C5H6S, H5H6S, T5H6S
Single-Stage Heat Pump
with R-454B Refrigerant
1-1/2 To 5 Nominal Tons

Installation Instructions

NOTE: For use with R-454B indoor units only. Read the entire instruction manual before starting the installation.

SAFETY CONSIDERATIONS

IMPORTANT: This appliance shall only be installed by EPA qualified personnel having appropriate certification. This appliance is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety

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 a dry powder or CO2 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.

Proper tools should be used that are designed for the refrigerant of the unit being installed. For A2L refrigerants, non-sparking tools are required. A refrigerant detector should be used prior to and during the installation process to check for leaks. Open flames or other ignition sources should not be present except during brazing. Brazing should only take place on refrigerant tubes that are open to the atmosphere or have been properly evacuated

Recognize safety information. This is the safety–alert symbol ⚠. When you see this symbol on the unit and in instructions or manuals, be alert to the potential for personal injury.

Understand these signal words; DANGER, WARNING, and CAUTION. These words are used with the safety–alert symbol. DANGER identifies the most serious hazards which will result in severe personal injury or death. WARNING signifies hazards which could result in personal injury or death. CAUTION is used to identify unsafe practices which may result in minor personal injury or product and property damage. NOTE is used to highlight suggestions which will result in enhanced installation, reliability, or operation.

⚠ WARNING

ELECTRICAL SHOCK HAZARD

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

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

⚠ WARNING

EXPLOSION HAZARD

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

Never use air or 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.

⚠ 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.

GENERAL

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

1. Maximum allowed elevation is 10,000 feet (3000 meters) above sea level.
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 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.

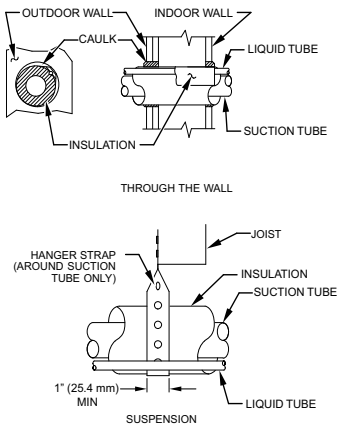


Fig. 1 – Connecting Tubing Installation

Refrigerant Tubing Connection Outdoor

IMPORTANT: Maximum liquid–line size is 3/8–in. OD for all residential applications including long line. Refer to Residential Piping and Long Line Guideline for further information

IMPORTANT: Always install the factory–supplied liquid–line filter drier.

If replacing the filter drier, refer to Product Replacement Parts List for appropriate part number. Obtain replacement filter driers from your distributor or branch.

INSTALLATION

IMPORTANT: Effective January 1, 2023, all split system and packaged heat pumps must be installed pursuant to applicable regional efficiency standards issued by the Department of Energy.

Check Equipment and Job Site

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 may require wind baffles. Consult the Application Guideline and Service Manual – Residential Split System Air Conditioners and Heat Pumps for wind baffle construction.

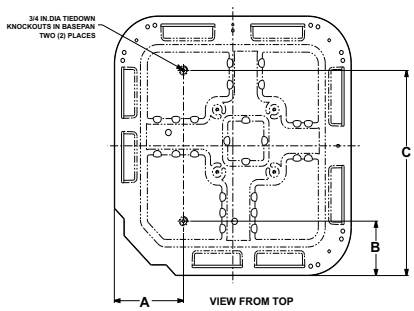
Unit must be level to within ±2° (±3/8 in/ft,±9.5 mm/m) per compressor manufacturer specifications.

Clearance Requirements

When installing, allow sufficient space for airflow clearance, wiring, refrigerant piping, and service. Allow 24 in. (610 mm) clearance to service end of unit and 48 in. (1219 mm) above unit. For proper airflow, a 6–in. (152 mm) clearance on 1 side of unit and 12–in. (305 mm) on all remaining sides must be maintained. Maintain a distance of 24 in. (610 mm) between units or 18 in. (457 mm) if no overhang within 12 ft. (4 m). Position so water, snow, or ice from roof or eaves cannot fall directly on unit.

NOTE: 18” (457 mm) clearance option described above is approved for outdoor units with wire grille coil guard only. Units with louver panels require 24” (610 mm) between units.

On rooftop applications, locate unit at least 6 in. (152 mm) above roof surface.



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UNIT BASE PAN Dimension in. (mm)	TIEDOWN KNOCKOUT LOCATIONS in. (mm)		
	A	B	C
31–1/2 X 31–1/2 (800 X 800)	9–1/8 (231.8)	6–9/16 (166.7)	24–11/16 (627.1)
35 X 35 (889 X 889)	9–1/8 (231.8)	6–9/16 (166.7)	28–7/16 (722.3)

Fig. 2 – Tiedown Knockout Locations

Operating Ambient

The minimum outdoor operating ambient in cooling mode without accessory is 55°F (13°C).

Check OAT and OCT Thermistor Attachments

⚠ WARNING

PERSONAL INJURY AND ENVIRONMENTAL HAZARD

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

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 do not contain an odor.

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 (see Fig. 3).

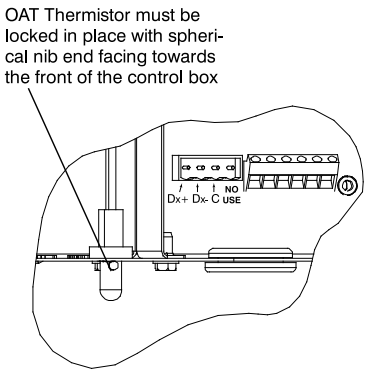

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Fig. 3 – Outdoor Air Thermistor (OAT) Attachment

The Outdoor Coil Temperature (OCT) Thermistor is factory installed on the 3/8” diameter stub tube located on the coil assembly. Check to make sure that it is securely attached with the clip as shown in Fig. 4.

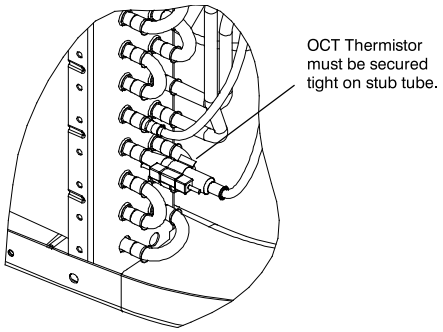

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Fig. 4 – Outdoor Coil Thermistor (OCT) Attachment

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 / 3.22 km)
Accumulator	Standard	Standard	Standard
Ball Bearing Fan Motor	Yes†	No	No
Compressor Start Assist Capacitor and Relay	Yes	Yes	No
Crankcase Heater	Yes	Yes	No
Evaporator Freeze Thermostat	Yes	No	No
Hard Shutoff TXV	Yes	Yes	No
Isolation Relay	Yes	No	No
Liquid Line Solenoid Valve	No	See Long–Line Application Guideline	No
Low Ambient 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 Long Line Guideline.
†. Additional requirement for Low–Ambient Controller.
‡. In units equipped with ECM OD motor, motor needs to be replaced per unit accessory guide to work properly. This motor kit comes with a new defrost board that also needs to be installed. Unit will not meet AHRI rated efficiency once motor and control board are replaced to use this accessory.

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 refrigerant is not vented into the atmosphere. Recover 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 mm) vertical rise at service valve. Refrigerant tubing lengths up to 36–in (914 mm). may be buried without further special consideration. Do not bury lines longer than 36 in (914 mm).

Outdoor units may be connected to indoor section using accessory tubing package or field–supplied refrigerant grade tubing of correct size and condition.

Rated tubing diameters shown in Table 2 are recommended up to 80 ft. (24 m). See Product Data for acceptable alternate vapor diameters and associated capacity losses.

For tubing requirements beyond 80 ft, 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.

There are no buried–line applications greater than 36 in. (914 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.

Refrigerant pipe should be installed with the minimum length possible and practical for the application. Piping should be protected from physical damage in operation and in service and be in compliance with national and local codes such as ASRHAE 15, ASHRAE 15.2, IAPMO Uniform Mechanical Code, ICC International Mechanical Code, or CSA B52. When piping is installed through studs in a wall, steel plates should be used for protection with a minimum thickness of 16 gage.

All field joints shall be accessible for inspection prior to being covered or enclosed.

Outdoor Unit Connected To Factory Approved R-454B Indoor Unit

When outdoor unit is connected to factory–approved R-454B indoor unit, outdoor unit contains approximate system refrigerant charge for operation with AHRI rated indoor unit when connected by 15 ft. (5 m) of field–supplied or factory accessory tubing and factory supplied filter drier. For all sizes, adjust charge by adding or removing 0.6 oz/ft of 3/8 liquid line above or below 15 ft. (5 m) respectively..

Some indoor units require additional subcooling to achieve optimal heating performance.

Connect vapor and liquid tubes to fittings on vapor and liquid service valves (see Table 2). 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
18, 24	3/8	3/8	5/8	5/8
30, 36	3/8	3/8	3/4	3/4
42, 48	3/8	3/8	7/8	7/8
60	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. (6.09 m) vertical differential 250 ft. (76.2 m) Total Equivalent Length, refer to the Residential Piping and Long Line Guideline – Air Conditioners and Heat Pumps using R-454B refrigerant.
3. For alternate liquid line options, see Product Data or Residential Piping and Long Line Application Guideline

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. 5 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.

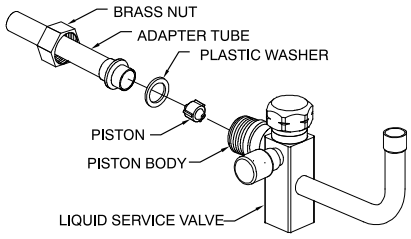

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Fig. 5 – Liquid Service Valve with Heating Piston and Adapter Tube

Brazing Connections

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.

If using brazing connections, use a properly sized swedge tool to create a swedge (bell) on one of the two copper tubes being connected. Alternatively, a copper coupling can be used which will require two braze joints instead of one.

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

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.

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.

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). Braze joints using a Sil-Fos or Phos-copper alloy. Consult local code requirements.

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

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. 6). Replace valve core when brazing is completed.

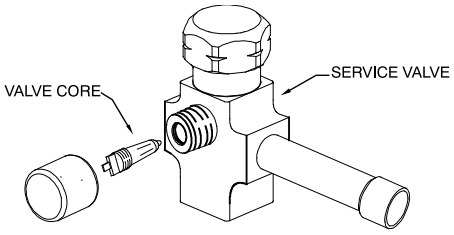

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Fig. 6 – Vapor Service Valve

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.

Mechanical Line Set Connections

If using mechanical or crimp-type line set connections, follow crimp tool manufacturer's instructions.

NOTE: Should the use of mechanical fittings cause failure of the fittings or failure of the equipment, such would not be covered under the equipment limited warranty.

Install Liquid Line Filter Drier Indoor

CAUTION

UNIT DAMAGE HAZARD

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

Installation of filter drier in liquid line is required.

Filter drier must be wrapped in a heat-sinking material such as a wet cloth while brazing

Refer to Fig. 7 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.

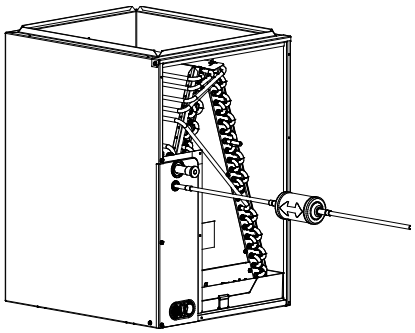

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Fig. 7 – Liquid Line Filter Drier

Mandatory Requirements

Pressure Proof Check

Refrigerant tubes and indoor coil should be pressure tested with an inert gas such as nitrogen. Pressurize the system with the inert gas to the Low Side Test Pressure listed on the outdoor unit rating plate

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.

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, makings sure wire ties on feeder tubes are secure and tight.

Pressure Test Tubing and Indoor Coil

Refrigerant tubes and indoor coil should be pressure tested with an inert gas such as nitrogen. Pressurize the system with the inert gas to the Low Side Test Pressure listed on the outdoor unit rating plate

⚠ WARNING

EXPLOSION HAZARD

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

Never exceed the test pressures listed on the rating plate when pressure testing an outdoor unit.

Leak Check

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. 8.)

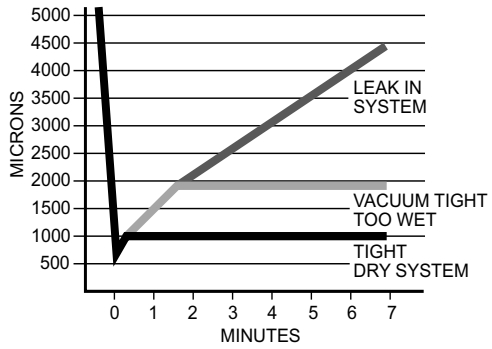

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Fig. 8 – Deep Vacuum Graph

⚠ 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.

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

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.

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.

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.

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. Refer to Product Data for breaker sizing.

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 national and local electrical codes.

This appliance incorporates an earth connection for safety purposes only. Connect ground wire to ground connection in control box for safety. Connect power wiring to contactor as shown in Fig. 9.

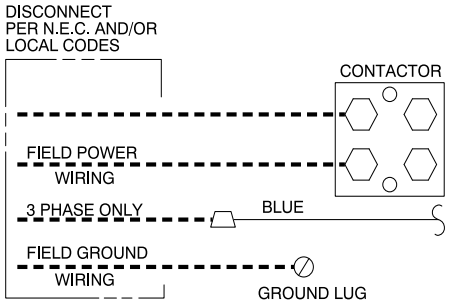

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Fig. 9 – Line Connections

Connect Control Wiring

Route 24v control wires through control wiring grommet and connect leads to control wiring. See Thermostat Installation Instructions for wiring specific unit combinations. (See Fig. 10 and Fig. 11.)

Use No. 18 AWG color–coded, insulated (35°C minimum) wire. If thermostat is located more than 100 ft (31 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.

NOTE: Factory Authorized Dissipation System must be installed with the indoor unit.

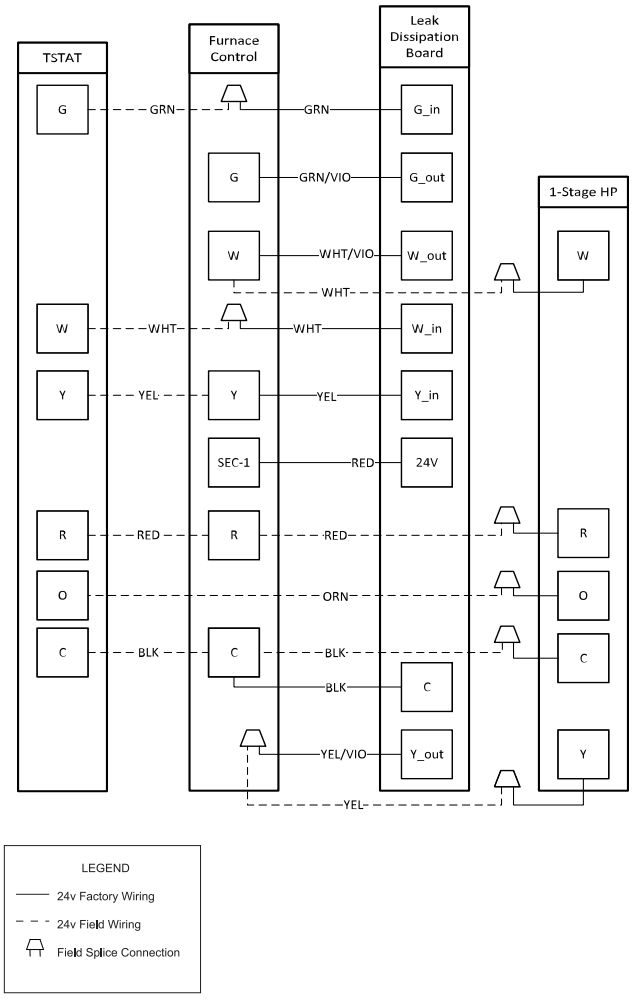

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Fig. 10 – Generic Wiring Diagram (non-communicating)

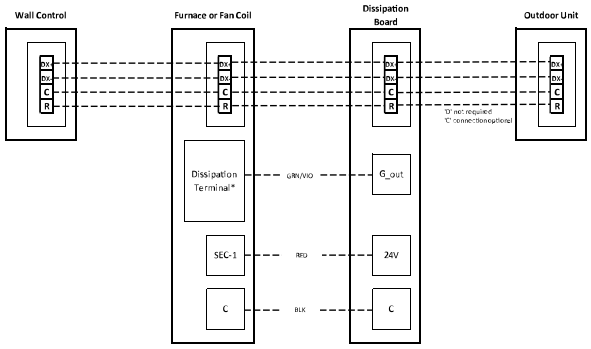

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Fig. 11 – Ion™ Communicating Control Four-Wire Connection

NOTE: Wiring must conform to NEC or local codes.

NOTE: For standard thermidistat or thermostat wiring, see Installation Instructions for those products.

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 m), or when outdoor unit is 20 ft (6 m) below indoor unit. Refer to the Residential Piping and Long Line Guideline and Service Manual.

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

Install Electrical Accessories

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

⚠ WARNING

PERSONAL INJURY AND/OR PROPERTY DAMAGE HAZARD

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

For continued performance, reliability, and safety, the only approved accessories and replacement parts are those specified by the equipment manufacturer. The use of non-manufacturer approved parts and accessories could invalidate the equipment limited warranty and result in fire risk, equipment malfunction, and failure.

Please review the manufacturer's literature and replacement parts catalogs available from your equipment supplier.

Start–Up

⚠ 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.

⚠ CAUTION

UNIT OPERATION AND SAFETY HAZARD

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

- 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.

Follow these steps to properly start up system:

⚠ WARNING

PERSONAL INJURY HAZARD

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

Do not use power tools to open and close service valves.

Power tools can cause valve stem to suddenly be ejected from the valve body followed by a high pressure refrigerant leak.

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 (back seated). Replace caps finger–tight and tighten with wrench an additional 1/12 turn.
3. Close electrical disconnects to energize system.
4. Set room thermostat at desired temperature. Be sure set point is below indoor ambient temperature for cooling mode operation.
5. 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

Factory charge amount and desired subcooling are shown on unit rating plate. Additional subcooling may be required to achieve optimal heating performance based on the installed indoor unit..

Care should be taken to ensure proper refrigerant is used for charging. Refer to outdoor unit rating plate to determine proper refrigerant. Refrigerant cylinders used for charging should be kept in an appropriate position and grounded to earth before charging. Hose length should be kept to a minimum. Care should be taken to not overcharge the system.

Charging method is shown on information plate inside unit. For TXV, use subcooling method. For piston, use superheat method. To properly check or adjust charge, conditions must be favorable for subcooling or superheat charging. Favorable conditions exist when the outdoor temperature is between 70°F and 100°F (21.1°C and 37.8°C), and the indoor temperature is between 70°F and 80°F (21.1°C and 26.7°C). Follow the procedure below:

Unit is factory charged for 15ft (5 m) of lineset. Adjust charge by adding or removing 0.6 oz/ft (.018 kg/m) of 3/8 liquid line above or below 15ft (5 m) respectively.

For standard refrigerant line lengths (80 ft/24 m or less), allow system to operate in cooling mode at least 15 minutes. If conditions are favorable, check system charge by super heat method for fixed metering device and subcooling method for TXV. 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 (26.7°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 (26.7°C) before attempting to check system charge by subcooling method as described above.

If the indoor temperature is below 70°F (21.1°C), or the outdoor temperature is not in the favorable range, adjust charge for line set length above or below 15ft (5 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 m) or greater than 20 ft (6 m) vertical separation, See Residential Piping and Long Line Guideline for special charging requirements.

Final charge should be recorded on the outdoor unit charging label with permanent and legible writing. Total refrigerant charge is factory charge plus any added charge. Verify that the indoor space served by the indoor unit, including spaces connected by ductwork, exceed the minimum room size as listed on the outdoor unit charging label. Refer to Table 3.

Table 3 – Minimum Room Area Charging Table

Total System Charge (lbs.)	Minimum Floor Area (sq. ft.)
4	61
5	76
6	91
7	106
8	122
9	137
10	152
11	167
12	182
13	198
14	213
15	228
16	243
17	258
18	274
19	289
20	304
21	319
22	335
23	350
24	365
25	380

Units with Cooling Mode TXV

Units installed with cooling mode TXV require charging by the subcooling method.

1. Operate unit a minimum of 15 minutes before checking charge.
2. Measure liquid service valve pressure by attaching an accurate gage to service port.
3. Measure liquid line temperature by attaching an accurate thermistor type or electronic thermometer to liquid line near outdoor coil.
4. Refer to unit rating plate for required subcooling temperature.
5. Refer to Table 5. Find the point where required subcooling temperature intersects measured liquid service valve pressure.
6. To obtain required subcooling temperature at a specific liquid line pressure, add refrigerant if liquid line temperature is higher than indicated or reclaim refrigerant if temperature is lower. Allow a tolerance of ±3°F (±1.7°C).

Heating Check Chart Procedure

To check system operation during heating cycle, refer to the Heating Check Chart on outdoor unit. This chart 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 chart to adjust refrigerant charge.

Table 4 – Required Liquid Line Temperature

Liquid (PSIG) Pressure at Service Valve	Required Subcooling Temperature °F					
	6	8	10	12	14	16
238	78	76	74	72	70	68
245	80	78	76	74	72	70
252	82	80	78	76	74	72
260	84	82	80	78	76	74
268	86	84	82	80	78	76
276	88	86	84	82	80	78
284	90	88	86	84	82	80
292	92	90	88	86	84	82
301	94	92	90	88	86	84
309	96	94	92	90	88	86
318	98	96	94	92	90	88
327	100	98	96	94	92	90
336	102	100	98	96	94	92
346	104	102	100	98	96	94
355	106	104	102	100	98	96
365	108	106	104	102	100	98
375	110	108	106	104	102	100
385	112	110	108	106	104	102
396	114	112	110	108	106	104
406	116	114	112	110	108	106
417	118	116	114	112	110	108
428	120	118	116	114	112	110
439	122	120	118	116	114	112
450	124	122	120	118	116	114

General Sequence of Operation - Standard Thermostat (non-communicating)

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

Cooling

On a call for cooling, thermostat (non-communicating) 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.

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

On a call for heating, a standard thermostat (non-communicating) 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 (field installed option), 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.

General Sequence of Operation - (ION™ Communicating Control)

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

Sequence of 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.

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).

Communication and Status Function Lights

Green Communications (COMM) Light (Communicating Control only):

A green LED (COMM light) on the outdoor board (see Fig. 12) 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.

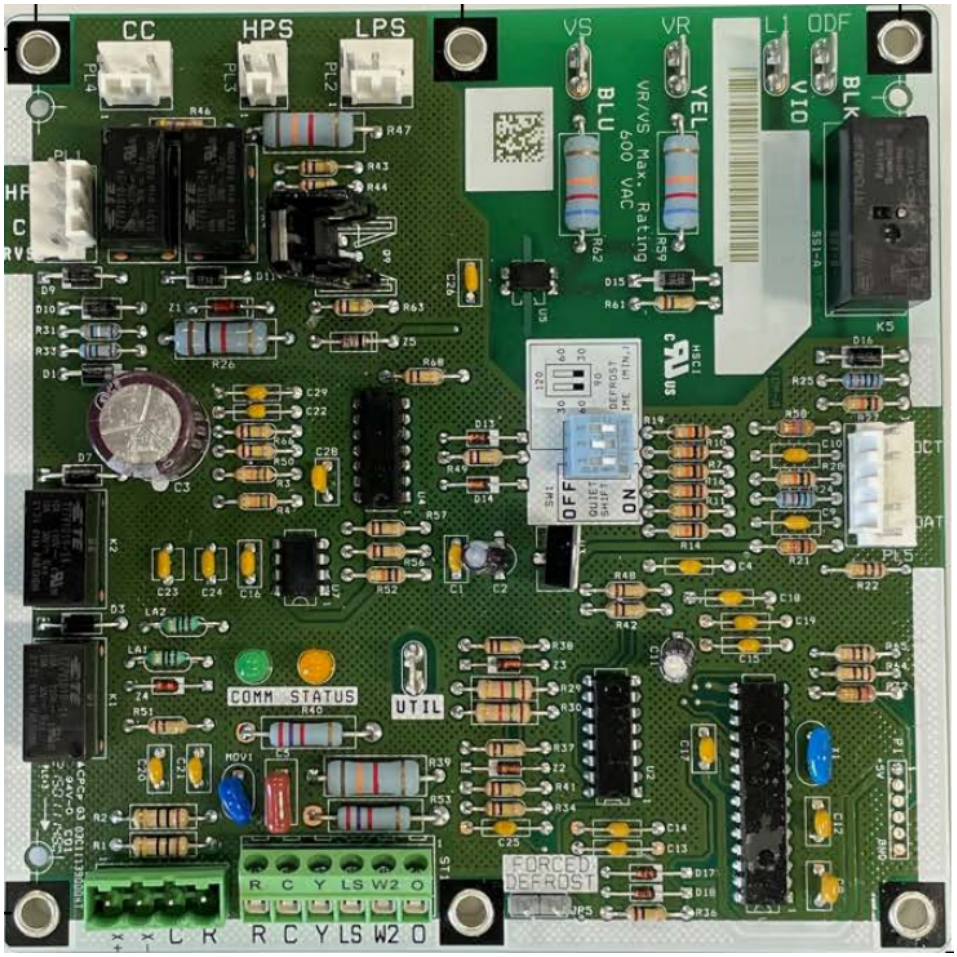

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Fig. 12 – Control Board

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™ Communicating Control selection overrides the control board dip switch settings.

When using a 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 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 as indicated earlier in this section.
- 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

Forced defrost can be initiated manually in a non-communicating system, or by communicated command from a Wall Control. The board contains a 2-pin header labeled FORCED DEFROST (Fig. 12). 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

Quiet Shift-2

Quiet Shift-2 is a field selectable defrost mode (factory set to OFF), which will reduce the occasional noise that could be heard at the start of defrost cycle and restarting of heating cycle. For installations using a standard 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 Quiet Shift-2 switch is enabled, and defrost is initiated, the following sequence of operation will occur:

– The compressor will be de--energized for approximately 1 minute, then the reversing valve will be energized. A few seconds later, the compressor will be re-energized and the normal defrost cycle starts.

Once defrost termination conditions have been met, the following sequence will occur:

– The compressor will be de-energized for approximately 1 minute, then the reversing valve will be de-energized. A few seconds later, the compressor will be re-energized and the normal heating cycle starts.

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 Communicaiton 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.

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 (See table 3) 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 15.5 volts for at least 4 seconds, the compressor contactor and fan relay are de-energized. Compressor and fan operation are not allowed until 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 (see Fig. 12) 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.

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. 13 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.

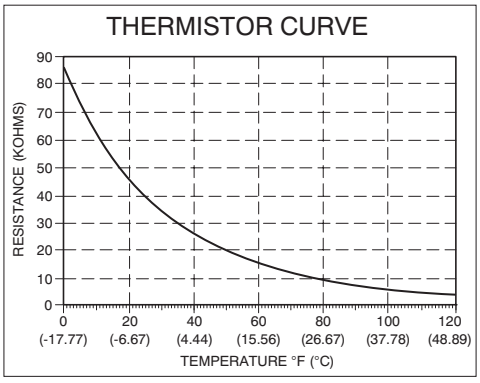

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Fig. 13 – Resistance vs Temperature Chart

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 ≥ 10°F/-12.22°C warmer than the coil sensor (or) the outdoor air sensor indicates ≥ 20°F/-6.67°C cooler than the coil sensor, the sensors are out of range.
- In heating if the outdoor air sensor indicates ≥ 35°F/1.67°C warmer than the coil sensor (or) the outdoor air sensor indicates ≥ 10°F/-12.22°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. 13 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.

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: 3 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	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.
	Contactor 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.

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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