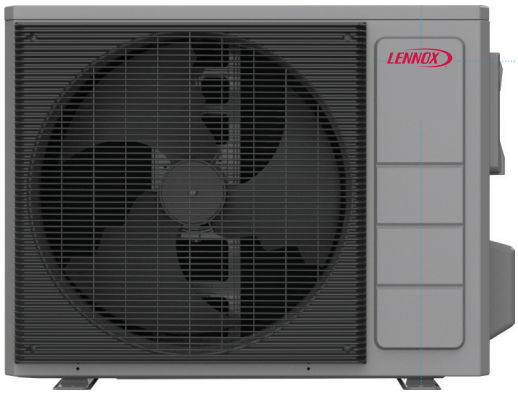
LENNOX
Service Literature

UNIT INFORMATION

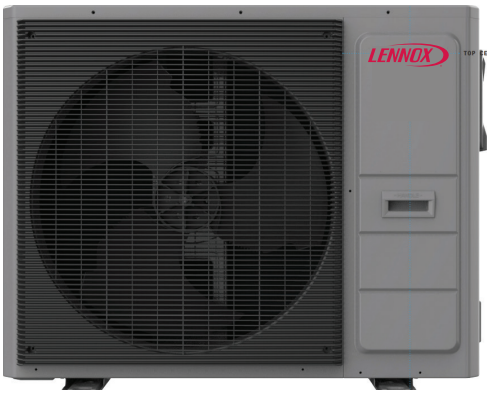
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August 2026

ML15KSPV

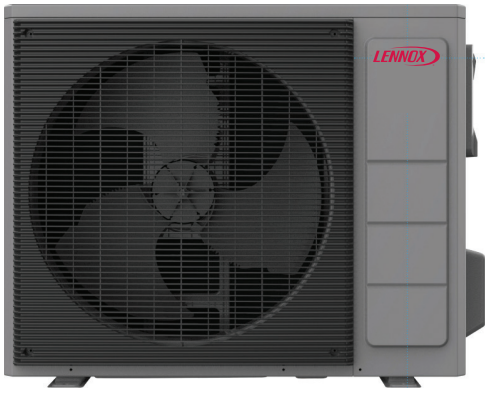
ML15KSPV (R-454B) SERIES OUTDOOR UNITS



ML15KSPV-018-230
ML15KSPV-024-230



ML15KSPV-042-230
ML15KSPV-048-230
ML15KSPV-060-230



ML15KSPV-030-230
ML15KSPV-036-230

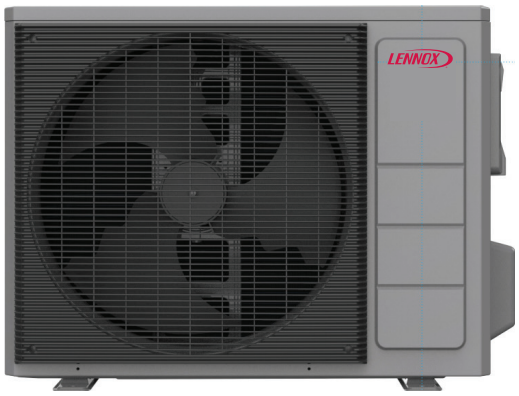
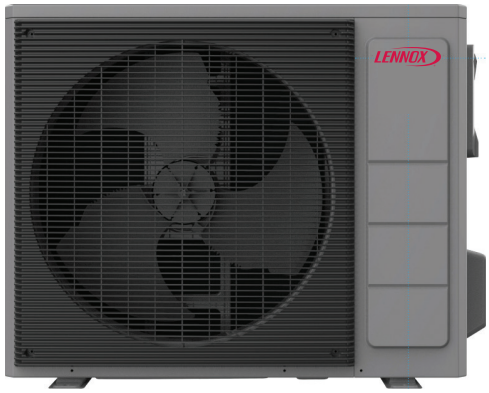
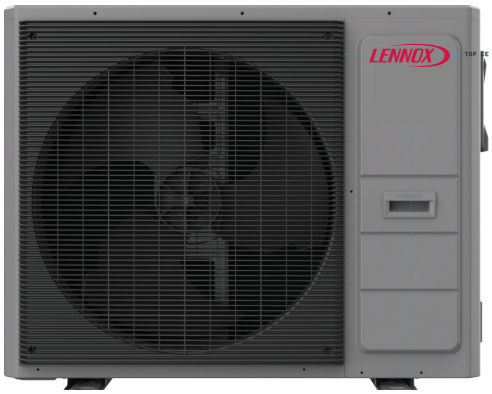
Design may vary by model number.

READ CAREFULLY.
KEEP THESE INSTRUCTIONS.

Table of Contents

LINEUP 3
SAFETY & PRECAUTIONS 4
SPECIFICATIONS. 13
COMPONENTS. 14
PCB OVERVIEW. 26
FUNCTIONS AND CONTROL 30
COOLING MODE SEQUENCE OF OPERATION. 32
HEATING MODE SEQUENCE OF OPERATION 35
DEFROST CYCLE SEQUENCE OF OPERATION. 38
OIL RETURN SEQUENCE OF OPERATIONS. 42
OPERATING PARAMETERS 45
COMPONENT TESTING. 52
WIRING DIAGRAMS. 67
OUTDOOR/INDOOR WIRING CONNECTIONS. 68
SENSOR RESISTANCE TABLES 71
DIP SWITCH 79
ERROR CODES 83
TROUBLESHOOTING 88

Lineup

	Model	Appearance
Outdoor Unit	ML15KSPV-018-230 ML15KSPV-024-230	
	ML15KSPV-030-230 ML15KSPV-036-230	
	ML15KSPV-042-230 ML15KSPV-048-230 ML15KSPV-060-230	

Safety & Precautions

- Read these Safety Precautions carefully to ensure correct installation.
- This manual classifies the precautions by WARNING and CAUTION.
- Follow all precautions below. They are all important for ensuring safety and preventing property/equipment damage.

⚠WARNING Failure to follow any of WARNING is likely to result in grave consequences such as death or serious injury.

⚠CAUTION Failure to follow any of CAUTION may, in some cases, result in grave consequences.

- The following safety symbols are used throughout this manual:

 Observe this instruction  Establish an earth connection  Never attempt

- After installation - pressure test for any leaks before start up. Give the user adequate instructions concerning the use and cleaning of the unit according to the Operation Manual.

⚠WARNING

- Installation should be performed by the dealer or another professional. Improper installation may cause water leakage, electrical shock, or fire.
- Install the heat pump according to the instructions given in this manual. Incomplete installation may cause water leakage, electrical shock, or fire.
- Use only the supplied or specified installation parts. Use of other parts may cause the unit to come lose, water leakage, electrical shock, or fire.
- Install the heat pump on a solid base that can support the unit's weight. An inadequate base or incomplete installation may cause injury in the event the unit falls off the base.
- Electrical work should be carried out in accordance with the installation manual and national/local electrical wiring codes and rules of practice. Insufficient capacity or incomplete electrical work may cause electrical shock or fire.
- Use a dedicated power circuit. Never use a power supply shared by another appliance.
- For wiring, use a cable long enough to cover the entire distance with no splices. Do not use an extension cord. Do not put other loads on the power supply, use a dedicated power circuit. (Failure to do so may cause abnormal errors codes and performance.)
- Use only the specified wire types for electrical connections between the indoor and outdoor units. Firmly clamp the interconnecting wires so they receive no external stresses. Incomplete connections or clamping may cause terminal overheating or fire.
- After completing interconnecting and supply wiring connections, shape the electrical wires so that they do not put undueforce on the electrical covers or panels. Install covers over the wires. Incomplete cover installation may cause terminal overheating, electrical shock, or fire.
- If any refrigerant has leaked out during the installation work, ventilate the room. (The refrigerant produces a toxic gas if exposed to flame.)
- After all installation is complete, check for and repair any system refrigerant leaks. (The refrigerant produces a toxic gas if exposed to flames.)
- When installing or relocating the system, keep the refrigerant circuit free from substances other than the specified refrigerant (R454B), such as air. (The presence of air or other foreign substance in the refrigerant circuit causes an abnormal pressure rise or rupture, resulting in injury.)
- During pump-down, stop the compressor before removing the refrigerant piping. If the compressor is still running, and the stop valve is open during pump-down, air will be sucked into the system while the compressor is running. This will cause abnormal pressure and noncondensables added to the system.
- Be sure to establish a ground. Do not ground the unit to a utility pipe, arrester, or telephone earth. An complete earth may cause electrical shock, or fire. A high surge current from lightning or other sources may cause damage to the heat pump.

Safety & Precautions

⚠CAUTION

- Do not install the heat pump in a place where there is danger of exposure to A2L gas. If the gas builds up around the unit, it may catch fire.
- Install drain piping according to the instructions of this manual. Inadequate piping may cause flooding.
- Tighten the flare nut according to the specified torque using a torque wrench. If the flare nut is overtightened, the flare nut may eventually crack and cause refrigerant leakage.
- Provide adequate measures to prevent the outdoor unit from being used as a shelter by rodents. Rodents making contact with electrical parts can cause malfunctions, smoke or fire. Please instruct the customer to keep the area around the unit clean.

Requirements for Operation, Service and Installation of Appliances Using A2L Refrigerants

- Do not use means to accelerate the defrosting process or to clean, other than those recommended by the manufacturer.
- The appliance shall be stored in a room without continuously operating ignition sources (for example: open flames, an operating gas appliance or an operating electric heater.
- Do not pierce or burn.
- Be aware that refrigerants may not contain an odor.



Warning; A2L Materials, Refrigerant class per ISO 817


Owner's Manual; Operating Instructions


Read Owner's Manual


Service Indicator; Read Technical Manual

General

- **During installation,due to the extended refrigerant pipes, additional REFRIGERANT may be charged. Refer to the nameplate attached to the unit for details.**
- **Handling, installation, cleaning, servicing and disposal of refrigerant must comply with the local regulation and the instruction.**
- Servicing shall be performed only as recommended by the manufacturer.
- Spaces where refrigerant pipes are allowed shall comply with the below requirement:
  - that piping material, pipe routing, and installation shall include protection from physical damage in operation and service, and be in compliance with national and local codes and standards,such as ASHRAE 15, IAPMO Uniform Mechanical Code, ICC International Mechanical Code, or CSA B52. All field joints shall be accessible for inspection prior to being covered or enclosed.
  - that the installation of pipe-work shall be kept to a minimum.
  - that the mechanical connections between parts created during installation are accessible for maintenance purposes.
  - that protection devices, piping, and fittings shall be protected as far as possible against adverse environmental effects, fo rexample, the danger of water collecting and freezing in relief pipes or the accumulation of dirt and debris.
  - that piping in refrigeration systems shall be so designed and installed to minimize the likelihood of hydraulic shock damaging the system.
  - that precautions shall be taken to avoid excessive vibration or pulsation.

Requirements for Operation, Service and Installation of Appliances Using A2L Refrigerants (Cont.)

General (Cont.)

- that after completion of field piping for split systems, the field pipe work shall be pressure tested with an inert gas and then vacuum tested prior to refrigerant charging, according to the following requirements:
  - The minimum test pressure for the low side of the system shall be the low side design pressure and the minimum test pressure for the high side of the system shall be the high side design pressure, unless the high side of the system, cannot be isolated from the low side of the system in which case the entire system shall be pressure tested to the low side design pressure.
  - The test pressure after removal of pressure source shall be maintained for at least 1 hour with no decrease of pressure indicated by the test gauge, with test gauge resolution not exceeding 5% of the test pressure.
  - During the evacuation test, after achieving a vacuum level specified in the manual or less, the refrigeration system shall be isolated from the vacuum pump and the pressure shall not rise above 500 microns within 20 min. The vacuum pressure level shall be specified in the manual, and shall be the lessor of 500 microns or the value required for compliance with national and local codes and standards, which may vary between residential, commercial, and industrial buildings.
- that field-made refrigerant joints indoors shall be tightness tested according to the following requirements: The test method shall have a sensitivity of 5 grams (0.18 oz.) per year of refrigerant or better under a pressure of at least 0.25 times the maximum allowable pressure. No leak shall be detected.

Qualification of Workers

Every working procedure that affects safety shall only be carried out by industry trained individuals.

Examples for such working procedures are:

- breaking into the refrigerating circuit;
- opening of sealed components;
- opening of ventilated enclosures.

The industry trained individuals are trained by the national training organizations or manufacturers that are accredited to teach the relevant national competency standards that may be set in legislation. The achieved competence should be documented by a certificate.

Information on Servicing

Prior to beginning work on systems containing **A2L REFRIGERANTS**, safety checks are necessary to ensure that the risk of ignition is minimized. For repair to the **REFRIGERATING SYSTEM**, the below requirement shall be completed prior to conducting work on the system:

- Work shall be undertaken under a controlled procedure so as to minimise the risk of a A2L gas or vapour being present while the work is being performed.
- All maintenance staff and others working in the local area shall be instructed on the nature of work being carried out. Work in confined spaces shall be avoided.
- The area shall be checked with an appropriate refrigerant detector prior to and during work, to ensure the technician is aware of potentially toxic or A2L atmospheres. Ensure that the leak detection equipment being used is suitable for use with all applicable refrigerants, i. e. non-sparking, adequately sealed or intrinsically safe.
- If any brazing needs to be performed on the refrigerating equipment or any associated parts,appropriate fire extinguishing equipment shall be available to hand. Have a dry powder or CO2 fire extinguisher adjacent to the charging area.

Safety & Precautions

Requirements for Operation, Service and Installation of Appliances Using A2L Refrigerants (Cont.)

Information on Servicing (Cont.)

- No person carrying out work in relation to a **REFRIGERATING SYSTEM** which involves exposing any pipe work shall use any sources of ignition in such a manner that it may lead to the risk of fire or explosion. All possible ignition sources, including cigarette smoking, should be kept sufficiently far away from the site of installation, repairing, removing and disposal,during which refrigerant can possibly be released to the surrounding space. Prior to work taking place, the area around the equipment is to be surveyed to make sure that there are no A2L hazards or ignition risks.“No Smoking” signs shall be displayed.
- Ensure that the area is in the open or that it is adequately ventilated before breaking into the system or having any type of open flame. A degree of ventilation shall continue during the period that the work is carried out. The ventilation should safely disperse any released refrigerant and preferably expel it externally into the atmosphere.
- Where electrical components are being changed, they shall be fit for the purpose and to the correct specification. At all times the manufacturer’s maintenance and service guidelines shall be followed. If in doubt, consult the manufacturer’s technical department for assistance.
- The following checks shall be applied to installations using **A2L REFRIGERANTS**:
  - marking to the equipment continues to be visible and legible. Markings and signs that are illegible shall be corrected;
  - refrigerating pipe or components are installed ina position where they are unlikely to be exposed to any substance which may corrode refrigerant containing components, unless the components are constructed of materials which are inherently resistant to being corroded or are suitably protected against severe corrosion.
- Repair and maintenance to electrical components shall include initial safety checks and component inspection procedures. If a fault exists that could compromise safety, then no electrical supply shall be connected to the circuit until it is satisfactorily dealt with. If the fault cannot be corrected immediately but it is necessary to continue operation, an adequate temporary solution shall be used. This shall be reported to the owner of the equipment so all parties are advised.
- Initial safety checks shall include:
  - that capacitors are discharged: this shall be done ina safe manner to avoid possibility of sparking;
  - that no live electrical components and wiring are exposed while charging, recovering or purging the system;
  - that there is continuity of grounding.

Repairs to Sealed Components, Intrinsically Safe Components

- Sealed electrical components shall be replaced.
- Intrinsically safe components must be replaced.
- Replace components only with parts specified by the manufacturer. Other parts may result in the ignition of refrigerant in the atmosphere from a leak.

Electrical Wire

- Check that electrical wire will not be subject to wear, corrosion, excessive pressure, vibration, sharp edges or any other adverse environmental effects. The check shall also take into account the effects of aging or continual vibration from sources such as compressors or fans. Wire routing is designed to keep electrical wiring away from refrigerant containing components. Ensure wire is returned to original routing if any are moved during inspection or repair.

Requirements for Operation, Service and Installation of Appliances Using A2L Refrigerants (Cont.)

Detection of A2L Refrigerants

- Under no circumstances shall potential sources of ignition be used in the searching for or detection of refrigerant leaks. A halide torch (or any other detector using a naked flame) shall not be used.
- The following leak detection methods are deemed acceptable for all refrigerant systems:
  - Electronic leak detectors may be used to detect refrigerant leaks but, in the case of **A2L REFRIGERANTS**, the sensitivity may not be adequate, or may need re-calibration. (Detection equipment shall be calibrated in a refrigerant-free area.) Ensure that the detector is not a potential source of ignition and is suitable for the refrigerant used. Leak detection equipment shall be set at a percentage of the Lower Flammability Limit (LFL) of the refrigerant and shall be calibrated to the refrigerant employed, and the appropriate percentage of gas (25% maximum) is confirmed.
  - Leak detection fluids are also suitable for use with most refrigerants but the use of detergents containing chlorine shall be avoided as the chlorine may react with the refrigerant and corrode the copper pipe-work.

  NOTE: Examples of leak detection fluids are:
  - bubble method,
  - fluorescent method agents.
- If a leak is suspected, all naked flames shall be removed/ extinguished.
- If a leakage of refrigerant is found which requires brazing, all of the refrigerant shall be recovered from the system, or isolated (by means of shut off valves) in a part of the system remote from the leak. Removal of refrigerant shall be according to the manual.

Removal and Evacuation

- When breaking into the refrigerant circuit to make repairs – or for any other purpose – industry standard procedures shall be used. However, for A2L refrigerants it is important that best practice be followed, since flammability is a consideration. The following procedure shall be adhered to:
  1. safely remove refrigerant following local and national regulations;
  2. purge the circuit with inert gas;
  3. open the circuit by cutting or brazing.
- The refrigerant charge shall be recovered into the correct recovery cylinders if venting is not allowed by local and national codes. For appliances containing A2L refrigerants, the system shall be purged with oxygen-free nitrogen to render the appliance safe for A2L refrigerants. This process might need to be repeated several times.
- Compressed air or oxygen shall not be used for purging refrigerant systems.
- The outlet for the vacuum pump shall not be close to any potential ignition sources, and ventilation shall be available.

Requirements for Operation, Service and Installation of Appliances Using A2L Refrigerants (Cont.)

Charging Procedures

- In addition to industry standard charging procedures, the following requirements shall be followed.
  - Ensure that contamination of different refrigerants does not occur when using charging equipment. Hoses or lines shall be as short as possible to minimise the amount of refrigerant contained in them.
  - Cylinders shall be kept in an appropriate position according to the instructions.
  - Ensure that the **REFRIGERATING SYSTEM** is grounded prior to charging the system with refrigerant.
  - Label the system when charging is complete (if not already).
  - Extreme care shall be taken not to overfill the **REFRIGERATING SYSTEM**.
- Prior to recharging the system, it shall be pressure tested with the dry nitrogen. The system shall be leak-tested on completion of charging but prior to commissioning. A follow up leak test shall be carried out prior to leaving the site.

Decommissioning

- Before carrying out this procedure, it is essential that the technician is completely familiar with the equipment and all its detail. It is recommended good practice that all refrigerants are recovered safely. Prior to the task being carried out, an oil and refrigerant sample shall be taken in case analysis is required prior to re-use of recovered refrigerant. It is essential that electrical power is available before the task is commenced.

1. Become familiar with the equipment and its operation.
2. Isolate system electrically.
3. Before attempting the procedure, ensure that:
   - mechanical handling equipment is available, if required, for handling refrigerant cylinders;
   - all personal protective equipment is available and being used correctly;
   - the recovery process is supervised at all times by a competent person;
   - recovery equipment and cylinders conform to the appropriate standards.
4. Pump down refrigerant system, if possible.
5. If a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system.
6. Make sure that cylinder is situated on the scales before recovery takes place.
7. Start the recovery machine and operate in accordance with instructions.
8. Do not overfill cylinders (no more than 80% volume liquid charge).
9. Do not exceed the maximum working pressure of the cylinder, even temporarily.
10. When the cylinders have been filled correctly and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.
11. Recovered refrigerant shall not be charged into another **REFRIGERATING SYSTEM** unless it has been cleaned and checked.

Labeling

- Equipment shall be labeled stating that it has been de-commissioned and emptied of refrigerant. The label shall be dated and signed. For appliances containing **A2L REFRIGERANTS**, ensure that there are labels on the equipment stating the equipment contains **A2L REFRIGERANTS**.

Requirements for Operation, Service and Installation of Appliances Using A2L Refrigerants (Cont.)

Recovery

- When removing refrigerant from a system, either for servicing or decommissioning, it is recommended good practice that all refrigerants are removed safely.
- When transferring refrigerant into cylinders, ensure that only appropriate refrigerant recovery cylinders are employed. Ensure that the correct number of cylinders for holding the total system charge is available. All cylinders to be used are designated for the recovered refrigerant and labelled for that refrigerant (i. e. special cylinders for the recovery of refrigerant). Cylinders shall be complete with pressure-relief valve and associated shut-off valves in good working order. Empty recovery cylinders are evacuated and, if possible, cooled before recovery occurs.
- The recovery equipment shall be in good working order with a set of instructions concerning the equipment that is at hand and shall be suitable for the recovery of all appropriate refrigerants including, when applicable, **A2L REFRIGERANTS**. In addition, a set of calibrated weighing scales shall be available and in good working order. Hoses shall be complete with leak-free disconnect couplings and in good condition. Before using the recovery machine, check that it is in satisfactory working order, has been properly maintained and that any associated electrical components are sealed to prevent ignition in the event of a refrigerant release. Consult manufacturer if in doubt.
- The recovered refrigerant shall be returned to the refrigerant supplier in the correct recovery cylinder, and the relevant waste transfer note arranged. Do not mix refrigerants in recovery units and especially not in cylinders.
- If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that **A2L REFRIGERANT** does not remain within the lubricant. The evacuation process shall be carried out prior to returning the compressor to the suppliers. Only electric heating to the compressor body shall be employed to accelerate this process. When oil is drained from a system, it shall be carried out safely.

A2L REFRIGERANTS

- In addition, a set of calibrated weighing scales shall be available and in good working order. Hoses shall be complete with leak-free disconnect couplings and in good condition. Before using the recovery machine, check that it is in satisfactory working order, has been properly maintained and that any associated electrical components are sealed to prevent ignition in the event of a refrigerant release. Consult manufacturer if in doubt.
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Safety & Precautions

Application

These units are designed for use in residential and light commercial type buildings. Units should be installed with approved indoor matches listed in the Air-Conditioning, Heating and Refrigeration Institute (AHRI) Directory of Certified Products. Refer to AHRI Directory.org.

These units comply with UL 60335-2-40/CSA C22.2 No. 60335-2-40, or UL 1995/CSA C22.2 No 236. and must be connected to other units that also are compliant.

The majority of states codes have adopted UL60335-2-40 Edition 4. A limited number of local and state codes may require compliance to UL 60335- 2-40 Edition 3. Please refer to our website at www.**LennoxPros.com** for guidance on installations in those localities.

1) These units are PARTIAL UNIT AIR CONDITIONERS, complying with PARTIAL UNIT requirements of this Standard, and must only be connected to other units that have been confirmed as complying to corresponding PARTIAL UNIT requirements of this Standard, UL60335-2-40/CSA C22.2 No. 60335-2-40, or UL 1995/CSA C22.2 No 236.

2) **⚠WARNING** Assure that PARTIAL UNITS shall only be connected to an appliance suitable for the same refrigerant.

3) Assure the maximum operating pressure is considered when connecting to any indoor units.

4) According to ASHRAE 15, these units can stop compressor working in 10s when receiving the signal from the Refrigerant detection systems in indoor units. Please verify and assure the validity during installation.

NOTE: R-454B is a A2L refrigerant. The system installation must meet the following parameters based upon total refrigerant charge (line set included). TAmin (Total minimum conditioned area)is the minimum allowable conditioned area based upon the total system charge at sea level. Values must be multiplied by altitude adjustment factor at installed altitude.

Qmin table refers to minimum airflow requirements during refrigerant leak mitigation by the refrigerant detection system, based upon total system charge.

See tables on this page.

TAmin Table

Charge (lbs)	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11
Charge (kg)	1.8	2.0	2.2	2.5	2.7	2.9	3.1	3.4	3.6	3.8	4.0	4.3	4.5	4.7	5.0
Minimum Conditioned Area (ft^2)	59	67	74	82	89	97	104	112	119	127	134	142	149	157	164
Minimum Conditioned Area (m^2)	5.4	6.2	6.8	7.6	8.2	9.0	9.6	10.4	11.0	11.7	12.4	13.1	13.8	14.5	15.2

NOTE: Table is based on the configuration where the discharge port and air return port in the room is higher than 7.22 ft (2.2 m).
NOTE: Multiply values in TAmin table by the Altitude Adjustment Factors to correct TAmin based on installed altitude.

Altitude Adjustment Factor

Altitude (m)	0	200	400	600	800	1000	1200	1400	1600
Altitude (ft)	0	660	1310	1970	2620	3280	3940	4590	5250
Adj. Factor	1	1	1	1	1.02	1.05	1.04	1.1	1.12
Altitude (m)	1600	1800	2000	2200	2400	2600	2800	3000	3200
Altitude (ft)	5250	5910	6560	7220	7870	8530	9190	9840	10500
Adj. Factor	1.12	1.15	1.18	1.21	1.25	1.28	1.32	1.36	1.4

Qmin Table

Refrigerant Charge lb (kg)	CFM Required	Refrigerant Charge lb (kg)	CFM Required
5 (2.268)	135	18 (8.165)	487
6 (2.722)	162	19 (8.618)	514
7 (3.175)	189	20 (9.072)	541
8 (3.629)	216	21 (9.525)	568
9 (4.082)	244	22 (9.979)	595
10 (4.536)	271	23 (10.433)	622
11 (4.990)	298	24 (10.886)	649
12 (5.443)	325	25 (11.340)	676
13 (5.897)	352	26 (11.793)	704
14 (6.350)	379	27 (12.247)	731
15 (6.804)	406	28 (12.701)	758
16 (7.257)	433	29 (13.154)	785
17 (7.711)	460	30 (13.608)	812

Safety & Precautions

Application (Cont.)

These three tables are used together.

For example, a ML15KSPV-024 unit with a 33 ft line set paired with a CBK45UHVT-024-230 has stock refrigerant + piping additional refrigerant + IDU additional refrigerant = 59.6 + 10oz + 16oz = 85.6 oz = 5.35 lbs.

If the altitude = 660ft , the altitude correction factor = 1. Because 5< 5.35 * 1 < 5.5 , the corresponding minimum area of the table is 82 ft2, and the minimum airflow rate of the table is 162CFM. It is calculated that the room area of ML15KSPV-024 shouldn't be less than 82 ft2, and the minimum airflow rate of the unit should not be less than 162CFM.

General

Read this entire instruction manual, as well as the instructions supplied in separate equipment, before starting the troubleshoot. Observe and follow all warnings, cautions, instructional labels, and tags. Failure to comply with these instructions could result in an unsafe condition and/or premature component failure.

These instructions are intended as a general guide only for use by qualified personnel and do not supersede any national or local codes in any way. The installation must comply with all provincial, state, and local codes as well as the National Electrical Code (U.S.) or Canadian Electrical Code (Canada). Compliance should be determined prior to installation.

This unit uses R-454B, which is an ozone-friendly HFC refrigerant. The unit must be installed with a matching indoor coil and line set. A filter drier approved for use with R-454B is factory installed in the unit. **No externally installed biflow filter dryer required.**

Safety Precautions

Follow all safety codes. Wear safety glasses and work gloves. Use quenching cloth for brazing operations. Have fire extinguisher available. Read these instructions thoroughly and follow all warning or cautions attached to the unit.

1. Always wear proper personal protection equipment.
2. Always disconnect electrical power before removing panel or servicing equipment.
3. Keep hands and clothing away from moving parts.
4. Handle refrigerant with caution; refer to proper MSDS from refrigerant supplier.
5. Use care when lifting, avoid contact with sharp edges.

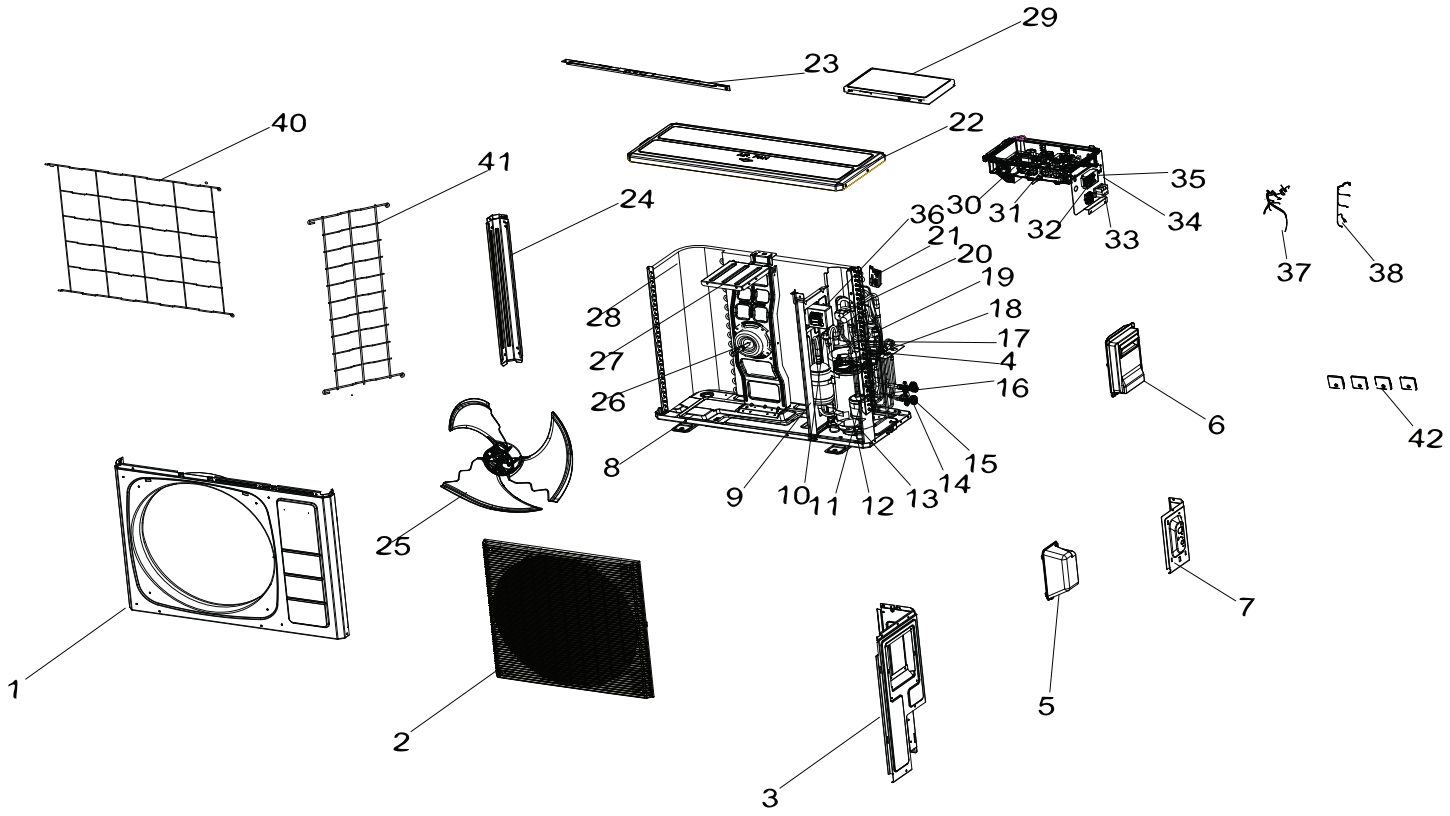
Specifications

Model	Outdoor	ML15KSPV-018	ML15KSPV-024	ML15KSPV-030	ML15KSPV-036	ML15KSPV-042	ML15KSPV-048	ML15KSPV-060
	UPC	084691984641	084691984696	084691984689	084691984672	084691984665	084691984658	084691984740
Operating Range	Cooling °F(°C)	40~125 (5~52)	40~125 (5~52)	40~125 (5~52)	40~125 (5~52)	40~125 (5~52)	40~125 (5~52)	40~125 (5~52)
	Heating °F(°C)	0~75 (-18~24)	0~75 (-18~24)	0~75 (-18~24)	0~75 (-18~24)	0~75 (-18~24)	0~75 (-18~24)	0~75 (-18~24)
Power Supply	Voltage, Cycle, Phase V/Hz/-	208-230 / 60 / 1	208-230 / 60 / 1	208-230 / 60 / 1	208-230 / 60 / 1	208-230 / 60 / 1	208-230 / 60 / 1	208-230 / 60 / 1
	Compressor Type	DC Inverter Driven Twins Rotary	DC Inverter Driven Twins Rotary	DC Inverter Driven Twins Rotary	DC Inverter Driven Twins Rotary	DC Inverter Driven Twins Rotary	DC Inverter Driven Twins Rotary	DC Inverter Driven Twins Rotary
	Maximum Fuse Size A	20	20	30	30	35	35	40
	Minimum Circuit Amp A	18	18	20	20	26	26	32
Cooling	Rated Capacity Btu/hr	18000	24000	30000	35400	42000	48000	55000
	Capacity Range Btu/hr	7300-18000	10200-24000	13000-30000	15300-35400	15100-42000	17100-48000	15000-55000
	Rated Power Input W	1640	2670	2730	3730	4290	5050	5980
	SEER2	16.2	16	16	16	16.2	16	16
	EER2	11	9	11	9.5	9.8	9.5	9.2
Heating	Rated Heating Capacity 47°F Btu/hr	18000	24000	30000	35400	42500	48000	55000
	Heating Capacity Range Btu/hr	6500-18000	7200-24000	12000-30000	13400-35400	11300-42500	16500-48000	15600-55000
	Rated Power Input W	1760	2270	2660	3240	4150	4540	5040
	HSPF2 (IV)	8.5	8.5	8.8	8.5	8.8	9.0	8.5
	HSPF2 (V)	6.8	6.8	6.8	6.8	6.8	7.0	6.8
	Rated Heating Capacity 17°F Btu/hr	15000	18600	23400	25000	33000	35600	42000
	Max. Heating Capacity 5°F Btu/hr	12600	18000	19000	22000	26800	30800	36600
	COP @ 5°F	1.8	1.8	1.8	2	2	2	1.8
Outdoor Unit	Outdoor Fan	Variable Speed	Variable Speed	Variable Speed	Variable Speed	Variable Speed	Variable Speed	Variable Speed
	Sound Power Noise Level dB	69	69	71	72	74	74	76
	Dimension: Height in (mm)	27-9/16 (700)	27-9/16 (700)	30-1/8 (765)	30-1/8 (765)	33-1/16 (840)	33-1/16 (840)	33-1/16 (840)
	Dimension: Width in (mm)	35-1/16 (890)	35-1/16 (890)	36-1/4 (920)	36-1/4 (920)	41-3/8 (1050)	41-3/8 (1050)	41-3/8 (1050)
	Dimension: Depth in (mm)	13-3/8 (340)	13-3/8 (340)	14-5/8 (372)	14-5/8 (372)	15-3/4 (400)	15-3/4 (400)	15-3/4 (400)
	Carton Dimension: Height in (mm)	35-5/16 (897)	35-5/16 (897)	37-5/8 (955)	37-5/8 (955)	40-15/16 (1040)	40-15/16 (1040)	40-15/16 (1040)
	Carton Dimension: Width in (mm)	42-1/8 (1070)	42 -1/8 (1070)	43-5/16 (1100)	43-5/16 (1100)	45-11/16 (1160)	45-11/16 (1160)	45-11/16 (1160)
	Carton Dimension: Depth in (mm)	17-15/16 (455)	17-15/16 (455)	19-13/16 (503)	19-13/16 (503)	20-1/2 (520)	20-1/2 (520)	20-1/2 (520)
	Weight (Ship/Net)- lbs (kg)	145.5 / 112.4 (66 / 51)	145.5 / 112.4 (66 / 51)	176.4 / 136.7 (80 / 62)	176.4 / 136.7 (80 / 62)	224.9 / 178.6 (102 / 81)	224.9 / 178.6 (102 / 81)	255.7 / 209.4 (116 / 95)
	Stack Height (Storage)	4	4	4	4	3	3	3
	Base Pan Heater	No	No	No	No	No	No	No
	GEA3 Compatible	No	No	No	No	No	No	No
Refrigerate Line	Connections	Flare + Weld	Flare + Weld	Flare + Weld	Flare + Weld	Flare + Weld	Flare + Weld	Flare + Weld
	Service valve size (liquid) in	3/8	3/8	3/8	3/8	3/8	3/8	3/8
	Service valve size (suction) in	5/8	5/8	5/8	5/8	3/4	3/4	3/4
	Liquid O.D. in	3/8	3/8	3/8	3/8	3/8	3/8	3/8
	Suction O.D. in	3/4	3/4	3/4	3/4	7/8	7/8	7/8
	Refrigerant Type	R-454B	R-454B	R-454B	R-454B	R-454B	R-454B	R-454B
	Factory Charge Oz	3-4 (1470)	3-11.6 (1690)	4-8.3 (2050)	4-8.3 (2050)	6-11.4 (3040)	7-5.5 (3330)	8-1.1 (3660)
	Max line length with furnished charge (ft)	15 (4.57)	15 (4.57)	15 (4.57)	15 (4.57)	15 (4.57)	15 (4.57)	15 (4.57)
	Additional charge required per linear foot (oz) 0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
	Maximum Line Length Ft / m	150 / 45	150 / 45	150 / 45	150 / 45	100 / 30	100 / 30	100 / 30
	Maximum Height Ft / m	50 / 15	50 / 15	50 / 15	50 / 15	50 / 15	50 / 15	50 / 15
	Connected	24V Communication	24V Communication	24V Communication	24V Communication	24V Communication	24V Communication	24V Communication
	Thermostat connections	R, C, Y1, Y2, W1, O	R, C, Y1, Y2, W1, O	R, C, Y1, Y2, W1, O	R, C, Y1, Y2, W1, O	R, C, Y1, Y2, W1, O	R, C, Y1, Y2, W1, O	R, C, Y1, Y2, W1, O
	Service Port adaptor (Ship with)	3/8"(1) 5/8" to 3/4"(1)	3/8"(1) 5/8" to 3/4"(1)	3/8"(1) 5/8" to 3/4"(1)	3/8"(1) 5/8" to 3/4"(1)	3/8"(1) 3/4" to 7/8"(1)	3/8"(1) 3/4" to 7/8"(1)	3/8"(1) 3/4" to 7/8"(1)

Sensor	Definition	Sensor	Definition
Td	Compressor discharge sensor	Te	Outdoor coil out temperature sensor
Tc	Coil temperature sensor	Ts	Compressor suction temperature sensor
Tao	Outdoor air temperature	Pt	Refrigerant pressure transducer

Components

ML15KSPV-018 / ML15KSPV-024



Components

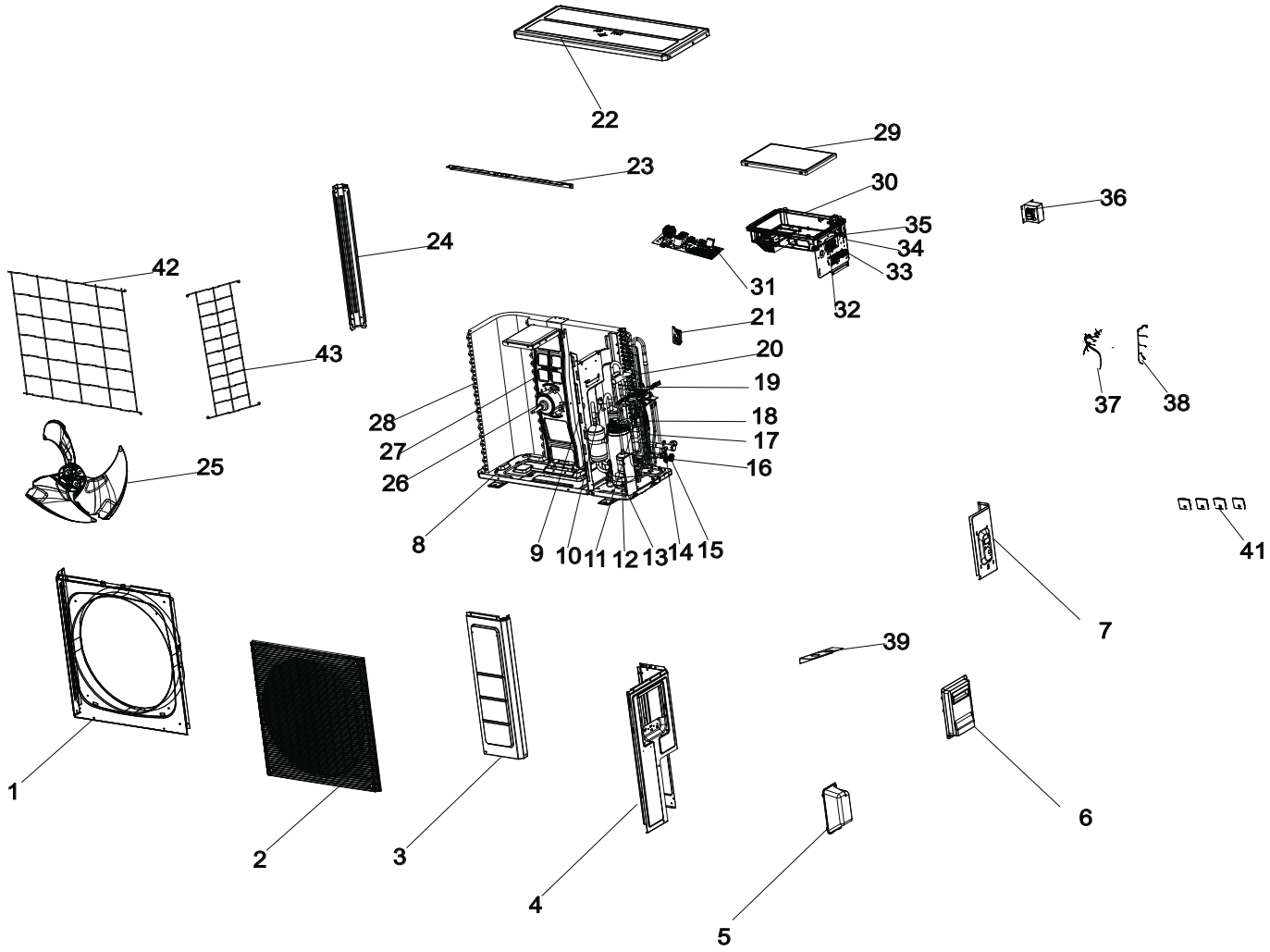
ML15KSPV-018 / ML15KSPV-024

No.	Spare Parts Description	Qty.
1	Front Panel	1
2	Outlet Grill	1
3	Right Service Panel	1
4	Connect Components	1
5	Valve Cover	1
6	Handle	1
7	Valve Seat Group	1
8	Bottom Plate Assembly	1
9	Partion Plate	1
10	Low Pressure Switch	1
11	High Pressure Switch	1
12	Compressor (DC)	1
13	Crankcase Heater	1
14	Liquid Stop Valve	1
15	Gas Stop Valve	1
16	Dry Filter	1
17	Gas-Liquid Segerator	1
18	Expansion Valve	1
19	Pressure Transducer	1
20	4-Way Valve	1
21	Sensor Fixing Card	1

No.	Spare Parts Description	Qty.
22	Top Cover	1
23	Rear Beam	1
24	Stand Column	1
25	Fan	1
26	Fan Motor (DC)	1
27	Motor Bracket	1
28	Condensor Assembly	1
29	Electrical Box Cover	1
30	Electric Control Box Base	1
31	Main PCB	1
32	Small Service PCB	1
33	Terminal Block	1
34	Terminal Strip Sheet Metal	1
35	Display Board Base	1
36	Reactor	1
37	Wiring Harnesses (Other)	1
	Wiring Harnesses (Ground Wire)	1
38	Wiring Harnesses (Sensor Assembly)	1
39	Carton	1
40	Coil Guard (Back)	1
41	Coil Guard (Left)	1
42	Rubber Pad	1

Components

ML15KSPV-030 / ML15KSPV-036



Components

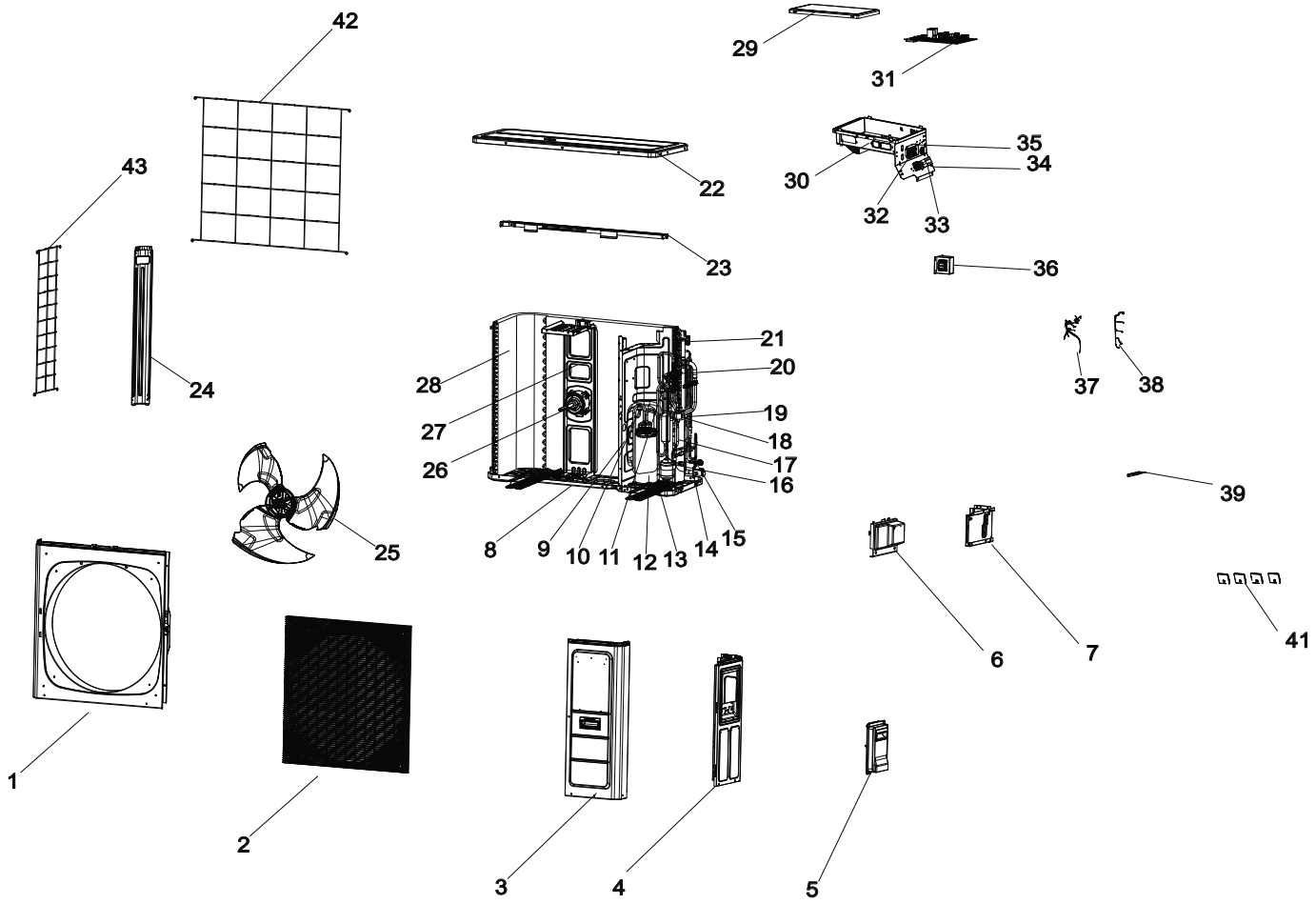
ML15KSPV-030 / ML15KSPV-036

No.	Spare Parts Description	Qty.
1	Front Panel	1
2	Outlet Grill	1
3	Front Service Panel	1
4	Right Service Panel	1
5	Valve Cover	1
6	Handle	1
7	Valve Seat Group	1
8	Bottom Plate Assembly	1
9	Partion Plate	1
10	Low Pressure Switch	1
11	High Pressure Switch	1
12	Compressor (DC)	1
13	Crankcase Heater	1
14	Liquid Stop Valve	1
15	Gas Stop Valve	1
16	Dry Filter	1
17	Gas-Liquid Segerator	1
18	Expansion Valve	1
19	Pressure Transducer	1
20	4-Way Valve	1
21	Sensor Fixing Card	1

No.	Spare Parts Description	Qty.
22	Top Cover	1
23	Rear Beam	1
24	Stand Column	1
25	Fan	1
26	Fan Motor (DC)	1
27	Motor Bracket	1
28	Condensor Assembly	1
29	Electrical Box Cover	1
30	Electric Control Box Base	1
31	Main PCB	1
32	Small Service PCB	1
33	Terminal Block	1
34	Terminal Strip Sheet Metal	1
35	Display Board Base	1
36	Reactor	1
37	Wiring Harnesses (Other)	1
	Wiring Harnesses (Ground Wire)	1
38	Wiring Harnesses (Sensor Assembly)	1
39	Sheet Metal for Securing Wires	1
40	Carton	1
41	Rubber Pad	1
42	Coil Guard (Back)	1
43	Coil Guard (Side)	1

Components

ML15KSPV-042 / ML15KSPV-048



Components

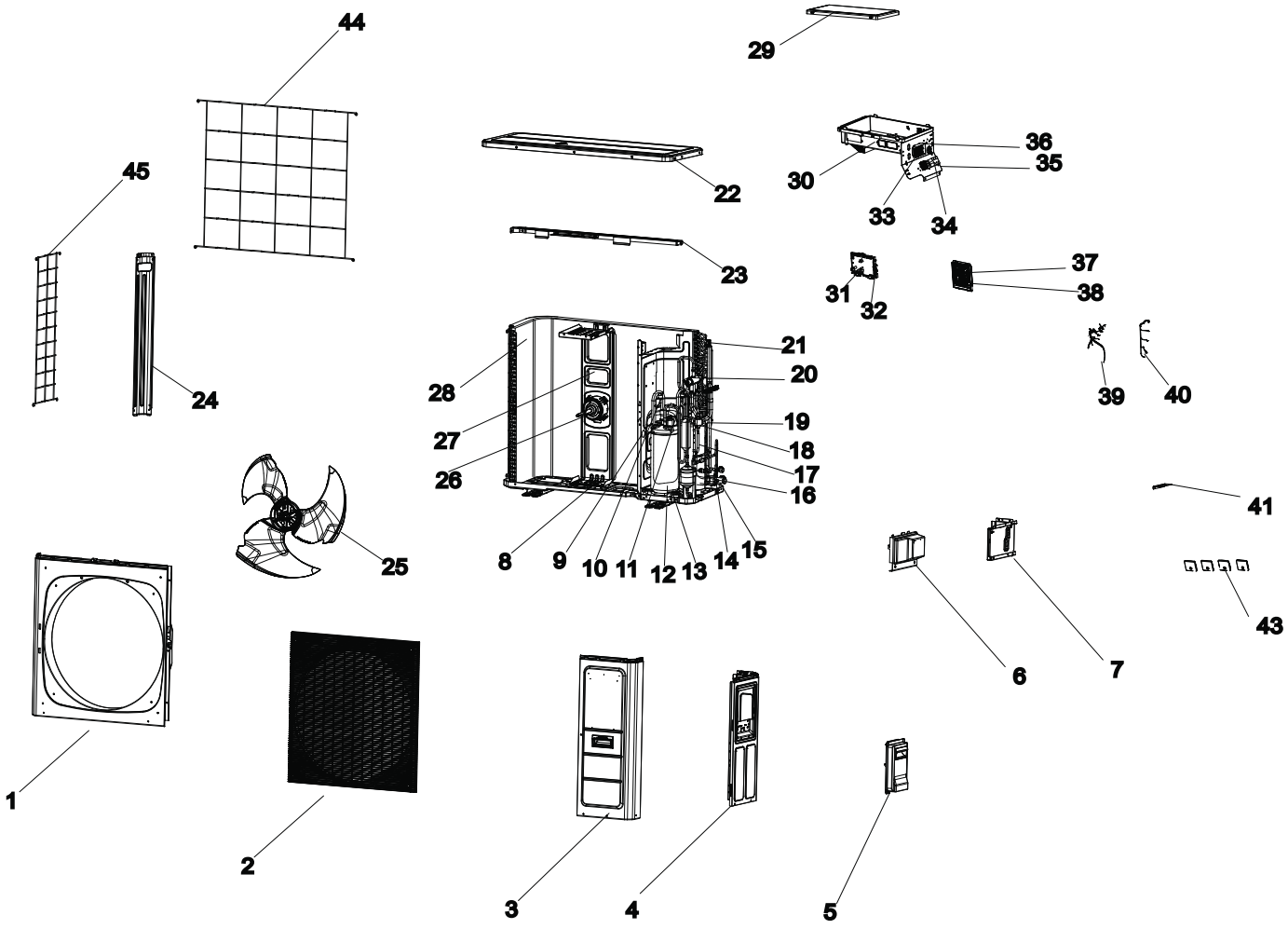
ML15KSPV-042 / ML15KSPV-048

No.	Spare Parts Description	Qty.
1	Front Panel	1
2	Outlet Grill	1
3	Front Service Panel	1
4	Right Service Panel	1
5	Handle	1
6	Valve Cover	1
7	Valve Seat Group	1
8	Bottom Plate Assembly	1
9	Partion Plate	1
10	Low Pressure Switch	1
11	High Pressure Switch	1
12	Compressor (DC)	1
13	Crankcase Heater	1
14	Liquid Stop Valve	1
15	Gas Stop Valve	1
16	Dry Filter	1
17	Gas-Liquid Segerator	1
18	Expansion Valve	1
19	Pressure Transducer	1
20	4-Way Valve	1
21	Sensor Fixing Card	1

No.	Spare Parts Description	Qty.
22	Top Cover	1
23	Rear Beam	1
24	Stand Column	1
25	Fan	1
26	Fan Motor (DC)	1
27	Motor Bracket	1
28	Condensor Assembly	1
29	Electrical Box Cover	1
30	Electric Control Box Base	1
31	Main PCB	1
32	Small Service PCB	1
33	Terminal Block	1
34	Terminal Strip Sheet Metal	1
35	Display Board Base	1
36	Reactor	1
37	Wiring Harnesses (Other)	1
	Wiring Harnesses (Ground Wire)	1
38	Wiring Harnesses (Sensor Assembly)	1
39	Sheet Metal for Securing Wires	1
40	Carton	1
41	Rubber Pad	1
42	Coil Guard (Back)	1
43	Coil Guard (Side)	1

Components

ML15KSPV-060



Components

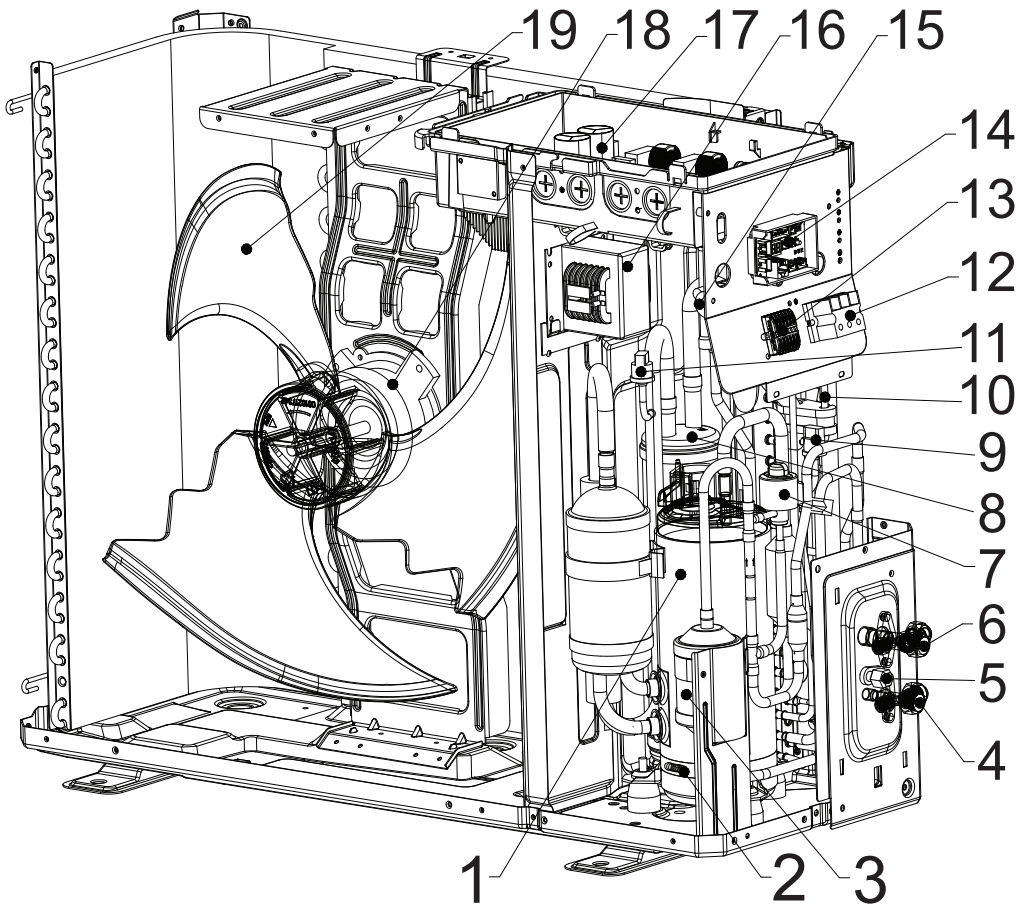
ML15KSPV-060

No.	Spare Parts Description	Qty.
1	Front Panel	1
2	Outlet Grill	2
3	Front Service Panel	1
4	Side Service Panel	1
5	Handle	1
6	Valve Cover	1
7	Valve Seat Group	1
8	Bottom Plate Assembly	1
9	Partion Plate	1
10	Low Pressure Switch	1
11	High Pressure Switch	1
12	Compressor (DC)	1
13	Crankcase Heater	1
14	Liquid Stop Valve	1
15	Gas Stop Valve	1
16	Dry Filter	1
17	Gas-Liquid Segerator	1
18	Expansion Valve	1
19	Pressure Transducer	1
20	4-Way Valve	1
21	Sensor Fixing Card	1
22	Top Cover	1

No.	Spare Parts Description	Qty.
23	Rear Beam	1
24	Stand Column	1
25	Fan	1
26	Fan Motor (DC)	2
27	Motor Bracket	2
28	Condensor Assembly	1
29	Electrical Box Cover	1
30	Electric Control Box Base	1
31	Main PCB	1
32	PCB Board Base	1
33	Small Service PCB	1
34	Terminal Block	1
35	Terminal Strip Sheet Metal	1
36	Display Board Base	1
37	PCB Board	1
38	PCB Board Base	1
39	Wiring Harnesses (Other)	1
40	Wiring Harnesses (Sensor Assembly)	1
41	Sheet Metal for Securing Wires	1
42	Carton	1
43	Rubber Pad	1
44	Coil Guard (Back)	1
45	Coil Guard (Side)	1

Components

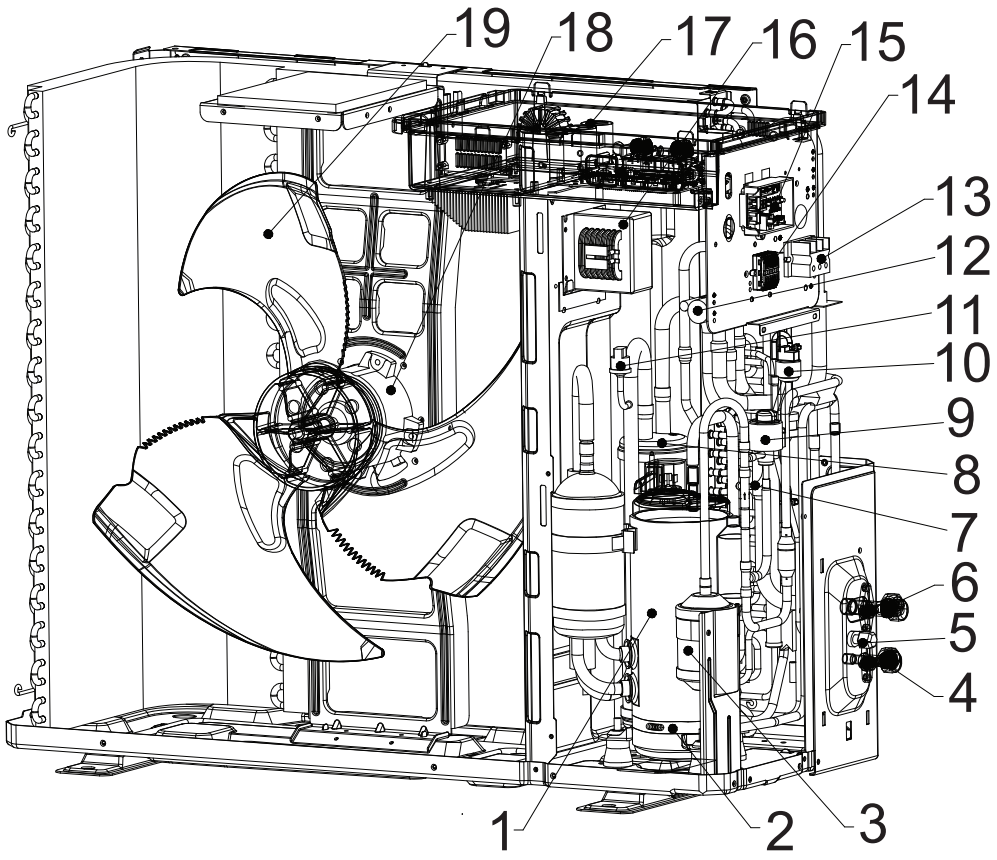
18K / 24K Component Overview



No.	Name	No.	Name
1	Compressor	10	Pressure Transducer
2	Crankcase Heater	11	Low Pressure Switch
3	Dry Filter	12	Terminal Block (Power)
4	Service Valves (Liquid)	13	Terminal Block (24V)
5	Service Valves (Low Pressure)	14	Small Service PCB
6	Service Valves (Gas)	15	4-Way Valve
7	Electronic Expansion Valve	16	Reactor
8	Accumulator	17	PCB (Main & Module Board)
9	High Pressure Switch	18	Outdoor Fan Motor
		19	Fan Blade

Components

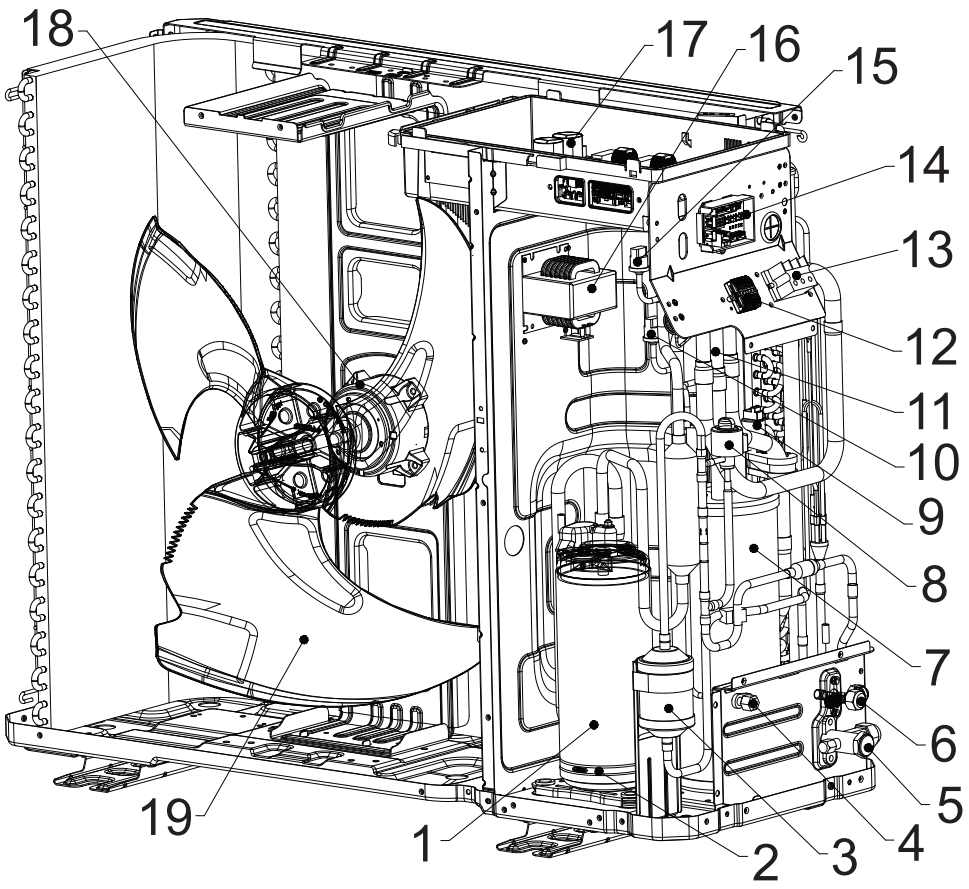
30K / 36K Component Overview



No.	Name	No.	Name
1	Compressor	10	Pressure Transducer
2	Crankcase Heater	11	Low Pressure Switch
3	Dry Filter	12	4-Way Valve
4	Service Valves (Liquid)	13	Terminal Block (Power)
5	Service Valves (Low Pressure)	14	Terminal Block (24V)
6	Service Valves (Gas)	15	Small Service PCB
7	High Pressure Switch	16	Reactor
8	Accumulator	17	PCB (Main & Module Board)
9	Electronic Expansion Valve	18	Outdoor Fan Motor
		19	Fan Blade

Components

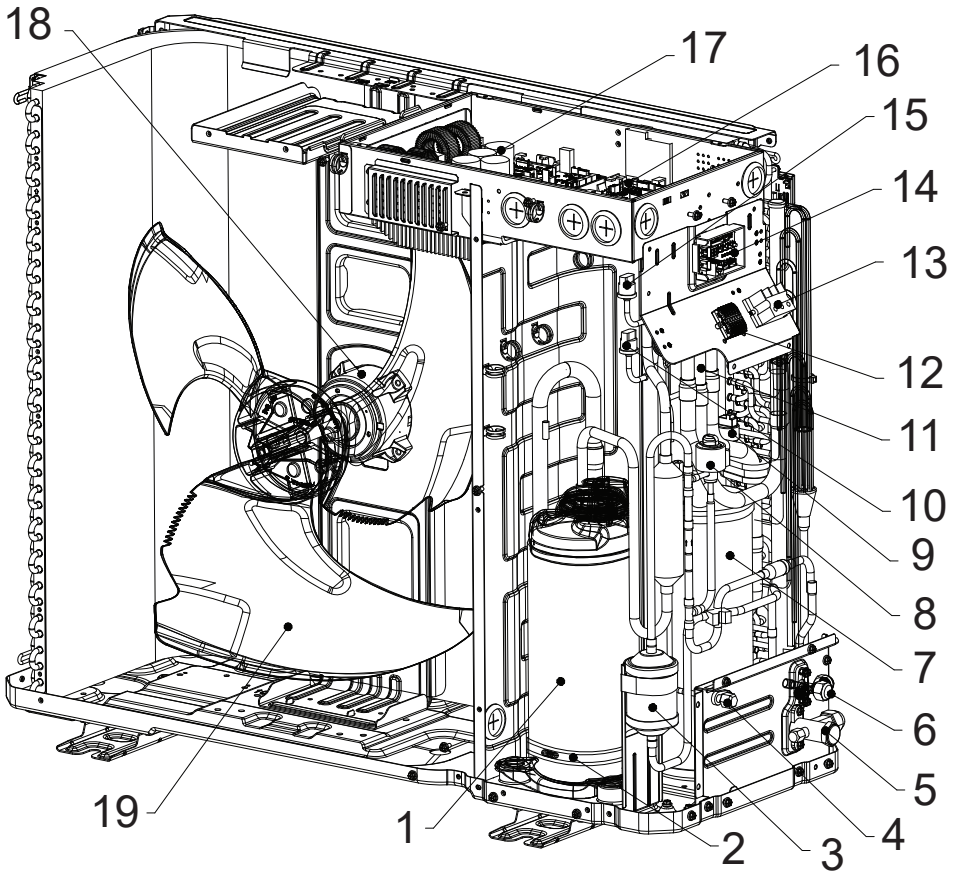
42K / 48K Component Overview



No.	Name	No.	Name
1	Compressor	11	4-Way Valve
2	Crankcase Heater	12	Terminal Block (24V)
3	Dry Filter	13	Terminal Block (Power)
4	Service Valves (Low Pressure)	14	Small Service PCB
5	Service Valves (Gas)	15	High Pressure Switch
6	Service Valves (Liquid)	16	Reactor
7	Accumulator	17	PCB (Main & Module Board)
8	Electronic Expansion Valve	18	Outdoor Fan Motor
9	Pressure Transducer	19	Fan Blade
10	Low Pressure Switch		

Components

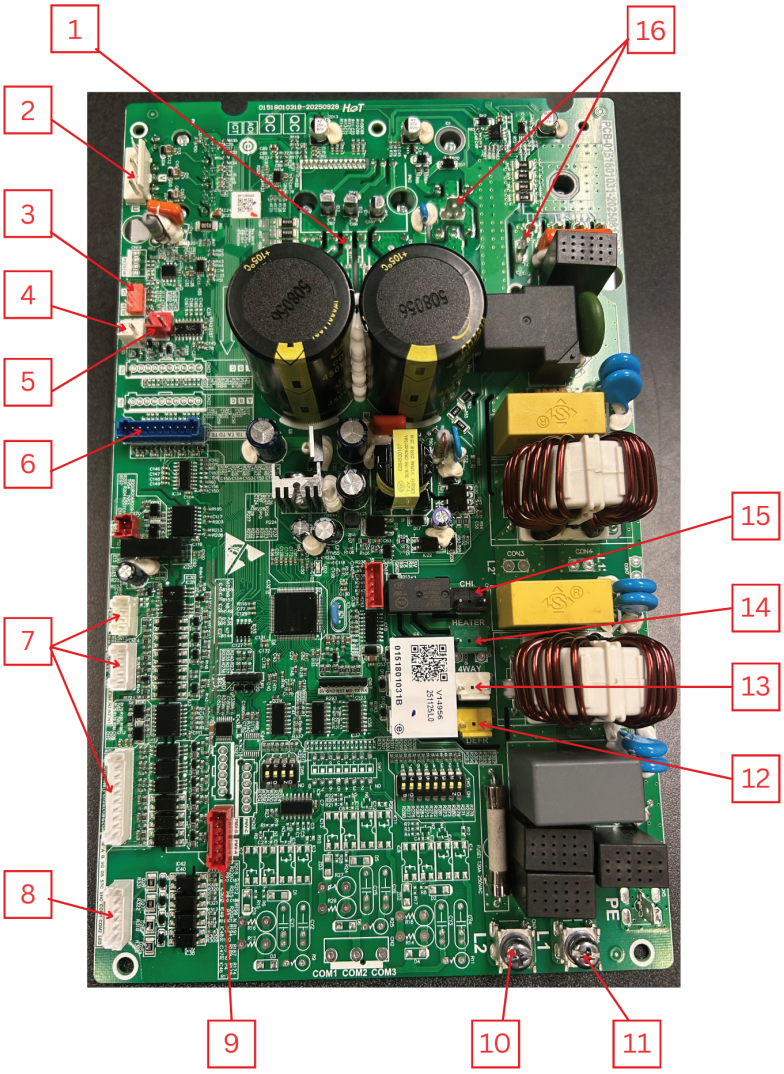
60K Component Overview



No.	Name	No.	Name
1	Compressor	11	4-Way Valve
2	Crankcase Heater	12	Terminal Block (24V)
3	Dry Filter	13	Terminal Block (Power)
4	Service Valves (Low Pressure)	14	Small Service PCB
5	Service Valves (Gas)	15	High Pressure Switch
6	Service Valves (Liquid)	16	Main PCB
7	Accumulator	17	Module Board
8	Electronic Expansion Valve	18	Outdoor Fan Motor
9	Pressure Transducer	19	Fan Blade
10	Low Pressure Switch		

PCB Overview

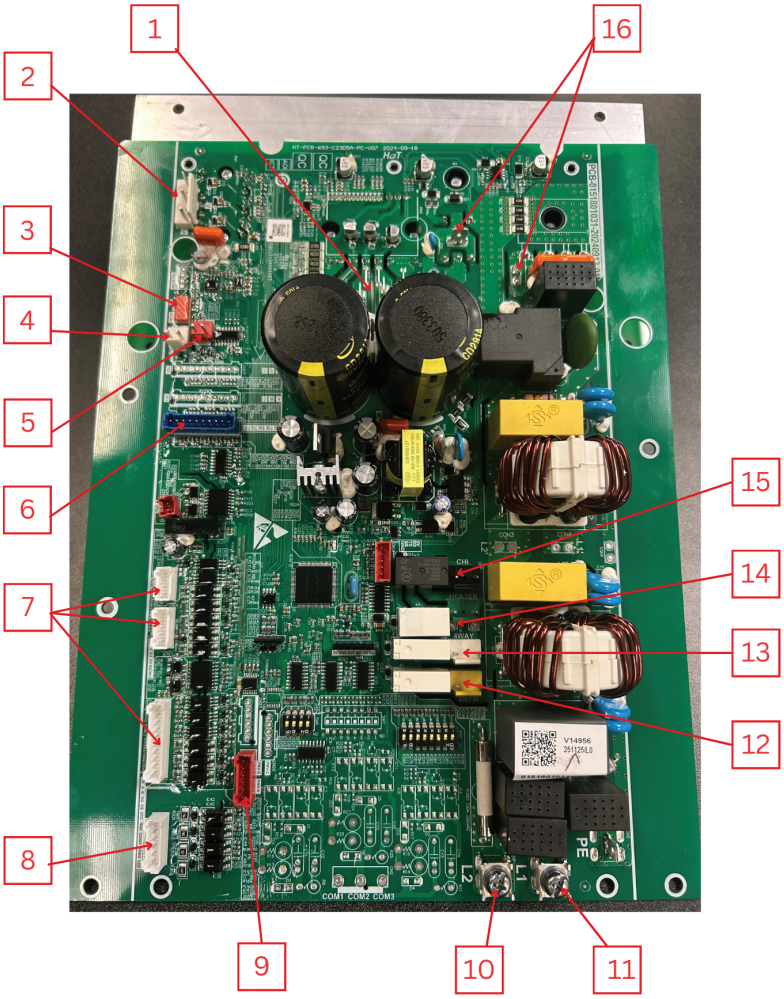
ML15KSPV-018 / ML15KSPV-024



No.	Name	No.	Name
1	U1V1W1 Compressor Terminal	9	CN1 Electronic Expansion Valve
2	CN29 Outdoor Fan Motor	10	CN3 Power Terminal L2
3	CN20 Pressure Transducer	11	CN4 Power Terminal L1
4	CN25 Low Pressure Switch	12	CN6 W1 Defrost Signal
5	CN24 High Pressure Switch	13	CN7 4-way Valve Terminals
6	CN21 Temperature Sensor Tc, Ts, Tao, Td, Te	14	CN9 Crankcase Heater
		15	CN8 Base Pan Heater
7	CN13 CN14 CN15T Connect the Display Board Terminals	16	Reactor
8	CN26 24V Thermostat Terminals		

PCB Overview

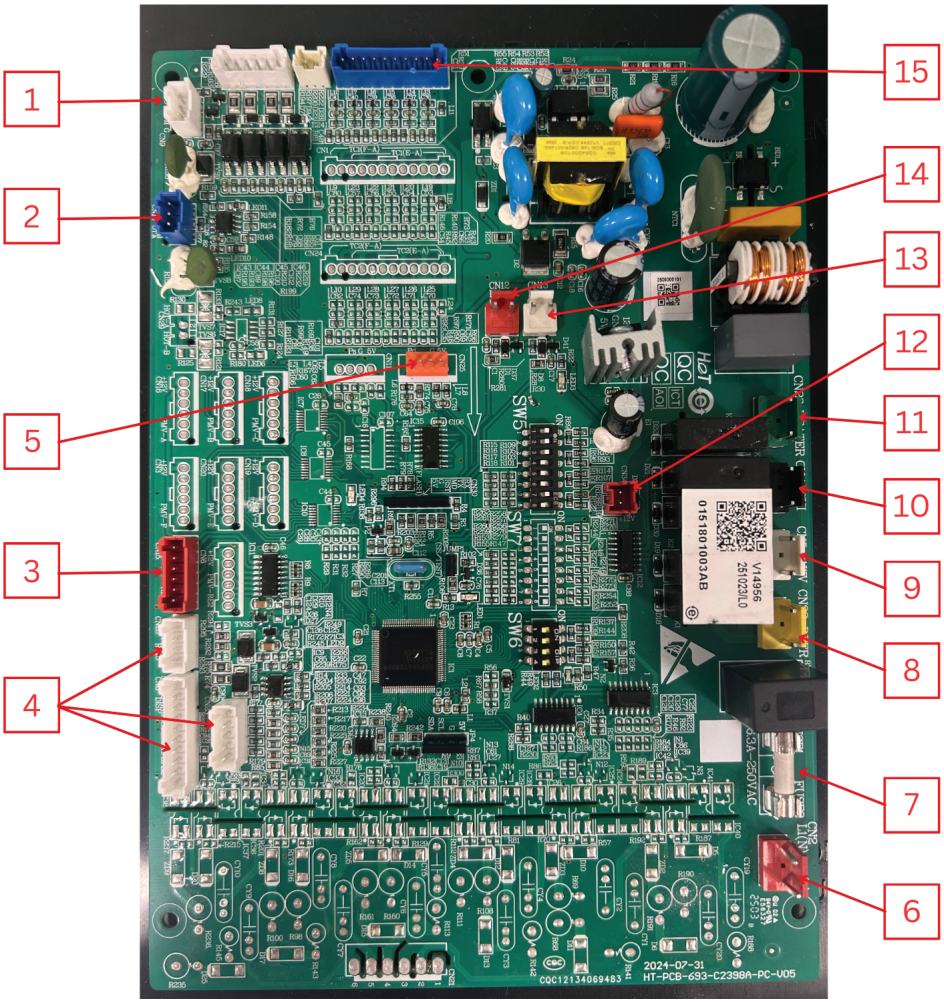
ML15KSPV-030 / ML15KSPV-036 / ML15KSPV-042 / ML15KSPV-048



No.	Name	No.	Name
1	U1V1W1 Compressor Terminal	9	CN1 Electronic Expansion Valve
2	CN29 Outdoor Fan Motor	10	CN3 Power Terminal L2
3	CN20 Pressure Transducer	11	CN4 Power Terminal L1
4	CN25 Low Pressure Switch	12	CN6 W1 Defrost Signal
5	CN24 High Pressure Switch	13	CN7 4-way Valve Terminals
6	CN21 Temperature Sensor Tc, Ts, Tao, Td, Te	14	CN9 Crankcase Heater
		15	CN8 Base Pan Heater
7	CN13 CN14 CN15T Connect the Display Board Terminals	16	Reactor
8	CN26 24V Thermostat Terminals		

PCB Overview

ML15KSPV-060

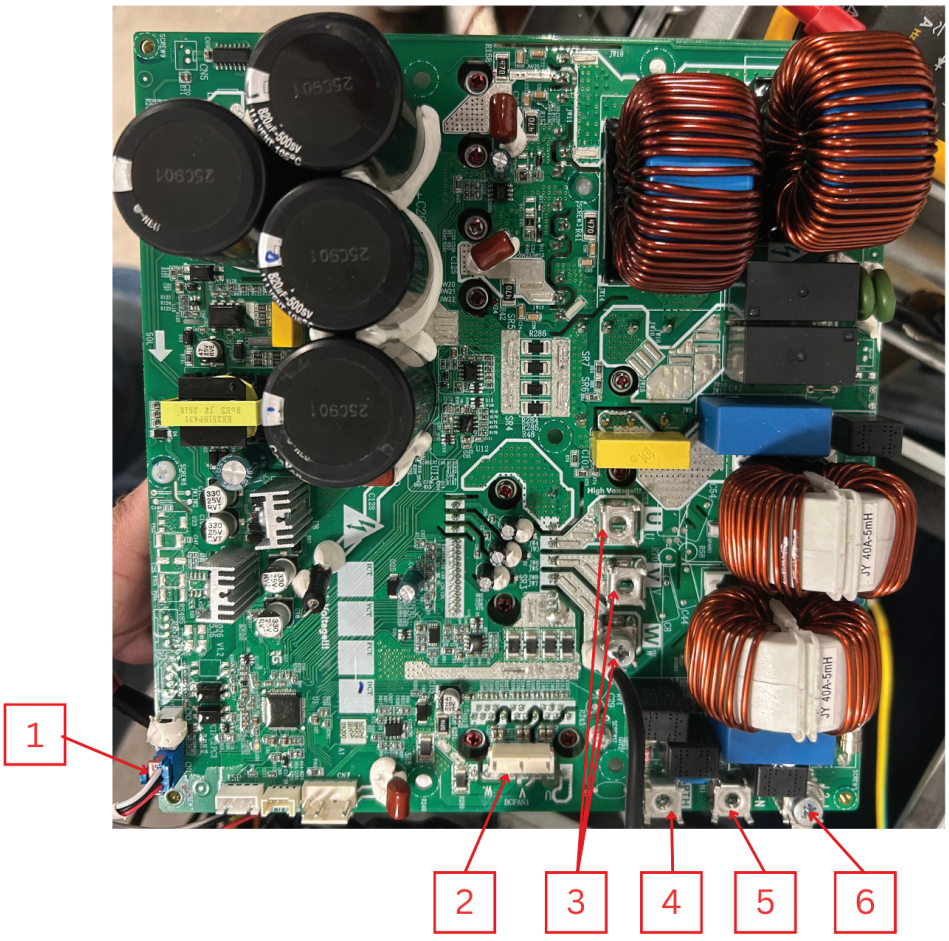


No.	Name
1	CN9 Main Control Module Communication Terminal
2	CN25 OTA (Reserve)
3	CN15 Electronic Expansion Valve
4	CN8 CN23 CN26 Connect the Display Board Terminals
5	CN21 Pressure Transducer
6	CN2 Main Control Board Power Supply
7	Fuse
8	CN22 W1 Defrost Signal

No.	Name
9	CN5 4-way Valve Terminals
10	CN4 Base Pan Heater
11	CN28 Crankcase Heater
12	CN34 12V Port on the Driver
13	CN13 Low Pressure Switch
14	CN12 High Pressure Switch
15	CN14 Temperature Sensor Tc, Ts, Tao, Td, Te

PCB Overview

ML15KSPV-060



No.	Name
1	CN1 Communication Terminal
2	DSFAN1 Outdoor Fan Motor
3	U1V1W1 Compressor Terminal
4	Earth Ground Terminal
5	Inverter Board1 Power Supply L1
6	Inverter Board1 Power Supply L2

Outdoor Fan Motor Control Logic — Sequence of Operation

Applicable to Heating and Cooling Modes

1. General Fan Speed Change Rules:

The Outdoor Fan Motor speed is controlled based on sensor inputs from:

- **Tao** = Outdoor Air Temperature Sensor
- **Tc** = Outdoor Coil Temperature Sensor

The control priority depends on the operating mode and sensor conditions.

- **Cooling Mode**
- Minimum 15 seconds before fan speed can change
- After changing, must stay at new speed for at least 45 seconds
- **Heating Mode**
- Minimum 30 seconds before fan speed can change
- After changing, must stay at new speed for at least 45 seconds

The following table lists the Outdoor Fan Motor control speed levels (Lv1 through Lv7) and their corresponding target RPM values based on unit size. This information applies to all fan control logic described in both Cooling Mode and Heating Mode.

Outdoor Fan Motor Speed Levels and RPM by Model								
Model	Rotary Speed Level	Rotary Speed RPM	Model	Rotary Speed Level	Rotary Speed RPM	Model	Rotary Speed Level	Rotary Speed RPM
1.5-Ton 2-Ton	Lv1	250	2.5-Ton 3-Ton	Lv1	250	3.5-Ton 4-Ton 5-Ton	Lv1	250
	Lv2	350		Lv2	300		Lv2	300
	Lv3	400		Lv3	400		Lv3	400
	Lv4	490		Lv4	500		Lv4	500
	Lv5	600		Lv5	550		Lv5	600
	Lv6	680		Lv6	680		Lv6	680
	Lv7	700		Lv7	720		Lv7	720

2. Cooling Mode Sequence — Fan Control Logic Control Priority:

1) When **Outdoor Air Temperature (Tao)** is greater than 89.6°F (32°C), fan speed is controlled based on Tao.
2) When **Tao ≤ 89.6°F (32°C)**, control shifts to **Coil Temperature (Tc)**.

Fan Speed Control by Outdoor Temperature (Tao Sensor):	
Condition	Fan Speed Level Set
Tao < 104°F (40°C)	Level LV7
Tao < 89.6°F (32°C)	Level LV6

Fan Speed Control by Coil Temperature (Tc Sensor)	
Condition	Fan Speed Control Action
Tc > 113°F (45°C)	Set to LV6
Tc < 104°F (40°C)	Set to LV5
Tc < 89.6°F (32°C)	Gradually slow from LV5 → LV1
Tc < 78.8°F (26°C)	Stop fan motor
Tc > 95°F (35°C)	Set to LV1
Tc > 96.8°F (36°C)	Gradually speed up LV1 → LV5
Tc > 109.4°F (43°C)	Jump directly to LV5
Tc < 86°F (30°C)	Reduce to LV2

3. Heating Mode Sequence — Fan Control Logic Control Priority:

1) When **Outdoor Air Temperature (Tao)** is less than 35.6°F (2°C), fan speed is controlled based on Tao.
2) When **Tao ≥ 2°C 35.6°F (2°C)**, control shifts to **Coil Temperature (Tc)**.

Fan Speed Control by Outdoor Temperature (Tao Sensor):	
Condition	Fan Speed Level Set
Tao < 14°F (-10°C)	Level LV7
Tao < 35.6°F (2°C)	Level LV6

Fan Speed Control by Coil Temperature (Tc Sensor)	
Condition	Fan Speed Control Action
Tc < 35.6°F (2°C)	Set to LV6
Tc > 46.4°F (8°C)	Set to LV5
Tc > 50°F (10°C)	Gradually slow down LV5 → LV1
Tc > 39.2°F (4°C)	Gradually speed up LV1 → LV5
Tc < 30.2°F (-1°C)	Jump directly to LV5

Summary:

- Fan speed logic prioritizes Tao or Tc depending on conditions.
- Always confirm the sensor readings for **Tao** and **Tc** to verify fan behavior.
- **Heating Mode:** Minimum 30 seconds at current level before change, and minimum 45 seconds at new level after change.
- **Cooling Mode:** Minimum 15 seconds between potential changes, and minimum 45 seconds at new level after change.
- Improper fan speed changes or sensor failures may lead to speed-change malfunctions or system lockouts

Functions and Control

Outdoor Unit EEV Operation and Superheat Control

Cooling Mode Operation

- When the system starts in cooling mode, the Outdoor Unit's EEV moves to a fixed default opening of **470 pulses** for all models.
- The Indoor Unit uses a **TXV** to control refrigerant flow and maintain suction vapor superheat at the evaporator coil.
- The targeted suction vapor superheat in cooling mode is approximately 10°F (5.6°C), controlled by the Indoor Unit TXV.
- The Outdoor Unit EEV does not actively modulate during cooling. It will maintain its 470-pulse position while the indoor TXV performs the metering function.

Heating Mode Operation:

- In heating mode, the Indoor TXV is no longer used for metering refrigerant.
- Instead, the Outdoor Unit EEV dynamically modulates its opening (adjusts pulse position) to control refrigerant flow and maintain suction vapor superheat.
- The target suction superheat in heating mode is very low, between **1°F to 5°F** (0.5~3°C), to optimize heating efficiency and system capacity.

EEV Behavior During System Off:

- When the unit shuts down (in either cooling or heating mode), the Outdoor Unit EEV closes to a minimum position of **5 pulses**.
- This prevents the valve needle from fully seating and potentially causing damage.
- It also allows a small amount of refrigerant migration control and prepares the system for a smoother next startup.

Technician Note:

- "Around 10°F" superheat applies to normal cooling operation (TXV-controlled).
- "1°F to 5°F (0.5~3°C)" superheat applies to heating operation (EEV-controlled).

Reversing Valve O/B

- Factory Default is O (O/B in Cool)
When the Reversing Valve O/B is energized with 24VAC, the outdoor unit is in cooling mode. When the Reversing Valve is de-energized, the outdoor unit is in heating mode.

- Can be changed to B (O/B in Heat)
(Turn the PCB dip switch SW5-7 to ON)
When the Reversing Valve O/B is energized with 24VAC, the external unit is in heating mode. When the Reversing Valve is de-energized, the outdoor unit is in cooling mode.

NOTE: The relevant control instructions at the end of this manual are based on the factory default setting of O (O/B in cool).

Four-Way Valve Control (Heating & Cooling Operation)

During a call for heating (Y1 or Y2 without an O signal), the outdoor unit (ODU) fan starts, and the compressor turns on operating initially in the default cooling mode. After approximately 20 seconds of operation, the four-way valve is energized, shifting the system into heating mode.

If the compressor fails to start or the system exits heating mode for any reason, the compressor will stop, and after a 2-minute delay (anti-short cycle protection), the four-way valve will de-energize, returning to its default cooling position.

IMPORTANT NOTE:
Unlike traditional heat pump operation, this system uses the **24V AC "O" signal in an unconventional way**. During a normal call for cooling (Y1 or Y2 energized with the O signal present), the outdoor unit control board **uses the O signal NOT to energize** the four-way reversing valve but instead **to prevent it from energizing.**

The four-way valve's default position is cooling mode. Therefore, by blocking power to the reversing valve when the 24V AC O signal is present, the system stays in cooling mode without shifting the valve.

For the details of defrosting four-way valve control, see the defrosting process on page 38.

Cooling Mode Sequence of Operation

1. Cooling Startup Process

When the outdoor unit (ODU) receives a cooling call from the thermostat (Y1 or Y2 energized with the 24V AC "O" signal present), the system enters the cooling startup pre-processing stage.

a. If the unit has been off for at least the required 5-minute Anti Short Cycle Delay (ASCD), the outdoor fan will start immediately.

b. After a 30-second delay, the compressor will start operating.

c. Every time the power is cycled off to on, the system imposes a 3-minute startup delay before engaging the fan and compressor.

IMPORTANT NOTE:
The four-way reversing valve is de-energized by default, placing the system in cooling mode. During a cooling call, the presence of the O signal prevents the reversing valve from energizing, ensuring that the system remains in the default cooling configuration without shifting the valve.

2. Cooling Operation Sequence

Once the compressor is operating, refrigerant begins circulating through the refrigeration circuit:

a. The hot high-pressure refrigerant gas exits the compressor and flows directly to the outdoor coil (because the four-way valve remains in its de-energized cooling position).

b. The outdoor coil acts as the condenser, where the refrigerant condenses and subcools.

c. The electronic expansion valve (EEV) at the outdoor unit adjusts to maintain proper suction superheat (target ~10°F/5.6°C) for system efficiency.

d. The refrigerant flows through the indoor unit's TXV, regulating the refrigerant entering the evaporator coil.

e. The operating frequency of the compressor is monitored and displayed on the Service Monitor Board for diagnostic and operational purposes.

3. Outdoor Fan Operation During Cooling

a. Five seconds after the compressor starts, the outdoor fan will begin operating at medium speed.

b. After 30 seconds of runtime, the fan speed is dynamically controlled based on outdoor ambient conditions and coil temperature sensors (Tc and Tao).

c. Fan speed adjustments occur in ~15-second increments to avoid rapid fluctuations.

4. Four-Way Valve Behavior (Critical Detail)

a. The four-way valve remains de-energized throughout the cooling cycle unless the O signal is removed.

b. If the system exits the cooling mode or if the compressor shuts down for any reason, the system will enforce a minimum 5-minute anti-short cycle delay before the compressor can restart.

CONTROL NOTE:
The O signal does not energize the four-way valve to place the system into cooling mode. Instead, it prevents the valve from energizing, maintaining the system in the default cooling position without shifting.

5. Target Subcooling by Unit Size

After 10 minutes of stabilized operation, subcooling should be verified and compared against the following targets for cooling mode operation (TXV system)

System Size	Cooling Subcooling	Heating Subcooling
1.5 Ton	3-6°F	3-6°F
2 Ton	6-9°F	4-7°F
2.5 Ton	3-7°F	4-10°F
3 Ton	3-7°F	3-6°F
3.5 Ton	3-5°F	3-6°F
4 Ton	8-11°F	4-7°F
5 Ton	8-10°F	5°F (nominal)

NOTE: Refer to Table 10 on page 59 to determine the exact subcooling specification for your matched system combination.

6. Cooling Mode Shutdown Sequence

When the system receives a shutdown signal in cooling mode (thermostat call ends or Y1/Y2 is de-energized):

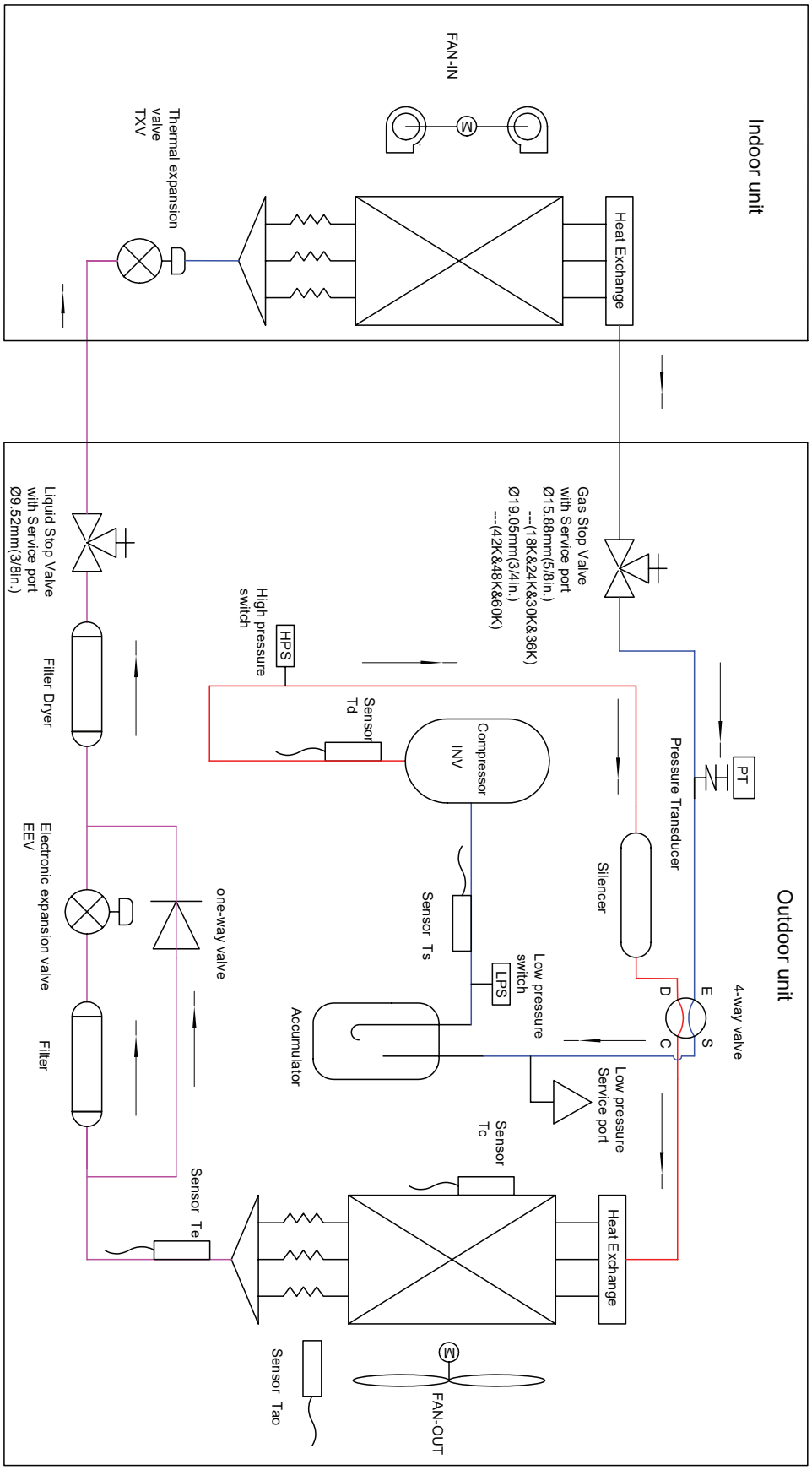
a. Compressor Ramp-Down Behavior:

- If the operating frequency of the compressor is greater than 55 Hz at the time of shutdown, the system will gradually ramp down the frequency by 2 Hz per second until it reaches 48 Hz, at which point the compressor stops.
- If the compressor is operating at 55 Hz or below, it will shut off immediately.

b. Outdoor Fan Motor Post-Shutdown Operation:

- If either the outdoor coil temperature (Tc) > 104°F (40°C) or the outdoor ambient temperature (Tao) > 95°F (35°C), the outdoor fan will continue operating for 30 seconds after the compressor stops.
- If both **Tc** and **Tao** are below these thresholds, the outdoor fan stops immediately along with the compressor.

Cooling Mode Sequence of Operation



Cooling Mode Sequence of Operation

1. Temperature Sensor Td (Compressor discharge sensor)

The temperature of the compressor discharge hot gas will be monitored by the Discharge Temperature Sensor. If the sensor reads too hot or cool, the frequency/status of the operation will be adjusted accordingly.

The hot gas will leave the oil separator and enter the 4-way valve, which directs the hot gas to the outdoor coil. The refrigerant will condense in the outdoor coil and be subcooled. The refrigerant is now in a liquid state.

2. Temperature Sensor Tc (Outdoor coil temperature sensor)

This sensor monitors the temperature of the outdoor coil during condensing operation. If abnormal condensing temperature is detected, the outdoor fan motor speed or compressor frequency may be adjusted.

3. Temperature Sensor Tao (Outdoor ambient air temperature)

The outdoor air temperature will be monitored by the PCB. If the outdoor air temperature rises or falls, the speed of the outdoor fan may be changed.

4. Temperature Sensor Te (Outdoor coil out temperature)

The Liquid Pipe Sensor will monitor the temperature of the refrigerant.

It is used to control the outdoor fan and refrigerant charging to calculate the subcool.

5. Temperature Sensor Ts (Compressor suction temperature)

The temperature of the suction gas entering the compressor is monitored by the Suction Temperature Sensor. Before stopping operation, the EEV may open to feed more refrigerant or close to warm up the line.

6. Pressure Transducer Pt (Refrigerant pressure)

During cooling, the low pressure is detected and converted to the saturation temperature of the refrigerant, which is compared with the target temperature and used to control the compressor frequency.

Heating Mode Sequence of Operation

1. Heating Startup Process

When the ODU receives a heating call from the thermostat (Y1 or Y2), the four-way valve is its default de-energized cooling position (no 24V AC "O" signal), the system enters the heating startup pre-processing stage.

a. If the unit has been off for at least the required 5-minute Anti-Short Cycle Delay (ASCD), the outdoor fan will start immediately.

b. After a 30-second delay, the compressor and OD fan will start.

c. Every time the system is powered on (after loss of power or breaker reset), a 3-minute startup delay is imposed before the outdoor fan and compressor can turn on.

Important Startup Behavior:

- Although a heating call is active, the system initially starts in default cooling mode (with the four-way valve de-energized)
- After the compressor has been running for approximately 20 seconds, the four-way valve energizes, shifting refrigerant flow into heating mode. This all happens without a 24V O signal!

Why this is important:

- Starting in cooling mode helps stabilize system pressures.
- This protects the compressor from discharge spikes and ensures a smooth transition into heating mode.
- This design behavior is intentional and should not be mistaken for a fault.

Heating Startup Summary:

Thermostat heating call → Compressor starts → Fan starts → 20 sec delay → Four-way valve energizes → Heating operation begins.

IMPORTANT NOTES:

- The four-way valve is energized during heating mode.
- The absence of the O signal causes the valve to energize and shift to the heating configuration.

2. Heating Operation Sequence

Once the compressor begins running, refrigerant begins circulating through the system:

a. The hot high-pressure gas exits the compressor and flows directly to the four-way valve, which is in the energized heating position, sending the gas to the indoor coil.

b. The indoor coil acts as the condenser, releasing heat to the indoor air as the refrigerant condenses.

c. The outdoor coil now acts as the evaporator, absorbing outdoor heat.

d. The electronic expansion valve (EEV) at the outdoor unit modulates dynamically to maintain proper suction superheat (target range: 1–5°F / 0.5-2.8°C, nominal ~5°F / 2.8°C), ensuring system efficiency.

e. The operating frequency of the compressor is monitored and displayed on the Service Monitor Board for diagnostics and performance verification.

3. Outdoor Fan Operation During Heating

a. Five seconds after the compressor starts, the outdoor fan will begin operating at medium speed.

b. After 30 seconds of runtime, fan speed is dynamically adjusted based on outdoor coil temperature (Tc) and ambient temperature (Tao).

c. During heating mode, fan speed changes occur in ~45-second intervals to prevent rapid fluctuations and allow for stable defrost readiness.

4. Four-Way Valve Behavior (Critical Detail)

a. The four-way valve remains energized (except in the defrost mode) throughout the heating cycle to maintain the heating configuration.

b. If the system exits heating mode or the compressor shuts off, a 5-minute anti-short cycle delay is enforced before compressor restart.

CONTROL NOTES:

- The system defaults to cooling mode (valve de-energized).
- Heating mode requires the absence of the O signal.
- An active 24V O signal actually causes the four-way valve to de-energize and redirect refrigerant flow appropriately.

5. Target Subcooling by Unit Size

After at least 10 minutes of stable operation, verify subcooling and compare against the following heating mode targets (TXV system):

System Size	Cooling Subcooling	Heating Subcooling
1.5 Ton	3-6°F	3-6°F
2 Ton	6-9°F	4-7°F
2.5 Ton	3-7°F	4-10°F
3 Ton	3-7°F	3-6°F
3.5 Ton	3-5°F	3-6°F
4 Ton	8-11°F	4-7°F
5 Ton	8-10°F	5°F (nominal)

Refer to Table 10 on page 59 to determine the exact subcooling specification for your matched system combination.

Heating Mode Sequence of Operation

6. Heating Mode Shutdown Sequence

When the system receives a shutdown signal (thermostat call ends or Y1/Y2 is de-energized):

a. Compressor Ramp-Down Behavior

- If the compressor is operating above 55 Hz, it will ramp down at 2 Hz per second until it reaches 48 Hz, then it will shut off.
- If the frequency is 55 Hz or lower, the compressor will shut off immediately.

b. Outdoor Fan Shutdown Behavior

- The outdoor fan motor will continue running for 60 seconds after the compressor shuts off, regardless of temperature conditions.
- After this delay, the fan stops.

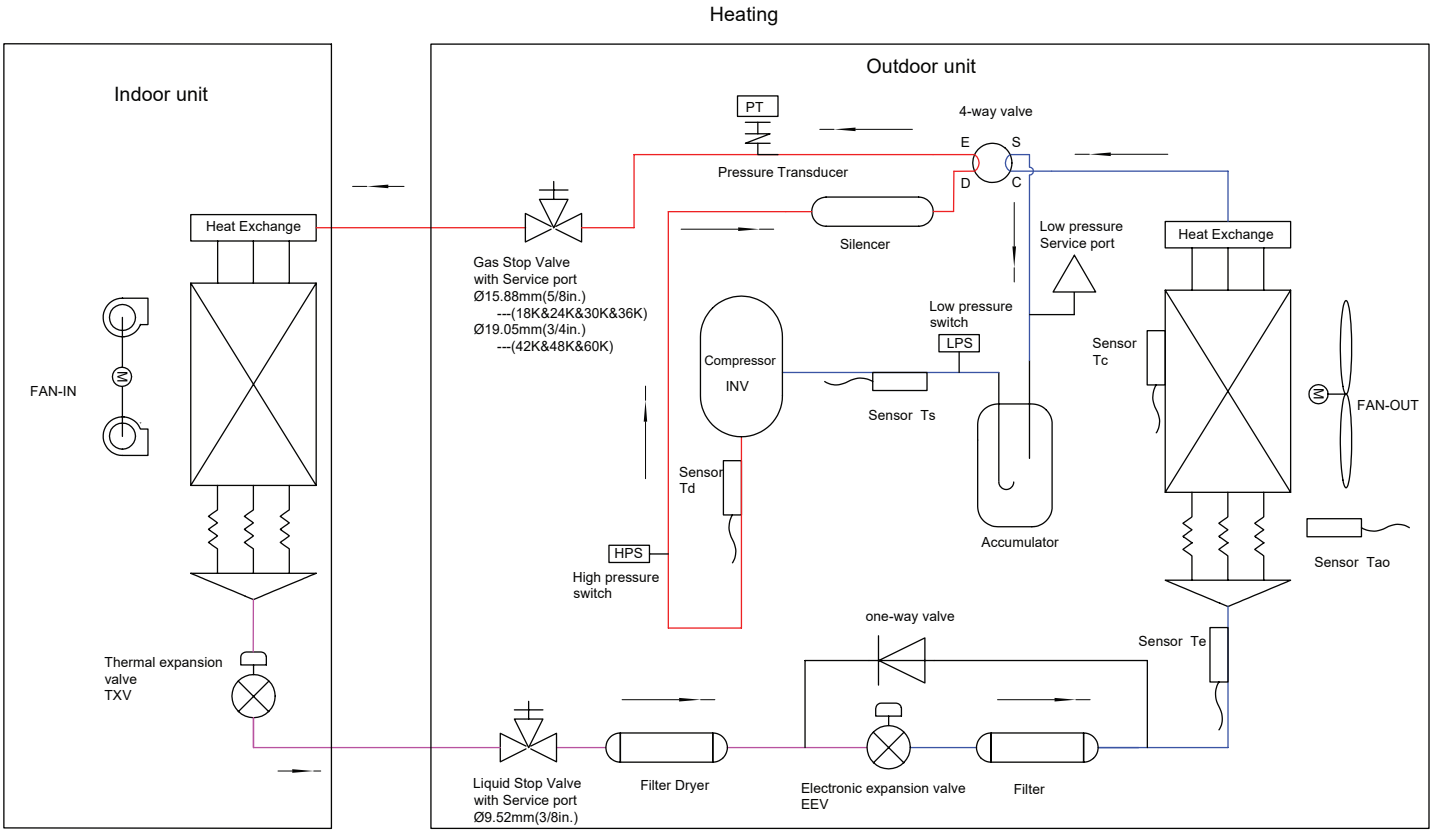
REMEMBER:

Superheat targets differ between modes:

- **Cooling:** ~10°F / 5.6°C (controlled by indoor TXV)
- **Heating:** 1–5°F / 2.8°C (controlled by outdoor EEV)

The four-way valve logic is reversed from conventional systems:

- No 24V O signal means the four-way valve is energized!
- Meaning, with Y1 or a Y2 call for heat, and no 24V to the O terminal, the four-way valve will be energized and reverse for the heating mode.
- A Y1 or Y2 call for cooling AND 24V to O, the four-way valve will NOT energize and stay in the default cooling mode.



Heating Mode Sequence of Operation

1. Temperature Sensor Td (Compressor discharge sensor)

The temperature of the compressor discharge hot gas will be monitored by the Discharge Temperature Sensor. If the sensor reads too hot or cool, the frequency/status of the operation will be adjusted as needed.

The hot gas will leave the compressor and enter the 4-way valve. The 4-way valve will direct the hot gas to ALL of the indoor coils.

2. Temperature Sensor Tc (Outdoor coil temperature sensor)

The temperature of Tc should now be cool. This will indicate the 4-way valve is directing hot gas to the indoor coils. If it is not, there is a problem with the 4-way valve. The PCB will detect the temperature difference and generate an Error Code.

The outdoor coil temperature will be sensed by the Defrost Sensor. The sensor will use this temperature to to adjust EEV open position and to calculate when a defrost cycle is necessary.

3. Temperature Sensor Tao (Outdoor ambient air temperature)

This sensor monitors the temperature of the refrigerant liquid returning from the EEV.

4. Temperature Sensor Te (Outdoor coil out temperature)

The outdoor coil temperature will be sensed by the Defrost Sensor. The sensor will use this temperature to to adjust the EEV position and to calculate when a defrost cycle is necessary.

5. Temperature Sensor Ts (Compressor suction temperature)

The temperature of the suction gas entering the compressor is monitored by the Suction Temperature Sensor.

The sensor will use this temperature to to adjust the EEV position.

6. Pressure Transducer Pt (Refrigerant pressure)

During Heating, the high pressure is detected and converted to the saturation temperature of the refrigerant, which is compared with the target temperature and used to control the compressor frequency.

Defrost Cycle Sequence of Operation

Defrost Entry Conditions

A defrost cycle will initiate when all of the following conditions are met:

1) Compressor Runtime Requirements:

- The compressor must run continuously for at least 10 minutes.
- The system must accumulate a total runtime of 55 minutes (since last defrost or since power-up).
- This timer resets when high-voltage power is cycled, i.e., power loss clears runtime memory.

2) Temperature Delta Between Sensors:

- The system compares the ambient temperature (Tao) to the lower of the two defrost sensors (Te or Tc).
- A defrost is triggered if:

– Tao ≤ 50°F / 10°C (Normal Defrost)

– Tao ≤ 37.4°F / 3°C (Strong Defrost)

– min(Te, Tc) ≤ C × Tao − A

Where:

- C = 0.8 if Tao < 32°F (0°C) for moderate climates
- C = 0.6 if Tao ≥ 32°F (0°C) for moderate climates
- C = 0.8 for severe climates (when strong defrost DIP is enabled)
- A = 8 if Tao < 32°F (0°C) for moderate climates
- A = 1.6 if Tao ≥ 32°F (0°C) for moderate climates
- A = 4.4 for severe climates (when strong defrost DIP is enabled)

3) Condition Persistence:

- The condition above must persist for 5 consecutive minutes to trigger defrost.

Defrost Cycle Operation (Chart Breakdown)

The defrost cycle is divided into control stages that follow a fixed timing sequence. These are represented by vertical markers 1–9 in the defrost timing chart:

Line	Function
1	Compressor frequency begins gradual ramp down to 40 Hz (1 Hz/sec)
2	Compressor continues operation
3	Compressor reaches 40 Hz
4	After maintaining 40 Hz for 15 seconds, the 4-way valve shifts to cooling mode
5	• Actual defrost begins. Outdoor fan turns off. EEV set to 470 pulses. Compressor ramps up to defrost frequency: • 60 Hz – Default defrost; 70 Hz – Strong defrost for 18K & 24K • 70 Hz – Default defrost; 80 Hz – Strong defrost for 36K - 60K
6	Defrost active – this stage lasts approximately 400 seconds
7	Defrost logic evaluates exit conditions (Te > 44°F for 60 sec OR Te > 54°F for 30 sec OR Te > 59°F). If not met, defrost continues until max time.
8	Defrost ends. Compressor frequency ramps down.
9	System resets operating parameters to pre-defrost “auto” states. Compressor resumes target frequency.

Total max defrost duration: 10 minutes from line 1 to line 9

Actual defrosting (lines 3–6): ~6.5 minutes (~400 seconds)

Defrost Exit Conditions

The defrost cycle will terminate when any of the following occurs:

1) Temperature-based Termination:

- Te > 44°F (7°C) for 60 continuous seconds, OR
- Te > 54°F (12°C) for 30 continuous seconds, OR
- Te > 59°F (15°C) instantaneously

2) Time-based Termination:

- If temperature conditions are not met, defrost will end 10 minutes after initiation (starting from Line 1).

Minimum Defrost Duration: 2 minutes

The temperature sensors are ignored until the 2-minute minimum is satisfied, even if they call for termination earlier.

Defrost Behavior and Restart

- If a system fault occurs during defrost and the unit resets itself:

– The defrost logic will re-evaluate immediately.

– If defrost conditions are still met, a new defrost cycle will start again (even if this happens multiple times).

– No hard lockout is triggered by repeated defrost entries.

Manual Defrost and Strong Defrost Modes

Manual Defrost:

- Activated by toggling SW1, dip switch 4 from OFF → ON.
- If already in heating mode:
- Defrost begins immediately.
- If unit is in standby:
- Defrost begins 2 minutes after compressor startup.

Strong Defrost:

- Automatically follows a manual defrost.
- Starts 3.6°F (2°C) earlier than normal mode.
- Compressor runs 10 RPM faster during strong defrost for more aggressive frost removal.

Defrost Cycle Sequence of Operation

ADDITIONAL NOTES:
- “Auto” in chart:
  - On left side = current operational state
  - On right side = return to pre-defrost operation state
- “40 Hz (E)” label: The “E” was deemed unnecessary and can be ignored or deleted.
- Sensor priority: The control board uses min (Te, Tc) to determine defrost eligibility. There is no weighted average or priority between sensors as the colder reading is always used.

Explanation of Terms:
- Te = Evaporator temperature (or one of the defrost sensors)
- Tc = Coil temperature (other defrost sensor)
- Tao = Ambient temperature
- C = Slope coefficient
- A = Offset constant

Example 1: Normal Defrost in Moderate Climate:
Ambient Temp (Tao): 30°F
Sensor Readings: Te = 20°F, Tc = 24°F
Mode: Normal defrost (A = 8)
Since Tao < 32°F → C = 0.8

Step 1: Find the minimum of Te and Tc
- min(Te, Tc) = min(20, 24) = 20°F

Step 2: Calculate the threshold
- C × Tao – A = 0.8 × 30 – 8 = 24 – 8 = 16°F

Step 3: Evaluate the condition
- 20°F ≥ 16°F→ Not true — No defrost

Result: Even though the coil is cold, it's not cold enough relative to ambient to trigger defrost.

Example 2: Strong Defrost Mode in Humid Climate:
Ambient Temp (Tao): (36°F)
Sensor Readings: Te = 27°F, Tc = 30°F
Mode: Strong defrost (A = 4.4)
Strong defrost (C = 0.8)

Step 1: Find the minimum of Te and Tc
- min(27, 30) = 27°F

Step 2: Calculate the threshold
- 0.8 × 36 – 4.4 = 28.8 – 4.4 = 24.4°F

Step 3: Evaluate the condition
- 27°F ≥ 24.4°F→ Not true — No defrost

Result: Coil is still too warm to justify defrost at this ambient temperature, even in strong defrost mode.

Example 3: Defrost Condition is Met:

Normal Defrost in Moderate Climate:
Ambient Temperature (Tao): 25°F
Sensor Readings: Te = 10°F, Tc = 18°F
Mode: Normal Defrost (A = 8)
Since Tao < 32°F, use: C = 0.8

Step 1: Find the minimum of Te and Tc
- min(Te, Tc) = min(10, 18) = 10°F

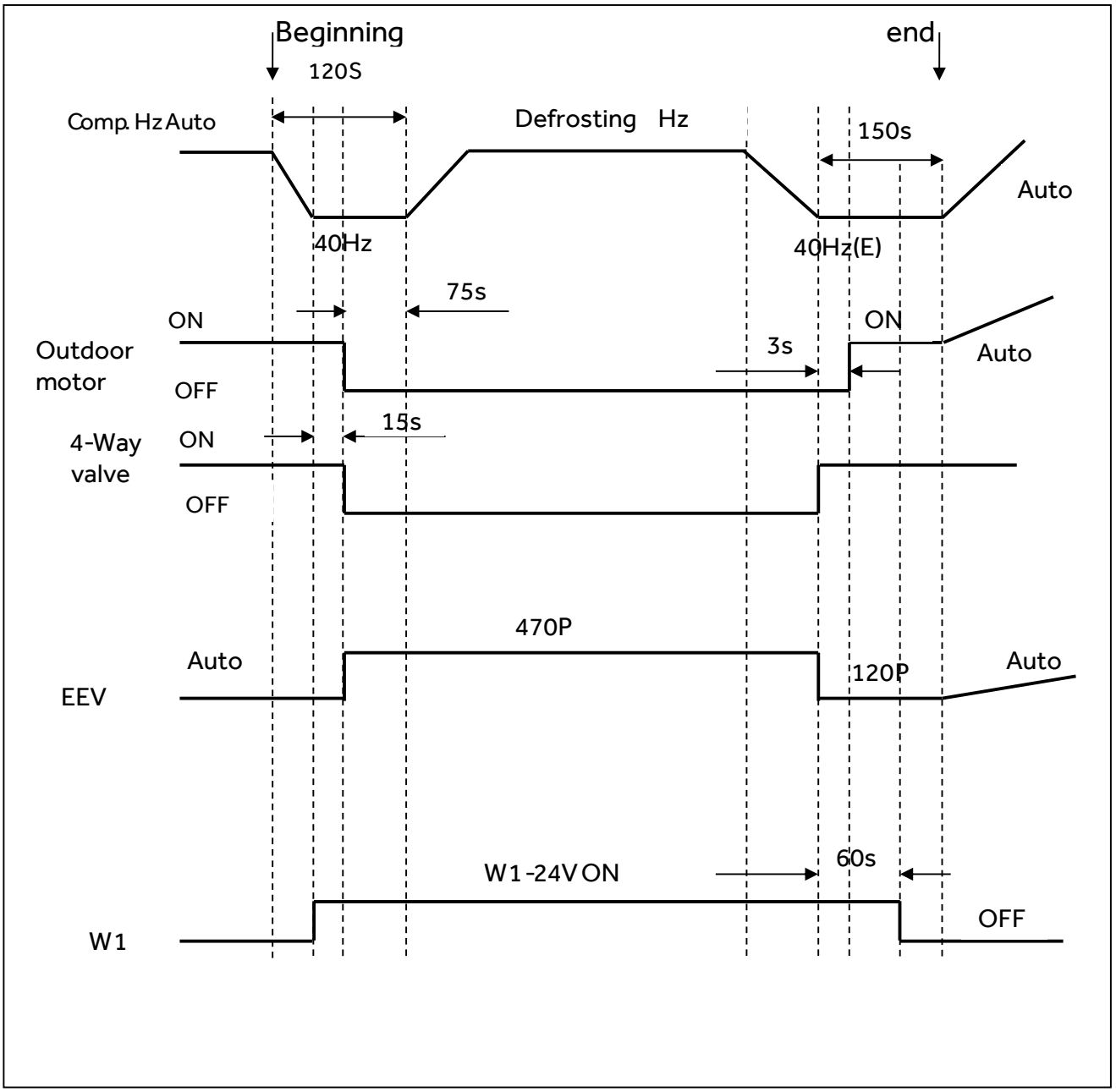
Step 2: Calculate the threshold using the formula
- C × Tao – A = 0.8 × 25 – 8 = 20 – 8 = 12°F

Step 3: Evaluate the condition
- 10°F≤12°F→ TRUE — Defrost Entry Triggered

Result: Defrost Initiated
- The coil is colder than expected relative to ambient.
- The system recognizes this as possible frost buildup and begins a defrost cycle (after 5 minutes of persistent condition + compressor runtime requirements are also met).

EXAMPLE NOTES:
- Even though 10°F (-12°C) is not “extremely cold,” what matters is the difference between the coil and the ambient temp.
- A cold coil at 10°F (-12°C) when it’s 25°F (-4°C) outside indicates the unit may be frosting, especially if that low temp persists.
- The lower the ambient, the higher the slope (C), which increases the defrost sensitivity.
- Strong defrost lowers the threshold (A = 4.4 instead of 8) which means defrost happens sooner.
- This formula ensures efficient defrosting only when frost buildup is likely.

Defrost Cycle Sequence of Operation



Defrost Cycle Sequence of Operation

Detailed Interpretation of the Connect Defrost Chart

Chart Structure Overview:

- The x-axis represents time in seconds, spanning approximately 600 seconds (~10 minutes).
- The y-axis represents changes in compressor frequency (Hz) and transitions in system components.
- Numbered vertical lines 1–9 correspond to key control events in the defrost sequence.

Event-by-Event Breakdown of Lines 1–9:

Line 1 – Defrost Initialization

- The defrost cycle is triggered after compressor runtime and sensor conditions are met.
- Compressor begins ramping down from its current operating frequency (e.g., 50–70 Hz) to 40 Hz.
- Ramp rate: 1 Hz per second

Line 2 – Ramp-Down in Progress

- Compressor continues decreasing speed toward 40 Hz.
- System maintains current state: 4-way valve is still in heating mode.
- Sensors are being stabilized before valve transition.

Line 3 – Compressor Hits 40 Hz

- This marks the start of the compressor stabilization hold at 40 Hz.
- System begins preparing for valve shift and refrigerant reversal.

Line 4 – 15-Second Delay Completed

- After holding at 40 Hz for 15 seconds, the 4-way reversing valve energizes, switching the system to cooling mode.
- This reverses refrigerant flow so the outdoor coil becomes the evaporator (for frost melting).
- Outdoor fan turns off.

Line 5 – Defrost Active

- The compressor begins ramping up to the defrost frequency:
  - 60Hz- Default defrost; 70Hz- strong defrost for 24K systems
  - 70Hz- Default defrost; 80Hz- strong defrost for 36K and 60K systems
- EEV (Electronic Expansion Valve) is forced to a fixed open position: 470 pulses
- Fan remains off
- 4-way valve stays in cooling position
- This is the core defrost period, lasting approximately 300 seconds (~5 minutes).
- The compressor maintains its target frequency to rapidly heat the outdoor coil and melt accumulated frost.

Line 6 – Sustained Defrost Operation

- At this point, the system checks whether Te (defrost sensor) has reached:
  - > 44°F (7°C) for 60 continuous seconds, or
  - > 54°F (12°C) for 30 continuous seconds, or
  - > 59°F (15°C) instantaneously
- If not, the system continues defrost until maximum time is reached.
- If the exit temperature is reached, the compressor frequency will drop from 60-80Hz to 40Hz

Line 7 – Defrost Exit Conditions Begin Monitoring

- The compressor frequency remains stable at 40Hz
- 4-way valve returns to heating position
- EEV decreased from 470 pulses to 120 fixed pulses

Line 8 – Defrost Ends

- The compressor frequency remains stable at 40Hz
- The outdoor unit fan starts, running at pre-defrost speed

Line 9 – System Resumes Heating Mode

- Compressor ramps back up to match load demand
- EEV exits fixed 120-pulse state and re-enters auto modulation
- Outdoor fan resumes normal logic

Timing Summary		
Segment	**Action**	**Duration**
1 → 2	Ramp down to 40 Hz	~10–30 sec
2 → 3	40 Hz stabilization	15 sec
3 → 4	Valve shift + fan OFF	75 sec
4 → 5	Active defrost + compressor ramp-up	~300 sec
5 → 6	Ramp down to 40 Hz	~30 sec
6 → 8	Valve shift+ fan ON	60 sec
8 → 9	Defrost exit + ramp-up	90 sec
Total	Entire defrost sequence	~10 min

Technician Notes for Chart Interpretation

- The ramp-down and hold at 40 Hz before valve reversal ensures refrigerant pressures stabilize, preventing a pressure spike during mode reversal.
- The fixed EEV opening (470 pulses) allows steady, predictable refrigerant flow during defrost — not modulated like normal cooling.
- The outdoor fan stays OFF throughout defrost to allow coil temperature to rise quickly.
- The system does not monitor defrost exit sensors until after 2 minutes, even if termination conditions are met earlier.

Oil Return Sequence of Operations

Oil Return Control Specification

1. Control Overview

The system implements an oil return management algorithm based on estimated oil carryover and runtime conditions. Since oil mass cannot be directly measured, the controller calculates oil discharge (carryover) using compressor operating parameters and initiates oil return when defined thresholds are met. Oil return is achieved by temporarily operating the compressor at conditions that ensure sufficient refrigerant velocity for oil entrainment and transport back to the compressor.

Without controlled oil return, oil can accumulate in system components, reducing compressor lubrication and increasing risk of long-term failure.

2. Oil Carryover Estimation

The system continuously estimates oil carryover volume based on compressor operating frequency and system superheat conditions.

Low-Speed Oil Carryover Behavior

When the compressor operates below the minimum oil return frequency, refrigerant velocity decreases, reducing oil entrainment and increasing oil retention in the system. The control algorithm accounts for this by increasing the effective oil carryover accumulation during low-speed operation. Oil return is not triggered by compressor speed alone, but by accumulated oil volume or time-based thresholds.

2.1 Oil Carryover Rate Table

Compressor Frequency (Hz)	Oil Carryover Rate (cc / 10 sec)
20 Hz	0.1185 × OCSF
30 Hz	0.2765 × OCSF
40 Hz	0.4345 × OCSF
50 Hz	0.93656 × OCSF

Oil Carryover Rate = Base Rate × OCSF

2.2 Superheat Correction Factor (OCSF)

- Superheat Correction Factor: 1.0 – 3.0
- This factor adjusts oil carryover estimation based on system superheat.

ENGINEERING NOTE:
Higher superheat reduces refrigerant density and effective mass flow, decreasing oil entrainment and transport capability and increasing oil carryover accumulation.

2.3 Accumulation Method

- Oil carryover is integrated over time and accumulated continuously.
- Accumulation continues across compressor cycles unless explicitly reset (see Section 6).

3. Oil Return Initiation Conditions

Oil return is initiated when any one of the following conditions is satisfied:

3.1 Accumulated Oil Threshold

- Estimated cumulative oil carryover ≥ predefined oil return threshold

3.2 Runtime Safeguard

- Continuous compressor runtime ≥ 120 minutes since last oil return
- This condition is ignored if oil return has already occurred within this interval

3.3 Maximum Interval Fail-Safe

- No oil return operation has occurred within 480 minutes

4. Oil Return Operation

When oil return is initiated, the system adjusts compressor operation to ensure sufficient refrigerant velocity for oil entrainment.

4.1 Compressor Frequency Control

- Oil return frequency is determined by system target conditions:
  - Cooling Mode: ETS (Evaporator Target Saturation Temperature) = 39°F
  - Heating Mode: CTS (Condenser Target Temperature) = 122°F
- Compressor frequency during oil return:
  - Must achieve minimum oil return frequency* threshold
  - Must not exceed system maximum allowable frequency at current ambient conditions

NOTE: These target temperatures indirectly control compressor speed and refrigerant mass flow, which determine the velocity required for effective oil entrainment and return.

***Minimum Oil Return Frequency:** The minimum compressor operating frequency required to generate sufficient refrigerant velocity for reliable oil entrainment and return under typical system conditions.

4.2 System Control Behavior During Oil Return

During oil return operation, system control behavior differs by operating mode:

Cooling Mode:

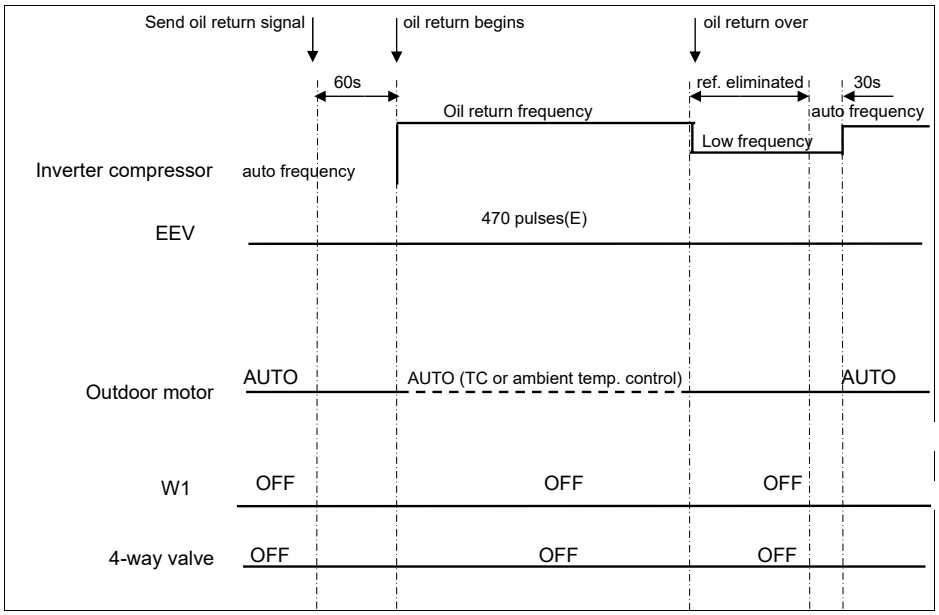
The following components continue operating under normal control logic without forced override states:

- Outdoor fan
- Indoor fan
- Electronic Expansion Valve (EEV)
- Four-Way Valve (4WV)

System target conditions may indirectly influence their operation, but no discrete state overrides are applied.

Oil Return Sequence of Operations

Oil Return Control Specification (Cont.)

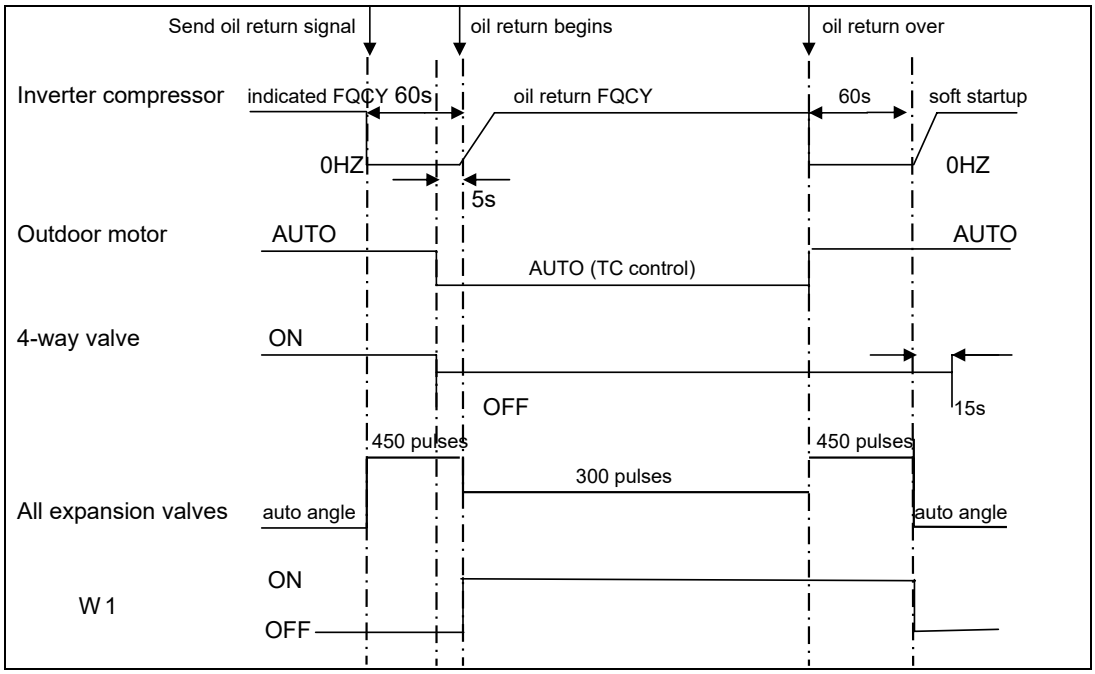


Heating Mode:

Oil return operation includes temporary control overrides and forced state changes to facilitate oil recovery. These may include:

- Temporary compressor shutdown and controlled restart sequence
- Four-way valve switching to alter refrigerant flow path
- Pre-positioning of expansion valves to fixed positions
- Temporary changes in system control signals (e.g., W1)

These actions are intentional and are required to mobilize and return oil that may accumulate in the outdoor coil and system piping during heating operation.



Oil Return Sequence of Operations

Oil Return Control Specification (Cont.)

4.3 Y1 Operation Override

- During oil return, compressor frequency is not restricted by normal Y1 maximum frequency limits
- This allows the system to temporarily exceed low-capacity constraints to achieve the minimum refrigerant velocity required for oil transport

5. Oil Return Completion Criteria

Oil return is considered complete when either of the following conditions is met:

5.1 Primary Completion Condition

- Compressor speed ≥ minimum oil return frequency
- Maintained continuously for ≥ 5 minutes

5.2 Maximum Duration Condition

- Oil return operation duration reaches 10 minutes

5.3 Heating Mode Defrost Interaction

- In heating mode, oil return is also considered complete if:
  - Defrost operation duration ≥ 2 minutes

Engineering Note:

Defrost operation inherently promotes oil return due to:

- Increased mass flow
- Oil accumulated in outdoor coil and piping is mobilized during flow reversal

6. Accumulation and Reset Logic

6.1 Pause Conditions (No Reset)

During the following events:

- Mode changes (cooling ↔ heating)
- System shutdown (non-oil-return related)

→ Oil carryover accumulation and timing are:

- Paused
- Not reset

Accumulation resumes upon compressor restart.

6.2 Reset Conditions

The following events reset oil accumulation and timing to zero:

- Completion of oil return cycle
- System shutdown during active oil return operation

7. Oil Return Cycle Timing Requirements

- Oil return operation duration must fall within:
  - Minimum: 5 minutes (if primary condition satisfied)
  - Maximum: 10 minutes (absolute limit)

System control logic must ensure oil return cycles operate within this defined window.

8. Functional Summary

The oil return control strategy is designed to maintain compressor lubrication integrity by ensuring oil that migrates into the system is reliably returned under all operating conditions.

This is accomplished by:

- Estimating oil carryover using compressor operating parameters and system superheat
- Continuously accumulating estimated oil displacement over time
- Initiating oil return based on multiple independent triggers:
  - Load-based (accumulated oil threshold)
  - Runtime-based (extended operation safeguard)
  - Time-based (maximum interval fail-safe)
- Temporarily increasing compressor output to achieve the refrigerant velocity required for effective oil entrainment and transport
- Confirming oil return through defined completion criteria and resetting accumulation accordingly

Oil return occurs automatically and independently of thermostat demand. A temporary increase in compressor speed without a corresponding call change is a normal and expected system behavior associated with oil return, not a control fault.

9. Key Engineering Principle

Oil return is governed by **refrigerant mass flow and velocity**, not simply runtime. The control algorithm ensures that whenever oil is likely to have migrated from the compressor, system conditions are temporarily adjusted to guarantee its return.

Operating Parameters

Electronic Expansion Valve (EEV) Control

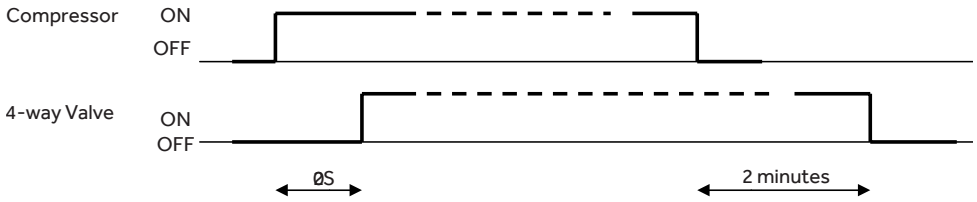
Electronic characteristics	
Max. position	47 0 pulses
Driving speed	PPS

Position limitation of EEV				
	Unit Stop	Max. Open Angle	Thermostat OFF	Min. Open Angle
Cool/dehum	5 pulses	470 pulses	470 pulses	80 pulses
Heat	5 pulses	470 pulses	200 pulses	76 pulses

The EEV routinely opens and closes to maintain the compressor discharge temperature within an acceptable range.

4-Way Valve Heating Control

When the compressor starts in the heating mode, there is a 20 second delay before power is applied to the 4-way valve to switch the flow of hot refrigerant to the indoor coil. When the call for heat is satisfied and the compressor shuts of, a 2-minute delay will occur before the 4-way valve is powered down and switches back to the at-rest (cooling) position.



If the 4-way valve does not switch into the heating mode, after 10 minutes of compressor run time and Tc is greater than 81°F/27°C, the compressor will stop and the unit will display a 17-flash error code on the outdoor PCB.

Compressor Sump Heater

The crankcase (sump) heater keeps refrigerant at a higher temperature than the coldest part of the system. This prevents refrigerant from mixing with the compressor oil and also dries condensed refrigerant inside the sump. The sump heater will be energized when the ambient temperature is below 37°F/3°C and will be off when the ambient is 41°F/5°C.

	Heater OFF	Heater ON*min
Tao<37°F (3°C) & Comp. OFF	40 min	60 min
Tao>41°F (5°C)	/	0

Operating Parameters

Strong Defrost Mode and Manual Defrost Trigger

Dip Switch 4 – Dual Function

• Manual (Forced) Defrost Trigger (when toggled OFF → ON):

– During heating mode:
- Immediate defrost if active
- Waits 2 minutes before entering defrost if in standby.

– After power cycle:
- If the switch remains "ON", it will not enter manual defrosting. You need to switch from "off" to "on" again and wait for 2 minutes after the compressor starts before entering defrosting.

1) After that manual (forced) defrost finishes, the next defrost cycle that the system automatically initiates (based on frost/coil ambient air conditions) will:
- Engage Strong Defrost Mode, even if the dip switch is not set for Strong Defrost.

2) After that Strong Defrost finishes, the system resets to whatever defrost behavior the dip switch is currently set to:
- If Strong Defrost is OFF → standard defrost resumes.
- If Strong Defrost is ON → Strong Defrost continues as normal.

Manual Defrost temporarily forces one cycle of Strong Defrost afterward. It does not permanently change the dip switch behavior.

• Normal Strong Defrost Mode:
– Activates defrost 2°C (3.6°F) earlier than standard defrost
– Compressor runs at 10 RPM faster during strong defrost
– Improves performance in high humidity / heavy frost conditions

Purpose
- Shorten time between defrosts
- Extend defrost duration
- Accelerate frost removal

Airflow Assumption Summary

What It Does
• Adjusts ODU refrigerant logic based on airflow assumption, not actual IDU airflow
• Lowers target coil temperature (cooling) or raises condensing temp (heating)
• Increases latent capacity (dehumidification)
• Improves heating comfort and defrost efficiency

What It Does Not Do
• Change or monitor indoor fan speed
• Communicate with or control IDU operation
• Measure actual indoor airflow directly

Technician Takeaway
•Set these dip switches based on installation conditions, not customer complaints after the fact.
Use lower airflow assumptions when:

Use these settings (via dip switch) when:
• Dehumidification is a priority
• A warmer supply air heat is a priority (like for an elderly end-user).
• Ductwork is undersized or restrictive (not a fix for improperly sized ductwork!)
• The indoor unit uses a non-variable-speed blower (PSC or constant torque ECM).
• Manufacturer defines <300 CFM/ Ton as the internal airflow model for its ODU refrigerant logic, but remember, <300 CFM/ Ton is not the actual or field measurable IDU airflow.

Dehumidification Modes: DEHUM.1 and DEHUM.2

Function
• Reduce the ODU's target evaporating temperature.
- DEHUM.1 lowers it by 2–5°F / 1.1-2.8°C
- DEHUM.2 lowers it by 5–7°F / 2.8-3.9°C
• Increase latent cooling performance for moisture removal.
• Help when airflow is lower than typical or when coil temperature needs to be reduced.

Purpose
1) Improve dehumidification performance when:
• IDU airflow has a fixed speed motor (PSC, ECM, constant torque blowers).
• Ductwork is restrictive.
• Customers are unsatisfied with moisture removal in cooling mode.

2) Help lower indoor discharge air temperature if it feels too warm during cooling mode.

Scenario Application
• Use DEHUM. 1 for moderate humidity control.
• Use DEHUM. 2 for high-humidity environments or challenging comfort conditions.

Comfort Heating Mode:

Function
• Raises the target condensing temperature by 2–5°F / 1.1-2.8°C.
• Helps maintain warmer supply air to improve indoor comfort.

Purpose
1) Improves space heating comfort, especially during:
• Mild ambient temperatures
• Transition seasons (fall/spring)
• Fixed speed IDU fan configurations (PSC motor or constant torque ECM motor)

Scenario Application
• Use when:
- When SW1 dip switch 1, 2 or 3 have been changed, then we want the outdoor unit to behave as if airflow is <300 CFM/ ton, even though the actual airflow is unknown and not monitored or measured.
- Customers report cold supply air during heating
- Installations involve restrictive ducting or legacy furnaces.

Operating Parameters

Discharge Sensor Protection Logic

The discharge temperature sensor (Td) monitors the temperature of the refrigerant gas exiting the compressor to protect the system from overheating and potential compressor damage.
This sensor does not act as an internal overload, but provides proactive compressor modulation and shutdown control. Here's how the logic operates:

Discharge Temperature Response Zones

1. > 239°F (115°C) — Critical Shutdown
- If the discharge temperature exceeds 239°F (115°C) for 10 seconds, the compressor shuts off immediately.
- A 5-minute delay is imposed before restart is permitted.
- Restart Condition: Compressor restarts only if Td has dropped below 221°F (105°C) after the delay.
  - Error Code 08 will be shown when this condition is triggered.
  - No hard lockout is enforced as the system will continue retrying after each 5-minute timeout, assuming temperatures recover.

2. 234–239°F (112–115°C) — Aggressive Ramp-Down
- The compressor frequency is reduced at 2 Hz per second until temperature drops into a safer range.

3. 228–234°F (109–112°C) — Standard Ramp-Down
- The system lowers compressor frequency at a moderate 1 Hz per second.

4. 223–228°F (106–109°C) — Gentle Ramp-Down
- The system decreases frequency at 1 Hz every 10 seconds, allowing gradual cooling without drastically impacting capacity.

5. 217–223°F (103–106°C) — Stable Zone
- The compressor holds its current operating frequency without adjustment.
- This zone is considered safe but closely monitored.

6. 198–217°F (92–103°C) — Recovery Zone
- As discharge temperature drops below 217°F, the system begins to gradually increase compressor frequency at 1 Hz every 10 seconds, allowing return to full performance.

7. < 198°F (92°C) — Normal Operation
- No protective adjustments are made.
- Compressor operates freely per demand and load conditions.

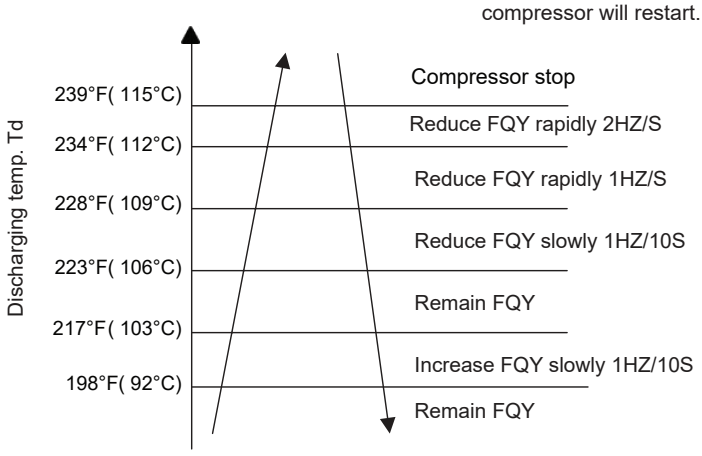
Target Temperature Behavior & Control Philosophy

- There is no single fixed “target” discharge temperature, but:
  - < 198°F (92.2°C) is considered fully normal.
  - 217°F (102.8°C) serves as a transition threshold, below which the system ramps up and above which it begins ramping down.
  - Temperatures above 239°F (115°C)are considered dangerous and trigger full shutdown.
- This modulation logic applies in both heating and cooling modes to protect compressor integrity under all load conditions.

NOTES:

- Error Code: 08 appears when the system shuts down due to high discharge temperature.
- Auto Recovery: There is no hard lockout, and the system will automatically attempt to restart after each 5-minute timeout (if Td < 221°F / 105°C).
- This logic helps prevent compressor overheating by managing discharge temperatures, reducing the risk of thermal damage and extending compressor life.
- Compressor ramping rates (Hz/sec) should be understood during diagnostics to avoid misinterpreting normal protection behavior as a fault.

If the discharge temperature sensor reaches 239°F (115°C) for 10 seconds, the compressor will shut off. After the 5-minute time delay, the compressor will restart.



Operating Parameters

Compressor High Current Protection Logic

To protect the compressor from electrical overloading, the system continuously monitors compressor current draw and adjusts operation dynamically. The logic aims to limit compressor damage due to high current by modulating frequency or initiating shutdown.
This current-based protection applies during both cooling and heating modes and is designed to prevent overcurrent-related faults or hardware failure.

Compressor Current Thresholds (by Model Size)			
ODU Model	**Nominal Max Current Limit**	**Lockout Threshold**	**Restart Allowed After**
1.5 Ton	10 A	Trips ≥ 6 times in 60 min	5-minute delay after trip
2 Ton	12 A	Trips ≥ 6 times in 60 min	5-minute delay after trip
2.5 Ton	15 A	Trips ≥ 6 times in 60 min	5-minute delay after trip
3 Ton	15 A	Trips ≥ 6 times in 60 min	5-minute delay after trip
3.5 Ton	17 A	Trips ≥ 6 times in 60 min	5-minute delay after trip
4 Ton	18 A	Trips ≥ 6 times in 60 min	5-minute delay after trip
5 Ton	24 A	Trips ≥ 6 times in 60 min	5-minute delay after trip

- Lowest measurable compressor current: 1 A (for all models).
- Ideal control range: Current remains below 94% of rated limit.

Compressor Frequency Modulation Based on Current Load

The system uses a stepped-response approach based on percentage of rated current ("I"):

1. ≥ 100% of I — Overcurrent Trip
- The compressor shuts off immediately to prevent damage.
- After a 5-minute delay, the system attempts an automatic restart if current has fallen below 100%.

2. 96% – 100% of I — Emergency Frequency Ramp-Down
- Compressor frequency is reduced at 2 Hz per second to bring current back under control.

3. 95% – 96% of I — Moderate Frequency Ramp-Down
- Frequency is reduced at 1 Hz per second.

4. 94% – 95% of I — Slow Ramp-Down
- Frequency is reduced gradually at 1 Hz every 10 seconds.

5. 90% – 94% of I — Safe Operating Band
- Compressor continues to operate at steady-state frequency without modulation.
- This is considered a safe current zone.

6. < 90% of I — Recovery Ramp-Up
- If current is stable and < 90%, the compressor gradually increases frequency at 1 Hz per second, resuming full performance.

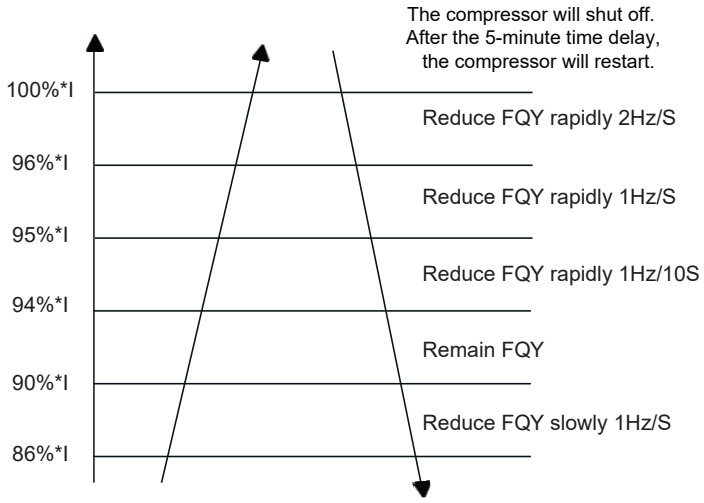
Error Codes and Lockout Logic

- Error Code 03 and Error Code 24 are associated with high current protection events.
- These protections are designed specifically to protect the compressor from overcurrent-related damage and not the IPM board, main board, or fan motors.
- Lockout condition: If the compressor trips due to high current 6 times within 60 minutes, the system enters a hard lockout and requires manual reset.

Control Philosophy

- The system does not actively "target" a single ideal compressor current, but protection logic is optimized to keep operation below 94% of the rated current.
- While current thresholds exist at specific points (90%, 94%, etc.), this does not imply the system targets those values. It simply triggers modulation rules when thresholds are crossed.
- This logic ensures smooth operation near peak loads, especially during ramp-ups in heating or cooling modes.

NOTES:
- Current readings vary with system load, voltage supply, and environmental conditions.
- Overcurrent protection is one of several layered protections (including discharge temperature and voltage monitoring).
- If Error Code 03 or 24 occurs repeatedly, check for:
  - Dirty coils or airflow issues
  - Overcharging
  - Incorrect voltage supply
  - Faulty compressor windings or poor connections



Operating Parameters

High Pressure Protection Logic (Cooling Mode Only)

To protect the compressor and refrigerant circuit from dangerously high pressures during cooling mode, the system continuously monitors the outdoor coil temperature (Tc sensor). This temperature is used as a proxy for discharge pressure. Based on Tc readings, the system modulates compressor frequency or shuts down to avoid overpressure conditions.

NOTE: This logic is only active in cooling mode. It is not used in heating mode, as this is a non-communicating system between the indoor and outdoor units.

Tc-Based Frequency Modulation Zones

1. Tc ≥ 154°F (68°C) — Critical Shutdown
- If coil temperature reaches 154°F (68°C), the compressor shuts off immediately.
- A 5-minute delay is imposed before restart is allowed.

2. Tc 149–154°F (65–68°C) — Rapid Ramp-Down
- Compressor frequency is decreased at 2 Hz per second to reduce system pressure.

3. Tc 145–149°F (63–65°C) — Moderate Ramp-Down
- Frequency is reduced at a slower rate: 1 Hz per second.

4. Tc 138–145°F (59–63°C) — Safe Operating Band
- Compressor maintains its current frequency with no modulation.

5. Tc 135–138°F (57–59°C) — Recovery Zone
- If Tc is falling, the compressor frequency is increased gradually at 1 Hz every 10 seconds.

6. Tc < 135°F (57°C) — Normal Operation
- No adjustments. Compressor runs at frequency based on cooling load.

Control Philosophy: Tc is ideally kept below 145°F (63°C) to allow full compressor performance without triggering modulation.

High Pressure Switch Backup (Mechanical Protection)

In addition to Tc-based logic, the system includes a normally closed high pressure switch (mechanical fail-safe).

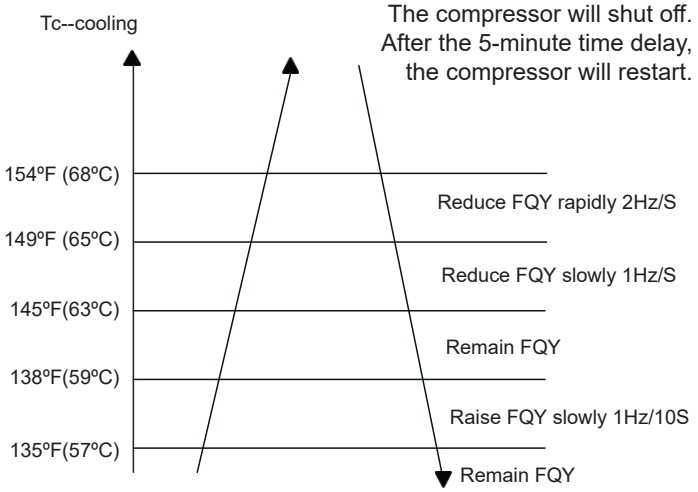
Trip Condition	Reset Condition	Switch Type	Voltage	Purpose
Opens at 623 psig (4.3 MPa)	Closes at 522 psig (3.6 MPa)	Normally Closed	5v	Backup high-pressure trip for compressor protection

If the switch opens:
- Compressor stops immediately.
- Error Code 44 is triggered.
- No hard lockout is applied (the system will retry after conditions normalize).

Outdoor Fan Behavior During High Pressure Conditions

To assist in reducing pressure, the outdoor fan speed increases when high Tc conditions are detected
- Fan speed is elevated above normal levels, even if compressor frequency does not justify it.
- This provides additional condenser cooling to prevent shutdown.
- A chart showing this behavior is not yet provided, but the factory confirmed this logic is built-in.

NOTES:
- High pressure protection is temperature-driven, not pressure-sensor-driven, unless the emergency switch trips.
- The Tc sensor is the primary control element for pressure modulation during cooling.
- No protection logic is applied in heating mode, since outdoor and indoor units do not share Tc data.
- If you're seeing Error 44 frequently:
  - Check outdoor airflow (clean coil, verify fan operation).
  - Look for overcharging.
  - Verify proper indoor airflow (a backed-up evaporator may reflect downstream).
  - Make sure line lengths and refrigerant charge comply with spec.



Operating Parameters

Low Pressure Protection Logic

To protect the compressor from running under low refrigerant pressure conditions, the Connect Series system uses a normally closed low pressure switch located in the suction circuit. The system monitors this switch differently depending on whether the compressor is running or idle.

Low Pressure Switch Specifications

- Type: Mechanical, Normally Closed (N.C.)
- Trip (open) pressure: 0.03 MPa (4.35 psig)
- Reset pressure: 0.10 MPa (14.5 psig)
- Voltage Signal: 5v

Compressor Running

1) If the low pressure switch remains open for 1 minute while the compressor is running:
- The compressor will stop.
- Error Code 43 will be displayed on the outdoor unit.
- If this condition occurs three times within one hour, the system will enter a hard lockout condition and require manual reset.

Compressor Not Running

1) If the low pressure switch opens for 30 seconds while the compressor is off:
- Error Code 43 is displayed.
- No compressor shutdown is required since it is already inactive.

Built-in Exceptions to Low Pressure Shutdown

The system intentionally ignores low pressure switch trips under the following specific operating conditions:

1) During the first 8 minutes of compressor runtime after a new cycle starts
2) During defrost mode and for up to 6 minutes after defrost ends
3) During the oil return process
4) For 6 minutes following the end of oil return (cooling mode only)

These temporary suspensions allow for pressure stabilization during transitional system states and are part of the designed protection strategy.

Technical Concerns and Clarifications

1) Will running the compressor for 8 minutes with no refrigerant harm it?
- Answer: This scenario has been laboratory-tested by the supplier. The compressor has been shown to withstand this short-duration exposure without damage. The 8-minute exception is carefully chosen to allow for stabilization without compromising compressor integrity.

2) After oil return ends, how long is low pressure ignored?
- Cooling Mode: Low pressure switch trips are ignored for 6 minutes after oil return ends.
- Heating Mode: Low pressure trips are ignored only during the oil return process (not after).
- These deferrals ensure oil return is prioritized without prematurely shutting the compressor down due to temporary suction dips.

3) Are there other low-pressure monitoring methods besides the switch?
- Answer: No. The system only uses the low pressure switch for this function. No alternate sensors or logic are involved.

Condition	System Response
LP switch open ≥ 1 min (compressor ON)	Compressor stops, error 43, lockout if 3x/hour
LP switch open ≥ 30 sec (compressor OFF)	Error 43, no shutdown
Exception windows	Startup (8 min), Defrost + 6 min, Oil return + 6 min (cooling only)
Lockout condition	3 trips in 60 minutes

NOTE: Low pressure protection is active only outside of exception periods and is calibrated to allow operational flexibility without sacrificing compressor safety.

Operating Parameters

Operational Sound Ratings

Model	Sound Power[1] (Low)	Estimated Sound Pressure (dBA) [2]			Sound Power[1] (High)	Estimated Sound Pressure (dBA)2		
		Approximate Distance[3]				Approximate Distance3		
		One Meter (3.3 feet)	Two Meters (6.6 feet)	Three Meters (9.8 feet)		One Meter (3.3 feet)	Two Meters (6.6 feet)	Three Meters (9.8 feet)
ML15KSPV-018	58	48	42	38	70	60	54	50
ML15KSPV-024	58	48	42	38	71	61	55	51
ML15KSPV-030	57	47	41	37	73	63	57	53
ML15KSPV-036	57	47	41	37	74	64	58	54
ML15KSPV-042	57	47	41	37	75	65	59	55
ML15KSPV-048	57	47	41	37	76	66	60	56
ML15KSPV-060	62	52	46	42	77	67	61	57

1 Rated in accordance with AHRI standard 270 (2015)

2 Rated in accordance with AHRI standard 275 (2010).

3 Based only on distance factor; other factors may change this value such as:
Unit location (reflective surfaces adjacent to the unit)
Barrier shielding sources
Sound path/elevation
Outside noise sources

ML15KSPV Unit Operation with a Conventional 24VAC 2-Stage Thermostat

When the ML15KSPV unit is installed with a conventional 24VAC 2-stage thermostat, a Y1 first stage heating or cooling demand will initiate heating or cooling operation and first stage indoor blower operation. The compressor will be controlled in the variable capacity mode by varying the compressor capacity to obtain the target suction pressure set point. The Y2 second stage heating or cooling demand will initiate second stage blower operation. Increased air volume will increase the load on the indoor coil and increase the suction pressure. The ML15KSPV compressor capacity will continue to be controlled based upon the suction pressure. The unit capacity will be controlled in the variable capacity mode throughout the range of capacity from minimum capacity to maximum capacity. If the Y2 demand remains after 30 minutes, the ML15KSPV control will begin to adjust to the target refrigerant temperature (evaporating for cooling and condensing for heating) to enable the compressor to reach its maximum speed. The minimum value for ETS can be as low as 36°F (2.22°C), and the maximum valve for CTS can reach up to 131°F (55°C).

The ML15KSPV unit will cycle off once the thermostat demand is satisfied.

NOTE: The unit will time the first 30 minutes when power is cycled and this 30 minutes will not be included in the 30 minute timer for Y2 active.

Unit Operation with a Conventional 24VAC Single-Stage Thermostat

When the unit is installed with a conventional 24VAC singlestage thermostat, the Y signal of the single-stage thermostat must be connected.

The compressor will be controlled in the variable capacity more by varying the compressor capacity to obtain the target suction pressure set point.

If the heating or cooling demand remains after 30 minutes, the ML15KSPV control will begin to adjust the target refrigerant temperature (evaporating for cooling and condensing for heating) to enable the compressor to reach its maximum

speed. The minimum value for ETS can be as low as 36ºF (2.22ºC), and the maximum value for CTS can reach up to 131ºF (55ºC).

The ML15KSPV unit will cycle off once the thermostat demand is satisfied.

NOTE: The unit will time the first 30 minutes when power is cycled and this 30 minutes will not be included in the 30 minute timer for Y2 active

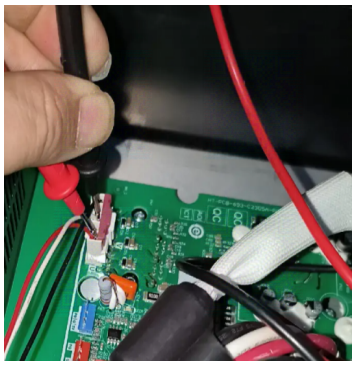
Component Testing

Outdoor Fan Motor

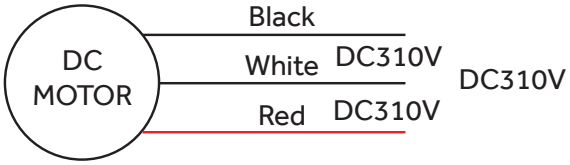
Check that the wiring and plug connections are in good condition. If the outdoor unit fan motor does not run, or the Service Monitor Board indicates an error code of 09, check the following voltages at connector CN11 on the outdoor unit PCB. Set the meter to read DC volts with a minimum voltage range of 350 volts. All voltage values are approximate. Initiate forced cooling.

1. DC voltage between the Red and Black wires should read 310 ~ 334VDC. This is the main voltage for powering the fan motor.
2. DC voltage between the White and Black wires should read 310~334VDC. This is the main voltage for powering the fan motor.
3. DC voltage between the Red and White wires should read 310~334VDC. This is the main voltage for powering the fan motor.

If the outdoor fan initially runs, increases speed then stops, and the Service Monitor Board indicates an error code of 09, the feedback circuit is not functioning. Check that the wiring and plug connections are in good condition.



PCB design may vary by model number



Component Testing

Temperature Sensor

Safety First

1. Turn off power to the outdoor unit (ODU) at the disconnect or breaker panel.
2. Wait 5-10 minutes after shutdown before touching any components to allow internal capacitors to discharge.

Step-by-Step Sensor Test Procedure

1. Identify and Disconnect the Sensors

- Connector Location:
  - For 2- and 3-ton ODUs: Disconnect sensors from PCB at CN21.
  - For 5-ton ODUs: Disconnect from PCB at CN14.

2. Remove Each Sensor from Its Installed Location

NOTE: Each sensor must be fully removed from both the PCB and its sensing location for proper ice water testing.

Sensor Details & Removal Notes

Tc (Condenser Coil Pipe Temperature) & Te (Evaporator Coil Pipe Temperature)

- Mounted in drywells attached to U-bends on the outdoor coil.
- Secure metal clip holds the sensing bulb tightly to the drywell.
- ➤ **Important: Do not lose the clip!**
- ➤ Reinstallation Tip I: When reinstalling, make sure the sensor bulb sits closest to the U-bend for best thermal contact.
- ➤ Reinstallation Tip II: When reinstalling, make sure that the wires on the senor bulb is facing downwards.

Ts (Suction Line Temperature) & Td (Discharge Line Temperature)

- These are strap-on sensors clamped directly to their respective suction or discharge refrigerant lines.
- Covered with insulation to shield from ambient air and ensure accurate pipe temperature sensing.
- ➤ Reinstallation Tip: Re-clamp securely and re-insulate after testing.

Tao (Ambient Air Temperature)

- Located on the airside of the outdoor coil, secured in a plastic grill enclosure with a rubber-tipped sensor.
- ➤ Gently remove the sensor from its clip without damaging the protective housing.

3. Perform Ice Water Test

- Fill a clean cup or container with crushed ice and water to form a 32°F (0°C) bath.
- Place the sensing tip of each NTC thermistor into the mixture for at least 2–3 minutes.
- Do not allow the sensor wires or connector to get wet—only submerge the sensing bulb.

What You're Looking For:

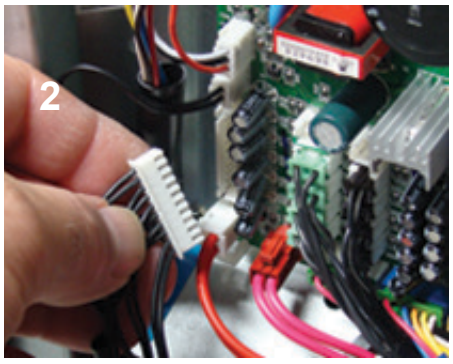
- After stabilization in the ice bath, the resistance reading across the sensor should match the temperature and resistance charts starting at page 60 at 32°F (0°C) ± 2°F (0°C)

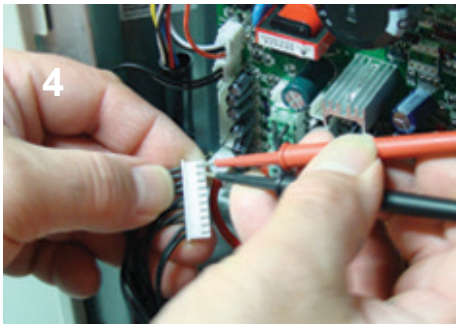
Why Ice Water?

- Provides a stable, known reference temperature (32°F / 0°C).
- Eliminates ambient temperature fluctuations that would cause unreliable readings.
- Ensures that sensor faults are real and not caused by poor contact or variable surface temperatures.
- It demonstrates the sensor has a reaction.

4. Reinstallation After Test

- Carefully reinstall each sensor in its original location.
- For Tc & Te: Replace the clip and verify sensor bulb is seated against the U-bend and the wire end facing downwards.
- For Ts & Td: Ensure clamp is snug and insulation is replaced.
- For Tao: Reinsert it into the plastic grill and ensure it is secure.



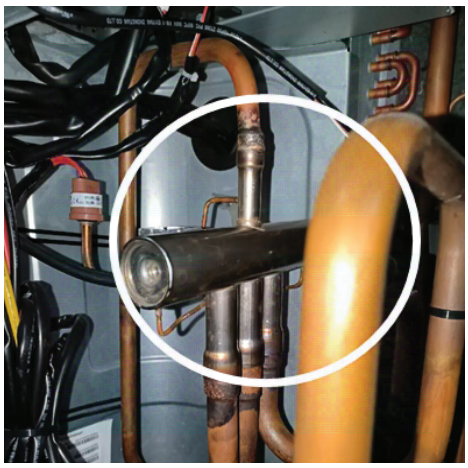


Component Testing

4-Way Valve

The 4-way valve will control the direction of hot gas discharge via an internal slide assembly. The valve has a line voltage solenoid that is energized in heat mode. The solenoid will direct the internal slide to send the hot gas to the indoor coil. During cooling mode de-energized operation, the internal slide will direct compressor hot gas to the outdoor coil.

4-way valves may have a failure of the electrical solenoid that prevents the valve from shifting, or they may become stuck due to debris lodging inside the valve body. If the valve fails to direct the hot gas in the proper direction, temperature sensors within the outdoor unit will detect the problem and generate an error code.



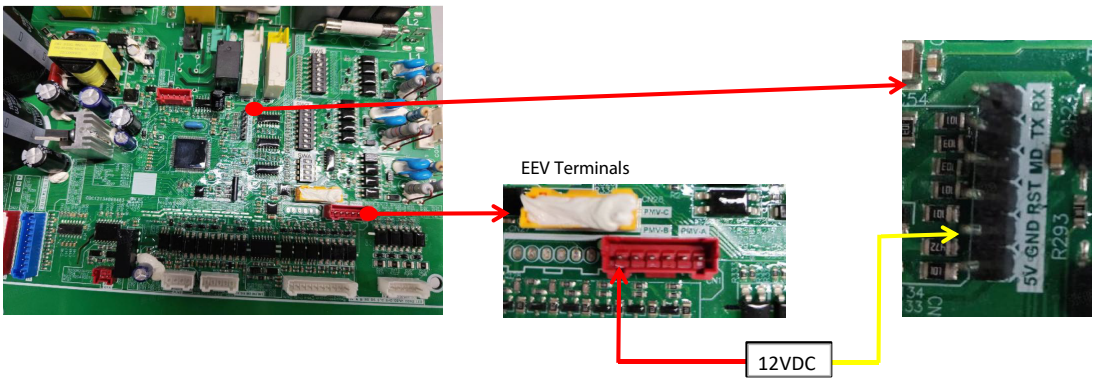
If the valve fails to shift the hot gas to the proper coil, or it only partially shifts, perform the following:

1. Check for correct refrigerant charge, and that all other operating parameters have been met.
2. In the heating mode, the solenoid will shift after a short time delay. Check for line voltage to the solenoid coil.
3. If the valve has voltage but fails to shift the hot gas to the indoor coil, shut the system down and unplug the 4-way valve from the PCB plug.
4. Use an ohmmeter to check continuity through the solenoid coil. If the coil resistance does not match the chart in this manual, or if a winding shows open or shorted, the solenoid coil will have to be replaced.
5. If the coil resistance is within the tolerance, use a strong magnet along the valve body to determine the location of the piston. If one end of the piston is against the end of the valve body, it is stuck and the valve must be replaced.
6. Partial shifting of the valve can be detected by measuring the temperature of the suction gas where it enters the reversing valve and then comparing that temperature to the temperature of the suction gas exiting the 4-way valve. There should be no more than 3°F (1.67ºC) difference. Excessive temperature rise through the suction gas path is an indication of a stuck piston. If the piston will not become free by switching from heating to cooling several times, a slight tapping on the valve body, or by using a powerful magnet, the valve will require replacement.

Component Testing

Electronic Expansion Valve (EEV)

1. Check to see if the Electronic expansion valve (EEV) connector is correctly and firmly inserted in the PCB.
2. Turn the power off and back on again,
3. Check to see whether the EEV have a reposition sound. This sound will start after approx 2 min. If the EEV doesn't have noise, please disconnect the connector and check the resistance (refer to resistance tables below).
4. If the resistance is OK, The PCB may be at fault.



18K & 24K
EEV(6-pin, 6 wire)

	Red	Brown	Blue	Orange	Yellow	White
Red	-	OL	46	OL	46	OL
Brown	-	-	OL	46	OL	46
Blue	-	-	-	OL	92	OL
Orange	-	-	-	-	OL	92
Yellow	-	-	-	-	-	OL
White	-	-	-	-	-	-

30K & 36K & 42K & 48K & 60K
EEV(6-pin, 6 wire)

	Blue	Grey	Orange	Red	Yellow	Black
Blue	-	OL	46	OL	46	OL
Grey	-	-	OL	46	OL	46
Orange	-	-	-	OL	92	OL
Red	-	-	-	-	OL	92
Yellow	-	-	-	-	-	OL
Black	-	-	-	-	-	-

Component Testing

Filter Drier

The factory-installed filter dryer is very important for system reliability. The filter dryer should be replaced before re-charging the unit with refrigerant if the unit needs to have refrigerant evacuated for repair. The specification of the filter dryer can be found in the table below.

ODF	Temperature Range	MWP	Compatible Refrigerant
3/8 in.	−40°F to +248°F	650 psig	R-454B
9.52 mm	−40°C to +120°C	4.5 MPa	R-454B

1. Recycle the outdoor unit refrigerant and keep the stop valve open.
2. The filter dryer is located at the outlet side of the outdoor unit.
3. The two ends of the filter dryer need to be brazed, and the filter dryer is bidirectional.
4. Remove sensors, wiring harnesses and other A2L materials around the filter before brazing.
5. Brazing qualified professionals are required to perform brazing operations in a safe environment.



Crankcase Heater

1. Crankcase heater normal, please refer to the following table.
2. The PCB is normal but the crankcase heater does not work, and if there is no resistance value measured, the crankcase heater is damaged.

Model	Resistance
ML15KSPV-018-230	1793Ω ± 7%
ML15KSPV-024-230	
ML15KSPV-030-230	
ML15KSPV-036-230	
ML15KSPV-042-230	
ML15KSPV-048-230	
ML15KSPV-060-230	2057Ω ± 9%

Reactor

1. The reactor is in normal state and PCB runs normally.
2. The reactor is damaged and the lamp board does not display.
3. The internal circuit of the reactor is broken, and the multimeter buzzer is used to judge.

Pressure Transducer.

1. Refrigerant pressure is detected during operation by a pressure sensor.
2. Compressor frequencies are controlled by an algorithm from input of the pressure transducer and other sensor and inputs.
3. Reads high pressure in the heating mode/ low pressure in the cooling mode.



Black wire = common/ground
Red wire = 5V DC input
White wire = 0.5V to 3.5V DC output

Voltage DC	Pressure PSI	Voltage DC	Pressure PSI
0.5	0	2.1	321
0.6	20	2.2	341
0.7	40	2.3	361
0.8	60	2.4	381
0.9	80	2.5	401
1	100	2.6	421
1.1	120	2.7	441
1.2	140	2.8	461
1.3	160	2.9	481
1.4	181	3	501
1.5	201	3.1	522
1.6	221	3.2	542
1.7	241	3.3	562
1.8	261	3.4	582
1.9	281	3.5	602
2	301		

Component Testing

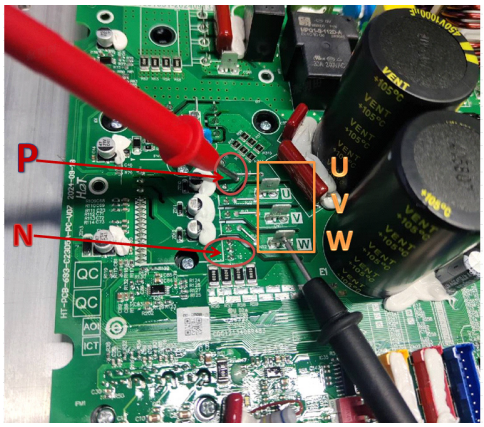
IGBT Test

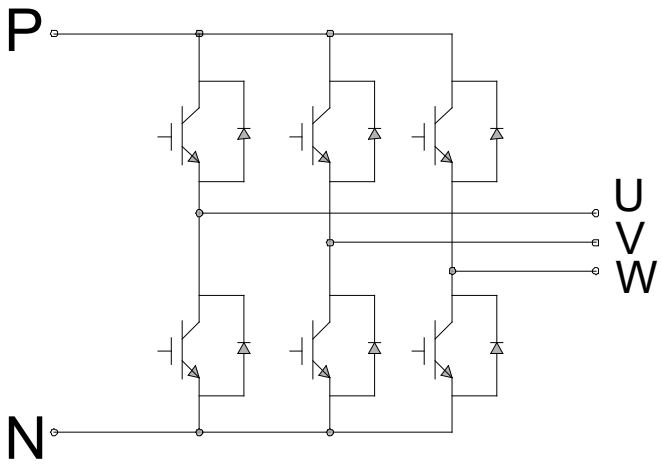
Need to pull the U,V,W leads off the control board

Remember,the leads are polarity sensitive .

	Test 1	Test 2	Test 3	Test 4
Meter Lead	Control Board+	UVW	Control Board-	UVW
Meter Lead	UVW	Control Board+	UVW	Control Board-
Good	Several KΩ to Several MΩ			
Faulty	0Ω or OL			







Insulate-Gate Bipolar Transistor

Component Testing

Charge Mode Operation with a Conventional 24VAC Heat Pump Thermostat

Charge Mode Display Message

When unit is in the cooling charge mode, 2-segment display displays the current Subcooling.

Charge Mode DIP Operation in the Cooling Mode

The operation mode of DIP switch SW1 on the display board is shown in Table 9. After the system is started, the system needs to be stabilized for 10 minutes. Compare the subcooling value that is displayed after 10 minutes with the target subcooling value in Table 10.

Charge Mode DIP Operation in the Heating Mode

To test the supercooling degree in heating mode, an external pressure gauge and thermometer need to be connected, and the pressure and measurement temperature are connected as shown in the Figure 21. The saturation temperature of the refrigerant is checked through Table 11, and the current supercooling degree is obtained by using the temperature measured by the saturation temperature minus the thermometer, and the target supercooling degree is compared with that in Table 10.

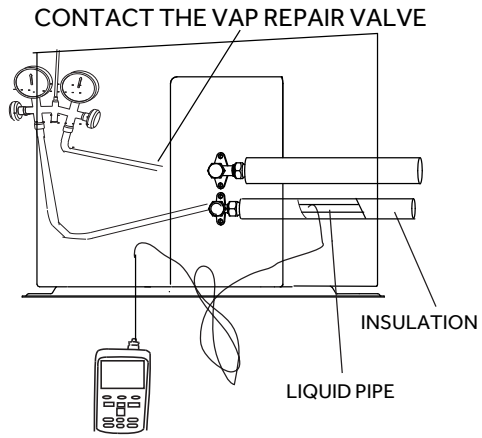


Figure 21

Component Testing

Table 10. Indoor Unit Matches and Sub-cooling Charge Levels (TXV System) and Additional Charge (15 ft. Line set)

Indoor Matchup	Subcool		Additional Charge
	Heat (±3ºF)	Cool (±1ºF)	lbs/oz
18K HP			
CBK43UHE-018	5	6	0 lb 6 oz
CBK43UHE-024	4	6	0 lb 9 oz
CBK45UHVT-018	5	4	0 lb 6 oz
CBK45UHET-024	4	4	0 lb 9 oz
CBK45UHVT-024	4	4	0 lb 9 oz
CBK47UHET-024	4	4	0 lb 11 oz
CBK48MVT-018/024	4	4	0 lb 11 oz
CK40[C,U]T-24A	4	4	0 lb 9 oz
CK40[C,U]T-24B	4	4	0 lb 9 oz
CK40[C,U]T-30A	3	5	0 lb 13 oz
CK40[C,U]T-30B	3	5	0 lb 13 oz
CK40HT-24A	5	3	0 lb 3 oz
CK40HT-24B	6	3	0 lb 0 oz
CK40HT-30A	5	3	0 lb 3 oz
CK40HT-30B	3	5	0 lb 13 oz
CK40DT-24A	5	4	0 lb 8 oz
CK40DT-24B	5	4	0 lb 8 oz
24K HP			
CBK43UHE-024	6	7	1 lb 0 oz
CBK43UHE-030	5	8	1 lb 4 oz
CBK45UHET-024	6	7	1 lb 0 oz
CBK45UHVT-024	6	7	1 lb 0 oz
CBK45UHET-030	5	8	1 lb 4 oz
CBK45UHVT-030	5	8	1 lb 4 oz
CBK47UHET-024	6	7	1 lb 1 oz
CBK47UHET-030	5	9	1 lb 6 oz
CBK48MVT-018/024	6	7	1 lb 1 oz
CBK48MVT-030	5	9	1 lb 6 oz
CK40[C,U]T-24A	6	7	1 lb 0 oz
CK40[C,U]T-24B	6	7	1 lb 0 oz
CK40[C,U]T-30A	5	8	1 lb 4 oz
CK40[C,U]T-30B	5	8	1 lb 4 oz
CK40[C,U]T-36A	4	9	1 lb 7 oz
CK40[C,U]T-36B	4	9	1 lb 7 oz
CK40HT-18A	7	6	0 lb 0 oz
CK40HT-24A	6	7	0 lb 10 oz
CK40HT-24B	7	7	0 lb 7 oz
CK40HT-30A	6	7	0 lb 10 oz
CK40HT-30B	7	9	1 lb 6 oz
CK40DT-24A	6	7	0 lb 14 oz
CK40DT-24B	6	7	0 lb 14 oz

Indoor Matchup	Subcool		Additional Charge
	Heat (±3ºF)	Cool (±1ºF)	lbs/oz
30K HP			
CBK43UHE-030	4	7	1 lb 5 oz
CBK43UHE-036	5	5	1 lb 5 oz
CBK45UHET-030	4	7	1 lb 5 oz
CBK45UHVT-030	4	7	1 lb 5 oz
CBK45UHET-036	5	5	1 lb 5 oz
CBK45UHVT-036	5	5	1 lb 5 oz
CBK47UHET-030	7	7	1 lb 2 oz
CBK47UHET-036	7	7	1 lb 2 oz
CBK48MVT-030	7	7	1 lb 2 oz
CBK48MVT-036	7	7	1 lb 2 oz
CK40[C,U]T-30A	4	5	0 lb 14 oz
CK40[C,U]T-30B	4	5	0 lb 14 oz
CK40[C,U]T-36A	5	5	1 lb 5 oz
CK40[C,U]T-36B	5	5	1 lb 5 oz
CK40HT-30A	4	3	0 lb 3 oz
CK40HT-30B	5	5	1 lb 5 oz
CK40HT-36A	4	3	0 lb 5 oz
CK40HT-36B	4	3	0 lb 0 oz
CK40HT-36C	8	4	0 lb 8 oz
CK40DT-24A	10	4	0 lb 8 oz
CK40DT-30/36B	10	5	0 lb 13 oz
CK40DT-42B	7	7	1 lb 6 oz

NOTE: For AHRI Certified system match-ups and expanded ratings, visit www.LennoxPros.com.

Table 10 (cont.). Indoor Unit Matches and Sub-cooling Charge Levels (TXV System) and Additional Charge (15 ft. Line set)

Indoor Matchup	Subcool		Additional Charge
	Heat (±3ºF)	Cool (±1ºF)	lbs/oz
36K HP			
CBK43UHE-036	4	5	1 lb 5 oz
CBK43UHE-042	4	5	1 lb 5 oz
CBK45UHET-036	4	5	1 lb 5 oz
CBK45UHVT-036	4	5	1 lb 5 oz
CBK45UHET-042	4	5	1 lb 5 oz
CBK45UHVT-042	4	5	1 lb 5 oz
CBK47UHET-036	5	5	1 lb 2 oz
CBK47UHET-042	3	5	2 lb 0 oz
CBK48MVT-036	5	4	1 lb 2 oz
CBK48MVT-042	3	5	2 lb 0 oz
CK40[C,U]T-30A	5	4	0 lb 14 oz
CK40[C,U]T-30B	5	4	0 lb 14 oz
CK40[C,U]T-36A	4	6	1 lb 5 oz
CK40[C,U]T-36B	4	6	1 lb 5 oz
CK40[C,U]T-36C	4	6	1 lb 5 oz
CK40HT-36A	6	4	0 lb 5 oz
CK40HT-36B	6	3	0 lb 0 oz
CK40HT-36C	6	4	0 lb 8 oz
CK40DT-30/36B	4	4	0 lb 13 oz
CK40DT-30/36C	4	4	0 lb 13 oz
CK40DT-42B	3	6	1 lb 6 oz
CK40DT-48C	3	7	1 lb 11 oz
42K HP			
CBK43UHE-042	4	4	0 lb 0 oz
CBK43UHE-048	4	5	0 lb 6 oz
CBK45UHET-042	4	4	0 lb 0 oz
CBK45UHVT-042	4	4	0 lb 0 oz
CBK45UHET-048	5	5	0 lb 6 oz
CBK45UHVT-048	5	5	0 lb 6 oz
CBK47UHET-042	5	4	1 lb 6 oz
CBK47UHET-048	5	4	1 lb 6 oz
CBK48MVT-042	5	4	1 lb 6 oz
CBK48MVT-048	5	4	1 lb 6 oz
CK40[C,U]T-48B	6	5	0 lb 6 oz
CK40[C,U]T-48C	6	5	0 lb 6 oz
CK40[C,U]T-49C	5	5	0 lb 11 oz
CK40HT-42B	4	5	1 lb 8 oz
CK40HT-42C	3	3	0 lb 2 oz
CK40HT-48B	3	3	0 lb 1 oz
CK40HT-48C	4	3	0 lb 2 oz
CK40DT-42B	3	3	0 lb 2 oz
CK40DT-48C	3	5	0 lb 7 oz

Indoor Matchup	Subcool		Additional Charge
	Heat (±3ºF)	Cool (±1ºF)	lbs/oz
48K HP			
CBK43UHE-042	4	4	0 lb 0 oz
CBK43UHE-048	4	5	0 lb 6 oz
CBK45UHET-042	4	4	0 lb 0 oz
CBK45UHVT-042	4	4	0 lb 0 oz
CBK45UHET-048	5	5	0 lb 6 oz
CBK45UHVT-048	5	5	0 lb 6 oz
CBK47UHET-042	5	4	1 lb 6 oz
CBK47UHET-048	5	4	1 lb 6 oz
CBK48MVT-042	5	4	1 lb 6 oz
CBK48MVT-048	5	4	1 lb 6 oz
CK40[C,U]T-48B	6	5	0 lb 6 oz
CK40[C,U]T-48C	6	5	0 lb 6 oz
CK40[C,U]T-49C	5	5	0 lb 11 oz
CK40HT-42B	4	5	1 lb 8 oz
CK40HT-42C	3	3	0 lb 2 oz
CK40HT-48B	3	3	0 lb 1 oz
CK40HT-48C	4	3	0 lb 2 oz
CK40DT-42B	3	3	0 lb 2 oz
CK40DT-48C	3	5	0 lb 7 oz
60K HP			
CBK43UHE-060	5	8	0 lb 10 oz
CBK45UHET-060	5	10	0 lb 10 oz
CBK45UHVT-060	5	10	0 lb 10 oz
CBK47UHET-060	5	9	1 lb 7 oz
CBK48MVT-060	5	9	1 lb 7 oz
CK40[C,U]T-50/60C	5	9	0 lb 0 oz
CK40[C,U]T-60C	5	9	0 lb 10 oz
CK40[C,U]T-60D	5	10	0 lb 5 oz
CK40HT-51/61C	5	10	1 lb 3 oz
CK40HT-60D	5	8	1 lb 3 oz
CK40DT-50/60C	5	10	0 lb 8 oz
CK40DT-60D	5	10	0 lb 8 oz

NOTE: For AHRI Certified system match-ups and expanded ratings, visit www.LennoxPros.com.

Component Testing

Table 11. HFC-454B Temperature (°F) Pressure (Psig)

Pressure (psig)	Saturated Liquid Temp (ºF)	Saturated Vapor Temp (ºF)	Pressure (psig)	Saturated Liquid Temp (ºF)	Saturated Vapor Temp (ºF)	Pressure (psig)	Saturated Liquid Temp (ºF)	Saturated Vapor Temp (ºF)	Pressure (psig)	Saturated Liquid Temp (ºF)	Saturated Vapor Temp (ºF)
0	-58.9	-57.1	158	58.9	61.3	272	93.0	95.4	362	113.3	115.6
25	-19.2	-17.2	160	59.6	62.0	274	93.5	95.9	364	113.8	116.0
30	-13.9	-11.8	165	61.4	63.8	276	94.0	96.4	366	114.2	116.4
35	-9.0	-6.9	170	63.1	65.5	278	94.5	96.9	368	114.6	116.8
40	-4.4	-2.3	175	64.9	67.3	280	95.0	97.4	370	115.0	117.2
45	-0.2	1.9	180	66.6	69.0	282	95.5	97.9	372	115.4	117.6
50	3.7	5.9	185	68.2	70.6	284	96.0	98.4	374	115.8	118.0
55	7.5	9.7	190	69.8	72.2	286	96.5	98.8	376	116.2	118.4
60	11.0	13.2	195	71.4	73.8	288	97.0	99.3	378	116.6	118.8
65	14.4	16.6	200	73.0	75.4	290	97.5	99.8	380	117.0	119.2
70	17.6	19.8	202	73.6	76.0	292	97.9	100.3	382	117.4	119.5
75	20.6	22.9	204	74.2	76.6	294	98.4	100.7	384	117.7	119.9
80	23.6	25.9	206	74.9	77.3	296	98.9	101.2	386	118.1	120.3
85	26.4	28.7	208	75.5	77.9	298	99.4	101.7	388	118.5	120.7
90	29.1	31.4	210	76.1	78.5	300	99.8	102.1	390	118.9	121.1
95	31.7	34.0	212	76.7	79.1	302	100.3	102.6	392	119.3	121.5
100	34.3	36.6	214	77.3	79.7	304	100.7	103.1	394	119.7	121.9
102	35.3	37.6	216	77.9	80.2	306	101.2	103.5	396	120.1	122.2
104	36.2	38.6	218	78.4	80.8	308	101.7	104.0	398	120.4	122.6
106	37.2	39.5	220	79.0	81.4	310	102.1	104.4	400	120.8	123.0
108	38.1	40.5	222	79.6	82.0	312	102.6	104.9	405	121.8	123.9
110	39.1	41.4	224	80.2	82.6	314	103.0	105.3	410	122.7	124.8
112	40.0	42.4	226	80.8	83.1	316	103.5	105.8	415	123.6	125.8
114	40.9	43.3	228	81.3	83.7	318	103.9	106.2	420	124.6	126.7
116	41.8	44.2	230	81.9	84.3	320	104.4	106.7	425	125.5	127.6
118	42.7	45.1	232	82.5	84.8	322	104.8	107.1	430	126.4	128.5
120	43.6	46.0	234	83.0	85.4	324	105.3	107.6	435	127.3	129.3
122	44.5	46.9	236	83.6	86.0	326	105.7	108.0	440	128.2	130.2
124	45.4	47.7	238	84.1	86.5	328	106.2	108.4	445	129.0	131.1
126	46.2	48.6	240	84.7	87.1	330	106.6	108.9	450	129.9	132.0
128	47.1	49.4	242	85.2	87.6	332	107.0	109.3	460	131.6	133.7
130	47.9	50.3	244	85.8	88.1	334	107.5	109.7	470	133.3	135.3
132	48.8	51.1	246	86.3	88.7	336	107.9	110.2	480	135.0	137.0
134	49.6	51.9	248	86.8	89.2	338	108.3	110.6	490	136.7	138.6
136	50.4	52.8	250	87.4	89.7	340	108.8	111.0	500	138.3	140.2
138	51.2	53.6	252	87.9	90.3	342	109.2	111.4	510	139.9	141.7
140	52.0	54.4	254	88.4	90.8	344	109.6	111.9	520	141.5	143.3
142	52.8	55.2	256	88.9	91.3	346	110.0	112.3	530	143.0	144.8
144	53.6	56.0	258	89.5	91.8	348	110.4	112.7	540	144.5	146.3
146	54.3	56.7	260	90.0	92.4	350	110.9	113.1	550	146.1	147.8
148	55.1	57.5	262	90.5	92.9	352	111.3	113.5	560	147.5	149.2
150	55.9	58.3	264	91.0	93.4	354	111.7	113.9	570	149.0	150.7
152	56.6	59.0	266	91.5	93.9	356	112.1	114.4	580	150.5	152.1
154	57.4	59.8	268	92.0	94.4	358	112.5	114.8	590	151.9	153.5
156	58.1	60.5	270	92.5	94.9	360	112.9	115.2	600	153.3	154.8

Note

1.R454B is a zerotropk blend and must be charged with liquid refrigerant only.
2.Saturated liquid temperatute is used to calculate liquid subcooling.
3.Saturated Vapor temperatute is used to calculate suction superheat.
4.See unit charging label for subcooling values and additional charging information.

Component Testing

Operating and Temperature Pressures (All Builds)

Minor variations in these pressures may be expected due to differences in installations. Significant differences could mean that the system is not properly charged or that a problem exists with some component in the system.

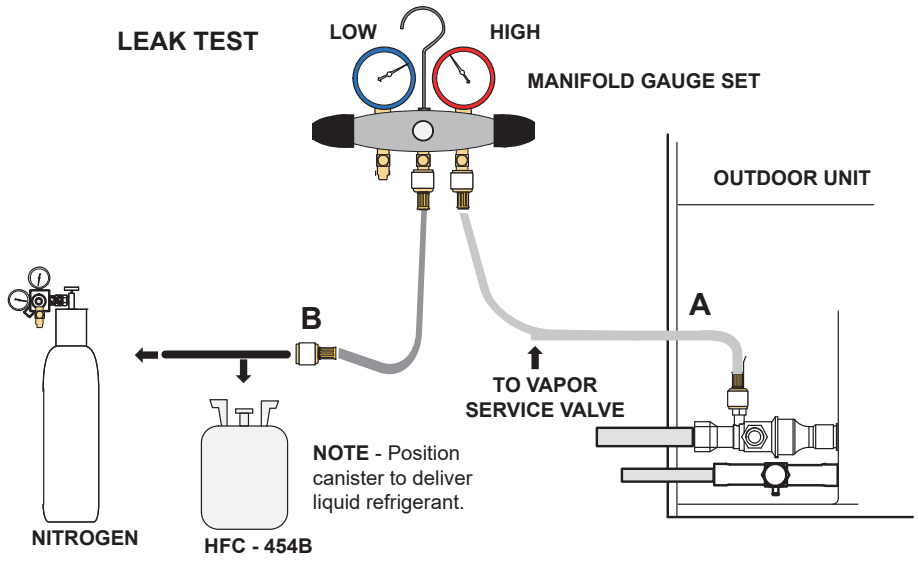
Table 12. Charge Mode Operating Pressure − Liquid ±10 and Vapor ±5 psig

ºF (ºC)	18K			24K			30k			36k		
	Liq. (PSI)	Vap. (PSI)	IDU SCFM	Liq. (PSI)	Vap. (PSI)	IDU SCFM	Liq. (PSI)	Vap. (PSI)	IDU SCFM	Liq. (PSI)	Vap. (PSI)	IDU SCFM
Heating Operation												
20(-7)	270	59	600	270	59	800	240	53	940	243	63	1080
30(-1)	289	71		289	71		250	70		261	76	
35(2)	299	77		299	77		256	77		365	82	
40(4)	306	82		306	82		261	80		271	91	
50(10)	323	94		323	94		269	89		286	110	
60(16)	335	102		335	102		261	92		300	124	
Cooling Operation												
65(18)	253	124	600	253	124	800	202	137	940	224	133	1080
70(21)	272	124		272	124		221	137		244	133	
75(24)	293	126		293	126		240	138		265	134	
80(27)	316	127		316	127		261	139		286	135	
85(29)	332	128		332	128		275	138		306	134	
90(32)	358	130		358	130		298	140		324	136	
95(35)	383	132		383	132		322	142		351	138	
100(38)	409	134		409	134		349	144		375	140	
105(41)	438	136		438	136		374	145		402	141	
110(43)	456	137		456	137		394	146		420	142	
115(46)	491	133		491	133		420	147		449	143	

ºF (ºC)	42K			48K			60k		
	Liq.(PSI)	Vap.(PSI)	IDU SCFM	Liq.(PSI)	Vap.(PSI)	IDU SCFM	Liq.(PSI)	Vap.(PSI)	IDU SCFM
Heating Operation									
20(-7)	247	59	1200	248	61	1600	241	59	1900
30(-1)	259	74		259	74		258	73	
35(2)	273	86		268	83		260	79	
40(4)	275	94		274	86		261	85	
50(10)	285	106		290	105		273	98	
60(16)	298	118		308	120		285	107	
Cooling Operation									
65(18)	228	137	1200	228	137	1600	239	137	1900
70(21)	249	137		249	137		248	137	
75(24)	270	138		270	138		265	137	
80(27)	292	139		292	139		287	138	
85(29)	312	138		312	138		301	138	
90(32)	330	140		330	140		324	138	
95(35)	358	142		358	142		347	140	
100(38)	383	144		383	144		390	145	
105(41)	410	145		410	145		396	148	
110(43)	428	146		428	146		412	148	
115(46)	458	147		458	147		438	148	

Component Testing

Leak Test and Evacuation



1. Connect Gauge Set

A - Connect the high pressure hose of an HFC-454B manifold gauge set to the vapor valve service port.
NOTE - Normally, the high pressure hose is connected to the liquid line port. However, connecting it to the vapor port better protects the manifold gauge set from high pressure damage.

B - With both manifold valves closed, connect the nitrogen container to the center port of the manifold gauge set.

2. Test For Leaks

After the line set has been connected to the indoor and outdoor units, check the line set connections and indoor unit for leaks. Use the following procedure to test for leaks:

A - With both manifold valves closed, connect the nitrogen container to the center port of the manifold gauge set.

B - Open the high pressure side of the manifold to allow HFC-454B into the line set and indoor unit. Weigh in a trace amount of HFC-454B. [A trace amount is a maximum of two ounces (57 g) refrigerant or three pounds (31 kPa) pressure.] Close the valve on the HFC-454B cylinder and the valve on the high pressure side of the manifold gauge set. Disconnect the HFC-454B cylinder.

C - Connect a cylinder of nitrogen with a pressure regulating valve to the center port of the manifold gauge set.

D - Adjust nitrogen pressure to 150 psig (1034 kPa). Open the valve on the high side of the manifold gauge set in order to pressurize the line set and the indoor unit.

E - After a few minutes, open one of the service valve ports and verify that the refrigerant added to the system earlier is measurable with a leak detector.

F - After leak testing, disconnect gauges from service ports.
NOTE - Service valve cores remain removed for the following evacuation procedure.

3. Connect Gauge Set
NOTE - Remove cores from service valves (if not already done).

A - Connect low side of manifold gauge set with 1/4 SAE in-line tee to vapor line service valve.

B - Connect high side of manifold gauge set to liquid line service valve.

C - Connect available micron gauge connector on the 1/4 SAE in-line tee.

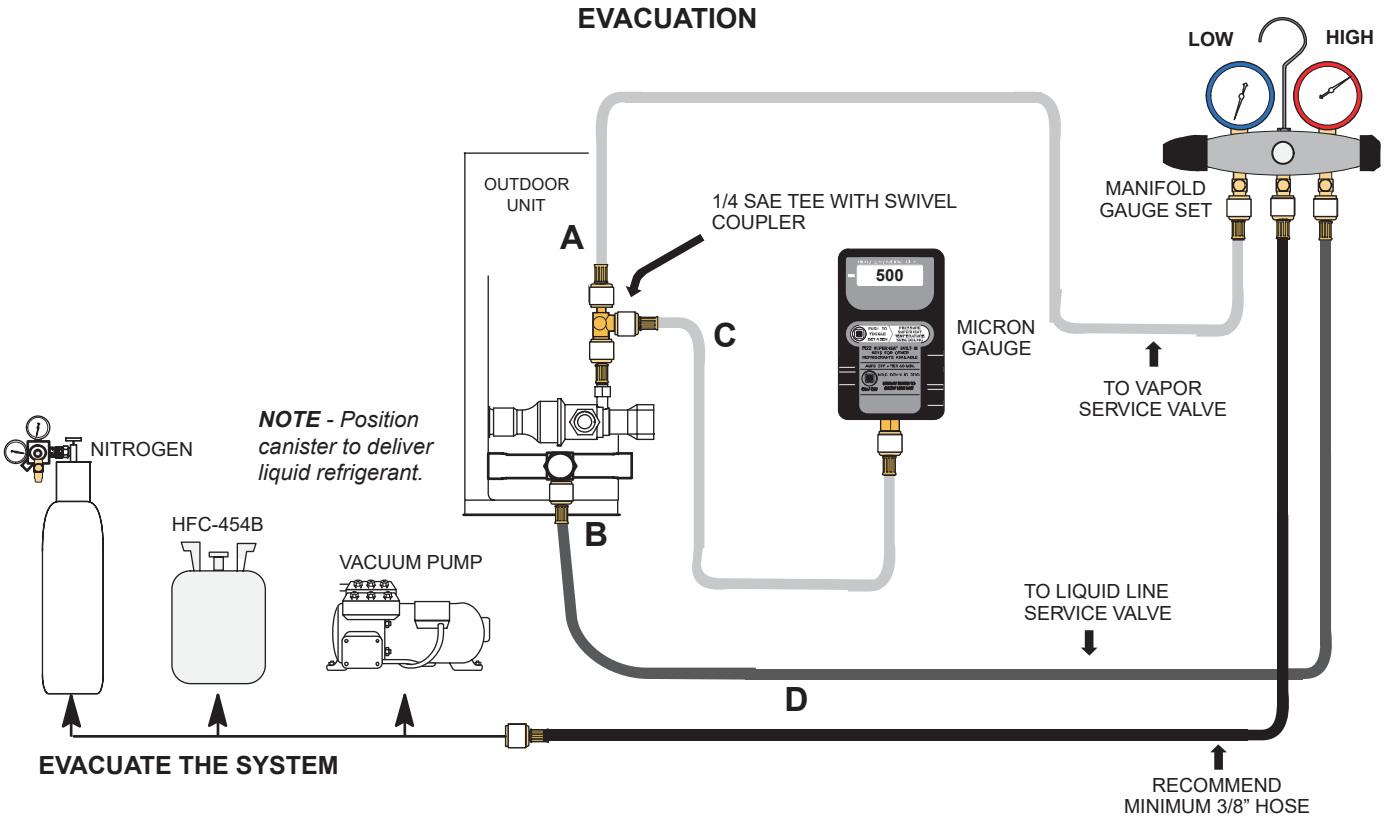
D - Connect the vacuum pump (with vacuum gauge) to the center port of the manifold gauge set. The center port line will be used later for both the HFC-454B and nitrogen containers.

Component Testing

Leak Test and Evacuation (Cont.)

⚠WARNING

Possible equipment damage. Avoid deep vacuum operation. Do not use compressors to evacuate a system. Extremely low vacuum can cause internal arcing and compressor failure. Damage caused by deep vacuum operation will void warranty.



Component Testing

Leak Test and Evacuation (Cont.)

4. EVACUATE THE SYSTEM

A - Open both manifold valves and start the vacuum pump.

B - Evacuate the line set and indoor unit until a slight vacuum is indicated on the micron gauge (approximately 23,000 microns or 29.01 in. / 73.69 cm of mercury).
NOTE - During the early stages of evacuation, it is desirable to close the manifold gauge valve at least once. A rapid rise in pressure indicates a relatively large leak. If this occurs, repeat the leak testing procedure.
NOTE - The term absolute pressure means the total actual pressure above absolute zero within a given volume or system. Absolute pressure in a vacuum is equal to atmospheric pressure minus vacuum pressure.

C - When the absolute pressure reaches 23,000 microns (29.01 in. / 73.69 cm of mercury), perform the following:

- Close manifold gauge valves.
- Close valve on vacuum pump.
- Turn off vacuum pump.
- Disconnect manifold gauge center port hose from vacuum pump.
- Attach manifold center port hose to a nitrogen cylinder with pressure regulator set to 150 psig (1034 kPa) and purge the hose.
- Open manifold gauge valves to break the vacuum in the line set and indoor unit.
- Close manifold gauge valves.

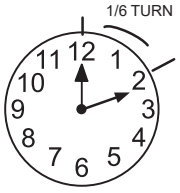
D - Shut off the nitrogen cylinder and remove the manifold gauge hose from the cylinder. Open the manifold gauge valves to release the nitrogen from the line set and indoor unit.

E - Reconnect the manifold gauge to the vacuum pump, turn the pump on, and continue to evacuate the line set and indoor unit until the absolute pressure does not rise above 500 microns (29.9 in. / 75.95 cm of mercury) within a 20-minute period after shutting off the vacuum pump and closing the manifold gauge valves.

F - When the absolute pressure requirement above has been met, disconnect the manifold hose from the vacuum pump and connect it to a cylinder of HFC-454B positioned to deliver liquid refrigerant. Open the manifold gauge valve 1 to 2 psig (6.9 to 13.8 kpa) in order to release the vacuum in the line set and indoor unit.

G - Perform the following:

- Close manifold gauge valves.
- Shut off HFC-454B cylinder.
- Reinstall service valve cores by removing manifold hose from service valve. Quickly install cores with core tool while maintaining a positive system pressure.
- Replace stem caps and finger tighten them, then tighten an additional one-sixth (1/6) of a turn as illustrated.



H - Open suction service valve first before liquid valve to release the unit charge into the system. Replace valve caps and tighten (8 ft. lb. / 10.85 N.m). Caps are the primary seal.

Component Testing

Standard Line Set Installation: Pipe Connection

- Attach the flare nuts to the outdoor Service Valve, Torque the fittings according to the specifications shown in the torque chart below.

NOTE: Forced fastening without careful centering may damage the threads and cause a refrigerant leak.

Pipe Diameter(ø)	Fastening torque
Liquid side 6.35mm(1/4”)	18N.m/13.3Ft.lbs
Liquid/Gas side 9.52mm(3/8”)	42 N.m/30.1Ft.lbs
Gas side 12.7mm(1/2”)	55N.m/40.6Ft.lbs
Gas side 15.88mm(5/8”)	60 N.m/44.3Ft.lbs
Gas side 19.05mm(3/4”)	100N.m/73.8Ft.lbs

- Add additional refrigerant charge if needed before you open outdoor service valves.
- Record the amount of refrigerant added in permanent ink at the line set length location entered earlier.

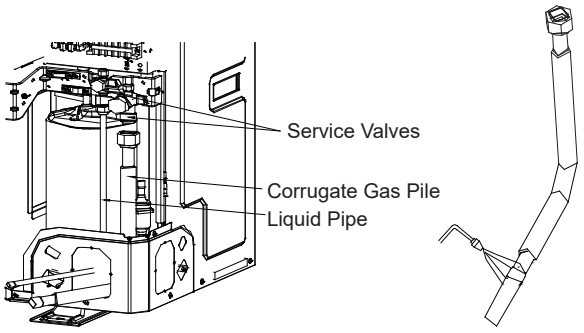


Figure 12.

- Two wrenches are required to join the flare connection; one standard wrench and one torque wrench adjusted to the proper settings.
- Repeat the process for attaching the other end of the line set.

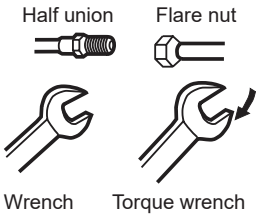


Figure 13.

Pipe Matching Capabilities of Pipe Extensions

Model	Extension	Extension Type	Extension Length (in)	Line Set Receiving End Pipe Diameter (in)	Flared End Pipe Diameter (in)	Line Set Connection Type
18K / 24K	Suction Extension	Rigid	7-3/4	3/4	5/8	Braze and Mechanical
	Liquid Extension			3/8	3/8	Braze and Mechanical
30K / 36K	Suction Extension			3/4	5/8	Braze and Mechanical
					3/4	Braze
	Liquid Extension			3/8	3/8	Braze and Mechanical
42K / 48K / 60K	Suction Extension			3/4	3/4	Braze and Mechanical
						Braze
	Liquid Extension			3/8	3/8	Braze and Mechanical

IMPORTANT: A 5/16” female by 1/4” male adapter will be required to connect traditional gauge hoses to the service valves.

NOTE: It shows the gauge connection will need to have the high side gauge hose connected to the high side liquid valve so both lines can be evacuated and leak checked.

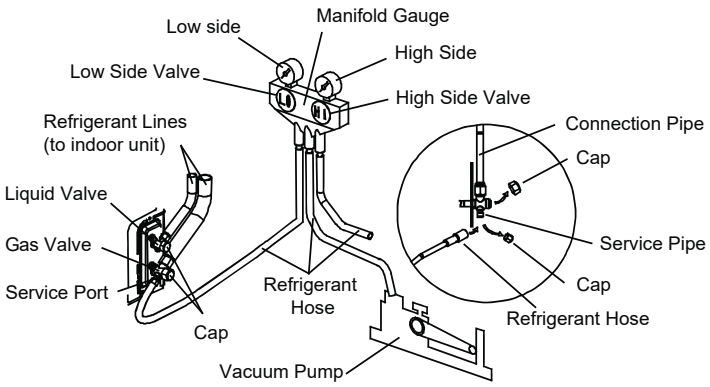
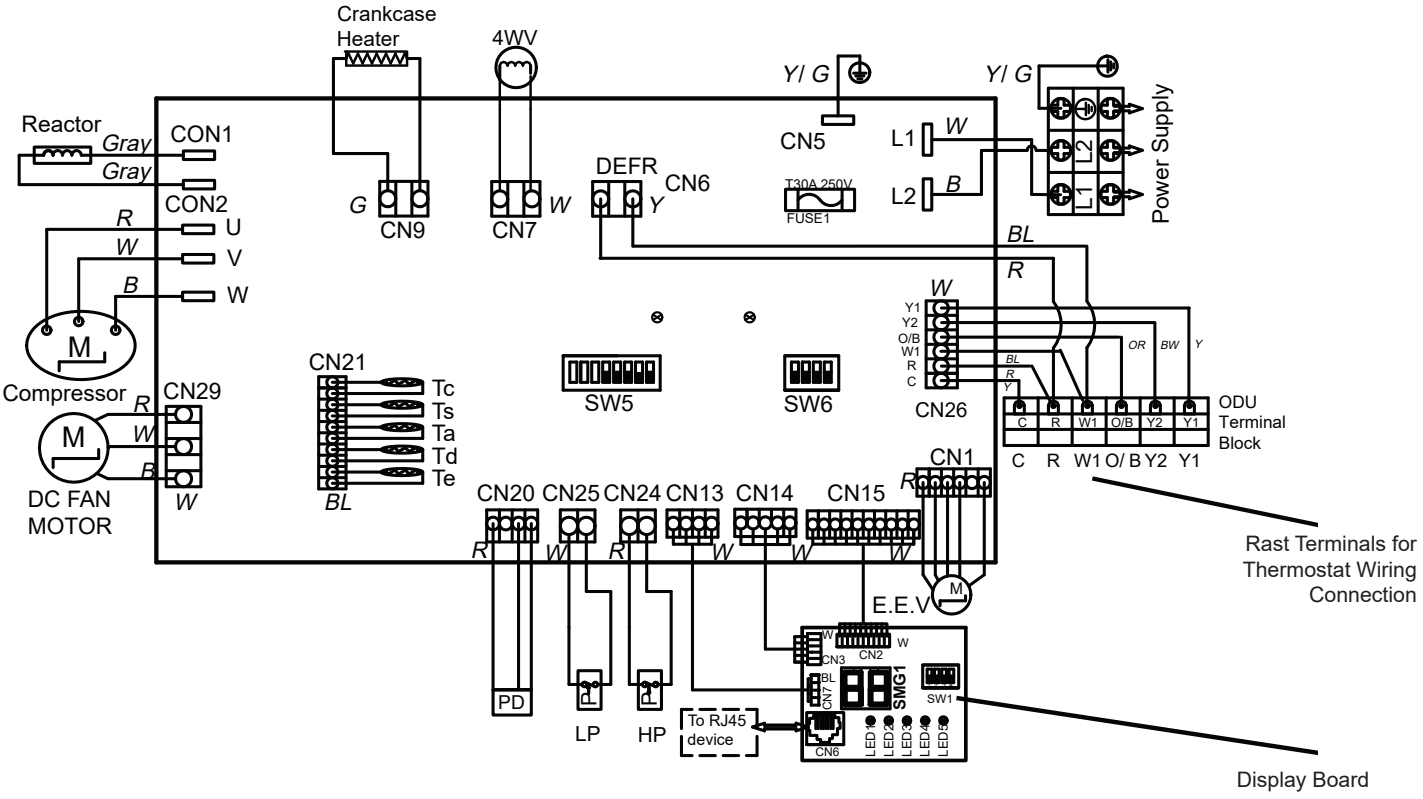


Figure 14.

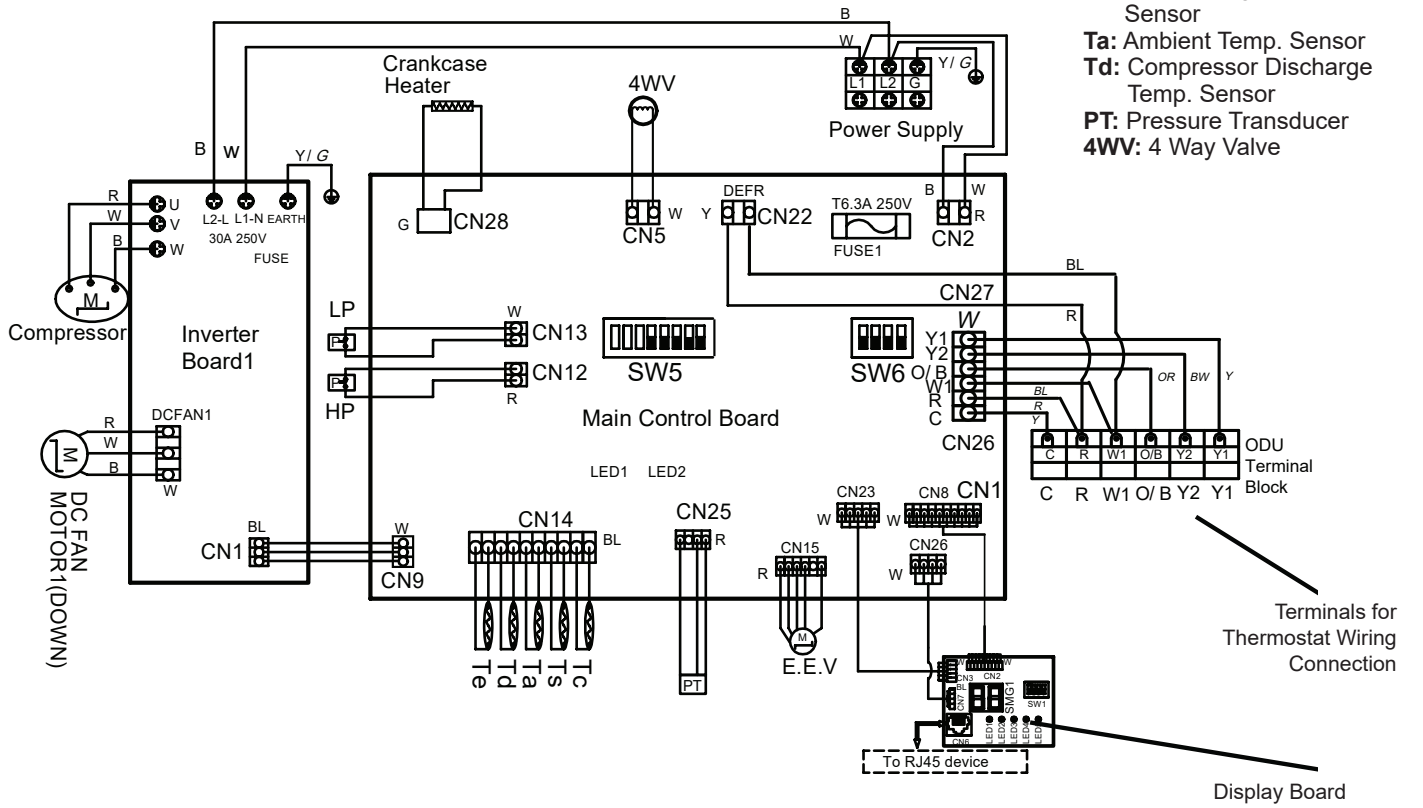
Wiring Diagrams

18K/24K/30K/36K/42K/48K



60K

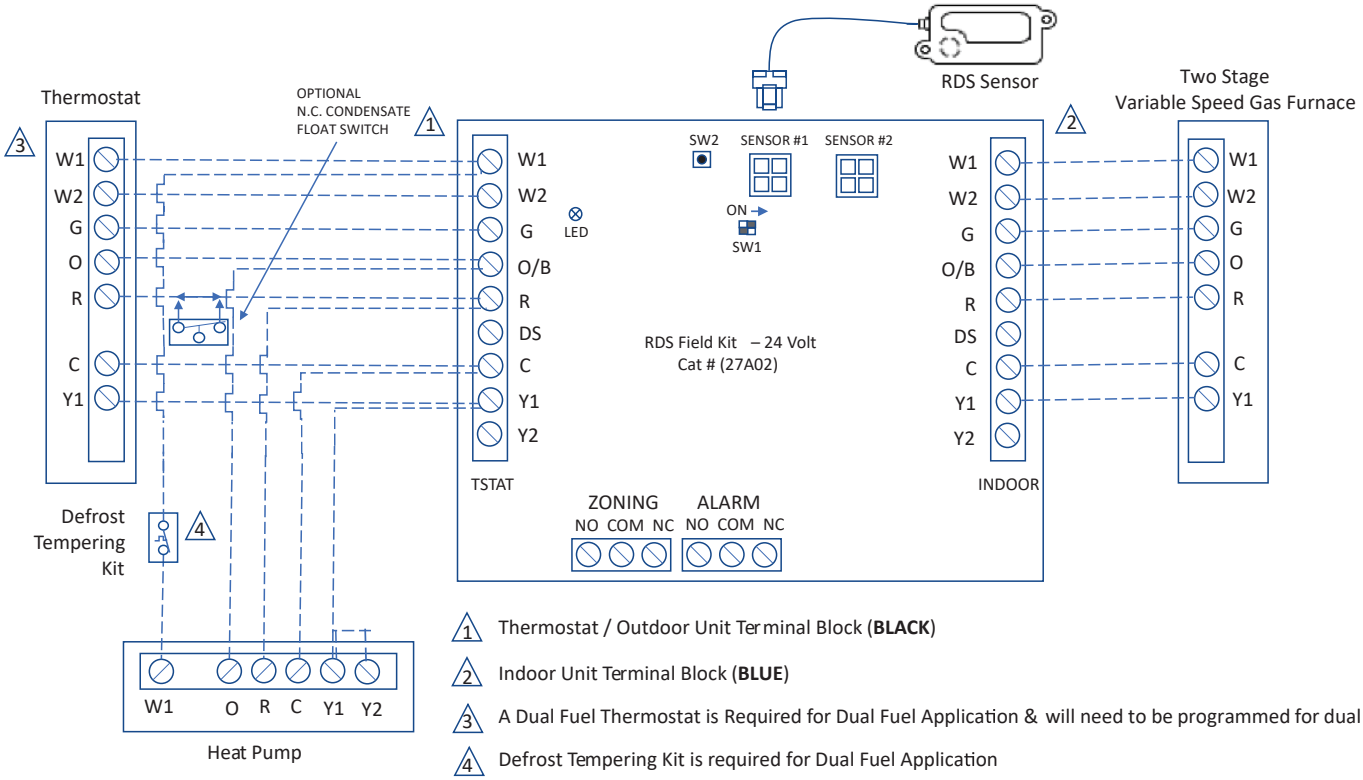
LP/HP: Low / High Pressure Switch
Tc: Condensing Temp. Sensor
Ts: Condensing Suction Temp. Sensor
Ta: Ambient Temp. Sensor
Td: Compressor Discharge Temp. Sensor
PT: Pressure Transducer
4WV: 4 Way Valve



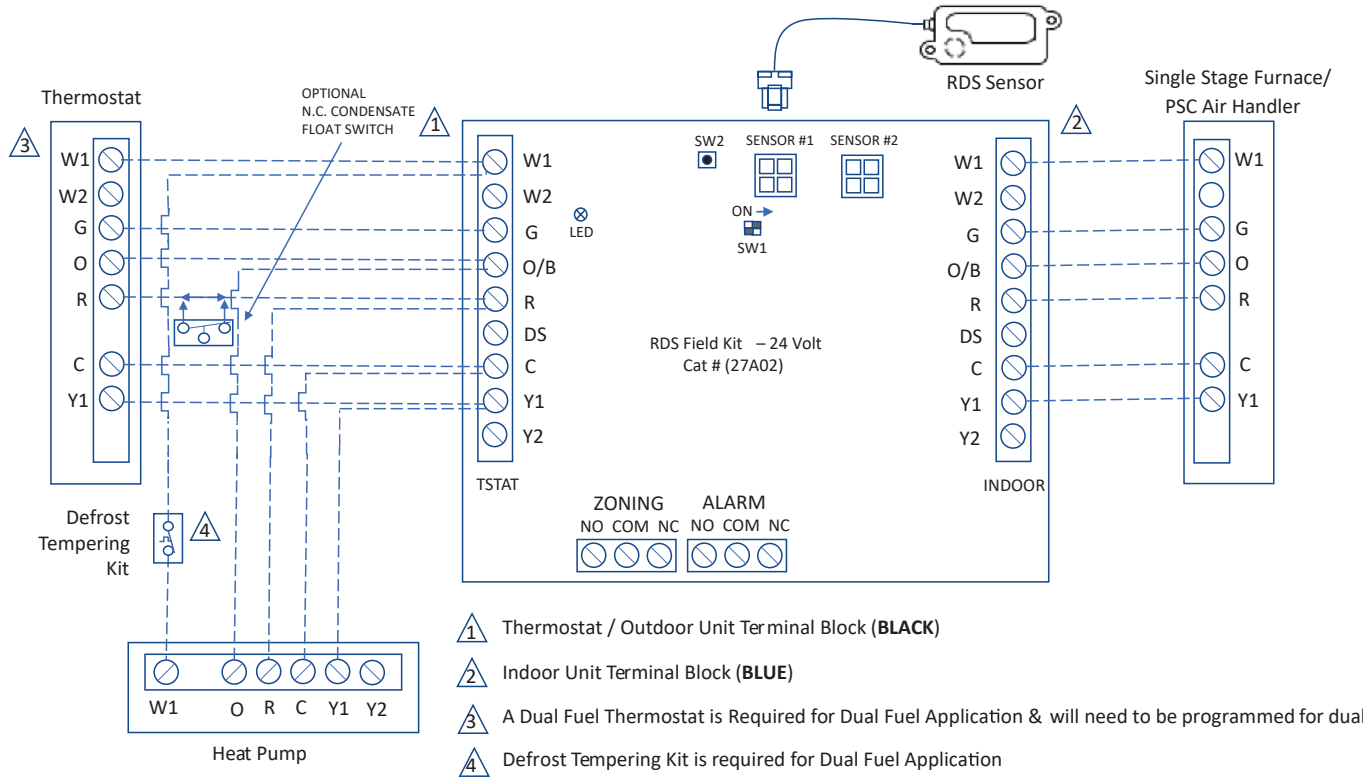
Outdoor/Indoor Wiring Connections

RDS Wiring Diagrams for Heat Pumps

RDS Wiring Diagrams for Single Stage Heat Pump with Air Handler



1. Thermostat / Outdoor Unit Terminal Block (**BLACK**)
2. Indoor Unit Terminal Block (**BLUE**)
3. A Dual Fuel Thermostat is Required for Dual Fuel Application & will need to be programmed for dual fuel
4. Defrost Tempering Kit is required for Dual Fuel Application

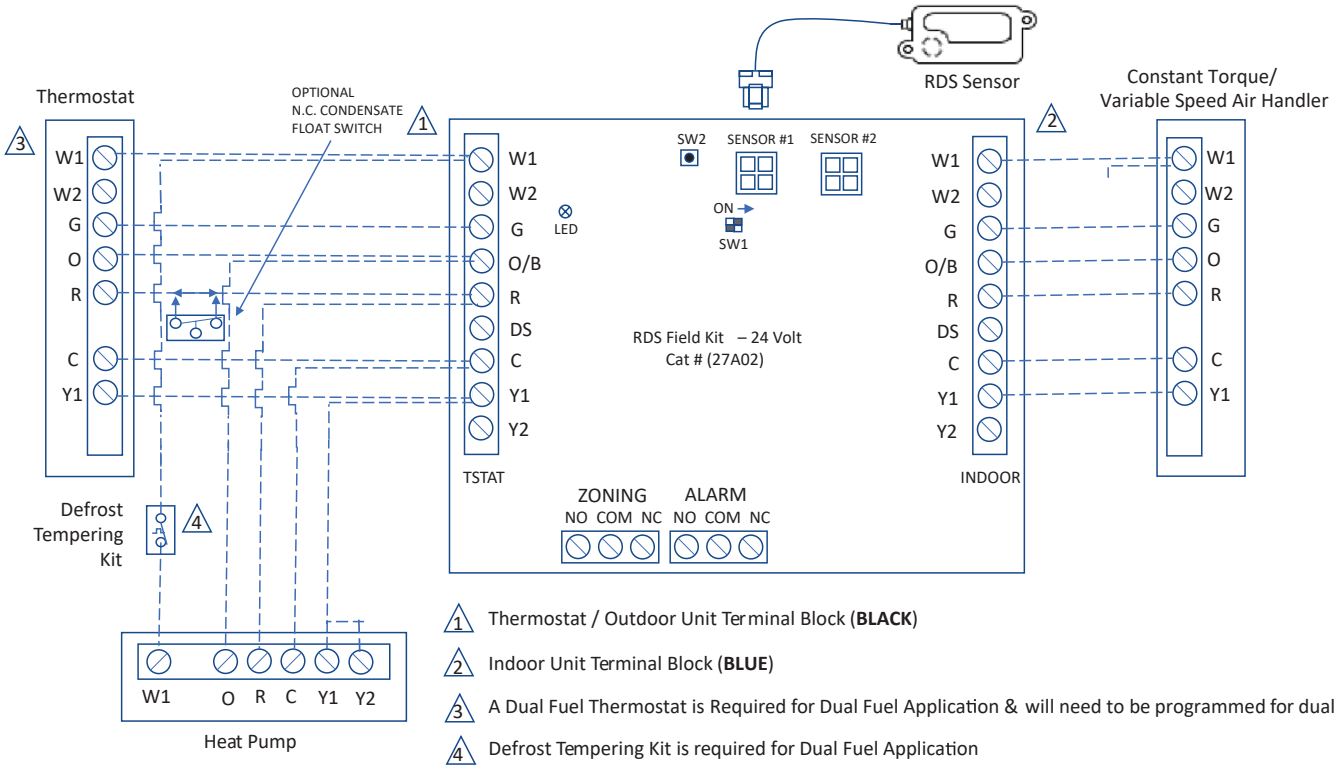


1. Thermostat / Outdoor Unit Terminal Block (**BLACK**)
2. Indoor Unit Terminal Block (**BLUE**)
3. A Dual Fuel Thermostat is Required for Dual Fuel Application & will need to be programmed for dual fuel
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Outdoor/Indoor Wiring Connections

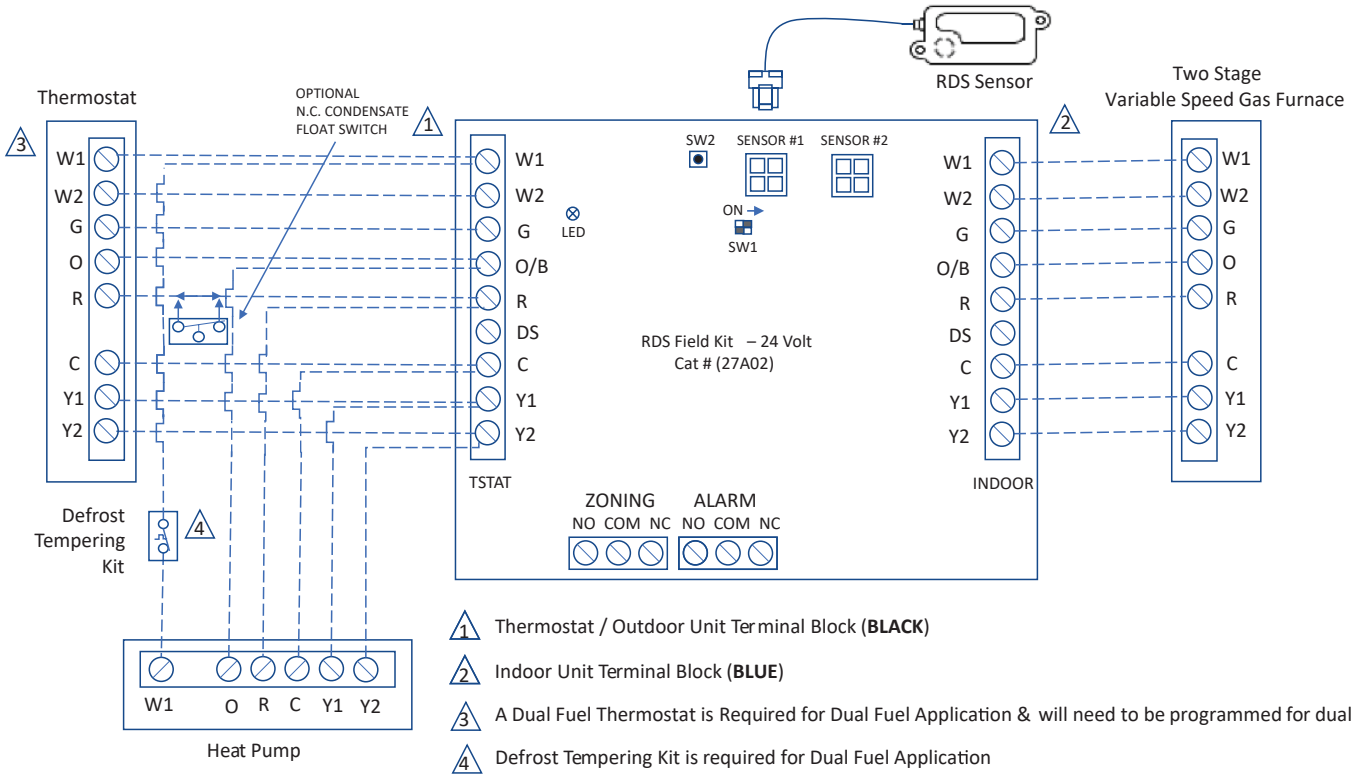
RDS Wiring Diagrams for Heat Pumps

RDS Wiring Diagrams for Single Stage Heat Pump with Air Handler (Cont.)



1. Thermostat / Outdoor Unit Terminal Block (**BLACK**)
2. Indoor Unit Terminal Block (**BLUE**)
3. A Dual Fuel Thermostat is Required for Dual Fuel Application & will need to be programmed for dual fuel
4. Defrost Tempering Kit is required for Dual Fuel Application

RDS Wiring Diagrams for Two Stage Heat Pump with Two Stage Furnace/Air Handler

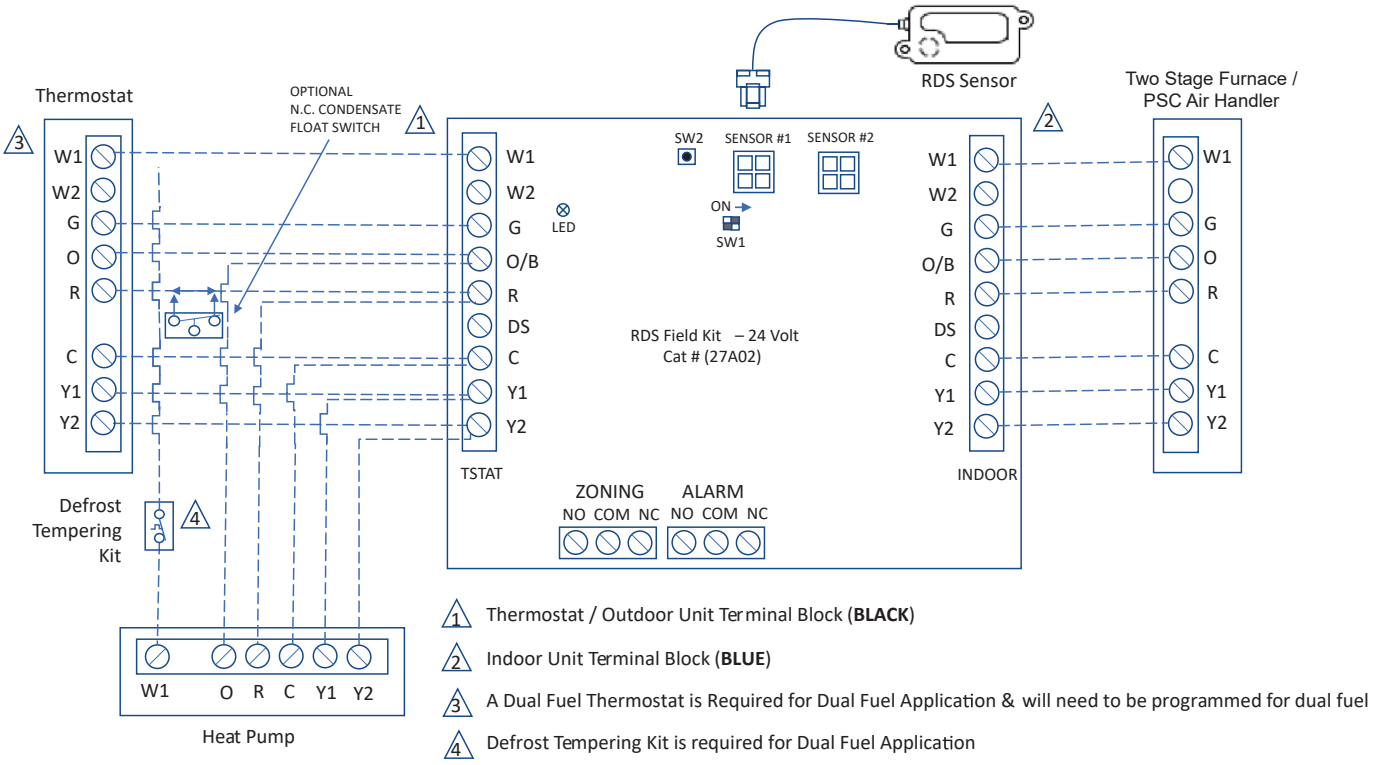


1. Thermostat / Outdoor Unit Terminal Block (**BLACK**)
2. Indoor Unit Terminal Block (**BLUE**)
3. A Dual Fuel Thermostat is Required for Dual Fuel Application & will need to be programmed for dual fuel
4. Defrost Tempering Kit is required for Dual Fuel Application

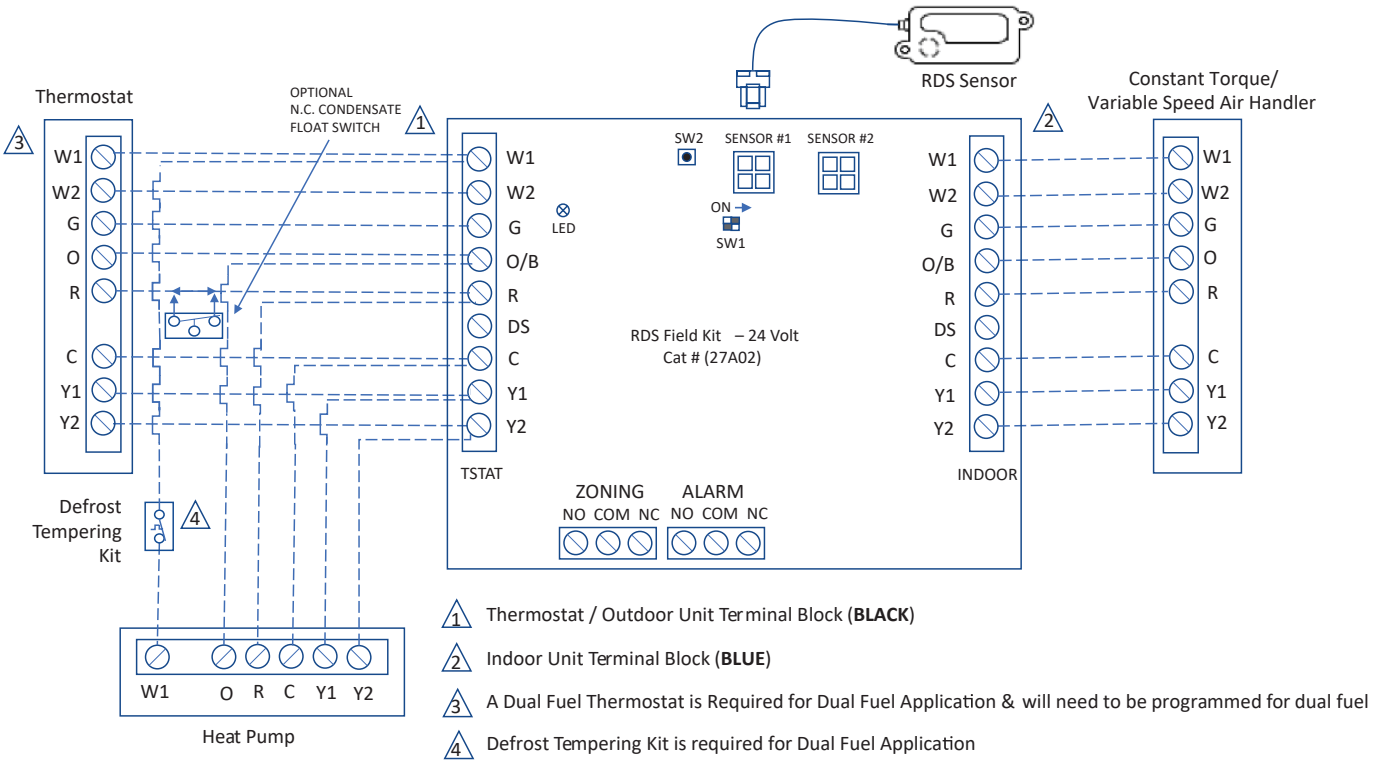
Outdoor/Indoor Wiring Connections

RDS Wiring Diagrams for Heat Pumps

RDS Wiring Diagrams for Two Stage Heat Pump with Two Stage Furnace/Air Handler (Cont.)



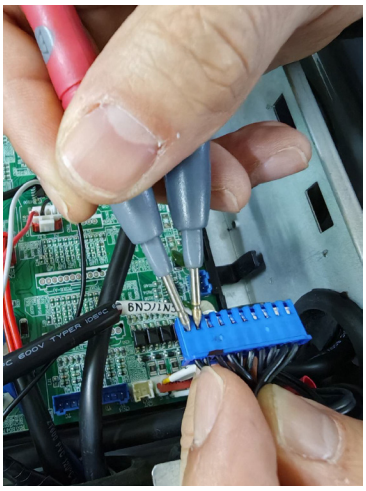
1. Thermostat / Outdoor Unit Terminal Block (**BLACK**)
2. Indoor Unit Terminal Block (**BLUE**)
3. A Dual Fuel Thermostat is Required for Dual Fuel Application & will need to be programmed for dual fuel
4. Defrost Tempering Kit is required for Dual Fuel Application



1. Thermostat / Outdoor Unit Terminal Block (**BLACK**)
2. Indoor Unit Terminal Block (**BLUE**)
3. A Dual Fuel Thermostat is Required for Dual Fuel Application & will need to be programmed for dual fuel
4. Defrost Tempering Kit is required for Dual Fuel Application

Sensor Resistance Tables

Model	Outdoor Ambient Temperature Sensor	
	Resistance Value	Spare Part Number
ML15KSPV-018-230 ML15KSPV-024-230 ML15KSPV-030-230 ML15KSPV-036-230 ML15KSPV-042-230 ML15KSPV-048-230 ML15KSPV-060-230	TE B25/50= 3700K ±3%, R25= 10KΩ ±3%TD B25/80= 4450K ±3%, R80= 50KΩ ±3% Tao B25/50= 3700K ±3%, R25= 10KΩ ±3% TS B25/50= 3700K ±3%, R25= 10KΩ ±3% TC B25/50= 3700K ±3%, R25= 10KΩ ±3%	WJ26X37521



Model	PCB	Fuse
ML15KSPV-018-230 ML15KSPV-024-230	WJ26X37348	pin T30A250VAC ceramic tube package
ML15KSPV-030-230 ML15KSPV-036-230 ML15KSPV-042-230 ML15KSPV-048-230	WJ26X37367	pin T30A250VAC ceramic tube package
ML15KSPV-060-230	WJ26X37360	T6.3A250VAC anti-explosion(main control board) pin 30A250VAC ceramic explosion-proof(inverter board)

Sensor Resistance Tables

B(25/50)=3700K±3%, R25=10kΩ±3%				
Temp		Resistance (kΩ)		
C°	F°	Rmax	R(t)Normal	Rmin
-30	-22	144.35	134.907	125.464
-29	-20.2	136.519	127.675	118.831
-28	-18.4	129.381	121.081	112.781
-27	-16.6	122.638	114.849	107.06
-26	-14.8	116.268	108.958	101.648
-25	-13	110.249	103.388	96.527
-24	-11.2	104.563	98.123	91.683
-23	-9.4	99.19	93.144	87.098
-22	-7.6	94.111	88.435	82.759
-21	-5.8	89.311	83.982	78.653
-20	-4	84.518	79.529	74.54
-19	-2.2	80.484	75.785	71.086
-18	-0.4 76.	428	72.015	67.602
-17	1.4	72.591	68.447	64.303
-16	3.2	68.963	65.071	61.179
-15	5	65.53	61.874	58.218
-14	6.8	62.283	58.848	55.413
-13	8.6	59.21	55.983	52.756
-12	10.4	56.3	53.269	50.238
-11	12.2	53.547	50.699	47.851
-10	14	50.94	48.264	45.588
-9	15.8	48.472	45.957	43.442
-8	17.6	46.134	43.77	41.406
-7	19.4	43.918	41.697	39.476
-6	21.2	41.819	39.731	3 7.643
-5	23	39.83	37.868	35.906
-4	24.8	37.944	36.1	34.256
-3	26.6	36.157	34.423	32.689
-2	28.4	34.462	32.832	31.202
-1	30.2	32.854	31.322	29.79
0	32	31.362	29.92	28.478
1	33.8	29.881	28.527	27.173
2	35.6	28.507	27.234	25.961
3	37.4	27.202	26.006	24.81
4	39.2	25.965	24.84	23.715
5	41 24.	788.23	731	22.674
6	42.8	23.672	22.678	21.684
7	44.6	22.61	21.676	20.742
8	46.4	21.601	20.723	19.845
9	48.2	20.642	19.817	18.992
10	50	19.73	18.955	18.18
11	51.8	18.864	18.135	17.406
12	53.6	18.039	17.354	16.669
13	55.4	17.254	16.611	15.968

Sensor Resistance Tables

14	57.2	16.507	15.903	15.299
15	59	15.797	15.229	14.661
16	60.8	15.12	14.587	14.054
17	62.6	14.476	13.975	13.474
18	64.4	13.862	13.392	12.922
19	66.2	13.277	12.836	12.395
20	68	12.72	12.306	11.892
21	69.8	12.189	11.801	11.413
22	71.6	11.683	11.319	10.955
23	73.4	11.2	10.858	10.516
24	75.2	10.739	10.419	10.099
25	77	10.3	10	9.7
26	78.8	9.894	9.6	9.306
27	80.6 9.	505	9.217	8.929
28	82.4	9.134	8.852	8.57
29	84.2	8.779	8.503	8.227
30	86	8.441	8.17	7.899
31	87.8	8.116	7.851	7.586
32	89.6	7.805	7.546	7.287
33	91.4	7.509	7.255	7.001
34	93.2	7.225	6.976	6.727
35	95	6.953	6.71	6.467
36	96.8	6.692	6.454	6.216
37	98.6	6.443	6.21	5.977
38	100.4	6.204	5.976	5.748
39	102.2	5.976	5.753	5.53
40	104.5	756.5	538	5.32
41	105.8	5.546	5.333	5.12
42	107.6	5.345	5.136	4.927
43	109.4	5.151	4.947	4.743
44	111.2	4.967	4.767	4.567
45	113	4.788	4.593	4.398
46	114.8	4.618	4.427	4.236
47	116.6	4.455	4.268	4.081
48	118.4	4.298	4.115	3.932
49	120.2	4.147	3.968	3.789
50	122	4.004	3.829	3.654
51	123.8	3.863	3.692	3.521
52	125.6	3.729	3.562	3.395
53	127.4	3.601	3.438	3.275
54	129.2	3.478	3.318	3.158
55	131 3.	359 3.	203	3.047
56	132.8	3.246	3.093	2.94
57	134.6	3.136	2.987	2.838
58	136.4	3.031	2.885	2.739
59	138.2	2.93	2.787	2.644
60	140	2.833	2.693	2.553

Sensor Resistance Tables

61	141.8	2.739	2.602	2.465
62	143.6	2.649	2.515	2.381
63	145.4	2.562	2.431	2.3
64	147.2	2.478	2.35	2.222
65	149	2.398	2.273	2.148
66	150.8	2.32	2.198	2.076
67	152.6	2.246	2.126	2.006
68	154.4	2.174	2.057	1.94
69	156.2	2.104	1.99	1.876
70	158	2.038	1.926	1.814
71	159.8	1.974	1.864	1.754
72	161.6	1.912	1.805	1.698
73	163.4	1.853	1.748	1.643
74	165.2	1.795	1.692	1.589
75	167 1.	739 1.	639 1.	539
76	168.8	1.686	1.588	1.49
77	170.6	1.634	1.538	1.442
78	172.4	1.585	1.491	1.397
79	174.2	1.537	1.445	1.353
80	176	1.49	1.4	1.31
81	177.8	1.445	1.357	1.269
82	179.6	1.402	1.316	1.23
83	181.4	1.361	1.276	1.191
84	183.2	1.321	1.238	1.155
85	185	1.281	1.2	1.119
86	186.8	1.244	1.165	1.086
87	188.6	1.209	1.131	1.053
88	190.4	1.173	1.097	1.021
89	192.2	1.14	1.065	0.99
90	194	1.107	1.034	0.961
91	195.8	1.076	1.004	0.932
92	197.6	1.045	0.975	0.905
93	199.4	1.016	0.947	0.878
94	201.2	0.987	0.92	0.853
95	203 0.	96	0.894	0.828
96	204.8	0.934	0.869	0.804
97	206.6	0.907	0.844	0.781
98	208.4	0.883	0.821	0.759
99	210.2	0.859	0.798	0.737
100	212	0.836	0.776	0.716
101	213.8	0.814	0.755	0.696
102	215.6	0.791	0.734	0.677
103	217.4	0.771	0.715	0.659
104	219.2	0.75	0.695	0.64
105	221	0.731	0.677	0.623

Sensor Resistance Tables

B25/80=4450K±3%, R80=50kΩ±3%				
Temp		Resistance (kΩ)		
C°	F°	Rmax	R(t)Normal	Rmin
-40	-40	23982.342	21280.977	18579.613
-39	-38.2	22397.462	19890.917	17384.372
-38	-36.4	20925.744	18599.155	16272.567
-37	-34.6	19558.506	17398.211	15237.916
-36	-32.8	18287.777	16281.212	14274.647
-35	-31	17106.237	15241.843	13377.45
-34	-29.2	16007.159	14274.298	12541.437
-33	-27.4	14984.359	13373.234	11762.109
-32	-25.6	14032.148	12533.735	11035.322
-31	-23.8	13145.291	11751.273	10357.255
-30	-22	12318.968	11021.678	9724.388
-29	-20.2	11551.311	10343.407	9135.504
-28	-18.4	10835.229	9710.234	8585.239
-27	-16.6	10167.003	9118.935	8070.867
-26	-14.8	9543.2	8566.532	7589.865
-25	-13	8960.652	8050.276	7139.901
-24	-11.2	8416.43	7567.624	6718.818
-23	-9.4	7907.828	7116.224	6324.62
-22	-7.6	7432.345	6693.901	5955.457
-21	-5.8	6987.666	6298.642	5609.618
-20	-4	6571.65	5928.583	5285.516
-19	-2.2	6187.164	5586.374	4985.585
-18	-0.4	5826.712	5265.313	4703.915
-17	1.4	5488.692	4964.004	4439.315
-16	3.2	5171.616	4681.148	4190.68
-15	5	4874.1	4415.539	3956.978
-14	6.8	4594.858	4166.054	3737.249
-13	8.6	4332.694	3931.647	3530.6
-12	10.4	4086.494	3711.346	3336.198
-11	12.2	3855.222	3504.244	3153.266
-10	14	3637.915	3309.498	2981.082
-9	15.8	3433.673	3126.321	2818.969
-8	17.6	3241.661	2953.98	2666.299
-7	19.4	3061.098	2791.79	2522.482
-6	21.2	2891.257	2639.114	2386.971
-5	23	2731.46	2495.357	2259.253
-4	24.8	2581.076	2359.962	2138.848
-3	26.6	2439.514	2232.412	2025.31
-2	28.4	2306.222	2112.221	1918.22
-1	30.2	2180.688	1998.938	1817.187
0	32	2094.972	1921.993	1749.014
1	33.8	1975.099	1813.265	1651.431
2	35.6	1863.127	1711.646	1560.165
3	37.4	1758.449	1616.593	1474.737
4	39.2	1660.513	1527.611	1394.709
5	41	1568.817	1444.25	1319.683
6	42.8	1482.897	1366.096	1249.295

Sensor Resistance Tables

7	44.6	1402.336	1292.773	1183.21
8	46.4	1326.746	1223.935	1121.124
9	48.2	1255.774	1159.265	1062.756
10	50	1189.098	1098.474	1007.85
11	51.8	1126.419	1041.293	956.167
12	53.6	1067.463	987.477	907.491
13	55.4	1011.977	936.799	861.621
14	57.2	959.732	889.052	818.372
15	59	910.51	844.042	777.574
16	60.8	864.114	801.59	739.066
17	62.6	820.361	761.533	702.705
18	64.4	779.081	723.717	668.353
19	66.2	740.117	688.001	635.885
20	68	703.323	654.254	605.185
21	69.8	668.565	622.355	576.145
22	71.6	635.715	592.189	548.663
23	73.4	604.657	563.651	522.645
24	75.2	575.282	536.644	498.006
25	77	547.49	511.076	474.662
26	78.8	521.186	486.862	452.538
27	80.6	496.281	463.922	431.563
28	82.4	472.693	442.182	411.671
29	84.2	450.344	421.572	392.8
30	86	429.165	402.028	374.891
31	87.8	409.087	383.489	357.891
32	89.6	390.047	365.898	341.749
33	91.4	371.986	349.201	326.416
34	93.2	354.85	333.349	311.848
35	95	338.586	318.295	298.004
36	96.8	323.147	303.995	284.843
37	98.6	308.485	290.407	272.329
38	100.4	294.559	277.493	260.427
39	102.2	281.328	265.216	249.104
40	104	268.753	253.541	238.329
41	105.8	256.801	242.437	228.073
42	107.6	245.438	231.873	218.308
43	109.4	234.63	221.82	209.01
44	111.2	224.35	212.252	200.154
45	113	214.569	203.142	191.715
46	114.8	205.26	194.467	183.674
47	116.6	196.399	186.204	176.009
48	118.4	187.963	178.333	168.703
49	120.2	179.929	170.832	161.735
50	122	172.275	163.682	155.089
51	123.8	164.984	156.866	148.748
52	125.6	158.036	150.367	142.698
53	127.4	151.412	144.168	136.924
54	129.2	145.099	138.255	131.411
55	131	139.078	132.613	126.148
56	132.8	133.336	127.229	121.122

Sensor Resistance Tables

57	134.6	127.858	122.089	116.32
58	136.4	122.63	117.181	111.732
59	138.2	117.641	112.494	107.347
60	140	112.879	108.018	103.157
61	141.8	108.332	103.741	99.15
62	143.6	103.989	99.654	95.319
63	145.4	99.841	95.748	91.655
64	147.2	95.879	92.014	88.149
65	149	92.091	88.443	84.795
66	150.8	88.472	85.028	81.584
67	152.6	85.011	81.761	78.511
68	154.4	81.703	78.636	75.569
69	156.2	78.538	75.645	72.752
70	158	75.51	72.781	70.052
71	159.8	72.614	70.04	67.466
72	161.6	69.842	67.415	64.988
73	163.4	67.189	64.901	62.613
74	165.2	64.649	62.493	60.337
75	167	62.216	60.185	58.154
76	168.8	59.886	57.973	56.06
77	170.6	57.653	55.852	54.051
78	172.4	55.515	53.82	52.125
79	174.2	53.465	51.87	50.275
80	176	51.5	50	48.5
81	177.8	49.684	48.206	46.728
82	179.6	47.94	46.484	45.028
83	181.4	46.267	44.832	43.397
84	183.2	44.659	43.246	41.833
85	185	43.114	41.723	40.332
86	186.8	41.629	40.26	38.891
87	188.6	40.203	38.856	37.509
88	190.4	38.831	37.506	36.181
89	192.2	37.513	36.209	34.905
90	194	36.244	34.962	33.68
91	195.8	35.025	33.764	32.503
92	197.6	33.851	32.612	31.373
93	199.4	32.722	31.504	30.286
94	201.2	31.636	30.439	29.242
95	203	30.59	29.413	28.236
96	204.8	29.583	28.427	27.271
97	206.6	28.614	27.478	26.342
98	208.4	27.68	26.564	25.448
99	210.2	26.781	25.685	24.589
100	212	25.914	24.838	23.762
101	213.8	25.08	24.023	22.966
102	215.6	24.275	23.237	22.199
103	217.4	23.5	22.481	21.462
104	219.2	22.753	21.752	20.751
105	221	22.031	21.049	20.067
106	222.8	21.336	20.372	19.408

Sensor Resistance Tables

107	224.6	20.667	19.72	18.773
108	226.4	20.02	19.091	18.162
109	228.2	19.397	18.485	17.573
110	230	18.795	17.9	17.005
111	231.8	18.215	17.337	16.459
112	233.6	17.655	16.793	15.931
113	235.4	17.114	16.268	15.422
114	237.2	16.593	15.763	14.933
115	239	16.09	15.275	14.46
116	240.8	15.603	14.804	14.005
117	242.6	15.133	14.349	13.565
118	244.4	14.681	13.911	13.141
119	246.2	14.243	13.488	12.733
120	248	13.821	13.08	12.339
121	249.8	13.412	12.685	11.958
122	251.6	13.019	12.305	11.591
123	253.4	12.638	11.938	11.238
124	255.2	12.271	11.584	10.897
125	257	11.917	11.242	10.567
126	258.8	11.573	10.911	10.249
127	260.6	11.243	10.593	9.943
128	262.4	10.923	10.285	9.647
129	264.2	10.614	9.988	9.362
130	266	10.315	9.701	9.087
131	267.8	10.028	9.425	8.822
132	269.6	9.75	9.158	8.566
133	271.4	9.481	8.9	8.319
134	273.2	9.222	8.651	8.08
135	275	8.972	8.411	7.85
136	276.8	8.731	8.18	7.629
137	278.6	8.498	7.957	7.416
138	280.4	8.273	7.741	7.209
139	282.2	8.055	7.533	7.011
140	284	7.846	7.333	6.82
141	285.8	7.628	7.125	6.621
142	287.6	7.417	6.923	6.429
143	289.4	7.213	6.728	6.243
144	291.2	7.014	6.538	6.062
145	293 6.	822	6.355	5.888
146	294.8	6.636	6.178	5.719
147	296.6	6.455	6.006	5.556
148	298.4	6.28	5.839	5.398
149	300.2	6.111	5.678	5.244
150	302	5.946	5.521	5.096

Dip Switch

Understanding SW1 Dip Switch Logic for Airflow, Dehumidification, Comfort Heating, and Defrost:

System Architecture Overview

1. ODU: Inverter-driven, non-communicating
2. IDU: Unitary-style air handler or gas furnace (non-communicating)
3. Thermostat: Standard 24V AC heat pump thermostat (Y1, Y2, O, etc.)
4. No communication exists between the ODU and IDU
5. ODU cannot control IDU fan speed or airflow

What Do the Airflow-Related Dip Switches Actually Do?

Although the ODU cannot directly control the indoor fan, dip switch settings related to airflow, such as DEHUM.1, DEHUM.2, Comfort Heating, and <300 CFM/ton, are critical because they tell the ODU what airflow assumptions to make. This is not actual airflow that can or needs to be field tested. Instead, it is the algorithm the ODU uses as if that actually was there at the IDU. These assumed airflow algorithms are used to:

- Interpret sensor readings (pressure, temperature)
- Modulate refrigerant flow and compressor frequency
- Adjust the target evaporating or condensing temperatures
- Optimize system operation for stability, efficiency, and comfort

The dip switch does not change actual indoor airflow. Instead, it adjusts logic on how the ODU calculates and responds to refrigerant conditions under the assumption that airflow is either normal or reduced.

Dip Switch

Table 13. Control Board DIP SW5

<table>
<tr><td colspan="8">SW5</td></tr>
<tr><td rowspan="18">SW5_1_2_3*</td><td rowspan="18">ODU</td><td></td><td>[1]</td><td>[2]</td><td>[3]</td><td colspan="2">Outdoor Unit Size</td></tr>
<tr><td>ON</td><td>■</td><td></td><td></td><td colspan="2" rowspan="2">18K</td></tr>
<tr><td>OFF</td><td></td><td>■</td><td>■</td></tr>
<tr><td>ON</td><td></td><td>■</td><td></td><td colspan="2" rowspan="2">24K</td></tr>
<tr><td>OFF</td><td>■</td><td></td><td>■</td></tr>
<tr><td>ON</td><td>■</td><td>■</td><td></td><td colspan="2" rowspan="2">30K</td></tr>
<tr><td>OFF</td><td></td><td></td><td>■</td></tr>
<tr><td>ON</td><td></td><td></td><td>■</td><td colspan="2" rowspan="2">36K</td></tr>
<tr><td>OFF</td><td>■</td><td>■</td><td></td></tr>
<tr><td>ON</td><td>■</td><td></td><td>■</td><td colspan="2" rowspan="2">42K</td></tr>
<tr><td>OFF</td><td></td><td>■</td><td></td></tr>
<tr><td>ON</td><td></td><td>■</td><td>■</td><td colspan="2" rowspan="2">48K</td></tr>
<tr><td>OFF</td><td>■</td><td></td><td></td></tr>
<tr><td>ON</td><td>■</td><td>■</td><td>■</td><td colspan="2" rowspan="2">60K</td></tr>
<tr><td>OFF</td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">SW5_4*</td><td rowspan="2">Communication Mode</td><td colspan="3" rowspan="2">ON</td><td colspan="2">Reserved</td></tr>
<tr><td colspan="2">24V Control</td></tr>
<tr><td rowspan="5">SW5_5_6*</td><td rowspan="5">24V Control Energy Efficiency Testing and Actual Use of Internal Machine Selection</td><td colspan="2">[5]</td><td colspan="2">[6]</td><td colspan="2">24V control indoor unit set</td></tr>
<tr><td colspan="2">OFF</td><td colspan="2">OFF</td><td>IDU 1</td><td>For AHU Test & Use</td></tr>
<tr><td colspan="2">OFF</td><td colspan="2">ON</td><td>IDU 2</td><td>For Coil+Furnace Test & Use</td></tr>
<tr><td colspan="2">ON</td><td colspan="2">OFF</td><td>IDU 3</td><td>For A-coil Test</td></tr>
<tr><td colspan="2">ON</td><td colspan="2">ON</td><td>IDU 4</td><td>Reserved</td></tr>
<tr><td rowspan="2">SW5_7</td><td rowspan="2">24V Control Heat Pump Changeover Valve</td><td colspan="4">ON</td><td colspan="2">Heating Changeover Valve: Use this setting if your thermostat heating is “B”</td></tr>
<tr><td colspan="4">OFF</td><td colspan="2">Cooling Changeover Valve: Use this setting if your thermostat cooling is “O”.</td></tr>
<tr><td rowspan="2">SW5_8*</td><td rowspan="2">Reserved</td><td colspan="4">ON</td><td colspan="2">Reserved</td></tr>
<tr><td colspan="4">OFF</td><td colspan="2">Reserved</td></tr>
<tr><td colspan="8">* LEAVE AS FACTORY DEFAULT</td></tr>
</table>

Operating Mode		
Mode	**Condition 1**	**Condition 2**
Dehum.1	Areas in need of dehumidification	Full-load airflow rate <300 scfm/ton
Dehum.2	When still humid and need further dehumidification after Dehum.1	Full-load airflow rate <300 scfm/ton
Comfort heating	Default heating cannot meet the indoor temperature requirement	Full-load airflow rate <300 scfm/ton
Strong defrost	An area with high outdoor humidity during the heating season such as houses near river/lake, etc	When still frost left after default defrost operated

Dip Switch

Table 14. Service Board Dip SW1

SW1		1	2	3	4		
		Dehum. 1	Dehum. 2	Heating	Defrost	Cooling	Heating
MODE	ON					Default Cooling	Default Heating + Default Defrost
	OFF	■	■	■	■		
	ON				■	Default Cooling	Default Heating + Strong Defrost
	OFF	■	■	■			
	ON			■		Default Cooling	Comfort Heating or Full-Load Airflow Rate <300 Scfm/Ton + Default Defrost
	OFF	■	■		■		
	ON			■	■	Default Cooling	Comfort Heating or Full-Load Airflow Rate <300 Scfm/Ton + Strong Defrost
	OFF	■	■				
	ON	■				Dehum. 1 or Full-Load Airflow Rate <300 Scfm/Ton	Default Heating + Default Defrost
	OFF		■	■	■		
	ON	■			■	Dehum. 1 or Full-Load Airflow Rate <300 Scfm/Ton	Default Heating + Strong Defrost
	OFF		■	■			
	ON	■		■		Dehum. 1 or Full-Load Airflow Rate <300 Scfm/Ton	Comfort Heating or Full-Load Airflow Rate <300 Scfm/Ton + Default Defrost
	OFF		■		■		
	ON	■		■	■	Dehum. 1 or Full-Load Airflow Rate <300 Scfm/Ton	Comfort Heating or Full-Load Airflow Rate <300 Scfm/Ton + Strong Defrost
	OFF		■				
	ON		■			Dehum. 2 or Full-Load Airflow Rate <300 Scfm/Ton	Default Heating + Default Defrost
	OFF	■		■	■		
	ON		■		■	Dehum. 2 or Full-Load Airflow Rate <300 Scfm/Ton	Default Heating + Strong Defrost
	OFF	■		■			
	ON		■	■		Dehum. 2 or Full-Load Airflow Rate <300 Scfm/Ton	Comfort Heating or Full-Load Airflow Rate <300 Scfm/Ton + Default Defrost
	OFF	■			■		
	ON		■	■	■	Dehum. 2 or Full-Load Airflow Rate <300 Scfm/Ton	Comfort Heating or Full-Load Airflow Rate <300 Scfm/Ton + Strong Defrost
	OFF	■					
FORCED & CHARGE MODE	ON	■	■			TEST MODE	
	OFF			■	■		
	ON	■	■		■	DIAGNOSTIC MODE	
	OFF			■			
	ON	■	■	■		CHARGE MODE FOR HEATING	
	OFF				■		
	ON	■	■	■	■	CHARGE MODE FOR COOLING	
	OFF						
FUNCTION DESCRIPTION	1. When dehum. mode 1 is effective, it wil immediately reduces the unit's target evaporation temperature by 2~5ºF (1.1~2.8ºC); When dehum. mode 2 is effective, it wil immediately reduces the unit's target evaporation temperature by 5~7ºF (2.8~3.9ºC); And reduce the target evaporation temperature by 1.8ºF (1.0ºC) every 30 minutes until the frequency reaches its max. or the target evaporation temperature reaches its min.						
	2. When the comfortable heating mode is effective, it wil immediately increases the unit's target condensation temperature by 2~5ºF (1.1~2.8ºC).And increase the target condensation temperature by 1.8F every 30 minutes until the frequency reaches its maximum or the target condensation temperature reaches its maximum value.						
	3. SW1-4 perform manual defrosting from off to on (only the heating mode is valid, the exit conditions refer to normal defrosting, each dip switch from OFF to ON only enters once, the next time you enter must meet the dip switch from OFF to ON, after manual defrosting, the dip switch is still ON, enter the strong defrosting mode).						
	4. When strong defrosting is effective, the unit defrosting interval will be shorter, and the defrosting time will be increased, which is suitable for areas with high humidity. Default defrost control is the factory setting. If the unit is being installed in a heavy snow or a cold, humid area, change the defrost mode to strong defrost per instructions.						

Dip Switch

Diagnostic Mode Check Table

1. When the diagnostic mode is activated, the inspection sequence number and the inspection content will be displayed content will be displayed in sequence, such as 00 24 02 Co ..... 15 13 18 --.The content will be displayed in the sequence described in the table below. The display will show the sequence number for 1 second. Then it will display the content value for 1 second. Then it will display the content value for 1 second.
2. After the unit has cycled through all content and content values, it will return to normal display.

NO.	Point Check Content	Example	Remark
0	Outdoor Unit Capacity	24	Model
1	Outdoor Unit Mode	Co	Cooling: Co, Heating: He, Holding State: oF, Return Oil Mode: ol, Defrost: dE
2	Compressor Speed	56	Units: Hz
3	Outdoor Fan Speed Step	6	The current fan speed step is at 6.
4	Opening of EXV	26	Actual value/10 (Round)
5	Target Refrigerant Temperature	48	Cooling: ETS, Heating CTS, Units: ºF
6	Current Refrigerant Temperature	48	Cooling: ETS, Heating CTS, Units: ºF
7	Tao	95	Units: ºF
8	TC	115	Units: ºF
9	Te	109	Units: ºF
10	Ts	65	Units: ºF
11	Td	156	Units: ºF
12	Compressor Input Current	10	Units: A
13	Module Temp	65	Units: ºF
14	Soft Ver.	30	Mean: Software Version is 3.0
15	E2 Ver.	12	Mean: E2 Parameter Version is 1.2
16	ER	ER	If the ER is displayed, it indicates a malfunction. If there is no malfunction, it will not be displayed and will be skipped directly.
17	The Current Fault Code	12	If 16 indicates “ER”, display the current fault code; otherwise, skip without showing anything.
18	--	--	End Mark

1. When the number exceeds 100, it is represented by letters. A1 stands for 101, B1 represents 111, and C1 indicates 121.
2. Add a dot after the negative value, for example, 01. represents -1ºF.

Error Codes

OUTDOOR UNIT TROUBLE SHOOTING			
Error Code	**Malfunction Description**	**Diagnosis and Analysis**	**Remark**
1	EEPROM malfunction	EEPROM chip damaged or data wrong or related circuit damaged	1 time lock
2	Compressor drive module hardware over current	IPM* over current been detected by compressor drive module hardware	6 times lock
3	Compressor drive module AC input over current	AC Input over current been detected by compressor drive module or input current higher than main board setting.	6 times lock
4	Communication abnormal with compressor drive module	Communication abnormal between main control boar and compressor drive module	resumeable
5	Compressor overload -drive module	Compressor current or input current been detected by compressor drive module software higher than main board setting. (seconds level)	resumeable
6	DC voltage or AC voltage high/low	Over/low voltage been detected by compressor drive module(ACvoltage high/low or DCBUS voltage high/low	resumeable
7	Compressor stuck and stops instantly	The PFC is turned on, the current detected continuously for 10ms is less than 0.5A	resumeable
8	Discharge temperature too high protection	Compressor discharge tempreature over 115°C, error clear within 3 minutes if temperature goes down	resumeable
9	DC fan motor abnormal	DC fan motor blocked or damage or not connected or related circuit broken. (Display 09-92 indicates a wind speed malfunction, Display 09-93 indicates a communication failure of the fan module.)	4 times lock
10	Outdoor defrosting temperature sensor Te abnormal	Sensor temperature been detected below-55°C or higher than 90°C or been detected as short circuit or open circuit	resumeable
11	Suction temperature sensor Ts abnormal		
12	Outdoor ambient temperature sensor Ta abnormal		
13	Discharging temperature sensor Td abnormal	Sensor temperature been detected below-30°C or higher than 150°C or sensor short circuit or open circuit	resumeable
15	Communication issue between the indoor and outdoor units	The position of the dip switch SW5-4 is incorrect.	resumeable
16	Lack of refrigerant or discharging pipe blocked	Discharge & suction temperature Td-Ts > 80°C after compressor started 10 minutes.	resumeable
17	4-way valve converse abnormal	Outdoor defrost sensor Te > 28°C and after compressor start 10 minutes	resumeable
18	Compressor motor desynchronizing	Rotor desynchronizing occurred, caused by overload or load sharply flucuating or compressor current sensor circuit abnormal or one of the inverter s gate drive signal missing.	resumeable
19	Detection circuit malfunction	The current is greater than the upper limit or lower than the lower limit.	resumeable
20	IPM protection (IPM hardware overcurrent)	The rectifier side / PFC current exceeds the set value	6 times lock
22	Freezing of indoor coils	Blocked air intake of indoor coil or failure of indoor fan.	resumeable
23	Temperature too high for compressor driver module	Compressor drive module temperature too high, detected by module itself or temperature over main board setting.	resumeable
24	Compressor overcurrent - main board	Compressor over current been detected by main control board software (EEPROM setting)	6 times lock
25	Compressor momentary overcurrent -compressor module inverter side	Compressore momentary overcurrent, detected by compressor module inverter side (ms level)	resumeable
26	Compressor drive module power supply failure or MCU abnormal reset	Compressure drive module power supply failure or MCU reset occurs when compressor is running	resumeable
27	Current sampling circuit fault of compressure drive module	Inverter side or convert side current sampling circuit failt of compressor drive module	resumeable
39	Outdoor unit mid-condenser temp. sensor Tc abnormal	The temperature detected is not within the range of-55°C to 90°C	resumeable

NOTES: 1. Do not change any switch settings unless directed to do so. * IPM: Inverter Power Module

Error Codes

OUTDOOR UNIT TROUBLE SHOOTING			
Error Code	**Malfunction Description**	**Diagnosis and Analysis**	**Remark**
42	High pressure switch abnormal	After compressor running for 3 minutes, switch open circuit and last 30 seconds	resumeable
43	Low pressure switch abnormal	After coompressor running for 3 minutes, switch open circuit and last 60 seconds or open circuit for 30 seconds at standby mode	3 times lock
44	Outdoor condenser tempreature Tc too high protection	The maximum temperature of Tc and Te is over 65°C	resumeable
45	System low pressure protection	The minimum tempreature of indoor pipe Tm and outdoor Ts ≤ 45°C at cooling mode or minimum temperature outdoor Tc and outdoor Te <-50°C at heating mode	3 times lock
46	Compressor driver module heat sink sensor abnormal	The compressor driver module heat sink sensor tempreature detected is not within the range of -25°C to 150°C	resumeable
50	Minimum rotational speed malfunction	The estimated rotational speed for 5 consecutive seconds is lower than the minimum rotational speed set by EE	resumeable
51	Pressure transducer malfunction	Continous detection of AD value below 11 or above 1012 for 30 seconds	resumeable
54	Driver EE failure	Driver Module EEPROM Data error	resumeable
55	Phase loss of the compressor	The current of any phase lasts for 1.28 seconds and is lower than the phase loss protection value set by EE	resumeable
LE / 73	Signal wire connected incorrectly	Presence of a W signal while in cooling mode	1 time lock

NOTES: 1. Do not change any switch settings unless directed to do so. * IPM: Inverter Power Module

Error Codes

When the system generates an error code, it will be displayed on the Service Monitor Board, the number of flashes on the PCB.

Temperature Sensor Error Codes

The easiest problems to solve will involve codes that are related to potential failure of temperature sensors. Common problems may include loose connections, open or shorted, and out of calibration. Checking the condition of the sensors requires a temperature probe and an ohmmeter.

The Reference Section of this manual contains temperature resistance tables that can be used to check the calibration of the sensors. The measured resistance must be within the tolerances located in the tables.

ERROR CODE 10

This code indicates an electrical failure of the sensor that is used to sense the temperature of the outdoor coil during defrost. This sensor is connected to the PCB via a connection at Plug CN-21(24K&36K),CN-14(48K&60K).

ERROR CODE 11

This code indicates an electrical failure of Ts that is used to sense the temperature of the suction gas that enters the compressor. The sensor is connected to the PCB via two wires at Plug CN-21(24K&36K),CN-14(48K&60K).

ERROR CODE 12

This code indicates an electrical failure of Tao that is used to sense the temperature of the outdoor air. The sensor is connected to the PCB via two wires at Plug CN-21(24K&36K),CN-14(48K&60K).

ERROR CODE 13

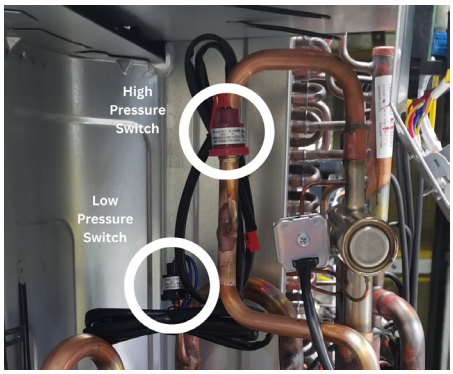
This code indicates an electrical failure of Td that is used to sense the temperature of the compressor hot gas discharge line. The sensor is connected to the PCB via two wires at Plug CN-21(24K&36K),CN-14(48K&60K).

ERROR CODE 39

This code indicates an electrical failure of Tc that is used to sense the condensing temperature of the outdoor coil. The sensor is connected to the PCB via two wires at Plug CN-21(24K&36K),CN-14(48K&60K).

Pressure-Related Error Codes

To protect the compressor, the PCB has a low pressure switch connection at CN25(24K&36K), CN13(48K&60K), and a high pressure switch connection at CN-24(24K&36K),CN12(48K&60K).



The illustrated position is for reference only.

ERROR CODE 42 & 43

The low pressure switch will generate an Error Code 43 if open. An open high pressure switch will show an Error Code 42.

Testing Procedure

If the system generates either of these two codes, check the continuity of the switch to ensure it is not open or shorted. High or low pressures are usually related to dirt in the coils, dirt in the air filter, or incorrect refrigerant charge. There are no pressure ports that can be accessed to measure low pressure in heat mode nor high pressure in cool mode. If the system trips on one of these errors, it will be necessary to remove the refrigerant and re-charge to confirm low or high charge is not causing the problem.

Error Codes

Pressure-Related Error Codes (Cont.)

ERROR CODE 44

The system is operating at excessive refrigerant pressure. If the system is a new installation, it is likely that the charge is too high. Note the Weigh-In Method is the ONLY way to charge this system.

Typical Causes of High Pressure in Cooling Mode:
- Overcharge
- Dirty outdoor coil
- Restriction

Typical Causes of High Pressure in Heating Mode:
- Overcharge
- Undersized refrigerant lines or excessive length
- Restriction

NOTE: If the refrigerant pressures are correct, yet the system does not close the error reporting pressure switch, replace the defective pressure switch.

ERROR CODE 45

This code is indicating that system pressure is too low.

Typical Causes of Low Pressure in Cooling Mode:
- Lack of charge
- Low Heat on Indoor coil
- Restrictions, air flow, or dirt
- Low indoor load

Typical Causes of Low Pressure in Heating Mode:
- Cold outdoor air
- Lack of charge
- Restriction

Communication Error Code

ERROR CODE 51

This code indicates an electrical failure of the sensor that is used to sense the refrigerant pressure of the system. The sensor is connected to the PCB via three wires at Plug CN-20(24K&36K),CN-21(48K&60K).

Error Codes Caused by Abnormal Refrigerant Circuit Conditions

ERROR CODE 8

This code indicates the temperature of the compressor hot gas is too high. This error occurs after the PCB has attempted to correct high temperature by reducing the compressor speed, adjusting the fan speed,

Causes of this type of condition are typically a lack of refrigerant in the system, excessive heat in the conditioned space, or a restriction in the refrigeration circuit.

ERROR CODE 16

This error code indicates the system may lack refrigerant. Recover and check the system charge.

ERROR CODE LE

There can be no "w" signal when cooling, please check the thermostat and unit wiring.

ERROR CODE 1

The EEPROM of the PCB cannot read or write data. Replace the PCB.

Error Codes Related to the IPM

ERROR CODE 2

The IPM has either failed or has detected excessive current.

Before replacing the IPM, check these potential causes of high current:
- Overcharge
- Dirty outdoor coil
- Hot conditioned space
- High temperature or excessive load
- Refrigeration circuit restriction
- Seized compressor
- Faulty wiring or wiring connections

ERROR CODE 4

This code indicates the IPM is not communicating with the PCB. Check the wiring and the connections CN34 on the PCB and CN2 on the IPM. If the connections are good, yet the boards do not communicate and the code will not clear, check for correct voltage at the IPM CN2 connection. If the communication voltage is correct and the high voltage input is present, replace the IPM. If the communication voltage is not correct, replace the PCB.

ERROR CODE 5

The IPM is protecting the compressor from overload, which can be caused by low building power supply, restrictions, a non-condensible in the system, a plugged coil, an excessive load, or a refrigerant overcharge.

Error Codes

Error Codes Related to the IPM (Cont.)

ERROR CODE 6

This code indicates the operating voltage of the system is either too high or too low. Check line voltage for proper limits. The line voltage supplied to the outdoor unit should be no lower than 187VAC when the compressor starts. The running voltage should be no lower than 197VAC. The incoming line voltage to the outdoor unit should never be higher than 253VAC. If improper voltage is present, check the supply voltage circuit from the building for correct wire size and good connections. If the voltage is still outside operating limits, contact the power company to have the service corrected.

If the line voltage from the power company is correct, check the output voltage of the Power Filter. This voltage connects to the IPM at terminals ACL and ACN. If the voltage is not within specifications shown above, replace the PFB.

ERROR CODE 18

There is a loss of synchronization among the U, V, and W compressor windings during frequency changes as they slow down or speed up the compressor.

Possible causes include:
- Unstable power supply
- Internal compressor fault
- IPM fault
- Compressor terminal wiring incorrect
- Poor wiring condition
- Loose compressor wiring connection

ERROR CODE 23

This code indicates an IPM thermal overload. This error was generated by a temperature sensor located in the IPM heat sink. Causes of overheating are typically overcharge of refrigerant, excessively plugged coil, sensor open or shorted, or a non-condensable in system.

ERROR CODE 26

Module reset indicates possible PCB power anomalies. This usually occurs when low line voltage conditions are present.

ERROR CODE 27

The IPM has detected that the compressor current is too high.

Possible Causes:
- Overcharge
- Dirty outdoor coil
- Hot conditioned space temperature or high load
- Refrigeration circuit restriction
- Seized compressor
- Defective IPM

Error Codes Related to Compressor, Outdoor Fan & 4-Way Valve

ERROR CODE 9

This code indicates the outdoor fan motor is not running. The fault is detected very quickly by the PCB. The system will shut off and display this error code. If this error occurs, refer to the outdoor fan motor test procedure.

ERROR CODE 17

This error code indicates that the 4-way valve is not directing hot gas to the proper coil. Refer to the 4-way valve testing procedure.

ERROR CODE 24

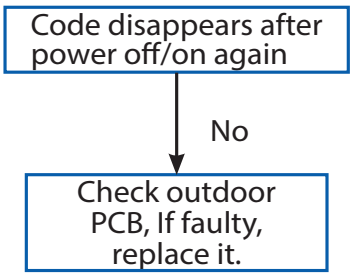
This error code indicates the compressor failed to start when a call for operation occurred. Refer to the compressor testing procedure.

Troubleshooting

[1] Outdoor EEPROM malfunction

EEPROM communication error; EEPROM data check error (model ID, checksum, etc.); EEPROM data logic error (wider data range, wrong order, etc.)

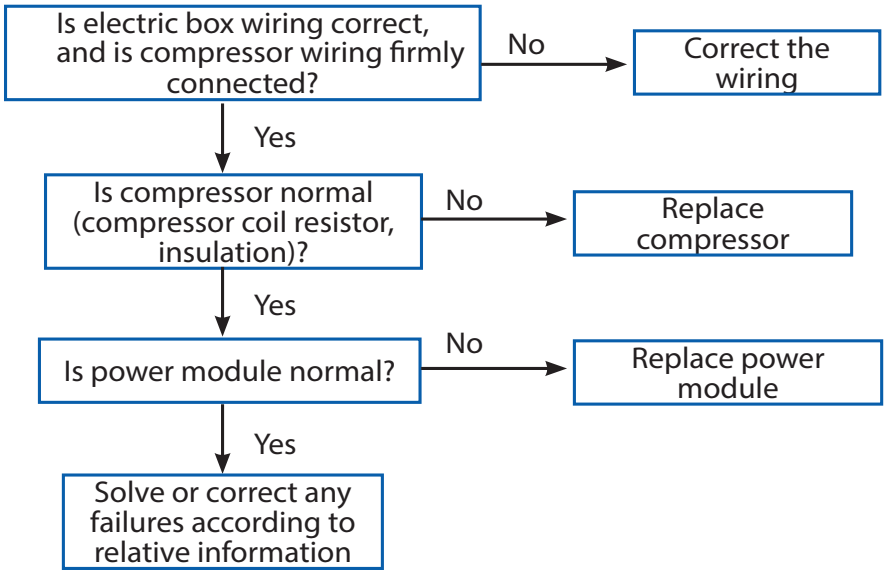
Possible causes:
- EEPROM is bad
- Loose EEPROM wiring



[2] Outdoor IPM over current or short circuit

Input over current detected by PIM's hardware.

Possible causes:
- The IPM is bad
- Loose compressor wire
- The compressor is bad

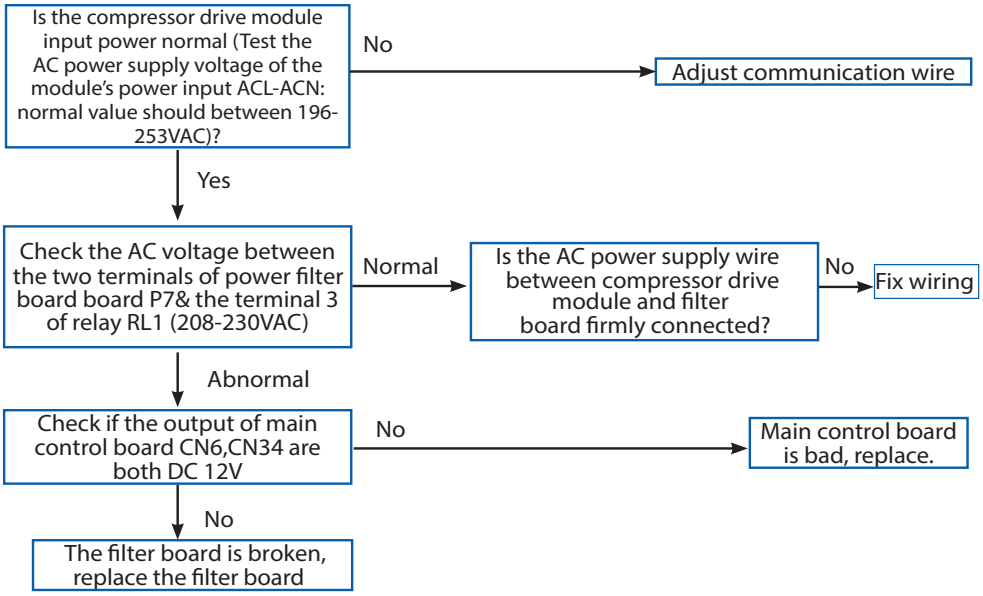


Troubleshooting

[4] Communication abnormal between PCB and IPM

Control board can not communicate with the compressor driver module for over 4 minutes.

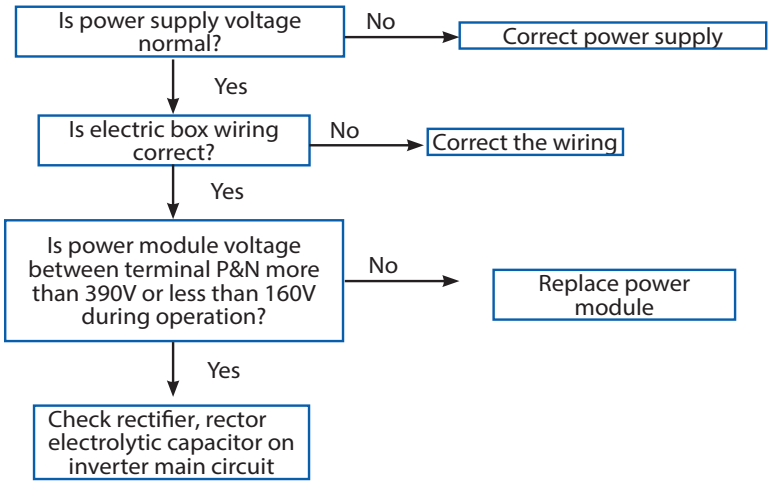
Possible causes:
- The communication wire is bad
- The PCB is bad
- The power module is bad



[6] DC voltage or AC voltage high

Driver module AC power supply voltage over 280VAC, or driver module DC-BUS voltage over 390VDC.

Possible causes:
- The power supply is abnormal
- Incorrect wiring
- Power module is bad

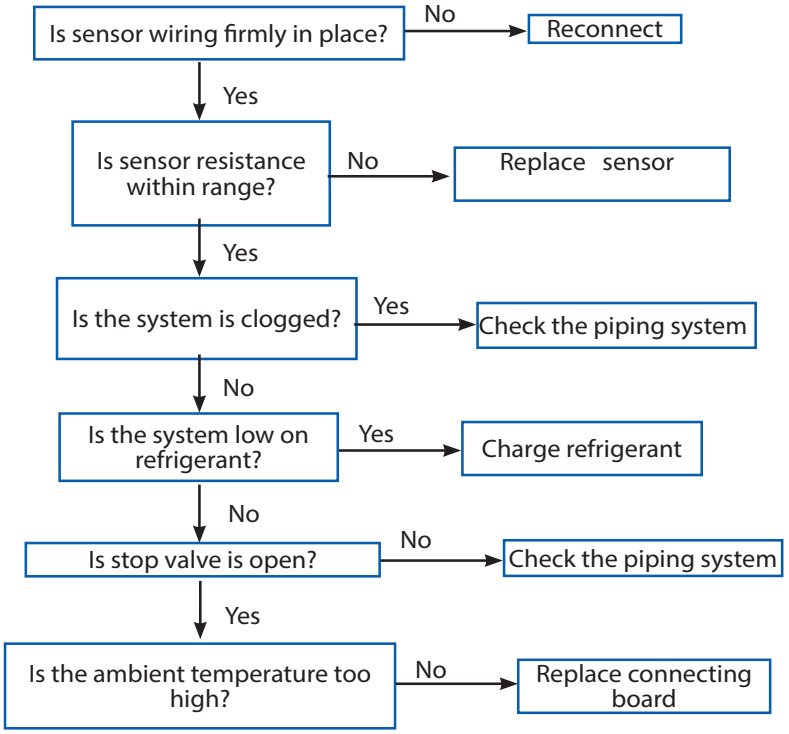


Troubleshooting

[8] Discharge temperature too high protection

Compressor discharge temperature over 115°C (239ºF). Error clears within 3 minutes if temperature lowers below 115°C (239ºF).

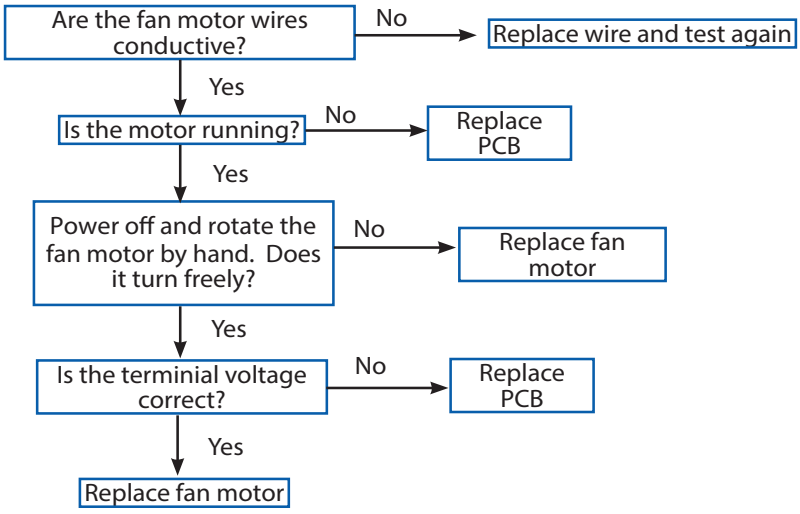
Possible causes:
- The sensor is bad or fixed bad
- The system is clogged
- The system lack of refrigerant
- The valve opening is wrong



[9] DC fan motor fault

DC fan motor damaged, not connected, or related circuit broken. Error status confirms and locks if occurs 4 times within 60 minutes.

Possible causes:
- Loose motor wiring
- The motor is bad
- The PCB is bad



Troubleshooting

[10] Outdoor defrosting temp. sensor Te abnormal

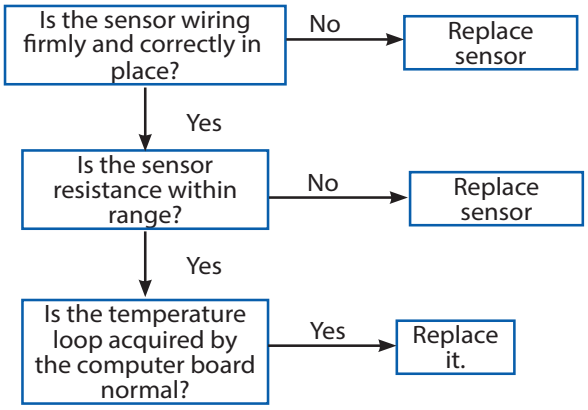
[11] Suction temp.sensor Ts abnormal

[12] Outdoor ambient temp. sensor Tao abnormal

[13] Discharging temp. sensor Td abnormal

Sensor temperature has been detected below or higher than expected, or has been detected as a shorted or open circuit (for expected temperature, refer to part failure code).

Possible causes:
- Bad sensor connection
- The sensor is bad
- Sensor resistance drift
- The temperature acquired by PCB is not accurate

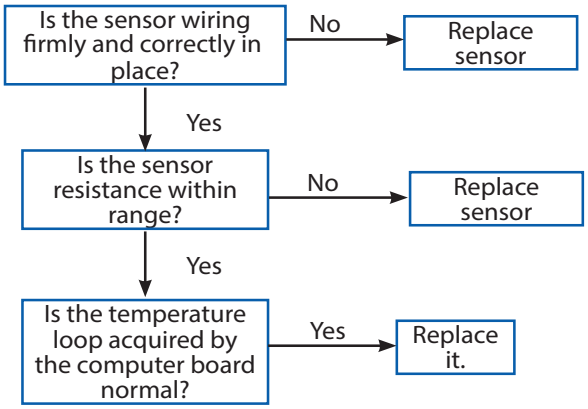


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[51] High pressure sensor malfunction

Has been detected as a shorted or open circuit.

Possible causes:
- Bad sensor connection
- The sensor is bad
- Sensor resistance drift
- The pressure acquired by PCB is not accurate

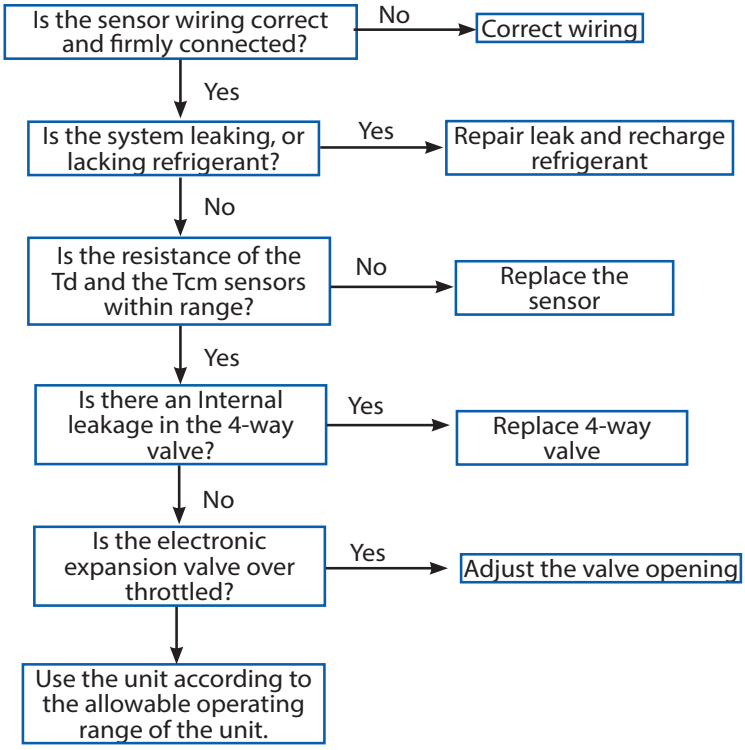


Troubleshooting

[16] Lack of refrigerant or discharging pipe blocked

Discharge & suction temperature Td-Ts ≥ 239ºF (80°C)
10 minutes after compressor start.

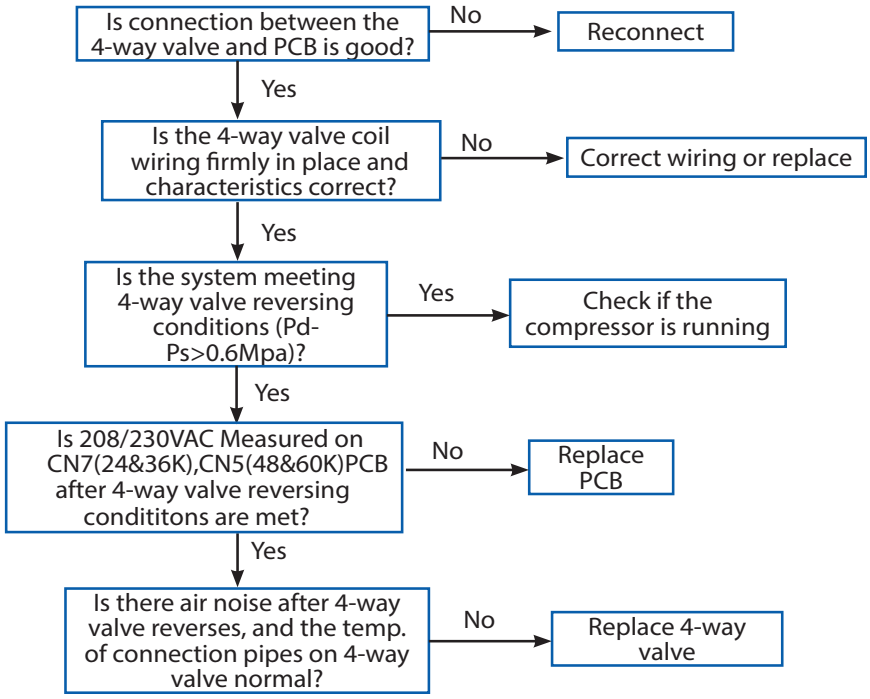
Possible causes:
- Wrong sensor connection
- Lack of refrigerant
- The senor is bad
- The 4-way valve is bad
- The electronic expansion valve is bad
- Out of the operating range



[17] 4-way valve reversing failure

Indoor pipe & indoor ambient temperature TC ≥ 82ºF
(28°C) 10 minutes after compressor started.

Possible causes:
- The 4-way valve is bad
- The PCB is bad
- The 4-way valve coil connection is bad
- The system pressure difference is too small.

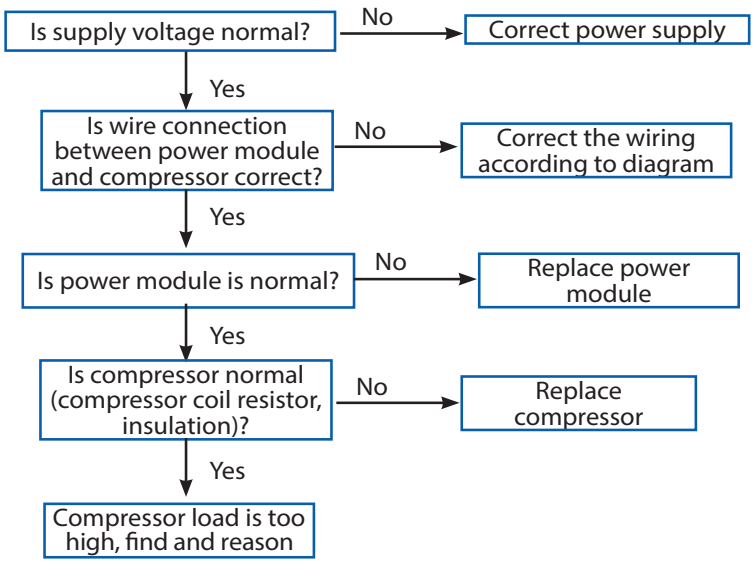


Troubleshooting

[18] Compressor motor desynchronizing

Motor desynchronizing occurred. Caused by overload, load sharply fluctuating, abnormal compressor current sensor circuit, or one of the inverter gate drive signals is missing.

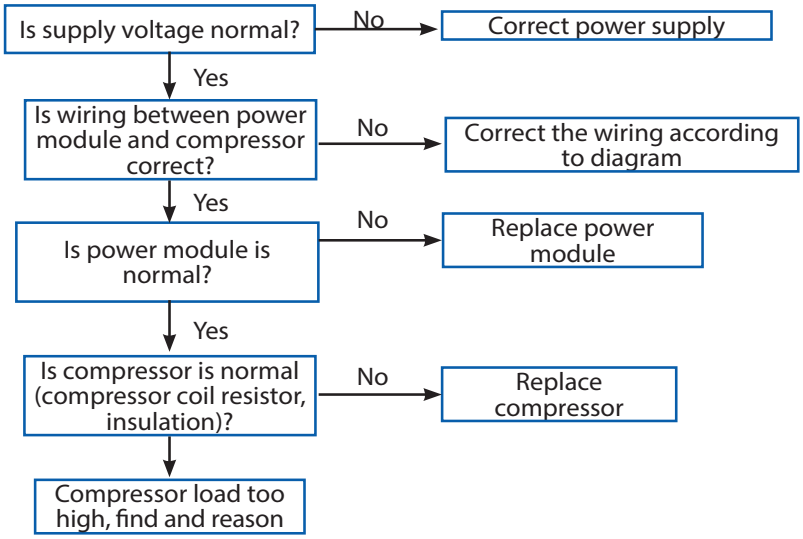
Possible causes:
- The power supply is abnormal
- Incorrect compressor wiring
- The power module is bad
- The compressor is bad
- The system is overload



[24] Compressor startup failure

Compressor start failure has been detected by driver module.

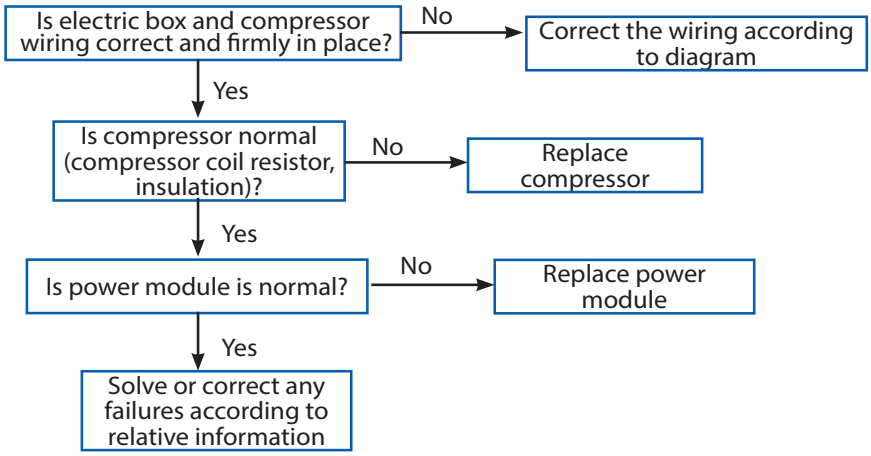
Possible causes:
- The power supply is abnormal
- Incorrect compressor wiring
- The power module is bad
- The compressor is bad
- System overload



[25] Input overcurrent of the drive module

Compressor drive module input current higher than 30A (48&60k), or 15A (24k),or18A (36K)

Possible causes:
- Incorrect compressor wiring
- The power module is bad
- The compressor is bad

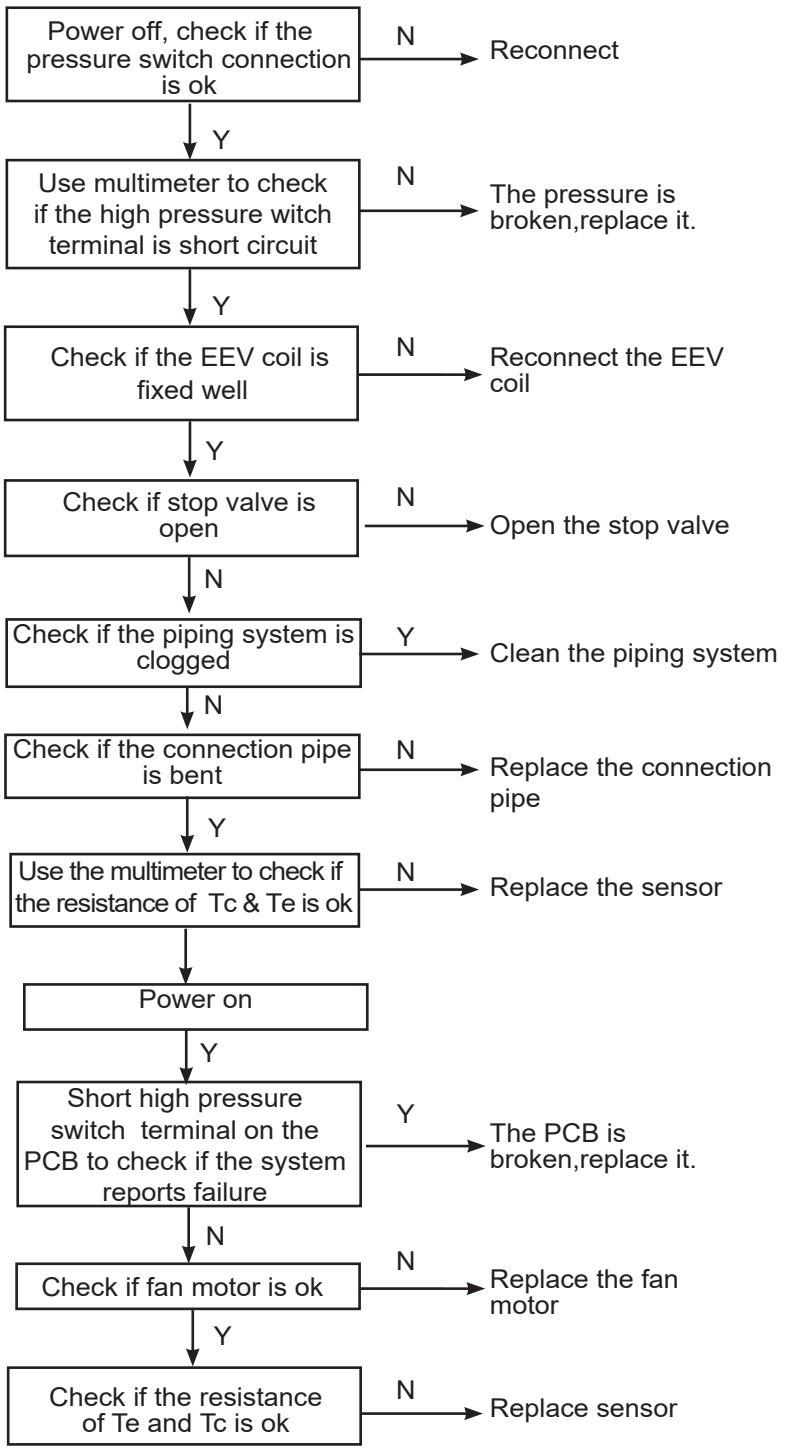


Troubleshooting

[42] Open high pressure switch

High pressure switch: Switch circuit has been detected open for 30 seconds (after 5 minute of compressor run time).

Possible causes:
- Incorrect pressure switch wiring
- Abnormal system pressure
- System is clogged
- Incorrect refrigerant charge
- Bad valve
- Pressure switch is bad
- PCB is bad

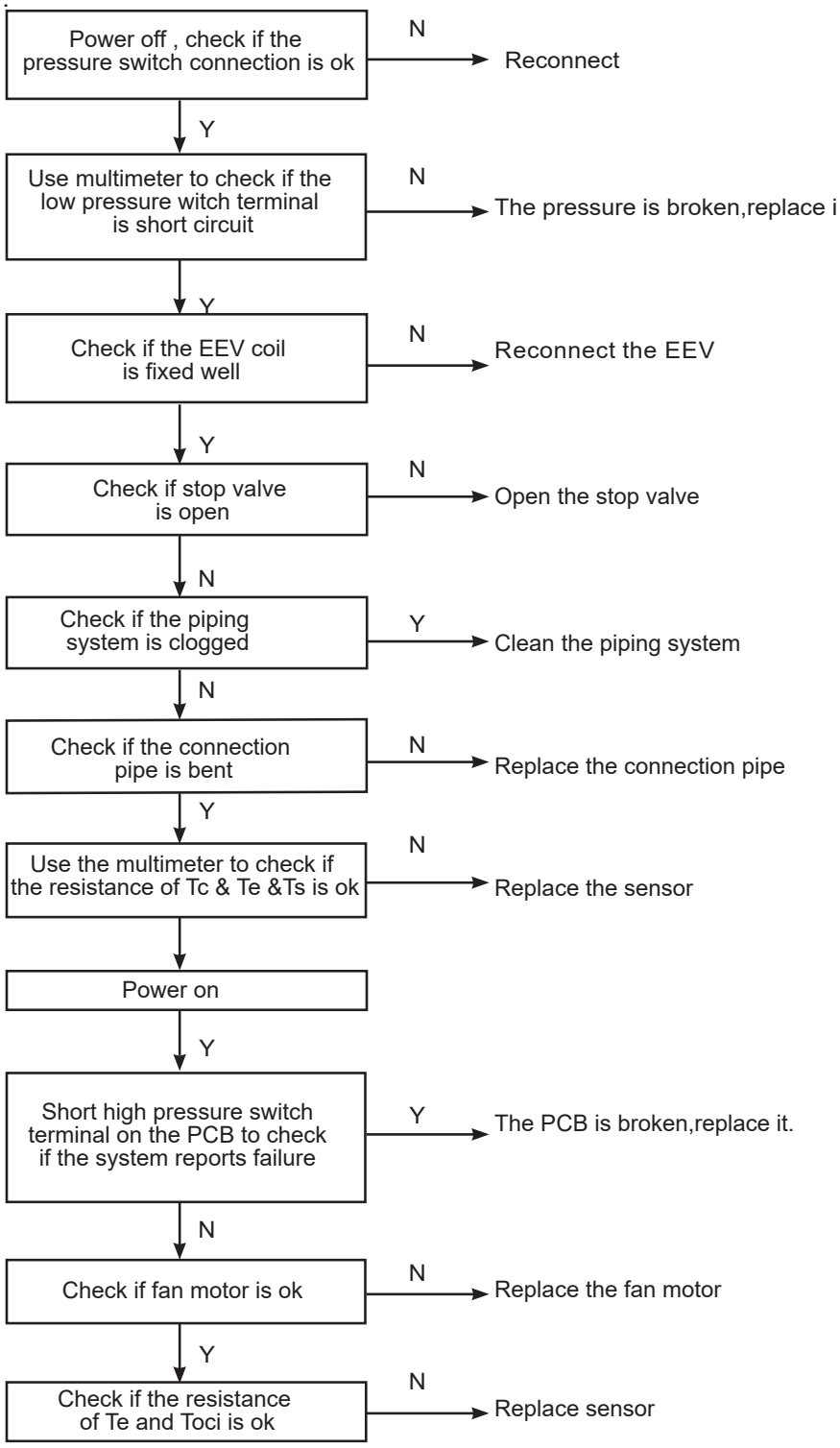


Troubleshooting

[43] Open low pressure switch

Low pressure switch: Switch has been detected open for 60 seconds (after 5 minute of compressor run time) or open for 30 seconds during standby.

Possible causes:
- Incorrect pressure switch wiring
- Abnormal system pressure
- System is clogged
- Incorrect refrigerant charge
- Bad valve
- Pressure switch is bad
- PCB is bad

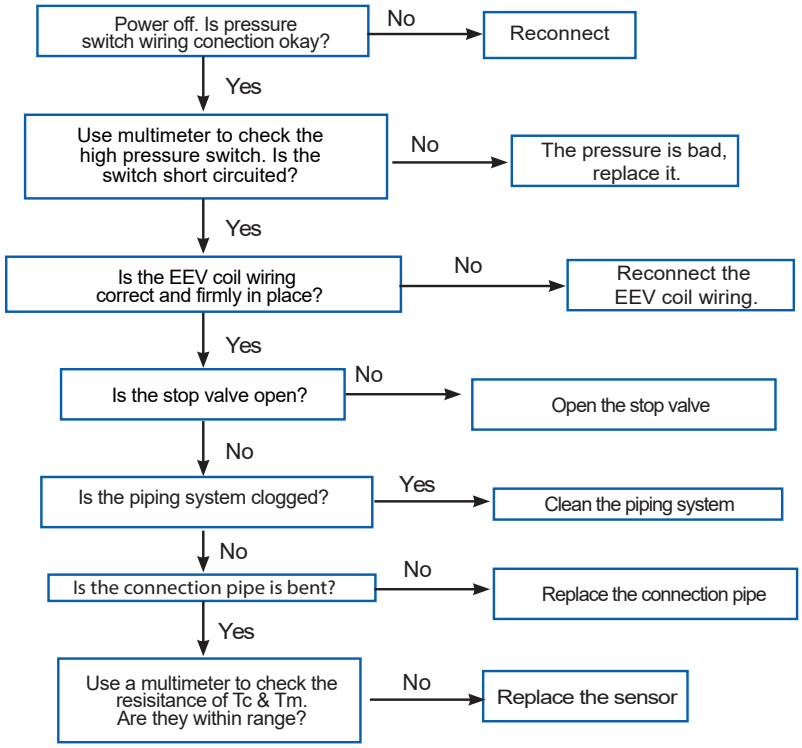


Troubleshooting

[44] High pressure detected in system

Outdoor TC sensor temperature > 149ºF (65°C) during cooling.

Possible causes:
• High pressure transducer detection value is incorrect Refrigerant overcharge
• Blocked liquid line piping
• The outdoor unit cannot be turned on normally due to failure to open outdoor heat exchanger electronic expansion valve when heating.
• The operation environment is beyond the allowed range



45] Low pressure detected in system

The minimum temperature value of outdoor Ts is lower than -49ºF (-45°C) during cooling mode, or minimum temperature value of outdoor Tc and outdoor Te is lower than -49ºF (-45°C).

Possible causes:
• Low pressure sensor detection value is incorrect
• Low refrigerant charge
• System air leakage
• Blocked low pressure or liquid line piping
• The outdoor unit cannot be turned on normally due to failure to open outdoor heat exchanger electronic expansion valve when heating.
• The operation environment is beyond the allowed range.

