

TOSHIBA

FILE NO. A07-009

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SERVICE MANUAL

AIR-CONDITIONER SPLIT TYPE

OUTDOOR UNIT <DIGITAL INVERTER>

RAV-SM1603AT-E
RAV-SM1603ATZ-E
RAV-SM1603ATZG-E

INDOOR UNIT <DIGITAL INVERTER>

RAV-SM1103DT-A
RAV-SM1403DT-A
RAV-SM1603DT-A

* For the 4HP and 5HP outdoor units, refer to the Service Manuals with File No. A06-010 and A07-003.



Adoption of New Refrigerant

This Air Conditioner is a new type which adopts a new refrigerant HFC (R410A) instead of the conventional refrigerant R22 in order to prevent destruction of the ozone layer.

WARNING

Cleaning of the air filter and other parts of the air filter involves dangerous work in high places, so be sure to have a service person do it. Do not attempt it yourself.

The cleaning diagram for the air filter is there for the service person, and not for the customer.

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SAFETY CAUTION




The important contents concerned to the safety are described on the product itself and on this Service Manual. Please read this Service Manual after understanding the described items thoroughly in the following contents (Indications/Illustrated marks), and keep them.

[Explanation of indications]

Indication	Explanation
 DANGER	Indicates contents assumed that an imminent danger causing a death or serious injury of the repair engineers and the third parties when an incorrect work has been executed.
 WARNING	Indicates possibilities assumed that a danger causing a death or serious injury of the repair engineers, the third parties, and the users due to troubles of the product after work when an incorrect work has been executed.
 CAUTION	Indicates contents assumed that an injury or property damage (*) may be caused on the repair engineers, the third parties, and the users due to troubles of the product after work when an incorrect work has been executed.

* Property damage : Enlarged damage concerned to property, furniture, and domestic animal/pet





[Explanation of illustrated marks]










Mark	Explanation
	Indicates prohibited items (Forbidden items to do) The sentences near an illustrated mark describe the concrete prohibited contents.
	Indicates mandatory items (Compulsory items to do) The sentences near an illustrated mark describe the concrete mandatory contents.
	Indicates cautions (Including danger/warning) The sentences or illustration near or in an illustrated mark describe the concrete cautious contents.








[Confirmation of warning label on the main unit]




Confirm that labels are indicated on the specified positions
(Refer to the Parts disassembly diagram (Outdoor unit).)

If removing the label during parts replace, stick it as the original.

 DANGER	
 Turn off breaker.	Turn "OFF" the breaker before removing the front panel and cabinet, otherwise an electric shock is caused by high voltage resulted in a death or injury. During operation, a high voltage with 400V or higher of circuit (*) at secondary circuit of the high-voltage transformer is applied. If touching a high voltage with the naked hands or body, an electric shock is caused even if using an electric insulator. * : For details, refer to the electric wiring diagram.
 Execute discharge between terminals.	When removing the front panel or cabinet, execute short-circuit and discharge between high-voltage capacitor terminals. If discharge is not executed, an electric shock is caused by high voltage resulted in a death or injury. After turning off the breaker, high voltage also keeps to apply to the high-voltage capacitor.
 Prohibition	Do not turn on the breaker under condition that the front panel and cabinet are removed. An electric shock is caused by high voltage resulted in a death or injury.

 WARNING	
 Check earth wires.	Before troubleshooting or repair work, check the earth wire is connected to the earth terminals of the main unit, otherwise an electric shock is caused when a leak occurs. If the earth wire is not correctly connected, contact an electric engineer for rework.
 Prohibition of modification.	Do not modify the products. Do not also disassemble or modify the parts. It may cause a fire, electric shock or injury.
 Use specified parts.	For spare parts, use those specified (*). If unspecified parts are used, a fire or electric shock may be caused. *: For details, refer to the parts list.
 Do not bring a child close to the equipment.	Before troubleshooting or repair work, do not bring a third party (a child, etc.) except the repair engineers close to the equipment. It causes an injury with tools or disassembled parts. Please inform the users so that the third party (a child, etc.) does not approach the equipment.
 Insulating measures	Connect the cut-off lead wires with crimp contact, etc, put the closed end side upward and then apply a water-cut method, otherwise a leak or production of fire is caused at the users' side.
 No fire	When repairing the refrigerating cycle, take the following measures. 1) Be attentive to fire around the cycle. When using a gas stove, etc, be sure to put out fire before work; otherwise the oil mixed with refrigerant gas may catch fire. 2) Do not use a welder in the closed room. When using it without ventilation, carbon monoxide poisoning may be caused. 3) Do not bring inflammables close to the refrigerant cycle, otherwise fire of the welder may catch the inflammables.
 Refrigerant	Check the used refrigerant name and use tools and materials of the parts which match with it. For the products which use R410A refrigerant, the refrigerant name is indicated at a position on the outdoor unit where is easy to see. To prevent miss-charging, the route of the service port is changed from one of the former R22. For an air conditioner which uses R410A, never use other refrigerant than R410A. For an air conditioner which uses other refrigerant (R22, etc.), never use R410A. If different types of refrigerant are mixed, abnormal high pressure generates in the refrigerating cycle and an injury due to breakage may be caused. Do not charge refrigerant additionally. If charging refrigerant additionally when refrigerant gas leaks, the refrigerant composition in the refrigerating cycle changes resulted in change of air conditioner characteristics or refrigerant over the specified standard amount is charged and an abnormal high pressure is applied to the inside of the refrigerating cycle resulted in cause of breakage or injury. Therefore if the refrigerant gas leaks, recover the refrigerant in the air conditioner, execute vacuuming, and then newly recharge the specified amount of liquid refrigerant. In this time, never charge the refrigerant over the specified amount. When recharging the refrigerant in the refrigerating cycle, do not mix the refrigerant or air other than R410A into the specified refrigerant. If air or others is mixed with the refrigerant, abnormal high pressure generates in the refrigerating cycle resulted in cause of injury due to breakage. After installation work, check the refrigerant gas does not leak. If the refrigerant gas leaks in the room, poisonous gas generates when gas touches to fire such as fan heater, stove or cooking stove though the refrigerant gas itself is innocuous. Never recover the refrigerant into the outdoor unit. When the equipment is moved or repaired, be sure to recover the refrigerant with recovering device. The refrigerant cannot be recovered in the outdoor unit; otherwise a serious accident such as breakage or injury is caused.
 Assembly/Cabling	After repair work, surely assemble the disassembled parts, and connect and lead the removed wires as before. Perform the work so that the cabinet or panel does not catch the inner wires. If incorrect assembly or incorrect wire connection was done, a disaster such as a leak or fire is caused at user's side.

 WARNING	
 Insulator check	<p>After the work has finished, be sure to use an insulation tester set (500V Megger) to check the resistance is 2MΩ or more between the charge section and the non-charge metal section (Earth position).</p> <p>If the resistance value is low, a disaster such as a leak or electric shock is caused at user's side.</p>
 Ventilation	<p>When the refrigerant gas leaks during work, execute ventilation.</p> <p>If the refrigerant gas touches to a fire, poisonous gas generates. A case of leakage of the refrigerant and the closed room full with gas is dangerous because a shortage of oxygen occurs. Be sure to execute ventilation.</p>
 Be attentive to electric shock	<p>When checking the circuit inevitably under condition of the power-ON, use rubber gloves and others not to touch to the charging section.</p> <p>If touching to the charging section, an electric shock may be caused.</p>
 Compulsion	<p>When the refrigerant gas leaks, find up the leaked position and repair it surely.</p> <p>If the leaked position cannot be found up and the repair work is interrupted, pump-down and tighten the service valve, otherwise the refrigerant gas may leak into the room. The poisonous gas generates when gas touches to fire such as fan heater, stove or cooking stove though the refrigerant gas itself is innocuous.</p> <p>When installing equipment which includes a large amount of charged refrigerant such as a multi air conditioner in a sub-room, it is necessary that the density does not the limit even if the refrigerant leaks.</p> <p>If the refrigerant leaks and exceeds the limit density, an accident of shortage of oxygen is caused.</p> <p>For the installation/moving/reinstallation work, follow to the Installation Manual.</p> <p>If an incorrect installation is done, a trouble of the refrigerating cycle, water leak, electric shock or fire is caused.</p>
 Check after repair	<p>After repair work has finished, check there is no trouble.</p> <p>If check is not executed, a fire, electric shock or injury may be caused. For a check, turn off the power breaker.</p>
 Check after reinstallation	<p>After repair work (installation of front panel and cabinet) has finished, execute a test run to check there is no generation of smoke or abnormal sound.</p> <p>If check is not executed, a fire or an electric shock is caused. Before test run, install the front panel and cabinet.</p> <p>Check the following items after reinstallation.</p> <ol style="list-style-type: none"> 1) The earth wire is correctly connected. 2) The power cord is not caught in the product. 3) There is no inclination or unsteadiness and the installation is stable. <p>If check is not executed, a fire, an electric shock or an injury is caused.</p>

 CAUTION	
 Put on gloves	<p>Be sure to put on the gloves (*) and a long sleeved shirt: otherwise an injury may be caused with the parts, etc.</p> <p>(*) Heavy gloves such as work gloves</p>
 Cooling check	<p>When the power was turned on, start to work after the equipment has been sufficiently cooled.</p> <p>As temperature of the compressor pipes and others became high due to cooling/heating operation, a burn may be caused.</p>

• New Refrigerant (R410A)

This air conditioner adopts a new HFC type refrigerant (R410A) which does not deplete the ozone layer.

1. Safety Caution Concerned to New Refrigerant

The pressure of R410A is high 1.6 times of that of the former refrigerant (R22).

Accompanied with change of refrigerant, the refrigerating oil has been also changed.

Therefore, be sure that water, dust, the former refrigerant or the former refrigerating oil is not mixed into the refrigerating cycle of the air conditioner with new refrigerant during installation work or service work.

If an incorrect work or incorrect service is performed, there is a possibility to cause a serious accident.

Use the tools and materials exclusive to R410A to purpose a safe work.

2. Cautions on Installation/Service

- 1) Do not mix the other refrigerant or refrigerating oil.

For the tools exclusive to R410A, shapes of all the joints including the service port differ from those of the former refrigerant in order to prevent mixture of them.

- 2) As the use pressure of the new refrigerant is high, use material thickness of the pipe and tools which are specified for R410A.

- 3) In the installation time, use clean pipe materials and work with great attention so that water and others do not mix in because pipes are affected by impurities such as water, oxide scales, oil, etc.

Use the clean pipes.

Be sure to brazing with flowing nitrogen gas. (Never use gas other than nitrogen gas.)

- 4) For the earth protection, use a vacuum pump for air purge.

- 5) R410A refrigerant is azeotropic mixture type refrigerant.

Therefore use liquid type to charge the refrigerant. (If using gas for charging, composition of the refrigerant changes and then characteristics of the air conditioner change.)

3. Pipe Materials

For the refrigerant pipes, copper pipe and joints are mainly used.

It is necessary to select the most appropriate pipes to conform to the standard.

Use clean material in which impurities adhere inside of pipe or joint to a minimum.

1) Copper pipe

<Piping>

The pipe thickness, flare finishing size, flare nut and others differ according to a refrigerant type.

When using a long copper pipe for R410A, it is recommended to select "Copper or copper-base pipe without seam" and one with bonded oil amount 40mg/10m or less.

Also do not use crushed, deformed, discolored (especially inside) pipes.
(Impurities cause clogging of expansion valves and capillary tubes.)

<Flare nut>

Use the flare nuts which are attached to the air conditioner unit.

2) Joint

The flare joint and socket joint are used for joints of the copper pipe.

The joints are rarely used for installation of the air conditioner.

However clear impurities when using them.

4. Tools

1. Required Tools for R410A

Mixing of different types of oil may cause a trouble such as generation of sludge, clogging of capillary, etc. Accordingly, the tools to be used are classified into the following three types.

- 1) Tools exclusive for R410A (Those which cannot be used for conventional refrigerant (R22))
- 2) Tools exclusive for R410A, but can be also used for conventional refrigerant (R22)
- 3) Tools commonly used for R410A and for conventional refrigerant (R22)

The table below shows the tools exclusive for R410A and their interchangeability.

Tools exclusive for R410A (The following tools for R410A are required.)

Tools whose specifications are changed for R410A and their interchangeability

No.	Used tool	Usage	R410A air conditioner installation		Conventional air conditioner installation
			Existence of new equipment for R410A	Whether conventional equipment can be used	Whether conventional equipment can be used
①	Flare tool	Pipe flaring	Yes	* (Note)	Yes
②	Copper pipe gauge for adjusting projection margin	Flaring by conventional flare tool	Yes	* (Note)	* (Note)
③	Torque wrench	Tightening of flare nut	Yes	No	No
④	Gauge manifold	Evacuating, refrigerant charge, run check, etc.	Yes	No	No
⑤	Charge hose				
⑥	Vacuum pump adapter	Vacuum evacuating	Yes	No	Yes
⑦	Electronic balance for refrigerant charging	Refrigerant charge	Yes	Yes	Yes
⑧	Refrigerant cylinder	Refrigerant charge	Yes	No	No
⑨	Leakage detector	Gas leakage check	Yes	No	Yes

(Note) When flaring is carried out for R410A using the conventional flare tools, adjustment of projection margin is necessary. For this adjustment, a copper pipe gauge, etc. are necessary.

General tools (Conventional tools can be used.)

In addition to the above exclusive tools, the following equipments which serve also for R22 are necessary as the general tools.

- | | |
|----------------------------------------------------------------------|----------------------------------------|
| 1) Vacuum pump. Use vacuum pump by
attaching vacuum pump adapter. | 7) Screwdriver (+, -) |
| 2) Torque wrench | 8) Spanner or Monkey wrench |
| 3) Pipe cutter | 9) Hole core drill |
| 4) Reamer | 10) Hexagon wrench (Opposite side 4mm) |
| 5) Pipe bender | 11) Tape measure |
| 6) Level vial | 12) Metal saw |

Also prepare the following equipments for other installation method and run check.

- | | |
|----------------|------------------------------------------|
| 1) Clamp meter | 3) Insulation resistance tester (Megger) |
| 2) Thermometer | 4) Electroscop |

1. SPECIFICATIONS

1-1. Indoor Unit

1-1-1. High Static Duct Type

<Single type>

Model	Indoor unit		RAV-	SM1103DT-A	SM1403DT-A	SM1403DT-A	SM1603DT-A
	Outdoor unit		RAV-	SP1104AT-E	SM1403AT-E	SP1404AT-E	SM1603AT(Z)(ZG)-E
Cooling capacity			(kW)	10.4	12.5	13.0	14.3
Heating capacity			(kW)	11.3	14.0	14.0	16.0
Power supply			1 phase 240V, 50Hz				
Electrical characteristics	Cooling	Running current	(A)	13.5	21.3	18.5	21.97
		Power consumption	(kW)	3.15	4.95	4.32	5.01
		Power factor	(%)	97.2	96.8	97.3	95
		EER		3.30	2.53	3.01	2.85
		Energy efficiency class *		(A)	(E)	(B)	(C)
		Energy rating **	—				
	Heating	Running current	(A)	11.1	16.9	14.5	20.04
		Power consumption	(kW)	2.58	3.94	3.38	4.57
		Power factor	(%)	96.8	97.1	97.1	95.0
		COP		4.38	3.55	4.14	3.50
		Energy efficiency class *		(A)	(B)	(A)	(B)
		Energy rating **	—				
Maximum current			(A)	22.8	22.8	22.8	32.0
Appearance	Main unit			Zinc hot dipping steel plate			
Outer dimension	Main unit	Height	(mm)	380			
		Width	(mm)	1050			
		Depth	(mm)	600			
Total weight	Main unit			(kg)	57		
Heat exchanger			Finned tube				
Fan unit	Fan		Centrifugal fan				
	Standard air flow	at 100Pa/HH tap *** (m³/min.)		41.6	55	55	58
	Fan speed		2				
	Motor		(W)	600			
	External static pressure	Standard (at HH tap) *** (Pa)		100			
		Range at HH tap *** (Pa)		40 – 225	50 – 250		
Air filter			None (Arranged locally)				
Controller (sold separately)			RBC-AMT32E, AMS41E, AS21E2				
Sound pressure level		H	(dB•A)	49	49	49	50
Sound power level		H	(dB•A)	64	64	64	65
Connecting pipe		Gas side	(mm)	15.9			
		Liquid side	(mm)	9.5			
		Drain port	(mm)	32 (VP25)			

* : IEC standard, ** : AS standard, *** : SM110 at H tap.

1-1-2. 4-way Air Discharge Cassette Type

<Single type>

Model	Indoor unit		RAV-	SM1604UT-E
	Outdoor unit		RAV-	SM1603AT(Z)(ZG)-E
Cooling capacity			(kW)	14.0
Heating capacity			(kW)	16.0
Power supply			1 phase 230V (220 – 240V) 50Hz	
Electrical characteristics	Cooling	Running current	(A)	21.38 – 19.69
		Power consumption	(kW)	4.49
		Power factor	(%)	95
		EER		3.12
		Energy efficiency class *		(B)
		Energy rating **		—
	Heating	Running current	(A)	21.20 – 19.43
		Power consumption	(kW)	4.43
		Power factor	(%)	95
		COP		3.61
		Energy efficiency class *		(A)
		Energy rating **		—
	Maximum current		(A)	29.7
Appearance	Main unit		Zinc hot dipping steel plate	
	Ceiling panel (Sold separately)	Model	RBC-U31PG (W, WS)-E, RBC-U31PGS (W, WS)-E	
		Panel color	W: Moon-white (2.5GY 9.0/0.5), WS: Stripe-white (2.5GY 9.0/0.5 (Gray: 8B 3/0.3))	
Outer dimension	Main unit	Height	(mm)	319
		Width	(mm)	840
		Depth	(mm)	840
	Ceiling panel (Sold separately)	Height	(mm)	30
		Width	(mm)	950
		Depth	(mm)	950
Total weight	Main unit		(kg)	24
	Ceiling panel (Sold separately)		(kg)	4.2
Heat exchanger			Finned tube	
Fan unit	Fan		Turbo fan	
	Standard air flow	H/M/L	(m³/min.)	35.5 / 25 / 21
	Motor		(W)	72
Air filter			Standard filter attached (Long life filter)	
Controller (sold separately)			RBC-AMT32E, AMS41E, AS21E2, AX31U (W)-E	
Sound pressure level		H/M/L	(dB•A)	45 / 40 / 36
Sound power level		H/M/L	(dB•A)	60 / 55 / 51
Connecting pipe		Gas side	(mm)	15.9
		Liquid side	(mm)	9.5
		Drain port	(mm)	32 (VP25)

* : IEC standard, ** : AS standard

<Twin type>

Model	Indoor unit 1		RAV-	SM804UT-E
	Indoor unit 2		RAV-	SM804UT-E
	Outdoor unit		RAV-	SM1603AT(Z)(ZG)-E
Cooling capacity			(kW)	14.0
Heating capacity			(kW)	16.0
Indoor unit				
Power supply			1 phase 230V (220 – 240V) 50Hz	
Electrical characteristics	Cooling	Running current (A)		21.48 – 19.69
		Power consumption (kW)		4.49
		Power factor (%)		95
		EER		3.12
		Energy efficiency class *		(B)
	Heating	Running current (A)		21.20 – 19.43
		Power consumption (kW)		4.43
		Power factor (%)		95
		COP		3.61
		Energy efficiency class *		(A)
Fan unit	Fan		Turbo fan	
	Standard air flow	H/M/L (m³/min.)	20.5 / 16.0 / 13.5	
	Motor (W)		20	
Sound pressure level		H/M/L (dB•A)	35 / 31 / 28	
Sound power level		H/M/L (dB•A)	50 / 46 / 43	
Outdoor unit				
Power supply			1 phase 230V (220 – 240V) 50Hz	
Refrigerant pipe	Standard length (m)		7.5	
	Min. length (m)		5	
	Max. total length (m)		50	
	Height difference	Outdoor lower (m)	30	
		Outdoor higher (m)	30	
Fan unit	Fan		Propeller fan	
	Standard air flow volume (m³/min.)		103	
	Motor (W)		100 + 100	
Connecting pipe	Gas side	Main (mm)	15.9	
		Sub (mm)	15.9	
	Liquid side	Main (mm)	9.5	
		Sub (mm)	9.5	
Sound pressure level		Cooling/Heating (dB•A)	51 / 53	
Sound power level		Cooling/Heating (dB•A)	68 / 70	

* : IEC standard

<Triple type>

Model	Indoor unit 1		RAV-	SM564UT-E	
	Indoor unit 2		RAV-	SM564UT-E	
	Indoor unit 3		RAV-	SM564UT-E	
	Outdoor unit		RAV-	SM1603AT(Z)(ZG)-E	
Cooling capacity			(kW)	14.0	
Heating capacity			(kW)	16.0	
Indoor unit					
Power supply			1 phase 230V (220 – 240V) 50Hz		
Electrical characteristics	Cooling	Running current (A)		21.48 – 19.69	
		Power consumption (kW)		4.49	
		Power factor (%)		95	
		EER		3.12	
		Energy efficiency class *		(B)	
	Heating	Running current (A)		21.20 – 19.43	
		Power consumption (kW)		4.43	
		Power factor (%)		95	
		COP		3.61	
		Energy efficiency class *		(A)	
Fan unit	Fan		Turbo fan		
	Standard air flow	H/M/L (m³/min.)	17.5 / 14.5 / 13.0		
	Motor (W)		14		
Sound pressure level		H/M/L (dB•A)	32 / 29 / 28		
Sound power level		H/M/L (dB•A)	47 / 44 / 43		
Outdoor unit					
Power supply			1 phase 230V (220 – 240V) 50Hz		
Refrigerant pipe	Standard length (m)		7.5		
	Min. length (m)		5		
	Max. total length (m)		50		
	Height difference	Outdoor lower (m)		30	
		Outdoor higher (m)		30	
Fan unit	Fan		Propeller fan		
	Standard air flow volume (m³/min.)		103		
	Motor (W)		100 + 100		
Connecting pipe	Gas side	Main (mm)	15.9		
		Sub (mm)	12.7		
	Liquid side	Main (mm)	9.5		
		Sub (mm)	6.4		
Sound pressure level		Cooling/Heating (dB•A)	51 / 53		
Sound power level		Cooling/Heating (dB•A)	68 / 70		

* : IEC standard

1-1-3. Concealed Duct Type

<Twin type>

Model	Indoor unit 1		RAV-	SM802BT-E	
	Indoor unit 2		RAV-	SM802BT-E	
	Outdoor unit		RAV-	SM1603AT(Z)(ZG)-E	
Cooling capacity			(kW)	14.0	
Heating capacity			(kW)	16.0	
Indoor unit					
Power supply			1 phase 230V (220 – 240V) 50Hz		
Electrical characteristics	Cooling	Running current	(A)	24.50 – 22.46	
		Power consumption	(kW)	5.12	
		Power factor	(%)	95	
		EER		2.73	
		Energy efficiency class *		—	
	Heating	Running current	(A)	22.44 – 20.57	
		Power consumption	(kW)	4.69	
		Power factor	(%)	95	
		COP		3.41	
		Energy efficiency class *		—	
Fan unit	Fan		Centrifugal fan		
	Standard air flow	H/M/L	(m³/min.)	19.0 / 16.2 / 13.3	
	Motor		(W)	120	
	External static pressure	Standard (at shipment)		(Pa)	40
		Set up for tap exchange		(Pa)	20 / 40 / 70 / 100
Sound pressure level		H/M/L	(dB•A)	40 / 37 / 34	
Sound power level		H/M/L	(dB•A)	55 / 52 / 49	
Outdoor unit					
Power supply			1 phase 230V (220 – 240V) 50Hz		
Refrigerant pipe	Standard length		(m)	7.5	
	Min. length		(m)	5	
	Max. total length		(m)	50	
	Height difference	Outdoor lower		(m)	30
		Outdoor higher		(m)	30
Fan unit	Fan		Propeller fan		
	Standard air flow volume		(m³/min.)	103	
	Motor		(W)	100 + 100	
Connecting pipe	Gas side	Main	(mm)	15.9	
		Sub	(mm)	15.9	
	Liquid side	Main	(mm)	9.5	
		Sub	(mm)	9.5	
Sound pressure level		Cooling/Heating	(dB•A)	51 / 53	
Sound power level		Cooling/Heating	(dB•A)	68 / 70	

* : IEC standard

<Triple type>

Model	Indoor unit 1		RAV-	SM562BT-E
	Indoor unit 2		RAV-	SM562BT-E
	Indoor unit 3		RAV-	SM562BT-E
	Outdoor unit		RAV-	SM1603AT(Z)(ZG)-E
Cooling capacity			(kW)	14.0
Heating capacity			(kW)	16.0
Indoor unit				
Power supply			1 phase 230V (220 – 240V) 50Hz	
Electrical characteristics	Cooling	Running current (A)		24.50 – 22.46
		Power consumption (kW)		5.12
		Power factor (%)		95
		EER		2.73
		Energy efficiency class *		—
	Heating	Running current (A)		22.44 – 20.57
		Power consumption (kW)		4.69
		Power factor (%)		95
		COP		3.41
		Energy efficiency class *		—
Fan unit	Fan		Centrifugal fan	
	Standard air flow	H/M/L (m³/min.)	13.0 / 11.9 / 9.8	
	Motor (W)		120	
	External static pressure (Factory setting) (Pa)		40	
	External static pressure (Pa)		20 / 40 / 70 / 100	
Sound pressure level		H/M/L (dB•A)	40 / 37 / 33	
Sound power level		H/M/L (dB•A)	55 / 52 / 48	
Outdoor unit				
Power supply			1 phase 230V (220 – 240V) 50Hz	
Refrigerant pipe	Standard length (m)		7.5	
	Min. length (m)		5	
	Max. total length (m)		50	
	Height difference	Outdoor lower (m)	30	
		Outdoor higher (m)	30	
Fan unit	Fan		Propeller fan	
	Standard air flow volume (m³/min.)		103	
	Motor (W)		100 + 100	
Connecting pipe	Gas side	Main (mm)	15.9	
		Sub (mm)	12.7	
	Liquid side	Main (mm)	9.5	
		Sub (mm)	6.4	
Sound pressure level		Cooling/Heating (dB•A)	51 / 53	
Sound power level		Cooling/Heating (dB•A)	68 / 70	

* : IEC standard

1-1-4. Under Ceiling Type

<Twin type>

Model	Indoor unit 1		RAV-	SM802CT-E	
	Indoor unit 2		RAV-	SM802CT-E	
	Outdoor unit		RAV-	SM1603AT(Z)(ZG)-E	
Cooling capacity			(kW)	14.0	
Heating capacity			(kW)	16.0	
Indoor unit					
Power supply			1 phase 230V (220 – 240V) 50Hz		
Electrical characteristics	Cooling	Running current (A)		23.88 – 21.89	
		Power consumption (kW)		4.99	
		Power factor (%)		95	
		EER		2.81	
		Energy efficiency class *		—	
	Heating	Running current (A)		22.44 – 20.57	
		Power consumption (kW)		4.69	
		Power factor (%)		95	
		COP		3.41	
		Energy efficiency class *		—	
Fan unit	Fan		Centrifugal fan		
	Standard air flow	H/M/L (m³/min.)	18.5 / 16.7 / 14.6		
	Motor (W)		60		
Sound pressure level		H/M/L (dB•A)	38 / 36 / 33		
Sound power level		H/M/L (dB•A)	53 / 51 / 48		
Outdoor unit					
Power supply			1 phase 230V (220 – 240V) 50Hz		
Refrigerant pipe	Standard length (m)		7.5		
	Min. length (m)		5		
	Max. total length (m)		50		
	Height difference	Outdoor lower (m)		30	
		Outdoor higher (m)		30	
Fan unit	Fan		Propeller fan		
	Standard air flow volume (m³/min.)		103		
	Motor (W)		100 + 100		
Connecting pipe	Gas side	Main (mm)	15.9		
		Sub (mm)	15.9		
	Liquid side	Main (mm)	9.5		
		Sub (mm)	9.5		
Sound pressure level		Cooling/Heating (dB•A)	51 / 53		
Sound power level		Cooling/Heating (dB•A)	68 / 70		

* : IEC standard

<Triple type>

Model	Indoor unit 1		RAV-	SM562CT-E	
	Indoor unit 2		RAV-	SM562CT-E	
	Indoor unit 3		RAV-	SM562CT-E	
	Outdoor unit		RAV-	SM1603AT(Z)(ZG)-E	
Cooling capacity			(kW)	14.0	
Heating capacity			(kW)	16.0	
Indoor unit					
Power supply			1 phase 230V (220 – 240V) 50Hz		
Electrical characteristics	Cooling	Running current (A)		23.88 – 21.89	
		Power consumption (kW)		4.99	
		Power factor (%)		95	
		EER		2.81	
		Energy efficiency class *		—	
	Heating	Running current (A)		22.44 – 20.57	
		Power consumption (kW)		4.69	
		Power factor (%)		95	
		COP		3.41	
		Energy efficiency class *		—	
Fan unit	Fan		Centrifugal fan		
	Standard air flow	H/M/L (m³/min.)	13.0 / 11.2 / 10.0		
	Motor (W)		60		
Sound pressure level		H/M/L (dB•A)	36 / 33 / 30		
Sound power level		H/M/L (dB•A)	51 / 48 / 45		
Outdoor unit					
Power supply			1 phase 230V (220 – 240V) 50Hz		
Refrigerant pipe	Standard length (m)		7.5		
	Min. length (m)		5		
	Max. total length (m)		50		
	Height difference	Outdoor lower (m)		30	
		Outdoor higher (m)		30	
Fan unit	Fan		Propeller fan		
	Standard air flow volume (m³/min.)		103		
	Motor (W)		100 + 100		
Connecting pipe	Gas side	Main (mm)	15.9		
		Sub (mm)	12.7		
	Liquid side	Main (mm)	9.5		
		Sub (mm)	6.4		
Sound pressure level		Cooling/Heating (dB•A)	51 / 53		
Sound power level		Cooling/Heating (dB•A)	68 / 70		

* : IEC standard

1-1-5. High Wall Type

<Twin type>

Model	Indoor unit 1		RAV-	SM802KRT-E	
	Indoor unit 2		RAV-	SM802KRT-E	
	Outdoor unit		RAV-	SM1603AT(Z)(ZG)-E	
Cooling capacity			(kW)	14.0	
Heating capacity			(kW)	16.0	
Indoor unit					
Power supply			1 phase 230V (220 – 240V) 50Hz		
Electrical characteristics	Cooling	Running current (A)		24.40 – 22.37	
		Power consumption (kW)		5.10	
		Power factor (%)		95	
		EER		2.75	
		Energy efficiency class *		—	
	Heating	Running current (A)		23.83 – 21.84	
		Power consumption (kW)		4.98	
		Power factor (%)		95	
		COP		3.21	
		Energy efficiency class *		—	
Fan unit	Fan		Cross flow fan		
	Standard air flow	H/M/L (m³/min.)	18.5 / 14.6 / 12.2		
	Motor (W)		30		
Sound pressure level		H/M/L (dB•A)	45 / 41 / 36		
Sound power level		H/M/L (dB•A)	60 / 56 / 51		
Outdoor unit					
Power supply			1 phase 230V (220 – 240V) 50Hz		
Refrigerant pipe	Standard length (m)		7.5		
	Min. length (m)		5		
	Max. total length (m)		50		
	Height difference	Outdoor lower (m)		30	
		Outdoor higher (m)		30	
Fan unit	Fan		Propeller fan		
	Standard air flow volume (m³/min.)		103		
	Motor (W)		100 + 100		
Connecting pipe	Gas side	Main (mm)	15.9		
		Sub (mm)	15.9		
	Liquid side	Main (mm)	9.5		
		Sub (mm)	9.5		
Sound pressure level		Cooling/Heating (dB•A)	51 / 53		
Sound power level		Cooling/Heating (dB•A)	68 / 70		

* : IEC standard

<Triple type>

Model	Indoor unit 1		RAV-	SM562KRT-E	
	Indoor unit 2		RAV-	SM562KRT-E	
	Indoor unit 3		RAV-	SM562KRT-E	
	Outdoor unit		RAV-	SM1603AT(Z)(ZG)-E	
Cooling capacity			(kW)	14.0	
Heating capacity			(kW)	16.0	
Indoor unit					
Power supply			1 phase 230V (220 – 240V) 50Hz		
Electrical characteristics	Cooling	Running current (A)		24.40 – 22.37	
		Power consumption (kW)		5.10	
		Power factor (%)		95	
		EER		2.75	
		Energy efficiency class *		—	
	Heating	Running current (A)		23.83 – 21.84	
		Power consumption (kW)		4.98	
		Power factor (%)		95	
		COP		3.21	
		Energy efficiency class *		—	
Fan unit	Fan		Cross flow fan		
	Standard air flow	H/M/L (m³/min.)	14.0 / 12.5 / 10.7		
	Motor (W)		30		
Sound pressure level		H/M/L (dB•A)	39 / 36 / 33		
Sound power level		H/M/L (dB•A)	54 / 51 / 48		
Outdoor unit					
Power supply			1 phase 230V (220 – 240V) 50Hz		
Refrigerant pipe	Standard length (m)		7.5		
	Min. length (m)		5		
	Max. total length (m)		50		
	Height difference	Outdoor lower (m)		30	
		Outdoor higher (m)		30	
Fan unit	Fan		Propeller fan		
	Standard air flow volume (m³/min.)		103		
	Motor (W)		100 + 100		
Connecting pipe	Gas side	Main (mm)	15.9		
		Sub (mm)	12.7		
	Liquid side	Main (mm)	9.5		
		Sub (mm)	6.4		
Sound pressure level		Cooling/Heating (dB•A)	51 / 53		
Sound power level		Cooling/Heating (dB•A)	68 / 70		

* : IEC standard

1-1-6. Compact 4-way Cassette (600 × 600) Type

<Triple type>

Model	Indoor unit 1		RAV-	SM562MUT-E	
	Indoor unit 2		RAV-	SM562MUT-E	
	Indoor unit 3		RAV-	SM562MUT-E	
	Outdoor unit		RAV-	SM1603AT(Z)(ZG)-E	
Cooling capacity			(kW)	14.0	
Heating capacity			(kW)	16.0	
Indoor unit					
Power supply			1 phase 230V (220 – 240V) 50Hz		
Electrical characteristics	Cooling	Running current (A)		23.88 – 21.89	
		Power consumption (kW)		4.99	
		Power factor (%)		95	
		EER		2.81	
		Energy efficiency class *		—	
	Heating	Running current (A)		22.44 – 20.57	
		Power consumption (kW)		4.69	
		Power factor (%)		95	
		COP		3.41	
		Energy efficiency class *		—	
Fan unit	Fan		Turbo fan		
	Standard air flow	H/M/L (m³/min.)	13.3 / 11.2 / 9.1		
	Motor (W)		60		
Sound pressure level		H/M/L (dB•A)	43 / 39 / 34		
Sound power level		H/M/L (dB•A)	58 / 54 / 49		
Outdoor unit					
Power supply			1 phase 230V (220 – 240V) 50Hz		
Refrigerant pipe	Standard length (m)		7.5		
	Min. length (m)		5		
	Max. total length (m)		50		
	Height difference	Outdoor lower (m)		30	
		Outdoor higher (m)		30	
Fan unit	Fan		Propeller fan		
	Standard air flow volume (m³/min.)		103		
	Motor (W)		100 + 100		
Connecting pipe	Gas side	Main (mm)	15.9		
		Sub (mm)	12.7		
	Liquid side	Main (mm)	9.5		
		Sub (mm)	6.4		
Sound pressure level		Cooling/Heating (dB•A)	51 / 53		
Sound power level		Cooling/Heating (dB•A)	68 / 70		

* : IEC standard

1-1-7. Slim Duct Type

<Triple type>

Model	Indoor unit 1		RAV-	SM564SDT-E
	Indoor unit 2		RAV-	SM564SDT-E
	Indoor unit 3		RAV-	SM564SDT-E
	Outdoor unit		RAV-	SM1603AT(Z)(ZG)-E
Cooling capacity			(kW)	14.0
Heating capacity			(kW)	16.0
Indoor unit				
Power supply			1 phase 230V (220 – 240V) 50Hz	
Electrical characteristics	Cooling	Running current (A)		23.88 – 21.89
		Power consumption (kW)		4.99
		Power factor (%)		95
		EER		2.81
		Energy efficiency class *		—
	Heating	Running current (A)		22.44 – 20.57
		Power consumption (kW)		4.69
		Power factor (%)		95
		COP		3.41
		Energy efficiency class *		—
Fan unit	Fan		Centrifugal fan	
	Standard air flow	H/M/L (m³/min.)		13.0 / 11.3 / 9.7
	Motor		(W) 60	
	External static pressure	Standard (at shipment) (Pa)		10
		Set up for tap exchange (Pa)		10 / 20 / 35 / 50
Sound pressure level	Under air inlet	H/M/L (dB•A)		45 / 40 / 36
	Back air inlet	H/M/L (dB•A)		33 / 31 / 28
Sound power level	Under air inlet	H/M/L (dB•A)		60 / 55 / 51
	Back air inlet	H/M/L (dB•A)		48 / 46 / 43
Outdoor unit				
Power supply			1 phase 230V (220 – 240V) 50Hz	
Refrigerant pipe	Standard length (m)		7.5	
	Min. length (m)		5	
	Max. total length (m)		50	
	Height difference	Outdoor lower (m)		30
		Outdoor higher (m)		30
Fan unit	Fan		Propeller fan	
	Standard air flow volume (m³/min.)		103	
	Motor (W)		100 + 100	
Connecting pipe	Gas side	Main (mm)	15.9	
		Sub (mm)	12.7	
	Liquid side	Main (mm)	9.5	
		Sub (mm)	6.4	
Sound pressure level		Cooling/Heating (dB•A)	51 / 53	
Sound power level		Cooling/Heating (dB•A)	68 / 70	

* : IEC standard

1-2. Outdoor Unit

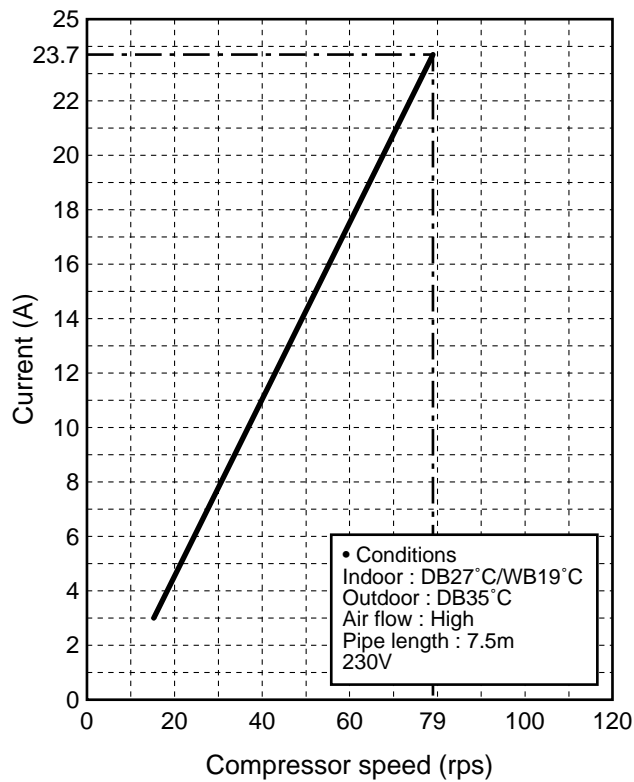
Model name			RAV-SM1603AT(Z)(ZG)-E	
Power supply			1 phase 230V (220 – 240V) 50Hz	
Compressor	Type		Hermetic compressor	
	Motor (kW)		3.75	
	Pole		4	
Refrigerant charged (kg)			3.1	
Refrigerant control			Pulse motor valve	
Inter connecting pipe	Standard length (m)		7.5	
	Min. length (m)		5	
	Max. total length (m)		50	
	Additional refrigerant charge under long piping connector		40g/m (31m to 50m)	
	Height difference	Outdoor lower (m)	30	
		Outdoor higher (m)	30	
Outer dimension	Height (mm)		1340	
	Width (mm)		900	
	Depth (mm)		320	
Appearance			Silky shade (Muncel 1Y8.5/0.5)	
Total weight (kg)			99	
Heat exchanger			Finned tube	
Fan unit	Fan		Propeller fan	
	Standard air flow (m³/h)		103	
	Motor (W)		100 + 100	
Connecting pipe	Gas side (mm)		15.9	
	Liquid side (mm)		9.5	
Sound pressure level		Cooling/Heating (dB•A)	51 / 53	
Sound power level		Cooling/Heating (dB•A)	68 / 70	
Outside air temperature, Cooling (°C)			43 to –15	
Outside air temperature, Heating (°C)			15 to –15	

1-3. Operation Characteristic Curve

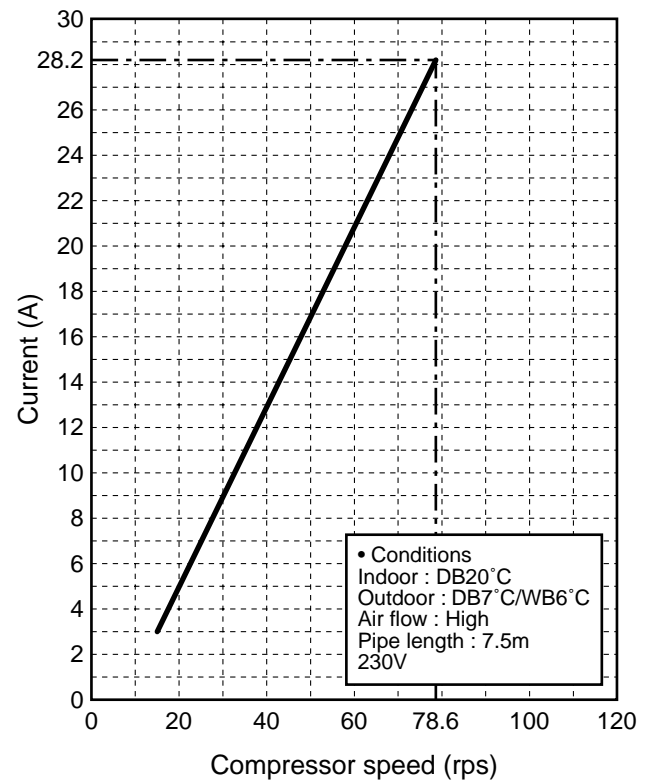
- Operation characteristic curve

RAV-SM1603AT-E, RAV-SM1603ATZ-E, RAV-SM1603ATZG-E

<Cooling>



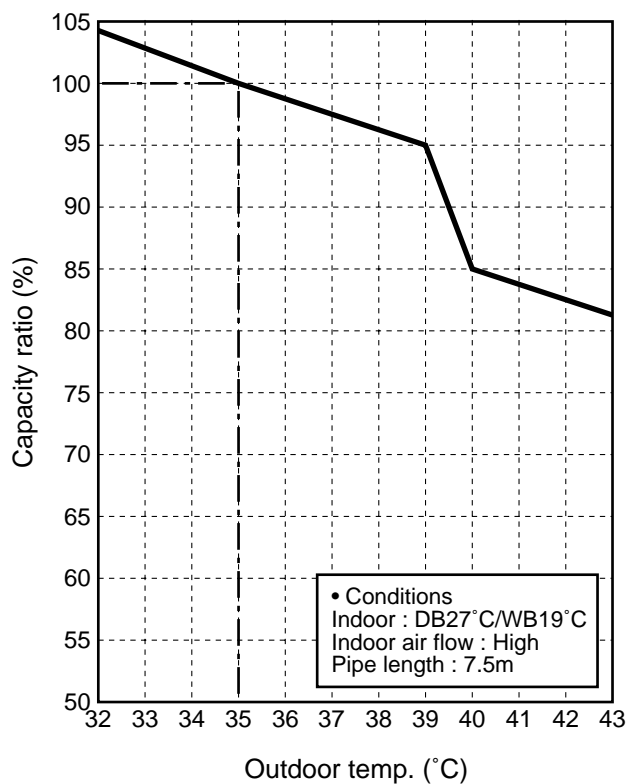
<Heating>



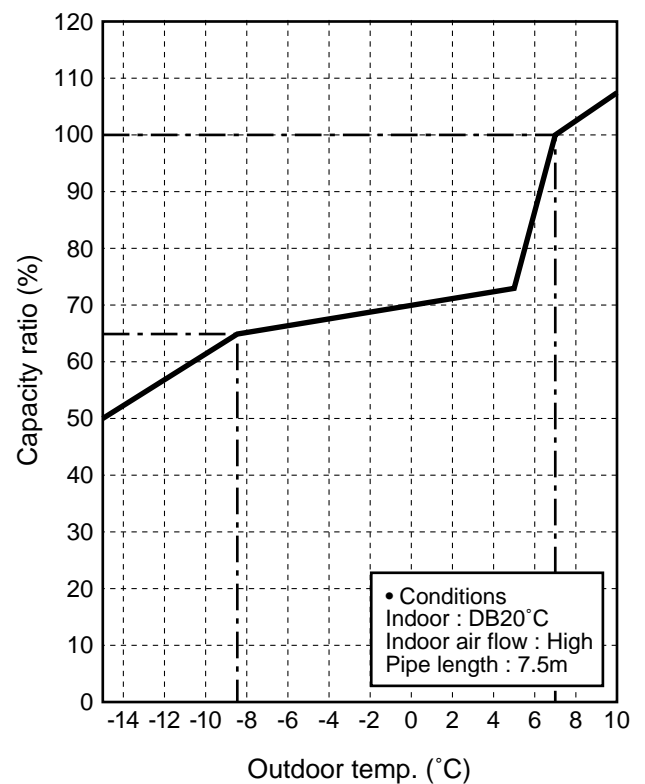
- Capacity variation ratio according to temperature

RAV-SM1603AT-E, RAV-SM1603ATZ-E, RAV-SM1603ATZG-E

<Cooling>



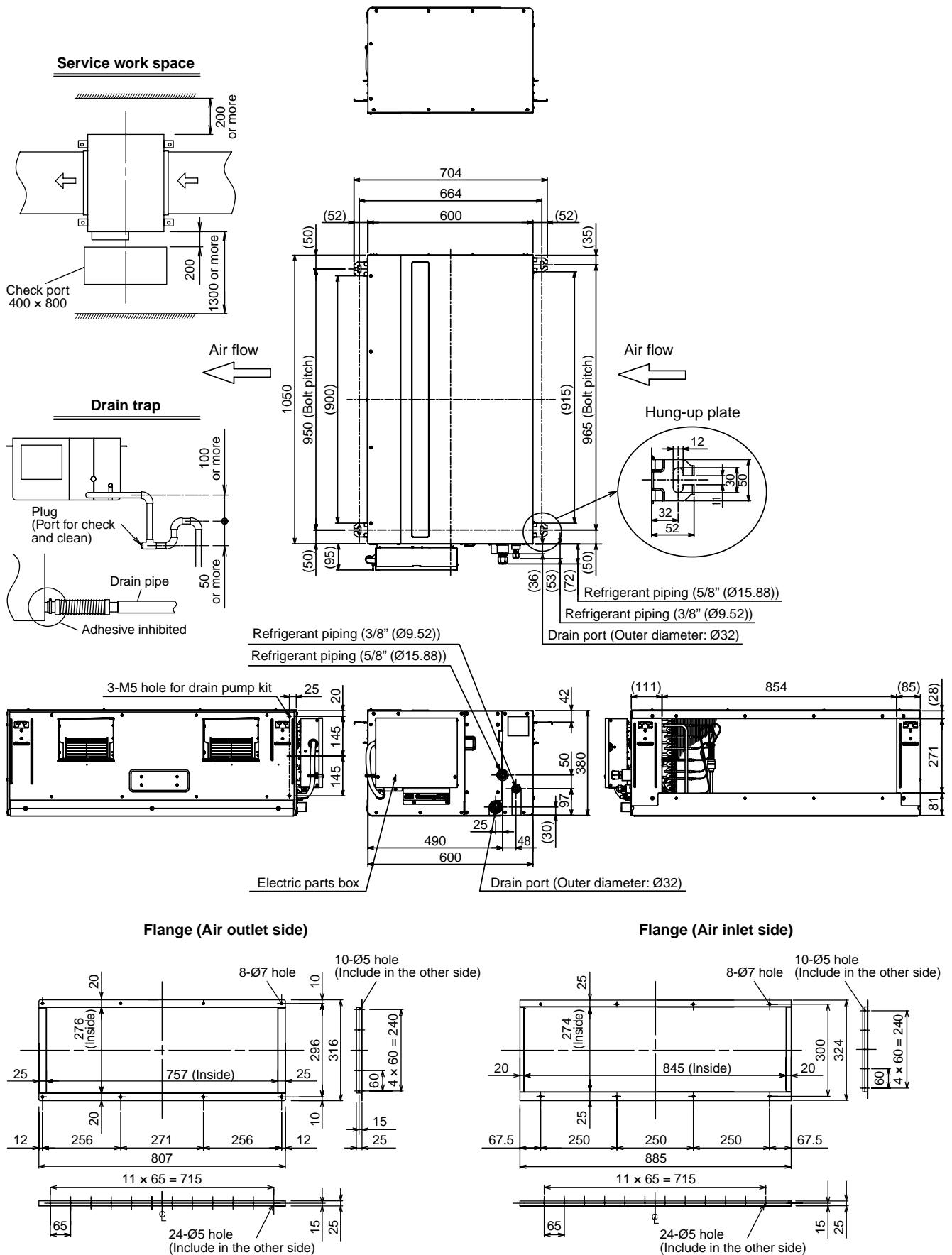
<Heating>



2. CONSTRUCTION VIEWS (EXTERNAL VIEWS)

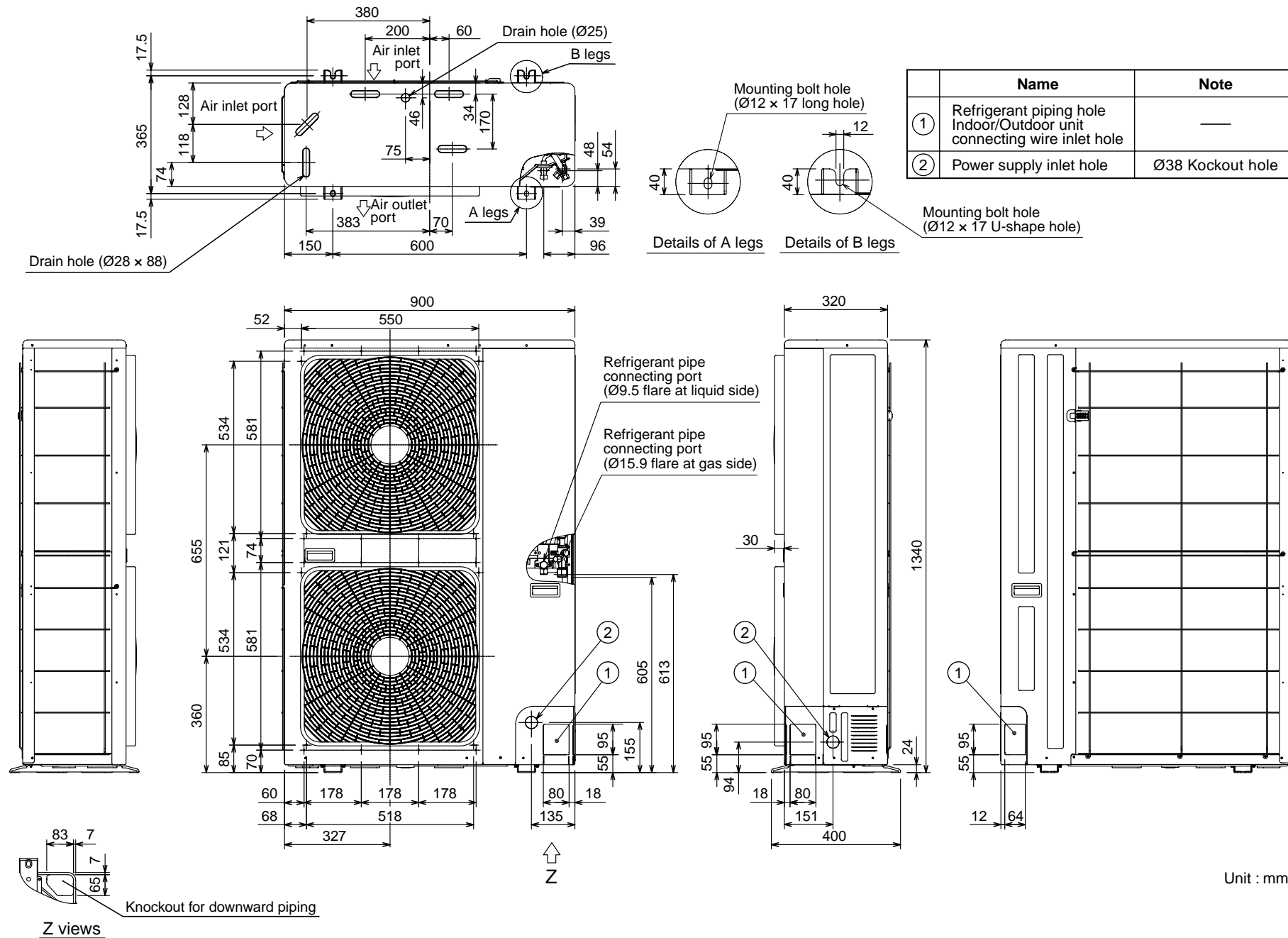
2-1. Indoor Unit

RAV-SM1103DT-A, RAV-SM1403DT-A, RAV-SM1603DT-A

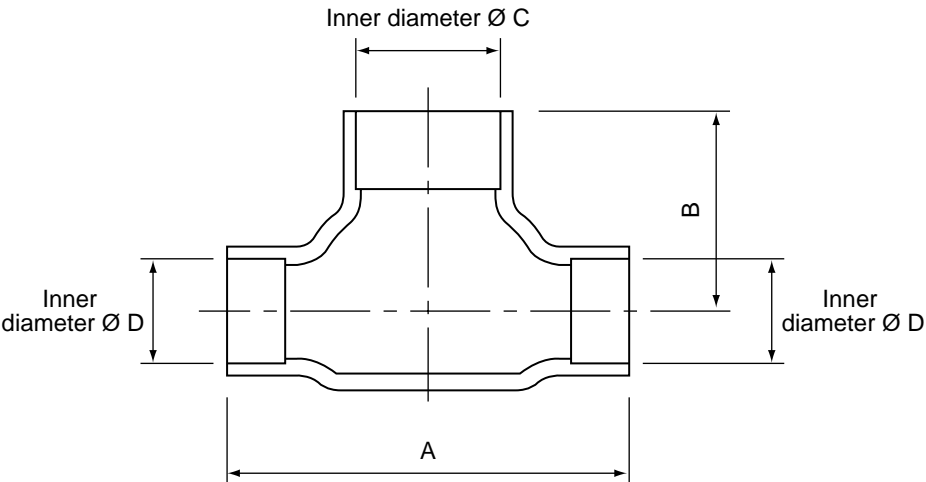


2-2. Outdoor Unit

RAV-SM1603AT-E, RAV-SM1603ATZ-E, RAV-SM1603ATZG-E



RBC-TWP30E2, RBC-TWP50E2 (Simultaneous Twin)

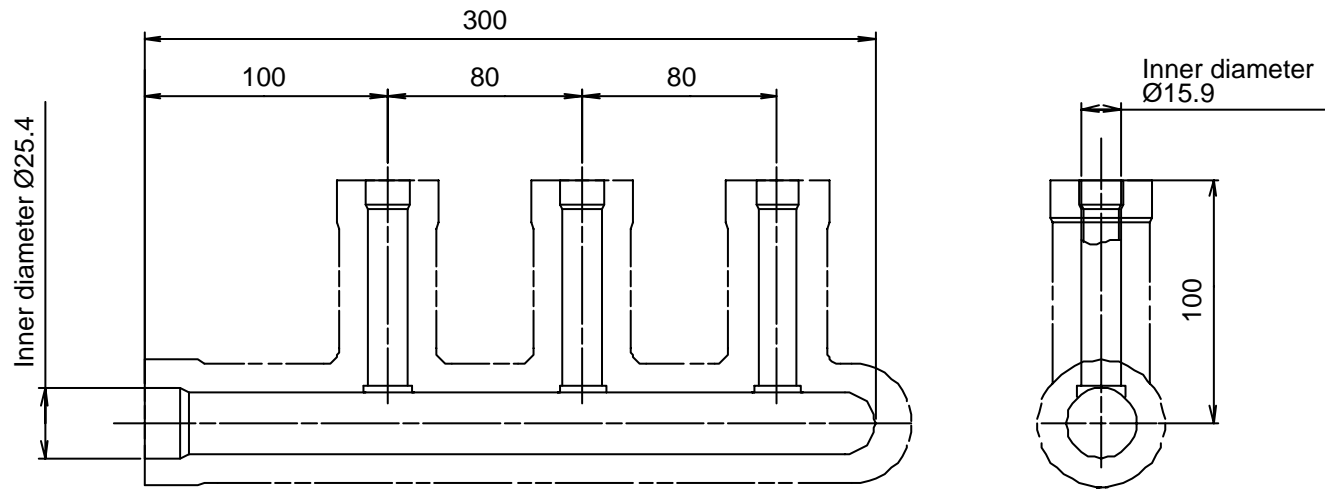


Model (RBC-)		A	B	C	D
TWP30E2	Liquid side	36	14	Ø9.5	Ø6.4
	Gas side	43	23	Ø15.9	Ø12.7
TWP50E2	Liquid side	34	14	Ø9.5	Ø9.5
	Gas side	44	21	Ø15.9	Ø15.9

RBC-TRP100E (Simultaneous Triple)

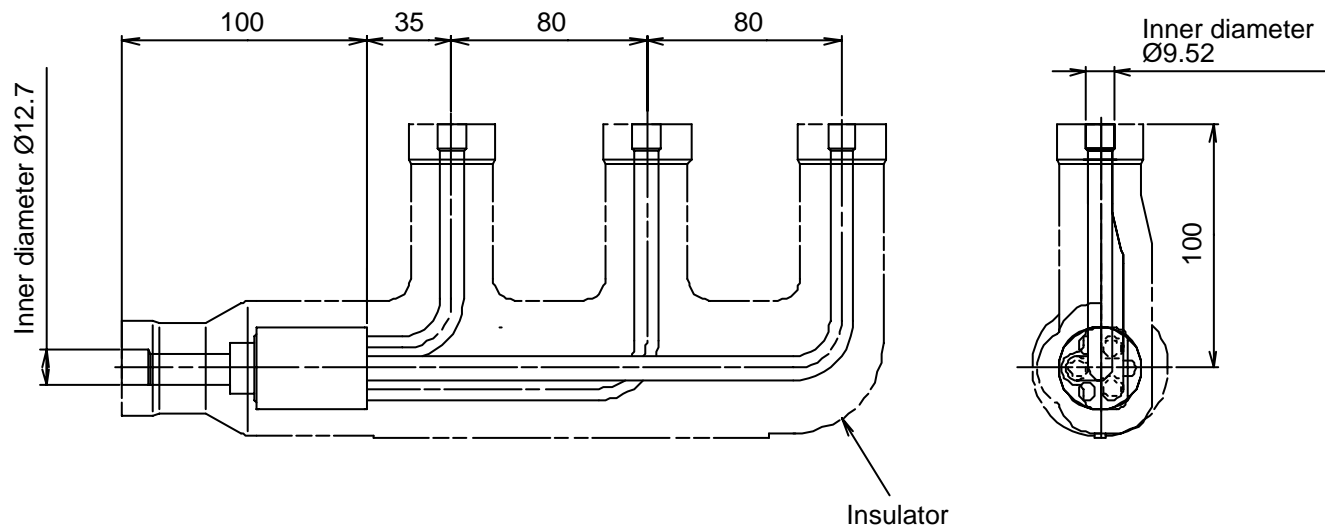
<Gas side>

Header assembly

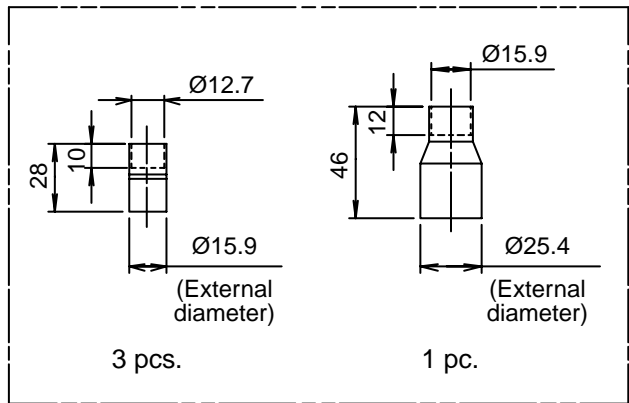


<Liquid side>

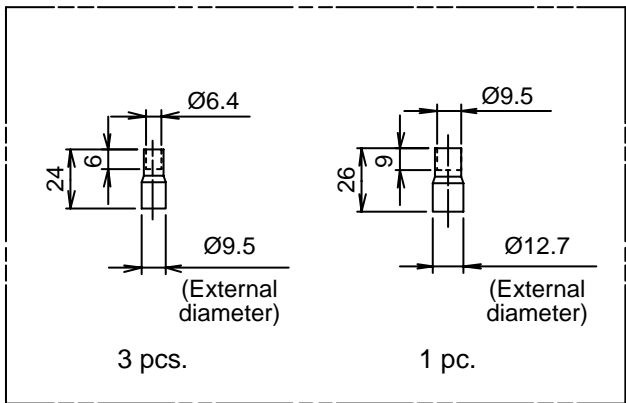
Branch pipe assembly



Gas side socket



Liquid side socket

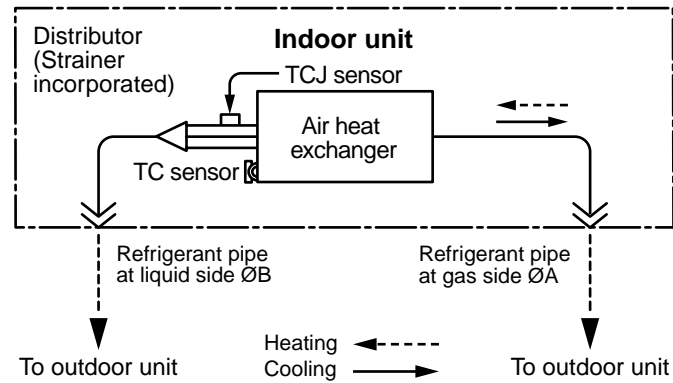


3. SYSTEMATIC REFRIGERATING CYCLE DIAGRAM

3-1. Indoor Unit

RAV-SM1103DT-A, RAV-SM1403DT-A, RAV-SM1603DT-A

- Single type (Combination of one indoor unit and one outdoor unit)



Dimension table

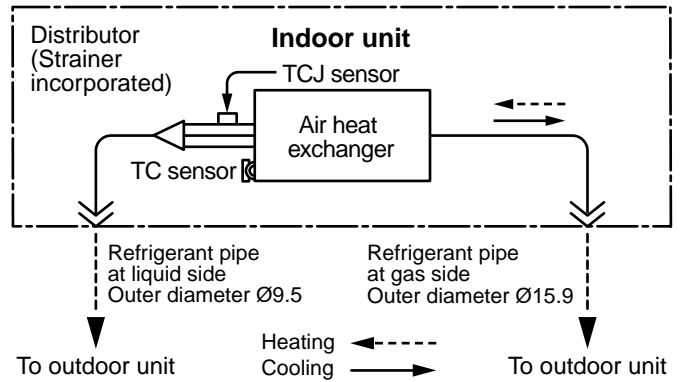
Indoor unit	Outer diameter of refrigerant pipe	
	Gas side ØA	Liquid side ØB
SM110, 140, 160 type	15.9	9.5

Capillary tube specifications

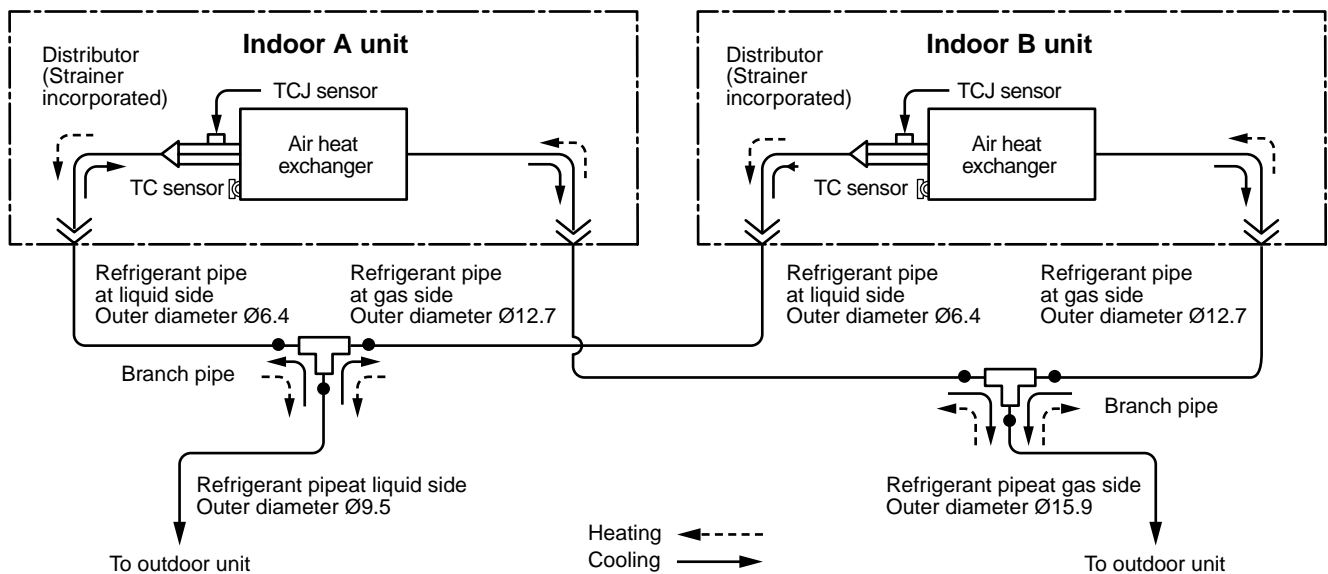
Model RAV-SM***DT	Inner dia. × Length × Q'ty
SM110, 140, 160 type	Ø2 × 200 × 3, Ø2 × 300 × 1 Ø2 × 350 × 2, Ø2 × 400 × 1

<Indoor unit to be connected to RAV-SM1603AT-E, RAV-SM1603ATZ-E, RAV-SM1603ATZG-E>

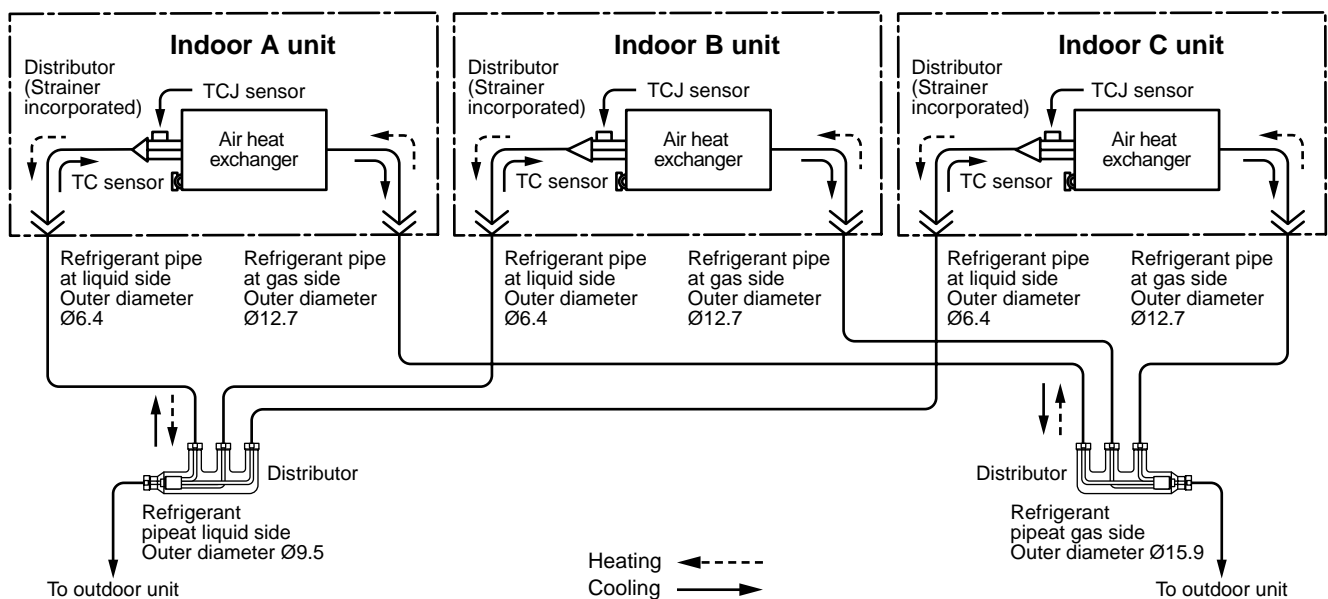
- **Single type**
(Combination of one indoor unit and one outdoor unit)



- **Twin type** (Combination of two indoor units and one outdoor unit)

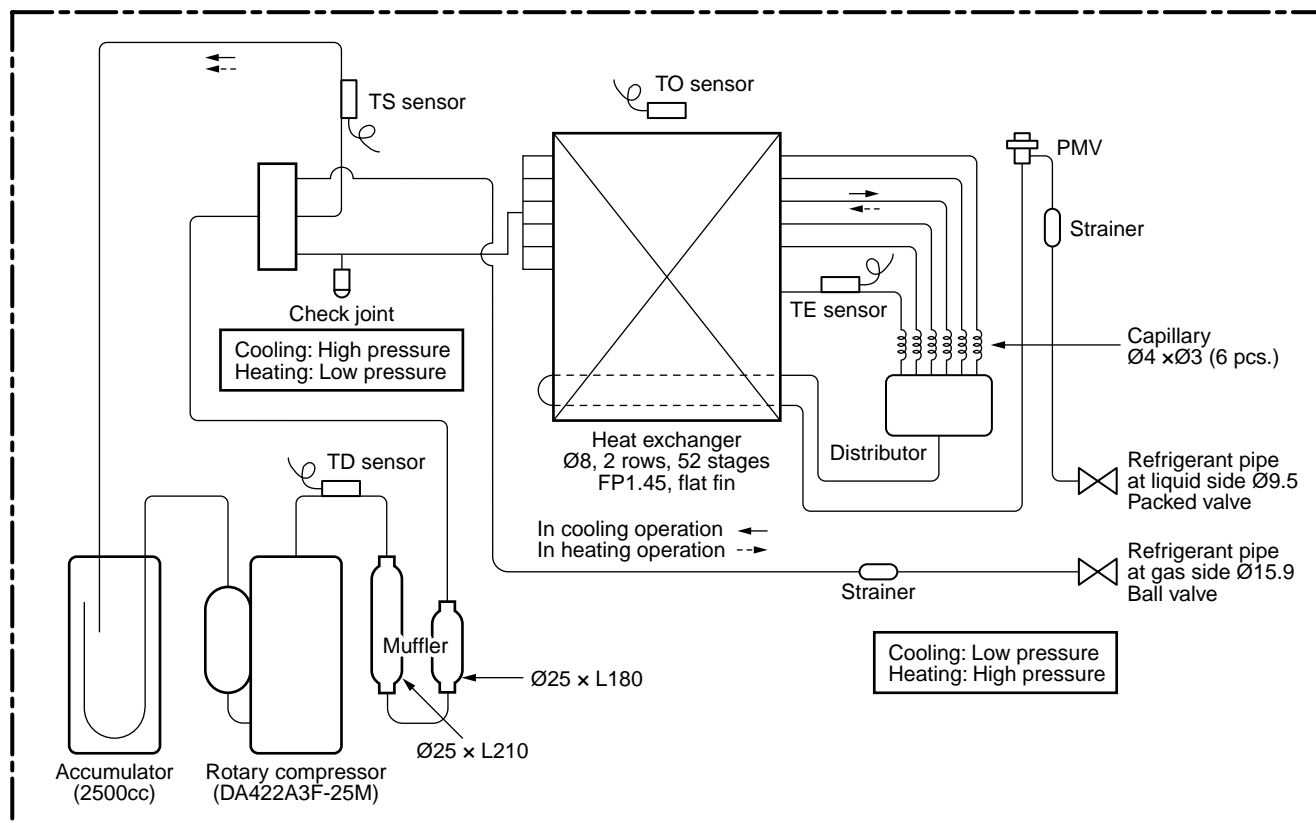


- **Triple type** (Combination of three indoor units and one outdoor unit)



3-2. Outdoor Unit

RAV-SM1603AT-E, RAV-SM1603ATZ-E, RAV-SM1603ATZG-E



Systematic Diagram of Refrigerating Cycle

* This compressor has 4-pole motor.

The value when compressor frequency

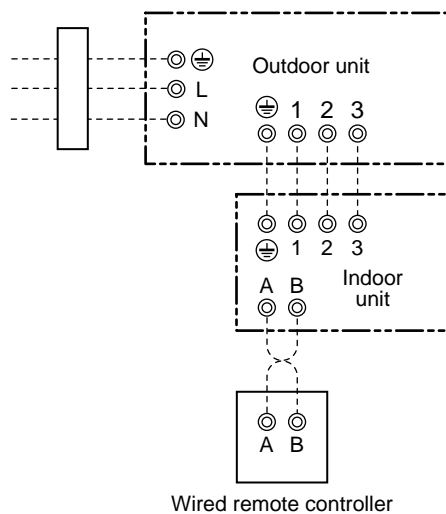
(Hz) is measured by a clamp meter becomes 2 times of No. of compressor revolutions (rps).

		Pressure				Pipe surface temperature (°C)				Compressor drive revolution frequency (rps)	Indoor fan	Indoor/Outdoor temp. conditions (DB/WB) (°C)	
		(MPa)		(kg/cm²g)		Discharge	Suction	Indoor heat exchanger	Outdoor heat exchanger			Indoor	Outdoor
		Pd	Ps	Pd	Ps	(TD)	(TS)	(TC)	(TE)				
Cooling	Standard	2.85	0.83	29.1	8.5	80	11	9	39	65	HIGH	27/19	35/–
	Overload	3.41	1.04	34.8	10.6	84	14	15	49	56	HIGH	32/24	43/–
	Low load	2.08	0.54	21.2	5.5	54	5	8	37	30	LOW	18/15.5	–15/–
Heating	Standard	2.82	0.66	28.7	6.7	83	3	46	2	62	HIGH	20/–	7/6
	Overload	2.44	1.13	24.9	11.5	82	18	55	15	32	LOW	30/–	24/18
	Low load	2.32	0.25	23.7	2.5	88	–20	38	–16	84	HIGH	15/–	–15/–

RAV-SM1103DT-A, RAV-SM1403DT-A, RAV-SM1603DT-A

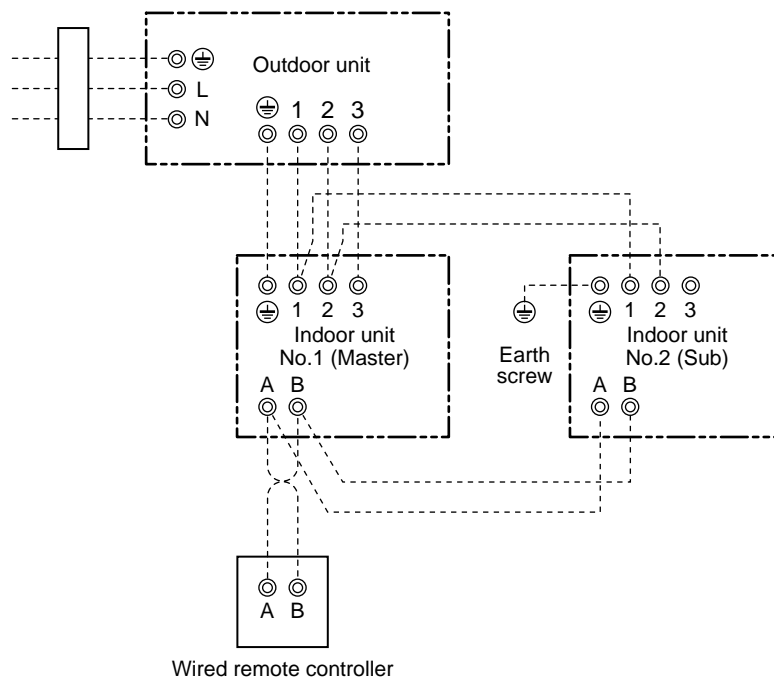
• Single type

Power supply 220-240V
Single phase 50Hz



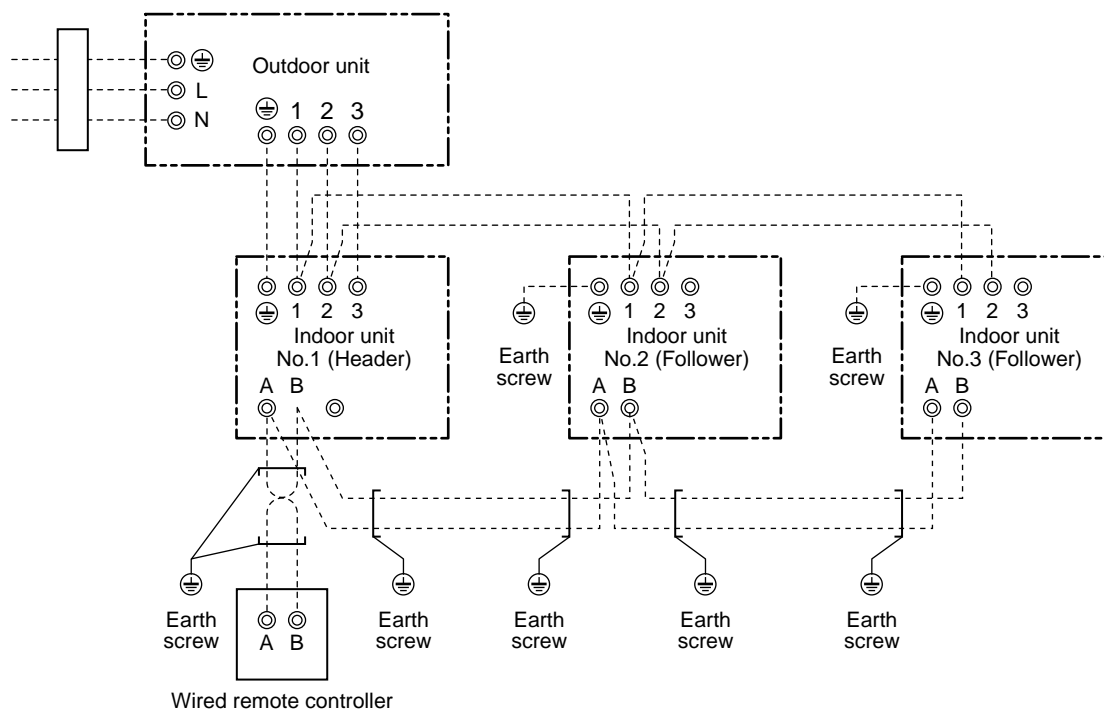
• Twin type

Power supply 220-240V
Single phase 50Hz



• Triple type

Power supply 220-240V
Single phase 50Hz

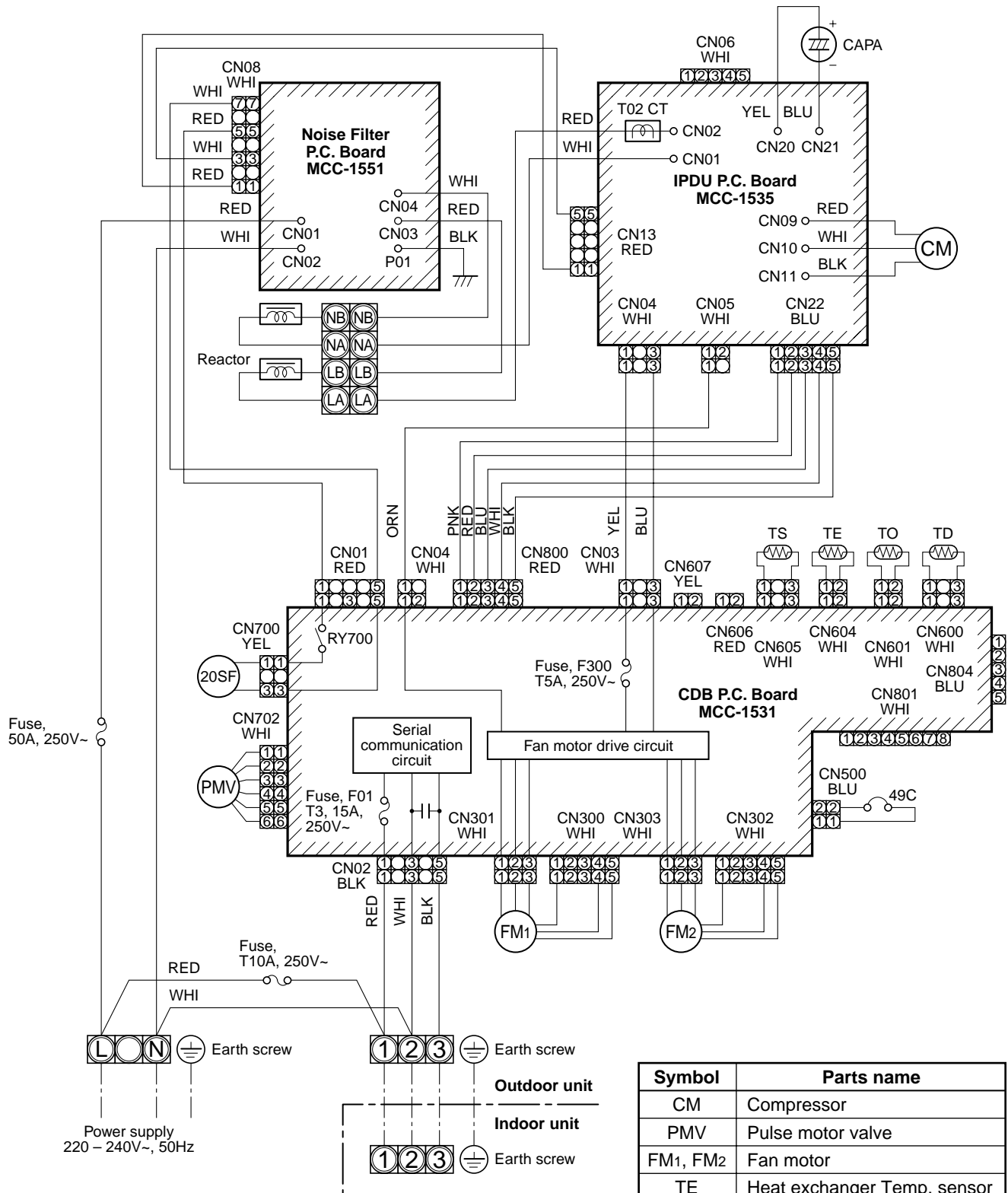


Notes

1. ◎ : indicates a terminal block
2. Broken line and chain line indicate wiring at local site.
3. For the inner wiring diagram of the outdoor unit and the indoor unit, refer to the wiring diagram of each model.
4. There is no polarity. It is no problem that the remote controller is connected to the indoor unit terminal block A and B reversely.
5. When using a wireless remote controller, connection of the remote controller to A and B terminal blocks are unnecessary. (Wire connection between indoor unit No.1 and No.2 is necessary.)

4-2. Outdoor Unit

RAV-SM1603AT-E, RAV-SM1603ATZ-E, RAV-SM1603ATZG-E



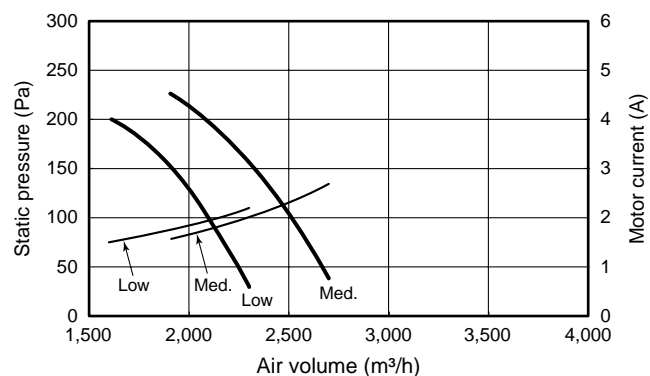
4-3. Fan Characteristics

Current value as a criterion, adjust the air volume value to become within the range of the chart below.

<RAV-SM1103DT-A>

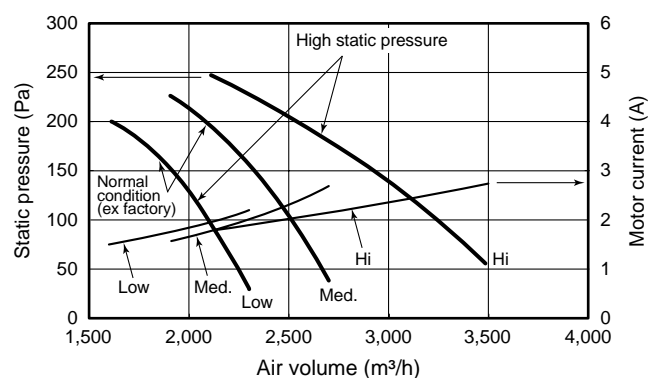
Fan-tap	(unit)	Static pressure (Pa)						
		30	40	50	100	200	225	250
Med	m³/h		2,700	2,670	2,500	2,100	1,900	
	l/s		750	742	694	583	527	
	CMM		45.0	44.5	41.6	35.0	31.6	
Low	m³/h	2,300	2,270	2,250	2,100	1,600		
	l/s	638	631	625	583	513		
	CMM	38.3	37.8	37.5	35.0	30.8		

Using Med fan tap (High static pressure tap is not available)



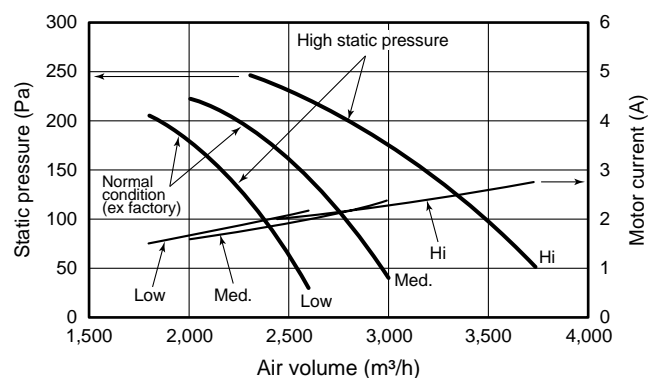
<RAV-SM1403DT-A>

Fan-tap	(unit)	Static pressure (Pa)						
		30	40	50	100	200	225	250
Hi	m³/h			3,480	3,300	2,500	2,330	2,100
	l/s			966	916	694	647	583
	CMM			58.0	55.0	41.6	38.8	35.0
Med	m³/h		2,700	2,670	2,500	2,100	1,900	
	l/s		750	742	694	583	527	
	CMM		45.0	44.5	41.6	35.0	31.6	
Low	m³/h	2,300	2,270	2,250	2,100	1,600		
	l/s	638	631	625	583	513		
	CMM	38.3	37.8	37.5	35.0	30.8		



<RAV-SM1603DT-A>

Fan-tap	(unit)	Static pressure (Pa)						
		30	40	50	100	200	225	250
Hi	m³/h			3,740	3,500	2,800	2,600	2,300
	l/s			1,038	972	777	722	638
	CMM			62.3	58.3	46.6	43.3	38.3
Med	m³/h		3,000	2,970	2,790	2,260	2,000	
	l/s		833	825	775	627	555	
	CMM		50.0	49.5	46.5	37.6	33.3	
Low	m³/h	2,600	2,580	2,550	2,380	1,850		
	l/s	722	717	708	66	513		
	CMM	43.3	43.0	42.5	39.6	30.8		

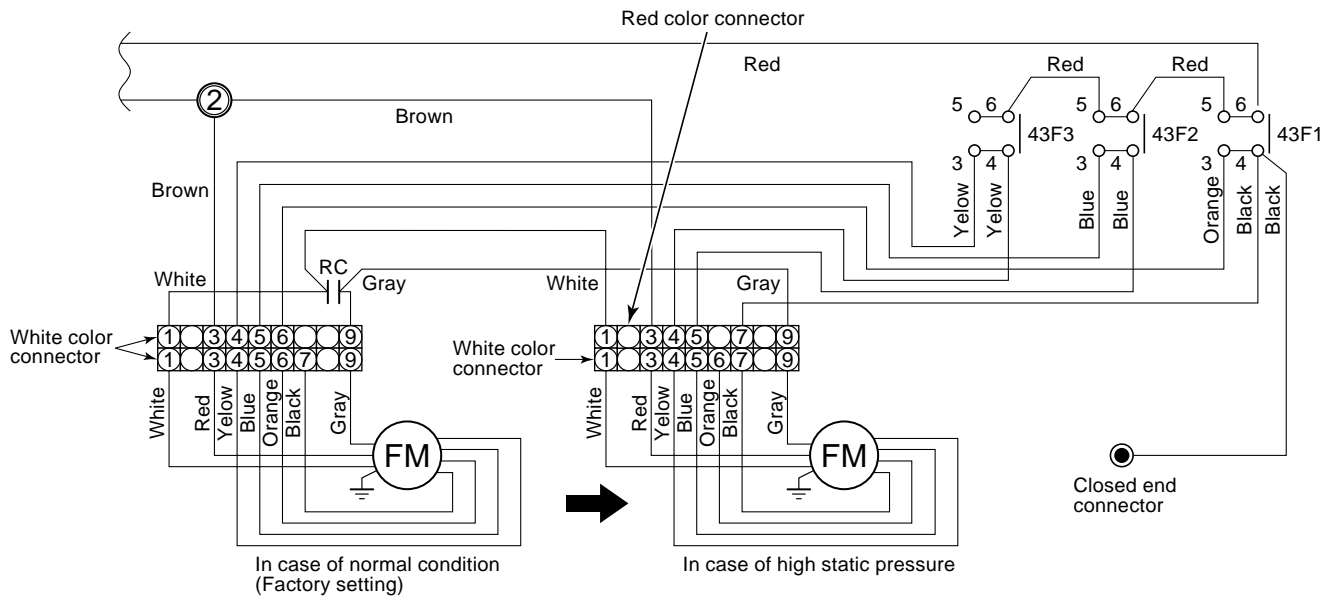


REQUIREMENT

Install the volume damper in the air outlet, and adjust the airflow to become within the range of the chart above.

■ Wire connection change of fan motor

Wiring connection of the fan motor is connected that external static pressure makes to 200P during factory setting. In cases where external static pressure is required to change by the duct resistor, change the wiring connection. The fan motor connector is connected to the 9P white color connector during factory setting. When the fan motor is set to high static pressure, connect to the 9P red color connector such as arrow mark. In addition, 9P red color connector is bundled along with wirings into the electric parts box.



5. SPECIFICATIONS OF ELECTRICAL PARTS

5-1. Indoor Unit

RAV-SM1103DT-A, RAV-SM1403DT-A, RAV-SM1603DT-A

No.	Parts name	Type	Specifications
1	Fan motor	SWF-240-600-4A	Output (Rated) 600 W
2	TA sensor	Lead wire length : 1200mm	10 kΩ at 25°C
3	TC sensor	Ø6 size lead wire length : 1200mm Vinyl tube (Black)	10 kΩ at 25°C
4	TCJ sensor	Ø6 size lead wire length : 1200mm Vinyl tube (Red)	10 kΩ at 25°C

5-2. Outdoor Unit

RAV-SM1603AT-E, RAV-SM1603ATZ-E, RAV-SM1603ATZG-E

No.	Parts name	Type	Specifications
1	Fan motor	ICF-280-100-1R	Output (Rated) 100 W
2	Compressor	DA422A3F-25M	3 phase, 4P, 3500 W
3	Reactor	CH-65	2.75 – 3.15 mH, 27.8 ± 1.9 V
4	Outdoor temp. sensor (To-sensor)	—	10 kΩ at 25°C
5	Heat exchanger sensor (Te-sensor)	—	10 kΩ at 25°C
6	Suction temp. sensor (Ts-sensor)	—	10 kΩ at 25°C
7	Discharge temp. sensor (Td-sensor)	—	50 kΩ at 25°C
8	Fuse (Switching power (Protect))	—	T3.15 A, AC 250 V
9	Fuse (Inverter, input (Current protect))	—	50 A, AC 250 V
10	4-way valve solenoid coil	STF-01AJ502EJ	AC 220 – 240 V
11	Compressor thermo. (Protection)	US-622	OFF : 125 ± 4°C, ON : 90 ± 5°C
12	Coil (Pulse Motor Valve)	UKV-25D100	—

6. REFRIGERANT R410A

This air conditioner adopts the new refrigerant HFC (R410A) which does not damage the ozone layer.

The working pressure of the new refrigerant R410A is 1.6 times higher than conventional refrigerant (R22). The refrigerating oil is also changed in accordance with change of refrigerant, so be careful that water, dust, and existing refrigerant or refrigerating oil are not entered in the refrigerant cycle of the air conditioner using the new refrigerant during installation work or servicing time.

The next section describes the precautions for air conditioner using the new refrigerant.

Conforming to contents of the next section together with the general cautions included in this manual, perform the correct and safe work.

6-1. Safety During Installation/Servicing

As R410A's pressure is about 1.6 times higher than that of R22, improper installation/servicing may cause a serious trouble. By using tools and materials exclusive for R410A, it is necessary to carry out installation/servicing safely while taking the following precautions into consideration.

1. Never use refrigerant other than R410A in an air conditioner which is designed to operate with R410A.

If other refrigerant than R410A is mixed, pressure in the refrigeration cycle becomes abnormally high, and it may cause personal injury, etc. by a rupture.

2. Confirm the used refrigerant name, and use tools and materials exclusive for the refrigerant R410A.

The refrigerant name R410A is indicated on the visible place of the outdoor unit of the air conditioner using R410A as refrigerant.

To prevent mischarging, the diameter of the service port differs from that of R22.

3. If a refrigeration gas leakage occurs during installation/servicing, be sure to ventilate fully.
If the refrigerant gas comes into contact with fire, a poisonous gas may occur.
4. When installing or removing an air conditioner, do not allow air or moisture to remain in the refrigeration cycle.
Otherwise, pressure in the refrigeration cycle may become abnormally high so that a rupture or personal injury may be caused.
5. After completion of installation work, check to make sure that there is no refrigeration gas leakage.
If the refrigerant gas leaks into the room, coming into contact with fire in the fan-driven heater, space heater, etc., a poisonous gas may occur.

6. When an air conditioning system charged with a large volume of refrigerant is installed in a small room, it is necessary to exercise care so that, even when refrigerant leaks, its concentration does not exceed the marginal level.

If the refrigerant gas leakage occurs and its concentration exceeds the marginal level, an oxygen starvation accident may result.

7. Be sure to carry out installation or removal according to the installation manual.
Improper installation may cause refrigeration trouble, water leakage, electric shock, fire, etc.
8. Unauthorized modifications to the air conditioner may be dangerous. If a breakdown occurs please call a qualified air conditioner technician or electrician.
Improper repair may result in water leakage, electric shock and fire, etc.

6-2. Refrigerant Piping Installation

6-2-1. Piping Materials and Joints Used

For the refrigerant piping installation, copper pipes and joints are mainly used.

Copper pipes and joints suitable for the refrigerant must be chosen and installed.

Furthermore, it is necessary to use clean copper pipes and joints whose interior surfaces are less affected by contaminants.

1. Copper Pipes

It is necessary to use seamless copper pipes which are made of either copper or copper alloy and it is desirable that the amount of residual oil is less than 40 mg/10 m.

Do not use copper pipes having a collapsed, deformed or discolored portion (especially on the interior surface).

Otherwise, the expansion valve or capillary tube may become blocked with contaminants.

As an air conditioner using R410A incurs pressure higher than when using R22, it is necessary to choose adequate materials.

Thicknesses of copper pipes used with R410A are as shown in Table 6-2-1. Never use copper pipes thinner than 0.8mm even when it is available on the market.

NOTE:

Refer to the "6-6. Instructions for Re-use Piping of R22 or R407C".

Table 6-2-1 Thicknesses of annealed copper pipes

		Thickness (mm)	
Nominal diameter	Outer diameter (mm)	R410A	R22
1/4	6.4	0.80	0.80
3/8	9.5	0.80	0.80
1/2	12.7	0.80	0.80
5/8	15.9	1.00	1.00

1. Joints

For copper pipes, flare joints or socket joints are used. Prior to use, be sure to remove all contaminants.

a) Flare Joints

Flare joints used to connect the copper pipes cannot be used for pipings whose outer diameter exceeds 20 mm. In such a case, socket joints can be used.

Sizes of flare pipe ends, flare joint ends and flare nuts are as shown in Tables 6-2-3 to 6-2-5 below.

b) Socket Joints

Socket joints are such that they are brazed for connections, and used mainly for thick pipings whose diameter is larger than 20 mm. Thicknesses of socket joints are as shown in Table 6-2-2.

Table 6-2-2 Minimum thicknesses of socket joints

Nominal diameter	Reference outer diameter of copper pipe jointed (mm)	Minimum joint thickness (mm)
1/4	6.4	0.50
3/8	9.5	0.60
1/2	12.7	0.70
5/8	15.9	0.80

6-2-2. Processing of Piping Materials

When performing the refrigerant piping installation, care should be taken to ensure that water or dust does not enter the pipe interior, that no other oil other than lubricating oils used in the installed air conditioner is used, and that refrigerant does not leak.

When using lubricating oils in the piping processing, use such lubricating oils whose water content has been removed. When stored, be sure to seal the container with an airtight cap or any other cover.

1. Flare Processing Procedures and Precautions

a) Cutting the Pipe

By means of a pipe cutter, slowly cut the pipe so that it is not deformed.

b) Removing Burrs and Chips

If the flared section has chips or burrs, refrigerant leakage may occur.

Carefully remove all burrs and clean the cut surface before installation.

c) Insertion of Flare Nut

d) Flare Processing

Make certain that a clamp bar and copper pipe have been cleaned.

By means of the clamp bar, perform the flare processing correctly.

Use either a flare tool for R410A or conventional flare tool.

Flare processing dimensions differ according to the type of flare tool.

When using a conventional flare tool, be sure to secure "dimension A" by using a gauge for size adjustment.

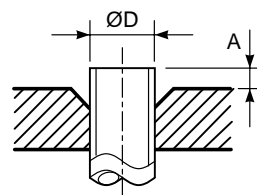


Fig. 6-2-1 Flare processing dimensions

Table 6-2-3 Dimensions related to flare processing for R410A / R22

Nominal diameter	Outer diameter (mm)	Thickness (mm)	A (mm)				
			Flare tool for R410A, R22 clutch type	Conventional flare tool (R410A)		Conventional flare tool (R22)	
				Clutch type	Wing nut type	Clutch type	Wing nut type
1/4	6.4	0.8	0 to 0.5	1.0 to 1.5	1.5 to 2.0	0.5 to 1.0	1.0 to 1.5
3/8	9.5	0.8	0 to 0.5	1.0 to 1.5	1.5 to 2.0	0.5 to 1.0	1.0 to 1.5
1/2	12.7	0.8	0 to 0.5	1.0 to 1.5	2.0 to 2.5	0.5 to 1.0	1.5 to 2.0
5/8	15.9	1.0	0 to 0.5	1.0 to 1.5	2.0 to 2.5	0.5 to 1.0	1.5 to 2.0

Table 6-2-4 Flare and flare nut dimensions for R410A

Nominal diameter	Outer diameter (mm)	Thickness (mm)	Dimension (mm)				Flare nut width (mm)
			A	B	C	D	
1/4	6.4	0.8	9.1	9.2	6.5	13	17
3/8	9.5	0.8	13.2	13.5	9.7	20	22
1/2	12.7	0.8	16.6	16.0	12.9	23	26
5/8	15.9	1.0	19.7	19.0	16.0	25	29

Table 6-2-5 Flare and flare nut dimensions for R22

Nominal diameter	Outer diameter (mm)	Thickness (mm)	Dimension (mm)				Flare nut width (mm)
			A	B	C	D	
1/4	6.4	0.8	9.1	9.2	6.5	13	17
3/8	9.5	0.8	13.0	13.5	9.7	20	22
1/2	12.7	0.8	16.2	16.0	12.9	20	24
5/8	15.9	1.0	19.4	19.0	16.0	23	27
3/4	19.0	1.0	23.3	24.0	19.2	34	36

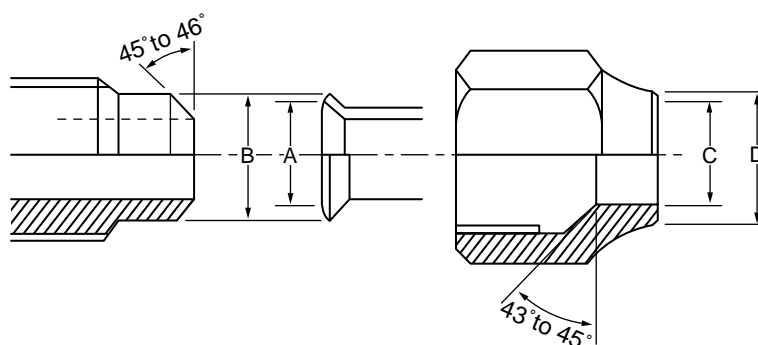


Fig. 6-2-2 Relations between flare nut and flare seal surface

2. Flare Connecting Procedures and Precautions

- Make sure that the flare and union portions do not have any scar or dust, etc.
- Correctly align the processed flare surface with the union axis.
- Tighten the flare with designated torque by means of a torque wrench.

The tightening torque for R410A is the same as that for conventional R22.

Incidentally, when the torque is weak, the gas leakage may occur.

When it is strong, the flare nut may crack and may be made non-removable.

When choosing the tightening torque, comply with values designated by manufacturers.

Table 6-2-6 shows reference values.

NOTE:

When applying oil to the flare surface, be sure to use oil designated by the manufacturer.

If any other oil is used, the lubricating oils may deteriorate and cause the compressor to burn out.

Table 6-2-6 Tightening torque of flare for R410A [Reference values]

Nominal diameter	Outer diameter (mm)	Tightening torque N•m (kgf•m)	Tightening torque of torque wrenches available on the market N•m (kgf•m)
1/4	6.4	14 to 18 (1.4 to 1.8)	16 (1.6), 18 (1.8)
3/8	9.5	33 to 42 (3.3 to 4.2)	42 (4.2)
1/2	12.7	50 to 62 (5.0 to 6.2)	55 (5.5)
5/8	15.9	63 to 77 (6.3 to 7.7)	65 (6.5)

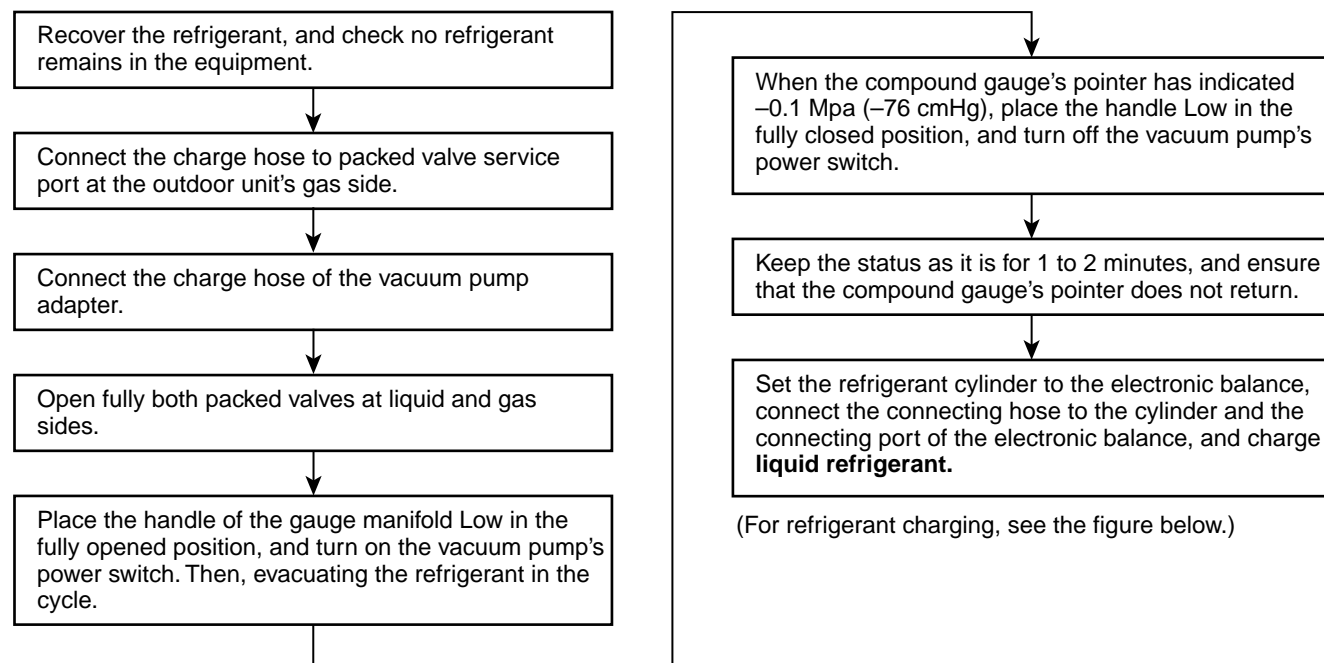
6-3. Tools

6-3-1. Required Tools

Refer to the “4. Tools” (Page 8)

6-4. Recharging of Refrigerant

When it is necessary to recharge refrigerant, charge the specified amount of new refrigerant according to the following steps.



- 1) Never charge refrigerant exceeding the specified amount.
- 2) If the specified amount of refrigerant cannot be charged, charge refrigerant **bit by bit** in COOL mode.
- 3) Do not carry out additional charging.

When additional charging is carried out if refrigerant leaks, the refrigerant composition changes in the refrigeration cycle, that is characteristics of the air conditioner changes, refrigerant exceeding the specified amount is charged, and working pressure in the refrigeration cycle becomes abnormally high pressure, and may cause a rupture or personal injury.

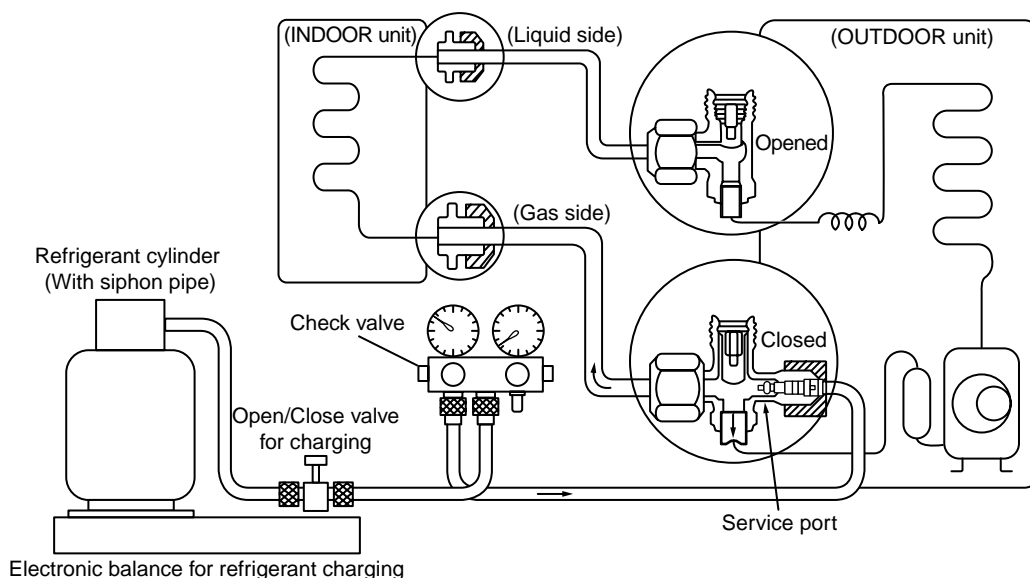
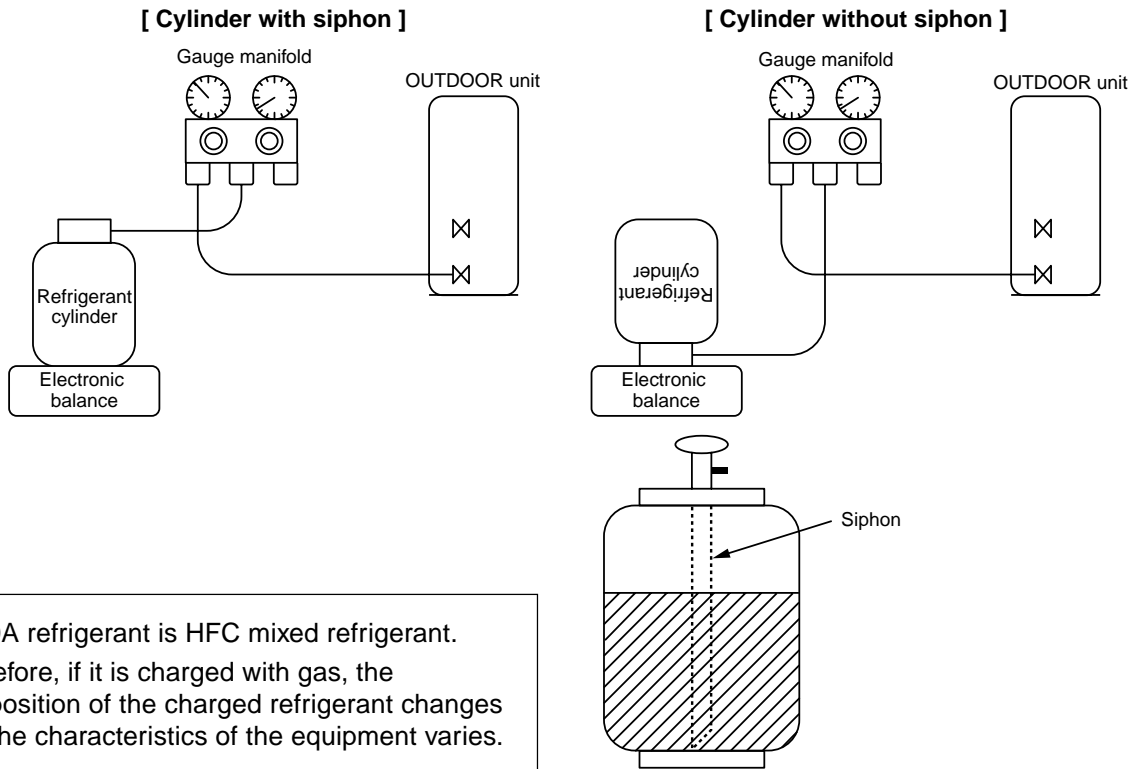


Fig. 6-4-1 Configuration of refrigerant charging

- 1) Be sure to make setting so that **liquid** can be charged.
- 2) When using a cylinder equipped with a siphon, liquid can be charged without turning it upside down.

It is necessary for charging refrigerant under condition of liquid because R410A is mixed type of refrigerant. Accordingly, when charging refrigerant from the refrigerant cylinder to the equipment, charge it turning the cylinder upside down if cylinder is not equipped with siphon.



R410A refrigerant is HFC mixed refrigerant. Therefore, if it is charged with gas, the composition of the charged refrigerant changes and the characteristics of the equipment varies.

Fig. 6-4-2

6-5. Brazing of Pipes

6-5-1. Materials for Brazing

1. Silver brazing filler

Silver brazing filler is an alloy mainly composed of silver and copper.

It is used to join iron, copper or copper alloy, and is relatively expensive though it excels in solderability.

2. Phosphor bronze brazing filler

Phosphor bronze brazing filler is generally used to join copper or copper alloy.

3. Low temperature brazing filler

Low temperature brazing filler is generally called solder, and is an alloy of tin and lead.

Since it is weak in adhesive strength, do not use it for refrigerant pipes.

- 1) Phosphor bronze brazing filler tends to react with sulfur and produce a fragile compound water solution, which may cause a gas leakage. Therefore, use any other type of brazing filler at a hot spring resort, etc., and coat the surface with a paint.
- 2) When performing brazing again at time of servicing, use the same type of brazing filler.

6-5-2. Flux

1. Reason why flux is necessary

- By removing the oxide film and any foreign matter on the metal surface, it assists the flow of brazing filler.
- In the brazing process, it prevents the metal surface from being oxidized.
- By reducing the brazing filler's surface tension, the brazing filler adheres better to the treated metal.

2. Characteristics required for flux

- Activated temperature of flux coincides with the brazing temperature.
- Due to a wide effective temperature range, flux is hard to carbonize.
- It is easy to remove slag after brazing.
- The corrosive action to the treated metal and brazing filler is minimum.
- It excels in coating performance and is harmless to the human body.

As the flux works in a complicated manner as described above, it is necessary to select an adequate type of flux according to the type and shape of treated metal, type of brazing filler and brazing method, etc.

3. Types of flux

• Noncorrosive flux

Generally, it is a compound of borax and boric acid.

It is effective in case where the brazing temperature is higher than 800°C.

• Activated flux

Most of fluxes generally used for silver brazing are this type.

It features an increased oxide film removing capability due to the addition of compounds such as potassium fluoride, potassium chloride and sodium fluoride to the borax-boric acid compound.

4. Piping materials for brazing and used brazing filler/flux

Piping material	Used brazing filler	Used flux
Copper - Copper	Phosphor copper	Do not use
Copper - Iron	Silver	Paste flux
Iron - Iron	Silver	Vapor flux

- 1) Do not enter flux into the refrigeration cycle.
- 2) When chlorine contained in the flux remains within the pipe, the lubricating oil deteriorates. Therefore, use a flux which does not contain chlorine.
- 3) When adding water to the flux, use water which does not contain chlorine (e.g. distilled water or ion-exchange water).
- 4) Remove the flux after brazing.

6-5-3. Brazing

As brazing work requires sophisticated techniques, experiences based upon a theoretical knowledge, it must be performed by a person qualified.

In order to prevent the oxide film from occurring in the pipe interior during brazing, it is effective to proceed with brazing while letting dry Nitrogen gas flow.

Never use gas other than Nitrogen gas.

1. Brazing method to prevent oxidation

- 1) Attach a reducing valve and a flow-meter to the Nitrogen gas cylinder.
- 2) Use a copper pipe to direct the piping material, and attach a flow-meter to the cylinder.
- 3) Apply a seal onto the clearance between the piping material and inserted copper pipe for Nitrogen in order to prevent backflow of the Nitrogen gas.
- 4) When the Nitrogen gas is flowing, be sure to keep the piping end open.
- 5) Adjust the flow rate of Nitrogen gas so that it is lower than 0.05 m³/Hr or 0.02 MPa (0.2kgf/cm²) by means of the reducing valve.
- 6) After performing the steps above, keep the Nitrogen gas flowing until the pipe cools down to a certain extent (temperature at which pipes are touchable with hands).
- 7) Remove the flux completely after brazing.

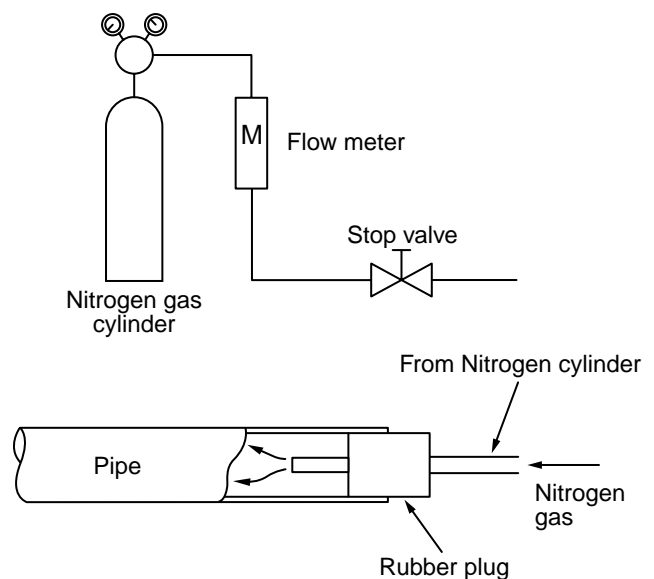


Fig. 6-5-1 Prevention of oxidation during brazing

6-6. Instructions for Re-use Piping of R22 or R407C

Instruction of Works:

The existing R22 and R407C piping can be reused for our digital inverter R410A products installations.

NOTE)

Confirmation of existence of scratch or dent of the former pipes to be applied and also confirmation of reliability of the pipe strength are conventionally referred to the local site.

If the definite conditions can be cleared, it is possible to update the existing R22 and R407C pipes to those for R410A models.

6-6-1. Basic Conditions Needed to Reuse the Existing Pipe

Check and observe three conditions of the refrigerant piping works.

1. Dry (There is no moisture inside of the pipes.)
2. Clean (There is no dust inside of the pipes.)
3. Tight (There is no refrigerant leak.)

6-6-2. Restricted Items to Use the Existing Pipes

In the following cases, the existing pipes cannot be reused as they are. Clean the existing pipes or exchange them with new pipes.

1. When a scratch or dent is heavy, be sure to use the new pipes for the works.
2. When the thickness of the existing pipe is thinner than the specified "Pipe diameter and thickness" be sure to use the new pipes for the works.
 - The operating pressure of R410A is high (1.6 times of R22 and R407C). If there is a scratch or dent on the pipe or thinner pipe is used, the pressure strength is poor and may cause breakage of the pipe at the worst.

* Pipe diameter and thickness (mm)

Pipe outer diameter		Ø6.4	Ø9.5	Ø12.7	Ø15.9	Ø19.0
Thickness	R410A	0.8	0.8	0.8	1.0	1.0
	R22 (R407C)					

- In case that the pipe diameter is Ø12.7 mm or less and the thickness is less than 0.7 mm, be sure to use the new pipes for works.
3. The pipes are left as coming out or gas leaks. (Poor refrigerant)
 - There is possibility that rain water or air including moisture enters in the pipe.
 4. Refrigerant recovery is impossible. (Refrigerant recovery by the pump-down operation on the existing air conditioner)
 - There is possibility that a large quantity of poor oil or moisture remains inside of the pipe.
 5. A dryer on the market is attached to the existing pipes.
 - There is possibility that copper green rust generated.

6. Check the oil when the existing air conditioner was removed after refrigerant had been recovered. In this case, if the oil is judged as clearly different compared with normal oil
 - The refrigerator oil is copper rust green : There is possibility that moisture is mixed with the oil and rust generates inside of the pipe.
 - There is discolored oil, a large quantity of the remains, or bad smell.
 - A large quantity of sparkle remained wear-out powder is observed in the refrigerator oil.
7. The air conditioner which compressor was exchanged due to a faulty compressor. When the discolored oil, a large quantity of the remains, mixture of foreign matter, or a large quantity of sparkle remained wear-out powder is observed, the cause of trouble will occur.
8. Installation and removal of the air conditioner are repeated with temporary installation by lease and etc.
9. In case that type of the refrigerator oil of the existing air conditioner is other than the following oil (Mineral oil), Suniso, Freol-S, MS (Synthetic oil), alkyl benzene (HAB, Barrel-freeze), ester series, PVE only of ether series.
 - Winding-insulation of the compressor may become inferior.

NOTE)

The above descriptions are results of confirmation by our company and they are views on our air conditioners, but they do not guarantee the use of the existing pipes of the air conditioner that adopted R410A in other companies.

6-6-3. Branching Pipe for Simultaneous Operation System

- In the concurrent twin, triple systems, when TOSHIBA-specified branching pipe is used, it can be reused. Branching pipe model name: RBC-TWP30E-2, RBC-TWP50E-2, RBC-TRP100E On the existing air conditioner for simultaneous operation system (twin, triple systems), there is a case of using branch pipe that has insufficient compressive strength. In this case please change it to the branch pipe for R410A.

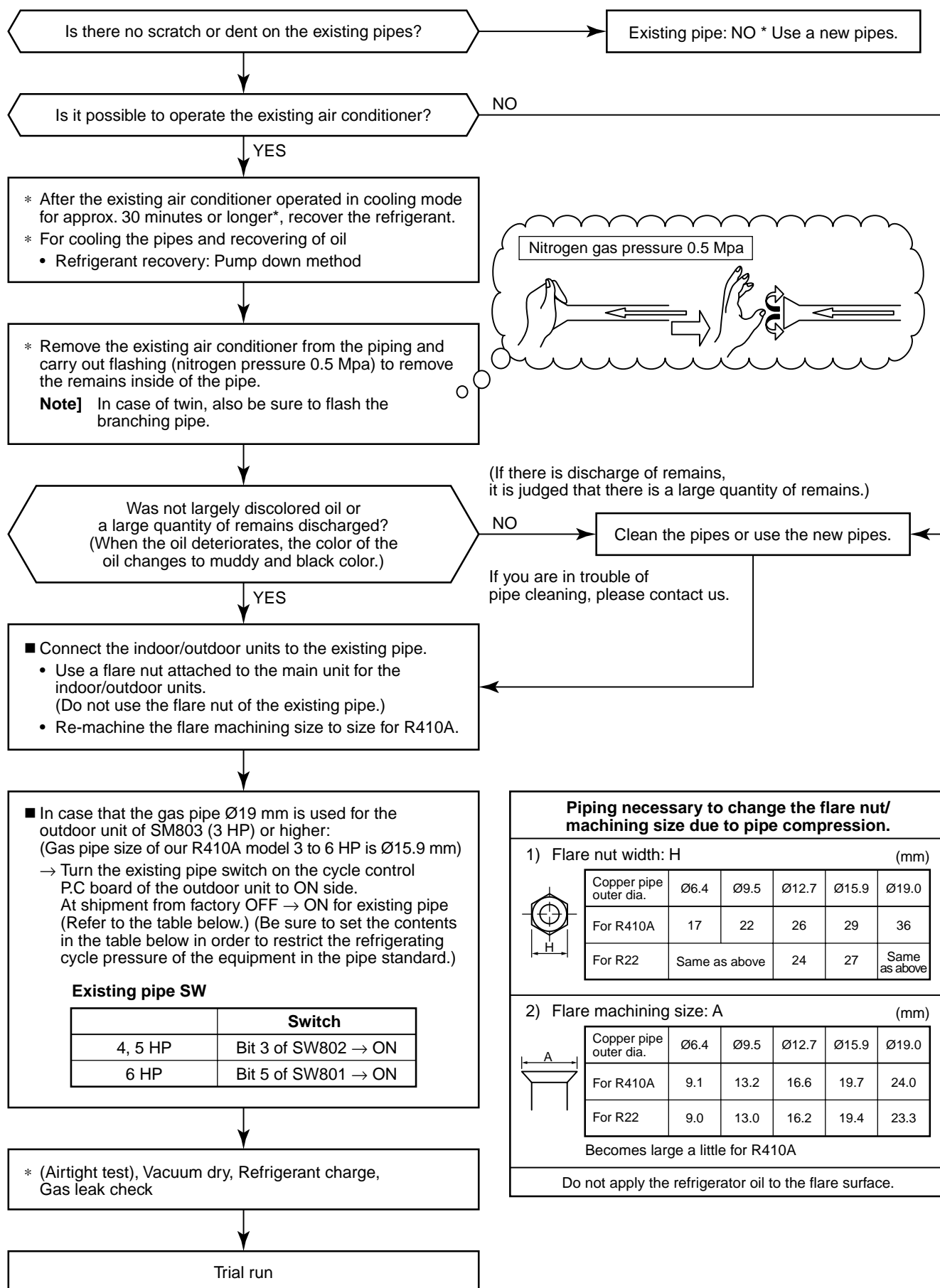
6-6-4. Curing of Pipes

When removing and opening the indoor unit or outdoor unit for a long time, cure the pipes as follows:

- Otherwise rust may generate when moisture or foreign matter due to dewing enters in the pipes.
- The rust cannot be removed by cleaning, and a new piping work is necessary.

Place position	Term	Curing manner
Outdoors	1 month or more	Pinching
	Less than 1 month	Pinching or taping
Indoors	Every time	

6-6-5. Final Installation Checks



6-6-6. Handling of Existing Pipe

When using the existing pipe, carefully check it for the following:

- Wall thickness (within the specified range)
- Scratches and dents
- Water, oil, dirt, or dust in the pipe
- Flare looseness and leakage from welds
- Deterioration of copper pipe and heat insulator

Cautions for using existing pipe

- Do not reuse the flare to prevent gas leak.
Replace it with the supplied flare nut and then process it to a flare.
- Blow nitrogen gas or use an appropriate means to keep the inside of the pipe clean.
If discolored oil or much residue is discharged, wash the pipe.
- Check welds, if any, on the pipe for gas leak.
When the pipe corresponds to any of the following, do not use it. Install a new pipe instead.
- The pipe has been open (disconnected from indoor unit or outdoor unit) for a long period.
- The pipe has been connected to an outdoor unit that does not use refrigerant R22, R410A or R407C.
- The existing pipe must have a wall thickness equal to or larger than the following thickness.

Reference outside diameter (mm)	Wall thickness (mm)
Ø9.5	0.8
Ø15.9	1.0
Ø19.1	1.0

- Never use any pipe with a wall thickness less than these thicknesses due to insufficient pressure capacity.

RAV-SP1404AT-E, RAV-SP1404ATZ-E, RAV-SP1404ATZG-E

- To use an existing Ø19.1 mm pipe, set bit 3 of SW802 (switch for existing pipe) on the P.C. board of the outdoor unit to ON.

In this case, the heating performance may be reduced depending on the outside air temperature and room temperature.

SW802	
When shipped from factory	When using existing pipe

RAV-SM1603AT-E, RAV-SM1603ATZ-E, RAV-SM1603ATZG-E

- To use an existing Ø19.1 mm pipe, set bit 5 of SW801 (switch for existing pipe) on the P.C. board of the outdoor unit to ON.

In this case, the heating performance may be reduced depending on the outside air temperature and room temperature.

SW801 No.5	

6-6-7. Recovery Method of Refrigerant

RAV-SP1404AT(Z)(ZG)-E

- Use the refrigerant recovery switch SW801 on the P.C. board of the outdoor unit to recover refrigerant when the indoor unit or outdoor unit is moved.

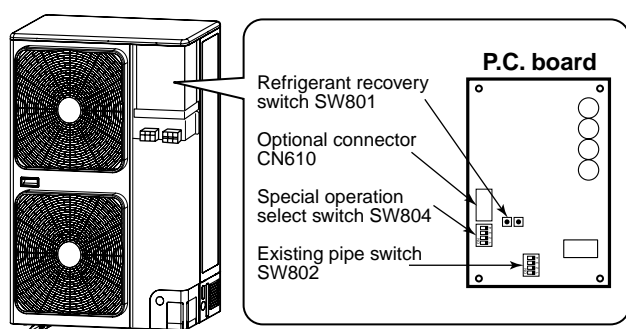
Procedure

1. Turn on the power of the air conditioner.
2. Select the FAN mode for indoor unit operation with the remote controller.
3. Set SW804 on the P.C. board of the outdoor unit to all OFF, and then push SW801 for one second or more.

The air conditioner enters the forced cooling mode for up to 10 minutes.

Operation or handling the valve to recover refrigerant during this time period.

4. Upon completion of refrigerant recovery, close the valve and push SW801 for at least one second to stop operation.
5. Turn off the power.



RAV-SM1603AT(Z)(ZG)-E

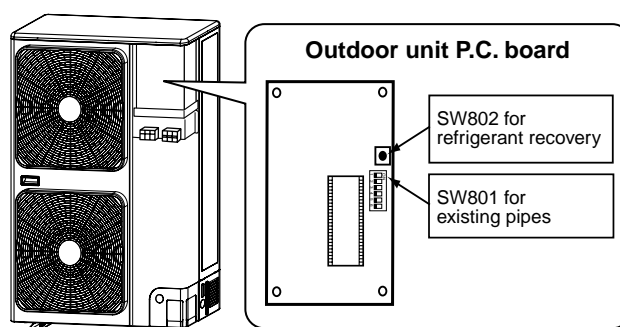
- Use the refrigerant recovery switch SW802 on the P.C. board of the outdoor unit to recover refrigerant when the indoor unit or outdoor unit is moved.

Procedure

1. Turn on the power of the air conditioner.
2. Select the FAN mode for indoor unit operation with the remote controller.
3. Press the refrigerant recovery switch SW802 on the P.C. board of the outdoor unit to drive the air conditioner into the forced cooling mode for up to 10 minutes.

Open the valve to start refrigerant recovery.

4. Upon completion of refrigerant recovery, close the valve and press SW802 for at least one second to stop operation.
5. Turn off the power.



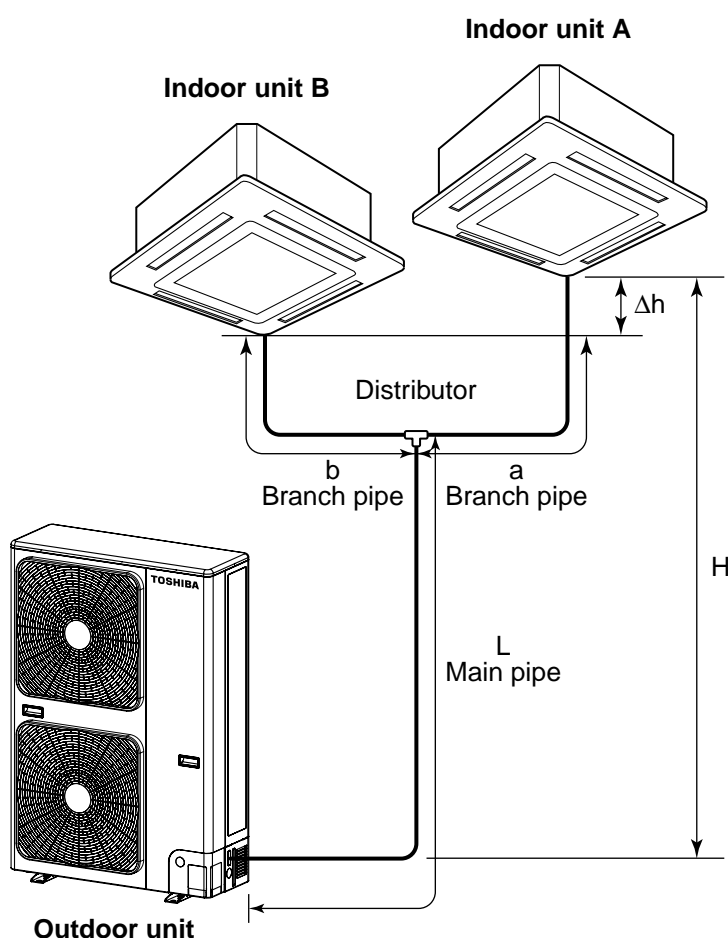
 **DANGER**

Take care for an electric shock because the P.C.board is electrified.

6-7. Tolerance of Pipe Length and Pipe Head

■ Twin system

Refrigerant pipe specification	Pipe length (one way)	Total length (L + a or L + b)		50 m
		Branch pipe length (a, b)		15 m
		Maximum difference between indoor units (b – a, or a - b)		10 m
	Height difference	Between indoor units (Δ h)		0.5 m
		Between indoor unit	When outdoor unit heigher (H)	30 m
		and outdoor unit	When outdoor unit lower (H)	30 m
	Number of bent portions			



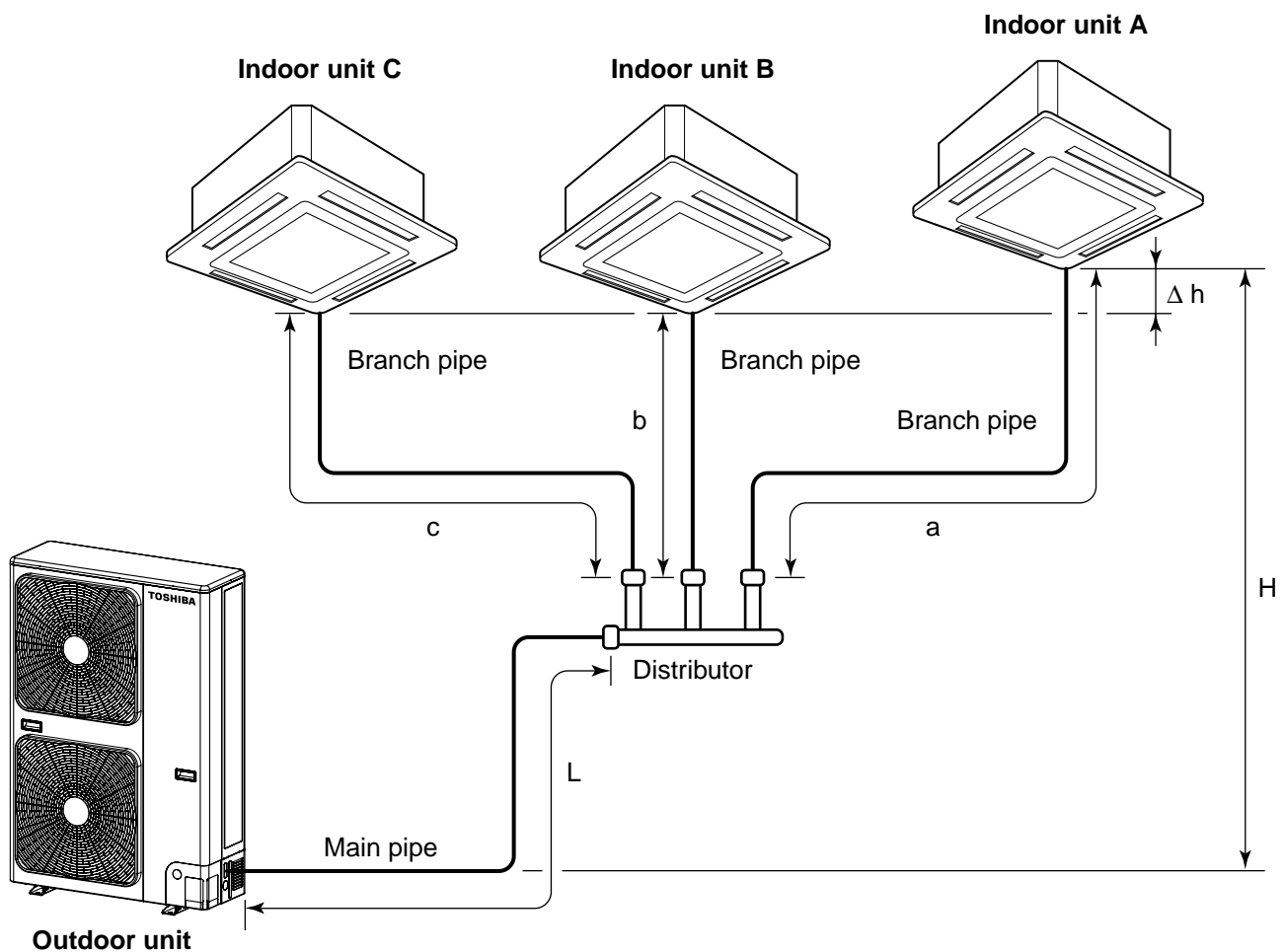
CAUTION

When planning a layout for Units A and B, comply with the following:

1. The lengths after branching ("a" and "b") should be equal if feasible.
Install Units A and B so that the difference of the branching lengths becomes less than 10m if the lengths cannot be equal due to the branch pipe position.
2. Install Units A and B on the same level.
If Units A and B cannot be installed on the same level, the difference in level should be limited to 0.5m or less.
3. Be certain to install Units A and B in the same room.
Units A and B cannot be operated independently each other.

■ Triple system

Refrigerant pipe specification	Pipe length (one way)	Total length (L + a, L +b, L+c)		50 m
		Branch pipe length (a, b, c)		15 m
		Maximum difference between indoor units (a – b , b – c , c – d)		10 m
	Height difference	Between indoor units (Δ h)		0.5 m
		Between indoor unit	When outdoor unit heigher (H)	30 m
		and outdoor unit	When outdoor unit lower (H)	30 m
	Number of bent portions			10 m or less



⚠ CAUTION

When planning a layout for Units A, B and C, comply with the following:

1. The lengths after branching (" a " and " b ", " b " and " c ", " a " and " c ") should be equal if feasible.
Install Units A, B and C so that the difference of the branching lengths becomes less than 10m if the lengths cannot be equal due to the branch pipe position.
2. Install Units A, B and C on the same level.
If Units A, B and C cannot be installed on the same level, the difference in level should be limited to 0.5 m or less.
3. Be certain to install Units A and B and C in the same room.
Units A, B and C cannot be operated independently each other.

6-8. Additional Refrigerant Amount

■ Twin system

<Formula for Calculating Additional Refrigerant Amount>

Do not remove the refrigerant even if the additional refrigerant amount becomes minus result as a result of calculations by the following formula and operate the air conditioner as it is.

$$\begin{aligned} \text{Additional refrigerant amount (kg)} &= \text{Main piping additional refrigerant amount (kg)} \\ &\quad + \text{Branch piping additional refrigerant amount (kg)} \\ &= \alpha \times (L - 18) + \gamma \times (a + b - 4) \end{aligned}$$

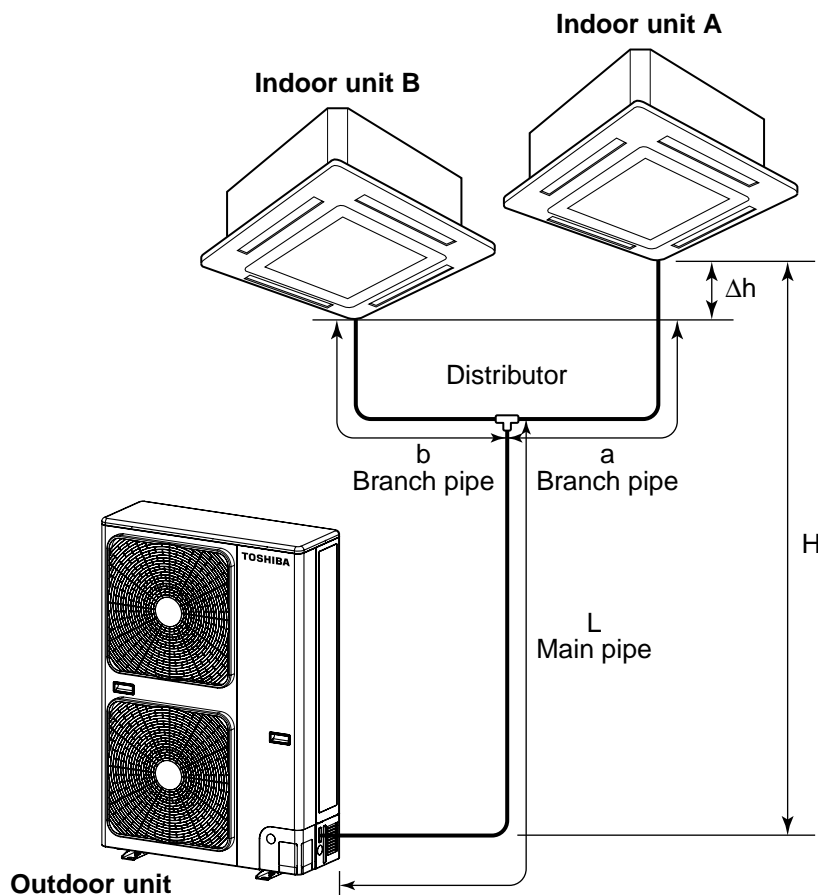
α : Additional refrigerant amount per meter of actual main piping length (kg)

γ : Additional refrigerant amount per meter of actual branch piping length (kg)

L : Actual length of main piping (m)

a, b : Actual length of branch piping (m)

Standard piping length		Connecting pipe diameter			Additional refrigerant amount per Meter (kg/m)		
Main piping	Branch piping	L	a	b	α	β	γ
18 m	2 m	Ø9.5	Ø6.4	Ø6.4	0.040	—	0.020



⚠ CAUTION

1. Be certain to wire the additional refrigerant amount, pipe length (actual length), head and other specification on the nameplate put on the outdoor unit for recording.
2. Seal the correct amount of additional refrigerant in the system.

■ Triple system

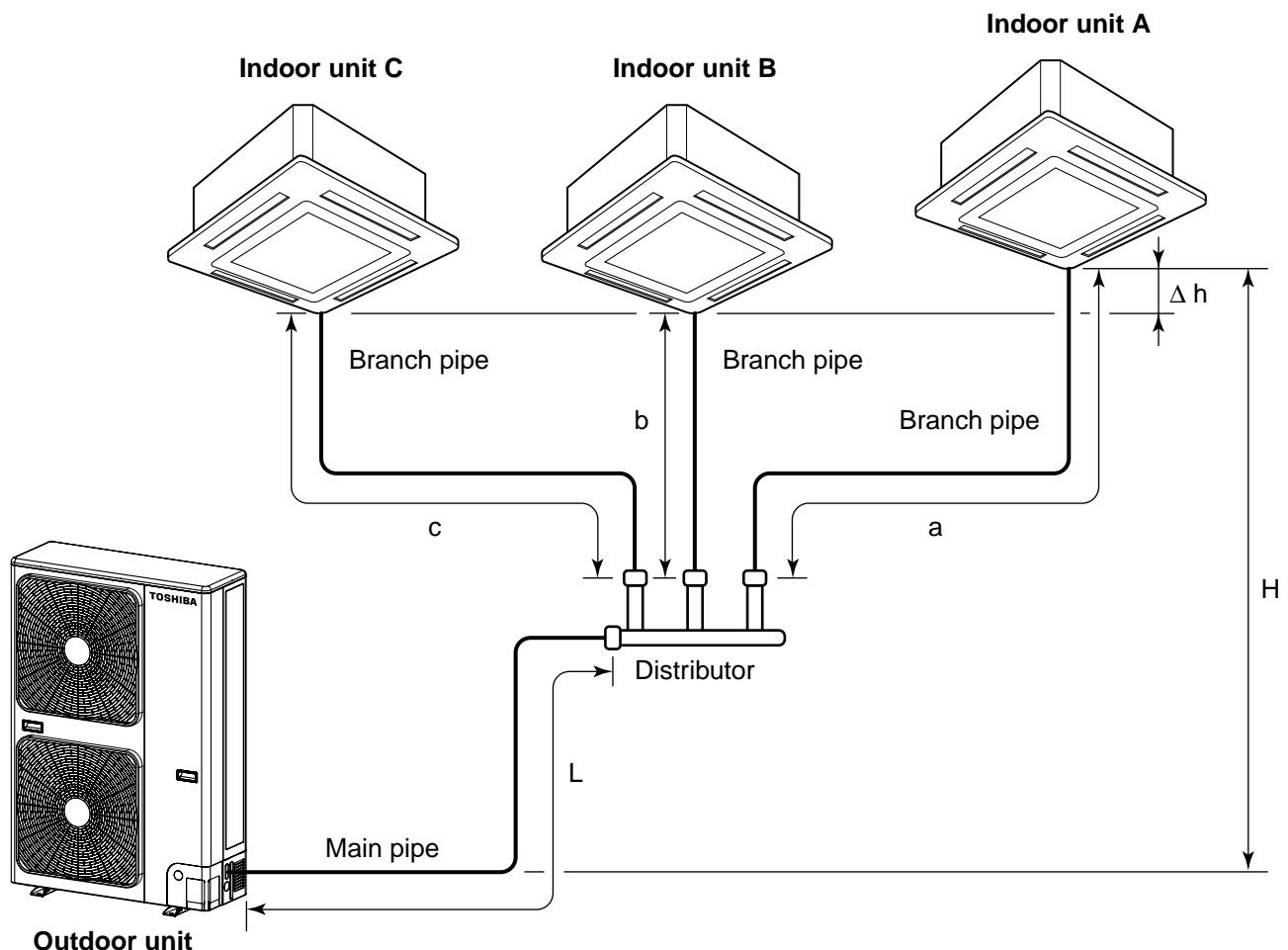
<Formula for Calculating Additional Refrigerant Amount>

Do not remove the refrigerant even if the additional refrigerant amount becomes minus result as a result of calculations by the following formula and operate the air conditioner as it is.

$$\begin{aligned} \text{Additional refrigerant amount (kg)} &= \text{Main piping additional refrigerant amount (kg)} \\ &\quad + \text{Branch piping additional refrigerant amount (kg)} \\ &= \{\alpha \times (L - 28)\} + \{\gamma \times (a + b + c - 6)\} \end{aligned}$$

α : Additional refrigerant amount per meter of actual main piping length (kg)
 γ : Additional refrigerant amount per meter of actual branch piping length (kg)
 L : Actual length of main piping (m)
 a, b, c : Actual length of branch piping (m)

Connecting pipe diameter				Additional refrigerant amount per Meter (kg/m)		
L	a	b	c	α	β	γ
Ø9.5	Ø6.4	Ø6.4	Ø6.4	0.04	—	0.02



⚠ CAUTION

1. Be certain to wire the additional refrigerant amount, pipe length (actual length), head and other specification on the nameplate put on the outdoor unit for recording.
2. Seal the correct amount of additional refrigerant in the system.

6-9. Piping Materials and Sizes

■ Twin system

Use copper tube of Copper and copper alloy seamless pipes and tubes, with 40mg/10m or less in the amount of oil stuck on inner walls of pipe and 0.8mm in pipe wall thickness for diameters for diameters 6.4, 9.5 and 12.7mm and 1.0mm, for diameter 15.9mm. Never use pipes of thin wall thickness such as 0.7mm.

In parentheses () are wall thickness

Pipe side	Gas side	Main pipe	Ø15.9 (1.0)
		Branch pipe	Ø12.7 (0.8)
	Liquid side	Main pipe	Ø9.5 (0.8)
		Branch pipe	Ø6.4 (0.8)

■ Triple system

Use copper tube of Copper and copper alloy seamless pipes and tubes, with 40 mg/10 m or less in the amount of oil stuck on inner walls of pipe and 0.8 mm in pipe wall thickness for diameters 6.4, 9.5 and 12.7 mm and 1.0 mm, for diameter 15.9 mm. Never use pipes of thin wall thickness such as 0.7 mm.

<Between outdoor unit and distributor>

[Unit: mm]

Outdoor unit		
Main pipe	Gas side	Ø15.9 (1.0)
	Liquid side	Ø9.5 (0.8)

* (): Pipe wall thickness

<Between distributor and indoor unit>

[Unit: mm]

Indoor unit		SM56 type
Branch pipe	Gas side	Ø12.7 (0.8)
	Liquid side	Ø6.4 (0.8)

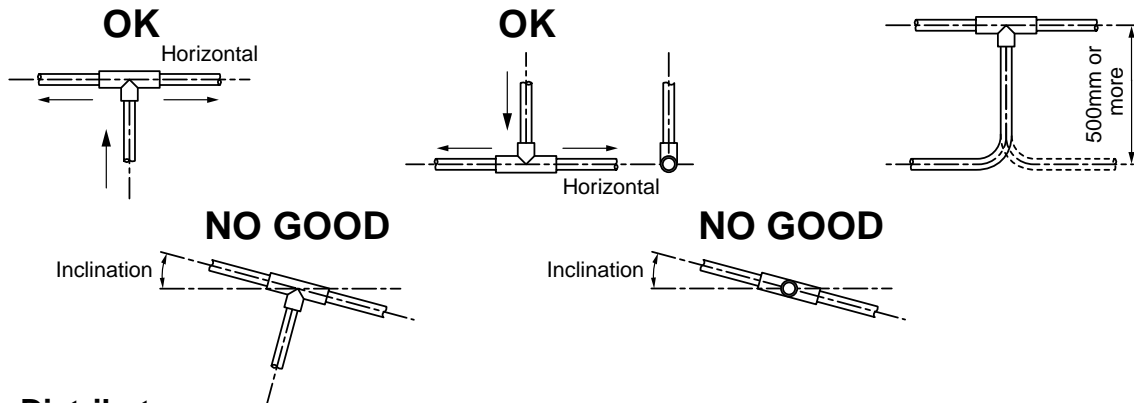
* (): Pipe wall thickness

6-10. Branch Pipe

■ Twin system

Now the refrigerant pipe is installed using branch pipes supplied as accessories.

- Bend and adjust the refrigerant piping so that the branch pipes and pipe after branching become horizontal.
- Fix the branch pipes onto a wall in a ceiling or onto a column.
- Provide a straight pipe longer than 500mm in length as the main piping of the branches.



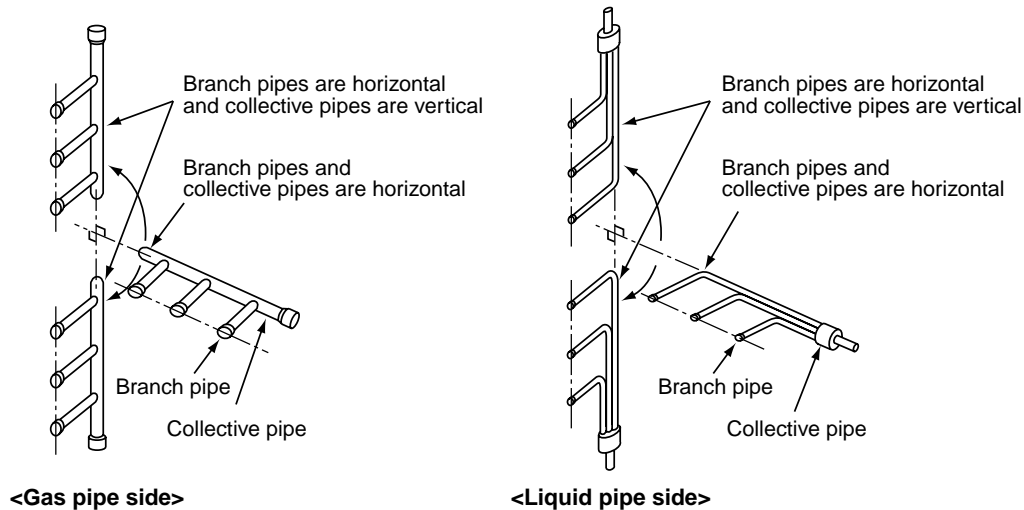
6-11. Distributor

■ Triple system

Now the refrigerant pipe is installed using distributor supplied as accessories.

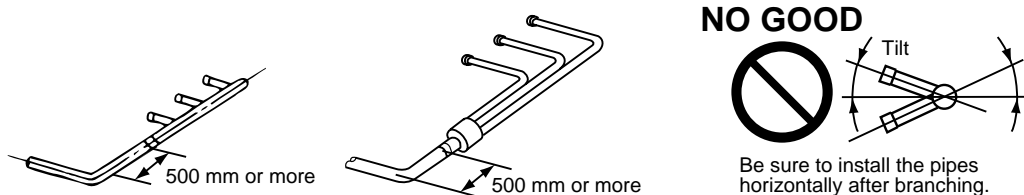
- Bend and adjust the refrigerant piping so that the distributor and pipe after branching become horizontal.
- Fix the distributor onto a wall in a ceiling or onto a column.
- Provide a straight pipe longer than 500 mm in length as the main piping of the branches.

<How to install distributor>



<Restrictions in length of the straight area of the branch pipe (main pipe side)>

Provide a straight area of 500 mm or more on the main pipe side of the branch pipe (for both gas pipe and liquid pipe sides).



■ Air Purging

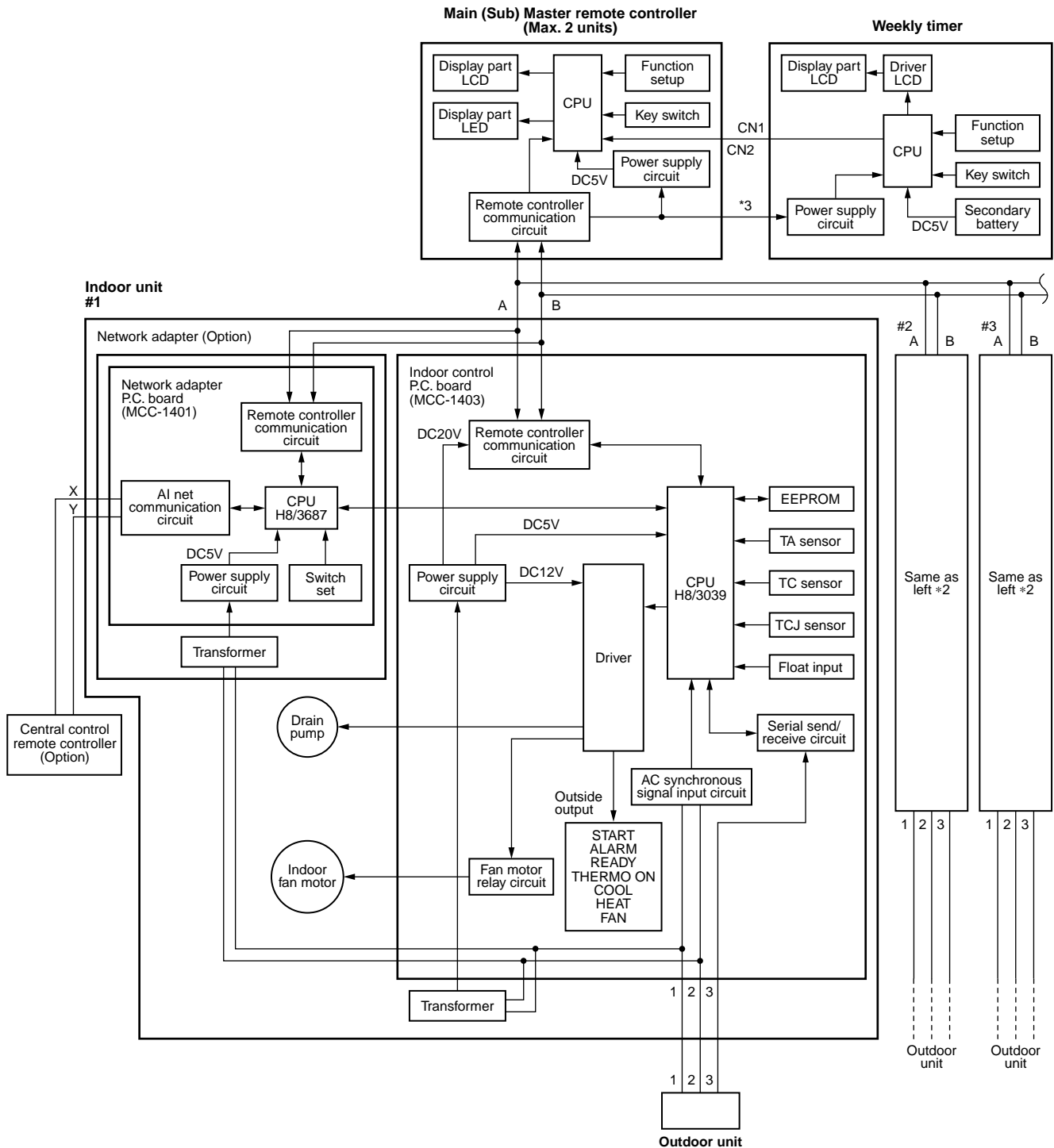
For the complete information, read the installation manual for outdoor units of air conditioner.

7. INDOOR CONTROL CIRCUIT

7-1. Indoor Controller Block Diagram

RAV-SM1103DT-A, RAV-SM1403DT-A, RAV-SM1603DT-A

7-1-1. Connection of Main (Sub) Remote Controller



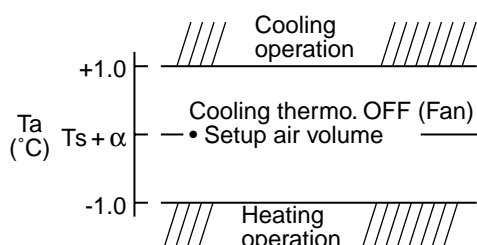
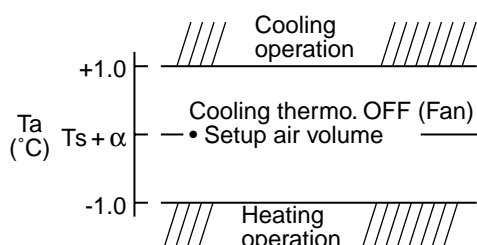
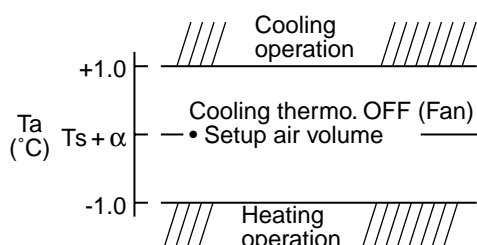
Max. 8 units are connectable. *1

*1 However when mounting a network adapter while 2 main (sub) remote controllers are connected, Max. 7 units are connectable.

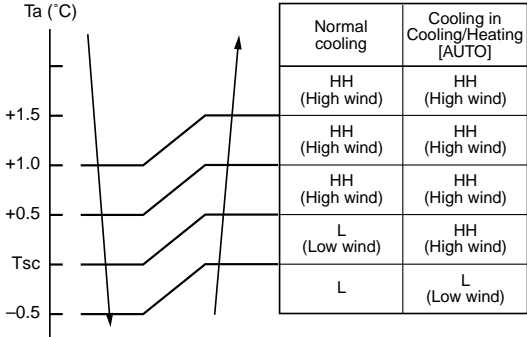
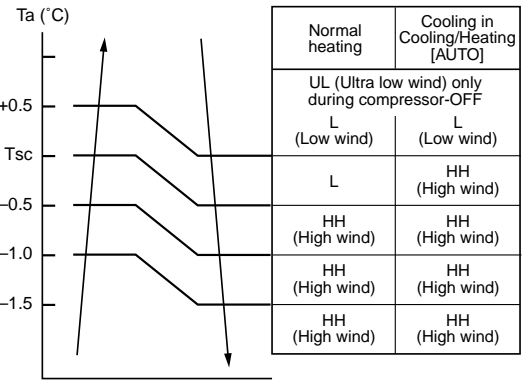
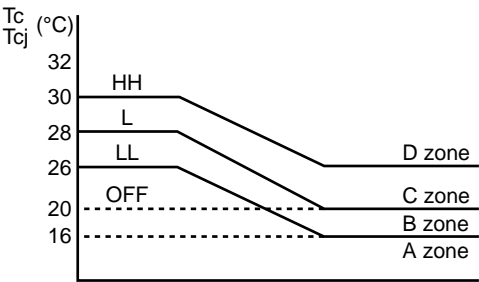

*2 A network adapter is mounted to only 1 unit.

*3 Connection of weekly timer to the sub remote controller is unavailable.

7-2. Control Specifications









No.	Item	Outline of specifications	Remarks																								
1	When power supply is reset	1) Distinction of outdoor unit When the power supply is reset, the outdoors are distinguished and the control is selected according to the distinguished result.																									
2	Operation mode selection	1) Based on the operation mode selecting command from the remote controller, the operation mode is selected. <table><tr><th>Remote controller command</th><th>Control outline</th></tr><tr><td>STOP</td><td>Air conditioner stops.</td></tr><tr><td>FAN</td><td>Fan operation</td></tr><tr><td>COOL</td><td>Cooling operation</td></tr><tr><td>HEAT</td><td>Heating operation</td></tr><tr><td>AUTO</td><td><ul style="list-style-type: none">COOL/HEAT operation mode is automatically selected by Ta, Ts and To for operation.The operation is performed as shown in the following figure according to Ta value at the first time only. (In the range of $T_s + \alpha - 1 < T_a < T_s + \alpha + 1$, Cooling thermo. OFF (Fan)/Setup air volume operation continues.)<div></div><ul style="list-style-type: none">α is corrected according to the outside temperature.<table><tr><th>Outside temp.</th><th>Correction value (a)</th></tr><tr><td>No To</td><td>0K</td></tr><tr><td>To ≥ 24°C</td><td>-1K</td></tr><tr><td>24 > To ≥ 18°C</td><td>0K</td></tr><tr><td>To < 18°C</td><td>+1K</td></tr><tr><td>To error</td><td>0K</td></tr></table></td></tr></table>	Remote controller command	Control outline	STOP	Air conditioner stops.	FAN	Fan operation	COOL	Cooling operation	HEAT	Heating operation	AUTO	<ul style="list-style-type: none">COOL/HEAT operation mode is automatically selected by Ta, Ts and To for operation.The operation is performed as shown in the following figure according to Ta value at the first time only. (In the range of $T_s + \alpha - 1 < T_a < T_s + \alpha + 1$, Cooling thermo. OFF (Fan)/Setup air volume operation continues.) <div></div> <ul style="list-style-type: none">α is corrected according to the outside temperature. <table><tr><th>Outside temp.</th><th>Correction value (a)</th></tr><tr><td>No To</td><td>0K</td></tr><tr><td>To ≥ 24°C</td><td>-1K</td></tr><tr><td>24 > To ≥ 18°C</td><td>0K</td></tr><tr><td>To < 18°C</td><td>+1K</td></tr><tr><td>To error</td><td>0K</td></tr></table>	Outside temp.	Correction value (a)	No To	0K	To ≥ 24°C	-1K	24 > To ≥ 18°C	0K	To < 18°C	+1K	To error	0K	<p>Ta: Room temp. Ts: Setup temp. To: Outside temp.</p> <p>k = deg</p>
Remote controller command	Control outline																										
STOP	Air conditioner stops.																										
FAN	Fan operation																										
COOL	Cooling operation																										
HEAT	Heating operation																										
AUTO	<ul style="list-style-type: none">COOL/HEAT operation mode is automatically selected by Ta, Ts and To for operation.The operation is performed as shown in the following figure according to Ta value at the first time only. (In the range of $T_s + \alpha - 1 < T_a < T_s + \alpha + 1$, Cooling thermo. OFF (Fan)/Setup air volume operation continues.) <div></div> <ul style="list-style-type: none">α is corrected according to the outside temperature. <table><tr><th>Outside temp.</th><th>Correction value (a)</th></tr><tr><td>No To</td><td>0K</td></tr><tr><td>To ≥ 24°C</td><td>-1K</td></tr><tr><td>24 > To ≥ 18°C</td><td>0K</td></tr><tr><td>To < 18°C</td><td>+1K</td></tr><tr><td>To error</td><td>0K</td></tr></table>	Outside temp.	Correction value (a)	No To	0K	To ≥ 24°C	-1K	24 > To ≥ 18°C	0K	To < 18°C	+1K	To error	0K														
Outside temp.	Correction value (a)																										
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To < 18°C	+1K																										
To error	0K																										

No.	Item	Outline of specifications	Remarks																								
3	Room temp. control	<div>1) Adjustment range: Remote controller setup temperature (°C)</div> <table><tr><td></td><td>COOL</td><td>HEAT</td><td>AUTO</td></tr><tr><td>Wired type</td><td>18 to 29</td><td>18 to 29</td><td>18 to 29</td></tr><tr><td>Wireless type</td><td>18 to 30</td><td>16 to 30</td><td>17 to 27</td></tr></table> <div>2) Using the Item code 06, the setup temperature in heating operation can be corrected.</div> <table><tr><td>Setup data</td><td>0</td><td>2</td><td>4</td><td>6</td></tr><tr><td>Setup temp. correction</td><td>+0°C</td><td>+2°C</td><td>+4°C</td><td>+6°C</td></tr></table> <div>Setting at shipment</div> <table><tr><td>Setup data</td><td>2</td></tr></table>		COOL	HEAT	AUTO	Wired type	18 to 29	18 to 29	18 to 29	Wireless type	18 to 30	16 to 30	17 to 27	Setup data	0	2	4	6	Setup temp. correction	+0°C	+2°C	+4°C	+6°C	Setup data	2	Shift of suction temperature in heating operation
	COOL	HEAT	AUTO																								
Wired type	18 to 29	18 to 29	18 to 29																								
Wireless type	18 to 30	16 to 30	17 to 27																								
Setup data	0	2	4	6																							
Setup temp. correction	+0°C	+2°C	+4°C	+6°C																							
Setup data	2																										
4	Automatic capacity control (GA control)	<div>1) Based on the difference between Ta and Ts, the operation frequency is instructed to the outdoor unit.</div> <div>2) Cooling operation</div> <div>Every 90 seconds, the room temperature difference between temperature detected by Ta and Ts and the varied room temperature value are calculated to obtain the correction value of the frequency command and then the present frequency command is corrected.</div> <div>Ta (n) – Ts (n) : Room temp. difference n : Counts of detection Ta (n-1) – Ts (n) : Varied room temp. value n – 1 : Counts of detection of 90 seconds before</div> <div>3) Heating operation</div> <div>Every 1 minute (60 sec.), the room temperature difference between temperature detected by Ta and Ts and the varied room temperature value are calculated to obtain the correction value of the frequency command and then the present frequency command is corrected.</div> <div>Ts (n) – Ta (n) : Room temp. difference n : Counts of detection Ta (n) – Ta (n – 1) : Varied room temp. value n – 1 : Counts of detection of 1 minute before</div>																									
5	Automatic cooling/heating control	<div>1) The judgment of selecting COOL/HEAT is carried out as shown below. When +1.5 exceeds against Tsh 10 minutes and after thermo.-OFF, heating operation (Thermo. OFF) exchanges to cooling operation. Description in the parentheses shows an example of cooling ON/OFF.</div> <div><div><div>Ta (°C)</div><div>+1.5</div><div>or Tsc</div><div>Tsh</div><div>-1.5</div></div><div><div>Cooling</div><div>(Cooling ON)</div><div>(Cooling OFF)</div><div>Heating</div></div></div> <div>When –1.5 lowers against Tsc 10 minutes and after thermo. OFF, cooling operation (Thermo. OFF) exchanges to heating operation.</div> <div>2) For the automatic capacity control after judgment of cooling/heating, see Item 4.</div> <div>3) For temperature correction of room temp. control in automatic heating, see Item 3.</div>	<div>Tsc: Setup temp. in cooling operation</div> <div>Tsh: Setup temp. in heating operation + temp. correction of room temp. control</div>																								

No.	Item	Outline of specifications	Remarks
6	Air speed selection	<p>1) Operation [HH], [L] or [AUTO] is performed by command from the remote controller.</p> <p>2) The air speed is varied with difference between Ta and Ts while the air speed is set to [AUTO].</p> <p><COOL></p>  <p><HEAT></p>  <p>3) If thermostat is turned off during heating operation, the mode changes to [UL] or [STOP].</p> <p>4) If Ta ≥ 25°C when the heating operation has started or when defrost operation has been cleared, the air conditioner operates with [L] mode or higher mode for 1 minute after Tc entered in A zone of the cooling air discharge preventive control (Item 7).</p> <p>5) In automatic cooling/heating operation, the mode enters in [AUTO].</p>	<p>HH > L > UL</p> <p>STOP operation is the cooling air discharge preventive control by Tc.</p> <p>Tc: Indoor heat exchanger sensor temperature</p> <p>Display: [AUTO]</p>
7	Cool air discharge preventive control	<p>1) In heating operation, the indoor fan is controlled based on the detected temperature of Tc sensor or Tcj sensor. As shown below, the upper limit of the revolution frequency is restricted.</p> <p>However B zone is assumed as C zone for 6 minutes and after when the compressor activated.</p> <p>In defrost operation, the control value of Tc is shifted by 6°C.</p> 	<p>In D zone, the priority is given to air speed selection setup of remote controller.</p> <p>In A and B zones while thermo is ON, [PRE-HEAT  (Heating ready)] is displayed.</p>

No.	Item	Outline of specifications	Remarks
8	Freeze preventive control (Low temperature release)	<p>1) The cooling operation (including Dry operation) is performed as follows based on the detected temperature of Tc sensor or Tcj sensor.</p> <p>When [J] zone is detected for 6 minutes (Following figure), the commanded frequency is decreased from the real operation frequency.</p> <p>After then the commanded frequency changes every 30 seconds while operation is performed in [J] zone.</p> <p>In [K] zone, time counting is interrupted and the operation is held.</p> <p>When [I] zone is detected, the timer is cleared and the operation returns to the normal operation.</p> <p>If the commanded frequency becomes S0 because the operation continues in [J] zone, the return temperature A is raised from 5°C to 12°C until [I] zone is detected and the indoor fan operates with [L] mode.</p> <p>In heating operation, the freeze-preventive control works if 4-way valve is not exchanged and the following conditions are satisfied. (However the temperature for J zone dashing control is changed from 2°C to -5°C.)</p> <p><Conditions></p> <ul style="list-style-type: none"> When ① or ② is established 5 minutes after activation. <ul style="list-style-type: none"> ① $T_{cn} \leq T_c (n - 1) - 5$ ② $T_{cn} < T_c (n - 1) - 1$ and $T_{cn} \leq T_a < 5^\circ\text{C}$ 	<p>Tcj: Indoor heat exchanger sensor temperature</p> <p>Tcn: Tc temperature when 5 minutes elapsed after activation</p> <p>Tc (n – 1): Tc temperature at start time</p>

No.	Item	Outline of specifications	Remarks						
9	High-temp. release control	<div>1) The heating operation is performed as follows based on the detected temperature of Tc sensor or Tcj sensor.</div> <div><ul style="list-style-type: none">When [M] zone is detected, the commanded frequency is decreased from the real operation frequency. After then the commanded frequency changes every 30 seconds while operation is performed in [M] zone.In [N] zone, the commanded frequency is held.When [L] zone is detected, the commanded frequency is returned to the original value by approx. 6Hz every 60 seconds.</div> <div><div>Setup at shipment</div><table><tr><th colspan="2">Control temp. (°C)</th></tr><tr><th>A</th><th>B</th></tr><tr><td>56 (54)</td><td>52 (52)</td></tr></table></div> <div><div>Tc(°C) Tcj</div><div><div>A</div><div>B</div><div>L</div><div>M</div><div>N</div></div></div> <div><div>NOTE:</div><div>When the operation has started or when Tc or Tcj < 30°C at start of the operation or after operation start, temperature is controlled between values in parentheses of A and B.</div></div>	Control temp. (°C)		A	B	56 (54)	52 (52)	<div>However this control is ignored in case of the follower unit of the twin.</div> <div>Same status as that when “thermostat-OFF” (status that the air conditioner enters in the room temp. monitor mode when the temperature reached the setup temperature on the remote controller)</div>
Control temp. (°C)									
A	B								
56 (54)	52 (52)								
10	Drain pump control (Sold separately)	<div>1) In cooling operation, the drain pump is usually operated.</div> <div>2) If the float switch works while drain pump drives, the compressor stops, the drain pump continues the operation, and a check code is output.</div> <div>3) If the float switch works while drain pump stops, the compressor stops and the drain pump operates. If the float switch keeps operating for approx. 4 minutes, a check code is output.</div>	Check code [P10]						
11	After-heat elimination	When heating operation stops, in some cases, the indoor fan operates with (L) for approx. 30 seconds.							
12	Frequency fixed operation (Test run)	<div><In case of wired remote controller></div> <div>1) When pushing [CHK] button for 4 seconds or more, [TEST] is displayed on the display screen and the mode enters in Test run mode.</div> <div>2) Push [ON/OFF] button.</div> <div>3) Using [MODE] button, set the mode to [COOL] or [HEAT].</div> <div><ul style="list-style-type: none">Do not use other mode than [COOL]/[HEAT] mode.During test run operation, the temperature cannot be adjusted.An error is detected as usual.A frequency fixed operation is performed.</div> <div>4) After the test run, push [ON/OFF] button to stop the operation. (Display in the display part is same as the procedure in Item 1.)</div> <div>5) Push [CHK] button to clear the test run mode. ([TEST] display in the display part disappears and the status returns to the normal stop status.)</div>							

No.	Item	Outline of specifications	Remarks
13	Filter sign display (Except wireless type) * It is provided on the separately sold type TCB-AX21E2.	<ol style="list-style-type: none"> 1) The operation time of the indoor fan is calculated, the filter reset signal is sent to the remote controller when the specified time (2500H) has passed, and it is displayed on LCD. 2) When the filter reset signal has been received from the remote controller, time of the calculation timer is cleared. In this case, the measurement time is reset if the specified time has passed, and display on LCD disappears. 	<p>[FILTER ] goes on.</p> <p>Specified time: 2500H</p>
14	Central control mode selection	<ol style="list-style-type: none"> 1) Setting at the centerl controller side enables to select the contents which can be operated on the remote controller at indoor unit side. 2) Setup contents <ul style="list-style-type: none"> • 64 line central controller (TCB-SC642TLE2) <p>[Individual]: Operated on the remote controller (Priority to second pushing)</p> <p>[Central 1]: ON/OFF operation cannot be operated on the remote controller.</p> <p>[Central 2]: ON/OFF, mode selection, temp. setup operations cannot be operated on the remote controller.</p> <p>[Central 3]: Mode selection and temp. setup operations cannot be operated on the remote controller.</p> <p>[Central 4]: Mode selection cannot be operated on the remote controller.</p> <p>* In case of the wireless type, the display lamp does not change but the contents are same.</p> <p>If operating an item which is prohibited by the central control mode from the remote controller, it is notified with the receive sound, Pi, Pi, Pi, Pi, Pi (5 times).</p> 	<p>Display at remote controller side (No display)</p> <p>[Central ] goes on</p> <p>[Central ] goes on</p> <p>[Central ] goes on</p> <p>[Central ] goes on</p>
15	Save operation	<ol style="list-style-type: none"> 1) Turn on  button on the remote controller. 2) During operation of save operation,  lights on the wired remote controller. 3) During save operation, the current release control is performed with the restriction ratio set in EEPROM on the outdoor unit. 4) The restriction ratio can be set by keeping  button pushed for 4 seconds or more on the remote controller. 5) When validating the save operation, the next operation starts with save operation valid because contents are held even when operation stops, operation mode changes or power supply is reset. 6) The restriction ratio can be set by changing the setup data of Item code (DN) [C2] in the range of 50 to 100% (every 1%, Setting at shipment: 75%). 	<p>Operation and display also are unavailable on the wired remote controller RBC-AMT31E and before.</p> <p>Carry out setting operation during stop of the unit; otherwise the unit stops operation.</p> <p>For the setup operation, refer to "How to set up contents of save operation" of Installation Manual.</p> <p>The setting of the save operation differs according to combination of the outdoor units to be connected.</p> <p>(Although the setting value of the remote controller varies on the display, the real operation of the air conditioner itself is "Fixed with 75%".)</p>

7-3. Optional Connector Specifications of Indoor P.C. Board

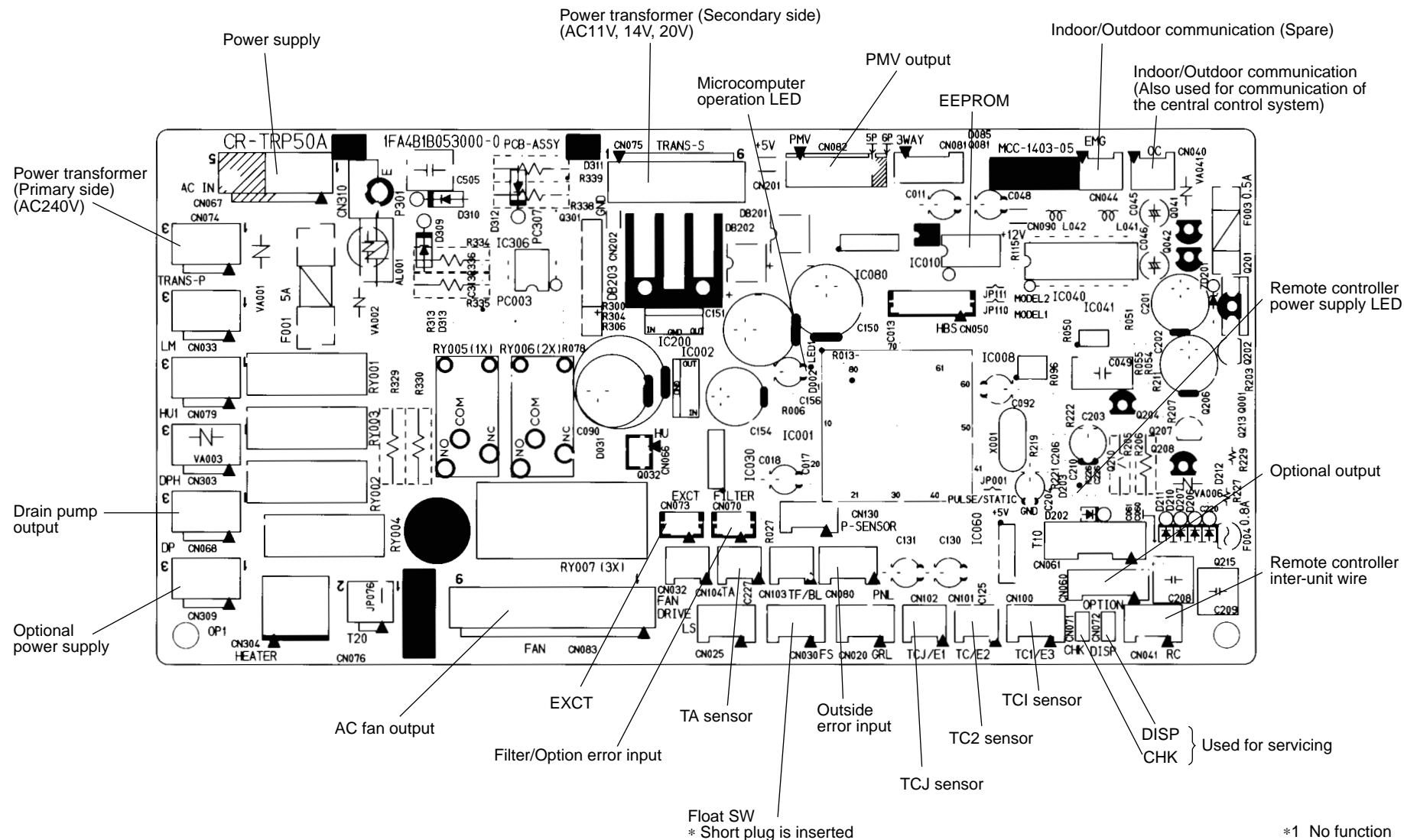
Function	Connector No.	Pin No.	Specifications	Remarks
Ventilation output	CN32	1	DC12V	Setting at shipment: Interlock of ON by indoor unit operation, with OFF by stop operation * The single operation setting by FAN button on the remote controller is performed on the remote controller (DN [31] = 0000 → 0001)
		2	Output (Open collector)	
Option output	CN60	1	DC12V	
		2	Defrost output (Open collector)	ON when outdoor unit is defrosted
		3	Thermostat ON output (Open collector)	ON when real thermostat is on. (Compressor ON)
		4	Cooling output (Open collector)	ON when operation mode is cooling system (COOL, DRY, Cooling/Heating automatic cooling)
		5	Heating output (Open collector)	ON when operation mode is heating system (HEAT, Cooling/Heating automatic heating)
		6	Fan output (Open collector)	ON when indoor fan is on. (When air cleaner is used) OFF while clean operation is performed.
Outside error input	CN80	1	DC12V	Generate the warning code "L30" (continuously for 1 minute) and stop the operation forcibly.
		2	NC	
		3	Outside error input	
AUTO up/down grille (*)	CN20	1	DC12V	The grille is controlled according to up/down operation from the remote controller. * Setting of automatic up/down grille provided is performed on the remote controller. (DN [30] = 0000 → 0001)
		2	Panel operation input	
		3	Panel up output (Open collector)	
		4	Panel down output (Open collector)	
		5	0V	
FILTER Option error / Humidifier setting (*)	CN70	1	A	Selection of option error input (Protective operation display of device attached to outside) or Humidifier setting input (Vaporizing + Drain pump ON) Humidifier is set at shipment from factory. * Setting of option error input is performed on the remote controller. (DN [2A] = 0002 → 0001)
		2	0V	
CHK Operation check	CN71	1	0V	This check is used to check indoor operation. (Performs operation of indoor fan "H", Louver horizontal and Drain pump ON without communication with outdoor and remote controller)
		2		
DISP Exhibition mode	CN72	1	0V	Communication is available by indoor unit and remote controller only.
		2	Demand input	
EXCT Demand	CN73	1	0V	Indoor unit forced thermostat OFF operation
		2		

* This option is not provided to oversea models.

7-4. Indoor Print Circuit Board

RAV-SM1103DT-A, RAV-SM1403DT-A, RAV-SM1603DT-A

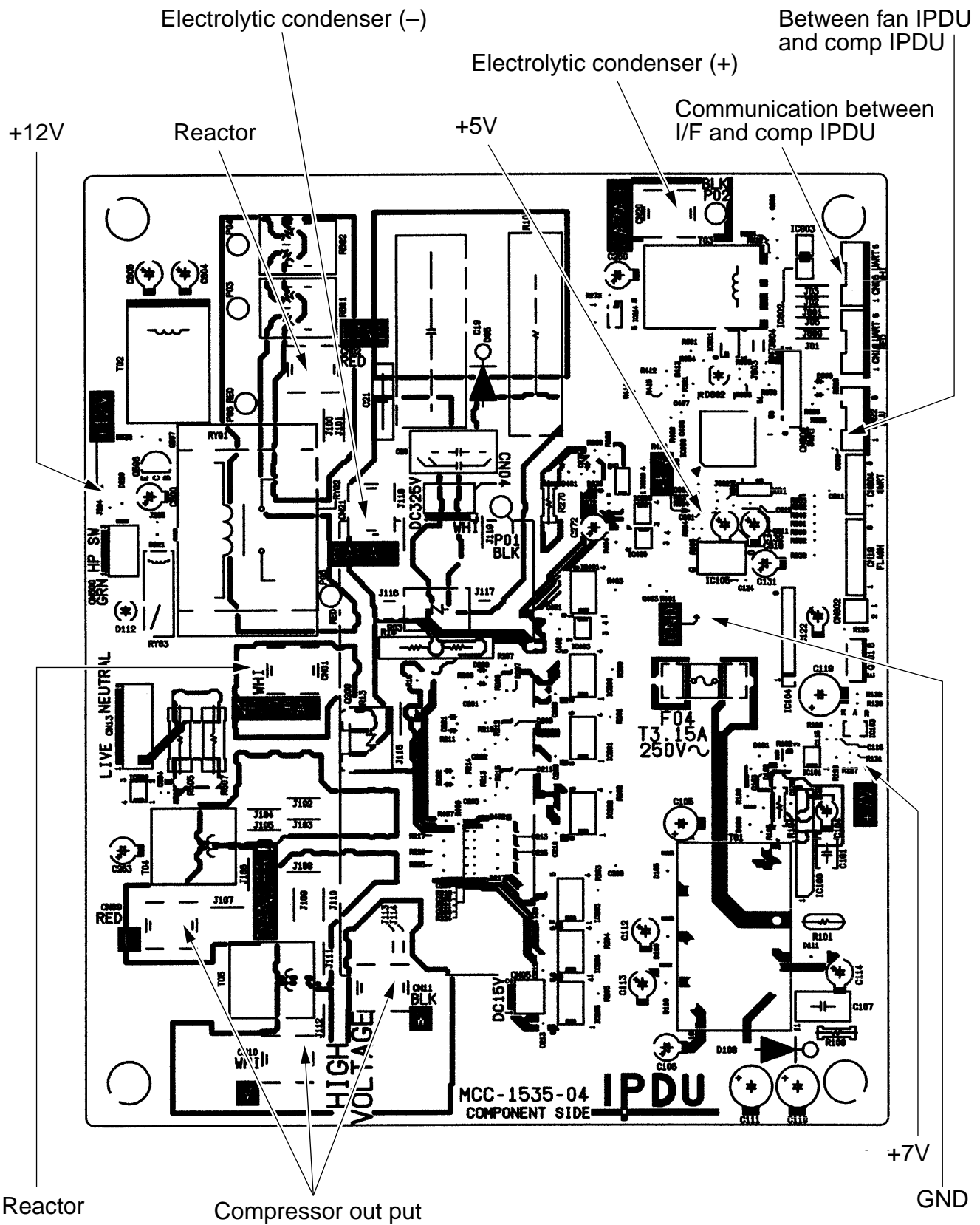
<MCC-1403>



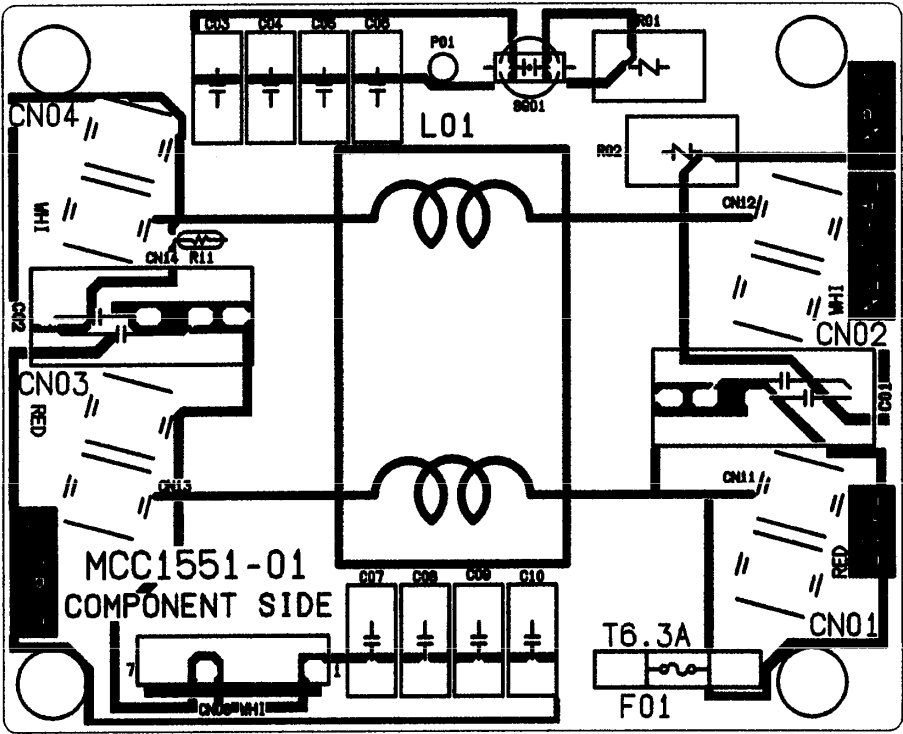
7-5. Outdoor Print Circuit Board

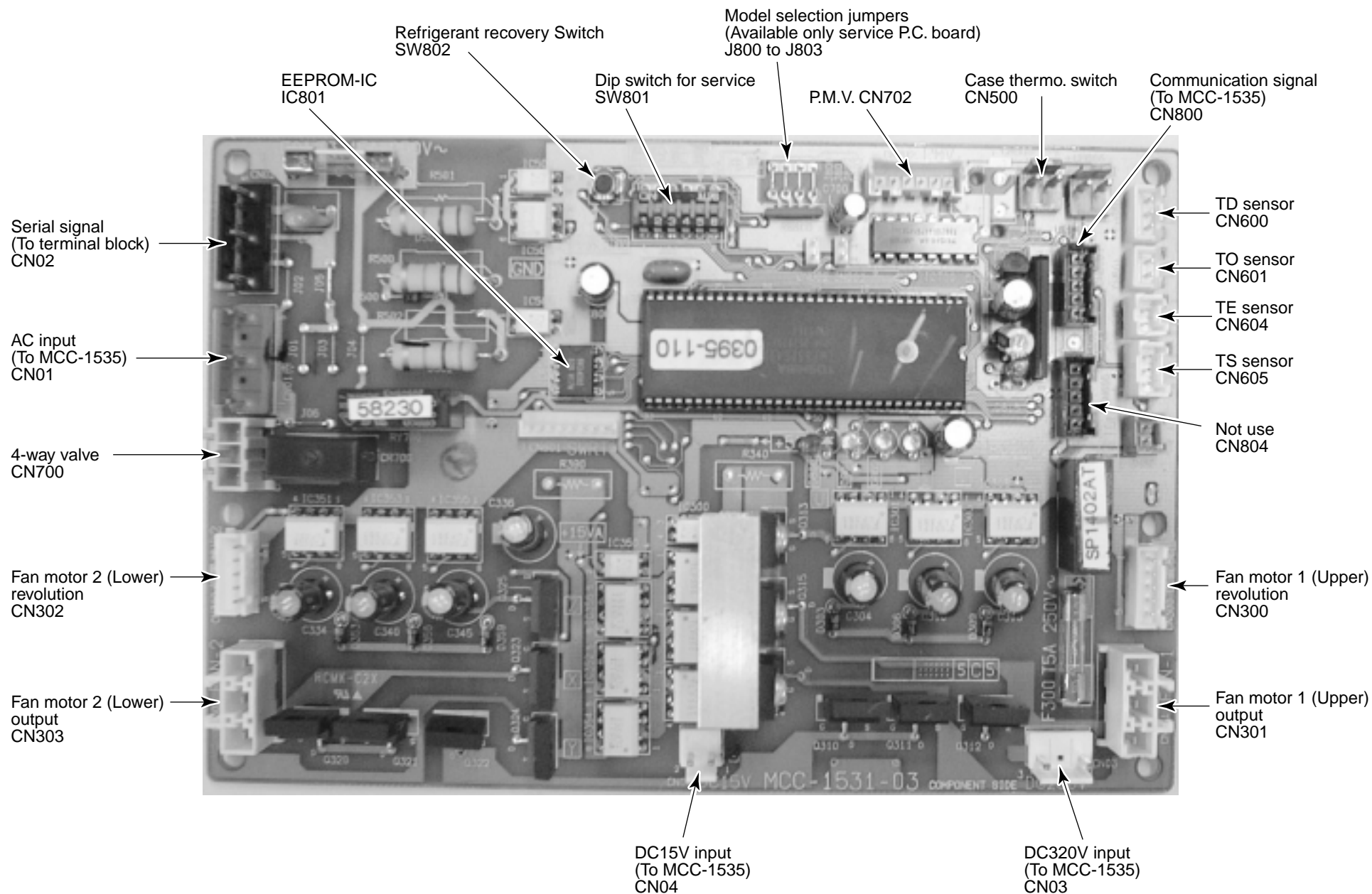
RAV-SM1603AT-E, RAV-SM1603ATZ-E, RAV-SM1603ATZG-E

Inverter P.C. board <MCC-1535> [IPDU1]



Noise filter P.C. board <MCC-1551>





8. CIRCUIT CONFIGURATION AND CONTROL SPECIFICATIONS

8-1. Outdoor Controls

8-1-1. Outline of Main Controls

1. Pulse Motor Valve (PMV) control

- 1) For PMV with 45 to 500 pulses during operation, respectively.
- 2) In cooling operation, PMV is controlled with the temperature difference between TS sensor and TC sensor.
- 3) In heating operation, PMV is controlled with the temperature difference between TS sensor and TE sensor.
- 4) For the temperature difference in items 2) and 3), 1 to 5K is aimed as the target in both cooling and heating operations.
- 5) When the cycle excessively rose in both cooling and heating operations, PMV is controlled by TD sensor. The aimed value is usually 92°C for SM160 in both cooling and heating operations.

REQUIREMENT

A sensor trouble may cause a liquid back-flow or abnormal overheat resulting in excessive shortening of the compressor life. In a case of trouble on the compressor, be sure to check there is no error in the resistance value an the refrigerating cycle of each sensor after repair and then start the operation.

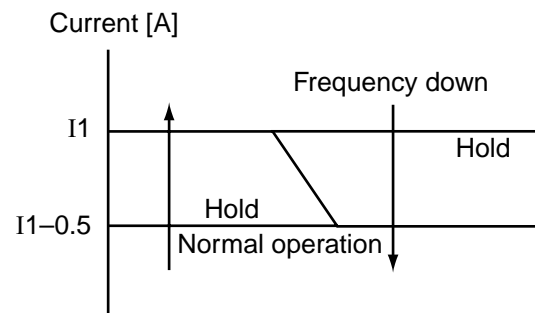
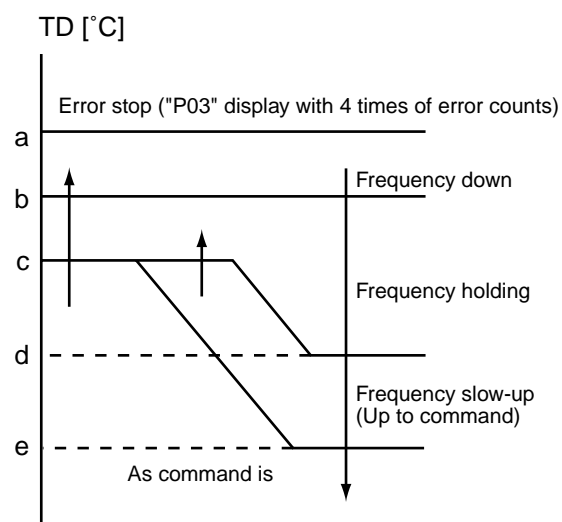
2. Discharge temperature release control

- 1) This function controls the operation frequency, that is, lowers the operation frequency when the discharge temperature has not lower or the discharge temperature has rapidly risen during PMV control. It subdivides the frequency control up to a unit of 0.6 Hz to stabilize the cycle.
- 2) When the discharge temperature is detected in an abnormal stop zone, the unit stops the compressor and restarts after 2 minutes 30 seconds. The error counter is cleared when it has continued the operation for 10 minutes. If the abnormal stop zone has been detected by 4 times without clearing of counter, an error "P03" is displayed.

* The cause is considered as excessively little amount of refrigerant, defective PMV, or clogging of cycle.

[°C]

	a	b	c	d	e
SM160	111	106	100	95	90



3. Current release control

The output frequency and the output voltage are controlled by AC current value detected by T02 on the outdoor P.C. board so that input current of the inverter does not exceed the specified value.

Objective model	SM160	
	COOL	HEAT
I1 value [A]	24.69	28.80

4. Outdoor fan control

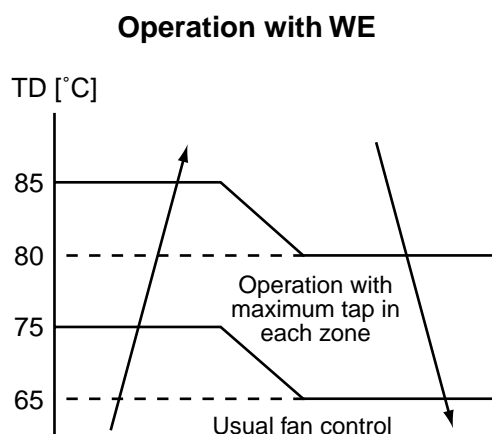
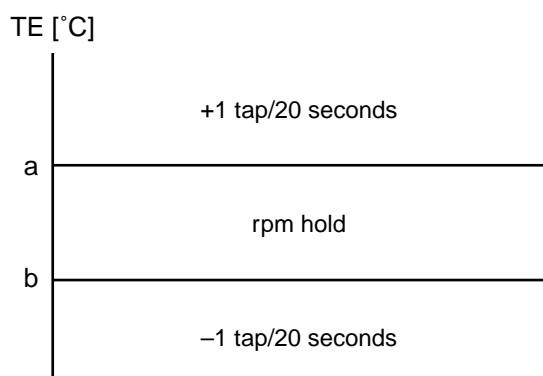
Allocations of fan tap revolutions [rpm]

SM160	W1	W2	W3	W4	W5	W6	W7	W8	W9	WA	WB	WC	WD	WE	WF
High	250	260	260	320	380	480	500	530	610	640	660	720	720	720	780
Low	—	—	240	300	400	500	520	550	630	660	700	740	740	740	820

1) Cooling fan control

- ① The outdoor fan is controlled by TE, TD, and TO sensors and also revolution frequency of the operation.
The outdoor is controlled by every 1 tap of DC fan control (15 taps).
- ② Only during 60 seconds after the operation has started, the fan is fixed with the maximum fan tap which corresponds to the zone in the following table.
After then the fan is controlled by TE sensor temperature.
- ③ Considering a case that TE sensor has come out of the holder, the fan is controlled so that revolution frequency of the fan increases regardless of TE if temperature of TD sensor has risen.

	a	b
SM160	37	34



(The operation frequency differs according to the model type.)

Temp. range	Below 30Hz		Above 30 Hz below 45 Hz		Above 45 Hz	
	Min.	Max.	Min.	Max.	Min.	Max.
$29^{\circ}\text{C} \leq \text{TO}$	W5	WA	W7	WC	W9	WE
$15 \leq \text{TO} < 29^{\circ}\text{C}$	W3	W7	W5	W9	W7	WB
$5 \leq \text{TO} < 15^{\circ}\text{C}$	W2	W5	W4	W7	W6	W9
$0 \leq \text{TO} < 5^{\circ}\text{C}$	W1	W3	W3	W5	W4	W7
$-5 \leq \text{TO} < 0^{\circ}\text{C}$	W1	W2	W2	W4	W3	W5
$\text{TO} < -5^{\circ}\text{C}$	OFF	OF	OFF	W3	OFF	W3
TO error	W1	WE	W1	WE	W1	WE

2) Heating fan control

- ① The outdoor fan is controlled by TE sensor, TO sensor and the operation frequency.
(From Min. W1 to Max. are controlled according to the following table.)
- ② During 3 minutes after start-up, the fan is fixed with the maximum fan tap corresponding to zone in the following table. After then the fan is controlled by temperature of TE sensor.
- ③ If status, $TE \geq 24^{\circ}\text{C}$ continues for 5 minutes, the operation stops. This status is same to the usual Thermo-OFF which has no alarm display, and the fan restarts after 2 minutes and 30 seconds. This intermittent operation is not abnormal.
- ④ When the above status ② occurs frequently, it is considered that the filter of suction part of the indoor unit is stain. Clean the filter and then restart the operation.

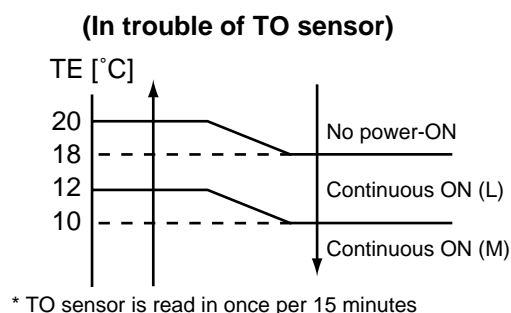
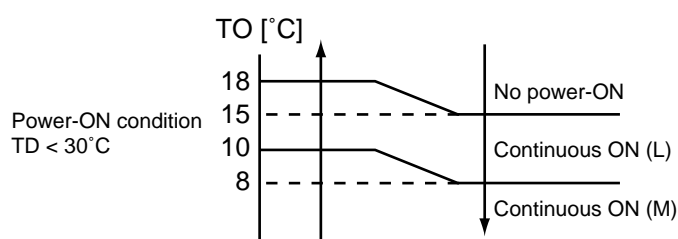
TE [$^{\circ}\text{C}$]	
24	-2 tap/20 seconds STOP timer count
21	-2 tap/20 seconds
18	-1 tap/20 seconds
15	rpm hold
	+1 tap/20 seconds

(The operation frequency differs according to the model type. The case of SM110 is shown in the table below.)

	Temp. range	Below 37 Hz	Above 37 Hz below 60 Hz	Above 60 Hz
Maximum	$10^{\circ}\text{C} < \text{TO}$	W7	W8	W9
	$5 < \text{TO} < 10^{\circ}\text{C}$	WA	WB	WC
	$\text{TO} < 5^{\circ}\text{C}$	WF	WF	WF
	TO error	WF	WF	WF

5. Coil heating control

- 1) This control function heats the compressor by turning on the stopped compressor instead of a case heater. It purposes to prevent slackness of the refrigerant inside of the compressor.
- 2) As usual, turn on power of the compressor for the specified time before a test run after installation, otherwise a trouble of the compressor may be caused.
As same as a test run, it is recommended to turn on power of the compressor beforehand when starting operation after power of the compressor has been interrupted for a long time.
- 3) A judgment for electricity is performed by TD and TO sensors. If TO sensor is defective, a backup control is automatically performed by TE sensor.
For a case of defective TO sensor, judge it with the outdoor LED display.
- 4) The power is turned off when TD is 30°C or more.



	SM160
L	30W and equivalent
M	40W and equivalent

REQUIREMENT

While heating the coil, the power sound may be heard. However it is not a trouble.

6. Short intermittent operation preventive control

- 1) For 3 to 10 minutes after operation start, in some cases, the compressor does not stop to protect the compressor even if receiving the thermostat-OFF signal from indoor.
However it is not abnormal status. (The operation continuance differs according to the operation status.)
- 2) When the operation stops by the remote controller, the operation does not continue.

7. High pressure restraint TE control

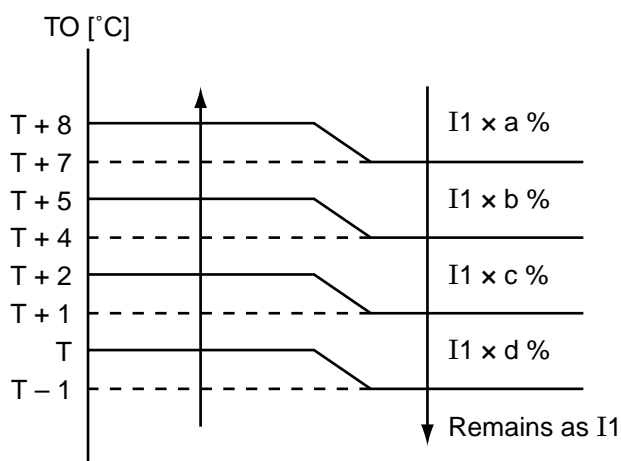
- 1) Control to restraint abnormal rising of high pressure in cooling operation
- 2) Stop the compressor at $TE \geq 67^{\circ}\text{C}$ and the error is counted by 1.
- 3) After 2 minutes and 30 seconds, if $TE < 67^{\circ}\text{C}$, restart the compressor.
When the operation continues for 10 minutes, the error count is cleared.
- 4) If $TE \geq 67^{\circ}\text{C}$ was detected again within 10 minutes, add 1 to the error count and then repeat to restart the compressor.
- 5) When the error count 10 is detected, determine it as an error.
Do not restart the compressor. The error "P04" is displayed.
- 6) After restart of the compressor, control the current release by lowering control value by 70% to 90% for minimum 30 minutes or more.

8. Over-current protective control

- 1) When the over-current protective circuit detected an abnormal current, stop the compressor.
- 2) Restart the compressor 2 minutes and 30 seconds after the error count 1 was indicated.
- 3) When the error is determined as the error count 8, do not restart the compressor.
The error display is "H01", "H02" or "P26".

9. Current release value shift control

- 1) This control purposes to prevent trouble of the electronic parts such as G-Tr, etc of the inverter in the compressor driving system and trouble of the compressor.
- 2) This control corrects the current release control value (I1) of item 3. by TO sensor value.
- 3) The correction amount is based on the following control diagram and correction amount table.



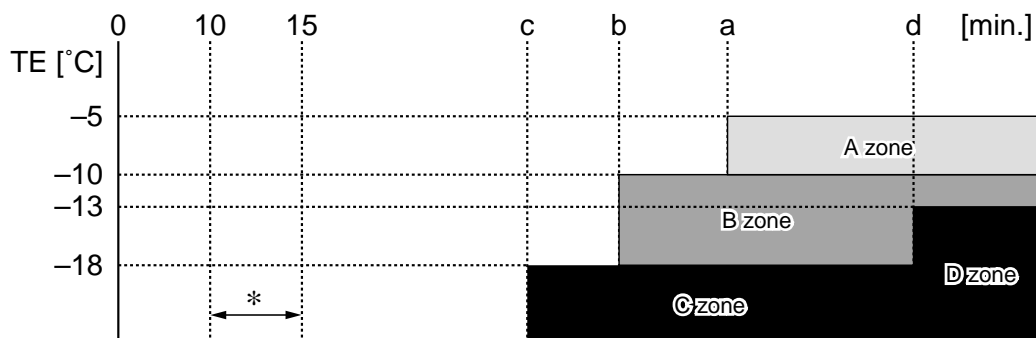
Correction amount

	SM160
T	39 $^{\circ}\text{C}$
a	60
b	70
c	80
d	90

10. Defrost control

- ① In heating operation, defrost operation is performed when TE sensor temperature satisfies any condition in A zone to D zone.
- ② The defrost operation is immediately finished if TE sensor temperature has become 12°C or more, or it also is finished when condition of $7^{\circ}\text{C} \leq \text{TE} < 12^{\circ}\text{C}$ has continued for 1 minute.
The defrost operation is also finished when defrost operation has continued for 10 minutes even if TE sensor temperature has become 7°C or lower.
- ③ After defrost operation has finished, the compressor and the outdoor fan start heating operation after stopped for approx. 50 seconds.

Start of heating operation



* The minimum TE value between 10 and 15 minutes after heating operation has started is stored in memory as TE0.

A zone	Defrost operation is performed in this zone when $\text{TE0} - \text{TE} \geq 3$ continued for T seconds.
B zone	Defrost operation is performed in this zone when $\text{TE0} - \text{TE} \geq 3$ continued for T seconds.
C zone	Defrost operation is performed when this zone continued for T seconds.
D zone	Defrost operation is performed when this zone continued for T seconds.

	SM160
a	55
b	45
c	40
d	150
T	20

9. INDOOR UNIT TROUBLESHOOTING

9-1. Summary of Troubleshooting

<Wired remote controller type>

1. Before troubleshooting

1) Required tools/instruments

- ⊕ and ⊖ screwdrivers, spanners, radio cutting pliers, nippers, push pins for reset switch
- Tester, thermometer, pressure gauge, etc.

2) Confirmation points before check

a) The following operations are normal.

1. Compressor does not operate.

- Is not 3-minutes delay (3 minutes after compressor OFF)?
- Is not the outdoor unit in standby status though the remote controller reached the setup temperature?
- Does not timer operate during fan operation?
- Is not an overflow error detected on the indoor unit?
- Is not outside high-temperature operation controlled in heating operation?

2. Indoor fan does not rotate.

- Does not cool air discharge preventive control work in heating operation?

3. Outdoor fan does not rotate or air volume changes.

- Does not high-temperature release operation control work in heating operation?
- Does not outside low-temperature operation control work in cooling operation?
- Is not defrost operation performed?

4. ON/OFF operation cannot be performed from remote controller.

- Is not the control operation performed from outside/remote side?
- Is not automatic address being set up?
(When the power is turned on at the first time or when indoor unit address setting is changed, the operation cannot be performed for maximum approx. 5 minutes after power-ON.)
- Is not being carried out a test run by operation of the outdoor controller?

b) Did you return the cabling to the initial positions?

c) Are connecting cables of indoor unit and remote controller correct?

2. Troubleshooting procedure

When a trouble occurred, check the parts along with the following procedure.



NOTE :

For cause of a trouble, power conditions or malfunction/erroneous diagnosis of microcomputer due to outer noise is considered except the items to be checked. If there is any noise source, change the cables of the remote controller to shield cables.

9-2. Troubleshooting

9-2-1. Check Code List (Indoor)

(Indoor unit detected)

Check code indication	Representative defective position	Explanation of error contents	Air conditioner operation	
			Automatic reset	Operation continuation
E03	Regular communication error between indoor and remote controller	No communication from remote controller and network adapter (Also no communication from central control system)	○	✕
E04	Indoor/Outdoor serial error	There is error on serial communication between indoor and outdoor units	○	✕
E08	Duplicated indoor addresses	Same address as yours was detected.	○	✕
E10	Communication error between indoor MCU	MCU communication error between main motor and micro computer	○	✕
E18	Regular communication error between indoor master and follower units	Regular communication between indoor master and follower units is impossible, Communication between twin master (main) and follower (sub) units is impossible.	○	✕
F01	Indoor unit, Heat exchanger (TCJ) error	Open/short was detected on heat exchanger (TCJ).	○	✕
F02	Indoor unit, Heat exchanger (TC) error	Open/short was detected on heat exchanger (TC).	○	✕
F10	Indoor unit, Room temp. sensor (TA) error	Open/short was detected on room temp. sensor (TA).	○	✕
F29	Indoor unit, other indoor P.C. board error	EEPROM error (Other error may be detected. If no error, automatic address is repeated.	✕	✕
L03	Duplicated setting of indoor group master unit	There are multiple master units in a group.	✕	✕
L07	There is group cable in individual indoor unit.	When even one group connection indoor unit exists in individual indoor unit.	✕	✕
L08	Unset indoor group address	Indoor group address is unset.	✕	✕
L09	Unset indoor capacity	Capacity of indoor unit is unset.	✕	✕
L20	Duplicated central control system address	Duplicated setting of central control system address	○	✕
L30	Outside error input to indoor unit (Interlock)	Abnormal stop by outside error (CN80) input	✕	✕
P01	Indoor unit, AC fan error	An error of indoor AC fan was detected. (Fan motor thermal relay worked.)	✕	✕
P10	Indoor unit, overflow detection	Float switch worked.	✕	✕
P19	4-way valve system error	In heating operation, an error was detected by temp. down of indoor heat exchanger sensor.	○	✕
P31	Other indoor unit error	Follower unit in group cannot operate by warning from [E03/L03/L07/L08] of master unit.	○	✕

◇ When this warning was detected before group construction/address check finish at power supply was turned on, the mode shifts automatically to AUTO address setup mode.

(Remote controller detected)

Check code indication	Representative defective position	Explanation of error contents	Air conditioner operation	
			Automatic reset	Operation continuation
E01	No master remote controller, Remote controller communication (Receive) error	Signal cannot be received from indoor unit. Master remote controller was not set. (including 2 remote controllers)	—	—
E02	Remote controller communication (Send) error	Signal cannot be sent to indoor unit.	—	—
E09	Duplicated master remote controller	In 2-remote controller control, both were set as master. (Indoor master unit stops warning and follower unit continues operation.)	✕	△

(Central control devices detected)

Check code indication	Representative defective position	Explanation of error contents	Air conditioner operation	
			Automatic reset	Operation continuation
C05	Central control system communication (send) error	Signal sending operation of central control system is impossible. There are multiple same central devices. (AI-NET)	—	—
C06	Central control system communication (receive) error	Signal receiving operation of central control system is impossible.	—	—
C12	General-purpose device control interface batched warning	An error on device connected to general-purpose device control interface of exclusive to TCC-LINK/AI-NET	—	—
P30	Group follower unit is defective.	Group follower unit is defective. (For remote controller, above-mentioned [***] details are displayed with unit No.)	—	—

NOTE: Even for the same contents of error such as communication error, the display of check code may differ according to detection device.

When remote controller or central controller detects an error, it is not necessarily related to operation of the air conditioner. In this list, the check codes that outdoor unit detects are not described.

Error mode detected by indoor unit

Operation of diagnostic function				Judgment and measures
Check code	Cause of operation	Status of air conditioner	Condition	
E03	No communication from remote controller (including wireless) and communication adapter	Stop (Automatic reset)	Displayed when error is detected	1. Check cables of remote controller and communication adapters. • Remote controller LCD display OFF (Disconnection) • Central remote controller [97] check code
E04	The serial signal is not output from outdoor unit to indoor unit. • Miswiring of inter-unit wire • Defective serial sending circuit on outdoor P.C. board • Defective serial receiving circuit on indoor P.C. board	Stop (Automatic reset)	Displayed when error is detected	1. Outdoor unit does not completely operate. • Inter-unit wire check, correction of miswiring • Check outdoor P.C. board. Correct wiring of P.C. board. 2. When outdoor unit normally operates Check P.C. board (Indoor receiving / Outdoor sending).
E08	Duplicated indoor unit address	Stop	Displayed when error is detected	1. Check whether remote controller connection (Group/Individual) was changed or not after power supply turned on (Finish of group construction/Address check). * If group construction and address are not normal when the power has been turned on, the mode automatically shifts to address setup mode. (Resetting of address)
L03	Duplicated indoor master unit			
L07	There is group wire in individual indoor unit.			
L08	Unset indoor group address			
L09	Unset indoor capacity	Stop	Displayed when error is detected	1. Set indoor capacity (DN=11)
L30	Abnormal input of outside interlock	Stop	Displayed when error is detected	1. Check outside devices. 2. Check indoor P.C. board.
P10	Float switch operation • Float circuit, Disconnection, Coming-off, Float switch contact error	Stop	Displayed when error is detected	1. Trouble of drain pump 2. Clogging of drain pump 3. Check float switch. 4. Check indoor P.C. board.
P19	4-way valve system error • After heating operation has started, indoor heat exchangers temp. is down.	Stop (Automatic reset)	Displayed when error is detected	1. Check 4-way valve. 2. Check 2-way valve and check valve. 3. Check indoor heat exchanger (TC/TCJ). 4. Check indoor P.C. board.
P31	Own unit stops while warning is output to other indoor units.	Stop (Follower unit) (Automatic reset)	Displayed when error is detected	1. Judge follower unit while master unit is [E03], [L03], [L07] or [L08]. 2. Check indoor P.C. board.
F01	Coming-off, disconnection or short of indoor heat exchanger temp. sensor (TCJ)	Stop (Automatic reset)	Displayed when error is detected	1. Check indoor heat exchanger temp. sensor (TCJ). 2. Check indoor P.C. board.
F02	Coming-off, disconnection or short of indoor heat exchanger temp. sensor (TC)	Stop (Automatic reset)	Displayed when error is detected	1. Check indoor heat exchanger temp. sensor (TC). 2. Check indoor P.C. board.
F10	Coming-off, disconnection or short of indoor heat exchanger temp. sensor (TA)	Stop (Automatic reset)	Displayed when error is detected	1. Check indoor heat exchanger temp. sensor (TA). 2. Check indoor P.C. board.
F29	Indoor EEPROM error • EEPROM access error	Stop (Automatic reset)	Displayed when error is detected	1. Check indoor EEPROM. (including socket insertion) 2. Check indoor P.C. board.
E10	Communication error between indoor MCU • Communication error between fan driving MCU and main MCU	Stop (Automatic reset)	Displayed when error is detected	1. Check indoor P.C. board.
E18	Regular communication error between indoor aster and follower units and between main and sub units	Stop (Automatic reset)	Displayed when error is detected	1. Check remote controller wiring. 2. Check indoor power supply wiring. 3. Check indoor P.C. board.

Error mode detected by remote controller or central controller (TCC-LINK)

Operation of diagnostic function				Judgment and measures
Check code	Cause of operation	Status of air conditioner	Condition	
Not displayed at all (Operation on remote controller is impossible.)	No communication with master indoor unit <ul style="list-style-type: none"> Remote controller wiring is not correct. Power of indoor unit is not turned on. Automatic address cannot be completed. 	Stop	—	Power supply error of remote controller, Indoor EEPROM error <ol style="list-style-type: none"> 1. Check remote controller inter-unit wiring. 2. Check remote controller. 3. Check indoor power wiring. 4. Check indoor P.C. board. 5. Check indoor EEPROM. (including socket insertion) → Automatic address repeating phenomenon generates.
E01 *2	No communication with master indoor unit <ul style="list-style-type: none"> Disconnection of inter-unit wire between remote controller and master indoor unit (Detected by remote controller side) 	Stop (Automatic reset) * If center exists, operation continues.	Displayed when error is detected	Receiving error from remote controller <ol style="list-style-type: none"> 1. Check remote controller inter-unit wiring. 2. Check remote controller. 3. Check indoor power wiring. 4. Check indoor P.C. board.
E02	Signal send error to indoor unit (Detected by remote controller side)	Stop (Automatic reset) * If center exists, operation continues.	Displayed when error is detected	Sending error of remote controller <ol style="list-style-type: none"> 1. Check sending circuit inside of remote controller. → Replace remote controller.
E09	There are multiple main remote controllers. (Detected by remote controller side)	Stop (Sub unit continues operation.)	Displayed when error is detected	1. In 2-remote controllers (including wireless), there are multiple main units. Check that there are 1 main remote controller and other sub remote controllers.
L20 ----- Central controller L20	Duplicated indoor central addresses on communication of central control system (Detected by indoor/central controller side)	Stop (Automatic reset)	Displayed when error is detected	1. Check setting of central control system network address. (Network adapter SW01) 2. Check network adapter P.C. board.
— *3 ----- Central controller (Send) C05 (Receive) C06	Communication circuit error of central control system (Detected by central controller side)	Continues (By remote controller)	Displayed when error is detected	1. Check communication wire / miswiring 2. Check communication (U3, U4 terminals) 3. Check network adapter P.C. board. 4. Check central controller (such as central control remote controller, etc.) 5. Check terminal resistance. (TCC-LINK)
— ----- Central controller P30	Indoor Gr sub unit error (Detected by central controller side)	Continuation/Stop (According to each case)	Displayed when error is detected	Check the check code of the corresponding unit from remote controller.

*2 The check code cannot be displayed by the wired remote controller.
(Usual operation of air conditioner becomes unavailable.)

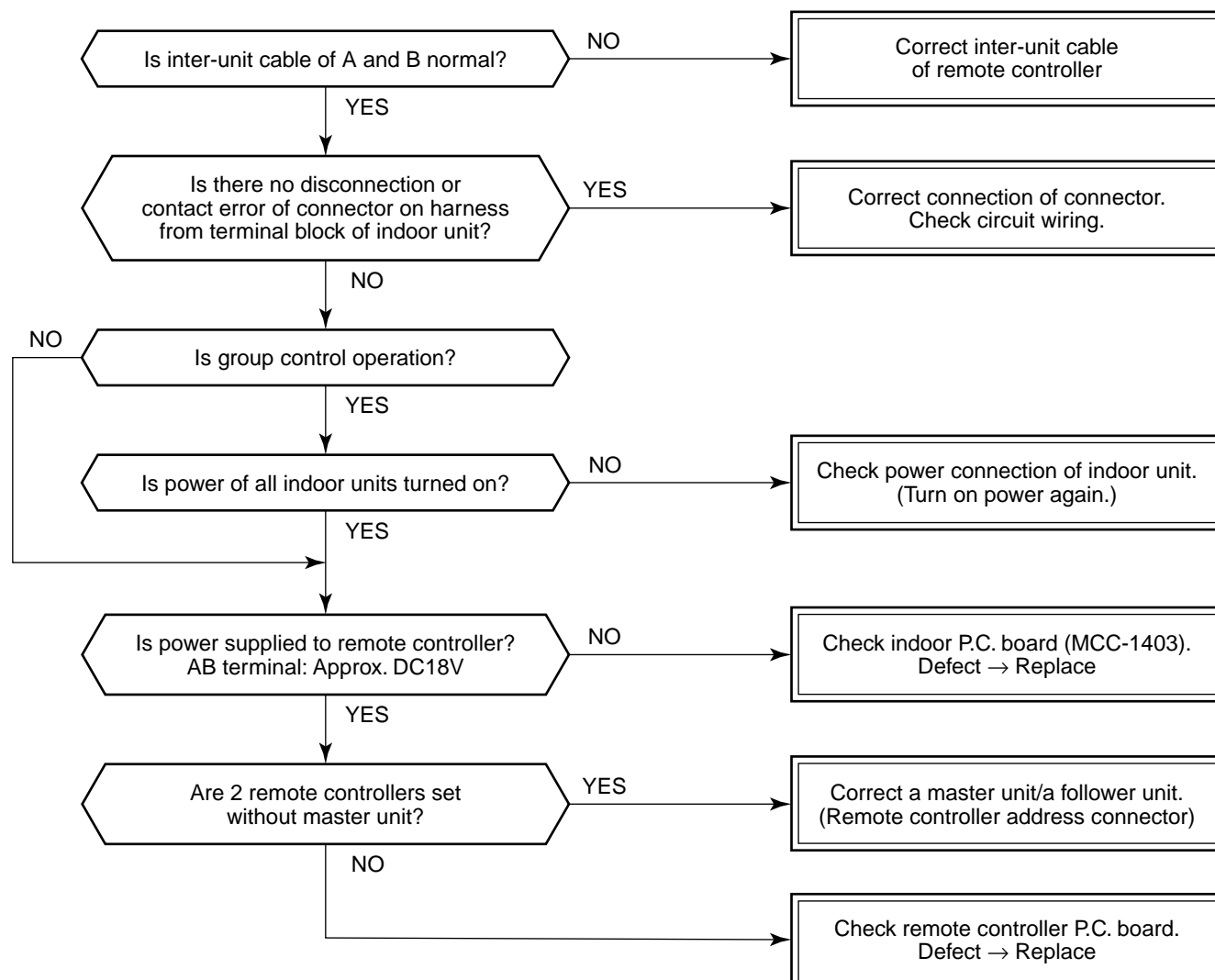
For the wireless models, an error is notified with indication lamp.

*3 This trouble is related to communication of remote controller (A, B), central system (TCC-LINK U3, U4), and [E01], [E02], [E03], [E09] or [E18] is displayed or no check display on the remote controller according to the contents.

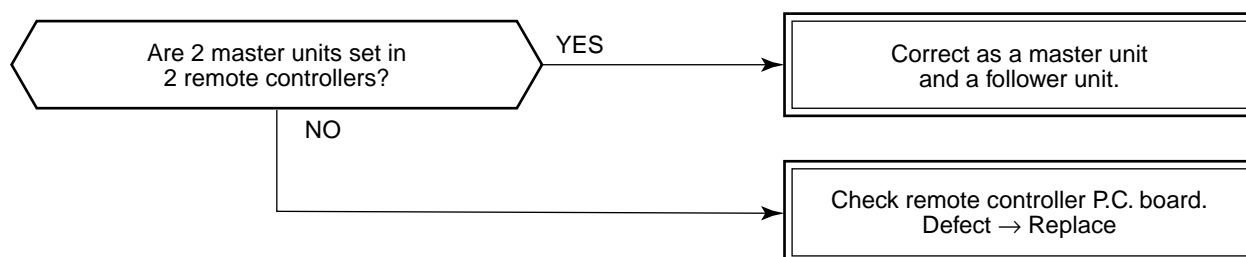
9-2-2. Diagnostic Procedure for Each Check Code (Indoor Unit)

Check code

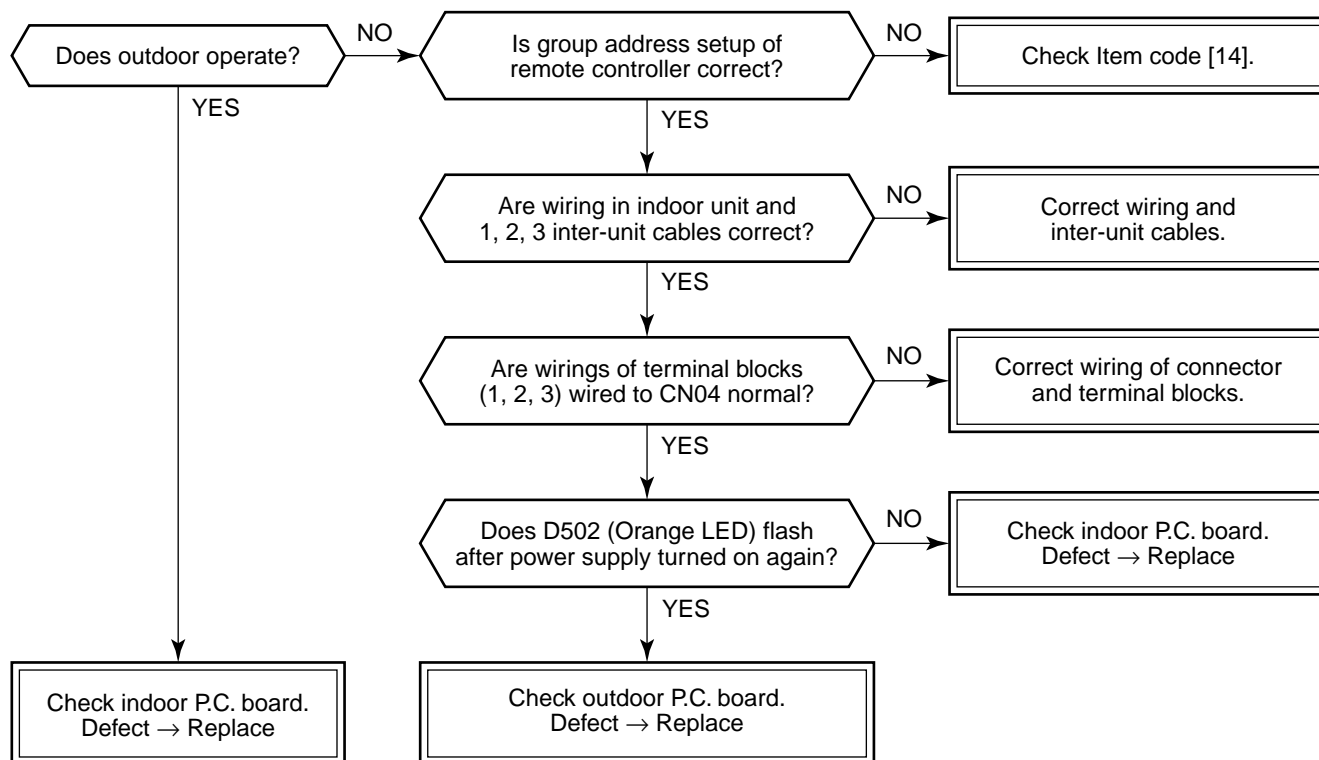
[E01 error]



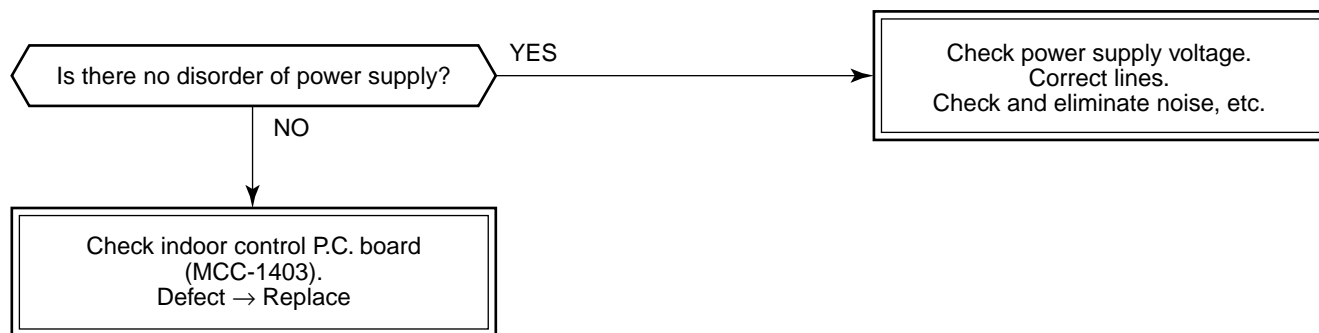
[E09 error]



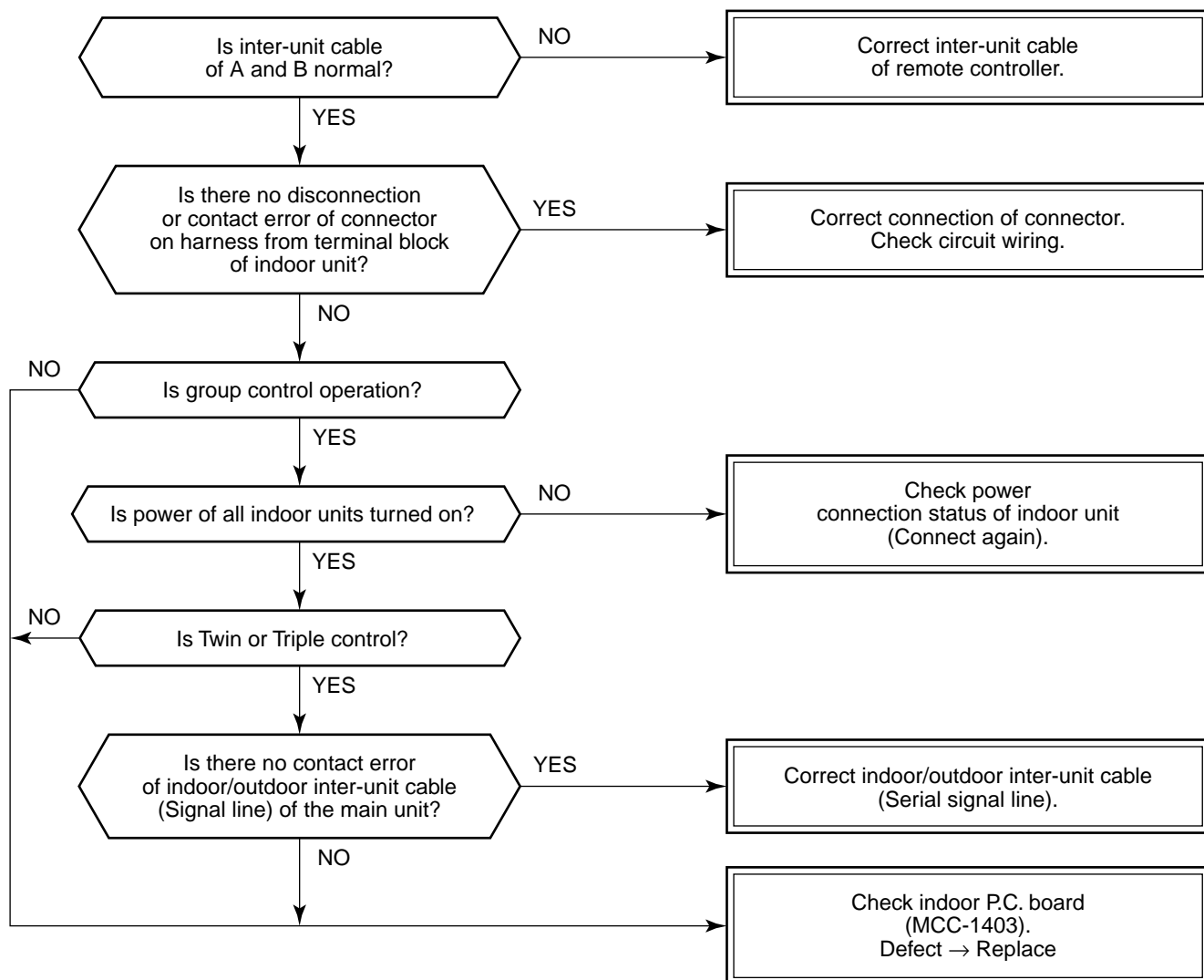
[E04 error]



[E10 error]



[E18 error]



[E08, L03, L07, L08 error]

E08: Duplicated indoor unit No.

L03: There are 2 or more master units in a group control.

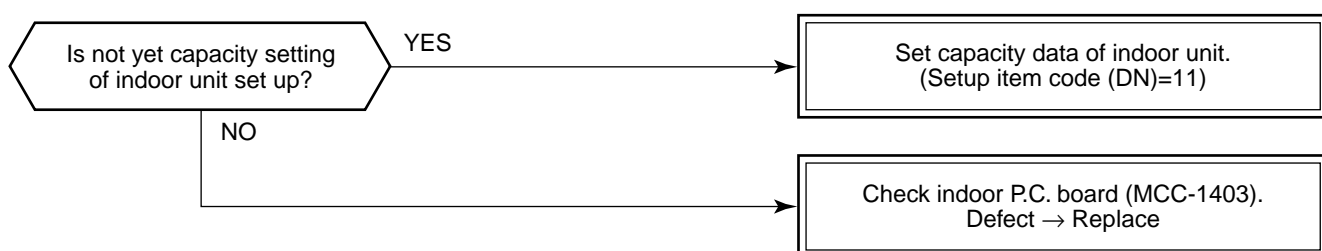
L07: There is 1 or more group address [Individual] in a group control.

L08: The indoor group address is unset. **(13. ADDRESS SETUP)**

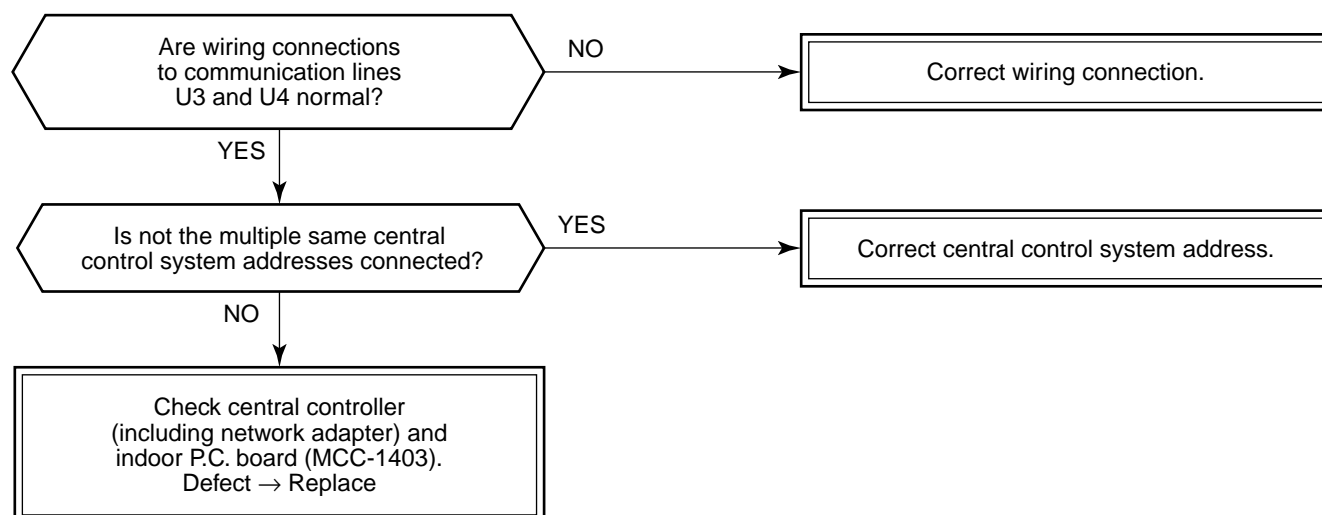
If the above error is detected when power supply turned on, the mode enters automatically in the automatic address set mode. (Check code is not output.)

However, if the above error is detected during the automatic address set mode, a check code may be output.

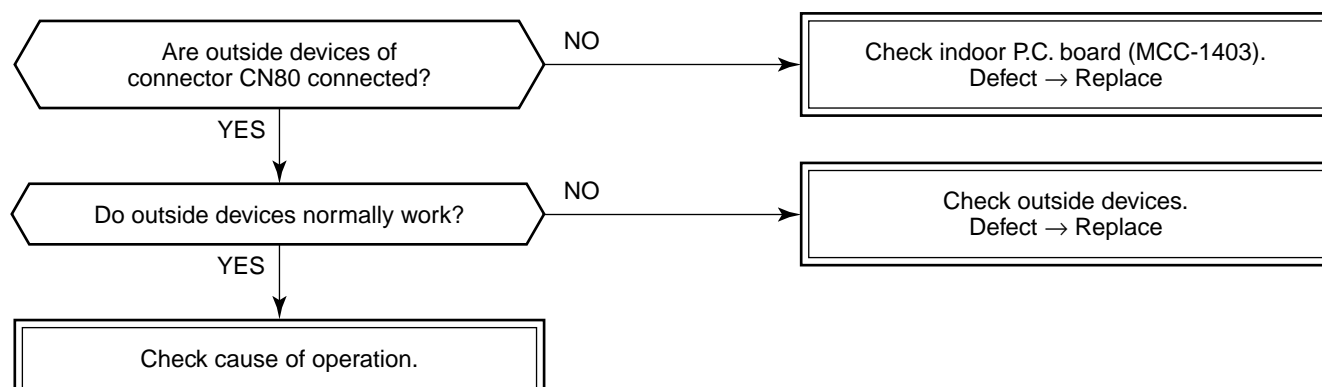
[L09 error]



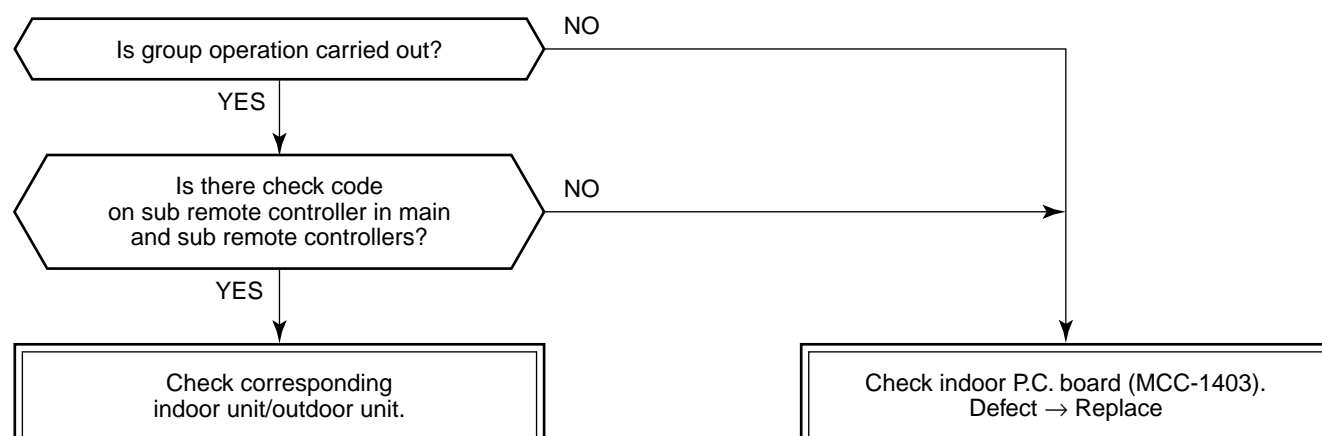
[L20 error]



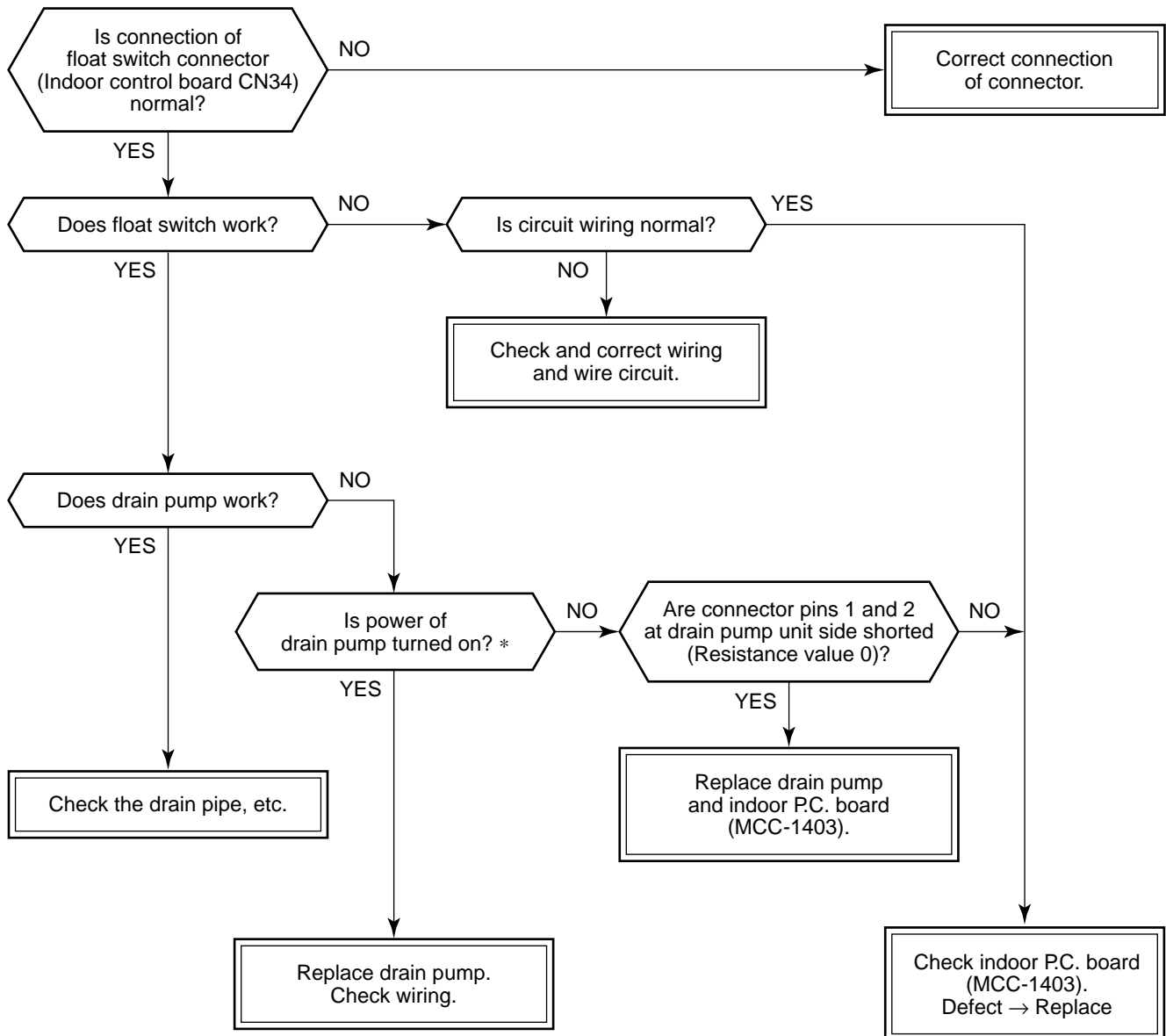
[L30 error]



[P30 error] (Central controller)

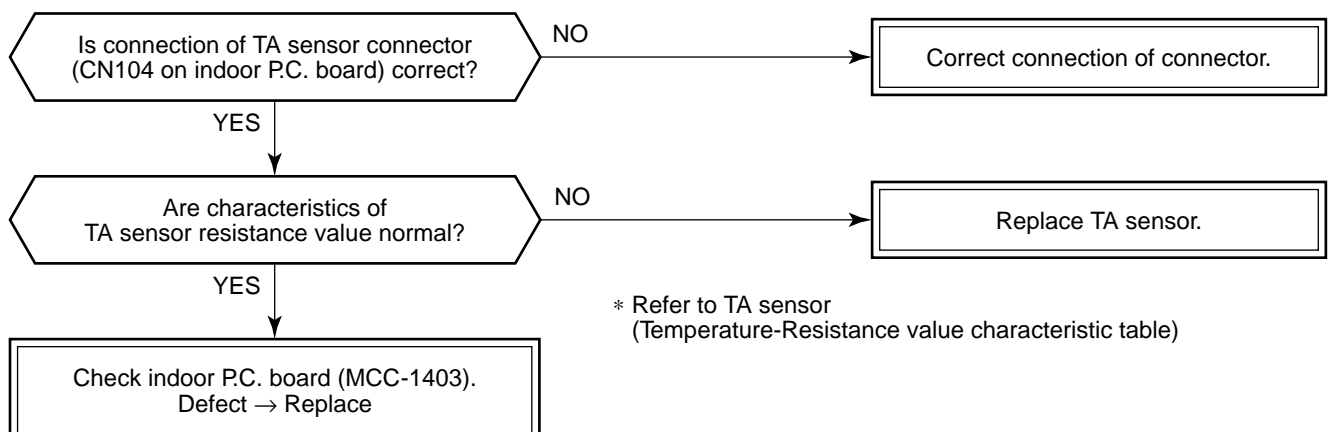


[P10 error]



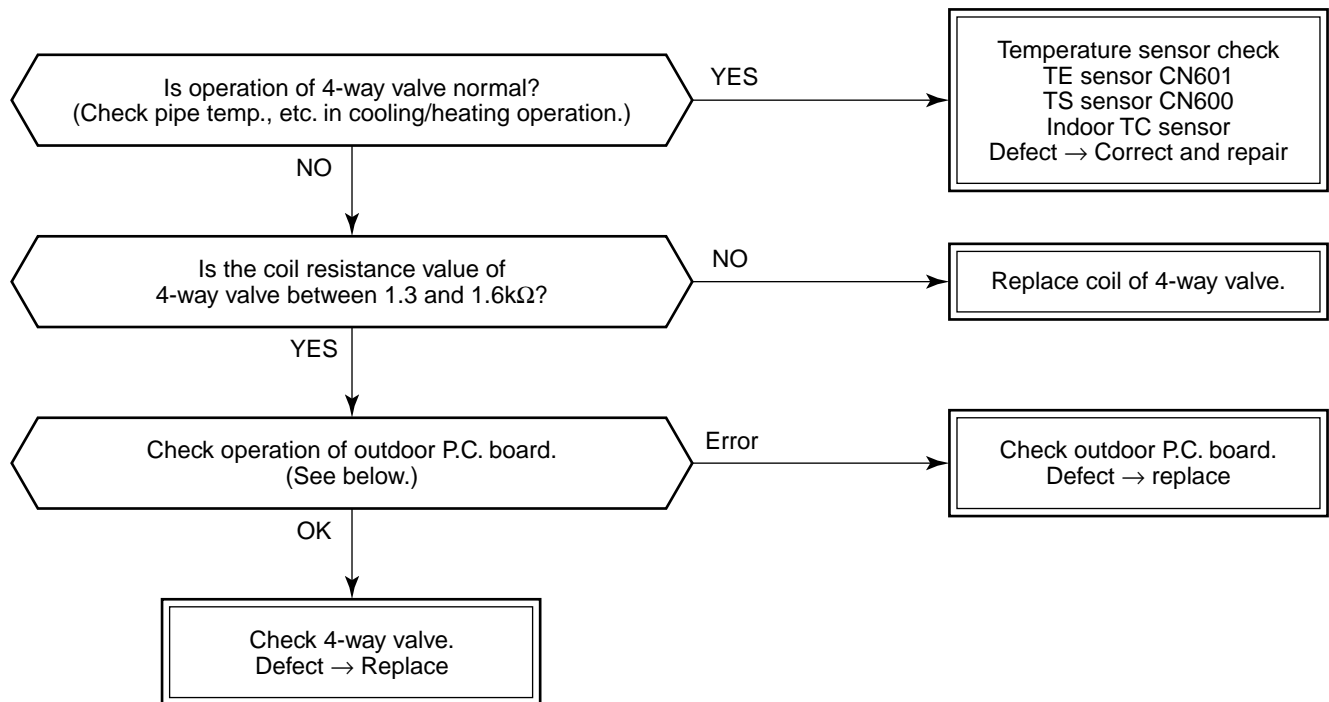
* Check that voltage of 1-2 pin of CN504 on the indoor P.C. board is +12V. (1 pin is plus (+).)

[F10 error]



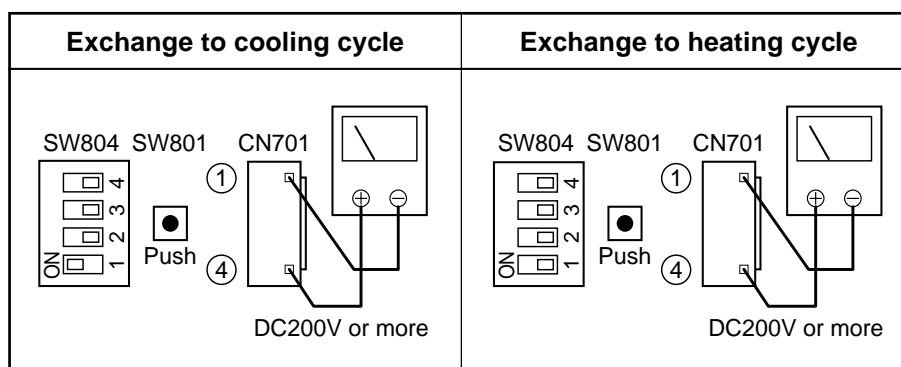
* Refer to TA sensor
(Temperature-Resistance value characteristic table)

[P19 error]



Check method of outdoor P.C. board operation (Self-hold valve type : SP110, SP140)

- 1) Set SW804 of Dip switch as the following figure and then push SW801 for approx. 1 second to check exchange operation to cooling cycle/heating cycle.
 - Power is turned on for approx. 10 seconds.
 - When checking again, check operation 1 minute or more after the first check because exothermic of part (Coil, resistance R700) is large. (There is no problem when coil is not connected.)
- 2) After check, turn off all the Dip switch SW804.

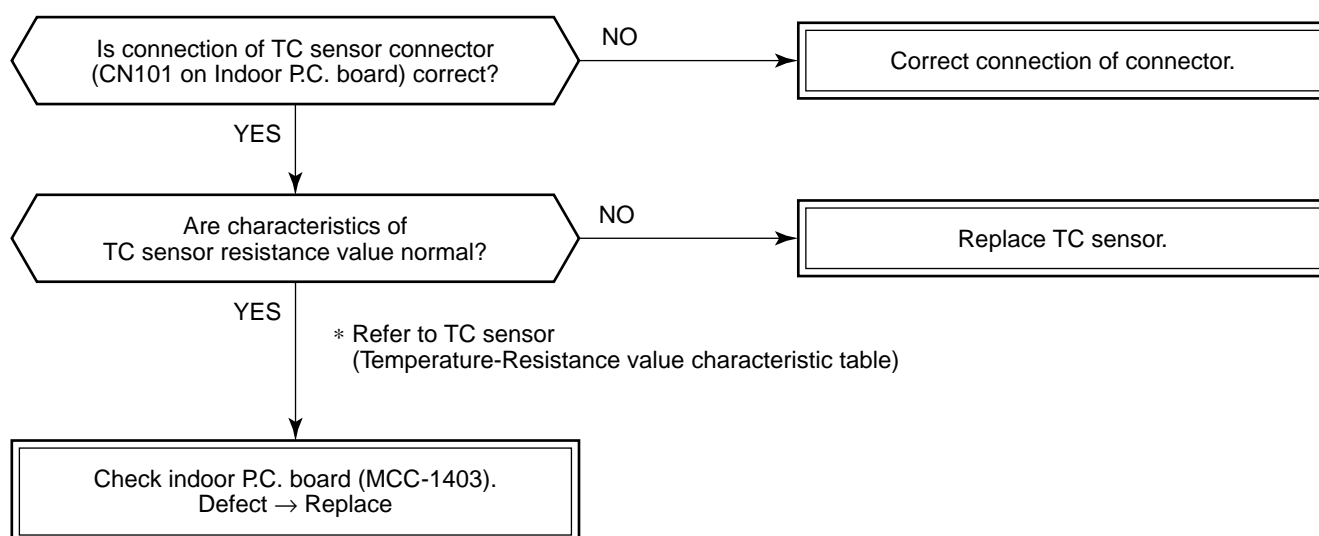


Note) Check by tester

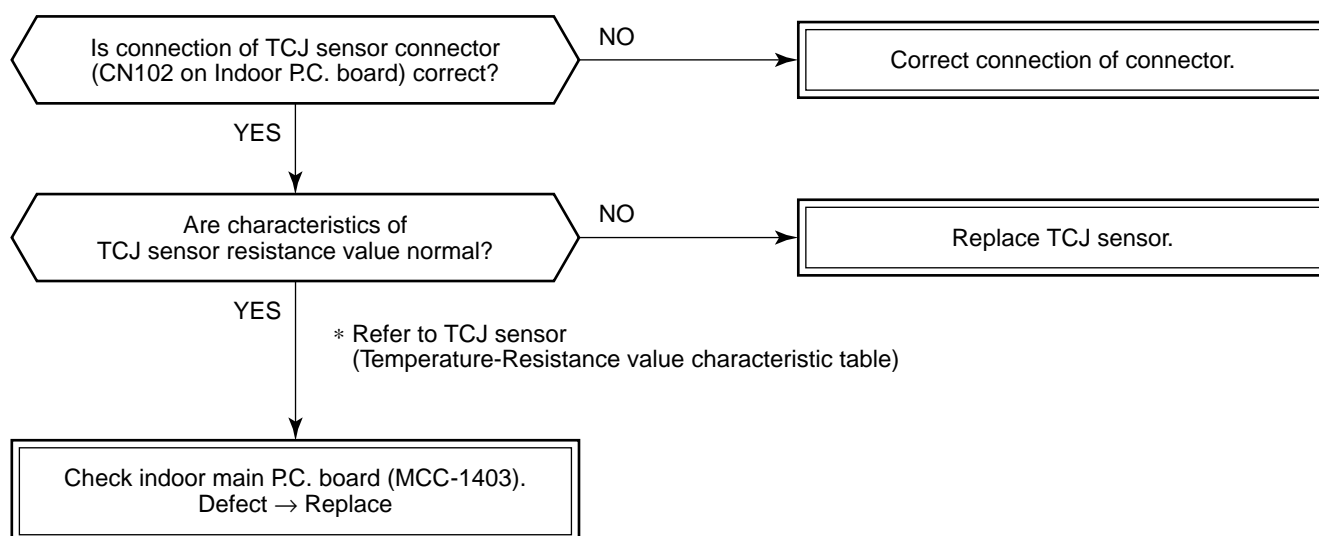
Analog tester : Good if over DC200V

Digital tester : Good if Max. value is over DC200V though the varied value may be displayed.

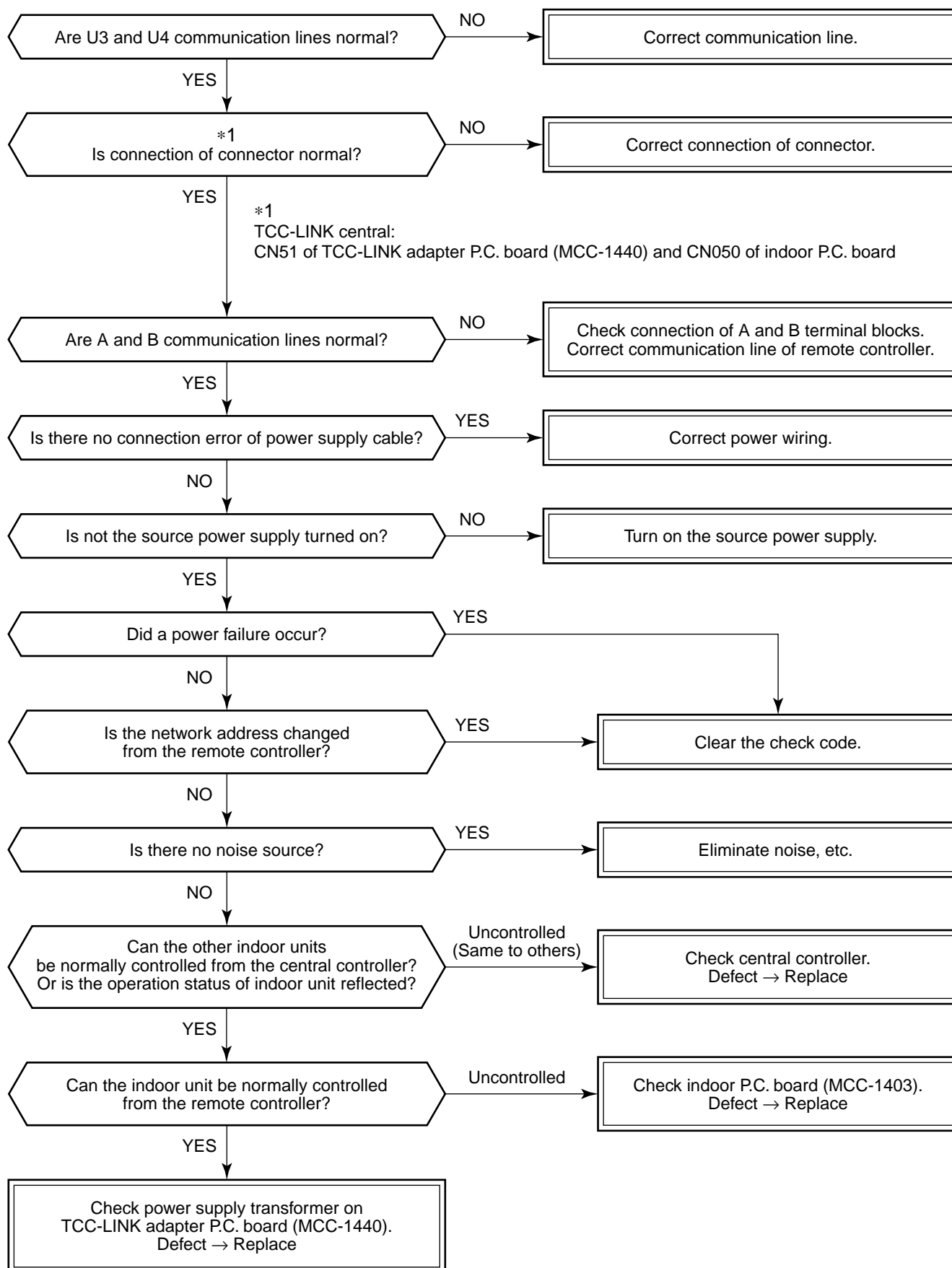
[F02 error]



[F01 error]



[C06 error] (TCC-LINK central controller)



[E03 error] (Master indoor unit)

[E03 error] is detected when the indoor unit cannot receive a signal from the remote controller (also central controller).

Check A and B remote controllers and communication lines of the central control system U3 and U4.

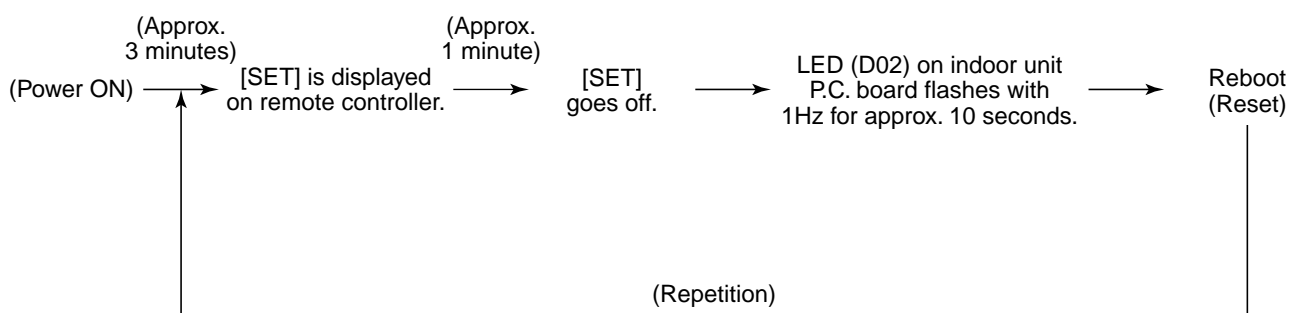
As communication is impossible, this check code [E03] is not displayed on the remote controller and the central controller. [E01] is displayed on the remote controller and [C06 error] is displayed on the central controller.

If these check codes generate during operation, the air conditioner stops.

[F29 error]

This check code indicates a detection error of IC10 non-volatile memory (EEPROM) on the indoor unit P.C. board, which generated during operation of the air conditioner. Replace the service P.C. board.

* When EEPROM was not inserted when power supply turned on or when the EEPROM data read/write operation is impossible at all, the automatic address mode is repeated. In this time, [97 error] is displayed on the central controller.



[P31 error] (Follower indoor unit)

When the master unit of a group operation detected [E03], [L03], [L07] or [L08] error, the follower unit of the group operation detects [P31 error] and then the unit stops.

There is no display of the check code or alarm history of the remote controller. (In this model, the mode enters in automatic address set mode when the master unit detected [L03], [L07] or [L08] error.)

Temperature sensor

Temperature – Resistance value characteristic table

TA, TC, TCJ, TE, TS, TO sensors

TD, TL sensors

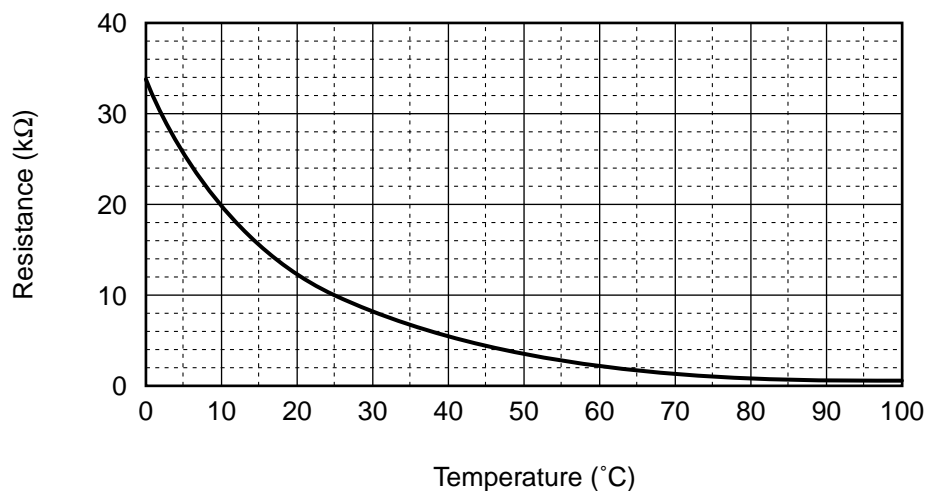
Representative value

Temperature (°C)	Resistance value (kΩ)		
	(Minimum value)	(Standard value)	(Maximum value)
0	32.33	33.80	35.30
10	19.63	20.35	21.09
20	12.23	12.59	12.95
25	9.75	10.00	10.25
30	7.764	7.990	8.218
40	5.013	5.192	5.375
50	3.312	3.451	3.594
60	2.236	2.343	2.454
70	1.540	1.623	1.709
80	1.082	1.146	1.213
90	0.7740	0.8237	0.8761
100	0.5634	0.6023	0.6434

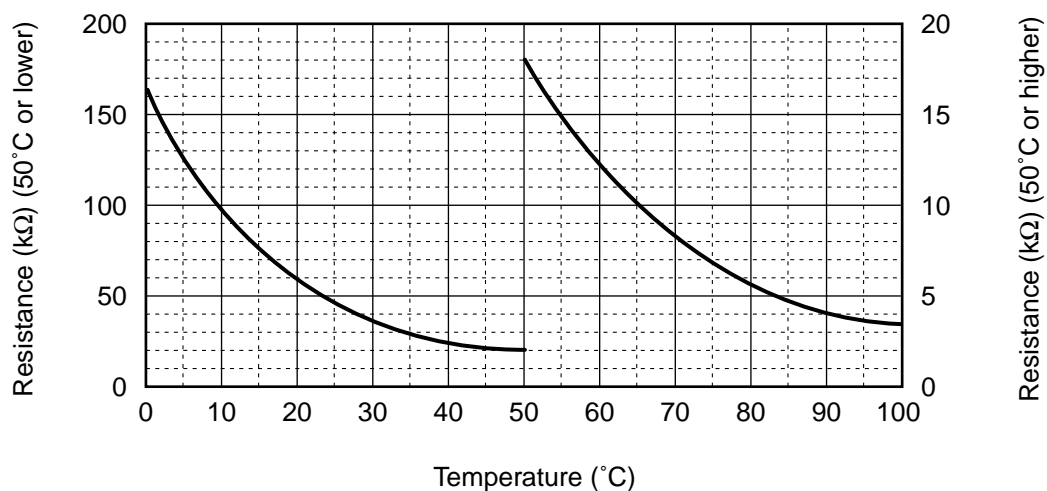
Representative value

Temperature (°C)	Resistance value (kΩ)		
	(Minimum value)	(Standard value)	(Maximum value)
0	150.5	161.3	172.7
10	92.76	99.05	105.6
20	58.61	62.36	66.26
25	47.01	49.93	52.97
30	37.93	40.22	42.59
40	25.12	26.55	28.03
50	17.00	17.92	18.86
60	11.74	12.34	12.95
70	8.269	8.668	9.074
80	5.925	6.195	6.470
90	4.321	4.507	4.696
100	3.205	3.336	3.468

TA, TC, TCJ, TE, TS, TO sensors



TD, TL sensors



* As TH sensor (Outdoor unit heat sink temp. sensor) is incorporated in the outdoor control P.C. board, the resistance value cannot be measured.

10. OUTDOOR UNIT TROUBLESHOOTING

10-1. Summary of Troubleshooting

<Wired remote controller type>

1. Before troubleshooting

1) Required tools/instruments

- ⊕ and ⊖ screwdrivers, spanners, radio cutting pliers, nippers, push pins for reset switch
- Tester, thermometer, pressure gauge, etc.

2) Confirmation points before check

a) The following operations are normal.

1. Compressor does not operate.

- Is not 3-minutes delay (3 minutes after compressor OFF)?
- Is not the outdoor unit in standby status though the remote controller reached the setup temperature?
- Does not timer operate during fan operation?
- Is not an overflow error detected on the indoor unit?
- Is not outside high-temperature operation controlled in heating operation?

2. Indoor fan does not rotate.

- Does not cool air discharge preventive control work in heating operation?

3. Outdoor fan does not rotate or air volume changes.

- Does not high-temperature release operation control work in heating operation?
- Does not outside low-temperature operation control work in cooling operation?
- Is not defrost operation performed?

4. ON/OFF operation cannot be performed from remote controller.

- Is not the control operation performed from outside/remote side?
- Is not automatic address being set up?

(When the power is turned on at the first time or when indoor unit address setting is changed, the operation cannot be performed for maximum approx. 5 minutes after power-ON.)

- Is not being carried out a test run by operation of the outdoor controller?

b) Did you return the cabling to the initial positions?

c) Are connecting cables of indoor unit and remote controller correct?

2. Troubleshooting procedure

When a trouble occurred, check the parts along with the following procedure.



NOTE :

For cause of a trouble, power conditions or malfunction/erroneous diagnosis of microcomputer due to outer noise is considered except the items to be checked. If there is any noise source, change the cables of the remote controller to shield cables.

<Wireless remote controller type>

1. Before troubleshooting

- 1) Required tools/instruments
 - ⊕ and ⊖ screwdrivers, spanners, radio cutting pliers, nippers, etc.
 - Tester, thermometer, pressure gauge, etc.
- 2) Confirmation points before check
 - a) The following operations are normal.
 1. Compressor does not operate.
 - Is not 3-minutes delay (3 minutes after compressor OFF)?
 - Is not the outdoor unit in standby status though the remote controller reached the setup temperature?
 - Does not timer operate during fan operation?
 - Is not an overflow error detected on the indoor unit?
 - Is not outside high-temperature operation controlled in heating operation?
 2. Indoor fan does not rotate.
 - Does not cool air discharge preventive control work in heating operation?
- 3) Outdoor fan does not rotate or air volume changes.
 - Does not high-temperature release operation control work in heating operation?
 - Does not outside low-temperature operation control work in cooling operation?
 - Is not defrost operation performed?
- 4) ON/OFF operation cannot be performed from remote controller.
 - Is not forced operation performed?
 - Is not the control operation performed from outside/remote side?
 - Is not automatic address being set up?
(When the power is turned on at the first time or when indoor unit address setting is changed, the operation cannot be performed for maximum approx. 5 minutes after power-ON.)
 - a) Did you return the cabling to the initial positions?
 - b) Are connecting cables between indoor unit and receiving unit correct?

2. Troubleshooting procedure

(When the power is turned on at the first time or when indoor unit address setting is changed, the operation cannot be performed for maximum approx. 5 minutes after power-ON.)

When a trouble occurred, check the parts along with the following procedure.




10-2. Troubleshooting







10-2-1. Outline of Judgment

The primary judgment to check whether a trouble occurred in the indoor unit or outdoor unit is carried out with the following method.

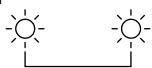
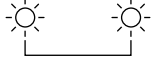
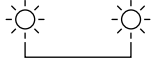
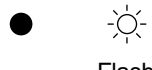


Method to judge the erroneous position by flashing indication on the display part of the indoor unit (sensors of the receiving part)

The indoor unit monitors the operating status of the air conditioner, and the blocked contents of self-diagnosis are displayed restricted to the following cases if a protective circuit works.

● : Go off, ○ : Go on,  : Flash (0.5 sec.)


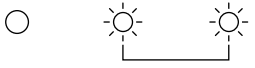
Lamp indication	Check code	Cause of trouble occurrence
Operation Timer Ready ● ● ● No indication at all	—	Power supply OFF or miswiring between receiving unit and indoor unit
Operation Timer Ready  ● ● Flash	E01	Receiving error } Receiving unit } Sending error } Communication stop } Miswiring or wire connection error between receiving unit and indoor unit
	E02	
	E03	
	E08	Duplicated indoor unit No. } Duplicated master units of remote controller } Setup error
	E09	
	E10	Communication error between CPUs on indoor unit P.C. board
	E18	Wire connection error between indoor units, Indoor power OFF (Communication stop between indoor master and follower or between main and sub indoor twin)
Operation Timer Ready ● ●  Flash	E04	Miswiring between indoor unit and outdoor unit or connection error (Communication stop between indoor and outdoor units)
Operation Timer Ready ●   Alternate flash	P01	Indoor AC fan error } Overflow was detected. } Protective device of indoor unit worked. Indoor DC fan error }
	P10	
	P12	
Operation Timer Ready  ●  Alternate flash	P03	Outdoor unit discharge temp. error } Outdoor high pressure system error } Protective device of outdoor unit worked. *1
	P04	
	P19	4-way valve system error (Indoor or outdoor unit judged.)
	P31	Stopped because of error of other indoor unit in a group (Check codes of E03/L03/L07/L08)

*1: These are representative examples and the check code differs according to the outdoor unit to be combined.

Lamp indication	Check code	Cause of trouble occurrence
Operation Timer Ready  Alternate flash	F01	Heat exchanger sensor (TCJ) error Heat exchanger sensor (TC) error Heat exchanger sensor (TA) error } Indoor unit sensor error
	F02	
	F10	
Operation Timer Ready  Alternate flash	F04	Discharge temp. sensor (TD) error Temp. sensor (TE, TS) error Temp. sensor (TO) error } Sensor error of outdoor unit *1
	F06	
	F08	
Operation Timer Ready  Simultaneous flash	F29	Indoor EEPROM error
Operation Timer Ready  Flash	H01	Compressor break down Compressor lock Current detection circuit error } Outdoor compressor system error *1
	H02	
	H03	
	H06	Outdoor unit low pressure system error
Operation Timer Ready  Simultaneous flash	L03	Duplicated master indoor units There is indoor unit of group connection in individual indoor unit. Unsetting of group address Missed setting (Unset indoor capacity) } → AUTO address * If group construction and address are not normal when power supply turned on, automatically goes to address setup mode.
	L07	
	L08	
	L09	
Operation Timer Ready  Simultaneous flash	L20	Duplicated indoor central addresses Outdoor unit and other error Outside interlock error Negative phase error } Others
	L29	
	L30	
	L31	

*1: These are representative examples and the check code differs according to the outdoor unit to be combined.

10-2-2. Others (Other than Check Code)

Lamp indication	Check code	Cause of trouble occurrence
Operation Timer Ready  Simultaneous flash	—	During test run
Operation Timer Ready  Alternate flash	—	Disagreement of cool/heat (Automatic cool/heat setting to automatic cool/heat prohibited model, or setting of heating to cooling-only model)

New Check Code

1. Difference between the new check code and the existing check code




	Existing check code	New check code
Used characters	Hexadecimal, 2 digits	Alphabet + decimal, 2 digits
Characteristics of code classification	Few classifications for communication and defective setting	Many classifications for communication and defective setting
Block display	Indoor P.C. board, outdoor P.C. board, cycle, communication	Communication/defective setting (4 types), indoor protection, outdoor protection, sensor, compressor protection, etc.

Display	Classification
A	NEW SPE is not used.
C	Central control system error
E	Communication system error
F	Each sensor error (Defective)
H	Compressor protection system error
J	NEW SPE is not used.
L	Setting error / Other error
P	Protective device operated

<Display on wired remote controller>

- [] goes on.
- [UNIT No.] + Check code + Operation lamp (Green) flash.

<Display on wireless sensor>

- Combination block of [Operation ], [Timer ] and [Ready ] is displayed.

10-2-3. Check Code List (Outdoor)

○ : Go on, ◎ : Flash, ● : Go off
ALT (Alternate): Alternate flashing when there are two flashing LED SIM (Simultaneous): Simultaneous flashing when there are two flashing LED

Remote controller indication	Sensor lamp part				Representative defective position	Detection	Explanation of error contents	Automatic reset	Operation continuation
	Block indication								
	Operation	Timer	Ready	Flash					
F04	◎	◎	○	ALT	Outdoor unit Discharge temp. sensor (TD) error	Outdoor	Open/Short of discharge temp. sensor was detected.	✕	✕
F06	◎	◎	○	ALT	Outdoor unit Temp. sensor (TE, TS, TL) error	Outdoor	Open/Short of heat exchanger temp. sensor was detected. Miswiring between TE sensor and TS sensor	✕	✕
F08	◎	◎	○	ALT	Outdoor unit Outside temp. sensor (TO) error	Outdoor	Open/Short of outside temp. sensor was detected.	○	○
H01	●	◎	●		Outdoor unit Compressor break down	Outdoor	When reached min-Hz by current release control, short-circuited current (Idc) after DC excitation was detected.	✕	✕
H02	●	◎	●		Outdoor unit Compressor lock	Outdoor	Compressor lock was detected.	✕	✕
H03	●	◎	●		Outdoor unit Current detection circuit error	Outdoor	Current detection circuit error	✕	✕
H06	●	◎	●		Outdoor unit Low pressure system error	Outdoor	Ps pressure sensor error, low pressure protective operation.	✕	✕
L29	◎	○	◎	SIM	Outdoor unit Other outdoor unit error	Outdoor	1) Defective parts on outdoor P.C. board (MCU communication, EEPROM, TH sensor error) 2) When outdoor service P.C. board was used, model type selection was inappropriate. 3) Other error (Heat sink abnormal overheat, gas leak, 4-way valve inverse error) was detected.	✕	✕
P03	◎	●	◎	ALT	Outdoor unit Discharge temp. error	Outdoor	Error was detected by discharge temp. release control.	✕	✕
P04	◎	●	◎	ALT	Outdoor unit High pressure system error, Power supply voltage error	Outdoor	When case thermostat worked, error was detected by high release control from indoor/ outdoor heat exchanger temp. sensor. Power supply voltage error	✕	✕
P22	◎	●	◎	ALT	Outdoor unit Outdoor fan error	Outdoor	Error (Over-current, lock, etc.) was detected on outdoor fan drive circuit.	✕	✕
P26	◎	●	◎	ALT	Outdoor unit Inverter Idc operation	Outdoor	Short-circuited protective operation of compressor drive circuit element (G-Tr /IGBT) worked.	✕	✕
P29	◎	●	◎	ALT	Outdoor unit Position detection error	Outdoor	Position detection error of compressor motor was detected.	✕	✕
E01	◎	●	●		No remote controller master unit Remote controller communication error	Remote controller	Signal was not received from indoor unit. Main remote controller was not set. (including 2 remote controllers)	—	—
E02	◎	●	●		Remote controller send error	Remote controller	Signal cannot be sent to indoor unit.	—	—
E03	◎	●	●		Regular communication error between indoor and remote controller	Indoor	No communication from remote controller and network adapter	○	✕
E04	●	●	◎		Indoor/Outdoor serial error	Indoor	Serial communication error between indoor and outdoor	○	✕
E08	◎	●	●		Duplicated indoor addresses ◇	Indoor	Same address as yours was detected.	○	✕
E09	◎	●	●		Duplicated main remote controllers	Remote controller	In 2-remote controller control, both were set as master. (Indoor master unit stops warning and follower unit continues operation.)	✕	✕
E10	◎	●	●		Communication error between CPU	Indoor	MCU communication error between main motor and micro computer	○	△
E18	◎	●	●		Regular communication error between master and follower indoor units	Indoor	Regular communication was impossible between master and follower indoor units. Communication between twin master (Main unit) and follower (sub unit) was impossible.	○	✕
L03	◎	●	◎	SIM	Duplicated indoor master units ◇	Indoor	There are multiple master units in a group.	✕	✕
L07	◎	●	◎	SIM	There is group cable in individual indoor unit. ◇	Indoor	When even one group connection indoor unit exists in individual indoor unit	✕	✕
L08	◎	●	◎	SIM	Unset indoor group address ◇	Indoor	Indoor address group was unset.	✕	✕
L09	◎	●	◎	SIM	Unset indoor capacity	Indoor	Capacity of indoor unit was unset.	✕	✕
L30	◎	○	◎	SIM	Outside error input to indoor unit (Interlock)	Indoor	Abnormal stop by CN80 outside error input	✕	✕
L31	◎	○	◎	SIM	Phase order error and others	Outdoor	Phase order of 3-phases power supply is abnormal (Thermo-OFF operation continues.) and others.	✕	△
P19	◎	●	◎	ALT	4-way valve inverse error	Indoor Outdoor	In heating operation, error was detected by temp. down of indoor heat exchanger or temp. up of TE, TS.	○	✕

☆ When this warning was detected before group construction/address check finish at power supply was turned on, the mode shifts automatically to AUTO address setup mode.

○ : Go on, ◎ : Flash, ● : Go off
 ALT (Alternate): Alternate flashing when there are two flashing LED SIM (Simultaneous): Simultaneous flashing when there are two flashing LED

Remote controller indication	Sensor lamp part				Representative defective position	Detection	Explanation of error contents	Automatic reset	Operation continuation	
	Block indication									
	Operation	Timer	Ready	Flash						
F01	◎	◎	●	ALT	Indoor unit Heat exchanger sensor (TCJ) error	Indoor	Open/Short of heat exchanger (TCJ) was detected.	○	✕	
F02	◎	◎	●	ALT	Indoor unit Heat exchanger sensor (TC) error	Indoor	Open/Short of heat exchanger (TC) was detected.	○	✕	
F10	◎	◎	●	ALT	Indoor unit Room temp. sensor (TA) error	Indoor	Open/Short of room temp. (TA) was detected.	○	✕	
F29	◎	◎	●	SIM	Indoor unit Other indoor P.C. board error	Indoor	EEPROM error (Other error may be detected. If no error, automatic address is repeated.	✕	✕	
P01	●	◎	◎	ALT	Indoor unit Indoor fan error	Indoor	Indoor AC fan error was detected. (Fan thermal relay worked.)	✕	✕	
P10	●	◎	◎	ALT	Indoor unit Overflow detection	Indoor	Float switch worked.	✕	✕	
P12	●	◎	◎	ALT	Indoor unit Indoor fan error	Indoor	Indoor fan error (Over-current / Lock, etc.) was detected.	✕	✕	
P31	◎	●	◎	ALT	Other indoor unit error	Indoor	Other indoor under condition of warning in group. E03/L07/L03/L08 warning	○	✕	
—	By unit with warning No.				ALT	Error in indoor group	Network adapter	Sub remote controller error in a group (Details of remote controller are displayed with unit No. Only central control side is displayed.)	—	—
—	—					LAN system communication error	Network adapter/ Center	Communication error of central control system signal * Is not displayed on the remote controller	○	○
L20	◎	○	◎	SIM	LAN system communication error	Network adapter/ Center	Duplicated indoor address of central control system communication	○	✕	
—	—					There are multiple communication adapters.	Network adapter	There are multiple communication adapters on remote controller communication line.	○	○

Error mode detected by indoor unit

Operation of diagnostic function				Judgment and measures
Check code	Cause of operation	Status of air conditioner	Condition	
E03	No communication from remote controller (including wireless) and communication adapter	Stop (Automatic reset)	Displayed when error is detected	1. Check cables of remote controller and communication adapters. • Remote controller LCD display OFF (Disconnection) • Central remote controller [97] check code
E04	The serial signal is not output from outdoor unit to indoor unit. • Miswiring of inter-unit wire • Defective serial sending circuit on outdoor P.C. board • Defective serial receiving circuit on indoor P.C. board	Stop (Automatic reset)	Displayed when error is detected	1. Outdoor unit does not completely operate. • Inter-unit wire check, correction of miswiring • Check outdoor P.C. board. Correct wiring of P.C. board. 2. When outdoor unit normally operates Check P.C. board (Indoor receiving / Outdoor sending).
E08	Duplicated indoor unit address	Stop	Displayed when error is detected	1. Check whether remote controller connection (Group/Individual) was changed or not after power supply turned on (Finish of group construction/Address check). * If group construction and address are not normal when the power has been turned on, the mode automatically shifts to address setup mode. (Resetting of address)
L03	Duplicated indoor master unit			
L07	There is group wire in individual indoor unit.			
L08	Unset indoor group address			
L09	Unset indoor capacity	Stop	Displayed when error is detected	1. Set indoor capacity (DN=11)
L30	Abnormal input of outside interlock	Stop	Displayed when error is detected	1. Check outside devices. 2. Check indoor P.C. board.
P01	Fan motor thermal protection	Stop	Displayed when error is detected	1. Check fan motor thermal relay. 2. Check indoor P.C. board.
P10	Float switch operation • Float circuit, Disconnection, Coming-off, Float switch contact error	Stop	Displayed when error is detected	1. Trouble of drain pump 2. Clogging of drain pump 3. Check float switch. 4. Check indoor P.C. board.
P12	Indoor DC fan error	Stop	Displayed when error is detected	1. Position detection error 2. Over-current protective circuit of indoor fan driving unit operated. 3. Indoor fan locked. 4. Check indoor P.C. board.
P19	4-way valve system error • After heating operation has started, indoor heat exchangers temp. is down.	Stop (Automatic reset)	Displayed when error is detected	1. Check 4-way valve. 2. Check 2-way valve and check valve. 3. Check indoor heat exchanger (TC/TCJ). 4. Check indoor P.C. board.
P31	Own unit stops while warning is output to other indoor units.	Stop (Follower unit) (Automatic reset)	Displayed when error is detected	1. Judge follower unit while master unit is [E03], [L03], [L07] or [L08]. 2. Check indoor P.C. board.
F01	Coming-off, disconnection or short of indoor heat exchanger temp. sensor (TCJ)	Stop (Automatic reset)	Displayed when error is detected	1. Check indoor heat exchanger temp. sensor (TCJ). 2. Check indoor P.C. board.
F02	Coming-off, disconnection or short of indoor heat exchanger temp. sensor (TC)	Stop (Automatic reset)	Displayed when error is detected	1. Check indoor heat exchanger temp. sensor (TC). 2. Check indoor P.C. board.
F10	Coming-off, disconnection or short of indoor heat exchanger temp. sensor (TA)	Stop (Automatic reset)	Displayed when error is detected	1. Check indoor heat exchanger temp. sensor (TA). 2. Check indoor P.C. board.
F29	Indoor EEPROM error • EEPROM access error	Stop (Automatic reset)	Displayed when error is detected	1. Check indoor EEPROM. (including socket insertion) 2. Check indoor P.C. board.
E10	Communication error between indoor MCU • Communication error between fan driving MCU and main MCU	Stop (Automatic reset)	Displayed when error is detected	1. Check indoor P.C. board.
E18	Regular communication error between indoor aster and follower units and between main and sub units	Stop (Automatic reset)	Displayed when error is detected	1. Check remote controller wiring. 2. Check indoor power supply wiring. 3. Check indoor P.C. board.

Error mode detected by remote controller or central controller (TCC-LINK)

Operation of diagnostic function				Judgment and measures
Check code	Cause of operation	Status of air conditioner	Condition	
Not displayed at all (Operation on remote controller is impossible.)	No communication with master indoor unit <ul style="list-style-type: none"> Remote controller wiring is not correct. Power of indoor unit is not turned on. Automatic address cannot be completed. 	Stop	—	Power supply error of remote controller, Indoor EEPROM error <ol style="list-style-type: none"> Check remote controller inter-unit wiring. Check remote controller. Check indoor power wiring. Check indoor P.C. board. Check indoor EEPROM. (including socket insertion) → Automatic address repeating phenomenon generates.
E01 *2	No communication with master indoor unit <ul style="list-style-type: none"> Disconnection of inter-unit wire between remote controller and master indoor unit (Detected by remote controller side) 	Stop (Automatic reset) * If center exists, operation continues.	Displayed when error is detected	Receiving error from remote controller <ol style="list-style-type: none"> Check remote controller inter-unit wiring. Check remote controller. Check indoor power wiring. Check indoor P.C. board.
E02	Signal send error to indoor unit (Detected by remote controller side)	Stop (Automatic reset) * If center exists, operation continues.	Displayed when error is detected	Sending error of remote controller <ol style="list-style-type: none"> Check sending circuit inside of remote controller. → Replace remote controller.
E09	There are multiple main remote controllers. (Detected by remote controller side)	Stop (Sub unit continues operation.)	Displayed when error is detected	<ol style="list-style-type: none"> In 2-remote controllers (including wireless), there are multiple main units. Check that there are 1 main remote controller and other sub remote controllers.
L20 ----- Central controller 98	Duplicated indoor central addresses on communication of central control system (Detected by indoor/central controller side)	Stop (Automatic reset)	Displayed when error is detected	<ol style="list-style-type: none"> Check setting of central control system network address. (Network adapter SW01) Check network adapter P.C. board.
— *3 ----- Central controller 99	There are multiple network adapters on the remote controller communication line. (Central controller side detected.)	Continues	Displayed when error is detected	<ol style="list-style-type: none"> Check the multiple network adapters. Check inter-unit wire of remote controller / miswiring. → There should be only 1 adapter on the network.
— *3 ----- Central controller 97	Communication circuit error of central control system (Detected by central controller side)	Continues (By remote controller)	Displayed when error is detected	<ol style="list-style-type: none"> Check communication wire / miswiring Check communication (U3, U4 terminals) Check network adapter P.C. board. Check central controller (such as central control remote controller, etc.) Check terminal resistance. (TCC-LINK)
— ----- Central controller 67	Indoor Gr sub unit error (Detected by central controller side)	Continuation/Stop (According to each case)	Displayed when error is detected	Check the check code of the corresponding unit from remote controller.

*2 The check code cannot be displayed by the wired remote controller.
(Usual operation of air conditioner becomes unavailable.)

For the wireless models, an error is notified with indication lamp.

*3 This trouble is related to communication of remote controller (A, B), central system (TCC-LINK U3, U4), and [E01], [E02], [E03], [E09] or [E18] is displayed or no check display on the remote controller according to the contents.

Error mode detected by outdoor unit

Operation of diagnostic function				Judgment anAd measures
Check code	Cause of operation	Status of air conditioner	Condition	
Indoor unit				
F04	Disconnection, short of discharge temp. sensor (TD)	Stop	Displayed when error is detected	1. Check discharge temp. sensor (TD). 2. Check outdoor P.C. board.
F06	Disconnection, short of outdoor temp. sensor (TE, TS)	Stop	Displayed when error is detected	1. Check temp. sensor (TE, TS). 2. Check outdoor P.C. board (CDB, IPDU).
F08	Disconnection, short of outside temp. sensor (TO)	Continue	Displayed when error is detected	1. Check outside temp. sensor (TO). 2. Check outdoor P.C. board (CDB, IPDU).
H01	Compressor break down * Although operation has started, operation frequency decreases and operation stops.	Stop	Displayed when error is detected	1. Check power supply voltage. (AC198 to 264V) 2. Overload operation of refrigerating cycle
H02	Compressor lock * Over-current detection after compressor start-up	Stop	Displayed when error is detected	1. Trouble of compressor (Lock, etc.): Replace compressor. 2. Wiring error of compressor (Open phase)
H03	Current detection circuit error	Stop	Displayed when error is detected	1. Check outdoor P.C. board. (AC current detection circuit)
H06	Low pressure switch operated. (Model with low-pressure switch) Cooling: 30 seconds Heating: 10 minutes	Stop	Displayed when error is detected	1. Check the refrigerating cycle. (Gas leak) 2. Check low-pressure switch system circuit. 3. Check P.C. board of the outdoor CDB.
L29	Overload for (compressing) of compressor, outdoor unit error and other error • Communication error between CDB and IPDU (Coming-out of connector) • Temperature error of heat sink (Temperature over specified value was detected.)	Stop	Displayed when error is detected	1. Check wiring of CDB and IPDU. 2. Abnormal overload operation of refrigerating cycle. 3. Check power supply voltage.
L31 *1	Phase detection protective circuit operated.	Continues (Compressor stops.)	Displayed when error is detected	1. Check phase missing. 2. Check outdoor P.C. board. 3. Check high pressure switch. 4. Check circuit wiring of high pressure switch.
P03	Discharge temperature error • Discharge temperature higher than specified value was detected.	Stop	Displayed when error is detected	1. Check refrigerating cycle. (Gas leak) 2. Trouble of electron expansion valve 3. Check piping sensor (Td).
P04	High-pressure protection error of TE sensor (Temperature higher than specified value was detected.) High pressure switch (Model with high pressure switch)	Stop	Displayed when error is detected	1. Overload operation of refrigerating cycle 2. Check outdoor temperature sensor (TE). 3. Check outdoor control P.C. board. (CDB and main P.C. board) 4. Check high pressure switch and circuit.
P22	Outdoor fan system error	Stop	Displayed when error is detected	1. Check lock of fan motor. 2. Check power supply voltage. AC198 to 264V 3. Check outdoor P.C. board.
P26	Short-circuit error of compressor driving element	Stop	Displayed when error is detected	1. When performing operation while taking-off compressor wire, P26 error occurs. Check control P.C. board. 2. When performing operation while taking-off compressor wire, an error does not occur. (Compressor rare short)
P29	Position detection circuit error	Stop	Displayed when error is detected	1. Check control P.C. board.

10-2-4. Distinction of error mode by LED indication of outdoor unit

On the Type AP112, AP140 and AP160, a Dip switch (SW801) and LED are provided on the P.C. board of the outdoor unit.

Exchanging this Dip switch enables users to know the status of the outdoor unit in that time.

Lighting status of LED enables users to know the distinction stage before trouble of the outdoor unit will be determined and displayed on the remote controller.

Depending on the indoor unit to be combined, the error of the outdoor temperature sensor (TO) may be confirmed on LED indication only.

Model	Dip switch		LED			
SM160 (MCC-1531)	SW801		D800 (Red)	D801 (Yellow)	D802 (Yellow)	D803 (Yellow)
	Bit 1	Bit 2				
	OFF	OFF		For error display, refer to on the next page.		
			During timer short			
			✧	●	●	●
			During pump down operation			
			●	✧	✧	✧
	ON	OFF	—	Protective operation count Normal time, Count 1 ● ● Count2, Count 3 ● ○ Count 4, Count 5 ○ ● Count 6, Count 7 ○ ○ Protective operation ✧ ✧		Under backup control ⊗
	OFF	ON	PMV opening data (Lower 4 bits data)			
			When this LED lights, add +16 pulses.	When this LED lights, add +8 pulses.	When this LED lights, add +4 pulses.	When this LED lights, add +2 pulses.
	ON	ON	PMV opening data (Upper 4 bits data)			
			When this LED lights, add +256 pulses.	When this LED lights, add +128 pulses.	When this LED lights, add +64 pulses.	When this LED lights, add +32 pulses.
			Total pulses of LED which lights at the respective positions become PMV opening. For example, in case of ○●●○ ●●○○ (Upper 4 bits, Lower 4 bits), PMV opening becomes 256 + 32 + 4 + 2 = 294 pulses.			

○ : Go on, ● : Go off, ✧ : 1Hz flash, ⊗ : 5Hz flash

You can perform fault diagnosis of the outdoor unit with the LEDs on the P.C. board of the outdoor unit in addition to check codes displayed on the wired remote controller of the indoor unit.

Use the LEDs and check codes for various checks. Details of check codes displayed on the wired remote controller of the indoor unit are described in the Installation Manual of the indoor unit.

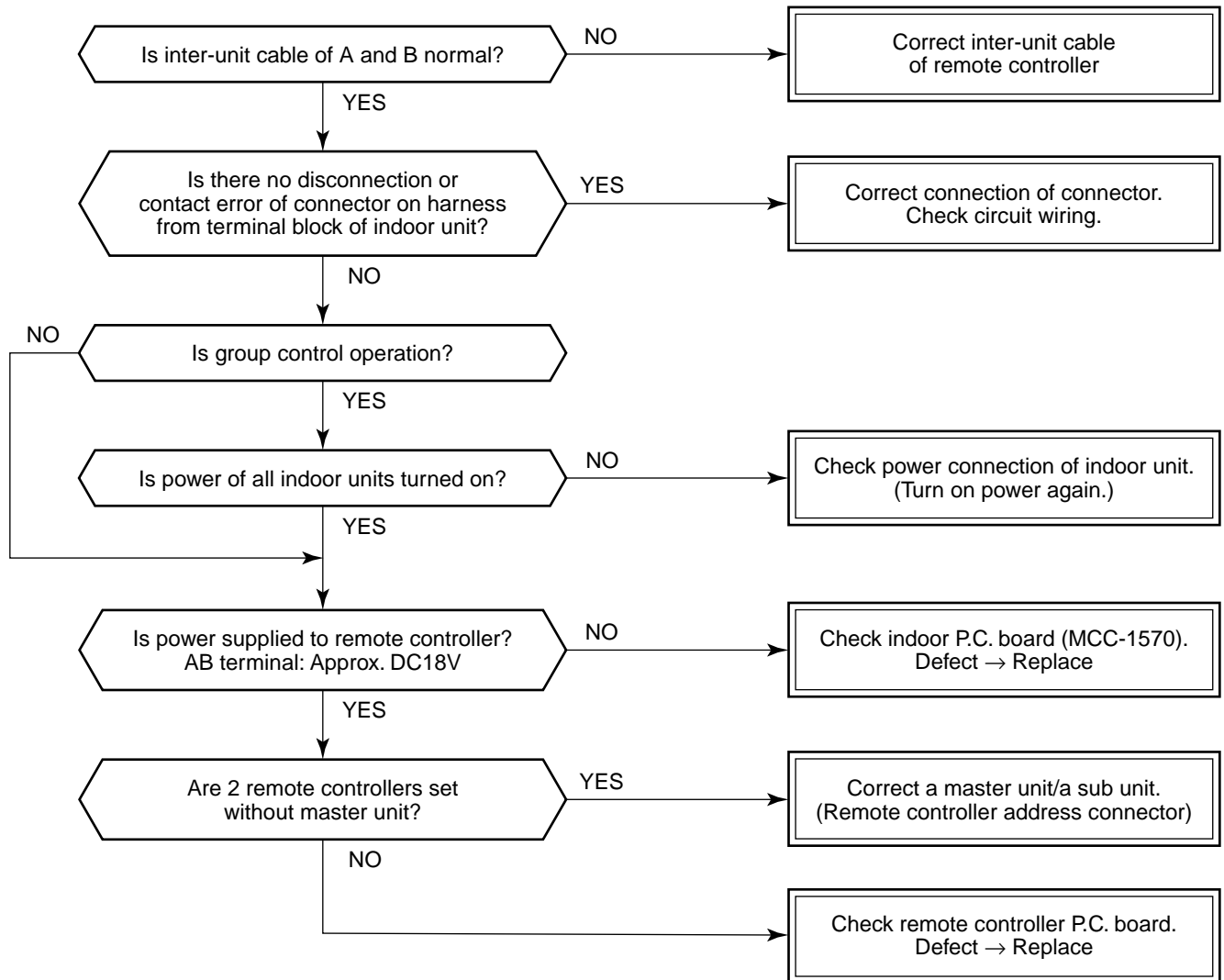
LED indication and code checking

LED indication	Cycle control P.C. board				Cause
	LED indication				
	D800	D801	D802	D803	
D800 ○ : Red D801 ○ : Yellow D802 ○ : Yellow D803 ○ : Yellow ◎ : Rapid flash ● : Go off ○ : Go on	○	●	●	●	Heat exchanger sensor (TE) error
	●	●	○	●	Suction sensor (TS) error
	○	○	●	●	Discharge sensor (TD) error
	●	○	●	○	Thermostat for compressor activated.
	●	○	●	●	Outdoor temperature sensor (TO) error
	○	○	○	●	DC outdoor fan error (Upper side)
	○	○	○	○	DC outdoor fan error (Lower side)
	○	●	●	○	Communication error between IPDU (Abnormal stop)
	◎	◎	◎	●	Comp. case thermo. operate – Serial signal error
	●	○	○	●	Discharge temp. error
	○	○	●	○	EEPROM error
	●	●	○	○	Communication error between IPDU (No abnormal stop)
	◎	●	●	●	G – Tr short – circuit protection
	●	◎	●	●	Detect circuit error
	◎	◎	●	●	Current sensor error
	●	●	◎	●	Comp. lock error
	◎	●	◎	●	Comp. break down
	●	○	●	○	High-pressure release operation
	◎	◎	◎	●	TH sensor error

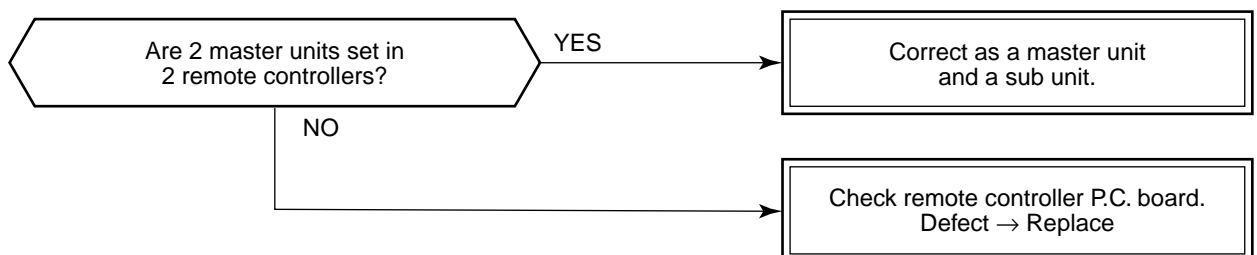
10-2-5. Diagnostic Procedure for Each Check Code (Indoor Unit)

Check code

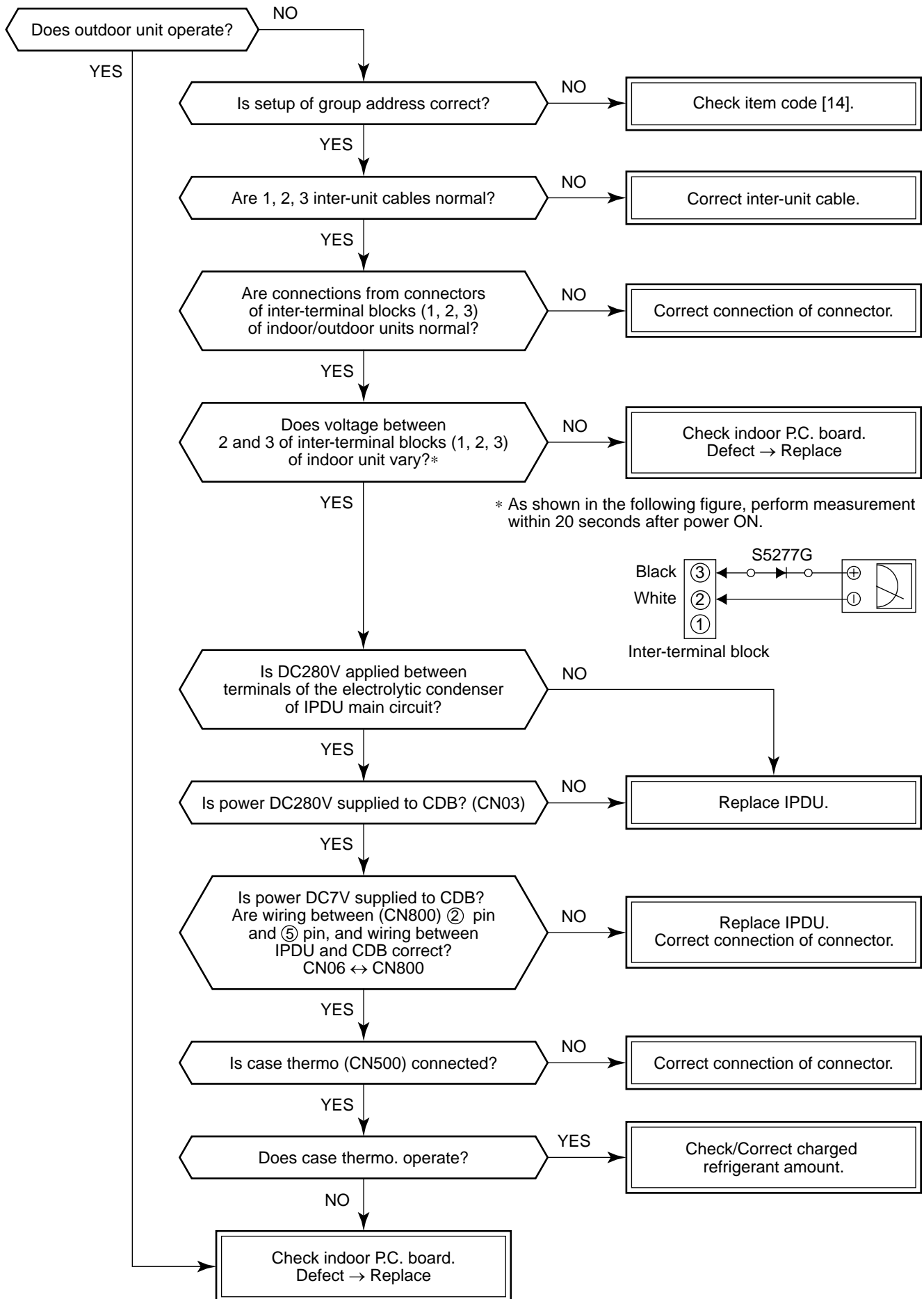
[E01 error]



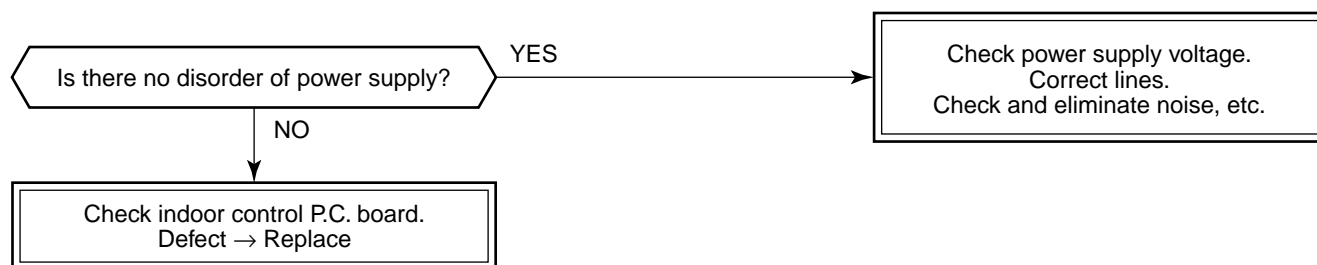
[E09 error]



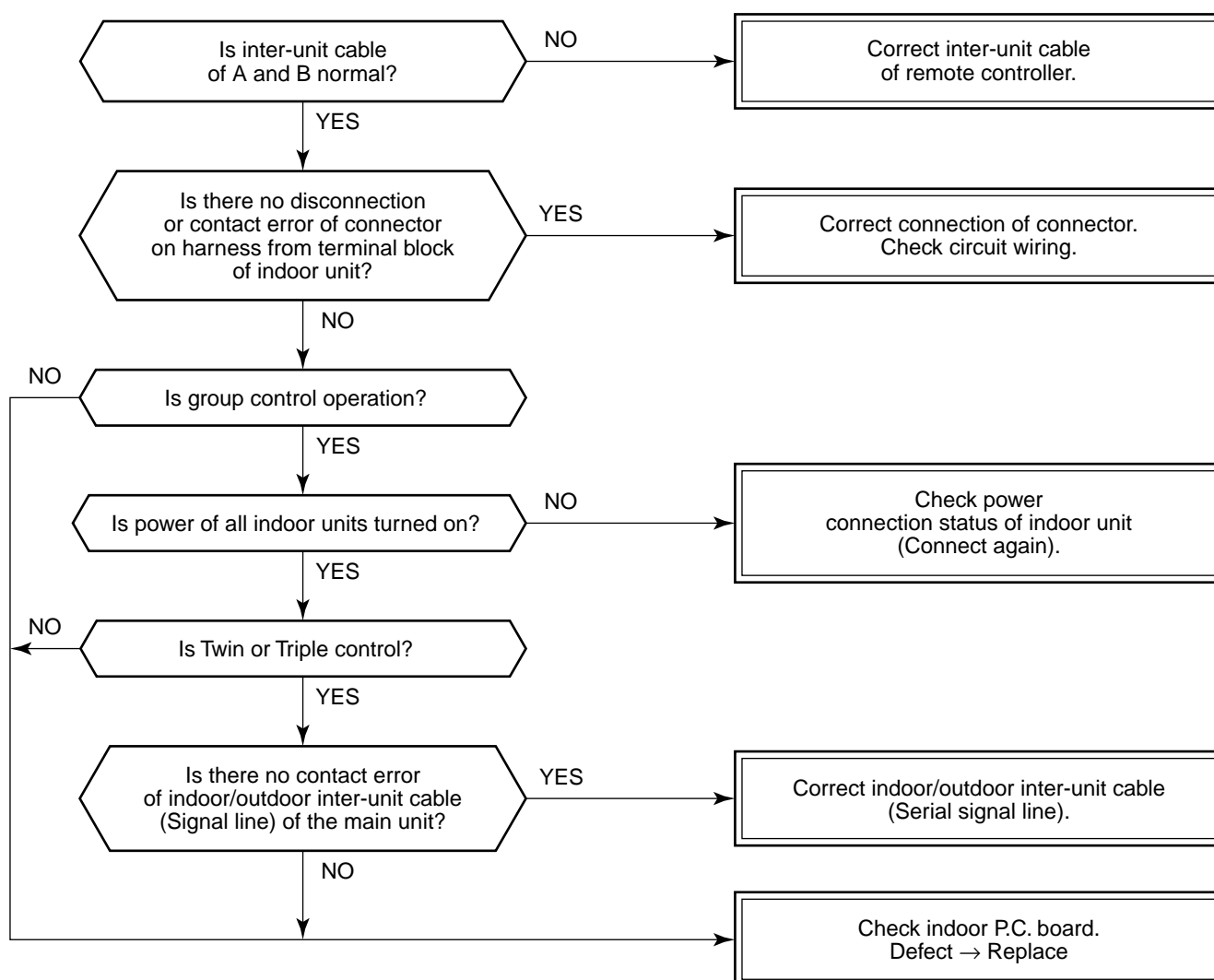
[E04 error]



[E10 error]



[E18 error]



[E08, L03, L07, L08 error]

E08: Duplicated indoor unit No.

L03: There are 2 or more master units in a group control.

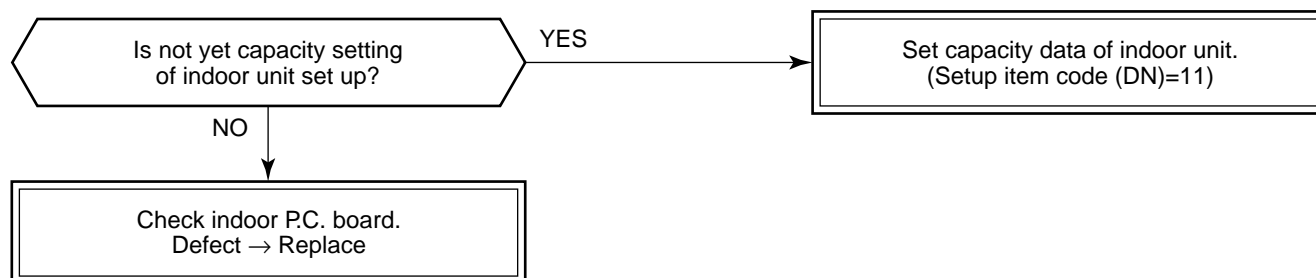
L07: There is 1 or more group address [Individual] in a group control.

L08: The indoor group address is unset. **(13. ADDRESS SETUP)**

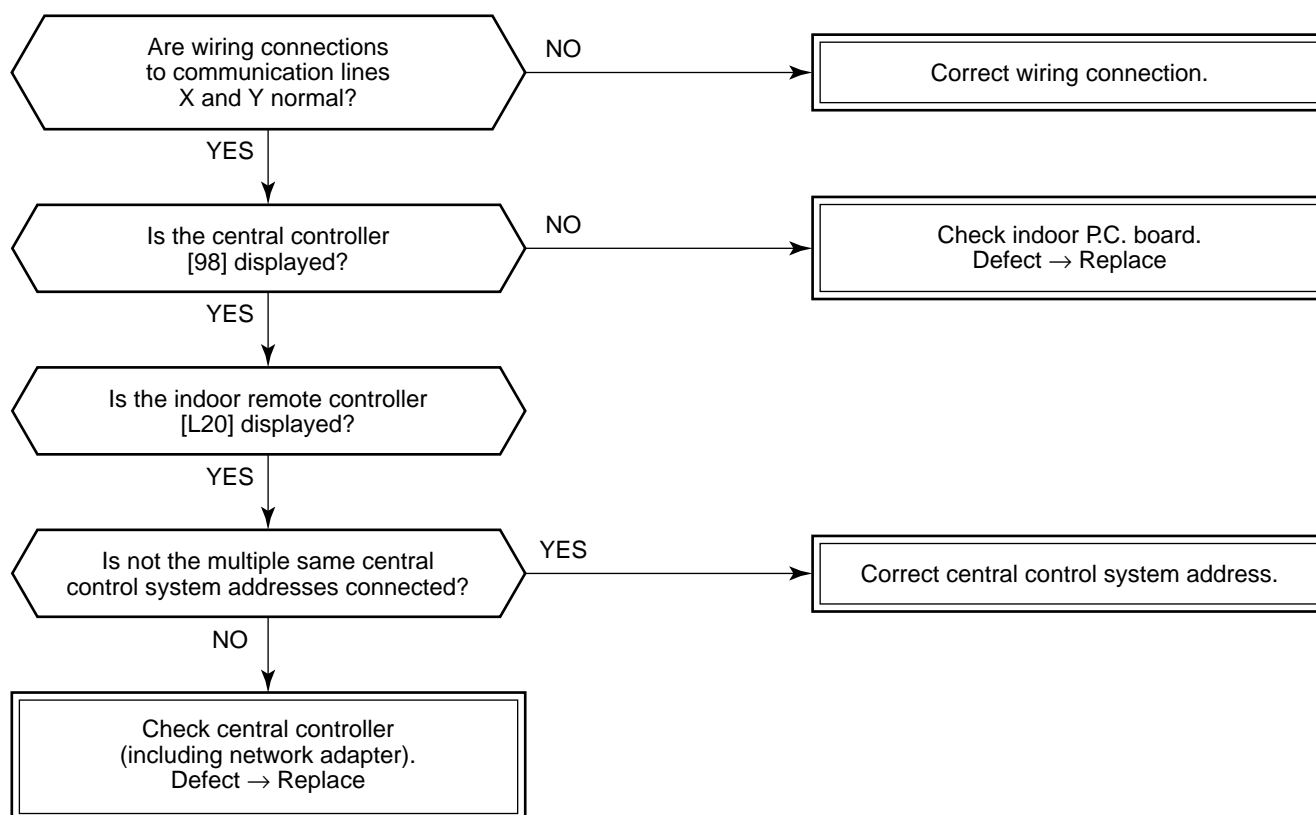
If the above error is detected when power supply turned on, the mode enters automatically in the automatic address set mode. (Check code is not output.)

However, if the above error is detected during the automatic address set mode, a check code may be output.

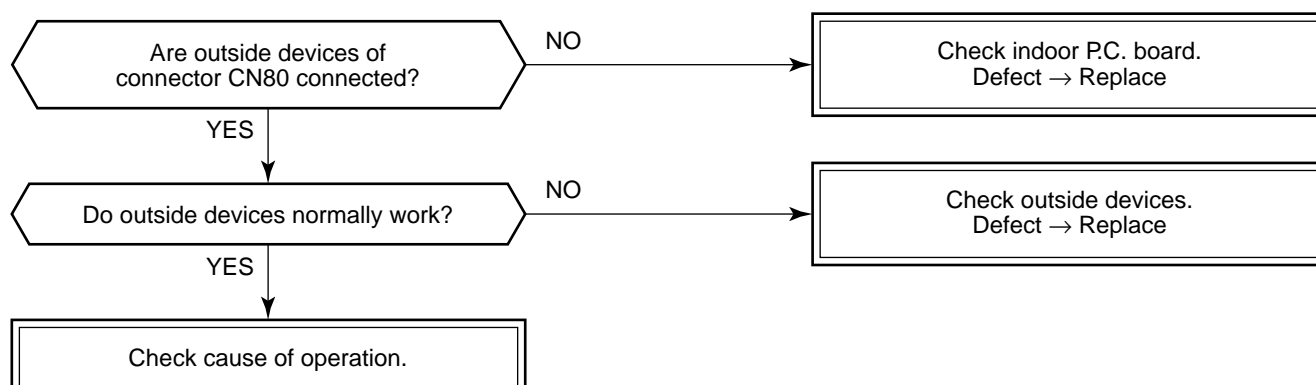
[L09 error]



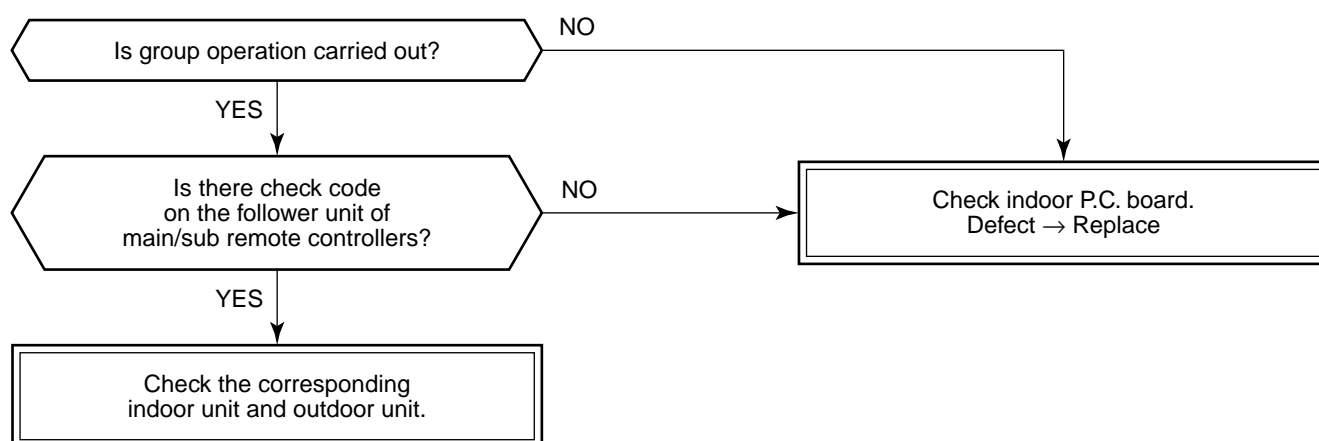
[L20 error]



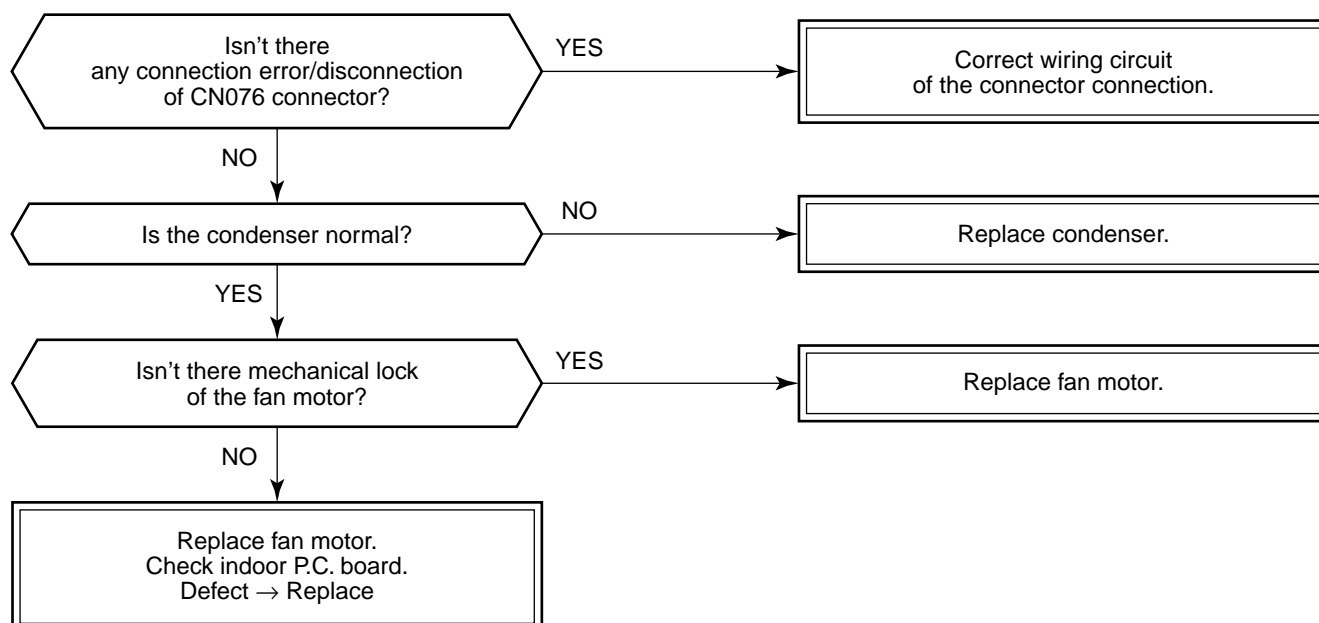
[L30 error]



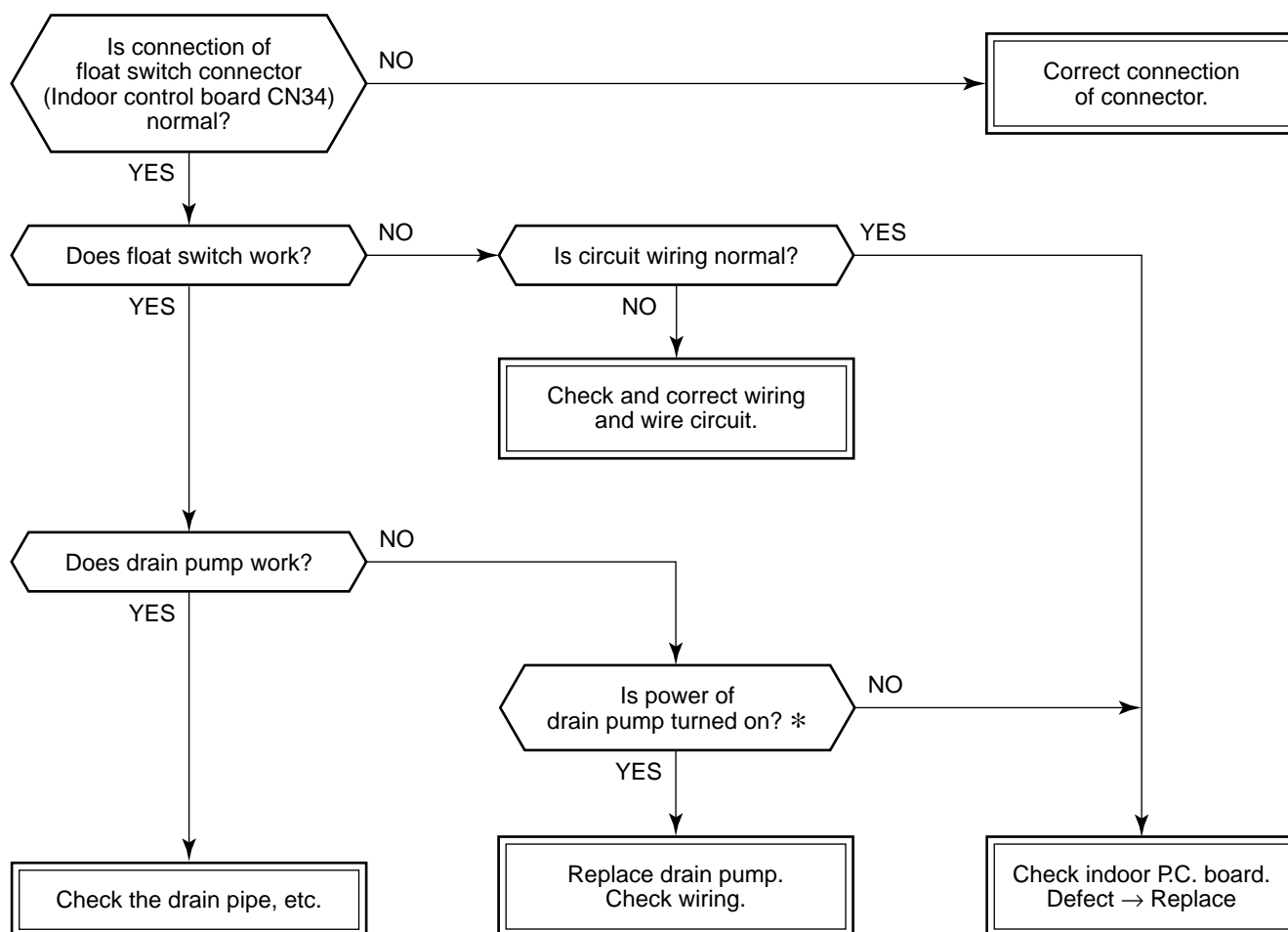
[b7 error] (Central controller)



[P01 error]

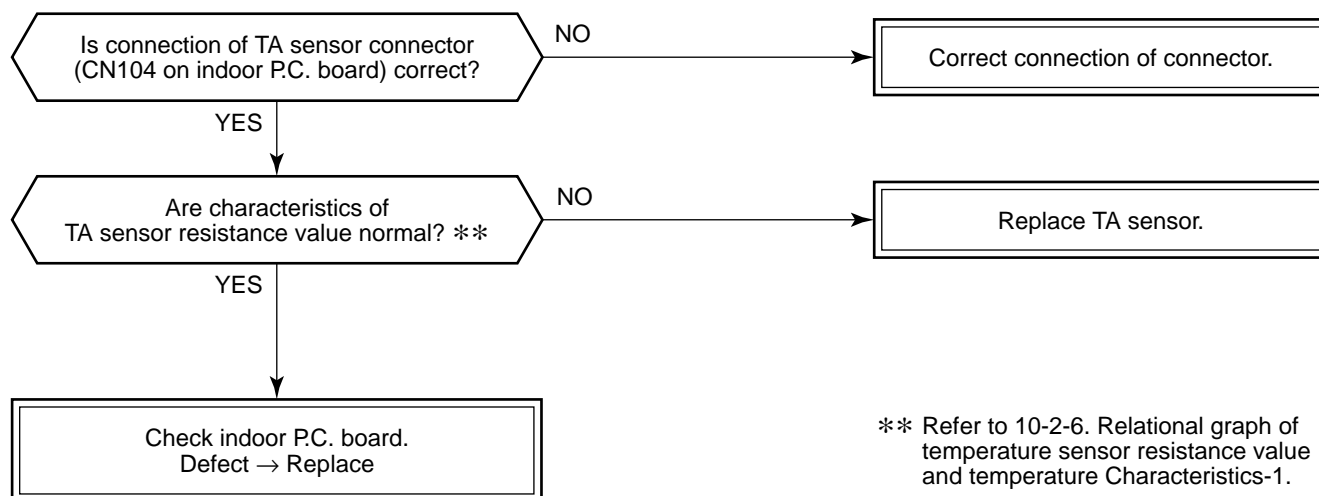


[P10 error]



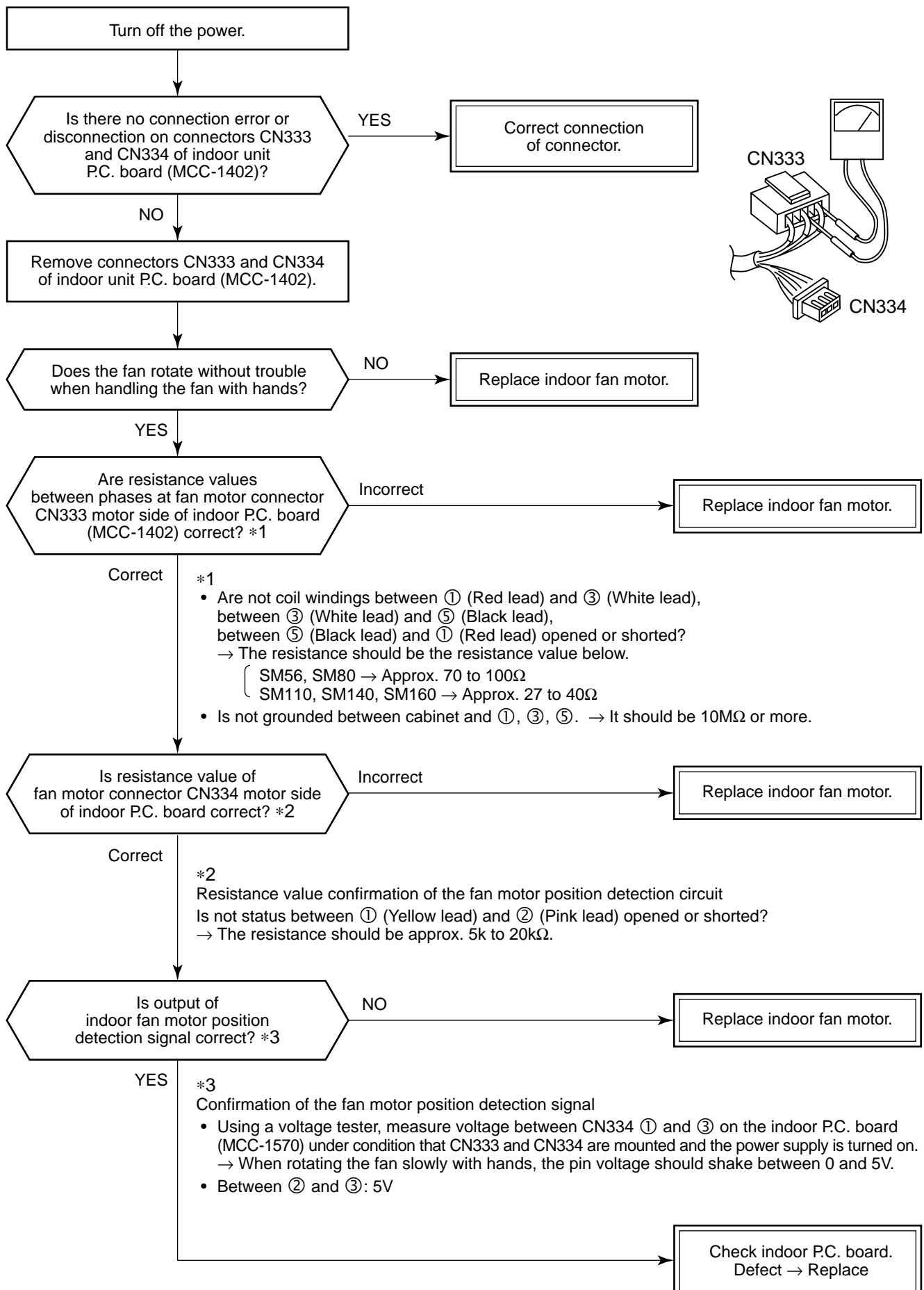
* Check that voltage of 1-3 pin of CN68 on the indoor P.C. board is +200V.

[F10 error]

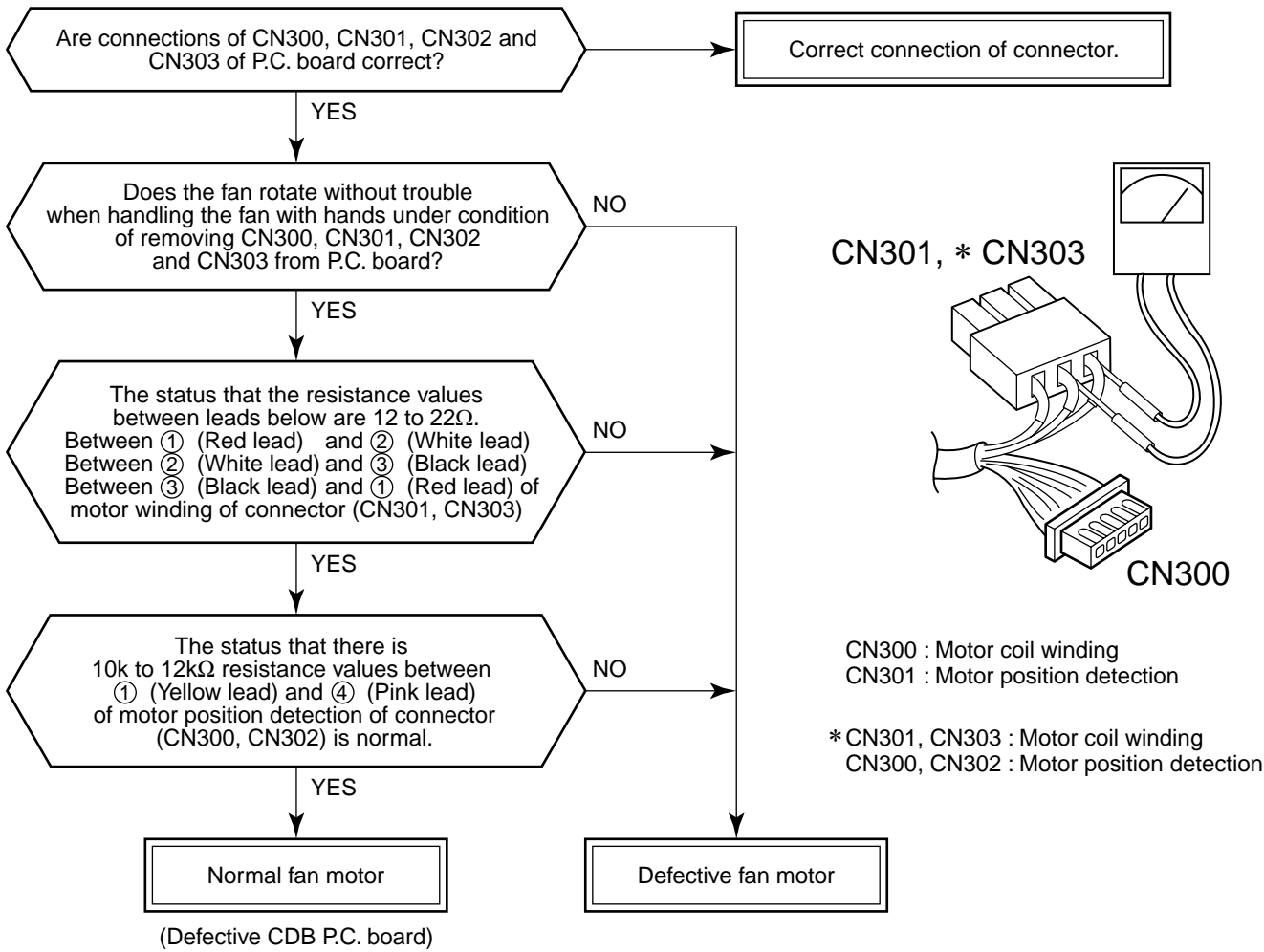


** Refer to 10-2-6. Relational graph of temperature sensor resistance value and temperature Characteristics-1.

[P12 error]



[P22 error]

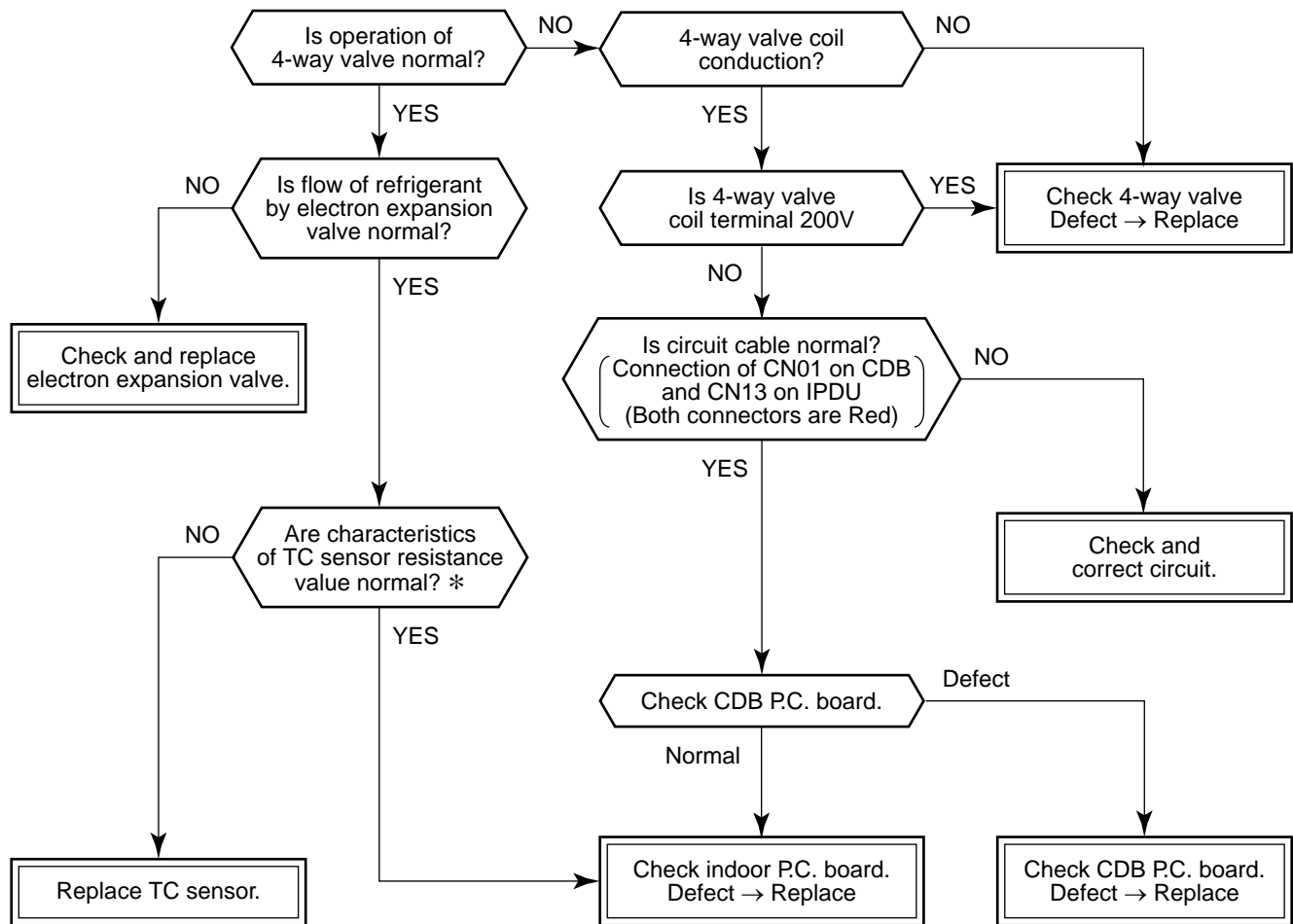


NOTE :

However, GND circuit error inside of the motor is rarely detected even if the above check is carried out.
When the circuit does not become normal even if P.C. board has been replaced, replace outdoor fan motor.

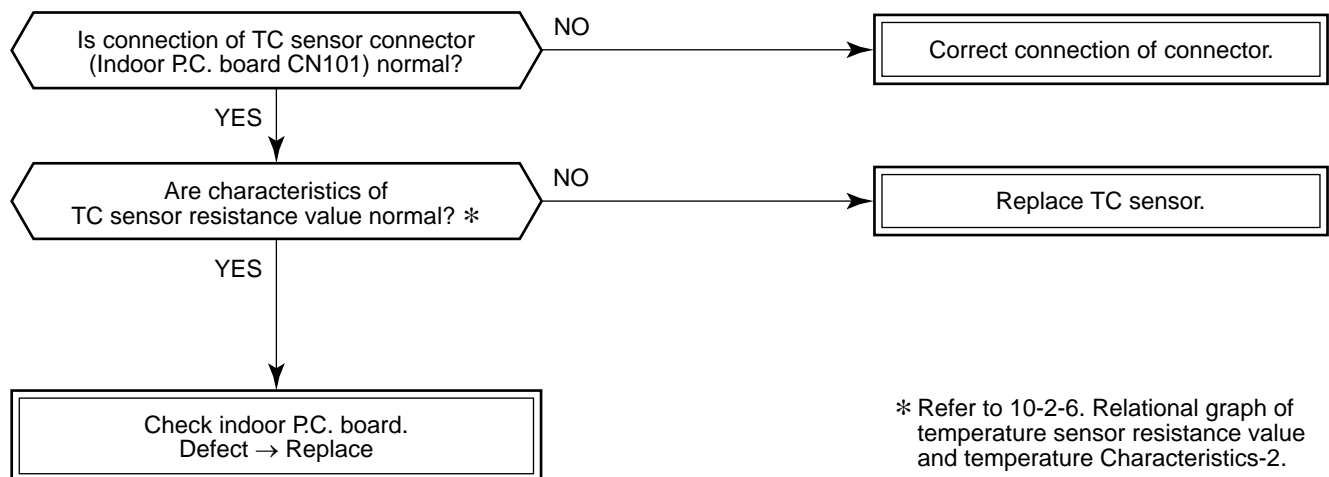
	RAV-SM160AT-E
Objective P.C. board	CDB P.C. board (MCC-1531)
Fan motor winding	CN301/CN303
Motor position detection	CN300/CN302
Fan motor model	ICF-280-100
Motor winding resistance	12 to 22 Ω

[P19 error]



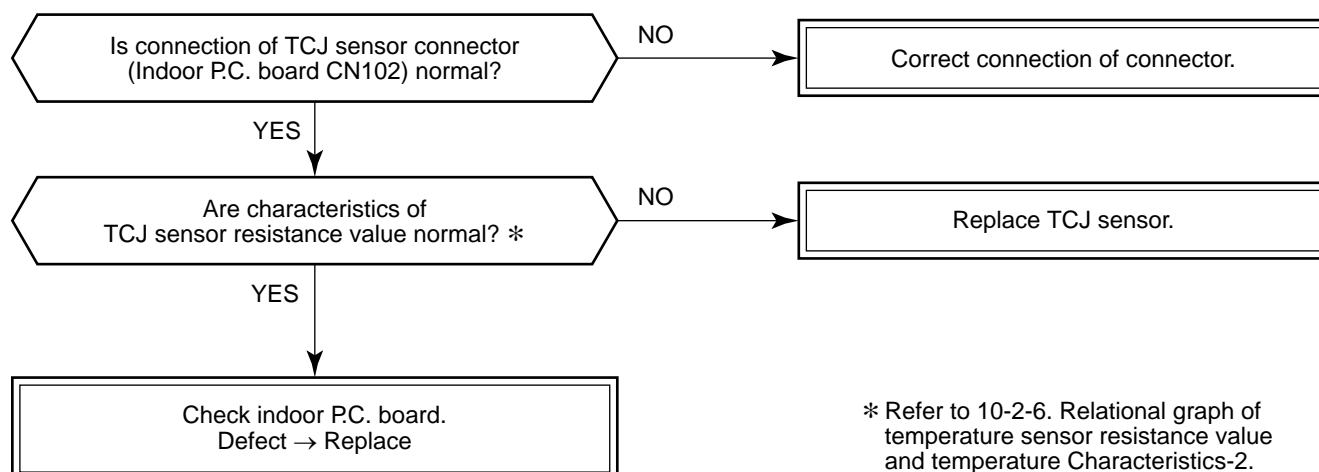
- In cooling operation, if high pressure is abnormally raised, [P19 error]/[08 error] may be displayed. In this case, remove cause of pressure up and then check again referring to the item [P04 error]/[21 error].

[F02 error]

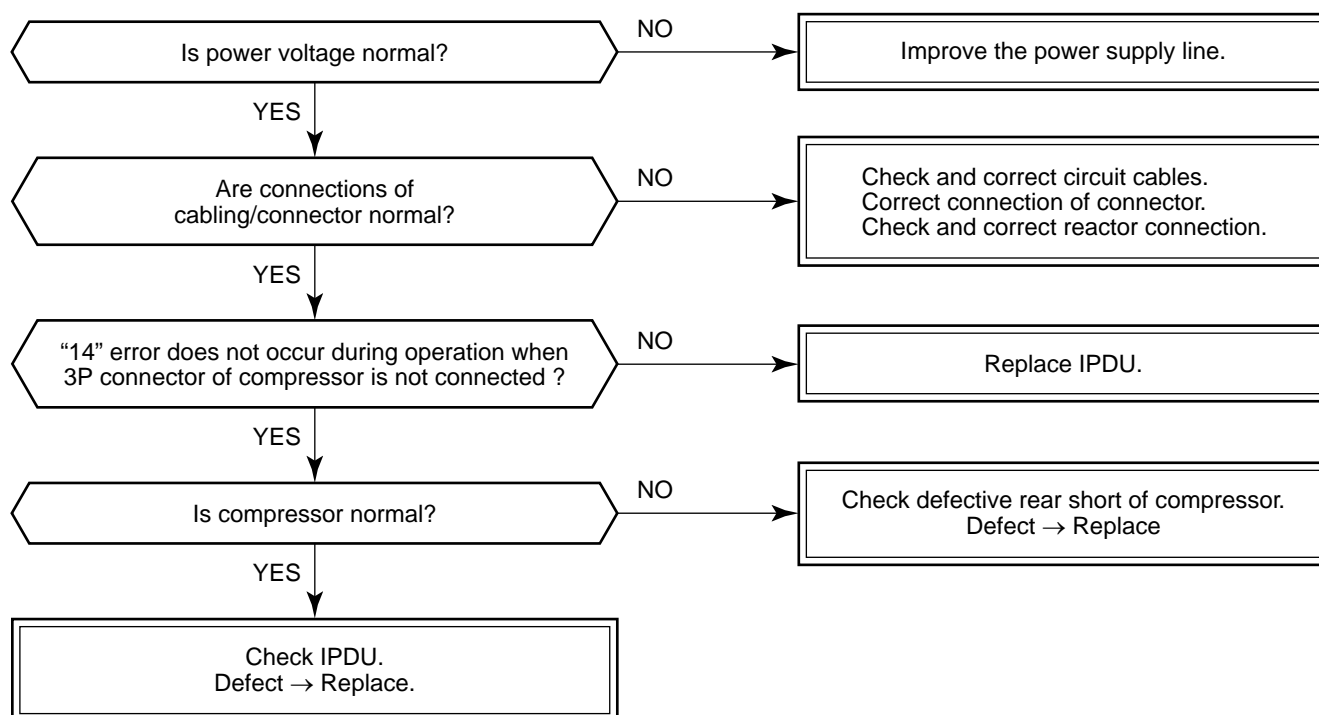


* Refer to 10-2-6. Relational graph of temperature sensor resistance value and temperature Characteristics-2.

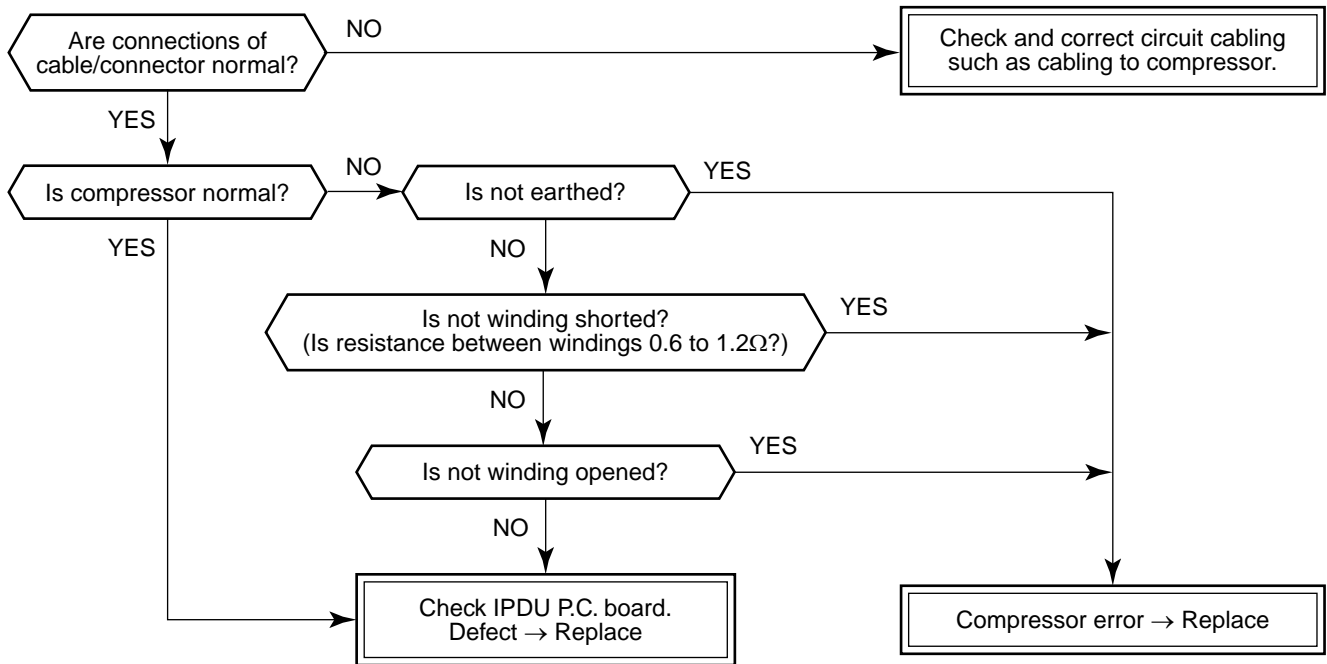
[F01 error]



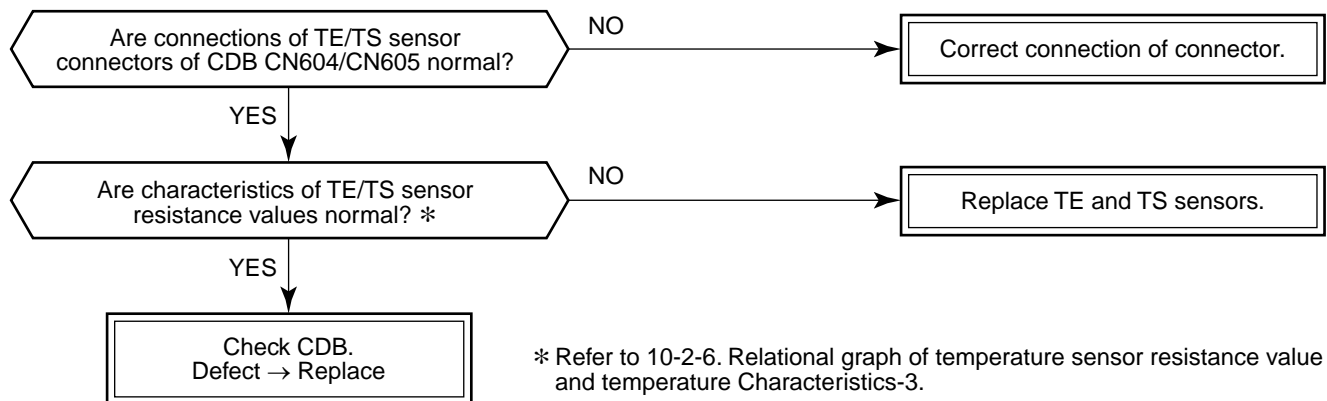
[P26 error]



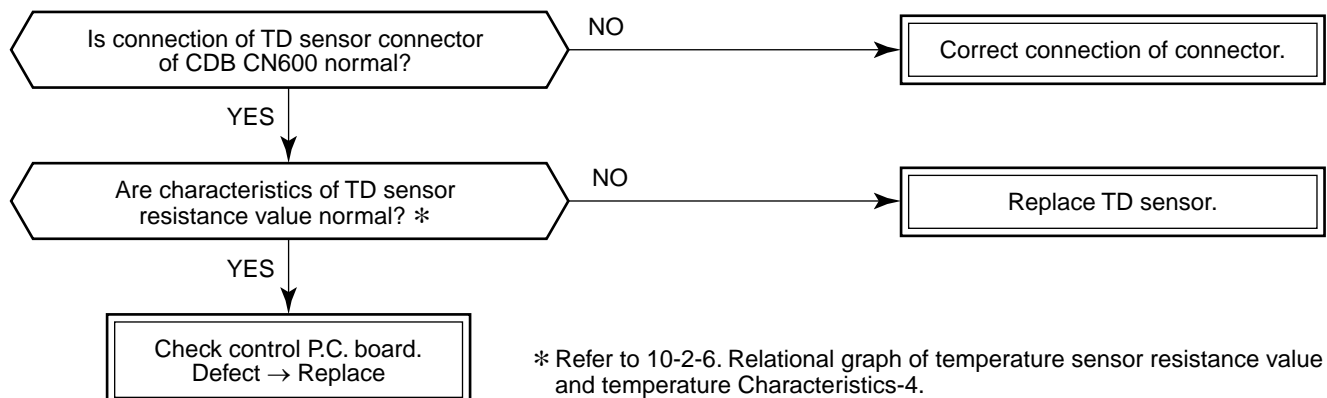
[P29 error]



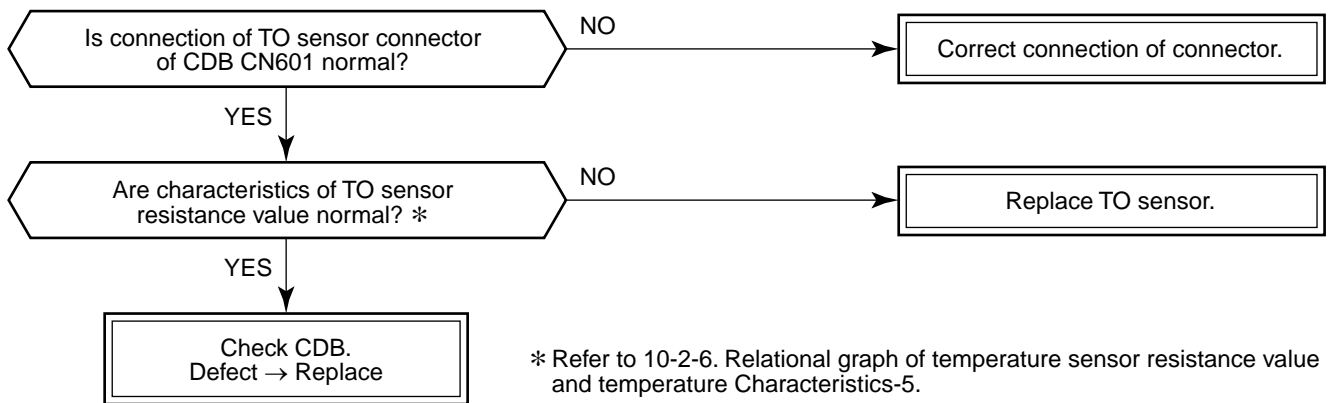
[F06 error]



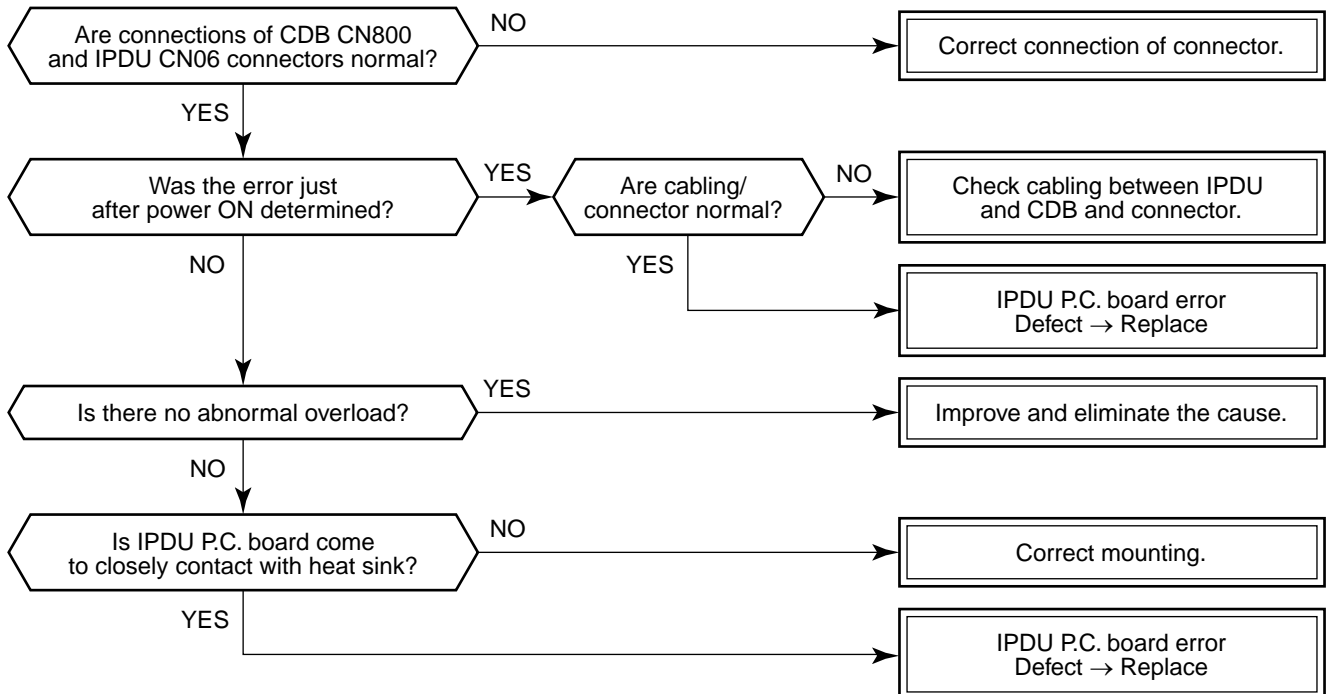
[P04 error]



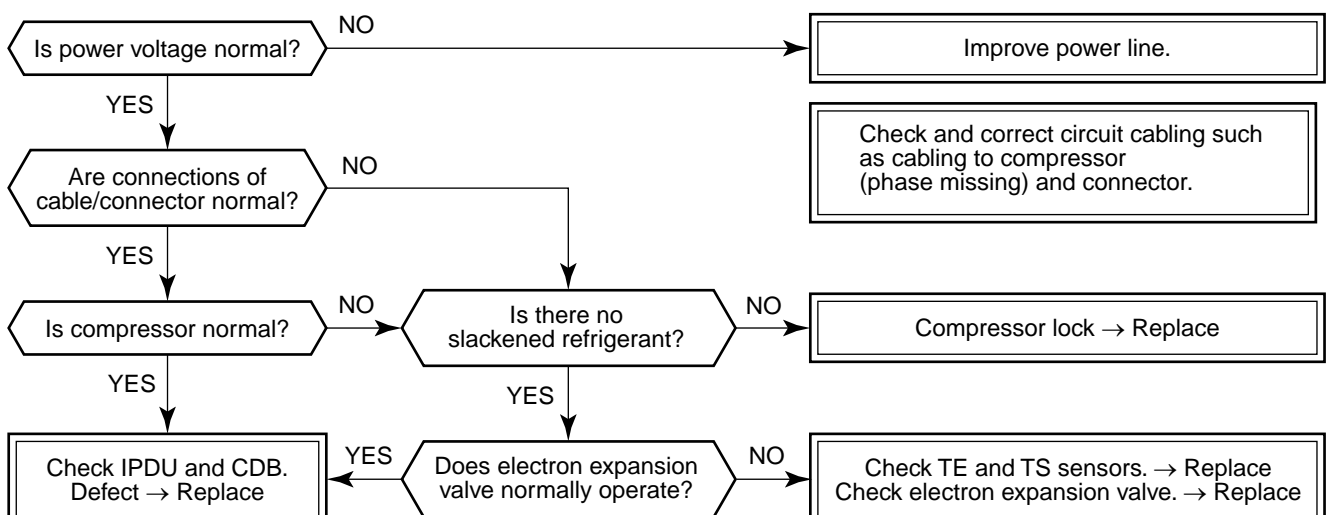
[F08 error]



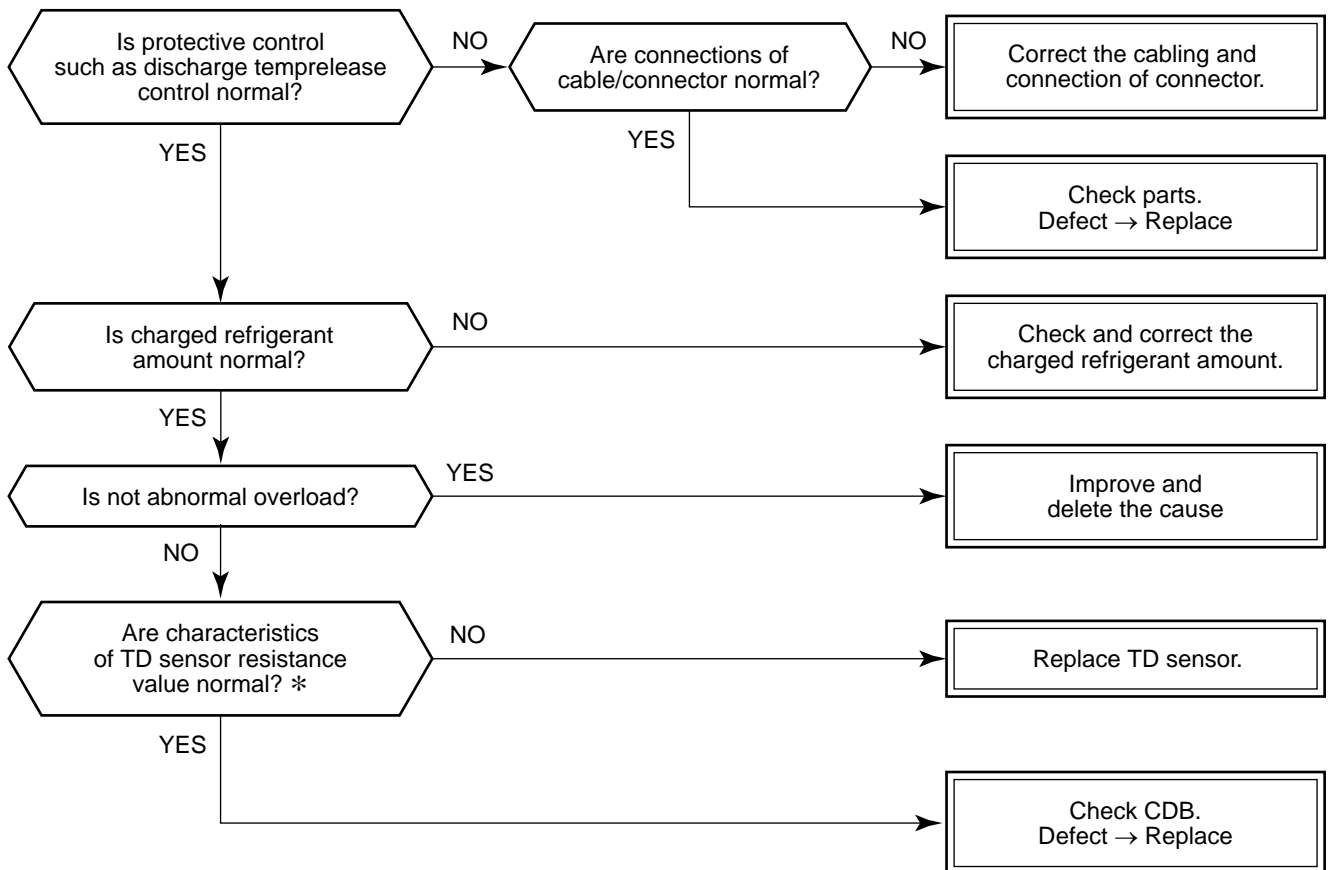
[L29 error]



[H02 error]

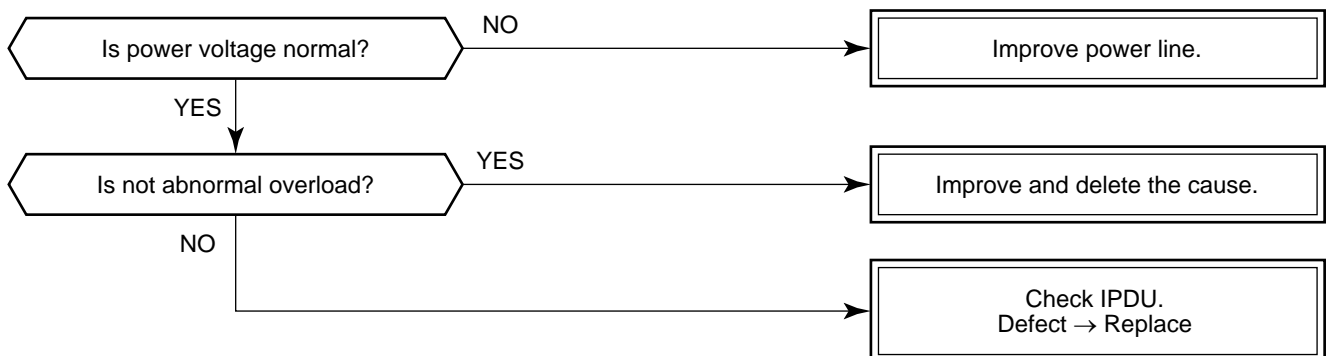


[P03 error]

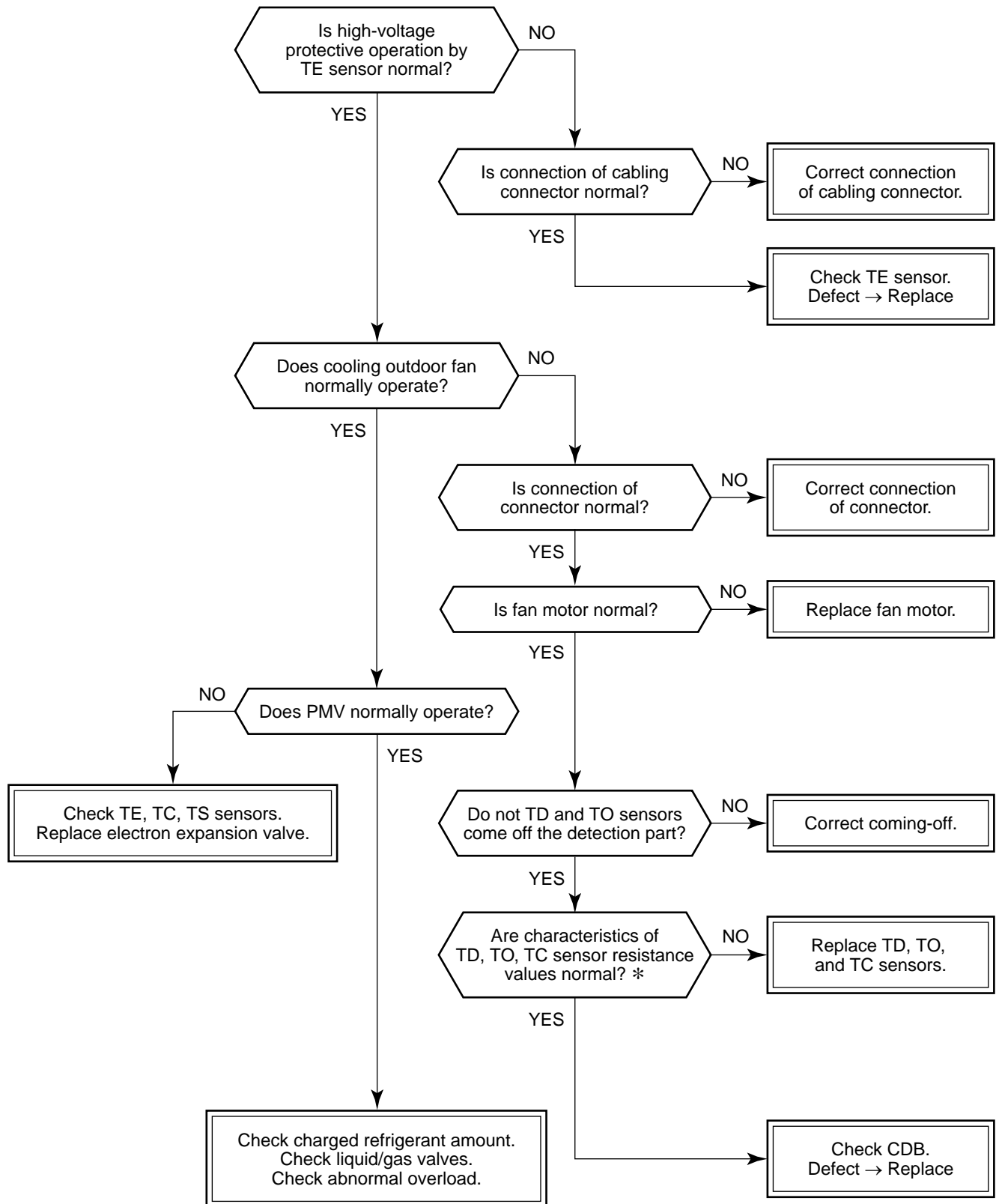


* Refer to 10-2-6. Relational graph of temperature sensor resistance value and temperature Characteristics-4.

[H01 error]

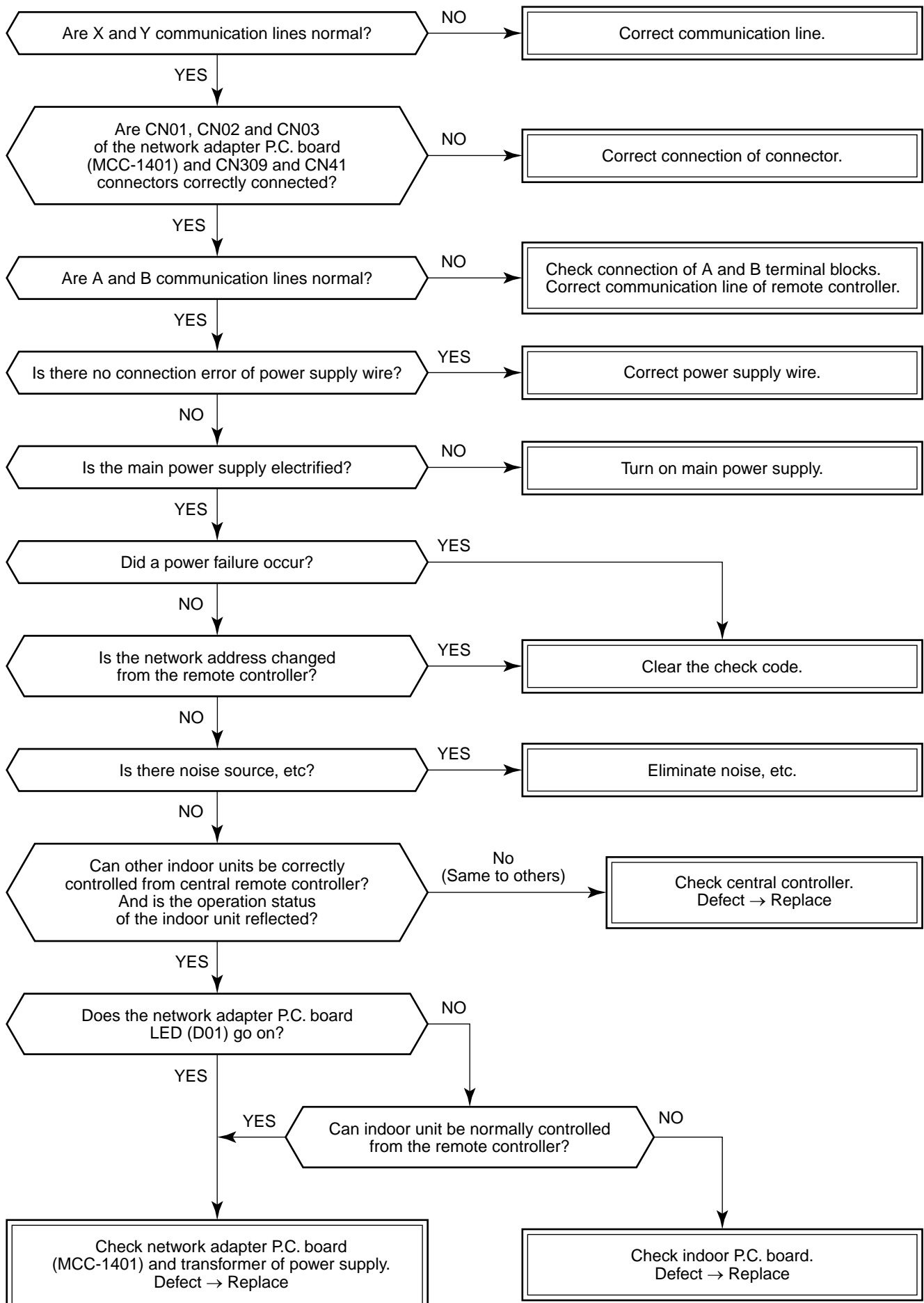


[P04 error]



* Refer to 10-2-6. Relational graph of temperature sensor resistance value and temperature Characteristics-3, 4.

[97 error] (Central controller)



[E03 error] (Master indoor unit)

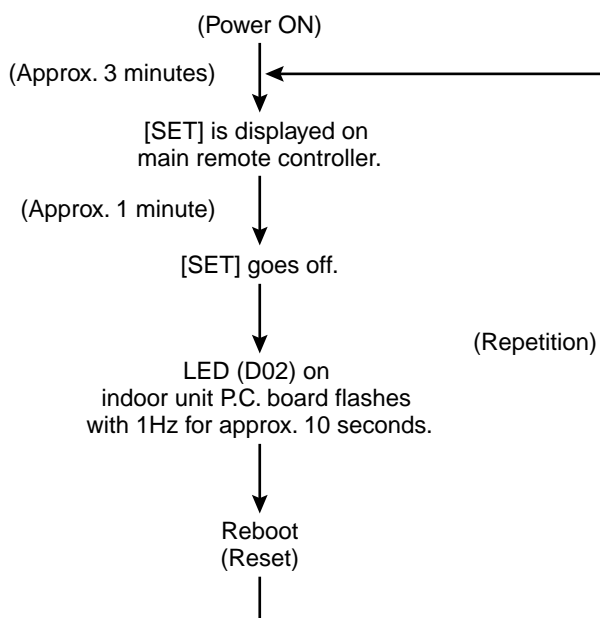
[E03 error] is detected when the indoor unit cannot receive a signal sent from the main remote controller (and central controller).

In this case, check the communication cables of the remote controllers A and B, the central control system X and Y. As communication is disabled, [E03] is not displayed on the main remote controller and the central controller. [E01] is displayed on the main remote controller and [97 error] on the central controller, respectively. If [E03] occurs during an operation, the air conditioner stops.

[F29 error] / [12 error]

[F29 error] or [12 error] indicates detection of trouble which occurred on IC10 non-volatile memory (EEPROM) on the indoor unit P.C. board during operation of the air conditioner. Replace the service P.C. board.

* If EEPROM has not been inserted when the power was turned on or if EEPROM data never be read/written, the automatic address mode is repeated. In this time, the central controller displays [97 error].



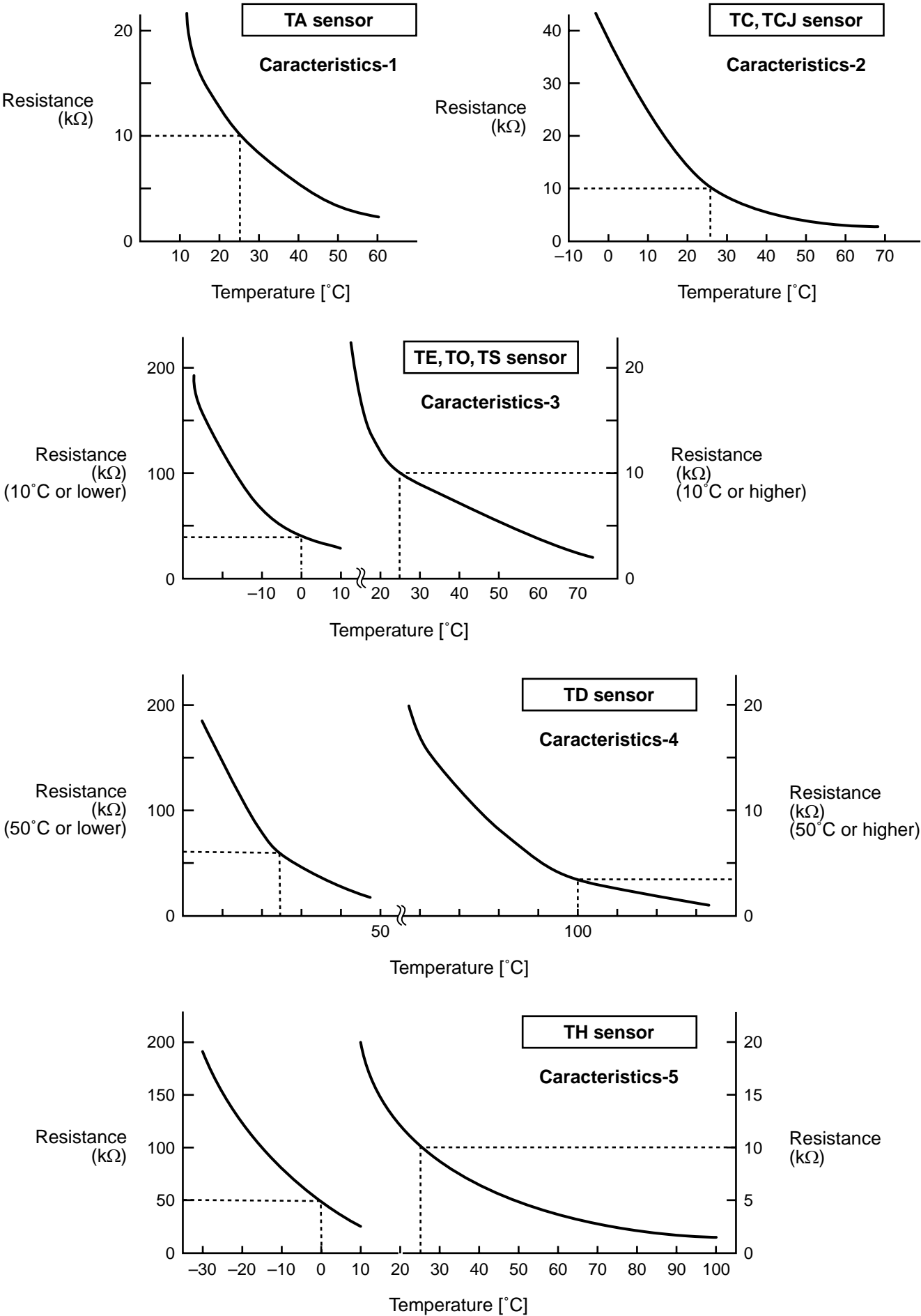
[P31 error] (Sub indoor unit)

When the master unit of a group operation has detected [E03], [L03], [L07], or [L08] error, the sub unit of the group operation detects [P31 error] and then it stops.

There is no display of the check code or alarm history of the main remote controller.

(In this model, the mode enters in automatic address set mode when the master unit has detected [E03], [L03], [L07], or [L08] error.)

10-2-6. Relational Graph of Temperature Sensor Resistance Value and Temperature



11. REPLACEMENT OF SERVICE P.C. BOARD

11-1. Indoort Unit

<Note: when replacing the P.C. board for indoor unit servicing>

The nonvolatile memory (hereafter called EEPROM, IC503) on the indoor unit P.C. board before replacement includes the model specific type information and capacity codes as the factory-set value and the important setting data which have been automatically or manually set when the indoor unit is installed, such as system/indoor/group addresses, high ceiling select setting, etc.

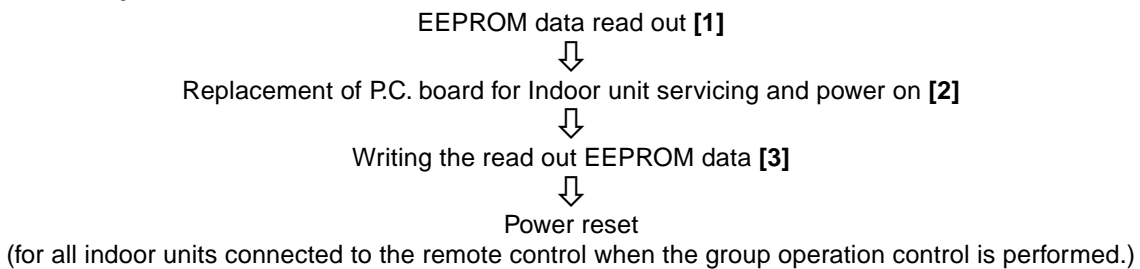
When replacing the P.C. board for indoor unit servicing, follow the procedures below.

After replacement completes, confirm whether the settings are correct by checking the indoor unit No., Group master unit / sub unit settings and perform the cooling cycle confirmation through the trial operation.

<Replacement procedures>

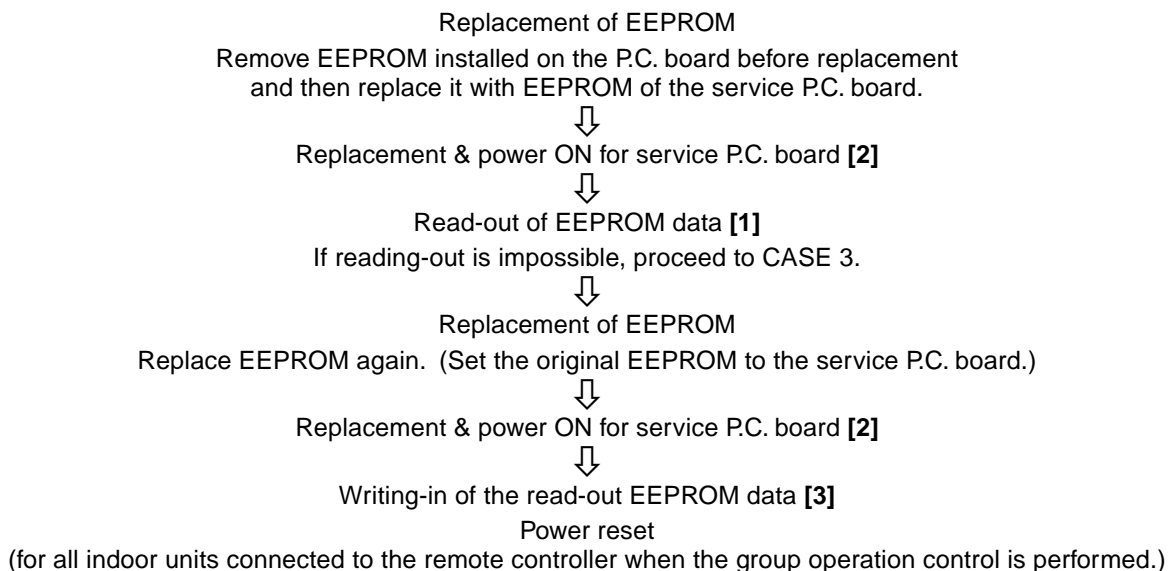
CASE 1

Before replacement, the indoor unit can be turned on and the setting data can be read out by wired remote control operation.



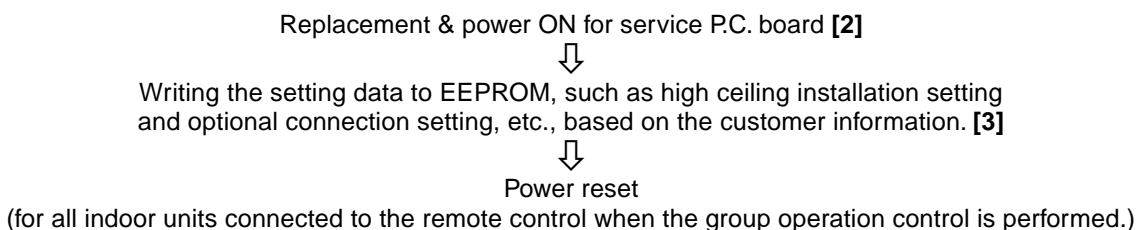
CASE 2

Before replacement, the indoor unit cannot be turned on or the wired remote controller operation is impossible due to trouble of the power supply circuit to the remote controller. (Defective P.C. board)












CASE 3

The EEPROM before replacement is defective and the setting data cannot be read out.



[1] Setting data read out from EEPROM

The setting data modified on the site, other than factory-set value, stored in the EEPROM shall be read out.




- Step 1** Push ,  and  button on the remote controller simultaneously for more than 4 seconds.
- * When the group operation control is performed, the unit No. displayed for the first time is the header unit No. At this time, the CODE No. (DN) shows "10". Also, the fan of the indoor unit selected starts its operation and the swing operation also starts if it has the louvers.
- Step 2** Every time when the  button is pushed, the indoor unit No. under the group control is displayed in order. Specify the indoor unit No. to be replaced.
- 1. Change the CODE No. (DN) to 10 → 01 by pushing  /  buttons for the temperature setting. (this is the setting for the filter sign lighting time.)**
At this time, be sure to write down the setting data displayed.
 - Change the CODE No. (DN) by pushing  /  buttons for the temperature setting.
Similarly, be sure to write down the setting data displayed.
 - Repeat the step 2-2 to set the other settings in the same way and write down the setting data as shown in the table 1 (example).
- * The CODE No. (DN) are ranged from "01" to "FF". The CODE No. (DN) may skip.
- Step 3** After writing down all setting data, push  button to return to the normal stop status.
(It takes approx. 1 min until the remote controller operation is available again.)

CODE No. required at least

DN	Contents
10	Type
11	Indoor unit capacity
12	System address
13	Indoor unit address
14	Group address

1. The CODE No. for the Indoor unit type and Indoor unit capacity are required to set the rotation number setting of the fan.
2. If the system/indoor/group addresses are different from those before replacement, the auto-address setting mode starts and the manual resetting may be required again.
(when the multiple units group operation including twin system.)

[2] P.C. Board for indoor unit servicing replacement procedures

- Step 1** Replace the P.C. board to the P.C. board for indoor unit servicing.
On the new P.C. board, set the same setting of the jumper wire and setting of shortcut connection connector as those of the P.C. board before replacement.
- Step 2** According to the system configuration, turn on the indoor unit following to the either methods shown below.
- a) Single operation (Indoor unit is used as standalone.)
Turn on the indoor unit.
 1. After completion of the auto-address setting mode (required time: approx. 5 min.), proceed to [3].
(System address = 1, Indoor unit address = 1, Group address = 0 (standalone) are automatically set.)
 2. Push ,  and  buttons simultaneously for more than 4 seconds to interrupt the auto-address setting mode, and proceed to [3]. (The unit No. "ALL" is displayed.)
 - b) Group operation (including twin system)
Turn on the indoor unit(s) with its P.C. board replaced to the P.C. board for indoor unit servicing, according to either methods 1 or 2 shown below.
 1. Turn on only the indoor unit with its P.C. board replaced. (Be sure to confirm the remote controller is surely connected. If not, the operation [3] cannot be performed.)
Perform either methods 1 or 2 described in item a) above.
 2. Turn on the multiple indoor units including the indoor unit with its P.C. board replaced.
 - Twin 1 system only
 - All group connections

After completion of the auto-address setting mode (required time: approx. 5 min.), proceed to [3].

- * The header unit of the group may be changed by performing the auto-address setting.
Also, the system address/Indoor unit address of the indoor unit with its P.C. board replaced may be assigned to the addresses (not used) other than those of the indoor units without its P.C. board replaced.
It is recommended to keep the information in advance, which cooling system the indoor unit belongs to or whether the indoor unit works as the header unit or the follower unit in the group control operation.

[3] Writing the setting data to EEPROM

The settings stored in the EEPROM of the P.C. board for indoor unit servicing are the factory-set values.

- Step 1** Push , and buttons on the remote controller simultaneously for more than 4 seconds.
 * In the group control operation, the unit No. displayed for the first time is the header unit No.
 At this time, the CODE No. (DN) shows “/0”. Also, the fan of the indoor unit selected starts its operation and the swing operation starts if it has the louvers.
 (The unit No. “ALL” is displayed if the auto-address setting mode is interrupted in [2] step 2 a))
- Step 2** Every time when button is pushed, the indoor unit No. in the group control operation are displayed in order.
 (The settings stored in the EEPROM of the P.C. board for indoor unit servicing are the factory-set values.)
 Specify the indoor unit No. with its P.C. board replaced to the P.C. board for indoor unit servicing.
 (You cannot perform this operation if “ALL” is displayed.)
- Step 3** Select the CODE No. (DN) can be selected by pushing the / button for the temperature setting.
 • Set the indoor unit type and capacity.
 The factory-set values shall be written to the EEPROM by changing the type and capacity.
 1. Set the CODE No. (DN) to “/0”. (without change)
 2. Select the type by pushing / buttons for the timer setting.
 (For example, 4-way Air Discharge Cassette Type is set to “0001”. Refer to table 2)
 3. Push button.
 (The operation completes if the setting data is displayed.)
 4. Change the CODE No. (DN) to “//” by pushing / buttons for the temperature setting.
 5. Select the capacity by pushing / buttons for the timer setting.
 (For example, 80 Type is set to “0012”. Refer to table 3)
 6. Push button.
 (The setting completes if the setting data are displayed.)
 7. Return to the normal stop status by pushing button.
 (Approx. 1 minute is needed to start operation of the remote controller.)
- Step 4** Write the on-site setting data to the EEPROM, such as address setting, etc. Perform the steps 1 and 2 above again.
- Step 5** Change the CODE No. (DN) to “/1” by pushing / buttons for the temperature setting.
 (this is the setting for the filter sign lighting time.)
- Step 6** Check the setting data displayed at this time with the setting data put down in [1].
 1. If the setting data is different, modify the setting data by pushing / buttons for the timer setting to the data put down in [1].
 The operation completes if the setting data is displayed.
 2. If the data is the same, proceed to next step.
- Step 7** Change the CODE No. (DN) by pushing / buttons for the temperature setting.
 As described above, check the setting data and modify to the data put down in [1].
- Step 8** Repeat the steps 6 and 7.
- Step 9** After the setting completes, push button to return to the normal stop status. (It takes approx. 1 min until the remote control operation is available again.)
 * The CODE No. (DN) are ranged from “/1” to “FF”.
 The CODE No. (DN) is not limited to be serial No.
 Even after modifying the data wrongly and pushing button, it is possible to return to the data before modification by pushing button if the CODE No. (DN) is not changed.

<Fig. 1 RBC-AMT32E>

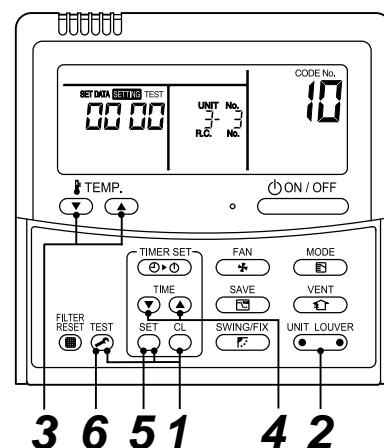


Table 1

DN	Item	Setting data	Factory-set value
01	Filter sign lighting time		Depending on Type
02	Filter pollution leve		0000: standard
03	Central control address		0099: Not determined
06	Heating suction temperature shift		0002: +2°C (flooring installation type: 0)
OF	Cooling only		0000: Heat pump
10	Type		Depending on model type
11	Indoor unit capacity		Depending on capacity type
12	System address		0099: Not determined
13	Indoor unit address		0099: Not determined
14	Group address		0099: Not determined
1E	Temperature range of cooling/heating automatic SW control point		0003: 3 deg (Ts ± 1.5)
28	Power failure automatic recovery		0000: None
2b	Thermo output SW (T10 ③)		0000: Thermo ON
31	Ventilation fan (standalone)		0000: Not available
32	Sensor SW (Selection of static pressure)		0000: Body sensor
40	Humidifier control (+ drain pump control)		0003: Humidifier ON + Pump OFF
60	Timer setting (wired remote controller)		0000: Available

Table 2. Type: CODE No. 10

Setting data	Type	Type name abb.
0023	Concealed Duct High Static Type	RAV-SM***DT-A

Table 3. Indoor unit capacity: CODE No. 11

Setting data	Type
0000*	Disable
0015	110
0017	140
0018	160



* EEPROM initial value on the P.C. board for indoor unit servicing.


12. SETUP AT LOCAL SITE AND OTHERS

12-1. Indoor Unit

12-1-1. Test Run Setup on Remote Controller




<Wired remote controller>


1. When pushing  button on the remote controller for 4 seconds or more, "TEST" is displayed on LC display. Then push  button.
 - "TEST" is displayed on LC display during operation of Test Run.
 - During Test Run, temperature cannot be adjusted but air volume can be selected.
 - In heating and cooling operation, a command to fix the Test Run frequency is output.
 - Detection of error is performed as usual. However, do not use this function except case of Test Run because it applies load on the unit.
2. Use either heating or cooling operation mode for [TEST].





NOTE : The outdoor unit does not operate after power has been turned on or for approx. 3 minutes after operation has stopped.
3. After a Test Run has finished, push  button again and check that [TEST] on LC display has gone off. (To prevent a continuous test run operation, 60-minutes timer release function is provided to this remote controller.)

12-1-2. Forced Defrost Setup of Remote Controller (For wired remote controller only)

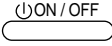
(Preparation in advance)

- 1 Push  +  +  buttons simultaneously for 4 seconds or more on the remote controller. (Push buttons while the air conditioner stops.)**

The first displayed unit No. is the master indoor unit address in the group control.
- 2 Every pushing  button, the indoor unit No. in the group control is displayed one after the other.**

Select a main indoor unit (outdoor unit is connected) which is to be defrosted. In this time, fan and louver of the selected indoor unit operate.
- 3 Using the set temperature  buttons, specify the item code (DN) 8C.**
- 4 Using the timer time  buttons, set time to data 0001. (0000 at shipment)**
- 5 Push  button. (OK if indication lights)**
- 6 Pushing  button returns the status to the normal stop status.**

(Practical operation)

- Push ON/OFF  Key.
- Select the HEAT mode.
- After while, the forced defrost signal is sent to the outdoor unit and then the outdoor unit starts defrost operation. (The forced defrost operation is performed for Max. 12 minutes.)
- After defrost operation finished, the operation returns to the heating operation.

To execute the defrost operation again, start procedure from above item 1.

(If the forced defrost operation was executed once, setting of the above forced defrost operation is cleared.)

12-1-3. LED Display on P.C. Board

1. D02 (Red)

- Goes on at the same time when power was turned on (Main microcomputer operates and goes on.)
- Flashes with 1-second interval (every 500ms): When EEPROM is not provided or writing was an error.
- Flashes with 10-seconds interval (every 5S): When the mode is DISP

2. D203 (Red)

- Goes on when power is supplied to remote controller (Lights on the hardware)

12-1-4. Function Selection Setup

<Procedure> Perform setting while the air conditioner stops.

1 Push **TEST** + **SET** + **CL** buttons simultaneously for 4 seconds or more.

The first displayed unit No. is the master indoor unit address in the group control.

In this time, fan and louver of the selected indoor unit operate.



2 Every pushing **UNIT LOUVER** button (button at left side), the indoor unit No. in the group control is displayed one after the other. In this time, fan and louver of the selected indoor unit only operate.



3 Using the set temperature **TEMP.** buttons, specify the item code (DN).



4 Using the timer time **TIME** buttons, select the set data.

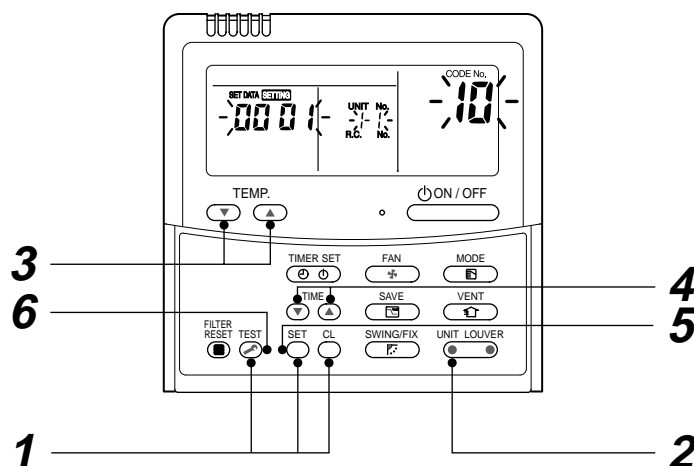


5 Push **SET** button. (OK if indication lights)

- To change the selected indoor unit, proceed to Procedure **2**.
- To change item to be set up, proceed to Procedure **3**.



6 Pushing **TEST** button returns the status to the normal stop status.



<Operation procedure>

1 → 2 → 3 → 4 → 5 → 6 END

Function selection item No. (DN) list

DN	Item	Contents	At shipment from factory
01	Filter sign lighting time	0000:None 0002:2500H 0004:10000H 0001: 150H 0003: 5000H 0005: Clogging sensor used	According to type
03	Central control address	0001:No.1 unit to 0064: No.64 unit 0099:Undecided	0099:Undecided
06	Heating suction temp. shift	0000:No shift to 0001: +1°C 0002:+2°C to 0010: +10°C (Up to +6 is recommended.)	0002:+2°C (Floor type 0000: 0°C)
10	Type	0000:(1-way air discharge cassette) 0001:(4-way air discharge cassette) to 0037	According to model type
11	Indoor unit capacity	0000:Undecided 0001 to 0034	According to capacity type
12	Line address	0001:No.1 unit to 0030: No.30 unit	0099:Undecided
13	Indoor unit address	0001:No.1 unit to 0064: No.64 unit	0099:Undecided
14	Group address	0000:Individual 0001: Master unit in group 0002:Follower unit in group	0099:Undecided
1E	In automatic cooling/heating, temp. width of cool → heat, heat → cool mode selection control point	0000:0 deg to 0010: 10 deg (Cool/heat are reversed with ± (Data value) / 2 against the set temperature)	0003:3 deg (Ts±1.5)
28	Automatic reset of power failure	0000:None 0001: Provided	0000:None
2A	Selection of option / error input (CN70)	0000:Filter input 0001:Alarm input (Air cleaner, etc.) 0002:Humidifier input	0002:Humidifier
2b	Selection of thermostat output (T10 ③)	0000:Indoor thermostat ON 0001:ON receiving output of outdoor compressor	0000:Thermostat ON
31	Fan (Single operation)	0000:Impossible 0001: Possible	0000:Impossible
32	Sensor selection	0000: Body TA sensor 0001: Remote controller sensor	0000:Body sensor
40	Humidifier control (+Drain pump control) (This function is not provided.)	0000:No control 0001:Humidifier + Vaporizing type (Pump ON) 0002:Humidifier + Supersonic type (Pump ON when specified time elapsed) 0003:Humidifier + Natural drain type (Pump OFF)	0003:Humidifier ON Pump OFF
60	Timer setting (Wired remote controller)	0000:Operable 0001:Operation prohibited	0000:Operable
C2	Current demand X% to outdoor unit	0050:50% to 0100: 100%	0075:75%
D0	Existence of remote controller save function	0000:Invalid (Impossible) 0001: Valid (Possible)	0001:Valid (Possible)

* Restriction ratio setting for save operation (DN code No. [C2]) can be set/changed from the normal DN setup (Detail DN setup).

12-1-5. Wiring and Setting of Remote Controller Control

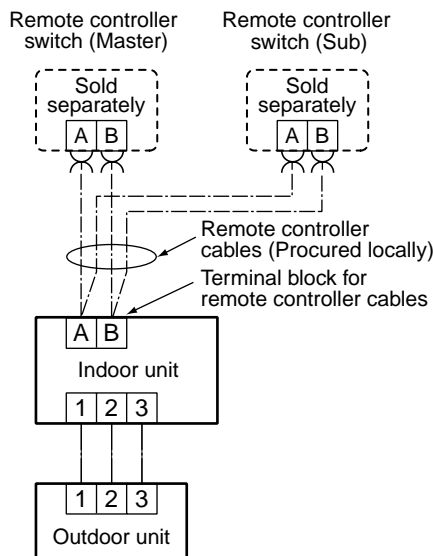
2-remote controller control

(Controlled by 2 remote controllers)

This control is to operate 1 or multiple indoor units are operated by 2 remote controllers.

(Max. 2 remote controllers are connectable.)

- When connected 2 remote controllers operate an indoor unit



(Setup method)

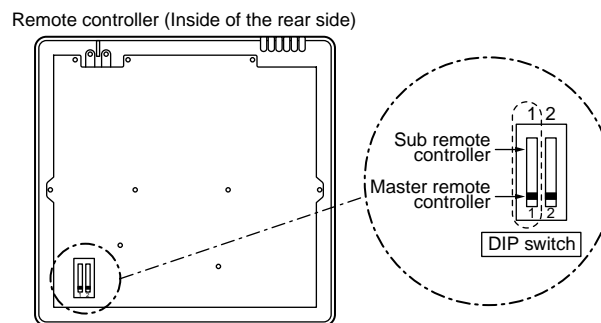
One or multiple indoor units are controlled by 2 remote controllers.

(Max. 2 remote controllers are connectable.)

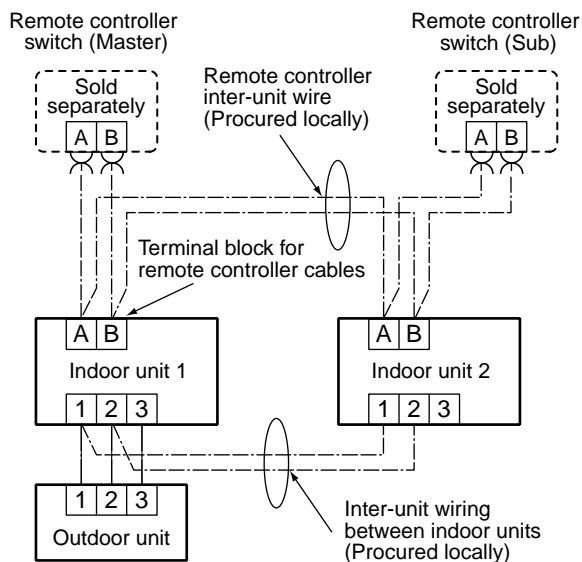
<Wired remote controller>

How to set wired remote controller as sub remote controller

Change DIP switch inside of the rear side of the remote controller switch from remote controller master to sub. (In case of RBC-AMT32E)



- When connected 2 remote controllers operate the twin



[Operation]

1. The operation contents can be changed by Last-push-priority.
2. Use a timer on either Master remote controller or Sub remote controller.

12-1-6. Monitor Function of Remote Controller Switch

■ Calling of sensor temperature display

<Contents>

Each data of the remote controller, indoor unit and outdoor unit can be understood by calling the service monitor mode from the remote controller.

<Procedure>

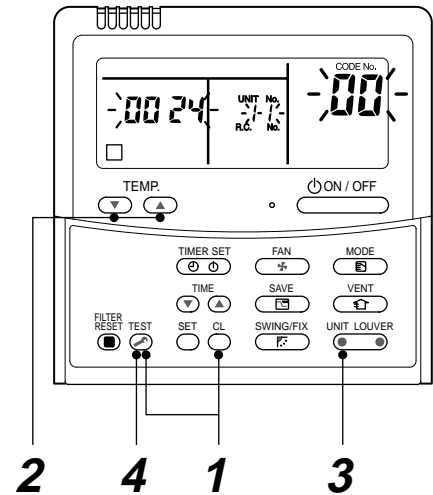
- 1 Push **TEST** + **CL** buttons simultaneously for 4 seconds to call the service monitor mode.

The service monitor goes on, the master indoor unit No. is displayed at first and then the temperature of item code **00** is displayed.



- 2 Push temperature set **TEMP.** buttons and then change the item code of data to be monitored.

The item code list is shown below.



<Operation procedure>

1 → 2 → 3 → 4

Returned to usual display

	Item code	Data name	Unit
Indoor unit data	01	Room temperature (Remote controller)	°C
	02	Indoor suction temperature (TA)	°C
	03	Indoor heat exchanger (Coil) temperature (TCJ)	°C
	04	Indoor heat exchanger (Coil) temperature (TC)	°C
	* 07	Indoor fan revolution frequency	rpm
	* F2	Indoor fan calculated operation time	×100h
	F3	Filter sign time	×1h
	* F8	Indoor discharge temperature*1	°C

	Item code	Data name	Unit
Outdoor unit data	60	Outdoor heat exchanger (Coil) temperature (TE)	°C
	61	Outside temperature (TO)	°C
	62	Compressor discharge temperature (TD)	°C
	63	Compressor suction temperature (TS)	°C
	65	Heat sink temperature (THS)	°C
	6A	Operation current (× 1/10)	A
	* 6D	Outdoor heat exchanger (Coil) temperature (TL)	°C
	* 70	Compressor operation frequency	rps
	* 72	Outdoor fan revolution frequency (Lower)	rpm
	* 73	Outdoor fan revolution frequency (Upper)	rpm
	F1	Compressor calculated operation time	×100h

Item with * marks are not provided to the Concealed Duct Type.



- 3 Push **UNIT LOUVER** button to select the indoor unit to be monitored.
Each data of the indoor unit and its outdoor units can be monitored.



- 4 Pushing **TEST** button returns the status to the usual display.

*1 The indoor discharge temperature of item code [F8] is the estimated value from TC or TCJ sensor.

Use this value to check discharge temperature at test run.

(A discharge temperature sensor is not provided to this model.)

- The data value of each item is not the real time, but value delayed by a few seconds to ten-odd seconds.
- If the combined outdoor unit is one before 2 or 3 series, the outdoor unit data [6D], [70], [72] and [73] are not displayed.

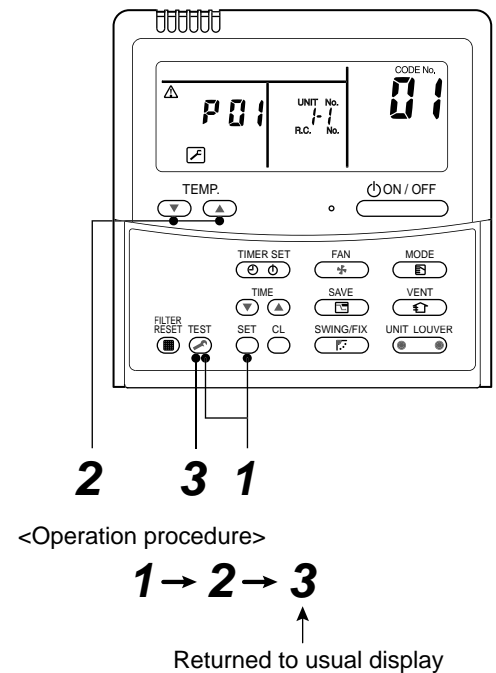
■ Calling of error history

<Contents>

The error contents in the past can be called.

<Procedure>

- 1** Push **SET** + **TEST** buttons simultaneously for 4 seconds or more to call the service check mode.
Service Check goes on, the **item code 01** is displayed, and then the content of the latest alarm is displayed.
The number and error contents of the indoor unit in which an error occurred are displayed.
- 2** In order to monitor another error history, push the set temperature **▼** / **▲** buttons to change the error history No. (Item code).
Item code **01** (Latest) → Item code **04** (Old)
NOTE : 4 error histories are stored in memory.
- 3** Pushing **TEST** button returns the display to usual display.



REQUIREMENT

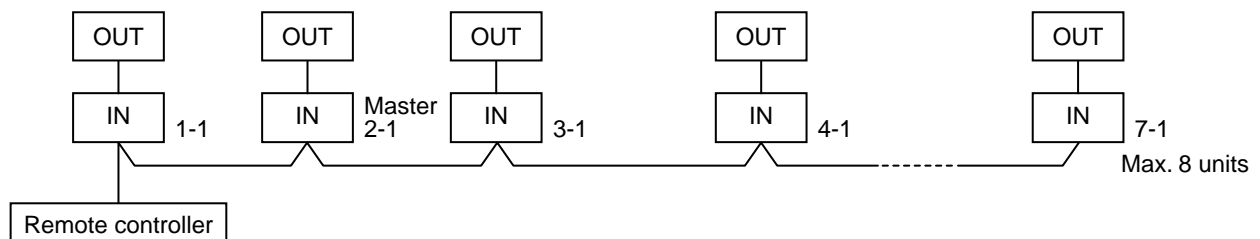
Do not push **CL** button, otherwise all the error histories of the indoor unit are deleted.

(Group control operation)

In a group control, operation of maximum 8 indoor units can be controlled by a remote controller.

The indoor unit connected with outdoor unit (Individual/Master of twin) controls room temperature according to setting on the remote controller.

<System example>



1. Display range on remote controller

The setup range (Operation mode/Air volume select/Setup temp) of the indoor unit which was set to the master unit is reflected on the remote controller.

1) Concealed duct (RAV-SMXXDT) is not set up on the master unit.

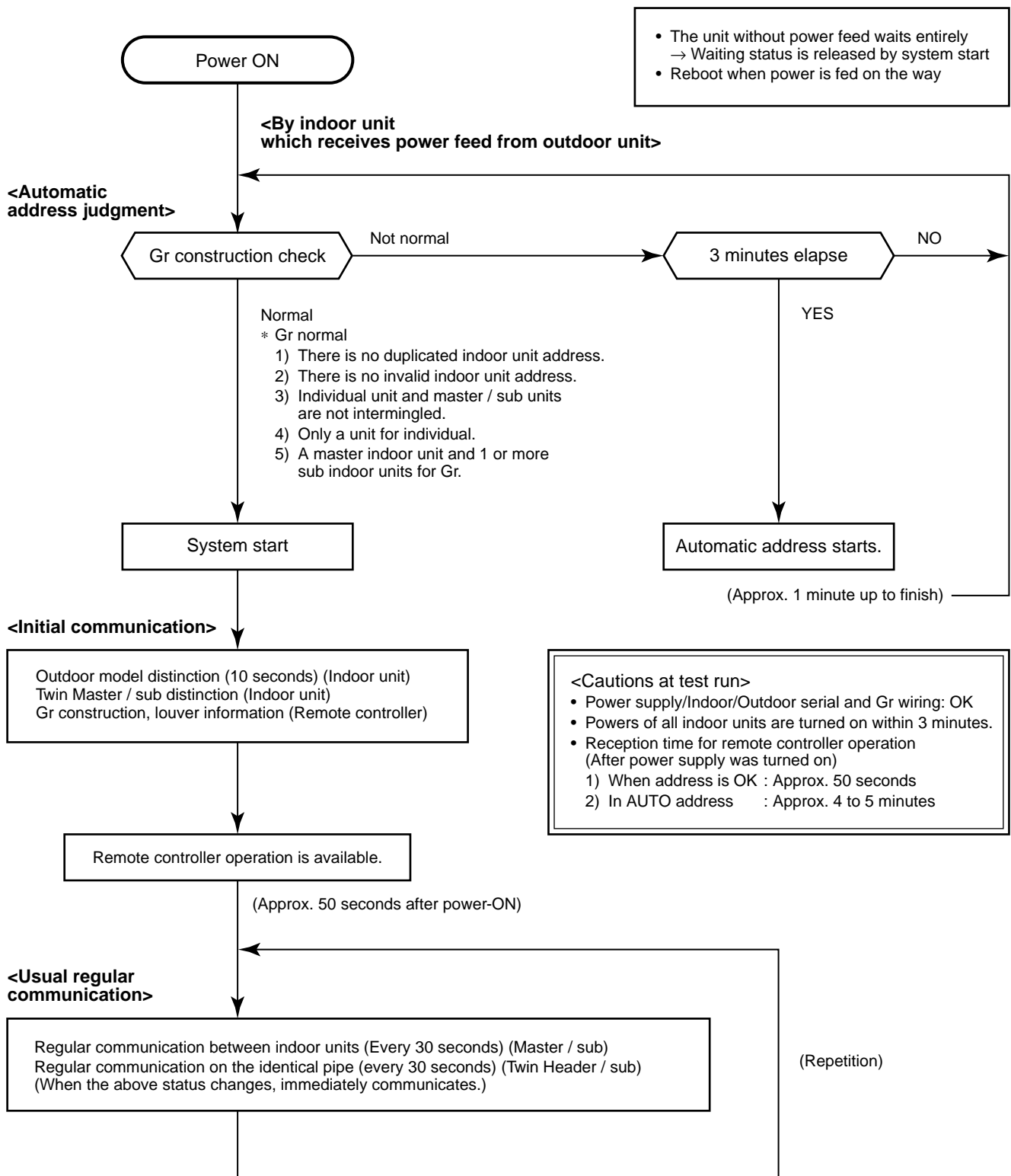
- If the Concealed duct is the master unit:
Operation mode: [Cooling/Heating AUTO] [HEAT] [COOL] [FAN] and no [DRY]
Air volume select: [HIGH]
- When the operation mode is [DRY], [FAN] stops in duct models.

2. Address setup

Turn on power of the indoor unit to be controlled in a group within 3 minutes after setting of automatic address. If power of the indoor unit is not turned on within 3 minutes (completion of automatic address setting), the system is rebooted and the automatic address setting will be judged again.

- 1) Connect 3 In/Out cables surely.
- 2) Check line address/indoor address/group address of the unit one by one.
- 3) The unit No. (line/indoor gout address) which have been set once keep the present status as a rule if the unit No. is not duplicated with one of another unit.

■ Indoor unit power-ON sequence



- In a group operation, if the indoor unit which was fed power after judgment of automatic address cannot receive regular communication from the master unit and regular communication on identical pipe within 120 seconds after power was turned on, it reboots (system reset).
→ The operation starts from judgment of automatic address (Gr construction check) again.
(If the address of the master unit was determined in the previous time, the power fed to the master unit and reboot works, the master unit may change though the indoor unit line address is not changed.)

12-2. Setup at Local Site / Others

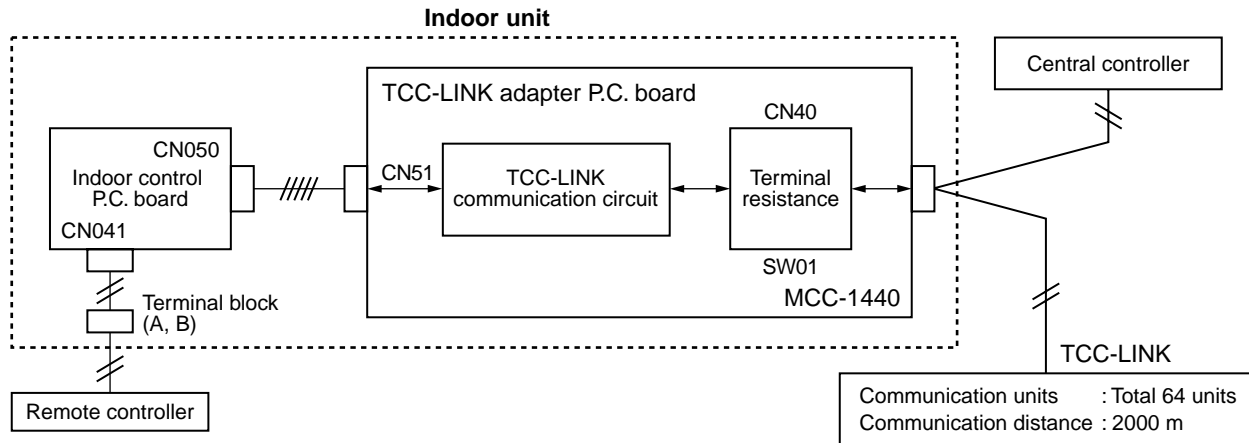
Model name: TCB-PCNT30TLE2

12-2-1. TCC-LINK Adapter (For TCC-LINK Central Control)

1. Function

This model is an optional P.C. board to connect the indoor unit to TCC-LINK (Central controller).

2. Microprocessor block diagram

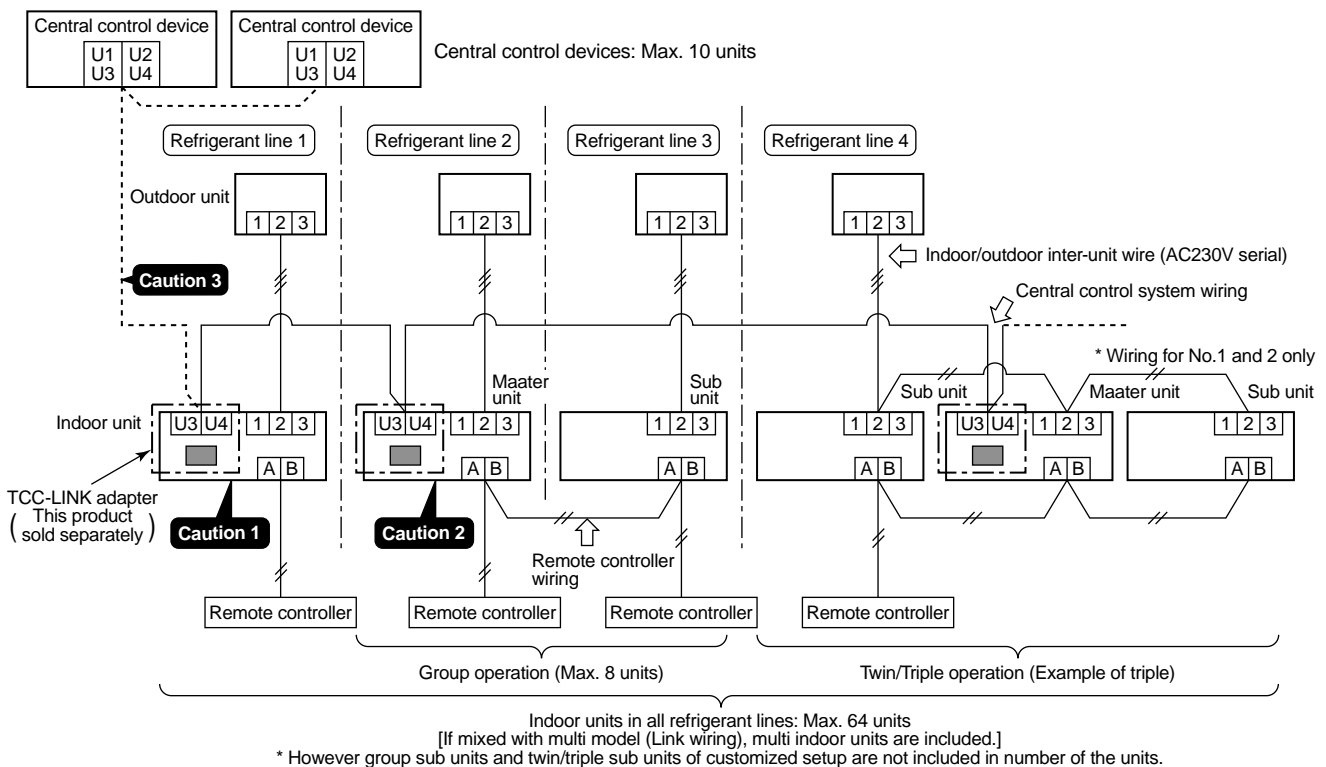


3. TCC-LINK wiring connection

CAUTION

- 1) When controlling customized setup collectively, TCC-LINK adapter (This option) is required.
- 2) In case of group operation or twin/triple operation, the adapter is necessary to be connected to the main unit.
- 3) Connect the central control devices to the central control system wiring.
- 4) When controlling collectively customized setup only, turn on only Bit 1 of SW01 of the least line of the system address No. (OFF when shipped from the factory)

*** In case of customized setup, the address is necessary to be set up again from the wired remote controller after automatic addressing.**



4. Wiring specifications

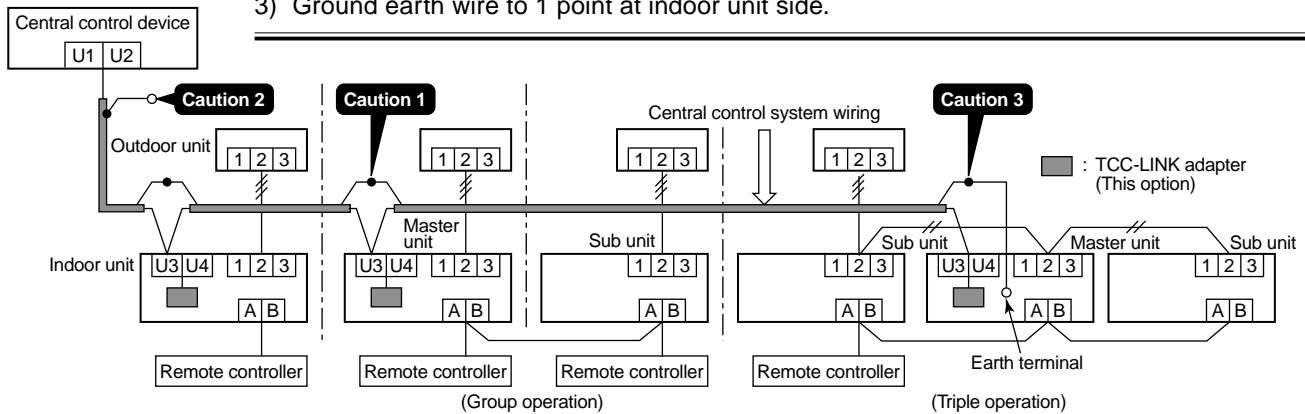
- Use 2-core with no polar wire.
- Match the length of wire to wire length of the central control system.
If mixed in the system, the wire length is lengthened with all indoor/outdoor inter-unit wire length at side.

No. of wires	Size
2	Up to 1000m: twisted wire 1.25mm ² Up to 2000m: twisted wire 2.0mm ²

- To prevent noise trouble, use 2-core shield wire.
- Connect the shield wire by closed-end connection and apply open process (insulating process) to the last terminal. Ground the earth wire to 1 point at indoor unit side. (In case of central controlling of digital inverter unit setup)

CAUTION

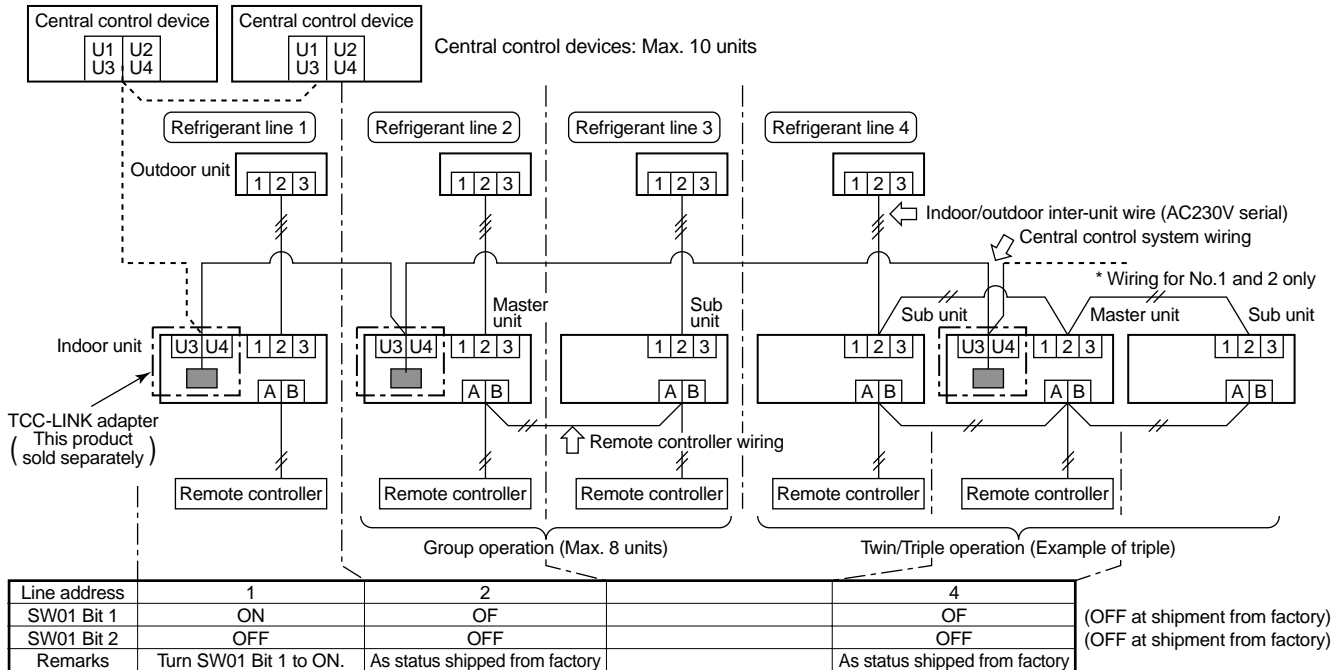
- 1) Closed-end connection of shield wire (Connect all the connecting parts of each indoor unit)
- 2) Apply open process to the last terminal (insulating process).
- 3) Ground earth wire to 1 point at indoor unit side.



5. P.C. board switch (SW01) setup

When performing collective control by DI or SDI only, the setup of terminator is necessary.

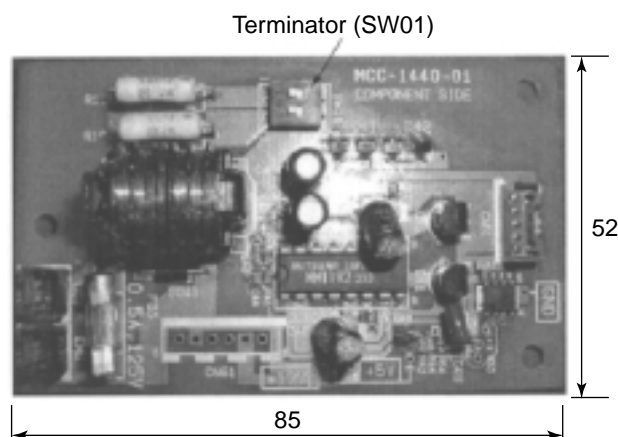
- Using SW01, set up the terminator.
- Set up the terminator to only the adapter connected to the indoor unit of least line address No.



(Reference) Setup contents of switch

SW01		Terminator	Remarks
Bit 1	Bit 2		
OFF	OFF	None	Mixed with multi (Link wiring) at shipment from factory
ON	OFF	100Ω	Central control by digital inverter only
OFF	ON	75Ω	Spare
ON	ON	43Ω	Spare

6. External view of P.C. board assembly



7. Address setup

In addition to set up the central control address, it is necessary to change the indoor unit number. (Line/Indoor/Group address). For details, refer to TCC-LINK Adapter Installation Manual.

12-3. How to Set up Central Control Address Number

When connecting the indoor unit to the central control remote controller using TCC-LINK adapter, it is necessary to set up the central control address number.

- The central control address number is displayed as the line No. of the central control remote controller.

<Procedure> Perform setup while the unit stops.

1 Push + buttons for 4 seconds or more.

When group control is executed, first the unit No. **ALL** is displayed and all the indoor units in the group control are selected. In this time, fans of all the selected indoor units are turned on. (Fig. 1)
(Keep **ALL** displayed status without pushing button.)

In case of individual remote controller which is not group-controlled, Line address and Indoor unit address are displayed.

2 Using temperature setup buttons, specify item code 03.

3 Using timer time buttons, select the setup data. The setup data is shown in the table below (Table 1).

4 Push button. (OK if display goes on.)

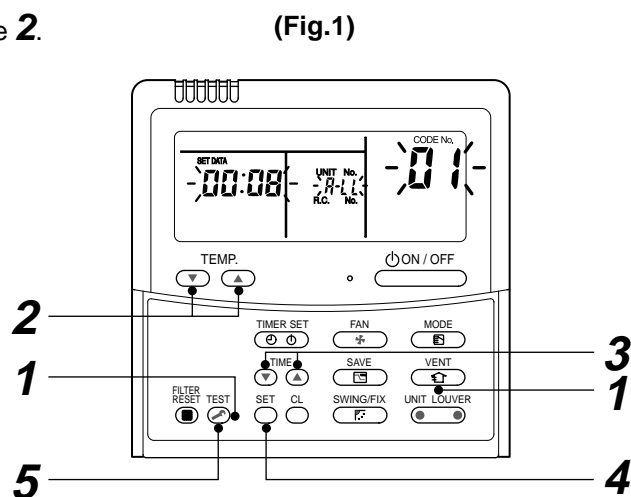
- To change the item to be set up, return to Procedure 2.

5 Push button.

The status returns to usual stop status.

(Table 1)

Setup data	Central control address No.
0001	1
0002	2
0003	3
⋮	⋮
0064	64
0099	Unset (Setup at shipment from factory)



How to confirm the central control address (New function for AMT32 remote controller)

<Procedure> It can be confirmed even during operation or stopping.

1 Push  button for 4 seconds or more.



2 In the frame at left side of the remote controller screen, the lighting set contents are displayed.

During unset time, *0099* (At shipment from factory) is displayed.



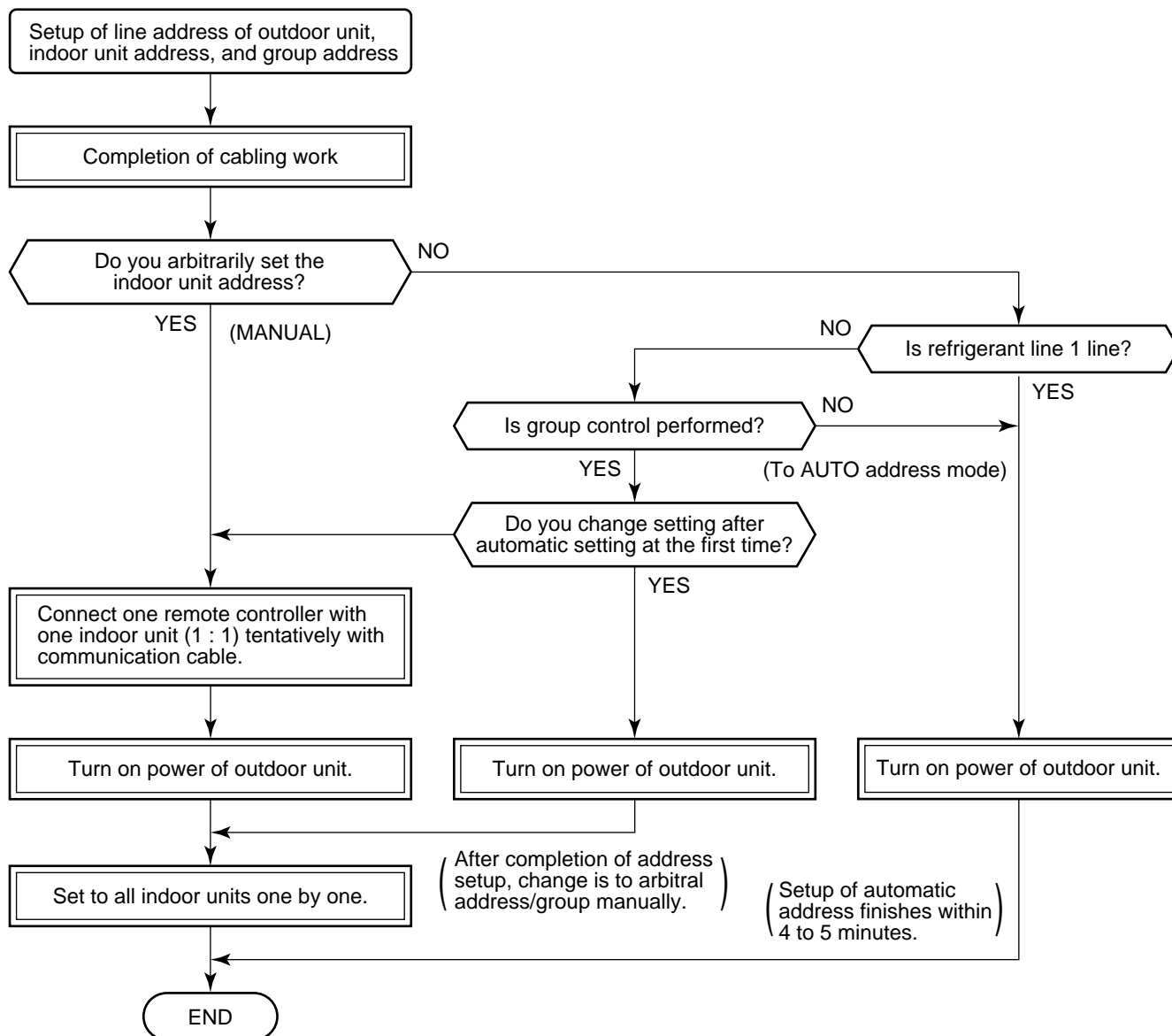
3 After lighting display for 3 seconds, the display automatically disappears.

If any button is pushed during display, immediately the display disappears and then the pushed button is displayed.

13. ADDRESS SETUP

13-1. Address Setup Procedure

When an outdoor unit and an indoor unit are connected, or when an outdoor unit is connected to each indoor unit respectively in the group operation even if multiple refrigerant lines are provided, the automatic address setup completes with power-ON of the outdoor unit. The operation of the remote controller is not accepted while automatic address works. (Approx. 4 to 5 minutes)



- When the following addresses are not stored in the neutral memory (IC503) on the indoor P.C. board, a test run operation cannot be performed. (Unfixed data at shipment from factory)

	Item code	Data at shipment	Setup data range
Line address	12	0099	0001 (No. 1 unit) to 0064 (No. 64 unit)
Indoor unit address	13	0099	0001 (No. 1 unit) to 0064 (No. 64 unit) Max. value of indoor units in the identical refrigerant line
Group address	14	0099	0000 : Individual (Indoor units which are not controlled in a group) 0001 : Master unit (1 indoor unit in group control) 0002 : Sub unit (Indoor units other than master unit in group control)

13-2. Address Setup & Group Control

<Terminology>

Indoor unit No. : $N - n$ = Outdoor unit line address N (Max. 30) - Indoor unit address n (Max. 64)

Group address : 0 = Single (Not group control)
1 = Master unit in group control
2 = Sub unit in group control

Master unit (= 1) : The representative of multiple indoor units in group operation sends/receives signals to/from the remote controllers and sub indoor units.
(* It has no relation with an indoor unit which communicates serially with the outdoor units.)
The operation mode and setup temperature range are displayed on the remote controller LCD. (Except air direction adjustment of louver)

Sub unit (= 2) : Indoor units other than master unit in group operation
Basically, sub units do not send/receive signals to/from the remote controllers.
(Except errors and response to demand of service data)

Header unit (Representative unit) (Master Twin)

: This unit communicates with the indoor unit (follower) which serial-communicates with the outdoor units and sends/receives signal (Command from compressor) to/from the outdoor units as the representative of the cycle control in the indoor units of the identical line address within the minimum unit which configures one of the refrigerating cycles of Twin.

Follower unit (Subordinate unit) (Sub Twin)

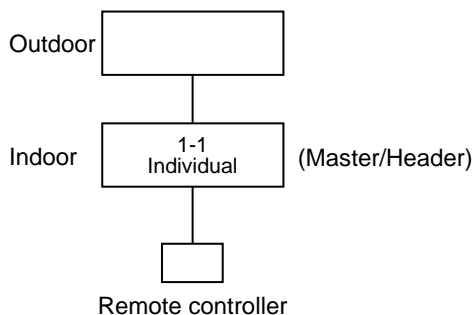
: Indoor units excluding the header unit in Twin

This unit communicates with (Header) indoor unit in the identical line address and performs control synchronized with (Header) indoor unit.

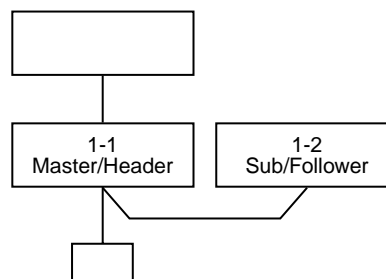
This unit does not perform the signal send/receive operation with the outdoor units. :
No judgment for serial signal error.

13-2-1. System Configuration

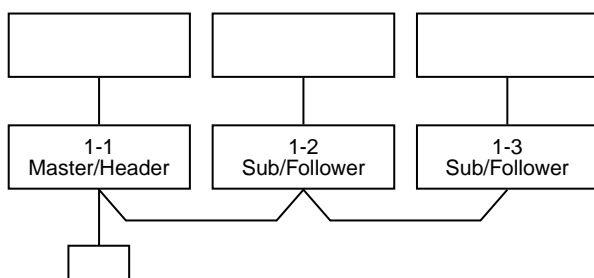
1. Single



2. Twin

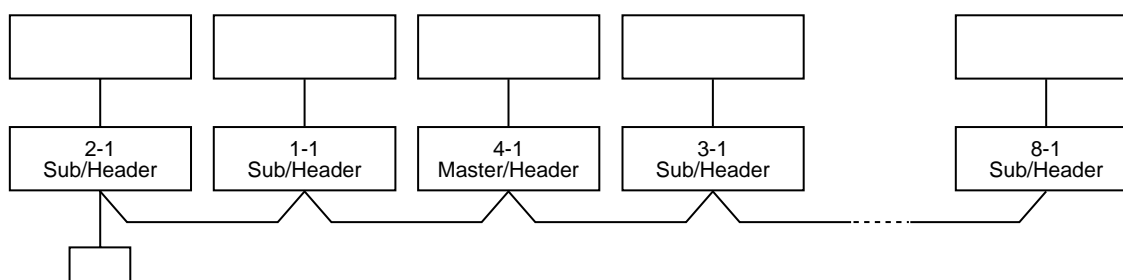


3. Triple

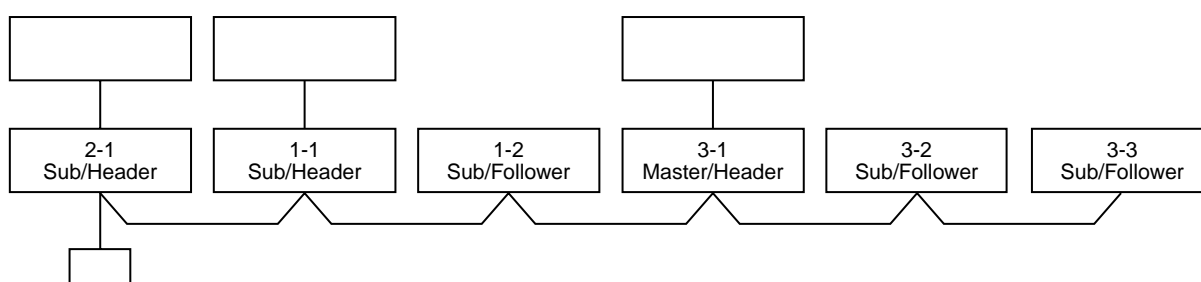


4. Single group operation

- Each indoor unit controls the outdoor unit individually.



5. Multiple groups operation (Manual address setting)



- Header unit: The header unit receives the indoor unit data (thermo status) of the follower (Without identical line address & indoor/outdoor serial) and then finally controls the outdoor compressor matching with its own thermo status. The header unit sends this command information to the follower unit.
- Follower unit: The follower unit receives the indoor unit data from the header (With identical line address & indoor/outdoor serial) and then performs the thermo operation synchronized with the header unit. The follower unit sends own thermo ON/OFF demand to the header unit.

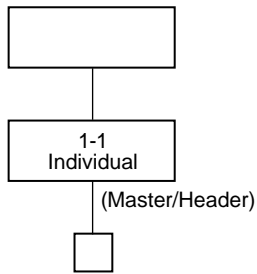
(Example)

No. 1-1 header unit sends/receives signal to/from No. 1-2 and No. 1-3 follower units.
(It is not influenced by the line 2 or 3 address indoor unit.)

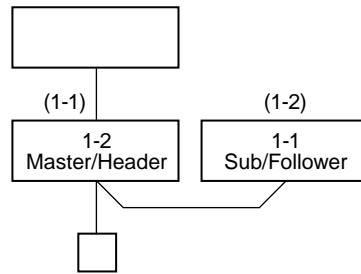
13-2-2. Automatic Address Example from Unset Address (No miswiring)

1. Standard (One outdoor unit)

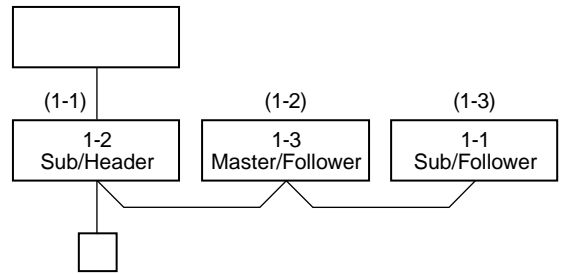
1) Single



2) Twin



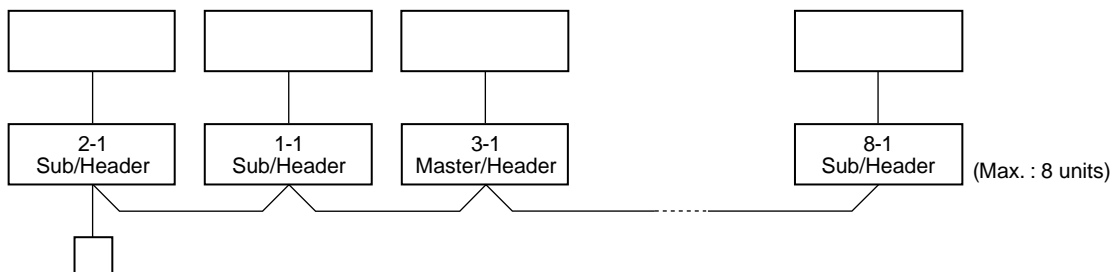
3) Triple



Only turning on source power supply (Automatic completion)

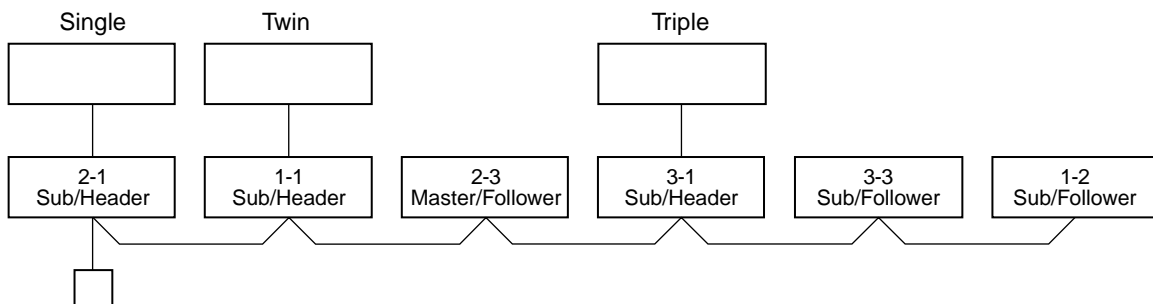
2. Group operation

(Multiple outdoor units = Multiple indoor units with serial communication only, without twin)

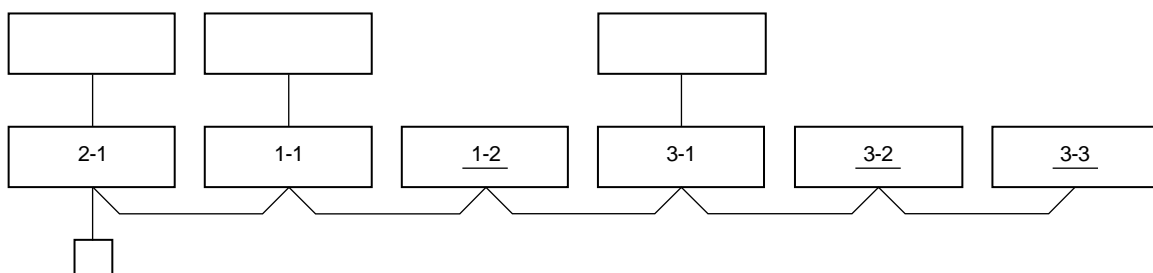


Only turning on source power supply (Automatic completion)

3. Multiple groups operation



Change is necessary
Manually change addresses of the multiple follower units
simultaneously from the remote controller.

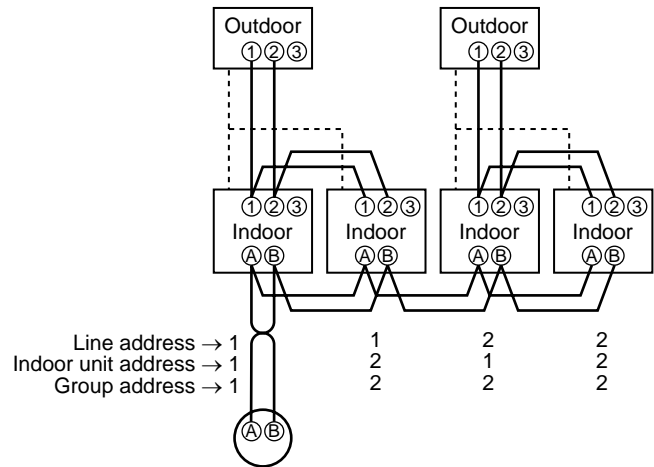


13-3. Address Setup (Manual Setting from Remote Controller)

In case that addresses of the indoor units will be determined prior to piping work after cabling work

- Set an indoor unit per a remote controller.
- Turn on power supply.

(Example of 2-lines cabling)
(Real line: Cabling, Broken line: Refrigerant pipe)

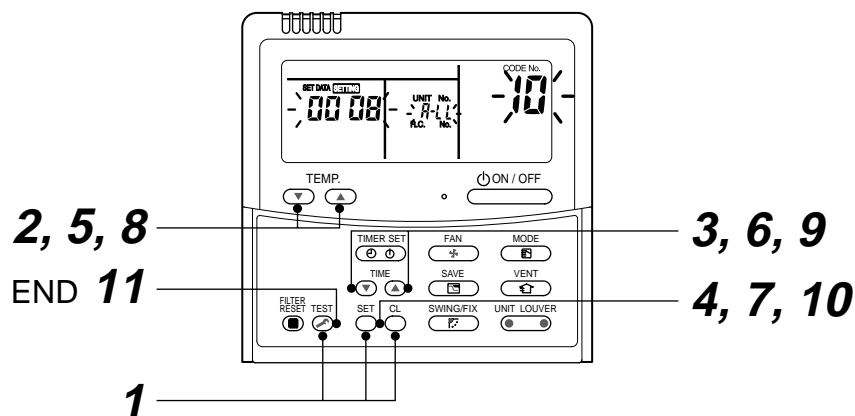


Remote controller

For the above example, perform setting by connecting singly the wired remote controller without remote controller inter-unit cable.

Group address
Individual : 0000
Master unit : 0001
Sub unit : 0002 } In case of group control

- 1 Push **SET** + **CL** + **TEST** buttons simultaneously for 4 seconds or more.
- 2 (← Line address)
Using the temperature setup **▼** / **▲** buttons, set **/2** to the item code.
- 3 Using timer time **▼** / **▲** buttons, set the line address.
- 4 Push **SET** button. (OK when display goes on.)
- 5 (← Indoor unit address)
Using the temperature setup **▼** / **▲** buttons, set **/3** to the item code.
- 6 Using timer time **▼** / **▲** buttons, set 1 to the line address.
- 7 Push **SET** button. (OK when display goes on.)
- 8 (← Group address)
Using the temperature setup **▼** / **▲** buttons, set **/4** to the item code.
- 9 Using timer time **▼** / **▲** buttons, set **0000** to Individual, **0001** to Master unit, and **0002** to sub unit.
- 10 Push **SET** button. (OK when display goes on.)
- 11 Push **TEST** button.
Setup completes. (The status returns to the usual stop status.)



<Operation procedure>

1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → 11 END


■ Confirmation of indoor unit No. position

1. To know the indoor unit addresses though position of the indoor unit body is recognized

- In case of individual operation (Wired remote controller : indoor unit = 1 : 1)
(Follow to the procedure during operation)

<Procedure>

1 Push  button if the unit stops.

2 Push  button.

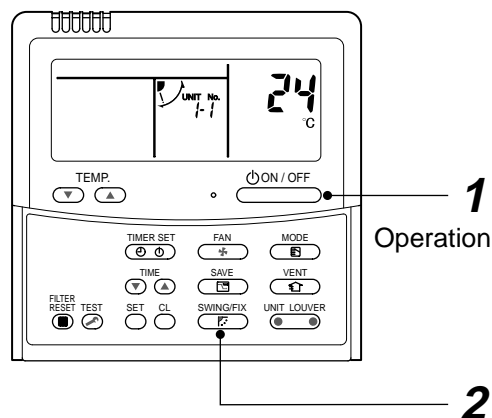
Unit No. *1-1* is displayed on LCD.

(It disappears after several seconds.)

The displayed unit No. indicate line address and indoor unit address.

(When other indoor units are connected to the identical remote controller (Group control unit), other unit numbers are also displayed every pushing

 button.



<Operation procedure>



1 → 2 END

2. To know the position of indoor unit body by address

- To confirm the unit No. in the group control
(Follow to the procedure during operation) (in this procedure, the indoor units in group control stop.)

<Procedure>

The indoor unit numbers in the group control are successively displayed, and fan, louver, and drain pump of the corresponding indoor unit are turned on.
(Follow to the procedure during operation)

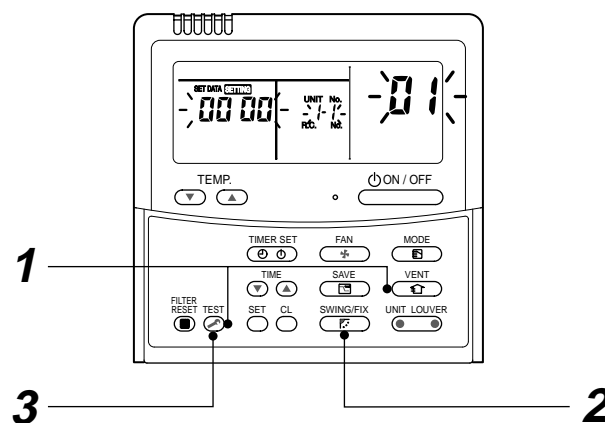
1 Push  and  buttons simultaneously for 4 seconds or more.

- Unit No. *ALL* is displayed.
- Fans and louvers of all the indoor units in the group control operate.

2 Every pushing  button, the unit numbers in the group control are successively displayed.

- The unit No. displayed at the first time indicates the master unit address.
- Fan and louver of the selected indoor unit only operate.

3 Push  button to finish the procedure.
All the indoor units in the group control stop.



<Operation procedure>

1 → 2 → 3 END

14. DETACHMENTS

14-1. Indoor Unit

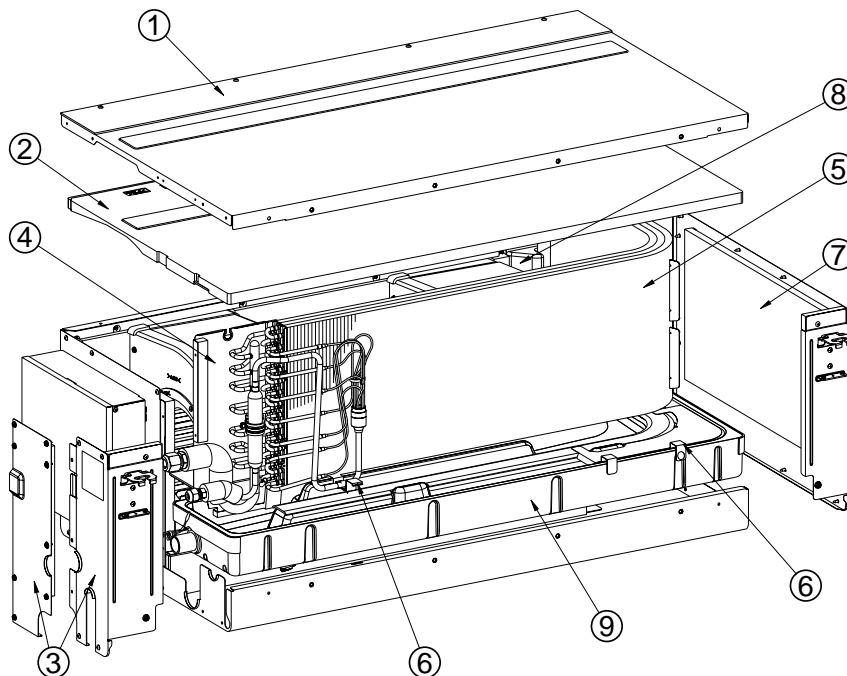
REQUIREMENT

- At the service replacing time of the heat exchanger, the following tools are necessary.
Prepare them before the service work.
- Necessary tools: Plus screwdriver, monkey wrench, spanner, etc

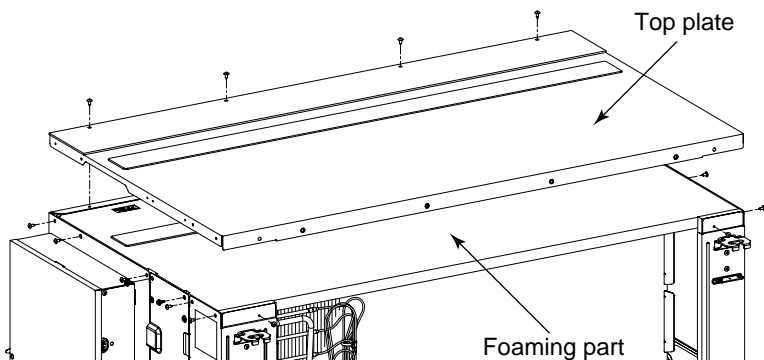
CAUTION

- Be sure to place the heat exchanger at safe and flat place and then start the work.
- Necessarily put gloves when starting the work. Working with the naked hands may cause injury on the hands.

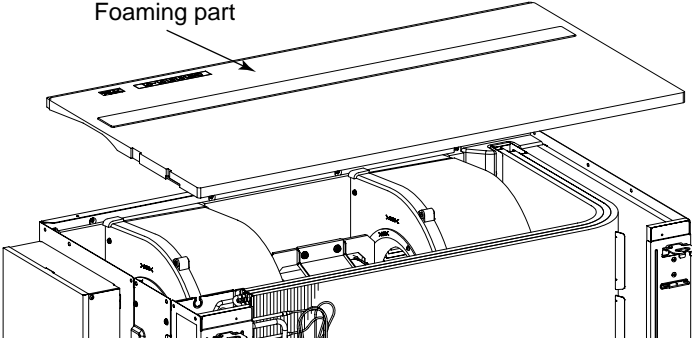
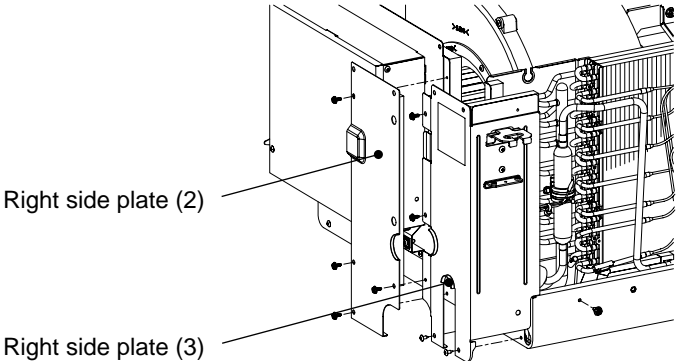
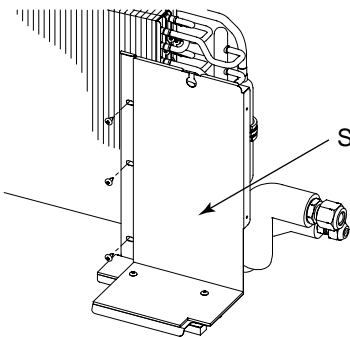
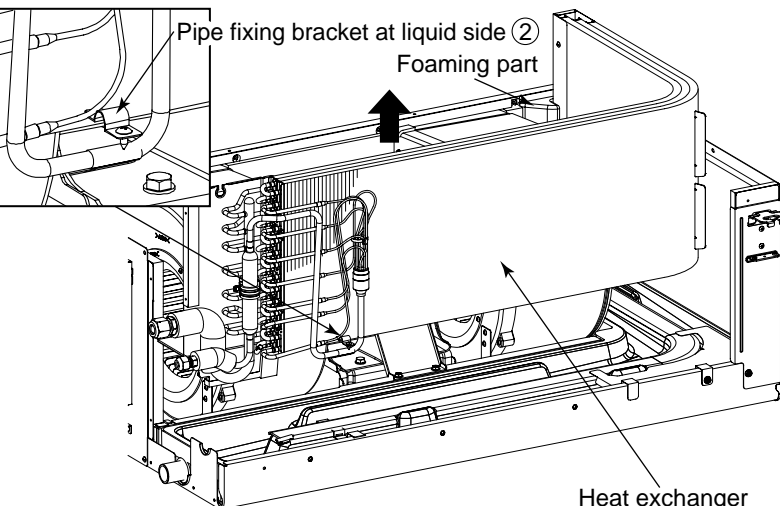
1. Decomposition drawing for the parts replacement of heat exchanger and drain pan



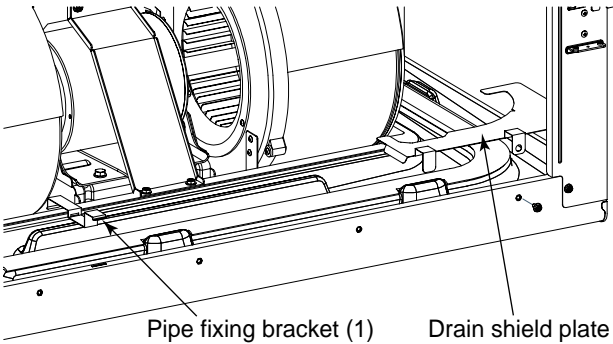
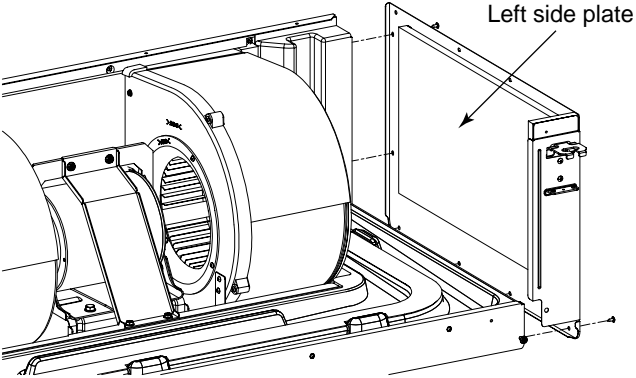
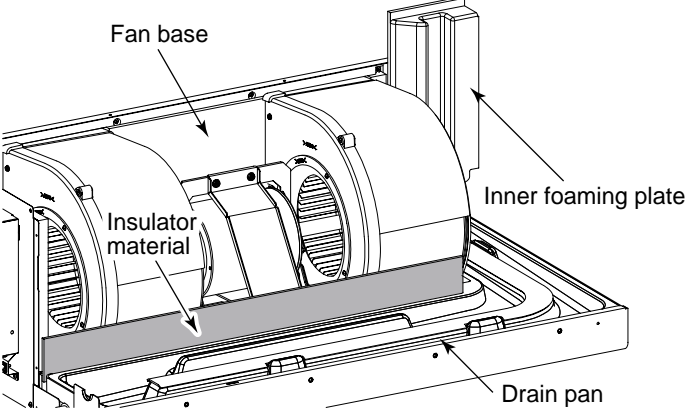
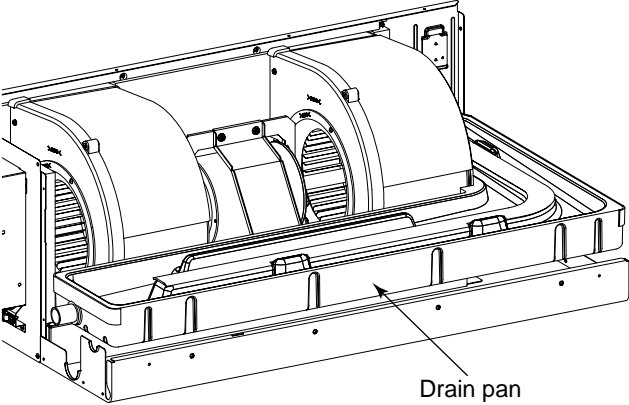
2. How to replace the parts

No.	Work procedure	Explanatory drawing
①	<p>Remove the top plate.</p> <p>Note) Remove the top plate carefully so that corners of the foaming part of the inner plate are not chipped off by being caught.</p>	

2. How to replace the parts (Continued)

No.	Work procedure	Explanatory drawing
②	<p>Remove the foaming part.</p> <p>Note) Remove the foaming part carefully so that corners of the foaming part of the inner plate are not chipped off by being caught.</p>	 <p>Foaming part</p>
③	<p>Remove the right side plates (2) and (3).</p> <p>Note) Remove the side plates so as not to damage the pipe cover.</p>	 <p>Right side plate (2)</p> <p>Right side plate (3)</p>
④	<p>Take off the shield plate from the heat exchanger.</p>	 <p>Shield plate</p>
⑤	<p>Pull up the heat exchanger.</p> <p>1) Take off the pipe fixing bracket at liquid side.</p> <p>Note) Take off the bracket and heat exchanger carefully so that insulator materials of the foaming part and side plates are not chipped off.</p>	 <p>Pipe fixing bracket at liquid side ②</p> <p>Foaming part</p> <p>Heat exchanger</p>

2. How to replace the parts (Continued)

No.	Work procedure	Explanatory drawing
⑥	Take off the pipe fixing bracket (1) and the drain shield plate.	 <p>Pipe fixing bracket (1) Drain shield plate</p>
⑦	Remove the left side plate.	 <p>Left side plate</p>
⑧	<p>Remove the inner foaming plate and the insulator material.</p> <p>1) Pull off the insulator material between the drain pan and the mounting plate.</p> <p>2) Take off the inner foaming which is fit into between the fan base and the drain pan.</p> <p>Note) Remove them carefully so that corners of the inner foaming part are not chipped off by being caught.</p>	 <p>Fan base Inner foaming plate Insulator material Drain pan</p>
⑨	<p>Remove the drain pan.</p> <p>Note) Remove the drain pan carefully so that the foaming part or drain socket part of the drain pan are not chipped off or damaged.</p>	 <p>Drain pan</p>

REQUIREMENT

- At the service replacing time of the fan motor, the following tools are necessary.
Prepare them before the service work.

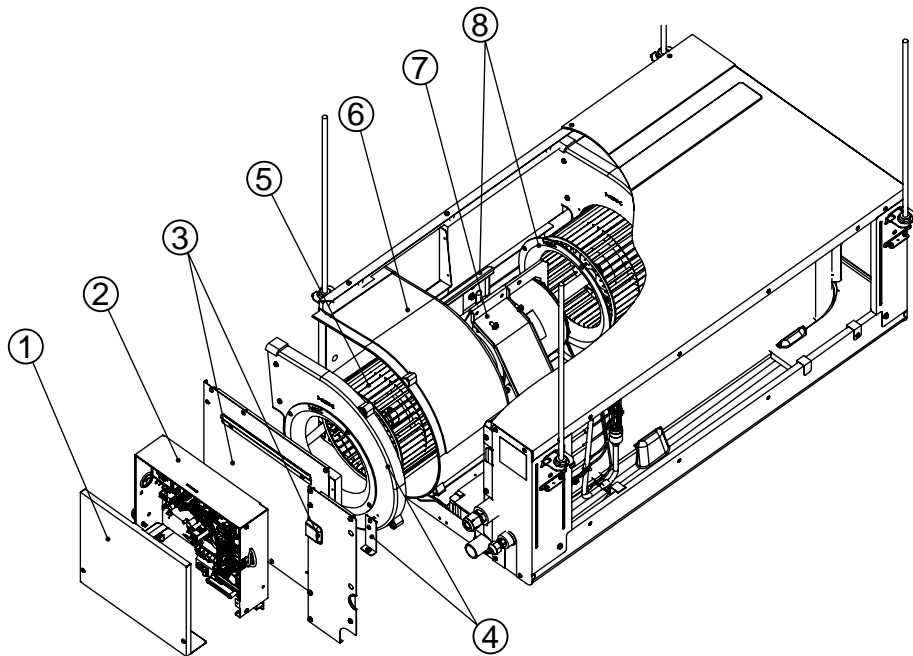
- Necessary tools:

Plus screwdriver, L-shape hexagonal wrench (For ØM8mm (Face to face 4mm)),
ratchet wrench (For Ø6mm nut (Face to face 10mm)), monkey wrench, spanner, etc.

CAUTION

- The weight of the fan motor which is mounted on this product is heavy (Approx. 20kg) (including peripheral parts).
Therefore perform the service work with great care; otherwise an excessive work may cause backache.
- Necessarily put gloves when starting the work. Working with the naked hands may cause injury on the hands.
- When taking out the fan motor from the main unit and put it tentatively in the ceiling and others, set it at a place durable the motor weight; otherwise a fall may be caused.

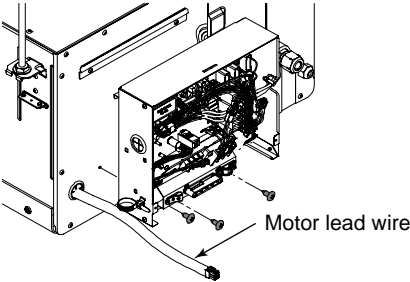
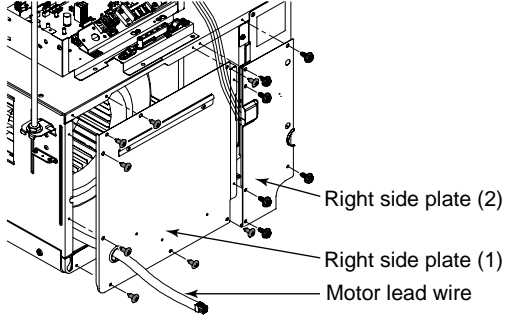
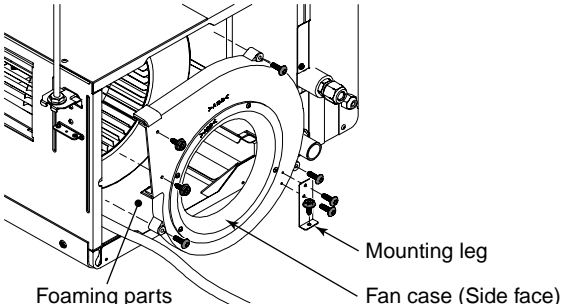
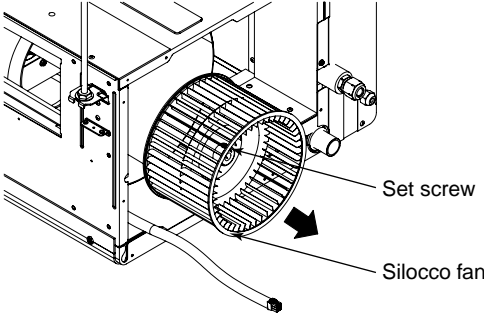
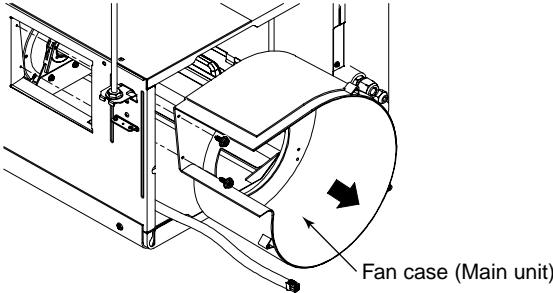
3. Decomposition drawing for the parts replacement of fan motor



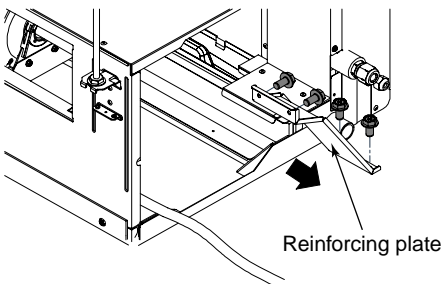
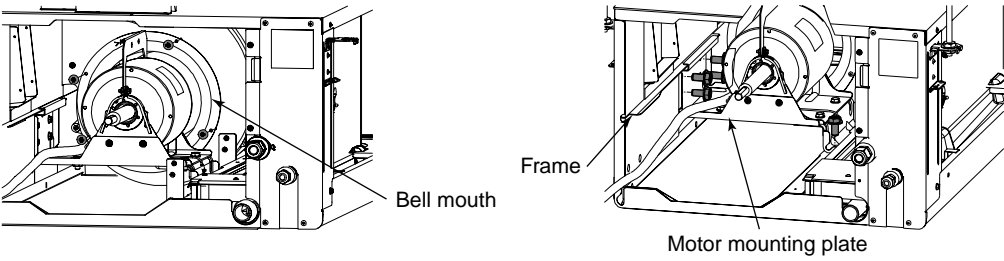
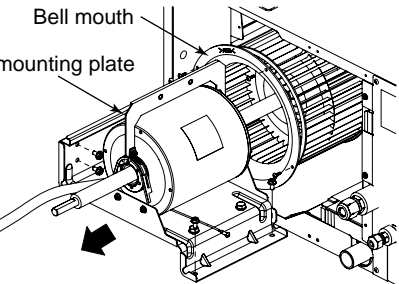
4. How to replace the parts

No.	Work procedure	Explanatory drawing
①	<p>Remove the electric parts cover and then remove 9P connector of the motor lead wire which is connected inside of the electric parts box.</p> <p>Note)</p> <p>1) Do not remove other cords than 9P connector from the terminal block.</p> <p>2) Keep the electric parts cover in the empty space.</p>	

4. How to replace the parts (Continued)

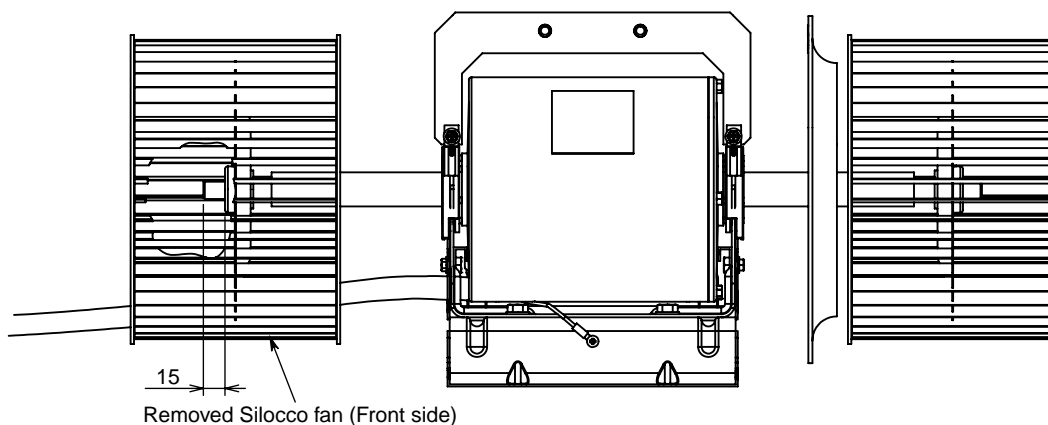
No.	Work procedure	Explanatory drawing
②	<p>Remove the electric parts box.</p> <p>Note)</p> <ul style="list-style-type: none"> When keeping the electric parts box, be sure not to damage or take off the sensor lead wire connected to the main unit. 	
③	<p>Remove the right side plates (1) and (2).</p> <p>1) First remove the right side plate (2) and then the right side plate (1).</p> <p>Note)</p> <ul style="list-style-type: none"> After removing the right side plate (1), do not tear or put out the bushing when pulling off the motor lead wire through bushing. 	
④	<p>Remove the fan case (Side face) and the mounting leg.</p> <p>1) First remove the mounting leg fixed to the fan case (Side face).</p> <p>2) Next remove the fan case (Side face).</p> <p>Note)</p> <ul style="list-style-type: none"> When taking out the fan case (Side face), do not damage the foaming parts. 	
⑤	<p>Remove the Silocco fan.</p> <p>1) When removing the Silocco fan, loosen the set screw which fixes it to the fan motor shaft part, pull it toward you and then remove it from the shaft.</p> <p>L-shape hexagonal wrench (Face to face 4mm)</p>	
⑥	<p>Remove the fan case (Main unit).</p> <p>Note)</p> <ul style="list-style-type: none"> When taking out the fan case (Main unit), do not damage the foaming parts. 	

4. How to replace the parts (Continued)

No.	Work procedure	Explanatory drawing
⑦	<p>Remove the reinforcing plate.</p> <p>Note)</p> <ul style="list-style-type: none"> The reinforcing plate is provided to protect the transportation. Scrap it after unpacking because it is unnecessary to attach when reassembling. 	 <p>Reinforcing plate</p>
⑧	<p>Take off the screws which fix the bell mouth at the rear side of the motor and also take off the screws of the motor mounting plate of the mounted fan motor.</p> <p>Pull the motor mounting plate toward you while pushing it to the frame. Be careful not to drop it.</p>	 <p>Bell mouth</p> <p>Frame</p> <p>Motor mounting plate</p>
⑨	<p>Together with the removed bell mouth, slide the motor mounting plate under fan motor mounting status toward you and then take it out from the main unit.</p> <p>Note)</p> <ul style="list-style-type: none"> Take out the motor mounting plate by sliding it while pushing it to the frame side so that the motor mounting plate is not dropped from the frame. 	 <p>Bell mouth</p> <p>Motor mounting plate</p>

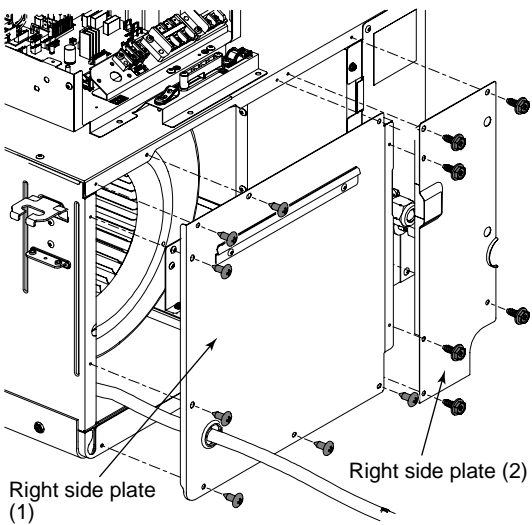
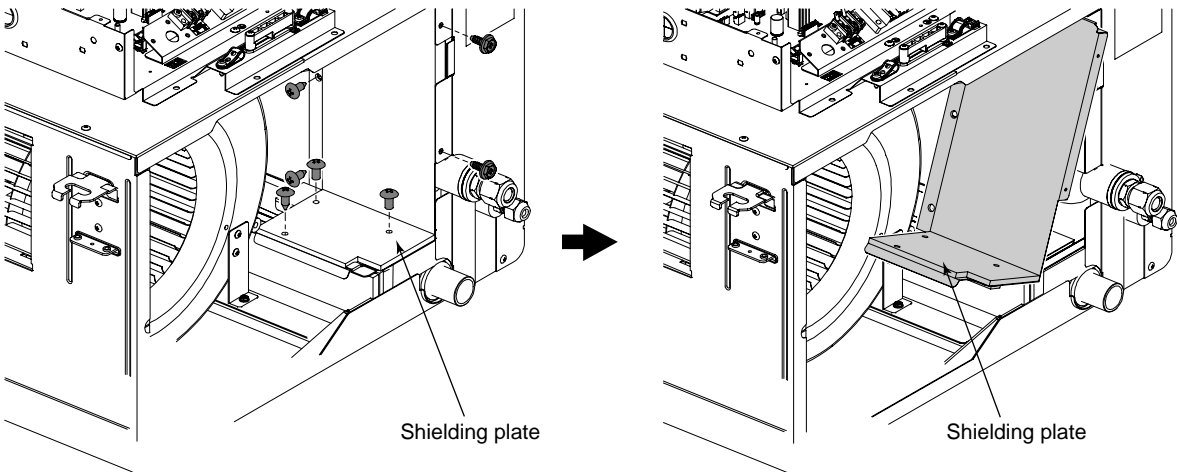
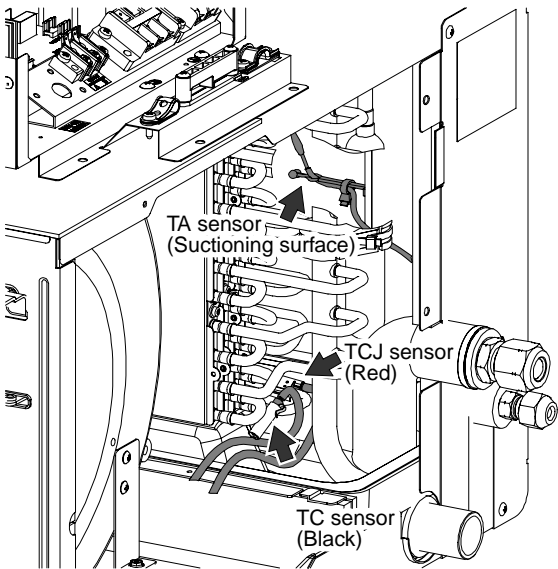
5. Assembling work after replacing fan motor

- After replacing of the parts, assemble the fan motor in the reverse procedure of the parts removal process.
- Mount the removed Silocco fan at the following position as shown in the figure.

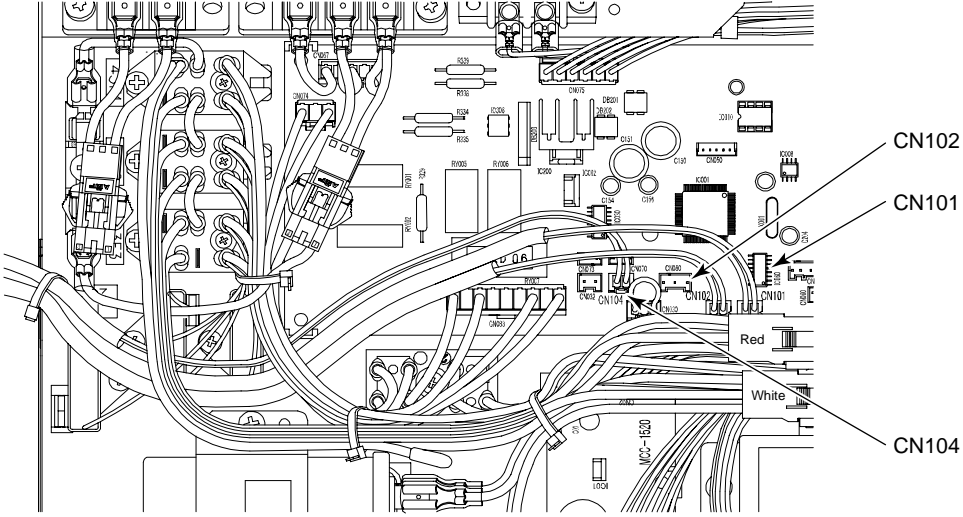


Detailed drawing of Silocco fan mounting position

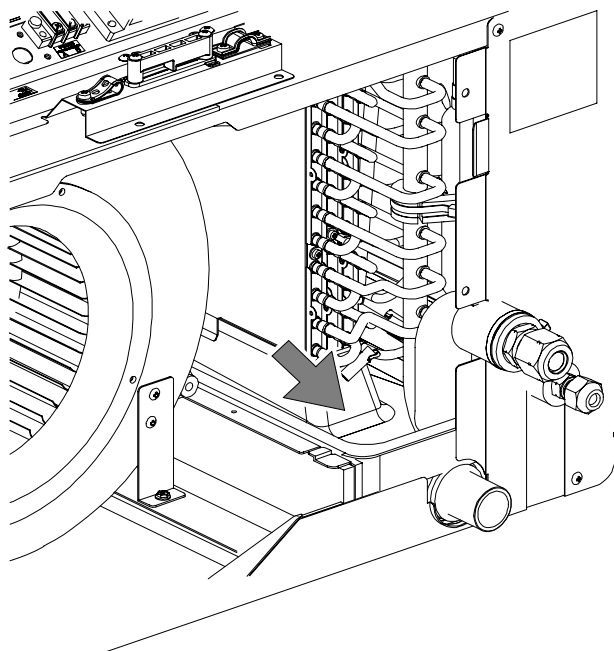
6. How to replace the sensor

No.	Work procedure	Explanatory drawing
①	As same as the work procedure of the fan motor replacing, remove the right side plates (1) and (2).	 <p>Right side plate (1)</p> <p>Right side plate (2)</p>
②	<p>Remove the shielding plate.</p> <p>As the shielding plate is assembled with screws, take the fixing screws off to divide the plate.</p>	 <p>Shielding plate</p> <p>Shielding plate</p>
③	<p>Cut the bunding band which ties 3 sensors together and then remove each sensor to replace them.</p> <p>1) TC sensor TC sensor can be mounted and fixed also by removing the sensor holder and inserting the sensor from the backward direction.</p> <p>2) TCJ sensor TCJ sensor can be mounted and fixed by entering the sensor into the sensor holder and then push the holder including the sensor on the pipes.</p> <p>3) TA sensor Remove TA sensor together with the holder because the work space is narrow. If remounting of the holder is difficult, direct the sensor receiving part to the suction port and then mount and fix the sensor to the pipes using bunding band, etc.</p>	 <p>TA sensor (Suctioning surface)</p> <p>TCJ sensor (Red)</p> <p>TC sensor (Black)</p>


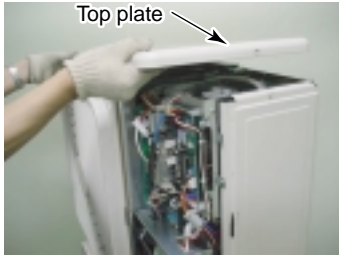
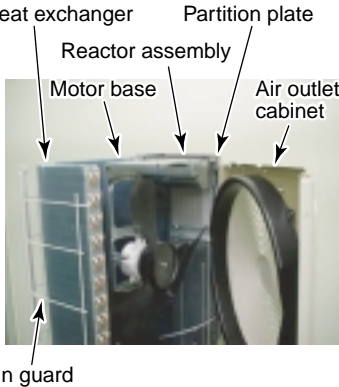
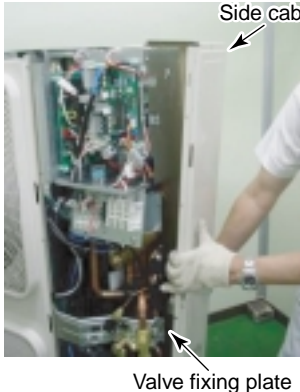
6. How to replace the sensor (Continued)

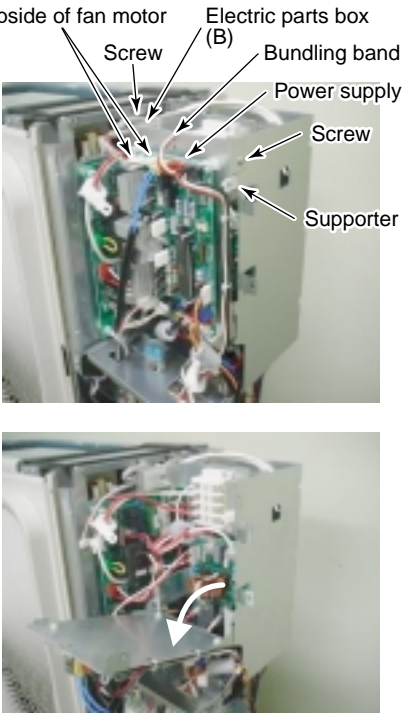
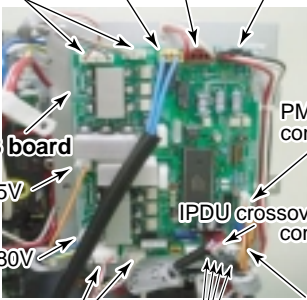
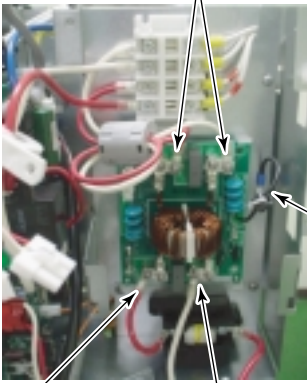
No.	Work procedure	Explanatory drawing
④	<p>Insert the connectors into the specified positions on P.C. board. Check carefully the directions on P.C. board so that wrong insertion is not done.</p> <ul style="list-style-type: none"> • TA sensor : CN104 (Yellow) • TC sensor : CN101 (Black) • TCJ sensor : CN102 (Red) 	

7. How to clean the drain port

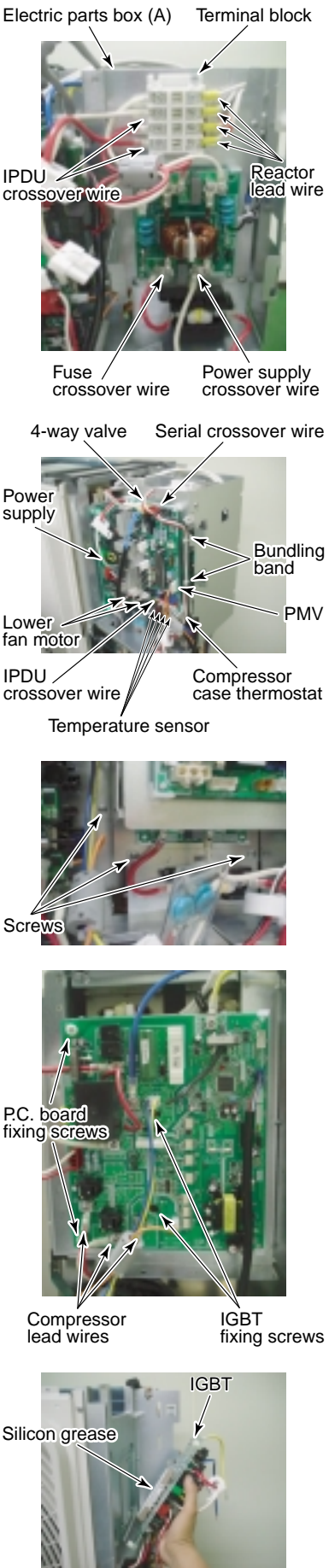
No.	Work procedure	Explanatory drawing
①	<p>As same as the work procedure of the sensor replacing, remove the right side plates and the shielding plate, and then carry on the work.</p>	

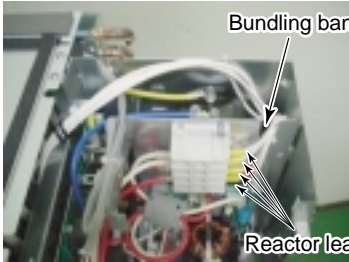
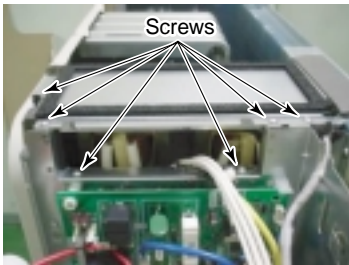
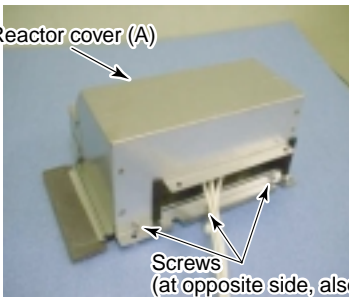
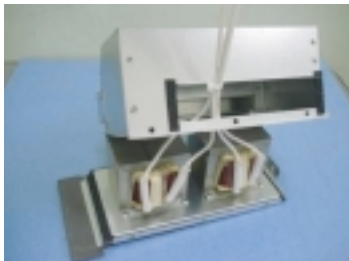
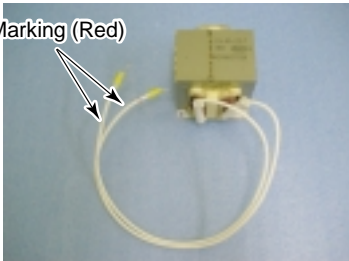
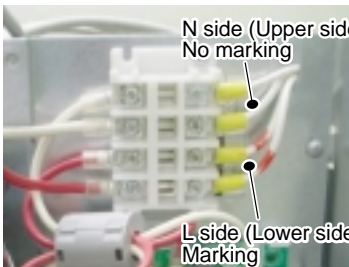
14-2. Outdoor Unit

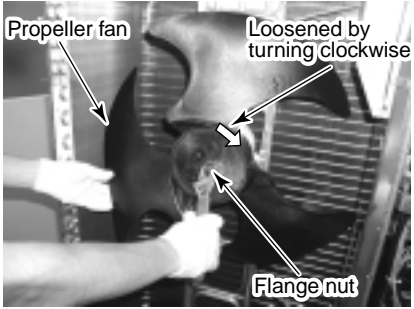
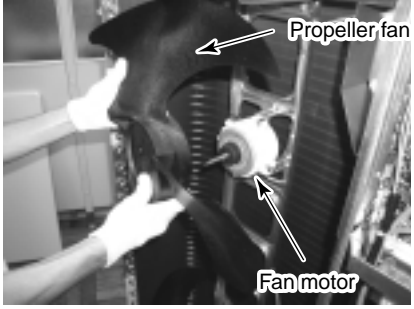
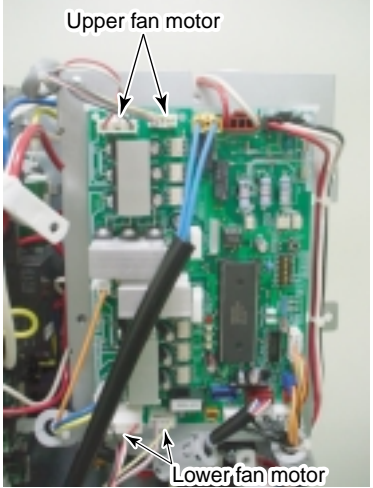
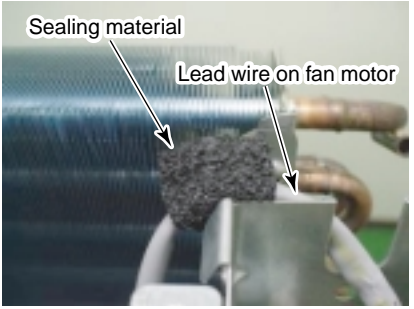
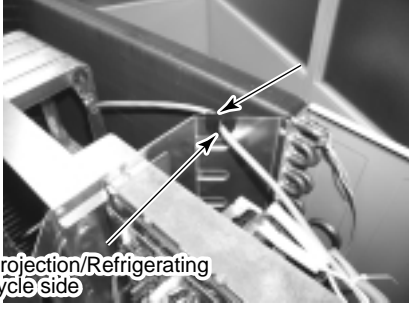
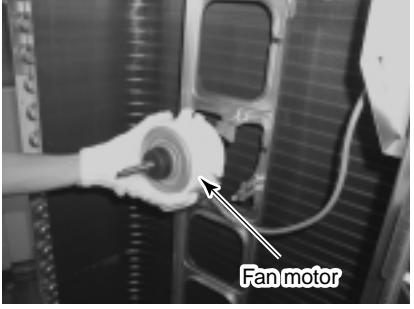
No.	Part name	Procedure	Remarks
①	Common procedure	<p style="text-align: center;">REQUIREMENT</p> <p>Be sure to put on the gloves at any process; otherwise an injury will be caused by the parts, etc.</p> <p>1. Detachment</p> <ol style="list-style-type: none"> 1) Stop operation of the air conditioner and then turn off switch of the breaker. 2) Remove the front panel. (Hexagonal screws $\varnothing 4 \times 10$, 2 pcs.) <ul style="list-style-type: none"> • Remove the screws and then remove the front panel by pulling it downward. 3) Remove the power supply cable and the indoor/outdoor connecting wire from the cord clamp and the terminal. 4) Remove the top plate. (Hexagonal screws $\varnothing 4 \times 10$, 5 pcs.) <p>2. Attachment</p> <ol style="list-style-type: none"> 1) Attach the top plate. (Hexagonal screws $\varnothing 4 \times 10$, 5 pcs.) 2) Connect the power supply cable and the indoor/outdoor connecting wire to the terminal and then fix them with the cord clamp. <p style="text-align: center;">REQUIREMENT</p> <p>For the power supply cable and the indoor/outdoor connecting wire, be sure fix them using the bundling band (procured locally) along the crossover pipe so that they do not come to contact with the compressor, valve at gas side, pipe at gas side and discharge pipe.</p> <p>3) Attach the front panel. (Hexagonal screws $\varnothing 4 \times 10$, 2 pcs.)</p>	 
②	Air outlet cabinet	<p>1. Detachment</p> <ol style="list-style-type: none"> 1) Carry out work of 1 of ①. 2) Remove screws for the air outlet cabinet and the partition board. (ST1T $\varnothing 4 \times 8$, 4 pcs.) 3) Remove screws for the air outlet cabinet and the bottom plate. (Hexagonal screws $\varnothing 4 \times 10$, 2 pcs.) 4) Remove screws for the air outlet cabinet and the motor base. (ST1T $\varnothing 4 \times 8$, 2 pcs.) 5) Remove screw for the air outlet cabinet and the heat exchanger. (ST1T $\varnothing 4 \times 8$, 1 pc.) 6) Remove screws for the air outlet cabinet and the fin guard. (Hexagonal screws $\varnothing 4 \times 10$, 2 pcs.) 7) Remove screws for the air outlet cabinet and the reactor assembly. (ST1T $\varnothing 4 \times 8$, 2 pcs.) 	
③	Side cabinet	<p>1. Detachment</p> <ol style="list-style-type: none"> 1) Carry out work of 1 of ①. 2) Remove the screws which fix the inverter assembly and the side cabinet. (ST1T $\varnothing 4 \times 8$, 2 pcs.) 3) Remove the screws which fix the side cabinet and the valve fixing plate. (ST1T $\varnothing 4 \times 8$, 2 pcs.) 4) Remove screws which fix the side cabinet and the piping panel (Rear). (Hexagonal screws $\varnothing 4 \times 10$, 2 pcs.) 5) Remove screw for the side cabinet and the bottom plate. (Hexagonal screws $\varnothing 4 \times 10$, 1 pc.) 6) Remove screws for the side cabinet and the fin guard (Heat exchanger). (Hexagonal screws $\varnothing 4 \times 10$, 5 pcs.) 	

No.	Part name	Procedure	Remarks
④	Replacement of electric parts Common procedure	1. Detachment <ol style="list-style-type: none"> 1) Carry out works of 1 of ① and ③. 2) Remove the connectors connected to CDB board. (Connector of power supply and upper side fan motor) <ul style="list-style-type: none"> • Unlock the lock of the housing part and then remove the connectors. 3) Cut the bundling band which binds the power supply leads. 4) Remove the fixing screws for the electric parts box (B). (BT2T Ø4 × 6, 2 pcs.) 5) Unlock the lock of the supporter for the electric parts box (B). 6) Open the CDB part. 	 <p>Upside of fan motor Screw Electric parts box (B) Bundling band Power supply Screw Supporter</p>
⑤	Replacement of electric parts CDB board	1. Detachment <ol style="list-style-type: none"> 1) Carry out work of 1 of ①. 2) Remove connectors connected to CDB board. (Power supply, serial, upper/lower fan motor, 4-way valve coil, PMV coil, compressor case thermo, temperature sensor, IPDU crossover wire, DC15V, DC280V) 3) Remove CDB board. (Supporters at 4 positions) 4) Attach a new CDB board. 	 <p>4-way valve coil connector Serial crossover wire connector Upper fan motor connector Power supply connector CDB board DC15V DC280V Lower fan motor connector PMV coil connector IPDU crossover wire connector Compressor case thermo connector Temperature sensor connector</p>
⑥	Replacement of electric parts Noise filter board	1. Detachment <ol style="list-style-type: none"> 1) Carry out works of 1 of ①, ③ and ④. 2) Remove the lead wire connected to the noise filter board. (Power supply crossover wire, fuse crossover wire, terminal block crossover wire) 3) Remove the earth screw. (BT2T Ø4 × 6, 1 pc.) 4) Remove the noise filter board. (Supporter: 4 positions) 5) Attach a new noise filter board. 	 <p>Terminal block crossover wire terminal Earth screw Fuse crossover wire terminal Power supply crossover wire terminal</p>

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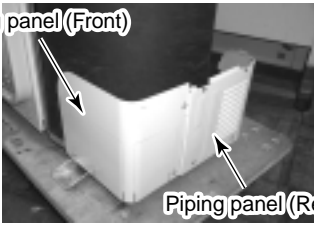
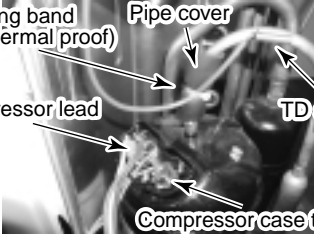
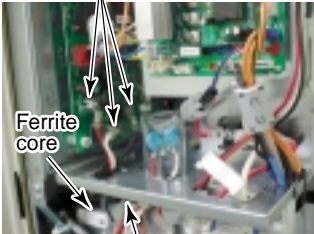
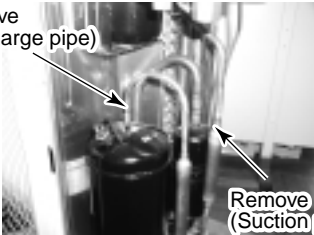
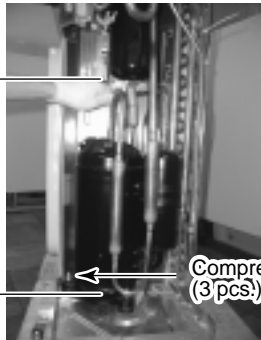
No.	Part name	Procedure	Remarks
⑧	Replacement of electric parts IPDU P.C. board	1. Detachment 1) Carry out works of 1 of ①, ③ and ④. 2) Remove the lead wire connected to the terminal block. (IPDU crossover wire, reactor lead wire) 3) Remove the lead wire connected to the noise filter. (Fuse crossover wire, power supply crossover wire) 4) Close CDB part. (Tentative fixing with supporter) 5) Remove the connector connected to CDB board. (Serial, lower fan motor, 4-way valve coil, PMV coil, compressor case thermostat, temperature sensor, IPDU crossover wire, DC15V, DC280V) 6) Cut the bundling band which binds the serial lead wires. 7) Remove the connector connected to IPDU P.C. board. (Power supply) 8) Carry out works of 5) and 8) of ⑦. 9) Remove screws to connect the electric parts box and screws of the terminal block mounting plate. (BT2T Ø4 × 6, 3 pcs.) 10) Pull up the electric parts box to separate the unit at CDB side. 11) Remove the compressor lead wire. 12) Remove IGPT fixing screws. (B Ø4 × 15, 2 pcs.) 13) Remove screws which fix the P.C. board. (TT2P Ø3 × 18, 2 pcs.) 14) Remove IPDU P.C. board. (Supporter: 2 positions) 15) Remove lead wires connected to P.C. board. 16) Mount a new IPDU P.C. board. (Apply silicon grease to surface to be contacted with IGBT heat sink.)	 <p>The diagram illustrates the process of removing the IPDU P.C. board. It shows the internal wiring and components of the unit. Labels point to various parts: Electric parts box (A), Terminal block, IPDU crossover wire, Reactor lead wire, Fuse crossover wire, Power supply crossover wire, 4-way valve, Serial crossover wire, Power supply, Bundling band, PMV, Lower fan motor, IPDU crossover wire, Compressor case thermostat, Temperature sensor, Screws, P.C. board fixing screws, Compressor lead wires, IGBT fixing screws, Silicon grease, and IGBT.</p>

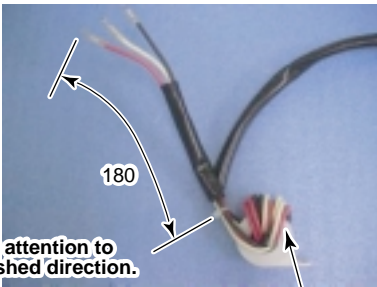
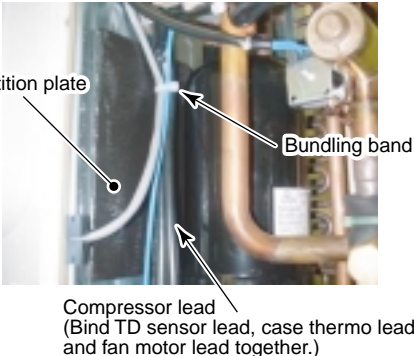
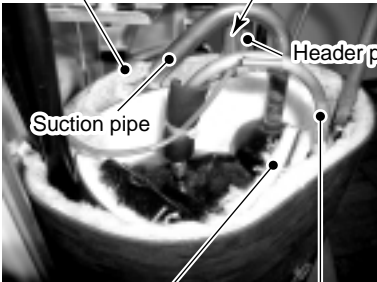
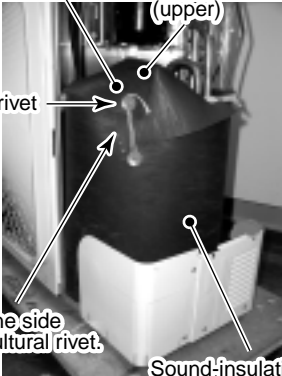
No.	Part name	Procedure	Remarks						
⑨	Reactor assembly	<p>1. Detachment</p> <p>1) Carry out works of 1 of ①, ③ and ④.</p> <p>2) Remove lead wires connected to the terminal block.</p> <p>3) Cut the bundling band which binds the reactor lead wires.</p> <p>4) Remove screws of the reactor assembly. (ST1T Ø4 × 8, 7 pcs.)</p> <p>5) Lift up the reactor assembly and then remove it from the main unit.</p> <hr/> <div><div>⚠</div><div>CAUTION</div></div> <p>The reactor assembly has heavy weight (9kg); be careful for handling it.</p> <hr/> <p>6) Remove the reactor cover. (ST1T Ø4 × 10, 6 pcs.)</p> <p>Note)</p> <p>The lead wires pass through the square hole of the reactor cover. Therefore pay attention so that lead wires are not damaged by edge when they are pulled out.</p> <p>7) Remove the reactor. (ST1T Ø4 × 10, 4 pcs.)</p>	<div><div>Bundling band</div><div>Reactor lead</div></div> <div><div>Screws</div></div> <div><div>Reactor cover (A)</div><div>Screws (at opposite side, also)</div></div> <div></div>						
		<p>1. Assembly</p> <p>1) Assemble the reactor with procedure 7) to 1).</p> <hr/> <div><div></div><div>REQUIREMENT</div></div> <p>Arrange the reactor as same as that which is replaced.</p> <hr/> <table><tr><th>Service reactor</th><th>Marking</th></tr><tr><td>N side</td><td>No</td></tr><tr><td>L side</td><td>Yes</td></tr></table>	Service reactor	Marking	N side	No	L side	Yes	<div><div>Marking (Red)</div></div> <div><div>N side (Upper side) No marking</div><div>L side (Lower side) Marking</div></div>
Service reactor	Marking								
N side	No								
L side	Yes								

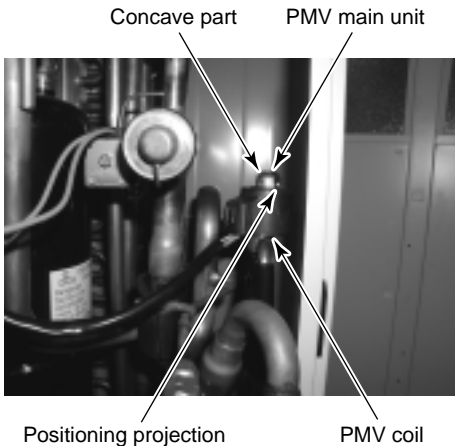
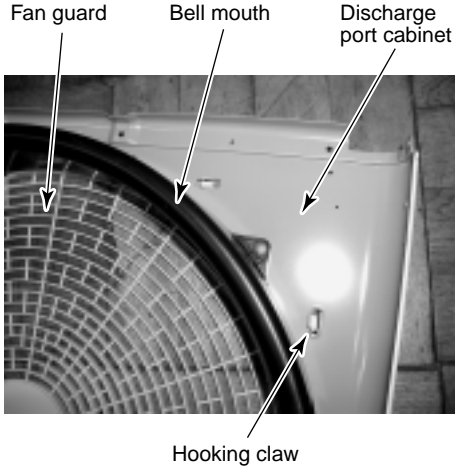
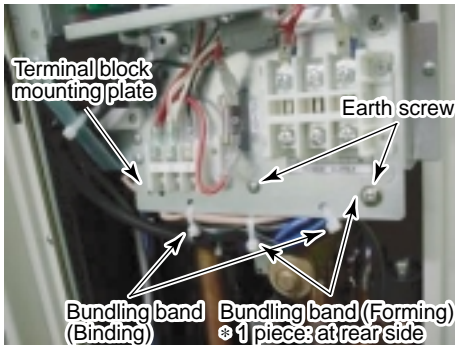
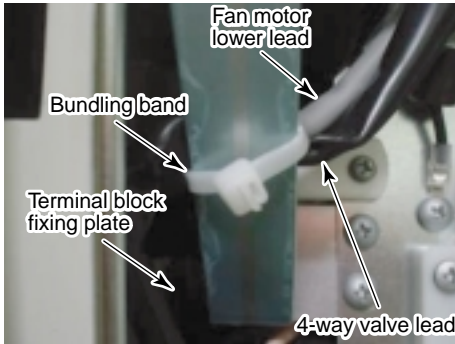
No.	Part name	Procedure	Remarks
⑩	Fan motor	<p>1) Carry out works of ① and work of ②.</p> <p>2) Remove the flange nut fixing the fan motor and the propeller fan. * The flange nut is loosened by turning it clockwise. (When tightening it, turn it counterclockwise.)</p> <p>3) Remove the propeller fan.</p> <p>4) Remove the connector for the fan motor from CDB.</p> <p>5) Remove fan motor lead wires at lower side from the fan motor lead fixing rubber of the penetrated part of the partition plate.</p> <p>6) Remove sealing material from the fan motor lead wires at upper side of the upper penetrated part of the partition plate. Remove the sealing material carefully because it is reused for the fan motor to be replaced.</p> <p>7) Remove fixing screws (4 pieces each) while support the fan motor with hands so that it does not fall.</p> <p>* Cautions at assembling of fan motor</p> <ul style="list-style-type: none"> • Tighten the flange nut with 4.95N•m (50kgf•cm). • Adjust length of the fan motor lead wire at the fan motor lead fixing rubber so that the fan motor lead is not slackened; otherwise the fan motor lead may come to contact with the propeller fan. <p>Attach the fan motor lead fixing rubber to the partition plate so that the projection is set at the refrigerating cycle side.</p> <ul style="list-style-type: none"> • Stick the sealing material, which is wound around the upper fan motor lead wires, at the position 550mm from the connector part. (After replacement of the fan motor and after piping work, confirm that the fan motor lead wires do not come to contact with the propeller fan.) • Be sure to bind the removed bundling band with the bundling band (procured locally). 	     

REQUIREMENT

Be sure to fix the fan motor lead wires to the motor base with metal band of the motor base so that they do not come to contact with the propeller fan.

No.	Part name	Procedure	Remarks
⑪	Compressor Compressor lead	<p>1. Removal of defective compressor</p> <ol style="list-style-type: none"> 1) Recover the refrigerant gas. 2) Carry out work of item 1 of ① and work of ③. 3) Remove the piping panel (Front). Remove the piping panel (Front) and screws of the bottom plate. (Hexagonal screw $\varnothing 4 \times 10$, 2 pcs.) Remove screw of the piping panel (Front) and the piping panel (Rear). (Hexagonal screw $\varnothing 4 \times 10$, 1 pc.) 4) Remove the piping panel (Rear). Remove the piping panel (Rear) and screws of the bottom plate. (Hexagonal screw $\varnothing 4 \times 10$, 2 pcs.) 5) Remove the sound-insulation plate. (Upper, rolling in, rolling out) 6) Remove the terminal cover of the compressor and then remove the compressor lead and the compressor case thermo. 7) Remove TD sensor which is fixed to the discharge pipe. 8) Remove the inverter partition plate. (ST1T $\varnothing 4 \times 10$, 2 pcs.) 9) Remove the compressor lead wires. <ul style="list-style-type: none"> • IPDU P.C. board: U : CN09 Red V : CN10 White W : CN11 Black • Remove the ferrite core. (TT2P $\varnothing 4 \times 10$, 1 pc.) 10) Using a burner, remove the discharge pipe and the suction pipe which are connected to the compressor. <hr/> <p style="text-align: center;"><u>⚠ WARNING</u></p> <p>In case of removing the piping by broiling the welded part with a burner, if there is oil in the pipe, it may burst into flames at the moment that wax melted, so take sufficient care.</p> <hr/> <p style="text-align: center;"><u>CAUTION</u></p> <p>Note so that the flame does not catch the 4-way valve and PMV. (A malfunction may be caused.)</p> <hr/> <ol style="list-style-type: none"> 11) Pull off the discharge pipe and the suction pipe of the refrigerating cycle upward. 12) Remove the compressor nuts which fix the compressor to the bottom plate. (3 pcs.) 13) Pull out the compressor toward you. <hr/> <p style="text-align: center;"><u>CAUTION</u></p> <p>As weight of the compressor is 20kg or more, handle it by 2 workers.</p> <hr/>	 <p>Piping panel (Front) Piping panel (Rear)</p>  <p>Bundling band (For thermal proof) Pipe cover Compressor lead TD sensor Compressor case thermo.</p>  <p>Compressor lead Ferrite core Inverter partition plate</p>  <p>Remove (Discharge pipe) Remove (Suction pipe)</p>  <p>450 Compressor nuts (3 pcs.)</p>

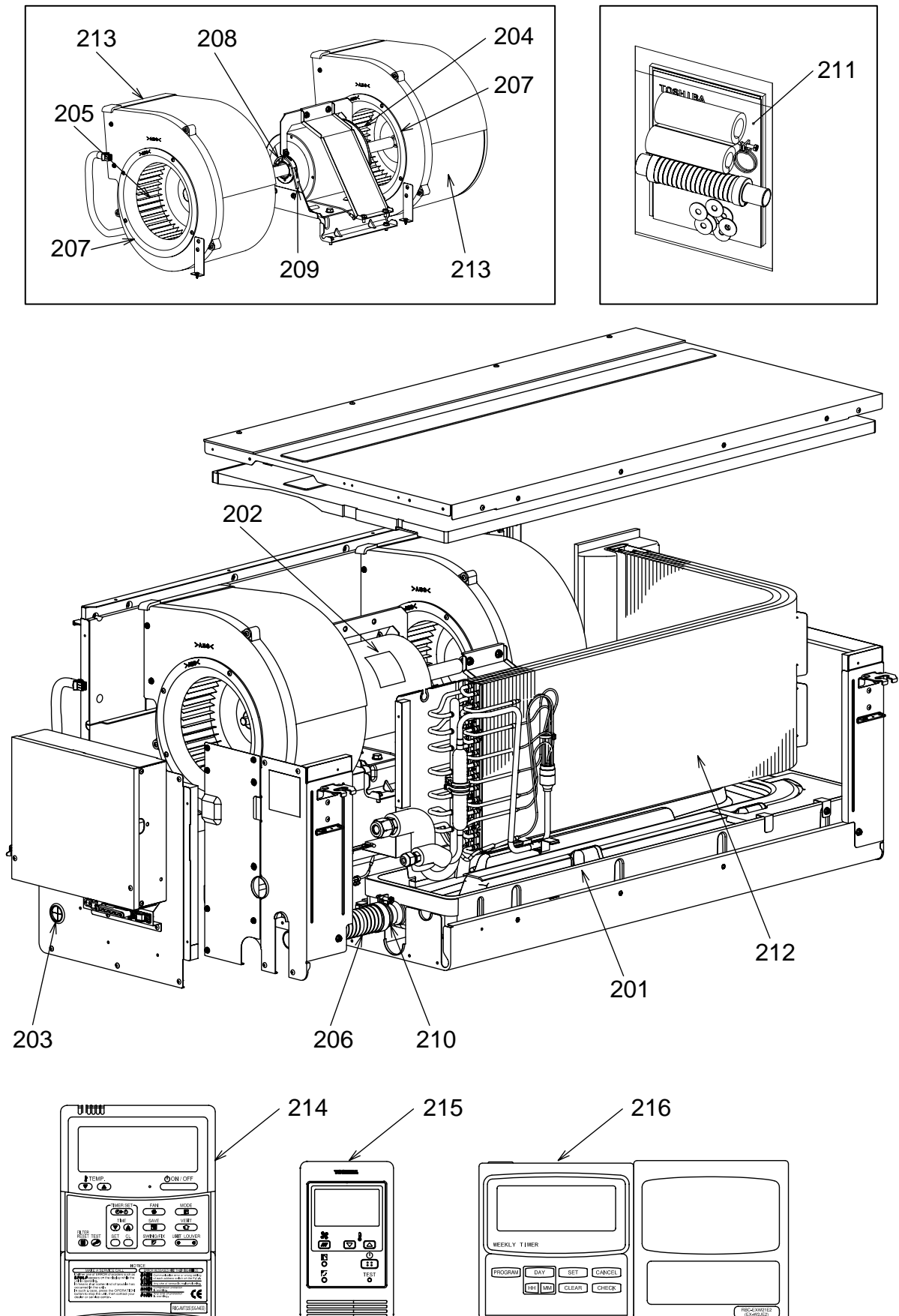
No.	Part name	Procedure	Remarks
⑪	Compressor Compressor lead (Continued)	<p>2. Mounting of compressor</p> <p>1) Mount the compressor in the reverse procedure for removal.</p> <p>Note)</p> <ul style="list-style-type: none"> After replacement of the compressor, necessarily replace the compressor lead wires. (Spare parts code: 43160591) <p>In this time, wind compressor lead around the ferrite core by 5 times.</p> <p>Treat the compressor lead wire which was wound around the ferrite core so that it does not come to contact with piping.</p> <p>After replacement of compressor lead as original, perform piping along the partition plate with natural tension.</p> <ul style="list-style-type: none"> As shown in the right figure, mount the sound-insulation plate (rolling in, rolling out) by passing through it between compressor and the piping, and between the piping and the partition plate. Fix TD sensor by the bundling band for heat-proof (procured locally) via the pipe cover so that TD sensor does not directly come to contact with the discharge pipe. <p>3. Vacuuming</p> <p>1) Connect the vacuum pump to the charge port and the check joint of the gas pipe valve and then drive the vacuum pump.</p> <p>2) Carry out vacuuming until the vacuum low pressure gauge indicates 1 (mmHg).</p> <p>4. Refrigerant charge</p> <p>1) Add the refrigerant amount determined by the pipe length from the charge port of the valve.</p>	 <p>Winding by 5 times Wind lead wires while tightening so that loop does not expand.</p>  <p>Put the end of sound-insulation plate (rolling out) on the other end at this position.</p> <p>Pass through sound-insulation plate (rolling out) between suction pipe and header pipe.</p>  <p>Pass through sound-insulation plate (rolling in) between compressor and discharge pipe, suction pipe and then put the end of sound-insulation plate on the other end at this position.</p> <p>There should be no clearance between sound-insulation plate (upper) and sound-insulation plate (rolling out).</p>  <p>Insert one side under cultural rivet.</p>

No.	Part name	Procedure	Remarks
⑫	PMV coil	1. Detachment 1) Carry out work of item 1 of ⑪. 2) Turn the coil while pulling upward and then remove the coil from the PMV main unit. 2. Attachment 1) Surely match the positioning projection of the coil with the concave part of PMV main unit and then fix it.	
⑬	Fan guard	1. Detachment 1) Carry out works of item 1 of ⑪ and work of ⑫. <div style="text-align: center;">REQUIREMENT</div> To prevent scratch on the product, carry out the work on cardboard, cloth, etc. 2) Remove the discharge port cabinet and then put on it so that the fan guard side directs downward. 3) Remove the hooking claws (8 positions) of the fan guard. 2. Attachment 1) Push the hooking claws (8 positions) with hands from the front side to fix the claws. <div style="text-align: center;">REQUIREMENT</div> Check that all the hooking claws are fixed at the specified positions.	
⑭	Wiring process (Final check)	1. Sensor lead, compressor case thermo lead, PMV lead 1) Turn the remained length of lead, bind it and then fix with bundling band. 2) Fix the lead with bundling band so that it does not come to contact with earth screw. 2. Fan motor lower lead, 4-way valve lead 1) Fix them to terminal block fixing plate with bundling band. (Bind with crossed right-up)	 

15. EXPLODED VIEWS AND PARTS LIST

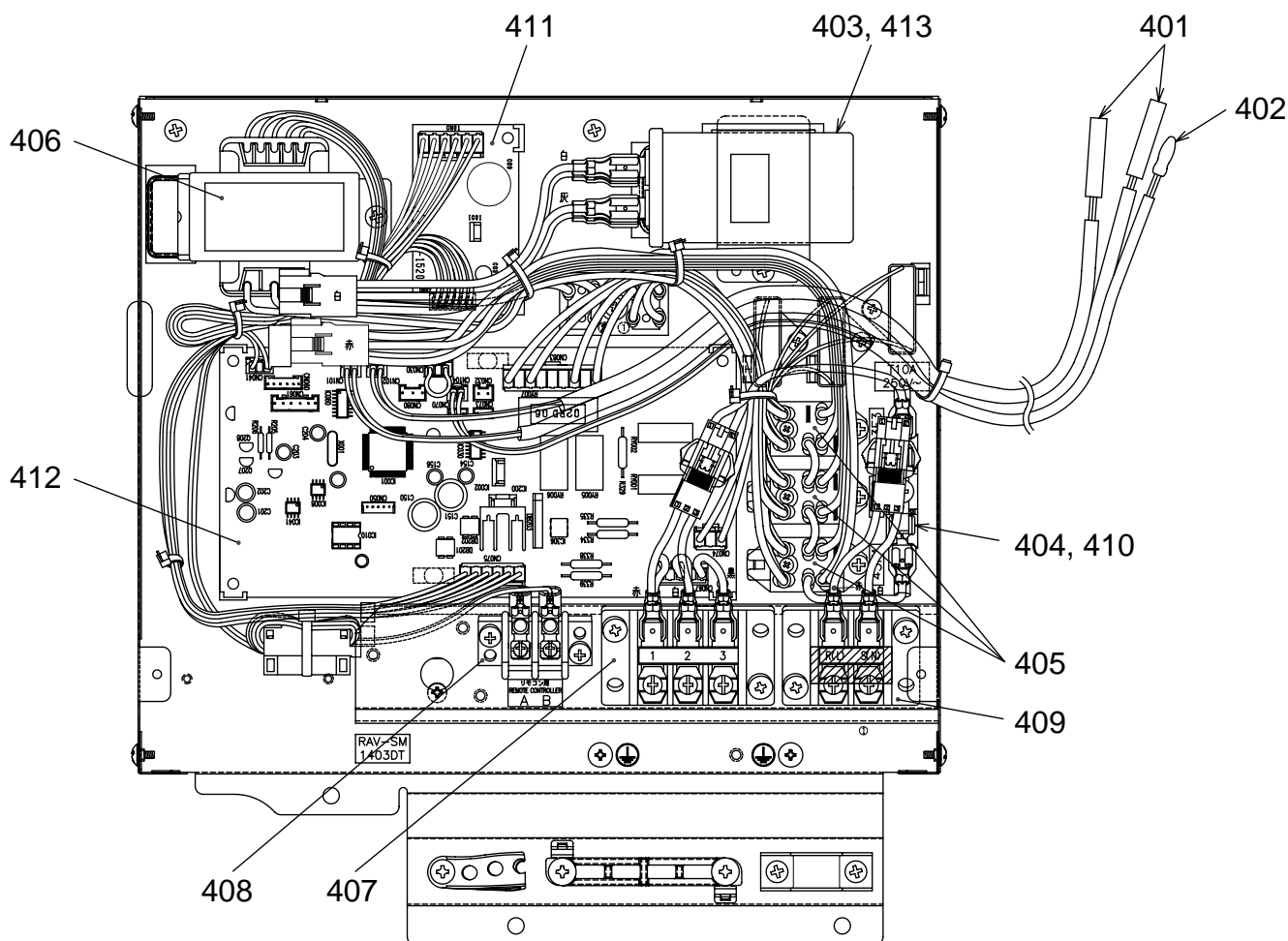
15-1. Indoor Unit

RAV-SM1103DT-A, RAV-SM1403DT-A, RAV-SM1603DT-A



Location No.	Part No.	Description	Model Name RAV-SM
			1103DT-A, 1403DT-A, 1603DT-A
201	43172203	Pan Ass'y, Drain	1
202	4312C041	Motor, Fan, AC240V, 50Hz, 600W	1
203	43019830	Bushing	1
204	43020352	Fan	1
205	43020353	Fan	1
206	43170244	Hose, Drain, 25A	1
207	43139167	Bell Mouth	2
208	43139154	Band, Motor, Left	2
209	43139155	Band, Motor, Right	2
210	43179135	Band, Hose, 37-40	1
211	431S8089	Owner's Manual	1
212	4314J404	Refrigeration Cycle Ass'y	1
213	43122118	Case Ass'y, Fan	2
214	43166011	Remote Controller, SX-A4EE	1
215	43166004	Remote Controller, SX-A11JE2	1
216	43166005	Remote Controller, EX-W2JE2	1

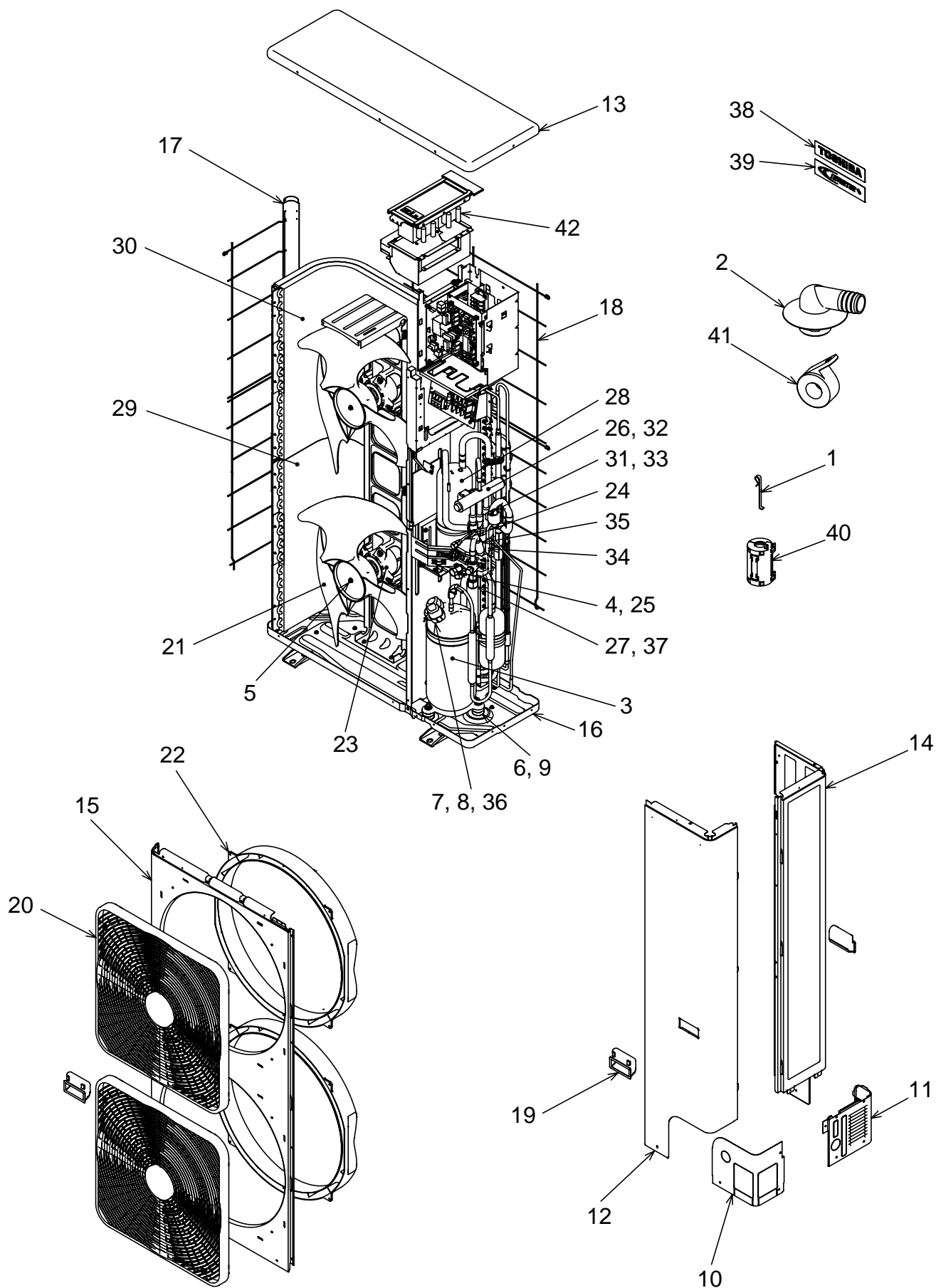
RAV-SM1103DT-A, RAV-SM1403DT-A, RAV-SM1603DT-A



Location No.	Part No.	Description	Model Name	
			1103DT-A, 1403DT-A	1603DT-A
401	43050425	Sensor TC (F6) Ass'y, Service	2	2
402	43050426	Sensor TA, Service	1	1
403	43055529	Capacitor, AC450V, 8 μ F	1	
404	43060859	Fuse Block, 30A, 250V, * FH153-PB	1	1
405	43154175	Relay, LY1F, AC220 / 240V	3	3
406	43158204	Transformer, TT13 (AC220 – 240V)	1	1
407	43160565	Terminal Block, 3P, AC250V, 20A	1	1
408	43160568	Terminal, 2P, AC30V / DC42V, 1A	1	1
409	43160575	Terminal Block, 2P, AC300V, 20A	1	1
410	43160577	Fuse, 10A	1	1
411	4316V345	P.C. Board Ass'y, MCC-1520	1	1
412	4316V369	P.C. Board Ass'y, MCC-1403 (220 – 240V)	1	
413	43155215	Capacitor, AC450V, 10MFD		1

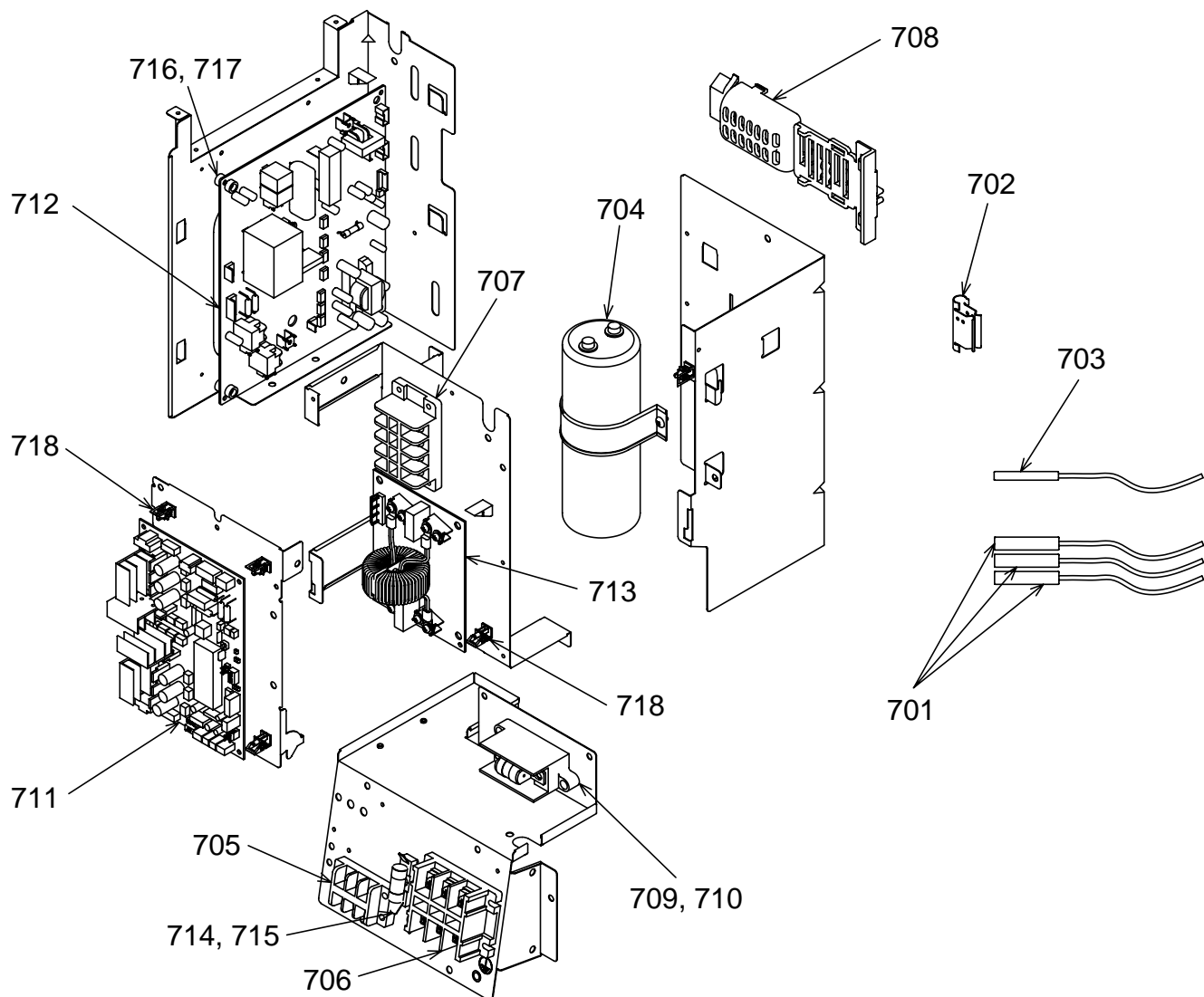
15-2. Outdoor Unit

RAV-SM1603AT-E, RAV-SM1603ATZ-E, RAV-SM1603ATZG-E



Location No.	Part No.	Description	Model Name RAV-SM		
			1603AT-E	1603ATZ-E	1603ATZG-E
1	43019904	Holder, Sensor, SUS	2	2	2
2	43032441	Nipple, Drain	1	1	1
3	43041794	Compressor, DA422A3F-25M	1	1	1
4	43047246	Bonnet, 3/8 IN	1	1	1
5	43047669	Nut, Flange	2		
5	43197164	Nut, Flange, SUS304-WSB		2	2
6	43049739	Cushion, Rubber	3	3	3
7	43050407	Thermostat, Bimetal	1	1	1
8	43063317	Holder, Thermostat	1	1	1
9	43097212	Nut	3		
9	43197174	Nut, Comp., SWCH10R		3	3
10	43100437	Panel, Front, Piping	1	1	1
11	43100438	Panel, Back, Piping	1	1	1
12	43100439	Panel, Front	1	1	1
13	43100451	Plate, Roof	1	1	1
14	43100441	Panel, Side	1	1	1
15	43100442	Panel, Air Outlet	1	1	1
16	43100443	Base Ass'y	1	1	1
17	43107274	Guard, Fin, Side	1	1	1
18	43107275	Guard, Fin, Back	1	1	1
19	43107276	Hanger, PP	3	3	3
20	43109422	Guard, Fan, PP	2	2	2
21	43120244	Fan, Propeller, PB521, SAN-GF20	2	2	2
22	43122113	Bell, Mouth, PP	2	2	2
23	43121744	Motor, Fan, ICF-280-100-1R	2	2	2
24	43146676	Joint, Check	1	1	1
25	43146686	Valve, Packed, 9.52	1	1	1
26	43146687	Valve, 4-Way, STF-0401G	1	1	1
27	43146724	Valve, Ball, SBV-JA5GTC-1, RoHs	1	1	1
28	43148170	Accumulator Ass'y, 2.5L	1	1	
28	43148188	Accumulator, 2.5L			1
29	4314G266	Condenser Ass'y, Down	1		
29	4314G267	Condenser Ass'y, Down		1	
29	4314G268	Condenser Ass'y, Down			1
30	4314G269	Condenser Ass'y, Up	1		
30	4314G270	Condenser Ass'y, Up		1	
30	4314G271	Condenser Ass'y, Up			1
31	4314N023	Valve, Pulse, Modulaing, UKV-25D100	1	1	1
32	43146722	Coil, Valve, Solenoid, STF-01AJ502E1	1	1	1
33	4314N025	Coil, PMV, UKV-A038	1	1	1
34	4314Q031	Strainer, DIA 9.52, C1220T-H	1	1	1
35	4314Q032	Strainer	1	1	1
36	43160591	Lead Ass'y, Compressor	1	1	1
37	43194029	Bonnet	1	1	1
38	4301P703	Mark, TOSHIBA	1	1	1
39	4301P729	Mark, Inverter	1	1	1
40	43060029	Filter, Noise	1	1	1
41	43155216	Filter, Noise	1	1	1
42	43158197	Reactor, CH-65	2	2	2

RAV-SM1603AT-E, RAV-SM1603ATZ-E, RAV-SM1603ATZG-E



Location No.	Part No.	Description	Model Name
			RAV-SM 1603AT-E, 1603ATZ-E, 1603ATZG-E
701	43050425	Sensor TC (F6) Ass'y, Service	3
702	43063325	Holder, Sensor, 6 - 6.35, 8	1
703	43150319	Sensor Ass'y, TD (F4), Service	1
704	43155211	Capacitor	1
705	43160565	Terminal Block, 3P, AC250V, 20A	1
706	43160581	Terminal, 3P, 60A	1
707	43160579	Terminal, 4P, 30A	1
708	43163055	Holder, Sensor	1
709	43160594	Fuse, AC250V, 50A	1
710	43160595	Holder-Fuse	1
711	4316V370	P.C. Board Ass'y, CDB, MCC-1531	1
712	4316V371	P.C. Board Ass'y, A3-IPDU, MCC-1535	1
713	4316V372	P.C. Board Ass'y, Noise-Filter, MCC-1551	1
714	43060859	Fuse Block, 30A, 250V, * FH153-PB	1
715	43060700	Fuse, 10A, 250V	1
716	43282001	Bushing, NB-300	2
717	43183020	Collar, NA310	2
718	43063248	Supporter Ass'y	2

WARNINGS ON REFRIGERANT LEAKAGE

Check of Concentration 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 concentration 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 to be imposed which protect the ozone layer.

However, since it contains more than air, it poses the risk of suffocation if its concentration should rise excessively. Suffocation from leakage of R410A is almost non-existent.

With the recent increase in the number of high concentration 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 with conventional individual air conditioners.

If a single unit of the multi 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 concentration 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 concentration may exceed the limit, create an opening with adjacent rooms, or install mechanical ventilation combined with a gas leak detection device.

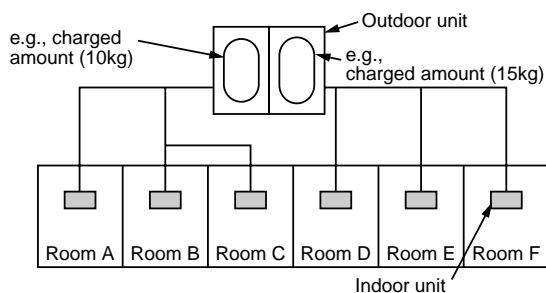
The concentration is as given below.

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

The concentration limit of R410A which is used in multi air conditioners is 0.3kg/m³.

NOTE 1 :

If there are 2 or more refrigerating systems in a single refrigerating device, the amounts 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 10kg.

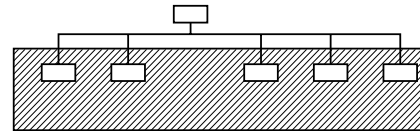
The possible amount of leaked refrigerant gas in rooms D, E and F is 15kg.

Important

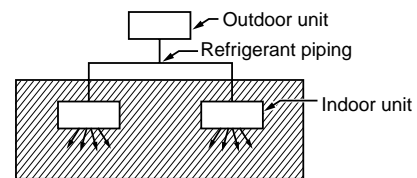
NOTE 2 :

The standards for minimum room volume are as follows.

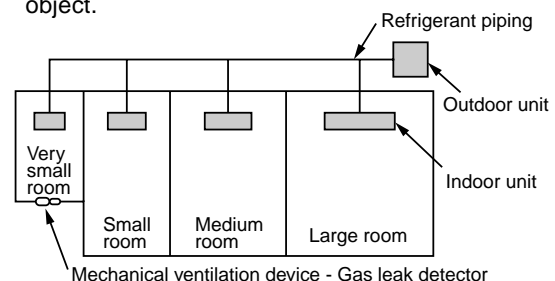
(1) No partition (shaded portion)



(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).

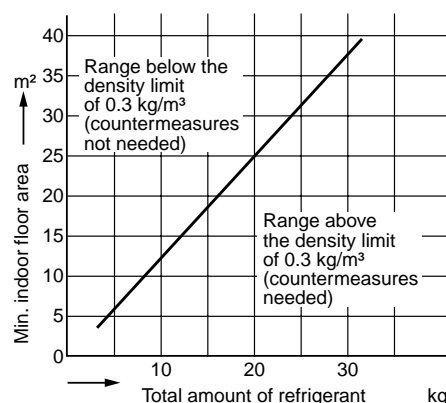


(3) If an indoor unit is installed in each partitioned room and the refrigerant piping is interconnected, the smallest room of course becomes the object. But when a mechanical ventilation is installed interlocked with a gas leakage detector in the smallest room where the density limit is exceeded, the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



NOTE 3 :

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



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