MITSUBISHI ELECTRIC

Changes for the Better

HOT WATER HEAT PUMP

2026

R290

Service Handbook

Model

CAHV-Z450YA-HPB(-BS)

2nd edition

Safety Precautions

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

⚠ WARNING	Describes precautions that must be observed to prevent danger of injury or death to the user.
⚠ CAUTION	Describes precautions that must be observed to prevent damage to the unit and/or limit the danger of injury or death to the user.
IMPORTANT	Indicates a risk of damage to the unit or other components in the system.

All electric work (from installation to disposal of units) must be performed by personnel certified by Mitsubishi Electric.

MEANINGS OF SYMBOLS DISPLAYED ON THE UNIT

	WARNING (Risk of fire)	This unit uses R290, a highly flammable refrigerant. If any refrigerant leaks or comes in contact with fire or a heated surface or environment, there is a risk of fire or explosion, and the installer and/or user is warned to take all possible safety precautions when handling the unit and R290, being sure to keep a safe distance at all times to any related fire or explosion and to notify the fire department immediately on becoming aware of such an outcome.
	Read the OPERATION MANUAL carefully before operation.	
	Service personnel are required to carefully read the OPERATION MANUAL and INSTALLATION MANUAL before operation.	
	Further information is available in the OPERATION MANUAL, INSTALLATION MANUAL, and the like.	

[1] General

⚠ WARNING

The unit must only be installed/serviced/relocated/repaired/disposed, including any work undertaken on a related refrigerant circuit, by a competent electrician, with the requisite professional qualifications to install this unit and perform electrical works in your jurisdiction. Please contact your dealer for them. Failure to conduct electric work, deal with the refrigerant circuit(s) and install/service/relocate/repair/ uninstall or dispose the unit correctly in accordance with the foregoing and all laws and regulations may lead to prosecution, water leakage, electric shock or fire. Mitsubishi Electric does not accept responsibility for any direct, indirect, special or consequential loss, damage, liability or expense incurred or suffered which results from any works undertaken by an unqualified or third party installer, or any failure, claim, damage or deficiency caused to a unit by improper installation, servicing, relocation, repair, uninstallation, or disposing.

The work on refrigerant circuit can only be performed by certified or qualified personnel who are trained properly. Please contact your dealer for them.

For installation and relocation work, follow the instructions in the Installation/Operation Manual and use tools and pipe components specifically made for use with R290 refrigerant.

When installing the unit, use appropriate protective equipment and tools for safety.
Failure to do so could cause injuries.

Ventilate the space if refrigerant leaks into an enclosed area during operation. If refrigerant comes into contact with a flame, there is risk of fire or explosion.

In order to not invalidate unit warranty and maintain the correct and safe functioning of the unit, please use only parts and accessories recommended by Mitsubishi Electric, to be installed by a competent electrician with the requisite professional qualifications in your jurisdiction. We accept no liability for damage or expenses caused by the incorrect installation of the unit and/or third party accessories, parts or

components, which may result in water leakage, electric shock or fire.

A protective zone is defined for the area close around the product.
In the event of a refrigerant leak, it must be ensured that no one is endangered outdoors or in adjacent buildings and no refrigerant can get into the building.

When carrying out work on the refrigerant circuit or working in the protective zone, a competent electrician with the requisite professional qualifications must use only the specified and appropriate tools.

After installation has been completed, the installer must check for refrigerant leaks by using a professional leak detector tool. If refrigerant leaks into a space from the outdoor, machine room, or through indoor valves, and comes into contact with the flame of a heater, portable cooking range, sparks, static electricity or objects with high surface temperature (>370°C), a fire or explosion will occur. In case the leak detector detects the refrigerant leakage, all persons in close or adjacent vicinity of the leak must be immediately advised to move away to a safe distance in order for the area to be checked by a professional.

In the event of refrigerant leakage, to do as follows:
- Evacuate any people from the danger zone.
- When the refrigerant leak fault is detected and the fans are rotating, wait until the fans stop.
- Remove ignition sources from the danger zone.
- Do not operate the unit until repairs are completed.

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 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 sulfur gas, hydrogen sulfide, or chlorine gas, are present or where acidic/alkaline solutions or sprays containing sulfur or siloxane 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 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.

Do not turn off the breaker except for servicing.
- If the power supply to the unit is interrupted, the safety features (refrigerant sensor and fans) will stop, resulting in refrigerant accumulation and causing a fire and explosion.

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

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.

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.

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) who lack experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety.

Keep the space well ventilated. Refrigerant can displace air and cause oxygen starvation.
- If leaked refrigerant comes in contact with a heat source, toxic gas may be generated.

Always replace a fuse with one with the correct current rating.
- The use of improperly rated fuses or a substitution of fuses with steel or copper wire may result in fire or explosion.

If any abnormality (e.g., burning smell) is noticed, stop the operation, turn off the power switch, and consult your dealer.
- Continuing the operation may result in electric shock, malfunctions, or fire.

Properly install all required covers and panels on the terminal box and control box to keep moisture and dust out.
- Dust accumulation and water may result in electric shock, smoke, or fire.

Consult an authorized agency for the proper disposal of the unit.
- Refrigerant oil and refrigerant that may be left in the unit pose a risk of fire, explosion, or environmental pollution.

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.

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 refrigerant leakage and resultant fire and explosion.

In areas where temperature drops to freezing, use Anti-freeze mode and leave the main power turned on to prevent the water in the water circuit from freezing and damaging the unit or causing refrigerant leakage and resultant fire and explosion.

Use clean tap water.
- The use of acidic or alkaline water or water high in chlorine may corrode the unit or the pipes, causing refrigerant leakage and resultant fire and explosion.

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 refrigerant leakage and resultant fire and explosion.

Periodically inspect and clean the water circuit.
- Dirty water circuit may compromise the unit's performance or corrodes the unit or cause refrigerant leakage and resultant fire and explosion.

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.

Do not install the units or cylinders in or around underground, hollow, and enclosed space.
- If the refrigerant leaks, a fire or explosion may result.
- The unit must be stored where leaking refrigerant will not accumulate.

Be aware that refrigerants may not contain an odorant.

The maximum refrigerant amount in the unit is specified by IEC 60335-2-40.
- Refrigerant must not be charged beyond the maximum amount.

⚠ CAUTION

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 water pipe from the unit 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.

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.

Should not release refrigerant to air, the refrigerant should be collected in a cylinder.
- If the recovery is not required by national regulations, drain the refrigerant to the outside, it must be done safely.

Do not connect multiple units to other models with different refrigerants.

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.

[2] Transportation

⚠ WARNING

Do not smoke during work and transportation.

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 are specified in local regulations.

[3] Installation

⚠ WARNING

When the installer is performing brazing work, make sure that there are no hazardous or flammable materials nearby.
Make sure that there are no refrigerant leaks before performing the work.
If refrigerant leaks and accumulates, it may ignite.

Keep gas-burning appliances, electric heaters, and other fire sources (ignition sources) away from the location where installation, repair, and other outdoor unit work will be performed.
If refrigerant comes into contact with a flame, a fire or explosion will occur.

When carrying out work on the refrigerant circuit, take protective measures to prevent static discharges.

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.

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 mandatory.

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.

Before turning on the power, perform vacuum drying and charge refrigerant.

It is strongly recommended to install breakers outside the protective zone.
However, if the laws and regulations of each country allow, it is also acceptable to install them inside the protective zone.
In both cases, installation personnel must always carry a leak detector.

⚠ CAUTION

All drainage work should be performed by the dealer or qualified personnel according to the instructions detailed in the Installation/Operation Manual.
- Improper drainage work may cause rain water or drain water to enter the buildings and damage the furnishings.

[4] Pipe installation

⚠ WARNING

Pipe-work shall be protected from physical damage.

The installation of pipe-work shall be kept to a minimum.

The outlet piping of automatic air vent valves and pressure relief valves installed in machine rooms or indoors must always be installed outdoors. The outlet piping is considered part of a protective zone.

When drain piping is necessary, the condensate drain must not be connected to the waste water directly.

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.

Piping work should be performed by the dealer or qualified personnel according to the instructions detailed in the Installation/Operation Manual.
- Improper piping work may cause water resulting in refrigerant leakage and resultant fire and explosion.

Do not open the control box cover while charging refrigerant.
- If the refrigerant leaks, a fire or explosion may result.

⚠ CAUTION

Check that no substance other than the specified refrigerant (R290) 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.

[5] 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/Operation 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.

⚠ 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.

[6] 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.

Do not open the control box cover while charging refrigerant.

- If the refrigerant leaks, a fire may result.

⚠ 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.

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[7] 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 keep the power constantly ON. This unit is equipped with refrigerant sensor and electrically powered safety measures. To be effective, the unit must be electrically powered at all times after installation, other than when servicing.

Should not release refrigerant to air, the refrigerant should be collected in a cylinder.

- If the recovery is not required by national regulations, drain the refrigerant to the outside, it must be done safely.

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 hot water heat pumps 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 leakage due to damaged piping.

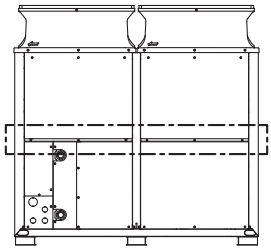


Please build the water circuit so that it is a closed system.
- Do not use water directly for showers or other applications.
- Do not allow other heat source water to mix with the water circuit.

Store the unit in a place large enough to allow clearance in the event of refrigerant leakage.
Comply with the national regulations of each country regarding storage.

Refrigerant R290 is highly flammable. Do not use a nakedflame type detector.

The following 6 screws securing the upper and lower panels are longer. Please ensure they are not mixed up during panel attachment or removal.



To protect the plate heat exchanger evacuate the system and collect refrigerant with the pump in the water circuit being operated.

[8] Using R290 refrigerant outdoor units

⚠ CAUTION

Servicing shall be performed only as recommended by the manufacturer.

Do not use refrigerant other than R290 refrigerant. If another refrigerant is used, the chlorine will cause the oil to deteriorate.

Use the following tools specifically designed for use with R290 refrigerant. The following tools are necessary to use R290 refrigerant. Contact your nearest dealer for any questions. If incorrect tools are

used, a fire or explosion will occur.

Tools (for R290)	
Gauge manifold	Cutter/Reamer
Charge hose	Refrigerant cylinder
Charge valve	Adapter for refrigerant cylinder
Electronic refrigerant charging scale	Refrigerant recovery equipment
Leak detector	Refrigerant recovery cylinder
Vacuum pump	Electrical tools
Vacuum pump adapter	Fan

Be sure to use the correct tools. If dust, debris, or moisture enters the refrigerant lines, refrigeration oil deterioration may result.

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

Prior to beginning work on systems containing flammable refrigerants, safety checks are necessary to ensure that the risk of ignition is minimized. For repair to the refrigerating systems, (1) to (5) shall be completed prior to conducting work on the systems.

(1) 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.

(2) The area shall be checked with an appropriate refrigerant detector prior to and during work, to ensure the technician is aware of potentially toxic or flammable atmospheres. Ensure that the leak detection equipment being used is suitable for use with all applicable refrigerants, i.e. non-sparking, adequately sealed or intrinsically safe.

(3) 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 CO_2 fire extinguisher adjacent to the charging area.

(4) No person carrying out work 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.

(5) Ensure that the area is in the open or that it is adequately ventilated before breaking into the system 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.

Where electrical components are being changed, they shall be fit for the purpose and to the correct specification. At all times the manufacturer’s maintenance and service guidelines shall be followed. If in doubt, consult the manufacturer’s technical department for assistance.
The following checks shall be applied to installations using flammable refrigerants:
- The charge size is in accordance with the room size within which the refrigerant containing parts are installed.
- The ventilation machinery and outlets are operating adequately and are not obstructed.
- 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 refrigerant containing components, unless the components are constructed of materials which are inherently resistant to being corroded or are suitably protected against being corroded.

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.
Initial safety checks shall include that:

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

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.

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.
Ensure that the apparatus is mounted securely.
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 manufacturer's specifications.

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.
Intrinsically safe components are the only types that can be worked on while live in the presence of a flammable atmosphere. The test apparatus shall be at the correct rating.
Replace components only with parts specified by the manufacturer. Other parts may result in the ignition of refrigerant in the atmosphere from a leak.

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 pumps.

Under no circumstances shall potential sources of ignition be used in the searching for or detection of refrigerant leaks.
A halide torch (or any other detector using a naked flame) shall not be used.

Electronic leak detectors may be used to detect refrigerant leaks but, in the case of 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. Leak detection equipment shall be set at a percentage of the LFL of the refrigerant and shall be calibrated to the refrigerant employed, and the appropriate percentage of gas (25% maximum) is confirmed.
Leak detection fluids are suitable for use with most refrigerants but the use of detergents containing chlorine shall be avoided as the chlorine may react with the refrigerant and corrode the copper pipe work.
If a leak is suspected, all naked flames shall be removed/extinguished.
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.
For appliances containing flammable refrigerants, oxygen free nitrogen (OFN) shall then be purged through the system both before and during the brazing process.

When breaking into the refrigerant circuit to make repairs – or for any other purpose conventional procedures shall be used. However, for flammable refrigerants it is important that best practice is followed since flammability is a consideration. The following procedure shall be adhered to:
- remove refrigerant
- purge the circuit with inert gas
- evacuate
- purge again with inert gas
- open the circuit by cutting.

The refrigerant charge shall be recovered into the correct recovery cylinders. For appliances containing 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.

For appliances containing flammable refrigerants, 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 pipe-work are to take place.
Ensure that the outlet for the vacuum pump is not close to any ignition sources and that ventilation is available.

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.

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.

Before carrying out this procedure, it is essential that the technician is completely familiar with the equipment and all its details. It is recommended as 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.

(1) Become familiar with the equipment and its operation.

(2) Isolate system electrically.

(3) 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.

(4) If a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system.

(5) Make sure that cylinder is situated on the scales before recovery takes place.

(6) Start the recovery machine and operate in accordance with manufacturer's instructions.

(7) Do not overfill cylinders. (No more than 80% volume liquid charge).

(8) Do not exceed the maximum working pressure of the cylinder, even temporarily.

(9) 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.

(10) Recovered refrigerant shall not be charged into another refrigeration system unless it has been cleaned and check.

Equipment shall be labelled stating that it has been decommissioned and emptied of refrigerant. The label shall be dated and signed. For appliances containing flammable refrigerants, ensure that there are labels on the equipment stating the equipment contains flammable refrigerant.

When removing refrigerant from a system, either for servicing or decommissioning, it is recommended as good practice that all refrigerants are removed safely. 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 the recovered 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 occurs.
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, flammable refrigerants. In addition, a set of calibrated weighing scales shall be available

and in good working order.
Hoses shall be complete with leak-free 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 manufacturer if in doubt.
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 in recovery units and especially not in cylinders. If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that 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.

[9] Before temporarily decommissioning

⚠ CAUTION

If there is a risk of frozen damage, drain the heating water from the unit.

[10] Before disposal

⚠ CAUTION

The unit needs to be treated according to WEEE.
Be sure to observe the following.

Do not dispose of the unit with the household waste.

If the unit is disposed, hand in the unit to a collection center for waste electrical or electronic equipment or to a recycler authorised by manufacturer.

Dispose of the unit in an appropriate way according to the laws and ordinances of each country.

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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-Z450YA-HPB(-BS): R290

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 R290 (Adaptability of tools that are for use with R454C or R407C)

1. To be used exclusively with R290 (not to be used if used with R454C or R407C)

Tools/Materials	Use	Notes
Gauge Manifold	Evacuation and refrigerant charging	♦Higher than 4.82 MPa on the high-pressure side ♦port size R290: 7/16-20 UNF R454C: 1/2-20 UNF
Charge Hose	Evacuation and refrigerant charging	♦Cap size R290: 7/16-20 UNF R454C: 1/2-20 UNF
Charge Valve	Preventing gas escaping from the hose and hot water heat pump when removing the charge hose	Connection diameter: 7/16-20 UNF×7/16-20 UNF
Refrigerant Cylinder	Refrigerant charging	Be sure to use the cylinders labeled according to the type of refrigerant
Adapter for Refrigerant Cylinder	Refrigerant charging	Charge port: 7/16-20 UNF
Refrigerant Recovery Cylinder	Refrigerant recovery	Be sure to use the cylinders labeled according to the type of refrigerant

2. Tools and materials that may be used with R290 with some restrictions

Tools/Materials	Use	Notes
Gas Leak Detector	Gas leak detection	Do not use a combustion-based leak detector with R290 refrigerant
Vacuum Pump	Vacuum drying	♦It is better to use the vacuum pump that complies with explosion-proof standards, such as ATEX and IECEx ♦Use a reverse-flow prevention adapter
Vacuum Pump Adapter	Vacuum drying	It is better to use the vacuum pump that complies with explosion-proof standards, such as ATEX and IECEx
Cutter/Reamer	Cutting/Reaming	Do not use the tool that generates sparks due to tool friction, such as a saw
Refrigerant Recovery Equipment	Refrigerant recovery	It is better to use the vacuum pump that complies with explosion-proof standards, such as ATEX and IECEx
Electrical tools	Cutting/Grinding and so on	Do not use the electrical tools that generate sparks due to tool frction
Fan	Making wind	It is better to use the vacuum pump that complies with explosion-proof standards, such as ATEX and IECEx

3. Tools and materials that are used with R454C or R407C that may also be used with R290

Tools/Materials	Use	Notes
Electronic Refrigerant Charging Scale	Refrigerant charging	-

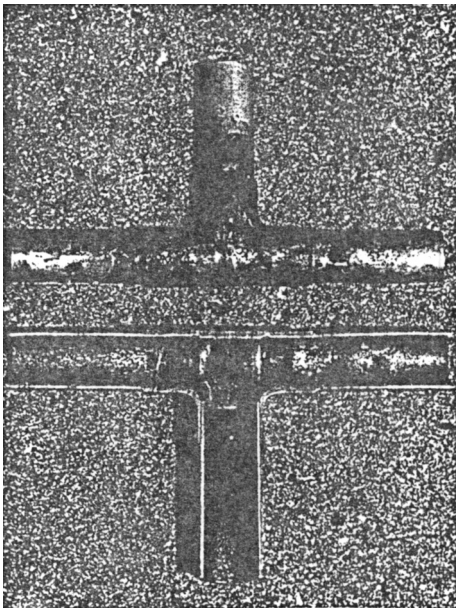
Tools for R290 must be handled with special care to keep moisture and dust from infiltrating the cycle.

[3] Brazing

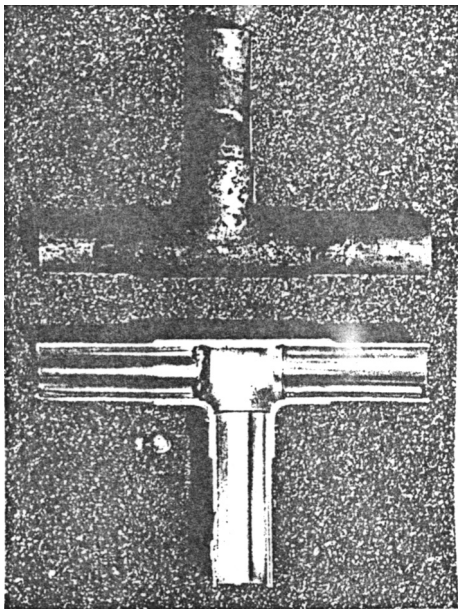
No changes have been made in the brazing procedures. Perform brazing with special care to keep foreign objects (such as oxide scale, water, and dust) out of the refrigerant system.

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

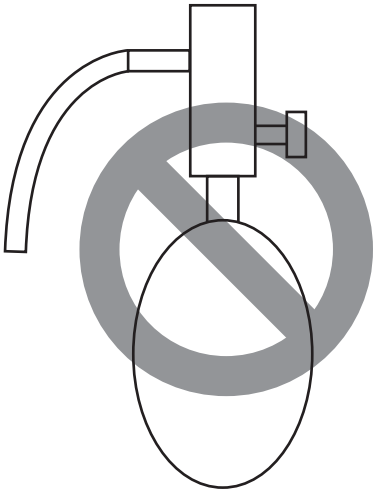
- The new refrigerating machine oil is hygroscopic and is more likely to cause unit failure if water infiltrates into the system.
- Flux generally contains chloride. Residual flux in the refrigerant circuit will cause sludge to form.

3. Notes

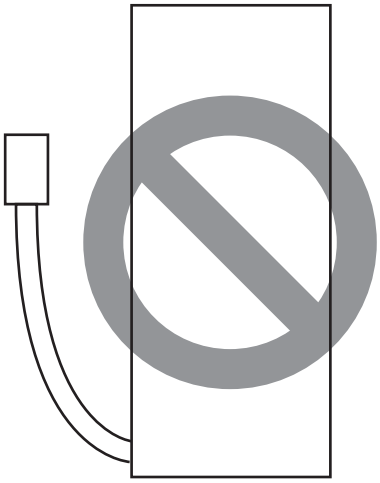
Do not use commercially available antioxidants because they may cause the pipes to corrode or refrigerating machine oil to deteriorate.

[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 R290 leak.



Halide torch



R22 leakage detector

1. Items to be strictly observed

- Pressurize the equipment with nitrogen up to the design pressure (3.85MPa), and then judge the equipment's air tightness, taking temperature variations into account.
- Refrigerant R290 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 R290 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.

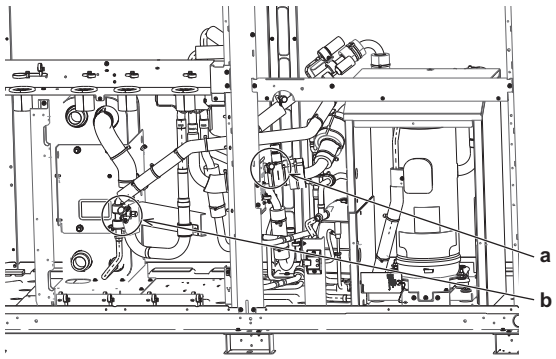
3. Notes

Procure a leak detector that is specifically designed to detect an HFC leak. A leak detector for R22 will not detect an R290 leak.

[5] Vacuum Drying (Evacuation)

1. Prior to vacuum drying

Release inert gas charged in the unit from the check joint on the low-pressure side.
For vacuum drying, use the low-pressure check joint and refrigerant service valve.
The refrigerant service valve is set the low-pressure side when shipping from the factory.
The check joint and valve of the unit is 7/16-20 UNF.
Do not evacuate after the unit turns on the power since LEV will close in the unit.
Once the LEV closes, the evacuating takes more time.



a Low-pressure check joint
b Refrigerant service valve
(At the factory shipment, the valve is set to the low-pressure side)

2. Vacuum pump

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.
Also, use a vacuum pump compatible with A3 refrigerant.

3. Standard of vacuum degree

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

4. Required precision of vacuum gauge

Use a vacuum gauge that registers a vacuum degree of 2 Torr (266 Pa).
Do not use a commonly used gauge manifold because it cannot register a vacuum degree of 2 Torr (266 Pa).

5. Evacuation time

- After the degree of vacuum has reached 2 Torr (266 Pa), evacuate for an additional 1 hour. (A thorough vacuum drying removes moisture in the pipes.) When the outdoor temperature drops below 1°C (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 outdoor temperature. When performing vacuum drying at a low outdoor 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) 1 hour 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 7. Special vacuum drying.

6. 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.

7. Special vacuum drying

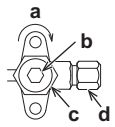
- When 2 Torr (266 Pa) or lower degree of vacuum cannot be attained after 3 hours of evacuation, it is likely that

water has penetrated the system or there is a leakage.

- If water infiltrates the system, break the vacuum with nitrogen. Pressurize the system with nitrogen gas to 0.5 kgf/cm^2G (0.05 MPa) and evacuate again. Repeat this cycle of pressurizing and evacuation either until the degree of vacuum below 2 Torr (266 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.)

8. Notes

- Evacuating the system only from the high-pressure side may damage the compressor.
- When dry-vacuuming and recovering refrigerant, let the water circulate to keep the plate heat exchanger from freezing.
- If power is accidentally turned on before vacuuming and refrigerant charge, evacuate not only from the low-pressure check joint and the refrigerant service valve but also from the high-pressure check joint.
- Do not purge the air using refrigerant. Use a vacuum pump to evacuate the system.
  Residual gas in the refrigerant lines will cause bursting of the pipes or an explosion.
- After the unit has been run once, the pressure of the refrigerant service valve may reverse depending on the four-way valve. Do not use the refrigerant service valve except for initial commissioning.
- Tighten the valve/valve cap with your hands as far as they go, and then turn them further by approximately 30 to 45 degrees.
  - Tightening the valve/valve cap too hard may damage the screw head, which may render the screw unable to be tightened.
- Close the refrigerant service valve immediately after the completion of maintenance work.
  The refrigerant service valve must be closed at all times during operation.

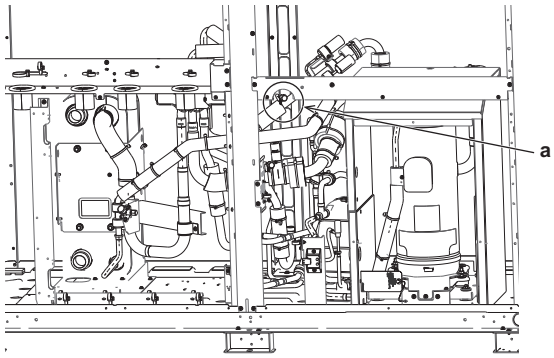


a Turn to close.
b Valve tightening torque 6.0±10%N · m
c Valve cap tightening torque 15.0±10%N · m
d Tightening torque for the parts to be connected to the equipment on site 12.7±2N · m

[6] Refrigerant Charge

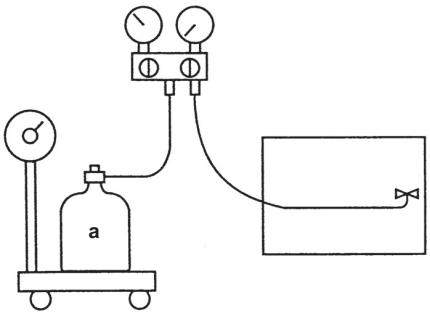
1. Refrigerant charge

Charge 4.8 kg of R290 refrigerant only from the high-pressure check joint.
Use a scale with a maximum error of ±30 g that has been calibrated at least once per year.
R290 refrigerant must not be charged beyond 4.94 kg required by IEC 60335-2-40.
Be aware that the refrigerant may not contain an odorant.
Draw out the refrigerant from the cylinder in the liquid phase.

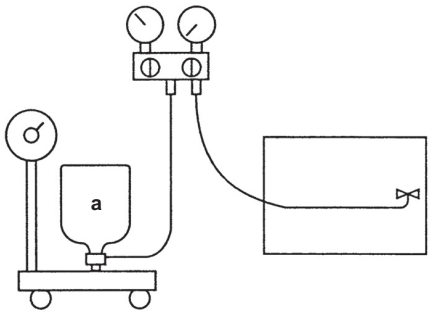


a High-pressure check joint

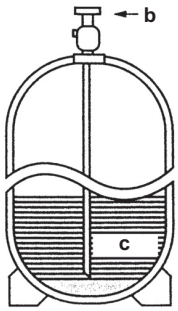
Cylinder with a siphon

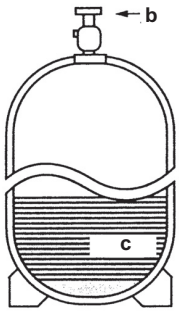


Cylinder without a siphon



Refrigerant charging in the liquid state





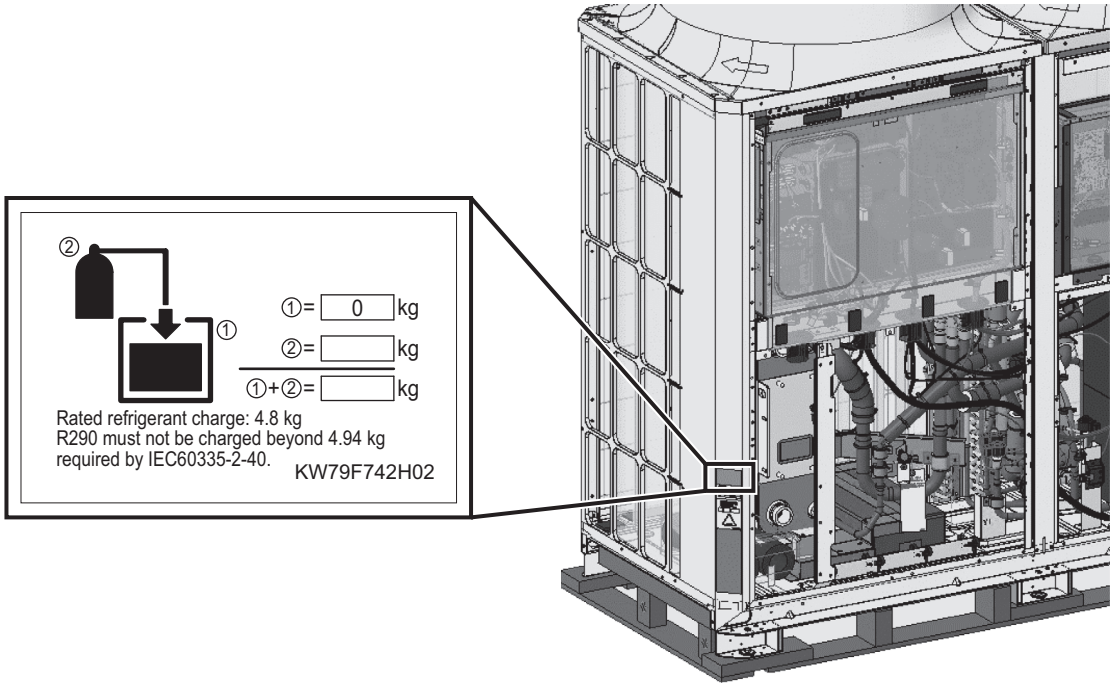
a Cylinder
b Valve
c liquid

2. Record of Refrigerant Charge on Label

After charging the refrigerant, record on the label both the actual charged amount ② and the resulting total refrigerant amount ① + ②.

The amount of factory-charged refrigerant ① is 0 kg.

Use a permanent marker so that the entry will not be easily erased.



3. 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] Actions to be taken in the event of refrigerant leakage

- Evacuate any people from the danger zone.
- Do not turn the switch ON/OFF or plug/unplug any device.
  Do not use any devices that may have ignition source.
- Prepare the fire extinguishers or other fire prevention equipment for use.
- When the refrigerant leak fault is detected and the fans are rotating, wait until the fans stop.
- Ventilate the area around the unit.
- Remove ignition sources from the danger zone.
- Do not operate the unit until repairs are completed.

[8] Characteristics of the Conventional and the New Refrigerants

1. Chemical property

The new refrigerant (R290) is low in toxicity and 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.

	HFC Refrigerant			Natural Refrigerant	Conventional Refrigerant (HCFC type)
	R410A	R407C	R454C	R290	R22
	R32/R125	R32/R125/ R134a	R32/R1234yf	R290	R22
Composition (wt%)	(50/50)	(23/25/52)	(21.5/78.5)	(100)	(100)
Type of Refrigerant	Pseudo-azeotropic Refrigerant	Non-azeotropic Refrigerant	Non-azeotropic Refrigerant	Single Refrigerant	Single Refrigerant
Chloride	Not included	Not included	Not included	Not included	Included
Safety Class	A1/A1	A1/A1	A2L/A2L	A3	A1
Molecular Weight	72.6	86.2	90.8	44.1	86.5
Boiling Point (°C/°F)	-51.4/-60.5	-43.6/-46.4	-45.9/-50.6	-42.1/-43.8	-40.8/-41.4
Steam Pressure (25°C, MPa/77°F, psi) (gauge)	1.56/226	0.92/133	0.88/127	0.85/123	0.94/136
Saturated Steam Density (25°C, kg/m^3)	64.0	42.5	44.5	20.6	44.4
Flammability	Nonflammable	Nonflammable	Slightly flammable	Flammable	Nonflammable
Ozone Depletion Coefficient (ODP)[*1]	**0**	**0**	**0**	0	**0.055**
Global Warming Coefficient (GWP)[*2]	1920	1624	146	3	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 liquid state	Refrigerant charging in the gaseous state

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

2. Pressure characteristics

The pressure in the system using R290 is 0.86 times as great as that in the system using R22.

Temperature (°C/°F)	Saturation Pressure (gauge)				
	R410A	R407C	R454C	R290	R22
	MPa/psi	MPa/psi	MPa/psi	MPa/psi	MPa/psi
-20/-4	0.30/44	0.18/26	0.12/17	0.14/20	0.14/20
0/32	0.70/102	0.47/68	0.35/51	0.37/54	0.40/58
20/68	1.34/194	0.94/136	0.75/108	0.74/107	0.81/117
40/104	2.31/335	1.44/209	1.36/197	1.27/184	1.44/209
60/140	3.73/541	2.43/354	2.27/329	2.02/293	2.33/338
65/149	4.17/605	2.74/399	2.55/370	2.24/325	2.60/377

[9] Precautions for handling equipment using R290

When handling the units that use R290 refrigerant, observe the following notes. (The notes are based on the precautions regarding R290 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 flammable gas.

3. Disposal

1) Follow the local regulations on proper disposal of equipment using R290.

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 by local regulations.

5. Servicing information

1) Checks to the area
Prior to beginning work on systems containing 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 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 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 CO_2 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 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

Under no circumstances shall potential sources of ignition be used in the searching for or detection of refrigerant leaks.
A halide torch (or any other detector using a naked flame) shall not be used.
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 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. Leak detection equipment shall be set at a percentage of the LFL of the refrigerant and shall be calibrated to the refrigerant employed, and the appropriate percentage of gas (25% maximum) is confirmed.

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 R290 is flammable, oxygen free nitrogen (OFN) shall be poured through the system both before and during the brazing process to purge R290.

4) Leak detection fluids are also suitable for use with most refrigerants but the use of detergents containing chlorine shall be avoided as the chlorine may react with the refrigerant and corrode the copper pipe-work.

5) Examples of leak detection fluids are
- bubble method,
- fluorescent method agents.

10. Refrigerant removal and vacuum drying for service

1) R290 is flammable. Follow the procedures below to reduce the risk of R290 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 R290. For appliances containing 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 R290 is 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 in an appropriate position according to the instructions.
- 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.

12) If a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system.

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 R290 is 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, 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 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 flammable refrigerants are affected.

(2) Training

The training should include the substance of the following:
Information about the explosion potential of 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 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 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

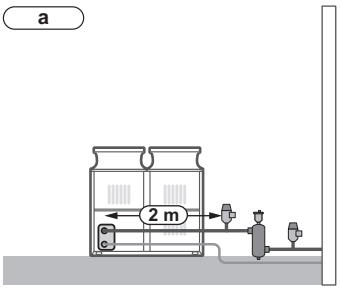
To prevent ignition of the refrigerant, follow these instructions*1 during installation.

*1: Established based on the Mitsubishi Electric's Risk Assessment Standards.

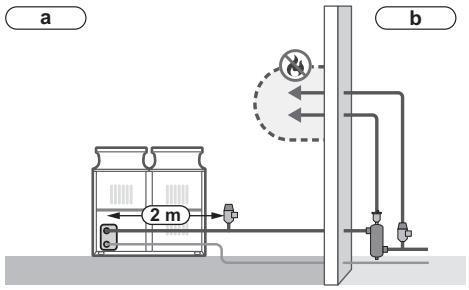
(1) System configuration



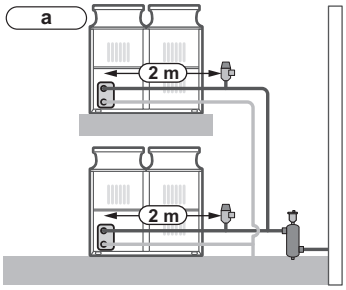
<Example 1>
Individual unit installation Pattern 1



<Example 2>
Individual unit installation Pattern 2



<Example 3>
Multiple unit installation



a Outside
b Machine room

In order to ensure that the safety measures function properly in the event of a refrigerant leakage, Pressure Relief Valve (PRV) and Automatic Air vent Valve with Air Separator (AAV with air separator) must be installed as defined. Mitsubishi Electric strongly recommends that these be installed outdoors to reduce the risk of ignition with the leakage. In that case, they must be located inside the protective zone around the unit, as these open components may discharge flammable refrigerant. Make sure to follow the points below;

<PRV>

All the conditions below must be followed;

1) At least two PRVs that remain opened must be installed in the whole system. (It is acceptable for a greater number of them to be installed.)

2) One of the two PRVs must be located within 2 m of the unit.
One efficiently discharges refrigerant outdoors while the other regulates the water pressure, in the event of rapid refrigerant leakage from the water heat exchanger.

<AAV with air separator>

The condition below must be followed;

1) At least one AAV with an air separator must be installed in the whole system. It efficiently discharges refrigerant outdoors in the event of slow refrigerant leakage from the water heat exchanger.

- It is also acceptable to install an AAV with air separator equipped with a PRV. However, in this case, it must be installed within 2 m of the unit.

The PRV installed within 2 m of the unit and the AAV with air separator must comply with the following specifications;

<PRV>

Regarding the unit installation;

1) Individual unit installation: Discharge capacity must be ≥2,700 NL/min.
2) Multiple unit installation: Each unit must be equipped with a PRV installed within 2 m of the unit (each PRV must be ≥2,700 NL/min.).

Regarding the operating pressure;

1) The PRV must be set at the appropriate point so that it operates first in the event of the refrigerant leakage.
2) The operating pressure of the PRV must be set to the lowest value. Proper consideration of head difference and pressure loss is required to ensure correct operation.

<AAV with air separator>

Regarding the unit installation;

1) Individual unit installation;
- Discharge capacity must be ≥90 NL/min.
- Gas-liquid separation efficiency must be ≥90% at maximum water flow rate of 10.0 m^3/h.

2) Multiple unit installation;
- Discharge capacity must be ≥90 NL/min.
- When installing it on the combined piping system, the gas-liquid separation efficiency must be ≥90% at the water flow rate of (10.0 × number of units) m^3/h.
- When installing it on the pipe of each unit, the gas-liquid separation efficiency must be ≥90% at the maximum water flow rate of 10.0 m^3/h.

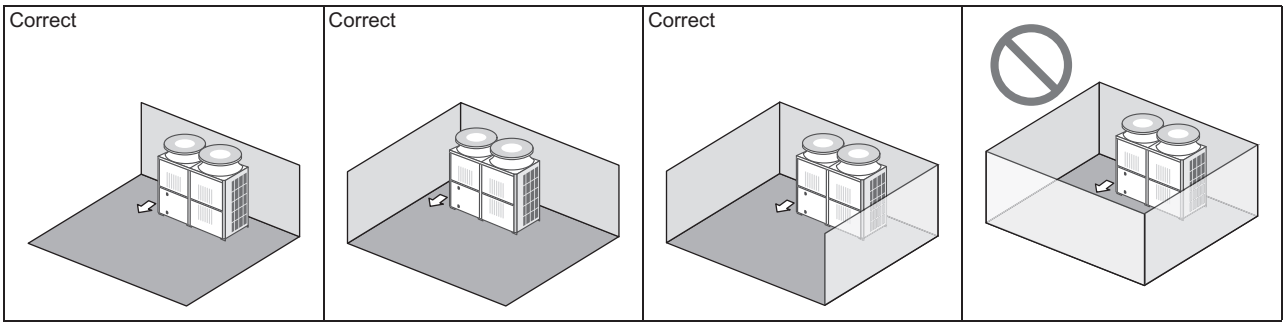
Even when PRVs and AAVs with air separator are installed indoors unavoidably, any leaked refrigerant must always be discharged outdoors. Make sure to follow the points below;

1) If it is necessary to discharge from indoor PRVs or AAVs with air separator, the outlet piping must always be led outdoors because the indoor discharge is not permitted. The protective zone rule also applies to the discharge destination; therefore, no ignition sources should exist at that location. Refer to "Protective Zone" (page 21).
2) When the primary side is isolated from the secondary side by an indirect heat exchanger or a tank with coil, the restrictions above do not apply to the secondary side.

In addition to the above, if there is any mechanism that releases gas throughout the entire system, it is not recommended to leave it open. If it is to be left open, ensure that the outlet piping is led outdoors. In case of heat exchanger failure, a small amount of flammable refrigerant could leak inside the building from it.

(2) Surrounding Conditions for Outdoor Units

Install outdoor units in a place where at least one of the four sides is open or in a sufficiently large space without depressions.



If you unavoidably install a unit in a space where all four sides are blocked or there are depressions, confirm that one of these situations below (**1)** or **2)**) is satisfied.

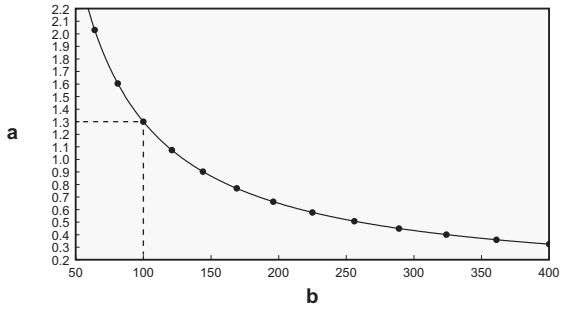
1) Secure sufficient installation space and follow the restriction of the possible installation height regarding ignition sources.

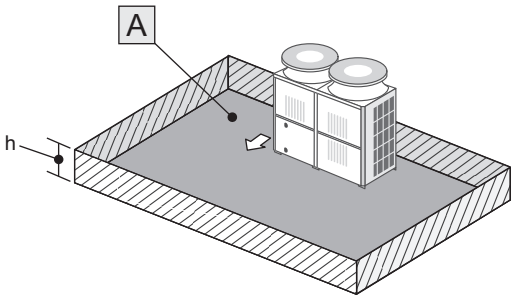
Based on the size of the installation area A (X-axis), find the possible installation height of h (Y-axis) in which ignition sources must not exist (refer to the graph below). Make sure any ignition source must not be placed below h.

However, when h is higher than the height of parapet *1, h can be equivalent to the height of parapet.

*1: Definition of parapet: a low protective wall along the edge of a roof, bridge, or balcony

e.g., When A is 100 m^2, any ignition source cannot be installed below h 1.3 m. (the dotted line on the graph below)

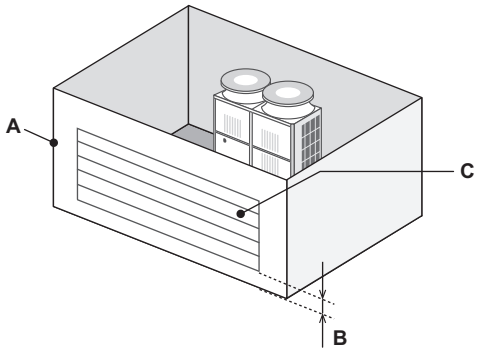




a The possible installation height of ignition sources h (m)
b The installation area A (m^2)

2) Create an appropriate ventilation open area.

The ventilation open area refers to those that meet all of the following conditions: it starts at a height of 0.125m or less from the ground (condition **B**), the vertical length of the sides is at least 80% of longitudinal direction of the wall on which it is placed (**A**), and the area must occupy more than 75% of the total area of the wall (condition **C**).
If one side of the walls out of four sides satisfies that, the installation rules of Fig. 6 are applied, and when 2 sides/ 3 sides of the walls satisfy that, that of Fig. 5/4 are applied.



A Longitudinal direction
B Height from the ground to an opening ≤ 0.125 m
C Opening:
- Must occupy 80% of the longitudinal side of a space.
- Must have an opening ratio of 75% or higher.

(Example: space with a louver)

NOTE

- These countermeasures (**1)** or **2)**) are for ke eping safety not for specification guarantee.
- In addition to the restriction of ignition sources, people are not allowed to enter the installation area where four surfaces are closed.
  In case qualified personnel enter for maintenance/removal, refer to "Safety Precautions"

17. Protective Zone

In the event of a refrigerant leakage, it must be ensured that no one is endangered outdoors or in adjacent buildings, and no refrigerant can get into the building. For this purpose, safety-relevant protective zone are specified below.

- There must not be any building openings, entrance to the basement, grooves, or into the wastewater system in this area.
- The protective zone must not extend to adjacent buildings or public traffic areas.
- Ignition sources must not be present in this area, either permanently or for a short period of time.
- When the unit is installed in an open area (e.g., on the ground), prepare a fence around the unit so that people cannot enter easily.
  The unit is not accessible to the general public.
- When the unit is installed on the roof, make sure to lock the entrance so that only authorized personnel can enter.

Protective zone

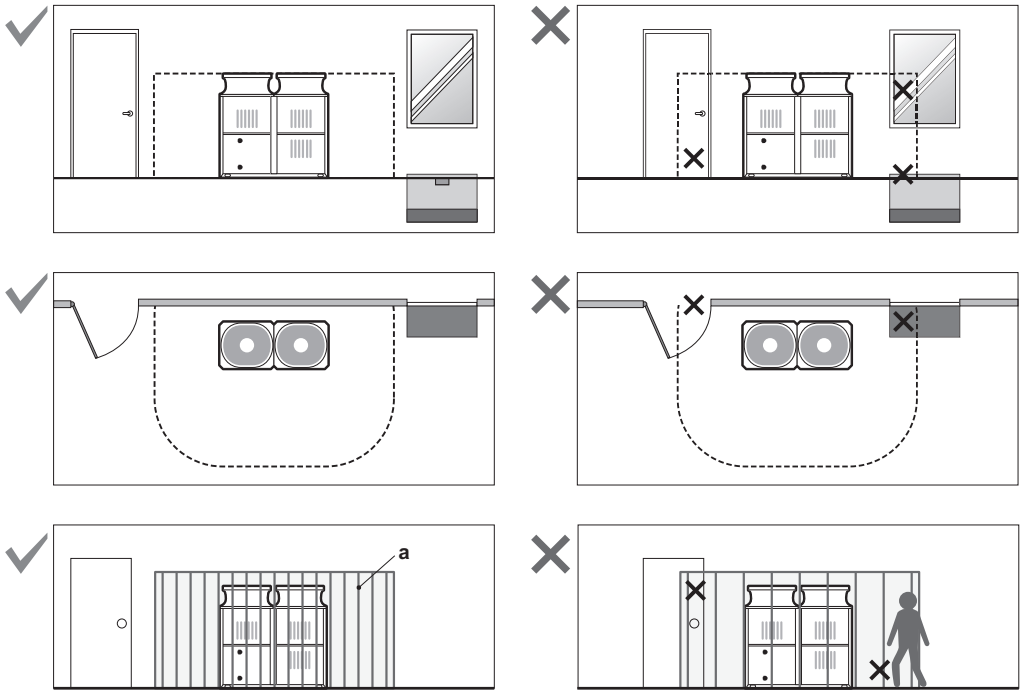


Fig. 1

a fence

NOTE

- In case qualified personnel enter for maintenance/removal. Refer to "Safety Precautions".

Specific dimensions of the protective zone are specified for each installation condition.
Refer to the figures for each case.

An object is considered to indicate the presence of a surface (or wall) when all of the following criteria are met:

- Its height is greater than 0.125 m and its width exceeds that of the unit.
- The opening ratio is less than 75%.
- It is within 5 m of the nearest side of the product enclosure.

(1) When installed in a location with an open around (Fig2, Fig3)

Define the protective zone as follows:

- 2 m around of the unit

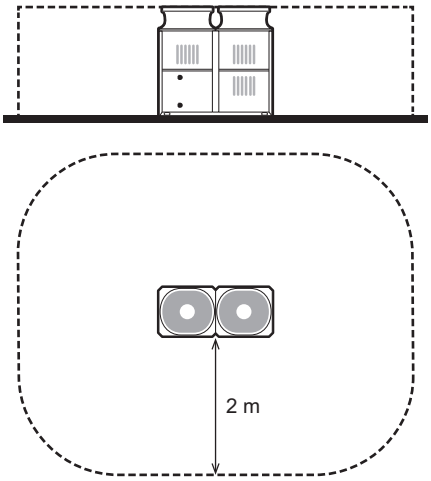


Fig. 2

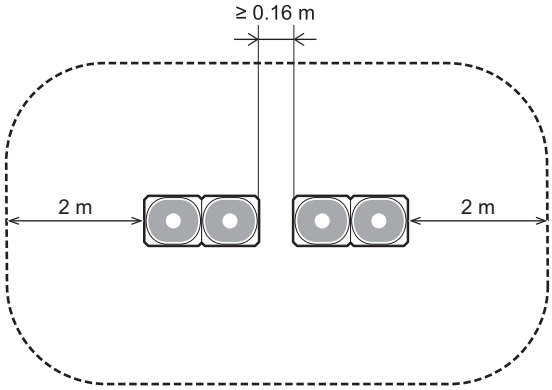


Fig. 3

(2) When installed in a location with 3 surfaces opened

- The open side distance from the unit x_l and x_r must be above 2 m.
- Calculate the forward distance y_{f1} and backward distance y_b to the unit with the table below.

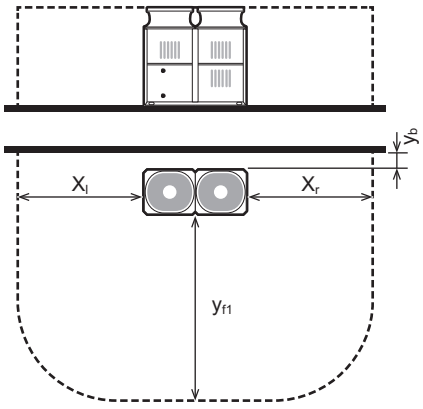


Fig. 4

(Unit: m)

y_b	y_{f1}
0.3	3.2
1.0	2.5
2.0	2.0
3.0	2.0

(3) When installed in a location with 2 surfaces opened (where the distance between one side of the unit and the wall is 0.3 m or more but less than 5 m)

- The open side distance from the unit x_l must be above 2 m.
- The forward distance from the unit y_{f2} must follow the table below. It depends on the distance l, which is defined by the smaller of the distances between x_r and y_b.

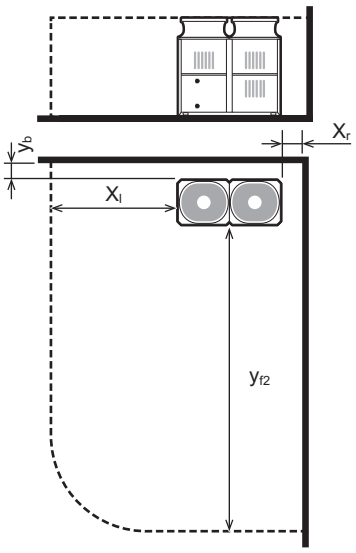


Fig. 5

(Unit: m)

l = min. (x_r, y_b)	y_{f2}
0.3	5.0
1.0	3.4
2.0	2.0
3.0	2.0

(4) When installed in a location where only the front opened

- The backward distance from the unit y_b must be above 0.3 m.
- The forward distance y_{f3} must follow the table below depending on the total side distance $x_l + x_r$.

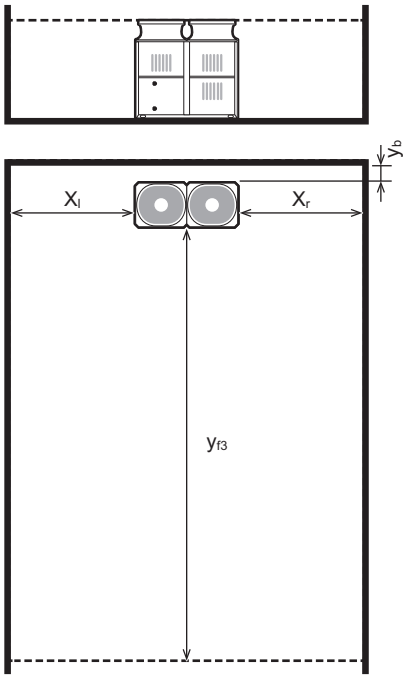


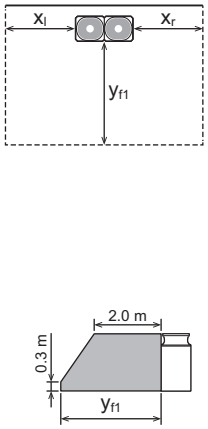
Fig. 6

(Unit: m)

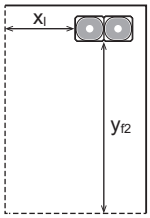
$x_l + x_r$	y_{f3}
2.0	12.0
4.0	7.5
6.0	5.3
8.0	4.0
10.0	3.1

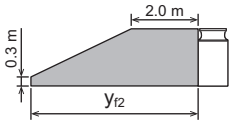
Protective zone (Side view)

3 surfaces opened

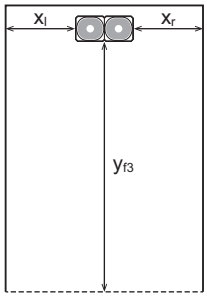


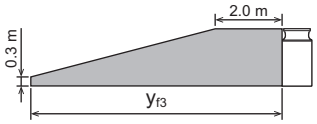
2 surfaces opened





1 surface opened





[10] Notes on Refrigerating Machine Oil

1. Refrigerating machine oil in the HFC refrigerant system

Refrigerant R290 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
R290	Polyalkylene glycol oil

2. Effects of contaminants*1

Refrigerating machine oil 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.

<table>
<tr><th colspan="2">Cause</th><th colspan="2">Symptoms</th><th>Effects on the refrigerant cycle</th></tr>
<tr><td colspan="2" rowspan="2">Water infiltration</td><td>Freezing</td><td>Frozen expansion valve and capillary tubes</td><td rowspan="3">Clogged expansion valve and capillary tubes
Poor heating performance
Compressor overheat
Motor insulation failure
Burnt motor
Coppering of the orbiting parts
Burn-in on the orbiting parts</td></tr>
<tr><td>Hydrolysis</td><td rowspan="2">Sludge formation and adhesion
Acid generation
Oxidization
Oil degradation</td></tr>
<tr><td colspan="2">Air infiltration</td><td>Oxidization</td></tr>
<tr><td rowspan="4">Infiltration of contaminants</td><td rowspan="2">Dust, dirt</td><td colspan="2">Adhesion to expansion valve and capillary tubes</td><td>Clogged expansion valve, capillary tubes, and drier
Poor heating performance
Compressor overheat</td></tr>
<tr><td colspan="2">Infiltration of contaminants into the compressor</td><td>Burn-in on the orbiting parts</td></tr>
<tr><td rowspan="2">Mineral oil etc.</td><td colspan="2">Sludge formation and adhesion</td><td>Clogged expansion valve and capillary tubes
Poor heating performance
Compressor overheat</td></tr>
<tr><td colspan="2">Oil degradation</td><td>Burn-in on the orbiting parts</td></tr>
</table>

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

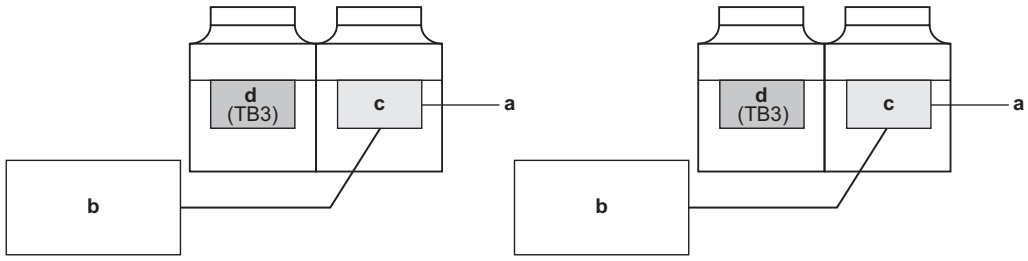
II Restrictions

[1] System Configuration....29
[2] Types and Maximum allowable Length of Cables....30
[3] Main Power Supply Wiring and Switch Capacity....31
[4] Schematics of Individual and Multiple Systems....35
[5] Switch Types and Default Settings....37
[6] Configuring the Settings....38
[7] Water Pipe Installation....45

[1] System Configuration

Schematics of Individual and Multiple Systems

(1) Schematics of individual and multiple systems

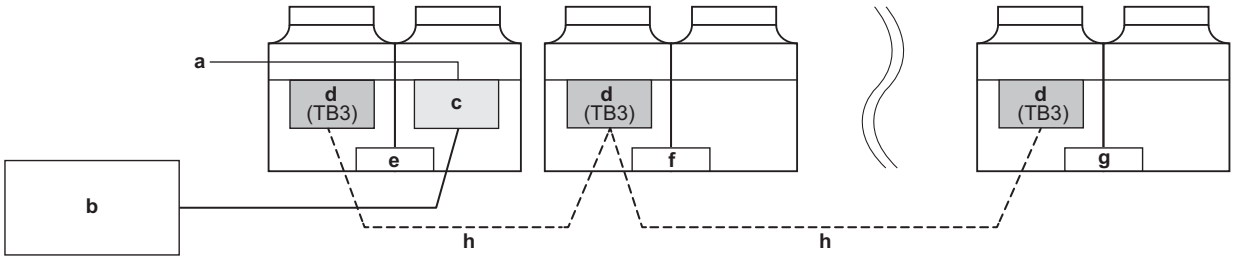


a External water temp. thermistor
b Dry contact switch/relay or remote controller (not supplied)
c Sub control box
d PCB

(2) Multiple system

For 2 ~ 7 units

Consists of one main unit that connects to an external water temp. thermistor and a dry contact switch/relay, and up to 6 sub units that are operated collectively



a External water temp. thermistor
b Dry contact switch/relay or remote controller (not supplied)
c Sub control box
d PCB
e Main unit
f Sub unit
g Sub unit(s)
h Inter-unit wiring (M-NET)

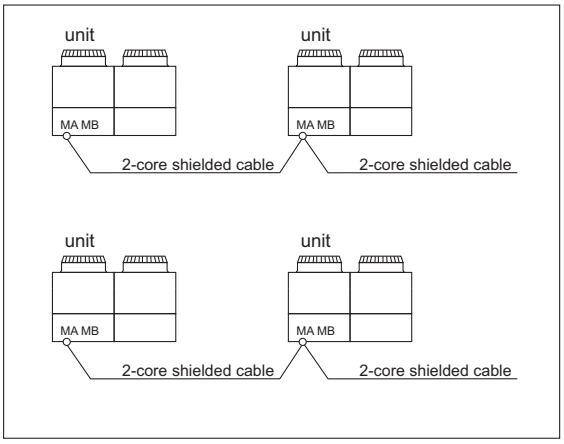
[2] Types and Maximum allowable Length of Cables

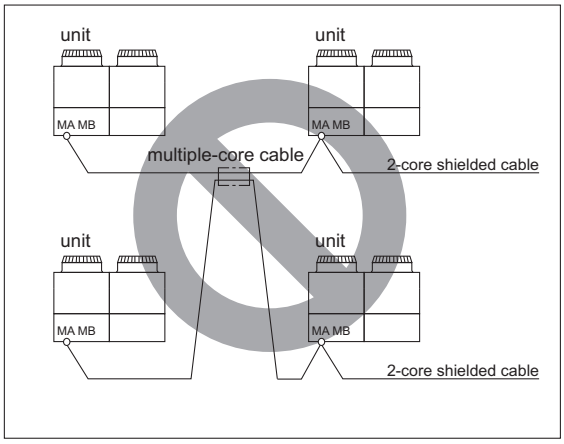
Wiring work

(1) Notes

1) Have all electrical work performed by an authorized electrician according to the local regulations and instructions in this manual.
2) Install external transmission cables at least 5cm [1-31/32"] away from the power supply cable to avoid noise interference. (Do not put the control cable and power supply cable in the same conduit tube.)
3) Provide grounding for the outdoor unit as required.
4) Run the cable from the electric box of the outdoor unit in such way that the box is accessible for servicing.
5) Do not connect power supply wiring to the terminal block for transmission line. Doing so will damage the electronic components on the terminal block.
6) Use 2-core shielded cables as transmission cables.

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





(2) Control wiring

Different types of control wiring are used for different systems.

Types and maximum allowable length of cables

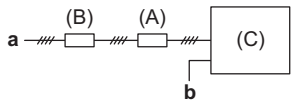
Control lines are categorized into 2 types: transmission line and remote controller line.

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

Wiring schematic

a 3N~380–415 V
L1, L2, L3, N
b PE (Protective Earth)



(A) Current breaking switch
(B) Earth leakage breaker (ELB)
(C) Outdoor unit

Wire size, switch capacity, and system impedance

Model	Min. wire size (mm^2)			ELB	Local switch (A)		Overcurrent breaker (A)	Max. permissive system impedance
	Main	Branch	Ground		Capacity	Fuse		
CAHV-Z450YA-HPB	14	-	14	50 A 100 mA 0.1 sec. or less	50	50	50	0.15 Ω

To minimize the risk of electrical leakage, electric shock, noise interference, malfunction, overheating, smoke, or fire, electrical work must be conducted only by a certified electrician, following all relevant local wiring regulations and the instructions detailed below and in this manual. Consider the ambient conditions, and consult the power company as necessary.

Power supply

- This equipment complies with IEC 61000-3-12, provided the short-circuit power S_{SC} at the interface point is greater than or equal to the S_{SC} value (MVA) of 3.93.
  Ensure the equipment is connected only to a power supply with a short-circuit power S_{SC} greater than or equal to this value.

- Ensure each unit has its own dedicated power supply and is individually wired.
- Connect this device to a power supply system that has a maximum permissible system impedance at the user's supply interface point as shown in the table.
- Maintain a power supply voltage drop of no more than 10%. The table provides the minimum wire size for use with a metal conduit. If voltage drop is a problem, consider increasing the wire size.

Breaker/ground

- Only use properly rated breakers and fuses, including an earth leakage breaker, a local switch (switch + fuse), or an overcurrent breaker that matches the unit capacity, leakage current limit, and current breaking threshold.
- Use breakers with at least 3.0 mm contact separation in each pole.
- When using an earth leakage breaker without an overcurrent breaker, combine it with a local switch and a molded case circuit breaker.
- Install an earth leakage breaker for each unit's power supply.
- For INV circuits, use a Mitsubishi Electric NV-S series earth leakage breaker or its equivalent.
- A large electric current due to malfunction or faulty wiring can trigger the earthleakage breakers on both the unit side and the upstream side of the power supply. Either separate the power supply system or coordinate breaker protection to provide higher protection.
- Some installation sites may require an additional earth leakage breaker for the inverter.
- Provide proper grounding, avoiding connections to gas pipes, water pipes, lightning rods, or telephone wires.

Cable/connector

- Only use standard power supply cable of sufficient capacity.
- For outdoor use, power supply cables should be no lighter than polychloroprene sheathed flexible cord (design 60245 IEC57).
- Include some slack in the power supply cable.
- Replace the power supply cable immediately if damaged.
- Grounding wire should be longer than the power supply cable.
- Use specified cables and avoid straining terminal connections.
- Tighten all terminal screws to the specified torque.

Misc.

Avoid installing a phase advancing capacitor on the motor as it could cause damage and potentially start a fire.

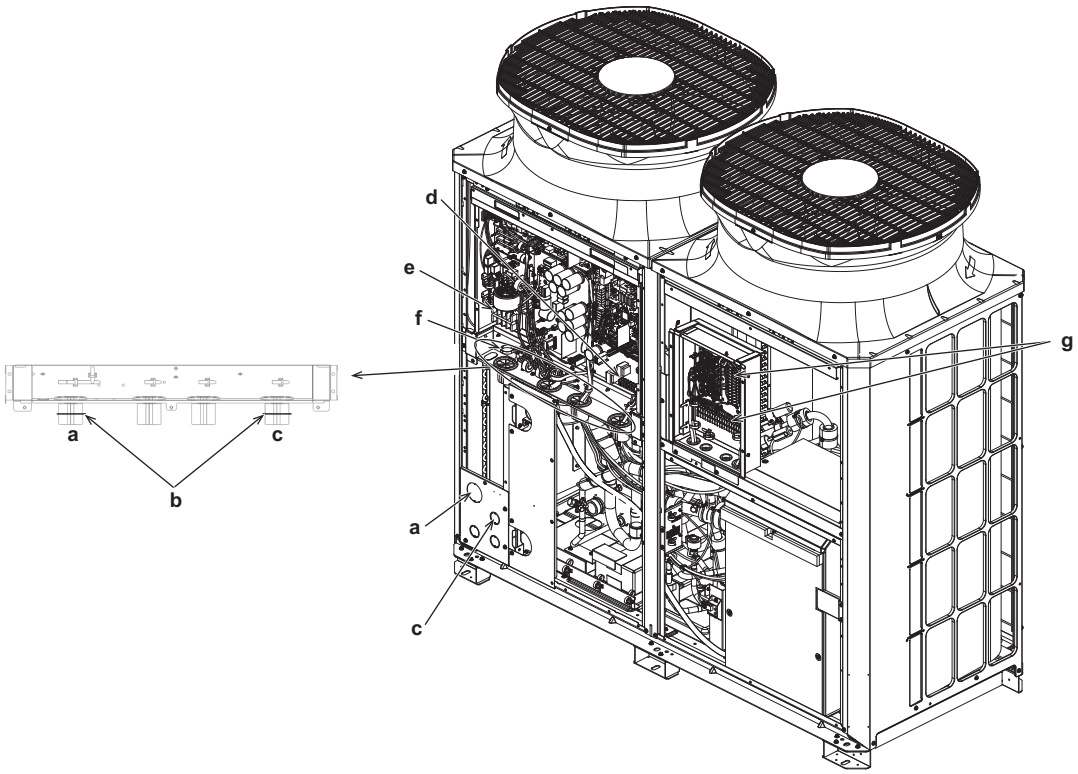
Control cable specifications

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

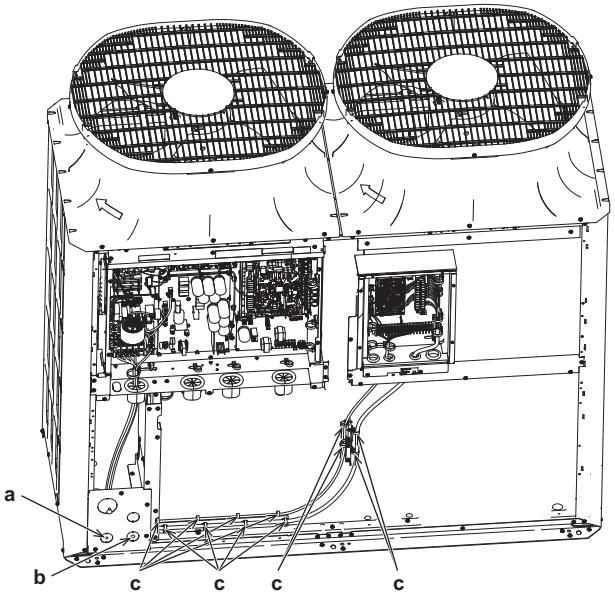
*1:Use a CVVS or CPEVS cable if a source of noise interference is nearby.
*2:With at least 1-mm-thick supplementary insulation

<1> Schematics of a Unit and Its Terminal Blocks

Front panels of the control box are removable by unscrewing the four screws and pulling the panels forward and down.



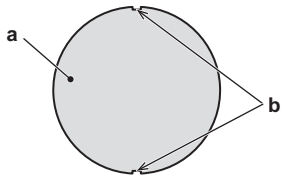
a Power wire
b Fasten with cable ties
c Transmission cable
d Transmission terminal block
e Power supply terminal block (TB1)
(Power supply cables larger than 25 mm^2 are not connectable to TB1. Use a pull box to connect them.)
f Cable tie
g Control terminal block (TB5,TB6)



a < 24 V
b > 100 V
c Cable tie

<2> Wire Knockout Hole and Conduit

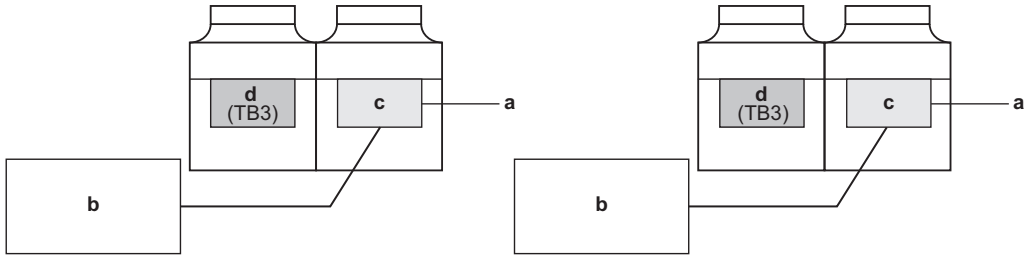
- Punch out the wire knockout hole at the bottom of the front panel with a hammer.
- Consider using a conduit if damage to wires by animals is a concern.
- If not using a conduit, deburr the knockout hole, and wrap the wires with protective tape.
- If damage from animals is a concern, use a conduit tube to narrow the opening.



a Knockout hole
b Burr

[4] Schematics of Individual and Multiple Systems

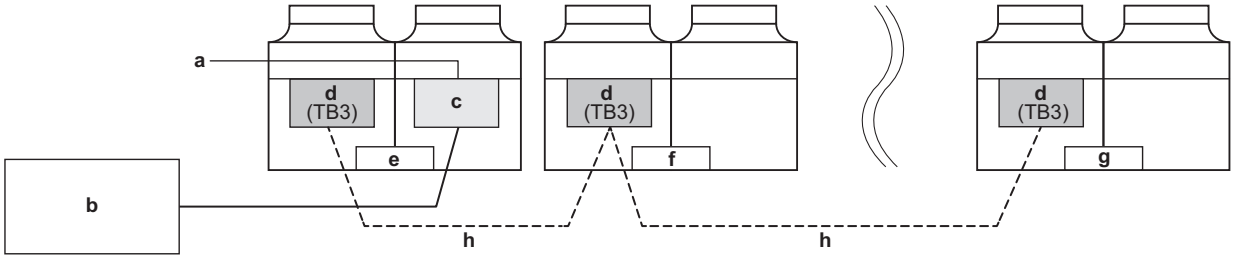
(1) Schematics of individual and multiple systems



a External water temp. thermistor
b Dry contact switch/relay or remote controller (not supplied)
c Sub control box
d PCB

(2) Multiple system
For 2 ~ 7 units

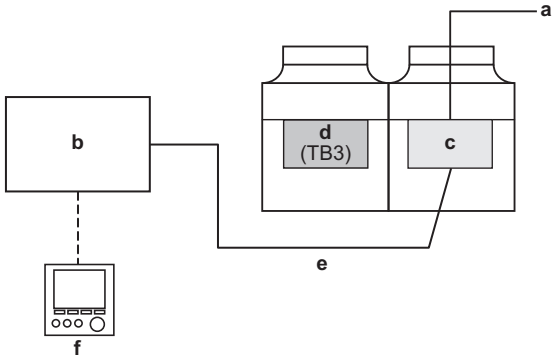
Consists of one main unit that connects to an external water temp. thermistor and a dry contact switch/relay, and up to 6 sub units that are operated collectively



a External water temp. thermistor
b Dry contact switch/relay or remote controller (not supplied)
c Sub control box
d PCB
e Main unit
f Sub unit
g Sub unit(s)
h Inter-unit wiring (M-NET)

(3) Individual system with FTC connection

Each unit connects to a primary FTC unit.



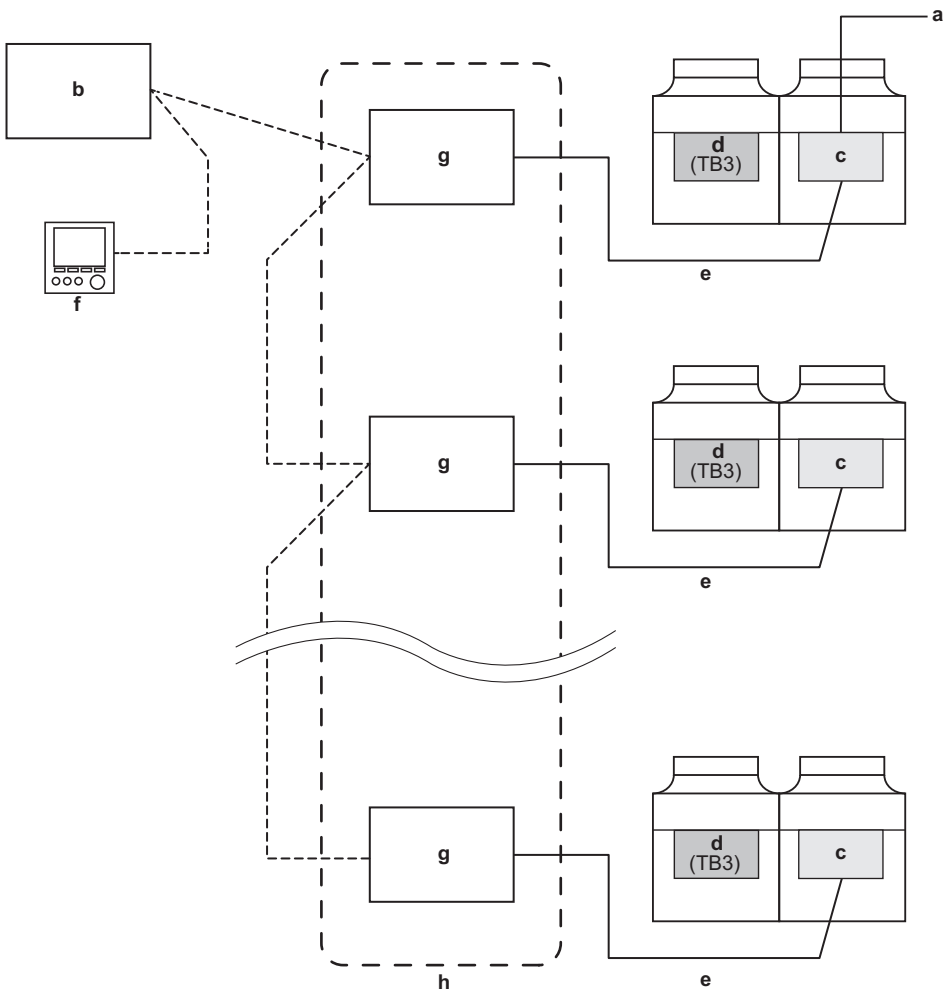
a External water temp. thermistor
b FTC (Primary)
c Sub control box
d PCB
e Outdoor unit
f Main RC

See the FTC manual for information about FTC.

(4) Multiple system with FTC connection

For 2 ~ 6 units

Consists of one main FTC that connects to the main remote controller, and up to six units, each with connection to a secondary FTC. The unit connected to an external temp. thermistor is the main unit.



a External water temp. thermistor
b FTC (Primary)
c Sub control box
d PCB
e Outdoor unit
f Main RC
g FTC (Secondary)
h Max. six secondary FTCs

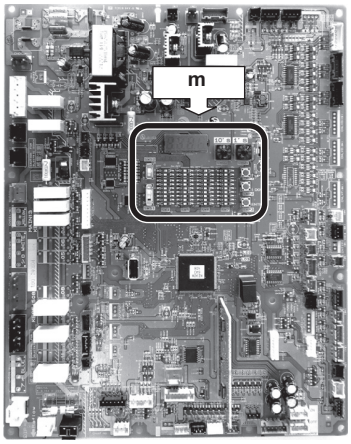
See the FTC manual for information about FTC.

[5] Switch Types and Default Settings

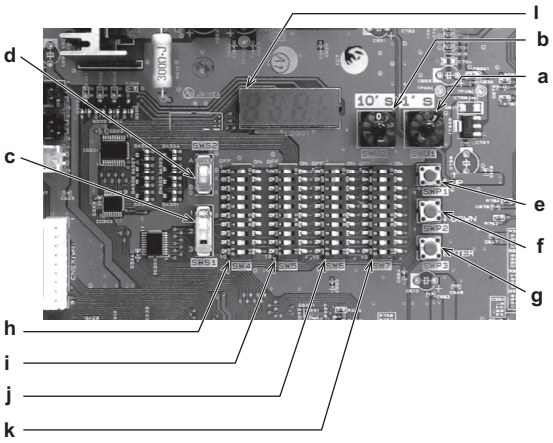
(1) Switches on the PCB

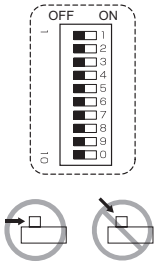
Dip switches (SW4-SW7)
Push switches (SWP1-SWP3)
Rotary switches (SWU1, SWU2)
Slide switches (SWS1, SWS2)

Switches on the PCB



Enlarged view





Slide (not push down) the dip switches.

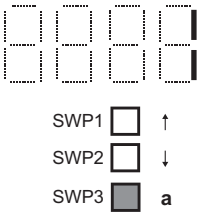
	Switch	Function	Default
a	Rotary switch (SWU1)	Sets the ones place of the unit address (multiple system)	1
b	Rotary switch (SWU2)	Sets the tens place of the unit address (multiple system)	0
c	Slide switch (SWS1)	Used to select Remote, OFF, or LOCAL. (Switch positions and corresponding functions depend on the system configuration.)	REMOTE
d	Slide switch (SWS2)	Not used	A
e	Push switch (SWP1)	Switches the display between the item code and the current value for a specific item, or increases the current value	-
f	Push switch (SWP2)	Switches the display between the item code and the current value for a specific item, or decreases the current value	-
g	Push switch (SWP3)	Advances the item code or saves the change	-
h	Dip switches (SW4)	Sets the LED display contents	
i	Dip switches (SW5)	Sets the LED display contents	
j	Dip switches (SW6)	Sets the LED display contents	
k	Dip switches (SW7)	Sets the LED display contents	
l	-	LED display	
m	-	Switches	

[6] Configuring the Settings

1. Setting configuration procedures

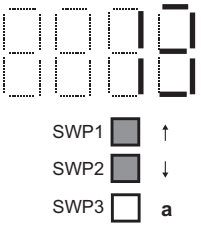
Use push switches SWP1, SWP2, and SWP3 to change or view the current settings on the circuit board.

1.



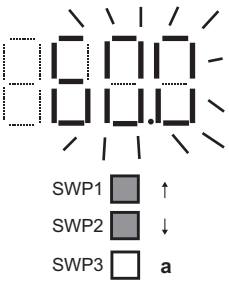
Normally, the LED shows an item code. (“1” in the left figure)
Press SWP3 to advance the item code to the desired code.

2.



Press SWP1 or SWP2 to display the current setting for the selected item code. ("13" in the left figure)

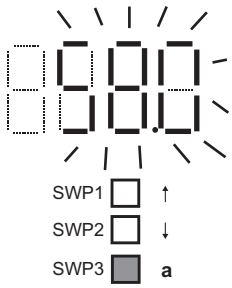
3.



Current setting will blink. (“60.0” in the left figure)
To change the setting, press SWP1 to increase and SWP2 to decrease the value while the LED is blinking.

- Some settings cannot be changed.
- Press and hold to fast-forward.

4.

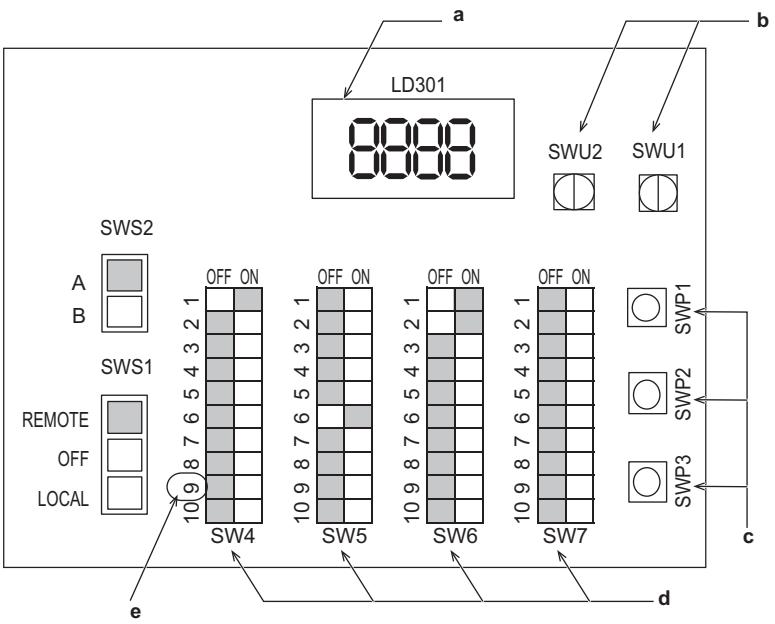


To save the change, press SWP3 while the item code is blinking. The LED will stop blinking and the change will be saved.

- If SWP3 is not pressed within one minute, the change will not be saved, and the LED will display the item code.
- If no buttons are pressed within one minute, the LED will automatically stop blinking, and an item code will stay lit.
- To change the values of other items, repeat the steps above.

a Enter

2. LED and switches on the control board



a LD301
b Rotary switches SWU1, SWU2: Use SWU1 to set the ones place of the address and use SWU2 to set the tens place.
c Push switches SWP1, SWP2, SWP3
d Dip switches SW4, SW5, SW6, SW7
e (Dip switch name example: SW4-9)

3. System configuration procedures: Individual system

(1) Set the dip switches on the control board for the items below.

- Water temp. control based on external water temp.
- Water temp. control based on inlet water temp.

Refer to the following page(s) for detail. "Default dip switch settings" (p. 91)

(2) Switch on the power to the unit.

[EEEE] will appear on LD301.

(3) Set the values for individual item codes as necessary.

1) Press SWP1, SWP2, or SWP3. [EEEE] will disappear and [101] will appear on LD301.
2) Press SWP3 to toggle through and select an item code.
([101]→[102]→[105]→[107]→[108]→Back to [101])
3) Press SWP1 to increase and SWP2 to decrease the value.
4) Press SWP3 to save the change.

(4) Perform an initial setup on the main unit

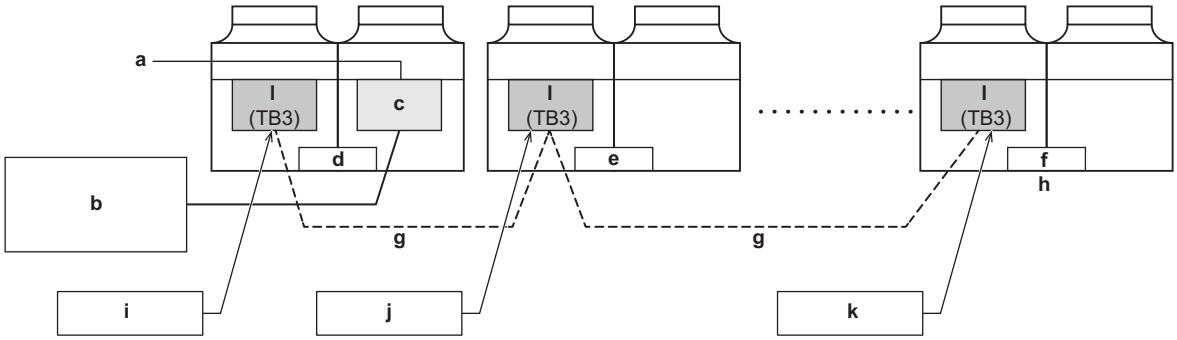
1) Set SW7-1, -2, -3, and -4 to ON.
[EEEE][*1] will appear on LD301.
2) Press and hold SWP3 for one second.
While the system is starting up, [9999] will appear on LD301.
3) Set SW7-1, -2, -3, and -4 to OFF.
The step above completes the initial setup, and the settings for clock, peak-demand control, schedule, and thermistor, etc. can now be set.

*1: If the start-up process has already been completed, [FFFF] will appear.

4. System configuration procedures: Multiple system

For 2 ~ 7 units

(1) Schematic of a multiple system



a External water temp. thermistor
b Dry contact switch/relay or remote controller (not supplied)
c Sub control box
d Main unit
e Sub unit
f Sub unit(s)
g M-NET lines
h "n"th unit
i SW5-8: ON, SW5-9: ON, Address: 1
j SW5-9: ON, Address: 2
k SW5-9: ON, Address: 1 + n
l PCB

(2) Set the switches on the main unit

1) Ensure that the address of the main unit is set to "1."
2) Set SW5-8 to ON. (external water temp. thermistor)
3) Set SW5-9 to ON. (multiple unit control)

Refer to the following page(s) for detail. "Default dip switch settings" (p. 91)

(3) Set the switches on all sub units

1) Set SW5-9 to ON. (multiple unit control)
2) Set the ones place of the address with SWU1 and tens place with SWU2. Assign sequential addresses to all sub units starting with 2.

(4) Switch on the power to the unit.

Check for proper wiring, and switch on the power to all units.
The following codes will appear on LD301.
- [EEEE] on the main unit
- [9999] on the sub units

(5) Set the values with the switches on the control board.

1) Press SWP1, 2, or 3.
[EEEE] will disappear, and an item code ([101]) will appear on LD301.
2) Press SWP3 to toggle through and select an item code.
[101]→[102]→[105]→[107]→[108]→Back to [101]
3) Press SWP1 to increase and SWP2 to decrease the value.
4) Press SWP3 to save the change.

Set the item [107] setting (total number of main and sub units in the system) when connecting multiple units to a system.
Leave the item [108] setting (secondary FTC unit group) to the default setting = 0.

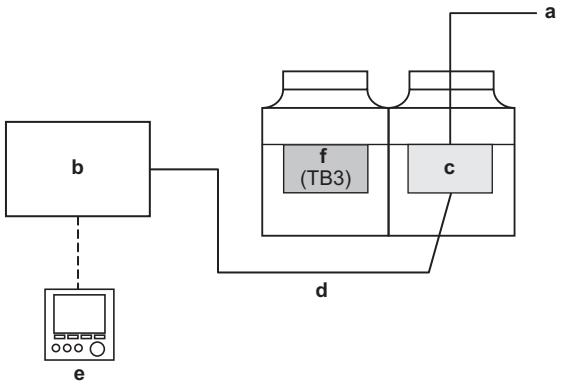
(6) Perform an initial setup on the main unit

1) Set SW7-1, -2, -3, and -4 to ON.
[EEEE]*1 will appear on LD301.
2) Press and hold SWP3 for one second.
While the system is starting up, [9999] will appear on LD301.
3) Set SW7-1, -2, -3, and -4 to OFF.
The step above completes the initial setup, and the settings for clock, peak-demand control, schedule, and thermistor, etc. can now be set.

*1: If the start-up process has already been completed, [FFFF] will appear.

5. System configuration procedures: Individual system (with connection to FTC)

(1) Schematic of an individual system with FTC connection



a External water temp. thermistor
b FTC (Primary)
c Sub control box
d Outdoor unit
e Main RC
f PCB

The unit connects to a primary FTC unit.

(2) Set the switches on the control board

Set SW6-1 on the primary FTC board to ON.

(3) Switch on the power to the unit.

Check for proper wiring, and switch on the power to all units.
[EEEE]*1 will appear on LD301.

(4) Set the values with the switches on the control board.

1) Press SWP1, 2, or 3.
[EEEE] will disappear, and an item code ([101]) will appear on LD301.
2) Press SWP3 to toggle through and select an item code. [101]→[102]→[105]→[107]→[108]→Back to [101]
3) Press SWP1 to increase and SWP2 to decrease the value.
4) Press SWP3 to save the change.
Leave the item [107] setting (number of units in the system) to the default setting = 1.
Leave the item [108] setting (secondary FTC unit group) to the default setting = 0.

(5) Perform an initial setup

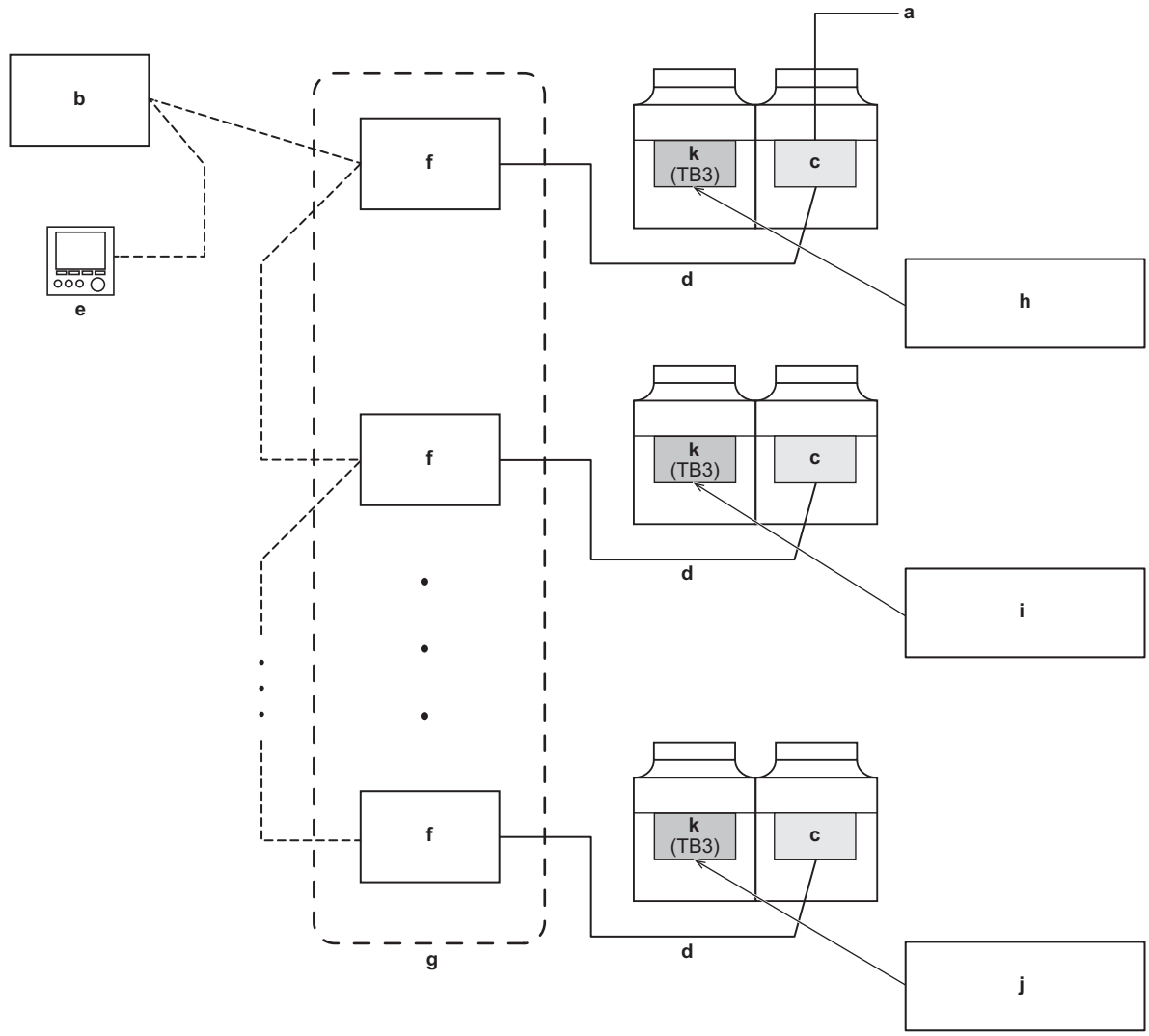
1) Set SW7-1, -2, -3, and -4 to ON.
[EEEE]*1 will appear on LD301.
2) Press and hold SWP3 for one second.
While the system is starting up, [9999] will appear on LD301.
3) Set SW7-1, -2, -3, and -4 to OFF.
The step above completes the initial setup, and the settings for clock, peak-demand control, schedule, and thermistor, etc. can now be set.

*1: If the start-up process has already been completed, [FFFF] will appear.
Refer to the FTC manual for detail.

6. Multiple system with FTC connection

For 2 ~ 6 units

(1) Schematic of a multiple system with FTC connection



a External water temp. thermistor
b FTC (Primary)
c Sub control box
d Outdoor unit
e Main RC
f FTC (Secondary)
g Max. six sub units
h Address: 1 secondary FTC unit group: 1
i Address: 1 secondary FTC unit group: 2
j Address: 1 secondary FTC unit group: 6
k PCB

- The main unit is the unit with connection to an external water temp. thermistor.
- Each unit connects to a secondary FTC unit.

(2) Set the switches on all units

1) Make sure the address of the main unit is set to "1."
2) Set SW5-8 to ON. (external water temp. thermistor)
Refer to the following page(s) for detail. "Default dip switch settings" (p. 91)
3) Set SW6-1 on both the primary and secondary FTC boards to ON.

(3) Switch on the power to the unit.

Check for proper wiring, and switch on the power to all units.
[EEEE]*1 will appear on LD301 of the main unit.

(4) Set the values with the switches on the control board.

1) Press SWP1, 2, or 3.
[EEEE] will disappear, and an item code ([101]) will appear on LD301.
2) Press SWP3 to toggle through and select an item code.
[101]→[102]→[105]→[107]→[108]→Back to [101]
3) Press SWP1 to increase and SWP2 to decrease the value.
4) Press SWP3 to save the change.
Leave the item [107] setting (number of units in the system) to the default setting =1.
Set the item [108] setting (secondary FTC unit group) when connecting multiple units to a system.

(5) Perform an initial setup on the unit

1) Set SW7-1, -2, -3, and -4 to ON.
[EEEE]*1 will appear on LD301.
2) Press and hold SWP3 for one second.
While the system is starting up, [9999] will appear on LD301.
3) Set SW7-1, -2, -3, and -4 to OFF.
The step above completes the initial setup, and the settings for clock, peak-demand control, schedule, and thermistor, etc. can now be set.

*1: If the start-up process has already been completed, [FFFF] will appear.
Refer to the FTC manual for detail.

7. Re-initializing the system

Changing the settings for the items below requires system re-initialization.
- SW5-8 (use or non-use of external water temp. thermistor) (Applicable only to multiple systems)
- SW5-9 (multiple unit control)
- SW6-3 (water temp. control method)
- System setting [107] (total number of units in the system)
- SWU1 and SWU2 (unit address)
- System setting [108] (secondary FTC unit group)

Steps

1) Set SW7-1, 2, 3, 4 to ON.
[FFFF] will appear on LD301.
2) Press and hold SPW3 for 3 seconds.
While the system is starting up, [EEEE] will appear on LD301.
3) Press and hold SPW3 for one second.
[9999] will appear on LD301.
4) Set SW7-1, 2, 3, 4 to OFF.

8. Resetting the system

Follow the steps below to reset the system or an error.
Note that errors must be reset on the main unit.
When an error on the main unit is reset, all sub units will stop.

Steps

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

9. Factory reset

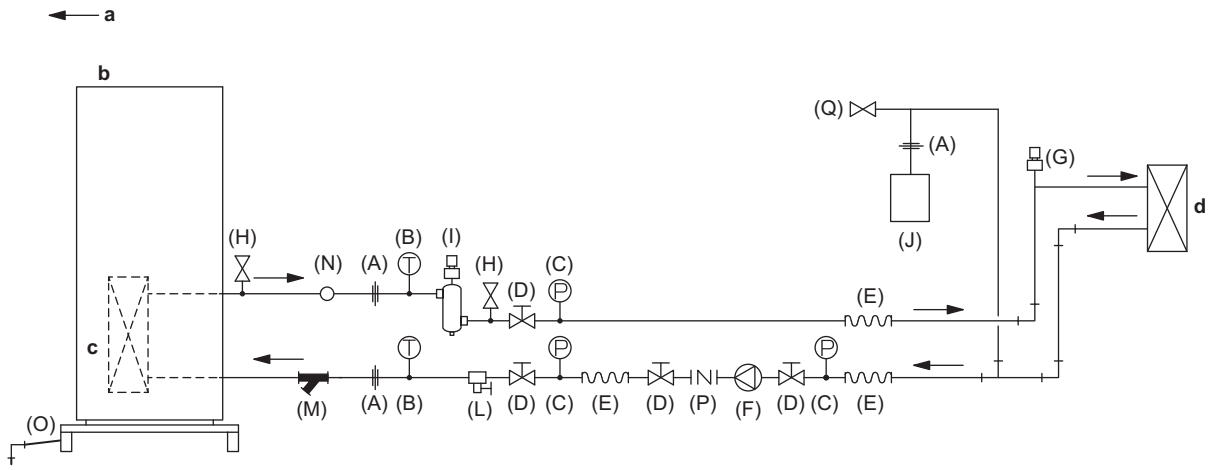
Factory reset the system as follows when necessary. All settings and information on cumulative operation time, etc. will be lost when the system is factory reset. Before resetting the system, be sure to write down the current settings, cumulative operation time, and other necessary information.

(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. Piping System Schematic



a Water flow direction
b Outdoor unit
c Water heat exchanger
d AC units, floor heater, etc.

(A)	Union joints/flange joints	Allows for equipment replacement
(B)	Thermistor	For performance check and unit operation monitoring
(C)	Water pressure gauge	For operation status monitoring (recommended)
(D)	Valve	Allows for replacement/cleaning of flow adjuster
(E)	Flexible joint	Reduces the noise and vibration from the pump from being transmitted (recommended)
(F)	Pump	Must be large enough to accommodate the total water pressure loss and capable of supplying sufficient water to the unit
(G)	Automatic air vent valve (AAV)	To be installed where air tends to accumulate
(H)	Pressure relief valve (PRV)	For addressing a refrigerant leak from water heat exchanger and regulating water pressure. The PRVs are to be field-supplied. Refer to the following page(s). "System configuration" (p. 29)
(I)	AAV with air separator	For addressing a refrigerant leak from water heat exchanger. The AAV with air separator is to be field-supplied. Refer to the following page(s). "System configuration" (p. 29)
(J)	Closed expansion tank	Accommodates expanded water supplies
(K)	Water pipe	Use pipes designed for easy air purging, and ensure proper insulation. Ensure that gaps between water pipe and the unit are filled. (e.g. Racking)
(L)	Drain valve	For draining water for servicing
(M)	Strainer	To be installed near the unit to keep debris from entering the water heat exchanger
(N)	Flow switch	Ensures sufficient water flow
(O)	Drain pipe	Install the drain pipe at a downward slope between 1/100 and 1/200. To keep drain water from freezing, install the pipes at a downward angle and minimize horizontal sections. For cold climate installation, take an appropriate measure (e.g., drain heater) to prevent the drain water from freezing.
(P)	Check valve	Prevents water backflow
(Q)	Safety valve	To be installed near the closed expansion tank

2. Maintaining Water Quality

· Water quality control

Poor-quality circulating water can corrode or scale up the water heat exchanger and compromises its performance. Proper water quality control and regular water treatment are required. During installation, remove debris (e.g., welding and sealant fragments, rust) out of the pipes.

Water circulation systems with 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. When using a water supply tank, minimize air exposure, and maintain dissolved oxygen levels in the water at or below 1 mg/ℓ.

(1) Water quality standard

Item			Lower mid-range temp. water system Water Temp. ≤ 60ºC		Higher mid-range temp. water system Water Temp. > 60ºC		Corrosive tendency	Scale-forming tendency
			Circulating water	Make-up water	Circulating water	Make-up water		
Standard	pH	(25°C)	7.0 – 8.0	7.0 – 8.0	7.0 – 8.0	7.0 – 8.0	○	○
	Electrical conductivity	(mS/m) (25°C)	≤ 30	≤ 30	≤ 30	≤ 30	○	○
		(μs/cm) (25°C)	≤ 300	≤ 300	≤ 300	≤ 300		
	Chloride ion	(mg Cl^-/ℓ)	≤ 50	≤ 50	≤ 30	≤ 30	○	
	Sulfate ion	(mg $SO4^{2-}$/ℓ)	≤ 50	≤ 50	≤ 30	≤ 30	○	
	Acid consumption	(pH4.8) (mg $CaCO_3$/ℓ)	≤ 50	≤ 50	≤ 50	≤ 50		○
	Total hardness	(mg $CaCO_3$/ℓ)	≤ 70	≤ 70	≤ 70	≤ 70		○
	Calcium hardness	(mg $CaCO_3$/ℓ)	≤ 50	≤ 50	≤ 50	≤ 50		○
	Ionic silica	(mg SiO_2/ℓ)	≤ 30	≤ 30	≤ 30	≤ 30		○
Reference	Iron	(mg Fe/ℓ)	≤ 1.0	≤ 0.3	≤ 1.0	≤ 0.3	○	○
	Copper	(mg Cu/ℓ)	≤ 1.0	≤ 0.1	≤ 1.0	≤ 0.1	○	
	Sulfide ion	(mg S^{2-}/ℓ)	Undetectable	Undetectable	Undetectable	Undetectable	○	
	Ammonium ion	(mg NH_4^+/ℓ)	≤ 0.3	≤ 0.1	≤ 0.1	≤ 0.1	○	
	Residual chlorine	(mg Cl/ℓ)	≤ 0.25	≤ 0.3	≤ 0.1	≤ 0.3	○	
	Free carbon dioxide	(mg CO_2/ℓ)	≤ 0.4	≤ 4.0	≤ 0.4	≤ 4.0	○	
	Ryznar stability index		–	–	–	–	○	○

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

(2) Consult a water quality control specialist before using anti-corrosive solutions.

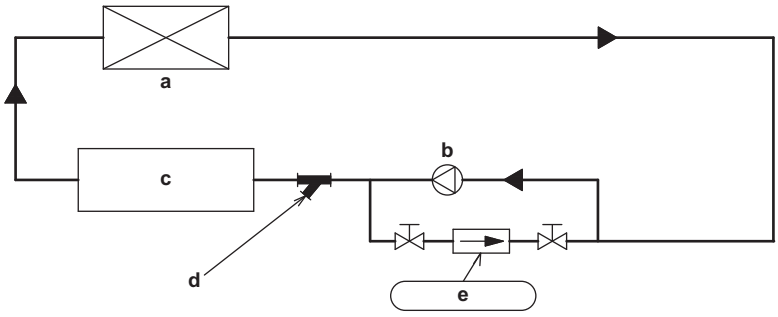
(3) Before replacing the hot water heat pump unit (or only the heat exchanger), analyze the water quality to see if the water is the problem.

Note that corrosion can suddenly occur in water systems with no obvious signs of corrosion. If improving the water quality solves the problem, there is no need to replace the unit.

(4) Debris Removal

Debris and corrosive substances in water can damage or corrode the heat exchanger surface. Install a 20 mesh or finer strainer at the inlet of the unit.

Consider installing a settlement tank or a bypass strainer capable of handling two to three percent of the circulating water to remove debris from the water system.



a Hot water heat pump unit
b Water pump
c Heat pump unit
d 20 mesh or finer strainer
e Bypass strainer

3. Installing the Strainer and Flow Switch

(1) Strainer

Install an optional strainer near the unit in the inlet water pipe to keep the heat exchanger from clogging and corrosion.

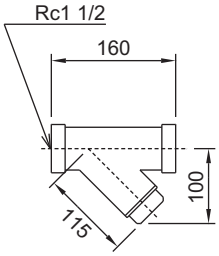
Operating the units with a clogged strainer may cause the units to make an abnormal stop.

Install the strainer for easy cleaning access, and advise the user to clean it regularly.

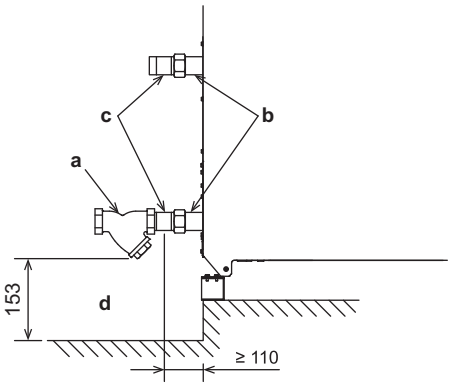
Consider the installation angle, insulation thickness, and maintenance access space.

- Y-strainer dimensions

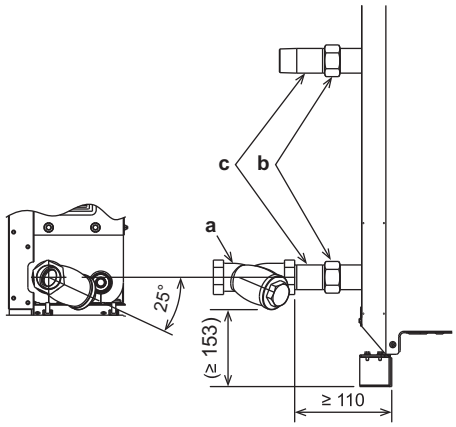
<Unit: mm>



- Space required around the Y-strainer for screwing it in



Example 1



Example 2

a Y-strainer (Option: YS-40A)
b Pipe
c Pipes (not supplied)
d Y-strainer maintenance access space

(2) Flow switch

Install a flow switch (not supplied) in the water pipe, and connect the flow switch to the contact point on the unit.

The water volume range of the unit is 4.0 - 10.0 m^3/h.

4. Installing the External water temperature thermistor

(1) Required parts for installing an external-water temperature thermistor TW-TH16

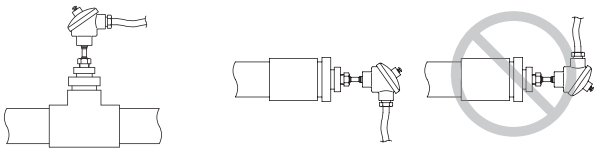
1) External-water temperature thermistor
2) Cable for connecting between the sensor and the unit *1
3) Cable terminal for connecting to the sensor and the unit terminal block *1
(Terminals for M4 screws × 4) *1
*1: 1) and 2) are field-supplied.

Cable specifications

Size	2-core, 1.25 mm^2 or larger
Type	CVVS or CPEVS
Length	20 m

(2) Installing an external-water temperature thermistor

As shown in the figures below, install the sensor at the merged part of water pipes or the load-side tank.
The sensor can be installed in either the vertical or the horizontal position. When installing the sensor in the horizontal position, make sure to place the cable-access-hole side down.

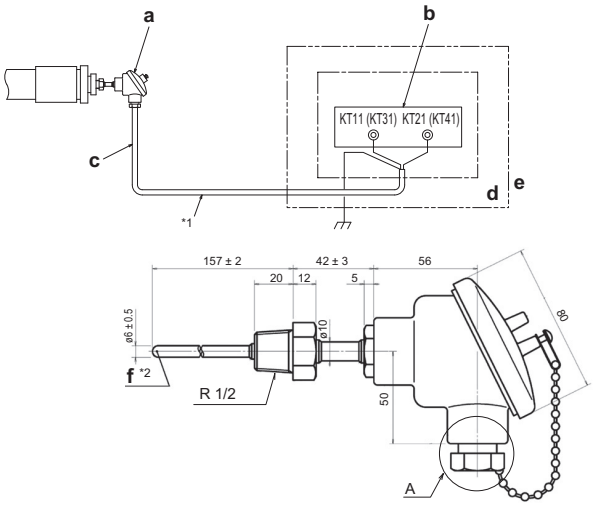


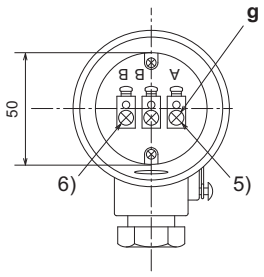
Vertical installation **Horizontal installation**

(3) Wiring for an external-water temperature thermistor

As shown in the figures below, connect the cable to the external-water temperature thermistor and the terminal block in the unit control box.

Unit: mm





Terminal block on the sensor

a External water temperature thermistor
b Terminal block in the control box on the unit
c Sensor wire
d Control box
e Unit
f Sensor
g 3 - M4 screw (Screw for cable terminal installation)
*1:Install the sensor cable at least 5 cm away from the power cable to which 100 V or higher voltage is applied.
*2:Sensor properties
Resistance: R = 15 KΩ ± 3% (0 °C)
B-constant: 3460 K

On the unit side, connect the sensor cable to the terminals T1 and T2 in the terminal block 18P in the unit sub box.

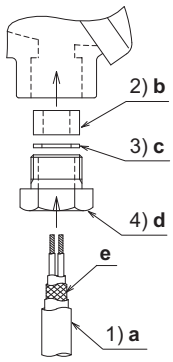
Connect the shielded cable to the ground terminal.

On the sensor side, as shown in the figure below, run the cable through 4), 3), and 2), attach the field-supplied terminals for M4 screws to the cable, and then connect the terminals to the screws 5) and 6) (terminal A and B).

Cut the shielded cable and leave it unconnected. (On the unit side, the shielded cable should be connected to the ground terminal already.)

Tighten the tightening screw 4), and caulk the gap between the tightening screw 4) and cable 1) to prevent water leakage.

*1: In a multiple module connection system, install the temperature thermistor where the cold/hot water from each module is sufficiently mixed to provide a representative temperature.
*2: The temperature thermistor must be installed on a pipe between the outlet of the unit and the entrance to the load-side system.
*3: To be used at or below the in-pipe water flow rate of 3m/sec.

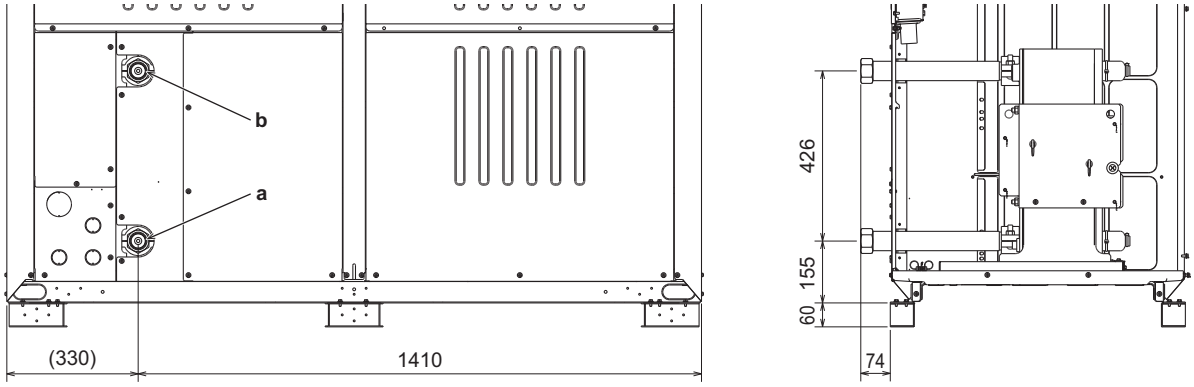


a Cable (field-supplied)
b Watertight sealing rubber (Inner diameter ø11)
c Washer (Inner diameter ø12)
d Tightening screw (Inner diameter ø15)
e Shielded cable (cut)

Enlarged view of area A: Cable installation

5. Water Pipe Connection Ports

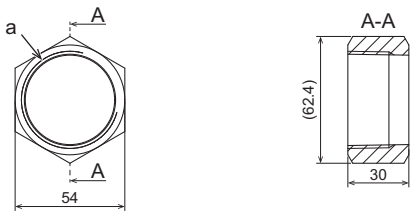
<Unit: mm>



With assembly of accessories.

a Water inlet (1-1/2B socket)
b Water outlet (1-1/2B socket)

(1) Water pipe connection specification

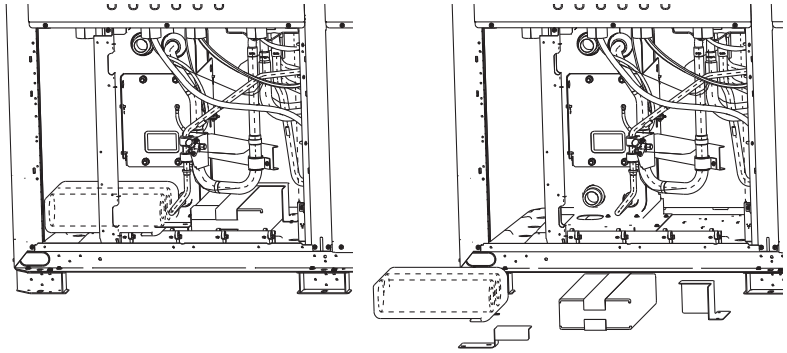


Recommended tightening torque: 150 N·m
a Rc1-1/2B

1) Open the bottom left panel of the unit and take the following parts out of the unit:

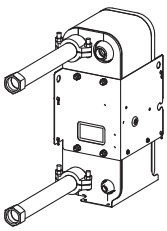
- A cardboard carton containing water pipes
- An insulation pipe
- Two types of fixing brackets for the cardboard carton
- Four securing screws for the bracket

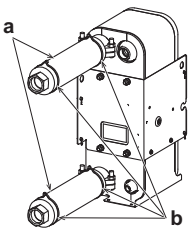
After removing the two types of fixing brackets and the four securing screws, dispose of them.



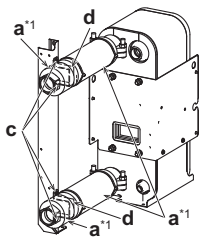
2) Take the water pipes and the pipe covers out of the cardboard carton and connect them to the plate heat exchanger using housing joints.

- Apply silicone spray to the rubber rings on the housing joints.
  Failure to do so may cause the rubber rings to twist, leading to breakage and a water leak.
- Recommended tightening torque for the housing joint bolt: 49 N · m
- Optional part: Saddle
  By attaching the supplied saddles as shown in the figures below, work efficiency is improved during water pipe installation.
  When using the saddles, cut the pipe covers to prevent interference with the saddles.





Without saddle



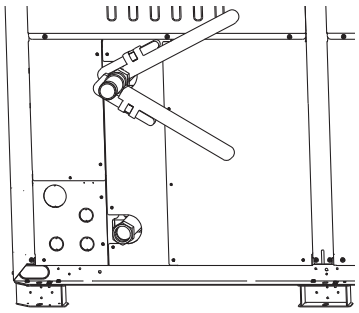
With saddle

a Pipe cover
b Band (not supplied)
c Screw
d Saddle

*1:When using the saddles, cut the pipe covers and attach them on both sides of the saddles on the pipes.

3) Close the bottom left panel to complete the installation of the supplied pipes.
Connect the field pipes using two pipe wrenches as shown in the figure at right.

- Recommended tightening torque for the pipe: 150 N · m ±10%
- After connecting the field pipes, provide piping supports to prevent them from sagging under their own weight.



6. Connecting Pipes of Different Materials

The contact surface of different types of metals will corrode. Install an insulating material between pipes of different materials to keep them out of direct contact.

7. Minimum Water Volume Requirements for Water Circuits

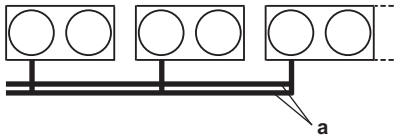
(1) Required water volume

Insufficient water in the water circuit may shorten unit operation time, cause drastic temperature fluctuations, or impair defrost function during heating. Refer to the table below for minimum water volume requirements. If the pipe is too short to hold sufficient water, install a cushion tank to ensure sufficient water volume.

Model	Min. water volume (ℓ)
CAHV-Z450YA-HPB(-BS)	525

Minimum water volume requirement for units that are installed in series under the condition with the outlet water temperature of 55ºC or higher: 360 × number of units.
(Ex. 360 × 3 = 1080 ℓ)
Up to 7 units can be installed within the same water circuit.

a Water pipe



(2) Calculating the necessary water volume for water circuits

Calculation formula
(Necessary amount of water in the water circuit) = (water capacity of water pipes) + (water capacity of heat source unit) + (water capacity of load-side unit)

Water capacity of water per meter (ℓ/m)

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

Water capacity of heat source unit (ℓ)

CAHV-Z450YA-HPB(-BS)
4.4

(3) Inlet/Outlet pipe fitting size

Model	Inlet	Outlet
CAHV-Z450YA-HPB(-BS)	40A, Rc 1-1/2B	40A, Rc 1-1/2B

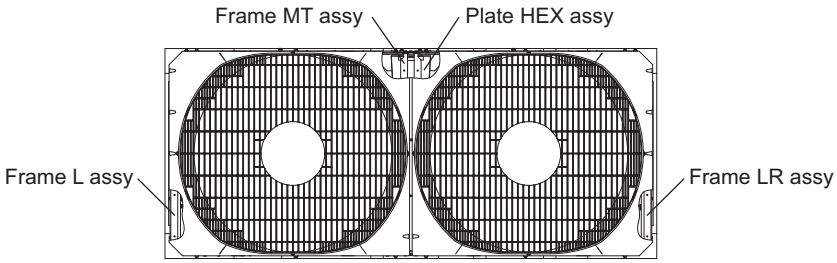
III Unit Components

[1] Unit Components and Refrigerant Circuit 55
[2] Control Box of the Unit 57
[3] Unit Circuit Board 58

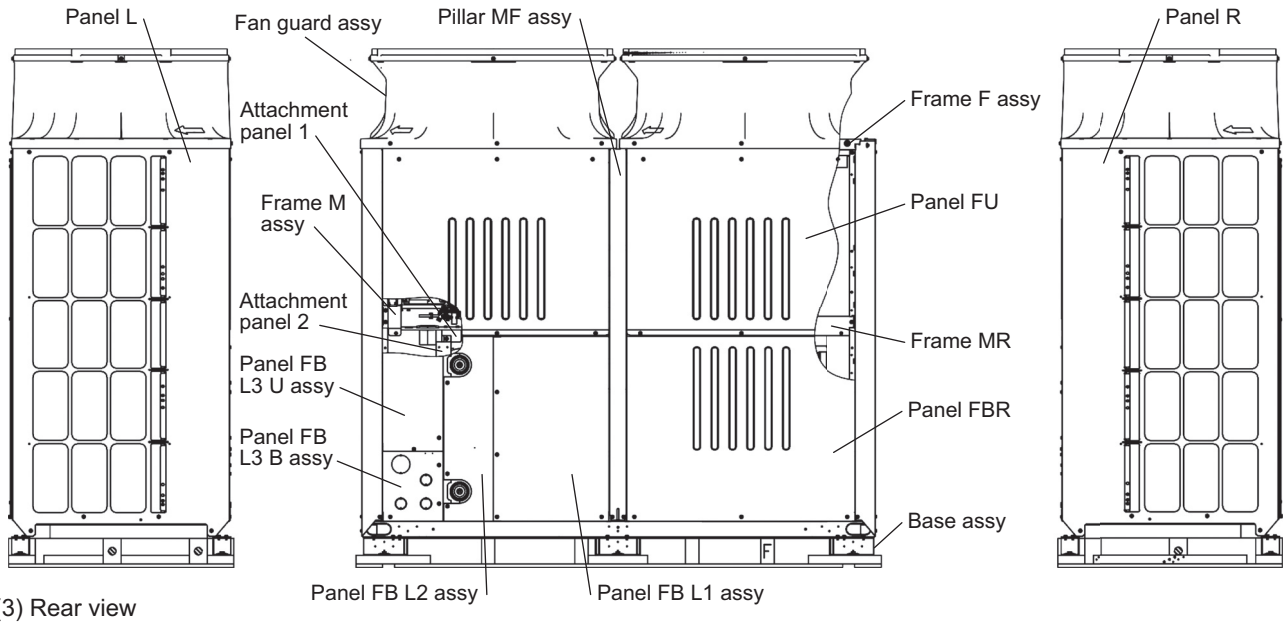
[1] Unit Components and Refrigerant Circuit

1. Unit Components

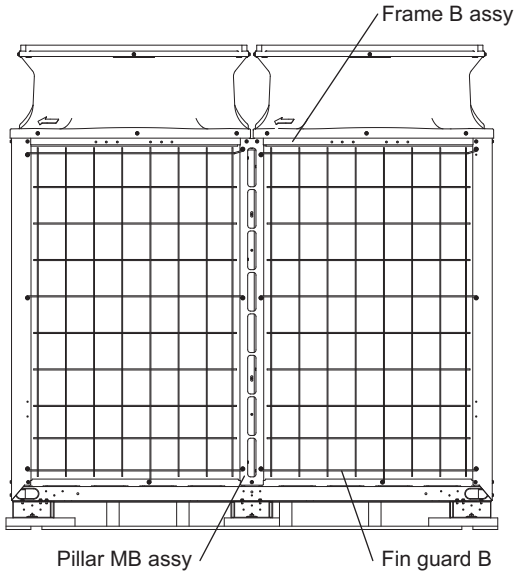
(1) Top view



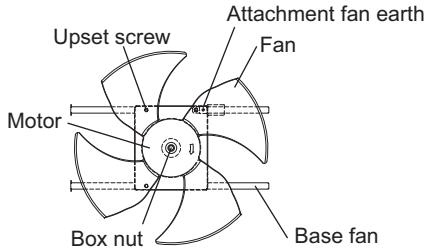
(2) Front and side view



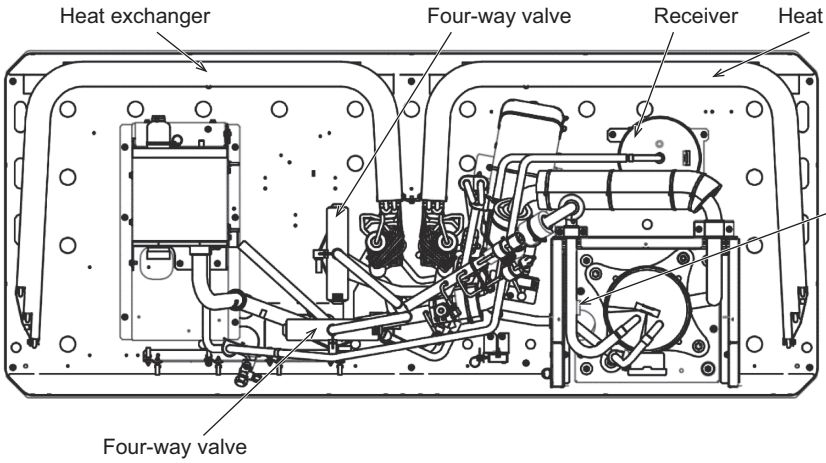
(3) Rear view

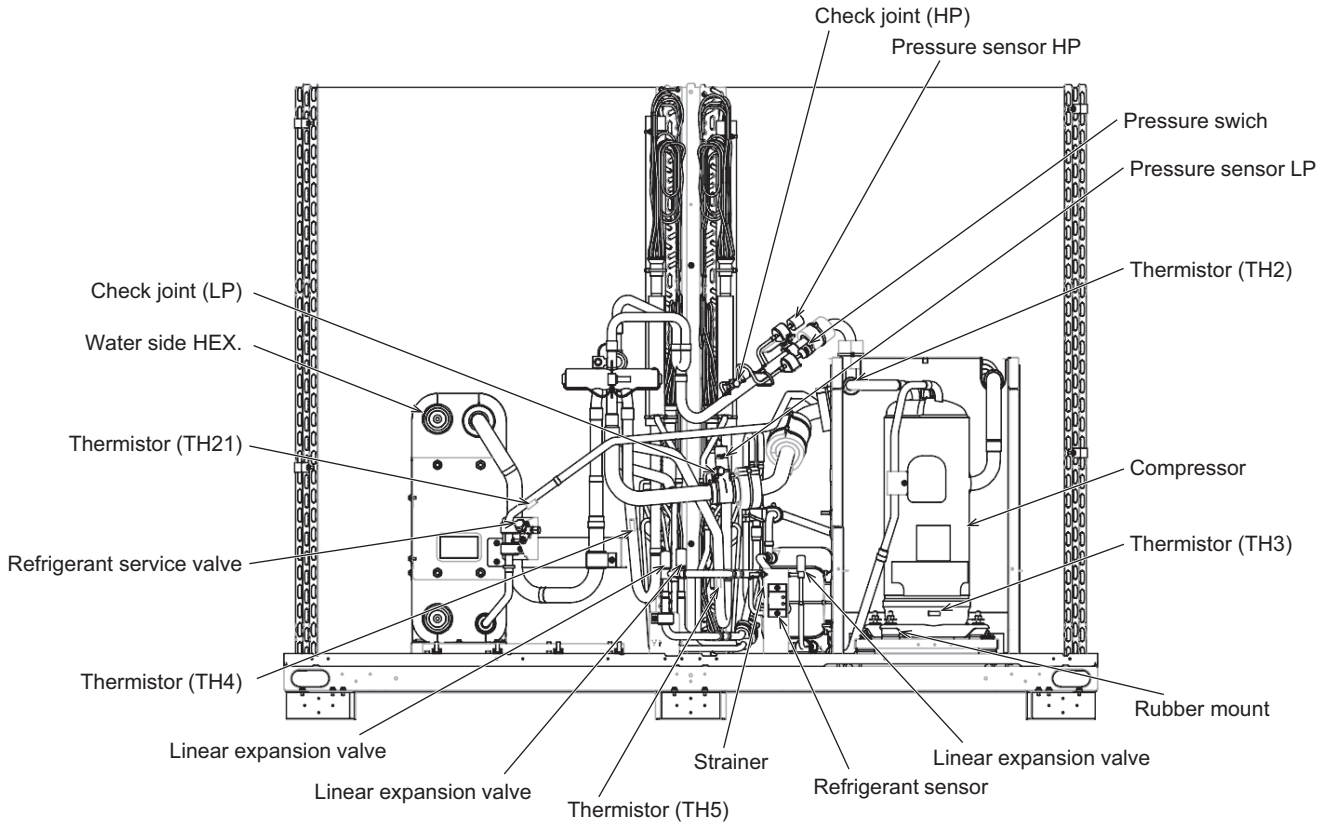


(4) Fan

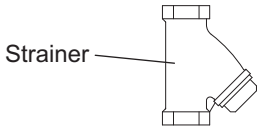


2. Refrigerant circuit



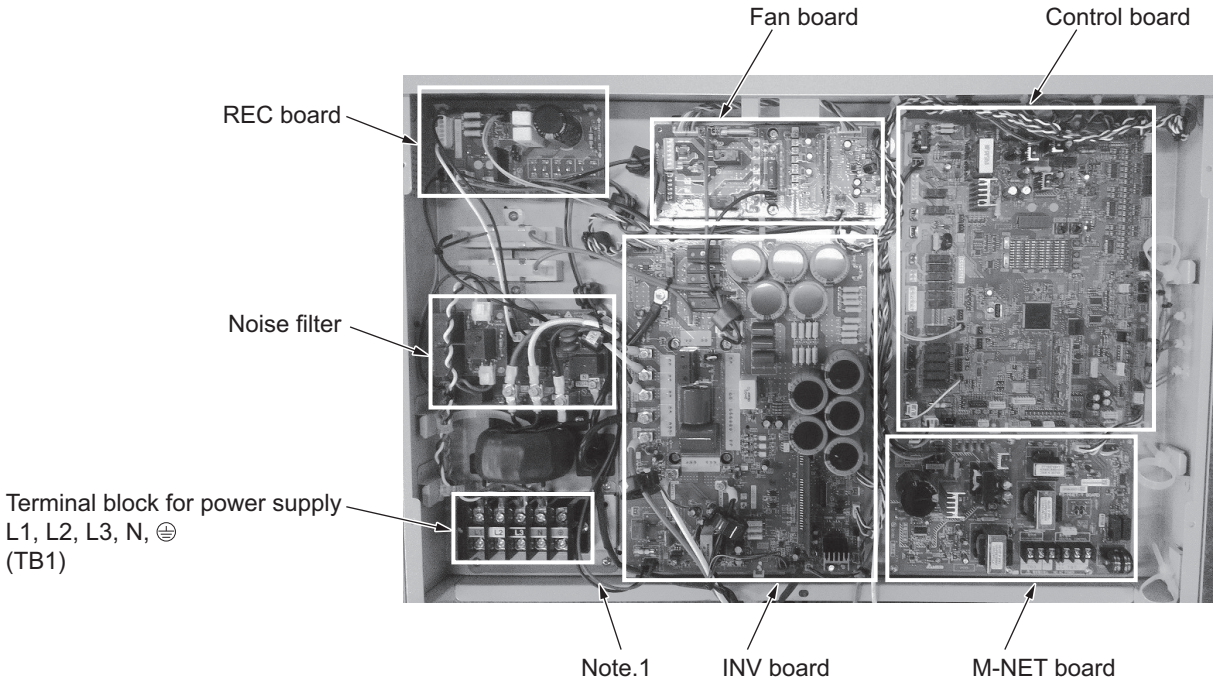


3. Water circuit (option)

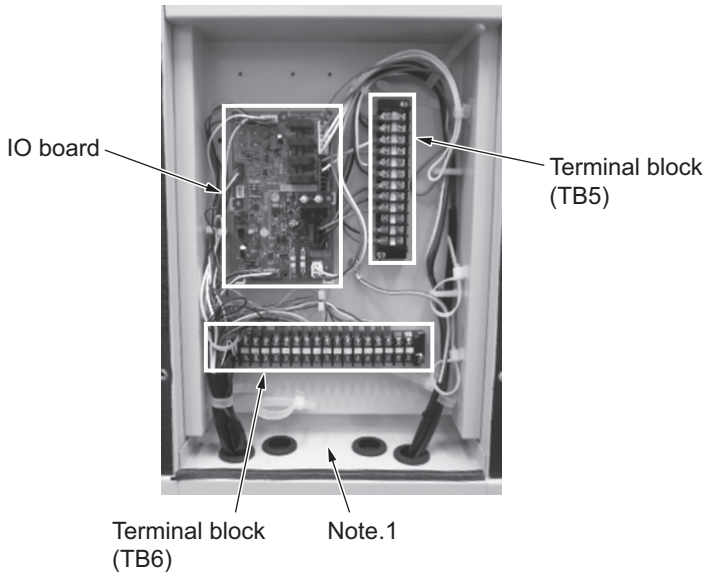


[2] Control Box of the Unit

1. Control box



2. Sub box

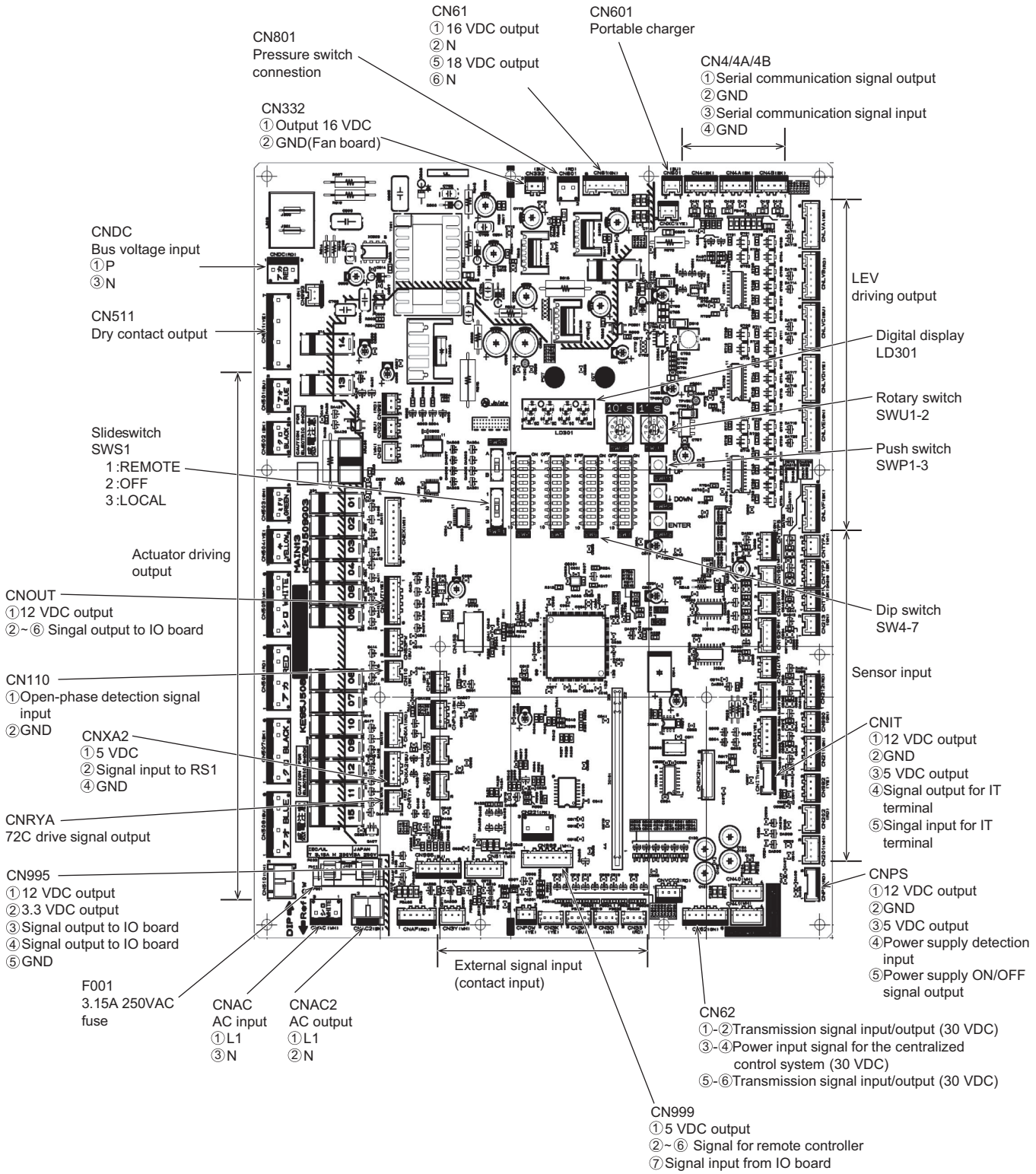


Note

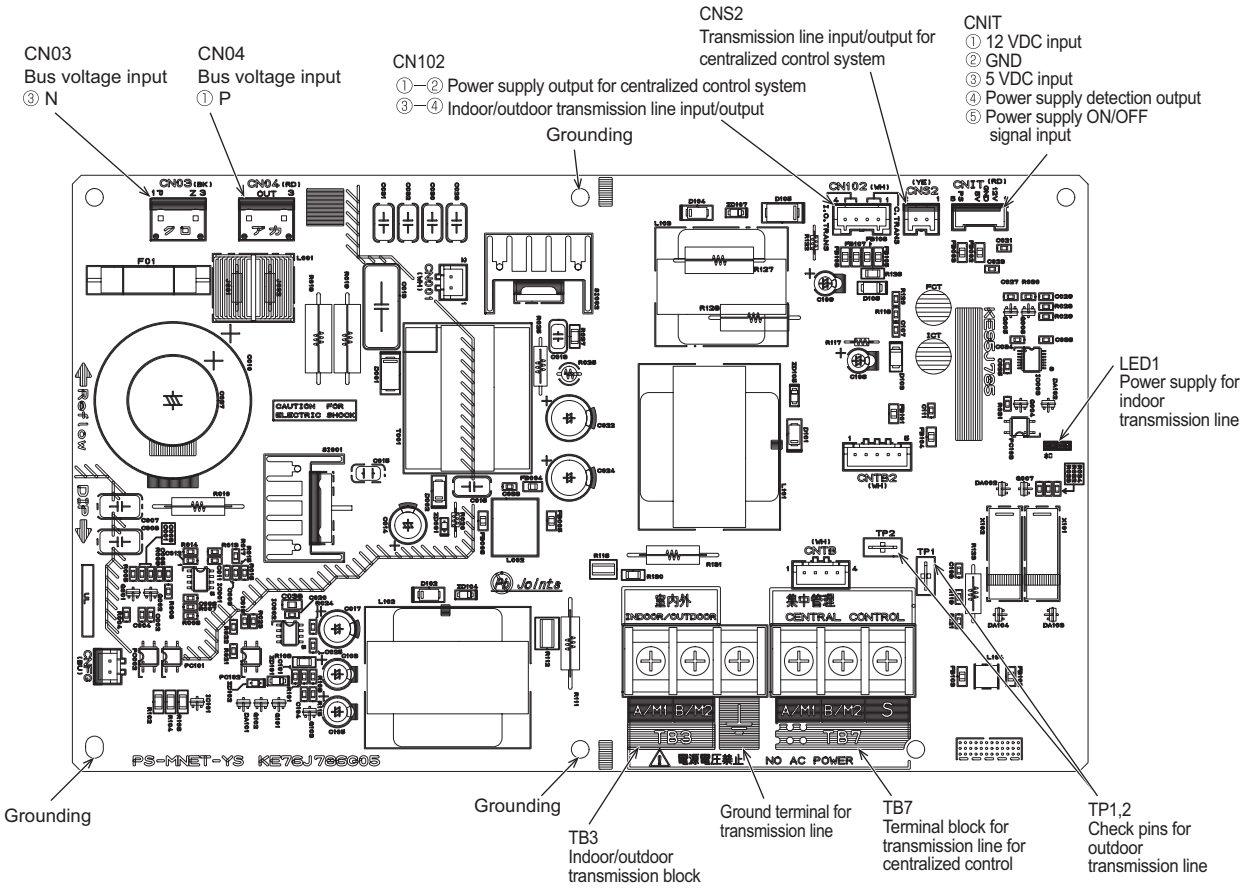
1) Exercise caution not to damage the bottom and the front panel of the control box. Damage to these parts affect the waterproof and dust proof properties of the control box and may result in damage to its internal components.
2) Faston terminals have a locking function. Make sure the cable heads are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

[3] Unit Circuit Board

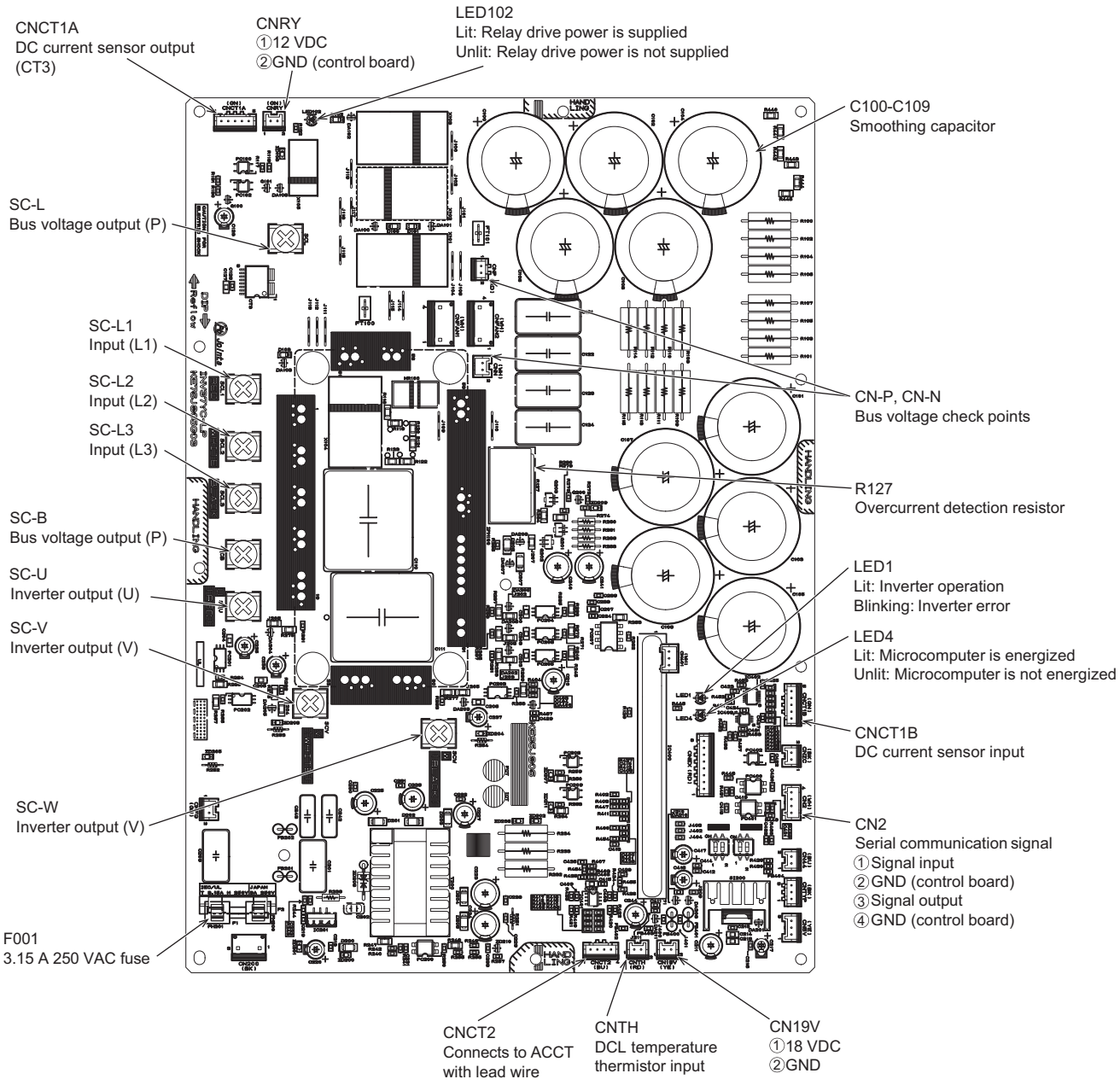
1. Control board (MAIN board)



2. M-NET board


CN03
Bus voltage input
③ N
CN04
Bus voltage input
① P
CN102
①—② Power supply output for centralized control system
③—④ Indoor/outdoor transmission line input/output
Grounding
CNS2
Transmission line input/output for centralized control system
CNIT
① 12 VDC input
② GND
③ 5 VDC input
④ Power supply detection output
⑤ Power supply ON/OFF signal input
LED1
Power supply for indoor transmission line
Grounding
Grounding
TB3
Indoor/outdoor transmission block
Ground terminal for transmission line
TB7
Terminal block for transmission line for centralized control
TP1,2
Check pins for outdoor transmission line
PS-MNET-YS KE76J786605
NO AC POWER

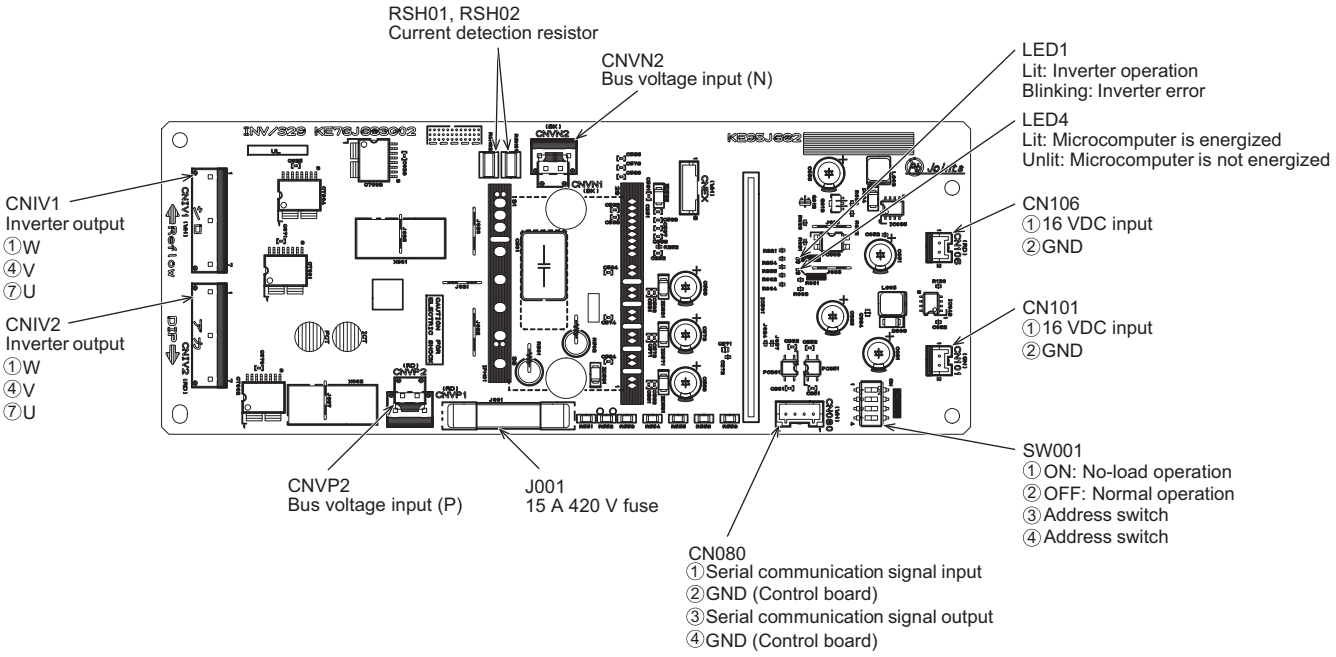
3. INV board



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 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.
2) 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.
3) Control box houses high temperature parts. Be well careful even after turning off the power source.
4) Perform the service after disconnecting the connector (CNINV1, CNINV2) 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.
5) After servicing, reconnect the relay connector (CNINV1, CNINV2) on the fan board as it was.
6) 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.

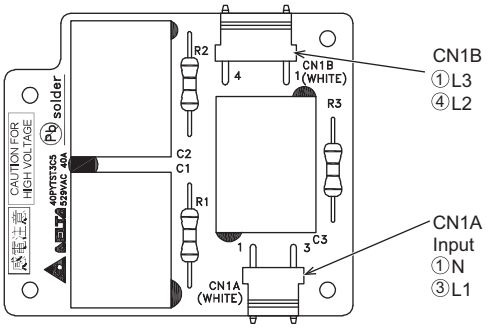
4. Fan board

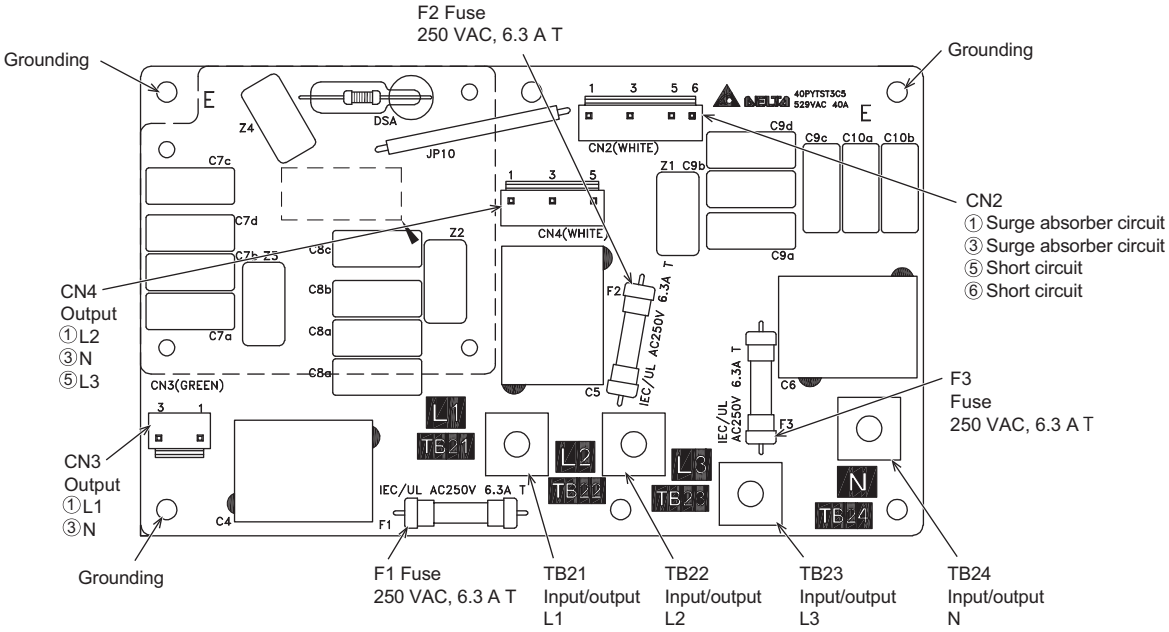


Note

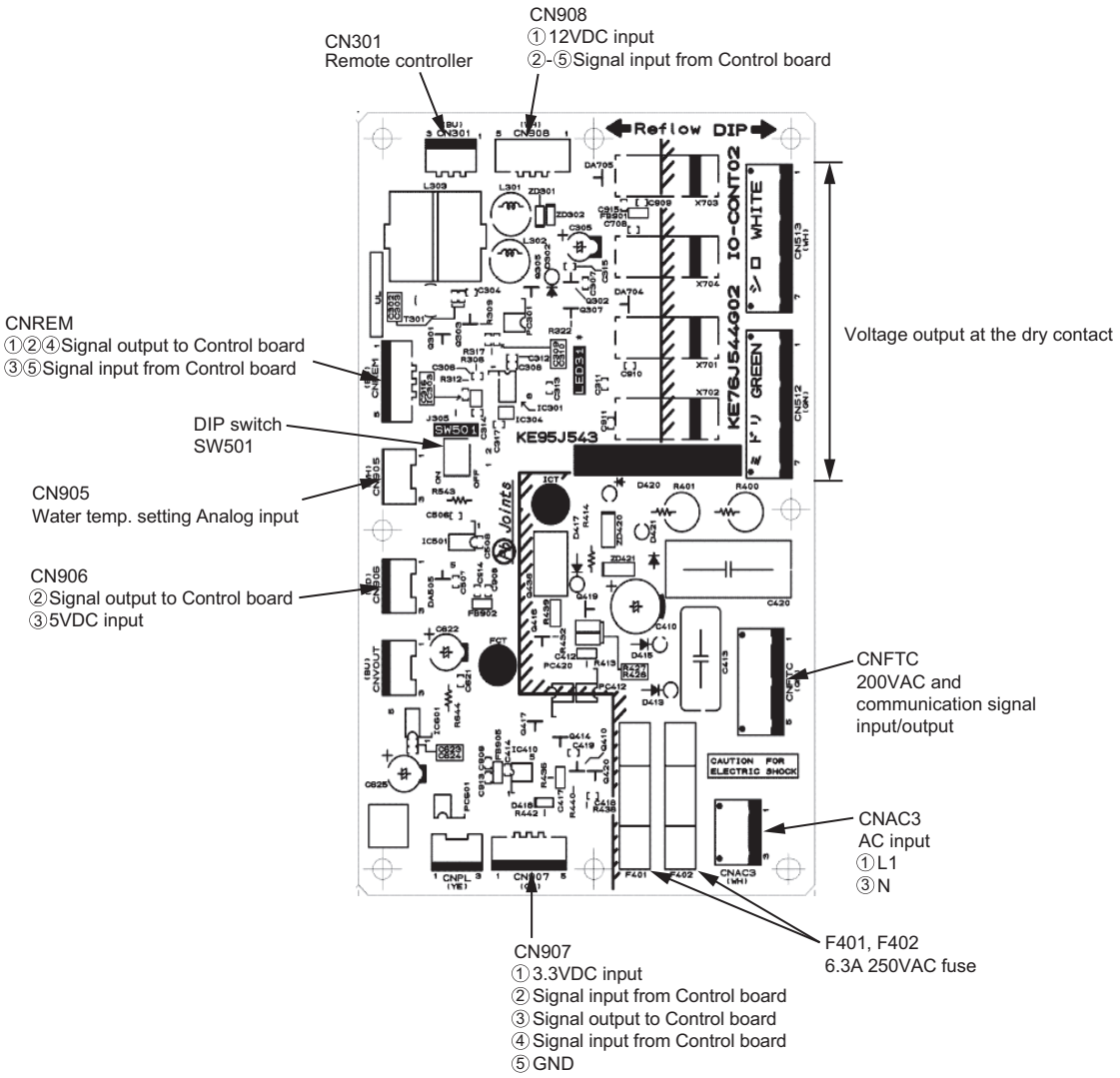
1) When opening or closing the front panel of the control box, do not let it come into contact with any of the internal components.
   Before inspecting the inside of the control box, turn off the power, keep the unit off for at least 10 minutes, and confirm that the capacitor voltage (inverter main 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) 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) on the fan board as it was.

5. Noise Filter

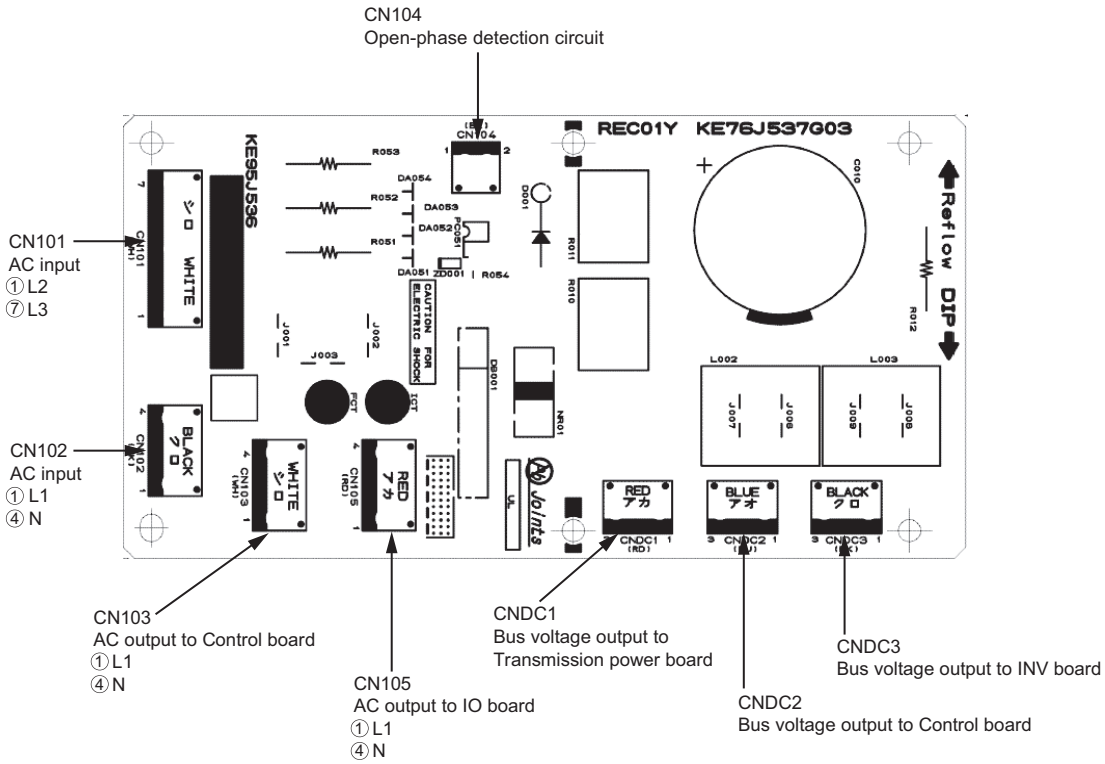




6. IO board


CN908
① 12VDC input
②-⑤ Signal input from Control board
CN301
Remote controller
Reflow DIP
IO-CONT02
KE76J544902
WHITE
GREEN
Voltage output at the dry contact
CNREM
①②④ Signal output to Control board
③⑤ Signal input from Control board
DIP switch
SW501
KE95J543
CN905
Water temp. setting Analog input
CN906
② Signal output to Control board
③ 5VDC input
CNFTC
200VAC and
communication signal
input/output
CAUTION FOR ELECTRIC SHOCK
CNAC3
AC input
① L1
③ N
F401, F402
6.3A 250VAC fuse
CN907
① 3.3VDC input
② Signal input from Control board
③ Signal output to Control board
④ Signal input from Control board
⑤ GND

7. REC board


CN104
Open-phase detection circuit
REC01Y KE76J537G03
KE95J536
CN101
AC input
① L2
⑦ L3
CN102
AC input
① L1
④ N
CN103
AC output to Control board
① L1
④ N
CN105
AC output to IO board
① L1
④ N
CNDC1
Bus voltage output to
Transmission power board
CNDC2
Bus voltage output to Control board
CNDC3
Bus voltage output to INV board
Reflow DIP
WHITE
BLACK
RED
BLUE

Ⅳ Remote Controller

[1] Remote Controller Operation 67

[1] Remote Controller Operation

Button functions

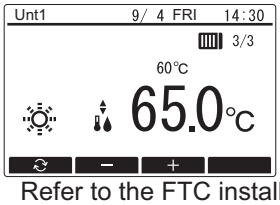
: Returns to the menu screen

: Saves the settings

: Returns to the previous screen

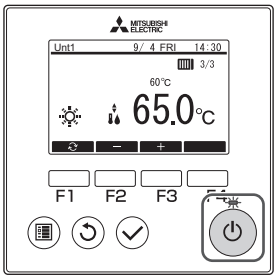
: Turns on/off the power

Main screen



Refer to the FTC installation manual for how to use the main remote controller with connection to FTC.

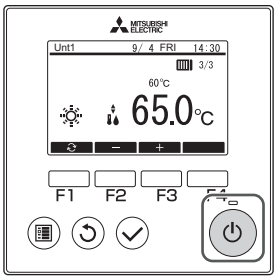
<1> Power ON/OFF



To start

Press [⏻].

The LED above [⏻] will light up in green, and operation will start.



To stop

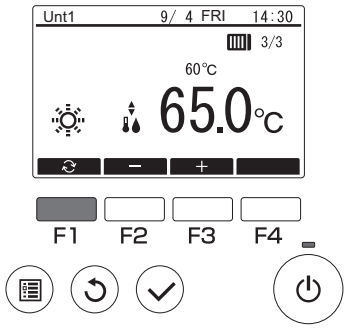
Press [⏻].

Press [F3] on the confirmation screen.

[⏻] will light off, and the operation will stop.

<2> Setting the operation mode and temperature

Operation mode



Press [F1] to select the operation mode from Heating, Heating ECO, Hot water and Anti-Freeze.
Each press advances the mode.

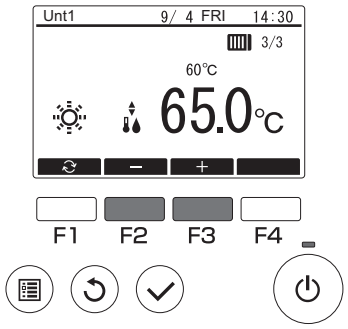

Heating


Heating ECO


Hot water


Anti-Freeze

Temperature



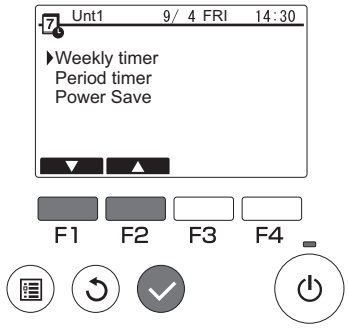
Press [F2] to decrease the temperature, and [F3] to increase.

<3> Using the Weekly timer

Use the Weekly timer to set the ON/OFF schedule, operation mode, and temperature for each day of the week.
Weekly timer will be disabled when the schedule function is disabled and when the period timer is enabled.
Weekly timer may not be executed under certain system configurations.

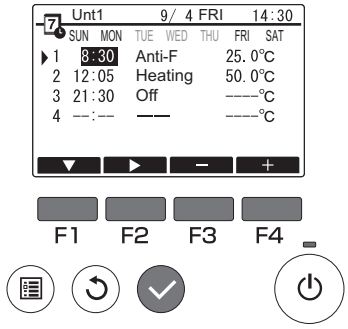
Steps

Step 1



Press [⊜].
Press [F3] to select [7].
Press [⊘].
On the Schedule menu, press [⊘] to select Weekly timer.

Step 2

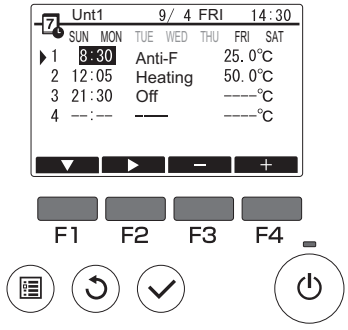


Weekly timer screen will appear.

To view the settings:
Press [F1] or [F2] to view the settings for each day.
Press [F4] to see the next page.

To change the settings:
Press [F1] or [F2] to toggle through the days. Press [F3] select a day, and press [⊘].
Multiple days are selectable by repeating the steps above.

Step 3



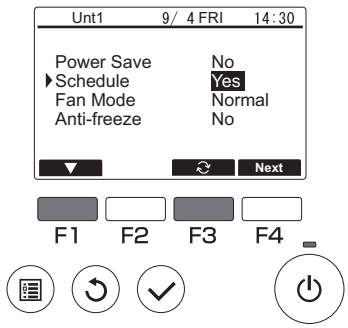
Pattern setting screen will appear.
Press [F1] to select a pattern to be set.
Press [F2] to select the item to change its settings.
Press [F3] or [F4] to change the setting for the selected item.

1) Time
Set in 5-minute increments.
Hold down the button to fast-forward.

2) Operation selection mode or Off
Available options vary with the connected unit.
Connected unit will operate unless set to Off.

3) Temperature
Settable in 0.5°C increments
Press [⊘] to save the change.

Step 4



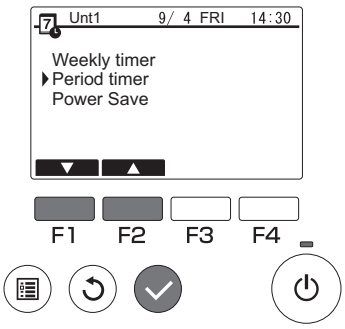
To enable schedule
Return to the main screen, and press [F4].
Press [F1] to move the cursor to Schedule.
Operation setting screen will appear.
Press [F3] to select Yes.

<4> Using the Period timer

Use the Period timer to set the daily operation schedule (ON/OFF, operation mode, temperature) for specific periods.
If the periods 1 and 2 overlap, only period 1 will be valid.
Weekly timer will be disabled when the Schedule function is disabled:
When the Schedule function is disabled from the centralized controller or the connected unit, Schedule settings cannot be made from the remote controller.

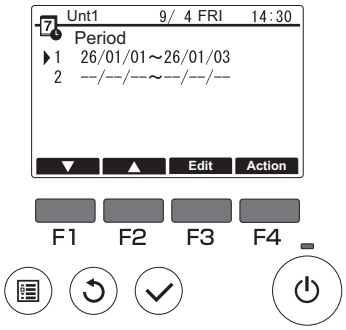
Steps

Step 1



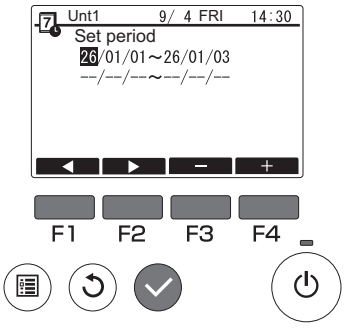
From the Schedule menu press [F1] or [F2] to select Period timer, and press [⊘].
Refer to the following page(s) for detail. "Using the Weekly timer"

Step 2



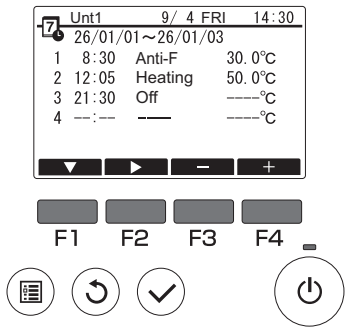
Pre-set periods will appear, if any.

Step 3



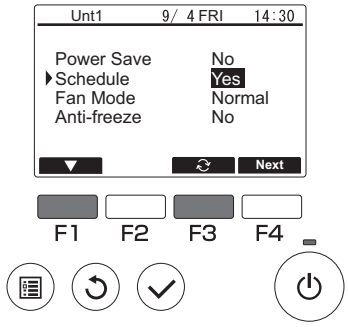
To select a period
Press [F1] or [F2] to select a period to set, and press [F3].
Press [F1] or [F2] to select the year, month, or date.
Press [F3] or [F4] to change the year, month, or date.
Press [⊘] to save the setting.

Step 4



To set the operation
Press [F1] or [F2] to select a period to set, and press [F4].
Operation pattern setting screen will appear.
Set the time, mode, and temp.
(Select an item with [F1] and [F2]. Change the value with [F3] and [F4].)
Press [⊘] to save the change.

Step 5



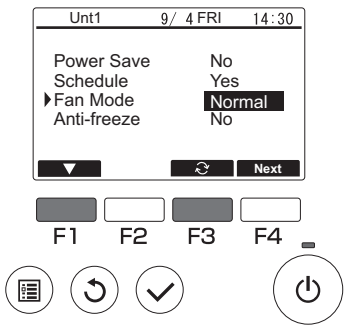
To enable schedule
Refer to the following section. "Using the Weekly timer"

<5> Fan mode

- The following two fan modes are available.
  Normal: Fan stops when compressor stops.
  Snow: Fan keeps operating after compressor has stopped to keep snow off the unit.

Steps

Step 1



Press [F4] on the Menu screen.
Operation setting screen will appear.
Press [F1] to select Fan mode.
Press [F3] to select Normal or Snow.

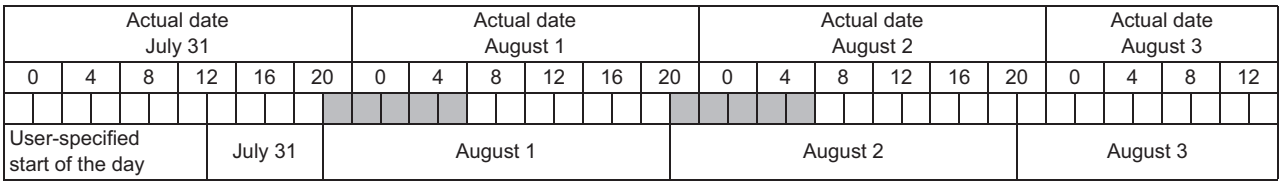
<6> Using power save

Power save is a function that regulates the compressor's rotation count and reduces power consumption during high load on a daily schedule, during specific time periods, or based on the regulated unit capacity.

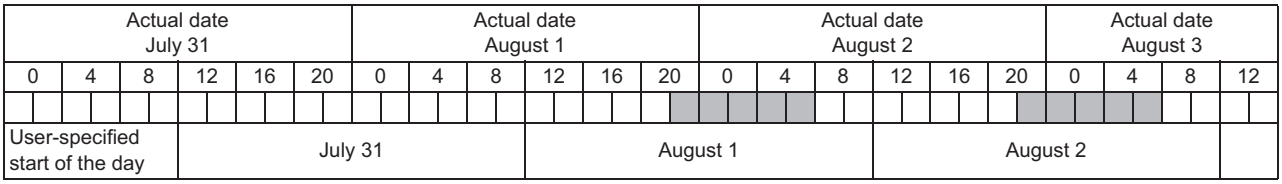
Definition of a Day in using power save

Each Day starts with the time specified by the user. No periods can be specified that spans the Day. Refer to "Unit Setting" in the Remote controller Installation Manual for detail.

Ex. 1: When the start of the day is specified as 22:00 on August 1 and 2, and the power save period is set to the period between 22:00 and 8:00



Ex. 2: When the start of the day is specified as 22:00 on August 1 and 2, and the power save period is set to the period between 22:00 and 8:00



Shaded areas in the figure show when power save is enabled.

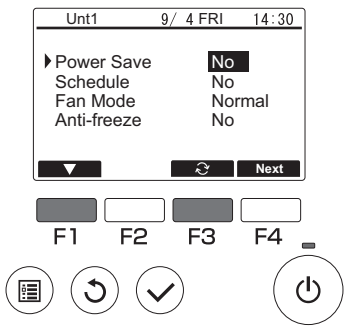
Power save will be disabled when a system controller is connected to the system or when power save is disabled.

Using demand control on the connected units

(1) Using the demand control (contact point) of the connected units without using power save on the remote controller

Steps

Step 1



Press [F4] on the Menu screen.
Press [F1] to access power save.
Press [F3] to select No.

- Do not set the power save settings on the remote controller.
- Some items may not be available for selection.
- Refer to the Remote controller Instruction Book of the connected units for details on demand control.

(2) Using both the demand control (contact point) of the connected units and power save on the remote controller

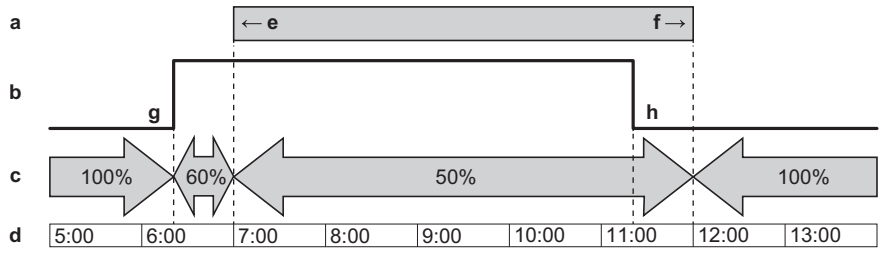
The system will be controlled based on the lower of the following: demand control setting and power save control capacity.

If the contact-ON time and the power save start time are set to different times, whichever the earlier will be valid. Refer to the table below.

Control values for using power save and demand control

Period	Power save value	Demand control value	Actual control target capacity
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%

Ex, When power save is enabled between 7:00 and 12:00 at the control capacity of 50%, and the contact for the connected unit is on (capacity setting of 60%)

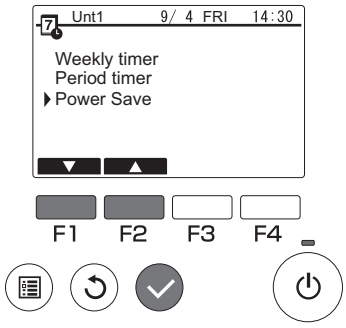


a Power save time period setting
b Unit contact input
c Max. capacity of the unit
d Time
e Power save starts
f Power save ends
g Contact ON
h Contact OFF

- While the contact is on or power save is enabled, the maximum capacity will be limited to whichever is the lower between the power save and demand control settings.
- While the contact is off and power save is disabled, units will operate at 100% capacity.
- Units will operate at up to 100% capacity during non-power-saving periods.

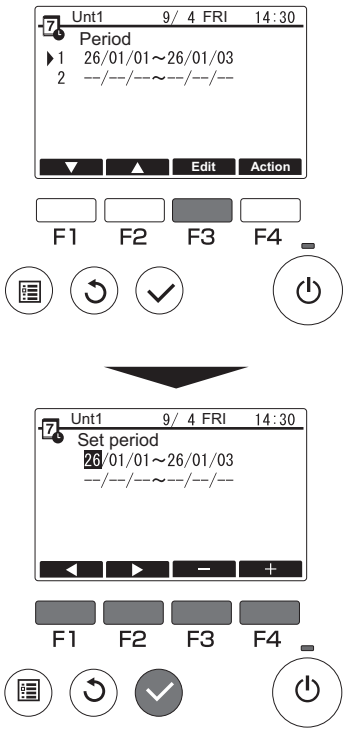
Steps

Step 1



From the Menu screen, select Schedule, then power save.
Press [⊘].

Step 2

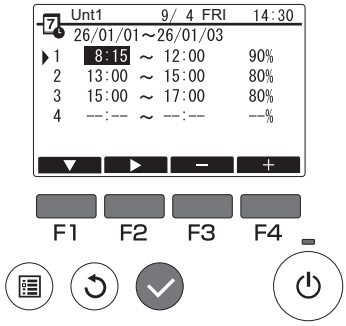


Two different periods can be set by specifying the start and end dates.

- If the dates specified in periods 1 and 2 overlap, only the dates specified in period 1 will be valid.

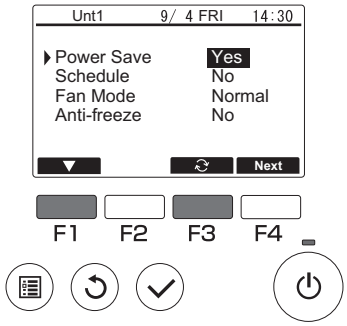
Refer to Step 3 of the section on using the period timer for how to set the periods.
Refer to the following page(s) for detail. "Using the Period timer"

Step 3



Refer to Step 4 of the section on using the period timer for how to set the power save start/end time and the demand control value.
Refer to the following page(s) for detail. "Using the Period timer"
Press [⊘] to save the change.

Step 4



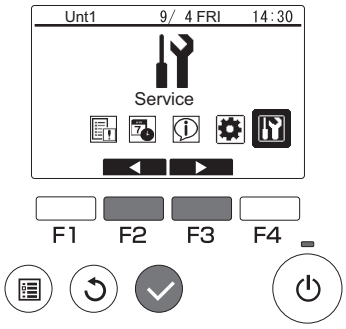
Refer to Step 4 of the section on using the weekly timer for how to enable power save.
Refer to the following page(s) for detail. "Using the Weekly timer"

<7> Setting the functions

Set the functions for each connected unit from the remote controller as necessary.
Record any changes made to the functions of the connected units to allow for proper management.

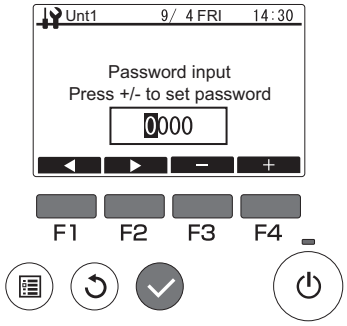
Steps

Step 1



From the Menu screen, select Service, and press [⊘].

Step 2

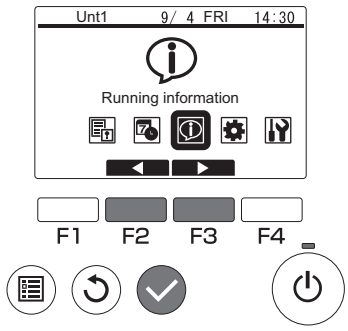


A password screen will appear.
Enter the current maintenance password (a 4-digit number), and press [⊘] to access the Service menu.

<8> Monitoring the operating status from the remote controller

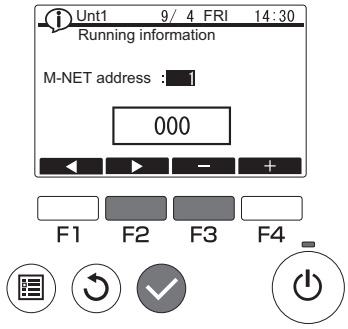
Steps

Step 1



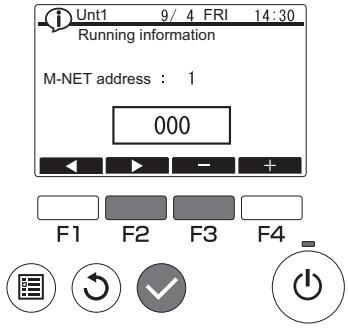
From the Menu screen, select Running information, and press [⊘].

Step 2

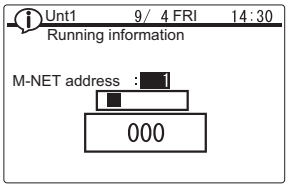


Set the M-NET address with [F2] and [F3], and press [⊘].

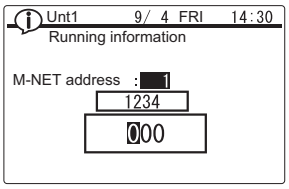
Step 3



Enter a 3-digit running inf. number, and press [⊘].



The setting-inf.-send screen will appear.



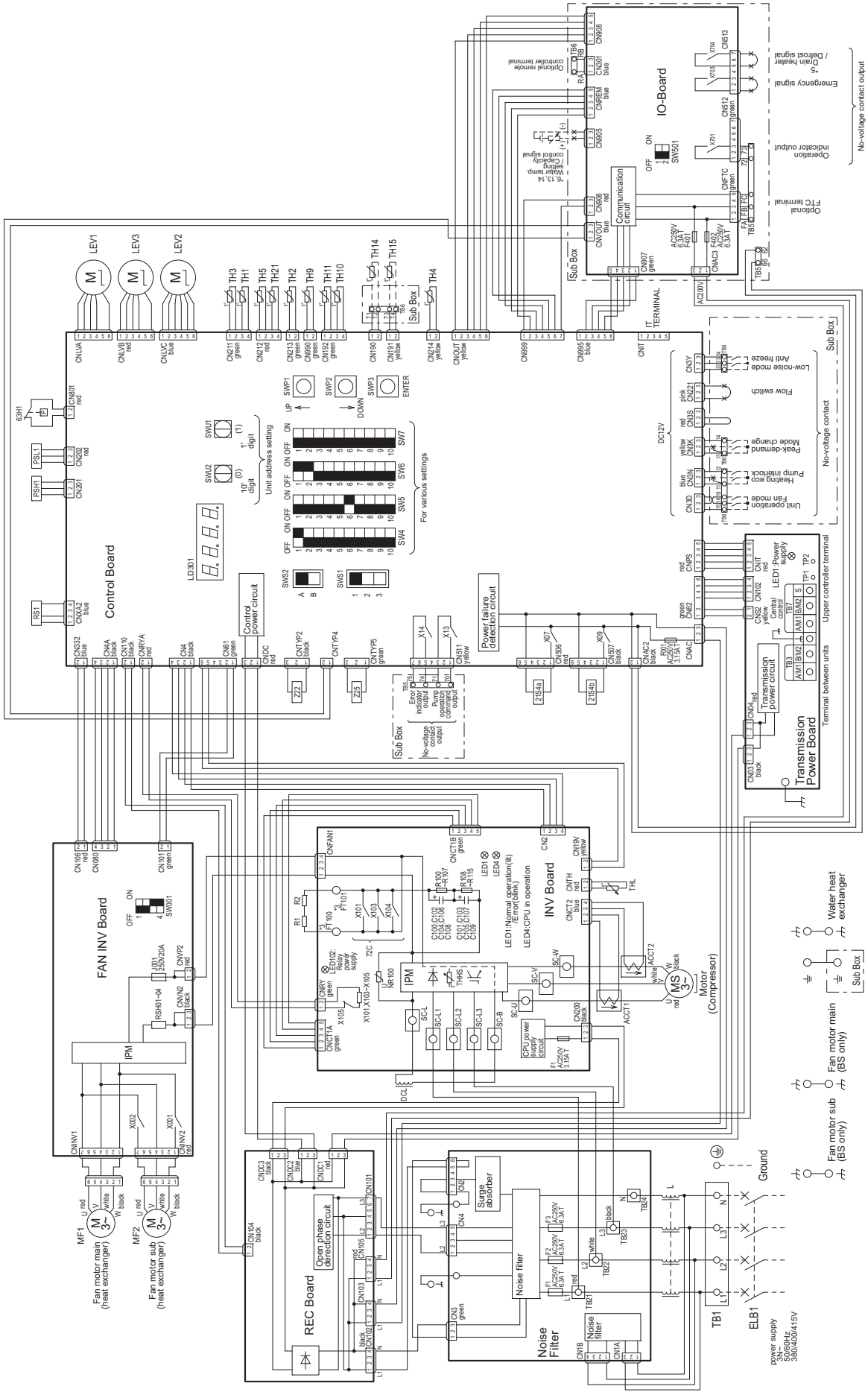
If sent successfully, the running inf. will appear on the screen.
Press [↺] to return to the screen shown in Step 2.
Set other M-NET address and running inf. number in the same way.

Ⅴ Electrical Wiring Diagram

[1] Electrical Wiring Diagram..... 79

[1] Electrical Wiring Diagram

CAHV-Z450YA-HPB (-BS)



The specification of the product is for the improvement a previous notice and might change.

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 ×: Connection by cutting the short circuit wire
5. Selects either Drain heater signal or Defrost signal by SW5 and SW6 settings.
(Item code 1056)
6. Selects either Water temp. setting 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 temp. setting can be switched from the no-voltage contact or by setting time ranges.
9. The method of input signal of operation can choose 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 cabtyre cable as this will damage the circuit board.
11. When cabtyre cable is used for the control cable wiring, use a separate cabtyre cable for the following wiring.
Using the same cabtyre cable may cause malfunctions and damage to the unit.
(a) Optional remote controller wiring
(b) No-voltage contact input wiring
(c) No-voltage contact output wiring
(d) Remote water temp. setting
12. Use a contact that takes 12VDC 1mA for no-voltage contact input.
13. Need to selects either Water temp. setting input signal.
Set the SW501 as shown in the table below.

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

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

Symbol explanation

Symbol	Explanation	
ACCT1, 2	AC current sensor	
DCL	DC reactor	
F1 (INV Board)	Fuse	
J001 (FAN INV Board)		
LEV1, 3	Linear expansion valve	Pressure control, Refrigerant flow rate control
LEV2		HIC bypass, Refrigerant flow rate control in HIC circuit
MF1, 2	Motor	Fan
MS		Compressor
63H1	Pressure switch	High pressure protection
PSH1	Pressure sensor	High pressure
PSL1		Low pressure
R1, 2	Electrical resistance	
21S4a, b	4-way valve	Heating/Defrost switching
TH1	Thermistor	Discharge pipe temp.
TH2		Suction pipe temp.
TH3		Compressor shell bottom temp.
TH4, 5		Air heat exchanger outlet pipe temp.
TH9		Outdoor temp.
TH10		Inlet water temp.
TH11		Outlet water temp.
TH21		Water heat exchanger outlet pipe temp. (refrigerant side)
THHS		IPM temp.
THL		DC reactor temp.
TH14, 15	External Thermistor (optional)	Water temp.
RS1	Refrigerant sensor	Leakage from refrigerant pipe
Z22, 25	Function setting connector	
72C	Electromagnetic relay (Inverter main circuit)	
ELB1	Earth leakage breaker (field-supplied)	

External Input/Output

Available signals for local controllers

Input

Dry contact		ON (Close)	OFF (Open)	Terminal block/ connector
(a) UNIT OPERATION	ON/OFF	Unit will start when water temp. drops below the pre-set temp.	Unit will stop except when in the Anti-Freeze mode.	TB6 15-16
(b) HEATING ECO	Heating ECO/ Heating	Unit will start when water temp. drops below water temp. setting C. (Heating ECO mode)	Unit will start when water temp. drops below water temp. setting A. (Heating mode)	CN3N 1-2
(c) MODE CHANGE	Hot water/Heating	Unit will operate when water temp. drops below water temp. setting B.	Unit will start when water temp. drops below water temp. setting A. (Heating)	TB6 13-14
(d) ANTI FREEZE	ON/OFF	Unit will operate in the Anti-Freeze mode (target temp. 25ºC) when the contact status of unit operation (item (a)) is Stop, or the ON/OFF button on the remote controller is off.	Unit will operate based on the status of the unit operation contact (item (a)) or the ON/OFF command from the remote controller.	TB6 22-24
(e) LOW-NOISE MODE	ON/OFF	Unit will operate in the Low-noise mode and below the max. capacity for low noise.	Unit will operate at the max. capacity.	TB6 22-23
(f) FAN MODE	Forced/Normal	Fan will stay in operation after the compressor has stopped (incl. when the operating status is Stop).	Fan will stop when compressor stops.	TB6 15-19
(g) FLOW SWITCH	Normal/Error	Unit is allowed to operate.	Unit will not operate.	CN221 1-3
(h) PUMP INTERLOCK	Normal/Error	Unit is allowed to operate.	Unit will not operate.	TB6 11-12
(i) PEAK-DEMAND CONTROL	ON/OFF	Unit will operate at or below the max. capacity for peak-demand control.	Unit will operate at the max. capacity.	CN3K 1-2
Analog				Terminal block/ connector
Input type		Action		
(j) WATER TEMP. SETTING/CAPACITY CONTROL		Settable by using external analog input to CN905 on IO board. Available analog inputs: 4-20 mA, 1-5 V, 0-10 V, or 2-10 V.		CN905 2-3
(k) EXTERNAL WATER TEMP. THERMISTOR (TH14/Optional)		-		TB6 T1-T2
(l) EXTERNAL WATER TEMP. THERMISTOR (TH15/Optional)		-		TB6 T3-T4

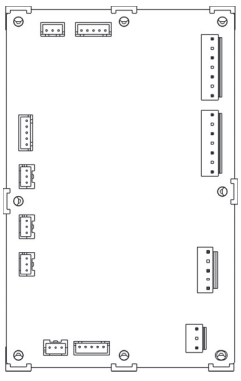
Output

Contact type		Conditions in which the contact closes (turns on)	Conditions in which the contact opens (turns off)	Terminal block/ connector
(m) ERROR INDICATOR	Close/Open	Unit has stopped abnormally.	During normal operation	TB5 74-75
(n) OPERATION INDICATOR	Close/Open	Unit operation contact (item (a)) or the ON/OFF button on the remote controller is ON.	Unit operation contact (item (a)) or the ON/OFF button on the remote controller is OFF.	TB5 72-73
(o) PUMP OPERATION COMMAND	Close/Open	(1) When SW5-8 is set to ON Pump will operate based on Thermo-ON/OFF status. (2) When SW5-8 is set to OFF Pump will operate based on the status of the unit operation contact or the ON/OFF button on the remote controller.	All conditions other than the ones at left	TB5 70-71
(p) EMERGENCY SIGNAL	Close/Open	Water temp. below booster heater operation water temp. (TWL1 value) (Item code 1057) and outdoor temp. (TAL1 value) (Item code 1058).	Water temp.≥ TWL1 + 2ºC or Outdoor temp.≥ TAL1 + 2ºC	CN513 1-3
(q) DRAIN HEATER SIGNAL/ DEFROST SIGNAL	Close/Open	Item code 1056 set to "1": Defrost signal Item code 1056 set to "0": Drain heater signal Outdoor temp. ≤ 1ºC, Outdoor temp. ≤ 3ºC after having once dropped below 1°C, or 1°C ≤ Outdoor temp. ≤ 8°C during defrost cycle	-	CN513 5-7

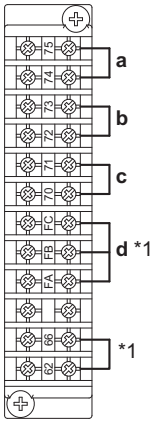
RC/M-NET

REMOTE CONTROLLER	PAR-W31MAA	TB6 RA-RB
M-NET	Transmission line	TB3 A/M1-B/M2
Centralized controller	AE-C400E, EW-C50E	TB7 A/M1-B/M2
Internal/external A-control signal Flow temp. controller	Flow temp. controller (FTC) PAC-IF071B-E PAC-IF072B-E PAC-IF073B-E PAC-SIF051B-E	TB5 FA-FB-FC

(1) IO board



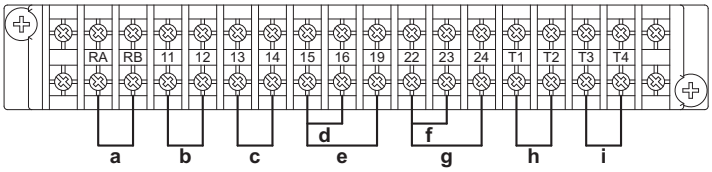
(2) TB5



a Error indicator output
b Operation indicator output
c Pump operation command output
d Optional FTC terminal
Refer to the FTC manual for detail.
*1:CAUTION: High voltage

Outdoor unit	FA	FB	FC
FTC control board	S1	S2	S3

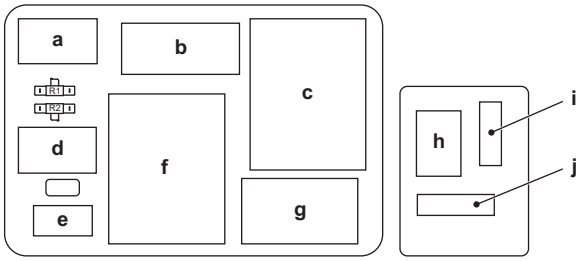
(3) TB6



a Optional remote controller terminal
b Pump interlock
c Mode change
d Unit operation
e Fan mode
f Low-noise mode
g Anti-freeze
h External water temp. thermistor (option) TH14
i External water temp. thermistor (option) TH15

Wire color
Heating ECO: Black
Demand: Brown
Flow switch: White

(4) Inside the control box (front view)



a Rec board
b Fan INV board
c Control board
d Noise filter
e TB1
f INV board
g Transmission power board
h IO board
i TB5
j TB6

(5) Display setting

Control board display	Control board SW setting *1	
Pre-set water temp.	SW6-5: ON	SW6-6: OFF
Current water temp. *2	SW6-5: ON	SW6-6: ON
High pressure/Low pressure	SW5-10: OFF	SW6-8: OFF
	SW6-5: OFF	SW6-9: OFF
	SW6-6: OFF	SW6-10: OFF
	SW6-7: OFF	

*1:Select an item to be displayed by setting the switches.
*2:The current water temperature will be displayed according to the selection on the pre-set water temperature display option.

Ⅵ Refrigerant Circuit

[1] Refrigerant Circuit Diagram 85
[2] Principal Parts and Functions 86

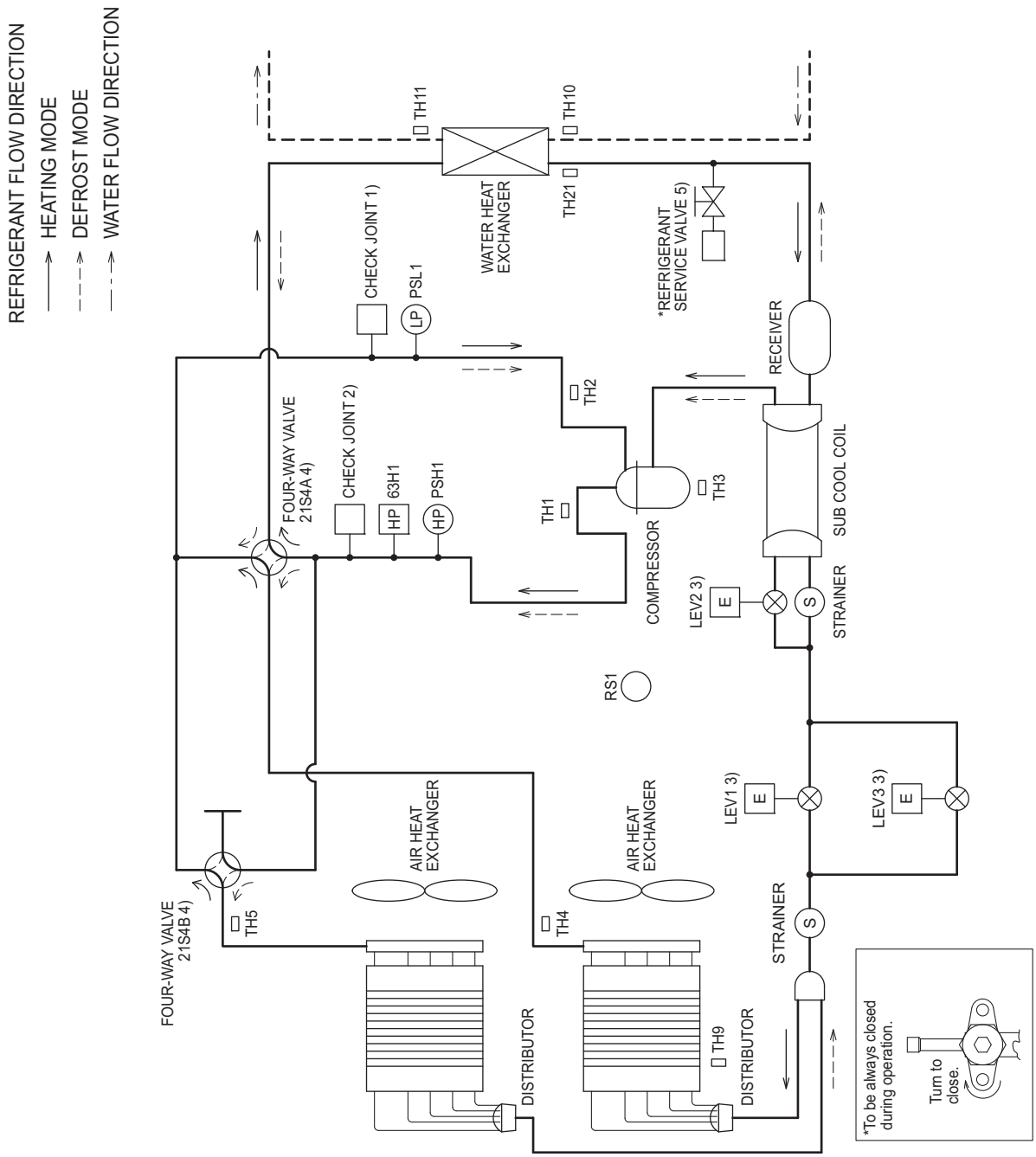
[1] Refrigerant Circuit Diagram

SYMBOL EXPLANATION

SYMBOL	DESCRIPTION
PSH1	HIGH-PRESSURE SENSOR
PSL1	LOW-PRESSURE SENSOR
RS1	REFRIGERANT SENSOR
63H1	HIGH PRESSURE SWITCH
TH1	DISCHARGE PIPE TEMP. THERMISTOR
TH2	SUCTION PIPE TEMP. THERMISTOR
TH3	COMPRESSOR SHELL BOTTOM TEMP. THERMISTOR
TH4,5	AIR HEAT EXCHANGER OUTLET PIPE TEMP. THERMISTOR
TH9	OUTDOOR TEMP. THERMISTOR
TH10	INLET WATER TEMP. THERMISTOR
TH11	OUTLET WATER TEMP. THERMISTOR
TH21	WATER HEAT EXCHANGER OUTLET PIPE TEMP. THERMISTOR (REFRIGERANT SIDE)

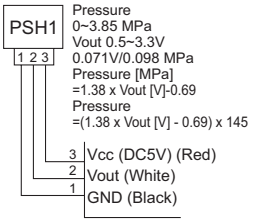
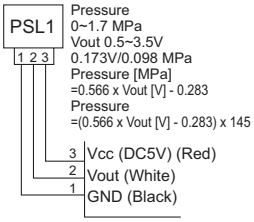
JOINTS AND VALVES

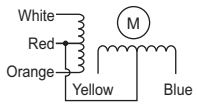
NO.	NAME
1)	CHECK JOINT (LOW PRESSURE EXTRACTION)
2)	CHECK JOINT (HIGH PRESSURE EXTRACTION)
3)	LEV
4)	FOUR-WAY VALVE
5)	REFRIGERANT SERVICE VALVE



[2] Principal Parts and Functions

Outdoor unit

Part name	Symbols (functions)	Notes	Usage	Specifications	Check method
Compressor	COMP		Adjusts the refrigerant flow rate by adjusting the operating frequency based on the operating pressure	Low-pressure shell scroll compressor	
High pressure sensor	PSH1		1) Detects high pressure 2) Regulates frequency and provides high-pressure protection 3) Calculates condensing temp.		
Low pressure sensor	PSL1		1) Detects low pressure 2) Provides low-pressure protection 3) Calculates evaporating temp.		
Pressure switch	63H1		1) Detects high pressure 2) Provides high-pressure protection	3.85 MPa OFF setting	
Thermistor	TH1 (Discharge pipe temp.)		1) Detects discharge temperature 2) Provides high-pressure protection 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	Degrees Celsius R_{120} = 7.465kohm $R_{25/120}$ = 4057 $R_t = 7.465\exp\{4057(\frac{1}{273+t} - \frac{1}{393})\}$	Resistance check

Part name	Symbols (functions)	Notes	Usage	Specifications	Check method
Thermistor	TH2 (Suction pipe temp.)		Detects suction pipe temp.	Degrees Celsius R_0 = 15kohm $R_{0/80}$ = 3385 $R_t = 15\exp\{3385\ (\frac{1}{273+t} - \frac{1}{273})\}$ 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 bottom temp.)		1) Detects compressor shell bottom temp. 2) Prevents compressor flooding		
	TH4 TH5 (Air heat exchanger outlet pipe temp.)		Controls defrosting during heating operation		
	TH9 (Outdoor temp.)		1) Detects outdoor temp. 2) Controls fan operation		
	TH10 (Inlet water temp.)		Controls compressor operation		
	TH11 (Outlet water temp.)		Controls compressor operation		
	TH21 (Water heat exchanger outlet pipe temp. (refrigerant side))		Detects water heat exchanger outlet pipe temp.		
4-way valve	21S4a 21S4b		Changeover between heating and defrost	AC 220-240 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.	AC 415 V, 920 W	
Linear expansion valve	LEV2 (INJ control)		Adjusts the bypass flow rate from the liquid pipe on the outdoor unit during heating	DC 12 V Opening of a valve driven by a stepping motor 0-480 pulses (direct driven type)	Refer to the following. Continuity between white, yellow, and orange. Continuity between blue, brown, and red.
	LEV1 LEV3 (Refrigerant flow adjustment)		Adjusts refrigerant flow rate	DC 12 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)	Refer to the following. Continuity between white, red, and orange. Continuity between yellow and blue. 
Refrigerant sensor	RS1		Detects leakage from refrigerant pipe	DC 5 V, 0.375 W Equivalent to IP55	

VII Control

[1] Functions and Factory Settings of the Dip switches 91
[2] Operating characteristics and Control Capabilities 112

[1] Functions and Factory Settings of the Dip switches

1. Default dip switch settings

SW		Function		Circuit board (Default)	OFF	ON	Setting timing
SW 4	1	Model setting	Sets the model	Depends on the unit	-		Upon reset
	2						
	3						
	4						
	5						
	6						
	7	External static pressure option	Selects the fan's operating mode from Normal or External static pressure mode	OFF	Disable	Enable	
	8	Model setting	Sets the model	Depends on the unit	-		
	9						
	10						
SW 5	1	Freeze-up protection	Starts the pump to prevent water pipe freeze-up	OFF	Outdoor temp. ≤ 1°C Water temp. ≤ 13°C	Same as when set to OFF	Upon reset
	2	Scheduled operation display	Turns on and off the remote display when the units are scheduled to stop	OFF	Leaves the display on	Turns off the display	Upon reset
	3	Model setting	Sets the model	OFF	-		Upon reset
	4	Model setting	Sets the model	OFF	-		Upon reset
	5	Recovery conditions after forced stoppage	Selects the thermistor used to determine if the water outlet temp. meets the recovery conditions	OFF	External thermistor	Built-in thermistor	Upon 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	Supplies power	Any time
	7	Remote water-temp. setting	Enables or disables the water temp. to be set using external analog signals from a remote location	OFF	Disabled	Enabled	Upon reset
	8	Water temp. control option	Selects the thermistor to be used to control water temp.	OFF	Built-in thermistor	External thermistor	Upon reset
	9	Individual/Multiple system	Selects between individual and multiple systems	OFF	Individual system	Multiple system	Upon reset
	10	Display mode 7	Used to set or view the settings when performing a test run or changing system configuration	OFF	-		Any time
SW 6	1	Remote reset	Enables or disables an error to be reset remotely	ON	Disabled	Enabled	Upon reset
	2	Auto recovery after power failure	Automatic recovery of operation after power failure (in the mode before power failure)	ON	Displays an alarm	Automatically restores operation	Upon reset
	3	Water temp. control	Switches between inlet- and outlet-water-temp-based control.	OFF	Outlet	Inlet	Upon reset
	4	Pump-thermistor interlock	Interlocks or does not interlock the operation of pump with external thermistor (Effective only when SW5-8 is set to ON)	OFF	Pump operates when turned on, regardless of Thermo-ON/OFF status	Pump operation is interlocked with Thermo-ON/OFF status	Upon reset
	5	Display mode 1	Used to set or view the settings when performing a test run or changing system configuration	OFF	Changes the 7-segment LED display mode		Any time
	6	Display mode 2		OFF	Same as above		Any time
	7	Display mode 3		OFF	Same as above		Any time
	8	Display mode 4		OFF	Same as above		Any time
	9	Display mode 5		OFF	Same as above		Any time
	10	Display mode 6		OFF	Same as above		Any time

-: Do not change the settings.

2. SWS1 settings

(1) Individual system

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

(2) 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 from the main unit
	OFF		Ignores the input signal
	LOCAL		Follows the input signal from the main unit
OFF	REMOTE	Ignores the input signal	Ignores the input signal
	OFF		
	LOCAL		
LOCAL	REMOTE	ON	Follows the input signal from the main unit
	OFF		Ignores the input signal
	LOCAL		Follows the input signal from the main unit

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

1. When FTC is not connected

Water temperature can be controlled by signals from different types of input sources. The setting for the item with higher priority will override the settings for the items with lower priorities. Water temperature will be controlled based on the temperature setting in the "Target water temperature" column.

Priority 1	Priority 2	Priority 3		Priority 4			Priority 5	Target water temp.	Active sensor when SW5-8 is ON(*1)
Analog input (SW 5-7)	Schedule setting from control board	SWS1 RC	Schedule type (RC)	Dry contact (*2) Anti-freeze	Dry contact (*2) Hot water	Dry contact (*2) Heating ECO	Remote controller Input from centralized controller AE-C400 or BMS		
ON	ON	SWS1:LOCAL	-	-	-	-	-	Temp. setting for analog signal input	TH14
		SWS1: REMOTE Dry contact: ON	In time	-	-	-	-	Temp. setting for analog signal input	TH14
			After-hours	ON	-	-	-	25°C	-
				OFF	-	-	-	Stop	-
		SWS1: REMOTE Dry contact: Stop	-	ON	-	-	-	25°C	-
				OFF	-	-	-	Stop	-
	OFF	SWS1: LOCAL Operation command: ON	-	ON	-	-	-	25°C	-
				OFF	-	-	Anti-freeze	25°C	-
					-	-	Heating	Temp. setting for analog signal input	TH14
		SWS1: REMOTE Operation command: OFF	-	ON	-	-	-	25°C	-
				OFF	-	-	Anti-freeze	Stop	-
					-	-	Heating	Stop	-
OFF	ON	SWS1: LOCAL	-	-	-	-	-	Selectable from temp. settings A through C by scheduled operation of the control board	Selectable fromTH14 or TH15
		SWS1: REMOTE Dry contact: ON	In time	-	-	-	-	Selectable from temp. settings A through C by scheduled operation of the control board	Selectable fromTH14 or TH15
			After-hours	ON	-	-	-	25°C	-
				OFF	-	-	-	Stop	-
		SWS1: REMOTE Dry contact: Stop	-	ON	-	-	-	25°C	-
				OFF	-	-	-	Stop	-
	OFF	SWS1: LOCAL Operation command: ON	-	ON	-	-	-	25°C	-
				OFF	ON	-	-	Temp. setting B (Hot water mode)	Selectable fromTH14 or TH15
					OFF	ON	-	Temp. setting C (Heating ECO mode)	Selectable fromTH14 or TH15
						OFF	Heating	Temp. setting A (Heating mode)	Selectable fromTH14 or TH15
							Hot water	Temp. setting B (Hot water mode)	Selectable fromTH14 or TH15
							Heating ECO	Temp. setting C (Heating ECO mode)	Selectable fromTH14 or TH15
							Anti-freeze	25°C	-
		SWS1: REMOTE Operation command: OFF	-	ON	-	-	-	25°C	-
				OFF	ON	-	-	Stop	-
					OFF	ON	-	Stop	-
						OFF	Heating	Stop	-
							Hot water	Stop	-
							Heating ECO	Stop	-
							Anti-freeze	Stop	-

*1:When SW5-8 is set to OFF, water temp. will be controlled by the built-in thermistor TH11 on the unit.

*2:Priority is given in the order of Anti-freeze, Hot water, and Heating ECO.

IMPORTANT

- When the outlet water temp. setting is below 35°C or the inlet water temp. setting is below 30°C, the target water temp. may be overridden to the lower limit shown in the specifications from the perspective of the unit protection. Refer to "Specifications" in the Installation/Operation Manual for detail.
- The Thermo-ON/OFF control follows the overridden target.
- Set the target water temp. within the upper and lower limits shown in the specifications.

2. FTC connection

Priority1	Priority2	Priority3		Priority4			Priority5	Priority6	Target water temperature	Sensor that becomes active (when SW5-8 is set to ON) (*1)
Analog input (SW5-7)	Schedule setting from control board	SWS1	Schedule type (RC)	Dry contact (*2)			Remote controller input from centralized controller AE-C400 or BMS	FTC operation mode command		
		RC		Anti-freeze	Hot water	Heating Eco				
–	–	SWS1: LOCAL operation command: ON or SWS1: REMOTE operation command: Run	–	–	–	–	–	Shutdown	Stop	–
								Heating	Temperature setting A (Heating mode)	Selectable from TH14 or TH15
								Hot water	Temperature setting B (Hot water mode)	Selectable from TH14 or TH15
								Anti-freeze	25°C	Selectable from TH14 or TH15
								Legionella prevention	Temperature setting B (Hot water mode)	Selectable from TH14 or TH15
–	–	SWS1: LOCAL operation command: OFF or SWS1: REMOTE operation command: top	–	–	–	–	–	Shutdown	Stop	–
								Heating	Stop	–
								Hot water	Stop	–
								Anti-freeze	Stop	–
								Legionella prevention	Stop	–

Water-temperature setting

Different water temperature settings can be set for different modes. Use item codes 11, 13, 22, 23, 24, or 25 to set the water temperatures.
*** When FTC is connected, the unit water temperature setting range follows FTC.**

(1) Setting the individual water temp. for item codes 11, 13, and 22-27

Steps

Step 0

Set SWS1 to OFF.

Set SWS1 to OFF with the local switch.

The settings for items 22 through 27 cannot be changed unless SWS1 is set to OFF (except from the optional remote controller).

Step 1

Select the outdoor temp. input source.

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

Settable item	Item Code	Initial value	Unit	Limits and increments			Notes	Setting change from optional remote controller
				Increments	Lower limit	Upper limit		
Outdoor temp. input source	1080	0		1	0	1		No

0: Outdoor temp. thermistor (TH9)

1: IT terminal

Step 2

Set SW5 and SW6 as follows.

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

Step 3

Press SWP3 to select an item code.

Step 4

Press SWP1 to increase and SWP2 to decrease the value.

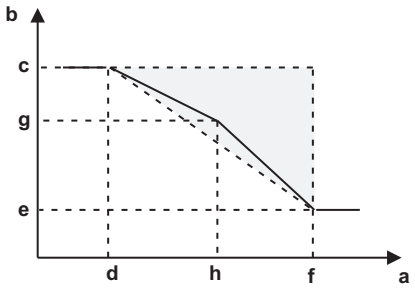
Settable item	Item Code	Initial value	Unit	Limits and increments			Setting change from optional remote controller
				Increments	Lower limit	Upper limit	
Water temp. setting A (Heating mode)	11	45	°C	0.1°C	24	75	Yes
Water temp. setting B (Hot water mode)	13	65	°C	0.1°C	24	75	Yes
Heating ECO/Water temp. setting C1 *1	22	34	°C	0.1°C	24	75	No
Heating ECO/Outdoor temp. setting C2 *1	23	-7	°C	0.1°C	-25	50	No
Heating ECO/Water temp. setting C3 *1	24	24	°C	0.1°C	24	75	No
Heating ECO/Outdoor temp. setting C4 *1	25	12	°C	0.1°C	-25	50	No
Heating ECO/Water temp. setting C5 *1	26	30	°C	0.1°C	24	75	No
Heating ECO/Outdoor temp. setting C6 *1	27	2	°C	0.1°C	-25	50	No

*1:Need not be set when only a single water temp. setting is used

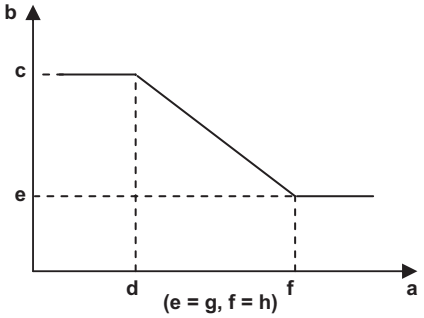
When a signal through a dry contact is used to switch between the Heating, Hot water, and Heating ECO modes, the water temp. setting will be as shown in the figures below.

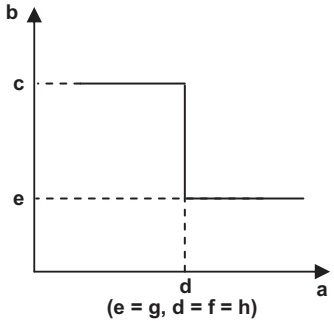
The ranges for water temp. settings A, B, C1, and C3 are shown in the figures below.

Setting ranges for water temp. settings A, B, C1-C6



a Outdoor temp.
b Water temp.
c Water temp. setting C1
d Outdoor temp. setting C2
e Water temp. setting C3
f Outdoor temp. setting C4
g Water temp. setting C5
h Outdoor temp. setting C6





Water temp. control	Lower limit	Upper limit
Outlet-water-temp-based control	24.0°C	75.0°C
Inlet-water-temp-based control	24.0°C	70.0°C

Step 5

Press SWP3 to save the change.

The LED will stop blinking and stay lit. Then, an item code will appear on the LED.

If SWP3 is not pressed within one minute, the change will not be saved, and an item code will appear on the LED.

(2) Scheduled operation

Three sets of start/end times can be set for a day.
A single mode (pre-set temp.) can be selected for each period.
Refer to the following page(s) for detail. "Setting the temperatures for different operation periods"
The function is valid only when SWS1 is set to "REMOTE."

Steps

Step 0
Set SWS1 to OFF.
Set SWS1 to OFF with the local switch.
Settings cannot be changed unless SWS1 is set to OFF (except from the optional remote controller).

Step 1
Set SW5 and SW6 as follows.

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

Step 2
Press SWP3 to select an item code.
Set item code 5 to 1, and set the times for item codes 1, 6 through 9, 18, and 19 as necessary.

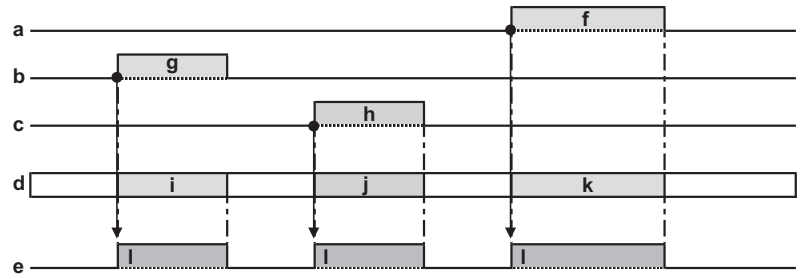
Step 3
Press SWP1 to increase and SWP2 to decrease the value.

Settable item	Item Code	Initial value	Unit	Limits and increments		
				Increments	Lower limit	Upper limit
Current time	1	0000	Hour: minute	1 min.	0000	2359
Enable or disable schedule (ON/OFF)	5	0	Enable: 1 Disable: 0	1	0	1
Start time 1	6	0000	Hour: minute	1 min.	0000	2359
End time 1	7	0000	Hour: minute	1 min.	0000	2359
Start time 2	8	0000	Hour: minute	1 min.	0000	2359
End time 2	9	0000	Hour: minute	1 min.	0000	2359
Start time 3	18	0000	Hour: minute	1 min.	0000	2359
End time 3	19	0000	Hour: minute	1 min.	0000	2359

Step 4
Press SWP3 to save the change.
The LED will stop blinking and stay lit. Then, an item code will appear on the LED.
If SWP3 is not pressed within one minute, the change will not be saved, and the LED will display the item code.
Note: Setting code 5 to "1" will lock the remote controller's schedule function.

(1) Effective/ineffective settings for overlapping and non-overlapping periods

[No overlapping periods]



a Period 1
b Period 2
c Period 3
d Set temp.
e Operation command signal
f Period 1
g Period 2
h Period 3
i Item code 1219 setting
j Item code 1220 setting
k Item code 1218 setting
l ON

[Overlapping periods 1 and 2](Period 2 setting will be ineffective.)

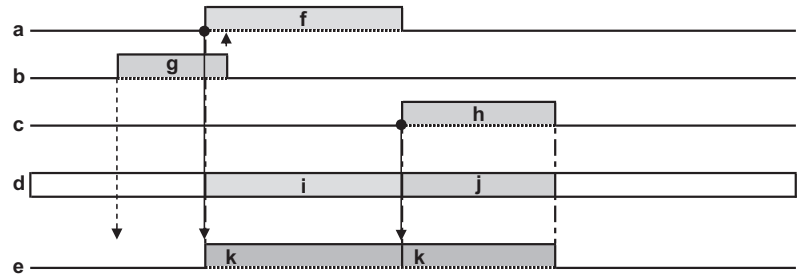
Note:

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

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

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

Note that once the compressor stops at End time 1, the restart delay function will keep the compressor from restarting for three minutes.

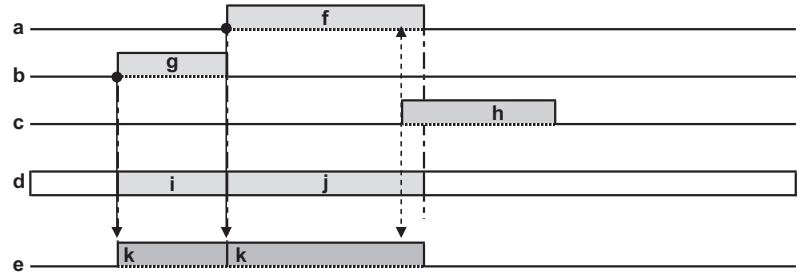


a Period 1
b Period 2
c Period 3
d Set temp.
e Operation command signal
f Period 1
g Period 2
h Period 3
i Item code 1218 setting
j Item code 1220 setting
k ON

[Overlapping periods 1 and 3](Period 3 setting will be ineffective.)

Note:

Refer to the following page(s) for detail. "[Overlapping periods 1 and 2](Period 2 setting will be ineffective.)"

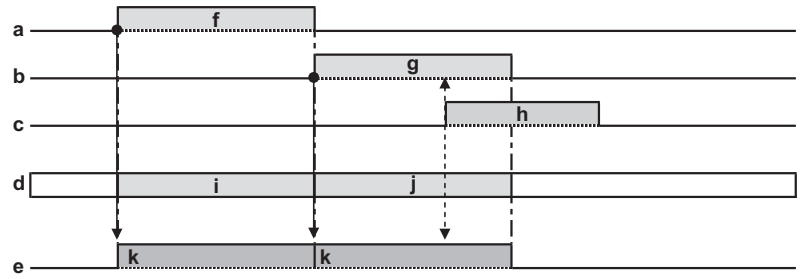


a Period 1
b Period 2
c Period 3
d Set temp.
e Operation command signal
f Period 1
g Period 2
h Period 3
i Item code 1218 setting
j Item code 1219 setting
k ON

[Overlapping periods 2 and 3](Period 3 setting will be ineffective.)

Note:

Refer to the following page(s) for detail. "[Overlapping periods 1 and 2](Period 2 setting will be ineffective.)"

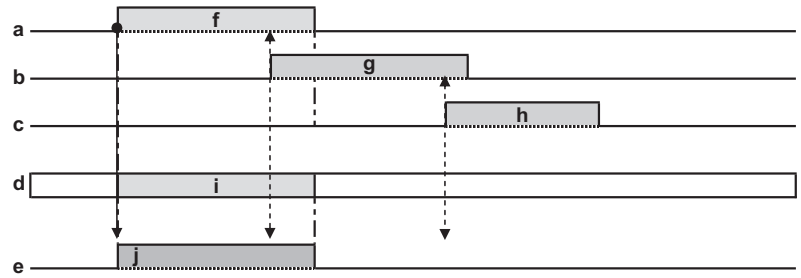


a Period 1
b Period 2
c Period 3
d Set temp.
e Operation command signal
f Period 1
g Period 2
h Period 3
i Item code 1218 setting
j Item code 1219 setting
k ON

[Overlapping periods 1 and 2, and 2 and 3](Period 2 and 3 settings will be ineffective.)

Note:

Refer to the following page(s) for detail. "[Overlapping periods 1 and 2](Period 2 setting will be ineffective.)"



a Period 1
b Period 2
c Period 3
d Set temp.
e Operation command signal
f Period 1
g Period 2
h Period 3
i Item code 1218 setting
j ON

(3) Setting the temperatures for different operation periods

Steps

Step 0

Set SWS1 to OFF.

Set SWS1 to OFF with the local switch.

Settings cannot be changed unless SWS1 is set to OFF (except from the optional remote controller).

Step 1

Set SW5 and SW6 as follows.

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

Step 2

Press SWP3 to select an item code (1215-1220), and set the temperature for each item.

Step 3

Press SWP1 to increase and SWP2 to decrease the value.

Settable item	Item Code	Initial value	Unit	Limits and increments			Setting change from optional remote controller
				Increments	Lower limit	Upper limit	
Pre-set temp. A (Heating)	1215	14	TH	1	14	15	No
Pre-set temp. B (Hot Water)	1216	14	TH	1	14	15	No
Pre-set temp. C (Heating ECO)	1217	14	TH	1	14	15	No
Start/End time 1 (ON/OFF) water temp. setting *1	1218	1		1	1	3	No
Start/End time 2 (ON/OFF) water temp. setting *2	1219	1		1	1	3	No
Start/End time 3 (ON/OFF) water temp. setting *3	1220	1		1	1	3	No

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

Step 4

Press SWP3 to save the change.

The LED will stop blinking and stay lit. Then, an item code will appear on the LED.

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

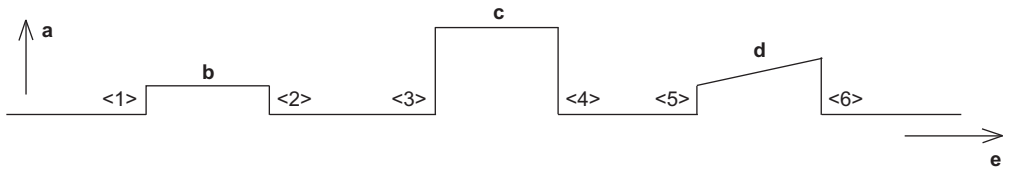
Temp. settings for periods 1, 2, and 3 are selectable from pre-set temp. A, B, or C.

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

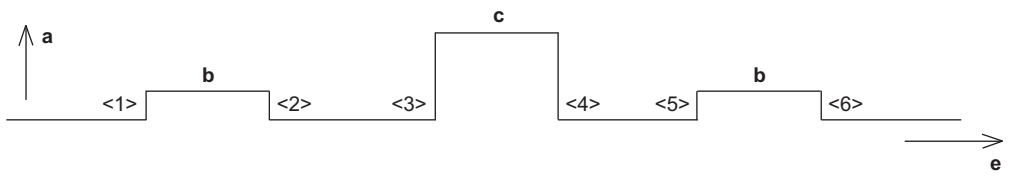
Temp. settings for each period

	Item code 1218-1220	Item code 1215-1217	Ex. 1	Ex. 2	Ex. 3
<1> <2>	Start time 1 End time 1	Operation 1 (Select pre-set temp. from A, B, or C)	Heating	Heating	Hot Water
<3> <4>	Start time 2 End time 2	Operation 2 (Select pre-set temp. from A, B, or C)	Hot Water	Hot Water	Heating ECO
<5> <6>	Start time 3 End time 3	Operation 3 (Select pre-set temp. from A, B, or C)	Heating ECO	Heating	Hot Water

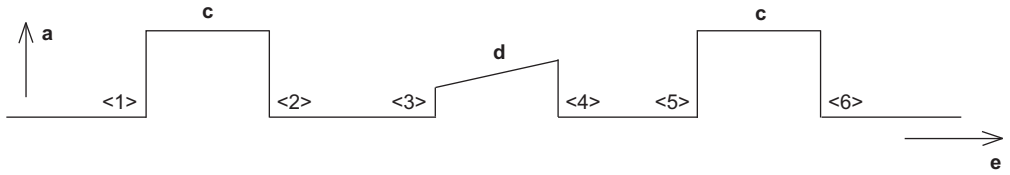
Ex. 1



Ex. 2



Ex. 3



a Temperature
b Heating
c Hot Water
d Heating ECO
e Time

(4) Peak-demand control

The peak-demand control function controls the maximum compressor frequency and the number of units in operation during high loads according to the peak-demand control signal.

Individual system	Multiple system
Max.	Compressor frequency

Steps

(1) Setting the maximum frequency setting

Step 0

Set SWS1 to OFF.

Set SWS1 to OFF with the local switch.

Settings cannot be changed unless SWS1 is set to OFF (except from the optional remote controller).

Step 1

Set SW5 and SW6 as follows.

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

Step 2

Press SWP3 to select item code 2, 3, or 4.

Step 3

Press SWP1 to increase and SWP2 to decrease the value.

Settable item	Item Code	Initial value	Unit	Limits and increments			Setting change from optional remote controller
				Increments	Lower limit	Upper limit	
Max. frequency ratio	2	100	%	5%	0	100	Yes
Peak-demand control start time	3	1300	Hour: minute	1	0000	2359	No
Peak-demand control end time	4	1300	Hour: minute	1	0000	2359	No

---

Step 4

Press SWP3 to save the change.

The LED will stop blinking and stay lit. Then, an item code will appear on the LED.

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

♦ When the peak-demand control contact is ON, units will operate at the max. capacity set in the steps above.

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

Step 0
Set SWS1 to OFF.
Set SWS1 to OFF with the local switch.
Settings cannot be changed unless SWS1 is set to OFF.

Step 1
Set SW5 and SW6 as follows to select the type of external inputs.

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

Step 2
Press SWP3 to select item code 107.

Step 3
Press SWP1 to increase and SWP2 to decrease the value.

Item Code	Increments	Lower limit	Upper limit	Initial value
107	1	1	7	1

*1:Including the main unit. Applicable only to the main unit.

Step 4
Press SWP3 to save the change.
The LED will stop blinking and stay lit. Then, an item code will appear on the LED.
If SWP3 is not pressed within one minute, the change will not be saved, and the LED will display the item code.

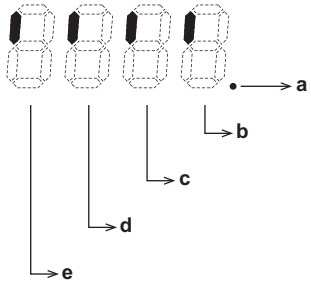
Step 5
Turn the power back on to re-initialize the system.
Refer to the following page(s) for detail."Re-initializing the system"
The new setting will not be saved unless re-initialization is performed.

Setting the unit addresses
Refer to the following page(s) for detail. "System configuration procedures: Multiple system"

(6) Selecting the item to display on the LED

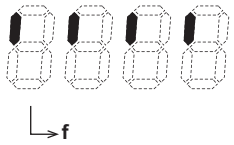
SW5	SW6						Display content
10	5	6	7	8	9	10	
OFF	OFF	OFF	ON	OFF	OFF	OFF	Displays operation mode 1
OFF	OFF	ON	ON	OFF	OFF	OFF	Displays operation mode 2
OFF	ON	ON	OFF	OFF	OFF	OFF	Displays the current water temp.
OFF	ON	OFF	OFF	OFF	OFF	OFF	Displays the water-temp. setting
OFF	OFF	OFF	OFF	OFF	OFF	OFF	Displays the high and low refrigerant pressures

Operation mode 1



a Lights up when the operation command signal is ON
Lights off when the operation command signal is OFF
b A: Compressor in operation
S: Compressor is stopped.
c S: Fan is forced to operate.
-: Function is disabled.
d d: Demand control is enabled
-: Function is disabled.
e Displays the operation mode
H: Water heating operation
F: Pump in freeze-up protection operation

Operation mode 2



f Displays the system control mode
S: Multiple system control
A: Individual system control

(7) Selecting the remote water temp. setting input signal type

The following four external analog input signals can be used to set water temperatures by setting SW5-7.
"0": 4-20 mA
"1": 0-10 V
"2": 1-5 V
"3": 2-10 V

Steps

Step 1

Set SW501-1, SW501-2, SW5, and SW6 as follows.

	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
OFF	OFF	OFF	OFF	OFF	ON	OFF

Step 2

Press SWP3 to select item code 21.

Step 3

Press SWP1 or SWP2 to select the input signal type.

Settable item	Item Code	Initial value *1	Limits and increments			Setting change from optional remote controller
			Increments	Lower limit	Upper limit	
Water temp. setting input signal type	21	0	1	0	3	No

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

Step 4

Press SWP3 to save the change.

The LED will stop blinking and stay lit. Then, an item code will appear on the LED.
If SWP3 is not pressed within one minute, the change will not be saved, and the LED will display the item code.

(8) Setting the water temperature using analog signal input

For how to set the settings, refer to the following section."Selecting the remote water temp. setting input signal type" (p. 106)
When SW5-7 is set to ON (enable external input), target water temp. will be determined based on the pre-set temp. A and B and the type of analog input signal.

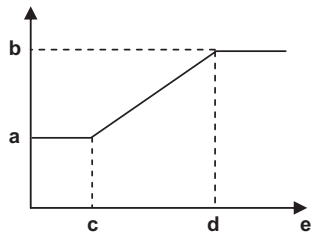
SW5	SW6					
10	5	6	7	8	9	10
OFF	OFF	OFF	OFF	OFF	ON	OFF

Settable item	Item Code	Initial value	Unit	Limits and increments			Note	Setting change from optional remote controller
				Increments	Lower limit	Upper limit		
Analog input signal	1051	0		1	0	3		No

0: Water temp. input analog
1: Capacity control input 4-20 mA
2: Water temp. input IT terminal
3: Capacity control input IT terminal

(1) Input signal type 0 (4-20 mA)

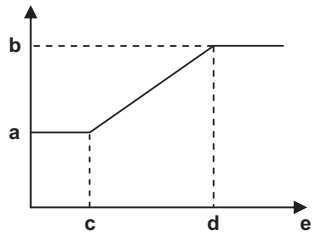
- External analog input signal of 5.9 mA: Pre-set temp. A (Item code 11)
- External analog input signal of 18.3 mA: Pre-set temp. B (Item code 13)
- External analog input signal of between 5.9 and 18.3 mA: Pre-set temp. will be linearly interpolated.
  Pre-set temp. = (B - A) * (Input current - 5.9 mA)/12.4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



a Pre-set temp. A
b Pre-set temp. B
c 5.9 mA
d 18.3 mA
e Input current

(2) Input signal type 1 (0-10 V)

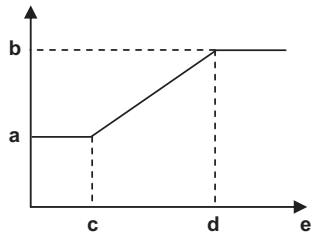
- External analog input signal of 1.0 V: Pre-set temp. A (Item code 11)
- External analog input signal of 9.1 V: Pre-set temp. B (Item code 13)
- External analog input signal of between 1.0 and 9.1 V: Pre-set temp. will be linearly interpolated.
  Pre-set temp. = (B - A) * (Input voltage - 1.0 V)/8.1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



a Pre-set temp. A
b Pre-set temp. B
c 1.0 V
d 9.1 V
e Input voltage

(3) Input signal type 2 (1-5 V)

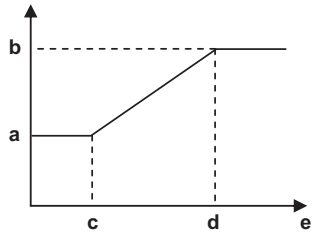
- External analog input signal of 1.5 V: Pre-set temp. A (Item code 11)
- External analog input signal of 4.5 V: Pre-set temp. B (Item code 13)
- External analog input signal of between 1.5 and 4.5 V: Pre-set temp. will be linearly interpolated.
  Pre-set temp. = (B - A) * (Input voltage - 1.5 V)/3.0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



a Pre-set temp. A
b Pre-set temp. B
c 1.5 V
d 4.5 V
e Input voltage

(4) Input signal type 3 (2-10 V)

- External analog input signal of 2.9 V: Pre-set temp. A (Item code 11)
- External analog input signal of 9.1 V: Pre-set temp. B (Item code 13)
- External analog input signal of between 2.9 and 9.1 V: Pre-set temp. will be linearly interpolated.
  Pre-set temp. = (B - A) * (Input voltage - 2.9 V)/6.2 V + A
  Change of 59 mV or less is not recognized.



a Pre-set temp. A
b Pre-set temp. B
c 2.9 V
d 9.1 V
e Input voltage

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

For how to set the settings, refer to the following section."Selecting the remote water temp. setting input signal type" (p. 106)
(Set item code 1051 instead of 21.)

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

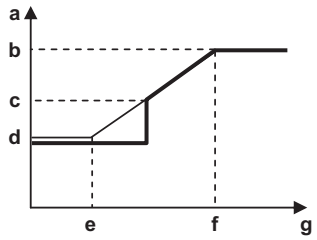
Settable item	Item Code	Initial value	Unit	Limits and increments			Note	Setting change from optional remote controller
				Increments	Lower limit	Upper limit		
Analog signal input	1051	0		1	0	3		No

0: Water temp. input analog
1: Capacity control input 4-20 mA
2: Water temp. input IT terminal
3: Capacity control input IT terminal

When SW5-7 is set to ON (Enable external input), the capacity control ratio will be determined based on the type of analog input signal.

(1) Input signal type 0 (4-20 mA)

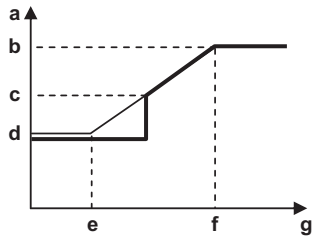
- External analog input signal of 5.9 mA: 0%
- External analog input signal of 18.3 mA: 100%
- External analog input signal of between 5.9 and 18.3 mA: Percentage will be linearly interpolated.
  Pre-set temp. = 100% * (Input current - 5.9 mA)/12.4 mA
  Change of 0.12 mA or less is not recognized.



a Load ratio
b 100%
c *%
d 0%
e 5.9 mA
f 18.3 mA
g Input current

(2) Input signal type 1 (0-10 V)

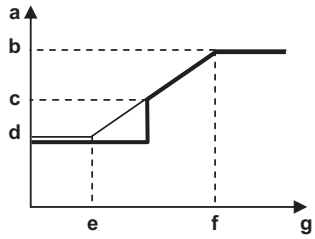
- External analog input signal of 1.0 V: 0%
- External analog input signal of 9.1 V: 100%
- External analog input signal of between 1.0 and 9.1 V: Percentage will be linearly interpolated.
  Pre-set temp. = 100% * (Input voltage - 1.0 V)/8.1 V
  Change of 59 mV or less is not recognized.



a Load ratio
b 100%
c *%
d 0%
e 1.0 V
f 9.1 V
g Input voltage

(3) Input signal type 2 (1-5 V)

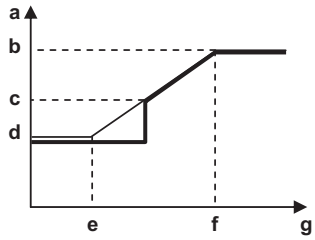
- External analog input signal of 1.5 V: 0%
- External analog input signal of 4.5 V: 100%
- External analog input signal of between 1.5 and 4.5 V: Percentage will be linearly interpolated.
  Pre-set temp. = 100% * (Input voltage - 1.5 V)/3.0 V
  Change of 29 mV or less is not recognized.



a Load ratio
b 100%
c *%
d 0%
e 1.5 V
f 4.5 V
g Input voltage

(4) Input signal type 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: Percentage will be linearly interpolated.
  Pre-set temp. = 100% * (Input voltage - 2.9 V)/6.2 V
  Change of 59 mV or less is not recognized.



a Load ratio
b 100%
c *%
d 0%
e 2.9 V
f 9.1 V
g Input voltage

* %: Compressor will stop when the compressor frequency drops below the low frequency limit, depending on the outside and water temperatures.

(10) Setting the booster heater 1 operation conditions

Set the booster heater 1 trigger temperatures for item codes 1057 and 1058 (TWL1 and TAL1).

Booster heater 1 start conditions

(1) Individual system

Operation command signal is ON, and at least one of the following two conditions is met.

1) Water temp. control is set to OFF, water temp. drops below TWL1, and outdoor temp. drops below TAL1.

2) Water temp. control is set to ON, external water temp. thermistor reading drops below TWL1, and outdoor temp. drops below TAL1.

(2) Multiple system

Operation command signal is ON, and the following conditions are met.

External water temp. thermistor readings (TH14 and TH15) drop below TWL1, and the reading of the outdoor temp. thermistor connected to the main unit drops below TWL1.

Booster heater 1 stop conditions

Operation command signal is OFF, or both of the following conditions are met.

1) Water temp. is at or above TWL1+2°C, or outdoor temp. is at or above TAL1+2°C.

2) External water temp. thermistor readings (TH14 and TH15) are at or above TWL1+2°C, or the reading of the outdoor temp. thermistor (TH9) connected to the main unit exceeds TAL1+2°C.

Steps

Step 1

Set SW5 and SW6 as follows to select the outdoor temp. input source.

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

Settable item	Item Code	Initial value	Unit	Limits and increments			Note	Setting change from optional remote controller
				Increments	Lower limit	Upper limit		
Outdoor temp. input source	1080	0		1	0	1		No

0: Outdoor temp. thermistor (TH9)

1: IT terminal

Step 2

Set SW5 and SW6 as follows to select the output temp. input source.

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

Settable item	Item Code	Initial value	Unit	Limits and increments			Setting change from optional remote controller
				Increments	Lower limit	Upper limit	
Booster heater 1 trigger water temp. (TWL1)	1057	40	°C	0.1	0	75	No
Booster heater 1 trigger outdoor temp. (TAL1)	1058	-10	°C	0.1	-30	50	No

Step 3

Press SWP3 to save the change.

The LED will stop blinking and stay lit.

Then, an item code will appear on the LED.

If SWP3 is not pressed within one minute, the change will not be saved, and an item code will appear on the LED.

[2] Operating characteristics and Control Capabilities

-1- Operating characteristics

Function	Component		Symbol	Control/ Detection		Action	Unit	Trigger condition
Unit protection	Pressure switch	High-pressure switch	63H1	HP	63H1	ON	MPa	(2.95)
						OFF	MPa	$3.85\ ^{+0}_{-0.15}$
	Pressure sensor	High-pressure sensor	PSH1	HP	PSH1	OFF	MPa	-
		Low-pressure sensor	PSL1	LP	PSL1	OFF	MPa	⬧Instantaneous detection of PSL1 ≤ 0.06 MPa after 30 s have elapsed since the start of the defrost. ⬧Instantaneous detection of PSL1 ≤ 0.06 MPa within 30 s after the compressor starts. ⬧Continuous detection of PSL1 ≤ 0.05 MPa for 10 min. ⬧Continuous detection of PSL1 ≤ 0.01 MPa for 1 min. ⬧Instantaneous detection of PSL1 ≤ - 0.02 MPa.
	Compressor overcurrent relay			Comp. current		OFF	A	56
	Thermistor	Discharge pipe temp. (discharge temp. overrise and compressor flooding protection)	TH1	Discharge gas temp.		OFF	ºC	⬧Continuous detection of TH1 110°C for 30 sec. ⬧Instantaneous detection of TH1 ≥ 115°C ⬧Continuous detection of discharge SH ≤ 2°C for 40 min.
		Suction pipe temp. (vacuum and freeze-up protection)	TH2	Suction gas temp.		OFF	ºC	⬧Continuous detection of TH2 ≤ -36°C for 1 min.
		Compressor shell bottom temp. (compressor flooding protection)	TH3	Comp. shell temp.		OFF	ºC	⬧Continuous detection of shell bottom SH ≤ 10°C for 40 min.
		Air heat exchanger outlet pipe temp. (vacuum protection)	TH4 TH5	Air heat exchanger outlet refrigerant temp.		OFF	ºC	⬧Continuous detection of TH4 or TH5 ≤ -33°C for 1 min.
		Outdoor temp.	TH9	Outdoor temp.		ON	ºC	-25
						OFF	ºC	-28
		Inlet water temp.	TH10	Water temp.		OFF	ºC	⬧When the water temp. is reached the water temp. setting. ⬧When water temp. has reached Tmax. After comp. startup, if LP never falls below 0.1 MPa, Tmax = 77°C If the outdoor temperature ≤ -25°C, Tmax = 65°C If the outdoor temperature ≥ -15°C, Tmax = 75°C Tmax is linearly interpolated between -25°C and -15°C.
		Outlet water temp.	TH11					
Pump control	Water temp. thermistor (freeze-up protection)		TH10 TH11	Water temp.		ON	ºC	13
						OFF	ºC	15
	Outdoor temp. thermistor		TH9	Outdoor temp.		ON	ºC	1
						OFF	ºC	3
	Freeze-up protection circuit							The pump turns on when the water inlet temperature has reached below the "ON" threshold AND the outdoor 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 " displays 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 is controlled every 30 seconds so that the frequency fluctuation is kept between -8 and +3 Hz.
- If the water temperature is controlled based on the external water temperature thermistor reading or the inlet water temperature (SW6-3 is set to ON.), for 90 seconds after the startup, the compressor is controlled every 30 seconds so that the frequency fluctuation is 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 pre-set water temperatures.
- The minimum operating frequency is 30 ~ 40 Hz.
  It is determined based on the relationship to the outdoor temperature.
- The maximum operating frequency is 71 ~ 140 Hz.
  It is determined based on the relationship between the water temperature and outdoor temperature.

-4- Outdoor unit fan

The fan rotating speed is determined based on the relationship between outdoor temperature and low pressure.
The minimum fan rotating speed is 250 rpm when Dip switch SW4-7 is OFF.
The maximum fan rotating speed is 780 rpm when Dip switch SW4-7 is OFF.
The minimum fan rotating speed is 320 rpm when Dip switch SW4-7 is ON (external static pressure mode).
The maximum fan rotating speed is 920 rpm when Dip switch SW4-7 is ON (external static pressure mode).

-5- Injection LEV

Operating range of the LEV
Opening range: 0-480 (fully open)

At startup
- For one minute after startup, the valve is fixed to Initial Setting.

During operation
- Injection LEV opening is controlled every 15 seconds to approximate the discharge SH to the target value.
- The target value varies based on the relationship among outdoor temperature, outlet water temperature and compressor operating frequency.

-6- LEV in the main circuit

Operating range of the LEV
The opening range of the LEV1 is between 41 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 is fixed to the Initial Setting.

During operation
- Ninety or more seconds after startup, the LEV opening is controlled every 30 seconds according to the changes in compressor frequency, pressure, and temperature.
- The LEV is controlled to keep the suction SH in the range between 0 and 7 K.

-7- Refrigerant sensor

At startup

After the initial setup is completed, the refrigerant sensor enters the initial stabilization period for 60 s.

Detection of R290

Declared alarm set point is approximately 6.2% LFL (1302 ppm).

After detection of R290, the outdoor unit fans rotate for 3 min while the unit transitions to the refrigerant leak error (1510).

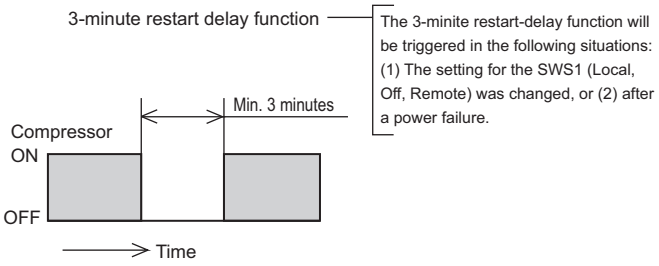
When refrigerant leakage of approximately 25-30% LFL or more is continuously detected for 6 minutes or longer, the unit transitions from the refrigerant leak error (1510) to the refrigerant sensor fault (5501).

-8- Operation during power failure

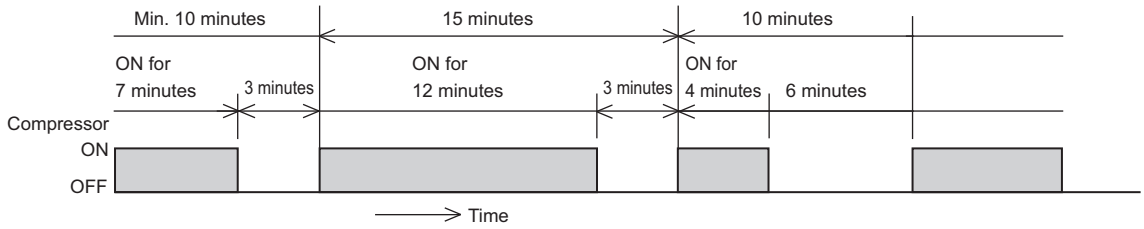
Duration of power failure		20 ms or shorter	20 ~ 200ms	200 ms or longer
Detection of power failure		Undetectable	Instantaneous power failure	Detection of power failure
Operation during power failure		Normal operation	During an instantaneous power failure, the unit will be controlled according to the input status of the circuit board immediately before the instantaneous power failure.	All outputs will be turned off immediately after power failure.
Operation after power is restored	Automatic restoration after power failure is set to "Enabled" (SW6-2 is set to ON.)	Normal operation	The circuit board will start receiving input.	The unit will be controlled according to the input status of the circuit board immediately before the power failure, except that the input status of the dry contact after the power is restored will override the one before the power failure. For three minutes after the power is restored, the unit will not operate.
	Automatic restoration after power failure is set to "Disabled" (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.

-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.

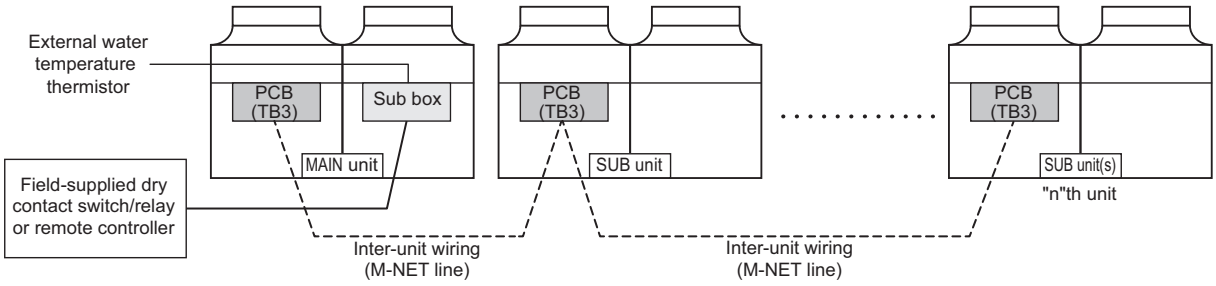


The unit has a function to keep the compressor from short-cycling when the amount of circulating water is low or when the load is light. If the compressor stops within 10 minutes of startup, restart is delayed until 10 minutes after that startup.



-10- Multiple system control

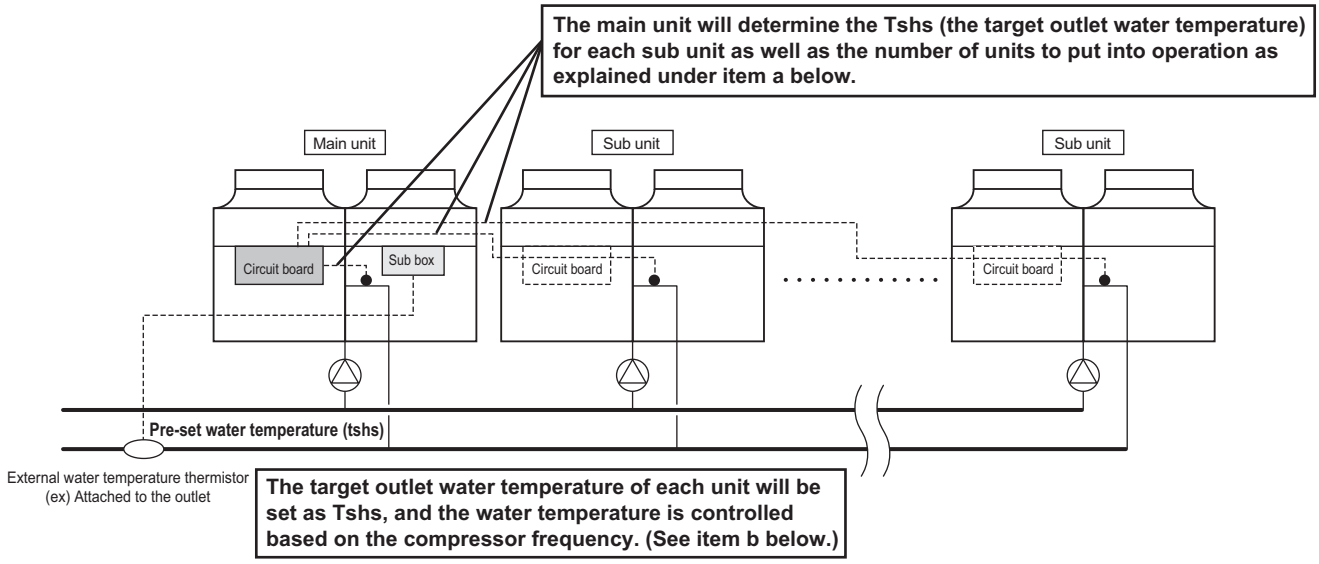
1. Electrical wiring diagram



(*) Main/Sub units and switch settings

	SW5-8 (Use of external water temperature thermistor)	SW5-9 (Multiple system)
Main unit (Unit to which the external water temperature thermistor 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)

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

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

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

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

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

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

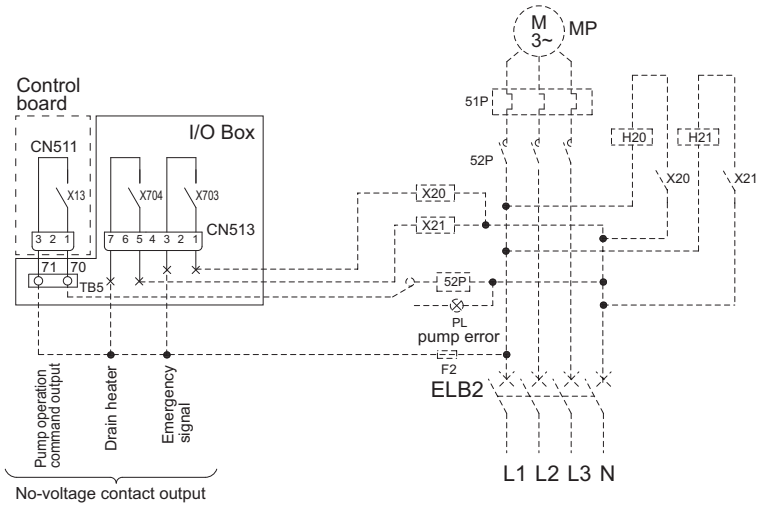
Each unit increases or decreases the compressor frequency based on the difference between the pre-set and the current water temperatures.

-11- Automatic operation of pump for freeze-up protection

1. Purpose

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

2. Pump wire connection



3. Natural freeze-up protection

The units will operate according to the dip switch 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 outdoor temperature and the water temperature	Natural freeze-up protection based on both the outdoor temperature and the water temperature
Details	Pump start conditions	"Outdoor temperature is less than ±1 ºC of 1 ºC" AND "Water temperature is less than ±1 of 13 ºC"	Same as left.
	Pump stop conditions	"Outdoor temperature is more than ±1ºC of 3 ºC" AND "Water temperature is more than ±1ºC of 15 ºC"	Same as left.

-12- 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 thermistor 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 water temp. is reached the water temp. setting.
- When water temp. has reached Tmax.

After comp. startup, if LP never falls below 0.1 MPa, Tmax = 77°C
If the outdoor temperature ≤ -25°C, Tmax = 65°C
If the outdoor temperature ≥ -15°C, Tmax = 75°C
Tmax is linearly interpolated between -25°C and -15°C.

DIFF1 = 2 ºC (Initial setting): “1015” Digitally set value
DIFF2 = 2 ºC (Initial setting): “1016” Digitally set value

Single/Multiple system	Thermistor	Control method	Thermo-ON conditions
Individual system	Built-in thermistor	Inlet-water-temperature-based control	Outlet water temp. < (Pre-set water temp. - DIFF1) AND Inlet water temp. < (Pre-set water temp. - DIFF1)
		Outlet-water-temperature-based control	
	External water temp. thermistor	Water temp. control based on the external water temp. reading	External water temp. < (Pre-set water temp. - DIFF1)
Multiple system	External water temp. thermistor	Water temp. control based on the external water temp. reading	External water temp. < (Pre-set water temp. - DIFF2/2) AND The number of units to run an optimal operation is determined by the main unit. (The unit with the least amount of cumulative operation hours goes into operation first.)

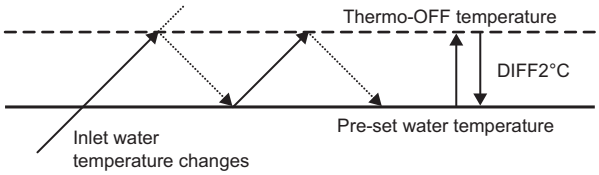
2. Normal Thermo-ON/OFF operations

DIFF1 = 2 ºC (Initial setting): “1015” Digitally set value
DIFF2 = 2 ºC (Initial setting): “1016” Digitally set value

Single/Multiple system	Thermistor	Thermo-ON conditions	Thermo-ON conditions	Thermo-OFF conditions
Individual system	Built-in thermistor	Inlet-water-temperature-based control	Inlet water temp. < (Inlet water temp. at Thermo-OFF - DIFF2)	Inlet water temp. > (Pre-set water temp. + DIFF2) AND At least 60 s have passed since the last Thermo-ON
		Outlet-water-temperature-based control		Outlet water temp. > (Pre-set water temp. + DIFF2) AND At least 60 s have passed since the last Thermo-ON
	External water temp. thermistor	Water temp. control based on the external water temp. reading	Inlet water temp. < (Inlet water temp. at Thermo-OFF - DIFF2)	External water temp. > (Pre-set water temp. + DIFF2) AND At least 60 s have passed since the last Thermo-ON
Multiple system	External water temp. thermistor	Water temp. control based on the external water temp. reading	External water temp. < (Inlet water temp. at Thermo-OFF - DIFF2/2) AND At least 60 s have passed since the last Thermo-ON AND The number of units to run an optimal operation is determined by the main unit. (The unit with the least amount of cumulative operation hours goes into operation first.)	External water temp. > (Pre-set water temp. + DIFF2/2) AND At least 60 s have passed since the last Thermo-ON AND The number of units to run an optimal operation is determined by the main unit. (The unit with the least amount of cumulative operation hours goes into operation first.)

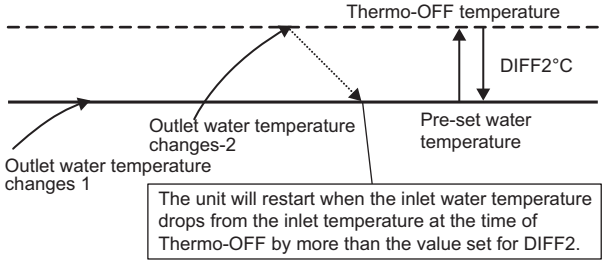
1) Thermo-ON/OFF temperature conditions

♦Intlet-temperature-based water temperature control in an individual system (with the external water temperature thermistor setting being set to ON and the Inlet-/outlet-based control option being set to inlet)



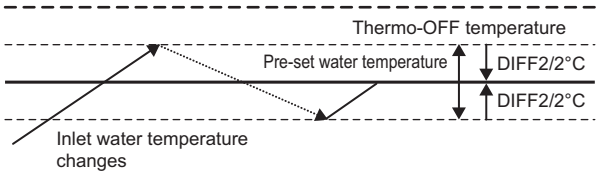
When the water temperature is controlled based on the inlet temperature, compressor frequency will be controlled as described in section -3- "Compressor frequency" (page 113). (Automatic operation according to the pre-set temperature)

♦Outlet-temperature-based water temperature control in an individual system (with the external water temperature thermistor setting being set to ON and the Inlet-/outlet-based control option being set to outlet)



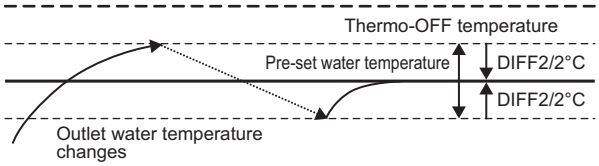
When the water temperature is controlled based on the external water temperature thermistor reading (outlet water temperature), compressor frequency will be controlled in the way that the target water temperature will be maintained. If there is a sudden increase in water temperature and the unit did not stop at the pre-set temperature, the unit will stop when the temperature that equals "the pre-set temperature + the value set for DIFF2" is reached.

♦**Multiple system control (inlet-water-temperature-based control)**



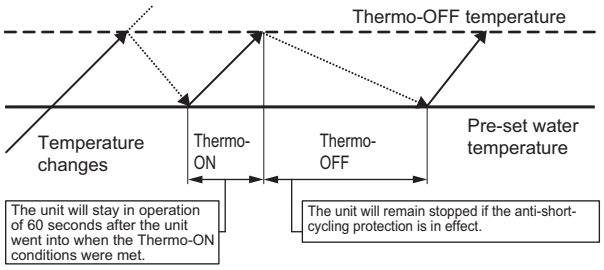
When the water temperature is controlled based on the representative inlet temperature, compressor frequency will be controlled as described in section -3- "Compressor frequency" (page 113). (Automatic operation according to the pre-set temperature)

♦**Multiple system control (outlet-water-temperature-based control)**



When the water temperature is controlled based on the external water temperature thermistor 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 113). (Automatic operation according to the pre-set temperature)

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

DIFF1 = 2 ºC (Initial setting): “1015” Digitally set value
DIFF2 = 2 ºC (Initial setting): “1016” Digitally set value
After comp. startup, if LP never falls below 0.1 MPa, Tmax = 77°C
If the outdoor temperature ≤ -25°C, Tmax = 65°C
If the outdoor temperature ≥ -15°C, Tmax = 75°C
Tmax is linearly interpolated between -25°C and -15°C.

Individual system	sensor	Control method	Thermo-ON conditions	Thermo-OFF conditions
Refer to the section on individual system.	Built-in thermistor External water temperature	Inlet-water-temperature-based control Outlet-water-temperature-based control Water temperature control based on the external water temperature reading	When SW5-5 (operation restoration after forced stoppage) is set to ON Inlet water temperatures are lower than the "Inlet temperature at Thermo-OFF DIFF2ºC" AND outlet temperatures are lower than "Tmax - DIFF1ºC."	"External water temperature of each unit > Tmax" or "Inlet water temperature of each unit > Tmax"
			When SW5-5 (operation restoration after forced stoppage) is set to OFF Inlet temperatures are lower than "Tmax - DIFF1ºC" AND outlet temperatures are lower than "Tmax - DIFF1ºC."	

-13- 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 thermistor.
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 thermistor, 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 "Re-initializing the system" (page 44).
A separately sold water temperature thermistor "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 thermistor and wiring according to the instructions on page 48.

-14- 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 123
[2] Test Run Method 125
[3] Operating the Unit 126
[4] Refrigerant 128
[5] Symptoms that do not Signify Problems 128
[6] Standard operating characteristics (Reference data) 128

[1] Items to be checked before a Test Run

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

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

Note

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

Note

Securely tighten the cap.

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

(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 (outdoor temperature: between -25 ºC and +43 ºC)	
	At the initial stage of heating water (Before water has been heated up)	During normal operation
Condensing temperature	Outlet water temperature + (0 - 10 °C)	Outlet water temperature + (0 - 5 °C)
Evaporating temperature	Outside temp. - (5 - 13 °C)	Outside temp. - (3 - 8 °C)*

* To maintain proper compression ratio, when the outdoor temperature exceeds 17 ºC, evaporating temperature may drop below "(Outdoor temperature) - 8 ºC"

(7) Check that the correct voltage is applied.

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

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

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

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

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

(10) Check for proper circulating water flow rate.

Measure the circulating water flow rate, if possible. If it is not, check that the temperature difference between the outlet and inlet temperatures is between 3 and 5 ºC. A temperature difference of 8.6ºC or more indicates not enough water flow. Check for air pockets in the pipe, and make sure that the pump has the appropriate capacity for the circuit.

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

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

Notes on temperature adjustment function

The water temperature can be controlled based on the inlet or the outlet temperature thermistor reading. Select one to use. Refer to “Default dip switch settings” (page 91) and "Setting the individual water temp. for item codes 11, 13, and 22-27" (page 95) for how to select the water temperature control method and how to set the water temperature.

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

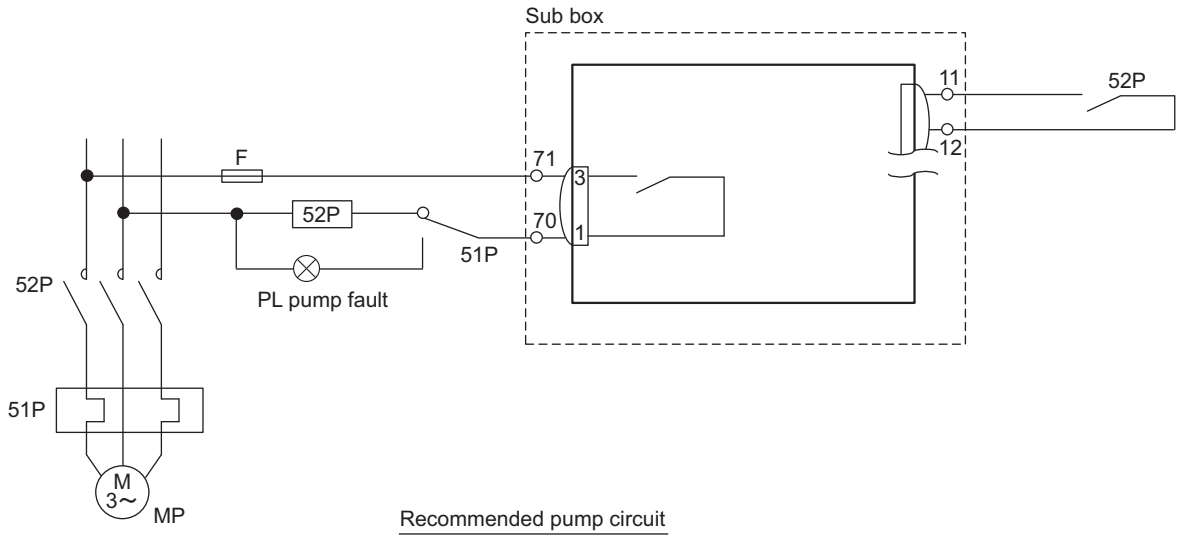
(12) Connect the pump-interlock wire to the appropriate contacts.

1) Connecting the pump-interlock wire

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

2) Notes on connecting the pump-interlock wire

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



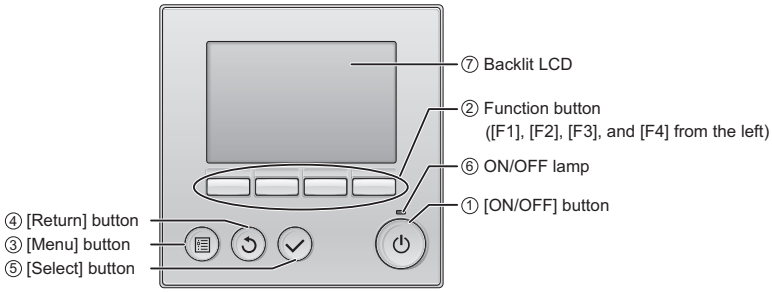
Recommended pump circuit

(13) Checking the rotation direction of the pump

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

[2] Test Run Method

∗Refer to FTC install manual for using the main remote control connected to the FTC.

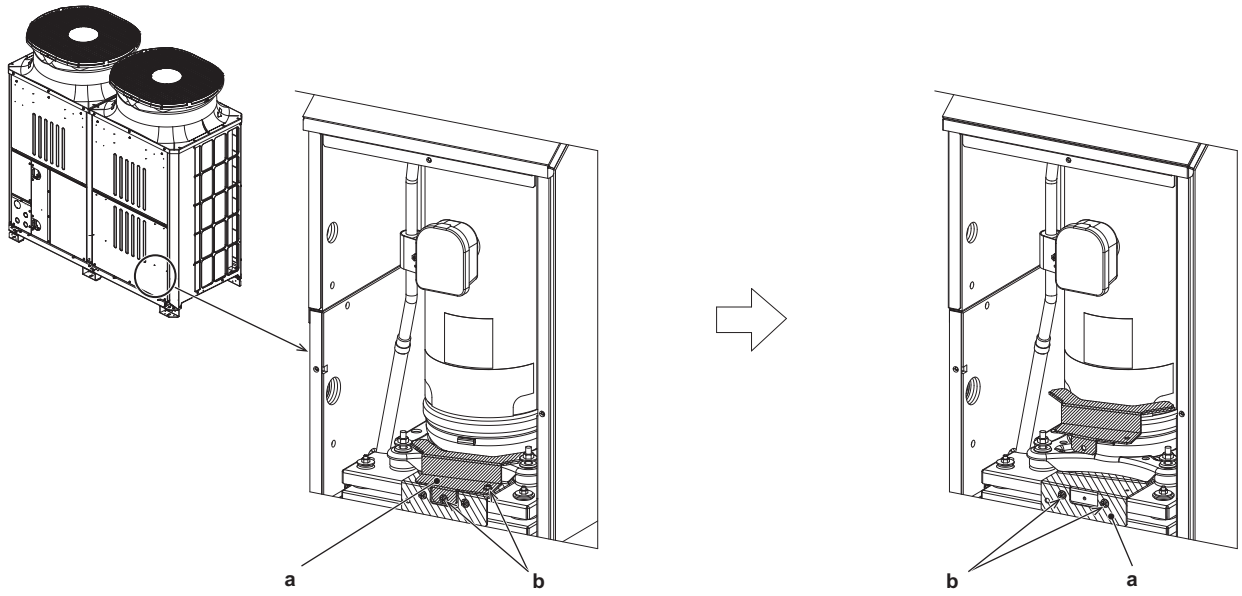


Operation procedures
Turn on the main power.
Set the water temperature to a temperature at least 5 ºC above the current settings. Press the ① ON/OFF button to start operation. → Run
To stop the operation, press the ① ON/OFF button. → Stop
Note 1: Refer to the following pages if an error code appears on the remote controller or when the unit malfunctions.

[3] Operating the Unit

1. Initial Operation

1) Ensure the unit ON/OFF switch on the local control panel is turned off.
2) Remove the metal plates from the compressor by unscrewing the four screws (circled in the figure).



a Shipping bracket
b Unscrew to remove the brackets

3) Turn on the main power. Perform an initial setup. The compressor will not be activated until the initial setup is completed. Refer to the following page(s) for detail. "Setting configuration procedures" (p. 38)
4) Keep the main power turned on for at least 12 hours to heat the compressor.
5) Turn on the unit ON/OFF switch on the control panel.

IMPORTANT
- The refrigerant sensor is not activated before the initial setup is completed. Complete the initial setup promptly.

2. Daily Operation

To start an operation

Switch on the unit ON/OFF switch on the local control panel, or press the ON/OFF button on the remote controller. Refer to the following pages for how to use the remote controller. "Remote Controller Operation" (p. 67)

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

To stop an operation

Switch off the unit ON/OFF switch on the 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).
- Keep the power constantly ON. This unit is equipped with the refrigerant sensor and electrically powered safety measures. To be effective, the unit must be electrically powered at all times after installation, other than when servicing.

3. Using Units in Cold Climates

In sub-freezing conditions, take measures to prevent water in the water circuit from freezing, bursting pipes, and damaging water leaks.

- Remove any snow off the unit before turning on the unit.
- Operate the unit frequently enough to reduce the chance of water freeze-ups.
- Blow the water out of the pipes, or fill them with anti-freeze before a long period of non-operation.
- Ensure that the water circuit has an anti-freeze feature, and keep the main power turned on.
- If the water circulation circuit is connected to a separate circuit from the unit, keep its power on as well.
- Starting the unit with the outlet water temperature outside the specified range may result in an abnormal stop.
- When the outside air temperature is low, use auxiliary heat sources such as heaters to ensure that the water temperature at the startup of the unit is equal to or above the lower limit of the specified outlet water temperature range.

[4] Refrigerant

Unit type	CAHV-Z450YA-HPB(-BS)
Refrigerant type	R290
Refrigerant charge	4.8 kg

[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

Ambient temperature	DB	°C	7
	WB	°C	6
Temperature	Discharge refrigerant	°C	64
	Suction refrigerant	°C	0.5
	Shell temperature	°C	34
	Air-side heat exchanger inlet	°C	0.1
	Outdoor temperature	°C	7
	Inlet water temperature	°C	40
	Outlet water temperature	°C	45
Pressure	High pressure	MPa	1.5
	Low pressure	MPa	0.4
LEV opening	Main circuit	pulse	800
	Injection	pulse	146
Compressor	Frequency	Hz	109
Fan	Frequency	Hz	650

IX Maintenance

[1] Periodic maintenance inspections 131
[2] Guidelines for Maintenance and Inspection of Major Parts 132

[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)
	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)
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.
	3. Check the refrigerant sensor for proper operation.	Visual 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 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 under the same given conditions (evaporating temperature, outdoor temperature).

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

[2] Guidelines for Maintenance and Inspection of Major Parts

The table below details regular inspection and preventive maintenance, including inspection items, methods, criteria, and schedules.

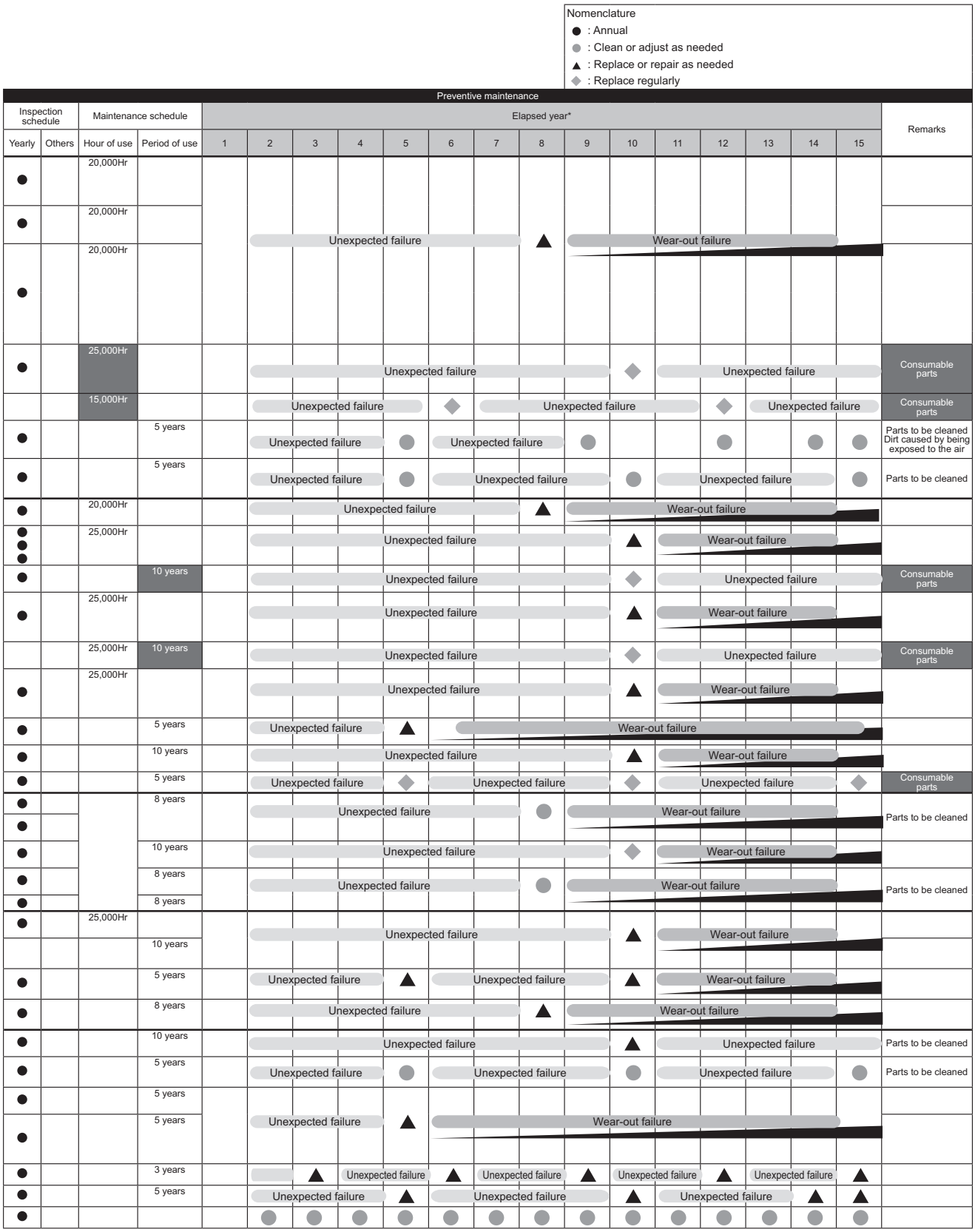
Parts			Regular inspection			Preventive maintenance
Component parts	Parts		Item	Method/tool	Criteria <Reference>	Item
Refrigerant circuit	Compressor		• Sound and vibration at start-up, during operation, during compressor stoppage • Insulation resistance • Terminals, wiring	Visual, auditory, tactile 500 VDC ohmmeter Screwdriver, visual	• No abnormal sound and vibration • ≥ 1 MΩ • No loose terminals and wiring contacts	• Replace if abnormal sound or vibration was detected • Replace if “insulation resistance ≤ 1 MΩ” • Retighten terminals and reconnect connectors
	Linear expansion valve		• Operation • Operating sound (pressure)	Tactile Auditory and tactile By turning ON/OFF the unit	• Normal refrigerant circulation • Normal operating sound and temp. change	• Replace if stuck
	Refrigerant system	Inner piping	• Sympathetic vibration, contact, corrosion of inner piping • Sympathetic vibration, capillary tubes in contact	Visual Visual	• No abnormal sympathetic vibration, sound, and corrosion • No abnormal sympathetic vibration and contact wear	• Replace or repair if pipes are severely corroded or worn • Replace if “insulation resistance ≤ 1 MΩ” • Paint any corroded surface.
		Solenoid valve, four-way valve	• Operation, insulation • Corrosion, noise	500 VDC ohmmeter Visual, auditory	• Insulation resistance ≥1 MΩ • No abnormal sound and corrosion	
		Container	• Corrosion of accumulator or oil separator	Visual	• No corrosion	
	Protection device	High-pressure switch	• Operating pressure, refrigerant leak, insulation resistance	Pressure gauge	• Operates at the set value • Measured value within the specified range	• Replace regularly
		Fusible plug	• Swollen soluble metal	Visual	• Soluble metal in the normal position	
	Heat exchanger	Air	• Clogging, damage • Refrigerant leak	Visual Refrigerant leak detector	• No clogging and damage • No leaks	• Clean air inlet if clogged • Repair or replace heat exchanger if leaking
		Water	• Water volume, temp. • Refrigerant leak • Drain water in the heat exchanger or pipes	• Thermometer, flowmeter, differential pressure gauge • Refrigerant leak detector	• Tolerance • No refrigerant leaks • Proper installation	• Adjust valve and valve operation settings • Repair or replace heat exchanger if leaking • Install a drain valve
Electrical/ Electronic parts	Fan motor		• Noise • Insulation resistance	Auditory 500 VDC ohmmeter	• No abnormal sound • Insulation resistance ≥1 MΩ	• Replace bearing if making loud noise • Replace motor if insulation is eroded
	Switch (incl. FFB and ELB)	Solenoid switch Overcurrent relay Auxiliary relay	• Operation and appearance • Contact	Visual	• No deformation • Normal operation, no deformation • No deformation and discoloration	• Replace switches if malfunctioning, deformed, or discolored
	Fuse		• Appearance	Visual	• No deformation and discoloration	• Replace fuse if blown
	Control box (incl. inverter) Electrolytic capacitor		• Insulation resistance • Dust on circuit board • Terminals, connectors • Appearance of electrolytic capacitor	500 VDC ohmmeter Visual Screwdriver, visual Visual	• Insulation resistance ≥1 MΩ • No dust • All connectors properly connected • No liquid leaks and deformation	• Clean dust with a brush • Replace circuit board if malfunctioning • Re-tighten terminals and reconnect connectors • Replace electrolytic capacitor if leaking. (Note4)
	Smoothing capacitor		• Capacitance, insulation resistance	Electrostatic meter, 500 VDC ohmmeter	• Insulation resistance ≥ specified value	• Replace regularly
	Electric box (incl. circuit board)		• Insulation resistance of circuit, appearance of capacitor • Terminals, connectors • Self-diagnosis mode, appearance	500 VDC ohmmeter Visual Visual	• Insulation resistance ≥1 MΩ • All connectors properly connected • No errors appear on the display.	• Replace circuit board if malfunctioning • Re-tighten terminals and reconnect connectors • Replace circuit board if leaking
	Pressure sensor, thermistor		• Open- or short-circuit, appearance	Tester, visual	• Within the specified value, no discoloration	• Replace if short-circuited or disconnected
	SW power source		• Output voltage	Tester	• Within the specified range	• Replace SW if voltage is abnormal
	Refrigerant sensor		• Burial • Refrigerant leak	• Visual • Refrigerant leak detector	• No burial • No leaks	• Replace regularly • Replace if malfunctioning
Structural parts	Decorative part		• Grime and damage	Visual	• No dirt, damage, and deformation	• Wash panels with neutral detergent, and paint the surface
	Frame, bottom plate		• Rust, insulation material • Peeling coating	Visual	• No rust and insulation damage	• Repair frame or bottom plate if insulation is torn. • Paint the surface
	Propeller fan		• Vibration, appearance	Visual	• No propeller runout and catching	• Replace if propeller runout or balance problem exists
	Drain pan		• Clogging • Peeling paint	Visual	• No clogging • No rust and holes	• Clean drain pan, and check for tilt. • Touch up paint
	Guard panel		• Peeling coating	Visual	• No rust	• Paint the surface
External parts	Remote controller switch		• Controllability	Visual	• Display follows the commands.	• Replace if the display does not follow the commands or wrong display appears
	Central control system		• Controllability • Loose terminal, wiring contact • Insulation resistance	• Visual • 500 VDC ohmmeter	• Display follows the commands • No loose contacts • > 1 MΩ	• Re-tighten terminals and reconnect connectors • Replace if “resistance < 1MΩ”
	Flow switch		• Controllability • Water leak • Insulation resistance	• Visual • 500 VDC ohmmeter	• Display follows the commands • No water leaks • >1 MΩ	• Replace
	Phase-advance capacitor Elapsed time integrator Ammeter		• Insulation resistance	• 500 VDC ohmmeter	• >1 MΩ	• Replace if “resistance < 1MΩ”
Water circuit	Strainer		• Clogging	• Visual	• No stain and clogging	• Clean
	Water pipe		• Water leak • Presence of air • Open air vent valve	• Visual • Sensory	• No water leaks • No abnormal sound	• Re-tighten terminals and reconnect connectors • Release air, or replace and adjust valve
	Flow regulating valve		• Water temp. difference (flow rate)	• Thermistor	• Proper temp. difference range	• Replace and adjust
	Pump		• Vibration • Insulation resistance • Water leak • Loose terminal, wiring contact • Strainer	• Visual, audibility, tactile • 500 VDC ohmmeter • Visual	• No abnormal sound • > 1 MΩ • No water leaks • No loose contacts • No clogging	• Replace • Re-tighten terminals and reconnect connectors • Reconnect wiring • Clean strainer
	Pressure gauge		• Displayed value	• Visual	• Correct display	• Replace if wrong values are displayed
	Thermistor		• Displayed value	• Surface thermistor	• Correct display	• Replace if wrong values are displayed
	Water		• Water quality	• Water quality analysis	• Water quality standards	• Improve water quality

Note1) Unexpected failure is a sudden and unpredictable failure that occurs randomly before parts or device reaches its lifespan. It is difficult to apply technical measures, leaving applying statistical measures as the only solution.

Note2) Elapsed year refers to the time period in which a given product has been used for 10 hours a day and 2500 hours a year without frequent start-stops.

Note3) ◢ shows that the likelihood of wear-out and failure increases over time.

Note4) If the compressor or fans have accumulated more than 25,000 operating hours or have been in service for 10 years, please consider replacing any circuit boards that contain electrolytic capacitors.


Nomenclature
● : Annual
● : Clean or adjust as needed
▲ : Replace or repair as needed
◆ : Replace regularly
Preventive maintenance
Inspection schedule
Yearly
Others
Maintenance schedule
Hour of use
Period of use
Elapsed year*
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Remarks
20,000Hr
25,000Hr
15,000Hr
5 years
10 years
8 years
3 years
Unexpected failure
Wear-out failure
Consumable parts
Parts to be cleaned
Parts to be cleaned Dirt caused by being exposed to the air

X Troubleshooting

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[2] Troubleshooting 145
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[4] Refrigerant Leak 168
[5] Parts Replacement Procedures 169

[1] Maintenance items

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

Note

Refer to “Error code list” for information about error codes. (page 147)

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 pipe temp. TH1	c03	First decimal place	○	○	
Suction pipe temp. TH2	c04	First decimal place	○	○	
Compressor shell bottom temp. TH3	c05	First decimal place	○	○	
Air heat exchanger outlet pipe temp. TH4	c06	First decimal place	○	○	
Air heat exchanger outlet pipe temp. TH5	c42	First decimal place	○	○	
Outdoor temp. TH9	c07	First decimal place	○	○	
Inlet water temp. TH10	c08	First decimal place	○	○	
Outlet water temp. TH11	c09	First decimal place	○	○	
External water temp. TH14	c10	First decimal place	○	Fixed to 0	
External water temp. 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 139)
(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 pipe temp. TH1	c03	First decimal place	○	○	(Note2)
Suction pipe temp. TH2	c04	First decimal place	○	○	(Note2)
Compressor shell bottom temp. TH3	c05	First decimal place	○	○	(Note2)
Air heat exchanger outlet pipe temp. TH4	c06	First decimal place	○	○	(Note2)
Air heat exchanger outlet pipe temp. TH5	c42	First decimal place	○	○	(Note2)
Outdoor temp. TH9	c07	First decimal place	○	○	(Note2)
Inlet water temp. TH10	c08	First decimal place	○	○	(Note2)
Outlet water temp. TH11	c09	First decimal place	○	○	(Note2)
External water temp. TH14	c10	First decimal place	○	Fixed to 0	(Note2)
External water temp. 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 137)
(Note2) Codes c01 through c11 and c42 indicate temperature thermistors.
(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 pipe temp. TH1	c03	First decimal place	○	○
Suction pipe temp. TH2	c04	First decimal place	○	○
Compressor shell bottom temp. TH3	c05	First decimal place	○	○
Air heat exchanger outlet pipe temp. TH4	c06	First decimal place	○	○
Air heat exchanger outlet pipe temp. TH5	c42	First decimal place	○	○
Outdoor temp. TH9	c07	First decimal place	○	○
Inlet water temp. TH10	c08	First decimal place	○	○
Outlet water temp. TH11	c09	First decimal place	○	○
External water temp. TH14	c10	First decimal place	○	Fixed to 0
External water temp. 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	Incre-ments	Lower limit	Upper limit	Default	Switch setting timing	Unit type		Notes
							Main unit	Sub unit	
Outlet water temperature thermistor correction (hot water)TH11	1009	-	-	-	-	-	○	○	(Note1)
Inlet water temperature thermistor 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	-	-	-	-	-	○	○	(Note2)
Built-in thermistor differential DIFF2	1016	-	-	-	-	-	○	○	
Cumulative operation time of the compressor	1017	-	-	-	-	Can be reset only when unit is stopped	○	○	(Note3) (Note4) (Note5)
Cumulative operation time of the compressor (Unit: 10,000 hours)	1018	-	-	-	-	Can be reset only when unit is stopped	○	○	(Note3) (Note4) (Note5) (Note6)
Temperature data collection interval (S seconds)	1019	1 second	1	9999	60	When unit is stopped	○	○	(Note7)
Multiple system Thermo-ON/OFF status check interval	1020	1 minute	1	5	1	When unit is stopped	○	-	(Note8)
External water temperature thermistor while the "Temperature shift (Setting temperature A)" function is enabled.	1215	1	14	15	14	When unit is stopped	○	-	(Note9)
External water temperature thermistor while the "Temperature shift (Setting temperature B)" function is enabled.	1216	1	14	15	14	When unit is stopped	○	-	
External 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	○	-	(Note10)
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) Consult your nearest Mitsubishi representative if the sensors go off below the pre-set values.
(Note2) Consult your nearest Mitsubishi representative.
(Note3) These items can only be displayed. (Their settings cannot be changed.)
(Note4) The cumulative time between 1 and 9999 hours will be displayed in four digits. (unit: hour)
(Note5) Pressing the push switches SW01 and SW02 simultaneously while the time is displayed will reset (initialize) the data to 0.
(Note6) The cumulative time between 10,000 and 99,990,000 hours will be displayed in four digits (unit: 10000 hours)
(Note7) Set the data collection interval by referring to section “3. Operation status before error”. (Page 141)
(Note8) 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.
(Note9) Set these settings when using both external thermistors TH14 and TH15 and switching between the two according to the pre-set water temperature. (Heating temperature = A°C, Hot water temperature = B °C, Heating ECO temperature = C °C)
(Note10) 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 circuit or ground fault		Resolve the cause, and replace the fuse.
	The compressor does not operate.	Protection devices have not tripped.	INV board problem		Repair or replace the INV board.
			Noise filter board problem		Repair or replace the noise filter board.
		High-pressure cutout switch has tripped. AHP1	Abnormal high pressure	Dirty condenser (scaling formation)	Clean the condenser.
				Air in the refrigerant circuit	Vacuum the refrigerant circuit, and charge it with refrigerant.
				Water flow shortage	Secure enough water flow rate.
		The discharge temperature thermistor has tripped. AC61	LEV fault in the main circuit		Replace the LEV in the main circuit.
			LEV solenoid valve fault		Replace the solenoid valve.
			Injection LEV fault		Replace the injection LEV.
			Injection solenoid valve fault		Replace the solenoid valve.
			Refrigerant gas leakage		Leakage test
			Refrigerant undercharge		Repair the cause of refrigerant shortage, evacuate the system, and charge the refrigerant circuit with refrigerant.
		A thermistor error was detected. 5101~5121	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 pre-set 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	Outdoor 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.
			LEV solenoid valve fault	Replace the solenoid valve.
			Injection LEV actuation failure	Replace the injection LEV.
			Injection solenoid valve fault	Replace the injection solenoid valve.
			Clogged strainer	Replace the strainer.
			The cooling fan is stopped.	Check the evaporator fan for proper operation, and replace it if necessary.
			High pressure is too high.	Check the items above and make necessary adjustments so that the suction gas temperature falls within the specified temperature range.
The unit has stopped during operation and does not restart.	Overcurrent passed through the compressor. 4250	Outdoor 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

If a problem occurs, refer to the table below for troubleshooting before calling for service.

A: Errors resettable regardless of switch settings
B: Errors resettable when the remote reset setting on the unit is set to Enable (default)
Errors non-resettable when the remote reset setting on the unit is set to Disable
C: Errors non-resettable
-: Errors auto-canceled when the cause is removed

Error code *1 (PCB *2)	Preliminary error code	Error (preliminary) detail code	Error type	Cause (Installation/Setting error) (Component problems)	Error reset	
					Unit (PCB)	Remote controller
					SWS1	Operation SW
A000	-	-	Unreset errors *4	Some errors have not been reset.	-	-
4106 A-P0	-	-	Power failure *2	Power failure occurred while the operation switch is on.	A	A
2501 AFSA	-	-	Water supply interruption (Flow switch trip)	Water flow rate dropped below the flow switch threshold. Water supply interruption Open-circuited flow switch Broken flow switch wiring	B	B
1302 AHP1	-	-	High-pressure fault	Water supply interruption LEV fault High-pressure sensor fault	B	B
1502 AdSH	-	-	Compressor flooding	Fan motor fault/broken fan motor wiring Low-pressure sensor fault Compressor shell bottom temp. thermistor fault High-pressure sensor fault Discharge pipe temp. thermistor fault LEV fault	B	B
1505	1605	-	Low-pressure fault	Outdoor temp. below the operating range Clogged air heat exchanger outlet pipe temp. due to sudden frosting or heavy snow Low-pressure sensor fault Air heat exchanger outlet pipe temp. thermistor fault Suction pipe temp. thermistor fault LEV fault Fan motor fault/broken fan motor wiring Refrigerant shortage (refrigerant leak)	B	B
1103	-	-	Compressor shell bottom temp. fault	Outdoor temp. above the operating range Excessive oil flow Compressor shell bottom temp. thermistor fault LEV fault	B	B
Thermistor fault (5101, 5102, 5103, 5104, 5105, 5109, 5116, 5111, 5114, 5115, 5121)						
5101	-	-	Discharge pipe temp. thermistor fault (TH1)	Broken or short-circuited thermistor wiring	B	B
5102	-	-	Suction pipe temp. thermistor fault (TH2)	Same as above	B	B
5103	-	-	Compressor shell bottom temp. thermistor fault (TH3)	Same as above	B	B
5104	-	-	Air heat exchanger outlet pipe temp. thermistor fault (TH4)	Same as above	B	B
5105	-	-	Air heat exchanger outlet pipe temp. thermistor fault (TH5)	Same as above	B	B
5109	-	-	Outdoor temp. thermistor fault (TH9)	Same as above	B	B
5116	-	-	Inlet water temp. thermistor fault (TH10)	Same as above	B	B
5111	-	-	Outlet water temp. thermistor fault (TH11)	Same as above	B	B
5114	-	-	External water temp. thermistor fault (TH14)	Same as above	B	B
5115	-	-	External water temp. thermistor fault (TH15)	Same as above	B	B
5121	-	-	Water heat exchanger outlet pipe temp. thermistor fault (TH21)	Same as above	B	B
5201	-	-	High-pressure sensor fault	Broken or short-circuited pressure sensor wiring	B	B
5202	-	-	Low-pressure sensor fault	Same as above	B	B
5501	-	-	Refrigerant sensor fault (RS1)	Broken or short-circuited sensor wiring Leakage from refrigerant pipe	B	B
7113	-	(12) (14) (15) (16) (56) (66)	Model setting error	Resistor Z22, 24, 25, or 26 fault	B	B

Error code *1 (PCB *2)	Preliminary error code	Error (preliminary) detail code	Error type	Cause (Installation/Setting error) (Component problems)	Error reset	
					Unit (PCB)	Remote controller
					SWS1	Operation SW
7117	-	(12) (14) (15) (16) (56) (66)	Model setting error (open)	Resistor Z22, 24, 25, or 26 fault (open)	B	B
4102 A471	-	-	Open phase	Power supply fault Open phase Voltage drop Circuit board fault Wiring fault	B	B
4106 (255)	-	-	Power supply fault	Transmission power supply PCB fault	-	-
1102 AC61	1202	-	(Discharge temp. ≥ 110ºC for 30s while compressor is in operation) Brief discharge temp. rise to ≥ 115ºC while the compressor is in operation	No water Sudden change in water temp. (≥ 5 K/min.) Pump fault High-pressure sensor fault LEV fault (main circuit, injection) Refrigerant shortage (refrigerant leak)	B	B
1503	-	-	Heat exchanger freeze-up *5	Drop in water flow or water supply interruption during defrost cycle Water temp. drop during defrost cycle Four-way valve switching fault	B	B
1510	-	(01)	Refrigerant leak	Leakage from refrigerant pipe Sensitization due to gas exposure containing hydrogen sulfide, chlorine, or siloxane.	-	-
	-	(02)	Refrigerant leak	Fan board fault, occurring together with 1510 (01).	-	-
INV fault **Electric current related errors during operation (101, 107, 106, 104, 105, 137, 121, 128, 122)**						
4250 4255 4256 *6	4350 4355 4356	(101)	IPM error	INV board fault Compressor ground fault Compressor coil fault IPM error (loose terminal screws, cracking) Fan motor fault Fan board fault	B	B
		(107)	Overcurrent during operation (effective value)	Inter-phase voltage drop (≤ 180)	B	B
		(106)	Momentary overcurrent during operation	INV board fault	B	B
		(104)	Short-circuited IPM/ground fault during operation	Compressor ground fault Compressor coil fault	B	B
		(105)	Overcurrent due to short-circuit during operation	IPM error (loose terminal screws, cracking) Fan motor fault Fan board fault	B	B
4255 4256 *6	4355 4356	(137)	Step-out fault	Motor desynchronization Fan motor fault Fan board fault	B	B
4250	4350	(121) (128)	DCL overcurrent (H/W)	DCL overcurrent INV board fault	B	B
4250	4350	(122)	DCL overcurrent (S/W)	Compressor ground fault Compressor coil fault	B	B
INV fault **Electric current related errors during operation (101, 107 ,106)**						
4250 4255 4256 *6	4350 4355 4356	(101)	IPM error	INV board fault Compressor ground fault Compressor coil fault IPM error (loose terminal screws, cracking) Fan motor fault Fan board fault	B	B
		(107)	Overcurrent at start-up (effective value)	INV board fault	B	B
		(106)	Momentary overcurrent at start-up	Compressor ground fault Compressor coil fault IPM error (loose terminal screws, cracking) Fan motor fault Fan board fault	B	B

Error code *1 (PCB *2)	Preliminary error code	Error (preliminary) detail code	Error type	Cause (Installation/Setting error) (Component problems)	Error reset	
					Unit (PCB)	Remote controller
					SWS1	Operation SW
INV fault **Voltage related problems during operation (108, 109, 110, 111, 112)**						
4220 4225 4226 *6	4320 4325 4326	(108)	Bus voltage drop protection (S/W)	(Momentary) power failure Power supply voltage drop (interphase voltage ≤ 248 V) Voltage drop INV board fault 72C fault Noise filter coil (L) fault Wiring fault between noise filter board and INV board Wiring fault between fan board and INV board Resistor (R1, R2) fault	B	B
4220	4320	(109)	Bus voltage rise protection (S/W)	Incorrect power supply voltage INV board fault	B	B
4220	4320	(110)	Bus voltage error (H/W)	VDC error INV board fault	B	B
4220 4225 4226 *6	4320 4325 4326	(111) (112)	Logic error	Malfunction due to noise interference Faulty grounding Improper transmission wiring and external wiring installation (Use of non-shielded cable) Low-voltage signal wire and high-voltage wire in contact (Signal and power wires in the same conduit) INV board fault Fan board fault	B	B
4220 4225 4226 *6	4320 4325 4326	(131)	Voltage fault at start up (Bus voltage drop protection at start up (detected by the main unit))	Voltage drop INV board fault 72C fault Noise filter coil (L) fault Wiring fault between noise filter board and INV board Wiring fault between fan board and INV board Resistor (R1, R2) fault	B	B
4220	4320	(129)	Control power supply fault	Control power supply fault INV board, main control board fault Broken wiring between INV and main control boards Contact fault	B	B
4220	4320	(123)	Voltage boost control error	Voltage drop Poor installation condition INV board fault Compressor ground fault	B	B
4230 4235 4236 *6	4330 4335 4336		Heatsink fault (Heatsink overheat protection)	Power supply voltage drop (interphase voltage ≤ 180 V) Clogged heatsink cooling air passage Fan motor fault INV and fan board fault THHS sensor fault IPM error (loose terminal screws, cracking)	B	B
4230	4320	(126)	DCL temp. fault	Above 150ºC Contact or connector fault (CNTH) INV board fault	B	B
4240 4245 4246 *6	4320 4325 4326	-	Overload protection	Short-cycling (reduced air flow) Clogged heatsink cooling air passage Power supply voltage drop (interphase voltage ≤ 180 V) THHS sensor fault Fan motor fault Current sensor fault Compressor fault INV and fan board fault	B	B
5301	4301	(115)	ACCT sensor fault	INV board fault Compressor ground fault and IPM error	B	B
		(117)	ACCT sensor/circuit fault	Poor INV board CNCT2 contact (ACCT) ACCT sensor fault	B	B
		(119)	Open-circuited IPM/loose ACCT sensor	ACCT sensor (CNCT2) disconnection ACCT sensor fault Broken compressor wiring INV circuit fault (IPM error etc.)	B	B
		(120)	Wiring fault	Wrong ACCT sensor phase Wrong ACCT sensor orientation	B	B
5110	1214	(01) (05) (06)	THHS sensor/circuit fault	THHS sensor contact fault THHS sensor fault INV board fault	B	B
5301	4300	(127)	DCL electric current circuit fault	Contact fault between CNCT1A and CNCT1B INV board fault	B	B

Error code *1 (PCB *2)	Preliminary error code	Error (preliminary) detail code	Error type	Cause (Installation/Setting error) (Component problems)	Error reset	
					Unit (PCB)	Remote controller
					SWS1	Operation SW
5305 5306 *6	4305 4306	(135)	Current sensor fault	Fan board fault Fan motor fault	B	B
		(136)	Current sensor/circuit fault	Fan board fault	B	B
5120	1248	(01)	THL sensor/circuit fault	THL sensor contact fault (CNTH) THL sensor fault INV board fault	B	B
0403	4300 4305 4306	(01) (05) (06)	Serial communication error	Communication error between control board and INV board (noise interference, broken wiring)	B	B
-	-	-	IPM system error	INV board switch setting error Loose wiring or connectors on IPM-driven power supply circuit INV board fault	B	B
Remote controller error (incl. remote controller wiring fault)(6830, 7109 ,6831 ,6832 ,6834)						
6830	-	-	Address overlap	Duplicate addresses	C	C
7109	-	-	Non-consecutive address, system error	Address setting error (non-consecutive address)	C	C
6831	-	-	Remote controller signal reception error 1	Remote controller cable disconnection Broken wiring Broken remote controller wiring Main control board communication circuit fault	-	-
6832	-	-	Remote controller signal transmission error	Communication error due to noise interference Main control board communication circuit fault	-	-
6834	-	-	Remote controller signal reception error 2	Same as above	-	-
Multiple system error (7105, 7130, 7102)						
7105	-	-	Address setting error	Address setting error (non-consecutive address)	C	C
7130	-	-	Incompatible unit combination	Incompatible units in the same system	C	C
7102	-	-	Connected unit setting error	The number of connected unit setting is incorrect (main unit)	C	C
6500	-	-	Communication error between main and sub units		-	-
6600	-	-	Transmission line power supply PCB fault	Communication error due to noise interference	C	C
6602 6603 6606 6607 6608			Communication error between main and sub units (Simple multiple unit control mode) *3	Broken transmission power supply circuit board wiring Transmission power supply PCB communication circuit fault	-	-
0100	2-digit code *7 *8		FTC error		C	C

*1: Parenthesized codes in the Error code column are detail codes.
*2: Error codes will appear in the PCB's 4-digit digital display.
Power failure will be detected as an error only when the Automatic recovery after power failure setting on the unit is set to Disable. (Default: Enable)
*3: Depending on the system configuration, unit may stop abnormally when the communication error lasts for 10 minutes.
Reset the error by setting SWS1 on the PCB of the unit or the remote operation switch.
*4: 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.
*5: Before resetting this error, resolve its causes to prevent possible damage to the heat exchanger.
*6: Last digit 5: MF2 (Top left fan motor when seen from front)
Last digit 6: MF2 (Top right fan motor when seen from front)
*7: Refer to the FTC installation manual.
*8: Operable only from the main remote controller connected to FTC

[3] Troubleshooting Principal Parts

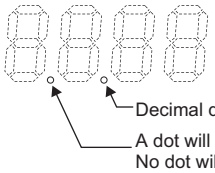
-1- High-Pressure Sensor (PSH1)

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.





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 0.098MPa, internal pressure is caused due to gas leak.
2) When the pressure displayed on self-diagnosis LD301 is between 0 and 0.09MPa, 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 3.85MPa, go to (3).
4) If other than 1), 2) or 3), compare the pressures while the sensor is running. Go to (2).

(2) Compare the gauge pressure and the pressure displayed on self-diagnosis LD301 while the sensor is running. (Compare them by MPa unit.)

1) When the difference between both pressures is within 0.098MPa, both the high pressure sensor and the control board are normal.
2) When the difference between both pressures exceeds 0.098MPa, the high pressure sensor has a problem. (performance deterioration)
3) When the pressure displayed on self-diagnosis 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 0.09MPa, the high pressure sensor has a problem.
2) When the pressure displayed on self-diagnosis LD301 is approximately 3.85MPa, the control board has a problem.

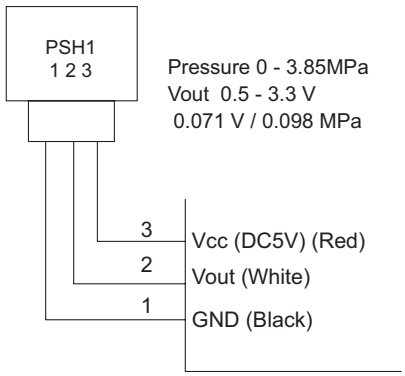
(4) Remove the high pressure sensor from the control board, and short-circuit between the No.2 and 3 connectors (PSH1:CN201) to check the pressure with self-diagnosis LD301.

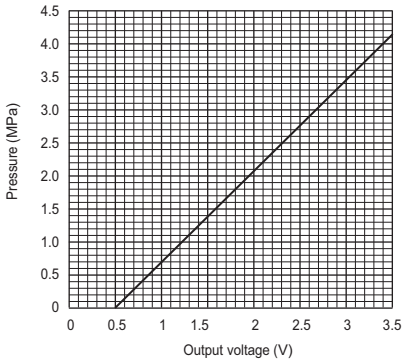
1) When the pressure displayed on the self-diagnosis LD301 exceeds 3.85MPa, the high pressure sensor has a problem.
2) If other than 1), the control board has a problem.

2. Pressure sensor configuration

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

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





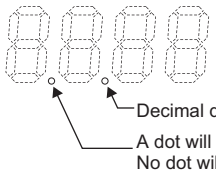
-2- Low-Pressure Sensor (PSL1)

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.





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 0.098MPa, internal pressure is caused due to gas leak.
2) When the pressure displayed on self-diagnosis LD301 is between 0 and 0.09MPa , 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 1.7MPa, go to (3).
4) If other than 1), 2) or 3), compare the pressures while the sensor is running. Go to (2).

(2) Compare the gauge pressure and the pressure displayed on self-diagnosis LD301 while the sensor is running.(Compare them by MPa unit.)

1) When the difference between both pressures is within 0.03MPa, both the low pressure sensor and the control board are normal.
2) When the difference between both pressures exceeds 0.03MPa, the low pressure sensor has a problem. (performance deterioration)
3) When the pressure displayed on the self-diagnosis 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 0.09MPa, the low pressure sensor has a problem.
2) When the pressure displayed on self-diagnosis LD301 is approximately 1.7MPa, the control board has a problem.
   - ♦When the outdoor temperature is 40°C or less, the control board has a problem.
   - ♦When the outdoor temperature exceeds 40°C, go to (5).

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

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

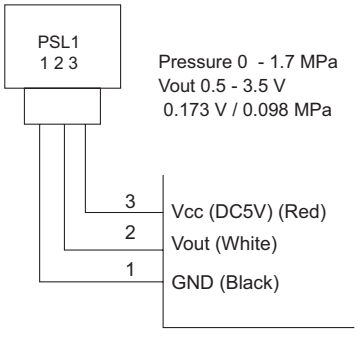
(5) Remove the high pressure sensor (PSH1) from the control board, and insert it into the connector for the low pressure sensor (PSL1:CN202) to check the pressure with the self-diagnosis LD301.

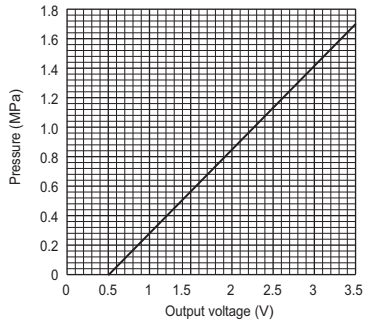
1) When the pressure displayed on the self-diagnosis LD301 exceeds 1.7MPa, the control board has a problem.
2) If other than 1), the control board has a problem.

2. Low-pressure sensor configuration

The low pressure sensor consists of the circuit shown in the figure below. If DC5V is applied between the red and the black wires, voltage corresponding to the pressure between the white and the black wires will be output, and the value of this voltage will be converted by the microcomputer. The output voltage is 0.173V per 0.098MPa.

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

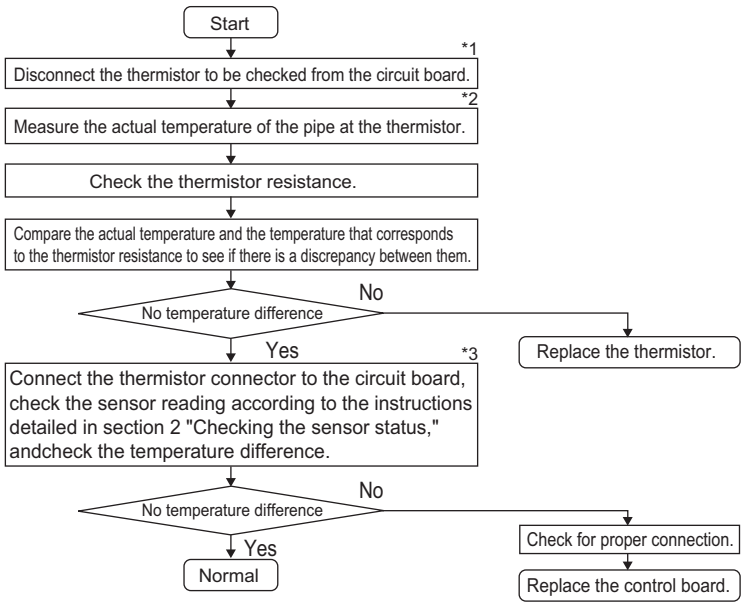




-3- Temperature thermistor

Use the flowchart below to troubleshoot the temperature thermistor.

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
TH5	CN212 1-2		

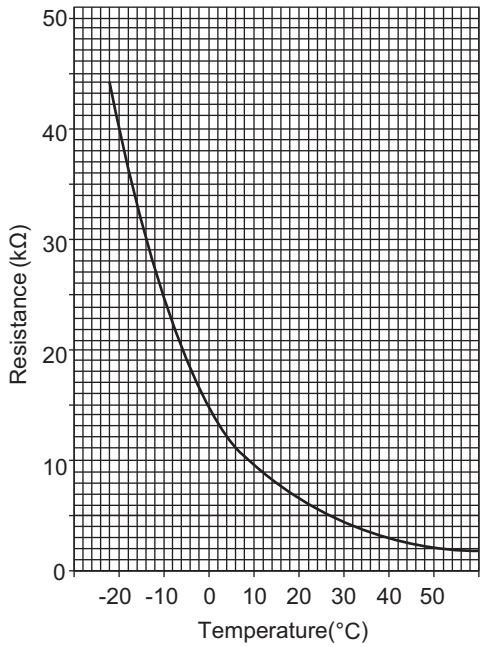
* 2 · Pull out the sensor connector from the control board.
Do not pull on the lead wire.
· Measure the resistance with a tester.
· If the measured value is within ± 10% of the value as shown in below, the circuit sensor is normal.

* 3 Use the dip switches and push switches to view the sensor reading on the LED.

(1) Low-temperature-range thermistor
: TH2,3,4,5,9,10,11,21

Thermistor R_0 = 15kohm±3%

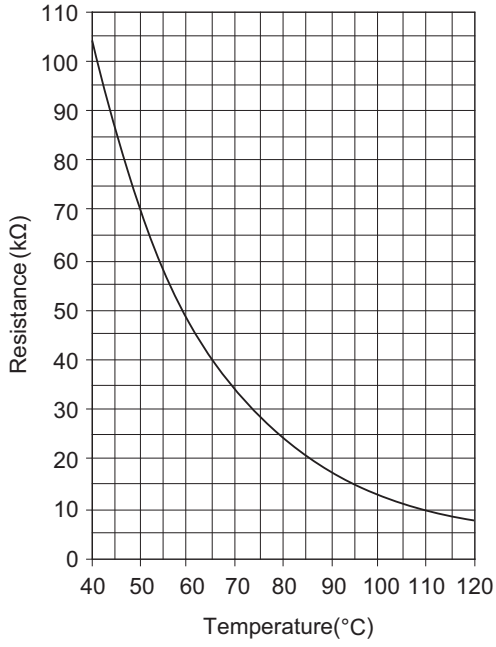
$$R_t = 15\exp\{3385(\frac{1}{273+t}-\frac{1}{273})\}$$



(2) High-temperature-range thermistor: TH1

Thermistor R_{120} = 7.465kohm±2%

$$R_t = 7.465\exp\{4057(\frac{1}{273+t}-\frac{1}{393})\}$$



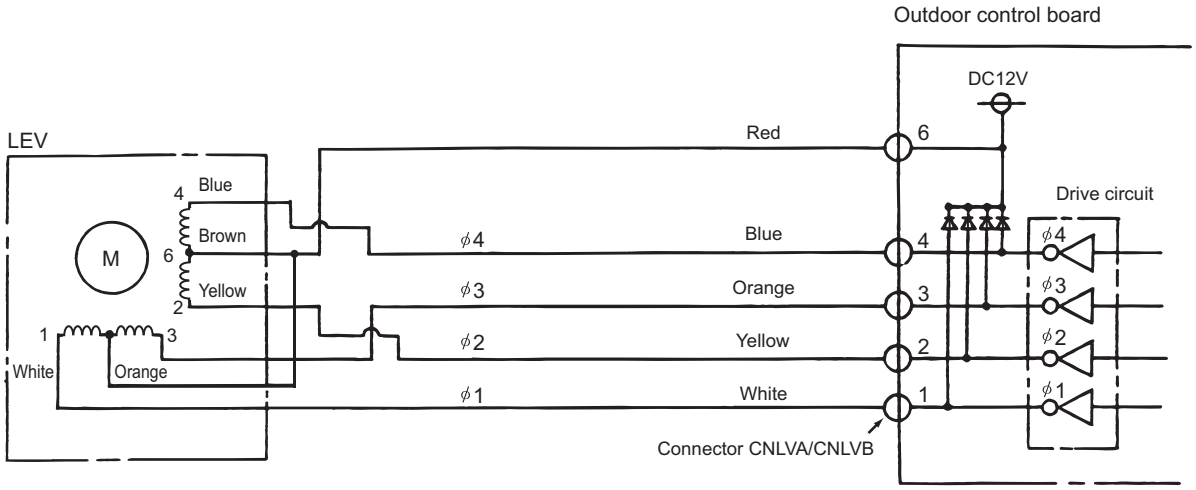
-4- LEV

1. General descriptions of the operation of the LEV in the main circuit

LEV1 is driven by the pulse signal from the circuit board and is controlled by a stepping motor.

The valve opening changes according to the number of pulses

1) Control board and LEV



Note. The connector numbers on the intermediate connector and the connector on the control board differ. Check the color of the lead wire to judge the number.

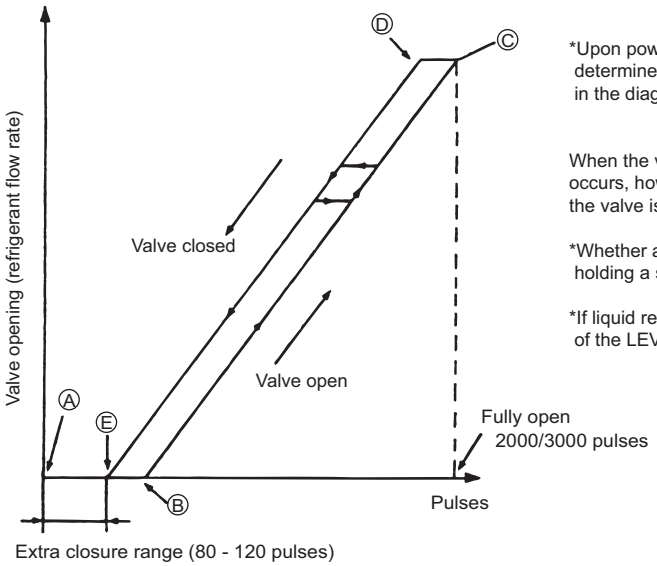
2) Pulse signal output and valve operation

Output (phase) number	Output state			
	1	2	3	4
ϕ1	ON	OFF	OFF	ON
ϕ2	ON	ON	OFF	OFF
ϕ3	OFF	ON	ON	OFF
ϕ4	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 " Ⓐ " in the diagram

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

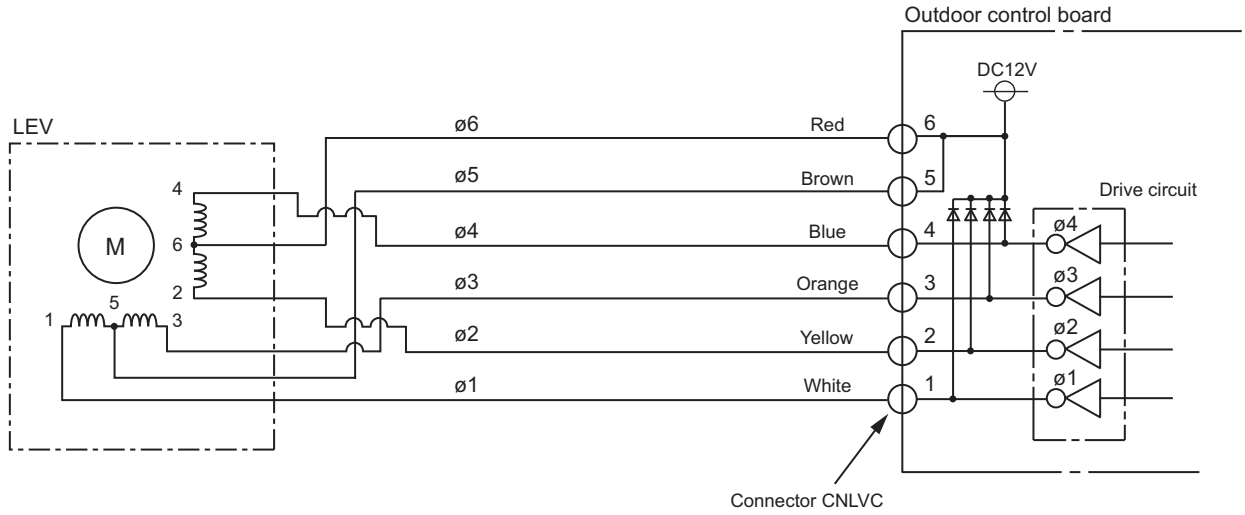
*Whether a sound is generated or not can be determined by holding a screwdriver against it, then placing your ear against the handle.

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

2. General descriptions of injection LEV operation

The valve opening changes according to the number of pulses.

1) Control board and LEV



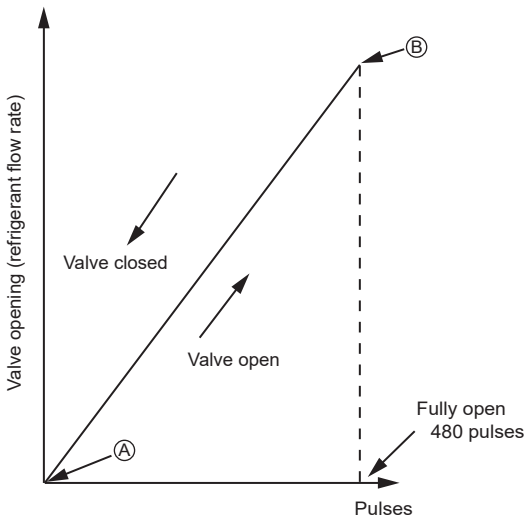
2) Pulse signal output and valve operation

Output (phase) number	Output state							
	1	2	3	4	5	6	7	8
ϕ1	ON	OFF	OFF	OFF	OFF	OFF	ON	ON
ϕ2	ON	ON	ON	OFF	OFF	OFF	OFF	OFF
ϕ3	OFF	OFF	ON	ON	ON	OFF	OFF	OFF
ϕ4	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 operatio



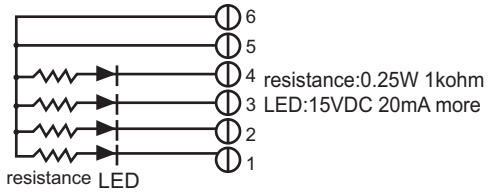
*Upon power on, a 520 pulse signal is sent to the LEV to determine the valve position and bring the valve to the position indicated by "Ⓐ" in the diagram. (Pulse signal is output for approximately 17 seconds.)

The LEV is free of noise and vibration when it is functioning properly, but it makes a noise when it becomes locked.

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

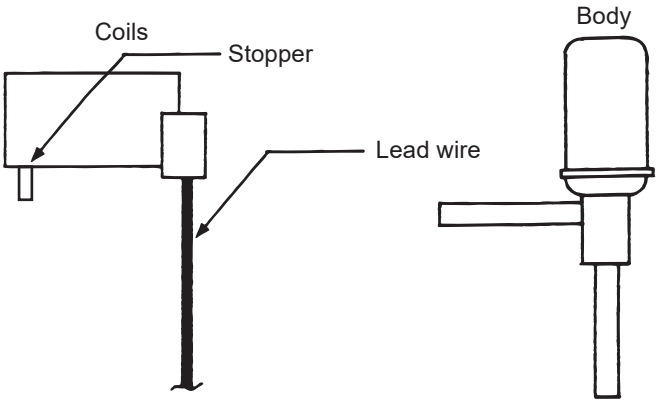
*If liquid refrigerant is present in the LEV, it may make the operating sound of the LEV difficult to detect.

(1) Judgment methods and possible failure mode

Malfunction mode	Judgment method	Remedy
Microcomputer driver circuit failure	Disconnect the control board connector and connect the check LED as shown in the figure below.  Pulse signal is output for 17 seconds when the main power is turned on. If there is any LED that remains unlit or remains lit, there is a problem with the drive circuit.	When the drive circuit has a problem, replace the control board.
LEV mechanism is locked	If the LEV is locked, the drive motor runs idle, and makes a small clicking sound. When the valve makes a closing and opening sound, the valve has a problem.	Replace the LEV.
Disconnected or short-circuited LEV motor coil	Measure resistance between the coils (red - white, red - orange, red - yellow, red - blue) using a tester. They are normal if resistance is 150ohm ± 10% (LEV1) / 100ohm ± 10% (LEV3).	Replace the LEV coils in the main circuit.
	Measure resistance between the coils (red - white, red - orange, brown - yellow, brown - blue) using a tester. They are normal if resistance is 46ohm ± 3%.	Replace the injection LEV coils.
Faulty wire connections in the connector or faulty contact	1. Check for loose pins on the connector and check the colors of the lead wires visually 2. Disconnect the control board's connector and conduct a continuity check using a tester.	Check the continuity at the points where an error occurs.

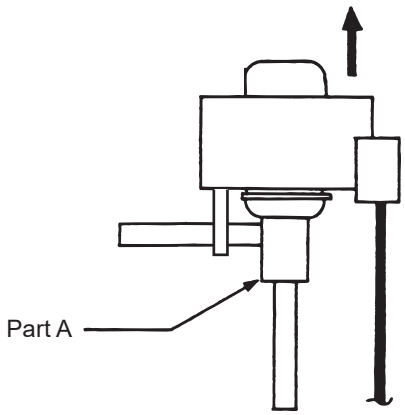
3. Injection LEV coil removal procedure

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



(1) Removing the coils

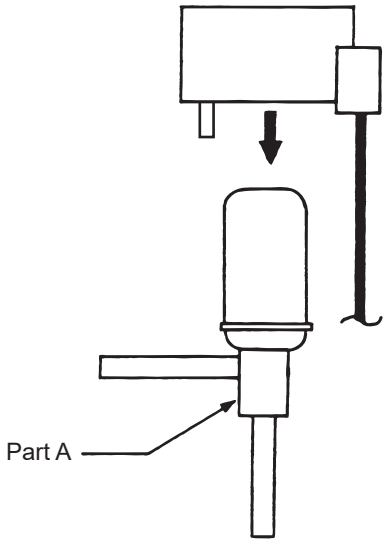
Fasten the body tightly at the bottom (Part A in the figure) so that the body will not move, then pull out the coils toward the top.If the coils are pulled out without the body gripped, undue force will be applied and the pipe will be bent.



(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.

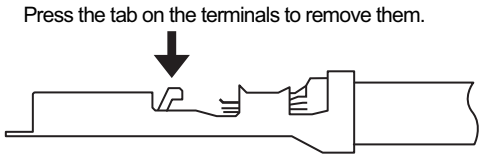


-5- Inverter

- ♦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 overcurrrent 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 (CNINV1 and CNINV2). 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 (CNINV1 and CNINV2) after completion of maintenance work.
4) The IPM on the inverter becomes damaged if there are loose screws are connectors. If a problem occurs after replacing some of the parts, mixed up wiring is often the cause of the problem. Check for proper connection of the wiring, screws, connectors, and Faston terminals.
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, 4250, 4255, 4256, 5110, 5301, 5305, 5306	Check the details of the inverter error in the error log at "Error history item list". (page 138) Take appropriate measures to the error code and the error details in accordance with "Error code list". (page 147)
[2]	Main power breaker trip	Refer to "Trouble treatment when the main power breaker is tripped". (page 162)
[3]	Main power earth leakage breaker trip	Refer to "Trouble treatment when the main power earth leakage breaker is tripped". (page 163)
[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 161)
[5]	The compressor vibrates violently at all times or makes an abnormal sound.	See (2)-[4]. (page 161)
[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 161)
[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 161)
[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 hot water heat pump and other electric appliances.
		<7> If the error occurred suddenly, a ground fault of the inverter output can be considered. See (2)-[4]. (page 161)
		*Contact the factory for cases other than those listed above.
[9]	Sudden malfunction (as a result of external noise.)	<1> Check that the grounding work is performed properly.
		<2>Check that the shielded wire is used as the transmission line when it is required, and check that the grounding work is performed properly on the shielded wire.
		<3>Check that neither the transmission line nor the external connection wiring does not run close to another power supply system or does not run through the same conduit pipe.
		* Contact the factory for cases other than those listed above.

(2) Inverter output related troubles

	Items to be checked	Phenomena	Remedy
[1] Check the INV board error detection circuit.	(1) Disconnect the inverter output wire from the terminals of the INV board (SC-U, SC-V, SC-W). (2) Put the outdoor unit into operation.	1) Overcurrent error (4250 Detail code No. 101, 104, 105, 106, and 107)	Replace the INV board.
		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)	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 5V	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 5V	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 1Mohm or less.	Replace the fan motor.
		2) Fan motor disconnection Standard: The winding resistance is approximately several ohm. (It varies depending on the temperature, or while the inner thermo is operating, it will be ∞ ohm)	
[6] Check the fan inverter board failure.	(1) Check the fan output wiring.	Connector contact failure ♦Board side (CNINV1 and CNINV2) ♦Fan motor side	Connect the connector.
	(2) Check the connector CNDCP and CNDCN connection.	Connector contact failure	Connect the connector.
[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. (2) To allow for the disconnection of output wiring from the fan motor, disconnect connector CNINV. (CNINV1 corresponds to the left fan and CNINV2 corresponds to the right fan (when seen from the front).) (3) Turn on breaker. (4) Operate unit.	1) Overcurrent error occurs. (4255, 4256 Detail code 101, 104)	Replace the FAN board.
		2) Logic error occurs. (4255, 4256 Detail code 111)	Replace the FAN board.
		3) Position detection at startup error occurs. (5305,5306 Detail code 132)	Normal *When done checking, reconnect all connectors as they were.

	Items to be checked	Phenomena	Remedy
[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 "Simple checking procedure for individual components of main inverter circuit". (page 164) ♦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 160)

(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 "Simple checking procedure for individual components of main inverter circuit". (page 164) ♦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

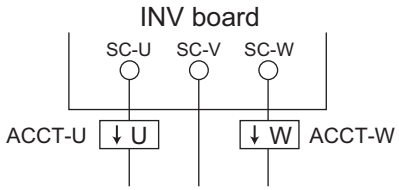
♦For easy on-site measurement of the earth leakage current, enable the filter with a measurement instrument that has filter functions as below, clamp all the power supply wires, and measure.
Recommended measurement instrument: AC LEAKAGE CLAMP METER CM4002 made by HIOKI E.E. CORPORATION
♦When measuring 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.

<table>
<tr><th>Part name</th><th>Judgment method</th></tr>
<tr><td>IGBT module</td><td>See "Troubleshooting for IGBT Module" (page 164)</td></tr>
<tr><td>Rush current protection resistor
R1, R2</td><td>Measure the resistance between terminals R1 and R5: 22 ohm ±10%</td></tr>
<tr><td>Electromagnetic relay
72C</td><td>This electromagnetic relay is rated at DC12V and is driven by a coil.
Check the resistance between terminals
 

<table>
<tr><th></th><th>Check point</th><th>Checking criteria</th></tr>
<tr><td>Coil</td><td>INV board
X101, X103
Across pins 1-2</td><td>160 ohm ± 10%</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></td></tr>
<tr><td>DC reactor
DCL</td><td>Measure the resistance between terminals: 1 ohm or lower (almost 0 ohm)
Measure the resistance between terminals and the chassis: ∞</td></tr>
<tr><td>Current sensor
ACCT</td><td>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)
 

*Check ACCT wiring for correct phase and direction.</td></tr>
</table>

(6) Troubleshooting for IGBT Module

Measure the resistances between each pair of terminals on the IGBT with a tester, and use the results for troubleshooting. The terminals on the INV board are used for the measurement.

1) Notes on measurement

- Check the polarity before measuring. (On the tester, black normally indicates plus.)
- Check that the resistance is not open (∞ ohm) or not shorted (to 0 ohm).
- The values are for reference, and the margin of errors is allowed.
- The result that is more than double or half of the result that is measured at the same measurement point is not allowed.
- Disconnect all the wiring connected the INV board, and make the measurement.

2) Tester restriction

- Use the tester whose internal electrical power source is 1.5V or greater
- Use the dry-battery-powered tester.

Note

(The accurate diode-specific resistance cannot be measured with the button-battery-powered card tester, as the applied voltage is low.)

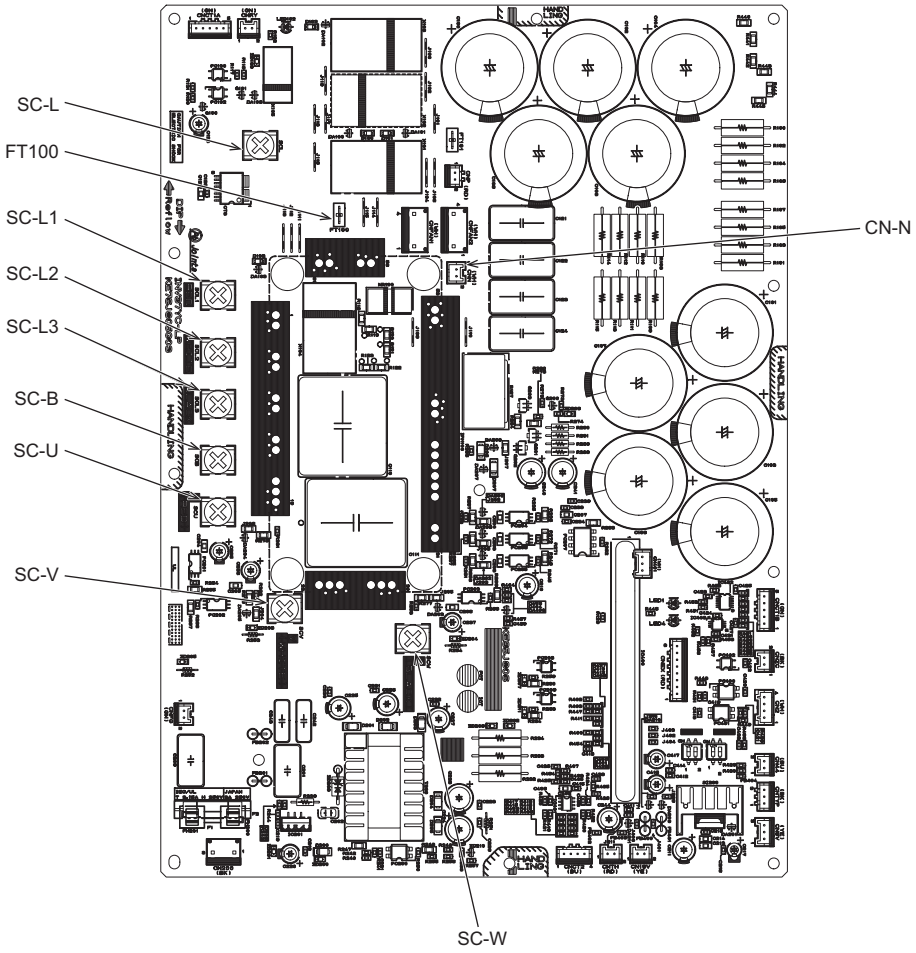
- Use a low-range tester if possible. A more accurate resistance can be measured.

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	∞	∞	∞	-	-	-	-

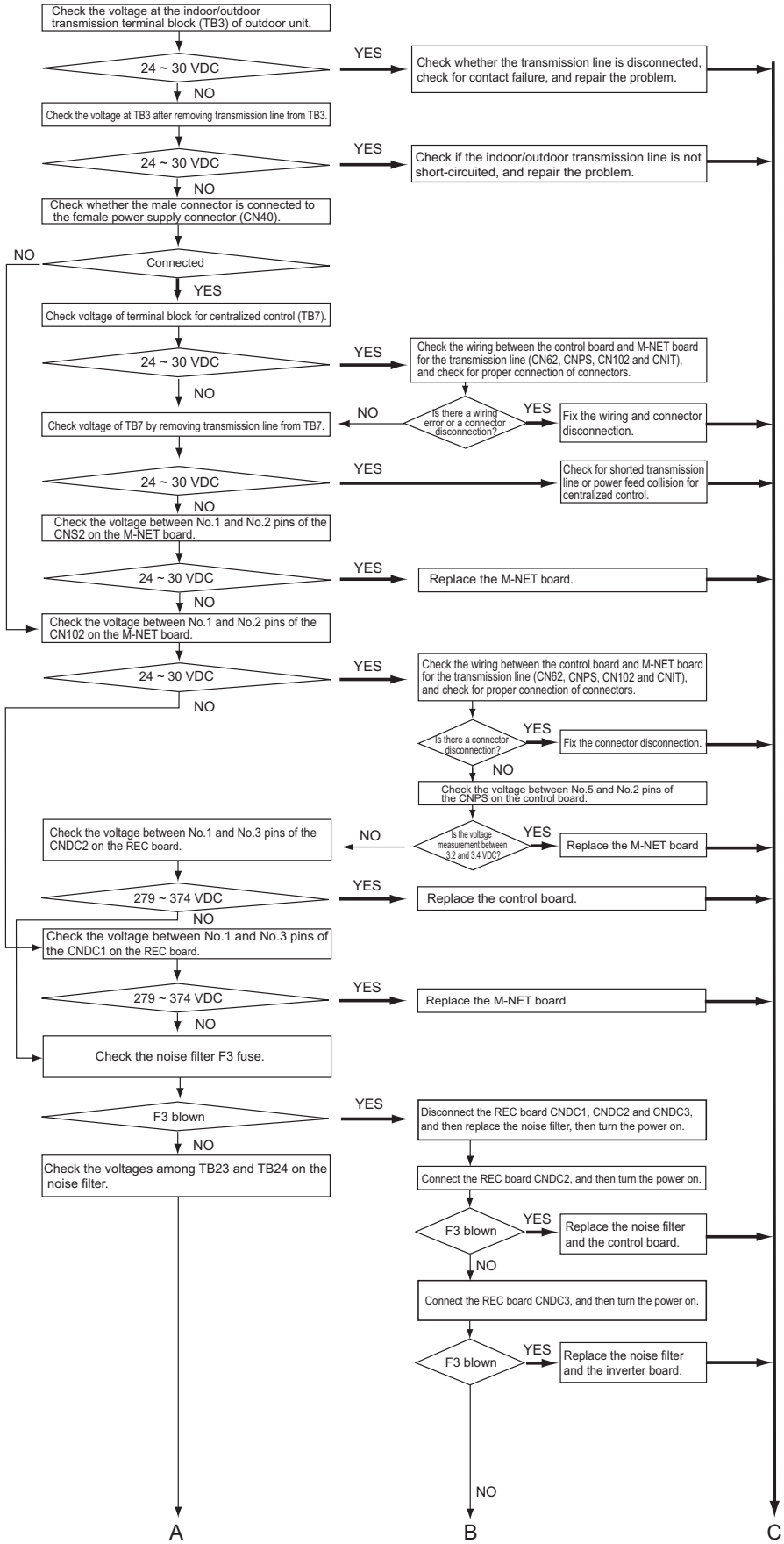
		Black (+)				
		FT100	CN-N	SC-U	SC-V	SC-W
Red (-)	FT100	-	-	5-200 ohm	5-200 ohm	5-200 ohm
	CN-N	-	-	∞	∞	∞
	SC-U	∞	5-200 ohm	-	-	-
	SC-V	∞	5-200 ohm	-	-	-
	SC-W	∞	5-200 ohm	-	-	-

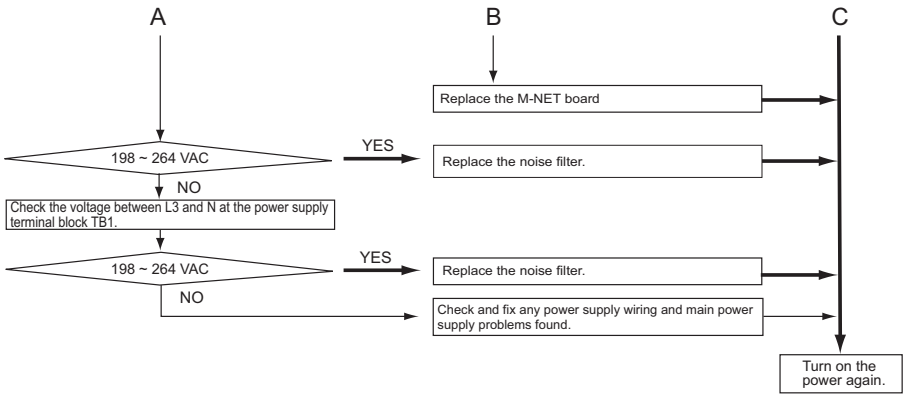
INV board outline drawing



-6- Control Circuit

Troubleshooting transmission power circuit of outdoor unit





-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 [rpm/10]. Refer to "Checking the sensor status" for how to use the display function (page 139). 78 (780/10) 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 [5] "Check the fan motor ground fault or the winding." (page 161) and [6] "Check the fan inverter board failure." (page 161)

-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.
   Charge the system with 4.8 kg of R290.

[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.

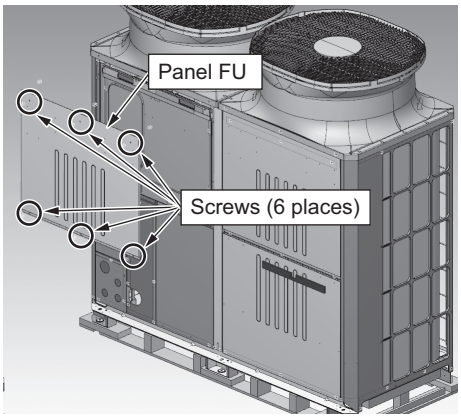
- Doing so may cause the unit or pipes to burst, or result in explosion or fire during use, during repair, or at the time of disposal of the unit.
- It may also be in violation of applicable laws.
- MITSUBISHI ELECTRIC CORPORATION cannot be held responsible for malfunctions or accidents resulting from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

1. Compressor replacement instructions

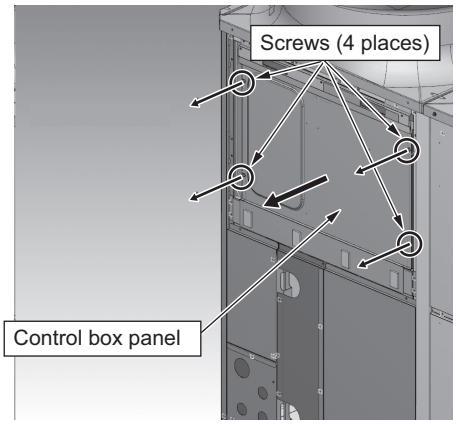
Procedure

(1) Unscrew the six screws, and remove service panel FU on the left.
For information on the panel screws, see page ix.

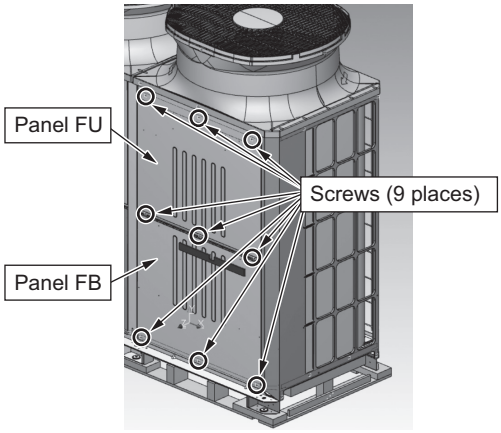
Illustration



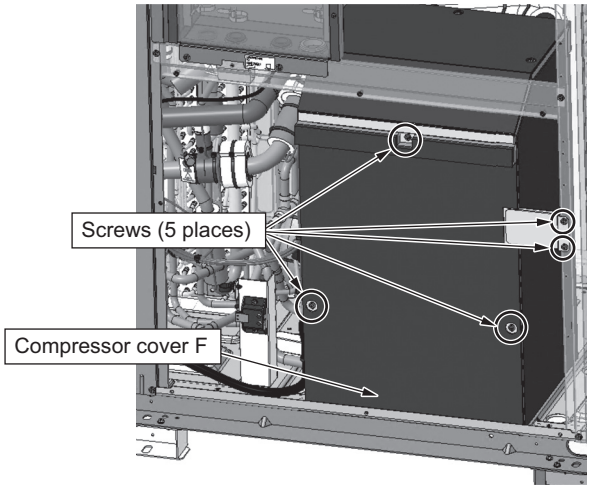
(2) Unscrew the four screws, and remove the control box panel. Turn OFF the switch SWS1 on the control board, and turn OFF the main power supply (breaker).



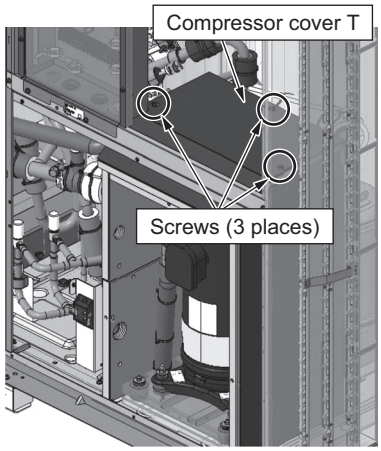
(3) Unscrew the nine screws, and remove the service panels FB and FU.
For information on the panel screws, see page ix.



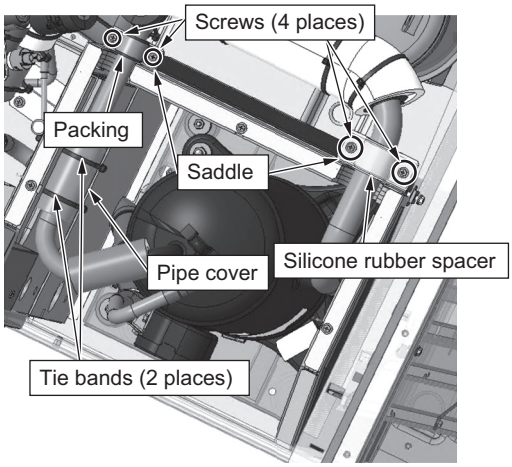
(4) Unscrew the five screws, and remove the compressor cover F.



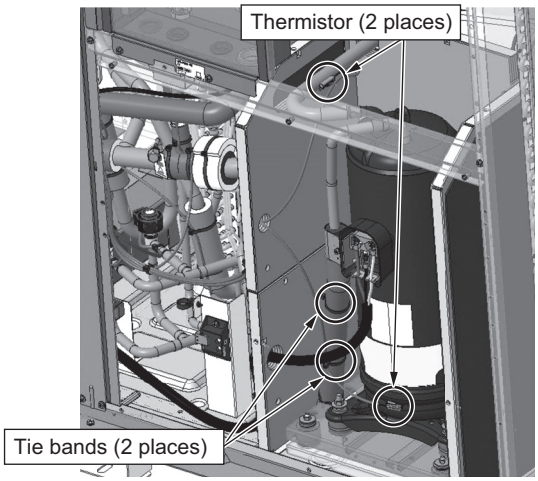
(5) Unscrew the three screws, and remove the compressor cover T.



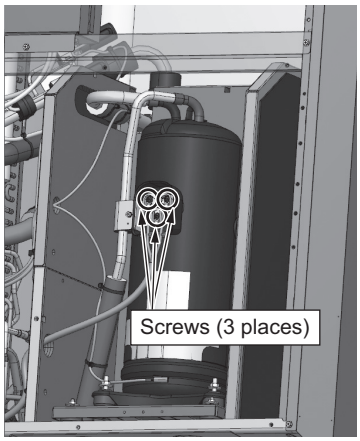
(6) Remove the four screws, two saddles, silicon rubber spacer, packing, two tie bands, and discharge pipe cover.



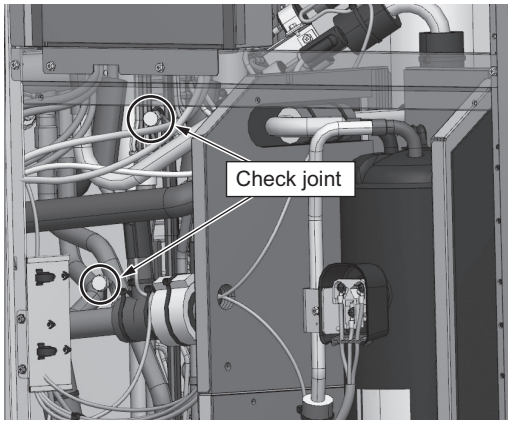
(7) Remove the two tie bands holding the pipe cover, and take the thermistor out of the thermistor holder.



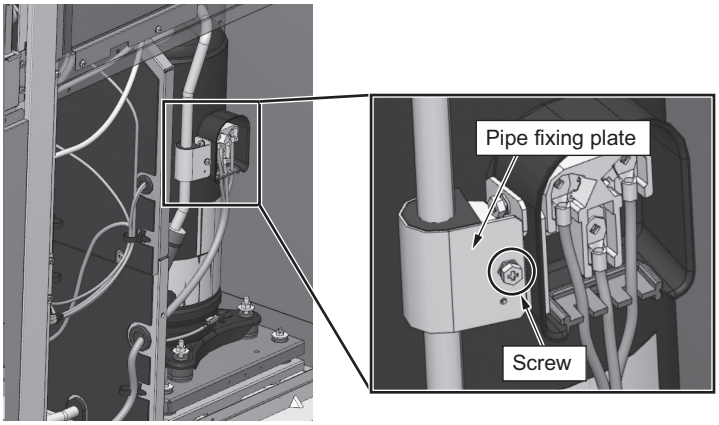
(8) Disconnect the three wires from the terminal screws of the compressor.



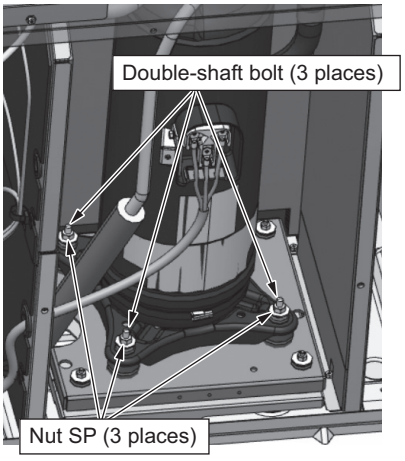
(9) Recover the refrigerant through the high-pressure and low-pressure check joints.



(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.)



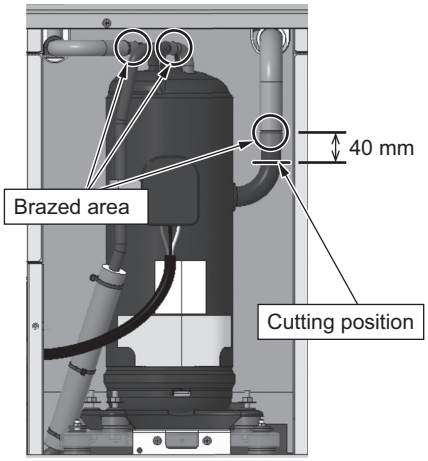
(12) Remove the three pipes of the compressor with a pipe cutter or hacksaw. Heat the remaining brazed area and remove the remaining the compressor pipes after cutting. Since there is a possibility of R290 dissolved in the refrigeration oil, the brazed area is removed while purging with nitrogen.

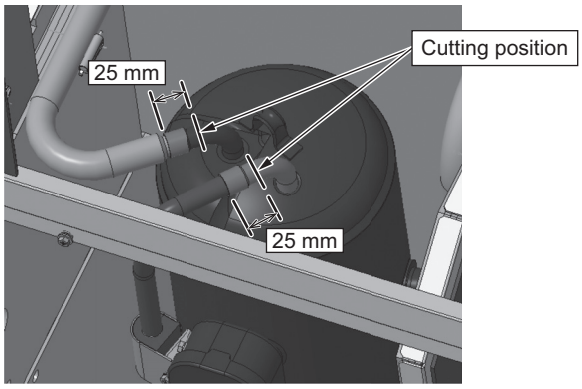
(13) Pull out the compressor and replace it.
(Be careful not to get the injection pipe caught with the suction pipe of the compressor.)

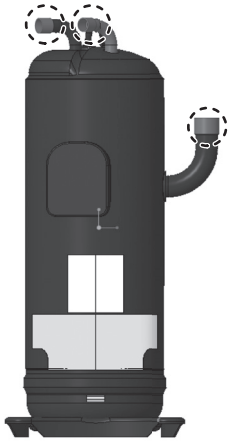
(14) Measure the weight of the removed compressor to adjust the refrigerant oil in the refrigerant circuit. Include the weight of the three pipes removed at step 12 and the weight of the compressor terminal cover.

(15) Calculate the amount of refrigerant oil to be discharged from the replaced compressor x kg
x = 47.4 - M_{comp} - M_{OC}
47.4kg: The compressor weight including 2.5 kg of refrigeration oil (Service compressor weight)
x: The amount of oil to be removed from the service compressor
M_{comp}: The removed compressor weight
M_{OC}: The Amount of oil left in an oil separator during refrigerant recovery.
If an oil separator cannot be provided, count the amount of discharged oil during refrigerant recovery as 0.1 kg.
Ex) If the replaced compressor weight is 46.4 kg and If there is 0.1 kg of refrigerant oil left in the oil separator during refrigerant recovery, refrigeration oil x = 47.4kg - 46.4kg - 0.1kg = 0.9 kg, is removed

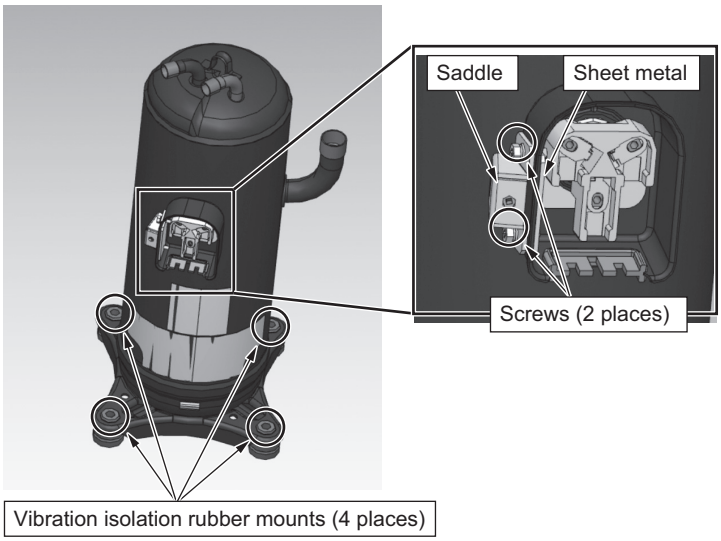
(16) Drain x kg of refrigeration oil from the suction pipe of the service compressor. The compressor is tilted from the suction pipe side. The refrigeration oil is poured into a beaker. The weight is measured with a scale.
* The use of the oil separator is recommended when removing the compressor.



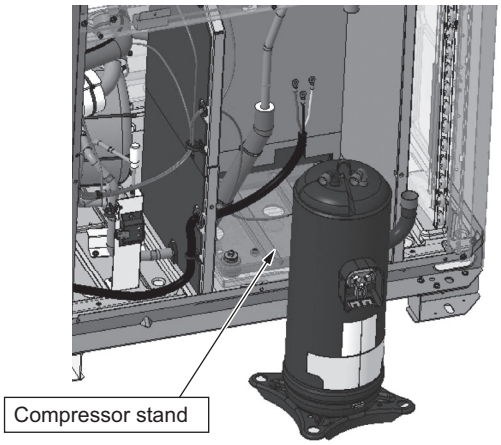




(17) After removing the compressor, remove the four vibration isolation rubber mounts, two screws, saddle, and sheet metal, and install a new compressor.



(18) Place the compressor on the compressor stand.



(19) Fit the double-shaft bolt to a torque of 17.5±20% N・m and the nut SP to a torque of 9.8 N・m.

(20) Connect the discharge pipe, suction pipe, and injection pipe by brazing.

(21) Vacuum the system through the low-pressure check joint with a vacuum pump.

(22) 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.)

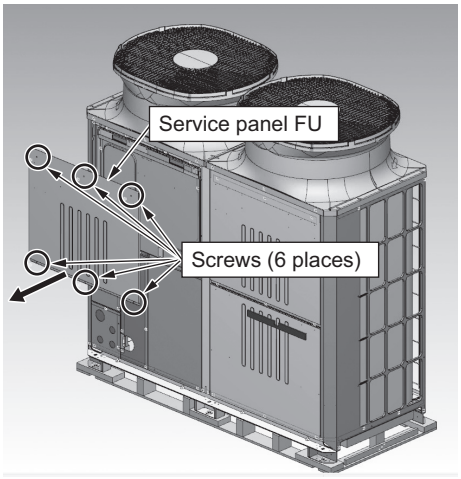
(23) Reinstall the removed wires, compressor cover, and panels to complete the procedure.

2. Thermistor replacement instructions

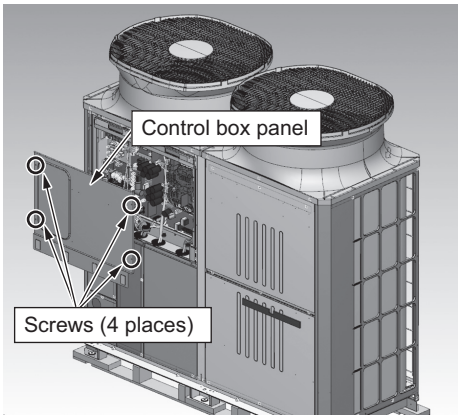
Procedure

(1) Unscrew the six screws, and remove the service panel FU on the top left.
For information on the panel screws, see page ix.

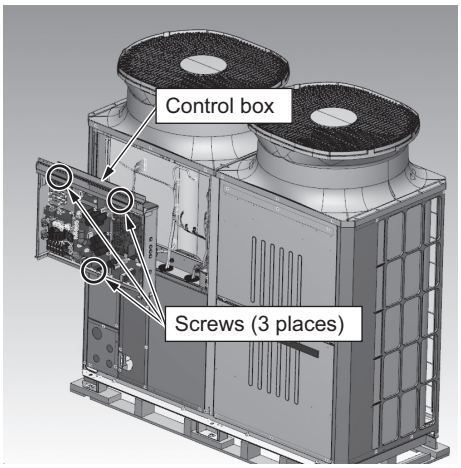
Illustration



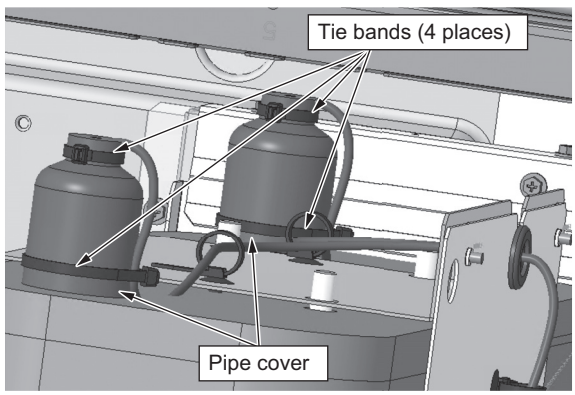
(2) Unscrew the four screws, and remove the control box panel.



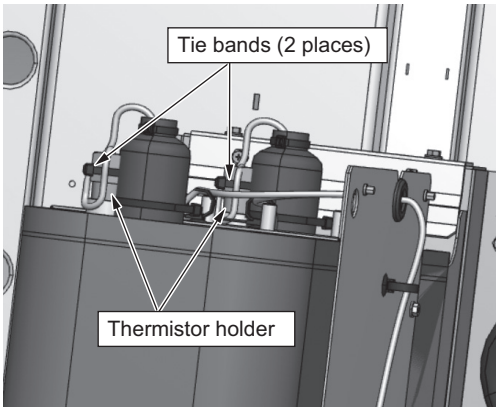
(3) Disconnect the wire from the control box, unscrew the three screws, take the control box out of the box, and set it down. (Control box: Approximately 25 kg)



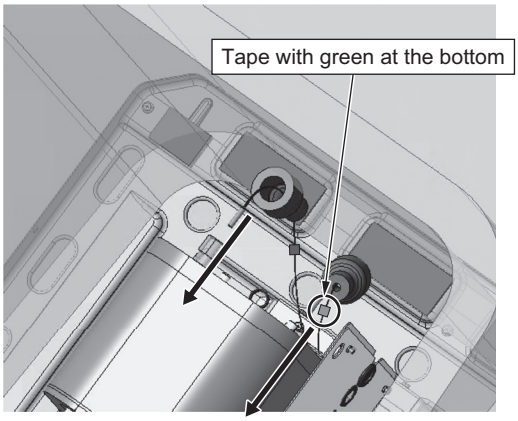
(4) Slide off the four tie bands and the pipe cover from the back of the water heat-exchanger.



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

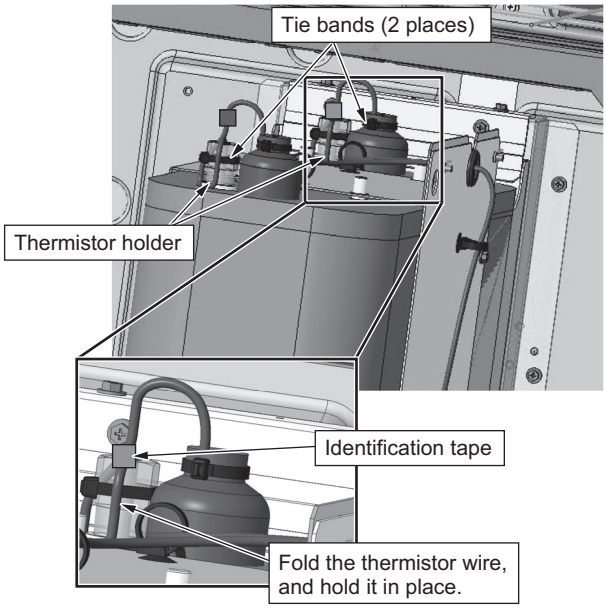


(6) Insert the thermistor into the thermistor holder.
(Tape with green at the bottom (TH10))



(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.)

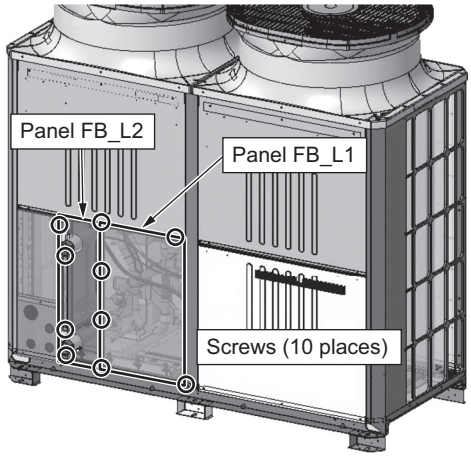
(8) Reinstall the removed parts back in place to complete the procedure.



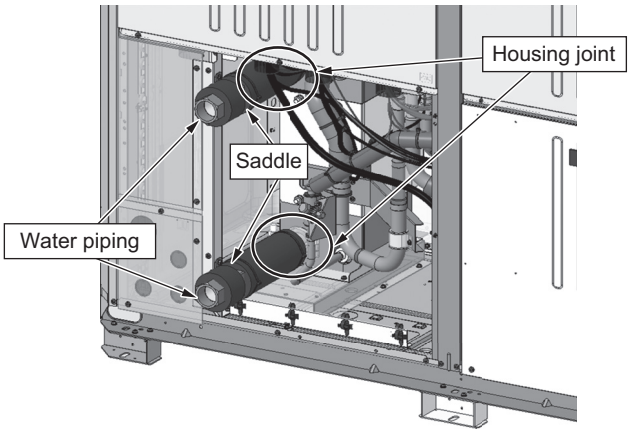
3. Plate heat excanger replacement instructions

Procedure

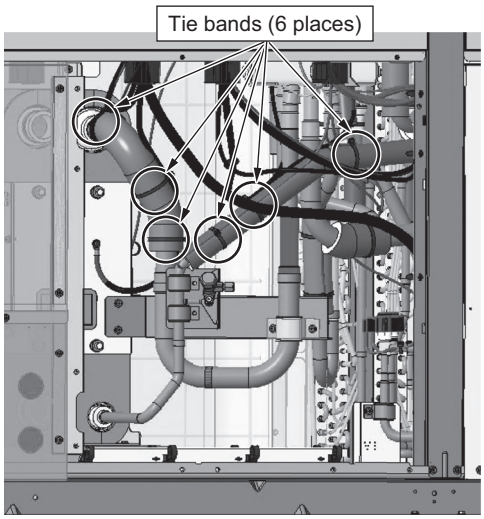
(1) Unscrew the 10 screws, and remove the service panels FB_L1 and FB_L2 on the left.

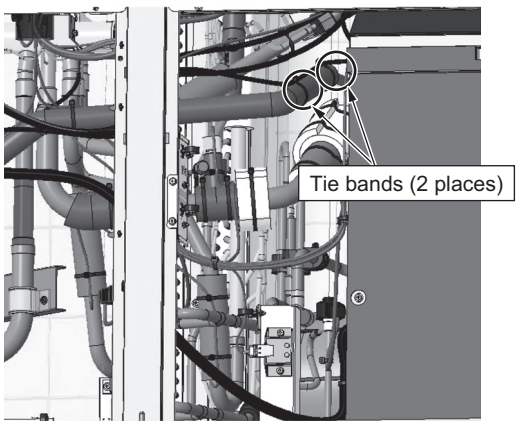


(2) Remove the housing joint and the pipes on site (including any optional saddle installed).

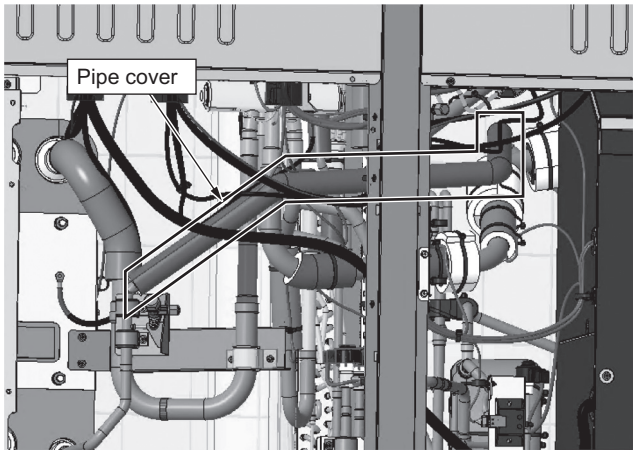


(3) Remove the eight tie bands from the pipe cover.

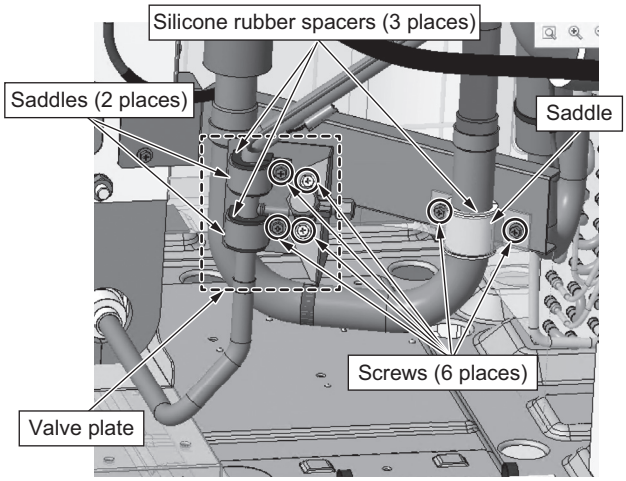




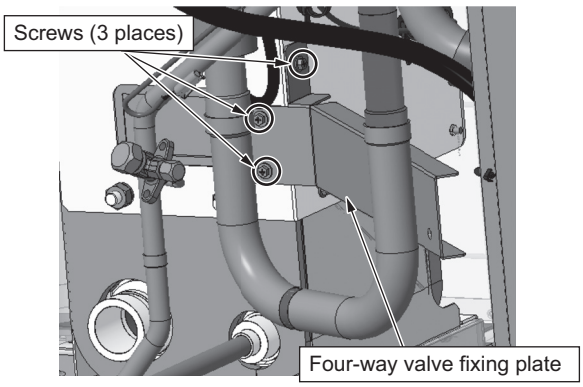
(4) Remove a pipe cover.



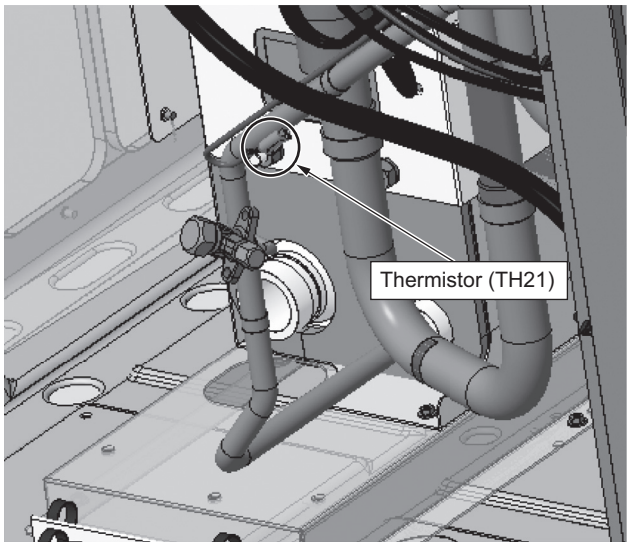
(5) Unscrew the six screws, and remove the three saddles and the three silicon rubber spacers.
Then, remove the valve plate.



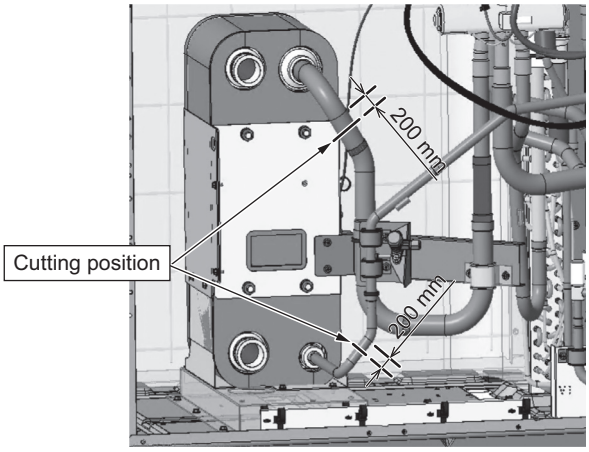
(6) Unscrew the three screws, and remove the four-way valve fixing plate.



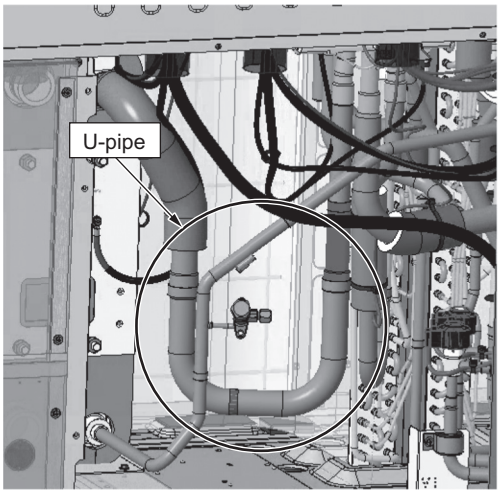
(7) Disconnect the thermistor.



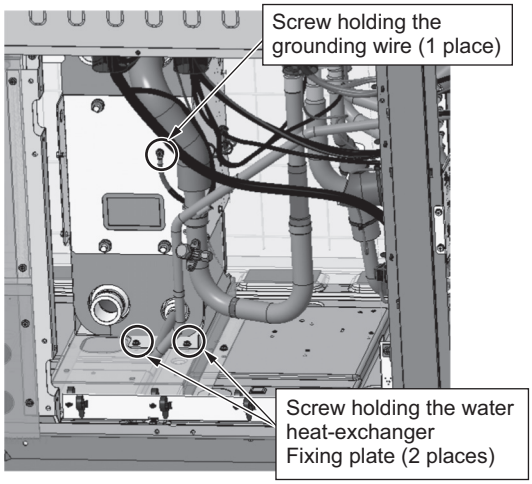
(8) Cut the inlet and outlet refrigerant pipe of plate heat exchanger using a pipe cutter or hacksaw.



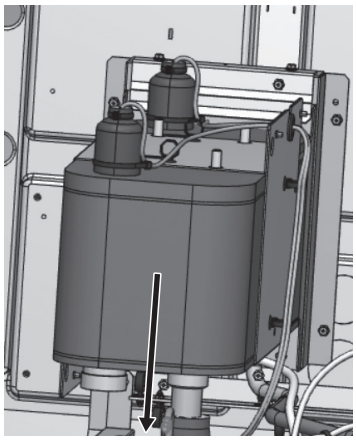
(9) Heat the remaining brazed areas at both ends of the U-pipe and remove them. Since there is a possibility of R290 dissolved in the refrigeration oil, the brazed area is removed while purging with nitrogen.



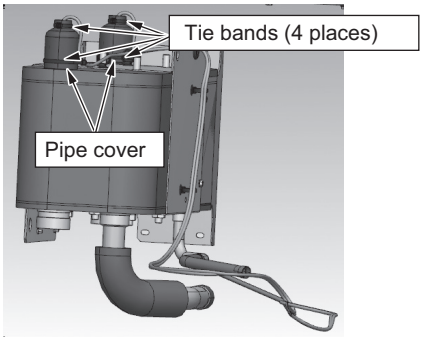
(10) Unscrew the screws holding the water heat-exchanger fixing plate. Unscrew the screw holding the ground wire on the water heat-exchanger side.



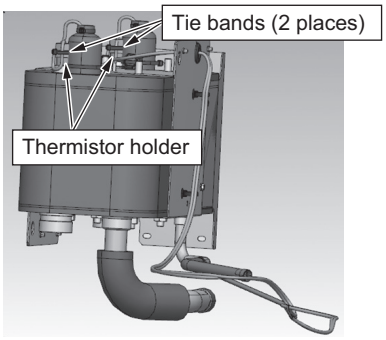
(11) Pull the water heat-exchanger forward.



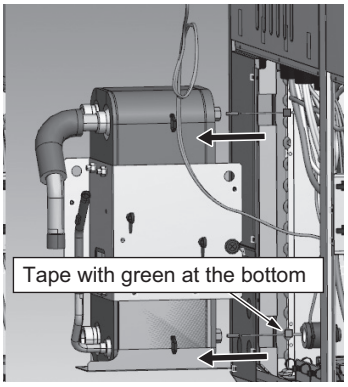
(12) Slide off the four tie bands and the pipe cover from the back of the water heat-exchanger.



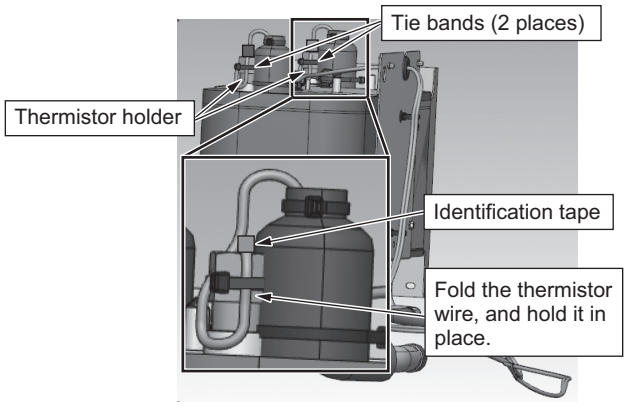
(13) Cut the tie bands, and take the thermistor out of the thermistor holder.



(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.)

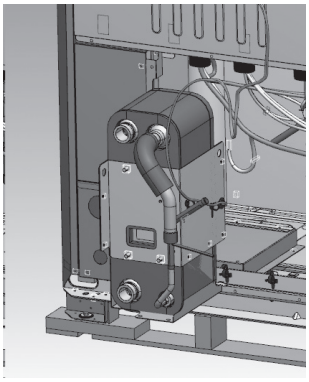


(16) Place the water heat-exchanger on the water heat-exchanger stand.

(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.

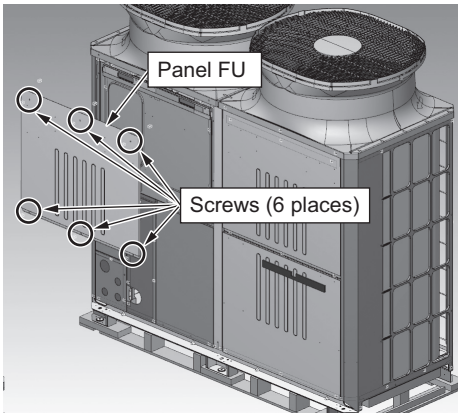


4. Reactor replacement instructions

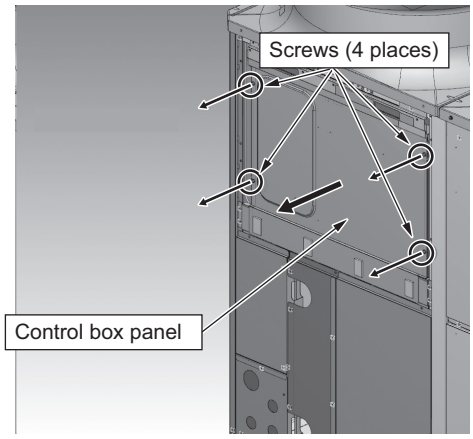
Procedure

(1) Unscrew the six screws, and remove the service panel FU on the left.
For information on the panel screws, see page ix.

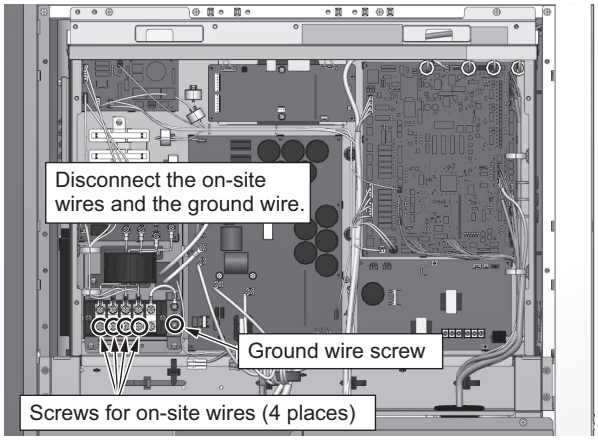
Illustration



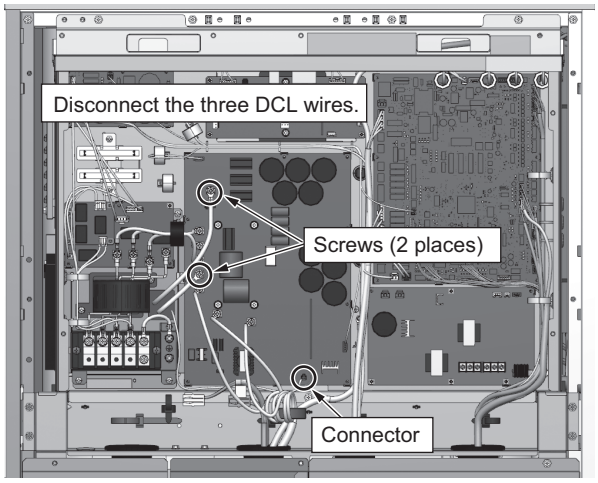
(2) Unscrew the four screws, and remove the control box panel. Set SWS1 of the control board to OFF, and turn off the main power supply (breaker).



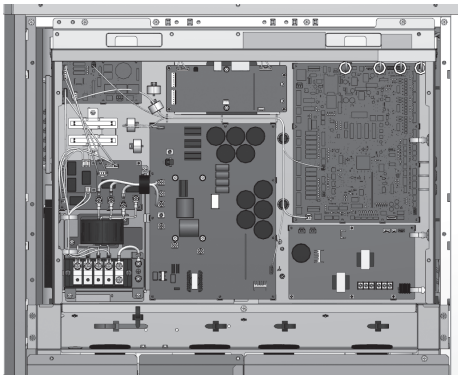
(3) Disconnect the four on-site wires and the ground wire from the terminal screws.



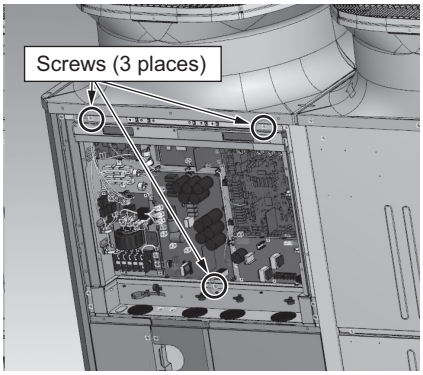
(4) Disconnect the three DCL wires by unscrewing two screws and disconnecting a connector.



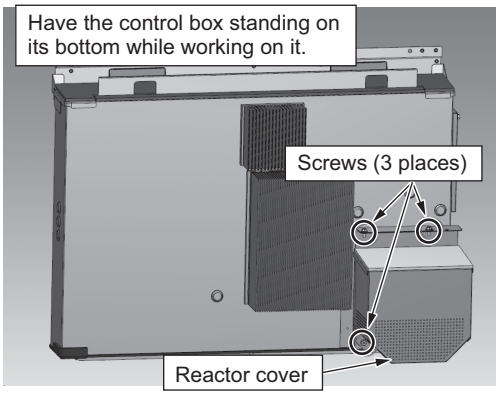
(5) Disconnect the wires from inside the control box.



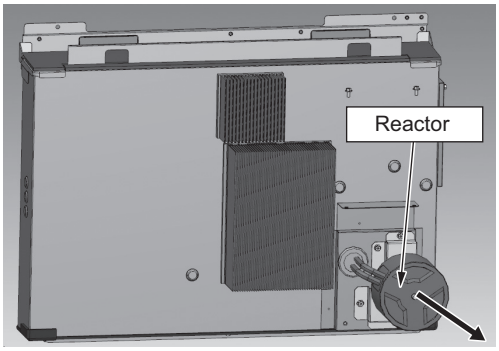
(6) Unscrew three screws from the control box, lower the control box, and let it stand on its bottom. (Control box: Approximately 25 kg)



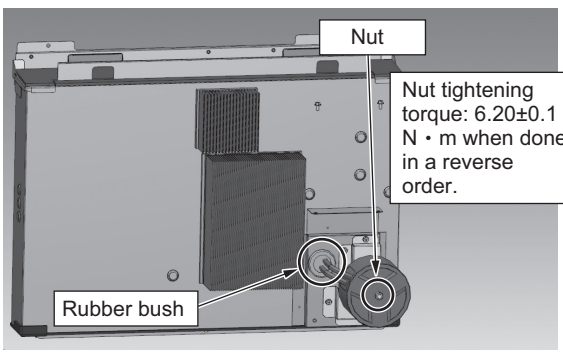
(7) Unscrew three screws, and remove the reactor cover.



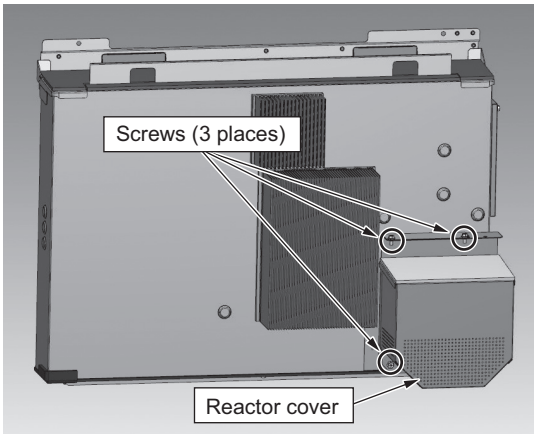
(8) Remove the nut, and disconnect the wires and the reactor from the rubber bush.



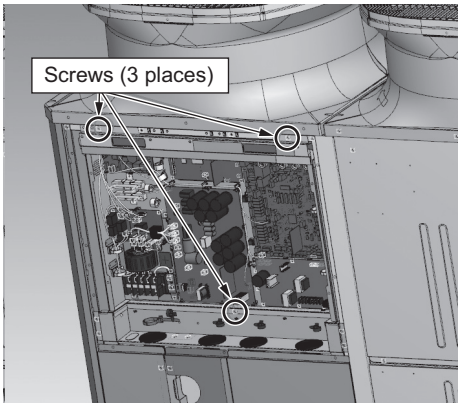
(9) After the new reactor is installed, tighten the nut to a torque of 6.20±0.1 N•m, and thread the wire through the rubber bush from the back to the front.



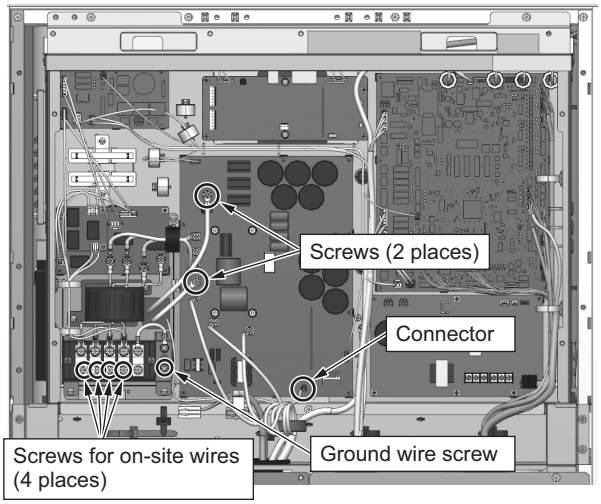
(10) Screw down the reactor cover with three screws.



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



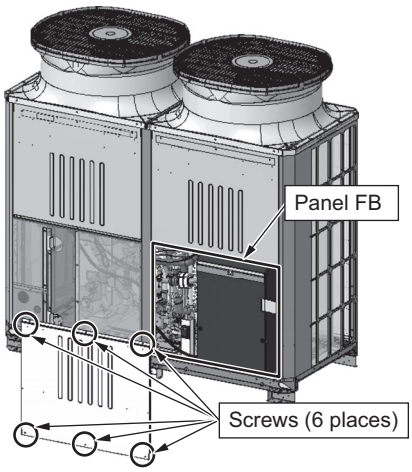
(12) Reinstall the wires inside the control box, control box panel, and the service panel FU back in place to complete the procedure.



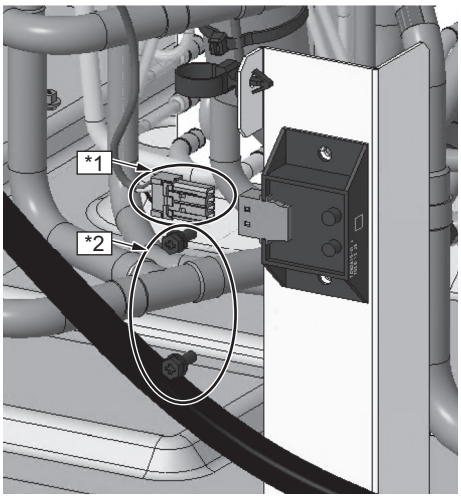
5. Refrigerant sensor replacement instructions

Procedure

(1) Unscrew the six screws and remove service panel FB.
For information on the panel screws, see page ix.



(2) Disconnect the refrigerant sensor connector and remove the two screws.
*1. Replace the refrigerant sensor every five years.
*2. Handle the refrigerant sensor with care; it can be damaged by even slight impact.



XI USB Function

[1] Service Overview 187
[2] Software Rewrite Function on the USB 189
[3] Maintenance LED Display and Troubleshooting 191

[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

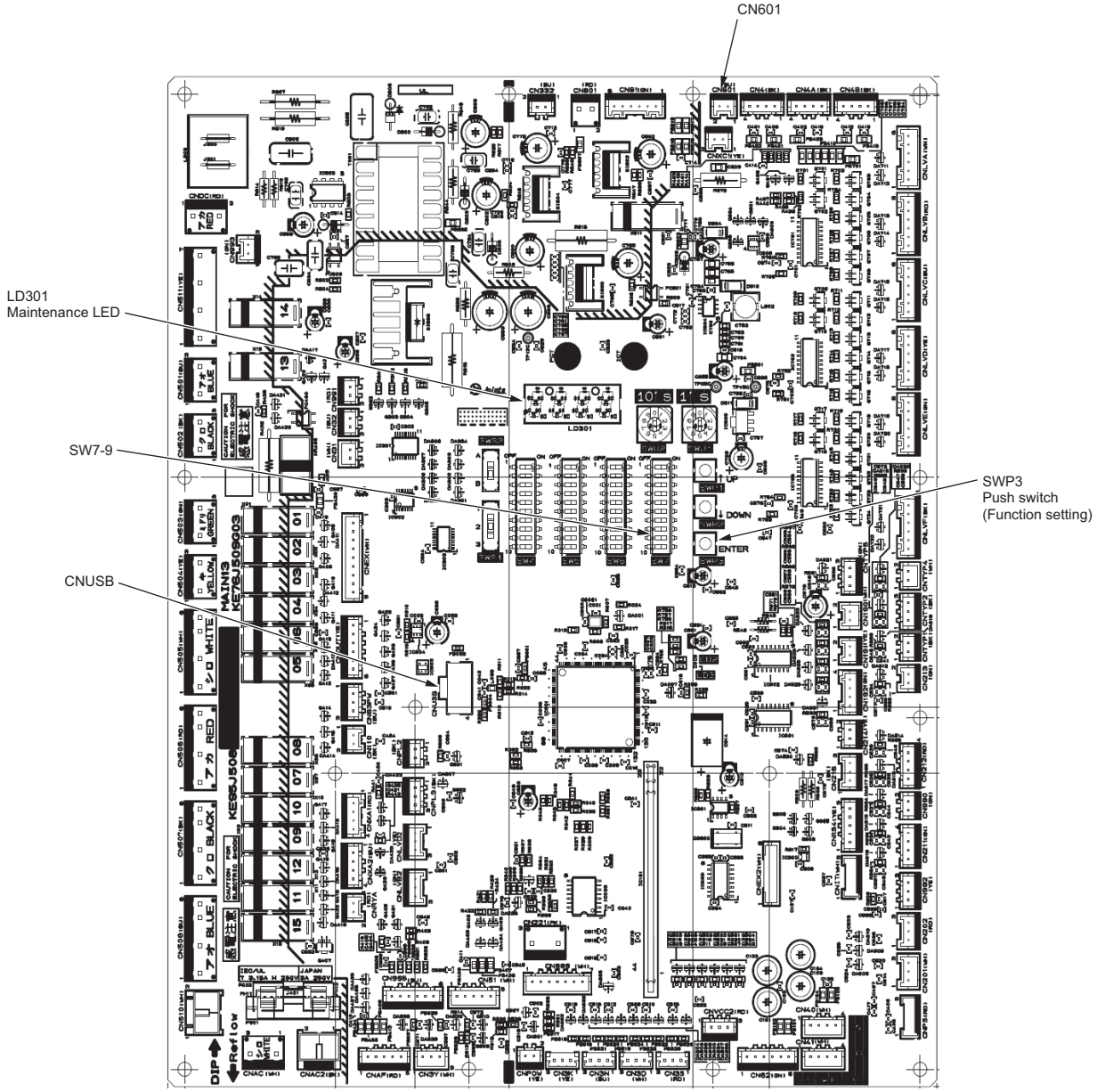
The software on outdoor units can be rewritten using a USB memory stick.

For detailed information about each function, refer to “Software Rewrite Function on the USB”. (page 189)

For information regarding the maintenance LED display content and regarding troubleshooting, refer to “Maintenance LED Display and Troubleshooting”. (page 191)

<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

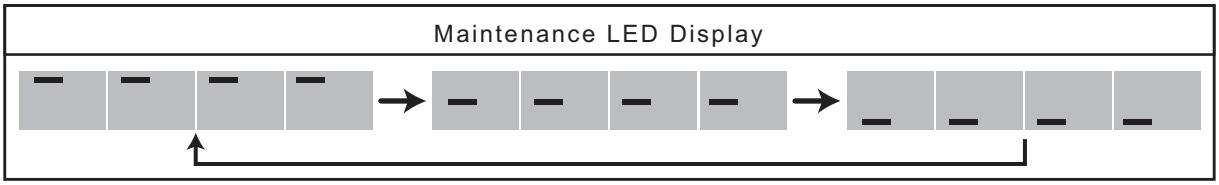
(1) Starting software rewrite mode

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 “Maintenance LED Display and Troubleshooting”. (page 191)

- 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). “Rewriting Software” (page 189) If these precautions are not taken, the system may not start normally.
- When rewriting ended unsuccessfully, redo the procedure from step (1) - 3). “Rewriting Software” (page 189) 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 “Troubleshooting”. (page 192)
- 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“Troubleshooting”. (page 192)

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 “Troubleshooting” 1-(1), 1-(2) and 1-(3). (page 192)
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 “Troubleshooting” 1-(4). (page 192)
				“Er02” Software rewrite was stopped due to failure of the USB memory stick during the software rewrite process. See “Troubleshooting” 1-(5). (page 193)
5		Error (control board side)		“Er10” Software rewrite was not completed due to failure in deleting the existing software. See “Troubleshooting” 1-(6). (page 193)
				“Er11” Software rewrite has not been completed due to failure in writing new software. See “Troubleshooting” 1-(6). (page 193)

<2> Troubleshooting

Troubleshooting of USB functions are shown below.
The displays on the maintenance LED described in “Maintenance LED Display Content List” (page 191) 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 “Rewriting Software” (page 191) 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 “USB memory stick”. (page 188)
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 “Starting software rewrite mode”. (page 189) 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 “USB memory stick”. (page 188)
- 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 “Starting software rewrite mode”. (page 189)

(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 “Starting software rewrite mode”. (page 189)

(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 “Starting software rewrite mode ”. (page 189) If the problem persists, rewrite the software, using a ROM writer.

XII Attachments

[1] R290 saturation temperature table 197

[1] R290 saturation temperature table

Saturation pressure	Saturating temperature	Saturation pressure	Saturating temperature	Saturation pressure	Saturating temperature	Saturation pressure	Saturating temperature	Saturation pressure	Saturating temperature
MPa (gauge)	°C	MPa (gauge)	°C	MPa (gauge)	°C	MPa (gauge)	°C	MPa (gauge)	°C
0.00	-42.12	0.80	22.86	1.60	49.68	2.40	68.29	3.20	82.83
0.01	-39.96	0.81	23.29	1.61	49.95	2.41	68.49	3.21	82.99
0.02	-37.95	0.82	23.71	1.62	50.21	2.42	68.69	3.22	83.16
0.03	-36.07	0.83	24.14	1.63	50.48	2.43	68.89	3.23	83.32
0.04	-34.29	0.84	24.55	1.64	50.75	2.44	69.10	3.24	83.48
0.05	-32.60	0.85	24.97	1.65	51.01	2.45	69.30	3.25	83.64
0.06	-31.00	0.86	25.38	1.66	51.28	2.46	69.49	3.26	83.80
0.07	-29.48	0.87	25.79	1.67	51.54	2.47	69.69	3.27	83.97
0.08	-28.02	0.88	26.19	1.68	51.80	2.48	69.89	3.28	84.13
0.09	-26.62	0.89	26.59	1.69	52.06	2.49	70.09	3.29	84.29
0.10	-25.28	0.90	26.99	1.70	52.32	2.50	70.29	3.30	84.45
0.11	-23.99	0.91	27.39	1.71	52.58	2.51	70.48	3.31	84.61
0.12	-22.74	0.92	27.78	1.72	52.83	2.52	70.68	3.32	84.77
0.13	-21.53	0.93	28.17	1.73	53.09	2.53	70.87	3.33	84.92
0.14	-20.37	0.94	28.56	1.74	53.34	2.54	71.07	3.34	85.08
0.15	-19.24	0.95	28.95	1.75	53.60	2.55	71.26	3.35	85.24
0.16	-18.14	0.96	29.33	1.76	53.85	2.56	71.46	3.36	85.40
0.17	-17.08	0.97	29.71	1.77	54.10	2.57	71.65	3.37	85.56
0.18	-16.04	0.98	30.09	1.78	54.36	2.58	71.84	3.38	85.71
0.19	-15.03	0.99	30.46	1.79	54.61	2.59	72.04	3.39	85.87
0.20	-14.05	1.00	30.83	1.80	54.85	2.60	72.23	3.40	86.02
0.21	-13.09	1.01	31.20	1.81	55.10	2.61	72.42	3.41	86.18
0.22	-12.16	1.02	31.57	1.82	55.35	2.62	72.61	3.42	86.34
0.23	-11.24	1.03	31.94	1.83	55.60	2.63	72.80	3.43	86.49
0.24	-10.35	1.04	32.30	1.84	55.84	2.64	72.99	3.44	86.65
0.25	-9.48	1.05	32.66	1.85	56.09	2.65	73.18	3.45	86.80
0.26	-8.62	1.06	33.02	1.86	56.33	2.66	73.36	3.46	86.95
0.27	-7.78	1.07	33.37	1.87	56.57	2.67	73.55	3.47	87.11
0.28	-6.96	1.08	33.73	1.88	56.81	2.68	73.74	3.48	87.26
0.29	-6.16	1.09	34.08	1.89	57.05	2.69	73.93	3.49	87.41
0.30	-5.37	1.10	34.43	1.90	57.29	2.70	74.11	3.50	87.57
0.31	-4.59	1.11	34.77	1.91	57.53	2.71	74.30	3.51	87.72
0.32	-3.83	1.12	35.12	1.92	57.77	2.72	74.48	3.52	87.87
0.33	-3.09	1.13	35.46	1.93	58.01	2.73	74.67	3.53	88.02
0.34	-2.35	1.14	35.80	1.94	58.24	2.74	74.85	3.54	88.17
0.35	-1.63	1.15	36.14	1.95	58.48	2.75	75.04	3.55	88.32
0.36	-0.92	1.16	36.48	1.96	58.71	2.76	75.22	3.56	88.47
0.37	-0.22	1.17	36.81	1.97	58.95	2.77	75.40	3.57	88.62
0.38	0.47	1.18	37.14	1.98	59.18	2.78	75.58	3.58	88.77
0.39	1.15	1.19	37.48	1.99	59.41	2.79	75.77	3.59	88.92
0.40	1.81	1.20	37.81	2.00	59.64	2.80	75.95	3.60	89.07
0.41	2.47	1.21	38.13	2.01	59.87	2.81	76.13	3.61	89.22
0.42	3.12	1.22	38.46	2.02	60.10	2.82	76.31	3.62	89.37
0.43	3.76	1.23	38.78	2.03	60.33	2.83	76.49	3.63	89.52
0.44	4.39	1.24	39.10	2.04	60.56	2.84	76.67	3.64	89.66
0.45	5.01	1.25	39.42	2.05	60.79	2.85	76.85	3.65	89.81
0.46	5.62	1.26	39.74	2.06	61.02	2.86	77.03	3.66	89.96
0.47	6.23	1.27	40.06	2.07	61.24	2.87	77.20	3.67	90.11
0.48	6.83	1.28	40.37	2.08	61.47	2.88	77.38	3.68	90.25
0.49	7.42	1.29	40.69	2.09	61.69	2.89	77.56	3.69	90.40
0.50	8.00	1.30	41.00	2.10	61.91	2.90	77.74	3.70	90.54
0.51	8.57	1.31	41.31	2.11	62.14	2.91	77.91	3.71	90.69
0.52	9.14	1.32	41.62	2.12	62.36	2.92	78.09	3.72	90.83
0.53	9.70	1.33	41.93	2.13	62.58	2.93	78.26	3.73	90.98
0.54	10.26	1.34	42.23	2.14	62.80	2.94	78.44	3.74	91.12
0.55	10.81	1.35	42.53	2.15	63.02	2.95	78.61	3.75	91.27
0.56	11.35	1.36	42.84	2.16	63.24	2.96	78.79	3.76	91.41
0.57	11.89	1.37	43.14	2.17	63.46	2.97	78.96	3.77	91.55
0.58	12.42	1.38	43.44	2.18	63.67	2.98	79.13	3.78	91.70
0.59	12.94	1.39	43.74	2.19	63.89	2.99	79.30	3.79	91.84
0.60	13.46	1.40	44.03	2.20	64.11	3.00	79.48	3.80	91.98
0.61	13.98	1.41	44.33	2.21	64.32	3.01	79.65	3.81	92.12
0.62	14.49	1.42	44.62	2.22	64.54	3.02	79.82	3.82	92.26
0.63	14.99	1.43	44.91	2.23	64.75	3.03	79.99	3.83	92.41
0.64	15.49	1.44	45.20	2.24	64.96	3.04	80.16	3.84	92.55
0.65	15.98	1.45	45.49	2.25	65.18	3.05	80.33	3.85	92.69
0.66	16.47	1.46	45.78	2.26	65.39	3.06	80.50	3.86	92.83
0.67	16.95	1.47	46.07	2.27	65.60	3.07	80.67	3.87	92.97
0.68	17.43	1.48	46.35	2.28	65.81	3.08	80.84	3.88	93.11
0.69	17.91	1.49	46.64	2.29	66.02	3.09	81.01	3.89	93.25
0.70	18.38	1.50	46.92	2.30	66.23	3.10	81.17	3.90	93.38
0.71	18.85	1.51	47.20	2.31	66.44	3.11	81.34	3.91	93.52
0.72	19.31	1.52	47.48	2.32	66.65	3.12	81.51	3.92	93.66
0.73	19.77	1.53	47.76	2.33	66.86	3.13	81.68	3.93	93.80
0.74	20.22	1.54	48.04	2.34	67.06	3.14	81.84	3.94	93.94
0.75	20.67	1.55	48.31	2.35	67.27	3.15	82.01	3.95	94.07
0.76	21.12	1.56	48.59	2.36	67.47	3.16	82.17	3.96	94.21
0.77	21.56	1.57	48.86	2.37	67.68	3.17	82.34	3.97	94.35
0.78	22.00	1.58	49.14	2.38	67.88	3.18	82.50	3.98	94.48
0.79	22.43	1.59	49.41	2.39	68.09	3.19	82.67	3.99	94.62

Service Handbook

Model

CAHV-Z450YA-HPB(-BS)

MITSUBISHI ELECTRIC CORPORATION

www.MitsubishiElectric.com

HWE2418A

New publication effective Aug. 2026
Specifications subject to change without notice