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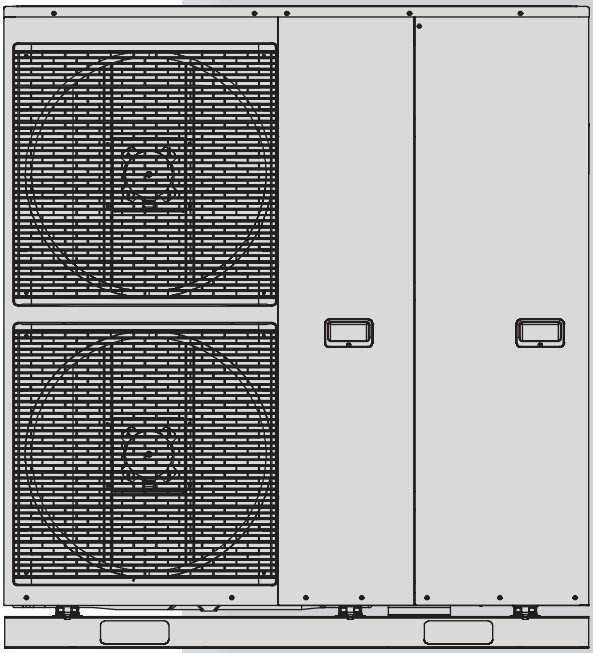
CENTRUS
Lochinvar

Residential Air-Water Heat Pump

Service Manual
Mono Bloc Unit
RAH040



⚠ WARNING This service information is designed for experienced repair technicians only and is not designed for use by the general public. It does not contain warnings or cautions to advise non-technical individuals of potential dangers in attempting to service a product. Products powered by electricity should be serviced or repaired only by experienced professional technicians. Any attempt to service or repair the products dealt with in this service information by anyone else could result in serious injury or death.

Save this manual for future reference.

AHRI CERTIFIED®
www.ahridirectory.org
Water-Cooled Water Chilling and Heat Pump Water-Heating Packages AHRI Standards 550/590 and 551/591

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Lochinvar®
HIGH EFFICIENCY BOILERS & WATER HEATERS

Contents

1 Safety Precautions

Read the following "SAFETY PRECAUTIONS" carefully before installation of (Mono bloc) Air-to-Water Heatpump system (hereafter referred to as "Mono bloc unit"). Electrical works and water installation works must be done by licensed electrician and licensed water system installer respectively. Be sure to use the correct rating and main circuit for the model to be installed. The caution items stated here must be followed because these important contents are related to safety. The meaning of each indication used is as below. Incorrect installation due to ignorance or negligence of the instructions will cause harm or damage, and the seriousness is classified by the following indications.

⚠WARNING WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠CAUTION CAUTION indicates the possibility of causing injury or damage to properties only.

The items to be followed are classified by the symbols:

⃠ Symbol with white background denotes item that is PROHIBITED.

❗ Symbol with dark background denotes item that must be carried out.

NOTICE NOTICE indicates special instructions on installation, operation, or maintenance that are important but not related to personal injury or property damage.

⚠WARNING	
This appliance is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety. Children should be supervised to ensure that they do not play with the appliance.	
Do not use means to accelerate the defrosting process or to clean, other than those recommended by the manufacturer. Any unfit method or using incompatible material may cause product damage, burst and serious injury.	⃠
Do not install Mono bloc unit near handrail of balcony. When installing Mono bloc unit at balcony of high rise building, child may climb up to Mono bloc unit and cross over the handrail and causing accident.	⃠
Do not use unspecified cord, modified cord, joint cord or extension cord for power supply cord. Do not share the single outlet with other electrical appliances. Poor contact, poor insulation or over current will cause electrical shock or fire.	⃠
Do not tie up the power supply cord into a bundle by band. Abnormal temperature rise on power supply cord may happen.	⃠
Do not insert your fingers or other objects into the unit, high speed rotating fan may cause injury.	⃠
Do not sit or step on the unit, you may fall down accidentally.	⃠
Keep plastic bag (packaging material) away from small children, it may cling to nose and mouth and prevent breathing.	⃠
Do not purchase unauthorized electrical parts for installation, service, maintenance and etc.. They might cause electrical shock or fire.	⃠
Do not pierce or burn as the appliance is pressurized. Do not expose the appliance to heat, flame, sparks, or other sources of ignition. Else, it may explode and cause injury or death.	⃠
This Mono bloc unit is a multi supply appliance. All circuits must be disconnected before accessing the unit terminals.	⃠
Do not modify the wiring of Mono bloc unit for installation of other components (i.e. heater, etc). Overloaded wiring or wire connection points may cause electrical shock or fire.	⃠
Do not add or replace refrigerant other than specified type. It may cause product damage, burst and injury etc.	⃠
For electrical work, follow the national regulation, legislation and this installation instructions. An independent circuit and single outlet must be used. If electrical circuit capacity is not enough or defect found in the electrical work, it will cause electrical shock or fire.	❗

1 Safety Precautions

⚠WARNING	
For water circuit installation work, follow to relevant North American and national regulations and local plumbing and building regulation codes.	❗
Engage a qualified installer or technician or specialist for installation. If installation done by the user is incorrect, it will cause water leakage, electrical shock or fire.	❗
Install according to this installation instructions strictly. If installation is defective, it will cause water leakage, electrical shock or fire.	❗
Only use the supplied or specified installation parts. Else, it may causes Mono bloc unit vibrate, fall, water leakage, electrical shock or fire.	❗
Install at a flat, strong and firm location which is able to withstand the Mono bloc unit's weight. If the location is slanting, or strength is not enough the set will fall and cause injury.	❗
Wire routing must be properly arranged so that control board cover is fixed properly. If control board cover is not fixed perfectly, it will cause fire or electrical shock.	❗
This equipment is strongly recommended to be installed with Residual Current Device (RCD) on-site according to the respective national wiring rules or country-specific safety measures in terms of residual current.	❗
The unit is only for use in a closed water system. Utilization in an open water system may lead to excessive corrosion of the water piping and risk of incubating bacteria colonies, particularly Legionella, in water.	❗
If there is any doubt about the installation procedure or operation, always contact the a qualified installer or technician for advice and information.	❗
Select a location where in case of water leakage, the leakage will not cause damage to other properties.	❗
When installing electrical equipment in a wooden building that uses metal lath or wire lath, contact between the building and electrical components is not allowed. This is in accordance with electrical facility standards. An insulator must be installed in between the electrical components and the building.	❗
This installation may be subjected to building regulation approval applicable to respective country that may require to notify the local authority before installation.	❗
Any work carried out on the Mono bloc unit after removing any panel which is secured by screws, must be carried out under the supervision of a qualified installer or technician and licensed installation contractor.	❗
Be aware that refrigerants may not contain an odor.	❗
This equipment must be properly connected to the ground. Earth line must not be connected to gas pipe, water pipe, earth of lightning rod and telephone. Otherwise, it may cause electrical shock in case of equipment breakdown or insulation breakdown.	❗

FCC Responsible Party:

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1 Safety Precautions

⚠CAUTION	
Do not install the Mono bloc unit at place where leakage of flammable gas may occur. In case gas leaks and accumulates at surrounding of the Mono bloc unit, it may cause fire.	⊘
Do not release refrigerant during piping work for installation, re-installation and during repairing a refrigeration parts. Take care of the liquid refrigerant, it may cause frostbite.	⊘
Make sure the insulation of power supply cord does not contact hot part (i.e. refrigerant piping, water piping) to prevent from insulation failure (melt).	⊘
Do not touch the sharp aluminium fin; sharp parts may cause injury.	⊘
Do not apply excessive force to water pipes that may damage the pipes. If water leakage occurs, it will cause flooding and damage to other properties.	⊘
Carry out drainage piping as mentioned in installation instructions. If drainage is not perfect, water leakage may happen and may cause damage to properties of the user.	!
The piping installation work must be flushed before the Mono bloc unit is connected to remove contaminants. Contaminants may damage the Mono bloc unit components.	!
Select an installation location which is easy for maintenance. Incorrect installation, service or repair of this Mono bloc unit may increase the risk of rupture and this may result in loss damage or injury and/or property.	!
Ensure the correct polarity is maintained throughout all wiring. Otherwise, it will cause electrical shock or fire.	!
Power supply connection to Mono bloc unit. • Power supply point should be in easily accessible place for power disconnection in case of emergency. • Must follow local national wiring standard, regulation and this installation instruction. • Strongly recommended to make permanent connection to a circuit breaker. It must be a double pole switch with a minimum 1/8 inch gap. - Power supply 1: Use approved 30A circuit breaker - Power supply 2: Use approved 30A circuit breaker	!
After installation, the installer is obliged to verify correct operation of the Mono bloc unit. Check the connection point for water leakage during test run. If leakage occurs, it will cause damage to other properties.	!
Keep any required ventilation openings clear of obstruction.	!
Installation work. Four or more people are required to carry out the installation work. The weight of Mono bloc unit might cause injury if carried by less than four people.	!

Federal Communications Commission Interference Statement

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution: To ensure continued compliance, follow the attached installation instruction. Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Industry Canada Notice

CAN ICES-3(B)/NMB-3(B)

2 Precaution for Using R32 Refrigerant

The basic installation work procedures are the same as conventional refrigerant (R410A, R22) models.
However, pay careful attention to the following points:

⚠WARNING	
Since the working pressure is higher than that of refrigerant R22 models, some of the piping and installation and service tools are special. Especially, when replacing a refrigerant R22 model with a new refrigerant R32 model, always replace the conventional piping with the R32 and R410A piping on the outdoor unit side. For R32 and R410A, the same pipe can be used.	❗
The mixing of different refrigerants within a system is prohibited. Models that use refrigerant R32 and R410A have a different charging port thread diameter to prevent erroneous charging with refrigerant R22 and for safety. Therefore, check beforehand. [The charging port thread diameter for R32 and R410A is 1/2 inch.]	❗
Ensure that foreign matter (oil, water, etc.) does not enter the piping.	❗
Operation, maintenance, repairing and refrigerant recovery should be carried out by trained and certified personnel in the use of flammable refrigerants and as recommended by the manufacturer. Any personnel conducting an operation, servicing or maintenance on a system or associated parts of the equipment should be trained and certified.	❗
Any part of refrigerating circuit (evaporators, air coolers, AHU, condensers or liquid receivers) or piping should not be located in the proximity of heat sources, open flames, operating gas appliance or an operating electric heater.	❗
The user/owner or their authorized representative shall regularly check the alarms, mechanical ventilation and detectors, at least once a year, where as required by national regulations, to ensure their correct functioning.	❗
A logbook shall be maintained. The results of these checks shall be recorded in the logbook.	❗
In case of ventilations in occupied spaces shall be checked to confirm no obstruction.	❗
Before a new refrigerating system is put into service, the person responsible for placing the system in operation should ensure that trained and certified operating personnel are instructed on the basis of the instruction manual about the construction, supervision, operation and maintenance of the refrigerating system, as well as the safety measures to be observed, and the properties and handling of the refrigerant used.	❗
The general requirement of trained and certified personnel are indicated as below: a) Knowledge of legislation, regulations and standards relating to flammable refrigerants; and, b) Detailed knowledge of and skills in handling flammable refrigerants, personal protective equipment, refrigerant leakage prevention, handling of cylinders, charging, leak detection, recovery and disposal; and, c) Able to understand and to apply in practice the requirements in the national legislation, regulations and Standards; and, d) Continuously undergo regular and further training to maintain this expertise.	❗
Protect the refrigerating system from accidental rupture due to moving furniture or reconstruction activities.	❗
To ensure no leaking, refrigerant joints shall be tightness tested. The test method shall have a sensitivity of 0.17 ounces per year of refrigerant or better under a pressure of at least 0.25 times the maximum allowable pressure (>151 Psi, max 624 Psi). No leak shall be detected.	❗

2 Precaution for Using R32 Refrigerant

⚠CAUTION	
INSTALLATION (Space)	• Must comply with national gas regulations, state municipal rules and legislation. Notify relevant authorities in accordance with all applicable regulations. • Must ensure mechanical connections be accessible for maintenance purposes. • In cases that require mechanical ventilation, the ventilation openings shall be kept clear of obstruction. • When disposal of the product, do follow to the precautions in the RECOVERY section of this manual and comply with national regulations. • Always contact to local municipal offices for proper handling.
SERVICING	**Service personnel** • Any qualified person who is involved with working on or breaking into a refrigerant circuit should hold a current valid certificate from an industry-accredited assessment authority, which authorizes their competence to handle refrigerants safely in accordance with an industry recognized assessment specification. • Servicing shall only be performed as recommended by the equipment manufacturer. Maintenance and repair requiring the assistance of other skilled personnel shall be carried out under the supervision of the person competent in the use of flammable refrigerants. • Servicing shall be performed only as recommended by the manufacturer. • The system is inspected, regularly supervised and maintained by a trained and certified service personnel who is employed by the person user or party responsible. • Ensure refrigerant charge not to leak. **Work** • 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 system, the precautions in the Servicing section under Work and Checks to Electrical devices must be followed before conducting work on the system. • 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. • All maintenance staff and others working in the local area shall be instructed and supervised on the nature of work being carried out. • Avoid working in confined spaces. Always ensure away from source, at least 6 1/2 feet of safety distance, or zoning of free space area of at least 6 1/2 feet in radius. • Wear appropriate protective equipment, including respiratory protection, as conditions warrant. • Keep all sources of ignition and hot metal surfaces away. **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 flammable refrigerants, i.e. non sparking, adequately sealed or intrinsically safe. • In case of leakage/spillage happened, immediately ventilate area and stay upwind and away from spill/release. • In case of leakage/spillage happened, do notify persons downwind of the leaking/spill, isolate immediate hazard area and keep unauthorized personnel out. **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 at hand. • Have a dry powder or CO2 fire extinguisher adjacent to the charging area.

2 Precaution for Using R32 Refrigerant

⚠ CAUTION

SERVICING

No ignition sources

- No person carrying out work in relation to a refrigerating system which involves exposing any pipe work that contains or has contained flammable refrigerant shall use any sources of ignition in such a manner that it may lead to the risk of fire or explosion. He/She must not be smoking when carrying out such work.
- All possible ignition sources, including cigarette smoking, should be kept sufficiently far away from the site of installation, repairing, removing and disposal, during which flammable 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.

Ventilated area

- 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.

Refrigeration Equipment Checks

- 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 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.

Checks to electrical devices

- Repair and maintenance to electrical components shall include initial safety checks and component inspection procedures.
- Initial safety checks shall include but not limit to:
  - That capacitors are discharged: this shall be done in a safe manner to avoid possibility of sparking.
  - That there is no live electrical components and wiring are exposed while charging, recovering or purging the system.
  - That there is continuity of earth-ground bonding.
- At all times the manufacturer's maintenance and service guidelines shall be followed.
- If in doubt consult the manufacturer's technical department for assistance.
- 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.
- The owner of the equipment must be informed or reported so all parties are advised thereinafter.

Repairs to sealed components

- Sealed electrical components shall be replaced.

2 Precaution for Using R32 Refrigerant

⚠CAUTION	
REPAIR TO SAFE COMPONENTS	• Intrinsically safe components must be replaced.
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.
DETECTION OF FLAMMABLE REFRIGERANTS	• Under no circumstances shall potential sources of ignition be used in the searching or detection of refrigerant leaks. • A halide torch (or any other detector using a naked flame) shall not be used.
LEAK DETECTION	**The following leak detection methods are deemed acceptable for all refrigerant systems:** • No leaks shall be detected when using detection equipment with a sensitivity of 0.17 ounces per year of refrigerant or better under a pressure of at least 0.25 times the maximum allowable pressure (>151 Psi, max 624 Psi) for example, a universal sniffer. • Electronic leak detectors may be used to detect flammable refrigerants, but 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 also suitable for use with most refrigerants, for example, bubble method and fluorescent method agents. • 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. The precautions in the Removal and Evacuation section of this manual must be followed to remove the refrigerant.

2 Precaution for Using R32 Refrigerant

⚠ CAUTION	
REMOVAL AND EVACUATION	• When breaking into the refrigerant circuit to make repairs – or for any other purpose – conventional procedures shall be used. However, it is important that best practice is followed since flammability is a consideration. The following procedure shall be adhered to: 1. Safely remove refrigerant following local and national regulations 2. Evacuate 3. Purge the circuit with inert gas 4. Evacuate 5. Continuously flush with inert gas when using flame to open circuit 6. Open the circuit • The refrigerant charge shall be recovered into the correct recovery cylinders if venting is not allowed by local and national codes. • The system shall be purged with OFN to render the appliances safe. (remark: OFN = oxygen free nitrogen, type of inert gas) • This process may need to be repeated several times. • Compressed air or oxygen shall not be used for this task. • Purging 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 there is ventilation available.
CHARGING PROCEDURES	• 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 refrigerating 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 over fill the refrigeration system. • Prior to recharging the system it shall be pressure tested with OFN (refer to LEAK DETECTION). • 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. • Electrostatic charge may accumulate and create a hazardous condition when charging and discharging the refrigerant. • To avoid fire or explosion, dissipate static electricity during transfer by grounding and bonding containers and equipment before charging/discharging.

2 Precaution for Using R32 Refrigerant

⚠CAUTION	
DECOMMISSIONING	• Before carrying out this procedure, it is essential that the technician is completely familiar with the equipment and all its details. • 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 recovered refrigerant. • It is essential that electrical power is available before the task is commenced. a) Become familiar with the equipment and its operation. b) Isolate system electrically. c) 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. d) Pump down refrigerant system, if possible. e) If a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system. f) Make sure that cylinder is situated on the scales before recovery takes place. g) Start the recovery machine and operate in accordance with manufacturer's instructions. h) Do not over fill cylinders. (No more than 80% volume liquid charge). i) Do not exceed the maximum working pressure of the cylinder, even temporarily. j) 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. k) Recovered refrigerant shall not be charged into another refrigeration system unless it has been cleaned and checked. • Electrostatic charge may accumulate and create a hazardous condition when charging or discharging the refrigerant. • To avoid fire or explosion, dissipate static electricity during transfer by grounding and bonding containers and equipment before charging/discharging.
LABELLING	• Equipment shall be labelled stating that it has been de-commissioned and emptied of refrigerant. • The label shall be dated and signed. • Ensure that there are labels on the equipment stating the equipment contains flammable refrigerant.

2 Precaution for Using R32 Refrigerant

⚠CAUTION	
RECOVERY	• When removing refrigerant from a system, either for servicing or decommissioning, it is recommended 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. • 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 flammable refrigerants. If in doubt, the manufacturer should be consulted. • 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. • The recovered refrigerant shall be processed according to local legislation 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 compressor body shall not be heated by an open flame or other ignition sources to accelerate this process. When oil is drained from a system, it shall be carried out safely.

3 Specifications

ITEM	UNIT	REFRIGERANT SYSTEM	
Performance Test Condition		AHRI 550/590	
Cooling Capacity	Condition (Ambient/Water)	A95/W44	
	BTU/h (kW)	34800 (10.2)	
Cooling COP	W/W	2.83	
Heating Capacity	Condition (Ambient/Water)	A47/W105	
	BTU/h (kW)	41000 (12)	
Heating COP	W/W	3.93	
Air Flow	ft^3/min (m^3/min)	Cooling: 3620 (102.4) Heating: 2870 (81.3)	
Refrigerant Control Device		Expansion Valve	
Refrigerant Oil (FW50S)	fl oz (cm^3)	40.58 (1200)	
Refrigerant (R32)	lbs (kg)	3.53 (1.60)	
R32	GWP		675
	CO_2eq (ton) (Precharged / Maximum)		1.080 / -
Compressor	Type		Hermetic Motor
	Motor Type		Brushless (4-poles)
	Rated Output	Btu/h (kW)	10236 (3)
Fan	Type		Propeller Fan
	Material		PP
	Motor Type		DC (8-poles)
	Output Power	W	60
	Fan Speed	rpm	Cooling: Top: 680, Bottom: 720 Heating: Top: 520, Bottom: 560
Fin-Tube Heat Exchanger	Fin Material		Aluminium (Pre Coat)
	Fin Type		Corrugated Fin
	Row x Stage x FPI		2 x 51 x 19
	Size (W x H X L)	inch (mm)	1.5 (38.1) x 49.6 (1259.4) x 35.6 (903.7)

3 Specifications

ITEM		UNIT	Mono bloc Unit	
Dimension	Height	inch (mm)	55-5/8 (1412.9)	
	Width	inch (mm)	50-5/8 (1285.9)	
	Depth	inch (mm)	12-5/8 (320.7)	
Net Weight		lbs (kg)	317.5 (144)	
Noise Level at a distance of 3.2 ft		Condition (Ambient/Water)	A95/W44	A47/W105
		dB(A)	Cooling: 52	Heating: 52
		Power level dB	Cooling: 69	Heating: 69
Power Source (Phase, Voltage, Cycle)		Ø	Single	
		V	208/240	
		Hz	60	
Input Power		Condition (Ambient/Water)	A95/W44	A47/W105
		kW	Cooling: 3.6	Heating: 3.05
Maximum Input Power for Heatpump System		kW	6.54	
Power Supply 1 : Phase (Ø) / Max. Current (A) / Max. Input Power (W)			1Ø / 29.0 / 6.54k	
Power Supply 2 : Phase (Ø) / Max. Current (A) / Max. Input Power (W)			1Ø / 27.2 / 6.53k	
Starting current		A	15.8	
Running Current		Condition (Ambient/Water)	A95/W44	A47/W105
		A	Cooling: 18.6 - 16.1	Heating: 15.8 - 13.7
Maximum Current for Heatpump System		A	29.0	
Power Factor Power factor means total figure of compressor and outdoor fan motor.		Condition (Ambient/Water)	A95/W44	A47/W105
		%	Cooling: 93	Heating: 93
Thermostat			Electronic Control	
Protection Device			Electronic Control	

3 Specifications

ITEM		UNIT	Water System
Performance Test Condition			AHRI 550/590
Operation Range	Outdoor Ambient	°F (min. / max.)	Cooling: 50 / 109 Heating: -4 / 95
	Water Outlet	°F (min. / max.)	Cooling: 41 / 68 Heating: 68/131 (Below Ambient -4°F) *3 68/140 (Ambient 5~32°F) or Above Ambient 77°F) *3 68/149 (Ambient 41~68°F) *3*4
Internal Pressure Differential		Psi	Cooling: 6 Heating: 8
Water Pipe Diameter	Inlet	inch	1-1/4 NPT
	Outlet	inch	1-1/4 NPT
Water Drain Hose Inner Diameter		inch (mm)	5/8 (15.9)
Pump	Motor Type		DC Motor
	Input Power	W	145
Brazed Plate Heat Exchanger	Type		Brazed Plate
	No. of Plates		38 or 36
	Size (H x W x L)	inch (mm)	2-7/8 (73) x 4-7/8 (123.9) x 13-1/8 (333.4)
	Water Flow Rate	gal/min (m^3/h)	Cooling: 9.1 (2.1) Heating: 7.7 (1.8)
Pressure Relief Valve Water Circuit		Psi	Open: 50, Close: 35 and below
Flow Switch	Type		Electronic Sensor
Protection Device		A	Residual Current Circuit Breaker (40)
Expansion Vessel	Volume	G	2.6
	MWP	Psi	14.5
Capacity of Integrated Electric Heater / OLP TEMP		kW / °F	3.33

Note:

- Cooling capacities are based on outdoor air temperature of 95°F Dry Bulb with controlled indoor water inlet temperature of 54°F and water outlet temperature of 44°F.
- Heating capacities are based on outdoor air temperature of 47°F Dry Bulb, 44.6°F Wet Bulb with controlled indoor water inlet temperature of 95°F and water outlet temperature of 105°F.
- Specification are subjected to change without prior notice for further improvement.
- Flow rate indicated are based on nominal capacity adjustment of leaving water temperature (LWT) 105°F and Δ10°F.

*3 Between outdoor ambient 5°F and -4°F, the water outlet temperature gradually decreases from 140°F to 131°F.
*3 Between outdoor ambient 41°F and 32°F, the water outlet temperature gradually decreases from 149°F to 140°F.
*3 Between outdoor ambient 68°F and 77°F, the water outlet temperature gradually decreases from 149°F to 140°F.
*4 Only when ΔT is set to 27°F, the set temperature above 140°F will take effect.

4 Features

- **Inverter Technology**
  -Energy saving
- **High Efficiency**
- **Compact Design**
- **Environment Protection**
  - Non-ozone depletion substances refrigerant (R32)
- **Easy to use control panel**
- **Weekly Timer**
- **Quality Improvement**
  - Random auto restart after power failure for safety restart operation
  - Gas leakage protection
  - Prevent compressor reverse cycle
  - Inner protector to protect compressor
- **Serviceability Improvement**
  - Breakdown Self Diagnosis function
  - System Status Check Buttons for servicing purpose
  - System Pumpdown Button for servicing purpose
  - Front maintenance design for outdoor unit
- **Operation Condition**

	Heating (Circuit)	Cooling (Circuit)
Water outlet temperature °F (Min. / Max)	68 / 131 (Below Ambient -4 °F)*1 68 / 140 (Ambient 5~32°F or Above Ambient 77°F) *1 68 / 149 (Ambient 41~68°F) *1*2	41 / 68
Outdoor ambient temperature °F (Min. / Max)	-4 / 95	50 / 109

NOTICE : When the outdoor temperature is out of the range in the table, the heating capacity will drop significantly and the mono bloc unit may stop operating for its protection.
The unit will restart automatically after the outdoor temperature returns to the specified range.
*1 Between outdoor ambient 5°F and -4°F, the water outlet temperature gradually decreases from 140°F to 131°F.
*1 Between outdoor ambient 41°F and 32°F, the water outlet temperature gradually decreases from 149°F to 140°F.
*1 Between outdoor ambient 68°F and 77°F, the water outlet temperature gradually decreases from 149°F to 140°F.
*2 Only when ΔT is set to 27°F, the set temperature above 140°F will take effect.

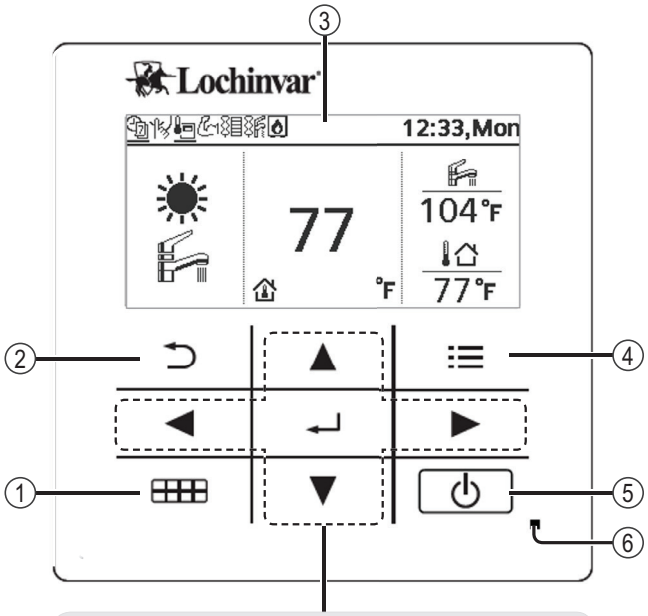
5 Location of Controls and Components

Indoor Unit

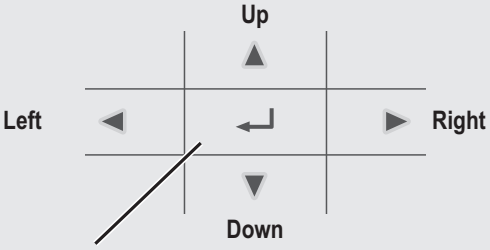
Remote control buttons and display

Figure 5-1 Control buttons

Buttons / Indicator	
①	**Quick Menu button**
②	**Back button** Returns to the previous screen
③	**LCD Display**
④	**Main Menu button** For function setup
⑤	**ON/OFF button** Starts/Stops operation
⑥	**Operation indicator** Illuminates during operation, blinks during alarm.

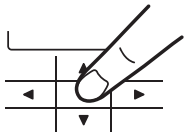


Cross key buttons
Selects an item.

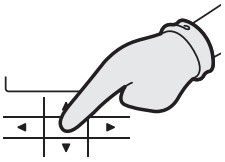


Enter button
Fixes the selected content.

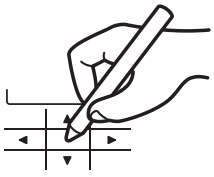
Press center



No glove

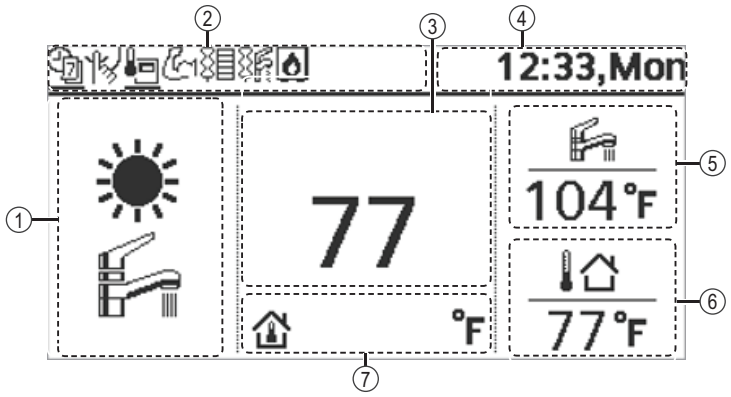


No pen



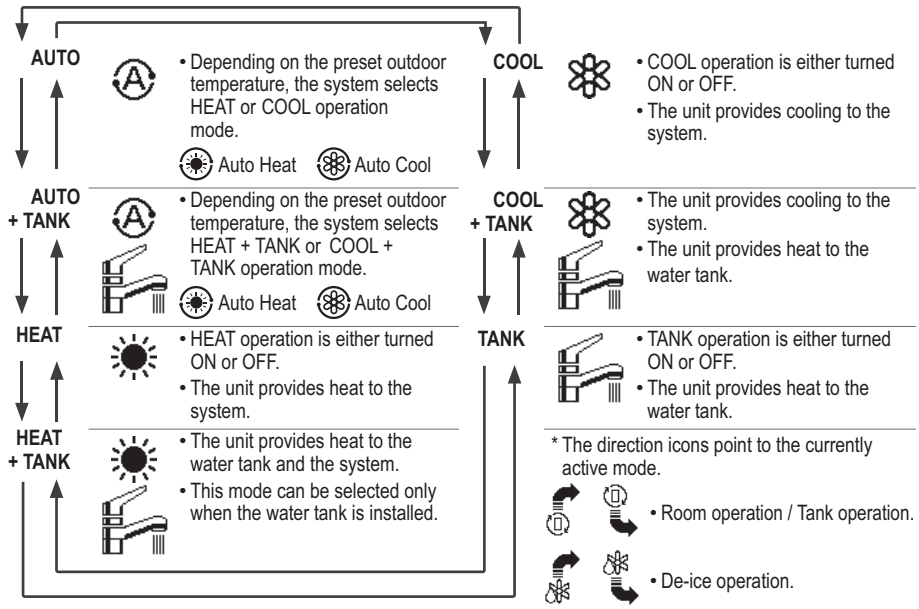
5 Location of Controls and Components

Figure 5-2 *Display*



Display

① **Mode selection**



② **Operation icons**

The status of operation is displayed.
Icon will not display (under operation OFF screen) whenever operation is OFF except weekly timer.

- Holiday operation status
- Weekly Timer operation status
- Quiet operation status
- Zone:Room Thermostat →Internal sensor status
- Powerful operation status
- Room Heater status
- Tank Heater status
- Backup Boiler

③ **Temperature of each zone**

④ **Time and day**

⑤ **Water Tank temperature**

⑥ **Outdoor temperature**

⑦ **Sensor type/Set temperature type icons**

- Water Temperature →Compensation curve
- Water Temperature →Direct
- Room Thermostat →External
- Room Thermostat →Internal

5 Location of Controls and Components

Initialization

Before customizing the various menu settings, please initiate the Remote Controller by selecting the desired language of operation and entering the date and time correctly. When power is turned on for the first time, it will show the Settings Screen automatically. It can also be set from Personal Settings of the menu.

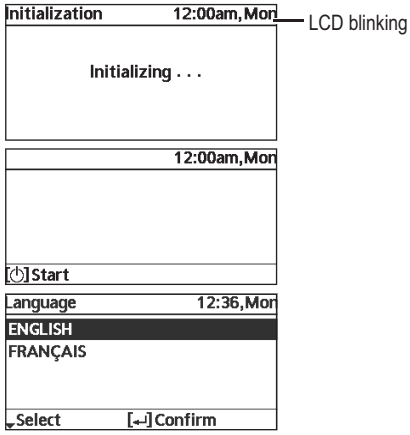
Figure 5-3 *Settings*

Selecting the language

Wait while the display is initializing.
When initializing screen ends, it turns to normal screen.
When any button is pressed, language setting screen appears.

① Scroll with ▼ and ▲ to select the language.

② Press ↵ to confirm the selection.



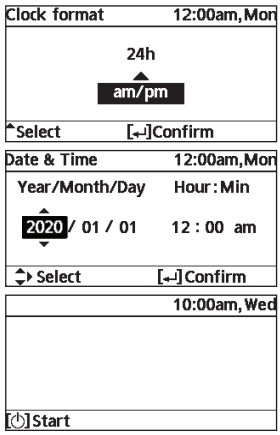
Setting the clock

① Select with ▼ or ▲ how to display the time, either 24h or am/pm format (for example, 15:00 or 3:00 pm).

② Press ↵ to confirm the selection.

③ Use ▼ and ▲ to select year, month, day, hour and minutes. (Select and move with ▶ and press ↵ to confirm.)

④ Once the time is set, time and day will appear on the display even if the Remote Controller is turned OFF.

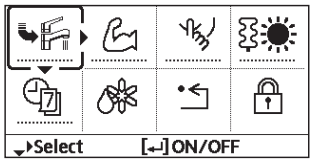


Quick Menu

After the initial settings have been completed, you can select a quick menu from the following options and edit the setting:

Figure 5-4 *Quick menu*

① Press ⊞ to display the quick menu.



② Use ▲ ▼ ◀ ▶ to select menu.

③ Press ↵ to turn on/off the select menu.

5 Location of Controls and Components

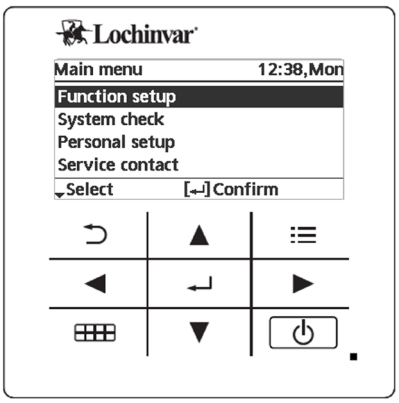
Menus for User

Select menus and determine settings according to the system available in the household. All initial settings must be done by a qualified installer or service technician. It is recommended that all alterations of the initial settings are also done by an authorised dealer or a specialist.

- After initial installation, you may manually adjust the settings.
- The initial setting remains active until the user changes it.
- The Remote Controller can be used for multiple installations.
- Ensure the operation indicator is OFF before setting.
- The system may not work properly if set wrongly.

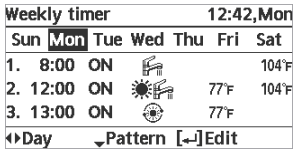
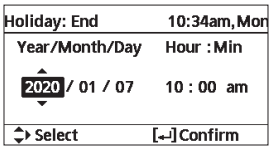
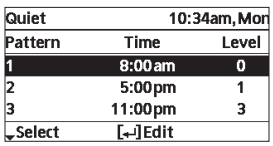
Please consult a qualified installer or service technician.

Figure 5-5 Navigation



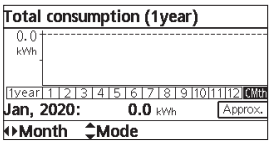
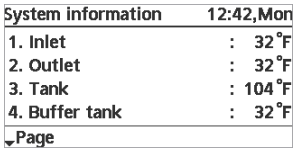
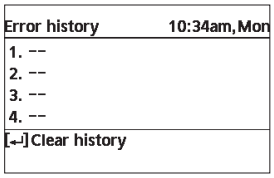
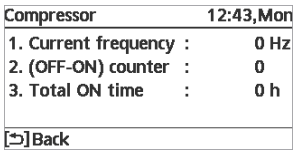
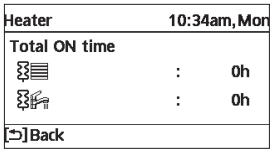
To display <Main Menu>:
To select menu:
To confirm the selected content:

Table 5-1 Menu Functions

Menu Function		Description	Default Setting	Display
FUNCTION SETUP	**Weekly Timer**	• To set up to 6 patterns of operation on a daily basis. • Once the weekly timer is set up, User can edit from Quick Menu. • Disabled if Heat-Cool SW is select "Yes" or if Force Heater is on.	**Timer setup** Select day of the week and set the patterns needed. (Time / Operation / ON/OFF / Mode) **Timer copy** Select the day of the week	
	Holiday Timer	• To save energy, a holiday period may be set to either turn OFF the system or lower the temperature during the period. • Weekly timer setting may be temporarily disabled during Holiday timer setting but it will restart once the Holiday timer is completed.	OFF	
			ON Holiday start and end.	
	Quiet Timer	• To operate quietly during the preset period. • 6 patterns may be set. • Level 0 means the mode is off.	**Time to Start Quiet** Date and time **Level of Quietness** 0-3	
	Room Heater	• To set the room heater ON or OFF.	OFF	
	Tank Heater	• To set the tank heater ON or OFF. • Available only if connected to the tank.	OFF	

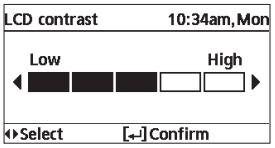
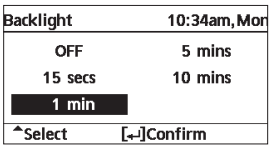
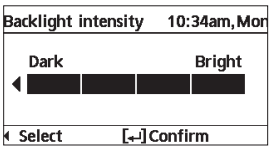
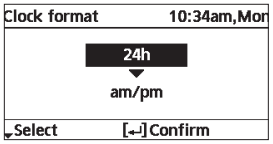
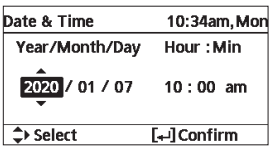
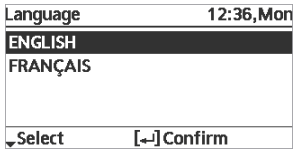
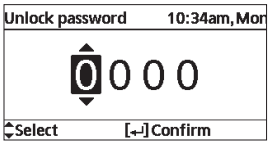
5 Location of Controls and Components

Table 5-1 Menu Functions continued

Menu Function		Description	Default Setting	Display
FUNCTION SETUP	**Sterilization**	• To set the auto sterilization ON or OFF. • Available only if connected to the tank. • Do not use the system during sterilization in order to prevent scalding with hot water, or overheating of shower. • Ask a qualified installer or service technician to determine the level of sterilization function field settings according to the local laws and regulations.	OFF	
SYSTEM CHECK	**Energy monitor**	• Present or historical chart of energy consumption, generation, or COP (Coefficient of Performance). • For historical chart, the period is selected from 1 day/1 week/1year. • Energy consumption (kWh) of heating, cooling, tank and total may be retrieved. • The total power consumption is an estimated value based on 240 VAC and may differ from value measured by precise equipment.	**Present** Select and retrieve **Historical Chart** Select and retrieve	
	System information	• Shows all system information in each area.	**Actual system information of 10 items: Inlet / Outlet / Tank / Buffer tank / COMP frequency / Pump flow rate** Select and retrieve	
	Error history	• Refer to Troubleshooting for error codes. • The most recent error code is displayed at the top.	Select and retrieve	
	Compressor	• Shows the compressor performance.	Select and retrieve	
	Heater	• Total hours of ON time for Room heater/ Tank heater.	Select and retrieve	

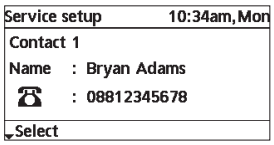
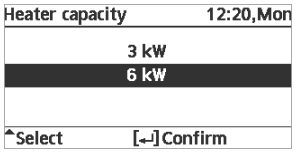
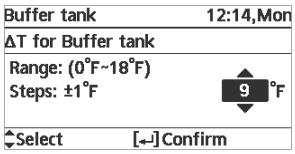
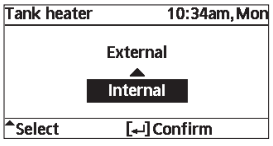
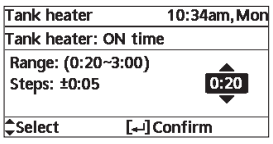
5 Location of Controls and Components

Table 5-1 Menu Functions continued

Menu Function		Description	Default Setting	Display
PERSONAL SETUP	**Touch sound**	•Turns the operation sound ON/ OFF.	ON	
	LCD contrast	•Sets the screen contrast.	3	
	Backlight	•Sets the duration of screen backlight.	1 min	
	Backlight intensity	•Sets screen backlight brightness.	4	
	Clock format	•Sets the type of clock display.	24h	
	Date & Time	•Sets the present date and time.	Year / Month / Day / Hour / Min	
	Language	•Sets the display language for the top screen.	ENGLISH / FRANCAIS	
	Unlock password	•4 digit password for all the settings.	0000	

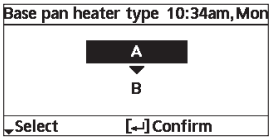
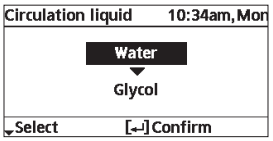
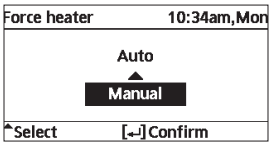
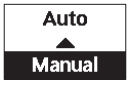
5 Location of Controls and Components

Table 5-1 Menu Functions continued

Menu Function		Description	Default Setting	Display
INSTALLER SETUP > SYSTEM SETUP	**Service Contact 1 / Contact 2**	• Preset contact number for installer	OFF	
	Heater capacity	• To reduce the heater power if unnecessary.	6 kW	
	Anti-freezing	• To activate or deactivate the water freeze prevention when the system is OFF	Yes	
	Tank connection	• To connect tank to the system.	No	
	DHW capacity	• To select tank heating capacity to variable or standard. Variable capacity heat up tank with fast mode and keep the tank temperature with efficient mode. • While standard capacity heat up tank with rated heating capacity. This option is available if Tank connection is selected (YES).	Variable	
	Buffer tank connection	• To connect tank to the system and if selected YES, to set ΔT temperature.	No	
			9°F	
	Tank heater	• To select external or internal tank heater and if External is selected, set a timer for the heater to come on. This option is available if Tank connection is selected (YES).	Internal	
			0:20	

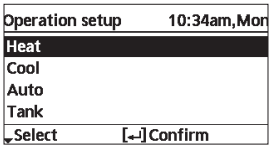
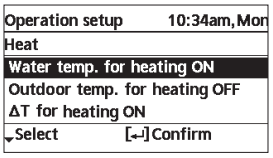
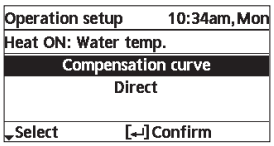
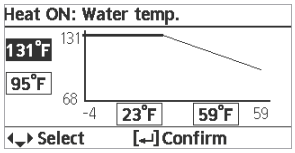
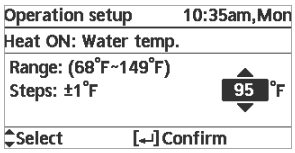
5 Location of Controls and Components

Table 5-1 Menu Functions continued

Menu Function		Description	Default Setting	Display
INSTALLER SETUP > SYSTEM SETUP	**Base pan heater**	• Type A - The base pan heater activates only during de-ice operation. • Type B -The base pan heater activates when outdoor ambient temperature is 41°F or lower.	A	
	Alternative outdoor sensor	• To select an alternative outdoor sensor.	No	
	Backup boiler	• To select to enable or disable backup boiler.	No	
	Circulation liquid	• To select whether to circulate water or glycol mixture in the system.	Water	
	Heat-Cool SW		No	
	Force heater	• To turn on Force heater either manually (by default) or automatically.	Manual	
	Force defrost	• If auto selection is set, the unit will start defrost operation if long heating hour operate during low outdoor temperature.	Manual	
	Defrost signal	• To turn on defrost signal to stop fan coil during defrost operation. If defrost signal set to Yes, Backup boiler function will not be available to use.	No	
	Pump flow rate	• To set variable flow pump control or fix pump duty control.	ΔT	

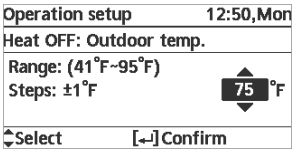
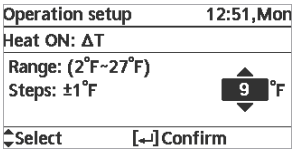
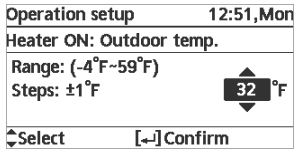
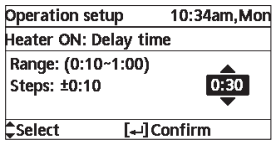
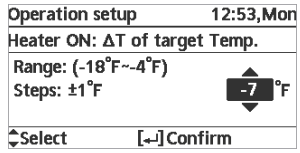
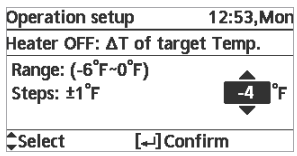
5 Location of Controls and Components

Table 5-1 Menu Functions continued

Menu Function		Description	Default Setting	Display
INSTALLER SETUP > OPERATION SETUP	**Operation Setup**	• To access to the four major functions or modes.	Heat / Cool/ Auto / Tank	
	Heat	• To set various water & ambient temperatures for heating.	Water temp. for heating ON/ Outdoor temp. for heating OFF/ ΔT for heating ON / Heater ON/ OFF	
			Water temp. for heating ON Compensation curve Heating ON temps in compensation curve or direct input	
			Compensation Curve X axis: 23°F, 59°F Y axis: 131°F, 95°F Input the 4 temperature points (2 on horizontal X axis, 2 on vertical Y axis).	
			• Temperature range: X axis: -4°F ~ 59°F, Y axis: See below. • Temperature range for the Y axis input: 1. RAH040 model: 68°F ~ 149°F • Regardless of the above setting, there is a limit to the water set temperature.	
			Water temp. for heating ON > Direct 95°F	Temperature for heating ON 
			• Min. ~ Max. range is conditional as follows: RAH040 model: 68°F ~ 149°F Regardless of the above setting, there is a limit to the water set temperature.	

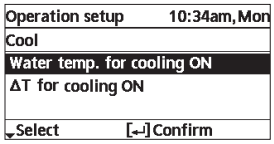
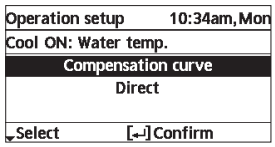
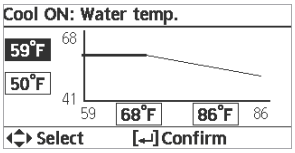
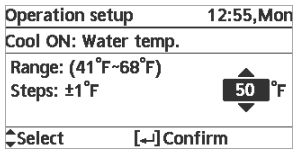
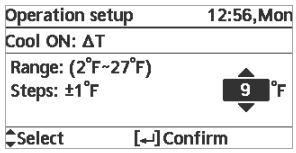
5 Location of Controls and Components

Table 5-1 Menu Functions continued

Menu Function		Description	Default Setting	Display
INSTALLER SETUP > OPERATION SETUP	**Heat**	• To set various water & ambient temperatures for heating.	**Outdoor temp. for heating OFF** 75°F	Temperature for heating OFF 
			ΔT for heating ON 9°F Set ΔT for heating ON. * This setting will not be available to set when pump flow rate set to Max. duty.	
			Heater ON/OFF	
			Heater ON/OFF> Outdoor temp. for heater ON 32°F Temperature for heater ON	
			Heater ON/OFF> Delay time for heater ON 0:30 min Delay time for heater to turn on	
			Heater ON/OFF> Water temperature for heater ON -7°F Setting of water temperature to turn on from water set temperature.	
			Heater ON/OFF> Water temperature for heater OFF -4°F Setting of water temperature to turn off from water set temperature.	

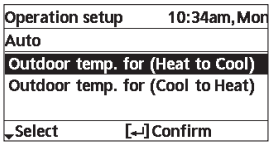
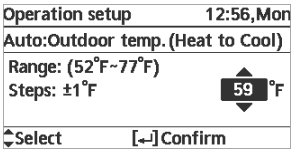
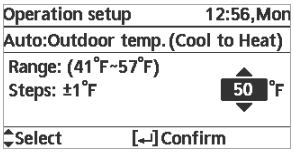
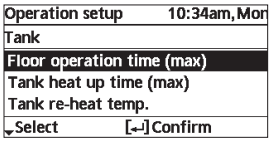
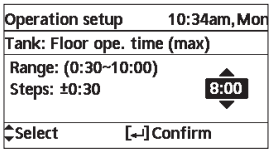
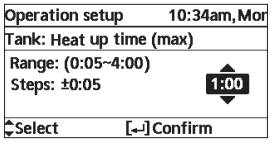
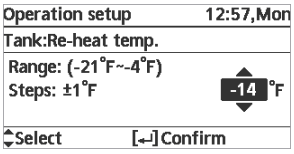
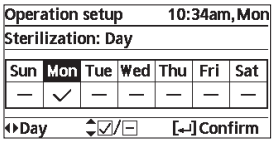
5 Location of Controls and Components

Table 5-1 Menu Functions continued

Menu Function		Description	Default Setting	Display
INSTALLER SETUP > OPERATION SETUP	**Cool**	• To set various water & ambient temperatures for cooling.	Water temperatures for cooling ON and ΔT for cooling ON.	
			Water temp. for cooling ON Cooling ON temperatures in compensation curve or direct input.	
			Water temp. for cooling ON > Compensation Curve X axis: 68°F, 86°F Y axis: 59°F, 50°F Input the 4 temperature points (2 on horizontal X axis, 2 on vertical Y axis)	
			Water temp. for cooling ON > Direct 50°F Set temperature for Cooling ON	
			ΔT for cooling ON 9°F Set ΔT for cooling ON * This setting will not be available to set when pump flowrate set to Max. duty.	

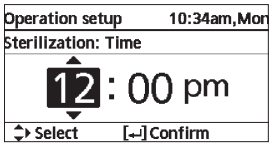
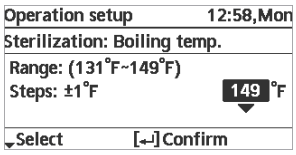
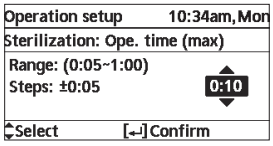
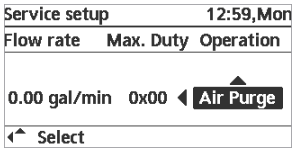
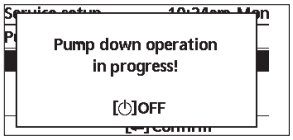
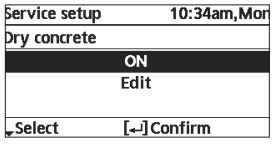
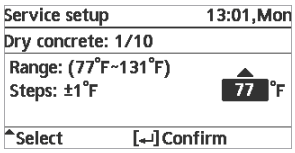
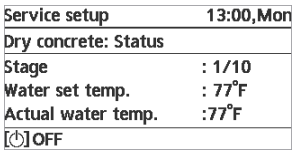
5 Location of Controls and Components

Table 5-1 Menu Functions continued

Menu Function		Description	Default Setting	Display
INSTALLER SETUP > OPERATION SETUP	**Auto**	• Automatic switch from Heat to Cool or Cool to Heat.	Outdoor temperatures for switching from Heat to Cool or Cool to Heat. Outdoor temp. for (Heat to Cool) / Outdoor temp. for (Cool to Heat)	
			Outdoor temp. for (Heat to Cool) 59°F Set outdoor temperature for switching from Heat to Cool.	
			Outdoor temp. for (Cool to Heat) 50°F Set outdoor temperature for switching from Cool to Heat.	
	Tank	• Setting functions for the tank. • Available only if connected to the tank.	Floor operation time (max) / Tank heat up time (max) / Tank re-heat temp. / Sterilization The display will show 3 functions at a time.	
			Floor operation time (max) 8:00 Maximum time for floor operation (in hours and minutes)	
			Tank heat up time (max) 1:00 Maximum time for heating the tank (in hours and minutes)	
			Tank re-heat temp. -14°F Set temperature to perform re-heat of tank water.	
			Sterilization Monday Sterilization may be set for 1 or more days of the week. Sun / Mon / Tue / Wed / Thu / Fri / Sat	

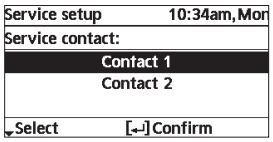
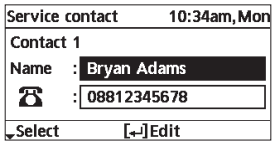
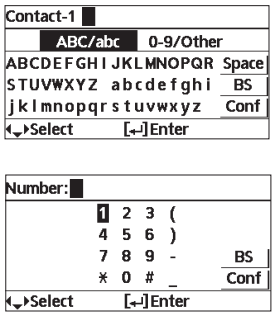
5 Location of Controls and Components

Table 5-1 Menu Functions continued

Menu Function		Description	Default Setting	Display
INSTALLER SETUP > OPERATION SETUP	**Tank**	• Automatic switch from Heat to Cool or Cool to Heat.	**Sterilization: Time** 12:00 Time of the selected day(s) of the week to sterilize the tank 0:00 ~ 23:59	
			Sterilization: Boiling Temp 149°F Set boiling temperatures for sterilize the tank.	
			Sterilization: Ope. time (max) 0:10 Set sterilizing time (in hours and minutes)	
INSTALLER SETUP > SERVICE SETUP	**Pump maximum speed**	• To set the maximum speed of the pump.	Setting the flow rate, max. duty and operation ON/OFF of the pump. Flow rate: XX:X gal/min Max. Duty: 0x40 ~ 0xFE, Pump: ON/OFF/Air Purge	
	Pump down	• To set the pump down operation.	**Pump down operation** ON	
	Dry Concrete	• To dry the concrete (floor, walls, etc.) during construction. • Do not use this menu for any other purposes and in period other than during construction	Edit to set the temperature of dry concrete. ON / Edit	
			Edit Stages: 1 Temperature: 77°F Heating temperature for drying the concrete. Select the desired stages: 1 ~ 10, range: 1 ~ 99	
			ON Confirm the setting temperatures of dry concrete for each stage.	

5 Location of Controls and Components

Table 5-1 Menu Functions continued

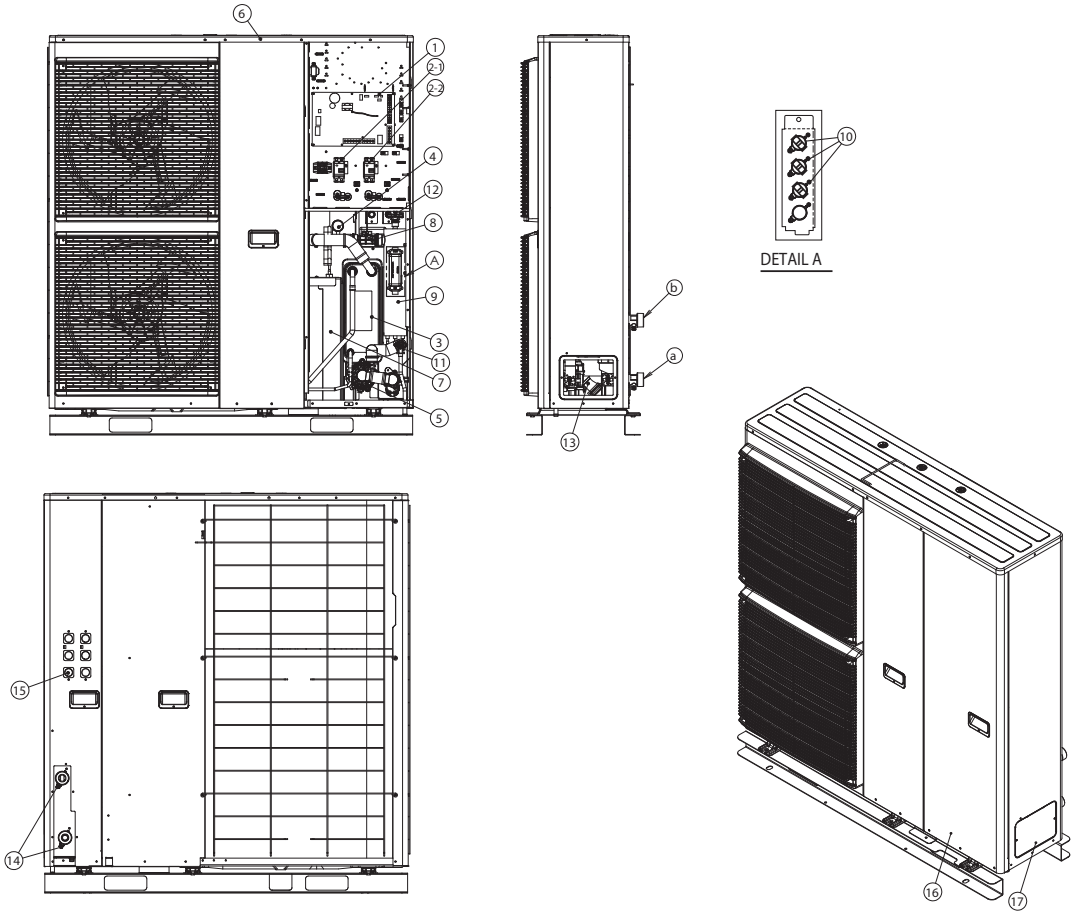
Menu Function		Description	Default Setting	Display
INSTALLER SETUP > SERVICE SETUP	**Service contact**	• To set up to 2 contact names and numbers for the User.	Service engineer's name and contact number. Contact 1 / Contact 2	
			Contact 1 / Contact 2 Contact name or number. Name / phone icon	
			Input name and number Contact name: alphabet a ~ z. Contact number: 1 ~ 9	

5 Location of Controls and Components

Main Components

1. **Printed Circuit Board**
   Used to control the unit function
2. **Single phase Residual Current Circuit Breaker**
   Used to protect the electrical components.
3. **Heat exchanger**
   A brazed plate heat exchanger used to transfer energy between refrigerant and the liquid medium used in the system.
4. **Water pressure gauge**
   Used to measure the internal water pressure of the unit.
5. **Water pump**
   A pump used to circulate the liquid medium through the unit.
6. **Cabinet top plate**
   The top cover for the unit.
7. **Expansion vessel**
   A component used to compensate for pressure fluctuations in the liquid piping.
8. **Flow sensor**
   A component used to measure the flow rate of the liquid medium moving through the unit.
9. **Heater assembly**
   An assembly consisting of two 3kW heating elements.
10. **Overload protector**
    OLP is used to protect the heating elements and electrical components from abnormal power consumption.
11. **Pressure relief valve**
    Used to relieve pressure in the water system when the systems maximum pressure is surpassed.
12. **Air purge valve**
    Used to dispose of any air pockets in the pressurized water system. Ensures proper fluid flow through the unit.
13. **Water filter set**
    A magnetic filter used to protect the water system from harmful particulate.
14. **Plug (2 pieces)**
    Used to keep unwanted particulate out of water piping during shipping.
15. **Bushing (6 pieces)**
    Used to help ensure wires are not cut by sheet metal when protruding into the unit PCB.
16. **Cabinet front plate**
    The front cover for the unit..
17. **Cover**
    The service port cover for the water system.
18. **Water inlet**
    The port of the unit where water is received by the unit.
19. **Water outlet**
    The port of the unit where water is expelled by the unit.

It is advisable to avoid more than 2 blockage directions. For better ventilation & multiple-outdoor installation, please consult a qualified installer or service technician.



6 Dimensions

Figure 6-1 *Unit Dimensions - Front & back view*

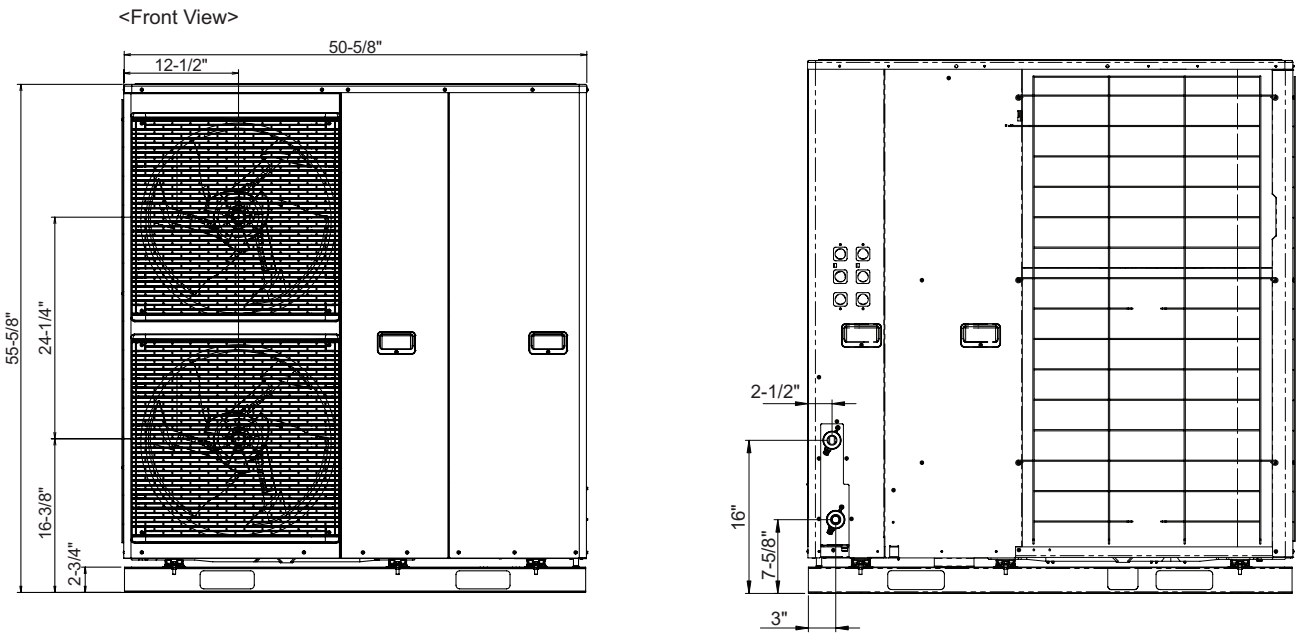
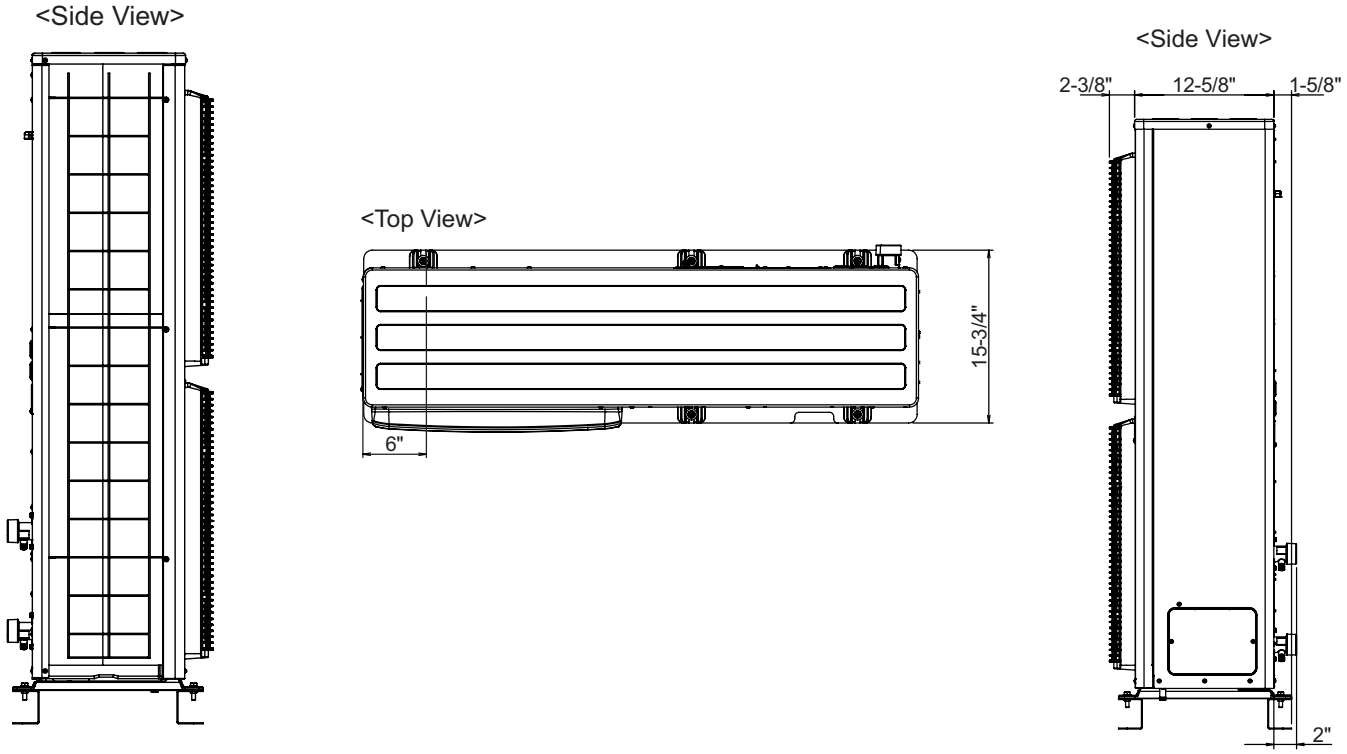
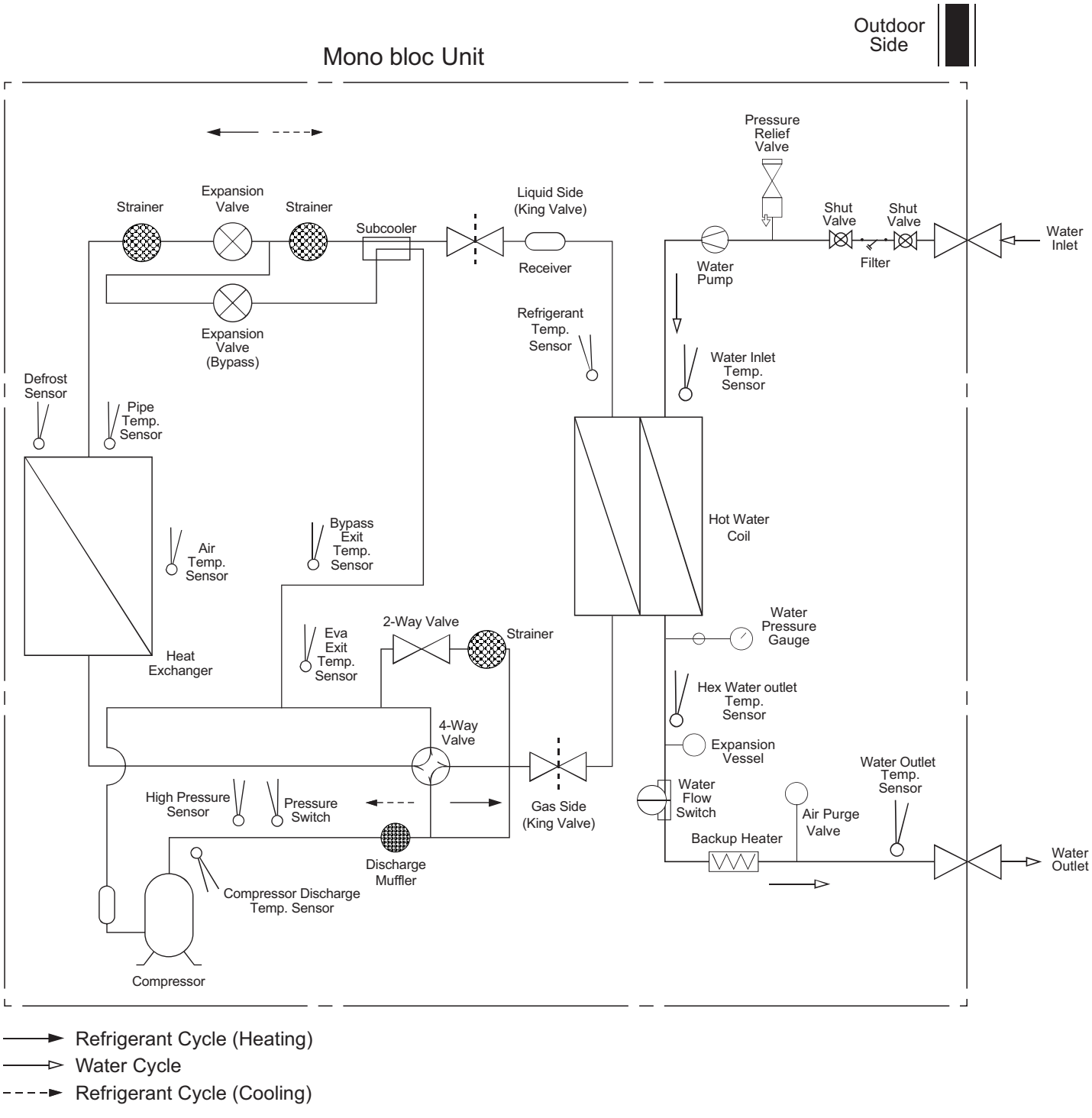


Figure 6-2 *Unit Dimensions - Side & top view*



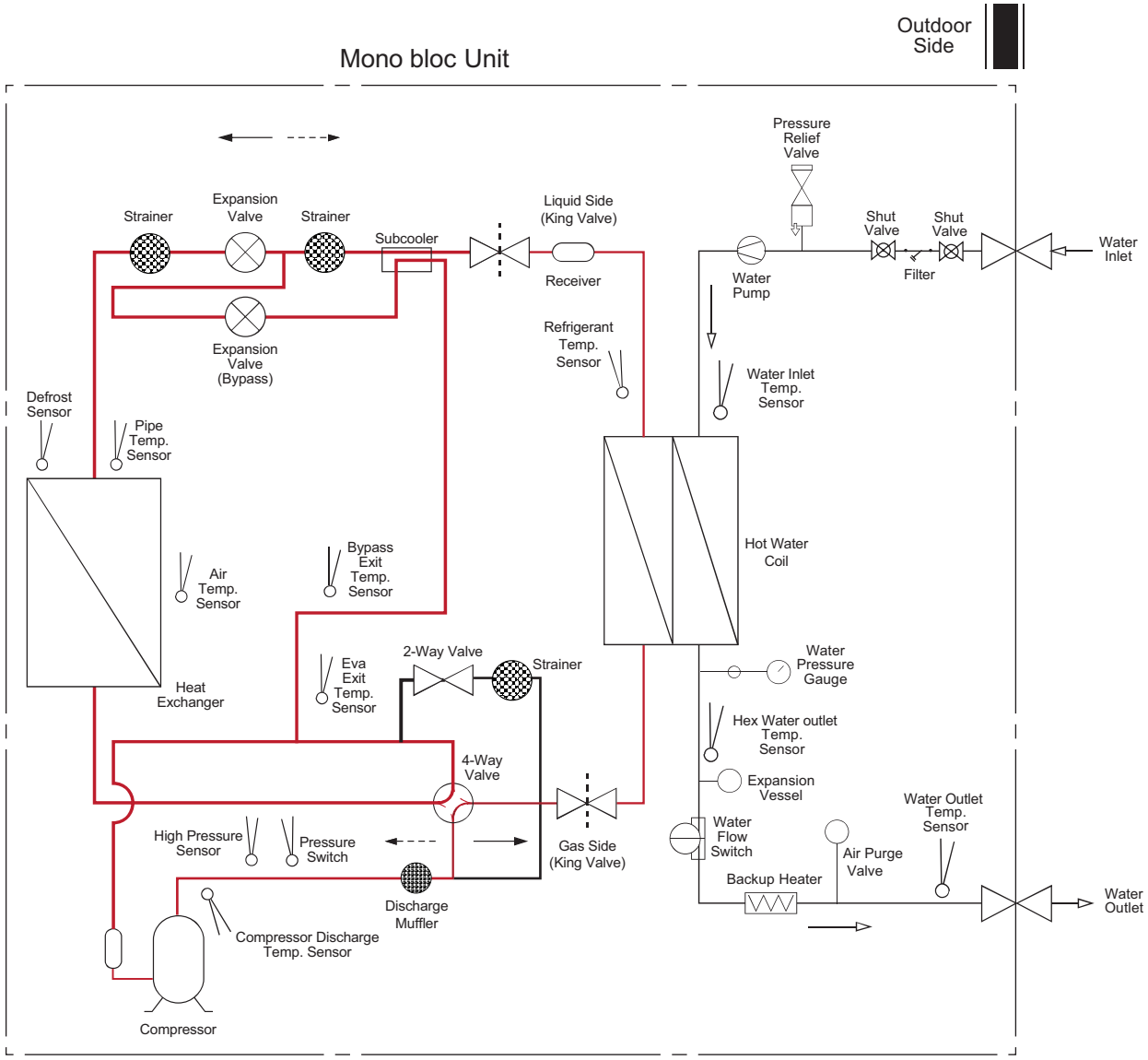
7 Diagrams

Figure 7-1 *Refrigeration and Water Cycle Diagram*



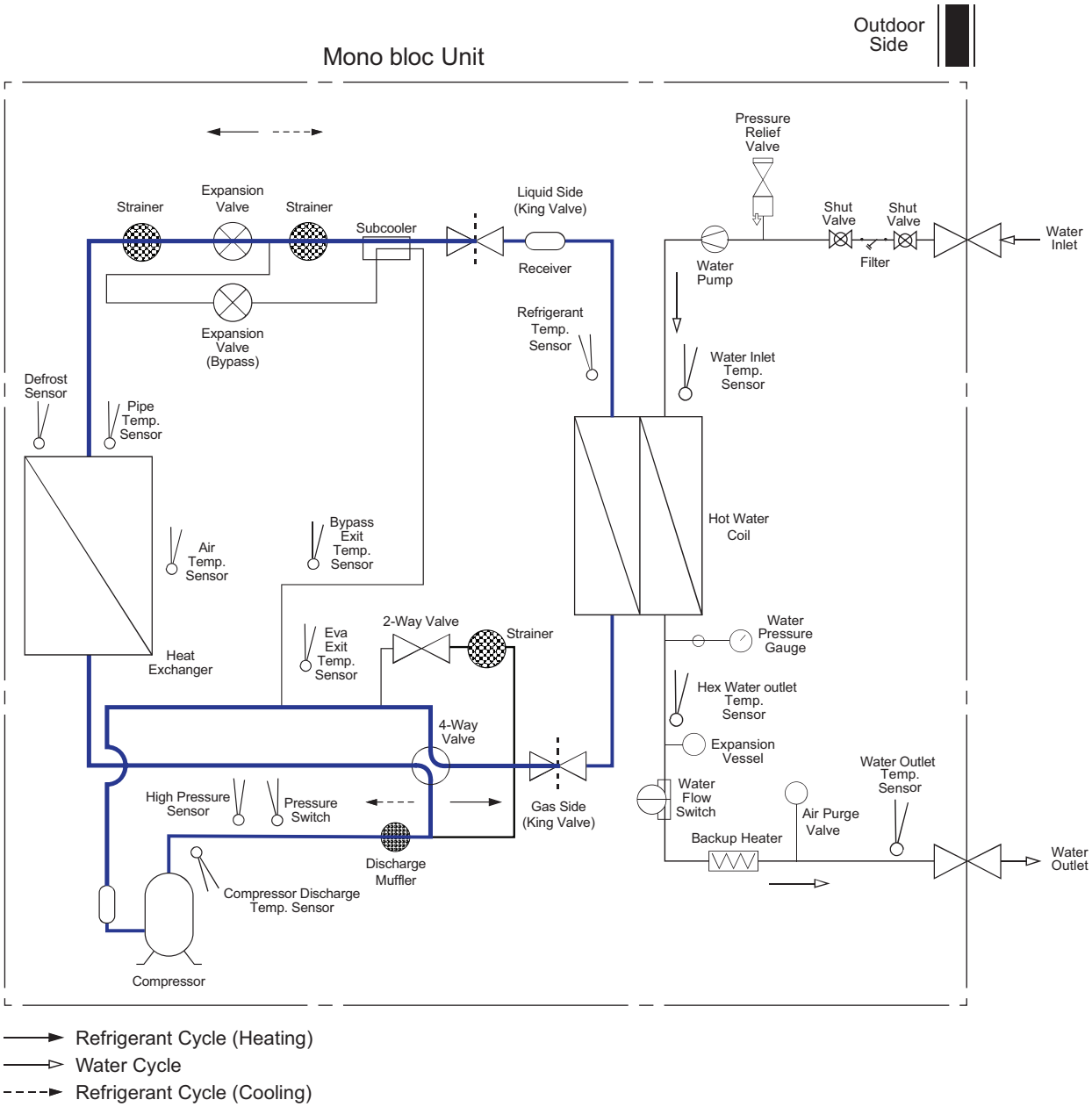
7 Diagrams

Figure 7-2 *Refrigeration and Water Cycle Diagram - Heating Loop*



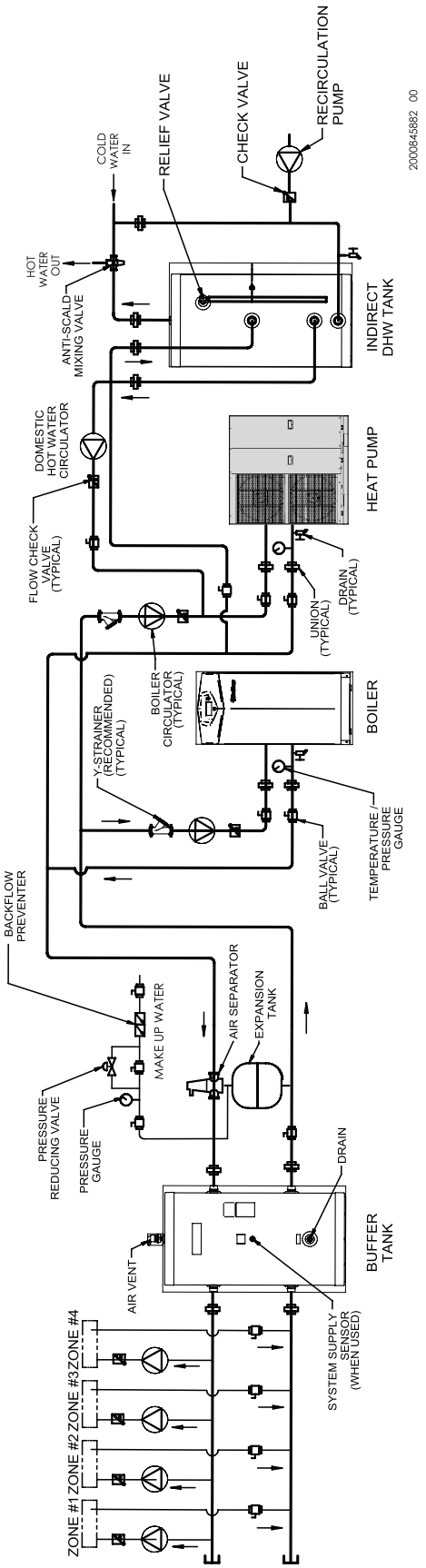
7 Diagrams

Figure 7-3 *Refrigeration and Water Cycle Diagram - Cooling Loop*



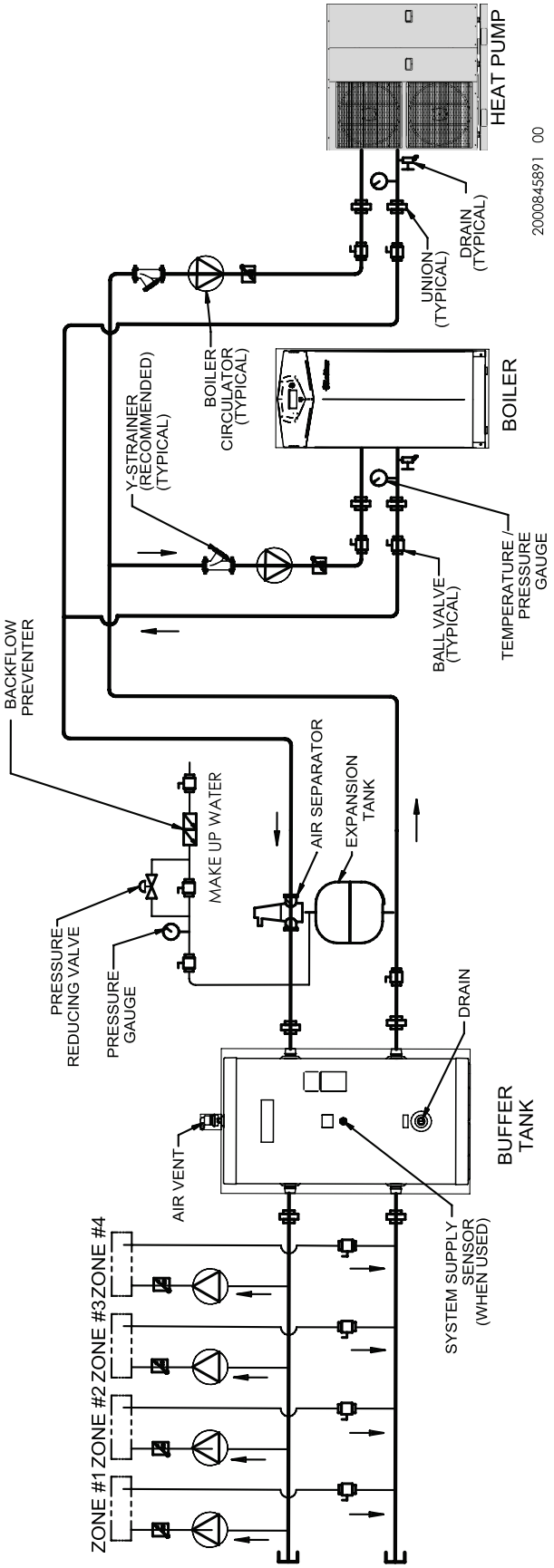
7 Diagrams

Figure 7-4 *Optional Piping System*



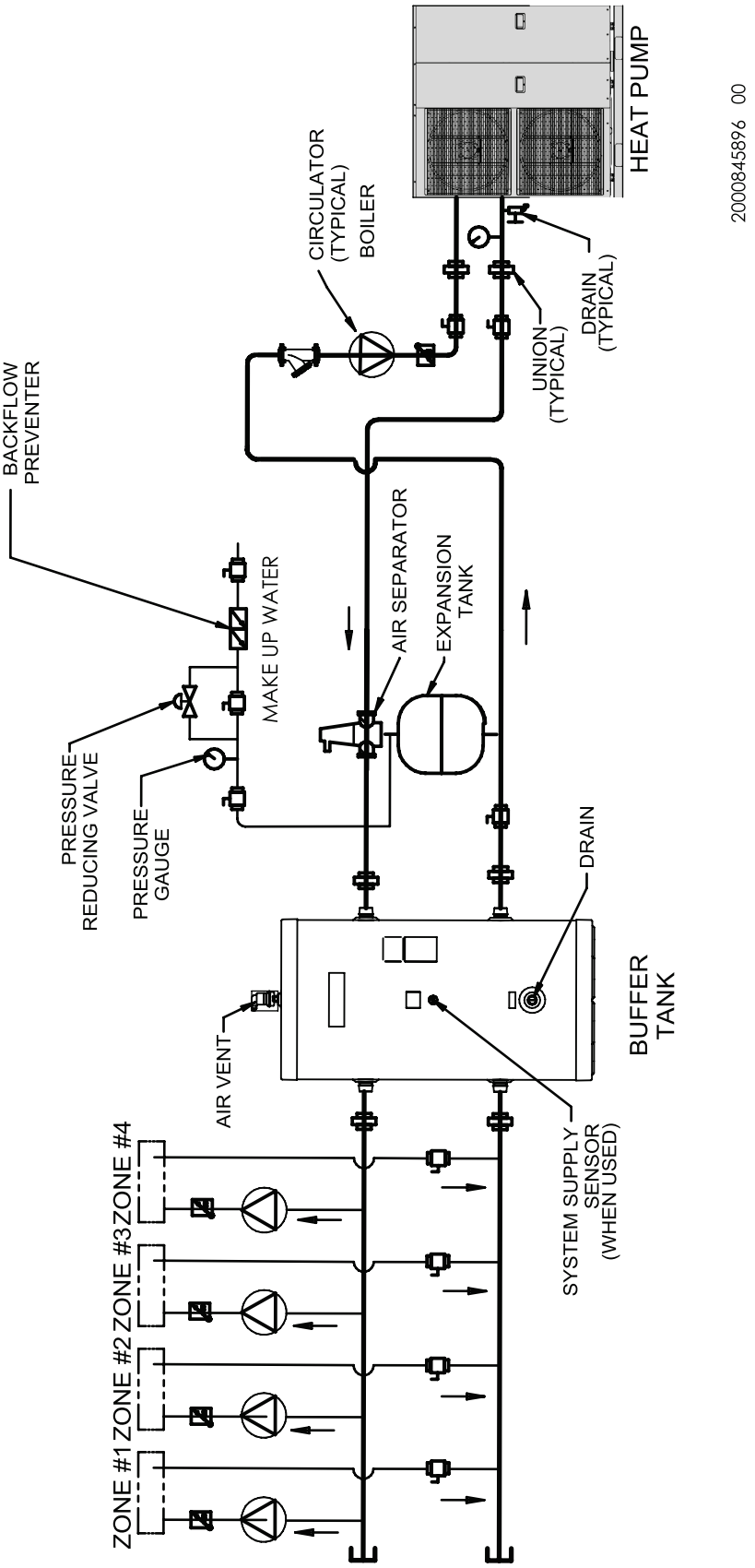
7 Diagrams

Figure 7-5 *Indirect Tank Piping System*



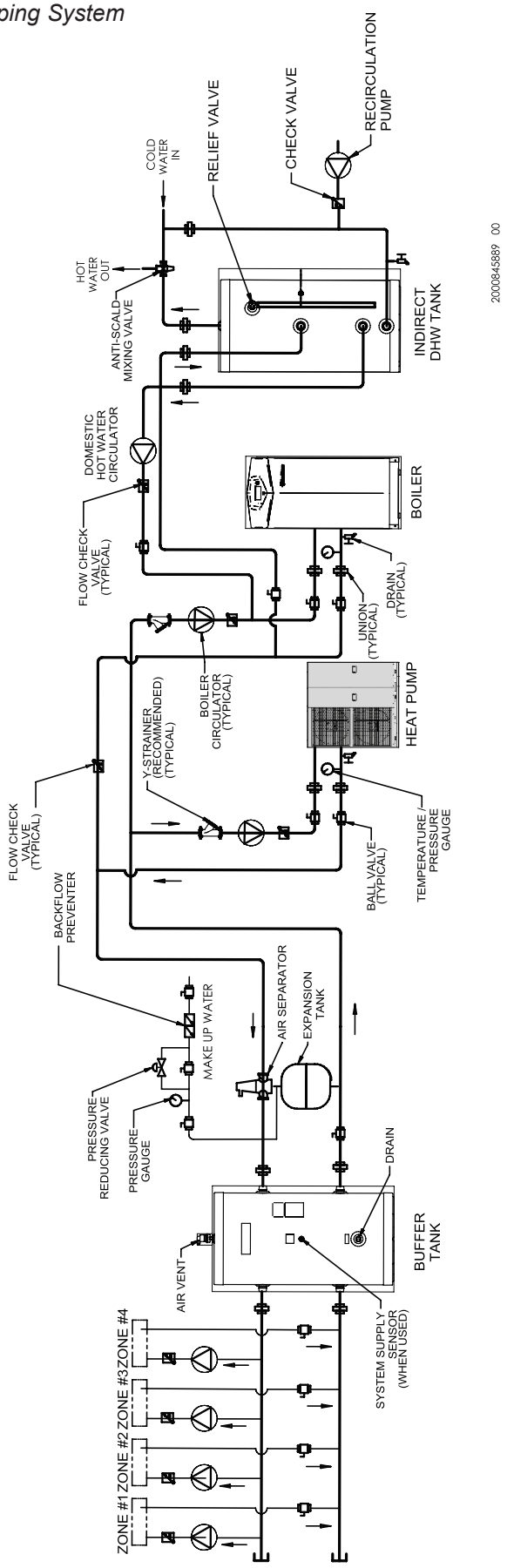
7 Diagrams

Figure 7-6 *No Boiler, No Indirect Tank Piping System*



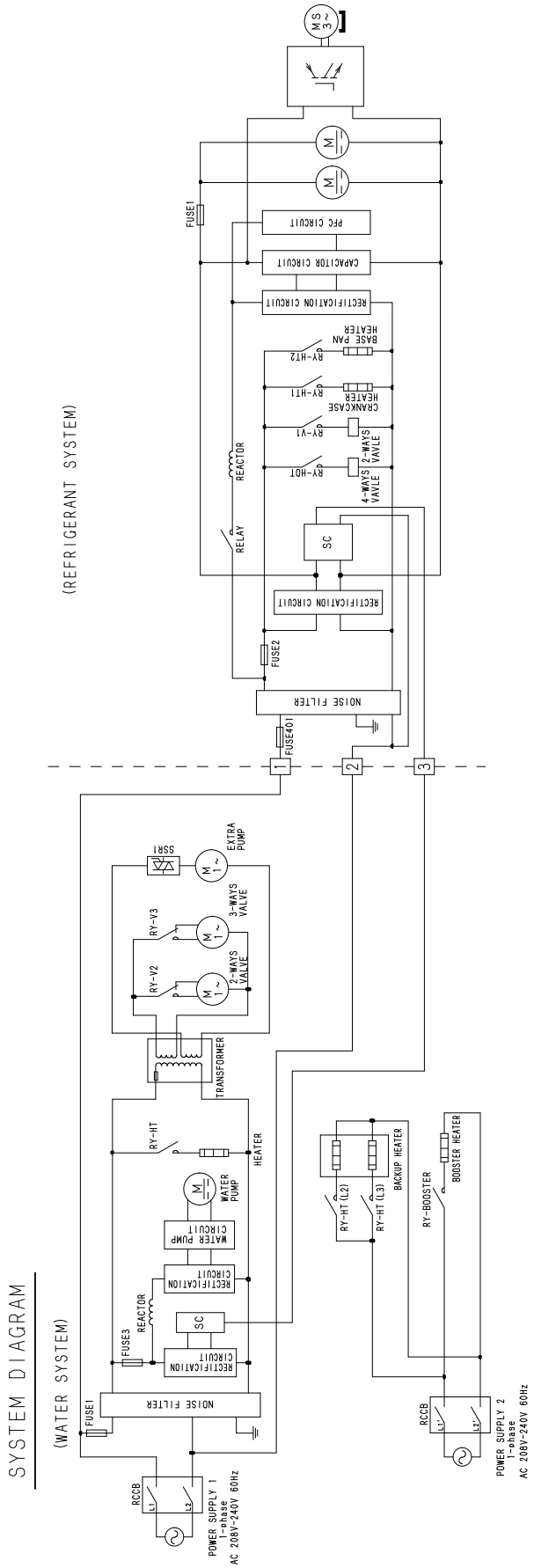
7 Diagrams

Figure 7-7 *Indirect DHW Piping System*



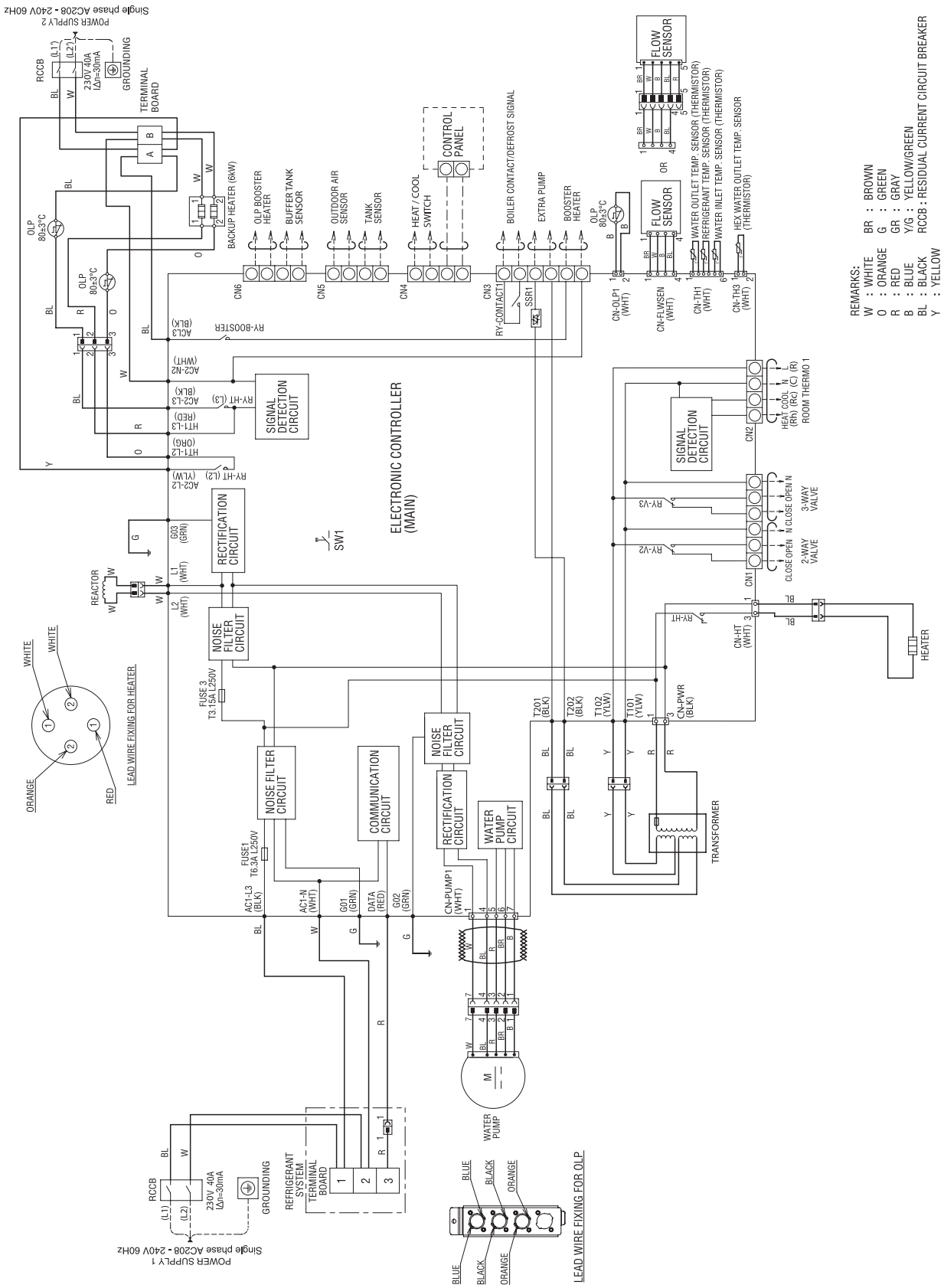
7 Diagrams

Figure 7-8 *Block Diagram*



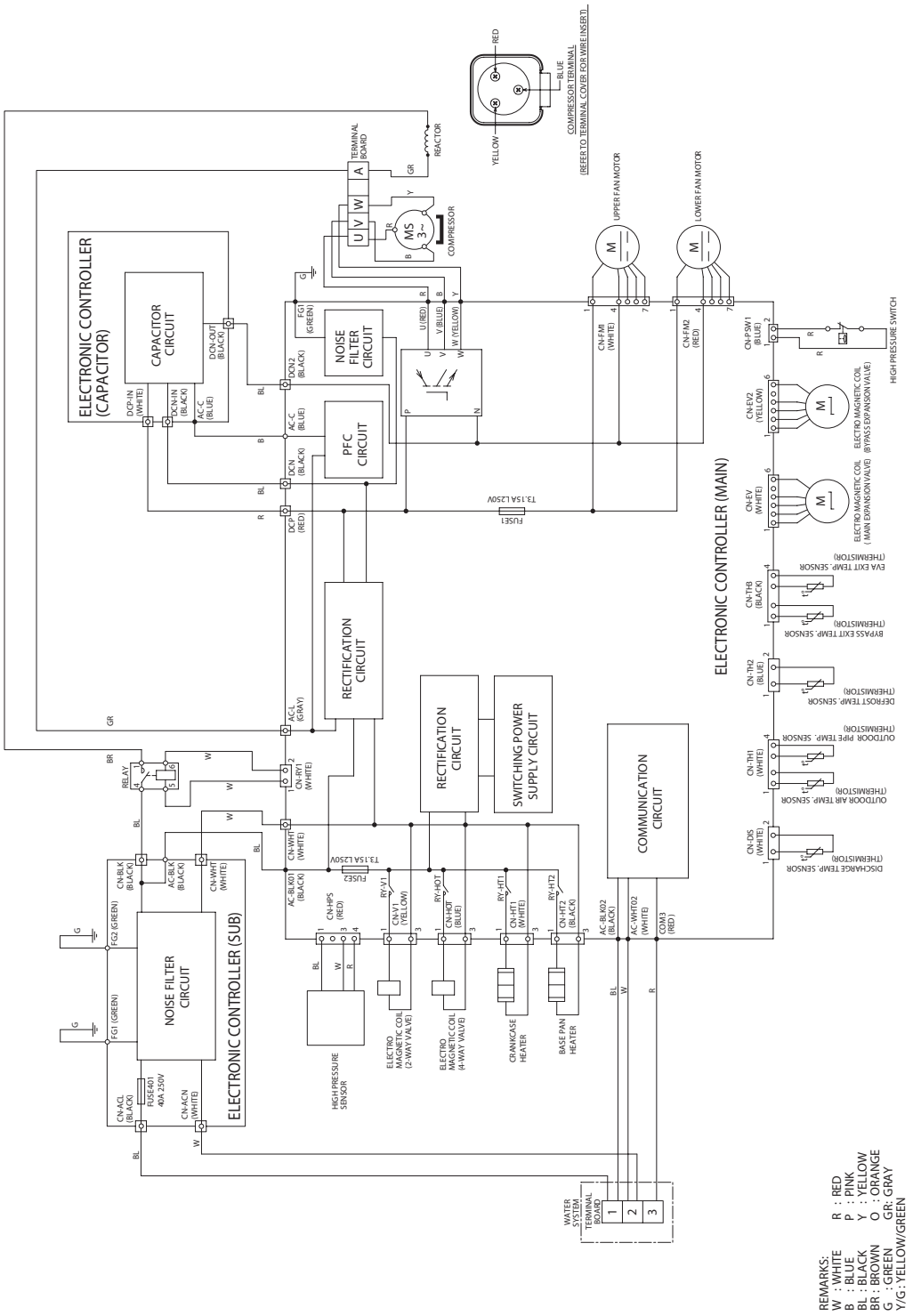
7 Diagrams

Figure 7-9 *Wiring Diagram - Water System*



7 Diagrams

Figure 7-10 *Wiring Diagram - Refrigerant System*

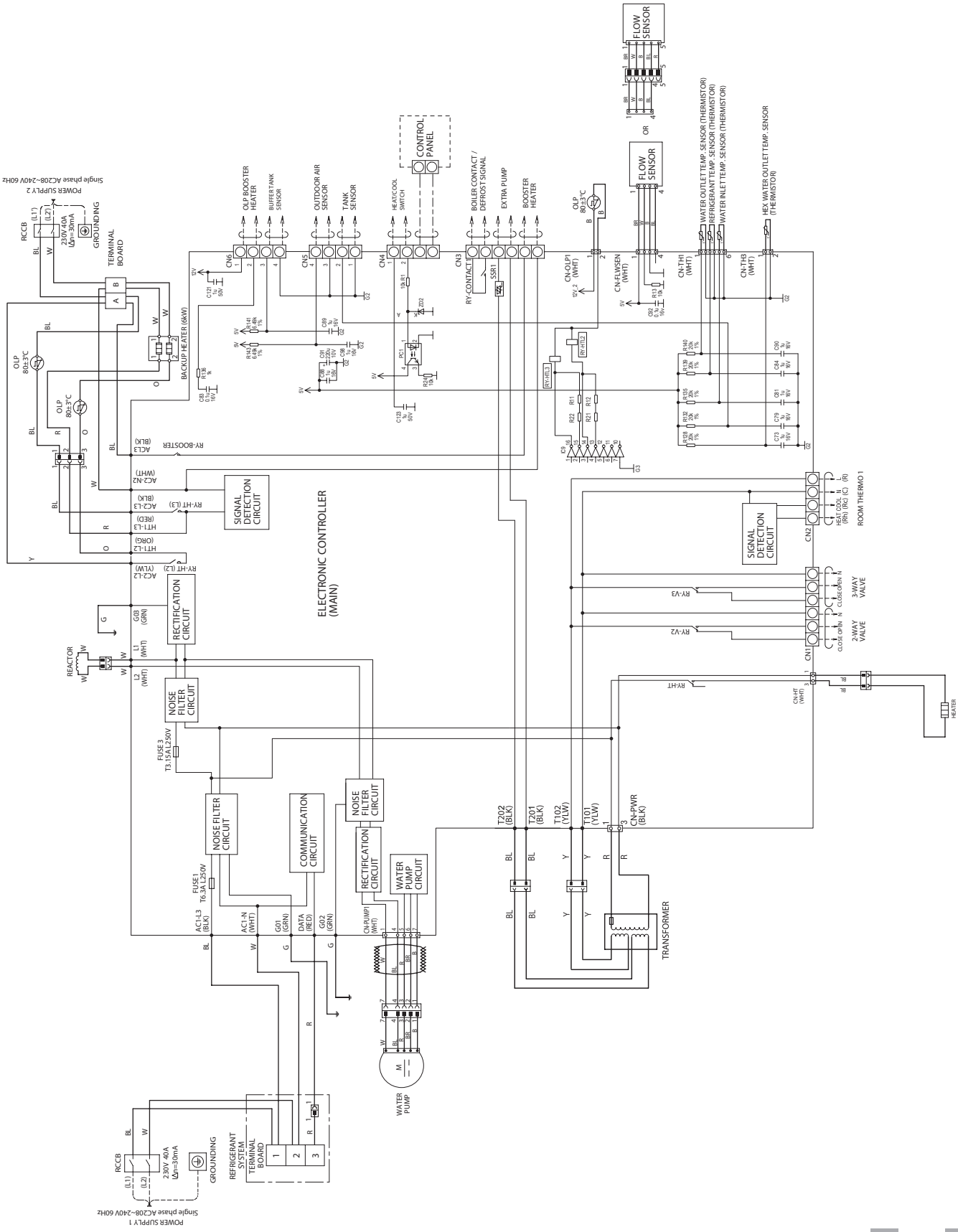


⚠ CAUTION / ATTENTION

DUE TO HIGH VOLTAGE, DO NOT TOUCH THE TERMINALS IN THE CONTROL BOARD DURING OPERATION AND 5 MINUTES AFTER SWITCHING OFF. NEXT, CONFIRM THE VOLTAGE BETWEEN RECTIFICATION DIODE BRIDGE (+) AND (-) HAS DROPPED TO BELOW 42V, BEFORE ACCESSING THE TERMINALS IN THE CONTROL BOARD.

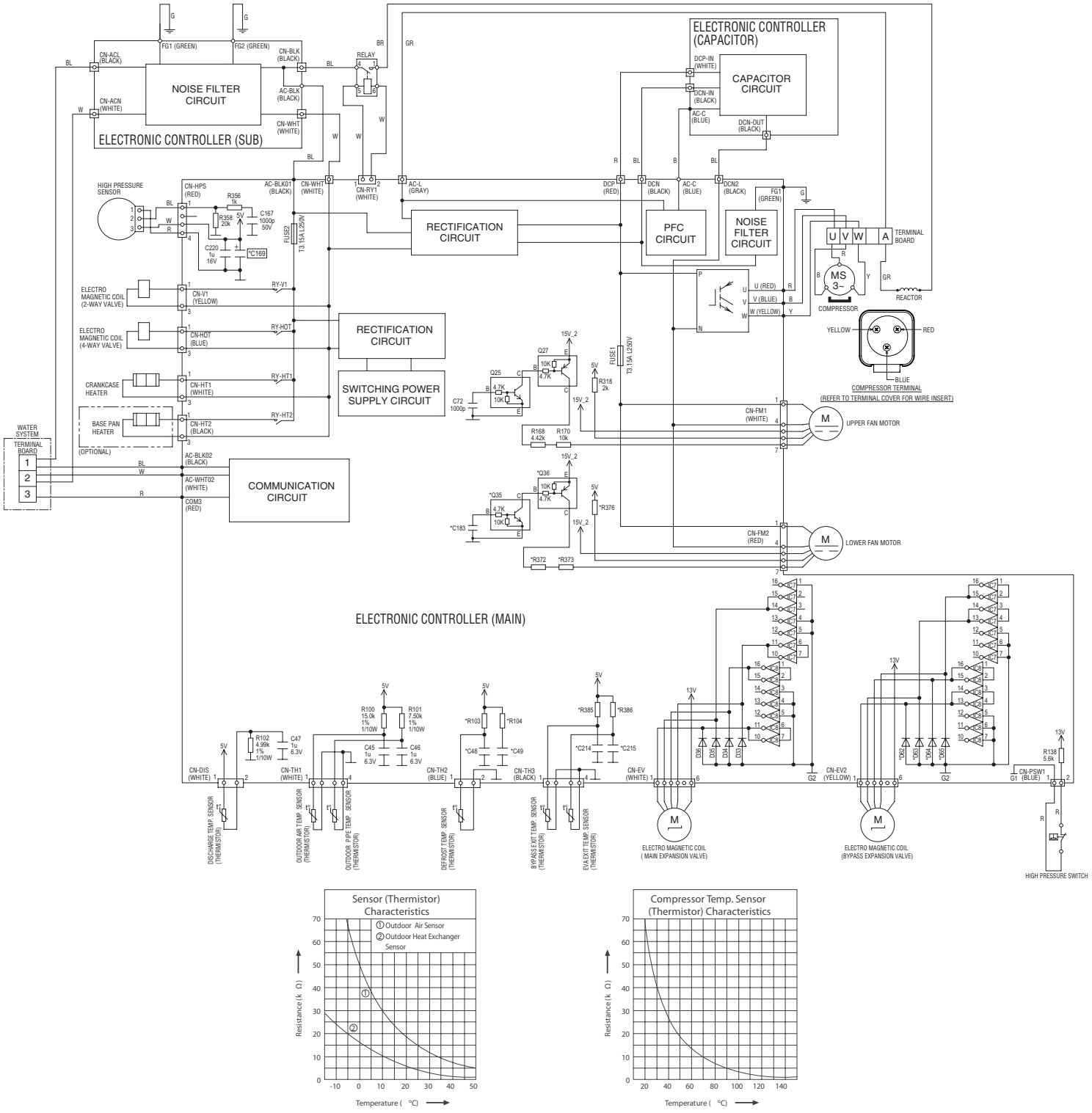
7 Diagrams

Figure 7-11 *Electronic Circuit Diagram - Water System*



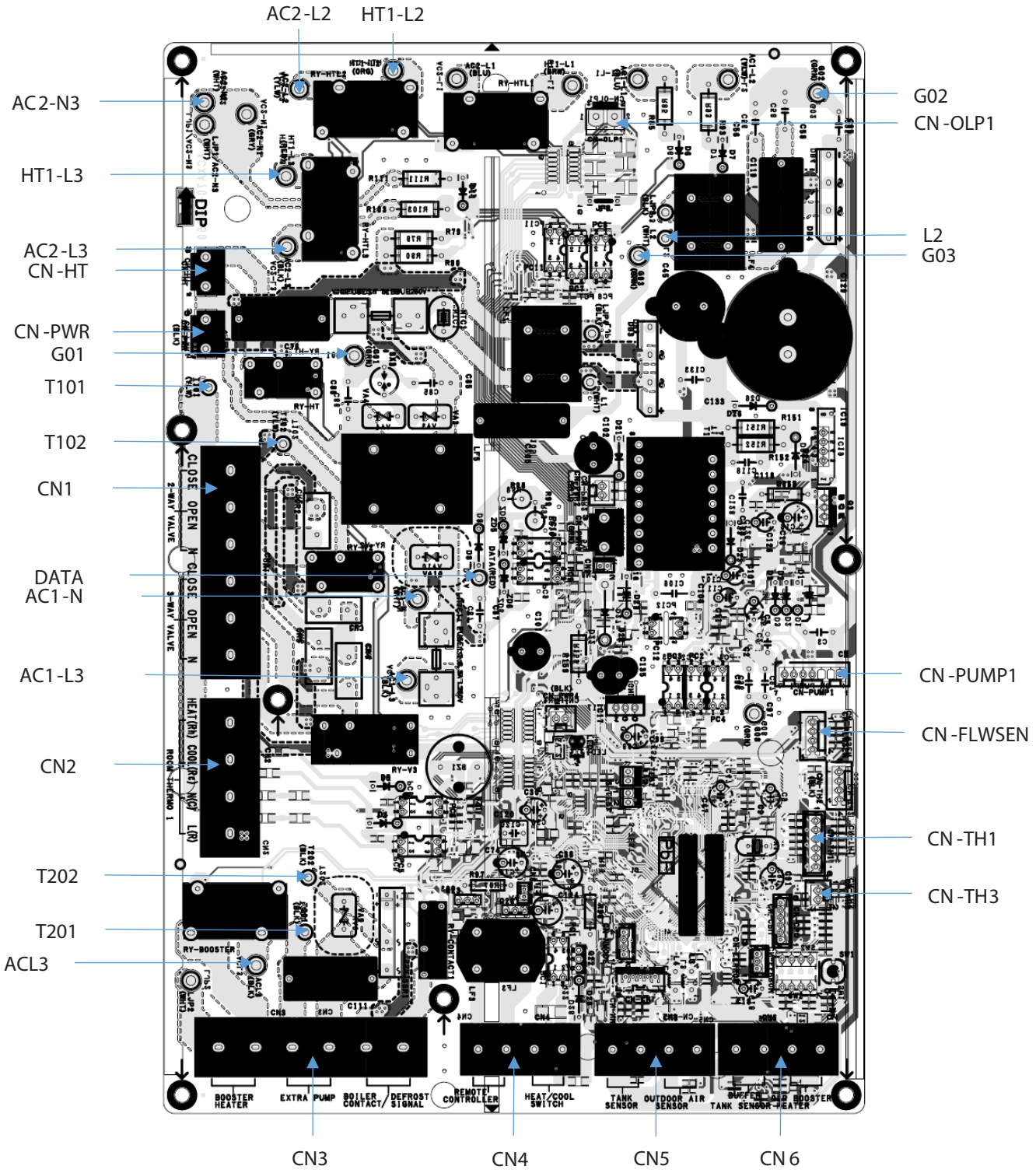
7 Diagrams

Figure 7-12 *Electronic Circuit Diagram - Refrigerant System*



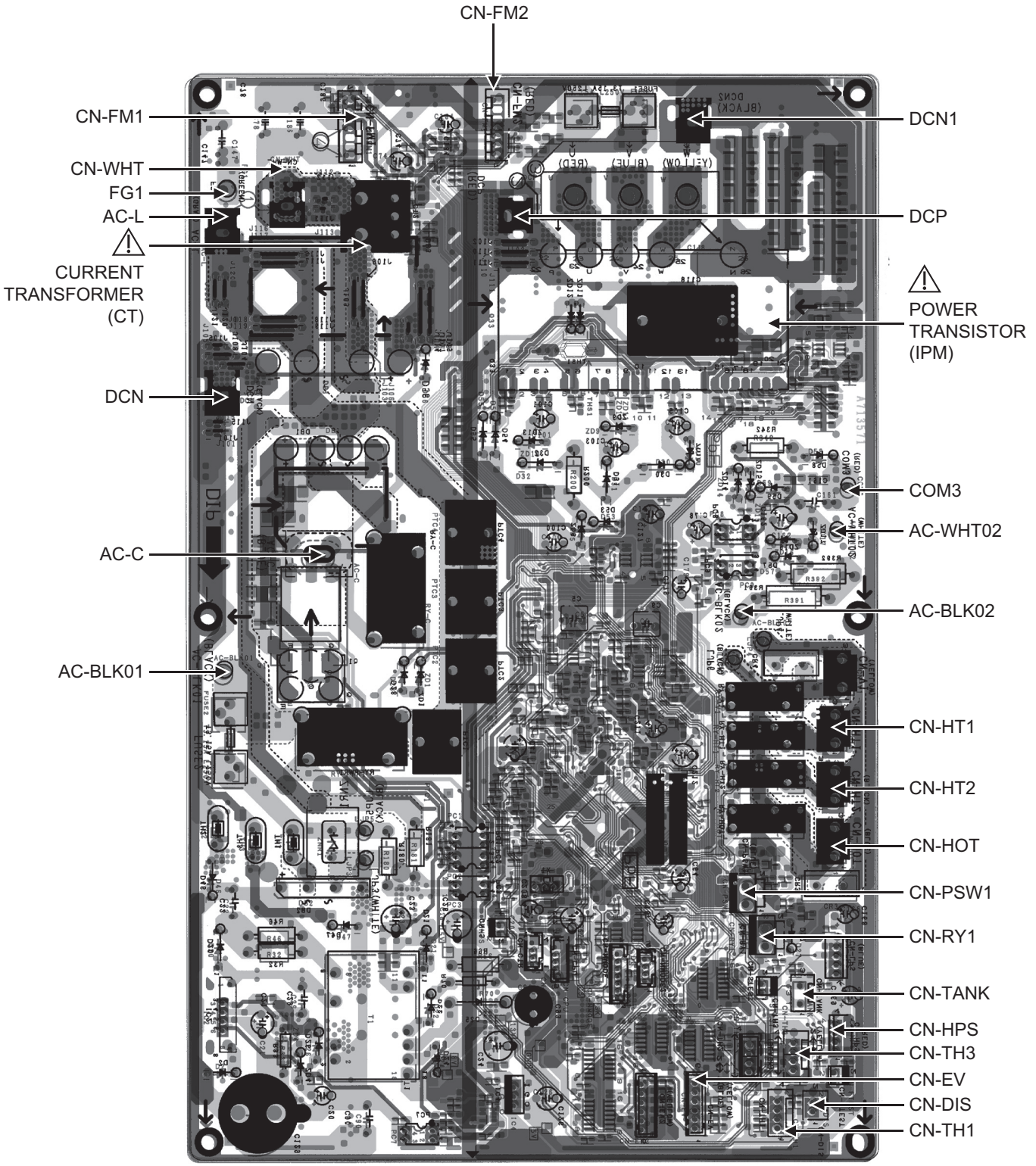
8 Circuit Boards

Figure 8-1 *Main Circuit Board - Water System*



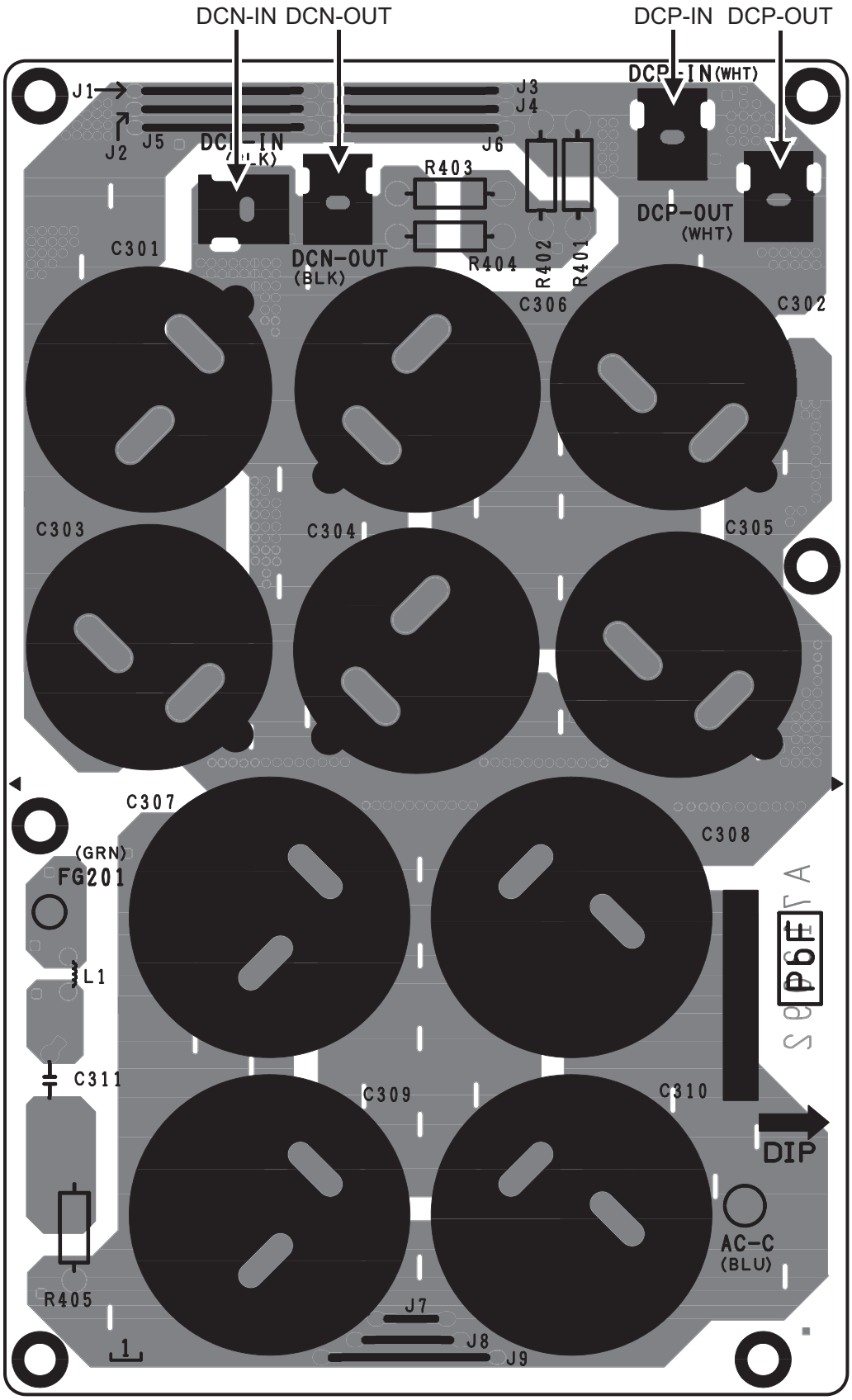
8 Circuit Boards

Figure 8-2 *Main Circuit Board - Refrigeration System*



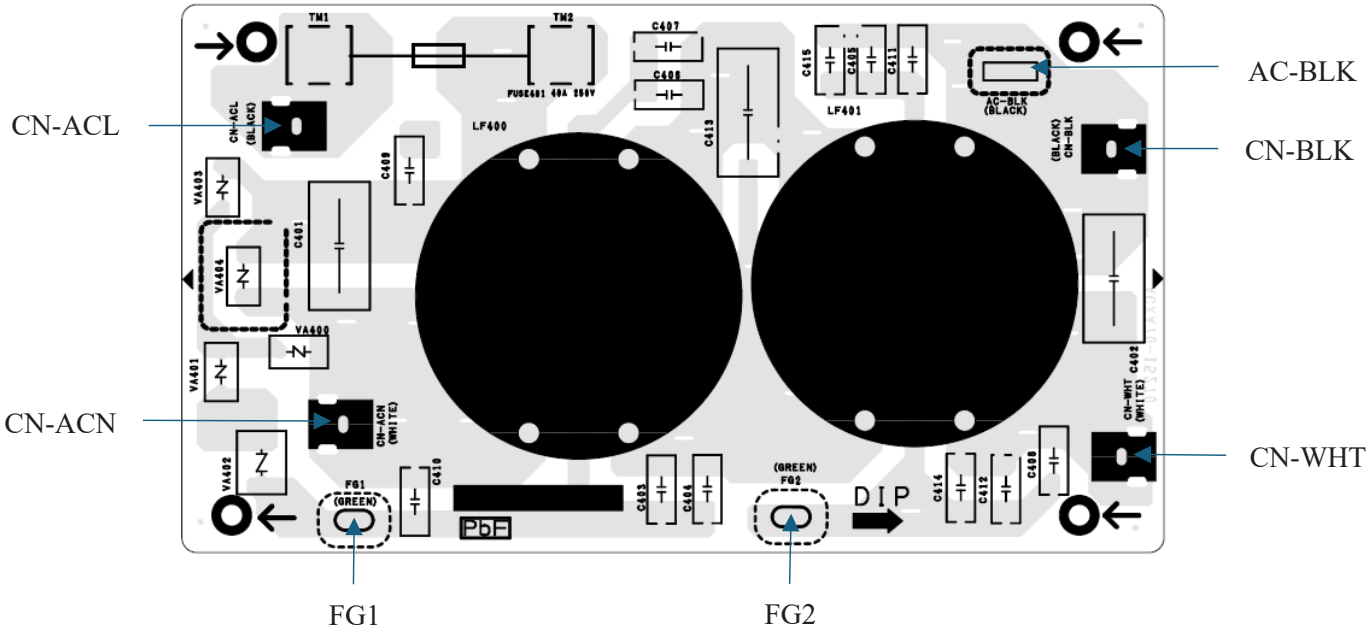
8 Circuit Boards

Figure 8-3 *Capacitor Circuit Board*



8 Circuit Boards

Figure 8-4 *Noise Filter Circuit Board*



9 Installation

Handling of the Mono bloc unit

The Mono bloc unit is a large and heavy unit. The handling of the unit is only to be done by lifting tools with slings. These slings can be fitted into sleeves at the unit's base frame.

Select the best location

Install the Mono bloc unit in outdoor locations only. Avoid installations in areas where the ambient temperature may drop below -4°F. The Mono bloc unit must be installed on a flat, solid surface. The installation place must be removed from any heat source or steam which may effect the operation of the Mono bloc unit.

The Mono bloc unit must be installed:

- In a place where air circulation is good.
- In a place where drainage can be easily done.
- In a place where Mono bloc unit's operation noise will not cause discomfort to the user.
- In a place which is accessible for maintenance.
- In a place where flammable gas leaking might not occur.
- In a place where the Mono bloc unit's piping and wiring lengths come within reasonable ranges.

Be sure to keep minimum distance of spaces as illustrated in Figure 9-1, from the wall, ceiling, or other obstacles.

If an awning is built over the unit to prevent direct sunlight or rain, be careful that heat radiation from the condenser is not obstructed. Do not place any obstacles which may cause a short circuit of the discharged air. Avoid installing the Mono bloc unit at a location where the suction side may be exposed directly to wind.

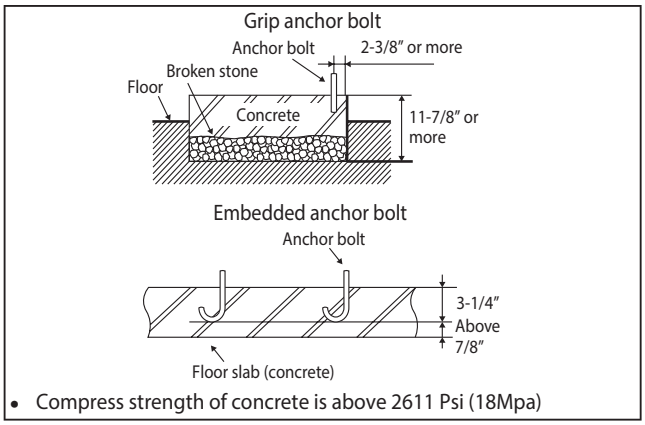
If the Mono bloc unit installed near the sea, a region with high content of sulphur, or an oily location (e.g. machinery oil, etc.), its lifespan may be shortened.

When installing the product in a place where it will be affected by typhoon or strong wind such as wind blowing between buildings, including the rooftop of a building and a place where there is no building in surroundings, fix the product with an overturn prevention wire, etc.

Mono bloc unit installation

Mono bloc unit will become heavy when filled with water. Please install the unit on a strong concrete floor and consider the weight of the unit and water. Fix Mono bloc unit on the concrete floor with 7/16" - 20 UNF anchor bolt at 4 locations. The pull-out strength of these anchor bolts must be above 3372 lbf (15000N).

Figure 9-1 *Grip anchor vs Embedded anchor*



- Compress strength of concrete is above 2611 Psi (18Mpa)

Disposal of Mono block unit drain water

When a Drain elbow is used, please ensure to follow below:

- The unit should be placed on a stand which is taller than 2 inches.
- Cover the 8 holes (ø7/8 inches) with Rubber cap (refer to illustration below)
- Use a tray (field supply) when necessary to dispose the Mono bloc unit drain water.

If the unit is used in an area where the temperature falls below 32°F for 2 or 3 consecutive days, it is recommended not to use the Drain elbow and Rubber cap. If used, the drain water freezes and the fan will not rotate.

Figure 9-2 *Unit drain*

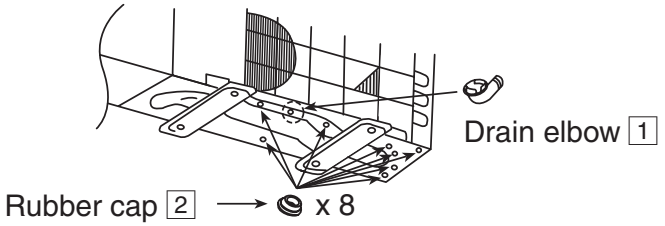


Table 9-1 *Attached Accessories*

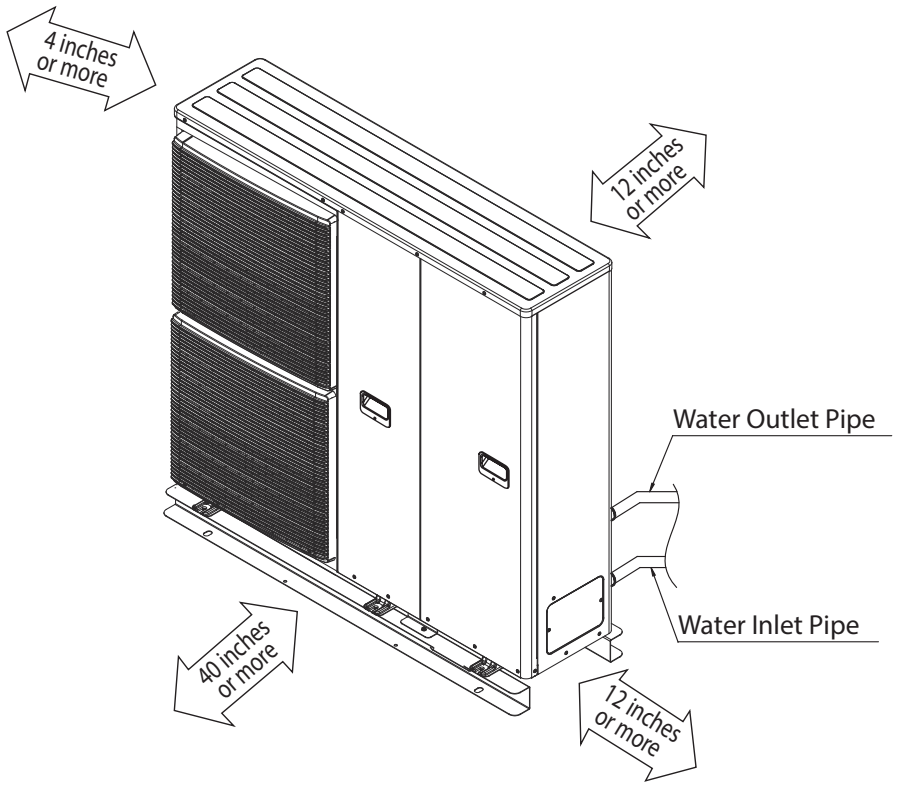
No.	Accessories Part	Qty.
1	Drain elbow	1
2	Rubber cap	8
3	Remote controller	1
4	Outdoor sensor	1
5	Tank sensor	1
6	Buffer tank sensor	1

9 Installation

Table 9-2 *Field Supplied Accessories (Optional)*

No.	Part	Specification
i	two-way valve	20 - 30VAC, 0.5A
ii	three-way valve	20 - 30VAC, 0.5A
iii	Room thermostat	20 - 30VAC, 2VA (0.15A)
v	Extra pump	110-130VAC, 0.54A

Figure 9-3 *Minimum distance for installation*



9 Installation

Piping installation

⚠WARNING This section is for authorized and licensed electrician / water system installers only. Work behind the cabinet front plate secured by screws must only be carried out under supervision of qualified installer or service technician.

Typical Piping Installation

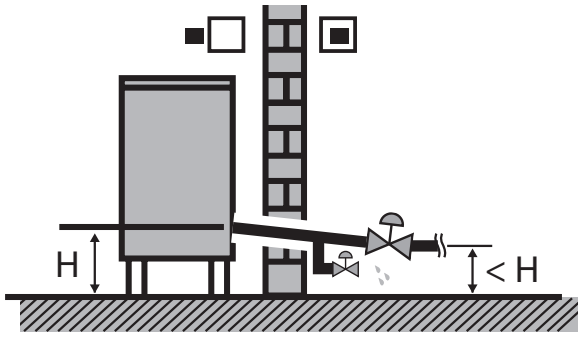
A qualified installer or service technician should install this water circuit.

This water circuit must comply with relevant national regulations, and local building regulation codes. Ensure the components installed in the water circuit could withstand water pressure during operation. Do not apply excessive force to piping that may damage the pipes. Use Rp 1¼" nut for both water inlet and water outlet connection and clean all piping with tap water before connecting to the Mono bloc unit. Cover the pipe end to prevent dirt and dust when inserting it through a wall. If an existing tank is to be connected to this Mono bloc unit, ensure the pipes are clean before water pipe installation is carried out.

Choose proper sealer which can withstand the pressures and temperatures of the system. Make sure to use two spanners to tighten the connection. Tighten the nuts with torque wrench: 86.74 lb*ft. If non-brass metallic piping is used for installation, make sure to insulate the piping to prevent galvanic corrosion. Do not use pipes that are crushed or deformed. If these inferior pipes are used, it may cause unit malfunction. Make sure to insulate the water circuit piping (insulator thickness: 3/4 inches or more) to prevent condensation during cooling operation and reduction of heating capacity, as well as avoid freezing of the outdoor water circuit piping during winter season.

After installation, check the water leakage condition in connection area during test run. In case of a power supply failure or pump operating failure, drain the system. When water is idle inside the system, it is likely to freeze which could damage the system. See Figure 9-4 for example illustration.

Figure 9-4 *Unit drainage in case of power outage*



Drainage Piping Installation

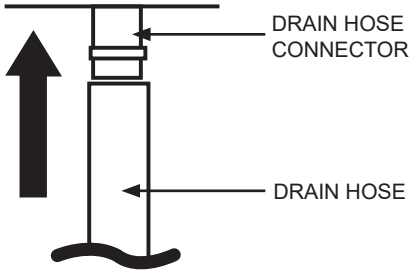
Use a drain hose with an inner diameter of 5/8 inches The hose must be installed in a continuously downward direction and left open to the frost-free atmosphere.

If the drain hose is long, use a metal support fixture along the way to eliminate the wavy pattern of the drain tube. Water will drip from this hose, therefore the outlet of this hose must be installed in an area where the outlet cannot become blocked.

Do not insert this hose into a sewage or drain pipe that may generate ammonia gas, sulfuric gas, etc. If necessary, use a hose clamp to tighten the hose at the drain hose connector to prevent it from leaking.

⚠ CAUTION Do not over tighten. This can cause water leakage.

Figure 9-5 *Drain hose connector*



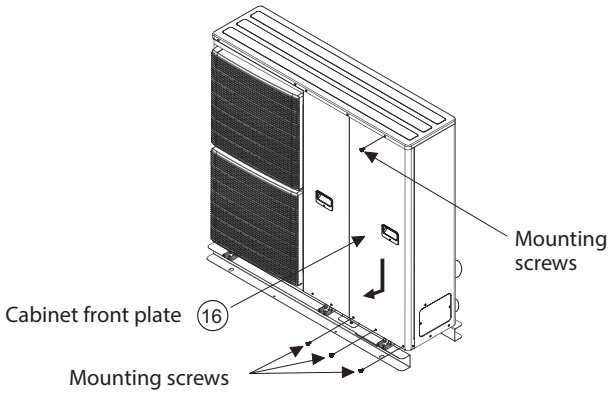
9 Installation

⚠WARNING This section is for authorised and licensed electricians only. Work behind the cabinet front plate secured by screws must only be carried out under supervision of qualified installer or service technician.

Remove the cabinet front plate

1. Remove the four (4) mounting screws as shown in the illustration.
2. Slide the cabinet front plate downward to release the pawls. Then, pull it toward front to remove it.

Figure 9-6 *Removing the cabinet front plate*



Fixing of power supply cord

1. An isolating device must be connected to the power supply cable.
2. The isolating device (disconnecting means) should have minimum 1/8 inch contact gap.
   - Connect the approved polychloroprene sheathed power supply 1 cord and power supply 2 cord and type designation 60245 IEC 57 or heavier cord to the terminal board, and to the other end of the cord to isolating device (Disconnecting means). See table 9-3 for cable size requirement.
   - To avoid the cable and cord being damaged by sharp edges, the cable and cord must be passed through the designated holes before being connected to the terminal block.
3. Secure the cable onto the control board with the holder (clamper).

Table 9-3 *Cable size requirements*

Model	Cable Size	Isolating Devices	Recommended RCD
RAH040	3 x min. 10 AWG	30A	30mA, 2P, type A

Figure 9-7 *Unit terminal*

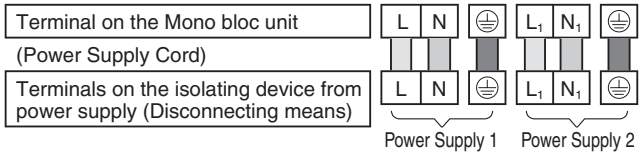
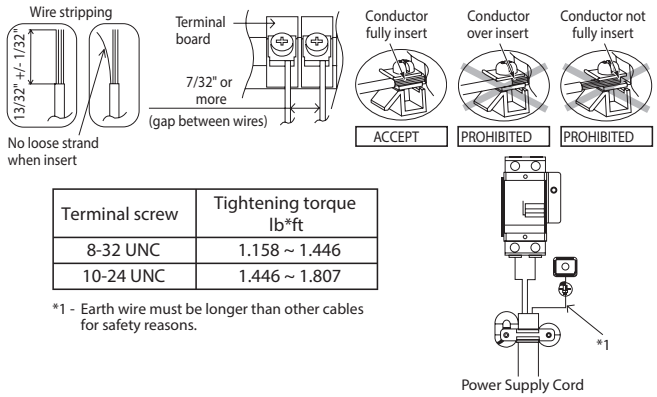


Figure 9-8 *Wire stripping and connecting requirement*



Terminal screw	Tightening torque lb*ft
8-32 UNC	1.158 ~ 1.446
10-24 UNC	1.446 ~ 1.807

*1 - Earth wire must be longer than other cables for safety reasons.

Connection requirement for RAH040

This equipment's Power Supply 1 complies with IEC 61000-3-12 provided that the short circuit power Ssc is greater than or equal to 1900kW at the interface point between the user's supply and the public system. It is the responsibility of the installer or user of the equipment to ensure, by consultation with the distribution network operator if necessary, that the equipment is connected only to a supply with a short circuit power Ssc greater than or equal to 1900kW.

The equipment's Power Supply 1 complies with IEC 61000-3-11 and shall be connected to a suitable supply network, having services current capacity ≥ 100A per phase. Please confirm with the local power provider that the service current capacity at the interface point is sufficient for the installation of the equipment.

This equipment's Power Supply 2 complies with IEC 61000-3-12. The equipment's Power Supply 2 complies with IEC 61000-3-11 and shall be connected to suitable supply network, with the following maximum permissible system impedance Zmax = 0.193 ohm (Ω) at the interface.

Please confirm with local power provider to ensure that the Power Supply 2 is connected only to a supply whose impedance is less than the units rated value.

9 Installation

Connection requirement for RAH040

All connections shall follow the local national wiring standard. It is strongly recommended to use manufacturer-recommended parts and accessories for installation.

For connection to main PCB:

1. Two-way valve connection is 20-30VAC, with a 0.5A maximum. Wires shall be a minimum 16AWG with type designation 60245 IEC 57 or heavier, or similarly double insulation sheathed cable.
2. Three-way valve connection is 20-30VAC,with a 0.5A maximum. Wires shall be a minimum 16AWG, with type designation 60245 IEC 57 or heavier, or similarly double insulation sheathed cable.
3. Room Thermostat connection is 20-30VAC, with a 0.15A maximum. Wires shall be a minimum 22AWG, with type designation 60245 IEC 57 or heavier cord, or similarly double insulation sheathed cable.
4. Maximum output power of booster heater shall be ≤ 3 kW. Booster heater connection is 208-240VAC, with a 13A maximum. Wires shall be a minimum 12AWG, with type designation 60245 IEC 57 or heavier.
5. Extra pump connection is 110-130VAC, with a 0.54A maximum. Wires shall be a minimum 16AWG, with type designation 60245 IEC 57 or heavier.
6. Boiler contact/Defrost signal connection is 120/240VAC, with a 3A maximum. Wires shall be a minimum 16AWG, with type designation 60245 IEC 57 or heavier.
7. Heat/Cool switch connection is 24VDC, with a 0.2A maximum. Wires shall be a minimum 18AWG, double insulation layer of PVC-sheathed or rubber-sheathed cable.
8. Tank sensor connection is 5VDC, with a 0.2mA maximum. Wires shall be a minimum 22AWG, double insulation layer (with insulation strength of min 30V) of PVCsheathed or rubber-sheathed cable.
9. Buffer tank sensor connection is 5VDC, with a 0.2mA maximum. Wires shall be a minimum 22AWG, double insulation layer(with insulation strength of min 30V) of PVCsheathed or rubber-sheathed cable.
10. Outdoor air sensor connection is 5VDC, with a 0.2mA maximum. Wires shall be a minimum 22AWG, double insulation layer of PVC-sheathed or rubbersheathed.
11. OLP booster heater connection is 12VDC, with a 0.2A maximum. Wires shall be a minimum 16AWG, double insulation layer of PVC-sheathed or rubber-sheathed cable.

Figure 9-9 *Cable and cord connections*

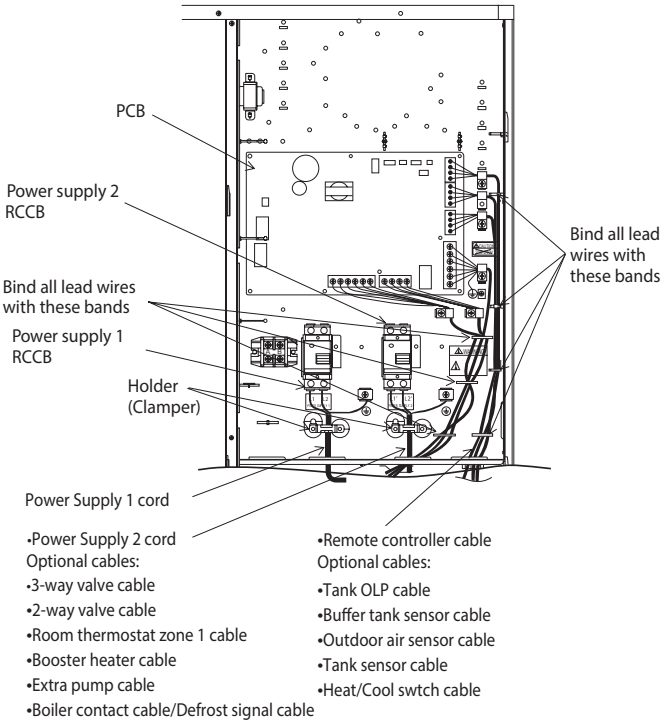


Table 9-4 *Screw terminal tightening torque*

Terminal screw on PCB	Maximum tightening torque lb*ft
4-40 UNC	0.3688
8-32 UNC	0.8851

Installation of Remote Controller

Installation location

Install at the height of 3-1/4 to 5 feet from the floor at a location where average room temperature can be detected). Install vertically against the wall.

Avoid the following locations for installation.

1. By the window, etc. exposed to direct sunlight or direct air.
2. In the shadow or backside of objects deviated from the room airflow.
3. Location where condensation occurs (The Remote Controller is not moisture proof or drip proof.)
4. Location near a heat source.
5. Uneven surface.

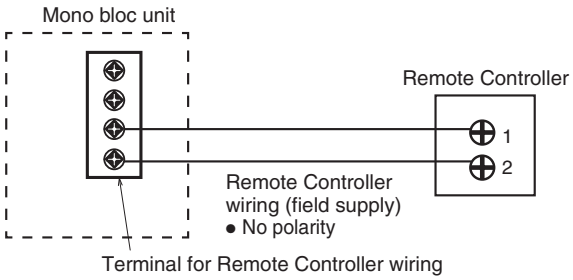
Keep distance of 3-1/4 feet or more from the TV, radio and PC (due to fuzzy image or noise).

9 Installation

Remote controller wiring

Remote controller connection is 16VDC, with a 25mA maximum. Wires shall be a minimum 22AWG, of double insulation PVC-sheathed or rubber sheathed cable. Total cable length shall be 165 feet or less. Be careful not to connect cables to other terminals (e.g. power source wiring terminal). Malfunction may occur. Do not bundle together with the power source wiring or store in the same metal tube. Operation error may occur.

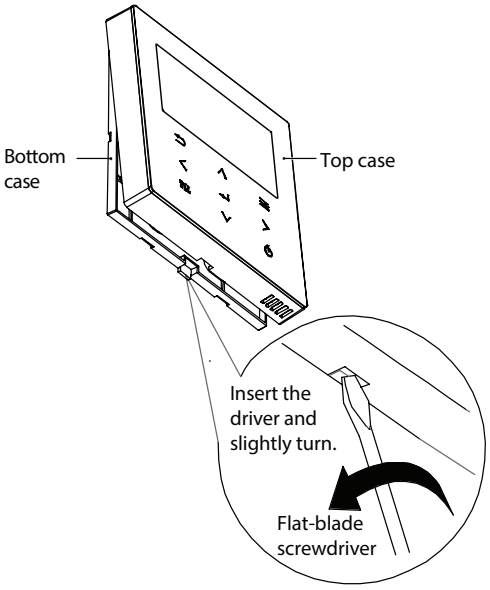
Figure 9-10 *Terminal for remote control wiring*



Mounting the remote controller

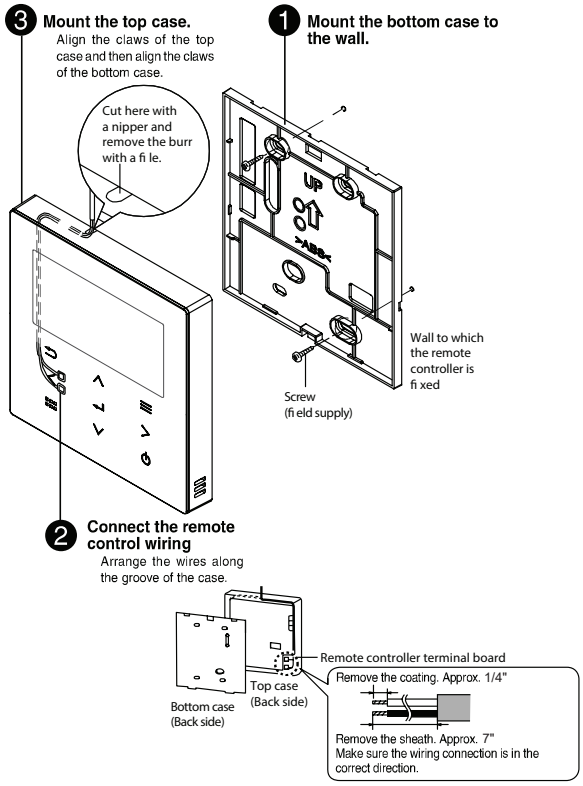
For the exposed type, use a drill to make two holes for the mounting screws.

Figure 9-11 *Removing top case from remote controller*



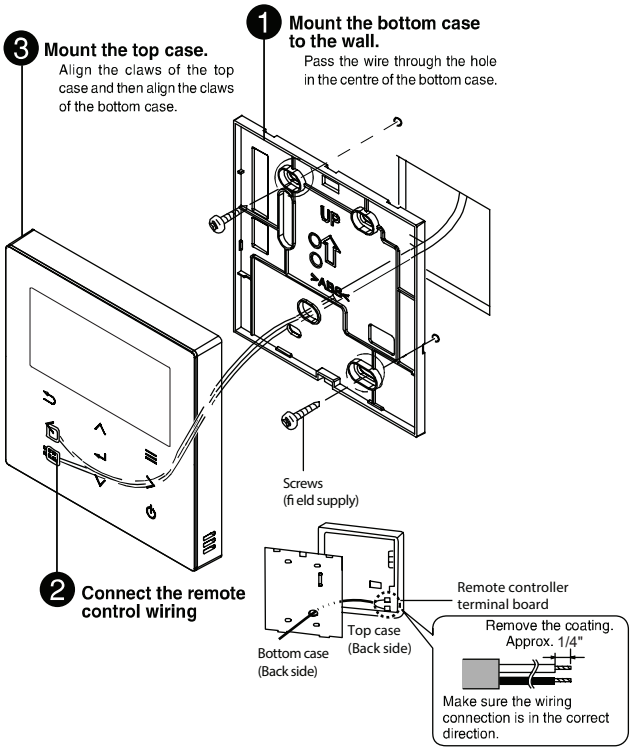
⚠WARNING This section is for authorized and licensed electrician only. Work behind the Cabinet Front Plate secured by screws must only be carried out under supervision of qualified contractor, installation engineer or service person.

Figure 9-12 *Mounting instructions - exposed*



For the embedded type, use a drill to make two holes for the mounting screws.

Figure 9-13 *Mounting instructions - embedded*



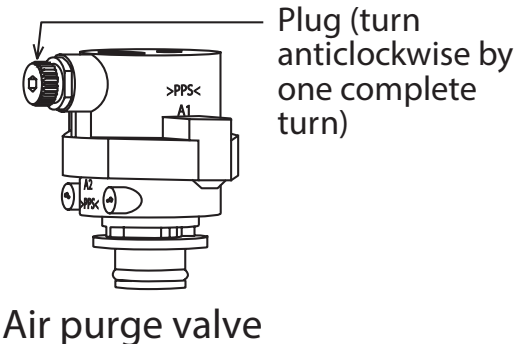
9 Installation

Charging the water

Make sure all the piping installations are properly done before carrying out the following steps:

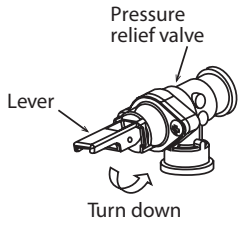
1. Open Cabinet front plate to access to the Pressure Relief Valve and Air Purge Valve.
2. Turn the plug on the Air Purge Valve outlet counterclockwise by one complete turn from fully closed position.

Figure 9-14 *Turn plug counter clockwise*



3. Set the Pressure Relief Valve level "DOWN".

Figure 9-15 *Pressure relief valve*



Pressure relief valve

4. Start filling water (with pressure more than 15 Psi) to the Mono bloc unit via water inlet. Stop filling water if the free water flow through Pressure Relief Valve drain hose.
5. Turn ON the power supply and make sure Water Pump is running.
6. Check and make sure no water leaking at the tube connecting points.
7. Reinstall the Cabinet front plate by tightening the 2 mounting screws.

Reconfirmation

⚠WARNING Be sure to switch off all power supply before performing each of the processes in this section. Before obtaining access to terminals, all supply circuits must be disconnected.

Check Water Pressure

Water pressure should not be lower than 7 Psi (with inspects the Water Pressure Gauge). If necessary add tap water into the water circuit.

Check Pressure Relief Valve

1. Check for correct operation of Pressure Relief Valve by turning on the lever to become horizontal.
2. If you do not hear a clacking sound (due to water drainage), contact your local a qualified installer or technician.
3. Push down the lever after finish checking.
4. In the case water keeps draining out from the unit, switch off the system, and then contact your local a qualified installer or technician.

Expansion Vessel Pre Pressure Checking

1. The Mono bloc unit has a build-in Expansion Vessel with 2.64 Gallons air capacity and initial pressure of 15 Psi.
2. Without an antifreeze agent, the total amount of water in the system should be below 52.83 Gallons.
3. If the total amount of water is more than 52.83 Gallons, please add an expansion vessel (field supply).
4. In the case of using an antifreeze agent, the expansion rate ε is different depending on its maker.
5. Please refer to the antifreeze agent maker for the expansion rate ε before calculating the upper limit water volume of the system.
6. The expansion vessel capacity required for the system can be calculated from the formula below.

$$V = \frac{\ell \times Vo}{(P_0/P_1) - (P_0/P_2)}$$

V : Required gas volume <expansion vessel volume Gallons>
Vo : System total water volume <Gallons>
ℓ : Expansion rate

P_1 : Starting system pressure (PSI)
P_2 : Final system pressure (PSI)
P_0 : Initial pressure (PSI)

❍ It's advised to add 10% margin for required volume of calculation.

If the height difference between the Mono bloc unit and the highest point of the system water circuit (H) is more than 23 feet, please adjust the initial pressure of the expansion vessel (P_0) according to the following formula.

$P_0 = (1.45*H+4.35)$ PSI

Check RCCB

Ensure the RCCB set to "ON" before checking RCCB. Turn on the power supply to the Mono bloc unit. This testing can only be done when power is supplied to the Mono bloc unit.

9 Installation

⚠WARNING Be careful not to touch parts other than RCCB test button when the power is supplied to Mono bloc unit. Touching the Mono bloc unit while powered could result in electrical shock.

Push the "TEST" button on the RCCB. The lever will turn down and indicate "0", if it is functioning normally. Contact authorized installer or technician if the RCCB malfunctions.

Turn off the power supply to the Mono bloc unit.

If the RCCB functions normally, set the lever to "ON" again after testing is complete.

This product contains fluorinated greenhouse gasses.
Refrigerant type : R32 (GWP=675) for RAH040
Amount : 3.53 lbs (1.080 ton CO2 equivalent)

Test Run

1. Before test run, make sure below items have been checked:
   - Pipe work is properly done.
   - Electric cable connections are properly done.
   - Mono bloc unit is filled up with water and trapped air is released.
2. Antifreeze agent must be added into the water circuit to prevent freezing of water when outdoor ambient temperatures are low.
   - Recommended antifreeze: Propylene glycol: 40% (equivalent to -4°F)
3. Turn ON the Mono bloc unit and RCCB.

NOTICE During winter, turn on the power supply and standby the unit for at least 15 minutes before test run. Allow sufficient time to warm up refrigerant and prevent wrong error code judgement.

4. For normal operation, Water Pressure Gauge reading should be between 7 Psi and 43.5 Psi.
5. After test run, clean the Magnetic Water Filter Set. Reinstall it after cleaning.

Air Purge Valve Test Run

Before test running the water circulation circuit, loosen the plug on the air purge valve on the unit counterclockwise and be sure to thoroughly release any air from the drain plugs on each terminal.

During air purging, keep water pressure applied to the circulation circuit by supplying water to the circuit. (If the water pressure drops, the air cannot be discharged sufficiently.) Particularly, when the three-way valve switches from the heating circuit to the tank circuit five minutes after the air purge operation begins, the air that has accumulated in the heat exchanger inside the tank may flow into the pump, causing it to dry run. In this case, please quickly remove the air from the circulation circuit by releasing the air from the drains located at the back of the mono bloc unit.

Figure 9-16 *Air purge valve*

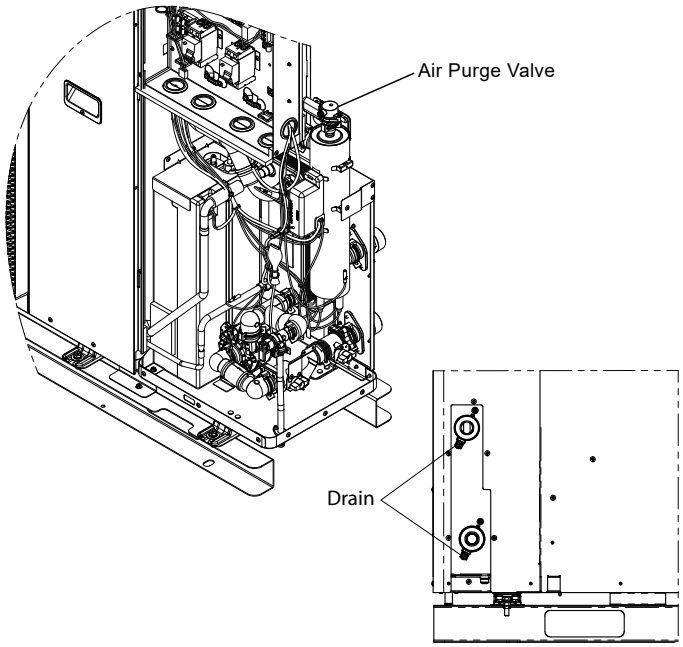
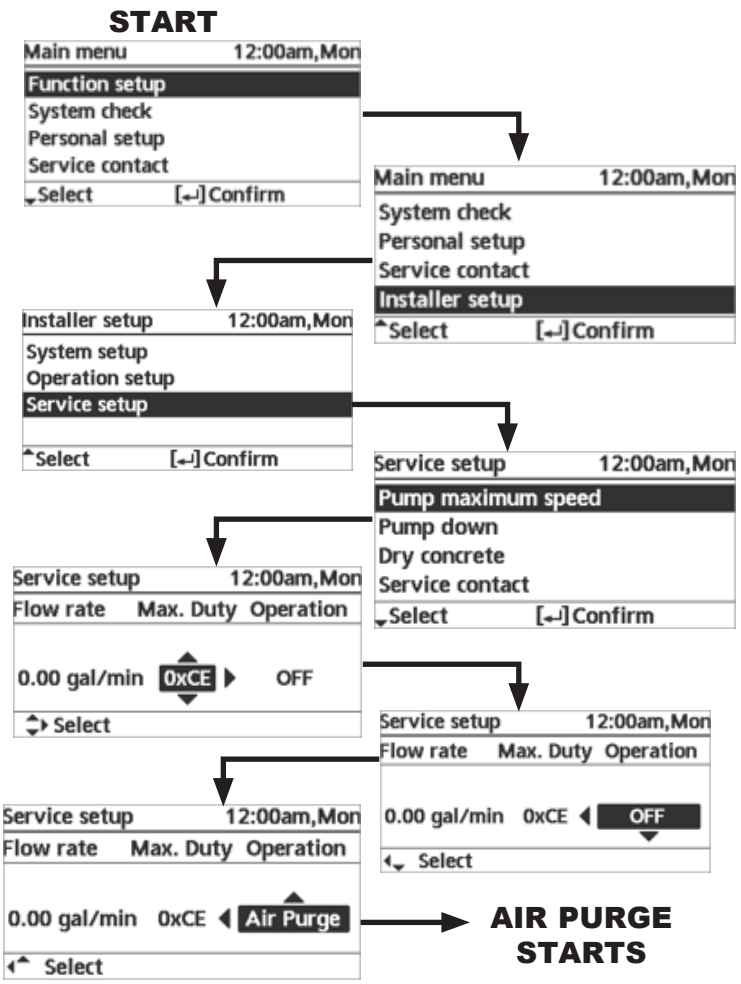


Figure 9-17 *Air purge valve screens - step by step*



9 Installation

NOTICE If the pump is left running dry for a long period of time, it may cause the pump to malfunction.

Once all the air has been removed from the water circulation circuit, such as when the flow rate remains constant for a certain period of time, turn it OFF with ▲and press Menu to end the air purge. After the air purge operation, carry out normal operation, and when you can no longer hear the sound of air flowing from the water circulation circuit, turn the air purge valve plug clockwise to tighten it.

Check water flow or water circuit

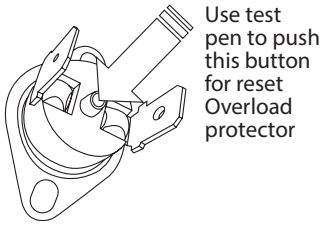
Confirm the maximum water flow during main pump operation is no less than 3.96 GPM. Water flow can be checked through service setup. Heating operation at low water temperature with lower water flow may trigger "H75" during defrost process.

Reset overload protector

Overload Protector prevents the water from over heating. When the Overload Protector trips at high water temperature, take the following steps to reset it:

1. Take out the cover.
2. Use a test pen to push the center of the button gently in order to reset the Overload Protector.
3. Fix the cover to its original position.

Figure 9-16 *Overload protector*



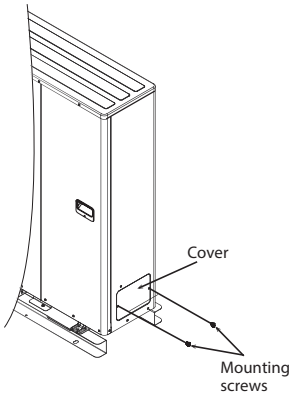
Maintenance

In order to ensure optimal performance of the unit, seasonal inspections on the unit, functional check of RCCB, field wiring, and piping have to be carried out at regular intervals. This maintenance should be carried out by a qualified installer or service technician.

Maintenance for magnetic water filter set

1. Remove the cover by loosening the mounting screws to access to the Magnetic Water Filter Set.
2. Turn OFF power supply.
3. Set the two valves for the Magnetic Water Filter Set to "CLOSE".
4. Take off the clip, then gently pull out the mesh. A small amount of water may drain out from it.
5. Clean the mesh with warm water to remove all stains. Use a soft brush if necessary.
6. Reinstall the mesh to the Magnetic Water Filter Set and clip it back on.
7. Set the two valves for the Magnetic Water Filter Set to "OPEN".
8. Turn ON power supply.
9. After cleaning, reinstall the cover by tightening the mounting screws properly.

Figure 9-17 *Remove/ reinstall cover*



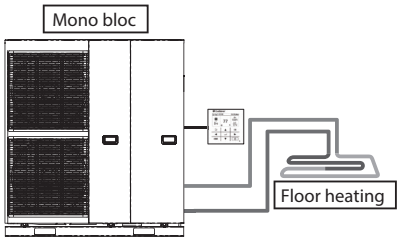
Variation of system

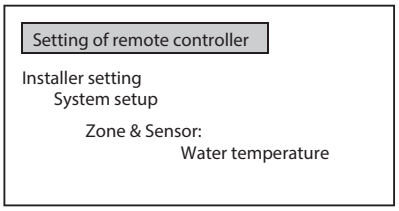
This section introduces variation of various systems using Air-To-Water Heatpump and actual setting method.

Temperature setting variation for heating

Remote Controller

Connect floor heating or radiator directly to the Mono bloc. This is the basic form of the most simple system.

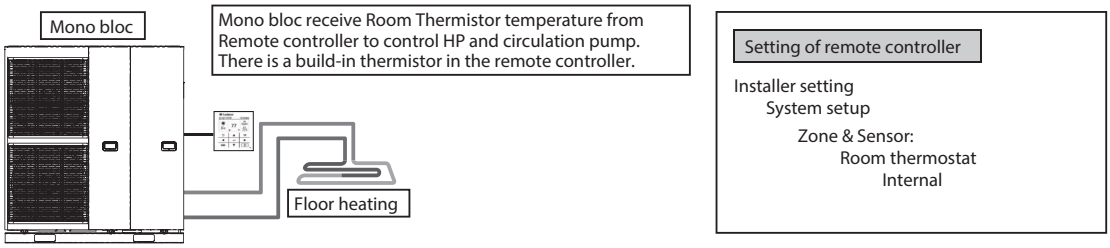




9 Installation

Room Thermostat

Connect floor heating or radiator directly to the Mono bloc. Install the remote controller in the room where floor heating is installed. This is an application that uses remote controller as Room Thermostat.



External Room Thermostat

Connect floor heating or radiator directly to Mono bloc. Install separate external Room Thermostat (field supply) in the room where floor heating is installed. This is an application that uses external Room Thermostat.

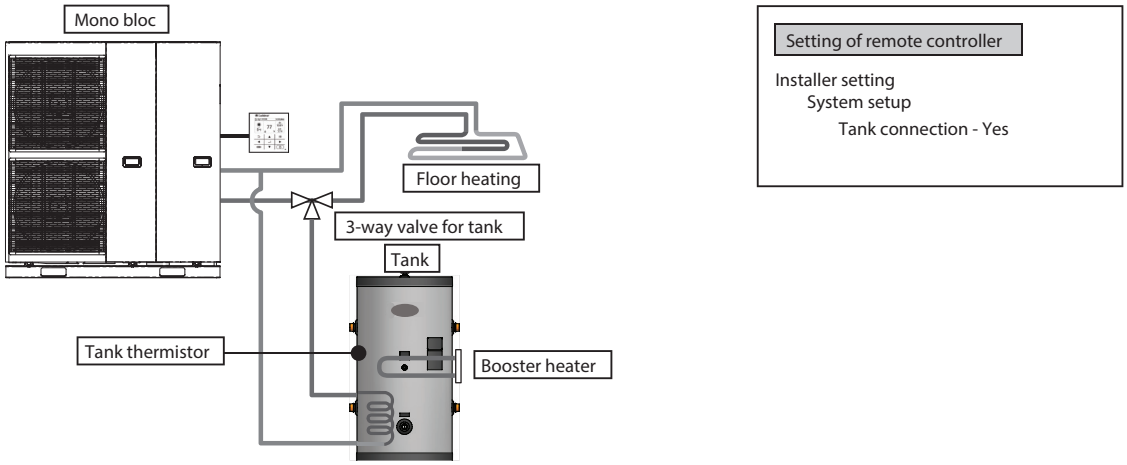
Installation Examples - Systems with Optional Equipment

DHW (Domestic Hot Water) tank connection

This is an application that connects the DHW tank to the Mono bloc through three-way valve.

DHW tank's temperature is detected by tank thermistor (specified by the manufacturer).

Figure 9-18 *DHW Tank System Connection*

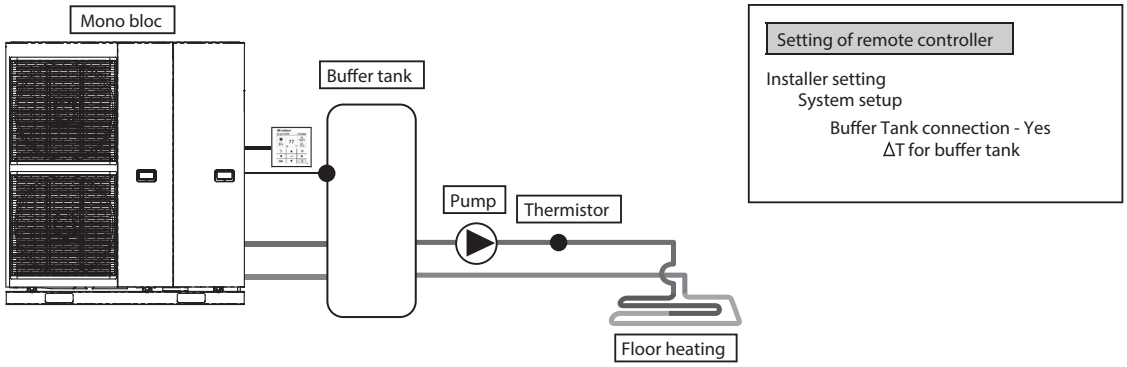


9 Installation

Buffer tank connection

This is an application that connects the buffer tank to the Mono bloc. Buffer tank's temperature is detected by buffer tank thermistor (specified by the manufacturer).

Figure 9-19 *Buffer Tank system connection*



Boiler connection

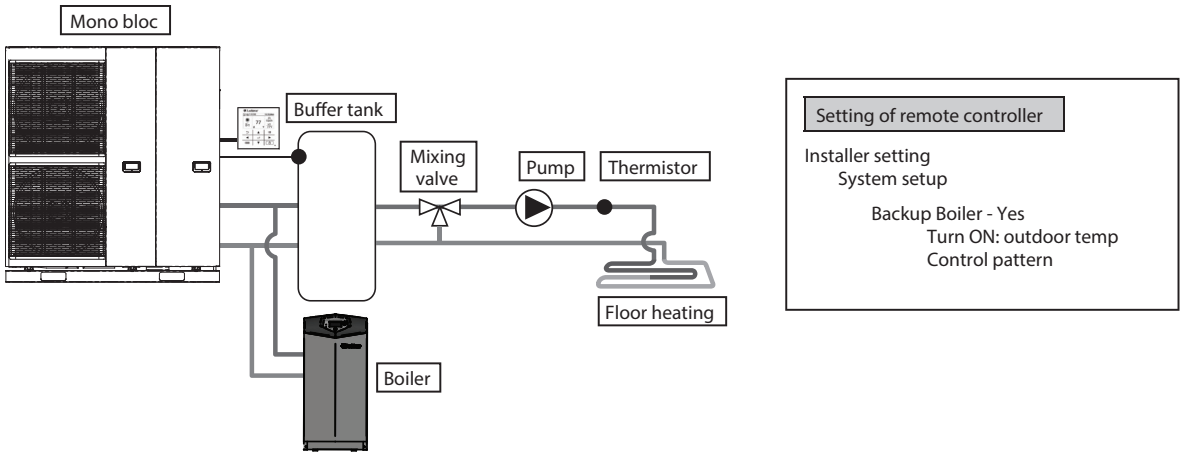
This is an application that connects the boiler to the Mono bloc, to compensate for insufficient capacity by operate boiler when outdoor temperature drops & heat pump capacity is insufficient.

Boiler is connected parallel with heat pump against heating circuit. There are 3 modes selectable by remote controller for boiler connection. Besides that, an application that connects to the DHW tank's circuit to heat up tank's hot water is also possible.

(Operation setting of boiler shall be responsible by installer.)

Depending on the settings of the boiler, it is recommended to install buffer tank as temperature of circulating water may get higher. (It must connect to buffer tank especially when selecting Advanced Parallel setting.)

Figure 9-20 *Boiler system connection*



⚠ CAUTION Make sure the boiler and its integration in the system complies with applicable legislation. Make sure the return water temperature from the heating circuit to the Mono bloc does NOT exceed 131°F. Boiler is turned off by safety control when the water temperature of the heating circuit exceed 185°F.

⚠WARNING Lochinvar is NOT responsible for incorrect or unsafe installations of the boiler system.

9 Installation

Fixing external devices

Length of Connecting Cables

When connecting cables between Mono bloc and external devices, the length of the said cables must not exceed the maximum length as shown in the following table.

Table 9-5 *Cable length requirements*

External Device	Maximum cable length (ft)
Two-way valve	164
Three-way valve	164
Room thermostat	164
Booster heater	164
Extra pump	164
Boiler contact / Defrost signal	164
Tank sensor	98
Outdoor air sensor	98
Tank OLP	98
Buffer tank sensor	98
Heat/Cool switch	98

Figure 9-21 *Main PCB connections*

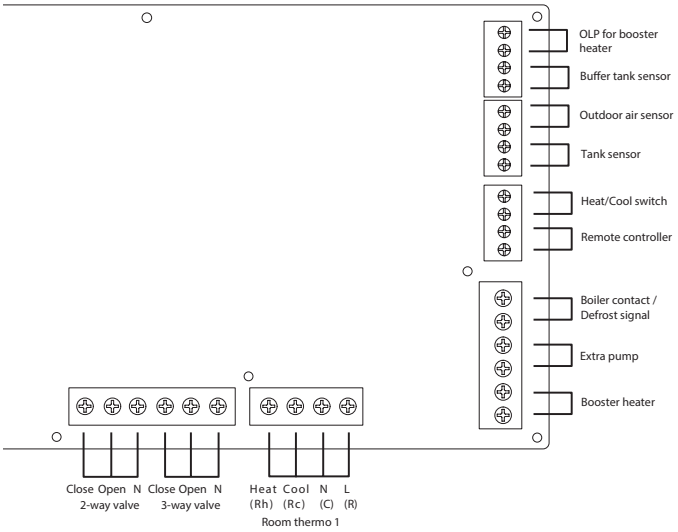


Table 9-6 *PCB Connections*

Signal Inputs	Room Thermostat 1	L N = 24VAC, Heat, Cool=Thermostat heat, Cool terminal
	OLP for booster heater	Dry contact Vcc-Bit1, Vcc-Bit2 open/short (System setup necessary) It is connected to the safety device (OLP) of DHW tank.
	Remote controller	16VDC (Please use 2 cores wire for relocation and extension.
Outputs	Three-way valve	24VAC N=Neutral Open, Close=direction (For circuit switching when connected to DHW tank)
	Two-way valve	24VAC N=Neutral Open, Close (Prevent water circuit pass through during cooling mode)
	Extra pump	120VAC (Used when Mono bloc pump capacity is insufficient)
	Booster heater	240VAC (Used when using booster heater in DHW tank)
	Boiler contact / Defrost signal	Dry contact (System setup necessary)
Thermistor Imputs	Outdoor air sensor	5VDC
	Tank sensor	5VDC

9 Installation

Remote control outline

Figure 9-22 *Remote Controller*

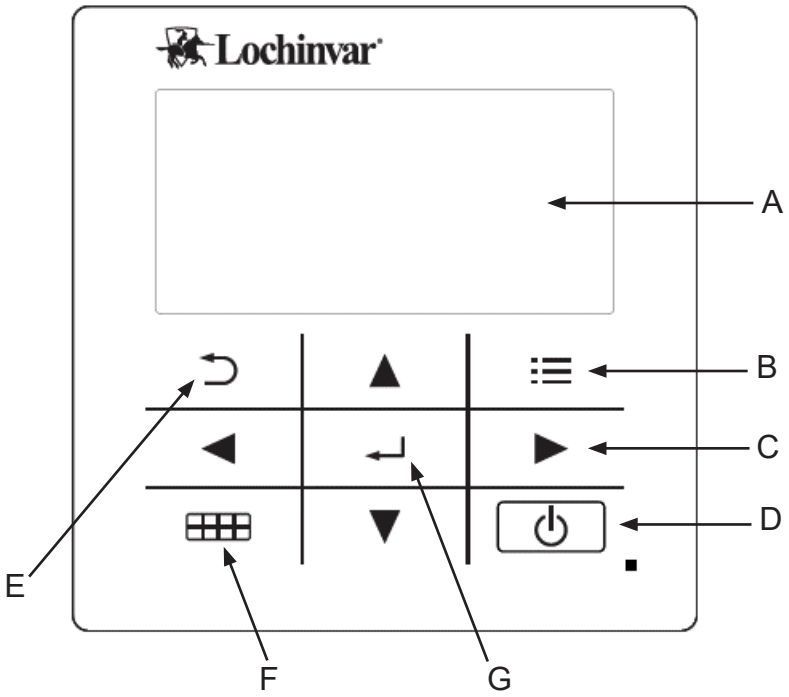
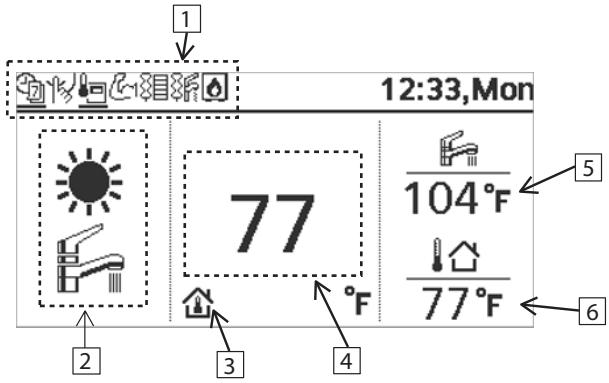


DIAGRAM	NAME	FUNCTION
A	Main screen	Display information
B	Menu	Open/Close main menu
C	Triangle (Move)	Select or change item
D	Operate	Start/Stop operation
E	Back	Back to previous item
F	Quick Menu	Open/Close Quick menu
G	OK	Confirm

9 Installation

Figure 9-23 *Remote controller home screen*



	Name	Function
1:	Function icon	Display set function/status

Holiday mode
Weekly timer
Quiet mode
Remote controller room thermostat
Powerful mode
Room heater
Tank heater
Backup boiler

2: Mode — Display set mode/current status of mode

Heating, Cooling, Auto, Hot water supply, Auto heating, Auto cooling, Heat pump operating

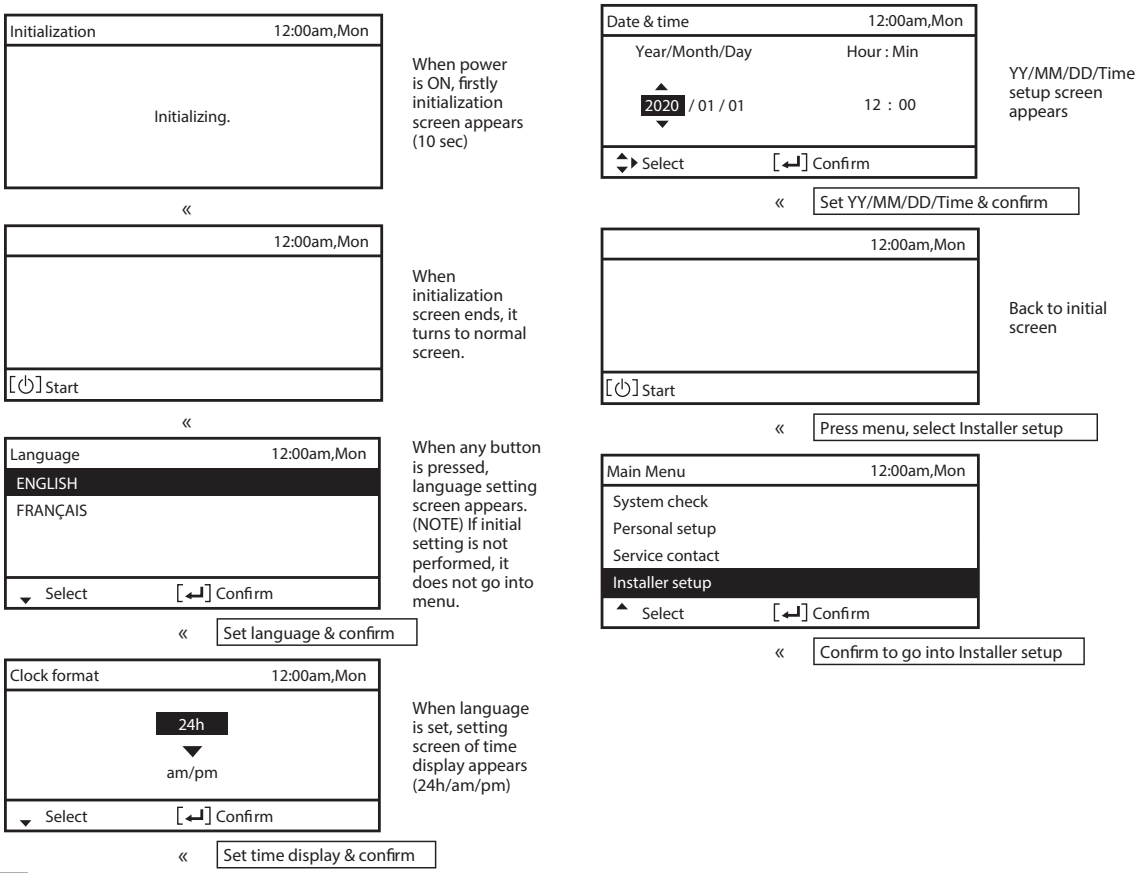
3: Temp setting — Set room temp, Compensation curve, Set direct water temp

4: Display Heat temp — Display current heating temperature (it is set temperature when enclosed by line)

5: Display tank temp — Display current tank temperature (it is set temperature when enclosed by line)

6: Outdoor temp — Display outdoor temp

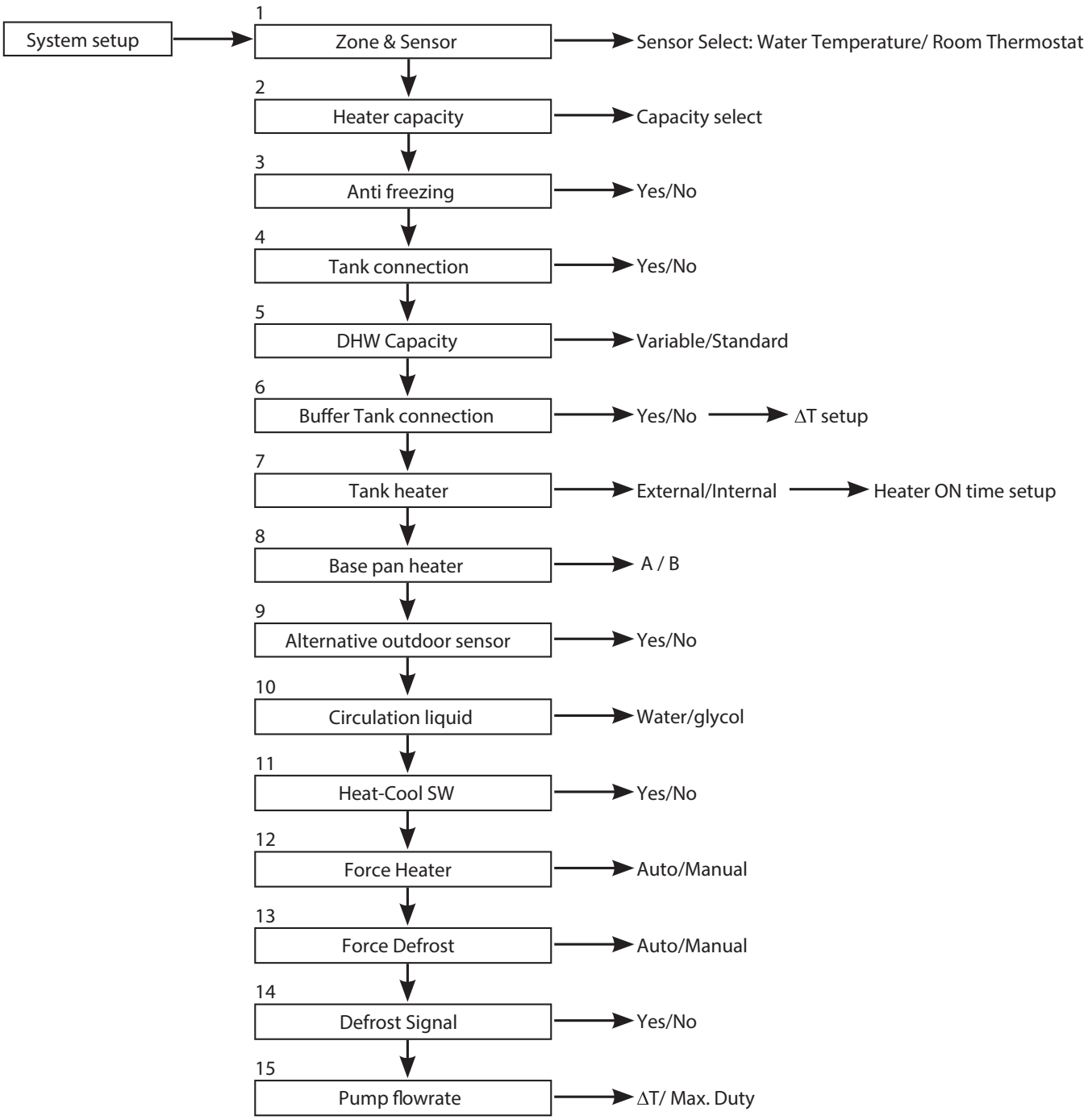
Figure 9-24 *Remote Controller Initialization*



9 Installation

System setup

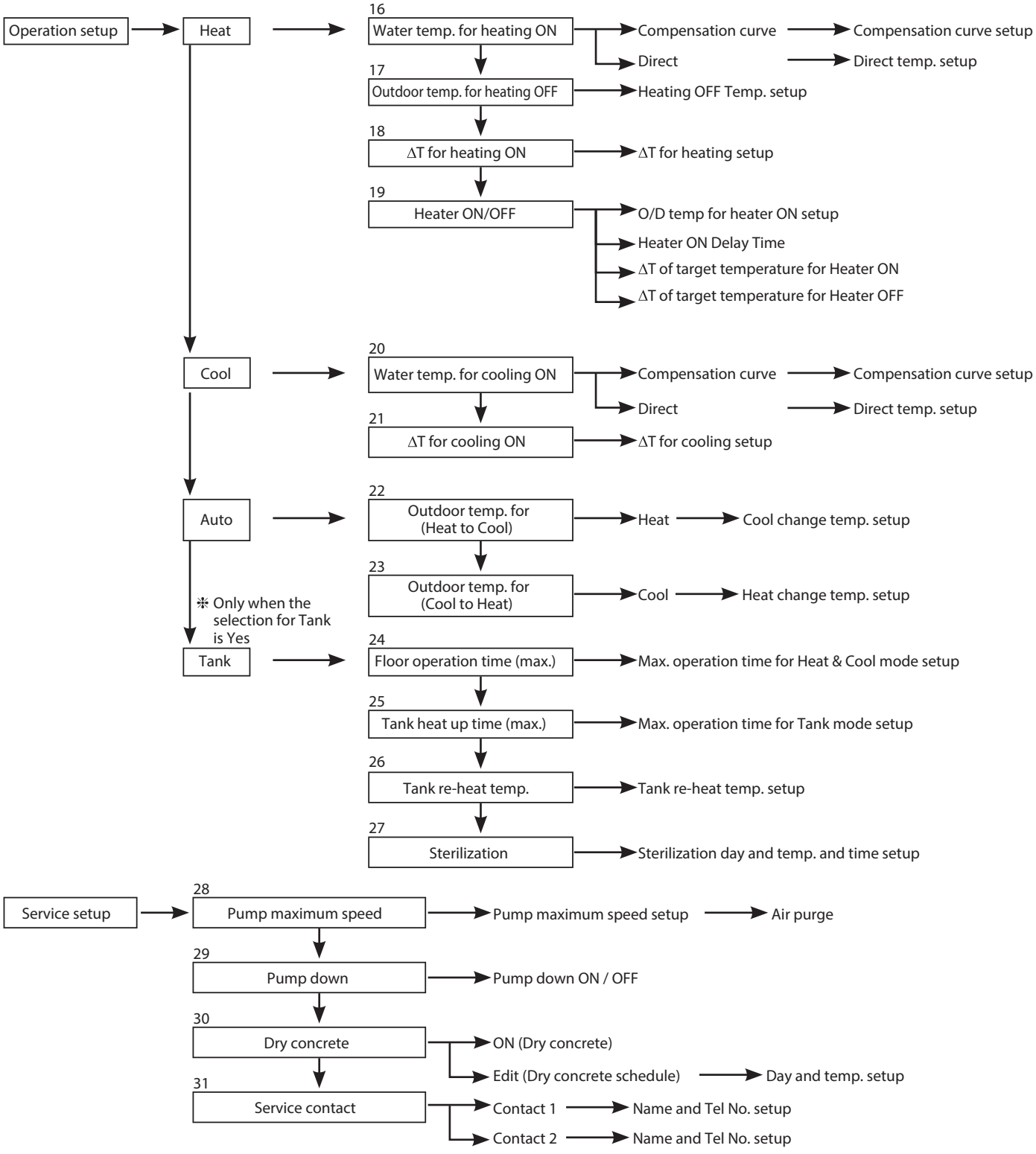
Figure 9-25 *Remote controller flow chart*



9 Installation

Operation setup

Figure 9-25 *Remote controller flow chart continued*



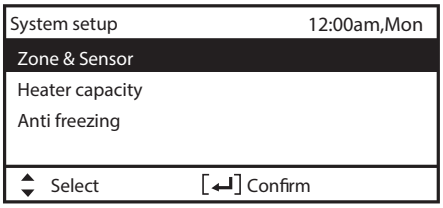
9 Installation

System setup

Figure 9-26 *Remote controller settings*

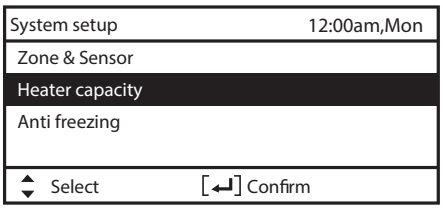
1. Zone & Sensor	Initial setting: Water temp.

Select sensor of room temperature control from the following 2 items
1 Water temperature (Circulation water temperature)
2 Room thermostat (Internal or External)



2. Heater capacity	Initial setting: 6kW

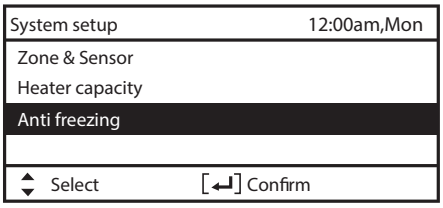
Set the selectable heater capacity.



3. Anti freezing	Initial setting: Yes

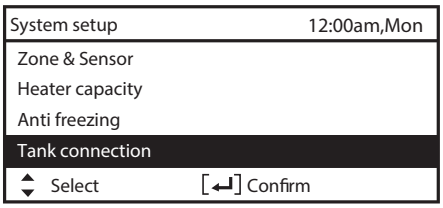
Operate anti-freezing of water circulation circuit.
If select Yes, when the water temperature is reaching its freezing temperature, the circulation pump will start up. If the water temperature does not reach the pump stop temperature, back-up heater will be activated.

(NOTE) If set No, when the water temperature is reaching its freezing temperature or below 32°F, the water circulation circuit may freeze and cause malfunction.



4. Tank connection	Initial setting: No

Select whether it is connected to hot water tank or not.
If set Yes, it becomes setting that uses hot water function.
Hot water temperature of tank can be set from main screen.

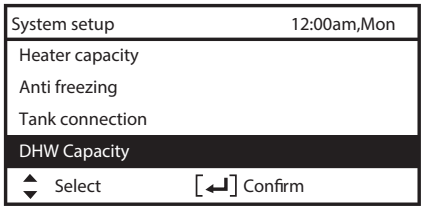


9 Installation

Figure 9-26 *Remote controller settings continued*

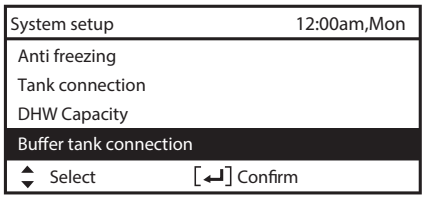
5. DHW Capacity | Initial setting: Variable

Variable DHW capacity setting normally run with efficient heating which is energy saving heating. But while hot water usage high and tank water temperature low, variable DHW mode will run with fast heat up which heat up the tank with high heating capacity.
If standard DHW capacity setting is selected, heat pump run with heating rated capacity at tank heat up operation.



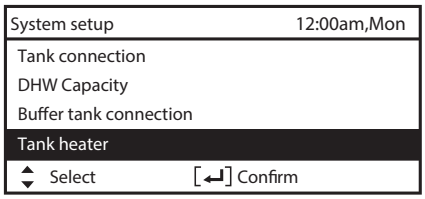
6. Buffer Tank connection | Initial setting: No

Select whether it is connected to buffer tank for heating or not.
If buffer tank is used, please set Yes.
Connect buffer tank thermistor and set, ΔT (ΔT use to increase primary side temp against secondary side target temp).
If the buffer tank capacity is not so large, please set larger value for ΔT.



7. Tank heater | Initial setting: Internal

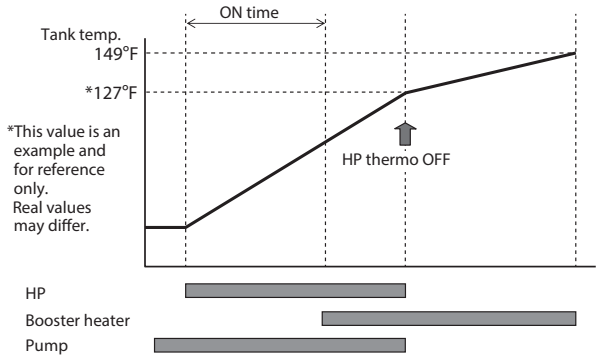
Select to use either built-in heater or external heater as heater for hot water tank.
If heater is installed on tank, please select External.



Please set "Tank heater" to "ON" in the "Function setup" from remote controller when using heater to raise the tank temperature.

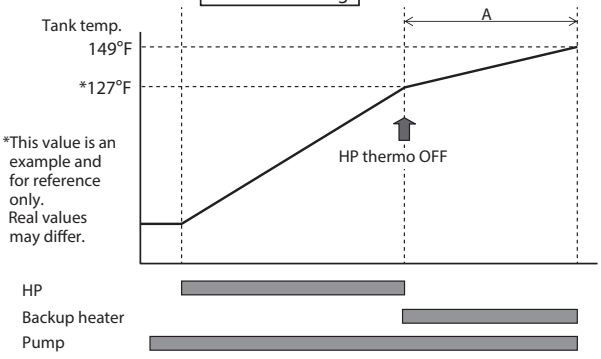
External A setting which is using booster heater installed on DHW tank to re-heat the tank.
The permissible heater capacity is 10236 Btu/h and below.
The operation to re-heat the tank with heater is as below.
In addition, be sure to set suitable "Tank heater: ON time"

For 149°F setting



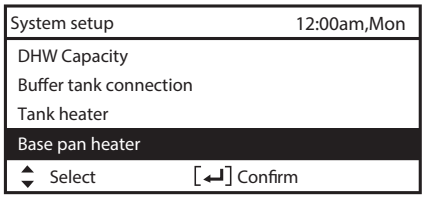
Internal A setting which is using backup heater of Mono bloc to re-heat the tank.
The operation to re-heat the tank with heater is as below.

For 149°F setting



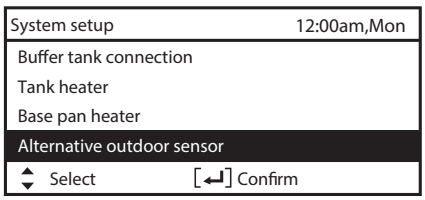
8. Base pan heater | Initial setting: A

A: Turn on Heater when heating with defrost operation only
B: Turn on Heater at heating



9. Alternative outdoor sensor | Initial setting: No

Set Yes if outdoor sensor is installed.
Controlled by optional outdoor sensor without reading the outdoor sensor of heat pump unit.



9 Installation

Figure 9-26 *Remote controller settings continued*

10. BackupBoiler connection	Initial setting: No

System setup	12:00am,Mon
Tank heater	
Base pan heater	
Alternative outdoor sensor	
Backup Boiler	
Select	[↵] Confirm

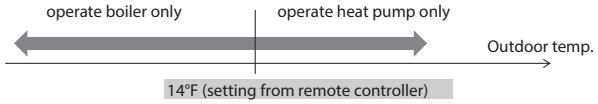
Set if heat pump linked with boiler operation.
Connect the start signal of the boiler in boiler contact terminal (main PCB).
Set Backup Boiler connection to YES.
After that, please begin setting according to remote controller instruction.
Boiler icon will be displayed on remote controller top screen.

There are 3 different modes in the boiler operation. Movement of each modes are shown below.

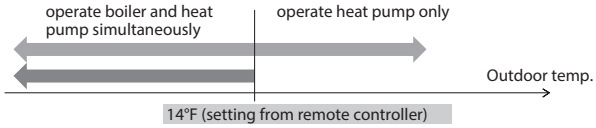
1 Alternative (switch to boiler operation when drops below setting temperature)
2 Parallel (allow boiler operation when drops below setting temperature)
3 Advanced Parallel (able to slightly delay boiler operation time of parallel operation)

When the boiler operation is "ON", "boiler contact" is "ON", "_"(underscore) will be displayed below the boiler icon.
Please set target temperature of boiler to be the same as heat pump temperature.
When boiler temperature is higher than heat pump temperature, zone temperature cannot be achieved if mixing valve is not installed.
This product only allows one signal to control the boiler operation. Operation setting of boiler shall be responsible by installer.

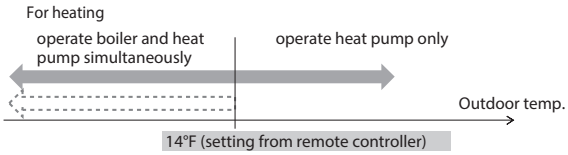
Alternative mode

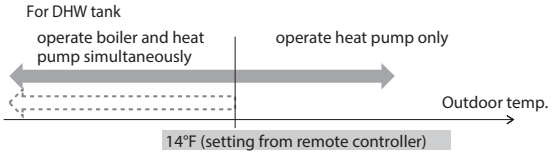


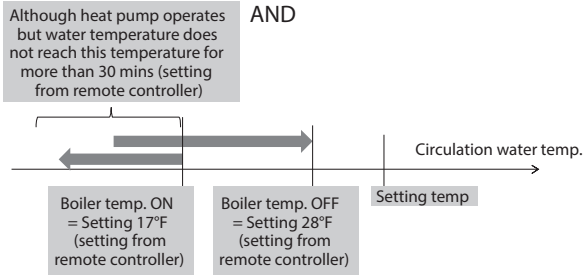
Parallel mode

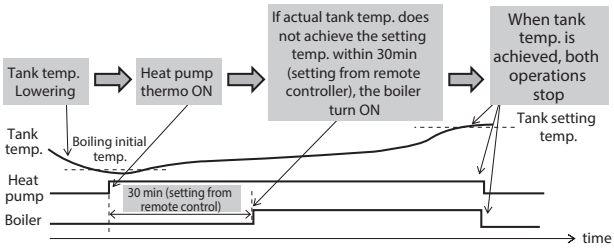


Advanced Parallel mode









In Advanced Parallel mode, setting for both heating and tank can be made simultaneously. During operation of "Heating/Tank" mode, when each time the mode is switched, the boiler output will be reset to OFF. Please have good understanding on the boiler control characteristic in order to select the optimal setting for the system.

9 Installation

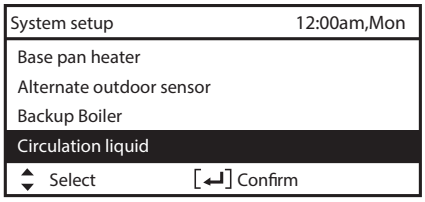
Figure 9-26 *Remote controller settings continued*

11. Circulation Liquid | Initial setting: Water

Set circulation of heating water.

There are 2 types of settings, water and glycol mixture.

(NOTE) Please set glycol when using anti-freeze liquid.
It may cause error if setting is wrong.

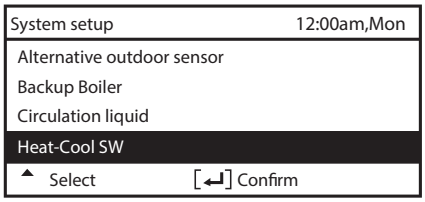


12. Heat-Cool SW | Initial setting: Disable

Able to switch (fix) heating & cooling by external switch.

(Open) : Fix at Heating (Heating +DHW)
(Short) : Fix at Cooling (Cooling +DHW)

Timer function cannot be used. Cannot use Auto mode.

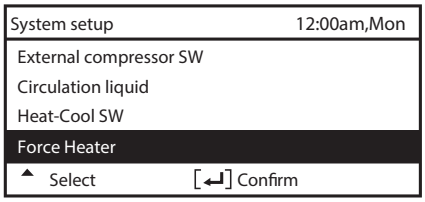


13. Force Heater | Initial setting: Manual

Under manual mode, user can turn on force heater through quick menu.

If selection is 'auto', force heater mode will turn automatically if pop up error happen during operation.
Force heater will operate follow the latest mode selection, mode selection is disable under force heater operation.

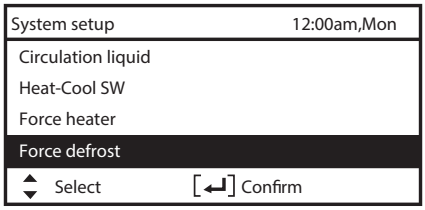
Heater source will ON during force heater mode.



14. Force Defrost | Initial setting: Manual

Under manual code, user can turn on force defrost through quick menu.

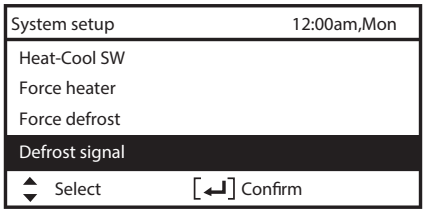
If selection is 'auto', outdoor unit will run defrost operation once if heat pump have long hour of heating without any defrost operation before at low ambient condition.
(Even auto is selected, user still can turn on force defrost through quick menu)



15. Defrost signal | Initial setting: No

Defrost signal sharing same terminal as boiler contact in main board. When defrost signal set to YES, boiler connection reset to NO. Only one function can be set between defrost signal and bivalent.

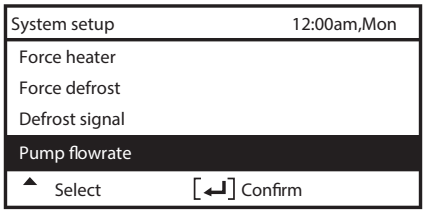
When defrost signal set to YES, during defrost operation is running at outdoor unit defrost signal contact turn ON. Defrost signal contact turn OFF after defrost operation end.
(Purpose of this contact output is to stop indoor fan coil or water pump during defrost operation).



16. Pump flowrate | Initial setting: ΔT

If pump flowrate setting is ΔT, unit adjust pump duty to get different of water inlet and outlet base on setting on * ΔT for heating ON and * ΔT for cooling ON in operation setup menu during room side operation.

If pump flowrate setting is set to Max. duty, unit will set the pump duty to the set duty at *Pump maximum speed in service setup menu during room side operation.



9 Installation

Figure 9-26 *Remote controller settings continued*

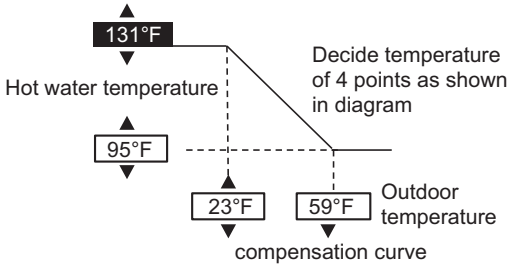
17. Water temp. for heating ON | Initial setting: compensation curve

Set target water temperature to operate heating operation.
Compensation curve: Target water temperature change in conjunction with outdoor ambient temperature change.
Direct: Set direct circulation water temperature.

Regardless of the above setting, the water temperature will be limited as follows.

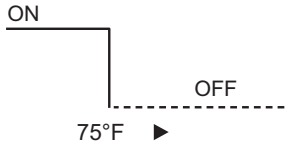
Outdoor temperature	Maximum water temperature limit
-4°F	131°F
5 ~ 32°F	140°F
41~ 68°F	149°F
77~ 95°F	140°F

However, only when ΔT is set to 27°F, the water temperature setting of 141°F or higher will take effect.



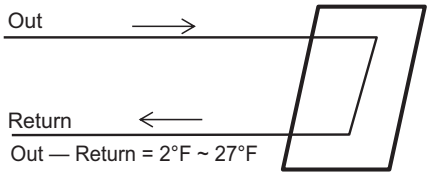
18. Outdoor temp. for heating OFF | Initial setting: 75°F

Set outdoor temp to stop heating.
Setting range is 41°F ~ 95°F



19. ΔT for heating ON | Initial setting: 9°F

Set temp difference between out temp & return temp of circulating water of Heating operation.
When temp gap is enlarged, it is energy saving but less comfort. When the gap gets smaller, energy saving effect gets worse but it is more comfortable.
Setting range is 2°F ~ 27°F



20. Heater ON/OFF

a. Outdoor temp. for heater ON | Initial setting: 32°F

Set outdoor temp when back-up heater starts to operate.
Setting range is -4°F ~ 59°F

User shall set whether to use or not to use heater.

b. Heater ON delay time | Initial setting: 30 minutes

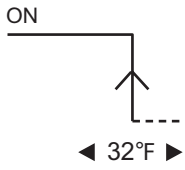
Set delay time from compressor ON for heater to turn ON if not achieve water set temperature.
Setting range is 10 minutes ~ 60 minutes

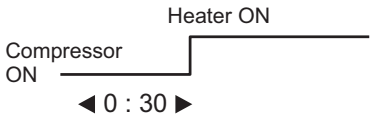
c. Heater ON: ΔT of target Temp | Initial setting: -7°F

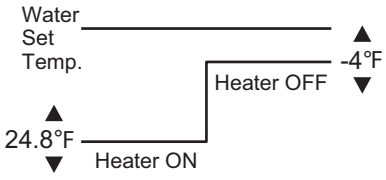
Set water temperature for heater to turn on at heat mode.
Setting range is -18°F ~ -4°F

d. Heater OFF: ΔT of target Temp | Initial setting: -4°F

Set water temperature for heater to turn off at heat mode.
Setting range is -6°F ~ 0°F





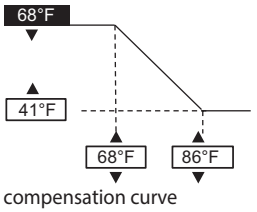


9 Installation

Figure 9-26 *Remote controller settings continued*

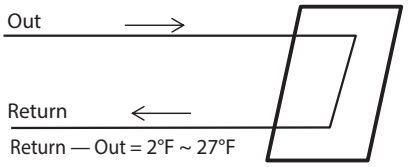
21. Water temp. for cooling ON | Initial setting: Compensation curve

Set target water temperature to operate cooling operation.
Compensation curve: Target water temperature change in conjunction with outdoor ambient temperature change.
Direct: Set direct circulation water temperature.



22. ΔT for cooling ON | Initial setting: 9°F

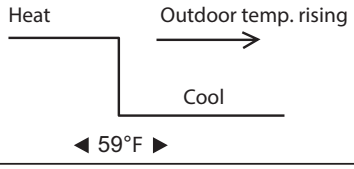
Set temp difference between out temp & return temp of circulating water of Cooling operation.
When temp gap is enlarged, it is energy saving but less comfort. When the gap gets smaller, energy saving effect gets worse but it is more comfortable.
Setting range is 2°F ~ 27°F



23. Outdoor temp. for (Heat to Cool) | Initial setting: 59°F

Set outdoor temp that switches from heating to cooling by Auto setting.
Setting range is 41°F ~ 77°F

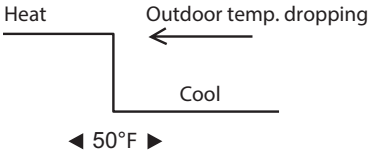
Timing of judgement is every 1 hour



24. Outdoor temp. for (Cool to Heat) | Initial setting: 50°F

Set outdoor temp that switches from Cooling to Heating by Auto setting.
Setting range is 41°F ~ 77°F

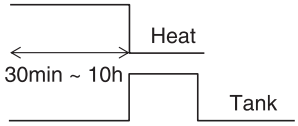
Timing of judgement is every 1 hour



25. **Floor operation time (max.)** | Initial setting: 8h

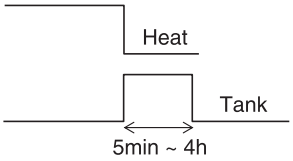
Set max operating hours of heating.
When max operation time is shortened, it can boil the tank more frequently.

It is a function for Heating + Tank operation.



26. **Tank heat up time (max.)** | Initial setting: 60min

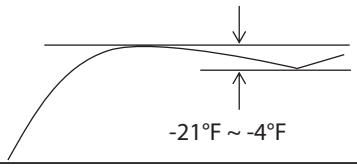
Set max boiling hours of tank.
When max boiling hours are shortened, it immediately returns to Heating operation, but it may not fully boil the tank.



27. **Tank re-heat temp.** | Initial setting:-14°F

Set temp to perform reboil of tank water.

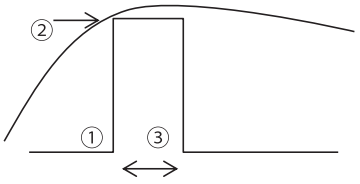
Setting range is -21°F ~ -4°F



28. **Sterilization** | Initial setting: 149°F 10min

Set timer to perform sterilization.
① Set operating day & time. (Weekly timer format)
② Sterilization temp (131°F ~ 167°F ❊ If use back-up heater, it is 149°F)
③ Operation time (Time to run sterilization when it reached setting temp 5min ~ 60min)

User shall set whether to use or not to use sterilization mode.



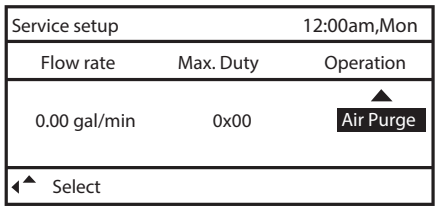
9 Installation

Figure 9-26 *Remote controller settings continued*

29. Pump maximum speed

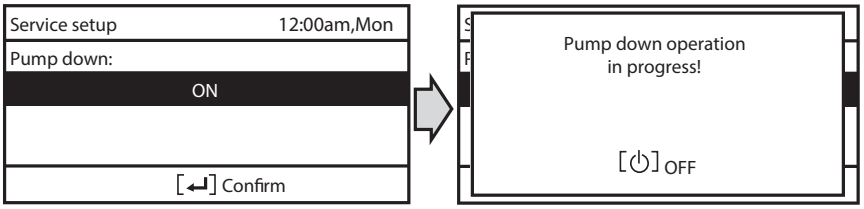
Normally setting is not necessary.
Please adjust when need to reduce the pump sound etc.
Besides that, it has Air Purge function.

When *Pump flow setting is Max. Duty, this duty set is the fix pump duty run during room side operation.



30. Pump down

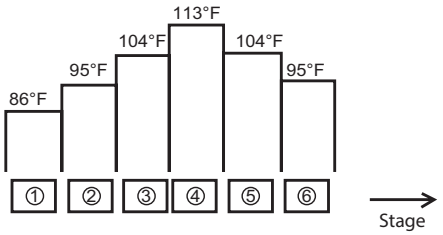
Operate pump down operation



31. Dry concrete

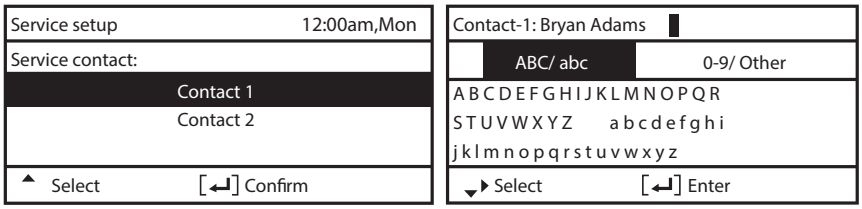
Operate concrete curing operation.
Select Edit, set temp for every stage (1~99 1 is for 1 day).
Setting range is 77~131°F

When it is turned ON, dry concrete starts.



32. Service contact

Able to set name & tel no. of contact person when there is breakdown etc. or client has trouble. (2 items)



10 Servicing Centrus using R32

About R32 Refrigerant

For refrigerants such as R410A, the refrigerants were collected back in order to prevent their air dissipation and to curb the global warming impact, in case they were released into the atmosphere. In the "4th Environmental Basic Plan", 80% reduction of greenhouse gas emissions by 2050 is required, and due to this requirement, further reduction in the emission of high greenhouse effect gas, such as CFCs, is required. Therefore, the conversion of air conditioning refrigerant into the ones who has smaller greenhouse effect, even if it is dissipated into the atmosphere, became our responsibility.

It would be the best if there is a refrigerant that has a smaller impact on global warming, but ensures good energy efficiency and performance, and is safe; however, there is no such refrigerant which satisfies all these conditions. As a result, we have been considering the practical usage, within the safety frame-work, of R32 refrigerant which has short lifetime in the atmosphere, and has smaller effect of global warming, but is slightly flammable.

In 2004, due to the revision of air conditioner safety standards by the International Electro-safety Commission (IEC), the safety standards of air conditioners using slightly flammable refrigerant was issued. In 2010, the regulations of American Society of Heating, Refrigerating and Air-Conditioning Engineers in the United States (ANSI/ASHRAE34) was issued adopting the grades for refrigerants which are difficult to inflame due to their slow burning rates, and as a result have smaller damages in cases of fire. The burning rate of R32 is lower by 4 inches / per second, and safety standardization for various usage is now being processed.

Characteristics of R32 Refrigerant

Chemical characteristics

R32 is one of the refrigerants used in R410A. It has almost no toxicity and is a chemically stable compound formed by hydrogen, carbon, and fluorine.

R32 has a short lifespan of 4 to 9 years in case of being released into the atmosphere; therefore, it has smaller greenhouse gas effects but has slight inflammability because of the large proportion of hydrogen.

Characteristics of pressure

As shown in Table 10-2, R32 does not have much difference in vapor pressure at the same refrigerant temperature comparing to R410A. Compared to R22, R32 is higher at 1.6 times more. Thus, the same as in case of R410A, it is necessary to do installation and service using high-pressure tools and components.

Table 10-1 *Chemical Characteristic of R32, R410A and R22.*

	R32	R410A	R22
Chemical Formula	CH2F2	CH2F2 / CHF2CF3	CHCLF2
Composition (mixture ratio wt. %)	Single Composition	R32 / R125A (50 / 50 wt.%)	Single Composition
Boiling Point (F)	-61.06	-60.7	-41.44
Pressure (physical) *1	455	445	281
Capacity (physical) *2	160	141	100
COP (physical) *3	95	91	100
Ozone Depletion Potential (ODP)	0	0	0.055
Global Warming Potential (GWP) *4	675	2090	1810
Inflammability *5	Slightly Inflammable (A2L)	Non-inflammable (A1)	Non-inflammable (A1)
Toxicity	None	None	None

*1: Physical property of temperature condition 122°F
*2: Relative value of temperature condition 32/122°F, providing R22=100
*3: Te/Tc/SC/SH=41/122/5/0°F
*4: GWP=Global Warming Potential, each figure is based on "4th IPCC4 Report"
*5: Based on ANSI / ASHRAE std. 34-2010

10 Servicing Centrus using R32

Table 10-2 *Saturated vapor pressure comparison*

Temperature	Refrigerant		
	R32 (PSI)	R410A (PSI)	R22 (PSI)
-4	43.5	43.5	20.3
32	102.9	101.5	58.0
68	198.7	195.8	117.5
104	345.2	336.5	207.4
140	556.9	540.9	337.9
149	622.2	604.8	377.1

Reference: Thermal properties table of Japan Society of Refrigerating and Air Conditioning Engineers (140, 149°F) NIST REFPROP V8.0 (-4 ~ 104°F)

Refrigerant piping installation

Required Tools

R32 refrigerant air conditioners use the common parts as R410A air conditioners for two-way valves and three-way valves (diameters of service ports); thus, they maintain commonality in the maintenance of the compressive strength, the size of pipe flaring, and the size of flare nuts as R410A. For refrigerant pipe installation and services, you can use tools for R410A.

However, mixing of refrigerants is not allowed. You must separate the cylinders for the recovery of refrigerants.

Table 10-3 *Tools used for installation*

Works	R32	R410A	R22
Flaring	Flare tools for R410A (clutch type)		Flare tools for R22 (clutch type)
Connection of pipes	Torque wrench (diameter 1/4 3/8)		
	Torque wrench (diameter 1/2 5/8) *1		Torque wrench (diameter 1/2 5/8)
Manifold gauge charging hose	R32 & R410A Common (As of November 2013)		R22 Only
Air purging	Vacuum pump + Reducer / expander		Vacuum pump
Gas leakage test	Detection liquid or soap water, HFC detector		

*1. Nut diameters of 1/2 5/8, the size of torque wrench common with R410A

Table 10-4 *Tools used for services*

Works	R32	R410A	R22
Insertion of refrigerant	Digital scale for refrigerant charging, refrigerant cylinders, cylinder adopters and packing *a		
Recovery of refrigerant	Refrigerant recovery devices, refrigerant cylinders, manifold gauges, charging hoses *b		

*a. Use cylinder for each refrigerant, cylinder adopter and packing.

*b. Use refrigerant recovery cylinder separately for each refrigerant (no mixture of refrigerant allowed). Please be aware that there are some refrigerant collection devices which do not have self-certification.

10 Servicing Centrus using R32

Tools for R32 (common with R410A)

Flare gauges

Use flare gauges when you perform flaring with flare tools (crutch type).

Figure 10-1 *Flare gauges*

Flare tools (clutch type)

Flare tools have larger holes and clump bars, and have stronger springs inside to ensure solid flaring torques. These flare tools can be used commonly for R22.

Figure 10-2 *Flare tools (clutch type)*

Torque wrenches (diameters 1/2, 5/8)

In order to strengthen the compressive strength, the diameters of wrenches change depending on the flare nut sizes.

Figure 10-3 *Torque wrenches*

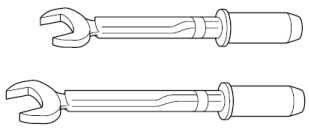


Table 10-5 *Differences in torque wrenches*

	R32 (common R410A)	R22
1/2 (diameter x torque)	1 in × 40.5 lb*ft	15/16 in × 40.5 lb*ft
5/8 (diameter x torque)	1-1/8 in × 47.9 lb*ft	1-1/16 in × 47.9 lb*ft

Manifold gauges

R22 gauges cannot be used because of the high pressures. Each port of manifold has different shapes in order to prevent inserting the wrong refrigerant.

*However, the port shape for R410A and R32 is the same; therefore, attention needs to be paid to ensure the wrong refrigerant is not used.

Table 10-6 *Differences in high/low pressure gauges*

	R32 (common R410A)	R22
High pressure gauges (red)	-14 ~ 753.8 PSI	-14~497.8 PSI
Low pressure gauges (blue)	-14~540.5 PSI	-14~241.8 PSI

Table 10-7 *Difference in manifold port sizes*

	R32 (common R410A)	R22
Port sizes	1/2 UNF20	7/16 UNF20

Charging hoses

The pressure resistance of charge hoses is increased. At the same time, the material is changed to HFC resistant, and the size of each manifold adopter is changed, as well as the port size of manifold gauge itself. Further, some hoses have anti-gas pressure backflow valves placed near the adapters.

Figure 10-4 *Manifold gauges / Charging hoses*

10 Servicing Centrus using R32

Table 10-8 Difference in manifold port sizes

		R32 (common R410A)	R22
Pressure Resistance	Normal operation pressure	739.7 PSI	493.1 PSI
	Burst pressure	3974 PSI	2494.6 PSI
Material		HNBR rubber Internal nylon coating	NBR rubber

Vacuum pump and Vacuum pump adopter

When using a vacuum pump, it is necessary to set a solenoid valve in order to prevent backflow of vacuum pump oil into the charge hoses. Use a vacuum pump with oil backflow prevention function, or use the vacuum pump with vacuum pump adapter. If vacuum pump oil (mineral oil-based) mixes with R410A (R32), it may cause damage to the machine.

Figure 10-5 Vacuum pump

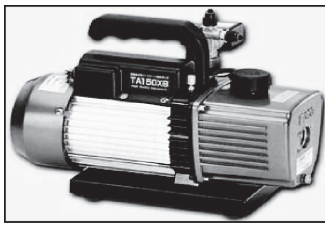
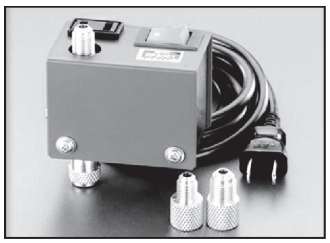


Figure 10-6 Vacuum pump adapter



HFC refrigerant electric gas leakage tester

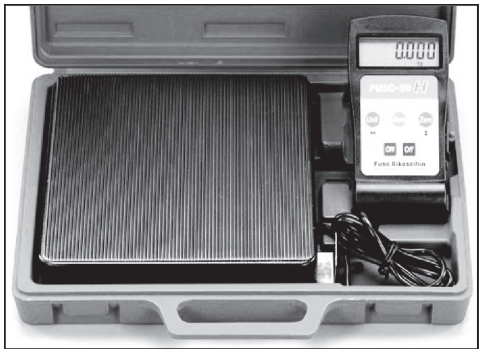
R32 refrigerant is often used for other mixed refrigerant (R410A, R404A, R407C etc.). Therefore, the usage of existing HFC detectors is possible, but in order to detect more accurately, we recommend to use detectors specially set and adjusted for R32 detection.

Figure 10-7 HFC refrigerant electric gas leakage tester

Digital scale for refrigerant charging

R32 and R410A have high pressure level and their evaporation speed is high. Thus, if you recover the refrigerant by cylinder charging method, the refrigerant evaporates within the weighing scale glass, which makes reading the scale difficult, rather than liquidating the refrigerant into the cylinder. (Charging cylinders for R22 have different pressure resistance, scale, connection port size; therefore, they are not usable.) At the same time, the digital scale for refrigerant charging is strengthened by receiving the weight of the refrigerant cylinders with four pillars at the corners. The connection ports of charging hoses have two separate ports for R22 (7/16 UNF20) and R32/R410A (1/2 UNF20) therefore, they can be used for the insertion of the existing refrigerants.

Figure 10-8 Digital scale for refrigerant charging



10 Servicing Centrus using R32

Refrigerant cylinders

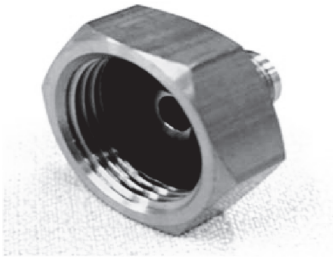
Refrigerant cylinders for R410A are painted in pink, and the ones for R32 are painted in other colors that are subject to change according to the international standards. R32 is a single refrigerant, so that both liquid and gas insertion are possible. Additional charging is also possible. (R410A is a mixed refrigerant, so only liquid insertion is possible).

Figure 10-9 *Refrigerant cylinder*

Connection ports of refrigerant cylinders and packing

Charging ports which fit to the charging hose connection port size (1/2 UNF20) are needed. At the same time, the packing has to be of HFC resistant materials.

Figure 10-10 *Connection port*



10 Servicing Centrus using R32

Table 10-9 *Tools used for refrigerant piping installations and services*

Tools for R410A	Common with R32	Possibility of usage for R22
Pipe cutters, reamers or scrapers	○	○
Flare tools (clutch type)	○	○
Torque wrench (1/4, 3/8)	○	○
Torque wrench (1/2, 5/8)	○	×
Manifold gauges / charging hoses	○	×
Vacuum pumps, vacuum pump adopters	○ Connection 5/16	○ Connection 1/4
Electric gas leakage testers for HFC *1	○	△
Digital scale for refrigerant charging	○	○
HCF recovery devices (connection port 5/16) *2	○ Connection 5/16	○ Connection 1/4
Refrigerant cylinders (pressure resistant: FC3)	Same specs ×	×
Refrigerant cylinders (pink)	Other (colors that might subject to change according to the international standards).	×
Refrigerant cylinder connection ports and packing	○	×
Allen wrench (5/32 in) Electric knives	○	○

*1 Those testers only for HCFC22 (R22), but not for HCF32 (R32) and HCF410A (R410A) cannot be for common use.
*2 Recovery devices which are self-certified for each HCF type can be used.

Knowledge for the common usage of tools for R410A & R32

R410A and R32 machines use different compressor oils. If unregulated compressor oil gets mixed in, it may cause damage to the machine function. Careful pump down will ensure the recovery of compressor oil, and it will minimize the remaining amount of the oil in the manifold gauge and charging hose. If you only perform the recovery of refrigerant and are not be able to perform pump down, you have to dispose of the compressor oil in the charging hose.

Precaution of repairing refrigerant cycle

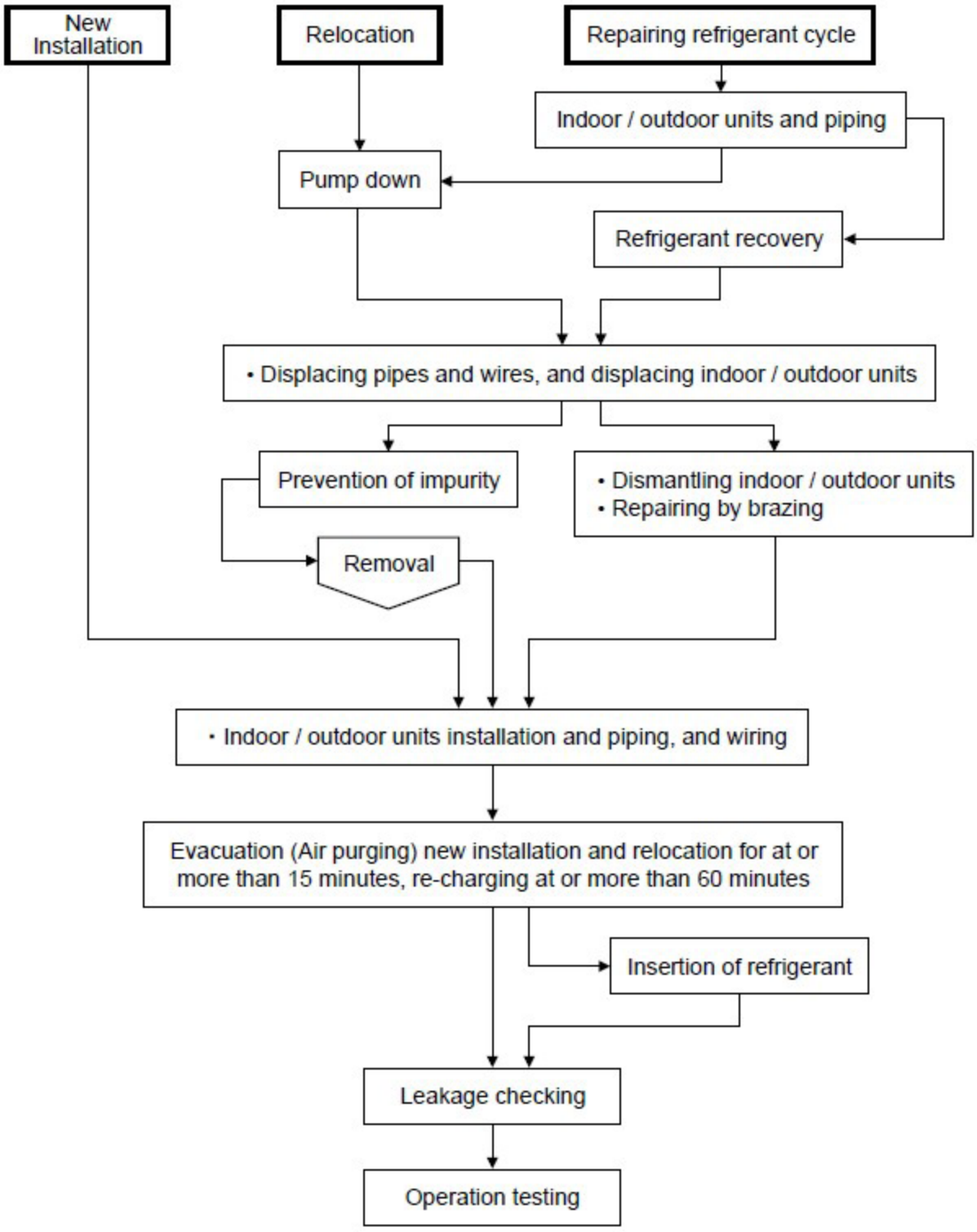
In the brazing, open two-way and three-way valves, and make sure the refrigerant is completely recovered back and not remaining the system. When repairing outside, make sure no refrigerant is in the air, ensure good air flow, and perform the brazing.

Inserting wrong refrigerant

It may cause “not cooling” and “not heating” customer claims because each component (expansion valve, compressor, PCB) of the refrigeration cycle is specially adjusted for R32. At the same time, if the wrong refrigerant was inserted into the system, it is not subject to product warranty.

10 Servicing Centrus using R32

New installation, Relocation, Repairing of Refrigerant Cycle System The Procedures



10 Servicing Centrus using R32

Piping installation of R32

Pipe materials used and flaring

Copper pipes are used for refrigerant piping. Pipes which comply with JIS Regulations need to be used. Room air conditioners which use R410A and R32 have higher pressure; thus, using pipes which comply with the regulations is important. The pipe thickness is regulated by revised JIS B 8607 "Flaring and brazing fittings for refrigerant" and the pipe thickness for R410A, R32 is shown in the table.

⚠CAUTION For connection piping, use copper phosphate seamless pipes (1220T) as regulated in "JIS H 3300" and the pipe thickness is 1/32 inches.

⚠CAUTION In the market, there are some pipes of 1/38 inches thickness, but do not use these pipes (1/32 inches thickness has to be strictly followed).

⚠CAUTION It is recommended to use pipes whose adhesion amount of oil is at or less than 0.0014 oz / 32.8 ft. At the same time, do not use pipes that have dents, are misshapen, or have changed colors (especially inside).

Processing and connection of pipes

For refrigerant pipe installation, be certain moisture and dirt do not get into the pipes, and make sure there is no refrigerant leakage.

The procedure of flaring and precautions:

a) Using a pipe cutter, cut the pipe slowly being sure not to misshape the pipe.

b) Remove the burrs on the edge of pipe using a reamer or scraper. If the condition of pipe edge after the deburring is no good or if burrs attach on the flaring, it may cause refrigerant leakage. Turn the pipe end down and perform deburring carefully.

c) Insert the flare nut.

d) Ensure the cleanliness of clump bar and pipe, and perform flaring carefully.

Use the existing flare tools or flare tools for R410A. Be aware that the sizes and dimensions of flaring is different in each flaring tool. If you use the existing flaring tools, use a flaring gauge to measure the length of the flaring part.

Table 10-10 *Pipe Thickness*

O and OL materials	Thickness (inches)		
Diameter	R410A	R32	R22
1/4	1/32		
3/8	1/32		
1/2	1/32		
5/8	1/25		

10 Servicing Centrus using R32

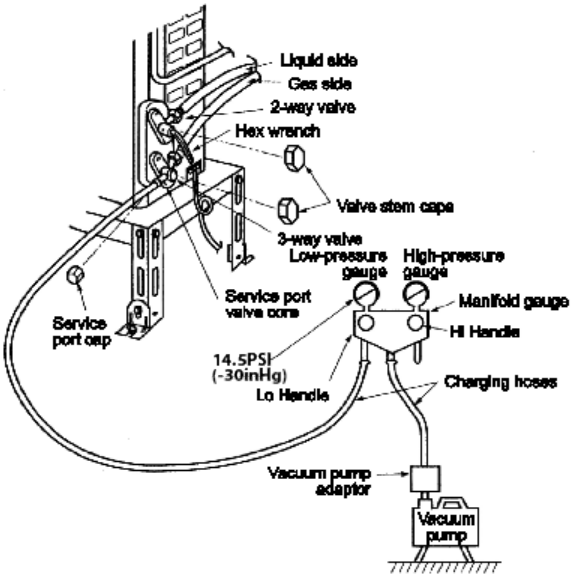
Installation, Relocation, and Service

Air purge and gas leak test for new installation (using new refrigerant pipes) using vacuum pump

From the point of view of global environment protection, do not release CFCs into the atmosphere during installation work.

1. Connect the charging hose of the manifold gauge to the service port of the three-way valve (pushing insert pin).
2. Fully open the handle "Lo" of the manifold gauge and operate the vacuum pump. (If the needle of the low-pressure gauge reaches the vacuum immediately, check procedure again)
3. Perform vacuuming 15 minutes or more, and make sure low pressure gauge reaches to (-30inHg). When done vacuuming, fully open the handle "Lo" of the manifold gauge and stop the of vacuum pump. Leave it for 1 ~ 2 minutes. Then remove the connection side of the charging hose of the vacuum pump adopter after ensuring the needle of the manifold gauge does not turn back.
4. Open the stem of the two-way valve 90° counter-clockwise, and close the two-way valve after 10 seconds. Perform a gas leakage test.
5. Remove the charge hose from the service port of the three-way valve. Carefully open the stems of the two-way and three-way valves counter-clockwise. Do not use full strength to open.
6. Tighten the service port cap with a torque wrench 13.3 lb*ft. Tighten the caps of the two-way and three-way valves with a torque wrench 13.3 lb*ft.
7. After tightening each cap, check for gas leakage around the cap.

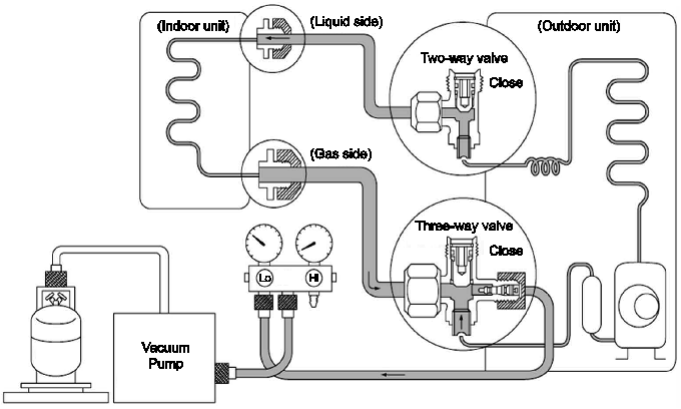
Figure 10-11 *Vacuum pump connection*



Process of refrigerant recovery

1. Connect the center charging hose of the manifold gauge to the in-let side of the recovery device.
2. Connect the valves of the discharge side of the recovery device and liquid side of refrigerant cylinder with the red hose (charging hose).
3. Connect the yellow float switch cable of the recovery device to the refrigerant cylinder.
4. Open the low pressure side valve of the manifold gauge.
5. Slightly loosen the charging hose of inlet connecting side of recovery device and perform an air purge.
6. Open the valve of the refrigerant cylinder and slightly loosen the charging hose in the discharging side of recovery device. Perform an air purge. The recovery cylinder needs slight pressure inside.
7. Insert the electric plug of the recovery device into an electrical outlet. The fan operation will start.
8. Turn valves 1 and 2 of the recovery device to pressure equalization point.
9. After a few seconds, turn the valves back to the original position.
10. Turn the switch of the recovery device to “ON”. The compressor operation will start.
11. When the low pressure of manifold gauge is close to “0”, close the low pressure side valve and turn “OFF” the recovery device switch.
12. Remove the center charging hose of the manifold gauge from the recovery device.

Figure 10-12 *Refrigerant recovery*



10 Servicing Centrus using R32

Relocation - Removing the air conditioning unit

Recovery of outdoor unit refrigerant by pumping down

Press “forced cooling button” (as a general rule, since 1998 the name of cooling testing button is changed, and this name is unified within the air conditioning industry), and then you are able to start cooling operation in which the room temperature is low, and you can recover the refrigerant from the outdoor unit.

1. Check the valve stems of the two-way and three-way valves are open by turning them counter-clockwise Remove the caps, and confirm the bars are fully open. Use a hexagon wrench (0.16 inches) to open and close the valves.
2. Press the “Emergency Operation” button of the indoor units for five seconds and release"Forced Cooling Operation" (for old models, press “forced cooling” button). Then operate the air conditioning unit for about 10 minutes.
3. Turn the stem of the two-way valve clock-wise and close the valve.
4. After about 2 ~ 3 minutes, turn the stem of the three-way valve quickly clock-wise, and stop the operation.
5. Attach and tighten the caps of the two-way and three-way valves with a torque wrench.

⚠CAUTION In the pump down operation, stop the compressor before removing the refrigerant pipes. If you do not stop the compressor operation, if the valve is open, and remove the refrigerant pipes, the air may be sucked into the system causing extremely high temperatures in the refrigerant cycle. This may result in rupture or injury, etc.

6. 6. Remove the connecting pipes (liquid side and gas side).

Removal of indoor and outdoor units

1. Remove the connecting pipes and wires between the indoor and outdoor units.
2. Attach capping flare nuts to the edges of the pipes connecting the indoor and outdoor units, in order to prevent dust and moisture from getting into the pipes.
3. Remove the indoor and outdoor units.

Replacement of air conditioning units and evacuation (when re-using the existing pipes)

When replacing the air conditioning units, you might use the existing pipes, but it is recommended to perform flaring again. In case of unit replacement, even if the unit is a new refrigerant air conditioner, if the refrigerant oil is different, it may cause problems. When re-using the existing refrigerant pipes, it is recommended to evacuate the pipes as much as possible because refrigerant oil may be attached on the surface of the pipes. If the pipes are used without evacuation, the remaining refrigerant oil may cause under-performance and abnormal refrigerant cycles caused by the non-compatibility of those oils.

⚠WARNING Do not operate air conditioning units inserting wrong (or mixed) refrigerant (R22, R410A, R32). It may cause malfunction of the units, and at the same time, may cause serious incident such as rupture of the refrigerant cycle.

Re-insertion of refrigerant in service

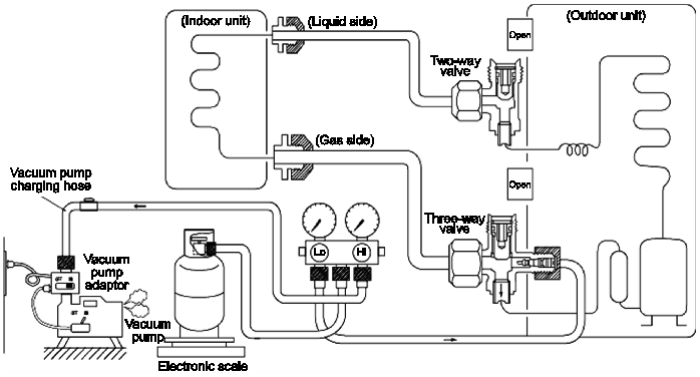
When re-insertion is needed, follow this procedure to ensure the insertion of new refrigerant at the correct amount.

1. Attach a charging hose (blue) to the service port of the outdoor unit.
2. Attach a charging hose (red) to the vacuum pump. Fully open the two-way and three-way valves.
3. Place the refrigerant cylinder on the digital scale for refrigerant charging and connect the charge hose (yellow) to the connection port of the vacuum pump and the digital scale. Leave the cylinder valve fully open.
4. Fully open the handles Lo and Hi of the manifold gauge, and switch on the vacuum pump. Then perform evacuation for at least one hour or more.
5. Confirm the compound gauge of (-30inHg) and fully open the handles of Lo and Hi. Switch off the vacuum pump. Leave it for about 1 ~ 2 minutes and confirm the needle of the compound gauge does not turn back. Refer to Figure 10-12.
6. Remove the charging hose (red) of the manifold gauge from the vacuum pump adopter.
7. After adjusting the digital scale to zero, open the cylinder valve and valve Lo of the manifold gauge, and insert the refrigerant.
8. If it is not possible to insert the refrigerant at regulated amount at once, operate the cooling mode and gradually insert the refrigerant (recommended amount approx. 5.3 oz / 1 time)
   *Do not insert too much refrigerant at once.

10 Servicing Centrus using R32

9. Close the open/close valve and insert the refrigerant in the charging hose to the outdoor unit.
   *Perform this procedure during cooling operation. Close the stem of the two-way valve, and when the pressure of the manifold gauge becomes zero (0), quickly remove the charging hose (blue). Immediately open the two-way valve and stop the cooling operation.
10. Confirm the two-way and three-way valves are fully open. Attach the caps of the service port and control valve, and then check for gas leakage around the caps.

Figure 10-13 *Re-insertion of refrigerant*



Analysis method for no error code, no cooling / no warming

In order to obtain appropriate operation characteristics, minimum 15 minutes or more operation time [testing operation (rated operation)] is required.

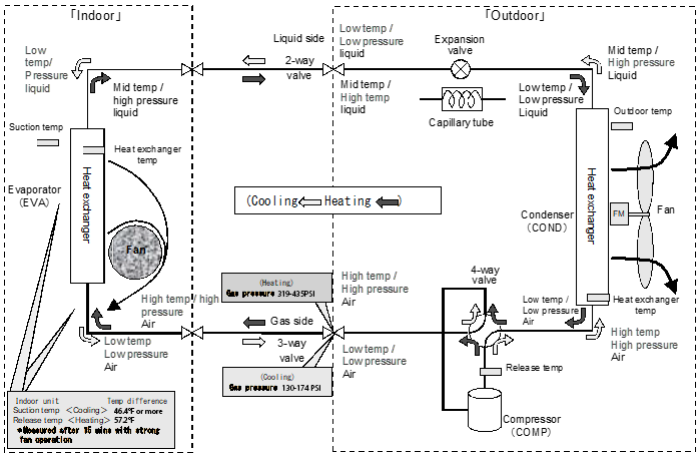
Method of rated operation

For the models which have two buttons of "emergency operation and forced cooling operation", press forced cooling button once. For the models which have only emergency operation button, press the button once for 5 seconds and when hear "beep" sound, release the button. Then, cooling operation starts.

Checking the mal-functions of indoor / outdoor units

1. Are any obstacles against heat release and air suction? (Short circuit, forget to remove the outdoor unit cover or fallen leaves blocking the outdoor unit)
2. Are the indoor unit air filters clean? (obstructing heat suction)
3. Is the setting temperature on the remote controller correct? (is the setting temperature set at lower/higher than the room temperature?)

Figure 10-14 *Analysis for no error*



10 Servicing Centrus using R32

Measuring temperature

1. Indoor unit suction temperature, release temperature, temperature difference, → Measure by thermometer
2. Two-way valve pipe temperature in cooling mode is low temperature (benchmark: 41 ~ 50°F), in heating mode is medium temperature (benchmark: 77 ~ 95°F).
3. Three-way valve pipe temperature in cooling mode is low temperature (benchmark: 44.6 ~ 59°F) in heating mode is high temperature (benchmark: 100.4 ~ 122°F).

Measuring electric current

Measuring electric current in operation → check by clump meter (refer to table of technical characteristic guideline)

Measuring pressure

Measuring gas pressure → check the pressure by manifold gauge (refer to table of technical characteristic guideline)

Any sound from the expansion valve? (when starting the operation and the outdoor unit is turned on, the expansion valve is re-set, check if there is any edged sound or clack sound)

Table 10-11 *Diagnosis of refrigeration cycle*

COMPARISON WITH NORMAL OPERATION	COOLING MODE	
	HIGH	LOW
REFRIGERANT PRESSURE	Excess insertion of refrigerant	Clogged capillary, expansion valve malfunction
	Heat releasing obstruction	Clog by moisture
	Dirty condenser, attachment of impurity	Lack of refrigerant gas
	Compressor malfunction	
OPERATION ELECTRIC CURRENT	Excess insertion of refrigerant	Lack of refrigerant gas
	Heat releasing obstruction	Compressor malfunction
	Dirty condenser, impurity	Mixture of air
		(Insufficient evacuation)
TWO-WAY VALVE TEMPERATURE	Excess insertion of refrigerant	Clogged capillary, expansion valve malfunction
	Compressor malfunction	Lack of refrigerant gas
THREE-WAY VALVE TEMPERATURE	Lack of refrigerant gas • Compressor malfunction	Excess insertion of refrigerant
	Clogged capillary, expansion valve malfunction	
SUCTION TEMPERATURE & RELEASE AIR TEMPERATURE	TEMPERATURE DIFFERENCE AT OR LESS THAN 46.4°F IN COOLING OPERATION CAUSES	
	• Heat releasing obstruction • Dirty condenser • Attachment of impurity	
	• Lack of refrigerant gas • Excess insertion of refrigerant	
	• Mixture of air • Mixture of moisture	
	• Clogged capillary • Expansion valve malfunction • Compressor malfunction	

All of the information above is based on the condition that the installation work is properly performed (no issues in indoor / outdoor pipe connections, etc.)

11 Operation and Control

Basic Function

Inverter control, which is equipped with a microcomputer for determining the most suitable operating mode as time passes, automatically always adjusts output power for maximum comfort. In order to achieve the suitable operating mode, the microcomputer maintains the set temperature by measuring the temperature of the environment and performing temperature shifting. The compressor of the outdoor unit operates following the frequency instructed by the microcomputer of the indoor unit, and judges the condition according to internal water setting temperature and water outlet temperature.

Internal water setting temperature

Once the operation starts, the control panel temperature setting will be taken as base value for temperature shifting processes. These shifting processes are dependent on the Air-to-Water Heat pump settings and the operation environment. The final shifted value will be used as internal water setting temperature and it is updated continuously whenever the electrical power is supplied to the unit.

Heating Operation

Thermostat control

The compressor is OFF when Water Outlet Temperature – Internal Water Setting Temperature > 3°F for continuously 3 minutes. The compressor is ON after waiting for 3 minutes, if the Water Outlet Temperature – Water Inlet Temperature (temperature at thermostat OFF is triggered) <-5°F.

Thermostat control (Outdoor Ambient Temperature)

Stops provided heating to room side during high outdoor ambient condition.

Control content:

Heating operation and water pump will turn OFF when outdoor ambient temperature > outdoor thermo off temperature + 5°F. (Outdoor thermo off set temperature is set by control panel. Thermo off set temperature is between 41°F ~ 95°F). Heating operation will resume when Outdoor ambient temperature < Outdoor thermo OFF set temperature + 1°F.

Heat Mode Operation

Operation of heat pump provide heating capacity to room side by hot water through heating panel, floor heating, or fan coil unit.

1. Three-way valve will switch and fix to room side.
2. Heat pump operation follows normal heating operation.
3. Back up heater operation follows normal operation.
4. Two-way valve will open.

Cooling Operation

Thermostat control

The compressor is OFF when Water Outlet Temperature – Internal Water Setting Temperature > -2°F for 3 minutes continuously. The compressor is ON after waiting for 3 minutes, if the Water Outlet Temperature – Water Inlet Temperature (temperature at thermostat OFF is triggered) >5°F.

Cool Mode Operation

1. Three-way valve will switch and fix to room side.
2. Heat pump operation follows normal cooling operation.
3. Room heater DOES NOT operate during cool mode.
4. Two-way valve is closed.

Target Water Temperature Setting

Target Water Temperature Control of Standard System

There are two types of temperature control selections: Compensation and Direct.

- Temperature control type selection by installer:
  1. Compensation: WLo, WHi, ODLo, ODHi can be set at installer menu.
  2. Direct: Direct Water Temperature Set
- Remote control setting by user:
  1. Compensation: Shift value ±9°F from the compensation curve
  2. Direct: Direct water temperature set change

*This setting is only able to set when the room sensor is selected as Water Temperature.

*Instead of water temperature, user will set target room temperature when room sensor select as Room Thermistor OR Internal Room Thermostat.

Target water temperature is calculated as below condition.

- Target water temperature = A (Base temperature) + B (shift temperature)
- B (shift temperature) value is depend on the room sensor selection at remote controller as Table 11-14

11 Operation and Control

Table 11-1 *Maximum/minimum regulation of Target Water Temperature.*

A (Base Temperature)	Compensation	Direct
	Value from the curve + User shift value set	Direct value from user setting

B (Shift Temp.)	B shift value depends on the room sensor selection at remote controller as shown in table below
Sensor selection	
Water temperature	B = 0
External Room thermostat	B = 0
Internal Room Thermostat & Room Thermistor	Cool Mode: B = 0 ; when Zone OFF or Zone Room Thermo OFF B = 1* (room set temp (R/C) - actual room temp) Max/Min Regulation of B: (Max = 9 ; Min = -9)
	Heat Mode: B = 0 ; when Zone OFF or Zone Room Thermo OFF B = follow Heating PI control contents

Table 11-2 *Operating Conditions*

	Heating	Cooling
Max	131°F (Below Ambient 24.8°F) *1 140°F (Ambient 5°F ~ 32°F or Above Ambient 77°F) *1 149°F (Ambient 41°F ~ 68°F) *1*2	68°F
Min	68°F	41°F

Update as below:-
*1 Between outdoor ambient 5°F and 68°F, the water outlet temperature gradually decreases from 140°F to 131°F.
*1 Between outdoor ambient 41°F and 32°F, the water outlet temperature gradually decreases from 149°F to 140°F.
*1 Between outdoor ambient 68°F and 77°F, the water outlet temperature gradually decreases from 149°F to 140°F.
*2 Only when ΔT is set to 27°F, the set temperature above 140°F will take effect.

Compensation Type: Operation under Heat Mode and Cool Mode

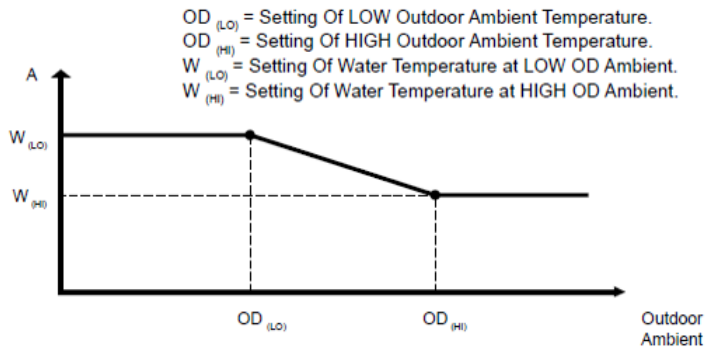
The set temperature defines the parameters for the ambient (Outdoor temperature) dependent operation of the unit. The water temperature is determined automatically depending on the outdoor temperature. If the default setting is colder outdoor temperature, the result will be warmer water and vice versa. The user has the possibility to shift up and shift down the target water by remote control setting.

Outdoor ambient is updated every 30 minutes when operation is ON. When setting the water outlet temperature always follow W(LO) or W(HI) whenever it is higher if outdoor ambient sensor or indoor communication error happens.

However, when a powerful mode is requested by remote control during heating mode, the higher value of WLo or WHi will be used for a calculation.

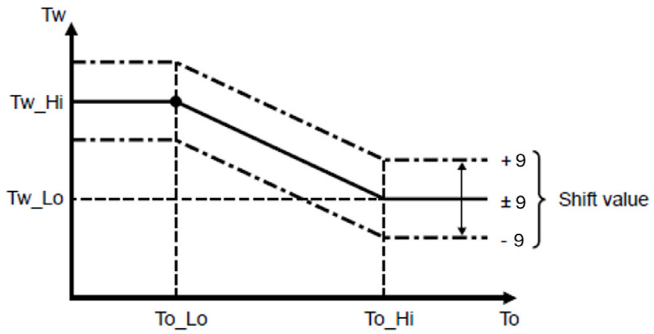
There are 2 compensation curves (for heating and cooling). During heating mode, the heating curve is used and during cooling mode, the cooling curve is used.

Figure 11-1 *Heating and cooling operation*



11 Operation and Control

Figure 11-2 Compensation curve



Auto Mode Operation

Control details:

To enable the unit to operate either heat or cool mode automatically, heat to cool set temperature and cool to heat set temperature can be set by the control panel. Automatic operation is judged based on control panel setting temperature and outdoor ambient temperature. Minimum setting of heat to cool set temperature is 2°F higher than cool to heat set temperature.

Judgement control:

If outdoor ambient temperature < Heat to Cool Set Temperature, unit will operate in Heat Mode or else the unit will operate in Cool Mode. If current operation is Cool mode, outdoor ambient temperature > Cool to Heat Temperature, unit will maintain Cool mode operation or else the unit will operate Heat mode.

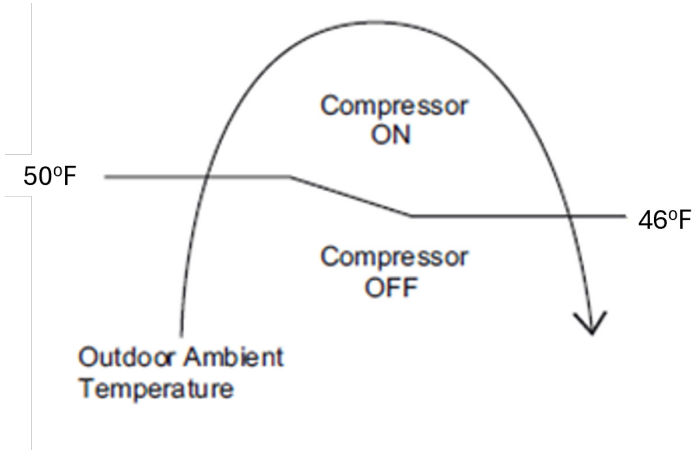
If current operation is Heat mode, outdoor ambient temperature > Heat to Cool Temperature, unit will maintain Heat mode operation or else the unit will operate Cool mode. Every 60 minutes the outdoor ambient temperature is judged. When Auto + Tank mode is selected, operating mode switching is judged by both outdoor ambient temperature and indoor air temperature.

Auto Cooling Mode Operation Limit

Auto Mode Cooling Only operation will start once the outdoor ambient temperature reaches 50°F and the compressor will continue to run until the outdoor ambient temperature drops to 46°F.

Due to this limitation, If Heat to Cool temperature is set lower than 50°F, the compressor will not operate until the outdoor ambient temperature reaches 50°F or higher.

Figure 11-3 Auto Cooling mode



Tank Mode Operation

The three-way valve will switch to tank side during Tank Thermo ON condition. Switch the three-way valve to room side when the tank achieves Tank Thermo OFF temperature.

Tank Thermo ON/OFF Characteristics: Tank Thermo OFF

Case 1: Internal Tank Heater is select and Tank Heater ON

- Tank temperature > Tank Set Temperature continuously for 15 seconds.
- Water outlet >167°F

Case 2: Tank Heater OFF OR External Heater is select

- When heat pump OFF due to water thermos & Tank temperature > Tank water set temperature for continuously 20 seconds. OR
- Tank temperature > Tank set temperature + 1°F for continuously 20 seconds.

Tank Thermo ON/OFF Characteristics: Tank Thermo ON

Case 1: Internal Tank Heater is select and Tank Heater ON

- Tank temperature < Tank set temperature + R/C (Tank re-heat temperature)

Case 2: Tank Heater select OFF OR External Heater is select

- Tank temperature < Tank water set temperature + R/C (Tank re-heat temperature)

  *When tank thermo ON, water pump will be ON for 3 minutes, then only the heat pump will turn ON.

  *Tank water set temperature = tank set temperature or tank limit temperature (whichever is lower).

11 Operation and Control

Outdoor ambient temperature	Tank limit temperature
OD < 1°F	118°F
1°F <= OD < 96°F	125°F
96°F <= OD	122°F

Heat pump Water Outlet set temperature is set to below table:

Outdoor ambient temperature	Tank limit temperature
OD < 1°F	129°F
1°F <= OD < 26°F	132°F
26°F <= OD	138°F

Characteristic of heat pump thermos ON/OFF under tank mode condition:

1. Heat pump thermo OFF temperature = Target Water outlet temperature + 3°F.
2. Water outlet temperature > heat pump thermo OFF temperature for continuously 90 seconds, heat pump OFF but water pump continue ON.
3. Heat pump thermo ON temperature = water inlet during thermo OFF time + [-5°F].
4. When water outlet temperature < heat pump thermo ON temperature, heat pump ON.
5. Water inlet temperature > [140°F] for continuously 30 seconds, heat pump OFF, water pump continue ON.
6. Heat pump thermos ON temp = water inlet temperature < [140°F].

Thermo ON/OFF for Heat Pump in Tank Operation:

When tank temperature achieves heat pump OFF condition, refer to the below condition:

Condition 1: When Internal Tank Heater is selected and Tank Heater ON

- Heat pump will turn OFF, water pump continue ON and room heater will continue ON if tank temperature below tank heater thermo ON condition. Three-way valve will only switch to room side after tank temperature reaches tank heater thermo OFF condition.

Condition 2: When Tank Heater selected OFF OR when External Tank Heater is selected and Tank heater ON

- If the tank temperature achieves tank thermo OFF, heat pump will turn OFF, water pump will turn OFF, room heater will turn OFF and the three-way valve switches to room side.

When tank temperature achieve heat pump ON condition, water pump ON, heat pump ON and room heater turn OFF.

Heat pump OFF condition at Tank Mode

- Tank temperature > tank water set temperature continuously for 20 seconds after heat pump thermos OFF due to water thermo. (Heat pump turn OFF but water pump continue ON and room heater turn ON to achieve tank set temperature)

OR

- Tank temperature > tank set temperature + [1°F] for continuously 20 seconds. (Heat pump OFF, water pump OFF, room heater OFF and three-way valve switches to room side)

Heat pump ON condition at Tank Mode

- Tank temperature < tank water set temperature + R/C setting (Tank re-heat temp)

(Water pump turn ON OR continue ON, heat pump ON and three-way valve switches to tank side or maintains at tank side)

11 Operation and Control

Internal heater control

Internal heater only operates to tank side if the Internal Tank Heater is select, Tank heater ON and backup heater is enable.

Internal heater turn ON condition:

- Tank temperature < tank set temperature AND
- Heat pump thermos OFF AND
- 20 minutes from previous heater off AND
- Internal tank heater selects USE from control panel.

Internal heater turn OFF condition:

- Tank temperature > tank set temperature for continuously 15 seconds OR
- Heat pump thermo ON OR
- Mode change or operation is off by control panel.

External Heater control

- External heater only operate to tank side if tank heater ON & External Heater select.

Heat + Tank Mode Operation

1. Three-way valve control:
   - Three-way valve switch to room side during room heat-up interval and switch to tank side during tank heatup interval. Both modes will switch alternately. Tank mode is the initial running mode of Heat + Tank mode.
2. Heat pump operation control:
   - During room heat-up interval, Follow normal heating operation. Switching to tank side depends to below cases:

     Case 1: Previous switch from tank interval to room interval due to thermo OFF

     - Switch to tank heat-up interval when Tank temp < Tank thermos ON temp (Room heat-up interval ends)

     Case 2: If heating operation at room side is less than 30 minutes and switch to tank side 3 times consecutively

     - Maintain at room heat-up interval regardless of the tank temperature. Switch to tank heat-up interval only when (Room Interval Timer is complete OR Room heat pump thermo OFF) AND Tank temperature < Tank thermo ON temperature.

     Case 3: Previous switch from tank interval to room interval due to tank interval timer is complete

     - Maintain at room heat-up intervals regardless of the tank temperature. Switch to tank heat-up intervals only when (Room Interval Timer is complete OR Room heat pump thermo OFF) AND tank temperature < Tank thermo ON temperature.
     - Tank interval is the first mode running when heat + tank mode is select.
     - Switch to room interval only when tank achieve tank thermo OFF OR tank heat-up interval timer is complete.
     - Heat pump operates according to normal tank mode operation.
3. Room heater control:
   - During heating heat-up interval, follow the normal room heater control operation.
4. Tank heater control:
   - During heating heat-up interval, if External tank heater is selected, External heater is ON/OFF according to external tank heater operation control.
   - If internal tank heater is selected, internal tank heater will not function under heating heat-up interval.
   - During tank heat-up interval, if External tank heater is selected, once the heating heat-up interval is switched to tank heat-up interval and tank heater is turned OFF, tank heater delay timer will start counting.
   - Tank heater will turn ON after tank heater delay timer is fulfilled and the tank temperature is lower than the tank set temperature.
   - Tank heater delay timer is clear when switching to heating heat-up interval.
   - If internal tank heater is selected, The Internal tank heater will turn ON once the heat pump is off and will continue to heat the tank up to tank set temperature.
   - Two-way valve control is open
   - Indoor water pump will always turn ON if the room heat pump thermo is ON OR Tank thermo is ON.

11 Operation and Control

Cool + Tank Mode Operation

The three-way valve switches to room side during room cooling interval and switches to tank side during tank heat-up interval. Both modes will switch alternately. Tank mode is the initial mode of cool + tank mode.

During room heat-up intervals, follow normal cooling operation.

Switching to tank side depends on the below cases:

Case 1: Previous switch from tank interval to room interval due to thermo OFF.

- Switch to tank heat-up interval when Tank temperature < Tank Thermo ON temperature (Room interval will end).

Case 2: If cooling operation at room side is less than 30 minutes and switches to tank side for 3 times consecutively.

- Maintain at room cooling interval regardless of the tank temperature. Switch to tank heat-up interval only when (Room Interval Timer is complete OR Room heat pump thermo OFF) AND Tank temperature < Tank thermo ON temperature.

Case 3: Previous switch from tank interval to room interval is due to tank interval timer is complete.

- Maintain at room cooling interval regardless of the tank temperature. Switch to tank heat-up interval only when (Room Interval Timer is complete OR Room heat pump thermo OFF) AND tank temperature < Tank thermo ON temperature.

Table 11-3 *Cool and Tank Mode Operation*

Internal Tank Heater select USE	<Tank set temperature + R/C setting (Tank re-heat temperature)
Others	<Tank water set temperature + R/C setting (Tank re-heat temperature)

During tank heat-up interval, tank interval is the first mode running when the cool + tank mode is select. Switch to room interval only when tank achieves tank thermo OFF OR the tank heat-up interval timer is complete. Heat pump operates according to normal tank mode operation.

Room heater control

During room cooling interval, room heater is OFF and does not operate.

Tank heater control

During room cooling interval, if External tank heater is selected, the external heater will be ON/OFF according to external tank heater operation control.

If internal tank heater is selected and tank heater ON, the internal tank heater will not function under room cooling interval.

During tank heat-up interval, if External tank heater is selected, once room cooling interval switches to tank heat-up interval, the tank heater will turn OFF and tank heater delay timer will start counting.

Tank heater turns ON after the tank heater delay timer is fulfilled, and the tank temperature is lower than tank set temperature. Tank heater delay timer is clear when switching to room cooling interval.

If internal tank heater is selected and tank heater is ON, internal tank heater will turn ON after heat pump thermos is off and will continute to heat until boil tank temperature is met.

The two-way valve is closed.

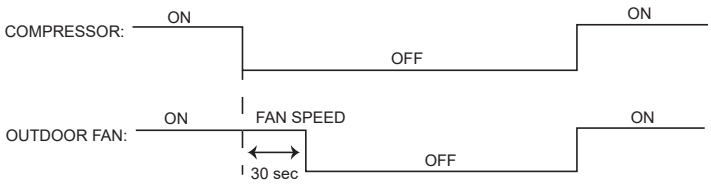
Indoor water pump control:

The indoor water pump always turns ON if the room heat pump thermo is ON OR Tank thermo is ON.

Outdoor Fan Motor Operation

Outdoor fan motor is adjusted according to operation conditions. It starts when the compressor starts operation and it stops 30 seconds after compressor stops operation.

Figure 11-4 *Outdoor fan operation*



11 Operation and Control

Water Pump

Water pump control

Once the indoor unit is ON, the water pump will be ON immediately with no error judgment for 70 seconds. However, during this 70 seconds of operation, if there is any abnormality caused at outdoor or malfunction, the compressor should be OFF immediately and restart delay after 3 minutes.

The system will start checking on the water flow level after operation starts for 70 seconds. If water flow level is detected to be low continuously for 60 seconds, the water pump and the compressor will be OFF permanently and OFF/ON control panel LED will blink (H62 error occurs).

When the H62 error happens, the power has to be reset to clear the error. If there is no error indication, the water pump shall be continuously running.

The water pump will remain ON when the compressor is OFF until the thermostat OFF setting is reached. The water pump will be OFF when room thermo, tank thermo, OR buffer tank thermo is OFF.

The water pump will delay for 15 seconds and turn OFF when requested to turn OFF except when anti-freeze de-ice activates or during air purge mode.

Water pump control

Once the indoor unit is ON, the water pump will turn ON immediately with no error judgment for 70 seconds. However, during this 70 seconds of operation, if there is any abnormality caused at outdoor or malfunction, the compressor should turn OFF immediately and delay restart for 3 minutes.

The system will start checking on the water flow level after operation starts for 70 seconds. If water flow level is detected to be low continuously for 60 seconds, the water pump and the compressor will turn OFF permanently, and the OFF/ON control panel LED will blink (H62 error occurs).

When error H62 occurs, the power has to be reset to clear the error. If there is no error indication, the water pump will be continuously running.

The water pump will remain ON when the compressor is OFF due to the thermostat OFF setting being reached.

The water pump will be OFF when room thermo, tank thermo, OR buffer tank thermo is OFF.

The water pump will delay for 15 seconds, turn OFF when requested to be OFF except during anti-freeze de-ice activation or air purge mode.

Maximum pump speed setting on remote control

When Pump flowrate setting is ΔT Standard pump speed is automatically controlled to get the designated water temperature difference between the water inlet and outlet (ΔT). The maximum pump speed setting limitation can be adjusted by the installer according to water circuit pressure drop condition.

When pump flowrate setting is Max Duty Indoor water pump speed will operate at the maximum pump speed setting at room side operation. The maximum pump speed setting can be adjusted by the installer according to water circuit pressure drop condition. However, the following sequences do not follow maximum pump duty setting by remote control:

- Pump down mode
- Air purge mode
- Normal de-ice

11 Operation and Control

Figure 11-5 *Water pump controls*

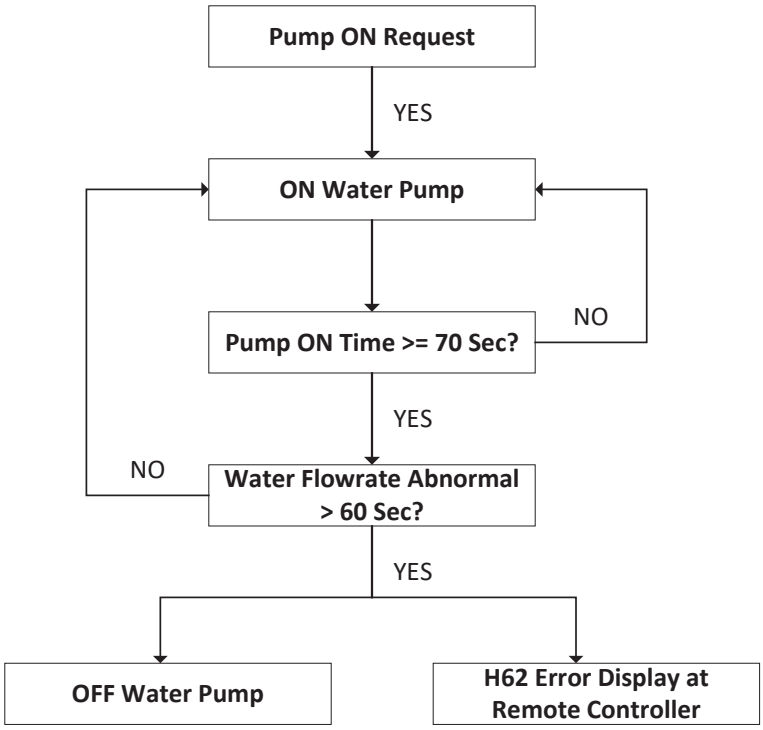
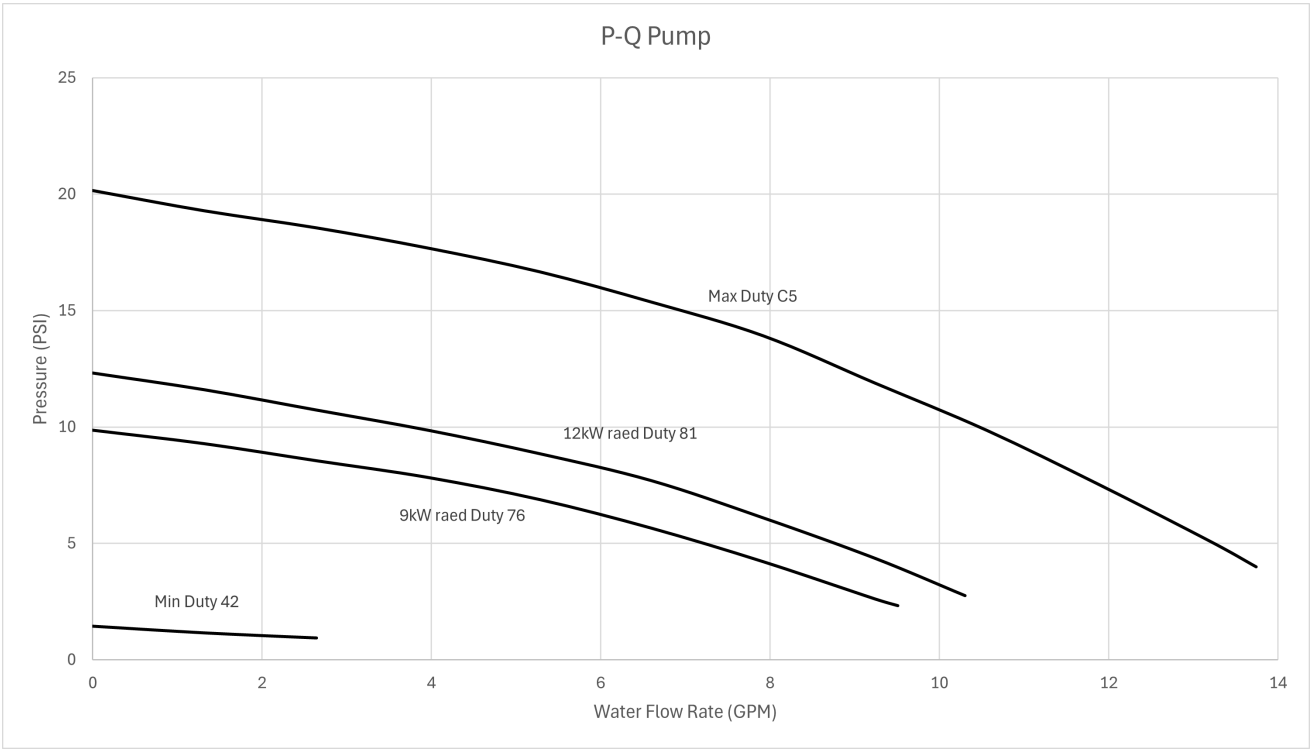


Figure 11-6 *P-Q graph for different pump HEX duty*



11 Operation and Control

Water Pump Speed Feedback Error

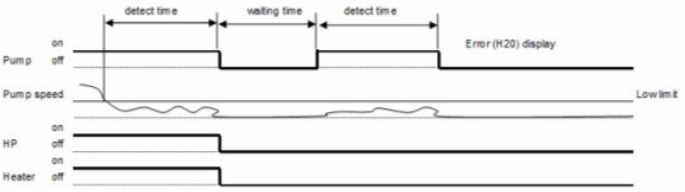
Pump speed feedback is controlled by micon. When pump speed is below low limit or over high limit for a few seconds, micon detects a pump error and the system is stopped.

Error detection conditions are the following:

- Detect abnormal water pump speed for continuous 10 secs.
- Current pump speed < 700 rpm or
- Current pump speed > 6000 rpm for 10 seconds.

When an error occurs, water pump, heating, and heater is stopped for 30 seconds. Then restart (Retry control). When micon detects an error again, the system is stopped and error code "H20" is displayed on the control panel.

Figure 11-7 *Pump speed feedback*



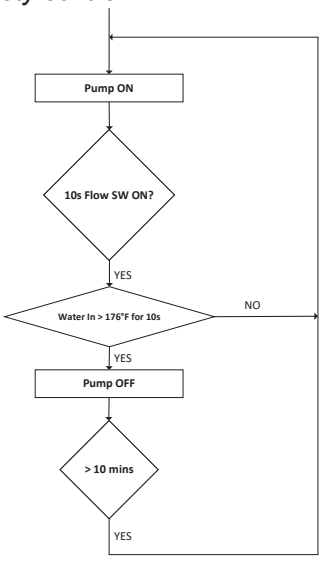
Indoor Unit Safety

Indoor Unit Safety Control

When the water pump is ON, the system will start checking flow switch status (ON/OFF). If the flow switch is ON for 10 seconds, the system will check the water inlet temperature for 10 seconds. If the water inlet temperature does not exceed 176°F, the water pump will run continuously with normal mode. If the water inlet temperature exceeds 176°F continuously for 10 seconds, the water pump will turn OFF immediately.

After the water pump is OFF for more than 10 minutes, it will turn ON, and the indoor unit safety control check is restarted.

Figure 11-8 *Safety control*



Auto Restart Control

When the power supply is cut off during the operation of Air-to-Water Heat pump, the compressor will reoperate after power supply resumes.

Indication Panel

Table 11-4 *Indication Panel*

LED	Operation
Color	Green
Light ON	Operation ON
Light OFF	Operation OFF

NOTICE If Operation LED is blinking, there is an abnormality in operation occurring.

Internal Back-Up Heater Control

Internal Electric Heater Control

Normal Heating Mode

- Heater On condition:
  a. Heater switch is ON.
  b. After Heatpump thermo ON for [Remote Control Set Delay Time] mins
  c. After water pump operates for [1] min
  d. Outdoor air temperature < Outdoor set temperature for heater
  e. When water outlet temperature < Water set temperature + [Remote Control Heater ON Setting]
  f. [20] minutes since previous Backup heater Off

  *When heatpump cannot operate due to an error happening during normal operation, the heater will go into force mode automatically.

  *Heater needs to operate during de-ice operation.
- Heater Stop Condition:
  a. When outdoor set temperature > outdoor set temperature +3°F for continuous 15 secs OR
  b. When water out temp> water set temperature + [Remote Control Heater OFF Setting] for a continuous 15 secs OR
  c. Heater switch is Off OR
  d. Heatpump thermo-off or OFF condition

11 Operation and Control

Force Heater Mode

- Heater On condition:
  a. After water pump operate [2] mins
  b. When water outlet temperature < water set temperature + [Remote Control Heater ON Setting]
  c. [20] minutes since previous Backup heater Off
- Heater Stop condition
  a. Force mode off OR
  b. When water outlet temperature > water set temperature + [Remote Control Heater OFF Setting] for continuous 15 secs

Do not operate heater if:

- the water outlet temperature sensor and water inlet sensor are abnormal
- The flow switch is abnormal
- The circulation pump stops

Room Heater Operation during De-ice

The purpose of this function is to protect the indoor Heat Exchanger from ice forming and preventing heat exchanger plate breakage.

This Heater protection control will activate only if the backup heater is enabled at custom setup by the remote controller. Once the start condition is fulfilled, the room heater will turn ON together (based on max heater capacity selection) and stop together if stop condition is fulfilled.

If the heater is requested to turn ON, OLP feedback will be detected.

Starting conditions:

1. During normal de-ice operation 4~9
2. Water outlet temperature < 44°F
3. Water Flow rate < 5.28gal/min
4. Water outlet temperature < 50°F or
5. Outdoor air temperature < -22°F or
6. Water inlet temperature < 50°F

The heater operates when 1 ~2 fulfilled OR When 1 and 3 ~ 4 is fulfilled.

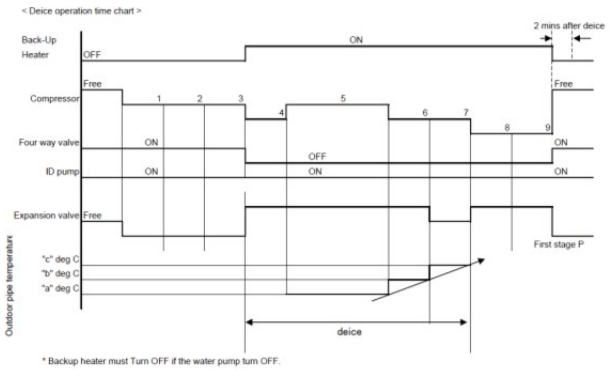
However, this control does not relate to the Heater ON/OFF button on remote control.

Stop condition:

1. When normal de-ice end or
2. Water outlet temperature > 113°F

However, the room heater keeps ON if indoor electric heater control activates.

Figure 11-9 *Heating operation condition*



Tank Heater Control

Tank Heater Remote Control Setting

Tank heater selection:

- External: - Booster Heater used to heat up the tank when selected external
- Internal: - Backup Heater used to heat up the tank when selected internal

* When selected External Tank Heater, Heater Delay is ON and Timer need to be set. (range 20 min ~ 3 hrs)

Tank Heater ON/OFF selection by user.

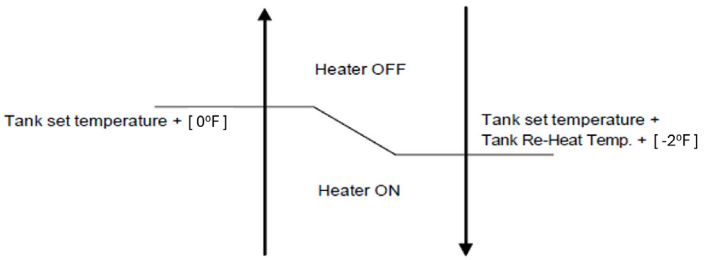
The remote control Tank set Temperature range will change according to the External and Internal Tank Heater use.

Table 11-5 *Tank heater selection*

Tank Heater Selection	Range
External	104 ~ 167°F
Internal	104 ~ 149°F

External Heater Control at Tank Side

Figure 11-10 *Heating control at tank side*



11 Operation and Control

Tank heater Turn On condition:

1. External Heater selected for Tank heater by remote controller.
2. Tank Heater selected ON by user.
3. Tank mode operation ON (Tank mode, Heat + Tank, or Cool + Tank).
4. After TANK HEATER DELAY TIMER is fulfilled during heat pump startup time in tank mode, or during switching from heating heat-up interval to tank heat + up interval in heat + tank mode.
5. Tank temperature < tank set temperature +[Remote controller Set Tank Re-heat Temp] + [-1°F].
6. 20 minutes since previous heater off.

* TANK HEATER DELAY TIMER is clear when tank heat-up interval end.

Tank heater Turn Off condition:

1. Tank temperature > tank set temperature + [0°F] for a continuous 15 seconds.
2. When BOOSTER HEATER DELAY TIMER start count after switch from heating heat-up interval to tank heatup interval.
3. Tank Heater select OFF by user.
4. Tank Mode Operation OFF.

Internal Heater Control at Tank Mode

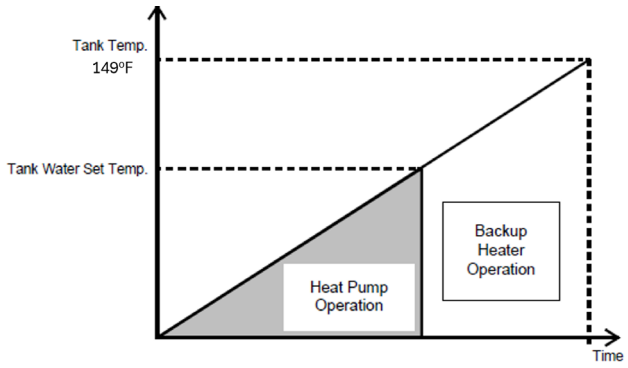
Internal heater turn On condition:

1. Internal Heater selected for Tank heater by remote controller
2. Tank Heater select ON by user
3. Backup Heater Enabled
4. Tank Temperature < Tank Set Temperature
5. Heat Pump Thermo OFF
6. 20 minutes since previous heater off

Internal heater turn OFF condition:

1. Tank Temperature > Tank Set Temperature + [0°F] for a continuous 15 seconds OR
2. Heat Pump Thermo ON OR
3. Mode Change or Operation OFF by remote controller OR
4. Water outlet temperature >167°F.

Figure 11-11 *Internal heater control*



Base Pan Heater Control

There are 2 start conditions that can be selected: Type A or Type B.

Type A is the default mode. It will start when outdoor air temperature is ≤ 37°F during heating and de-ice operation is ON. Base pan heater is ON during de-ice operation and continues to be ON for 10 minutes after de-ice operation ends.

Type A will turn off when outdoor temperature > 42°F after de-ice end, when operation is not at heating mode, or Base pan heater ON timer count is completed.

Type B is the ON Mode. It will start hen outdoor air temperature is ≤ 41°F and operates in heating mode, base pan heater is ON.

Type B will turn of hen outdoor air temperature is > 44°F or when operation is not at heating mode.

Heater Turn ON/OFF Priority Control

This control allows only one heater between room and tank heater to turn ON at the same time due to both heater power supplies sharing the same ELCB. Prohibit two heater sources from turning ON at the same time to avoid overcurrent.

Heater Turn ON/OFF Priority Control will turn on when the Tank heater function is selected YES by the remote controller.

When there is only one heater source (Room Heater or Tank Heater) request to turn ON, it will operate same as normal room heater and tank heater operation.

When both backup heater and booster heater request to turn ON at same the time, it will turn ON only ONE heater source. Under normal conditions, tank heater has priority to turn ON with the exception of the below conditions:

- 1 Backup Heater Priority to Turn ON when
  - ◊ Request Backup heater turn ON at Hex Protection control during de-ice
  - ◊ Request Backup Heater turn ON at Hex Protection Control during low water temperature
  - ◊ Request Backup Heater turn ON at Anti-frost control
  - ◊ Heat pump error and Force Mode operate.

11 Operation and Control

When switching from booster heater to backup heater OR backup heater to booster heater, delay 5 seconds in between Turn OFF one heater source and Turn ON another heater source.

Force Heater Mode

The purpose of Force Heater Mode is to have a backup heat source when there is a heat pump error. Force Heater Mode controls backup heaters to heat up the room circuit, and turn ON back up heater or booster heater to heat up tank water based on the tank heater selection (internal or external).

To start Force Heater Control, Force Heater request ON by user OR auto turn ON by remote controller during error. Force Heater mode can be operated regardless of mode selection. Remote controller will be sent the latest mode selection and force bit to indoor. Indoor will judge whether to turn ON heater to room side if heat mode is selected, and turn ON heater to heat up tank water base on tank heater selection.

During an Error, exclude the error list below.

Table 11-6 *Force Heater Errors to Exclude*

H12	Capacity Mismatch
H20	Abnormal Water Pump
H62	Abnormal Water Flow
H70	Abnormal Back-up Heater OLP
H74	PCB Communication Error
H76	Indoor-Remote Controller Communication Error
H95	Abnormal Voltage Connection
F37	Abnormal Water Inlet sensor
F45	Abnormal Water Outlet sensor
H91	Abnormal tank heater OLP
[When tank mode operates with external heater selected & tank heater select ON]	
H72	Abnormal tank sensor

Force Heater Control Stop Conditions:

- Force Heater request OFF OR
- Operation OFF request OR
- Mode change request OR
- Power reset OR
- Error of above list happens during force heater operation.

After fulfilling start conditions, indoor will operate the force heater operation according to the below mode conditions"

- Heat mode Only: Turn ON backup heater to achieve room heat pump target water temperature.
- Heat + Tank mode: Turn ON backup heater to heat up room OR Turn ON Heater to heat up tank water.
- Cool mode Only: Water pump and backup heater will be OFF in force heater mode
- Cool + Tank mode: Operate pump and internal Heater OR External heater to heat up tank water.
- Tank mode Only: Operate pump and internal Heater OR External heater to heat up tank water.

*For heat mode conditions, backup heater will only turn ON if the backup heater is enabled, regardless of Room.

Heater Selection

For tank mode conditions, if internal heater is selected, the backup heater will turn ON to heat up tank water. If external heater is selected, booster heater will turn ON to heat up tank water regardless of tank heater selection.

Room Side: (Heat Mode)

1. When force heater mode start conditions are fulfilled, turn ON water pump and turn ON backup heater follow below control.
2. Operate the three-way valve at room side only and turn ON two-way valve as heat mode is operating.
3. If buffer tank connect is YES, control according to normal zone pump and mixing valve control.
4. When Force heater mode stop conditions are fulfilled, turn OFF heater as below condition and turn OFF water pump after pump delay time.

Backup Heater On Condition:

1. When Force Heater Control start conditions are fulfilled AND
2. After water pump operates for 2 minutes AND
3. When water outlet temperature < water set temperature + [Remote Control Heater ON Setting] AND
4. 20 minutes since previous Backup heater Off AND
5. Backup Heater Enabled

Tank side (Tank mode)

1) When tank mode is selected and force heater bit received, turn ON backup heater (INTERNAL) or Booster Heater (EXTERNAL) depending on the tank heater selection. If tank heater selection is INTERNAL, follow normal thermo judgement to switch the three-way valve to tank side and room side. If tank heater selection is EXTERNAL, only turn ON booster heater according to tank thermo.

11 Operation and Control

Tank Heater selection is INTERNAL

Backup Heater ON Condition:

1. After water pump operates for 2 mins AND
2. When tank temperature < Tank set temperature - [Remote controller Set Tank Re-heat Temp] AND
3. 20 minutes since previous backup heater OFF AND
4. Backup heater enable

Backup Heater OFF Condition:

1. Force mode OFF OR
2. When tank temperature > Tank set temperature for continuous 15 secs OR
3. Tank Operation OFF

Tank Heater selection is EXTERNAL

Backup Heater ON Condition:

1. After water pump operates for 2 mins AND
2. When tank temperature < Tank set temperature + [Remote controller Set Tank Re-heat Temp] -1°F AND
3. 20 minutes since previous backup heater OFF AND
4. Backup heater enabled

Backup Heater OFF Condition:

1. Force mode OFF OR
2. When tank temperature > Tank set temperature for a continuous 15 secs OR
3. Tank Operation OFF

Powerful Operation

Powerful mode is used to increase the capacity of the heat pump to achieve higher target temperature. Powerful mode is applicable when heat mode is operating.

Remote control setting

On the quick menu of the remote control, there are 4 options for Powerful Mode that can be selected:

- OFF: Cancel powerful mode
- 30 minutes: Set powerful for 30 minutes
- 60 minutes: Set powerful for 60 minutes
- 90 minutes: Set powerful for 90 minutes

During the time set by remote control, Powerful Mode will activate according to 2 shift up controls. However, this function is applicable only for heating. Remote control will transmit the signal to indoor unit once this function is selected, then transmit OFF signal to indoor when the timer is complete. Indoor will transmit the signal to outdoor for frequency control.

Indoor setting temperature shift targets water temperature, and will shift up to Wlo or Whi, whichever higher. If "Direct Type" temperature control is select, this powerful shift up setting is not effective.

Powerful function is selected by remote control. It can turned off if the OFF/ON button is pressed or Powerful function is turned OFF by remote control.

Quiet Operation

Quiet mode is used to reduce the noise of outdoor unit by reducing the frequency or fan speed.

Quiet level

There are 3 levels (Level 1, Level 2, Level 3) to set menu function on remote control. Once the quiet function is selected, the remote control will transmit the signal to indoor and outdoor units.

Quiet mode is set on remote control, or can be set by a weekly timer.

To turn off Quiet mode, press the OFF/ON button, turn it off using the remote control, or can be turned off with a weekly timer.

Sterilization Mode

The purpose of the Sterilization Mode is to sterilize the water tank by setting the required boiling temperature.

Day and time for Sterilization mode to start can be selected on the remote control. The boiling temperature of the external heater is 131°F ~ 167°F. For the internal heater is 131°F ~ 149°F. Maximum operation time is 5 minutes to 1 hour.

To turn on Sterilization mode:

- Tank connection set to "YES" by remote control
- Sterilization function is selected "YES"
- Sterilization signal received from remote controller by timer.
- Tank mode request ON.

To stop Sterilization mode:

- When boiling timer is completed. Boiling timer (Remote control set maximum operation time) start counting once tank achieves boiling set temperature OR
- After 8 hours of operation since sterilization started
- Tank mode request OFF

During Sterilization mode activation time, the target tank set temperature will internally change to boiling set temperature.

When Sterilization mode activates, the heat pump and heater (external or internal) will operate as normal tank mode to achieve the boiling set temperature. Sterilization mode will end when the stop condition is fulfilled. After sterilization is complete, the tank set temperature will resume to normal operation.

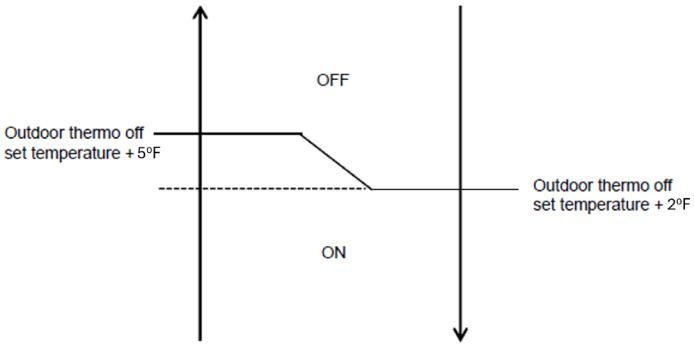
* Tank temperature may not achieve boiling set temperature if tank heater is selected OFF OR external compressor switch.

11 Operation and Control

Outdoor Ambient Thermo OFF Control

The purpose of the Outdoor Ambient Thermo OFF control is to stop providing heat to room side during high outdoor ambient conditions.

Figure 11-12 *Outdoor ambient control*



Heating outdoor ambient thermos OFF control is only applicable when heat pump operates in heat mode. This control will not activate when running in tank side. The Heat pump and water pump will turn OFF when outdoor ambient is higher than the outdoor thermo OFF set temperature.

Heat pump thermos ON when outdoor ambient < outdoor thermos OFF set temperature + 1°F.

Alternative Outdoor Ambient Sensor Control

There is some possibility that the air to water heat pump unit will install at a location where the original ambient sensor is exposed to direct sunlight. Another optional ambient sensor can be connected to indoor PCB and located at a new and better reading location to improve the heat pump's performance.

The remote controller can select whether the extra outdoor ambient sensor is connected or not. (YES/NO)

The alternative outdoor ambient sensor will connect to an indoor unit main PCB terminal when the alternative sensor is selected NO.

The original Outdoor temperature sensor will be used as Indoor & Outdoor heat pump operation reference sensor.

The OUTDOOR unit will send outdoor temperature readings to the INDOOR unit. The OUTDOOR will judge the original outdoor sensor error (F36 displays if error detected). There is no judgement error on alternative outdoor sensors when alternative sensor is selected YES.

An alternative Outdoor temperature sensor will be used as Indoor & Outdoor heat pump operation reference sensor.

The INDOOR unit will send outdoor temperature readings to OUTDOOR unit. INDOOR will judge the Extra outdoor sensor error only after operation ON request is received from the remote controller (F36 displays if error detected). There is a no judge error on the original outdoor sensor.

Force DHW mode

When the user wants to use hot water now, the user can press the Force DWH mode under the quick menu to operate tank only mode to heat up the tank temperature.

Force DHW mode can be activated under the quick menu.
When the user presses the Force DHW function during operation OFF condition, indoor will run tank only mode regardless of the mode selection. After tank temperature achieves tank thermo off temperature, turn OFF Force DHW mode and return the mode OFF with previous mode selection.

When the user presses the Force DHW function during operation ON condition, indoor will memorize the running mode and run tank only mode regardless of the mode selection. After tank temperature achieves tank thermo off temperature, turn OFF force DHW bit and return to the previous memorized running mode.

*When operation is OFF or mode change is requested from remote controller during force DHW mode operation, End Force DHW mode and follow the new request operation.

*Once Force DHW mode is received from the remote controller, indoor direct will start tank mode and consider tank thermo ON.

Thermo is OFF only when achieving tank thermo OFF, depending on the Tank System Setting.

SMART DHW mode

Lochinvar All In One model provides the option to choose STANDARD DHW Mode or SMART DHW Mode for Tank Heat Up according to requirements. SMART DHW mode comparatively consumes lower tank heat up power but a longer re-heat time than STANDARD DHW Mode.

During SMART DHW start time 20:00 (Default Setting) to SMART DHW stop time 05:00 (Default setting), the Heat pump reheats the tank water only when tank temperature drops below 68°F. This is the default setting.

In the time between 05:00 to 20:00 the heat pump will reheat the tank water when the tank temperature meets the following conditions:

- Condition 1: Tank Heater ON

  Reheat when tank temperature below tank set temperature + R/C (Tank re-heat Temperature) -5°F

- Condition 2: Tank Heater OFF

  Reheat when tank temperature below Tank set temperature or tank limit temperature (Whichever lower) + R/C (Tank re-heat Temperature) -5°F

11 Operation and Control

*SMART DHW start time, stop time and SMART ON Temperature can change in CUSTOM menu.

In STANDARD DHW Mode, the heat pump always reheats the tank water when tank temperature meets the following conditions:

- Condition 1: Tank Heater ON

  Reheats when tank temperature is below tank set temperature + R/C (Tank re-heat temperature)

- Condition 2: Tank Heater OFF

  Reheats when tank temperature is below Tank set temperature or tank limit temperature (whichever is lower) + R/C (Tank re-heat temperature)

Table 11-7 *Smart DHW conditions*

Outdoor ambient temperature	Tank limit temperature
OD < -1°F	118°F
1°F <= OD < 96°F	125°F
96°F <= OD	122°F

DHW Capacity Setting

DHW Capacity is the heat pump heating capacity output control during tank heating operation. There are two DHW capacity settings (VARIABLE & STANDARD) which can be set in remote control.

For the VARIABLE DHW Capacity, the heat pump operates with efficient (Low) Capacity to heat tank temperature during the re-heat process. And heat pump regulated to operate with high capacity to heat tank temperature when tank temperature drop below 77°F.

For the STANDARD DHW Capacity, the heat pump operates according to outdoor rated heating capacity during the tank heating process.

Anti Freeze Control

The Anti freeze protection control menu can be set to YES or NO from the control panel. In the heat pump system, there are 3 types of anti freeze control:

1. Expansion tank anti-freeze control
   - Expansion tank anti freeze heater ON condition: Outdoor ambient temp. < 37°F
   - Expansion tank anti freeze heater OFF condition: Outdoor ambient temp. > 40°F
2. Water pump circulation anti freeze control
   - Water pump turns ON when ALL below conditions are fulfilled:
     - ◊ Heatpump OFF (stand by) OR error occurs.
     - ◊ Water flowing flag is ON.
     - ◊ Water flow switch is not abnormal.
     - ◊ Outdoor ambient temp. < 37°F OR outdoor ambient temp. sensor is abnormal.
     - ◊ Water inlet/outlet temp. < 42°F.
     - ◊ After 5 minutes from previous water pump OFF.
   - Water pump turn OFF when ANY of below conditions is fulfilled:
     - ◊ Outdoor ambient temperature ≥ 40°F.
     - ◊ During 23°F < outdoor ambient temp. <40°F
   - After water pump ON for 4 minutes, and water inlet temp. ≥ 47°F.
   - Else, shift to back up heater anti freeze control.
   - During outdoor ambient temp. < 23°F
   - After water pump ON for 4 minutes, and water inlet/outlet ≥ 68°F.
   - Else, shift to back up heater anti freeze control.
   - However, if flow switch is abnormal (H62), then water pump circulation anti freeze control will not activate.
3. Back up heater anti freeze control:
   - Back up heater turn ON when ALL below conditions is fulfilled:
     - ◊ Water inlet/outlet temp. < 42°F.
     - ◊ Water pump circulation anti freeze control activated and water pump ON for 4 minutes.
   - Back up heater turns OFF when ANY of below conditions is fulfilled:
     - ◊ Water inlet/outlet temp. > 83°F.
     - ◊ Water pump circulation anti freeze control deactivated/water pump OFF.
   - However, if back up heater is abnormal (H70) then back up heater anti freeze control will not activate.

11 Operation and Control

Boiler prohibit flag control

The boiler prohibit flag control is for product safety. The boiler signal is OFF when water temperature is too high.

When the water outlet ≥ 185°F continues for 5 minutes or the water inlet ≥ 185°F continues for 5 minutes, it will trigger the control.

After the control is triggered, set boiler prohibit flag = 1
The control can be canceled 30 minutes after the control is triggered.

External Room Thermostat Control (Optional)

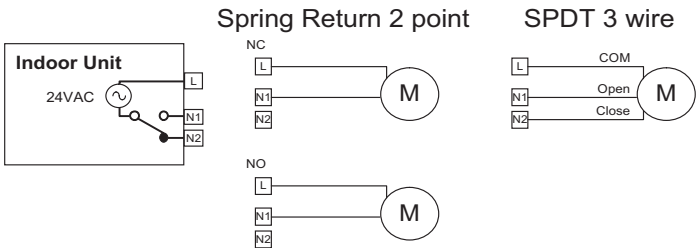
External room thermostat control is used for better room temperature control to fulfill different temperature requested by the external room thermostat.

External room thermostat control activates only when remote the thermostat connection is selected YES by the Indoor control panel. When the indoor is running heat mode, refer to thermo On/Off from heating line feedback. And when indoor is running cool mode, refer to thermo On/Off from cooling line feedback. Turn the heat pump Off immediately when thermo off feedback is received.

Three-way Valve Control

The three-way valve is used to change flow direction of hot water from the heat pump between heating side and tank side.
During the three-way valve switch Off time, the hot water will provide heat capacity to the heating side.
During the three-way valve switch On time, the hot water will provide heat capacity to the tank side.
During stop mode, the three-way valve switch will be in the OFF position.

Figure 11-13 *Three-way valve*



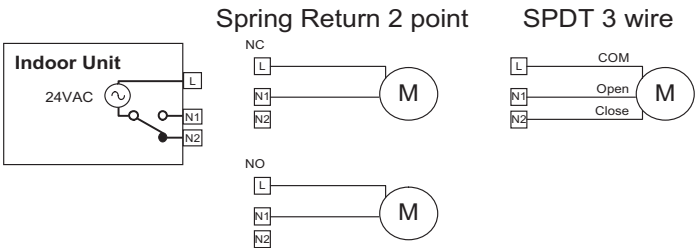
* During pump down and force mode, fix three-way valve in close condition.

Two-way Valve Control

The two-way valve is used to allow hot water to the floor heating panel or block cold water to the floor heating panel.

1. When indoor running in heat mode, OPEN the two-way valve.
2. When indoor running in cool mode, CLOSE the two-way valve.
3. During stop mode, fix two-way valve in close condition.

Figure 11-14 *Two-way valve*



* During pump down mode, fix two-way valve in close condition.
* During force mode, open two-valve.

Heat/Cool Switch

The user can switch the running mode from heat to cool or cool to heat through the external installed Heat/Cool switch. This kind of heat / cool switch can be built inside the field supply room remote controller as well.

This heat/cool switch control will activate only when the installer sets the Heat/Cool Switch to "USE" through the remote controller. Once the Heat/Cool Switch is set to "USE", the remote controller will check the indoor send Signal to judge the options of the mode selected.

When Heat/Cool Switch Contact is Open, the remote controller can only select Heat Mode, or Heat + Tank Mode, or Tank

Mode. When Heat/Cool Switch Contact is Closed, the remote controller can only select Cool Mode, or Cool + Tank Mode, or Tank.

The Heat/Cool Switch Operation ON/OFF will depend on remote controller request. When Heat Mode is running with Contact Open, the user can change this setting to contact close. Indoor will use this signal from the remote controller to judge and change the mode to cool and send back to indoor. And it is same as from cool mode change to heat mode. This switch has higher priority, and the remote controller will follow indoor send signal when control is activated.

There is no effect to the operation when the only mode running is Tank Mode. Weekly Timer is ignored and cannot be set when Heat / Cool Switch is enabled.

11 Operation and Control

Backup Boiler Control

Boiler is an additional or alternative heat source to heat up the room when necessary. The purpose of this control is to turn ON and turn OFF the Boiler output signal when boiler heating capacity is needed in the system. Boiler can connect to DHW Tank and Buffer Tank, depending on the installer. Boiler operation parameter needs to be set on Boiler itself, indoor does not control the boiler operation direction and operation. There are Alternative modes, Parallel mode and Advance Parallel mode, that available to be selected by the installer to fit to the total system.

AUTO Control Mode

There are Alternative mode, Parallel mode, & Advance Parallel mode available to select by the installer to fit to the total system.

Backup control selection by remote controller

Remote control setting value:

Outdoor Ambient Set = (Range: 5°F ~ 59°F) Make heating similar to Parallel mode:

- Only one heat source operates at one time, either heat pump or boiler depends on condition.
- External pump will turn ON when the external pump selection is ON when boiler is ON even heat pump is OFF.

During Operation ON at Heat mode or Tank mode or Heat + Tank Mode, Boiler signal will turn ON, while the heat pump and water pump turn OFF when:

- Outdoor ambient < Outdoor Ambient Set AND
- Boiler prohibit flag = 0

However, the indoor water pump can operate when Anti-freeze control condition are fulfilled.

Boiler signal will turn OFF, and heat pump and water pump turn ON when:

- Outdoor ambient > Outdoor Ambient Set + [3°F] OR
- Boiler prohibit flag = 1

Parallel Mode

Parallel mode allows heat pump and boiler ON at the same time. Boiler operates as an additional heating capacity when there is low heat pump capacity at low ambient.

During operation ON at Heat mode or Tank mode or Heat + Tank mode Boiler signal turns ON when:

- Outdoor ambient < Outdoor Ambient Set AND
- Boiler prohibit flag = 0

Boiler signal turns OFF when:

- Outdoor ambient > Outdoor Ambient Set + [3°F] OR
- Boiler prohibit flag = 1

Advance Parallel Mode

Advance parallel mode will allow the heat pump to operate and turn ON the boiler only when the ambient and temperature condition is fulfilled.

Remote control setting value:

1. Outdoor Ambient Set = (Range : 5°F ~ 59°F)
2. Selection of boiler connection direction. (Heat only, DHW only, Heat & DHW)
3. Setting data under Heat Direction
   Start Temperature | START_TEMP |
   Start Delay Timer | START_TIMER |
   Stop Temperature | STOP_TEMP |
   Stop Delay Timer | STOP_TIMER |
4. Setting data under DHW Direction
   Delay Timer | DELAY_TIMER |

During operation, Advance Parallel mode is ON at Heat Mode. The boiler signal turns ON when:

- Outdoor ambient < Outdoor Ambient Set AND
- Buffer tank temperature < Target Buffer Tank Temperature + [START_TEMP] for [START_TIMER] AND
- Heat pump operate at room side AND
- Connection of Boiler to Heating Select "YES" From installer menu AND
- Buffer Tank connection select "YES" AND
- Boiler prohibit flag = 0

The boiler signal turns OFF when:

- Outdoor ambient > Outdoor Ambient Set + [3°F] OR
- Buffer Tank temperature > Target Buffer Tank temperature + [STOP_TEMP] for [STOP_TIMER] OR
- Heat pump not at room side. OR]
- Boiler prohibit flag = 1

During operation ON at Tank Mode, the boiler signal turns ON when:

- Outdoor ambient < Outdoor Ambient Set AND
- Heat pump operate at tank side for continuous | DELAY_TIMER | AND
- Connection of Boiler to DHW Tank select "YES" from installer menu. AND
- Boiler prohibit flag = 0

The boiler signal turns OFF when

- Outdoor ambient > Outdoor Ambient Set + [3°F] OR
- Heat pump not operates at tank side. OR
- Boiler prohibit flag = 1

11 Operation and Control

Holiday Mode

Holiday Mode promotes energy saving by allowing the user to stop the system during holiday and enables the system to resume at the preset temperature after holiday.

Indoor operate the unit according to the running mode request. Target temperatures will follow holiday setting temperature. If heat mode request is received, Target Water Out Temperature will change according to the holiday shift temperature set. If a tank mode request is receive, Target Tank Set Temperature will change according to the holiday tank shift temperature set. If the tank is set to OFF at holiday, heat pump and tank heater will be OFF.

After days of holiday have been set, the heat pump will stop and only resume operation at the end of holiday countdown. The day holiday mode is set is counted as day 1.

Holiday Mode will stop when the OFF/ON button is pressed or the end of the Holiday timer is reached.

Dry Concrete

Provide a heat-to-floor heating panel and dry the wet concrete during installation.

The Dry concrete parameter can be set through remote control under system setup. Parameters are possible to setup up to 99 days with different target set temperatures.
Dry concrete mode will be activated when selected ON from service setup. Once the Dry concrete function is started, remote control will send step 1 "setting temperature" to the indoor unit. The Heat pump will start heat mode operation to room side with received target water outlet temperature.

* Heat pump will operate according to Heat pump Target Water Temperature.

After completing day 1 setup operation, day 2 data will be sent to the indoor unit at 12:00am on the second day. Each preset data will be sent every day until dry concrete mode is complete. The unit will turn OFF and exit dry concrete function. The three-way valve and booster heater will turn OFF and two-way valve will turn ON.
To cancel:
Dry concrete mode is complete and OFF signal is received. The OFF signal is received by pressing OFF/ON button.

Flow Sensor

The water flow sensor serves as an overload protector that shuts down the unit when the water level is detected to the values.

Table 11-8 *Abnormal flow detection*

Condition	Abnormal Flow	Normal Flow
Normal Case	Flow rate < 1.3 gal/min or >= 18.2 gal/min	>= 1.3 gal/min
During De-ice Operation OR COOL Mode	Flow rate < 2.9 gal/min or >= 18.2 gal/min	>= 2.9 gal/min
During status 2~6 on Anti-freeze de-ice	Flow rate >= 1.3 gal/min	< 1.3 gal/min

12 Protection Control

Protection Control for All Operations

Time Delay Safety Control

The compressor will not start for three minutes after stopping operation.

30 Seconds Forced Operation

Once the compressor starts operation, it will not stop its operation for 30 seconds. However, it can be stopped using control panel at indoor unit.

Total Running Current Control

When the outdoor running current exceeds X value, the compressor frequency will decrease. If the outdoor running current does not exceed X value, the compressor frequency will return to normal operating frequency. If the outdoor running current continues to increase till exceed Y value, the compressor will stop. If this occurs 3 times within 20 minutes, system will stop operation and OFF/ON control panel LED will blink (F16 error occurs).

Table 12-1 Current control

	RAH040	
Operation Mode	X (A)	Y (A)
Heating	28.0	30.0
Cooling	20.0	30.0

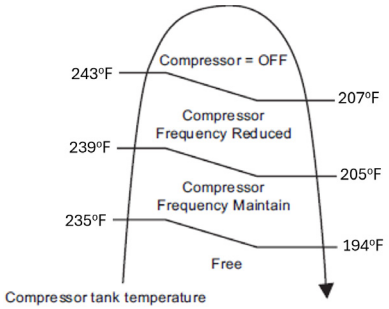
DC Peak Current Control

When the current to IPM exceeds set value, the compressor will stop. Compressor will restart after three minutes. If the IPM exceeds the set value for more than 30 seconds after the compressor restarts, operation will restart after two minutes. If the set value exceeds again within 30 seconds after the compressor restarts, operation will restart after one minute. If this condition repeats continuously seven times, the system will stop operation and the OFF/ON control panel LED will blink (F23 error occurs).

Compressor Overheating Prevention Control

The compressor operating frequency is regulated in accordance to compressor tank temperature as shown in figure 12-1. When the compressor tank temperature exceeds 224.6°F, the compressor will stop. If this occurs 4 times within 30 minutes, the system will stop operation and the OFF/ON control panel LED will blink (F20 error occurs).

Figure 12-1 Compressor over heating control

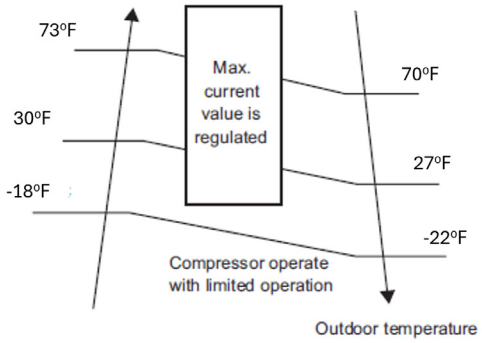


High Pressure Sensor Control

The purpose of the High Pressure Sensor Control is to protect the system operation. The detection period is after the compressor is on for 1 minute. The detection conditions are when there is an abnormally high voltage detection, 5 V, or when open an circuit detects 0V for 5 seconds continuously. After an abnormality is detected, or 5 seconds continuously, the unit will stop operation, and the OFF/ON control panel LED will blink (H64 error occurs).

Outside Temperature Current Control

Figure 12-2 Pump speed feedback



Crank Case Heater Control

For compressor protection during low outdoor ambient operation (during heating low temperature operation):

a. Trigger heater START condition
   1. When the outdoor air temperature is below than 39°F, and discharge temperature is 48°F or below.

b. Resetting heater STOP condition:
   1. When the outdoor air temperature exceeds entry condition (43°F)
   2. When the discharge temperature exceeds entry condition (56°F)

12 Protection Control

Protection Control for Heating Operation

Outdoor Air Temperature Control

The maximum current value is regulated when the outdoor air temperature rises above 57.2°F in order to avoid compressor overloading.

De-ice Operation

When the outdoor pipe temperature and outdoor air temperature is low, de-ice operation starts when outdoor fan motors stop. Normally, de-ice starts if the pipe sensor temperature fulfills de-ice conditions. If the remote controller is set to AUTO force defrost setting, the unit will start Force De-ice after the heat pump operates for 3 hours without de-ice at below an outdoor temperature of 41°F.

There are 2 de-ice modes. The de-ice mode is decided according to water inlet temperature and outdoor ambient temperature.

When the water inlet temperature is more than 140°F, the unit will operate de-ice mode 1. When the water inlet temperature is less than 80.6°F, the unit will operate de-ice mode 2. When the water inlet temperature is less than 140°F and outdoor ambient temperature is less than 14°F, the unit will operate de-ice mode 2. When water outlet temperature sensor 2 detects temperatures less than 71°F, the unit will operate de-ice mode 2.

Figure 12-3 *De-ice operation time diagram - control 1*

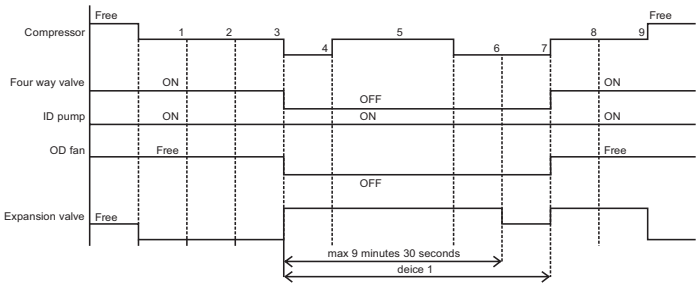
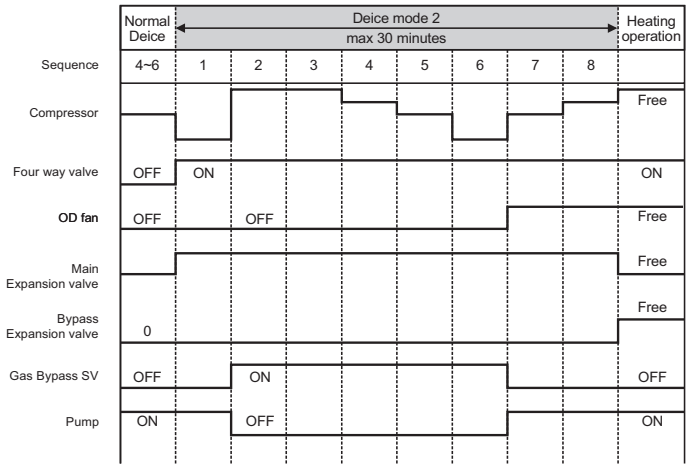


Figure 12-4 *De-ice operation time diagram - control 2*



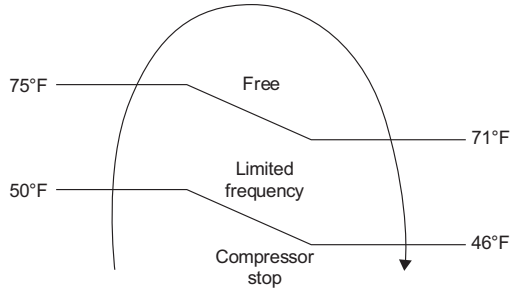
Force Defrost Operation

Force defrost can be set through remote control with two selections (Manual OR Auto). If Manual defrost is set, the heat pump will only run force defrost at heat mode when force defrost request it from the quick menu remote control. If Auto defrost is set, heat pump automatically runs the force defrost operation after 3 hours heating accumulation time without defrost when ambient below 41°F.

Outdoor Air Temperature Control

The Compressor operating frequency is regulated in accordance to the outdoor air temperature as shown in the diagram below This control will begin 1 minute after the compressor starts. Compressor frequency will adjust base on outdoor air temperature.

Figure 12-5 *Outdoor air compressor control*



Freeze Prevention Control 1

When the indoor heat exchanger temperature is lower than 32°F continuously for 10 seconds, the compressor will stop operating. The compressor will resume its operation three minutes after the indoor heat exchanger is higher than 34°F. Indoor heat exchanger freeze prevention (H99) will be stored in the error history.

13 Servicing Mode

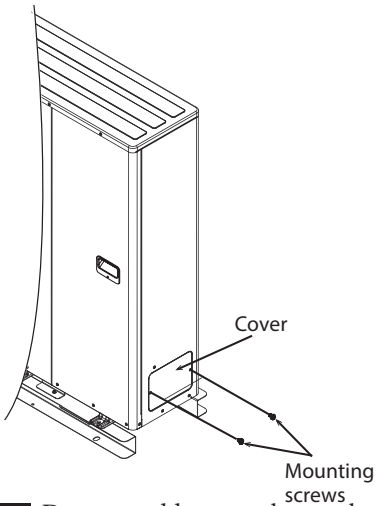
Maintenance

In order to ensure optimal performance of the unit, seasonal inspections on the unit, functional check of RCCB, field wiring and piping have to be carried out at regular intervals. This maintenance should be carried out by a qualified installer or technician.

Maintenance for Water Filter Set

1. Remove the Cover by loosening the mounting screws to access to the Magnetic Water Filter Set.
2. Turn OFF power supply.
3. Set the two valves for the Magnetic Water Filter Set to "CLOSE".
4. Take off the clip, then gently pull out the mesh. Be aware that a small amount of water will drain out from it.
5. Clean the mesh with warm water to remove all the stains. Use a soft brush if necessary.
6. Reinstall the mesh to the Magnetic Water Filter Set and set the clip on it.
7. Set the two valves for the Magnetic Water Filter Set to "OPEN".
8. Turn ON power supply.
9. After cleaning, reinstall the Cover by tightening the mounting screws properly.

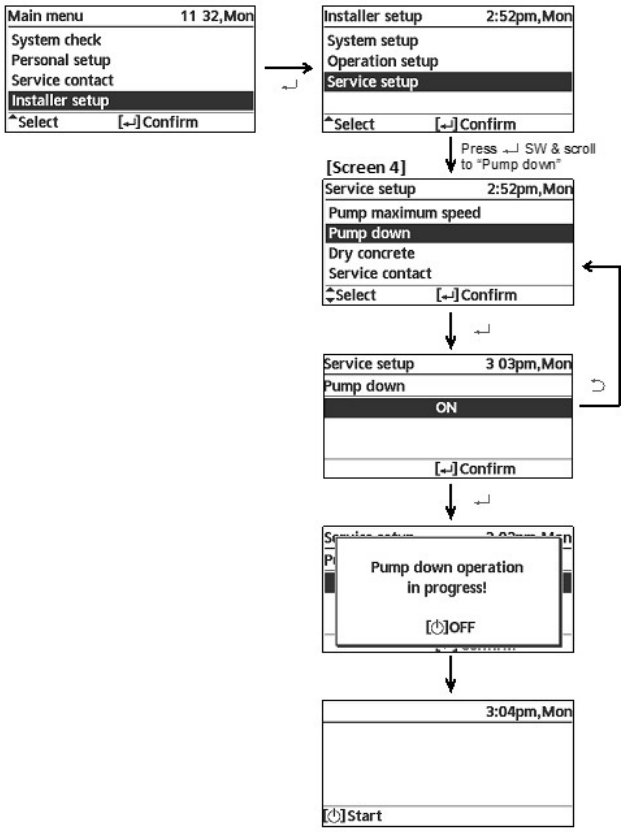
Figure 13-1 *Water filter maintenance port*



⚠WARNING Do not add or replace other than R32 type. It may cause product damage, burst, injury, etc. Use compatible R32 tools for refrigerant piping work and refrigerant charging during installation or servicing.

Pump Down Procedures

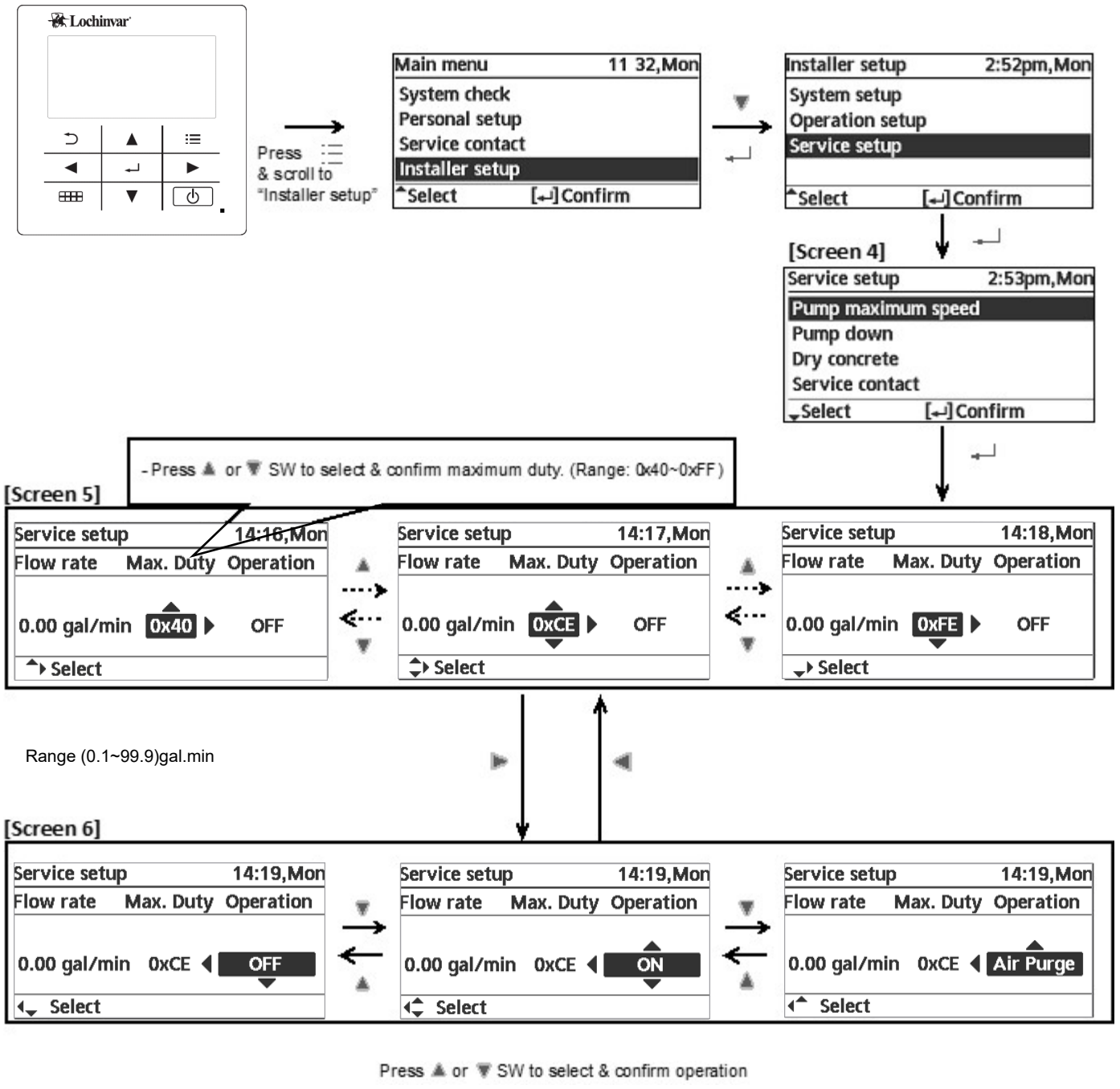
Refer below steps for proper pump down procedure.



13 Servicing Mode

How To Adjust Pump Speed

Refer below steps for proper pump down procedure.

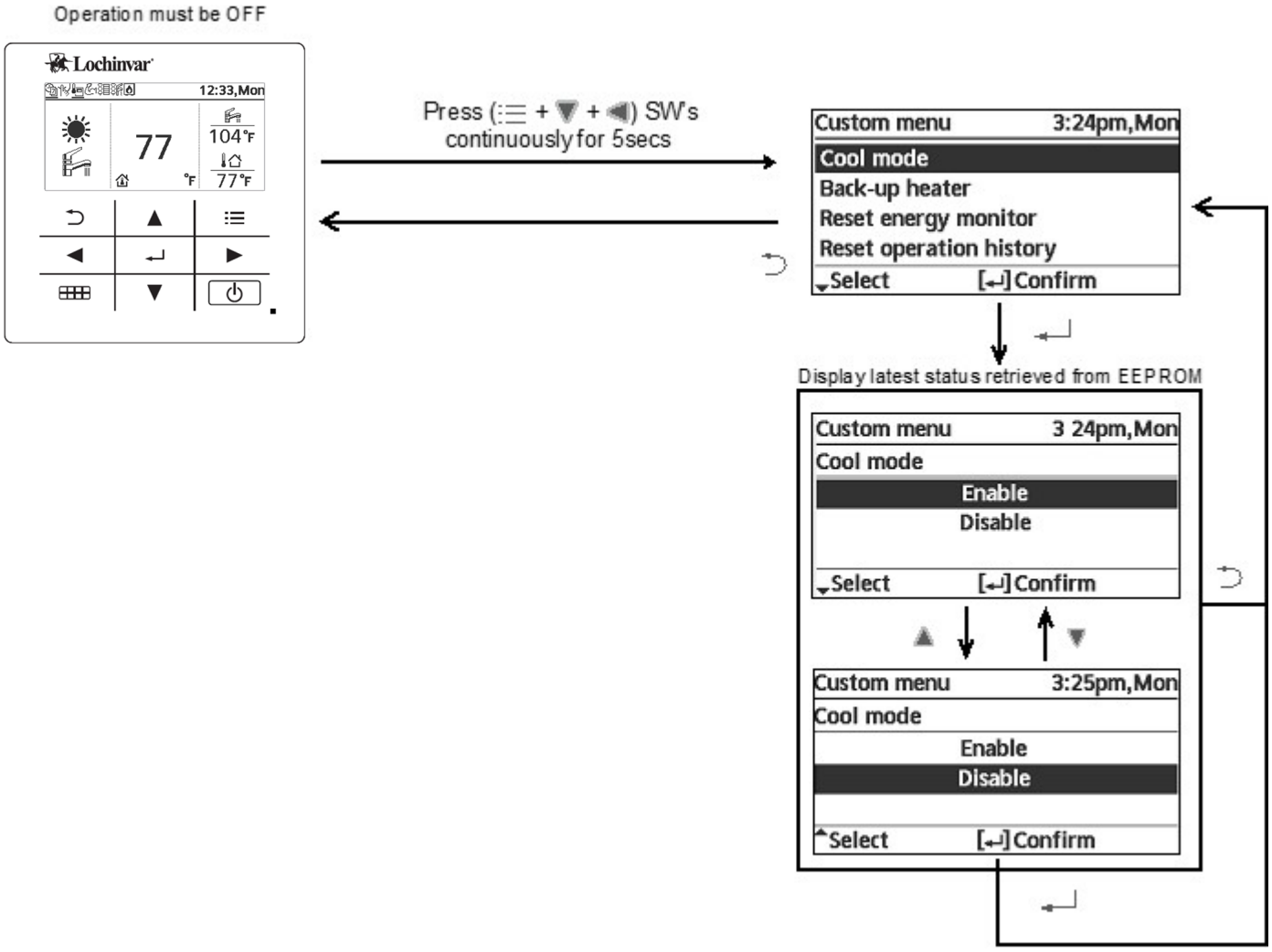


NOTICE Whenever at [Screen 5], if press SW to OFF, pump operation should be turned OFF.

NOTICE Whenever at [Screen 6], if press SW to OFF, pump operation should be turned OFF.

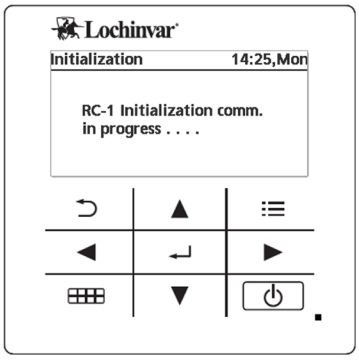
13 Servicing Mode

How To Unlock Cool Mode



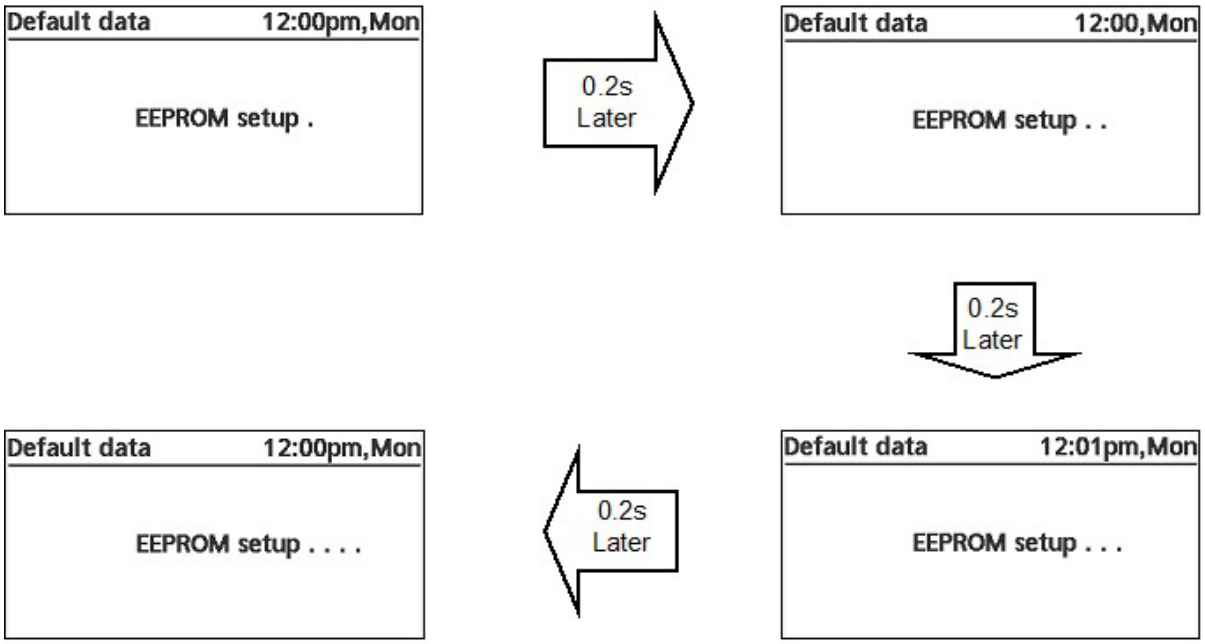
13 Servicing Mode

EEPROM Factory Default Data Setup Procedure

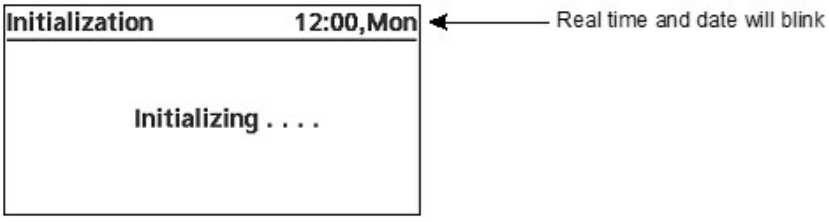


- EEPROM default data setup is only possible during initialization process.
- Press (▲, ▼, ◀, ▶) simultaneously for 5secs continuously, initialization process will stop & EEPROM default data setup process will start.

During EEPROM default data setup process, display should be as shown below.

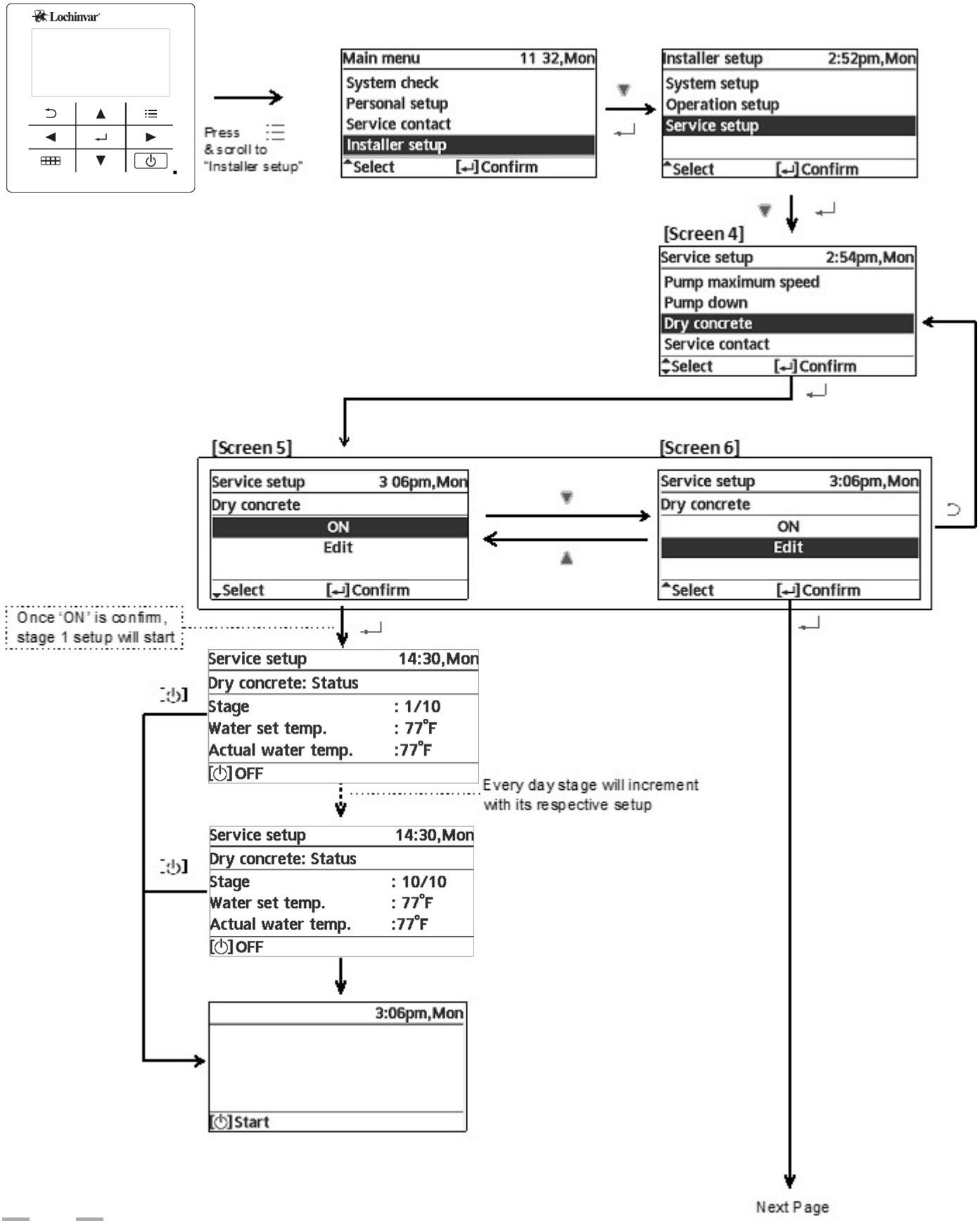


- Once EEPROM default data setup process is complete, initialization process will re-start from beginning.



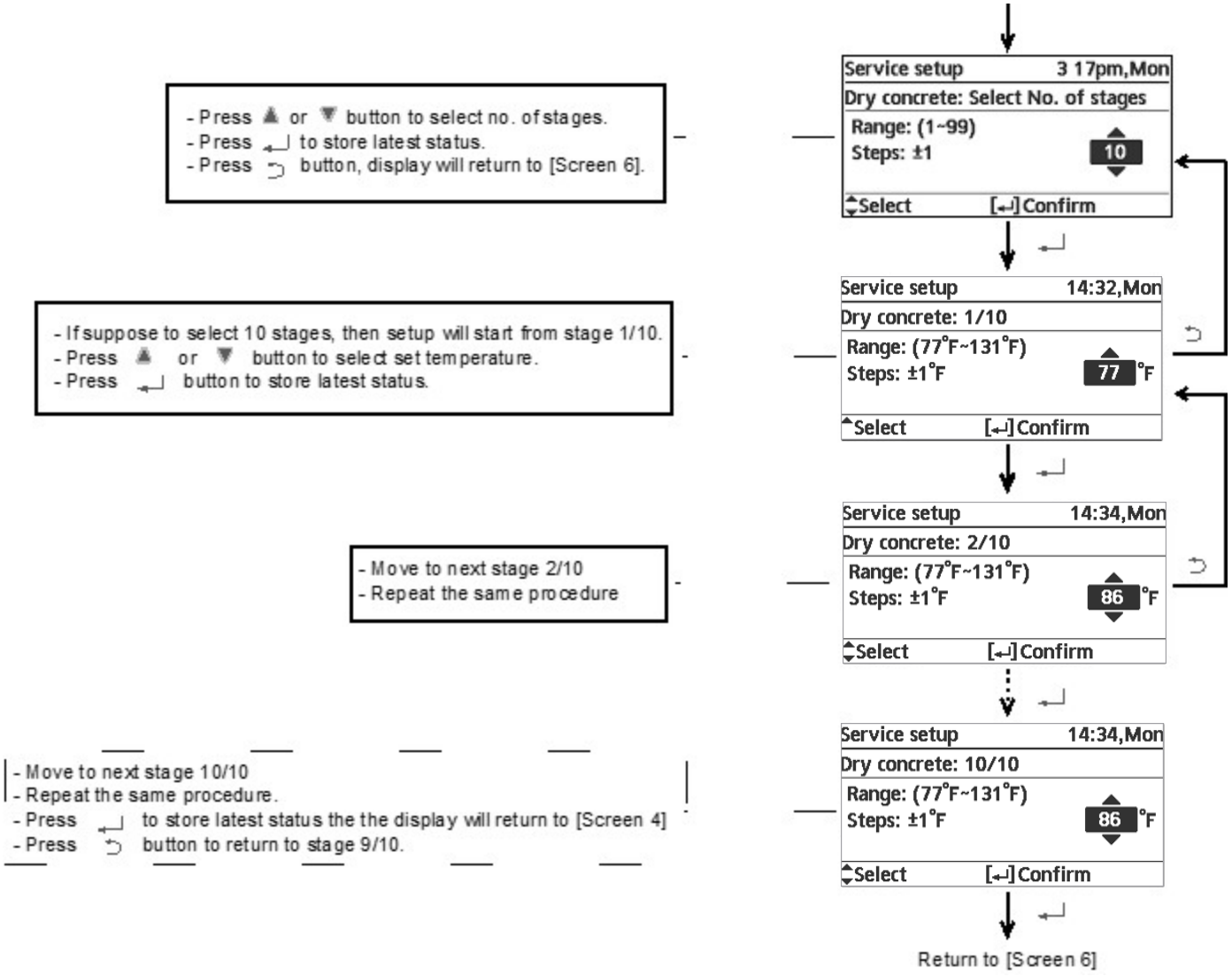
13 Servicing Mode

Dry Concrete Setup



13 Servicing Mode

Dry Concrete Setup



14 Maintenance Guide

In order to ensure safety and optimal performance of the unit, seasonal inspections on the unit, functional check of RCCB/ELCB, field wiring and piping have to be carried out at regular intervals. This maintenance should be carried out by a qualified installer or technician. Contact the manufacturer for scheduled inspection.

Air purge valve

Make sure all the piping installations are properly done before carrying out the steps below.

1. Open Cabinet front plate to access to the Pressure Relief Valve and Air Purge Valve.
2. Turn the plug on the Air Purge Valve outlet counterclockwise by one complete turn from fully closed position.
3. Set the Pressure Relief Valve level "DOWN".
4. Start filling water (with pressure more than 14.5 PSI) to the Mono bloc unit via water inlet. Stop filling water if the free water flow through Pressure Relief Valve drain hose.
5. Turn ON the power supply and make sure Water Pump is running.
6. Check and make sure no water leaking at the tube connecting points.
7. Reinstall the Cabinet front plate by tightening the two mounting screws.

Water pressure *(14.5 PSI)

Water pressure should not lower than 7.3 PSI (with inspects the Water Pressure Gauge). If necessary add tap water into the water circuit.

Pressure relief valve

1. Check for correct operation of the Pressure Relief Valve by turning on the lever to become horizontal.
2. If you do not hear a clacking sound (due to water drainage), contact your local a qualified installer or technician.
3. Push down the lever after finish checking.
4. In case the water keeps drained out from the unit, switch off the system, and then contact your local a qualified installer or technician.

Expansion vessel

The Mono bloc unit has a built-in Expansion Vessel with 2.64 gal air capacity and initial pressure of 14.5 PSI.

Without an antifreeze agent condition, the total amount of water in the system should be below 52.8 gal. If the total amount of water is more than 52.8 gal, please add expansion vessel (field supply).

With antifreeze agent condition, the expansion rate is different depending on its maker. Please refer to the antifreeze agent maker for the expansion rate before calculating the upper limit water volume of the system.

RCCB

Ensure the RCCB is set to "ON" before checking the RCCB. Turn on the power supply to the Mono bloc unit. This testing can only be done when power is supplied to the Mono bloc unit.

1. Push the "TEST" button on the RCCB. The lever would turn down and indicate "0", if it functions normal.
2. Contact a qualified installer or technician if the RCCB malfunction.
3. Turn off the power supply to the Mono bloc unit.
4. If RCCB functions normal, set the lever to "ON" again after testing finish.

This product contains fluorinated greenhouse gasses.
Refrigerant type : R32 (GWP=675)
For RAH040
Amount : 3.53 lbs (1.080 ton CO2 equivalent)

Test run

Before doing a test run, make sure the below items have been checked:

- Pipework is properly done.
- Electric cable connecting work are properly done.
- Mono bloc unit is filled up with water and trapped air is released. Antifreeze agent must be added into water circuit to prevent freezing of water when outdoor ambient temperatures is low.

  Recommended antifreeze: Propylene glycol: 40% (equivalent to -4°F)

Turn ON to the Mono bloc unit and RCCB 2. Then, for remote control operation, please refers to (Mono bloc) Air-to-Water Heatpump's operation instruction. For normal operation, Water Pressure Gauge reading should be in between 7.3 PSI and 43.5 PSI. After a test run, please clean the Magnetic Water Filter Set. Reinstall it after cleaning.

Water flow of water circuit

Confirm the maximum water flow during main pump operation is not less than 3.96 gal/min.

*Water flow can be checked through service setup (Pump Max Speed) [Heating operation at low water temperature with lower water flow may trigger "H75" during defrost process.]

14 Maintenance Guide

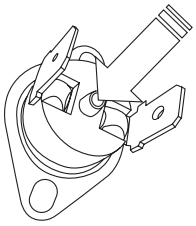
Reset overload protector

Overload Protector a serves the safety purpose to prevent the water over heating. When the Overload Protector trip at high water temperature, take below steps to reset it.

a. Take out the cover.

b. Use a test pen to push the centre button gently in order to reset the Overload Protector.

c. Fix the cover to the original fixing condition.



Use test pen to push this button for reset Overload protector

Maintenance Menu

Service and maintenance

If forget Password and cannot operate remote controller

Press ⮌ + ↵ + ▶ for 5 sec.
Password unlock screen appears, press Confirm and it shall reset.
Password will become 0000. Please reset it again.
(NOTE) Only display when it is locked by password.

Maintenance Menu

Setting method of Maintenance menu

Maintenance menu	12:00am,Mon
Actuator check	
Test mode	
Sensor setup	
Reset password	
▼ Select	[↵] Confirm

Press ⮌ + ↵ + ▶ for 5 sec.

Items that can be set

1 Actuator check (Manual ON/OFF all functional parts)
(NOTE) As there is no protection action, please be careful not to cause any error when operating each part (do not turn on pump when there is no water etc.)

2 Test mode (Test run)
Normally it is not used.

3 Sensor setup (offset gap of detected temp of each sensor within 28.4~35.6°F range)
(NOTE) Please use only when sensor is deviated.
It affects temperature control.

4 Reset password (Reset password)

Custom Menu

Setting method of Custom menu

Custom menu	12:00am,Mon
Cool mode	
Back-up heater	
Reset energy monitor	
Reset operation history	
▼ Select	[↵] Confirm

Please press ☰ + ▼ + ◀ for 10 sec.

Items that can be set

① Cool mode (Set With/Without Cooling function) Default is without
(NOTE) As with/without Cool mode may affect electricity application, please be careful and do not simply change it.
In Cool mode, please be careful if piping is not insulated properly, dew may form on pipe and water may drip on the floor and damage the floor.

② Backup heater (Use/Do not use Backup heater)
(NOTE) It is different from to use/not to use backup heater set by client. When this setting is used, heater power on due to protection against frost will be disabled. (Please use this setting when it is required by utility company.)
By using this setting, it cannot defrost due to low Heating's setting temp and operation may stop (H75)
Please set under the responsibility of installer.
When it stops frequently, it may be due to insufficient circulation flow rate, setting temp of heating is too low etc.

③ Reset energy monitor (delete memory of Energy monitor)
Please use when moving house and handover the unit.

④ Reset operation history (delete memory of operation history).
Please use when moving house and handover the unit.

Specifications

Table 14-1 Specifications of fresh water was heat transfer medium in brazed heat exchanger

Parameter	Quality Limits for Tap Water on the Secondary Side
Temperature	Below 140°F
pH	7 to 9
Alkalinity	0.0005 lbs/gal <HCO3 <0.0025 lbs/gal
Conductivity	< 1.26 mS/in
Hardness	[Ca+, Mg+] / [HCO3 -] > 5
Chloride	< 0.0017 lbs/gal at 140°F
Sulphate	[SO4 2-] > 0.0008 lbs/gal and [HCO3 -] / [SO4 2-] > 1
Nitrate	NO3 < 0.0008 lbs/gal
Chlorine	< 0.000004 lbs/gal

External filter

Solids in the water must be filtered. Minimum filter mesh size required for the field supply external filter in the water inlet is 20 mesh.

15 Troubleshooting Guide

Refrigeration Cycle System

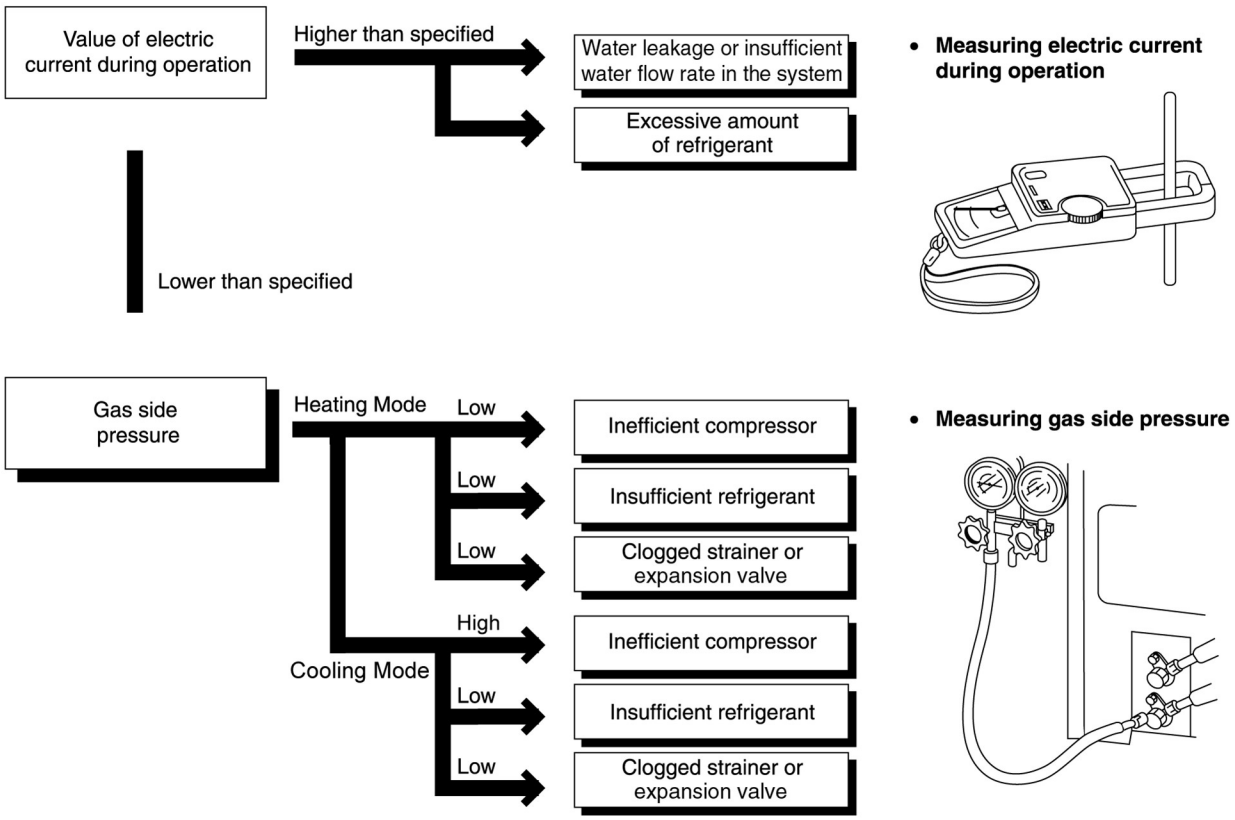
In order to diagnose malfunctions, make sure that there are no electrical problems before inspecting the refrigeration cycle. Such problems include insufficient insulation, problem with the power source, or malfunction of a compressor and a fan. The normal pressure of the refrigeration cycle depends on various conditions, the standard values for them are shown in table 15-1.

Table 15-1 *Standard Pressure*

	Gas pressure PSI
Heating Mode	333.6 ~ 420.6
Cooling Mode	130.5 ~ 174

*Conditions: Outdoor temperature 44.6°F at heating mode and 95°F at cooling mode. Compressor operates at rated frequency.

Figure 15-1 *Electric Current during operation*



15 Troubleshooting Guide

Table 15-2 *Relationship between the Condition of the Air-to-Water Heatpump Indoor and Outdoor Units, Pressure, and Electric Current*

Condition of the Air-to-Water Heat pump indoor and outdoor units	Heating Mode			Cooling Mode		
	Low Pressure	High Pressure	Electric current during operation	Low Pressure	High Pressure	Electric current during operation
Water leakage or insufficient water flow rate in the system	↗	↗	↗	↘	↘	↘
Excessive amount of refrigerant	↗	↗	↗	↘	↘	↘
Inefficient compression	↗	↘	↘	↗	↘	↘
Insufficient refrigerant (gas leakage)	↘	↘	↘	↘	↘	↘
Outdoor heat exchange deficiency	↘	↘	↘	↗	↗	↗
Clogged expansion valve or Strainer	↘	↗	↗	↗	↘	↘

*Carry out the measurements of pressure, electric current, and temperature fifteen minutes after an operation is started.

Breakdown Self Diagnosis Function

Self Diagnosis Function (Three Digits Alphanumeric Code)

When an abnormality occurs during operation, the system will stop operation, the OFF/ON control panel LED will blink, and an error code will display on the control panel. The error code is reset by turning OFF power supply or by selecting ERROR RESET. If the system abnormality is still showing, the system will again stop operation, and the OFF/ON control panel LED will blink again, and an error code will be display. The error code will be stored in the IC memory.

To check the error code

When an abnormality occurs, systems will stop operation and the OFF/ON control panel LED will blink. The error code of the abnormality will be displayed on the control panel. To determine the abnormality description, refer to the error code table.

To display past/last error code

Turn ON power supply. Refer to the following procedures to retrieve the error code history.

To permanently delete error code from IC memory

Turn ON power supply. Refer to the following procedures to clear error history.

15 Troubleshooting Guide

Figure 15-2 *Locate error code*

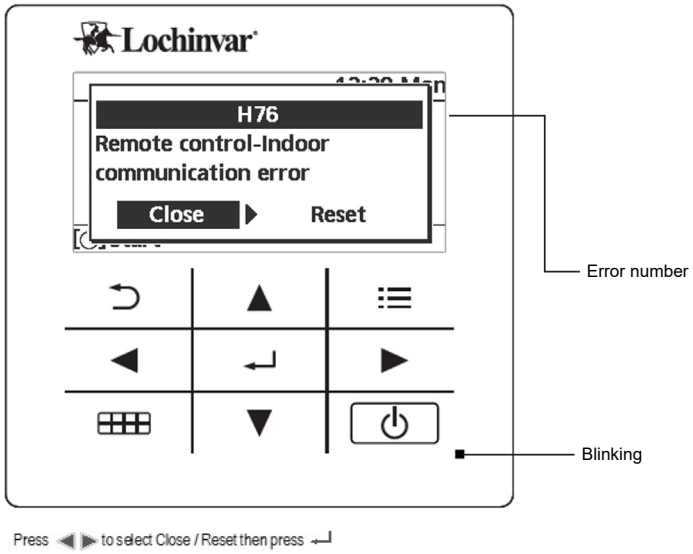
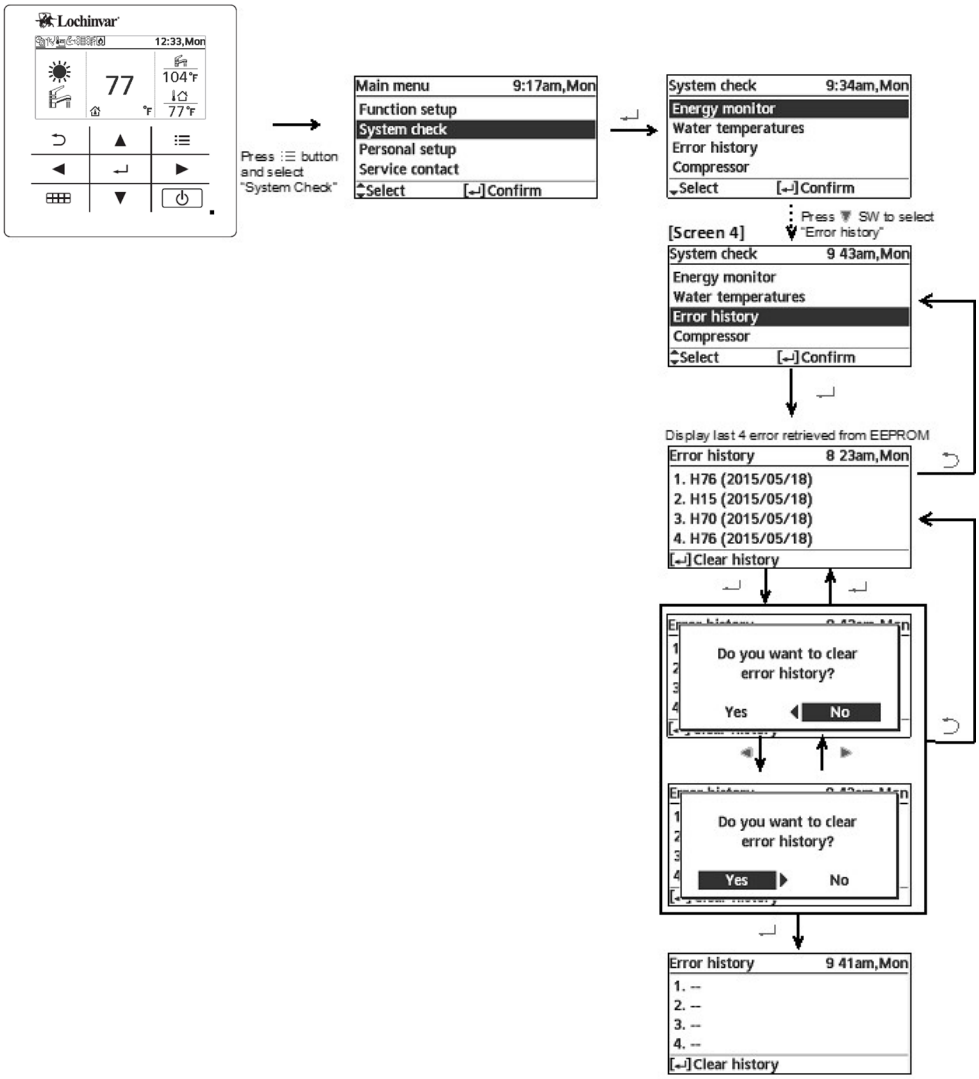


Figure 15-3 *Display past/ last error code*



15 Troubleshooting Guide

Table 15-3 *Error chart*

Diagnosis display	Abnormality/Protection control	Abnormality judgement	Primary location to verify
H00	No abnormality detected	-	-
H12	Indoor/Outdoor capacity unmatched	90s after power supply	• Indoor/outdoor connection wire • Indoor/outdoor PCB • Specification and combination table in catalogue
H15	Outdoor compressor temperature sensor abnormality	Continue for 5 sec.	• Compressor temperature sensor (defective or disconnected)
H20	Water pump abnormality	Continue for 10 sec.	• Indoor PCB • Water pump (malfunction)
H23	Indoor refrigerant liquid temperature sensor abnormality	Continue for 5 sec.	• Refrigerant liquid temperature sensor (defective or disconnected)
H27	Service valve error	Continue for 5 minutes	• High pressure sensor (defective or disconnected)
H36	Abnormal buffer tank sensor	Continue for 5 sec.	• Buffer tank sensor (defective or disconnected)
H42	Compressor low pressure abnormality	-	• Outdoor pipe temperature sensor • Clogged expansion valve or strainer • Insufficient refrigerant • Outdoor PCB • Compressor
H62	Water flow switch abnormality	Continue for 1 min.	• Water flow switch
H64	Refrigerant high pressure abnormality	Continue for 5 sec.	• Outdoor high pressure sensor (defective or disconnected)
H65	Abnormal de-ice water circulation	water flow > 1.8 gal/min continuously for 20 seconds during anti freeze de-ice	• Water pump

15 Troubleshooting Guide

Table 15-3 *Error chart continued*

Diagnosis display	Abnormality/Protection control	Abnormality judgement	Primary location to verify
H70	Back-up heater OLP abnormality	Continue for 60 sec.	• Back-up heater OLP (Disconnection or activated)
H72	Tank sensor abnormal	Continue for 5 sec.	• Tank sensor
H74	PCB communication error	Communication or transfer error	• Indoor main PCB and Sub PCB
H75	Low water temperature control	Room heater disable and de-ice request to operate under low water temperature	• Heater operation must enable to increase water temperature
H76	Indoor - control panel communication abnormality	-	• Indoor - control panel (defective or disconnected)
H90	Indoor/outdoor abnormal communication	> 1 min after starting operation	• Internal/external cable connections • Indoor/Outdoor PCB
H91	Tank heater OLP abnormality	Continue for 60 sec.	• Tank heater OLP (Disconnection or activated)
H95	Indoor/Outdoor wrong connection	-	• Indoor/Outdoor supply voltage
H98 / F95	Outdoor high pressure overload protection Cooling high pressure overload protection	-	• Outdoor high pressure sensor • Water pump or water leakage • Clogged expansion valve or strainer • Excess refrigerant • Outdoor PCB
H99	Indoor heat exchanger freeze prevention	-	• Indoor heat exchanger • Refrigerant shortage
F12	Pressure switch activate	4 times occurrence within 30 minutes	• Pressure switch
F14	Outdoor compressor abnormal revolution	4 times occurrence within 20 minutes	• Outdoor compressor
F15	Outdoor fan motor lock abnormality	2 times occurrence within 30 minutes	• Outdoor PCB • Outdoor fan motor
F16	Total running current protection	3 times occurrence within 20 minutes	• Excess refrigerant • Outdoor PCB
F20	Outdoor compressor overheating protection	4 times occurrence within 30 minutes	• Compressor tank temperature sensor • Clogged expansion valve or strainer • Insufficient refrigerant • Outdoor PCB • Compressor

15 Troubleshooting Guide

Table 15-3 Error chart continued

Diagnosis display	Abnormality/Protection control	Abnormality judgement	Primary location to verify
F22	IPM (power transistor) overheating protection	3 times occurrence within 30 minutes	• Improper heat exchange • IPM (Power transistor)
F23	Outdoor Direct Current (DC) peak detection	7 times occurrence continuously	• Outdoor PCB • Compressor
F24	Refrigeration cycle abnormality	2 times occurrence within 30 minutes	• Insufficient refrigerant • Outdoor PCB • Compressor low compression
F25	Cooling/Heating cycle changeover abnormality	4 times occurrence within 30 minutes	• 4-way valve • V-coil
F27	Pressure switch abnormality	Continue for 1 min.	• Pressure switch
F30	Water outlet sensor 2 abnormality	Continue for 5 sec.	• Water outlet sensor 2 (defective or disconnected)
F32	Abnormal Internal Thermostat	Continue for 5 sec.	• Control panel PCB thermostat
F36	Outdoor air temperature sensor abnormality	Continue for 5 sec.	• Outdoor air temperature sensor (defective or disconnected)
F37	Indoor water inlet temperature sensor abnormality	Continue for 5 sec.	• Water inlet temperature sensor (defective or disconnected)
F40	Outdoor discharge pipe temperature sensor abnormality	Continue for 5 sec.	• Outdoor discharge pipe temperature sensor (defective or disconnected)
F41	PFC control	4 times occurrence within 10 minutes	• Voltage at PFC
F42	Outdoor heat exchanger temperature sensor abnormality	Continue for 5 sec.	• Outdoor heat exchanger temperature sensor (defective or disconnected)
F43	Outdoor defrost sensor abnormality	Continue for 5 sec.	• Outdoor defrost sensor (defective or disconnected)
F45	Indoor water outlet temperature sensor abnormality	Continue for 5 sec.	• Water outlet temperature sensor (defective or disconnected)
F46	Outdoor Current Transformer open circuit	-	• Insufficient refrigerant • Outdoor PCB • Compressor low
F48	Outdoor EVA outlet temperature sensor abnormality	Continue for 5 sec.	• Outdoor EVA outlet temperature sensor (defective or disconnected)
F49	Outdoor bypass outlet temperature sensor abnormality	Continue for 5 sec.	• Outdoor bypass outlet temperature sensor (defective or disconnected)

15 Troubleshooting Guide

Self-diagnosis Method

Connection Capability Rank Abnormality (H12).

Malfunction Decision Conditions

During startup operation of cooling and heating, the capability rank of indoor checked by the outdoor is used to determine connection capability rank abnormality.

Malfunction Caused

1 Wrong model interconnected.

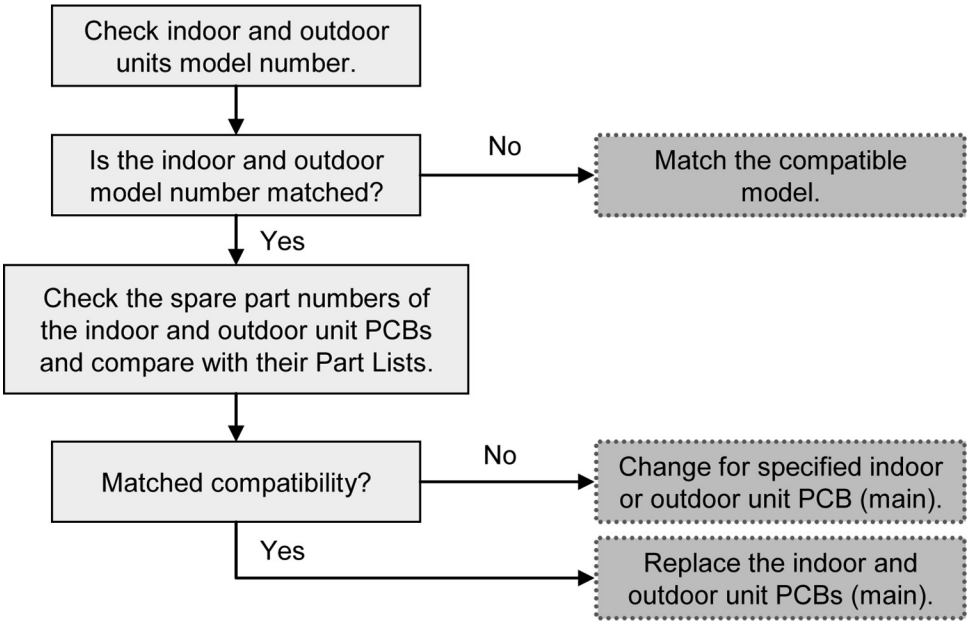
2 Wrong indoor unit or outdoor unit PCB (main) used.

3 Faulty indoor unit or outdoor unit PCB (main).

Abnormality Judgment

Continue for 90 seconds.

Figure 15-4 Troubleshooting H12



15 Troubleshooting Guide

Compressor Tank Temperature Sensor Abnormality (H15)

Malfunction Decision Conditions

During startup and operation of cooling and heating, the temperatures detected by the compressor tank temperature sensor are used to determine sensor error.

Malfunction Caused

1 Faulty connector connection.

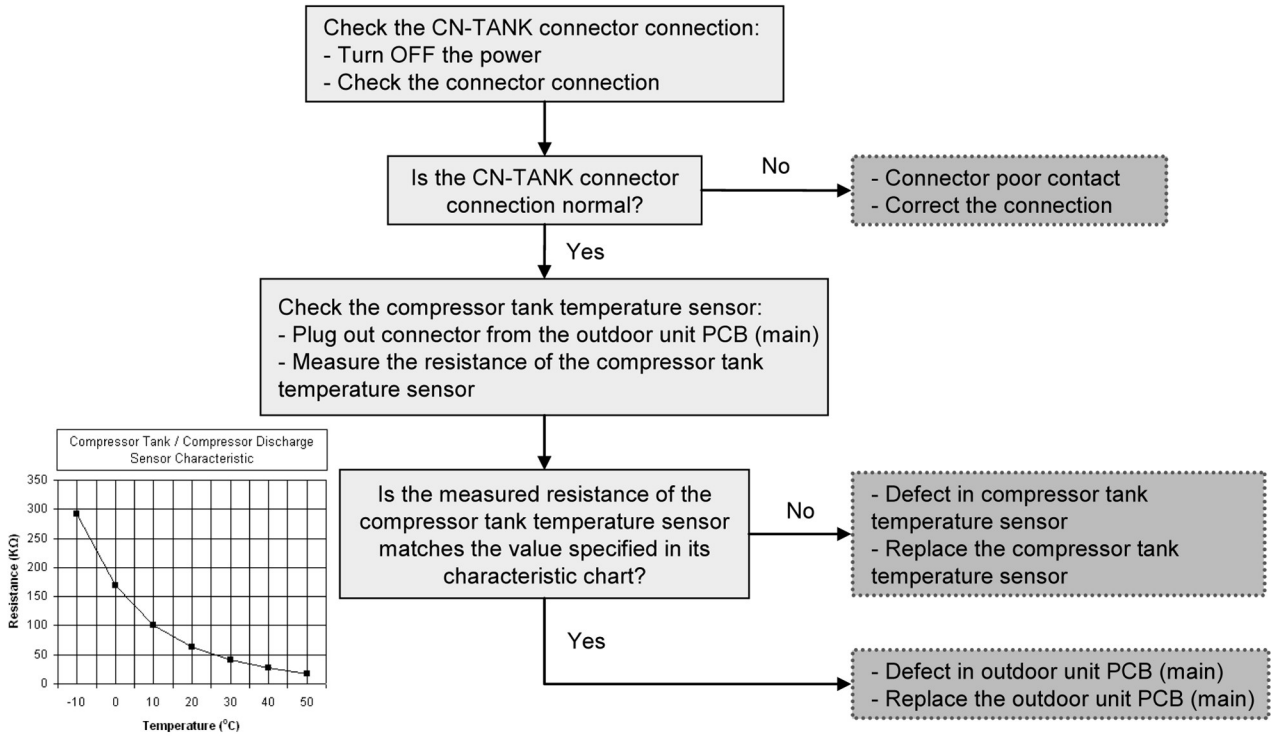
2 Faulty sensor.

3 Faulty outdoor unit PCB (main).

Abnormality Judgment

Continue for 5 seconds.

Figure 15-5 *Troubleshooting H15*



15 Troubleshooting Guide

Water Pump Abnormality (H20)

Malfunction Decision Conditions

During startup and operation of cooling and heating, the rotation speed detected by the IPM of water pump motor during water pump operation is used to determine abnormal water pump (feedback of rotation > 6,000rpm or < 700rpm).

Malfunction Caused

1 Operation stop due to short circuit inside the water pump motor winding.

2 Operation stop due to breaking of wire inside the water pump motor.

3 Operation stop due to breaking of water pump lead wires.

4 Operation stop due to water pump motor IPM malfunction.

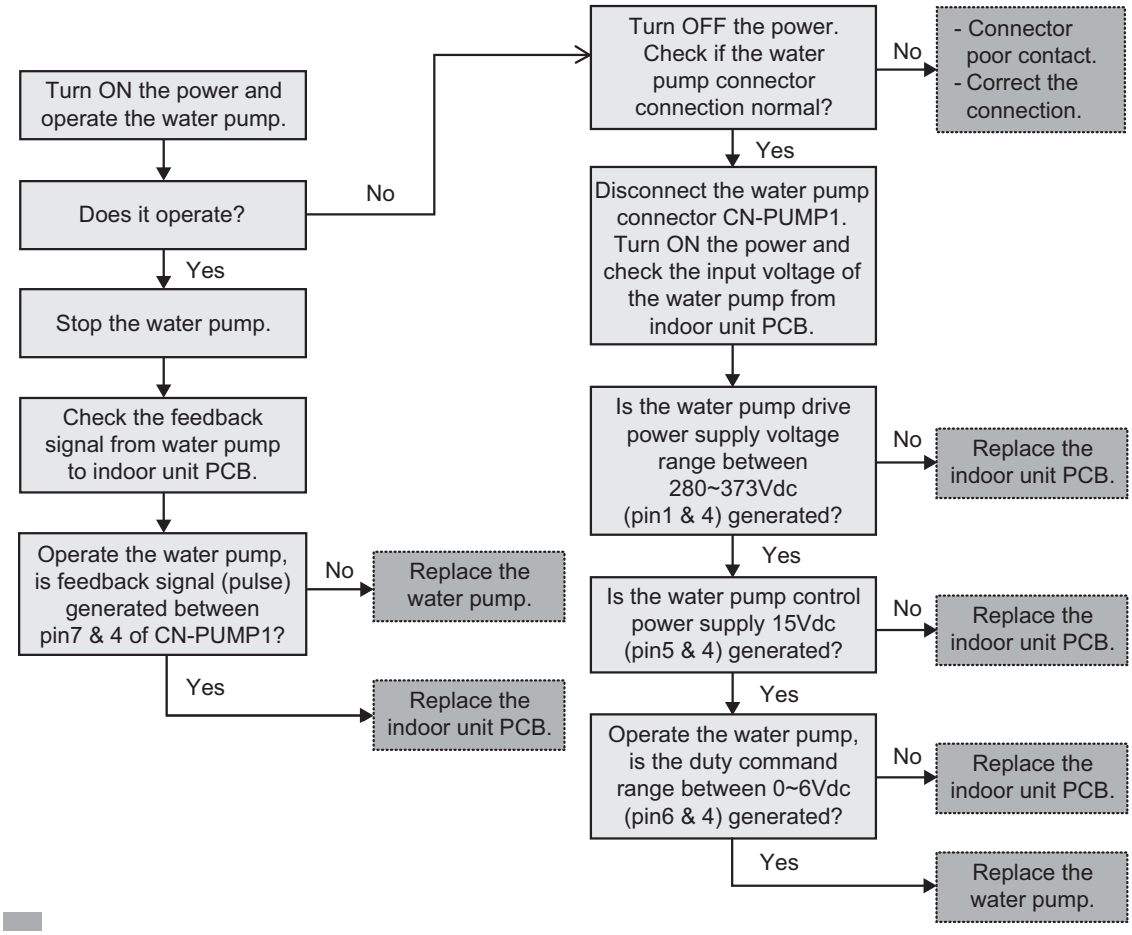
5 Operation error due to faulty indoor unit PCB.

Abnormality Judgment

Continue for 5 seconds.

Figure 15-6 *Troubleshooting H20*

Troubleshooting: **Caution** For safety reason and to prevent component breakdown, always switch off the power before remove and connect the component.



15 Troubleshooting Guide

Indoor Refrigerant Liquid Temperature Sensor Abnormality (H23)

Malfunction Decision Conditions

During startup and operation of cooling and heating, the temperatures detected by the indoor refrigerant liquid temperature sensor are used to determine sensor error.

Malfunction Caused

1 Faulty connector connection.

2 Faulty sensor.

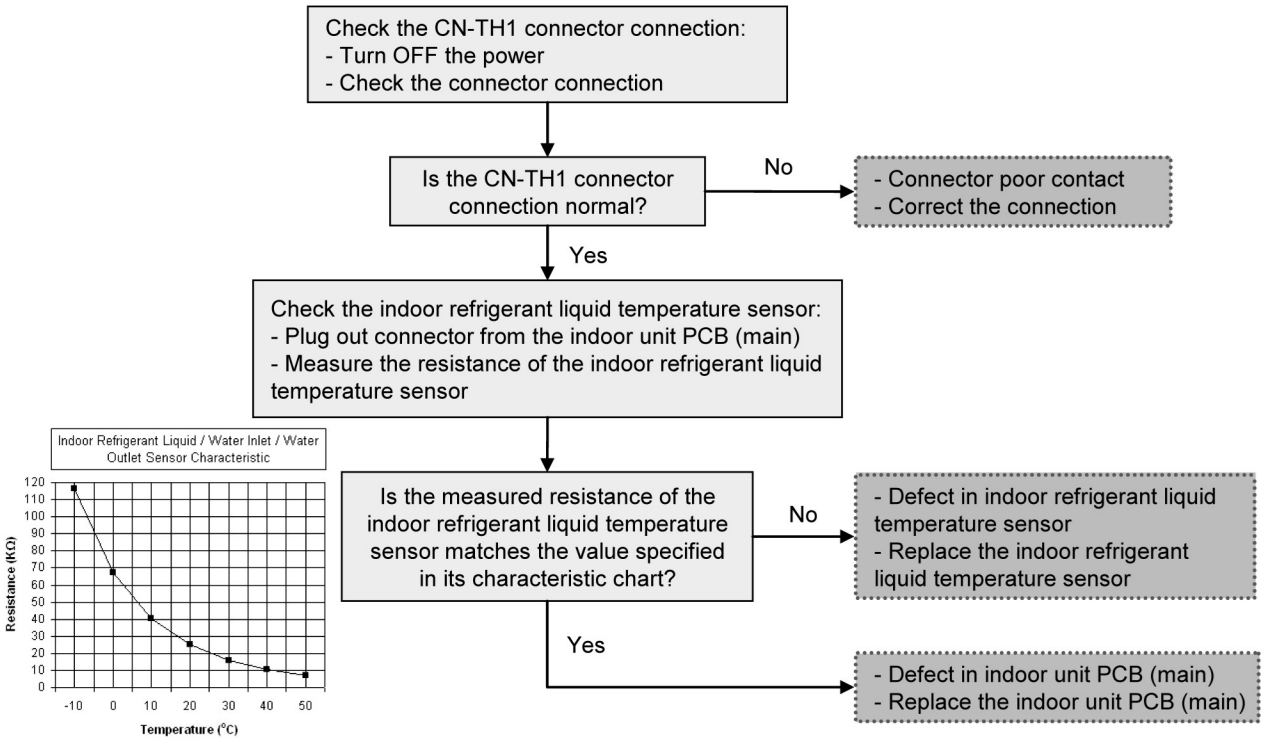
3 Faulty indoor unit PCB (main).

Abnormality Judgment

Continue for 5 seconds.

Figure 15-7 *Troubleshooting H23*

Troubleshooting: **Caution** For safety reason and to prevent component breakdown, always switch off the power before remove and connect the component.



15 Troubleshooting Guide

Service Valve Error (H27)

Malfunction Decision Conditions

During cooling operation, when:-

1. Indoor refrigerant pipe temperature at compressor startup - present indoor refrigerant pipe temperature < 5.4°F
2. Present high pressure - high pressure at compressor startup < 14.2 PSI

**Judgment only for first time cooling operation and not during pump down operation.

Malfunction Caused

1 Three-way valves closed.

2 Faulty high pressure sensor.

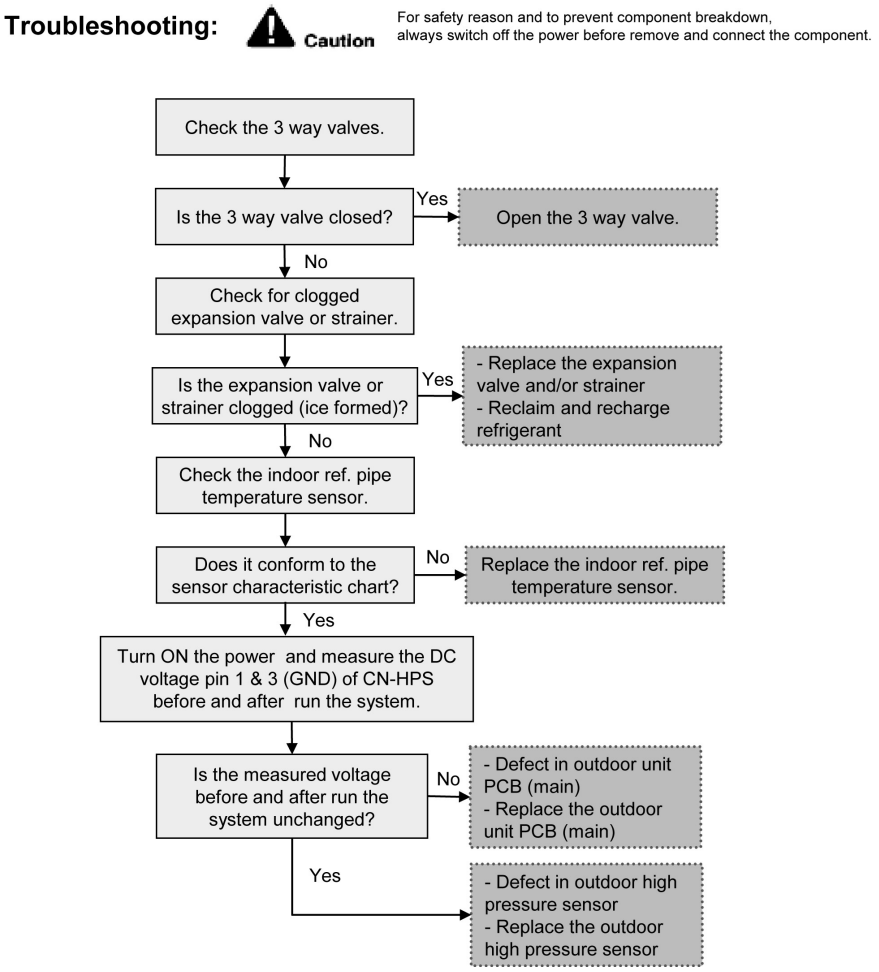
3 Faulty indoor refrigerant pipe temperature sensor

4 Faulty outdoor unit PCB (main).

Abnormality Judgment

Continue for 5 minutes.

Figure 15-8 Troubleshooting H27



15 Troubleshooting Guide

Abnormal Buffer Tank Sensor (H36)

Malfunction Caused

1 Faulty connector connection.

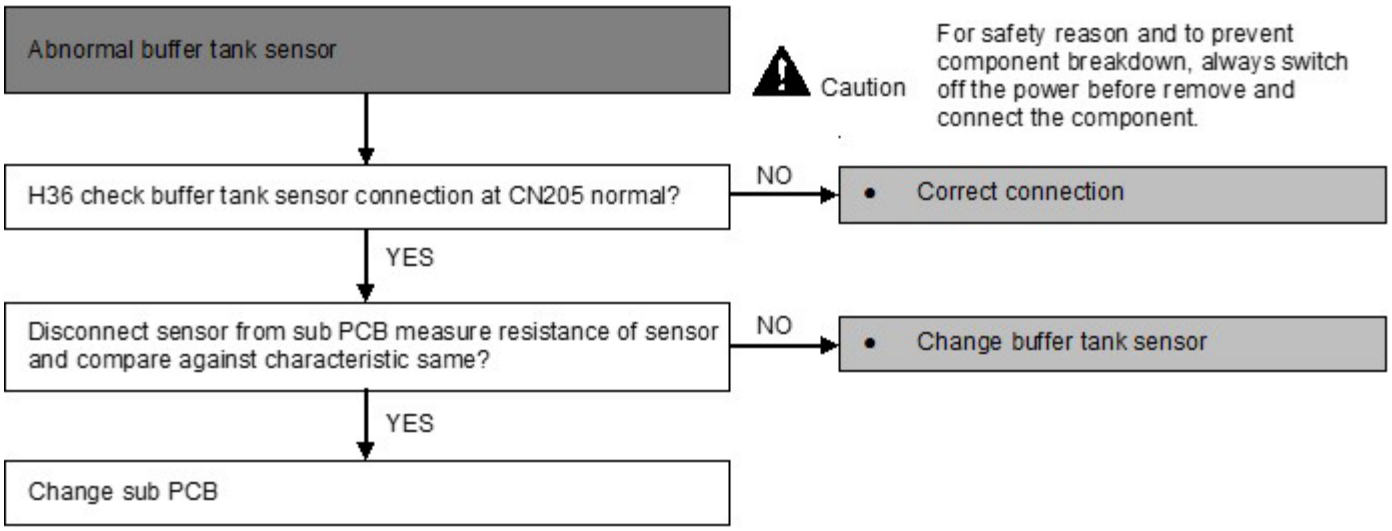
2 Faulty buffer tank sensor.

3 Faulty indoor sub PCB.

Abnormality Judgment

Continue for 5 seconds.

Figure 15-9 *Troubleshooting H36*



15 Troubleshooting Guide

Compressor Low Pressure Protection (H42)

Malfunction Decision Conditions

During operation of heating and after 5 minutes compressor ON, when outdoor pipe temperature below 34.6°F or above 78.8°F is detected by the outdoor pipe temperature sensor.

Malfunction Caused

1 Dust accumulation on the outdoor unit heat exchanger.

2 Air short circuit at outdoor unit.

3 2 way valve partially closed.

4 Faulty outdoor unit fan motor.

5 Refrigerant shortage (refrigerant leakage).

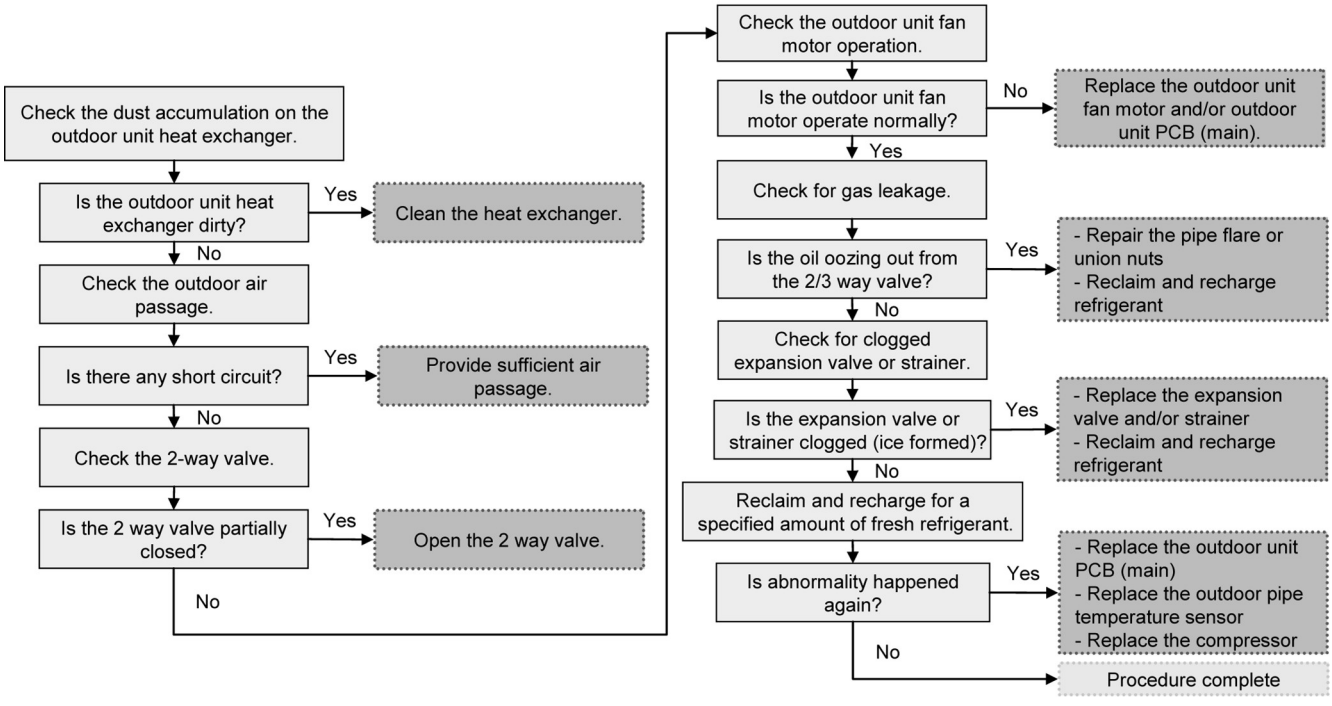
6 Clogged expansion valve or strainer.

7 Faulty outdoor pipe temperature sensor.

8 Faulty outdoor unit main PCB (main).

Figure 15-10 *Troubleshooting H42*

Troubleshooting: **Caution** For safety reason and to prevent component breakdown, always switch off the power before remove and connect the component.



15 Troubleshooting Guide

Water Flow Switch Abnormality (H62)

Malfunction Decision Conditions

During operation of cooling and heating, the water flow detected by the indoor water flow switch is used to determine water flow error.

Malfunction Caused

1 Faulty water pump.

2 Water leak in system.

3 Faulty connector connection.

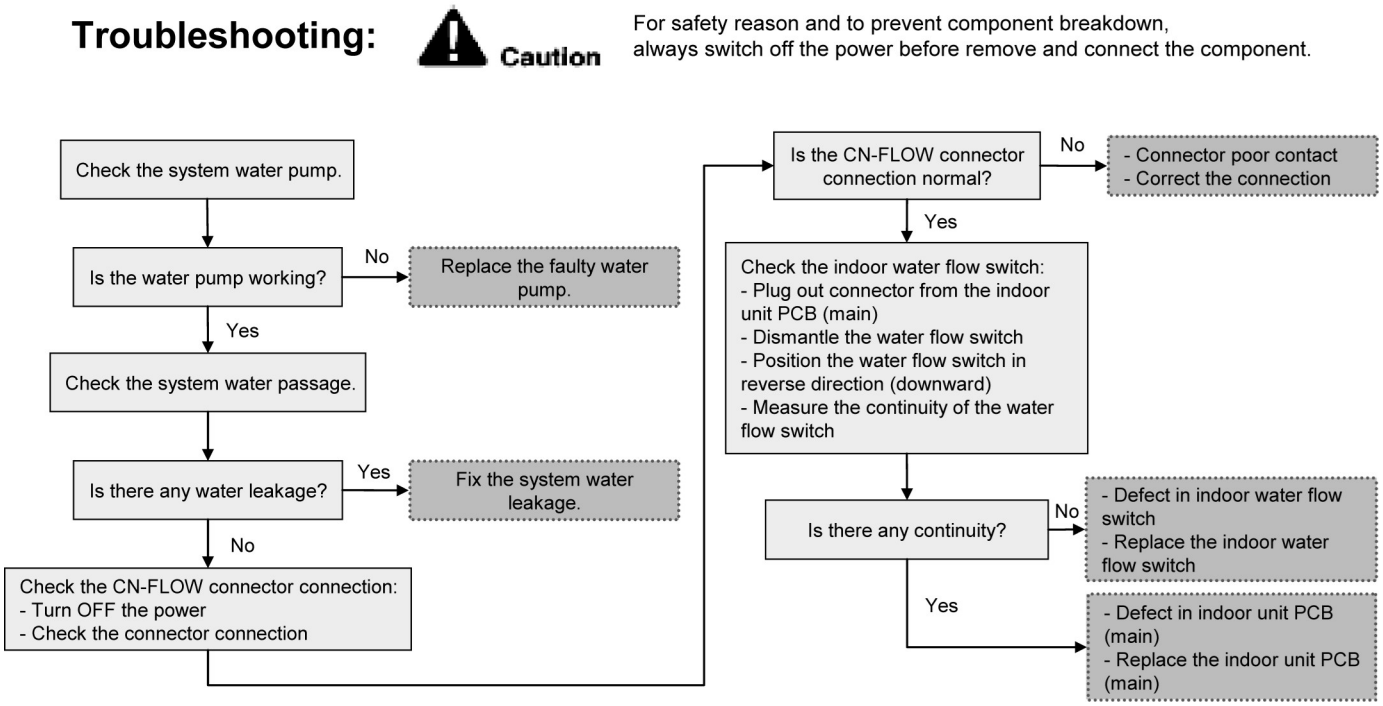
4 Faulty water flow switch.

5 Faulty indoor unit PCB (main).

Abnormality Judgment

Continue for 10 seconds (but no judgment for 9 minutes after compressor startup/restart).

Figure 15-11 *Troubleshooting H62*



15 Troubleshooting Guide

Outdoor High Pressure Abnormality (H64)

Malfunction Decision Conditions

During operation of cooling and heating, when the outdoor high pressure sensor output signal is 0 Vdc or 5 Vdc.

Malfunction Caused

1 Faulty connector connection.

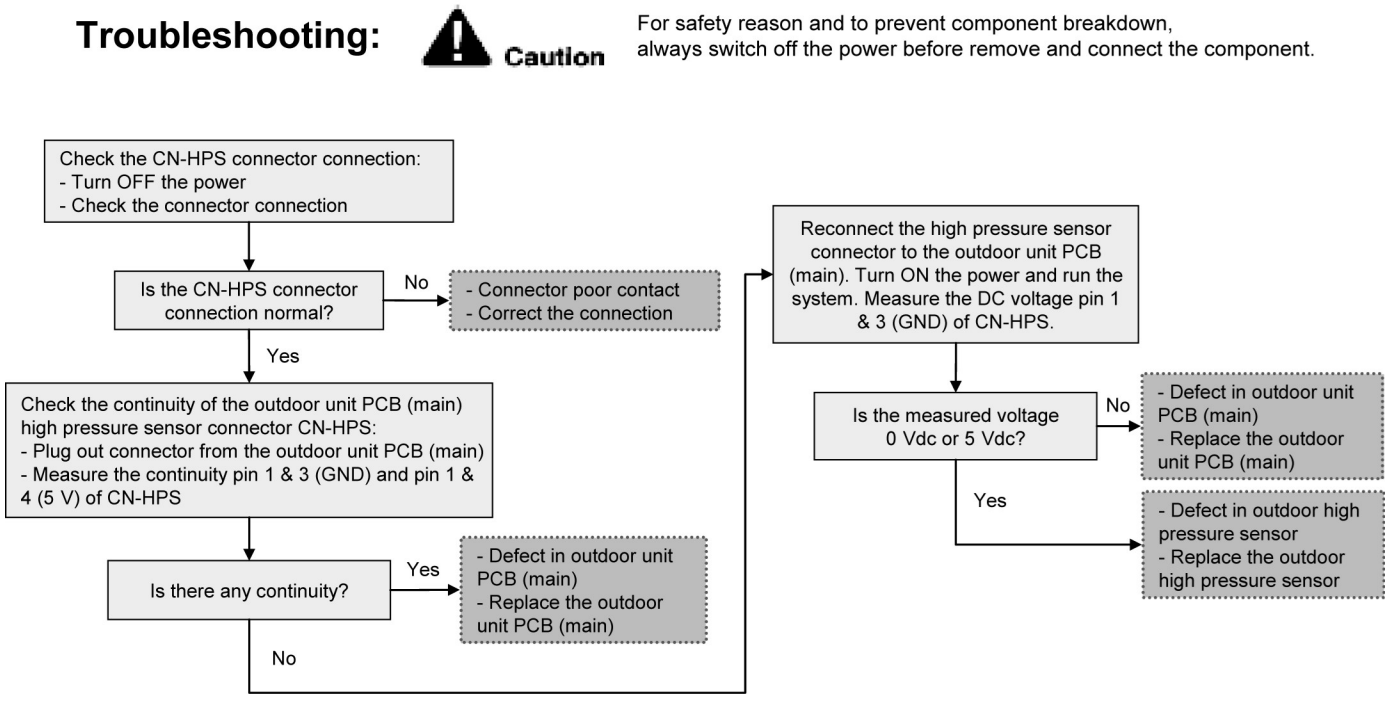
2 Faulty sensor.

3 Faulty outdoor unit PCB (main).

Abnormality Judgment

Continue 4 times in 20 minutes.

Figure 15-12 *Troubleshooting H64*



15 Troubleshooting Guide

De-ice Circulation Error (H65)

Malfunction Decision Conditions

During startup and operation of de-ice (mode 2), the water flow (> 1.3 gal/min) detected by the water flow switch is used to determine de-ice circulation error.

Malfunction Caused

1 Water flow in air-to-water heatpump indoor unit circuitry.

2 Faulty indoor unit water flow switch.

3 Faulty indoor unit water pump.

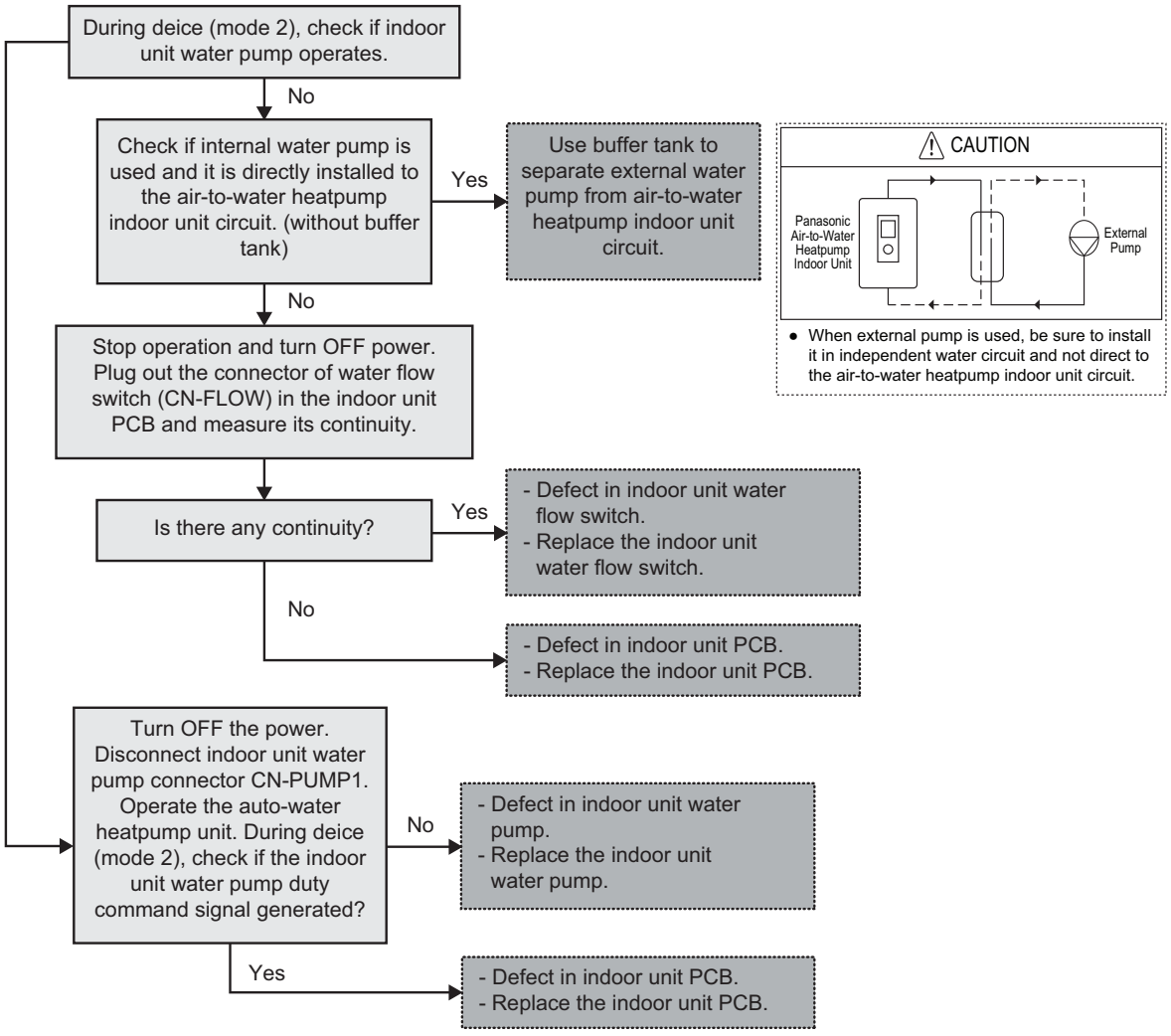
4 Faulty indoor unit PCB.

Abnormality Judgment

Continue for 10 seconds.

Figure 15-13 *Troubleshooting H65*

Troubleshooting: **Caution** For safety reason and to prevent component breakdown, always switch off the power before remove and connect the component.



15 Troubleshooting Guide

Indoor Backup Heater OLP Abnormality (H70)

Malfunction Decision Conditions

During operation of indoor backup heater, when no power supplies to indoor backup heater or OLP open circuit.

Malfunction Caused

1 Faulty power supply connector connection.

2 Faulty connector connection.

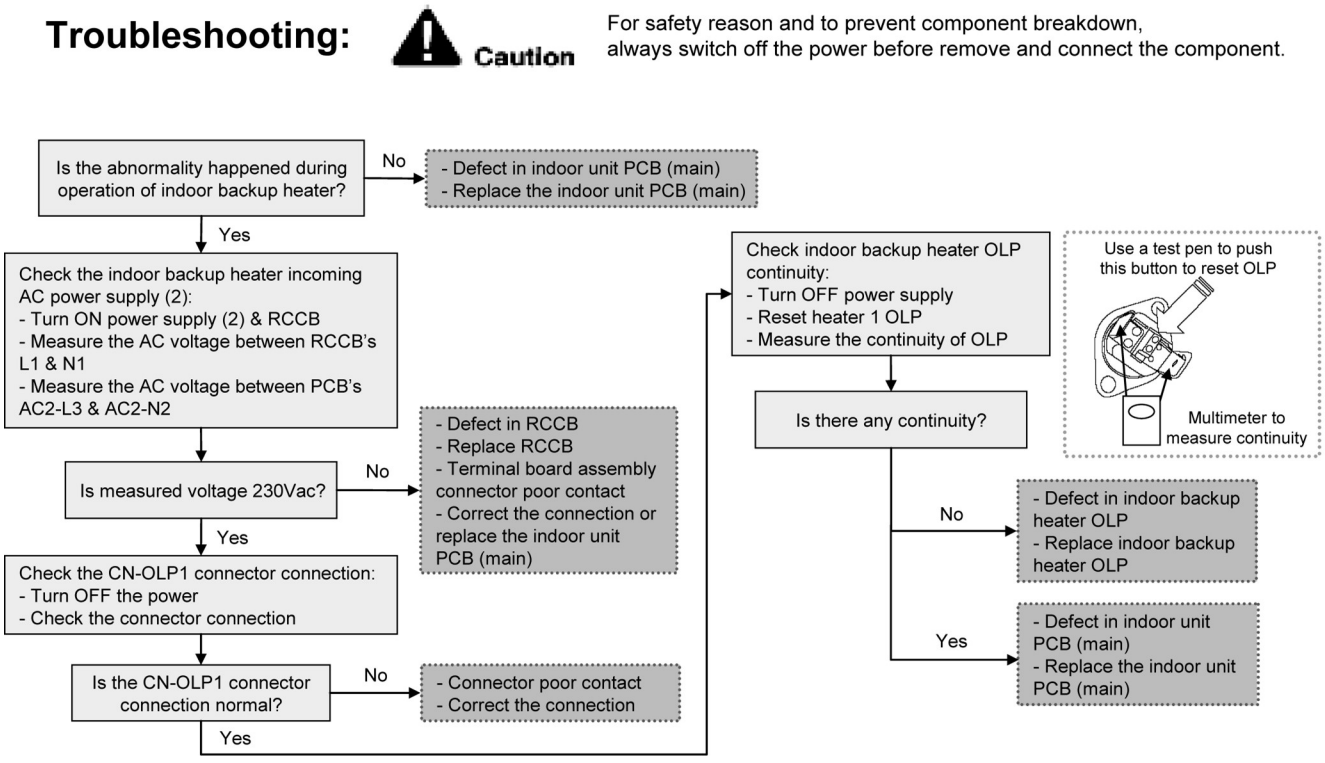
3 Faulty indoor backup heater overload protector (OLP).

4 Faulty indoor unit PCB (main).

Abnormality Judgment

Continue for 60 seconds.

Figure 15-14 *Troubleshooting H70*



15 Troubleshooting Guide

Tank Temperature Sensor Abnormality (H72)

Malfunction Decision Conditions

When tank connection is set to ON, the temperatures detected by the tank temperature sensor are used to determine sensor error.

Malfunction Caused

1 Faulty connector connection.

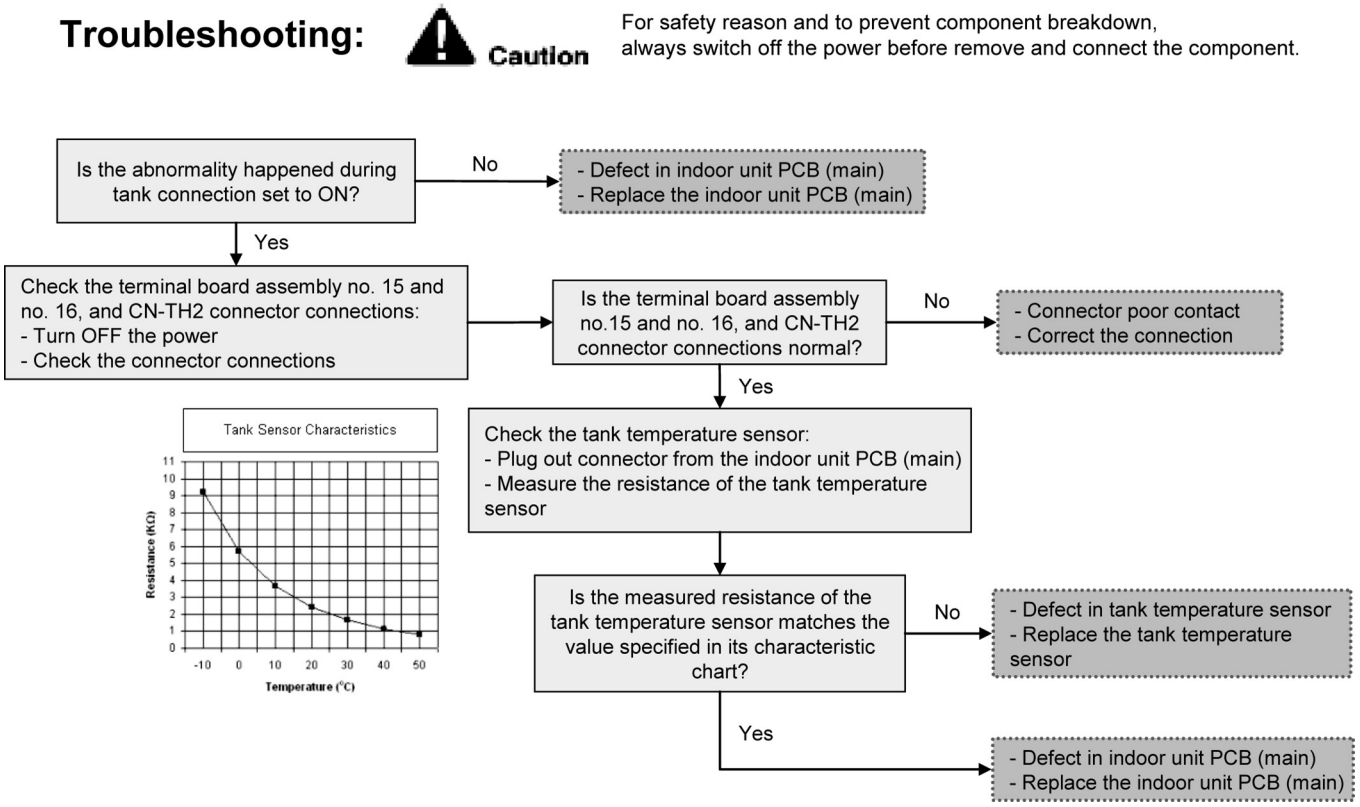
2 Faulty sensor.

3 Faulty indoor unit PCB (main).

Abnormality Judgment

Continue for 5 seconds.

Figure 15-15 Troubleshooting H72



15 Troubleshooting Guide

PCB Communication Error (H74)

Malfunction Decision Conditions

When External PCB connection is select “YES” and no communication with External PCB micon for 10 seconds and above.

Malfunction Caused

1 Faulty connector connection.

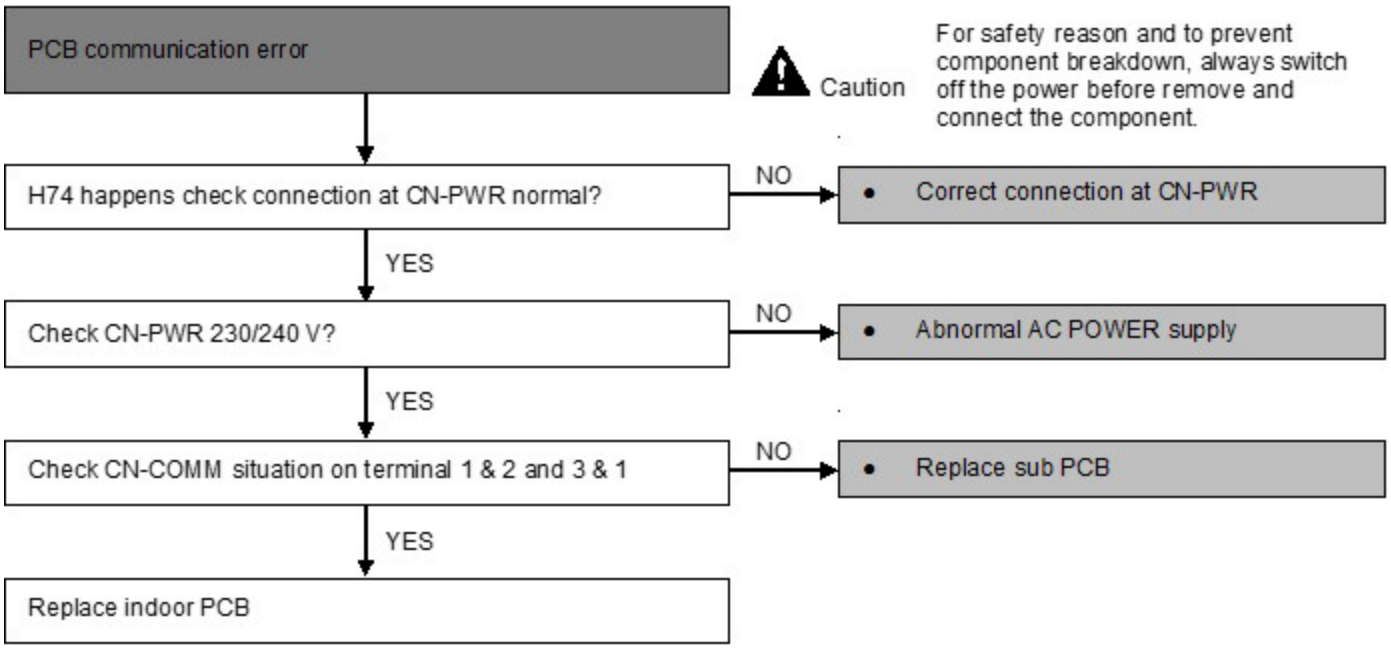
2 Faulty indoor PCB.

3 Faulty indoor sub PCB.

Abnormality Judgment

After 1 minute operation started.

Figure 15-16 Troubleshooting H74



15 Troubleshooting Guide

Indoor-Control Panel Communication Abnormality (H76)

Malfunction Decision Conditions

During standby and operation of cooling and heating, indoor-control panel error occurs.

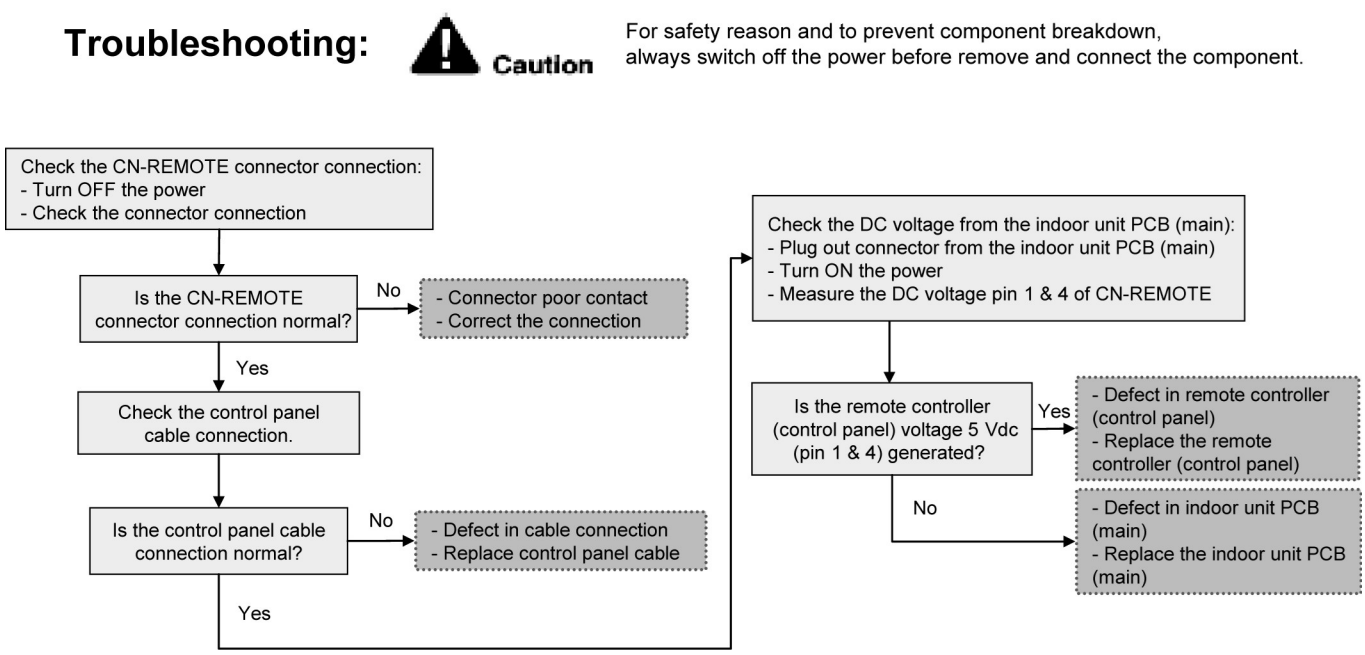
Malfunction Caused

1 Faulty connector connection.

2 Faulty control panel.

3 Faulty indoor unit PCB (main).

Figure 15-17 Troubleshooting H76



15 Troubleshooting Guide

Indoor/Outdoor Abnormal Communication (H90)

Malfunction Decision Conditions

During operation of cooling and heating, the data received from outdoor unit in indoor unit signal transmission is checked whether it is normal.

Malfunction Caused

1 Faulty outdoor unit PCB (main).

2 Faulty indoor unit PCB (main).

3 Indoor-outdoor signal transmission error due to wrong wiring.

4 Indoor-outdoor signal transmission error due to breaking of wire in the connection wires between the indoor and outdoor units.

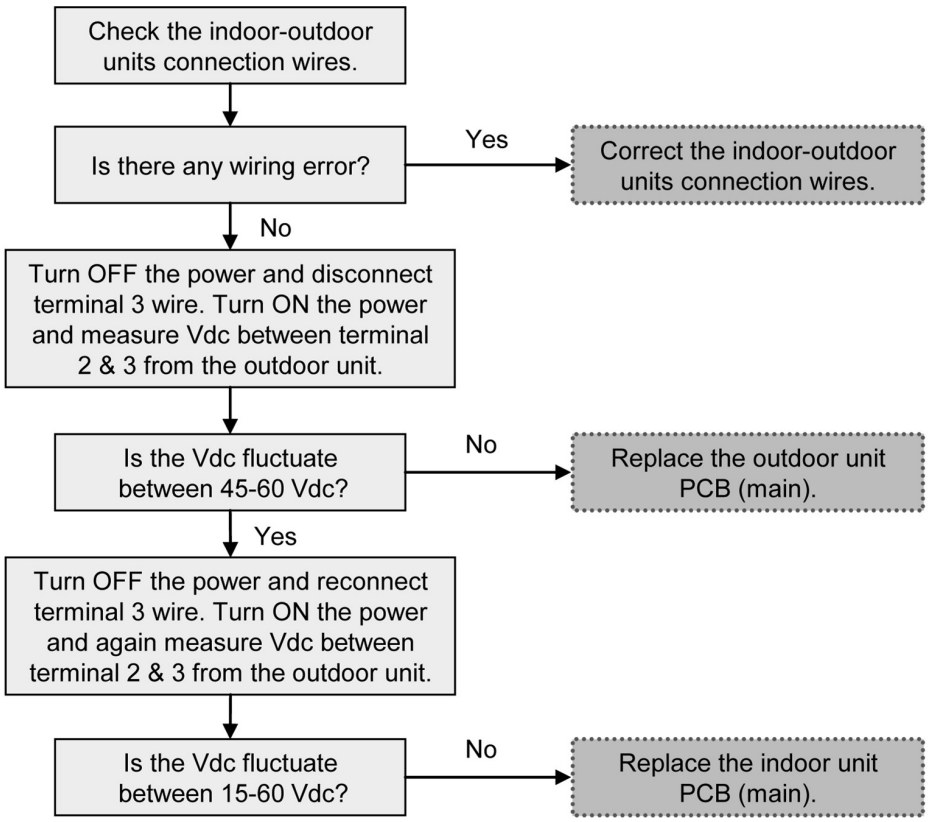
5 Indoor-outdoor signal transmission error due to disturbed power supply waveform.

Abnormality Judgment

Continue for 1 minute after operation.

Figure 15-18 Troubleshooting H90

Troubleshooting: **Caution** For safety reason and to prevent component breakdown, always switch off the power before remove and connect the component.



15 Troubleshooting Guide

Tank Booster Heater OLP Abnormality (H91)

Malfunction Decision Conditions

During operation of tank booster heater, and tank booster heater OLP open circuit.

Malfunction Caused

1 Faulty connector connection.

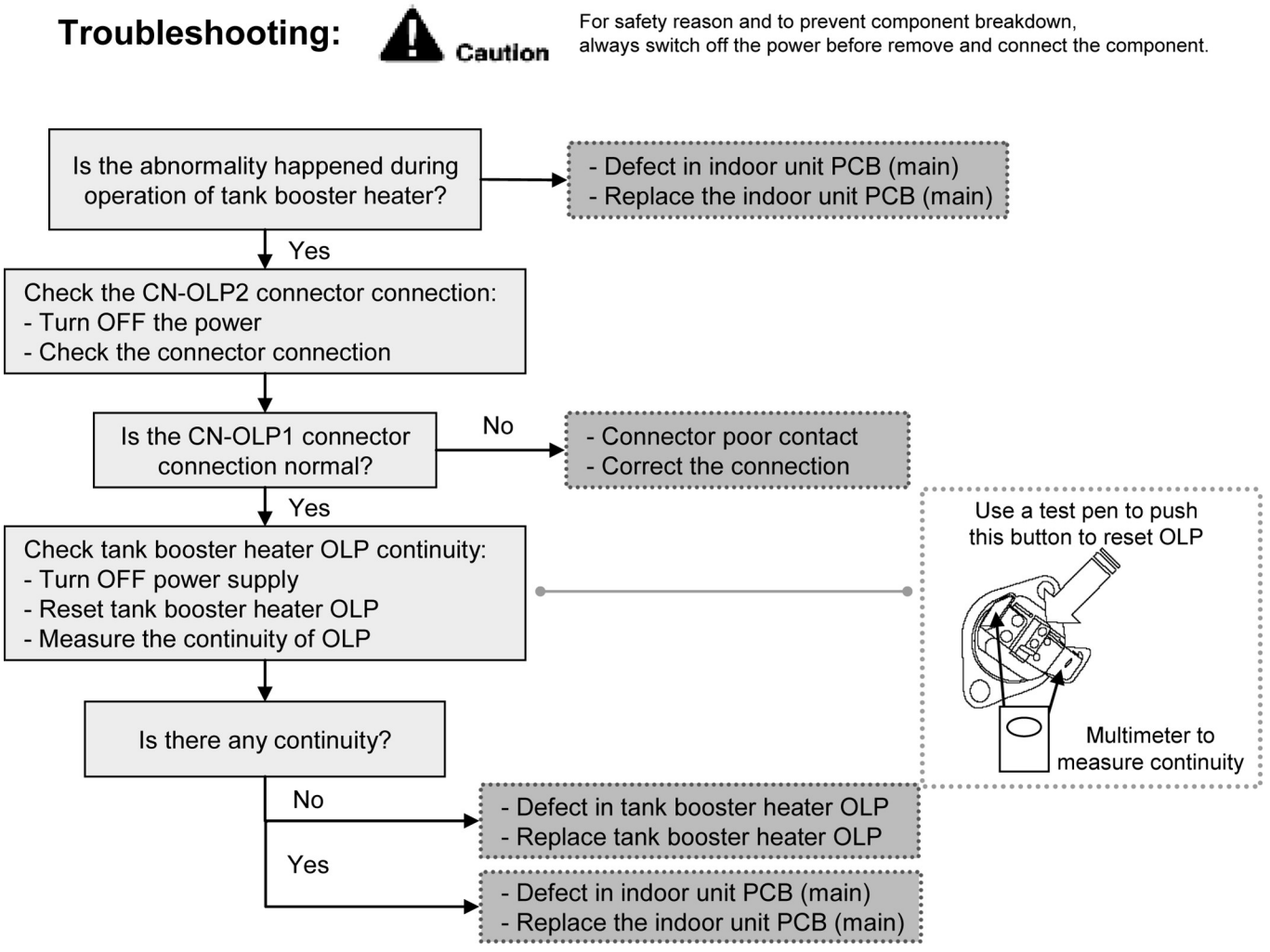
2 Faulty tank booster heater overload protector (OLP).

3 Faulty indoor unit PCB (main).

Abnormality Judgment

Continue for 60 seconds.

Figure 15-19 Troubleshooting H91



15 Troubleshooting Guide

Unspecified Voltage between Indoor and Outdoor (H95)

Malfunction Decision Conditions

The supply power is detected for its requirement by the indoor/outdoor transmission.

Malfunction Caused

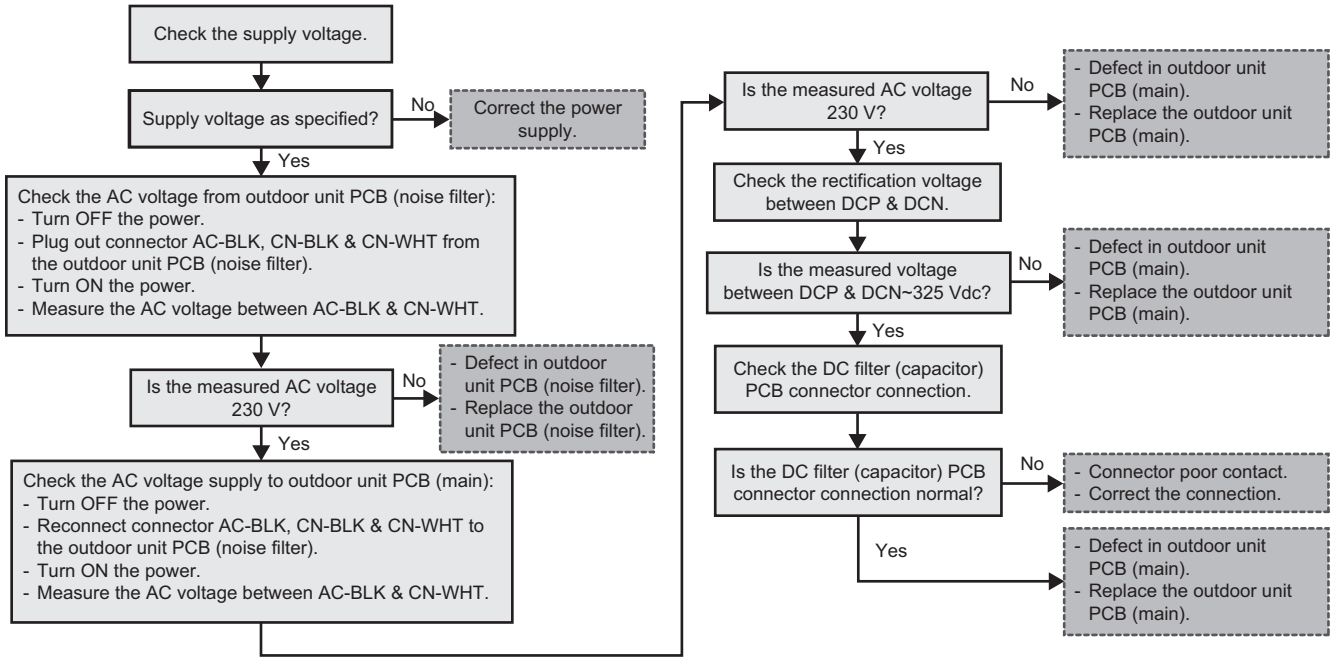
1 Insufficient power supply.

2 Faulty outdoor unit PCB (noise filter/main).

Figure 15-20 Troubleshooting H95

Troubleshooting:

Caution For safety reason and to prevent component breakdown, always switch off the power before remove and connect the component.



15 Troubleshooting Guide

Outdoor High Pressure Protection (H98 / F95)

Malfunction Decision Conditions

During operation of cooling / heating, when pressure 609.2 PSI and above is detected by outdoor high pressure sensor.

Malfunction Caused

1 Faulty water pump.

2 Insufficient water flow rate in system.

3 Water leak in system.

4 Dust accumulation in the outdoor unit heat exchanger.

5 Air short circuit at outdoor.

6 Faulty outdoor unit fan motor.

7 2/three-way closed.

8 Clogged expansion valve or strainer.

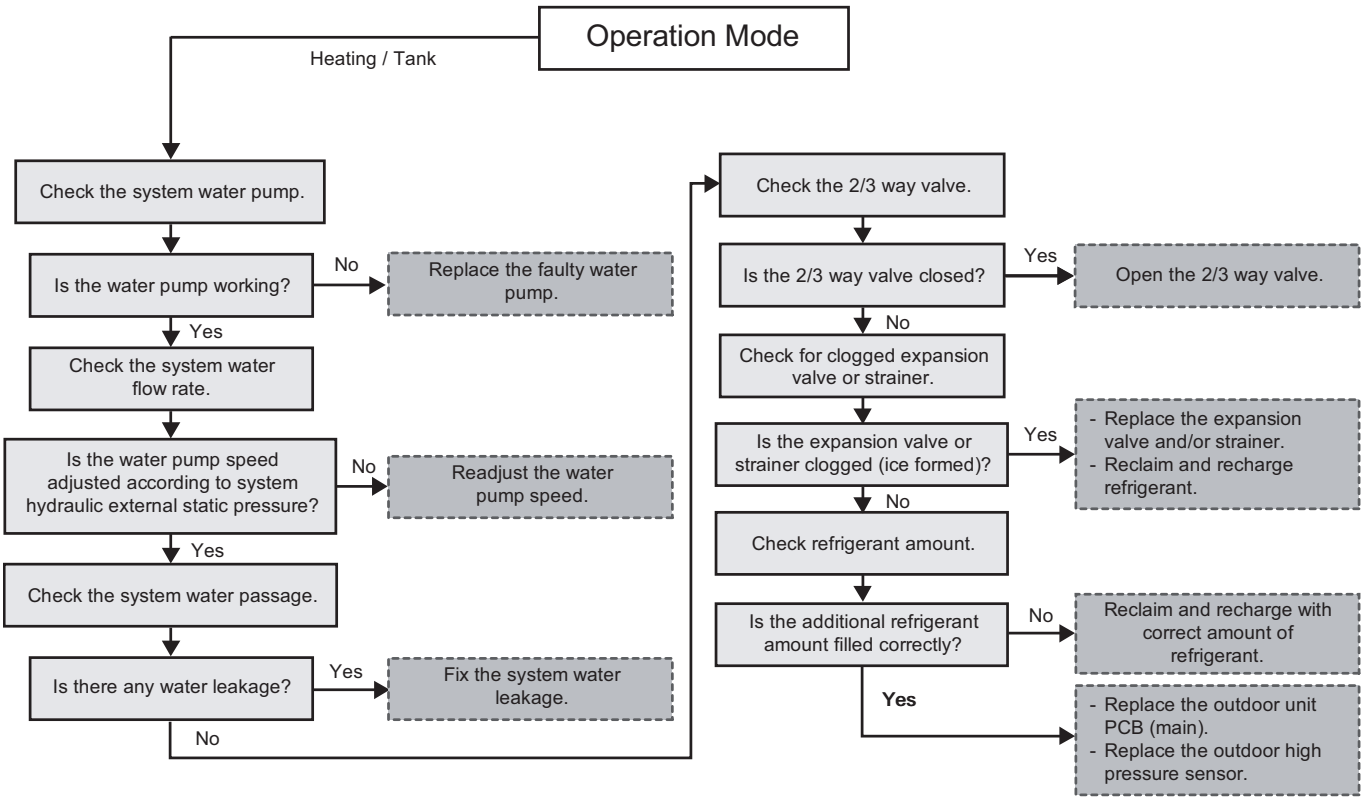
9 Excessive refrigerant.

10 Faulty outdoor high pressure sensor.

11 Faulty outdoor unit PCB (main).

Figure 15-21 *Troubleshooting H98*

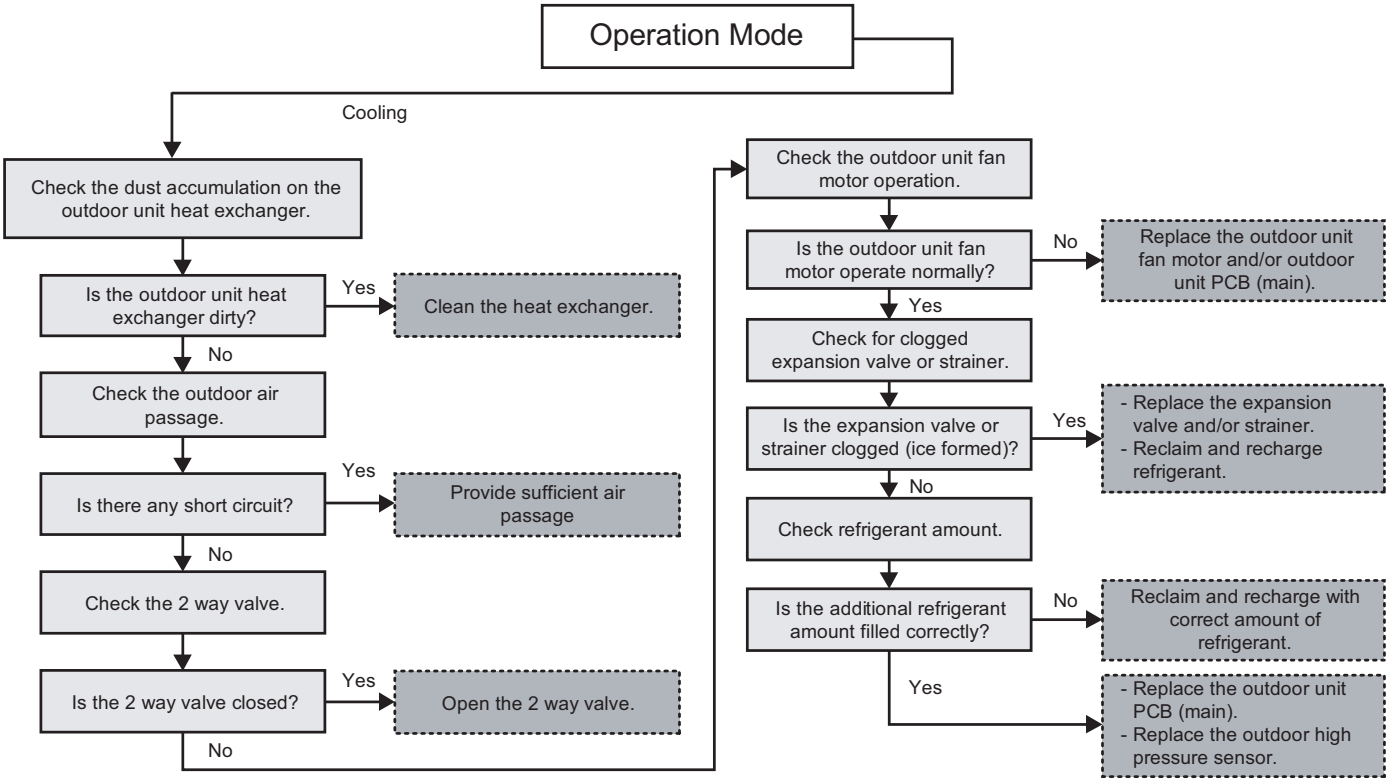
Troubleshooting: **Caution** For safety reason and to prevent component breakdown, always switch off the power before remove and connect the component.



15 Troubleshooting Guide

Figure 15-22 Troubleshooting F95

Troubleshooting: **Caution** For safety reason and to prevent component breakdown, always switch off the power before remove and connect the component.



15 Troubleshooting Guide

Indoor Freeze-up Protection (H99)

Malfunction Decision Conditions

During anti-freezing control in cooling operation, when the indoor refrigerant liquid temperature < 32°F.

Malfunction Caused

1 Faulty water pump.

2 Insufficient water flow rate in system.

3 Water leak in system.

4 2 way valve partially closed.

5 Clogged expansion valve or strainer.

6 Refrigerant shortage (refrigerant leakage).

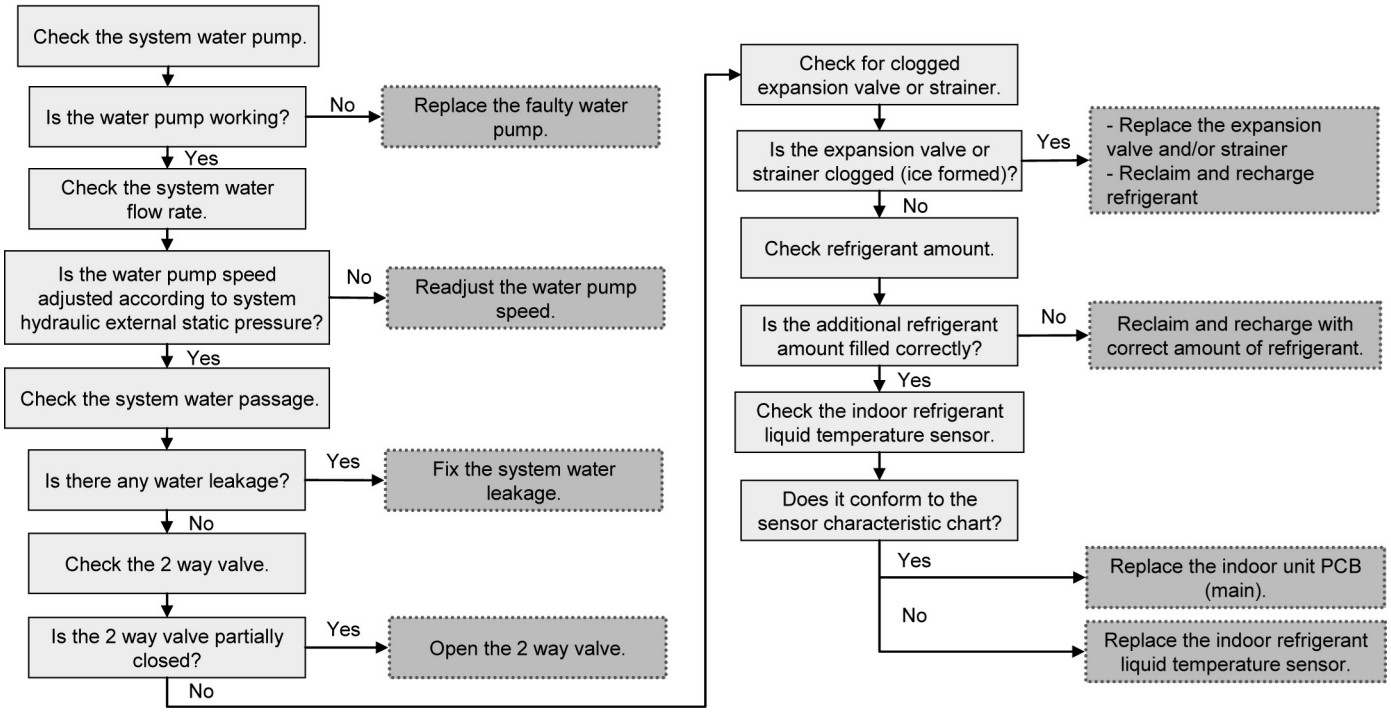
7 Faulty indoor refrigerant liquid temperature sensor.

8 Faulty indoor unit PCB (main).

Figure 15-23 Troubleshooting H99

Troubleshooting:

Caution For safety reason and to prevent component breakdown, always switch off the power before remove and connect the component.



15 Troubleshooting Guide

Outdoor High Pressure Switch Activate (F12)

Malfunction Decision Conditions

During operation of cooling and heating, when pressure 623.7 PSI and above is detected by outdoor high pressure switch.

Malfunction Caused

1 Dust accumulation on the outdoor unit heat exchanger.

2 Air short circuit at outdoor unit.

3 Faulty water pump.

4 Insufficient water flow rate in system.

5 Water leak in system.

6 2/three-way valve closed.

7 Clogged expansion valve or strainer.

8 Excessive refrigerant.

9 Faulty outdoor high pressure sensor and switch.

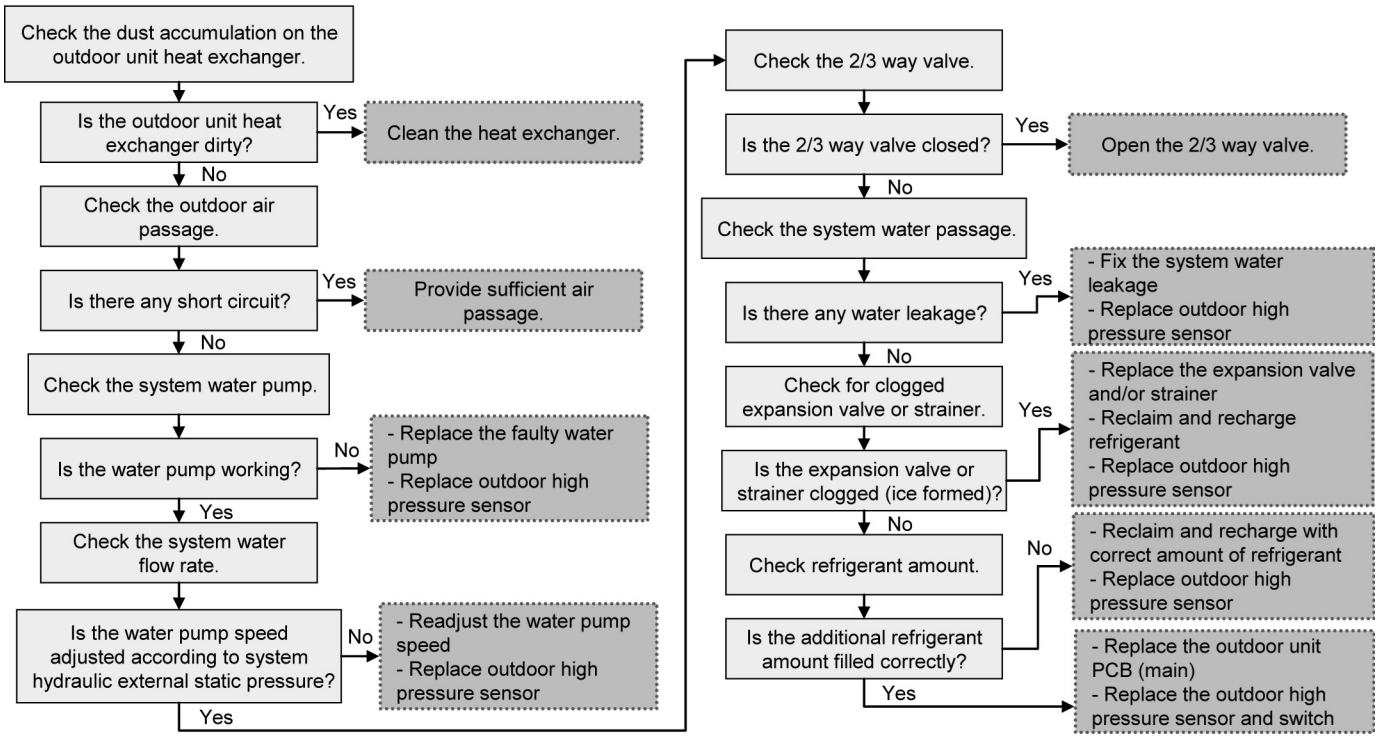
10 Faulty outdoor unit PCB.

Abnormality Judgment

After 1 minute operation started.

Figure 15-24 *Troubleshooting F12*

Troubleshooting: **Caution** For safety reason and to prevent component breakdown, always switch off the power before remove and connect the component.



15 Troubleshooting Guide

Compressor Rotation Failure (F14)

Malfunction Decision Conditions

A compressor rotation failure is detected by checking the compressor running condition through the position detection circuit.

Malfunction Caused

1 Compressor terminal disconnect.

2 Faulty outdoor unit PCB (main).

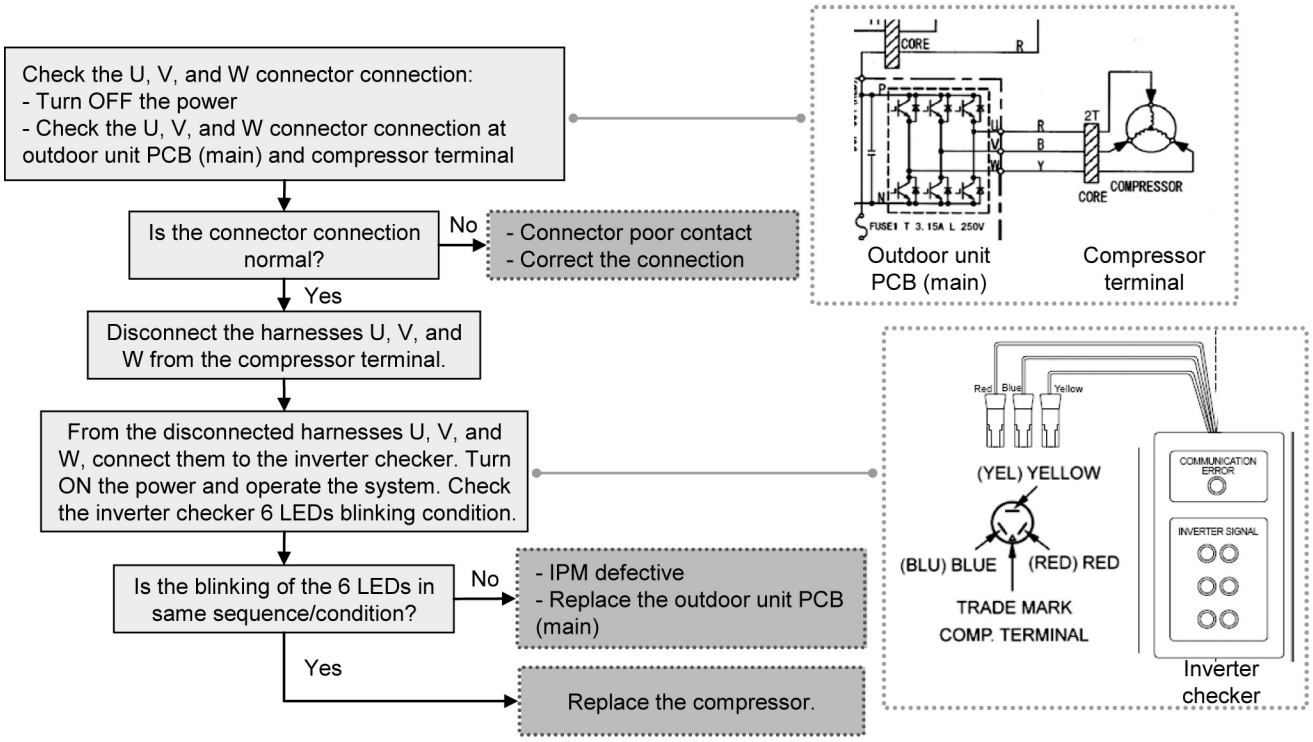
3 Faulty compressor.

Abnormality Judgment

Continue 4 times in 20 minutes.

Figure 15-25 Troubleshooting F14

Troubleshooting: **Caution** For safety reason and to prevent component breakdown, always switch off the power before remove and connect the component.



15 Troubleshooting Guide

Outdoor Fan Motor (DC Motor) Mechanism Locked (F15)

Malfunction Decision Conditions

The rotation speed detected by the Hall IC of the fan motor during fan motor operation is used to determine abnormal fan motor (feedback of rotation > 2550 rpm or < 20 rpm).

Malfunction Caused

1 Operation stop due to short circuit inside the fan motor winding.

2 Operation stop due to breaking of wire inside the fan motor.

3 Operation stop due to breaking of fan motor lead wires.

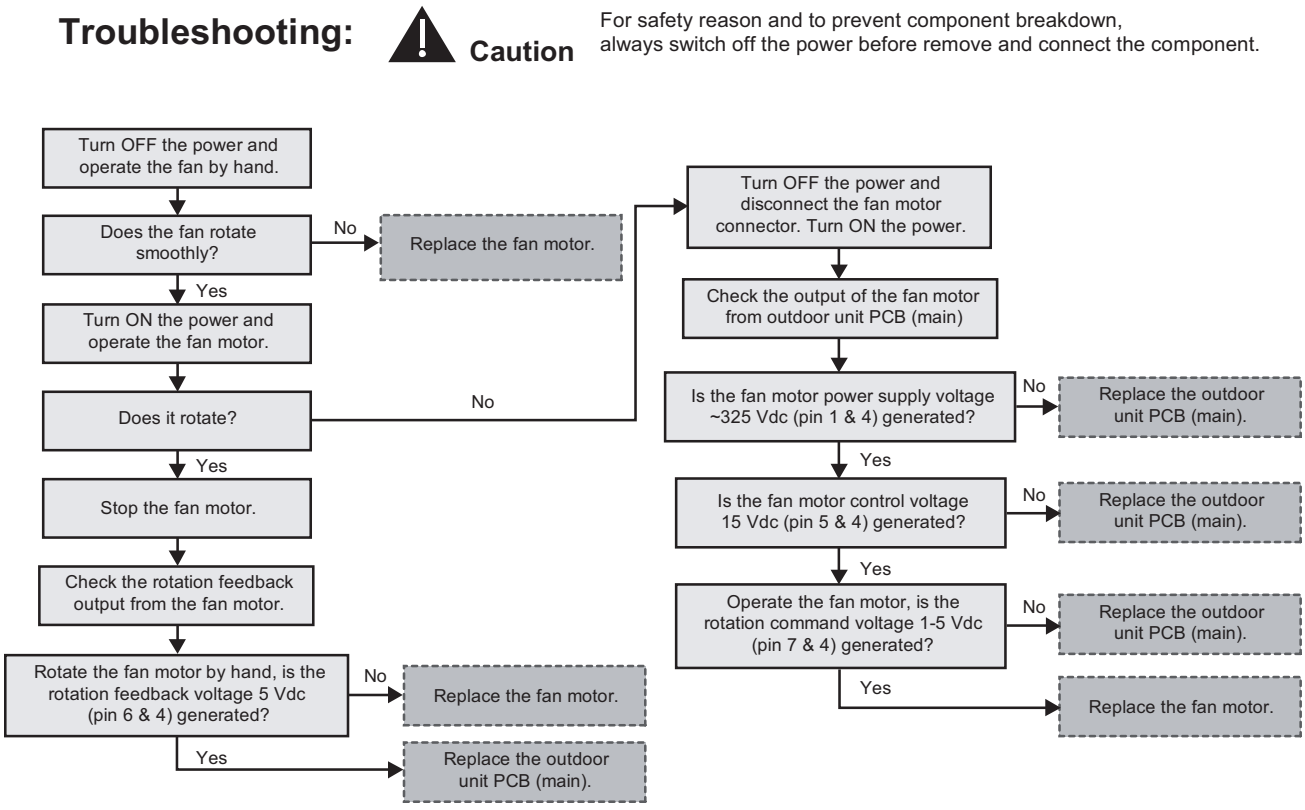
4 Operation stop due to fan motor Hall IC malfunction.

5 Operation error due to faulty outdoor unit PCB.

Abnormality Judgment

Continue 2 times in 30 minutes.

Figure 15-26 *Troubleshooting F15*



15 Troubleshooting Guide

Input Over Current Detection (F16)

Malfunction Decision Conditions

During operation of cooling and heating, when outdoor current above 28.0A (Heating) and 20.0A (Cooling) is detected by the current transformer (CT) in the outdoor unit PCB.

Malfunction Caused

1 Excessive refrigerant.

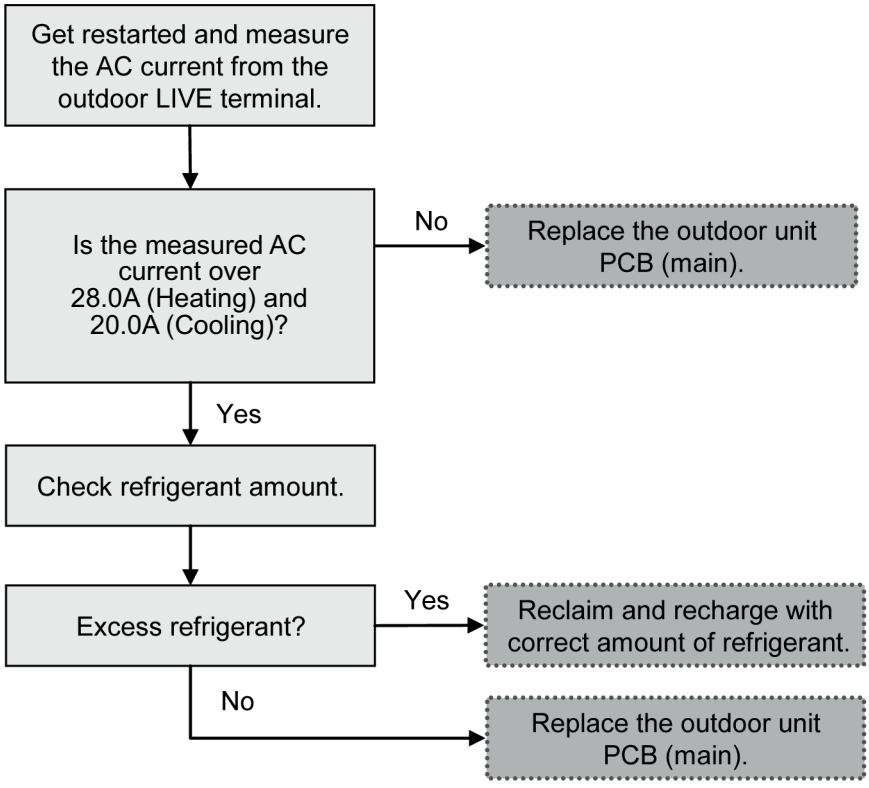
2 Faulty outdoor unit PCB (main).

Abnormality Judgment

Continue 3 times in 20 minutes.

Figure 15-27 *Troubleshooting F16*

Troubleshooting: **Caution** For safety reason and to prevent component breakdown, always switch off the power before remove and connect the component.



15 Troubleshooting Guide

Compressor Overheating (F20)

Malfunction Decision Conditions

During operation of cooling and heating, when temperature above 242.6°F is detected by the outdoor discharge pipe temperature sensor.

Malfunction Caused

1 Faulty outdoor discharge pipe temperature sensor.

2 2/three-way valve closed.

3 Refrigerant shortage (refrigerant leakage).

4 Clogged expansion valve or strainer.

5 Faulty outdoor unit PCB (main).

6 Faulty compressor.

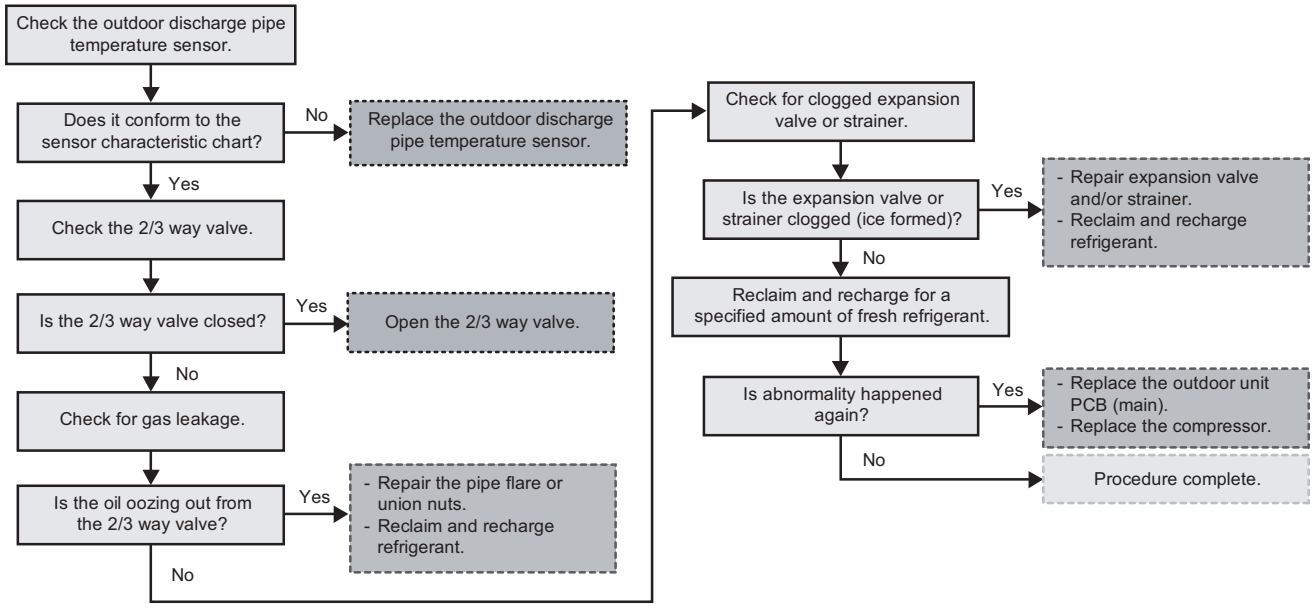
Abnormality Judgment

Continue 4 times in 30 minutes.

Figure 15-28 Troubleshooting F20

Troubleshooting:

Caution For safety reason and to prevent component breakdown, always switch off the power before remove and connect the component.



15 Troubleshooting Guide

IPM Overheating (F22)

Malfunction Decision Conditions

During operation of cooling and heating, when temperature 203°F is detected by the outdoor IPM temperature sensor.

Malfunction Caused

1 Faulty outdoor unit fan motor.

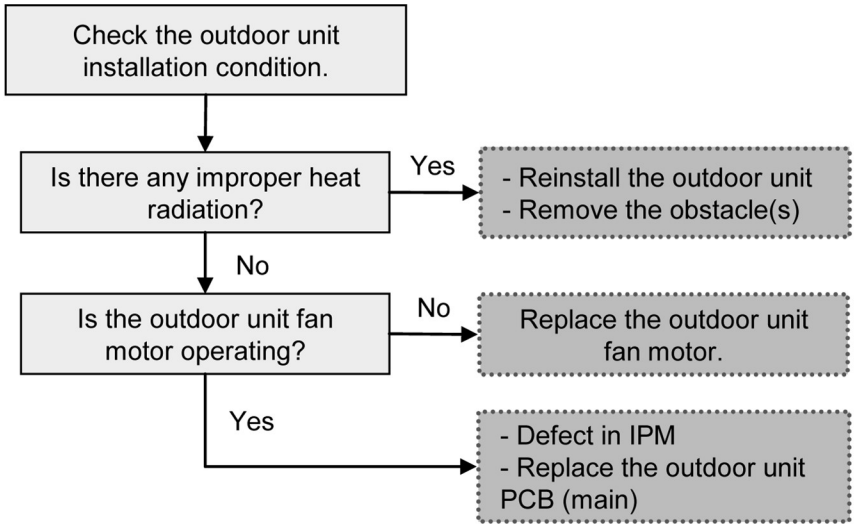
2 Faulty outdoor unit PCB (main).

Abnormality Judgment

Continue 3 times in 30 minutes.

Figure 15-29 Troubleshooting F22

Troubleshooting: **Caution** For safety reason and to prevent component breakdown, always switch off the power before remove and connect the component.



15 Troubleshooting Guide

Output Over Current Detection (F23)

Malfunction Decision Conditions

During operation of cooling and heating, when outdoor DC current is above 53 A is detected by the IPM DC Peak sensing circuitry in the outdoor unit PCB (main).

Malfunction Caused

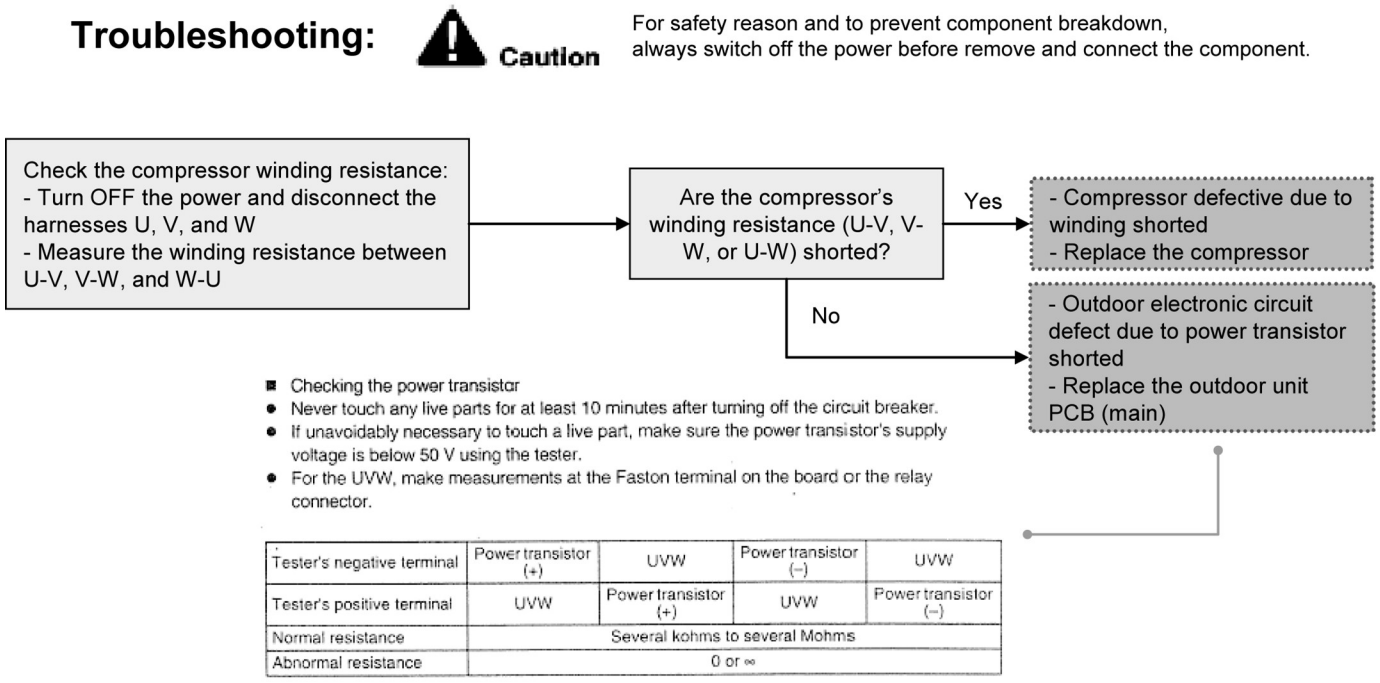
1 Faulty outdoor unit PCB (main).

2 Faulty compressor.

Abnormality Judgment

Continue for 7 times.

Figure 15-30 *Troubleshooting F23*



Tester's negative terminal	Power transistor (+)	UVW	Power transistor (−)	UVW
Tester's positive terminal	UVW	Power transistor (+)	UVW	Power transistor (−)
Normal resistance	Several kohms to several Mohms			
Abnormal resistance	0 or ∞			

15 Troubleshooting Guide

Refrigeration Cycle Abnormality (F24)

Malfunction Decision Conditions

1 During operation running (heating / cooling) for more than 5 minutes expect de-ice, pumpdown and test mode.

2 During heating / cooling, water outlet and water inlet difference is less than 1.8°F.

3 During heating / cooling, high pressure < 275 PSI for more than 10 minutes or < 232 PSI for more than 4 minutes.

4 During heating / cooling, discharge temperature - saturation temperature of high pressure ≥ 140°F.

Malfunction Caused

1 Refrigerant shortage (refrigerant leakage).

2 Faulty indoor water inlet, indoor water outlet, compressor discharge temp sensor or high pressure sensor.

3 2/three-way valve closed.

4 Clogged expansion valve or strainer.

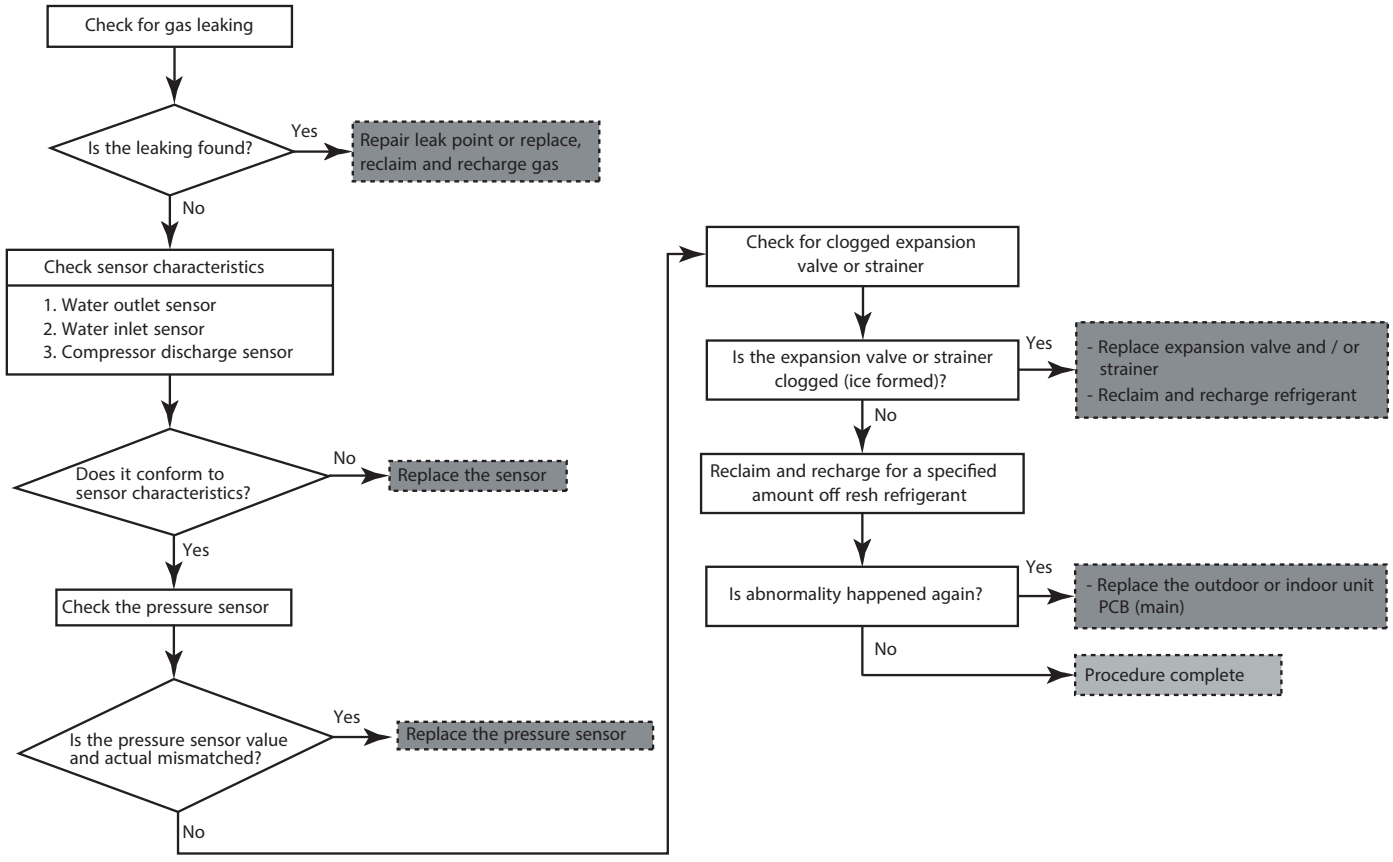
5 Faulty outdoor unit PCB (main).

6 Poor compression of compressor.

Abnormality Judgment

Continue 2 times in 30 minutes.

Figure 15-31 Troubleshooting F24



15 Troubleshooting Guide

Four Way Valve Abnormality (F25)

Malfunction Decision Conditions

1 During heating operation, when the indoor pipe temperature of thermostat ON indoor unit < 32°F.

2 During cooling operation, when the indoor pipe temperature of thermostat ON indoor unit > 113°F.

Malfunction Caused

1 Faulty sensor.

2 Faulty connector connection.

3 Faulty outdoor unit PCB (noise filter/main).

4 Faulty four way valve.

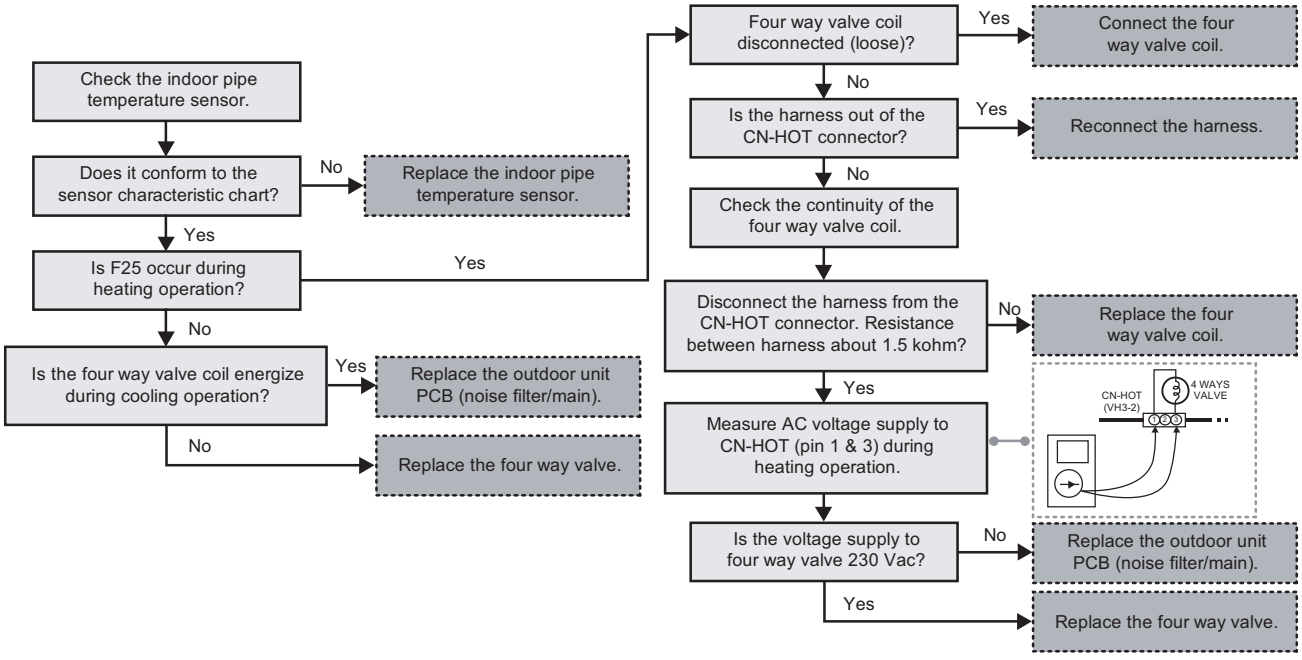
Abnormality Judgment

Continue 4 times in 30 minutes.

Figure 15-32 Troubleshooting F25

Troubleshooting:

Caution For safety reason and to prevent component breakdown, always switch off the power before remove and connect the component.



15 Troubleshooting Guide

Outdoor High Pressure Switch Abnormal (F27)

Malfunction Decision Conditions

During compressor stop, and outdoor high pressure switch is remain opened.

Malfunction Caused

1 Faulty connector connection.

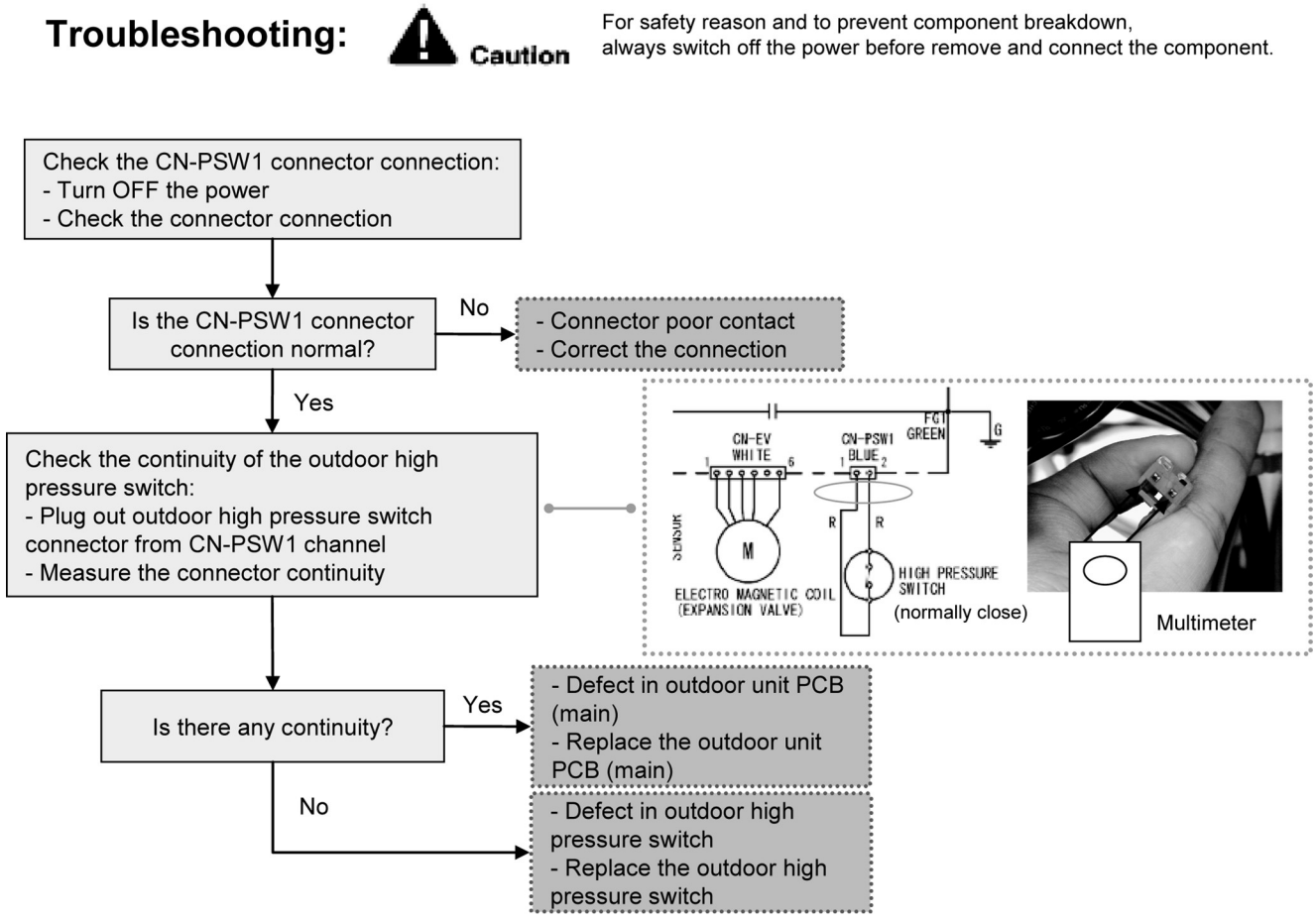
2 Faulty switch.

3 Faulty outdoor unit PCB (main).

Abnormality Judgment

Continue for 1 minute.

Figure 15-33 Troubleshooting F27



15 Troubleshooting Guide

Indoor Water Outlet Temperature Sensor 2 Abnormality (F30)

Malfunction Decision Conditions

During startup and operation of cooling and heating, the temperatures detected by the indoor water outlet temperature sensor 2 are used to determine sensor error.

Malfunction Caused

1 Faulty connector connection.

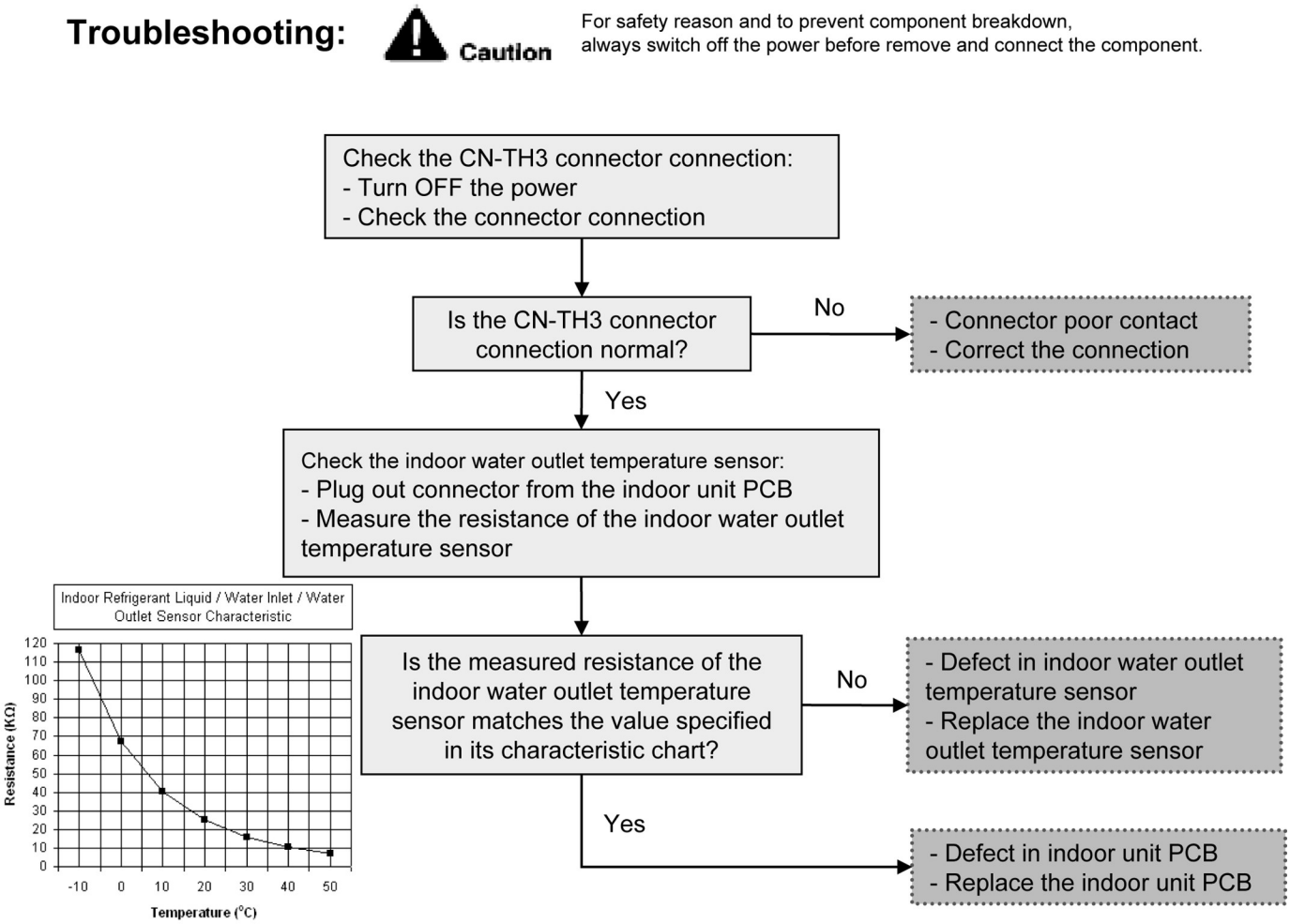
2 Faulty sensor.

3 Faulty indoor unit PCB.

Abnormality Judgment

Continue for 5 seconds.

Figure 15-34 *Troubleshooting F30*



15 Troubleshooting Guide

Outdoor Air Temperature Sensor Abnormality (F36)

Malfunction Decision Conditions

During startup and operation of cooling and heating, the temperatures detected by the outdoor air temperature sensor are used to determine sensor error.

Malfunction Caused

1 Faulty connector connection.

2 Faulty sensor.

3 Faulty outdoor unit PCB (main).

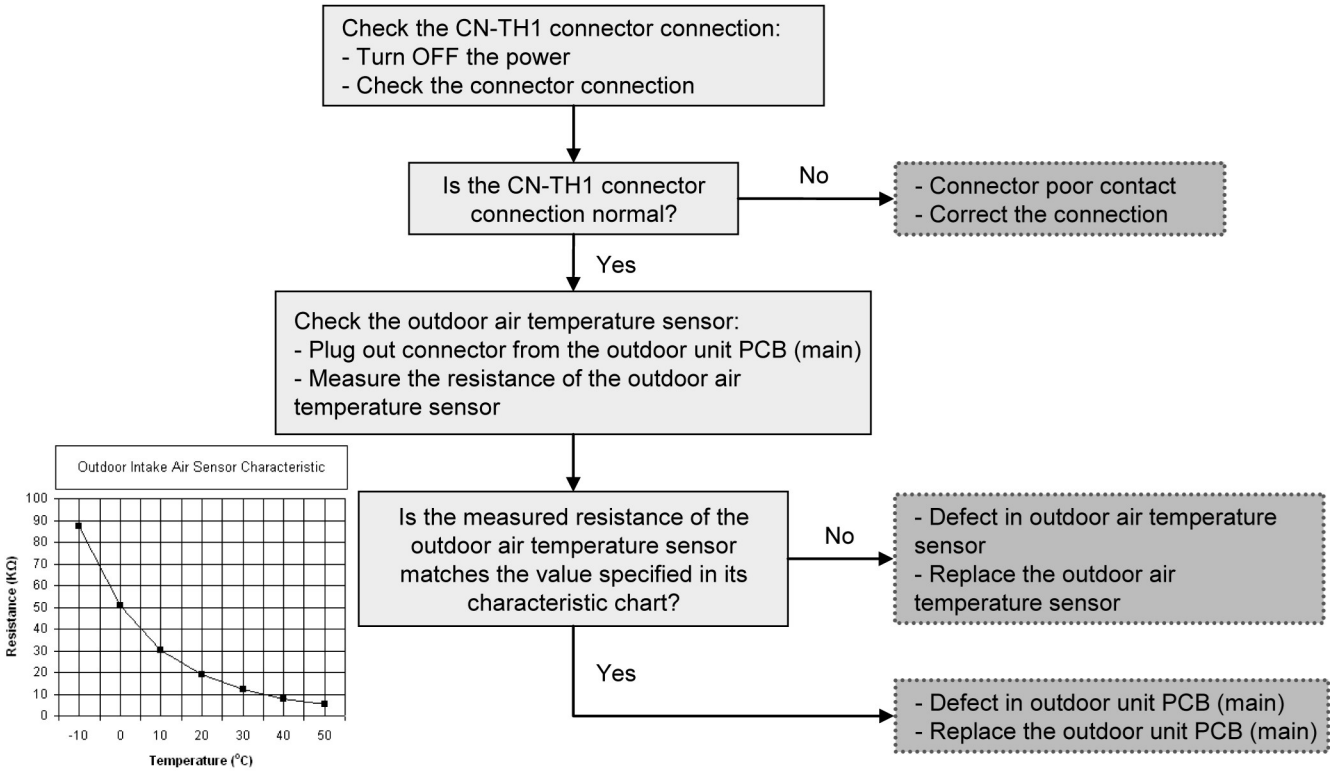
Abnormality Judgment

Continue for 5 seconds.

Figure 15-35 Troubleshooting F36

Troubleshooting:

Caution For safety reason and to prevent component breakdown, always switch off the power before remove and connect the component.



15 Troubleshooting Guide

Indoor Water Inlet Temperature Sensor Abnormality (F37)

Malfunction Decision Conditions

During startup and operation of cooling and heating, the temperatures detected by the indoor water inlet temperature sensor are used to determine sensor error.

Malfunction Caused

1 Faulty connector connection.

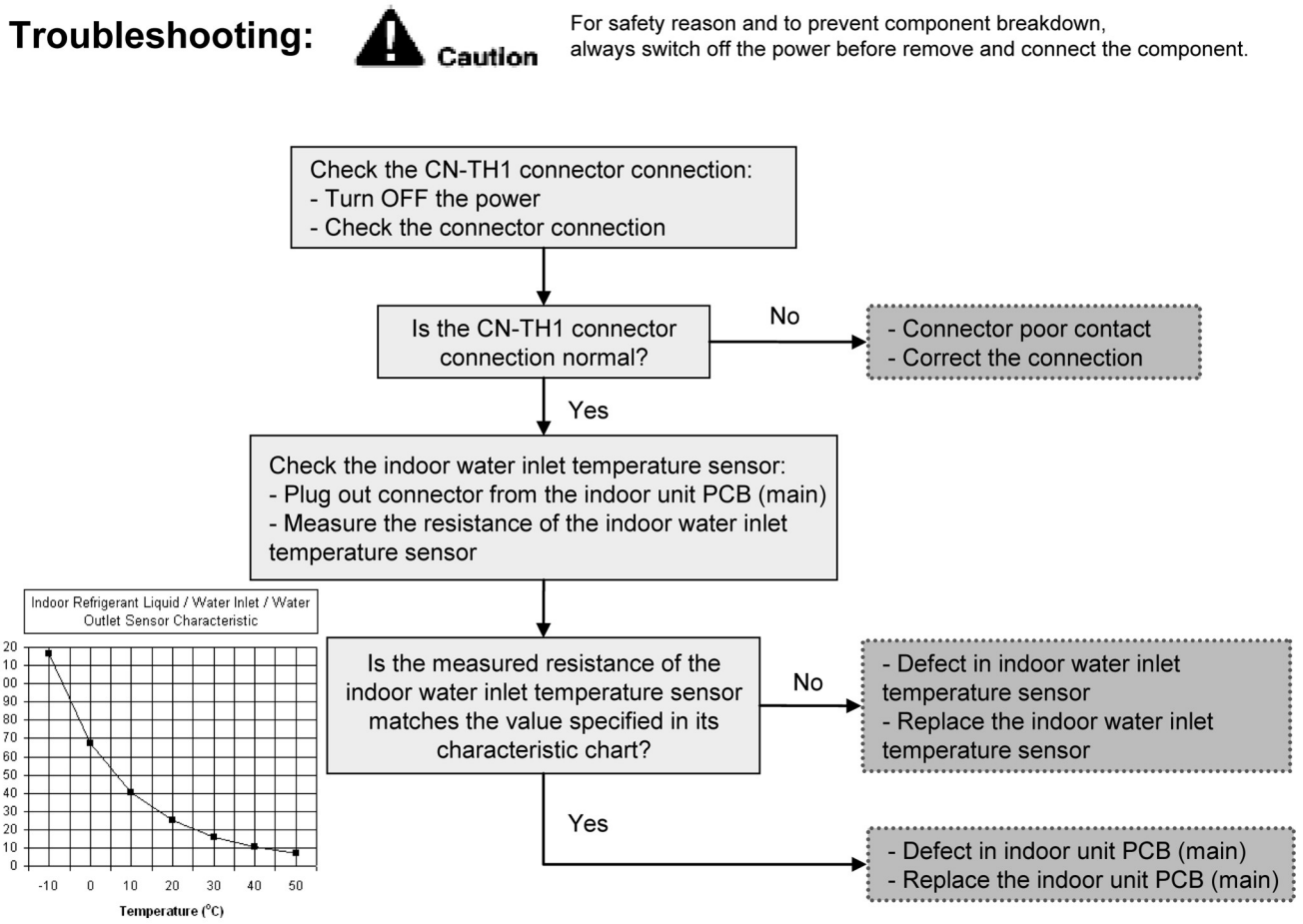
2 Faulty sensor.

3 Faulty indoor unit PCB (main).

Abnormality Judgment

Continue for 5 seconds.

Figure 15-36 *Troubleshooting F37*



15 Troubleshooting Guide

Outdoor Discharge Pipe Temperature Sensor Abnormality (F40)

Malfunction Decision Conditions

During startup and operation of cooling and heating, the temperatures detected by the outdoor discharge pipe temperature sensor are used to determine sensor error.

Malfunction Caused

1 Faulty connector connection.

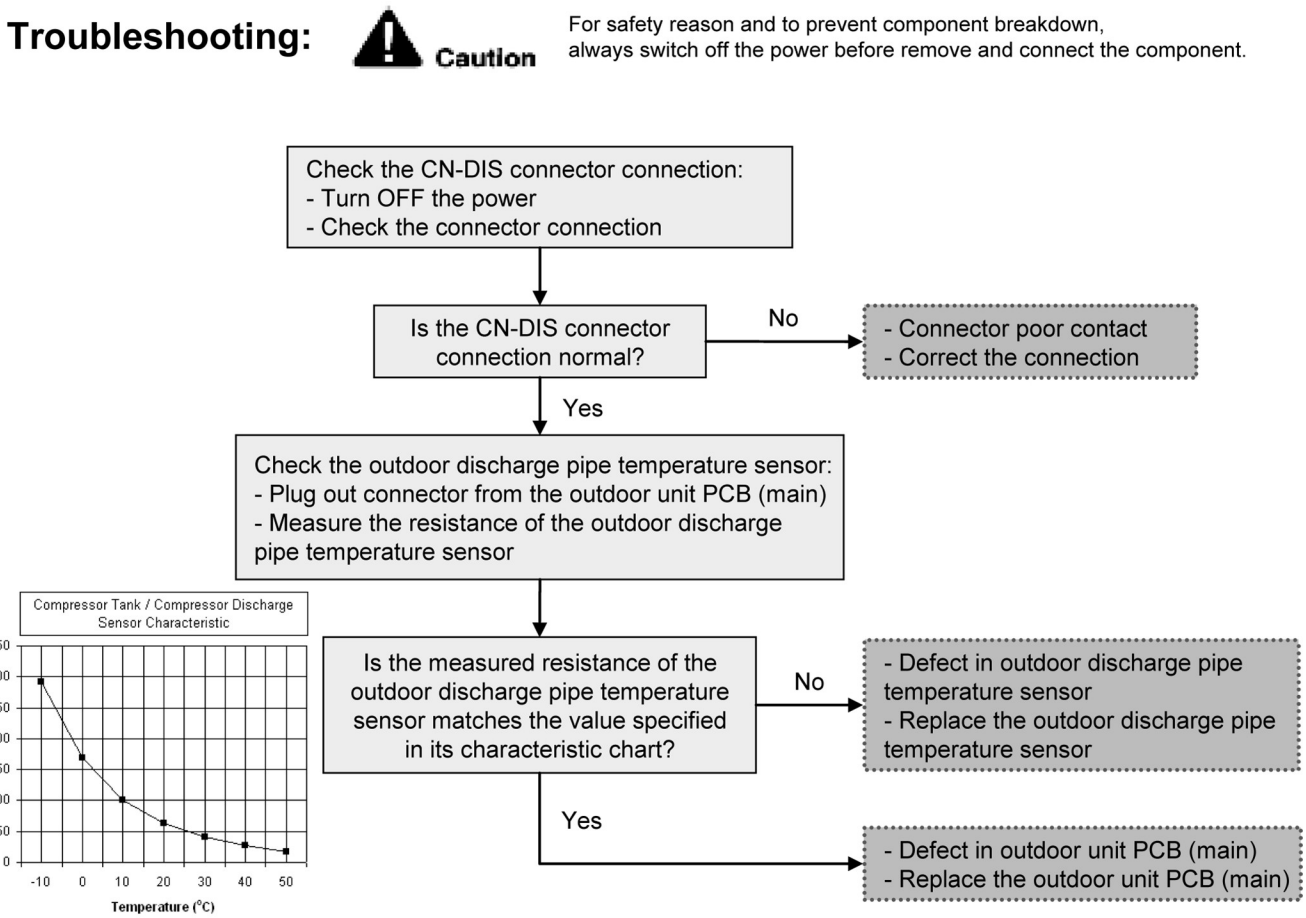
2 Faulty sensor.

3 Faulty outdoor unit PCB (main).

Abnormality Judgment

Continue for 5 seconds.

Figure 15-37 *Troubleshooting F40*



15 Troubleshooting Guide

Power Factor Correction (PFC) Abnormality (F41)

Malfunction Decision Conditions

During operation of cooling and heating, when the PFC protection circuitry in the outdoor unit PCB (main) senses abnormal high DC voltage level.

Malfunction Caused

1 Power supply surge.

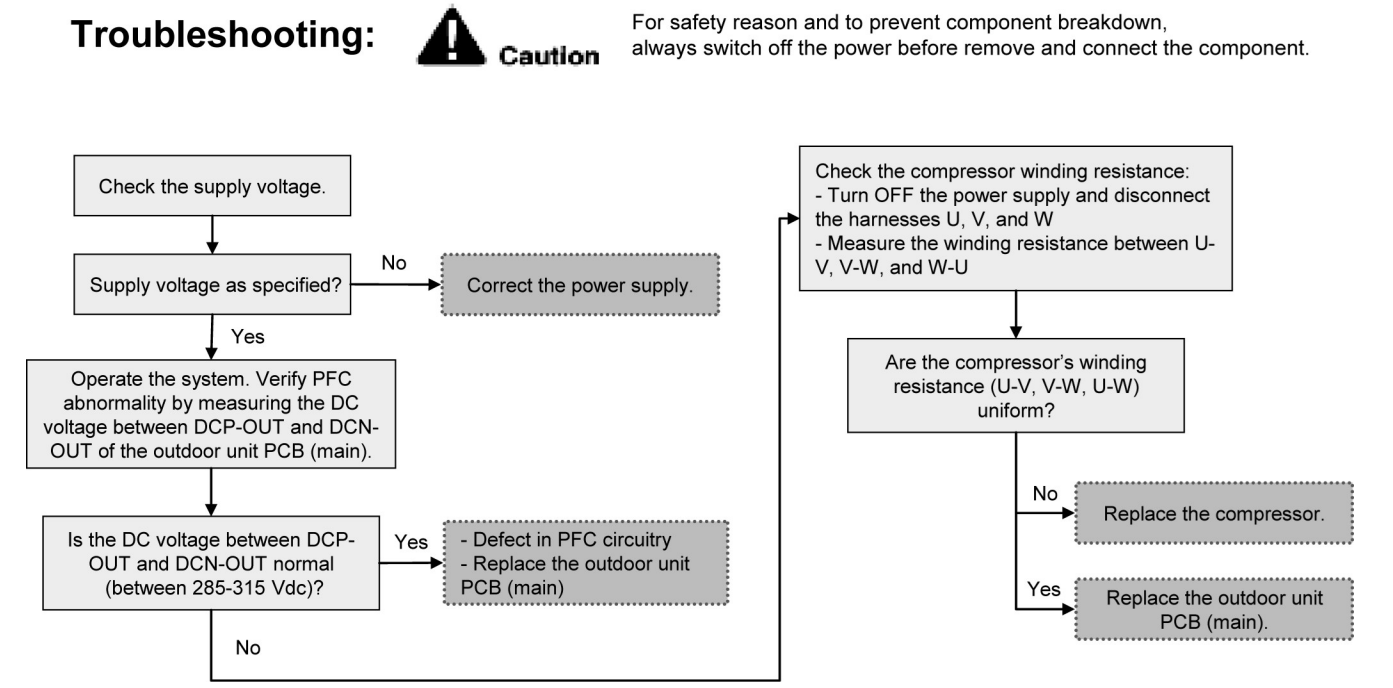
2 Compressor windings not uniform.

3 Faulty outdoor unit PCB (main).

Abnormality Judgment

Continue 4 times in 10 minutes.

Figure 15-38 Troubleshooting F41



15 Troubleshooting Guide

Outdoor Pipe Temperature Sensor Abnormality (F42)

Malfunction Decision Conditions

During startup and operation of cooling and heating, the temperatures detected by the outdoor pipe temperature sensor are used to determine sensor error.

Malfunction Caused

1 Faulty connector connection.

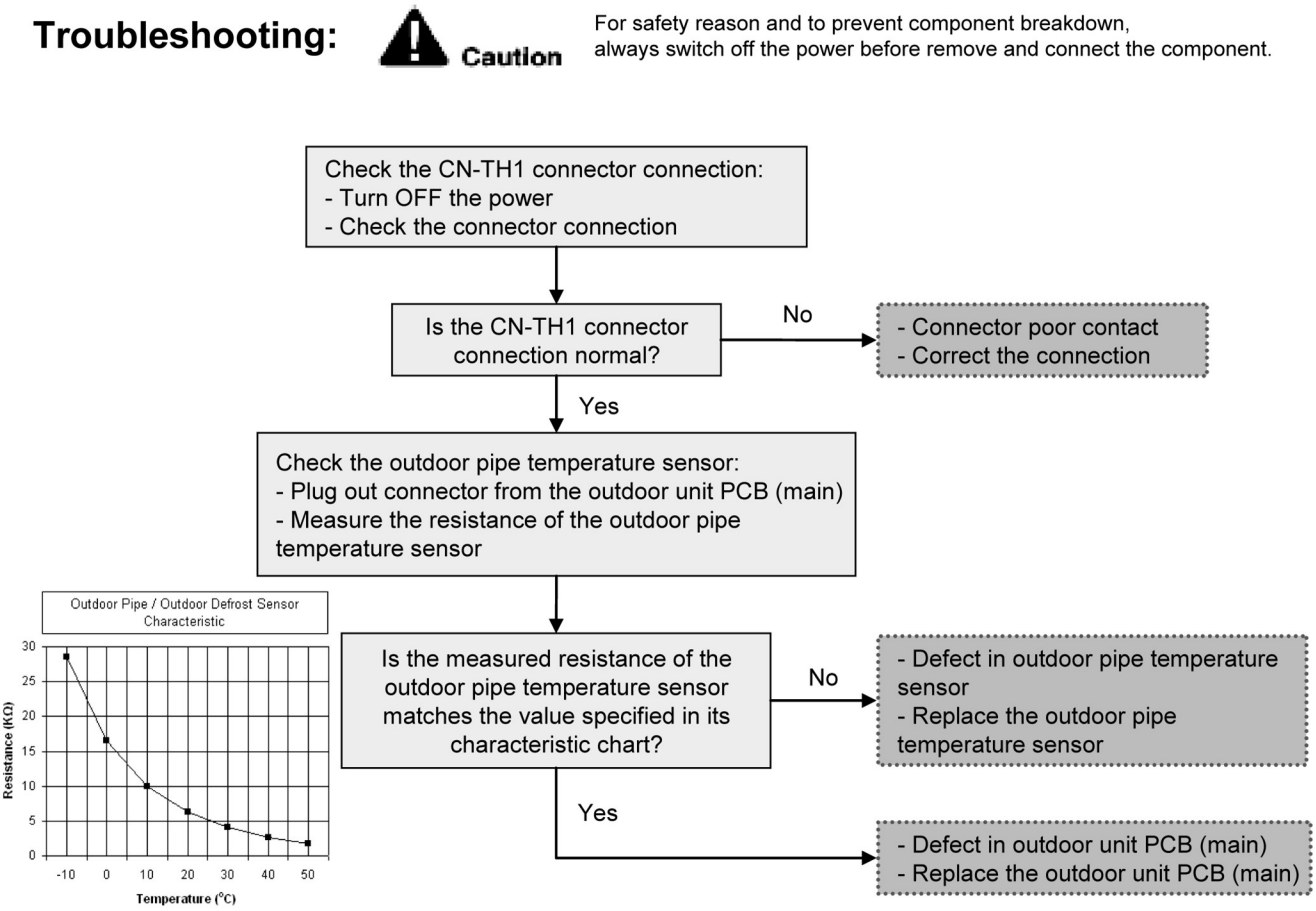
2 Faulty sensor.

3 Faulty outdoor unit PCB (main).

Abnormality Judgment

Continue for 5 seconds.

Figure 15-39 *Troubleshooting F42*



15 Troubleshooting Guide

Outdoor Defrost Temperature Sensor Abnormality (F43)

Malfunction Decision Conditions

During startup and operation of cooling and heating, the temperatures detected by the outdoor defrost temperature sensor are used to determine sensor error.

Malfunction Caused

1 Faulty connector connection.

2 Faulty sensor.

3 Faulty outdoor unit PCB (main).

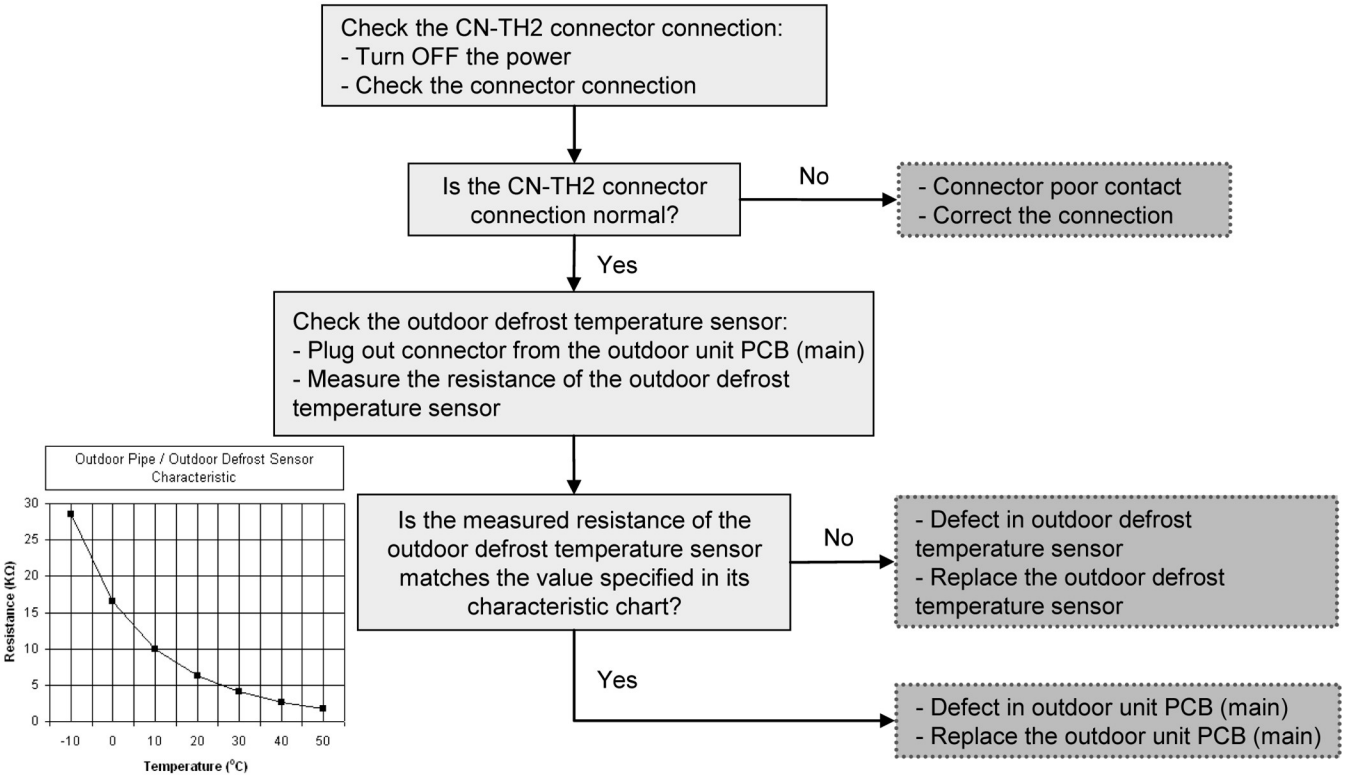
Abnormality Judgment

Continue for 5 seconds.

Figure 15-40 Troubleshooting F43

Troubleshooting:

Caution For safety reason and to prevent component breakdown, always switch off the power before remove and connect the component.



15 Troubleshooting Guide

Indoor Water Outlet Temperature Sensor Abnormality (F45)

Malfunction Decision Conditions

During startup and operation of cooling and heating, the temperatures detected by the indoor water outlet temperature sensor are used to determine sensor errors.

Malfunction Caused

1 Faulty connector connection.

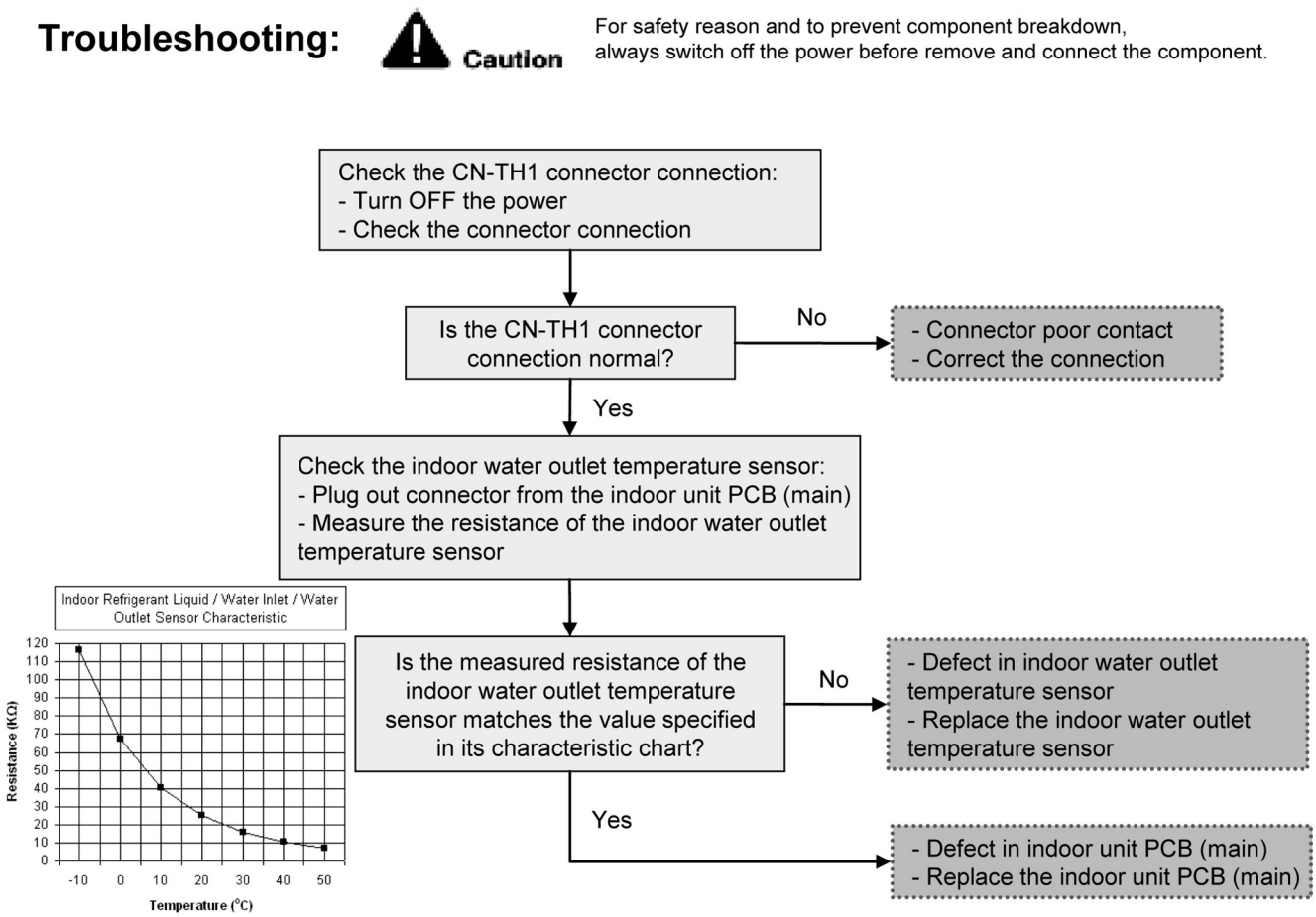
2 Faulty sensor.

3 Faulty indoor unit PCB (main).

Abnormality Judgment

Continue for 5 seconds.

Figure 15-41 *Troubleshooting F45*



15 Troubleshooting Guide

Outdoor Current Transformer Open Circuit (F46)

Malfunction Decision Conditions

A current transformer (CT) open circuit is detected by checking the compressor running frequency (rated frequency) and CT detected input current (< 1.6 A) for continuously 20 seconds.

Malfunction Caused

1 CT defective.

2 Faulty outdoor unit PCB (main).

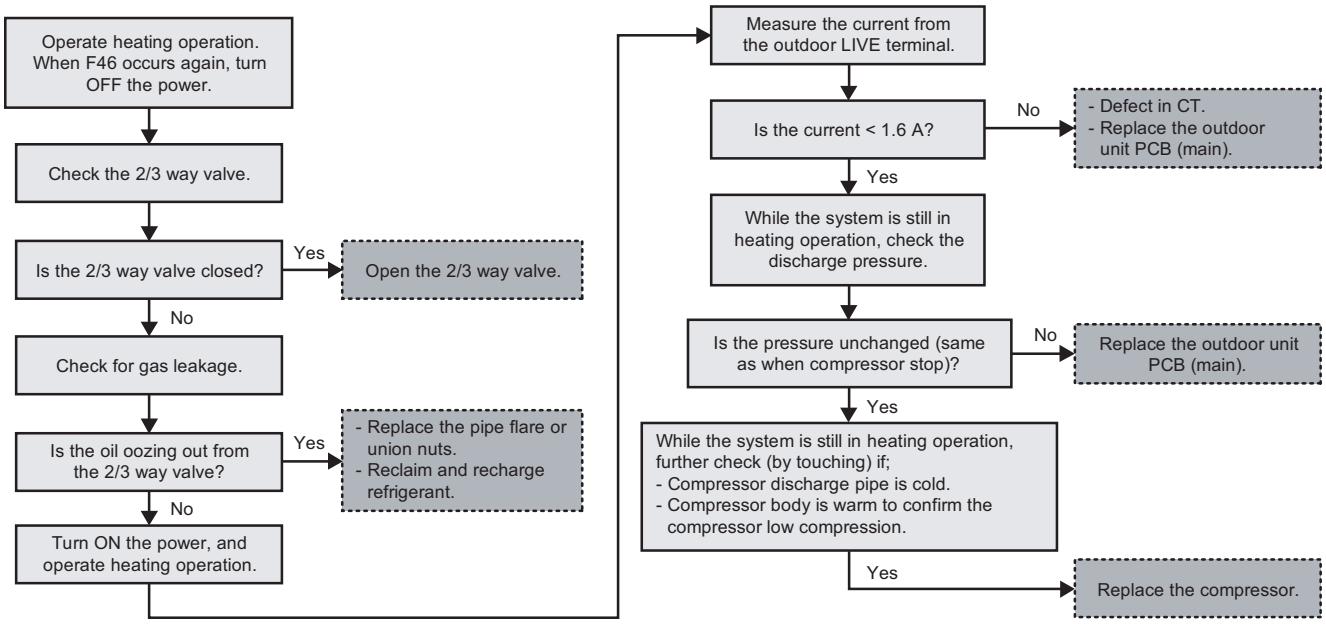
3 Compressor defective (low compression).

Abnormality Judgment

Continue 3 times in 20 minutes.

Figure 15-42 *Troubleshooting F46*

Troubleshooting: **Caution** For safety reason and to prevent component breakdown, always switch off the power before remove and connect the component.



16 Disassembly and Assembly Instructions

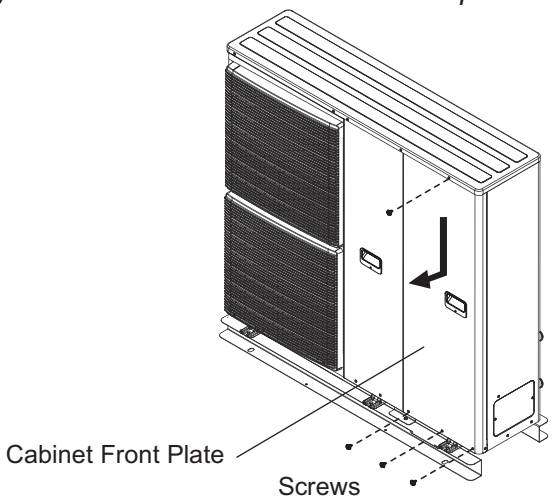
⚠WARNING This section is for authorised and licensed electrician only. Work behind the cabinet front plate secured by screws must only be carried out under supervision of qualified installer or service technician.

⚠WARNING This section is for authorised and licensed electrician only. Work behind the cabinet front plate secured by screws must only be carried out under supervision of qualified installer or service technician.

To Remove The Cabinet Front Plate

1. Remove 4 mounting screws.
2. Slide the cabinet front plate downward to release the pawls. Then, pull it toward front to remove it.

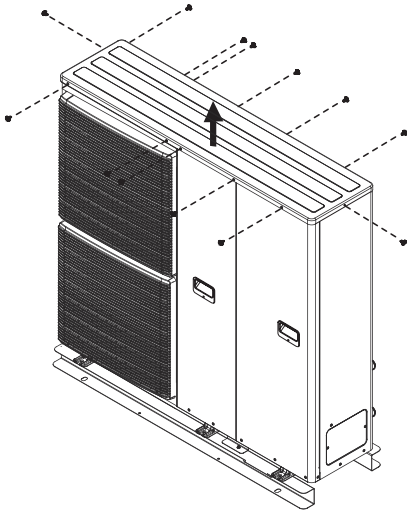
Figure 16-1 *Remove screws and front plate*



To Remove The Cabinet Top Plate

1. Remove the thirteen mounting screws.
2. Lift the cabinet top plate upward to remove it.

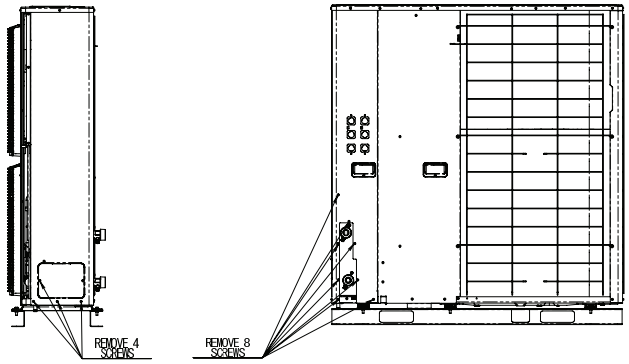
Figure 16-2 *Remove screws and top plate*



To Remove The Cabinet Rear Plate

1. Remove the four mounting screws from the side of the unit.
2. Remove the eight mounting screws from the back of the unit.

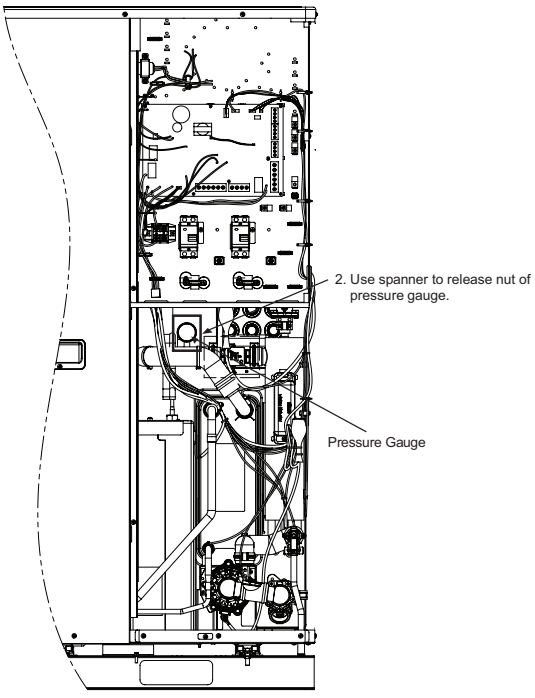
Figure 16-3 *Remove screws and service plate*



To Remove The Pressure Gauge

1. Remove the four mounting screws.
2. Use a spanner to release the nut of the pressure gauge.

Figure 16-4 *Remove pressure gauge*



16 Disassembly and Assembly Instructions

To Remove The Water System Electronic Control Board

1. Remove all the connectors from the Electronic Controller.
2. Disconnect all lead wires of G01 (Green), G02 (Green), G03 (Green), AC2-N2 (White), AC2-L2 (Yellow), Data (Red), AC1-N (White), AC1-L3 (Black), and ACL3 (Black).

Figure 16-5 *Main PCB*

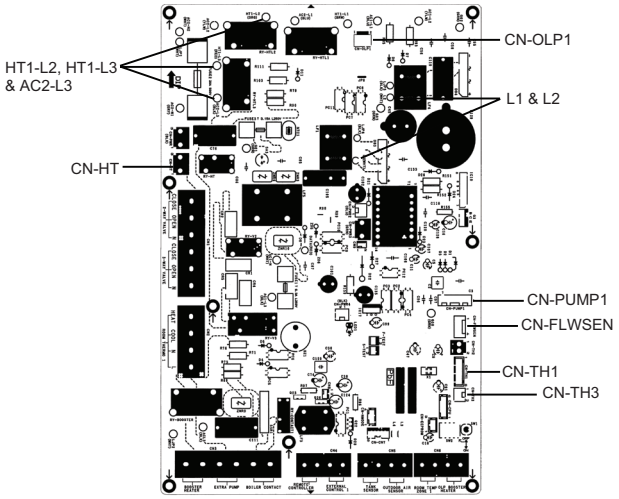
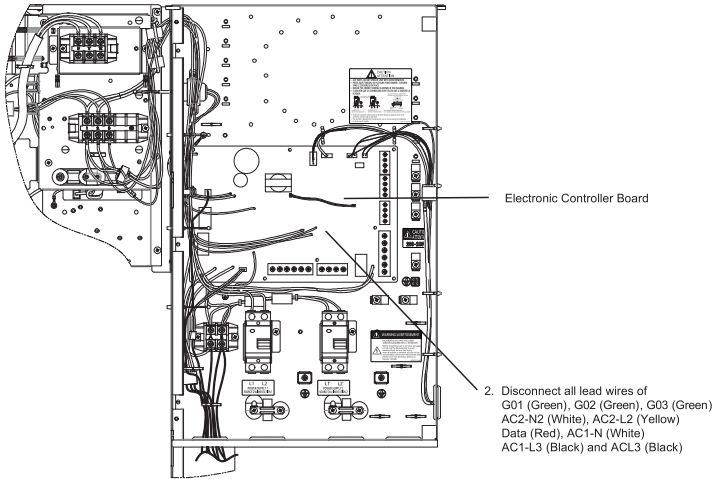


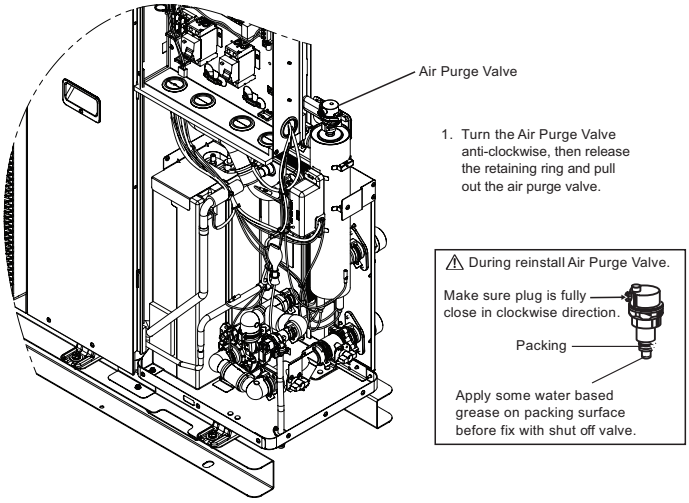
Figure 16-6 *Main PCB connections*



To Remove Air Purge Valve

1. Turn the Air Purge Valve counter-clockwise, then release the retaining ring and pull out the air purge valve.

Figure 16-7 *Remove air purge valve*

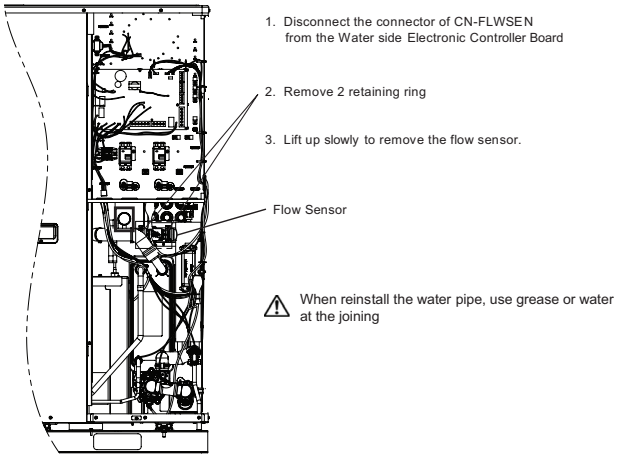


To Remove Flow Sensor

1. Disconnect the connector of CN-FLWSEN from the Water side Electronic Controller Board.
2. Remove the two retaining rings.
3. Lift up slowly to remove the flow sensor.

⚠WARNING When reinstalling the water pipe, use grease or water at the joining.

Figure 16-8 *Remove flow sensor*



16 Disassembly and Assembly Instructions

To Remove Water Pump

1. Disconnect the CN-PUMP1 connector from the Electronic Controller Board.
2. Remove the two screws from Pump Bracket.
3. Remove the two retaining rings, then slowly pull out the water pump.

Figure 16-9 *Remove connector*

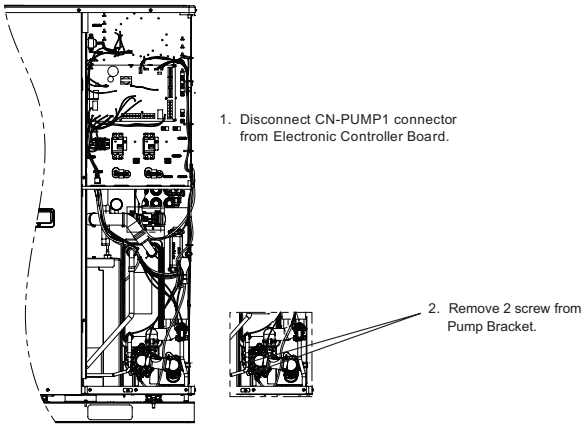
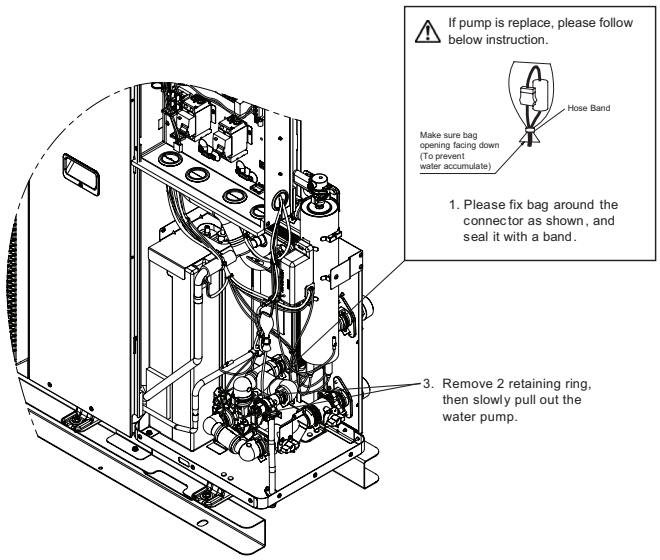


Figure 16-10 *Remove water pump*



To Remove Heater

1. Remove the four lead wires, HT1-L2 (Orange), HT-L3 (Red) and AC2-N2 (White) and N1 (White) from below the Heater.
2. Remove terminal cover by releasing the one screw, then remove the Overload Protector (OLP) lead wire (Blue), (Black) and (Orange).
3. Remove the screw from the Heater Bracket.
4. Release the two retaining rings, and slowly remove the Heater.

Figure 16-11 *Remove wires*

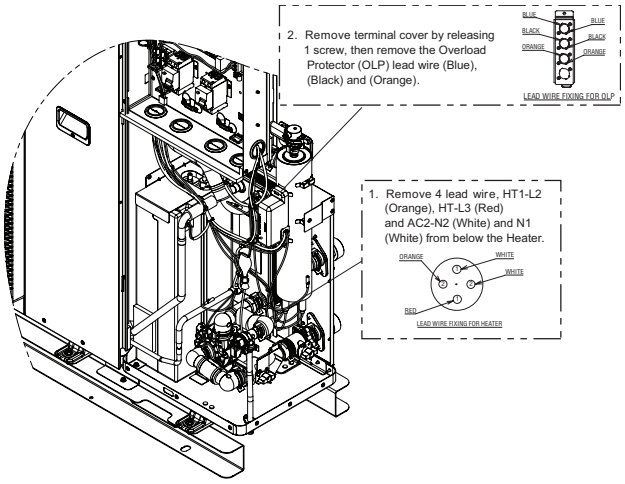
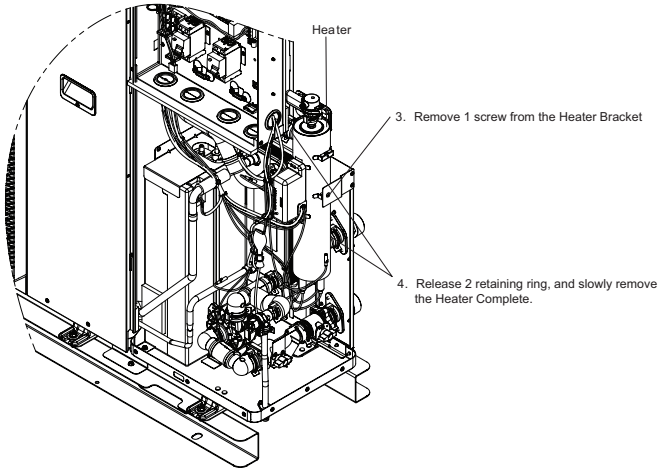


Figure 16-12 *Remove heater*



16 Disassembly and Assembly Instructions

To Remove Filter

1. Remove the access cover by removing the two screws.
2. Set the two valves for the Water Filter Set to “CLOSE”.
3. Pull up the Water Filter set.
4. Remove the retaining ring, then remove the Water Filter.

Figure 16-13 *Remove service plate*

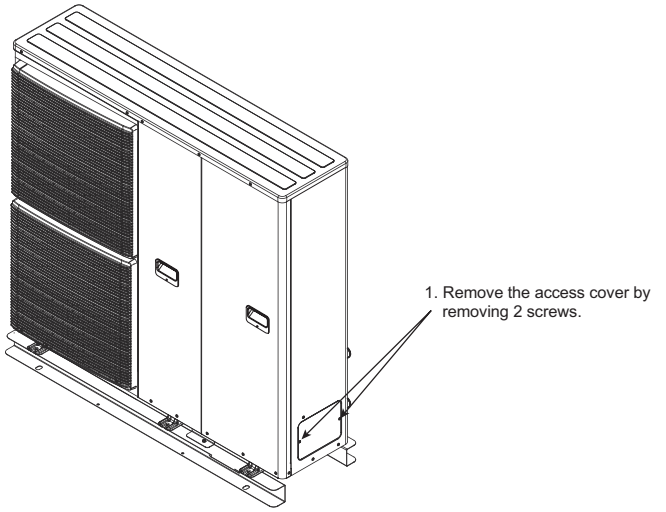
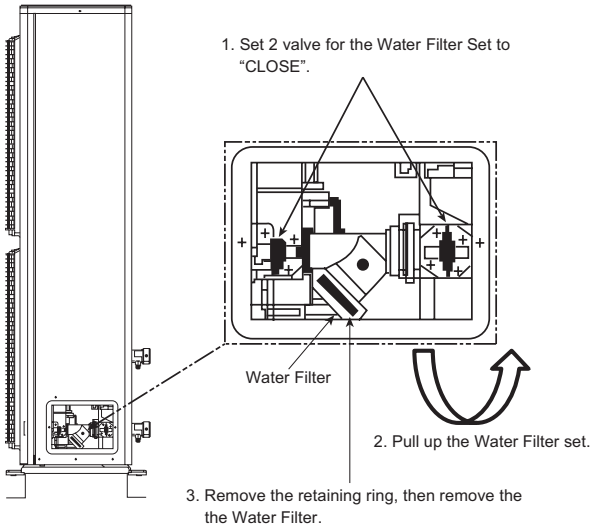


Figure 16-14 *Remove filter*



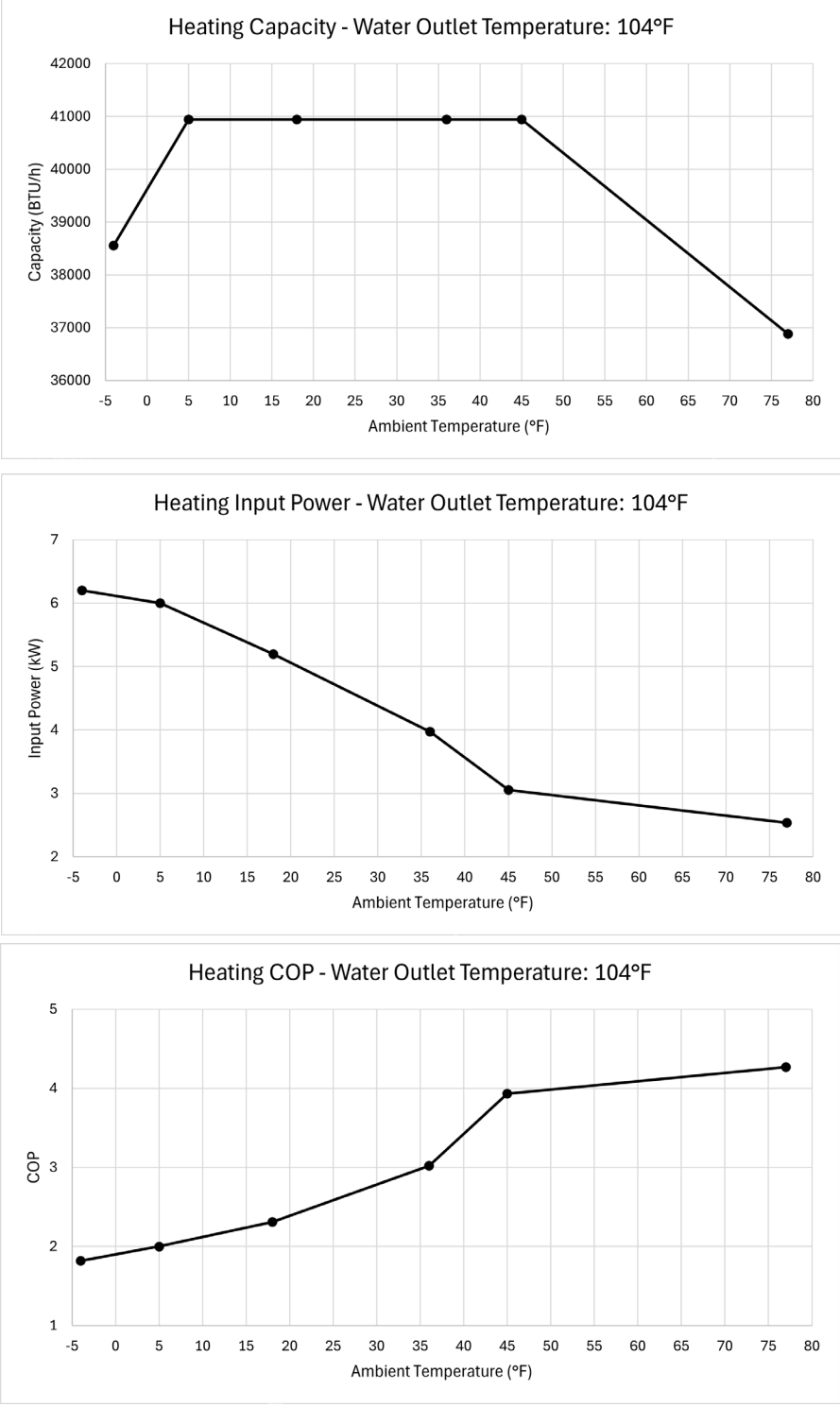
17 Technical Data

Operation Characteristics

Heating Characteristics at Different Outdoor Air Temperature

Water outlet temperature : 104°F

Figure 17-1 *Heating Capacity - Water outlet temperature: 104°F*

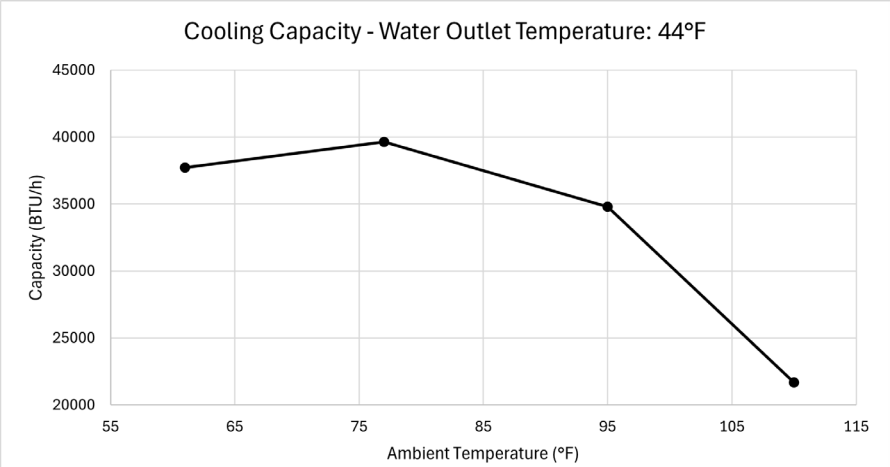


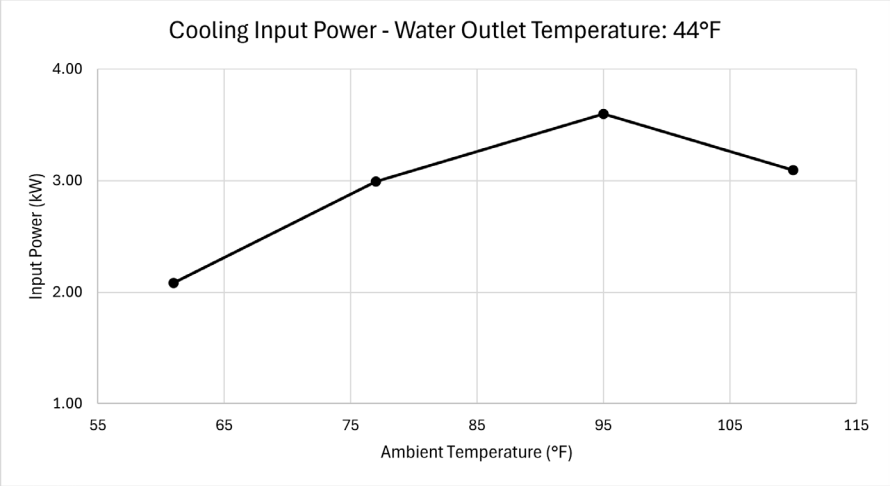
17 Technical Data

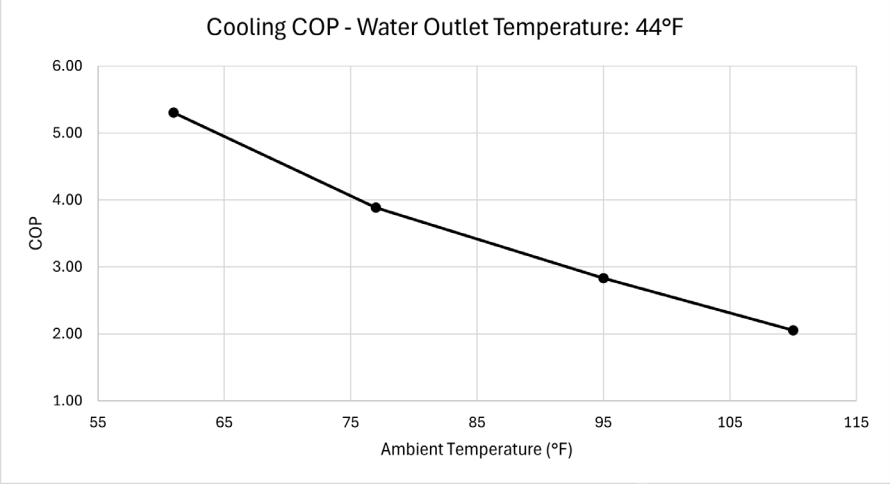
Cooling Characteristics at Different Outdoor Air Temperature

Water outlet temperature : 44°F

Figure 17-2 Cooling Capacity - Water outlet temperature: 44°F





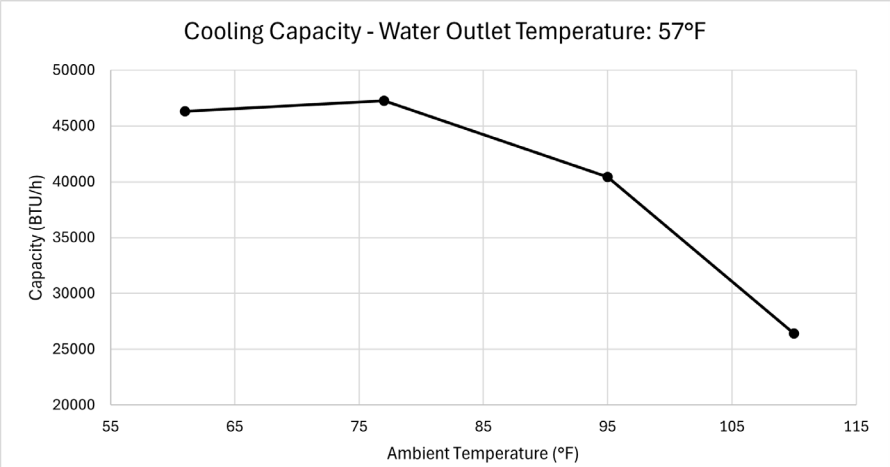


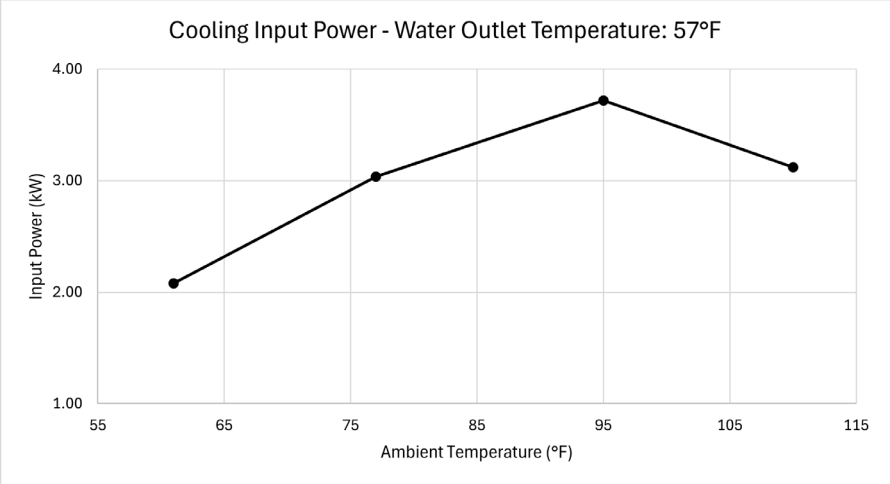
17 Technical Data

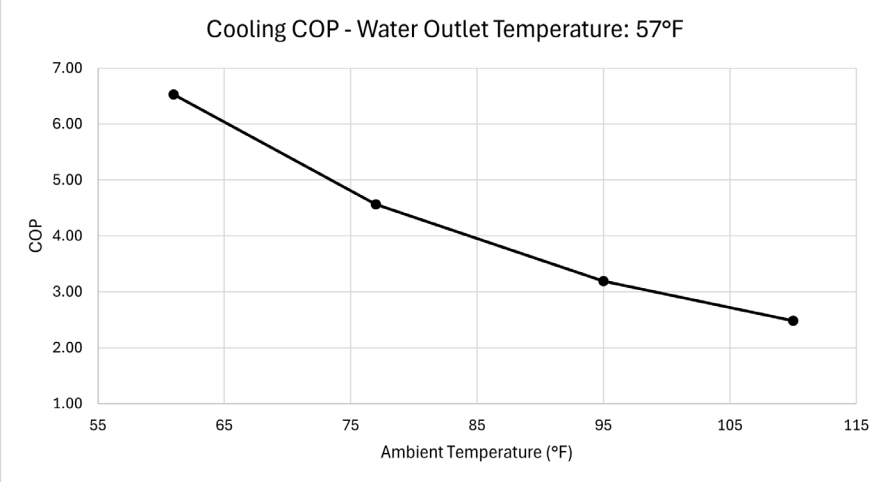
Cooling Characteristics at Different Outdoor Air Temperature

Water outlet temperature : 57°F

Figure 17-3 *Cooling capacity - Water outlet temperature: 57°F*





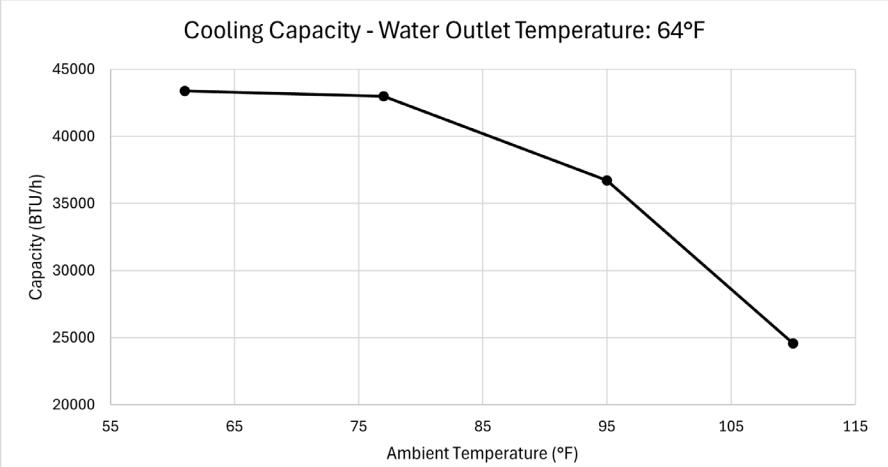


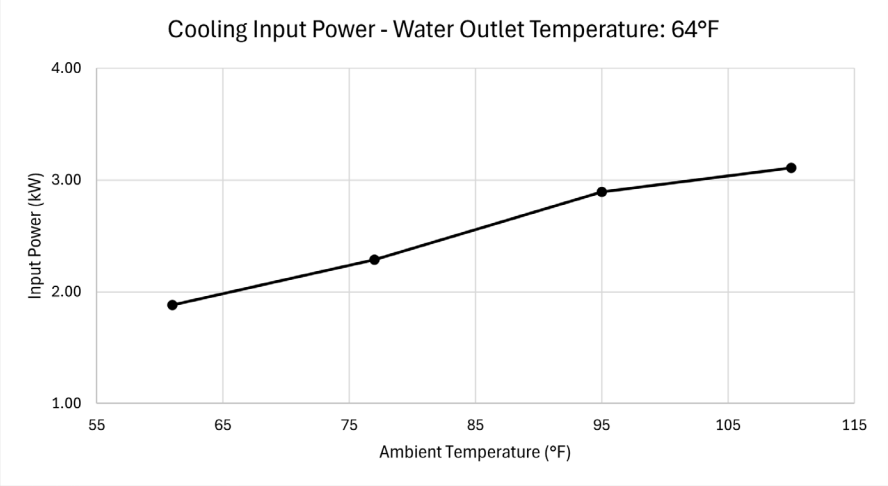
17 Technical Data

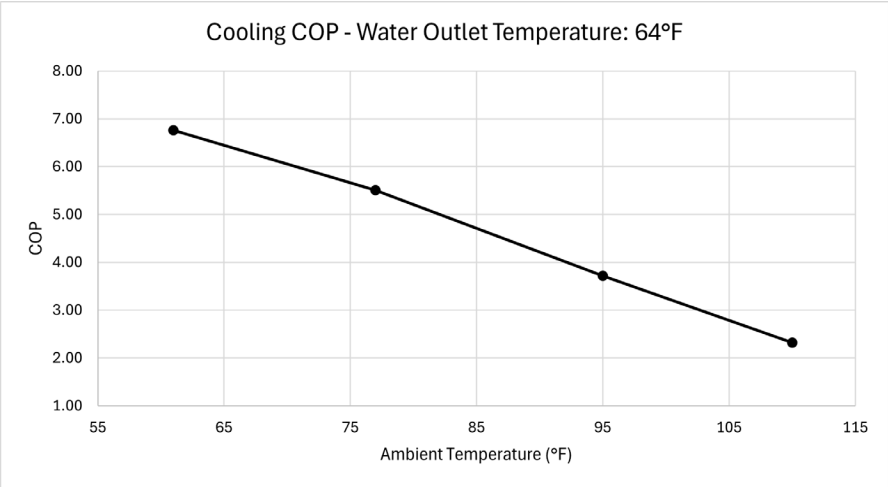
Cooling Characteristics at Different Outdoor Air Temperature

Water outlet temperature : 64°F

Figure 17-4 *Cooling capacity - Water outlet temperature: 64°F*







17 Technical Data

Table 17-1 *Heating Capacity*

Water Out	86°F			104°F			122°F		
Outdoor Air	Capacity (BTU/h)	Input Power(W)	COP	Capacity (BTU/h)	Input Power(W)	COP	Capacity (BTU/h)	Input Power(W)	COP
-4	39240	5.5	2.09	38557	6.2	1.82	34804	6.5	1.57
5	40946	5.20	2.30	40946	6.00	2.00	35486	6.30	1.65
18	40754	4.32	2.76	40946	5.19	2.31	36169	5.49	1.93
36	38017	3.11	3.58	40946	3.97	3.02	39194	4.70	2.45
45	42299	2.42	5.13	40946	3.05	3.93	40946	3.93	3.05
77	40733	1.16	10.30	36879	2.53	4.27	36060	3.30	3.20

Water Out	140°F		
Outdoor Air	Capacity (BTU/h)	Input Power(W)	COP
-4	N/A	N/A	N/A
5	26922	6.43	1.23
18	29003	5.80	1.47
36	38325	5.44	2.06
45	40946	5.20	2.31
77	35357	3.66	2.83

Note:

* Between outdoor ambient 5°F and -4°F, the water outlet temperature gradually decreases from 140°F to 131°F.

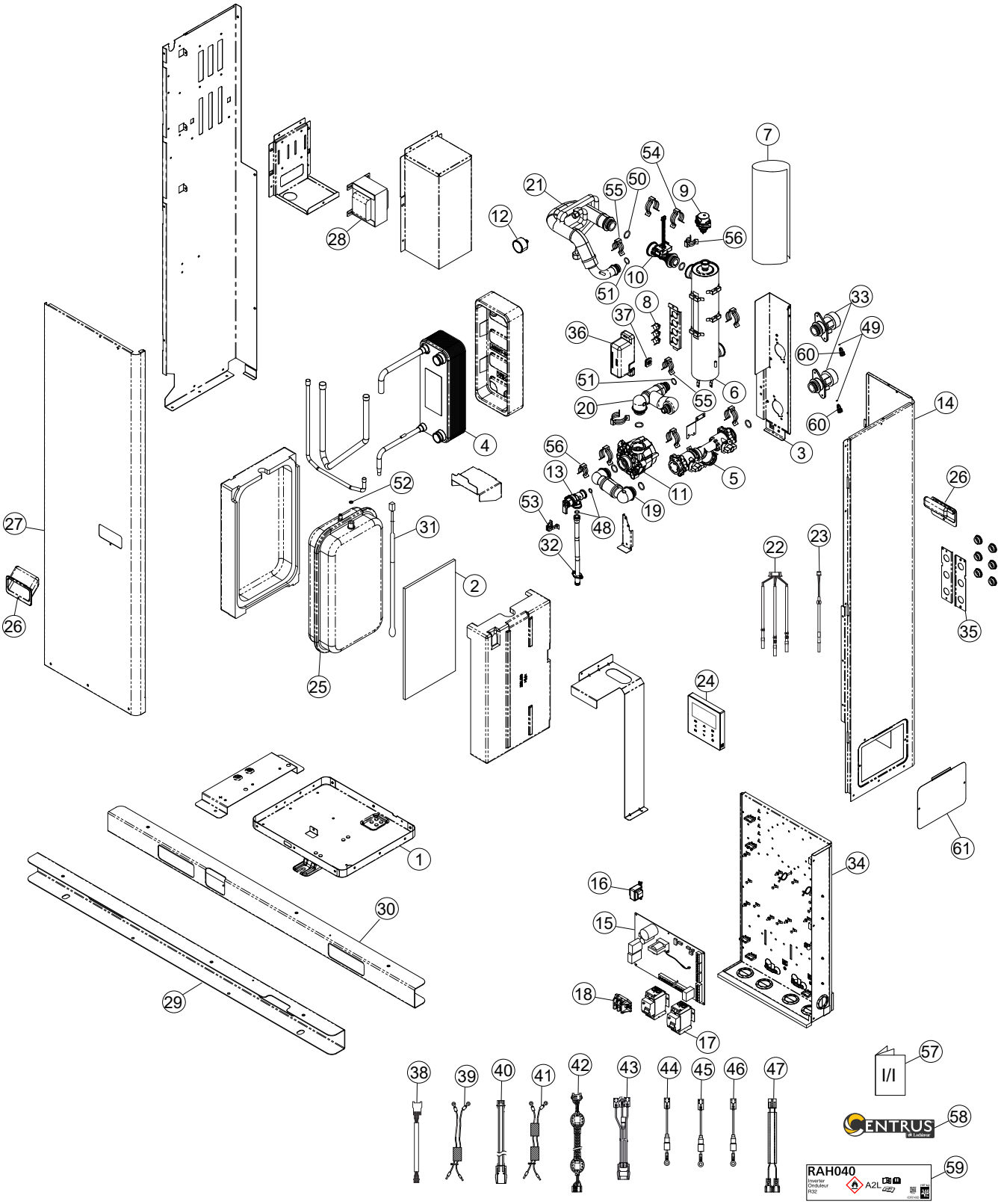
* Only when ΔT is set to 27°F, the set temperature above 140°F will take effect.

Table 17-2 *Cooling Capacity*

OD	Water Out 44°F			Water Out 57°F			Water Out 64°F		
	Capacity (BTU/h)	Input Power(W)	COP	Capacity (BTU/h)	Input Power(W)	COP	Capacity (BTU/h)	Input Power(W)	COP
61	37713	2.08	5.31	46324	2.08	6.53	43396	1.88	6.76
77	39628	2.99	3.88	47252	3.04	4.56	42994	2.29	5.51
95	34804	3.60	2.83	40435	3.72	3.19	36707	2.89	3.72
110	21670	3.09	2.05	26416	3.12	2.48	24581	3.11	2.32

18 Exploded View and Replacement Parts

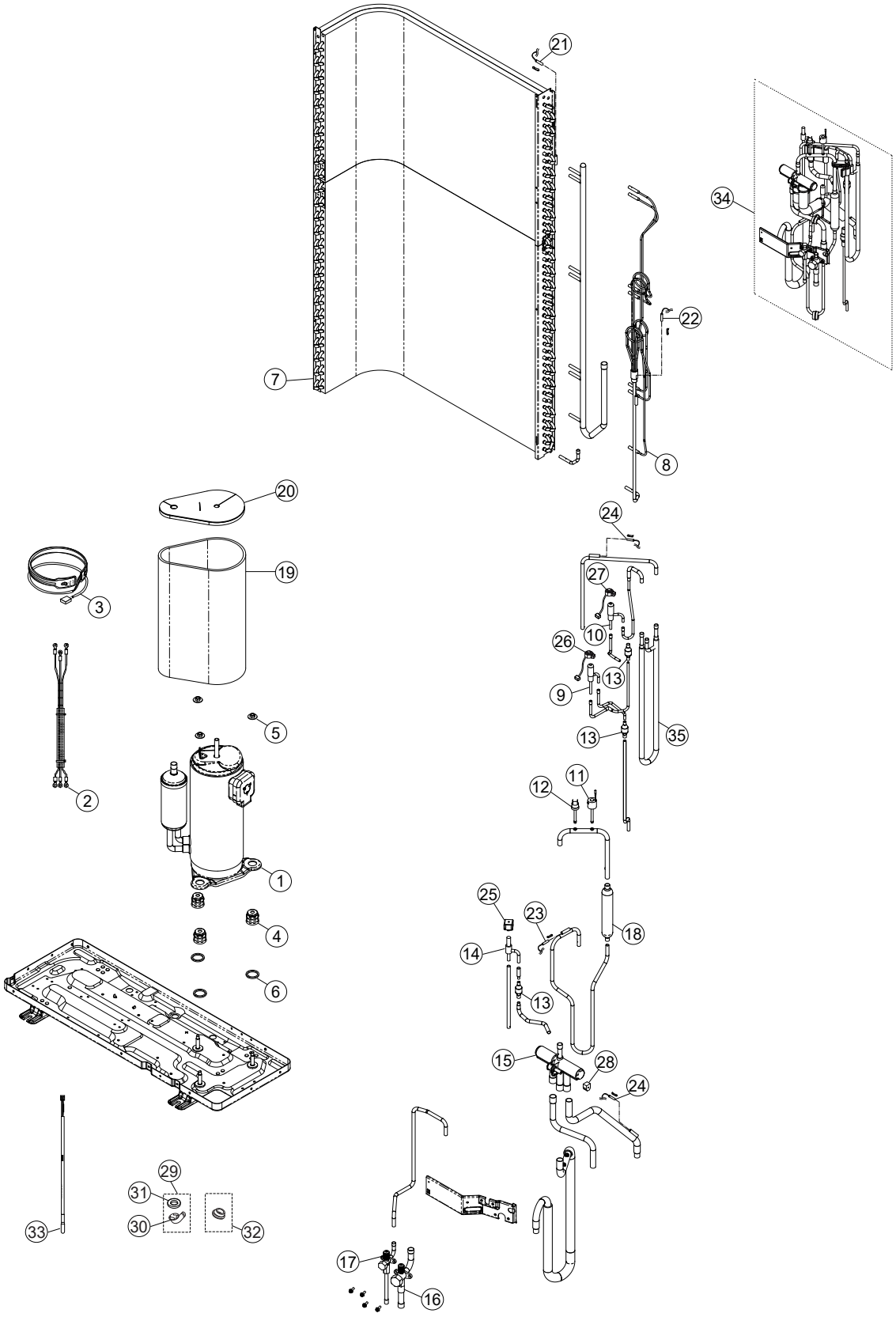
Water System



NOTICE The above exploded view is for the purpose of parts disassembly and replacement. The non-numbered parts are not kept as standard service parts.

18 Exploded View and Replacement Parts

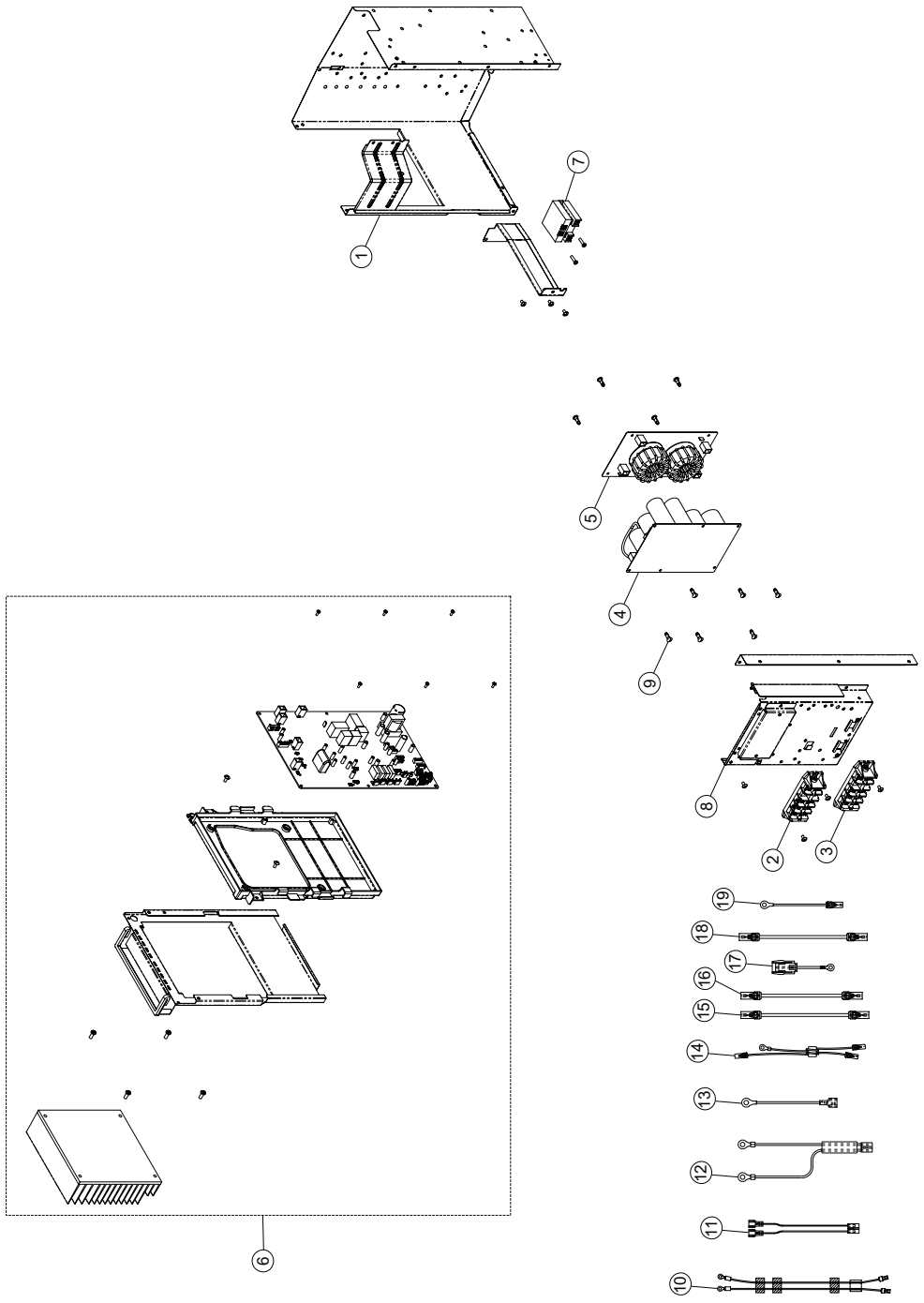
Refrigerant System



NOTICE The above exploded view is for the purpose of parts disassembly and replacement. The non-numbered parts are not kept as standard service parts.

18 Exploded View and Replacement Parts

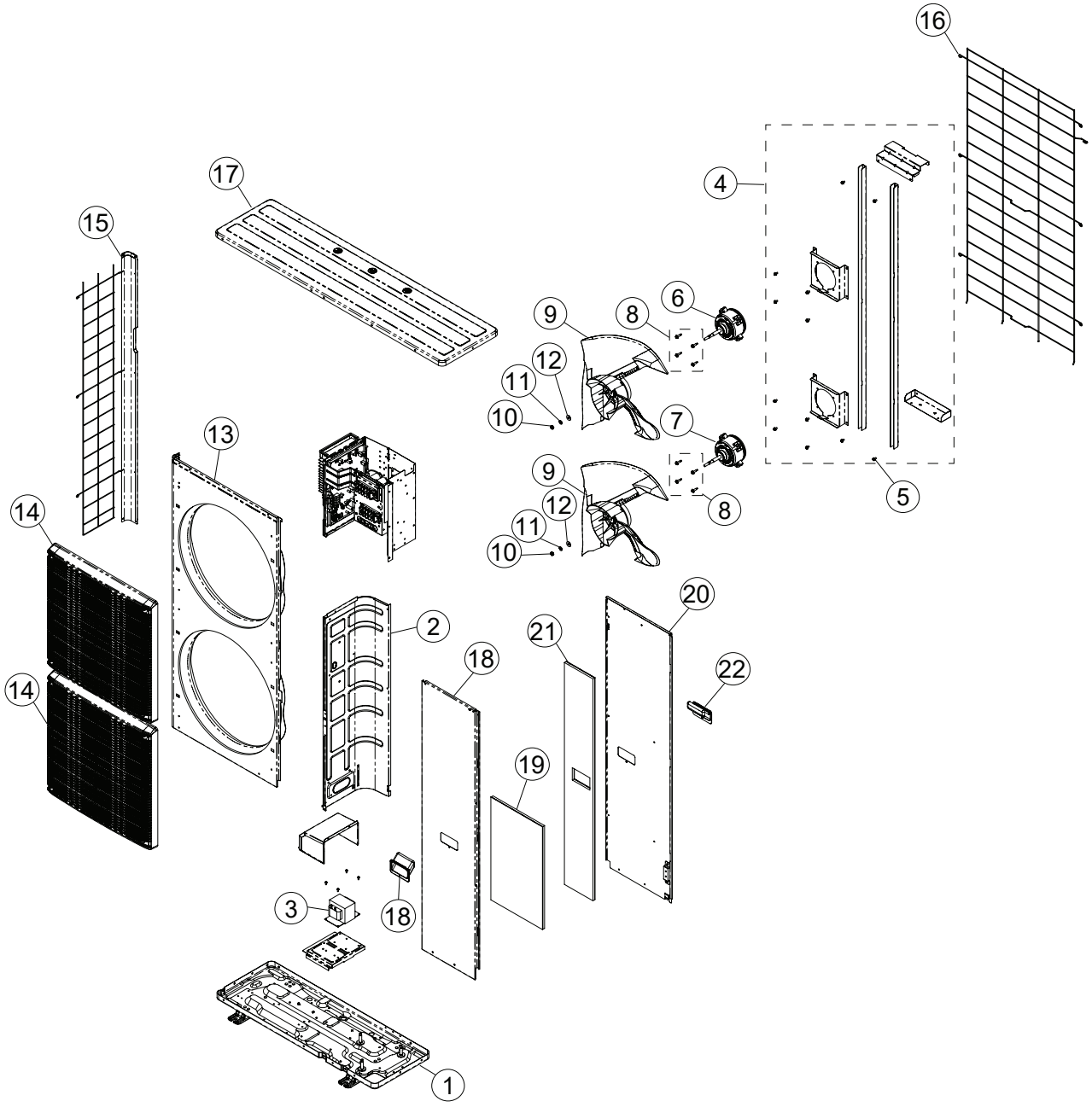
Outdoor Control Board



NOTICE The above exploded view is for the purpose of parts disassembly and replacement.
The non-numbered parts are not kept as standard service parts.

18 Exploded View and Replacement Parts

Air Flow



NOTICE The above exploded view is for the purpose of parts disassembly and replacement. The non-numbered parts are not kept as standard service parts.

18 Exploded View and Replacement Parts

SAFETY	ITEM NO.	DESCRIPTION	QTY.	PART NO.
		WATER SYSTEM		
	1	BASE PAN,WTR,ASSY,RAH040	1	100390420
	2	INSUL,SOUND,ETNK,RAH040	1	100390421
	3	PANEL,CPLG,SUPT,RAH040	1	100390422
	4	HEX,WATER,RAH040	1	100390423
	5	FILTER,ASSY,RAH040	1	100383552
⚠	6	HEATER,ELEM,ASSY,RAH040	1	100390425
	7	INSUL,SOUND,HTR,RAH040	1	100390426
⚠	8	THERMOSTAT,HTR,RAH040	3	100390427
	9	VALVE,PURGE,AIR,RAH040	1	100390428
	10	SENSOR,FLOW,RAH040	1	100383553
⚠	11	PUMP,WATER,RAH040	1	100383554
	12	GAUGE,PRESSURE,RAH040	1	100383555
	13	VALVE,RELIEF,T&P,RAH040	1	100383556
	14	PANEL,SIDE,RAH040	1	100390433
⚠	15	PCB,MAIN,RAH040	1	100383557
⚠	16	REACTOR,MAIN,PCB,RAH040	1	100390471
⚠	17	BREAKER,CIRCUIT,RCCB,RAH040	2	100383559
⚠	18	BOARD,TERMINAL,AB,ASSY,RAH040	1	100390473
⚠	19	PIPE,FLTR,PMP,WTR,ASSY,RAH040	1	100390474
⚠	20	PIPE,PMP,HEX,WTR,ASSY,RAH040	1	100390475
⚠	21	PIPE,HEX,HTR,WTR,ASSY,RAH040	1	100390476
⚠	22	SENSOR,HRNS,WTR,OUT,IN,RAH040	1	100390477
⚠	23	SENSOR,HEX,WTR,OUT,RAH040	1	100390478
⚠	24	CONTROLLER,REMOTE,RAH040	1	100390479
⚠	25	TANK,EXPANSION,RAH040	1	100390480
	26	HANDLE,PANEL,RAH040	2	100390567
	27	PANEL,FRONT,WTR,RAH040	1	100390482
⚠	28	XFRMR,RAH040	1	100390483
	29	BASE,LEG,FRONT,RAH040	1	100390484
	30	BASE,LEG,REAR,RAH040	1	100390485
⚠	31	TRACE,HEAT,ETNK,RAH040	1	100390486
	32	TUBE,VALVE,RELIEF,ASSY,RAH040	1	100390487
	33	COUPLING,BRASS,RAH040	2	100390488
	34	PANEL,PCB,MAIN,RAH040	1	100390489
	35	PANEL,EXTERNAL,WIRE,RAH040	2	100390490
	36	COVER,HEATER,TSTAT,RAH040	1	100390491
	37	O-RING,COVER,HTR,TSTAT,RAH040	1	100390492
	38	HRNS,SENSOR,FLOW,RAH040	1	100390493
⚠	39	HRNS,RCCB,TERM,12,RAH040	1	100390494
⚠	40	HRNS,TRACE,HEAT,ETNK,RAH040	1	100390495
⚠	41	HRNS,RCCB,TERM,AB,RAH040	1	100390496
⚠	42	HRNS,PUMP,RAH040	1	100390497
⚠	43	HRNS,TSTAT,HTR,RAH040	1	100390498
⚠	44	HRNS,TERM,B,HTR,ELEM,RAH040	1	100390499
⚠	45	HRNS,TERM,A,TSTAT,HTR,RAH040	1	100390502
⚠	46	HRNS,HTR,ELEM,TSTAT,RAH040	1	100390503
⚠	47	HRNS,OLP,RAH040	1	100390504
	48	O-RING,VALVE,RELIEF,RAH040	2	100390505

PLEASE HAVE PART NUMBER AVAILABLE WHEN ORDERING PARTS

18 Exploded View and Replacement Parts

SAFETY	ITEM NO.	DESCRIPTION	QTY.	PART NO.
		WATER SYSTEM CONTINUED		
	49	O-RING,CPLG,PLUG,RAH040	2	100390507
	50	O-RING,SENSOR,FLOW,RAH040	7	100390508
	51	O-RING,HEX,WTR,RAH040	2	100390509
	52	O-RING,ETNK,RAH040	1	100390510
	53	CLAMP,RETN,RLV,TUBE,RAH040	1	100390511
	54	CLAMP,RETN,SENSOR,FLOW,RAH040	7	100390513
	55	CLAMP,RETN,HEX,WTR,RAH040	2	100390514
	56	CLAMP,RETN,RLV,PIPE,RAH040	2	100390515
	57	INSTR,INSTALL,OPERATION,RAH040	1	100390516
	58	LABEL,CENTRUS,RAH040	1	100390517
	59	LABEL,MODEL,RAH040	2	100390518
	60	PLUG,CPLG,WTR,RAH040	2	100390520
	61	PANEL,SVC,FILTER,RAH040	1	100390521
		PLEASE HAVE PART NUMBER AVAILABLE WHEN ORDERING PARTS		

18 Exploded View and Replacement Parts

SAFETY	ITEM NO.	DESCRIPTION	QTY.	PART NO.
		REFRIGERANT SYSTEM		
⚠	1	COMPRESSOR,RAH040	1	100390353
⚠	2	HRNS,COMPRESSOR,RAH040	1	100390354
⚠	3	TRACE,HEAT,CRANKCASE,RAH040	1	100390355
	4	ABSORBER,VIBRATION,COMP,RAH040	3	100390356
	5	NUT,MOUNT,COMP,RAH040	3	100390357
	6	GASKET,MOUNT,COMP,RAH040	3	100390359
	7	HEX,AIR,RAH040	1	100390360
	8	PIPE,CAPILLARY,RAH040	1	100390362
	9	VLV,EXPANSION,BYPASS,RAH040	1	100390363
	10	VLV,EXPANSION,MAIN,RAH040	1	100390364
⚠	11	SENSOR,PRESSURE,HIGH,RAH040	1	100390366
⚠	12	SWITCH,PRESSURE,RAH040	1	100390368
	13	STRAINER,RAH040	3	100390369
	14	VALVE,2-WAY,RAH040	1	100390370
	15	VALVE,4-WAY,RAH040	1	100390392
	16	VALVE,KING,LOW,RAH040	1	100390393
	17	VALVE,KING,HIGH,RAH040	1	100390394
	18	MUFFLER,DISCHARGE,RAH040	1	100390395
	19	INSUL,SOUND,SIDE,COMP,RAH040	1	100390396
	20	INSUL,SOUND,TOP,COMP,RAH040	1	100390397
⚠	21	SENSOR,AMBIENT,RAH040	1	100390399
⚠	22	SENSOR,DEFROST,RAH040	1	100390400
⚠	23	SENSOR,DISCHARGE,RAH040	1	100390401
⚠	24	SENSOR,EEV,BYPASS,RAH040	1	100390403
⚠	25	COIL,VLV,2-WAY,RAH040	1	100390404
⚠	26	COIL,EEV,BYPASS,RAH040	1	100390405
⚠	27	COIL,EEV,MAIN,RAH040	1	100390406
⚠	28	COIL,VLV,4-WAY,RAH040	1	100390407
	29	ELBOW,O-RING,DRAIN,ASSY,RAH040	1	100390408
	30	ELBOW,DRAIN,RAH040	1	100390409
	31	O-RING,ELBOW,DRAIN,RAH040	1	100390410
	32	PLUG,BASE,RAH040	1	100390412
⚠	33	TRACE,HEAT,BASE PAN,RAH040	1	100390413
	34	PIPE,REFRIGERANT,ASSY,RAH040	1	100390415
	35	HEX,PIPE,RAH040	1	100390416
		PLEASE HAVE PART NUMBER AVAILABLE WHEN ORDERING PARTS		

18 Exploded View and Replacement Parts

SAFETY	ITEM NO.	DESCRIPTION	QTY.	PART NO.
		OUTDOOR CONTROL BOARD		
	1	HOUSING,PCB,OUTDOOR,RAH040	1	100390321
⚠	2	BOARD,TERM,UVWA,ASSY,RAH040	1	100390323
⚠	3	BOARD,TERM,123,ASSY,RAH040	1	100390324
⚠	4	BOARD,CAPICITOR,RAH040	1	100390325
⚠	5	BOARD,FILTER,NOISE,RAH040	1	100390326
⚠	6	PCB,OUTDOOR,RAH040	1	100390328
⚠	7	SWITCH,ELECTRO-MAGNETIC,RAH040	1	100390330
	8	PANEL,PCB,OUTDOOR,RAH040	1	100390331
	9	SPACER,RAH040	10	100390333
⚠	10	HRNS,TERM,12,NOISE,FILTER,RAH040	1	100390334
⚠	11	HRNS,SWITCH,PRESS,HIGH,RAH040	1	100390335
⚠	12	HRNS,RELAY,RAH040	1	100390336
⚠	13	HRNS,GROUND,RAH040	1	100390337
⚠	14	HRNS,NOISE,FILTER,RELAY,RAH040	1	100390338
⚠	15	HRNS,CAPACITOR,MOTOR,RAH040	1	100390339
⚠	16	HRNS,CAPACITOR,NOISE,RAH040	1	100390340
⚠	17	HRNS,TERM,3,COMMUNICATION,RAH040	1	100390341
⚠	18	HRNS,CAPACITOR,FUSE,RAH040	1	100390342
⚠	19	HRNS,TERM,A,RECTIFICATION,RAH040	1	100390343
		PLEASE HAVE PART NUMBER AVAILABLE WHEN ORDERING PARTS		

18 Exploded View and Replacement Parts

SAFETY	ITEM NO.	DESCRIPTION	QTY.	PART NO.
		AIR FLOW		
	1	BASE PAN,MAIN,ASSY,RAH040	1	100390523
	2	INSUL,SOUND,COMP,PNL,RAH040	1	100390524
⚠	3	REACTOR,OUTDOOR,PCB,RAH040	1	100390525
	4	BRACKET,MOTOR,FAN,RAH040	1	100390527
	5	SCREW,BRKT,MOTOR,FAN,RAH040	14	100390528
⚠	6	MOTOR,FAN,UPPER,RAH040	1	100390529
⚠	7	MOTOR,FAN,LOWER,RAH040	1	100390530
	8	SCREW,MOTOR,MOUNT,RAH040	8	100390551
	9	PROPELLER,FAN,ASSY,RAH040	2	100390552
	10	NUT,PROPELLER,FAN,RAH040	2	100390553
	11	WASHER,PROPELLER,FAN,RAH040	1	100390554
	12	BUSHING,PROPELLER,FAN,RAH040	1	100390555
	13	PANEL,FAN,RAH040	1	100390556
	14	GRILLE,FAN,DISCHARGE,RAH040	2	100390557
	15	NET,WIRE,SIDE,RAH040	1	100390558
	16	NET,WIRE,REAR,RAH040	1	100390559
	17	PANEL,TOP,RAH040	1	100390560
	18	PANEL,FRONT,AIR,RAH040	1	100390561
	19	INSUL,SOUND,PNL,FRONT,AIR,RAH040	1	100390562
	20	PANEL,REAR,RAH040	1	100390563
	21	INSUL,SOUND,PNL,REAR,RAH040	1	100390564
	22	HANDLE,PANEL,RAH040	2	100390567
		PLEASE HAVE PART NUMBER AVAILABLE WHEN ORDERING PARTS		

NOTES

Lochinvar®
HIGH EFFICIENCY BOILERS & WATER HEATERS

Revision Notes: *(PCP #3000066159 / CN #500051740) initial release.*

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