

C4H7T, H4H7T, T4H7T SPLIT-SYSTEM 2-STAGE HEAT PUMP WITH R-410A REFRIGERANT 2-5 TONS


Installation Instructions

NOTE: Read the entire instruction manual before starting the installation.

SAFETY CONSIDERATIONS

Improper installation, adjustment, alteration, service, maintenance, or use can cause explosion, fire, electrical shock, or other conditions which may cause death, personal injury, or property damage. Consult a qualified installer, service agency, or your distributor or branch for information or assistance. The qualified installer or agency must use factory-authorized kits or accessories when modifying this product. Refer to the individual instructions packaged with the kits or accessories when installing.

Follow all safety codes. Wear safety glasses, protective clothing, and work gloves. Use quenching cloth for brazing operations. Have fire extinguisher available. Read these instructions thoroughly and follow all warnings or cautions included in literature and attached to the unit. Consult local building codes and current editions of the National Electrical Code (NEC) NFPA 70. In Canada, refer to current editions of the Canadian Electrical Code CSA 22.1.

Recognize safety information. This is the safety-alert symbol . When you see this symbol on the unit and in instructions or manuals, be alert to the potential for personal injury. Understand these signal words; DANGER, WARNING, and CAUTION. These words are used with the safety-alert symbol. **DANGER** identifies the most serious hazards which will result in severe personal injury or death. **WARNING** signifies hazards which could result in personal injury or death. **CAUTION** is used to identify unsafe practices which would result in minor personal injury or product and property damage. **NOTE** is used to highlight suggestions which will result in enhanced installation, reliability, or operation.

WARNING

ELECTRICAL SHOCK HAZARD

Failure to follow this warning could result in personal injury or death. Before installing, modifying, or servicing system, main electrical disconnect switch must be in the OFF position. There may be more than 1 disconnect switch. Lock out and tag switch with a suitable warning label.

WARNING

EXPLOSION HAZARD

Failure to follow this warning could result in death, serious personal injury, death, and/or property damage.

Never use air or any gas containing oxygen for leak testing or operating refrigerant compressors. Never allow compressor suction pressure to operate in a vacuum with service valves closed. See Service Manual for pump-down instructions.



Installation Recommendations

NOTE: In some cases noise in the living area has been traced to gas pulsations from improper installation of equipment.

1. This unit is intended to be installed in a location that is 10,000 feet (3000 meters) above sea level or lower.
2. Locate unit away from windows, patios, decks, etc. where unit operation sound may disturb customer.
3. Ensure that vapor and liquid tube diameters are appropriate for unit capacity.
4. Run refrigerant tubes with no bends with centerline bend radius less than 2.5 times the external pipe diameter.
5. Leave some slack between structure and unit to absorb vibration.
6. When passing refrigerant tubes through the wall, seal opening with RTV or other pliable silicon-based caulk. (See [Fig. 1](#).)
7. Avoid direct tubing contact with water pipes, duct work, floor joists, wall studs, floors, and walls.
8. Do not suspend refrigerant tubing from joists and studs with a rigid wire or strap which comes in direct contact with tubing (see [Fig. 1](#)).
9. Ensure that tubing insulation is pliable and completely surrounds vapor tube.
10. When necessary, use hanger straps which are 1 in. (25 mm) wide and conform to shape of tubing insulation. (See [Fig. 1](#).)
11. Isolate hanger straps from insulation by using metal sleeves bent to conform to shape of insulation.
12. Provision shall be made for expansion and contraction of long runs of piping.
13. Piping and fittings shall be protected as far as possible against adverse environmental effects. For example, the accumulation of dirt and debris.
14. Piping should be installed to reduce the likelihood of hydraulic shock damaging the system.
15. Certified piping and components must be used in order to protect against corrosion.
16. Flexible pipe elements shall be protected against mechanical damage, excessive stress by torsion, or other forces. They should be checked for mechanical damage annually.
17. Piping material, routing, and installation shall be include protection from physical damage in operation and service, and be in compliance with the national and local codes and standards of the installation site.
18. When setting up refrigerant piping, precautions shall be taken to avoid excessive vibration or pulsation

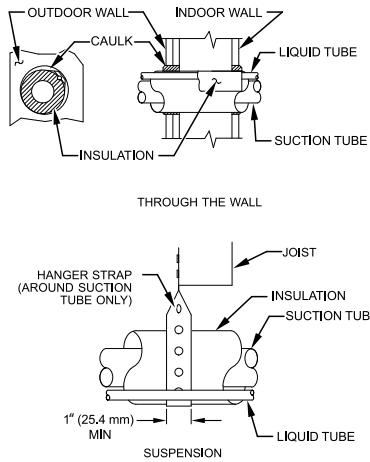


Fig. 1 – Piping Installation

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When outdoor unit is connected to factory-approved indoor unit, outdoor unit contains system refrigerant charge for operation with AHRI rated indoor unit when connected by 15 ft. (4.57 m) of field-supplied or factory accessory tubing. For proper unit operation, check refrigerant charge using charging information located on control box cover and/or in the Check Charge section of this instruction.

IMPORTANT: Maximum liquid-line size is 3/8-in. OD for all residential applications including line line.

IMPORTANT: Always install the factory-supplied liquid-line filter drier. Obtain replacement filter driers from your distributor or branch.

Installation

! CAUTION

CUT HAZARD

Failure to follow this caution may result in personal injury. Sheet metal parts may have sharp edges or burrs. Use care and wear appropriate protective clothing and gloves when handling parts.

Check Equipment and Job Site

IMPORTANT: All split system and packaged heat pumps must be installed pursuant to applicable regional efficiency standards issued by the Department of Energy.

Unpack Unit

Move to final location. Remove carton taking care not to damage unit.

Inspect Equipment

File claim with shipping company prior to installation if shipment is damaged or incomplete. Locate unit rating plate on unit corner panel. It contains information needed to properly install unit. Check rating plate to be sure unit matches job specifications.

Install on a Solid, Level Mounting Pad

If conditions or local codes require the unit be attached to pad, tie down bolts should be used and fastened through knockouts provided in unit base pan. Refer to unit mounting pattern in Fig. 2 to determine base pan size and knockout hole location.

For hurricane tie downs, contact distributor for details and PE Certification (Professional Engineer), if required.

On rooftop applications, mount on level platform or frame. Place unit above a load-bearing wall and isolate unit and tubing set from structure. Arrange supporting members to adequately support unit and minimize transmission of vibration to building. Consult local codes governing rooftop applications.

Roof mounted units exposed to winds above 5 mph (8.05 km/h) may require wind baffles. Consult the Service Manual - Residential Split System Air Conditioners and Heat Pumps for wind baffle construction.

NOTE: Unit must be level to within $\pm 2^\circ$ ($\pm 3/8$ in./ft, ± 9.5 mm/m.) per compressor manufacturer specifications.

! CAUTION

UNIT OPERATION HAZARD

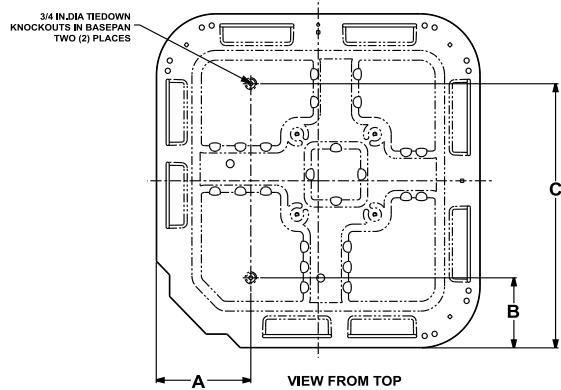
Failure to follow this caution may result in equipment damage or improper operation.

Locate the unit in such a way that it is stable in all circumstances including adverse weather conditions.

Clearance Requirements

When installing, allow sufficient space for airflow clearance, wiring, refrigerant piping, and service. Allow 24 in. (609.6 mm) clearance to service end of unit and 48 in. (1219.2 mm) (above unit. For proper airflow, a 6-in. (152.4 mm) clearance on 1 side of unit and 12-in. (304.8 mm) on all remaining sides must be maintained. Maintain a distance of 24 in. (609.6 mm) between units. Position so water, snow, or ice from roof or eaves cannot fall directly on unit.

On rooftop applications, locate unit at least 6 in. (152.4 mm) above roof surface.



UNIT BASE PAN Dimension in. (mm)	TIEDOWN KNOCKOUT LOCATIONS in. (mm)		
	A	B	C
35 X 35 (889 X 889)	9-1/8 (231.8)	6-9/16 (166.7)	28-7/16 (722.3)

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Fig. 2 – Tiedown Knockout Locations

Elevate Unit

! CAUTION

UNIT OPERATION HAZARD

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

Do not allow water and/or ice to build up in base pan.

Elevate unit per local climate and code requirements to provide clearance above estimated snowfall level and ensure adequate drainage of unit.

Table 1 – Accessory Usage

Accessory	Required for Low Ambient Cooling Applications (Below 55°F / 12.8°C)	Required for Long Line Applications	Required for Sea Coast Applications (within 2 miles/3.2 km)
Compressor Start Assist Capacitor and Relay	Yes	Yes	No
Crankcase Heater	Yes (standard)	Yes (standard)	No
Evaporator Freeze Thermostat	Yes	No	No
Hard Shutoff TXV	Yes (standard w/factory approved indoor unit)	Yes (standard w/factory approved indoor unit)	Yes (standard w/factory approved indoor unit)
Isolation Relay	Yes	No	No
Liquid Line Solenoid Valve	No	See Residential Piping and Long Line Guideline	No
Low-Ambient Pressure Switch	Yes	No	No
Support Feet	Recommended	No	Recommended

*. For tubing line sets between 80 and 200 ft. (24.38 and 60.96 m) and/or 20 ft. (6.09 m) vertical differential, refer to Residential Piping and Longline Guideline.

In Long-Line Applications, Install Liquid-Line Solenoid Valve (LSV)

For refrigerant piping arrangements with equivalent lengths greater than 80 ft. (24.38 m) and/or when elevation difference between indoor and outdoor unit is greater than ±20 ft. (±6.10 m), follow all requirements of the Residential Piping and Long-Line Guideline. If required by Long-Line Guideline, install LSV kit, part no. NASA001LS, specifically designed for R-410A refrigerant heat pumps. LSV should be installed within 2 ft. (0.61 m) of outdoor unit with flow arrow pointing toward outdoor unit. Follow the Installation Instructions included with accessory kit.

IMPORTANT: Flow arrow must point toward outdoor unit.

Make Piping Connections

! WARNING

PERSONAL INJURY AND ENVIRONMENTAL HAZARD

Failure to follow this warning could result in personal injury or death. Relieve pressure and recover all refrigerant before system repair or final unit disposal.

Use all service ports and open all flow-control devices, including solenoid valves.

Federal regulations require that you do not vent refrigerant into the atmosphere. Recover refrigerant during system repair or final unit disposal.

! CAUTION

UNIT DAMAGE HAZARD

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

If ANY refrigerant tubing is buried, provide a 6-in (152.4 mm) vertical rise at service valve. Refrigerant tubing lengths up to 36-in (914.4 mm) may be buried without further special consideration. Do not bury lines longer than 36 in (914.4 mm).

Outdoor units may be connected to indoor section using accessory tubing package or field-supplied refrigerant grade tubing of correct size and condition. For tubing requirements beyond 80 ft (24.4 m), substantial capacity and performance losses can occur. Following the recommendations in the Residential Piping and Long Line Guideline will reduce these losses. Refer to Table 1 for accessory requirements. Refer to Table 2 for field tubing diameters.

There are no buried-line applications greater than 36 in. (914.4 mm)

If refrigerant tubes or indoor coil are exposed to atmosphere, they must be evacuated to 500 microns to eliminate contamination and moisture in the system.

Outdoor Unit Connected to Factory Approved Indoor Unit:

Outdoor unit contains the correct system refrigerant charge for operation with factory approved, AHRI rated, indoor unit with highest sales volume when connected by 15 ft (4.57 m) of field-supplied or factory accessory tubing and factory-supplied filter drier. Check refrigerant charge for maximum efficiency.

Service Valves

Service valves are closed and plugged from the factory. Outdoor units are shipped with a refrigerant charge sealed in the unit. Leave the service valves closed until all other refrigerant system work is complete or the charge will be lost. Leave the plugs in place until line set tubing is ready to be inserted.

Heat pumps require a piston metering device in the liquid service valve for proper heating operation. Piston is shipped in the piston body of the liquid service valve, temporarily held in place with a plastic cap. Do not remove the plastic cap until line set tubing is ready to be installed.

Refer to Fig. 3 and follow these steps for piston installation:

1. Remove plastic cap holding piston in piston body of liquid service valve.
2. Check that piston size (stamped on side of piston) matches with number listed on unit rating plate. Return piston to piston body of liquid service valve (either direction).
3. Find plastic bag taped to unit containing copper adapter tube, brass nut, and plastic washer.
4. Install plastic washer in the seat inside piston body.
5. Fit brass nut onto adapter tube and install tube onto liquid service valve. Tighten nut finger tight, then wrench additional ½ turn only [15-ft lbs (20.3 N-m)]. Over tightening may damage the plastic washer and service valve's piston body.

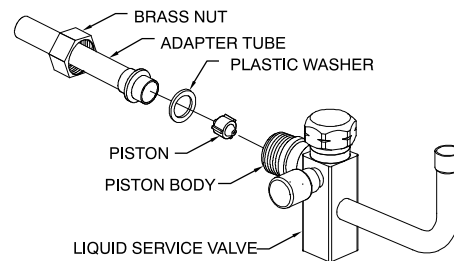


Fig. 3 – Liquid Service Valve with Heating Piston and Adapter Tube

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Brazing Connections

! WARNING

FIRE HAZARD

Failure to following this warning could result in personal injury, death and/or property damage.

Refrigerant and oil mixture could ignite and burn as it escapes and contacts brazing torch. Make sure the refrigerant charge is properly removed from both the high and low sides of the system before brazing any component or lines.

Connect vapor tube to fitting on outdoor unit vapor service valves (see [Table 2](#)). Connect liquid tubing to adapter tube on liquid service valve. Use refrigerant grade tubing.

Table 2 – Refrigerant Connections and Recommended Liquid and Vapor Tube Diameters (In.)

UNIT SIZE	LIQUID		RATED VAPOR*	
	Connection Diameter	Tube Diameter	Connection Diameter	Tube Diameter
024	3/8	3/8	3/4	3/4
036	3/8	3/8	7/8	7/8
048, 060	3/8	3/8	7/8	1-1/8

*. Units are rated with 25 ft. (7.6 m) of lineset. See Product Data sheet for performance data when using different size and length linesets.

Notes:

1. Do not apply capillary tube indoor coils to these units.
2. For Tubing Set lengths between 80 and 200 ft. (24.38 and 60.96 m) horizontal or 20 ft. (6.1 m) vertical differential, refer to the Residential Piping and Longline Guideline.

! CAUTION

UNIT DAMAGE HAZARD

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

Service valves must be wrapped in a heat-sinking material such as a wet cloth while brazing.

! CAUTION

BURN HAZARD

Failure to follow this Caution may result in personal injury.

Components will be HOT after brazing. Wear appropriate personal protective equipment and allow to cool before handling parts and equipment

Apply heat absorbing paste or heat sink product between service valve and joint. Wrap service valves with a heat sinking material such as a wet cloth.

After wrapping service valve with a wet cloth, tubing set can be brazed to service valve using either silver bearing or non-silver bearing brazing material. Do not use soft solder (materials which melt below 800°F/427°C). Consult local code requirements.

NOTE: Some outdoor units contain a mechanical fitting at the liquid distributor. This connection is not field serviceable and should not be disturbed.

NOTE: For Liquid Service Valve - Braze lineset to adapter tube BEFORE bolting adapter to valve. This helps prevent overheating and damage to plastic washer or o-ring.

For Vapor Service Valve - remove valve core from schrader port on Service Valve BEFORE brazing. This helps prevent overheating and damage to valve seals (refer to [Fig. 4](#)). Replace valve core when brazing is completed.

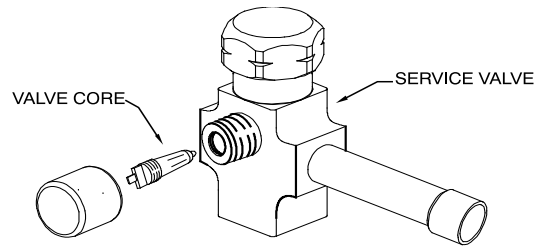


Fig. 4 – Vapor Service Valve

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Clean line set tube ends with emery cloth or steel brush. Remove any grit or debris.

Insert line set tube ends into service valve tube stubs.

Apply heat absorbing paste or heat sink product between service valve and joint. Wrap service valves with a heat sinking material such as a wet cloth.

Braze joints using a Sil-Fos or Phos-copper alloy.

Install Liquid Line Filter Drier Indoor

! CAUTION

UNIT DAMAGE HAZARD

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

1. Installation of filter drier in liquid line is required.
2. Filter drier must be wrapped in a heat-sinking material such as a wet cloth while brazing.

Refer to [Fig. 5](#) and install filter drier as follows:

1. Braze 5 in. (127 mm) liquid tube to the indoor coil.
2. Wrap filter drier with damp cloth.
3. Braze filter drier to 5 in. (127 mm) long liquid tube from step 1.
4. Connect and braze liquid refrigerant tube to the filter drier.

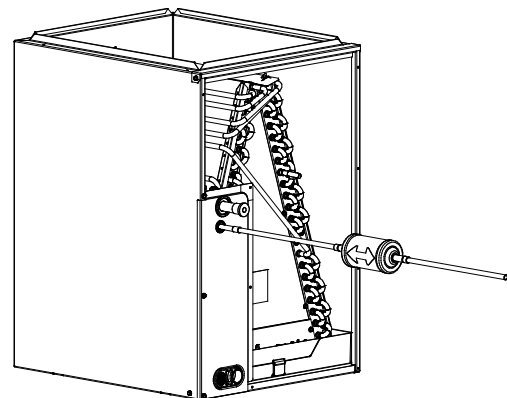


Fig. 5 – Liquid Line Filter Drier

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Refrigerant tubing and indoor coil are now ready for leak testing. This check should include all field and factory joints.

Evacuate Refrigerant Tubing and Indoor Coil

! CAUTION

UNIT DAMAGE HAZARD

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

Never use the system compressor as a vacuum pump.

Refrigerant tubes and indoor coil should be evacuated using the recommended deep vacuum method of 500 microns. The alternate triple evacuation method may be used (see triple evacuation procedure in service manual). Always break a vacuum with dry nitrogen.

Deep Vacuum Method

The deep vacuum method requires a vacuum pump capable of pulling a vacuum of 500 microns and a vacuum gage capable of accurately measuring this vacuum depth. The deep vacuum method is the most positive way of assuring a system is free of air and liquid water. A tight dry system will hold a vacuum of 1000 microns after approximately 7 minutes. See Fig. 6.

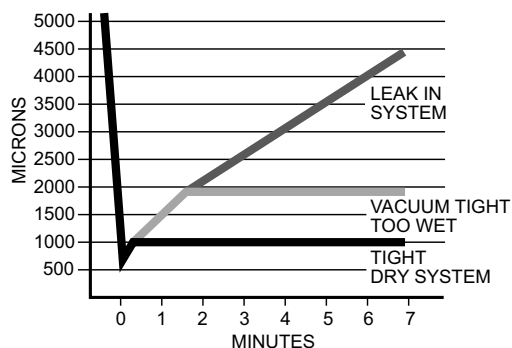


Fig. 6 – Deep Vacuum Graph

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Mandatory Requirements

Pressure Proof Check

1. Perform a pressure check of the unit with a nitrogen charge of about 200psi.
2. the Nitrogen holding charge must **NOT** decrease in pressure for **1 hour**, as indicated by the test gauge. The measuring test gauge resolution not exceeding 5% of the holding charge.

Leak Check

This leak check requires a vacuum pump capable of pulling a vacuum of at least 500 microns and a vacuum gage capable of accurately measuring this vacuum depth.

! WARNING

FIRE HAZARD

Failure to following this warning could result in personal injury, death and/or property damage.

DO NOT USE FLAMES OR IGNITION SOURCES TO LEAK CHECK.

1. Vacuum unit to 500 microns.
2. When isolating the unit from the pump, the pressure shall not rise above 1500 microns in 10 minutes.

Final Tubing Check

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

Be sure field wiring complies with local and national fire, safety, and electrical codes, and voltage to system is within limits shown on unit

rating plate. Contact local power company for correction of improper voltage. See unit rating plate for recommended circuit protection device.

NOTE: Operation of unit on improper line voltage constitutes abuse and could affect unit reliability. See unit rating plate. Do not install unit in system where voltage may fluctuate above or below permissible limits.

Make Electrical Connections

! WARNING

ELECTRICAL SHOCK HAZARD

Failure to follow this warning could result in personal injury or death.

Do not supply power to unit with compressor terminal box cover removed.

NOTE: Use copper wire only between disconnect switch and unit.

NOTE: Install branch circuit disconnect of adequate size per NEC to handle unit starting current. Locate disconnect within sight from and readily accessible from unit, per Section 440-14 of NEC.

Route Ground and Power Wires

Remove access panel to gain access to unit wiring. Extend wires from disconnect through power wiring hole provided and into unit control box.

Connect Ground and Power Wires

! WARNING

ELECTRICAL SHOCK HAZARD

Failure to follow this warning could result in personal injury or death.

The unit cabinet must have an uninterrupted or unbroken ground to minimize personal injury if an electrical fault should occur. The ground may consist of electrical wire or metal conduit when installed in accordance with existing electrical codes.

Connect ground wire to ground connection in control box for safety. Connect power wiring to contactor as shown in Fig. 7.

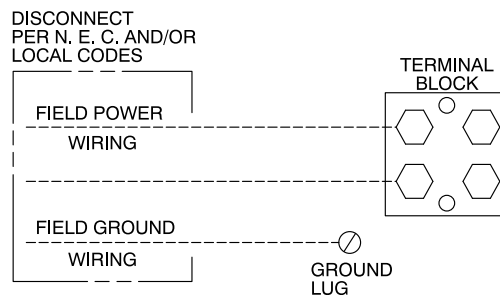


Fig. 7 – Line Connections

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Connect Control Wiring

Route 24-v control wires through control wiring grommet and connect leads to control wiring (see Fig. 8). Refer to thermostat Installation Instructions for wiring specific unit combinations.

Use No. 18 AWG color-coded, insulated (35°C minimum) wire. If thermostat is located more than 100 ft. (30.48 m) from unit, as measured along the control voltage wires, use No. 16 AWG color-coded wire to avoid excessive voltage drop.

All wiring must be NEC Class 2 and must be separated from incoming power leads.

Use furnace transformer, fan coil transformer, or accessory transformer for control power, 24v/40va minimum.

NOTE: Use of available 24v accessories may exceed the minimum 40va power requirement. Determine total transformer loading and increase the transformer capacity or split the load with an accessory transformer as required.

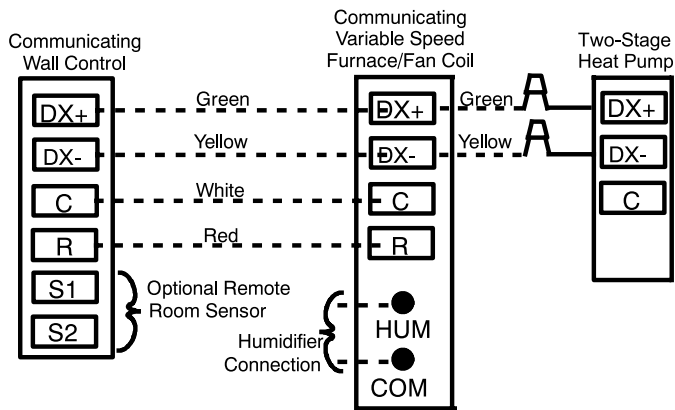


Fig. 8 – Ion™ Communicating Control 4-Wire Connection Diagram A200318

Final Wiring Check

IMPORTANT: Check factory wiring and field wire connections to ensure terminations are secured properly. Check wire routing to ensure wires are not in contact with tubing, sheet metal, etc.

Compressor Crankcase Heater

When equipped with a crankcase heater, furnish power to heater a minimum of 24 hr before starting unit. To furnish power to heater only, set thermostat to OFF and close electrical disconnect to outdoor unit.

A crankcase heater is required if refrigerant tubing is longer than 80 ft. (24.38 m), or when outdoor unit is 20 ft (6.1 m) below indoor unit, or when the installation requires a low ambient kit. Refer to the Long Line Applications Guideline.

Install Electrical Accessories

Refer to the individual instructions packaged with kits or accessories when installing.

Check OAT Thermistor and OCT Thermistor Attachments

Outdoor Air Temperature (OAT) Thermistor is factory installed by inserting the nibs on either sides of the thermistor body through a keyhole in the bottom shelf of the control box and locking it in place by turning it 90 degrees, such that the spherical end of a nib faces the front of the control box.

Check to make sure the OAT is locked in place (Fig. 9).

OAT Thermistor must be locked in place with spherical nib end facing towards the front of the control box

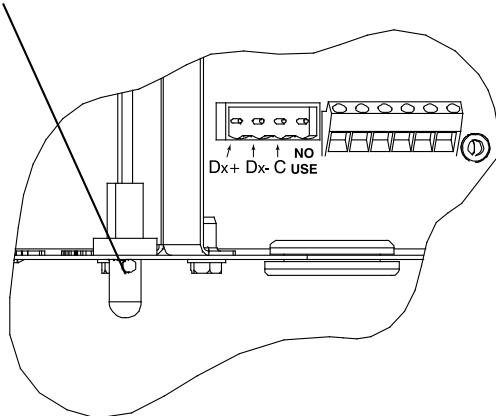


Fig. 9 – Outdoor Air Thermistor (OAT) Attachment A150065

The Outdoor Coil Temperature (OCT) Thermistor is factory installed on the 3/8-in. diameter stub tube - approximately 2-in. (50.8 mm) long - located on the coil assembly. Check to make sure that it is securely

attached with the clip as shown in Fig. 10. Note that there is only one stub tube used with the liquid heater, and on most units it is the bottom circuit.

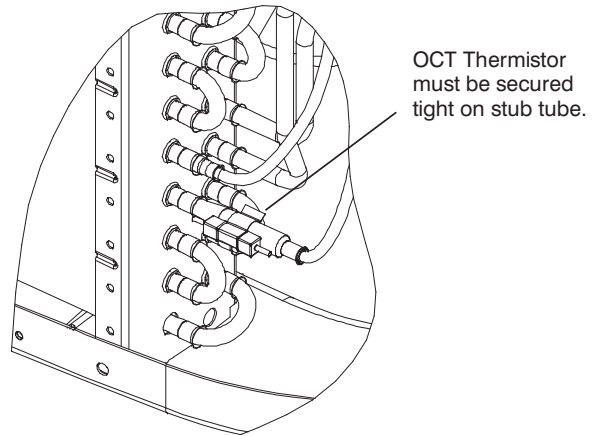


Fig. 10 – Outdoor Coil Thermistor (OCT) Attachment A05408

Start-Up

! CAUTION

UNIT OPERATION AND SAFETY HAZARD

Failure to follow this caution may result in minor personal injury, equipment damage or improper operation.

To prevent compressor damage or personal injury, observe the following:

- Do not overcharge system with refrigerant.
- Do not operate unit in a vacuum or at negative pressure.
- Do not disable low pressure switch in scroll compressor applications.
- Compressor dome temperatures may be hot.

! CAUTION

PERSONAL INJURY HAZARD

Failure to follow this caution may result in personal injury.

Wear safety glasses, protective clothing, and gloves when handling refrigerant and observe the following:

- Front seating service valves are equipped with Schrader valves.

! CAUTION

ENVIRONMENTAL HAZARD

Failure to follow this caution may result in environmental damage.

Federal regulations require that you do not vent refrigerant to the atmosphere. Recover during system repair or final unit disposal.

Follow these steps to properly start up the system:

1. After system is evacuated, fully open liquid and vapor service valves.
2. Unit is shipped with valve stem(s) front seated (closed) and caps installed:
 - Replace stem caps after system is opened to refrigerant flow.
 - Replace caps finger-tight and tighten with wrench an additional 1/12 turn
3. Close electrical disconnects to energize system.

- Set room thermostat at desired temperature. Be sure set point is below indoor ambient temperature.
- Set room thermostat to HEAT or COOL and fan control to ON or AUTO mode, as desired. Operate unit for 15 minutes. Check system refrigerant charge.

Check Charge

Two-stage equipment should be charged in high stage compressor operation only.

Factory charge amount and desired subcooling are shown on unit rating plate. Charging method is shown on information plate inside unit. Additional subcooling may be required to achieve optimal heating performance based on installed indoor unit. To properly check or adjust charge, conditions must be favorable for subcooling charging. Favorable conditions exist when the outdoor temperature is between 70°F and 100°F (21.11°C and 37.78°C), and the indoor temperature is between 70°F and 80°F (21.11°C and 26.67°C). Follow the procedure below:

Unit is factory charged for 15 ft (4.57 m) of lineset. Adjust charge by adding or removing 0.6 oz/ft of 3/8 liquid line above or below 15 ft (4.57 m) respectively.

For standard refrigerant line lengths (80 ft/24.38 m or less), allow system to operate in cooling mode at least 15 minutes. When operating with the Ion™ Control make sure that indoor airflow is set to “Efficiency” during charging. If conditions are favorable, check system charge by subcooling method. If any adjustment is necessary, adjust charge slowly and allow system to operate for 15 minutes to stabilize before declaring a properly charged system.

If the indoor temperature is above 80°F (26.67°C), and the outdoor temperature is in the favorable range, adjust system charge by weight based on line length and allow the indoor temperature to drop to 80°F (26.67°C) before attempting to check system charge by subcooling method as described above.

If the indoor temperature is below 70°F (21.11°C), or the outdoor temperature is not in the favorable range, adjust charge for line set length above or below 15 ft (4.57 m) only. Charge level should then be appropriate for the system to achieve rated capacity. The charge level could then be checked at another time when the both indoor and outdoor temperatures are in a more favorable range.

NOTE: If line length is beyond 80 ft (24.38 m) or greater than 20 ft (6.10 m) vertical separation, See Long Line Applications Guideline for special charging requirements.

Heating Tech Label

To check system operation during heating cycle, refer to the Heating Tech Label on outdoor unit. This label indicates whether a correct relationship exists between system operating pressure and air temperature entering indoor and outdoor units. If pressure and temperature do not match on chart, system refrigerant charge may not be correct. Do not use label to adjust refrigerant charge.

General Sequence of Operation Standard Thermostat

Turn on power to indoor and outdoor units. Transformer is energized with power supplied.

Cooling

When called for cooling, a standard non-communicating thermostat makes circuits R-O and R-Y and R-G. Circuit R-O energizes reversing valve, switching it to cooling position. Circuit R-Y energizes contactor, starting outdoor fan motor and compressor circuit. R-G energizes indoor unit blower relay, starting indoor blower motor on high speed.

When a standard thermostat (non-communicating) is satisfied, its contacts open, de-energizing contactor and blower relay. Compressor and motors should stop.

NOTE: If indoor unit is equipped with a time-delay relay circuit, the indoor blower will run an additional 90 seconds to increase system efficiency.

Heating

When called for heating, a standard non-communicating thermostat makes circuits R-Y and R-G. Circuit R-Y energizes contactor, starting outdoor fan motor and compressor. Circuit R-G energizes indoor blower relay, starting blower motor on high speed.

Should temperature continue to fall, R-W2 is made through second-stage room thermostat. Circuit R-W2 energizes a relay, bringing on first bank of supplemental electric heat and providing electrical potential to second heater relay (if used). If outdoor temperature falls below setting of outdoor thermostat (factory installed), contacts close to complete circuit and bring on second bank of supplemental electric heat.

When thermostat is satisfied, its contacts open, de-energizing contactor and relay. All heaters and motors should stop after all fan off delays.

Heat Pump System Functions and Sequence of Operation

The outdoor unit control system has special functions. The following is an overview of the control functions.

Sequence of Operation

Cooling & Heating Operation

This product utilizes either a standard indoor thermostat or Ion™ Communicating Control. With a call for cooling, the outdoor fan, reversing valve, and compressor are energized. When the cooling demand is satisfied, the compressor and fan will shut off. The reversing valve will remain energized until the control board power is removed or a call for heating is initiated.

NOTE: The outdoor fan motor will continue to operate for one minute after compressor shuts off, when the outdoor ambient is greater than or equal to 100°F (37.78°C).

With a call for heating, the outdoor fan and compressor are energized. The reversing valve is de-energized in the heating mode.

Communication and Status Function Lights

Green Communications (COMM) Light (Communicating Control only): A green LED (COMM light) on the outdoor board (Fig. 11) indicates successful communication with the other system products. The green LED will remain OFF until communications is established. Once a valid command is received, the green LED will turn ON continuously. If no communication is received within 2 minutes, the LED will be turned OFF until the next valid communication.

Amber Status Light

An amber colored STATUS light is used to display the operation mode and fault codes as specified in the troubleshooting section. See Table 5 for codes and definitions.

NOTE: Only one fault code will be displayed on the outdoor unit control board (the most recent, with the highest priority).

Crankcase Heater Operation

The crankcase heater (when applicable) is energized during the off cycle below 65°F (37.78°C)

Outdoor Fan motor Operation

The outdoor unit control energizes outdoor fan any time the compressor is operating (except defrost and intermittently during low ambient cooling). The outdoor fan remains energized for 15 minutes if a pressure switch or compressor thermal protector should open. Outdoor fan motor will continue to operate for one minute after the compressor shuts off when the outdoor ambient is greater than or equal to 100°F (37.78°C).

Time Delays

The unit time delays include:

- Five minute time delay to start cooling or heating operation when there is a call from the thermostat. (To bypass this feature in a non-communicating system, momentarily short and release forced defrost pins.
- Five minute compressor recycle delay on return from a brown out condition
- Two minute time delay to return to standby operation from last valid communications (with Ion™ Communicating Control only)
- One minute time delay of outdoor fan at termination of cooling mode when outdoor ambient is greater than or equal to 100°F (37.78°C).
- Fifteen second delay at termination of defrost before the auxiliary heat (W2) is de-energized.
- Twenty second delay at termination of defrost before the outdoor fan is energized.
- Seventy and sixty second compressor delays when Quiet Shift-2 enabled.

Utility Interface

With Non-Communicating Thermostats

Utility curtailment will work when the unit is operating with a non-communicating thermostat and the utility interface. It will also work with the Ion™ Communicating Control without the need for the utility interface.

When the utility curtailment interface is applied with a non-communicating thermostat, the utility relay should be wired between R & Y.

Low Ambient Cooling

When this unit is required to operate below 55°F (12.78°C) to a minimum of 0°F (-17.78°C) outdoor temperature, provisions must be made for low ambient operation.

Low ambient applications require the installation of accessory kits:

- Low Ambient Pressure Switch Kit
- Evaporator Freeze Thermostat
- Hard Start kit
- Crankcase Heater
- Field Supplied Isolation Relay

Support feet are recommended for low ambient cooling. See Product Specification sheet for kit part numbers on appropriate unit size and series unit.

For low ambient cooling with the Ion™ Communicating Control, the cooling lockout must be set to “Off” in the Wall Control setup.

Defrost

This control offers 4 possible defrost interval times: 30, 60, 90 or 120 minutes. These are selected by dip switches on the unit control board, or in the Ion™ Communicating Control (if used). The Ion™ selection overrides the control board dip switch settings.

When using standard thermostat the defrost interval times set by the dip switches are initial settings only and may vary after initial defrost when quiet shift-2 is not activated. When quiet shift-2 is activated the times set by the dip switch will not vary from the setting.

Auto defrost is available with Ion™ Communicating Control only and it must be enabled in the Wall Control. Auto defrost adjusts the defrost interval time based on the last defrost time. The initial interval time is set by the dip switches when using this mode and are the only way to adjust the initial time. Quiet shift-2 can be selected while using Auto Defrost Mode.

The control board accumulates compressor run time. As the accumulated run time approaches the selected defrost interval time, the control board monitors the coil temperature sensor for a defrost demand. If a defrost demand exists, a defrost cycle will be initiated at the end of the selected

time interval. A defrost demand exists when the coil temperature is at or below 32°F/0°C for 4 minutes during the interval.

The defrost cycle is terminated when the coil temperature reaches 65°F/18.33°C or 10 minutes has passed.

If the coil temperature does not reach 32°F/0°C within the interval, the interval timer will be reset and start over.

NOTE:

- Upon initial power up the first defrost interval is defaulted to 30 minutes. Remaining intervals are at selected times.
- Defrost is only allowed to occur below 50°F/10°C outdoor ambient temperature.
- The Quiet Shift-2 compressor on/off delays, as described below, will be included in a forced defrost if Quiet Shift-2 is enabled.

Defrost Hold

In a non-communicating system, if the thermostat becomes satisfied before the defrost cycle is terminated, the control will “hold” in defrost mode and finish the defrost cycle on the next call for heat. Defrost hold is not needed in a communicating system because the Wall Control will complete the defrost cycle before shutting down the system.

Forced Defrost

In a non-communicating system, forced defrost can be initiated manually, or by communicated command from a Wall Control. The board contains a 2-pin header labeled FORCED DEFROST (Fig. 11). To initiate a forced defrost:

- Manually, short FORCED DEFROST pins for 5 seconds then release
- If coil temp is at defrost temp of 32°F/0°C, and outdoor air temperature is below 50°F/10°C, a full defrost sequence will occur
- If the coil temp or outdoor air temperature do not meet the above requirements, an abbreviated 30 second defrost will occur

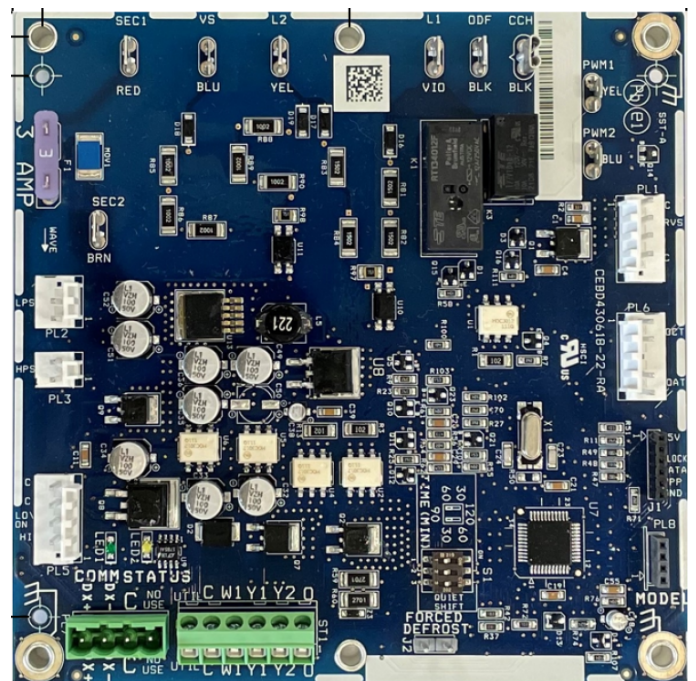


Fig. 11 – 2-Stage Control Board

Quiet Shift-2

Quiet Shift-2 is a field-selectable defrost mode which may eliminate occasional noise that could be heard at the start and finish of the defrost cycle. For installations using a standard 2-stage thermostat, this feature must be enabled by selecting the 3rd position dip switch on the outdoor control board. For installations using an Ion™ Control, this feature must be enabled at the Wall Control. When activated, the following sequence of operation occurs: Defrost Initiation - the compressor is de-energized

for 70 seconds. During this 70 second compressor off time, the reversing valve will be energized. Once the 70 second compressor off time has been reached, the compressor will be energized then the outdoor fan will be de-energized at which time the normal defrost cycle begins. Defrost Termination - the outdoor fan will be energized shortly before the compressor is de-energized for 60 seconds. During the compressor 60 second off time, the reversing valve will be deenergized. Once the 60 second compressor off time has been completed, the compressor will be energized at which time the system will be in normal heat mode.

Liquid Line Solenoid Accessory

In heat pump long line applications, a liquid line solenoid is required to control refrigerant migration in the heating mode. The solenoid should be installed near the outdoor unit with the arrow facing the outdoor unit. This is the direction of flow control. See Long Line Application Guideline for details.

Accessory Liquid Solenoid with Ion™ Communicating Control: When using the Ion™ Communicating Control, a liquid line solenoid output labeled LS is provided. Connect the solenoid as shown in the wiring label diagram. This is a 24VAC output that is energized whenever the compressor is energized. It closes in the compressor-off mode to prevent refrigerant migration into the unit through the liquid line.

Accessory Liquid Solenoid with Non-Communicating Thermostat: The liquid solenoid is connected to the Y and C terminal connections. The liquid solenoid closes in the compressor-off mode to prevent refrigerant migration into the unit through the liquid line.

Major Components

Control Board

The Heat Pump control board controls the following functions:

- Compressor contactor operation
- Outdoor fan motor operation
- Reversing valve operation
- Defrost operation
- Compressor external protection
- Pressure switch monitoring
- Time delays

Field Connections

When using the Ion™ Communicating Control, 4 field wires are required to be connected to the factory wires already wired to the DX+DX-CR terminal (Fig. 11). Unit as provided by manufacturer is set up for the Ion™ Communicating Control.

When used with a standard non-communicating thermostat, 5 field wires are required to be connected to R, Y, W2, O and C. Disconnect factory provided wires from DX+, DX-, C, and R terminals. Using factory provided wires, connect to R, Y, W2, O and C terminals on the control board. Connect field 24V wires to factory provided wires now connected to R, Y, W2, O and C and unused factory provided wires.

When using Ion™ Communication Control only, the 24VAC LS (liquid solenoid) output terminal is energized for the liquid solenoid accessory. The connection is located at the side of the control board just below the DX+DX-CR connector.

Compressor Internal Relief

The compressor is protected by an internal pressure relief (IPR) which relieves discharge gas into the compressor shell when differential between suction and discharge pressure exceeds 550-625 psi. The compressor is also protected by an internal overload attached to motor windings.

Troubleshooting

Systems Communication Failure

If communication between Wall Control, and condensing unit is lost, the outdoor control will flash the appropriate fault code (Table 5). Check the wiring to the Wall Control, indoor and outdoor units.

Model Plug

Each control board contains a model plug. The correct model plug must be installed for or the system to operate properly (see Table 3).

Table 3 – Model Plug

Model Size	WindiModel Plug Number	Pin Resistance (KOhms)	
		Pin 1-4	Pin 2-3
24	HK70EZ041	18	91
36	HK70EZ043	18	150
48	HK70EZ045	18	220
60	HK70EZ047	18	360

The model plug is used to identify the type and size of unit to the control.

On new units, the model and serial numbers are input into the board's memory at the factory. If a model plug is lost or missing at initial installation, the unit will operate according to the information input at the factory and the appropriate error code will flash temporarily.

A FAST® Parts replacement board contains no model and serial information. If the factory control board fails, the model plug must be transferred from the original board to the replacement board for the unit to operate.

NOTE: The model plug takes priority over factory model information input at the factory. If the model plug is removed after initial power up, the unit will operate according to the last valid model plug installed, and flash the appropriate fault code temporarily.

Pressure Switch Protection

The outdoor unit is equipped with high- and low-pressure switches. If the control senses the opening of a high or low-pressure switch, it will de-energize the compressor contactor, keep the outdoor fan operating for 15 minutes and display the appropriate fault code (Table 5).

After a 15 minute delay, if there is still a call for cooling, and the LPS or HPS is reset, the compressor contactor is energized. If the LPS or HPS has not closed after a 15 minute delay, the outdoor fan is turned off. If the open switch closes anytime after the 15-minute delay, then the unit will resume operation with a call for cooling.

If the LPS or HPS trips for five consecutive cycles, then unit operation is locked out for 4 hours and the appropriate fault code (Table 5) is displayed.

In the event of a high-pressure switch trip or high-pressure lockout, check the refrigerant charge, outdoor fan operation and outdoor coil (in cooling) for airflow restrictions, or indoor airflow in heating.

In the event of a low-pressure switch trip or low-pressure lockout, check the refrigerant charge and indoor airflow (cooling) and outdoor fan operation and outdoor coil in heating.

Control Fault

If the outdoor unit control board has failed, the control will flash the appropriate fault code (Table 5). The control board should be replaced.

24V Brown Out Protection

If the control voltage is less than 15.5volts for at least 4 seconds, the compressor contactor and fan relay are de-energized. Compressor and fan operation are not allowed until the control voltage is a minimum of 17.5 volts. The control will flash the appropriate fault code (Table 5). Verify the control voltage is in the allowable range of 18-30 volts.

Compressor Voltage Sensing

The input terminals labeled VR and VS on the control board (Fig. 11) are used to detect compressor voltage status, and alert the user of potential problems. The control continuously monitors the high voltage on the run capacitor of the compressor motor. Voltage should be present any time the compressor contactor is energized, and voltage should not be present when the contactor is de-energized.

Compressor Thermal Cutout or Loss of 230V Power

If the control senses the compressor voltage after start-up, and is then absent for 10 consecutive seconds while cooling demand exists, it will de-energize the compressor contactor, keep the outdoor fan operating for 15 minutes (if 230V power present) and display the appropriate fault code (Table 5). Possible causes are compressor internal overload trip or loss of high voltage (230V) to compressor without loss of control voltage.

After a 15 minute delay, if there is still a call for cooling, the compressor contactor is energized. If the thermal protector has not re-set, the outdoor fan is turned off. If the call for cooling continues, the control will energize the compressor contactor every 15 minutes. If the thermal protector closes, (at the next 15 minute interval check), the unit will resume operation.

If the thermal cutout trips for three consecutive cycles, then unit operation is locked out for 4 hours and the appropriate fault code (Table 5) is displayed.

Contactor Shorted Detection

If there is compressor voltage sensed when there is no demand for compressor operation, the contactor may be stuck closed. The control will flash the appropriate fault code. Check the contactor and control box wiring.

No 230V At Compressor

If the compressor voltage is not sensed when the compressor should be starting, the contactor may be stuck open or the unit disconnect or circuit breaker may be open. The control will flash the appropriate fault code. Check the contactor, unit disconnect or circuit breaker and control box wiring.

Troubleshooting units for proper switching between low & high stages

Check the suction pressures at the service valves. Suction pressure should be reduced by 3-10% when switching from low to high capacity.

NOTE: The liquid pressures are very similar between low and high stage operation so liquid pressure should not be used for troubleshooting.

Compressor current should increase 20-45% when switching from low to high stage. The compressor solenoid, when energized in high stage, should measure 24vac across pin numbers PL5-2 HI and PL5-5 C. When the compressor is operating in low stage the 24v DC compressor solenoid coil is de-energized. When the compressor is operating in high stage, the 24v DC solenoid coil is energized. The solenoid plug harness that is connected to the compressor has an internal rectifier that converts the 24v AC signal to 24v DC.

NOTE: DO NOT INSTALL A PLUG WITHOUT AN INTERNAL RECTIFIER.

Unloader Test Procedure

The unloader is the compressor internal mechanism, controlled by the DC solenoid, that modulates between high and low stage. If it is suspected that the unloader is not working, the following methods may be used to verify operation.

1. Operate the system and measure compressor amperage. Cycle the unloader on and off at 30 second plus intervals at the Wall Control (from low to high stage and back to low stage). Wait 5 seconds after

staging to high before taking a reading. The compressor amperage should go up or down at least 20 percent.

2. If step one does not give the expected results, remove the solenoid plug from the compressor and, with the unit running and the Wall Control (or Thermostat) calling for high stage, test the voltage output at the plug with a DC voltmeter. The reading should be 24 volts DC.
3. If the correct DC voltage is at the control circuit molded plug, measure the compressor unloader coil resistance. The resistance should be approximately 1640 ohms. If the coil resistance is infinite or is grounded, the compressor must be replaced.

Temperature Thermistors

Thermistors are electronic devices which sense temperature. As the temperature increases, the resistance decreases. Thermistors are used to sense outdoor air (OAT) and coil temperature (OCT). Refer to Fig. 12 for resistance values versus temperature.

If the outdoor air or coil thermistor should fail, the control will flash the appropriate fault code (Table 5).

IMPORTANT: The outdoor air thermistor and coil thermistor are factory mounted in the correct locations. Do not re-locate thermistor sensors.

Thermistor Sensor Comparison

The control continuously monitors and compares the outdoor air temperature sensor and outdoor coil temperature sensor to ensure proper operating conditions. The comparison is:

- In cooling if the outdoor air sensor indicates $\geq 10^{\circ}\text{F}/-12.22^{\circ}\text{C}$ warmer than the coil sensor (or) the outdoor air sensor indicates $\geq 20^{\circ}\text{F}/-6.67^{\circ}\text{C}$ cooler than the coil sensor, the sensors are out of range.
- In heating if the outdoor air sensor indicates $\geq 35^{\circ}\text{F}/1.67^{\circ}\text{C}$ warmer than the coil sensor (or) the outdoor air sensor indicates $\geq 10^{\circ}\text{F}/-12.22^{\circ}\text{C}$ cooler than the coil sensor, the sensors are out of range.

If the sensors are out of range, the control will flash the appropriate fault code (Table 5).

The thermistor comparison is not performed during low ambient cooling or defrost operation.

Failed Thermistor Default Operation

Factory defaults have been provided in the event of failure of outdoor air thermistor and/or coil thermistor.

If the OAT sensor should fail, low ambient cooling will not be allowed and the one-minute outdoor fan off delay will not occur. Defrost will be initiated based on coil temperature and time.

If the OCT sensor should fail, low ambient cooling will not be allowed. Defrost will occur at each time interval during heating operation, but will terminate after 5 minutes.

If there is a thermistor out of range error, defrost will occur at each time interval during heating operation, but will terminate after 5 minutes.

Thermistor Curve: The resistance vs. temperature chart shown in Fig. 12 enables the technician to check the outdoor air and outdoor coil thermistors for proper resistance. Unplug the thermistor assembly from the circuit board and measure resistance across each thermistor. For example, if the outdoor temperature is 60°F (15.56°C), the resistance reading across the outdoor air thermistor should be around 16,000 Ohms.

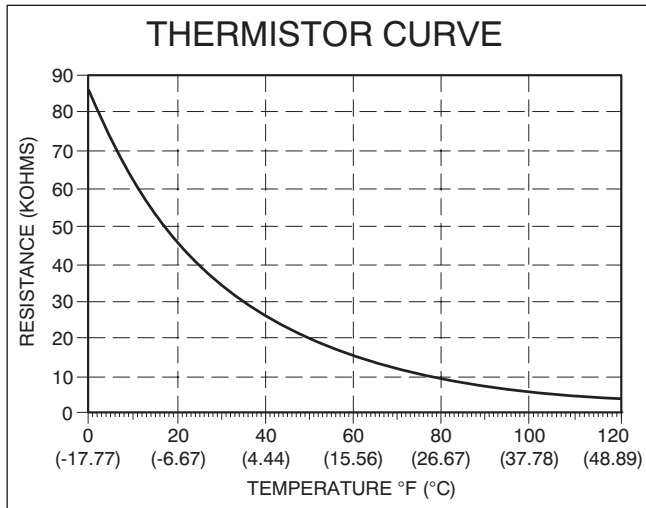


Fig. 12 – Resistance vs Temperature Chart

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If the compressor fails to operate with a cooling call, Table 4 (Resistance table) can be used to verify if there is any damage to the compressor windings causing system malfunction.

Table 4 – Winding Resistance

Winding	Winding resistance at 70°F +/- 20°F (21.11°C +/- 11.11°C)			
	Unit Size			
	024	036	048	060
Start (S-C)	1.652	1.587	1.299	1.203
Run (R-C)	1.065	0.751	0.477	0.383

Status Codes

Table 5 shows the status codes flashed by the amber status light. Most system problems can be diagnosed by reading the status code as flashed by the amber status light on the control board.

The codes are flashed by a series of short and long flashes of the status light. The short flashes indicate the first digit in the status code, followed by long flashes indicating the second digit of the error code. The short flash is 0.25 second ON and the long flash is 1.0 second ON. Time between flashes is 0.25 second. Time between short flash and first long flash is 1.0 second. Time between code repeating is 2.5 seconds with LED OFF.

Count the number of short and long flashes to determine the appropriate flash code. Table 5 gives possible causes and actions related to each error.

Example: Three short flashes followed by 2 long flashes indicates a 32 code. Table 5 shows this to be low pressure switch open.

Table 5 – Status Codes

Operation	Fault	Amber LED Flash Code	Possible Cause and Action
Standby – no call for unit operation	None	On solid, no flash	Normal operation - with communicating Control
Cooling Operation	None	1, pause	Normal operation
	System Communications Failure	16	Communication with wall control lost. Check wiring to wall control, indoor and outdoor units
	High Pressure Switch Open	31	High pressure switch trip. Check refrigerant charge, outdoor fan operation and coils for airflow restrictions.
	Low Pressure Switch Open	32	Low pressure switch trip. Check refrigerant charge and indoor air flow
	Control Fault	45	Outdoor unit control board has failed. Control board needs to be replaced.
	Brown Out (24 v)	46	The control voltage is less than 15.5v for at least 4 seconds. Compressor and fan operation not allowed until control voltage is a minimum of 17.5v. Verify control voltage.
	Outdoor Air Temp Sensor Fault	53	Outdoor air sensor not reading or out of range. Ohm out sensor and check wiring
	Outdoor Coil Sensor Fault	55	Coil sensor not reading or out of range. Ohm out sensor and check wiring
	Thermistors out of range	56	Improper relationship between coil sensor and outdoor air sensor. Ohm out sensors and check wiring.
	Thermal Cutout	72	Compressor voltage sensed after start-up, then absent for 10 consecutive seconds while cooling demand exists. Possible causes are internal compressor overload trip or loss of high voltage to compressor without loss of control voltage. The control will continue fan operation and wait 15 minutes to attempt a restart. Fault will clear when restart is successful, or low voltage power is cycled.
	Contactors Shorted	73	Compressor voltage sensed when no demand for compressor operation exists. Contactor may be stuck closed or there is a wiring error.
	No 230V at Compressor	74	Compressor voltage not sensed when compressor should be starting. Disconnect may be open or contactor may be stuck open or there is a wiring error.
	Thermal Lockout	82	Thermal cutout occurs in three consecutive cycles. Unit operation locked out for 4 hours or until 24v power recycled.
	Low Pressure Lockout	83	Low pressure switch trip has occurred during 3 consecutive cycles. Unit operation locked out for 4 hours or until 24v power recycled.
	High Pressure Lockout	84	High pressure switch trip has occurred during 3 consecutive cycles. Unit operation locked out for 4 hours or until 24v power recycled.

Major Components

2-Stage Compressor

The 2-stage compressor contains motor windings that provide 2-pole (3500 RPM) operation.

Compressor Internal Relief

The compressor is protected by an internal pressure relief (IPR) which relieves discharge gas into compressor shell when differential between suction and discharge pressures exceeds and 550 - 625 psi. The compressor is also protected by an internal overload attached to motor windings.

Compressor Control Contactor

The contactor has a 24 volt coil and is controlled by Y1 input from the thermostat

Low Pressure Switch

Low pressure switch is provided in line with the Y1 signal to the contactor for protection.

Final Checks

IMPORTANT: Before leaving job, be sure to do the following:

1. Ensure that all wiring is routed away from tubing and sheet metal edges to prevent rub-through or wire pinching.
2. Ensure that all wiring and tubing is secure in unit before adding panels and covers. Securely fasten all panels and covers.
3. Tighten service valve stem caps to 1/12-turn past finger tight.
4. Leave Owner’s Manual with owner. Explain system operation and periodic maintenance requirements outlined in manual.
5. Fill out Dealer Installation Checklist and place in customer file.

Repairing Refrigerant Circuit

When breaking into the refrigerant circuit to make repairs, or for any other purpose, the following procedures shall be used.

1. Safely remove the refrigerant using a recovery pump certified for flammable refrigerants.
2. Purge the refrigerant circuit with nitrogen gas.
3. Evacuate the refrigerant circuit to 1500 microns.
4. Break vacuum with a nitrogen purge of the refrigerant circuit ensuring that the outlet of the vacuum pump is not near a potential ignition source.
5. Open the circuit by cutting or brazing.

Care and Maintenance

For continuing high performance and to minimize possible equipment failure, periodic maintenance must be performed on this equipment.

Frequency of maintenance may vary depending upon geographic areas, such as coastal applications. See Users Manual for information.



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