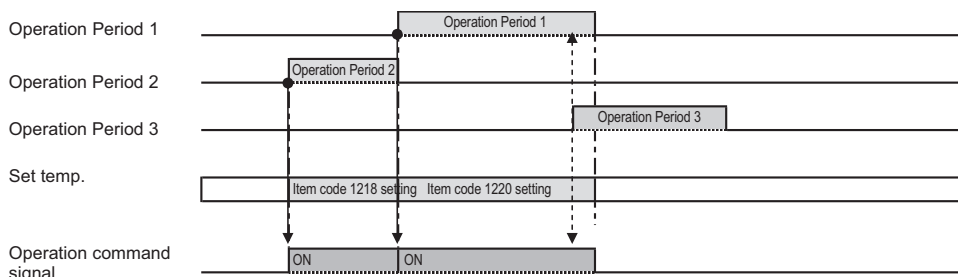
If two or more operation periods overlap, the settings for the period with a larger number will be ineffective.

If Start time 1 and start time 3 are set to the same value, the setting for Start time 3 will be ineffective.

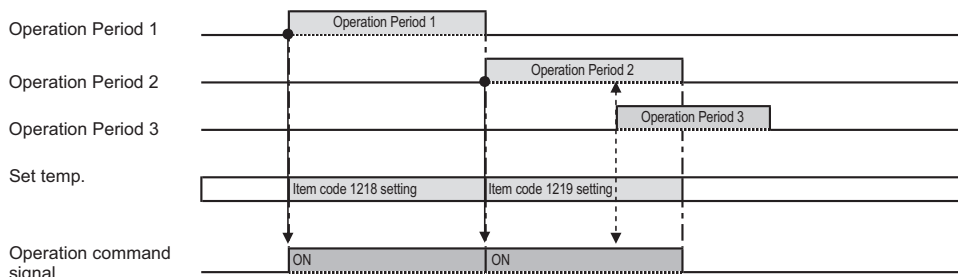
Set the setting for Start time 3 to a time at least one minute after End time 1.

(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 time 3 is set to a time within three minutes after End time 1, the compressor will not start right away.)

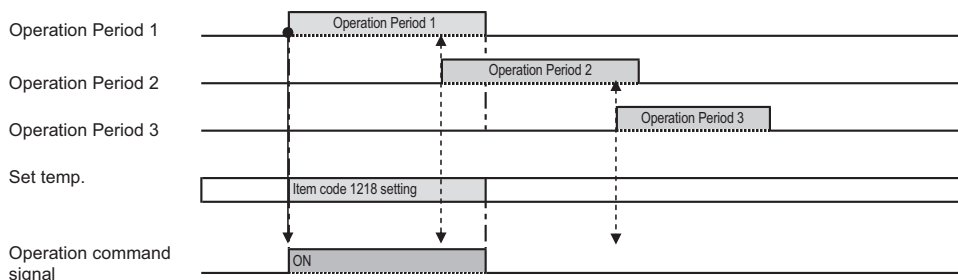
[When operation periods 1 and 3 overlap]



[When operation periods 2 and 3 overlap]



[When operation periods 1 and 2, 2 and 3 overlap]



(*) 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 SW5 and SW6.

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

SW5		SW6					
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			Setting change from an optional remote controller
				Increments	Lower limit	Upper limit	
Preset temp. A (Heating)	1215	14	TH	1	14	15	Possible
Preset temp. B (Hot Water)	1216	14	TH	1	14	15	Possible
Preset temp. C (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

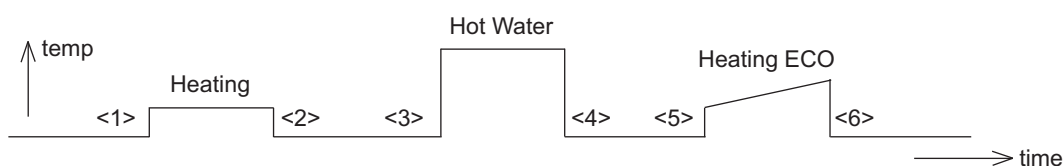
When operating the units on schedule, preset temperatures can be selected from A, B, or C for time periods 1 through 3.

Item code 1218: Operation time setting 1		Item code 1215: Preset temp. A (Item code 11: Heating)
Item code 1219: Operation time setting 2		Item code 1216: Preset temp. B (Item code 13: Hot Water)
Item code 1220: Operation time setting 3		Item code 1217: Preset temp. C (Item codes: 22-27: Heating ECO)

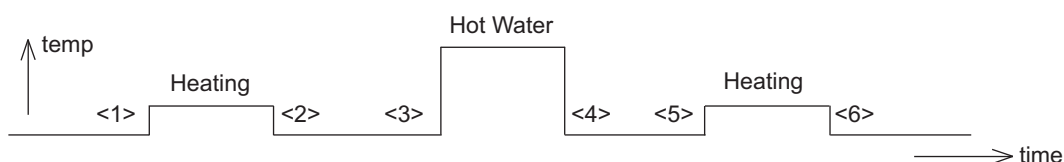
Preset temperature selection for different time periods

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

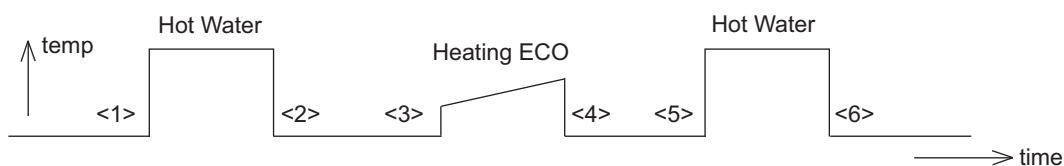
Example 1



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 SW5 and SW6.

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

SW5	SW6					
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	Possible
Peak-demand control start time	3	1300	Hour: minute	1	0000	2359	Possible
Peak-demand control end time	4	1300	Hour: minute	1	0000	2359	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 SW5 and SW6.

Set the dip switches on the circuit board as follows to select how external inputs are received.

SW5	SW6					
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 the total 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 38.

Note

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

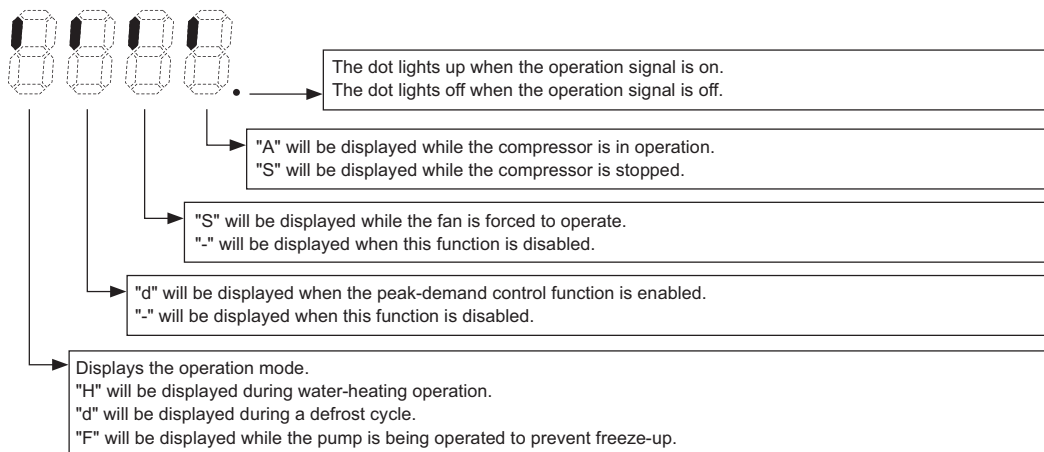
Setting the unit addresses

Refer to "System configuration procedures: Multiple system" (page 34).

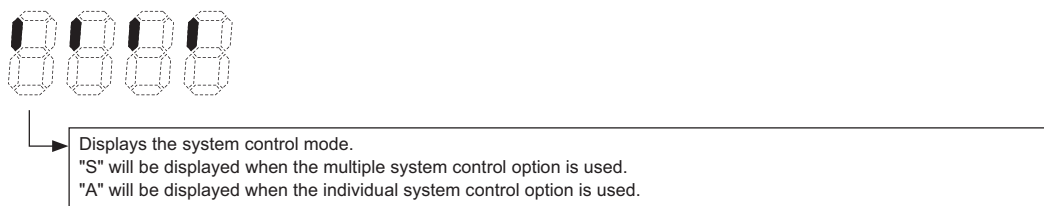
(6) Selecting the item that normally appears on the LED

SW5	SW6						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)



(*2)



(7) Remote water temperature setting input signal type

By setting SW5-7 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 SW5, SW6, SW501-1, and SW501-2.

	SW501-1	SW501-2
4-20 mA	ON	ON
0-10 V	OFF	OFF
1-5 V	OFF	ON
2-10 V	OFF	OFF

	SW5	SW6					
	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	Setting			Setting change from an optional remote controller
			Increments	Lower limit	Upper limit	
Water temperature setting input signal type	21	0	1	0	3	Not possible

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

Step 4

Press push switch SWP1 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

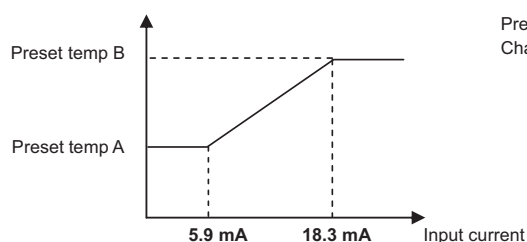
	SW5	SW6					
	10	5	6	7	8	9	10
Switch settings	OFF	OFF	OFF	OFF	OFF	ON	OFF

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

Select "0"

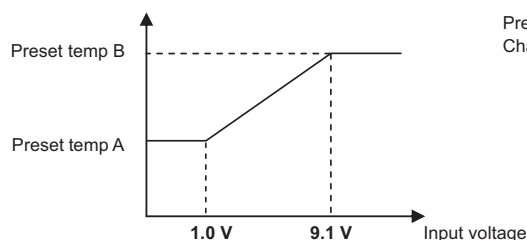
0: Water temperature input 4-20 mA
1: Capacity control input 4-20 mA
2: Water temperature input IT terminal
3: Capacity control input IT terminal

- When dip switch SW5-7 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.



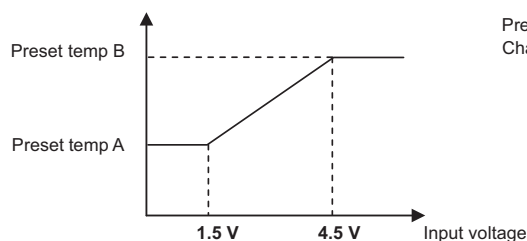
Preset temperature = (B - A) * (Input current - 5.9 mA) / 12.4 mA + A
Change of 0.12 mA or less is not recognized.

- 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.



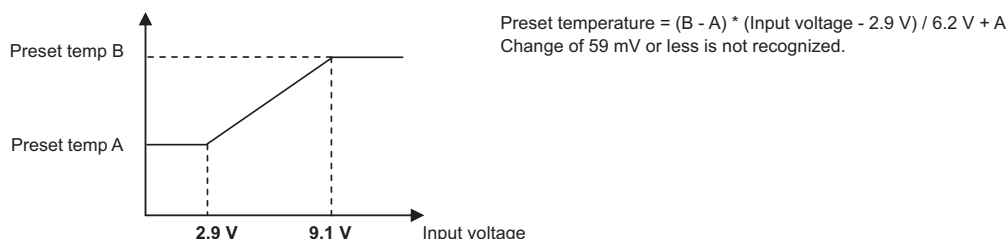
Preset temperature = (B - A) * (Input voltage - 1.0 V) / 8.1 V + A
Change of 59 mV or less is not recognized.

- 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.



(9) Setting the capacity control ratio using analog signal input

Select the analog input format

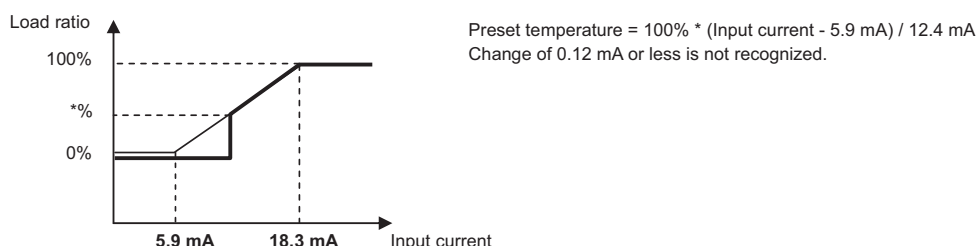
	SW5	SW6					
	10	5	6	7	8	9	10
Switch settings	OFF	OFF	OFF	OFF	OFF	ON	OFF

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

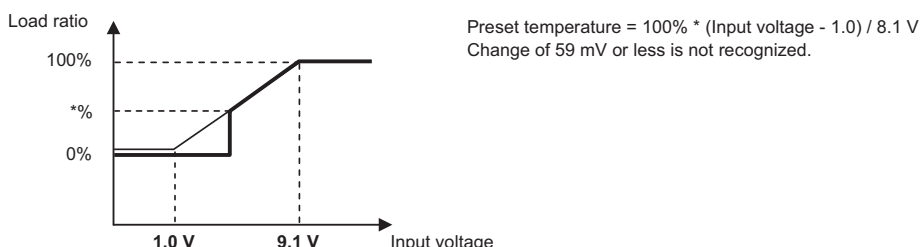
Select "1"

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 SW5-7 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.

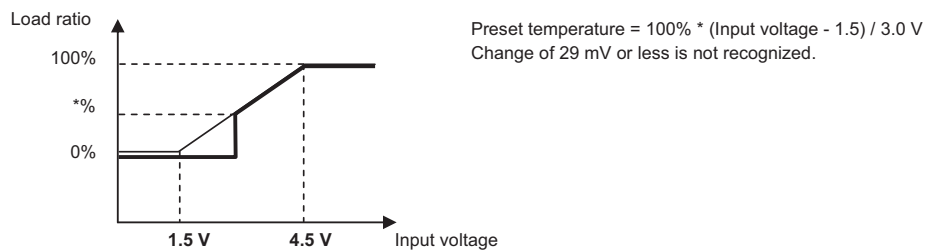


- When the water temperature setting input signal type is set to 1 (0-10 V)
 - External analog input signal of 1.0 V: 0%
 - External analog input signal of 9.1 V: 100%
 - External analog input signal of between 1.0 and 9.1 V: the percent will be linearly interpolated.



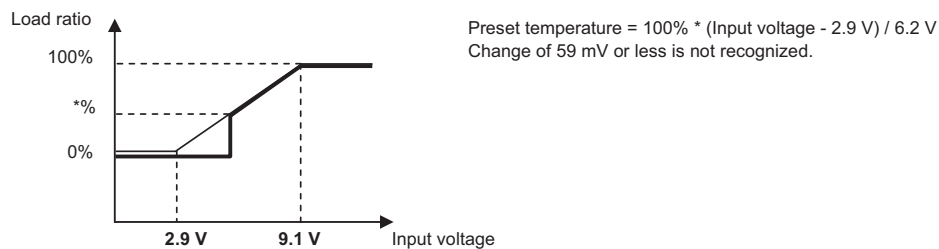
- When the water temperature setting input signal type is set to 2 (1-5 V)

- 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.



- 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.



*%: When the compressor frequency drops below the lowest frequency, 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 unit 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 unit drops below TWL1.

The booster heater 1 signal of the main unit 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 (TWL1+3.6°F) or the outside temperature is at or above TAL1+2°C (TAL1+3.6°F).
- 2 External water temperature sensor readings (TH14 and TH15) are at or above TWL1+2°C (TWL1+3.6°F), or the reading of the outside temperature sensor (TH9) connected to the main unit exceeds TAL1+2°C (TAL1+3.6°F).

Setting procedures

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

Step 1
Outdoor temperature
input source selection

	SW5	SW6					
	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
SW5 and SW6.

	SW5	SW6					
	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			Setting change from an optional remote controller
				Increments	Lower limit	Upper limit	
Booster heater 1 operation water temperature (TWL1)	1057	104	°F	0.2	32	165	Not possible
Booster heater 1 operation outside temperature (TAL1)	1058	14		0.2	-22	122	

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 [psi]	(2.95 [428])
						OFF	MPa [psi]	$3.85^{+0}_{-0.15}$ [558 $^{+0}_{-22}$]
		High-pressure sensor	PSH1	HP	PSH1	OFF	MPa [psi]	-
		Low-pressure sensor	PSL1	LP	PSL1	OFF	MPa [psi]	<ul style="list-style-type: none"> •The low pressure has dropped below 0.03 MPa [4 psi] within 30 seconds of compressor start-up. •The low pressure has dropped below 0.03 MPa [4 psi] within 30 seconds of a defrost cycle. •During water heating, the low pressure has dropped by 0.02 MPa [2 psi] after the air-side heat exchanger outlet temperature has reached -31°C [-24°F]. •During water heating, the low pressure has dropped by 0.02 MPa [2 psi] after the air-side suction pipe temperature has reached -33°C [-27°F]. •The outside temperature of 10°C [50°F] or above has been detected for 20 minutes and the low pressure has dropped below 0.03 MPa [4 psi] during water heating.
	Compressor overcurrent protection		MS	Compressor current		OFF	A	99A (CAHV-R136TAU) 56A (CAHV-R136YAU)
	Thermistor	Discharge refrigerant temp. (Discharge temp. override protection)	TH1	Discharge gas temp.		OFF	°C [°F]	<ul style="list-style-type: none"> •A discharge gas temperature of 110°C [230°F] 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 115°C [239°F] or above was detected, the unit will make an abnormal stop.
		Air-side HEX outlet temp. (vacuum protection)	TH4	Air-side HEX outlet temp.		OFF	°C [°F]	An air side heat exchanger outlet temperature of -33°C [-27°F] was detected.
		Suction temp. (vacuum and freeze-up protection)	TH2	Suction gas temp.		OFF	°C [°F]	A suction gas temperature of -36°C [-33°F] was detected.
		Compressor shell temp. (compressor floodback protection)	TH3	Comp. shell temp.		OFF	°C [°F]	A shell bottom SH temperature of 10°C [18°F] or below has been detected for 40 minutes while the compressor is in operation.
		Water inlet temp.	TH10	Water temp.		OFF	°C [°F]	When the inlet water temperature or outlet water temperature detects Tmax or higher Tmax is 74°C [158°F] when the outdoor air temperature is -20°C [-4°F] or higher, and 65°C [149°F] when the outdoor air temperature is -25 °C [77°F]. The outdoor air temperature during that time is linearly interpolated.
		Water outlet temp.	TH11					
Refrigerant circuit control	Liquid injection circuit		LEV2	Discharge gas temp.			°C [°F]	Injection is controlled by referencing the discharge gas temperature.

Function	Component	Symbol	Control/ Detection	Action	Unit	Trigger condition
Pump control	Inlet (freeze-up protection)	TH10	Water inlet	ON	°C [°F]	3 [37]
				OFF	°C [°F]	5 [41]
	Outside temperature thermistor	TH11	Outside temp.	ON	°C [°F]	1 [34]
				OFF	°C [°F]	3 [37]
	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 (SW6-3 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 between -8 and +3 Hz.
 - If the water temperature is controlled based on the external water temperature sensor reading or the inlet water temperature (SW6-3 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 between -8 and +3 Hz.
(The above does not apply when the high-pressure and low-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 21 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)

Water temperature °C [°F]	Outside temp. °C [°F]												
	Tw	-25 [-13]	-20 [-4]	-10 [14]	0 [32]	5 [41]	7 [45]	10 [50]	15 [59]	20 [68]	25 [77]	30 [86]	35 or above [95 or above]
35 [95]	40	100	120	120	120	110	106	101	86	76	74	70	70
45 [113]	40	100	120	120	120	112	108	108	92	77	75	72	71
60 [140]	40	100	120	120	120	120	120	113	101	79	77	75	73
70 [158]	40	100	120	120	120	120	120	120	107	80	78	77	74
71 [160]	40	100	120	120	120	120	120	120	107	80	78	77	74

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

CAHV-R136TAU (-BS)

(Maximum frequency of the compressor Hz)

Water temperature °C [°F]	Outside temp. °C [°F]												
	Tw	-25 [-13]	-20 [-4]	-10 [14]	0 [32]	5 [41]	7 [45]	10 [50]	15 [59]	20 [68]	25 [77]	30 [86]	35 or above [95 or above]
35 [95]	40	100	120	120	120	120	120	120	120	120	120	120	120
45 [113]	40	100	120	120	120	120	120	120	120	120	120	120	120
60 [140]	40	100	120	120	120	120	120	120	120	120	120	120	104
70 [158]	40	100	120	120	120	120	120	120	120	118	118	117	100
71 [160]	40	100	120	120	120	118	117	115	113	110	110	110	91

CAHV-R136YAU (-BS)

(Maximum frequency of the compressor Hz)

Water temperature °C [°F]	Outside temp. °C [°F]												
	Tw	-25 [-13]	-20 [-4]	-10 [14]	0 [32]	5 [41]	7 [45]	10 [50]	15 [59]	20 [68]	25 [77]	30 [86]	35 or above [95 or above]
35 [95]	40	100	120	120	120	120	120	120	120	120	120	120	120
45 [113]	40	100	120	120	120	120	120	120	120	120	120	120	120
60 [140]	40	100	120	120	120	120	120	120	120	120	120	120	120
70 [158]	40	100	120	120	120	120	120	120	120	120	120	120	120
71 [160]	40	100	120	120	120	120	120	120	120	120	120	120	110

-4- Defrost operation

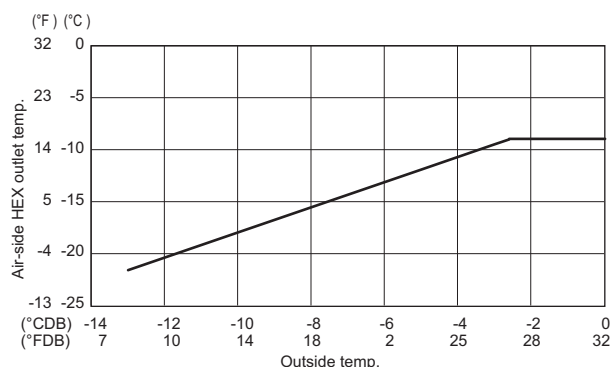
1. Defrost start

The defrost cycle will start when one of the following conditions 1 through 4 is met.

Defrost operation will be performed in the circuit that meets the defrost-start condition below.

Defrost-start conditions 1

- 1) Three minutes have passed since the compressor started up.
- 2) Cumulative compressor operation time after the completion of the last defrost cycle has reached 25 minutes.
- 3) The air-side heat exchanger outlet temperature is equal to or below the defrost-start temperature. (See the figure at right.)
- 4) Inlet water temperature is above 18°C [64°F].



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 outlet temperature is below -22°C [-8°F].
- 4) Inlet water temperature is above 18°C [64°F].
- 5) Outside temperature is -13°C [9°F] or above.

Defrost-start conditions 3

- 1) Forty-five 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 240 minutes.
- 3) Under low pressure drop suppression control.
- 4) Inlet water temperature is above 18°C [64°F].
- 5) Compressor frequency is below a certain value.

Defrost-start conditions 4

- 1) Compressor shell superheat is below 10K [18°F] over 30 minutes.
- 2) Inlet water temperature is above 18°C [64°F].

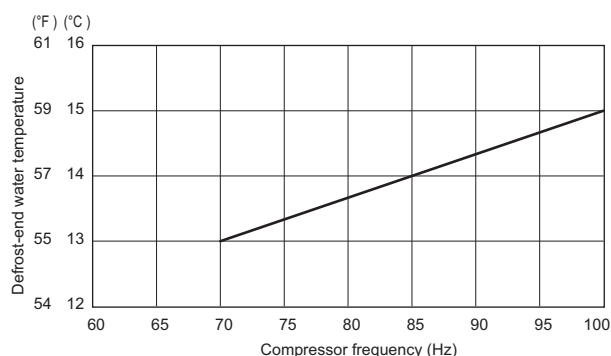
Defrost-start conditions 5

- 1) Three minutes have passed since the compressor started up.
- 2) After the last defrost cycle, the compressor cumulative operating time at outdoor air temperature below 12°C [54°F] reached 150 minutes.
- 3) Inlet water temperature is above 18°C [64°F].

2. Defrost end

The defrost cycle will end when one of the following conditions is met.

- 1) 30 seconds have passed since the beginning of the defrost cycle or later, the high-pressure has reached 2.0 MPa [2901 psi] or above.
- 2) The inlet or outlet water temperature has dropped below the value. (See the right graph)
- 3) 15 minutes have passed since the beginning of the defrost start (20 minutes, if the defrost operation is performed at the defrost-start setting 2).
- 4) 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 [°F])	Fan rotation speed (rpm)	Frequency (Hz)	Outdoor temp. (A) (°C [°F])
277	28	42 [108] < A	488	49	12 [54] < A ≤ 17 [63]
304	30	37 [99] < A ≤ 42 [108]	537	54	10 [50] < A ≤ 12 [54]
334	33	32 [90] < A ≤ 37 [99]	600	60	8 [46] < A ≤ 10 [50]
367	37	27 [81] < A ≤ 32 [90]	651	65	4 [39] < A ≤ 8 [46]
403	40	22 [72] < A ≤ 27 [81]	718	72	2 [36] < A ≤ 4 [39]
443	44	17 [63] < A ≤ 22 [72]	780	78	A < 2 [36]

-6- Injection LEV**Operating range of the LEV**

Opening range: 60-480 (fully open)

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, 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 X [1] 2. "Checking the sensor status." (page 137)

Outlet water temperature (B) (°C [°F])	Outside temperature (A) (°C [°F])				
	≤ -20 [≤ -4]	-20 < A ≤ -17 [-4 < A ≤ 1]	-17 < A ≤ -14 [1 < A ≤ 7]	-14 < A ≤ -11 [7 < A ≤ 12]	-11 < A ≤ -8 [12 < A ≤ 18]
B ≤ 45 [113]	20 - 28* [36 - 50*]	20 - 28* [36 - 50*]	20 - 28* [36 - 50*]	20 - 28* [36 - 50*]	20 - 28* [36 - 50*]
45 [113] < B ≤ 50 [122]	20 - 30* [36 - 54*]	20 - 30* [36 - 54*]	20 - 30* [36 - 54*]	20 - 30* [36 - 54*]	20 - 30* [36 - 54*]
50 [122] < B ≤ 55 [131]	20 - 32* [36 - 58*]	20 - 32* [36 - 58*]	20 - 32* [36 - 58*]	20 - 32* [36 - 58*]	20 - 32* [36 - 58*]
55 [131] < B ≤ 60 [140]	20 - 32* [36 - 58*]	20 - 32* [36 - 58*]	20 - 32* [36 - 58*]	20 - 32* [36 - 58*]	20 - 32* [36 - 58*]
60 [140] < B ≤ 65 [149]	20 - 32* [36 - 58*]	20 - 32* [36 - 58*]	20 - 32* [36 - 58*]	20 - 32* [36 - 58*]	20 - 32* [36 - 58*]
65 [149] < B ≤ 68 [154]	20 - 28* [36 - 50*]	20 - 28* [36 - 50*]	20 - 28* [36 - 50*]	20 - 28* [36 - 50*]	20 - 28* [36 - 50*]
68 [154] < B	20 - 24* [36 - 43*]	20 - 24* [36 - 43*]	20 - 24* [36 - 43*]	20 - 24* [36 - 43*]	20 - 24* [36 - 43*]

Outlet water temperature (B) (°C [°F])	Outside temperature (A) (°C [°F])				
	-8 < A ≤ -5 [18 < A ≤ 23]	-5 < A ≤ -2 [23 < A ≤ 28]	-2 < A ≤ 1 [28 < A ≤ 34]	1 < A ≤ 5 [34 < A ≤ 41]	5 < A [41 < A]
B ≤ 45 [113]	20 - 28* [36 - 50*]	20 - 28* [36 - 50*]	20 - 27* [36 - 49*]	12 - 24* [22 - 43*]	10 - 17* [18 - 31*]
45 [113] < B ≤ 50 [122]	20 - 28* [36 - 50*]	20 - 28* [36 - 50*]	20 - 27* [36 - 49*]	16 - 24* [29 - 43*]	14 - 22* [25 - 40*]
50 [122] < B ≤ 55 [131]	20 - 28* [36 - 50*]	20 - 28* [36 - 50*]	20 - 27* [36 - 49*]	20 - 24* [36 - 43*]	18 - 22* [32 - 40*]
55 [131] < B ≤ 60 [140]	20 - 28* [36 - 50*]	20 - 28* [36 - 50*]	22 - 27* [40 - 49*]	22 - 26* [40 - 47*]	22 - 24* [40 - 43*]
60 [140] < B ≤ 65 [149]	20 - 28* [36 - 50*]	21 - 28* [38 - 50*]	23 - 27* [41 - 49*]	24 - 27* [43 - 49*]	26 [47]
65 [149] < B ≤ 68 [154]	20 - 28* [36 - 50*]	22 - 28* [40 - 50*]	24 - 28* [43 - 50*]	26 - 28* [47 - 50*]	28 [50]
68 [154] < B	20 - 24* [36 - 43*]	22 - 24* [40 - 43*]	24 [43]	24 [43]	24 [43]

*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 LEV1 is between 100 and 2000 (fully open).
 The opening range of the LEV3 is between 41 and 3000 (fully open).

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 [36 and 45°F].

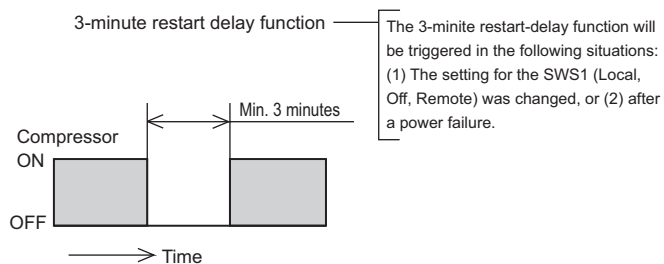
-8- Operation during power failure

Duration of power failure		shorter than 200 ms *1	200 ms or longer
Detection of power failure		Instantaneous power failure	Detection of power failure
Operation during power failure		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" (SW6-2 is set to ON.)	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" (SW6-2 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.

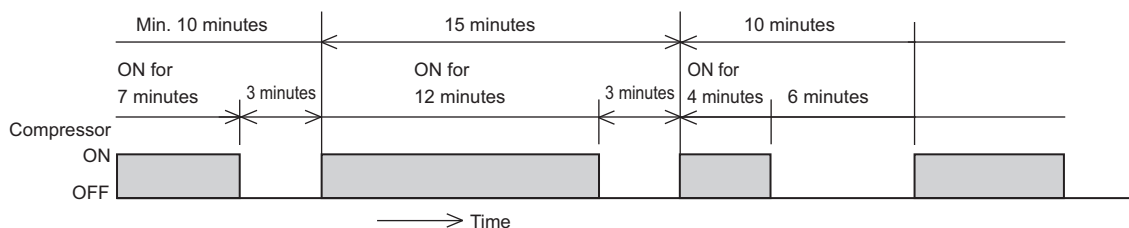
*1 If the power failure is short, it may not be detected.

-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.



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.

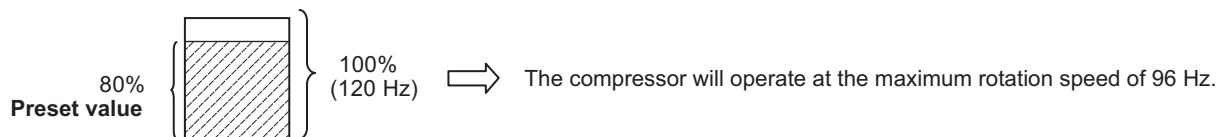


-10- Peak-demand control

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 (120 Hz on the unit described in this manual)) being set as 100%.



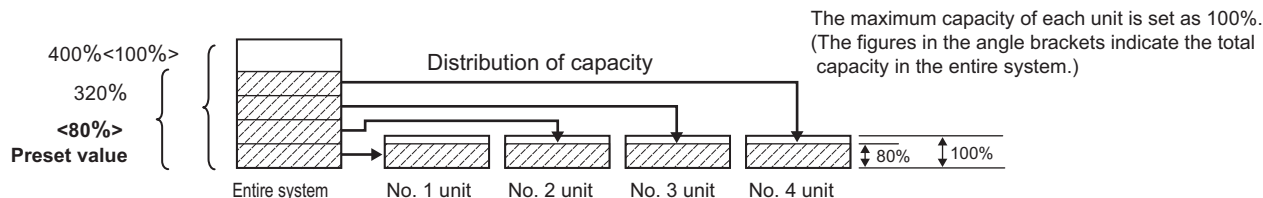
2. Peak-demand control in a multiple system

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 (120 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.

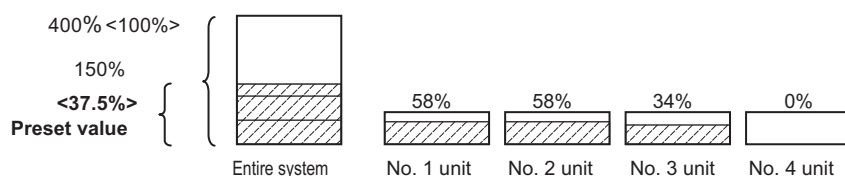
a. Maximum capacity setting (D%) ≥ 58% → All units will be operated at D Hz.



b. Maximum capacity setting D% < 58% → 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.

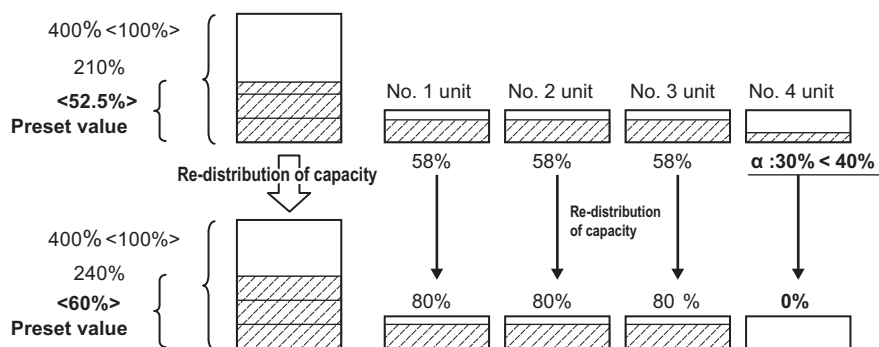
$$1) D \times M = 58\% \times (N-1) + \alpha \times 1 \quad (40\% \leq \alpha < 58\%)$$

(N-1) units will be operated at 70 Hz, and one unit will be operated at α Hz.



$$2) D \times M = \alpha \times N \quad 58\% \leq \alpha, \text{ The } \alpha \text{ value will be set to a value as close to 70 Hz as possible.}$$

N units will be operated at α Hz.



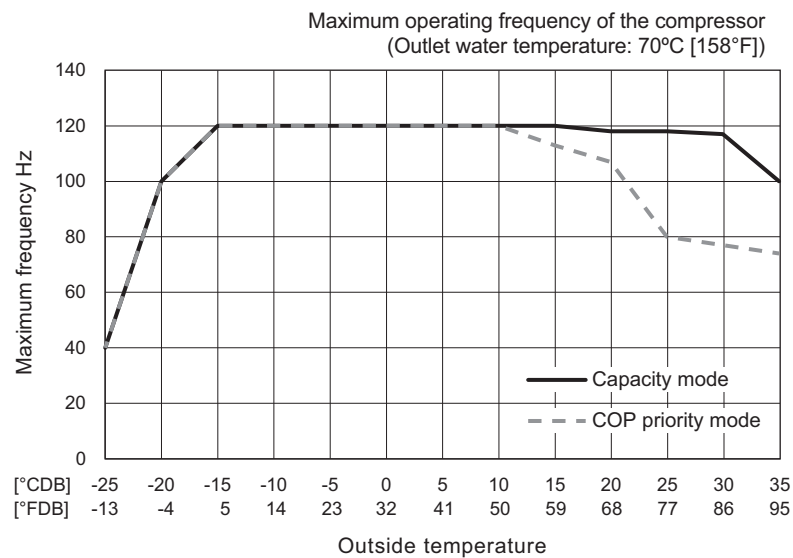
Nomenclature

D %	Maximum capacity setting: The capacity of the system when all units are operated at 120 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)

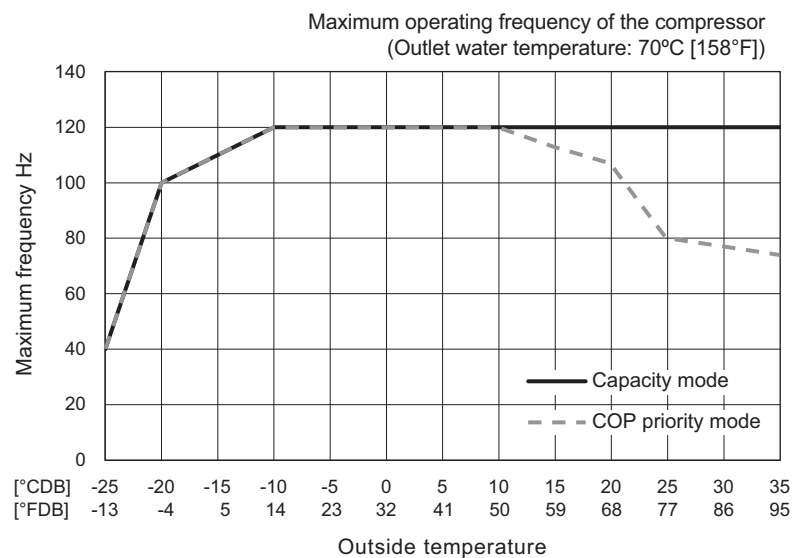
note. During the heating season, the unit will not be operated at 120 Hz to save energy consumption in the first place, so the unit's performance may not be affected even if the maximum capacity setting is changed.

3. Operating characteristics

CAHV-R136TAU (-BS)

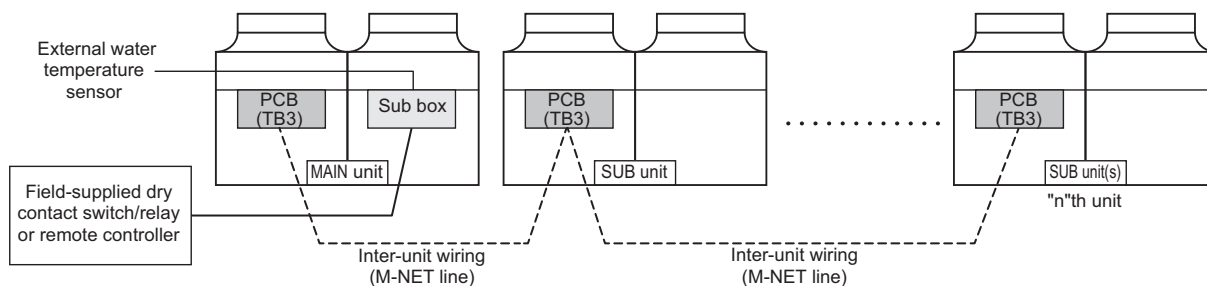


CAHV-R136YAU (-BS)



-11- Multiple system control

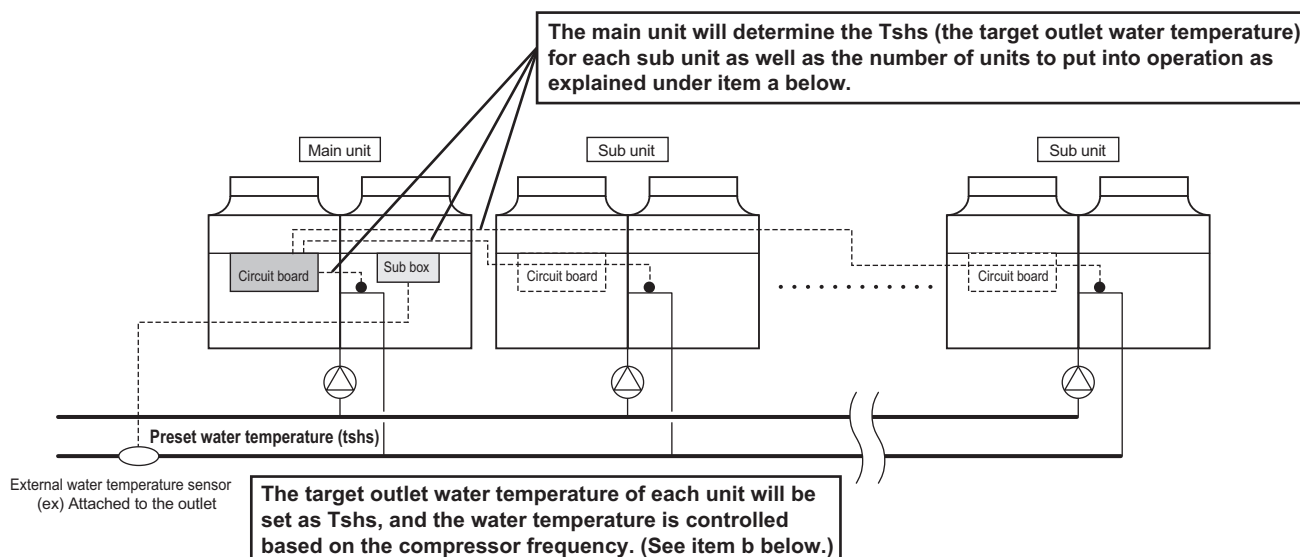
1. Electrical wiring diagram



(*) Main/Sub units and switch settings

	SW5-8 (Use of external water temperature sensor)	SW5-9 (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



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 minutes

DIFF2 : Differential (Variable between 0 and 8 K (0 and 14.4°F))

- 1) One unit will stop when the external water temperature meets the following formula: External water temperature \leq [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 \leq [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. Natural freeze-up protection

The units will operate according to the dip switch SW5-1 on the control board as shown in the table below.

Dip switch settings		SW5-1 OFF	SW5-1 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 $\pm 1^{\circ}\text{C}$ [1.8°F] of 1°C [34°F]" AND "In-let water temperature is within $\pm 1^{\circ}\text{C}$ [1.8°F] of 3°C [37°F]"	Same as left.
	Pump stop conditions	"Outside temperature is more than $\pm 1^{\circ}\text{C}$ [1.8°F] of 3°C [37°F]" AND "In-let water temperature is more than $\pm 1^{\circ}\text{C}$ [1.8°F] of 5°C [41°F]"	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	SW6-3	OFF
Inlet-water-temperature-based control		-
Water temperature control based on the external water temperature reading	SW5-8	OFF

	SW6-3	SW5-8
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 SW5-8 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 SW6-3 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 65°C [149°F] (when the outside temperature ≤ -25°C [-13°F]) or
 2. Tmax has reached 74°C [165°F] (when the outside temperature > -20°C [-4°F]).

DIFF1 = 2°C [3.6°F] (Initial setting): "1015" Digitally set value

DIFF2 = 2°C [3.6°F] (Initial setting): "1016" Digitally set value

Tmax (Outside temperature ≤ -25°C [-13°F]: 65°C [149°F], Outside temperature > -20°C [-4°F]: 74°C [165°F])

Single/Multiple system	sensor	Control method	Thermo-ON conditions
Individual system	Built-in thermistor	Inlet-water-temperature-based control	Outlet water temperatures < (Preset water temperature - DIFF1) AND Inlet water temperatures < (Preset water temperature - DIFF1)
		Outlet-water-temperature-based control	Outlet water temperatures < (Preset water temperature - DIFF1) AND Inlet water temperatures < (Preset water temperature - DIFF1) AND Average outlet water temperature ≤ (Preset water temperature + DIFF2)
	Representative water temperature	Representative water temperature	Representative water temperature < (Preset water temperature - DIFF1)
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°C [3.6°F] (Initial setting): "1015" Digitally set value

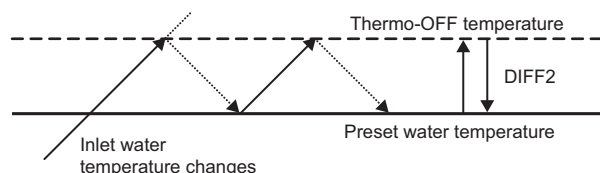
DIFF2 = 2°C [3.6°F] (Initial setting): "1016" Digitally set value

Tmax (Outside temperature ≤ -25°C [-13°F]: 65°C [149°F], Outside temperature > -20°C [-4°F]: 74°C [165°F])

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 - DIFF2" and the system is not in the short-cycling protection mode.	Inlet water temperatures are greater than the "set temperature + DIFF2" 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 - DIFF2" AND the average outlet temperature is at or below "Preset temperature + DIFF2" AND the system is not in the short-cycling protection mode.	Average outlet water temperature is greater than the "set temperature + DIFF2" 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 - DIFF2"	External water temperature sensor reading is greater than the "set temperature * DIFF2" 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 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" 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.)

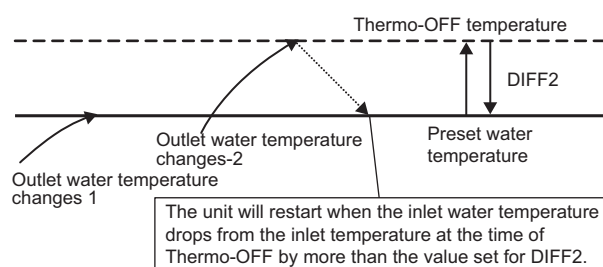
1) Thermo-ON/OFF temperature conditions

♦Inlet-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)



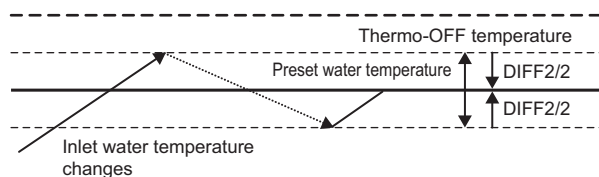
When the water temperature is controlled based on the inlet temperature, compressor frequency will be controlled as described in section -3- "Compressor frequency" (page 105). (Automatic operation according to the preset temperature)

♦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)



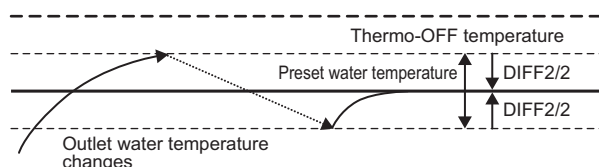
When the water temperature is controlled based on the external water temperature sensor reading (outlet water temperature), compressor frequency will be controlled in the way that the target water temperature will be maintained. If there is a sudden increase in water temperature and the unit did not 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)



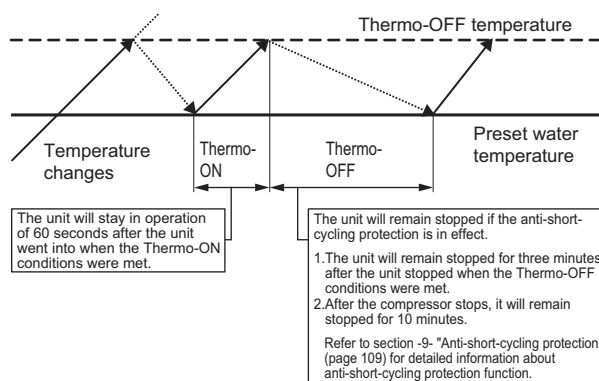
When the water temperature is controlled based on the representative inlet temperature, compressor frequency will be controlled as described in section -3- "Compressor frequency" (page 105). (Automatic operation according to the preset temperature)

•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 105). (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°C [3.6°F] (Initial setting): "1015" Digitally set value

DIFF2 = 2°C [3.6°F] (Initial setting): "1016" Digitally set value

Tmax (Outside temperature ≤ -25°C [-13°F]: 65°C [149°F], Outside temperature > -20°C [-4°F]: 74°C [165°F])

Individual system	sensor	Control method	Thermo-ON conditions	Thermo-OFF conditions
Vidual system	Built-in thermistor External water temperature	Inlet-water-temperature-based control	When SW5-5 (operation restoration after forced stoppage) is set to ON Inlet water temperatures are lower than the "Inlet temperature at Thermo-OFF DIFF2" AND outlet temperatures are lower than "Tmax - DIFF1."	"External water temperature of each unit > Tmax" or "Inlet water temperature of each unit > Tmax"
		Outlet-water-temperature-based control	When SW5-5 (operation restoration after forced stoppage) is set to ON Inlet water temperatures are lower than the "Inlet temperature at Thermo-OFF DIFF2" AND outlet temperatures are lower than "Tmax - DIFF1."	
		Water temperature control based on the external water temperature reading	When SW5-5 (operation restoration after forced stoppage) is set to OFF Inlet temperatures are lower than "Tmax - DIFF1" AND outlet temperatures are lower than "Tmax - DIFF1."	

-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." (SW5-8: OFF)

To control the water temperature with an external water temperature sensor, set SW5-8 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 II [6] "(6) Re-initializing the system" (page 38).

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 SW5-7 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

VIII Test Run Mode

[1]	Items to be checked before a Test Run	121
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[4]	Refrigerant	125
[5]	Symptoms that do not Signify Problems	125
[6]	Standard operating characteristics (Reference data)	125

[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 500 V megger and make sure it reads at least 1.0 Mohm.

Note

- Do not operate the unit if the insulation resistance is below 1.0 Mohm.
- 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 1 Mohm 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 1 Mohm, 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.

(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. 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 -25°C [-13°F] and +43°C [+109°F])	
	At the initial stage of heating water (Before water has been heated up)	During normal operation
Condensing temperature	Outlet water temperature + (0-10°C [0-18°F])	Outlet water temperature + (0-5°C [0-9°F])
Evaporating temperature	Outside temp. - (5-13°C [9-23.4°F])	Outside temp. - (3-8°C [5.4-14.4°F])*

* To maintain proper compression ratio, when the outside temperature exceeds 17°C [63°F], evaporating temperature may drop below "(Outside temperature) -8°C [18°F]"

(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 (U, V, and W), 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 (U, V, and W).

(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 [2°F] 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°C [5.4 and 9°F]. A temperature difference of 6°C [10.8°F] 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 87) and "(1) Setting procedures" (page 89) 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.)

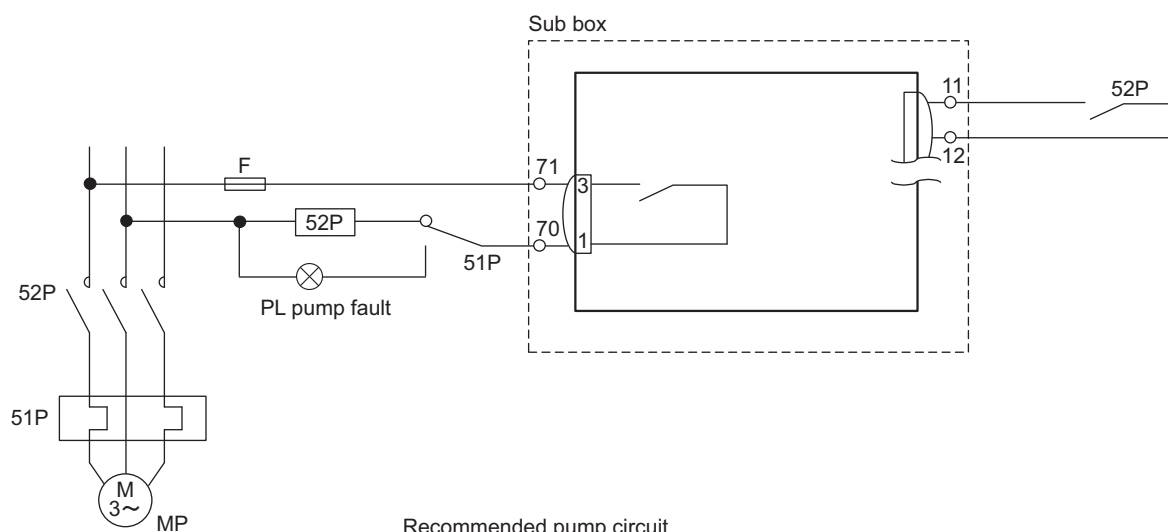
(12) Connect the pump-interlock wire to the appropriate contacts.

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

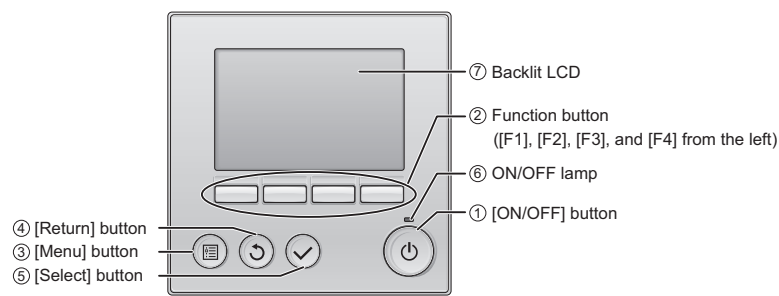
- Connect an NO relay (solenoid switch) for the pump.
- This circuit is a low-voltage circuit. Keep the pump-interlock wire at least 5 cm (1-31/32 inch) away from any wire that carries a voltage of 100 V or above to avoid damage to the circuit board.



(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

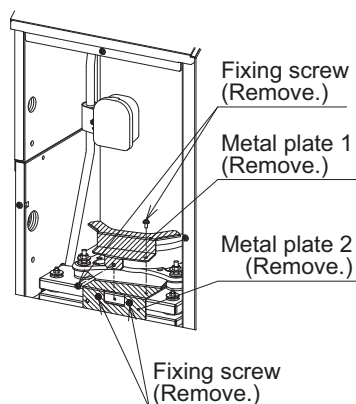


Operation procedures	
Turn on the main power.	
Set the water temperature to a temperature at least 5°C above the current settings.	
Press the ① ON/OFF button to start operation.	→ Run
To stop the operation, press the ① ON/OFF button.	→ Stop
Note 1: Refer to the following pages if an error code appears 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. Remove the shipping fixture from the compressor.



3. Switch on the main power.
4. 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.
5. 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.

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.

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.

[4] Refrigerant

Unit type	CAHV-R136TAU(-BS) CAHV-R136YAU(-BS)
Refrigerant type	R454C
Refrigerant charge	9.0 kg (19.8 lbs)

[5] Symptoms that do not Signify Problems

Symptom	Remote controller display	Cause
Fan does not stop while stopping operation.	Extinguished	If terminals 15 and 19 on TB6 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 [°F]	7 [45]
Ambient temperature	WB	°C [°F]	6 [43]
Temperature	Discharge refrigerant	°C [°F]	70 [158]
	Suction refrigerant	°C [°F]	2 [36]
	Shell temperature	°C [°F]	20 [68]
	Air-side heat exchanger inlet	°C [°F]	2 [36]
	Outside temperature	°C [°F]	7 [45]
	Inlet water temperature	°C [°F]	40 [104]
	Outlet water temperature	°C [°F]	45 [113]
Pressure	High pressure	MPa [psi]	1.85 [268]
	Low pressure	MPa [psi]	0.36 [52]
LEV opening	Main circuit	pulse	1100
	Injection	pulse	130
Compressor	Frequency	Hz	108
Fan	Frequency	Hz	650

IX Maintenance

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[1] Periodic maintenance inspections

Periodically check the refrigerant circuits, circulating-water circuits, and the entire electronic parts.

Check items

Check item	Check point	Standard
1. Around the unit (Twice/year)	1. Check for debris such as dust and fallen leaves.	Visual check
	2. Check for loose screws and bolts.	Visual check
	3. Check for rust.	Apply anti-rust agent as necessary.
	4. Check the thermal and sound insulator for peeling off.	Visual check
	5. Check for abnormal sound and vibration.	
2. Refrigerant system (Twice/year)	1. Check for gas leakage.	Use a gas leak tester.
	2. Check the pipes and capillary tubes for resonance.	Visual check
	3. Check the valves (expansion, solenoid, four-way valve, etc.) for proper operation.	See the check content of the parts and "IX [2] Guidelines for Maintenance and Inspection of Major Parts."
	4. Condensing temperature Substitute the outlet pipe temperature of the water-side heat exchanger* ¹ during heating for the condensing temperature	Outlet water temperature during heating + (0-5°C [0-9°F])
	5. Evaporating temperature Substitute the outlet pipe temperature of the air-side heat exchanger* ² during heating for the evaporating temperature	Intake air temperature during heating - (3-8°C [5.4-14.4°F])
3. Compressor	1. Check the operating current.	Compare with the rated current value.
	2. Check for abnormal sound and vibration.	Immediately stop the operation and inspect the compressor if abnormal sound or vibration from the compressor or other parts are noticed. Visually check for debris.
	3. Check the start-stop interval.	10 minutes or longer between startup and restart
4. Protection device (Twice/year)	1. Check the high-pressure switch for proper operation.	Conduct an operation check.
	2. Check the pump interlock for proper operation.	Conduct an operation check.
5. Electrical system (Twice/year)	1. Check the terminal screws for loosening.	Check each one with a screwdriver.
	2. Check the contact for cleanliness and abnormality.	Visual check
	3. Check the conductors and relays for proper operation.	Check the operation of the relays.
	4. Check the operation circuit for proper insulation resistance.	5 Mohm or above when measured with a 500 V ohmmeter
	5. Check the main circuit for proper insulation resistance.	10 Mohm or above when measured with a 500 V ohmmeter
	6. Check the ground wire for proper connection.	Visual check
	7. Check the wires inside the unit for disconnection and loosening.	Check with a screwdriver.
6. Hot water system (Twice/year)	1. Check that the water is clean.	Check the strainers in the water pipes.
	2. Check that the water pressure is appropriate.	1.0 MPa [145 psi] or below
	3. Check for water leakage.	Visual check
	4. Check the pump for head loss during stoppage.	
	5. Check the water-side heat exchanger and pipes for air pockets.	Open the air-vent valves to make sure no air comes out. (Install the air-vent valves for the pipes on site.)
	6. Check the water pump for proper voltage and current.	
	7. Check for proper water flow rate.	
	8. Test the water quality.	Water quality standard
7. Air-side heat exchanger (Twice/year)	1. Check the fins for corrosion.	Visual check
	2. Check the fins for debris.	Clean the heat exchanger if the high pressure has risen by 0.1 MPa [15 psi] under the same given conditions (evaporating temperature, outside temperature).

*1 Pipe temperature reading of the water-side heat exchanger refrigerant temperature sensor at the sensor installation point.

*2 Pipe temperature reading of the air-side heat exchanger refrigerant temperature sensor at the sensor installation point.

[2] Guidelines for Maintenance and Inspection of Major Parts

The following maintenance intervals indicate the estimated intervals of parts replacement and repair to be required as a result of periodic inspections. They do not necessarily mean that replacement is required at the maintenance intervals.

The maintenance intervals do not indicate the warranty period.

Component parts	Parts		Inspection item	Maintenance interval	Yearly inspection	Remarks
Refrigerant circuit	Compressor		<ul style="list-style-type: none"> • Sound or vibration at startup, during operation, and at stoppage of the compressor • Insulation resistance • Terminals and wiring 	20000 hr	•	
	Electronic expansion valve		<ul style="list-style-type: none"> • Operation • Operating sound by turning ON or OFF the unit (pressure check) 		•	
	Refrigerant system	Inner piping	<ul style="list-style-type: none"> • Sympathetic vibration, contact, and corrosion of the inner piping • Sympathetic vibration and contact of the capillary tube 		•	
		Solenoid valve, 4-way valve	<ul style="list-style-type: none"> • Operation and insulation performance of the solenoid valve and the 4-way valve • Corrosion and abnormal sound 		•	
	Protection device (security parts)	High pressure switch	<ul style="list-style-type: none"> • Operating pressure, refrigerant leak, and insulation resistance 	25000 hr	•	Consumable parts
		Fusible plug	<ul style="list-style-type: none"> • Appearance (swollen soluble metal) 	15000 hr		Consumable parts
	Heat exchanger	Air side	<ul style="list-style-type: none"> • Clogging and damage • Refrigerant leak 	5 years	•	Parts to be cleaned Dirt caused by being exposed to the air
		Water side	<ul style="list-style-type: none"> • Amount of water, temperature • Refrigerant leak • Drain 	5 years	•	Parts to be cleaned
Electrical/ Electronic parts	Fan motor		<ul style="list-style-type: none"> • Abnormal sound • Insulation resistance 	20000 hr	•	
	Switch	Electromagnetic switch Overcurrent relay Auxiliary relay	<ul style="list-style-type: none"> • Operation and appearance • Contact points 	25000 hr	•	
	Crankcase heater		<ul style="list-style-type: none"> • Whether the crankcase heater is powered during compressor stop • Insulation resistance of the crankcase heater 	8 years	•	Consumable parts
	Control box (including inverter) Electrolytic capacitor		<ul style="list-style-type: none"> • Insulation resistance of the circuit • Dust of the circuit board • Terminals and connectors • Appearance of the electrolytic capacitor 	25000 hr	•	
		Smoothing capacitor	<ul style="list-style-type: none"> • Capacitance and insulation resistance 	10 years		Consumable parts
	Electric parts box (including circuit board)		<ul style="list-style-type: none"> • Insulation resistance of the circuit and appearance of the capacitor • Terminals and connectors • Self-diagnosis mode and appearance 	25000 hr	•	
	Pressure sensor, thermistor		<ul style="list-style-type: none"> • Open, short-circuit, and appearance 	5 years	•	
	SW power source		<ul style="list-style-type: none"> • Output voltage 	10 years	•	

Component parts	Parts	Inspection item	Maintenance interval	Yearly inspection	Remarks
Structural parts	Decorative part (design part)	• Dirt and damage	8 years	•	Parts to be cleaned
	Frame, bottom plate	• Rust and insulation material • Flaked coating		•	
	Propeller fan	• Vibration and appearance	10 years	•	
	Drain pan	• Check the drain for clogging. • Check for peeling paint.	8 years	•	Parts to be cleaned
	Guard panel	• Flaked coating		•	
External parts	Remote controller switch	• Controllability	25000 hr	•	
	Central control system	• Controllability • Loose terminal, wiring contact • Insulation resistance	10 years		
	Flow switch	• Controllability • Water leak check • Insulation resistance	5 years	•	
	Phase-advanced capacitor Elapsed time integrator Ammeter	• Insulation resistance	8 years	•	
Water circuit	Strainer	• Check clogging	10 years	•	Parts to be cleaned
	Water pipe	• Water leak • Inclusion of air	5 years	•	Parts to be cleaned
	Flow regulating valve	• Water temperature difference (flow rate)	5 years	•	
	Pump	• Vibration • Insulation resistance • Water leak check • Loose terminal, wiring contact • Clean and inspect the strainer	5 years	•	
	Pressure gauge	• Display value under suspension	3 years	•	
	Thermometer	• Display value under suspension	5 years	•	
	Water	• Water quality management	-	•	

X Troubleshooting

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[1] Maintenance items

1. Checking the error history

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

Note

Refer to "[2] 2.Error code list" for information about error codes. (page 145)

Setting procedure

Step 1

Set the dip switches SW5 and SW6.

Set the dip switches on the circuit board as follows to view error histories.

SW5	SW6					
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	
Error history 1	1	Error Code	○	○	(Note1) (Note2) (Note3)
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	○	○	
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)	c01	First decimal place	○	○	(Note4)
Outlet water temperature (Two)	c02	First decimal place	○	○	
Discharge refrigerant temperature TH1	c03	First decimal place	○	○	
Suction refrigerant temperature TH2	c04	First decimal place	○	○	
Shell temperature TH3	c05	First decimal place	○	○	
Air-side heat exchanger outlet refrigerant temperature TH4	c06	First decimal place	○	○	
Outside temperature TH9	c07	First decimal place	○	○	
Inlet water temperature TH10	c08	First decimal place	○	○	
Outlet water temperature TH11	c09	First decimal place	○	○	
External water sensor temperature 1 TH14	c10	First decimal place	○	Fixed to 0	
External water sensor temperature 2 TH15	c11	First decimal place	○	Fixed to 0	
High pressure HP	c12	Second decimal place	○	○	
Low pressure LP	c13	Second decimal place	○	○	
THL temperature	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	
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	○	○	
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 LEV1 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	
Water temperature setting using an external analog input (1-5 V Voltage input)	c36	First decimal place	(Note5)	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 137)

(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 SW5 and SW6.

Set the dip switches on the circuit board as follows to check temperatures and pressures.

SW5	SW6					
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 unit	Sub unit	
Error history 1	1	Error Code	○	○	(Note1)
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	○	○	
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)	c01	First decimal place	○	○	(Note2)
Outlet water temperature (Two)	c02	First decimal place	○	○	(Note2)
Discharge refrigerant temperature TH1	c03	First decimal place	○	○	(Note2)
Suction refrigerant temperature TH2	c04	First decimal place	○	○	(Note2)
Shell temperature TH3	c05	First decimal place	○	○	(Note2)
Air-side heat exchanger outlet refrigerant temperature TH4	c06	First decimal place	○	○	(Note2)
Outside temperature TH9	c07	First decimal place	○	○	(Note2)
Inlet water temperature TH10	c08	First decimal place	○	○	(Note2)
Outlet water temperature TH11	c09	First decimal place	○	○	(Note2)
External water sensor temperature 1 TH14	c10	First decimal place	○	Fixed to 0	(Note2)
External water sensor temperature 2 TH15	c11	First decimal place	○	Fixed to 0	(Note2)
High pressure HP	c12	Second decimal place	○	○	(Note3)
Low pressure LP	c13	Second decimal place	○	○	(Note3)
THL temperature	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	(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 LEV1 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	(Note14)
Water temperature setting using an external analog input (1-5 V Voltage input)	c36	First decimal place	(Note13)	Fixed to 0	(Note14)

(Note1) Refer to the section "1. Checking the error history" for further information. (Page 135)

(Note2) Codes c01 through C11 and c11 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**Step 1**

Set the dip switches SW5 and SW6.

Set the dip switches on the circuit board as follows to view the operation status before error.

SW5	SW6					
10	5	6	7	8	9	10
ON	OFF	OFF	OFF	OFF	OFF	OFF

Step 2

Select the desired item with the push switch SWP3.

Press the push switch SWP3 to toggle through the item codes listed below.

Step 3

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

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.

Step 4

Press the push switch SWP3 to save the change.

Press SWP3 to stop the blinking and return to the item code display.

Time of data storage before error

Item	Item code	LED display	Unit and circuit type	
			Main unit	Sub unit
Inlet water temp (Twi)	c01	First decimal place	○	○
Outlet water temperature (Two)	c02	First decimal place	○	○
Discharge refrigerant temperature TH1	c03	First decimal place	○	○
Suction refrigerant temperature TH2	c04	First decimal place	○	○
Shell temperature TH3	c05	First decimal place	○	○
Air-side heat exchanger outlet refrigerant temperature TH4	c06	First decimal place	○	○
Outside temperature TH9	c07	First decimal place	○	○
Inlet water temperature TH10	c08	First decimal place	○	○
Outlet water temperature TH11	c09	First decimal place	○	○
External water sensor temperature 1 TH14	c10	First decimal place	○	Fixed to 0
External water sensor temperature 2 TH15	c11	First decimal place	○	Fixed to 0
High pressure HP	c12	Second decimal place	○	○
Low pressure LP	c13	Second decimal place	○	○
THL temperature	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
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 LEV1 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
Water temperature setting using an external analog input (1-5 V Voltage input)	c36	First decimal place	(Note3)	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

Step 1

Set the dip switches SW5 and SW6.

Set the dip switches on the circuit board as follows.

SW5	SW6					
10	5	6	7	8	9	10
OFF	OFF	OFF	OFF	ON	OFF	OFF

Note

By setting SW6-9 to ON after setting the dip switches SW5 and SW6 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	Item code	Increments	Lower limit	Upper limit	Default	Switch setting timing	Unit type		Notes
							Main unit	Sub unit	
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)
Inlet water temperature sensor correction (hot water)TH10	1011	-	-	-	-	-	○	○	
External water sensor 1 correction (hot water) TH14	1013	-	-	-	-	-	○	-	
External water sensor 2 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 139)

(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, Hot water temperature = B, Heating ECO temperature = 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. AFSA	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 or the circuit board including the blown 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.
			Solenoid valve fault		Replace the solenoid valve.
			Injection LEV fault		Replace the injection LEV.
			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. 5101~5121	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.
		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. 1505	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.
			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.
			Solenoid valve fault	Replace the solenoid valve.
			Injection LEV actuation failure	Replace the injection LEV.
			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

Error type		Cause (Installation/Setting error)	Cause (Parts problems)	Preliminary code	Error code *1 (PCB *2)	Error reset *3	
						Unit side (PCB)	Remote
						SWS1	Operation SW
Unreset errors		*6 Some of the errors have not been reset.		—	A000	—	—
Power failure		*4 Power failure occurred when the operation switch is switched on.		—	4 106 A-PQ	⊙	⊙
Water supply cutoff (Flow switch has been triggered.)		The water flow rate dropped below the flow switch threshold. Water supply cutoff	<ul style="list-style-type: none"> Open-circuited flow switch Broken flow switch wiring 	—	2501 AF5A	○	○
High pressure fault		No water Water supply cutoff	<ul style="list-style-type: none"> Linear expansion valve fault High-pressure sensor fault 	—	1302 AHP1	○	○
Compressor flooding			<ul style="list-style-type: none"> Fan motor fault/broken fan motor wiring Low-pressure sensor fault Shell temperature thermistor fault High-pressure sensor fault Discharge refrigerant temperature thermistor fault Linear expansion valve fault 	—	1502 Ad5H	○	○
Suction pressure fault		The outside temperature was below the operating range. Sudden frosting or heavy snow clogged up the air-side heat exchanger.	<ul style="list-style-type: none"> Low-pressure sensor fault Air-side heat exchanger outlet thermistor fault Suction refrigerant temperature thermistor fault Linear expansion valve fault Fan motor fault/broken fan motor wiring Refrigerant deficiency (refrigerant gas leak) 	—	1505	○	○
Shell temperature fault		The outside temperature was above the upper limit of the operating range. Excessive oil flow	<ul style="list-style-type: none"> Shell temperature thermistor fault Linear expansion valve fault 	—	1103	○	○
Ther- mistor fault	Discharge refrigerant temperature (TH1)		• Broken or shorted thermistor wiring	—	5101	○	○
	Suction refrigerant temperature (TH2)		• Broken or shorted thermistor wiring	—	5102	○	○
	Shell temperature (TH3)		• Broken or shorted thermistor wiring	—	5103	○	○
	Air-side heat exchanger outlet refrigerant temperature (TH4)		• Broken or shorted thermistor wiring	—	5104	○	○
	Outside temperature (TH9)		• Broken or shorted thermistor wiring	—	5109	○	○
	Inlet water temperature (TH10)		• Broken or shorted thermistor wiring	—	5116	○	○
	Outlet water temperature (TH11)		• Broken or shorted thermistor wiring	—	5111	○	○
	External water sensor temperature 1 (TH14)		• Broken or shorted thermistor wiring	—	5114	○	○
	External water sensor temperature 2 (TH15)		• Broken or shorted thermistor wiring	—	5115	○	○
	Water-side heat exchanger refrigerant temperature thermistor error (TH21)		• Broken or shorted thermistor wiring	—	5121	○	○
High-pressure sensor fault/high-pressure fault			• Broken or shorted pressure sensor wiring	—	5201	○	○
Low-pressure sensor fault/low-pressure fault			• Broken or shorted pressure sensor wiring	—	5202	○	○
Model setting error 1		Dip switches on the PCB were set incorrectly during maintenance.		—	7113	×	×
Model setting error 2			• Resistor Z22, 24 or 25 fault (connected to the Main control board)	—	7117	×	×
Power supply frequency fault		Power supply frequency is a frequency other than 50 Hz or 60 Hz.		—	4115	×	×
Open phase		Power supply problem • There is an open phase. • Power supply voltage drop	<ul style="list-style-type: none"> Circuit board fault Wiring fault The fuse is blown (F4 or F5) Transformer fault (T02) 	—	4102 A471	×	×
Power supply fault			• Transmission power supply PCB fault	—	4106 (255)	—	—
External analog signal error			<ul style="list-style-type: none"> Broken analog input signal device Broken analog signal wiring 	—	4126	○	○

Error type			Cause (Installation/Setting error)	Cause (Parts problems)	Preliminary code	Error code *1 (PCB *2)	Error reset *3	
							Unit side (PCB)	Remote
							SWS1	Operation SW
Discharge temperature fault (A discharge refrigerant temperature of 120°C [248°F] or above is detected for 30 seconds while the compressor is in operation.) (A discharge refrigerant temperature of 125°C [257°F] or above is detected momentarily while the compressor is in operation.)			No water Abrupt change in water temperature (5K/min. [9°F/min] or greater) Pump failure	<ul style="list-style-type: none"> High-pressure sensor fault Linear expansion valve fault (Main circuit LEV, injection LEV) Refrigerant deficiency (refrigerant gas leak) 	1202	1102 RC61	○	○
Heat exchanger freeze up *7			Drop in water flow or water supply cutoff during the defrost cycle Water temperature drop during defrost cycle	<ul style="list-style-type: none"> 4-way valve switching failure 	—	1503	○	○
Inverter error	Inverter error Electric current related errors during operation	IPM error		<ul style="list-style-type: none"> INV board fault Ground fault of the compressor Compressor coil problem IPM error (loose terminal screws, cracked due to swelling) Fan motor failure Fan board failure 	4350 4355 4356 (101)	4250 4255 4256 (101) *9	○	○
		Over current due to current sensor detection (effective value) (During operation)		<ul style="list-style-type: none"> INV board fault Ground fault of the compressor Compressor coil problem IPM error (loose terminal screws, cracked due to swelling) 	4350 4355 4356 (107)	4250 4255 4256 (107) *9	○	○
		Over current due to current sensor detection (momentary value) (During operation)		<ul style="list-style-type: none"> Fan motor failure Fan board failure 	4350 4355 4356 (106)	4250 4255 4256 (106) *9	○	○
		Short-circuited IPM/ground fault (During operation)			4350 4355 4356 (104)	4250 4255 4256 (104) *9	○	○
		Overcurrent error due to a short-circuited (During operation)	Inter-phase voltage drop (Inter-phase voltage at or below 180 V)		4350 4355 4356 (105)	4250 4255 4256 (105) *9	○	○
		Step-out fault	Motor synchronization loss	<ul style="list-style-type: none"> Fan motor failure Fan board failure 	4355 4356 (137)	4255 4256 (137) *9	○	○
		DCL over current error (H/W)	DCL overcurrent	<ul style="list-style-type: none"> INV board fault Ground fault of the compressor Compressor coil problem 	4350 (121) (128)	4250 (121) (128)	○	○
		DCL over current error (S/W)			4350 (122)	4250 (122)	○	○
	Current related problems at start up	IPM error (At startup)		<ul style="list-style-type: none"> INV board fault Ground fault of the compressor Compressor coil problem IPM error (loose terminal screws, cracked due to swelling) Fan motor failure Fan board failure 	4350 4355 4356 (101)	4250 4255 4256 (101) *9	○	○
		Over current due to current sensor detection (effective value) (At startup)		<ul style="list-style-type: none"> INV board fault Ground fault of the compressor Compressor coil problem IPM error (loose terminal screws, cracked due to swelling) 	4350 4355 4356 (107)	4250 4255 4256 (107) *9	○	○
		Over current due to current sensor detection (momentary value) (At startup)		<ul style="list-style-type: none"> Fan motor failure Fan board failure 	4350 4355 4356 (106)	4250 4255 4256 (106) *9	○	○
	Voltage related problems during operation	Bus voltage drop protection (S/W)	Momentary power failure/power failure Power supply voltage drop (Inter-phase voltage is 248 V or below.) Voltage drop	<ul style="list-style-type: none"> INV board fault 72C fault Noise filter coil (L) fault Wiring connections between noise filter board and INV board fault Wiring connections between noise Fan board and INV board fault Resistor (R1, R2) fault 	4320 4325 4326 (108)	4220 4225 4226 (108) *9	○	○
		Bus voltage rise protection (S/W)	Incorrect power supply voltage	<ul style="list-style-type: none"> INV board fault Fan board fault 	4320 4325 4326 (109)	4220 4225 4226 (109)	○	○
		Bus voltage error (H/W)	VDC error	<ul style="list-style-type: none"> INV board fault 	4320 (110)	4220 (110)	○	○

Error type			Cause (Installation/Setting error)	Cause (Parts problems)	Preliminary code	Error code *1 (PCB *2)	Error reset *3	
							Unit side (PCB)	Remote
							SWS1	Operation SW
Inverter error	Voltage related problems during operation	Logic error	Malfunction due to external noise interference • Faulty grounding • Improper transmission and external wiring installation (Shielded cable is not used.) • Low-voltage signal wire and high-voltage wire are in contact. (Placing the signal wire and power wire in the same conduit)	• INV board fault • Fan board fault	4320 4325 4326 (111) (112)	4220 4225 4226 (111) (112) *9	○	○
		Voltage meter error at start up (Bus voltage drop protection at start up (detected by the Main unit side))	Power supply voltage drop	• INV board fault • 72C fault • Noise filter coil (L) fault • Wiring connections between noise filter board and INV board fault • Wiring connections between noise Fan board and INV board fault • Resistor (R1, R2) fault	4320 4325 4326 (131)	4220 4225 4226 (131) *9	○	○
	Control power supply error		Control power supply failure	• INV board, main board fault • Broken wiring between INV and main control board • Contact failure	4320 (129)	4220 (129)	○	○
	Voltage boost control error		• Power supply voltage drop • Installation condition	• INV board fault • Ground fault of the compressor	4320 (123)	4220 (123)	○	○
	Heatsink fault (Heatsink overheat protection)		Power supply voltage drop (Inter-phase voltage is 180 V or below.) Clogged heatsink cooling air passage	• Fan motor fault • INV and Fan board fault • THHS sensor fault • IPM error (loose terminal screws, cracked due to swelling)	4330 4335 4336	4230 4235 4236 *9	○	○
	DCL temperature fault		DCL temperature exceeds 150°C [302°F]	• Contact or connector failure (CNTH) • INV board fault	4320 (126)	4230 (126)	○	○
	Overload protection		Short-cycling of air (reduced air flow) Clogged heatsink cooling air passage Power supply voltage drop (Inter-phase voltage is 180 V or below.)	• THHS sensor fault • Fan motor fault • Current sensor fault • Compressor fault • INV and Fan board fault	4320 4325 4326	4240 4245 4246 *9	○	○
	ACCT sensor fault			• INV board fault • Ground fault of the compressor and IPM error	4301 (115)	5301 (115)	○	○
	ACCT sensor/circuit fault			• Poor contact at the INV board connector CNCT2 (ACCT) • ACCT sensor fault	4300 (117)	5301 (117)	○	○
	Open-circuited IPM/loose ACCT sensor			• Disconnected ACCT sensor (CNCT2) ACCT sensor fault • Broken compressor wiring INV circuit fault (IPM error etc.)	4300 (119)	5301 (119)	○	○
	Faulty wiring			• ACCT sensor is connected in the wrong phase. • ACCT sensor is connected in the wrong orientation.	4300 (120)	5301 (120)	○	○
	THHS sensor/circuit fault			• THHS sensor contact failure • THHS sensor fault • INV board fault	1214 (01)(05) (06)	5110 (01)(05) (06)	○	○
	DCL electric current circuit error			• Contact failure between CNCT1A and CNCT1B • INV board fault	4300 (127)	5301 (127)	○	○
	Current sensor fault			• Fan board fault • Fan motor error	4305 4306 (135)	5305 5306 (135) *9	○	○
	Current sensor/circuit fault			• Fan board fault	4305 4306 (136)	5305 5306 (136) *9	○	○
	THL sensor/circuit fault			• THL sensor contact failure (CNTH) • THL sensor fault • INV board fault	1248 (01)	5120 (01)	○	○

Error type		Cause (Installation/Setting error)	Cause (Parts problems)	Preliminary code	Error code *1 (PCB *2)	Error reset *3	
						Unit side (PCB)	Remote
Inverter error	Serial communication error		• Communication error between control board and INV board (noise interference, broken wiring)	4300 4305 4306 (01)(05) (06)	0403 (01)(05) (06)	○	○
	IPM system error	INV board switch setting error	• Wiring or connector connection between connectors on IPM-driven power supply circuit • INV board fault	—	—	○	○
Remote control- ler error (incl. remote control- ler 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)		—	7109	×	×
	Remote controller signal reception error 1	Remote controller cable is not connected. Broken wiring	• Broken remote controller wiring • Main control board communication circuit fault	—	6831	—	—
	Remote controller signal transmission error	Communication error due to external noise interference	• Main control board communication circuit fault	—	6832	—	—
	Remote controller signal reception error 2	Communication error due to external noise interference	• Main control board communication circuit fault	—	6834	—	—
Multiple 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	×	×
Communication error between the main and sub units *8				—	6500	—	—
Transmission line power supply PCB fault Communication error between the main and sub units (Simple multiple unit control mode) *5		Communication error due to external noise interference	• Broken wiring to the transmission power supply circuit board (between the main and sub units) • Transmission power supply PCB communication circuit fault	—	6600 6602 6603 6606 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 appear 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 can 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 communication error 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.

*8: When the AE-C400A, TE-C400A, EW-C50A, TW-C50A is disconnected from a system and will not be reconnected, the circuit board needs to be factory reset to reset the errors. Refer to II [6] "(8) Factory reset" for how to reset the circuit board.

*9: When the last digit is 5: MF1 (Fan motor at the upper left when seen from the front of the unit)

When the last digit is 6: MF2 (Fan motor at the upper right when seen from the front of the unit)

[3] Troubleshooting Principal Parts

-1- High-Pressure Sensor (PSH1)

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

SW5	SW6					
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 3 second intervals. 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 LD301.

- 1) When the gauge pressure is between 0 and 0.098 MPa [14 psi], internal pressure is caused due to gas leak.
- 2) When the pressure displayed on self-diagnosis LD301 is between 0 and 0.09 MPa [13 psi], the connector may be defective or be disconnected. Check the connector and go to (4).
- 3) When the pressure displayed on self-diagnosis LD301 exceeds 3.85 MPa [558 psi], 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 LD301 while the sensor is running. (Compare them by MPa unit.)

- 1) When the difference between both pressures is within 0.098 MPa [14 psi], both the high pressure sensor and the control board are normal.
- 2) When the difference between both pressures exceeds 0.098 MPa [14 psi], the high pressure sensor has a problem. (performance deterioration)
- 3) When the pressure displayed on self-diagnosis LD301 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 LD301.

- 1) When the pressure displayed on self-diagnosis LD301 is between 0 and 0.09 MPa [13 psi], the high pressure sensor has a problem.
- 2) When the pressure displayed on self-diagnosis LD301 is approximately 3.85 MPa [558 psi], the control board has a problem.

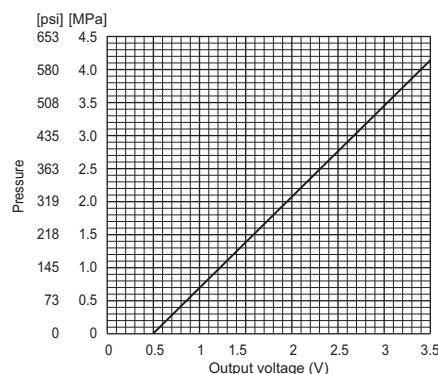
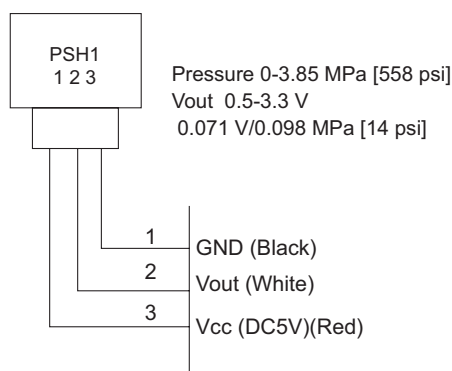
(4) Remove the high pressure sensor from the control board, and short-circuit between the No.2 and 3 connectors (PSH1:CN201) to check the pressure with self-diagnosis LD301.

- 1) When the pressure displayed on the self-diagnosis LD301 exceeds 3.85 MPa [558 psi], 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 0.071 V per 0.098 MPa [14 psi].

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



-2- Low-Pressure Sensor (PSL1)

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

SW5	SW6					
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 3 second intervals. 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 LD301.

- 1) When the gauge pressure is between 0 and 0.098 MPa [14 psi], internal pressure is caused due to gas leak.
- 2) When the pressure displayed on self-diagnosis LD301 is between 0 and 0.09 MPa [13 psi], the connector may be defective or be disconnected. Check the connector and go to (4).
- 3) When the pressure displayed on self-diagnosis LD301 exceeds 1.7 MPa [247 psi], 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 LD301 while the sensor is running. (Compare them by MPa [psi] unit.)

- 1) When the difference between both pressures is within 0.03 MPa [4 psi], both the low pressure sensor and the control board are normal.
- 2) When the difference between both pressures exceeds 0.03 MPa [4 psi], the low pressure sensor has a problem. (performance deterioration)
- 3) When the pressure displayed on the self-diagnosis LD301 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 LD301 display.

- 1) When the pressure displayed on self-diagnosis LD301 is between 0 and 0.09 MPa [13 psi], the low pressure sensor has a problem.
- 2) When the pressure displayed on self-diagnosis LD301 is approximately 1.7 MPa [247 psi], the control board has a problem.
 - When the outdoor temperature is 40°C [104°F] or less, the control board has a problem.
 - When the outdoor temperature exceeds 40°C [104°F], go to (5).

- (4) Remove the low pressure sensor from the control board, and short-circuit between the No.2 and 3 connectors (PSL1:CN202) to check the pressure with the self-diagnosis LD301.

- 1) When the pressure displayed on the self-diagnosis LD301 exceeds 1.7 MPa [247 psi], the low pressure sensor has a problem.
- 2) If other than 1), the control board has a problem.

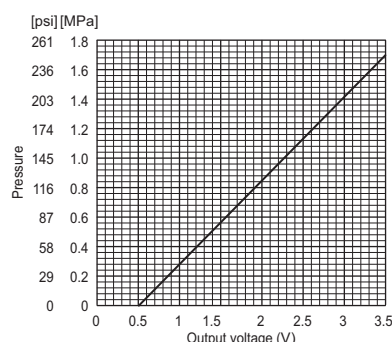
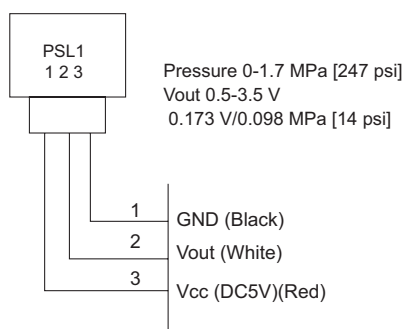
- (5) Remove the high pressure sensor (PSH1) from the control board, and insert it into the connector for the low pressure sensor (PSL1:CN202) to check the pressure with the self-diagnosis LD301.

- 1) When the pressure displayed on the self-diagnosis LD301 exceeds 1.7 MPa [247 psi], 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 0.173 V per 0.098 MPa [14 psi].

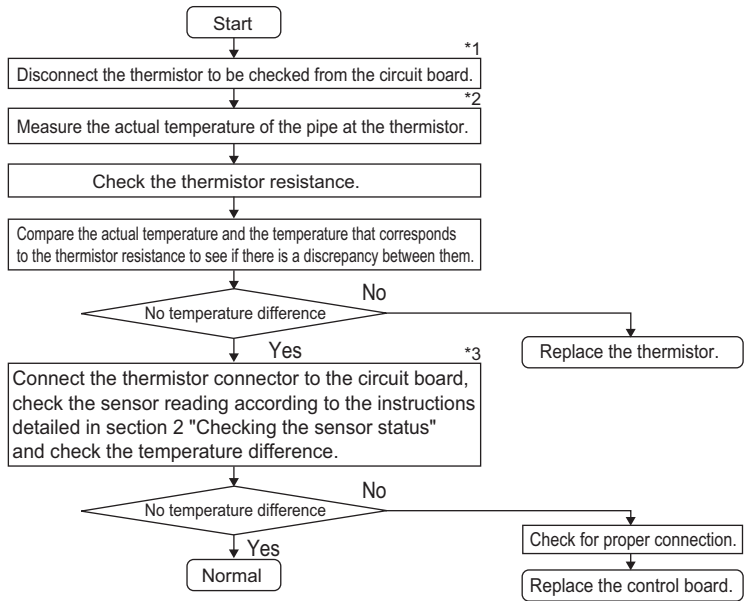
	Control board side
Vcc	Pin 3
Vout	Pin 2
GND	Pin 1



-3- Temperature sensor

Use the flowchart below to troubleshoot the temperature sensor.

Troubleshooting the thermistor



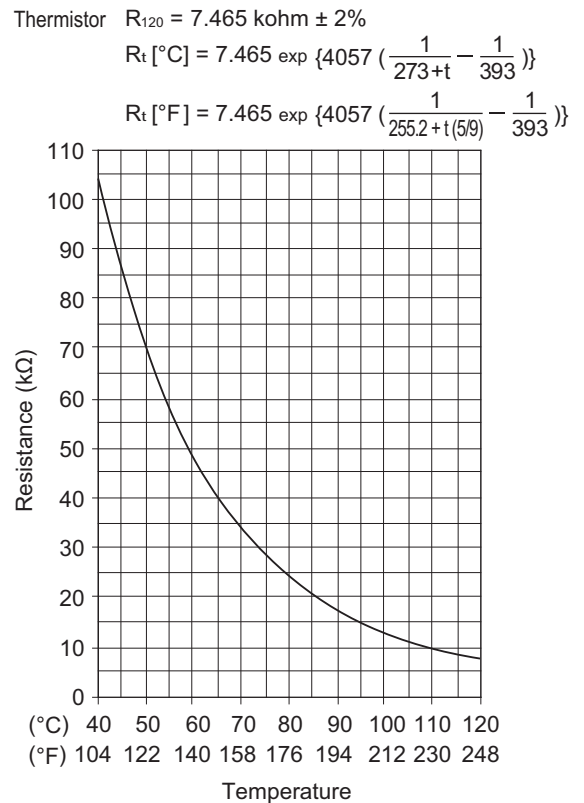
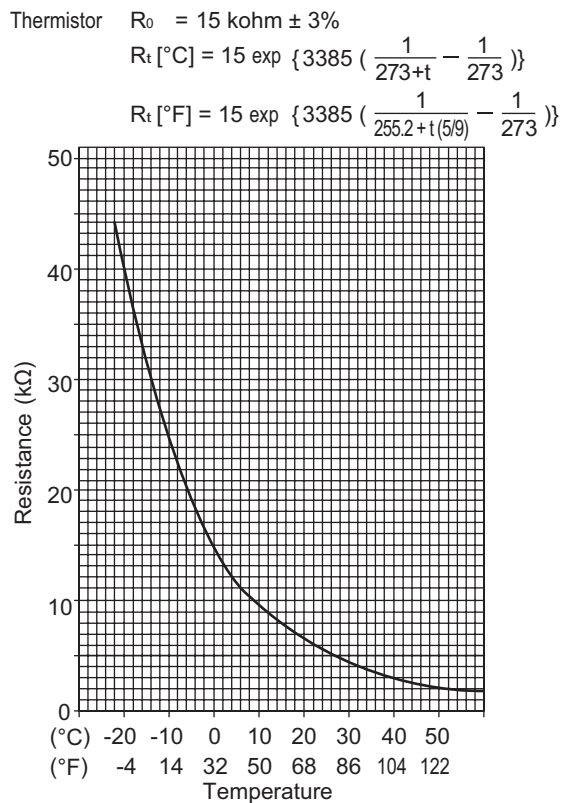
* 1 The table below shows the thermistor numbers and their corresponding connectors. Check each sensor by disconnecting the corresponding connector.

TH1	CN211	3-4	TH9	CN990	1-2
TH3	CN211	1-2	TH10	CN192	3-4
TH2	CN213	1-2	TH11	CN192	1-2
TH4	CN214	1-2	TH21	CN212	3-4

- * 2
- Pull out the sensor connector from the control board.
Do not pull on the lead wire.
 - Measure the resistance with a tester.
 - If the measured value is within $\pm 10\%$ of the value as shown in the graph below, the circuit sensor is normal.
- * 3 Use the dip switches and push switches to view the sensor reading on the LED.

(1) Low-temperature-range thermistor
: TH2,3,4,9,10,11,21

(2) High-temperature-range thermistor: TH1



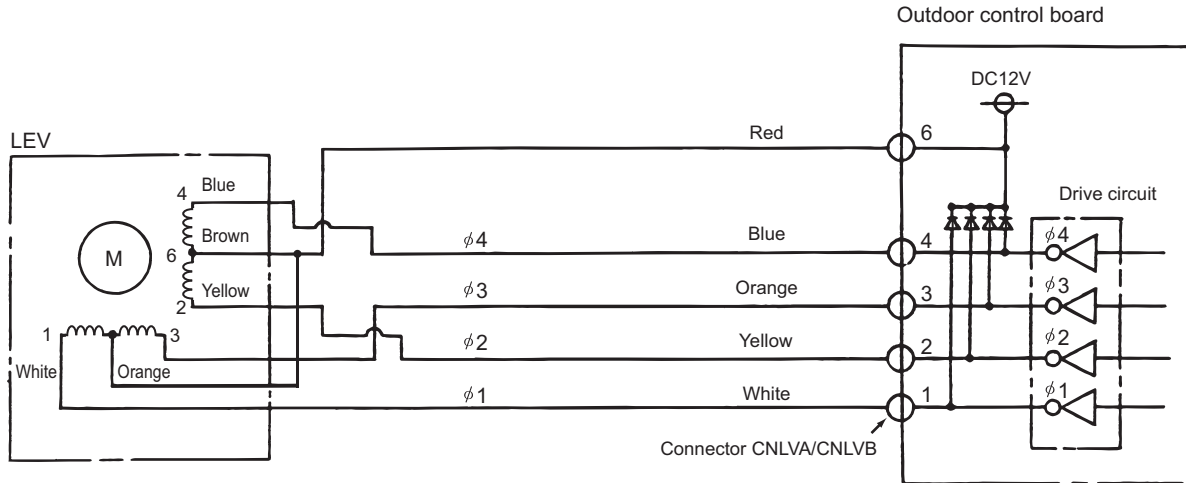
-4- LEV

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
φ 1	ON	OFF	OFF	ON
φ 2	ON	ON	OFF	OFF
φ 3	OFF	ON	ON	OFF
φ 4	OFF	OFF	ON	ON

Output pulses change in the following orders when the

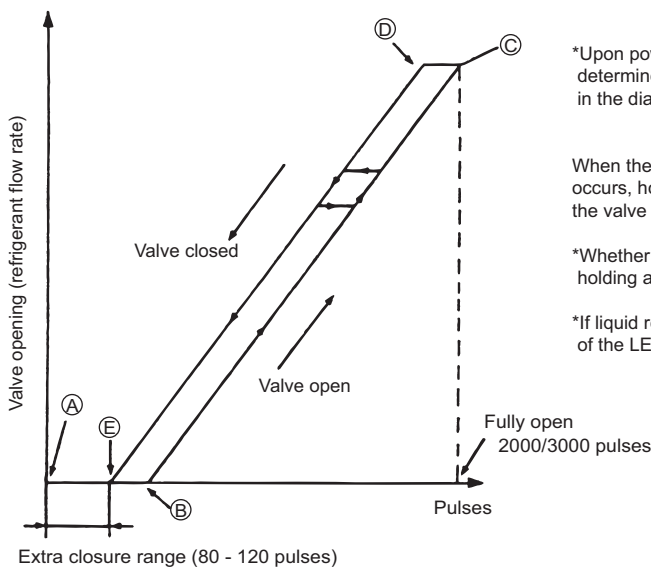
Valve is closed; 1 → 2 → 3 → 4 → 1

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 operation



*Upon power on, a 2200 pulse(LEV1)/3200 pulse(LEV3) signal is sent to the LEV to determine the valve position and bring the valve to the position indicated by "A" in the diagram

When the valve operates smoothly, no sound from LEV or no vibration occurs, however, when the pulses change from E to A in the chart or the valve is locked, a big sound occurs.

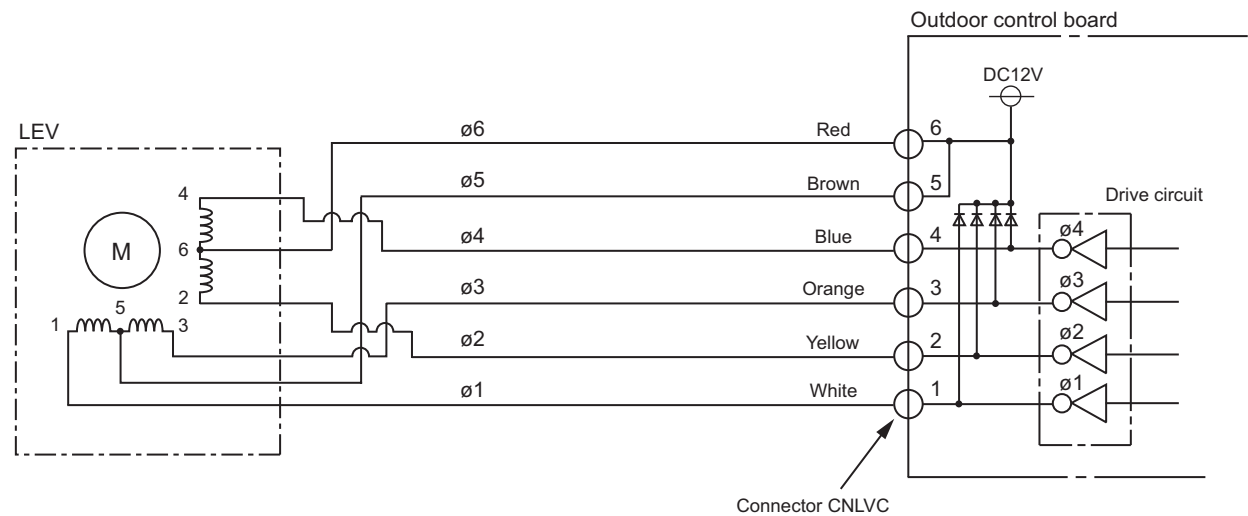
*Whether a sound is generated or not can be determined by holding a screwdriver against it, then placing your ear against the handle.

*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



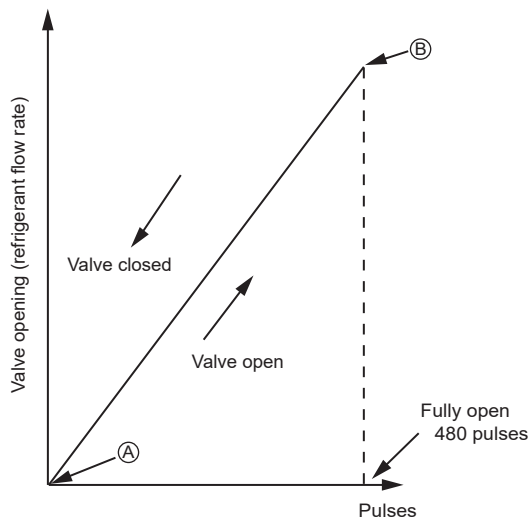
2) Pulse signal output and valve operation

Output (phase) number	Output state							
	1	2	3	4	5	6	7	8
φ 1	ON	OFF	OFF	OFF	OFF	OFF	ON	ON
φ 2	ON	ON	ON	OFF	OFF	OFF	OFF	OFF
φ 3	OFF	OFF	ON	ON	ON	OFF	OFF	OFF
φ 4	OFF	OFF	OFF	OFF	ON	ON	ON	OFF

Output pulses change in the following orders when the Valve is open; 1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 1
Valve is closed; 8 → 7 → 6 → 5 → 4 → 3 → 2 → 1 → 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 operation



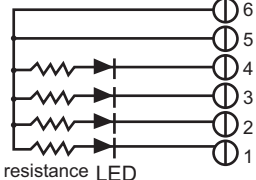
*Upon power on, a 520 pulse signal is sent to the LEV to determine the valve position and bring the valve to the position indicated by "A" in the diagram. (Pulse signal is output for approximately 17 seconds.)

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.

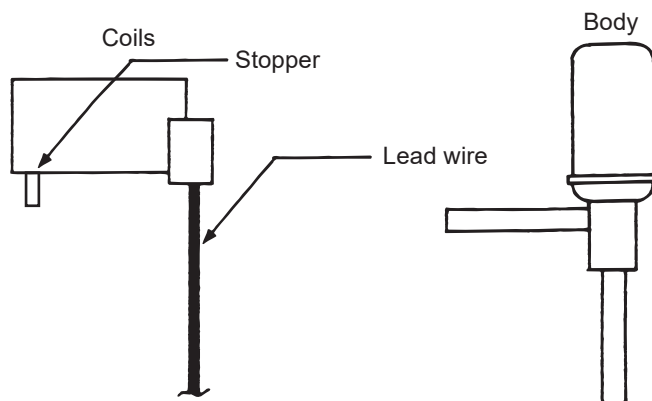
*If liquid refrigerant is present in the LEV, it may make the operating sound of the LEV difficult to detect.

(1) Judgment methods and possible failure mode

Malfunction mode	Judgment method	Remedy
Microcomputer driver circuit failure	<p>Disconnect the control board connector and connect the check LED as shown in the figure below.</p>  <p>resistance LED</p> <p>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.</p>	When the drive circuit has a problem, replace the control board.
LEV mechanism is locked	<p>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.</p>	Replace the LEV.
Disconnected or short-circuited LEV motor coil	<p>Measure resistance between the coils (red - white, red - orange, red - yellow, red - blue) using a tester. They are normal if resistance is 150 ohm \pm 10% (LEV1) / 100 ohm \pm 10% (LEV3).</p>	Replace the LEV coils in the main circuit.
	<p>Measure resistance between the coils (red - white, red - orange, brown - yellow, brown - blue) using a tester. They are normal if resistance is 46 ohm \pm 3%.</p>	Replace the injection LEV coils.
Faulty wire connections in the connector or faulty contact	<ol style="list-style-type: none"> 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.

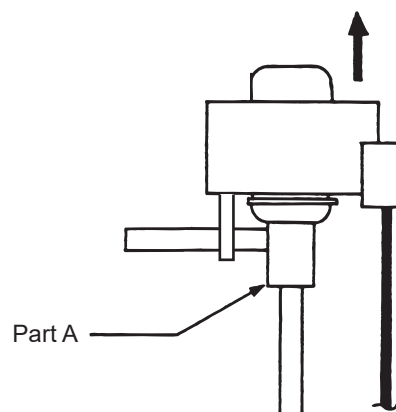
3. Injection LEV coil removal procedure

The LEV consists of a coil and a valve body that can be separated from each other.



(1) Removing the coils

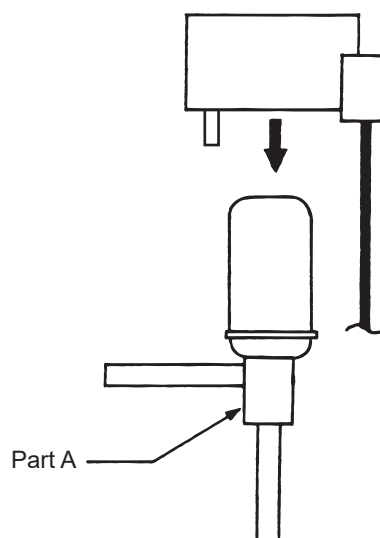
Fasten the body tightly at the bottom (Part A in the figure) so that the body will not move, then pull out the coils toward the top. If the coils are pulled out without the body gripped, undue force will be applied and the pipe will be bent.



(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.

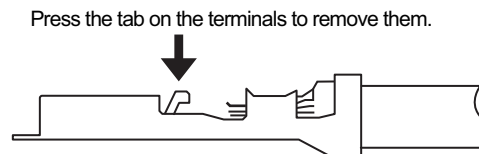


-5- Inverter

- Replace only the compressor if only the compressor is found to be defective. (Overcurrent will flow through the inverter if the compressor is damaged, however, the power supply is automatically cut when overcurrent is detected, protecting the inverter from damage. Make sure that the model selection switches on the outdoor unit (Dip switches SW4-1 through 4-6 on the outdoor unit control board) are set correctly.)
- Replace only the fan motor if only the fan motor is found to be defective. (Overcurrent will flow through the inverter if the fan motor is damaged, however, the power supply is automatically cut when overcurrent is detected, protecting the inverter from damage.)
- 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) Inside the inverter is a large capacity electrolytic capacitor, and the residual voltage that remains after the main power is turned off presents a risk of electric shock. Before inspecting the inside of the control box, turn off the power, leave the unit turned off for at least 10 minutes, and check that the voltage across CN-P and CN-N on the INV board has dropped to 20 VDC or less. (It takes approximately 10 minutes to discharge electricity after the power is turned off.)
- 2) Perform the service after disconnecting the connectors on the Fan board (CNIV1, CNIV2 (CAHV-R136TAU)/CNINV1, CNINV2 (CAHV-R136YAU)). Before plugging in or unplugging connectors, check that the outdoor unit fan is not rotating and that the voltage across CN-P and CN-N on the INV board is 20 VDC or less. The capacitor may collect a charge and cause an electric shock when the outdoor unit fan rotates in windy conditions. Refer to the wiring nameplate for details.
- 3) Reconnect the connectors on the Fan board (CNIV1, CNIV2 (CAHV-R136TAU)/CNINV1, CNINV2 (CAHV-R136YAU)) after completion of maintenance work.
- 4) The IPM on the inverter becomes damaged if there are loose screws on 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.
- 5) To avoid damage to the circuit board, do not connect or disconnect the inverter-related connectors with the main power turned on.
- 6) Faston terminals have a locking function. Make sure the terminals are securely locked in place after insertion.



- 7) 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.
- 8) Faulty wiring to the compressor damages the compressor. Connect the wiring in the correct phase sequence.
- 9) When the power is turned on, the compressor is energized even while they are not operating. Before turning on the power, disconnect all power supply wires from the compressor terminal block, and measure the insulation resistance of the compressor. Check the compressor for a ground fault. If the insulation resistance is 1.0 Mohm or below, connect all power supply wires to the compressor, and turn on the power to the outdoor unit. (The liquid refrigerant in the compressor will evaporate by energizing the compressor.)

	Error display/failure condition	Measure/inspection item
[1]	Inverter related errors 0403, 4220, 4225, 4226, 4230, 4235, 4240, 4245, 4236, 4246, 4250, 4255, 4256, 5110, 5301, 5305, 5306	Check the details of the inverter error in the error log at [1] Error history item list. (page 136) Take appropriate measures to the error code and the error details in accordance with [2] 2.Error code list. (page 145)
[2]	Main power breaker trip	Refer to "(3) Trouble treatment when the main power breaker is tripped". (page 161)
[3]	Main power earth leakage breaker trip	Refer to "(4) Trouble treatment when the main power earth leakage breaker is tripped". (page 161)
[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 159)
[5]	The compressor vibrates violently at all times or makes an abnormal sound.	See (2)-[4]. (page 159)
[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 159)
[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 159)
[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 159)
[9]	Sudden malfunction (as a result of external noise.)	*Contact the factory for cases other than those listed above.
		<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 M ohm.	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 0.212 ohm (20°C [60°F])	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.	*Select item code [1092], set the LED display to [0000] and press SWP3, and set SW5-10, SW6-10 on the main board back to as it was. Go to section [1].
	(2) Apply the power.	2) Inverter voltage is not output at the terminals (SC-U, SC-V, and SC-W)	Replace the INV board.
	(3) Turn on SW5-10 and SW6-9, select the item code [1092], set the LED display to [0001], and press SWP3.	3) There is an voltage imbalance between the wires. Greater than 5% imbalance or 5 V	Replace the INV board.
	(4) Put the outdoor unit into operation. Check the inverter output voltage after the inverter output frequency has stabilized.	4) There is no voltage imbalance between the wires.	Normal *Select item code [1092], set the LED display to [0000] and press SWP3, and set SW5-10, SW6-10 on the main board back to as it was.

	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, 128	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. 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 5 V	Replace the INV board if there is a 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 1 Mohm 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 (CNI(N)V1 and CNI(N)V2) •Fan motor side	Connect the connector.
	(2) Check the connector CNVP1 and CNVN1 (CAHV-R136TAU) CNDCP and CNDCN (CAHV-R136YAU) connection.	Connector contact failure	Connect the connector.

	Items to be checked	Phenomena	Remedy
[7] Check whether the Fan Board Detection Circuit at No Load.	(1) Stop the unit. Turn off the breaker. *Be sure to turn off the power.	1) Overcurrent error occurs. (4255, 4256 Detail code 101, 104)	Replace the FAN board.
	(2) To allow for the disconnection of output wiring from the fan motor, disconnect connector CNI(N)V. (CNI(N)V1 corresponds to the left fan and CNI(N)V2 corresponds to the right fan (when seen from the front).)	2) Logic error occurs. (4255, 4256 Detail code 111)	Replace the FAN board.
	(3) Turn on breaker. (4) Operate unit.	3) Position detection at startup error occurs. (5305, 5306 Detail code 132)	Normal *When done checking, reconnect all connectors as they were.
[8] Check whether the converter is damaged. (During Compressor Operation)	Put the outdoor unit into operation. Check the BUS voltage after the converter circuit went into operation and the BUS voltage has boost. *The voltage generally boost at or above 80 rps, depending on the power source voltage.	BUS voltage does not boost (does not change) BUS voltage does not boost to approximately between 650 and 750 VDC, or the following errors are detected. Error code: 4220 Detail code: 123	Replace the INV board.
		An overcurrent error occurs after converter circuit goes into operation. Error code: 4250 Detail code: 121, 122	a. If the problem persists after startup, replace the INV board. b. If the problem persists after replacing the INV board, replace the DCL.
		An overvoltage error occurs after converter circuit goes into operation. Error code: 4220 Detail code: 109, 110, 112	a. If the problem persists after startup, replace the INV board. b. If the problem persists after replacing the INV board, replace the DCL.
[9] Check to see if a 4225/4226 (109) error occurs.	(1) Execute factory reset or initializing the system. (2) Check to see if the error listed at right occurs.	Voltage overload error Check code: 4225, 4226 Detail code: 109	This event can occur only once after factory reset or initializing the system is executed. When this happens, power-reset the unit. *If power-resetting the unit solves the problem, it is not necessary to replace the circuit board. If the problem persists after power-resetting the unit, see section [10].
[10] Check whether the fan board is damaged with load.	(1) Check the power supply voltage on the power supply terminal block (TB1) to check different voltage connection. (2) Turn off breaker. (3) Turn on breaker. (4) Operate unit.	Voltage overload error Check code: 4225, 4226 Detail code: 109	a. Check the gusts or windy conditions. b. Replace the fan board if it is not windy.

(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 the terminals on the power terminal block.	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 162) •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. 2) Main power breaker trip	a) The wiring may have been short-circuited. Search for the wire that short-circuited, and repair it. b) If item a) above is not the cause of the problem, refer to (2)-[1]-[6]. (page 158)

(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 162) •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

Turn off the power to the unit, and leave it turned off for at least 10 minutes. Check that the voltage across CN-P(+) and CN-N(-) on the INV board is 20 VDC or less before removing components from the control box.

Part name	Judgment method									
IGBT module	See "Troubleshooting for IGBT Module" (X [3] -5- (6)) (page 162)									
Rush current protection resistor R1, R2	Measure the resistance between terminals R1 and R2: 22 ohm ± 10%									
Electromagnetic relay 72C	<p>This electromagnetic relay is rated at DC12V and is driven by a coil. Check the resistance between terminals</p> <div><div><div><div>○ 4</div><div>○ 3</div><div>1 ○</div><div>○ 2</div></div></div><table><tr><td></td><td>Check point</td><td>Checking criteria</td></tr><tr><td>Coil</td><td>INV board X100, X101, X102, X103 (CAHV-R136TAU) X101, X102, X103 (CAHV-R136YAU) Across pins 1-2</td><td>102.9 ohm ± 10% (CAHV-R136TAU) 160 ohm ± 10% (CAHV-R136YAU)</td></tr><tr><td>Contact</td><td>INV board FT100 and FT101 *Faston terminal removed</td><td>INV board CNRY Open: ∞ INV board CNRY At a voltage input of 12 VDC: 0 ohm</td></tr></table></div>		Check point	Checking criteria	Coil	INV board X100, X101, X102, X103 (CAHV-R136TAU) X101, X102, X103 (CAHV-R136YAU) Across pins 1-2	102.9 ohm ± 10% (CAHV-R136TAU) 160 ohm ± 10% (CAHV-R136YAU)	Contact	INV board FT100 and FT101 *Faston terminal removed	INV board CNRY Open: ∞ INV board CNRY At a voltage input of 12 VDC: 0 ohm
	Check point	Checking criteria								
Coil	INV board X100, X101, X102, X103 (CAHV-R136TAU) X101, X102, X103 (CAHV-R136YAU) Across pins 1-2	102.9 ohm ± 10% (CAHV-R136TAU) 160 ohm ± 10% (CAHV-R136YAU)								
Contact	INV board FT100 and FT101 *Faston terminal removed	INV board CNRY Open: ∞ INV board CNRY At a voltage input of 12 VDC: 0 ohm								
DC reactor DCL	Measure the resistance between terminals: 1 ohm or lower (almost 0 ohm) Measure the resistance between terminals and the chassis: ∞									
Current sensor ACCT	<p>Disconnect the wiring connector from CNCT2, and measure the inter-terminal resistance: 280 ohm ± 30 ohm Between pins 1 and 2 (U-phase), pins 3 and 4 (W-phase)</p> <div><p>INV board</p><div><div>SC-U</div><div>SC-V</div><div>SC-W</div></div><div><div>ACCT-U</div><div>↓ U</div><div>ACCT-W</div><div>↓ W</div></div></div> <p>*Check ACCT wiring for correct phase and direction.</p>									

(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 1.5 V 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.

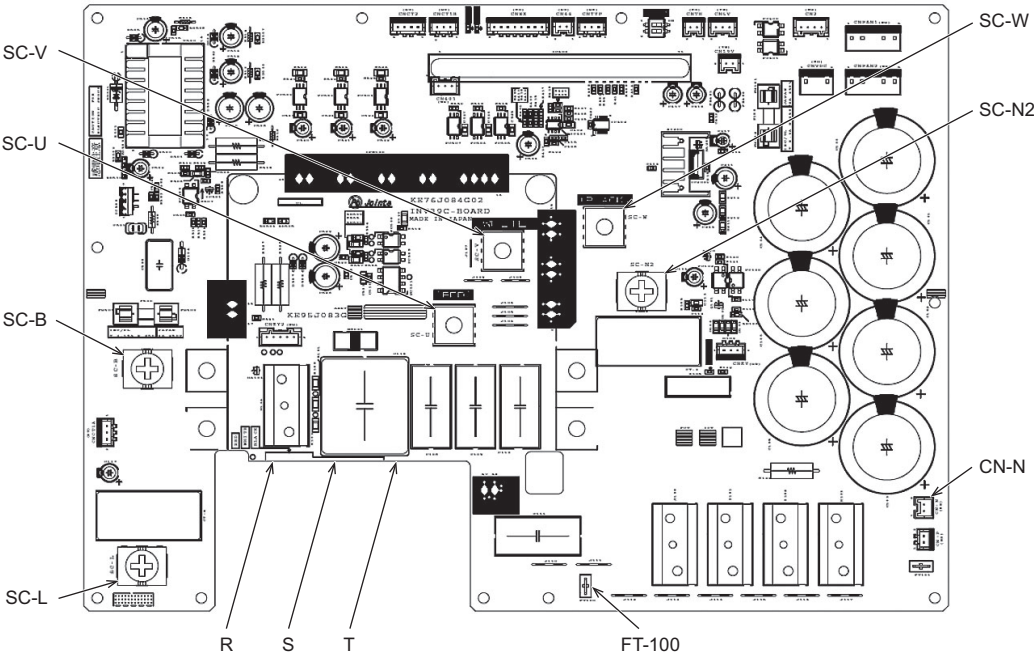
CAHV-R136TAU (-BS)

Reference resistance value

		Black (+)						
		R	S	T	SC-B	SC-L	FT100	CN-N
Red (-)	R	-	-	-	-	∞	-	5-200 ohm
	S	-	-	-	-	∞	-	5-200 ohm
	T	-	-	-	-	∞	-	5-200 ohm
	SC-B	-	-	-	-	-	∞	-
	SC-L	5-200 ohm	5-200 ohm	5-200 ohm	-	-	-	-
	FT100	-	-	-	5-200 ohm	-	-	-
	CN-N	∞	∞	∞	-	-	-	-

		Black (+)				
		FT100	CN-N2	SC-U	SC-V	SC-W
Red (-)	FT100	-	-	5-200 ohm	5-200 ohm	5-200 ohm
	CN-N2	-	-	∞	∞	∞
	SC-U	∞	5-200 ohm	-	-	-
	SC-V	∞	5-200 ohm	-	-	-
	SC-W	∞	5-200 ohm	-	-	-

INV board outline drawing



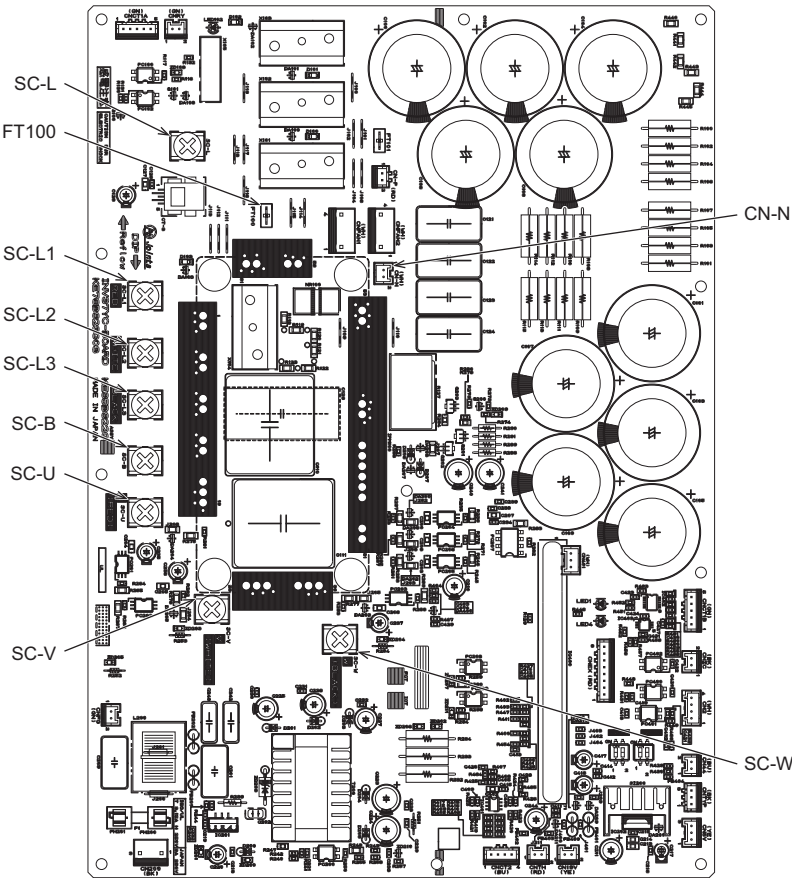
CAHV-R136YAU (-BS)

Reference resistance value

		Black (+)						
		SC-L1	SC-L2	SC-L3	SC-B	SC-L	FT100	CN-N
Red (-)	SC-L1	-	-	-	-	∞	-	5-200 ohm
	SC-L2	-	-	-	-	∞	-	5-200 ohm
	SC-L3	-	-	-	-	∞	-	5-200 ohm
	SC-B	-	-	-	-	-	∞	-
	SC-L	5-200 ohm	5-200 ohm	5-200 ohm	-	-	-	-
	FT100	-	-	-	5-200 ohm	-	-	-
	CN-N	∞	∞	∞	-	-	-	-

		Black (+)				
		FT100	CN-N	SC-U	SC-V	SC-W
Red (-)	FT100	-	-	5-200 ohm	5-200 ohm	5-200 ohm
	CN-N	-	-	∞	∞	∞
	SC-U	∞	5-200 ohm	-	-	-
	SC-V	∞	5-200 ohm	-	-	-
	SC-W	∞	5-200 ohm	-	-	-

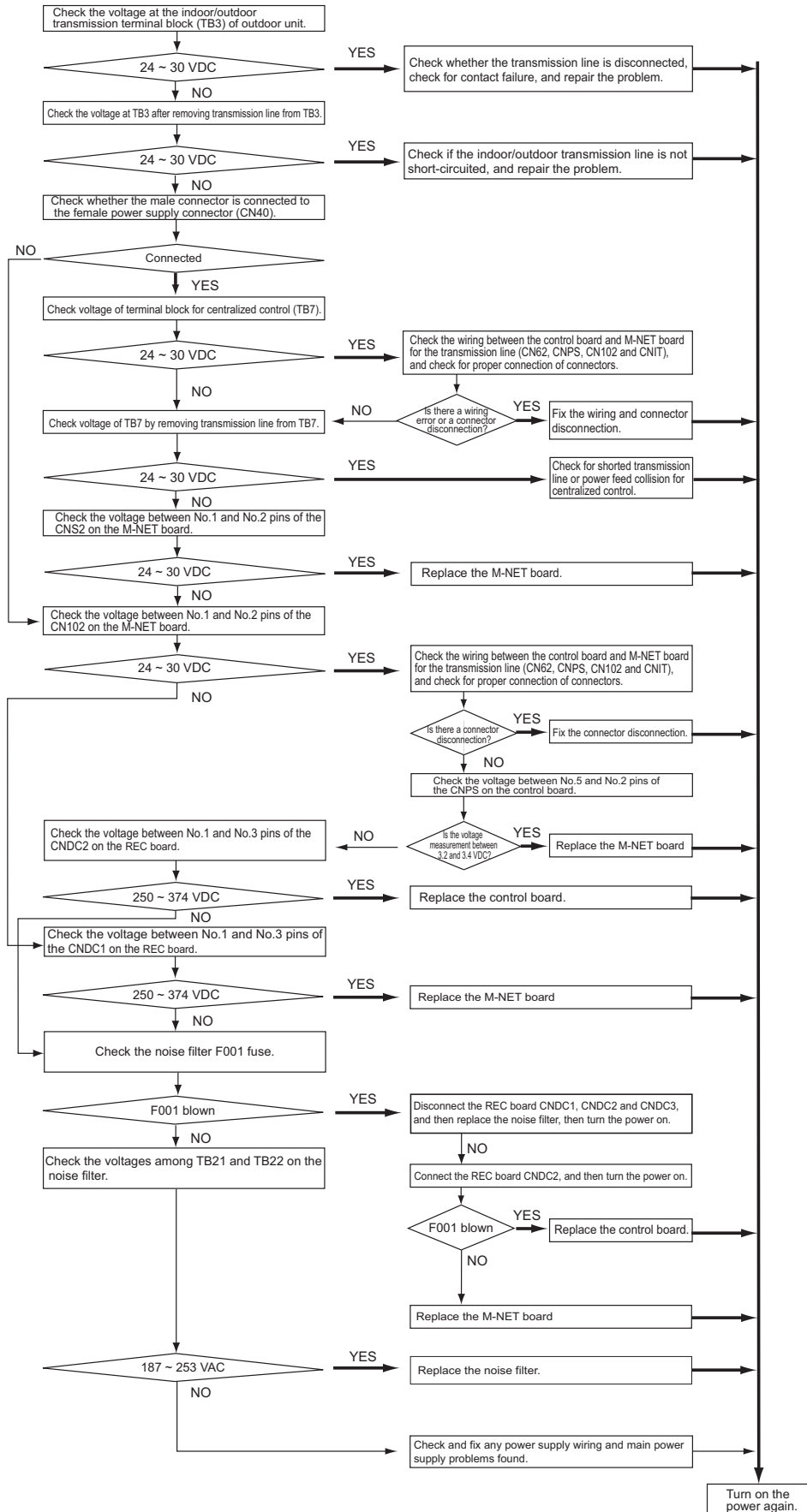
INV board outline drawing



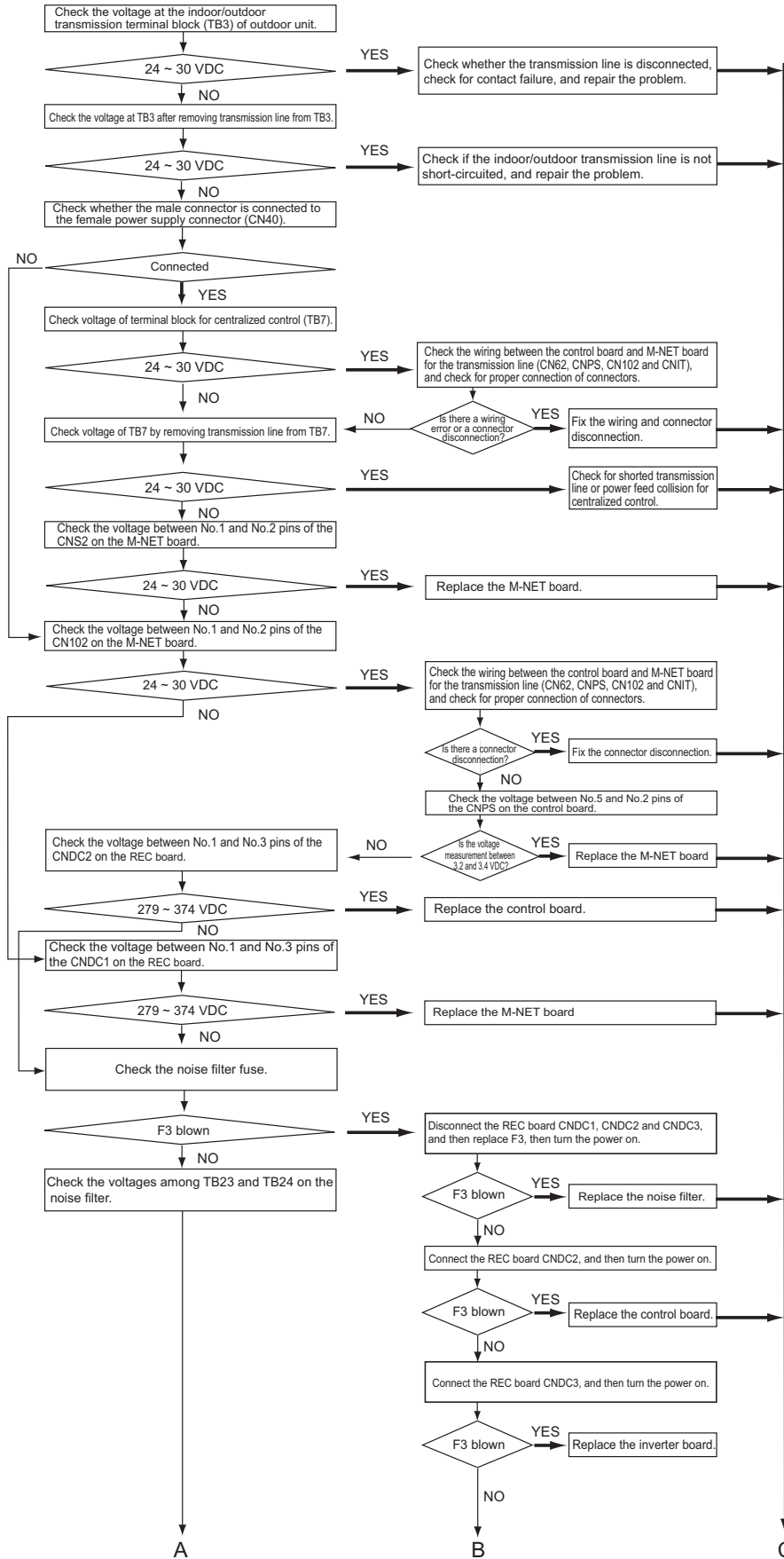
-6- Control Circuit

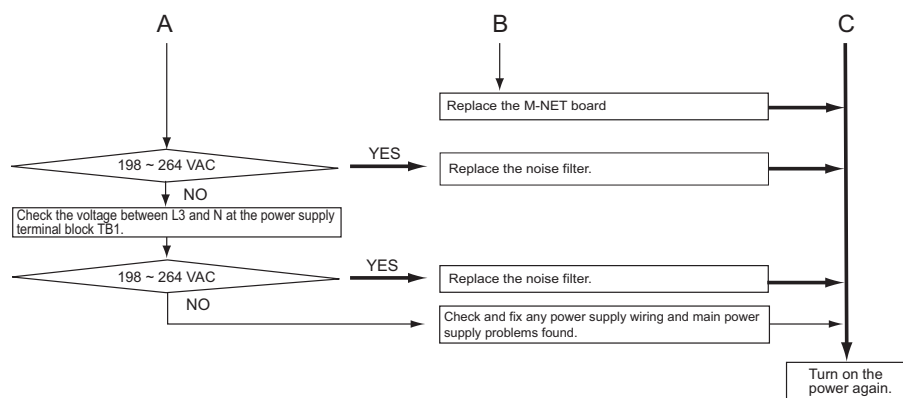
Troubleshooting transmission power circuit of outdoor unit

CAHV-R136TAU (-BS)



CAHV-R136YAU (-BS)





-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 780 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 137). 78% 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 159) and section [6] "Check the fan inverter board failure." (page 159)

-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.
- (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

- 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 9.0 kg (19.8 lbs) of R454C.

*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.

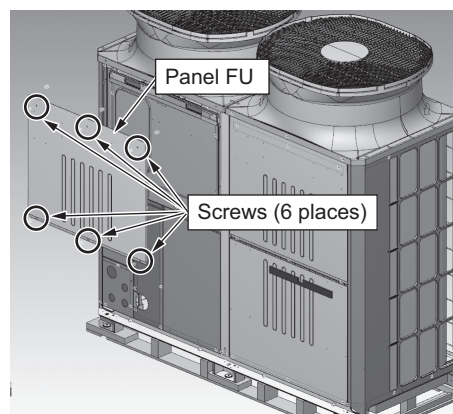
1. Compressor replacement instructions

Procedure

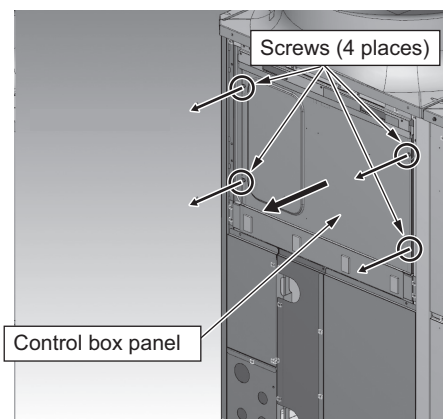
- (1) Unscrew the six screws, and remove service panel FU on the left.

* Compressor must be replaced after removal of the trans box. (Refer to **5. Trans Box replacement instructions**)

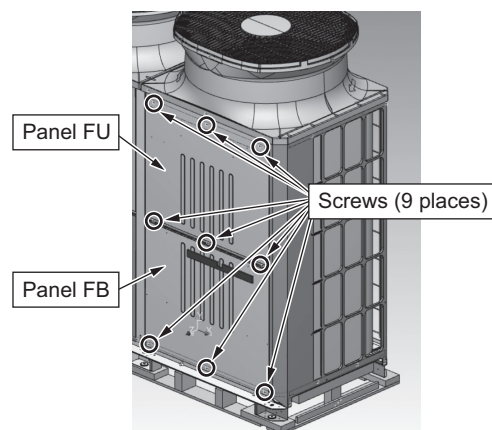
Illustration



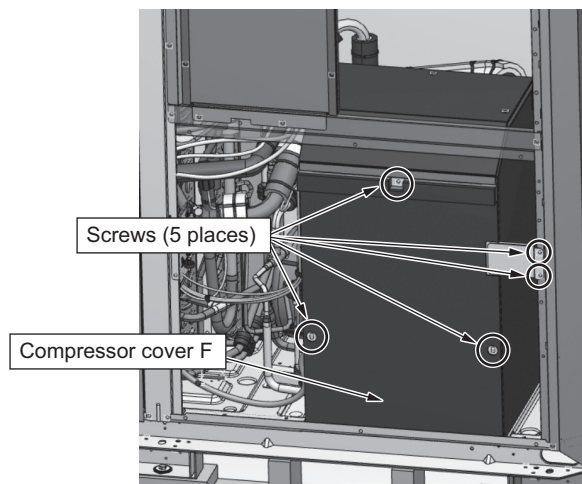
- (2) Unscrew the four screws, and remove the control box panel. Turn OFF the switch SWS1 on the control board, and turn OFF the main power supply (breaker).



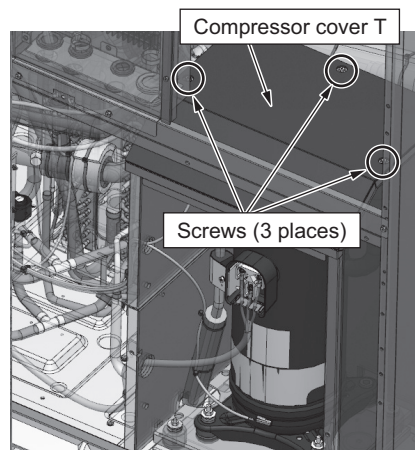
- (3) Unscrew the nine screws, and remove the service panels FB and FU.



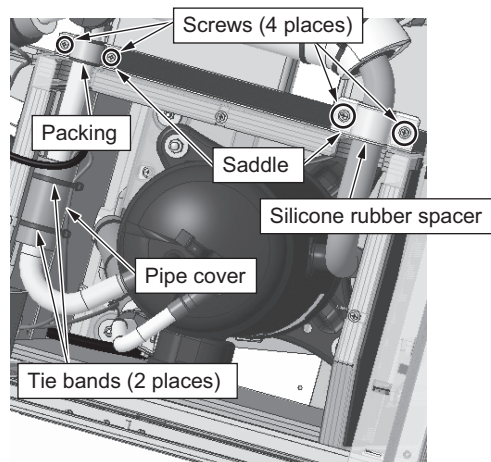
- (4) Unscrew the five screws, and remove the compressor cover F.



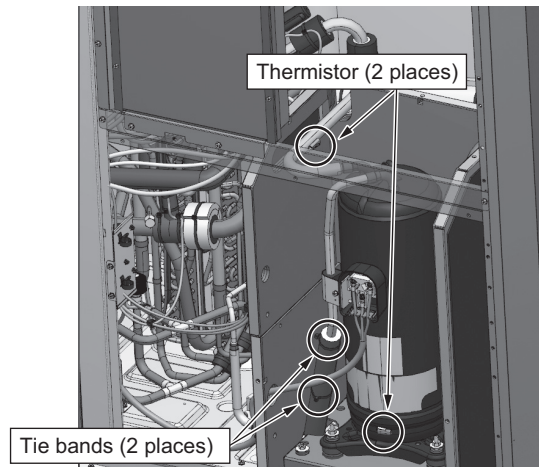
- (5) Unscrew the three screws, and remove the compressor cover T.



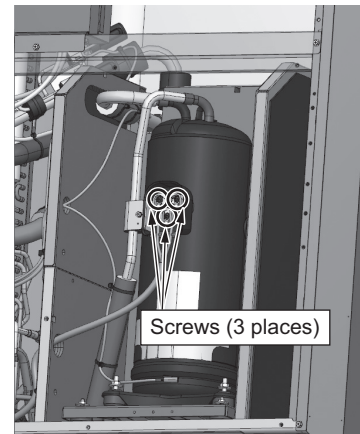
- (6) Remove the four screws, two saddles, silicon rubber spacer, packing, two tie bands, and discharge pipe cover.



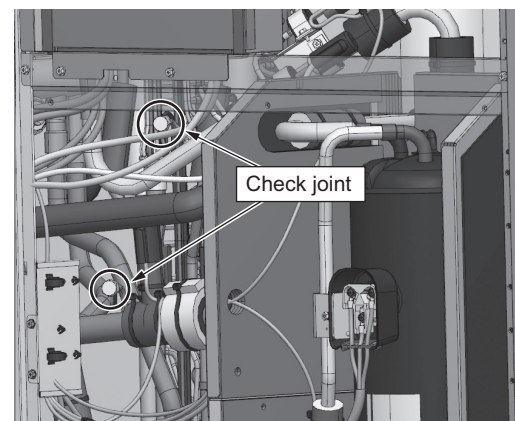
- (7) Remove the two tie bands holding the pipe cover, and take the thermistor out of the thermistor holder.



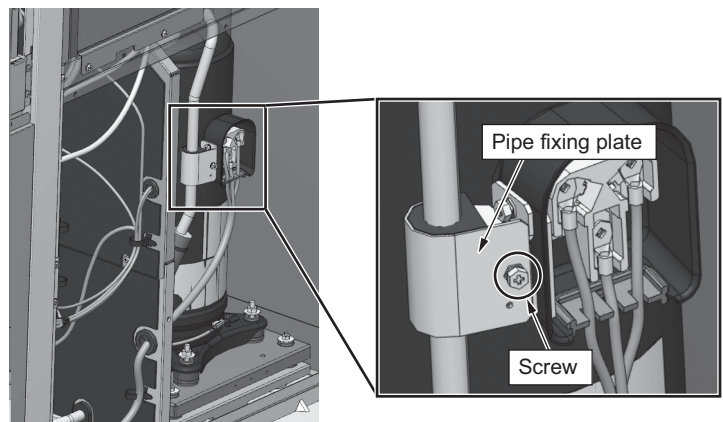
- (8) Disconnect the three wires from the terminal screws of the compressor.



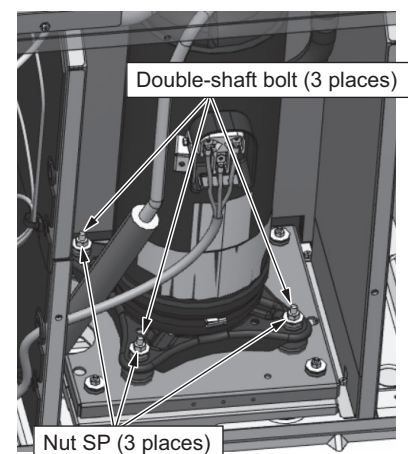
- (9) Recover the refrigerant through the high-pressure and low-pressure check joints.



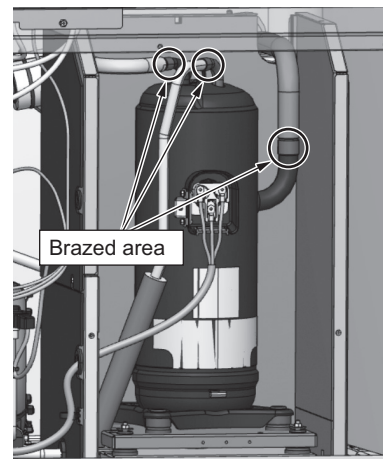
- (10) Unscrew the screw, and remove the pipe fixing plate of the coil.



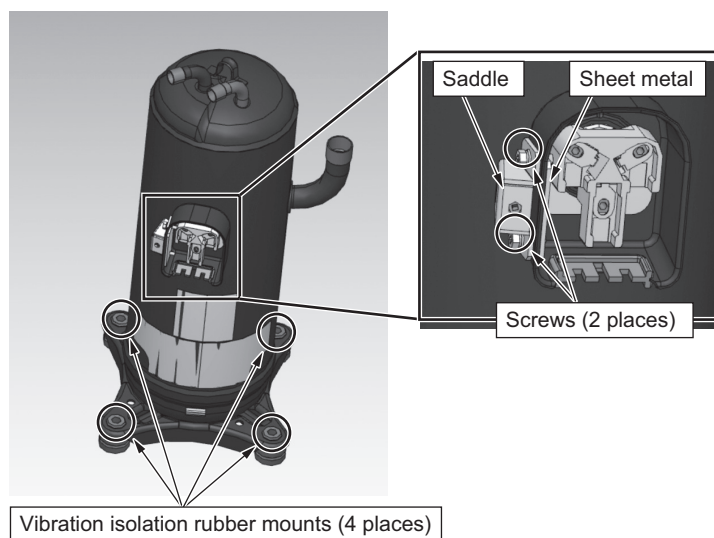
- (11) Remove the nuts SP and the three double-shaft bolts.
(Removing the bolts allows the compressor to be pulled out without being lifted.)



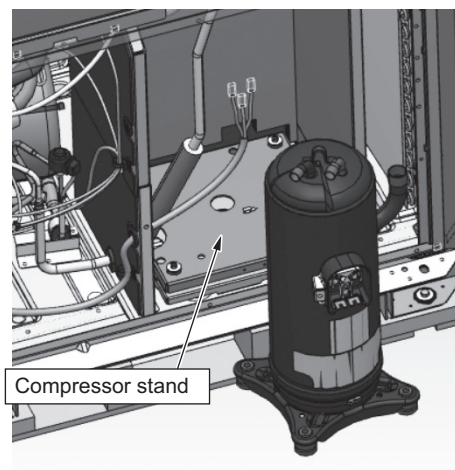
- (12) Disconnect the discharge pipe, suction pipe, and injection pipe from the compressor by removing the braze.
- (13) Pull out the compressor, and replace it.
(Be careful not to get the injection pipe caught with the suction pipe of the compressor.)



- (14) After removing the compressor, remove the four vibration isolation rubber mounts, two screws, saddle, and sheet metal, and install a new compressor.



- (15) Place the compressor on the compressor stand.



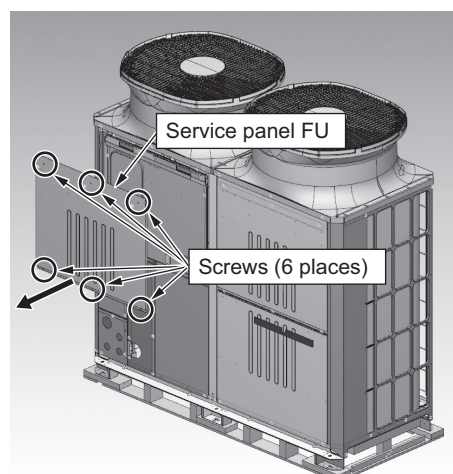
- (16) Fit the double-shaft bolt to a torque of $17.5 \pm 20\%$ N · m [$154.9 \pm 20\%$ lbf · in] and the nut SP to a torque of 9.8 N · m [86.7 lbf · in].
- (17) Connect the discharge pipe, suction pipe, and injection pipe by brazing.
- (18) Vacuum the system through the low-pressure check joint with a vacuum pump.
- (19) Charge the refrigerant through the high-pressure check joint.
(To prevent back pressure from being applied to the compressor, be sure to charge the refrigerant through the high-pressure check joint.)
- (20) Reinstall the removed wires, compressor cover, and panels to complete the procedure.

2. Thermistor replacement instructions

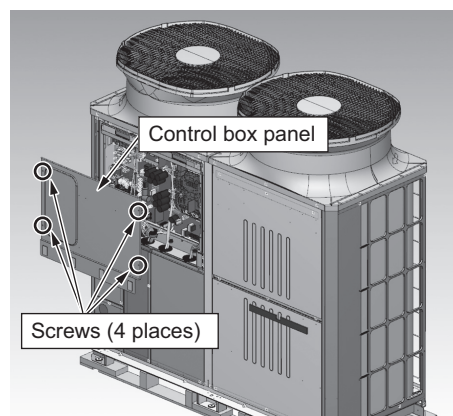
Procedure

- (1) Unscrew the six screws, and remove the service panel FU on the top left.

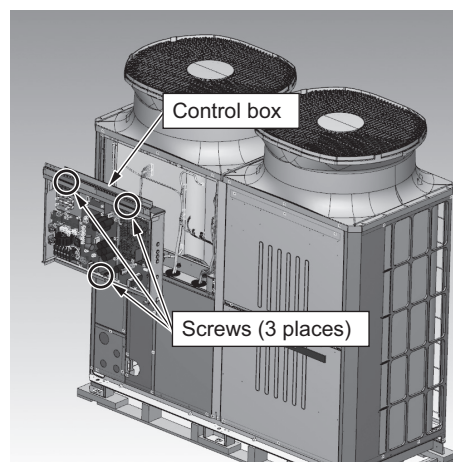
Illustration



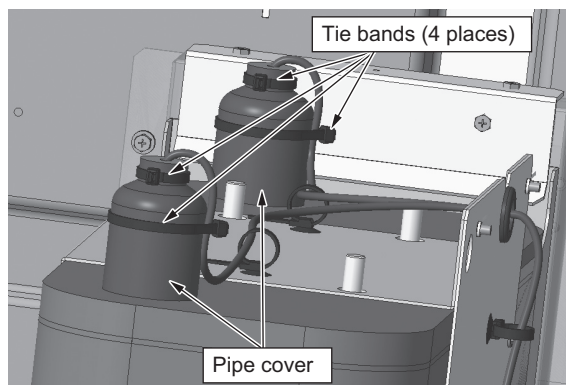
- (2) Unscrew the four screws, and remove the control box panel.



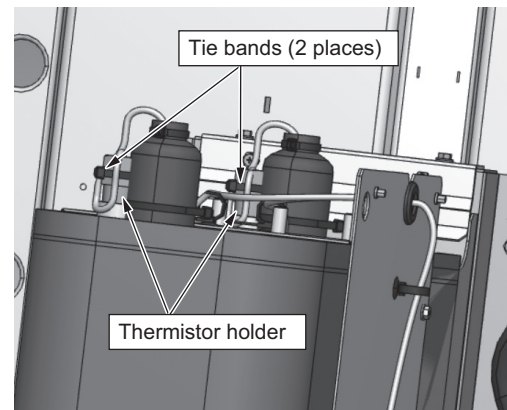
- (3) Disconnect the wire from the control box, unscrew the three screws, take the control box out of the box, and set it down. (Control box: Approximately 25 kg [55.1 lbs])



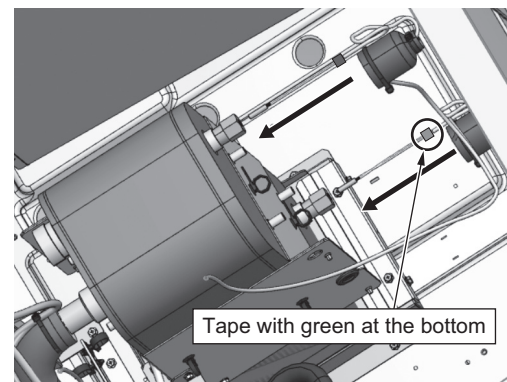
- (4) Slide off the four tie bands and the pipe cover from the back of the water heat-exchanger.



- (5) Cut the two tie bands, and take the thermistor out of the thermistor holder.

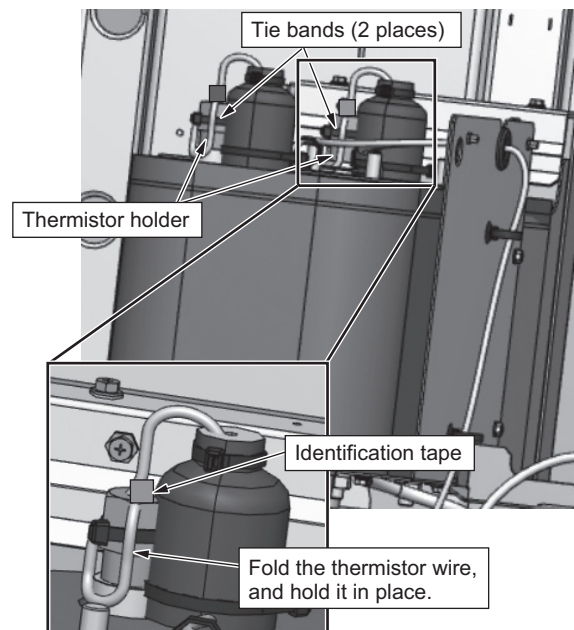


- (6) Insert the thermistor into the thermistor holder.
(Tape with green at the bottom (TH10))



- (7) Hold the thermistor holder and the thermistor wire together with tie bands.
(Fold the thermistor wire to keep the sensor wire from coming out.
Insert the thermistor until the identification tape has reached the entrance to the thermistor holder.)

- (8) Reinstall the removed parts back in place to complete the procedure.

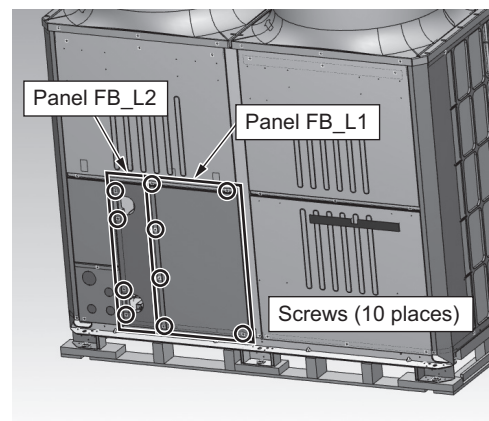


3. Plate heat exchanger replacement instructions

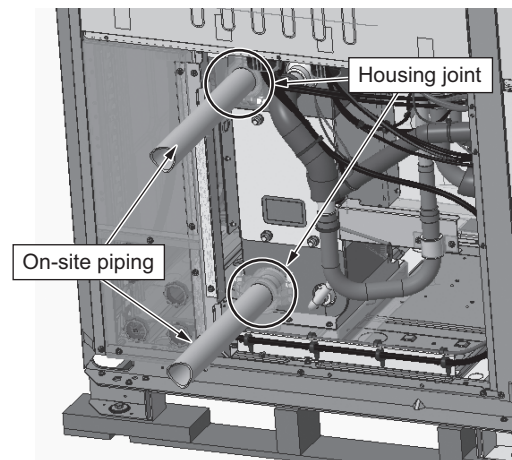
Procedure

- (1) Unscrew the 10 screws, and remove the service panels FB_L1 and FB_L2 on the left.

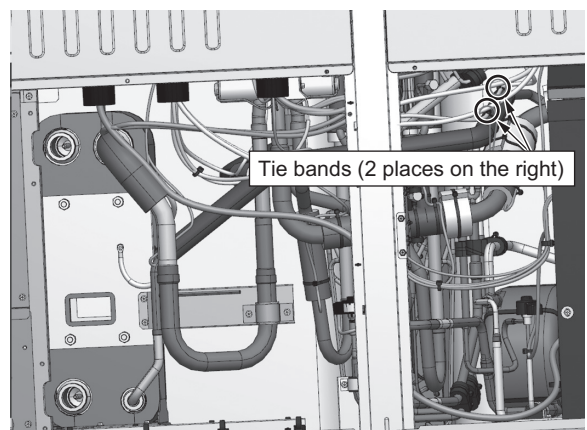
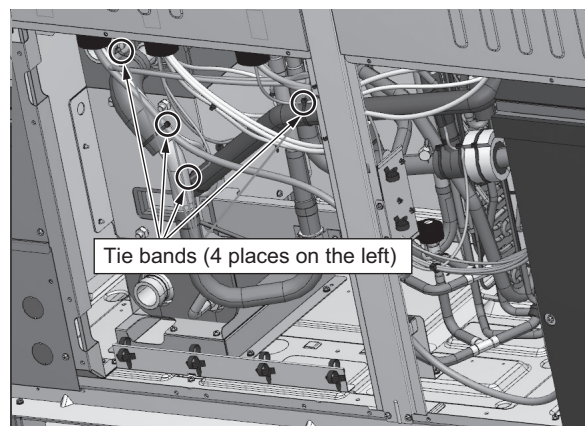
Illustration



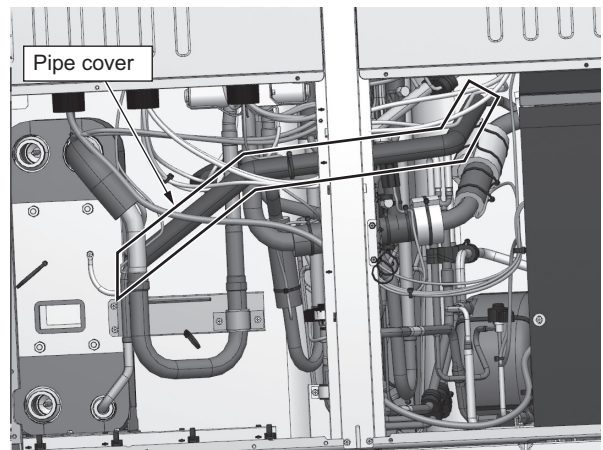
- (2) Remove the housing joint, and then the pipes on site.



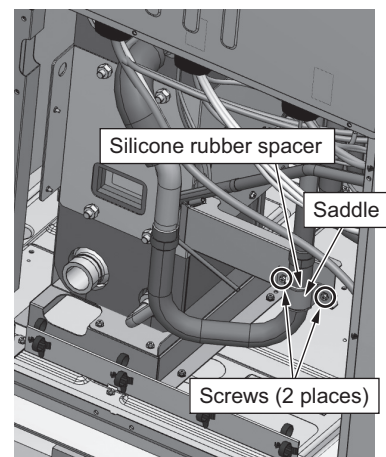
- (3) Remove the six tie bands from the pipe cover.



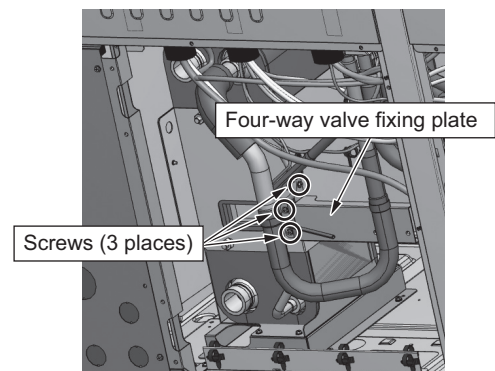
- (4) Remove a pipe cover.



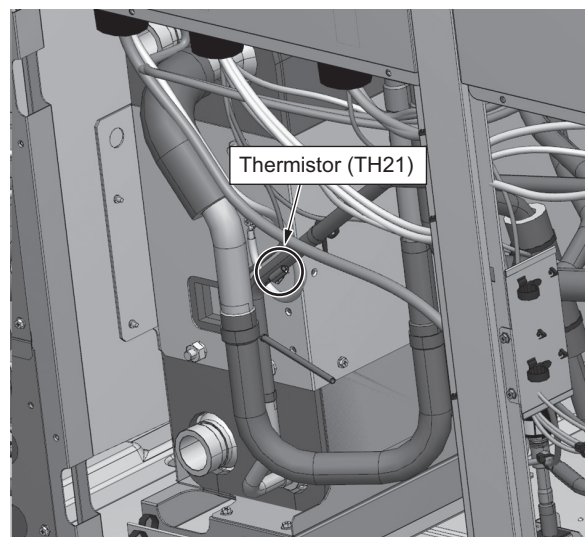
- (5) Unscrew the two screws, and remove the saddle and the silicon rubber spacer.



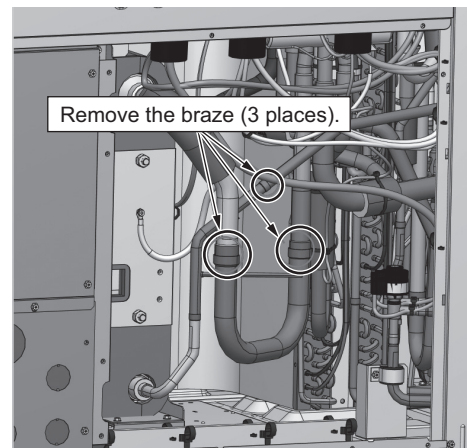
- (6) Unscrew the three screws, and remove the four-way valve fixing plate.



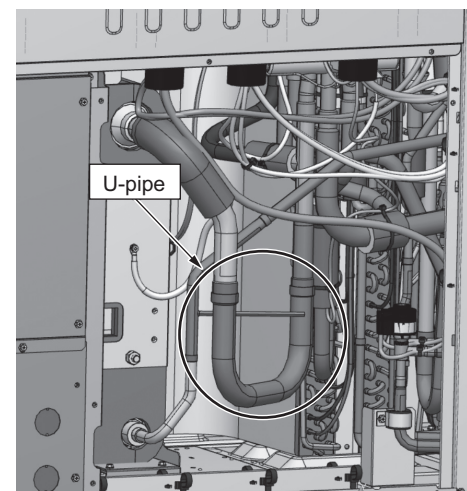
- (7) Disconnect the thermistor.



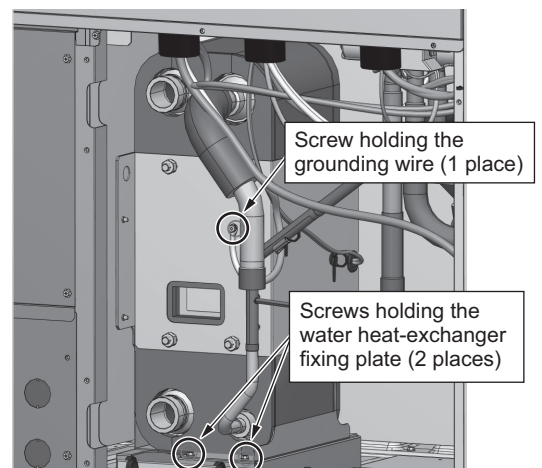
(8) Remove the braze from three areas.



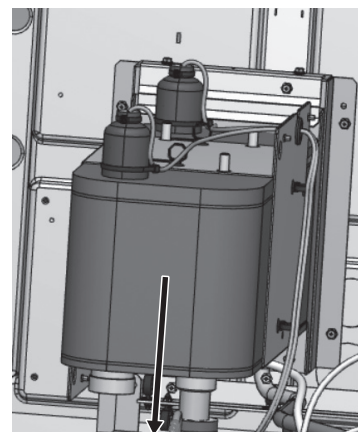
(9) Disconnect the U-pipe.



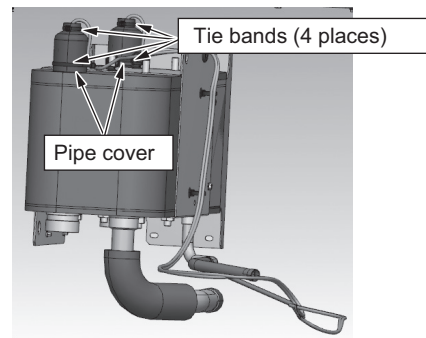
(10) Unscrew the screws holding the water heat-exchanger fixing plate. Unscrew the screw holding the ground wire on the water heat-exchanger side.



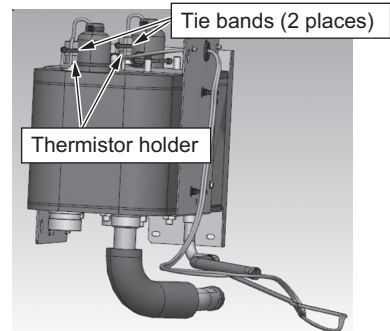
(11) Pull the water heat-exchanger forward.



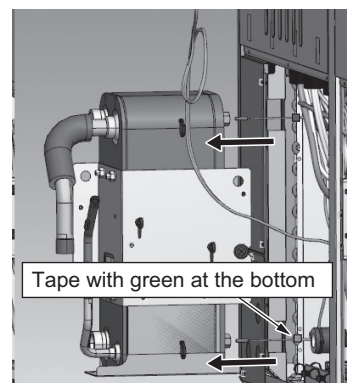
- (12) Slide off the four tie bands and the pipe cover from the back of the water heat-exchanger.



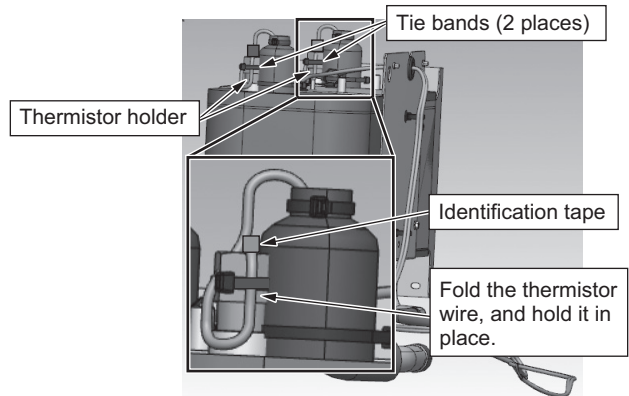
- (13) Cut the tie bands, and take the thermistor out of the thermistor holder.



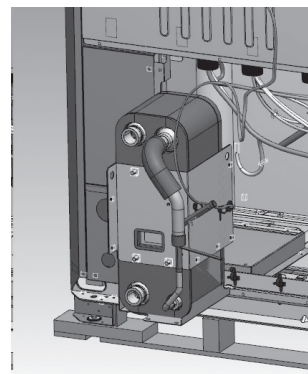
- (14) Insert the thermistor into the thermistor holder.
(Tape with green at the bottom (TH10))



- (15) Hold the thermistor holder and the thermistor wire together with tie bands.
(Fold the thermistor wire to keep the sensor wires from coming out.
Insert the thermistor until the identification tape has reached the entrance to the thermistor holder.)



- (16) Place the water heat-exchanger on the water heat-exchanger stand.
(17) Install the U-pipe that was removed in step (9).
(18) Attach the four-way valve fixing plate.
(19) Reinstall the removed parts back in place to complete the procedure.



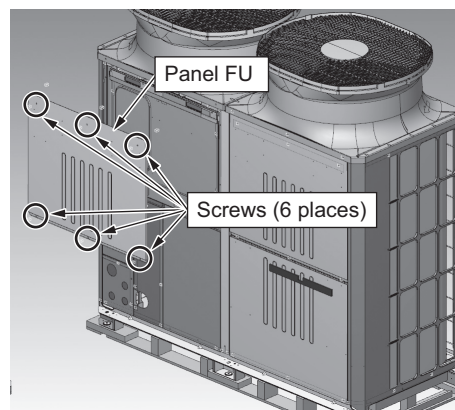
4. Reactor replacement instructions

Procedure

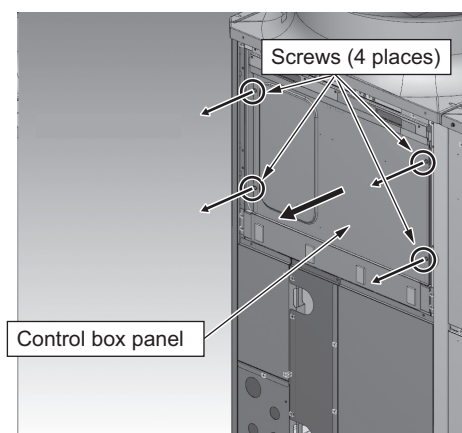
CAHV-R136TAU (-BS)

- (1) Unscrew the six screws, and remove the service panel FU on the left.

Illustration



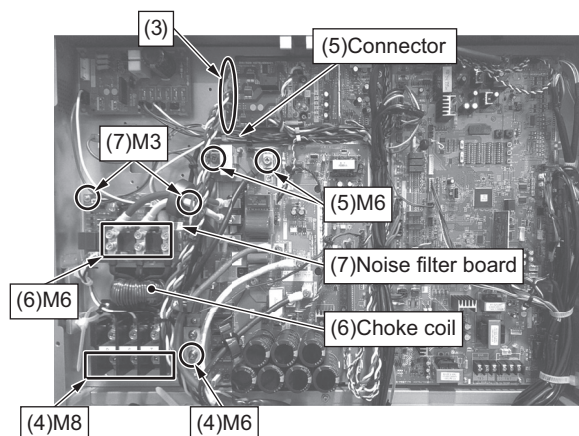
- (2) Unscrew the four screws, and remove the control box panel. Set SWS1 of the control board to OFF, and turn off the main power supply (breaker).



- (3) Start replacement works after disconnecting the connector of FAN inverter board (CNIV1 and CNIV2).

- (4) Remove the power cables and the earth cable from the terminal block.

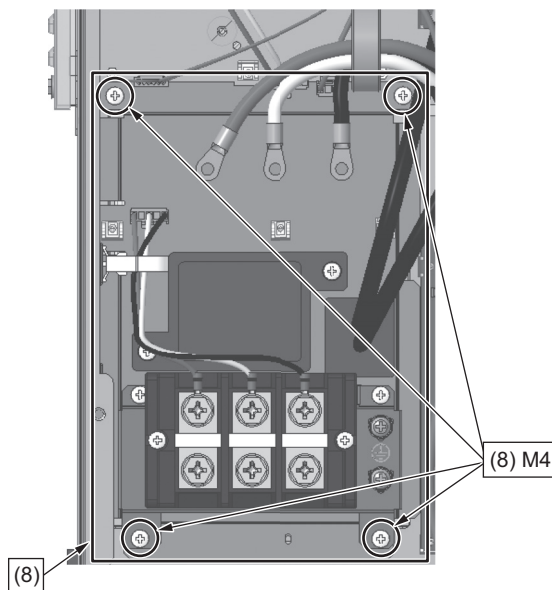
- (5) Remove the lead wires of the reactor from the inverter board and detach the thermistor connector of the reactor.
*The wires of thermistor are fixed to the other wires with cable ties.



- (6) Remove all wires and the choke coil connected to the noise filter board.

- (7) Remove the noise filter board by removing two screws fixing the board.

- (8) Remove the metal plate at the back of the noise filter board by removing four screws.



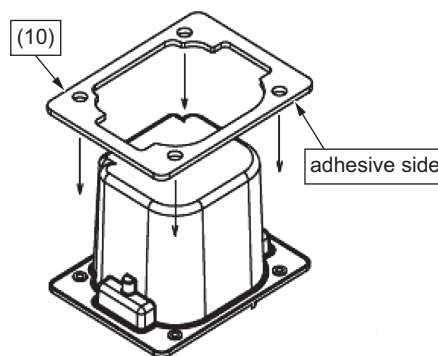
- (9) Remove the reactor by removing four screws fixing it.

*Dispose of the four removed screws.

- (10) Remove the release paper from the adhesive side of the sealing material, and then, attach the sealing material to the service reactor paying attention to the orientation. Set the service reactor to the mounting position and secure it with attached new screws.

Tighten the screws in the order ①→②→③→④ described in [Reactor mounting plate].

*The attached screws are coated with waterproof paint. Be sure to use them.



- (11) Reinstall the parts which are removed in the procedure from (4) to (8).

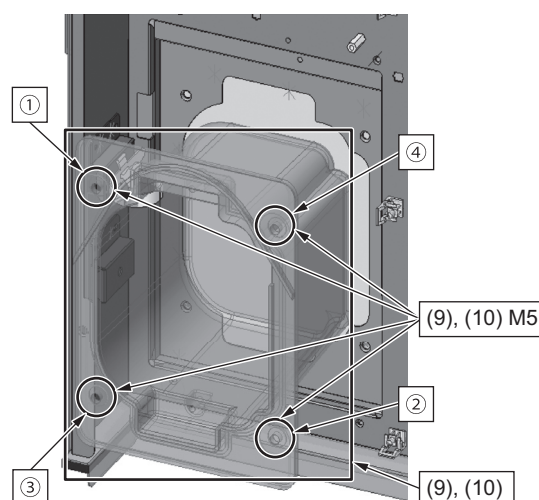
[Caution]

Securely tighten screws to specified torque.

(Poor contacts caused by loose screws may result in smoke, overheating, and fire.)

Screw	Specified tightening torque (N · m)
M3	0.69 N · m [0.51 lbf · ft]
M3.5	1.00 N · m [0.74 lbf · ft]
M4	1.47 N · m [1.08 lbf · ft]
M5	2.55 N · m [1.88 lbf · ft]
M6	2.75 N · m [2.03 lbf · ft]
M8	6.20 N · m [4.57 lbf · ft]

[Reactor mounting plate]

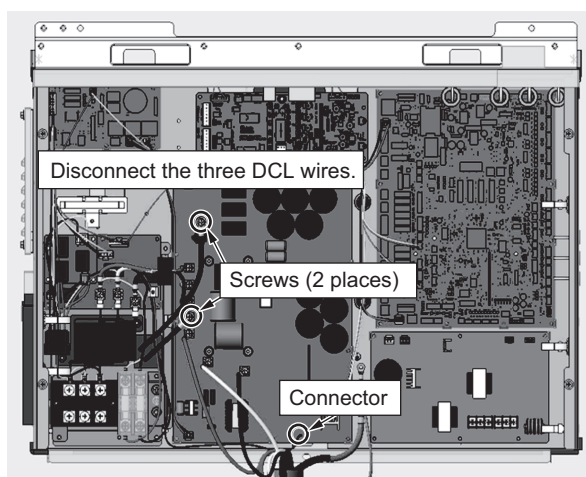
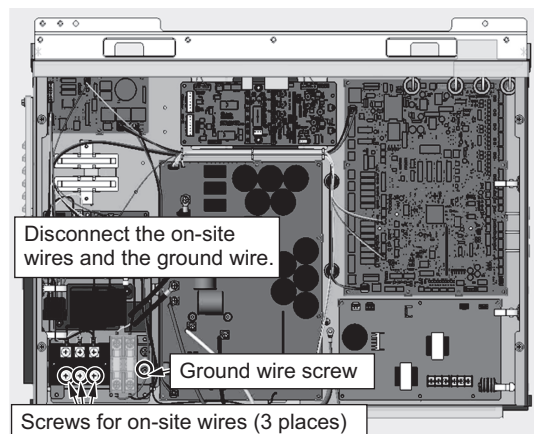
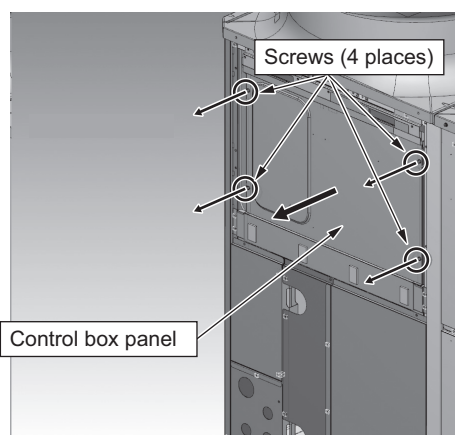
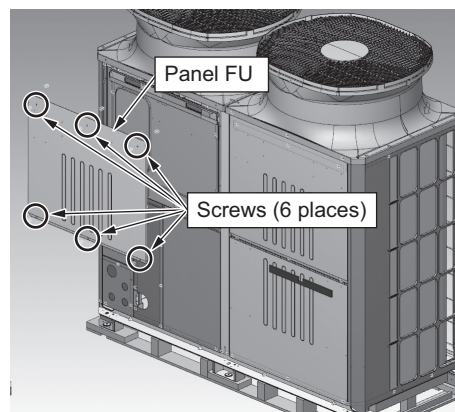


Procedure

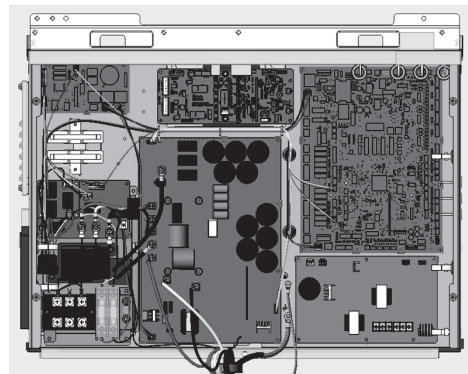
CAHV-R136YAU (-BS)

Illustration

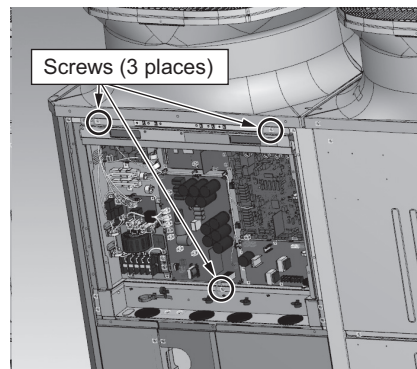
- (1) Unscrew the six screws, and remove the service panel FU on the left.
- (2) Unscrew the four screws, and remove the control box panel. Set SWS1 of the control board to OFF, and turn off the main power supply (breaker).
- (3) Disconnect the four on-site wires and the ground wire from the terminal screws.
- (4) Disconnect the three DCL wires by unscrewing two screws and disconnecting a connector.



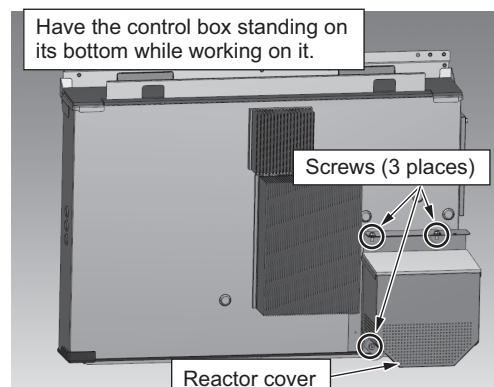
(5) Disconnect the wires from inside the control box.



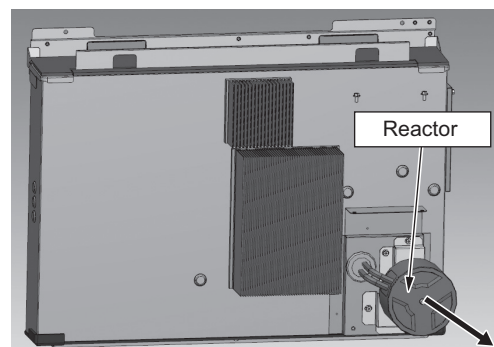
(6) Unscrew three screws from the control box, lower the control box, and let it stand on its bottom. (Control box: Approximately 25 kg)



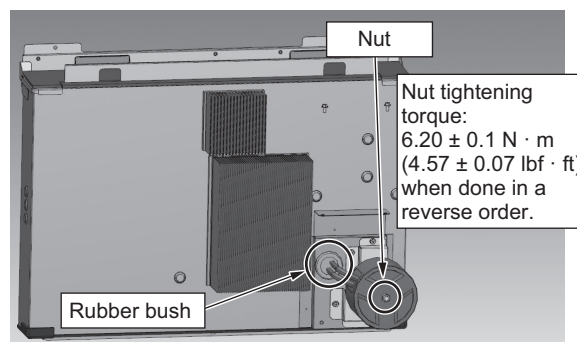
(7) Unscrew three screws, and remove the reactor cover.



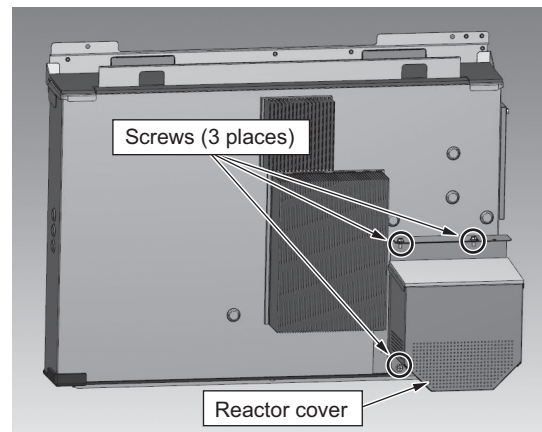
(8) Remove the nut, and disconnect the wires and the reactor from the rubber bush.



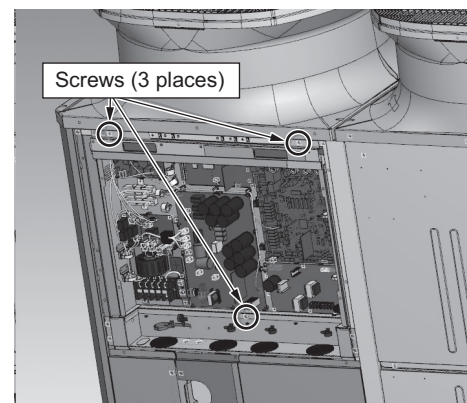
(9) After the new reactor is installed, tighten the nut to a torque of $6.20 \pm 0.1 \text{ N} \cdot \text{m}$ ($4.57 \pm 0.07 \text{ lbf} \cdot \text{ft}$), and thread the wire through the rubber bush from the back to the front.



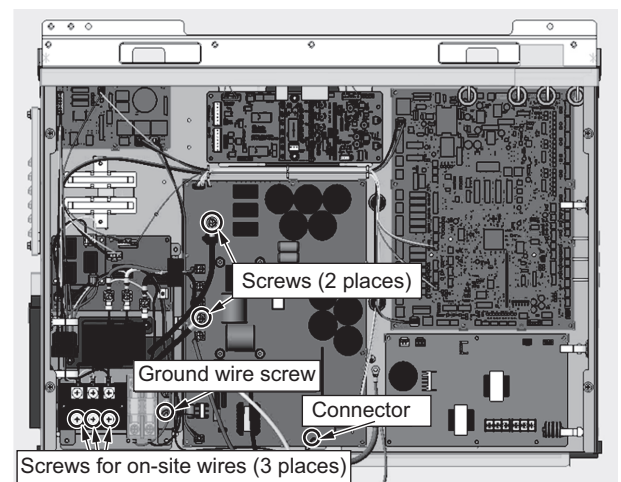
(10) Screw down the reactor cover with three screws.



(11) Screw down the control box with three screws to the unit.



(12) Reinstall the wires inside the control box, control box panel, and the service panel FU back in place to complete the procedure.

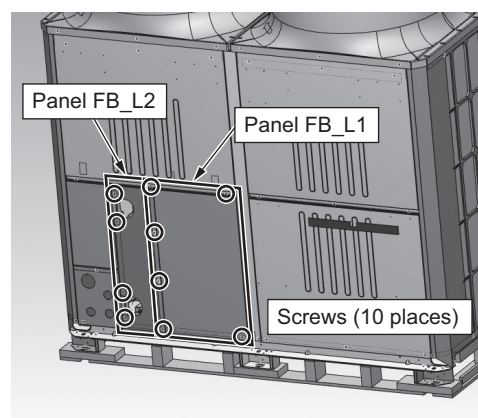
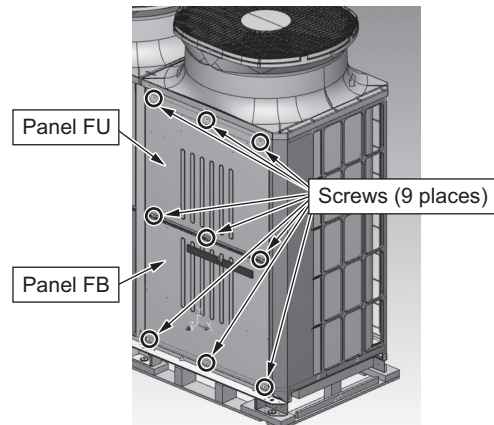
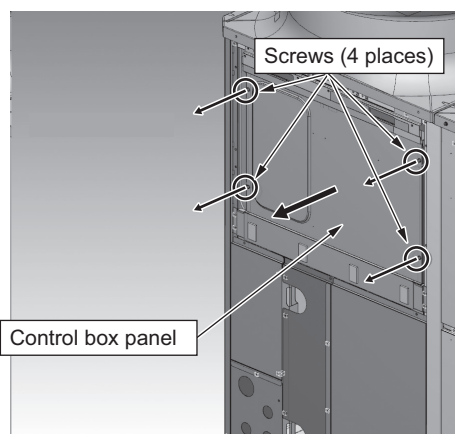
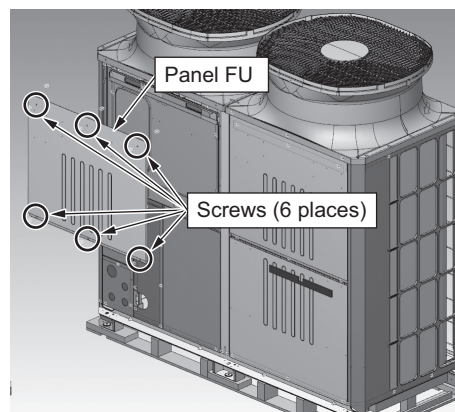


5. Trans Box replacement instructions

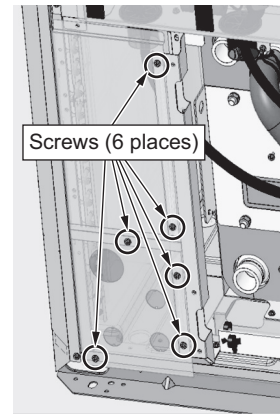
Procedure

- (1) Unscrew the six screws, and remove service panel FU on the left.
- (2) Unscrew the four screws, and remove the control box panel. Turn OFF the switch SWS1 on the control board, and turn OFF the main power supply (breaker).
- (3) Unscrew the nine screws, and remove the service panels FB and FU.
- (4) Unscrew the ten screws, and remove the service panels FB_L1 and FB_L2 on the left.

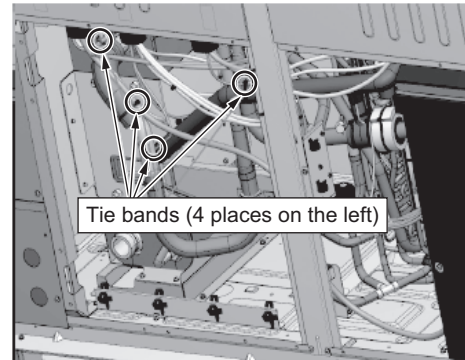
Illustration



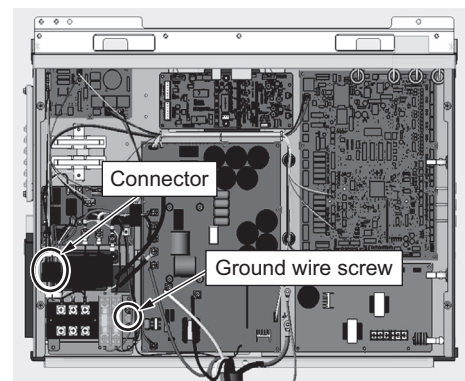
- (5) Unscrew the six screws, and remove the service panels.



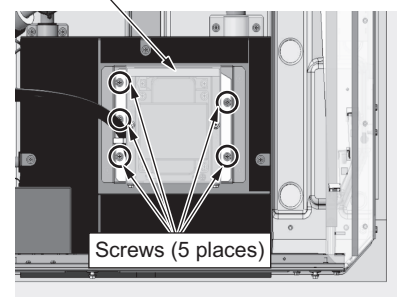
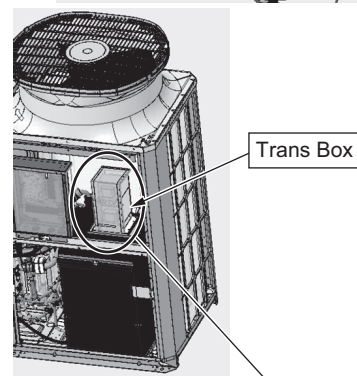
- (6) Remove the four tie bands from the pipe cover.



- (7) Disconnect the connector and the ground wire.



- (8) Unscrew the five screws, and remove the trans box.



- (9) Install the replacement box and make wiring connections.

XI USB Function

[1]	Service Overview	189
[2]	Software Rewrite Function on the USB	191
[3]	Maintenance LED Display and Troubleshooting.....	193

[1] Service Overview

<1> Function Overview

The control board has a USB port that allows the use of the following function.

1. Software rewrite function

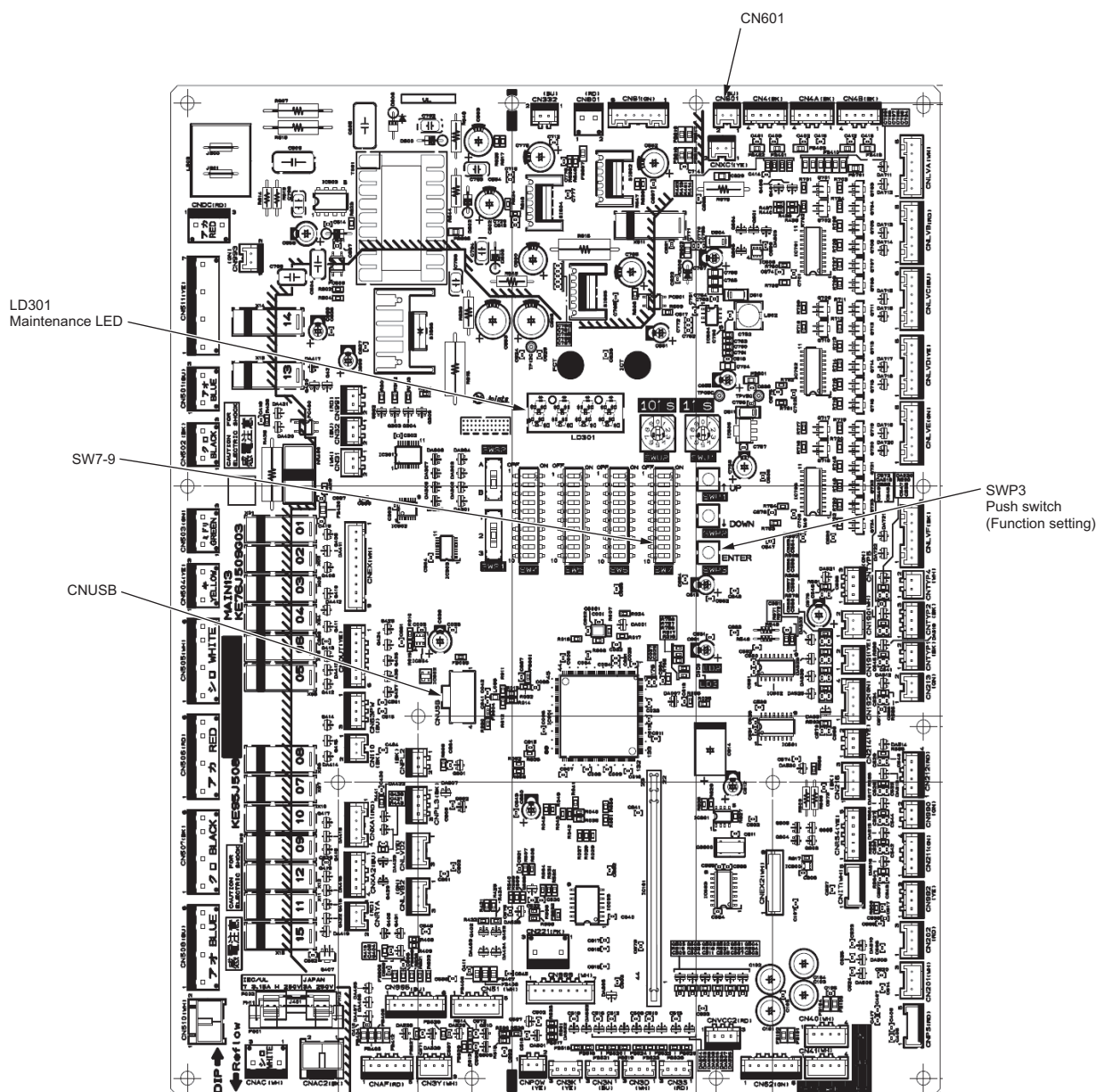
The software on outdoor units can be rewritten using a USB memory stick.

For detailed information about each function, refer to Section “XI [2] Software Rewrite Function on the USB”.

For information regarding the maintenance LED display content and regarding troubleshooting, refer to Section “XI [3] Maintenance LED Display and Troubleshooting”.

<2> System Structure

(1) Control board on the unit



<3> Necessary Materials

The use of the USB function requires a USB memory stick and a portable battery charger.
See below for the types of USB memory stick and portable charger that can be used.

(1) USB memory stick

Use a USB memory stick that meets the following specifications.

- USB 2.0 compatible
- Formatted in FAT 32
- Without a security function

(2) Portable battery charger

Use a portable battery charger that meets the following specifications for rewriting the software.

- USB 2.0 compatible
- Voltage and amperage rating of 5 V and 2.1 A (MAX)
- Supports the low current charging mode

A battery charger not compatible with the low current charging mode may turn off while the S/W is being re-write, and the actions may not be completed successfully.

A LEAD WIRE ASSY USB is required to connect the control board and the portable charger.

Use a cable that meets the following specifications.

- [Type A male] - [Male XA connector for the PCB] USB cable. For details of "LEAD WIRE ASSY USB", please contact the sales office.

The connector on the control board side is a female XA connector for the PCB.

[2] Software Rewrite Function on the USB

The USB memory stick may be used to rewrite the software of the outdoor unit in the same way as using a ROM writer.

<1> Preparation

- Prepare a USB memory stick and a portable battery charger.
A LEAD WIRE ASSY USB for connecting the control board and the charger is also necessary.
Make sure the portable battery charger is sufficiently charged.
- Prepare a countermeasure program file "*****.mot" for the intended model.
- Copy the software rewrite program file "*****.mot" onto the root folder of the USB memory stick.
Install only one program and only in the root folder of the USB memory stick.

<2> Rewriting Software

The procedure is shown below.

1. Operation procedure

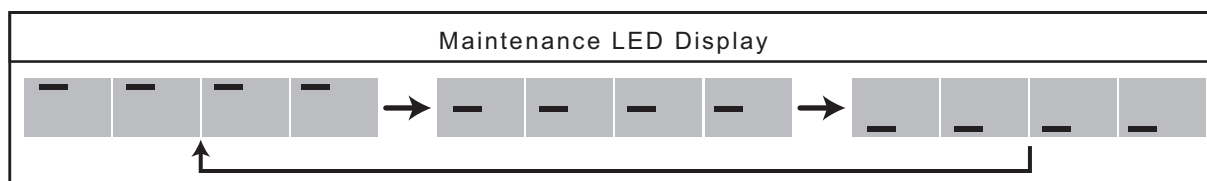
(1) Starting software rewrite mode

- 1) Shut down the power for the outdoor unit. Make sure the power for the control board is off.
This is done by confirming LD2 is off.
- 2) Turn on switches SW7-9 of the control board.
- 3) Insert the USB memory stick into the USB port (CNUSB) on the control board.
- 4) Connect the portable battery charger to the XA connector (CN601). The control board will turn on.
- 5) Make sure the display "Pro" is shown on the maintenance LED (LD301)
This shows that Software Rewrite Mode has been started.



(2) Performing software rewriting

- 1) Wait for 5 seconds after "Pro" appeared on the LED, and press SWP3 (ENTER) to start software rewrite.
When the rewrite process is in progress, progress bars move as shown below.



- 2) If "End" is displayed on the LED, the rewrite process has been completed correctly. * Generally, this process takes about five minutes.



(3) Confirmation of operation

- 1) Disconnect the portable battery charger from the XA connector (CN601). The control board will turn off.
- 2) Remove the USB memory stick from the USB port (CNUSB) on the control board.
- 3) Turn off the switches SW7-9 on the control board.
- 4) Turn on the outdoor unit, and check that the versions of the outdoor unit and the software are the same.
The version of the software may be found using the maintenance tool or other means.
Perform a test run, and check for normal operation.

<3> Precautions

For dealing with the displays shown on the maintenance LED and other problems, refer to Section "XI [3] Maintenance LED Display and Troubleshooting".

- Take care to choose the correct countermeasure program for the intended model and version.
Store only one software rewrite program on the USB memory stick.
If this requirement is not met, software rewrite may not start.
- Be cautious of electric shock when connecting an USB memory stick or a portable battery charger to the control board.
- Connect the portable battery charger to the LEAD WIRE ASSY USB and then to the control board.
- Make sure the portable battery charger is sufficiently charged. Rewrite error may occur if battery charge is insufficient.
- Take care not to forget to remove the USB memory stick in step (3) - 2) or forget to turn off SW7-9 in step (3) - 3). "XI [2] <2> Rewriting Software" If these precautions are not taken, the system may not start normally.
- When rewriting ended unsuccessfully, redo the procedure from step (1) - 3). "XI [2] <2> Rewriting Software" When rewriting ended unsuccessfully, the system may be started in Software Rewrite Mode instead of using the switches on the control board.
Also refer to Section "XI [3] <2> Troubleshooting".
- If software cannot be successfully rewritten using an USB memory stick, use a ROM writer to rewrite the software.

[3] Maintenance LED Display and Troubleshooting

<1> Maintenance LED Display Content List

The following table shows the maintenance LED displays for each function.
When dealing with the errors shown on the display, refer to Section "XI [3] <2> Troubleshooting".

1. Rewriting software

No.	Switch	Meaning	Maintenance LED Display	Description
1	SW7-9: ON	Rewrite Mode activated		“PRO” Software rewrite mode is active. Software rewrite is enabled. See Section “XI [3] <2> Troubleshooting” 1-(1), 1-(2) and 1-(3).
2		Rewrite in progress		Software rewrite is in progress. Bars are displayed in turn.
3		Software rewrite has been completed.		“END” Software rewrite has been completed successfully.
4		Error (USB memory side)		“Er01” Software rewrite process cannot be started due to failure of the USB memory stick. See Section “XI [3] <2> Troubleshooting” 1-(4).
				“Er02” Software rewrite was stopped due to failure of the USB memory stick during the software rewrite process. See Section “XI [3] <2> Troubleshooting” 1-(5).
5		Error (control board side)		“Er10” Software rewrite was not completed due to failure in deleting the existing software. See Section “XI [3] <2> Troubleshooting” 1-(6).
				“Er11” Software rewrite has not been completed due to failure in writing new software. See Section “XI [3] <2> Troubleshooting” 1-(6).

<2> Troubleshooting

Troubleshooting of USB functions are shown below.

The displays on the maintenance LED described in "XI [3] <1> Maintenance LED Display Content List" may also be used as a reference.

1. Rewriting software

(1) Maintenance LED does not display "Pro."

(Meaning or Cause)

The system is not started in Software Rewrite Mode.

Switches SW7-9 on the control board may not be in the ON position, or the portable charger may not be charged sufficiently.

(Solution)

Make sure switches SW7-9 are ON using "XI [2] <2> Rewriting Software" as a reference.

Restart using a fully charged portable charger or a different charger.

Check that the power-supply units (outdoor units/power-supply expansion unit) are turned off.

(2) Pressing the switch for starting the storage process does not start the process, and Maintenance LED continues to display "Pro."

(Meaning or Cause)

There may be a problem with the USB memory stick.

(Solution)

Check the connection of the USB memory stick.

If no problem is found, the USB memory stick may be at fault.

Check if the USB memory stick meets the specification described in Section "XI [1] <3> Necessary Materials" (1) USB memory stick.

If compliance is confirmed, the USB memory stick may be broken. Replace it with a new one.

(3) At the time of the system start after "END" was displayed, Maintenance LED displays "Pro."

(Meaning or Cause)

The system was started in Software Rewrite Mode.

Switches SW7-9 on the control board may not be in the OFF position.

If the switches are in the OFF position, it means the software rewrite process has failed.

(Solution)

After turning off control board switches SW7-9, turn on the system again.

If the switches are in the OFF position, it means the software rewrite process has failed.

Try rewriting the software again by following the procedure detailed in 1 (1) Starting software rewrite mode under Section "XI [2] <2> Rewriting Software". If the problem persists, rewrite the software, using a ROM writer.

(4) Maintenance LED displays "Er01."

(Meaning or Cause)

- Because an error occurred in the USB memory stick before the start of software rewrite, software rewrite has not been completed.

- Error Er01 occurs when SWP3 on the control board is pressed to rewrite the software immediately after power is supplied to the USB-connected control board.

(When the software rewriting is started before the control board recognizes the USB memory stick.)

(Solution)

Check the connection of the USB memory stick.

If no problem is found, the USB memory stick may be at fault.

Check the following five items.

- After supplying power to the USB-connected control board, wait at least five seconds before pressing SWP3 on the control board to rewrite software because it takes approximately five seconds for the control board to recognize the USB memory stick.
- Compliance of the USB memory stick to the specification of Section "XI [1] <3> Necessary Materials" (1) USB memory stick.
- The countermeasure program file "*****.mot" for the intended model is used.
The countermeasure program is not for a different model or version.
- The countermeasure program file "*****.mot" is stored in the root folder. It is not stored in another folder.
- Make sure that the program file "*****.mot" is stored in the root folder of the USB memory and not in any folder created on the USB memory stick.

When there is no problem in the five items above, the USB memory stick may be broken. Replace it with a new one. After the check is completed, follow the procedure starting with the step explained in 1. Operation procedure (1) Starting software rewrite mode under "XI [2] <2> Rewriting Software".

(5) Maintenance LED displays "Er02."

(Meaning or Cause)

Software rewrite is suspended due to a problem with the USB memory stick during the software rewrite process.

For example, if the USB memory stick is disconnected during data storage, this display appears on the maintenance LED.

(Solution)

Check the connection of the USB memory stick.

If no problems are found, follow the procedure starting with the step explained in 1. Operation procedure (1) Starting software rewrite mode under "XI [2] <2> Rewriting Software".

(6) Maintenance LED displays "Er10" or "Er11."

(Meaning or Cause)

Because there was a problem in the control board during the software rewrite process, software rewrite has not been completed.

(Solution)

Try rewriting the software again by following the procedure detailed in 1. Operation procedure (1) Starting software rewrite mode under Section "XI [2] <2> Rewriting Software". If the problem persists, rewrite the software, using a ROM writer.

XII Attachments

[1] R454C saturation temperature table	199
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[1] R454C saturation temperature table

Saturation pressure			Saturation temperature °C			Saturation pressure			Saturation temperature °C			Saturation pressure			Saturation temperature °C			Saturation pressure			Saturation 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	MPa (gauge)	Saturated liquid	Saturated gas	MPa (gauge)	Saturated liquid	Saturated gas	MPa (gauge)	Saturated liquid	Saturated gas
0.00	-45.56	-37.76	0.80	14.68	22.16	1.60	39.44	46.12	2.40	56.71	62.37	3.20	70.38	74.70	4.00	80.78	83.24	4.80	88.97	90.84	5.60	95.16	96.61
0.01	-43.55	-35.73	0.81	15.07	22.54	1.61	39.69	46.36	2.41	56.90	62.55	3.21	70.54	74.84	4.81	89.16	91.62	4.81	89.16	91.62	5.61	95.36	96.81
0.02	-41.68	-33.85	0.82	15.46	22.93	1.62	39.94	46.60	2.42	57.09	62.72	3.22	70.69	74.97	4.82	89.36	91.82	4.82	89.36	91.82	5.62	95.56	97.01
0.03	-39.92	-32.08	0.83	15.85	23.31	1.63	40.18	46.83	2.43	57.28	62.90	3.23	70.85	75.11	4.83	89.56	92.02	4.83	89.56	92.02	5.63	95.76	97.21
0.04	-38.26	-30.42	0.84	16.24	23.68	1.64	40.43	47.07	2.44	57.46	63.07	3.24	71.00	75.24	4.84	89.76	92.23	4.84	89.76	92.23	5.64	95.96	97.41
0.05	-36.69	-28.85	0.85	16.62	24.06	1.65	40.67	47.30	2.45	57.65	63.24	3.25	71.16	75.37	4.85	89.96	92.43	4.85	89.96	92.43	5.65	96.16	97.61
0.06	-35.20	-27.35	0.86	17.00	24.43	1.66	40.92	47.53	2.46	57.84	63.41	3.26	71.31	75.51	4.86	90.16	92.64	4.86	90.16	92.64	5.66	96.36	97.81
0.07	-33.79	-25.93	0.87	17.38	24.80	1.67	41.16	47.77	2.47	58.02	63.58	3.27	71.46	75.64	4.87	90.36	92.84	4.87	90.36	92.84	5.67	96.56	98.01
0.08	-32.43	-24.57	0.88	17.75	25.16	1.68	41.40	48.00	2.48	58.21	63.75	3.28	71.62	75.77	4.88	90.56	93.05	4.88	90.56	93.05	5.68	96.76	98.21
0.09	-31.13	-23.27	0.89	18.12	25.52	1.69	41.64	48.23	2.49	58.39	63.92	3.29	71.77	75.91	4.89	90.76	93.25	4.89	90.76	93.25	5.69	96.96	98.41
0.10	-29.88	-22.02	0.90	18.49	25.88	1.70	41.88	48.45	2.50	58.58	64.09	3.30	71.92	76.04	4.90	90.96	93.46	4.90	90.96	93.46	5.70	97.16	98.61
0.11	-28.68	-20.82	0.91	18.85	26.24	1.71	42.12	48.68	2.51	58.76	64.26	3.31	72.08	76.17	4.91	91.16	93.66	4.91	91.16	93.66	5.71	97.36	98.81
0.12	-27.52	-19.66	0.92	19.22	26.59	1.72	42.36	48.91	2.52	58.94	64.43	3.32	72.23	76.30	4.92	91.36	93.87	4.92	91.36	93.87	5.72	97.56	99.01
0.13	-26.40	-18.54	0.93	19.58	26.95	1.73	42.60	49.13	2.53	59.13	64.60	3.33	72.38	76.43	4.93	91.56	94.07	4.93	91.56	94.07	5.73	97.76	99.21
0.14	-25.32	-17.45	0.94	19.94	27.30	1.74	42.83	49.36	2.54	59.31	64.76	3.34	72.53	76.56	4.94	91.76	94.28	4.94	91.76	94.28	5.74	97.96	99.41
0.15	-24.27	-16.41	0.95	20.29	27.64	1.75	43.07	49.58	2.55	59.49	64.93	3.35	72.68	76.69	4.95	91.96	94.48	4.95	91.96	94.48	5.75	98.16	99.61
0.16	-23.25	-15.39	0.96	20.64	27.99	1.76	43.30	49.80	2.56	59.67	65.10	3.36	72.83	76.82	4.96	92.16	94.69	4.96	92.16	94.69	5.76	98.36	99.81
0.17	-22.26	-14.40	0.97	21.00	28.33	1.77	43.54	50.02	2.57	59.85	65.26	3.37	72.98	76.95	4.97	92.36	94.89	4.97	92.36	94.89	5.77	98.56	100.01
0.18	-21.30	-13.44	0.98	21.34	28.67	1.78	43.77	50.24	2.58	60.03	65.43	3.38	73.13	77.08	4.98	92.56	95.10	4.98	92.56	95.10	5.78	98.76	100.21
0.19	-20.37	-12.51	0.99	21.69	29.00	1.79	44.00	50.46	2.59	60.21	65.59	3.39	73.28	77.20	4.99	92.76	95.30	4.99	92.76	95.30	5.79	98.96	100.41
0.20	-19.46	-11.60	1.00	22.03	29.34	1.80	44.23	50.68	2.60	60.39	65.75	3.40	73.43	77.33	5.00	92.96	95.51	5.00	92.96	95.51	5.80	99.16	100.61
0.21	-18.57	-10.72	1.01	22.37	29.67	1.81	44.46	50.90	2.61	60.57	65.92	3.41	73.58	77.46	5.01	93.16	95.71	5.01	93.16	95.71	5.81	99.36	100.81
0.22	-17.70	-9.85	1.02	22.71	30.00	1.82	44.69	51.12	2.62	60.75	66.08	3.42	73.73	77.59	5.02	93.36	95.92	5.02	93.36	95.92	5.82	99.56	101.01
0.23	-16.85	-9.01	1.03	23.05	30.33	1.83	44.92	51.33	2.63	60.92	66.24	3.43	73.88	77.71	5.03	93.56	96.12	5.03	93.56	96.12	5.83	99.76	101.21
0.24	-16.03	-8.18	1.04	23.38	30.65	1.84	45.14	51.55	2.64	61.10	66.40	3.44	74.03	77.84	5.04	93.76	96.33	5.04	93.76	96.33	5.84	99.96	101.41
0.25	-15.22	-7.38	1.05	23.72	30.98	1.85	45.37	51.76	2.65	61.28	66.57	3.45	74.18	77.96	5.05	93.96	96.53	5.05	93.96	96.53	5.85	100.16	101.61
0.26	-14.43	-6.59	1.06	24.05	31.30	1.86	45.60	51.98	2.66	61.46	66.73	3.46	74.33	78.09	5.06	94.16	96.74	5.06	94.16	96.74	5.86	100.36	101.81
0.27	-13.65	-5.82	1.07	24.38	31.62	1.87	45.82	52.19	2.67	61.63	66.89	3.47	74.48	78.21	5.07	94.36	96.94	5.07	94.36	96.94	5.87	100.56	102.01
0.28	-12.89	-5.06	1.08	24.70	31.93	1.88	46.04	52.40	2.68	61.81	67.05	3.48	74.62	78.34	5.08	94.56	97.15	5.08	94.56	97.15	5.88	100.76	102.21
0.29	-12.14	-4.32	1.09	25.03	32.25	1.89	46.27	52.61	2.69	61.98	67.21	3.49	74.77	78.46	5.09	94.76	97.35	5.09	94.76	97.35	5.89	100.96	102.41
0.30	-11.41	-3.60	1.10	25.35	32.56	1.90	46.49	52.82	2.70	62.16	67.36	3.50	74.92	78.58	5.10	94.96	97.56	5.10	94.96	97.56	5.90	101.16	102.61
0.31	-10.70	-2.88	1.11	25.67	32.87	1.91	46.71	53.03	2.71	62.33	67.52	3.51	75.06	78.71	5.11	95.16	97.76	5.11	95.16	97.76	5.91	101.36	102.81
0.32	-9.99	-2.18	1.12	25.99	33.18	1.92	46.93	53.24	2.72	62.51	67.68	3.52	75.21	78.83	5.12	95.36	97.97	5.12	95.36	97.97	5.92	101.56	103.01
0.33	-9.30	-1.50	1.13	26.30	33.49	1.93	47.15	53.45	2.73	62.68	67.84	3.53	75.36	78.95	5.13	95.56	98.17	5.13	95.56	98.17	5.93	101.76	103.21
0.34	-8.62	-0.82	1.14	26.62	33.79	1.94	47.37	53.65	2.74	62.85	67.99	3.54	75.50	79.07	5.14	95.76	98.38	5.14	95.76	98.38	5.94	101.96	103.41
0.35	-7.95	-0.16	1.15	26.93	34.09	1.95	47.59	53.86	2.75	63.02	68.15	3.55	75.65	79.19	5.15	95.96	98.58	5.15	95.96	98.58	5.95	102.16	103.61
0.36	-7.29	0.50	1.16	27.24	34.39	1.96	47.81	54.06	2.76	63.20	68.31	3.56	75.80	79.31	5.16	96.16	98.79	5.16	96.16	98.79	5.96	102.36	103.81
0.37	-6.65	1.14	1.17	27.55	34.69	1.97	48.02	54.27	2.77	63.37	68.46	3.57	75.94	79.44	5.17	96.36	98.99	5.17	96.36	98.99	5.97	102.56	104.01
0.38	-6.01	1.77	1.18	27.86	34.99	1.98	48.24	54.47	2.78	63.54	68.62	3.58	76.09	79.55	5.18	96.56	99.20	5.18	96.56	99.20	5.98	102.76	104.21
0.39	-5.38	2.39	1.19	28.16	35.29	1.99	48.46	54.67	2.79	63.71	68.77	3.59	76.23	79.67	5.19	96.76	99.40	5.19	96.76	99.40	5.99	102.96	104.41
0.40	-4.77	3.00	1.20	28.47	35.58	2.00	48.67	54.88	2.80	63.88	68.92	3.60	76.38	79.79	5.20	96.96	99.61	5.20	96.96	99.61	6.00	103.16	104.61
0.41	-4.16	3.60	1.21	28.77	35.87	2.01	48.88	55.08	2.81	64.05	69.08	3.61	76.52	79.91	5.21	97.16	99.81	5.21	97.16	99.81	6.01	103.36	104.81
0.42	-3.56	4.20	1.22	29.07	36.16	2.02	49.10	55.28	2.82	64.22	69.23	3.62	76.66	80.03	5.22	97.36	100.02	5.22	97.36	100.02	6.02	103.56	105.01
0.43	-2.97	4.78	1.23	29.37	36.45	2.03	49.31	55.48	2.83	64.39	69.38	3.63	76.81	80.15	5.23	97.56	100.22	5.23	97.56	100.22	6.03	103.76	105.21
0.44	-2.39	5.36	1.24	29.67	36.74	2.04	49.52	55.68	2.84	64.56	69.53	3.64	76.95	80.26	5.24	97.76	100.43	5.24	97.76	100.43	6.04	103.96	105.41
0.45	-1.81	5.93	1.25	29.96	37.03	2.05	49.73	55.87	2.85	64.73	69.69	3.65	77.10	80.38	5.25	97.96	100.63	5.25	97.96	100.63	6.05	104.16	105.61
0.46	-1.25	6.49	1.26	30.26	37.31	2.06	49.94	56.07	2.86	64.89	69.84	3.66	77.24	80.50	5.26	98.16	100.84	5.26	98.16	100.84	6.06	104.36	105.81
0.47	-0.69	7.04	1.27	30.55	37.59	2.07	50.15	56.27	2.87	65.06	69.99	3.67	77.38	80.61	5.27	98.36	101.04	5.27	98.36	101.04	6.07	104.56	106.01
0.48	-0.13	7.59	1.28	30.84	37.87	2.08	50.36	56.46	2.88	65.23	70.14	3.68	77.53	80.73	5.28	98.56	101.25	5.28	98.56	101.25	6.08	104.76	106.21
0.49	0.41	8.12	1.29	31.13	38.15	2.09	50.57	56.66	2.89	65.39	70.29	3.69	77.67	80.84	5.29								

Pressure Conversion Table

psi	MPa	psi	MPa	psi	MPa	psi	MPa
1	0.007	30	0.207	230	1.586	430	2.965
2	0.014	40	0.276	240	1.655	440	3.034
3	0.021	50	0.345	250	1.724	450	3.103
4	0.028	60	0.414	260	1.793	460	3.172
5	0.034	70	0.483	270	1.862	470	3.241
6	0.041	80	0.552	280	1.931	480	3.309
7	0.048	90	0.621	290	1.999	490	3.378
8	0.055	100	0.689	300	2.068	500	3.447
9	0.062	110	0.758	310	2.137	510	3.516
10	0.069	120	0.827	320	2.206	520	3.585
11	0.076	130	0.896	330	2.275	530	3.654
12	0.083	140	0.965	340	2.344	540	3.723
13	0.090	150	1.034	350	2.413	550	3.792
14	0.097	160	1.103	360	2.482	560	3.861
15	0.103	170	1.172	370	2.551	570	3.930
16	0.110	180	1.241	380	2.620	580	3.999
17	0.117	190	1.310	390	2.689	590	4.068
18	0.124	200	1.379	400	2.758	600	4.137
19	0.131	210	1.448	410	2.827	650	4.482
20	0.138	220	1.517	420	2.896	700	4.826

MPa = psi/145.038

Temperature Conversion Table

°F	°C
-20	-28.9
-10	-23.3
0	-17.8
10	-12.2
20	-6.7
30	-1.1
40	4.4
50	10.0
60	15.6
70	21.1
80	26.7
90	32.2
100	37.8
110	43.3
120	48.9
130	54.4
140	60.0
150	65.6
160	71.1
170	76.7

°C = (°F × 5/9) - 32

Temperature Difference Conversion Table

°F	°C
0	0.0
1	1.8
2	3.6
3	5.4
4	7.2
5	9.0
6	10.8
7	12.6
8	14.4
9	16.2
10	18.0
11	19.8
12	21.6
13	23.4
14	25.2
15	27.0
16	28.8
17	30.6
18	32.4
19	34.2

°C = °F × 1.8

The background of the page is decorated with a pattern of purple triangles of various sizes, some pointing up and some pointing down, creating a geometric, crystalline effect.

Service Handbook

Model
CAHV-R136TAU(-BS)
CAHV-R136YAU(-BS)

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