ENG

USER MANUAL

BLAUBERG

OUTDOOR UNIT MINI-VRF

Used for:

BLAUBERG BLHV-R125-O/3R1A
BLAUBERG BLHV-R140-O/3R1A
BLAUBERG BLHV-R160-O/3R1A
BLAUBERG BLHV-R180-O/3R1A
BLAUBERG BLHV-R200-O/3R1A
BLAUBERG BLHV-R224-O/3R1A
BLAUBERG BLHV-R260-O/3R1A
BLAUBERG BLHV-R280-O/3R1A
BLAUBERG BLHV-R335-O/3R1A

INSTALLATION AND OPERATING MANUAL

CONTENTS

The unit contains fluorinated greenhouse gas R410A
Global warming potential (GWP): 2087.5

1. SAFETY REQUIREMENTS

WARNING

* This air conditioner is designed to create a comfortable microclimate and should not be used in special places where precise temperature control is required for storing tools, food, plants, poultry, artwork, etc.
- Installation works must be performed by the distributor, its service agent or similar qualified personnel. The person performing the installation works must have the appropriate knowledge, otherwise incorrect operation of the device may result in fire, electric shock, personal injury, water leakage, etc.
- If the air conditioner is installed in a small room, appropriate precautions must be taken to ensure that the refrigerant concentration in the room does not exceed the critical level. For more information, please consult your distributor.
- When connecting to the power mains, follow the regulations established by your local power provider.
- Reinstallation and dismantling works should be performed by the distributor, its service agent, or similarly qualified persons.
- Incorrect installation may result in fire, electric shock, personal injury, water leakage, etc. Do not attempt to install the product, connect it to the mains, or perform maintenance yourself. This is unsafe and impossible without special knowledge.
- Incorrect repairs may result in fire, electric shock, personal injury, water leakage, etc., therefore repairs must be carried out by a distributor or professional technician.
- This appliance can be used by children aged from 8 years and above and persons with reduced physical, sensory or mental capabilities or lack of experience and knowledge if they have been given supervision or instruction concerning use of the appliance in a safe way and understand the hazards involved.
- Supervise the children and do not let them play with the unit.
- Cleaning and user maintenance shall not be made by children without supervision.
- The main board must be connected via a fuse: see settings 5-1 on page 19.

NOTE

- Make sure that the water drainage system is suitable for use.
- Make sure that the overcurrent protection switch is installed. Otherwise, electric shock hazard may occur.
- Do not use the unit in a hazardous or explosive environment containing spirits, gasoline, insecticides, etc.
- Make sure that the mounting base and lifting devices are reliable and secure. Otherwise, an accident may occur.
- Make sure that all cables are correctly connected. Incorrect connection of cables can damage electrical components.
- In the event of a refrigerant leak during installation, immediately ventilate the room. Prevent the refrigerant from exposure to flame sources to avoid release of toxic gases.
- Make sure that there are no refrigerant leaks after completing the installation works.
- If the refrigerant in a room is exposed to a flame source, such as a heater, stove or electric cooker, toxic gases are produced.
- The product must be equipped with a lightning protection device in accordance with national laws and regulations in order to protect against lightning strikes.

2. INSTALLATION AND SET-UP

2-1. Receiving the product and inspecting the packaging

1) On receipt of the product, check for any damage that may have occurred during transportation. If there is any surface or internal damage, please notify the transport company in writing.
2) On receipt of the product, check that the type, specification and packaging are correct.
3) When unpacking the product, make sure to keep the manual and check all the accessories.

2-2. Refrigerant pipe

1) Installation of the refrigerant pipes must be carried out using refnet joints (Y-branch fittings) manufactured by our company.
2) Use a pipe with the specified diameter and wall thickness for the refrigerant pipework.
3) A protected nitrogen filling must be used to weld the copper pipe. Prior to welding, the copper pipe must be filled with nitrogen at a pressure of 0.2 kgf/cm². After welding, the nitrogen supply must be shut off until the pipe's cooldown.
4) The refrigerant pipe must be insulated.
5) After installing the refrigerant pipe, do not switch on the indoor unit until the leakage test and vacuuming have been completed.

2-3. Airtightness test

Once the refrigerant pipe is installed, it must be filled with nitrogen at 40 kgf/cm² (4 MPa) simultaneously from both the gas and liquid sides for performing a 24-hour airtightness test.

2-4. Vacuuming

After the airtightness test, a vacuuming (-0.1 MPa) must be performed simultaneously from both the gas and liquid sides.

2-5. Refrigerant charging

1) The charge refrigerant volume to be added is calculated based on the diameter and length (actual length) of the liquid side pipe of the indoor and outdoor units.
2) The refrigerant charge volume, the diameter and length (actual length) of the liquid pipe, and the height difference between the indoor and outdoor units must be recorded in the outdoor unit usage confirmation table (on the cover of the electronic control unit) for future reference.

2-6. Electrical wiring

1) The power supply output and wire diameter should be selected according to the design manual.
2) To prevent the air conditioner from malfunctioning, do not intertwine or wind the power line (220~240V/380~415V 3N) with the connecting low-voltage wires of the indoor and outdoor units.
3) The indoor unit is switched on after performing the airtightness test and vacuuming.

2-7. Testing

1) Before running the test, the outdoor unit must remain connected to the power mains and powered on for at least 12 hours to warm up, otherwise the system may be damaged.

3. OUTDOOR UNIT MOUNTING

WARNING

- The air conditioner mounting surface must be strong enough to support the weight of the unit.
- If the surface is not sufficiently strong, the unit may fall and cause injury.
- The unit must be installed in a location that is protected from strong winds.
- Incorrect installation may result in accidents.

3.1. Selecting the mounting location

1) Before mounting, ensure sufficient space for installation and maintenance.
2) The location must be free from obstructions at the air inlet and outlet and away from strong winds.
3) Mount in a dry and well-ventilated place.
4) Mount on a flat support surface capable of supporting the weight of the outdoor unit. The unit must be mounted horizontally and not cause any noise or vibration.
5) Do not store any explosive or highly flammable substances in close proximity to the unit.
6) While mounting the unit provide the minimum required access to the unit for maintenance and repair.

3.2. Dimentsions of the outdoor unit [mm]

1) Fig. 3-1 refers to 12.5 kW (200V-220V), 14 kW, 16 kW models.

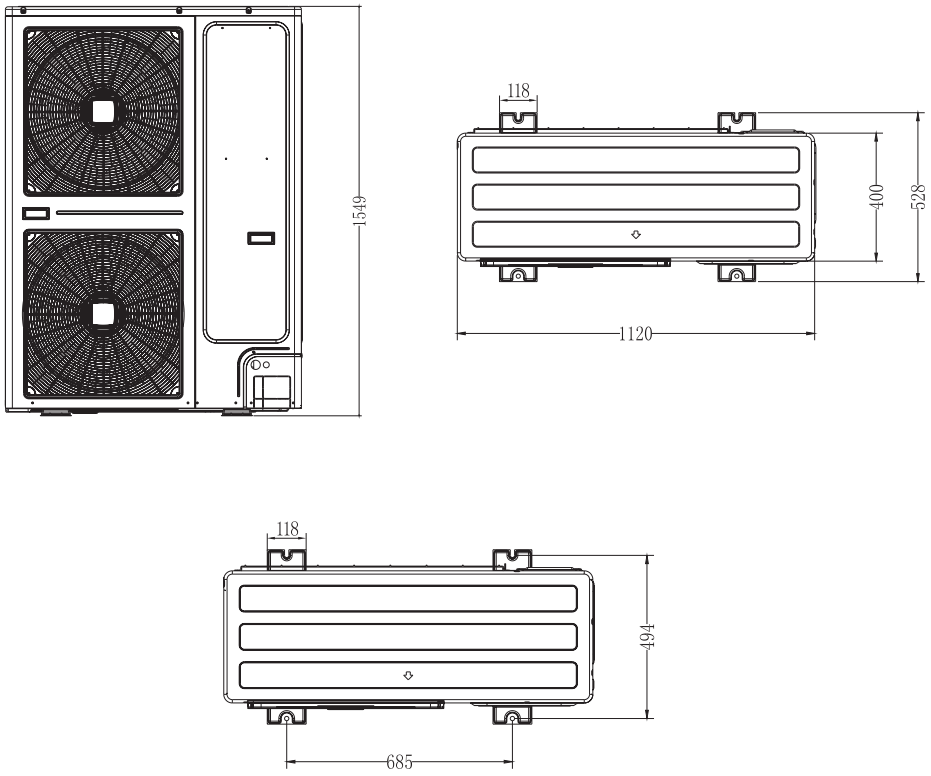


Fig. 3-1 (260/280/335)

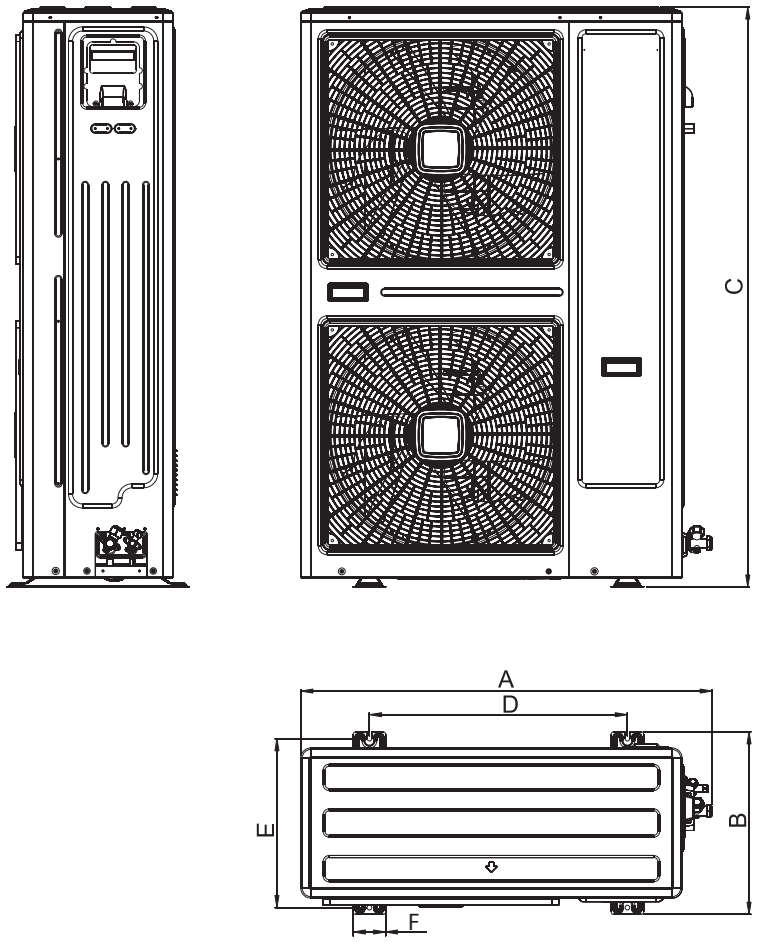


Fig. 3-2 (125-224)

Table 3-2 [mm]

Outdoor unit model / Dimension code	**A**	**B**	**C**	**D**	**E**	**F**
200/224	1015	450	1430	636	417	80
125/140/160/180	975	400	1335	586	370	80

3-4. Storage and transportation regulations

1) Do not remove any packaging when lifting the unit. Lift and carry the unit using two ropes, keeping at least 8 cm between the packaging and the floor. The unit must be balanced and lifted in a safe and secure manner. If there is no packaging or the packaging material is damaged, use pads or packaging materials to protect the unit.
2) The outdoor unit should be carried and lifted in a vertical position with a maximum inclination of 15° prioritising safety precautions when carrying and hoisting.
3) The centre of gravity of the unit is not in the middle of the assembly, so be careful when hoisting the unit.
4) Do not hold the unit by the intake outlet on the casing, to avoid deformation. While installling the unit, avoid compression of the casing!

3-5. Place for installation and maintenance of the outdoor unit

1) Ensure a secure and reliable foundation in order to:
   - prevent the outdoor unit from tilting;
   - prevent increased noise due to installation on an inadequate mounting surface.
2) Mounting surface types:
   - steel structure;
   - concrete structure (shown in the figure below).

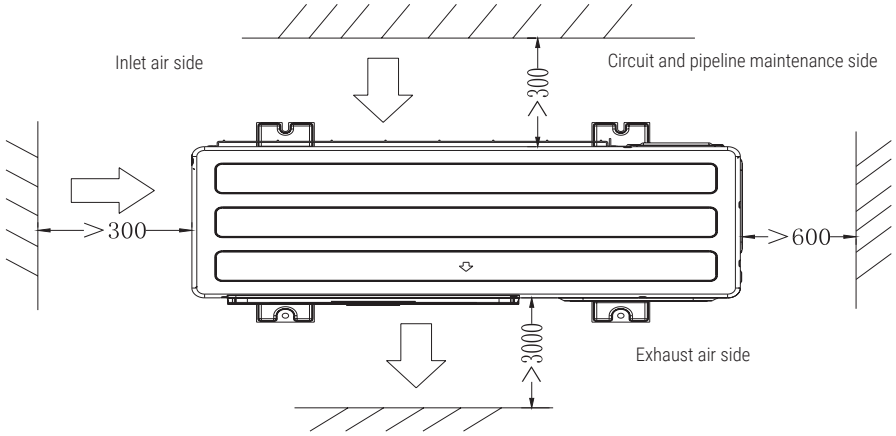


Fig. 3-3

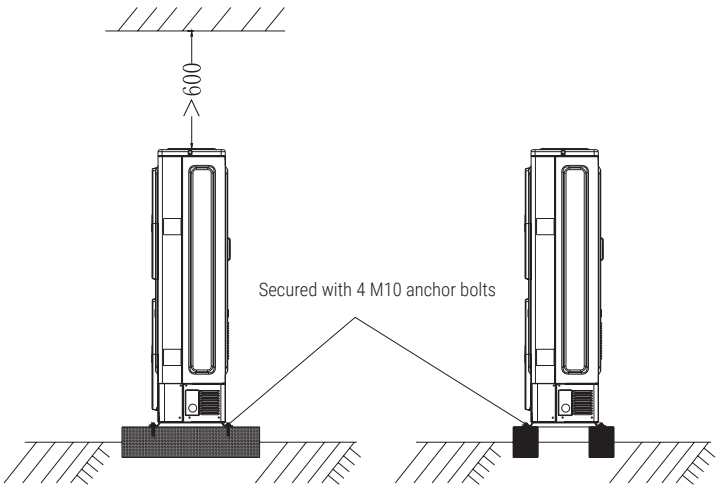


Fig. 3-4

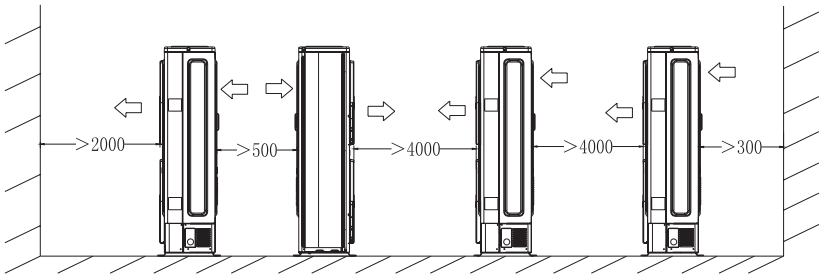


Fig. 3-5

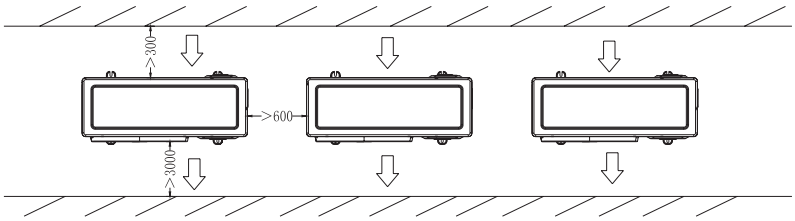


Fig. 3-6

3-6. Position and installation of the outlet pipe

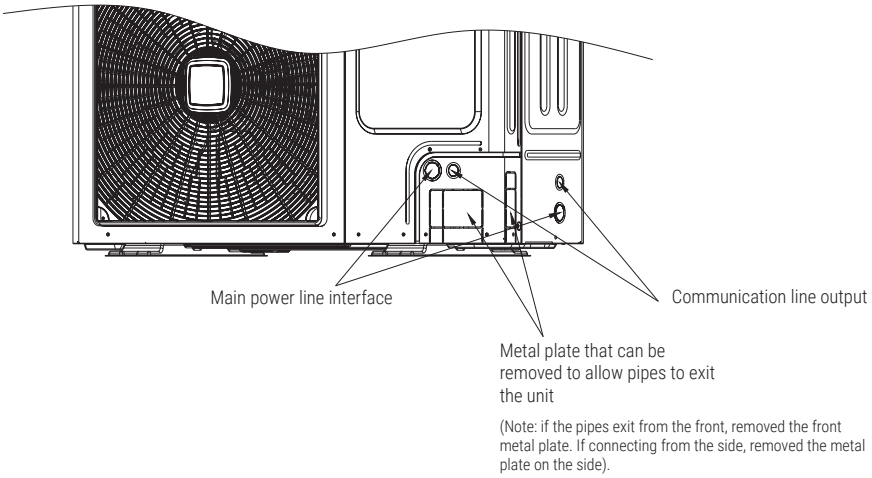


Fig. 3-7

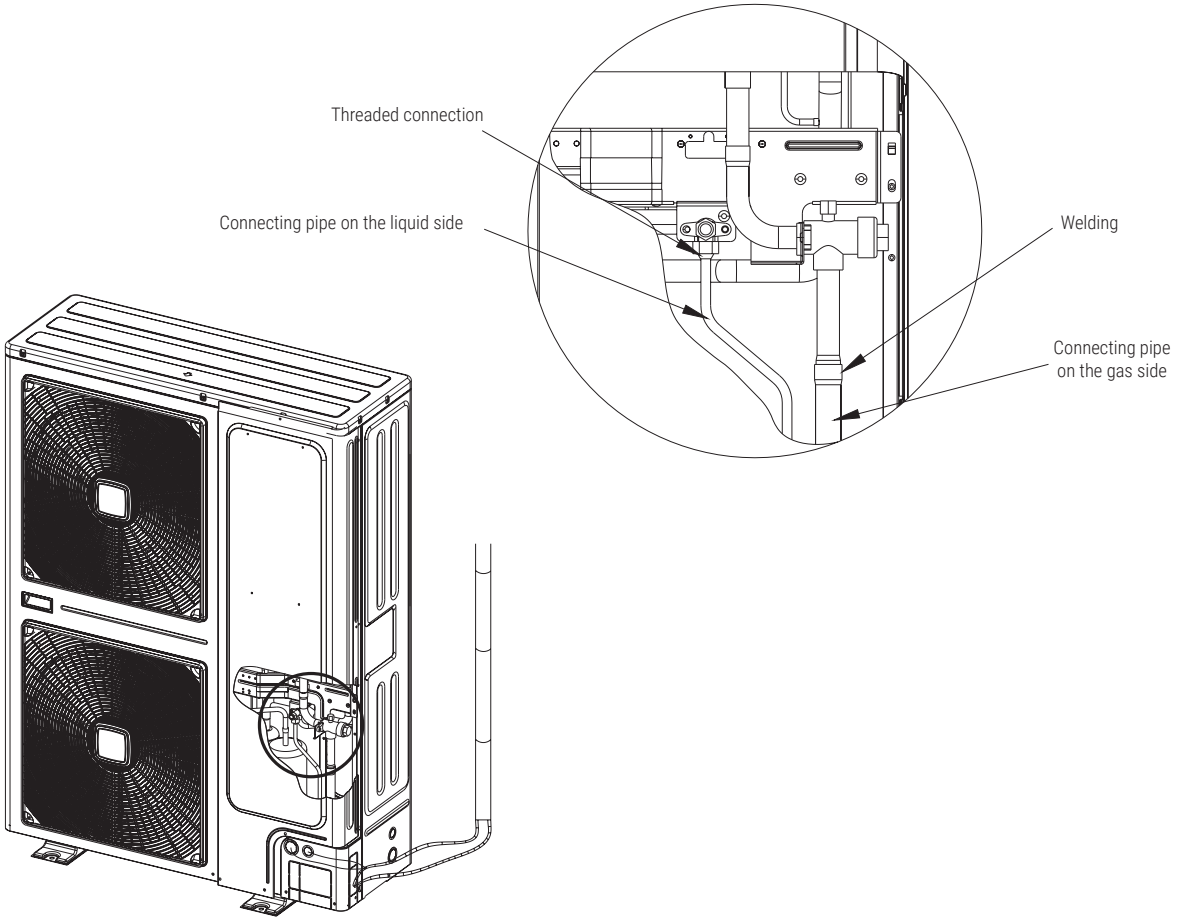


Fig. 3-8

3-7. Drainage system connection

Connect the drainage system as shown in Figure 3-9. Install the outlet pipe or plug together with the casing and then connect the central drainage system.

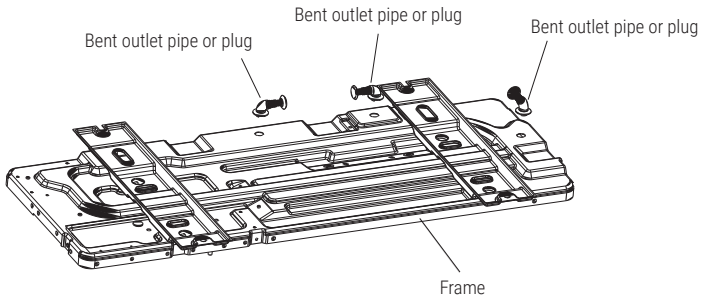


Fig. 3-9

4. CONNECTING PIPE INSTALLATION

4.1. Refrigerant pipe

4-1-1. Flaring

Use a pipe cutter to cut the refrigerant pipe and a pipe expander to flare it.

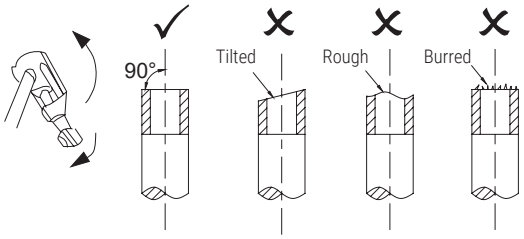
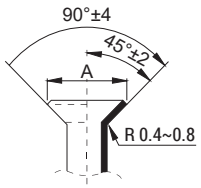


Fig. 4-1. Cutting the connecting pipe

Table 4-1. Flaring size of connection tube

Outer diameter [mm]	A [mm]	
	Minimum	Maximum
∅ 6.4	8.7	8.3
∅ 9.5	12.4	12.0
∅ 12.7	15.8	15.4
∅ 15.9	19.0	18.6
∅ 19.1	23.3	22.9



4-1-2. Fastening nut

Align the connecting pipe, tighten it by hand and then with a wrench.

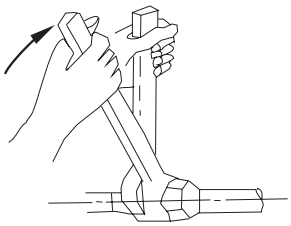


Table 4-2. Tightening torque

Pipe dimensions [mm]	Tightening torque, Nm
∅ 6.4	14.2-17.2 Nm (144-176 kgf*cm)
∅ 9.5	32.7-39.9 Nm (333-407 kgf*cm)
∅ 12.7	49.5-60.3 Nm (504-616 kgf*cm)
∅ 15.9	61.8-75.4 Nm(630-770 kgf*cm)
∅ 19.1	97.2-118.6 Nm (1115-1364 kgf*cm)

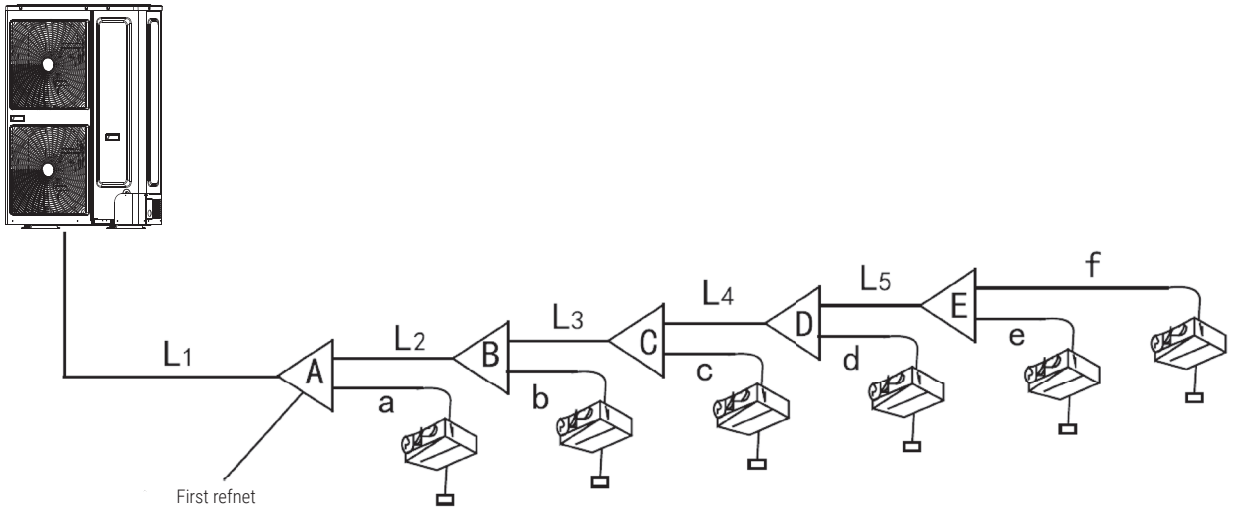
NOTE

- To prevent internal oxidation of the copper pipe after welding, it must be filled with nitrogen, otherwise the oxide film will block the cooling system!
- When tightening the nut, too much force can damage the flaring and too little can result in leakage. Refer to the table above for nut tightening torque.

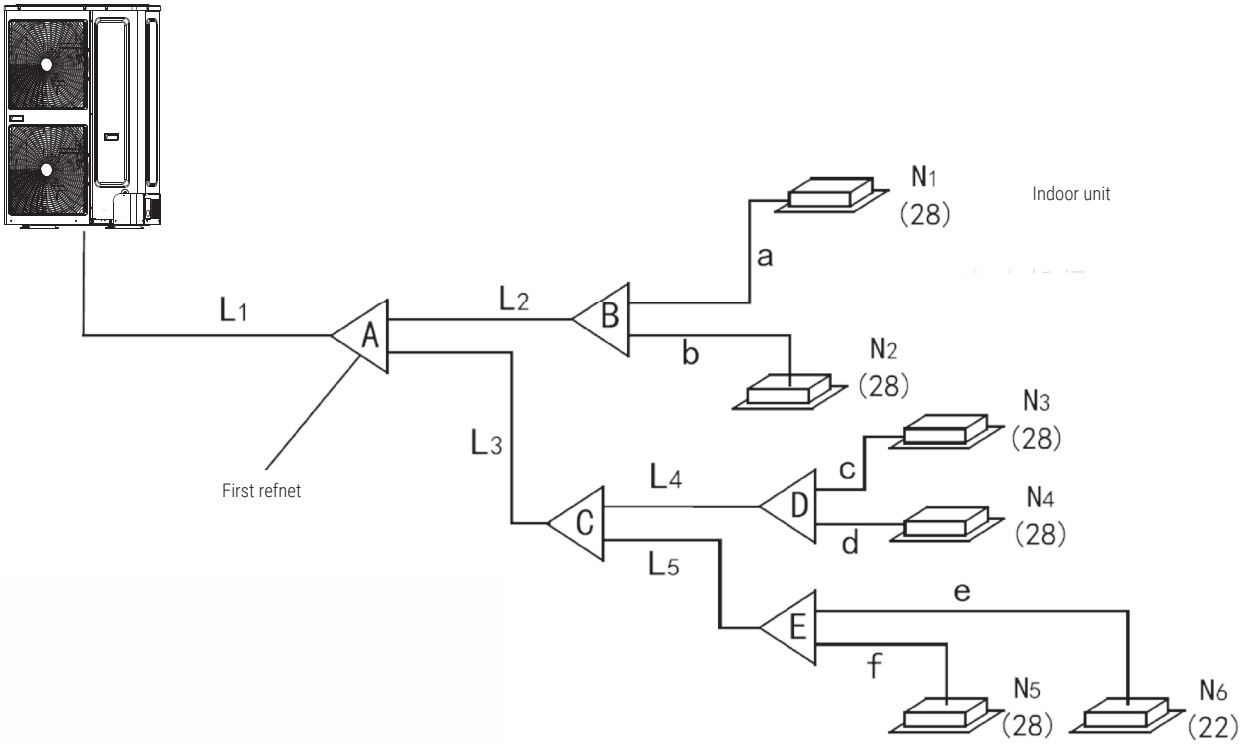
4.2. Determining the refrigerant pipe size and pipe connection sequence

Pipe name	Pipe connection position	Code
Main pipe	The pipe between the outdoor unit and the first indoor refnet	L_1
Main pipe of indoor units	The pipe behind the first indoor refnet and indirectly connected to the indoor units	L_2~L_5
Indoor unit pipe	The pipe behind the refnet and directly connected to the indoor unit	A, b, c, d, e, f
Refnet components for the indoor unit assembly	The coupler for connecting the main pipe, the main pipe to the indoor units and the pipe to the indoor unit	A, B, C, D, E

Connection option I



Connection option II



NOTE

- All distributors must use our company's refnets. Failure to do so may result in severe system malfunction!
- The indoor unit must be installed in the same way on both sides of the U-shaped refnet.

4.3. Determining the main pipe diameter (L_1)

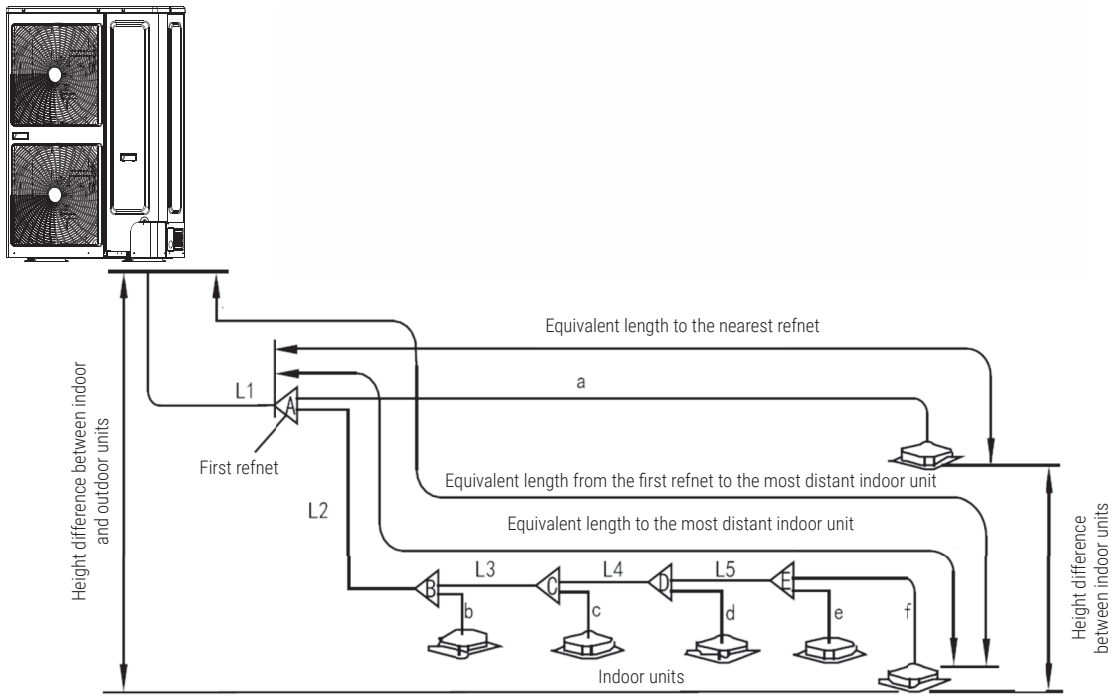
Outdoor unit power output, kW	Pipe				
	Main pipe dimensions [mm]				
	L_1<30 m		L_1≥30 m		First refnet
	Liquid pipe	Gas pipe	Liquid pipe	Gas pipe	
12.5/14/16	∅ 9.52	∅ 15.88	∅ 9.52	∅ 19.05	BL-SP-A01D
18/20/22.4	∅ 9.52	∅ 19.05	∅ 9.52	∅ 22.2	BL-SP-A01D
26.0	∅ 9.52	∅ 22.2	∅ 12.7	∅ 25.4	BL-SP-A02D
28.0	∅ 12.7	∅ 28.6	∅ 12.7	∅ 28.6	BL-SP-A03D
33.5	∅ 12.7	∅ 28.6	∅ 12.7	∅ 28.6	BL-SP-A03D

4.4. Determining the indoor unit main pipe diameter (L2-L5)

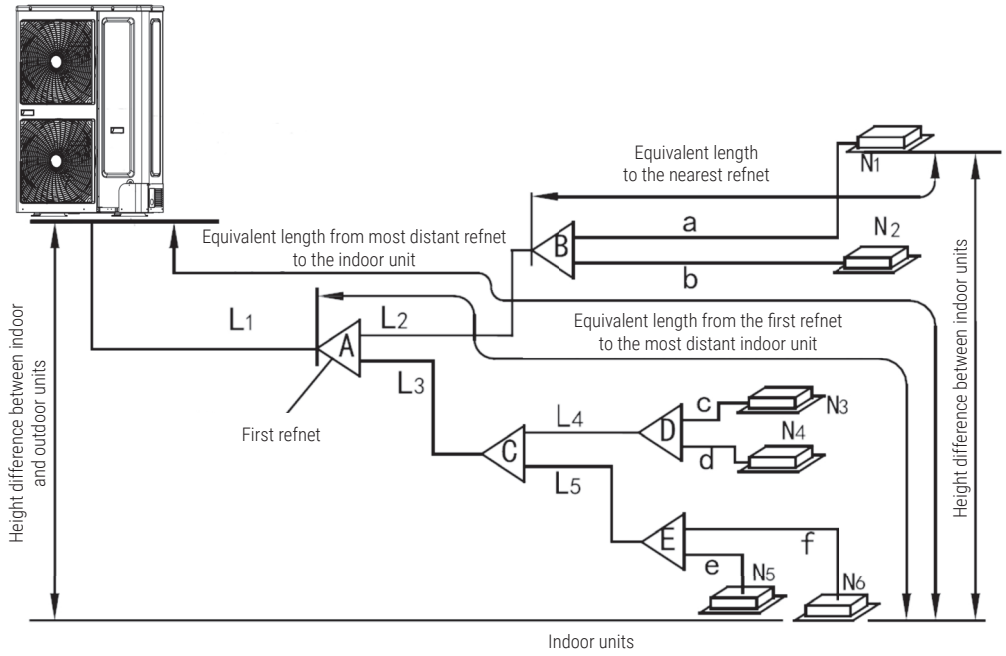
Power output of subsequent indoor units, kW	Length of the equivalent pipe of the lower circuit		
	Indoor unit main pipe dimensions		Used for refnet
	Liquid pipe [mm]	Gas pipe [mm]	
W<6.5	∅ 9.52	∅ 12.7	BL-SP-A01D
6.5≤W<18	∅ 9.52	∅ 15.88	BL-SP-A01D
18≤W<22.4	∅ 9.52	∅ 19.05	BL-SP-A01D
22.4<W<28	∅ 9.52	∅ 22.2	BL-SP-A02D
28≤W≤33.5	∅ 12.7	∅ 28.6	BL-SP-A02D

4.5. Allowed refrigerant piping length and height differences.

Connection option I



Connection option II

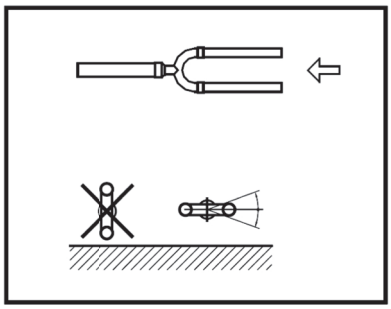


				Allowed value	Pipeline designation
12.5 kW 14.0 kW 16.0 kW 18.0 kW 20.0 kW 22.4 kW	Pipeline length	Total pipe length		≤100 m	L1+L2+L3+L4+L5+a+b+c+d+e+f
		Length of the most distant pipe L	Actual length	≤60 m	L1+L2+L3+L4+L5+f (connection option 1) L1+L3+L5+f (connection option 2)
			Equivalent length	≤70 m	
		Equivalent length from the first refnet to the most distant indoor unit		≤20 m	L2+L3+L4+L5+f (connection option 1) L3+L5+f (connection option 2)
		Equivalent length to the nearest refnet		≤15 m	a, b, c, d, e, f
	Height difference	Height difference between indoor and outdoor units	The outdoor unit is higher	≤30 m	-
			The outdoor unit is lower	≤20 m	-
		Height difference between indoor units		≤8 m	-

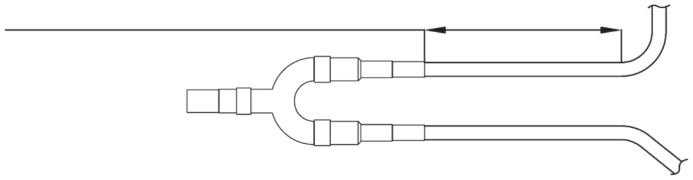
				Allowed value	Pipeline designation
26.0 kW 28.0 kW 33.5 kW	Pipeline length	Total pipe length		≤120 m	L1+L2+L3+L4+L5+a+b+c+d+e+f
		Length of the most distant pipe L	Actual length	≤60 m	L1+L2+L3+L4+L5+f (connection option 1) L1+L3+L5+f (connection option 2)
			Equivalent length	≤70 m	
		Equivalent length from the first refnet to the most distant indoor unit		≤20 m	L2+L3+L4+L5+f (connection option 1) L3+L5+f (connection option 2)
		Equivalent length to the nearest refnet		≤15 m	a, b, c, d, e, f
	Height difference	Height difference between indoor and outdoor units	The outdoor unit is higher	≤30 m	-
			The outdoor unit is lower	≤20 m	-
		Height difference between indoor units		≤8 m	-

4.6. Refnet installation

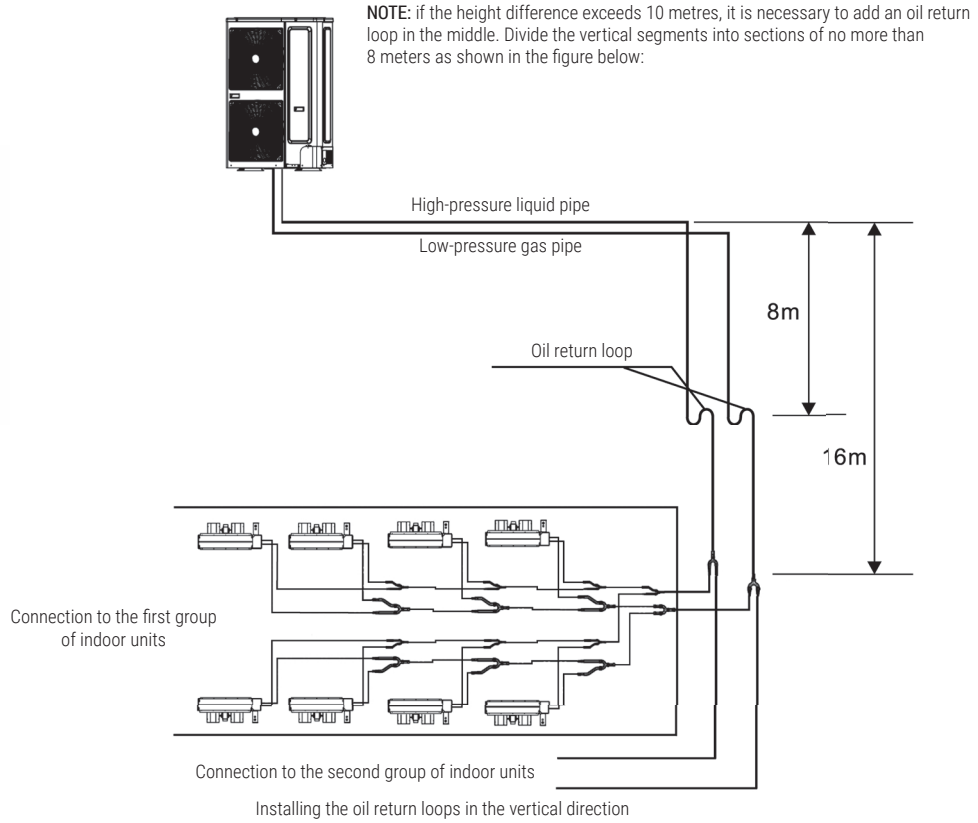
1) The refnet should be U- or Y-shaped instead of T-shaped.
2) The refnet must be installed in a horizontal position with a deflection angle of no more than ±10 °C.
3) The refnet installation site must be followed by a straight pipe section of a minimal length of 0.8 m.



The pipe may only be turned after a straight section of at least 0.8 m

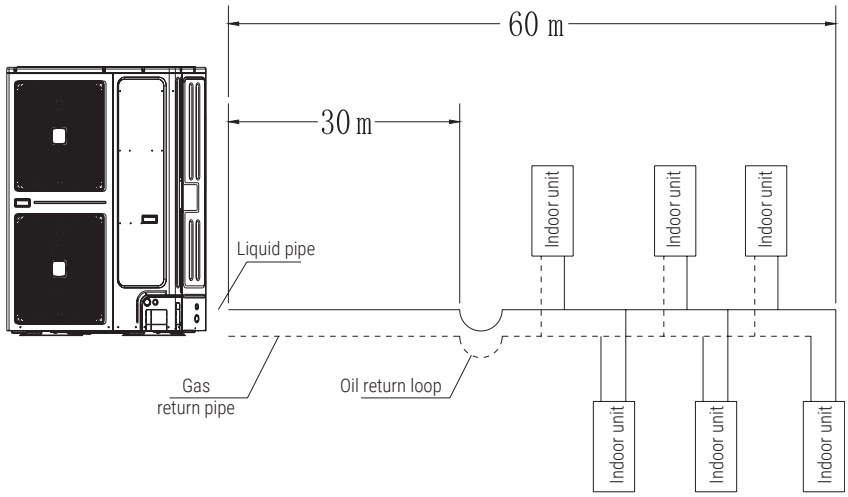


4-7. Oil return loop configuration



Installing the oil return loops in the vertical direction

NOTE: when the horizontal distance exceeds 40 m, it is necessary to add an oil return loop in the middle. Divide the horizontal segments into section of less than 30 m, as shown in the figure.



Installing the oil return loops in the horizontal direction

4-8. Removing foreign objects from the pipeline

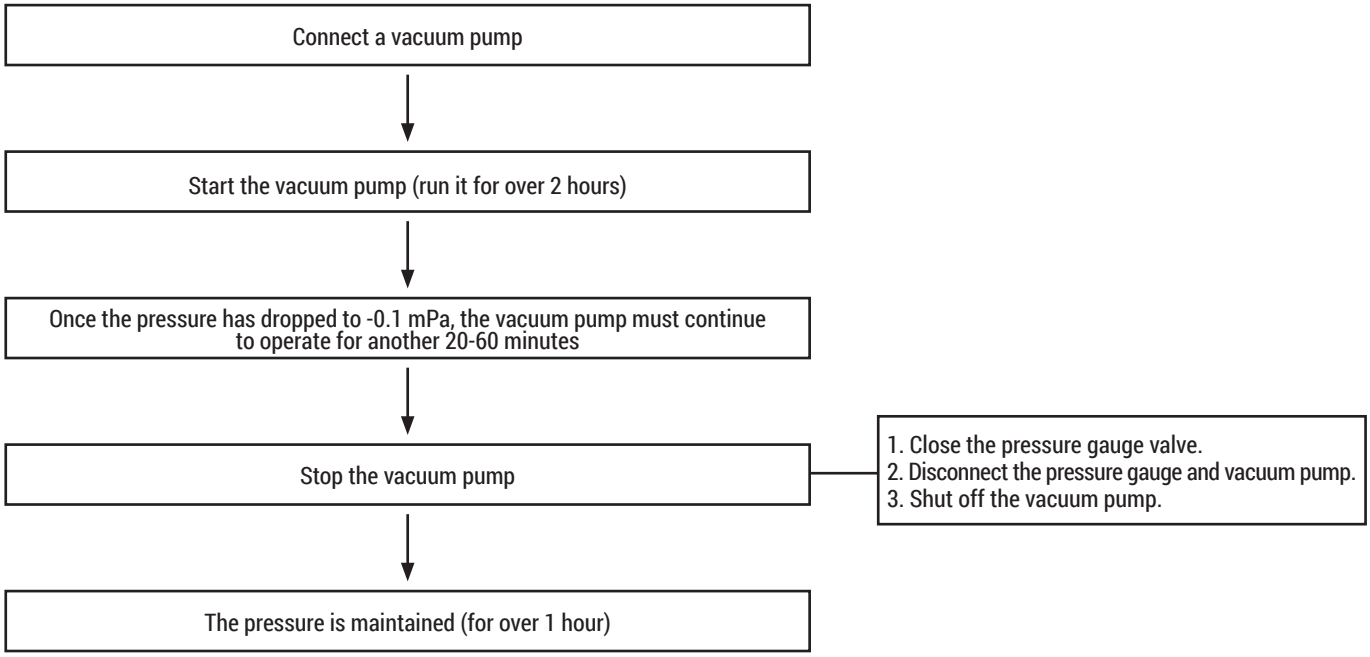
1) Any foreign material that entered the refrigerant pipe during installation should be removed with high pressure nitrogen.
2) Do not connect the indoor unit during cleaning.
3) Do not use refrigerant or oxygen or any other flammable toxic gas instead of nitrogen.

4-9. Airtightness test

1) After the refrigerant pipe is installed and connected to the indoor unit, and before the connecting pipes between the indoor and outdoor units are connected to the outdoor unit valves, charge nitrogen at a pressure of 40 kgf/cm² (4 MPa) on the gas side and liquid side. Simultaneously, mark the pressure valve and then perform a 24-hour airtightness test.
2) If the pressure drops, check all connections for leaks and then maintain the pressure for 24 hours.
3) Do not connect to the outdoor unit while maintaining pressure.

4-10. Vacuuming with a vacuum pump

1) The vacuum pump must maintain a pressure of less than -0.1 MPa and an air flow rate of at least 40 l/min.
2) There is no need to vacuum the outdoor unit, it is forbidden to open the shut-off valves on the gas and liquid side of the outdoor unit.
3) Make sure that the vacuum pump can reduce the pressure to -0.1 MPa within 2 hours; if it does not reduce to -0.1 MPa after 3 hours, check for moisture or air leaks.
4) The vacuum pump must be equipped with a check valve.



NOTE

- Do not mix the tools and measuring instruments that are used to work with different refrigerants or come into direct contact with the refrigerant.
- Do not suck out the air containing refrigerant.
- If the vacuum does not reach -0.1 mPa, check for leaks and if there are none, try leaving the pump running for another 1-2 hours.

4.11 Refrigerant charge volume

The refrigerant charge volume (R410A) is calculated based on the diameter and length of the pipe on the liquid side of the indoor and outdoor units.

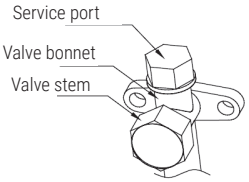
Liquid side pipe diameter [mm]	Refrigerant charge volume per 1 m of pipe [kg]
∅ 6.35	0.022
∅ 9.52	0.054
∅ 12.7	0.110

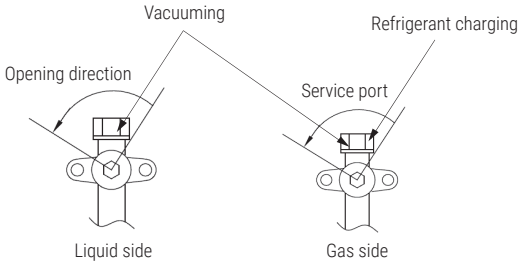
NOTE

- The R410A refrigerant must be weighed on an electronic scale and charged in liquid form.

4.12. Shut-off valve operation instructions

1) At the time of delivery, the shut-off valve is closed.
2) Open the valve counterclockwise or close it clockwise using a 6 mm socket wrench.
3) Tighten the valve cover when the operation is complete.
4) Use a tool designed for use with R410A refrigerant to vacuum the valve and charge the refrigerant. Charge the refrigerant through the service valve on the gas side and simultaneously vacuum the service valve on the liquid and gas sides.





4.13. Thermal insulation of pipes

1) Apply the insulation to the gas and liquid sides of the pipes respectively.
2) Use closed-cell insulation materials with fire resistance rating B1 and resistance to high temperatures of 120 °C.
3) The outer diameter of the copper pipe must be ≤φ 12.7 and thickness of the insulation wool ≥ 15 mm;
   the outer diameter of the copper pipe ≥ φ 15.88 and thickness of the insulation wool ≥ 20 mm.
4) The nut connections of the indoor unit must be insulated.

5. ELECTRICAL WIRING

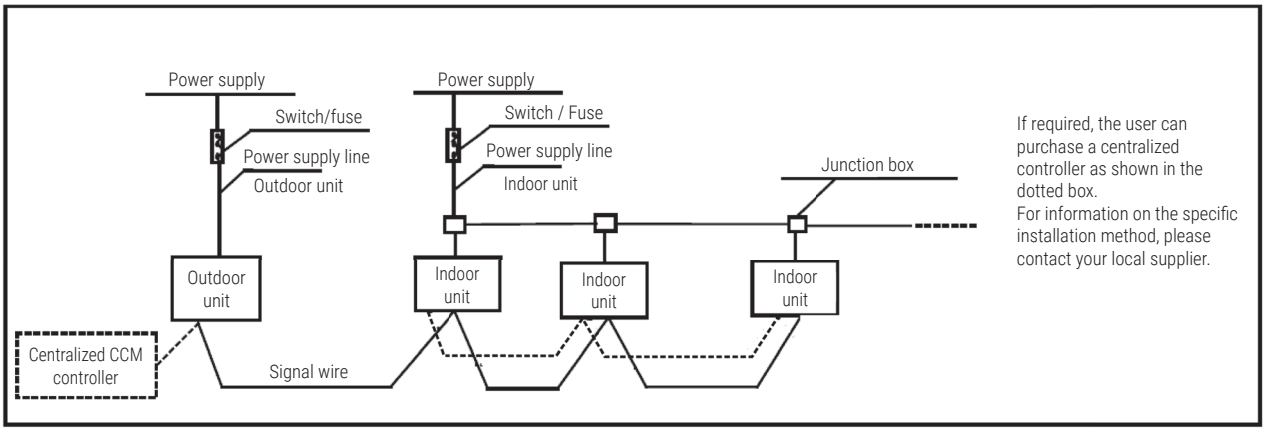
WARNING

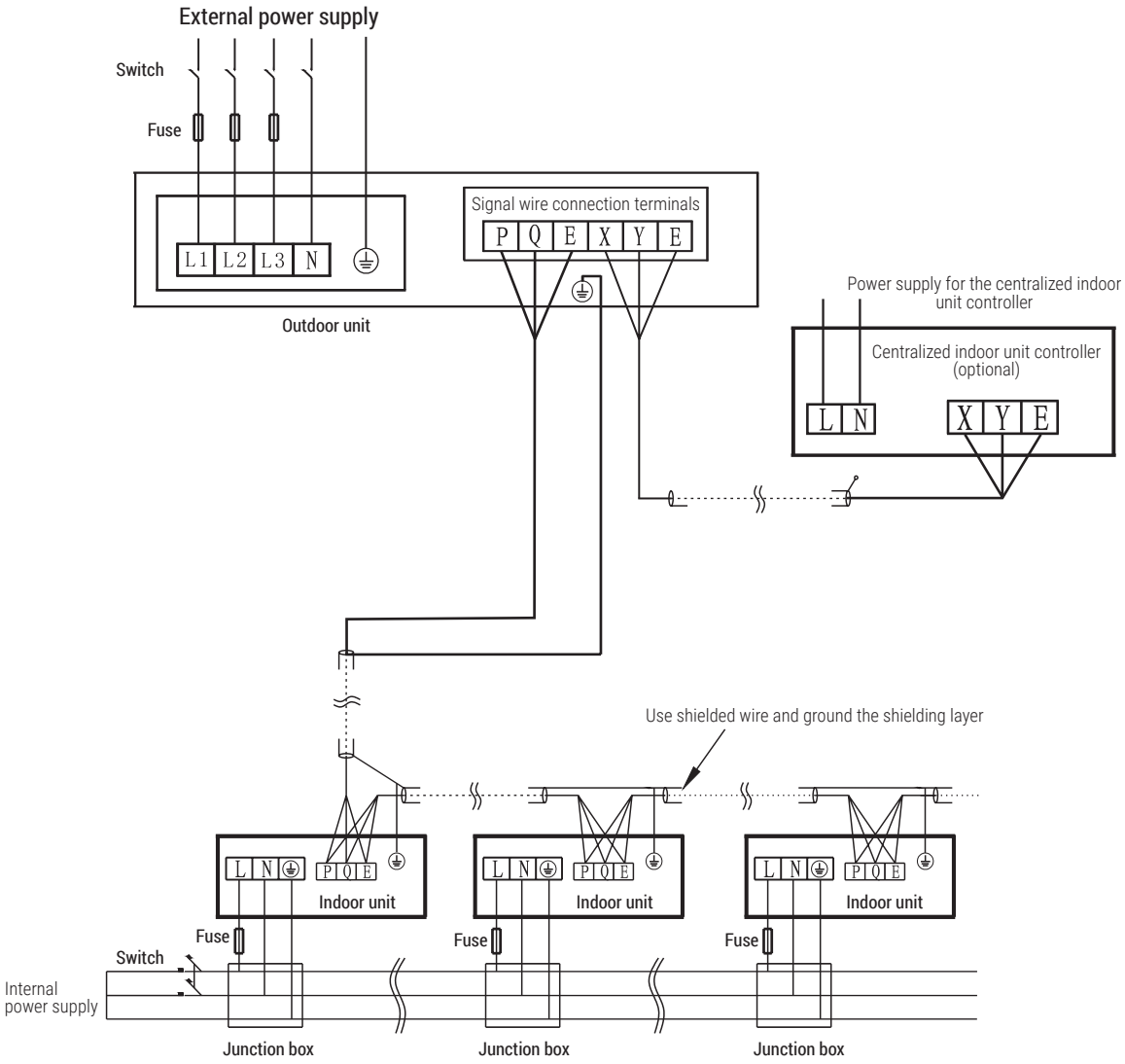
1) Separate power supplies are required for indoor and outdoor units.
2) The power supply must be designed with a sub-circuit, equipped with overcurrent protection and a manual switch.
3) All indoor units in the same system must be connected to the same power circuit and turned on/off at the same time, each indoor unit cannot be equipped with a separate power switch.
4) The connecting wire system and refrigerant piping system of the indoor and outdoor units should be combined into one system.
5) To reduce interference, the internal and external signal cables must be 3-core shielded cables instead of the usual multicore cables.
6) Electrical wiring must be arranged in accordance with the local national standards.
7) The product must be connected to power mains by a qualified electrician.

5.1. Connection to power mains

Table 5-1. Connection to power mains

Power supply		125/140/160/180	200/224/260	280	335
Outdoor unit power supply	Phase	3 phase	3 phase	3 phase	3 phase
	Voltage and frequency	380-415 V 50 and 60 Hz	380-415 V 50 and 60 Hz	380-415 V 50 and 60 Hz	380-415 V 50 and 60 Hz
	Power cable [mm^2]	5x2.5	5x6	5x6	5x6
Switch / fuse, A		25	30	40	40
Indoor/outdoor unit signal cable [mm^2] (low-current signal wire)		3-core shielded wire 3x0.75		2-core shielded wire 2x0.75	



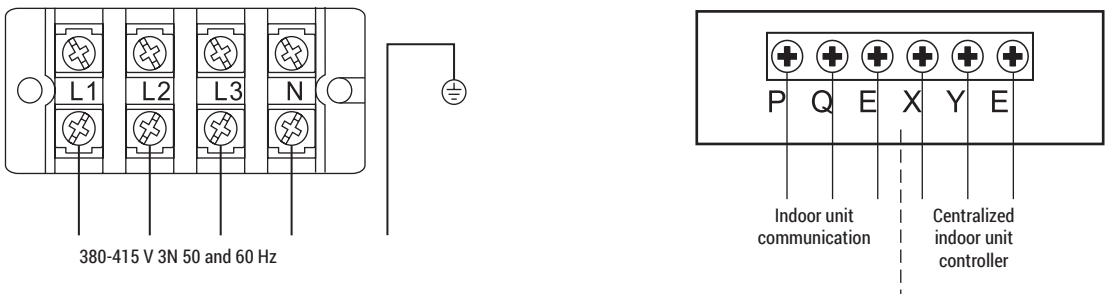


Electrical connection of outdoor units

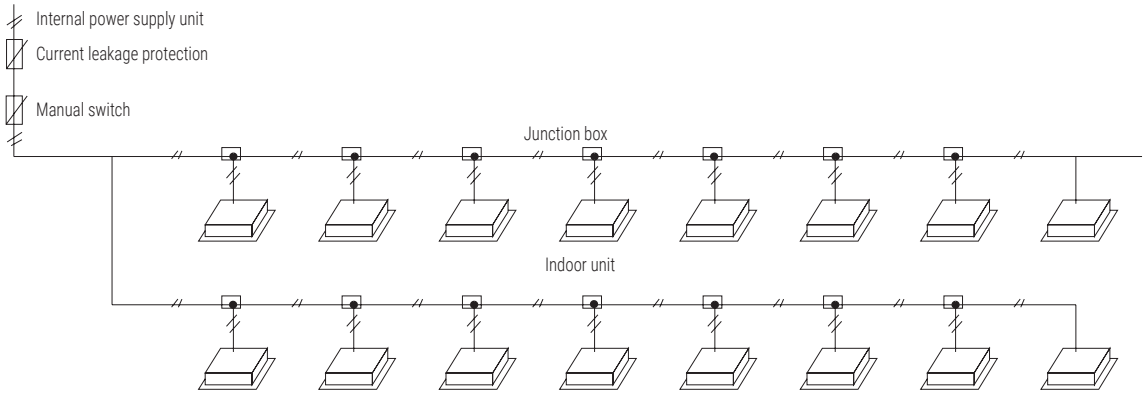
NOTE: 1. If the signal line uses a two-core shielded cable, the shielding mesh must be connected to terminal block ""E"". If the signal line uses three-core shielded cable, the shielding mesh must be grounded.

2. Do not connect the power line (strong current) to the terminal block of the signal line (weak current). This may result in the power supply board burning out.

5-2. Terminal functions description



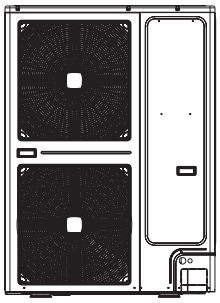
5.2. Connecting the power supply to the indoor unit



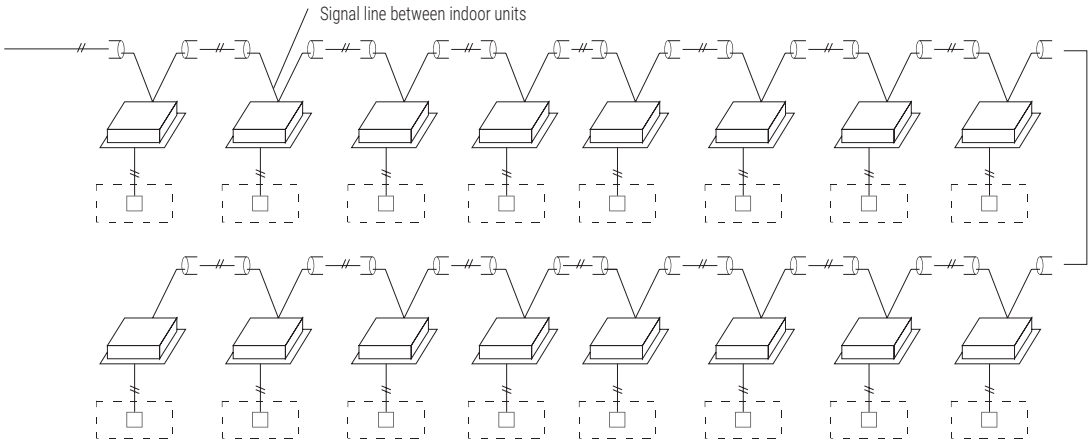
NOTE

- If the power supply line is parallel to the signal line, route the electrical cables in separate cable ducts with the correct cable spacing (10 A or less - 300 mm, 50 A or less - 500 mm).

5.3. Connecting the indoor unit signal line



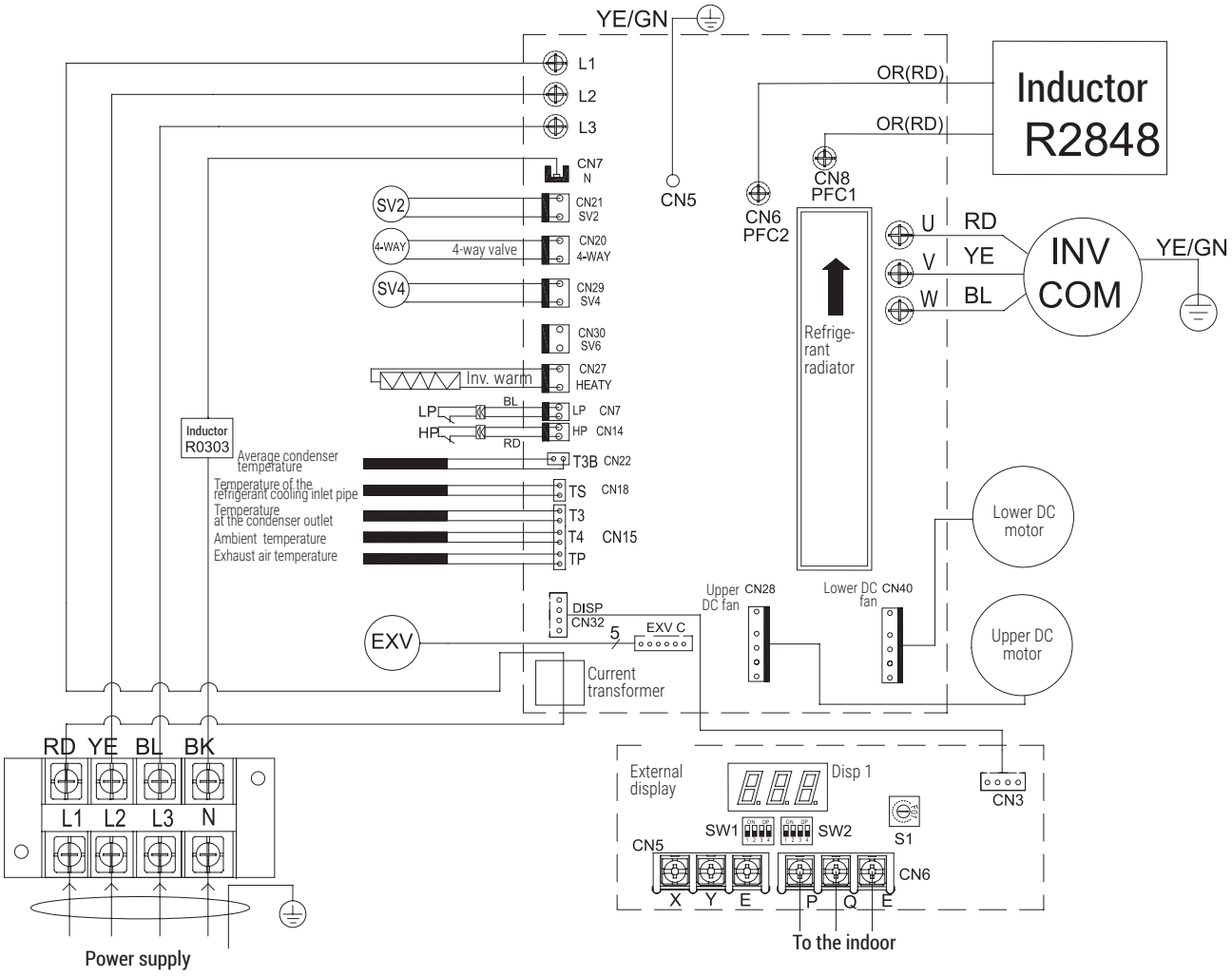
Signal lines for indoor and outdoor units



If necessary, the user can purchase a wired remote controller as shown in the dotted box.

5-4. Wiring diagram

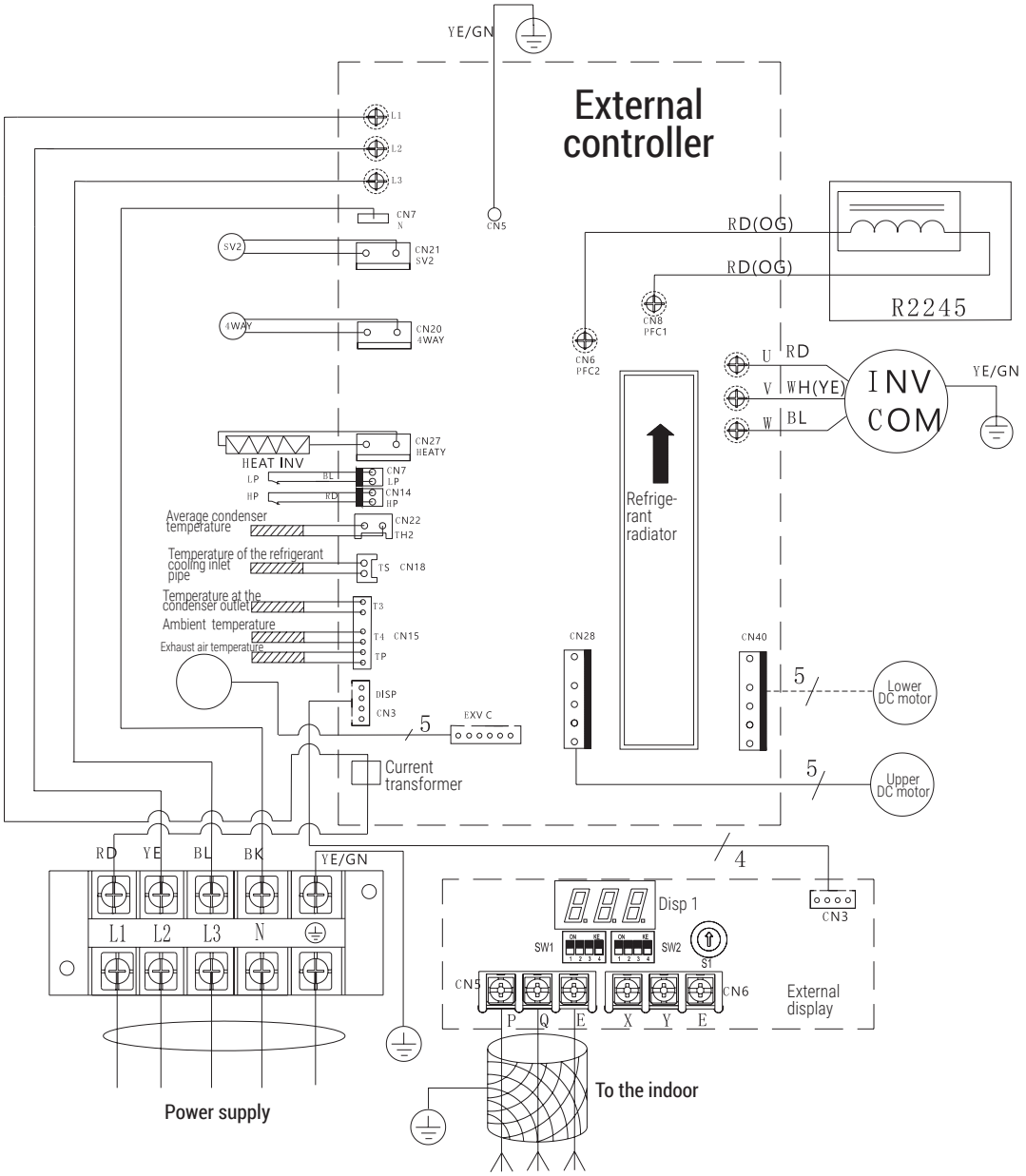
260/280/335



NOTE: the power line where the current transformer is located passes through the current transformer.

5-4. Wiring diagram

125-224



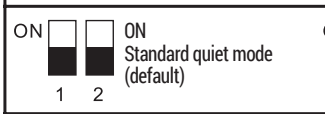
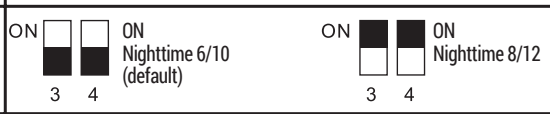
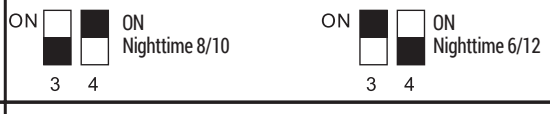
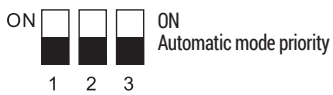
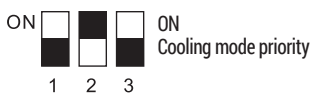
NOTE: the power line where the current transformer is located passes through the current transformer.

Table 5-5. Outdoor unit inspection instructions

Description for spot checkup

Control table			
№	Value displayed	№	Value displayed
0	Frequency / number of indoor units	16	Direct current
1	External power supply	17	AC voltage (current value = display value*2)
2	Operating mode (0: closed / ventilation; 2: cooling; 3: heating; 4: forced cooling)	18	DC voltage (current value = display value*4)
3	Capacity use of all indoor units	19	Number of indoor units
4	Outdoor unit capacity according to indoor unit use	20	Number of indoor units in operation
5	Current operating capacity	21	Priority mode: 0: automatic selection; 1: heating mode priority; 2: cooling mode priority; 3: heating mode only; 4: cooling mode only; 5: in accordance with the first mode; 6: VIP+ automatic mode priority
6	Fan speed (0-8)	22	Reserved
7	Average temperature T2/T2B	23	Reserved
8	Condenser outlet temperature T3	24	Reserved
9	Average temperature of the condenser T3B	25	Reserved
10	Ambient temperature T4	26	Frequency range display: 0: unlimited frequency; 1: frequency range T3B; 2: frequency range T4; 4: frequency range TP; 8: voltage range; 16: current range; 32: range T6; 64: volume range
11	Exhaust air temperature TP	27	Last error or security code
12	Module temperature T6/T9	28	Software version
13	Temperature of the refrigerant cooling inlet pipe T7	29	Memory device version
14	Opening of the electric expansion valve (current valve = value shown *4)	30	---
15	Alternating current		

Errors and protection			
Code	Error or protection indication	Code	Error or protection indication
E1	Phase sequence fault	P1	High pressure protection
E2	Communication error between indoor and outdoor units	P2	Low pressure protection
E4	Ambient temperature sensor fault (T4)	P3	Overvoltage protection
E6	Condenser temperature sensor fault (T3)	P4	Exhaust air overheating protection
E8	TP temperature sensor fault (TP)	P5	T3 or T3B condenser overheating protection
E9	AC over-/undervoltage protection	P6	IPM module protection
E10	EEPROM fault	P9	DC fan protection
EA	Condenser temperature sensor fault (T3B)	P10	Anti-wind protection protection
Eb	Reserved	P11	Protection against excessive heating temperature T2
Ec	Fault of the sensor of temperature of the refrigerant cooling inlet pipe (T7)	P13	Abnormal current detection
H0	Communication error between main chip and DSP	Pb	Module protection against overheating
H4	P6 fault triggering three times in 30 minutes		
H5	P2 fault triggering three times in 30 minutes		
H6	P fault triggering three times in 100 minutes		
H7	Decrease in the number of indoor units		
H9	P9 fault triggering twice in 10 minutes		
H10	P3 fault triggering three times in 60 minutes		
H11	P13 fault triggering twice in 10 minutes		
H12	Pb fault triggering three times in 60 minutes		

Description of SW1 (№ 1, № 2)	**Description of SW1 (№ 3, № 4)**
	
	
Description of SW2 (№ 1, № 2, №3)	
	
	
	

6. TESTING

6.1. Inspection and confirmation before commissioning

1) Ensure that the refrigeration pipework and communication line connecting the indoor and outdoor units are connected to the same refrigeration system. Otherwise, some malfunctions may occur.
2) The supply voltage is within the rated voltage range of ±10%.
3) Ensure that the power line and control line are connected correctly.
4) Before switching on, make sure there is no short circuit.
5) Check that all units have passed the 24-hour nitrogen pressure test (40 kgf/cm²).
6) Ensure that the system has been fully vacuumed, dried and charged with refrigerant according to the instructions.

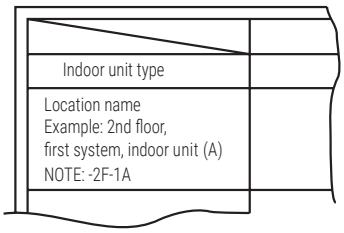


Fig. 6-1. Filling names in the system

6.2. Preparation for commissioning

1) Calculate the refrigerant charge volume for each set of units according to the actual liquid pipe length on-site.
2) Prepare the required volume of refrigerant.
3) Prepare the system plan, the system piping diagram, and the control diagram.
4) Mark the assigned address codes on the system plan.
5) Turn on the outdoor unit power switch in advance and make sure it remains operating for more than 12 hours to allow the heater to heat the compressor oil.
6) Fully open the gas pipe check valve, liquid pipe check valve, and oil balance valve of the outdoor unit, otherwise the unit may be damaged.
7) Check that the power supply phase sequence of the outdoor unit is correct.
8) Check that all dialling switches of the indoor and outdoor units are set according to the product specifications.

6.3. Filling names in the system

In case of installing multiple indoor units, in order to distinguish between the connection systems of the indoor and outdoor units, all systems must be named accordingly. The names must be specified on the cover of the external control box.

6.4. Refrigerant leakage precautions

1) The air conditioner refrigerant is environmentally friendly and non-flammable.
2) The room where the air conditioner is to be installed must have adequate space. In the event of a refrigerant leak, its concentration must not exceed the critical level. This requires appropriate measures to be taken.
3) The critical gas concentration that is harmless to human health is 0.3 kg/m³.
4) Confirm the critical concentration using the following steps and take appropriate action:
   a) Calculate the refrigerant charge volume (A(kg)).
   Volume of refrigerant = volume of refrigerant charged before delivery (see nameplate) + volume of refrigerant added according to the length of the pipe.
   b) Calculate the internal volume (B (m³)) (based on the minimum volume).
   c) Calculate the refrigerant concentration:

$$\frac{A\ (kg)}{B\ (m^3)} \leq \text{critical concentration: } 0.3\ kg/m^3$$

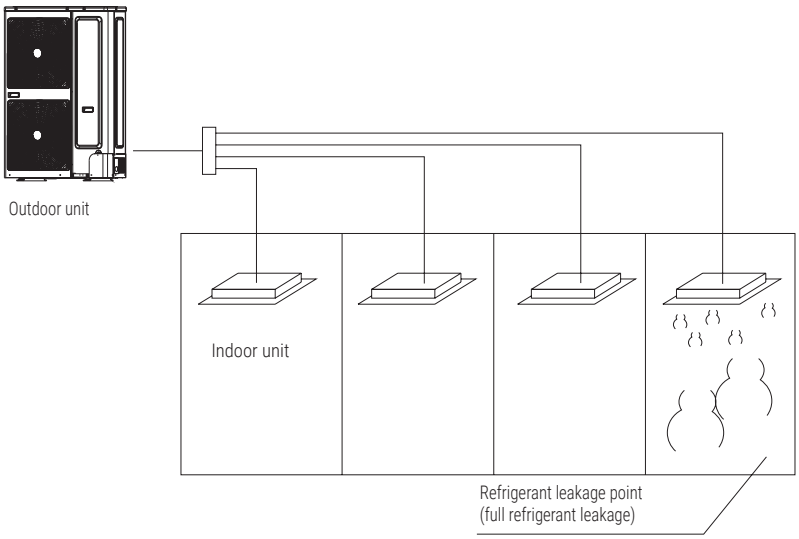
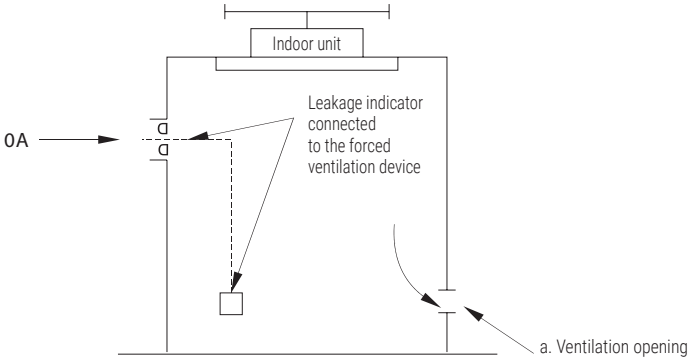


Fig. 6-2. Refrigerant leakage

5) Measures against exceeding the critical concentration.

a) To reduce the refrigerant concentration below the critical level, install a forced ventilation device (for regular ventilation).

b) If regular ventilation is not possible, install a leakage indicator connected to the forced ventilation device



(leakage indicator must be installed at the refrigerant collection point)

Fig. 6-3. Forced ventilation device

6.5 Handover to the customer

1) Provide the customer with the indoor unit operating manual and the outdoor unit installation manual.

2) Carefully explain the contents of the operating and installation manuals to the customer.

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