TOSHIBA

Universal Smart X

Safety Precautions

Original Installation Manual

Air-Cooled Chiller

Model Name: RUAGP Series

- Thank you for purchasing this Toshiba heat pump unit.
  This Installation Manual describes the installation method of the heat pump unit.
  Moreover, as this Installation Manual includes the important articles concerning the “Machinery Directive 2006/42/EC”, please read through the manual and make sure you understand it. After installation, give this Installation Manual and the Instruction Manual to the user and tell the user to keep them safe.
- Fluorocarbon must be recovered in accordance with the local laws and regulations when the product is repaired or thrown away. Type and volume of refrigerant and conversion values for CO_2 are listed in “Refrigerant recovery and charging” on page 75.
- This unit is only for industrial uses. And this unit is not usable in an residential.

Toshiba Carrier Corporation

English

Original instructions
30KQA060-01UIEN

Contents

Original instructions

Definition of qualified installer or qualified service person

The heat pump unit (called "unit" hereafter) must be installed, maintained, repaired and removed by a qualified installer or qualified service person.
When any of these jobs is to be done, ask a qualified installer or qualified service person to do them for you.
A qualified installer or qualified service person is an agent who has the qualifications and knowledge described in the table below.

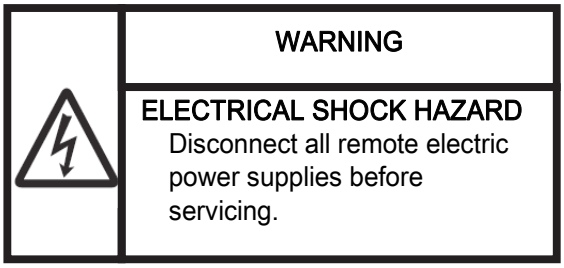
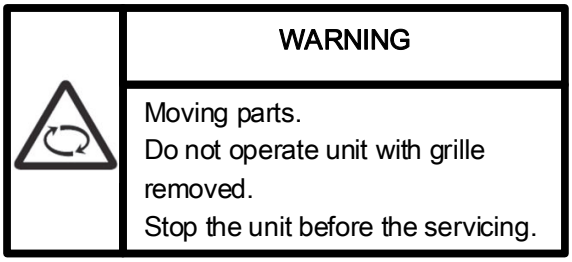
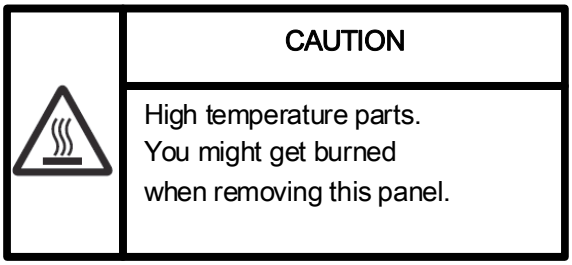
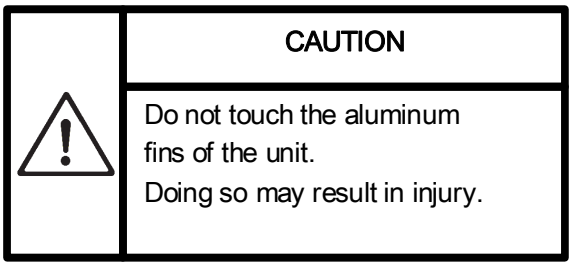
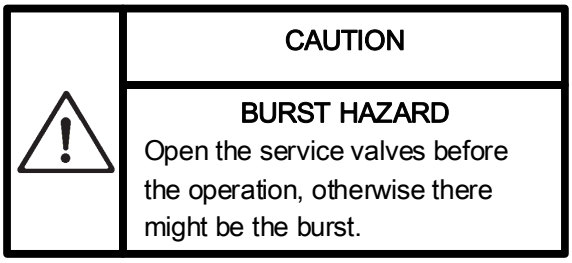
Agent	Qualifications and knowledge which the agent must have
Qualified installer	● The qualified installer is a person who installs, maintains, relocates and removes the unit made by Toshiba Carrier Corporation. He or she has been trained to install, maintain, relocate and remove the unit made by Toshiba Carrier Corporation or, alternatively, he or she has been instructed in such operations by an individual or individuals who ● The qualified installer who is allowed to do the electrical work involved in installation, relocation and removal has the qualifications pertaining to this electrical work as stipulated by the local laws and regulations, and he or she is a person who has been trained in matters relating to electrical work on the unit made by Toshiba Carrier Corporation or, alternatively, he or she has been instructed in such matters by an individual or individuals who have been trained and is thus thoroughly acquainted with the knowledge related to this work. ● The qualified installer who is allowed to do the refrigerant handling and piping work involved in installation, relocation and removal has the qualifications pertaining to this refrigerant handling and piping work as stipulated by the local laws and regulations, and he or she is a person who has been trained in matters relating to refrigerant handling and piping work on the unit made by Toshiba Carrier Corporation or, alternatively, he or she has been instructed in such matters by an individual or individuals who have been trained and is thus thoroughly acquainted with the knowledge related to this work. ● The qualified installer who is allowed to work at heights has been trained in matters relating to working at heights with the unit made by Toshiba Carrier Corporation or, alternatively, he or she has been instructed in such matters by an individual or individuals who have been trained and is thus thoroughly acquainted with the knowledge related to this work.
Qualified service person	● The qualified service person is a person who installs, repairs, maintains, relocates and removes the unit made by Toshiba Carrier Corporation. He or she has been trained to install, repair, maintain, relocate and remove the unit made by Toshiba Carrier Corporation or, alternatively, he or she has been instructed in such operations by an individual or individuals who have been trained and is thus thoroughly acquainted with the knowledge related to these operations. ● The qualified service person who is allowed to do the electrical work involved in installation, repair, relocation and removal has the qualifications pertaining to this electrical work as stipulated by the local laws and regulations, and he or she is a person who has been trained in matters relating to electrical work on the unit made by Toshiba Carrier Corporation or, alternatively, he or she has been instructed in such matters by an individual or individuals who have been trained and is thus thoroughly acquainted with the knowledge related to this work. ● The qualified service person who is allowed to do the refrigerant handling and piping work involved in installation, repair, relocation and removal has the qualifications pertaining to this refrigerant handling and piping work as stipulated by the local laws and regulations, and he or she is a person who has been trained in matters relating to refrigerant handling and piping work on the unit made by Toshiba Carrier Corporation or, alternatively, he or she has been instructed in such matters by an individual or individuals who have been trained and is thus thoroughly acquainted with the knowledge related to this work. ● The qualified service person who is allowed to work at heights has been trained in matters relating to working at heights with the unit made by Toshiba Carrier Corporation or, alternatively, he or she has been instructed in such matters by an individual or individuals who have been trained and is thus thoroughly acquainted with the knowledge related to this work.

Definition of protective gear

When the unit is to be transported, installed, maintained, repaired or removed, wear protective gloves and safety work clothing. In addition to such normal protective gear, wear the protective gear described below when undertaking the special work detailed in the table below. Failure to wear the proper protective gear is dangerous because you will be more susceptible to injury, burns, electric shocks and other injuries.

Work undertaken	Protective gear worn
All types of work	Injury protection gloves with non-slip function and long sleeved working clothes.
Electrical-related work	Gloves to provide protection for electricians and from heat Insulating shoes. Clothing to provide protection from electric shock.
Work done at heights (50 cm or more)	Helmets for use in industry.
Transportation of heavy objects	Shoes with additional protective toe cap.
Repair of the unit	Gloves to provide protection for electricians and from heat.

Warning indications on the air conditioner unit

Warning indication	Description
	**WARNING** **ELECTRICAL SHOCK HAZARD** Disconnect all remote electric power supplies before servicing
	**WARNING** Moving parts. Do not operate unit with grille removed. Stop the unit before the servicing.
	**CAUTION** High temperature parts. You might get burned when removing this panel.
	**CAUTION** Do not touch the aluminum fins of the unit. Doing so may result in injury.
	**CAUTION** **BURST HAZARD** Open the service valves before the operation, otherwise there might be the burst.

Safety Precautions

The manufacturer shall not assume any liability for the damage caused by not observing the description of this manual.

WARNING

General

- Before starting to install the unit, read through the Installation Manual carefully, and follow its instructions to install the unit. Otherwise, falling down of the unit may occur, or the unit may cause noise, vibration or water leakage.
- Only a qualified installer (*1) or qualified service person (*1) is allowed to do installation work. If installation is carried out by an unqualified individual, a fire, electric shocks, injury, water leakage, noise and/or vibration may result.
- Take measures to prohibit workers other than those concerned from entering the area where the installation work is carried out.
- If using separately sold products, make sure to use Toshiba specified products only. Using unspecified products may cause fire, electric shock, water leak or other failure.
- Do not use any refrigerant different from the one specified for complement or replacement. Otherwise, abnormally high pressure may be generated in the refrigeration cycle, which may result in a failure or explosion of the product or an injury to your body. The refrigerant used by this unit is the R32 .
- Before opening the service panel of the unit, set the circuit breaker to the OFF position, and wait for 10 minutes to discharge the capacitors completely. Failure to set the circuit breaker to the OFF position and wait for 10 minutes to discharge the capacitors may result in electric shocks through contact with the interior parts. Only a qualified installer (*1) or qualified service person (*1) is allowed to remove the service panel of the unit and do the work required.
- Before carrying out the installation, maintenance, repair or removal work, be sure to set the circuit breaker for the unit to the OFF position. Otherwise, electric shock may result.
- Place a "Work in progress" sign near the circuit breaker while the installation, maintenance, repair or removal work is being carried out. There is a danger of electric shocks if the circuit breaker is set to ON by mistake.
- Only a qualified installer (*1) or qualified service person (*1) is allowed to undertake work at heights using a stand of 50 cm or more or to remove the parts of the unit to undertake work.
- Wear protective gloves and safety work clothing during installation, servicing and removal.
- Do not touch the aluminum fin of the unit. You may injure yourself if you do so. If the fin must be touched for some reason, first put on protective gloves and safety work clothing, and then proceed.
- Do not climb onto or place objects on top of the unit. You may fall or the objects may fall off of the unit and result in injury.
- When working at height, put a sign in place so that no-one will approach the work location before proceeding with the work. Parts or other objects may fall from above, possibly injuring a person below. Also, be sure that workers put on helmets.
- When cleaning the parts of the unit, set the circuit breaker to OFF without fail, lock the circuit breaker in the OFF position, place a "work in progress" sign near the circuit breaker before proceeding with the work.
- Do not disassemble, modify, repair or move the product yourself. Doing so may cause fire, electric shock, injury or water leaks. Ask a qualified installer or qualified service person to do any repairs or to move the product.

- Be sure to use the company-specified products for the separately purchased parts. Use of non-specified products may result in fire, electric shock, water leakage, etc. Have the installation performed by a professional.(If using separately sold products, make sure to use Toshiba specified products only. Using unspecified products may cause fire, electric shock, water leak or other failure.)
- Do not customize the unit. Doing so may result in fire, electric shock, etc.
- Only a qualified installer or qualified service person is allowed to undertake work at heights using a stand of 50 cm or more or to remove the parts of the unit to undertake work.(Use of a stand more than 50 cm high to clean the body of the unit or to carry out other such jobs constitutes working at heights. Due to the danger of falling off the stand and injuring yourself while working at heights, this kind of work should not be done by unqualified individuals. When this kind of work must be carried out, do not do it yourself but ask a qualified installer or a qualified service person to do it for you.)
- When working at height, use a ladder which complies with the ISO 14122 standard, and follow the procedure in the ladder's instruction. Also, wear a helmet for use in industry as protective gear to undertake the work.

Transportation and storage

- When transporting the unit, wear shoes with protective toe caps, injury protection gloves with non-slip function and long sleeved working clothes.
- When transporting the unit, do not take hold of the packing materials. You may injure yourself if the packing materials should break.
- When storing or transporting the unit, heed the precautions written on the packages. Failure to heed the precautions may cause the unit to be damaged.
- You shall ensure that the unit is transported in stable condition. If you find any part of the product broken, contact your dealer.
- When storing or transporting the unit, be sure to place the ambient temperature of the unit within a range of -20 to +60°C.

Selection of installation location

- If you install the unit in a small and/or closed room, take appropriate measures to prevent the refrigerant from exceeding the limit concentration even if it leaks. Consult the dealer from whom you purchased the unit when you implement the measures. Accumulation of highly concentrated refrigerant may cause an oxygen deficiency accident.
- Do not install in a location where flammable gas may leaks are possible. If the gas should leak and accumulate around the unit, it may ignite and cause a fire.
- Do not provide with permanent scaffolds to easily access to the fans on the top of the unit. There is a risk of an injury due to the rotating parts.
- Do not place any combustion appliance in a place where it is directly exposed to the wind of unit, otherwise it may cause imperfect combustion.
- Places where the operation sound of the unit may cause a disturbance. (Especially at the boundary line with a neighbor, install the unit while considering the noise.)
- Do not install in a depression.

Installation

- Follow the instructions in the Installation Manual to install the unit. Failure to follow these instructions may cause the product to fall down or topple over or give rise to noise, vibration, water leakage or other failure.
- The designated bolts (M16) and nuts (M16) for securing the unit must be used when installing the unit.
- Install the unit property in a location that is durable enough to support the weight of the unit. Insufficient durability may cause the unit to fall, which may result in injury.

- Install the unit in the prescribed manner for protection against strong wind and earthquake. Incorrect installation may result in the unit falling down, or other accidents.
- Be sure to fix the screws back which have been removed for installation or other purposes.
- Installation is supplied from a dedicated power transformer or generator, and which is not connected to Low Voltage (LV) overhead power lines.
- Installation is physically separated from residential environments by distance greater than 30 m or by a structure which acts as a barrier to radiated phenomena.

Refrigerant piping

- Only a qualified installer (*1) or qualified service person (*1) is allowed to carry out the welding work of the unit. Under no circumstances must this work be done by an unqualified individual since failure to carry out the work properly may result in refrigerant leaks.
- After the installation work, confirm that refrigerant gas does not leak. If refrigerant gas leaks into the room and flows near a fire source, such as a gas heater, noxious gas may be generated.
- If refrigerant gas has leaked during the installation work, ventilate the room immediately. If the leaked refrigerant gas comes in contact with fire, noxious gas may be generated.
- Using the service port to charge and discharge the refrigerant. In case of using the other, it causes overcharge, leak, uncontrollable the refrigerant and unsafe connection and disconnection.

Electrical wiring

- Only a qualified installer (*1) or qualified service person (*1) is allowed to carry out the electrical work of the unit. Under no circumstances must this work be done by an unqualified individual since failure to carry out the work properly may result in electric shocks and/or electrical leaks.
- When connecting the electrical wires, repairing the electrical parts or undertaking other electrical jobs, wear gloves to provide protection for electricians and from heat, insulating shoes and clothing to provide protection from electric shocks. Failure to wear this protective gear may result in electric shocks.
- When executing address setting, test run, or troubleshooting with the control board in the electrical control box, put on insulated heat-proof gloves, insulated shoes and other clothing to provide protection from electric shock. Otherwise you may receive an electric shock.
- Use wiring that meets the specifications in the Installation Manual and the stipulations in the local regulations and laws. Use of wiring which does not meet the specifications may give rise to electric shocks, electrical leakage, smoking and/or a fire.
- Check that the product is properly earthed. (grounding work) Incomplete earthing may cause electric shock.
- Do not connect the earth wire to a gas pipe, water pipe, conduit pipe, lightning conductor, or a telephone earth wire.
- After completing the repair work, check that the ground wires are connected properly.
- Install a circuit breaker that meets the specifications in the installation manual and the stipulations in the local regulations and laws.
- Install the circuit breaker near the product and it can be easily accessible and located.
- The circuit breaker is required having an external operating means (for example handle).
- When installing the circuit breaker outdoors, install one which is designed to be used outdoors.
- Electrical wiring work shall be conducted according to law and regulation in the community and installation manual. Failure to do so may result in electrocution or short circuit.

- Do not supply power from the power terminal block equipped on the unit to another unit. Capacity overflow may occur on the terminal block and may result in fire.
- When carrying out electric connection, use the wire specified in the Installation Manual and connect and fix the wires securely to prevent them applying external force to the terminals. Improper connection or fixing may result in fire.
- Before connecting the power source cable, connecting the MC power source and check the connected terminal match the voltage. Before turning on the power, make sure that the power supply voltage and the specifications of the device match.
- Before turning on the power, make sure that the power supply voltage and the specifications of the device match.
- The power supply must be wired through a grounded metal conduit.
- Installation is supplied from a dedicated power transformer or generator, and which is not connected to Low Voltage (LV) overhead power lines.
- Installation is physically separated from residential environments by distance greater than 30 m or by a structure which acts as a barrier to radiated phenomena.
- The chiller must be located where there is a distance greater than 30 m between the equipment and third party sensitive radio communications.

Water piping

- Only a qualified installer (*1) or qualified service person (*1) is allowed to carry out the water piping work of the unit. Under no circumstances must this work be done by an unqualified individual since failure to carry out the work properly may result in water leakage.
- When a water supply pipe is connected to the system, relevant local ordinances and standards must be followed. The improper pipe connection may cause water leakage, etc.
- Prevent the clogging of the drain pipe.
- Dispose of antifreeze according to legal regulations.

Test run

- Before operating the unit after having completed the work, check that the electrical control box cover of the unit and service panel of the unit are closed, and set the circuit breaker to the ON position. You may receive an electric shock if the power is turned on without first conducting these checks.
- When you have noticed that some kind of trouble (such as when a failure display has appeared, there is a smell of burning, abnormal sounds are heard, the unit fails to cool or heat or water is leaking) has occurred in the unit, do not touch the unit yourself but set the circuit breaker to the OFF position, and contact a qualified service person. Continuing to use the unit in the trouble status may cause mechanical problems to escalate or result in electric shocks or other failure.
- After the work has finished, be sure to use an insulation tester set (500V Megger) to check the resistance is 2 MΩ or more between the charge section and the non-charge metal section (Earth section). If the resistance value is low, a disaster such as a leak or electric shock is caused at user's side.
- Upon completion of the installation work, check for refrigerant and water leaks and check the insulation resistance and water drainage. Then conduct a test run to check that the unit is operating properly.
- Do not insert a finger, stick and so on into the fans and pump.

Explanations given to user

- Upon completion of the installation work, tell the user where the circuit breaker is located. If the user does not know where the circuit breaker is, he or she will not be able to turn it

off in the event that trouble has occurred in the unit.
- If you have discovered that the fan grille is damaged, do not approach the unit but set the circuit breaker to the OFF position, and contact a qualified service person to have the repairs done. Do not set the circuit breaker to the ON position until the repairs are completed.
- After the installation work, follow the Instruction Manual to explain to the customer how to use and maintain the unit.

Removal
- Do not relocate the unit because this unit is one component part installed in the specified fixed equipment as an interpretation of the EMC Directive.
- Only a qualified installer (*1) or qualified service person (*1) is allowed to remove the unit. It is dangerous for the unit to be removed by an unqualified individual since a fire, electric shocks, injury, water leakage, and/or refrigerant leakage may result.
- Be sure to use a refrigerant recovery machine to recover the refrigerant when removing or repairing.

CAUTION
To disconnect the appliance from main power supply.
- This appliance must be connected to the main power supply by means of an circuit breaker with a contact separation of at least 3 mm.
- Certainly lay the drain pipe for perfect draining. Bad drainage may cause flooding around the unit and getting ground wet.
- Make sure to connect the unit to an exclusive power supply of the rated voltage, otherwise the unit may break down or cause a fire.
- Use circuit breakers at prescribed locations. Connecting more than prescribed units to the same circuit breaker may cause a fire and electric shocks.
- Electrical leakage breakers must be installed in some locations. If the electrical leakage breakers are not installed, it may lead to electric shocks.
- Do not install the unit in the locations with acidic and alkaline atmospheres, such as areas with hot springs, seashores, or oily areas.)
- This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

(*1) Refer to the "Definition of Qualified Installer or Qualified Service Person."

Delivery

Pay attention to the below points when transporting the chiller.

(1) The air heat exchanger of the heat pump is a copper tube and aluminium coil. It is extremely fragile and may be damaged by external impact, so be sure to handle it carefully.

(2) Pay attention to the below points when lifting or lowering the heat pump.
- Use a product equivalent to SA, SB and SC-type nominal size 18 shackles specified in the JIS-B-2801 standards to support the unit in the prescribed position (rigging hole) as shown in the below diagram.
- Secure it with wire at or above the dimensions in the below diagram to prevent damage to the product's top discharge opening.
- To prevent damaging the heat pump during lifting use either a spreader beam or place a piece of wood (or something similar) at the place where the wire is in contact with the unit.

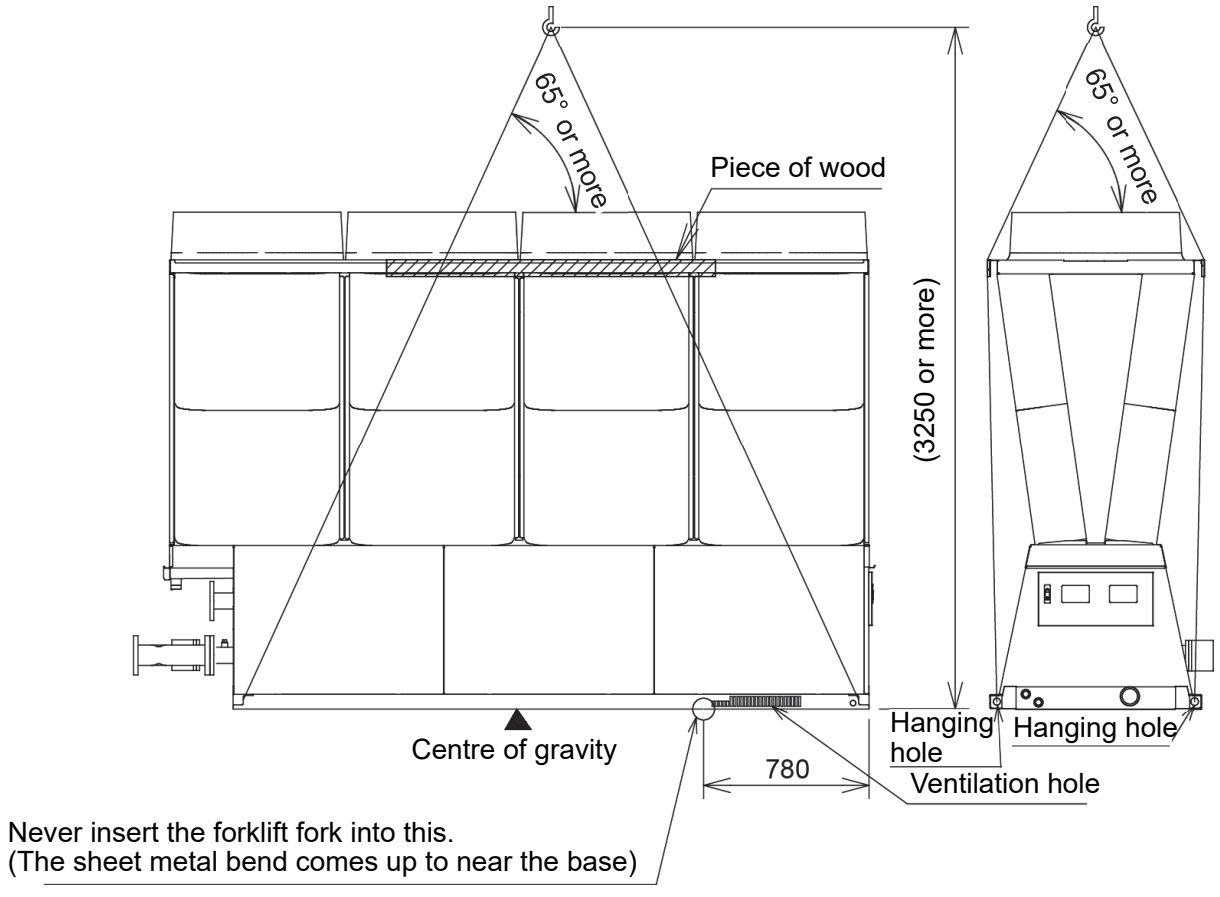
(3) Lift the heat pump to the installation location before removing the packaging for the heat pump. This will prevent it from being damaged during transportation.

(4) Do not lie the heat pump on its side or tilt it 15° or more.

(5) Only lift the units one at a time. Ensure the module containing the module controller (MC) is located in the correct position in accordance with the site installation instructions.

(6) Pay attention to the below points when lifting the heat pump by forklift, etc.
- Take care not to scratch the sheet metal when inserting the forklift fork. Be sure not to insert the fork in the position marked by the circle (○) in the below diagram as this may damage the sheet metal.
- Check that the end of the forklift fork has reached the end of the heat pump before lifting it.
- Lift the heat pump in a position at the centre of gravity as shown in the below diagram.

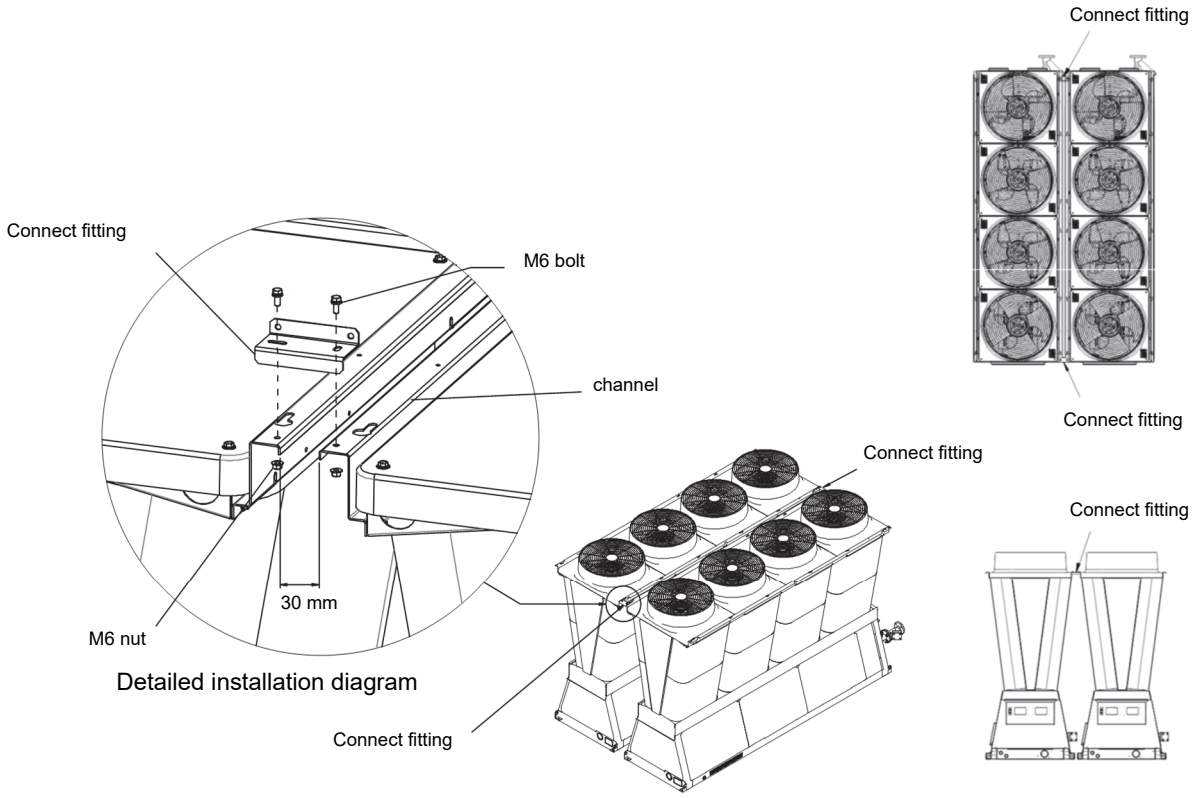
Lifting method



(7) Rip the polyethylene bag packaging before disposing of it and keep away from children to avoid danger of suffocation.

After installation

(1) When utilising connecting fittings (option), connect the modules with the said fittings and M6 nut and bolt as shown in the below diagram. The connecting fittings can only be utilised for continuous installations with the minimum space between modules (top module interval: 30mm).
The connecting fittings are aimed at preventing component contact when the chiller is operating. They are not strong enough to prevent deformation in the event of unforeseen circumstances such as an earthquake.



(2) After installation connect the power supply wiring to each module and control wiring between modules as required (see "Connecting the communication line between modules" for details). When completing the power supply and control wiring, use the cable clamps located inside the electrical box to ensure no load is placed on the terminals used for the power supply and control wiring connections.

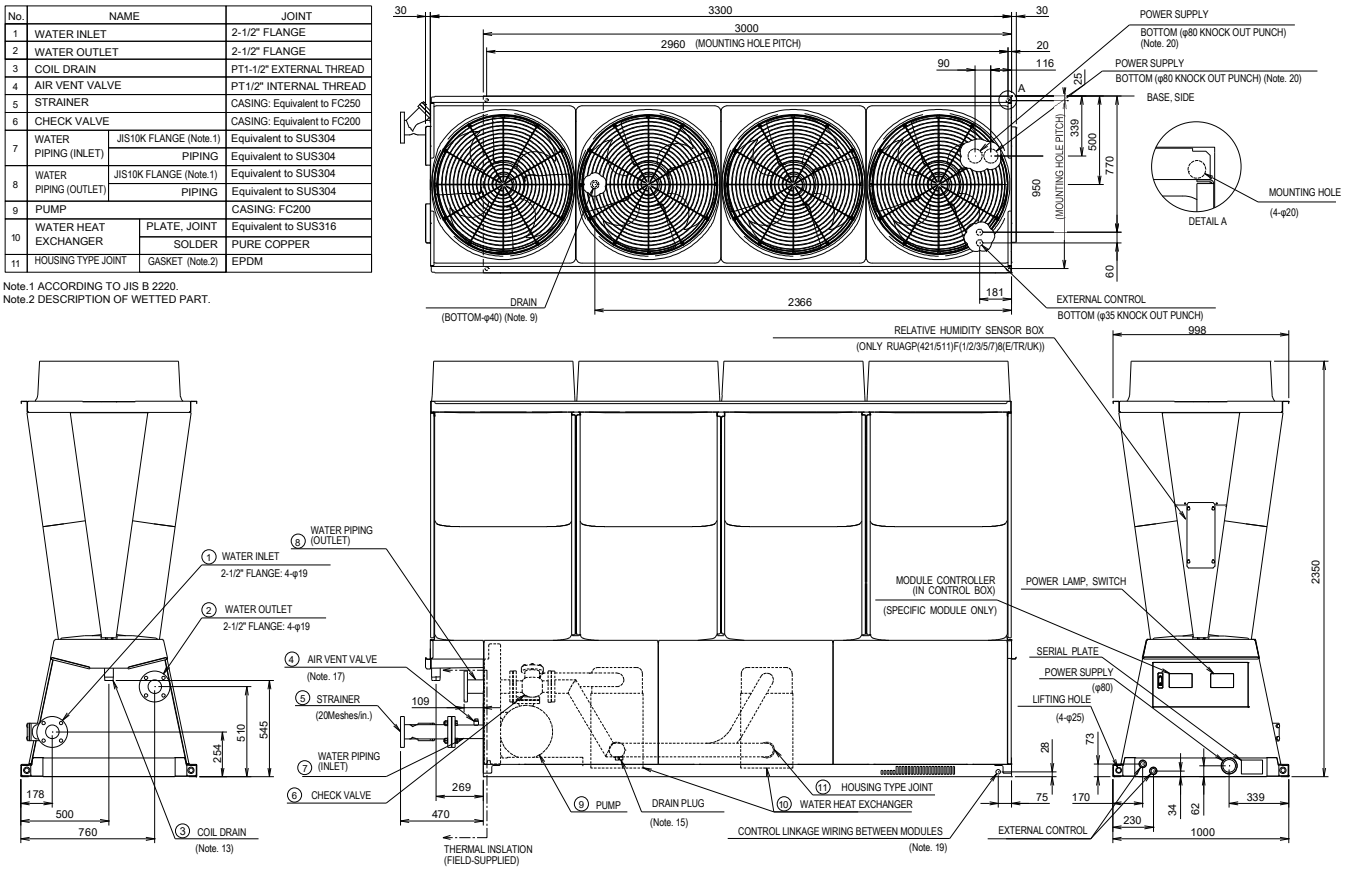
(3) An address will need to be set for each module.

Dimensional drawings (Integrated inverter pump, pumpless)

Standard type_50HP, 60HP

No.	NAME		JOINT
1	WATER INLET		2-1/2" FLANGE
2	WATER OUTLET		2-1/2" FLANGE
3	COIL DRAIN		PT1-1/2" EXTERNAL THREAD
4	AIR VENT VALVE		PT1/2" INTERNAL THREAD
5	STRAINER		CASING: Equivalent to FC250
6	CHECK VALVE		CASING: Equivalent to FC200
7	WATER PIPING (INLET)	JIS10K FLANGE (Note.1)	Equivalent to SUS304
		PIPING	Equivalent to SUS304
8	WATER PIPING (OUTLET)	JIS10K FLANGE (Note.1)	Equivalent to SUS304
		PIPING	Equivalent to SUS304
9	PUMP		CASING: FC200
10	WATER HEAT EXCHANGER	PLATE, JOINT	Equivalent to SUS316
		SOLDER	PURE COPPER
11	HOUSING TYPE JOINT	GASKET (Note.2)	EPDM

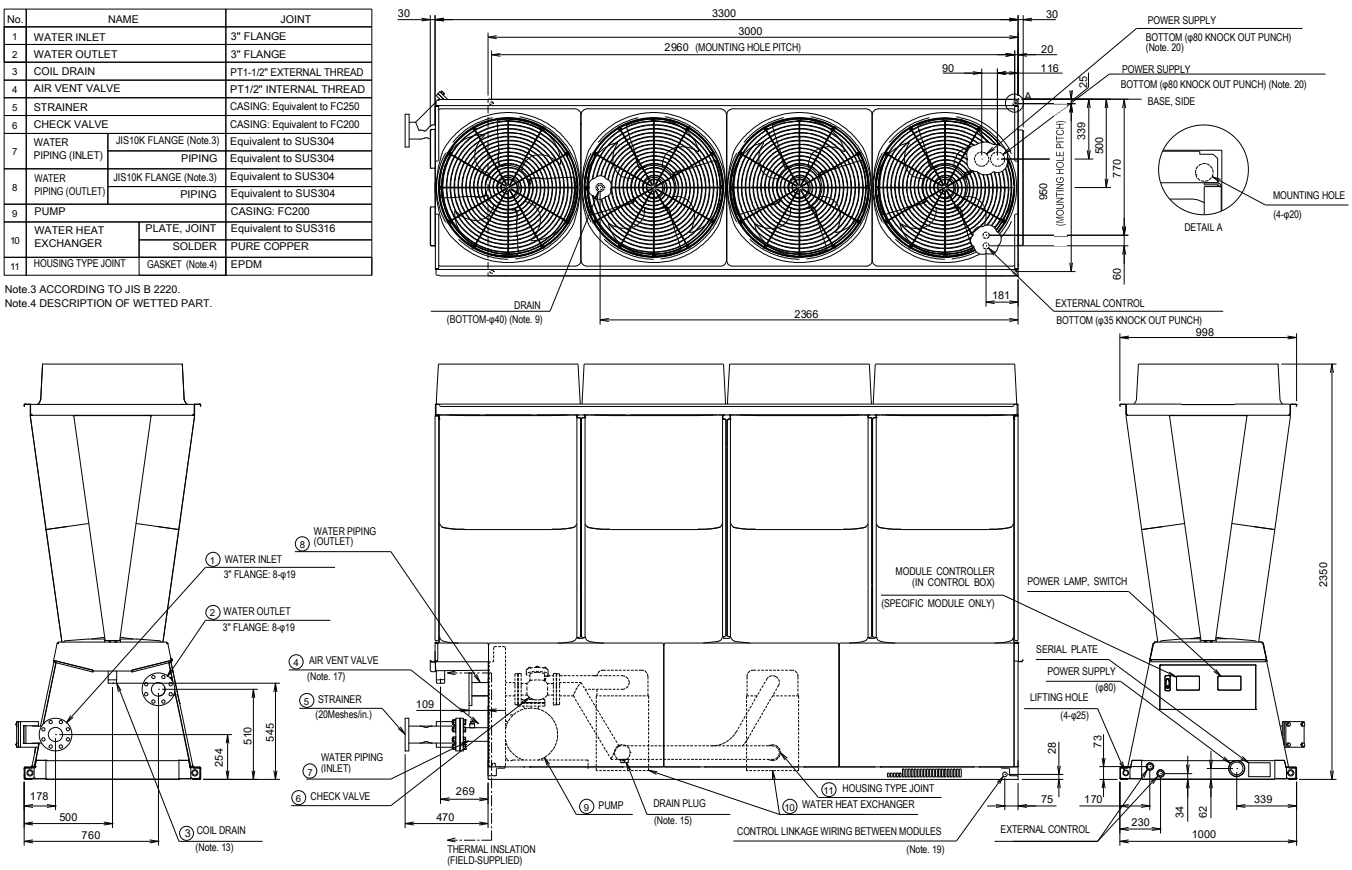
Note.1 ACCORDING TO JIS B 2220.
Note.2 DESCRIPTION OF WETTED PART.



Standard type_70HP

No.	NAME		JOINT
1	WATER INLET		3" FLANGE
2	WATER OUTLET		3" FLANGE
3	COIL DRAIN		PT1-1/2" EXTERNAL THREAD
4	AIR VENT VALVE		PT1/2" INTERNAL THREAD
5	STRAINER		CASING: Equivalent to FC250
6	CHECK VALVE		CASING: Equivalent to FC200
7	WATER PIPING (INLET)	JIS10K FLANGE (Note.3)	Equivalent to SUS304
		PIPING	Equivalent to SUS304
8	WATER PIPING (OUTLET)	JIS10K FLANGE (Note.3)	Equivalent to SUS304
		PIPING	Equivalent to SUS304
9	PUMP		CASING: FC200
10	WATER HEAT EXCHANGER	PLATE, JOINT	Equivalent to SUS316
		SOLDER	PURE COPPER
11	HOUSING TYPE JOINT	GASKET (Note.4)	EPDM

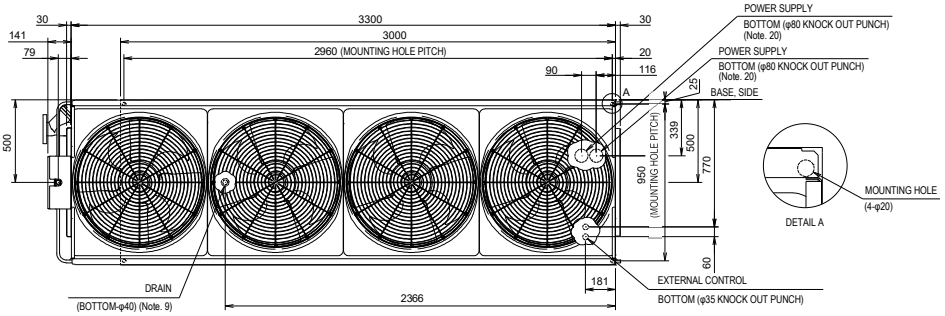
Note.3 ACCORDING TO JIS B 2220.
Note.4 DESCRIPTION OF WETTED PART.

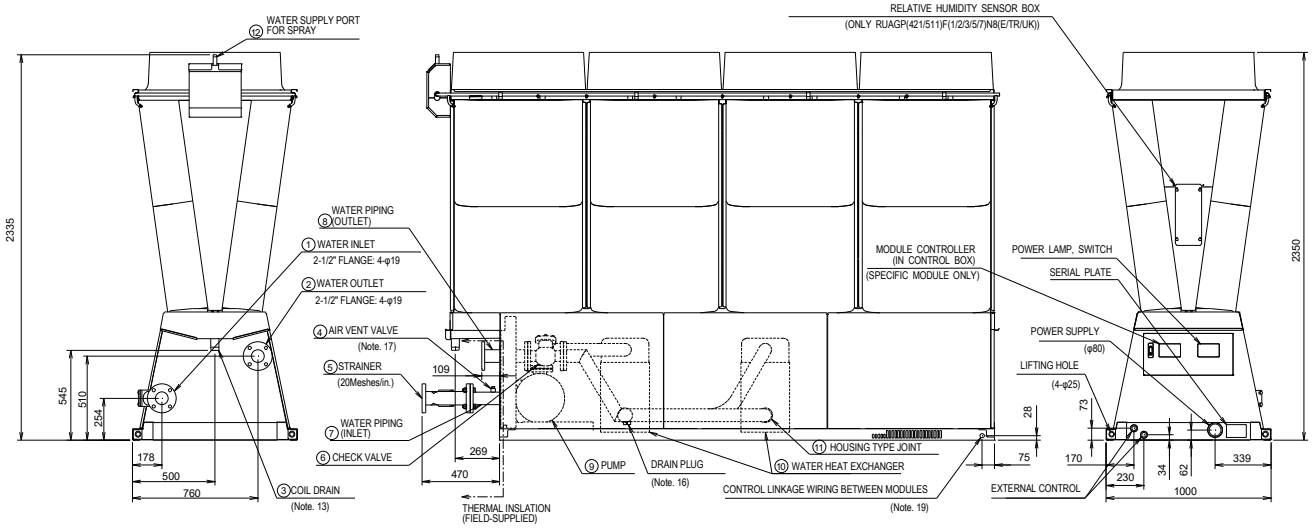


High EER Type_50HP, 60HP

No.	NAME		JOINT
1	WATER INLET		2-1/2" FLANGE
2	WATER OUTLET		2-1/2" FLANGE
3	COIL DRAIN		PT1-1/2" EXTERNAL THREAD
4	AIR VENT VALVE		PT1/2" INTERNAL THREAD
5	STRAINER		CASING: Equivalent to FC250
6	CHECK VALVE		CASING: Equivalent to FC200
7	WATER PIPING (INLET)	JIS10K FLANGE (Note.1)	Equivalent to SUS304
		PIPING	Equivalent to SUS304
8	WATER PIPING (OUTLET)	JIS10K FLANGE (Note.1)	Equivalent to SUS304
		PIPING	Equivalent to SUS304
9	PUMP		CASING: FC200
10	WATER HEAT EXCHANGER	PLATE, JOINT	Equivalent to SUS316
		SOLDER	PURE COPPER
11	HOUSING TYPE JOINT	GASKET (Note.2)	EPDM
12	WATER SUPPLY PORT FOR SPRAY		PT1/2" EXTERNAL THREAD

Note.1 ACCORDING TO JIS B 2220.
Note.2 DESCRIPTION OF WETTED PART.

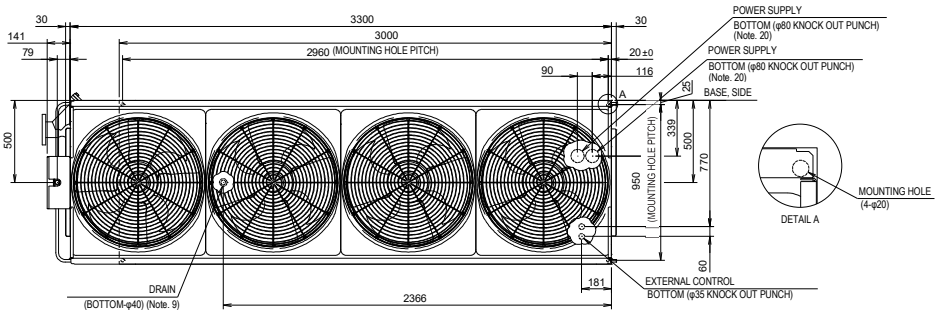


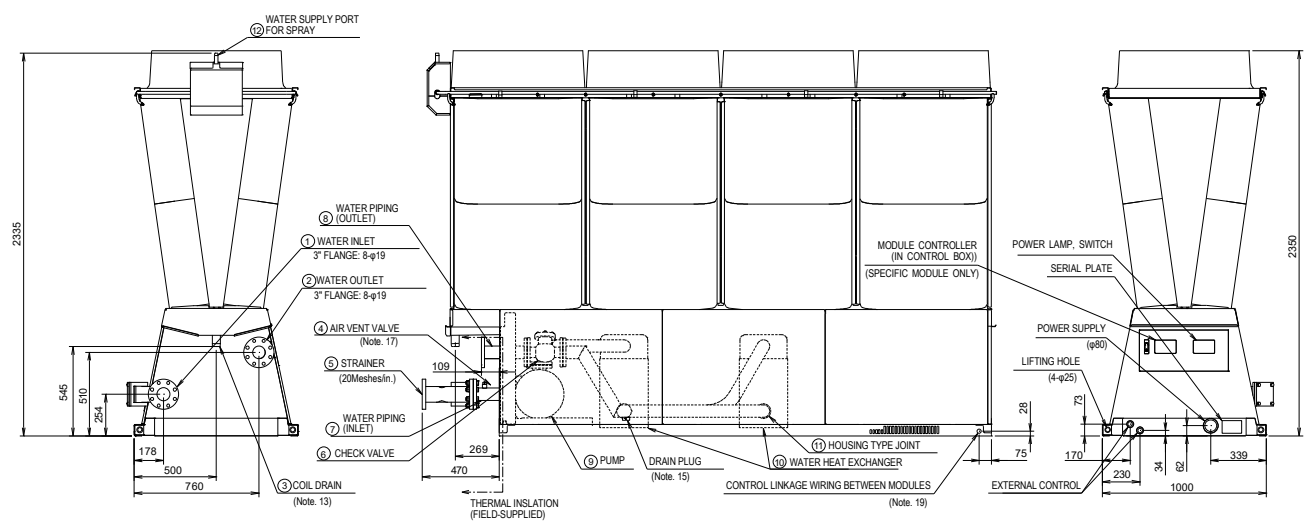


High EER Type_70HP

No.	NAME		JOINT
1	WATER INLET		3" FLANGE
2	WATER OUTLET		3" FLANGE
3	COIL DRAIN		PT1-1/2" EXTERNAL THREAD
4	AIR VENT VALVE		PT1/2" INTERNAL THREAD
5	STRAINER		CASING: Equivalent to FC250
6	CHECK VALVE		CASING: Equivalent to FC200
7	WATER PIPING (INLET)	JIS10K FLANGE (Note.3)	Equivalent to SUS304
		PIPING	Equivalent to SUS304
8	WATER PIPING (OUTLET)	JIS10K FLANGE (Note.3)	Equivalent to SUS304
		PIPING	Equivalent to SUS304
9	PUMP		CASING: FC200
10	WATER HEAT EXCHANGER	PLATE, JOINT	Equivalent to SUS316
		SOLDER	PURE COPPER
11	HOUSING TYPE JOINT	GASKET (Note.4)	EPDM
12	WATER SUPPLY PORT FOR SPRAY		PT1/2" EXTERNAL THREAD

Note.3 ACCORDING TO JIS B 2220.
Note.4 DESCRIPTION OF WETTED PART.

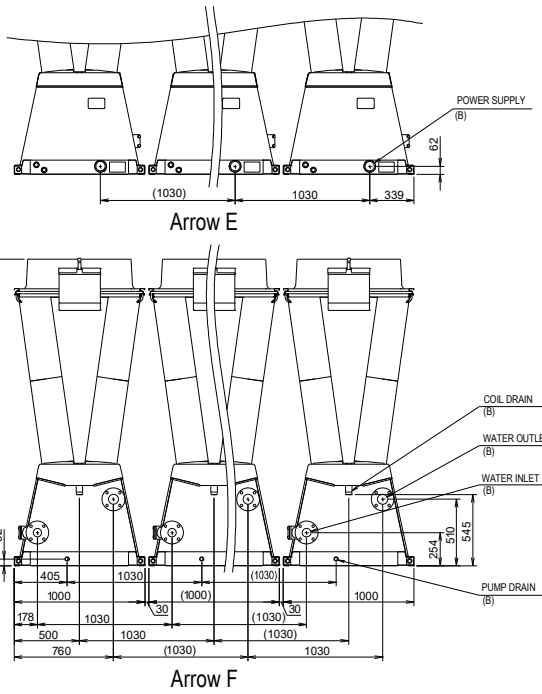


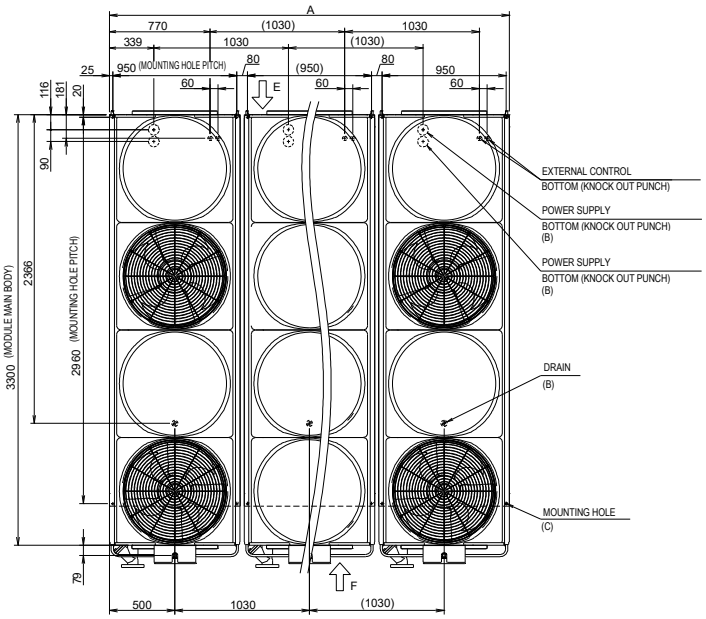


● Installed in a connected state

Note 2.number for A, B, C in the drawing.

Number of Modules	A	B	C
1	1000	1	4
2	2030	2	8
3	3060	3	12
4	4090	4	16
5	5120	5	20
6	6150	6	24
7	7180	7	28
8	8210	8	32
9	9240	9	36
10	10270	10	40
11	11300	11	44
12	12330	12	48
13	13360	13	52
14	14390	14	56
15	15420	15	60
16	16450	16	64





The spacing of 30 mm is the standard spacing. It can be increased to facilitate maintenance work. In that case, extend the communication line between modules as necessary.

Installation

1. Installation location

Be aware of the following points when selecting an installation location

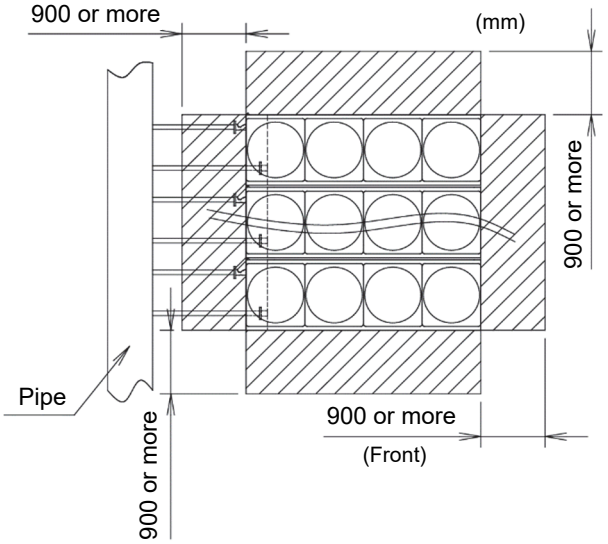
(1) Select a location that can fully support the heat pump's operating weight.
For operating weight, see "Centre of gravity / weight distribution".

(2) Providing a service space around the USX EDGE is essential to ensure the fresh air intake is maintained for the correct operation of the module and technicians are unobstructed whilst performing maintenance/repair activities. Please refer to the diagram below for the required service space dimensions. Please be aware that a space of at least 900mm is required between the connecting pipework and the module chassis to enable maintenance activities to be completed on the water filter etc.

(3) The required service space cannot be shared with any other site equipment that needs an intake of fresh air (additional heat pump or cooling tower).

※Do not install the USX EDGE module indoors or in an enclosed environment, Ensure sufficient ventilation is maintained so the air does not stagnate.

※Ensure that national and local regulations are taken into consideration when determining the service space around the USX EDGE module.



(4) Do not install the USX EDGE modules in any of the locations shown below as this may cause the heat pump to fail.

- Locations exposed to sprays of liquids such as engine oil
- Locations exposed to sulphide (gas) such as spas
- Locations where there is a danger of generation, inflow, or stagnation of flammable gas
- Other locations exposed to smoke
- Locations with an inclination of 1/2000 or more
- Locations that are not strong enough to withstand the heat pump’s operating weight
- Locations exposed to salt such as coastal areas (select salt resistant and heavy salt resistant specifications)
- Locations with an acidic or alkaline atmosphere
- Locations where carbon fibre or metal powder float in the air
- Locations with high humidity
- Locations directly exposed to radiant heat emitted from other heat sources

(5) Do not install in a location that could cause the air heat exchanger to corrode or in a location exposed to dust or any other foreign matter that could cause blockage on the air heat exchanger.

(6) When installing on the ground, avoid locations where water may rise above the base due to flooding or similar.

(7) The following points below, regarding the operating sound of the USX EDGE module, must be considered when installing the heat pump. Be sure to read these points before installation.

- As shown in the "Sound data" section, the direction in which the sound rises to the highest level will vary depending on the number of operated modules. Care must be taken to ensure the sound levels emitted from the installation do not exceed any noise threshold limits from adjacent building developments (for example housing estates etc,).
- The sound levels stated in the "Sound data" are values measured in a location with little reflected sound. Please be aware that the specified sound levels may increase due to the effects ambient noise or reflected sound) from the ground or surrounding buildings) when the USX EDGE modules are installed.
- There are no sound reduction options, on USX, to reduce the sound levels once the modules have been installed. Consider installing sound barriers around the module(s) to reduce the sound levels from the installation. If sound barriers are installed ensure the air flow and quantity is sufficient for correct operation of the USX EDGE module.

(8) Do not install the module in a location where there are components that cause higher harmonics (inverter equipment, private power generator, medical equipment, communication devices).
(This may cause a heat pump malfunction or control failure or obstruct such components due to noise.)

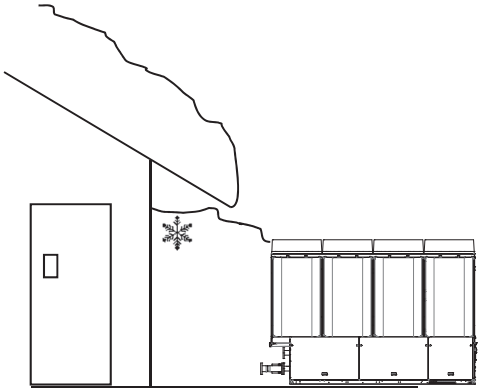
(9) Do not install the module in a location where there may be dust such as metal powder. If metal powder etc. attaches to or builds up inside the heat pump, it may self-heat and cause a fire.

(10) Change the CN7 connector assembly according to the power supply voltage.

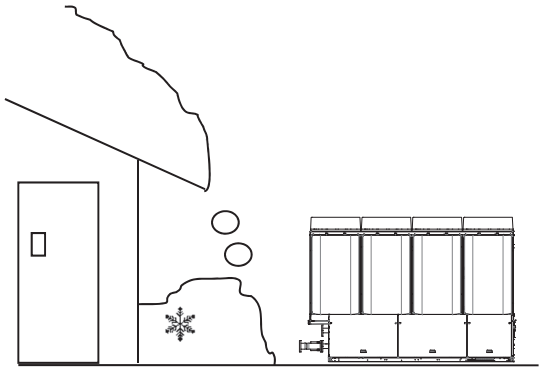
[Take care when operating in a cold region]

Installing it in a cold region may cause a component fault due to the effect of snow falling on the heat pump. Pay attention to the below points to operate the heat pump normally in cold regions.

(1) Do not install the module in a place or under the eaves of a roof where there are likely to be snowfalls.



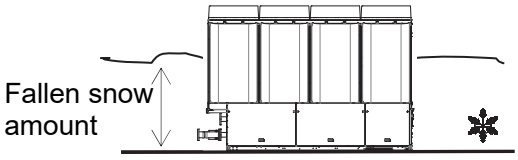
Bad example



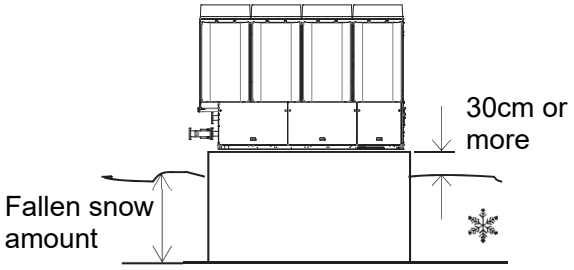
Good example

(2) Position the heat pump so that the surface of the air heat exchanger is not facing the direction of wind and snow. (The air heat exchanger should be positioned so its surface is parallel to the direction of wind and snow.)

(3) Install the module on a curb that is 30cm higher than the snowfall predicted in the place of installation. This will reduce the risk of snow being collected around the module and drawn into the air heat exchanger coils.



Bad example



Good example

(4) It is essential for the curb to be made out of angle steel materials and is installed in such a way that allows wind and snow to pass through.

(5) Ensure that the width dimensions of the curb do not allow snow to accumulate. When providing service access around the module for maintenance work, remove the snow from that area as required.

(6) Mount a snow-proof hood to prevent snow accumulating (falling) on the heat pump intake side or discharge opening.

When fixing a snow-proof net to the heat pump discharge side, we recommend mounting a snowfall sensor (procured locally) and forcefully operating a fan. Input and connect the snowfall sensor to the module controller to enable forced operation of the fan when snow is falling.

(7) In regions where the wind is strong during the winter season, especially regions near the coast, provide a wind-proof hood or, taking into account the wind direction, ensure that seasonal wind does not blow against the intake side. If the heat pump is directly exposed to wind during the winter season, mount a separate window baffle (strong wind screen) on the air-side coil surface and control box surface. (Procured locally)

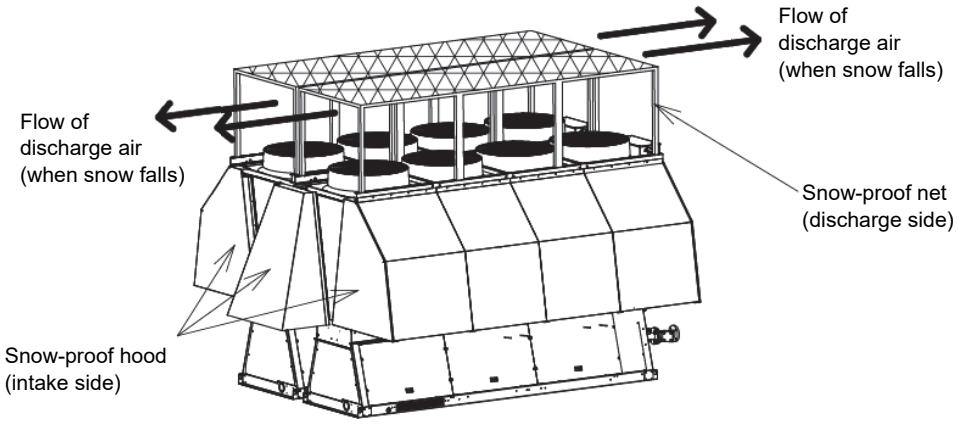
(8) Install the heat pump indoors if you expect an amount of snowfall that cannot be protected by the above methods (when there is strong wind or a different wind direction). In such a case, there may be outside ventilation, so install the heat pump inside a structure that prevents the short cycle of intake air and discharge air.

[Cautions concerning mounting a snow-proof hood and net]

To prevent snow accumulating in the heat pump intake side and discharge opening, mount the optional "Flange kit for mounting hood/net (for both intake /discharge sides)" and the discharge-side net (for snowproofing) and return-side hood (for snowproofing and windproofing). If the customer has already prepared a snow-proof hood/net, ensure that their shapes allow sufficient ventilation of intake and discharge air. An outline of the shape is shown below. If this is the shape, discharge air will mainly flow to the power supply box-side and water piping-side when snow accumulates. Ensure the structure of the snow-proof hood/net has been designed to withstand the weight of the fallen snow or strong winds normally found at the installation location.

Also, the snow hood and net need a structure to access to fans, motors and other parts.

Snow-proof hood reference diagram



Pay attention to the below points when fixing a snow-proof net

(1) Ensure that the total weight of the flange kit (20kg) option, snow-proof net and fallen snow do not exceed 400kg. Note that any load greater than this presents the risk of damaging the product. Also ensure that the weight does not exceed 400kg after removing fallen snow as required.

(2) To secure the required air quantity of the heat pump, prevent excessive resistance caused by the snow-proof net when snow accumulates.

(3) Orient the heat pump in a direction where seasonal wind will not blow against the snow-proof net opening when snow accumulates.

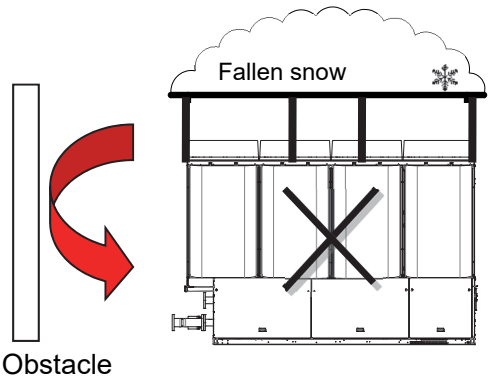
(4) Take care when there is an obstacle or when installed in at least two rows because a discharge air short circuit may occur.

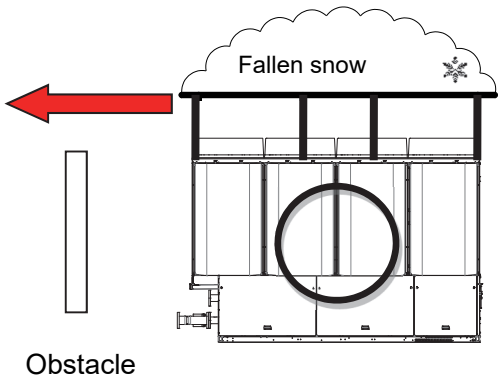
・ When there is an obstacle

When discharge air blows against the obstacle

= = ⇒

Assuming that the obstacle is the same height or lower than the product, ensure that it is not affected by discharge air blowing against it.

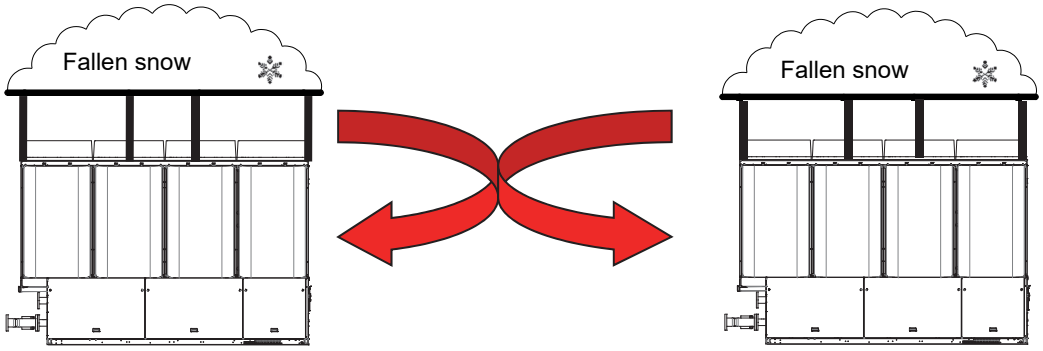




・ When installing two or more rows of modules

When installing two or more rows of modules, provide sufficient space because it may be affected by the discharge air from an own module as shown in the below diagram.

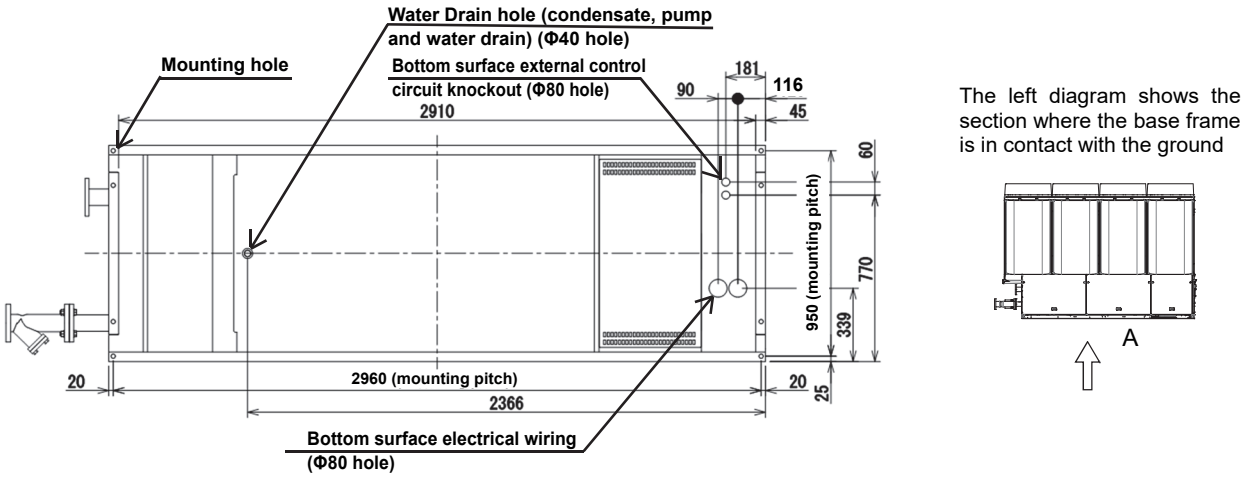
When affected by discharge air from an own module



2. Installation method/foundation

(1) The heat pump has two base frames in the short direction and two in the long direction. When installing the heat pump, secure it using the four Φ20 installation holes in the base frame.

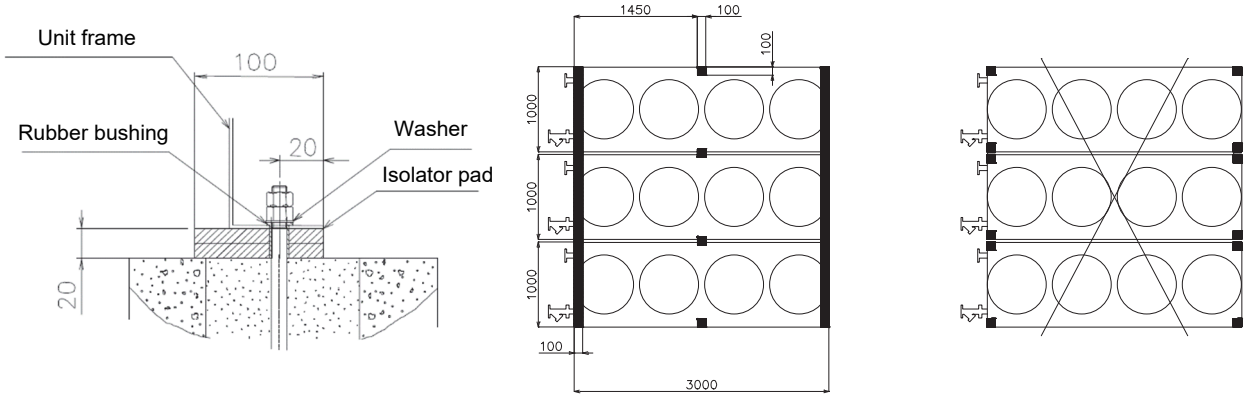
Structural diagram of base frame



View A

(2) If the anti-vibration stand is not utilised, insert a 20mm-thick isolator pad in the bottom of the heat pump and secure it with anchor bolts. Ensure that the isolator pad has a width of at least 100mm so that it can be laid over the entire base frame in the short direction of the heat pump. Do not use the four corners supported by four separate concrete foundations. (See below)

Anchor bolt and isolator pad

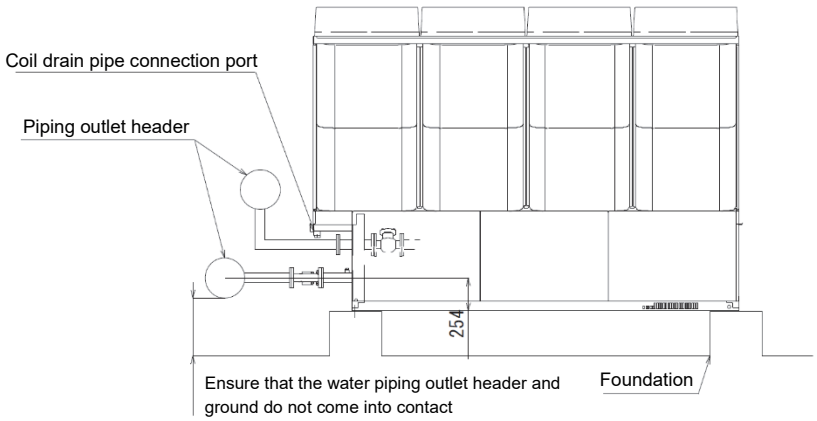


(3) When it is necessary to consider the centre of gravity position of the heat pump at installation, see "Centre of gravity / weight distribution".

(4) Water piping installation work

- Determine a foundation height that takes into account the size of the water piping outlet header including the insulating material. If the foundation is not high enough, the water piping outlet header may interfere with the ground.
- Piping that is separate from the water piping is needed to drain the coil drain water.

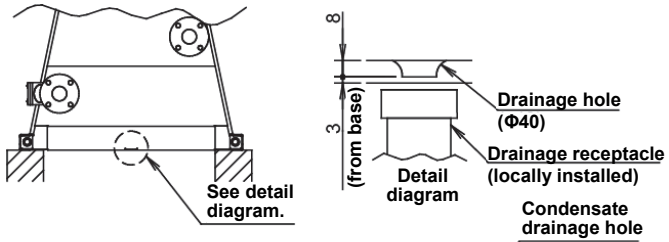
  Also, the drain water may freeze in cold regions, so take freeze-up protection measures such as using a heater in the coil drain piping. When mounting a heater, take care with the piping material (heat resistance).



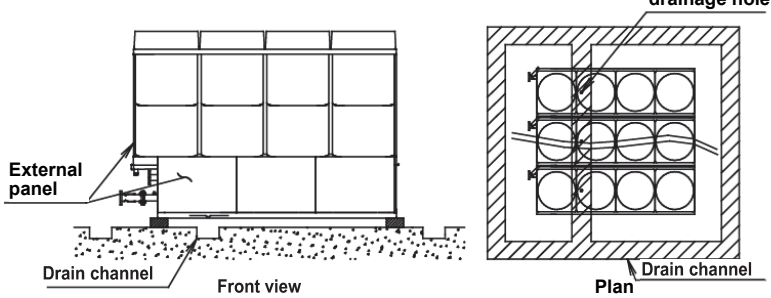
(5) Rainwater, internal condensate, pump drain, and water is drained from the drainage hole to the lower end surface of the heat pump. However, when cooling or heating in a high temperature or high humidity environment around the heat pump, condensation may occur on the covering panel or under the condensate drain pan, so waterproof the base surface and provide a sink or drainage hole around the heat pump so that drained water does not accumulate on the base surface. See the below installation example diagram when installing a drain receptacle or sink in the drainage hole.

Example of installing a drain receptacle

Example of installing a drain receptacle for a clog foundation



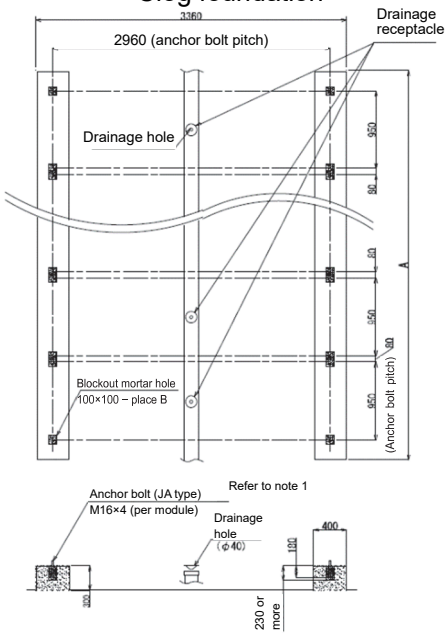
Example of installing a drain receptacle for a mat foundation



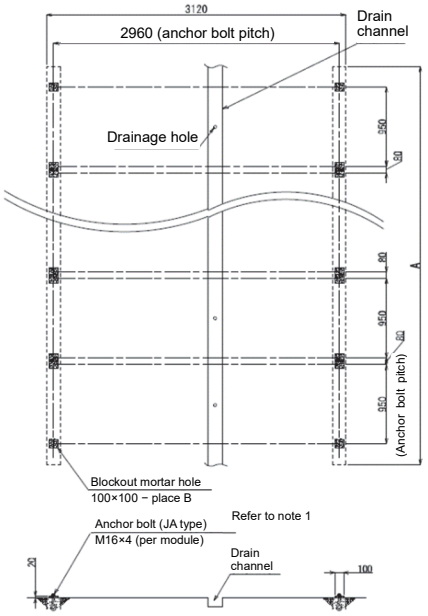
(6) Prepare a dedicated concrete foundation or similar, and install the heat pump on the level. Refer to the below diagram (example of installation foundation) and previously-mentioned "Structural diagram of base frame" when determining the foundation and anchor bolt pitch.

Example of installation foundation

Clog foundation

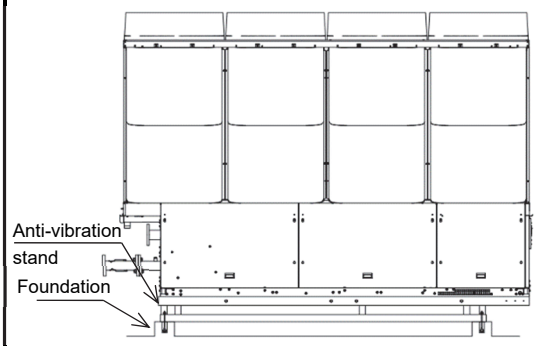
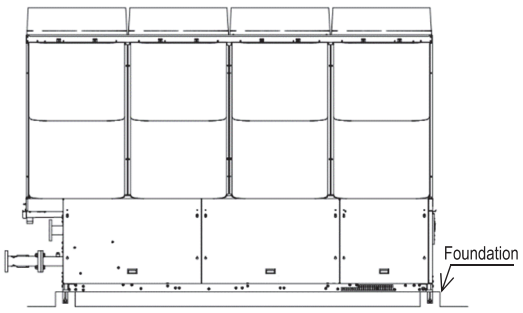


Mat foundation



Number of modules	1	2	3	4	5	6	7	8
A	1,350	2,380	3,410	4,440	5,470	6,500	7,530	8,560
B	4	8	12	16	20	24	28	32

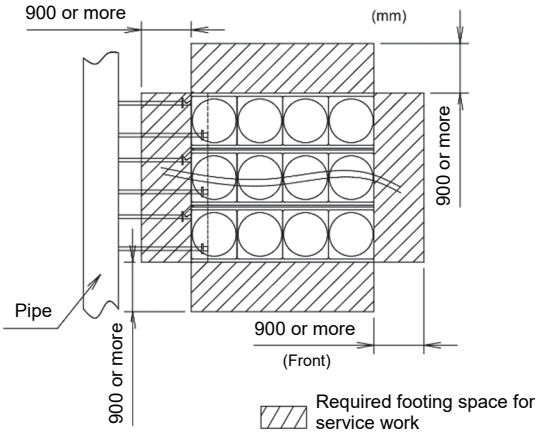
Number of modules	9	10	11	12	13	14	15	16
A	9,590	10,620	11,650	12,680	13,710	14,740	15,770	16,800
B	36	40	44	48	52	56	60	64

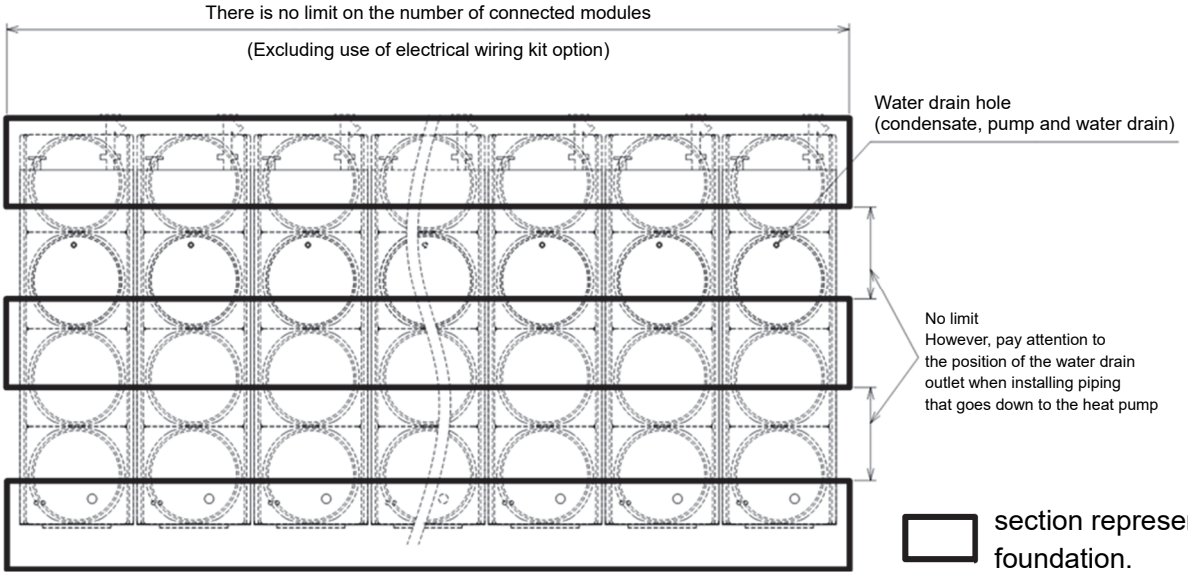
	When utilising an anti-vibration stand Note1)	When not utilising an anti-vibration stand Note2)
Image diagram		

Note1. Anchor bolt is shown when the horizontal seismic coefficient for design is 1.0G. For earthquake resistant specifications (design horizontal seismic coefficient of 1.5G), chemical anchors (M16) must be used.

Note2. Insert an isolator pad in the bottom of the heat pump base unit.

(7) When installing connected heat pumps on a clog foundation, a footing around the bottom of the heat pump will be required for service work.

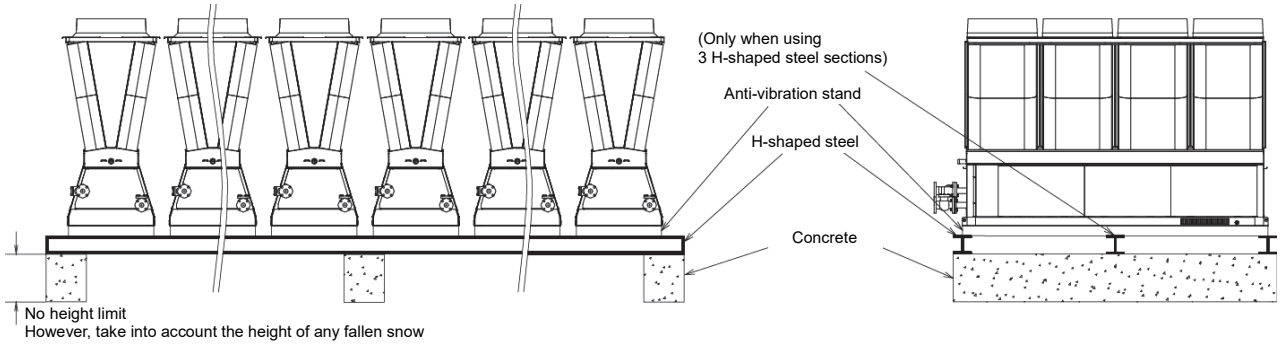




[Example of applying the installation foundation]

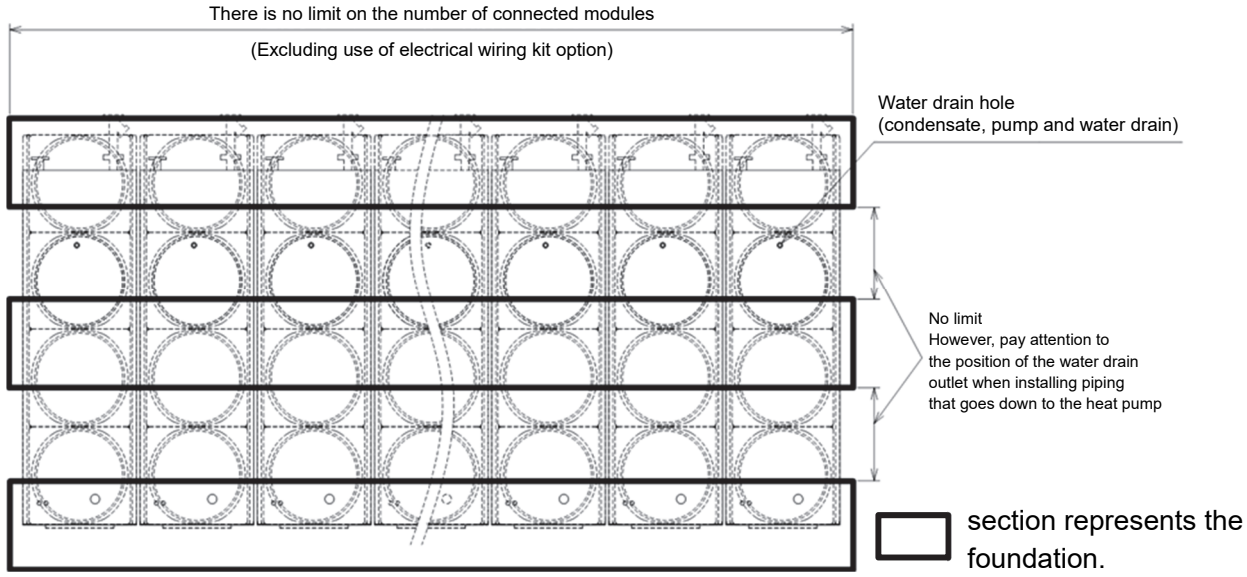
Foundation example 1 (Combining a concrete foundation and H-shape steel)

Regarding the number of concrete foundations and the size of H-shape steel, the deflection will be an inclination of up to 1/2000, and the strength must be sufficient to withstand the product operating weight.



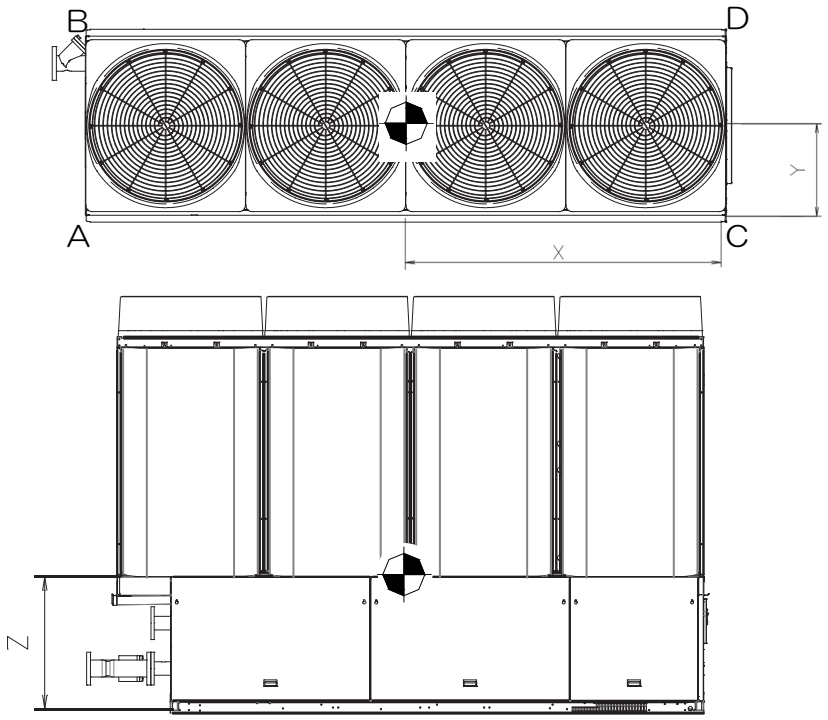
Foundation example 2 (3-piece concrete foundation in the short direction of the heat pump)

Depending on the strength of the anti-vibration stand, a 3-piece foundation such as that shown in the below diagram will be required (check with the anti-vibration stand manufacturer).



Installing it so that isolator pads laid only at the four corners near the installation holes or the four corners supported by four separate concrete foundations may cause the base frame of the heat pump to deform, so be sure to avoid such methods.

3. Centre of gravity / weight distribution



: Centre of gravity

3-1. 50HP

Heat pump standard type

Model number	pump size	Shipping weight	Operating weight	Centre of gravity G (mm)			Load distribution (kg)			
		(kg)	(kg)	X	Y	Z	A	B	C	D
RUAGP421HL*	less	1290	1326	1549	484	671	310	322	340	354
RUAGP421H1*	1.5kW	1348	1384	1587	480	657	317	325	367	375
RUAGP421H2*	2.2kW	1351	1387	1589	480	657	318	325	368	376
RUAGP421H3*	3.7kW	1368	1404	1602	480	652	319	325	376	384
RUAGP421H5*	5.5kW	1389	1425	1617	479	647	320	326	386	393
RUAGP421H7*	7.5kW	1422	1458	1641	478	639	323	327	401	407

Heat pump high EER type

Model number	pump size	Shipping weight	Operating weight	Centre of gravity G (mm)			Load distribution (kg)			
		(kg)	(kg)	X	Y	Z	A	B	C	D
RUAGP421HLN*	less	1302	1338	1560	484	685	311	322	346	359
RUAGP421H1N*	1.5kW	1360	1396	1597	480	670	318	325	373	380
RUAGP421H2N*	2.2kW	1363	1399	1599	480	669	318	325	374	382
RUAGP421H3N*	3.7kW	1380	1416	1612	479	665	320	325	382	389
RUAGP421H5N*	5.5kW	1401	1437	1627	479	660	321	326	392	398
RUAGP421H7N*	7.5kW	1434	1470	1650	478	652	323	327	407	413

Cooling only standard type

Model number	pump size	Shipping weight	Operating weight	Centre of gravity G (mm)			Load distribution (kg)			
		(kg)	(kg)	X	Y	Z	A	B	C	D
RUAGP421CL*	less	1251	1287	1545	479	682	305	310	333	339
RUAGP421C1*	1.5kW	1309	1345	1584	475	667	312	313	360	360
RUAGP421C2*	2.2kW	1312	1348	1586	475	666	313	313	361	361
RUAGP421C3*	3.7kW	1330	1366	1599	475	662	314	314	369	369
RUAGP421C5*	5.5kW	1351	1387	1615	474	656	315	315	379	378
RUAGP421C7*	7.5kW	1384	1420	1640	474	648	318	316	394	392

Cooling only high EER type

Model number	pump size	Shipping weight	Operating weight	Centre of gravity G (mm)			Load distribution (kg)			
		(kg)	(kg)	X	Y	Z	A	B	C	D
RUAGP421CLN*	less	1264	1300	1556	479	695	306	311	339	344
RUAGP421C1N*	1.5kW	1322	1358	1594	475	680	313	313	366	366
RUAGP421C2N*	2.2kW	1324	1360	1596	475	679	313	313	367	367
RUAGP421C3N*	3.7kW	1342	1378	1609	474	674	315	314	375	374
RUAGP421C5N*	5.5kW	1363	1399	1625	474	669	316	315	385	383
RUAGP421C7N*	7.5kW	1396	1432	1649	473	660	318	316	400	398

3-2. 50HP (Powerful Heating Type)

Heat pump standard type

Model number	pump size	Shipping weight (kg)	Operating weight (kg)	Centre of gravity G (mm)			Load distribution (kg)			
				X	Y	Z	A	B	C	D
RUAGP421FL*	less	1302	1338	1550	484	666	313	324	344	357
RUAGP421F1*	1.5kW	1359	1395	1587	480	652	320	327	370	378
RUAGP421F2*	2.2kW	1361	1397	1589	480	651	320	327	371	379
RUAGP421F3*	3.7kW	1378	1414	1602	480	647	321	328	379	386
RUAGP421F5*	5.5kW	1400	1436	1617	479	642	323	328	389	396
RUAGP421F7*	7.5kW	1433	1469	1641	478	635	325	330	404	410

Heat pump high EER type

Model number	pump size	Shipping weight (kg)	Operating weight (kg)	Centre of gravity G (mm)			Load distribution (kg)			
				X	Y	Z	A	B	C	D
RUAGP421FLN*	less	1314	1350	1561	483	679	313	325	350	362
RUAGP421F1N*	1.5kW	1371	1407	1597	480	665	321	327	376	383
RUAGP421F2N*	2.2kW	1374	1410	1599	480	664	321	327	377	385
RUAGP421F3N*	3.7kW	1391	1427	1612	479	660	322	328	385	392
RUAGP421F5N*	5.5kW	1413	1449	1627	479	655	324	329	395	401
RUAGP421F7N*	7.5kW	1446	1482	1650	478	647	326	330	411	415

3-3. 60HP

Heat pump standard type

Model number	pump size	Shipping weight (kg)	Operating weight (kg)	Centre of gravity G (mm)			Load distribution (kg)			
				X	Y	Z	A	B	C	D
RUAGP511HL*	less	1290	1326	1549	484	671	310	322	340	354
RUAGP511H1*	1.5kW	1348	1384	1587	480	657	317	325	367	375
RUAGP511H2*	2.2kW	1351	1387	1589	480	657	318	325	368	376
RUAGP511H3*	3.7kW	1368	1404	1602	480	652	319	325	376	384
RUAGP511H5*	5.5kW	1389	1425	1617	479	647	320	326	386	393
RUAGP511H7*	7.5kW	1422	1458	1641	478	639	323	327	401	407

Heat pump high EER type

Model number	pump size	Shipping weight (kg)	Operating weight (kg)	Centre of gravity G (mm)			Load distribution (kg)			
				X	Y	Z	A	B	C	D
RUAGP511HLN*	less	1302	1338	1560	484	685	311	322	346	359
RUAGP511H1N*	1.5kW	1360	1396	1597	480	670	318	325	373	380
RUAGP511H2N*	2.2kW	1363	1399	1599	480	669	318	325	374	382
RUAGP511H3N*	3.7kW	1380	1416	1612	479	665	320	325	382	389
RUAGP511H5N*	5.5kW	1401	1437	1627	479	660	321	326	392	398
RUAGP511H7N*	7.5kW	1434	1470	1650	478	652	323	327	407	413

Cooling only standard type

Model number	pump size	Shipping weight (kg)	Operating weight (kg)	Centre of gravity G (mm)			Load distribution (kg)			
				X	Y	Z	A	B	C	D
RUAGP511CL*	less	1251	1287	1545	479	682	305	310	333	339
RUAGP511C1*	1.5kW	1309	1345	1584	475	667	312	313	360	360
RUAGP511C2*	2.2kW	1312	1348	1586	475	666	313	313	361	361
RUAGP511C3*	3.7kW	1330	1366	1599	475	662	314	314	369	369
RUAGP511C5*	5.5kW	1351	1387	1615	474	656	315	315	379	378
RUAGP511C7*	7.5kW	1384	1420	1640	474	648	318	316	394	392

Cooling only high EER type

Model number	pump size	Shipping weight (kg)	Operating weight (kg)	Centre of gravity G (mm)			Load distribution (kg)			
				X	Y	Z	A	B	C	D
RUAGP511CLN*	less	1264	1300	1556	479	695	306	311	339	344
RUAGP511C1N*	1.5kW	1322	1358	1594	475	680	313	313	366	366
RUAGP511C2N*	2.2kW	1324	1360	1596	475	679	313	313	367	367
RUAGP511C3N*	3.7kW	1342	1378	1609	474	674	315	314	375	374
RUAGP511C5N*	5.5kW	1363	1399	1625	474	669	316	315	385	383
RUAGP511C7N*	7.5kW	1396	1432	1649	473	660	318	316	400	398

3-4. 60HP (Powerful Heating Type)

Heat pump standard type

Model number	pump size	Shipping weight (kg)	Operating weight (kg)	Centre of gravity G (mm)			Load distribution (kg)			
				X	Y	Z	A	B	C	D
RUAGP511FL*	less	1302	1338	1550	484	666	313	324	344	357
RUAGP511F1*	1.5kW	1359	1395	1587	480	652	320	327	370	378
RUAGP511F2*	2.2kW	1361	1397	1589	480	651	320	327	371	379
RUAGP511F3*	3.7kW	1378	1414	1602	480	647	321	328	379	386
RUAGP511F5*	5.5kW	1400	1436	1617	479	642	323	328	389	396
RUAGP511F7*	7.5kW	1433	1469	1641	478	635	325	330	404	410

Heat pump high EER type

Model number	pump size	Shipping weight (kg)	Operating weight (kg)	Centre of gravity G (mm)			Load distribution (kg)			
				X	Y	Z	A	B	C	D
RUAGP511FLN*	less	1314	1350	1561	483	679	313	325	350	362
RUAGP511F1N*	1.5kW	1371	1407	1597	480	665	321	327	376	383
RUAGP511F2N*	2.2kW	1374	1410	1599	480	664	321	327	377	385
RUAGP511F3N*	3.7kW	1391	1427	1612	479	660	322	328	385	392
RUAGP511F5N*	5.5kW	1413	1449	1627	479	655	324	329	395	401
RUAGP511F7N*	7.5kW	1446	1482	1650	478	647	326	330	411	415

3-5. 70HP

Heat pump standard type

Model number	pump size	Shipping weight (kg)	Operating weight (kg)	Centre of gravity G (mm)			Load distribution (kg)			
				X	Y	Z	A	B	C	D
RUAGP561HL*	less	1296	1332	1555	484.1	669.7	310	322	343	357
RUAGP561H2*	2.2kW	1357	1393	1593	480.1	655.1	318	325	371	379
RUAGP561H3*	3.7kW	1374	1410	1606	479.7	651	319	326	379	386
RUAGP561H5*	5.5kW	1394	1430	1621	479.2	645.9	321	326	388	395
RUAGP561H7*	7.5kW	1429	1465	1645	478.4	638.1	323	328	404	410

Heat pump high EER type

Model number	pump size	Shipping weight (kg)	Operating weight (kg)	Centre of gravity G (mm)			Load distribution (kg)			
				X	Y	Z	A	B	C	D
RUAGP561HLN*	less	1308	1344	1566	483.6	682.8	311	322	349	362
RUAGP561H2N*	2.2kW	1369	1405	1604	479.6	667.8	319	325	377	384
RUAGP561H3N*	3.7kW	1387	1423	1616	479.2	663.5	320	326	385	392
RUAGP561H5N*	5.5kW	1406	1442	1631	478.7	658.3	321	326	394	401
RUAGP561H7N*	7.5kW	1441	1477	1654	477.9	650.3	324	328	410	415

Cooling only standard type

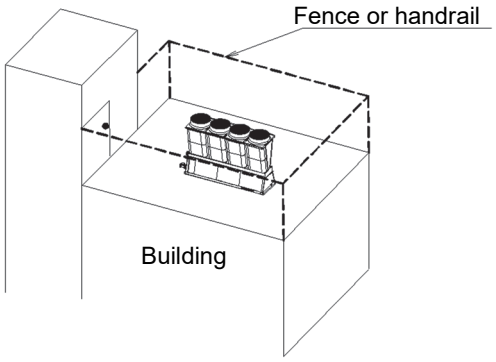
Model number	pump size	Shipping weight (kg)	Operating weight (kg)	Centre of gravity G (mm)			Load distribution (kg)			
				X	Y	Z	A	B	C	D
RUAGP561CL*	less	1258	1294	1551	479.1	679.9	305	311	336	342
RUAGP561C2*	2.2kW	1318	1354	1591	475.2	664.4	313	313	364	364
RUAGP561C3*	3.7kW	1335	1371	1604	474.8	660	314	314	372	371
RUAGP561C5*	5.5kW	1356	1392	1619	474.4	654.7	316	315	381	380
RUAGP561C7*	7.5kW	1390	1426	1644	473.6	646.5	318	316	397	395

Cooling only high EER type

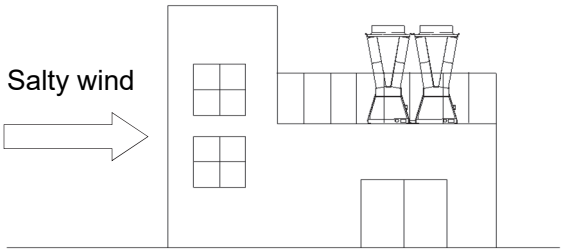
Model number	pump size	Shipping weight (kg)	Operating weight (kg)	Centre of gravity G (mm)			Load distribution (kg)			
				X	Y	Z	A	B	C	D
RUAGP561CLN*	less	1270	1306	1562	478.6	693.2	306	311	342	347
RUAGP561C2N*	2.2kW	1331	1367	1601	474.7	677.3	314	314	370	369
RUAGP561C3N*	3.7kW	1348	1384	1614	474.4	672.8	315	314	378	377
RUAGP561C5N*	5.5kW	1368	1404	1629	473.9	667.4	316	315	387	386
RUAGP561C7N*	7.5kW	1402	1438	1653	473.2	658.9	319	316	403	400

4. Other precautions

(1) Installing a handrail and fence
When installing the heat pump in the rooftop of a building, provide a handrail or fence, etc. around the heat pump taking into account the shipping method, initial start-up, daily maintenance safety and work aspects.
Also, when installing the heat pump on a foundation that is higher than the ground, provide secure footing that comes to the same height as the heat pump base.



(2) Aluminium fin protection
When salty wind from the coast, sulphur compounds such as hydrogen sulphide from spas, or atmosphere containing ammonia directly come into contact with the air-side coil surface; the air-side coil aluminium fins will be particularly damaged. Therefore, orient the heat pump so that the fins are facing a direction that will not sustain direct damage.
Also, when installing it in locations exposed to salt such as coastal areas, select salt resistant and heavy salt resistant specifications.
(See "Salt and heavy salt resistant specifications")



(3) Installation location check sheet

Use the checklist below, during the design stage of the installation, to ensure all of the items listed can be completed as detailed in the product literature and specifications.

Model:	RUAGP	Product weight	kg	Operating weight	kg

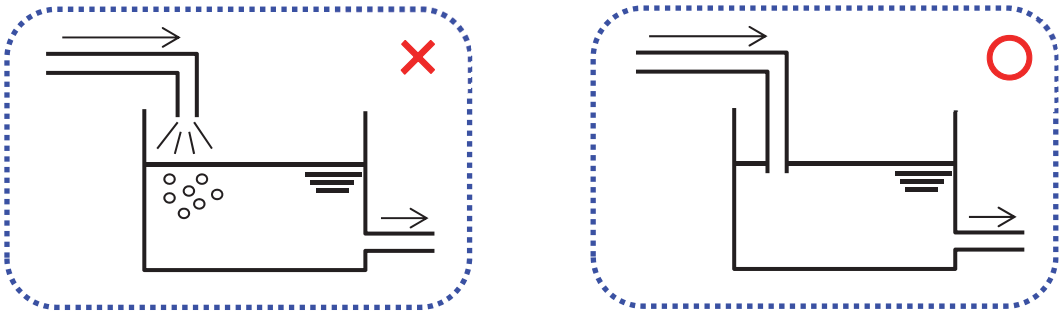
No.	Check item		Check sheet	Required action
1	Foundation	Install the heat pump in a place that can adequately support its operating weight.		
2		Ensure that the foundation quantity and shape can adequately support the heat pump's operating weight.		
3		Lay a foundation for the entire base channel in a short or long direction.		
4		Construct piping for the coil drain water drainage.		
5		Install it at a height so that there is a clearance between the water piping header and the ground.		Take into account the water piping outlet header and insulating material when selecting the foundation height.
6		Provide a drain or drainage receptacle.		
7		Take measures to prevent vibration reaching the floor and walls.		
8	Surrounding space	Secure a space around the heat pump for service work.		
9		Secure a space around the heat pump to allow intake of fresh air.		
10		Do not install it in a location where the operating noise may be a problem, such as a housing estate.		Take measures such as installing a sound barrier.
11		Prevent the short cycling of intake air and discharge air.		Take measures such as adjusting the height of the heat pump and its distance from obstacles.
12	Installation environment	Takes measures to safeguard against the accumulation of snow.		Refer to [When operating in a cold region].
13		Do not install it in a location exposed to sprays of liquids such as engine oil.		Beware of resin fan corrosion, etc.
14		Do not install it in a location exposed to salt such as coastal areas.		Select salt damage-proof and heavy salt damage specifications.
15		Do not install it in a location exposed to sulphide (gas) such as spas.		Beware of air coil and piping corrosion, etc.
16		Do not install it in locations where chimney smoke or exhaust gas is sucked into the heat pump.		
17		Do not install it in locations that are directly exposed to seasonal wind.		When installing the heat pump, orient it or use a window baffle (strong wind screen) to prevent the effect of wind.
18		Takes measures to safeguard against falling leaves.		
19		Do not install it in a place where water floods above the base.		Takes measures such as raising the height of the foundation.
20		Takes measures to safeguard against lightning striking the heat pump.		
21		Is the unit installed in a depression or indoors?		

Water Piping

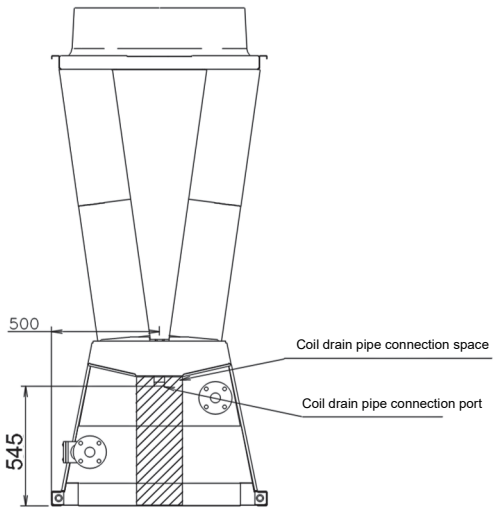
Determine the size of the water pipes when designing the water pipe layout. The chilled (warm) piping connection hole is on the back side of the heat pump as shown in "Outline diagram". Pay attention to the following points when carrying out chilled (warm) water piping work.

Water piping work is to be carried out in accordance with the laws and regulations of the installed location.

(1) Be sure not to mistake the chilled (warm) water inlet and outlet.
(2) Connect valves on the chilled (warm) water inlet and outlet piping.
(3) Install temperature gauges at the chilled (warm) water inlets and outlets. Mounting a pressure gauge on the chilled (warm) water inlet/outlet piping will give you a rough water flow.
(4) If the installation is a closed circuit an expansion vessel (locally supplied) must be installed in the water circuit.
(5) Construct the piping so that the flow rate (piping resistance) to each module is even. (Adjust reverse-return and header size)
(6) When using an open-end tank as a cushion tank or a heat storage tank, be sure to install tank return piping to prevent bubbles mixing in the water. (See below)
If installed wrongly, dissolved oxygen will increase in the water and contaminants in the atmosphere will condense in the water, creating a water quality that will accelerate the corrosion of the heat exchanger and piping.



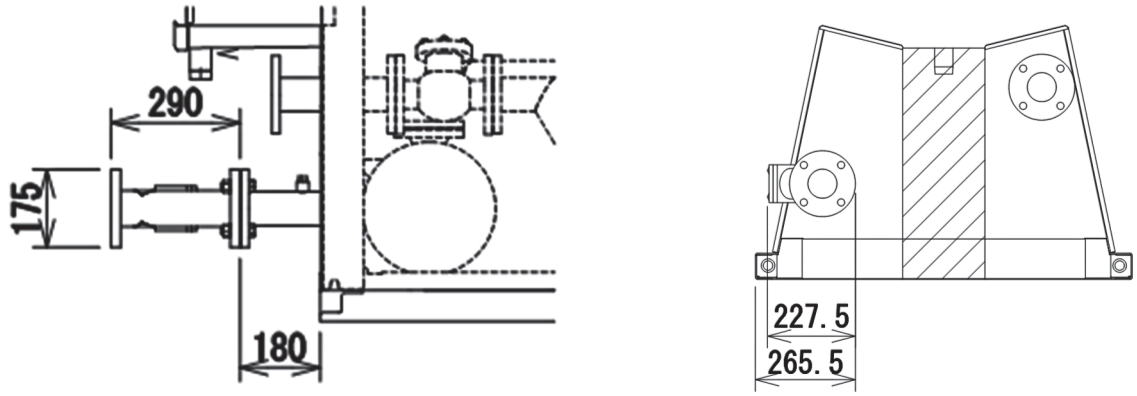
(7) Contact us to minimize the effect of lower feed water temperature by defrost operation.
(8) Carry out coil drain piping in addition to the chilled (warm) water piping system. Coil drain piping is PT40A a male thread. When connecting the coil drainage piping, ensure that the piping can fit in the coil drain piping connection space (see below diagram) to prevent the main piping and chilled (warm) water outlet piping interfering with each other.
Additionally, the drain water may freeze in cold regions, so take freeze-up protection measures such as using a heater in the coil drain piping. When mounting a heater, take care with the piping material.



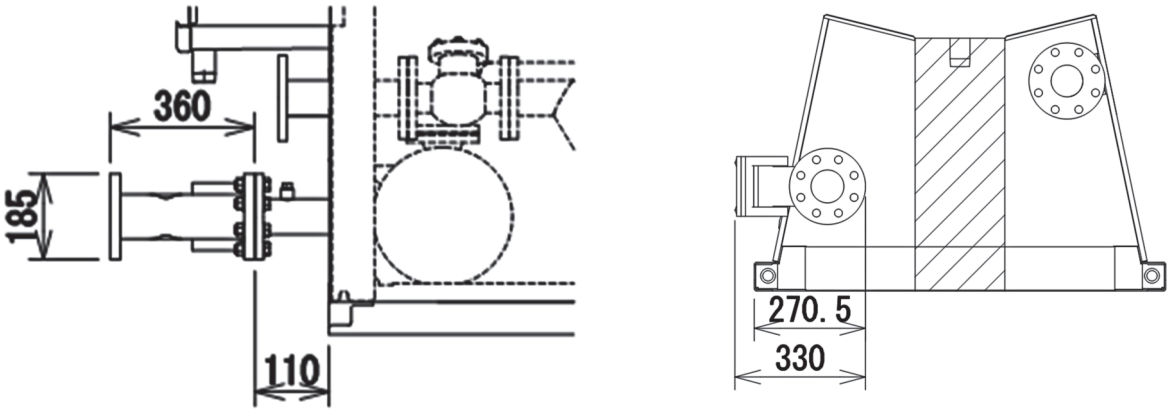
Note 1: This shows the minimum service space between the water piping header and modules.

(9) Be sure to insulate the chilled (warm) water piping. Also wrap insulating material around the strainer and piping exposed from the heat pump housing. (See below to refer to the strainer dimensions.)

50HP, 50HP (Powerful Heating Type), 60HP, 60HP (Powerful Heating Type)
base module (water piping connection: 2-1/2" INC)



70HP base module (water piping connection: 3 INC)



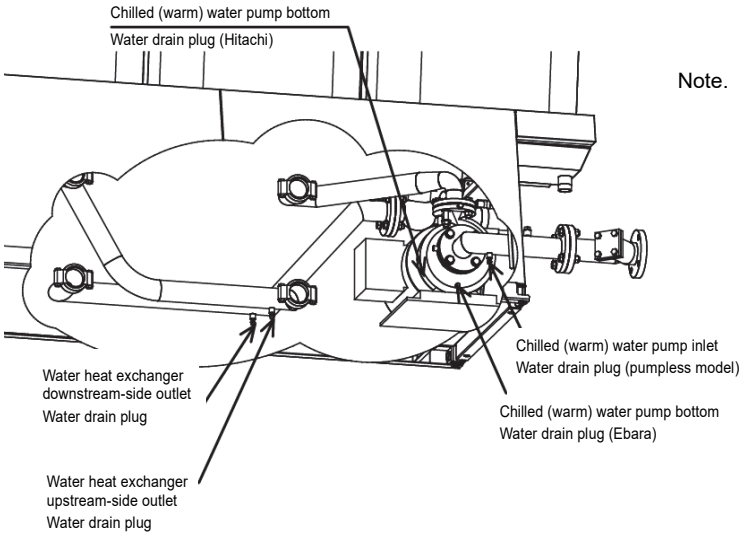
(10) A strainer is mounted on the chilled (warm) water piping inlet-side (lower side water piping) to prevent foreign matter such as dirt or sand entering the plate-style heat exchanger. When exchanging the strainer, be sure to utilise something with a 20 mesh/inch or higher.
(11) Secure the piping so that the weight of the piping is not applied to the heat pump.
(12) If there is a risk that the vibration of the facility-side piping pump may reach the heat pump via the piping, utilise a flexible joint near the chilled (warm) water piping pump. Take special care if the pump is close to the heat pump.
(13) Secure the minimum volume of holding water in the chilled (warm) water piping system to prevent a short cycle in the heat pump. For the holding water volume, calculate the minimum water volume for the piping flow passage, taking the bypass channel and other factors into consideration.
(14) Scale may build up in the plate heat exchanger, depending on the quality of the water, so it is necessary to periodically flush it with chemical cleansers to remove the scale. When using chemical cleansers, be careful not to damage USX. Therefore, provide a gate valve in the water piping.

(15) Provide an "air vent valve" and "drain valve" at the water piping inlet/outlets to clean and drain water (draining to stop for a long period in the winter or draining during the off-season) from the heat pump. Additionally, mount an "automatic air vent valve" when there is a rise section in the water piping or at the highest place where air tends to build up.
When the heat pump is in the highest position, provide an automatic air valve (with a check function) at the inlet piping of each module.

(16) Mount a cleanable strainer in an appropriate position separate from the piping section of the heat pump, such as near the pump inlet of the facility-side piping. Also, when exchanging the strainer, be sure to utilise something with a 20 mesh/inch or higher.

(17) Sufficiently insulate pipes for heat and cold and use moisture-proofing for outside sections. If the insulation for heat and cold is not sufficient, there will be heat loss and the risk of damage due to freezing during cold seasons.

(18) When stopping operation at winter or night-time, the water circuit will require natural freeze-up protection (e.g. draining water, operating a circulation pump, using a heater) in regions where the outdoor air temperature falls to 0°C or lower. Use measures appropriate to the conditions of use and installation location as freezing of the water circuit will damage the plate heat exchanger. Drain water from the 3 water draining plugs provided inside each module to prevent water remaining inside the heat pump.



Note. The left diagram shows the view from the bottom of a module.

(19) Set the water piping leak test pressure as 0.7MPa or less when the inverter pump is integrated or 0.98MPa or less when using the pumpless model. (Conduct a leak test with gas at a pressure of 1/3 or less of the above stated values).

(20) Ensure that the inlet-side collecting water piping is higher than the chilled (warm) water inlet piping of the heat pump (provide an air vent plug at a position higher than the heat pump's inlet piping to prevent air accumulating inside the heat pump). Ensure that the outlet-side collecting water piping is lower than the chilled (warm) water outlet piping of the heat pump (provide an air vent plug at a position lower than the heat pump's outlet piping to drain water). When doing so, ensure that the outlet-side collecting piping does not interfere with the ground.

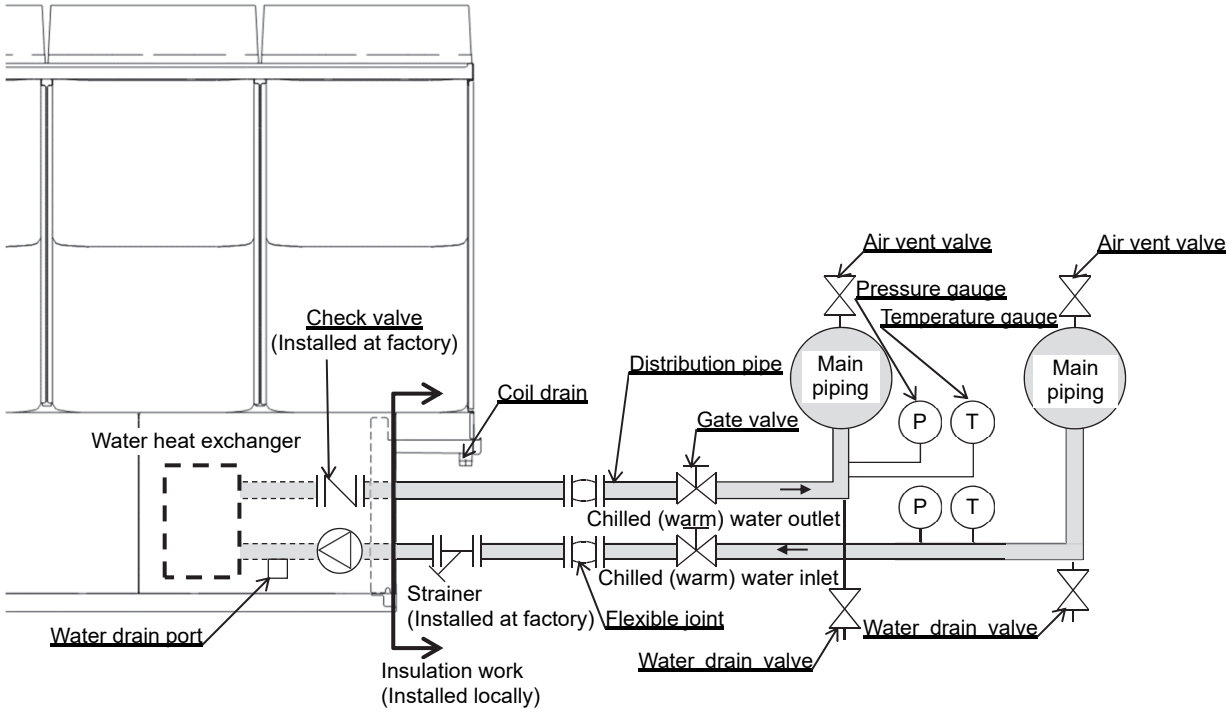
(21) When using SUS piping or lining piping, dissolved oxygen may cause the strainer, check valve, or pump to corrode. This can be changed to SUS by custom option.

(22) Use SUS piping for internal piping. Insulation can be performed by custom option.

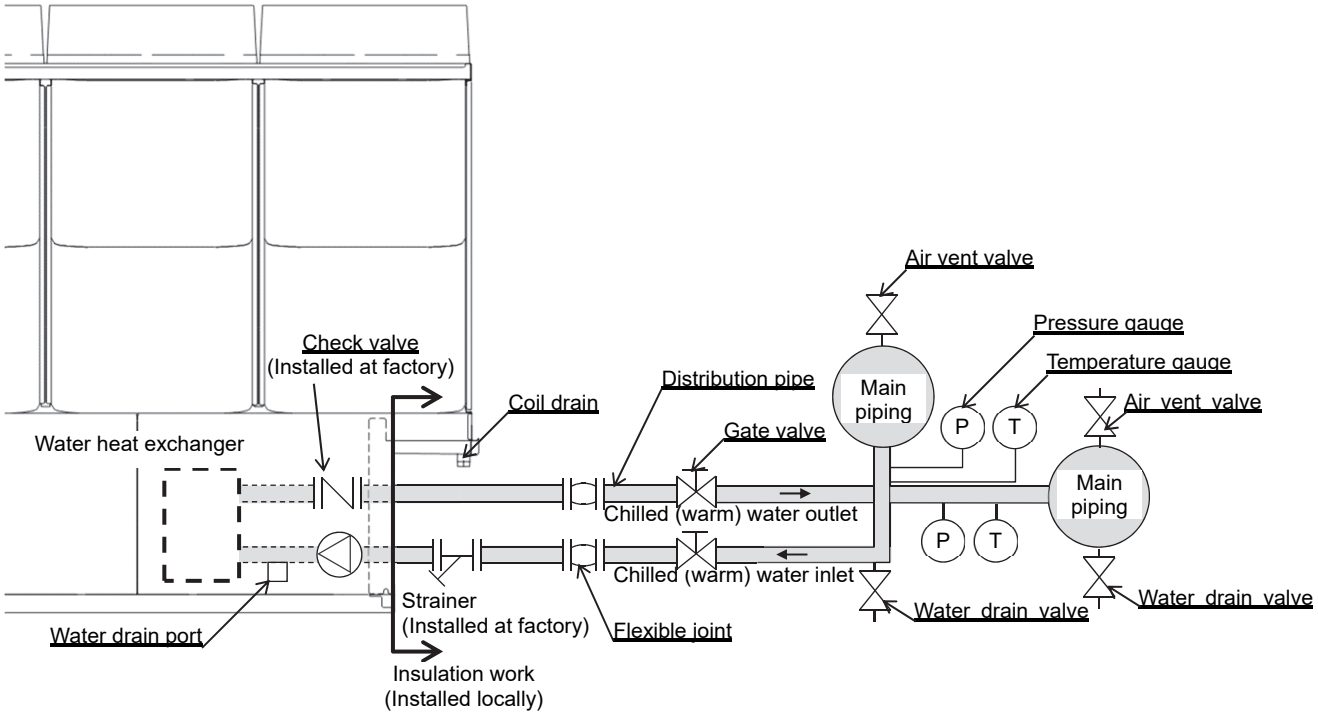
(23) For the chilled (warm) water inlet/outlet piping, use a flexible joint to absorb manufacturing dimensional tolerance that may occur.

1. Example of piping installation work

Installation work example (1): When arranging both the inlet-side and outlet-side main piping overhead (compatible with both the mat and clog foundations)
Note: Provide a water drain valve at the inlet and outlet piping of each module.

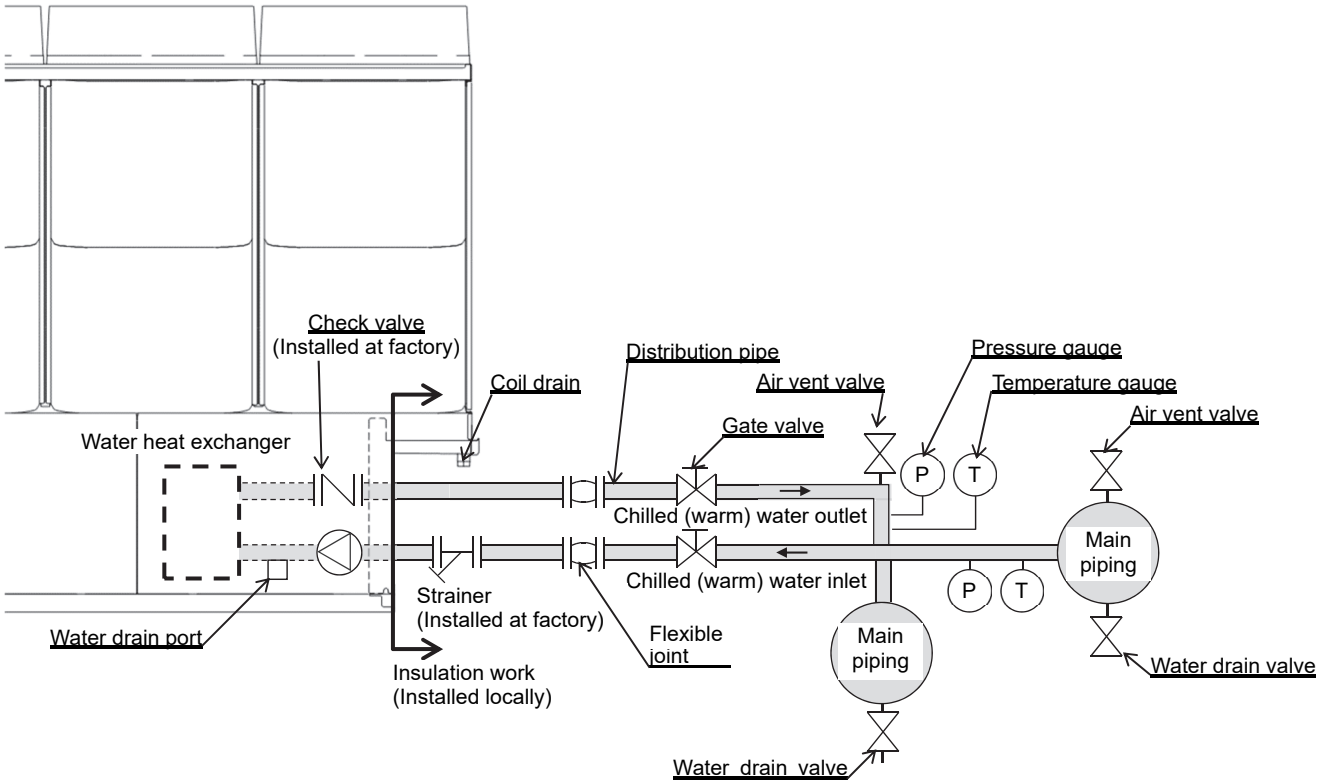


Installation work example (2): When arranging the inlet-side main piping overhead (compatible with both the mat and clog foundations)
Note: A mat foundation may interfere with the ground depending on the size of the outlet-side main piping. In such a case, install the outlet-side main piping overhead as shown by Installation work example (1).
Note: Provide a water drain valve at the inlet piping of each module.



Installation work example (3): When arranging the outlet-side main piping downward (compatible only with the clog foundation)

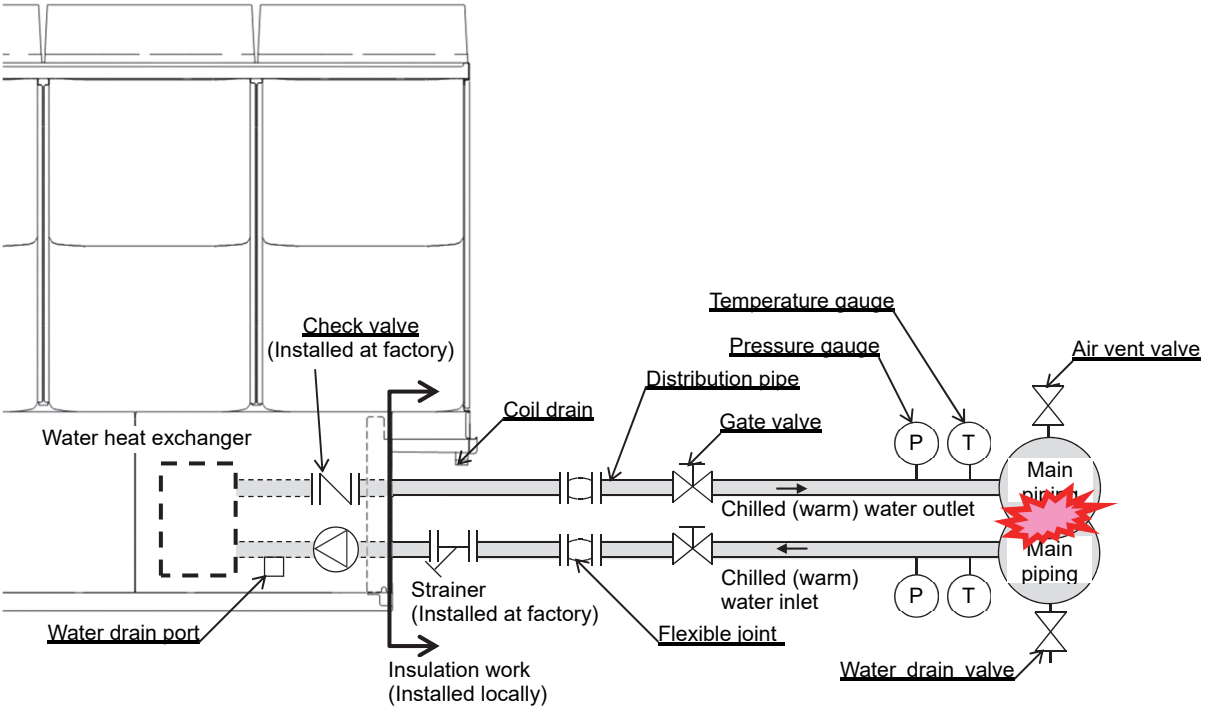
Note: Provide a water drain valve at the outlet piping of each module.



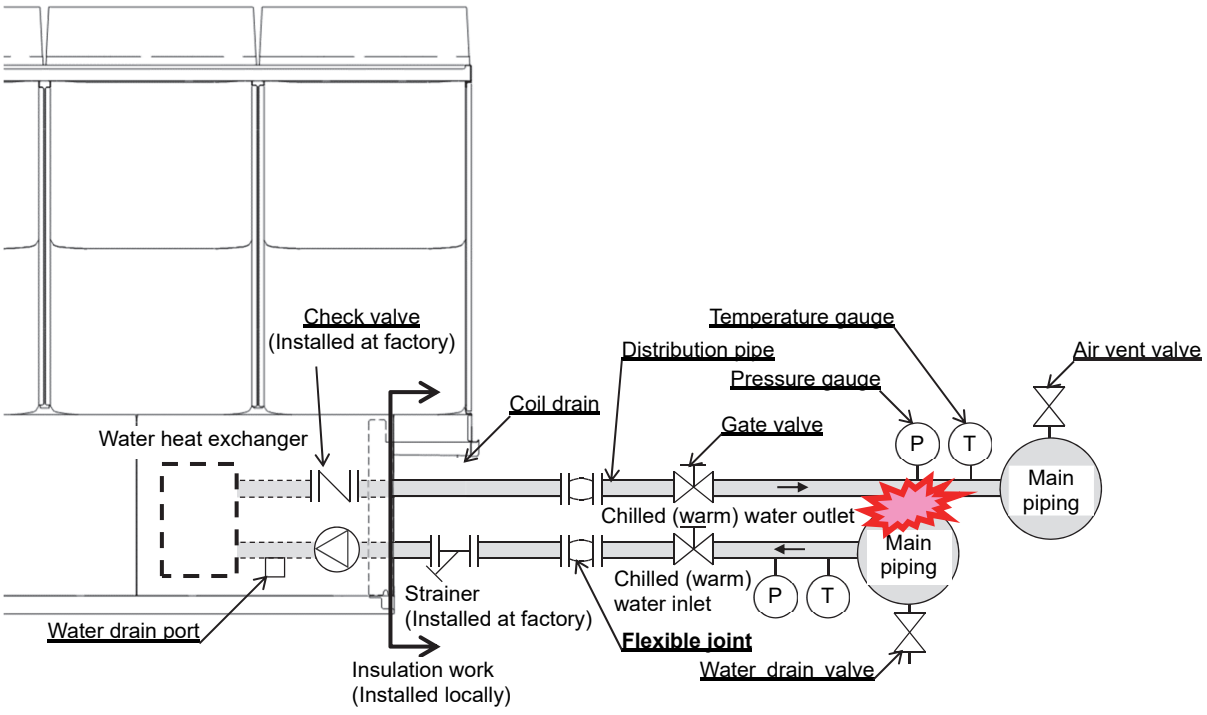
To prevent interference do not install the pipework as shown in the diagram below.

When designing the water pipework for the chiller system ensure the main water pipes are correctly sized and that the thickness of the pipe insulation has been considered so as to prevent interference / contact of the pipes when installed.
It is important that the diameter of the main water pipework is not smaller than the recommended pipe diameters shown on the next page.

Example 1: Case of interference between inlet/outlet-side main piping



Example 2: Case of interference between inlet-side or outlet-side main piping and distribution pipe
Note: In the case shown in the below diagram, the inlet-side distribution pipe is long and the outlet-side distribution pipe is short, but the same will apply even if the opposite is true.



2. Recommended main pipe size

The following recommendations take cost advantage into consideration.

50HP, 50HP (Powerful Heating Type)

Number of module	Nominal diameter of main piping						Bypass piping (Note)	
	Design temperature difference 5°C	Design temperature difference 6°C	Design temperature difference 7°C	Design temperature difference 8°C	Design temperature difference 9°C	Design temperature difference 10°C	Nominal diameter	Possible absorption flow rate[L/min]
1module	65A	65A	65A	65A	50A	50A	40A	150
2modules	100A	90A	80A	90A	80A	65A	65A	300
3modules	125A	125A	100A	125A	90A	90A	65A	450
4modules	150A	125A	125A	125A	100A	100A	80A	600
5modules	150A	150A	125A	150A	125A	125A	90A	750
6modules	200A	150A	150A	150A	125A	125A	100A	900
7modules	200A	200A	150A	200A	150A	125A	100A	1050
8modules	200A	200A	200A	200A	150A	150A	125A	1200
9modules	200A	200A	200A	200A	150A	150A	125A	1350
10modules	250A	200A	200A	200A	200A	150A	125A	1500
11modules	250A	200A	200A	200A	200A	200A	125A	1650
12modules	250A	250A	200A	250A	200A	200A	125A	1800
13modules	250A	250A	250A	250A	200A	200A	125A	1950
14modules	250A	250A	250A	250A	200A	200A	125A	2100
15modules	300A	250A	250A	250A	200A	200A	150A	2250
16modules	300A	250A	250A	250A	200A	200A	150A	2400

60HP, 60HP (Powerful Heating Type)

Number of module	Nominal diameter of main piping						Bypass piping (Note)	
	Design temperature difference 5°C	Design temperature difference 6°C	Design temperature difference 7°C	Design temperature difference 8°C	Design temperature difference 9°C	Design temperature difference 10°C	Nominal diameter	Possible absorption flow rate [L/min]
1module	80A	65A	65A	65A	65A	50A	40A	150
2modules	100A	100A	90A	90A	80A	80A	65A	300
3modules	125A	125A	125A	100A	100A	90A	65A	450
4modules	150A	150A	125A	125A	125A	100A	80A	600
5modules	200A	150A	150A	150A	125A	125A	90A	750
6modules	200A	200A	150A	150A	150A	125A	100A	900
7modules	200A	200A	200A	150A	150A	150A	100A	1050
8modules	250A	200A	200A	200A	200A	150A	125A	1200
9modules	250A	200A	200A	200A	200A	200A	125A	1350
10modules	250A	250A	200A	200A	200A	200A	125A	1500
11modules	250A	250A	250A	200A	200A	200A	125A	1650
12modules	300A	250A	250A	200A	200A	200A	125A	1800
13modules	300A	250A	250A	250A	200A	200A	125A	1950
14modules	300A	250A	250A	250A	250A	200A	125A	2100
15modules	300A	300A	250A	250A	250A	200A	150A	2250
16modules	300A	300A	250A	250A	250A	250A	150A	2400

70HP

Number of module	Nominal diameter of main piping						Bypass piping (Note)	
	Design temperature difference 5°C	Design temperature difference 6°C	Design temperature difference 7°C	Design temperature difference 8°C	Design temperature difference 9°C	Design temperature difference 10°C	Nominal diameter	Possible absorption flow rate[L/min]
1module	80A	80A	65A	65A	65A	65A	40A	150
2modules	125A	100A	100A	90A	90A	80A	65A	300
3modules	150A	125A	125A	125A	100A	100A	65A	450
4modules	200A	150A	150A	125A	125A	125A	80A	600
5modules	200A	200A	150A	150A	125A	125A	90A	750
6modules	200A	200A	200A	150A	150A	150A	100A	900
7modules	250A	200A	200A	200A	150A	150A	100A	1050
8modules	250A	200A	200A	200A	200A	200A	125A	1200
9modules	250A	250A	200A	200A	200A	200A	125A	1350
10modules	250A	250A	250A	200A	200A	200A	125A	1500
11modules	300A	250A	250A	200A	200A	200A	125A	1650
12modules	300A	250A	250A	250A	200A	200A	125A	1800
13modules	300A	300A	250A	250A	250A	200A	125A	1950
14modules	300A	300A	250A	250A	250A	250A	125A	2100
15modules	300A	300A	300A	250A	250A	250A	150A	2250
16modules	350A	300A	300A	250A	250A	250A	150A	2400

Note: Never install bypass pipes that are narrower than the pipes in the table. It would cause a loss of ability to control the chilled (warm) water temperature as well as possibly damaging the heat pump.
The bypass pipe diameters in the table indicate a size that has the capacity to absorb the flow of possible flow rates. This was determined in consideration of the possibility that all the integrated pumps could be operating during controlled operation to prevent freezing of the integrated pumps while the heat pump is idle. It may be necessary to enlarge the diameter of the bypass pipes if heat pump-side and load-side flow rates are expected to be inconsistent, such as during stoppage of load-side equipment, such as air handlers, while the heat pump is operating at high capacity.
If other heat pumps and water pipes share a common system, select a diameter for the bypass pipes that takes into account the bypass volume needed for the other heat pumps.

3. How to calculate in-system minimum holding water volume

The in-system minimum holding water volumes in the table of specifications are values for rated capacities and rated designed temperature differentials. If your designed capacity or designed temperature differential is different from the rated values, calculate your in-system minimum holding water volume with the following formulas. This minimum holding water volume is a volume to protect components, so to minimise water supply temperature fluctuations it will be necessary to secure sufficient holding water volume exceeding the minimum volume. Note that when estimating holding water volume, calculate the minimum water volume for the piping flow passage, taking the bypass channel and other factors into consideration.

For integrated pump specifications
In-system minimum holding water volume [L] = design capacity (rating capacity) [kW] ÷ (design temperature difference [°C] − 1) × 28.67

For pumpless specifications (utilise this method when controlling the constant flow at internal pump specifications)
In-system minimum holding water volume [L] = {design capacity (rating capacity) [kW] ÷ (design temperature difference [°C] − 1) × 28.67} × number of connected units

- Heat pump's water piping specifications are shown in the below table. Include the in-unit water volume shown in the following table when estimating the holding water volume.

50HP, 50HP (Powerful Heating Type)
60HP, 60HP (Powerful Heating Type)

Number of module	Internal water capacity [L]	Piping connection (flange)
1 module	36	65
2 modules	72	
3 modules	108	
4 modules	144	
5 modules	180	
6 modules	216	
7 modules	252	
8 modules	288	
9 modules	324	
10 modules	360	
11 modules	396	
12 modules	432	
13 modules	468	
14 modules	504	
15 modules	540	
16 modules	576	

70HP

Number of module	Internal water capacity [L]	Piping connection (flange)
1module	36	80
2modules	72	
3modules	108	
4modules	144	
5modules	180	
6modules	216	
7modules	252	
8modules	288	
9modules	324	
10modules	360	
11modules	396	
12modules	432	
13modules	468	
14modules	504	
15modules	540	
16modules	576	

- You can calculate the holding water volume in pipes (carbon steel pipes for piping: SGP) by referring to the following table.

Nominal diameter		Holding water volume per one meter length
20A	3/4 inch	0.4 L
25A	1 inch	0.6 L
32A	1-1/4 inch	1.0 L
40A	1-1/2 inch	1.4 L
50A	2 inch	2.2 L
65A	2-1/2 inch	3.6 L
80A	3 inch	5.1 L

Nominal diameter		Holding water volume per one meter length
90A	3-1/2 inch	6.8 L
100A	4 inch	8.7 L
125A	5 inch	13.4 L
150A	6 inch	19.8 L
200A	8 inch	34.4 L
250A	10 inch	53.1 L
300A	12 inch	76.3 L

System Examples

- When using a combination of several heat pumps or combining with other heat pump units, a meeting about piping and sensors must be held. Please contact your local importer, distributor and / or retailer.
- For modules with an integrated chilled (warm) water circulation pumps, adjustments including the whole water piping system, will be necessary during the test run.
  The adjustments will include the air conditioner auto control valves being forced OPENED / CLOSED.
- It detects the required water flow on the load-side, and automatically changes the number of integrated pumps for chilled (warm) water circulation and the operating frequency. When selecting internal pumps, see "Pump characteristics and internal resistance curve" and consider the max. flow rate and max. lifting height required by the system.
- Installation of the integrated pump's return side (boost pressure/pipe resistance) also requires attention. To prevent air mixing in from the mechanical seal area while the internal pump is idle, ensure that the internal pump's return side does not become negative pressure. Alternatively, ensure that the inlet-side main water piping is higher than the heat pump's chilled (warm) water inlet piping to prevent the mixed-in air accumulating inside the heat pump. Pay particular attention when providing an open-end cushion tank on the heat pump's inlet side.
- We recommend making the load side a variable flow system by using a two way valve to improve energy saving abilities.
- If the heat pump is the highest point in the system, install an automatic air vent valve (with a check valve function) at the outlet pipe for each module.
- To ensure stability of the water temperature the water pipe work should be designed so that the minimum holding water volume is available between the module and the bypass circuit.
  The water volume shown in the specifications table is required to operate a module for three minutes (minimum compressor run time). This value is the minimum holding water volume to protect components and to minimise outlet water water temperature fluctuations.
  It is important that the water circuit between the module and the bypass circuit is designed to hold at least the minimum holding water volume shown in the specifications table.
- A pressure differential valve or flow meter may be necessary depending on the system. Prepare the power source for the pressure differential valve and flow meter separately from the base unit, and power them separately from this product. Power cannot be taken from the base unit. When wiring the pressure differential valve and flow meter, follow the instructions of the respective manufacturer.
- Systems with high energy-saving abilities and high use frequency are listed as system examples. We also handle systems not included in these examples, so please contact us.
- The customer must prepare the power supply for the flow meter, etc.
- When using an open type expansion tank, install it at a position higher than the piping connection considering the piping pressure loss from the chiller base unit.

List of system examples

Piping system	Flow control	No. of MC units	Energy-saving ability
Single pump system	Variable flow	One unit	excellent
		Multiple (with GC)	excellent
		Multiple (without GC)	excellent
		One unit (combined with other heat pumps / without GC)	better
		One unit (combined with other heat pumps / with GC (RBP-GC001U))	better
	Constant flow	One unit	good
Duplex pump system	Variable flow	One unit	excellent
		Multiple (with GC)	excellent
		Multiple (without GC)	excellent
		One unit (combined with other heat pumps / without GC)	better
		One unit (combined with other heat pumps / with GC (RBP-GC001U))	better
	Constant flow	One unit	good
Indirect heat exchange system	Constant flow	One unit	–
Heat storage by water	Constant flow	One unit	–
Chilled/warm water simultaneous use (single system)	Variable flow	Multiple (with GC)	excellent

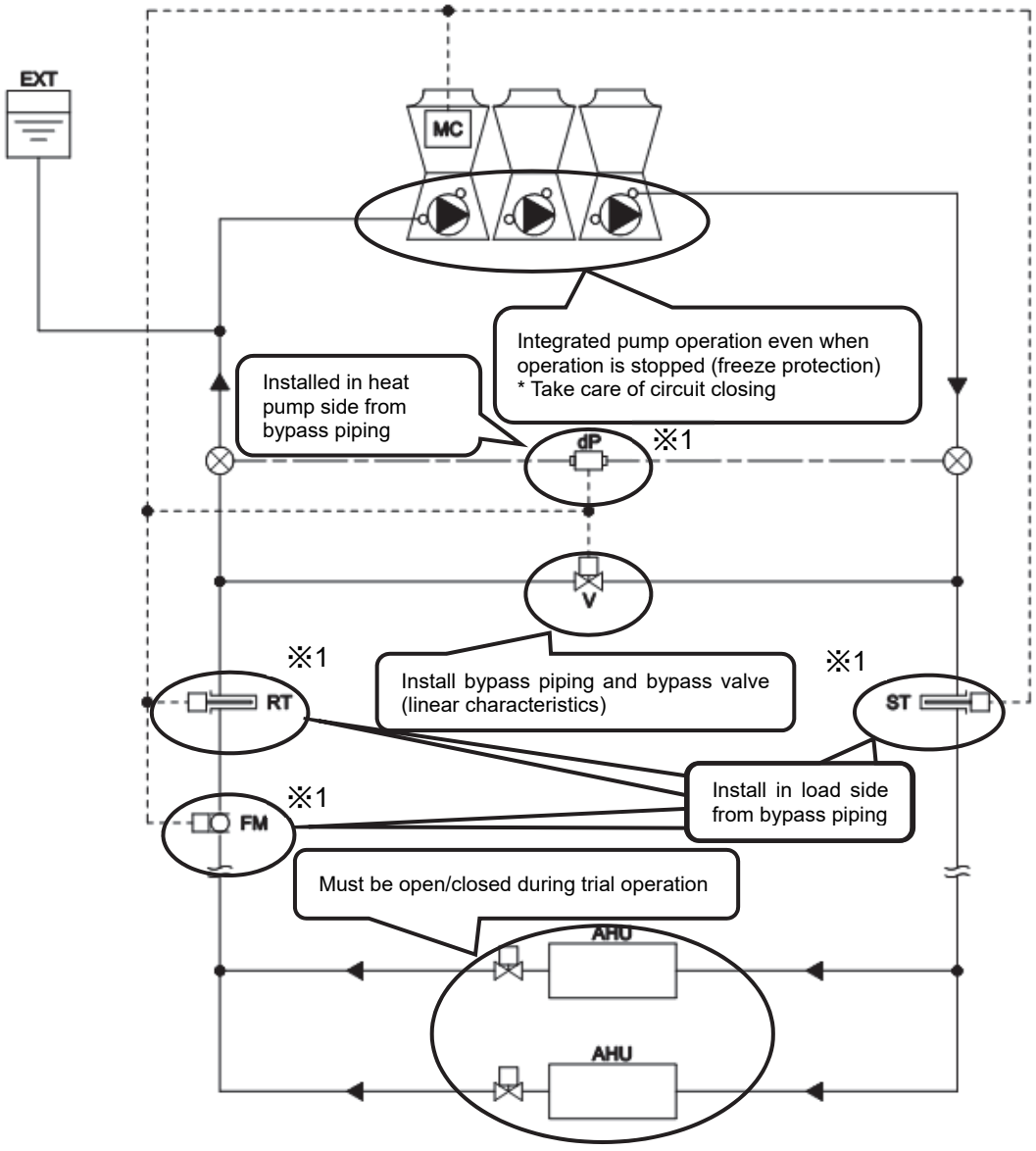
1. Single pump system

1. Install a bypass circuit (bypass pipe and valve (locally supplied)) to reduce any potential imbalance between the required load side water flow rate and the heat pump water flow rate. The bypass valve (V) can be achieved by connecting a differential pressure (dP) sensor (installed between the primary inlet and outlet water pipes) and a flow meter (installed on the load side of the water pipe work) to the module controller (MC). Select a bypass valve with linear characteristics for this application.
2. Even while the operation is stopped, freeze protection control may automatically let the internal pump to operate for chilled (warm) water circulation. To secure a flow channel, bypass valve may be forced to open. In this case, there could be no water flowing to load side. If water flow is needed in load side, please set up to not open the bypass valve automatically or set the 2 way valve on load side to open during freeze protection operation. Bypass valve is controlled by the module controller (MC) while operation is stopped.
3. Module with a running pump will control number of compressors and operating frequency to make leaving water temperature approach setting temperature.
4. All automatic control valves installed on load side equipment (air conditioners etc.) must be forced OPENED / CLOSED during the test run to ensure the bypass valve control is set accurately.

Note: Install the differential pressure sensor (dP) closer to the heat pump side bypass branching and merging parts than the bypass pipe.

Note: Install the flow meter (FM), supply water temperature sensor (ST) and the return water temperature sensor (RT) in the load side main pipe work (secondary circuit). Do not install these devices in the primary circuit between the heat pump and the bypass circuit as this will result in unstable temperature control for the outlet water.

※1 Although you can perform variable flow rate control even without differential pressure sensor, you need to connect the supply and return thermistor sensors to perform tasks such as measuring the amount of heat on the load side.



[Single pump system example]

1-1. Variable flow system

1. Connect the output of the flow meter (FM), if installed in the system, to the module controller (MC). This enables the water flow control to directly sense the required load side water flow rate. The flow meter must be locally supplied.
2. The values of the leaving and entering thermistor sensors in the heat pump and the values of the supply and return thermistor sensors for water temperature (ST and RT), are used for internal pump control within the system. The values of the thermistors are compared to find a temperature balance in the system and to control the number of chilled (warm) water circulation inverter pumps, and their operating frequency so that the primary water flow from the heat pump approaches the estimated load-side water flow. The thermistor sensors must be installed in the load-side supply water and return water pipes and connected to the module controller (MC).

Note: Depends on the thermistor sensors, there could be delays or errors when detecting water temperature. If the bypass pipe is too narrow or the load fluctuates quickly, fault may occur such as low flow rate failure due to pump stalling.

List of control devices

Control device	MC connection	Range (initial value)	Setting range
FM: Flow meter (load side) (Note 4)	4 to 20[mA] input (Note 2)	0 to 1000 [L/min]	0 to 65535 [L/min]
ST: Supply water temperature (load side)	Attached thermistor sensor for water temperature (Note 3) or 4 to 20[mA] input (Note 2)	0 to 70[°C] (At 4 to 20 [mA])	-50 to 100[°C]
RT: Return water temperature (load side)			
V：Bypass valve (Note 5)	4 to 20[mA] output	0 to 100[%]	—
dP: Differential pressure sensor	4 to 20[mA] input (Note 2)	0 to 500[kPa]	0 to 1000[kPa]

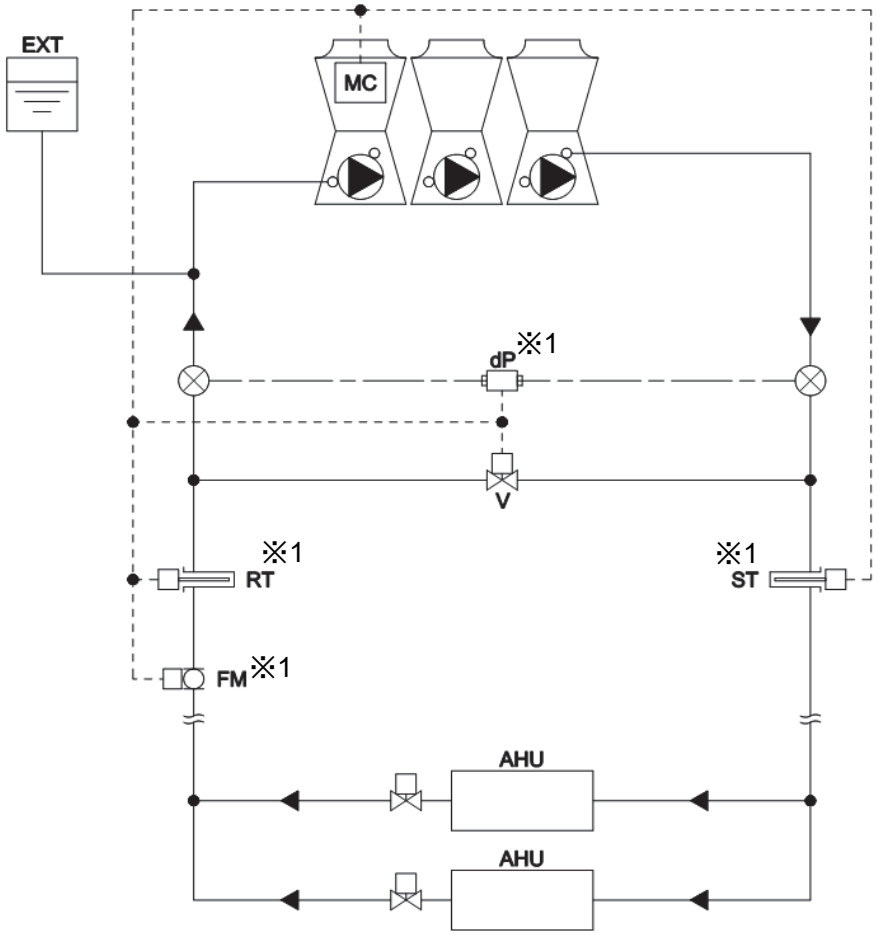
Note 1: Although you can perform variable flow rate control even without differential pressure sensor, you need to connect the supply and return thermistor sensors, Bypass valve and Differential pressure sensor to perform tasks such as measuring the amount of heat on the load side.

Note 2: MC can be set within the range of DC 1 - 5 [V].

Note 3: A set of ST, RT sensor is provided by factory with one MC for inbuilt pump module and 30m wire length (cannot be extended). When not using these provided sensors, a converter is needed (cannot be installed in heat source).

Note 4: A flow meter is needed when directly sensing the load side flow rate (instantaneous measurement).

Note 5: Bypass valve must have linear characteristics and be the same size with bypass pipe.



[Single pump system example]

1-2. Variable flow, multiple group system (with GC)

1. Connect the output of the flow meter (FM), if installed in the system, to the module controller (MC). This enables the water flow control to directly sense the required load side water flow rate. Flow rate ratio instructions and heat pump operation stop control is automatically performed by the group controller (GC). The flow meter must be locally supplied.
2. The values of the leaving and entering thermistor sensors in the heat pump and the values of the supply and return thermistor sensors for water temperature (ST and RT), are used for internal pump control within the system. The values of the thermistors are compared to find a temperature balance in the system and to control the number of chilled (warm) water circulation inverter pumps, and their operating frequency so that the primary water flow from the heat pump approaches the estimated load-side water flow. The thermistor sensors must be installed in the load-side supply water and return water pipes and connected to the module controller (MC) in addition to the flow meter connection detailed above.

Note: Depends on the thermistor sensors, there could be delays or errors when detecting water temperature. If the bypass pipe is too narrow or the load fluctuates quickly, fault may occur such as low flow rate failure due to pump stalling.

List of control devices

Control device	MC connection	Range (initial value)	Setting range
FM: Flow meter (load side) (Note 4)	4 to 20[mA] input (Note 2)	0 to 1000 [L/min]	0 to 65535 [L/min]
ST: Supply water temperature (load side)	Supplied thermistor sensor for water temperature (Note 3) or 4 to 20[mA] input (Note 2)	0 to 70[°C] (At 4 to 20 [mA])	-50 to 100[°C]
RT: Return water temperature (load side)			
V：Bypass valve (Note 5)	4 to 20[mA] output	0 to 100[%]	—
dP: Differential pressure sensor	4 to 20[mA] input (Note 2)	0 to 500[kPa]	0 to 1000[kPa]
GC	RS485 communication	—	—
Other MC	RS485 communication	—	—

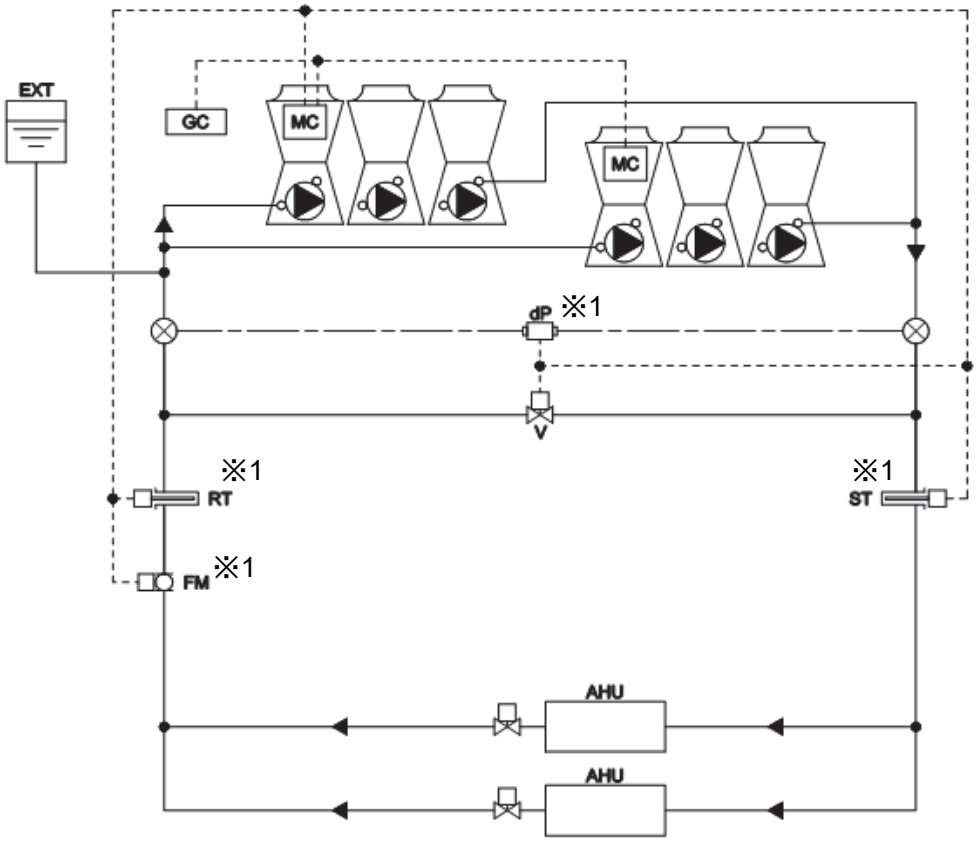
Note 1: Although you can perform variable flow rate control even without differential pressure sensor, you need to connect the supply and return thermistor sensors, Bypass valve and Differential pressure sensor to perform tasks such as measuring the amount of heat on the load side.

Note 2: MC can be set within the range of DC 1 - 5 [V].

Note 3: One complete sensor set (ST & RT) is supplied by the factory when ordering a built in pump module with module controller (MC). Both sensor cables are 30M in length (They cannot be extended). When using locally procured sensors, a converter must be used (This cannot be installed in the heat pump).

Note 4: A flow meter is needed when directly sensing the load side flow rate (instantaneous measurement).

Note 5: Bypass valve must have linear characteristics and be the same size with bypass pipe.



[Single pump system example]

1-3. Variable flow, multiple group system (without GC)

1. All module controllers (MC) must be started or stopped simultaneously. The water flow rate, in the system, will be insufficient if they are not started or stopped simultaneously resulting in the system stopping due to a low water flow alarm.
2. When a group controller (GC) is not used, install a flow meter (provided locally) into the load side pipe work and connect its output to all of the module controllers (MC) in the system. Flow rate and operation stop instructions must be entered into each module controller (MC) connected in the system.
3. (1) Install the accessory thermistor sensors for water temperature in the supply water and return water pipes, and connect to each module controller (MC).
   (2) When not using factory provided sensors because wire length exceeds 30m, install a locally supplied sensors for water temperature compatible with voltage or current output on each of the supply and return water pipes, and distribute to each module controller (MC) via a converter (provided locally).

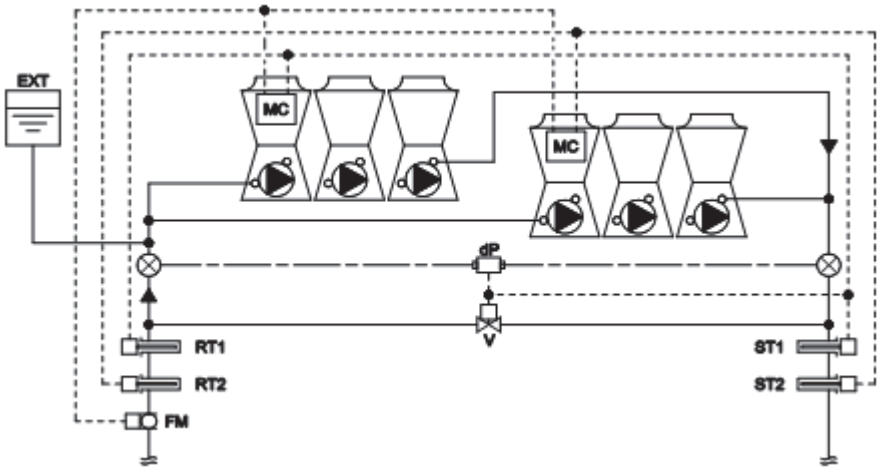
Note: Thermistor sensors for water temperature are only for measurement. They do not support flow rate detection.

List of control devices

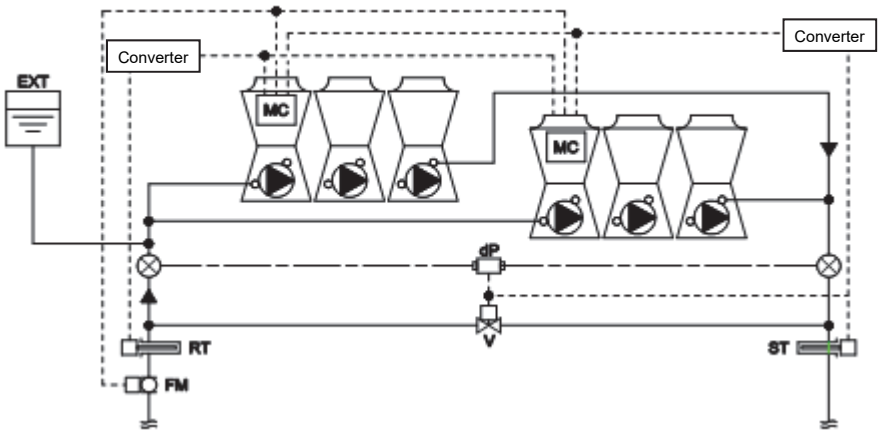
Control device	MC connection	Range (initial value)	Setting range
FM: Flow meter (load side) (Note 3)	4 to 20[mA] input (Note 1)	0 to 1000 [L/min]	0 to 65535 [L/min]
ST: Supply water temperature (load side)	Supplied thermistor sensor for water temperature (Note 2) or 4 to 20[mA] input (Note 1)	0 to 70[°C] (At 4 to 20 [mA])	-50 to 100[°C]
RT: Return water temperature (load side)			
V : Bypass valve (Note 4)	4 to 20[mA] output	0 to 100[%]	—
dP: Differential pressure sensor	4 to 20[mA] input (Note 1)	0 to 500[kPa]	0 to 1000[kPa]

Note 1: MC can be set within the range of DC 1 - 5 [V].
Note 2: One complete sensor set (ST & RT) is supplied by the factory when ordering a built in pump module with module controller (MC). Both sensor cables are 30M in length (They cannot be extended). When using locally procured sensors, a converter must be used (This cannot be installed in the heat pump).
Note 3: A flow meter is needed when directly sensing the load side flow rate (instantaneous measurement).
Note 4: Bypass valve must have linear characteristics and be the same size with bypass pipe.

(1) When using accessory thermistor sensors for water temperature



(2) When not using accessory thermistor sensors for water temperature

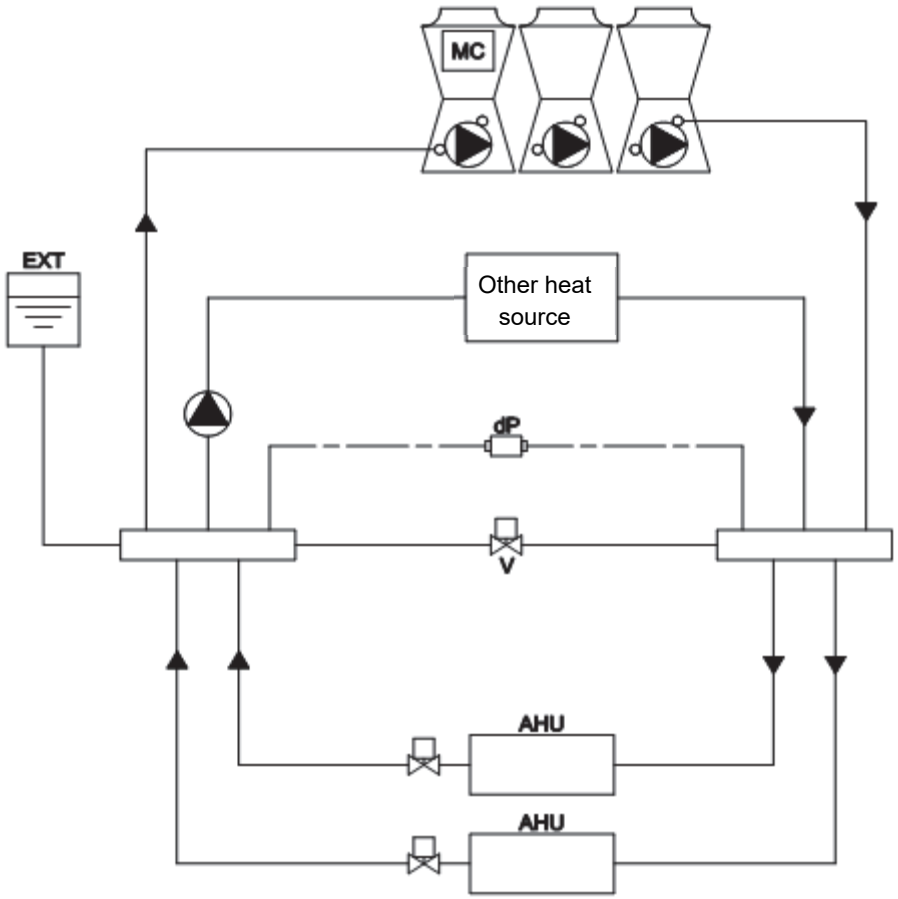


[Single pump system example]

1-4. Other heat source combination system (without GC)
(load side: variable flow, heat pump side: stepped variable flow (other heat source: constant flow))

1. The operation of the other heat source cannot be controlled by the USX module controller. All operation and control functions for the other heat source must be performed using the local instrumentation panel associated with the heat source.
2. The module controller (MC) controls the number of inverter driven pumps, set for constant speed (stepped variable flow) in accordance with the operation capacity of the heat pump.
3. Use a separate instrumentation panel for the differential pressure (dP) and bypass valve (V) control (The differential pressure (dP) and the bypass valve (V) can be controlled using the module controller (MC). Please contact your Toshiba sales person to discuss this option).

Control device	MC connection	Range (initial value)
FM: Flow meter (load side)	Not necessary	—
ST: Supply water temperature (load side)	Not necessary	—
RT: Return water temperature (load side)	Not necessary	—
V：Bypass valve	Not necessary	—
dP: Differential pressure sensor	Not necessary	—



[Single pump system example]

1-5. Other heat source combination system

(load side: variable flow, heat pump side: variable flow (other heat pump: constant flow))

1. The run and stop functions of the other heat source can be controlled using the new group controller (GC).
2. The new group controller (GC) can control the run and stop functions of the other heat source using the supply/return thermistor sensors for water temperature (ST/RT), the outlet water temperature sensor (AT) for the other heat source, load side flow rate and the load.
3. During simultaneous operation of USX and other heat source, the built-in pumps of USX operate at constant speed. (step/fix)
   Configure that the pumps of other heat source also operate at constant speed. (When other heat source stops, the flow control of USX can choose Variable flow or constant flow.)
4. Use a separate instrumentation panel for the differential pressure (dP) and bypass valve (V) control (The differential pressure (dP) and the bypass valve (V) can be controlled using the module controller (MC). Please contact your Toshiba sales person to discuss this option).

Control device	GC connection	Remarks
Other heat source (operation input)	Digital output	—
Other heat source (stop input)	Digital output	—
Other heat source (operation mode input)	Digital output	When switching between cooling/heating
Other heat source (set temperature input)	4 to 20[mA] output (Note 1)	When setting the set temperature output
Other heat source (operation output)	Digital input	—
Other heat source (fault output)	Digital input	—
Other heat source (operation mode output)	Digital input	When switching between cooling/heating
Other heat pump (auxiliary equipment operation output)	Digital input	When setting auxiliary equipment operation output
AT: Other heat source outlet temperature	4 to 20[mA] input (Note 1)	Thermistor sensor for water temperature not attached

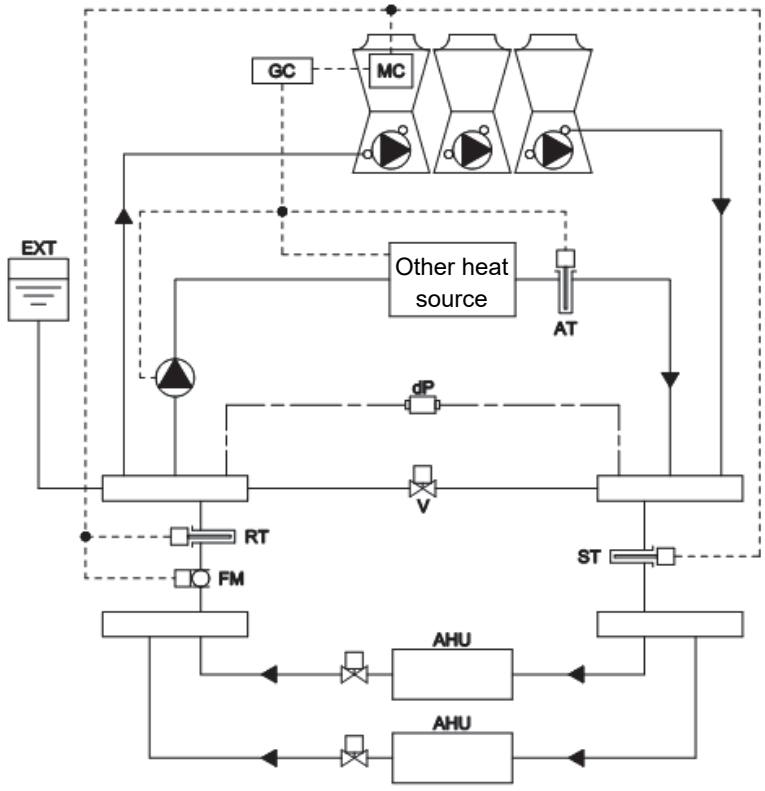
Control device	MC connection	Range (initial value)	Setting range
FM: Flow meter (load side) (Note 3)	4 to 20[mA] input (Note 1)	0 to 1000 [L/min]	0 to 65535 [L/min]
ST: Supply water temperature (load side)	Supplied thermistor sensor for water temperature (Note 2) or 4 to 20[mA] input (Note 1)	0 to 70[°C] (At 4 to 20 [mA])	-50 to 100[°C]
RT: Return water temperature (load side)			
MC-GC	RS485 communication	—	—

Note 1: MC can be set within the range of DC 1 - 5 [V].

Note 2: One complete sensor set (ST & RT) is supplied by the factory when ordering a built in pump module with module controller (MC). Both sensor cables are 30M in length (They cannot be extended). When using locally procured sensors, a converter must be used (This cannot be installed in the heat pump).

Note 3: A flow meter is needed when directly sensing the load side flow rate (instantaneous measurement).

Note 4: Bypass valve must have linear characteristics and be the same size with bypass pipe.



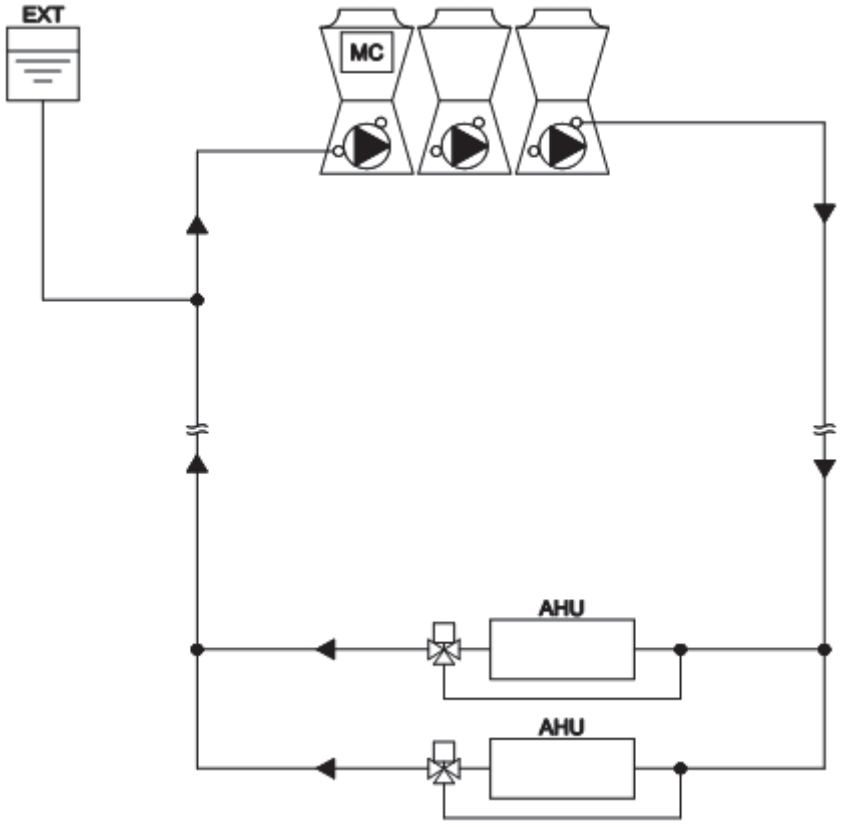
[Single pump system example]

1-6. Constant flow system

1. For integrated inverter pump modules all of the internal water pumps operate at a constant (fixed speed) while the heat pump is operating.
2. It is possible to use pumpless modules on installations that incorporate a chilled (warm) water circulation pump(s) outside of the heat pump. Any external pumps must be installed in the inlet (return) water pipe work to the heat pump.

List of control devices

Control device	MC connection	Range (initial value)
FM: Flow meter (load side)	Not necessary	—
ST: Supply water temperature (load side)	Not necessary	—
RT: Return water temperature (load side)	Not necessary	—
V：Bypass valve	Not necessary	—
dP: Differential pressure sensor	Not necessary	—

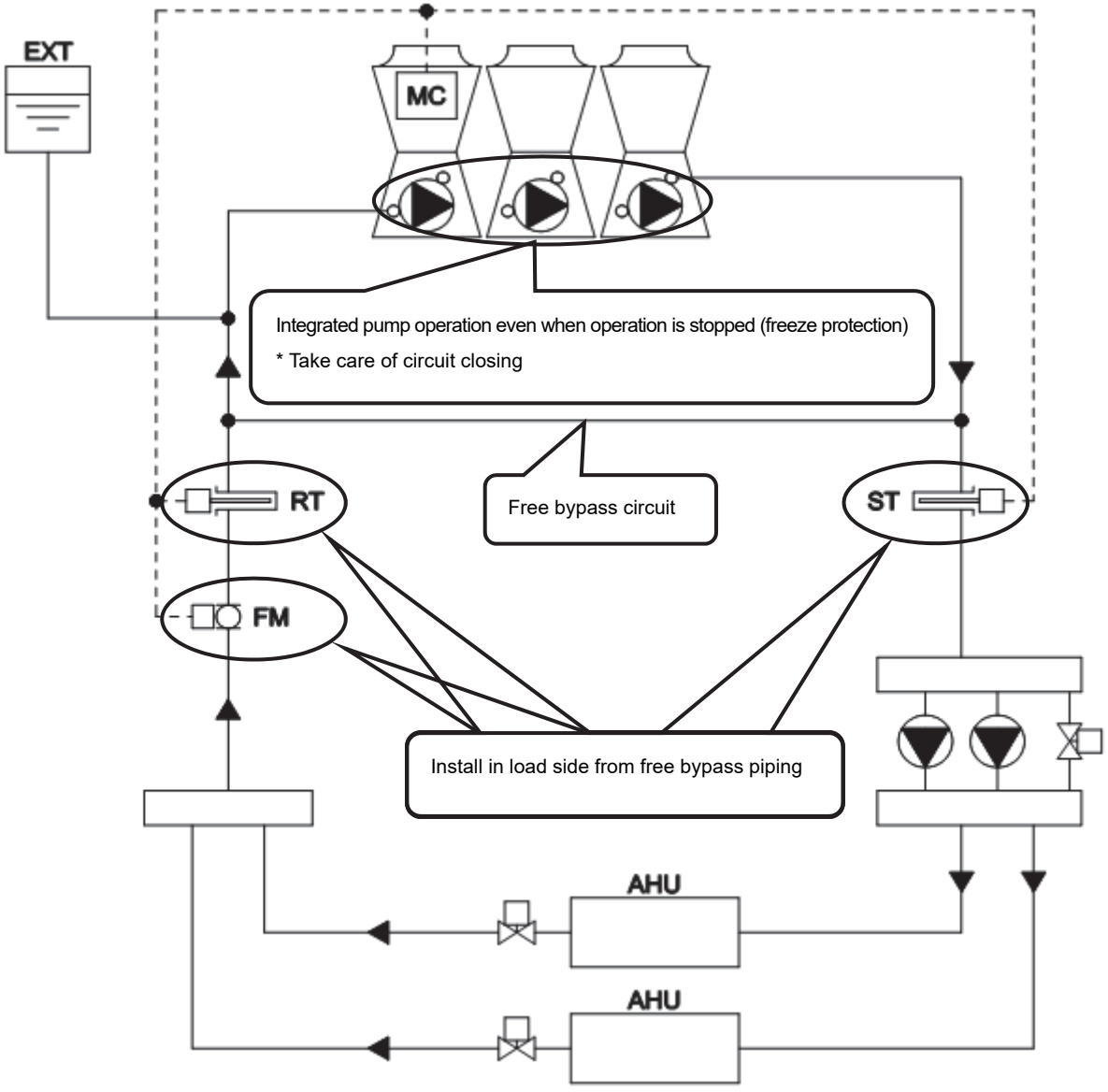


[Duplex pump system example]

2. Duplex pump system

1. Install a normally open free bypass circuit to reduce any imbalance between the load side pump(s) and the heat pump(s) water flow.
2. The integrated pump automatically operates to prevent freezing even when idle. Set the load-side pump to operate sequentially when the internal pump is running freeze-up protection (Utilise the module controller's pump interlocking signal). To secure a flow channel, bypass valve may be forced to open. In this case, there could be no water flowing to load side. If water flow is needed in load side, please set up to not open the bypass valve automatically or set the 2 way valve on load side to open during freeze protection operation.
3. Module with a running pump will control number of compressors and operating frequency to make leaving water temperature approach setting temperature.

Note: Install the flow meter (FM), supply water temperature sensor (ST) and the return water temperature sensor (RT) in the load side main pipe work (secondary circuit). Do not install these devices in the primary circuit between the heat pump and the bypass circuit as this will result in unstable temperature control for the outlet water.



[Duplex pump system example]

2-1. Variable flow system

1. Connect the output of the flow meter (FM), if installed in the system, to the module controller (MC). This enables the water flow control to directly sense the required load side water flow rate. The flow meter must be locally supplied.
2. The values of the leaving and entering thermistor sensors in the heat pump and the values of the supply and return thermistor sensors for water temperature (ST and RT), are used for internal pump control within the system. The values of the thermistors are compared to find a temperature balance in the system and to control the number of chilled (warm) water circulation inverter pumps, and their operating frequency to reduce any imbalance between the recommended load side water flow rate and the heat pump side water flow rate. The thermistor sensors must be installed in the load-side supply water and return water pipes and connected to the module controller (MC).

Note: Depends on the thermistor sensors, there could be delays or errors when detecting water temperature. If the bypass pipe is too narrow or the load fluctuates quickly, fault may occur such as low flow rate failure due to pump stalling.

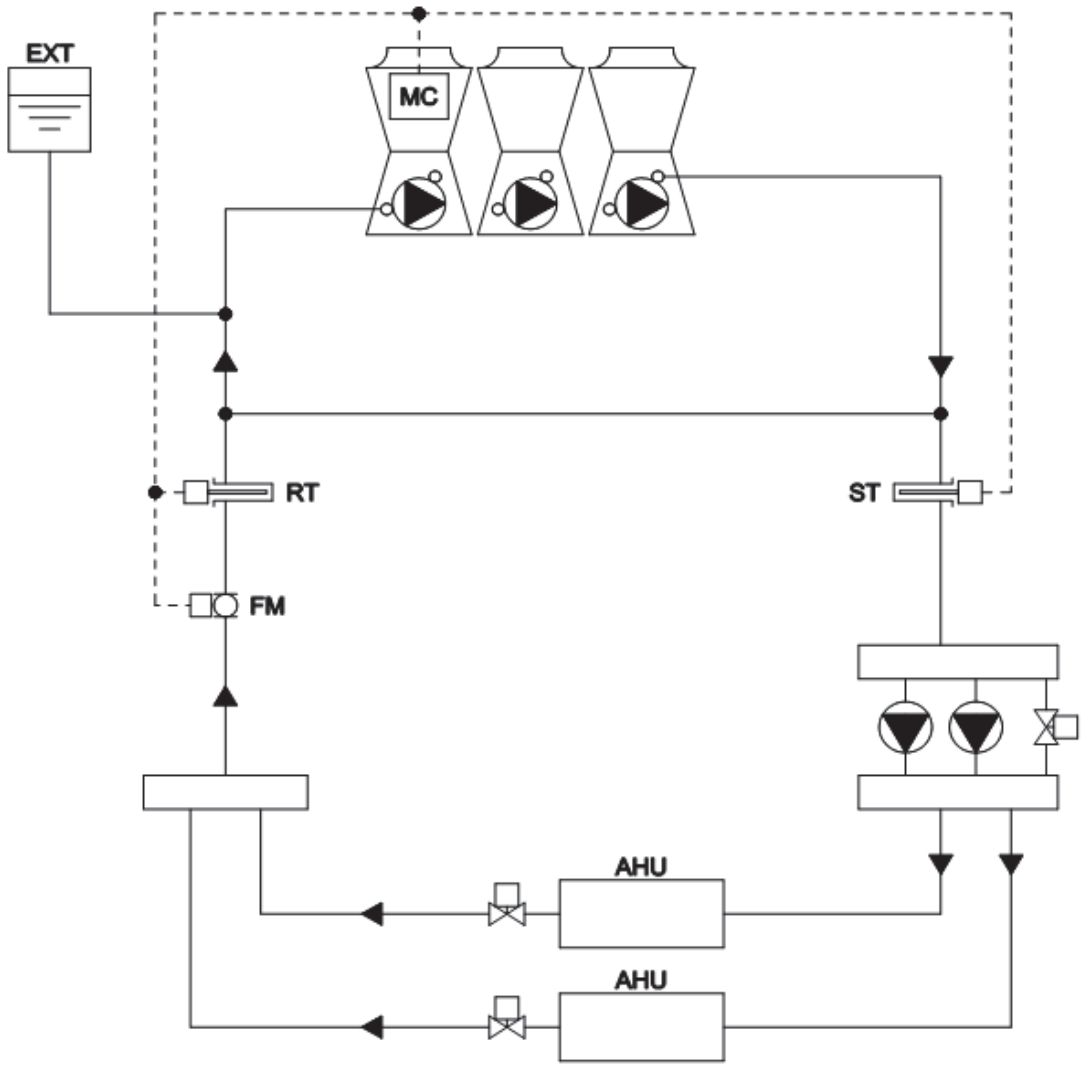
List of control devices

Control device	MC connection	Range (initial value)	Setting range
FM: Flow meter (load side) (Note 3)	4 to 20[mA] input (Note 1)	0 to 1000 [L/min]	0 to 65535 [L/min]
ST: Supply water temperature (load side)	Supplied thermistor sensor for water temperature (Note 2) or 4 to 20[mA] input (Note 1)	0 to 70[°C] (At 4 to 20 [mA])	-50 to 100[°C]
RT: Return water temperature (load side)			

Note 1: MC can be set within the range of DC 1 - 5 [V].

Note 2: One complete sensor set (ST & RT) is supplied by the factory when ordering a built in pump module with module controller (MC). Both sensor cables are 30M in length (They cannot be extended). When using locally procured sensors, a converter must be used (This cannot be installed in the heat pump).

Note 3: A flow meter is needed when directly sensing the load side flow rate (instantaneous measurement).



[Duplex pump system example]

2-2. Variable flow, multiple group system (with GC)

1. Connect the output of the flow meter (FM), if installed in the system, to the module controller (MC). This enables the water flow control to directly sense the required load side water flow rate. Flow rate ratio instructions and heat pump operation stop control is automatically performed by the group controller (GC). The flow meter must be locally supplied.
2. The values of the leaving and entering thermistor sensors in the heat pump and the values of the supply and return thermistor sensors for water temperature (ST and RT), are used for internal pump control within the system. The values of the thermistors are compared to reduce any imbalance between the recommended load side water flow rate and the heat pump side water flow rate. The temperature thermistors also control the number of chilled (warm) water circulation inverter pumps, and their operating frequency. The thermistor sensors must be installed in the load-side supply water and return water pipes and connected to the module controller (MC) in addition to the flow meter connection detailed above.

Note: Depends on the thermistor sensors, there could be delays or errors when detecting water temperature. If the bypass pipe is too narrow or the load fluctuates quickly, fault may occur such as low flow rate failure due to pump stalling.

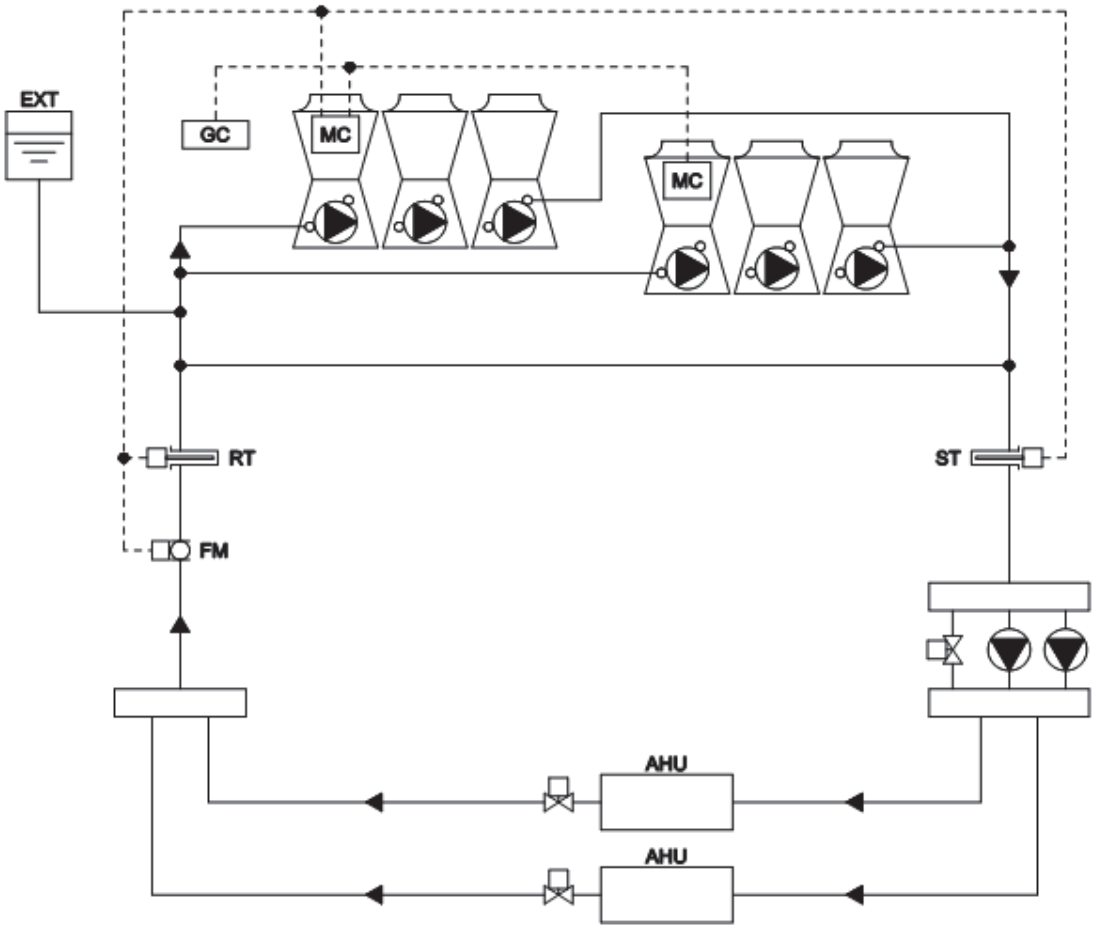
List of control devices

Control device	MC connection	Range (initial value)	Setting range
FM: Flow meter (load side) (Note 3)	4 to 20[mA] input (Note 1)	0 to 1000 [L/min]	0 to 65535 [L/min]
ST: Supply water temperature (load side)	Supplied thermistor sensor for water temperature (Note 2) or 4 to 20[mA] input (Note 1)	0 to 70[°C] (At 4 to 20 [mA])	-50 to 100[°C]
RT: Return water temperature (load side)			
GC	RS485 communication	—	—
Other MC	RS485 communication	—	—

Note 1: MC can be set within the range of DC 1 - 5 [V].

Note 2: One complete sensor set (ST & RT) is supplied by the factory when ordering a built in pump module with module controller (MC). Both sensor cables are 30M in length (They cannot be extended). When using locally procured sensors, a converter must be used (This cannot be installed in the heat pump).

Note 3: A flow meter is needed when directly sensing the load side flow rate (instantaneous measurement).



[Duplex pump system example]

2-3. Variable flow, multiple group system (without GC)

1. All module controllers (MC) must be started or stopped simultaneously. The water flow rate, in the system, will be insufficient if they are not started or stopped simultaneously resulting in the system stopping due to a low water flow alarm.
2. When a group controller (GC) is not used, install a flow meter (provided locally) into the load side pipe work and connect its output to all of the module controllers (MC) in the system. Flow rate ratio and operation stop instructions must be entered into each module controller (MC) connected in the system.
3. (1) Install an accessory thermistor sensor for water temperature in the supply water and return water pipes, and connect to each module controller (MC).
   (2) When not using factory provided sensors because wire length exceeds 30m, install a locally supplied sensors for water temperature compatible with voltage or current output on each of the supply water pipes and return water pipes, and distribute to each module controller (MC) via a converter (provided locally).

Note: Thermistor sensors for water temperature are only for measurement. They do not support flow rate detection.

List of control devices

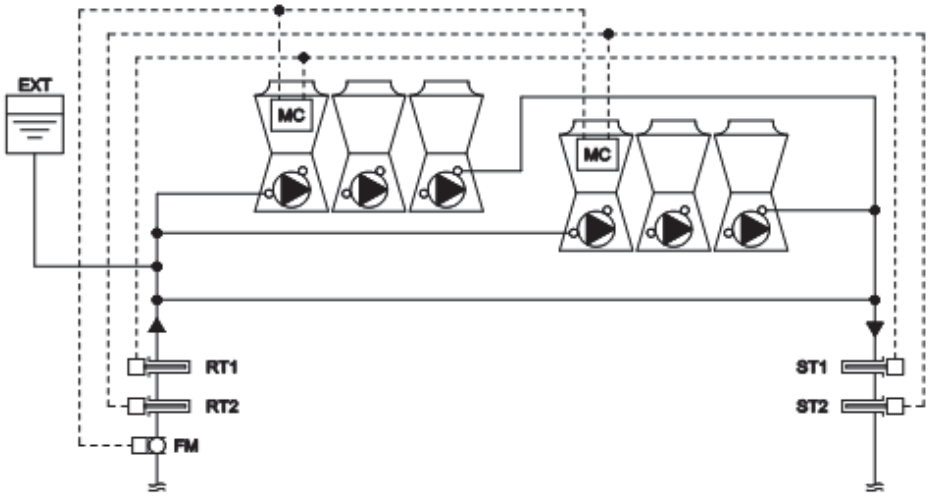
Control device	MC connection	Range (initial value)	Setting range
FM: Flow meter (load side) (Note 3)	4 to 20[mA] input (Note 1)	0 to 1000 [L/min]	0 to 65535 [L/min]
ST: Supply water temperature (load side)	Supplied thermistor sensor for water temperature (Note 2) or 4 to 20[mA] input (Note 1)	0 to 70[°C] (At 4 to 20 [mA])	-50 to 100[°C]
RT: Return water temperature (load side)			

Note 1: MC can be set within the range of DC 1 - 5 [V].

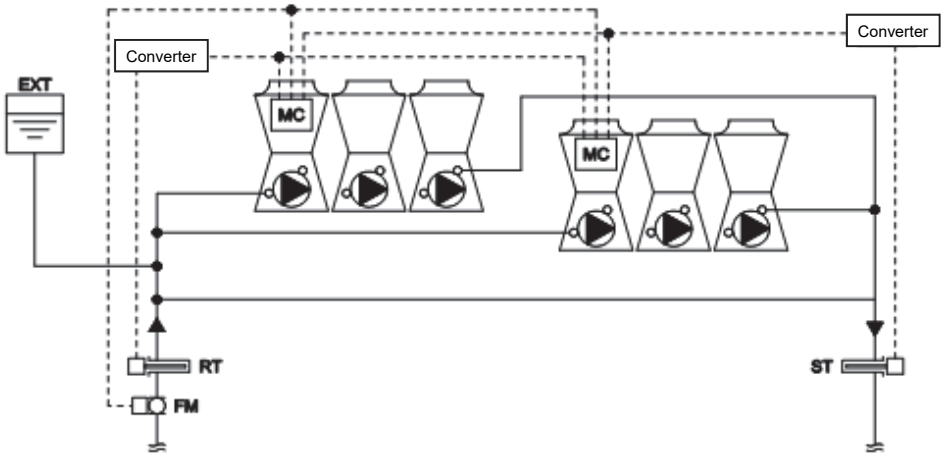
Note 2: One complete sensor set (ST & RT) is supplied by the factory when ordering a built in pump module with module controller (MC). Both sensor cables are 30M in length (They cannot be extended). When using locally procured sensors, a converter must be used (This cannot be installed in the heat pump).

Note 3: A flow meter is needed when directly sensing the load side flow rate (instantaneous measurement).

(1) When using accessory thermistor sensors for water temperature



(2) When not using accessory thermistor sensors for water temperature



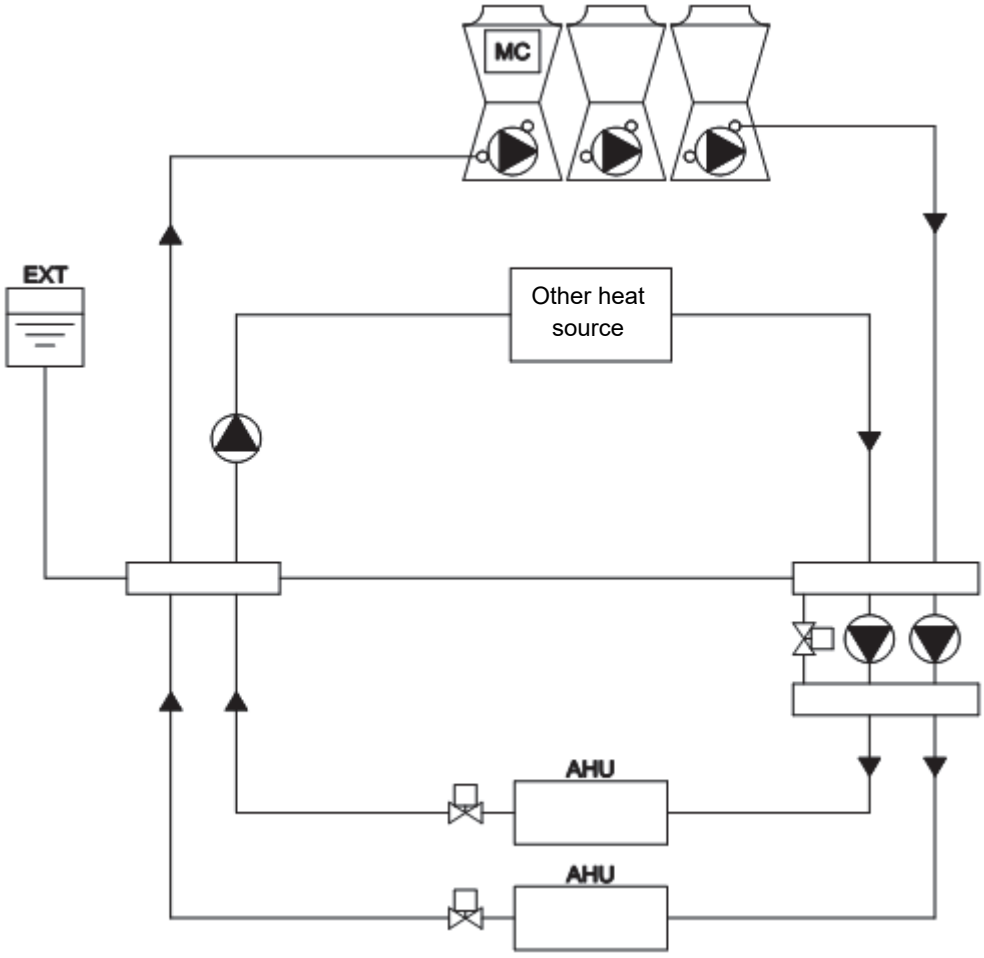
[Duplex pump system example]

2-4. Other heat source combination system (without GC)

(load side: variable flow, heat pump side: stepped variable flow (other heat pump: constant flow))

1. The operation of the other heat source cannot be controlled by the USX module controller. All operation and control functions for the other heat source must be performed using the local instrumentation panel associated with the heat source.
2. The module controller (MC) controls the number of inverter driven pumps, set for constant speed (stepped variable flow) in accordance with the operation capacity of the heat pump.

Control device	MC connection	Range (initial value)
FM: Flow meter (load side)	Not necessary	—
ST: Supply water temperature (load side)	Not necessary	—
RT: Return water temperature (load side)	Not necessary	—



[Duplex pump system example]

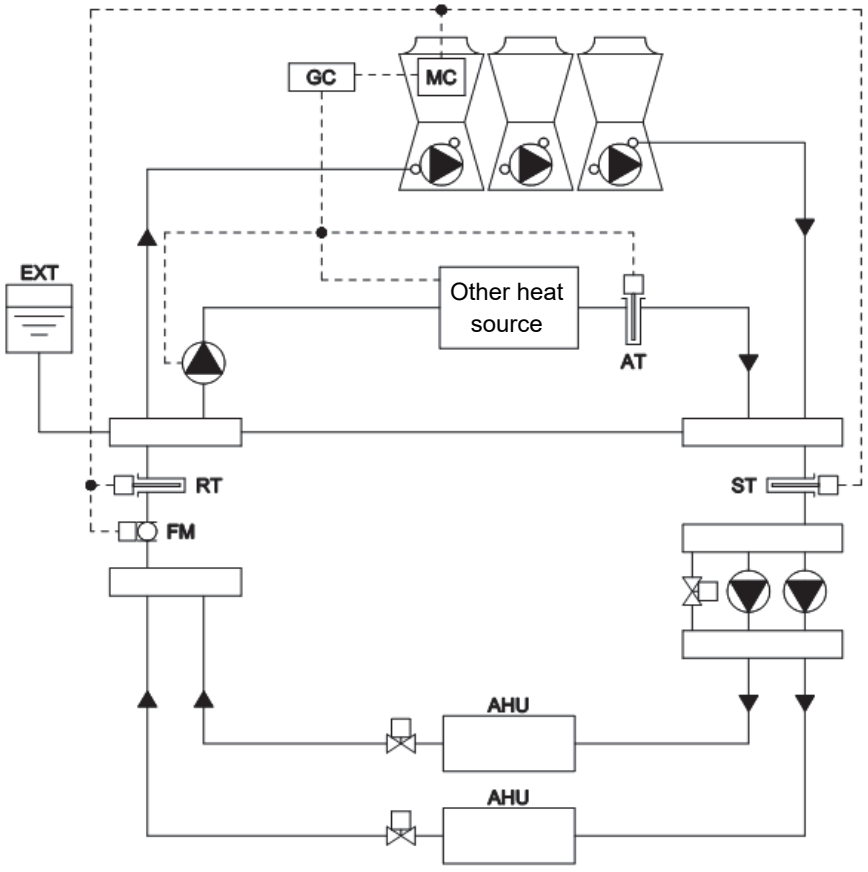
2-5. Other heat source combination system (with new GC)
(load side: variable flow, heat pump side: variable flow (other heat source: constant flow))

1. The run and stop functions of the other heat source can be controlled using the new group controller (GC).
2. The new group controller (GC) can control the run and stop functions of the other heat source using the supply/return thermistor sensors for water temperature (ST/RT), the outlet water temperature sensor (AT) for the other heat source, load side flow rate and the load.
3. During simultaneous operation of USX and other heat source, the built-in pumps of USX operate at constant speed. (step/fix)
   Configure that the pumps of other heat source also operate at constant speed. (When other heat source stops, the flow control of USX can choose Variable flow or constant flow.)

Control device	GC connection	Remarks
Other heat source (operation input)	Digital output	—
Other heat source (stop input)	Digital output	—
Other heat source (operation mode input)	Digital output	When switching between cooling/heating
Other heat source (set temperature input)	1 to 5 [V] output	When setting the set temperature output
Other heat source (operation output)	Digital input	—
Other heat source (fault output)	Digital input	—
Other heat source (operation mode output)	Digital input	When switching between cooling/heating
Other heat pump (auxiliary equipment operation output)	Digital input	When setting auxiliary equipment operation output
AT: Other heat source outlet temperature	4 to 20[mA] input (Note 1)	Thermistor sensor for water temperature not attached

Control device	MC connection	Range (initial value)	Setting range
FM: Flow meter (load side) (Note 3)	4 to 20[mA] input (Note 1)	0 to 1000 [L/min]	0 to 65535 [L/min]
ST: Supply water temperature (load side)	Supplied thermistor sensor for water temperature (Note 2) or 4 to 20 [mA] input (Note 1)	0 to 70 [°C] (At 4 to 20 [mA])	-50 to 100 [°C]
RT: Return water temperature (load side)			
MC-GC	RS485 communication	—	—

Note 1: MC can be set within the range of DC 1 - 5 [V].
Note 2: One complete sensor set (ST & RT) is supplied by the factory when ordering a built in pump module with module controller (MC). Both sensor cables are 30M in length (They cannot be extended). When using locally procured sensors, a converter must be used (This cannot be installed in the heat pump).
Note 3: A flow meter is needed to group control the load side flow rate and heat rate.



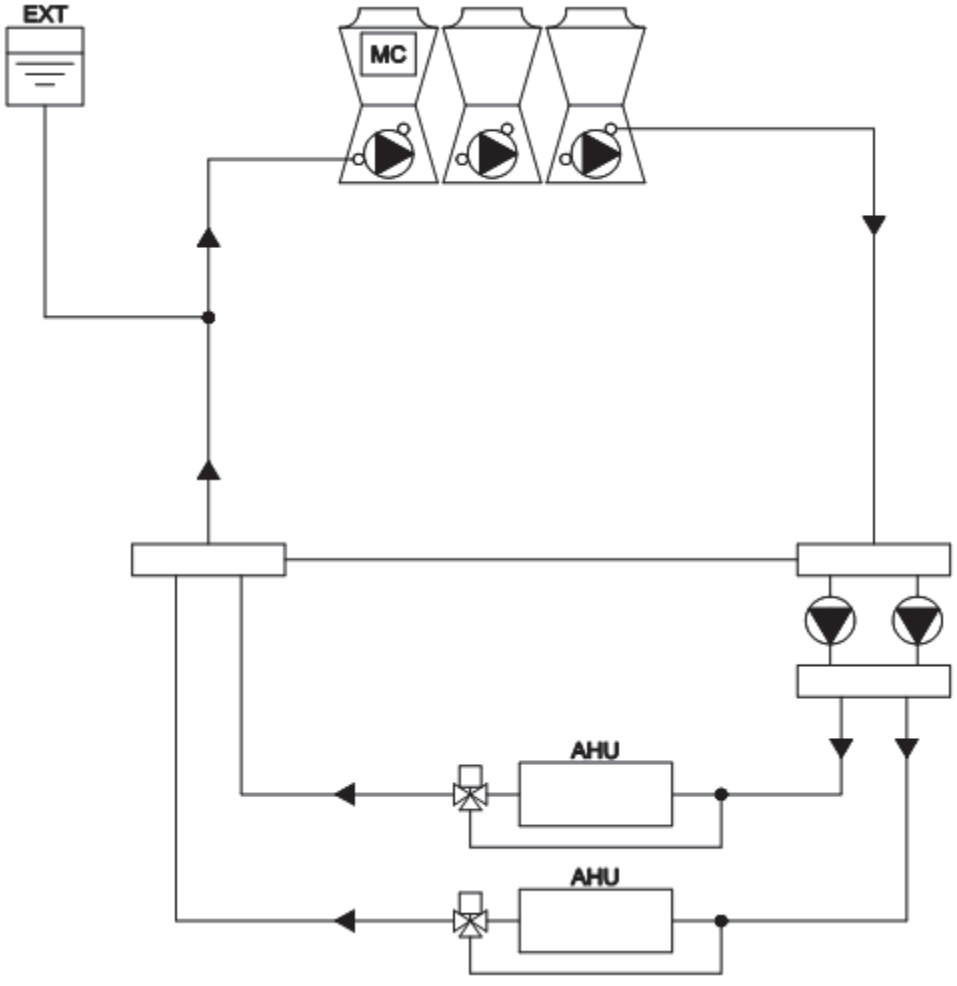
[Duplex pump system example]

2-6. Constant flow system (load-side: constant flow; heat pump-side: constant flow)

1. For integrated inverter pump modules all of the internal water pumps operate at a constant (fixed speed) while the heat pump is operating.
2. It is possible to use pumpless modules on installations that incorporate a chilled (warm) water circulation pump(s) outside of the heat pump. Any external pumps must be installed in the inlet (return) water pipe work to the heat pump.

List of control devices

Control device	MC connection	Range (initial value)
FM: Flow meter (load side)	Not necessary	—
ST: Supply water temperature (load side)	Not necessary	—
RT: Return water temperature (load side)	Not necessary	—



[Example of external sensor control systems]

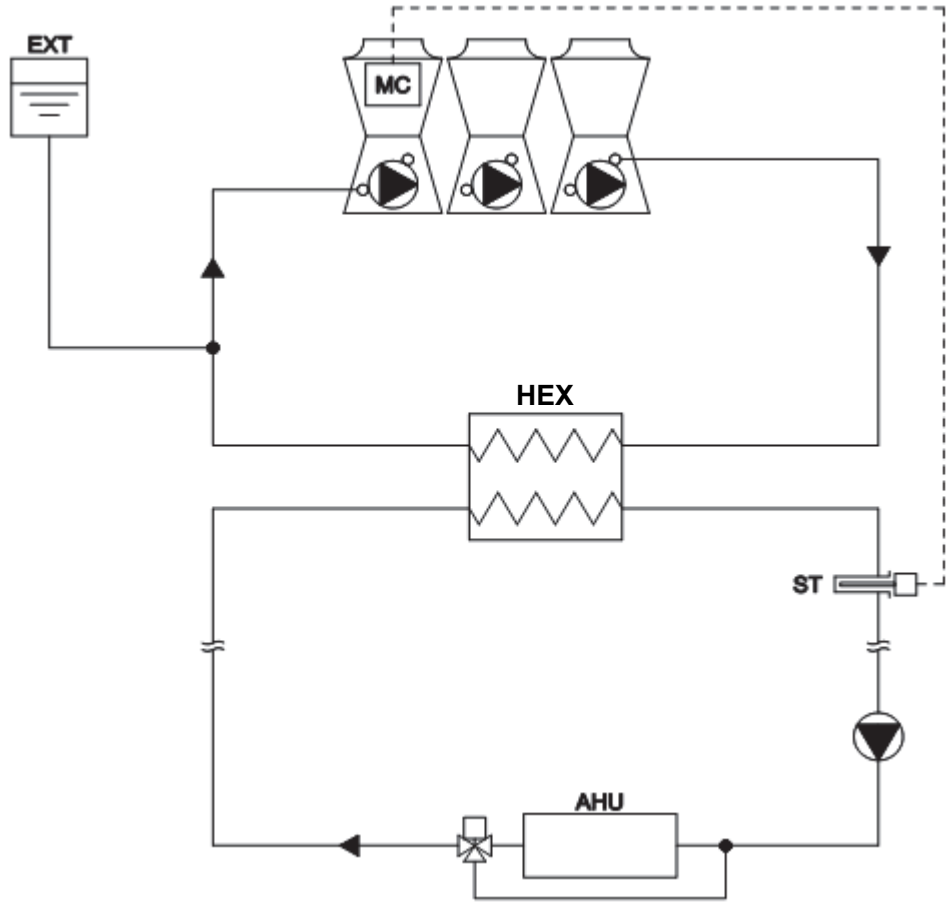
3. Other

3-1. Indirect heat exchange system (load side: constant flow, heat pump side: constant flow)

*External thermistor sensor for water temperature control

1. In the case of integrated inverter pump units, all the internal pumps operate at constant speed while the heat pump is operating.
2. It is possible to use pumpless modules on installations that incorporate a chilled (warm) water circulation pump(s) outside of the heat pump. Any external pumps must be installed in the inlet (return) water pipe work to the heat pump.
3. The load side supply water temperature is detected by the external temperature sensor (ST) as shown in the diagram below. The operating capacity is calculated using the the temperature difference between the outlet water temperature thermistor sensor, located inside the heat pump, and the external temperature sensor (ST) so that the load side supply water temperature approaches the water set point temperature for the system.

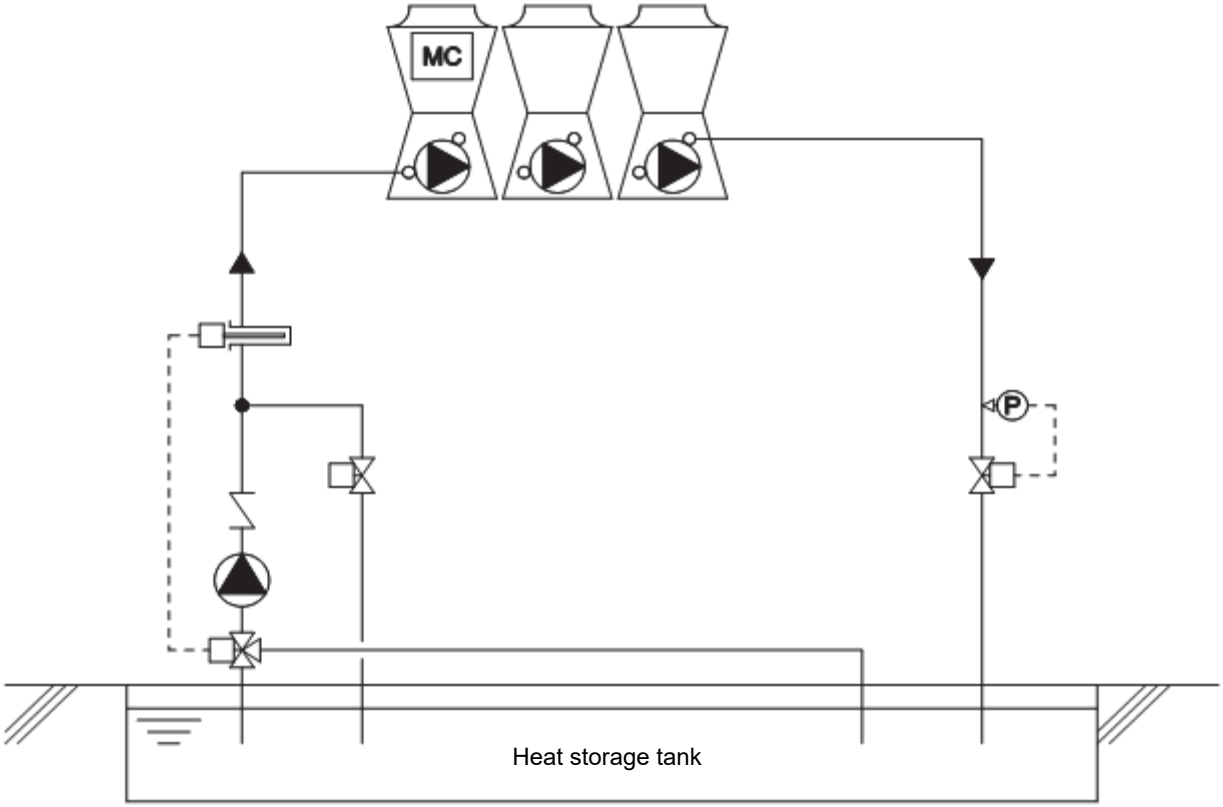
Note: Regarding the minimum cooling temperature and maximum heating temperature of the actual load-side supply water temperature; the temperature difference between the indirect heat exchange heat pump and load sides is higher than the heat pump's minimum cooling temperature and lower than the maximum set heating temperature.



[Water thermal storage system example]

3-2. Water thermal storage system (heat pump side: constant flow (custom option))

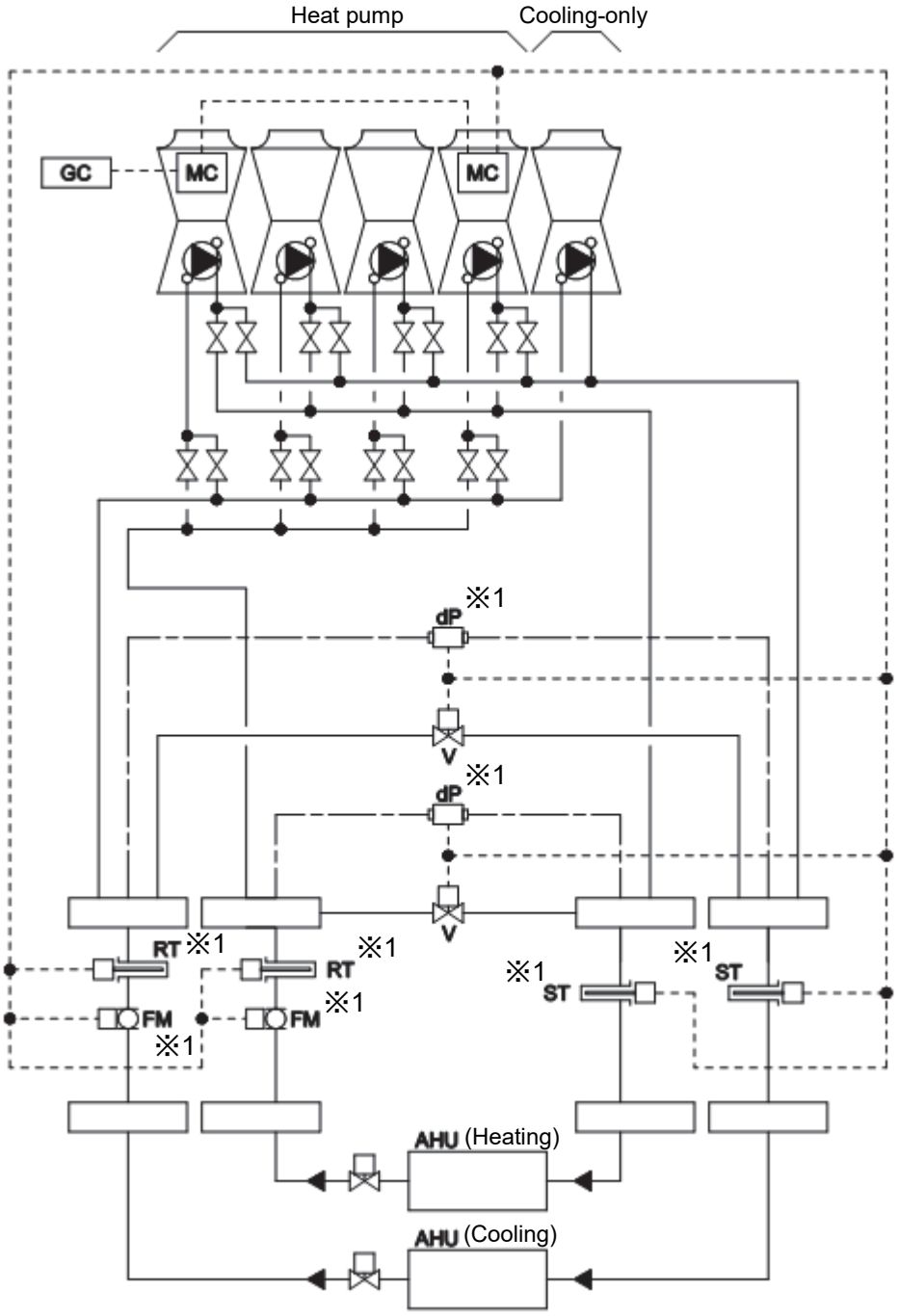
1. For systems that consist of integrated inverter pump modules, all of the internal pumps for chilled (warm) water circulation must be configured to operate at constant speed while the heat pump is operating. An external booster pump (constant speed) will be required to overcome the piping resistance from the heat storage tank to the heat pump.
2. Pumpless USX EDGE modules can be used for the system if the external booster pump is sized to overcome the the total system resistance, including the internal resistance of the heat pump.
3. If the freeze protection control is activated, the internal chilled (warm) water circulation pumps may automatically start even when the heat pump operation is stopped. The water pipework must be designed to ensure the minimum water flow rate, for the system, can be maintained despite any valve closures that may occur during the freeze protection operation of the internal chilled (warm) water circulation pumps (use the pump group signal of the module controller).



[Chilled/warm water simultaneous use system example]

3-3. Chilled/warm water simultaneous use system

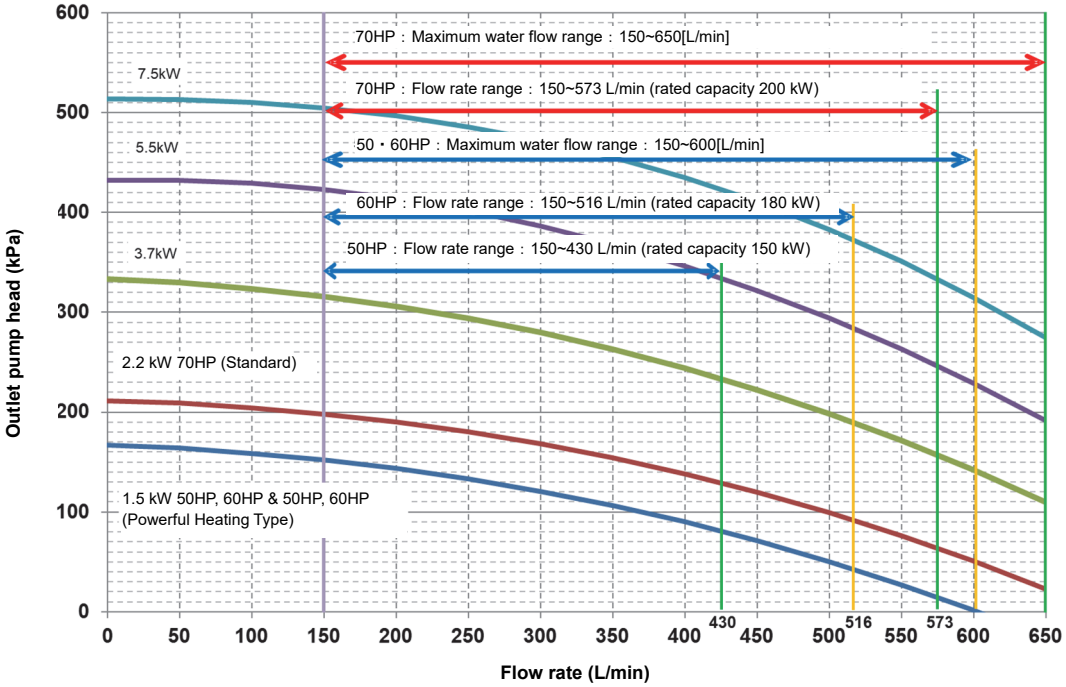
1. Install valves (locally supplied), as shown below, for switching between the inlet and outlet of heat pumps that are configured to change between chilled and warm water operation (motorised valves must be operated from a local instrumentation panel. It is not possible to operate these valves from the USX EDGE modules).
2. Connect each cooling and heating component (FM, ST, RT, dP, V) to the module controller (MC).
   ※1 Although you can perform variable flow rate control even without differential pressure sensor, you need to connect the supply and return thermistor sensors to perform tasks such as measuring the amount of heat on the load side.



Pump characteristics and internal resistance curve

Integrated pump performance curve (integrated inverter pump)

Note 1: Select a pump that can cover the required head and water flow.
Note 2: The outlet pump head is the value when internal resistance is subtracted from the pump head.
Note 3: The inlet/outlet temperature difference is 5 to 10°C. Operate within the range.



Pump specified values

		50HP,50HP (Powerful Heating Type) 60HP,60HP (Powerful Heating Type)					70HP			
Pump output	(kW)	1.5	2.2	3.7	5.5	7.5	2.2	3.7	5.5	7.5
Flow rate range Note1,2	(L/min)	150~516					150~573			
Outlet pump head Note3,4	(kPa)	43~151	92~198	190~315	284~422	370~512	64~198	158~315	247~422	335~512
Maximum operating current Note1,5	(A)	3.1	4.3	7.4	10	15	4.3	7.4	9.9	15
Maximum power consumption Note1,5	(kW)	2	2.8	4.5	6.4	9.8	2.8	4.5	6.4	9.8
Maximum allowable boost pressure	(MPa)	0.52	0.47	0.36	0.25	0.16	0.47	0.36	0.25	0.16
Maximum return head(water temperature of 60°C or less)	(kPa)	40	40	40	40	40	40	40	40	40

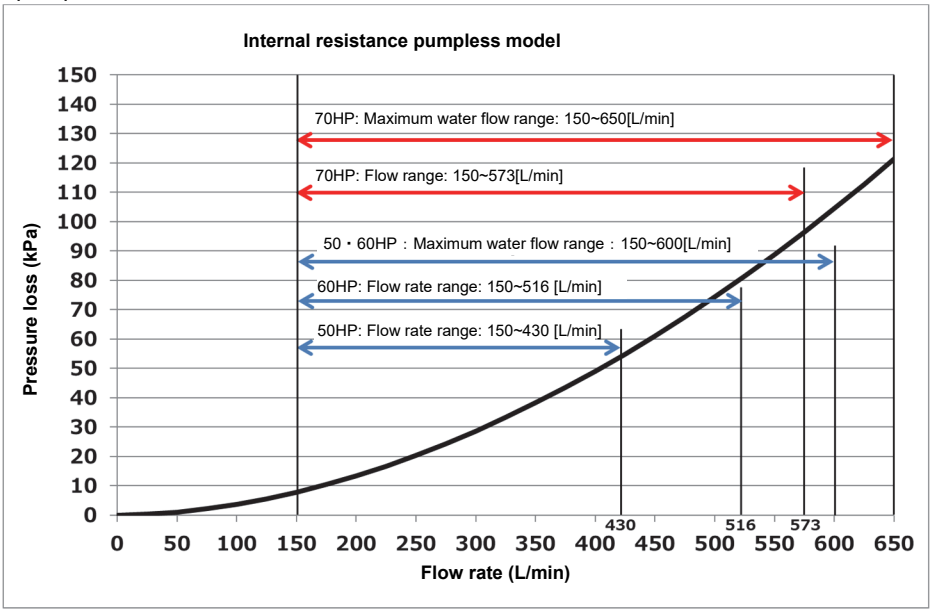
Note 1: The water flow rate range (upper limit), maximum operating current and the maximum power consumption shown in the table above are for 1 pump. To calculate the values for multiple module systems multiple the values shown in the table with the number of pumps (modules) included in the system.
Note 2: The table above shows the calculated flow rate at the rated capacities and also the maximum flow rate allowance for each model. The maximum water flow rate value can be used instead of the rated capacity flow rate when designing a system. The water flow rate can be calculated using the below formula.
50HP, 60HP Standard and 50HP, 60HP Powerful Heating Type...
Capacity kW x 860 / 60 / 5 (minimum temperature difference).
Maximum flow rate ≤600 L/min can be used if required.
70HP Standard...
Capacity kW x 860 / 60 / 5 (minimum temperature difference).
Maximum flow rate ≤650 L/min can be used if required.
Note 3: The maximum operating current and maximum power consumption shown in the table above are maximum values when the pump is operating at a frequency of 60 Hz.
Note 4: The external head in the table is the value when the pump frequency is 60 Hz for the above water flow range.
Note 5: The maximum operating electric current and maximum power consumption are the maximum values when the pump operating frequency is 60 Hz.
Note 6: 60 Hz pumps can also be used in 50 Hz regions.
Note 7: When selecting other than the rated conditions, make sure that the maximum water flow does not exceed the maximum allowable water flow.
Note 8: When using a 7.5 kW water pump, the distance between the modules must be kept at 100 mm.

Internal resistance curve

Note 1: The internal resistance of units with a built-in pump and pumpless units is the same.

Note 2: The pump characteristics on the previous page are the values obtained by subtracting the internal resistance from the total pump head (external head). Note that it is not necessary to add the internal resistance shown in the figure below to the piping resistance calculation when using the inverter pump built-in specification.

Note 3: The internal resistance of the USX EDGE module must be considered when selecting an external pump for use with USX EDGE pumpless models.



(1) Water quality standards

Use chilled (warm) water that meets the following water quality standards.

Lower water quality may lead to corrosion in the water piping and brazed plate heat exchanger which may

result in water leaks or reduced water flow through the system.

	Item(1) (6)	Chilled water system		Warm water system(3) Low-grade medium temperature water system		Tendency (2)	
		Circulation water [20ºC and lower]	Make up water	Circulation water [Over 20ºC and up to 60 ºC]	Make up water	Corrosion	Scale formation
Standard items	pH (25ºC)	6.8 to 8.0	6.8 to 8.0	7.0 to 8.0	7.0 to 8.0	○	○
	Electrical conductivity (mS/m)(25°C) {μS/cm} (25°C)(1)	40 or less {400 or less}	30 or less {300 or less}	30 or less {300 or less}	30 or less {300 or less}	○	○
	Chloride ion (mgCl^-/l)	50 or less	50 or less	50 or less	50 or less	○	
	Sulphate ion (mgSO_4^{2-}/l)	50 or less	50 or less	50 or less	50 or less	○	
	Acid consumption (pH4.8)(mg$CaCO_3$/l)	50 or less	50 or less	50 or less	50 or less		○
	Total hardness (mg$CaCO_3$/l)	70 or less	70 or less	70 or less	70 or less		○
	Calcium hardness (mg$CaCO_3$/l)	50 or less	50 or less	50 or less	50 or less		○
	Ionic silica (mgSiO_2/l)	30 or less	30 or less	30 or less	30 or less		○
Reference item	Iron (mgFe/l)	1.0 or less	0.3 or less	1.0 or less	0.3 or less	○	○
	Copper (mgCu/l)	1.0 or less	0.1 or less	1.0 or less	0.1 or less	○	
	Chloride ion (mgS^{2-}/l)	Undetectable	Undetectable	Undetectable	Undetectable	○	
	Ammonium ion (mgNH_4^+/l)	1.0 or less	0.1 or less	0.3 or less	0.1 or less	○	
	Residual chlorine (mgCl/l)	0.3 or less	0.3 or less	0.25 or less	0.3 or less	○	
	Free carbon (mgCO_2/l)	4.0 or less	4.0 or less	0.4 or less	4.0 or less	○	
	Stability index	-	-	-	-	○	○

Water quality standards relating to chilled water, cold water, hot water, make-up water

Note 1: Item names, term definitions, and units are in accordance with JIS K 0101. Units and values in brackets "{ }" are conventional units provided for reference.

Note 2: "○" marks in the columns show a factor connected to corrosion or scaling tendency.

Note 3: When corrosiveness is generally significant in high temperatures (40°C or higher) and, in particular, when ferrous material is directly in contact with water without any protective surface film, it would be desirable to take effective corrosion prevention measures such as deaeration treatment or adding an anticorrosive. If you choose to use an anticorrosive, be careful not to damage USX.

Note 4: Cooling water systems that use a sealed cooling tower, closed-circuit circulation water and other make up water depend on warm water system water quality standards, while sprinkler water and other make up water depend on circulative water system water quality standards.

Note 5: Supply and supplementary source water means tap water (water supply), industrial water, or groundwater. Purified water, grey water, and softened water are not included.

Note 6: The above 15 items show representative factors of corrosion and scale impairment.

* For details, refer to JRA-GL-02-1994 of the "Water Quality Guidelines for Cooling and Air Conditioning Devices" of the Japan Refrigeration and Air Conditioning Industry Association.

Electrical Wiring

1. Electrical wiring precautions

(1) Before installation, please read all the product literature, outline drawings and wiring diagrams provided for the USX EDGE.

(2) The power supply must be within ±10% of the rated voltage and 2% of phase to phase balance.
Operating the system outside of these tolerances will cause a malfunction of the module or components and will not be covered by the warranty.

(3) Please comply with all local and national regulations and the installation must be completed by electrically qualified engineers or technicians.

(4) Ground wire must be used, using the ground connection points provided on the USX EDGE module. The wire diameter must be determined refer to table below. Do not make ground connections, from the USX EDGE module, to either gas or water pipes within the installation area. Incorrect or failure to make ground connections may result in electric shock.

(5) When carrying out the electrical installation, ensure the correct sized circuit breaker is selected to ensure the protection against over current and short circuit accidents.

(6) The power supply isolator must be installed close to the module it is supplying so as to allow engineers to isolate the electrical supply for maintenance and service activities.

(7) Please confirm statement.

(8) The power supply for the USX module must be designed using the maximum electric current values shown in the following tables. The maximum electric current value is the current value when the module is operating normally.

(9) When passing electrical wire through holes ensure all burrs are removed from the hole and that the edges of the hole are protected to prevent damage to the insulation on the electrical wires. The holes must also be protected against any water or duct ingress into the module. Failure to do so may lead to component failure.

(10) If phase-advancing capacitors are installed in devices in the same power system, they may generate heat or ignite, so remove all phase-advancing capacitors.

(11) Change the CN7 connector assembly according to the power supply voltage.

(12) All equipments complying with IEC 61000-3-12

(13) If it is necessary to reduce emissions, please contact us.

2. Power supply design

Supply power to each module as shown in the below diagram. Use the power supply wiring hole (Φ80) in the module right-side end (on the opposite side from the water piping side) for power supply wiring.
Each value in the table is a reference value selected in accordance with Japanese regulations. Select values in accordance with the laws and regulations of the installed location.

* Regarding the internal pump output of the inverter-integrated model, 60HP standard specifications will be 1.5kW; and 70HP standard specifications will be 2.2kW.
This can be customized to 2.2kW (60HP only) and 3.7, 5.5, 7.5kW.

- **Power supply design physical data for single modules**

50HP

			Pumpless	Pump size				
Integrated pump rating output (kW)				1.5	2.2	3.7	5.5	7.5
Maximum electric current (A)			79.0	82.1	83.3	85.9	89.0	94.0
Power supply capacity (kVA)			54.8	56.9	57.8	59.6	61.7	65.2
Power supply wiring CSA	IV wire	Line length: 20m or less (mm^2)	38	38	38	38	38	38
		Line length: 50m or less (mm^2)	38	38	38	38	38	38
	CV wire	Line length: 20m or less (mm^2)	22	22	22	22	22	38
		Line length: 50m or less (mm^2)	22	22	22	22	22	38
Ground wire CSA (mm^2)			22	22	22	22	22	22
Remote switch (A)			100	100	100	100	100	100
Power supply fuse (A)			100	100	100	100	100	100
Earth leakage breaker capacity (A)			100	100	100	100	100	100
Earth leakage breaker current sensitivity (mA)			100	100	100	100	100	100

50HP(Powerful Heating Type)

			Pumpless	Pump size				
Integrated pump rating output (kW)				1.5	2.2	3.7	5.5	7.5
Maximum electric current (A)			79.0	82.1	83.3	85.9	89.0	94.0
Power supply capacity (kVA)			54.8	56.9	57.8	59.6	61.7	65.2
Power supply wiring CSA	IV wire	Line length: 20m or less (mm^2)	38	38	38	38	38	38
		Line length: 50m or less (mm^2)	38	38	38	38	38	38
	CV wire	Line length: 20m or less (mm^2)	22	22	22	22	22	38
		Line length: 50m or less (mm^2)	22	22	22	22	22	38
Ground wire CSA (mm^2)			22	22	22	22	22	22
Remote switch (A)			100	100	100	100	100	100
Power supply fuse (A)			100	100	100	100	100	100
Earth leakage breaker capacity (A)			100	100	100	100	100	100
Earth leakage breaker current sensitivity (mA)			100	100	100	100	100	100

60HP

			Pumpless	Pump size				
Integrated pump rating output (kW)				1.5	2.2	3.7	5.5	7.5
Maximum electric current (A)			99	103	104	106	109	114
Power supply capacity (kVA)			68.6	70.8	71.6	73.4	75.6	79.0
Power supply wiring CSA	IV wire	Line length: 20m or less (mm^2)	38	38	60	60	60	60
		Line length: 50m or less (mm^2)	38	38	60	60	60	60
	CV wire	Line length: 20m or less (mm^2)	38	38	38	38	38	38
		Line length: 50m or less (mm^2)	38	38	38	38	38	38
Ground wire CSA (mm^2)			22	22	38	38	38	38
Remote switch (A)			100	125	125	125	125	125
Power supply fuse (A)			100	125	125	125	125	125
Earth leakage breaker capacity (A)			100	125	125	125	125	125
Earth leakage breaker current sensitivity (mA)			100	200	200	200	200	200

60HP(Powerful Heating Type)

			Pumpless	Pump size				
Integrated pump rating output (kW)				1.5	2.2	3.7	5.5	7.5
Maximum electric current (A)			110	113	114	117	120	125
Power supply capacity (kVA)			75.9	78.1	78.9	80.7	82.8	86.3
Power supply wiring CSA	IV wire	Line length: 20m or less (mm^2)	60	60	60	60	60	60
		Line length: 50m or less (mm^2)	60	60	60	60	60	60
	CV wire	Line length: 20m or less (mm^2)	38	38	38	38	38	38
		Line length: 50m or less (mm^2)	38	38	38	38	38	38
Ground wire CSA (mm^2)			38	38	38	38	38	38
Remote switch (A)			125	125	125	125	125	125
Power supply fuse (A)			125	125	125	125	125	125
Earth leakage breaker capacity (A)			125	125	125	125	125	125
Earth leakage breaker current sensitivity (mA)			200	200	200	200	200	200

70HP

			Pumpless	Pump size			
Integrated pump rating output (kW)				2.2	3.7	5.5	7.5
Maximum electric current (A)			115	119	122	125	130
Power supply capacity (kVA)			79.4	82.4	84.2	86.3	89.8
Power supply wiring CSA	IV wire	Line length: 20m or less (mm^2)	60	60	60	60	60
		Line length: 50m or less (mm^2)	60	60	60	60	60
	CV wire	Line length: 20m or less (mm^2)	38	38	38	38	60
		Line length: 50m or less (mm^2)	38	38	38	38	60
Ground wire CSA (mm^2)			38	38	38	38	38
Remote switch (A)			125	125	125	125	200
Power supply fuse (A)			125	125	125	125	150
Earth leakage breaker capacity (A)			125	125	125	125	150
Earth leakage breaker current sensitivity (mA)			200	200	200	200	200

Power supply to the module controller (200/400 V)

Maximum electric current (A)			0.35
Power supply capacity (kVA)			70
Power supply wiring CSA	IV wire	Line length: 20m or less (mm^2)	2
		Line length: 50m or less (mm^2)	2
	CV wire	Line length: 20m or less (mm^2)	2
		Line length: 50m or less (mm^2)	2
Remote switch (A)			15
Power supply fuse (A)			10
Earth leakage breaker capacity (A)			10
Earth leakage breaker current sensitivity (mA)			30

Note 1. If not providing an external power source for the MC, use the accessory jumper cable.

● Power supply design physical data for single modules <Notes>

Note 1. The integrated pump can be changed to the appropriate output pump depending on the outlet pump head required for the indent. Power supply design may differ depending on the pump output, so be sure to refer to the values in the relevant column.

Note 2. Use fuses that comply with UL standards.

Note 3. When selecting a transformer or generator, select a capacity that considers the harmonic current pressure drop caused by an inverter. Regarding a capacity that takes into account the voltage drop caused by higher harmonics, confirm this with the transformer or generator manufacturer.

Note 4. The power supply capacity shows the minimum capacity required for the product only.

Note 5. The power supply wire thickness in the table applies to when the wire quantity is 3 or less to be stored in the same conduit as the rigid metal conduit (6 wires or less when utilising 2 per pole).

Note 6. The maximum power wire length and other parameters (volt drop in power wire etc.) must be determined using the National and Local regulations for the installation location.

Note 7. The values shown in the power supply tables are for maximum water flow conditions with the internal inverter pump operating at maximum frequency (60Hz).

Note 8. The ground wire CSA shown in the power supply tables is for IV type cable. Please refer to Table 1 below as a guide on how to size the ground wire depending on the power wire CSA. The table shows the minimum CSA required for the ground wire and the values should only be used as a guide. Please ensure the ground wire for the installation complies with the National and Local regulations for the installation location.

Table 1-Minimum cross-sectional area of the external protective copper conductor

Cross-sectional area of copper phase conductors supplying the equipment S mm^2	Minimum cross-sectional area of the external protective copper conductor S_P mm^2
$S \leq 16$	S
$16 < S \leq 35$	16
$S > 35$	$S/2$

Note 9. The standard electric current is a value that takes into account an 2% unbalance between power supply voltages.

Note 10. In the case of the specification for Europe, in-module power supply is the standard power supply.

3. Connecting the power supply wiring

Figure A - Power supply wiring example (using the right hand side power supply cable access)

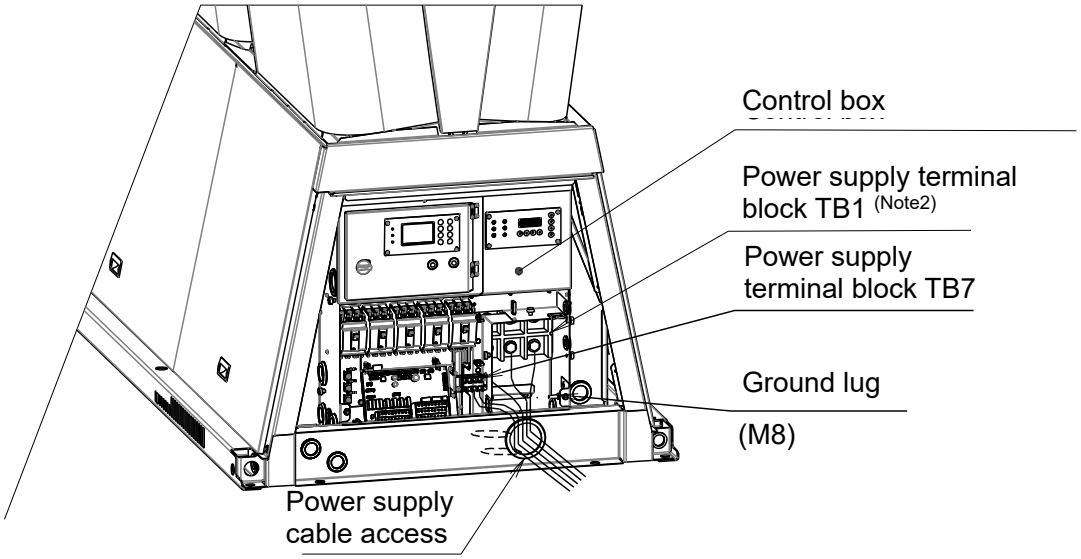
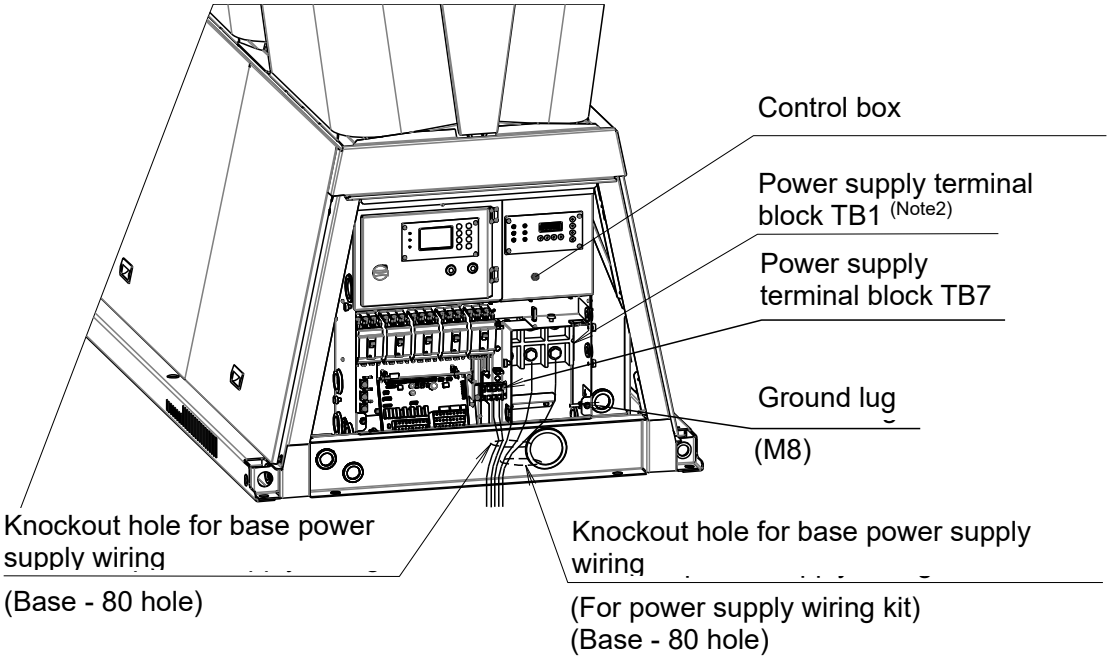


Figure B - Power supply wiring example (using the underside power supply cable access)



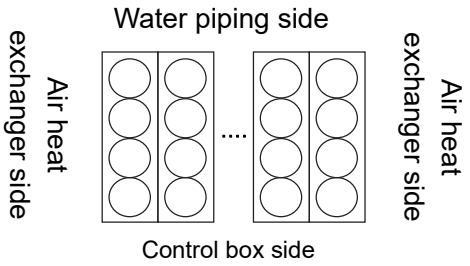
Note1. When installing the power supply cable, please use the provided power supply access points as shown in figure A and figure B.

Note2. Please refer to the table below for the power supply terminal block's (TB1) screw size and recommended torque setting.
Do not exceed the recommended torque settings. This could result in damaging the power supply terminal block (TB1).

Compatible models	Screw size	Torque value (recommended)
400V class model	M8	5.5 N•m

Noise characteristics

Noise Around the Units



Sound Power Level dB(A)

Configuration modules	Noise level
50HP 50HP(Powerful Heating Type)	83.8
60HP 60HP(Powerful Heating Type)	87.4
70HP	90.9

Sound Pressure Level dB(A)

Single Unit

Configuration modules	Control box side	Water piping side	Air heat exchanger side
50HP 50HP(Powerful Heating Type)	64.7	65.9	69.1
60HP 60HP(Powerful Heating Type)	68.2	68.3	71.2
70HP	69.7	68.6	74.0

(Note 1) Position of microphone for all measurements is 1.5 m high and 1 m from the unit.

(Note 2) Noise values measured in a quiet room or in a location with low reflected sound. Values may be higher than those shown due to the effect of reflected noise or ambient noise in the actual installation.

(Note 3) The noise values in the table are the A scale overall values.

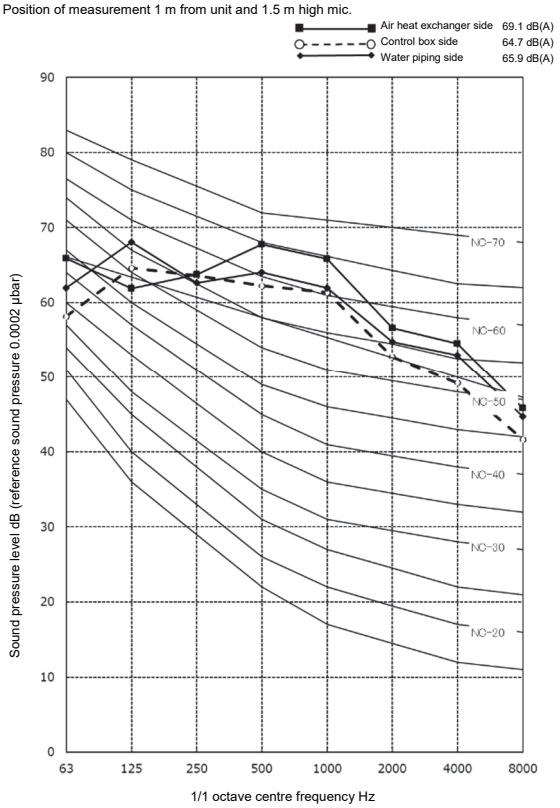
(Note 4) The sound pressure levels in the NC curve diagram are Z scale.

(Note 5) The specifications shown in the table above are for one module.

50HP, 50HP (Powerful Heating Type) ×1 module

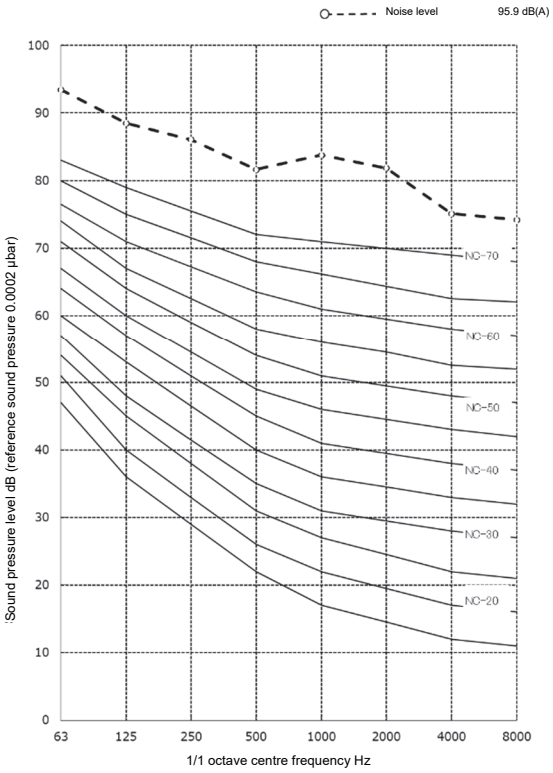
RUA-GP Series
PRESSURE LEVEL

Model type RUA-GP421 × 1 modules
Operating conditions JIS standard conditions
Location of measurement Outside
Position of measurement 1 m from unit and 1.5 m high mic.



RUA-GP Series
POWER LEVEL

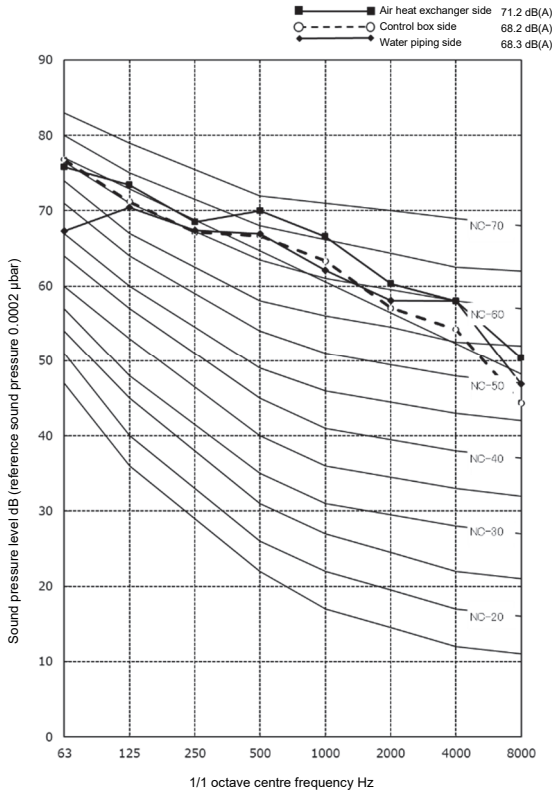
Model type RUA-GP421 × 1 modules
Operating conditions JIS standard conditions
Location of measurement Outside
Position of measurement 1 m from unit and 1.5 m high mic.



60HP, 60HP (Powerful Heating Type) ×1 module

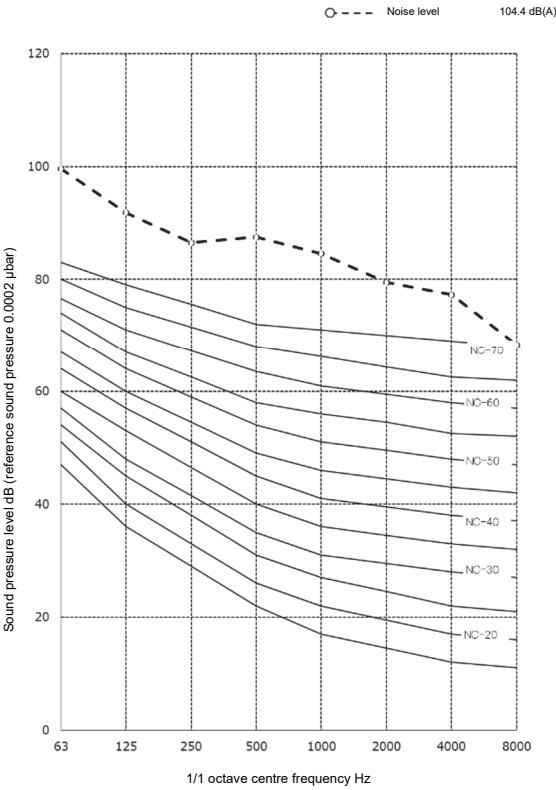
RUA-GP Series
PRESSURE LEVEL

Model type RUA-GP511 × 1 modules
Operating conditions JIS standard conditions
Location of measurement Outside
Position of measurement 1 m from unit and 1.5 m high mic.



RUA-GP Series
POWER LEVEL

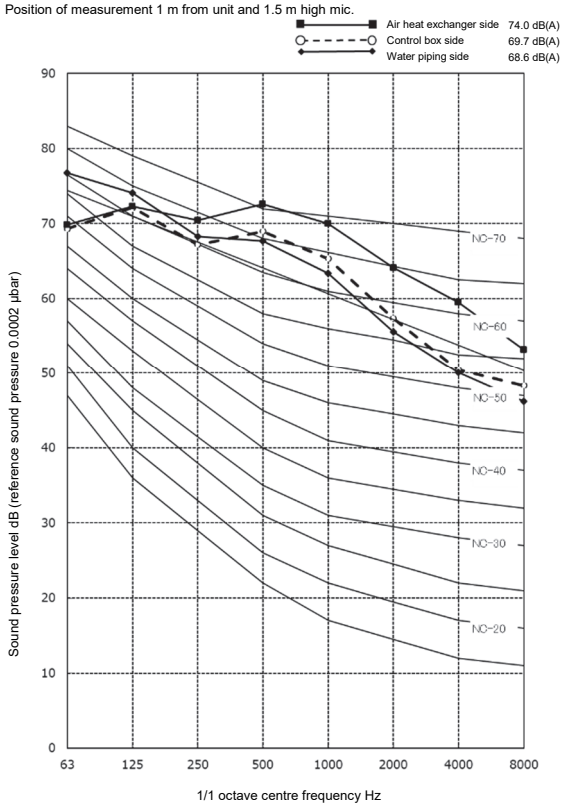
Model type RUA-GP511 × 1 modules
Operating conditions JIS standard conditions
Location of measurement Outside
Position of measurement 1 m from unit and 1.5 m high mic.



70HP ×1 module

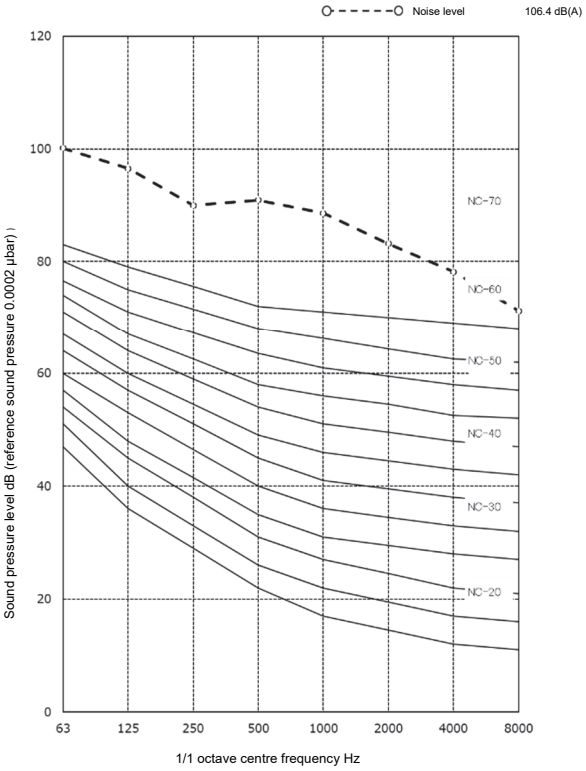
RUA-GP Series
PRESSURE LEVEL

Model type RUA-GP561 × 1 modules
Operating conditions JIS standard conditions
Location of measurement Outside
Position of measurement 1 m from unit and 1.5 m high mic.



RUA-GP Series
POWER LEVEL

Model type RUA-GP561 × 1 modules
Operating conditions JIS standard conditions
Location of measurement Outside
Position of measurement 1 m from unit and 1.5 m high mic.



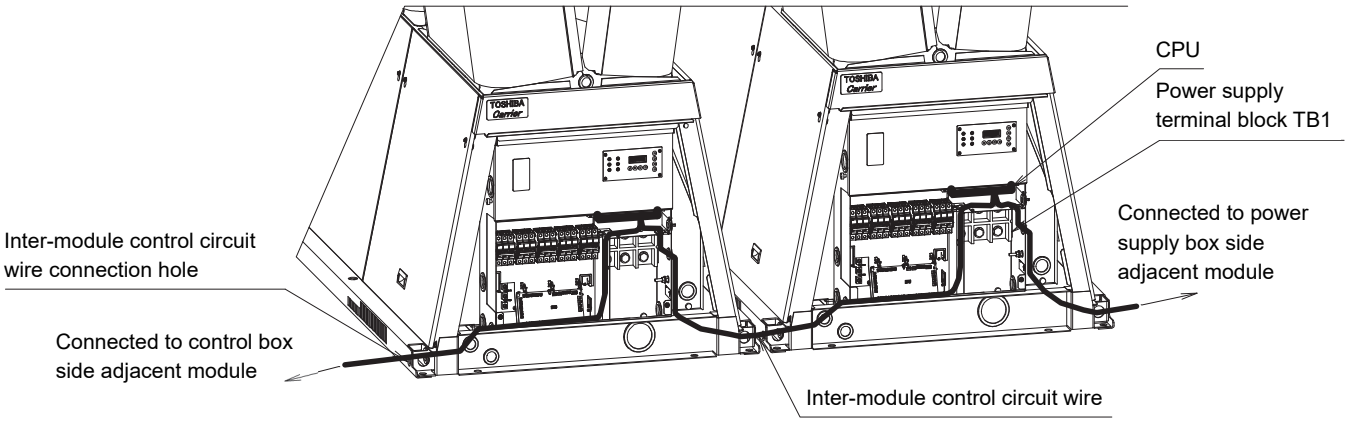
Construction of communication line between controllers (GC, MC, UC)

1. Construction of communication line between unit controllers (UC)

Isolate the electrical supply to all USX EDGE modules before removing the front cover to the electrical box.

Connect the communication wire between both unit controllers (UC) as shown in the diagram below.

* Connection of the communication line between the module controller (MC) and the unit controller (UC) is completed in the factory before the module is shipped.



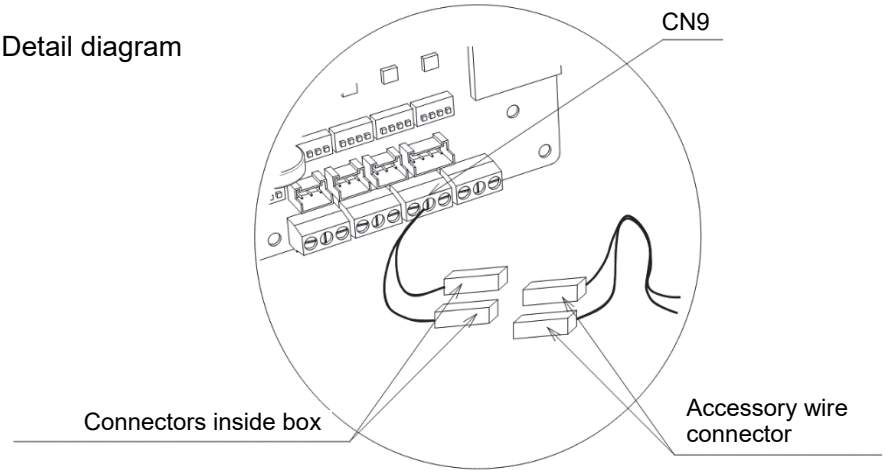
[When installing connected modules with a minimum space of 30mm between modules]

(1) The communication line accessory is stored near the power supply box on all modules that do not have a module controller fitted. Insert the accessory communication line through the inter-module control circuit wire connection hole located on the corner of the module base frame (near the electrical box).

(2) Route the communication line through the control box as shown in the diagram above. The communication line enters into the control box using the wiring access hole located on the left side of the control box.

(3) Connect the connectors of the CPU board in the control box with connectors of the communication lines for inter-module wiring. Secure the communication wire so that weight is not applied to the connecting section.

Detail diagram



[When installing connected modules with a distance greater than 30mm between modules]

(1) The accessory communication wire, supplied with the USX module, cannot be used to connect unit controllers (UC) if the distance between modules is greater than 30mm. In this case a new communication cable (locally supplied) must be prepared in accordance with Table1.

Table 1 Line size and allowable length

Nominal cross sectional area	Allowable length
0.5mm^2	50m or less
0.75mm^2	100m or less
1.5mm^2	500m or less

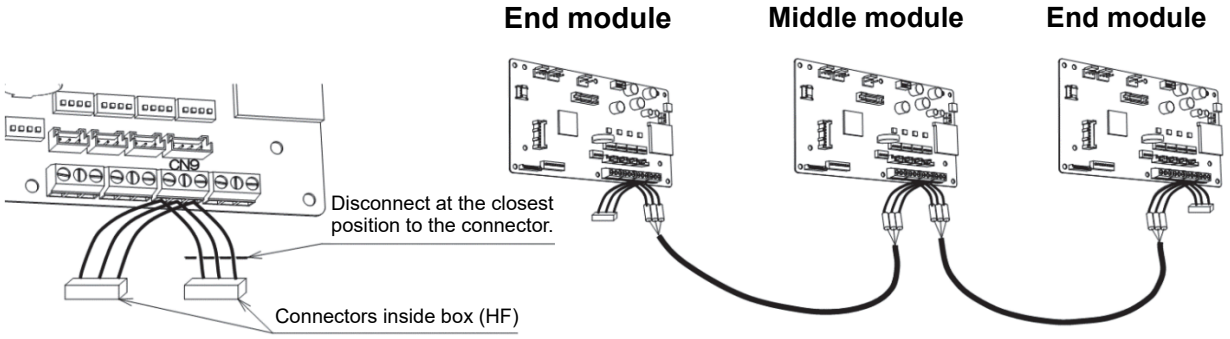
(1) Firmly fix the sleeve terminal shown below to the end of the arranged wire.

Terminal needed per 1 communication wire

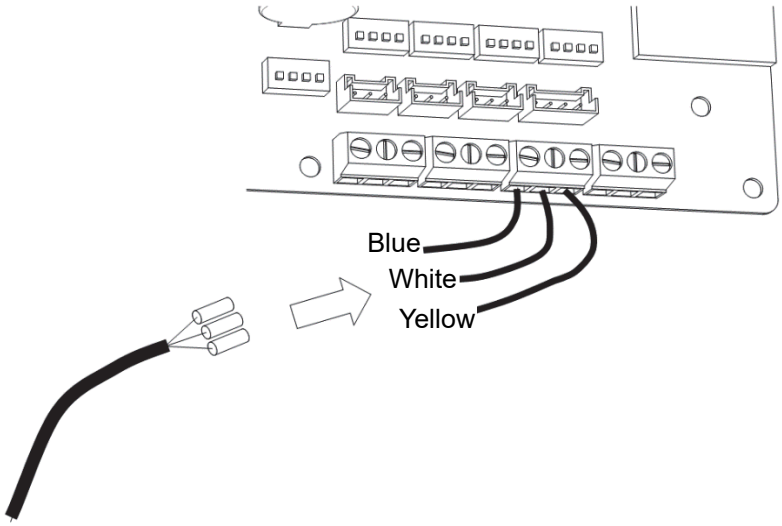
Manufacturer	Manufacturer number	Applicable wire (mm^2)	Utilised tools	Qty.
RS Components	534-288	0.50-1.50	437-0648	6

Note: The utilised tool is the manufacturers ratchet crimping tool

(2) Cut off the connectors (HM) on the wires connected to CN9 on the CPU board (located in the control box) at a position as close to the connector as possible. The number of connectors to be removed is one connector at the end module and two connectors form the middle modules installed between the module controller (MC) module and the end module in the group.



(3) Connect the twisted pair shielded wire fixed to the disconnected wire and sleeve terminal. When doing so, ensure that the wire colours (blue, white, yellow) match the colours (blue, white, yellow) of the adjacent module.



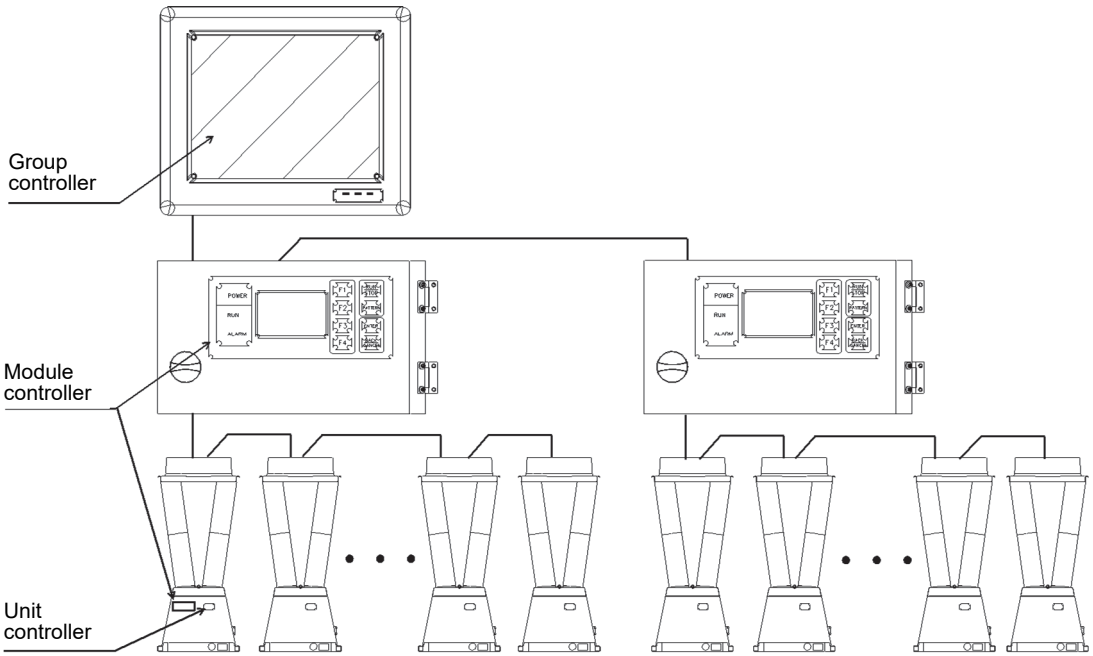
CAUTION

1. The communication wire (RS485) is a low voltage circuit. Do not run the communication wire in parallel with the power cable for each USX EDGE module.
2. Ensure a distance of at least 300mm between the communication wires and the heat pump power supply wire.
3. Ensure a distance of at least 300mm between the communication wires and all other power supply wires.
4. If power supply wires are run alongside the communication wire within the distance specified above, the communication wire should be run inside a steel conduit.
5. When using shielded wire run the wire inside a steel conduit.
6. Do not wire the control wire with a multi-core cable identical to the power wire.
7. Do not wire other control wires together with the same multi-core cable.
8. If high-frequency components are nearby, install the unit at least 3m away.
   Store control wire in the steel conduit.

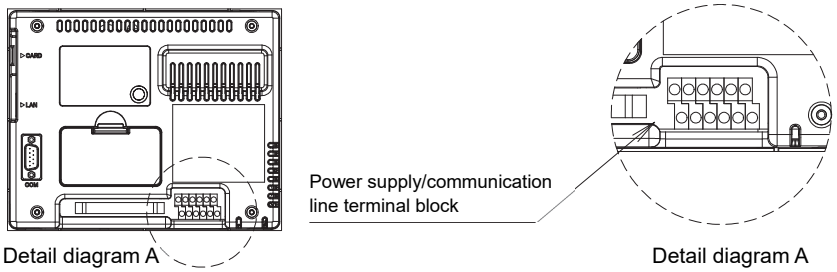
2. Construction of communication line between GC-MC and MC-MC

(1) Controller relationship

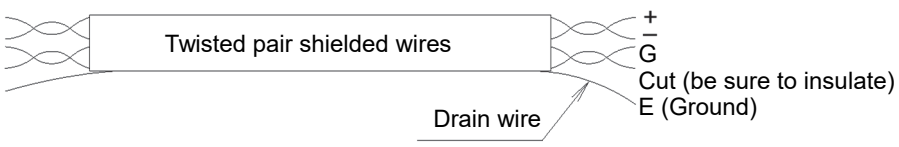
When several unit controllers (UC) in the heat pump are interlocked, there is a module controller (MC) that controls them as a group. Up to 16 UC can be controlled by 1 MC, and are incorporated inside the representative module. Also, there is a group controller (GC) that manages the operation of the module controllers as a group. 1 GC can control up to 8 MC.



(2) Construction of communication line between GC-MC and MC-MC



・Use twisted paired shielded cables.



Nominal cross sectional area	Allowable length
0.75 mm^2	100 m or less
1.5 mm^2	500 m or less

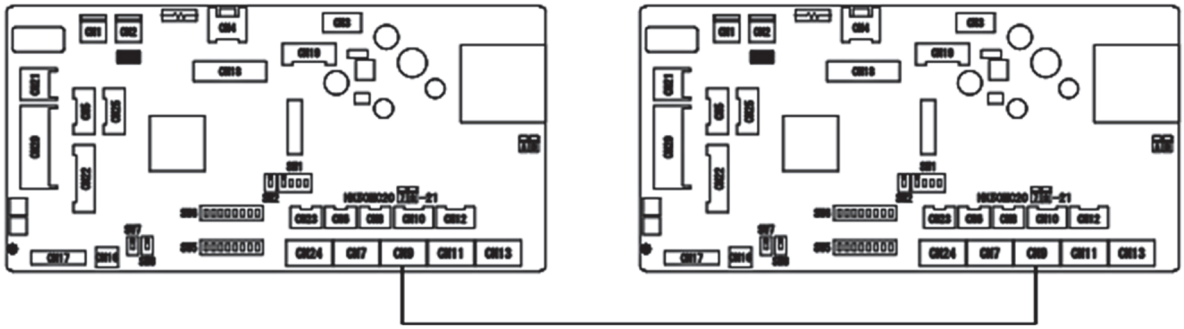
* The connection terminal is included with the GC

Rod terminal type	Single type
Rod terminal model	TGN TC-1.25-9T (Made by NICHIFU Co., Ltd.)
Applicable tool model	NH65 (Made by NICHIFU Co., Ltd.)

Rod terminal type	Double type
Rod terminal model	TGWV TC-1.25-9T (Made by NICHIFU Co., Ltd.)
Applicable tool model	NH65 (Made by NICHIFU Co., Ltd.)

(3) Construction of communication wire between MC and MC

As shown in the diagram below, connect the CN9 module controller circuit boards to each other. Also, if you are connecting 2 communication cables to a CN9, crimp the two communication cables to one rod terminal.



CAUTION

1. The communication wire (RS485) is a low voltage circuit. Do not run the communication wire in parallel with the power cable for each USX EDGE module.
2. Ensure a distance of at least 300mm between the communication wires and the heat pump power supply wire.
3. Ensure a distance of at least 300mm between the communication wires and all other power supply wires.
4. If power supply wires are run alongside the communication wire within the distance specified above, the communication wire should be run inside a steel conduit.
5. When using shielded wire run the wire inside a steel conduit.
6. Do not wire the control wire with a multi-core cable identical to the power wire.
7. Do not wire other control wires together with the same multi-core cable.
8. If high-frequency components are nearby, install the unit at least 3m away.
   Store control wire in the steel conduit.

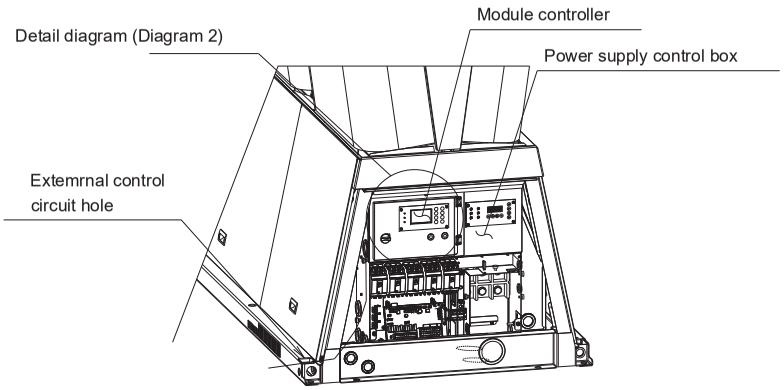
Connecting the heat pump external wiring

When wiring heat pump external wiring (locally procured) such as the chilled (warm) water pump interlock, follow the below procedure.

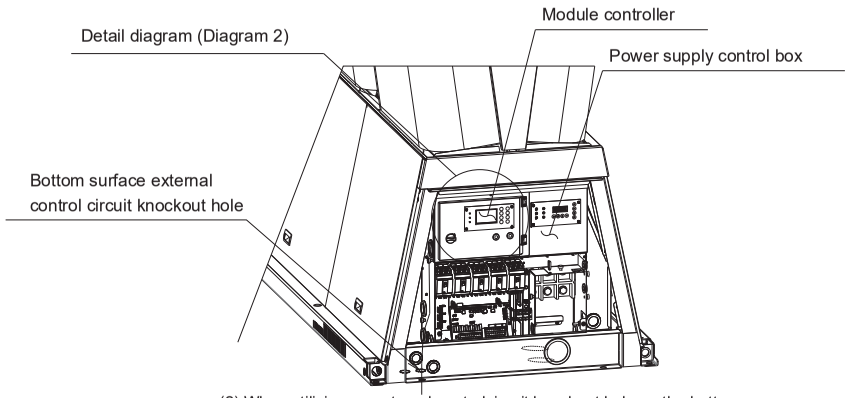
1. Pass the external wiring through the control circuit wire connection hole between modules and thehole in the left side of the control box (The highest hole in the control box).
2. fix the terminal (M3) to the end of the external wiring and then connect that wiring to the terminal No. position shown in the electrical wiring diagram.
3. Secure the external wiring with a lead wire clamp so that weight is not applied to the terminalsection.
4. When processing a hole for the external control circuit or a knockout hole for the external control circuit for passing the control circuit wire through, ensure that the hole edge is protected and water or dust etc. does not enter the module.

Different power supply specifications

1. Remove the Connecting wire from the Module controller power terminal block.
2. Pass the wire from a power supply different to the module base unit through the power supply wiring hole at the side or bottom. Then wire it to the primary side (bottom side) of the Module controller power terminal block.
3. Secure the power supply wiring with a lead wire so that weight is not applied to the terminal section. (Diagram 3)
4. 3.The power supply capacity of the module controller is 10VA.



(1) When utilising an external control curcuit hole on the side



(2) When utilising an external controlcircuit knockout hole on the bottom

Diagram 1 Example of heat pump external wiring

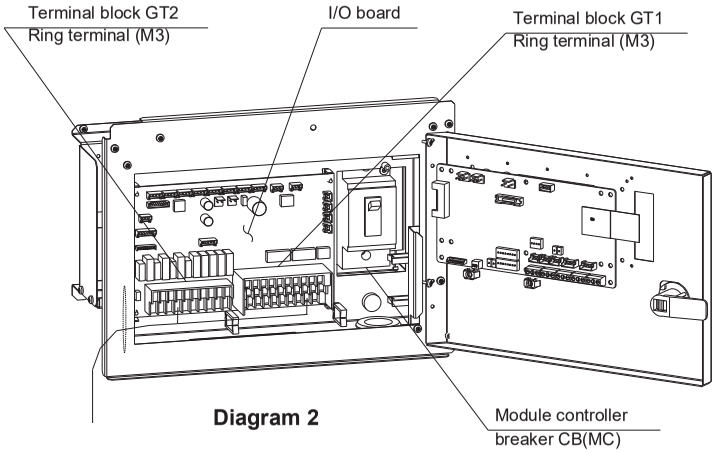


Diagram 2

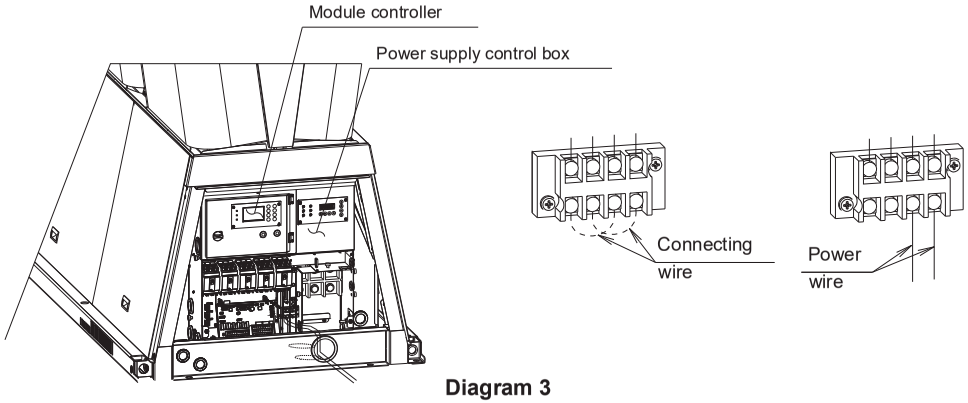
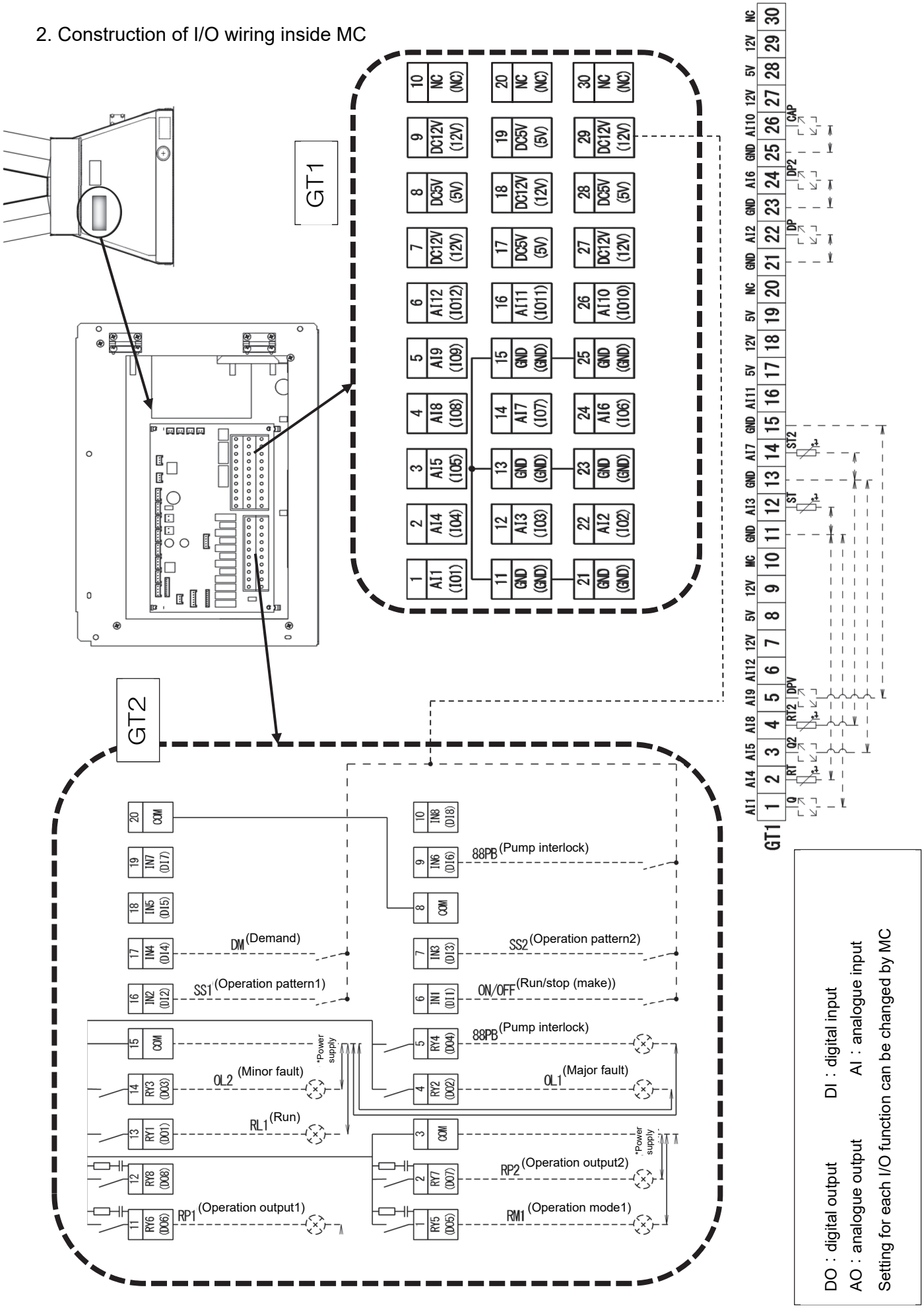


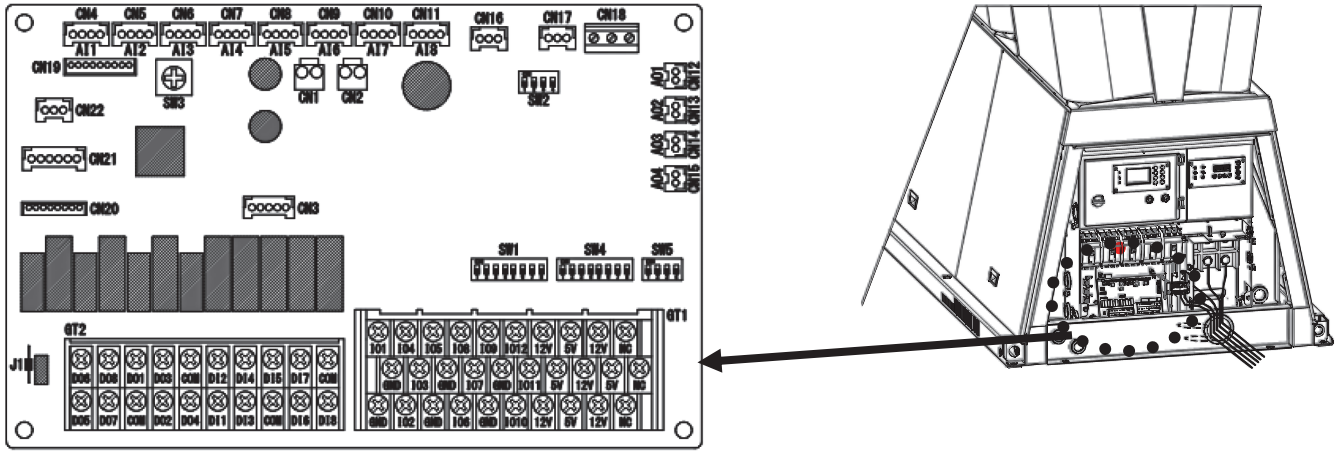
Diagram 3
Different power supply wiring example

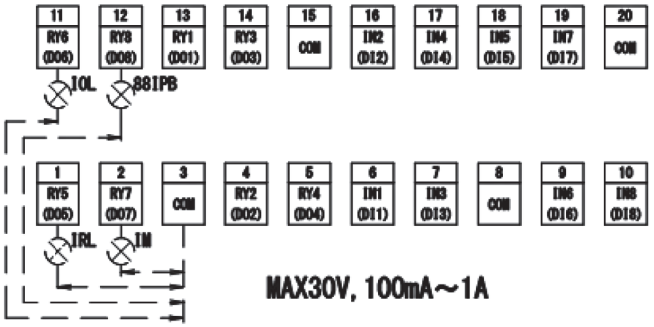
2. Construction of I/O wiring inside MC



IO-BOARD digital output

IO-BOARD digital output of each Module





Note 1: Take care not to mistake the unit controller (UC) I/O board with the module controller (MC) I/O board).

Note 2: This feature only outputs information about this module.

Note 3: Do not apply voltage to the no-voltage a-contact input terminal.

Note 4: Use the terminals, supplied with the USX EDGE module, when directly connecting wires for the digital outputs to the GT2 terminal block on the unit controller (UC) I/O board.

Note 5: Avoid carring out connection work on rainy days.
If it is unavoidable, open the access panel after taking measures to protect against rainfall.

Note 6: Use each GT2 output contact within a range of AC/DC 30V or less , and a contact current of 100mA to 1A.
The output contacts have a spark killer (120Ω/0.33μF) for inductive loads.

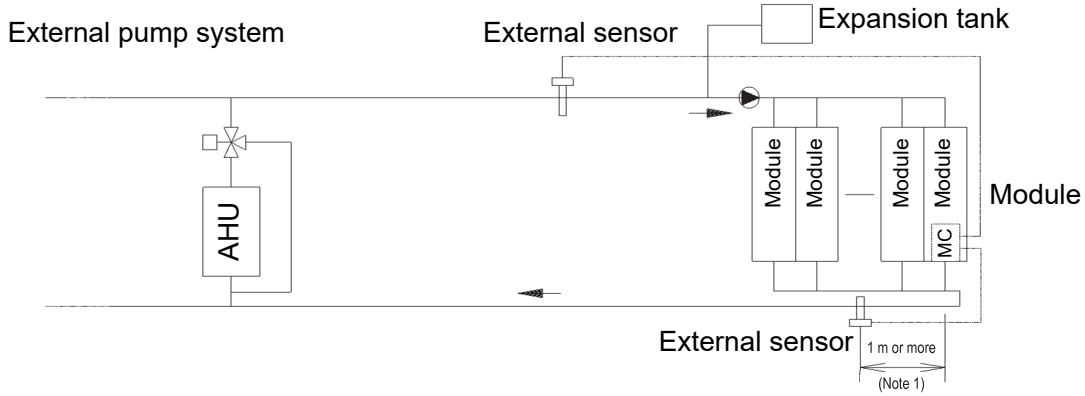
Output table (No-voltage a-contact continuous output)

Code	Terminal No.	Name	Description
IRL	GT2.1(DO5)-GT2.3(COM)	Compressor run	Outputs when the compressor is operating (contact on board becomes "Closed" when one compressor is running).
IOL	GT2.9(IN6)-GT2.20(COM)	Individual fault	Outputs when there is a fault.
IM	GT2.2(DO7)-GT2.3(COM)	Individual mode	Outputs the cooling/heating operating mode(contact on the board becomes "Closed" during heating).
88IPB	GT2.12(DO8)-GT2.3(COM)	Individual pump group operation	Used for group operating of external pumps, etc.

External sensor (for 2nd group)

1. Pumpless model control outline and sensor mounting position

Attach external sensors to supply/return water pipes, and connect them with the module controller. This will enable the module controller to monitor supply/return water temperature in the pipes of each module.

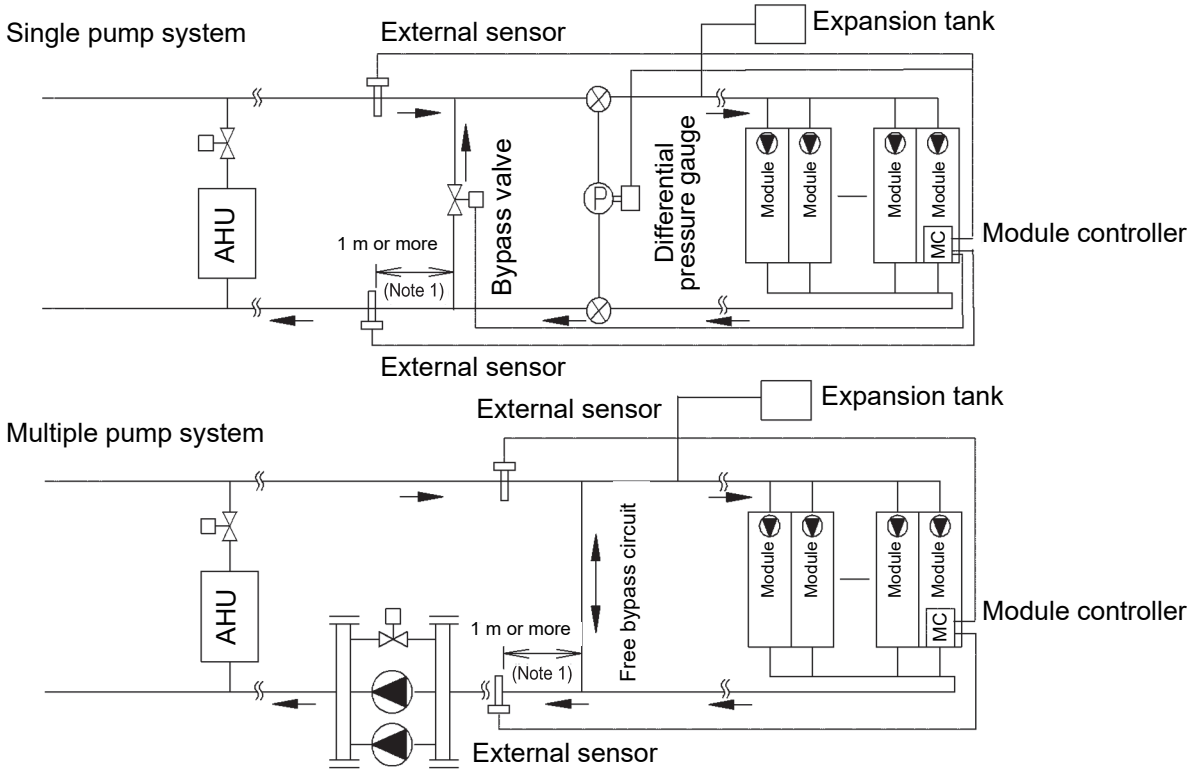


Note 1: To detect feed water temperature accurately, install the external sensor for supply water temperature 1 m or more apart from the junction.

Note 2: The external sensor wire is 30 m long. Consult with us if you need wire exceeding 30 m in length.

12-6-2. Outline of controlling a model with integrated inverter pump and sensor mounting position

The external sensor is used to detect an unbalance between the required load-side water flow and heat pump-side water flow, and to control the quantity and operating frequency of integrated pumps for chilled (warm) water circulation.



Note 1: To detect feed water temperature accurately, install the external sensor for supply water temperature 1 m or more apart from the junction.

Note 2: To prevent short cycling of chilled (warm) water by the module internal pump, install the bypass pipe in a place where the minimum holding water volume can be secured.

Note 3: The external sensor wire is 30 m long. Consult with us if you need wire exceeding 30 m in length.

Refrigerant recovery and charging

Refrigerant recovery and charging

This unit uses R32 refrigerant, which is a near-azeotropic mixture with an ozone depletion potential of 0. When charging the refrigerant, be sure to use R32 only. The table below shows enclosed capacities and global warming potential (GWP). In the event of a refrigerant leak, the systems refrigerant will need to be recovered and the leaks repaired. Once recovered, check for leaks, vacuum the system and then charge the system to the specified refrigerant amount. The system must be charged as a liquid and from the liquid line service port. Issues can arise when charging the system as a gas result in the refrigerant turning into a two phase mixture. composition changes are highly likely when charging as a gas so it is highly important to charge as a liquid.

Refrigerant			
Type	Number	Enclosed capacity (kg)	Global Warming Potential (GWP)
HFC	R32	35.2	675

Note

Never use anything other than the specified refrigerant (R32) when refilling or changing.
If a refrigerant other than that specified is used, it could cause the heater to break or rupture and cause an injury.

Salt and heavy salt resistant specifications

1. Selecting salt and heavy salt resistant specifications

1. Refer to the below table as a guide when selecting salt damage specifications or heavy salt damage specifications.
   "L" shows salt damage specifications and "H" shows heavy salt damage specifications.
   Select the salt damage specifications (L) or heavy salt damage specifications (H) after identifying the operating environment and results of that region.
   Installation distance guide (conditions differ according to the installation environment)

- Places not directly exposed to salty wind

	Installation distance guide		
	300m	500m	1km
(1) Regions facing an inland sea	L		–
(2) Regions facing the ocean	H		L
(3) Islands	H		L

- Places directly exposed to salty wind

	Installation distance guide		
	300m	500m	1km
(1) Regions facing an inland sea	H	L	–
(2) Regions facing the ocean	H		L
(3) Islands	H		

2. Salt-damage and heavy salt damage specifications are utilised near the coastline. Consult us if you are installing the product in a spa region or a location that uses chemical agents.
3. Even heavy salt damage specifications may not be completely effective at preventing rusting. The longevity of components greatly depends on the installation status and operating environment of components, so pay attention to the below points.

Installation

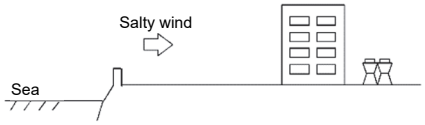
1. Components must be installed on the lee side of a building. (If they must be installed in a location facing the sea, provide a wind shield to prevent direct exposure to salty wind.)
2. Pay attention to the installation direction. (Orient the components in a direction where there is as little exposure to salty wind as possible.)
3. Install components in locations with good drainage.
4. Install components in locations exposed to rainfall.
5. Repair scratches made during installation.

During maintenance

1. Regularly inspect the state of components and, if necessary, re-treat to prevent rusting (applying waterproof wax, etc.) and replace parts.
2. When leaving machines idle for a long time, such as during the off season, treat them by, for example, placing a cover over them.
3. Repair scratches made during maintenance.

Definition of terms (extract from Salt Resistance Test Standards for Air Conditioners (JRA9002-1991), Japan Refrigeration and Air Conditioning Industry Association)

Salt damage specifications
This refers to specifications concerning installation in locations which, although not exposed to salty wind, are in a similar atmosphere.



High resistance to salt specifications
This refers to specifications concerning installation in locations which are exposed to salty wind. However, components are not directly exposed to water containing salt.

2. List of treatment specifications

● JRA salt damage treatment

Applicable place	Standard specifications			Salt damage specifications			
	Material	Base processing	Top coat	Material	Base processing	Under coat	Top coat
Outer plate frame	Surface treated steel	Zinc phosphate film treatment	Polyester powder coating film thickness of 45μ or more Single side coating	Surface treated steel	Zinc phosphate film treatment	–	Polyester powder coating Film thickness of 60μ or more Double side coating
Bottom plate Drain pan	Surface treated steel	Zinc phosphate film treatment	Polyester powder coating film thickness of 45μ or more Single side coating	Surface treated steel	Zinc phosphate film treatment	–	Polyester powder coating Film thickness of 60μ or more Double side coating
Base	Surface treated steel	Zinc phosphate film treatment	Polyester powder coating film thickness of 45μ or more Single side coating	Surface treated steel	Zinc phosphate film treatment	–	Polyester powder coating Film thickness of 60μ or more Double side coating
Screw	SWCH+Zinc-nickel alloy plating treatment	–	–	Stainless steel material (SUS304) + zinc-nickel alloy plating treatment	–	–	–
Bolts and nuts	SWCH+zinc-nickel alloy plating treatment SS,SC+zinc plating	–	–	Stainless steel material (SUS304) + zinc-nickel alloy plating treatment	–	–	–
Bolts and nuts (General concealing parts)	SS, SC+zinc plating	–	–	SS, SC+zinc plating	–	–	–
Air heat exchanger (Fin)	Aluminium+ Resin coating	–	–	Aluminium+ Resin coating	–	–	–
Propeller fan	AS-G resin	–	–	AS-G resin	–	–	–
Fan motor	Die-cast aluminium	–	–	Die-cast aluminium	–	–	–
Fan guard	Low-carbon steel rods	Zinc plating	Polyethylene coating	Low-carbon steel rods	Zinc plating	–	Polyethylene coating
Discharge cabinet	PP resin	–	–	PP resin	–	–	–
Switch box Other concealed sheet metal	Galvanized sheet iron	–	–	Surface treated steel	Zinc phosphate film treatment	–	Polyester powder coating film thickness of 60μ or more Double-side coating
Heat exchanger (Plate-style)	SUS316 equivalent	–	–	SUS316 equivalent	–	–	–
Water piping	SUS304 equivalent	–	–	SUS304 equivalent	–	–	–

● JRA heavy salt damage treatment

Applicable place	Standard specifications			High resistance to salt specifications			
	Material	Base processing	Top coat	Material	Base processing	Under coat	Top coat
Outer plate frame	Surface treated steel	Zinc phosphate film treatment	Polyester powder coating film thickness of 45μ or more Single side coating	Surface treated steel	Zinc phosphate film treatment	–	Polyester powder coating Film thickness of 60μ or more Double side coating
Bottom plate Drain pan	Surface treated steel	Zinc phosphate film treatment	Polyester powder coating film thickness of 45μ or more Single side coating	Surface treated steel	Zinc phosphate film treatment	–	Polyester powder coating Film thickness of 60μ or more Double side coating
Base	Surface treated steel	Zinc phosphate film treatment	Polyester powder coating film thickness of 45μ or more Single side coating	Surface treated steel	Zinc phosphate film treatment	–	Polyester powder coating Film thickness of 60μ or more Double side coating
Screw	SWCH+Zinc-nickel alloy plating treatment	–	–	Stainless steel material (SUS304) + zinc-nickel alloy plating treatment	–	–	–
Bolts and nuts	SWCH+zinc-nickel alloy plating treatment SS,AC+zinc plating	–	–	Stainless steel material (SUS304) + zinc-nickel alloy plating treatment	–	–	–
Bolts and nuts (General concealing parts)	SS, SC+zinc plating	–	–	SS, SC+zinc plating	–	–	–
Air heat exchanger (Fin)	Aluminium+ Resin coating	–	–	Aluminium+ High corrosion resistant resin coat End plate(SUS)	–	–	Epoxy corrosion resistant coating
Propeller fan	AS-G resin	–	–	AS-G resin	–	–	–
Fan motor	Die-cast aluminium	–	–	Die-cast aluminium	–	–	–
Fan guard	Low-carbon steel rods	Zinc plating	Polyethylene coating	Low-carbon steel rods	Zinc plating	–	Polyethylene coating
Discharge cabinet	PP resin	–	–	PP resin	–	–	–
Control box Other concealed sheet metal	Galvanized sheet iron	–	–	Surface treated steel	Zinc phosphate film treatment	–	Polyester powder coating film thickness of 60μ or more Double-side coating
Water heat exchanger (Plate-style)	SUS316 equivalent	–	–	SUS316 equivalent	–	–	–
Water piping	SUS304 equivalent	–	–	SUS304 equivalent	–	–	–

Note 1. Coating specifications Standard specifications: One-side coating (some double-side) Salt damage specifications / heavy salt damage specifications: Double-side coating (all sheet metal parts)

Note 2. “Salt damage/heavy salt damage specifications” are based on the JRA9002 standard of Japan Refrigeration and Air Conditioning Industry Association.

Note 3. Regarding the integrated pump, both “Salt damage specifications” and “Heavy salt damage specifications” will be the same as the standard specifications of the pump manufacturer.

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