**38MHRC**
Outdoor Unit Single Zone Ductless System
Sizes 09 to 24

# Service Manual

## TABLE OF CONTENTS



## SAFETY CONSIDERATIONS

Installing, starting up, and servicing air-conditioning equipment can be hazardous due to system pressures, electrical components, and equipment location (roofs, elevated structures, etc.).

Only trained, qualified installers and service mechanics should install, start-up, and service this equipment.

Untrained personnel can perform basic maintenance functions such as coil cleaning. All other operations should be performed by trained service personnel.

When working on the equipment, observe precautions in the literature and on tags, stickers, and labels attached to the equipment.

Follow all safety codes. Wear safety glasses and work gloves. Keep a quenching cloth and fire extinguisher nearby when brazing. Use care in handling, rigging, and setting bulky equipment.

Read this manual thoroughly and follow all warnings or cautions included in the literature and attached to the unit. Consult local building codes and National Electrical Code (NEC) for special requirements. Recognize safety information. This is the safety-alert symbol ⚠. When you see this symbol on the unit and in instructions or manuals, be alert to the potential for personal injury.

Understand these signal words: **DANGER**, **WARNING**, and **CAUTION**. These words are used with the safety-alert symbol. **DANGER** identifies the most serious hazards which **will** result in severe personal injury or death. **WARNING** signifies hazards which **could** result in personal injury or death.

**CAUTION** is used to identify unsafe practices which **may** result in minor personal injury or product and property damage.

**NOTE** is used to highlight suggestions which **will** result in enhanced installation, reliability, or operation.

### ⚠ WARNING

**ELECTRICAL SHOCK HAZARD**
Failure to follow this warning could result in personal injury or death.

Before installing, modifying, or servicing the system, the main electrical disconnect switch must be in the **OFF** position. There may be more than 1 disconnect switch. Lock out and tag switch with a suitable warning label.

### ⚠ WARNING

**EXPLOSION HAZARD**
Failure to follow this warning could result in death, serious personal injury, and/or property damage. Never use air or gases containing oxygen for leak testing or operating refrigerant compressors. Pressurized mixtures of air or gases containing oxygen can lead to an explosion.

### ⚠ CAUTION

**EQUIPMENT DAMAGE HAZARD**
Failure to follow this caution may result in equipment damage or improper operation.Do not bury more than 36 in. (914 mm) of refrigerant pipe in the ground. If any section of pipe is buried, there must be a 6 in. (152 mm) vertical rise to the valve connections on the outdoor units.

If more than the recommended length is buried, refrigerant may migrate to the cooler buried section during extended periods of system shutdown. This causes refrigerant slugging and could possibly damage the compressor at start-up.

## INTRODUCTION

This service manual provides the necessary information to service, repair, and maintain the outdoor units. This manual has an appendix (see “APPENDIX”on page 82) with data required to perform troubleshooting. Use the “Table of Contents” to locate a desired topic.

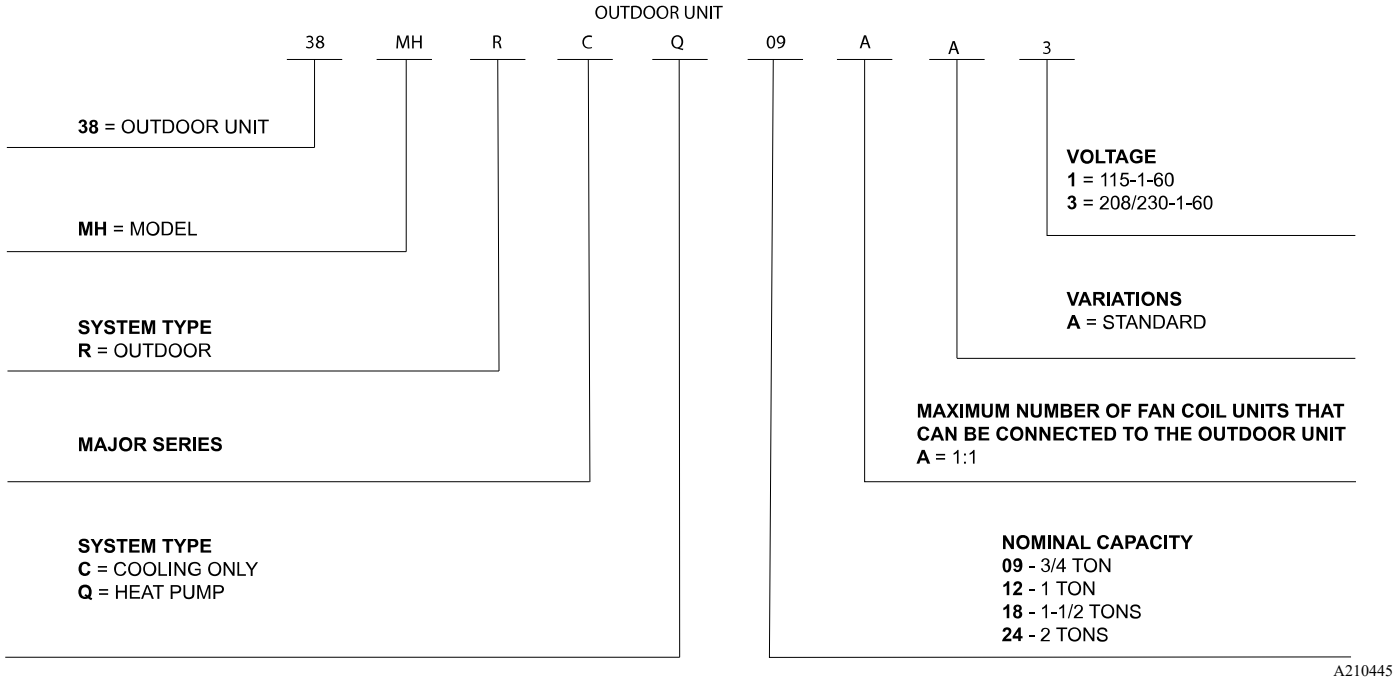
# MODEL / SERIAL NUMBER NOMENCLATURES

**Table 1 — Unit Sizes**

| | SYSTEM TONS | BTUh | VOLTAGE - PHASE | OUTDOOR MODEL |
|---|---|---|---|---|
| Heat Pump | 1.00 | 12,000 | 115-1-60 | 38MHRCQ12AA1 |
| | 0.75 | 9,000 | 208/230-1 | 38MHRCQ09AA3 |
| | 1.00 | 12,000 | | 38MHRCQ12AA3 |
| | 1.50 | 18,000 | | 38MHRCQ18AA3 |
| | 2.00 | 24,000 | | 38MHRCQ24AA3 |

**Table 2 — Unit Sizes**

| | SYSTEM TONS | BTUh | VOLTAGE - PHASE | OUTDOOR MODEL |
|---|---|---|---|---|
| Cooling Only | 1.00 | 12,000 | 115-1-60 | 38MHRCC12AA1 |
| | 1.00 | 12,000 | 208/230-1 | 38MHRCC12AA3 |
| | 1.50 | 18,000 | | 38MHRCC18AA3 |
| | 2.00 | 24,000 | | 38MHRCC24AA3 |

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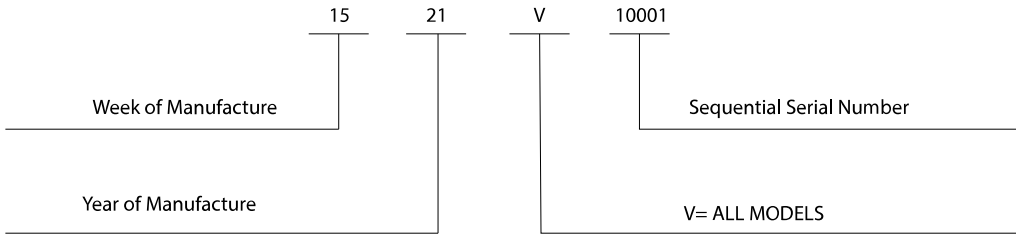


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Use of the AHRI Certified TM Mark indicates a manufacturer's participation in the program For verification of certification for individual products, go to www.ahridirectory.org.

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# WIRING

All wires must be sized per NEC (National Electrical Code) or CEC (Canadian Electrical Code) and local codes. Use Electrical Data table MCA (minimum circuit amps) and MOCP (maximum over current protection) to correctly size the wires and the disconnect fuse or breakers respectively.

## Recommended Connection Method for Power and Communication Wiring:

The main power is supplied to the outdoor unit. The field supplied 14/3 power/communication wiring, from the outdoor unit to the indoor unit, consists of four (4) wires and provides the power for the indoor unit. Two wires are high voltage AC power, one is communication wiring and the other is a ground wire. Wiring between indoor and outdoor unit is polarity sensitive. The use of BX wire is NOT recommended.

If installed in a high Electromagnetic field (EMF) area and communication issues exists, a 14/2 stranded shielded wire can be used to replace L2 and (S) between outdoor unit and indoor unit landing the shield onto ground in the outdoor unit only.

**⚠ CAUTION**

**EQUIPMENT DAMAGE HAZARD**

Failure to follow this caution may result in equipment damage or improper operation.

Wires should be sized based on NEC and local codes.

**⚠ CAUTION**

**EQUIPMENT DAMAGE HAZARD**

Failure to follow this caution may result in equipment damage or improper operation.

Be sure to comply with the local codes while running wire from the indoor unit to the outdoor unit.

Every wire must be connected firmly. Loose wiring may cause the terminal to overheat or result in unit malfunction. A fire hazard may also exist. Ensure all wiring is tightly connected.

No wire should touch the refrigerant tubing, compressor or any moving parts.

Disconnecting means must be provided and shall be located within sight and readily accessible from the air conditioner.

# CONNECTION DIAGRAMS

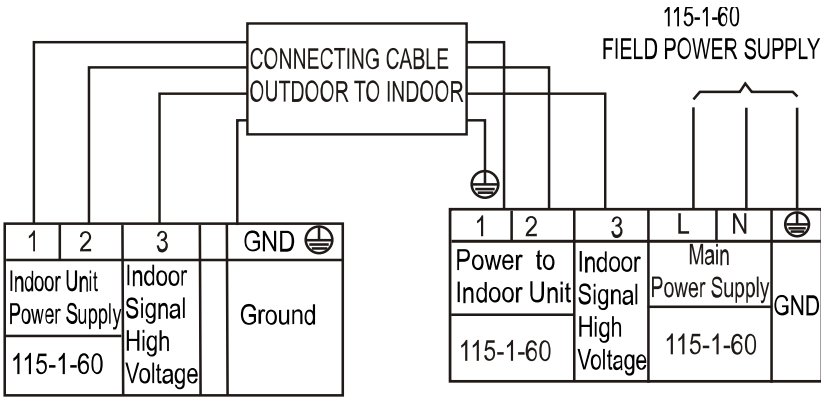


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**Fig. 1 — Connection Diagram 12K (115V)**

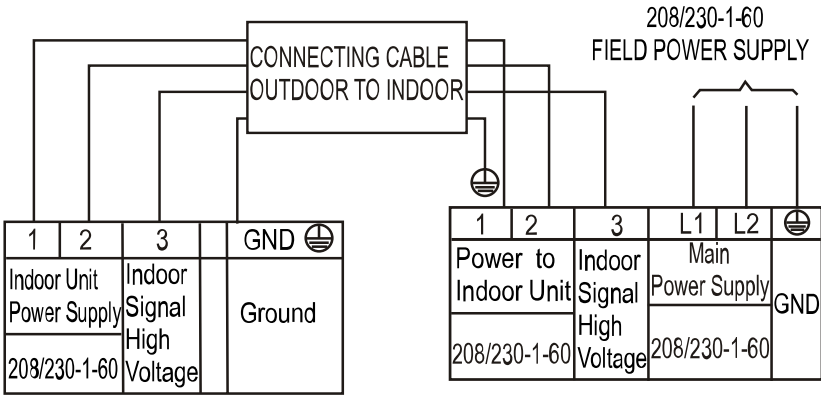


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**Fig. 2 — Connection Diagram 9K-24K (208-230V)**

**NOTES:**

1. Do not use thermostat wire for any connection between indoor and outdoor units.
2. All connections between the indoor and outdoor units must be made as shown in Figures 1 - 2. The connections are sensitive to polarity and results in a fault code.

# WIRING DIAGRAMS (HEAT PUMP)

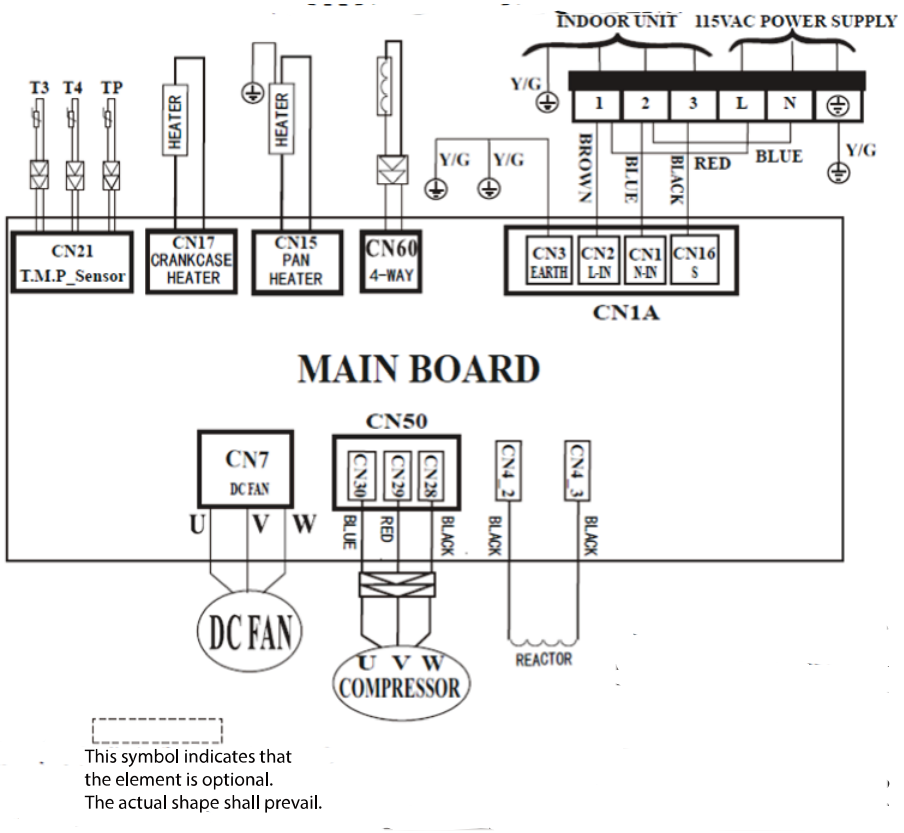


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**Fig. 3 — Wiring Diagram Size 12K (115V)**

**Table 3 — Wiring Diagram Size 12K (115V)**

| | | | | | |
|---|---|---|---|---|---|
| | | CN1A | INPUT | 115V | AC |
| | | CN4_2/4_3 | INPUT | 115V | AC |
| | | CN7 | OUTPUT | 0-310V | AC |
| | | CN60 | OUTPUT | 115V | AC |
| T3 | Condenser TEMP. Sensor | CN21 | INPUT | 0-5V | DC |
| T4 | Ambient TEMP. Sensor | | | | |
| TP | Discharge TEMP. Sensor | | | | |
| | | CN15 | OUTPUT | 115V | AC |
| | | CN17 | OUTPUT | 115V | AC |
| | | CN50 | OUTPUT | 0-310V | AC |

# WIRING DIAGRAMS (CONT)

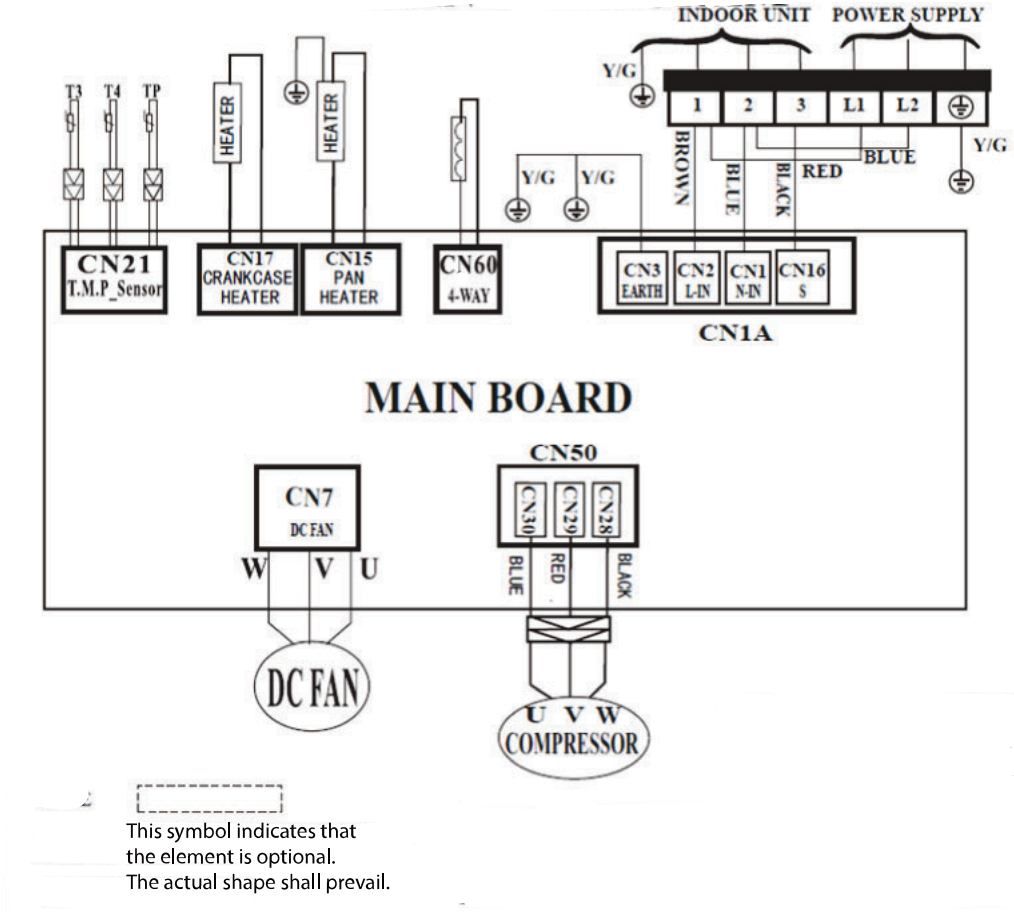


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**Fig. 4 —Wiring Diagram Sizes 9-18K (208-230V)**

**Table 4 — Wiring Diagram Sizes 9-18K (208-230V)**

| | | | | | |
|---|---|---|---|---|---|
| | | CN1A | INPUT | 230V | AC |
| | | CN7 | OUTPUT | 0-310V | AC |
| | | CN60 | OUTPUT | 230V | AC |
| T3 | Condenser TEMP. Sensor | CN21 | INPUT | 0-5V | DC |
| T4 | Ambient TEMP. Sensor | | | | |
| TP | Discharge TEMP. Sensor | | | | |
| | | CN15 | OUTPUT | 230V | AC |
| | | CN17 | OUTPUT | 230V | AC |
| | | CN50 | OUTPUT | 0-310V | AC |

# WIRING DIAGRAMS (CONT)

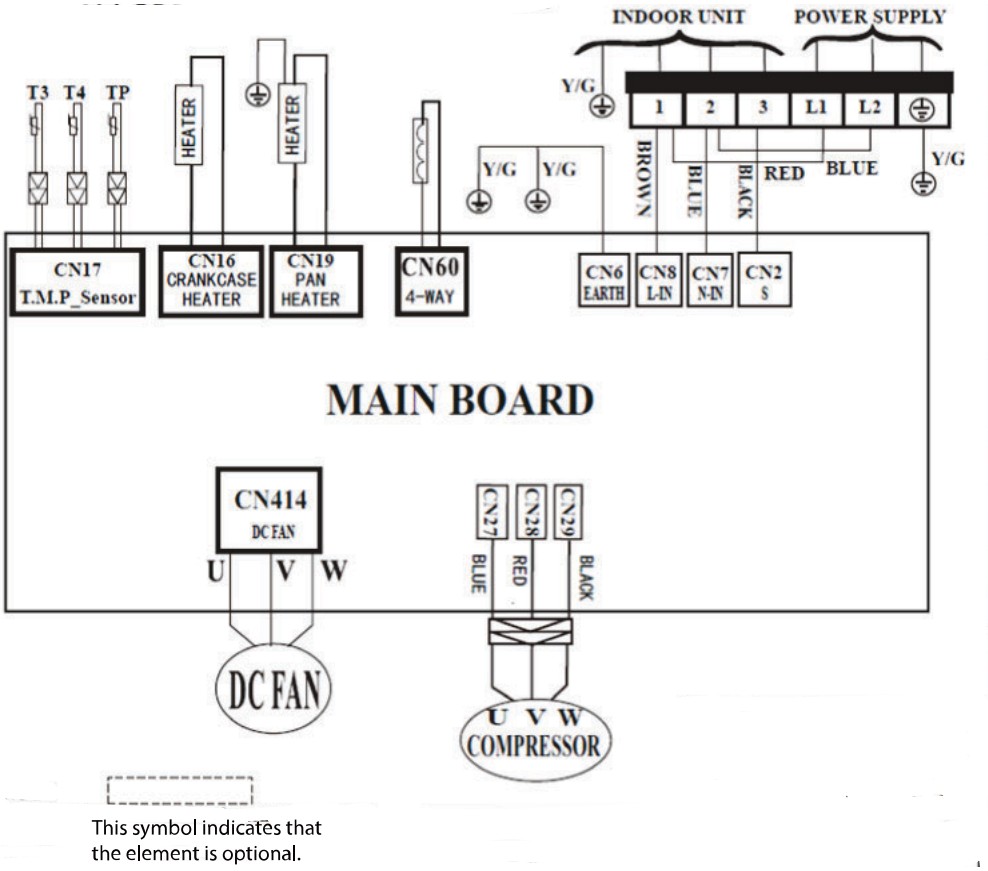


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**Fig. 5 —Wiring Diagram Size 24K (208-230V)**

**Table 5 — Wiring Diagram Size 24K (208-230V)**

| | | | | | |
|---|---|---|---|---|---|
| | | CN2/7/8 | INPUT | 230V | AC |
| | | CN414 | OUTPUT | 0-310V | AC |
| | | CN60 | OUTPUT | 230V | AC |
| T3 | Condenser TEMP. Sensor | CN17 | INPUT | 0-5V | DC |
| T4 | Ambient TEMP. Sensor | | | | |
| TP | Discharge TEMP. Sensor | | | | |
| | | CN16 | OUTPUT | 230V | AC |
| | | CN19 | OUTPUT | 230V | AC |
| | | CN27/28/29 | OUTPUT | 0-310V | AC |

# WIRING DIAGRAMS (CONT)

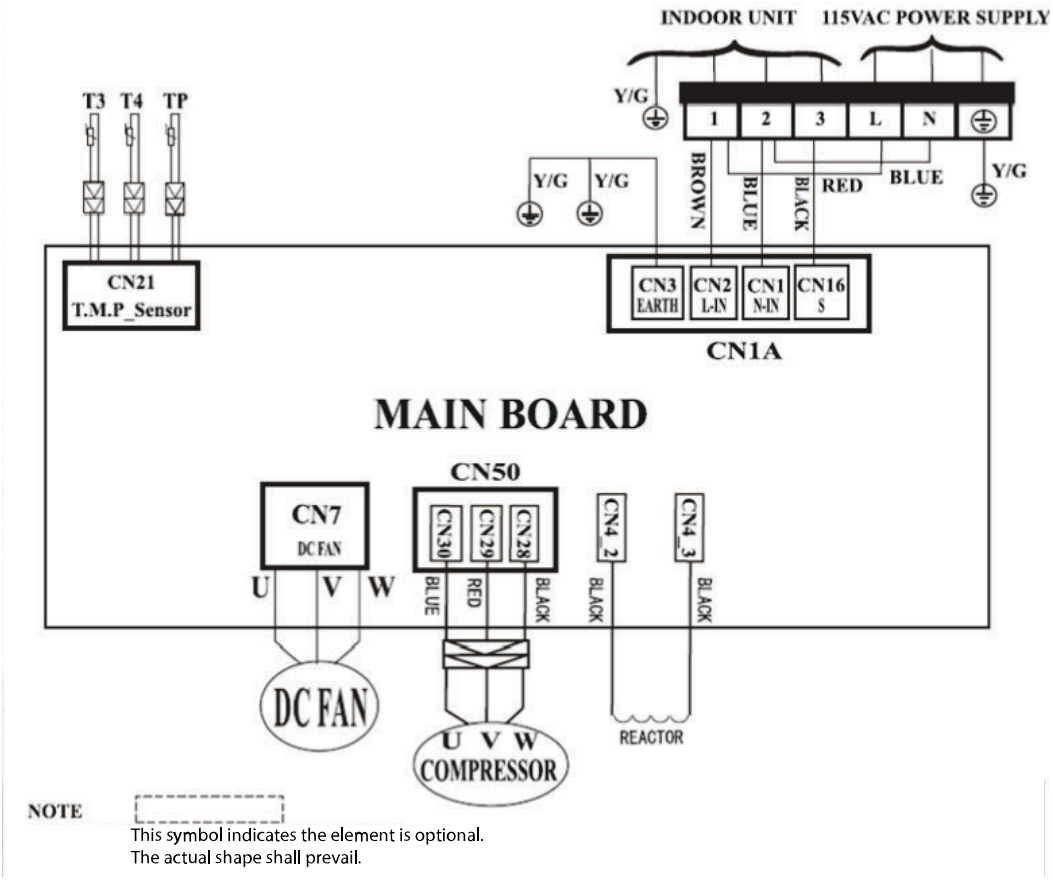


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**Fig. 6 —Wiring Diagram Size 12K (115V) Cooling Only**

**Table 6 — Wiring Diagram Size 12K (115V) Cooling Only**

| | | | | | |
|---|---|---|---|---|---|
| | | CN1A | INPUT | 115V | AC |
| | | CN4_2/4_3 | INPUT | 115V | AC |
| T3 | Condenser TEMP. Sensor | CN21 | OUTPUT | 0~5V | DC |
| T4 | Ambient TEMP. Sensor | CN7 | OUTPUT | 0~310V | AC |
| TP | Discharge TEMP. Sensor | CN50 | OUTPUT | 0~310V | AC |

# WIRING DIAGRAMS (CONT)

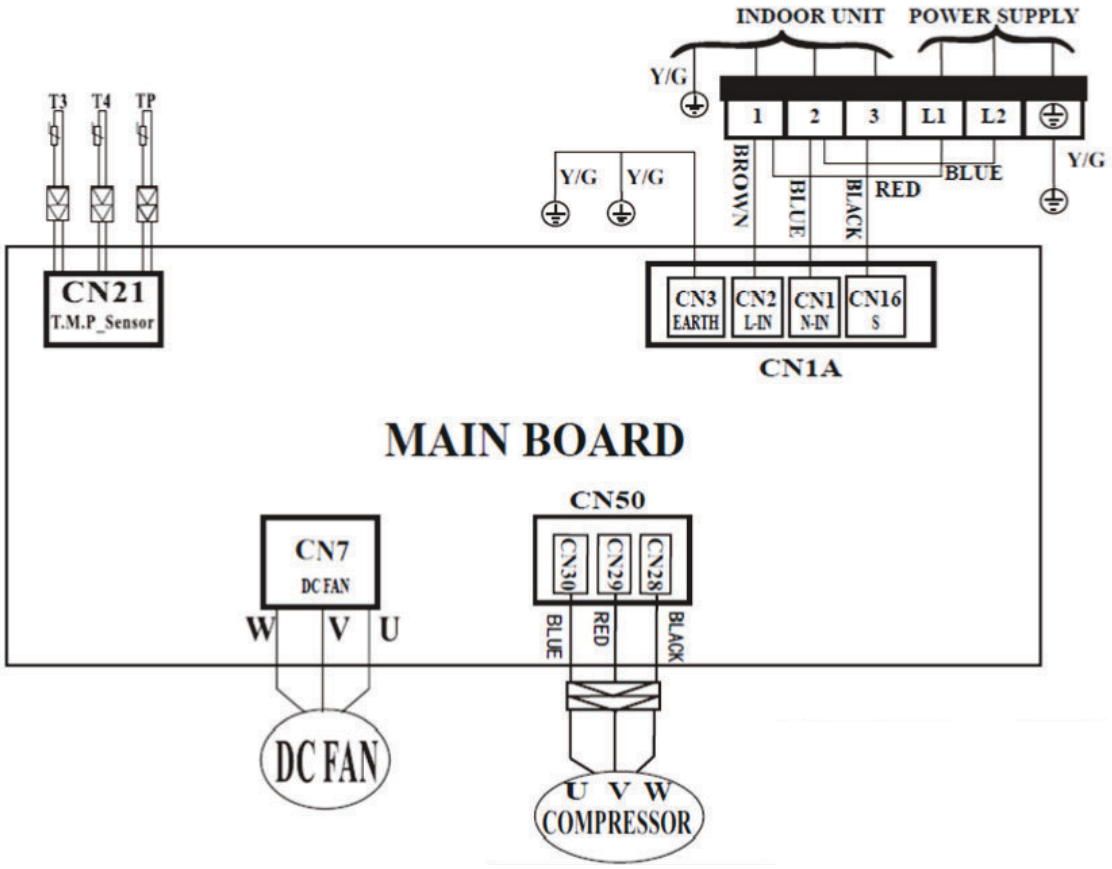


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**Fig. 7 —Wiring Diagram Size 12K and 18K (208/230V) Cooling Only**

**Table 7 — Wiring Diagram Size 12K and 18K (208/230V) Cooling Only**

| | | | | | |
|---|---|---|---|---|---|
| | | CN1A | INPUT | 230V | AC |
| | | CN7 | OUTPUT | 0~310V | AC |
| | | CN21 | OUTPUT | 0~5V | DC |
| T3 | Condenser TEMP. Sensor | CN15 | OUTPUT | 230V | AC |
| T4 | Ambient TEMP. Sensor | CN17 | OUTPUT | 230V | AC |
| TP | Discharge TEMP. Sensor | CN50 | OUTPUT | 0~310V | AC |

# WIRING DIAGRAMS (CONT)

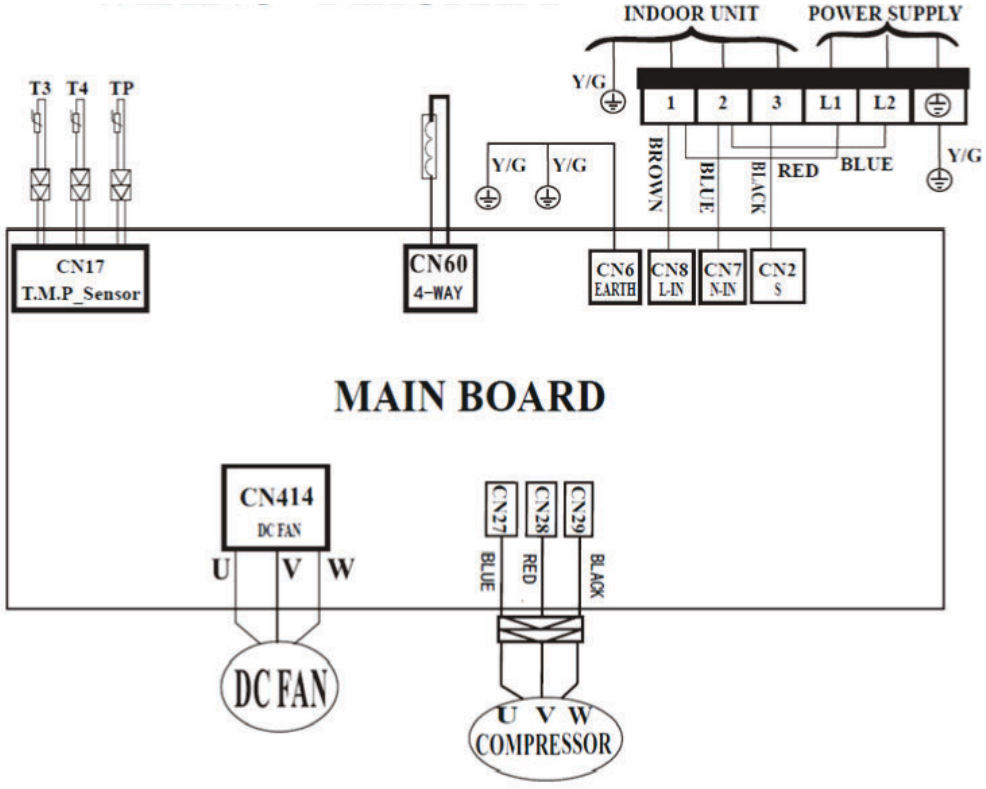


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**Fig. 8 —Wiring Diagram Size 24K (208/230V) Cooling Only**

**Table 8 — Wiring Diagram Size 24K (208/230V) Cooling Only**

| | | | | | |
|---|---|---|---|---|---|
| | | CN1A | INPUT | 230V | AC |
| | | CN7 | OUTPUT | 0~310V | AC |
| | | CN21 | OUTPUT | 0~5V | DC |
| T3 | Condenser TEMP. Sensor | CN15 | OUTPUT | 230V | AC |
| T4 | Ambient TEMP. Sensor | CN17 | OUTPUT | 230V | AC |
| TP | Discharge TEMP. Sensor | CN50 | OUTPUT | 0~310V | AC |

# REFRIGERATION HEAT PUMP CYCLE DIAGRAMS

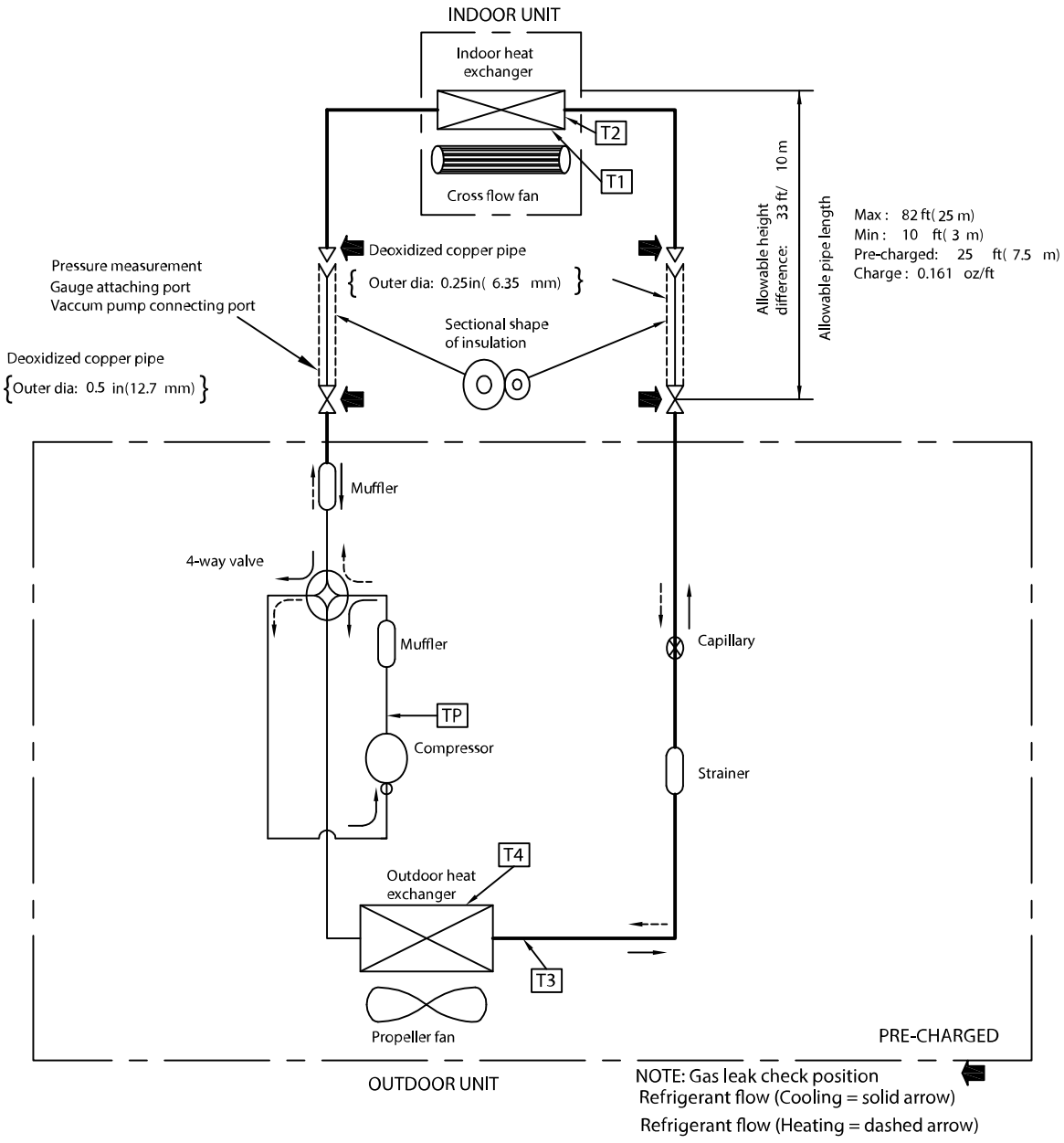


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**Fig. 9 —Size 12K - 115V and 208/230V**

# REFRIGERATION HEAT PUMP CYCLE DIAGRAMS (CONT)

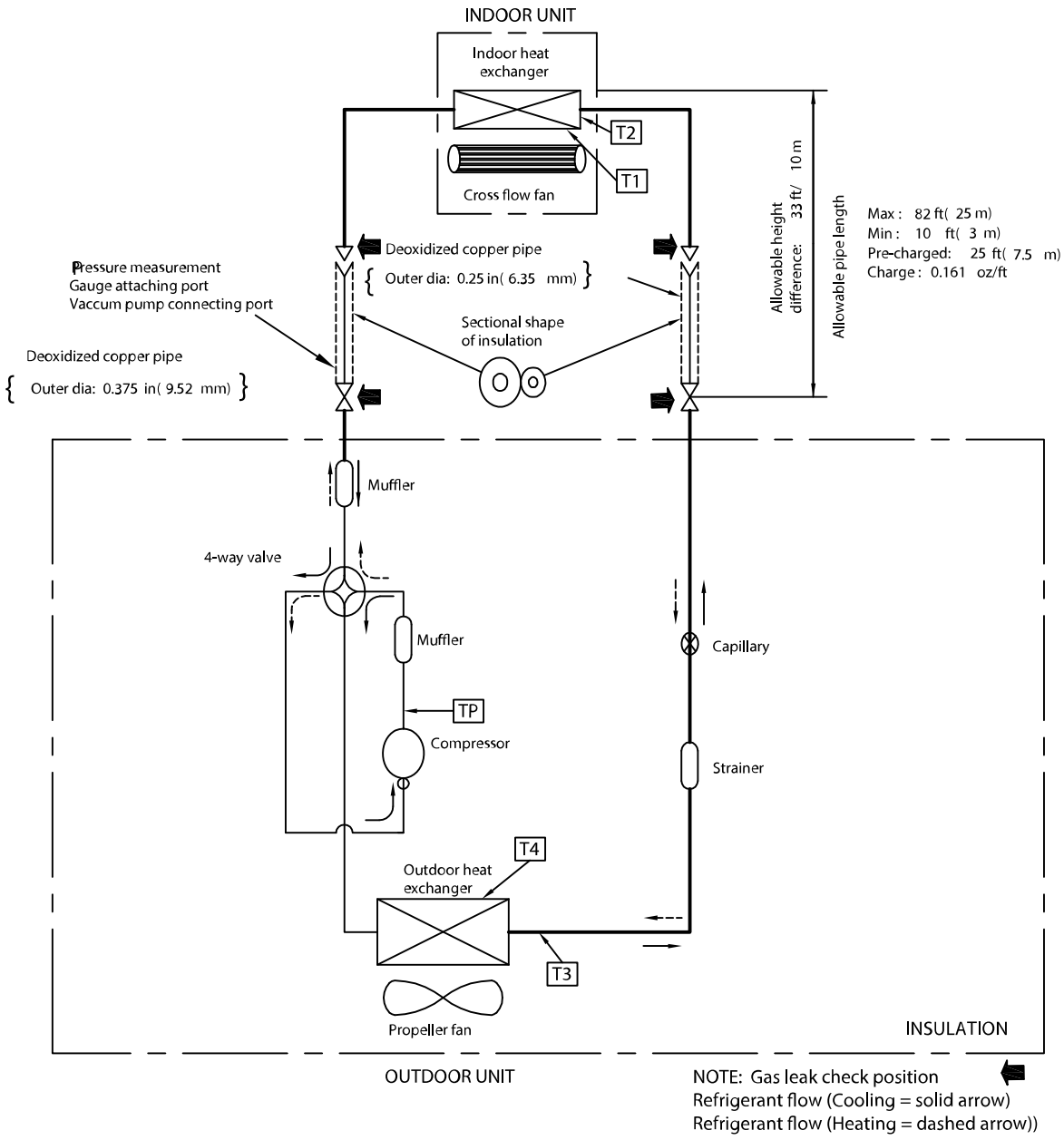


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**Fig. 10 —Size 9K - 208/230V Heat Pump**

# REFRIGERATION HEAT PUMP CYCLE DIAGRAMS (CONT)

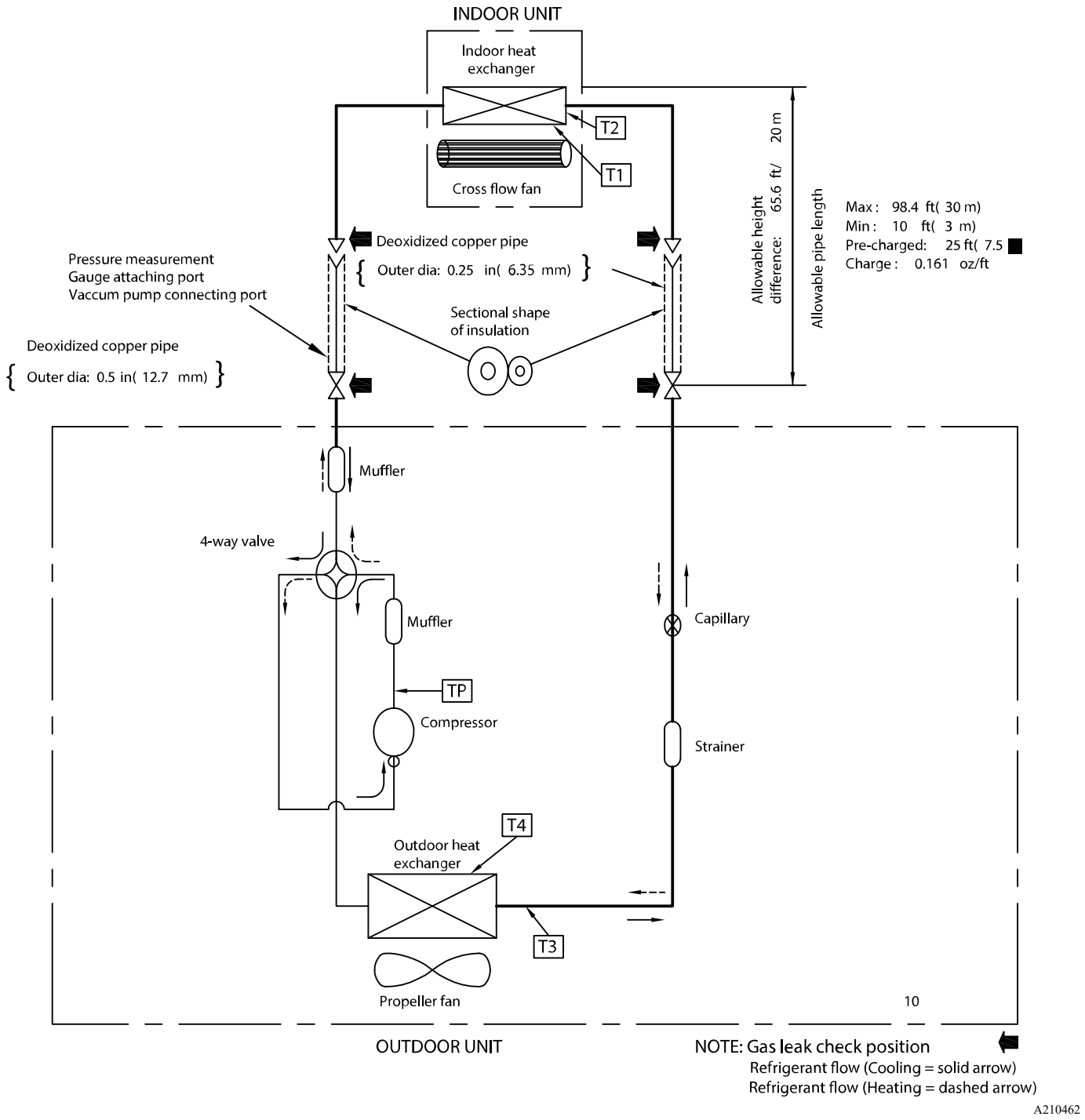


**Fig. 11 —Size 18K - 208/230V Heat Pump**

# REFRIGERATION HEAT PUMP CYCLE DIAGRAMS (CONT)

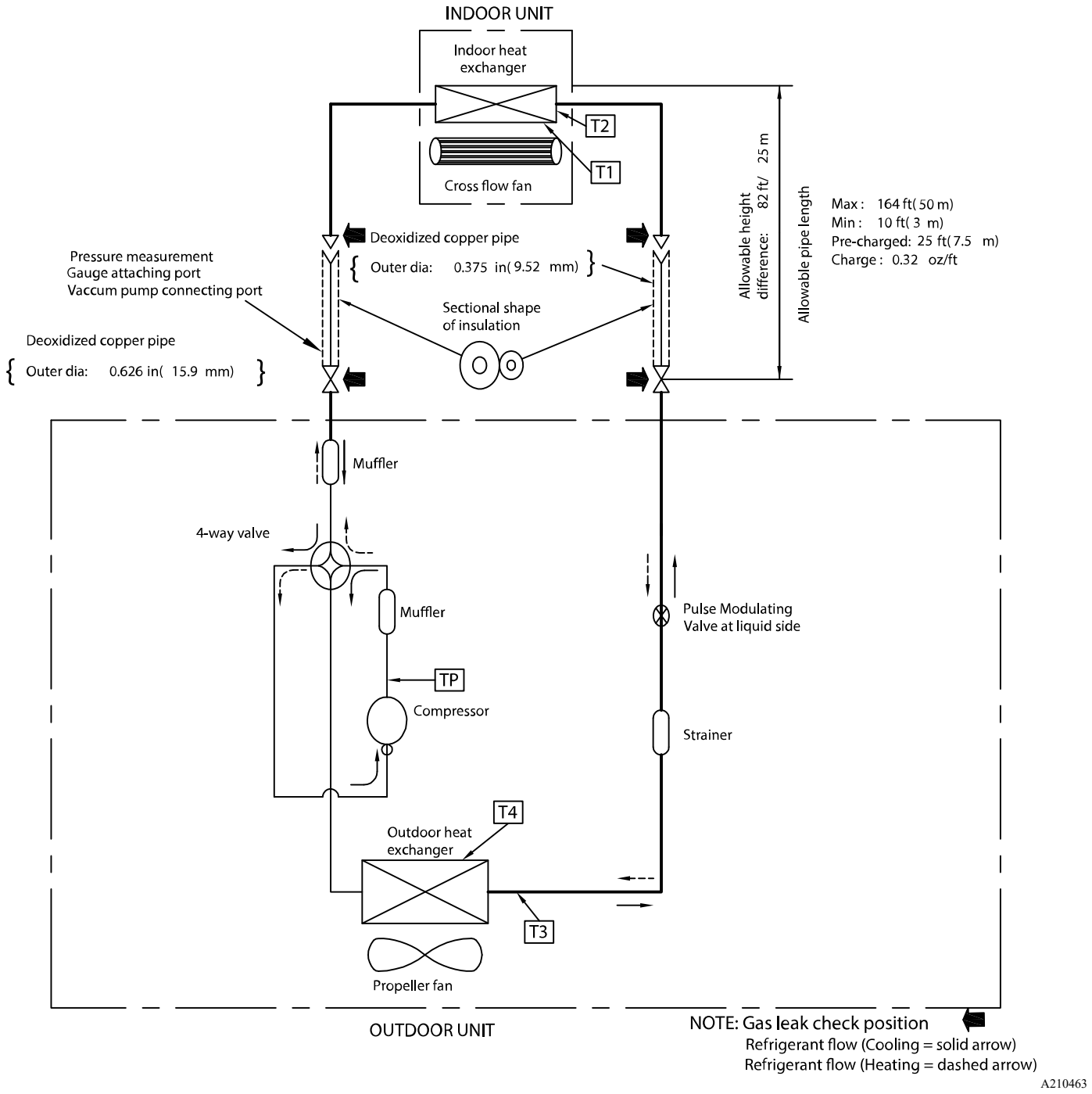


**Fig. 12 —Size 24K - 208/230V Heat Pump**

# REFRIGERATION COOLING ONLY CYCLE DIAGRAMS

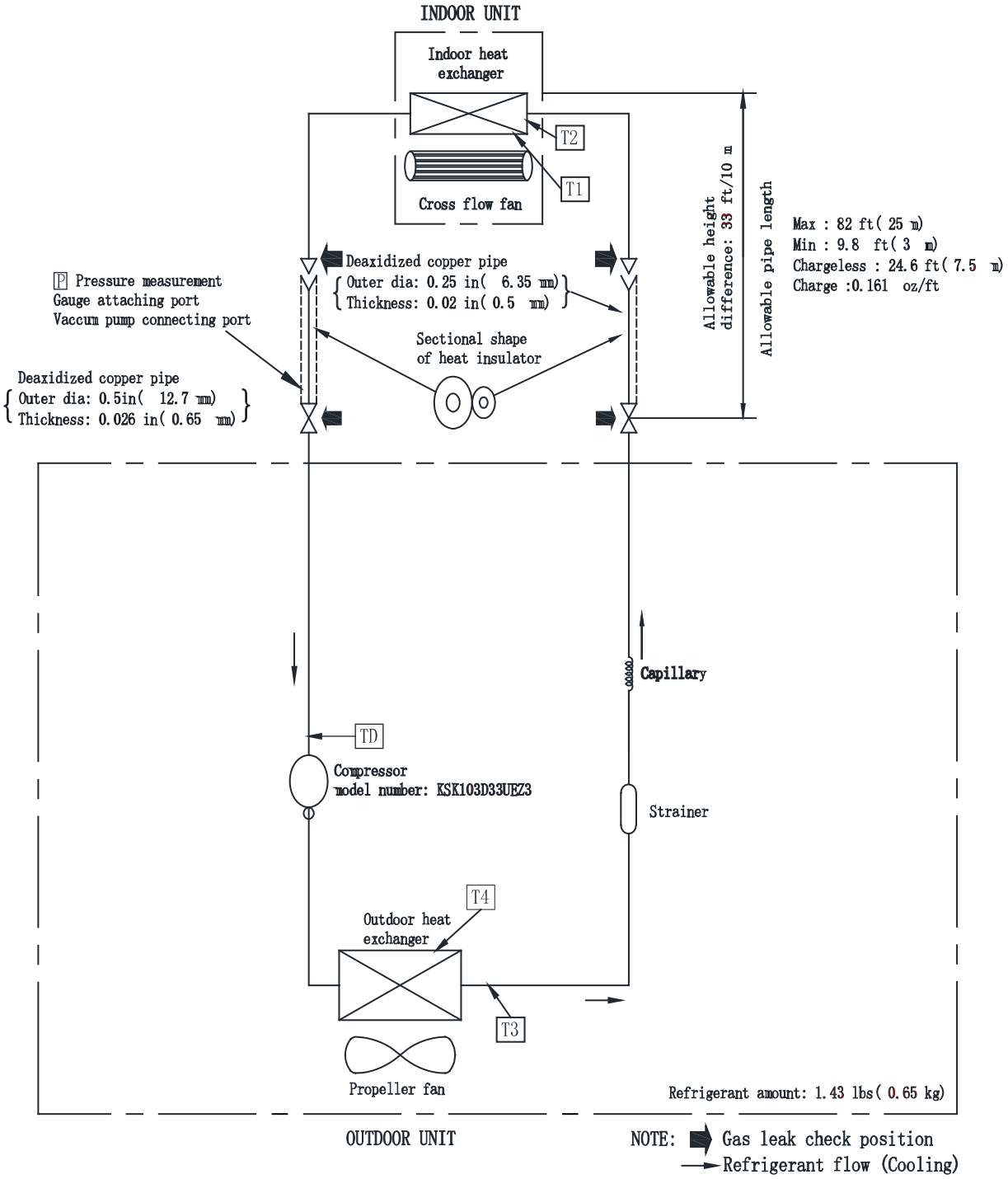


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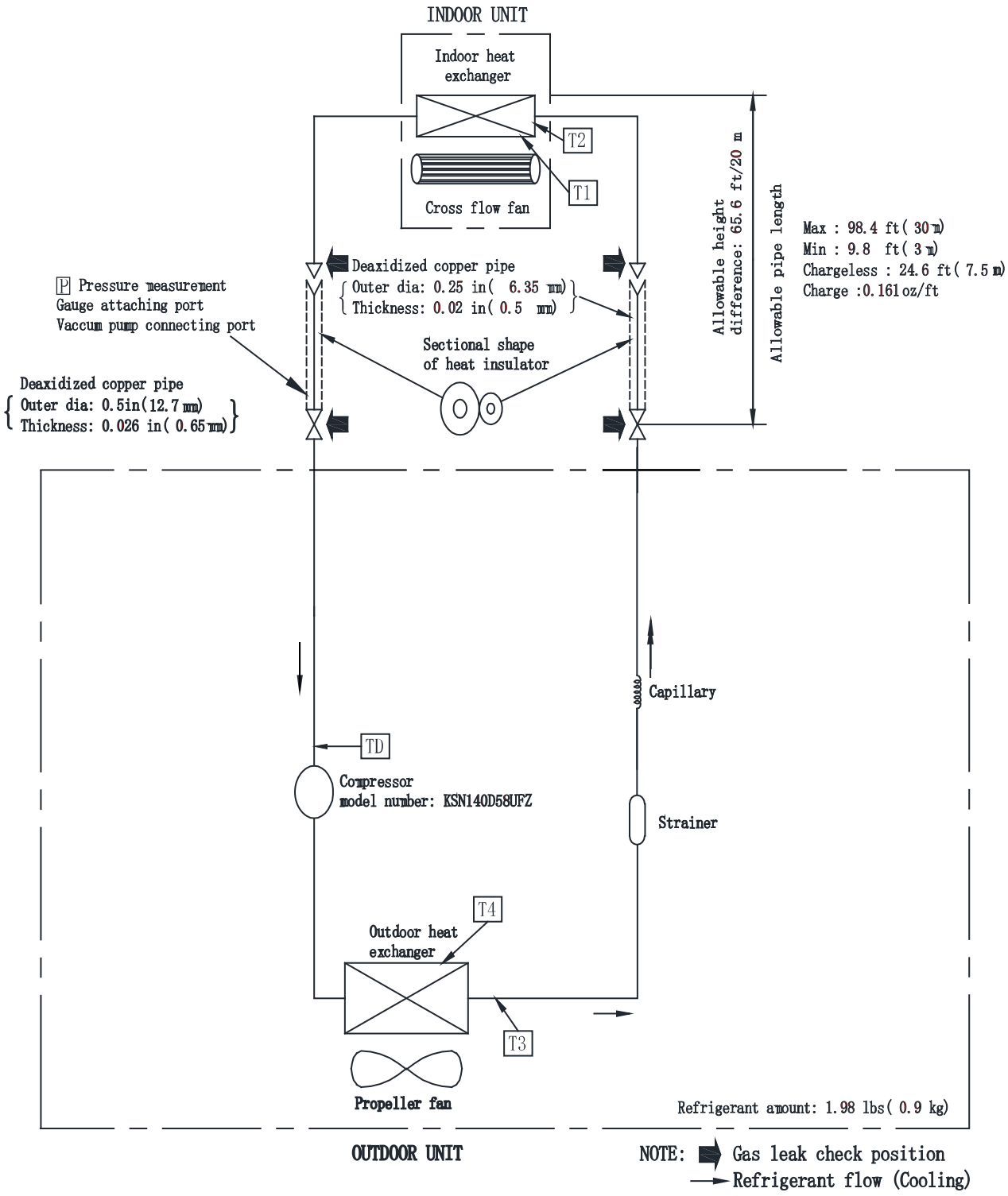
**Fig. 13 —Size 12K - 115V and 208/230V Cooling Only**

# REFRIGERATION COOLING ONLY CYCLE DIAGRAMS (CONT)

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**Size 18K - 208/230V Cooling Only**

# REFRIGERATION COOLING ONLY CYCLE DIAGRAMS (CONT)

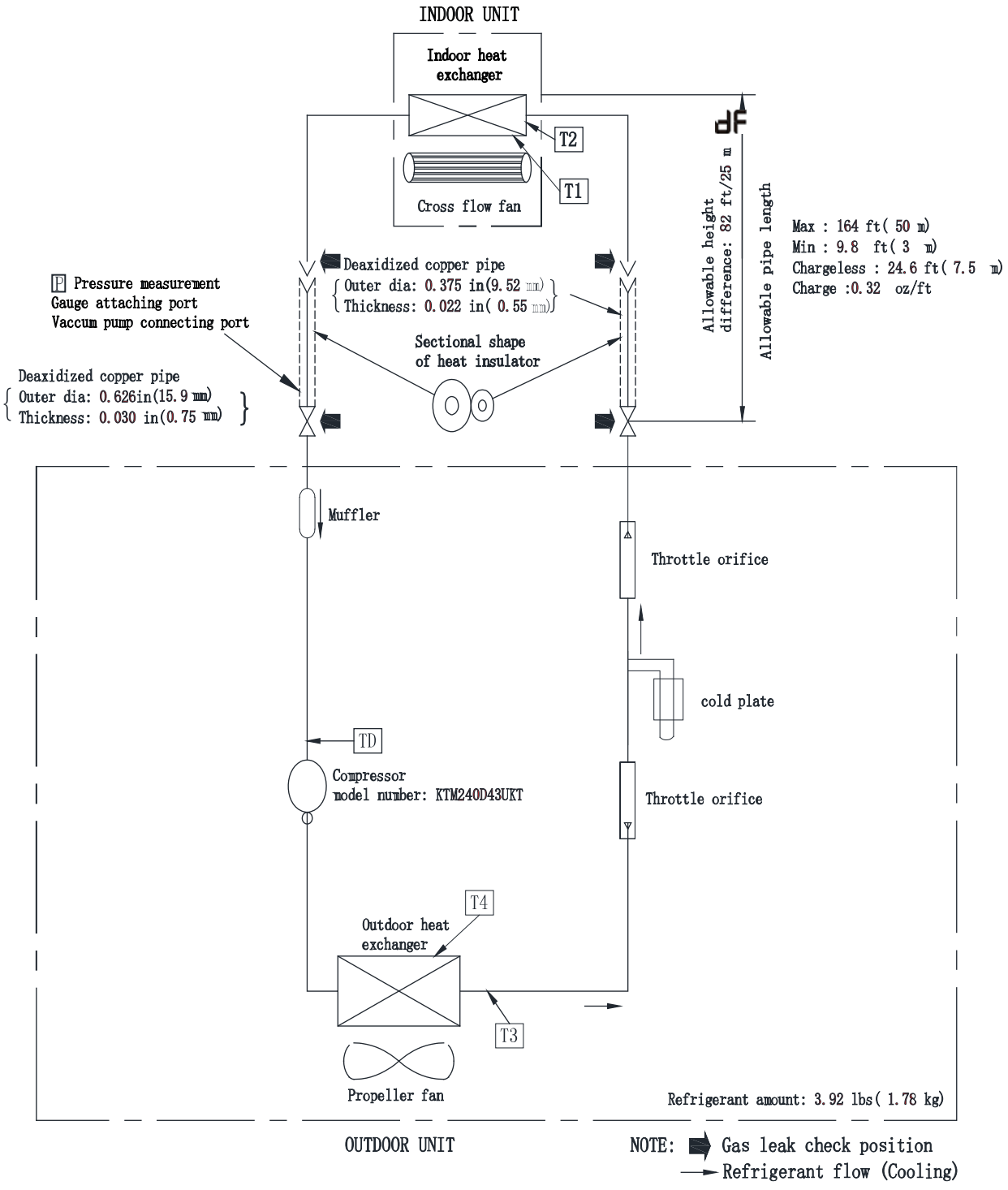


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**Fig. 14 —24K - 208/230V Cooling Only**

# Refrigerant Lines

## General Refrigerant Line Sizing

1. The outdoor units are shipped with a full charge of R410A refrigerant. All charges, line sizing, and capacities are based on runs of 25ft. (7.6 m). For runs over 25 ft. (7.6 m), refer to "Long-Line Applications"on page 18 for the proper charge adjustments.
2. The minimum refrigerant line length between the indoor and outdoor units is 10 ft. (3 m).
3. Refrigerant lines should not be buried in the ground. If it's necessary to bury the lines, not more than 36 in (914 mm) should be buried. Provide a minimum 6in (152 mm) vertical rise to the service valves to prevent refrigerant migration.
4. Both lines must be insulated. Use a minimum of 1/2in. (12.7 mm) thick insulation. Closed-cell insulation is recommended in all long-line applications.
5. Special consideration should be given to isolating interconnecting tubing from the building structure. Isolate the tubing so vibration or noise is not transmitted into the structure.

**IMPORTANT: Both refrigerant lines must be insulated separately.**

Table 9 lists the maximum lengths allowed.

**Table 9 — Piping and Refrigerant Information**

| System Size | | | 12K(115V) | 9K(208/230V) | 12K(208/230V) | 18K(208/230V) | 24K(208/230V) |
|---|---|---|---|---|---|---|---|
| Piping | Minimum Piping Length | ft. (m) | 9.8 (3) | 9.8 (3) | 9.8 (3) | 9.8 (3) | 9.8 (3) |
| | Standard Piping Length | ft. (m) | 24.6 (7.5) | 24.6 (7.5) | 24.6 (7.5) | 24.6 (7.5) | 24.6 (7.5) |
| | Maximum outdoor-indoor height difference (OU higher than IU) | ft. (m) | 32.8 (10) | 32.8 (10) | 32.8 (10) | 65.6 (20) | 82 (25) |
| | Maximum outdoor-indoor height difference (IU higher than OU) | ft. (m) | 32.8 (10) | 32.8 (10) | 32.8 (10) | 65.6 (20) | 82 (25) |
| | Maximum Piping Length with no additional refrigerant charge per System (Standard Piping length) | ft. (m) | 24.6 (7.5) | 24.6 (7.5) | 24.6 (7.5) | 24.6 (7.5) | 24.6 (7.5) |
| | Total Maximum Piping Length per system | ft. (m) | 82 (25) | 82 (25) | 82 (25) | 98.4 (30) | 164 (50) |
| | Additional refrigerant charge (between Standard – Maximum piping length) | Oz/ft (g/m) | 0.161(15) | 0.161(15) | 0.161(15) | 0.161(15) | 0.322(30) |
| | Suction Pipe (size - connection type) | In (mm) | ø1/2" (12.7) | ø3/8" (9.52) | ø1/2" (12.7) | ø1/2" (12.7) | ø5/8" (15.9) |
| | Liquid Pipe (size - connection type) | In (mm) | ø1/4" (6.35) | ø1/4" (6.35) | ø1/4" (6.35) | ø1/4" (6.35) | ø3/8" (9.52) |
| Refrigerant | Refrigerant Type | Type | R410A | R410A | R410A | R410A | R410A |
| | Charge Amount (**Heat Pump**) | lb. (kg) | 1.79(0.81) | 1.59(0.72) | 1.79(0.81) | 2.98(1.35) | 3.92(1.78) |
| | Charge Amount (**Cooling Only**) | lb. (kg) | 1.43 (0.65) | - | 1.43 (0.65) | 1.98(0.9) | 3.92 (1.78) |

## Long-Line Applications

1. No change in line sizing is required.
2. Add refrigerant per Table 9.

# SYSTEM EVACUATION AND CHARGING

**CAUTION**

**UNIT DAMAGE HAZARD**
Failure to follow this caution may result in equipment damage or improper operation.
Never use the system compressor as a vacuum pump.

Refrigerant tubes and indoor coil should be evacuated using the recommended deep vacuum method of 500 microns. Always break a vacuum with dry nitrogen.

## System Vacuum and Charge

### Using Vacuum Pump

1. Completely tighten all flare nuts and connect manifold gage charge hose to a charge port of the low side service valve (see Fig. 15).
2. Connect the charge hose to vacuum pump.
3. Fully open the low side of manifold gage (see Fig. 16).
4. Start the vacuum pump.
5. Evacuate using the triple evacuation method.
6. After evacuation is complete, fully close the low side of manifold gage and stop operation of vacuum pump.
7. The factory charge contained in the outdoor unit is good for up to 25 ft. (8 m) of line length. For refrigerant lines longer than 25 ft. (8 m), add refrigerant as specified in the Table 9 on page 18.
8. Disconnect the charge hose from the charge connection of the low side service valve.
9. Fully open the B and A service valves.
10. Securely tighten the service valves caps.

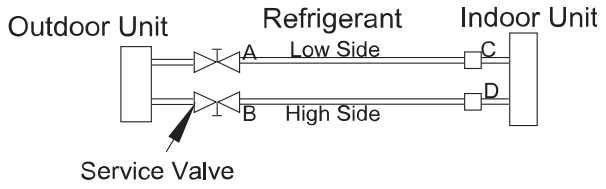


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**Fig. 15 —Service Valve**

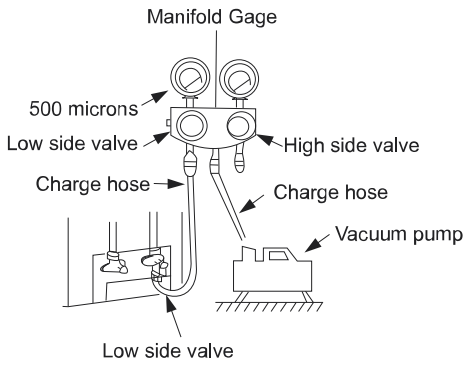


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**Fig. 16 —Manifold**

### Deep Vacuum Method

The deep vacuum method requires a vacuum pump capable of pulling a vacuum of 500 microns and a vacuum gage capable of accurately measuring this vacuum depth. The deep vacuum method is the most positive way of assuring a system is free of air and liquid water (see Fig. 17).

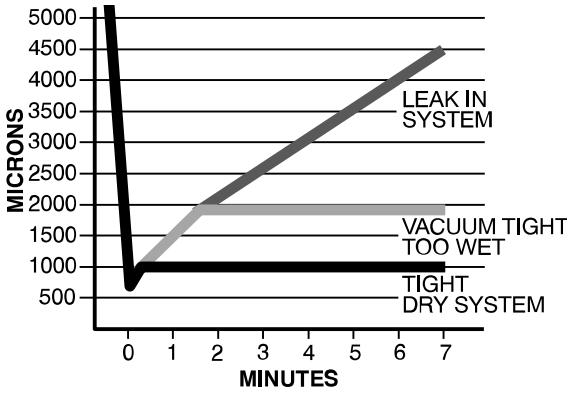


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**Fig. 17 —Deep Vacuum Graph**

### Triple Evacuation Method

The triple evacuation method should be used. Refer to Fig. 18 and proceed as follows:

1. Pump the system down to 500 MICRONS of mercury and allow the pump to continue operating for an additional 15 minutes.
2. Close the service valves and shut off the vacuum pump.
3. Connect a nitrogen cylinder and regulator to the system and open until the system pressure is 2 psig.
4. Close the service valve and allow the system to stand for 10 minutes. During this time, dry nitrogen will be able to diffuse throughout the system absorbing moisture.
5. Repeat this procedure as indicated in Fig. 18. The system is now free of any contaminants and water vapor.

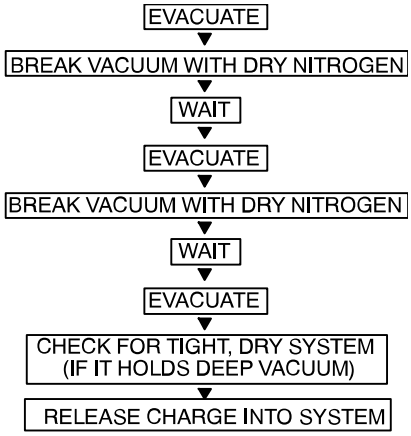


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**Fig. 18 —Triple Evacuation Method**

### Final Tubing Check

**IMPORTANT: Check to be certain factory tubing on both indoor and outdoor unit has not shifted during shipment. Ensure tubes are not rubbing against each other or any sheet metal. Pay close attention to feeder tubes, making sure wire ties on feeder tubes are secure and tight.**

## Electronic Functions

### Abbreviation:

- •T1: Indoor room temperature
- •T2: Coil temperature of indoor heat exchanger middle
- •T3: Coil temperature of condenser
- •T4: Outdoor ambient temperature
- •T5: Compressor discharge temperature
- •Td: Target temperature
- •Ts: Set Point Temperature

## Main Protection

### Three minute delay for compressor restart

Less than a 1 minute delay for the initial start-up and a 3 minute delay for subsequent starts.

### Compressor high temperature cutout

The unit stops working when the compressor high temperature cutout opens, and restarts after the compressor high temperature cutout closes.

### Compressor discharge temperature protection

Compressor discharge temp. T5>239°F(115°C) for 5s, compressor stops.

### Fan speed is out of control

When the indoor fan speed is too low (300RPM) or too high (1500RPM) for a certain time, the unit stops and the LED displays the failure.

### Inverter module protection

The inverter module has a protection function for current, voltage and temperature. If any of these protections engage, the corresponding code displays on the indoor unit and the unit stops working.

### Indoor fan delayed open function

When the unit starts up, the louver is active immediately and the indoor fan opens 10s later. If the unit is running in the **HEATING** mode, the indoor fan is also controlled by the anti-cold wind function.

### Compressor preheating functions

Preheat parameters: When the T4 (outdoor ambient temperature) <37.4°F (3°C), preheat function is activated.

### Zero crossing detection error protection

If the AC detects the time interval is not correct for a continuous 240s, the unit stops and the **LED** displays the failure. The correct zero crossing signal time interval should be between 6-13ms.

### Sensor protection at open circuit and breaking disconnection

If only one temperature sensor malfunctions, the air conditioner continues to work however the error code displays on the LED, in the event of any emergency use. If more than one temperature sensor malfunctions, the air conditioner stops working.

### Refrigerant leakage detection

This function is only active in the **COOLING** mode. The function helps prevent the compressor from being damaged by a refrigerant leakage or a compressor overload.

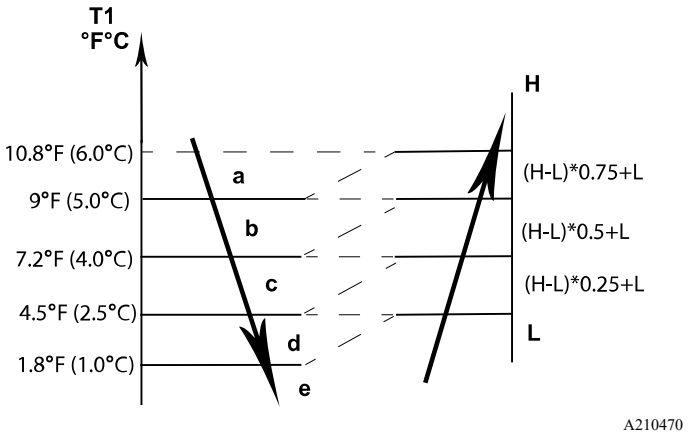
### Open condition:

When the compressor is active, the evaporator T2 coil temperature value has no or very little change.

## Operation Modes and Functions

### FAN Mode

1. Outdoor fan and compressor stop
2. Temperature setting function is disabled and no setting temperature appears.
3. Indoor fan can be set to high/med/low/auto
4. The louver operates same as in the **COOLING** mode.
5. Auto fan




A210470

**Fig. 19 —AUTO FAN Mode**

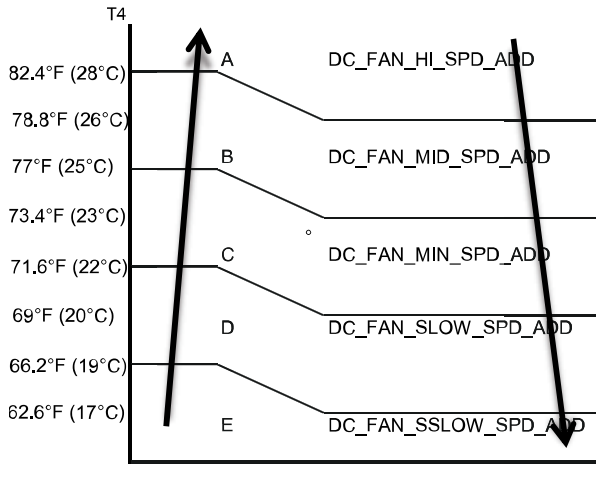
### COOLING Mode

#### Compressor Running Rules:

- When T1-Ts < -4°F (-2°C), the compressor stops.
- When T1-Ts > -1°F (-0.5°C), the compressor activates.
- When the AC runs in the **QUIET** mode, the compressor runs with low frequency.
- When the current is more than setting value, the current protection function activates, and the compressor stops.

#### Outdoor Fan Running Rules:

The outdoor unit runs at a different fan speed according to T4. For different outdoor units, the fan speeds differ.




A210471

**Fig. 20 —Outdoor Fan Running Rules**

### Indoor Fan Running Rules:

- In the **COOLING** mode, the indoor fan runs continuously and the user can select any of the following speeds: **HIGH**, **MEDIUM**, **LOW** and **AUTO**.
- When the setting temperature is reached, if the compressor stops running, the indoor fan motor runs in the minimum or setting speed (see Fig. 21).

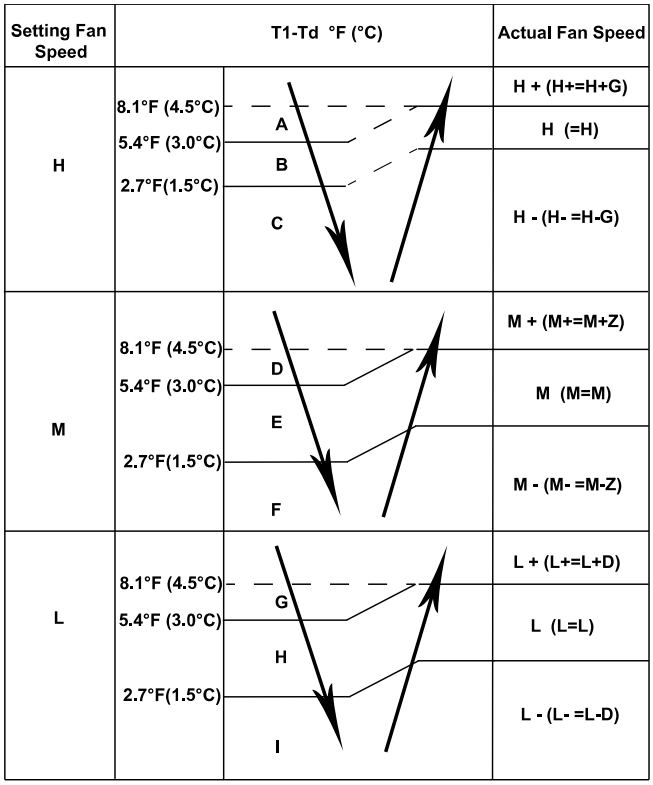



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**Fig. 21 —Indoor Fan Running Rules**

The **AUTO** fan adheres to the following rules (see Fig. 22):

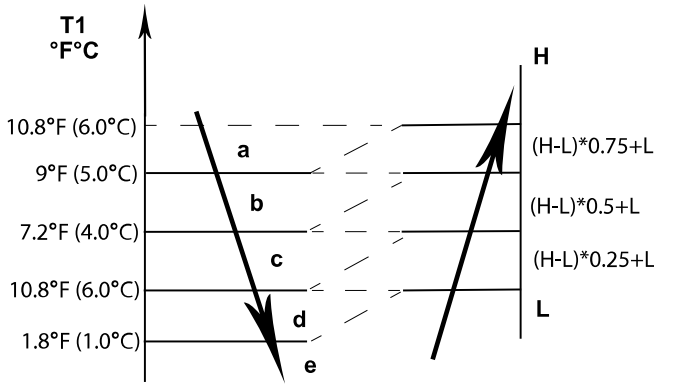


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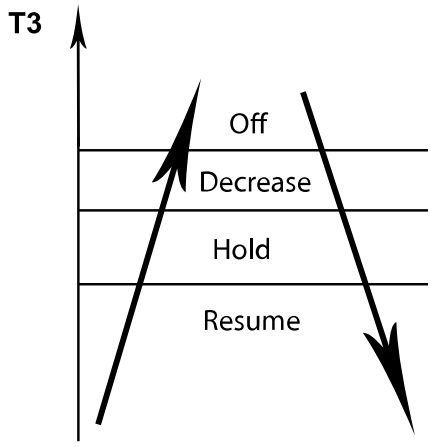
**Fig. 22 — AUTO FAN Running Rules**

### Compressor Temperature Protection




A210474

**Fig. 23 —Compressor Temperature Protection**

- **Off**: Compressor stops
- **Decrease**: Decrease the running frequency to the lower level
- **Hold**: Keep the current frequency
- **Resume**: No limitation for frequency

When the condenser temperature is higher than the setting value, the compressor stops.

### Evaporator Temperature Protection

When the evaporator temperature is lower than the setting value the compressor stops.

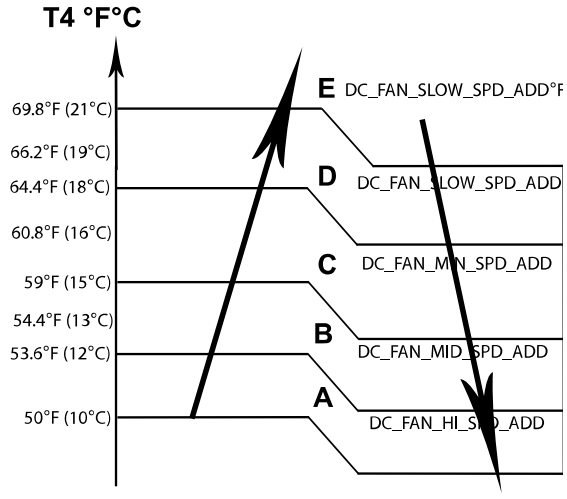
## HEATING Mode

### Compressor Running Rules:

- When T1-Ts>-ΔT, the compressor stops.
- When T1-Ts<ΔT-1.5, the compressor is on. ΔT is the programmed parameter for temperature compensation.
- When the AC runs in **MUTE** mode, the compressor runs with a low frequency.
- When the current is more than the setting value, the current protection function activates and the compressor stops.

### Outdoor Fan Running Rules:

The outdoor unit runs at a different fan speed according to T4. For different outdoor units, the fan speeds differ.



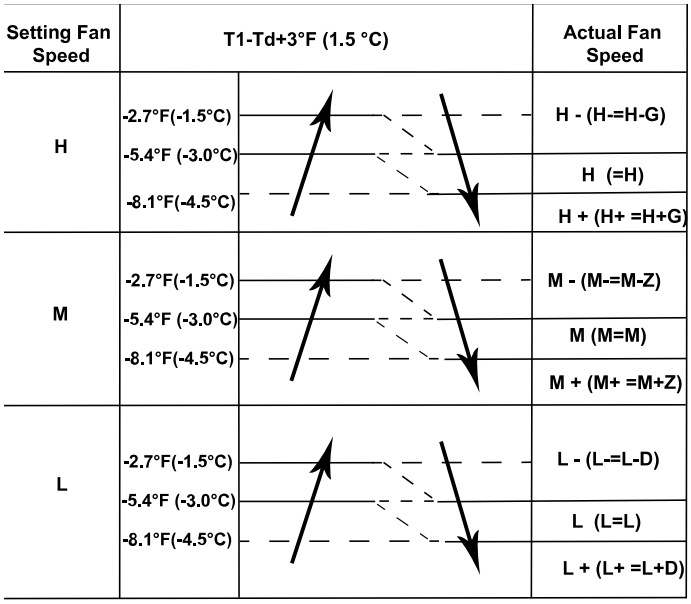

A210475

**Fig. 24 —Outdoor Fan Running Rules**

### Indoor Fan Running Rules:

When the compressor is on, the user can set the indoor fan to either **HIGH/MED/LOW/AUTO/MUTE**. When the indoor unit coil temperature is low, the anti-cold air function starts and the indoor fan motor runs at the low speed. The speed can not be changed.

When the temperature is lower than the setting value, the indoor fan motor stops. When the indoor temperature reaches the setting temperature, the compressor stops, the indoor fan motor runs at the minimum speed or setting speed. The anti-cold air function is valid. The indoor fan is controlled as shown in Fig. 25.




A210476

**Fig. 25 —Indoor Fan Running Rules**

Auto fan action in the **HEATING** mode.

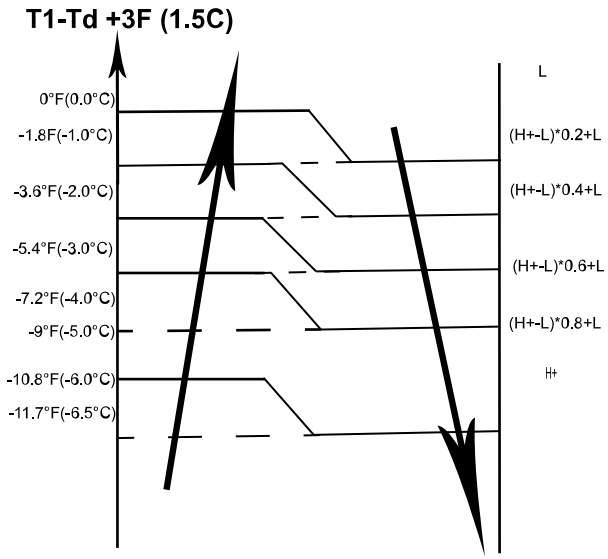



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**Fig. 26 —Auto Fan Action in HEATING Mode**

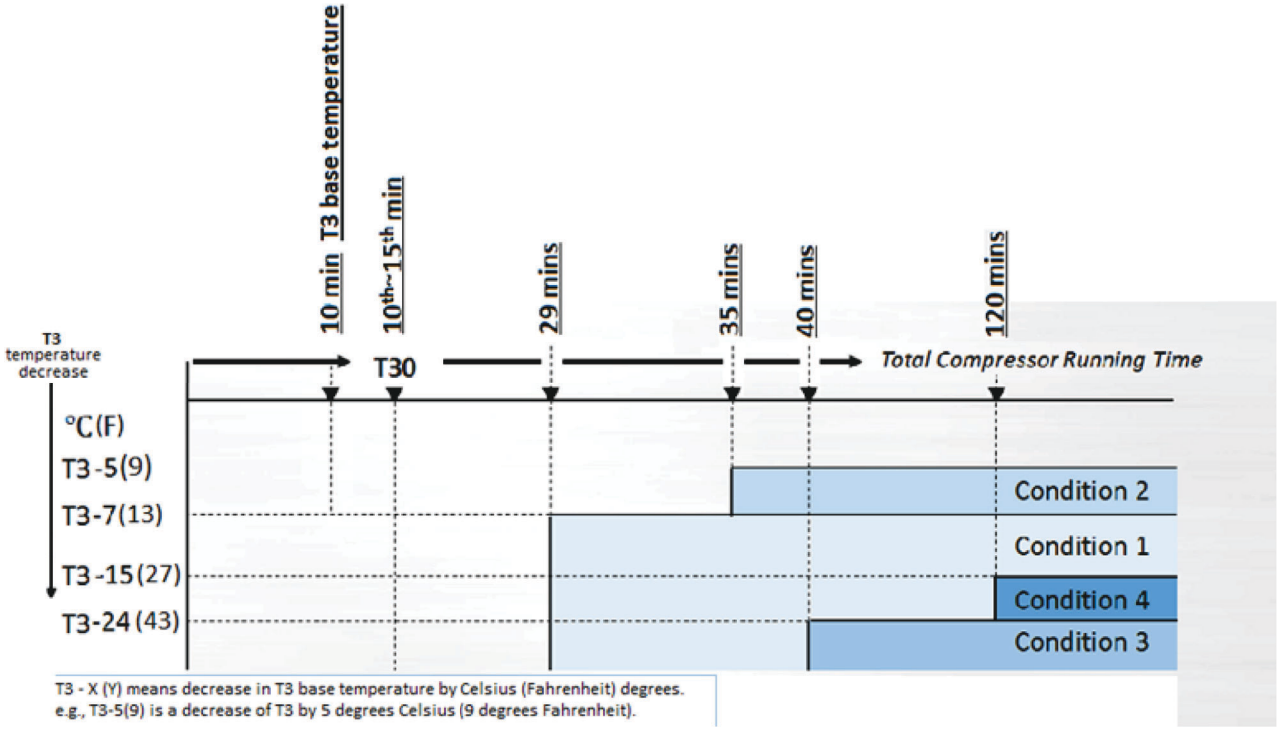
## DEFROST Mode

The air conditioning unit enters the **DEFROST** mode according to the value of temperature of T3 and the value range of temperature change of T3 plus the compressor running time (see Figure 27).

During the **DEFROST** mode, the compressor keeps running however the indoor and outdoor motors stop.

## Forced DEFROSTING Mode:)

1. Press and hold **AUTO/COOL** for 5s to enter the mode. The indoor fan stops and the defrosting lamp illuminates. Use the remote control to exit this mode and turn off the unit to stop the normal defrosting mode.
2. To exit the **FORCED DEFROSTING** mode, press and hold **AUTO/COOL** for 5s again.




| | Compressor run time | Temperature Change |
|---|---|---|
| Condition 1 | Total compressor running time is 29 mins | T3-7°C & **T30**-2.5°C |
| Condition 2 | Total compressor running time is 35 mins | T3 -5°C & **T30**-3°C |
| Condition 3 | Total compressor running time is 40 mins | T3 -24°C for 3 mins |
| Condition 4 | Total compressor running time is 120 mins | T3 -15°C |
| Condition 5 | Total compressor running time is 120 mins | T3 or T4 ≤ -3°C |

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**Fig. 27 —Defrost Chart**

**Defrost Exit Conditions:** Any of the following conditions cancels the **DEFROST** mode and changes the unit's operating mode to normal **HEATING**:
**NOTE:** T3 temperature refers to the sensor reading at the time when the **DEFROST** mode begins.

- T3 temperature rises above 59°F (15°C).
- T3 temperature remains above 46°F (8°C) for more than 80 seconds.
- The unit has been in the **DEFROST** mode for 10 minutes.

The indoor unit defrost lamp illuminates and the **DEFROST** logo appears.

## Evaporator Coil Temperature Protection

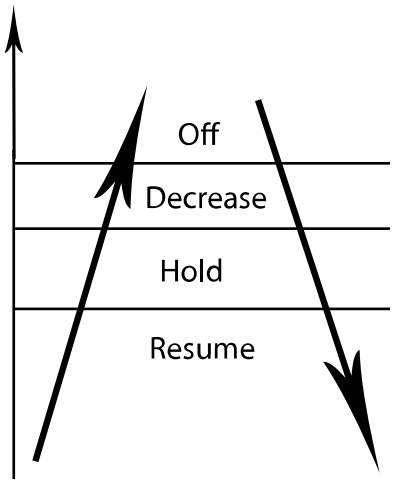


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**Fig. 28 —Evaporator Coil Temperature Protection**

When the evaporator temperature is higher than the setting protection value, the compressor stops.

## AUTO Mode

**AUTO** mode can be selected with the remote controller and the setting temperature can be changed between 60.0°F~86°F (16°C~30°C).

In **the AUTO** mode, the unit chooses either **COOLING**, **HEATING** or the **FAN-ONLY** mode accT2, T4 and relative humidity.

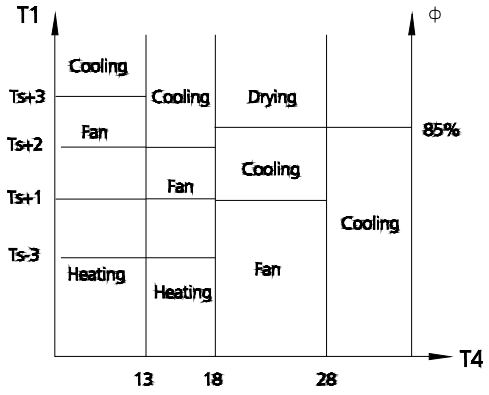


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**Fig. 29 —AUTO Mode**

**Heating*: COOLING ONLY** models run at fan speed. The indoor fan runs in the **AUTO** fan speed for the relevant mode. The louver operates the same as in the relevant mode.

If the unit switches mode between **HEATING** and **COOLING**, the compressor repeatedly stops for a certain time and then chooses the mode according to T1-Ts. If the setting temperature is modified, the unit selects a running function again.

## DRYING mode

The indoor fan speed is fixed at breeze and can not be changed. The louver angle is the same as in the **COOLING** mode.

### Low Indoor Room Temperature Protection

In the **DRYING** mode, if the room temperature is lower than 50°F (10°C), the compressor stops and does not resume until the room temperature exceeds 53.6°F (12°C).

Evaporator anti-freezing protection, condenser high temperature protection and outdoor unit frequency limit are active and are the same as that in the **COOLING** mode. The outdoor fan operates the same as in **COOLING** mode.

## FORCED OPERATION Function

### Enter FORCED OPERATION function:

When the machine is off, press **TOUCH** to engage the **Forced Auto Mode**. Press **TOUCH** again, within 5 seconds, to engage the **FORCED COOLING** mode. In **FORCED AUTO**, **FORCED COOLING** or any other operation mode, press **TOUCH** to turn off the unit.

In the **FORCED OPERATION** mode, all general protections and the remote controller are available.

## Operation Rules:

**FORCED COOLING mode:**

The compressor runs at the F2 frequency and the indoor fan runs as a breeze. After running for 30 minutes, the unit enters the **AUTO** mode at a 75.2°F (24°C) setting temperature.

**FORCED AUTO mode:**

The **FORCED AUTO** mode is the same as the normal **AUTO** mode with a 75.2°F (24°C) setting temperature.

### AUTO-RESTART function

The indoor unit is equipped with an **AUTO-RESTART** function, which is carried out through an auto-restart module. In case of a sudden power failure, the module memorizes the setting conditions before the power failure. The unit resumes the previous operation setting (not including the swing function) automatically 3 minutes after the power returns.

If the memorization condition is the **FORCED COOLING** mode, the unit runs in the **COOLING** mode for 30 minutes and enters the **AUTO** mode as 75.2°F (24°C) setting temp.

If the air conditioner turns off before the unit powers off and the air conditioner is required to restart immediately, the compressor delays for 1 minute when the power is on. Under other conditions, the compressor has a 3 minute delay when it restarts.

### Refrigerant Leakage Detection

With this new technology, the display area displays **EC** when the outdoor unit detects a refrigerant leak.

### 46°F (8°C) Heating

When the compressor is running, the indoor fan motor runs without the anti-cold air function. When the compressor is off, the indoor fan motor is off.

## Point Check Function

Press the remote controller **LED** three times, and then press **SWING** three times within ten seconds (the buzzer rings for two seconds). The air conditioner enters the information enquiry status.

Press **LED** or **SWING** to check the next or previous code in the sequence, respectively. When the air conditioner enters the information enquiry status, it displays the code name for 2 seconds. When the air conditioner enters the information enquiry status, it displays the code value in the next 25 seconds.

**Table 10 — Enquiry Information**

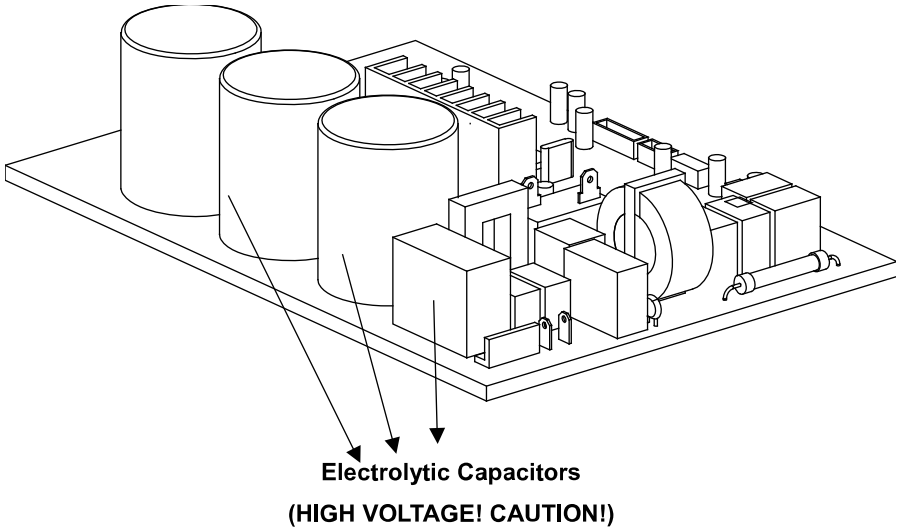
| Displayed Code | Explanation | Displayed Value | Meaning | Additional Notes |
|---|---|---|---|---|
| T1 | Room temperature | -1F,-1E,-1d,-1c,- 1b,-1A<br>-19—99<br>A0,A1,…A9<br>b0,b1,…b9 c0,c1,…c9<br>d0,d1,…d9 E0,E1,…E9<br>F0,F1,…F9 | -25,-24,-23,-22,<br>-21,-20<br>-19—99 100,101,…109<br>110,111,…119<br>120,121,…129<br>130,131,…139<br>140,141,…149<br>150,151,…159 | 1. All displayed temperatures use actual values.<br>2. All temperatures are displayed in °C regardless of remote used.<br>3. T1, T2, T3, T4, and T2B display ranges from -25 the to 70 °C. T5 display ranges from -20 to 130 °C.<br>4. The frequency display ranges from 0 to 159HZ.<br>5. If the actual values exceed or fall short of the defined range, the values closest to the maximum and minimum values appear. |
| T2 | Indoor coil temperature | | | |
| T3 | Outdoor coil temperature | | | |
| T4 | Ambient temperature | | | |
| Tb | Outlet temperature of indoor coil | | | |
| T5 | Discharge temperature | | | |
| FT | Targeted frequency | | | |
| Fr | Actual frequency | | | |
| IF | Indoor fan speed | 0<br>1,2,3,4 | OFF, Low speed, Medium speed, High speed, Turbo. | N/A - Used for some large capacity motors. |
| OF | Outdoor fan speed | 14-FF | Actual fan speed is equal to the display value converted to the decimal value and multiplied by 10. This is measured in RPM. | Used for some small capacity motors. The display value is 14-FF (hexadecimal). The corresponding fan speed ranges from 200 to 2550RPM. |
| LA | EXV opening angle | 0-FF | Actual EXV opening value is equal to the display value converted to decimal value and then multiplied by 2. | - |
| CT | Compressor continuous running time | 0-FF | 0-255 minutes | If the actual value exceeds or falls short of the defined range, the value closest to the maximum and minimum is displayed. |
| ST | Causes of compressor stop | 0-99 | For a detailed explanation, contact technical support. | - |
| **Displayed Code** | **Explanation** | **Displayed Value** | **Meaning** | **Additional Notes** |
| A0 | Reserved | 0-FF<br>2-28<br>5-20<br>5-25 | - | - |
| A1 | | | | |
| b0 | | | | |
| b1 | | | | |
| b2 | | | | |
| b3 | | | | |
| b4 | | | | |
| b5 | | | | |
| b6 | | | | |
| dL | | | | |
| Ac | | | | |
| Ub | | | | |
| Td | | | | |
| dA | | | | |
| d5 | | | | |
| dT | | | | |

# TROUBLESHOOTING

## Safety

Electricity power is kept in capacitors even if the power supply is shut off.

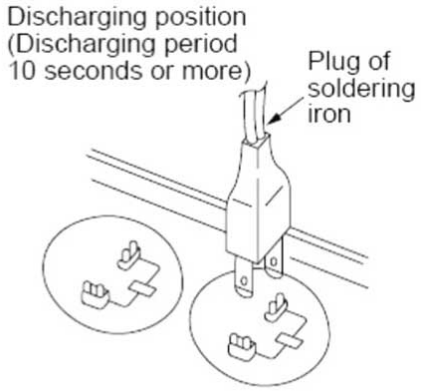
**NOTE: Remember to discharge the electricity power in capacitor.**




A210482

**Fig. 30 —Electrolytic Capacitors**

For other models, connect the discharge resistance (approximately 100Ω 40W) or a soldering iron (plug) between the +, - terminals of the electrolytic capacitor on the contrary side of the outdoor PCB.




A210484

**Fig. 31 —Discharge Position**

**NOTE: Figure 31 is for reference only. The plug on your unit may differ.**

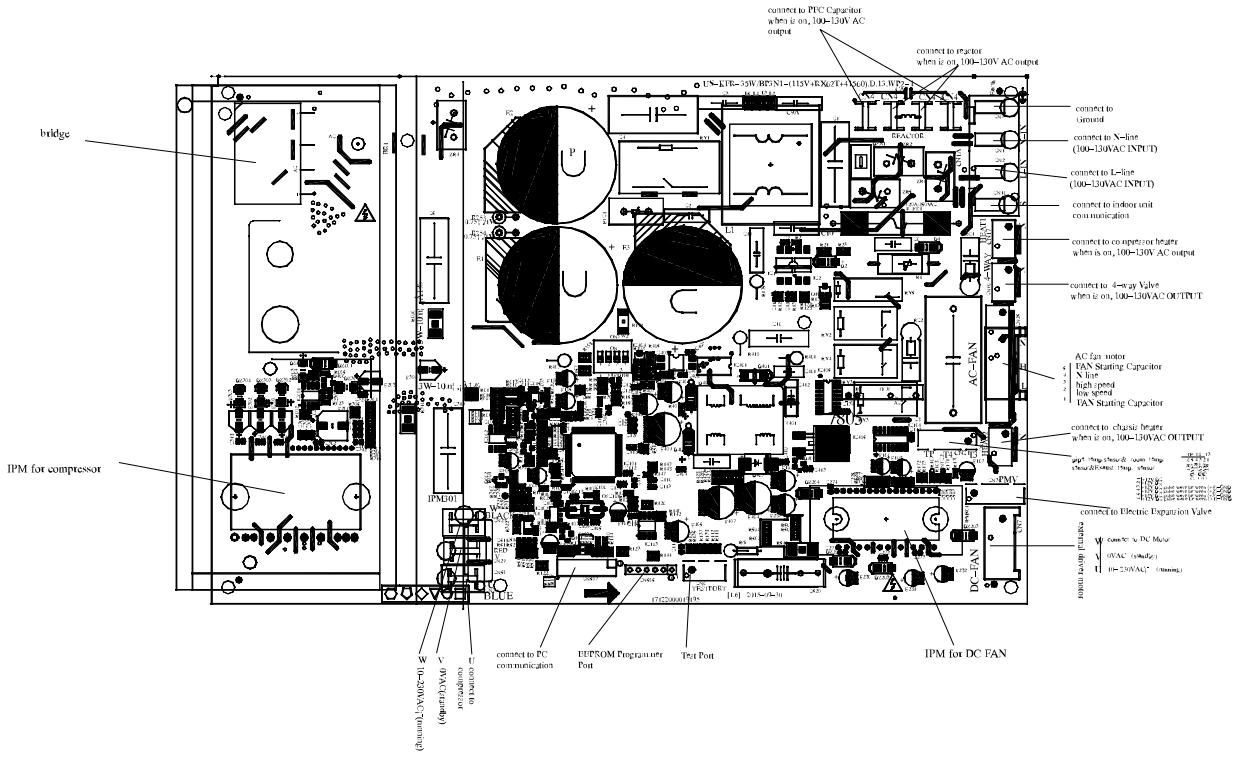
## Outdoor Unit Diagnostic Guide

### Table 11 — Outdoor Unit Diagnostic Guide

| Operation Lamp | Timer Lamp | Display | LED Status |
|---|---|---|---|
| ✪1 time | OFF | E0 | Indoor unit EEPROM parameter error |
| ✪2 times | OFF | E1 | Indoor / outdoor unit communication error |
| ✪3 times | OFF | E2 | Zero-crossing signal detection error (for some models) |
| ✪4 times | OFF | E3 | The indoor fan speed is operating outside of the normal range |
| ✪5 times | OFF | E4 | Indoor room temperature sensor T1 is in open circuit or has short circuited |
| ✪6 times | OFF | E5 | Evaporator coil temperature sensor T2 is in open circuit or has short circuited |
| ✪9 times | OFF | E7/EH Ob | Indoor PCB / Display board communication error (for some models) |
| ✪7 times | OFF | EC | Refrigerant leak detected |
| ✪1 time | ON | F0 | Current overload protection |
| ✪2 times | ON | F1 | Outdoor room temperature sensor T4 is in open circuit or has short circuited |
| ✪3 times | ON | F2 | Condenser coil temperature sensor T3 is in open circuit or has short circuited |
| ✪4 times | ON | F3 | Compressor discharge temperature sensor TP is in open circuit or has short circuited |
| ✪7 times | ON | F6 | Evaporator coil outlet temperature sensor T2B is in open circuit or has short circuited (for free-match indoor units) |
| ✪5 times | ON | F4 | Outdoor unit EEPROM parameter error |
| ✪6 times | ON | F5 | The outdoor fan speed is operating outside of the normal range (for some models) |
| ✪1 time | FLASH | P0 | IPM malfunction or IGBT over-strong current protection |
| ✪2 times | FLASH | P1 | Over voltage or over low voltage protection |
| ✪3 times | FLASH | P2 | High temperature protection of IPM module or High pressure protection |
| ✪5 times | FLASH | P4 | Inverter compressor drive error |
| ✪7 times | FLASH | P6 | Low pressure protection some models) |
| ✪6 times | FLASH | P5/-- | Indoor units mode conflict (match with multi outdoor unit) |

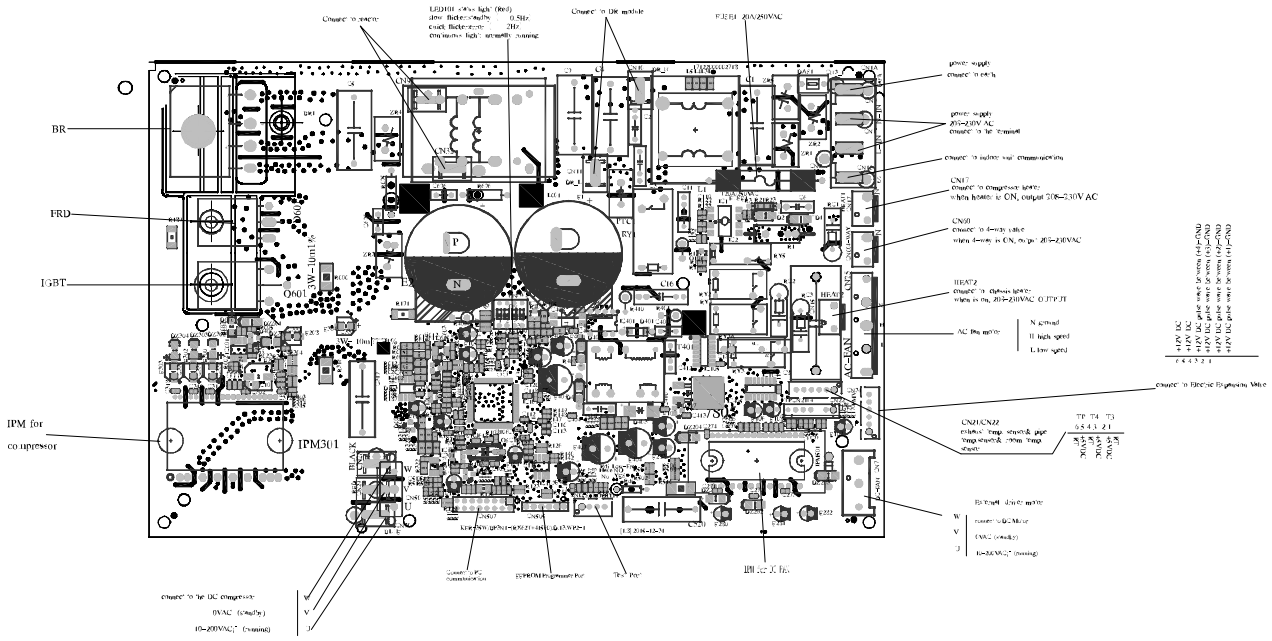
**O (light)  X (off)  ✪ (flash)**

# PCB DIAGRAMS (HEAT PUMP)




A210485

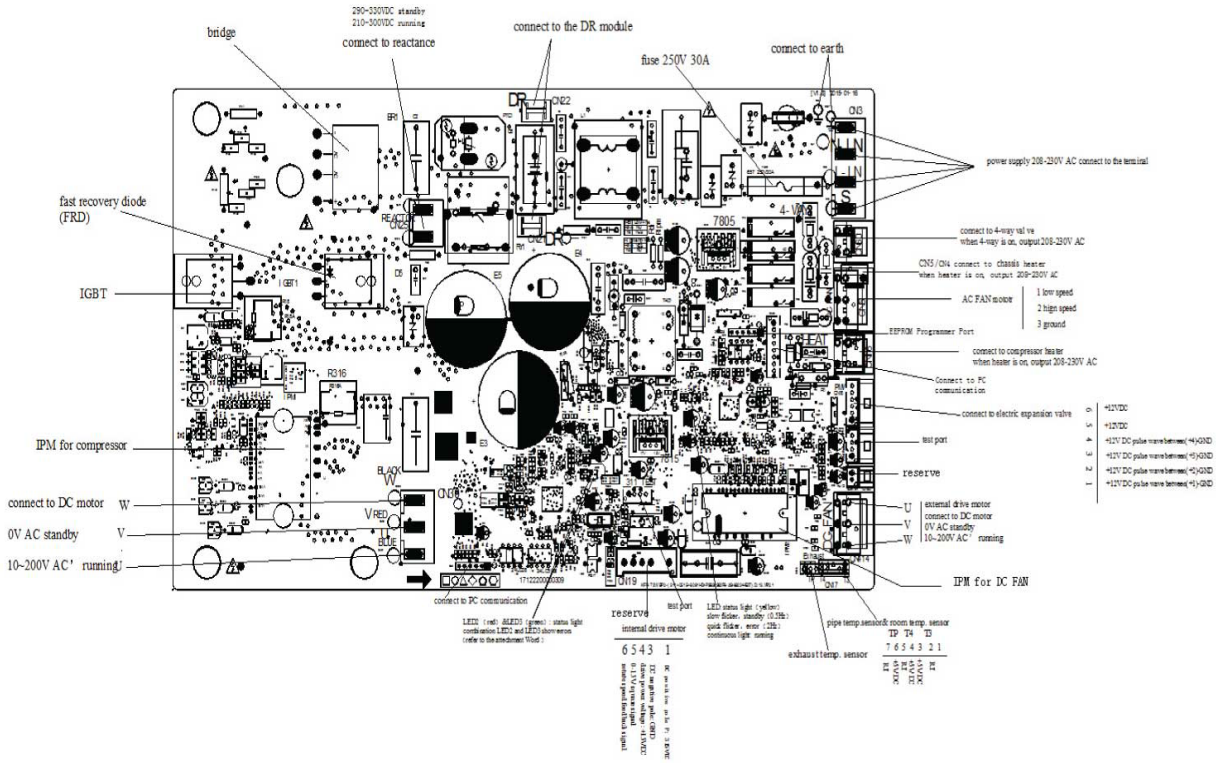
**Fig. 32 —Size 12K (115V)**




A210486

**Fig. 33 —Sizes 09-12K (208/230V)**

# PCB DIAGRAMS (CONT)




A210491

**Fig. 34 —Sizes 18-24K (208/230V)**

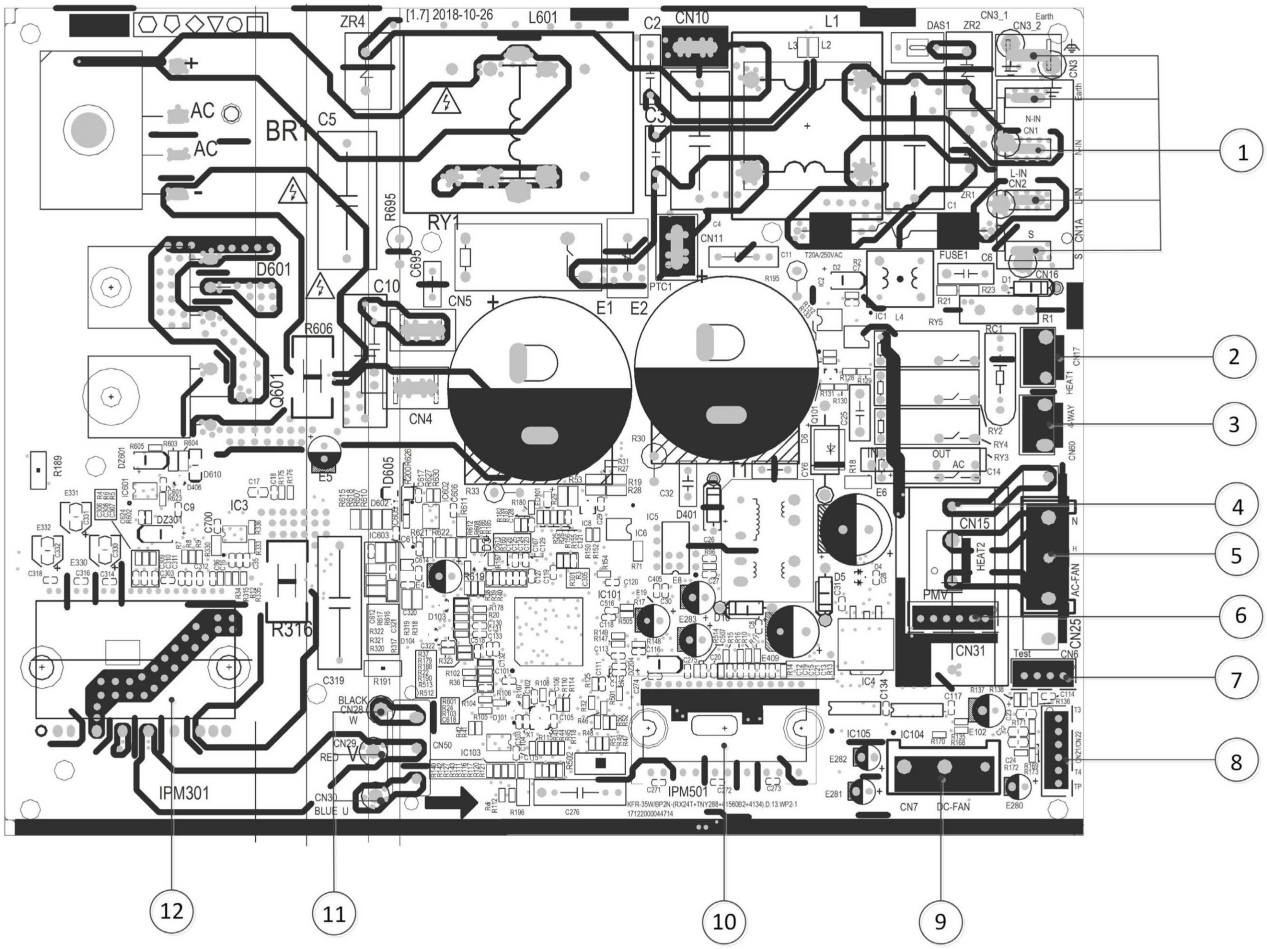
**NOTE: After powering the unit on, LED3(Green color) and LED2(Red color) flashes if the unit experiences an issue.**

**Table 12 — LED Codes**

| No. | Problems | LED3 (Green) | LED2 (Red) | IU display |
|---|---|---|---|---|
| 1 | standby for normal | O | X | |
| 2 | Operation normally | X | O | |
| 3 | IPM malfunction or IGBT over-strong current protection | ✪ | X | P0 |
| 4 | Over voltage or too low voltage protection | O | O | P1 |
| 5 | EEPROM parameter error | O | ✪ | E5 |
| 6 | Inverter compressor drive error | X | ✪ | P4 |
| 7 | Inverter compressor drive error | ✪ | O | P4 |
| 8 | Inverter compressor drive error | ✪ | ✪ | P4 |

O (light) X (off) ✪(flash)

# PCB DIAGRAMS (COOLING ONLY)



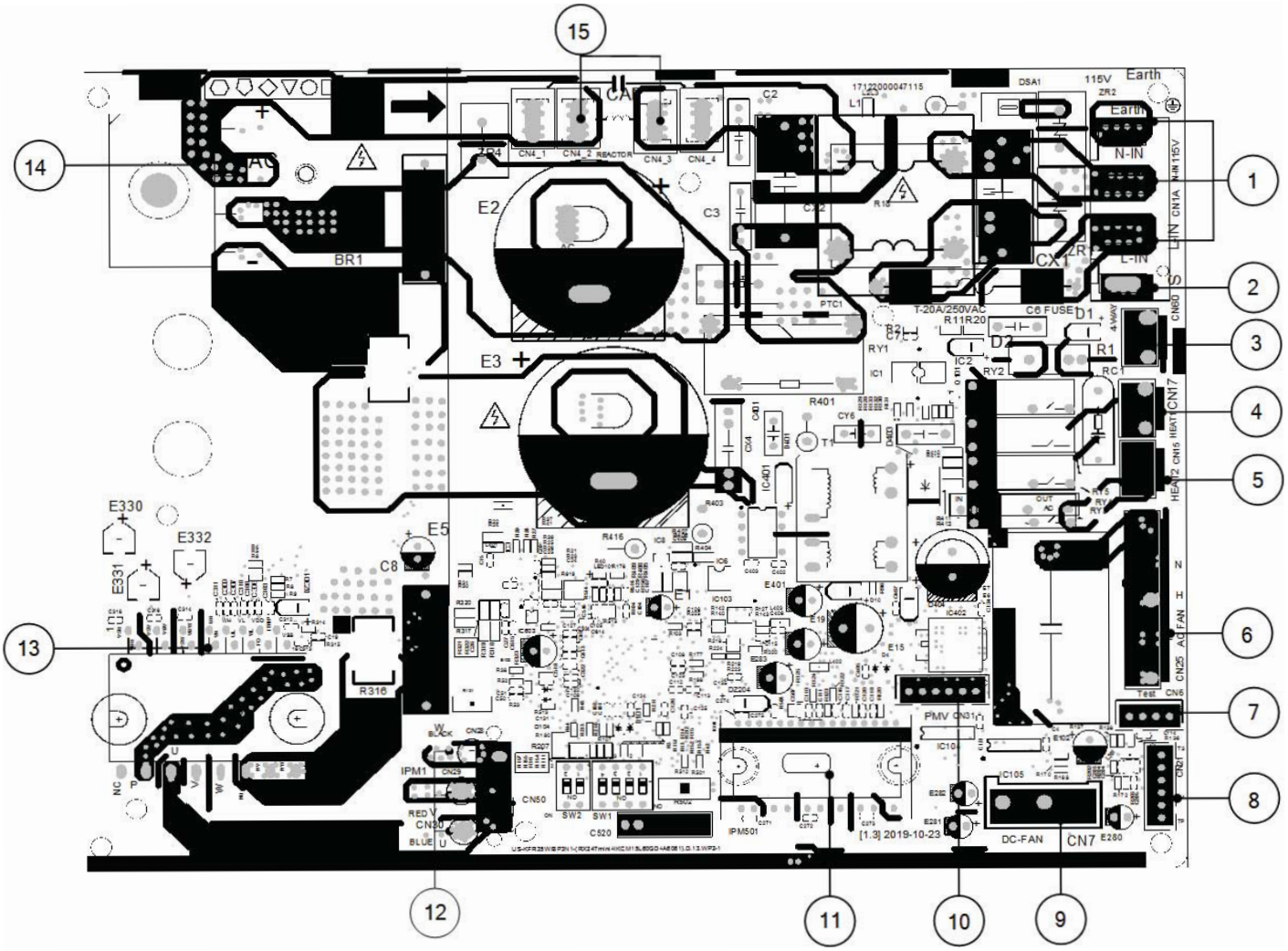

A210593

**Fig. 35 —Sizes 12K (115V) and 18K (208/230V)**

**Table 13 — LED Codes**

| No. | Name | CN# | Meaning |
|---|---|---|---|
| 1 | CN1A | CN3 | Earth: connect to Ground |
| | | CN1 | N_in: connect to N-line (208-230V AC input) |
| | | CN2 | L_in: connect to L-line (208-230V AC input) |
| | | CN16 | S: connect to indoor unit communication |
| 2 | HEAT1 | CN17 | Connect to compressor heater, 208-230V AC when is ON |
| 3 | 4-WAY | CN60 | Connect to 4 way valve, 208-230V AC when is ON. |
| 4 | HEAT2 | CN15 | Connect to chassis heater, 208-230V AC when is ON |
| 5 | AC-FAN | CN25 | Connect to AC fan |
| 6 | PMV | CN31 | Connect to Electric Expansion Valve |
| 7 | TESTPORT | CN6 | Used for testing |
| 8 | TP T4 T3 | CN21/CN22 | Connect to pipe temp. sensor T3, ambient temp. sensor T4, exhaust temp. sensor TP |
| 9 | DC-FAN | CN7 | Connect to DC fan |
| 10 | FAN_IPM | IPM 501 | IPM for DC fan |
| 11 | W | CN28 | Connect to compressor |
| | V | CN29 | 0V AC (standby) |
| | U | CN30 | 10-200V AC (running) |
| 12 | COMP_IPM | IPM 301 | IPM for compressor |

# PCB DIAGRAMS (COOLING ONLY) (CONT)



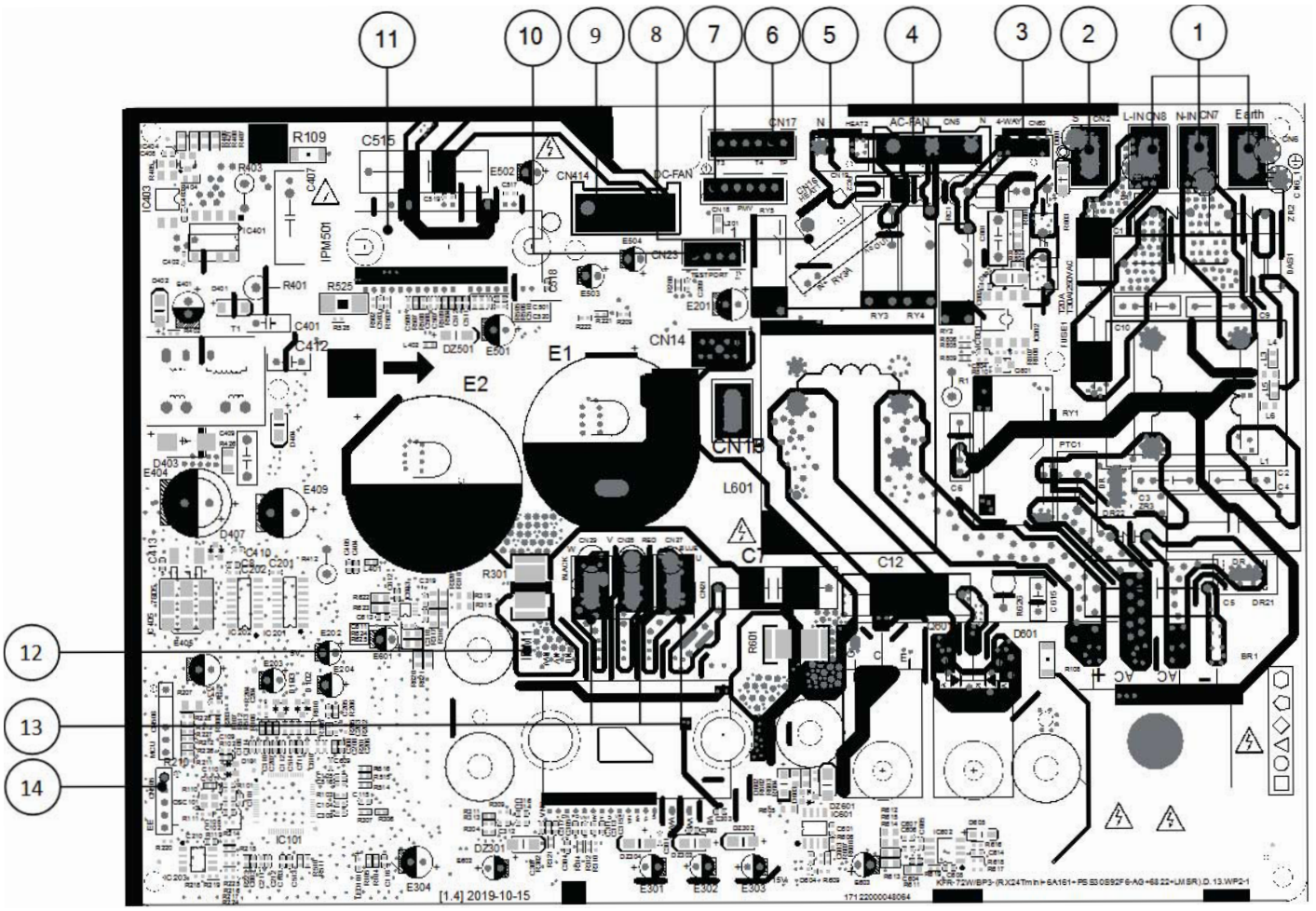

A210594

**Fig. 36 —Size 12K (208/230V)**

**Table 14 — LED Codes**

| No. | Name | CN# | Meaning |
|---|---|---|---|
| 1 | Power Supply | CN3 | Earth: connect to Ground |
| | | CN1 | N_in: connect to N-line (100-130V AC input) |
| | | CN2 | L_in: connect to L-line (100-130V AC input) |
| 2 | S | CN16 | S: connect to indoor unit communication |
| 3 | 4-WAY | CN60 | Connect to 4 way valve, 100-130V AC when is ON. |
| 4 | HEAT1 | CN17 | Connect to compressor heater, 100-130V AC when is ON |
| 5 | HEAT2 | CN15 | Connect to chassis heater, 100-130V AC when is ON |
| 6 | AC-FAN | CN25 | Connect to AC fan |
| 7 | TESTPORT | CN6 | Used for testing |
| 8 | TP T4 T3 | CN21 | Connect to pipe temp. sensor T3, ambient temp. sensor T4, exhaust temp. sensor TP |
| 9 | DC-FAN | CN7 | Connect to DC fan |
| 10 | PMV | CN31 | Connect to Electric Expansion Valve |
| 11 | FAN_IPM | IPM 501 | IPM for DC fan |
| 12 | W | CN28 | Connect to compressor |
| | V | CN29 | 0V AC (standby) |
| | U | CN30 | 10-230V AC (running) |
| 13 | COMP_IPM | IPM 1 | IPM for compressor |
| 14 | BR1 | BR1 | Bridge |
| 15 | CN4 | CN4_2 | Connect to reactor |
| | | CN4_3 | |

# PCB DIAGRAMS (COOLING ONLY) (CONT)




A210595

**Fig. 37 —Size 24K (208/230V)**

**Table 15 — LED Codes**

| No. | Name | CN# | Meaning |
|---|---|---|---|
| 1 | Power Supply | CN6 | Earth: connect to Ground |
| | | CN7 | N_in: connect to N-line (208-230V AC input) |
| | | CN8 | L_in: connect to L-line (208-230V AC input) |
| 2 | S | CN2 | S: connect to indoor unit communication |
| 3 | 4-WAY | CN60 | Connect to 4 way valve, 208-230V AC when is ON. |
| 4 | AC-FAN | CN5 | Connect to AC fan |
| 5 | HEAT2 | CN19 | Connect to chassis heater, 208-230V AC when is ON |
| 6 | TP T4 T3 | CN17 | Connect to pipe temp. sensor T3, ambient temp. sensor T4, exhaust temp. sensor TP |
| 7 | PMV | CN18 | Connect to Electric Expansion Valve |
| 8 | HEAT1 | CN16 | Connect to compressor heater, 208-230V AC when is ON |
| 9 | DC-FAN | CN414 | Connect to DC fan |
| 10 | TESTPORT | CN23 | Used for testing |
| 11 | FAN_IPM | IPM501 | IPM for DC fan |
| 12 | COMP_IPM | IPM1 | IPM for compressor |
| 13 | U | CN27 | Connect to compressor |
| | V | CN28 | 0V AC (standby) |
| | W | CN29 | 200-300V AC (running) |
| 14 | EE_PORT | CN505 | EEPROM programmer port |

# DIAGNOSIS AND SOLUTION

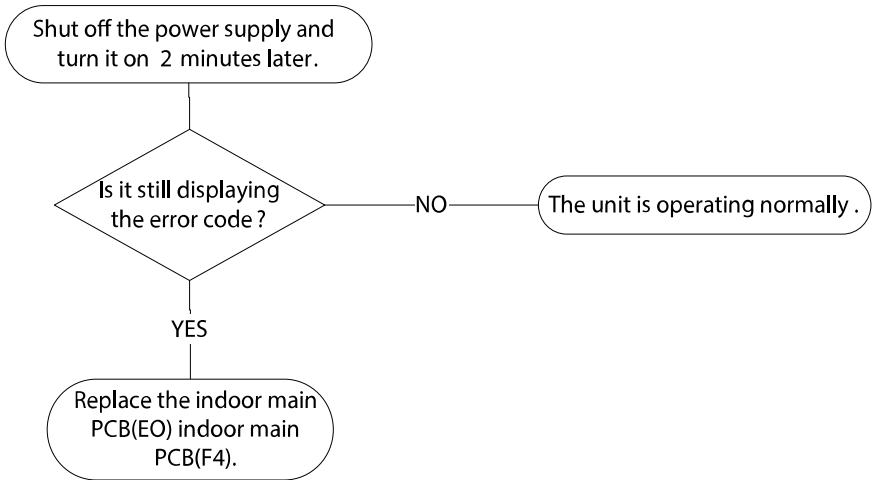
## EEPROM Parameter Error (E0/F4)

**Description:** Indoor or outdoor PCB main chip does not receive feedback from the EEPROM chip.

### Possible causes:

- Installation mistake
- Faulty PCB

### Troubleshooting




A210492

### Remarks:

A read-only memory whose contents can be erased and reprogrammed using a pulsed voltage. For the EEPROM chip location, refer to Figures 38 and 39.

A210512

**Fig. 38 —Indoor PCB**

A210513

**Fig. 39 —Outdoor PCB**

**NOTE: Figures 38 and 39 are for reference only and they may differ from the actual unit.**

# DIAGNOSIS AND SOLUTION (CONT)

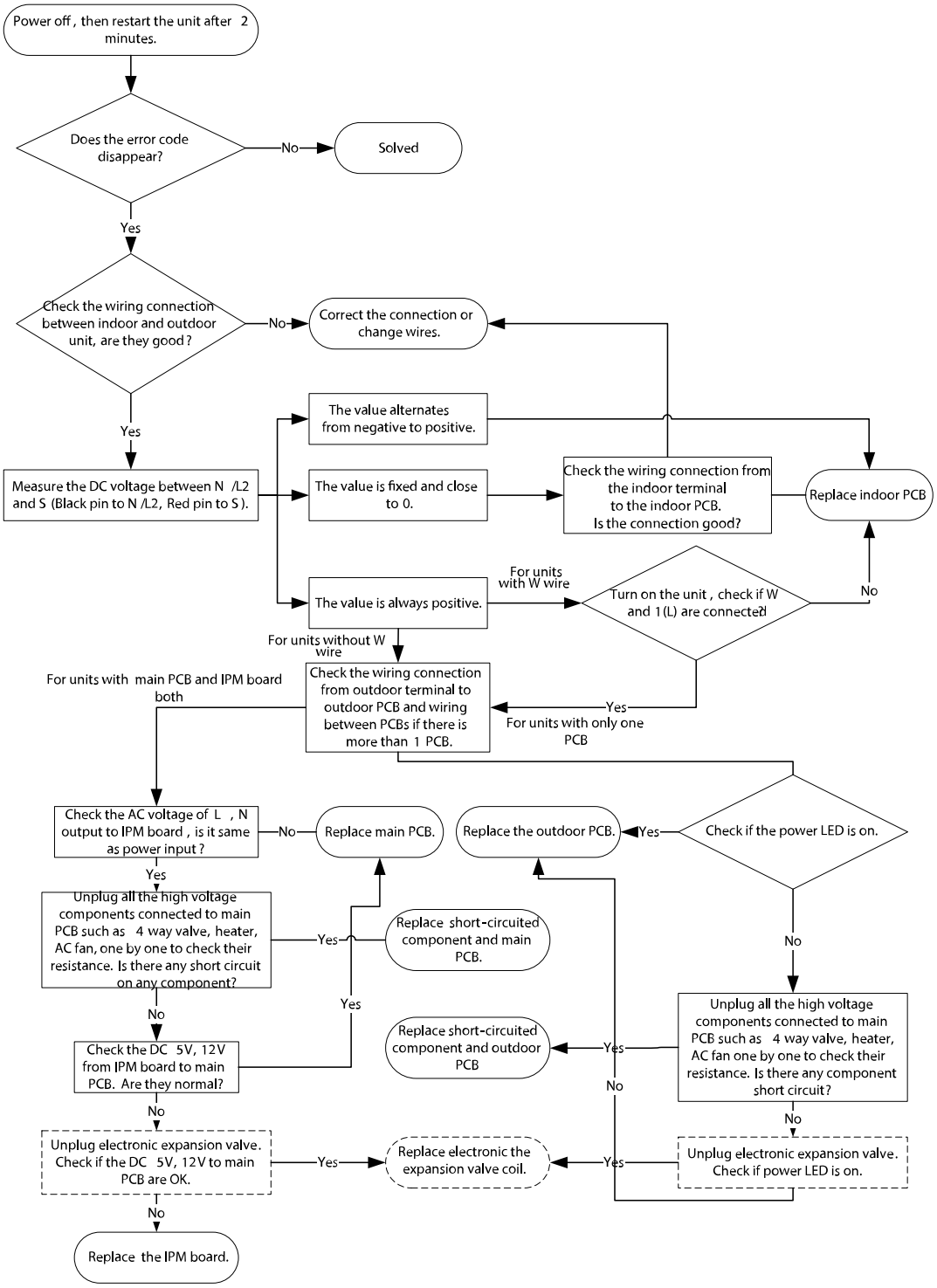
## Indoor and Outdoor Unit Communication Error (E1)

**Description:** The indoor/outdoor unit communication

### Possible causes:

- Wiring mistake
- Faulty Indoor or outdoor PCB

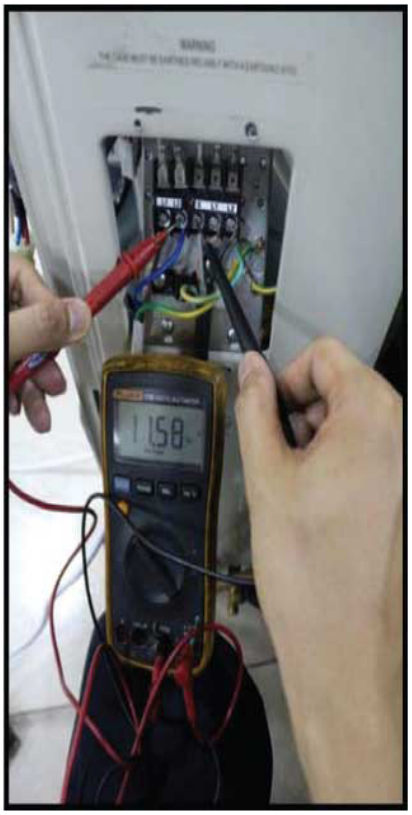
### Troubleshooting




A210596

For certain models, outdoor PCB could not be removed separately. In this case, the outdoor electric control box should be replaced as a whole.

# DIAGNOSIS AND SOLUTION (CONT)



A210524

**Fig. 40 —Test the DC Voltage**

Use a multimeter to test the DC voltage between the outdoor unit's L2 port and S port. The red pin of the multimeter connects with the L2 port while the black pin is for the S port. When the air conditioner is running normal, the voltage moves alternately between -50V to 50V. If the outdoor unit malfunctions, the voltage moves alternately with positive value. If the indoor unit malfunctions, the voltage has a certain value.

A210525

**Fig. 41 —Test the Reactor Resistance**

Use a multimeter to test the resistance of the reactor which does not connect with the capacitor. The normal value should be around zero (0) ohm. Otherwise, the reactor has a malfunction and needs to be replaced.

# DIAGNOSIS AND SOLUTION (CONT)

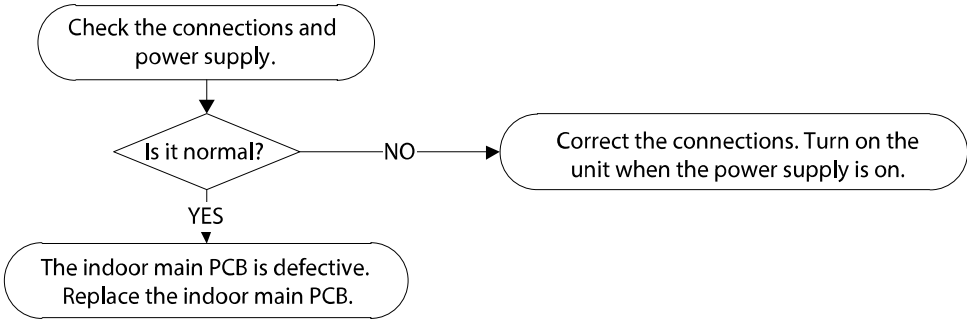
## Zero Crossing Detection Error Diagnosis and Solution (E2)

**Description:** When the PCB does not receive a zero crossing signal feedback for 4 minutes or the zero crossing signal time interval is abnormal.

**Possible causes:**

- Connection mistake
- Faulty PCB

**Troubleshooting**




A210597

# DIAGNOSIS AND SOLUTION (CONT)

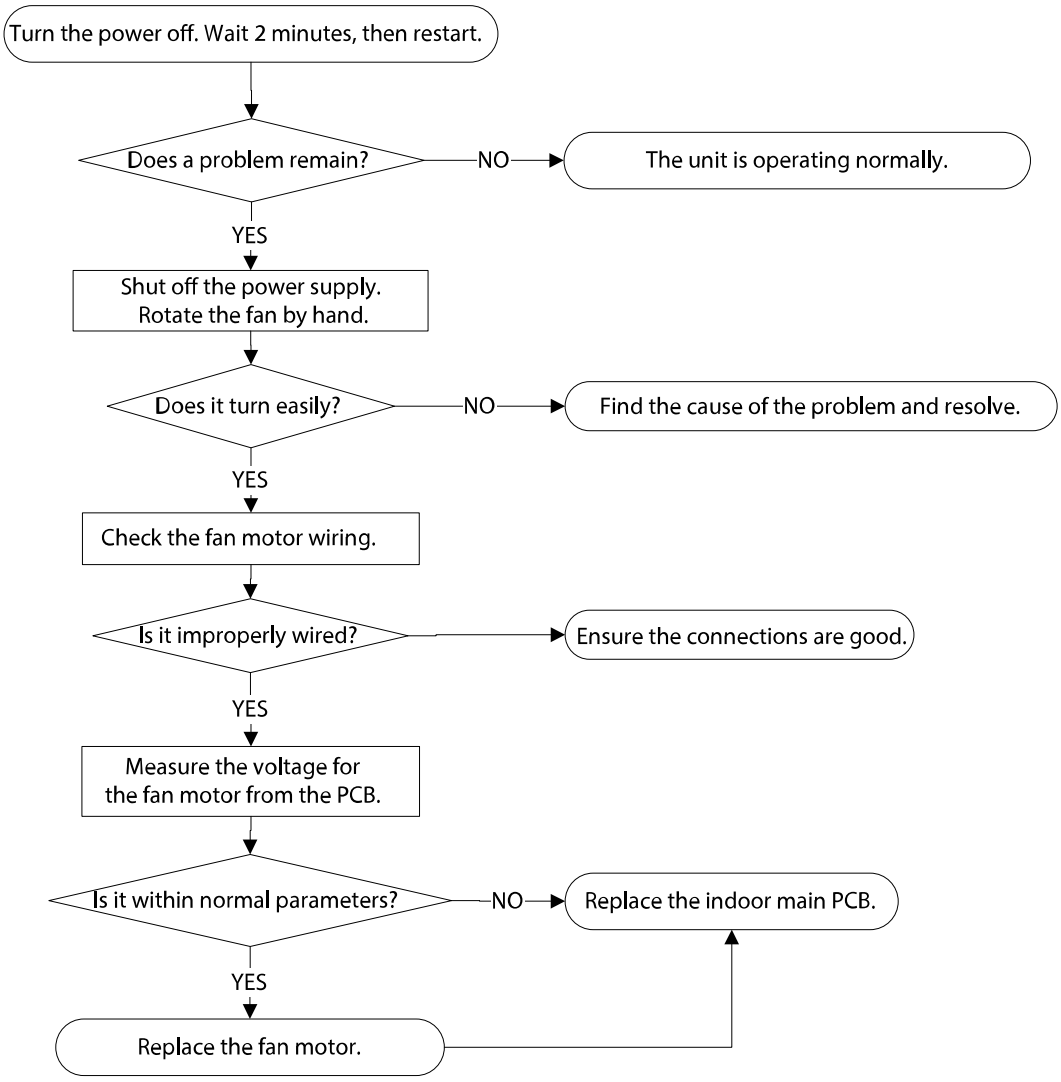
## The indoor fan speed is operating outside of the normal range (E3/F5)

**Description:** When the indoor fan speed remains too slow (below 300 RPM) for an extended period of time, the LED displays a failure code and the unit turns off.

**Possible causes:**

- Wiring mistake
- Faulty fan assembly
- Faulty PCB

### Troubleshooting

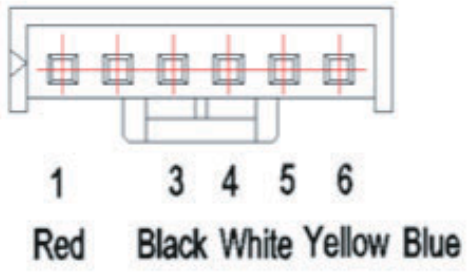



A210598

# DIAGNOSIS AND SOLUTION (CONT)

## Index 1

1. **Indoor or Outdoor DC Fan Motor (control chip is in fan motor)**
   Power on and when the unit is in standby mode, measure the pin1-pin3 and pin4-pin3 voltage in the fan motor connector. If the voltage value is not in the range shown in Table 16. the PCB is faulty and must be replaced.




A210526

**Fig. 42 — Motor Connector**

**Table 16 — DC motor voltage input and output (voltage: 220-240V~)**

| No. | Color | Signal | Voltage |
|---|---|---|---|
| 1 | Red | Vs/Vm | 280V~380V |
| 2 | --- | --- | --- |
| 3 | Black | GND | 0V |
| 4 | White | Vcc | 14~17.5V |
| 5 | Yellow | Vsp | 0~5.6V |
| 6 | Blue | FG | 14~17.5V |

**Table 17 — DC motor voltage input and output (voltage: 115V~):**

| No. | Color | Signal | Voltage |
|---|---|---|---|
| 1 | Red | Vs/Vm | 140V~190V |
| 2 | --- | --- | --- |
| 3 | Black | GND | 0V |
| 4 | White | Vcc | 14~17.5V |
| 5 | Yellow | Vsp | 0~5.8V |
| 6 | Blue | FG | 14~17.5V |

2. **Outdoor DC Fan Motor (control chip is in the outdoor PCB)**
   Power on the unit and check if the fan runs normally. If the fan runs normally, the PCB is faulty and needs to be replaced. If the fan does not run normally, measure the resistance of the two pins. If the resistance is not equal to each other, the fan motor is faulty and needs to be replaced, otherwise the PCB is faulty and needs to be replaced.
3. **Indoor AC Fan Motor**
   Power on the unit and set the unit to the **FAN** mode at the high fan speed. Run for 15 seconds then measure the voltage of pin1 and pin2. If the voltage value is less than 100V(208~240V power supply) or 50V(115V power supply), the PCB is faulty and needs to be replaced.

# DIAGNOSIS AND SOLUTION (CONT)

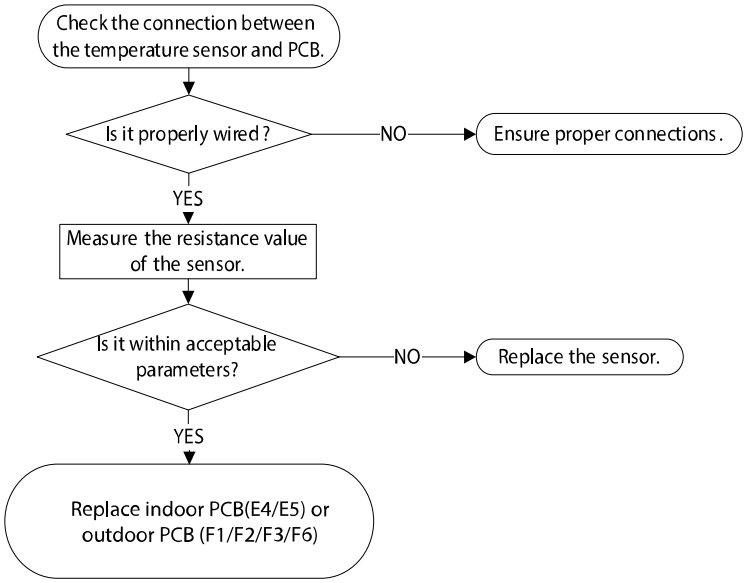
## Open circuit or short circuit of temperature sensor diagnosis and solution (E4/E5/F1/F2/F3)

**Description:** If the sampling voltage is lower than 0.06V or higher than 4.94V, the LED displays the failure.

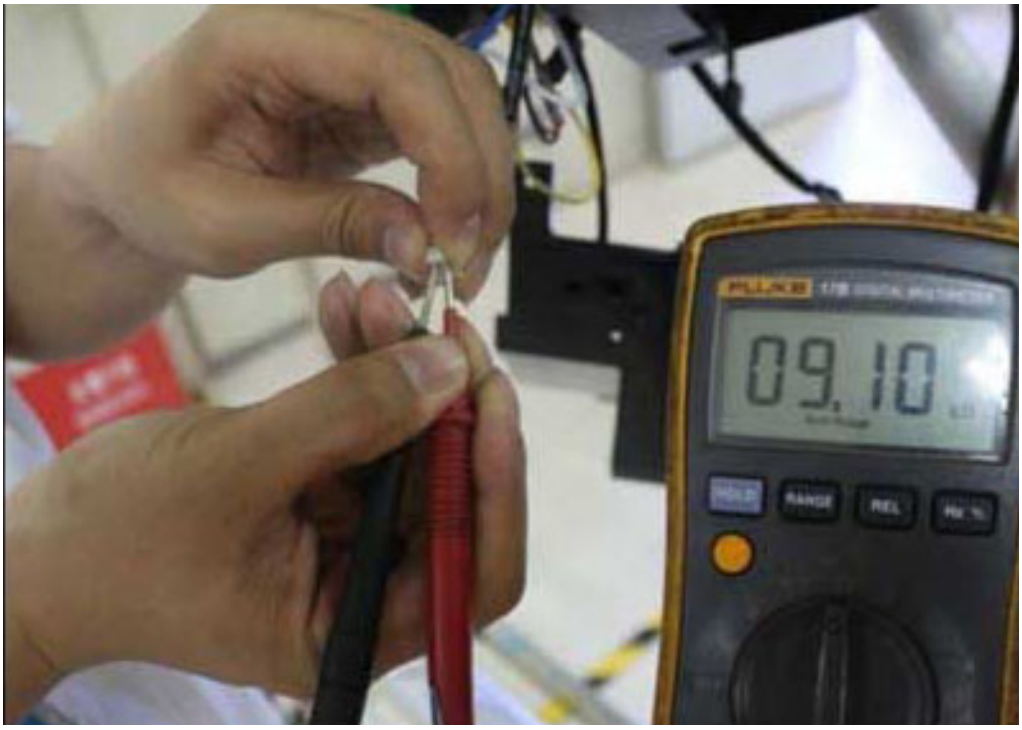
**Possible causes:**

- Wiring mistake
- Faulty sensor
- Faulty PCB

### Troubleshooting




A210599




A210527

**Fig. 43 —Check the Connection**

# DIAGNOSIS AND SOLUTION (CONT)

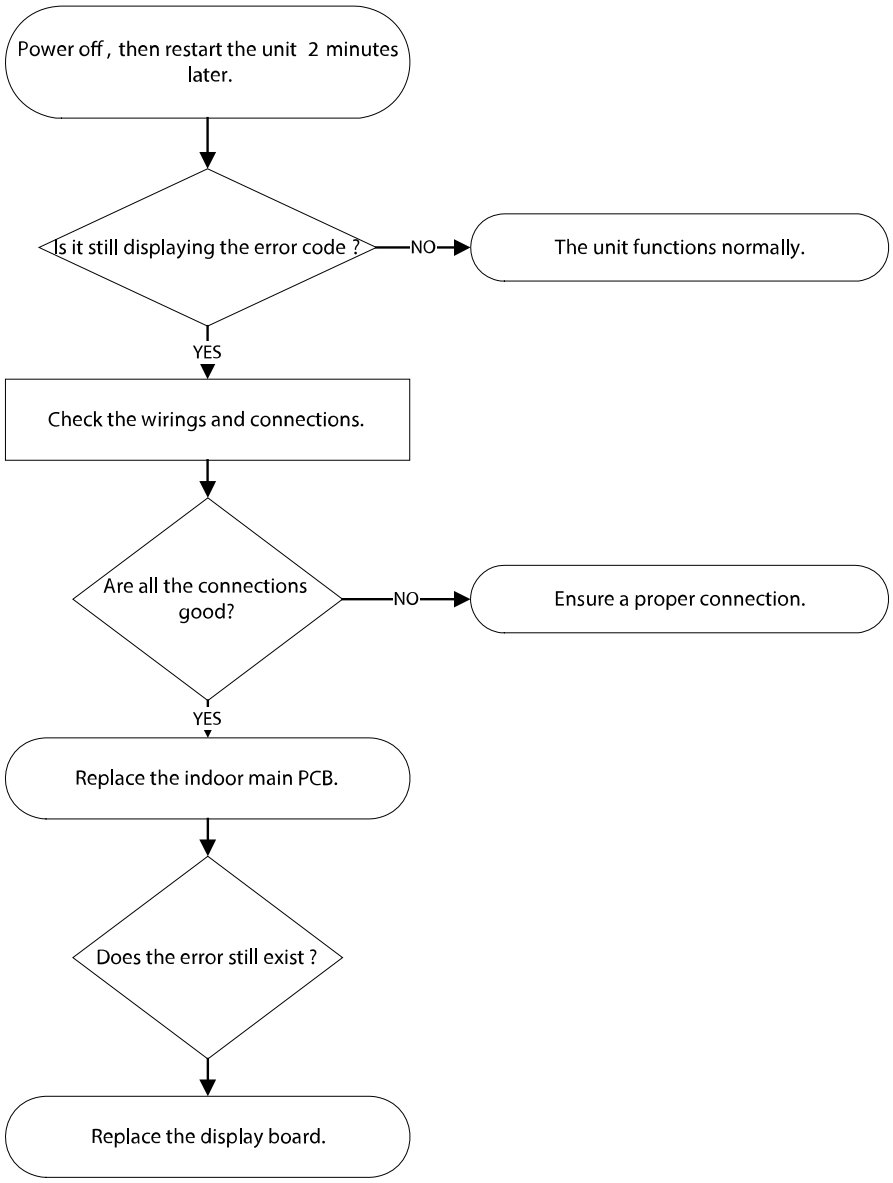
## Indoor PCB / Display board communication error diagnosis and solution (E7/EH 0b)

**Description:** Indoor PCB does not receive feedback from the display board.

### Possible causes:

- Communication wire
- Indoor PCB
- Display Board

## Troubleshooting




A210600

# DIAGNOSIS AND SOLUTION (CONT)

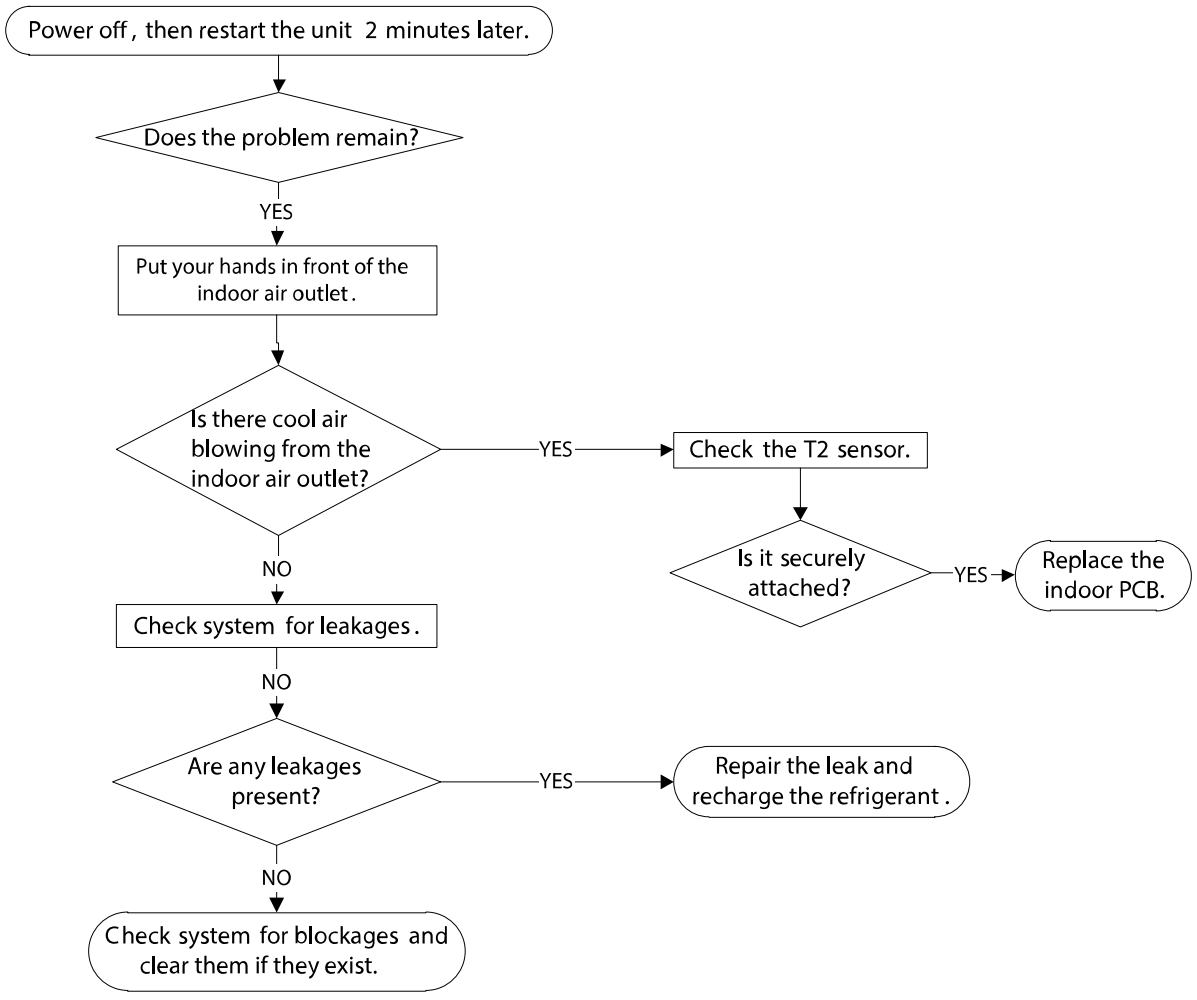
## Refrigerant Leakage Detection diagnosis and solution (EC)

**Description:** Define the evaporator coil temp.T2 of the compressor. The compressor starts running in Tcool. At first, 5 minutes after the compressor starts up, if T2 <Tcool-35.6°F (Tcool-2°C) does not run for 4 seconds and this situation occurs 3 times, the display area displays “EC” and the air conditioner turns off.

**Possible causes:**

- Faulty T2 sensor
- Faulty indoor PCB
- System problems, such as leaks or blockages

**Troubleshooting**




A210601

# DIAGNOSIS AND SOLUTION (CONT)

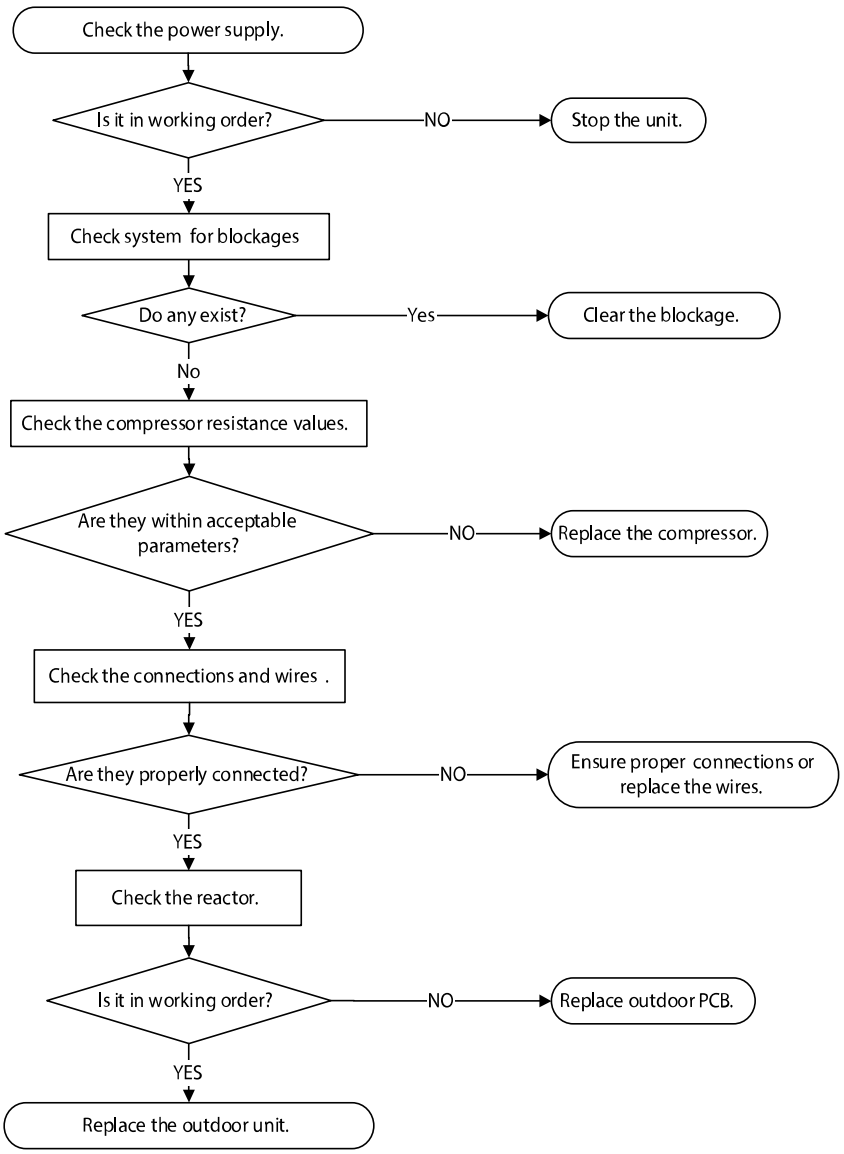
## Overload current protection diagnosis and solution (F0)

**Description:** An abnormal current rise is detected by checking the specified current detection circuit.

### Possible causes:

- Power supply problems
- System blockage
- Faulty PCB
- Wiring mistake
- Compressor malfunction

### Troubleshooting




A210602

# DIAGNOSIS AND SOLUTION (CONT)

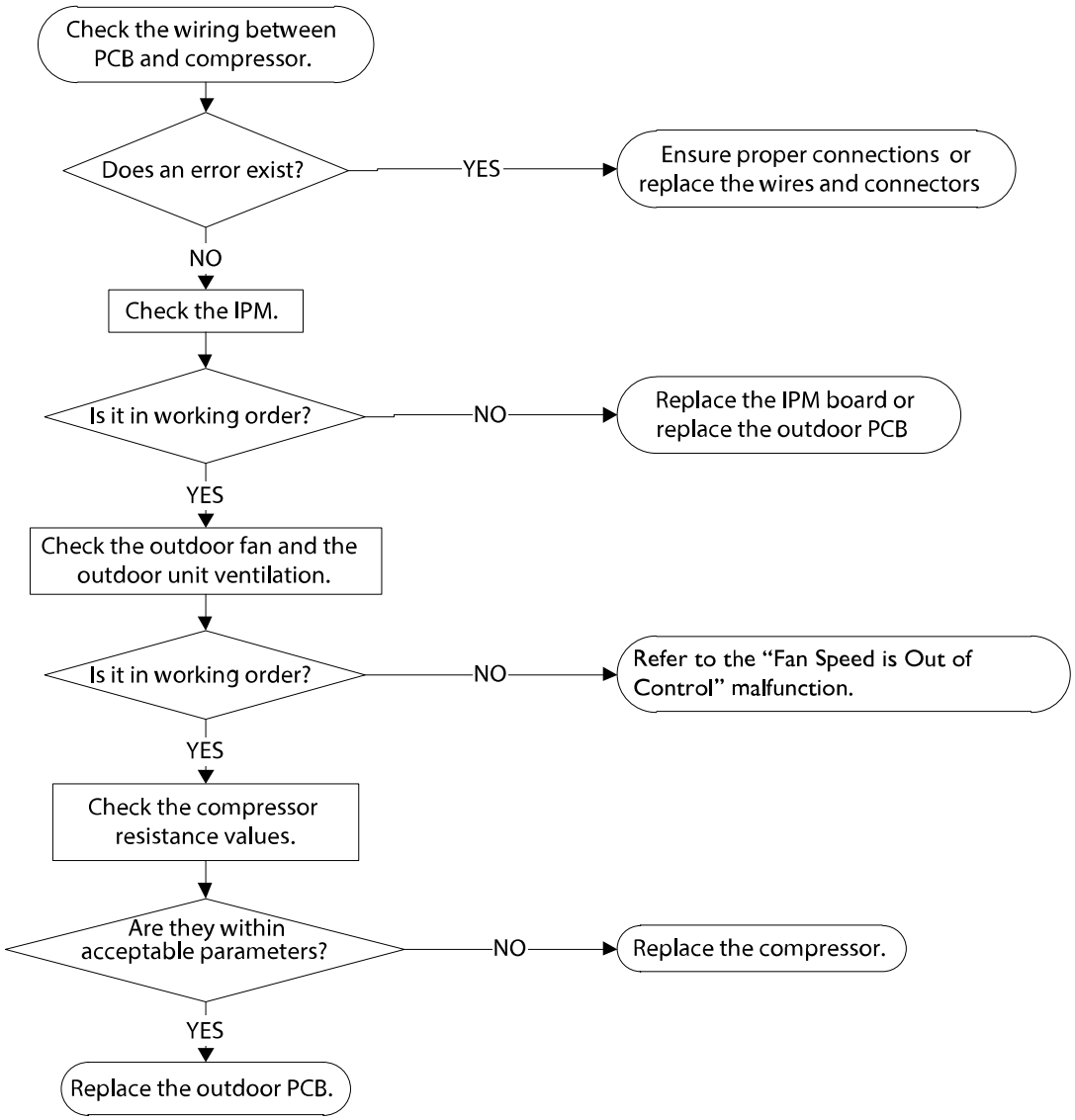
## IPM malfunction or IGBT over-strong current protection diagnosis and solution (P0)

**Description:** When the voltage signal, that the IPM sends to the compressor drive chip is abnormal, the display LED displays "**P0**"and the air conditioner turns off.

**Possible causes:**

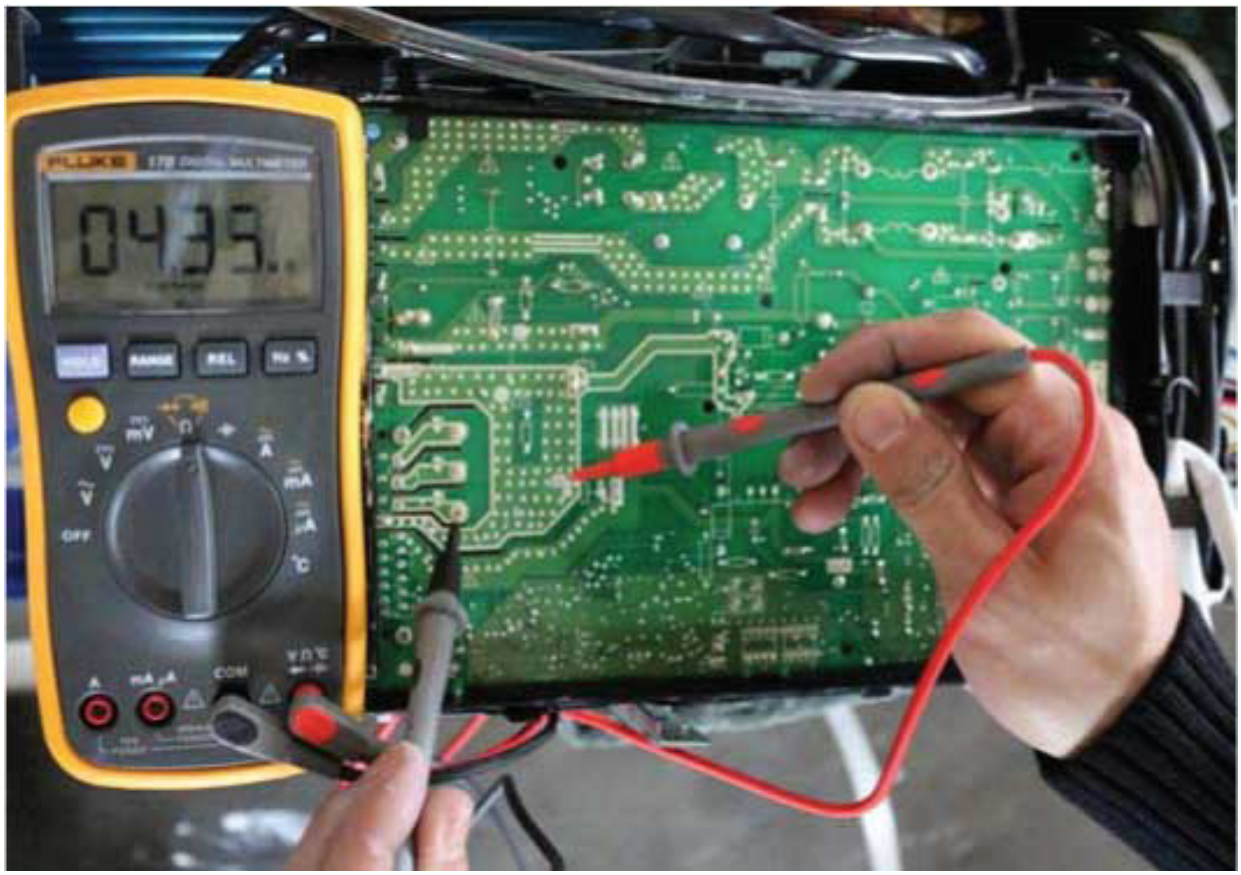
- Wiring mistake
- IPM malfunction
- Faulty outdoor fan assembly
- Compressor malfunction
- Faulty outdoor PCB

### Troubleshooting




A210603

# DIAGNOSIS AND SOLUTION (CONT)



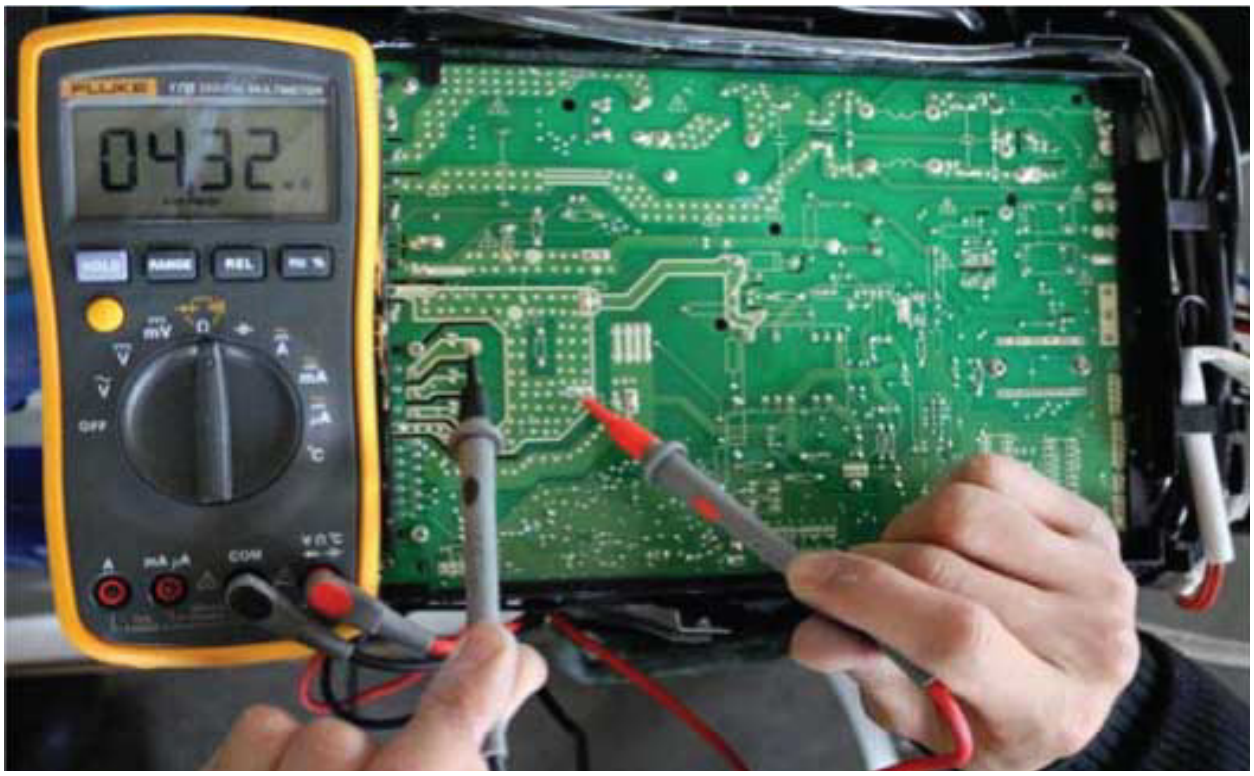

A210514

**Fig. 44 —P-U**


A210515

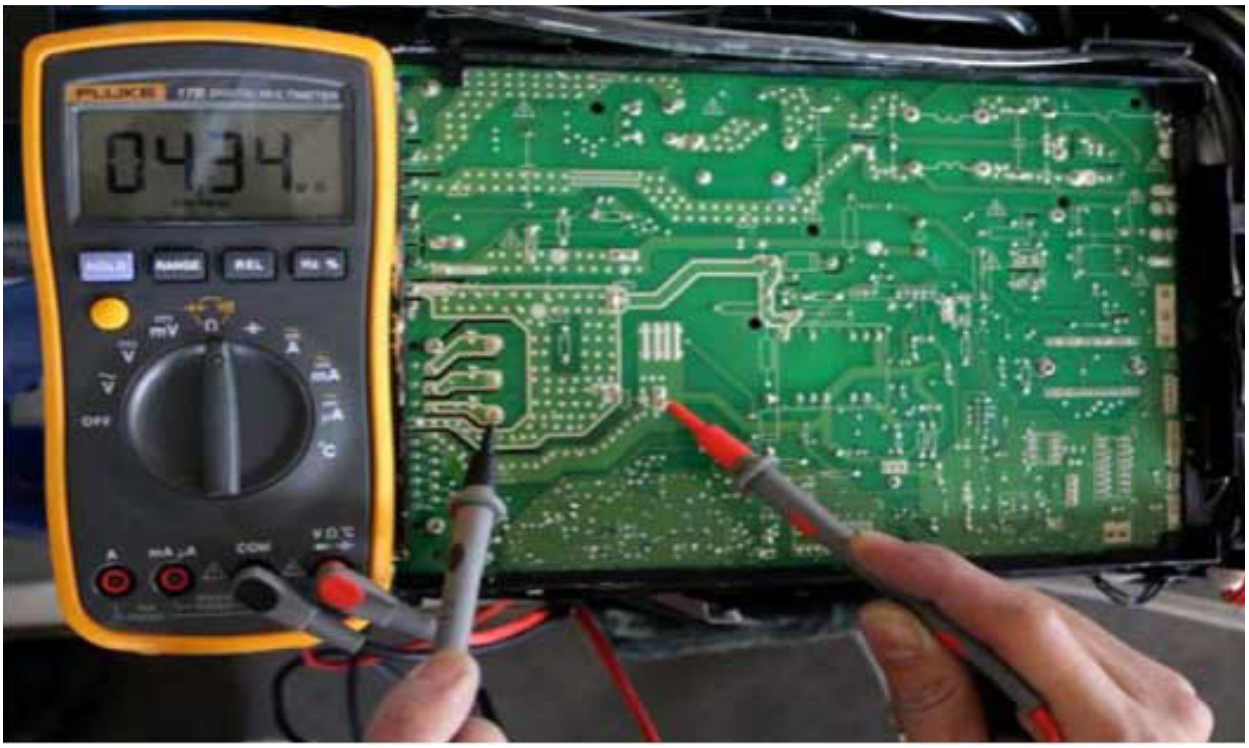
**Fig. 45 —P-V**

# DIAGNOSIS AND SOLUTION (CONT)




A210516

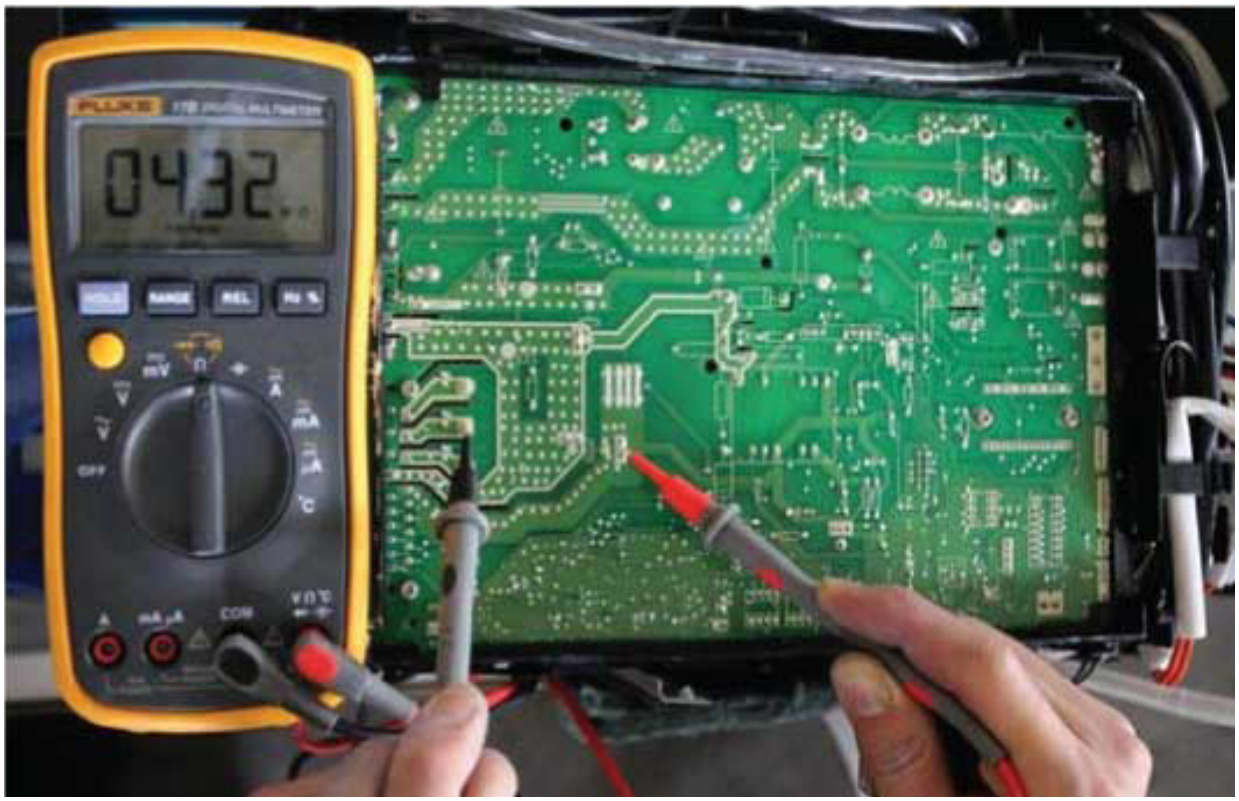
**Fig. 46 —P- W**




A210517

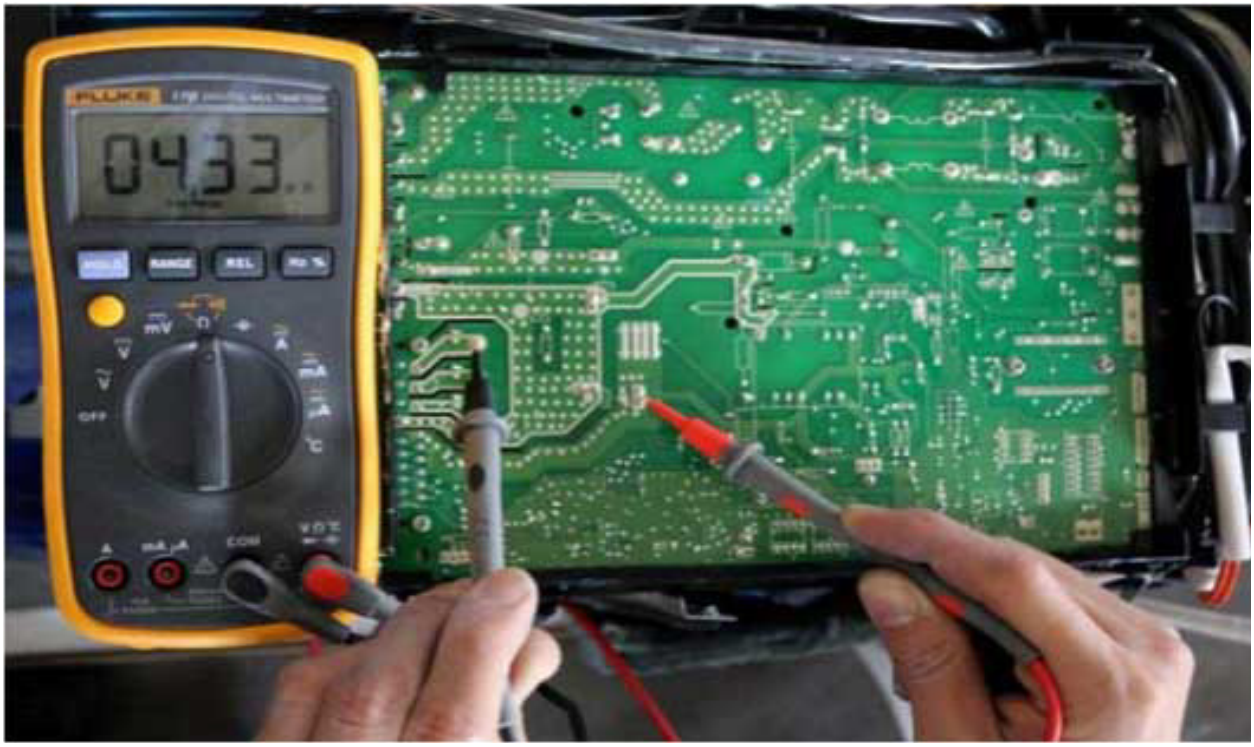
**Fig. 47 —N-U**

# DIAGNOSIS AND SOLUTION (CONT)




A210518

**Fig. 48 —N-V**




A210519

**Fig. 49 —N-W**

# DIAGNOSIS AND SOLUTION (CONT)

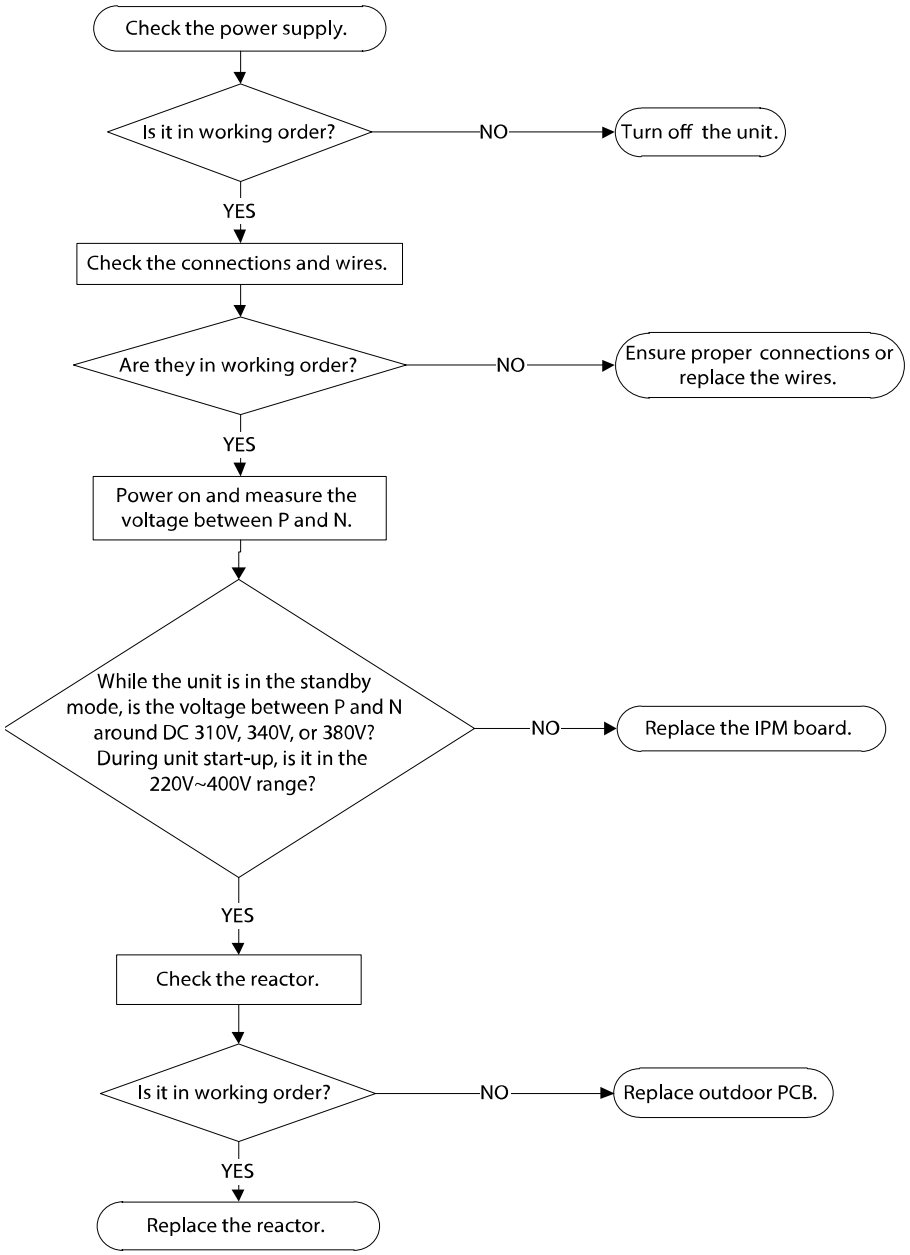
## Over voltage or too low voltage protection diagnosis and solution (P1)

**Description:** An abnormal voltage rise or drop is detected by checking the specified voltage detection circuit.

### Possible causes:

- Power supply problems
- System leak or block
- Faulty PCB

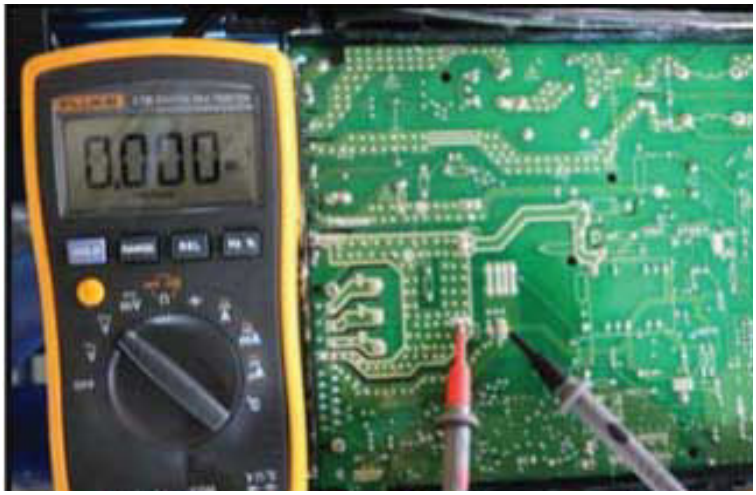
**Troubleshooting**




A210604

# DIAGNOSIS AND SOLUTION (CONT)

**Over voltage or too low voltage protection diagnosis and solution (P1) (Cont)**



A210520

**Fig. 50 —Test**

**NOTE: Measure the DC voltage between the P and N port. The normal value should be around 310V.**

# DIAGNOSIS AND SOLUTION (CONT)

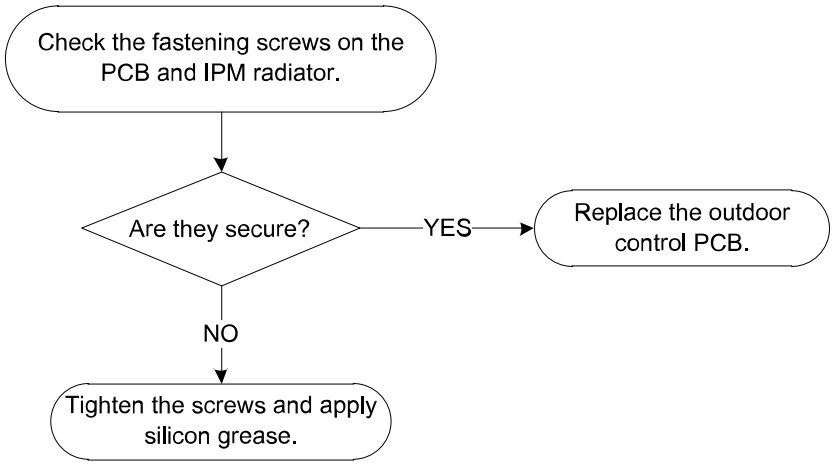
## High temperature protection of compressor top diagnosis and solution (P2)

**Description:** If the sampling voltage is not 5V, the LED displays the failure.

**Possible causes:**

- Power supply problems
- System leak or block
- Faulty PCB

### Troubleshooting

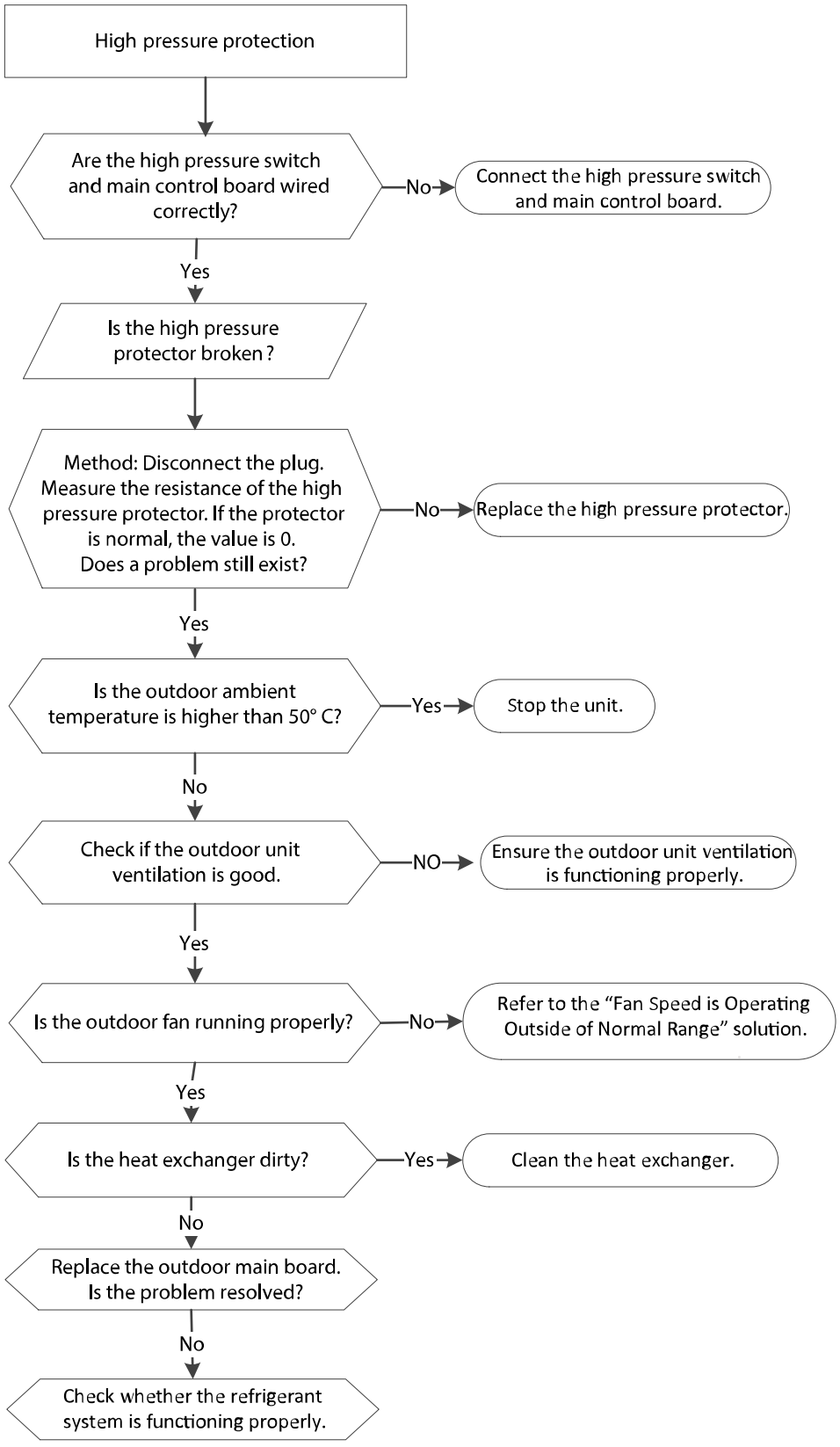



A210605

# DIAGNOSIS AND SOLUTION (CONT)

**High temperature protection of compressor top diagnosis and solution (P2) (Cont)**

**For all other models (sizes):**




A210606

# DIAGNOSIS AND SOLUTION (CONT)

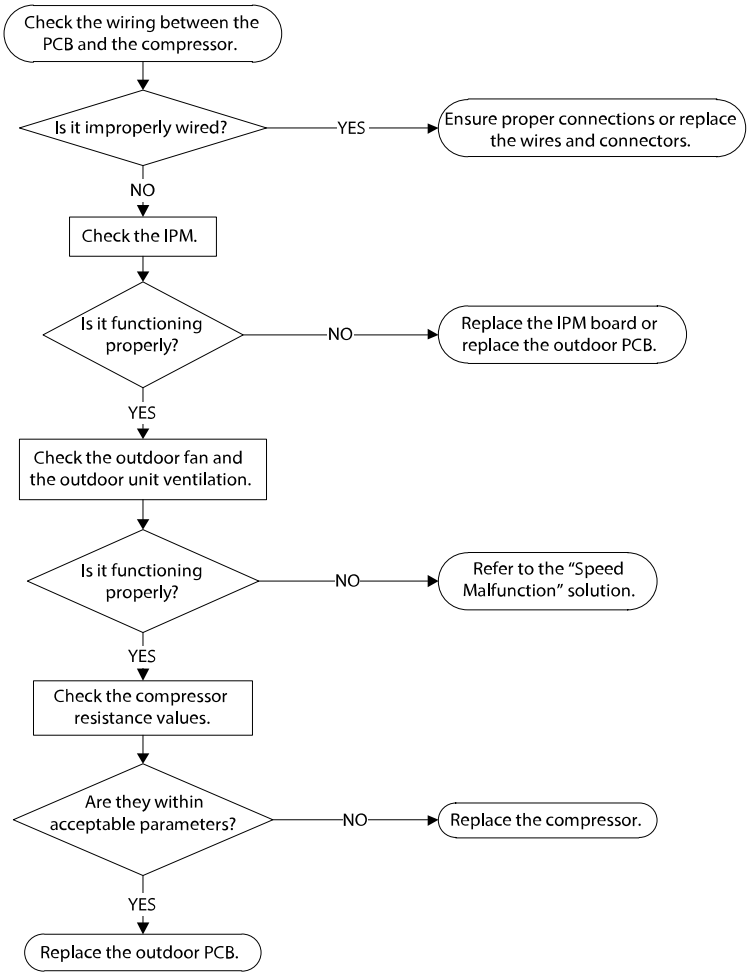
## Inverter compressor drive error diagnosis and solution (P4)

**Description:** An abnormal inverter compressor drive is detected by a special detection circuit, including the communication signal detection, voltage detection, compressor rotation speed signal detection, etc.

### Possible causes:

- Wiring mistake
- IPM malfunction
- Faulty outdoor fan assembly
- Compressor malfunction
- Faulty outdoor PCB

### Troubleshooting




A210607

## Main Parts Check

### Temperature Sensor Checking

Disconnect the temperature sensor from the PCB, measure the resistance value with a tester.

Temperature sensors,

Room temp.(T1) sensor,

Indoor coil temp.(T2) sensor,

Outdoor coil temp.(T3) sensor,

Outdoor ambient temp.(T4) sensor,

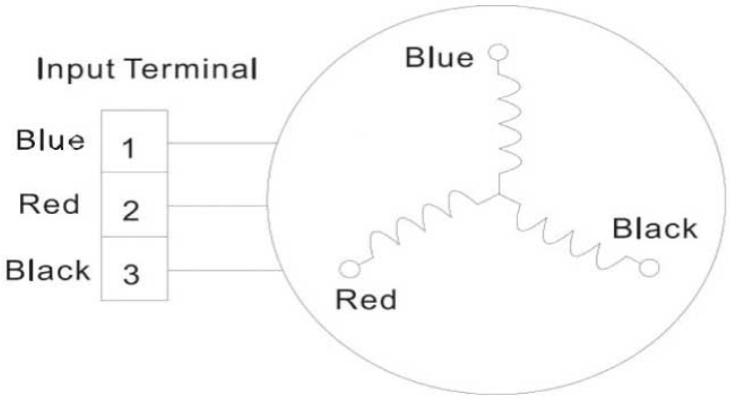
Compressor discharge temp.(T5) sensor.

Measure the resistance value of each winding by using the multi−meter.

# DIAGNOSIS AND SOLUTION (CONT)

## Compressor Checking

**Measure the resistance value of each winding by using the tester.**




A210521

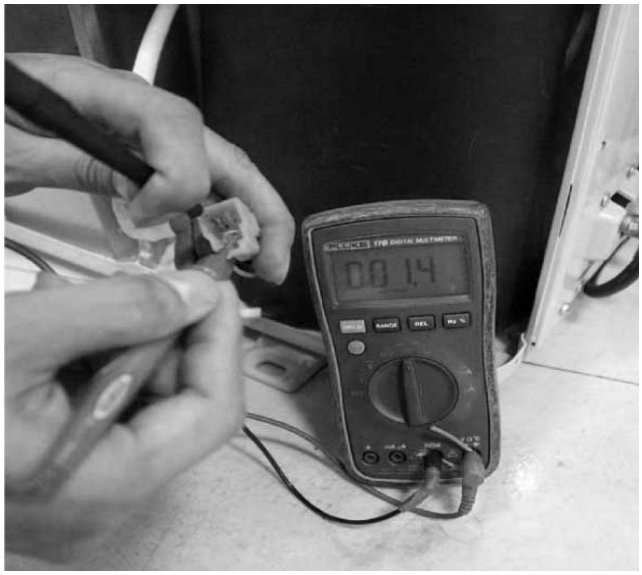
**Fig. 51 —Tester**

**Table 18 — Compressor Checking (Heat Pump)**

| Position | Resistance Value - Heat Pump | | | |
|---|---|---|---|---|
| | ASN98D22UFZ | ASM135D23UFZ | ATF235D22UMT | ATF250D22UMT |
| Blue - Red | 1.57 Ω | 1.75 Ω | 0.75 Ω | 0.75 Ω |
| Blue - Black | | | | |
| Red - Blue | | | | |

**Table 19 — Compressor Checking (Cooling Only)**

| Position | Resistance Value - Heat Pump | | |
|---|---|---|---|
| | KSK103D33UEZ3 | KSN140D58UFZ | KTM240D43UKT |
| Blue - Red | 2.13 Ω | 1.86 Ω | 1.03 Ω |
| Blue - Black | | | |
| Red - Blue | | | |



A210522

**Fig. 52 —Compressor Checking**

# DIAGNOSIS AND SOLUTION (CONT)

## IPM Continuity Check

Turn the power off, let the large capacity electrolytic capacitors discharge completely, then dismount the IPM. Use a digital tester to measure the resistance between P and UVWN; UVW and N.

**Table 20 — IPM Continuity Check**

| Digital Tester | | Normal Resistance Value | Digital Tester | | Normal Resistance Value |
|---|---|---|---|---|---|
| (+)Red | (-)Black | | (+)Red | (-)Black | |
| P | N | ∞ (Several MΩ) | U | N | ∞ (Several MΩ) |
| | U | | V | | |
| | V | | W | | |
| | W | | (+)Red | | |

## Fan Motor

Measure the resistance value of each winding by using the tester.

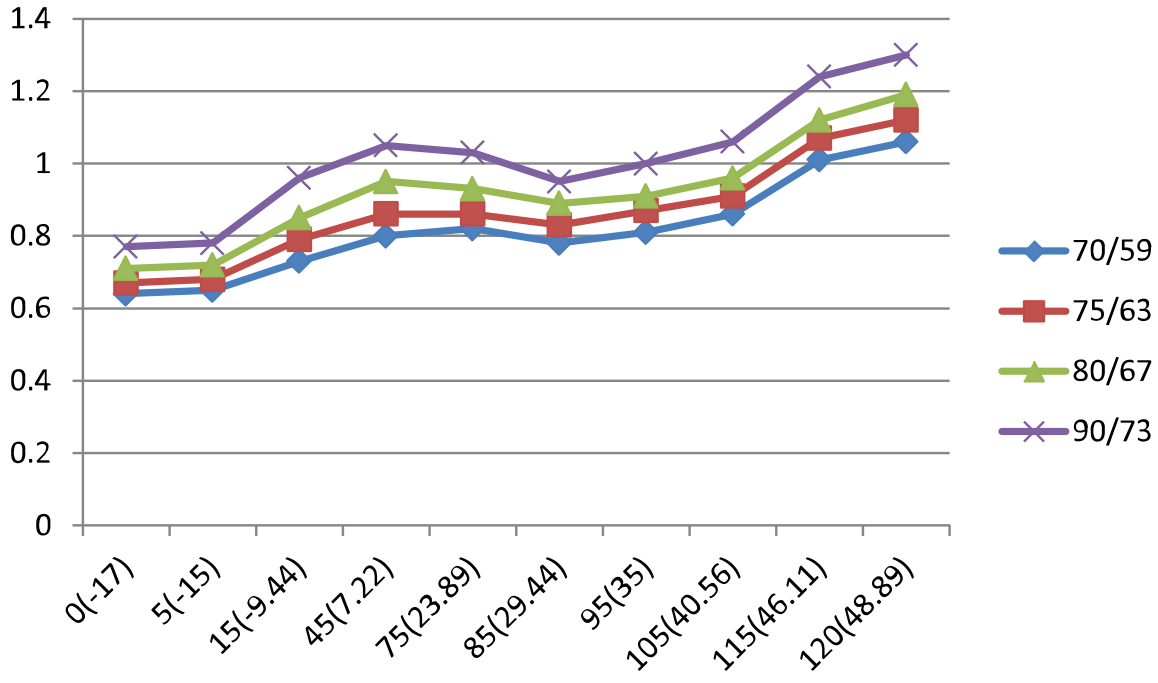
**Table 21 — Fan Motor**

| Model | | YKT-32-6-202L | YKT-32-6-3L | YKT-48-6-206 | YKT-63-6-200L |
|---|---|---|---|---|---|
| Brand | | Tongde | Welling | Welling | Welling |
| Black – Red (Main) | Ω | 86 | 213 | 152 | 88.5 |
| Blue – Black (AUX) | Ω | 64 | 156 | 142 | 138 |

## Pressure on the Service Port

**Table 22 — Cooling Chart**

| °F(°C) | ODU(DB) IDU(DB/WB) | 0(-17) | 5(-15) | 15(-9.44) | 45(7.22) | 75(23.89) | 85(29.44) | 95 (35) | 105(40.56) | 115(46.11) | 120(48.89) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BAR | 70/59 (21.11/15) | 6.4 | 6.5 | 7.3 | 8.0 | 8.2 | 7.8 | 8.1 | 8.6 | 10.1 | 10.6 |
| | 75/63 (23.89/17.22) | 6.7 | 6.8 | 7.9 | 8.6 | 8.6 | 8.3 | 8.7 | 9.1 | 10.7 | 11.2 |
| | 80/67 (26.67/19.44) | 7.1 | 7.2 | 8.5 | 9.5 | 9.3 | 8.9 | 9.1 | 9.6 | 11.2 | 11.9 |
| | 90/73 (32.22/22.78) | 7.7 | 7.8 | 9.6 | 10.5 | 10.3 | 9.5 | 10.0 | 10.6 | 12.4 | 13.0 |
| PSI | 70/59 (21.11/15) | 93 | 94 | 106 | 116 | 119 | 113 | 117 | 125 | 147 | 154 |
| | 75/63 (23.89/17.22) | 97 | 99 | 115 | 125 | 124 | 120 | 126 | 132 | 155 | 162 |
| | 80/67 (26.67/19.44) | 103 | 104 | 123 | 138 | 135 | 129 | 132 | 140 | 162 | 173 |
| | 90/73 (32.22/22.78) | 112 | 113 | 139 | 152 | 149 | 138 | 145 | 154 | 180 | 189 |
| MPa | 70/59 (21.11/15) | 0.64 | 0.65 | 0.73 | 0.8 | 0.82 | 0.78 | 0.81 | 0.86 | 1.01 | 1.06 |
| | 75/63 (23.89/17.22) | 0.67 | 0.68 | 0.79 | 0.86 | 0.86 | 0.83 | 0.87 | 0.91 | 1.07 | 1.12 |
| | 80/67 (26.67/19.44) | 0.71 | 0.72 | 0.85 | 0.95 | 0.93 | 0.89 | 0.91 | 0.96 | 1.12 | 1.19 |
| | 90/73 (32.22/22.78) | 0.77 | 0.78 | 0.96 | 1.05 | 1.03 | 0.95 | 1 | 1.06 | 1.24 | 1.3 |



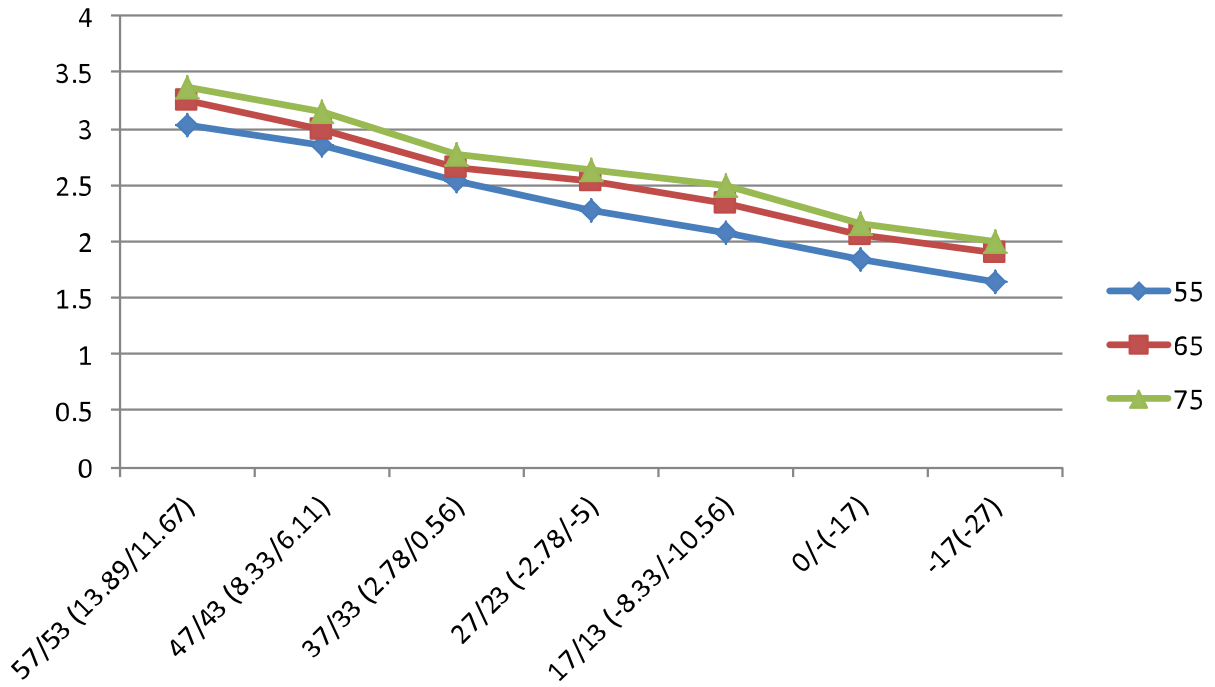

A210608

**Fig. 53 —Cooling Chart**

## Pressure on the Service Port (Cont)

**Table 23 — Heating Chart**

| °F(°C) | ODU(DB/WB) IDU(DB) | 57/53 (13.89/11.67) | 47/43 (8.33/6.11) | 37/33 (2.78/0.56) | 27/23 (-2.78/-5) | 17/13 (-8.33/-10.56) | 0/-2 (-17/-19) | -17/-18 (-27/-28) |
|---|---|---|---|---|---|---|---|---|
| BAR | 55(12.78) | 30.3 | 28.5 | 25.3 | 22.8 | 20.8 | 18.5 | 16.5 |
| | 65(18.33) | 32.5 | 30.0 | 26.6 | 25.4 | 23.3 | 20.5 | 19.0 |
| | 75(23.89) | 33.8 | 31.5 | 27.8 | 26.3 | 24.9 | 21.5 | 20.0 |
| PSI | 55(12.78) | 439 | 413 | 367 | 330 | 302 | 268 | 239 |
| | 65(18.33) | 471 | 435 | 386 | 368 | 339 | 297 | 276 |
| | 75(23.89) | 489 | 457 | 403 | 381 | 362 | 312 | 290 |
| MPa | 55(12.78) | 3.03 | 2.85 | 2.53 | 2.28 | 2.08 | 1.85 | 1.65 |
| | 65(18.33) | 3.25 | 3.00 | 2.66 | 2.54 | 2.33 | 2.05 | 1.90 |
| | 75(23.89) | 3.38 | 3.15 | 2.78 | 2.63 | 2.49 | 2.15 | 2.00 |

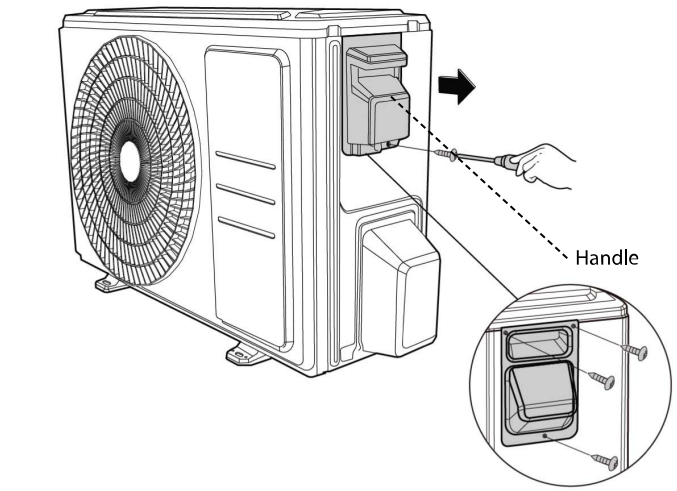
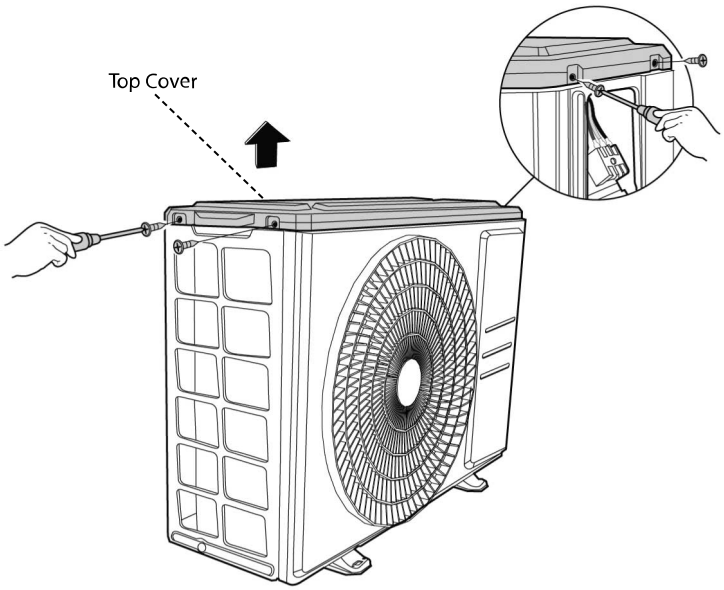



A210610

**Fig. 54 —Heating Chart**

# DISASSEMBLY INSTRUCTIONS

## SIZES 9K (115V) - 18K (208/230V) - Heat Pump and 18K (208/230V) - Cooling Only

| Procedure | Illustration |
|---|---|
| 1) Turn off the air conditioner and the power breaker.<br>2) Remove the handle screw (1) and then remove the handle. |  |
| 3) Remove the top cover screws (4) and then remove the top cover. One of the screws is located underneath the handle. |  |

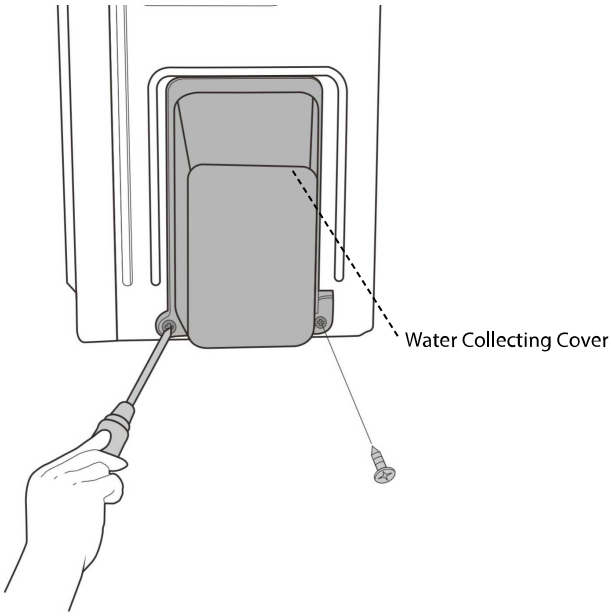
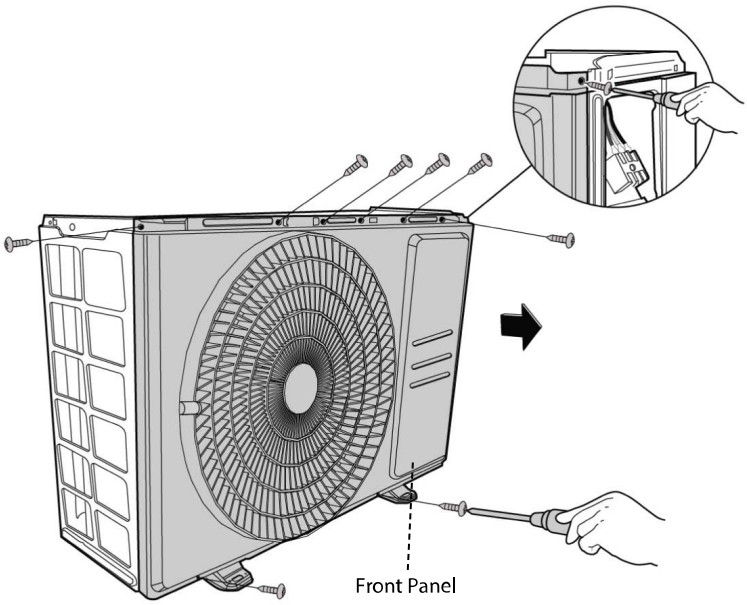
A210523

**Fig. 55 —Disassembly Instructions**

**NOTE: This section is for reference only. Actual unit appearance may vary.**

# DISASSEMBLY INSTRUCTIONS (CONT)

## SIZES 9K - 18K (115V and 208/230V) - Heat Pump and 18K (208/230V) - Cooling Only (CONT)

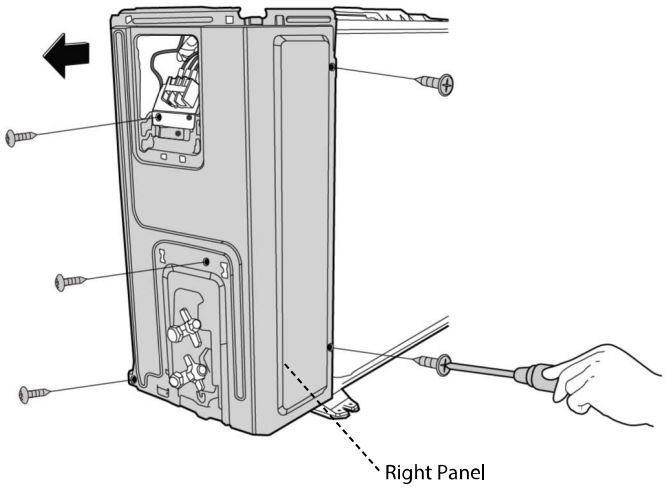
| Procedure | Illustration |
|---|---|
| 4) Remove the water collecting cover screws (2) and then remove the water collecting cover. |  |
| 5) Remove the front panel screws (7) and then remove the front panel. |  |

A210528

**Fig. 56 —Disassembly Instructions**

# DISASSEMBLY INSTRUCTIONS

## SIZES 9K - 18K (115V and 208/230V) - Heat Pump and 18K (208/230V) - Cooling Only (CONT)

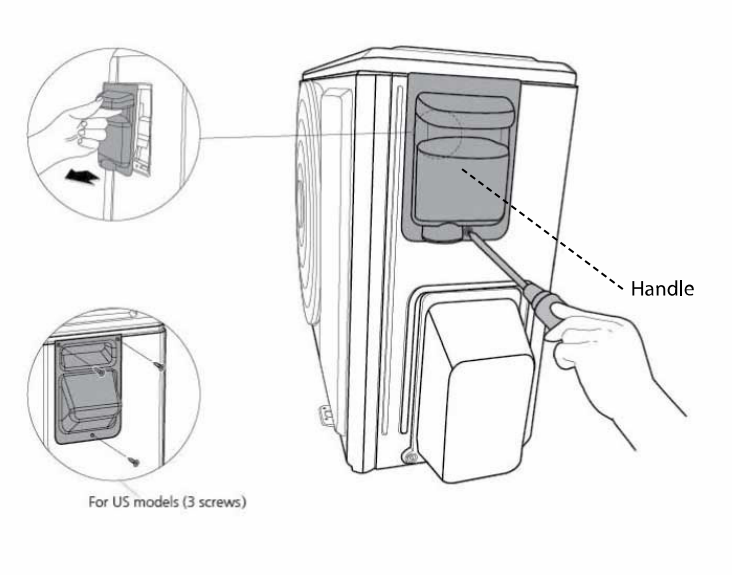
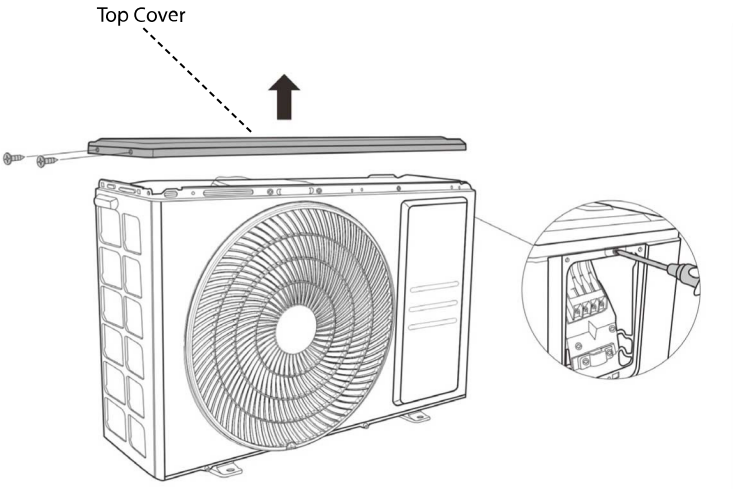
| Procedure | Illustration |
|---|---|
| 6) Remove the right panel screws (5) and then remove the right panel. |  |

A210529

**Fig. 57 —Disassembly Instructions**

# DISASSEMBLY INSTRUCTIONS

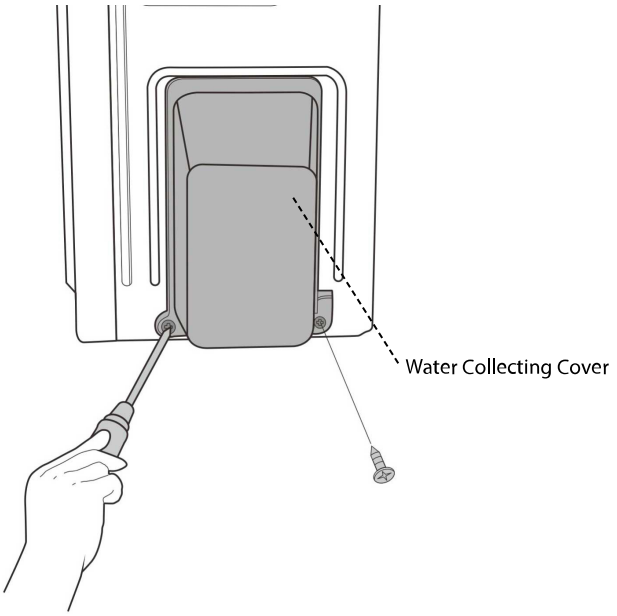
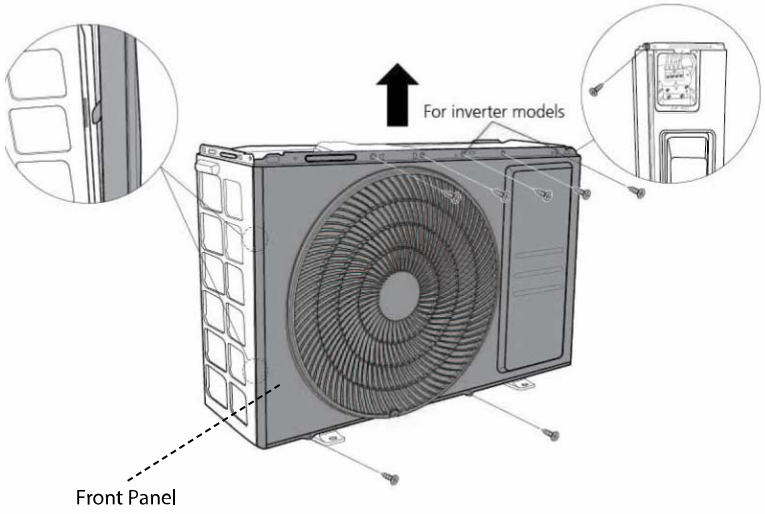
## Size 12K (115V and 208/230V) - Cooling Only

| Procedure | Illustration |
|---|---|
| 1) Turn off the air conditioner and the power breaker.<br>2) Remove the handle screw (1) and then remove the handle. |  |
| 3) Remove the top cover screws (3) then remove the top cover.<br>One of the screws is located under under the handle. |  |

A210614

# DISASSEMBLY INSTRUCTIONS (CONT)

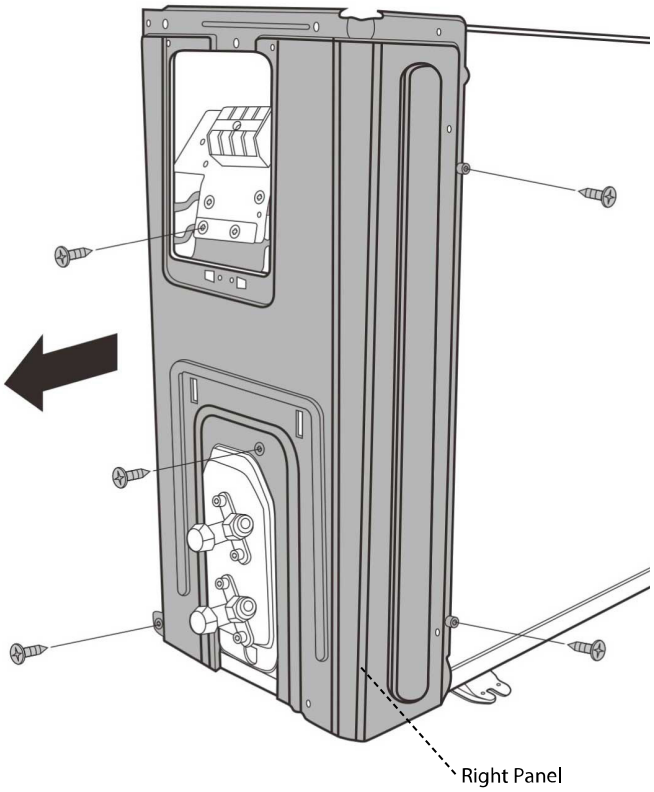
**Size 12K (115V and 208/230V) - Cooling Only (CONT)**

| Procedure | Illustration |
|---|---|
| 4) Remove the water collecting cover screws (2) then remove the water collecting cover. |  |
| 5) Remove the front panel screws and then remove the front panel (6 screws(onoff models) or 8 screws(inverter models). |  |

A210615

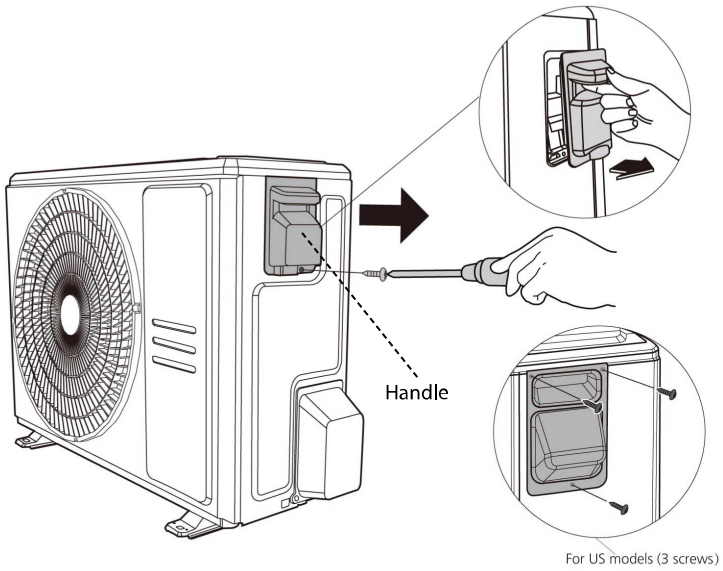
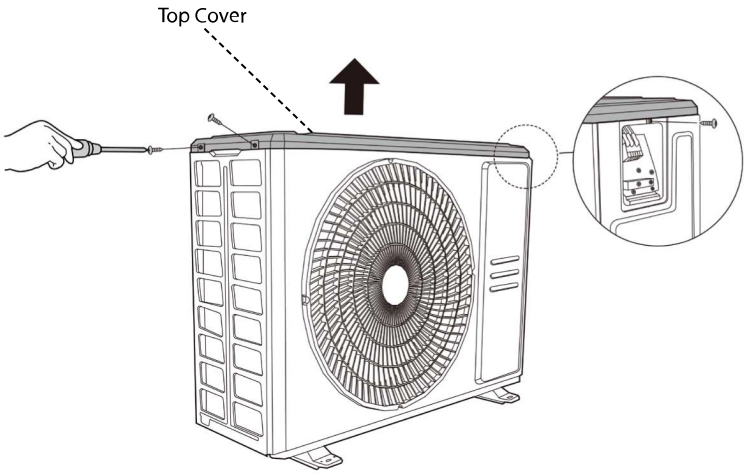
# DISASSEMBLY INSTRUCTIONS (CONT)

**Size 12K (115V and 208/230V) - Cooling Only (CONT)**

| Procedure | Illustration |
|---|---|
| 6) Remove the right panel screws (5) then remove the right panel. |  |

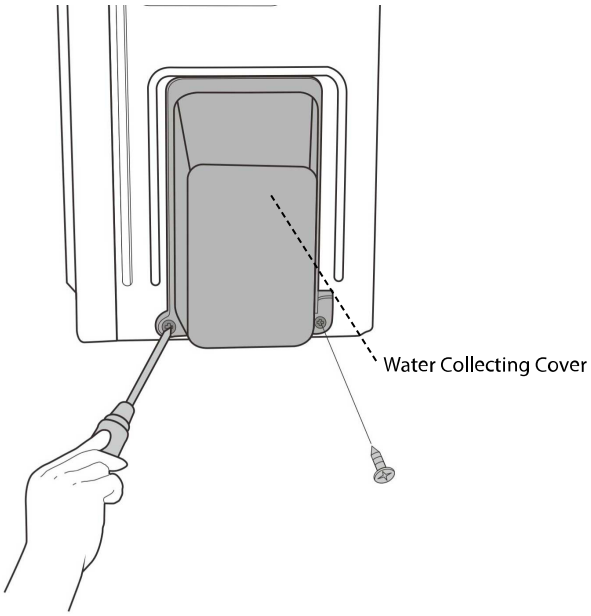
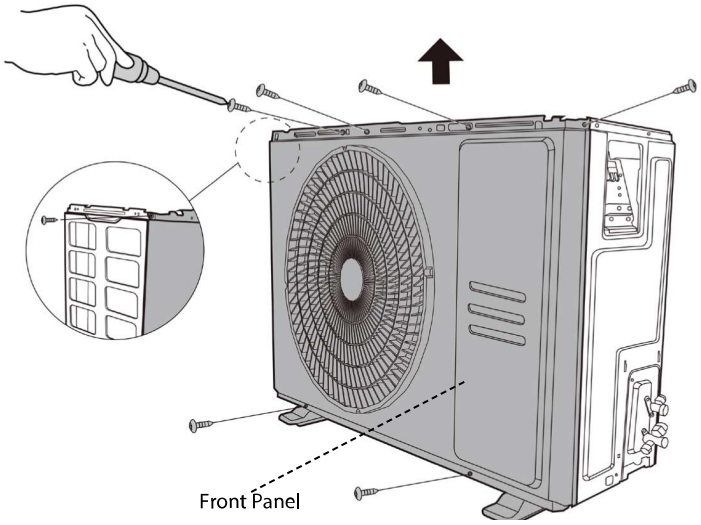
A210616

# DISASSEMBLY INSTRUCTIONS
## SIZE 24K - Heat Pump and Cooling Only

| Procedure | Illustration |
|---|---|
| 1) Turn off the air conditioner and the power breaker.<br>2) Remove the handle screw and then remove the handle. |  |
| 3) Remove the top cover screws (3) and then remove the top cover. One of the screws is located under the handle. |  |

A210530

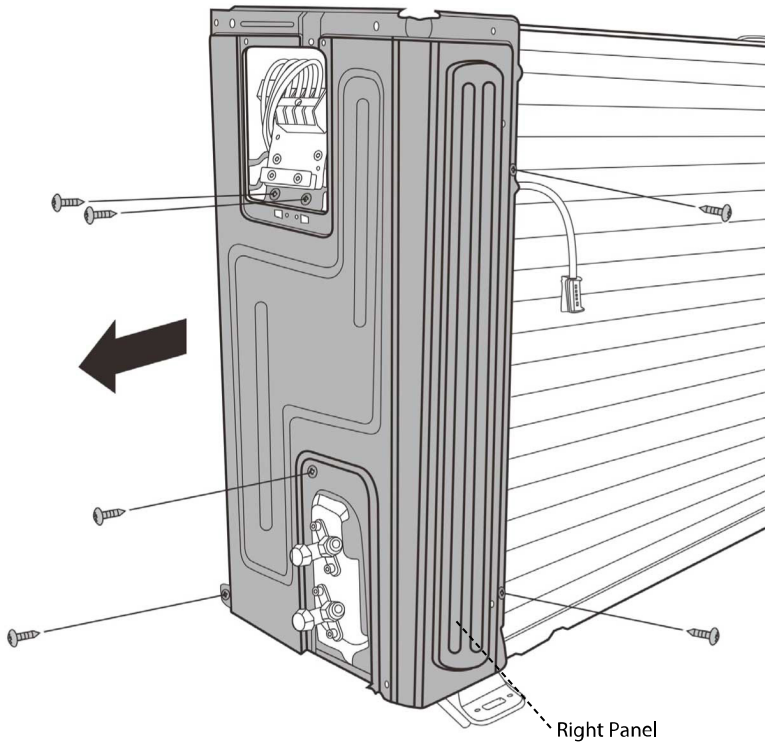
# DISASSEMBLY INSTRUCTIONS (CONT)
## SIZE 24K - Heat Pump and Cooling Only (CONT)

| Procedure | Illustration |
|---|---|
| 4) Remove the water collecting cover screws (2) and then remove the water collecting cover. |  |
| 5) Remove the front panel screws and then remove the front panel. |  |

A210531

# DISASSEMBLY INSTRUCTIONS 24K (CONT)

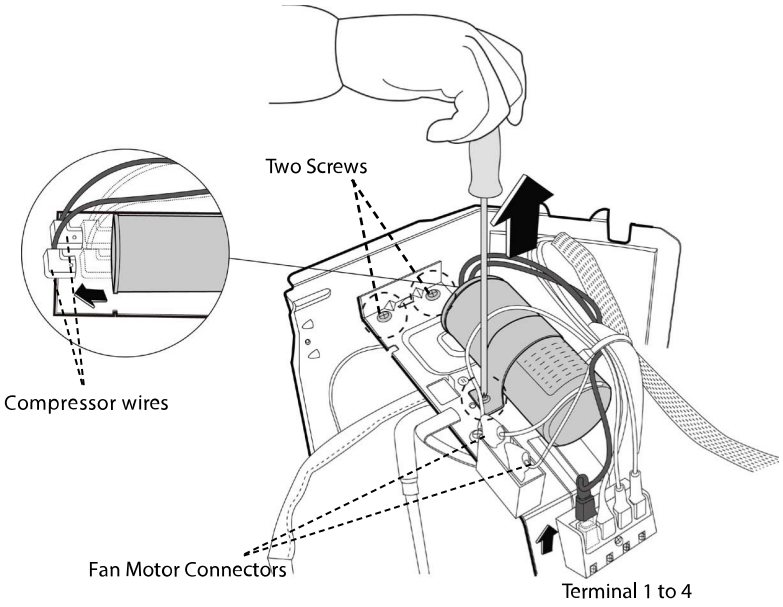
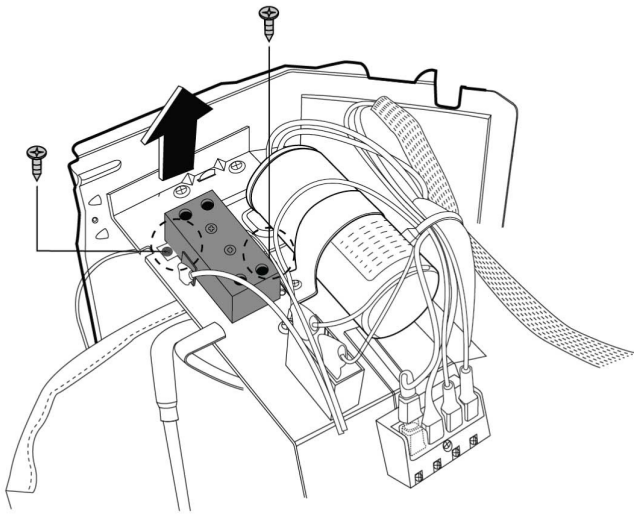
## SIZE 24K - Heat Pump and Cooling Only (CONT)

| Procedure | Illustration |
|---|---|
| 6) Remove the right panel screws (6) and then remove the right panel. |  |

A210532

# DISASSEMBLY INSTRUCTIONS (CONT)

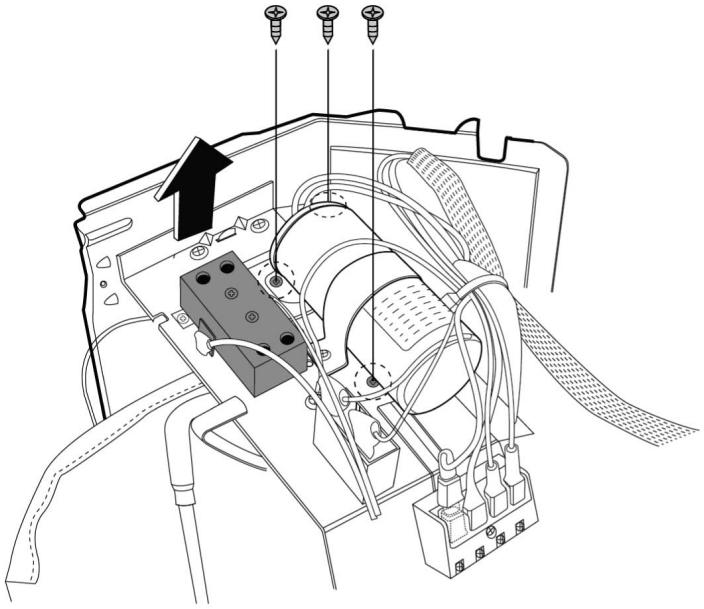
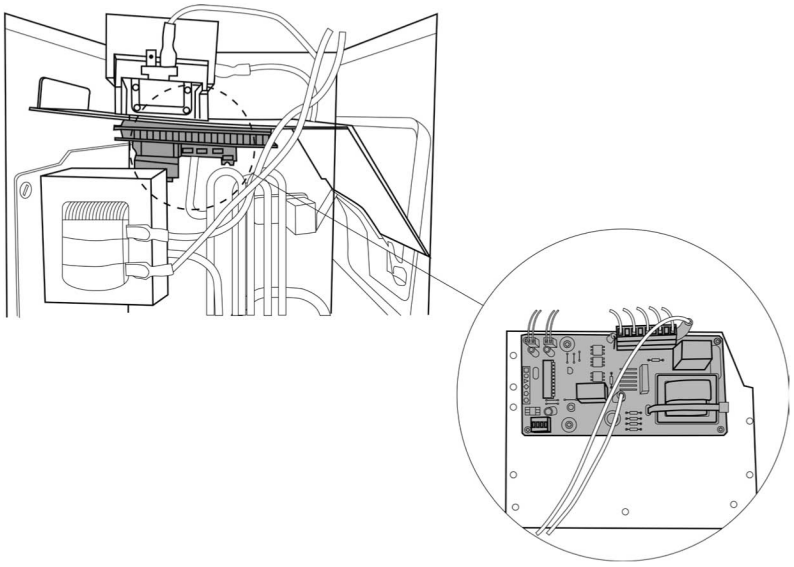
## Electrical Parts

| Procedure | Illustration |
|---|---|
| 1) Remove the two screws secured to the electronic control board.<br>2) Disconnect the fan motor connectors (blue wire, yellow wire, red wire, brown wire and black wire). The blue wire and red wire are on the capacitor. The black wire connects with terminal 4.<br>3) Disconnect the wires connected to the compressor (black wire connects with terminal 1, blue and red wires connect with the compressor capacitor).<br>4) Disconnect the wires connected to the 4-way valve (blue wires on terminal 2 & 3).<br>5) Remove the compressor capacitor screw then pull it out.<br>6) Remove the electrical parts.<br>7) For models with an AC conductor, remove the screws (2). |  <br>  |

A210617

# DISASSEMBLY INSTRUCTIONS (CONT)

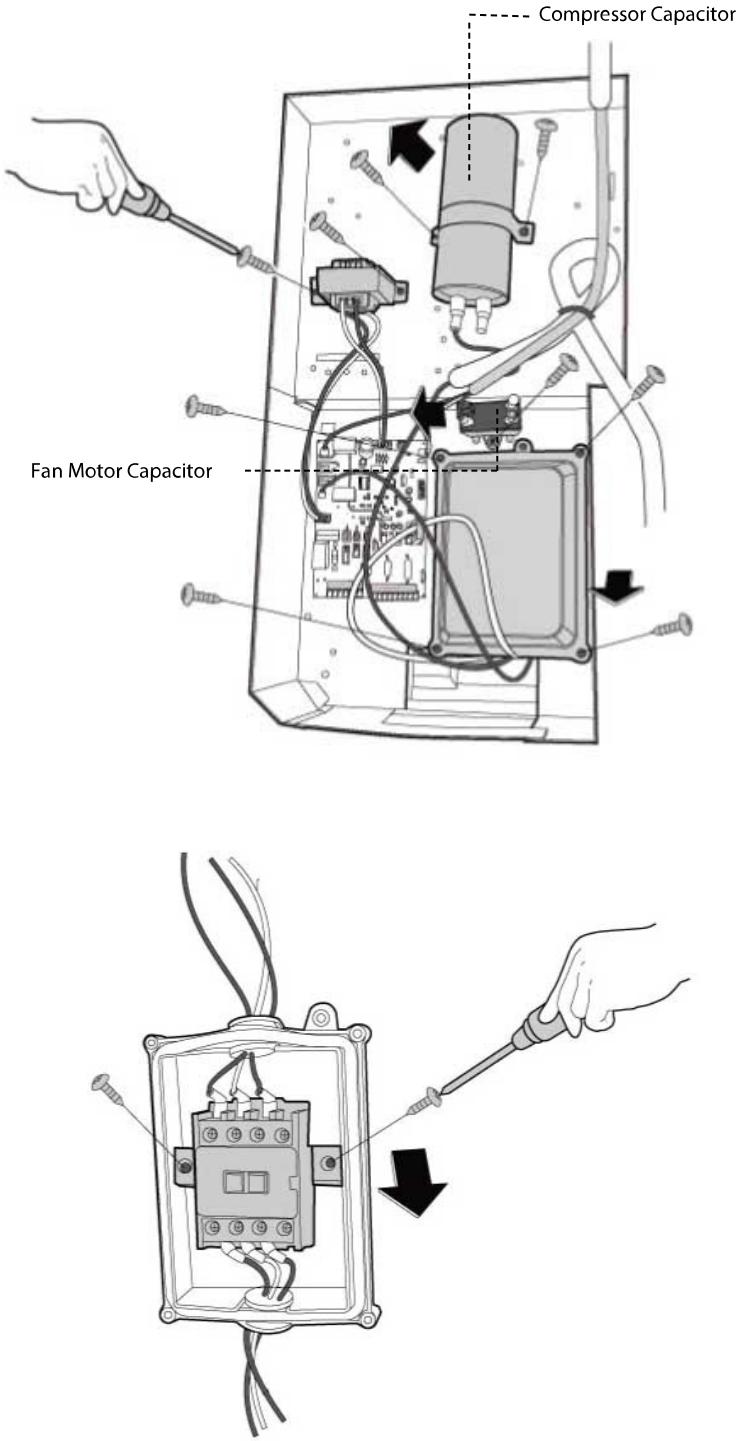
## Electrical Parts (CONT)

| Procedure | Illustration |
|---|---|
| 8) For models with a subzero refrigeration control board, remove the 3 screws. |  |
| 9) The subzero refrigeration control board is in the back of the metal sheet. |  |

A210618

# DISASSEMBLY INSTRUCTIONS (CONT)

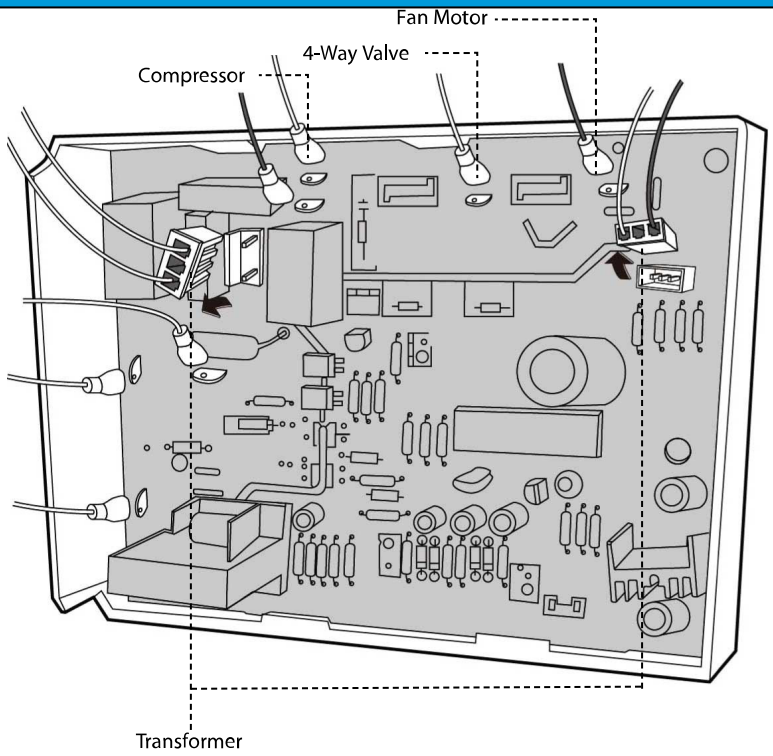
## Electrical Parts (CONT)

| Procedure | Illustration |
|---|---|
| 1) Remove the compressor capacitor screw then pull it out.<br>2) Remove the transformer screws (2) then remove the transformer.<br>3) Remove the fan motor capacitor screws then remove it.<br>4) Remove the electronic install box screws (4) and then remove it.<br>5) Remove the AC Contactor screws (2) then remove it. |  |

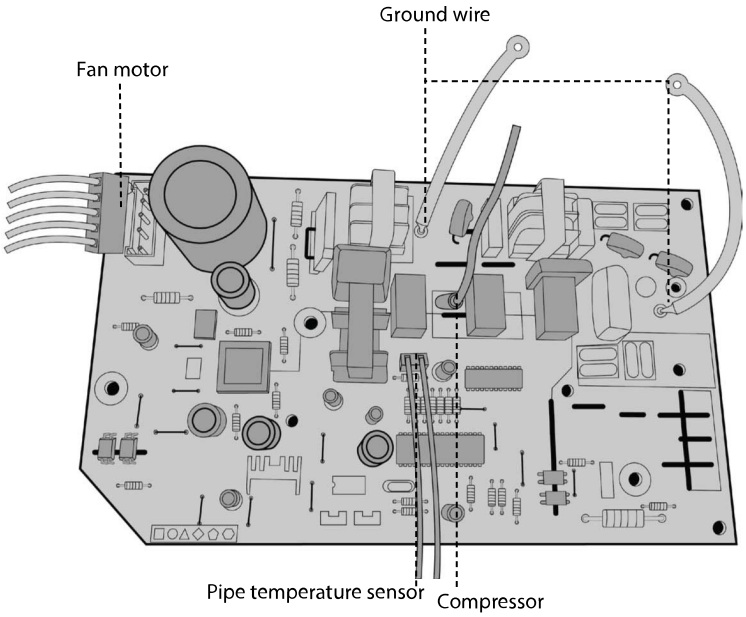
A210619

# DISASSEMBLY INSTRUCTIONS (CONT)

## Electrical Parts (CONT)

| Procedure | Illustration |
|---|---|
| 6) Disconnect the wires connected to the compressor (red wire connects with the PCB board, others connect with terminals).<br><br>7) Disconnect the connectors for the fan motor (blue wire, red wire, brown wire and black wire). The blue and brown wires are on the capacitor. The black wire connects with a terminal and the red wire is on the board.)<br><br>8) Disconnect the wires connected to the 4-way valve.<br><br>9) Disconnect the wires connected to the transformer.<br><br>10) Disconnect the other wires connected to terminals.<br><br>11) Remove the PCB board. |  |

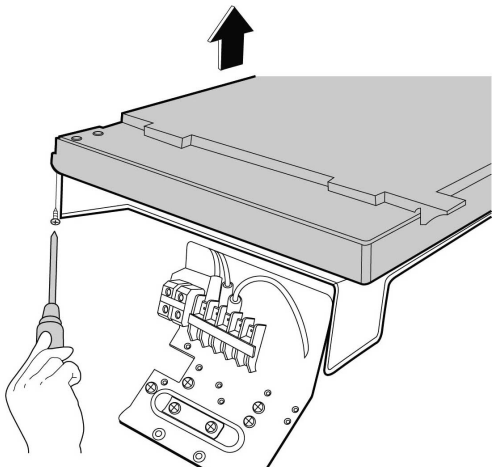
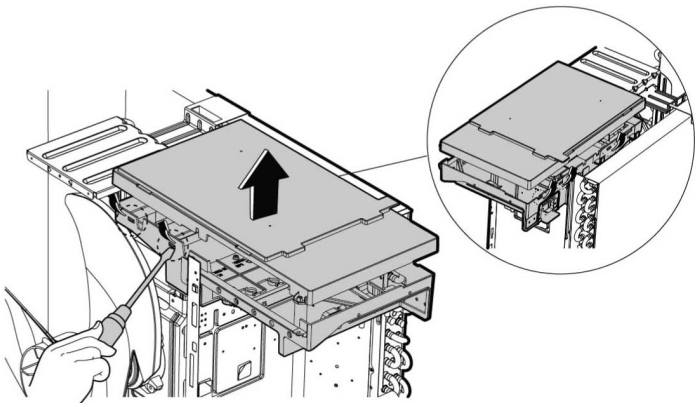
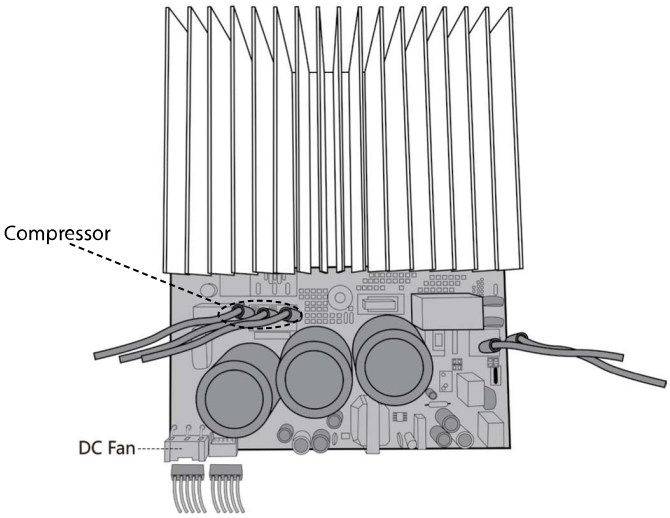
A210620

| Procedure | Illustration |
|---|---|
| 1) Disconnect the fan motor connectors.<br><br>2) Disconnect the wires connected to the compressor.<br><br>3) Disconnect the wires connected to pipe temperature sensor.<br><br>4) Disconnect the ground wire.<br><br>5) Remove the PCB board. |  |

A210622

# DISASSEMBLY INSTRUCTIONS (CONT)

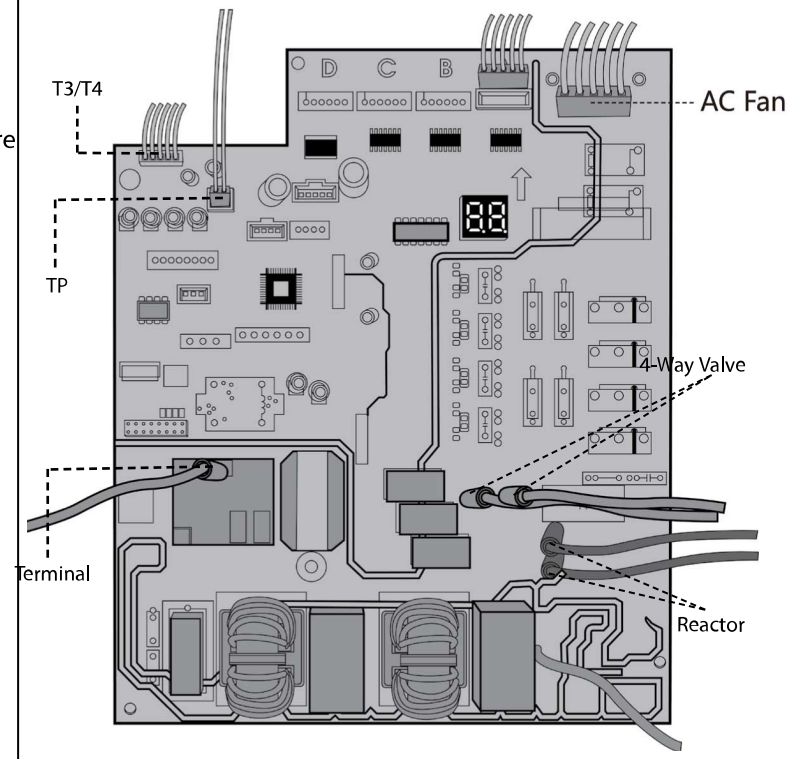
## Electrical Parts (CONT)

| Procedure | Illustration |
|---|---|
| 1) Remove the top cover screw (1). |  |
| 2) Loosen the hooks (5) then open the electronic control box cover. |  |
| 3) Disconnect the fan motor connector from the IPM board.<br>4) Remove the compressor connector. |  |

A210623

# DISASSEMBLY INSTRUCTIONS (CONT)

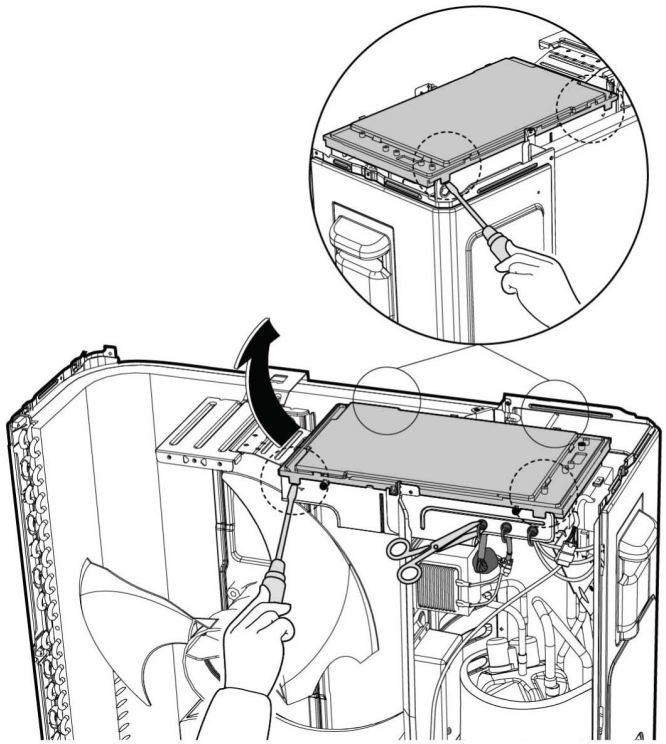
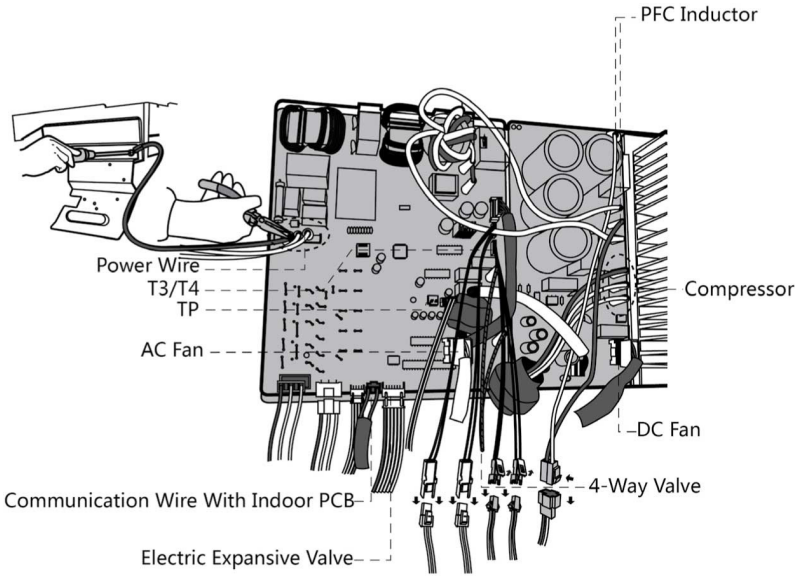
## Electrical Parts (CONT)

| Procedure | Illustration |
|---|---|
| 5) Pull out the wire connected to the terminal.<br>6) Pull out the condenser coil temperature sensor(T3),outdoor ambient temperature sensor(T4) and discharge temperature sensor(TP) connectors.<br>7) Disconnect the electronic expansion valve wire.<br>8) Remove the 4-way valve connector.<br>9) Remove the reactor connector.<br>10) Remove the electronic control box. |  |

A210625

# DISASSEMBLY INSTRUCTIONS (CONT)

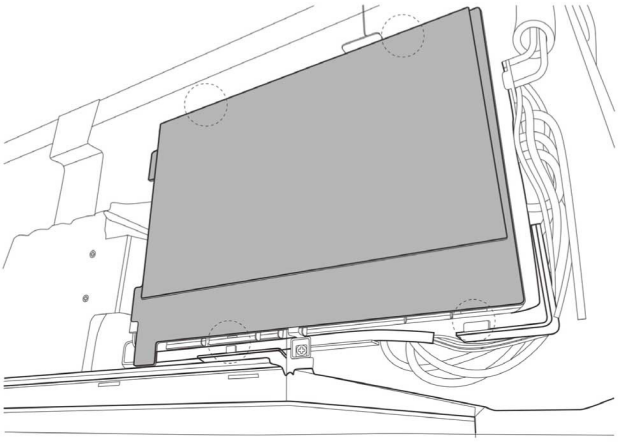
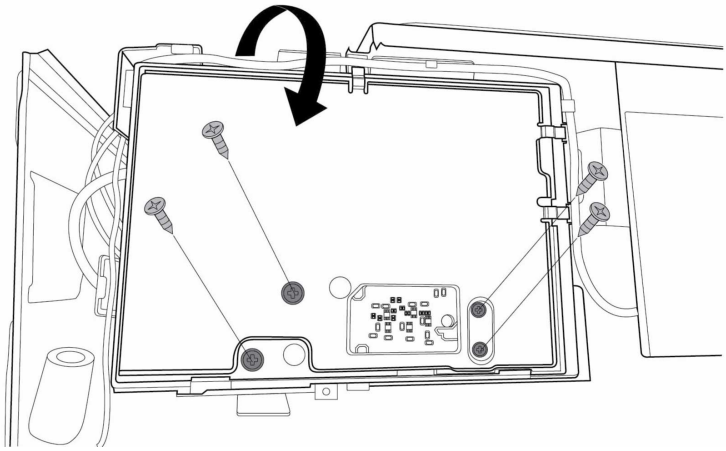
## Electrical Parts (CONT)

| Procedure | Illustration |
|---|---|
| 1) Loosen the hooks (4) then open the electronic control box cover.<br><br>2) Disconnect the outdoor DC fan connector from the electronic control board.<br><br>3) Remove the compressor connector.<br><br>4) Pull out the two blue wires connected to the 4 - way valve.<br><br>5) Pull out the condenser coil temperature sensor(T3),outdoor ambient temperature sensor(T4) and discharge temperature sensor(TP) compressor.<br><br>6) Disconnect the electronic expansion valve wire.<br><br>7) Disconnect the communication wire indoor PCB.<br><br>8) Disconnect the PFC inductor.<br><br>9) Remove the electronic control box. |  <br>  |

A210626

# DISASSEMBLY INSTRUCTIONS (CONT)

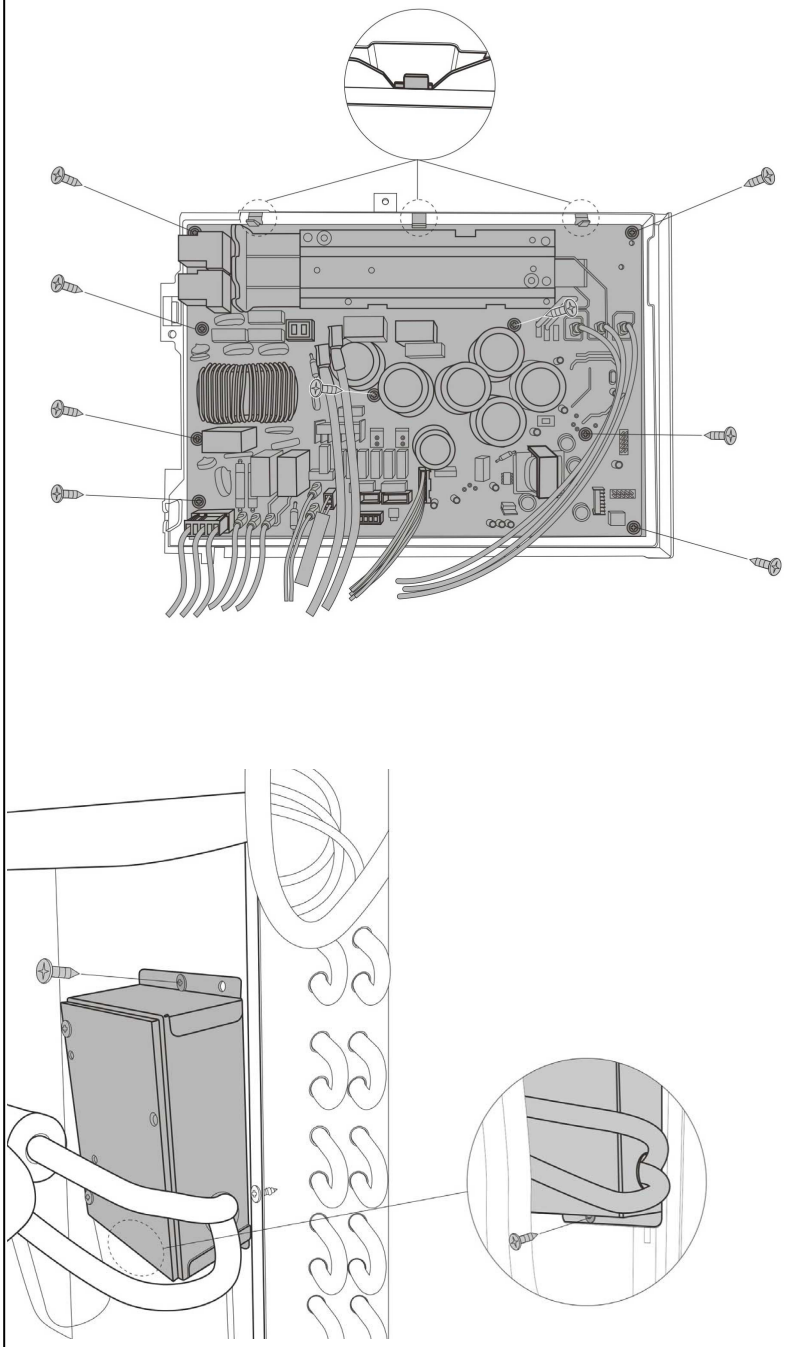
## Electrical Parts (CONT)

| Procedure | Illustration |
|---|---|
| 1) Loosen the hooks then open the electronic control box cover. |  |
| 2) Remove screws (4) on the electronic control board then turn over the the electronic control board. |  |

A210627

# DISASSEMBLY INSTRUCTIONS (CONT)

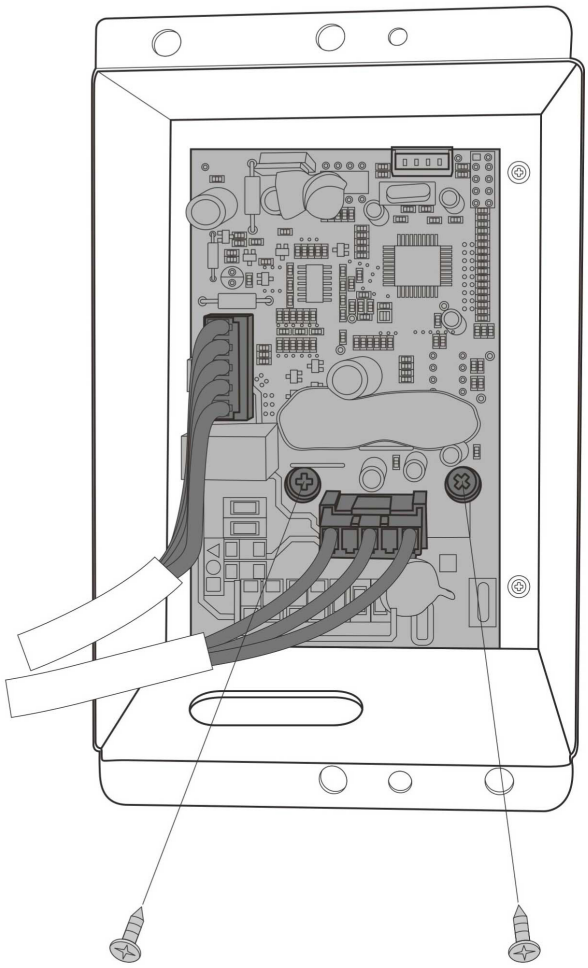
## Electrical Parts (CONT)

| Procedure | Illustration |
|---|---|
| 3) Remove the connectors.<br><br>4) Remove the screws (9) and loosen the 3 hooks then remove the electronic control board.<br><br>5) Remove screws (2) then remove the electronic control box subassembly on the partition board assembly. |  |

A210628

# DISASSEMBLY INSTRUCTIONS (CONT)

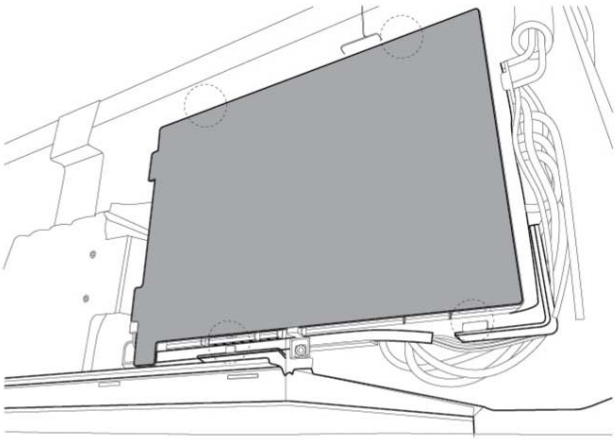
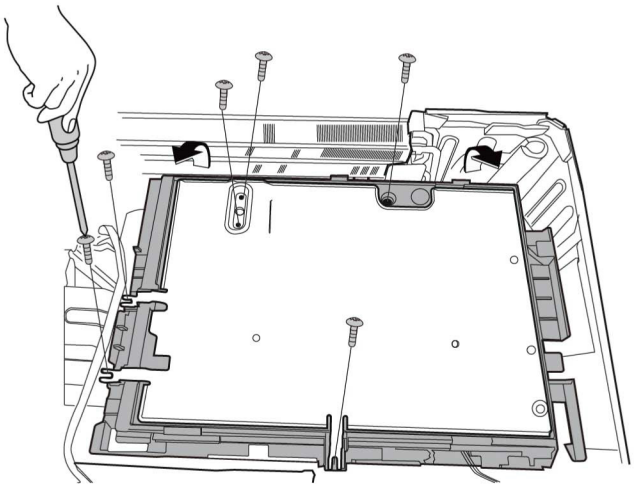
## Electrical Parts (CONT)

| Procedure | Illustration |
|---|---|
| 6) Remove the screws (2) and the two connectors then remove the inverter control board. |  |

A210629

# DISASSEMBLY INSTRUCTIONS (CONT)

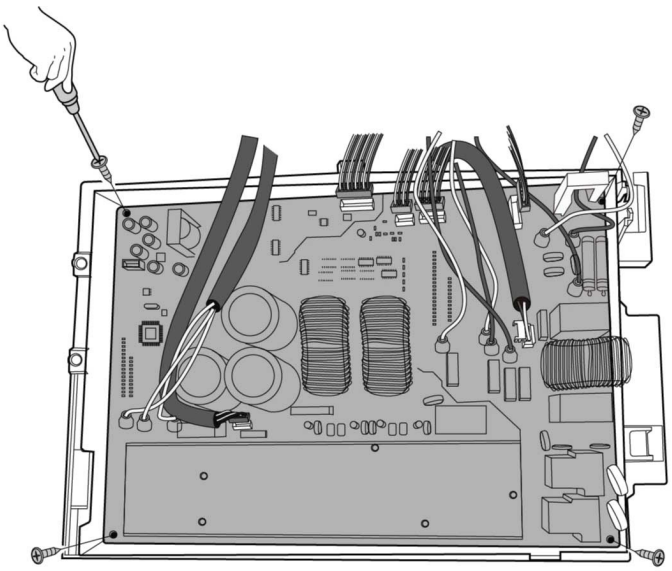
## Electrical Parts (CONT)

| Procedure | Illustration |
|---|---|
| 1) Loosen the hooks (4) then open the electronic control box cover. |  |
| 2) Remove the screws (6) on the electronic control board then turn over the electronic control board. |  |

A210630

# DISASSEMBLY INSTRUCTIONS (CONT)

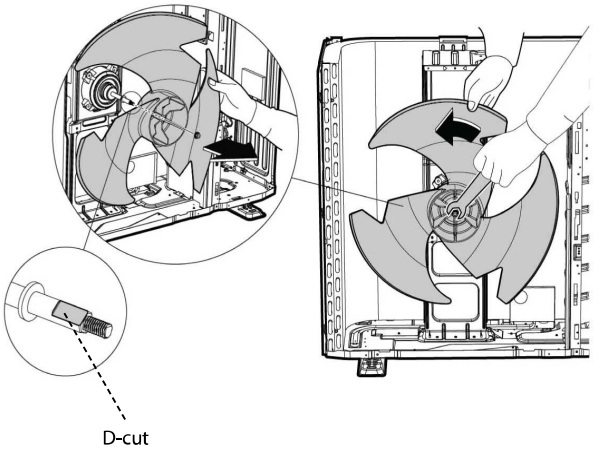
## Electrical Parts (CONT)

| Procedure | Illustration |
|---|---|
| 3) Remove the connectors.<br><br>4) Remove the screws (4) then remove the electronic control board. |  |

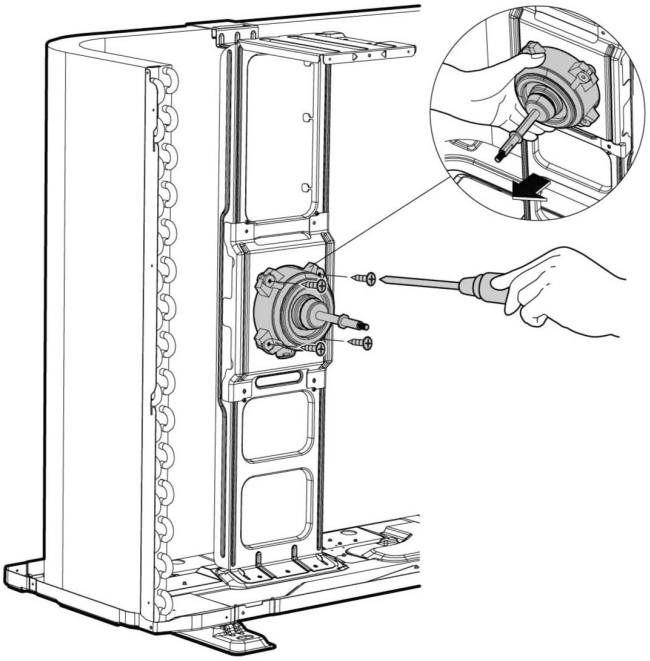
A210631

# DISASSEMBLY INSTRUCTIONS (CONT)

## Fan Assembly

| Procedure | Illustration |
|---|---|
| 1) Remove the nut, securing the fan, with a spanner.<br>2) Remove the fan. |  |

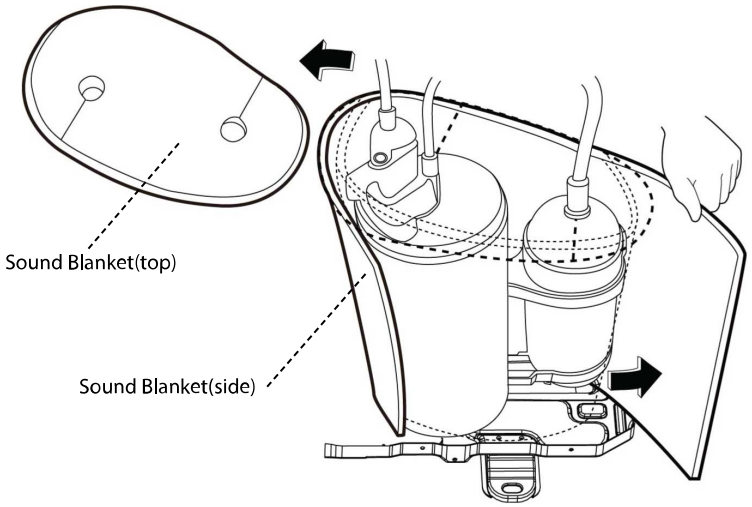
A210632

| Procedure | Illustration |
|---|---|
| 3) Remove the fan motor screws (4).<br>4) Remove the fan motor. |  |

A210633

# DISASSEMBLY INSTRUCTIONS (CONT)

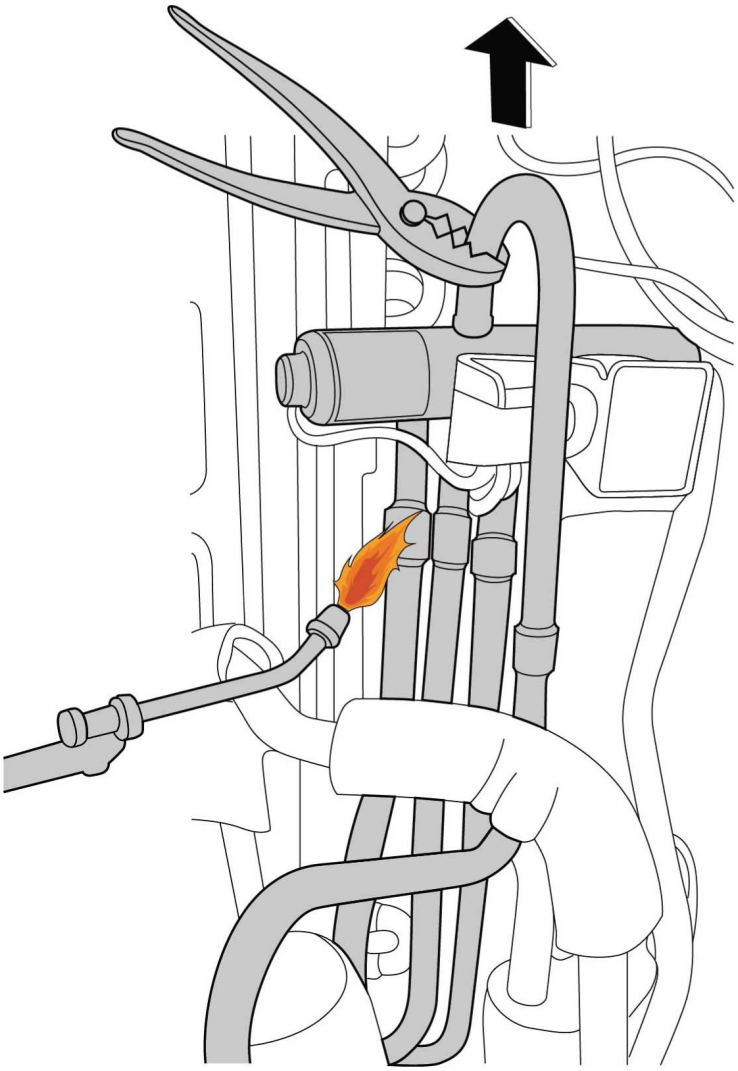
## Sound Blanket

| Procedure | Illustration |
|---|---|
| 1) Remove the sound blanket (side and top). |  |

A210634

# DISASSEMBLY INSTRUCTIONS (CONT)

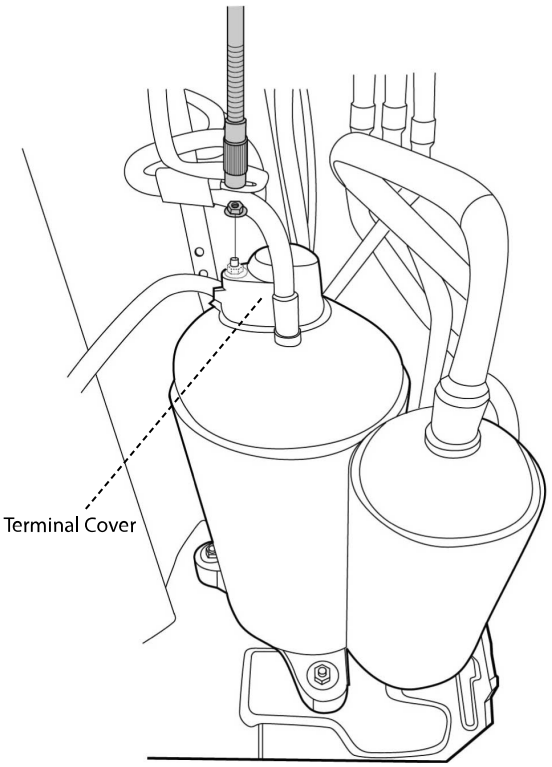
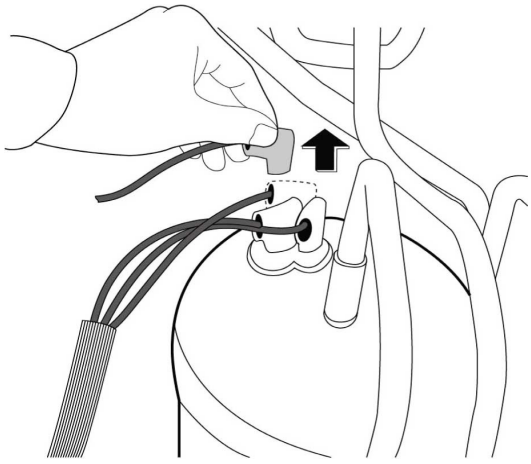
## Four-Way Valve

| Procedure | Illustration |
|---|---|
| 1) Heat up the brazed parts and then detach the the four-way valve and the pipe.<br><br>2) Use pliers. to remove the four-way valve assembly. |  |

A210635

# DISASSEMBLY INSTRUCTIONS (CONT)

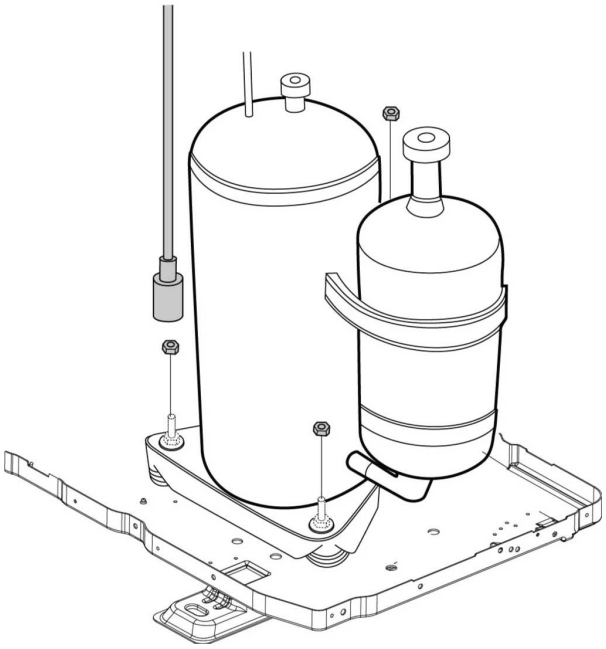
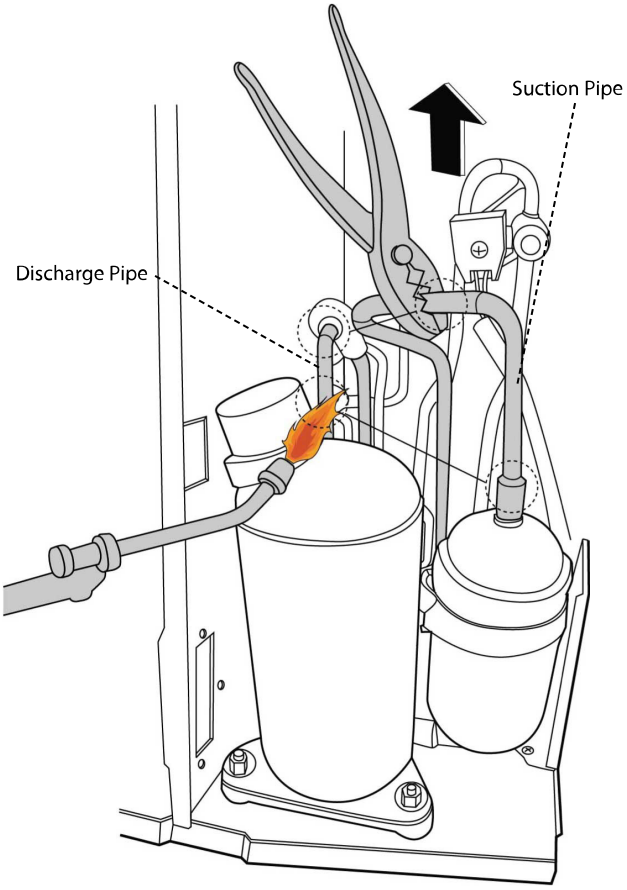
## Compressor

| Procedure | Illustration |
|---|---|
| 1) Remove the terminal cover flange nut and remove the terminal cover. |  |
| 2) Disconnect the connectors. |  |

A210636

# DISASSEMBLY INSTRUCTIONS (CONT)

**Compressor**

| Procedure | Illustration |
|---|---|
| 3) Remove the hex nuts and washers securing the compressor, located on the bottom plate. |  |
| 4) Heat up the brazed parts then remove the the discharge pipe and the suction pipe.<br>5) Lift the compressor from the base pan assembly with pliers. |  |

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# APPENDIX

## Appendix 1

### Table 24 — Temperature Sensor Resistance Value Table for T1, T2, T3, T4 (°C--K)

| °C | °F | K Ohm | °C | °F | K Ohm | °C | °F | K Ohm | °C | °F | K Ohm |
|---|---|---|---|---|---|---|---|---|---|---|---|
| - 20 | -4 | 115.266 | 20 | 68 | 12.6431 | 60 | 140 | 2.35774 | 100 | 212 | 0.62973 |
| - 19 | -2 | 108.146 | 21 | 70 | 12.0561 | 61 | 142 | 2.27249 | 101 | 214 | 0.61148 |
| - 18 | 0 | 101.517 | 22 | 72 | 11.5 | 62 | 144 | 2.19073 | 102 | 216 | 0.59386 |
| - 17 | 1 | 96.3423 | 23 | 73 | 10.9731 | 63 | 145 | 2.11241 | 103 | 217 | 0.57683 |
| - 16 | 3 | 89.5865 | 24 | 75 | 10.4736 | 64 | 147 | 2.03732 | 104 | 219 | 0.56038 |
| - 15 | 5 | 84.219 | 25 | 77 | 10 | 65 | 149 | 1.96532 | 105 | 221 | 0.54448 |
| - 14 | 7 | 79.311 | 26 | 79 | 9.55074 | 66 | 151 | 1.89627 | 106 | 223 | 0.52912 |
| - 13 | 9 | 74.536 | 27 | 81 | 9.12445 | 67 | 153 | 1.83003 | 107 | 225 | 0.51426 |
| - 12 | 10 | 70.1698 | 28 | 82 | 8.71983 | 68 | 154 | 1.76647 | 108 | 226 | 0.49989 |
| - 11 | 12 | 66.0898 | 29 | 84 | 8.33566 | 69 | 156 | 1.70547 | 109 | 228 | 0.486 |
| - 10 | 14 | 62.2756 | 30 | 86 | 7.97078 | 70 | 158 | 1.64691 | 110 | 230 | 0.47256 |
| -9 | 16 | 58.7079 | 31 | 88 | 7.62411 | 71 | 160 | 1.59068 | 111 | 232 | 0.45957 |
| -8 | 18 | 56.3694 | 32 | 90 | 7.29464 | 72 | 162 | 1.53668 | 112 | 234 | 0.44699 |
| -7 | 19 | 52.2438 | 33 | 91 | 6.98142 | 73 | 163 | 1.48481 | 113 | 235 | 0.43482 |
| -6 | 21 | 49.3161 | 34 | 93 | 6.68355 | 74 | 165 | 1.43498 | 114 | 237 | 0.42304 |
| -5 | 23 | 46.5725 | 35 | 95 | 6.40021 | 75 | 167 | 1.38703 | 115 | 239 | 0.41164 |
| -4 | 25 | 44 | 36 | 97 | 6.13059 | 76 | 169 | 1.34105 | 116 | 241 | 0.4006 |
| -3 | 27 | 41.5878 | 37 | 99 | 5.87359 | 77 | 171 | 1.29078 | 117 | 243 | 0.38991 |
| -2 | 28 | 39.8239 | 38 | 100 | 5.62961 | 78 | 172 | 1.25423 | 118 | 244 | 0.37956 |
| -1 | 30 | 37.1988 | 39 | 102 | 5.39689 | 79 | 174 | 1.2133 | 119 | 246 | 0.36954 |
| 0 | 32 | 35.2024 | 40 | 104 | 5.17519 | 80 | 176 | 1.17393 | 120 | 248 | 0.35982 |
| 1 | 34 | 33.3269 | 41 | 106 | 4.96392 | 81 | 178 | 1.13604 | 121 | 250 | 0.35042 |
| 2 | 36 | 31.5635 | 42 | 108 | 4.76253 | 82 | 180 | 1.09958 | 122 | 252 | 0.3413 |
| 3 | 37 | 29.9058 | 43 | 109 | 4.5705 | 83 | 181 | 1.06448 | 123 | 253 | 0.33246 |
| 4 | 39 | 28.3459 | 44 | 111 | 4.38736 | 84 | 183 | 1.03069 | 124 | 255 | 0.3239 |
| 5 | 41 | 26.8778 | 45 | 113 | 4.21263 | 85 | 185 | 0.99815 | 125 | 257 | 0.31559 |
| 6 | 43 | 25.4954 | 46 | 115 | 4.04589 | 86 | 187 | 0.96681 | 126 | 259 | 0.30754 |
| 7 | 45 | 24.1932 | 47 | 117 | 3.88673 | 87 | 189 | 0.93662 | 127 | 261 | 0.29974 |
| 8 | 46 | 22.5662 | 48 | 118 | 3.73476 | 88 | 190 | 0.90753 | 128 | 262 | 0.29216 |
| 9 | 48 | 21.8094 | 49 | 120 | 3.58962 | 89 | 192 | 0.8795 | 129 | 264 | 0.28482 |
| 10 | 50 | 20.7184 | 50 | 122 | 3.45097 | 90 | 194 | 0.85248 | 130 | 266 | 0.2777 |
| 11 | 52 | 19.6891 | 51 | 124 | 3.31847 | 91 | 196 | 0.82643 | 131 | 268 | 0.27078 |
| 12 | 54 | 18.7177 | 52 | 126 | 3.19183 | 92 | 198 | 0.80132 | 132 | 270 | 0.26408 |
| 13 | 55 | 17.8005 | 53 | 127 | 3.07075 | 93 | 199 | 0.77709 | 133 | 271 | 0.25757 |
| 14 | 57 | 16.9341 | 54 | 129 | 2.95896 | 94 | 201 | 0.75373 | 134 | 273 | 0.25125 |
| 15 | 59 | 16.1156 | 55 | 131 | 2.84421 | 95 | 203 | 0.73119 | 135 | 275 | 0.24512 |
| 16 | 61 | 15.3418 | 56 | 133 | 2.73823 | 96 | 205 | 0.70944 | 136 | 277 | 0.23916 |
| 17 | 63 | 14.6181 | 57 | 135 | 2.63682 | 97 | 207 | 0.68844 | 137 | 279 | 0.23338 |
| 18 | 64 | 13.918 | 58 | 136 | 2.53973 | 98 | 208 | 0.66818 | 138 | 280 | 0.22776 |
| 19 | 66 | 13.2631 | 59 | 138 | 2.44677 | 99 | 210 | 0.64862 | 139 | 282 | 0.22231 |

# Appendix 2

## Table 25 — Temperature Sensor Resistance Value Table for T5 (° C- -K)

| °C | °F | K Ohm | °C | °F | K Ohm | °C | °F | K Ohm | °C | °F | K Ohm |
|---|---|---|---|---|---|---|---|---|---|---|---|
| -20 | -4 | 542.7 | 20 | 68 | 68.66 | 60 | 140 | 13.59 | 100 | 212 | 3.702 |
| -19 | -2 | 511.9 | 21 | 70 | 65.62 | 61 | 142 | 13.11 | 101 | 214 | 3.595 |
| -18 | 0 | 483 | 22 | 72 | 62.73 | 62 | 144 | 12.65 | 102 | 216 | 3.492 |
| -17 | 1 | 455.9 | 23 | 73 | 59.98 | 63 | 145 | 12.21 | 103 | 217 | 3.392 |
| -16 | 3 | 430.5 | 24 | 75 | 57.37 | 64 | 147 | 11.79 | 104 | 219 | 3.296 |
| -15 | 5 | 406.7 | 25 | 77 | 54.89 | 65 | 149 | 11.38 | 105 | 221 | 3.203 |
| -14 | 7 | 384.3 | 26 | 79 | 52.53 | 66 | 151 | 10.99 | 106 | 223 | 3.113 |
| -13 | 9 | 363.3 | 27 | 81 | 50.28 | 67 | 153 | 10.61 | 107 | 225 | 3.025 |
| -12 | 10 | 343.6 | 28 | 82 | 48.14 | 68 | 154 | 10.25 | 108 | 226 | 2.941 |
| -11 | 12 | 325.1 | 29 | 84 | 46.11 | 69 | 156 | 9.902 | 109 | 228 | 2.86 |
| -10 | 14 | 307.7 | 30 | 86 | 44.17 | 70 | 158 | 9.569 | 110 | 230 | 2.781 |
| -9 | 16 | 291.3 | 31 | 88 | 42.33 | 71 | 160 | 9.248 | 111 | 232 | 2.704 |
| -8 | 18 | 275.9 | 32 | 90 | 40.57 | 72 | 162 | 8.94 | 112 | 234 | 2.63 |
| -7 | 19 | 261.4 | 33 | 91 | 38.89 | 73 | 163 | 8.643 | 113 | 235 | 2.559 |
| -6 | 21 | 247.8 | 34 | 93 | 37.3 | 74 | 165 | 8.358 | 114 | 237 | 2.489 |
| -5 | 23 | 234.9 | 35 | 95 | 35.78 | 75 | 167 | 8.084 | 115 | 239 | 2.422 |
| -4 | 25 | 222.8 | 36 | 97 | 34.32 | 76 | 169 | 7.82 | 116 | 241 | 2.357 |
| -3 | 27 | 211.4 | 37 | 99 | 32.94 | 77 | 171 | 7.566 | 117 | 243 | 2.294 |
| -2 | 28 | 200.7 | 38 | 100 | 31.62 | 78 | 172 | 7.321 | 118 | 244 | 2.233 |
| -1 | 30 | 190.5 | 39 | 102 | 30.36 | 79 | 174 | 7.086 | 119 | 246 | 2.174 |
| 0 | 32 | 180.9 | 40 | 104 | 29.15 | 80 | 176 | 6.859 | 120 | 248 | 2.117 |
| 1 | 34 | 171.9 | 41 | 106 | 28 | 81 | 178 | 6.641 | 121 | 250 | 2.061 |
| 2 | 36 | 163.3 | 42 | 108 | 26.9 | 82 | 180 | 6.43 | 122 | 252 | 2.007 |
| 3 | 37 | 155.2 | 43 | 109 | 25.86 | 83 | 181 | 6.228 | 123 | 253 | 1.955 |
| 4 | 39 | 147.6 | 44 | 111 | 24.85 | 84 | 183 | 6.033 | 124 | 255 | 1.905 |
| 5 | 41 | 140.4 | 45 | 113 | 23.89 | 85 | 185 | 5.844 | 125 | 257 | 1.856 |
| 6 | 43 | 133.5 | 46 | 115 | 22.89 | 86 | 187 | 5.663 | 126 | 259 | 1.808 |
| 7 | 45 | 127.1 | 47 | 117 | 22.1 | 87 | 189 | 5.488 | 127 | 261 | 1.762 |
| 8 | 46 | 121 | 48 | 118 | 21.26 | 88 | 190 | 5.32 | 128 | 262 | 1.717 |
| 9 | 48 | 115.2 | 49 | 120 | 20.46 | 89 | 192 | 5.157 | 129 | 264 | 1.674 |
| 10 | 50 | 109.8 | 50 | 122 | 19.69 | 90 | 194 | 5 | 130 | 266 | 1.632 |
| 11 | 52 | 104.6 | 51 | 124 | 18.96 | 91 | 196 | 4.849 | | | |
| 12 | 54 | 99.69 | 52 | 126 | 18.26 | 92 | 198 | 4.703 | | | |
| 13 | 55 | 95.05 | 53 | 127 | 17.58 | 93 | 199 | 4.562 | | | |
| 14 | 57 | 90.66 | 54 | 129 | 16.94 | 94 | 201 | 4.426 | | | |
| 15 | 59 | 86.49 | 55 | 131 | 16.32 | 95 | 203 | 4.294 | | | |
| 16 | 61 | 82.54 | 56 | 133 | 15.73 | 96 | 205 | 4.167 | | | |
| 17 | 63 | 78.79 | 57 | 135 | 15.16 | 97 | 207 | 4.045 | | | |
| 18 | 64 | 75.24 | 58 | 136 | 14.62 | 98 | 208 | 3.927 | | | |
| 19 | 66 | 71.86 | 59 | 138 | 14.09 | 99 | 210 | 3.812 | | | |

## Appendix 3

### Table 26 — Fahrenheit to Celsius Conversion

| °C | °F | °C | °F | °C | °F | °C | °F | °C | °F |
|---|---|---|---|---|---|---|---|---|---|
| -5 | 23 | 21 | 69.8 | 51 | 123.8 | 82 | 179.6 | 113 | 235.4 |
| -4 | 24.8 | 22 | 71.6 | 52 | 125.6 | 83 | 181.4 | 114 | 237.2 |
| -3 | 26.6 | 23 | 73.4 | 53 | 127.4 | 84 | 183.2 | 115 | 239 |
| -2 | 28.4 | 24 | 75.2 | 54 | 129.2 | 85 | 185 | 116 | 240.8 |
| -1 | 30.2 | 25 | 77 | 55 | 131 | 86 | 186.8 | 117 | 242.6 |
| 0 | 32 | 25.5 | 77.9 | 56 | 132.8 | 87 | 188.6 | 118 | 244.4 |
| 0.5 | 32.9 | 26 | 78.8 | 57 | 134.6 | 88 | 190.4 | 119 | 246.2 |
| 1 | 33.8 | 27 | 80.6 | 58 | 136.4 | 89 | 192.2 | 120 | 248 |
| 1.5 | 34.7 | 28 | 82.4 | 59 | 138.2 | 90 | 194 | 121 | 249.8 |
| 2 | 35.6 | 29 | 84.2 | 60 | 140 | 91 | 195.8 | 122 | 251.6 |
| 2.5 | 36.5 | 30 | 86 | 61 | 141.8 | 92 | 197.6 | 123 | 253.4 |
| 3 | 37.4 | 31 | 87.8 | 62 | 143.6 | 93 | 199.4 | 124 | 255.2 |
| 3.5 | 38.3 | 32 | 89.6 | 63 | 145.4 | 94 | 201.2 | 125 | 257 |
| 4 | 39.2 | 33 | 91.4 | 64 | 147.2 | 95 | 203 | 126 | 258.8 |
| 4.5 | 40.1 | 34 | 93.2 | 65 | 149 | 96 | 204.8 | 127 | 260.6 |
| 5 | 41 | 35 | 95 | 66 | 150.8 | 97 | 206.6 | 128 | 262.4 |
| 6 | 42.8 | 36 | 96.8 | 67 | 152.6 | 98 | 208.4 | 129 | 264.2 |
| 7 | 44.6 | 37 | 98.6 | 68 | 154.4 | 99 | 210.2 | 130 | 266 |
| 8 | 46.4 | 38 | 100.4 | 69 | 156.2 | 100 | 212 | 131 | 267.8 |
| 9 | 48.2 | 39 | 102.2 | 70 | 158 | 101 | 213.8 | 132 | 269.6 |
| 10 | 50 | 40 | 104 | 71 | 159.8 | 102 | 215.6 | 133 | 271.4 |
| 11 | 51.8 | 41 | 105.8 | 72 | 161.6 | 103 | 217.4 | 134 | 273.2 |
| 12 | 53.6 | 42 | 107.6 | 73 | 163.4 | 104 | 219.2 | 135 | 275 |
| 13 | 55.4 | 43 | 109.4 | 74 | 165.2 | 105 | 221 | 136 | 276.8 |
| 14 | 57.2 | 44 | 111.2 | 75 | 167 | 106 | 222.8 | 137 | 278.6 |
| 15 | 59 | 45 | 113 | 76 | 168.8 | 107 | 224.6 | 138 | 280.4 |
| 16 | 60.8 | 46 | 114.8 | 77 | 170.6 | 108 | 226.4 | 139 | 282.2 |
| 17 | 62.6 | 47 | 116.6 | 78 | 172.4 | 109 | 228.2 | 140 | 284 |
| 18 | 64.4 | 48 | 118.4 | 79 | 174.2 | 110 | 230 | 141 | 285.8 |
| 19 | 66.2 | 49 | 120.2 | 80 | 176 | 111 | 231.8 | 142 | 287.6 |
| 20 | 68 | 50 | 122 | 81 | 177.8 | 112 | 233.6 | 143 | 289.4 |


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