SANYO

SERVICE MANUAL

ECO i DC Inverter
W-3WAY MULTI

3-WAY ECO-i MULTI SYSTEM 5 series

R410A

Outdoor Unit

	Class	70	90	115	130	140
C	Model Name	SPW-C0705DZH8	SPW-C0905DZH8	SPW-C1155DZH8	SPW-C1305DZH8	SPW-C1405DZH8

Indoor Unit

	Class	7	9	12	16	18	25	30	36	48	60
X	4-Way Air Discharge Semi-Concealed	SPW-XDR74GXH56(A/B) X075XH	SPW-XDR94GXH56(A/B) X095XH	SPW-XDR124GXH56(A/B) X125XH	SPW-XDR164GXH56(A/B) X165XH	SPW-XDR184GXH56(A/B) X185XH	SPW-XDR254GXH56(A/B) X255XH		SPW-XDR364GXH56(A/B) X365XH	SPW-XDR484GXH56(A/B) X485XH	SPW-XDR604GXH56(A/B) X605XH
XM	4-Way Air Discharge Semi-Concealed	SPW-XM075XH	SPW-XM095XH	SPW-XM125XH	SPW-XM165XH	SPW-XM185XH					
S	2-Way Air Discharge Semi-Concealed	SPW-SR74GXH56(A/B)	SPW-SR94GXH56(A/B)	SPW-SR124GXH56(A/B)	SPW-SR164GXH56(A/B)	SPW-SR184GXH56(A/B)	SPW-SR254GXH56(A/B)				
A	1-Way Air Discharge Semi-Concealed	SPW-ADR74GXH56B	SPW-ADR94GXH56B	SPW-ADR124GXH56B							
L	1-Way Air Discharge Semi-Concealed Slim		SPW-LDR94GXH56(A/B)	SPW-LDR124GXH56(A/B)	SPW-LDR164GXH56(A/B)	SPW-LDR184GXH56(A/B)	SPW-LDR254GXH56(A/B)				
U	Concealed-Duct	SPW-UR74GXH56(A/B) U075XH U075XHN UR74SXH56B U075SXH U075SXHT	SPW-UR94GXH56(A/B) U095XH U095XHN UR94SXH56B U095SXH U095SXHT	SPW-UR124GXH56(A/B) U125XH U125XHN UR124SXH56B U125SXH U125SXHT	SPW-UR164GXH56(A/B) U165XH U165XHN UR164SXH56B U165SXH U165SXHT	SPW-UR184GXH56(A/B) U185XH U185XHN UR184SXH56B U185SXH U185SXHT	SPW-UR254GXH56(A/B) U255XH U255XHN UR254SXH56B U255SXH U255SXHT	SPW-UR304SXH56B U305SXH U305SXHT	SPW-UR364GXH56(A/B) U365XH U365XHN UR364SXH56B U365SXH U365SXHT	SPW-UR484GXH56(A/B) U485XH U485XHN UR484SXH56B U485SXH U485SXHT	SPW-UR604GXH56B U605XH U605XHN UR604SXH56B U605SXH U605SXHT
US	Concealed-Duct	SPW-US075XH	SPW-US095XH	SPW-US125XH	SPW-US165XH	SPW-US185XH					
T	Ceiling-Mounted			SPW-TDR124GXH56(A/B) T125XH	SPW-TDR164GXH56(A/B) T165XH	SPW-TDR184GXH56(A/B) T185XH	SPW-TDR254GXH56(A/B) T255XH		SPW-TDR364GXH56(A/B) T365XH	SPW-TDR484GXH56(A/B) T485XH	
K	Wall-Mounted	SPW-KR74GXH56(A/B) K075XH	SPW-KR94GXH56(A/B) K095XH	SPW-KR124GXH56(A/B) K125XH	SPW-KR164GXH56(A/B)	SPW-KR184GXH56(A/B)	SPW-KR254GXH56(A/B)				
FM	Concealed Floor Standing	SPW-FMR74GXH56(A/B)	SPW-FMR94GXH56(A/B)	SPW-FMR124GXH56(A/B)	SPW-FMR164GXH56(A/B)	SPW-FMR184GXH56(A/B)	SPW-FMR254GXH56(A/B)				
F	Floor Standing	SPW-FR74GXH56(A/B)	SPW-FR94GXH56(A/B)	SPW-FR124GXH56(A/B)	SPW-FR164GXH56(A/B)	SPW-FR184GXH56(A/B)	SPW-FR254GXH56(A/B)				
GU	Total Heat Exchanger with DX coil		SPW-GU055XH		SPW-GU075XH	SPW-GU105XH					

	Class	25	36	48	76	96
D	Concealed-Duct High-Static Pressure	SPW-DR254GXH56(A/B)	SPW-DR364GXH56(A/B)	SPW-DR484GXH56(A/B)	SPW-DR764GXH56(A/B)	SPW-DR964GXH56(A/B)

85464849271000

REFERENCE NO. SM830171-00

IMPORTANT!
Please Read Before Starting

This air conditioning system meets strict safety and operating standards. As the installer or service person, it is an important part of your job to install or service the system so it operates safely and efficiently.

For safe installation and trouble-free operation, you must:

- Carefully read this instruction booklet before beginning.
- Follow each installation or repair step exactly as shown.
- Observe all local, state, and national electrical codes.
- This product is intended for professional use. Permission from the power supplier is required when installing an outdoor unit that is connected to a 16 A distribution network.
- Pay close attention to all warning and caution notices given in this manual.

WARNING This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.

CAUTION This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.

If Necessary, Get Help

These instructions are all you need for most installation sites and maintenance conditions. If you require help for a special problem, contact our sales/service outlet or your certified dealer for additional instructions.

In Case of Improper Installation

The manufacturer shall in no way be responsible for improper installation or maintenance service, including failure to follow the instructions in this document.

SPECIAL PRECAUTIONS

WARNING When Wiring

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. ONLY A QUALIFIED, EXPERIENCED ELECTRICIAN SHOULD ATTEMPT TO WIRE THIS SYSTEM.

- Do not supply power to the unit until all wiring and tubing are completed or reconnected and checked.
- Highly dangerous electrical voltages are used in this system. Carefully refer to the wiring diagram and these instructions when wiring. Improper connections and inadequate grounding can cause **accidental injury or death.**
- **Ground the unit** following local electrical codes.
- Connect all wiring tightly. Loose wiring may cause overheating at connection points and a possible fire hazard.

When Transporting

Be careful when picking up and moving the indoor and outdoor units. Get a partner to help, and bend your knees when lifting to reduce strain on your back. Sharp edges or thin aluminum fins on the air conditioner can cut your fingers.

When Installing…

…In a Room

Properly insulate any tubing run inside a room to prevent "sweating" that can cause dripping and water damage to walls and floors.

…In Moist or Uneven Locations

Use a raised concrete pad or concrete blocks to provide a solid, level foundation for the outdoor unit. This prevents water damage and abnormal vibration.

…In an Area with High Winds

Securely anchor the outdoor unit down with bolts and a metal frame. Provide a suitable air baffle.

…In a Snowy Area (for Heat Pump-type Systems)

Install the outdoor unit on a raised platform that is higher than drifting snow. Provide snow vents.

When Connecting Refrigerant Tubing

- Ventilate the room well, in the event that is refrigerant gas leaks during the installation. Be careful not to allow contact of the refrigerant gas with a flame as this will cause the generation of poisonous gas.
- Keep all tubing runs as short as possible.
- Use the flare method for connecting tubing.
- Apply refrigerant lubricant to the matching surfaces of the flare and union tubes before connecting them, then tighten the nut with a torque wrench for a leak-free connection.
- Check carefully for leaks before starting the test run.

NOTE

Depending on the system type, liquid and gas lines may be either narrow or wide. Therefore, to avoid confusion the refrigerant tubing for your particular model is specified as either "narrow" or "wide" than as "liquid" or "gas".

When Servicing

- Turn the power OFF at the main power box (mains) before opening the unit to check or repair electrical parts and wiring.
- Keep your fingers and clothing away from any moving parts.
- Clean up the site after you finish, remembering to check that no metal scraps or bits of wiring have been left inside the unit being serviced.

CAUTION

- Ventilate any enclosed areas when installing or testing the refrigeration system. Escaped refrigerant gas, on contact with fire or heat, can produce dangerously toxic gas.
- Confirm after installation that no refrigerant gas is leaking. If the gas comes in contact with a burning stove, gas water heater, electric room heater or other heat source, it can cause the generation of poisonous gas.

Check of Density Limit

The room in which the air conditioner is to be installed requires a design that in the event of refrigerant gas leaking out, its density will not exceed a set limit.

The refrigerant (R410A), which is used in the air conditioner, is safe, without the toxicity or combustibility of ammonia, and is not restricted by laws imposed to protect the ozone layer. However, since it contains more than air, it poses the risk of suffocation if its density should rise excessively. Suffocation from leakage of refrigerant is almost non-existent. With the recent increase in the number of high density buildings, however, the installation of multi air conditioner systems is on the increase because of the need for effective use of floor space, individual control, energy conservation by curtailing heat and carrying power, etc.

Most importantly, the multi air conditioner system is able to replenish a large amount of refrigerant compared to conventional individual air conditioners.

If a single unit of the multi air conditioner system is to be installed in a small room, select a suitable model and installation procedure so that if the refrigerant accidentally leaks out, its density does not reach the limit (and in the event of an emergency, measures can be made before injury can occur).

In a room where the density may exceed the limit, create an opening with adjacent rooms, or install mechanical ventilation combined with a gas leak detection device. The density is as given below.

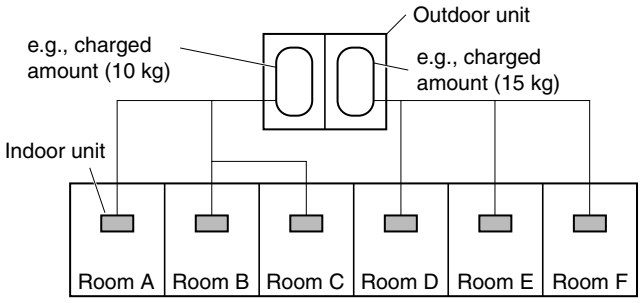
$$\frac{\text{Total amount of refrigerant (kg)}}{\text{Min. volume of the indoor unit installed room (m}^3\text{)}} \leq \text{Density limit (kg/m}^3\text{)}$$

The density limit of refrigerant which is used in multi air conditioners is 0.3 kg/m^3 (ISO 5149).

NOTE

1. If there are 2 or more refrigerating systems in a single refrigerating device, the amount of refrigerant should be as charged in each independent device.

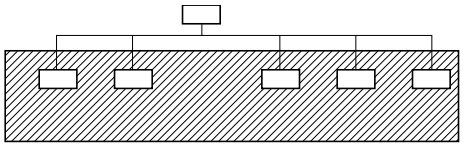
For the amount of charge in this example:



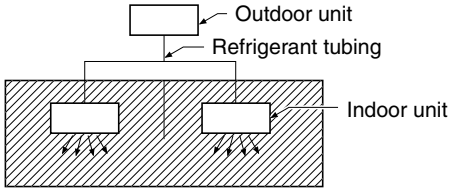
The possible amount of leaked refrigerant gas in rooms A, B and C is 10 kg.
The possible amount of leaked refrigerant gas in rooms D, E and F is 15 kg.

2. The standards for minimum room volume are as follows.

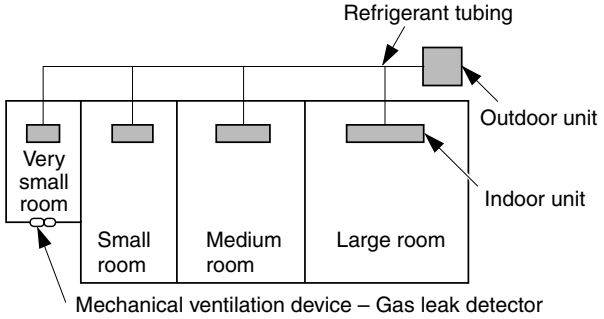
(1) No partition (shaded portion)



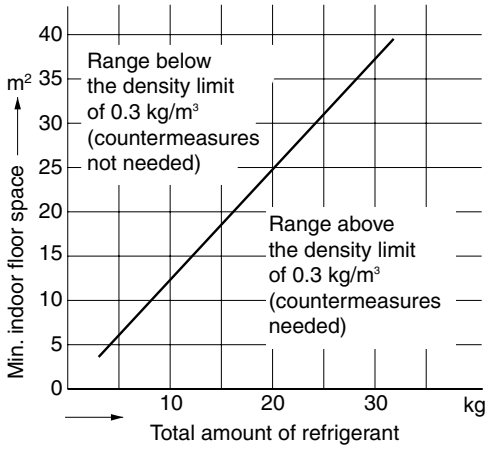
(2) When there is an effective opening with the adjacent room for ventilation of leaking refrigerant gas (opening without a door, or an opening 0.15% or larger than the respective floor spaces at the top or bottom of the door).



(3) If an indoor unit is installed in each partitioned room and the refrigerant tubing is interconnected, the smallest room of course becomes the object. But when mechanical ventilation is installed interlocked with a gas leakage detector in the smallest room where the density limit is exceeded, the volume of the next smallest room becomes the object.



3. The minimum indoor floor space compared with the amount of refrigerant is roughly as follows: (When the ceiling is 2.7 m high)



RoHS
· This product does not contain any hazardous substances prohibited by the RoHS Directive.

WARNING
· You are requested to use RoHS compliant parts for maintenance or repair.

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1. CONTROL FUNCTIONS

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The 3-WAY ECO-i is a system that allows multiple outdoor units to be connected. The outdoor units all contain inverter compressors, and the system does not utilize the sub units that were used in earlier systems.
The outdoor unit where the unit No. is set to “1” includes the CCU (command controller unit) functions that are used to control the entire system. As a result, the system will not operate if no outdoor unit has been set as unit No. “1.”

Required settings for Test Run

	Outdoor unit No. 1		Outdoor unit Nos. 2 ~ 3	
	At time of shipment	On-site setting	At time of shipment	On-site setting
System address	1	System 1 ~ 30	1	Not necessary
No. of indoor units	1	1 ~ 40 units	1	Not necessary
No. of outdoor units	1	1 ~ 3 units	1	Not necessary
Unit No.	1	Unit No. 1	1	Unit Nos. 2 ~ 3

This system can be expanded to connect a maximum of 3 outdoor units. (The system maximum capacity is 48 HP.)

The CCU functions are disabled at all units except the unit that is set as unit No. 1. Therefore no problems will result even if the system address, No. of indoor units, and No. of outdoor units settings are made at the other units. However, making these settings may be convenient for manual backup operation, as it eliminates the necessity of making the settings again if unit No. 1 fails. (If unit No. 1 fails, and the power supply to it is interrupted, it will be necessary to set a different unit as unit No. 1 in order to use manual backup operation.)

2. Selecting Outdoor Unit for Operation

2-1. Outdoor Unit Operating Rules

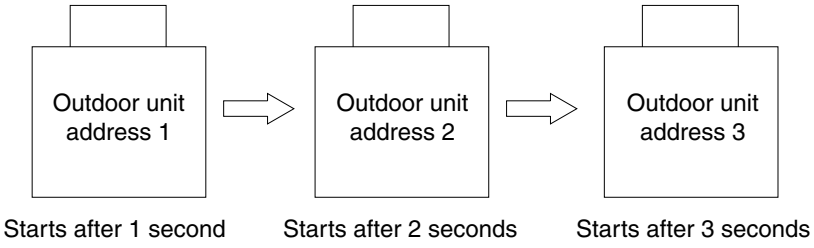
Because in this system all outdoor units contain an inverter compressor, ordinarily there is no absolute order of priority for compressor operation. Therefore there is no order of priority for the outdoor units.
However, it is possible to operate the outdoor units in sequence, beginning with unit No. 1, by using the outdoor unit maintenance remote controller to change the outdoor unit EEPROM settings.

* For information concerning EEPROM settings, refer to the field application functions.

2-2. Delayed Start of Outdoor Units

(1) Delayed start of outdoor units in the same system

If it is necessary to operate the compressors simultaneously at multiple outdoor units, each outdoor unit will start, beginning with unit No. 1, after a delay of a number of seconds equivalent to the outdoor unit address. **The units do not start simultaneously**.
This is in order to reduce the load on the power receiving equipment.



(2) Delayed start for each system

At the time of factory shipment, delayed start for each system is not set to occur. Therefore when systems are linked and multiple systems are selected for start simultaneously by the central control device, all systems will begin operating simultaneously. For this reason, a function is included to delay the start time for each system address when systems are linked and multiple systems are selected for start by the central control device.
In order to enable this delay time, it must be set in the EEPROM for each system. Those systems where this setting has been made will start after a delay according to their system addresses.

* For information concerning EEPROM settings, refer to the field application functions.

2-3. Outdoor Unit Stop Rules

(1) Simultaneous stop of multiple outdoor units

When all outdoor units, or multiple outdoor units, must stop, the units stop at the same time. However, depending on the communications timing, a difference of approximately 10 seconds may occur.

(2) Stopping individual outdoor units

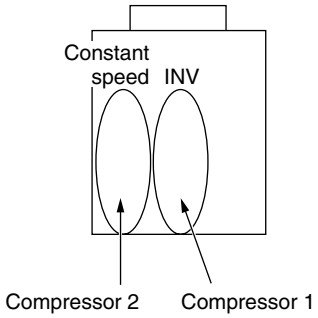
- The last unit to stop operating is the outdoor unit that contains the inverter compressor with the shortest amount of operating time.
- If the indoor load decreases, and it becomes necessary to reduce the number of operating outdoor units, the compressors are stopped individually, in sequence. When all compressors installed in an outdoor unit have stopped, that outdoor unit also stops.

3. Compressor Control

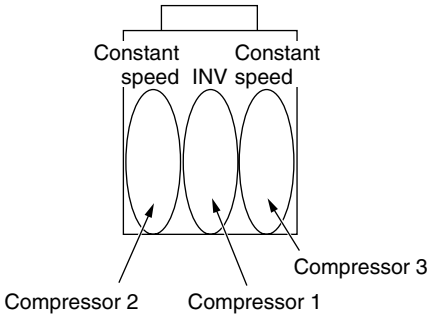
3-1. Compressors Mounted in the Outdoor Units [SPW-C0705DZH8, C0905DZH8, C1155DZH8, C1305DZH8, C1405DZH8]

Capacity			0705	0905	1155	1305	1405
Installed compressor	Compressor 1	Rotary	DC Inverter	DC Inverter	DC Inverter	DC Inverter	DC Inverter
	Compressor 2	Scroll	5 hp	6 hp	6.5 hp	5 hp	6 hp
	Compressor 3	Scroll	—	—	—	5 hp	6 hp

* For both 50 Hz and 60 Hz. hp = horsepower



Types 0705, 0905, 1155



Types 1305, 1405

3-2. Compressor Selection Rules

Because all outdoor units in this system contain an inverter compressor, ordinarily there is no absolute order of priority for compressor operation.

(1) Normal compressor operation sequence (set at time of shipment)

At least one inverter compressor is always operating in order to make fine adjustments to the system lower-limit capacity. When multiple outdoor units are connected, each unit contains an inverter compressor. Therefore, the inverter which operates is the inverter with the shortest amount of operating time. After the first inverter compressor has started, the remaining inverter compressors and constant-speed compressors start operating in order of the compressors which have the shortest amount of operating time.

* Immediately after installation, all compressors have an operating time of zero. In this case, the compressors start in the following sequence: Inverter compressor > Constant-speed compressor 1 > Constant-speed compressor 2.

<Details>

The A/C units are selected with consideration for the maximum load. Therefore, in most cases the maximum capacity is not required. Ordinarily, the operating range of an inverter compressor is approximately 25 Hz – 90 Hz, however operating efficiency declines somewhat in the high-frequency operating range. With consideration for these characteristics, control of inverter compressors in this system is divided into two ranges, according to the frequencies. Ordinarily, for reasons of efficiency, the upper limit for operation is approximately 50 Hz. If greater capacity is required, the next compressor is started. When all compressors are operating and greater capacity is required, the inverter compressors are operated at frequencies above approximately 50 Hz. This control may increase the lifetimes of the inverter compressors and refrigerant oil.

* If the number of connected outdoor units is small, the number of inverter compressors is also small. Therefore, the compressors may operate at a high frequency even when the load is not large.

(2) Sequential operation beginning from unit No. 1

By using the outdoor unit maintenance remote controller to change the outdoor unit EEPROM settings, it is possible to start the units in sequence, beginning from unit No. 1.

* For information concerning EEPROM settings, refer to the field application functions.

3-3. Compressor Capacity Control

The compressor operating conditions vary depending on the indoor unit operating conditions and on the effects of indoor heat load, outside temperature, and other factors. Unit No. 1 (CCU) calculates the required capacity according to these operating conditions, and allocates the capacity requirement among the outdoor units, according to the compressor start/stop rules. Fine adjustments to system capacity control are made by the inverter compressors. (Depending on the conditions, all inverter compressors may be operating for fine adjustment.)

3-4. Inverter Compressor Capacity Control

(1) The inverter compressor has a center limit value and upper limit value for the operating frequency. These limits are set for each outdoor unit capacity.

(2) The inverter frequency during operation may be lower than the frequency listed above due to overload current protection control. In this case, the inverter frequency lower limit is 22 Hz.

* If Quiet mode is selected, the inverter may stabilize at a frequency lower than those stated above. For information about Quiet mode, refer to the field application functions.

3-5. Forced Compressor Stop

After a compressor stops, it will not start for a period of 3 minutes (3 minutes forced OFF). However, this does not apply when the compressor was forced to stop as the result of a control operation during the special controls (start control, defrost control, refrigerant oil recovery control, etc.) which are described later.

3-6. Roadmap Control

(1) The below controls are performed according to the pressure sensor on the outdoor unit, and the 2 temperature sensors attached to the indoor unit heat exchanger.

* With roadmap control, the pressure detected by the pressure sensor is converted to saturation temperature. A temperature that has been converted to saturation temperature is called the pressure sensor temperature.

(2) These controls are performed every 30 seconds.

(3) The temperatures used to determine the area (A, AB, B, C) for the evaporation temperature control shown in the figure on the next page, and for condensation temperature control, may vary depending on the relationships among factors including the difference between the room temperature setting and the indoor unit air intake temperature (= air intake temperature difference) and the difference between the air discharge temperature setting and the air discharge temperature (= air discharge temperature difference).

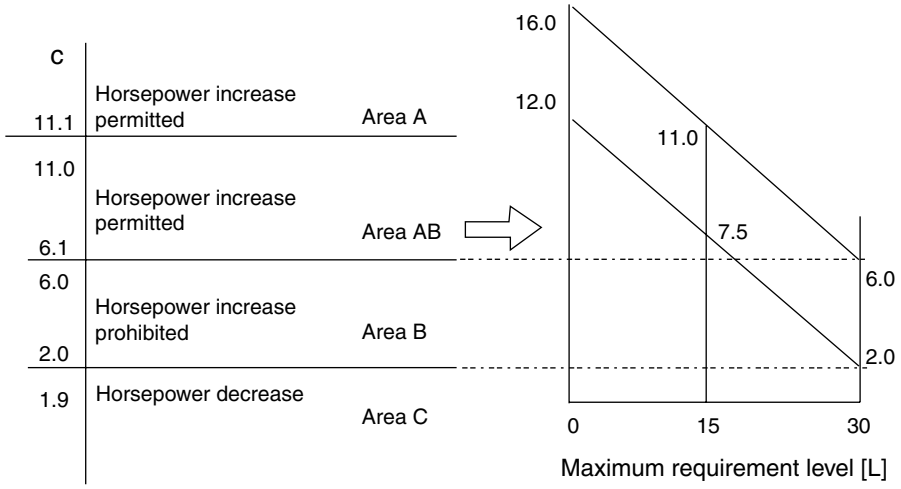
(4) Definitions of evaporation temperature and condensation temperature

Evaporation temperature (Te): Lowest heat exchanger temperature (E1, E3) at any indoor unit

Condensation temperature (Tc): Highest temperature among the outdoor unit pressure sensor temperature and the heat exchanger temperatures (E1) at all indoor units where the heating thermostat is ON.
Ordinarily, this is the outdoor unit pressure sensor temperature. (If multiple outdoor units are connected, this is the highest outdoor unit pressure sensor temperature.)

* E3 temperature is not used for condensation temperature detection, because it may indicate the temperature of superheated gas.

3-6-1. Evaporation Temperature (Te) Control: Control of Indoor Units Operating in Cooling Mode



* Depending on the maximum requirement level of the indoor unit, the judgment temperatures for each area may vary as shown in the figure (example).

(1) For indoor units that are operating in Cooling mode, if one unit is selected for a test run, then the air intake temperature difference (difference between the room temperature setting and indoor unit air intake temperature) is ignored, and areas B and C are considered to be area A for control purposes. (This is used for additional charging, test run checks, etc.)
For this reason, vapor may be discharged if the test run continues for a long period of time, however this does not indicate a problem. In addition, the test run is canceled automatically after 1 hour.

(2) Even within the same area, the compressor capacity varies depending on the refrigerant temperature.

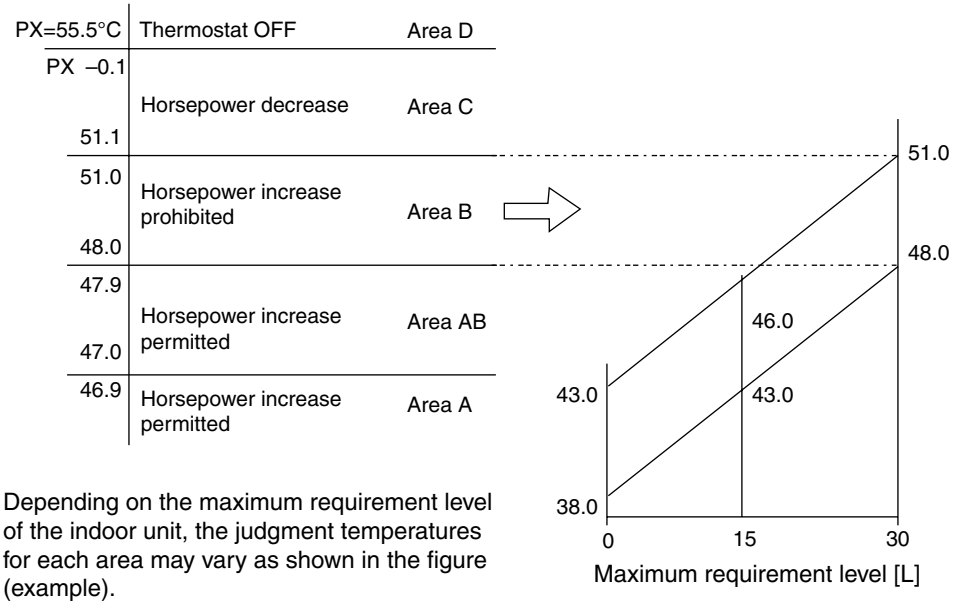
(3) For 6 minutes after the compressors start, area C is considered to be area B for control purposes.

(4) During special control, control of the compressor capacity according to Te is not performed.

(5) If the thermostat turns OFF while Te is within area C, the next time the compressor starts it may restart from a lower capacity.

(6) When the area changes to area C, area C is considered to be area B for control purposes for the first 6 minutes, even if the horsepower is the minimum value within the range where capacity control is possible (operation with inverter frequency of 25 Hz only). Subsequently if C area continues, the thermostat turns OFF.

3-6-2. Condensation Temperature (Tc) Control: Control when there are indoor units operating in Heating mode



* Depending on the maximum requirement level of the indoor unit, the judgment temperatures for each area may vary as shown in the figure (example).

(1) For indoor units which are operating in Heating mode, if one unit is selected for a test run, the air intake temperature difference is ignored, however Tc control is performed according to the figure above in order to prevent excessive load. (This is used for test run checks, etc.)

(2) Even within the same area, the compressor capacity varies depending on the refrigerant temperature.

(3) Temperature PX is the coefficient value used to correct for any deviation with the high pressure or condensation temperature. It may vary. (At the time of shipment it is 55.5°C.)

(4) If the condensation temperature (Tc) enters area D and the thermostat turns OFF, the next time the compressor starts it may restart from a lower capacity.

(5) When the area changes to area C, area C is considered to be area B for control purposes for the first 6 minutes, even if the horsepower is the minimum value within the range where capacity control is possible (operation with inverter frequency of 25 Hz only). Subsequently if C area continues, the thermostat turns OFF.

3-6-3. Control of condensation temperature and evaporation temperature during mixed cooling/heating operation

During mixed cooling/heating operation, the control maintains a heat balance with a target evaporation temperature (Te) for the Cooling mode indoor units of 2 ~ 6°C and a target condensation temperature (Tc) for the Heating mode indoor units of 48 ~ 51°C.

Heat balance control is performed by varying the compressor capacity and heat discharge (heat intake) of the heat exchanger.

(1) Increasing/decreasing the compressor capacity

- *When evaporation temperature (Te) is high and condensation temperature (Tc) is low*
  This occurs when both the cooling capacity (heat intake) and the heating capacity (heat discharge) are low. The compressor capacity and the circulation flow of refrigerant are increased in order to lower the evaporation temperature (Te) and raise the condensation temperature (Tc).
- *When evaporation temperature (Te) is low and condensation temperature (Tc) is high*
  This occurs when both the cooling capacity (heat intake) and the heating capacity (heat discharge) are high. The compressor capacity and the circulation flow of refrigerant are decreased in order to raise the evaporation temperature (Te) and lower the condensation temperature (Tc).
  * Under conditions other than those listed above, the capacity of the outdoor unit heat exchanger is adjusted. In some cases the heat exchanger capacity may also be adjusted at the same time when the compressor capacity is varied.

1

Compressor Control Table

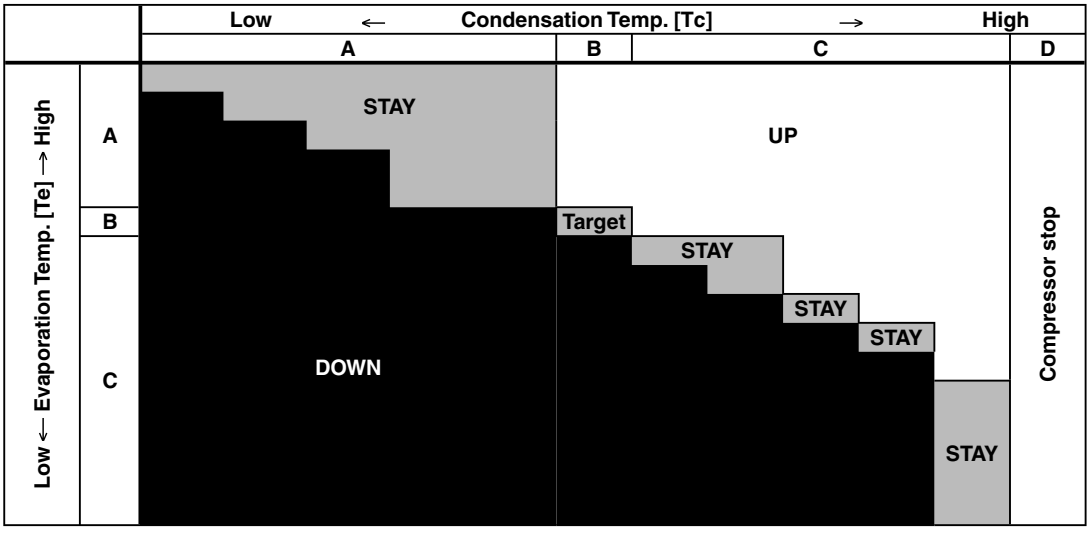
Low ← Evaporation Temp. [Te] → High	Low ← Condensation Temp. [Tc] → High			
	A	B	C	D
A	UP		not_UP	STOP
B	slow_UP	Target		
C	not_UP		DOWN	

Evaporation temperature (Te) and condensation temperature (Tc) areas A, B, C, and D are the same as for evaporation temperature control and condensation temperature control.

(2) Increasing/decreasing the heat exchanger capacity (when the outdoor unit heat exchanger is functioning as a condenser)

- *Primarily when both the evaporation temperature (Te) and condensation temperature (Tc) are high*
  This occurs when the cooling capacity (heat intake) is low and the heating capacity (heat discharge) is high. The outdoor heat exchanger capacity is increased, increasing the system condensation capacity and lowering the condensation temperature (Tc). The amount of heat discharge at the outdoor unit heat exchanger increases, increasing the heat intake at the Cooling mode indoor units and lowering the evaporation temperature (Te).
- *Primarily when both the evaporation temperature (Te) and condensation temperature (Tc) are low*
  This occurs when the cooling capacity (heat intake) is high and the heating capacity (heat discharge) is low. The outdoor heat exchanger capacity is decreased, decreasing the system condensation capacity and raising the condensation temperature (Tc). The amount of heat discharge at the outdoor unit heat exchanger decreases, decreasing the heat intake at the Cooling mode indoor units and raising the evaporation temperature (Te).

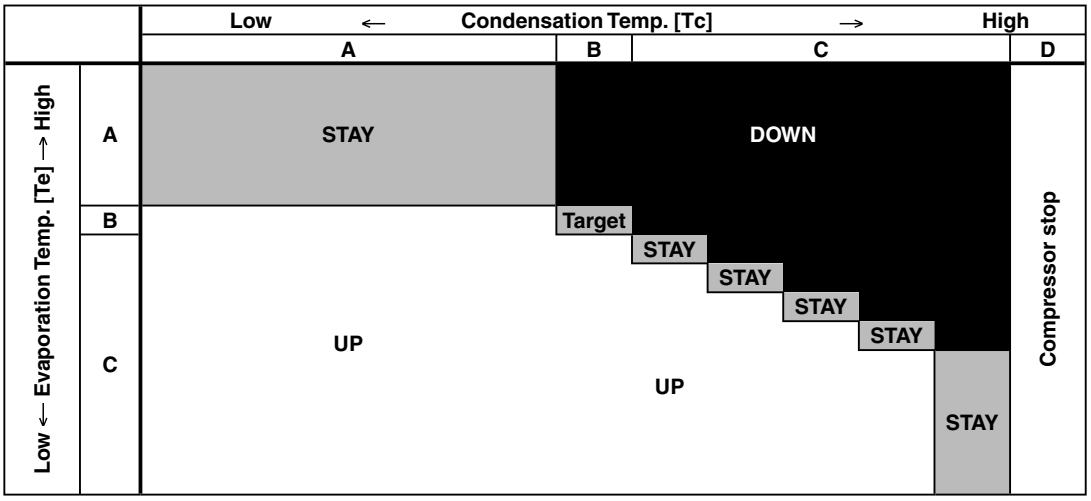
Outdoor Unit Heat Exchanger Control Table (when the outdoor unit heat exchanger is functioning as a condenser)



(3) Increasing/decreasing the heat exchanger capacity (when the outdoor unit heat exchanger is functioning as an evaporator)

- *Primarily when both the evaporation temperature (Te) and condensation temperature (Tc) are low*
  This occurs when the cooling capacity (heat intake) is high and the heating capacity (heat discharge) is low. The outdoor heat exchanger capacity is increased, increasing the system evaporation capacity and raising the evaporation temperature (Te). The amount of heat intake at the outdoor unit heat exchanger increases, increasing the heat discharge at the Heating mode indoor units and raising the condensation temperature (Tc).
- *Primarily when both the evaporation temperature (Te) and condensation temperature (Tc) are high*
  This occurs when the cooling capacity (heat intake) is low and the heating capacity (heat discharge) is high. The outdoor heat exchanger capacity is decreased, decreasing the system evaporation capacity and lowering the evaporation temperature (Te). The amount of heat intake at the outdoor unit heat exchanger decreases, decreasing the heat discharge at the Heating mode indoor units and lowering the condensation temperature (Tc).

Outdoor Heat Exchanger Control Table (when the outdoor heat exchanger is functioning as an evaporator)



3-6-4. Protection control

Protection control consists of 2 types of protection: air discharge temperature protection and current protection. The limit values from this protection control are incorporated into the output compressor capacity increase/decrease values that were calculated from control based on the temperature at the indoor unit heat exchanger (roadmap control).

* In some cases, the control shown below may stop the compressor, issue a warning, or reduce the compressor capacity.

(1) Air discharge temperature protection
During operation when only a single outdoor unit is installed, the air discharge temperature level is determined (the highest value is used), and the compressor capacity is limited, by using the air discharge temperature of the operating compressor (as shown in the tables below).

Air discharge temperature level: Highest level among the air discharge temperature levels of all compressors

Air discharge temp. level	Discharge temp.	Horsepower limit
5	104	Decrease by 2 horsepower
4	103	Decrease by 1 horsepower
3	102	Decrease by 0.5 horsepower
2	99~ Less than 102	Prohibit horsepower increase
1	97 ~ Less than 99	Permit horsepower increase
0	Less than 97	No control

The values shown in the table above are reduced to the values calculated by roadmap control.

(2) Current protection

Inverter compressor current control is composed of primary current control and secondary current control. Current protection control for the inverter compressor is performed by self-protection in the inverter circuit, and does not increase or decrease the compressor capacity.

Primary current	Secondary current		
–	75 or (150 °C)	Thermostat OFF	Operation stops instantaneously due to activation of hybrid IC
–	18.5 or above	Thermostat OFF	Thermostat OFF. Operation stops for 100 ms for current protection
26.5	14.5 ~ 18.5	Horsepower decreased	
25	14 ~ Less than 14.5	Prohibit horsepower increase	
24	Less than 14	Permit horsepower increase	

3-6-5. Roadmap control after trip

When restarting after trip stop occurs, the horsepower may increase slowly depending on the trip counter value.

(1) If Trip counter = 1, the horsepower increases at a speed that is 1/2 of ordinary roadmap control.

(2) If Trip counter = 2, the horsepower increases at a speed that is 1/3 of ordinary roadmap control.

The trip counter is cleared if no trip occurs within 10 minutes after operation starts.

In addition to ordinary heating and cooling operation, this system also includes the following 3 types of special controls for control of the system as a whole.

1. Tube refrigerant recovery control
2. System refrigerant oil recovery control
3. Defrost control

4-1. Tube Refrigerant Recovery Control

This control recovers refrigerant from the tubing when the microcomputer is initialized immediately after power-ON, after warning output occurs, and after a set amount of time has elapsed (standard = 60 minutes) when all outdoor units are stopped.
This control is intended to recover refrigerant if refrigerant has accumulated somewhere in the tubing when the units have been stopped for long periods, as well as to compensate for tubing thermal loss during heating start, and is also used for oil recovery.

(1) Control when the outdoor unit heat exchanger is acting as a condenser (when all units are in Cooling mode or at start of mixed operation when the cooling load is high)

Control time		60 seconds
Outdoor units		All outdoor units operate at maximum horsepower.
Indoor units	Electronic control valve	Valves at all indoor units operate at a fixed pulse according to the indoor unit capacity.
	RAP valve kit	Valve kits at all indoor units operate in Cooling mode (ON status).
	Fan	Fan operates at the set fan speed, stops, or operates at L speed, depending on the indoor unit operation mode.

* When the above operation is finished, normal operation starts at the horsepower determined by the indoor units where thermostats are ON.

(2) Control when outdoor unit heat exchanger is acting as a condenser (when all units are in Cooling mode or at start of mixed operation when cooling load is high)

Control time		Minimum 1 min – Maximum 10 min [until max (pressure sensor temp., E1) ≥ 35°C]
Outdoor units		All outdoor units operate at maximum horsepower.
Indoor units	Electronic control valve	Valves at all indoor units operate at 480 pulses.
	RAP valve kit	Valve kits at all indoor units operate in heating mode (ON status).
	Fan	Fan operates at the set fan speed, stops, or operates at L speed, depending on the indoor unit operation mode.

* When the above operation is finished, normal operation starts at the horsepower determined by the indoor units where thermostats are ON.

4-2. System Refrigerant Oil Recovery Control

4-2-1. System refrigerant oil recovery cycle

This control is performed using the cooling cycle during cooling operation and using the heating cycle during heating operation.

4-2-2. Start of system refrigerant oil recovery control

When the oil level in an operating compressor changes to 0, the compressor stops after 120 seconds. If this compressor repeats this operation 3 times and the oil level does not reach 2, system refrigerant oil recovery control is started.

* When the compressor has stopped because the oil level is 0, a count is added to the alarm counter. The counter for this compressor is not cleared unless the oil level for that compressor reaches 2, or else alarm output occurs.

4-2-3. Flow of system refrigerant oil recovery control

(1) Simplified flow of system refrigerant oil recovery control

System refrigerant oil recovery control follows this flow:

Normal operation → 3-minute stop (May stop for 6 minutes.) → System refrigerant oil recovery control (Max. 3 minutes) → 3-minute stop → Normal operation

(2) Cooling cycle

Control time		Maximum 3 minutes (Stops once before and once after control.)
Outdoor units		All outdoor units operate at maximum horsepower.
Indoor units	Electronic control valve	Valves at all indoor units operate at a fixed pulse according to the indoor unit capacity.
	RAP valve kit	Valve kits at all indoor units operate in Cooling mode (OFF status.)
	Fan	Fan operates at the set fan speed, stops, or operates at L speed, depending on the indoor unit operation mode.

(3) Heating cycle

Control time		Maximum 3 minutes (Stops once before and once after control.)
Outdoor units		All outdoor units operate at maximum horsepower.
Indoor units	Electronic control valve	Valves at all indoor units operate at 480 pulses.
	RAP valve kit	Valve kits at all indoor units operate in Heating mode (ON status).
	Fan	Fan operates at the set fan speed, stops, or operates at L speed, depending on the indoor unit operation mode.

4-3. Defrost Control

4-3-1. Defrost control method

This system uses the following 2 defrost methods.

(1) If there is 1 outdoor unit in the refrigerant system: Reverse cycle defrost

(2) If there are 2 or more outdoor units in the refrigerant system: Outdoor unit cycle defrost

4-3-2. Constraint conditions

(1) Frost detection does not occur for 5 minutes after operation starts.

(2) Defrost does not begin again for 35 minutes of A/C operation after defrost was once completed.

(3) If all indoor units are stopped while defrost control is in effect, or if the outdoor unit is stopped due to protection control or another reason, then defrost control will not start for a minimum of 10 minutes after restart occurs.

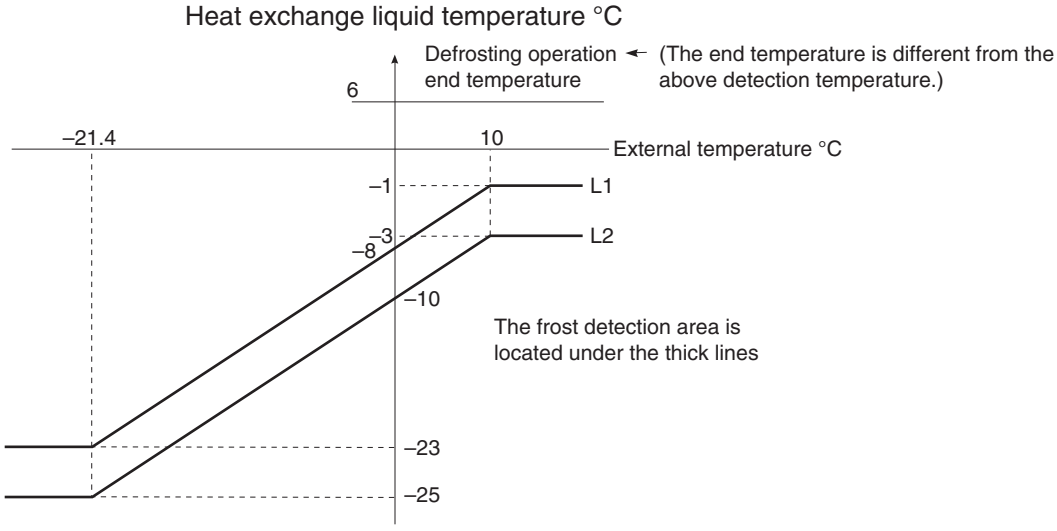
4-3-3. Frost detection

(A) Frost detection does not occur for 5 minutes after operation starts.

(B) Frost is detected when either condition 1 or 2 below is met.

Condition 1: L2 line or below is detected twice, each time continuously for 4 minutes, when the compressor is operating.

Condition 2: L1 line or below is detected for a total of 60 minutes when the compressor is operating.



4-3-4. Outdoor units where defrost occurs

Even if the total time has not reached 35 minutes, if there is 1 or more outdoor units that fulfills the defrost detection conditions, all operating outdoor units perform defrost control at the same time.

* Defrost control is also performed at outdoor units where the outdoor unit heat exchanger is not functioning as an evaporator (such as stopped outdoor units).

4-3-5. Reverse cycle defrost

Reverse cycle defrost is performed in systems where only 1 outdoor unit is connected to the refrigerant system.

- Defrost flow E: Evaporator operation
  C: Condenser operation
  S: Shut off
  E→C: Switching from evaporator operation to condenser operation
  C→E: Switching from condenser operation to evaporator operation

			Defrost preparation	Defrost in progress		Defrost end
Outdoor unit status			E→C	C		C→E
Compressor			Stopped	Operating		Stopped
Remote Controller	Mode		—	—		—
Stop	←		S	E		S
		*1 (Cooling)	S	E		S
		*2 (Heating)	C→E	E		E→C
Fan	←		S	E		S
		*1 (Cooling)	S	E		S
		*2 (Heating)	C→E	E		E→C
Cooling	←	Thermostat ON	E	E		E
		Thermostat OFF	S	E		S
Heating	←	Thermostat ON	C→E	E		E→C
		Thermostat OFF	C→E	E		E→C
Auto	Auto. Cooling	Thermostat ON	E	E		E
		Thermostat OFF	S	E		S
	Auto. Heating	Thermostat ON	C→E	E		E→C
		Thermostat OFF	C→E	E		E→C
Time			1 min	Max. 12 min		1 min

Defrost end judgment

* Types D and GU perform "E → C" for 3 minutes after defrost ends. Therefore, the thermostat remains OFF for 3 minutes.

*1: Function when a common use solenoid valve kit is used and there are more than one (1) indoor unit in the cooling mode within the same solenoid valve kit.

*2: Function when a common use solenoid valve kit is used and here are more than one (1) indoor unit in the heating mode within the same solenoid valve kit.

1

4-3-6. Outdoor unit cycle defrost

Outdoor unit cycle defrost is performed in systems where 2 or more outdoor units are connected to the refrigerant system.

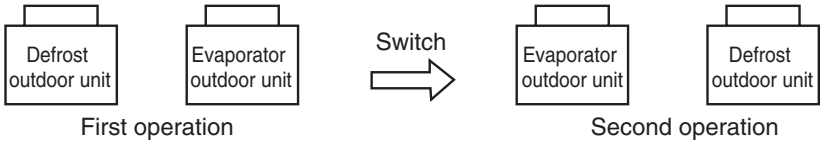
(1) Description of outdoor unit cycle defrost

With this defrost method, when 1 outdoor unit operates in defrost mode (heat exchanger operating as a condenser), another outdoor unit operates as an evaporator in the same way as in ordinary heating mode. In this way, the other outdoor unit is heating the unit where defrost is occurring. When 1 outdoor unit completes defrost, the other outdoor unit performs defrost in the same way. Because the amount of time that the unit operates as an evaporator is very short, there is little danger of frost forming again quickly. Rather, because the heat source is very powerful, it is possible to shorten the defrost operating time.

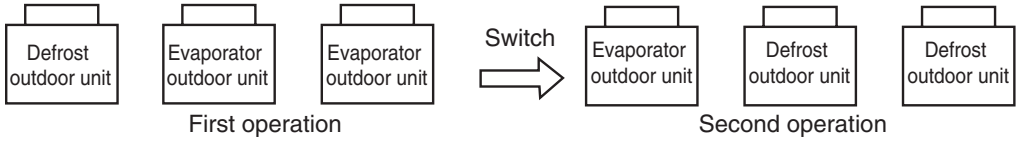
(2) Defrost sequence

Outdoor unit cycle defrost is always completed in 2 defrost operations.

(A) When there are 2 outdoor units



(B) When there are 3 outdoor units



• Defrost flow
E: Evaporator operation
C: Condenser operation
S: Shut off
E→C: Switching from evaporator operation to condenser operation
C→E: Switching from condenser operation to evaporator operation

			Defrost preparation	Defrost in progress		Switch	Defrost in progress		Defrost end
				1st outdoor unit :Defrost in progress		—	2nd outdoor unit :Defrost in progress		
Outdoor unit(s) where defrost occurs first			E→C	C		C→E	E		E or S
Outdoor unit(s) where defrost occurs secondly			E	E		E→C	C		C→E or S
Compressor			Operating	Operating		Stopped	Operating		Stopped
Remote Controller	Mode		—	—		—	—		—
Stop	←		S	S		S	S		S
		*1 (Cooling)	S	S		S	S		S
		*2 (Heating)	C	C		C	C		C
Fan	←		S	S	Defrost end judgment	S	S	Defrost end judgment	S
		*1 (Cooling)	S	S		S	S		S
		*2 (Heating)	C	C		C	C		C
Cooling	←	Thermostat ON	E	E		E	E		E
		Thermostat OFF	S	S		S	S		S
Heating	←	Thermostat ON	C	C		C	C		C
		Thermostat OFF	C	C		C	C		C
Auto	Auto. Cooling	Thermostat ON	E	E		E	E		E
		Thermostat OFF	S	S		S	S		S
	Auto. Heating	Thermostat ON	C	C		C	C		C
		Thermostat OFF	C	C		C	C		C
Time			1 min	Max. 7 min		1 min	Max. 7 min		1 min

* Types D and GU perform "E → C" for 3 minutes after defrost ends. Therefore, the thermostat remains OFF for 3 minutes.

*1: Function when a common use solenoid valve kit is used and there are more than one (1) indoor unit in the cooling mode within the same solenoid valve kit.

*2: Function when a common use solenoid valve kit is used and there are more than one (1) indoor unit in the heating mode within the same solenoid valve kit.

4-3-7. Defrost end judgment conditions

Defrost ends when either of the below defrost end judgment conditions is met.

Condition 1: The temperatures are 6°C or higher at all temperatures sensors installed on the outdoor unit heat exchangers.
However, if there is any other outdoor unit where the defrost end condition has not been met, defrost control continues for all outdoor units, and system defrost control is not ended.

Condition 2: The maximum defrost time listed in the table above has elapsed.

4-3-8. System defrost end

When all outdoor units where defrost control is in effect have met the defrost end conditions, defrost control is ended for the system.

5-1. Oil Control

5-1-1. Oil level

Oil level	Meaning	Oil state	Assessment
2	Sufficient	There is more than an adequate amount of oil in the compressor.	This is the normal operating state of the system and not a problem.
1	Slightly low	The compressor may contain an adequate amount of oil, but it may also contain less than an adequate amount of oil.	Check that oil control recovers oil.
0	Extremely low	There is not enough oil in the compressor.	Check that system oil recovery control restores the oil level.

The compressor contains enough oil when the oil level is in the range between level 2 and until it has just become 1. Thus oil level 1 does not mean that the compressor is empty of oil. When the compressor reaches oil level 0 during operation, the system is likely to run out of oil within 5 to 10 minutes. Check for oil leaks and make sure that refrigerant pipes are intact.

5-1-2. Oil level detection

Excess oil in the compressor is sent by bypass via a capillary tube to the low-pressure circuit. The temperature detected by a temperature sensor is used to determine whether it is oil (warm) or refrigerant (cold).

5-1-3. Self-separator oil recovery control

* When a low oil level is detected, this control recovers the oil which has accumulated in that oil separator and sends it to the compressor.

(1) Operation when oil level is 1
30 seconds after the oil level changes from 2 to 1, both the balance valve and recovery valve turn ON for up to 2 minutes.
However, if the oil level becomes 2 during these 2 minutes, this control is stopped.
When this control has been stopped, it will not restart for 3.5 minutes unless the oil level becomes 0.

(2) Operation when oil level is 0
Both the balance valve and recovery valve turn ON and remain ON.

5-1-4. Unit refrigerant oil recovery control – utilizing balance tubes

* If the low oil level continues, that outdoor unit (oil-receiving outdoor unit) receives a supply of oil from operating outdoor units where the oil level is not low (oil-supply outdoor units).

(1) Control at the oil-supply outdoor unit begins 3 minutes after the oil level at the outdoor unit changes to 0 or 1. Oil supply is performed for a maximum of 5 minutes from each unit.

(2) When oil supply is ended, oil supply from that outdoor unit will not occur again for a period of [(No. of outdoor units – 1) x 5 minutes]. In addition, oil supply is ended if the oil-receiving outdoor unit oil level changes to 2, or if the oil-supply outdoor unit oil level becomes low.

(3) The supply of oil is received from 1 unit at a time, in sequence, according to the order of priority of their inverter compressors.

(4) Operation during unit refrigerant oil recovery

(A) Oil-receiving outdoor unit
The recovery valve turns ON and remains ON.
* Because self-separator oil recovery may occur simultaneously at the same unit, both the balance valve and recovery valve turn ON at this time.

(B) Oil-supply outdoor unit
The balance valve turns ON and remains ON.
The bypass valve repeatedly turns ON and OFF according to a fixed cycle.
* When the balance valve is ON, the oil in the oil separator is discharged into the balance tube. The bypass valve releases high-pressure gas which forces this oil toward the oil-receiving outdoor unit, and flushes out the balance tubes.
The operation of this bypass valve allows oil to be supplied even when there is a difference in height between the outdoor units.

5-1-5. Indoor unit refrigerant oil self-recovery control

Refer to the items concerned with indoor unit special control.

6-1. Refrigerant Control Valve [RCV]

The main purpose of this valve is to detect the flow of refrigerant (refrigerant volume) on the indoor-unit side when the outdoor unit heat exchanger is functioning as a condenser. When the valve determines that there are signs of a low refrigerant level, refrigerant is supplied from the receiver tank to the system.

(1) The OFF conditions take priority over the ON conditions for this valve.

(2) This valve is OFF when the outdoor unit is stopped.

(3) This valve is ON when special control is in progress.

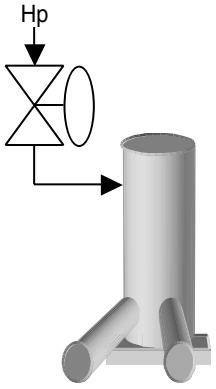
(4) Control during normal operation

(A) Cooling operation

- This valve turns ON when symptoms of insufficient refrigerant gas occur at an indoor unit.
- This valve turns ON when the outdoor air temperature is 15°C or below. (Under these conditions the high pressure is low and refrigerant flow becomes poor.)
- This valve turns OFF when symptoms of refrigerant overcharge are detected at the outdoor unit.

(B) Mixed cooling/heating operation

- The RCV turns ON at stopped outdoor units when the heat exchanger at another outdoor unit is functioning as a condenser.



6-2. Refrigerant Balance Valve [RBV] – Gas Purge Valve

The main purpose of this valve is to detect the flow of refrigerant (refrigerant volume) on the indoor-unit side when the outdoor unit heat exchanger is functioning as an evaporator. When the valve determines that there are signs of excess refrigerant, refrigerant is recovered at the receiver tank.
This valve is ON during heating operation and when the outdoor unit heat exchanger is functioning as an evaporator during mixed heating/cooling operation. It also turns ON in order to recover refrigerant at the outdoor unit after heating operation is stopped.
* This valve is never ON at the same time as the RCV.

(1) The OFF conditions take priority over the ON conditions for this valve.

(2) This valve turns ON for 30 – 50 seconds after the outdoor unit stops, and then turns OFF.

(3) This valve turns ON once after the outdoor unit starts.

(A) Heating operation

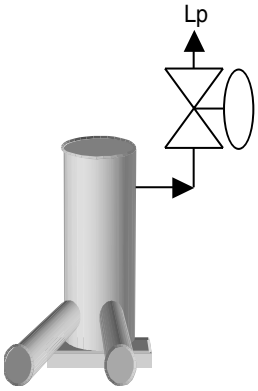
- This valve turns ON when poor refrigerant flow at an indoor unit is detected, and when symptoms of overcharge are detected.
  After the valve turns OFF, it will not turn ON again for 15 minutes.

(B) Mixed heating/cooling operation

- This valve turns ON when poor refrigerant flow at an indoor unit is detected, and when symptoms of overcharge are detected, if the heat exchanger at the outdoor unit is functioning as an evaporator.

(4) This valve turns OFF when an abnormal drop in discharge gas temperature is detected.

(5) This valve turns OFF when a drop in the detected receiver tank temperature continues for a set length of time, and when liquid back-flow is judged to be occurring.



6-3. Balance Valve (BALV)

This valve moves some of the oil from the oil separator to the balance tube.

(1) When unit is stopped
This valve is always OFF.

(2) When unit is operating
(A) This valve is ON when separator oil self-recovery control is in progress.
(B) This valve is ON when unit refrigerant oil recovery control is in progress (oil-supply unit).
(C) This valve turns ON for 30 seconds each time a constant-speed compressor starts.
(D) This valve turns ON for 60 seconds after defrost control ends.

6-4. Recovery Valve (ORVR)

This valve recovers refrigerant oil from the balance tube to the compressor.

(1) When unit is stopped
This valve is always OFF.

(2) When unit is operating
(A) This valve is ON when separator oil self-recovery control is in progress.
(B) This valve is ON when unit refrigerant oil recovery control is in progress (oil-receiving unit).
(C) This valve is ON when control for insufficient gas is in progress.
(D) This valve turns ON for 60 seconds after a constant-speed compressor starts.
(E) This valve turns ON for 120 seconds after defrost control ends.
(F) This valve turns ON for 10 seconds after the outdoor unit stops.
(G) This valve remains OFF at all times other than (A) – (F) above.

6-5. Bypass Valve (BPV)

This valve flushes the oil from the balance tubes. In addition, it is used for recovering refrigerant from stopped outdoor units during cooling operation.

(1) When unit is stopped
This valve is always OFF.

(2) When unit is operating
This valve is ON at the oil-supply outdoor unit when unit refrigerant oil recovery control is in progress.
* This valve repeatedly turns ON/OFF at regular intervals during unit refrigerant oil recovery control. (It is not constantly ON.)

7-1. Types of Electronic Control Valves [SPW-C0705DZH8, C0905DZH8, C1155DZH8, C1305DZH8, C1405DZH8]

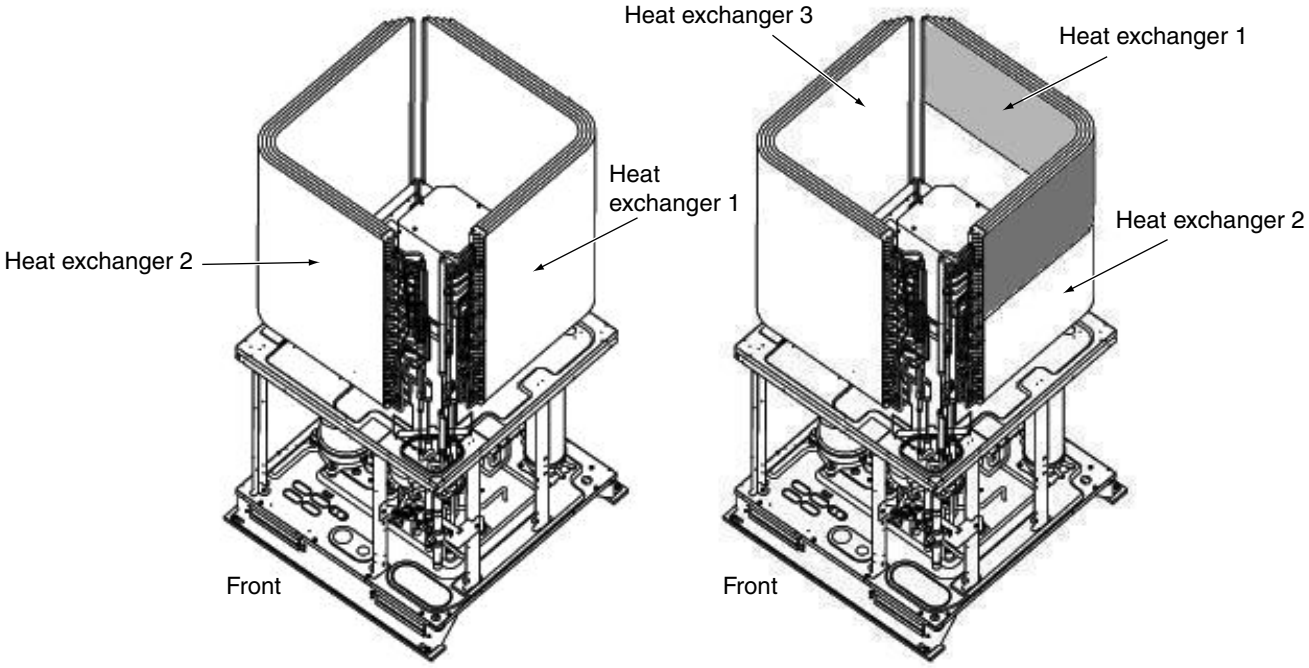
Capacity		0705	0905	1155	1305	1405
Electronic control valve	Electronic control valve 1	Heat exchanger 1 valve	Heat exchanger 1 valve	Heat exchanger 1 valve	Heat exchanger 1 valve	Heat exchanger 1 valve
	Electronic control valve 2	Heat exchanger 2 valve	Heat exchanger 2 valve	Heat exchanger 2 valve	Heat exchanger 2 valve	Heat exchanger 2 valve
	Electronic control valve 3	None	None	None	Heat exchanger 3 valve	Heat exchanger 3 valve
	Electronic control valve 4	For SC circuit	For SC circuit	For SC circuit	For SC circuit	For SC circuit

7-2. Power Initialization

If no indoor units have started (even once) after the power was turned ON, the outdoor unit electronic control valve operates at 480 pulses.

7-3. Heat Exchanger Controlled by Each Electronic Control Valve

The configuration of the heat exchangers is different depending on the capacity of the outdoor unit. MOV3 is not present in types 1155 and below.



Types 0705, 0905, 1155 **Types 1305, 1405**

Operation of electronic control valves during normal unit operation

		Heat exchanger status	MOV1	MOV2	MOV3	Remarks
All indoor units in Cooling mode		Condensor	480	480	480	Maximum flow control
		Stopped	0	0	0	Refrigerant shut-off
All indoor units in Heating mode		Evaporator	45~480	15~480	15~480	SH control
		Stopped	0	0	0	Refrigerant shut-off
Mixed heating/ cooling operation	Outdoor heat exchanger condenser	Condensor	50~480	50~480	480	Heat exchanger capacity control
		Stopped	0	0	0	Refrigerant shut-off
	Outdoor heat exchanger evaporator	Evaporator	45~480	15~480	15~480	SH control
		Stopped	0	0	0	Refrigerant shut-off

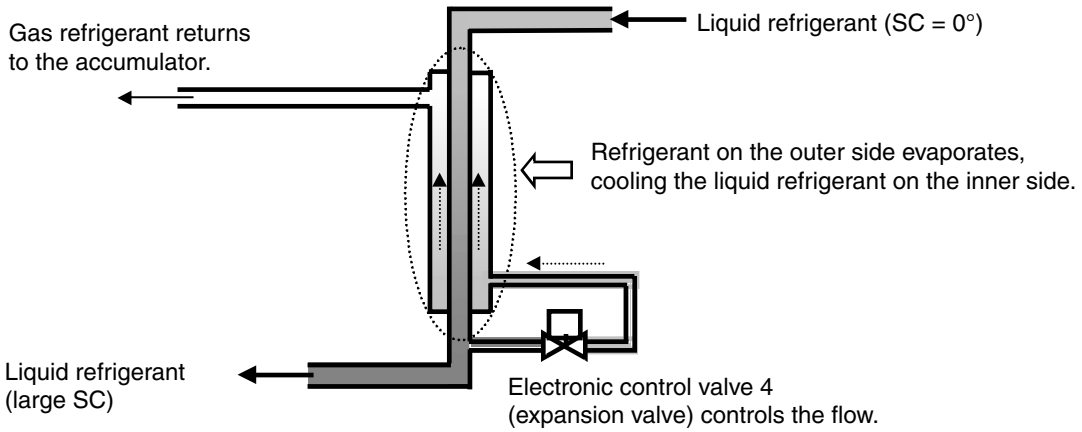
- When all indoor units are operating in Cooling mode or Heating mode, all outdoor unit heat exchangers are used if even one of the compressors in that outdoor unit is operating.
- During mixed heating/cooling operation, the number of heat exchangers used varies according to the conditions of the indoor units. However, heat exchanger 1 at the outdoor unit which contains the inverter compressor with the lowest amount of operating time is always used.
- SH control controls the difference between the liquid temperature and gas temperature to 1 ~ 5°C.
- During heating mode SH operation, refrigerant may not flow to the heat exchanger.

7-4. SC Circuit Electronic Control Valve [MOV4]

(1) Operation to increase SC

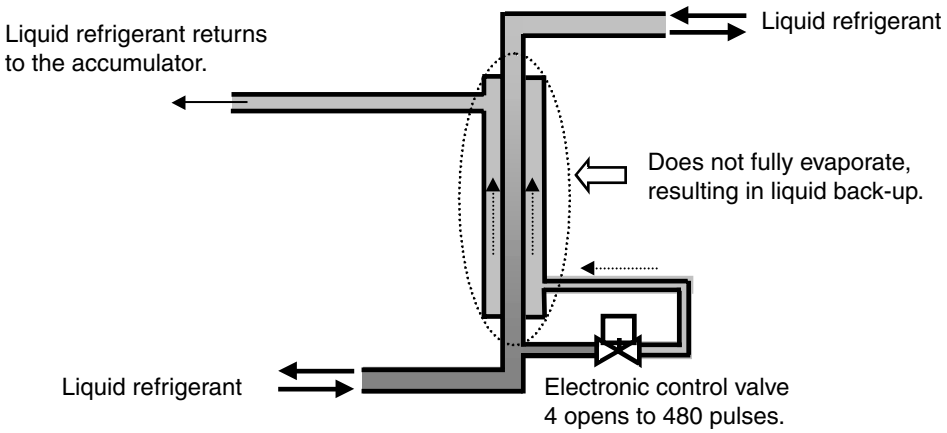
During cooling operation, or mixed heating/cooling operation when the outdoor unit heat exchanger is functioning as a condenser, the liquid refrigerant which condenses at the outdoor unit heat exchanger flows into the receiver tank, and SC (sub-cool = supercooling) approaches 0°C. When SC is small and the length of the tubing connecting the indoor and outdoor units is long, the pressure loss increases, possibly resulting in lower capacities. Therefore, MOV4 operates at the double tube near the discharge port of the outdoor unit in order to increase SC.

MOV4 uses the receiver tank detection sensor and low-pressure sensor located near the accumulator to perform control in order to prevent liquid back-up.



(2) Operation when discharge temperature is high

When the discharge temperature increases, the SC circuit electronic control valve opens to 480 pulses. This intentionally causes a mild liquid back-up, cooling the compressor. This operation takes priority over operation intended to increase SC. It is performed at top priority in all operating modes.



8. Outdoor Fan Control

8-1. Fan mode

These outdoor units utilize a DC fan motor that can be controlled in a maximum of 16 steps (16 modes).
However, fan modes 15 and 16 can only be used if high static-pressure mode has been set.

* For information concerning EEPROM settings, refer to the field application functions.

8-2. Outdoor Fan Min. Fan Mode and Max. Fan Mode

	Min. fan mode	Max. fan mode
Cooling operation	Outdoor air temp. > 15°C: 1 Outdoor air temp. ≤ 15°C: 0	14
Heating operation	1	14

* Even if the fan mode is 0 during cooling operation, the fan mode may change to 1 at regular intervals for temperature protection of the inverter hybrid IC.

8-3. Fixed Initial Fan Mode

For the first 30 seconds after operation starts, the mode is fixed at the initial mode which was calculated from the relationship between the outdoor air temperature and the outdoor unit horsepower.
If the outdoor unit horsepower changes dramatically, the initial mode may be recalculated and may be again fixed for 30 seconds.

8-4. Operation after Fixed Initial Fan Mode

After the fixed initial fan mode, the fan mode is increased or decreased according to the operating conditions.

(1) Cooling mode at all indoor units, or else mixed heating/cooling operation when the outdoor unit is functioning as a condenser

(A) Fan mode is increased when the pressure sensor temperature is high, and is decreased when the pressure sensor temperature is low.

* The fan mode is always increased when the pressure sensor temperature is 50°C or higher.

(B) The fan mode may be decreased when symptoms of insufficient gas are detected at an indoor unit.

(2) Heating mode at all indoor units, or else mixed heating/cooling operation when the outdoor unit is functioning as an evaporator

(A) If the condensation temperature is low, the fan mode is increased at regular intervals.

(B) If the condensation temperature is high, the fan mode is decreased in order to prevent excessive loads.

(C) The fan mode may be increased when the outdoor liquid temperature drops to 7°C or below.

8-5. Snow Removal Control

(1) When the outdoor air temperature is 10°C or below, the fan operates for 30 seconds every 2 hours in fan mode 8, even when the outdoor unit is stopped or the heat exchanger is not in use. This control is intended to prevent snow from accumulating on stopped fans. (Because the outdoor air temperature cannot be accurately detected when the unit is stopped, a higher outdoor air temperature is used for the control condition, in order to ensure correct operation.)

(2) If the fan mode becomes 0 during cooling operation, the fan mode is changed to 1.

* This control is predictive control. Use a snowfall sensor as necessary according to the installation conditions.

8-6. When the Compressor Magnet Switch Seizing Alarm Occurs

Because there is the possibility that the high pressure has increased, the fan operates in Max. fan mode.

8-7. Other

This unit includes settings for high static-pressure and for Quiet mode.
For information about these settings, refer to the field application functions.

9. Demand Control

Serial-parallel I/O must be connected in order to perform demand control. The below input is received by serial-parallel I/O, and demand control is performed.

The demand values can be set as needed with this device. For more information, refer to the field application functions.

Demand setting		Control	Demand meaning
Contact 1	Contact 2		
×	×	No control	Operates to maximum capacity.
○	×	Rated current	—
×	○	Operates at up to 70% of rated current	—
○	○	Shutdown state	—

○ : Input present × : Input not present

* The rated current indicates the current value that is listed in the catalog or similar material. If the capacity of this device is insufficient, the inverter compressor raises its operating frequency in order to maintain capacity. For this reason, it is capable of operating at a current which exceeds the rated current (up to approximately 130%).

10-1. Normal Control

(1) Except Types D and GU

			Position of electronic control valve	
Remote Controller	Mode		Outdoor unit operation	Outdoor unit stopped
Cooling	←	Thermostat ON	Performs SH control in the range of 55 - 480 pulses. *1	—
		Thermostat OFF	20 pulses	20 pulses
Heating	←	Thermostat ON	Performs SC control in the range of 55 - 480 pulses. *2	—
		Thermostat OFF	Returns the liquid refrigerant gradually into the outdoor unit in the range of 55 - 80 pulses.	85 pulses
Auto	Auto. Cooling	Thermostat ON	Performs SH control in the range of 55 - 480 pulses. *1	20 pulses
		Thermostat OFF	20 pulses	20 pulses
	Auto. Heating	Thermostat ON	Performs SC control in the range of 55 - 480 pulses. *2	85 pulses
		Thermostat OFF	Returns the liquid refrigerant gradually into the outdoor unit in the range of 55 - 80 pulses.	85 pulses
Fan	←		20 pulses *3	20 pulses
Stop	←		20 pulses *3	20 pulses

(1) Types D and GU

			Position of electronic control valve	
Remote Controller	Mode		Outdoor unit operation	Outdoor unit stopped
Cooling	←	Thermostat ON	Performs SH control in the range of 55 - 480 pulses. *1	—
		Thermostat OFF	20 pulses	20 pulses
Heating	←	Thermostat ON	Performs SC control in the range of 55 - 480 pulses. *4	—
		Thermostat OFF	20 pulses	20 pulses
Auto	Auto. Cooling	Thermostat ON	Performs SH control in the range of 55 - 480 pulses. *1	20 pulses
		Thermostat OFF	20 pulses	20 pulses
	Auto. Heating	Thermostat ON	Performs SC control in the range of 55 - 480 pulses. *4	85 pulses
		Thermostat OFF	20 pulses	20 pulses
Fan	←		20 pulses	20 pulses
Stop	←		20 pulses	20 pulses

*1 The SH target value is controlled so that the difference [E3 - E1] can become 2 - 6°C, depending on the operation conditions. However, a decline in the required level may cause the SH target value to increase. Be aware that in this case, the electronic control valve is intended to close and this will be wrongly identified as gas shortages.

*2 The SC target value is controlled so that the difference [pressure temp. sensor E1] can become 5 - 20°C, depending on the operating conditions.

*3 In the case of the common use electronic valve kit and more than one (1) indoor unit in the heating mode within the same electronic valve kit, performs the control of returning the liquid refrigerant gradually into the outdoor unit in the range of 55 - 80 pulses.

*4 The SC target value is controlled so that the difference [pressure temp. sensor - E1] can become 5 - 20°C, depending on the operating conditions. However, if installation is combined with the except types D and GU, the value is controlled so that the difference [pressure temp. sensor - E1] can become 5 - 40°C.

10-2. Special Control

Control	Outdoor heat exchanger mode	Subject indoor units			Position of electronic control valve
		Remote Controller	Mode		
Tube refrigerant oil recovery control	Condenser	All indoor units			Fixed pulse for cooling, according to indoor unit capacity
	Evaporator	All indoor units			480 pulses
Reverse cycle defrost control	Condenser	Stopped			Fixed pulse for cooling, according to indoor unit capacity
		Fan			Fixed pulse for cooling, according to indoor unit capacity
		Cooling	←	Thermostat ON	Fixed pulse for cooling, according to indoor unit capacity
				Thermostat OFF	Fixed pulse for cooling, according to indoor unit capacity However, position is 20 pulses for types D and GU.
		Heating	←	Thermostat ON	Fixed pulse for cooling, according to indoor unit capacity
				Thermostat OFF	Fixed pulse for cooling, according to indoor unit capacity However, position is 20 pulses for types D and GU.
		Cooling / Heating	Auto. Cooling	Thermostat ON	Fixed pulse for cooling, according to indoor unit capacity
				Thermostat OFF	Fixed pulse for cooling, according to indoor unit capacity However, position is 20 pulses for types D and GU.
			Auto. Heating	Thermostat ON	Fixed pulse for cooling, according to indoor unit capacity
				Thermostat OFF	Fixed pulse for cooling, according to indoor unit capacity However, position is 20 pulses for types D and GU.
Outdoor cycle defrost control	Condenser/ evapolator	Stopped			20 pulses *5
		Fan			20 pulses *5
		Cooling	←	Thermostat ON	Performs SH control in the range of 55 - 480 pulses. *1
				Thermostat OFF	20 pulses
		Heating	←	Thermostat ON	100 pulses
				Thermostat OFF	100 pulses However, position is 20 pulses for types D and GU.
		Cooling / Heating	Auto. Cooling	Thermostat ON	Performs SH control in the range of 55 - 480 pulses. *1
				Thermostat OFF	20 pulses
			Auto. Heating	Thermostat ON	100 pulses
				Thermostat OFF	100 pulses However, position is 20 pulses for types D and GU.

*5 In the case of the common use electronic valve kit and more than one (1) indoor unit in the heating mode within the same electronic valve kit, the position becomes 20 pulses.

11. Solenoid Valve Kit Control

This device connects the solenoid valve kit which is used to switch between indoor unit cooling/heating for 3-WAY types.

1. Operation of the except types D and GU solenoid valve kit

Remote Controller	Mode		Discharge valve	Intake valve	Balance valve	EP valve (evaporation temp. control valve)
Cooling	←	Thermostat ON	OFF	ON	ON	ON
		Thermostat OFF	OFF	ON	ON	ON
Heating	←	Thermostat ON	ON	OFF	OFF	OFF
		Thermostat OFF	ON	OFF	OFF	OFF
Auto	Auto. Cooling	Thermostat ON	OFF	ON	ON	ON
		Thermostat OFF	OFF	ON	ON	ON
	Auto. Heating	Thermostat ON	ON	OFF	OFF	OFF
		Thermostat OFF	ON	OFF	OFF	OFF
Fan	←		OFF	OFF	ON	OFF
		*1 (Cooling)	OFF	ON	ON	ON
		*2 (Heating)	ON	OFF	OFF	OFF
Stopped	←		OFF	OFF	ON	OFF
		*1 (Cooling)	OFF	ON	ON	ON
		*2 (Heating)	ON	OFF	OFF	OFF

*1: Function when a common use solenoid valve kit is used and there are more than one (1) indoor unit in the cooling mode within the same solenoid valve kit.

*2: Function when a common use solenoid valve kit is used and there are more than one (1) indoor unit in the heating mode within the same solenoid valve kit.

2. Operation of the types D and GU solenoid valve kit

Remote Controller	Mode		Discharge valve	Intake valve	Balance valve	EP valve (evaporation temp. control valve)
Cooling	←	Thermostat ON	OFF	ON	ON	ON
		Thermostat OFF	OFF	ON	ON	ON
Heating	←	Thermostat ON	ON	OFF	OFF	OFF
		Thermostat OFF	OFF	OFF	OFF	OFF
Auto	Auto. Cooling	Thermostat ON	OFF	ON	ON	ON
		Thermostat OFF	OFF	ON	ON	ON
	Auto. Heating	Thermostat ON	ON	OFF	OFF	OFF
		Thermostat OFF	OFF	OFF	OFF	OFF
Fan	←		OFF	OFF	ON	OFF
Stopped	←		OFF	OFF	ON	OFF

12-1. Switching Control (EC control)

If the settings indicate that an RAP valve kit is present (for types D and GU, the setting on initial shipment from the factory is “present”), then the thermostat does not turn ON for 3 minutes after the indoor unit operating mode is changed from any mode other than heating (including stopped) to heating with thermostat ON. This is done in order to balance the pressure within the heat exchanger.

* With types D and GU, this control is activated after defrost control is completed, turning the thermostat OFF for 3 minutes.

12-2. Indoor Unit Thermostat ON/OFF Delay Timer

(1) After the thermostat turns ON at an indoor unit, the thermostat will not be turned OFF by the room temperature thermostat or discharge temperature thermostat for a period of 3 minutes.

However, if the condensation temperature reaches or exceeds the PX temperature, the thermostat turns off in order to prevent overload.

(2) After the thermostat turns OFF at an indoor unit, the thermostat will not turn ON again for a minimum of 3 minutes.

12-3. Indoor Unit Refrigerant Oil Self-Recovery Control

This control is performed periodically only during cooling operation.

(1) At indoor units which are stopped, operating in fan mode, or where the thermostat is OFF, the electronic control valve is opened for 1 – 2 minutes.

(2) At indoor units where the thermostat is ON, the electronic control valve position is opened by 10 pulses from the current position.

<Alarm Information>

(1) Discharge temperature protection alarm

This device sets an upper limit discharge temperature of 105°C for all compressors. When the discharge temperature reaches 105°C, that compressor is stopped and restarted. If the same high discharge condition occurs 4 times, then an alarm occurs.

After a compressor has stopped, that compressor will not operate until the temperature has dropped to or below the start-prohibit temperature.

Discharge temperature protection list

Compressor No.	Compressor 1	Compressor 2	Compressor 3
Type	Inverter	Constant-speed	Constant-speed
Stop temp.	105	105	105
Start-prohibit temp.	90	90	90
Alarm display	P03	P17	P18

(2) Discharge sensor trouble detection control

An alarm occurs if the discharge temperature remains abnormally high when the system has been stopped for 60 minutes.

* In this case, possible causes include sensor failure and compressor overheating caused by an insufficient level of refrigerant.

The alarm also occurs if the sensor temperature is at or above the abnormal temperature (80°C) when 20 minutes have passed after the compressor stopped.

* In this case, it is possible that the discharge temperature from a different outdoor unit is being detected, due to an error in the installation of the discharge thermistor.

Discharge sensor failure list

Compressor No.	Compressor 1	Compressor 2	Compressor 3
Type	Inverter	Constant-speed	Constant-speed
Stop temp.	F04	F05	F22

(1) Fan motor

Alarm	Description
P22	Occurs when the fan motor detects overcurrent, or when the motor is locked and does not turn.

(2) Inverter compressor

Alarm	Description
P16	Occurs during ordinary operation when overcurrent (32.5 A) is detected.
P26	Occurs under the same conditions as P16 when the inverter compressor is operating at or above 80 Hz.
P29	Occurs when missing phase or overcurrent (48 A) is detected at inverter compressor start.
H31	Occurs when HIC detects overcurrent (75 A), or when an abnormal high temperature (150 °C) is reached.

The inverter current includes a primary current and secondary current. The alarm judgment utilizes both currents. Generally, the secondary current is larger that the primary current.

(3) Constant-speed compressor

An alarm occurs when overcurrent or lock current is detected.

List of overcurrent and lock currents

Outdoor unit type	Constant-speed compressor	Overload current [A]	Lock current [A]
0705	Compressor 2	12.1	13.7
0905	Compressor 2	12.7	14.3
1155	Compressor 2	12.7	14.3
1305	Compressor 2	12.1	13.7
	Compressor 3	12.1	13.7
1405	Compressor 2	12.1	14.3
	Compressor 3	12.7	14.3

List of Alarms

Compressor No.	Compressor 2		Compressor 3	
Detected current	Overcurrent	Lock current	Overcurrent	Lock current
Alarm display	H11	H12	H21	H22

(4) CT circuit detection trouble

	Alarm	Description
Compressor 1 (inverter compressor)	H03	Occurs when an open CT circuit is detected in the inverter compressor.
Compressor 2 (constant-speed compressor)	H13	Occurs when a current value of 1.5 A or less is detected when the constant-speed compressor is operating.
Compressor 3 (constant-speed compressor)	H23	Occurs when a current value of 1.5 A or less is detected when the constant-speed compressor is operating.

If the inverter compressor operating frequency is low, the current value is also low. Therefore this alarm is detected only when the compressor is stopped.

The operating current of the constant-speed compressors is always higher than 1.5 A. Therefore, this alarm occurs as the result of an open circuit or failure.

15. Low Oil Alarm

Ordinary operation is resumed after system oil recovery control is completed. If a stop occurs again as a result of a low oil level, this alarm occurs. This alarm will not occur if system oil recovery control has not already been performed.

However, the alarm may not occur if the outdoor unit where the system oil recovery conditions were met is not the same as the outdoor unit which stopped due to low oil level. In this case, system oil recovery control may be performed again.

Low oil alarm	
Alarm display	H07

16. Pressure Sensor Failure

This system contains 2 types of pressure sensors: a high-pressure sensor and a low-pressure sensor.

(1) High-pressure sensor failure

Identification of a failure caused by a loose or displaced connector is based on the relationship between the pressure detected by the high-pressure sensor and the operation of the high-pressure switch, and on the relationship between the temperature detected by the high-pressure sensor and the various temperature thermistors.

However, when the pressure increases suddenly, the judgment for the high-pressure sensor failure alarm may occur before operation of the high-pressure switch. Therefore, before concluding that there is a failure in the pressure sensor, first verify that the service valve was not accidentally left closed, that there are no blocked circuits, and that there is no leakage of refrigerant into stopped outdoor units. Also check for a difference between the high pressure measured by the manifold gauge and the pressure detected by the pressure sensor.

(2) Low-pressure sensor failure

Identification of a failure caused by a loose or displaced connector is based on the relationship between the temperature detected by the low-pressure sensor and the various temperature thermistors.

Before concluding that a failure has occurred, check for a difference between the low pressure measured by the manifold gauge and the pressure detected by the low-pressure sensor.

	High-pressure sensor failure	**Low-pressure sensor failure**
Alarm display	F16	F17

<Field Application Functions>

17-1. Automatic Backup Operation

This system includes a function for automatic backup operation. An alarm is also displayed to inform the operator that a failure has occurred.

(1) Alarms that result in automatic backup operation

When compressor trouble or fan motor trouble makes emergency continued operation impossible, automatic backup operation mode is engaged. Automatic backup mode is not engaged in cases of communications alarms, automatic reset alarms, and other instances when emergency operation is possible by pressing the remote controller buttons or changing other conditions.

The alarms that result in automatic backup mode are P16, P22, P26, P29, H11, H12, H21, H22 and H31.

(2) Start of automatic backup operation

If the above alarms occur, the alarm is displayed on the control device. Pressing the control device button again starts automatic backup mode.

(3) Operation

[1] When 1 outdoor unit is installed

When 1 compressor has failed, backup operation is possible using the other compressors. However, operation does not occur when the outdoor fan is unable to operate as a result of alarm P22.

[2] When multiple outdoor units are installed

When automatic backup mode is engaged, the outdoor unit where the above alarm occurred stops operating. However, if one or more of the compressors is able to operate, then this outdoor unit operates only when the operation of all outdoor units is required for special control or other system purposes.

(4) Alarm display

If a wired remote controller is present, the ⚠ display blinks during operation.

(5) Canceling automatic backup operation

Repair the outdoor unit where the failure occurred. When repairs are completed, reset the power on outdoor unit No.1.

<Caution>

After automatic backup mode has been engaged, it will not be canceled automatically when the repair of the failed outdoor unit is completed. Automatic backup mode will be canceled only when the power on outdoor unit No.1 is reset. Therefore, after repair work is completed, be sure to check whether or not automatic backup mode has been canceled.

How to check: [1] Use test run or other means to verify that all outdoor units operate continuously.
[2] If a wired remote controller is present, check that the ⚠ display has disappeared.

17-2. Manual Backup

If an alarm that does not result in automatic backup occurs frequently, possible causes include failure (such as refrigerant leakage) of a functional part at an outdoor unit other than the unit where the alarm occurs.

In this case, because the outdoor unit service valve must be closed, backup operation must be performed manually.

(1) Backup operation procedure

[1] Disconnecting the failed outdoor unit

(A) Reduce the number of outdoor units set at outdoor unit No.1 by the number of failed outdoor units. Then turn OFF the power or disconnect the inter-unit communications line at the failed outdoor units.

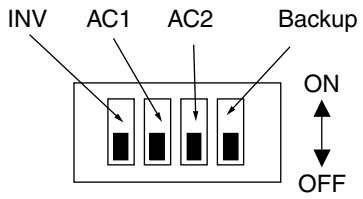
(B) Close all service valves at the failed outdoor units.

(C) Reset the power at outdoor unit No.1.

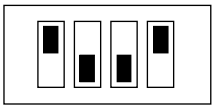
[2] Disabling operation of 1 compressor

At the S010 switch on the PCB of the failed outdoor unit, turn ON the switch for the compressor to disable, and turn ON the “backup” switch.

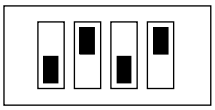
<S010 switch>



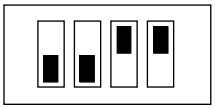
(A) Compressor 1 backup



(B) Compressor 2 backup



(C) Compressor 3 backup



• In order to perform simultaneous backup operation for 2 or more compressors, use a combination of the switch settings shown above.

The outdoor unit EEPROM settings can be used for the following functions.

18-1. Outdoor Unit Noise Countermeasure: EEPROM 05 (set at each outdoor unit)

This unit includes 3 types of Quiet modes. (However, when they are engaged, operation is in Quiet mode 24 hours a day.) Selecting a Quiet mode results in operation that gives priority to reducing noise. Because these modes involve restrictions on outdoor unit fan modes and the operation frequency, the capacity will be somewhat reduced.

Setting	Max. fan mode	Effect	Amount of capacity reduction
0	14	Normal operation (setting at time of factory shipment)	0
1	12	Noise reduced by approx. 1 – 2 dB from the catalog value.	Approx. 0.5 hp
2	11	Noise reduced by approx. 2 – 3 dB from the catalog value.	Approx. 1.2 hp
3	10	Noise reduced by approx. 5 dB from the catalog value.	Approx. 1.8 hp

* If Quiet mode is set, the capacity will begin to decrease during heating operation at low outdoor temperatures, when the outdoor air temperature is below standard conditions.
* It is possible to set Quiet mode only for nighttime by using the snowfall sensor input terminal and a timer for quiet operation. In this case, operation is the Quiet mode determined by the above setting.

18-2. Slime Countermeasure: EEPROM 0C (set only on the main unit)

This setting controls the operation of the drain pump.

Setting	Description
0	Normal control (setting at time of factory shipment)
1	The drain pump operates for 20 minutes at 2-hour intervals.
2	The drain pump operates for 20 minutes at 20-minute intervals.
3	The drain pump operates constantly.

18-3. Delayed Start for Each System: Outdoor EEPROM 3E (set only on outdoor unit No. 1)

The operation start time can be delayed according to the set system addresses.

This setting reduces the voltage drop by preventing multiple systems from starting at the same time when operation is restarted after multiple operating systems were stopped due to a power outage or other cause.

Setting	Effect
0	No delayed start (setting at time of factory shipment)
1	Start begins after [1 second × System address]
2	Start begins after [2 seconds × System address]
3	Start begins after [3 seconds × System address]

18-4. Automatic Backup: Outdoor EEPROM 48 (set only on outdoor unit No. 1)

Automatic backup is set to occur at the time the unit is shipped from the factory. However, the automatic backup function can be disabled by changing this setting to 1.

18-5. Automatic Backup Mode: Outdoor EEPROM 49 (set only on outdoor unit No. 1)

Two types of automatic backup modes (when multiple outdoor units are installed) can be selected.

Setting	Operation	Condition
0	Backup outdoor units operate only during special control.	Setting at time of factory shipment
1	Only the backup compressors remain stopped. Other OK compressors installed in the same outdoor unit operate as normal.	

* Even when “1” is set, the outdoor unit will remain stopped if all of the compressors in the outdoor unit have failed.

* If only 1 outdoor unit is installed, the operation is according to setting “1” even if “0” is set.

18-6. Snowfall Input Switching: Outdoor EEPROM 4A (set at each outdoor unit)

The snowfall sensor input terminal on the outdoor unit PCB is used for input from the snowfall sensor. It is also possible to connect an external timer and use it to enable nighttime Quiet mode operation.

Setting	Operation
0	Used for snowfall sensor input (setting at time of factory shipment).
1	Used for Quiet mode input.

18-7. Optional Solenoid Valve Control Operation Setting: Outdoor EEPROM C0 (set at each outdoor unit)

Setting	Operation
0	No output (setting at time of factory shipment)
1	Refrigerant shut-off valve control (for cooling when the outdoor air temperature is below standard conditions)
2	—
3	External liquid valve control (used in special cases when the discharge gas temperature is likely to especially rise)

18-8. High Static Pressure Mode: Outdoor EEPROM 8F (set at each outdoor unit)

This product can be made compatible with high static pressure by changing the settings.

By changing the setting item 8F to “6,” this product can be made compatibly.

18-9. Compressor operating sequence: Outdoor EEPROM 49 (set at outdoor units which include CCU functions)

When this setting is set to “1,” the compressors start in sequence beginning from the No. 1 outdoor unit. (The setting is “0” at the time of shipment. With this setting, compressors with lower operating time are started first in order to balance the compressor operating times.)

18-10. Demand value setting: Outdoor EEPROM 1A, 1B (set at outdoor units that include CCU functions)

Demand setting		Control	Demand meaning
Contact 1	Contact 2		
×	×	No limit	Operates to maximum capacity.
○	×	Demand can be set from 40 – 130% at EEPROM 1A.	Current is limited to the set values.
×	○	Demand can be set from 40 – 130% at EEPROM 1B.	Current is limited to the set values.
○	○	Remains stopped.	

18-11. Control function of indoor unit's alarm for communication error

When the remote controller is switched on, the alarm for communication error occurs even if only one (1) indoor unit is powered off.
The following setting can make the alarm for communication error not occur in case of only one indoor unit powered off with the remote controller switched on.

Change the outdoor EEPROM setting item code 23 (setting at each outdoor unit) into "1".

*1 Although this setting is made, other indoor units will continue operating.

*2 Although this setting is made, the alarm [E06] occurs when more than two (2) indoor units are powered off.

19-1. Snowfall Sensor Functions: Outdoor EEPROM 04

A unit identified as having a snowfall sensor attached will periodically send a signal indicating the snowfall sensor input status to all outdoor units in the same system (or all wired outdoor units in the case of linked systems). It is therefore unnecessary to install and wire multiple snowfall sensors.

(1) Snowfall sensor settings

Setting	Operation
0	Sensor input not present. Control is performed. (Setting at time of factory shipment)
1	Sensor input present. Control is performed.
2	Sensor input not present. Control is not performed.
3	Sensor input present. Control is not performed.

* If the snowfall sensor is used, then depending on the circumstances it is necessary to make the correct setting at all outdoor units in the system.
* If “control is not performed” is set, control by the above signal is ignored. This setting is used in order to conserve energy at outdoor units that include a snowfall-protection hood.
  Recommended: If a low-speed fan mode is required (for all-year cooling or other reasons), install a snowfall-protection hood and set this setting to ON.

(2) Control operation

[1] Outdoor units where “sensor input present” is set send the snowfall sensor input information every 10 minutes to all linked systems if the system wiring is linked.

[2] At systems where “control is performed” is set, the above information is used to control operation of the outdoor fan.

[3] At systems where “control is not performed” is set, the snowfall sensor input and above information ignored, and the outdoor fan does not operate.

[4] In the case of a W-Multi system, control can be performed when snowfall sensor input is connected to any outdoor unit.

<Caution>

Snowfall sensor input information is detected once every 10 minutes. Therefore, the outdoor fan may continue operating for up to 10 minutes even when there is no snowfall sensor input.

In addition, the outdoor fan may remain stopped for up to 10 minutes when snowfall sensor input is present.

19-2. Function for Automatic Judgment of Insufficient Refrigerant Gas and Overcharge

This system includes a simple function for judging the level of refrigerant. However, be aware that false judgments may occur if the control elements of the outdoor unit or indoor unit fail.

(1) Starting refrigerant level judgment mode

Short-circuit the CHECK pin on the No. 1 outdoor for 4 seconds or longer to engage this mode. (The LED on the outdoor unit PCB begins blinking.)

(2) Conditions for refrigerant level judgment

After judgment mode starts, judgment occurs when all outdoor units in the system have been operating continuously for 30 minutes or longer.

* Refrigerant level judgment requires that all outdoor units operate continuously for 30 minutes or longer. This is in order to prevent incorrect adjustment of the refrigerant level based on false detection caused by refrigerant accumulation or recovery at stopped outdoor units (stopped due to failures of functional elements). After the judgment is displayed, repeated judgment will occur under new operating conditions if all outdoor units continue operating. Therefore, the judgment display may change when later judgments occur.
* Judgment mode is automatically canceled after 4 hours.

(3) Outdoor unit PCB LED indications in judgment mode

	LED1	LED2	Recommended response
Judgment mode	Blinking	Blinking	
Normal	ON	ON	
Insufficient gas	Blinking	OFF	Charge with refrigerant a little at a time.
Overcharge	OFF	Blinking	Recover refrigerant a little at a time.
Judgment not possible	Blinking alternately		

When judgment mode is not engaged, the LED indicates the normal display (OFF), or else indicates alarms or other information.

If the insufficient gas or overcharge judgment is not stable, then recover refrigerant a little at a time when the overcharge display appears. End refrigerant adjustment when the normal or insufficient gas display appears.

(4) Canceling judgment mode

When judgment mode is cancelled, the LED returns to the standard status display (OFF unless an alarm or other event has occurred).

[1] Automatic cancel

Judgment mode is canceled automatically when 4 hours have passed after it was started.

[2] Forced cancel

Short-circuit the CHECK pin while the judgment mode display is active in order to cancel judgment mode.

<Reference> General Guidelines for Insufficient Gas and Overcharge

Judgment in automatic judgment mode can be problematic in some cases. Therefore, the following guidelines are provided for general judgment of the refrigerant amount.

• Symptoms of insufficient gas

Cooling operation	There is an indoor unit where the position of the electronic control valve is much higher (open by 300 pulses or more) than it was at start, and the difference [E3 – E1] at that indoor unit is large (15°C or more).
Heating operation	There is an outdoor unit where the position of the electronic control valve is much higher (open by 300 pulses or more) than it was at start, and the difference [Liquid temp. – Gas temp.] at that outdoor unit is large (15°C or more).

• Symptoms of overcharge

Cooling operation	The high-pressure sensor temperature is 57°C or higher, and the difference [Pressure sensor temp. – Liquid temp.] at that outdoor unit is large (15°C or more).
Heating operation	There is an indoor unit where the position of the electronic control valve is much higher (open by 300 pulses or more) than it was at start, and the difference [Pressure sensor temp. – E3] at that indoor unit is large (25°C or more).

These are only guidelines, therefore the judgment may vary depending on the installation conditions, load characteristics, and other elements.

2. OUTDOOR UNIT REPAIR PROCEDURES

1. Removing Panels **2**-2
2. Removing Electrical Component Box and Duct **2**-3
3. Discharging Compressor Oil **2**-5
4. Backup Operation **2**-6
5. Recovering Refrigerant **2**-9
6. Checking for Leakage After Repair **2**-14
7. Evacuating System **2**-15
8. Charging Compressor Oil **2**-16
9. Pumping Out Refrigerant from Outdoor Unit **2**-20
10. Compressor **2**-23
11. High and Low Pressure Sensors **2**-38
12. Replacing 4-way valve **2**-39

1. Removing Panels

Procedures:

1. Removing Panels
2. Removing Electrical Component Box and Duct
3. Discharging Compressor Oil
4. Backup Operation
5. Recovering Refrigerant
6. Checking for Leakage After Repair
7. Evacuating System
8. Charging Compressor Oil
9. Pumping Out Refrigerant from Outdoor Unit (when repairing parts other than compressor)
10. Compressor
11. High and Low Pressure Sensors
12. Replacing 4-way valve

(1) Front panel removal (Fig. 1)

- Remove the front panel (remove 11 screws).

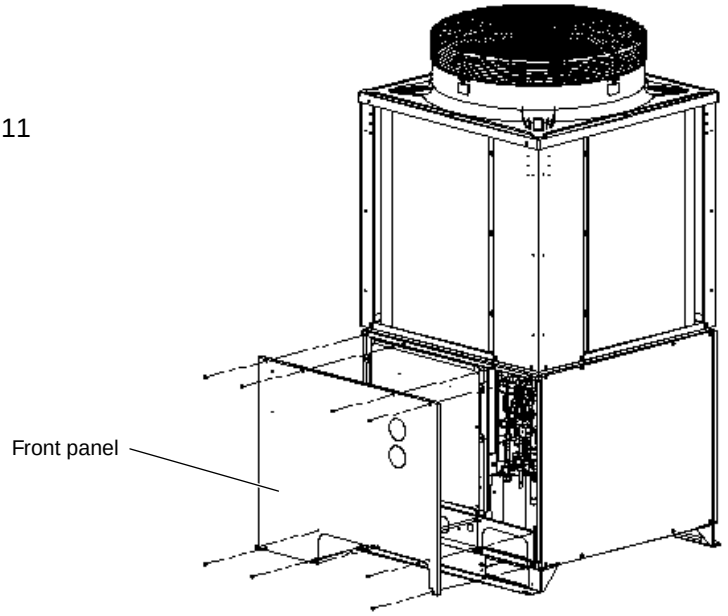


Fig. 1

(2) Power outlet panel & valve cover removal (Fig. 2)

- Remove the power outlet panel (remove 2 screws).
- Remove the valve cover (remove 2 screws).

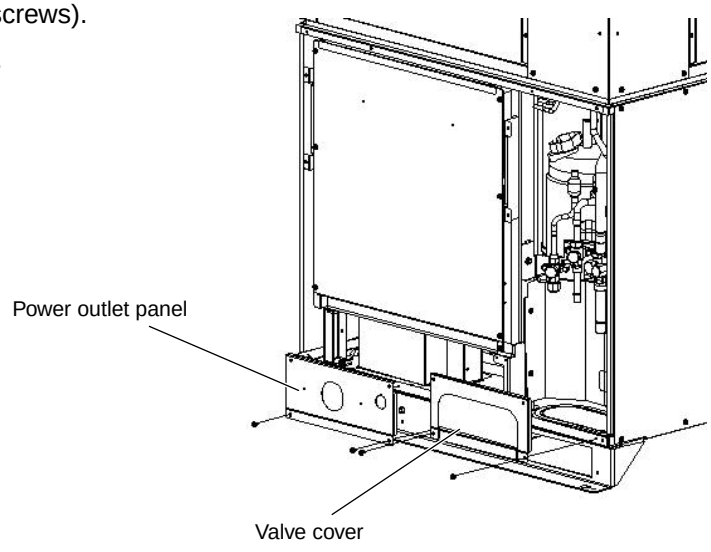


Fig. 2

2. Removing Electrical Component Box and Duct

Be sure to turn off the power before removing the electrical component box. Then check that the power LED (D53) on the control PCB of the outdoor unit is not lit.

(1) Remove the electrical component box cover (remove 6 screws). (Fig. 3)

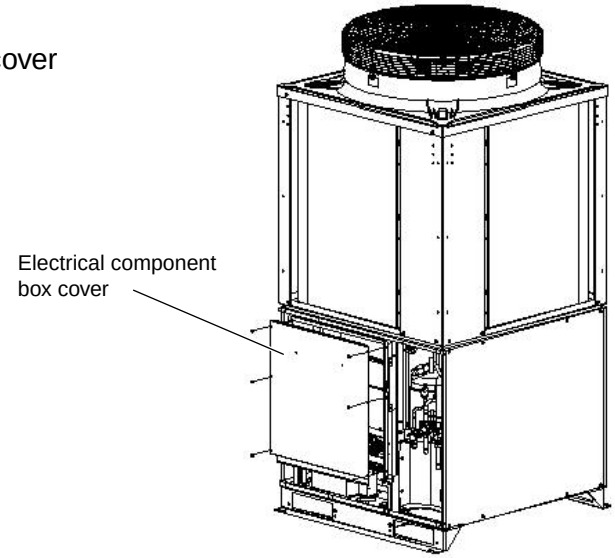


Fig. 3

(2) Remove power and control wires from terminals.

(3) Remove internal wires with extended connectors on the outdoor control PCB. (Solenoid valves, thermistors, crankcase heaters and others)

(4) Disconnect power lines connected to the secondary terminals of the magnetic contactor for the compressor.

(5) Remove the electrical component box (remove 2 screws). (Fig. 4)

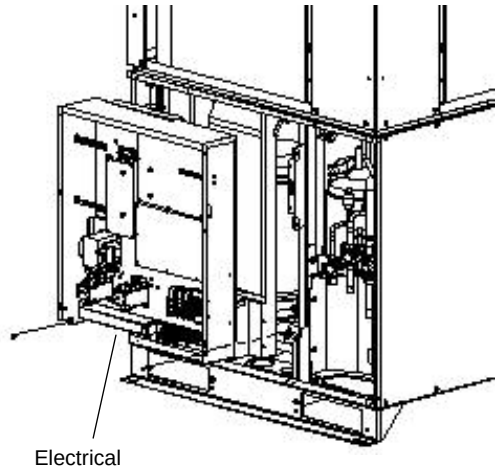


Fig. 4

CAUTION

Be sure to release the locking mechanism before disconnecting each connector.

(6) Remove the center duct. (Fig. 5)
※ The center duct is fitted into the upper and lower ducts and held in place by the electrical component box, an arrangement that makes possible independent removal of the center duct.

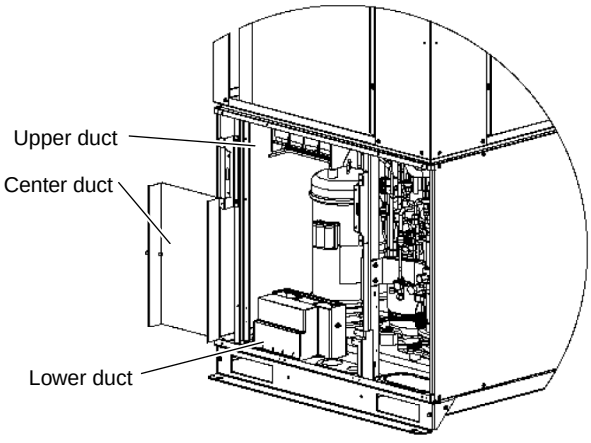


Fig. 5

(7) Remove the lower duct. (2 screws, 1 tab) (Fig. 5-1)

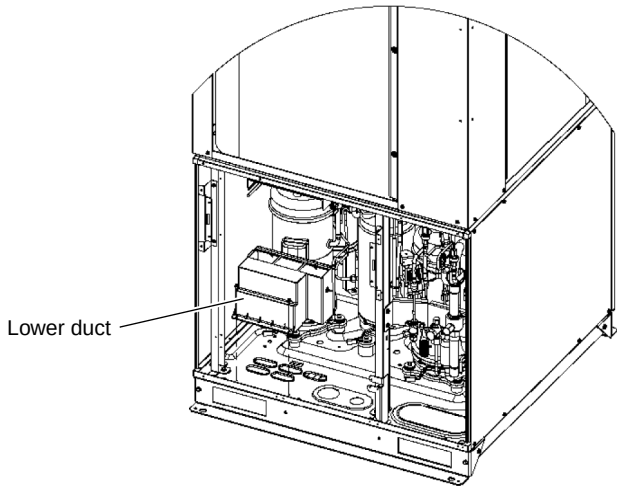


Fig. 5-1

(8) Remove the upper duct. (3 screws) (Fig. 5-2)

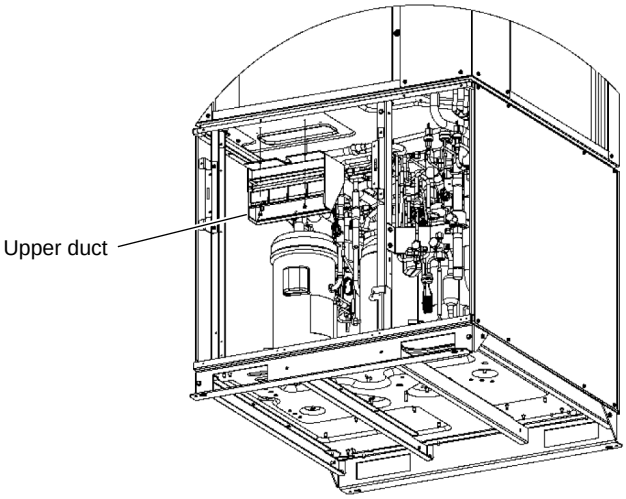


Fig. 5-2

3. Discharging Compressor Oil

Discharged oil can be used for checking the condition of the system. Based on the appearance and color of the discharged oil, a judgment can be made on whether the system is operating normally or not.

3-1. Discharging Oil from Oil Separator

Recover the refrigerant from the outdoor unit following the procedure given in "5. Recovering Refrigerant." Install hoses as indicated on the equipment and feed nitrogen gas gradually to provide pressure to the system from the low-pressure outlet and collect oil in a pan or container. (Fig. 6)

CAUTION

- **The low-pressure outlet port is at the Lo side of the right side.**
- **A faulty outdoor unit may remain pressurized. The oil delivery port employs a Schrader-type push-to-release valve. Be careful to avoid accidental oil release when using the port.**

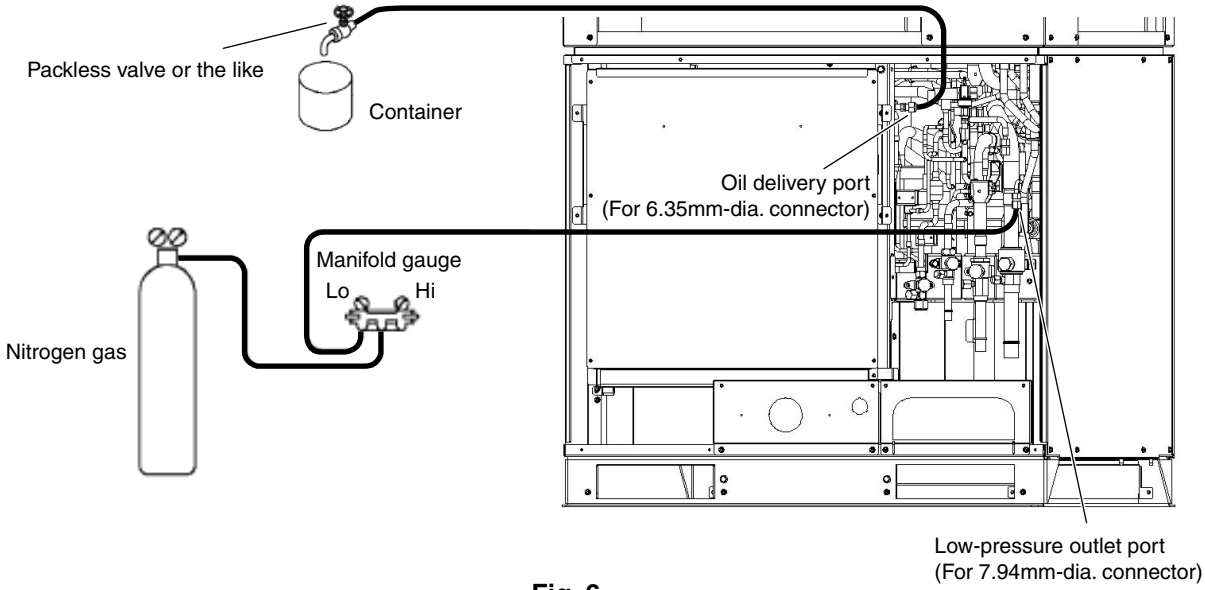


Fig. 6

3-2. Discharging Oil in Compressor

Recover the refrigerant in the outdoor unit following the procedures in "5. Recovering Refrigerant." Remove the compressor and discharge the oil in it. Refer to "10. Compressor" for detailed procedures.

3-3. Checking the Oil

Acceptance/rejection criteria for the oil

Condition of refrigeration cycle	Condition of oil		Judgment criteria for changing oil*	
	Color	Odor	Total acid value	Hue
Normal	Yellowish	None	0.02 or less	3.5 or less
Abnormal overheat operation	Brownish	Smells somewhat (not as strong as below)	0.06 or over	4.0 or over
			Changing the oil and system cleaning with dry-cores are necessary.	
Motor burnout	Brownish / blackish	Pungent / burnt odor	Changing the oil and system cleaning with dry-cores are necessary.	

* It is difficult to measure the total acid value in the field, therefore oil hue and odor are the rule of thumb. Checking for carbon deposits and abrasive metal powder can additionally be used to assess the system condition.

4. Backup Operation

This system includes an emergency automatic backup function that allows the A/C to operate during the period after trouble occurs until repairs are made. However, during repair and at other times, use manual backup operation.

4-1. Automatic Backup

For details, refer to the control functions section.

After the alarm details are sent to the control device, control for automatic backup operation begins when the ON/OFF button of the wired remote controller is pressed again (operation is started after the alarm is cleared). During this operating mode, “CHECK” flashes on the wired remote controller only to inform the user that operation is in backup mode. However this is not displayed on any other control devices.

- In order to cancel automatic backup mode, it is necessary to reset the power on the control PCB of the outdoor unit where the outdoor unit No. setting (S007) on the control PCB is set to No. 1 (main unit).

CAUTION

If the power is not reset on the control PCB of the No. 1 outdoor unit (main unit), backup mode operation will continue after the repairs are completed.

Backup operation is intended as emergency operation until repairs are made. Have repairs made as soon as possible.

4-2. Manual Backup

This backup operation is the conventional method of backup operation. It involves disconnecting the failed outdoor unit from the system, and operating only the normal outdoor units.

4-2-1. Backup operation by disconnecting the outdoor unit

(1) Changing the outdoor unit control PCB settings

<If the failed outdoor unit is not the No. 1 unit>

- Settings at No. 1 unit (main unit)

Switch on outdoor unit control PCB	Action
System address (S003, S002)	No change
No. of indoor units (S005, S004)	No change
No. of outdoor units (S006)	Subtract the number of failed units from the current setting.
Outdoor unit No. (S007)	No change

- Settings at normal outdoor units other than the No. 1 unit
  No particular changes

- Settings at the failed outdoor unit
  No particular changes
  However, close all service valves (suction tube, discharge tube, liquid tube, balance tube) at the failed outdoor unit, and disconnect the wiring between the outdoor units.

<If the failed unit is the No. 1 outdoor unit (main unit)>

If the No. 1 unit (main unit) has failed, a different outdoor unit must be set as the No. 1 unit (main unit).

- Settings at the failed No. 1 outdoor unit
  - – No particular changes
  - – However, close all service valves (suction tube, discharge tube, liquid tube, balance tube) at the failed outdoor unit, and disconnect the wiring between the outdoor units (main-sub unit wiring).
- Settings at No. 1 unit (main unit)

Switch on outdoor unit control PCB	Action
System address (S003, S002)	Make the same settings as on the failed No. 1 unit.
No. of indoor units (S005, S004)	Make the same settings as on the failed No. 1 unit.
No. of outdoor units (S006)	Subtract the number of failed units from the current setting.
Outdoor unit No. (S007)	Change to “1.”

To this outdoor unit, connect the inter-unit communication line which was previously connected to the No. 1 unit (main unit).

After recovery work is completed, return the outdoor unit No. setting (now = 1) to the value it was before the failure and repair. If this is not done, there will be duplicated outdoor unit No. settings. In this case an alarm does not occur immediately, however operation may be unstable.
Reconnect the inter-unit communications line to the No. 1 unit.

- Settings at other outdoor units
  No particular changes.

(2) Adjusting the refrigerant for backup operation

During backup operation, all of the service valves on the failed unit are closed. However, if a check of the backup operating conditions shows that the level of gas is low, recover the refrigerant from the failed outdoor unit. If the level of gas is too high, collect refrigerant at the failed outdoor unit.

- Recovering refrigerant

  With the normal outdoor units operating, monitor the operating condition and open/close the suction tube service valve on the failed outdoor unit where all the service valves were closed. In this way, recover refrigerant from the failed outdoor unit in order to adjust the amount of refrigerant in the system.
  After adjusting the amount of refrigerant, close the suction tube valve at the failed outdoor unit.
- Collecting refrigerant in the failed outdoor unit
  - Short-circuit the vacuum application pin (CN102) on the control PCB of the failed outdoor unit where the service valves are closed, then turn the power ON. Also disconnect the wiring between the outdoor units.
  - With the normal outdoor units operating, monitor the operating condition and open/close the liquid tube service valve on the failed outdoor unit where all the service valves were closed. In this way, collect refrigerant in the failed outdoor unit in order to adjust the amount of refrigerant in the system.

- After adjusting the amount of refrigerant, turn OFF the power at the failed outdoor unit, release the short-circuit at the vacuum application pin, and close the liquid tube valve at the failed outdoor unit.
  * Refrigerant recovery is not affected by the power status of the failed outdoor unit. However, collecting refrigerant in the failed outdoor unit is affected by whether the power at that outdoor unit can be turned ON. If the power cannot be turned ON, use a refrigerant recovery device and recover the refrigerant into a recovery cylinder in order to adjust the amount of refrigerant in the system.

4-2-2. Backup operation by setting the failed compressor not to operate

Backup operation settings for each compressor

INV compressor	AC1 compressor	AC2 compressor	Setting for backup operation
OK	OK	Failed	DIP switch S010: Turn BACK UP and AC2 ON.
OK	Failed	OK	DIP switch S010: Turn BACK UP and AC1 ON.
OK	Failed	Failed	DIP switch S010: Turn BACK UP, AC1, and AC2 ON.
Failed	OK	OK	DIP switch S010: Turn BACK UP and INV ON.
Failed	OK	Failed	DIP switch S010: Turn BACK UP, INV, and AC2 ON.
Failed	Failed	OK	DIP switch S010: Turn BACK UP, INV, and AC1 ON.

The following equipment and tools are required:

Jumper wire with clips, adjustable wrench, set of manifold gauge valves specially designed for refrigerant R410A only, vacuum pump, refrigerant recovery unit, pre-purged refrigerant cylinder for recovery, flathead screwdriver, and outdoor unit maintenance remote controller.

5-1. Refrigerant Recovery Procedures (from outdoor unit)

(1) Turn off the power of the outdoor unit beforehand (at power mains).

(2) Fully close each service valve on the suction tube, discharge tube, liquid tube, and the balance tube of the outdoor unit.

(3) Connect the outdoor unit's high-pressure and low-pressure outlet ports with the Hi and Lo sides of the manifold gauge valves using hoses. (Fig. 7)

CAUTION

The remaining refrigerant in the faulty outdoor unit may create internal pressure. Before connecting hoses, be sure to confirm that each of the manifold gauge valves is tightly closed. Note that the connection ports employ Schrader-type push-to-release valves.

(4) Connect the manifold gauge valves, refrigerant recovery unit, and recovery cylinder using hoses. To avoid the entry of air into the refrigerant tubing, carry out this connection work carefully. (Fig. 7)

CAUTION

For detailed procedures such as connecting the refrigerant recovery unit with the recovery cylinder and methods used for recovery, follow the specific instructions that came with the refrigerant recovery unit.

(5) Locate the AP (Air Purge) pins on the control PCB in the faulty outdoor unit and short them using the clips of the jumper wire. Then restore electrical power to the outdoor unit.

CAUTION

By short-circuiting the AP pins, each solenoid valve in the outdoor unit is forcibly opened as soon as power comes on, which releases all remaining refrigerant into the recovery cylinder. Since neglecting this procedure may leave some refrigerant in the system, it is important that you carry out this step.

(6) Carry out refrigerant recovery.

CAUTION

To determine the completion of refrigerant recovery, follow the instructions that came with the refrigerant recovery unit.

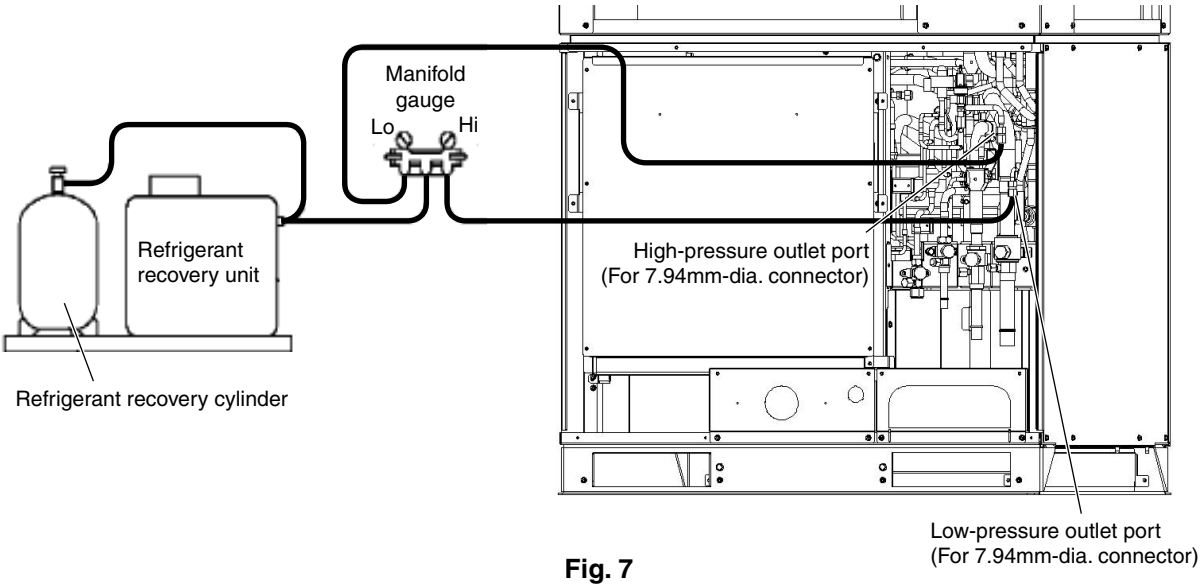
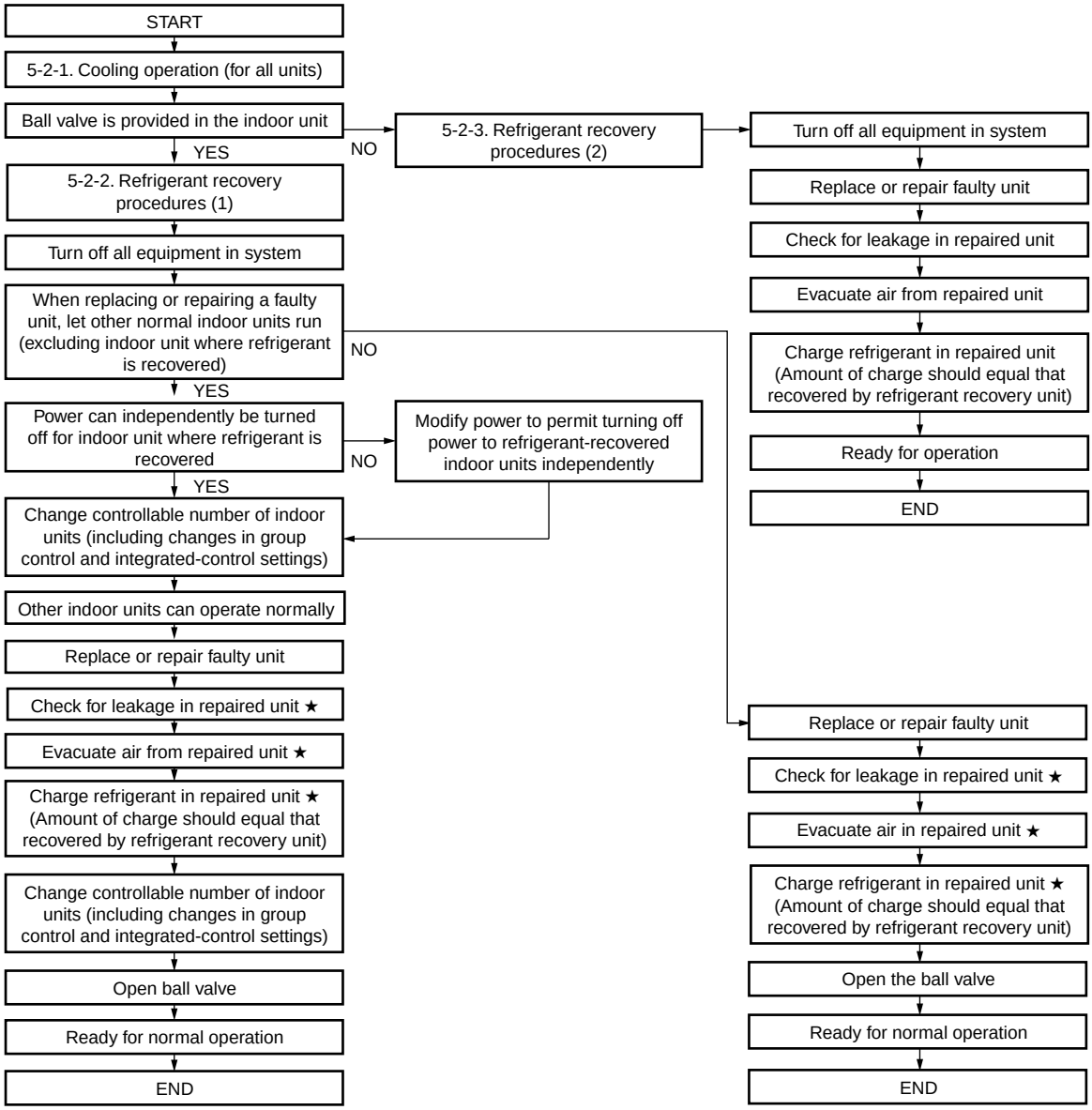


Fig. 7

5-2. Refrigerant Recovery Procedures (Indoor Unit)

The flowchart below shows the refrigerant recovery procedures you must follow when replacing or repairing the indoor unit due to trouble in the refrigerant circuit.



★ Service work performed on indoor units is done simultaneously using the service ports at the liquid (narrow tube) side and the gas (wide tube) side ball valves. Refer to each section in the “Installation Instructions” on refrigerant charging, leak checking, and evacuation procedures.

5-2-1. Cooling operation (for all units)

(1) If the remote controller (RCS-TM80BG) is used for maintenance of the outdoor unit

① Connect the outdoor unit maintenance remote controller to the RC connector (CN006) (3P) (BLU) on any one of the outdoor unit control PCBs. Then start a test run of all units. (Press and hold the (CHECK) button for 4 seconds.)

② Press the (MODE) button and change to cooling operation.

CAUTION

Even if the mode that is originally displayed is “Cool,” be sure to press the (MODE) button once or more to change to cooling operation. (Pressing the (MODE) button ensures that heating/cooling operation is not mixed and that all units are operating in either Heating or Cooling mode.)

③ Use the remote controller (RCS-TM80BG) to check the operating status of the indoor units. Check that all units are operating in Cooling mode.

CAUTION

With the 3-way valve, it is difficult to determine whether operation is heating or cooling by touching the tubing.

(2) If the remote controller (RCS-TM80BG) is not available for maintenance of the outdoor unit

① Determine the outdoor unit where the unit No. setting (S007) (3P DIP switch) (BLU) on the outdoor unit control PCB is set to No. 1.

② Short-circuit the mode-change pin (CN101) on the outdoor unit control PCB of the No. 1 unit. Then short-circuit the test-run pin (CN023) to start operation. (Short-circuiting the mode-change pin ensures that heating/cooling operation is not mixed and that all units are operating in either Heating or Cooling mode.)

③ Check the displays of the indoor unit remote controllers. Check that all units are operating in Cooling mode. If all units are operating in Heating mode, perform the steps listed below.

CAUTION **With the 3-way valve, it is difficult to determine whether operation is heating or cooling by touching the tubing.**

④ Release the short-circuit at the test-run pin (CN023) on the outdoor unit control PCB of the No. 1 unit. Then short-circuit the stop pin (CN104) to stop operation.

⑤ Short-circuit the mode-change pin (CN101) on the outdoor unit control PCB of the No. 1 unit.
* Switching of the 4-way valve occurs immediately before operation starts. Therefore it does not change at this time. (Mode change cannot be judged from the sound.)

⑥ Short-circuit the test-run pin (CN023) on the outdoor unit control PCB of the No. 1 unit. Then check the displays of the indoor unit remote controllers. Check that all units are operating in Cooling mode.

5-2-2. Refrigerant recovery procedures (1) (using indoor unit ball valve)

(1) If a ball valve with a service port has been provided in the indoor unit as shown in Fig. 8, follow the instructions given in (2) through (6) below. If the service port is instead located in the outdoor side, follow the instructions in "5-2-3. Refrigerant recovery procedures (2)."

(2) After running the unit in Cooling mode for about 5 minutes as described in "5-2-1. Cooling operation (for all units)," fully close the discharge line, the liquid line ball valve, and indoor unit ball valve.

(3) Run the unit in Cooling mode for 10 to 20 minutes more.

(4) Fully close the suction line ball valve, and stop the operation of all units.

(5) Use hoses to connect the manifold gauge valves, refrigerant recovery unit, and refrigerant recovery cylinder with each other. (Fig. 8) Do each connection quickly to prevent air from entering the tubing.

CAUTION **Remaining refrigerant may create internal pressure, therefore care should be taken when connecting the hoses.**

(6) Recover the remaining refrigerant from the indoor unit using the refrigerant recovery unit.

NOTE

To determine completion of refrigerant recovery, follow the instructions that came with the refrigerant recovery unit.

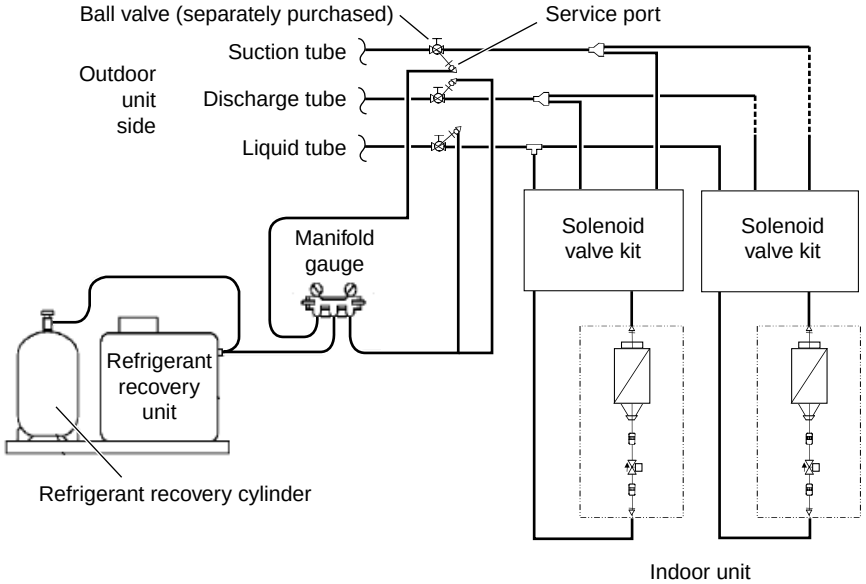


Fig. 8

5-2-3. Refrigerant recovery procedures (2): for indoor unit with no ball valve

Refrigerant in all indoor units and the refrigerant tubing circuit must be pumped into the outdoor unit. The maximum refrigerant storage capacity per a single outdoor unit is approx. 15kg. Thus, in order to collect all refrigerant from the system, a separate refrigerant recovery unit is necessary. Follow these procedures to correctly perform pump down.

Perform work correctly, according to the work procedures given below.

① Connect the manifold gauge to the high- and low-pressure outlet ports on the outdoor unit where pump down will be performed. Be sure that no air enters the tubing at this time.

② Fully close the discharge tube valve on the outdoor unit where pump down will be performed.

③ Follow the instructions in "5-2-1. Cooling operation (for all units)" and operate all units in Cooling mode for approximately 5 minutes. Then fully close the liquid tube valve on the outdoor unit where pump down will be performed.

④ When the high-pressure gauge reaches 2.8 MPa or higher, or the low-pressure gauge reaches 0.5 MPa or below, at the outdoor unit where pump down is being performed, press the ON/OFF button on the outdoor unit maintenance remote controller to stop operation at all units. Then immediately fully close the suction tube valve on the outdoor unit where pump down is being performed.

* If the outdoor unit maintenance remote controller is unavailable, follow the procedure below to stop all of the units.

Pull out the SCT connector (2P) (YEL) (CN231) on the outdoor unit control PCB of the unit where pump down is being performed. When the SCT connector is pulled out, immediately alarm F12 (sensor trouble) occurs and all outdoor units stop operating. Be sure that you do NOT grasp the lead wire when pulling out the connector. Removing any other connector may not cause the units to stop. Therefore be sure to pull out the SCT connector only.

It is not necessary to recover the refrigerant from the balance tube. Therefore do not operate the balance tube valve.

⑤ Turn off power to all equipment in the system. Then pull out the RC1 connector (4P) (BLU) (CN106) on the outdoor control PCB in the outdoor unit for which pump down has been completed.

* By pulling out the RC1 connector, communication between the main and the sub outdoor units will be isolated.

⑥ Change the setting of controllable outdoor unit numbers (reduce by 1 unit).

* If the setting is incorrect, the E30 alarm (outdoor unit serial communication signal error) occurs and the unit will not operate.

⑦ Turn on power for all equipment in the system and let the remaining outdoor units run in Cooling mode.

⑧ Repeat steps (1) through (7) and complete pump down for all outdoor units.

⑨ Using hoses with Schrader-type push-to-release valves, connect the manifold gauge valves to the suction line service port, the discharge line service port and the liquid line service port in the next outdoor unit to undergo pump down. (Fig. 9)

Remaining refrigerant in the system may cause internal pressure. Check that each valve on the manifold gauge is tightly closed. A Schrader-type push-to-release valve is provided for each connection port.

⑩ Use hoses to connect the manifold gauge valves, refrigerant recovery unit, and refrigerant recovery cylinder. Quickly connect each part to prevent air from entering the tubing.

⑪ Recover remaining refrigerant from the inter-unit tubing and indoor units using the refrigerant recovery unit.

NOTE

To determine the completion of refrigerant recovery, follow the instructions that came with the refrigerant recovery unit.

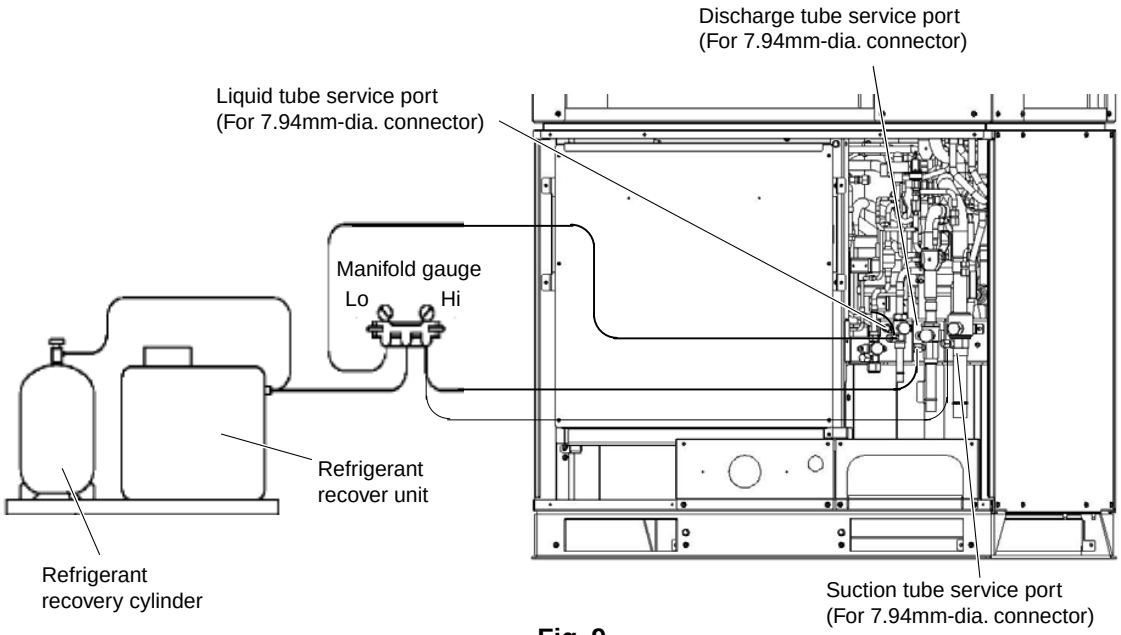


Fig. 9

5-3. Recovery of Refrigerant from Entire System

(1) Turn off power to the entire outdoor system.

(2) Short-circuit the AP (Air Purge) pins (CN102) on the outdoor control PCB of all outdoor units, then supply power to the outdoor units.

* By short-circuiting the AP pins and supplying power to the outdoor units, the solenoid valve in each unit is forcibly opened and all remaining refrigerant can be recovered.

(3) If any unit has encountered a power failure, follow the instructions in “5-1. Refrigerant Recovery Procedures (from Outdoor Units)” and perform refrigerant recovery for the faulty outdoor unit.

(4) Connect the manifold gauge to the high- and low-pressure outlet ports (Schrader-type valves) on any outdoor unit. (Fig. 9)

CAUTION

Remaining refrigerant may cause internal pressure. Check that each valve on the manifold gauge valves is tightly closed. The connection port uses a Schrader-type push-to-release valve.

(5) Connect the manifold gauge valves, refrigerant recovery unit, and refrigerant recovery cylinder. Quickly connect each part to prevent air from entering the tubing.

(6) Check that each service valve of the suction line, discharge line, liquid line, and the balance tube for the outdoor unit has opened, then perform refrigerant recovery.

* If only a single outdoor unit is installed, the balance tube is not used. Therefore, leave this valve closed.

NOTE

To determine the completion of refrigerant recovery, follow the instructions that came with the refrigerant recovery unit.

6-1. Pressure Check for Leakage of Outdoor Unit

After completing repair of the outdoor unit, carry out the following leakage check.

(1) Check that all service valves for suction tube, discharge tube, liquid tube, and balance tube in the repaired outdoor unit are fully closed.

(2) Connect the manifold gauge valves to the high- and low-pressure outlet ports of the outdoor unit.

(3) Feed nitrogen gas into the circuit until 3.6 MPa pressure is reached. If it is apparent that the nitrogen gas is not entering the repaired section, interrupt the feeding. Short-circuit the AP pins (CN102) on the outdoor unit control PCB, turn on power to run the outdoor unit, then resume feeding nitrogen.

(4) Apply soapy water to the repaired part (such as a newly welded part), and briefly inspect for any leakage. If there are any leaks, bubbles will show on the tubing surface.

* To continue the air-tight check after the brief leak inspection, turn on power while short-circuiting the AP pins. Again feed nitrogen gas to obtain a system pressure of 3.6 MPa. Then measure both the outdoor ambient temperature and the pressure in the system. Leave the system in this state for 1 full day and night, and again measure the outdoor ambient temperature and pressure (to determine any reduced values). During the inspection, it is recommended that an awning or cover be used to shield the unit in case of rain. If no problem is found, purge all nitrogen from the system.

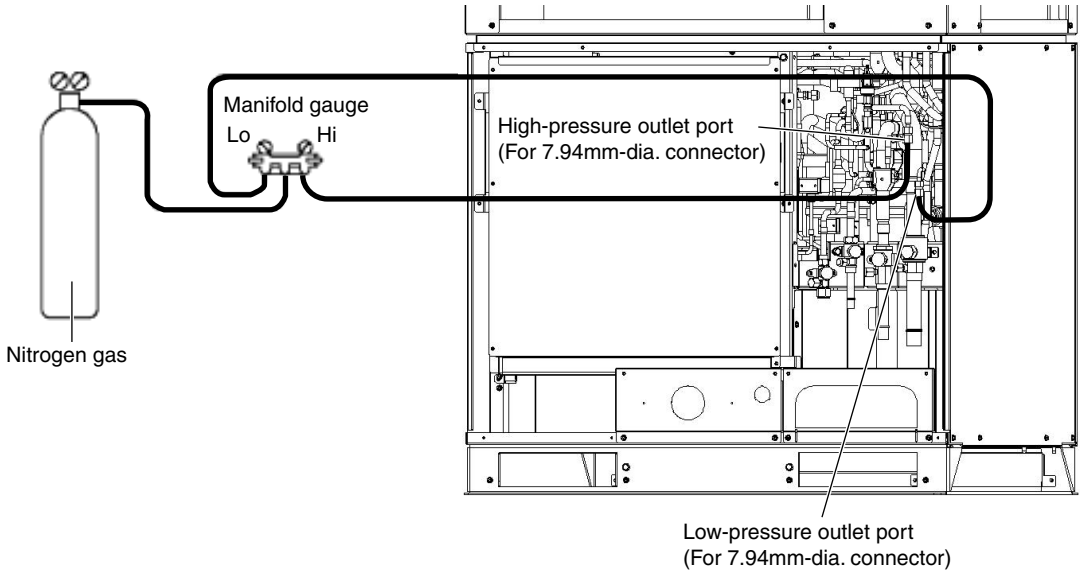


Fig. 10

6-2. Checking for Leakage in Refrigerant Tubing Between Indoor and Outdoor Units

Refer to the “Installation Instructions” that came with the outdoor unit.