MITSUBISHI ELECTRIC

Changes for the Better

CONDENSING UNIT

DATA BOOK

MODEL

ECOV-X15VA (-BS)

CONTENTS

ECOV-X-VA (-BS)

CONTENTS

1-1. Specifications

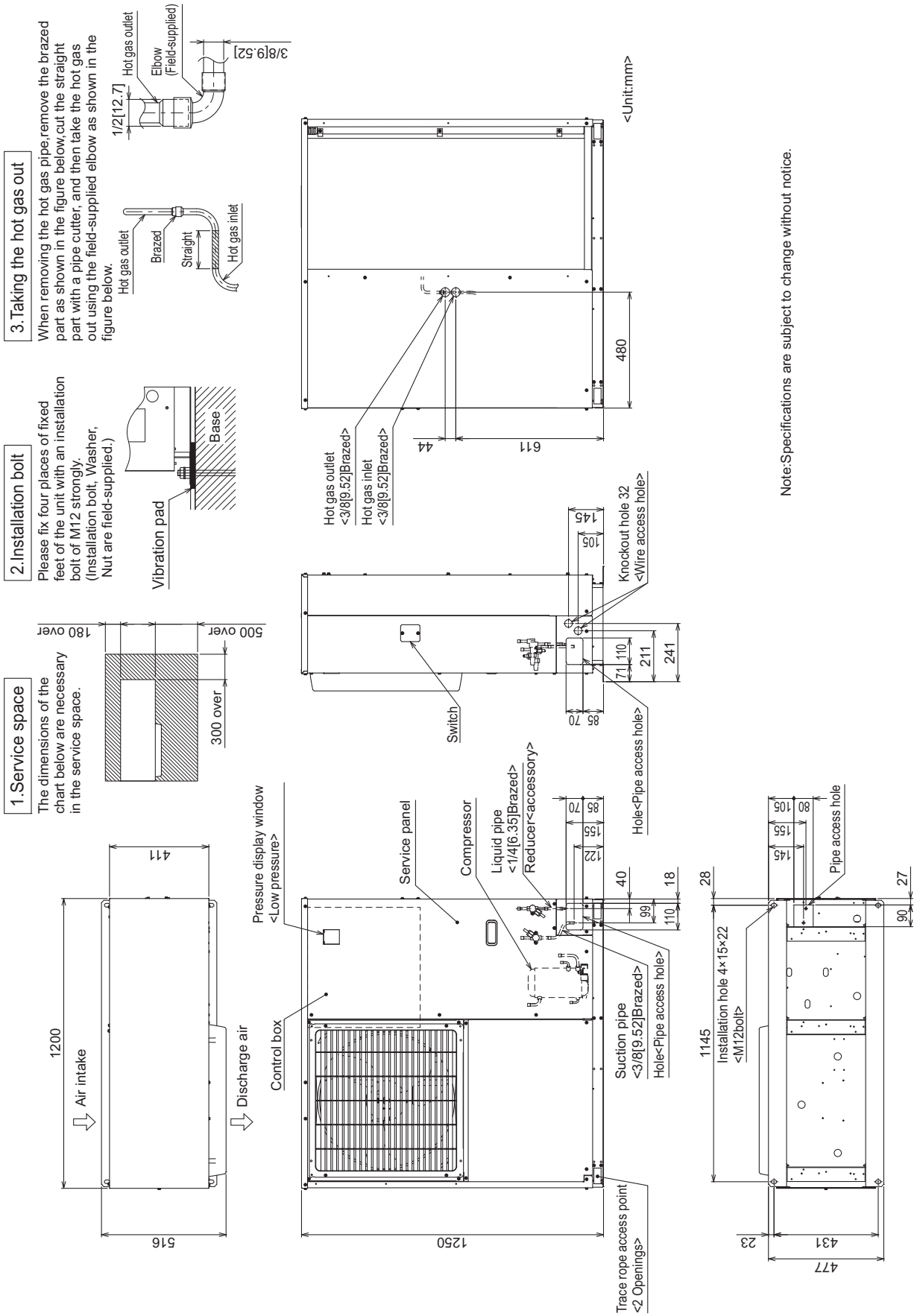
Item				Unit	ECOV-X15VA(-BS) <2HP>
Nominal output				kW	1.5
Suction pressure saturation temperature range				°C	-45 ~ -5
Refrigerant type				–	R744
Installation conditions				–	Outdoor installation
				°C	Ambient temperature -25 ~ +43
Power supply				–	Single phase 220-230-240V 50Hz
Electrical Characteristics	Power consumption		ET = -10deg <Note.1>	kW	1.90
			ET = -35deg <Note.1>	kW	1.72
	Operating current		ET = -10deg	A	9.0-8.6-8.2
			ET = -35deg	A	8.0-7.7-7.4
	Power factor		ET = -10deg <Note.5>	%	96.5
			ET = -35deg <Note.5>	%	97.3
	Starting current			A	5.5-5.3-5.1
Operating frequency				Hz	37 ~ 70
Refrigerating capacity			ET = -10deg <Note.1>	kW	4.00
			ET = -35deg <Note.1>	kW	1.98
COP			ET = -10deg <Note.1>	–	2.10
			ET = -35deg <Note.1>	–	1.15
Compressor	Model			–	C-CV163L0A (Rotary)
	Crank case heater			W	20
Lubricant	Type			–	PZ68S
	Charged amount	Compressor		L	0.3
		Others		L	0.4
Gas cooler	Heat exchanger type			–	All aluminum flat tube fin
	Fan	Motor output		W	74 × 1
		Fan diameter		mm	ø550 × 1
	Air flow rate <Note.8>			m^3/min	77.4
	Saturation pressure adjustment device			–	Electronic fan controller
Liquid receiver		Capacity		L	2.3
Capacity control				–	Inverter type
Startup method				–	Inverter startup
High-pressure-cut prevention function				–	Standard
Protection device <Note.4>	Pressure switch <high pressure/low pressure>			–	High pressure: Standard (Mechanical) Low pressure: Standard (Digital)
	Overcurrent protection			–	Standard
	Thermal switch (discharge pipe)			–	–
	Thermal switch (compressor inner thermostat)			–	–
	Fuse	For control circuit		–	250V 3.15A × 1, 6A × 1
		For gas cooler fan		–	250V 5A × 1
		For gas cooler fan power supply		–	250V 6.3A × 1
	Reverse phase preventer			–	–
	Discharge temperature detection protection			–	Standard
Built-in device				–	Suction accumulator (2.0L)
Communication <Note.6>				–	MODBUS®
Accessories		Spare fuse		–	6A
		Other		–	Connector for emergency operation
				–	Termination resistance for MODBUS®
				–	Reducer
External finish				–	MUNSELL 5Y 8/1 approximate color
External dimensions <Height × Width × Depth> <Note.7>				mm	1,250 × 1,200 × 477 (+ 39)
Weight	Package weight			kg	125
	Net weight			kg	115
Pipe size		Suction pipe		mm	ø9.52
		Liquid pipe <Note.2>		mm	ø6.35
		Hot gas pipe		mm	–
Maximum piping length (equivalent)				m	25
Sound pressure level			ET = -10deg <Note.3>	dB (A)	56.0
			ET = -35deg <Note.3>	dB (A)	54.0
Electrical wiring <Note.8>	Electric wire size <Note.9>			mm^2<m>	3.2<18>
	Maximum Circuit Amp (MCA)			A	10.5
	Overcurrent protection			A	Local switch: 16/Branch switch: 16
	Switch capacity			A	Local switch: 16/Branch switch: 16
	Control circuit wire size			mm^2	2.0
	Grounding wire diameter			mm^2	2.0

Note

1.Measurement conditions are as follows.
Ambient temperature: 32°C
Suction gas temperature (ET = -10°C): 0°C
Suction gas temperature (ET = -35°C): -25°C
Compressor operating frequency: 70Hz
Fan control: Target condensation temperature = Ambient temperature + 5°C (Air flow rate is 80% of maximum air flow rate.)
2.Use the included reducer to connect the liquid piping.
3.Measurement conditions of sound pressure level are as follows.
Ambient temperature: 32°C
Measurement location: Distance from the front of the unit 1m, height 1m
Compressor operating frequency: 70Hz
Fan control: Target condensation temperature = Ambient temperature + 5°C (Air flow rate is 80% of maximum air flow rate.)
4.A sight glass and a dryer must be installed on the liquid pipe.
Install a pressure relief device in accordance with applicable local regulations.
Please procure these parts locally.
5.Power condenser cannot be installed.
6.MODBUS® is a registered trademark of SCHNEIDER ELECTRIC USA. INC in the United States.
7.The maximum value of depth is the value obtained by adding the numbers in parentheses. Please refer to the external dimensions.
8.Maximum air flow rate varies with high pressure.
9.The figures in the angle brackets in the "Electric wire size" row indicate the maximum wire length where the voltage drop is 2.2V or less.
10.Install an earth leakage breaker.
An earth leakage breaker with at least 3 mm (2/16 in.) contact separation in each pole shall be provided by the installer.
Leaked current varies depending on wire length, wire routing, and/or presence of devices that emit high frequency.
Select high-harmonic-type earth leakage breakers.

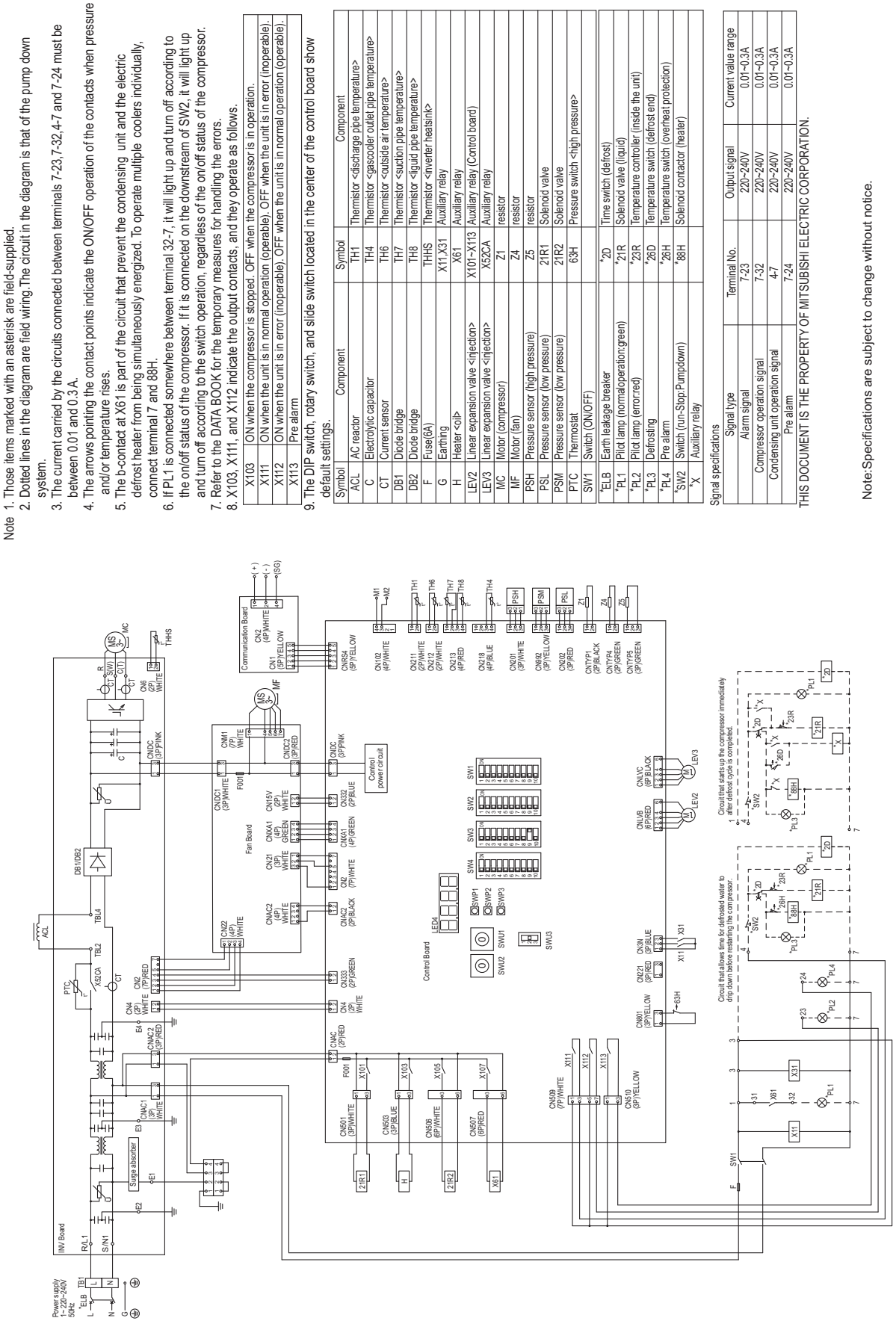
1-2. External dimensions

ECOV-X15VA(-BS)



1-3. Electrical wiring diagram

ECOV-X15VA(-BS)



Note 1. Those items marked with an asterisk are field-supplied.
2. Dotted lines in the diagram are field wiring.The circuit in the diagram is that of the pump down system.
3. The current carried by the circuits connected between terminals 7-23,7-32,4-7 and 7-24 must be between 0.01 and 0.3 A.
4. The arrows pointing the contact points indicate the ON/OFF operation of the contacts when pressure and/or temperature rises.
5. The b-contact at X61 is part of the circuit that prevent the condensing unit and the electric defrost heater from being simultaneously energized. To operate multiple coolers individually, connect terminal 7 and 88H.
6. If PL1 is connected somewhere between terminal 32-7, it will light up and turn off according to the on/off status of the compressor. If it is connected on the downstream of SW2, it will light up and turn off according to the switch operation, regardless of the on/off status of the compressor.
7. Refer to the DATA BOOK for the temporary measures for handling the errors.
8. X103, X111, and X112 indicate the output contacts, and they operate as follows.

X103	ON when the compressor is stopped. OFF when the compressor is in operation.
X111	ON when the unit is in normal operation (operable). OFF when the unit is in error (inoperable).
X112	ON when the unit is in error (inoperable). OFF when the unit is in normal operation (operable).
X113	Pre alarm

9. The DIP switch, rotary switch, and slide switch located in the center of the control board show default settings.

Symbol	Component	Symbol	Component
ACL	AC reactor	TH1	Thermistor <discharge pipe temperature>
C	Electrolytic capacitor	TH4	Thermistor <gascooler outlet pipe temperature>
CT	Current sensor	TH6	Thermistor <outside air temperature>
DB1	Diode bridge	TH7	Thermistor <suction pipe temperature>
DB2	Diode bridge	TH8	Thermistor <liquid pipe temperature>
F	Fuse(6A)	THHS	Thermistor <inverter heatsink>
G	Earthing	X11,X31	Auxiliary relay
H	Heater <oil>	X61	Auxiliary relay
LEV2	Linear expansion valve <injection>	X101~X113	Auxiliary relay (Control board)
LEV3	Linear expansion valve <injection>	X52CA	Auxiliary relay
MC	Motor (compressor)	Z1	resistor
MF	Motor (fan)	Z4	resistor
PSH	Pressure sensor (high pressure)	Z5	resistor
PSL	Pressure sensor (low pressure)	21R1	Solenoid valve
PSM	Pressure sensor (low pressure)	21R2	Solenoid valve
PTC	Thermostat	63H	Pressure switch <high pressure>
SW1	Switch (ON/OFF)		
*ELB	Earth leakage breaker	*2D	Time switch (defrost)
*PL1	Pilot lamp (normaloperation:green)	*21R	Solenoid valve (liquid)
*PL2	Pilot lamp (error:red)	*23R	Temperature controller (inside the unit)
*PL3	Defrosting	*26D	Temperature switch (defrost end)
*PL4	Pre alarm	*26H	Temperature switch (overheat protection)
*SW2	Switch (run-Stop:Pumpdown)	*88H	Solenoid contactor (heater)
*X	Auxiliary relay		

Signal specifications

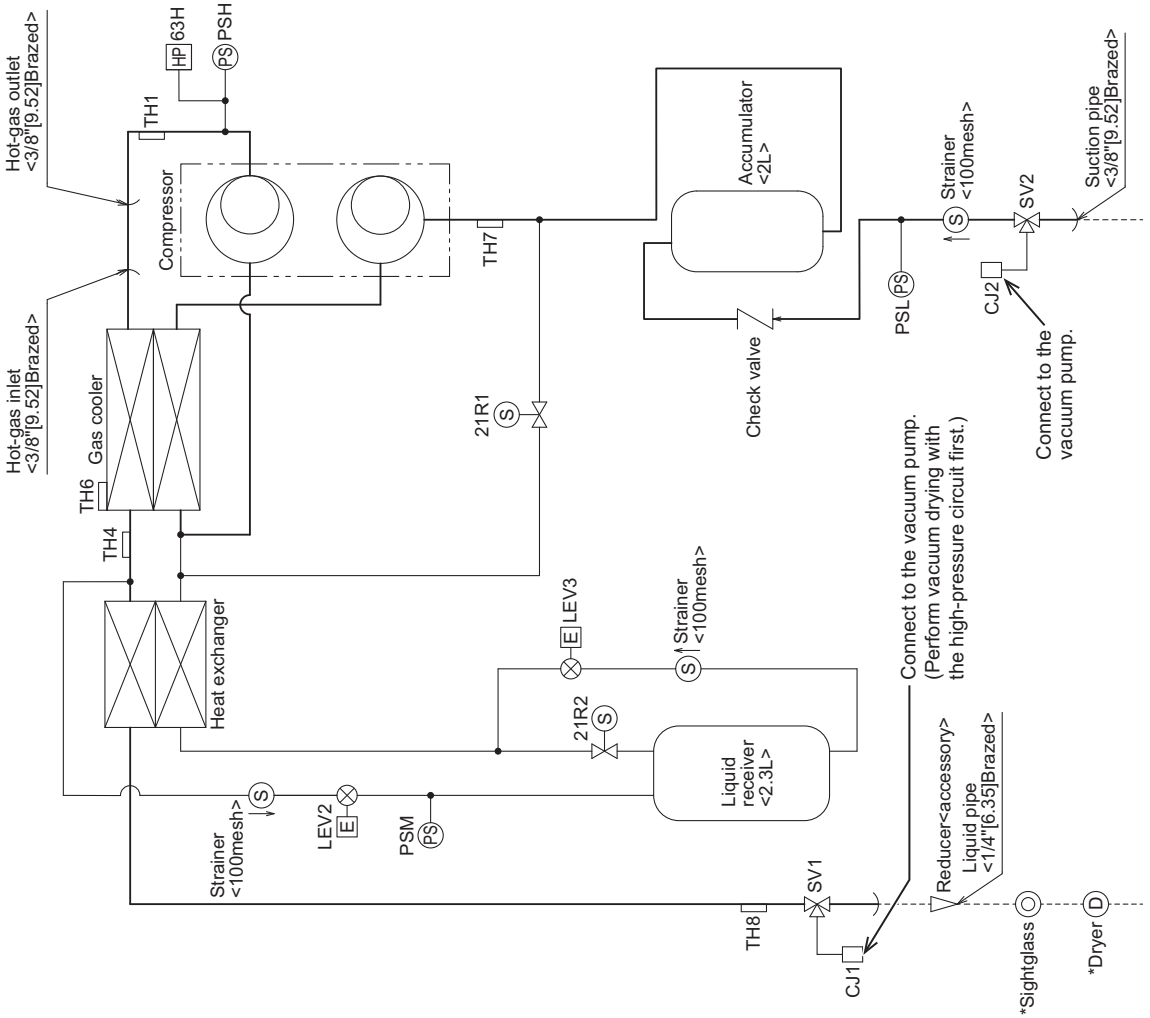
Signal type	Terminal No.	Output signal	Current value range
Alarm signal	7-23	220~240V	0.01~0.3A
Compressor operation signal	7-32	220~240V	0.01~0.3A
Condensing unit operation signal	4-7	220~240V	0.01~0.3A
Pre alarm	7-24	220~240V	0.01~0.3A

Note:Specifications are subject to change without notice.

1-4. Refrigerant circuit diagram

Symbol	Component	Trigger threshold
CJ1	Check joint	
CJ2	Check joint	
LEV2	Electronic expansion valve	
LEV3	Electronic expansion valve	
PSH	Pressure sensor<high pressure>	
PSM	Pressure sensor<low pressure>	
PSL	Pressure sensor<low pressure>	
SV1	Stop valve	
SV2	Stop valve	
TH1	Thermistor<discharge pipe temperature>	
TH4	Thermistor<gas cooler outlet pipe temperature>	
TH6	Thermistor<outside air temperature>	
TH7	Thermistor<suction pipe temperature>	
TH8	Thermistor<liguid pipe temperature>	
21R1	Solenoid valve	Open while energized
21R2	Solenoid valve	Open while energized
63H	Pressure switch<high pressure>	12MPa OFF,8.5MPa ON

Note1.Those items marked with an asterisk are field-supplied.



1-5. Sound level

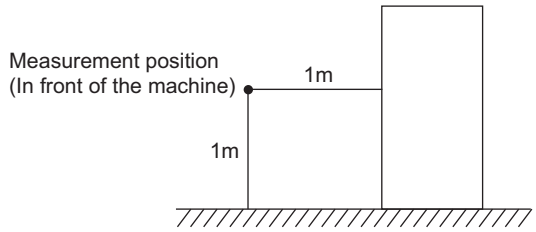
(1) Before replacing the fan, switch off the main power on the condensing unit.

Measurement conditions

Power supply Single-phase 230V 50Hz

Refrigerant R744 (CO_2)

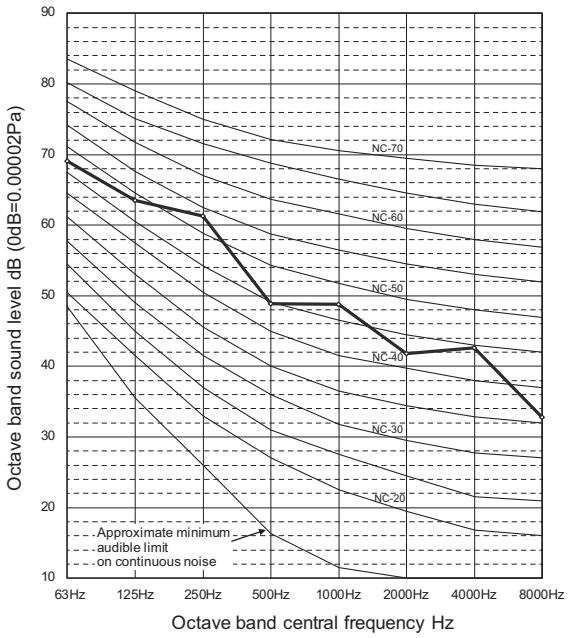
Measurement position



Note: The sound pressure level is a value measured in an anechoic room in accordance with the conventional method in JIS standard.
The sound pressure level actually measured at the installation site is usually higher than the value due to the influence of ambient noise and echoes.
Air flow rate is 80% of maximum air flow rate.

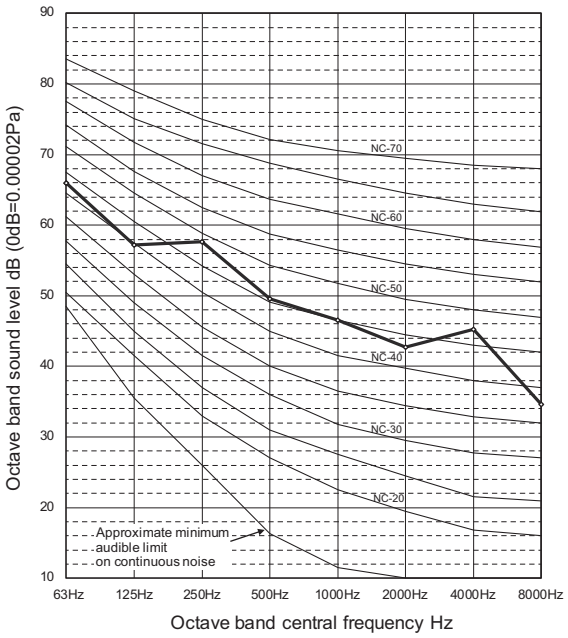
■ ECOV-X15VA

Evaporation temperature = -10°C



Octave band	63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	A Scale
Octave band sound level (dB)	69.0	63.5	61.2	48.8	48.7	41.7	42.5	32.7	56.0

Evaporation temperature = -35°C



Octave band	63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	A Scale
Octave band sound level (dB)	65.9	57.1	57.6	49.5	46.5	42.7	45.2	34.5	54.0

Measurement conditions

Ambient temperature	32°C
Target condensation temperature	Ambient temperature +5°C
Compressor operating frequency	70Hz

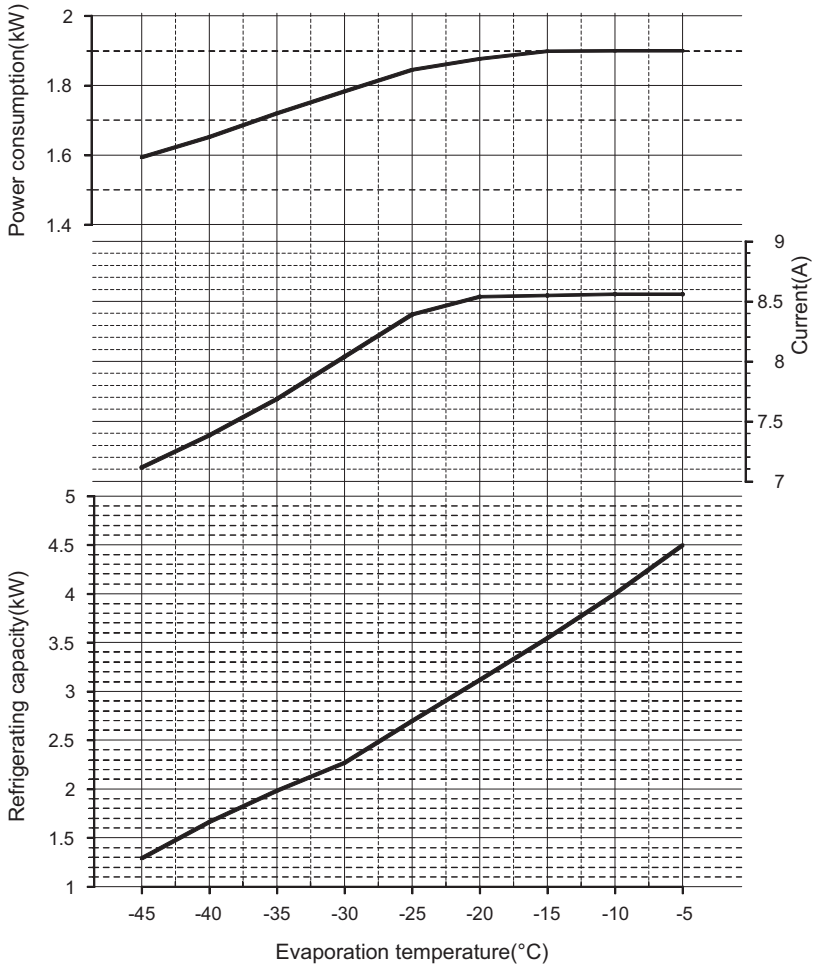
Ambient temperature	32°C
Target condensation temperature	Ambient temperature +5°C
Compressor operating frequency	70Hz

1-6. Capacity tables

Power supply: Single-phase 230V 50Hz
Superheat at the condensing unit inlet: 10K
Ambient temperature: 32°C

Note. The unit's capacity may decrease in high ambient temperatures. Refer to the "Correction by temperature" table for further details.

■ ECOV-X15VA
Operating frequency : 70Hz



1-7. Correction by temperature

Model name	Item	Ambient temperature [°C]	Evaporation temperature [°C]								
			-45	-40	-35	-30	-25	-20	-15	-10	-5
ECOV-X15VA	Refrigerating capacity [kW]	5	1.695	2.009	2.400	2.753	3.272	3.712	4.143	4.870	5.478
		10	1.632	1.946	2.340	2.696	3.220	3.666	4.102	4.832	5.446
		15	1.620	1.946	2.330	2.677	3.188	3.622	4.046	4.760	5.358
		20	1.552	1.847	2.214	2.546	3.035	3.449	4.015	4.537	5.109
		25	1.468	1.723	2.070	2.388	2.852	3.313	3.784	4.280	4.824
		32	1.290	1.661	1.980	2.269	2.694	3.115	3.546	4.000	4.497
		37	1.086	1.487	1.761	2.008	2.372	2.733	3.102	3.491	3.917
		40	0.976	1.263	1.573	1.791	2.109	2.424	2.746	3.085	3.457
		43	0.838	1.078	1.310	1.555	1.845	2.124	2.401	2.690	3.012

Note1. The refrigerating capacity of each condition shows the maximum value.
Note2. The refrigerating capacity is measured at superheat 10K of the condensing unit inlet.

1-8. Correction by refrigerant piping length

ECOV-X15VA

Ambient temperature: 35°C

Suction pipe (mm)	Evaporation temperature (°C)	Capacity according to pipe length (kW)					
		0m	5m	10m	15m	20m	25m
ø9.52 (Standard)	-5	4.317	4.228	4.150	4.078	4.010	3.947
	-10	3.847	3.767	3.697	3.631	3.570	3.512
	-15	3.403	3.330	3.266	3.207	3.151	3.098
	-20	2.984	2.918	2.860	2.806	2.755	2.707
	-25	2.589	2.531	2.478	2.429	2.384	2.341
	-30	2.220	2.168	2.121	2.078	2.037	2.000
	-35	1.876	1.830	1.790	1.752	1.716	1.683
	-40	1.558	1.518	1.483	1.451	1.421	1.393
	-45	1.264	1.231	1.202	1.176	1.151	1.128
ø12.7	-5	4.317	4.296	4.281	4.267	4.255	4.243
	-10	3.847	3.829	3.816	3.803	3.792	3.781
	-15	3.403	3.386	3.375	3.363	3.353	3.343
	-20	2.984	2.969	2.958	2.948	2.939	2.930
	-25	2.589	2.577	2.567	2.558	2.550	2.542
	-30	2.220	2.209	2.201	2.193	2.185	2.179
	-35	1.876	1.867	1.859	1.853	1.846	1.840
	-40	1.558	1.549	1.543	1.537	1.532	1.527
	-45	1.264	1.257	1.252	1.247	1.242	1.238

- Please read the following safety precautions carefully before installing the unit to ensure safety.
- To ensure your safety, be sure to observe the precautions described in this section.

⚠ WARNING
Indicates a risk of death or serious injury.

⚠ CAUTION
Indicates a risk of serious injury or structural damage.

- Make sure that this manual is passed on to the end user to retain for future reference.
- Retain this manual for future reference. When the unit is reinstalled or repaired, have this manual available to those who provide these services. Make sure that this manual is passed on to any future users.

⚠ WARNING

All electric work must be performed by qualified personnel.
Air tightness test must be performed by qualified personnel.
Brazing work must be performed by qualified personnel.

2-1. General precautions

⚠ WARNING

Do not use the type of refrigerant other than the one indicated on the nameplate and in the manuals for the unit. Doing so may cause the pipes or the units to burst or explode, or cause a fire during use, during repair, or at the time of disposal of the unit. It may also be in violation of applicable laws. MITSUBISHI ELECTRIC CORPORATION cannot be held responsible for malfunctions or accidents resulting from the use of the wrong type of refrigerant.

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

Do not install the unit in a place where large amounts of oil, steam, organic solvents, or corrosive gases, such as sulfuric gas, are present or where acidic/alkaline solutions or sprays containing sulfur are used frequently. These substances can compromise the performance of the unit or cause certain components of the unit to corrode, which can result in refrigerant leakage, water leakage, injury, electric shock, malfunctions, smoke, or fire.

Do not try to defeat the protective features of the unit or make unauthorized setting changes. Forcing the unit to operate by defeating the safety features of the devices such as the pressure switch or the temperature switch, making unauthorized changes to the switch settings, or using accessories other than the ones recommended by Mitsubishi Electric may result in smoke, fire, burst pipes or units, or an explosion.

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

The refrigeration system is under high pressure. Do not tamper with it. Contact qualified service personnel before disposal.
Tampering with the system may result in refrigerant or water leakage, injury, electric shock, or fire.

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

To reduce the risk of burns or electric shock, do not touch any electrical parts with bare hands during or immediately after stopping operation.

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

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

Do not change the settings for the safety or protective features of the unit. Incorrect settings may cause the unit to burst or explode.

To reduce the risk of pipe burst or explosion, do not allow gas refrigerant and refrigerant oil to be trapped in the refrigerant circuit.

To reduce the risk of injury or electric shock, stop the unit and turn off the main power before cleaning, maintaining, or inspecting the unit. Coming in contact with the fan and other rotating parts may cause injury.

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

Do not touch the pipes with bare hands. Pipes become hot, posing a risk of burn injury.

Keep the space well ventilated.
- **If refrigerant leak occurs in a poorly ventilated space, it can cause CO_2 poisoning and oxygen starvation.**
- **A high concentration of refrigerant (CO_2) can have negative effects on the human body.**

When tightening or loosening the check joint, use two spanners. The use of a single spanner may cause the pipe to twist and become damaged, resulting in refrigerant leakage, oil spatter, or oxygen deprivation.

Design the refrigerant circuit so that the circuit will meet all specifications. Refrigerant circuits that do not meet the specifications may cause electric leakage, fire, or burst pipes or units.

Stop the unit, turn off the unit, and contact your dealer or a customer service center if any abnormality (e.g., a burning smell) is noticed. Continued use of the unit may result in an electric shock, damage to the refrigerant circuit components, or fire.

To reduce the risk of electric shock, smoke, or fire due to infiltration of dust and water, properly install all required covers on the unit.

To reduce the risk of electric shock, smoke, or fire due to infiltration of dust and water, properly install all required covers and panels on the terminal box and control box.

To reduce the risk of injury from the unit falling or falling over, periodically check the installation base for damage.

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

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

⚠CAUTION

Do not place flammable objects or use flammable spray near the unit. Doing so may result in fire ignition, fire, or explosion.

Do not operate the unit without panels and safety guards properly installed. Coming in contact with the rotating parts, high-voltage parts, or high-temperature parts poses injury, electric shock, or burn injury hazards.

To reduce the risk of injury, do not sit, stand, or place objects on the unit.

Do not install the unit over things that are vulnerable to water damage from condensation dripping.

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

Wear protective gear to keep oil spatter from getting on your skin.

Wear protective gear before touching any electrical components. Touching high-temperature or high-voltage components with bare hands poses burn or electric shock hazards. Some components (e.g., terminals) on the circuit boards or terminal blocks carry voltage for several minutes after the ON/OFF switch or the main power is turned off, posing electric shock hazards.

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

To reduce the risk of injury, always wear protective gear when working on the unit.

Do not release refrigerant into the atmosphere. Have it properly disposed of by an authorized agency according to the applicable laws and regulations.

2-2. For transporting the unit

⚠WARNING

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

⚠ CAUTION

To reduce the risk of injury, do not carry the unit by the PP bands that are used on some packages.

To reduce the risk of injury, products weighing 20 kg or above must be carried by two or more people.

2-3. For installation

⚠WARNING

Do not install the unit where there is a risk of leaking flammable gas. If flammable gas accumulates around the unit, it may ignite and cause a fire or explosion.

To reduce the risk of injury from coming in contact with the unit, install the unit where it is not accessible to people other than maintenance personnel.

To reduce the risk of CO_2 poisoning in case of refrigerant leakage, do not install the unit indoors, in a dented space, or in a semi underground space where the value obtained by dividing the amount of refrigerant charge by the volume of the space reaches 0.072 kg/m^3 or above.

To reduce the risk of injury, properly dispose of the packing materials. Plastic bags pose suffocation hazard to children.

**Install a pressure relief device in accordance with applicable local regulations.
Failure to do so may result in a burst.**

All installation work must be performed by the dealer or qualified personnel according to the instructions detailed in the Installation Manual. Improper installation work may cause refrigerant leakage, water leakage, injury, electric shock, or fire.

Remove packing materials from the unit before operating the unit. Note that some accessories may be taped to the unit. Properly install all accessories that are required. Failing to remove the packing materials or failing to install required accessories may result in refrigerant leakage, oxygen deprivation, smoke, or fire.

To reduce the risk of CO_2 poisoning and oxygen starvation, take appropriate measures to prevent the refrigerant concentration from exceeding the safe level in case of refrigerant leakage in accordance with ISO5149. Install a refrigerant gas leak detector that meets the local laws and regulations.

Any additional parts must be installed by the dealer or qualified personnel. Only use the parts specified by Mitsubishi Electric. Installation by unauthorized personnel or use of unauthorized parts or accessories may result in water leakage, injury, electric shock, or fire.

Properly install the unit in accordance with all applicable instructions and regulations. Failure to do so may cause the unit to topple over or fall down and cause personal injury.

Install the unit horizontally, using a level. A unit installed on an inclined surface can result in water leakage or topple over and cause injury.

To reduce the risk of injury from units falling or falling over, install the unit on a surface that is strong enough to support its weight.

⚠ CAUTION

To reduce the risk of rain water or drain water from entering the room and damaging the interior, drainage work must be performed by your dealer or qualified personnel according to the instructions detailed in the Installation Manual.

2-4. For piping work

⚠ WARNING

Use caution when operating the refrigerant service valve. Refrigerant may spew out and cause oxygen starvation, frost bites, or injuries.

To reduce the risk of refrigerant catching fire and causing burns, remove the refrigerant gas and the residual refrigerant oil in the pipes before heating them.

To reduce the risk of pipe damage, refrigerant leakage, or oxygen deprivation, use pipes that meet the pipe thickness specifications, which vary by the type of refrigerant used, pipe diameter, and pipe material.

Evacuate the refrigerant circuit using a vacuum pump. Allowing the type of gasses other than the one specified to infiltrate into the refrigerant circuit may result in a burst or an explosion.

To reduce the risk of explosion or deterioration of refrigerant oil caused by chloride, do not use oxygen, flammable gas, or refrigerant that contains chloride as a pressurizing gas.

To prevent a burst or an explosion, do not heat the unit with refrigerant gas in the refrigerant circuit.

To reduce the risk of CO_2 poisoning and oxygen starvation, check for refrigerant leak by using an appropriate refrigerant leak detector.

Conduct an air-tightness test at the pressure specified on the unit and in the installation manual. Conducting an air tightness test above the specified pressure may result in damage to the unit and resultant refrigerant leakage, which can cause oxygen deprivation.

Insulate pipe connections after completing the air tightness test. Performing an air tightness test with the pipe being insulated may lead to failure to detect refrigerant leakage and cause oxygen deprivation.

To reduce the risk of pipe damage and resultant refrigerant leakage or oxygen deprivation, keep the field-installed pipes out of contact with the edges of components.

⚠ CAUTION

To reduce the risk of a burst or an explosion due to an abnormal pressure rise, do not allow any substances other than R744 (such as air) to enter the refrigerant circuit.

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

2-5. For wiring work

⚠ WARNING

Replace damaged circuit boards immediately. Continued use of damaged circuit boards may result in abnormal heat generation or fire.

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

To reduce the risk of wire breakage, overheating, smoke, or fire, properly secure the wires in place and provide adequate slack in the wires so as not to stress the terminals.

Tighten terminal screws to the specified torque. Loose screws or wire contact may cause smoke or fire.

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

All electric work must be performed by a qualified electrician according to the local regulations, standards, and the instructions detailed in the Installation Manual. Use specified electrical wires and a dedicated circuit. Capacity shortage in the power supply circuit or improper installation may result in electric shock, malfunction, smoke, or fire.

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

Use properly rated breakers and fuses (earth leakage breaker, local switch <switch + fuse>, no fuse breaker). The use of breaker with a breaking capacity greater than the specified capacity may cause electric shock, malfunctions, smoke, or fire.

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

Do not let bare wires protrude from the terminal block. Bare wires coming in contact with each other may cause electric shock, smoke, or fire.

Proper grounding must be provided by a licensed electrician. Do not connect the grounding wire to a gas pipe, water pipe, lightning rod, or telephone wire. Improper grounding may result in electric shock, smoke, fire, or malfunction due to electrical noise interference.

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

⚠ CAUTION

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

To reduce the risk of short circuit, electric shock, or malfunctions, keep wire shavings out of the terminal blocks.

2-6. For relocation and repairs

⚠ WARNING

Do not alter or modify the unit. The unit must only be moved, disassembled, or repaired by your dealer or qualified personnel. Unauthorized alteration, modification, or installation of the unit by unqualified personnel may result in refrigerant leakage, water leakage, injury, electric shock, or fire.

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

To reduce the risk of short circuit, current leakage, electric shock, smoke, or fire, do not perform maintenance work in the rain.

To reduce the risk of injury, electric shock, or fire, properly reinstall all removed components after completing repair work.

R744 is cold. Avoid skin contact with R744.

To reduce the risk of frost burn, wear leather gloves before touching the refrigerant hose or the valve.

To reduce the risk of CO_2 poisoning and oxygen starvation that can result from leaked refrigerant, install, provide maintenance services for, and uninstall the unit in accordance with ISO5149.

⚠ CAUTION

To reduce the risk of short circuit, electric shock, malfunctions, or fire, keep circuit boards dust free, and do not touch them with bare hands or tools.

To reduce the risk of refrigerant or water leakage, check the pipe supports and insulation for damage during inspection or repair, and replace or repair the ones that are found to be deteriorated.

Recover refrigerant through the check joints connected to the refrigerant service valve (three-way valve) <liquid> and the refrigerant service valve (three-way valve) <suction>.

The pressure of the refrigerant system using R744 is high. When removing R744 for maintenance or other purposes from the system, fix the refrigerant hose, and remove R744 gradually.

When removing R744 from the system, wrap the tip of the hose with a cloth, and remove R744 gradually. Refrigerant in the dry ice state may spew out along with a large amount of oil.

When removing R744 from the system, keep R744 away from plants and the building structures.

Observe all applicable local laws and regulations for the removal of R744.

Check that markings on the unit are clearly legible. Illegible warning or cautionary markings can lead to damage to the unit and personal injury.

2-7. Additional precautions

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

Recover all refrigerant in the unit, and dispose of it properly according to any applicable laws and regulations.

Do not repeatedly turn on and off the main power supply switch in less than 10 minutes. Doing so may stress the compressor and cause the compressor and the electrical parts to malfunction.

Operate the unit within the specified usage range. The use of the unit outside the specified operation range may cause the unit to malfunction.

Do not block the inlets or outlets of the unit. Obstruction of air flow may reduce the performance of the unit or cause the unit to malfunction.

Do not touch the switches on the unit or the components of the refrigerant circuit for no good reason. Doing so may change the operating mode and result in damage to the unit.

Only use R744. The use of refrigerant other than R744 may result in damage to the refrigerant system components.

Provide a maintenance access to allow for the inspection of pipes above the ceiling or the buried pipes.

Take appropriate measures against electrical noise interference when installing the air conditioning units in hospitals or facilities with radio communication capabilities. Inverter, high-frequency medical, or wireless communication equipment as well as power generators may cause the air conditioning system to malfunction. Air conditioning system may also adversely affect the operation of these types of equipment by creating electrical noise.

Direct the blazing torch flame away from the adjacent wires and sheet metal to keep them from being overheated and damaged.

Prepare tools for exclusive use with R744. Do not use the following tools if they have been used with other types of refrigerant: gauge manifold, charging hose, refrigerant leak detector, check valve, refrigerant charge spout, vacuum gauge, and refrigerant recovery equipment. If other types of refrigerant, refrigerant oil, or water remaining on these tools enter the refrigerant circuit, the refrigerant oil in the new system may deteriorate and the equipment may malfunction.

Use a vacuum pump with a check valve so that the vacuum pump oil will not backflow into the refrigerant circuit and cause the refrigerant oil to deteriorate.

Have a set of tools for exclusive use with R744. Consult your nearest Mitsubishi Electric Dealer.

Keep dust, dirt, and water off the charging hose. Infiltration of dust, dirt, or water into the refrigerant circuit may cause the refrigerant oil to deteriorate or damage the compressor.

Use refrigerant piping and couplings that are suitable for use with R744. Keep the inner and outer surfaces of pipes and couplings clean and free of such contaminants as sulfur, oxides, dust, dirt, shaving particles, oil, and moisture. Failure to do so may result in the deterioration of refrigerant oil and compressor failure.

Store the piping materials indoors, and keep both ends of the pipes sealed until immediately before brazing. Keep elbows and other joints in plastic bags. Infiltration of dust, dirt, or water into the refrigerant circuit may cause the refrigerant oil to deteriorate or damage the compressor.

To reduce the risk of oxidized film from entering the refrigerant pipe and causing the refrigerant oil to deteriorate or damaging the compressor, braze pipes under nitrogen purge.

Do not use the existing pipes. The high and low pressures in R744 systems are higher than those in the systems using other types of refrigerants, and the use of pipes not suitable for R744 may result in damage to the unit.

Charge the refrigerant from the high-pressure side. Charging the refrigerant from the low-pressure side may result in compressor damage.

Do not use a charging cylinder.

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

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

Have a backup system, if failure of the unit has a potential for causing significant problems or damages.

The installer must carry an R744 leak detector when installing or uninstalling the unit.

Connect an evaporator that is compatible with R744. The use of a refrigerant other than R744 may damage the equipment.

The design pressure must not be exceeded. (Equipment pressure: High pressure 12 MPa; Low pressure 8.5 MPa)

This unit <ECOV-X15VA> is a condensing unit, complying with condensing unit requirements of IEC60335-2-40, must only be connected to other units that have been confirmed as complying to corresponding evaporator requirements of this international standard.

2-8. Installation process and safety precautions for use with R744

<Steps for installation>	<Safety precautions for use with R744>	<Page>
Determination of installation area		
Check of condensing unit specifications	• Check that the unit is intended for use with R744. • Check the equipment pressure. (High pressure 12.0 MPa, Low pressure 8.5 MPa) • Use new pipes only.	
Drawing of working diagrams		
Installation of showcase/unit cooler	• Check that the unit is intended for use with R744.	
Refrigerant piping work (Dry, clean, tight) *1	• Check that the inside of the pipes is in proper condition. • Braze the pipes under nitrogen purge. • Use a torque wrench to tighten nuts. • Carry an R744 leak detector.	P31
Drain piping work		
Electrical wiring		
Foundation work of condensing unit		
Installation of condensing unit		P26
Refrigerant piping work Refer to *1.	• Do not allow the refrigerant oil to be exposed to air for more than 10 minutes, even during servicing. • Install a pressure relief device in accordance with applicable local regulations.	P31
Electric wiring of condensing unit		P37
Air tightness test	• Perform an air tightness test. (Liquid line pressure: 12.0 MPa; Suction line pressure: 8.0 MPa) x 24 hours An air-tightness test is conducted on the condensing unit before shipment.	P45
Heat-insulating work		
Vacuum drying	• Perform vacuum drying for one hour after the vacuum level reaches 266 Pa on the vacuum gauge. • Use a specified vacuum pump with a check valve.	P46
Refrigerant charging	• Use the proper amount of refrigerant and the proper amount of additionally charged refrigerant. • Charge the system with liquid refrigerant only. • Use a specified gauge manifold and a specified charging hose. • Write down the amount of charged refrigerant on the nameplate on the front of the unit.	P51
Target evaporation temperature setting		
Test run	• Check that the unit is not under short-cycling operation. • Check that the target evaporating temperature is appropriate.	P54
Leakage check		
Providing guidance on the usage to the end users		

2-8-1. Characteristics of R744

R744 is a natural refrigerant with the ozone depletion coefficient of zero and the global warming coefficient of 1. The pressure of R744 at the normal temperature (25°C(77°F)) is as high as 6.4 MPa, which is approximately five times that of R404A (1.24 MPa), requiring more stringent safety precautions.

2-8-2. Notes for the handling of R744

Seek appropriate treatment if exposed to R744.

(1) If R744 was inhaled

Move to an area with fresh air. Keep warm, and seek medical attention immediately.

(2) Skin contact with R744

Do not rub the affected area. Warm the affected area with lukewarm water, wrap a piece of gauze around, and seek medical attention immediately.

(3) If R744 gets in the eyes

Rinse the affected area with clean water, and seek medical attention immediately.

2-8-3. Precautions for working with R744

The pressure of the refrigerant system using R744 is high. When removing R744 for maintenance or other purposes from the system, fix the refrigerant hose, wrap the tip of the hose with a cloth, and remove R744 gradually.
R744 is cold. Avoid skin contact with R744.
Wear leather gloves before touching the refrigerant hose or the valve.

3-1. Usage conditions

Usage	-	Low/Medium temperature
Refrigerant type	-	R744
Evaporation temperature	°C (°F)	-45 to -5 (-49 to 23)
Suction pressure	MPa	0.73 to 2.94
Heat level of suction gas	K	10 to 40
Suction gas temperature	°C (°F)	18 (64) or below
Discharge pressure	MPa	1.60 to 11.0
Discharge gas temperature	°C (°F)	115 (239) or below
Ambient temperature	°C (°F)	-25 to 43 (-13 to 109)
Power supply voltage	-	Single phase 220/230/240 V ± 10%, 50 Hz
Maximum pipe length (suction/liquid)	m (ft)	25 (82) or below*1*2*3
Installation location	-	Outdoor*4

*1 Length that meets the piping work conditions stated in the Installation Manual, guarantees the proper oil return to the unit, and prevents refrigerant overcharge.

*2 Indicates an equivalent length.

*3 Refer to the relevant pages for details about the maximum pipe length and allowable amount of refrigerant to be charged. (page 52)

*4 Refer to the relevant pages. (page 26)

3-2. Usage conditions/environment

Follow the condition/environment specified below for installation.

Do not install the unit on moving vehicles such as cars or ships.

Do not install the unit in a place where acidic solutions or sprays containing sulfur are used frequently.

Avoid unsuitable places (hot springs, places where chemicals are frequently used) for installation.

Install the unit in an area where the noise from the unit will not disturb the neighbors.

Do not install the unit in a place where it is subjected to radiant heat from other heat sources.

Properly install the unit on a stable, load-bearing surface.

Do not install the unit in any environment where it can be exposed to airborne iron or copper powder, acidic or alkaline atmosphere, or an accumulation of a large amount of sand containing sea salt particles. Such environments can cause corrosion of the aluminum pipes.

Do not install the unit in a place where large amount of oil, steam, ammonia, or corrosive gas such as sulfuric gas is present. (Such place includes near a chimney opening.)

Do not install the unit in a space that is not large enough as specified in the DATA BOOK. (page 27)

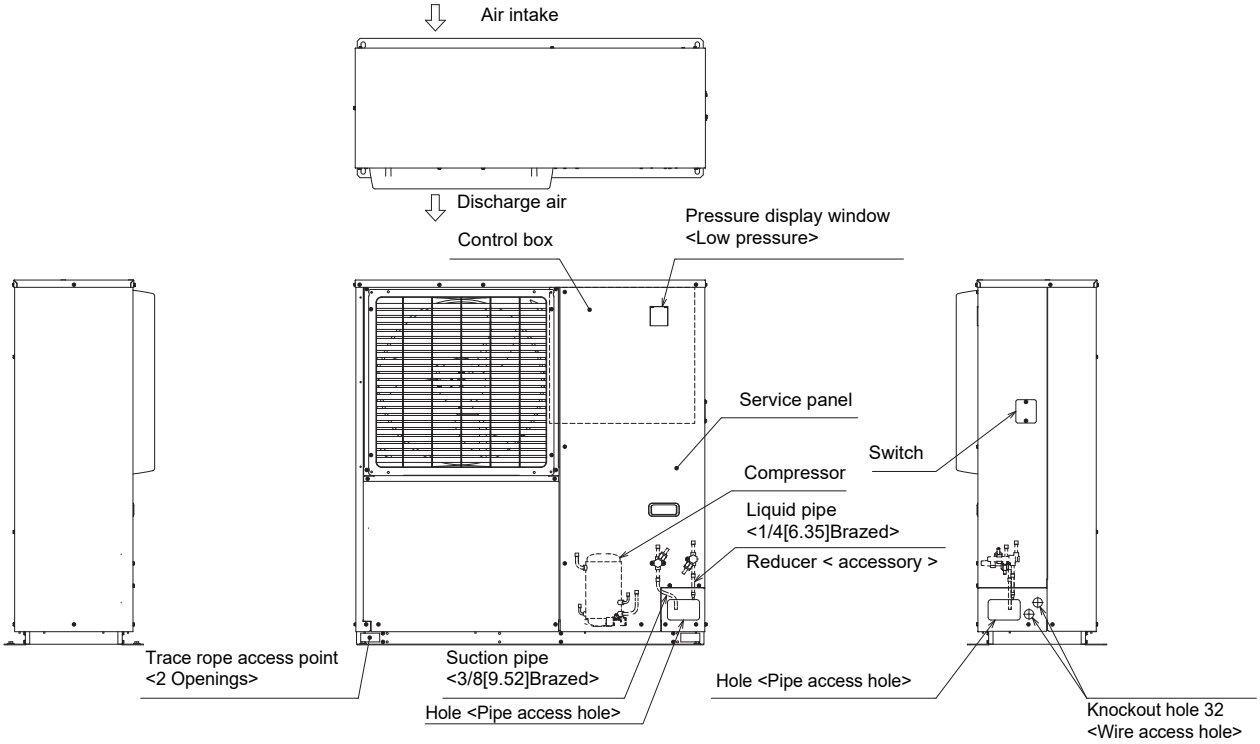
Do not install the unit in an area with heavy snowfall exceeding the tolerance of snow prevention work advised in the DATA BOOK. (page 28)

Do not install the unit indoors, in a semi underground space, or in a dented space where the value obtained by dividing the refrigerant charge by the volume of the space reaches 0.072 kg/m^3 or above.

4-1. Unit components

4-1-1. ECOV-X15VA

(Unit: in. [mm])



4-2. Package contents

Type	ECOV-X15VA
Fuse*1	6A
Connector for emergency operation*1	1
Termination resistance for MODBUS®*1,*2	1
Reducer	1

*1 Packaged in the control box.

*2 For usage, refer to the MODBUS® Interface Manual.
Please contact the supplier for the MODBUS® Interface Manual.
MODBUS® is a registered trademark of SCHNEIDER ELECTRIC USA, INC. in the United States.

4-3. Transporting and unpacking the unit

(1) Transporting the unit

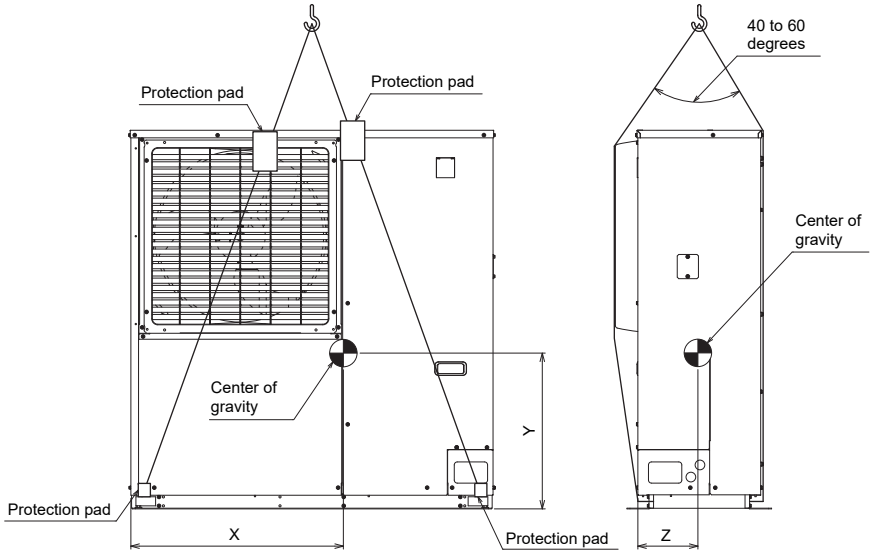
- Do not lift the unit. The unit must not be lifted and carried by hand.
  The handles on the unit are intended to be used for positioning during installation.
- If PP bands are used on the package of the unit, do not lift the unit in a way that applies a load on any of the PP bands.
- The unit must be upright during transportation and installation.

(2) Unpacking the unit

- Plastic bags can pose suffocation and choking hazards. Keep out of the reach of children and tear them before disposal.

(3) Lifting the unit

- If the unit needs to be lifted for installation, pass ropes through the two hanging parts at right and left under the unit.
- The ropes must support the unit at four points. Take measures to prevent any shock to the unit while it is lifted.
- The roping angle must be within 40 to 60 degrees as shown in the figure below.
- Use two ropes with sufficient length. <7 m or longer>
  The thickness of the ropes must match the size of the rope suspension parts.
  If the ropes are too thin, they may break and cause the unit to fall.
- The surfaces of the unit that come into contact with the ropes may be scratched if unprotected. Use rags or cloths to protect the surfaces.



Model	**ECOV-X15VA**
Weight (kg) (lbs)	115 (253)
X (mm) (in.)	710 (28)
Y (mm) (in.)	528 (21)
Z (mm) (in.)	201 (8)

5-1. Precautions for installing the unit

Note

- Protect and maintain the pipes to prevent infiltration of contaminants such as water and dirt.
- Nitrogen purge is required to prevent formation of oxide scale while brazing the pipes.

The unit contains a rotary compressor. The usage of this unit is different from that of a unit containing a reciprocating compressor. Improper use may cause damage to the compressor. Read carefully and follow the directions below.

(1) Use R744 refrigerant.

The design pressure on the liquid-line side is 12 MPa, and that on the suction-line side is 8 MPa. (Refer to "5-2-1. Refrigerant pipes".)
Only use the refrigerant that is specified by Mitsubishi Electric.

(2) Entire compressor is hot.

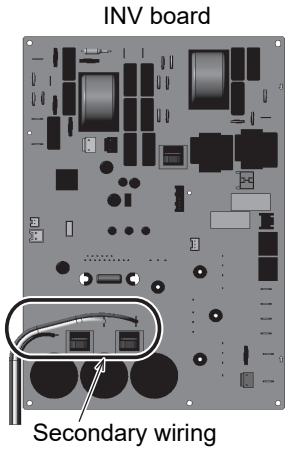
The entire compressor is hot during operation and immediately after stoppage. Wait for the pressure and temperature inside the compressor to drop, especially before conducting a test run, maintenance, or servicing.

(3) Use PAG oil as refrigerant oil.

The refrigerant oil used in this unit easily absorbs moisture and tends to cause deterioration of the refrigerant oil or formation of sludge (hydrate). Therefore, complete vacuum drying is required.
Ensure to follow the basic requirements and precautions for piping work to prevent infiltration of water or dirt.

(4) Do not change the wiring connection on the secondary side.

Do not change the phase of the wiring between the INV board and the compressor.
Do not change the phase at the compressor terminal block.



(5) Vacuum drying without specified tools is prohibited.

Vacuum drying must be performed by a specialist. Do not force the unit to operate with the refrigerant service valve (ball valve) <suction> closed. Refer to the relevant pages for the vacuum drying procedures. (page 46)

(6) Forced stop of the evaporator fan is prohibited.

Do not operate the unit with the evaporator fan stopped (except for the short period of time immediately after defrosting).
Close the solenoid valve <liquid> and pump down-stop the unit before stopping the evaporator fan.

(7) Closing the refrigerant service valve <suction> during operation is prohibited.

Do not perform a refrigerant service that suddenly lowers the low pressure, such as closing the refrigerant service valve (three-way valve) <suction> during operation.
Spend at least 30 seconds decreasing the pressure, for example, from 1.2 MPa to 1.0 MPa.

(8) Do not remove the compressor fixing sheet metal.

Do not remove the sheet metal holding the compressor. Operating the unit without the sheet metal may result in an accident.

5-2. Specifications of general commercial parts

5-2-1. Refrigerant pipes

Do not reuse the existing pipes!

(1) Piping materials/Wall thickness

The design pressures of the liquid line and suction line are as shown in the table below.

Liquid line (Unit outlet)	Suction line (Unit inlet)	Hot gas routing line
12.0 MPa	8.0 MPa	12.0 MPa

The thickness of pipes to be used depends on the type of refrigerant used, pipe diameter, and pipe material. Use pipes with appropriate thickness for a given application.
The pipe sizes for the liquid line (unit outlet) and suction line (unit inlet) are as shown in the table below.

mm (in.)

Liquid line (Unit outlet)	Suction line (Unit inlet)
ø6.35 (1/4)	ø9.52 (3/8)

Use the included reducer to connect the liquid piping.

(2) Copper pipe bending

Make sure that no wrinkles form when bending copper pipes. Such wrinkles may reduce the pipe thickness and/or increase the resistance to refrigerant flow.

(3) Brazing material

In a corrosive atmosphere, such as where there is a high sulfurous acid gas concentration, use silver filler. Do not use low-temperature fillers as they do not have sufficient strength.

(4) Flux

Select the flux according to the type and shape of substrate, filler type, and brazing method.

(5) Insulation

Refer to the relevant pages for details about heat insulation. (page 53)

(6) Electrical wiring

For more information on transmission lines (MODBUS®), refer to the MODBUS® Interface Manual.
Refer to the relevant pages for more information on the power line, grounding wire, and control wire (220-240 V). (page 39)

(7) Dryer

Refer to the relevant page for details about the dryer. (page 33)

(8) Sight glass

Refer to the relevant page for details about the sight glass. (page 33)

6-1. Statutory compliance

Select an installation location that is in compliance with the applicable laws and regulations related to noise, vibration, and installation environment.

6-2. Consideration for pollution prevention and environment protection

Select an installation location in consideration of pollution prevention and environment protection.

6-3. Selecting the installation site

Select an installation location that meets the following requirements so that the unit functions properly.

6-3-1. Installation environment and restrictions

- Select a place where the gas cooler inlet air temperature is -25 to 43°C (-13 to 109°F) and there is good airflow.
- Do not install the unit in a location where the gas cooler is exposed to direct sunlight. Take appropriate measures to protect the unit from the sunlight as necessary.
- Install the unit in a location where the noise or vibrations from the unit will not be a problem. (The unit must be installed according to the applicable laws and regulations.)
- Do not place any inflammable materials (such as foamed styrol and cardboards) near the unit.
- Select a place where there is plenty of space for operation or servicing.
- Take appropriate measures to prevent unauthorized access to the installation site and machine room.
- Do not install the unit indoor, in a depressed space, or in a halfway basement.
- Install a pressure relief device in accordance with applicable local regulations.
- Install a gas leak detector according to the applicable laws and regulations.
- **The all-aluminum heat exchanger may corrode if it comes into contact with substances contained in water spray. Do not spray water on the unit.**
- Do not install the unit in any environment where it can be exposed to airborne iron or copper powder, acidic or alkaline atmosphere, or accumulation of a large amount of sand containing sea salt particles. Such environments can cause corrosion in the aluminum pipes.
- Provide a certain amount of space around the unit for operation, maintenance, servicing, and heat dissipation. Insufficient space may decrease the refrigerant capacity and cause an operation failure.

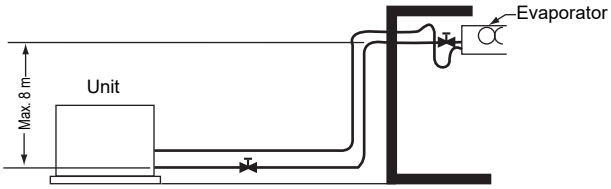
6-4. Height difference between devices

6-4-1. Height difference between the condensing unit and the evaporator

(1) When installing the evaporator above the unit

Keep the height difference (between the end part of the liquid pipe on the unit and the one on the evaporator) within 8 m.

A large height difference may cause a pressure drop due to the head difference of liquid refrigerant, generating flash gas.

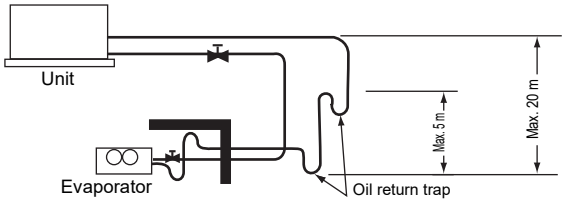


When the evaporator is installed above the unit

(2) When installing the evaporator below the unit

Keep the height difference (between the highest suction pipe and the lowest suction pipe) within 20 m.

A large height difference may cause a poor oil return to the compressor, resulting in a compressor failure. Install an oil return trap at every 5 m.



When the evaporator is installed below the unit

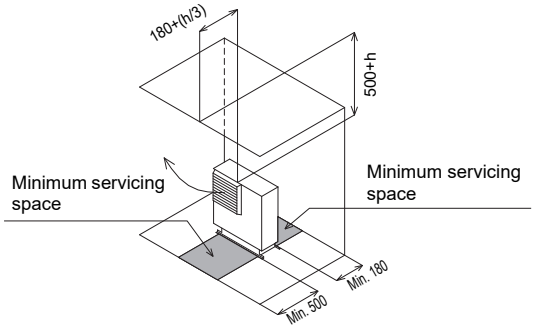
6-5. Required space

- Minimum installation spaces are shown below that are required for the use of the unit at the maximum ambient operating temperature. Up to three units can be installed side by side in each block.
- Letters "D" and "h" in the figure represent arbitrary values. (e.g. 100, 200) (The air flow direction is upward in the examples.)

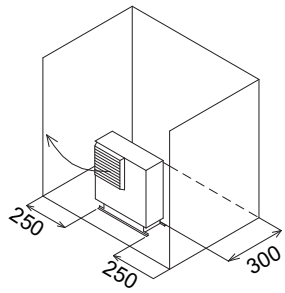
6-5-1. Installation examples: Maximum ambient operating temperature of 43°C (109°F)

(Unit: mm)

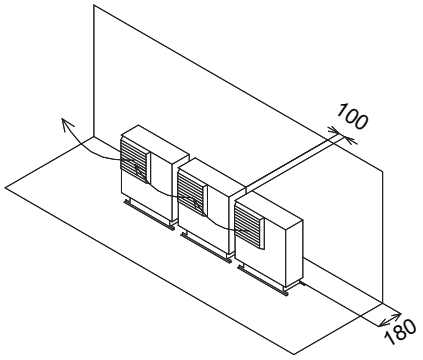
(1) Installation of a single unit with objects blocking the rear and top of the unit (unblocked on the sides and at the top)



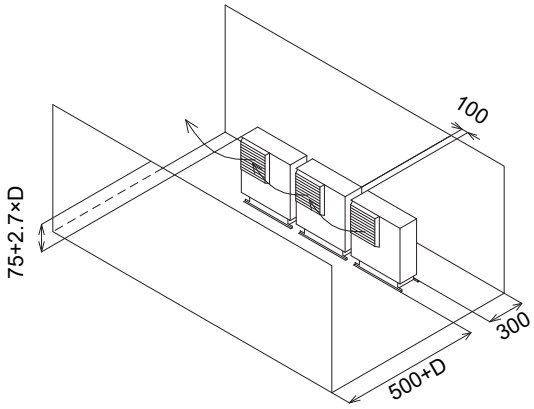
(2) Installation of a single unit with objects blocking both sides and the rear of the unit (unblocked in the front and at the top)



(3) Side-by-side installation of multiple units with objects blocking the rear of the units (unblocked in the front, on the sides, and at the top)



(4) Side-by-side installation of multiple units with objects blocking the rear and front of the units (unblocked on the sides and at the top)

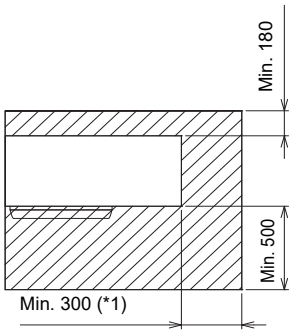


6-5-2. Minimum servicing space

Provide a space around the unit for installation work and maintenance as shown in the figure.

*1 To route the pipe from the right side of the unit, a space of approximately 300 mm is required on the right side.

(Unit: mm)



Minimum servicing space

6-6. Measures against strong winds

Precautions for installing the unit in a place exposed to strong winds

This unit is standard-equipped with air deflector grills to protect itself against headwinds. However, if the unit is installed on a roof or in an isolated place with no surrounding buildings, take appropriate measures so that the air discharge outlet on the unit is not exposed to winds. If strong winds blow directly into the air discharge outlet, the unit cannot hold sufficient air and will fail to operate properly.

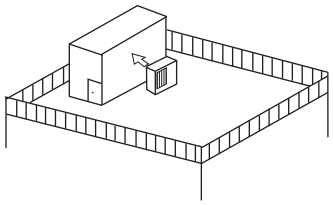
Air guides are available as optional parts. Install air guides as necessary to direct wind away from the unit.

If powder snow is expected to blow on the front side of the unit in winter, install a wall in front of the unit to keep the snow from entering the unit. When powder snow blows directly into the air discharge outlet while the unit is stopped, the snow entering the unit may cause operation problems.

(1) Installing the unit near a wall

Install the unit so that the air discharge outlet will face the wall. Leave 500 mm (20 in.) between the unit and the wall.

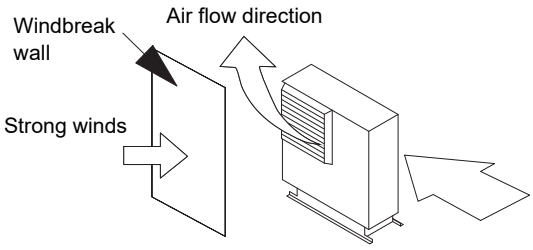
If the wall height exceeds the unit height, refer to the installation examples in the previous section to determine the amount of the space between the unit and the wall.



(2) Installing the unit in a place exposed to winds

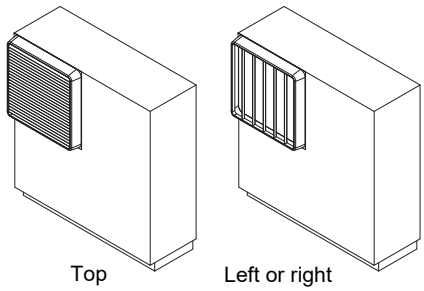
Install the unit so that the air discharge outlet is perpendicular to the direction of the winds.

If powder snow is expected to blow directly into the air discharge outlet, install a wall in front of the unit to keep the snow from entering the unit. Leave 500 mm (20 in.) between the unit and the wall.



Do not direct the air discharge outlet downward.

- Air deflector grills can direct the air upward (factory setting), to the left, or to the right. Select the air flow direction to suit the local installation conditions. (Refer to the figures on the right.)



Air deflector grill installation examples

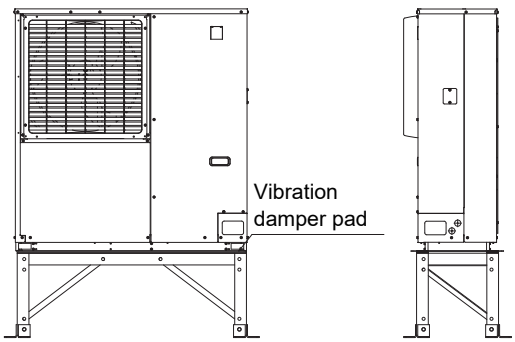
6-7. Measures against snow

6-7-1. Installing the unit in a winter snow area

Install the unit on a raised base (locally procured).

Insulate the area between the base and the outdoor unit by putting a rubber cushion or applying an electrically insulated coating to prevent the base from rusting.

If the unit is not installed on a raised base and not operated for a long time, moisture will accumulate inside the unit, forming rust.



Example of installing the unit on a raised base

- Do not install the unit indoor, in a depressed space, or in a halfway basement.

7-1. Progress of construction of building and construction conditions

Perform installation work when the building is ready for the installation of the unit.

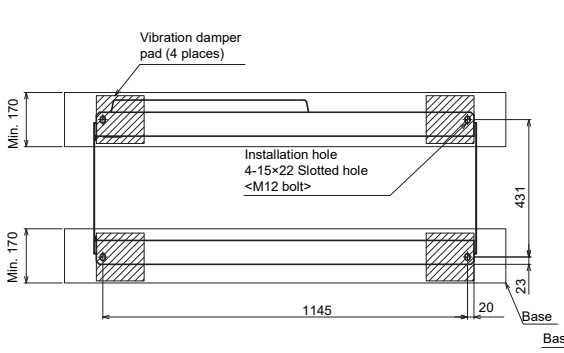
7-1-1. Installation on the foundation

- Form the base on a level surface (inclination no more than 1.5°) and with strong and solid materials such as concrete and angle steel to prevent the unit from toppling over under strong winds or earthquakes.
- Weakness or inclination of the base may cause abnormal vibrations or noise.
- Weakness of the base may cause the unit to vibrate, resulting in looseness or crack in the pipes.
- Generally, the base for the unit is formed with concrete. A mass of the base needs to be more than three times the weight of the unit to support the unit and to absorb vibration. It is recommended that the mass of the base is more than three times the weight of the unit.
  Alternatively, the unit may be directly connected to a construction with strong foundation.

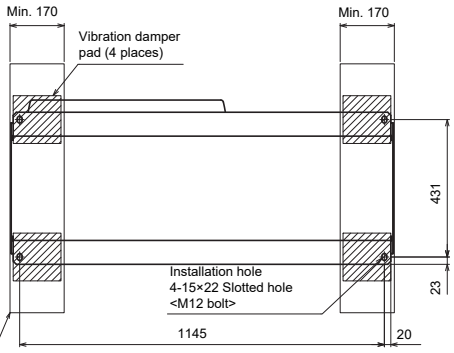
7-1-2. Installation bolt

- Secure the unit with anchor bolts as shown in the figure below so that the unit will not topple over.
  (M12 installation bolts are to be locally procured.)
- Be sure to bolt down 4 points.
- Select the installation dimensions from the available installation holes shown in the external dimensions according to the base. (page 4)

Dimensions
<Holes in lateral direction (recommended)>

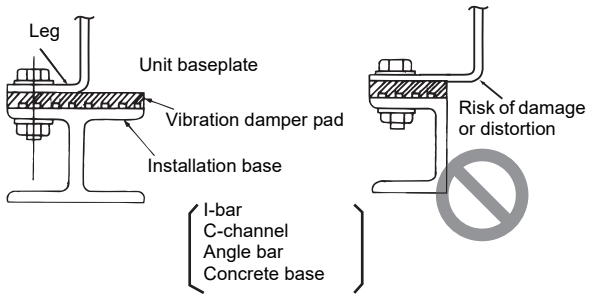


Dimensions
<Holes in depth direction (recommended)>
(Unit: mm)

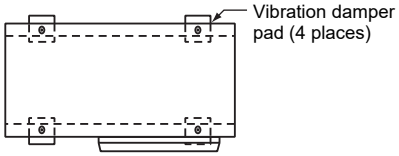


7-1-3. Anti-vibration measures

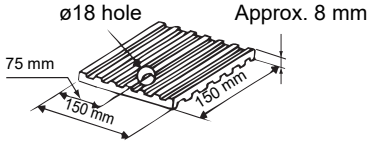
- Vibrations and noise may be transmitted from the unit through walls and floors, depending on the installation conditions. Take appropriate anti-vibration measures (e.g., vibration damper pad, vibration isolation base) as needed. (See the figure on the right.)
- The size of damper pad depends on the size and shape of the unit installation hole.



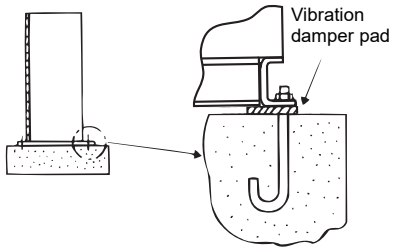
Sample of unit installation



♦Sandwich the damper pad between the unit and the base.



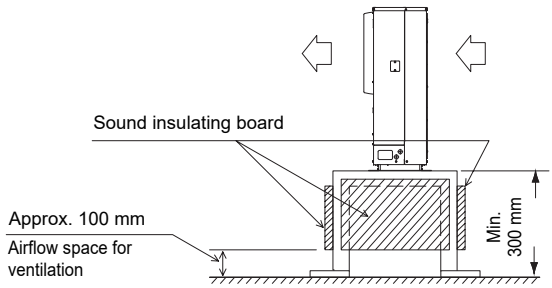
Vibration damper pad (example)



Sample of concrete base

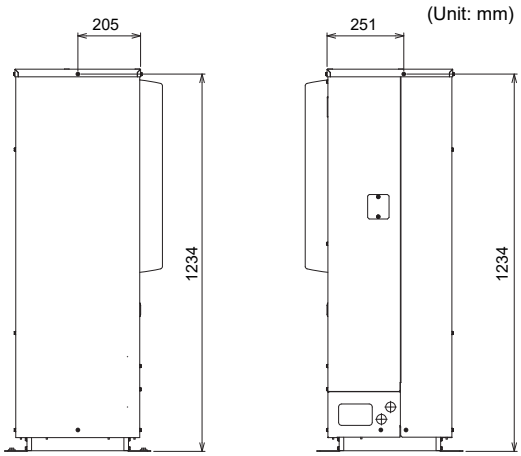
7-1-4. Sound insulation work

Attach sound insulation boards around the unit when installing the unit on a base that is more than 300 mm (12 in.) tall. (See the figure on the right.)
However, keep a space of approximately 100 mm (4 in.) over the boards because complete insulation may interrupt the ventilation in the unit (or the machine room or the control box may not be cooled).



7-1-5. Fixing the top of the unit to the wall

In addition to anchoring the unit's installation legs to the base, fix the top of the unit to prevent it from falling over due to winds, as necessary. Remove one screw from the right and the left side of the top panel, and use the screw hole to fix the top of the unit.
As a fixing screw, locally procure a self-tapping screw (M5 screw length ±12 mm).



Fixing hole on the top panel

Note

♦ Do not block the water-vent holes.

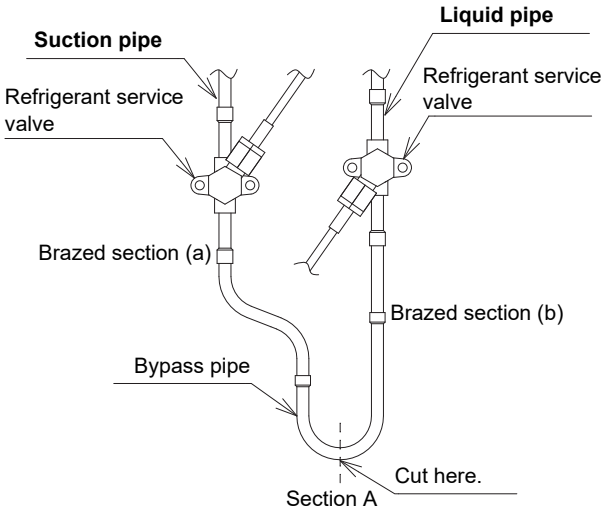
8-1. General information

Do not reuse the existing pipes!

- Improper design and installation of refrigerant piping may affect the function and life of cooling equipment, or occurrence of problems. Design and install a water piping system according to the applicable regulations and the following instructions.

8-1-1. Removing the bypass pipe

The unit is charged with nitrogen gas prior to the shipment from the factory.
To prevent infiltration of water or contaminants, do not leave the pipe open until immediately before connecting the pipe.
To connect the bypass pipe, remove the gas in the pipe. Then weld the pipe after checking that the residual pressure is not left.
To remove the pipe that bypasses the suction pipe and liquid pipe, first cut the bypass pipe at the section labeled (A) to remove the nitrogen gas from the pipe, and then debraze the pipe from sections labeled (a) and (b) in the figure on the right.
Do not directly heat the brazed sections using a burner or other heating device to remove the bypass pipe. Note that refrigerant oil may remain in the bypass piping. Be careful when removing it.



Note

- When brazing the suction pipe or liquid pipe, use a slate board to protect the control devices and wires from the torch flame.

8-1-2. Notes on water and contaminants

The refrigerant oil used in this unit easily absorbs moisture and tends to cause deterioration of the refrigerant oil or formation of sludge (hydrate).
Use caution to prevent infiltration of contaminants such as water and dirt during piping work.

Note

- Protect and maintain the pipes to prevent infiltration of contaminants such as water and dirt.
- Nitrogen purge is required to prevent formation of oxide scale while brazing the pipe.

1) Storage location
Store the pipes indoors. (Warehouse at site or owner's warehouse)
If the pipes are left outdoors, dust, dirt, or moisture may infiltrate and contaminate the pipes.

2) Sealing the pipe ends
Seal both ends of the pipes until just before brazing.
Keep elbow pipes and T-joints in plastic bags.

8-1-3. Pipe size

Select the size of the suction pipe and liquid pipe according to the diameter of the connection port of the condensing unit, not of the evaporator.
Select the size of the suction pipe in consideration of oil return and pressure loss.
Because the refrigerant oil of this unit is non-miscible, select the liquid piping size considering the refrigerant oil return.

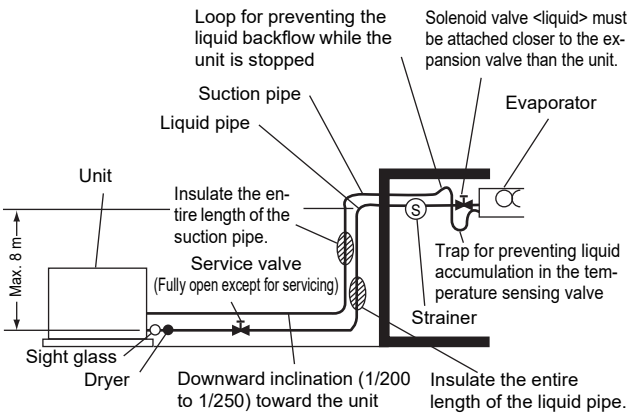
Model	Suction pipe [mm (in.)]	Liquid pipe [mm (in.)]
ECOV-X15VA	ø9.52 (3/8)	ø6.35 (1/4)

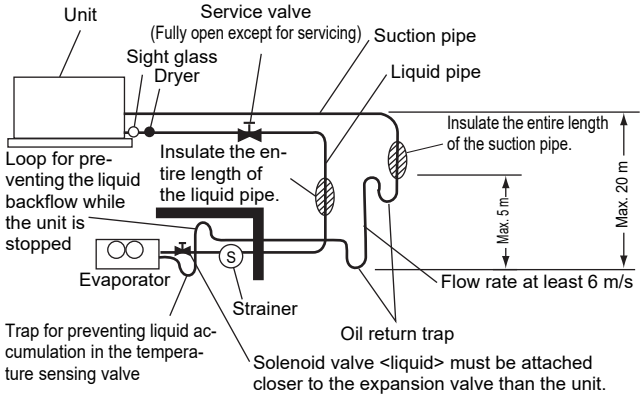
The pipe sizes shown above are standard pipe sizes.

The design pressure of the liquid pipe is 12.0 MPa, and the design pressure of the suction pipe is 8.0 MPa. Use pipes that can withstand the above design pressure.
Use the included reducer to connect the liquid piping.

8-1-4. Height difference between devices

When the unit is installed in a high place, ensure there is enough space for transporting a heavy load such as a refrigerant cylinder during servicing or test runs, and install the service valve at the most appropriate place for servicing.





Note

- Do not increase the liquid pipe diameter at the rising part of the liquid pipe because the refrigerant oil of this unit is non-miscible.
- Install a pressure relief device in an appropriate location in accordance with applicable local regulations.

8-1-5. Supporting the pipes

Support the pipes in proper distance. Install a bent pipe or a slide valve (horizontal loop) to absorb expansion and contraction of the pipes that is caused by temperature fluctuation.

8-1-6. Notes on contaminants while flaring the pipes

To reduce the risk of failures of the compressor or valves, follow the instructions below to prevent abrasive components contained in sandpaper or cutting tools from entering the refrigerant circuit.

- To deburr pipes, use a reamer or other deburring tools, not sandpaper or sanding tools that use abrasive materials.
- To cut pipes, use a pipe cutter, not a grinder or other tools that use abrasive materials.
- When cutting or deburring pipes, do not allow cutting chips or other foreign matters to enter the pipes.
- If cutting chips or other foreign matters entered pipes, wipe inside the pipes to remove them.

Purge the pipes of dust with nitrogen gas or dry air before connecting the pipes. (Do not use the tools that generate a large amount of shaving particles, such as saw and grind stone.)

8-2. Installation of suction pipe

8-2-1. Installing the horizontal pipe

Install the horizontal pipe in such a way that it has a downward inclination (at least 1/200) towards the unit.

8-3. Installation of liquid pipe

8-3-1. Installing the solenoid valve <liquid>

Install the solenoid valve <liquid> right in front of the expansion valve (upstream side). Installing the solenoid valve near the outdoor unit may cause capacity shortage to the pump down and the high pressure switch may cut the unit.

8-3-2. Installing the strainer <liquid>

Install the strainer at the solenoid valve <liquid> inlet. Check the strainer during test run and remove contaminants.

8-3-3. Installing the dryer

Be sure to attach a dryer to the unit outlet (liquid pipe).
When installing the dryer, do not leave the dryer open for more than 30 seconds. Install the dryer in the correct orientation.
Failure to install the dryer may cause damage to the compressor.
Procure a dryer locally.
Select the most suitable dryer that meets the following criteria.

- R744-compatible
- With a 100% molecular sieve solid core
- Design pressure of 12.0 MPa or higher

8-3-4. Installing the sight glass

Provide a sight glass to the unit outlet (liquid pipe).
Procure a sight glass locally.
Select a sight glass that meets the following criteria.

- R744-compatible
- Design pressure of 12.0 MPa or higher
- With a water-level indicator

8-3-5. Installing a pressure relief device

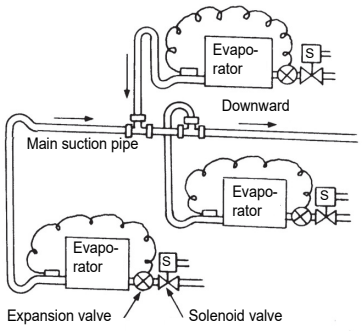
Install a pressure relief device in accordance with applicable local regulations.

8-3-6. When the ambient temperature around the pipe rises high

If the liquid pipe is heated by the effect of other heat source, flash gas is generated and a poor cooling problem occurs.
Route the liquid pipe where the temperature is low. Insulate the liquid pipe if it is installed in place where the temperature is high.

8-3-7. When the evaporator is installed below the main suction pipe

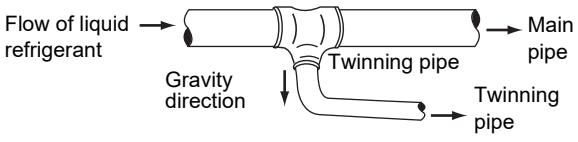
When an evaporator is installed below the main suction pipe, provide a small trap on the evaporator outlet to prevent the effect from the liquid refrigerant to the temperature sensing valve of the expansion valve. Provide an interlocking opposite trap above the main suction pipe to prevent the liquid refrigerant/oil from flowing from the main suction pipe to the riser pipe during stop operation. A solenoid valve must be installed to each evaporator that is installed above the main suction pipe as shown in the figure on the right.



Suction pipe

8-3-8. When there are multiple evaporators in the system

Equalize the pressure loss of each pipe circuit to equalize the flowing amount of the refrigerant to each evaporator. Branching point must be below the pipe. If the twinning pipe is installed above the pipe, a sufficient amount of the liquid refrigerant is not fed to the branched circuit, causing a poor cooling problem.



8-3-9. About the evaporator to be connected

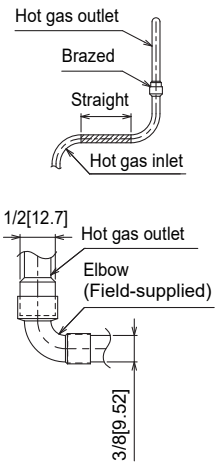
If the evaporator is too large or the refrigerant flow rate in the evaporator is not sufficient, refrigerant oil may accumulate in the evaporator and cause the compressor to fail. Consider the refrigerant oil return. (For 1 pass: pipe diameter of 1/2 inch or less; for 2 passes: pipe diameter of 3/8 inch or less as a guideline. If these conditions cannot be satisfied, reduce the evaporator volume to 150 cc or less.)
Use an electronic expansion valve for the expansion valve.

8-4. Installation of heat recovery port

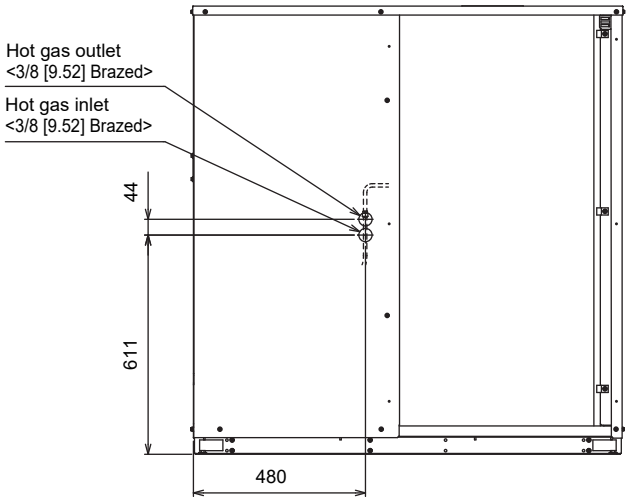
- To perform heat recovery, route the hot gas pipe from the hot gas outlet on the back of the unit or in the middle of the discharge pipe. Remove the pipe as shown on the right.
- Use the pipe sizes in the following table after external unit routing.

Model	Pipe size [mm (in.)]	
	Unit port	Pipe locally procured
ECOV-X15VA	ø9.52 (3/8)	ø9.52 (3/8)

When removing the hot gas pipe, remove the brazed part as shown in the figure on the right, cut the straight part with a pipe cutter, and then take the hot gas out using the field-supplied elbow as shown in the figure on the right.

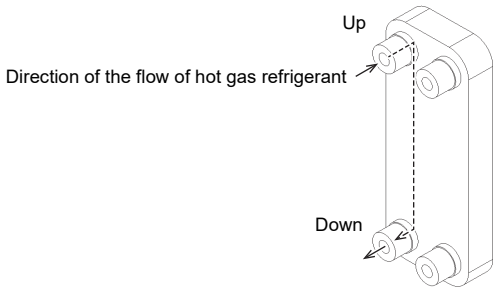


(Unit: mm)



- Large piping vibration may be caused by pressure pulsation depending on the operating conditions of the unit, the shape and length of the pipes, and the method to support the pipes.
  If large vibration occurs during a test run, change the support intervals and the method for fixing the pipes to prevent vibration.
  When attaching support fittings on the building or ceiling, take appropriate anti-vibration measures to prevent the piping vibration from being transmitted to the building.
- Provide insulation or protective cover to the parts of the pipes that can come into contact with a human body.
- When brazing the pipes, cool down the pipes with a wet cloth if packings are used in the pipe fixing parts.
  The unit is filled with nitrogen gas. Remove the nitrogen gas before brazing the pipes.
- To avoid the thermal impact from the hot gas pipe, allow at least 100 mm (4 in.) between the hot gas pipe and the liquid pipe.
- When brazing the suction pipe or liquid pipe, use a slate board to protect the control devices and wires from the torch flame. Minimize the welding flame so as to prevent the flame from touching the check joint.

- There is no set-up for hot gas defrosting.
  Due to the use of independent local hot gas (e.g. floor heating), only hot gas pipe routing is available.
- When using hot gas piping, ensure that refrigerant oil does not accumulate in the piping or heat exchanger.
- When using a plate heat exchanger, connect the refrigerant piping as shown in the figure below.



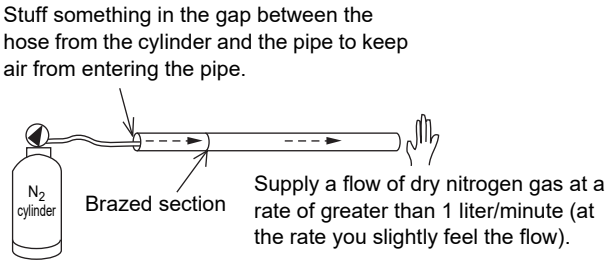
8-5. Connecting pipes

8-5-1. Brazing

- Use a clean copper pipe so as not to allow dirt and water to infiltrate inside the piping system.
- In a corrosive atmosphere, such as where there is high sulfurous acid gas concentration, use silver filler.
- Do not use low-temperature fillers because they do not have sufficient strength.
- When re-brazing, use the same filler material.
- Use an appropriate flux according to the type and shape of the substrate, filler type, and brazing method.
- Do not conduct refrigerant piping work outdoors when raining.
- If the installed pipes are left unconnected to any equipment, braze and seal both ends of the pipes.
- Flux generally contains chloride. Flux staying in the refrigerant circuit will cause sludge to form.

Procedures

1) When brazing, as shown in the figure below, heat the minimum necessary area to a temperature suitable for the filler material.
   When brazing, supply a flow of an inert gas, such as dry nitrogen gas, through the pipes to prevent formation of oxide scale.
   After finishing piping, keep the nitrogen gas flowing until the pipes have become cool enough to be touched by hand. (Be careful not to burn hands and fingers.)
   After brazing, cool the pipes without using water.
   Do not move the brazed pipes until the braze has solidified. (No vibration must be applied.)
2) Completely remove all the flux after brazing.



Brazing the pipe under nitrogen purge

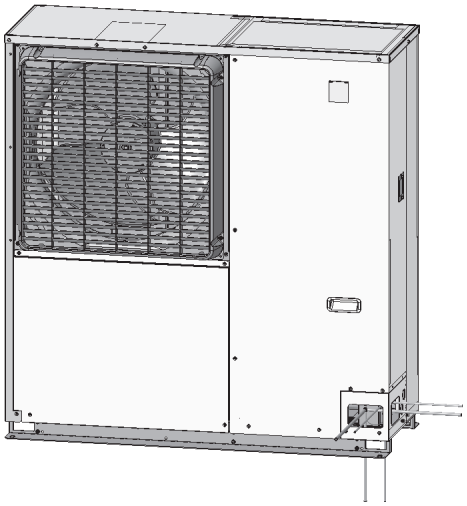
Note

- Ensure that the flame does not touch any surrounding wiring and plates during brazing. Prevent fire by using a metal plate as a shield and a wet towel.
  Contact with flame may cause fire damage and/or failure.
- When using anti-oxidant for brazing, check its components.
  (The anti-oxidant must not contain any components that may lead to corrosion of the pipes if it is mixed with refrigerant or refrigerant oil.)
- The dryer and filters (strainer, etc.) in the unit may be clogged with oxide scale, which shortens the unit life. Clean or replace the dryer and filters when they are clogged.
- Brazing must be performed by qualified personnel.

8-6. Pipe routing: Single and collective installations

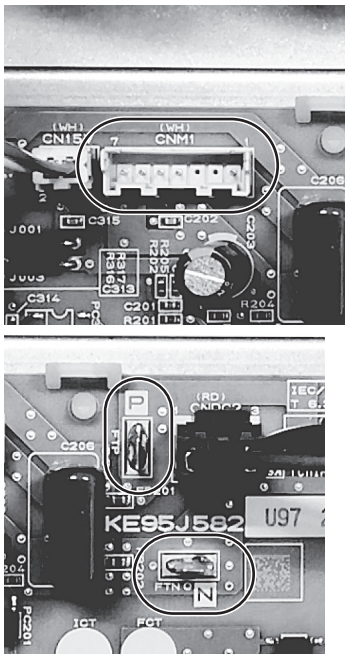
(1) The pipe can be routed from the front, right, or bottom of the unit. When multiple units are installed collectively or consecutively, any unit that has another unit on its right cannot have a pipe routed on its right side.

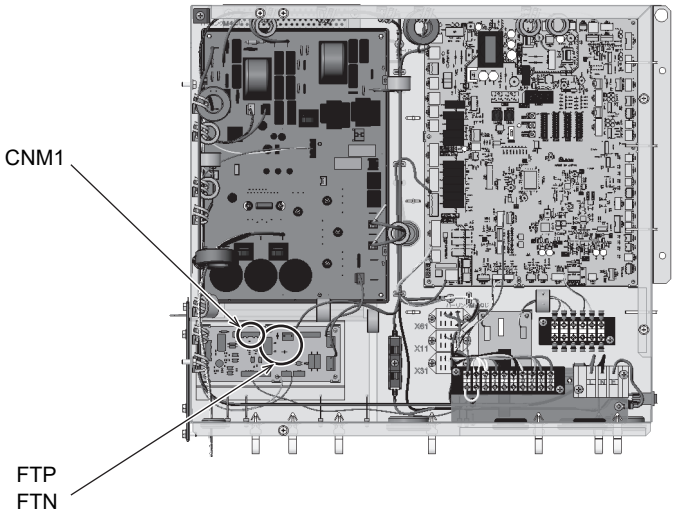
(2) Install the pipes so that they are out of contact with the wires, panels, and compressor.



9-1. Notes on wiring

- Install an earth leakage breaker.
  Installation must be according to the applicable laws and regulations.
  (Earth leakage breaker is required for all refrigerating appliances including show cases.)
- Do not wire at any place where dew may drop from suction parts.
- Ensure that no electric wires come into contact with high-temperature parts (compressor, heat exchanger, discharge pipe) or the edges of the unit.
- Wear protective gloves to prevent injury on wiring the unit.
- Do not route wires through insulation, such as pipes, to prevent overheat.
- Install the transmission cable at least 5 cm (2 in.) away from the power cable to avoid electrical noise interference. (Do not place them in the same conduit.)
- Before inspecting inside the control box, turn off the main power of the unit, wait at least 10 minutes, and check that the power-supply voltage of the unit is 0 VAC and that the voltage of the electrolytic capacitor (main inverter circuit) is no greater than 20 VDC. Check the voltage across pins L and N of TB1 of the unit power supply voltage (AC), and across FT-P and FT-N pins. Remove the fan motor connector (CNM1). (See the figures below for the voltage check position and location of the connectors.)





- Before starting servicing, disconnect the outdoor fan connector (CNM1).
  When connecting and disconnecting connectors, make sure that the outdoor fan is not running and that the voltage of the main circuit capacitor is no greater than 20 VDC.
  If the outdoor fan rotates due to strong wind, the main circuit capacitor will be charged and pose a risk of electric shock.
  Refer to the wiring nameplate for details.
  When finishing servicing, connect the outdoor fan connector (CNM1) as it was.
- When the ON/OFF switch (SW1) is ON, the components may still be carrying current even when the compressor is stopped. Do not touch the charging part of the power supply wiring. When performing a test run, if there is the possibility that refrigerant may be left inside the compressor after a long stoppage period or flood-back error stop, disconnect the power supply wiring from the terminal block of the compressor after power shutoff, and measure the insulation resistance of the compressor to check that the compressor is not ground-faulted.
- If the insulation resistance is 1 MΩ or below, energize the belt heater for 3 hours or more. Energize the unit and keep the ON/OFF switch (SW1) OFF for at least 3 hours.
  (When the compressor is energized to evaporate the liquid refrigerant inside, the insulation resistance rises.)

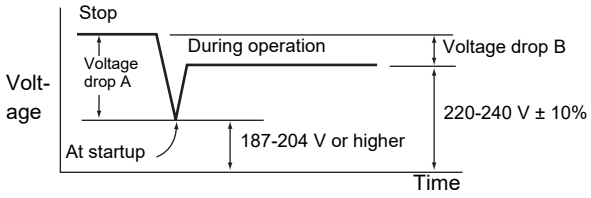
Note

- If the power supply cord is damaged, it must be replaced by the manufacturer, its service agent, or qualified personnel in order to avoid hazards.
- Do not keep switching on and off the main power in a short period. Changing the ON/OFF status within 10 minutes will apply undue force to the electronic parts, resulting in malfunctions. Once the power is turned on (or off), wait for at least 10 minutes before turning it off (or on).

9-2. Wire capacity

Maximum allowable voltage for this unit is shown in the figure.

Wire capacity must be according to the applicable laws and regulations. The range of allowable voltage is listed in the next section "Electrical characteristics".
The wire size is the minimum value for the metal conduit wiring. If the voltage drops, use a wire that is one size thicker in diameter.



Note

Starting voltage cannot be measured with a tester, but starting voltage drop (Voltage drop A) is about 5 times the voltage difference (Voltage drop B) between stoppage voltage and operation voltage. The amount of starting voltage can be estimated by subtracting operation voltage from voltage with the unit stopped.

(Voltage drop A) ≈ 5 × (Voltage drop B)

Starting voltage drop A can be disregarded because this unit starts with inverter.

9-3. Electrical characteristics

Model				ECOV-X15VA
Power source				Single phase, 220/230/240 V, 50 Hz
Safety class				Class I
Electrical characteristics	Electric power consumption <Note 1>		kW	1.90
	Running current (220V/230V/240V) <Note 1>		A	9.0/8.6/8.2
	Starting current		A	5.5/5.3/5.1
	Maximum current		A	10.5
Compressor	Rotation per minute (RPM)		min^{-1}	4200
	Electric heater <oil>		W	20
Condenser	Fan	Motor output	W	74
Electrical wiring	Electric wire size	<Note 2>	mm^2	3.2 or larger
	Overcurrent protector	Local switch	A	16
		Branch switch	A	16
	Switch capacity	Local switch	A	16
		Branch switch	A	16
	Control circuit wire size		mm^2	2.0 or larger
	Grounding wire diameter		mm^2	2.0 or larger
	Phase advance capacitor	Capacity	μF	N/A
	(Compressor)		kVA	N/A
	<Note 5>	Wire size	mm^2	N/A

Note 1 Measurement conditions are as follows.
Ambient temperature: 32°C (89°F), evaporation temperature: -10°C (14°F), suction superheat: 10 K
Inverter compressor operating frequency: 70 Hz

Note 2 Specific wiring requirements should adhere to the wiring regulations of the region.

Note 3 Power supply cords of appliances shall not be lighter than polychloroprene sheathed flexible cord (design 60245 IEC57).

Note 4 An earth leakage breaker with at least 3 mm (2/16 in.) contact separation in each pole shall be provided by the installer.
Leaked current varies depending on wire length, wire routing, and/or presence of devices that emit high frequency.
Select high-harmonic-type earth leakage breakers.

Note 5 Do not use a phase-advancing capacitor with inverter compressor.

If MODBUS® is used, follow the instructions below.

- Do not connect a power supply to the terminal block for transmission lines. If connected, the electronic parts will burn out.
- Use shielded cables for transmission wiring.
  Wiring using a multi-core cable with different types of transmission wires compromises correct transmission of signals and results in a malfunction.
- When splicing transmission wires, make sure to splice the shielded cables as well.

For details, refer to section 9-6.

9-4. Connecting wires

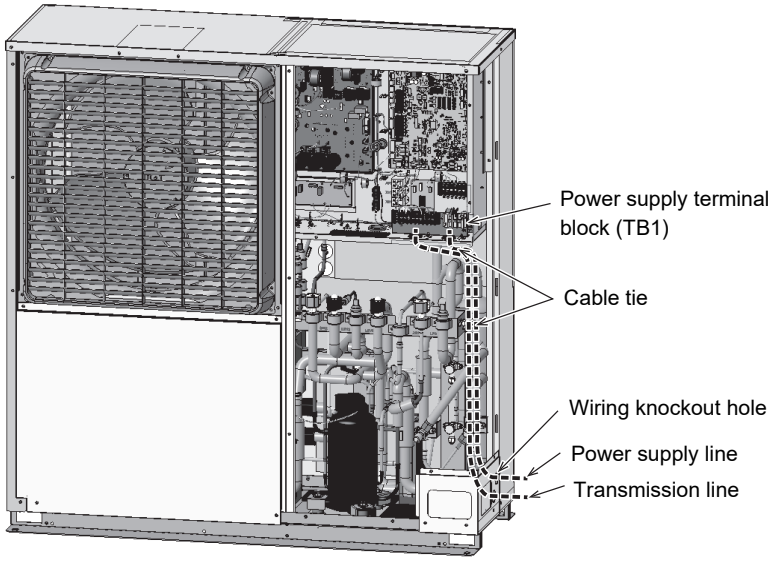
(1) Connecting the wires inside the control box

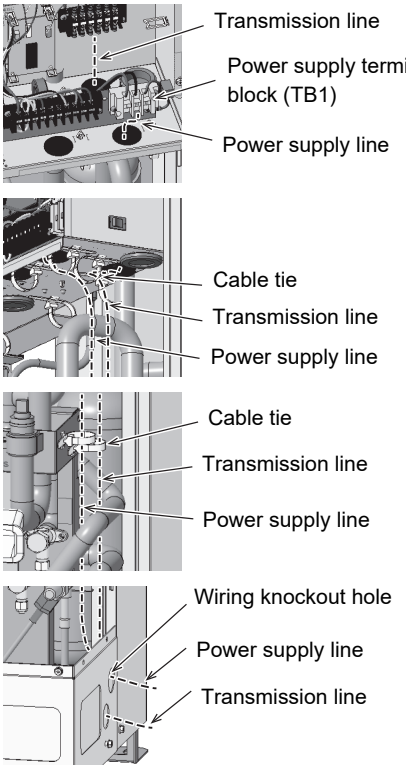
Procedures

1) Connect the power supply line to the power supply terminal block (TB1).
2) If necessary, connect the control line (220 to 240 V). (See 9-5.)
3) If necessary, connect the transmission line (MODBUS®). (See 9-6.)

Model	Wire type	Connected to	Notes
ECOV-X15VA	Power supply line	Power supply terminal block inside the unit control box (TB1)	-
	Control line (220 to 240 V)	Auxiliary terminal block (1 to 32)	-
	Transmission line (MODBUS®)	Terminals for transmission lines (+, -, SG)	-

Connection locations





Note

- Do not bundle the power supply line and the transmission line together. Keep them away from each other.
- When connecting wiring, keep the wiring out of contact with the refrigerant service valves and pipes.
- Hold the power cable to the liquid pipe, using a tie band as shown below so that the power cable does not come into contact with the refrigerant service valve, pipes, or edges of metal plates. Friction against the valves and pipes can damage the wiring.

- When connecting MODBUS® wiring, be sure to connect to **the terminals (+, -, SG) for transmission lines.**
- For details on the MODBUS® set-up, refer to the MODBUS® Interface Manual.
  Please contact the supplier for the MODBUS® Interface Manual.

9-5. Output signal to external devices

Operation signals can be output from the terminal block on the control box.

(1) Alarm signal

Alarm signals can be output from terminal blocks 7 and 23.
The output signal voltage of terminal blocks 7 and 23 are 220 to 240 VAC. <Use a current of 0.01 to 0.3 A.>
Alarm signal will be output if the refrigerator has come to an abnormal stop.

(2) Pre-alarm signal

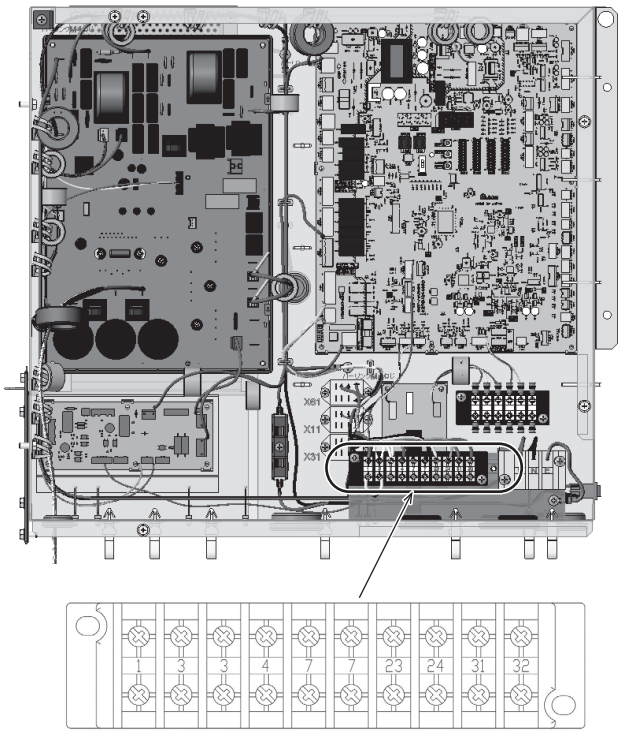
Pre-alarm signals can be output from terminal blocks 7 and 24. Output-signal between terminal blocks 7 and 24 is 220-240 VAC. <Use a current of 0.01 to 0.3 A.>
A pre-alarm signal will be output when the condensing unit detects a pre-alarm signal.

(3) Compressor operation signal

Compressor operation signals can be output from terminal blocks 7 and 32.
The output signal voltage of terminal blocks 7 and 32 are 220 to 240 VAC. <Use a current of 0.01 to 0.3 A.>
Signals will be output when the compressor is in operation. Signals will not be output when the compressor is not in operation.

(4) Condensing unit operation signal

Condensing unit operation signals can be output from terminal blocks 4 and 7.
The output signal voltage of terminal blocks 4 and 7 are 220 to 240 VAC. <Use a current of 0.01 to 0.3 A.>
Signals will be output when the condensing unit is operating normally (including the times when the compressor is stopped to prevent an excessive drop in low pressure).
Signals will not be output if the condensing unit has come to an abnormal stop.



(5) Precautions for screwing

When replacing electrical parts inside the control box, use the following recommended tightening torques for screwing.

Recommended tightening torque

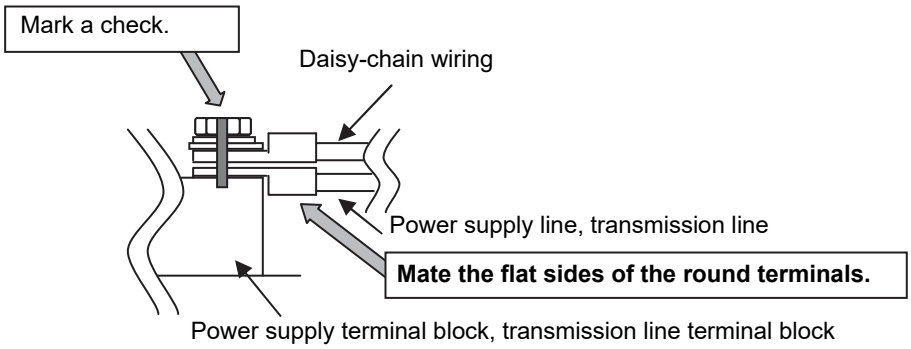
	Screw	Recommended tightening torque (N·m)
Power supply terminal block (TB1)	M4	**1.0 to 1.3**
Auxiliary terminal block (including terminal block for transmission lines)	M3.5	**0.82 to 1.0**

Follow the procedure below to check that the screws are properly tightened.

Procedures

1) If wires are connected, make sure that they are not loose on the screw terminals.
2) Tighten the screws straight so as to prevent the screw's threads from being damaged.
   To prevent screws from being tightened diagonally, mate the flat sides of the round terminals when attaching.
3) **After tightening the screws, mark the screw head, washer, and terminal with a check using a marker.**

(Example)



9-6. How to use MODBUS®

9-6-1. Precautions for using MODBUS®

- **Do not connect a power supply to the terminal block for transmission lines (+, -, SG).** If connected, the electronic parts will burn out.
- When connecting MODBUS® wiring, be sure to connect to **the terminals (+, -, SG) for transmission lines**.
- Use shielded cables for transmission wiring. For information on recommended cables, refer to section 9-6-2. Wiring using a multi-core cable with different types of transmission wires compromises correct transmission of signals and results in a malfunction.
- When splicing transmission wires, make sure to splice the shielded cables as well.
- For details on the MODBUS® set-up, refer to the MODBUS® Interface Manual.
- Please contact the supplier for the MODBUS® Interface Manual.

9-6-2. RS485 communication specifications

The table below shows the RS485 communication specifications of the refrigerator.

Item		Specifications
Transmission signal		RS-485 two-wire half-duplex transmission
Electrical specifications		RS-485 compliant
Communication protocol		MODBUS®-RTU
Transmission system		Asynchronous
Connection type		Daisy chain
Maximum communication cable length		1200 m
Terminating resistor		120 Ω, 1/2 W
Recommended cable	Type	Shielded cable
	Number of pairs	2 or 3
	Conductor resistance (20°C) (68°F)	88 Ω/km or less
	Insulation resistance (20°C) (68°F)	10000 MΩ-km or above
	Capacitance (1 Hz)	60 nF/km or less
	Characteristic impedance (100 kHz)	110±10 Ω

9-6-3. MODBUS® wiring procedure

(1) Preparing the cables
Prepare cables for wiring. (Refer to section 9-6-2.)

(2) Turning off the power
Check that the power of each unit is turned off before the wiring work.

(3) Connecting the communication devices

Connect the MODBUS® communication devices with cables.
Daisy-chain the MODBUS® communication devices as shown in Figure A.
Communication may not be established properly if the devices are connected in the star wiring configuration or branched from the module as shown in Figure B.

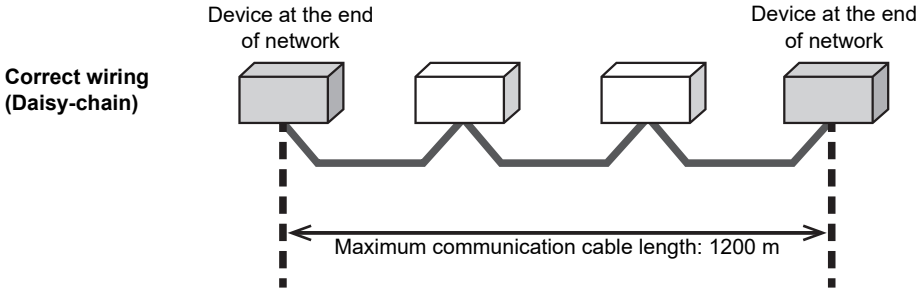


Figure A Example of correct wiring between communication devices

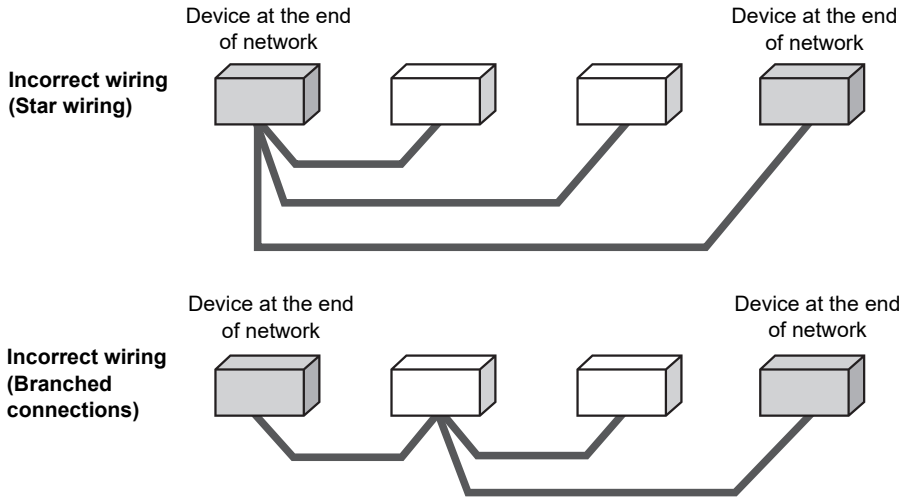


Figure B Examples of incorrect wiring between communication devices

(4) Connecting the terminating resistor

When this unit is at the end of the network, connect the supplied terminating resistor (120 Ω) to the unit.
The terminating resistor is packaged in the control box.

10-1. Air tightness test

10-1-1. Purpose of air tightness test

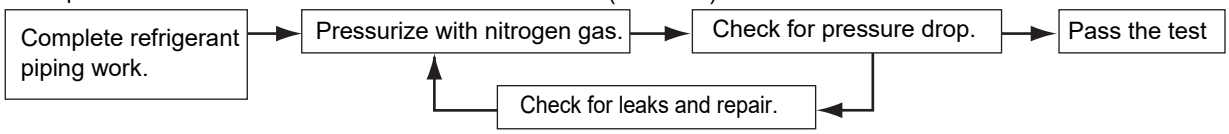
Check for any refrigerant leakage in the refrigerant pipes and the indoor unit.
The condensing unit has been subjected to an air tightness test prior to shipping.

10-1-2. Air tightness test pressure

When the refrigerant piping is completed, perform the air tightness test before insulating the pipes. The condensing unit has been tested prior to shipping.
The air tightness test pressure must be at or higher than the design pressure. Refer to 10-1-3. Air tightness test procedure for details.
The pressure used for the air tightness test must not exceed 12.0 MPa to protect the unit.
The design pressure for the refrigerant pipes and the indoor unit is shown in the table below.

Design pressure for refrigerant pipes and indoor unit	
High pressure side: 12.0 MPa	Low pressure side: 8.0 MPa

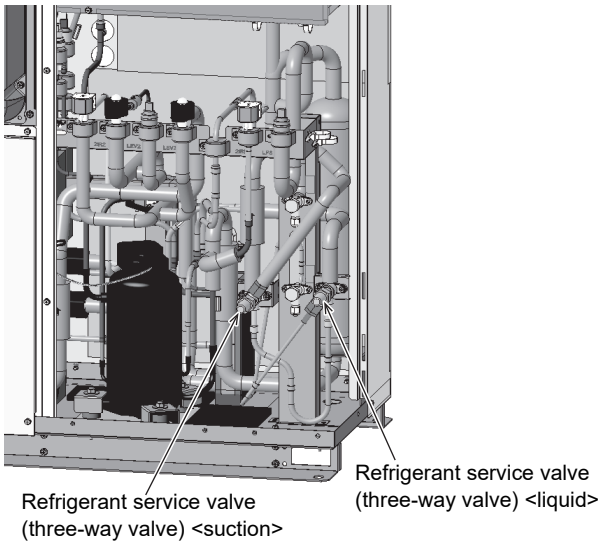
Test procedure



10-1-3. Air tightness test procedure

Procedures

1) The air tightness test is performed by pressurizing the refrigerant pipes up to the unit's design pressure with nitrogen gas. Connect the devices to the check joint connected to the refrigerant service valve (three-way valve) <suction> and the high-pressure check joint. See the figure on the right for connections.
   The check joints are all designed to be connected with Swagelok fittings.
   Air tightness test inside the condensing unit is not necessary.
2) Open the refrigerant service valve (three-way valve) <liquid> and the refrigerant service valve (three-way valve) <suction> halfway.
   For usage of the refrigerant service valves, refer to sections 10-2-6.(page 49).



3) Do not pressurize the system up to the design pressure at once. Increase the pressure in small increments. Pressurize the system to 0.5 MPa, stop increasing the pressure for at least 5 minutes, and check that the pressure does not drop.
4) Pressurize the system to 1.5 MPa, stop increasing the pressure for at least 5 minutes, and check that the pressure does not drop.
5) Write down the ambient temperature and pressure after pressurizing the system to the design pressure.
6) Apply a foaming agent. If no bubbles occur, there are no leaks.
   Leave the system in the defined value for 24 hours. If the pressure is maintained, there are no leaks.
   When the ambient temperature changes by 1°C, the pressure changes by approximately 0.01 MPa. Adjust the test conditions as necessary.
   If the pipe is pressurized before cooled down after welding, the pressure drops after the pipe cools down.
   The pressure changes (up/down) depending on the ambient temperature. (Gas in the container (scale-invariant) is in proportion to absolute temperature.)

Absolute pressure during measurement = absolute pressure during pressurization × (273°C + temperature during measurement) / (273°C + temperature during pressurization)

Absolute pressure = gauge pressure + 0.10133 (MPa)
(Gauge pressure indicates the gauge manifold-specified value.)
A pressure drop indicates a refrigerant leakage in the system. Find the refrigerant leaking area, and fix it.
If a leakage is found, inspect the welded part using soap water.
Nitrogen purge must be done before welding.

10-1-4. Refrigerant leakage detection

Special care for refrigerant leakage is important. Use a refrigerant leak detector for R744.

10-2. Vacuum drying

10-2-1. Purpose of vacuum drying

Completely evaporate any moisture that has entered the evaporator from the refrigerant pipes using vacuum in order to release it outside the system.

10-2-2. Vacuum drying procedure

(1) Level standard of a vacuum pump

Use a vacuum pump capable of attaining a vacuum pressure of 66 Pa at a point of 5 minutes from the startup of operation.

(2) Vacuum drying time

1) Perform vacuum drying for one hour after the vacuum level reaches 266 Pa on the vacuum gauge. (Thorough vacuum drying eliminates moisture in the pipes.)
2) Check that the vacuum pressure does not drop one hour after the vacuum drying is completed.

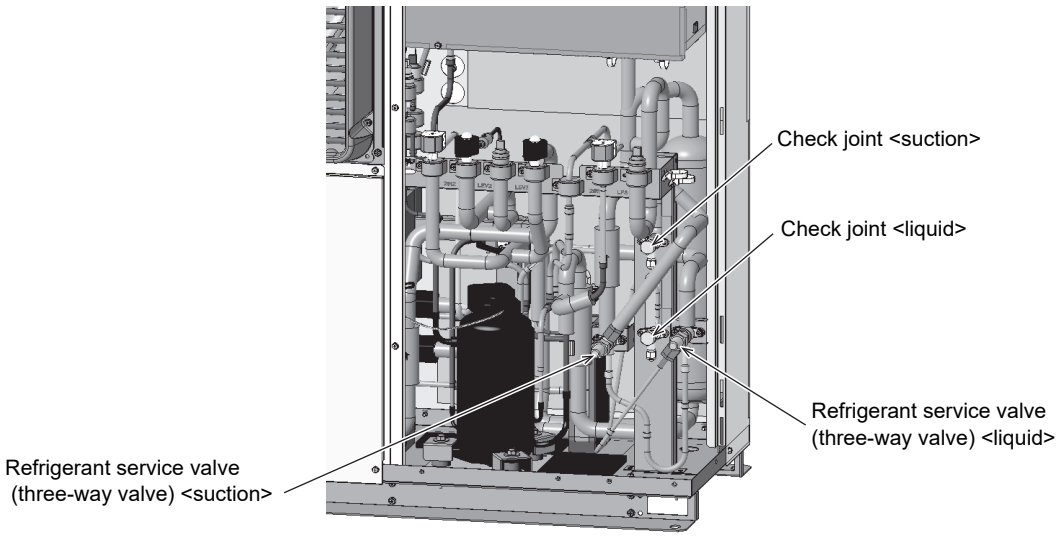
(3) Vacuum drying procedure

Be sure to use a vacuum pump for vacuum drying of the system. Vacuum drying must be performed by a specialist.

The low pressure is digitally displayed on the Control board. **Unless the unit is energized during the vacuum drying, the low-pressure is not displayed on the Control board. Check the low-pressure by using a gauge manifold and a vacuum gauge.**

Procedures

1) Open the solenoid valve and the LEV of the refrigerator by following the steps 2 through 4 below. (vacuum-drying mode)
2) Turn off the power to the unit.
3) Set the dipswitch SW4-10 to ON.
4) Turn on the unit.
   The solenoid valve and the LEV will open.
   * The compressor/fan will not operate when SW1 is set to ON.
5) Connect to the vacuum pump.
   For information on the vacuum pump connection, refer to the relevant page. (page 48)
6) Evacuate the air from the check joint connected to the refrigerant service valve (three-way valve) <liquid> in the high-pressure circuit.
   Because a check valve is used in the low-pressure circuit, perform vacuum drying with the high-pressure circuit first (the capacity will be larger).
7) Evacuate the air from the check joint connected to the refrigerant service valve (three-way valve) <suction> in the low-pressure circuit.
   When performing vacuum drying, open the refrigerant service valve (three-way valve) <liquid> and the refrigerant service valve (three-way valve) <suction> halfway.
   For how to open the refrigerant service valve (three-way valve) <liquid> and the refrigerant service valve (three-way valve) <suction> halfway, refer to section 10-2-6.(page 49).
   (The condensing unit is filled with nitrogen. Attempting vacuum drying without opening the three-way valve as described above will not eliminate air out of the condensing unit.)



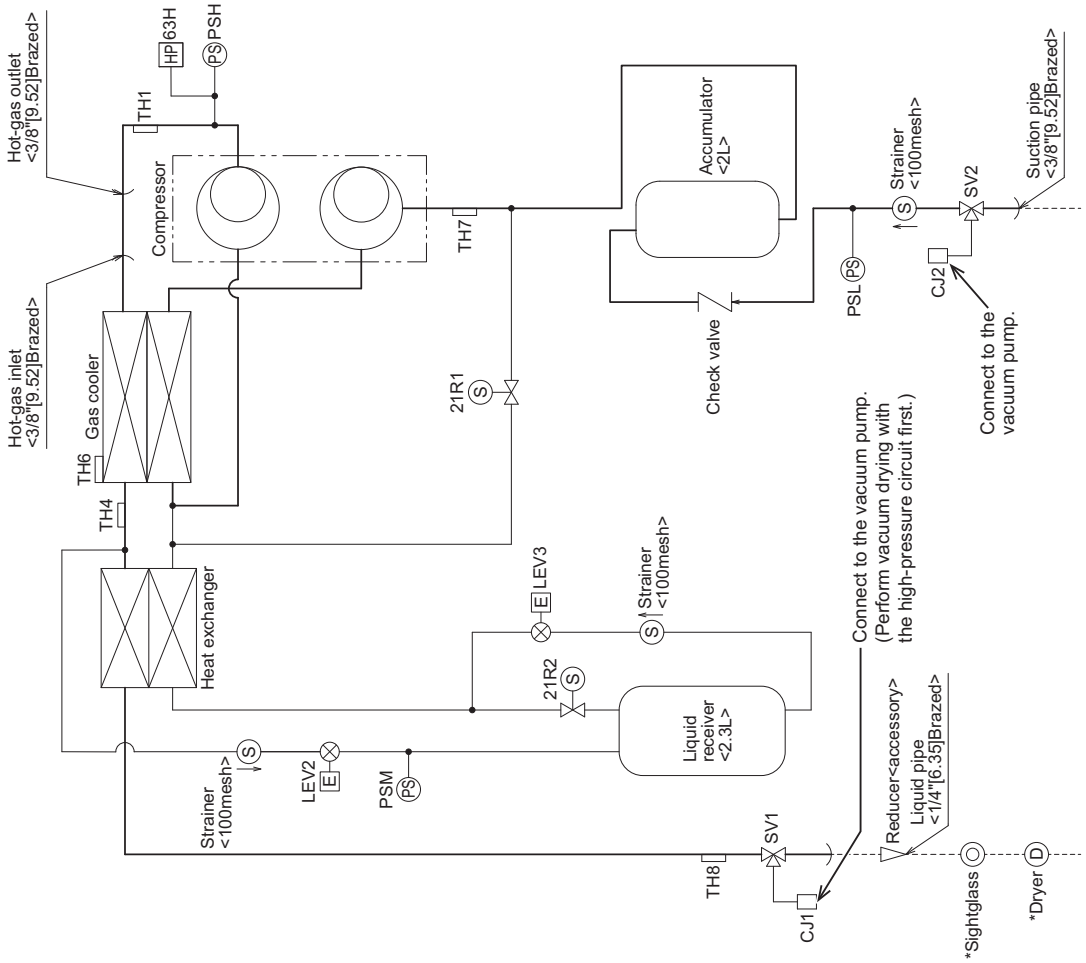
8) When the vacuum drying is completed, close the check joint and remove the vacuum pump.
9) Follow the procedure below to cancel the vacuum-drying mode.
10) Turn off the power to the unit.
11) Set the dipswitch SW4-10 to OFF.
12) Turning the unit power back on will cancel the vacuum-drying mode.
    * The compressor/fan may operate if SW1 is set to ON.

10-2-3. Connection of the vacuum pump

(1) ECOV-X15VA

Symbol	Component	Trigger threshold
CJ1	Check joint	
CJ2	Check joint	
LEV2	Electronic expansion valve	
LEV3	Electronic expansion valve	
PSH	Pressure sensor<high pressure>	
PSM	Pressure sensor<low pressure>	
PSL	Pressure sensor<low pressure>	
SV1	Stop valve	
SV2	Stop valve	
TH1	Thermistor<discharge pipe temperature>	
TH4	Thermistor<gas cooler outlet pipe temperature>	
TH6	Thermistor<outside air temperature>	
TH7	Thermistor<suction pipe temperature>	
TH8	Thermistor<liguid pipe temperature>	
21R1	Solenoid valve	Open while energized
21R2	Solenoid valve	Open while energized
63H	Pressure switch<high pressure>	12MPa OFF,8.5MPa ON

Note1.Those items marked with an asterisk are field-supplied.



10-2-4. Procedures for stopping the vacuum pump

To prevent the backflow of vacuum pump oil to the unit, open the relief valve on the vacuum pump, or draw in air by loosening the charging hose. Then stop operating the vacuum pump.
Use the same procedures when stopping a vacuum pump with a check valve.

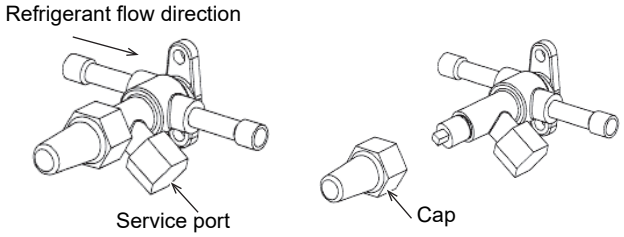
10-2-5. Required precision of vacuum gauge

(1) Use a vacuum gauge that can measure the vacuum pressure of 266 Pa and measure at 1 Torr (130 Pa) increments.
(2) A general gauge manifold cannot measure the vacuum pressure of 266 Pa.

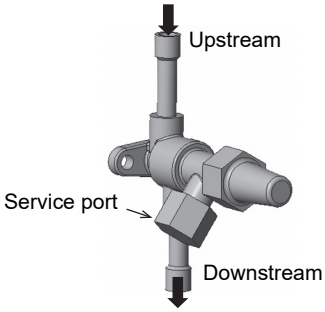
10-2-6. Operating the valve check joint

(1) Procedure to operate the refrigerant service valve (three-way valve) <liquid> and the refrigerant service valve (three-way valve) <suction>

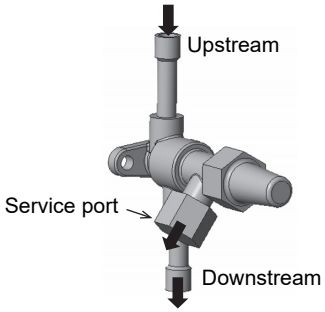
- Remove the cap, and turn the valve rod with pliers. Turn the valve rod counterclockwise to open the valve, and clockwise to close it.
- Tighten the cap to a torque of 25 to 35 N·m at the completion of valve operation.
  Failure to replace the cap will lead to refrigerant leakage.
  Do not damage the refrigerant sealing inside the cap.



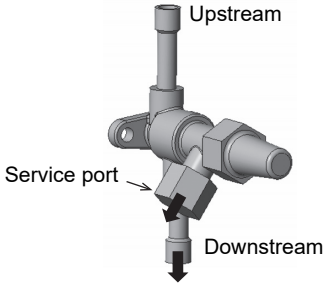
- Fully open
  Both the upstream and downstream pass refrigerant. Service port does not.



- Half open
  The upstream, downstream, and service port all pass refrigerant.

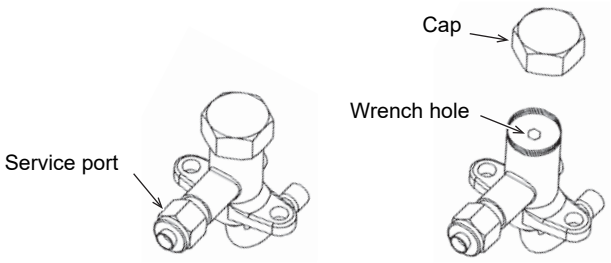


- Fully closed
  The downstream and service port pass refrigerant. Upstream does not.

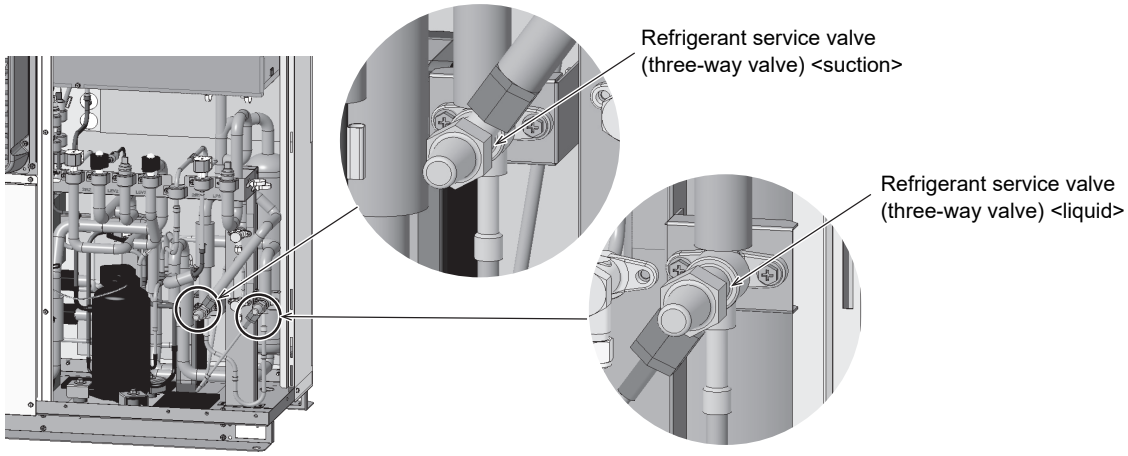


(2) Procedure to operate the check joint

- Remove the cap, and turn the valve rod with a 4-mm Allen wrench. Turn the valve rod counterclockwise to open the valve, and clockwise to close it.
- Tighten the cap to a torque of 15 N·m at the completion of valve rod operation.
  Failure to replace the cap will lead to refrigerant leakage.
  Do not damage the refrigerant sealing inside the cap.
- Securely tighten the cap on the charge port to a torque of 6 N·m.
  Failure to tighten the cap will lead to refrigerant leakage.
- The type of screw used for the check joint in the condensing unit is 7/16-20 UNF.



10-2-7. Parts names



11-1. Refrigerant charging procedure

Charge the system with refrigerant from the high-pressure side first.
Charging the system from the low-pressure side first may damage the compressor.

Follow the instructions below to charge refrigerant.

Procedures

1) Complete vacuum drying.
2) Weigh the refrigerant cylinder. <Before charging>
3) Charge the system with refrigerant through the check joint connected to the refrigerant service valve (three-way valve) <liquid>.

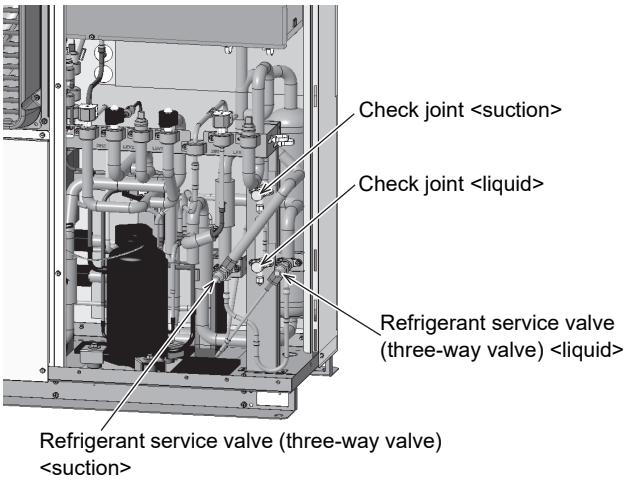
Note

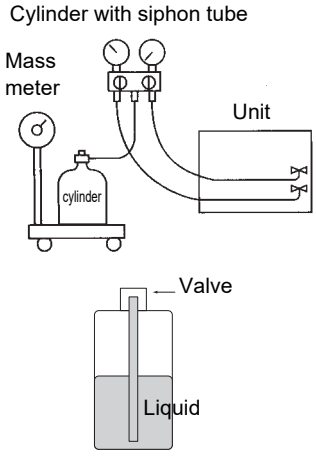
- Charge the high-pressure side with liquid refrigerant.
  Gradually add R744 in gas form to the refrigerant system until the internal pressure reaches 0.52 MPa.
  If R744 is charged in liquid form when the internal pressure is below 0.52 MPa, dry ice may form inside the system.
- Open the refrigerant service valve (three-way valve) <liquid> half-way to charge refrigerant.
- Do not charge liquid refrigerant from low-pressure side first.
  Charging liquid refrigerant from low-pressure side first may cause damage to the compressor.
  The compressor may suffer damage if the pressure on the compressor suction side is higher than the compressor discharge side (counter pressure).

4) Weigh the refrigerant cylinder.
5) Check that proper amount of refrigerant has been charged.

The amount of refrigerant to be charged = Cylinder weight before charging - Cylinder weight after charging

6) After the refrigerant has been charged, fully open the refrigerant service valve (three-way valve) <liquid> and the refrigerant service valve (three-way valve) <suction>.
   Then open the check joint to remove the refrigerant accumulated inside the pipe between the check joint and the three-way valve. Close the check joint cap. Do this with both the refrigerant service valve (three-way valve) <liquid> and the refrigerant service valve (three-way valve) <suction>.
7) After test run, check the operating conditions of the system, and then add an allowable amount of refrigerant if necessary. Overcharged refrigerant can raise the pressure inside the pipes. When adding refrigerant, charge additional refrigerant from the check joint connected to the refrigerant service valve (three-way valve) <suction> while operating the unit.





Note

- After the refrigerant is charged, fully open the refrigerant service valve (three-way valve) <liquid> and the refrigerant service valve (three-way valve) <suction>, open the check joint, remove the refrigerant accumulated inside the pipe between the check joint and the three-way valves, and close the check joint cap. Do this with both the refrigerant service valve (three-way valve) <liquid> and the refrigerant service valve (three-way valve) <suction>.
- Remove the refrigerant according to the applicable laws and regulations.

11-2. Allowable amount of refrigerant to be charged

Charge the refrigerant according to the table below.
(Install an additional accumulator if the amount of refrigerant exceeds the allowable amount shown in the table.)

(kg)

	Pipe length (m)	Medium temperature (ET -5~-20°C)				Low temperature (ET -20~-45°C)			
		Evaporator internal volume (L)				Evaporator internal volume (L)			
		1	2	3	4	1	2	3	4
Standard refrigerant charge	10	1.40	1.60	1.75	1.95	1.40	1.55	1.75	1.90
	20	1.50	1.70	1.90	2.05	1.50	1.65	1.85	2.00
	25	1.60	1.75	1.95	2.10	1.55	1.70	1.90	2.05
Maximum refrigerant charge	10	1.80	2.05	2.30	2.50	1.80	2.05	2.25	2.50
	20	1.95	2.20	2.45	2.65	1.90	2.15	2.40	2.65
	25	2.05	2.30	2.50	2.75	2.00	2.20	2.45	2.70

- The internal volume of the condensing unit is 7.07 L.
- When increasing the liquid pipe diameter to ø9.52, add 0.3 kg of refrigerant per 10 m of pipes to the amount of charge specified in the table above.
- If the value is not found in the table, calculate the amount of refrigerant to be charged by interpolation.
- Do not overcharge refrigerant more than the maximum amount.
- For information on evaporator internal volume, contact the manufacture of the indoor unit.
- After charging the refrigerant, check that no flash gas (bubbles) is seen through the sight glass while the unit is in operation.
  If the flash gas (bubbles) does not disappear, check the following:
  1) Check for refrigerant leakage.
  2) Check for liquid flood-back.
- Procure a sight glass locally.

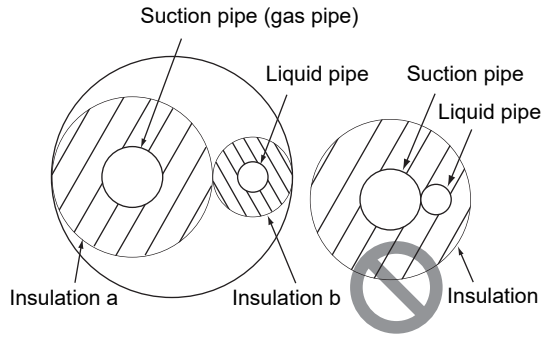
11-3. Insulating

- Insulating must be done after air tightness test.
- The liquid pipe and suction pipe must be insulated. Refer to the table below.
  Use foamed polyurethane and styrol with no hygroscopicity for insulation.

(Unit: mm)

Pipe	Insulation	Cold storage		Freezer storage	
		Thickness of insulation (recommended)		Thickness of insulation (recommended)	
Suction pipe	a	Pit piping	25 or more	Pit piping	50 or more
		Ceiling piping	50 or more	Pit piping	75 or more
Liquid pipe	b	20 or more			

* Calculate the thickness of the insulation with 0°C (32°F) as the cold storage refrigerant temperature for suction pipe and -30°C (-22°F) for freezer storage refrigerant temperature, and 0°C (32°F) for liquid pipe.



Prohibition of heat exchange between the suction pipe and the liquid pipe

- Do not exchange heat between the suction pipe and the liquid pipe.
- Hot gas pipe is always high temperature. Insulate pipes if they are installed in a place accessible to people. Use insulation that is rated for temperatures of at least 150°C (302°F), such as insulation tubes or glass wool insulation.

12-1. To ensure proper test run

Check if the wiring work has been done properly.
After wiring work, be sure to measure the insulation resistance between the cable run and ground, and that between each wire with a high voltage insulation megger tester to check that the resistance is 1 MΩ or more. (Do not measure the insulation resistance of the control board to prevent damage to the electronic circuit boards.)
After checking that the installation work has been done properly, power ON the main switch (earth leakage breakers etc.).
Check the phase order of the power supply and the interphase voltage. If the voltage is out of the ±10% range, discuss the countermeasure with the customer.

The crankcase heater that is used for preventing the foaming of lubricating oil is powered only when the compressor is stopped. Before starting up the unit after leaving it alone more than half a day with its main switch OFF, energize the unit at least 3 hours to heat the lubricating oil.
Fully open the refrigerant service valve.
Make sure that the compressor or fan is generating no abnormal noise or vibration. When there is any abnormality, immediately stop and inspect the unit.
After the operation becomes stable, check that the operation pressure and the temperature of each device are in the proper range. Refer to "Checking the unit condition". (page 63)
There are round holes on the bottom of the product for draining water in rainy weather and for discharging heat in the product. Do not block these holes.

12-2. Setting the pressure switch <high pressure>

(1) The unit is equipped with a pressure switch <high pressure> in the refrigerant circuit as a safety device. The default values of the switch are fixed and unchangeable.
(2) Do not change the settings or do not replace the switch.
(3) The default values of the pressure switch <compressor discharge pressure> are as follows.

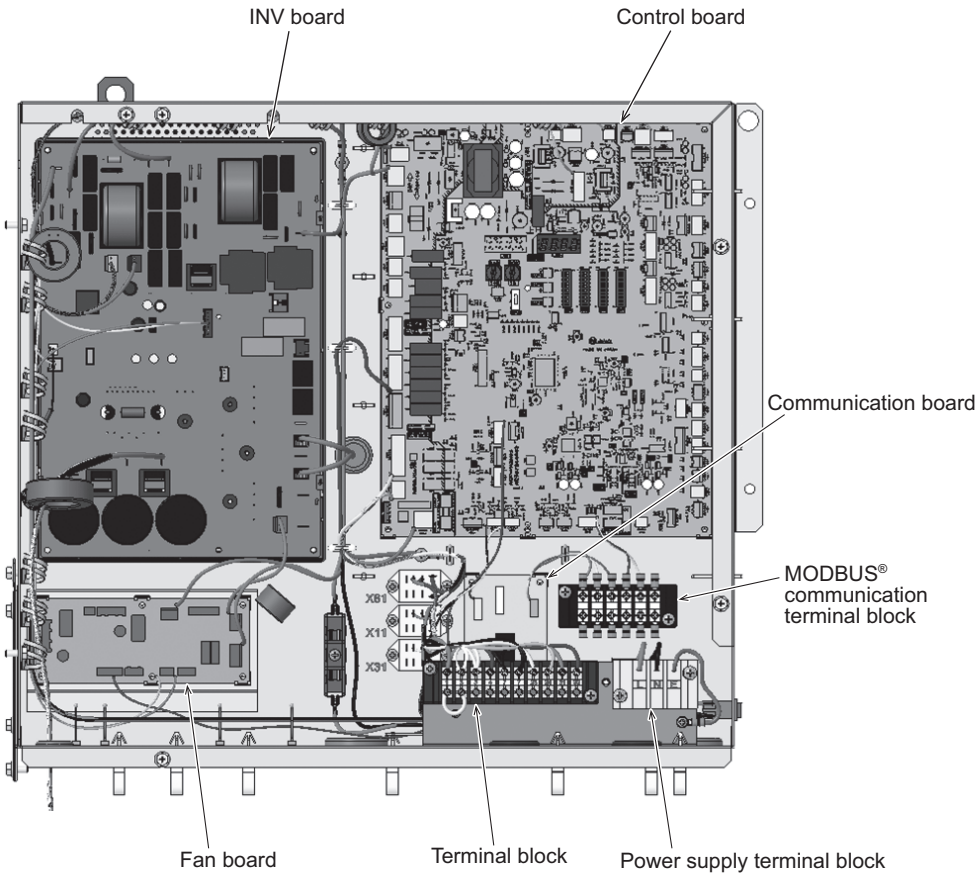
Safety device	Default setting value (MPa)	
	OFF	ON
Pressure switch <compressor discharge pressure>: 63H	12.0	8.5

12-3. Unit components of control devices

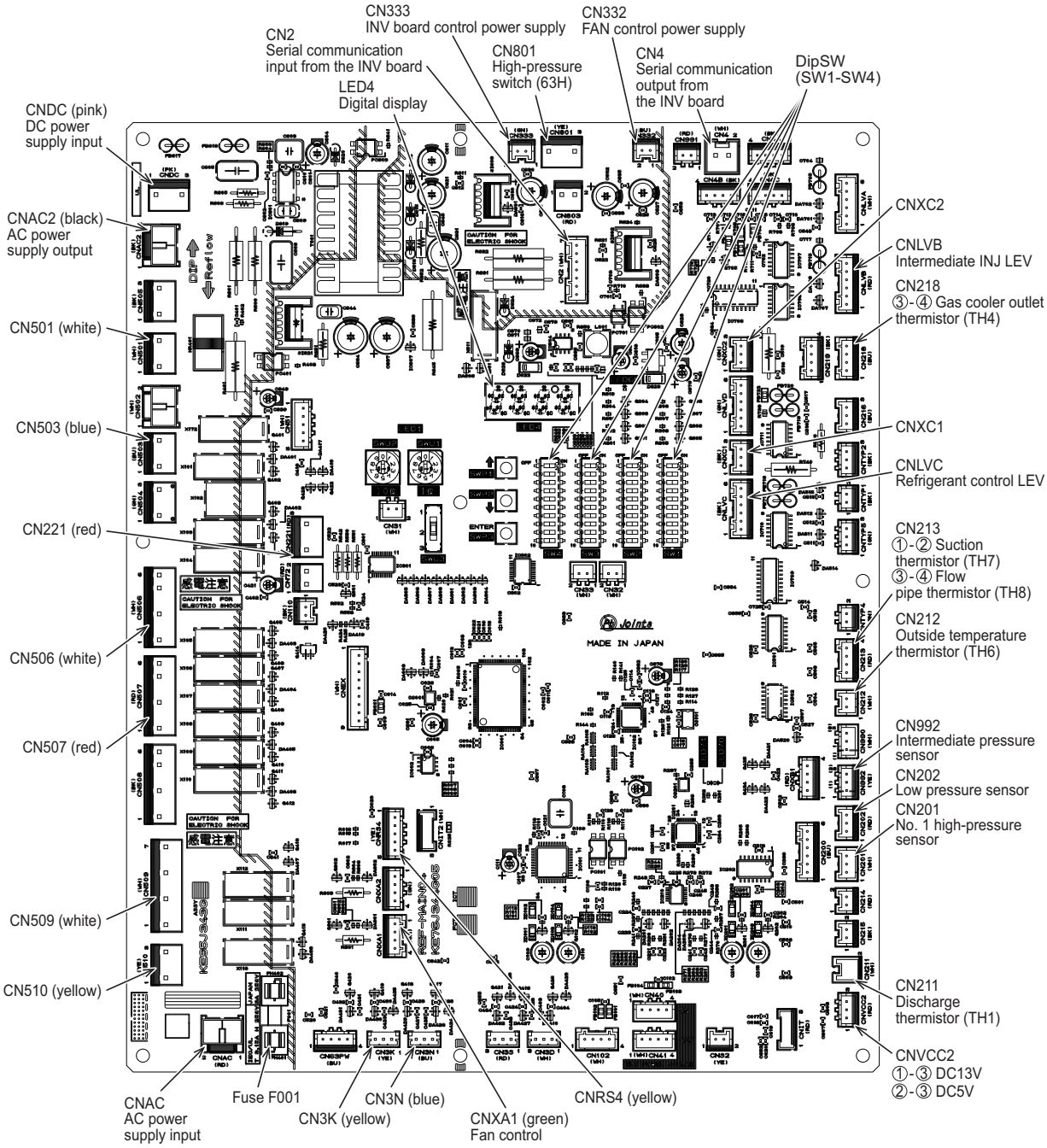
■ **Unit components**

Note

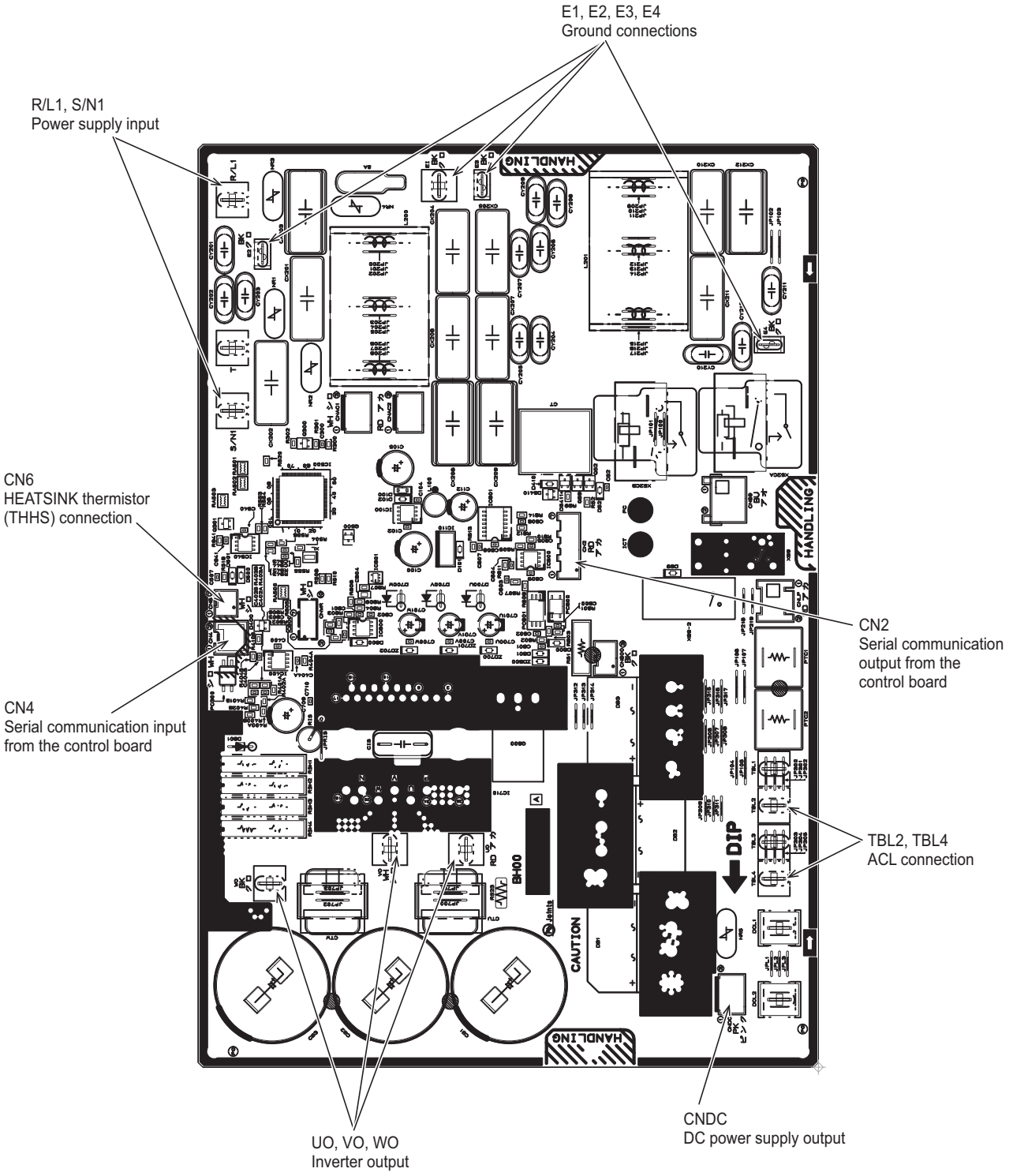
- Do not measure the insulation resistance of the controller because doing so will damage its electrical circuit.



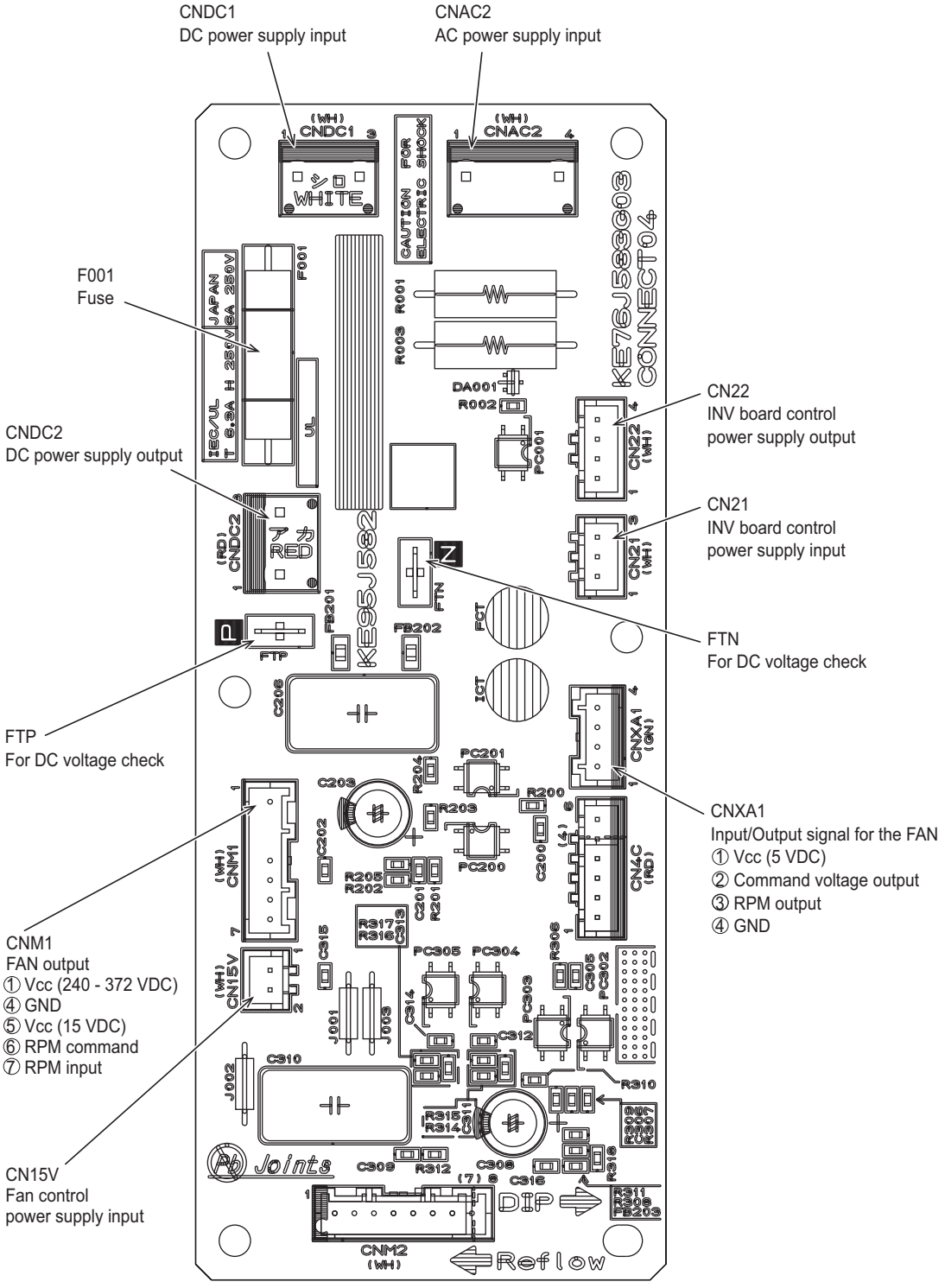
■ **Control board**



■ **INV board**


E1, E2, E3, E4
Ground connections
R/L1, S/N1
Power supply input
CN6
HEATSINK thermistor
(THHS) connection
CN4
Serial communication input
from the control board
CN2
Serial communication
output from the
control board
TBL2, TBL4
ACL connection
UO, VO, WO
Inverter output
CNDC
DC power supply output
HANDLING
DIP
CAUTION

■ **Fan board**


CNDC1
DC power supply input
CNAC2
AC power supply input
F001
Fuse
CNDC2
DC power supply output
FTP
For DC voltage check
CNM1
FAN output
① Vcc (240 - 372 VDC)
④ GND
⑤ Vcc (15 VDC)
⑥ RPM command
⑦ RPM input
CN15V
Fan control
power supply input
CN22
INV board control
power supply output
CN21
INV board control
power supply input
FTN
For DC voltage check
CNXA1
Input/Output signal for the FAN
① Vcc (5 VDC)
② Command voltage output
③ RPM output
④ GND
CNDC1
CNAC2
CAUTION FOR ELECTRIC SHOCK
WHITE
F001
R001
R003
DA001
R002
PC001
CN22
CN21
FTN
FTP
FB201
FB202
FGT
IGT
C206
CNXA1
PC201
R204
C203
R200
R203
C202
PC200
C200
CN4C
R205
R202
C201
R201
CNM1
R317
R316
C313
C315
PC305
PC304
R306
C305
PC302
PC303
C314
C312
CN15V
J001
J003
J002
C310
R310
R315
R314
C309
R312
C308
C316
R318
DIP
R311
R309
FB203
CNM2
Reflow
Joints

12-4. Setting the target evaporation temperature

Set the dip switch (SW2) according to the following table to set the target evaporation temperature.

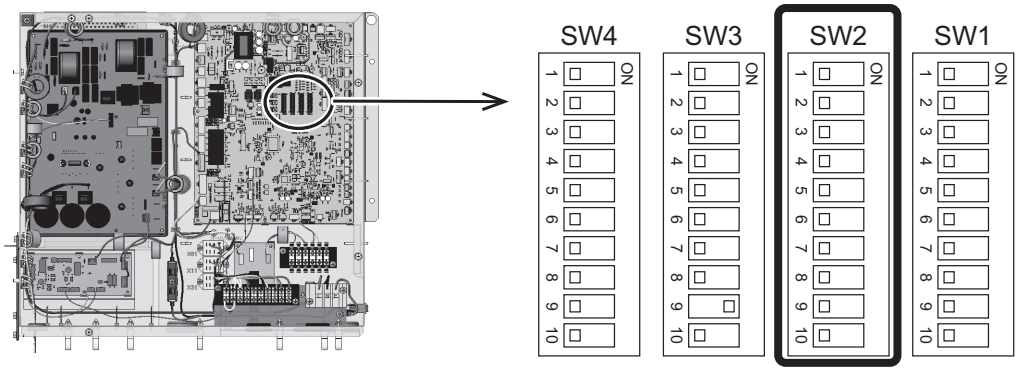
Note

- Always turn off the power of the unit before setting the dip switch (SW2).

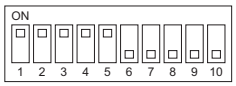
1: ON 0: OFF

Dip switch (SW2)						Target evaporation temperature
1	2	3	4	5	6	
0	1	0	0	1	0	-5
1	1	0	0	1	0	-6
0	0	1	0	1	0	-7
1	0	1	0	1	0	-8
0	1	1	0	1	0	-9
1	1	1	0	1	0	-10
0	0	0	1	1	0	-11
1	0	0	1	1	0	-12
0	1	0	1	1	0	-13
1	1	0	1	1	0	-14
0	0	1	1	1	0	-15
1	0	1	1	1	0	-16
0	1	1	1	1	0	-17
1	1	1	1	1	0	-18
0	0	0	0	0	1	-19
1	0	0	0	0	1	-20
0	1	0	0	0	1	-21
1	1	0	0	0	1	-22
0	0	1	0	0	1	-23
1	0	1	0	0	1	-24
0	1	1	0	0	1	-25

Dip switch (SW2)						Target evaporation temperature
1	2	3	4	5	6	
1	1	1	0	0	1	-26
0	0	0	1	0	1	-27
1	0	0	1	0	1	-28
0	1	0	1	0	1	-29
1	1	0	1	0	1	-30
0	0	1	1	0	1	-31
1	0	1	1	0	1	-32
0	1	1	1	0	1	-33
1	1	1	1	0	1	-34
0	0	0	0	1	1	-35
1	0	0	0	1	1	-36
0	1	0	0	1	1	-37
1	1	0	0	1	1	-38
0	0	1	0	1	1	-39
1	0	1	0	1	1	-40
0	1	1	0	1	1	-41
1	1	1	0	1	1	-42
0	0	0	1	1	1	-43
1	0	0	1	1	1	-44
0	1	0	1	1	1	-45



- Before operating the unit, set the target evaporation temperature using the dip switch (SW2).
  If the target evaporation temperature is not set, operation starts with the target evaporation temperature tentatively set to -10°C.
- Even when using MODBUS® to set the target evaporation temperature, always use the dip switch (SW2) to set the target evaporation temperature before operating the unit.
  When the power to the unit is shut off due to a power outage, the unit starts up with the target evaporation temperature that has been set with the dip switch (SW2) upon recovery of the power.
  Until the target evaporation temperature is set again using MODBUS®, the target evaporation temperature that has been set with the dip switch (SW2) is effective.
- For instructions on how to set the target evaporation temperature using MODBUS®, refer to the MODBUS® Interface Manual.
- Please contact the supplier for the MODBUS® Interface Manual.

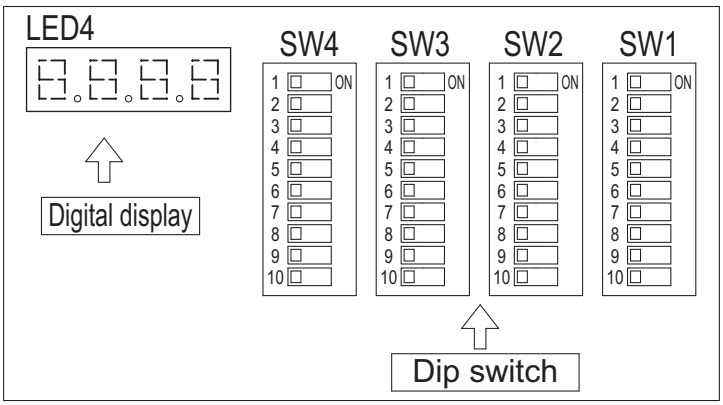


Switches 1 to 5 are ON, and switches 6 to 10 are OFF in the figure on the left.

12-4-1. Component names and display of the Control board (inside the control box)

[A] Digital display on the Control board: LED4
[B] Dip switch: SW1 - SW4

Display of the Control board (inside the control box)



Operation status display on LED4

Symbol	Operation status
oFF	Compressor stoppage (by using operation switch)
run	Compressor in operation
LPoF	Low-pressure cutoff function is stopped.
0H	Compressor stoppage (by using capacity control)
00H	Compressor preliminary stoppage (during the 3-minute restart delay mode)
000H	Compressor error stoppage
oIL1	Oil return operation in progress
udry	Evacuation mode
P01-P07	Pre-alarm

Note 1: This model stops the compressor when the solenoid valve <liquid> or other valves are closed and the low pressure falls below a certain level. (Low-pressure cutoff)
The low-pressure cutoff ON- and OFF-thresholds vary depending on the target evaporation temperature.

Note 2: If the low pressure has not reached "the low-pressure cutoff ON-threshold" even after the lapse of the low pressure cutoff restart delay time, the LED repeatedly shows "LPoF," "0H," and "low pressure" in order.

12-4-2. Evaporation temperature setting according to the usage

Target evaporation temperature needs to be set or changed according to the usage or depending on the cooling load.
This unit is controlled that it detects the low pressure and keeps the evaporation temperature at certain degree.
Set or change the target evaporation temperature according to the cooling load or usage.

(1) Target evaporation temperature setting

Target evaporation temperature can be set by using the DIP switches.
Refer to "12-4. Setting the target evaporation temperature" for procedures.

Target evaporation temperature

Refrigerator internal temperature range	Space temperature	Target evaporation temperature *1
−3ºC ~ +10ºC Fruit and vegetables/chilled grocery/ processed meat/ fresh dish/ dairy products	0ºC above	−10ºC ~ −5ºC
	−2ºC	−12ºC
−30 ºC ~ −5 ºC Chill-stored pre-frozen food	−10ºC or below	−20ºC or below
	-18ºC	−30ºC
Ice cream	-23ºC	−35ºC

*1. Take into consideration the pressure loss that occurs in a system with long refrigerant line, and adjust the target evaporating temperature as necessary.

- Even when using MODBUS® to set the target evaporation temperature, always use the dip switch (SW2) to set the target evaporation temperature before operating the unit.
  When the power to the unit is shut off due to a power outage, the unit starts up with the target evaporation temperature that has been set with the dip switch (SW2) upon recovery of the power.
  Until the target evaporation temperature is set again using MODBUS®, the target evaporation temperature that has been set with the dip switch (SW2) is effective.
- For instructions on how to set the target evaporation temperature using MODBUS®, refer to the MODBUS® Interface Manual.
- Please contact the local distributor for the MODBUS® Interface Manual.

(2) Target evaporation temperatures and corresponding control value (automatically calculated

Target evaporation temperature	ºC	-45	-40	-35	-30	-20	-10	-5
Target low pressure	MPa	0.73	0.90	1.11	1.32	1.86	2.54	2.94
Low-pressure cutoff compressor OFF-threshold	MPa	0.58	0.73	0.90	0.90	1.32	1.86	2.18
Low-pressure cutoff compressor ON-threshold	MPa	0.73	0.90	1.10	1.18	1.58	2.19	2.54

12-5. Test run procedure

12-5-1. Initial processing

It will take approximately two minutes (max. five minutes) for the low pressure to be displayed on the digital display on the Control board after the unit is turned on.
If the low pressure does not appear on the digital display after a while, check the power and transmission lines for wiring errors. If wiring is correctly done, check the power-supply frequency.

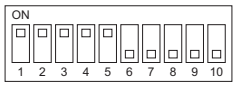
1) What to expect during the initial processing

During the initial setting of the LEV, the LEV will make clicking noises, but this is not a malfunction.
During the initial setting of the circuit board, a value will appear on the digital display for a few seconds.

12-5-2. Operation

(1) Operate the unit operation. (Capacity control)

1) Check that dip switch SW3-5 is OFF.
   Capacity control operation is performed using the inverter.
2) Set the ON/OFF switch (SW1) to ON.
   The unit starts operating.
   Low pressure will be displayed on the digital display on the Control board.



Switches 1 to 5 are ON, and switches 6 to 10 are OFF in the figure on the left.

12-5-3. Stop the unit. (Pump down stop)

(1) Stop the unit.

Set the ON/OFF switch (SW1) to OFF.
The unit stops operating.

Note

- To prevent refrigerant flood-back upon resuming operation, turn off the switch (SW1) after low-pressure cutoff from pump down operation.

(2) Stop the unit after pump down. (Pump-down mode)

Use the pump-down mode when closing the solenoid valve on the liquid line, recovering the refrigerant to the liquid receiver, and providing maintenance for the load-side equipment.

1)Set the ON/OFF switch (SW1) to OFF to stop the operation.
2)Set the unit power to OFF.
3)Set dip switch SW3-5 to ON to start the fixed frequency mode. Set dip switch SW3-1 on the unit to ON to start the pump-down mode.
4)Close the solenoid valve <liquid> or the refrigerant service valve (three-way valve) <liquid>.
5)Turn on the unit power supply, and the ON/OFF switch (SW1) to ON to start the operation.
The unit operates at the low-pressure cutoff OFF-threshold of 0.58 MPa and the ON-threshold of 0.73 MPa.
After completing the pump down process, set the ON/OFF switch (SW1) to OFF to stop the operation, and set dip switches SW3-5 and 3-1 to OFF with the unit power set to OFF .
* Do not operate the unit in the above settings except to perform maintenance.
* Even after pump down stop, approximately 1 MPa of refrigerant will remain on the low-pressure side. Refrigerant may spew out during servicing.

- If the system is overcharged with refrigerant, performing a pump-down operation through the liquid service valve in high ambient temperature (30°C (86°F) or above) may result in high-pressure cut off.
- If a pumpdown is performed on a system with refrigerant overcharge and is then stopped for a long time, the pressure may rise. Do not perform a pumpdown, and instead stop the unit by turning off the operation switch.
- Recover refrigerant from the system through the refrigerant service valve (three-way valve) <liquid> and the refrigerant service valve (three-way valve) <suction> before a long period of non-use or providing maintenance work.

12-6. Checking the unit condition

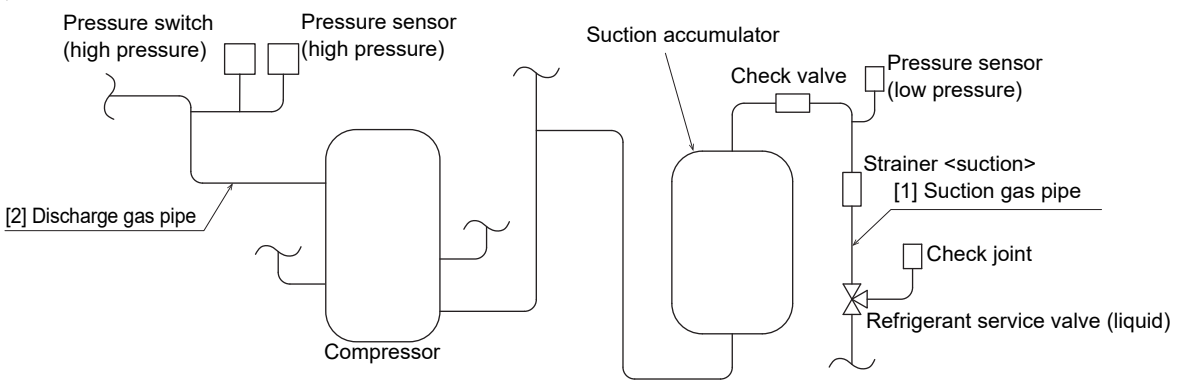
12-6-1. Regular operation check

Check that the discharge pressure is not abnormally high.

Ambient temperature (°C) (°F)	0 (32)	5 (41)	10 (50)	15 (59)	20 (68)	25 (77)	30 (86)	35 (95)	40 (104)
Discharge pressure (MPa)	5.5	5.5	5.7	6.0	6.5	7.0	8.0	9.0	9.5

Check that the unit's suction gas temperature does not exceed 20°C (68°F).
Check if the compressor is not flooding. If the compressor is flooding, adjust the opening of the expansion valve on the load side.
The solenoid valve may open or close while the compressor is stopping. This is not a malfunction.

- The table below shows the temperature of each part when the unit is properly adjusted.



Evaporation temperature (°C) (°F)	-10 (-14)	-35 (-31)
[1] Unit suction gas temperature (°C) (°F)	0 to 10 (32 to 50)	-15 to -5 (5 to 23)
[2] Discharge gas temperature (°C) (°F)	50 to 70 (122 to 158)	70 to 90 (158 to 194)

- Power supply: Single phase 220 to 240 V, 50 Hz
- Gas cooler return air temperature: 32°C (89°F)
- Operation at 40 Hz

Note

- Do not operate the unit with the compressor being flooded. Because the refrigerant oil used in this unit is non-miscible, if the unit is operated with a flooded compressor, refrigerant oil will not properly return to the compressor, resulting in compressor damage.

12-6-2. Preventing short-cycling operation

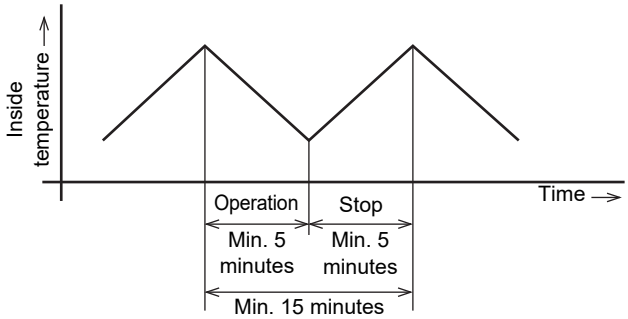
1) Checking if the operation is in short-cycling or not

Check the cycle of operation/stop time. If it is within 15 minutes, the operation is in short-cycling.
Eliminate the cause of the short-cycling.
The unit is equipped with a delay timer (at a maximum 200 seconds) to prevent frequent short-cycling operations.

2) Preventing short-cycling operation (frequent repeat of operation/stop)

As an essential measure to prevent short-cycling operation, the operation pattern needs to be set as shown in the figure.

- Short-cycling operation may cause a lack of lubricating oil because of a large oil trip at the startup.
- A large amount of current flows to the built-in motor when the unit starts, which may cause the motor to be overheated, resulting in burn-damage to the coil.



3) Major cause of short-cycling

Followings are possible major causes of short-cycling.

- Setting failure of low pressure control
  For example, the low pressure differential is set to 0.2 MPa or below.
- Clogged strainer <suction>
- Leakage in the injection circuit or in solenoid valve <liquid> on the evaporator side caused by device fault or foreign substances.
- Refrigerant undercharge
- Condensing unit selection error (Unit capacity is too large.)
- Frosted evaporator
- Excessive door opening/closing on refrigerator, showcase, etc. (load side)

12-6-3. Troubleshooting

(1) How to interpret the currently occurring abnormality

If the following code and value are shown on the digital display of the Control board, perform troubleshooting according to "Error codes and messages for troubleshooting" (page 77).

- 4-digit code → Detailed code → 000H → Low pressure (Alternating blinking display)

Note

- After the test run, check for leakage.

12-6-4. Troubleshooting when a pre-alarm occurs or when a failure occurs

(1) Error troubleshooting

Use the following procedure for the inspection when an error occurs.
When the unit detects an error, the error code will be displayed on the digital display LED4 and the compressor will stop.

Procedures

1) Eliminate the cause of the error that was detected.
2) Set the ON/OFF switch (SW1) to OFF.
3) After you inspect the location with the error, set the ON/OFF switch (SW1) to ON.
The error code will go out.

(2) Definition of a pre-alarm

The status when there is a risk of a condensing unit failure occurring, such as due to insufficient refrigerant, will be output as a pre-alarm. The pre-alarm will be output as a code (P code) that differs from an error code, and the following table shows those types of codes.

P code	Name	Description
P01	Insufficient refrigerant detected	Insufficient refrigerant due to a leak or seasonal fluctuation was detected from the change in the status of the refrigerant.
P02	Liquid backflow	A condition in which the degree of superheat of the compressor suction gas was detected at 5K or lower for a cumulative 30 minutes or longer.
P04	Excessive compressor starts/stops	The number of low-pressure cutoffs in the last 24 hours was the specified number or more.
P05	High ambient temperature	A value was detected at which the outdoor temperature thermistor (TH6) exceeds the operating range.
P06	Compressor operating time	The cumulative compressor operating time is the specified value or more.
P07	Thermistor/sensor error	A error was detected on a sensor of a type that does not output an alarm.

- When a pre-alarm is detected, one of the P codes listed above will be displayed on LED4 on the control board and the contact (220 to 240 V) between terminals 7 and 24 will be turned on (automatically canceled when the cancellation conditions are satisfied or manually canceled by the ON/OFF switch (SW1)).

(3) Insufficient refrigerant pre-alarm code details and troubleshooting

(1) Overview of insufficient refrigerant pre-alarm control

1) Detection method

The insufficient refrigerant pre-alarm is detected when LEV3 is fully open, solenoid valve 21R2 is closed, solenoid valve 21R1 is closed, and subcooling is 3K or lower. (The pre-alarm may not be detected when the outdoor temperature is high or low and when there is liquid backflow.)

2) Operation when the pre-alarm is detected

When the insufficient refrigerant status is detected, the following processing is performed as the insufficient refrigerant pre-alarm.

- The compressor will not stop.
- The "P01" pre-alarm code will be displayed on LED4 on the cotrol board. 220 to 240 V will be output between terminals 7 and 24.

3) Cancellation method

The cancellation condition for the insufficient refrigerant pre-alarm is one of the following conditions:

- When LEV3 ≠ fully open or solenoid valve 21R2 was opened
- ON/OFF SW1 is off or off between terminals 1 and 3

Note

- Since the P code displayed on LED4 of the unit will not disappear even when a cancellation condition is satisfied, set the ON/OFF switch (SW1) to OFF.

(2) Causes of the insufficient refrigerant pre-alarm

The primary causes for detecting the insufficient refrigerant pre-alarm, as well as check methods and remedies are shown in the following table.

No.	Cause	Check method and remedy
1	Insufficient refrigerant amount in initial charge	Charge with refrigerant again.(*1)
2	Refrigerant leak	Identify location of leak, repair, and charge with refrigerant again.
3	Liquid backflow	Did the fan delay time on the unit cooler side exceed 5 minutes? Did liquid backflow occur due to a failure, etc., on the evaporator side?
4	Evaporator temperature remains high in regard to target evaporation temperature for a long period time.	Eliminate cause listed at left.
5	Thermistor detected temperature/pressure sensor detected pressure differs from actual temperature/pressure or thermistor/sensor error.	Replace the thermistor or the sensor.

*1 Refer to "Notes on insufficient refrigerant pre-alarm control" in the next section.

(3) Notes on insufficient refrigerant pre-alarm control

- Insufficient refrigerant amount in the initial charge is a common cause for the first year from the start of operation because the necessary refrigerant amount will vary throughout the year.
- Refrigerant undercharge pre-alarm may be detected without the presence of flash gas (foam) in the sightglass. When checking the status of operation on site, check the data immediately before the pre-alarm in addition to whether flash gas (bubbles) is occurring in the sightglass.
- This control requires a certain amount of time for detection, so it cannot handle rapid refrigerant leaks other than a slow leak. For a rapid refrigerant leak, other errors will occur, such as a discharge temperature error, or there may be poor cooling.
- Insufficient refrigerant will not be detected when (1) to (5) below are applicable.
  (1) When the ambient temperature is less than 0°C or more than 40°C
  (2) 24 hours after the insufficient refrigerant pre-alarm was detected (except when canceled with the ON/OFF switch (SW1)) or the first cumulative 30 minutes of operation after the power is turned on
  (3) When the following pressure sensor and thermistors have an error:
  Pressure sensor <low pressure>, thermistor 6 <outside temperature>, thermistor 8 <liquid outlet temperature>, thermistor 4 <gas cooler outlet temperature>, thermistor 7 <suction pipe temperature>
  (4) When the compressor is stopped with an error or the compressor is stopped by the ON/OFF switch (SW1)
  (5) During emergency operation (fixed frequency)
- Insufficient refrigerant may not be detected when (1) or (2) below are applicable.
  (1) When there are operating conditions such as low operating frequency, low outside temperature, and low suction gas temperature.
  (2) When the gas cooler fan or the compressor frequency changes drastically
  (3) When a sudden refrigerant leakage occurs

(4) Troubleshooting when the P01 insufficient refrigerant pre-alarm is detected during test run, etc.

1) When the P01 insufficient refrigerant pre-alarm occurs during refrigerant charging

The P01 insufficient refrigerant pre-alarm may occur during refrigerant charging when performing a test run, etc.

After charging is completed, set the ON/OFF switch (SW1) to OFF → ON to reset the pre-alarm.
Then if operation is performed for about 1 hour and the P01 insufficient refrigerant pre-alarm occurs again, the refrigerant is insufficient. Consider adding refrigerant. (However, depending on the operating status, such as frequency starts/stops, it may take some time until the pre-alarm occurs.)

2) When no flash (bubbles) occurs in the sightglass but the P01 insufficient refrigerant pre-alarm was detected

Insufficient refrigerant will be detected when the amount of charged refrigerant is low in regard to the appropriate amount even if flash (bubbles) does not occur in the liquid pipe sightglass (this will be detected before flash (bubbles) occurs in the sightglass and poor cooling happens).
In this case, check the operating status and resolve the cause why there is insufficient refrigerant (insufficient initial charge, liquid backflow, refrigerant leak, etc.).

Note

- Since the operating status will vary, there may be an operating status under which insufficient refrigerant is not detected depending on the time period that was investigated after the P01 insufficient refrigerant pre-alarm occurred. In particular, insufficient refrigerant will occur more frequently when the operating frequency or evaporation temperature is high, such as during pull-down after defrosting, during the daytime when the temperature is high, and during liquid backflow. Investigate the pre-alarm during these time periods.

Note

- The system will perform an automatic recovery if LEV3 ≠ fully closed or if solenoid valve 21R2 was opened after the P01 insufficient refrigerant pre-alarm was detected. When an automatic recovery is performed, the P01 insufficient refrigerant pre-alarm will not occur for 24 hours after the pre-alarm was detected. However, detection will be resumed immediately when reset by setting the ON/OFF switch (SW1) to OFF → ON.

(5) Others

Refer to the specified page. "Troubleshooting by pre-alarm (P) code" (page 83).

12-6-5. Error code

(1) Error code list

The table below shows a list of Error code that are shown on the digital display.
Refer to "Error codes and messages for troubleshooting" for details.
The following codes blinks on the digital display in order.
• 4-digit code → Detailed code → 000H → Low pressure (Alternating blinking display)
Alarm (control board) output "Default" in the table indicates the following settings.
on: Alarm is output when an error occurs.; off: Alarm is not output when an error occurs.

Error code	Detail code	Preliminary code	Detail code	Error type	Alarm (X112) output
					Default
0403	001	4300	001	Serial communication <Control board> error	ON
1102	001	1202	001	Discharge temperature rise protection function trip	ON
1301	-	1401	-	Pressure sensor (PSL) fault	ON
1302	001	1402	001	High pressure (HPS1) fault	ON
1302	002	-	-	Mechanical protective device <pressure switch/thermal switch> trip	ON
1304	-	1404	-	Pressure (MPS) fault	ON
1500	001	-	-	Refrigerant floodback protection 1	ON
1500	002	-	-	Refrigerant floodback protection 2	ON
1521	-	1621	-	Injection pipe blockage fault	ON
4102	002	4152	002	Open phase due to primary current error	ON
4115	101	4165	101	Power supply error <power supply synchronization signal error>	ON
4116	001	4166	001	Fan rotation speed error (connector CNM1)	ON
4210	101	4310	101	Primary current error	ON
4220	108	4320	108	Inverter BUS voltage drop protection	ON
4220	109	4320	109	Inverter BUS voltage rise protection	ON
4220	131	4320	131	Inverter BUS voltage drop protection	ON
4220	253	4320	253	Converter Fo error	ON
4230	-	4330	-	Inverter heatsink overheat protection	ON
4250	104	4350	104	IGBT short-circuit/ground fault	ON
4250	106	4350	106	Overcurrent cutoff fault	ON
5101	-	1202	-	Thermistor <discharge pipe temperature (TH1)> fault	ON
5104	003	-	-	Thermistor <gas cooler outlet temperature (TH4)> fault	OFF
5106	-	-	-	Thermistor <ambient temperature (TH6)> fault	OFF
5107	-	-	-	Thermistor <suction pipe temperature (TH7)> fault	OFF
5108	-	-	-	Thermistor <liquid pipe temperature (TH8)> fault	OFF
5110	001	1214	001	Inverter heatsink temperature drop/thermistor circuit fault	OFF
5201	-	1402	-	Pressure sensor <PSH1> fault	ON
5204	001	1404	001	Pressure sensor <PSM> fault	ON
5301	117	4300	117	Current sensor circuit <inverter AC current> fault	ON
6600	-	6600	-	Duplicate address definition	-
-	-	6603	-	BUS BUSY	-
-	-	6606	-	Invalid telegraphic message length error	-
-	-	6607	-	No ACK error	-
-	-	6608	-	No response frame error	-
-	-	7000	050	IGBT system error (inverter reset)	-

Error code	Detail code	Preliminary code	Detail code	Error type	Alarm (X112) output
					Default
Function setting error					
7113	014	-	-	TYPE4 error	ON
7113	015	-	-	TYPE5 error	ON
Function setting error (unset)					
7117	014	-	-	TYPE4 open error	ON
7117	015	-	-	TYPE5 open error	ON

• Thermistor fault indicates that a shorted or open thermistor is detected.

12-6-6. Pre-alarm codes

The pre-alarm codes displayed on the digital display (LED4) are given in the following table.
For details, refer to the specified page. "Insufficient refrigerant pre-alarm code details and troubleshooting(page 65)"
Alternately displayed with low-pressure on LED4.
Pre-alarm (X113) output in the table means the following:
on: X113 outputs on when a pre-alarm is detected (between terminals 7 and 24).
off: X113 does not output on when a pre-alarm is detected (between terminals 7 and 24).

Pre-alarm code	Pre-alarm item	Pre-alarm (X113) output
P code		Default
P01	Insufficient refrigerant detected	ON
P02	Liquid backflow	OFF
P04	Excessive compressor starts/stops	OFF
P05	High ambient temperature	OFF
P06	Compressor operating time	OFF
P07	Thermistor or sensor error	OFF

12-6-7. Other codes

Other codes	Code explanation
Lo	It is suggested that the low pressure is -0.100MPa or below.
OIL1	Oil return operation in progress

12-7. Miscellaneous functions

12-7-1. To correspond the low ambient temperature

(1) When ambient temperature is below internal unit temperature

When ambient temperature is below internal unit temperature, operation failure may be caused to prevent the low pressure from its recovery after a compressor pumpdown stop. Also, a pipe flooding protection control may be detected in this condition. Follow the instructions below for troubleshooting.

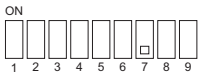
a) Raise high pressure.

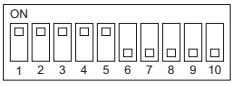
Take appropriate measures on site, such as narrowing the suction space of gas cooler.

b) Use the Low ambient temperature mode.

Changing the dip switch SW2 setting will switch the mode into the low ambient temperature mode which enables the unit to operate under low ambient temperature. When the ambient temperature is less than 0°C and the low-pressure cutoff OFF-threshold is reached, the compressor will stop and restart after three minutes in the Low ambient temperature mode.

If both the low-ambient-temperature mode and the pump-out mode are set, the pump-out mode takes priority when the system restarts after low-pressure cut-off. In the low-ambient-temperature mode, the low-pressure cut-off value decreases when the ambient air temperature is below -10°C. When using MODBUS® communication, the low-pressure cut-off value in the low-ambient-temperature mode takes priority over the value sent through MODBUS® communication.

Operation mode	Dip switch SW2	Notes
Normal mode (Factory setting)		A pump down operation is performed according to the low-pressure cutoff OFF and ON thresholds depending on the target evaporation temperature setting.
Low ambient temperature mode		When the ambient temperature is less than 0°C and the low-pressure cutoff OFF-threshold is reached, the compressor will stop and restart after three minutes even if the low-pressure is still below the ON-threshold. (The compressor will stop and be held when the low-pressure reaches the OFF-threshold after startup.)



Switches 1 to 5 are ON, and switches 6 to 10 are OFF in the figure on the left.

c) Decrease the target evaporation temperature.

If the low pressure does not recover after a pump down stop, change the setting of the dip switch (SW2) to decrease the target evaporation temperature.

For how to set the dip switch, refer to section 12-4. Setting the target evaporation temperature (page 59).

12-7-2. To use ECO operation (ECO mode setting)

Configure the following settings to enable ECO operation.

This mode is enabled when the outside temperature is in the medium temperature range (less than 27°C) or when operating at a light load (at night, etc.). However, the operating noise of the fan increases.

Setting	Target condensation temperature	Target evaporation temperature	Maximum operating frequency	Remarks
ECO mode	Outside temperature + 5°C	Depending on the status of the load, the target evaporation temperature is shifted and control is performed at the maximum operating frequency. The status of the load is judged from the operating status of the unit.		

• If poor cooling continues, cancel the ECO mode setting.

(1) Procedure to change the setting value

Procedures

1) Set the ON/OFF switch (SW1) in the control box to OFF , and then turn off the unit.
2) Set the dip switch (SW2-10) to ON .

13-1. The list of control item

Control type	Function	Content
Control at Startup	Frequency control	The inverter compressor will operate at or below 35 Hz for three minutes after startup.
Control at stoppage	High-pressure startup prevention control	When the high pressure is high, the unit will operate in the fan mode without starting up the compressor.
Normal operation control	Frequency control	Controls the compressor operating frequency and fan rotation speed for the high/low pressure to meet the target pressure.
	Fan control	
	Oil recovery control	When the cumulative operation time of the inverter compressor under the specified conditions reaches one hour, the compressor will stop and remain stopped for three minutes to allow the oil to migrate back to the compressor.
	Low-pressure cutoff control	Low-pressure cutoff threshold will automatically be calculated according to the target evaporation temperature setting.
	(Short-cycling operation)	Once stopped, the unit will not restart for three minutes to prevent short-cycling.
	Discharge temperature control	LEV2 is controlled so that the discharge temperature becomes the specified temperature.
Backup control	Low compression ratio protection (LED4: bP01)	Increases the compressor operation frequency when the compressor operation frequency is low and the compression ratio is small.
	Fan motor hunting prevention (LED4: bP02)	Decreases the fan output when the fan output is large and the rotation speed of the fan is unstable.
	Discharge pressure suppression 1 (LED4: bP03)	Decreases the compressor operation frequency and opens LEV2 when the discharge pressure is high.
	High-stage discharge temperature suppression (LED4: bP04)	Decreases the compressor operation frequency when the discharge temperature is high.
	Low-pressure suppression (LED4: bP05)	Decreases the compressor operation frequency when the low pressure approaches the cut-off value.
	High-stage discharge temperature overrise protection (LED4: bP06)	Decreases the compressor operation frequency and opens LEV3 when the discharge temperature is high.
	High-stage discharge temperature overrise protection (LED4: bP28)	Decreases the compressor operation frequency and opens LEV2 and LEV3 when the discharge temperature is high.
	Discharge pressure overrise protection (LED4: bP07)	Operates the fan at full speed when the discharge pressure is high.
	Low-pressure retraction speed protection (LED4: bP09)	Decreases the compressor operation frequency when the low-pressure retraction speed is fast.
	Refrigerant flood-back protection 1 (LED4: bP15)	Increases the compressor operation frequency when the temperature condition for triggering the refrigerant flood-back protection is met and the compressor operation frequency is low.
	Refrigerant flood-back protection 2 (LED4: bP17)	Decreases the compressor operation frequency when the temperature condition for triggering the refrigerant flood-back protection is met and the compressor operation frequency is high.
	Heatsink temperature overrise suppression (LED4: bP18)	Operates the fan at full speed when the heatsink temperature is high.
	Discharge pressure suppression 2 (LED4: bP27)	Decreases the compressor operation frequency, closes LEV3 and opens LEV2 when the discharge pressure is high.
	Liquid receiver pressure overrise protection (LED4: bP29)	Closes LEV2 when the liquid receiver pressure is high.
	Low-stage discharge temperature protection (LED4: bP30)	If the low-stage discharge temperature is high, the compressor will decelerate. (The low-temperature discharge temperature is calculated with the detected values of PSL, PSM, and TH7.)
	Restrictions on discharge superheat (LED4: bP21)	The compressor will accelerate when discharge superheat has fallen. (Discharge superheat = TH1 detection value - high-pressure saturation temperature)
	Pressure difference protection (LED4: bP31)	The compressor will decelerate when the difference between the PSM detection value and the PSL detection value has increased or when the difference between the PSH detection value and the PSM detection value has increased.
Abnormal stop control	Refer to the "Error codes and messages for troubleshooting" for the details of abnormal stop control.	
Service functions	Backup operation (During low-pressure sensor fault)	When an inverter compressor operation is available, the operating frequency will be fixed.

♦The inverter compressor of this unit cannot be operated with commercial power supply.
Refer to the clause "Troubleshooting the principal components" for any problems with the unit.

13-1-1. Initial processing

It will take approximately two minutes (max. five minutes) for the low pressure to be displayed on the digital display on the control board after the unit is turned on.
If the low pressure does not appear on the digital display after a while, check the power and transmission lines for wiring errors. If wiring is correctly done, check the power-supply frequency.

(1) What to expect during the initial processing
During the initial setting of the LEV, the LEV will make clicking noises, but this is not a malfunction.
During the initial setting of the circuit board, a value will appear on the digital display for a few seconds.

13-1-2. Low-pressure cutoff (normal operation)

- For low-pressure cutoff control (normal operation control), refer to the specific page. (page 61)
- The low-pressure cutoff value is automatically calculated and controlled according to the target evaporation temperature set point.
- The unit does not restart for 3 minutes after it stops to prevent short-cycling operation.
- If the high-pressure is high when the compressor starts, the compressor will not be started for a maximum of 5 minutes and just the fan will be run.

Note

- To lower the low-pressure to 0.00 MPa during service, perform operation in pumpdown mode. For details, refer to the specified page. (page 62)
- If the low-pressure cutoff state continues regardless of the increase of temperature in the chamber, LEV2 may be faulty.

The inverter compressor's operating frequency and fan speed are controlled from the external temperature, high-pressure, and low-pressure data so that the target high-pressure and low-pressure are achieved.

13-1-3. Oil return control

Procedures

1) Oil return operation will start when the operating frequency of the inverter compressor meets the conditions as defined in the table below.
2) Oil return operation will be terminated when the operating frequency of the inverter compressor meets the conditions as defined in the table below.

Unit model	Oil return control		
	Operation start conditions	Operation end conditions	Control frequency
ECOV-X15VA	Cumulative operation at or below the specified operating frequency has not exceeded 1 hour.	Compressor has been operating at 70 Hz or above for five minutes or longer.	70 Hz or above

See page 74 for how to set SET1 and SET2.

(1) Oil return operation

Procedures

1) The compressor will remain stopped for three minutes.
2) Operate the compressor at the specified frequency. (See the table above "Control frequency" for the frequency during oil-return operation.)
If the low pressure reaches the OFF-threshold, all compressors will stop for three minutes.
3) Oil-return operation will automatically end when the cumulative operation time of 2) has reached five minutes, and the unit will resume normal operation.

13-1-4. High pressure suppression control

(1) Control related to discharge pressure

- If the discharge pressure reaches 10 MPa or above, inverter compressor operating frequency will be reduced.

13-1-5. High-pressure start prevention control

- If the high-pressure is high when the compressor starts, the compressor will not be started for a maximum of 5 minutes and just the fan will be run.

13-1-6. Compressor flooding prevention

If the following conditions are detected during compressor operation, liquid backflow protection control is performed.

• When suction superheat*1 is detected at less than 3K continuously for 5 minutes

(1) Control method

1) The compressor will stop, and the alarm output (220-240 VAC between terminal block numbers 7 and 23) will be turned on.
2) [4-digit code → Detailed code → 000H → Low pressure] will appear on the digital display LED4 in order.
3) When suction superheat*1 is detected at 3K or more, the compressor will restart, and the unit will go back to normal control.
   At this time, [4-digit code → Detailed code → 000H → Low pressure] still appears on the digital display LED4.
   The display will go back to the normal low pressure display mode when the problem has been solved and the operation switch (ON/OFF) SW1 is turned off and then turned back on.

(2) Refrigerant flood-back alarm output display

1) When the following conditions are continuously met for 30 minutes while the compressor is in operation, the alarm output (220-240 VAC between terminal block numbers 7 and 23) will be turned on, and [4-digit code → Detailed code → 000H → Low pressure] will appear on the digital display LED4 in order. (The compressor will not stop.)
   • Suction superheat < 5K
2) If the following conditions are satisfied during compressor operation, the alarm output (220-240 VAC between terminal block numbers 7 and 23) will be turned on, and [4-digit code → Detailed code → 000H → Low pressure] will appear on the digital display LED4 in order.
   (The compressor will not stop.)
   • After suction superheat < 5K and LEV2 opening angle = minimum opening is detected, suction superheat < 5K and LEV2 opening angle = minimum angle is detected for 1 hour out of 2 hours

*1. Suction pipe temperature - current low-pressure saturation (gas) temperature

Note

- When the shell bottom thermistor (TH7) or pressure sensor (PSL) error is occurring, this control will not be performed.

13-2. Switch settings

13-2-1. Dip switch settings

Note

- Before setting the dip switch, turn off the main power of the unit.

(1) Dip switch settings

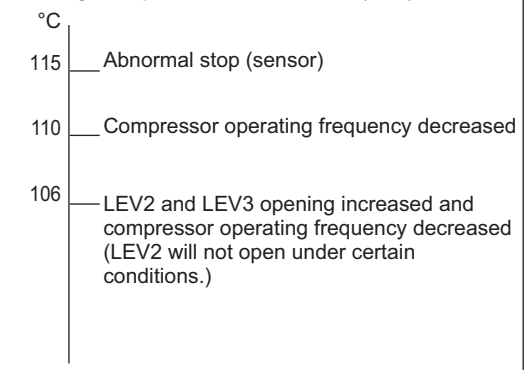
SW		Item	OFF	ON	Note
2	1–6	Target evaporation temperature setting	See the separate table for combination.		See the specified page. (page 59)
	7	Low ambient temperature mode	Low-pressure cutoff ON-threshold effective (normal operation)	The compressor resumes operation 3 minutes after it was stopped by the low-pressure cutoff function.	Effective when outside temperature is 0ºC or below (page 70)
	8	Use of oil-recovery operation (oil return)	SET2	SET1	Factory default setting: SET 2
	9	Compressor INV no-load operation mode	Disable	Enable	See the specified page. (page 92) (Set to OFF normally.)
	10	ECO mode	Disable	Enable	For details, refer to the specified page. (page 70)
3	1	Pump-down mode	Normal	Pump-down mode	Effective only when the compressor operating frequency is fixed: The low-pressure cutoff OFF-threshold will be 0 MPa.
	4	Use of emergency operation during a low-pressure sensor error	No	Yes	Effective when SW3-5 is set to ON: When the low-pressure sensor fails, the pressure switch (locally procured) will perform low-pressure cutoff control.
	5	Operation mode switching	Normal	Fixed frequency operation	The compressor operating frequency is fixed in the fixed frequency mode.
	4	Pump-out mode	Disable	Enable	Disabled by default for both SW3-4 and SW3-5. Enabled when SW3-4 is ON and SW3-5 is OFF. When the low-pressure cutoff switch is connected and pump-out mode is enabled, When the low-pressure cut-off switch is set to ON, the compressor will start three minutes after a low-pressure cut-off event has occurred.
	5		Disable	Enable	
4	10	Test run mode	Disable	Enable	Opens all solenoid valves and LEVs.

Note

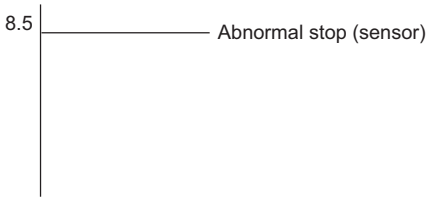
- Do not change the settings of the items that are not contained in the table above.
  (For the factory default settings, see the nameplate on the product.)

13-3. Control methods for the control items

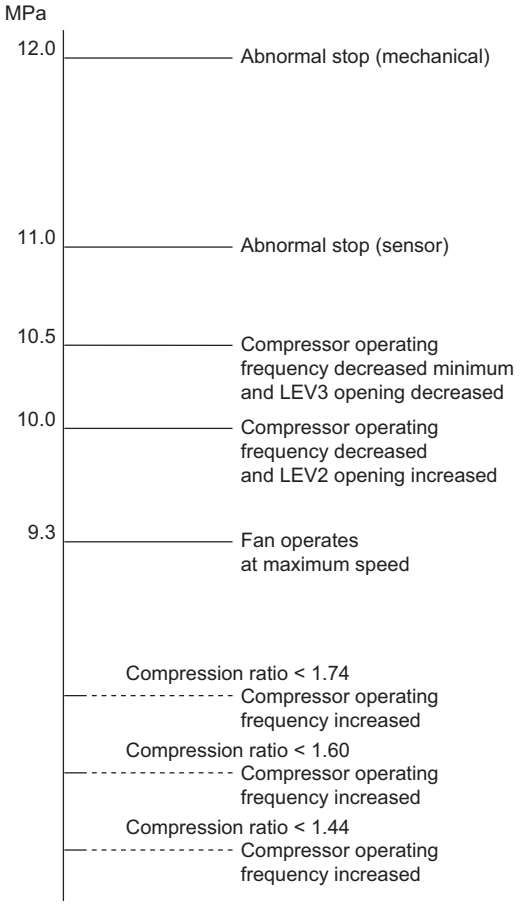
Discharge-temperature based control (TH1)



Liquid trap pressure-based control (MPS)



Discharge-pressure control (HPS1, 63H)



Use one of the following to troubleshoot problems with the condensing unit.
(1) If the digital display on the control board is lit, see the section "c) Error codes and messages for troubleshooting".
(2) If the digital display on the control board is unlit, check 14-3-4. "(3) Troubleshooting when the power is ON but the LEDs on the control board are not lit".
(3) If the compressor does not start, no error code appears on the display, check 14-2. "Checking the electrical circuit".

14-1. Troubleshooting

a) Checking tips for each error code
Troubleshooting can be done by using the digital display (the slide and rotary switches).
When the LED4 is alternately blinking
Perform troubleshooting according to the section "Error codes and messages for troubleshooting".
When the LED4 displays only low pressure
If the condensing units are not operating normally, check for a blown fuse, check that the target evaporation temperature setting, target condensation temperature setting, and dip switch settings for maintenance are set correctly, and that the refrigerant circuit (pressure/temperature), electrical circuits, and power supplies (voltage/frequency) are trouble-free.

b) Remedy
When an error occurs, follow the procedures below for checkup.

Procedures

1) When errors are detected, LED4 displays error codes, and compressor stops.
2) Remove the cause of the error.
3) Turn the ON/OFF switch (SW1) in the control box on the unit to OFF, and turn it back ON.

c) Error codes and messages for troubleshooting

Error (Maintenance) code/ Preliminary error code				Error type		Error description and detection method	Cause	Check method and remedy
Error code	Detail code	Preliminary code	Detail code					
0403	001	4300	001	Serial communication <control board> error	Comp	When serial communication between the control board and the INV board is not established	(i) Wiring fault	Check the following wirings for proper connection. Between the control board, FAN board and the INV board Control board side: CN2, CN4 FAN board side: CN21, CN22, - INV board side: CN2, CN4
							(ii) INV board fault, control board fault	If the problem persists after a power reset, replace the INV board or the control board.
1102	001	1202	001	Discharge temperature rise protection function trip		(1) If the thermistor <discharge pipe temperature> registers 120ºC during operation, the unit will stop, go into the three-minute restart-delay mode, and restart after three minutes. The error code will be written to the memory at this time. (2) If a temperature of 120ºC or higher is detected twice within 30 minutes of the stoppage of the units, the units will make an abnormal stop, and an error code will be displayed. The error code will be written to the memory at this time. (3) If a temperature of 120ºC or higher is detected after 30 minutes have elapsed after the stoppage of the units, it is regarded as the first detection, and the sequence as described in section (1) above will be followed.	(i) Refrigerant gas leakage, refrigerant gas undercharge	Check the refrigerant amount through the sight glass. Add refrigerant.
							(ii) Overload operation	Check the operation data. Check the suction gas temperature.
							(iii) Expansion valve actuation fault	Check the LEV for proper operation. Check the temperature at the LEV inlet/outlet. (Use the fixed LEV opening mode.)
							(iv) Temporary refrigerant shortage due to refrigerant flood-back	Check the operation status, such as incorrect opening angle of the expansion valve, solenoid valve <liquid> fault, fan motor fault, heat exchanger clogging, and the start-delay time of the fan.
							(v) Refrigerant service valve operation fault	Check that the refrigerant service valves are fully open.
							(vi) Fan motor fault Fan control board fault	Refer to 14-3-4. (8) Quick check of the DC fan motor (fan motor/control board).
							(vii) Thermistor <discharge pipe temperature> fault	Check the thermistor intake temperature. Check the thermistor resistance value.
							(viii) Control board thermistor <discharge pipe temperature) input circuit fault	Same as above
1301	–	1401	–	Pressure sensor (PSL) fault		(1) If an open- or short-circuited pressure sensor <PSL> is detected (first detection), the compressor will stop, go into the three-minute restart-delay mode, and restart after three minutes. The error code will be written to the memory at this time. (2) If an open- or short-circuit is detected twice within 30 minutes of the stoppage of the units, the units will make an abnormal stop. The error code will be written to the memory at this time.	(i) Pressure sensor <PSL> fault	Refer to page 86.
							(ii) Broken sensor wire sheath	Check the sensor wire sheath for tear.
							(iii) Missing connector pins	Check the connector for missing pins.
							(iv) Sensor wire breakage	Check the sensor wire for breakage.
							(v) Control board low-pressure input circuit fault	Check the sensor intake pressure.
							(vi) Pressure drop due to refrigerant gas leakage.	Check the pressure with a gauge manifold.
1302	001	1402	001	High pressure (HPS1) fault		(1) If the pressure sensor <PSH1> detects a pressure of 11.0 MPa or higher during operation (first detection), the compressor stops, goes into the three-minute restart-delay mode, and restarts after three minutes. The error code will be written to the memory at this time. (2) If a pressure of 11.0 MPa or higher is detected twice within 30 minutes of the stoppage of the unit, the unit will make an abnormal stop, and an error code will be displayed. The error code will be written to the memory at this time. (3) If a pressure of 11.0 MPa or higher is detected after 30 minutes have elapsed after the stoppage of the unit, it is regarded as the first detection, and the sequence as described in section (1) above will be followed.	(i) Stop valve operation fault	Check that the stop valves are fully open.
							(ii) Short-cycling operation	Check the suction air temperature.
							(iii) Dirty heat exchanger	Check the heat exchanger for soiling.
							(iv) Fan motor fault	Refer to page 99.
							(v) Loose fan motor connector	Check the fan motor connector for proper insertion.
							(vi) Pressure sensor <PSH1> fault	Refer to page 86.
							(vii) Control board pressure sensor <PSH1> input circuit fault	Check the sensor intake pressure.
							(viii) Pressure switch <high pressure> connector disconnection	Check the pressure switch <high pressure> connector for proper insertion. Wiring fault between the pressure switch <high pressure> and the control board.
							(ix) Refrigerant overcharge	Check the high pressure during operation.

Error (Maintenance) code/ Preliminary error code				Error type		Error description and detection method	Cause		Check method and remedy
Error code	Detail code	Preliminary code	Detail code						
1302	002	–	–	Mechanical protective device <pressure switch/thermal switch> trip		If the pressure switch of 12.0 MPa or a discharge thermostat trip at 135ºC is detected, the unit will make an abnormal stop, and an error code will be displayed. The error code will be written to the memory at this time.	(i)	Stop valve operation fault	Check that the stop valves are fully open.
							(ii)	Short-cycling operation	Check the suction air temperature.
							(iii)	Dirty heat exchanger	Check the heat exchanger for soiling.
							(iv)	Fan motor fault	Check the fan motor.
							(v)	Loose fan motor connector	Check the fan motor connector for proper insertion.
							(vi)	Pressure switch <high pressure> or discharge thermostat connector disconnection	Check the pressure switch <high pressure> and discharge thermostat connectors for proper connection.
							(vii)	Refrigerant overcharge	Check the high pressure during operation.
							(viii)	Faulty wiring of the pressure switch <high pressure> or discharge thermostat	Faulty wiring to the pressure switch <high pressure> or to the control board with a faulty discharge thermostat
							(ix)	Blown fuse	Check that the fuse (F01) is not blown.
							(x)	Refrigerant gas leakage, refrigerant gas undercharge	Check the refrigerant amount through the sight glass. Add refrigerant.
							(xi)	Overload operation	Check the operation data. Check the suction gas temperature.
							(xii)	Expansion valve actuation fault	Check the LEV for proper operation. Check the temperature at the LEV inlet/outlet. (Use the fixed LEV opening mode.)
							(xiii)	Temporary refrigerant shortage due to refrigerant flood-back	Check the operation status, such as incorrect opening angle of the expansion valve, solenoid valve <liquid> fault, fan motor fault, heat exchanger clogging, and the start-delay time of the fan.
1304	–	1404	–	High pressure (MPS) fault		(1) If a pressure of 8.5 MPa or higher is detected (first detection) by the pressure sensor <PSM> during operation, the compressor will stop, go into the three-minute restart-delay mode, and restart after three minutes. The error code will be written to the memory at this time. (2) If a pressure of 8.0 MPa or higher is detected twice within 30 minutes of the stoppage of the unit, the unit will make an abnormal stop, and an error code will appear. The error code will be written to the memory at this time. (3) If a pressure of 8.0 MPa or higher is detected after 30 minutes have elapsed after the stoppage of the unit, it is regarded as the first detection, and the sequence as described in section (1) above will be followed.	(i)	Stop valve operation fault	Check that the stop valves are fully open.
							(ii)	Short-cycling operation	Check the suction air temperature.
							(iii)	Dirty heat exchanger	Check the heat exchanger for soiling.
							(iv)	Fan motor fault	Refer to page 99.
							(v)	Loose fan motor connector	Check the fan motor connector for proper insertion.
							(vi)	Pressure sensor <PSM> fault	Refer to page 86.
							(vii)	Control board pressure sensor <PSM> input circuit fault	Check the sensor intake pressure.
							(viii)	Refrigerant overcharge	Check the high pressure during operation.

Error (Maintenance) code/ Preliminary error code				Error type		Error description and detection method	Cause	Check method and remedy
Error code	Detail code	Preliminary code	Detail code					
1500	001	–	–	Refrigerant floodback protection 1		(1) If a discharge superheat of 20 K or below (HPS1 ≤ 7.2 MPa or TH1 ≤ 80ºC (HPS1 > 7.2 MPa), and the compressor shell bottom superheat of below 10 K, and a suction superheat below 5 K are registered for continuous 30 minutes, the units will make an abnormal stop. The error code will be written to the memory at this time. (2) If the compressor shell oil temperature reaches 10ºC or above, the operation will be resumed. (3) If the compressor shell oil temperature of -15ºC or below has been registered for an hour, an error code will be displayed. (The compressor will not stop operating.) The error code will be written to the memory at this time. (4) If the compressor shell oil temperature reaches 10ºC or above, the error code will be cancelled.	(i) load-side fault	Check the operation status, such as incorrect opening angle of the expansion valve, solenoid valve <liquid> fault, fan motor fault, heat exchanger clogging, frost on the heat exchanger from excessively opening/closing the door, and the start- delay time of the fan.
							(ii) Expansion valve actuation fault	Check the LEV for proper operation. Check the temperature at the LEV inlet/outlet.
							(iii) Refrigerant leakage through solenoid valve <21R1>	Check solenoid valve <21R1> for refrigerant leakage.
1500	002	–	–	Refrigerant floodback protection 2			(iv) Thermistor fault (TH1, TH2, PSH1, PSL)	Refer to 14-3-4. (5) Simple check on the main inverter circuit components.
							(v) Thermistor installation problem (TH1, TH2, PSH1, PSL)	Check that the thermistor and the pressure sensor are installed in the correct places.
							(vi) Control board thermistor input circuit fault (TH1, TH2, PSH1, PSL)	Check the sensor intake temperature and pressure.
1521	–	1621	–	Injection pipe blockage fault		Errors detected when the injection circuit is clogged	(i) Missing pins in LEV2 or LEV3 connector	Check for missing pins in the connector.
							(ii) LEV2 fault	Check if LEV2 is clogged.
							(iii) Refrigerant undercharge	Charge the system with refrigerant.
4102	002	4152	002	Primary current sensor error	Comp	When a primary current sensor failure was detected	(i) INV board fault	If the error continues even after turning ON the power, replace the INV board.
4115	101	4165	101	Power-supply error (power-supply synchronization signal error)	Comp	Power-supply frequency cannot be determined	(i) Power-supply error	Measure the voltage and the frequency at the power-supply terminal block (L-N), and confirm that it is within 220 to 240 V ±10% and within 50 Hz ±10%.
							(ii) Wiring fault Between TB1 and INV board Between INV board CNAC2 and control board CNAC Between control board CNAC2 and fan board CNAC2 Between fan board CN22 and INV board CN2	Check for a disconnected connector or broken wiring.
							(iii) Board fault (fan board)	If the above items are normal and the error continues even after turning ON the power, replace the fan board.
							(iv) Board fault (control board)	If the above items are normal and the error continues even after turning ON the power, replace the control board.
							(v) Board fault (INV board)	If the above items are normal and the error continues even after turning ON the power, replace the INV board.
4116	001	4166	001	Fan rotation speed error (connector CNM1)	Fan	Fan motor fault (connector CNM1)	(i) Air passage blockage	Check the fan duct.
							(ii) Fan motor fault	Check the fan motor for proper operation.
							(iii) Wiring fault	Check for connector fault. Refer to 14-3-4. (8) Quick check of the DC fan motor (fan motor/control board).
							(iv) Circuit board fault	
							(v) Fan rotation problem due to strong wind	Install an air protection guide, and check for proper operation.
4210	101	4310	101	Primary current input error	Comp	When a primary current input board failure was detected	(i) INV board fault	If the error continues even after turning ON the power, replace the INV board.

Error (Maintenance) code/ Preliminary error code				Error type		Error description and detection method	Cause	Check method and remedy
Error code	Detail code	Preliminary code	Detail code					
4220	108	4320	108	Inverter BUS voltage drop protection	Comp	When Vdc ≤ 200 V is detected during inverter operation (software detection)	(i) Power supply environment	Check to see if a momentary power failure or a power failure occurred when an error was detected. Measure the voltage at the power-supply terminal block (L-N), and confirm that it is 198 V or more.
							(ii) Wire breaks and connector disconnections	Check if CN333 on the control board and CN2 on the INV board are disconnected or if the wires are broken. Check if the TBL2 and TBL4 terminals on the INV board and the terminals on the AC reactor are disconnected or if the wires are broken.
							(iii) AC reactor failure	Check the AC reactor ACL. Refer to 14-3-4. (5) Simple check on the main inverter circuit components.
							(iv) Inrush current limiting resistor operation	After the power supply to the unit has been turned off for 10 minutes or longer, restart and check the unit. (The problem is resolved when the inrush current limiting resistor cools to ambient temperature.)
							(v) INV board failure	Replace the INV board.
4220	109	4320	109	Inverter BUS voltage rise protection	Comp	When Vdc ≥ 400 V is detected during inverter operation	(i) Non-standard voltage	Measure the voltage at the power-supply terminal block (L-N), and confirm that it is within the range of 220 V - 10% and 240 V + 10%. If no problems are found with the power-supply, replace the INV board.
							(ii) INV board fault	
4220	131	4320	131	Inverter BUS voltage drop protection	Comp	If VDC ≤ 192 V is detected when the compressor or fan starts	Same as 4220_108	Same as 4220_108
4220	253	4320	253	Converter Fo error	Comp	When Vdc ≥ 373 V is detected or when the converter detects overcurrent during inverter operation	(i) AC reactor failure	Refer to 14-3-4. (5) Simple check on the main inverter circuit components.
							(ii) Wiring fault Between AC reactor and INV board	Check for a disconnected connector or broken wiring.
							(iii) Non-standard voltage	Check the power-supply voltage at the power-supply terminal block. If no problems are found with the power-supply, replace the INV board.
							(iv) INV board fault	
4230	–	4330	–	Inverter heatsink overheat protection	Comp	When the inverter heatsink temperature sensor THHS registers a temperature above 70ºC.	(i) Air passage blockage	Check the cooling air passage of the heatsink of the control box for blockage.
							(ii) Wiring fault	Check the thermistor resistance.
							(iii) THHS fault	Check the THHS sensor intake value. → Replace the INV board if an abnormal value is shown.
							(iv) Fan fault	Refer to 14-3-4. (8) Quick check of the DC fan motor (fan motor/control board).
							(v) INV board fault	Replace the INV board.
4250	104	4350	104	IGBT short-circuit/ground fault	Comp	When a short-circuit of the IGBT or a ground fault of the compressor is detected immediately before the inverter starts up	(i) Compressor ground fault	Refer to 14-3-4. (5) Simple check on the main inverter circuit components.
							(ii) Inverter output related fault	
4250	106	4350	106	Overcurrent cutoff fault	Comp	When the current sensor registers a current above 17.3 Apeak or 10.2 Arms.	(i) Inverter output related fault	Refer to 14-3-4. (5) Simple check on the main inverter circuit components.
							(ii) Compressor flooding	Check the compressor refrigerant flooding.
							(iii) The suction temperature of the gas cooler is above the operating range.	Check the suction temperature of the gas cooler.
5101	–	1202	–	Thermistor <discharge pipe temperature (TH1)> fault		A short-circuit (high temperature intake) or an open-circuit (low temperature intake) of the thermistor detected during operation will be regarded as a thermistor fault. The error code will be displayed and recorded. The operation will automatically be continued if other sensors can be substituted for.	(i) Thermistor fault	Check the thermistor resistance.
							(ii) Pinched lead wire	Check the lead wire for pinching.
							(iii) Torn wire sheath	Check the wire sheath for tear.
							(iv) Missing connector pins, contact failure	Check the connector for missing pins.
							(v) Broken wire	Check the wire for breakage.
							(vi) Circuit board thermistor input circuit fault	Check the sensor intake temperature.

Error (Maintenance) code/ Preliminary error code				Error type		Error description and detection method	Cause		Check method and remedy
Error code	Detail code	Preliminary code	Detail code						
5104	003	–	–	Thermistor <gas cooler outlet temperature (TH4)> fault		A short-circuit (high temperature intake) or an open-circuit (low temperature intake) of the thermistor detected during operation will be regarded as a thermistor fault. The error code will be displayed and recorded. Abnormal thermistor will be ignored, and the operation will be continued.	(i)	Thermistor fault	Check the thermistor resistance.
							(ii)	Pinched lead wire	Check the lead wire for pinching.
							(iii)	Torn wire sheath	Check the wire sheath for tear.
							(iv)	Missing connector pins, contact failure	Check the connector for missing pins.
							(v)	Broken wire	Check the wire for breakage.
							(vi)	Circuit board thermistor input circuit fault	Check the sensor intake temperature.
5106	–	–	–	Thermistor <ambient temperature (TH6)> fault		A short-circuit (high temperature intake) or an open-circuit (low temperature intake) of the thermistor detected during operation will be regarded as a thermistor fault. The error code will be displayed and recorded. The operation will automatically be continued if other sensors can be substituted for.	(i)	Thermistor fault	Check the thermistor resistance.
							(ii)	Pinched lead wire	Check the lead wire for pinching.
							(iii)	Torn wire sheath	Check the wire sheath for tear.
							(iv)	Missing connector pins, contact failure	Check the connector for missing pins.
							(v)	Broken wire	Check the wire for breakage.
							(vi)	Circuit board thermistor input circuit fault	Check the sensor intake temperature.
							(vii)	INV board fault	If the problem persists after restarting operation, replace the control board for TH6 and replace the INV board for THHS.
5107	–	–	–	Thermistor <suction pipe temperature (TH7)> fault		A short-circuit (high temperature intake) or an open-circuit (low temperature intake) of the thermistor detected during operation will be regarded as a thermistor fault. The error code will be displayed and recorded. The operation will automatically be continued if other sensors can be substituted for.	(i)	Thermistor fault	Check the thermistor resistance.
							(ii)	Pinched lead wire	Check the lead wire for pinching.
							(iii)	Torn wire sheath	Check the wire sheath for tear.
							(iv)	Missing connector pins, contact failure	Check the connector for missing pins.
							(v)	Broken wire	Check the wire for breakage.
							(vi)	Circuit board thermistor input circuit fault	Check the sensor intake temperature.
5108	–	–	–	Thermistor <liquid pipe temperature (TH8)> fault		A short-circuit (high temperature intake) or an open-circuit (low temperature intake) of the thermistor detected during operation will be regarded as a thermistor fault. The error code will be displayed and recorded. Abnormal thermistor will be ignored, and the operation will be continued.	(i)	Thermistor fault	Check the thermistor resistance.
							(ii)	Pinched lead wire	Check the lead wire for pinching.
							(iii)	Torn wire sheath	Check the wire sheath for tear.
							(iv)	Missing connector pins, contact failure	Check the connector for missing pins.
							(v)	Broken wire	Check the wire for breakage.
							(vi)	Circuit board thermistor input circuit fault	Check the sensor intake temperature.
5110	001	1214	001	Inverter heatsink temperature drop/ thermistor <heatsink temperature (THHS)>circuit fault	Comp	A short-circuit (high temperature intake) or an open-circuit (low temperature intake) of the thermistor detected during operation will be regarded as a thermistor fault. The error code will be displayed and recorded. The operation will automatically be continued if other sensors can be substituted for.	(i)	Thermistor fault	Check the thermistor resistance.
							(ii)	Pinched lead wire	Check the lead wire for pinching.
							(iii)	Torn wire sheath	Check the wire sheath for tear.
							(iv)	Missing connector pins, contact failure	Check the connector for missing pins.
							(v)	Broken wire	Check the wire for breakage.
							(vi)	Circuit board thermistor input circuit fault	Check the sensor intake temperature.
							(vii)	INV board fault	If the problem persists after restarting operation, replace the control board for TH6 and replace the INV board for THHS.
5201	–	1402	–	Pressure sensor <PSH1> fault		(1) If an open- or short-circuited pressure sensor is detected (first detection), the compressor will stop, go into the three-minute restart-delay mode, and restart after three minutes. The error code will be written to the memory at this time. (2) If an open- or short-circuit is detected twice within 30 minutes of the stoppage of the unit, an error code will be displayed. The error code will be written to the memory at this time.	(i)	Pressure sensor <PSH1> fault	Refer to page 86.
							(ii)	Torn sensor wire sheath	Check the sensor wire sheath for tear.
							(iii)	Missing connector pins	Check the connector for missing pins.
							(iv)	Sensor wire breakage	Check the sensor wire for breakage.
							(v)	Control board low-pressure input circuit fault	Check the sensor intake pressure.
5204	001	1404	001	Pressure sensor <PSM> fault		(1) If an open- or short-circuited pressure sensor is detected (first detection), the compressor will stop, go into the three-minute restart-delay mode, and restart after three minutes. The error code will be written to the memory at this time. (2) If an open- or short-circuit is detected twice within 30 minutes of the stoppage of the unit, an error code will be displayed. The error code will be written to the memory at this time.	(i)	Pressure sensor <PSM> fault	Refer to page 86.
							(ii)	Torn sensor wire sheath	Check the sensor wire sheath for tear.
							(iii)	Missing connector pins	Check the connector for missing pins.
							(iv)	Sensor wire breakage	Check the sensor wire for breakage.
							(v)	Control board low-pressure input circuit fault	Check the sensor intake pressure.

Error (Maintenance) code/ Preliminary error code				Error type		Error description and detection method	Cause		Check method and remedy
Error code	Detail code	Preliminary code	Detail code						
5301	117	4300	117	Current sensor circuit <inverter AC current> fault	Comp	If the current sensor is detected as open or short-circuited during operation	(i)	Compressor failure	Refer to 14-3-4. (2) Troubleshooting the inverter output-related problems.
							(ii)	INV board fault	Replace the INV board.
6600	–	6600	–	Duplicate address definition error		Errors detected when it is confirmed a unit with the same address has transmitted	(i)	Two or more controllers, such as the condensing unit, load equipment, or remote control, have the same address.	When this error occurs, cancel the error with the unit operation switch and restart operation.
							(ii)	When the signal changes due to noise in the transmission signal.	If the error occurs again within 5 minutes Search for the unit with the same address as the source of the error. If the error does not occur after operation for 5 minutes or longer Investigate the transmission waveform/noise on the transmission line.
–	–	6603	–	BUS BUSY		<Related to M-NET communication> (1) When a state occurs in which communication cannot be performed due to collisions of collision loss exceeded error transmissions and continues for 4 to 10 minutes (2) When a state occurs in which data cannot be output on the transmission line due to noise, etc., and continues for 4 to 10 minutes	(i)	The transmission processor cannot perform communication because voltage in a short cycle, such as noise, is continuously mixed on the transmission line.	If this state continues, check the wiring of the communication line and the power-supply to the transmission line.
–	–	6606	–	Invalid message length error		<Related to M-NET communication> Communication fault between device processor and transmission processor on control board	(i)	This error occurred because data could not be transmitted normally due to a random malfunction.	If this state continues, turn the power supply off and on again.
–	–	6607	–	No ACK error		<Related to M-NET communication> Where there is no response (ACK signal) from the remote device after a transmission	(i)	Communication line connection fault and power-supply to transmission line fault	If this state continues, check the wiring of the communication line and the power-supply to the transmission line.
–	–	6608	–	No response frame error		<Related to M-NET communication> Where there was a response (ACK signal) from the remote device after a transmission but no response command	(i)	The waveform changes and an error is detected when transmission data collides together if work is performed on the wires of the transmission line or the polarity is changed while the power supply is ON.	If this state continues, turn the power supply off and on again.
							(ii)	Transmission state repeatedly fails due to noise, etc.	Check the causes in (iii) and (iv) to the left.
							(iii)	Transmission line voltage/ signal attenuation due to exceeding the allowable range of the transmission line wiring Farthest end: 200 m or less	
							(iv)	Transmission line voltage/ signal attenuation due to unmatched transmission line types Wire diameter: 1.25 mm^2 or more	
–	–	7000	050	IGBT system error (inverter reset)		Too frequent circuit board resetting	(i)	Thermal switch <discharge>/pressure switch <high pressure> circuit fault	Check for thermal switch <discharge>/pressure switch <high pressure> circuit fault.
							(ii)	Circuit board fault	Check the circuit board for problem.
							(iii)	Noise	Check the power-supply wire for electrical noise.
7113	014	–	–	Function setting error		Function setting error with the resistor	(i)	Wiring fault	Check the connectors CNTYP 1, 4, and 5 on the control board for proper connection.
							(ii)	Connector disconnection, short-circuit, poor contact	
7113	015	–	–		Comp		(iii)	Unmatched control board and INV board (Replacement with the incorrect board)	
					Comp		(iv)	Disconnected transmission line of the condensing unit	
							(v)	Short-circuited transmission line	
7117	014	–	–	Function setting error (unset)			(i)	Wiring fault	Check the connectors CNTYP 1, 4, and 5 on the control board for proper connection.
7117	015	–	–		Comp		(ii)	Connector disconnection, short-circuit, poor contact	

d) Troubleshooting by pre-alarm (P) code

Pre-alarm code / P code	Error item	Meaning/detection method	Ignore time after detection	Cancel condition	Cause	Check method and remedy
P01	Insufficient refrigerant pre-alarm	When LEV3 is fully open, solenoid valve 21R2 is closed, and subcooling is 3K or less	24 hours after detection (except when canceled with switch (SW1) <ON/OFF>)	Canceled by one of the following conditions. (1) When LEV3 is not fully open or solenoid valve 21R2 is opened (2) When switch (SW1) <ON/OFF> or between terminals 1 and 3 is turned off	(i) Insufficient refrigerant amount in initial charge	Charge with refrigerant again.
					(ii) Refrigerant leak	Identify the location with the refrigerant leak, fix the leak, and charge with refrigerant again.
					(iii) Liquid backflow	Does the fan delay time exceed 5 minutes? Is liquid backflow occurring due to a failure, etc., on the evaporator side?
					(iv) Evaporation temperature continues to be high for a long period	Eliminate the causes to the left.
					(v) Difference between the detected thermistor temperature and actual temperature, difference between pressure detected by pressure sensor and actual pressure, or thermistor or sensor error	Replace the thermistor or sensor.
					(vi) Electronic expansion valve failure	Check the temperature at the inlet and outlet of the electronic expansion valve.
P02	Liquid backflow pre-alarm	(1) When compressor suction superheat is detected at 5K or lower for 30 minutes during compressor operation (2) When compressor suction superheat is detected at 5K or lower for 1 hour or longer within 2 hours of accumulated compressor operation time	24 hours after detection (except when canceled with switch (SW1) <ON/OFF>)	Canceled by one of the following conditions. (1) When compressor suction superheat is detected at 10K or higher for 5 minutes during compressor operation (2) When switch (SW1) <ON/OFF> or between terminals 1 and 3 is turned off	(i) Load-side fault	Check for expansion opening angle fault, feeler bulb mounting fault, liquid expansion valve fault, fan motor failure, heat exchange clogging, and the operating status such as fan delay time.
					(ii) Thermistor or pressure sensor fault (TH7 or PSL)	Check the thermistor resistance or pressure sensor output voltage.
					(iii) Thermistor or sensor wiring or connector fault (TH7 or PSL)	Check the thermistor wiring, connectors, and other parts.
					(iv) Thermistor (TH7) mounting fault	Check the thermistor mounting position.
					(v) Control board thermistor or pressure sensor input circuit fault	Replace the control board.
P04	Excessive compressor starts/stops pre-alarm	When the number of low-pressure cutoffs was 192 times or more in 24 hours	24 hours after detection (except when canceled with switch (SW1) <ON/OFF>)	When switch (SW1) <ON/OFF> or between terminals 1 and 3 is turned off	Refer to the specified page. “Preventing short-cycling operation” (page 64)	

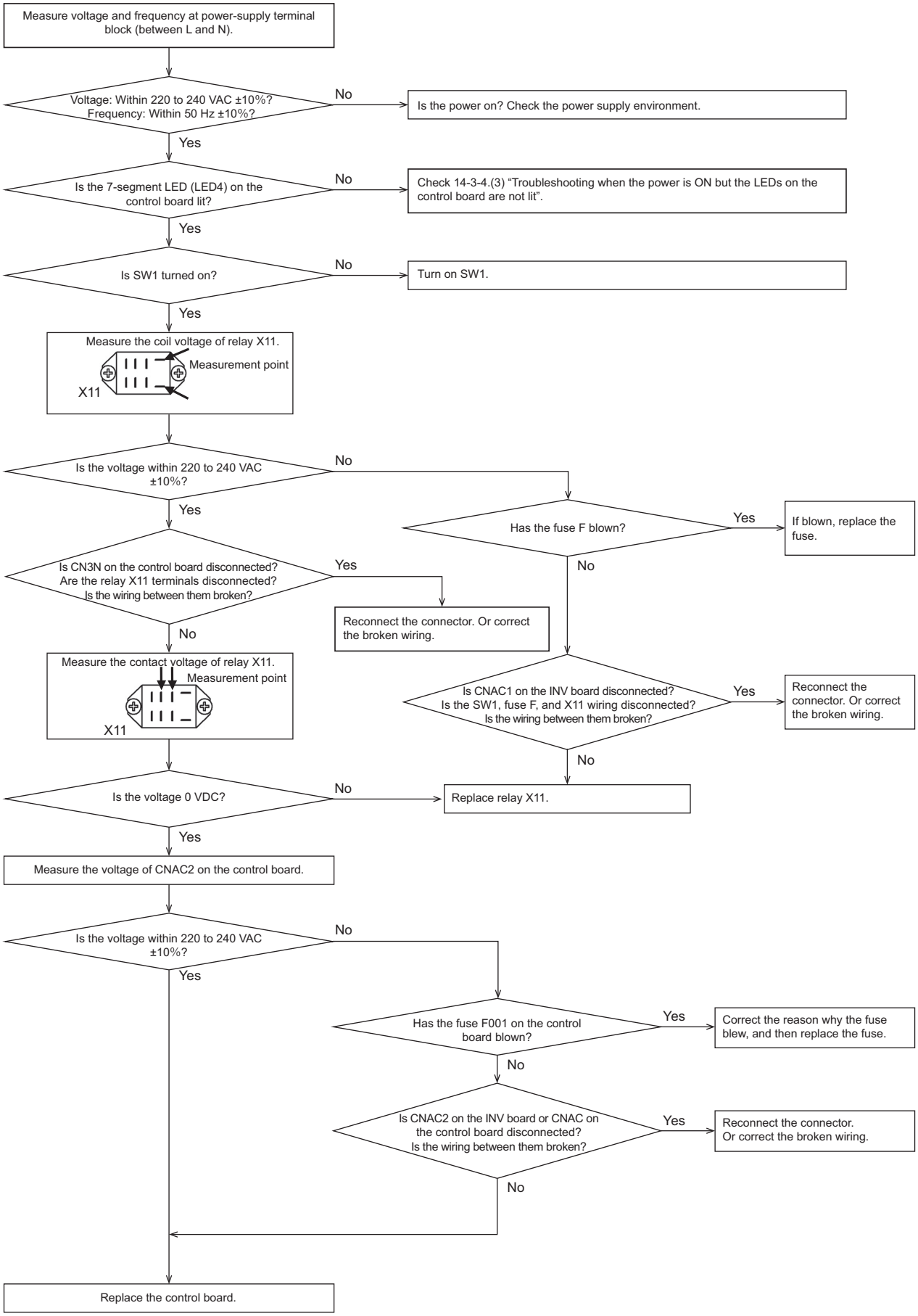
Pre-alarm code P code	Error item	Meaning/detection method	Ignore time after detection	Cancel condition	Cause	Check method and remedy
P05	High ambient temperature pre-alarm	When thermistor TH6 is detected at 47°C or higher continuously for a fixed amount of time during operation	24 hours after detection (except when canceled with switch (SW1) <ON/OFF>)	Canceled by one of the following conditions. (1) When thermistor TH6 is detected at 46°C or lower continuously for a fixed amount of time (2) When switch (SW1) <ON/OFF> or between terminals 1 and 3 is turned off	(i) Exhaust heat short-cycling, etc.	Check the heat exchange suction temperature, installation space, etc.
					(ii) Thermistor (TH6) fault	Check the thermistor resistance.
					(iii) Thermistor wiring or connector fault (TH6)	Check the thermistor wiring, connectors, and other parts.
					(iv) Thermistor (TH6) mounting fault	Check the thermistor mounting position.
					(v) Control board thermistor input circuit fault	Replace the control board.
P06	Compressor operating time pre-alarm	When the operating time is 78,840 hours or longer	Detected every 7884 hours of operating time after the condition to the left	When switch (SW1) <ON/OFF> or between terminals 1 and 3 is turned off	(i) Long operating time	Near the expected service life, so consider inspection or replacement, etc.
P07	Thermistor or sensor error pre-alarm	When an error occurs in thermistor TH4, TH6, TH7, or TH8 or in pressure sensor PSH, PSM, or PSL. However, thermistors and sensors with the error alarm output set to ON are excluded.	168 hours after detection	When switch (SW1) <ON/OFF> or between terminals 1 and 3 is turned off	(i) Thermistor fault	Check the thermistor resistance.
					(ii) Pressure sensor fault	Check the output voltage of the pressure sensor.
					(iii) Crushed lead wires	Check for crushed lead wires.
					(iv) Cable jacket breakage	Check for cable jacket breakage.
					(v) Contact fault from missing connector pins	Check for missing pins in connectors.
					(vi) Wire breaks	Check for wire breaks.
					(vii) Control board thermistor input circuit error	Replace the control board.

e) Troubleshooting by other codes

Other code		Meaning	Cause	Check method and remedy
Lo	Low-pressure indication	This means that low-pressure is -0.100 MPa or lower.	(i) Low-pressure drop	Check the low-pressure.
			(ii) Pressure sensor (low) error	Refer to 14-3-1. Pressure sensor (page 86) Check if the connector for the low-pressure sensor is disconnected.
oIL1	During oil return operation	Oil return control is performed when the control start conditions are satisfied.	For control details, refer to the specified page.13-1-3. Oil return control(page 72)	-

14-2. Checking the electrical circuit

If No error code is displayed on the control board, use the flowchart to troubleshoot.



14-3. Troubleshooting the principal components

14-3-1. Pressure sensor

(1) Pressure sensor circuit components

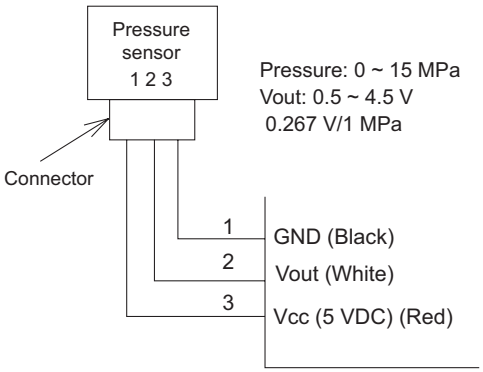
Pressure sensor consists of a circuit as shown in the figure below. When a voltage of 5 VDC is applied across red and black wires, the amount of voltage that corresponds to the pressure is output across white and black wires, and the microcomputer takes in this voltage. Output voltage is 0.4 V per 1 MPa.

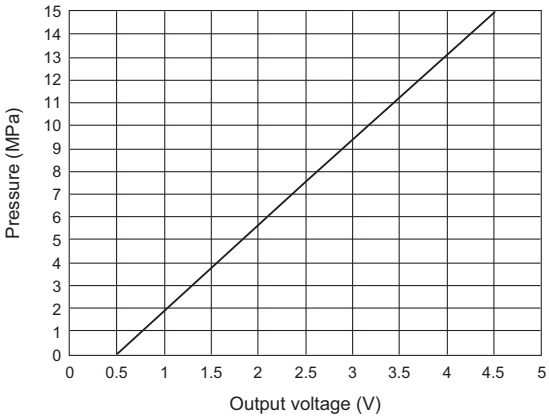
Note

Use a pressure sensor that is directly connected to the connector.
The pin numbers on the pressure sensor and those on the control board do not correspond to each other.

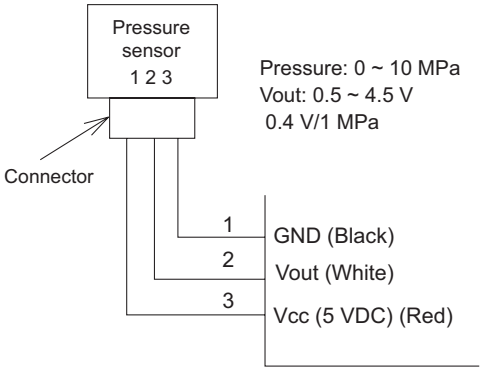
	Main body side	Control board side
Vcc	1 pin	3 pin
Vout	2 pin	2 pin
GND	3 pin	1 pin

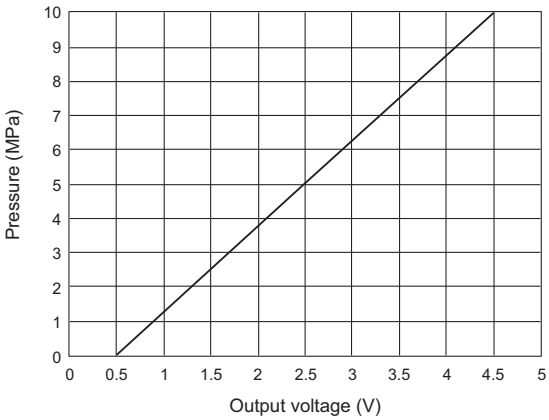
♦ PSH





♦ PSM, PSL

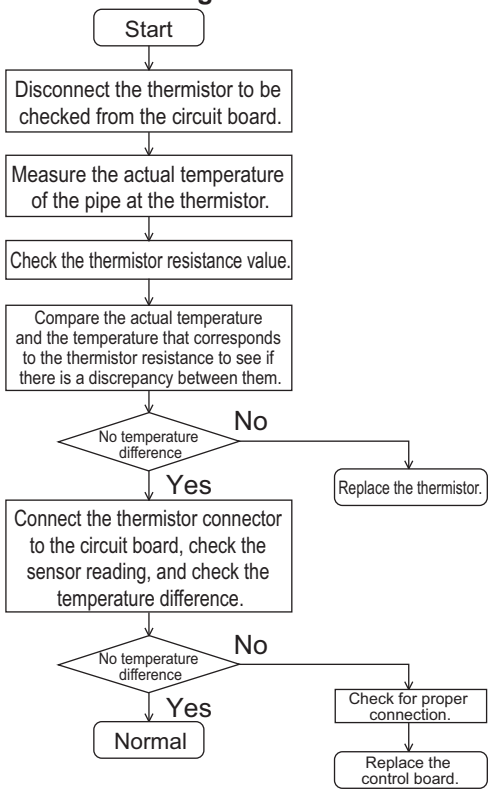




14-3-2. Temperature sensor

Use the flowchart below to troubleshoot the temperature sensor.

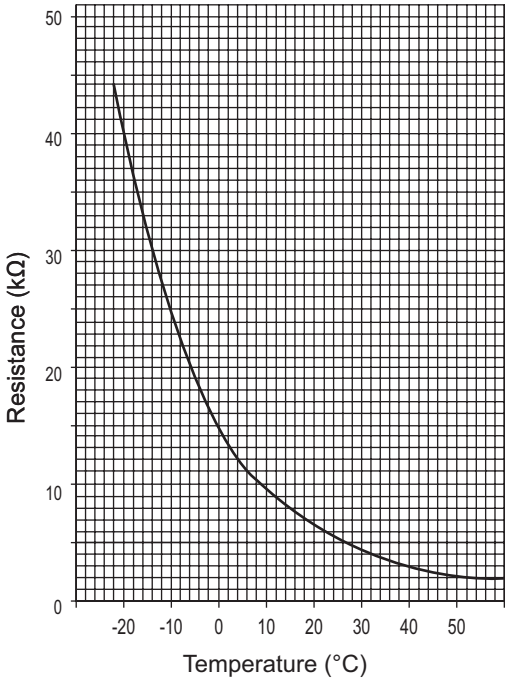
Troubleshooting the thermistor



(1) Low-mid temperature range thermistor : TH4, TH6, TH7, TH8

Thermistor $R_0 = 15\ k\Omega \pm 3\%$

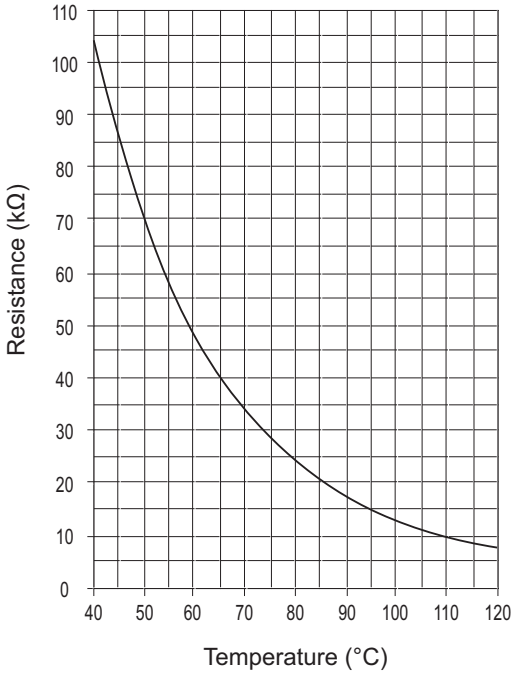
$$R_t = 15 \exp \{3385 \left(\frac{1}{273+t} - \frac{1}{273}\right)\}$$



(2) High-temperature-range thermistor: TH1

Thermistor $R_{120} = 7.465\ k\Omega \pm 2\%$

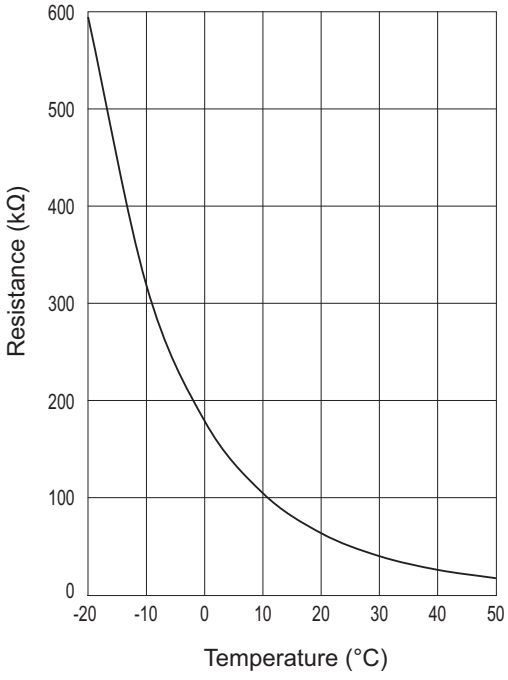
$$R_t = 7.465 \exp \{4057 \left(\frac{1}{273+t} - \frac{1}{393}\right)\}$$



(3) Heatsink temperature thermistor: THHS

Thermistor $R_{50} = 17\ k\Omega \pm 2\%$

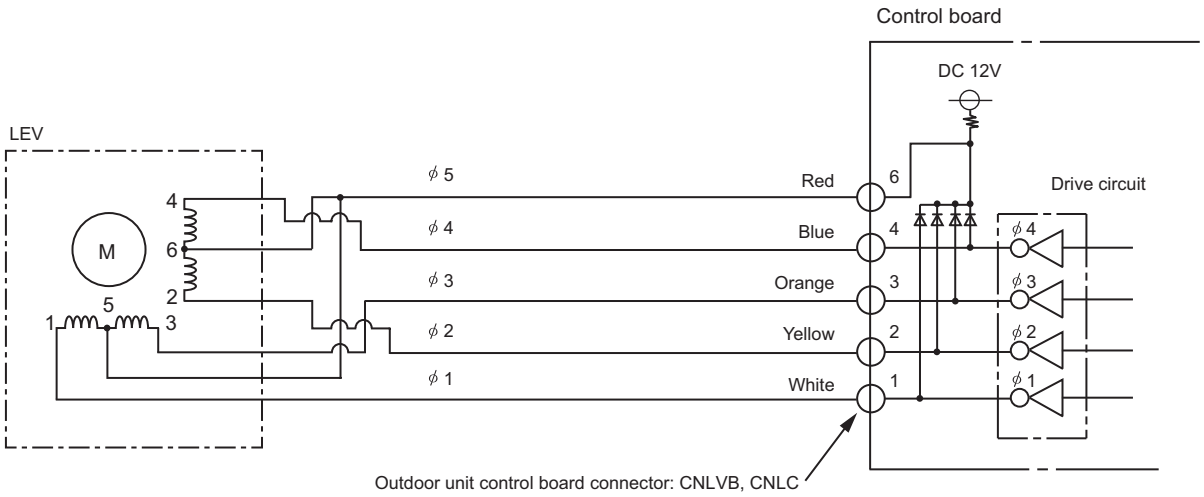
$$R_t = 17 \exp \{4150 \left(\frac{1}{273+t} - \frac{1}{323}\right)\}$$



14-3-3. Linear expansion valve

The valve opens and closes according to the pulse signals.

<Wiring between the control board and linear expansion valve (LEV) on the outdoor unit >



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

<Pulse signal output and valve motion>

Output pulses change in the following orders when the

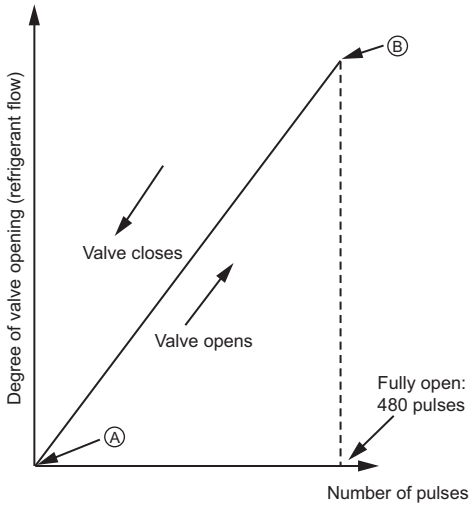
Valve is closed; 8→1→2→3→4→5→6→7→8

Valve is open; 1→8→7→6→5→4→3→2→1

*1. When the Linear expansion valve (LEV) opening angle does not change, all the output phases will be off.

*2. When the output is open phase or remains ON, the motor cannot run smoothly, and rattles and vibrates.

Opening and closing of the LEV



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

The LEVs are free of noise and vibration when they are functioning properly. When they become stuck, they make clicking noises.

* Listen for the valve noise by placing a screwdriver on the valve and placing your ear against the handle.

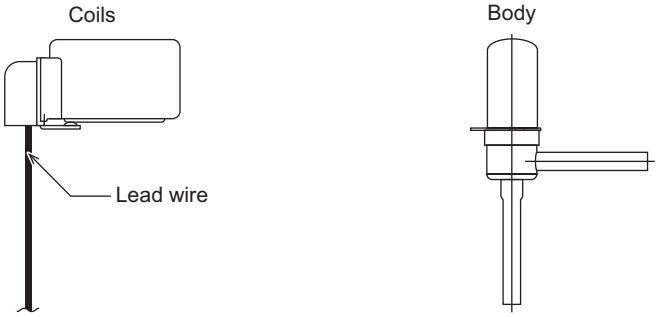
* If liquid refrigerant is inside the valves, it may make the sounds difficult to hear.

(1) Troubleshooting possible problems

Locked LEV	If the LEVs are driven when they are locked, their drive motor runs idle and makes a small clicking sound. If a valve makes noise both when it opens and when it closes, there is a problem with the valve.	Replace the LEV.
Broken or short-circuited motor coil on the LEV	Measure the resistance between coils (red and white, red and yellow, red and orange, and red and blue) with a tester. The resistance is nominal if within 46 ±3.7 Ω.	Replace the coil on the LEV.
Faulty wiring or loose connectors	♦Check for loose connectors and terminals, and visually check the lead wire colors. ♦Unplug the connector from the control board, and test for continuity using a tester.	Check for continuity.

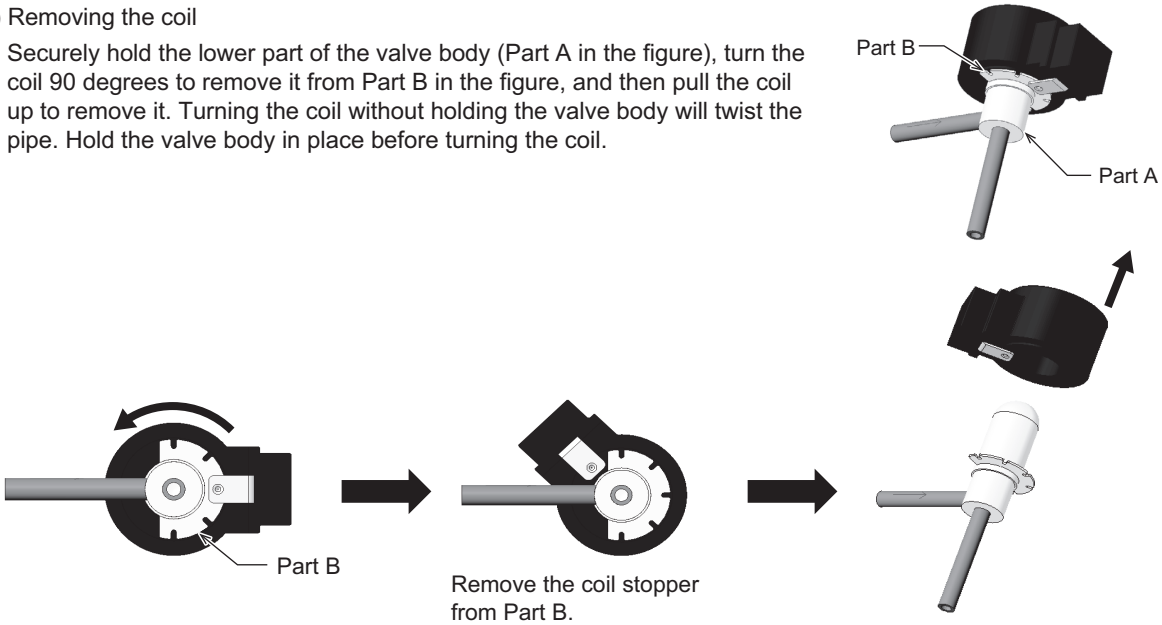
(2) LEV coil removal procedure

LEVs consist of a coil and a valve body that can be separated from each other.



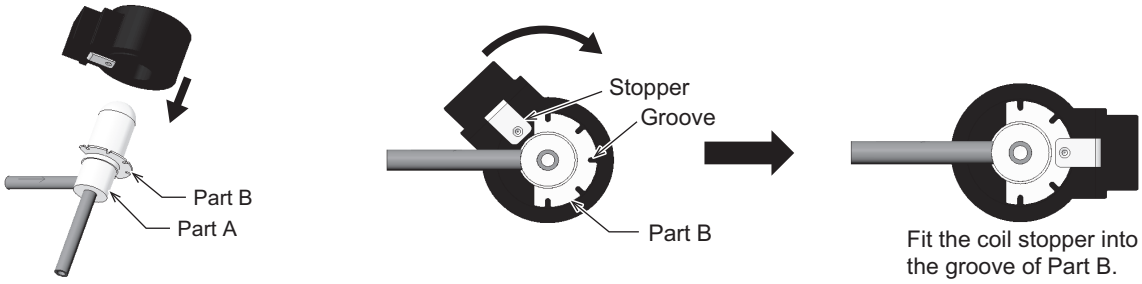
a) Removing the coil

Securely hold the lower part of the valve body (Part A in the figure), turn the coil 90 degrees to remove it from Part B in the figure, and then pull the coil up to remove it. Turning the coil without holding the valve body will twist the pipe. Hold the valve body in place before turning the coil.



b) Installing the coil

Securely hold the lower part of the valve body (Part A in the figure), insert the coil from above, and turn the coil 90 degrees to set it in Part B of the valve body (Part B in the figure). Turning the coil without holding the valve body will twist the pipe. Hold the valve body in place before turning the coil. Set the coil where indicated in the figure below. Fit the coil stopper in the groove of Part B of the valve body (Part B in the figure). The stopper will click into the groove.



14-3-4. Inverter

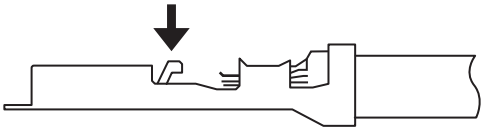
- If there are problems only with the compressor, replace the compressor only.
  Compressor failure will cause an overcurrent to pass through the inverter, but the inverter is protected from damage with the protection function that will stop the inverter when an overcurrent is detected.
- If the inverter fails, replace the failed components on the inverter.
- If both the compressor and inverter fail, replace the compressor and all applicable components on the inverter.

	Error codes and symptoms	Check items
[1]	Inverter-related errors 4220, 4230, 4250, 5301	See (2) Troubleshooting the inverter output-related problems-[1].
[2]	Main power breaker is tripped.	1) Check the breaker capacity.
		2) Check the electric circuits other than the inverter circuits for short-circuit and ground fault.
		3) If no problems are found with items 1) and 2), see (4) Troubleshooting when the main power breaker trips-[1].
[3]	The main earth leakage breaker is tripped.	1) Check the capacity and the sensitivity current of the earth leakage breaker.
		2) Insulation resistance failure of the electrical components other than the inverter
		3) If no problems are found with items 1) and 2), see (4) Troubleshooting when the main power breaker trips-[1].
[4]	Only the compressor is inoperative.	Check the inverter frequency on the LED and proceed to item [3] under section (2) Troubleshooting the inverter output-related problems.
[5]	The compressor vibrates excessively or makes abnormal sounds.	See (2) Troubleshooting the inverter output-related problems-[3].
[6]	Peripheral devices pick up noise.	1) Check that the power wire to the peripheral devices are not routed adjacent to the power wire to the outdoor unit.
		2) Check that the inverter output wiring is not routed adjacent to the power wire or transmission line.
		3) Insulation resistance failure of the electrical components other than the inverter
		4) Connect the unit to a different power supply circuit.
		5) If the problem appeared suddenly, there is a possibility that the inverter output line had a ground fault. See section (2) Troubleshooting the inverter output-related problems-[3].
		For problems other than the ones listed above, contact a local distributor.

(1) Troubleshooting the inverter-related problems

1) **Inside the inverter is a large capacity electrolytic capacitor, and the residual voltage that remains after the main power is turned off presents a risk of electric shock. Before checking the inverter-related parts, turn off the main power, keep it turned off for at least 10 minutes, and check that the voltage at both ends of the electrolytic capacitor between the FTP and FTN terminals on the FAN board has dropped to 20 V or less.**
2) The IGBT module on the inverter becomes damaged if there are loose screws or connectors. When a problem occurs after replacing components, faulty wiring is often the cause of the problem. Check the wiring, screws, connectors, and Fasten terminals for proper connection.
3) Do not plug or unplug the inverter connectors while the main power is turned on, as this will result in damage to the circuit board. Doing so may result in damage to the circuit board.
4) Faston terminal has a locking function. Make sure the terminal is securely locked in place after insertion.

Press the tab on the terminal to remove it.



5) When the INV board is replaced, apply a thin layer of heat radiation grease that is supplied evenly to these parts. Wipe off any grease that may get on the wiring terminal to avoid terminal contact failure.
6) Faulty wiring to the compressor damages the compressor. Connect the wiring in the correct phase sequence.

(2) Troubleshooting the inverter output-related problems

	Check items	Symptom	Remedy
[1] Check the compressor INV board error detection circuit.	1) Stop the unit. Remove power supply. 2) Disconnect the inverter output wires from the compressor terminals (U, V, W) *1. 3) Apply power supply. 4) Put the outdoor unit into operation.	a) Overcurrent error Error code: 4250 Detailed code: No. 104 and 106	Replace the INV board.
		b) ACCT sensor circuit failure Error code: 5301 Detailed code: No. 117	Replace the INV board.
		c) Voltage failure Error code: 4220 Detailed code: No. 108,109 and 131	Confirm that the voltage at the power-supply terminal block (L-N) is within 220 to 240 VAC ±10%. → If within the above range, replace the INV board.
		d) Converter failure Error code: 4220 Detailed code: No. 253	
		e) IGBT module open Error code: 4102 Detailed code: No. 002	Normal → See [2].
		f) No error detected	Normal → See [2].
[2] Checking the compressor for a ground fault and checking the coil	Disconnect the compressor wiring, and check the insulation resistance and the wirewound resistance of the compressor.	a) Compressor insulation resistance failure Insulation resistance of below 1 MΩ is considered abnormal. ♦With no liquid refrigerant present in the compressor b) Compressor coil resistance failure Coil resistance 0.992 Ω (25°C)	Replace the compressor. Check that no liquid refrigerant is present in the compressor. If there is no problems are found with the above item, see [3].
[3] Check the inverter for damage. Immediately before or after start-up	Perform the following procedures. **Procedures** 1) Reconnect the connector that was disconnected in step [1]. 2) Disconnect the compressor wiring. 3) Turn SW2-9 on the control board to ON. After the above procedure is completed, put the outdoor unit into operation. Check the inverter output voltage. ♦The use of the voltage tester that is listed in the section "Troubleshooting the diode and IGBT module" is recommended. ♦Measure the voltage when the compressor inverter output frequency is stable. ♦After the above procedure is completed, turn SW2-9 off on the control board.	a) IGBT module/overcurrent Error code: 4250 Detailed code: No. 104 and 106 b) If there is a inter-wire voltage imbalance of 5% or 5 V (whichever the greater), inverter circuit fault is suspected.	Check the inverter circuit for problems. See [5].
		c) There is no voltage difference between the wires.	See [2]. See item [5] if no problems are found with item [2]. Replace the compressor if no problems are found with item [5].
[4] Check the inverter for damage. When this error occurs during normal operation	Operate the unit. Check the inverter output voltage. ♦The use of the voltage tester that is listed in the section "Troubleshooting the diode and IGBT module" is recommended. ♦Measure the voltage when the compressor inverter output frequency is stable.	a) If there is a interwire voltage imbalance of 5% or 5 V (whichever the greater), inverter circuit fault is suspected.	Check the inverter circuit for problems. See [5].
		b) There is no voltage difference between the wires.	See [2]. See item [5] if no problems are found with item [2]. Replace the compressor if no problems are found with item [5].

*1 Output voltage is present at the inverter output wiring terminal. To avoid short-circuiting and ground fault, do not let the terminal come in contact with the unit or the compressor, and use caution not to damage the terminal.

	Check items	Symptom	Remedy
[5] Check the inverter circuit for problems.	Check the INV board and the compressor for proper terminal connection.	a) Loose or disconnected terminals	Check the INV board and the compressor for loose or disconnected terminals.
	Check the exterior of the IGBT module.	b) Cracked IGBT module due to swelling	Replace the INV board. After replacing the INV board, check for proper operation by following the procedures in sections [3] and [4].
	Measure the resistance between the terminals of the IGBT module. Refer to the section "Troubleshooting the diode and IGBT module".	c) Abnormal resistance between the terminals of the IGBT module	Replace the INV board. After replacing the INV board, check for proper operation by following the procedures in sections [3] and [4].
		d) All items a) - c) above are normal.	Replace the INV board.

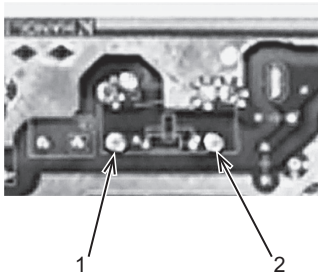
(3) Troubleshooting when the power is ON but the LEDs on the control board are not lit

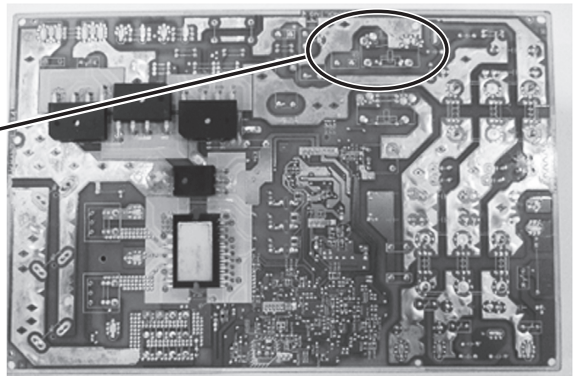
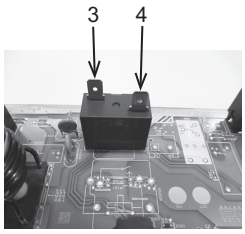
	Check items	Symptom	Remedy
[1]	Measure voltage at power-supply terminal block	Less than 198 VAC	• Check if the main power breaker is on. • Check if power-supply wiring is broken.
[2]	Check if the following connectors are properly connected. • INV board R/L1, S/N1, CNDC, TBL2, TBL4, CNAC1, CNAC2 • Fan board CNDC1, CNDC2 • Control board CNDC	A connector is disconnected.	Connect the connector and turn on the power.
[3]	Check the harness connected to [2].	Wires are broken or wire jacket is damaged.	Replace the harness.
[4]	Check if the AC reactor has failed. (Refer to page 95 for the check method.)	Failed.	Replace the AC reactor.
[5]	Check if fan board fuse F001 has blown.	Blown fuse.	1) Turn off the power and disconnect the CNM1 connector on the fan board. Measure the resistance between pins 1 and 4 on the disconnected connector. → If 0 Ω, replace the fan motor and the fan board. 2) Turn off the power and disconnect the CNDC2 connector on the fan board. Measure the resistance between pins 1 and 3 on the disconnected connector. → If 0 Ω, replace the control board and the fan board. 3) If none of the above are applicable, replace the fan board.
[6]	Wait 20 minutes or longer after the power is turned off, and then measure the resistance of the inrush current limiting resistor. (Refer to page 95 for the check method.)	Outside 10 to 42 Ω	Check if the part has cooled sufficiently and measure again. (When the part is hot, the resistance will read high.) → If ∞ Ω, replace the INV board.
		Between 10 to 42 Ω	• Turn on the power again and check if the control board started. → If the control board did not start, measure the voltage between the P and N terminals on the fan board. → If 263 VDC or higher, replace the control board. → If less than 263 VDC, replace the INV board.

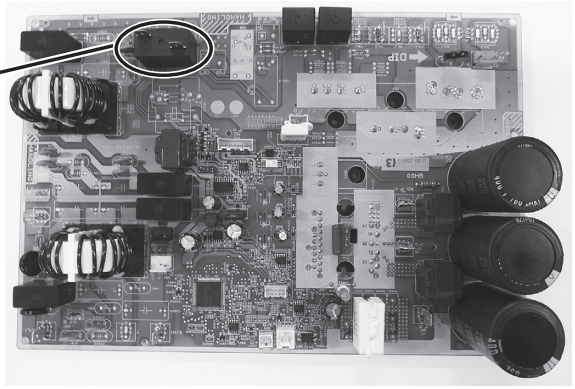
(4) Troubleshooting when the main power breaker trips

	Check items	Symptom	Remedy
[1]	Measure the insulation resistance between the L terminal and ground and between the N terminal and ground on the power-supply terminal block.	0 to several ohms, or insulation resistance failure	Check the components in the main inverter circuit. (e.g., register, insulation resistance) 1) IGBT module Refer to the section "Troubleshooting the diode and IGBT module". 2) Inrush current limiting resistor 3) Electromagnetic contactor 4) AC reactor For items 2) through 4), refer to the section "Simple check on the main inverter circuit components".
[2]	Turn the power back on and check again.	Main power breaker is tripped.	
		LED is blank.	Refer to (3) Troubleshooting when the power is ON but the LEDs on the control board are not lit.
[3]	Check the unit for normal operation.	The unit operates normally without tripping the main breaker.	1) Look for a possible short-circuit, and if found, repair. 2) If no problems are found with item 1) there may be problems with the compressor.
		Main power breaker is tripped.	It is suspected that the inverter (output side) or compressor had a ground fault. See (2)Troubleshooting the inverter output-related problems-[3].

(5) Simple check on the main inverter circuit components

<table>
<tr><th>Parts</th><th>Evaluation criteria</th></tr>
<tr><td>Diode and IGBT module</td><td>Refer to the section 14-3-4. (6)</td></tr>
<tr><td>Electromagnetic relay 52C
and
Inrush current limiting resistor
RSH1, RSH2</td><td>
1. Turn off the product power supply and measure resistance between the terminals with the INV board removed from the product.
Note: When the part is hot, the resistance will read high. Allow the part to cool before measuring.
<table>
<tr><th></th><th>Check point</th><th>Checking criteria</th></tr>
<tr><td>Relay coil</td><td>INV board X52C
Across pins 1-2</td><td>160 Ω ± 10%</td></tr>
<tr><td>Relay contact and Inrush current limiting resistor</td><td>INV board X52C
Across pins 3-4</td><td>10 Ω to 42 Ω</td></tr>
</table>
2. Power the product with the INV board mounted inside and measure voltage between the terminals.
Note: The instrument will be damaged if resistance is measured while the product is powered.
<table>
<tr><th></th><th>Check point</th><th>Checking criteria</th></tr>
<tr><td>Relay contact</td><td>INV board X52C
Across pins 3-4</td><td>0 V</td></tr>
</table>



Rear side of INV board



Front side of INV board
</td></tr>
<tr><td>AC reactor ACL</td><td>Measure the resistance between terminals.: 1 Ω or less (virtually 0 Ω)
Measure the resistance between the terminal and the chassis.: ∞</td></tr>
</table>

(6) Troubleshooting the diode and IGBT module

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

1) Notes on measurement

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

2) Tester restriction

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

Note

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

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

<INV board>

Reference resistance value

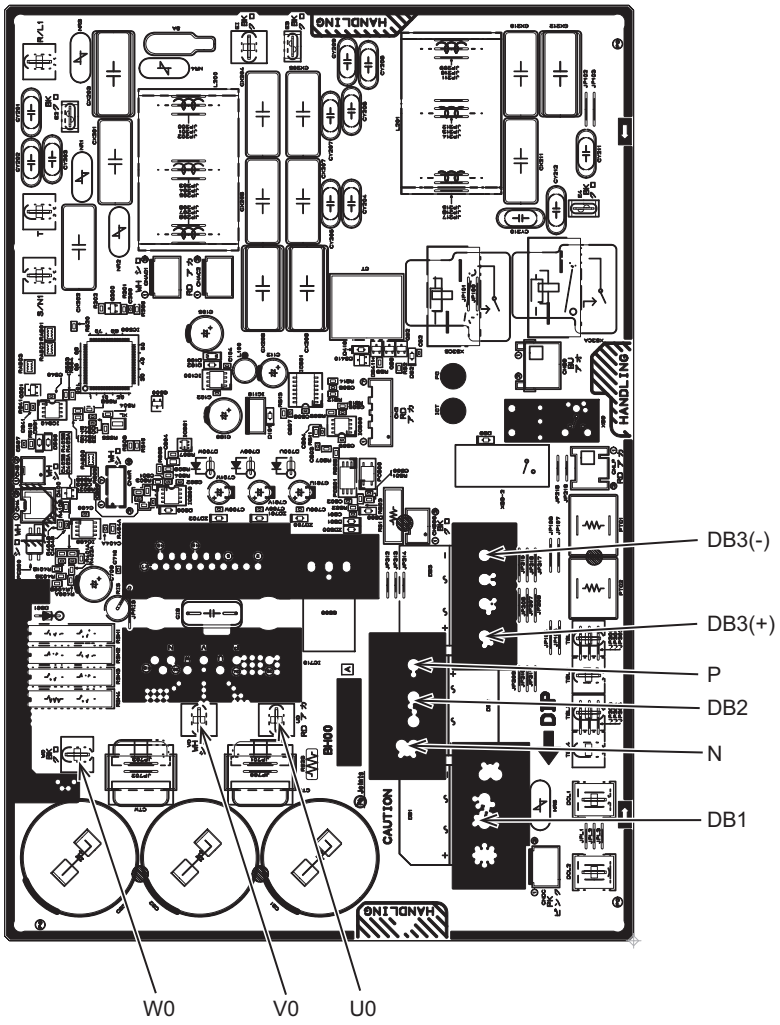
		Red (+)			
		P	N	DB1	DB2
Black (-)	P	-	-	1 k - 10 MΩ	1 k - 10 MΩ
	N	-	-	∞	∞
	DB1	∞	1 k - 10 MΩ	-	-
	DB2	∞	1 k - 10 MΩ	-	-

		Red (+)			
		DB3(+)	DB3(-)	DB1	DB2
Black (-)	DB3(+)	-	-	1 k - 10 MΩ	1 k - 10 MΩ
	DB3(-)	-	-	∞	∞
	DB1	∞	1 k - 10 MΩ	-	-
	DB2	∞	1 k - 10 MΩ	-	-

		Red (+)				
		P	N	U0	V0	W0
Black (-)	P	-	-	1 k - 10 MΩ	1 k - 10 MΩ	1 k - 10 MΩ
	N	-	-	∞	∞	∞
	U0	∞	1 k - 10 MΩ	-	-	-
	V0	∞	1 k - 10 MΩ	-	-	-
	W0	∞	1 k - 10 MΩ	-	-	-

* The measured result will depend on your tester.

INV board outline drawing



(7) Precautions for inverter parts replacement

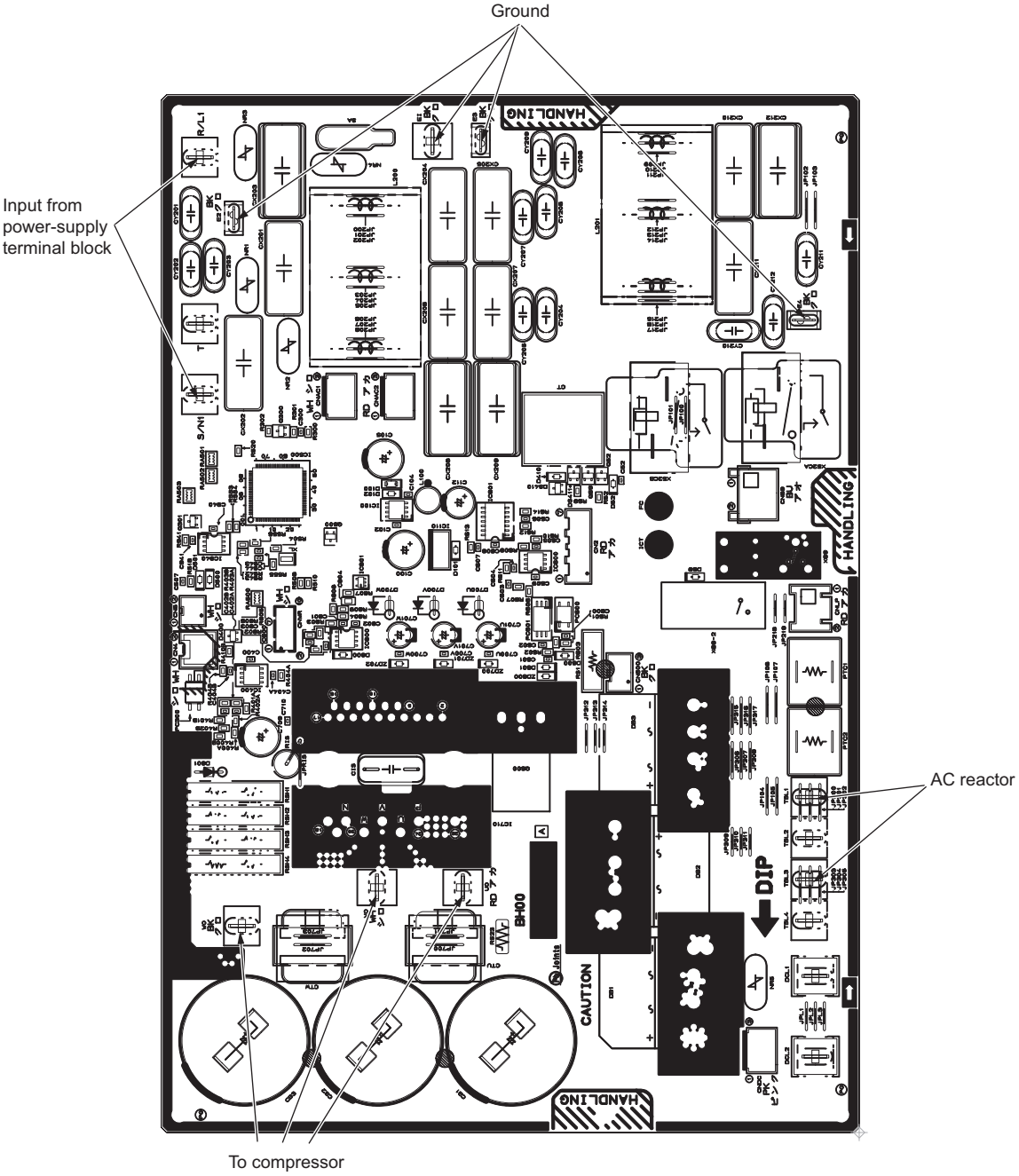
1) Check for faulty or loose wiring.

To avoid damage to the IGBT module, thoroughly check the wiring to the main circuit components in the IGBT module.

When all of work is completed, reconnect the connector and Faston terminals. Make the connections carefully to ensure good contact. If the output wiring from the IGBT module to the compressor is connected incorrectly, compressor damage will result. Refer to the wiring diagram below for wire color-coding.

2) Coat the radiation surface of the IGBT module evenly with the heat radiation grease that is provided with the service parts.

Apply a thin layer of heat radiation grease to the entire surface of the back of the IGBT module, and screw the module securely into place. Wipe off any grease that may get on the wiring terminal to avoid contact failure.



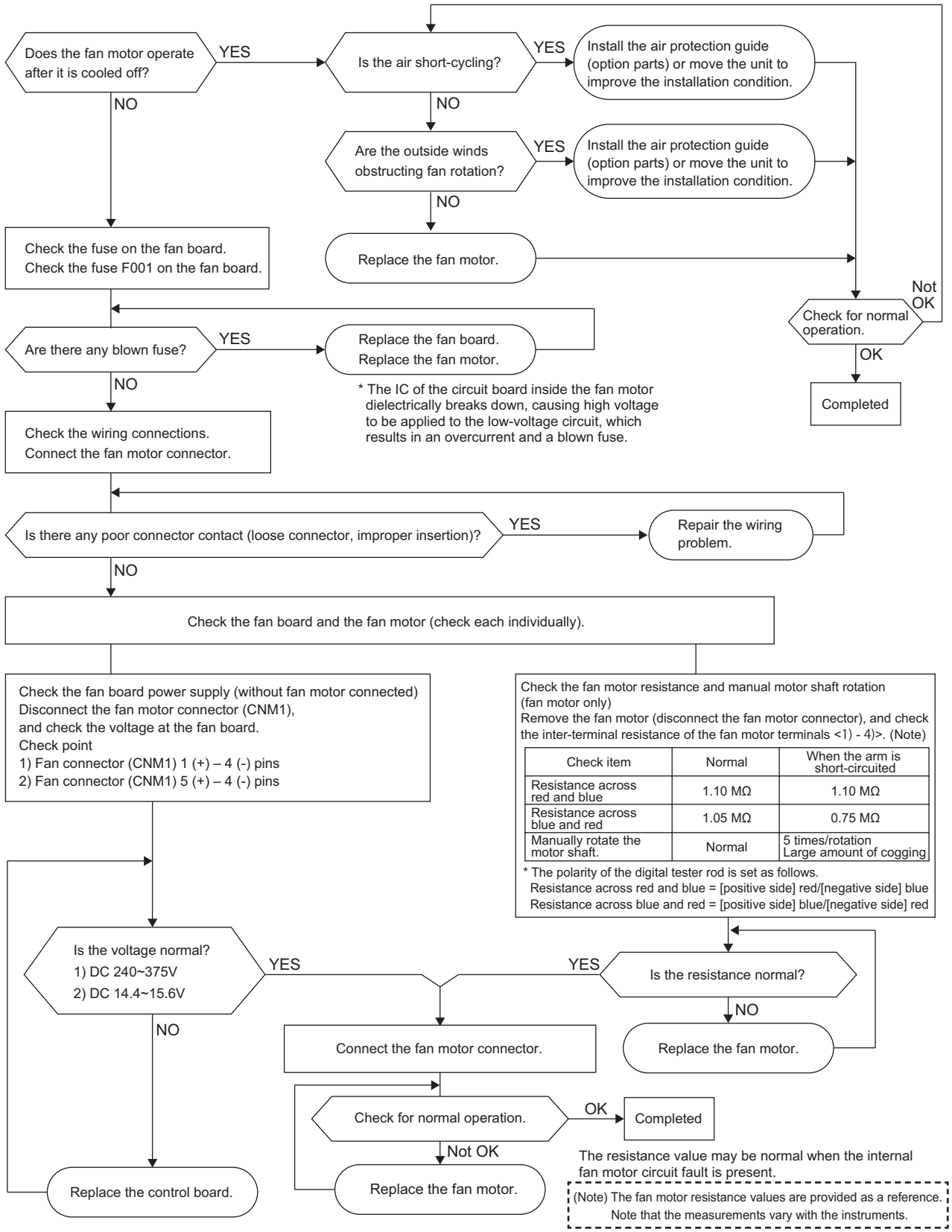
(8) Quick check of the DC fan motor (fan motor/control board)

1) Precautions

- Even when the power is turned off, fan motor connectors (CNM1) may carry high voltage if the fan is rotated by outside winds.
  Use caution not to get an electric shock.
- Do not connect or disconnect the fan motor connectors (CNM1) with the power being turned on.
  (Doing so can result in circuit board and fan motor malfunction.)

2) Troubleshooting

Symptom: Outdoor unit fan does not turn.



15-1. Important notes

If the unit or its refrigerant circuit components experiences malfunctions, take the following steps to prevent recurrence.

(1) Diagnose the problem and find the cause.
(2) Before repairing gas leakage from the brazed sections on the pipes, remove the refrigerant from the pipes to be repaired. Braze under nitrogen purge to prevent oxidation.
(3) If any component (including the compressor) malfunctions, only replace the parts; it is not necessary to replace the entire unit.
(4) When disposing of the unit, dispose of the refrigerant contained in the unit in accordance with the applicable local laws and regulations.
(5) If the cause of the problem cannot be identified, contact the local distributor and provide the following information: unit model, serial number, and nature of the problem.

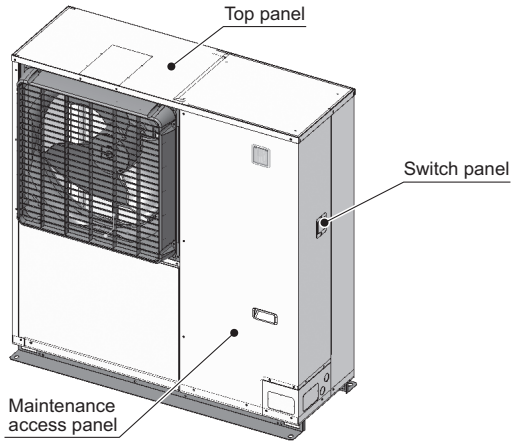
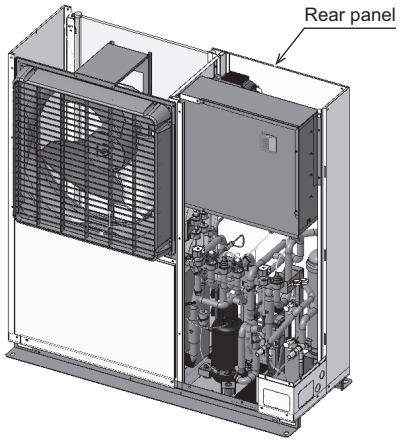
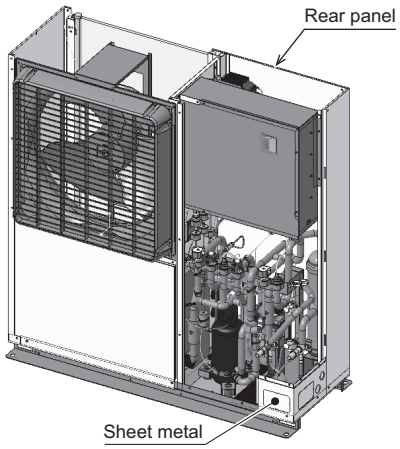
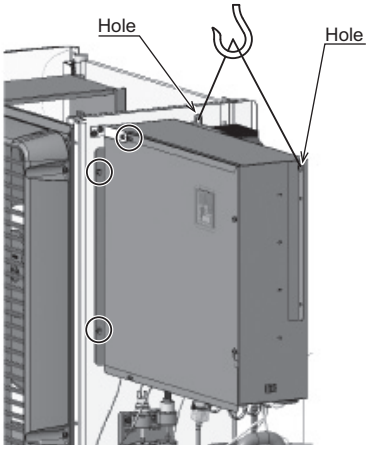
15-2. Replacing the fan

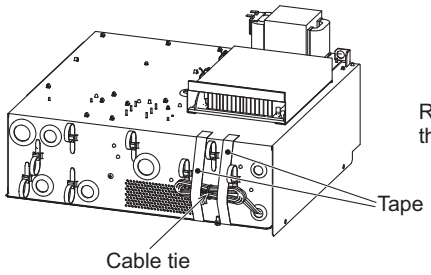
(1) Before replacing the fan, switch off the main power on the condensing unit.
(2) Motor connectors (CNM1) are the bottom of the control box. Remove the service panel, the fan guard and the bell-mouth.
(3) After replacing the fan, route the wires in the same route as the original fan wires, and secure them in place with the clamps.
<Use caution not to come in contact with the surrounding hot pipes.>

15-3. Replacing the control box

(1) Before inspecting inside the control box, turn off the main power of the unit, wait at least 10 minutes, and check that the voltage of the electrolytic capacitor (main inverter circuit) is no greater than 20 VDC. The voltage check position is between the FTP and FTN terminals on FAN board.
(2) Before starting servicing, disconnect the outdoor fan connectors (CNM1).
When connecting and disconnecting connectors, make sure that the outdoor fan is not running and that the voltage of the main circuit capacitor is no greater than 20 VDC.
If the outdoor fan rotates due to strong wind, the main circuit capacitor will be charged and pose a risk of electric shock.
Refer to the wiring nameplate for details.
When finishing servicing, connect the outdoor fan connectors (CNM1) as they were.

Please refer to the following page for further details.

	Procedure
1 	1. Remove the switch panel, set SW1 to OFF, and turn off the main power supply (breaker). 2. Remove the top panel and the maintenance access panel.
2 	3. Remove all wiring from the control box (except compressor wires) Disconnect the compressor wires from the terminal block on the compressor, and replace them along with the control box.
3 	4. Remove the rear panel. Note that the sheet metal hooks on to the rear panel (from top to bottom). The top part needs to be unhooked when removing the panel. Do not leave the rear panel removed because the rear panel helps hold the control box in place.
4 	5. When you are ready to remove the control box, unscrew the three screws that are located where circled to remove it. Use the holes shown in the figure when suspending the control box. (Weight: 14 Kg) (Procure a suspension wire locally.) 6. Re-place all components in the reverse order as they were removed. Be sure to reconnect all wires.

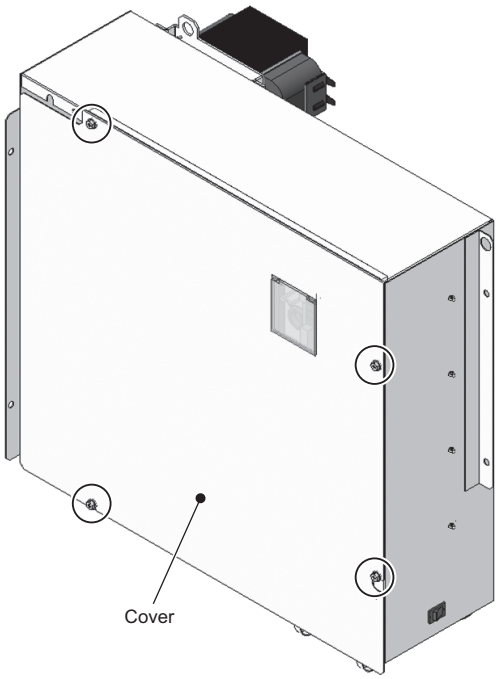
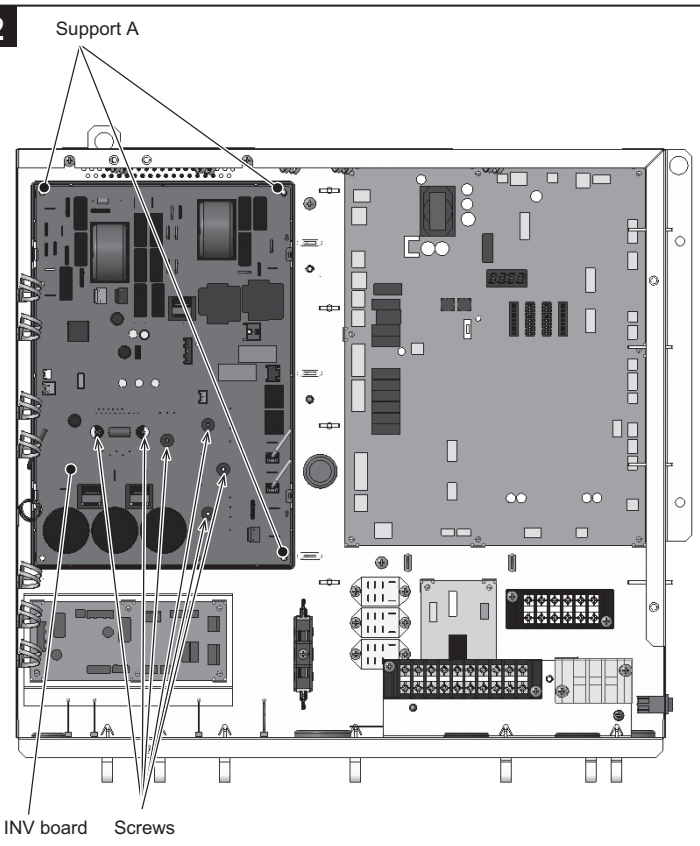


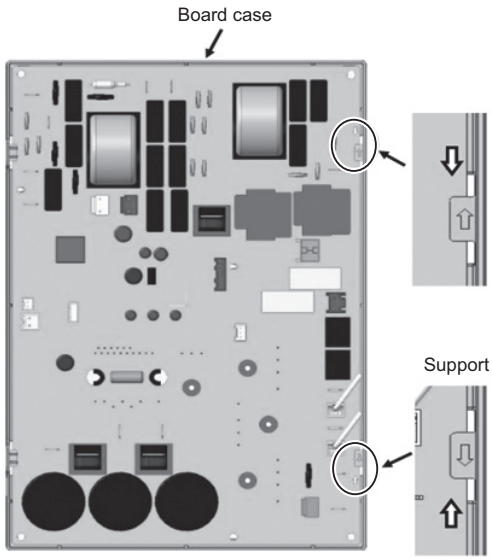
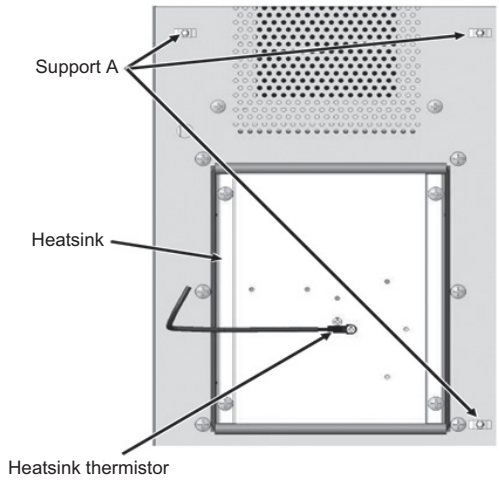
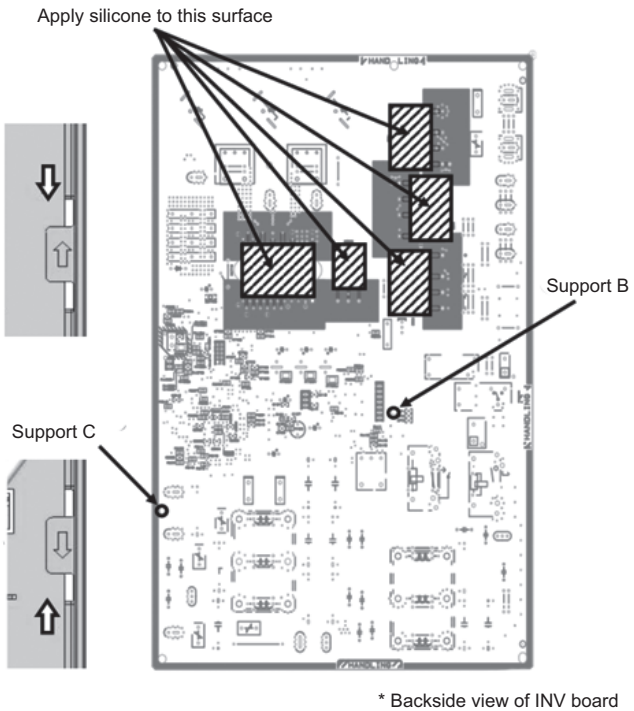
Remove the cable tie and tape that hold the wiring before installation.

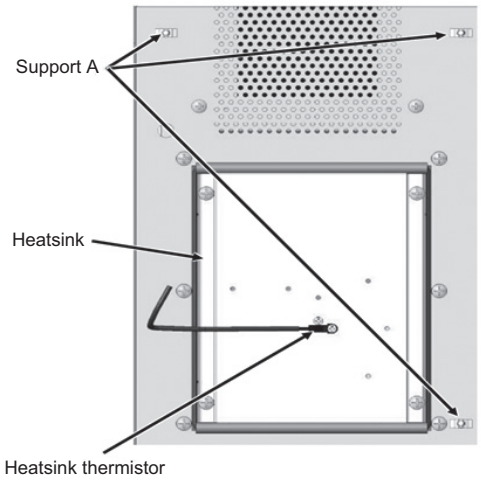
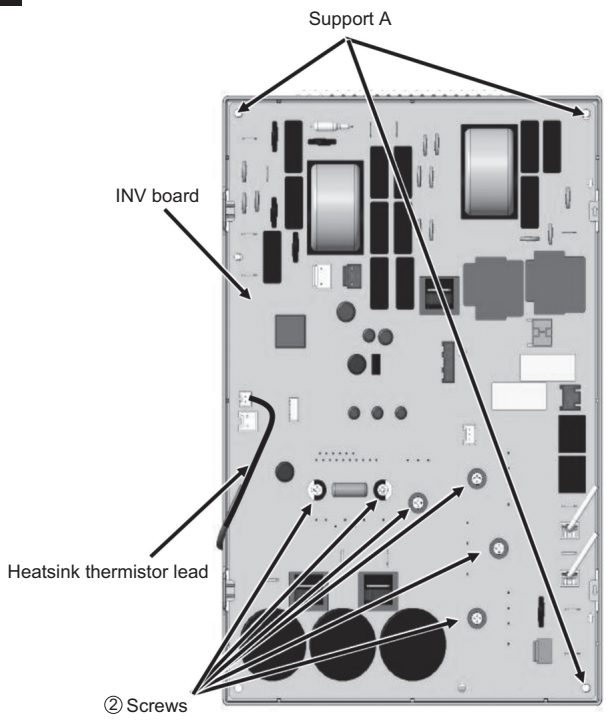
15-4. Replacing the circuit board

(1) Before inspecting inside the control box, turn off the main power of the unit, wait at least 10 minutes, and check that the power-supply voltage of the unit is 0 VAC and that the voltage of the electrolytic capacitor (main inverter circuit) is no greater than 20 VDC. Check the voltage across pins L and N of TB1 of the unit power supply voltage (AC), and across FT-P and FT-N pins.

(2) Before starting servicing, disconnect the outdoor fan connector (CNM1).
When connecting and disconnecting connectors, make sure that the outdoor fan is not running and that the voltage of the main circuit capacitor is no greater than 20 VDC.
If the outdoor fan rotates due to strong wind, the main circuit capacitor will be charged and pose a risk of electric shock.
Refer to the wiring nameplate for details.
When finishing servicing, connect the outdoor fan connector (CNM1) as it was.

Parts	Steps
1  	1. Remove the cover. Remove the circled fixing screws (4 locations).
2  	2. Disconnect all wirings from INV board. Make sure to unlock terminals before disconnecting these wirings. Remove 6 screws which fix INV board. Save the removed screws for later use. Remove support A which fix INV board. Remove INV board. Remove the board case from the removed INV board.

Parts	Steps
3  	3. Mount the new INV board in the board case that was removed. At installation, align " ➡ " marks on the board case and on the new INV board as shown. When holding the board, hold the "HANDLING" part marked on the board with both hands. Stress on the board may cause failure of electronic components.
4  	4. Wipe off silicone on heatsink thoroughly. Make sure not to leave any dirt and dust on heatsink. Dirt and dust can damage power module.
5  * Backside view of INV board	5. Attach support B and support C to the backside of INV board. Apply silicone on radiating surface of power module which is attached to the backside of INV board. Use provided silicone only. Apply it evenly to cover the whole contact surface. Carefully handle lead frame DB1, DB2, DB3 and Q600 as they could be deformed easily.

Parts	Steps
6  	6. Attach INV board to electrical parts box. If board support is old and damaged, replace it with the provided one. Be careful about heatsink thermistor not to be caught in between.
7  	7. Fix board with screws(②). Do not use an electric driver as it may screw too tightly and may damage power module. Tightening torque: temporary tightening...0.2-0.3 N•m, full tightening...0.6-0.75 N•m After the board is replaced, reassemble the product in the reverse order. Reconnect the fan motor connector after servicing.

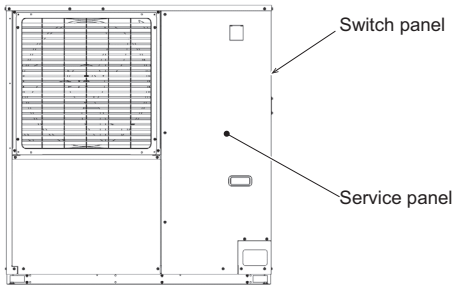
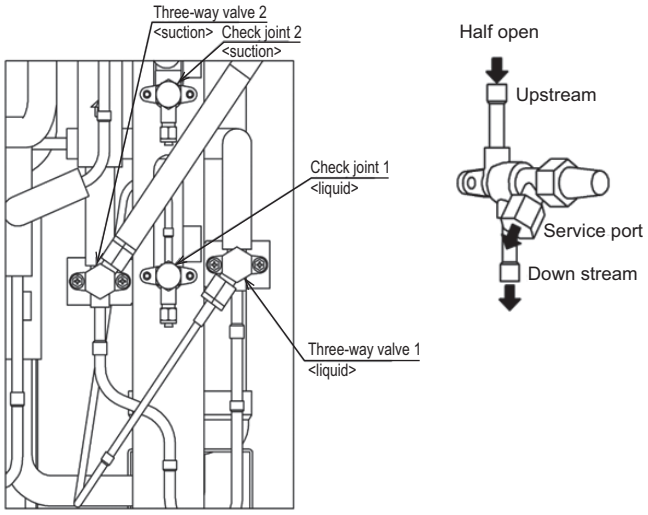
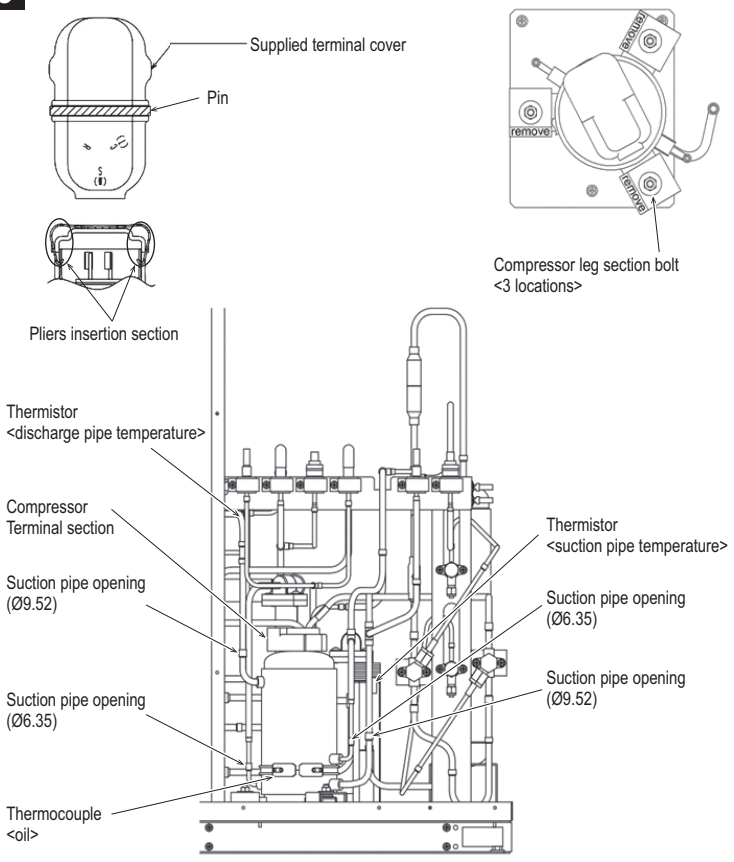
15-5. Replacing the compressor

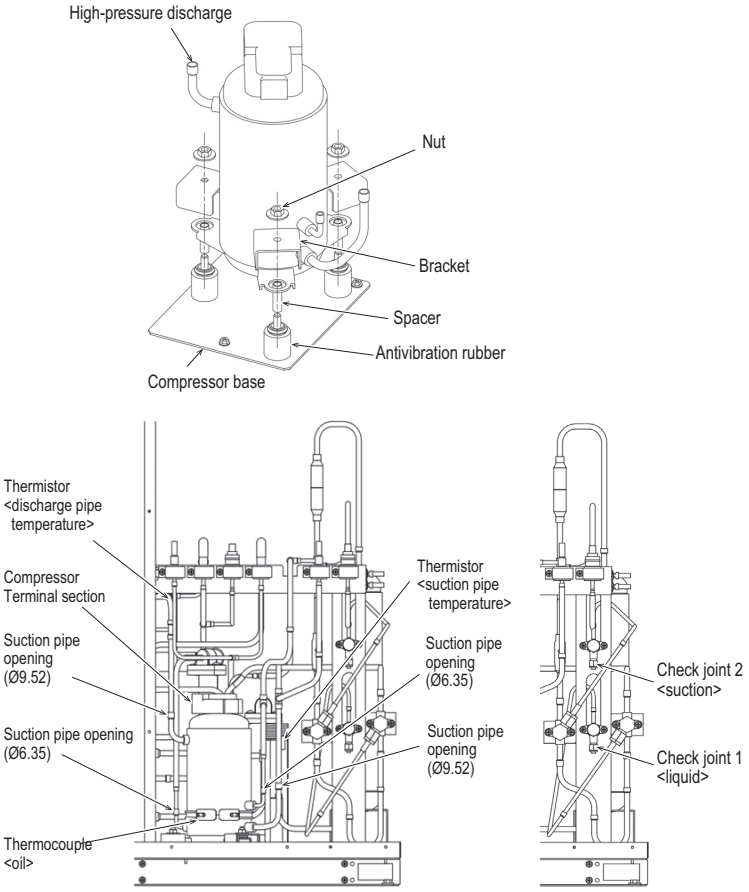
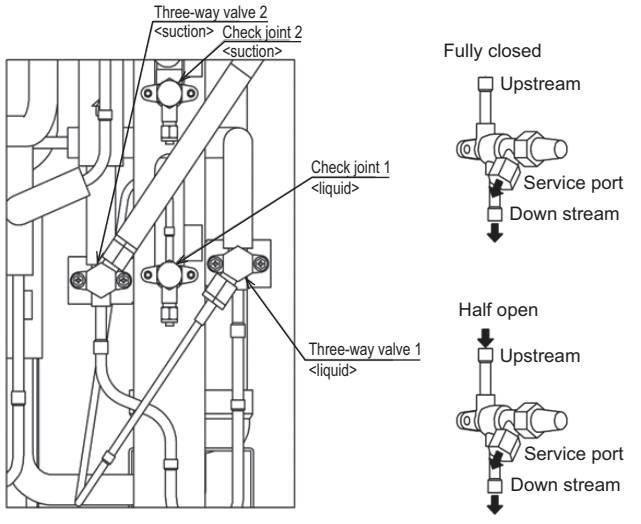
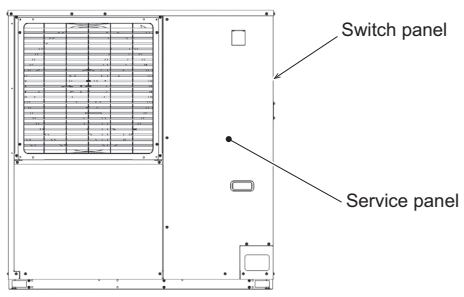
Wear protective gloves.

- Voltage still remains to each part of the circuit board or terminal block even after the switch (ON-OFF) is powered OFF.
  Touching the parts with bare hands poses electric shock hazards.
- Electricity charged to the circuit board remains for a few minutes even after the main switch (power breaker) is powered OFF.
  Touching the parts with bare hands poses electric shock hazards.

(1) Reconnect the suction, discharge, and injection pipes of the compressor to their original positions.
(2) Connect compressor wires in the correct phase (U, V, and W). Connecting them in the wrong phase may damage the compressor.
(3) Reinstall the cables in their original positions, and properly fix the cables in place.
(4) Remember to open the refrigerant service valve at the completion of work.
(5) When removing the compressor, remove the brackets for the compressor legs, too. Each bracket for the compressor legs is bolted down with one bolt.
(6) After the work is finished, make sure to attach 3 brackets for the compressor legs.

Please refer to the following page for further details.

Parts	Steps
1  	1. Preparations (1) Remove the switch panel on the side of the unit. (2) Turn off switch SW1 <ON/OFF> and turn off the main power (breaker). (3) Remove the service panel.
2  	2. Refrigerant discharge Set the three-way valve 1 <liquid> and the three-way valve 2 <suction> to half open, and discharge the refrigerant from the check joint 1 <liquid> and the check joint 2 <suction>. * If the refrigerant concentration in the atmosphere increases, there is a risk of CO2 poisoning and oxygen deprivation. For this reason, bring a suitable leak detector and use caution so that the refrigerant does not accumulate in the work area.
3  	3. Removing the compressor (1) Disconnect the wiring at the compressor terminal section. Insert the pliers into the positions shown in the figure to the left, release the pin, and open the terminal cover. (2) Disconnect the thermistor <discharge pipe temperature>, the thermistor <suction pipe temperature>, and the thermocouple <oil>. * If the main power is not turned off, the compressor terminal section will be live, even if switch SW1 is turned off. (3) Remove the insulation wrapped near the pipe openings. (4) Remove the bolts at the compressor leg section (3 locations). (5) Remove the brazing sections of the suction pipe opening (2 locations) and the discharge pipe opening (2 locations). * Remove a total of 4 brazing sections. (6) After the brazing sections are removed, remove the old compressor and replace it with the new compressor.

Parts	Steps
4 	4. Installing the compressor (1) After the compressor is removed, attach new pieces of antivibration rubber and spacers (3 locations) to the compressor base. (2) Mount the new compressor. After the new compressor is mounted, make sure to attach the brackets (3 locations). (3) Tighten the compressor leg section with nuts. Always tighten the nuts to 9.8 N•m. *Applying a 1/4 turn after hand tightening the nut is approximately equivalent to 9.8 N・m of torque. (4) Remove the rubber stoppers from the compressor pipes. Remove the rubber stoppers from the high-pressure discharge section first. There is a risk of oil spraying out of the pipes if a rubber stopper from a section other than the high-pressure discharge section is removed first. (5) Connect the brazing sections of the suction pipe opening (2 locations) and the discharge pipe opening (2 locations). * Connect a total of 4 brazing sections. * When making the connections, use caution to prevent clogging by the brazing material. * When brazing, cover wiring and insulation so they are not exposed to open flame. (6) Braze while passing an inert gas, such as dry nitrogen gas, through the pipes so that oxide scale does not form. Pass the dry nitrogen gas into check joint 2 <suction> and out of check joint 1 <liquid>. (Keep the gas flowing after brazing until the temperature of the brazed section drops to 200°C or less.) (7) Move the insulation back to its original position. Move the thermistors and the thermocouple back to their original positions. Connect the wiring to compressor terminal section. *Make sure the Faston terminal is inserted all the way in before connecting wiring to the compressor terminal.
5 	5. Air tightness test (1) When brazing is completed, conduct the air tightness test. Set the three-way valve 1 <liquid> and the three-way valve 2 <suction> to fully closed so that nitrogen is not passed to the load equipment side. (2) Pressurize the unit to the design pressure or higher (12.0 to 12.5 MPa) from the check joint 2 <suction>. * All locations inside the unit can be pressured to 12.5 MPa without problems. To release the nitrogen gas, do so from the check joint 1 <liquid> with the three-way valve 1 <liquid> set to half open.
6 	6. Charge with refrigerant (1) Perform vacuum drying and refrigerant charging according to chapter 10 and 11. (2) Confirm that each operation valve is opened and closed correctly. * Confirm that the three-way valves and ball valves are fully open. (3) Turn on the power and check operation according to chapter 12. (4) Reattach the panels.

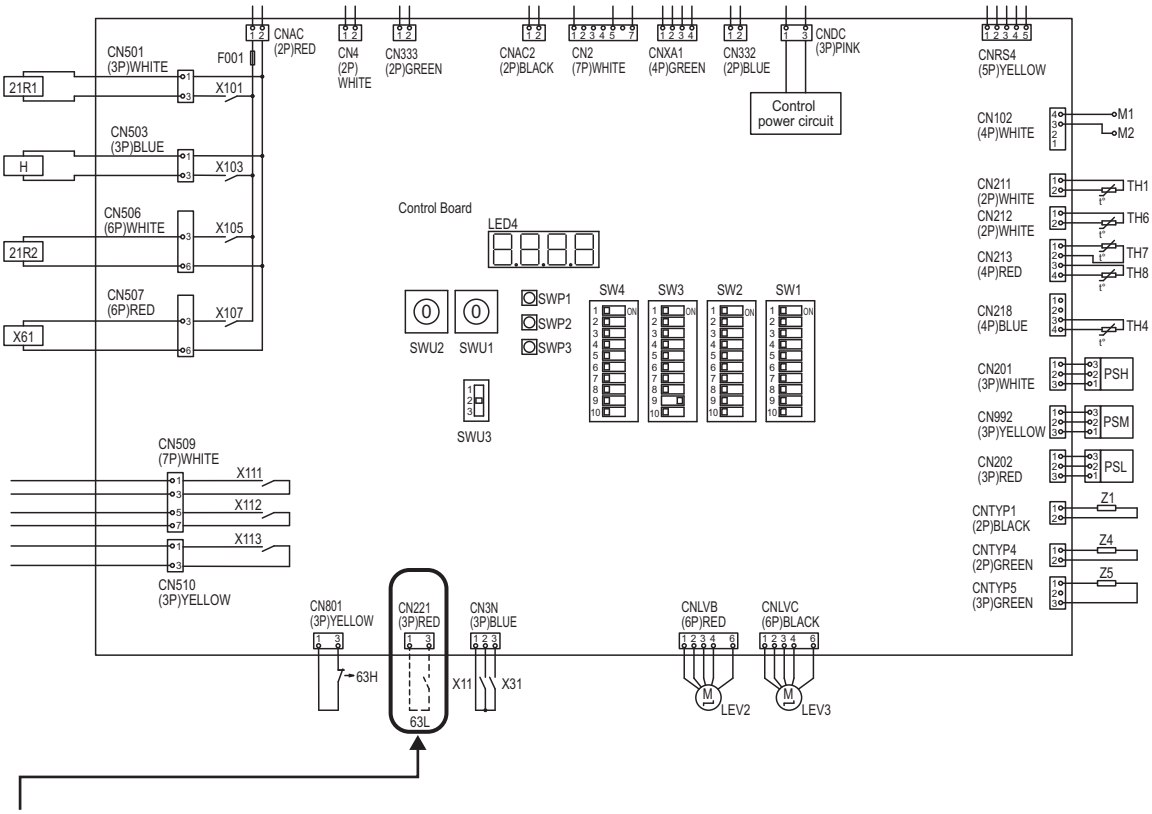
15-6. Backup operation

15-6-1. Low-pressure sensor fault

(1) Pressure switch (field supplied) can be used to operate the system when the low-pressure sensor is not working properly.

Procedures

1) Turn off the main power of the unit.



2) Replace this connector with the supplied connector, and connect a pressure switch (field supplied).

3) Connect the wire from CN211 to the pressure switch (field-supplied) contact.
4) Connect the low-pressure switch to the check joint of the refrigerant service valve (suction line stop valve).
5) Set dipswitches SW3-4 and SW3-5 to ON.
6) Turn on the main power.

Notes
If the connector CN211 is not connected to the pressure switch, and the unit starts operation under short-circuit condition, the low-pressure cutoff function will not work and compressor damage will result. Before turning on the main power, be sure to connect the wire from CN211 to the pressure switch contact.

The system can be operated in the emergency operation mode only when the low-pressure sensor is not working properly. It will take approximately six minutes from the time the main power is switched on until the compressor starts up.

16-1. Salt protection specifications

Part		Specifications	Standard specifications	Salt protection specifications (-BS)
Base assembly	Base	Material	Alloyed hot-dip galvanized steel sheet	
		Surface treatment	Polyester resin	
		Treatment thickness	70 µm or more	
	Base Beam	Material	Alloyed hot-dip galvanized steel sheet	
		Surface treatment	Polyester resin	
		Treatment thickness	70 µm or more	
	Base Leg	Material	Alloyed hot-dip galvanized steel sheet	
		Surface treatment	Polyester resin	
		Treatment thickness	70 µm or more	
Exterior metal sheet		Material	Alloyed hot-dip galvanized steel sheet	
		Surface treatment	Polyester resin	
		Treatment thickness	Front: 30 µm or more	70 µm or more
Interior metal sheet (basic)		Material	Hot-dip galvanized steel sheet	Alloyed hot-dip galvanized steel sheet
		Surface treatment	–	Polyester resin
		Treatment thickness	–	70 µm or more
Fan base		Material	Hot-dip galvanized steel sheet	Alloyed hot-dip galvanized steel sheet
		Surface treatment	–	Polyester resin
		Treatment thickness	–	70 µm or more
Control box Exterior metal sheet		Material	Hot-dip galvanized steel sheet	Aluminum-zinc alloyed plated steel sheet
		Surface treatment	–	Polyester resin
		Treatment thickness	–	Front: 70 µm or more
Control box Interior metal sheet		Material	Hot-dip galvanized steel sheet	Aluminum-zinc alloyed plated steel sheet
		Surface treatment	–	
		Treatment thickness	–	
Air guide Bell mouth Propeller fan		Material	Weather-resistant polypropylene resin	
		Surface treatment	–	
		Treatment thickness	–	
Heat exchanger		Material	Aluminum	
		Surface treatment	Zinc added	
		Treatment thickness	–	
Receiver		Material	Carbon steel	
		Surface treatment	Phenol modified alkyd resin	Polyurethane resin
		Treatment thickness	30 µm or more	75 µm or more
Accumulator		Material	Carbon steel	
		Surface treatment	Phenol modified alkyd resin	Polyurethane resin
		Treatment thickness	30 µm or more	75 µm or more
Panel fixing screw		Material	Carbon steel	
		Surface treatment	Zinc-nickel alloy plating + Geomet treatment	
		Treatment thickness	5 µm or more	

Application Guide

	Distance from sea		
Direct sea breeze	300 m	500 m	1 km
Facing inland sea	BS		STD
Facing ocean	BS		
Island location	BS		
Indirect sea breeze			
Facing inland sea	BS		STD
Facing ocean	BS		
Island location	BS		

Caution;
1 Set the outdoor unit to the place with rare direct sea breeze.
2 Don't attach a sunshade. A rain will clean the attached salt.
3 Set the outdoor unit horizontally. The water should not keep in the unit.
4 Please wash the outdoor unit periodically.
5 Repair the scratch on the panel as soon as possible.
6 Inspect periodically. Paint or change parts if necessary.

16-2. Detailed specification of high-pressure gas

Model name			ECOV-X15VA
Refrigerant			R744
Compressor	Model name		C-CV163LOA
	Discharge volume	m^3/h	4.1
Lubricant	Type		PZ68S
	Refrigerant oil (Compressor)	L	0.3
	Refrigerant oil (Other)	L	0.4
Design pressure	High pressure	MPa	12.0
	Low pressure	MPa	8.5
Design pressure of high-pressure breaker		MPa	12.0
Compressor	Quantity		1
	Withstand voltage test pressure	MPa	–
	Air-tightness test pressure	MPa	12.0
Receiver	Quantity		1
	Withstand voltage test pressure	MPa	–
	Air-tightness test pressure	MPa	8.5
	Fusible plug diameter	mm	–
	Fusible plug melting temperature	°C	–
Gas cooler	Quantity		1
	Withstand voltage test pressure	MPa	–
	Air-tightness test pressure	MPa	12.0
	Presence/absence of fusible plug		–
Gas-liquid separator (Suction accumulator)	Quantity		1
	Withstand voltage test pressure	MPa	–
	Air-tightness test pressure	MPa	8.5
	Presence/absence of fusible plug		–

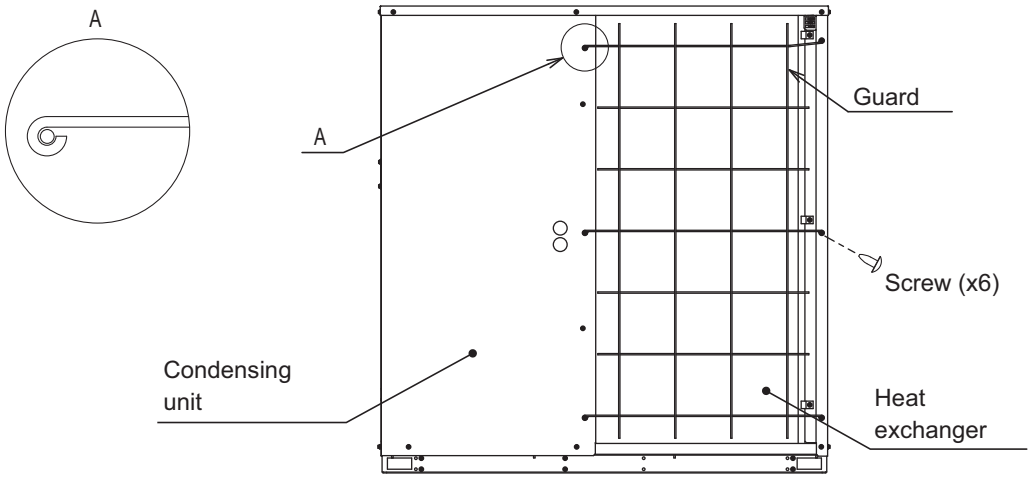
Conduct an air-tightness test for the on-site pipes at the pressure equal to or above the design pressure (air-tightness test pressure).

16-3. Option parts

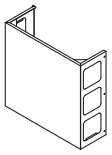
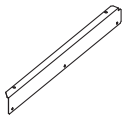
16-3-1. Fin guard LG-X15A

Parts name / Model	Guard dimensions (mm)	Screw (spare)
LG-X15A	634 × 1110	2 pcs.

Installation procedure
Remove the six screws from the unit as shown in the figure below, and use them to screw down the guard on the unit.



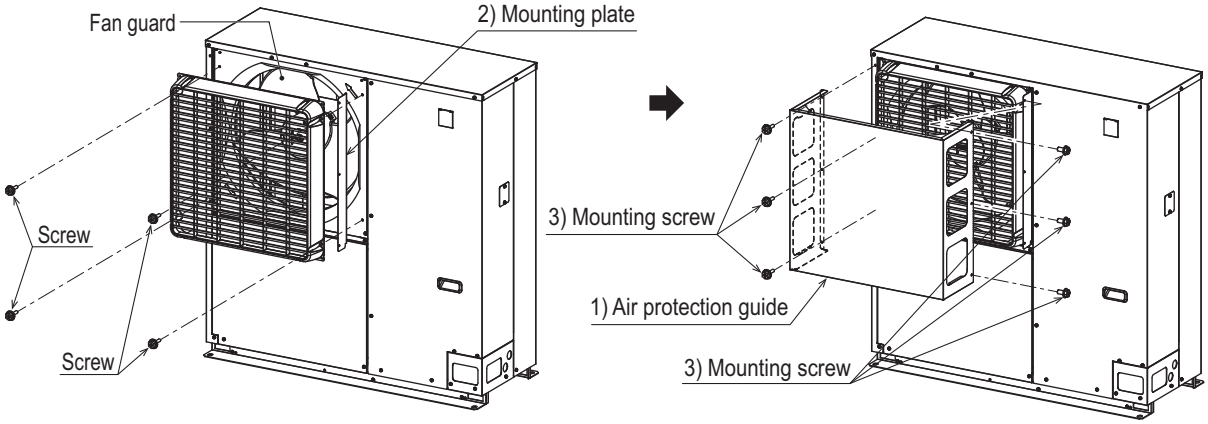
16-3-2. Air protection guide AG-X37A

Item	Air protection guide	Mounting plate	Mounting screw
Quantity	1	1	7 (including 1 spare)
Shape			

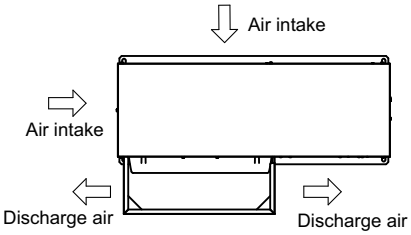
Installation procedure

(1) Remove the crews from the fan guard, and screw 2) mouning plate down together with the fan guard to the unit.

(2) Attach 1) air protection guide to the condensing unit using 3) mounting screws.

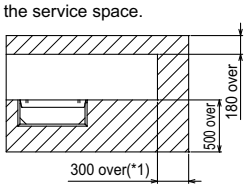


External dimensions

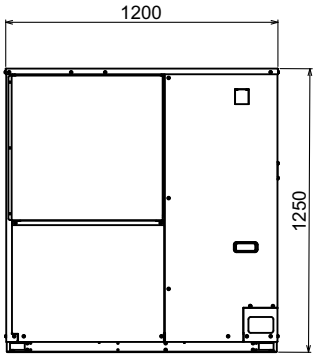


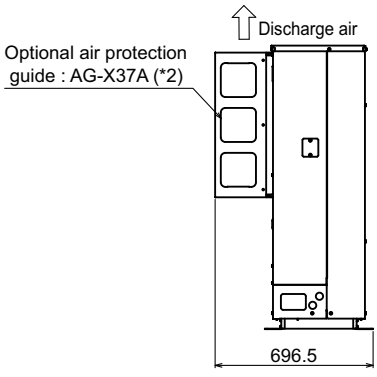
1.Service space

The dimensions of the chart below are necessary in the service space.



*1 When removing the piping and the wiring from the right side, a space of about 300 mm is required on the right side.





16-4. Refrigerant characteristics

♦ R744 refrigerant characteristics chart

Temperature (°C)	Saturated pressure (MPaG)
	Saturated liquid/gas
-45	0.73
-44	0.76
-43	0.80
-42	0.83
-41	0.87
-40	0.90
-39	0.94
-38	0.98
-37	1.02
-36	1.06
-35	1.10
-34	1.14
-33	1.19
-32	1.23
-31	1.28
-30	1.33
-29	1.38
-28	1.42
-27	1.48
-26	1.53
-25	1.58
-24	1.64
-23	1.69
-22	1.75
-21	1.81
-20	1.87
-19	1.93
-18	1.99
-17	2.06
-16	2.12
-15	2.19
-14	2.26
-13	2.33
-12	2.40
-11	2.47
-10	2.55
-9	2.62
-8	2.70
-7	2.78
-6	2.86
-5	2.94
-4	3.03
-3	3.12
-2	3.20
-1	3.29
0	3.38

Temperature (°C)	Saturated pressure (MPaG)
	Saturated liquid/gas
1	3.48
2	3.57
3	3.67
4	3.77
5	3.87
6	3.97
7	4.08
8	4.18
9	4.29
10	4.40
11	4.51
12	4.63
13	4.75
14	4.86
15	4.99
16	5.11
17	5.24
18	5.36
19	5.49
20	5.63
21	5.76
22	5.90
23	6.04
24	6.19
25	6.33
26	6.48
27	6.63
28	6.79
29	6.95
30	7.11

⚠Warning

■ Do not use refrigerant other than the type indicated in the manuals provided with the unit and on the nameplate.
- Doing so may cause the unit or pipes to burst, or result in explosion or fire during use, repair, or at the time of disposal of the unit.
- It may also be in violation of applicable laws.
- MITSUBISHI ELECTRIC CORPORATION cannot be held responsible for malfunctions or accidents resulting from the use of the wrong type of refrigerant.

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