

CHAPTER 3. FUNCTION AND OPERATION OF PROTECTIVE PROCEDURES

[1] PROTECTION DEVICE FUNCTIONS AND OPERATIONS

Function		Operation				Self-diagnosis result display	
		Description	Detection period	Reset condition	Indoor unit error display	Indoor unit	Outdoor unit
1	Indoor unit fan lock	Operation stops if there is no input of rotation pulse signal from indoor unit fan motor for 1 minute.	When indoor unit fan is in operation	Operation OFF or ON	☆2	Yes	None
	Indoor unit fan rotation speed error	Operation stops if rotation pulse signal from indoor unit fan indicates abnormally low speed (about 300 rpm or slower).	When indoor unit fan is in operation	Operation OFF or ON	☆2	Yes	None
2	Indoor unit freeze prevention	Compressor stops if temperature remains below 0°C for 4 minutes.	When in cooling or dehumidifying operation	Automatic reset when heat exchanger temperature rises above freeze prevention temperature (2°C or higher)	—	None	None
3	2-way valve freeze prevention	Compressor stops if temperature of outdoor unit 2-way valve remains below 0°C for 10 continuous minutes during cooling or dehumidifying operation.	When in cooling or dehumidifying operation	Automatic reset when temperature of 2-way valve rises above 10°C.	None	Yes	Yes
4	Indoor unit heat exchanger overheat shutdown	Operating frequency lowers if indoor unit heat exchanger temperature exceeds overheat temperature during heating operation. Compressor stops if indoor unit heat exchanger temperature exceeds overheat temperature for 60 seconds at minimum frequency. Overheat temperature setting value indoor unit heat exchanger thermistor temperature: about 45 to 54°C	When in heating operation	Automatic reset after safety period (180 sec).	None	Yes	Yes
5	Outdoor unit heat exchanger overheat shutdown	Operation frequency lowers if outdoor unit heat exchanger temperature exceeds about 55°C during cooling operation. Compressor stops if outdoor unit heat exchanger temperature exceeds about 55°C for 120 seconds at minimum frequency.	When in cooling or dehumidifying operation	Automatic reset after safety period (180 sec).	None	Yes	Yes
6	Compressor discharge overheat shutdown	Operating frequency lowers if temperature of compressor chamber thermistor (TH1) falls below about 110°C. Compressor stops if temperature of compressor chamber thermistor (TH1) remains at about 110°C (for 120 seconds in cooling operation, or 60 seconds in heating operation) at minimum frequency.	When compressor is in operation	Automatic reset after safety period (180 sec).	None	Yes	Yes
7	Dehumidifying operation temporary stop	Compressor stops if outside air temperature thermistor is lower than about 16°C during dehumidifying operation.	When in dehumidifying operation	Automatic reset when outside air temperature rises above 16°C.	None	Yes	Yes
8	DC overcurrent error	Compressor stops if electric current of about 25 A or higher flows in IPM.	When compressor is in operation	Operation OFF or ON	Yes ☆1	Yes	Yes

Function		Operation					Indoor unit	Outdoor unit
		Description	Detection period	Reset condition	Indoor unit error display	Indoor unit		
9	AC overcurrent error	Operating frequency lowers if compressor AC current exceeds peak control current value. Compressor stops if compressor AC current exceeds peak control current value at minimum frequency.	When compressor is in operation	Operation OFF or ON	Yes ☆1	Yes	Yes	
10	AC overcurrent error in compressor OFF status	Indoor and outdoor units stop if AC current exceeds about 3 A while compressor is in non-operation status.	When compressor is in non-operation	Replacement of defective parts such as IPM	Yes ☆2	Yes	Yes	
11	AC maximum current error	Compressor stops if compressor AC current exceeds 17 A.	When compressor is in operation	Operation OFF or ON	Yes ☆1	Yes	Yes	
12	AC current deficiency error	Compressor stops if operating frequency is 50 Hz or higher and compressor AC current is about 2.0 A or lower.	When compressor is in operation	Operation OFF or ON	Yes ☆1	Yes	Yes	
13	Thermistor installation error or 4-way valve error	Compressor stops if high and low values of temperatures detected by outdoor unit heat exchanger thermistor (TH2) and 2-way valve thermistor (TH5) do not match operating cycle.	3 minutes after compressor startup	Operation OFF or ON	Yes ☆1	Yes	Yes	
14	Compressor high temperature error	Compressor stops if compressor chamber thermistor (TH1) exceeds about 114°C, or if there is short-circuit in TH1.	When in operation	Operation OFF or ON	Yes ☆1	Yes	Yes	
15	Outdoor unit heat exchanger thermistor short-circuit error	Compressor stops if there is short-circuit in outdoor unit heat exchanger thermistor (TH2).	At compressor startup	Operation OFF or ON	Yes ☆1	Yes	Yes	
16	Outdoor unit outside air temperature thermistor short-circuit error	Compressor stops if there is short-circuit in outdoor unit outside air temperature thermistor (TH3).	At compressor startup	Operation OFF or ON	Yes ☆1	Yes	Yes	
17	Outdoor unit suction thermistor short-circuit error	Compressor stops if there is short-circuit in outdoor unit suction thermistor (TH4).	At compressor startup	Operation OFF or ON	Yes ☆1	Yes	Yes	
18	Outdoor unit 2-way valve thermistor short-circuit error	Compressor stops if there is short-circuit in outdoor unit 2-way valve thermistor (TH5).	At compressor startup	Operation OFF or ON	Yes ☆1	Yes	Yes	
19	Outdoor unit heat exchanger thermistor open-circuit error	Compressor stops if there is open-circuit in outdoor unit heat exchanger thermistor (TH2).	At compressor startup	Operation OFF or ON	Yes ☆1	Yes	Yes	
20	Outdoor unit outside air temperature thermistor open-circuit error	Compressor stops if there is open-circuit in outdoor unit outside air temperature thermistor (TH3).	At compressor startup	Operation OFF or ON	Yes ☆1	Yes	Yes	
21	Outdoor unit suction thermistor open-circuit error	Compressor stops if there is open-circuit in outdoor unit suction thermistor (TH4).	At compressor startup	Operation OFF or ON	Yes ☆1	Yes	Yes	
22	Outdoor unit 2-way valve thermistor open-circuit error	Compressor stops if there is open-circuit in outdoor unit 2-way valve thermistor (TH5).	At compressor startup	Operation OFF or ON	Yes ☆1	Yes	Yes	
23	Outdoor unit discharge thermistor open-circuit error	Compressor stops if there is open-circuit in outdoor unit discharge thermistor (TH1).	At compressor startup	Operation OFF or ON	Yes ☆1	Yes	Yes	
24	Serial signal error	Power relay turns OFF if indoor unit cannot receive serial signal from outdoor unit for 8 minutes.	When in operation	Operation OFF or ON (Automatic reset when less than 8 minutes)		Yes	None	
		Compressor stops if outdoor unit cannot receive serial signal from indoor unit for 30 seconds.	When in operation	Reset after reception of serial signal	None	None	None	

Function		Operation				Self-diagnosis result display	
		Description	Detection period	Reset condition	Indoor unit error display	Indoor unit	Outdoor unit
25	Compressor start-up error	Compressor stops if compressor fails to start up.	At compressor start-up	Operation OFF or ON	Yes ☆3	Yes	Yes
26	Compressor rotation error (at 120° energizing)	Compressor stops if there is no input of position detection signal from compressor or input is abnormal.	Compressor operating at 120° energizing	Operation OFF or ON	Yes ☆3	Yes	Yes
27	Outdoor unit DC fan error	Operation stops if there is no input of rotation pulse signal from outdoor unit fan motor for 30 seconds.	When outdoor unit fan is in operation	Operation OFF or ON	Yes ☆1	Yes	Yes
28	PAM overvoltage error	Compressor stops if DC voltage is 350 V or higher.	When in operation	Operation OFF or ON	Yes ☆1	Yes	Yes
29	PAM clock error	When power source frequency cannot be determined (at startup), or when power source clock cannot be detected for 1 continuous second (at startup).	At compressor start-up, when in operation	Compressor continues operation without stopping.	None	Yes	Yes
30	IPM pin level error	When Outdoor unit starts to run, MCU checks 6 control pin levels of IPM. If MCU detects some pin levels isn't different from another pin level. MCU doesn't run Compressor.	At compressor start-up	Operation OFF or ON	Yes ☆1	Yes	Yes

☆1—The outdoor unit restarts four times before the indoor unit error is displayed (complete shutdown).

☆2—A single error judgment results in the display of the indoor unit error (complete shutdown).

☆3—The outdoor unit restarts eight times before the indoor unit error is displayed (complete shutdown).

[2] AIR CONDITIONER OPERATION IN THERMISTOR ERROR

1. Indoor unit

Item	Mode	Control operation	When resistance is low (temperature judged higher than actual)	Short-circuit	When resistance is high (temperature judged lower than actual)	Open-circuit
Room temperature thermistor (TH1)	Auto	Operation mode judgment	Cooling mode is activated even if room temperature is low.	Cooling mode is activated in most cases.	Heating mode is activated even if room temperature is high.	Heating mode is always activated.
	Cooling	Frequency control	Room becomes too cold.	Air conditioner operates in full power even when set temperature is reached.	Room does not become cool.	Compressor does not operate.
	Dehumidifying	Room temperature memory Frequency control	Normal operation.	Room temperature is stored in memory as 31.0°C, and compressor does not stop.	Normal operation.	Room temperature is stored in memory as 18.5°C, and compressor does not operate.
	Heating	Frequency control	Room does not become warm.	Hot keep status results immediately after operation starts. Frequency does not increase above 30 Hz (40 Hz).	Room becomes too warm.	Air conditioner operates in full power even when set temperature is reached.

Item	Mode	Control operation	When resistance is low (temperature judged higher than actual)	Short-circuit	When resistance is high (temperature judged lower than actual)	Open-circuit
Heat exchanger thermistor (TH2)	Cooling Dehumidifying	Freeze prevention	Indoor unit evaporator may freeze.	Indoor unit evaporator may freeze.	Compressor stops occasionally.	Compressor does not operate.
	Heating	Cold air prevention	Cold air prevention deactivates too soon and cold air discharges.	Compressor operates at low speed or stops, and frequency does not increase.	Cold air prevention deactivates too slow.	Cold air prevention does not deactivate, and indoor unit fan does not rotate.

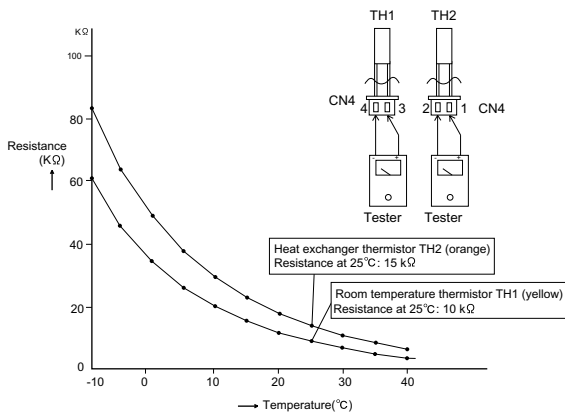
2. Outdoor unit

Item	Mode	Control operation	When resistance is low (temperature judged higher than actual)	Short-circuit	When resistance is high (temperature judged lower than actual)	Open-circuit
Compressor chamber thermistor (TH1)	Cooling Dehumidifying Heating	Expansion valve control and compressor protection	Compressor operates, but room does not become cool or warm (expansion valve is open).	Compressor high temperature error indication.	Layer short-circuit or open-circuit may result in compressor in normal operation.	Outdoor unit thermistor open-circuit error indication.
Heat exchanger thermistor (TH2)	Cooling Dehumidifying	Outdoor unit heat exchanger overheat prevention	Compressor operates at low speed or stops.	Outdoor unit thermistor short-circuit error indication.	Normal operation.	Outdoor unit thermistor open-circuit error indication.
	Heating	Expansion valve control Defrosting	Defrosting operation is not activated as needed, and frost accumulates on outdoor unit (expansion valve is closed).	Outdoor unit thermistor short-circuit error indication.	Defrosting operation is activated unnecessarily, and room does not become warm (expansion valve is open).	Outdoor unit thermistor open-circuit error indication.
Outside air temperature thermistor (TH3)	Auto	Operation mode judgment	Cooling mode is activated even if room temperature is low.	Outdoor unit thermistor short-circuit error indication.	Heating mode is activated even if room temperature is high.	Outdoor unit thermistor open-circuit error indication.
	Cooling Dehumidifying	Operation not affected	Normal operation.	Outdoor unit thermistor short-circuit error indication.	Normal operation.	Outdoor unit thermistor open-circuit error indication.
	Heating	Rating control Defrosting	Defrosting operation is activated unnecessarily.	Outdoor unit thermistor short-circuit error indication.	Defrosting operation is not activated, and frost accumulates on outdoor unit.	Outdoor unit thermistor open-circuit error indication.
Suction pipe thermistor (TH4)	Cooling Dehumidifying	Expansion valve control	Compressor operates, but room does not become cool (expansion valve is open).	Outdoor unit thermistor short-circuit error indication.	Frost accumulates on evaporator inlet section, and room does not become cool (expansion valve is closed).	Outdoor unit thermistor open-circuit error indication.
	Heating	Expansion valve control	Compressor operates, but room does not become warm (expansion valve is open).	Outdoor unit thermistor short-circuit error indication.	Frost accumulates on expansion valve outlet section, and room does not become warm (expansion valve is closed).	Outdoor unit thermistor open-circuit error indication.

Item	Mode	Control operation	When resistance is low (temperature judged higher than actual)	Short-circuit	When resistance is high (temperature judged lower than actual)	Open-circuit
2-way valve thermistor (TH5)	Cooling Dehumidifying	Expansion valve control	Frost accumulates on indoor unit evaporator and room does not become cool (expansion valve is closed).	Outdoor unit thermistor short-circuit error indication.	Compressor operates, but room does not become cool (expansion valve is open).	Outdoor unit thermistor open-circuit error indication.
	Heating	Operation not affected	Normal operation.	Outdoor unit thermistor short-circuit error indication.	Normal operation.	Outdoor unit thermistor open-circuit error indication.

[3] THERMISTOR TEMPERATURE CHARACTERISTICS

1. Indoor unit thermistor temperature characteristics

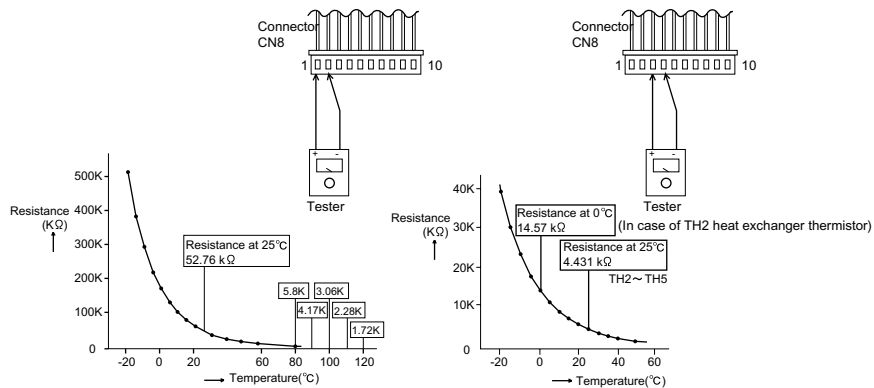


TH1 Room temperature thermistor
TH2 Heat exchanger thermistor

Thermistor	Symbol	Color
Room temperature	TH1 (CN4)	Yellow
Heat exchanger	TH2 (CN4)	Orange

Before measuring resistance, disconnect connectors as shown above.

2. Outdoor unit thermistor temperature characteristics



TH1 Compressor thermistor

TH2 Heat exchanger thermistor
TH3 Outdoor air temperature thermistor
TH4 Suction thermistor
TH5 2-way valve thermistor

Thermistor	No.	Connector	Color
Compressor thermistor	TH1	No. (1) - No. (2)	Red
Heat exchanger thermistor	TH2	No. (3) - No. (4)	Orange
Outdoor air temperature thermistor	TH3	No. (5) - No. (6)	Green
Suction thermistor	TH4	No. (7) - No. (8)	Black
2-way valve thermistor	TH5	No. (9) - No. (10)	Yellow

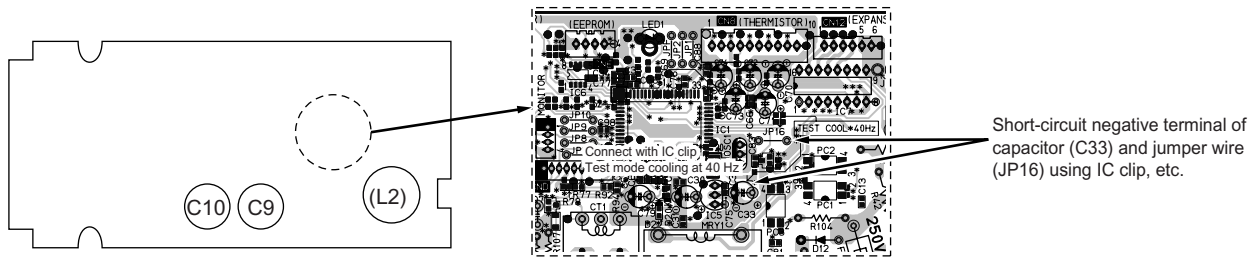
Before measuring resistance, disconnect connectors from PWB.

[4] HOW TO OPERATE THE OUTDOOR UNIT INDEPENDENTLY

1. Cooling in 40 Hz fixed mode

To operate the outdoor unit independently, short-circuit the sections indicated by arrows in the diagram below with an adapter, and apply 230 VAC between (1) and (N) on the terminal board of the outdoor unit. This allows the outdoor unit to be operated in cooling mode independently.

(Do not operate the outdoor unit in this condition for an extended period of time.)



[5] GENERAL TROUBLESHOOTING CHART

1. Indoor unit does not turn on

Main cause	Inspection method	Normal value/condition	Remedy
Cracked PWB. (Cracked pattern)	Check visually.	There should be no cracking in PWB or pattern.	Replace PWB.
Open-circuit in FU1 (250 V, 3 A), FU2 (250 V, 3 A)	Check melting of FU1, FU2.	There should be no open-circuit.	Replace PWB.

2. Indoor unit fan does not operate

Main cause	Inspection method	Normal value/condition	Remedy
Open-circuit in heat exchanger thermistor (TH2) (in heating operation)	Measure thermistor resistance (dismount for check).	Refer to Indoor unit thermistor temperature characteristics – 1	Replace thermistor.
		There should be no open-circuit or faulty contact.	Replace thermistor.
Disconnected heat exchanger thermistor (TH2) (in heating operation)	Inspect connector on PWB. Check thermistor installation condition.	Thermistor should not be disconnected.	Install correctly.

3. Indoor unit fan speed does not change

Main cause	Inspection method	Normal value/condition	Remedy
Remote control not designed to allow fan speed change.	Check operation mode.	Fan speed should change except during dehumidifying operation, ventilation, light dehumidifying operation, internally normal operation	Explain to user.

4. Remote control signal is not received

Main cause	Inspection method	Normal value/condition	Remedy
Batteries at end of service life.	Measure battery voltage.	2.5 V or higher (two batteries in series connection)	Install new batteries.
Batteries installed incorrectly.	Check battery direction.	As indicated on battery compartment.	Install batteries in indicated direction.
Lighting fixture is too close, or fluorescent lamp is burning out.	Turn off light and check.	Signal should be received when light is turned off.	Change light position or install new fluorescent lamp.
Use Sevvick light (Hitachi).	Check if Sevvick light (Hitachi) is used.	Signal may not be received sometimes due to effect of Sevvick light.	Replace light or change position.
Operating position/angle is inappropriate.	Operate within range specified in manual.	Signal should be received within range specified in manual.	Explain appropriate handling to user.
Open-circuit or short-circuit in wiring of light receiving section.	Check if wires of light receiving section are caught.	Wires of light receiving section should not have any damage caused by pinching.	Replace wires of light receiving section.

Main cause	Inspection method	Normal value/condition	Remedy
Defective light receiving unit.	Check signal receiving circuit (measure voltage between terminals 2 and 3 of connector BCN3B).	Tester indicator should move when signal is received.	Replace PWB.
Dew condensation on light receiving unit.	Check for water and rust.	Signal should be received within range specified in manual.	Take moisture-proof measure for lead wire outlet of light receiving section.

5. Louvers do not move

Main cause	Inspection method	Normal value/condition	Remedy
Caught in sliding section.	Operate to see if louvers are caught in place.	Louvers should operate smoothly.	Remove or correct catching section.
Disconnected connector (DCNC, DCND on relay PWB, louver motor side)	Inspect connectors.	Connectors or pins should not be disconnected.	Install correctly.
Contact of solder on PWB (connector section on PWB)	Check visually.	There should not be solder contact.	Correct contacting section.

6. There is noise in TV/radio

Main cause	Inspection method	Normal value/condition	Remedy
Grounding wires not connected properly.	Check grounding wire connections.	Grounding wires should be connected properly.	Connect grounding wires properly.
TV/radio is placed too close to outdoor unit.	Check distance between TV/radio and outdoor unit.	If TV/radio is placed too close, it may become affected by noise.	Move TV/radio away from outdoor unit.
Other than above.	Check for radio wave interference. (See page)		

7. Malfunction occurs

Main cause	Inspection method	Normal value/condition	Remedy
Malfunction caused by noise.	Check for radio wave interference. (See page)		

8. Compressor does not start

Main cause	Inspection method	Normal value/condition	Remedy
Erroneous inter-unit connection.	Check wiring between indoor and outdoor units.	Terminal board 1-N: 230 VAC, 50 Hz Terminal board 2: serial signal	Correct wiring.
Damaged IPM.	Check IPM continuity.	Refer to IPM check method – 3	Replace IPM.
Dried-up electrolytic capacitor.	Check electrolytic capacitor.	Refer to Inverter electrolytic capacitor (C9, C10) check method – 2	Replace electrolytic capacitor.
Blown outdoor unit fuse.	Check 20-A fuse. Check 15-A fuse.	Fuse should not be blown.	Replace fuse/diode bridge. Replace fuse. Replace outdoor unit PWB assembly.
Power supply voltage is too low.	Measure power supply voltage during startup.	230±10 VAC, 50 Hz	Make sure that power supply voltage is 180 V or higher.
Compressor lock.	Supply current and touch compressor cover (sound absorbing material) to check if operation starts.	Compressor should start normally.	Apply external impact to compressor. Replace compressor.

9. Operation stops after a few minutes and restarts, and this process repeats

Main cause	Inspection method	Normal value/condition	Remedy
Dried-up electrolytic capacitor.	Measure 320-VDC line voltage.	250 V or higher.	Replace electrolytic capacitor.
Layer short-circuit in expansion valve coil.	Measure resistance.	46±3Ω in each phase (at 20°C)	Replace coil.

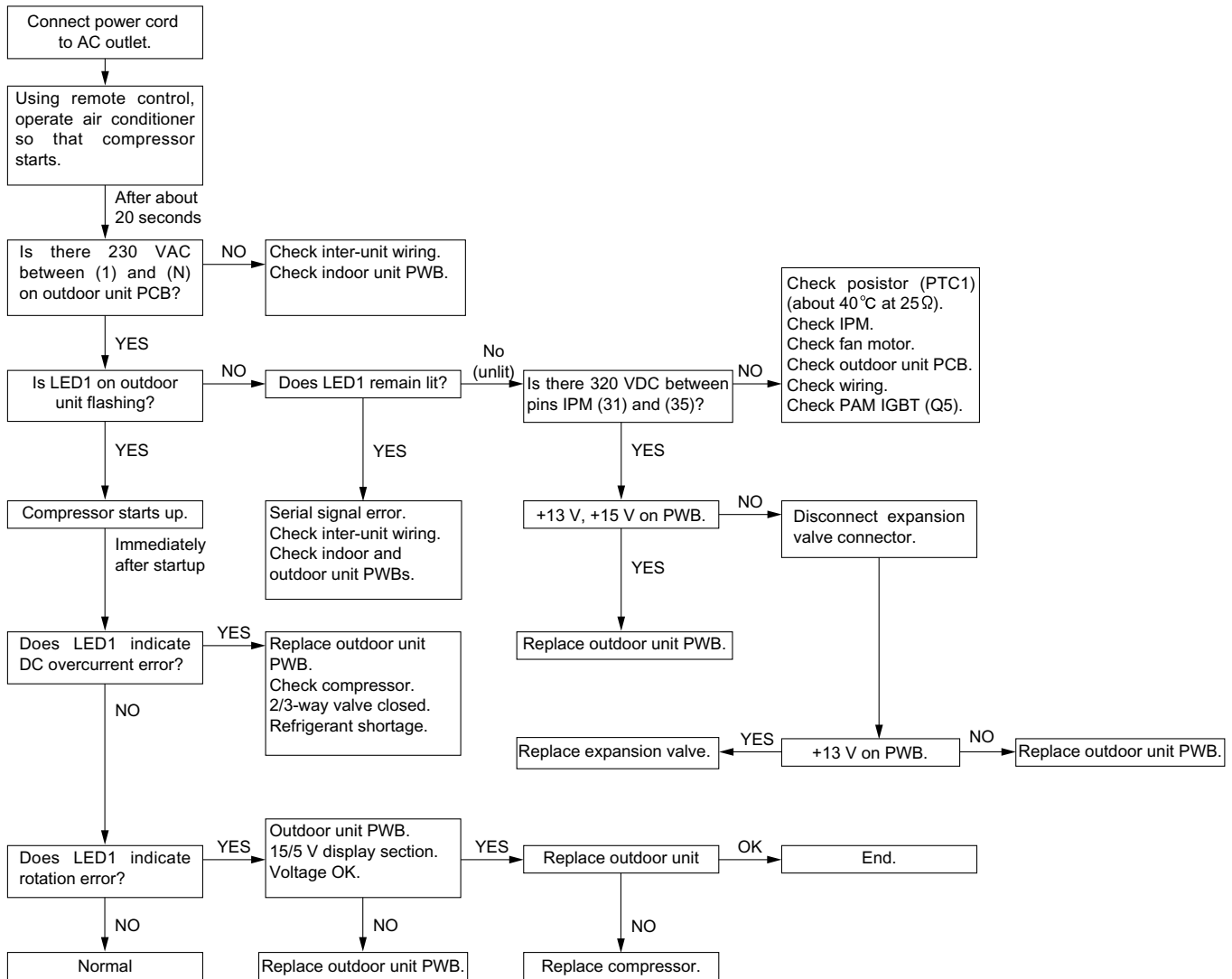
CAUTION: If fuse FU1/FU4/FU5 (outdoor unit control circuit board) is blown, be careful of charging voltage in inverter electrolytic capacitor C9, C10.

To discharge stored electricity, unplug the power cord and connect the plug of a soldering iron (100VAC, 50W) between the positive and negative terminals of inverter electrolytic capacitor C9, C10.

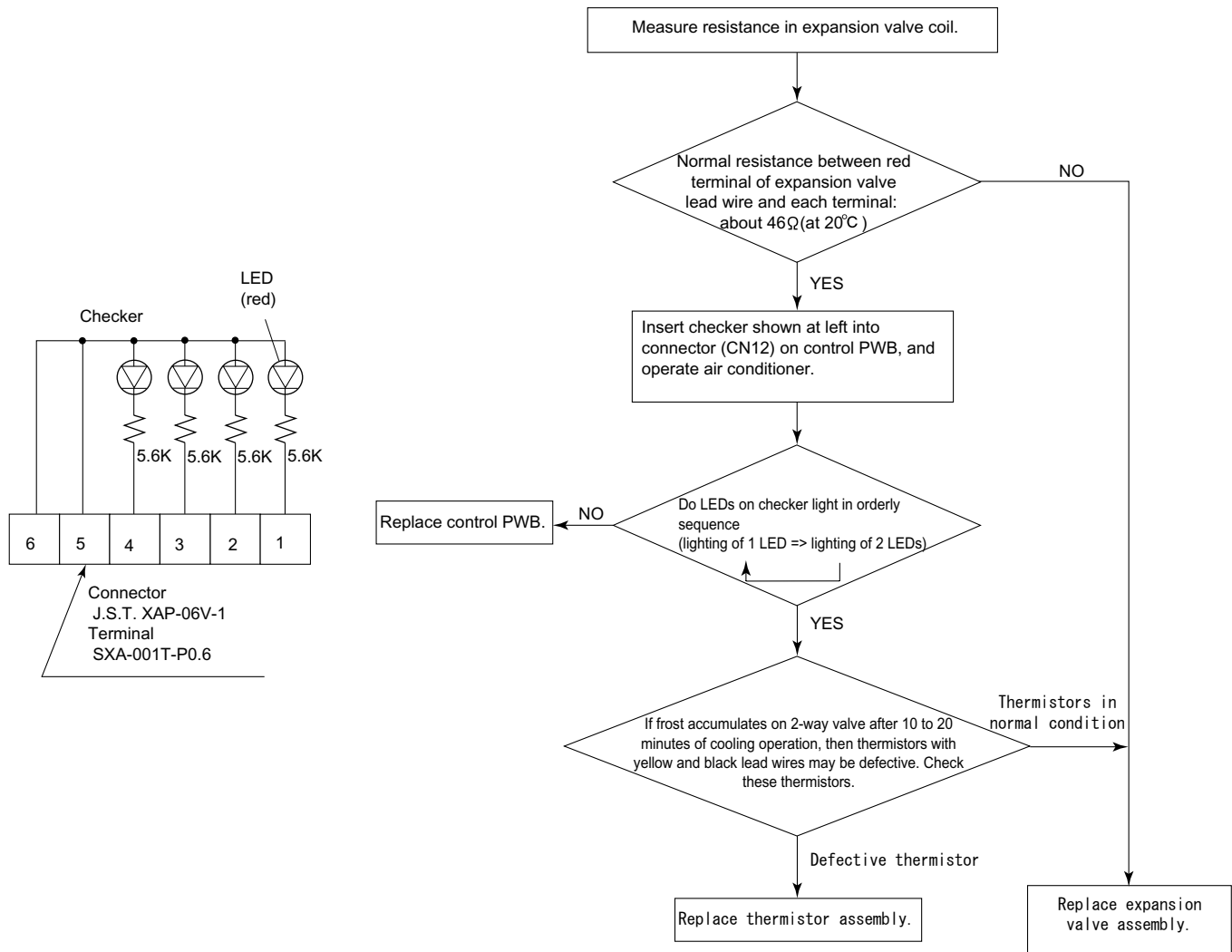
[6] MALFUNCTION (PARTS) CHECK METHOD

1. Procedure for determining defective outdoor unit IPM/compressor

The following flow chart shows a procedure for locating the cause of a malfunction when the compressor does not start up and a DC overcurrent indication error occurs.

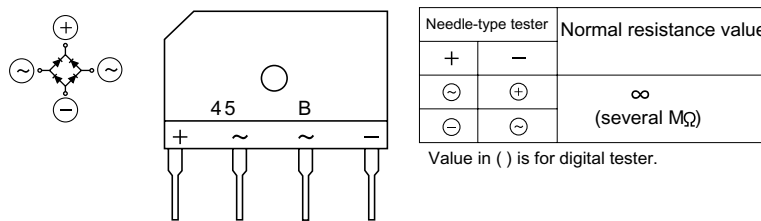


2. Procedure for determining defective expansion valve



3. Diode bridge check method

Turn off the power and let the inverter electrolytic capacitor (C9, C10) discharge completely. Then use a tester and check continuity. When using a digital tester, the (+) and (-) tester lead wires in the table must be reversed.



4. Inverter electrolytic capacitor (C9, C10) check method

Turn off the power, let the inverter electrolytic capacitor (C9, C10) discharge completely, and remove the capacitor from the control printed circuit board (PWB). First, check the case for cracks, deformation and other damages. Then, using a needle-type tester, check continuity.

Determination of normal condition
The tester needle should move on the scale and slowly returns to the original position. The tester needle should move in the same way when polarities are reversed. (When measurement is taken with the polarities reversed, the tester needle exceeds the scale range. Therefore, let the capacitor discharge before measurement.)

5. IPM check method

Turn off the power, let the large capacity electrolytic capacitor (C10) discharge completely, and dismount the IPM. Then, using a tester, check leak current between C and E.

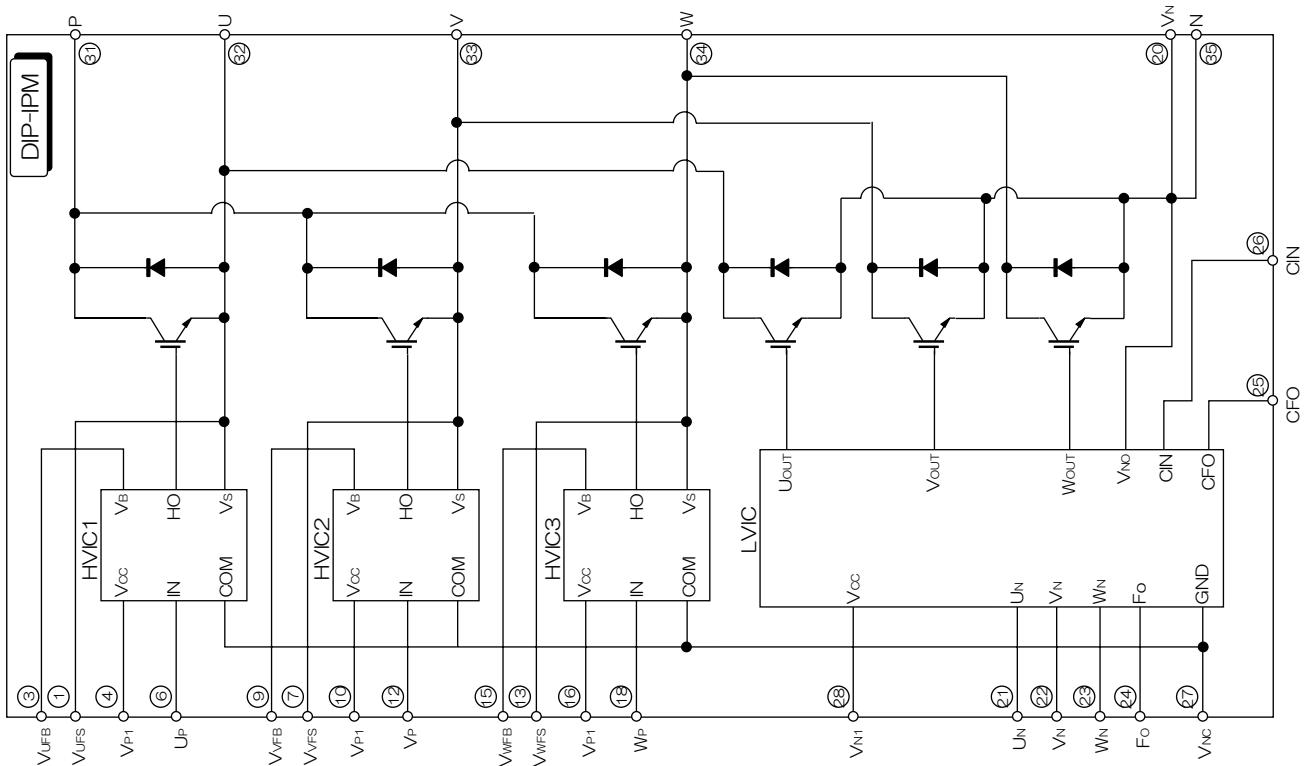
When using a digital tester, the (+) and (-) tester lead wires in the table must be reversed.

Needle-type tester		Normal resistance value
(-)	(+)	
P	N	∞ (several M Ω)
	U	
	V	
	W	

Needle-type tester		Normal resistance value
(-)	(+)	
U	N	∞ (several M Ω)
V		
W		

Values in () are for digital tester.

5.1. IPM internal circuit diagram



[7] OUTDOOR UNIT CHECK METHOD

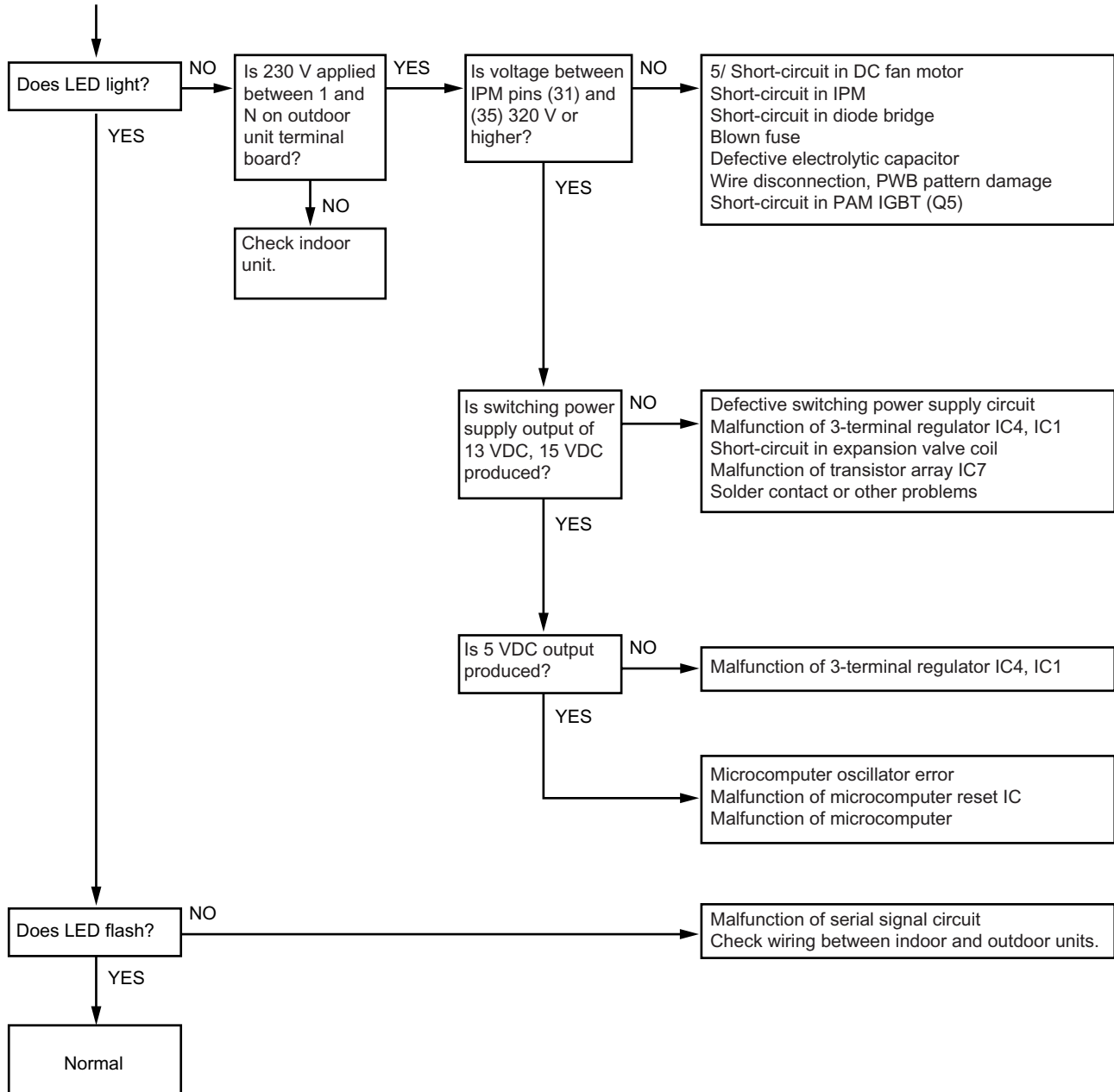
After repairing the outdoor unit, conduct the following inspection procedures to make sure that it has been repaired completely. Then, operate the compressor for a final operation check.

1. Checking procedures

No	Item	Check method	Normal value/condition	Remedy
1	Preparation	Disconnect compressor cords (white, orange, red: 3 wires) from compressor terminals, and connect simulated load (lamp used as load). Operate air conditioner in cooling or heating test operation mode.		
2	Inverter DC power supply voltage check	Measure DC voltage between IPM pins (31) and (35).	320 VDC	Replace control PWB. Replace diode bridge. Correct soldered section of Fasten tabs (T1, T2, T5 - T3) on control PWB and IMP (S, C, R). (Repair solder cracks.)
3	IPM circuit check	Check that 3 lamps (load) light. Check position detection voltage (+15 V, 5 V) on control PWB.	Each voltage should be normal. All 3 lamps (load) should light with same intensity.	Replace control PWB.

No	Item	Check method	Normal value/condition	Remedy
4	Compressor check	Measure compressor coil resistance (for each phase of U, V and W). Use multi-meter or digital tester capable of displaying two digits right of the decimal point (0.01Ω).	Resistance value at 20°C --- 0.65Ω	Correct connections at compressor terminals. Replace compressor.
5	Expansion valve check	Measure expansion valve coil resistance.	Each phase 46±3Ω (at 20°C)	Replace expansion valve.
6	Final check	Turn off power, and connect compressor cords to compressor. Operate air conditioner. Measure DC voltage between IPM pins (31) and (35).	Compressor should operate normally. 200 VDC or higher.	Replace control PWB. Replace outdoor unit thermistor. Replace compressor (in case of compressor lock).

2. Troubleshooting of outdoor unit electric components



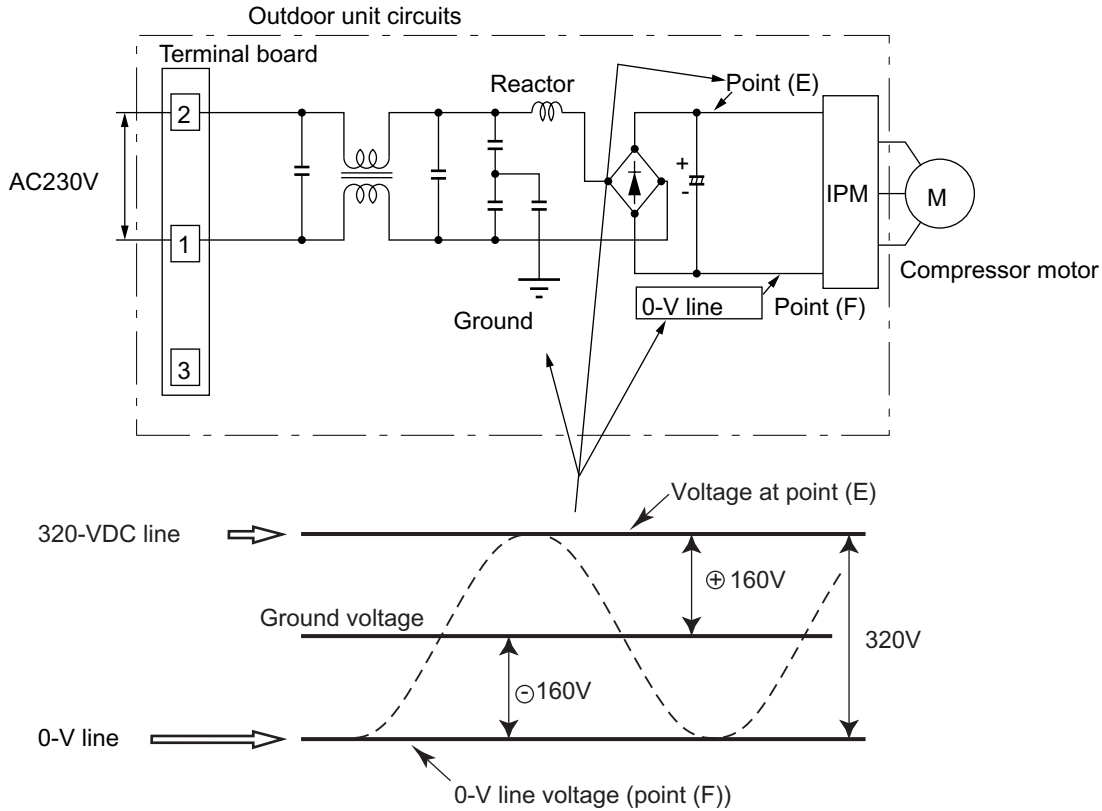
3. Caution in checking printed circuit boards (PWB)

3.1. Non-insulated control circuit

The GND terminals of the low-voltage circuits (control circuits for microcomputer and thermistors and drive circuits for expansion valve and relays) on the control printed circuit board (PWB) are connected to the compressor drive power supply (320-VDC negative terminal). Therefore, exercise utmost caution to prevent electric shock.

If a measuring instrument used for the test is grounded, its chassis (ground) has the same electric potential as the 0-V probe. Since non-insulated circuits have the following voltage potential difference from the ground, connection of the grounding wire results in a short-circuit between the 0-V line and the ground, thus allowing an excessive current to flow to the tester to cause damage.

If the sheaths of the thermistor lead wires or expansion valve lead wires inside the outdoor unit become damaged due to pinching by the front panel or other metal parts or contacting a pipe, a high voltage can flow and destroy the circuits. To prevent these problems, carefully conduct assembly work.



Reason

The oscilloscope (chassis ground) has the same electric potential as the 0-V probe. The entire electronic control section of the outdoor unit has a voltage potential difference from the ground as shown in the above diagram. When the oscilloscope is set up, the 0-V line and the ground voltage (ground) will be short-circuited, resulting in an excessive current flow to cause damage to the oscilloscope or indoor electric circuits.

1. Self-Diagnosis Function and Display Mode

To call out the content of the self-diagnosis memory, hold down the emergency operation button for more than 5 seconds when the indoor unit is not operating.

- The number of indications displayed by the LEDs on the outdoor unit differs from that for the 2001 cooling unit models (for detailed display of malfunction information).

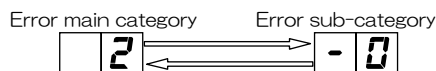
The display of malfunction No. differs from that of the 2001 cooling unit models. To show detailed malfunction information, two types of numbers flash alternately. (example: "21" ↔ "-0")

1) The content of the self-diagnosis memory can be called out and displayed on the seven-segment display section on the indoor unit. (The error data cannot be called out for display by the LED on the outdoor unit.)

2) If the power cord is unplugged from the AC outlet or the circuit breaker is turned off, the self-diagnosis memory loses the stored data.

- a) The self-diagnosis display function of the indoor unit indicates the content of diagnosis by showing the error main category (number) and the error sub-category (-number) alternately in 1-second intervals on the seven-segment display section of the indoor unit.

Example of self-diagnosis display on indoor unit: Compressor high-temperature error

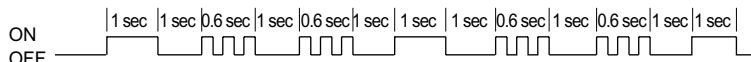


- b) The self-diagnosis display function of the outdoor unit indicates the error information by flashing LED1 on the outdoor unit according to the content of self-diagnosis.

The self-diagnosis display function of the outdoor unit is active only for about 3 to 10 minutes after self-diagnosis is performed during operation, and the display returns to normal condition after this display period.

The content of self-diagnosis cannot be called out by the self-diagnosis display function of the outdoor unit.

Example of self-diagnosis display on outdoor unit: Compressor high-temperature error



- c) The content of diagnosis is transferred to the indoor unit via serial communication, but it does not trigger a complete shutdown operation.

⊗ : Flashes in 2-sec intervals (normal), ● : On, × : Off, ⊙ : Flashes 3 times in 0.2-sec intervals (When LED1 on the outdoor unit flashes in 2-sec intervals, the outdoor unit is in normal condition.)

Status of indoor/outdoor units	Indication by LED1 on outdoor unit *2	Malfunction No. displayed on main unit display section *1		Content of diagnosis		Inspection location/method	Remedy
		Main category	Sub-category	Main category	Sub-category		
Indoor/outdoor units in operation	⊗ Normal flashing	0	0		Normal	-	-
Indoor/outdoor units in complete shutdown	⊙ 1 time	1	-0	Outdoor unit thermistor short-circuit	Heat exchanger thermistor short-circuit error	(1) Measure resistance of the outdoor unit thermistors. (TH2 to TH5: Approx. 4.4 kΩ at 25°C) (2) Check the lead wire of the outdoor unit thermistor for torn sheath and short-circuit. (3) No abnormality found in above inspections (1) and (2).	(1) Replace the outdoor unit thermistor assembly. (2) Replace the outdoor unit thermistor assembly. (3) Replace the outdoor unit control PWB assembly.
			-1		Outside temperature thermistor short-circuit error		
			-2		Suction thermistor short-circuit error		
			-3		2-way valve thermistor short-circuit error		

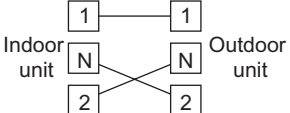
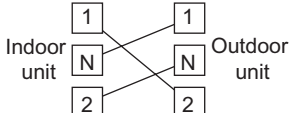
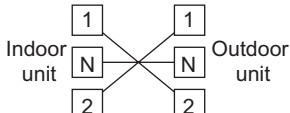
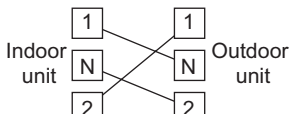
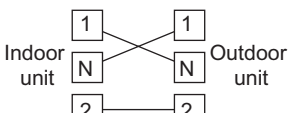
Status of indoor/outdoor units	Indication by LED1 on outdoor unit *2	Malfunction No. displayed on main unit display section *1		Content of diagnosis		Inspection location/method			
		Main category	Sub-category	Main category	Sub-category				
Indoor/outdoor units in complete shutdown	● 2 times	2	-0	Cycle temperature	Compressor high-temperature error	(1) Check the outdoor unit air outlet for blockage. (2) Check if the power supply voltage is 90 V or higher at full power. (3) Check the pipe connections for refrigerant leaks. (4) Measure resistance of the outdoor unit compressor thermistor. (TH1: Approx. 53 kΩ at 25°C) (5) Check the expansion valve for proper operation.	(1) Ensure unobstructed air flow from the outdoor unit air outlet. (2) Connect power supply of proper voltage. (3) Charge the specified amount of refrigerant. (4) Replace the outdoor unit compressor thermistor assembly. (5) Replace the expansion valve coil, expansion valve or outdoor unit control PWB assembly.		
			-1		Temporary stop due to compressor discharge overheat *3			(Temporary stop for cycle protection)	–
			-2		Temporary stop due to outdoor unit heat exchanger overheat *3			(Temporary stop for cycle protection)	–
			-3		Temporary stop due to outdoor unit heat exchanger overheat *3			(Temporary stop for cycle protection)	–
Indoor unit in operation Outdoor unit in temporary stop			-4		Temporary stop due to 2-way valve freeze *3	(Temporary stop for cycle protection)	–		
			-3		Temporary stop due to outdoor unit heat exchanger overheat *3	(Temporary stop for cycle protection)	–		
			-2		Temporary stop due to outdoor unit heat exchanger overheat *3	(Temporary stop for cycle protection)	–		
			-1		Temporary stop due to compressor discharge overheat *3	(Temporary stop for cycle protection)	–		
Indoor unit in operation Outdoor unit in temporary stop	● 3 times	3	-0	Dry operation	Temporary stop due to dehumidifying operation *3	(Temporary stop for cycle protection)	–		
Indoor/outdoor units in complete shutdown	● 5 times	5	-0	Outdoor unit thermistor open-circuit	Heat exchanger thermistor open-circuit error	(1) Check connector CN8 of the outdoor unit thermistor for secure installation. (2) Measure resistance of outdoor thermistors TH1 to TH5. (3) Check the lead wires of thermistors TH1 through TH5 on the outdoor unit control PWB for open-circuit. (4) No abnormality found in above inspections (1) through (3).	(1) Correct the installation. (2) Replace the outdoor unit thermistor assembly. (3) Replace the outdoor unit thermistor assembly. (5) Replace the outdoor unit control PWB assembly.		
			-1		Outside temperature thermistor open-circuit error				
			-2		Suction thermistor open-circuit error				
			-3		2-way valve thermistor open-circuit error				
			-4		Discharge thermistor open-circuit error				

Status of indoor/outdoor units	Indication by LED1 on outdoor unit *2	Malfunction No. displayed on main unit display section *1		Content of diagnosis		Inspection location/method	Remedy
		Main category	Sub-category	Main category	Sub-category		
Indoor/outdoor units in complete shutdown	● 6 times	6	-0	Outdoor unit DC	DC overcurrent error	(1) IPM continuity check (2) Check the IPM and heat sink for secure installation. (3) Check the outdoor unit fan motor for proper rotation. (4) No abnormality found in above inspections (1) through (3). (5) No abnormality found in above inspections (1) through (4).	(1) Replace the outdoor unit control PWB assembly. (2) Correct the installation (tighten the screws). (3) Replace the outdoor unit fan motor. (4) Replace the outdoor unit control PWB assembly. (5) Replace the compressor.
			-1		IPM pin level error	Check the IPM is attached correctly to the outdoor unit control PWB.	Replace the outdoor unit control PWB assembly.
Indoor/outdoor units in complete shutdown	● 7 times	7	-0	Outdoor unit AC	AC overcurrent error	(1) Check the outdoor unit air outlet for blockage. (2) Check the outdoor unit fan for proper rotation.	(1) Ensure unobstructed air flow from the outdoor unit air outlet. (2) Check the outdoor unit fan motor.
			-1		AC overcurrent error in OFF status	(1) IPM continuity check	(1) Replace the outdoor unit control PWB assembly.
			-2		AC maximum current error	(1) Check the outdoor unit air outlet for blockage. (2) Check the outdoor unit fan for proper rotation.	(1) Ensure unobstructed air flow from the outdoor unit air outlet. (1) Check the outdoor unit fan motor.
			-3		AC current deficiency error	(1) Check if there is an open-circuit in the secondary winding of the current transformer of the outdoor unit control PWB. (2) Check if the refrigerant volume is abnormally low. (3) Check if the refrigerant flows properly.	(1) Replace the outdoor unit control PWB assembly. (2) Charge the specified amount of refrigerant. (3) Correct refrigerant clogs. (2-way valve, 3-way valve, pipe, expansion valve)
Indoor/outdoor units in complete shutdown	● 9 times	9	-0	Outdoor unit cooling/heating switchover	Thermistor installation error or 4-way valve error	(1) Check to make sure outdoor unit thermistor TH2 (heat exchanger) and TH5 (2-way valve) are installed in correct positions. (2) Measure resistance of thermistors TH1 and TH5. (3) Check the 4-way valve for proper operation. (4) No abnormality found in above inspections (1) through (3).	(1) Correct the installation. (2) Replace the thermistor assembly. (3) Replace the 4-way valve. (4) Replace the outdoor unit control PWB assembly.
					-3	Torque control error	(1) Check if the refrigerant volume is abnormally low. (2) Check the 4-way valve for proper operation. (3) check to see compressor type is correct.

Status of indoor/outdoor units	Indication by LED1 on outdoor unit *2	Malfunction No. displayed on main unit display section *1		Content of diagnosis		Inspection location/method	
		Main category	Sub-category	Main category	Sub-category		
Indoor/outdoor units in complete shutdown	● 11 times	11	-0	Outdoor unit DC fan	Outdoor unit DC fan rotation error	(1) Check connector CN3 of the outdoor unit DC fan motor for secure installation. (2) Check the outdoor unit fan motor for proper rotation. (3) Check fuse FU3. (4) Outdoor unit control PWB	(1) Correct the installation. (2) Replace the outdoor unit fan motor. (3) Replace the outdoor unit control PWB assembly. (4) Replace the outdoor unit control PWB assembly.
Indoor/outdoor units in complete shutdown	● 13 times	13	-0	DC compressor	Compressor startup error	(1) Check the colors (red, white, orange) of the compressor cords for proper connection. (PWB side, compressor side) (2) Check if the IPM terminal resistance values are uniform. (3) No abnormality found in above inspections (1) and (2). (4) No abnormality found in above inspections (1) through (3).	(1) Correct the installation. (U: Red, V: White, W: Orange) (2) Replace the outdoor unit control PWB assembly. (3) Replace the outdoor unit control PWB assembly. (4) Replace the compressor.
			-1		Compressor rotation error (120° energizing error)		
Indoor/outdoor units in complete shutdown	● 14 times	14	-0	Outdoor unit PAM	PAM over voltage error Compressor rotation error	(1) Check the AC power supply voltage for fluctuation. (2) No abnormality found in above inspection (1).	(1) Connect stable power supply. (2) Replace the outdoor unit control PWB assembly.
Indoor/outdoor units in operation			-1		PAM clock error		
Indoor unit in operation Outdoor unit in complete shutdown	●	17	-0	Wires between units	Serial open-circuit	(1) Check the wires between units. (2) Check voltage between Nos. 1 and 2 on the indoor/outdoor unit terminal boards.	(1) Connect stable power supply. (2) Replace the outdoor unit control PCB assembly.
					Outdoor unit does not turn on due to erroneous wiring		
	(2) Check the outdoor unit fuse. (2) Replace the fuse/outdoor unit control PCB assembly.						
	(3) Check 15-V, 13-V and 5-V voltages on the PWB. Check resistance between IPM terminals. (3) Replace the outdoor unit control PCB assembly.						
	(4) Check pins No. 5 and 7 of connector CN3 of the outdoor unit fan motor for short-circuit. (4) Replace the outdoor unit fan motor.						
(5) Outdoor unit control PCB (5) Replace the outdoor unit control PCB board.							
●	18	-0	Serial short-circuit	(1) Check the wires between units. (1) Correct the wiring.			
		-1	Serial erroneous wiring	(1) Check the wires between units. (1) Correct the wiring.			

Status of indoor/outdoor units	Indication by LED1 on outdoor unit *2	Malfunction No. displayed on main unit display section *1		Content of diagnosis		Inspection location/method	Remedy
		Main category	Sub-category	Main category	Sub-category		
Indoor/outdoor units in complete shutdown	×	19	-0	Indoor unit fan	Indoor unit fan error	(1) Check the indoor fan motor for proper rotating operation.(Check fan lock.) (2) Check the lead wire of the indoor fan motor for open-circuit. (3) Check CN1 of the indoor unit fan motor for secure installation. (4) No abnormality found in above inspections (1) through (3).	(1) Replace the indoor fan motor. (2) Replace the indoor fan motor. (3) Correct the installation of CN1 of the indoor fan motor. (4) Replace the indoor unit control PWB.
Indoor/outdoor units in operation	×	20	-0	Indoor unit control PCB	EEPROM data error	(EEPROM read data error)	Replace the indoor unit control PWB.
Indoor/outdoor units in operation	×	88		Control and display PCB	Communication error	(1) Check for disconnected connector between control PCB and display PCB, and open-circuit in lead wires. (2) Check that control PCB outputs signals correctly.	(1) Insert connectors correctly, or replace control PWB. (2) Replace control PWB.

Malfunction indications due to erroneous wiring during air conditioner installation

1	Inter-unit wiring error mode	Symptom	
		Indoor unit relay Malfunction diagnosis display	Turns On momentarily, then turns Off. "18-1"
		Indoor unit relay Malfunction diagnosis display	Relays turns Off after about 30 minutes. None (Displays "18-0" when malfunction code is called out.)
		Indoor unit relay Malfunction diagnosis display	Relays turns Off after about 30 minutes. None (Displays "18-0" when malfunction code is called out.)
		Indoor unit relay Malfunction diagnosis display	Turns On momentarily, then turns Off. "18-1"
		Indoor unit relay Malfunction diagnosis display	Turns On momentarily, then turns Off. "18-1"