GE APPLIANCES

Service Manual

NS21H**M

High Efficiency Split Heat Pump

Contact GE Appliances at:

Homeowner: **GEAppliances.com**
HVAC Pro: **GEAppliancesairandwater.com**
or
866.814.3633

Split System USAC and USHP matches:
AHRIDirectory.org

READ CAREFULLY.
KEEP THESE INSTRUCTIONS.

31-5000949 Rev. 0 08-25

General Information

These instructions are intended as a general guide and do not supersede national or local codes in any way. Consult authorities having jurisdiction before installation.

The NS21H**M is a high-efficiency split system air conditioner with all-aluminum coil, designed for use with R454B refrigerant only.

All NS21H**M models feature a variable capacity rotary compressor.

This unit must be installed with an approved indoor air handler or coil. See the **AHRIDirectory.org** for approved indoor component match ups. These instructions are intended as a general guide and do not supersede local codes in any way. Consult authorities having jurisdiction before installation.

This outdoor unit is designed for use in systems that use the following refrigerant metering device:
• Check thermal expansion valve (CTXV)

⚠WARNING

- Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury or loss of life. Installation and service must be performed by a licensed professional HVAC installer or equivalent, service agency, or the gas supplier.
- The Clean Air Act of 1990 bans the intentional venting of refrigerant (CFCs, HCFCs and HFCs) as of July 1, 1992. Approved methods of recovery, recycling or reclaiming must be followed. Fines and/or incarceration may be levied for noncompliance.
- To prevent serious injury or death:
  1. Lock-out/tag-out before performing maintenance.
  2. If system power is required (e.g., smoke detector maintenance), disable power to blower, remove fan belt where applicable, and ensure all controllers and thermostats are set to the “OFF” position before performing maintenance.
  3. Always keep hands, hair, clothing, jewelry, tools, etc. away from moving parts.

- **Electric Shock Hazard.** Can cause injury or death. Unit must be properly grounded in accordance with national and local codes. Line voltage is present at all components when unit is not in operation on units with singlepole contactors. Disconnect all remote electric power supplies before opening access panel. Unit may have multiple power supplies.
- **Electrical Hazard! High Voltage! Wait 7 minutes after turning off power before servicing.** Electrical components may hold charge.

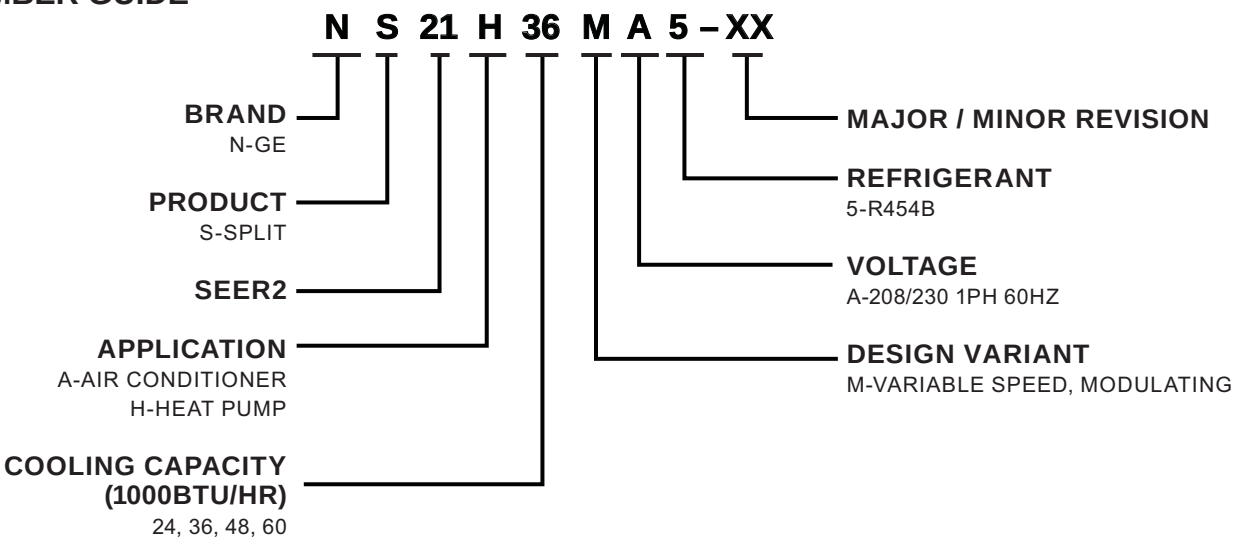
⚠CAUTION As with any mechanical equipment, contact with sharp sheet metal edges can result in personal injury. Take care while handling this equipment and wear gloves and protective clothing.

⚠IMPORTANT This unit must be matched with an indoor coil as specified. Coils previously charged with HCF410-A must be flushed.

⚠IMPORTANT Special procedures are required for cleaning the all-aluminum coil in this unit.

General Information

MODEL NUMBER GUIDE



Technical Specifications

General Data		Model No.	NS21H24MA5	NS21H36MA5	NS21H48MA5	NS21H60MA5
		Nominal Tonnage	2	3	4	5
Connections (Sweat)		Liquid line (o.d.) - in.	3/8	3/8	3/8	3/8
		Vapor line (o.d.) - in.	3/4	7/8	7/8	1-1/8
Refrigerant (15 ft. Line Set)	[1] R-454B charge furnished		9 lbs. 10 oz. (4.4 kg)	9 lbs. 14 oz. (4.5 kg)	12 lbs. 11 oz. (5.8 kg)	14 lbs. 2 oz. (6.4 kg)
Refrigerant (30 ft. Line Set)	[1] R-454B charge furnished		10 lbs. 3 oz. (4.6 kg)	10 lbs. 7 oz. (4.7 kg)	13 lbs. 4 oz. (6.0 kg)	14 lbs. 11 oz. (6.7 kg)
Outdoor Coil	Net face area - sq. ft.	Outer coil	30.50	30.50	26.10	30.50
		Inner coil	-	-	25.40	29.60
		Tube diameter - in.	5/16	5/16	5/16	5/16
		No. of rows	1	1	2	2
		Fins per inch	22	22	22	22
Outdoor Fan		Diameter - in.	28	28	28	28
		No. of blades	2	2	2	2
		Motor hp	1/3	1/3	1/3	1/3
		CFM - Max Speed	4743	5011	5450	5450
		Min Speed	1216	1310	2532	2594
		RPM - Max Speed	855	855	945	945
		Min Speed	206	221	415	425
		Watts - Max Speed	236	236	282	282
		Min Speed	10	10	40	41
Shipping Data		lbs. - 1 package	263	263	282	317

ELECTRICAL DATA						
			NS21H24MA5	NS21H36MA5	NS21H48MA5	NS21H60MA5
Line voltage data - 60 Hz			208/230V-1ph	208/230V-1ph	208/230V-1ph	208/230V-1ph
[2] Maximum Overcurrent Protection (MOCP) amps			20	30	45	50
[3] Minimum Circuit Ampacity (MCA)			15.0	20.1	26.9	32.5
Compressor Input (amps)			9.9	14.0	19.5	24.0
Outdoor Fan Motor - Full Load Amps			2.6	2.6	2.6	2.6
CONTROLS						
[4] Discharge Air Temperature Sensor		88K38	•	•	•	•
OPTIONAL ACCESSORIES - ORDER SEPARATELY						
Freezestat	3/8 in. tubing	93G35	•	•	•	•
Indoor Blower Off Delay Relay		58M81	•	•	•	•
Snow Guard	39 1/2 x 35 5/8 in.	Y1033	•	•	•	•
Stand-Off Guard-Edge Raiser Kit	27x34		•	•	•	•
	27x35		•	•	•	•

NOTE - Extremes of operating range are plus 10% and minus 5% of line voltage.

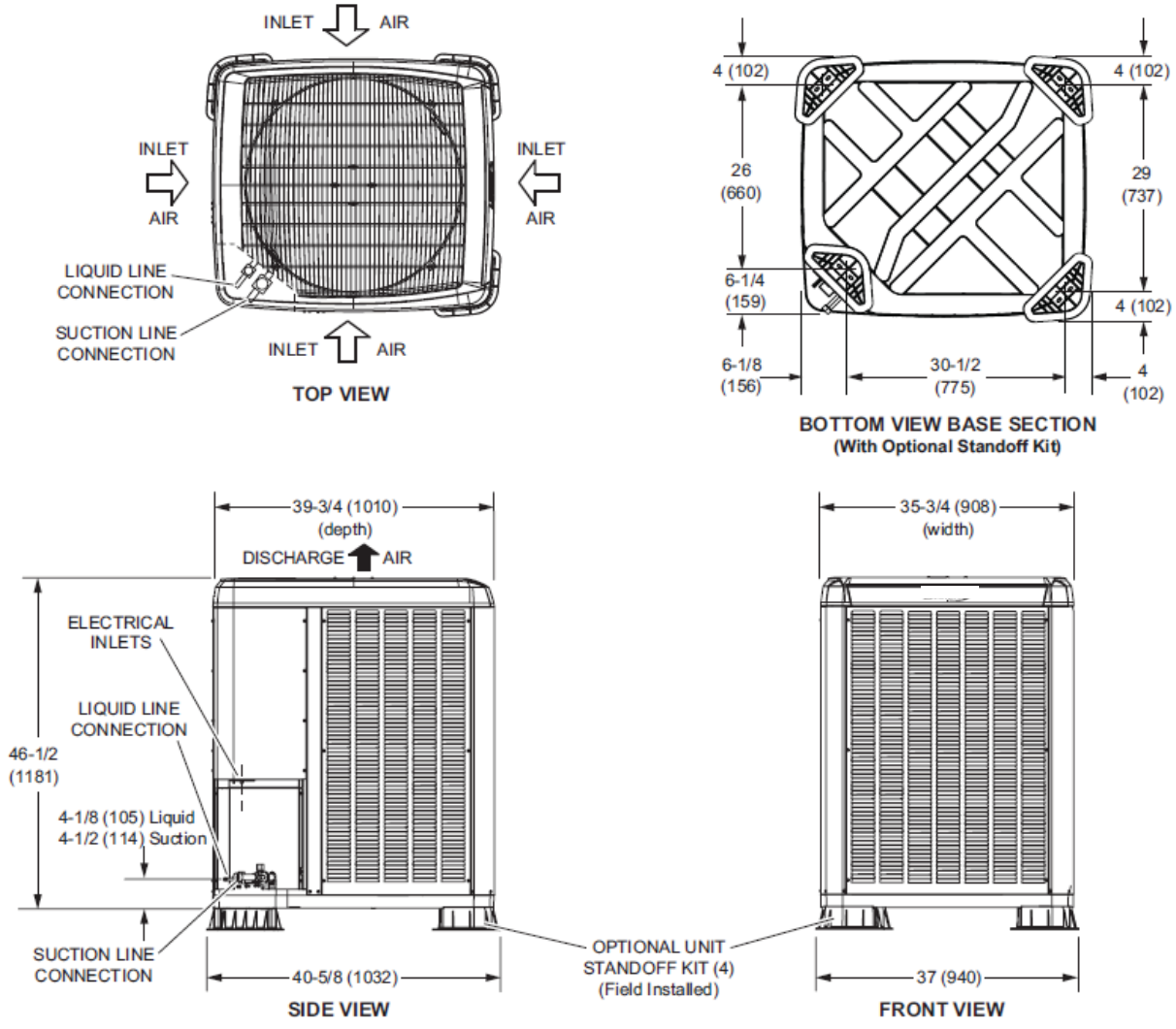
[1] Refrigerant charge sufficient for the line set length listed in parenthesis. For longer line set requirements see the Installation Instructions or unit Charging Label for information about line set length and additional refrigerant charge required.

[2] HACR type breaker or fuse.

[3] Refer to National or Canadian Electrical Code manual to determine wire, fuse and disconnect size requirements.

Service Information

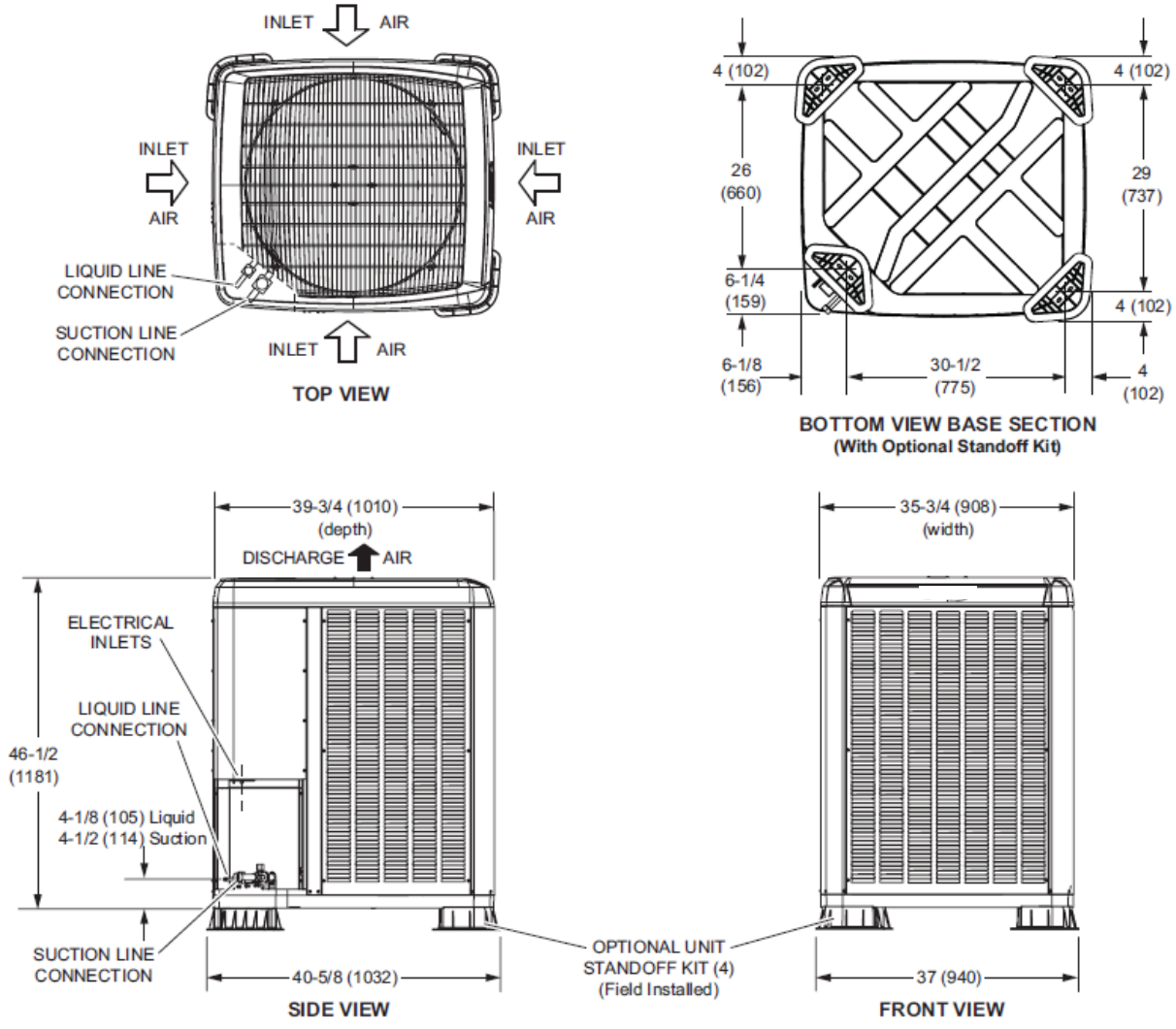
UNIT DIMENSIONS - Inches (mm)



UNIT DIMENSIONS: NS21H -024, -036, -060

Service Information

UNIT DIMENSIONS - Inches (mm)



UNIT DIMENSIONS: NS21H -048

TYPICAL UNIT PARTS ARRANGEMENT

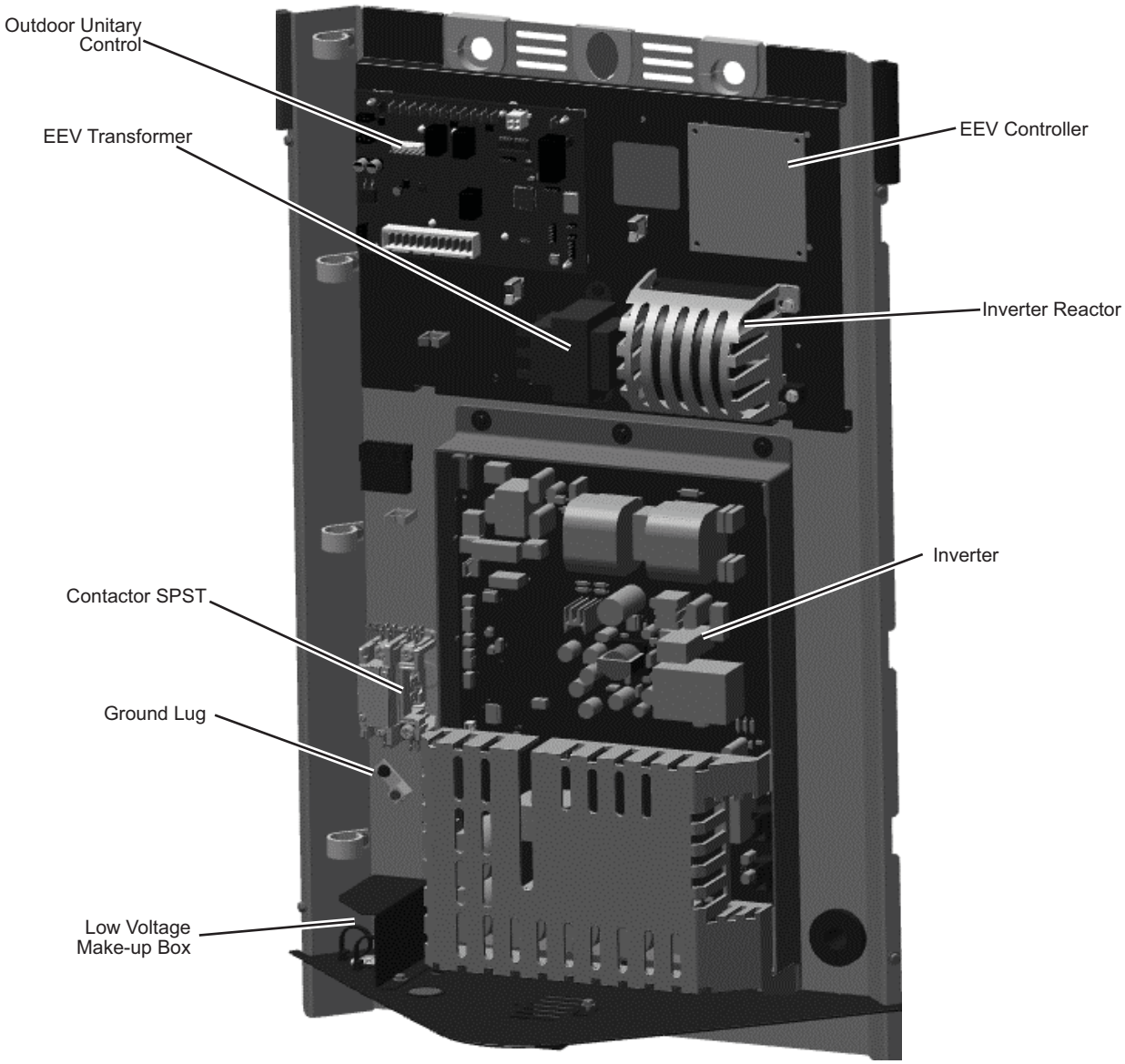


Figure 1. Control Panel Components

TYPICAL UNIT PARTS ARRANGEMENT (Cont.)

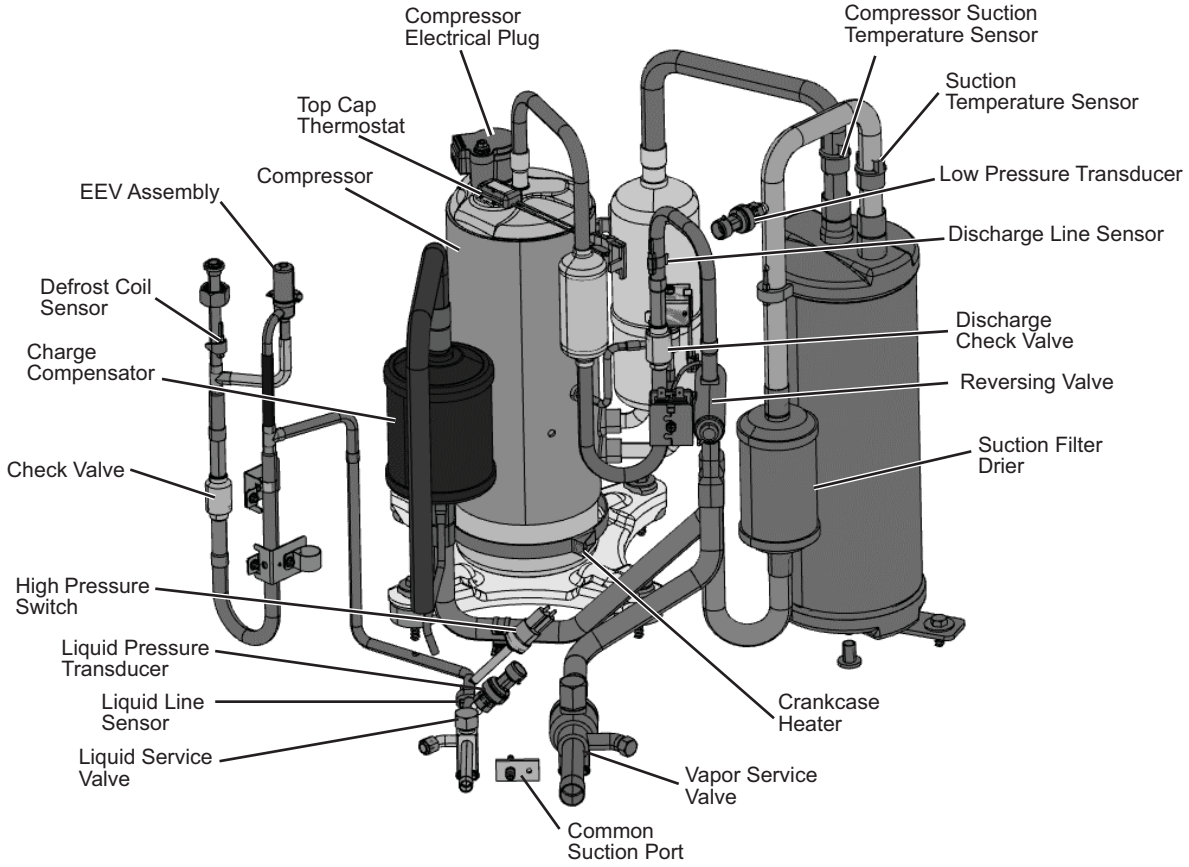


Figure 2. Component Locations – NS21H24, 36, 60

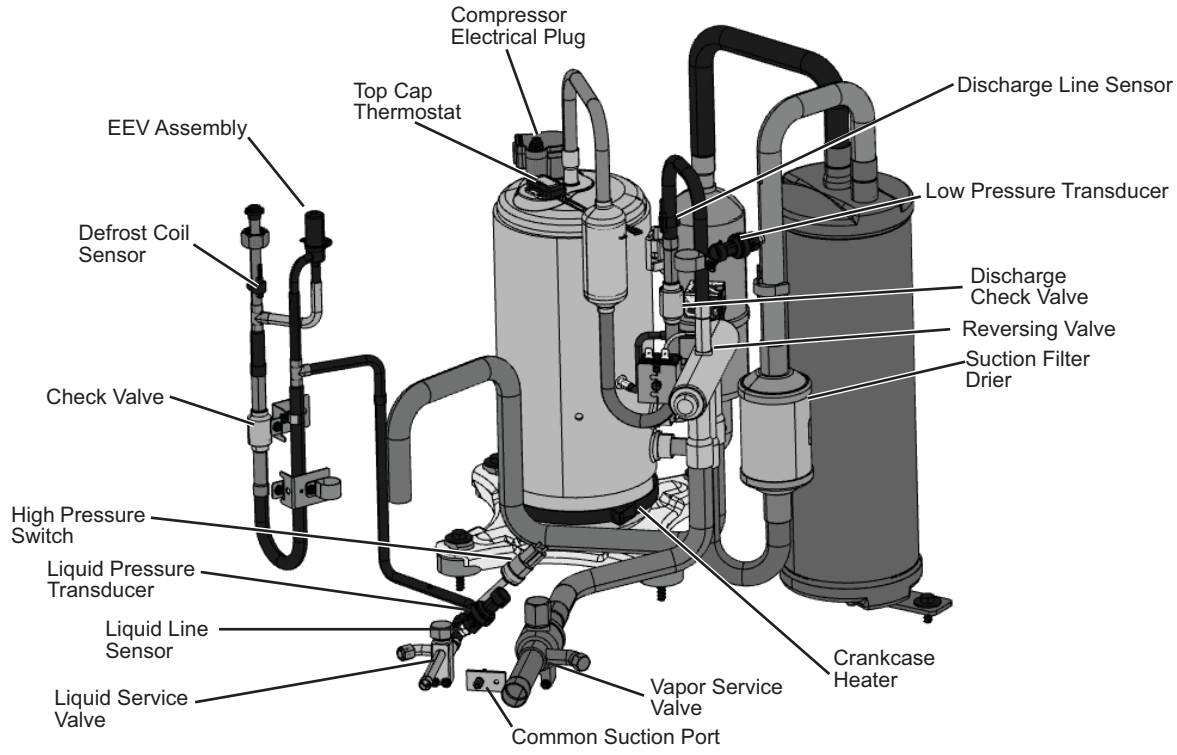


Figure 3. Component Locations - NS21H48

OPERATING GAUGE SET AND SERVICE VALVES

Torque Requirements

When servicing or repairing heating, ventilating, and air conditioning components, ensure the fasteners are appropriately tightened. **Table 1** lists torque values for fasteners.

⚠IMPORTANT Only use Allen wrenches of sufficient hardness (50Rc - Rockwell Harness Scale minimum). Fully insert the wrench into the valve stem recess.

Service valve stems are factory-torqued (from 9 ft-lbs for small valves, to 25 ft-lbs for large valves) to prevent refrigerant loss during shipping and handling. Using an Allen wrench rated at less than 50Rc risks rounding or breaking off the wrench, or stripping the valve stem recess.

⚠IMPORTANT To prevent stripping of the various caps used, the appropriately sized wrench should be used and fitted snugly over the cap before tightening.

Table 1. Torque Requirements

Parts	Recommended Torque	
Service valve cap	8 ft.- lb.	11 NM
Sheet metal screws	16 ft.- lb.	2 NM
Machine screws #10	28 ft.- lb.	3 NM
Compressor bolts	90 in.- lb.	10 NM
Gauge port seal cap	8 ft.- lb.	11 NM

Using Manifold Gauge Set

When checking the system charge, only use a manifold gauge set that features low loss anti-blow back fittings.

Manifold gauge set used with R454B refrigerant systems must be capable of handling the higher system operating pressures. The gauges should be rated for use with pressures of 0 - 800 psig on the high side and a low side of 30” vacuum to 250 psig with dampened speed to 500 psi. Gauge hoses must be rated for use at up to 800 psig of pressure with a 4000 psig burst rating.

Operating Service Valves

The liquid and vapor line service valves are used for removing refrigerant, flushing, leak testing, evacuating, checking charge and charging. Each valve is equipped with a service port which has a factory-installed valve core. **Figure 4** provides information on access and operation of both angle and ball service valves

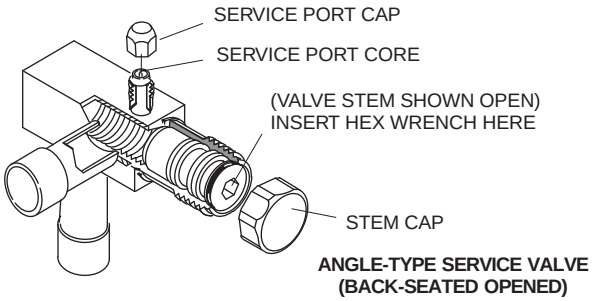
Service Information

SERVICE VALVES - ANGLE AND BALL

OPERATING ANGLE-TYPE SERVICE VALVE

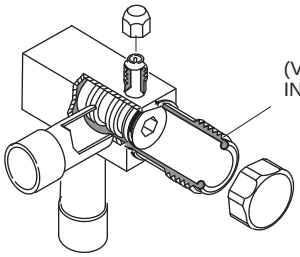
1 - Remove stem cap with an appropriately sized wrench.

2 - Use a service wrench with a hex-head extension (3/16" for liquid line valve sizes and 5/16" for vapor line valve sizes) to back the stem out counterclockwise as far as it will go.



ANGLE-TYPE SERVICE VALVE (BACK-SEATED OPENED)

When service valve is **OPEN**, the service port is open to line set, indoor and outdoor unit.



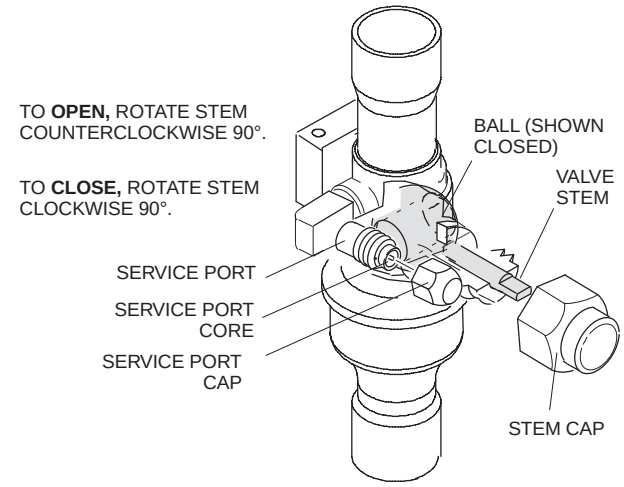
ANGLE-TYPE SERVICE VALVE (FRONT-SEATED CLOSED)

When service valve is **CLOSED**, the service port is open to the line set and indoor unit.

OPERATING BALL-TYPE SERVICE VALVE

1 - Remove stem cap with an appropriately sized wrench.

2 - Use an appropriately sized wrench to open. To open valve, rotate stem counterclockwise 90°. To close, rotate stem clockwise 90°.



ACCESS SERVICE PORT

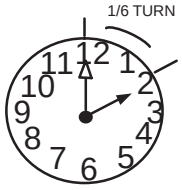
A service port cap protects the service port core from contamination and serves as the primary leak seal.

1 - Remove service port cap with an appropriately sized wrench.

2 - Connect gauge set to service port.

3 - When testing is completed, replace service port cap and tighten as follows:

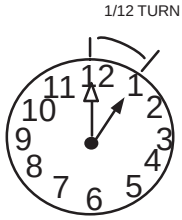
- With torque wrench, finger tighten and torque cap per table 2.
- Without torque wrench, finger tighten and use an appropriately sized wrench to turn an additional 1/6 turn clockwise.



Reinstall Stem Cap

Stem cap protects the valve stem from damage and serves as the primary seal. Replace the stem cap and tighten as follows:

- With torque wrench, finger tighten and then torque cap per table 2.
- Without torque wrench, finger tighten and use an appropriately sized wrench to turn an additional 1/12 turn clockwise.



NOTE — A label with specific torque requirements may be affixed to the stem cap. If the label is present, use the specified torque

Figure 4. Angle and Ball Service Valves

Installation

UNIT PLACEMENT

See Unit Dimensions on page 5 for sizing mounting slab, platforms or supports.

⚠CAUTION In order to avoid injury, take proper precaution when lifting heavy objects..

Positioning Considerations

Consider the following when positioning the unit:

• Some localities are adopting sound ordinances based on the unit's sound level registered from the adjacent property, not from the installation property. Install the unit as far as possible from the property line.

• When possible, do not install the unit directly outside a window. Glass has a very high level of sound transmission. For proper placement of unit in relation to a window see the provided illustration in **Figure 5**, detail A.

Placing Unit On Slab

When installing unit at grade level, the top of the slab should be high enough above grade so that water from higher ground will not collect around the unit. The slab should have a slope tolerance as described in **Figure 5**, detail B.

NOTE – If necessary for stability, anchor unit to slab as described in **Figure 5**, detail D.

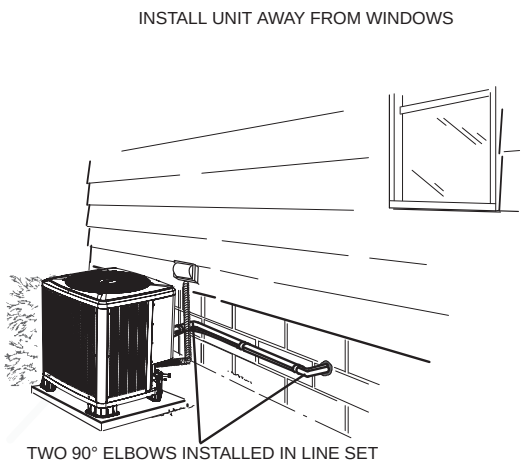
Elevating The Unit

Optional 3 inch and 6 inch Standoff Kits/Corner Post Raisers" are available to raise the unit.

Installation

UNIT PLACEMENT (Cont.)

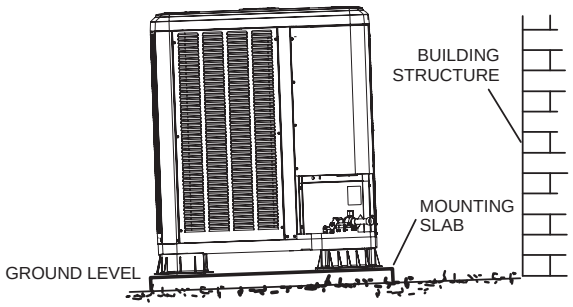
DETAIL A



Outside Unit Placement

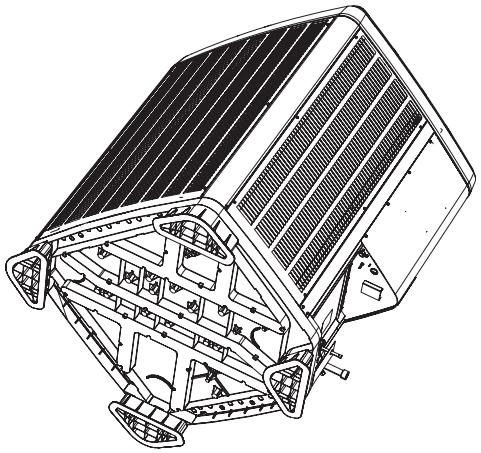
DETAIL B

INSTALL UNIT LEVEL OR, IF ON A SLOPE, MAINTAIN SLOPE TOLERANCE OF 2 DEGREES (OR 2 INCHES PER 5 FEET [50 MM PER 1.5 M]) AWAY FROM BUILDING STRUCTURE.



Slab Mounting at Ground Level

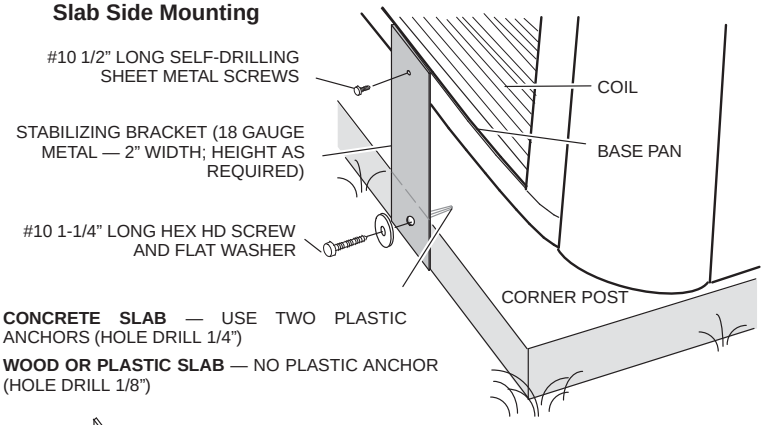
DETAIL C



Underside of Unit Showing Optional Corner Post Raisers

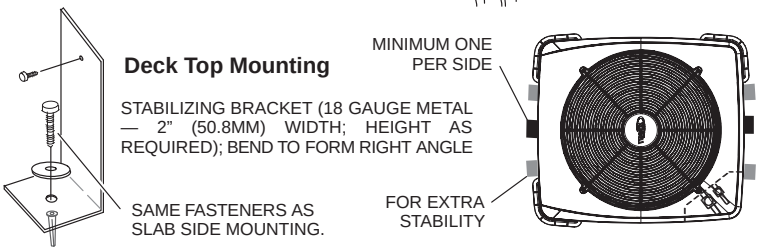
DETAIL D

Slab Side Mounting



CONCRETE SLAB — USE TWO PLASTIC ANCHORS (HOLE DRILL 1/4")

WOOD OR PLASTIC SLAB — NO PLASTIC ANCHOR (HOLE DRILL 1/8")



Stabilizing Unit on Uneven Surfaces

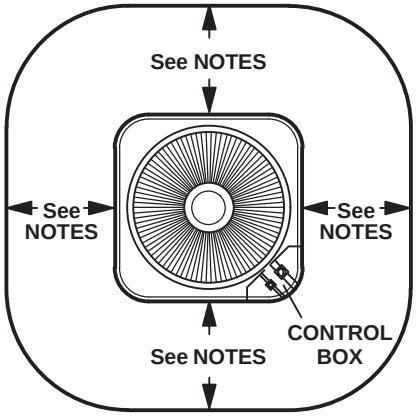
IMPORTANT — To help stabilize an outdoor unit, some installations may require strapping the unit to the pad using brackets and anchors commonly available in the marketplace.

Figure 5. Placement and Slab Mounting

Installation

SETTING THE UNIT

Clearances



NOTES -
Service clearance of 30 in. (762 mm) must be maintained on one of the sides adjacent to the control box.

Clearance to one of the other three sides must be 36 in. (914 mm).

Clearance to one of the remaining two sides may be 12 in. (305 mm) and the final side may be 6 in. (152 mm).

A clearance of 24 in. (610 mm) must be maintained between two units.

48 in. (1219 mm) clearance required on top of unit.

NOTICE: Specific applications may require adjustment of the listed installation clearances to provide protection for the unit from physical damage or to avoid conditions which limit operating efficiency. (Example: Clearances may have to be increased to prevent snow or ice from falling on the top of the unit. Additional clearances may also be required to prevent air recirculation when the unit is installed under a deck or in another tight space.)

Figure 6. Installation Clearances

Stabilizing Unit on Uneven Surfaces

⚠IMPORTANT **Use Unit Stabilizer Bracket (field-provided):** Always use stabilizers when unit is raised above the factory height. (Elevated units could become unstable in gusty wind conditions.) Stabilizers may be used on factory height units when mounted on unstable an uneven surface.

1. Remove the louvered panel from each side to expose the unit base.
2. Install the brackets as illustrated in **Figure 5**, detail D using conventional practices.
3. Replace the panels after installation is complete.

Roof Mounting

Locate the unit above a load-bearing wall or area of the roof that can adequately support the unit. Consult local codes for rooftop applications.

Roof Damage! This system contains both refrigerant and oil. Some rubber roofing material may absorb oil, causing the rubber to swell. Bubbles in the rubber roofing material can cause leaks. Protect the roof surface to avoid exposure to refrigerant and oil during service and installation. Failure to follow this notice could result in damage to roof surface.

⚠WARNING To prevent serious injury or death:

1. Lock-out/tag-out before performing maintenance.
2. If system power is required (e.g., smoke detector maintenance), disable power to blower, remove fan belt where applicable, and ensure all controllers and thermostats are set to the “OFF” position before performing maintenance.
3. Always keep hands, hair, clothing, jewelry, tools, etc. away from moving parts.

⚠CAUTION As with any mechanical equipment, contact with sharp sheet metal edges can result in personal injury. Take care while handling this equipment and wear gloves and protective clothing.

⚠WARNING

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

⚠CAUTION Servicing shall be performed only as recommended by the manufacturer.

⚠WARNING Ducts connected to an appliance shall not contain a potential ignition source.

SETTING THE UNIT (Cont.)

Stabilizing Unit on Uneven Surfaces (Cont.)

⚠WARNING Every working procedure that affects safety means shall only be carried out by competent persons. This appliance is not to be used 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. Children should be supervised to ensure they do not play with the appliance.

⚠IMPORTANT Ensure that the area is in the open or that it is adequately ventilated before breaking into the system or conducting any hot work. A degree of ventilation shall continue during the period that the work is carried out.

⚠IMPORTANT Verify cabling will not be subject to wear, corrosion, excessive pressure, vibration, sharp edges or any other adverse environmental effects.

⚠WARNING PARTIAL UNITS shall only be connected to an appliance suitable for the same refrigerant.

⚠IMPORTANT Pipe work, including piping material, pipe routing, and installation shall include protection from physical damage in operation and service, and be in compliance with national and local codes and standards, such as ASHRAE 15, ASHRAE 15.2, IAPMO Uniform Mechanical Code, ICC International Mechanical Code, or CSA B52. All field joints shall be accessible for inspection prior to being covered or enclosed.

⚠CAUTION Under no circumstances shall potential sources of ignition be used in the searching for or detection of refrigerant leaks. A halide torch (or any other detector using a naked flame) shall not be used.

The following leak detection methods are deemed acceptable for all refrigerant systems.

Electronic leak detectors may be used to detect refrigerant leaks but, in the case of flammable refrigerants, the sensitivity may not be adequate, or may need recalibration. (Detection equipment shall be calibrated in a refrigerant-free area.) Ensure that the detector is not a potential source of ignition and is suitable for the refrigerant used. Leak detection equipment shall be set at a percentage of the LFL of the refrigerant and shall be calibrated to the refrigerant employed, and the appropriate percentage of gas (25 % maximum) is confirmed. Leak detection fluids are also suitable for use with most refrigerants but the use of detergents containing chlorine shall be avoided as the chlorine may react with the refrigerant and corrode the copper pipe-work. If a leak is suspected, all naked flames shall be removed/extinguished. If a leakage of refrigerant is found which requires brazing, all of the refrigerant shall be recovered from the system, or isolated (by means of shut off valves) in a part of the system remote from the leak.

⚠CAUTION Some soaps used for leak detection are corrosive to certain metals. Carefully rinse piping thoroughly after leak test has been completed. Do not use matches, candles, flame or other sources of ignition to check for gas leaks.

⚠IMPORTANT When breaking into the refrigerant circuit to make repairs – or for any other purpose – conventional procedures shall be used. However, for flammable refrigerants it is important that best practice be followed and, since flammability is a consideration, procedures such as safely remove refrigerant following local and national regulations, purging the circuit with inert gas, evacuating (optional for A2L), purging with inert gas (optional for A2L), or opening the circuit by cutting or brazing be adhered to. The refrigerant charge shall be recovered into the correct recovery cylinders if venting is not allowed by local and national codes. For appliances containing flammable refrigerants, the system shall be purged with oxygen-free nitrogen to render the appliance safe for flammable refrigerants.

This process might need to be repeated several times. Compressed air or oxygen shall not be used for purging refrigerant systems. For appliances containing flammable refrigerants, refrigerants purging shall be achieved by breaking the vacuum in the system with oxygenfree nitrogen and continuing to fill until the working pressure is achieved, then venting to atmosphere, and finally pulling down to a vacuum (optional for A2L). This process shall be repeated until no refrigerant is within the system (optional for A2L). When the final oxygenfree nitrogen charge is used, the system shall be vented down to atmospheric pressure to enable work to take place. Ensure that the outlet for the vacuum pump is not close to any potential ignition sources and that ventilation is available.

SETTING THE UNIT (Cont.)

⚠IMPORTANT In addition to conventional charging procedures, the following requirements shall be followed.

- Ensure that contamination of different refrigerants does not occur when using charging equipment. Hoses or lines shall be as short as possible to minimize the amount of refrigerant contained in them.
- Cylinders shall be kept in an appropriate position according to the instructions.
- Ensure that the REFRIGERATING SYSTEM is earthed prior to charging the system with refrigerant.
- Label the system when charging is complete (if not already).
- Extreme care shall be taken not to overfill the REFRIGERATING SYSTEM.

Prior to recharging the system, it shall be pressure tested with the appropriate purging gas. The system shall be leak tested on completion of charging, but prior to commissioning. A follow up leak test shall be carried out prior to leaving the site.

⚠IMPORTANT When removing refrigerant from a system, either for servicing or decommissioning, it is recommended good practice that all refrigerants are removed safely.

When transferring refrigerant into cylinders, ensure that only appropriate refrigerant recovery cylinders are employed. Ensure that the correct number of cylinders for holding the total system charge is available. All cylinders to be used are designated for the recovered refrigerant and labelled for that refrigerant (i. e. special cylinders for the recovery of refrigerant). Cylinders shall be complete with pressure-relief valve and associated shut-off valves in good working order. Empty recovery cylinders are evacuated and, if possible, cooled before recovery occurs.

The recovery equipment shall be in good working order with a set of instructions concerning the equipment that is at hand and shall be suitable for the recovery of all appropriate refrigerants including, when applicable, flammable refrigerants. In addition, a set of calibrated weighing scales shall be available and in good working order. Hoses shall be complete with leak-free disconnect couplings and in good condition. Before using the recovery machine, check that it is in satisfactory working order, has been properly maintained and that any associated electrical components are sealed to prevent ignition in the event of a refrigerant release. Consult manufacturer if in doubt.

The recovered refrigerant shall be returned to the refrigerant supplier in the correct recovery cylinder, and the relevant waste transfer note arranged. Do not mix refrigerants in recovery units and especially not in cylinders.

If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that flammable refrigerant does not remain within the lubricant. The evacuation process shall be carried out prior to returning the compressor to the suppliers. Only electric heating to the compressor body shall be employed to accelerate this process. When oil is drained from a system, it shall be carried out safely.

⚠IMPORTANT After completion of field piping for split systems, the field pipework shall be pressure tested with an inert gas and then vacuum tested prior to refrigerant charging, according to the following requirements;

- Field-made refrigerant joints indoors shall be tightness tested. The test method shall have a sensitivity of .2 oz. per year of refrigerant or better, under pressure.
- No leak shall be detected.

⚠IMPORTANT Prior to beginning work on systems containing FLAMMABLE REFRIGERANTS, safety checks are necessary to ensure that the risk of ignition is minimized.

⚠IMPORTANT Work shall be undertaken under a controlled procedure so as to minimize the risk of a flammable gas or vapor being present while the work is being performed.

⚠IMPORTANT All maintenance staff and others working in the local area shall be instructed on the nature of work being carried out. Work in confined spaces shall be avoided.

⚠IMPORTANT The area shall be checked with an appropriate refrigerant detector prior to and during work, to ensure the technician is aware of potentially toxic or flammable atmospheres. Ensure that the leak detection equipment being used is suitable for use with all applicable refrigerants, i.e. nonsparking, adequately sealed or intrinsically safe.

⚠IMPORTANT If any hot work is to be conducted on the refrigerating equipment or any associated parts, appropriate fire extinguishing equipment shall be available to hand. Have a dry powder or CO^2 fire extinguisher adjacent to the charging area.

Installation

SETTING THE UNIT (Cont.)

⚠IMPORTANT Where electrical components are being changed, they shall be fit for the purpose and to the correct specification. At all times the manufacturer's maintenance and service guidelines shall be followed. If in doubt, consult the manufacturer's technical department for assistance.

The following checks shall be applied to installations using FLAMMABLE REFRIGERANTS:

- the actual REFRIGERANT CHARGE is in accordance with the room size within which the refrigerant containing parts are installed;
- the ventilation machinery and outlets are operating adequately and are not obstructed;
- if an indirect refrigerating circuit is being used, the secondary circuit shall be checked for the presence of refrigerant;
- marking to the equipment continues to be visible and legible. Markings and signs that are illegible shall be corrected;
- refrigerating pipe or components are installed in a position where they are unlikely to be exposed to any substance which may corrode refrigerant containing components, unless the components are constructed of materials which are inherently resistant to being corroded or are suitably protected against being so corroded.

⚠IMPORTANT No person carrying out work in relation to a REFRIGERATING SYSTEM which involves exposing any pipe work shall use any sources of ignition in such a manner that it may lead to the risk of fire or explosion. All possible ignition sources, including cigarette smoking, should be kept sufficiently far away from the site of installation, repairing, removing and disposal, during which refrigerant can possibly be released to the surrounding space. Prior to work taking place, the area around the equipment is to be surveyed to make sure that there are no flammable hazards or ignition risks. "No Smoking" signs shall be displayed.

⚠IMPORTANT Sealed electrical components shall be replaced.

⚠IMPORTANT Intrinsically safe components must be replaced.

TAmin Table					
Charge (lb)	10.0	15.0	20.0	25.0	30.0
Charge (kg)	4.5	6.8	9.1	11.3	13.6
Minimum Conditioned Area (ft2)	150.9	226.4	301.9	377.4	452.8
Minimum Conditioned Area (m2)	14.0	21.0	28.0	35.1	42.1

Altitude Adjustment Factor[3]									
Halt	0	200	400	600	800	1000	1200	1400	1600
AF	1	1	1	1	1.02	1.05	1.04	1.1	1.12
Halt	1600	1800	2000	2200	2400	2600	2800	3000	3200
AF	1.12	1.15	1.18	1.21	1.25	1.28	1.32	1.36	1.4

Qmin Table			
Refrigerant Charge lb (kg)	**CFM Required**	**Refrigerant Charge lb (kg)**	**CFM Required**
5 (2.3)	135	18 (8.1)	487
6 (2.7)	162	19 (8.6)	514
7 (3.2)	189	20 (9.1)	541
8 (3.6)	216	21 (9.5)	568
9 (4.1)	244	22 (10)	595
10 (4.5)	271	23 (10.4)	622
11 (5)	298	24 (10.9)	649
12 (5.4)	325	25 (11.3)	676
13 (5.9)	352	26 (11.7)	704
14 (6.4)	379	27 (12.2)	731
15 (6.8)	406	28 (12.7)	758
16 (7.3)	433	29 (13.2)	785
17 (7.7)	460	30 (13.6)	812

NOTE – Qmin minimum airflow requirement for refrigerant leak mitigation.

Installation

NEW OR REPLAEMENT LINE SET

⚠CAUTION If this unit is being matched with an approved line set or indoor unit coil that was previously charged with mineral oil, or if it is being matched with a coil which was manufactured before January of 1999, the coil and line set must be flushed prior to installation. Take care to empty all existing traps. Polyvinyl ether (PVE) and polyolester (POE) oils are used in GE Appliances variable-capacity units charged with HFC-410A refrigerant. Residual mineral oil can act as an insulator, preventing proper heat transfer. It can also clog the expansion device and reduce system performance and capacity. Failure to properly flush the system per this instruction and the detailed Installation and Service Procedures manual will void the warranty.

Flush the existing line set per the following instructions. For more information, refer to the Installation and Service Procedures manual.

⚠CAUTION DO NOT attempt to flush and re-use existing line sets or indoor coil when the system contains contaminants (i.e., compressor burn out).

Polyvinyl ether (PVE) oil is used in the compressor.

If a new line set is being installed, size the piping per **Table 2**.

Table 2.

REFRIGERANT LINE SET – INCHES (MM)				
Model	Valve Field Connections		Recommended Line Set	
	Liquid Line	Vapor Line	Liquid Line	Vapor Line
-024	3/8 in. (10 mm)	3/4 in. (19 mm)	3/8 in. (10 mm)	3/4 in. (19 mm)
-036	3/8 in. (10 mm)	7/8 in. (22 mm)	3/8 in. (10 mm)	7/8 in. (22 mm)
-048				
-060	3/8 in. (10 mm)	1-1/8 in. (28 mm)	3/8 in. (10 mm)	1-1/8 in. (28 mm)
NOTE - Some applications may require a field-provided 7/8” to 1-1/8” adapter.				

⚠IMPORTANT The Clean Air Act of 1990 bans the intentional venting of refrigerant (CFC’s and HCFC’s) as of July 1, 1992. Approved methods of recovery, recycling, or reclaiming must be followed. Fines and/or incarceration may be levied for non-compliance.

Line Set Joints - Furnace Application

Evaporator primary line set joints in all applications shall have a line set joint sleeve.

Evaporator primary line sets should not have additional joints not covered by line set joint sleeve. If additional joints are present, the system installation shall comply with one of the options below:

Option 1 - Furnace is installed as a direct vent appliance;

Option 2 - Furnace/Evaporator installation is in a space greater than the minimum conditioned area (Amin);

Option 3 - Furnace/Evaporator installation is connected to a space greater than the minimum conditioned area (Amin) through an opening of at least 15 in² (4-inch diameter hole equivalent) located below the level of the furnace burners;

Option 4 - Have a second refrigerant detection sensor installed below the level of the burners (see Secondary Sensor Installation section).

NOTE - When installing refrigerant lines longer than 50 feet, contact the Technical Support Department for assistance.

⚠WARNING When using a high pressure gas such as nitrogen to pressurize a refrigeration or air conditioning system, use a regulator that can control the pressure down to 1 or 2 psig (6.9 to 13.8 kPa).

⚠WARNING Refrigerant can be harmful if it is inhaled. Refrigerant must be used and recovered responsibly. Failure to follow this warning may result in personal injury or death.

⚠WARNING **Fire, Explosion and Personal Safety hazard.** Failure to follow this warning could result in damage, personal injury or death.

Never use oxygen to pressurize or purge refrigeration lines. Oxygen, when exposed to a spark or open flame, can cause fire and/ or an explosion, that could result in property damage, personal injury or death.

⚠WARNING Polyvinyl ether (PVE) oils used with R454B refrigerant absorb moisture very quickly. It is very important that the refrigerant system be kept closed as much as possible. DO NOT remove line set caps or service valve stub caps until you are ready to make connections.

The NS21H**M is a variable-capacity cooling system utilizing variable speed compressor technology. With the variable speed compressor and variable pumping capacity, additional consideration must be given to refrigerant piping sizing and application. The guidelines below are to be used exclusively for the NS21H**M systems.

NEW OR REPLAEMENT LINE SET (Cont.)

COOLING SYSTEM (R454B)

- Total equivalent length equals 180 feet (piping and all fittings included).

NOTE – Length is general guide. Lengths may be more or less, depending on remaining system design factors.

- Maximum linear (actual) length = 150 feet.
- Maximum linear liquid lift = 60 feet.

NOTE – Maximum lifts are dependent on total length, number of elbows, etc. that contribute to total pressure drop.

- Maximum length vapor riser = 60 feet.
- Up to 50 Linear Feet: Use rated line sizes listed in **Table 3**
- Between 51 and 150 Linear Feet: Crankcase heater and nonbleed port TXV factory installed. No additional components required. Vertical vapor riser must be sized to the vapor riser listed in the **Table 4** on systems with line sets longer than 51 feet. Use **Table 5** to determine the correct liquid and vapor line sizes. Over 150 Linear Feet: not recommended.
- Additional oil is not required for systems with line lengths up to 150 feet.

SUCTION TRAPS

For systems with the outdoor unit 5 - 60 feet above the indoor unit, one trap must be installed at the bottom of the suction riser.

Table 3. Standard Refrigerant Line Set – Up to 50 Linear Feet in Length

Inches (mm)					
	Valve Size Connections		Recommended Line Sets		
NS21H**M*	Liquid Line	Suction Line	L15 Line Set Model	Line Set Length	Catalog Number
-024	3/8” (10 mm)	3/4” (19 mm)	L15-41-20	20 feet (6.1 m)	89J56
-036 -048	3/8” (10 mm)	7/8” (22 mm)	L15-65-30	30 feet (12.2 m)	89J57
			L15-65-40	40 feet (15.2 m)	89J58
			L15-65-50	50 feet (15.2 m)	89J59
-060	3/8” (10 mm)	1-1/8” (29 mm) **	Field-fabricated		

* Applicable to all minor revision numbers unless otherwise specified.
** Some applications may require a field-provided 1-1/8” to 7/8” adapter.

Table 4. NS21HM Line Set Guidelines – 51 to 150 Linear Feet in Length**

Model	Maximum Total Equivalent Length (ft)	Maximum Linear (actual) Length (ft)	Maximum Vapor Riser (ft)	Maximum Linear Liquid Lift (ft)	Preferred Vapor Line Sizes for Horizontal Runs	Required Vapor Riser Size
-024	180	150	60	60	7/8”	5/8”
-036	180	150	60	60	7/8”	3/4”
-048	180	150	60	60	7/8”	7/8”
-060	180	150	60	60	7/8”	7/8”

Table 5. Liquid Line Diameter Selection Table

Unit	Line Size	Total Linear Length (feet)						
		25	50	75	100	125	150	
-024	5/16”	25	50	55	48	40	33	Max. Elevation (ft)
	3/8”	25	50	60	60	60	60	
-036	3/8”	25	50	60	56	51	45	
	1/2”	25	50	60	60	60	60	
-048	3/8”	25	50	50	41	31	22	
	1/2”	25	50	60	60	60	60	
-060	3/8”	25	50	36	22	8	NR	
	1/2”	25	50	60	60	60	5	

NOTE - Shaded rows indicate rated liquid line size.

A. Find your unit on the left side of the table.

B. Start with the rated liquid line size (shaded row) on the outdoor unit

C. Select the actual Total Linear Length of your system shown at the top of the table.

D. The elevation listed in the table is the maximum allowed for the liquid line listed.

E. Select or consider the larger liquid line size shown in the table if the elevation does not meet your requirements.

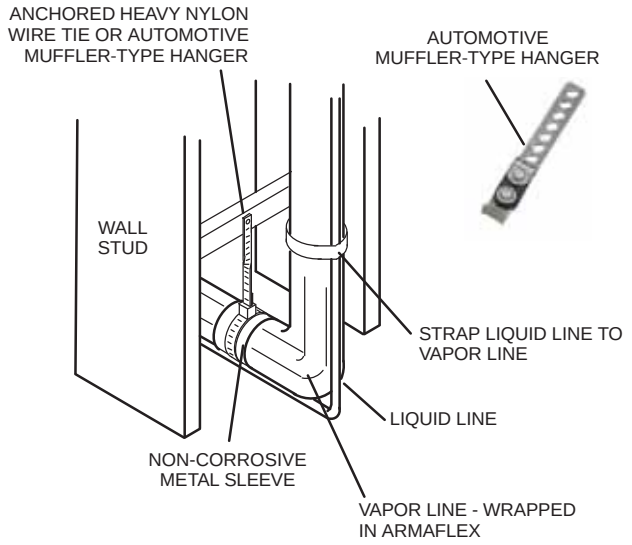
LINE SET

IMPORTANT — Refrigerant lines must not contact structure.

INSTALLATION

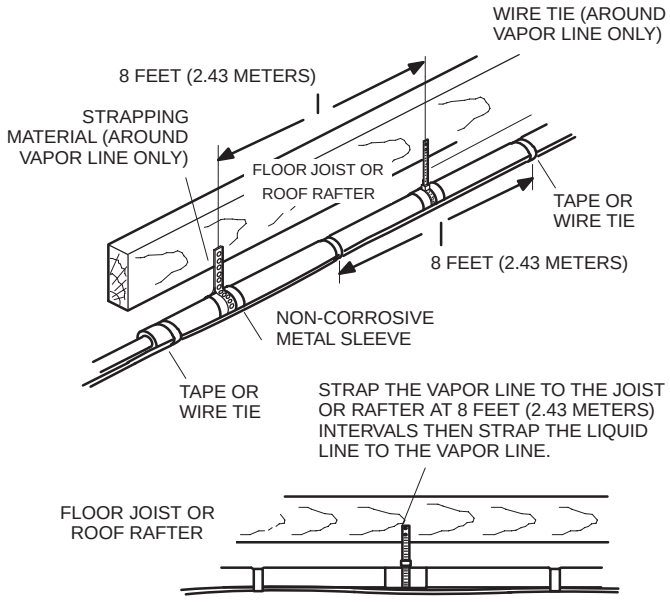
Line Set Isolation — The following illustrations are examples of proper refrigerant line set isolation:

REFRIGERANT LINE SET — TRANSITION FROM VERTICAL TO HORIZONTAL



REFRIGERANT LINE SET — INSTALLING HORIZONTAL RUNS

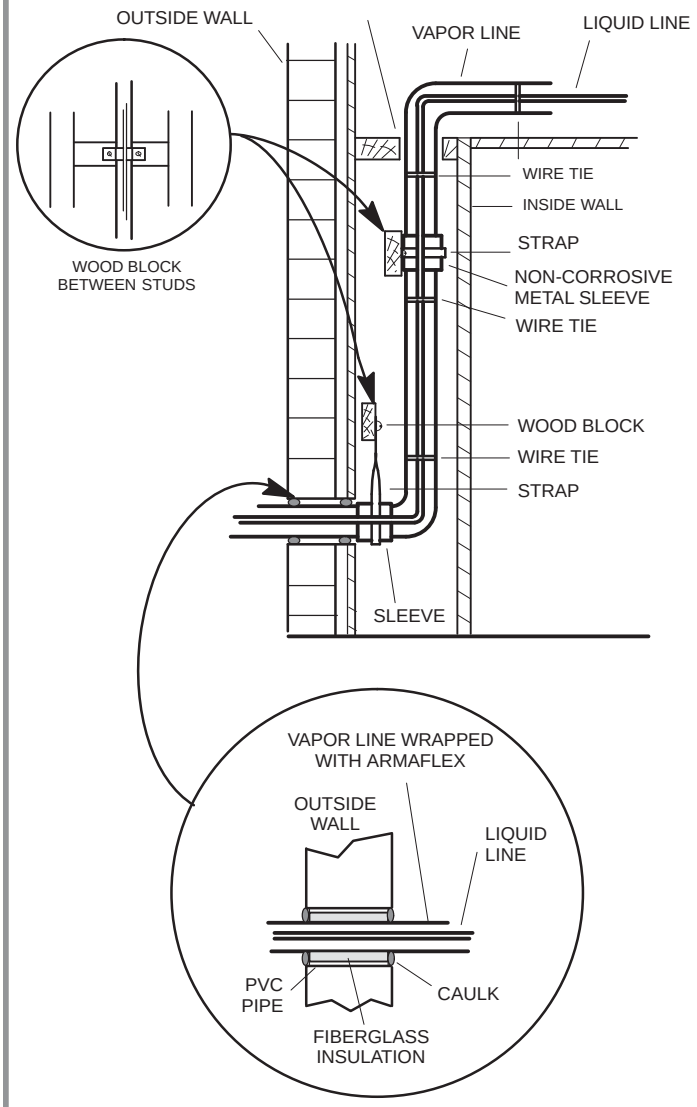
To hang line set from joist or rafter, use either metal strapping material or anchored heavy nylon wire ties.



REFRIGERANT LINE SET — INSTALLING VERTICAL RUNS (NEW CONSTRUCTION SHOWN)

NOTE — Insulate liquid line when it is routed through areas where the surrounding ambient temperature could become higher than the temperature of the liquid line or when pressure drop is equal to or greater than 20 psig.

IMPORTANT — Refrigerant lines must not contact wall



***NOTE** — Similar installation practices should be used if line set is to be installed on exterior of outside wall.*

WARNING — Polyol ester (POE) oils used with HFC-410A refrigerant absorb moisture very quickly. It is very important that the refrigerant system be kept closed as much as possible. DO NOT remove line set caps or service valve stub caps until you are ready to make connections.

Figure 7. Line Set Installation

BRAZING CONNECTIONS

Use the procedures outlined in **Figure 8** and **Figure 9** for brazing line set connections to service valves.

⚠WARNING **Danger of fire.** Bleeding the refrigerant charge from only the high side may result in pressurization of the low side shell and suction tubing. Application of a brazing torch to a pressurized system may result in ignition of the refrigerant and oil mixture. Check the high and low pressures before applying heat.

⚠WARNING When using a high pressure gas such as nitrogen to pressurize a refrigeration or air conditioning system, use a regulator that can control the pressure down to 1 or 2 psig (6.9 to 13.8 kPa).

⚠CAUTION Brazing alloys and flux contain materials which are hazardous to your health.

Avoid breathing vapors or fumes from brazing operations. Perform operations only in well-ventilated areas.

Wear gloves and protective goggles or face shield to protect against burns.

Wash hands with soap and water after handling brazing alloys and flux.

⚠IMPORTANT Allow braze joint to cool before removing the wet rag from the service valve. Temperatures above 250ºF can damage valve seals.

⚠IMPORTANT Use silver alloy brazing rods with 5% minimum silver alloy for copper-to-copper brazing. Use 45% minimum alloy for copper-to-brass and copper-to-steel brazing.

⚠IMPORTANT **Fire, Explosion and Personal Safety hazard.** Failure to follow this warning could result in damage, personal injury or death.

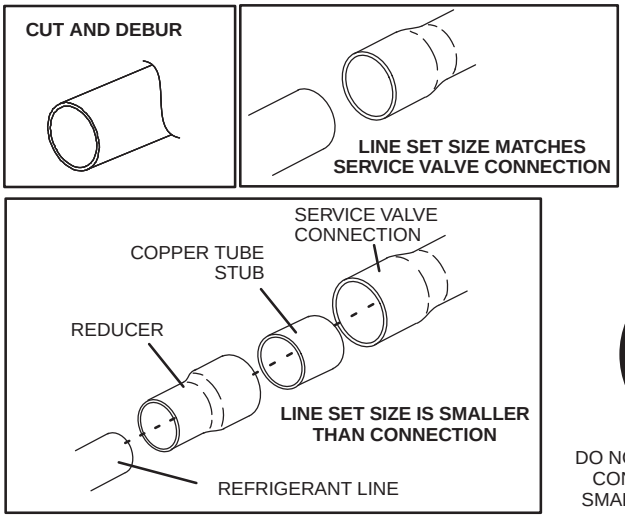
Never use oxygen to pressurize or purge refrigeration lines. Oxygen, when exposed to a spark or open flame, can cause fire and/ or an explosion, that could result in property damage, personal injury or death.

Installation

BRAZING CONNECTIONS (Cont.)

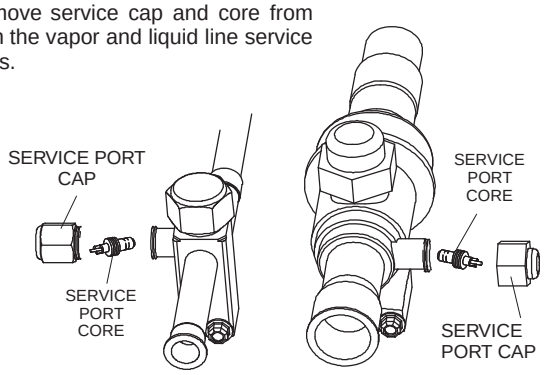
1 CUT AND DEBUR

Cut ends of the refrigerant lines square (free from nicks or dents) and debur the ends. The pipe must remain round. Do not crimp end of the line.



2 CAP AND CORE REMOVAL

Remove service cap and core from both the vapor and liquid line service ports.



DO NOT CRIMP SERVICE VALVE CONNECTOR WHEN PIPE IS SMALLER THAN CONNECTION

3 ATTACH THE MANIFOLD GAUGE SET FOR BRAZING LIQUID AND VAPOR LINE SERVICE VALVES

Flow regulated nitrogen (at 1 to 2 psig) through the low-side refrigeration gauge set into the liquid line service port valve, and out of the vapor line service port valve.

- **A -** Connect gauge set low pressure side to liquid line service valve (service port).
- **B -** Connect gauge set center port to bottle of nitrogen with regulator.
- **C -** Remove core from valve in vapor line service port to allow nitrogen to escape.

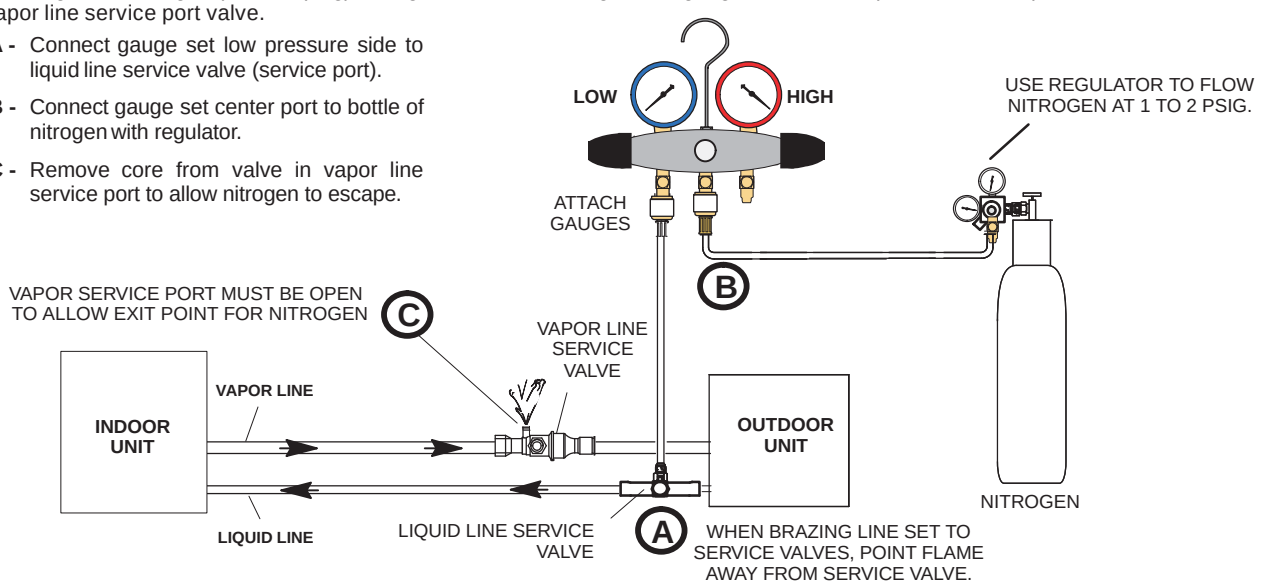


Figure 8. Brazing Procedures

BRAZING CONNECTIONS (Cont.)

4 WRAP SERVICE VALVES

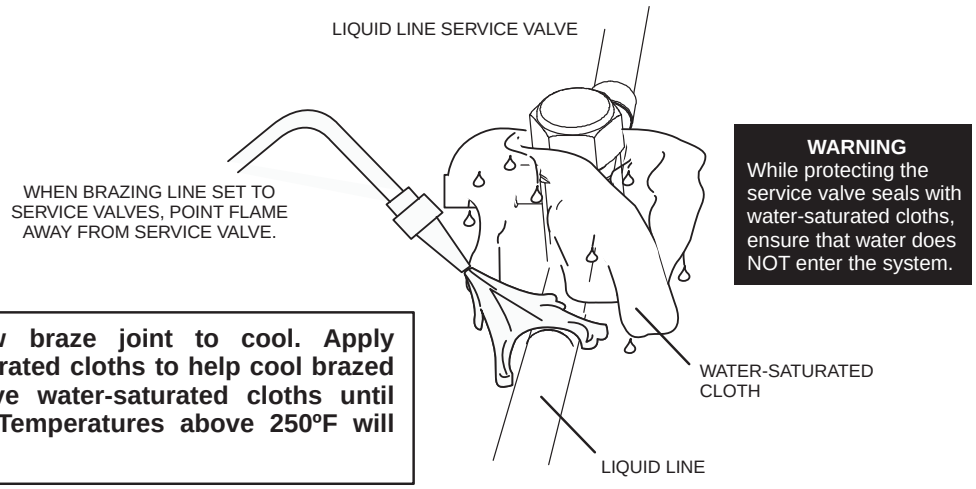
To help protect service valve seals during brazing, wrap water-saturated cloths around service valve bodies and copper tube stubs. Use additional water-saturated cloths underneath the valve body to protect the base paint.

5 FLOW NITROGEN

Flow regulated nitrogen (at 1 to 2 psig) through the refrigeration gauge set into the valve stem port connection on the liquid service valve and out of the vapor valve stem port. See steps **3A, 3B** and **3C** on manifold gauge set connections.

6 BRAZE LINE SET

Wrap both service valves with water-saturated cloths as illustrated here and as mentioned in step 4, before brazing to line set. Cloths must remain water-saturated throughout the brazing and cool-down process.



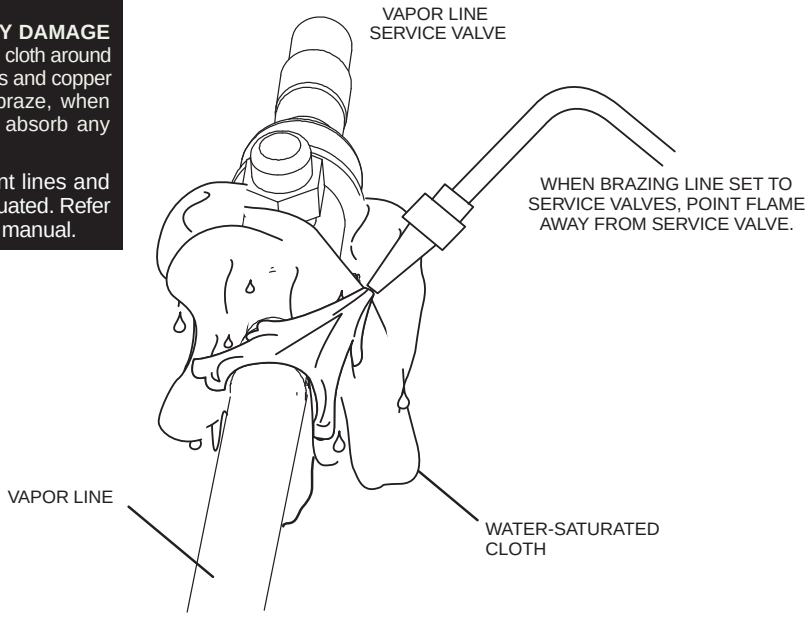
WARNING
While protecting the service valve seals with water-saturated cloths, ensure that water does NOT enter the system.

IMPORTANT — Allow braze joint to cool. Apply additional water-saturated cloths to help cool brazed joint. Do not remove water-saturated cloths until piping has cooled. Temperatures above 250ºF will damage valve seals.

WARNING

FIRE, PERSONAL INJURY, OR PROPERTY DAMAGE may result if you do not wrap a water-saturated cloth around both liquid and suction line service valve bodies and copper tube stub while brazing the line set! The braze, when complete, must be quenched with water to absorb any residual heat.

Do not open service valves until refrigerant lines and indoor coil have been leak-tested and evacuated. Refer to Leak Test and Evacuation section of this manual.



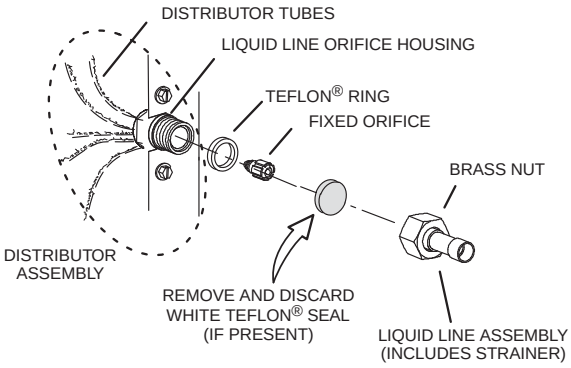
7 PREPARATION FOR NEXT STEP

After all connections have been brazed, disconnect manifold gauge set from service ports. Apply additional water-saturated cloths to both services valves to cool piping. Once piping is cool, remove all water-saturated cloths.

Figure 9. Brazing Procedures (Cont'd)

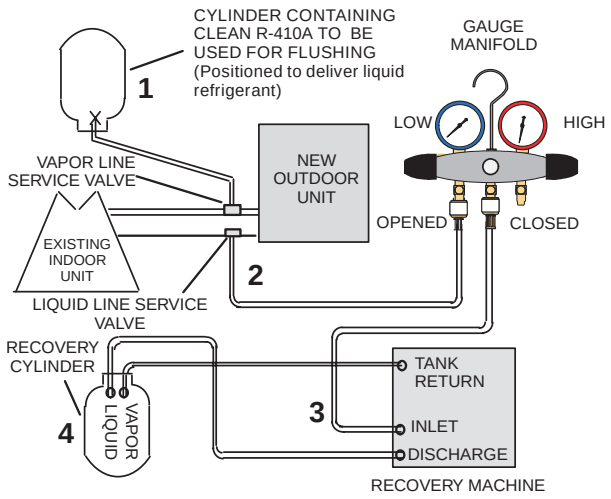
FLUSHING LINE SET AND INDOOR COIL

1A Typical Existing Fixed Orifice Removal Procedure (Uncased Coil Shown)



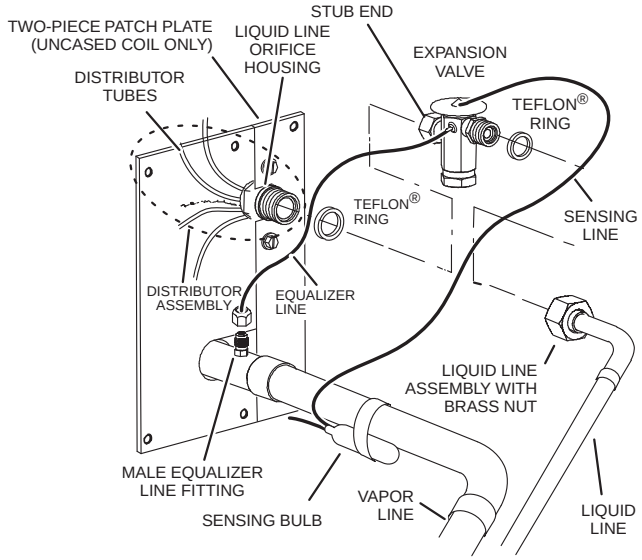
A. On fully cased coils, remove the coil access and plumbing panels.
B. Remove any shipping clamps from the liquid line and distributor assembly.
C. Using two wrenches (one to hold the orifice housing and one to remove the brass nut), disconnect liquid line from liquid line orifice housing. Take care not to twist or damage distributor tubes during this process.
D. Remove and discard fixed orifice, valve stem assembly (if present) and Teflon® washer, as shown above.
E. Use a field-provided fitting to temporarily reconnect the liquid line to the indoor unit's liquid line orifice housing.

2 Connect Gauges and Equipment for Flushing Procedure



A. Inverted R-454B cylinder with clean refrigerant* to the vapor service valve.
B R-454B gauge set (low side) to the liquid line valve.
C R-454B gauge set center port to inlet on the recovery machine with an empty recovery tank to the gauge set.
D Connect recovery tank to recovery machines per machine instructions.

OR 1B Typical Existing Expansion Valve Removal Procedure (Uncased Coil Shown)



A. On fully cased coils, remove the coil access and plumbing panels.
B. Remove any shipping clamps from the liquid line and distributor assembly.
C. Disconnect the equalizer line from the fitting on the vapor line.
D. Remove the vapor line sensing bulb.
E. Disconnect the liquid line from the expansion valve at the liquid line assembly.
F. Disconnect the expansion valve from the liquid line orifice housing. Take care not to twist or damage distributor tubes during this process.
G. Remove and discard expansion valve and the two Teflon® rings.
H. Use a field-provided fitting to temporarily reconnect the liquid line to the indoor unit's liquid line orifice housing.

3 Flushing Line Set

The line set and indoor unit coil must be flushed with at least the same amount of clean refrigerant* that previously charged the system. Check the charge in the flushing cylinder before proceeding.

A. Set the recovery machine for liquid recovery and start the recovery machine. Open the gauge set valves to allow the recovery machine to pull a vacuum on the existing system line set and indoor unit coil.
B. Invert the cylinder of clean R-454B* and open its valve to allow liquid refrigerant to flow into the system through the vapor line valve. Allow the refrigerant to pass from the cylinder and through the line set and the indoor unit coil before it enters the recovery machine.
C. After all of the liquid refrigerant has been recovered, switch the recovery machine to vapor recovery so that all of the R-454B vapor is recovered. Allow the recovery machine to pull the system down to 0.
C. Close the valve on the inverted R-454B drum and the gauge set valves. Pump the remaining refrigerant out of the recovery machine and turn the machine off.

***IMPORTANT - Clean refrigerant is any refrigerant in a system that has not had compressor burn out. If the system has experienced burn out, it is recommended that the existing line set and indoor coil be replaced.**

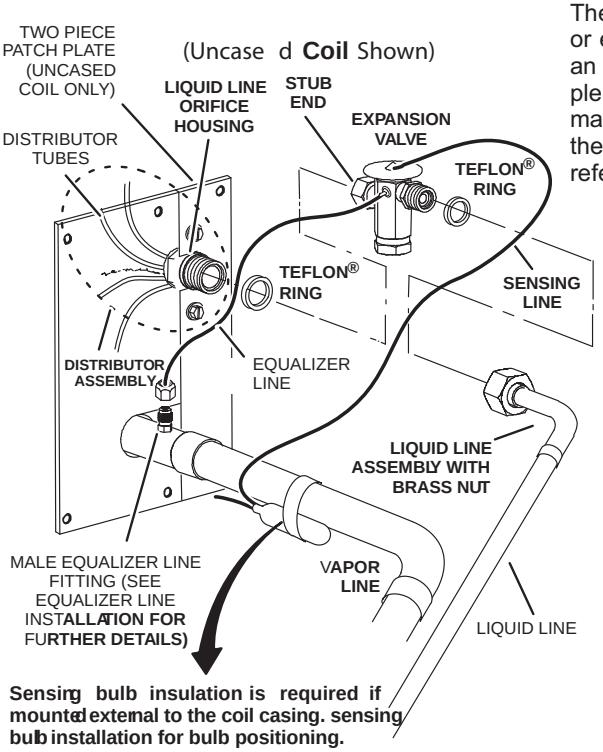
Figure 10. Removing Metering Device and Flushing

Installation

FLUSHING LINE SET AND INDOOR COIL (Cont.)

4 Typical New Check Expansion Valve Installation Procedure

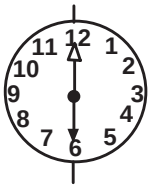
This outdoor unit is designed for use in systems that use a check expansion valve metering device. See the Unit Product Specifications for approved expansion valve kit match-ups and application information.



Sensing bulb insulation is required if mounted external to the coil casing. sensing bulb installation for bulb positioning.

The expansion valve unit can be installed internal or external to the indoor coil. In applications where an uncased coil is being installed in a field-provided plenum, install the check expansion valve in a manner that will provide access for field servicing of the expansion valve. Refer to below illustration for reference during installation of expansion valve unit.

1/2 Turn



A. Remove the field-provided fitting that temporarily reonnected the liquid line to the indoor units distributor assembly.

B. Install one of the provided Teflon® rings around the stubbed end of the expansion valve and lightly lubricate the connector threads and expose surface of the Teflon® ring with refrigerant oil.

C. Attach the stubbed end of the expansion valve to the liquid line orifice housing. Finger tighten and use an appropriately sized wrench to turn an additional 1/2 turn clockwise as illustrated in the figure, or 20 ft-lb.

D. Place the remaining Teflon® washer around the other end of the expansion valve. Lightly lubricate connector threads and expose surface of the Teflon® ring with refrigerant oil.

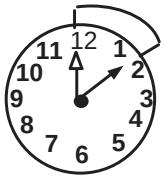
E. Attach the liquid line assembly to the expansion valve. Finger tighten and use an appropriately sized wrench to turn an additional 1/2 turn clockwise as shown above or 20 ft-lb.

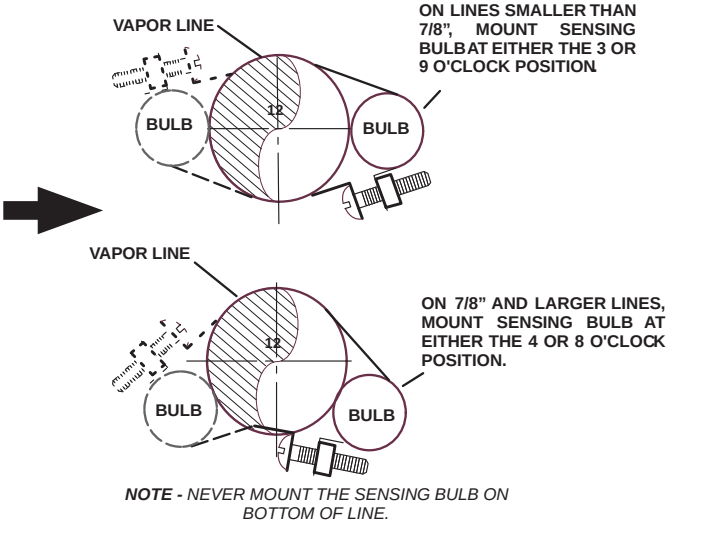
Sensing Bulb Installation

A. Attach the vapor line sensing bulb in the proper orientation as illustrated to the right using the clamp and screws provided. **NOTE:** Confirm proper thermal contact between vapor line and check expansion bulb before insulating the sensing bulb once installed.

B. Connect the equalizer line from the expansion valve to the equalizer vapor port on the vapor line. Finger tighten the flare nut plus 1/8 turn (7 ft-lb) as illustrated below.

1/8 Turn

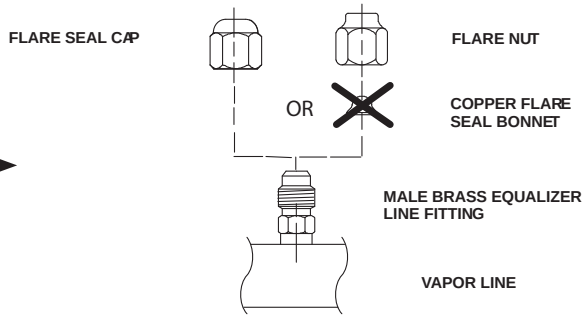




NOTE - *NEVER MOUNT THE SENSING BULB ON BOTTOM OF LINE.*

Equalizer Line Installation

Remove and discard either the flare seal cap or flare nut with copper flare seal bonnet from the equalizer line port on the vapor line as illustrated in the figure to the right.



Installation

FLUSHING LINE SET AND INDOOR COIL (Cont.)

⚠IMPORTANT The Environmental Protection Agency (EPA) prohibits the intentional venting of HFC refrigerants during maintenance, service, repair and disposal of appliance. Approved methods of recovery, recycling or reclaiming must be followed.

⚠IMPORTANT If this unit is being matched with an approved line set or indoor unit coil that was previously charged with mineral oil, or if it is being matched with a coil which was manufactured before January of 1999, the coil and line set must be flushed prior to installation. Take care to empty all existing traps. Polyvinyl ether (PVE) oils are used in variable-capacity units charged with R454B refrigerant. Residual mineral oil can act as an insulator, preventing proper heat transfer. It can also clog the expansion device and reduce system performance and capacity. Failure to properly flush the system per this instruction will void the warranty.

LEAK TESTING THE SYSTEM

⚠WARNING When using a high pressure gas such as nitrogen to pressurize a refrigeration or air conditioning system, use a regulator that can control the pressure down to 1 or 2 psig (6.9 to 13.8 kPa).

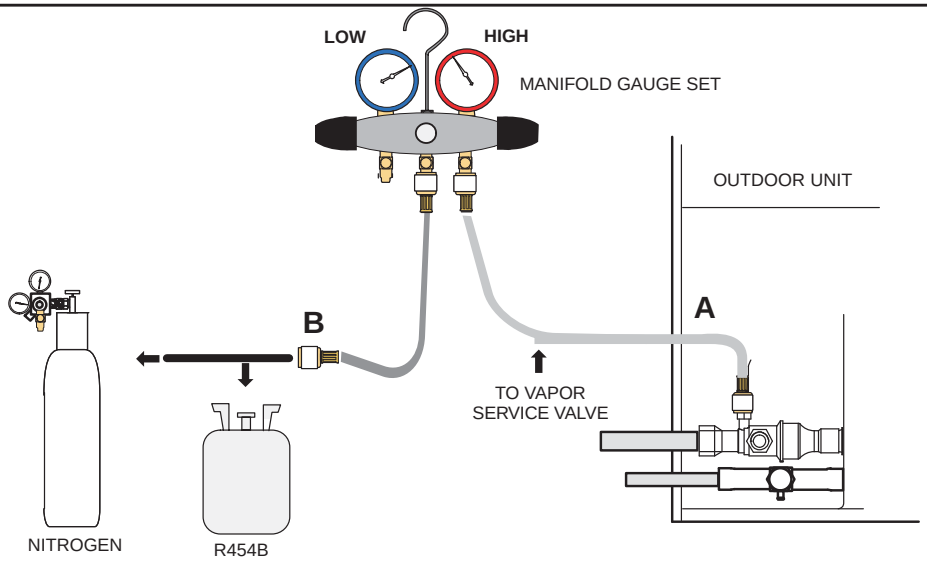
⚠IMPORTANT Leak detector must be capable of sensing HFC refrigerant.

⚠WARNING Refrigerant can be harmful if it is inhaled. Refrigerant must be used and recovered responsibly. Failure to follow this warning may result in personal injury or death.

LEAK TESTING THE SYSTEM (Cont.)

Leak Test - Line Set and Indoor Coil

NOTE - Normally, the high pressure hose is connected to the liquid line port. However, connecting it to the vapor port better protects the manifold gauge set from high pressure damage.



1 CONNECT GAUGE SET

A - Connect an R454B manifold gauge set high pressure hose to the vapor valve service port.

B - With both manifold valves closed, connect the cylinder of R454B refrigerant to the center port of the manifold gauge set.
NOTE - Later in the procedure, the R454B container will be replaced by the nitrogen container

2 TEST FOR LEAKS

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

A - With both manifold valves closed, connect the cylinder of R454B refrigerant to the center port of the manifold gauge set. Open the valve on the R454B cylinder (vapor only).

B - Open the high pressure side of the manifold to allow R454B into the line set and indoor unit. Weigh in a trace amount of R454B. *[A trace amount is a maximum of two ounces (57 g) refrigerant or three pounds (31 kPa) pressure.]* Close the valve on the R454B cylinder and the valve on the high pressure side of the manifold gauge set. Disconnect the R454B cylinder.

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

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

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

F - After leak testing, disconnect gauges from service ports.

Figure 11. System Leak Test

Installation

EVACUATING LINE SET AND INDOOR COIL

1 CONNECT GAUGE SET

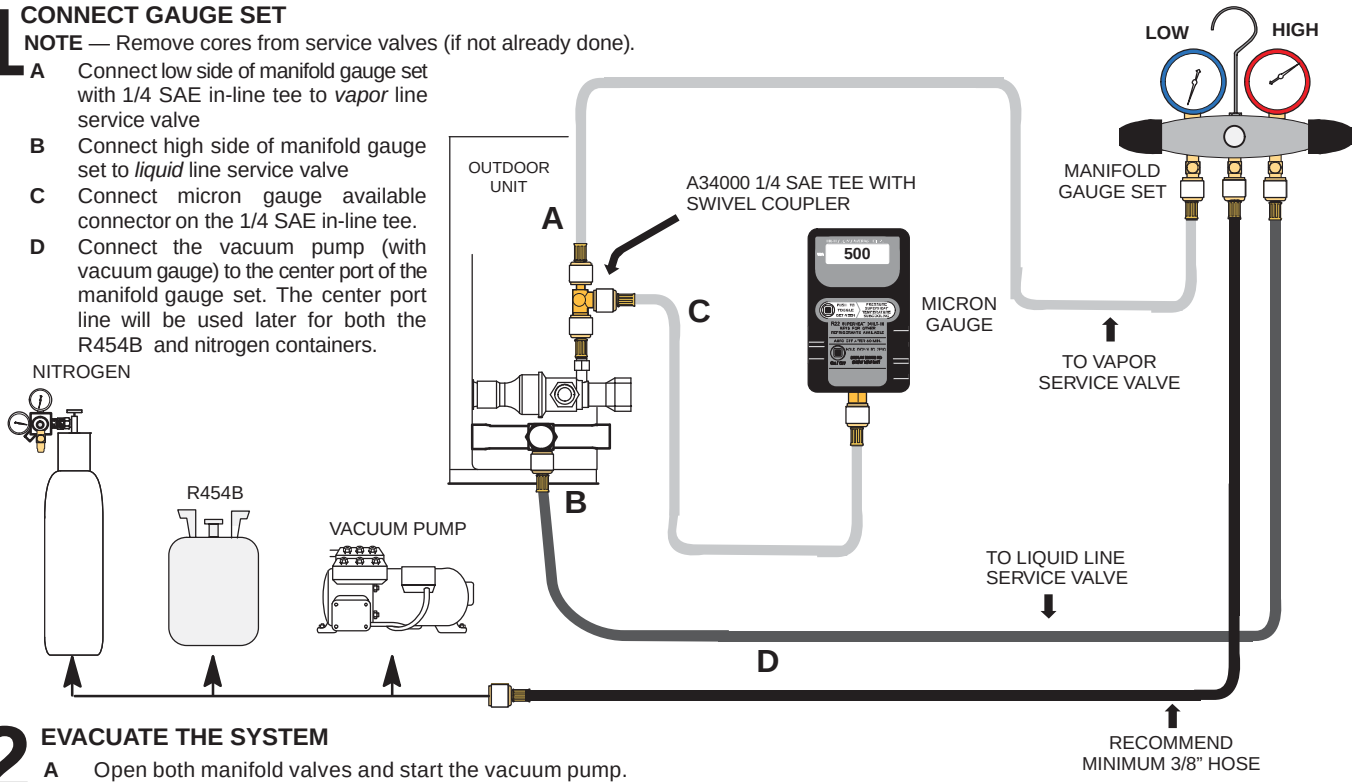
NOTE — Remove cores from service valves (if not already done).

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

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

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

D Connect the vacuum pump (with vacuum gauge) to the center port of the manifold gauge set. The center port line will be used later for both the R454B and nitrogen containers.



2 EVACUATE THE SYSTEM

A Open both manifold valves and start the vacuum pump.

B Evacuate the line set and indoor unit to an **absolute pressure** of 23,000 microns (29.01 inches of mercury).

***NOTE** — During the early stages of evacuation, it is desirable to close the manifold gauge valve at least once. A rapid rise in pressure indicates a relatively large leak. If this occurs, **repeat the leak testing procedure**.*

***NOTE** — The term **absolute pressure** means the total actual pressure within a given volume or system, above the absolute zero of pressure. Absolute pressure in a vacuum is equal to atmospheric pressure minus vacuum pressure.*

C When the absolute pressure reaches 23,000 microns (29.01 inches of mercury), perform the following:

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

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

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

F When the absolute pressure requirement above has been met, disconnect the manifold hose from the vacuum pump and connect it to an upright cylinder of R454B refrigerant. Open the manifold gauge valve 1 to 2 psig in order to release the vacuum in the line set and indoor unit.

G Perform the following:

- Close manifold gauge valves.
- Shut off R454B cylinder.
- Reinstall service valve cores by removing manifold hose from service valve. Quickly install cores with core tool while maintaining a positive system pressure.
- Replace stem caps and secure finger tight, then tighten an additional one-sixth (1/6) of a turn as illustrated.

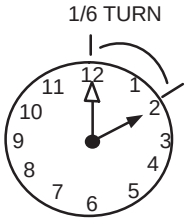


Figure 12. Evacuating the System

EVACUATING LINE SET AND INDOOR COIL (Cont.)

⚠IMPORTANT Use a thermocouple or thermistor electronic vacuum gauge that is calibrated in microns. Use an instrument capable of accurately measuring down to 50 microns.

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

Evacuating the system of non-condensables is critical for proper operation of the unit. Non-condensables are defined as any gas that will not condense under temperatures and pressures present during operation of an air conditioning system. Non-condensables and water suction combine with refrigerant to produce substances that corrode copper piping and compressor parts.

ELECTRICAL – Circuit Sizing and Wire Routing

In the U.S.A., wiring must conform with current local codes and the current National Electric Code (NEC). In Canada, wiring must conform with current local codes and the current Canadian Electrical Code (CEC).

Refer to the furnace or air handler installation instructions for additional wiring application diagrams and refer to unit nameplate for minimum circuit ampacity and maximum overcurrent protection size.

24VAC TRANSFORMER

Use the transformer provided with the furnace or air-handler for low-voltage control power for the NS21H**M Outdoor Unitary Control board (24VAC - 40VA minimum). The NS21H**M contains a dedicated transformer to supply low-voltage to the EEV Control Board.

THERMOSTAT CONTROL AND LOW VOLTAGE CONTROL WIRING

Thermostat Control Options

Conventional 24VAC Non-Communicating Thermostat Control

The variable capacity unit may be installed using a conventional 24VAC non-communicating two-stage heat pump or single-stage heat pump thermostat.

NOTE – The conventional 24VAC non-communicating thermostat must have a compressor minimum on time of three minutes to prevent compressor short cycling.

The unit will provide full variable capacity operation when installed with a conventional 24VAC non-communicating two stage heat pump or single-stage heat pump thermostat. The outdoor control has advanced control algorithms using the suction pressure sensor to provide true variable capacity operation in the cooling mode. In the heat pump heating mode, the advanced control algorithms use the liquid pressure sensor to provide true variable capacity operation.

When utilizing a two-stage conventional 24VAC non-communicating heat pump thermostat, six wires are required to control the outdoor unit (R, C, Y1, Y2, O and W). Refer to the field wiring diagram for a conventional 24VAC non-communicating 2-stage heat pump thermostat.

Low Voltage Control Wiring Connections

The variable capacity units are provided with (2) RAST 6-Pin connections in the installation instruction bag for connecting the field low voltage control wiring to the harnesses in the low voltage control make-up box. One RAST 6-pin connector is labeled with terminals TST, DF, R, I+, I- and C. The second RAST 6-pin connector is labeled with terminals DS, O, Y1, Y2, L and W.

⚠WARNING **Electric Shock Hazard.** Can cause injury or death. Unit must be properly grounded in accordance with national and local codes. Line voltage is present at all components when unit is not in operation on units with singlepole contactors. Disconnect all remote electric power supplies before opening access panel. Unit may have multiple power supplies.

⚠WARNING **Fire Hazard.** Use of aluminum wire with this product may result in a fire, causing property damage, severe injury or death. Use copper wire only with this product.

Installation

THERMOSTAT CONTROL AND LOW VOLTAGE CONTROL WIRING (Cont.)

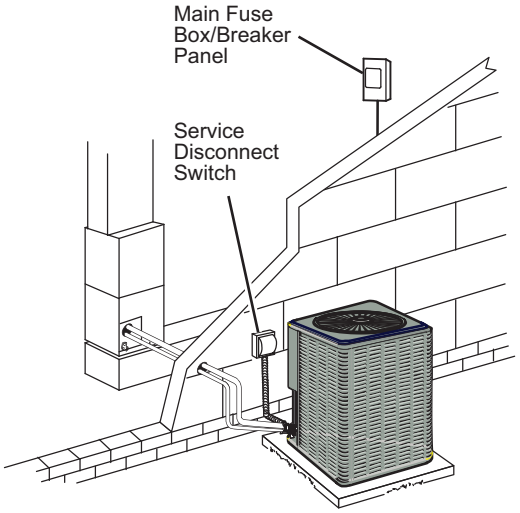
⚠WARNING Failure to use properly sized wiring and circuit breaker may result in property damage. Size wiring and circuit breaker(s) per Product Specifications and unit rating plate.

NS21H Thermostat Control Options

Thermostat Type	Indoor Unit Type	Qty. of Wires	Terminal Strip Connections	Unit Operation	Field Wiring Diagram
Conventional 24VAC 2-Stage Heat Pump Thermostat (non-communicating)	Any Furnace or Air Handler (non-communicating or communicating)	6	R, C, Y1, Y2, O, W	Full Variable Capacity Operation Controlled by Unitary Control Using Suction Pressure in Cooling Mode and Liquid Pressure in Heating Mode	Figure 25

Size Circuit and Install Service Disconnect Switch

Refer to the unit nameplate for minimum circuit ampacity, and maximum fuse or circuit breaker (HACR per NEC). Install power wiring and properly sized disconnect switch.



NOTE - Units are approved for use only with copper conductors. Ground unit at disconnect switch or to an earth ground.

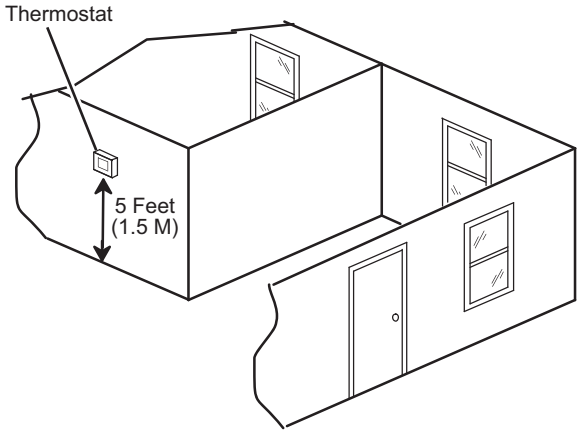
⚠WARNING ELECTROSTATIC DISCHARGE (ESD)

Precautions and Procedures

Electrostatic discharge can affect electronic components. Take care during unit installation and service to protect the unit's electronic controls. Precautions will help to avoid control exposure to electrostatic discharge by putting the unit, the control, and the technician at the same electrostatic potential. Touch hand and all tools on an unpainted unit surface before performing any service procedure to neutralize electrostatic charge.

Install Thermostat

Install room thermostat (ordered separately) on an inside wall approximately in the center of the conditioned area and 5 feet (1.5m) from the floor. It should not be installed on an outside wall or where it can be affected by sunlight or drafts.



NOTE - 24VAC, Class II circuit connections are made in the control panel.

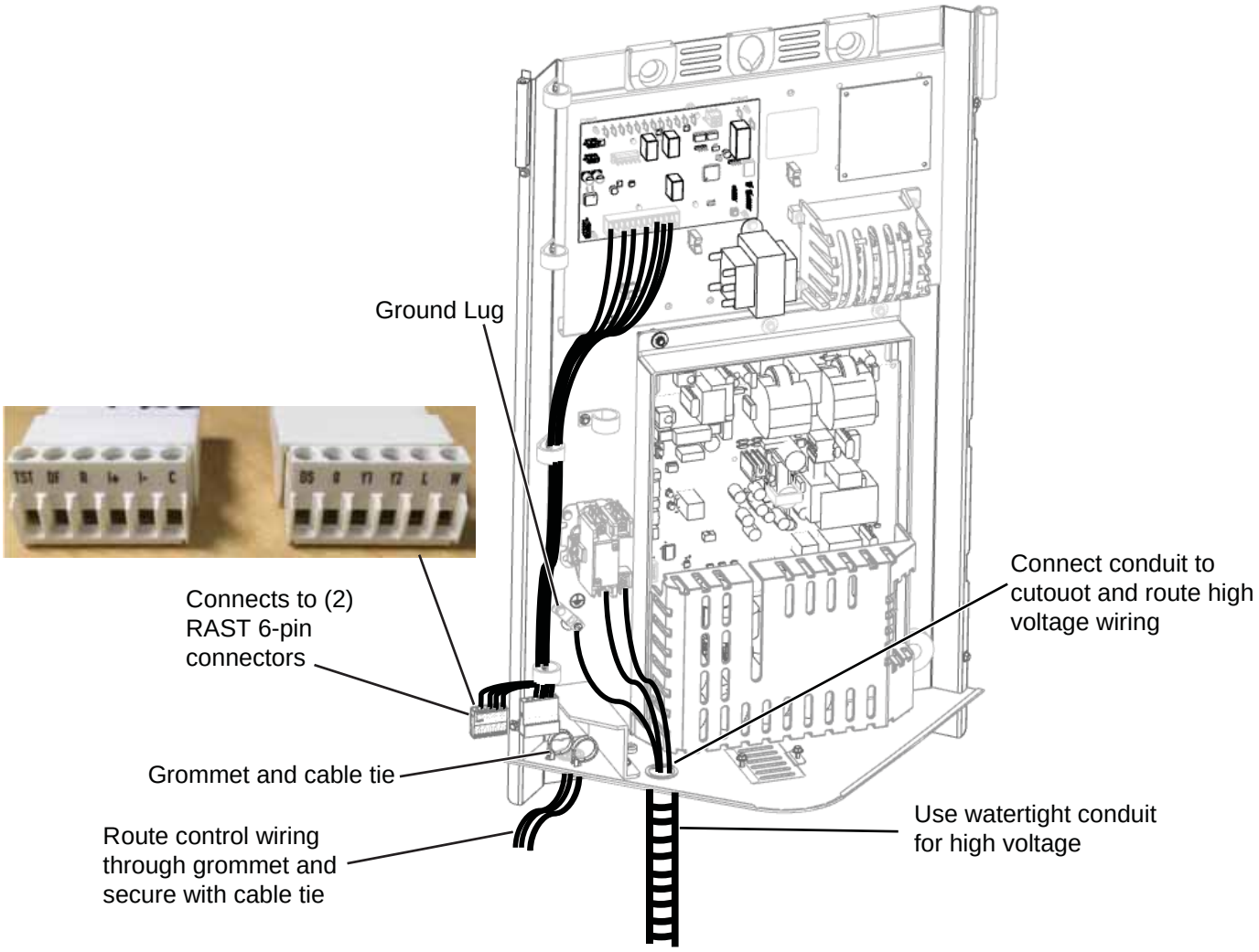
⚠WARNING Electrical Hazard! High Voltage! Wait 5 Minutes. Electrical components may hold charge. Do not remove this panel or service this area for 5 minutes after the power has been removed.

THERMOSTAT CONTROL AND LOW VOLTAGE CONTROL WIRING (Cont.)

3 ROUTE CONTROL WIRES

Conventional 24VAC Non-Communicating Thermostat Wiring

WIRE RUN LENGTH	AWG#	INSULATION TYPE
LESS THAN 100' (30 METERS)	18	TEMPERATURE RATING
MORE THAN 100' (30 METERS)	16	35°C MINIMUM



4 ROUTE HIGH VOLTAGE AND GROUND WIRES

Any excess high voltage field wiring should be trimmed and secured away from any low voltage field wiring. To facilitate a conduit, a cutout is located on the bottom of the control box. Connect conduit to the control box using a proper conduit fitting.

Connect the 208/230 high voltage power supply from the disconnect to the contactor as shown. Connect the ground wire from the power supply to the unit ground lug connection.

Figure 13. Typical Control Wiring

Installation

THERMOSTAT CONTROL AND LOW VOLTAGE CONTROL WIRING (Cont.)

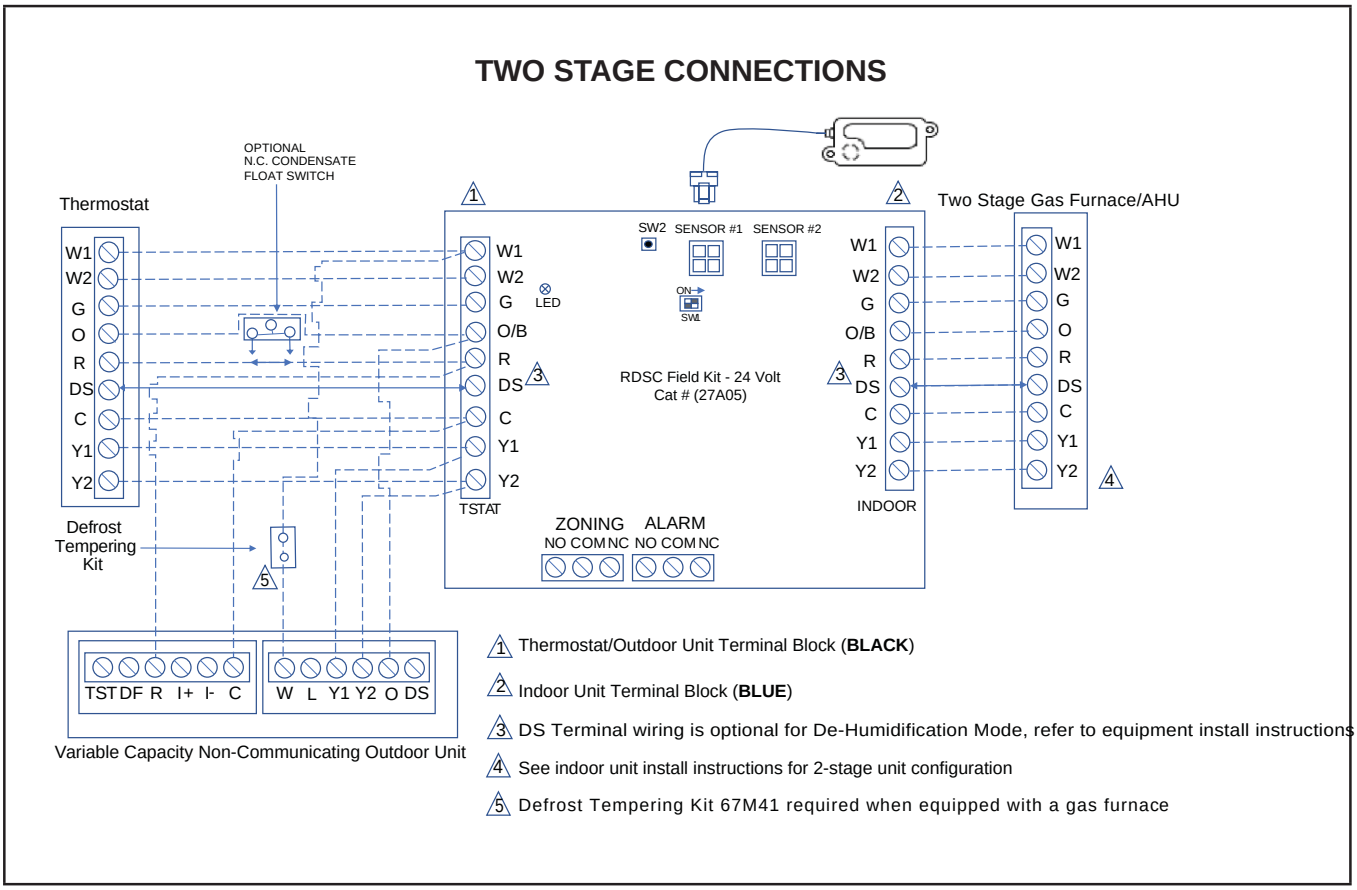


Figure 14. Conventional 24VAC Heat Pump Non-Communicating Thermostat Wiring

OUTDOOR UNITARY CONTROL - JUMPERS AND TERMINALS

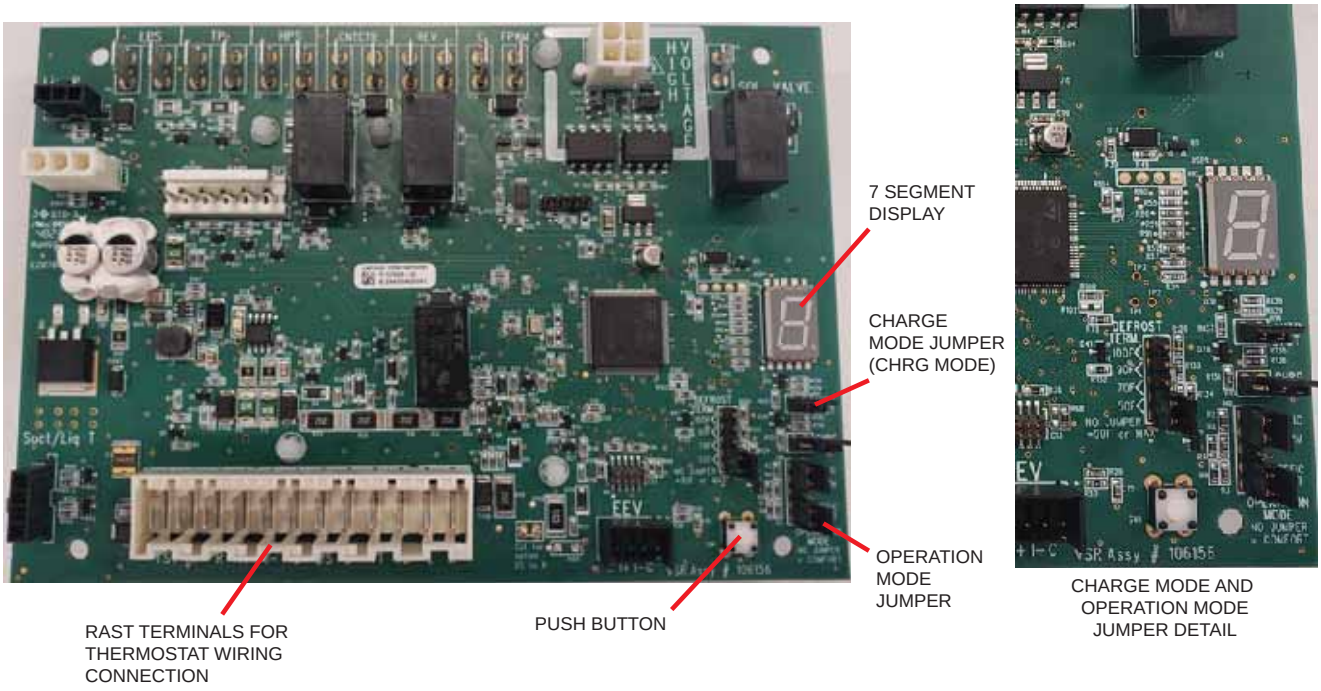


Figure 15.

Outdoor Control 7 Segment Display and Push Button

Information concerning the outdoor control 7-segment display and push button operations are available on the unit access panel.

Alarms

Alarm information is provided on the unit access panel.

Charge Mode Jumper

To initiate the Charge Mode function, install the jumper across the two Charge Mode Pins (CHRG MODE) on the outdoor control. The Charge Mode can be used when charging the system with refrigerant, checking the refrigerant charge, pumping down the system and performing other service procedures that requires outdoor unit operation at 100% capacity.

Charge Mode Operation with a Conventional 24VAC Non-Communicating Heat Pump Thermostat

On applications with a conventional 24VAC non-communicating thermostat, the charge mode jumper must be installed on the Charge Mode Pins after providing a Y1 compressor demand to the unit to initiate the Charge Mode. When using the Charge Mode in the cooling mode, the “O” must also be provided with a 24V signal to place the reversing valve in the cool position. In the heating mode only a Y1 compressor demand is required along with the blower demand for the full cooling air volume. A cooling blower demand must also be provided to initiate blower operation on the cooling speed on the indoor unit. The compressor and outdoor fan motor will operate at 100% capacity. To exit the charging mode, remove the Charge Mode Jumper and remove the Y1 Cooling demand and indoor blower demand. The Charge Mode has a maximum time of 60 minutes and will automatically exit the charge mode after 60 minutes if the charge mode jumper is left in place.

OUTDOOR UNITARY CONTROL - JUMPERS AND TERMINALS (Cont.)

Cooling Operation Mode Jumper

The Cooling Operation Mode Jumper is only used on applications installed with a conventional 24VAC non-communicating heat pump thermostat. In applications with a conventional 24VAC non-communicating heat pump thermostat, the compressor capacity is controlled to maintain the target suction pressure setpoint. The Cooling Operation Mode Jumper has three selectable cooling modes. The three modes are Efficiency (Jumper in stalled on Pins 1 & 2), Normal Mode (Jumper installed on Pins 2 & 3) and Comfort Mode (Jumper Removed).

When the Cooling Operation Mode jumper is installed in the “Comfort Mode” the suction pressure setpoint is 125 psig.

Heating Operation Mode Jumper

The Heating Operation Mode Jumper is only used on applications installed with a conventional 24VAC non-communicating heat pump thermostat. In applications with a conventional 24VAC non-communicating heat pump thermostat, the compressor capacity is controlled to maintain the target liquid pressure setpoint. The Heating Operation Mode Jumper has two selectable heating modes. The two modes are Efficiency (Jumper installed on Pins 1 & 2) and Comfort Mode (Jumper Removed). The factory default position is the Efficiency Mode. The Efficiency mode has a variable liquid pressure setpoint that will vary with the outdoor temperature; as the outdoor temperature decreases, the liquid pressure setpoint will increase. When the Operation Mode jumper is installed in the “Comfort Mode” the liquid pressure setpoint is 425 psig.

Unit Operation

Unit Operation with a Conventional 24VAC Non-Communicating 2-Stage Heat Pump Thermostat – Cooling Mode

When the unit is installed with a conventional 24VAC non-communicating 2-stage heat pump thermostat, the O terminal on the thermostat will energize the unit reversing valve to place the unit in the cooling mode. A Y1 first stage cooling demand will initiate cooling operation and first stage indoor blower operation. The compressor will be controlled in the variable capacity mode by varying the compressor capacity to obtain the target suction pressure set point. The Y2 second stage cooling demand will initiate second stage blower operation. Increased air volume will increase the load on the indoor coil and increase the suction pressure. The compressor capacity will continue to be controlled based upon the suction pressure. The unit capacity will be controlled in the variable capacity mode throughout the range of capacity from minimum capacity to maximum capacity. If the Y2 demand remains after 20 minutes, the control will begin to ramp up the compressor capacity until maximum capacity is achieved. The unit will cycle off once the thermostat demand is satisfied. Unit Operation with a Conventional 24VAC Non-Communicating 2-Stage Heat Pump Thermostat - Heating Mode When the NS21H unit is installed with a conventional 24VAC non-communicating 2-stage heat pump thermostat, O terminal is not powered during the heating mode and the reversing valve is de-energized placing the unit in heating mode. A Y1 first stage compressor demand will initiate compressor operation and first stage indoor blower operation. The compressor will be controlled in the variable capacity mode by varying the compressor capacity to obtain the target liquid pressure set point. The Y2 second stage compressor demand will initiate second stage blower operation. Increased air volume will increase heat transfer on the indoor coil and decrease the liquid pressure. if the liquid pressure drops below the target setpoint, the compressor capacity will be increased. The compressor capacity will continue to be controlled based upon the liquid pressure. The unit capacity will be controlled in the variable capacity mode throughout the range of capacity from minimum capacity to maximum capacity. If the Y2 demand remains after 20 minutes, the control will begin to ramp up the compressor capacity until maximum capacity is achieved. The unit will cycle off once the thermostat demand is satisfied.

OUTDOOR UNITARY CONTROL - JUMPERS AND TERMINALS (Cont.)

Defrost Function

The outdoor unit control uses a time dependent frost accumulation duration demand defrost control algorithm to provide a demand defrost when the system falls below optimum levels. The demand defrost control algorithm is reactive based upon the previous heat pump run time between defrost cycles (frost accumulation time) and the time spent in defrost (defrost time). The outdoor unit control monitors ambient temperature, outdoor coil temperature, compressor run time in heating mode, and defrost cycle time. The outdoor unit control monitors compressor run time in the heating mode when the outdoor coil temperature is below 35°F and determines the frost accumulation time. Once the frost accumulation time is met the unit control will initiate a defrost cycle. The unit will run in the defrost mode until the coil temperature reaches the defrost termination temperature setpoint. The maximum length of defrost cycle is 14 minutes and the defrost cycle. will automatically be terminated if the defrost cycle exceeds 14 minutes. The coil temperature sensor is designed with a spring clip to secure the sensor to the electronic expansion valve (EEV) distributor. The location of the coil sensor is important for proper defrost operation (see **Figure 2** and **Figure 3** for the proper location of the coil sensor).

NOTE - The outdoor unit control accurately measures the performance of the system as frost accumulates on the outdoor coil. This typically translates into longer running time between defrost cycles as more frost accumulates on the outdoor coil before the outdoor control initiates defrost cycles.

DEFROST OPERATING MODES

The outdoor control has the following operational modes:
- Defrost calibration
- Operation
- Defrost test

FROST ACCUMULATION TIME

The frost accumulation time is the amount of time the heat pump runs in the heating mode when the outdoor coil temperature is below 35°F. The initial target frost accumulation time is 90 minutes, but the control will adjust the frost accumulation time higher or lower based upon the previous defrost cycle time history. If the defrost cycle time is short (80% or less of the defrost cycle time) the defrost accumulation time will be increased by 30 minutes. If the defrost cycle time is long (120% or more of the target defrost cycle time) the defrost accumulation time will be decreased by 30 minutes. If the defrost accumulation time is significantly longer (200% or more of the target defrost cycle time) or if the defrost terminates at the 14-minute maximum time, the frost accumulation time is set to 30 minutes. No change in the frost accumulation time is made if the frost accumulation time is close to the target defrost cycle time (between 80% and 120% of the target defrost cycle time).

LOW AMBIENT DEFROST

When outdoor temperature is less than 10ºF, the Frost Accumulation Time will be set to 360 minutes. When the outdoor temperature is extremely cold, there is less moisture in the air, which reduces the defrost frequency requirements. Setting the frost accumulation time to 360 minutes will reduce the defrost cycle frequency which will increase the overall system efficiency and minimize operation costs. The Low Ambient Defrost has adjustable parameters, allowing the technician to make adjustments for the special application and climate.

DEFROST CYCLE TIME

The defrost cycle time is the amount of time the unit operates in the defrost mode from the point the defrost cycle was initiated until the coil temperature reaches 50°F regardless of defrost termination temperature setpoint. The demand defrost control target defrost cycle time is unique for each NS21H heat pump model. The target defrost cycle time of the -024 model is 100 seconds, the -036 model is 133 seconds, the -048 model is 105 seconds, and the -060 model is 102 seconds.

DEFROST TERMINATION TEMPERATURES

The defrost termination setting selections are 50, 70, 90 and 100°F. The factory default setting is 50°F (10°C). The defrost termination temperature is monitored by the coil sensor which is located at the outlet of the outdoor expansion valve. See **Figure 16** for sensor location details.

NOTE - Colder climates may require a higher defrost termination temperature setting to ensure the outdoor coil is cleared of frost during defrost. If the outdoor coil is not adequately cleared of frost, the heat pump may experience reduced heating performance or damage to the outdoor coil from the buildup of ice on the coil.

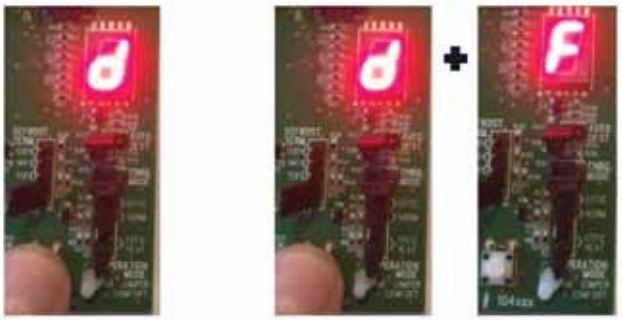
OUTDOOR UNITARY CONTROL - JUMPERS AND TERMINALS (Cont.)

DEFROST TEST

The defrost cycle can be tested for defrost diagnostic purposes or during service procedures to initiate a defrost cycle to clear the outdoor coil of frost or ice. The unit may be placed into a forced defrost mode by using the Outdoor Unitary Control push button. To Initiate a Forced Defrost Cycle Using the Unitary Control Push Button

1 - While the unit is operating in the heating mode, press push button until solid “-” is displayed to enter Field Test Mode and then release the button.

2 - Press and hold the button until “d” is displayed for forced defrost cycle, then release the button. Press the button again while the display is flashing “d” to select the forced defrost mode.



3 - The unit will enter a forced defrost cycle and “d” + “F” will be displayed on the 7-segment display.

4 - The 30-second Shift Delay will be observed. The compressor and outdoor fan will cycle off. After a 4-second delay, the reversing valve will be energized and will shift to the “cool” position. After a 26-second delay, the compressor will restart and will run at the maximum cooling speed in the defrost cycle to defrost the coil.

5 - Coil “C” and Ambient “A” temperature will be displayed on the 7-segment display.

THE FORCED DEFROST CYCLE WILL END WHEN ANY OF THE FOLLOWING CONDITIONS ARE MET:

- The defrost cycle will terminate upon reaching the defrost termination temperature setting set on the unitary control.
- Defrost cycle will terminate once the maximum allowable defrost time of 14 minutes has been reached.
- The defrost cycle will terminate after 10 seconds if the outdoor ambient temperature is 65°F or greater to prevent opening of the the high pressure switch.
- The unitary control push button is pressed to terminate the forced defrost cycle test.

Installation

OUTDOOR UNITARY CONTROL - JUMPERS AND TERMINALS (Cont.)

Table 6. Outdoor Control Terminal Designations and Inputs / Outputs

⚠WARNING Electric Shock Hazard. Can cause injury or death. Unit must be grounded in accordance with national and local codes. The 4 pins in P6 have the potential of transferring up to 250 volts to the unit cabinet ground.					
Designator		Description	Input	Output	Common
P6 - Pin 1	Tx	Transmit data to inverter, connects to Rx of inverter	Outdoor control communication transmit pin	– Pin 1 to pin 2 should read 4.5 to 5.55 VDC when not communicating – Pin 3 to pin 2 should read 4.5 to 5.55 VDC when not communicating – Pin 4 to pin 2 should read 4.5 to 5.5 VDC NOTE - Communication signals switch off and on rapidly. This may cause volt meter readings to fluctuate. This is normal. Communication signals will switch between this 5V and common (Pin 2).	
P6 - Pin2	Inverter Common	Inverter common **NOTE –** This is a signal reference point and not an earth ground.	Inverter common		
P6 - Pin 3	Rx	Receive data from the inverter Connects to Tx of inverter	Outdoor control communication receive pin		
P6 - Pin 4	Inv 5V	Inverter 5VDC volts	Inverter 5VDC volts		
DIS		Discharge Line temperature sensor supply	2.487k ohms to 336k ohms	N/A	N/A
DIS		Discharge Line temperature sensor return	2.487k ohms to 336k ohms	N/A	N/A
AMB		Outdoor ambient temperature sensor supply	2.487k ohms to 336k ohms	N/A	N/A
AMB		Outdoor ambient temperature sensor return	2.487k ohms to 336k ohms	N/A	N/A
COIL		Outdoor coil temperature sensor	2.487k ohms to 336k ohms	N/A	N/A
COIL		Outdoor coil temperature sensor	2.487k ohms to 336k ohms	N/A	N/A
Suction Pressure Out		Pressure transducer Supply Voltage Pin 1 of 3 5		VDC	
Suction Pressure In		Pressure transducer output voltage Pin 2 of 3	0.5-4.5	VDC	
Suction Pressure GND		Pressure transducer GND Pin 3 of 3			VDC Com
Liquid Pressure Out		Pressure transducer Supply Voltage Pin 1 of 3		5 VDC	
Liquid Pressure In		Pressure transducer Supply Voltage Pin 2 of 3	0.5-4.5 VDC		
Liquid Pressure GND		Pressure transducer GND Pin 3 of 3			VDC Com
SUCT1		Suction Line Temperature Sensor Supply - Pin 1 of 4	2.680k ohms to 327.3k ohms		
SUCT2		Suction Line Temperature Sensor Supply - Pin 2 of 4	2.680k ohms to 327.3k ohms		
LIQ1		Liquid Line Temperature Sensor Supply - Pin 3 of 4	2.680k ohms to 327.3k ohms		
LIQ2		Liquid Line Temperature Sensor Supply - Pin 4 of 4	2.680k ohms to 327.3k ohms		

OUTDOOR UNITARY CONTROL - JUMPERS AND TERMINALS (Cont.)

CHRG Mode

Charge Mode function. Can be used when charging, checking charge, pump down or checking unit operation. Unit will run at 100% capacity.

Conventional 24VAC heat pump thermostat - Cooling mode

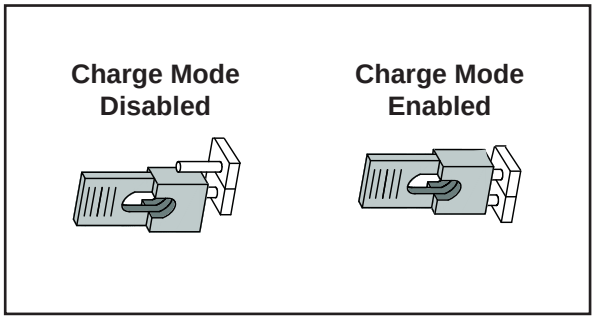
1. Provide a Y1 compressor demand and a O Reversing Valve signal to the unit.
2. Install the Charge Mode jumper (after the Y1 demand).
3. A blower demand must be provided to the indoor unit for 100% of the cooling air volume.
4. Remove the charge mode jumper to end the charge mode.

Conventional 24VAC Heat Pump Thermostat - Heating Mode

1. Provide a Y1 compressor heating demand (without an O demand).
2. Install the Charge Mode jumper (after the Y1 demand).
3. A blower demand must be provided to the indoor unit for 100% of the heating air volume.
4. Remove the charge mode jumper to end the charge mode.

NOTE - If the charge mode jumper is in the ON position during power-up, it is ignored.

NOTE - If the charge mode is left in place, it will be ignored after 60 minutes.



EEV AND CONTROLLER

Piping Assembly

The heat pump has an Electronic Expansion valve (EEV) and check valve assembly in the outdoor unit to control the system refrigerant flow in heat pump heating mode. The EEV precisely controls the refrigerant flow in the heating mode to optimize the unit heating performance. The EEV piping assembly consists of an EEV body, EEV coil assembly (powerhead), and check valve. See **Figure 17**. The EEV coil is controlled by the EEV control board.

Sensors

All units have two sensors for suction temperature. The suction temperature sensor located upstream of the main accumulator (labeled Compressor Suction Temperature Sensor in **Figure 16**) is connected to the Unitary Control Board. The suction temperature sensor located downstream of the main accumulator (labeled Compressor Suction Temperature Sensor) is connected to the EEV Control Board. See **Figure 16** and the Wiring Diagram in **Figure 25**.

Control Boards

The Unitary Control Board determines the system superheat by measuring the suction pressure and suction temperature. The system superheat is communicated to the EEV control board which will precisely control the valve position with up to 480 positions to maintain target superheat of 10°F. The EEV control board will drive the valve to a 40% open position upon compressor startup in heating mode. After a 60 second delay the EEV control will then begin to open or close the EEV in small increments to maintain the target superheat.

IMPORTANT - Allow EEV to stabilize 15-20 minutes before making charge adjustments based upon subcooling and super heat in the heating mode.

The Unitary Control Board communicates with the EEV Control Board via the RsBus (CAN Bus).

Via the RsBus, the Unitary Control board is able to read inputs, control outputs, and read diagnostic information from the EEV Control Board. The RsBus terminals used are C, I+, and I-. There is no R connection between the Unitary Control Board and the EEV Control Board. See **Figure 18** and **Figure 19** for connection locations on each board. Under normal operation, the CAN Status LED on the EEV Control Board should be blinking intermittently. See **Table 7** for a list of LED status signals.

Table 7. LED Status

LED	LED Status	Description
CAN LED (Green)	LED Flickers	Indicates RsBus Communication to the Unitary Control
	Off	No RsBus Communication between the EEV Controller and the Unitary Control
D10 Status LED (Green)	1s On, 1s Off	Normal Heartbeat of the EEV Controller Firmware
	Off	No Heartbeat

EEV AND CONTROLLER (Cont.)

NS21H EEV Alarm Codes

Alarm Code	Description
E480	The EEV control board has stopped communicating with the outdoor control. Heat pump heating operation stopped. Check EEV communication cable and EEV control board power.
E482	Compressor Suction Temperature Sensor has malfunctioned. Check temperature sensor resistance in the applicable Installation and Service Procedure Manual. Nominal resistance is 10K ohms at 77°F. Compressor speed limited to 70 hz.
E484	System EEV coil current too low. Heat pump operation can continue. Check system EEV coil connection to the EEV controller
E485	System EEV coil current too high. Heat pump heating operation stopped. Check system EEV coil connection to EEV controller
E486	System superheat below 3 degrees F for more than 10 minutes. Heat pump heating operation stopped.
E487	System superheat higher than 40 degrees F for more than 10 minutes. Heat pump heating operation stopped.

EEV Valve Coil

The valve coil is connected to the EEV body by sliding the coil over the valve body and turning the coil until the tab coil is locked into one of the five mating holes on the valve body. The EEV coil will drive the EEV valve open or closed in small increments up to 550 positions by pulsing the A, B, A- and B- in sequence to create a rotating action of the EEV valve stepper motor.

EEV AND CONTROLLER (Cont.)

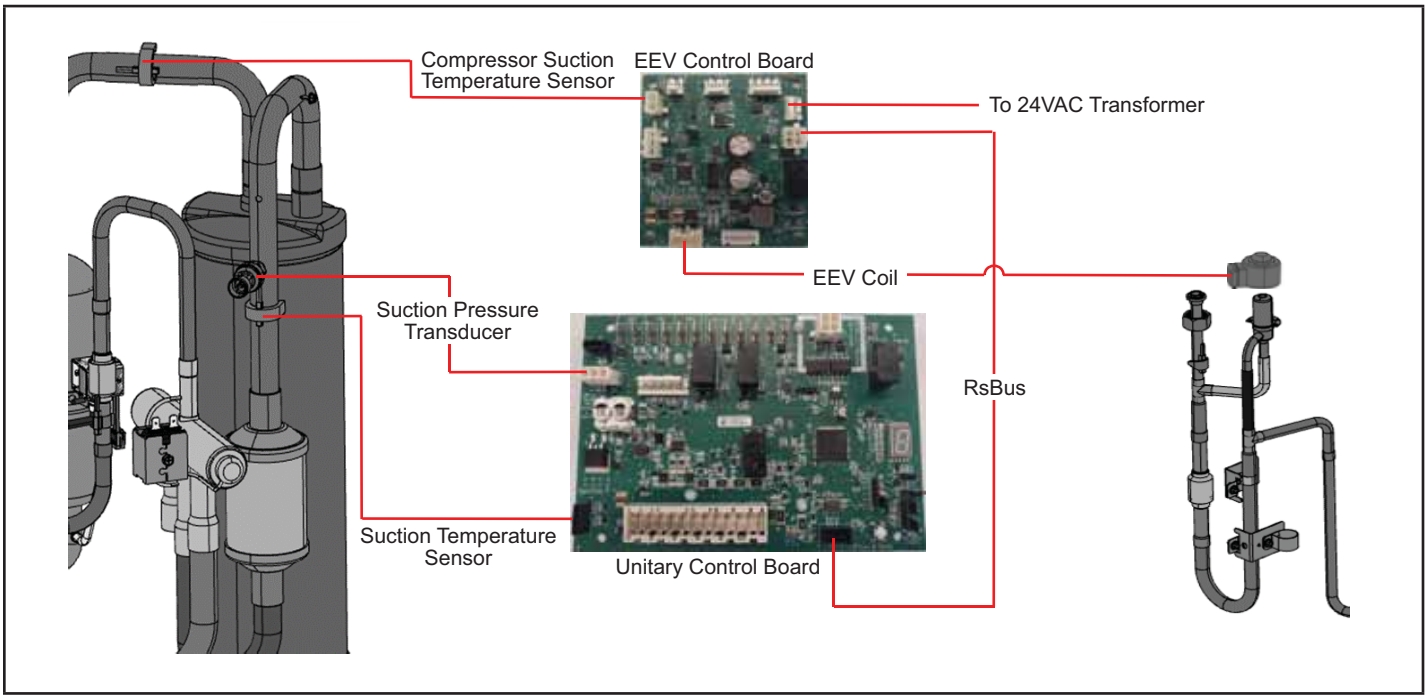


Figure 16. EEV Sensor Locations

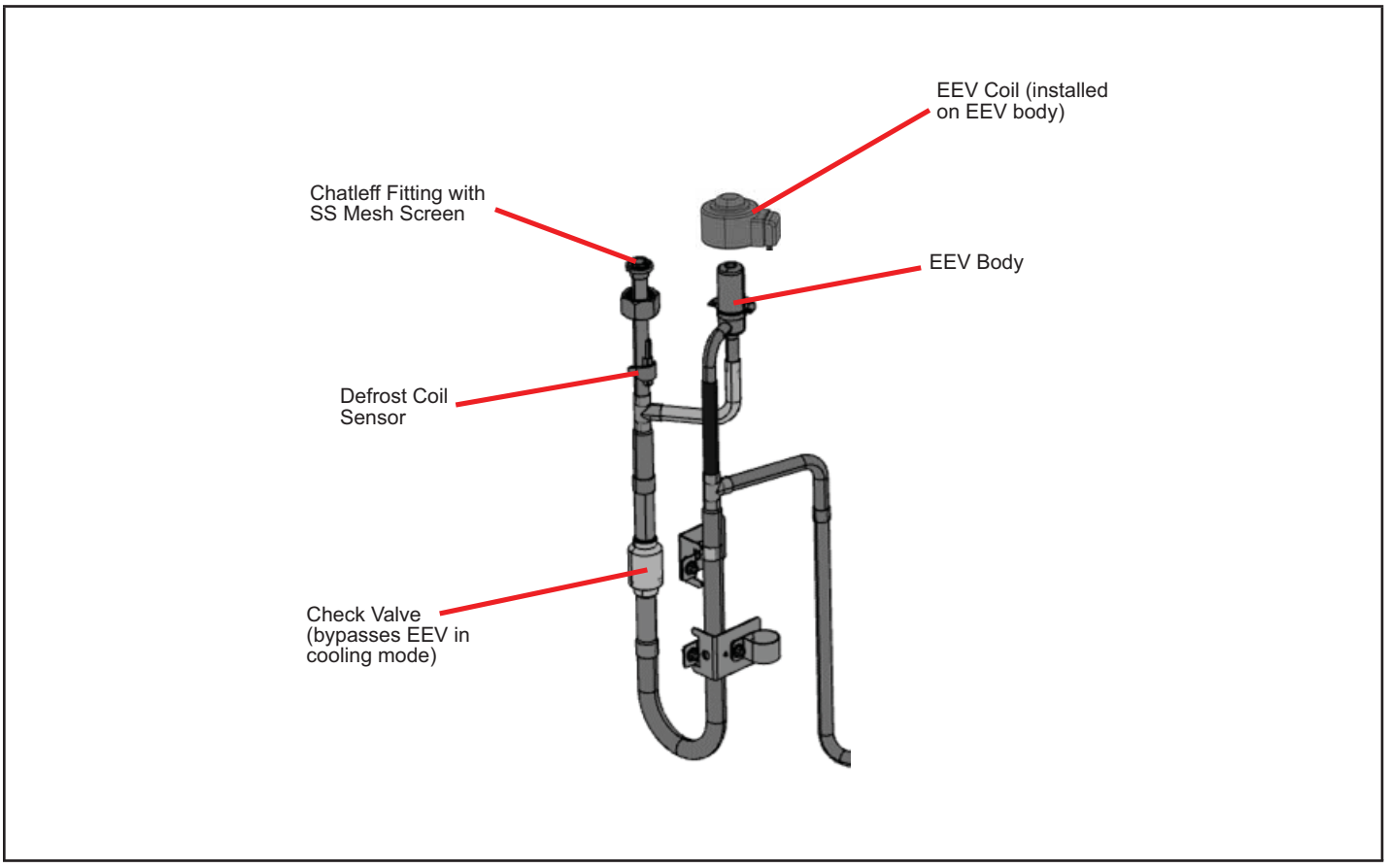


Figure 17. EEV Piping Assembly

EEV AND CONTROLLER (Cont.)

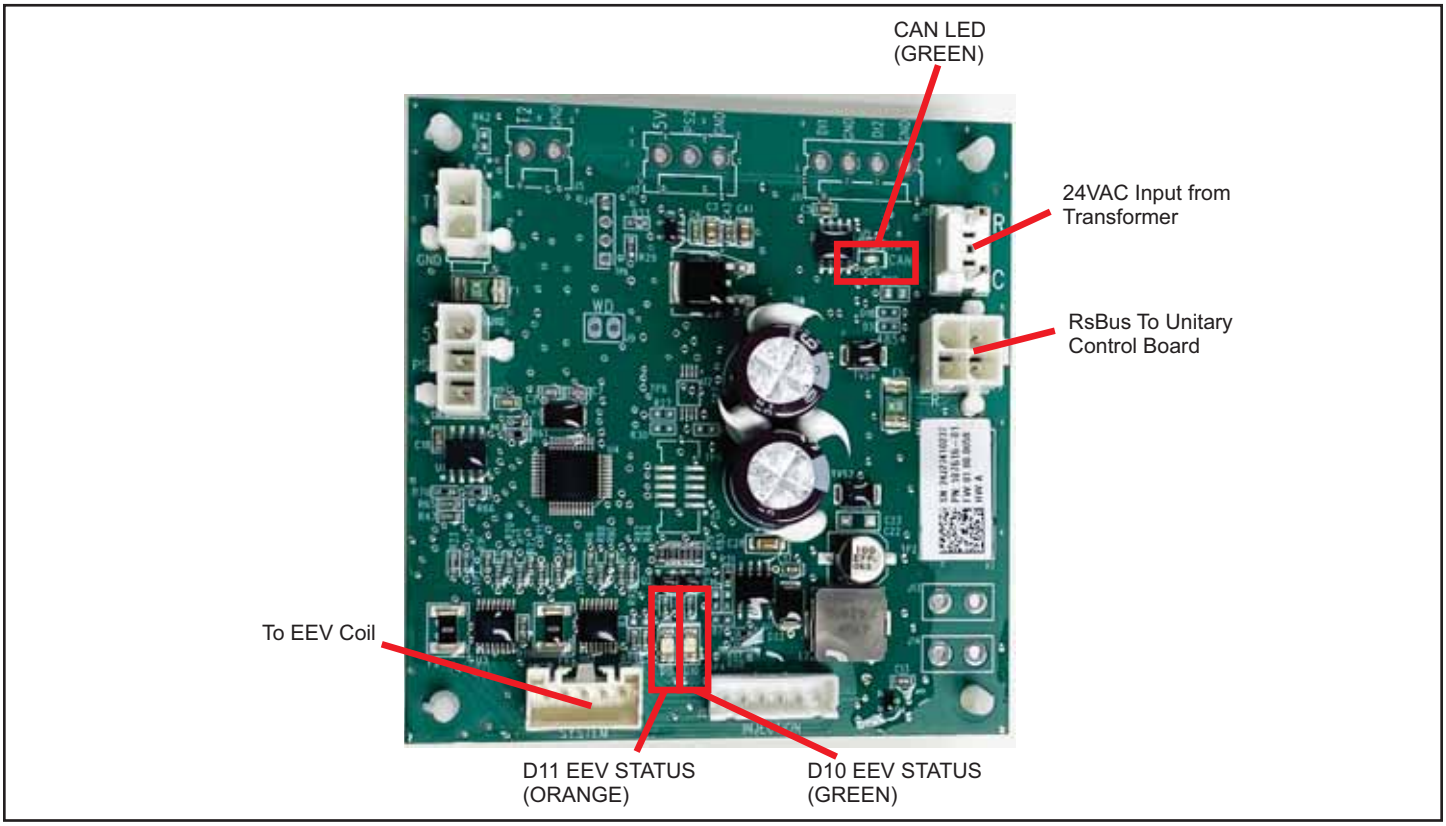


Figure 18. EEV Control Board Detail

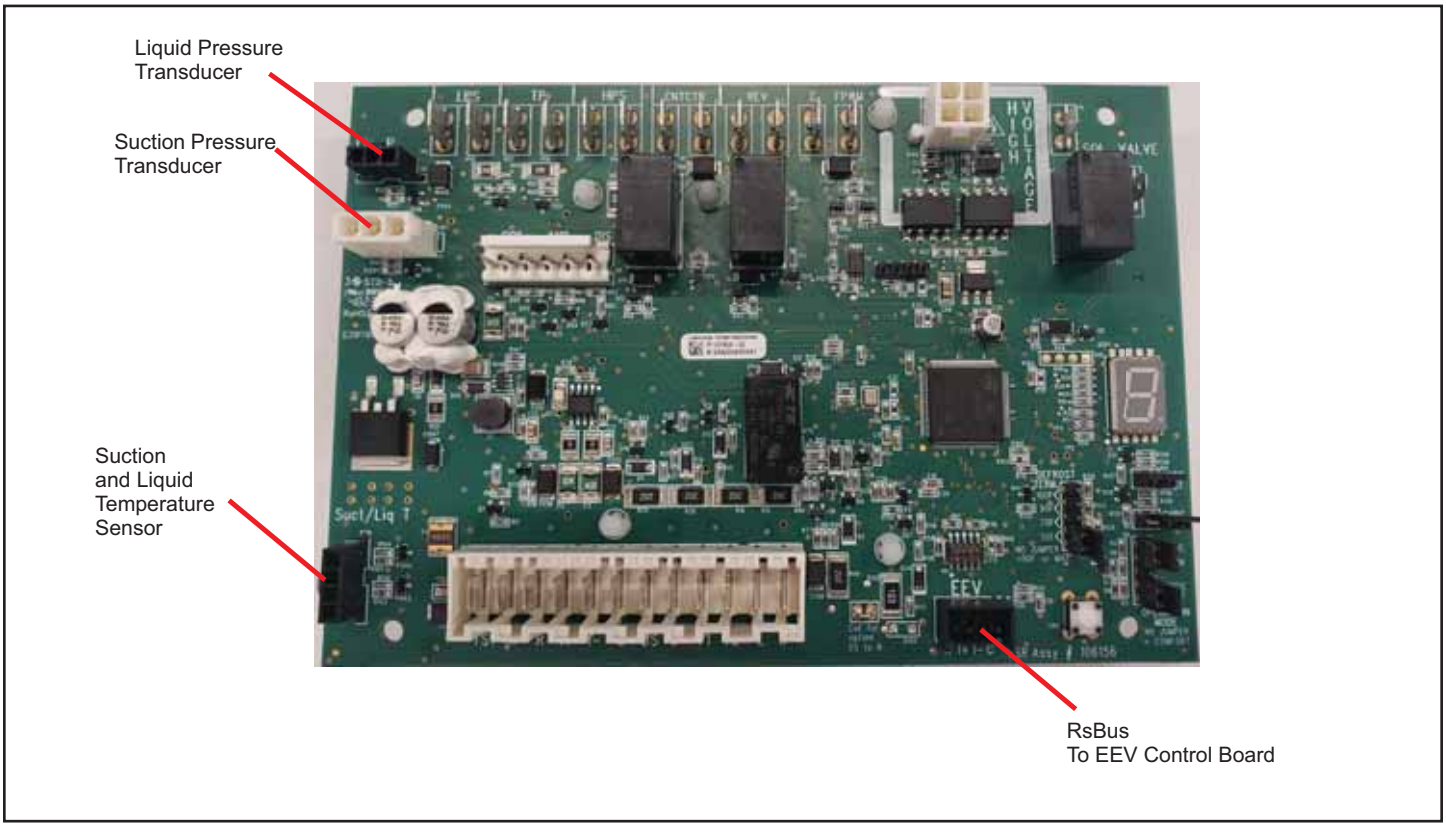


Figure 19. Unitary Control Board Detail

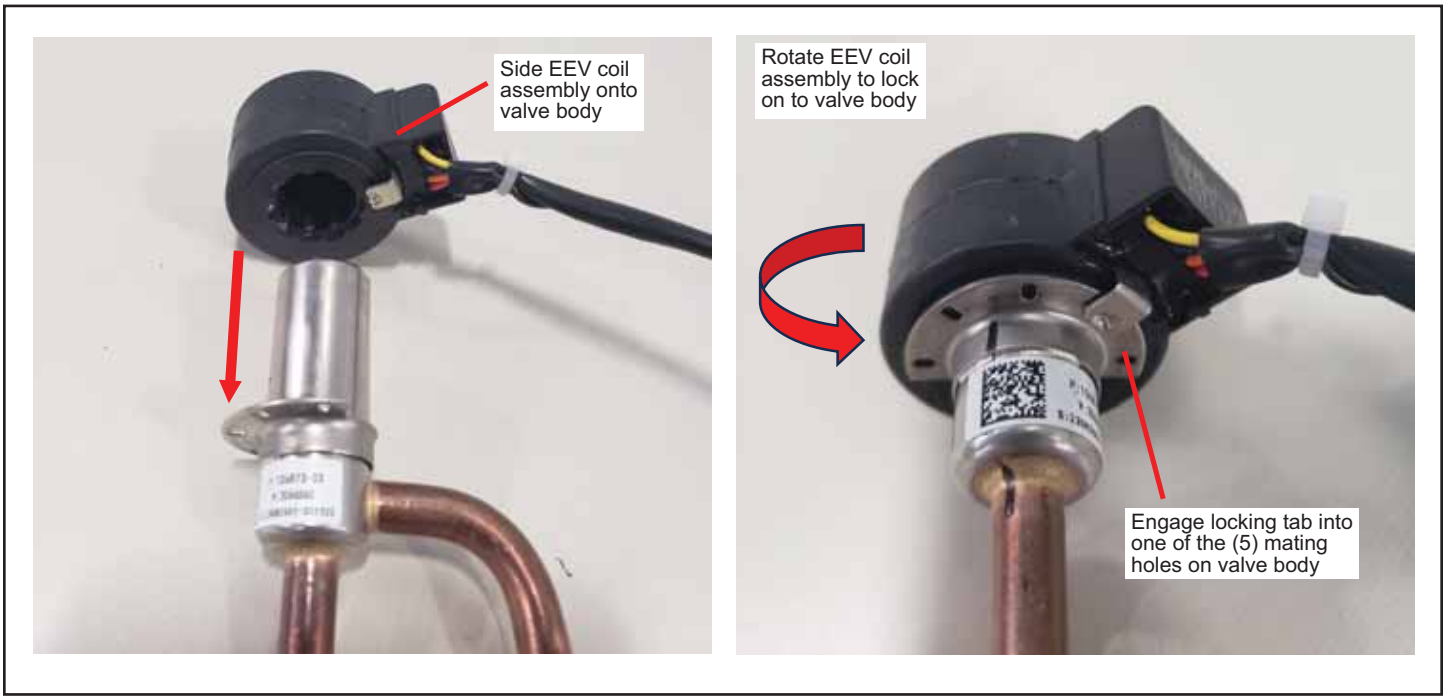
EEV AND CONTROLLER (Cont.)

EEV Transformer

The dedicated EEV transformer is located in the control panel. The transformer provides 24VAC to the EEV control board any time 230V power is supplied to the unit.

EEV Coil

The valve coil is connected to the EEV body by sliding the coil over the valve body and turning the coil until the coil tab is locked into one of the five mating holes on the valve body. The EEV coil will drive the EEV valve open or closed in small increments up to 480 positions by sequenced pulses to create a rotating action of the EEV stepper motor. The resistance measured between each EEV coil wire and COM should be approximately 40 to 50 ohms.



EEV Coil Detail

UNIT START-UP

⚠IMPORTANT If unit is equipped with a crankcase heater, it should be energized 24 hours before unit start-up to prevent compressor damage as a result of slugging.

1. Rotate fan to check for binding.
2. Inspect all factory- and field-installed wiring for loose connections.
3. After evacuation is complete, open both the liquid and vapor line service valves to release the refrigerant charge contained in outdoor unit into the system.
4. Replace the stem caps and tighten to the value listed in **Table 1**.
5. Check voltage supply at the disconnect switch. The voltage must be within the range listed on the unit's nameplate. If not, do not start the equipment until you have consulted with the power company and the voltage condition has been corrected.
6. Set the thermostat for a cooling demand. Turn on power to the indoor unit and close the outdoor unit disconnect switch to start the unit.
7. Recheck voltage while the unit is running. Power must be within range shown on the nameplate.
8. Check system for sufficient refrigerant by using the procedures listed

7-SEGMENT ALERT AND SYSTEM STATUS CODES

Alert codes are displayed using the 7-segment display located on the outdoor control.

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification).

The 7-segment will display an abnormal condition (error code) when detected in the system. A list of the codes are shown in **Table 9**.

Resetting Alert Codes

Alert codes can be reset manually or automatically:

1 - Manual Reset

Manual reset can be achieved by one of the following methods:

- Disconnecting R wire from the outdoor control R terminal.
- Turning the indoor unit off and back on again

After power up, all currently displayed codes are cleared.

9 - Automatic Reset

After an alert is detected, the outdoor control continues to monitor the unit's system and compressor operations. When/if conditions return to normal, the alert code is turned off automatically.

NOTE - Error codes can be recalled by following information shown in the last column.

Table 9. Outdoor Control 7-Segment Display Alert Codes and Inverter LED Flash Codes

NOTE – System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed.

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
N/A	N/A	ON	OFF	N/A	NS21H24, 36 only: Indicates inverter is operating normally.	
N/A	N/A	ON	OFF	N/A	NS21H48, 60 only: Indicates inverter is operating normally.	
N/A	N/A	OFF	OFF	N/A	Indicates inverter is NOT energized.	
E105	N/A	N/A	N/A	Service Soon	Wiring issue	- - -
E120	N/A	N/A	N/A	Service Soon	There is a delay in the outdoor unit responding to the system.	Typically, this alarm/code does not cause any issues and clears on its own. The alarm/code is usually caused by a delay in the outdoor unit responding to the thermostat. Check all wiring connections. Cleared after unresponsive device responds to any inquiry.
E125	N/A	N/A	N/A	Service Urgent	There is a hardware problem with the outdoor control.	There is a control hardware problem. Replace the outdoor control if the problem prevents operation and is persistent. The alarm / fault is cleared 300 seconds after the fault recovers.
E131	N/A	N/A	N/A	Service Urgent	The outdoor unit control parameters are corrupted.	Reconfigure the system. Replace the control if heating or cooling is not available.
E132	N/A	N/A	N/A	Service Urgent	Internal software error.	Replace outdoor control.
E180	N/A	N/A	N/A	Service Urgent	The outdoor unit ambient temperature sensor has malfunctioned. As a result the outdoor unit control will not perform low ambient cooling.	Valid temperature reading is lost during normal operation and after outdoor control recognized sensors. Compare outdoor sensor resistance to temperature/ resistance charts in unit installation instructions. Replace sensor pack if necessary. At the beginning of (any) configuration, furnace or airhandler control detects the presence of the sensor(s). The alarm / fault clears upon configuration, or when normal values are sensed.
E181	N/A	N/A	N/A	Service Soon	Suction pressure transducer fault.	Suction pressure transducer is out of range. The signal should be between 0.5 VDC and 4.5 VDC between blue and black. The error code will be cleared when proper signal is provided. System controlled by a conventional 24VAC heat pump thermostat will operate in the staged mode.
E182	N/A	N/A	N/A	Service Soon	Suction temperature sensor has malfunctioned.	Check temperature sensor in the applicable installation and service procedure. Nominal resistance is 10K Ohms at 77F.
E183	N/A	N/A	N/A	Service Soon	Liquid Pressure Transducer Fault	Liquid pressure transducer is out of range. The signal should be between 0.5 VDC and 4.5 VDC between Blue and Black. The error code will be cleared when the proper signal is provided. Systems controlled by a conventional 24VAC heat pump thermostat will operate in stage mode
E184	N/A	N/A	N/A	Service Soon	Faulty outdoor liquid line sensor	Sensor is open or shorted. Replace the sensor.
E186	N/A	N/A	N/A	Service Soon	Discharge temperature too low	Discharge temperature reading too low. Heat pump heating operation can continue. Check discharge temperature sensor location and verify the sensor is secure on the discharge line.
E187	N/A	N/A	N/A	Service Soon/ Service Critical	Discharge temperature/ pressure too high	Discharge temperature or pressure ratio exceeded upper limit. Heat pump heating stopped.

7-SEGMENT ALERT AND SYSTEM STATUS CODES (Cont.)

Table 9. Outdoor Control 7-Segment Display Alert Codes and Inverter LED Flash Codes

NOTE – System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed.

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
E345	N/A	N/A	N/A	Service Urgent	Heat Pump or Air Conditioner Alert Code - The “O” relay on the outdoor board has failed.	Either the pilot relay contacts did not close or the relay coil did not energize the circuit which confirms this operational sequence is not sensing properly.
E409	N/A	N/A	N/A	Service Soon	Outdoor control secondary voltage is 18VAC or less.	Secondary voltage is below 18VAC. After 10 minutes, operation is discontinued. Check the indoor line voltage and transformer output voltage. The alarm clears after the voltage is higher than 20VAC for 2 seconds or after a power reset.
E410	N/A	N/A	N/A	Service Soon	The outdoor unit cycled off due to low suction pressure.	Unit pressure is below the lower limit. The system is shut down. The suction pressure transducer emulates a low pressure switch, the unit does not have a low pressure switch. The cut-out is set at 35 PSIG and the cut-in set at 80 PSIG. Confirm that the system is properly charged with refrigerant. Check TXV, indoor unit blower motor, dirty filters or clogged refrigerant filter. Confirm that the evaporator coil is clean. The alarm clears after the pressure rises above 80 PSIG.
E411	N/A	N/A	N/A	Service Urgent	The low pressure fault has occurred 5 times within one hour. As a result, the outdoor unit is locked out.	Low pressure fault error count reached 5 strikes. The low pressure cut-out is at 35 PSIG and resets at 80 PSIG. Confirm that the system is properly charged with refrigerant. Check for clogged TXV, blockage to indoor unit blower motor, dirty filters or clogged refrigerant filter. Confirm that the evaporator coil is clean. The alarm clears after a power reset.
E412	N/A	N/A	N/A	Service Soon	The outdoor unit high pressure switch has opened.	Unit pressure is above the upper limit. System is shut down. The high pressure switch opens at 590 PSIG and closes at 418 PSIG. Confirm that the system is properly charged with refrigerant. Check for clogged TXV, blockage to indoor unit blower motor, clogged refrigerant filter. Confirm that the outdoor unit is clean. The alarm clears after the pressure switch closes or a power reset. For heating, indoor CFM may be set too low. For zoning system, zone CFM may be set too low.
E413	N/A	N/A	N/A	Service Urgent	The high pressure switch has opened 5 times within one hour. As a result, the outdoor unit is locked out.	Open high pressure switch error count reached 5 strikes. System is shut down. The high pressure switch for R454B opens at 590 PSIG and closes at 418 PSIG. Confirm that the system is properly charged with refrigerant. Check condenser fan motor, for clogged TXV, for blockage to indoor unit blower motor, for stuck reversing valve or clogged refrigerant filter. Confirm that the outdoor unit is clean. The alarm clears after a power reset. For heating, indoor CFM may be set too low. For zoning system, zone CFM may be set too low.
E416	N/A	N/A	N/A	Service Soon / Service Urgent	The outdoor coil sensor has malfunctioned.	Unit has a fixed 10K ohm resistor installed on the harness connector between pins 5 & 6. Check connections on pins 5 & 6 and check for resistance of 10K ohms. Error code will occur on open or shorted circuit.
E422	N/A	N/A	N/A	Service Soon	Compressor top cap switch exceeding thermal limit.	The top of the compressor is hot. Refrigerant charge may be low, or low mass flow of refrigerant. Check TXV, clogged filter drier, condenser fan motor, indoor blower motor, confirm indoor coil is clean.
E423	40	4 flashes	OFF	Service Soon / Service Urgent	The inverter has detected a circuit problem.	Control locks out after 10 strikes within an hour. To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter, and then re-apply power.
E424	N/A	N/A	N/A	Service Soon	The liquid line temperature sensor has malfunctioned.	Check connections between pin 3 and 4 of the four pin liquid/ suction temperature plug on the bottom left corner of the control. Check resistance of resistor. Nominal 10K Ohms at 77F. Error code occurs if sensor is open or shorted.
E425	N/A	N/A	N/A	Information Only	Outdoor control has increased minimum compressor speed to allow for proper oil return due to low ambient temperature. **NOTE -** Minimum speed adjustments begin at 45°F and increase to 100% minimum at 17°F.	Outdoor ambient temperature is below system limit. Control attempts to run at lowest allowed compressor speed to allow for proper oil return. Automatically clears when outdoor ambient temperature rises above limit for more than 5 minutes.

7-SEGMENT ALERT AND SYSTEM STATUS CODES (Cont.)

Table 9. Outdoor Control 7-Segment Display Alert Codes and Inverter LED Flash Codes

NOTE – System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed.

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
E427	21	2 flashes	1 flash	Service Soon / Service Urgent	The inverter has detected a DC peak fault condition. If condition (55A or higher) is detected, outdoor unit compressor and fan stop. Anti-short cycle is initiated. If peak current (55A or higher) occurs 10 times within an hour, system is locked out. Indicates high pressure, condenser fan failure, locked compressor rotor or overcharge. To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter and then re-apply power	
E428	22	2 flashes	2 flashes	Service Soon / Service Urgent	The inverter has detected a high main input current condition.	If condition is detected, outdoor unit compressor and fan stop. Antishort cycle is initiated. If condition occurs 5 times within an hour, the Unitary Control will cycle the contactor to prevent the unit from locking out. Indicates high pressure, condenser fan failure or overcharge. To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter and then re-apply power.
E429	23	2 flashes	3 flashes	Service Soon / Service Urgent	On a call for compressor operation, if DC link power in inverter does not rise above 180 VDC for 2 and 3 ton models, 250 VDC for 4 and 5 ton models, within 30 seconds, the control will display a Service Soon code. If condition is detected, outdoor unit will stop (Compressor and fan). Antishort cycles is initiated. If condition occurs 10 times within a 60 minute rolling time period, system will lock out and display a Service Urgent code.	**Issues:** (1) If DC link power in inverter does not rise above 180 VDC for 2- and 3-ton models, 250 VDC for 4- and 5-ton models, within 30 seconds, the outdoor control will display a Service Soon code. (2) Capacitors on inverter do not properly charge. **Corrective Actions:** (1) Check for proper main power to outdoor unit and for any loose electrical connections.
E430	26	2 flashes	6 flashes	Service Soon / Service Urgent	Compressor start failure	If condition is detected, outdoor unit compressor and fan stop. Antishort cycle is initiated. If condition occurs 10 times within an hour, system is locked out. Indicates poor connection at compressor harness, improper winding resistance, locked compressor rotor, or flooded compressor. To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter and then re-apply power.
E431	27	2 flashes	7 flashes	Service Soon / Service Urgent	Error occurs when PFC detects an over-current condition of 100A, the control will display a Service Soon code. If condition is detected, outdoor unit will stop (Compressor and fan). Anti-short cycle is initiated. Inverter is unavailable to communicate with the outdoor control for 3 minutes. If condition occurs 10 times within a 60 minute rolling time period, system will lock out and display a Service Urgent code.	**Issues:** (1) Indicates power interruption, brownout, poor electrical connection or loose inverter input wire. (2) System testing was set up and code was generated when the reversing valve is de-energized coming out of defrost (code appears with or without 30 compressor delay). **Corrective Actions:** (1) Check for proper main power to outdoor unit and for any loose electrical connections. (2) To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter and then re-apply power.
E432	28	2 flashes	8 flashes	Service Soon / Service Urgent	The inverter has detected a DC link high voltage condition	Error occurs when the DC link capacitor voltage is greater than 480VDC. If condition is detected, outdoor unit compressor and fan stop. Anti-short cycle is initiated. If condition occurs 10 times within an hour, system is locked out. System stops. To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter and then re-apply power.

7-SEGMENT ALERT AND SYSTEM STATUS CODES (Cont.)

Table 9. Outdoor Control 7-Segment Display Alert Codes and Inverter LED Flash Codes

NOTE – System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed.

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
E433	29	2 flashes	9 flashes	Service Soon / Service Urgent	The inverter has detected a compressor over-current condition.	Error occurs when compressor peak phase current is greater than 28A. Inverter issues code 14 first and slows down to try to reduce the current. If the current remains high, outdoor unit compressor and fan stop. Anti-short cycle is initiated. If condition occurs five times within an hour, the Unitary Control will cycle the contactor to prevent the unit from locking out. To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter and then re-apply power.
E434	53	5 flashes	3 flashes	Service Soon / Service Urgent	Outdoor control has lost communications with the inverter for greater than 3 minutes. Outdoor unit will stop all compressor demand. Outdoor control will attempt to establish communication multiple times and will automatically clear when the error clears. Unit will lock out after 60 minutes if communication is not established and will display a Service Urgent error code.	**Issues:** (1) Outdoor disconnect is off or outdoor power is off, when indoor power is on (source for 24VAC) (2) Loose electrical power connections (3) Interruption of main power to the inverter (4) Generator powers indoor unit, but not the outdoor unit. **Corrective Actions:** (1) To reset, cycle the indoor power off (source of 24VAC to outdoor unit) and back on. This will de-energize outdoor control and inverter by cycling the contactor. (2) Make sure the disconnect is on (3) Check electrical power supply connections (4) Check for proper main 230V power supply
E435	60	6 flashes	OFF	Service Soon / Service Urgent	Inverter internal error	When this error occurs, the outdoor control cycles power to the inverter by opening the contactor for two minutes. Check that the EEPROM is properly seated. After power is cycled to the inverter 3 times, the outdoor unit is locked out. If problem persists, replace the inverter.
E436	62	6 flashes	2 flashes	Service Soon / Service Urgent	Inverter heat sink temperature exceeded limit. Occurs when the heat sink temperature exceeds the inverter limit. Inverter issues code 13 first, then slows down to allow the heat sink to cool. If temperature remains high, outdoor unit stops (compressor and fan). Anti-short cycle is initiated. If condition occurs 5 times within an hour, the Unitary Control will cycle the contactor to prevent the unit from locking out. To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter and then re-apply power.	**Issue:** This error may occur if the outdoor fan fails to operate or the inverter heat sink is obstructed with debris. Feedback from supplier tear down of inverter indicates that the screws that hold the inverter to the inverter board were loose causing poor contact between these two components. **Corrective Action:** Tighten screws that hold the heat sink to the inverter control board. **NOTE:** Wait five minutes to allow capacitor to discharge before checking screws.
E437	65	6 flashes	5 flashes	Service Soon / Service Urgent	Heat sink temperature sensor fault has occurred (temperature less than 4ºF or greater than 264ºF after 10 minutes of operation).	Occurs when the temperature sensor detects a temperature less than 0.4ºF or greater than 264ºF after 10 minutes of operation. If condition is detected, outdoor unit will stop (compressor and fan). Anti-short cycle is initiated. If condition occurs 5 times within an hour, system will lock out. To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter and then re-apply power. If problem persists, replace inverter.

7-SEGMENT ALERT AND SYSTEM STATUS CODES (Cont.)

Table 9. Outdoor Control 7-Segment Display Alert Codes and Inverter LED Flash Codes

NOTE – System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed.

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
E438	73	7 flashes	3 flashes	Service Soon / Service Urgent	The inverter has detected a PFC over current condition. This would be caused by a high load condition, high pressure, or outdoor fan failure. Outdoor control will display the code when the inverter has the error. After 3 minutes, the inverter will reset and the compressor will turn on again. If it happens 10 times within a 60 minute rolling time period, the OD control will lock out operation of the outdoor unit and display a Service Urgent code.	Issue: Possible issue is system running at high pressures. Check for high pressure trips or other alert codes in room thermostat and outdoor control. To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter and then re-apply power.
E439	12	1 flash	2 flashes	Information Only - Dealer	Compressor slowdown due to high input current.	This error code is primarily for informational purposes as the inverter controls the compressor to operate within design parameters. Typically the inverter will make a minor speed reduction of 4 Hz (approximately a 5-6% speed reduction) for a brief period of time and to reduce the input current and will then resume normal operation.
E440	13	1 flash	3 flashes	Information Only - Dealer	Heat sink temperature is approaching limit. The compressor speed automatically slows to reduce heat sink temperature. The control sets indoor CFM and outdoor RPM to values according to demand percentage rather than the actual Hz. Alarm is automatically cleared.	This error code is primarily for informational purposes as the inverter controls the compressor speed to operate within design parameters. Typically the inverter will make a minor speed reduction of 4 Hz (approximately a 5-6% speed reduction) for a brief period of time and to reduce the heat sink temperature and will then resume normal operation. This may occur at high outdoor temperatures (above 110ºF) for brief periods of time (3 – 4 minutes) and is normal and expected operation of the inverter controlling the compressor safely within design parameters. The inverter finned aluminum heat sink is located on the back side of the inverter in the condenser air stream. f the alert code 440 occur frequently, especially at lower outdoor temperatures, check the heat sink for debris that may reduce heat transfer or possible obstructions that may impact air flow across the heat sink. The inverter will begin to briefly reduce the compressor speed when the heat sink temperature rises above 167ºF and will allow the inverter to resume the requested compressor demand speed once the inverter heat sink reaches 150ºF.
E441	14	1 flash	4 flashes	Information Only - Dealer	Compressor slowdown due to high compressor current. Compressor current is approaching limit. The compressor speed automatically slows. The control sets indoor CFM and outdoor RPM to values according to demand percentage rather than the actual Hz. Alarm is automatically cleared.	This error code is primarily for informational purposes as the inverter controls the compressor to operate within design parameters. Alert code 441 typically occurs at startup as the compressor as the currently increases rapidly during startup. The inverter will reduce the compressor speed by 4 hz and slow the compressor ramp up speed to the requested compressor demand (capacity). This is normal and expected operation of the inverter to control the compressor within design parameters. In most cases the alert code 441 does not require any additional service or diagnostic procedures. E441 may also occur if the system is operating at high pressures.
E442	N/A	N/A	N/A	Service Urgent	The top cap switch has opened five times within one hour. As a result, the outdoor unit is locked out.	When compressor thermal protection sensor opens five times within one hour, outdoor stops working. To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter and then re-apply power.
E443	N/A	N/A	N/A	Service Urgent	Incorrect appliance unit size code selected.	Check for proper configuring of unit size codes for outdoor unit in configuration guide or in installation instructions. If replacing inverter, verify inverter model matches unit size. The alarm/ fault clears after the correct match is detected following a reset. Remove the thermostat from the system while applying power and reprogramming.

7-SEGMENT ALERT AND SYSTEM STATUS CODES (Cont.)

Table 9. Outdoor Control 7-Segment Display Alert Codes and Inverter LED Flash Codes

NOTE – System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed.

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
E444	N/A	N/A	N/A	N/A	Reversing valve position does not match the position commanded by the outdoor control. Verify reversing valve wiring connections are secure.	
E480	N/A	N/A	N/A	N/A	The EEV control board has stopped communicating with the outdoor control. Heat pump heating operation stopped. Check EEV communication cable and EEV control board power.	
E482	N/A	N/A	N/A	N/A	Compressor Suction Temperature sensor has malfunctioned. Check temperature sensor resistance in the applicable Installation and Service Procedure Manual. Nominal resistance is 10K ohms at 77°F. Compressor speed limited to 70 hz.	
E484	N/A	N/A	N/A	N/A	System EEV coil current too low. Heat pump operation can continue. Check system EEV coil connection to the EEV controller.	
E485	N/A	N/A	N/A	N/A	System EEV coil currrent too high. Heat pump heating operation stopped. Check system EEV coil connection to the EEV controller.	
E486	N/A	N/A	N/A	N/A	System superheat below 3 degrees F for more than 10 minutes. Heat pump heating operation stopped.	
E487	N/A	N/A	N/A	N/A	System superheat higher than 40 degrees F for more than 10 minutes. Heat pump heating operation stopped.	
E600	N/A	N/A	N/A	N/A	Compressor has been cycled OFF on utility load shedding (24VAC power applied to L and C terminals).1	
E601	N/A	N/A	N/A	N/A	Outdoor unit has been cycled OFF on low temperature protection.1	
E600	N/A	N/A	N/A	Information Only - Dealer	Compressor has been cycled OFF on utility load shedding.	Load shedding function: Provides a method for a local utility company to limit the maximum power level usage of the outdoor unit. The feature is activated by applying 24 volts AC power to the L and C terminals on the outdoor control.
E601	N/A	N/A	N/A	Information Only - Dealer	Outdoor unit has been cycled OFF on low temperature protection.	Low temperature protection: Outdoor unit will not operate when the outdoor temperature is at or below -4°F (-20°C). If the unit is operating and the outdoor temperature drops below -4°F (-20°C), the unit continues to operate until the room thermostat is satisfied or the outdoor temperature drops to -15°F (-26°C). Outdoor unit ambient sensor provides temperature readings.

7-SEGMENT ALERT AND SYSTEM STATUS CODES (Cont.)

POWER-UP / RESET:

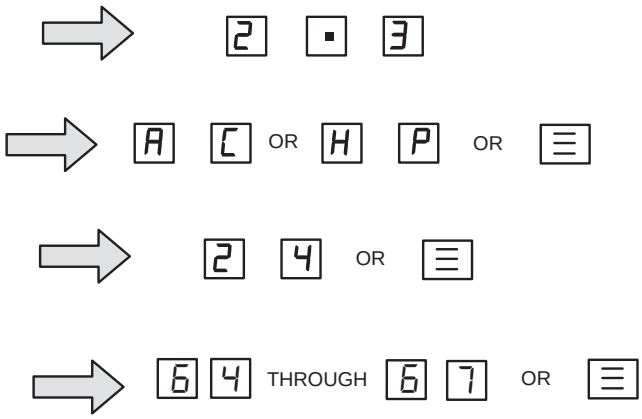
FIRMWARE VERSION: During initial power-up or reset, the first item displayed is the outdoor control firmware version. Example to the right shows firmware version 2.3.

UNIT TYPE: The next item displayed is the self discovery unit type. AC = air conditioner and HP = heat pump. If the unit type cannot be determined, three bars appear.

UNIT NOMINAL CAPACITY: The next item to be displayed is the self-discovery unit nominal capacity. Valid capacities are 24 for 2-ton, 36 for 3-ton, 48 for 4-ton and 60 for 5-ton units. If the unit type cannot be determined, three bars appear.

UNIT CODE: The next item to be displayed is the self discovery unit code. (may be a single character or two characters). If the unit code cannot be determined, three bars appear.

7-SEGMENT POWER-UP DISPLAY STRING



(These are just examples of firmware version, unit type, unit nominal capacity and unit codes.)

UNIT CODE	UNIT TYPE, SIZE AND MODEL	
	NOT PROGRAMMED	
64	2-TON HEAT PUMP	NS22HM-24
65	3-TON HEAT PUMP	NS22HM-36
66	4-TON HEAT PUMP	NS22HM-48
67	5-TON HEAT PUMP	NS22HM-60

7-SEGMENT POWER-UP DISPLAY STRING EXAMPLE

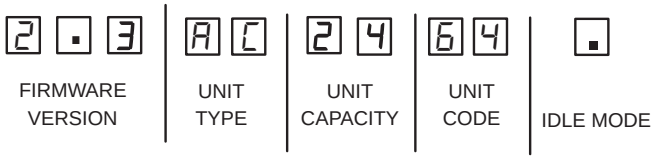


Figure 20. Outdoor Control 7-Segment Unit Status Displays

7-SEGMENT ALERT AND SYSTEM STATUS CODES (Cont.)

Table 10. Outdoor Control 7-Segment Unit Status Displays

Description	Example of Display
Idle Mode: Decimal point flashes at 1 Hz.	**Idle Mode**: Decimal point flashes at 1 Hz (0.5 second on, 0.5 second off). Display OFF.
Soft Disable Mode: Top and bottom horizontal line and decimal point flash at 1 Hz. If indoor or outdoor control displays Soft Disable code: 1) Confirm proper wiring between all devices (thermostat, indoor and outdoor). 2) Cycle power to the control that is displaying the Soft Disable code. 3) Put the room thermostat through Setup. 4) Go to Setup/System Devices/Thermostat/Edit/push Reset. 5) Go to Setup/System Devices/Thermostat/Edit/push Reset All. If the room thermostat detects a new device or a device that is not communicating, it sends a Soft Disable. When this occurs, Alarm 10 is activated and the room thermostat sends a Soft Disable command to the offending device on the bus (outdoor control, IFC, AHC, EIM or Damper Control Module).	**Soft Disable Mode:** Top and bottom horizontal line and decimal point flash at 1 Hz (0.5 second on, 0.5 second off). The control in Soft Disable Mode is indicated by the following: • On AHC, IFC and outdoor controls, Soft Disable Mode is indicated by flashing double horizontal lines on the 7-segment display. • On the Damper Control Module and EIM, the green LED will blink 3 seconds on and 1 second off.
O.E.M. Test Mode	All segments flashing at 2 Hz (unless error is detected). NOTE - Control should be replaced.
Anti-Short-Cycle Delay	The middle line flashes at 1 Hz for 2 seconds, followed by a 2-second display of the number of minutes left on the timer (value is rounded up: 2 min. 1 sec. is displayed as 3). If activated, the anti-short cycle delay time remaining is displayed (default is 300 sec./5 min.).
Cooling Capacity: Shows cooling stage C1 or C2 operating if non-communicating.	Cooling compressor capacity (1 second on, 0.5 second off) followed by ambient temperature. Non-Communicating thermostat with second stage cooling active and ambient of 95°F : C 2 pause A 9 5 repeat.
Diagnostic recall: Shows the last 10 stored diagnostic error codes.	If first error is E 2 5 0, second E 2 3 1 pause E 2 5 0 pause E 2 3 1 Next codes (up to 10) are shown using same method.
Fault memory clears	If there are no error codes stored: E pause 0 0 0. After the fault memory is cleared, the following string flashes every 0.5 seconds: 0 0 0 0 pause
Active error in outdoor control Idle mode: Show all active error(s) codes.	Following display string is repeated if Error E 125 and E 201 are present: E 1 2 5 pause E 2 0 1
Active error in run mode: Show current status and all active error(s) codes.	Following display string is repeated if Error E 440 is present while cooling demand is 80 percent: C 8 0 pause E 4 4 0
Outdoor Ambient Temperature (OAT): Any time OAT is within operating range, value is displayed if unit is in diagnostic and non-diagnostic modes.	Following display string is repeated if cooling is active and OAT is 104°F: C 3 5 pause A 1 0 4 pause
Liquid Line Temperature (LIQ): Any time LIQ is sensed in operating range, value is displayed if unit is in diagnostic mode or manually enabled for non-diagnostic modes.	Following display string is repeated if cooling is active and LIQ is 105°F: C 3 1 pause L 1 0 5 pause
Charge Mode: When unit is in the charge mode, Suction pressure (SPxxx), Suction Temp (Stxx.x), Superheat (SHxx.x), Liquid pressure (LPxxx), Liquid Temp (Ltxx.x) and subcooling (SCxx.x) will be scrolled on the 7-segment display	The following string is repeated: S P 1 3 5 pause S t 6 2 pause S H 1 5 pause L P 3 4 5 pause L t 9 6 pause S C 1 0 Repeat

7-SEGMENT ALERT AND SYSTEM STATUS CODES (Cont.)

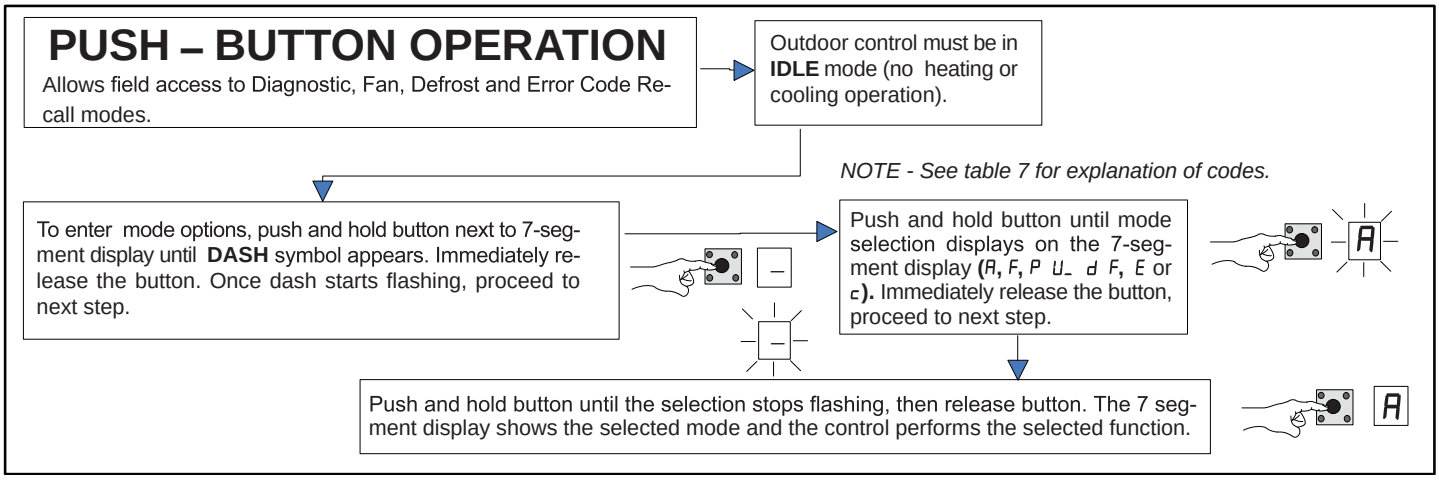


Figure 21. Push-Button Operation

UNIT SELECTION CODE FOR OUTDOOR CONTROL

If the single-character display shows three (3) horizontal lines, the unit selection code needs to be programmed. Press and hold the button until the P U menu option is displayed, release button. The single-character display displays the selected mode per example in **Figure 20**. When the desired unit selection code appears, press and hold the button until it stops flashing, then release.

Unit Code	Unit Type	Unit Model
92	2-ton heat pump	NS21H24M
93	3-ton heat pump	NS21H36M
94	4-ton heat pump	NS21H48M
95	5-ton heat pump	NS21H60M

Idle mode – System is energized with no demand – Decimal flashes at 1 Hertz > 0.5 second ON. 0.5 second OFF		
Display Symbol or Character	**Display**	**Fan Test and Display String Option**
Displayed during start-up or power recycling	Display string shows outdoor control firmware version 1 _ 6 > pause > A C or H P unit > pause > unit capacity in BTUs > pause > unit code. If 3 horizontal bars are displayed during any sequence of this display string, it indicates that the specific parameter is not configured.	
.	Idle mode — decimal flashes at 1 Hertz > 0.5 second ON, 0.5 second OFF	
C	Indicates cooling Capacity. C1 or C2 if conventional 24VAC thermostat	
F	Indicates you are in the outdoor fan test mode	**Control must be in Idle mode**: To enter fan test option - F mode, push and hold button until solid – appears, release button. Display begins flashing. Within 10 seconds, push and hold button until required symbol F displays, release button. Display begins flashing. Within 10 seconds, push and hold button until display stops flashing, release button. Control will initiate outdoor fan operation. Outdoor fan cycles ON for 10 minutes at the highest speed. To exit test – Push and hold button until three horizontal bars display. Release button, outdoor fan cycles **OFF**.
A	A in the display string represents the ambient temperature in °F at the sensor on the outdoor unit.	**Control can be in Idle or demand mode**: To enter display configuration option - A mode, push and hold button until solid – appears, release button. Display begins flashing. Within 10 seconds, push and hold button until required symbol A displays, release button. Display begins flashing. Within 10 seconds, push and hold button until display stops flashing, release button. Display shows error (E) code(s) and ambient (A), outdoor coil (c) and liquid (L) temperatures in Fahrenheit. **NOTE** - *If button is not pushed in the 10-second time period, the control exits the test mode. If this occurs, test mode must be repeated.*
d F	d F in the display indicates Forced Defrost Mode	Enters Forced Defrost Mode. While the NS21H is running in heating mode, press Push Button until a Solid "-" is displayed to Enter the Field Test Mode. Press and Hold the button until "d" id displayed for Forced Defrost Mode, the release the button. Press the button again while the display is flashing "d" to select the Forced Defrost Mode. See Defrost Test on page 37.

Error Code Recall Mode (NOTE – control must be in idle mode)	
E	To enter error code recall mode, push and hold button until solid E appears, then release button. Control displays up to 10 error codes stored in memory. If E 0 0 0 0 is displayed, there are no stored error codes.
≡	To exit error code recall mode, push and hold button until solid three horizontal bars appear, then release button. **NOTE -** Error codes are not cleared.
c	To clear error codes stored in memory, continue to hold button while the 3 horizontal bars are displayed. Release button when solid c is displayed.
c	Push and hold for one (1) second, release button. 7-Segment displays 0 0 0 0 and exits error recall mode.

Field Test Mode Operation

The field test mode allows the unit to be put into diagnostic mode and allows the installer to perform multiple tests on the control / unit.

Diagnostic Mode

Diagnostic mode is only available when the system is idle or during an active / suspended call for heating or cooling. Diagnostic mode is terminated when the exit command is given, the button is pressed and released without entering the diagnostic menu or 10 minutes has passed, whichever comes first.

When this mode is selected all installed temperature sensor valves (non-open and non-short) are shown on the 7-segment display. The following system status codes are displayed:

- Cooling
- Cooling stage or cooling percentage demand operation
- Active error codes

Outdoor Fan Mode

Diagnostic mode is only available while the system is in idle mode. This mode can be exited with the proper command or after 10 minutes has passed.

In diagnostic mode, the control energizes the outdoor fan at the highest speed.

Forced Defrost Test

The Defrost Cycle can be tested for defrost diagnositic purposes or during service procedures to initiate a defrost cycle to clear the outdoor coil of frost or ice. The Forced Defrost Mode is initiated by the Outdoor Unitary Control push button. See Defrost Testing on page 37.

Charge Mode Operation

To initiate the NS21HM Charge Mode function, install the jumper across the two Charge Mode Pins (CHRG MODE) on the outdoor control. The Charge Mode can be used when charging the system with refrigerant, checking the refrigerant charge, pumping down the system and performing other service procedures that requires outdoor unit operation at 100% capacity.

Charge Mode Operation with a Conventional 24VAC Non-Communicating Heat Pump Thermostat – Cooling Mode

On applications with a conventional 24VAC non-communicating thermostat, the charge mode jumper must be installed on the Charge Mode Pins after providing a Y1 compressor demand to the unit to initiate the Charge Mode. When using the Charge Mode in the cooling mode, the “O” must also be provided with a 24V signal to place reversing valve in the cool position. In the heating mode only a Y1 compressor demand is required along with the blower demand for the full cooling air volume. A cooling blower demand must also be provided to initiate blower operation on the cooling speed on the indoor unit. The compressor and outdoor fan motor will operate at 100% capacity. To exit the charging mode, remove the Charge Mode Jumper and remove the Y1 compressor demand and indoor blower demand. The Charge Mode has a maximum time of 60 minutes and will automatically exit the charge mode after 60 minutes if the charge mode jumper is left in place.

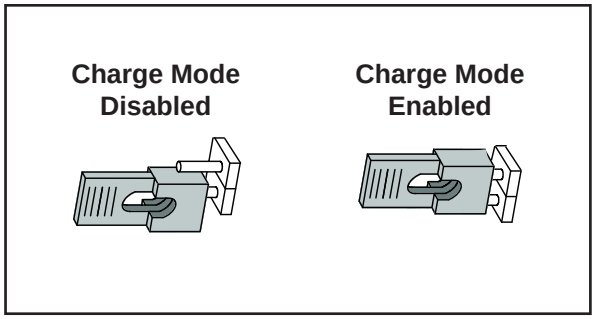


Table 11. Field Test, Diagnostic Recall and Program Menu Options

Display	Display and Action (normal operation)
No Change - idle (*)	No Change - idle (*)
Solid .	Enter or exit field test and program mode.
Solid A	Puts unit in diagnostic mode. (Displays ambient temperatures and any active error codes.)
Solid c	Clears error history (**)
Solid E	Enter diagnostic recall mode. Displays up to 10 error codes in memory.
Solid F	Starts outdoor fan.
String P U	Enter unit code programming.
String d F	Enters Forced Defrost Mode (Provides Defrost Test: Initiates a Forced Defrost to Defrost the outdoor coil) See Defrost Test on Page 37.
.	Idle mode — decimal flashes at 1 Hertz > 0.5 second ON, 0.5 second OFF
C	Cooling operation. Shows cooling stage C1 or C2 operating if non-communicating. Shows cooling capacity percentage i.e. C 7 0 operating if installed with a A3 communicating thermostat. Example: C 2 0 pause A 7 5
E	E in the display string represents the active error code(s) in the outdoor unit. Example: E 5 0 pause E 4 4 pause E 4 4 2 pause A 7 5 pause
A	A in the display string represents the outdoor ambient temperature in °F at the outdoor sensor on the outdoor unit. Example: C 5 0 pause A 7 5
Scrolling	When unit is in the charge mode, Suction pressure (SPxxx), Suction Temp (Stxx.x), Superheat (SHxx.x), Liquid pressure (LPxxx), Liquid Temp (Ltxx.x) and subcooling (SCxx.x) will be scrolled on the 7-segement display. Example: S P 1 3 5 pause S t 6 2 pause S H 1 5 pause L P 3 4 5 pause L t 9 6 pause S C 1 0 Repeat

*No change indicates the display will continue to show whatever is currently being displayed for normal operations.
**Note once the error history is deleted it cannot be recovered. After the history is deleted, the unit will reset itself.

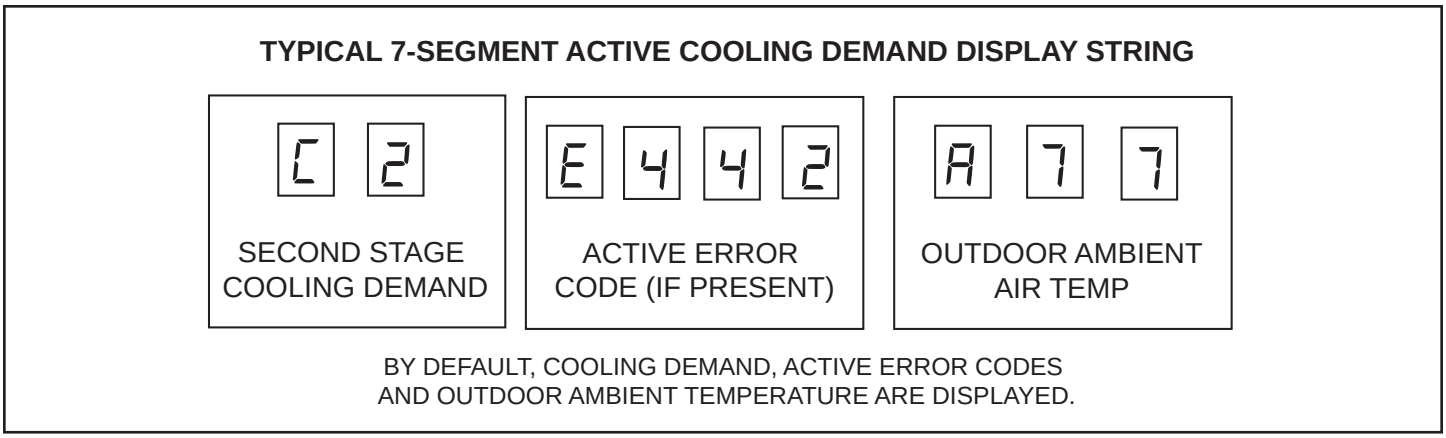


Figure 22. Typical 7-Segment Demand Display String

CONFIGURING UNIT

When installing a replacement outdoor control, the unit selection code may have to be manually assigned using the 7-segment display and push button on the control. The unit code sets unit type, capacity and outdoor fan profile.

Configuring Unit Selection Code

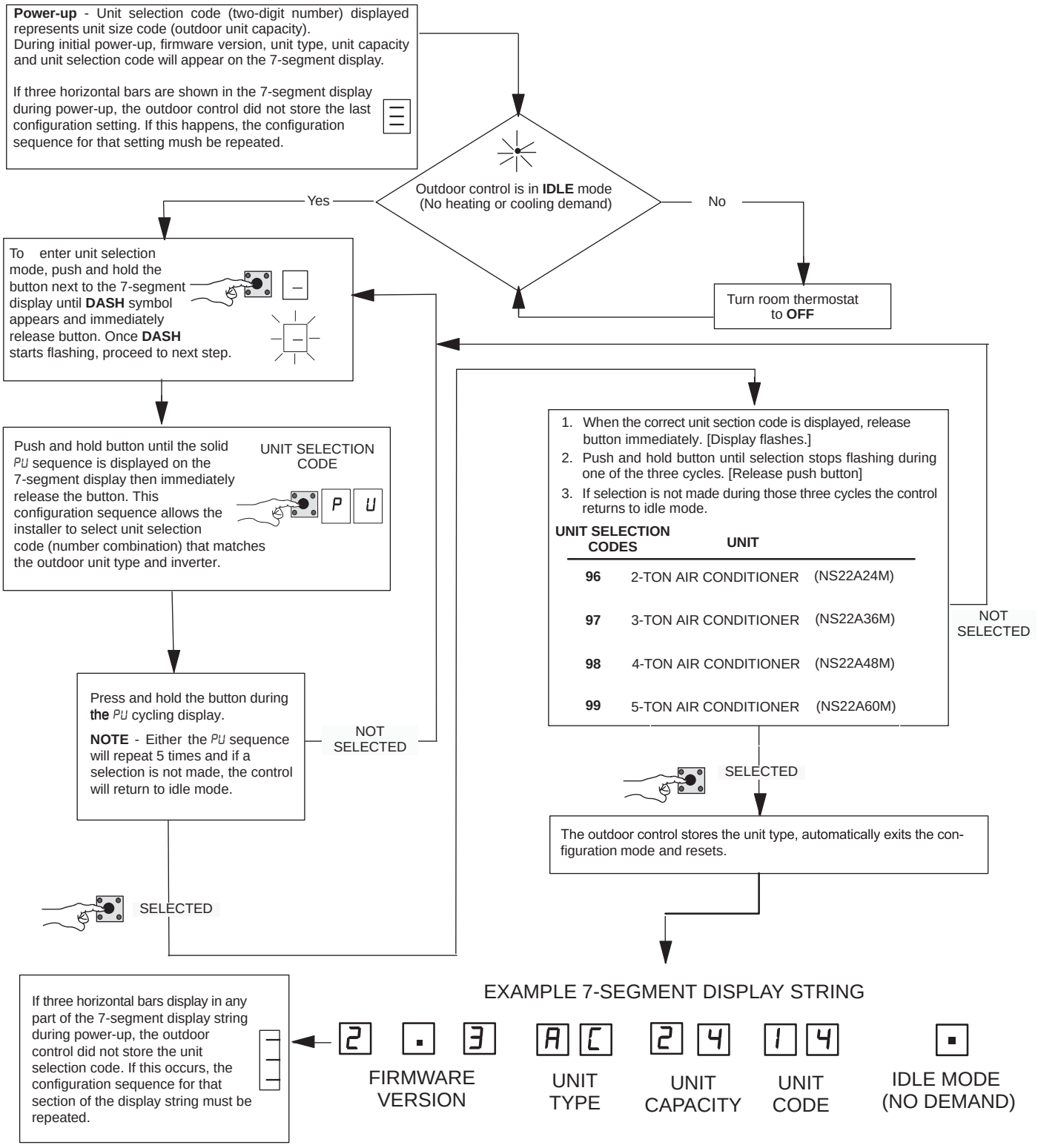


Figure 23. Configuring Unit Selection Code

CONFIGURING UNIT (Cont.)

System Overview

Refer to the applicable Thermostat Installer Setup Guide for configuration procedures.

The outdoor control provides the following functions:

- Internal switching of outputs.
- Compressor anti-short-cycle delay (adjustable through the thermostat interface).
- Five-strike lockout function.
- High Pressure protection using the High Pressure Switch (S4) and Low Pressure Pressure protection using the suction pressure transducer to emulate low pressure protection.
- Ambient (RT13), liquid line (RT36) and suction line (RT41) temperatures for monitoring and protection.
- Suction Pressure Transducer (A168) and Liquid Pressure Tranducer (A188) for monitoring and control.

COMPRESSOR PROTECTION – FIVE-STRIKE LOCKOUT
The five-strike lockout function is designed to protect the compressor from damage. The five-strike feature is used for both high (S4) and low (A168) pressure emulation.

Resetting Five-Strike Lockout

Once the condition has been rectified, power to the outdoor control R terminal must be cycled OFF.

COMPRESSOR SHORT CYCLING DELAY
The outdoor control protects the compressor from:

- Short cycling (five minutes) during initial power-up.
- Interruption in power to the unit.
- Pressure or sensor trips.
- Delay after demand is removed.

The delay is set by default for 300 seconds (five minutes).

Available settings are 60, 120, 180, 240 and 300 seconds.

CRANKCASE HEATER (HR1)
Compressors in all units are equipped with a 40-watt bellyband- type crankcase heater. HR1 prevents liquid from accumulating in the compressor. HR1 is controlled by the crankcase heater thermostat.

CRANKCASE HEATER THERMOSTAT (S40)
Thermostat S40 controls the crankcase heater in all units. S40 is located on the compressor shell. When the compressor shell temperature drops below 50°F, thermostat S40 closes, energizing HR1. The thermostat opens, de-energizing HR1, once compressor shell temperature reaches 70°F.

Defrost Function

The outdoor unit control uses a time dependent frost accumulation duration demand defrost control algorithm to provide a demand defrost when the system falls below optimum levels. The demand defrost control algorithm is reactive based upon the previous heat pump run time between defrost cycles (frost accumulation time) and the time spend in defrost (defrost time). The outdoor unit control monitors ambient temperature, outdoor coil temperature along with the compressor run time in heating mode and defrost cycle time. The outdoor unit control monitors compressor run time in the heating mode when the outdoor coil temperature is below 35°F and accumulates the frost accumulation time. Once the frost accumulation time is met the unit control will initiate a defrost cycle. The unit will run in the defrost mode until the coil temperature reaches the defrost termination temperature setpoint. The maximum length of defrost cycle is 14 minutes and the defrost cycle will automatically be terminated if the defrost cycle exceeds 14 minutes.

Two consecutive low pressure trips while operating in the heat pump heating mode will initiate a defrost cycle to defrost that may occur during a weather related event such as freezing rain.

Frost Accumulation Time
The frost accumulation time is the amount of time the heat pump runs in the heating mode when the outdoor coil temperature is below 35°F. The initial target frost accumulation time is 90 minutes, but the control will adjust the frost accumulation time higher or lower based upon the previous defrost cycle time history. If the defrost cycle time is short (80% or less of the defrost cycle time) the defrost accumulation time will be increased by 30 minutes. If the defrost cycle time is long (120% or more of the target defrost cycle time) the defrost accumulation time will be decreased by 30 minutes. If the defrost accumulation time is significantly longer (200% or more of the target defrost cycle time) or if the defrost terminates at the 14-minute maximum time, the frost accumulation time is set to 30 minutes. No change is he frost accumulation time is made if the frost accumulation time is close to the target defrost cycle time (between 80% and 120% of the target defrost cycle time).

Low Ambient Defrost
When outdoor temperature is less than 10ºF, the Frost Accumulation Time will be set to 360 minutes. When the outdoor temperature is extremely cold, there is less moisture in the air, which reduces the defrost frequency requirements. Setting the frost accumulation time to 360 minutes will reduce the defrost cycle frequency which will increase the overall system efficiency and minimize operation costs. The Low Ambient Defrost has adjustable parameters, allowing the technician to make adjustments for the special application and climate.

CONFIGURING UNIT (Cont.)

Defrost Function (Cont.)

Defrost Cycle Time

The defrost cycle time is the amount of time the unit operates in the defrost mode from the point the defrost cycle was initiated until the coil temperature reaches 50°F regardless of defrost termination temperature setpoint. The demand defrost control target defrost cycle time is unique for each NS21H**M heat pump model. The target defrost cycle time of NS21H24M is 100s, NS21H36M is 133s, NS21H48M is 105s, NS21H60M is 102s.

Defrost Termination Temperature

The defrost termination temperature is adjustable using the S40 thermostat when the unit is installed with a S40 communicating thermostat. The Defrost Termination Jumper on the Unitary Control is ignored when installed with a S40 communicating thermostat. If an S40 thermostat is used, this parameter may be selected at the thermostat using the dealer control center under the heat pump.

The defrost termination setting selections are 50, 70, 90 and 100°F. The factory default setting is 50°F (10°C). The defrost termination temperature is monitored by the coil sensor which is located at the outlet of the outdoor expansion valve. See coil sensor figure location below for details.

Installations with a Conventional 24VAC Heat Pump Thermostat

The unitary control has a defrost termination jumper to set the defrost termination temperature using the jumper on the unitary control. The defrost termination jumper setting selections are 50, 70, 9. and 100F. The factory default setting is 50F (10C)

NOTE – Colder climates may require a higher defrost termination temperature setting to ensure the outdoor coil is cleared of frost during defrost. If the outdoor coil is not adequately cleared of frost, the heat pump may experience reduced heating performance or damage to the outdoor coil from the buildup of ice on the coil.

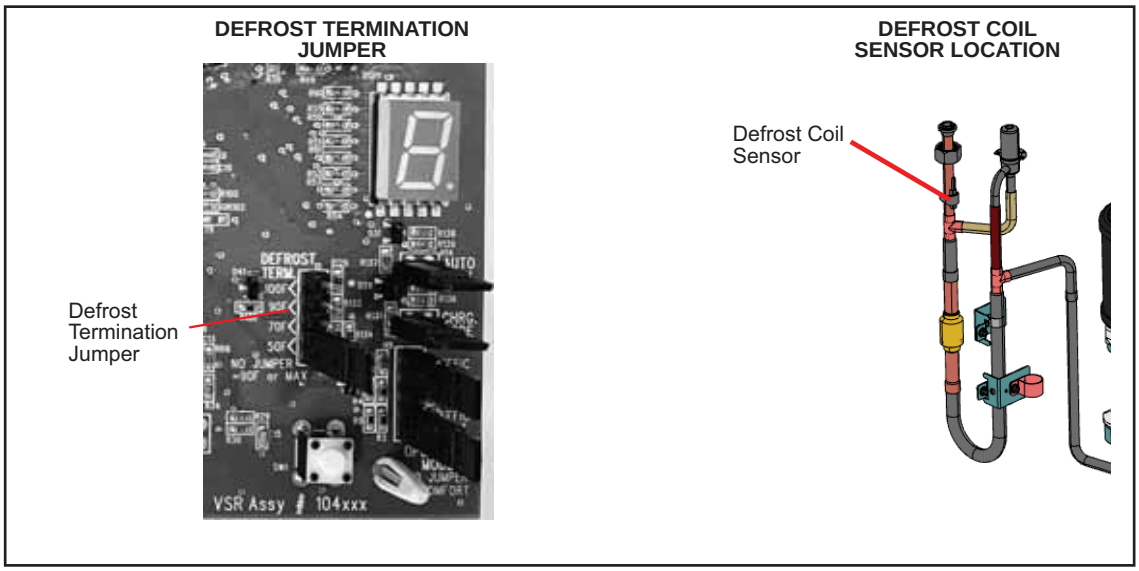


Figure 24. Defrost Components

Maintenance

OUTDOOR UNIT

Maintenance and service must be performed by a qualified installer or service agency. At the beginning of each cooling season, the system should be checked as follows:

1. Clean and inspect outdoor coil (may be flushed with a water hose). Ensure power is off before cleaning.
2. Outdoor unit fan motor is factory-lubricated and sealed. No further lubrication is needed.
3. Visually inspect all connecting lines, joints and coils for evidence of oil leaks.
4. Check all wiring for loose connections.
5. Check for correct voltage at unit (unit operating).
6. Check amp draw on outdoor fan motor.
7. Inspect drain holes in coil compartment base and clean if necessary.

NOTE - If insufficient heating or cooling occurs, the unit should be gauged and refrigerant charge should be checked.

Outdoor Coil

It may be necessary to flush the outdoor coil more frequently if it is exposed to substances which are corrosive or which block airflow across the coil (e.g., pet urine, cottonwood seeds, fertilizers, fluids that may contain high levels of corrosive chemicals such as salts).

- Outdoor Coil — The outdoor coil may be flushed with a water hose.
- Outdoor Coil (Coastal Area) — Moist air in ocean locations can carry salt, which is corrosive to most metal. Units that are located near the ocean require frequent inspections and maintenance. These inspections will determine the necessary need to wash the unit including the outdoor coil. Consult your installing contractor for proper intervals/ procedures for your geographic area or service contract.

Indoor Unit

1. Clean or change filters.
2. Blower motors are factory-lubricated and permanently sealed. No more lubrication is needed.
3. Adjust blower speed for cooling. Measure the pressure drop over the coil to determine the correct blower CFM. Refer to the unit information service manual for pressure drop tables and procedure.
4. Check all wiring for loose connections.
5. Check for correct voltage at unit. (blower operating)
6. Check amp draw on blower motor.

Indoor Coil

1. Clean coil if necessary.
2. Check connecting lines, joints and coil for evidence of oil leaks.
3. Check condensate line and clean if necessary.

Unit Wiring Diagrams

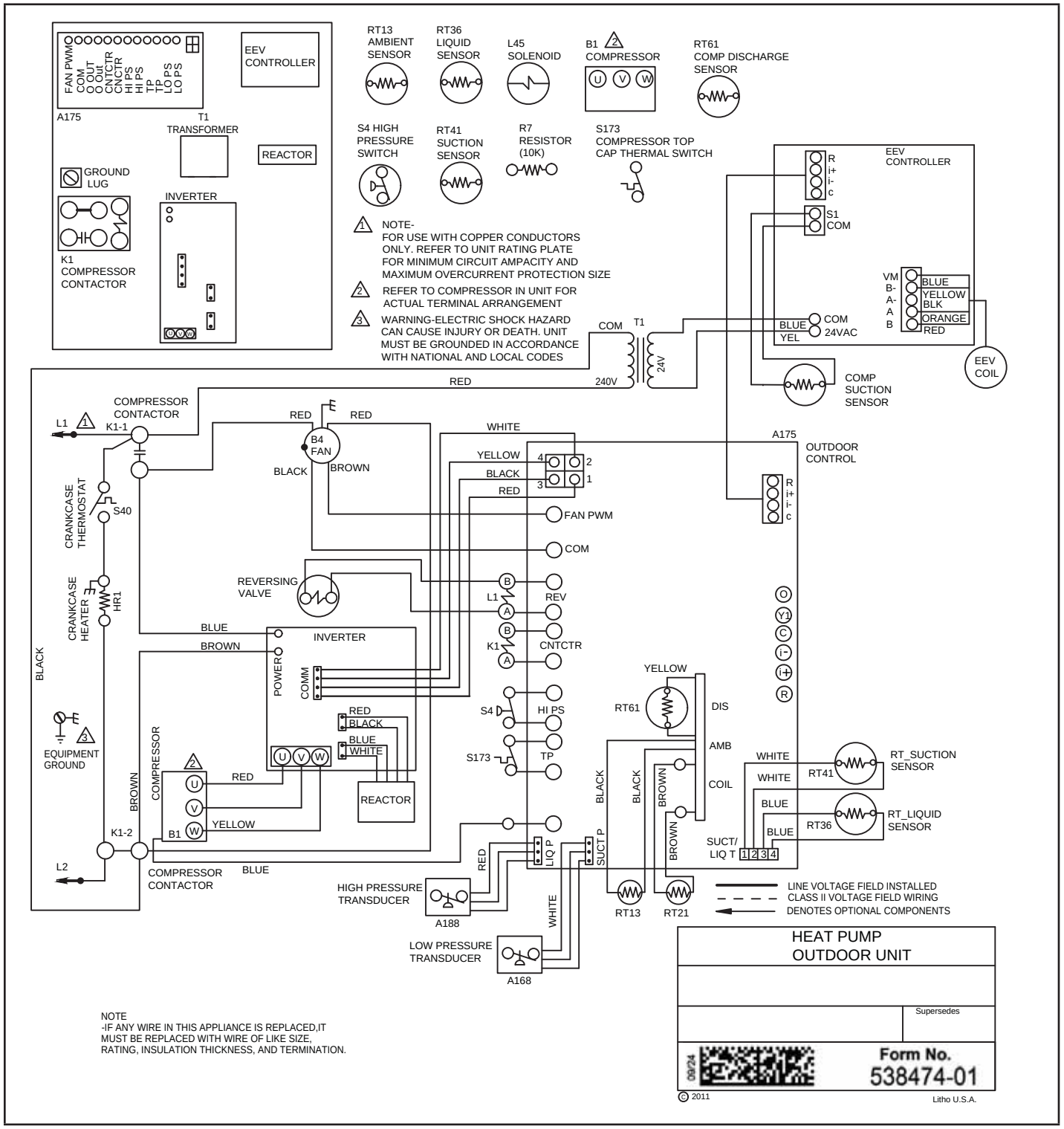


Figure 25. Typical Unit Wiring (NS21HM)**

Unit Wiring Diagrams

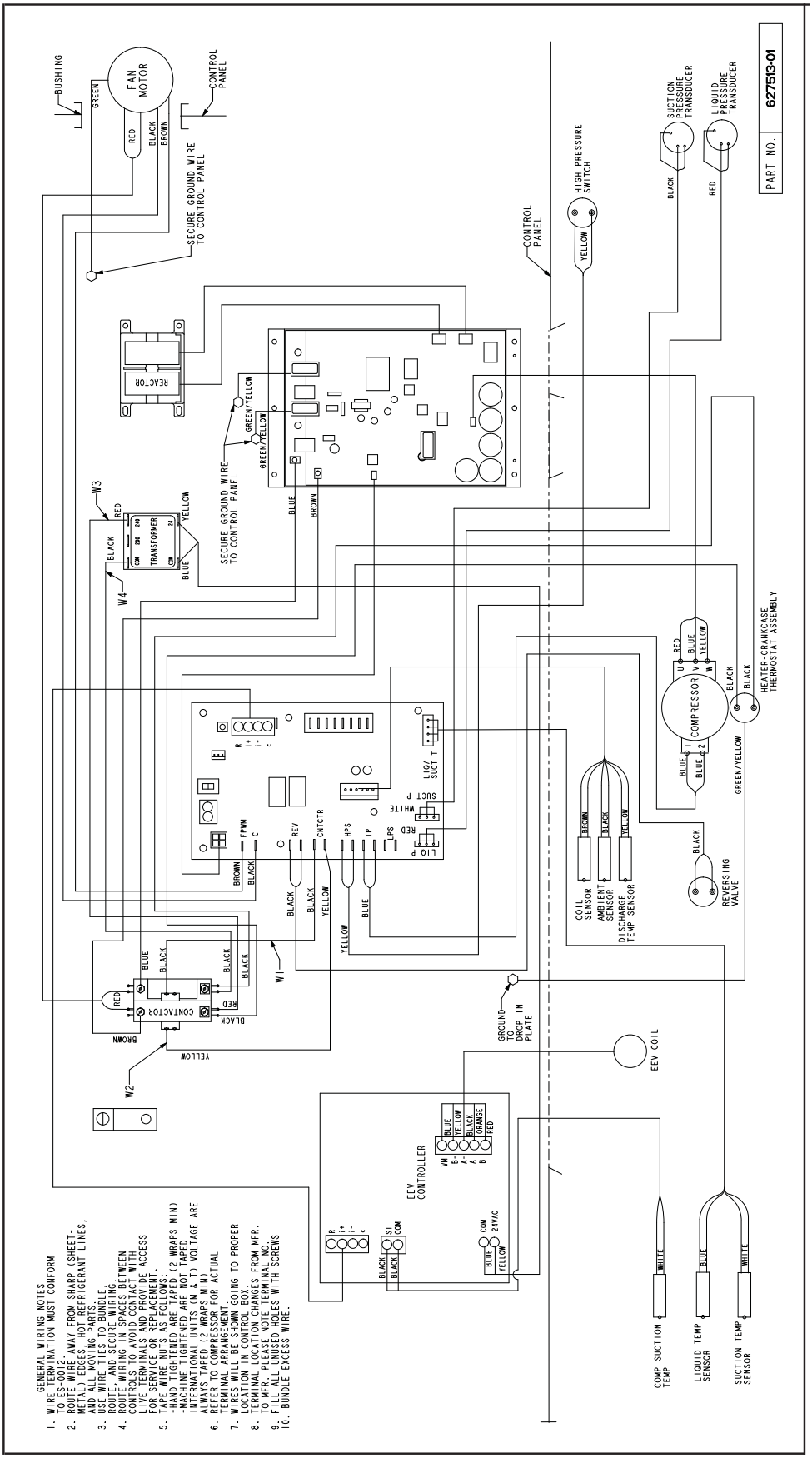


Figure 26. Typical Unit Wiring (NS21HM)**

Unit Sequence of Operation

The following figures illustrate the overall unit sequence of operation along with the operation of various pressure switches and temperature sensors. The figures also illustrate the use of the compressor anti-short-cycle function in relation to unit Status, unit Fault and lockout LED Codes and unit system operation interactions.

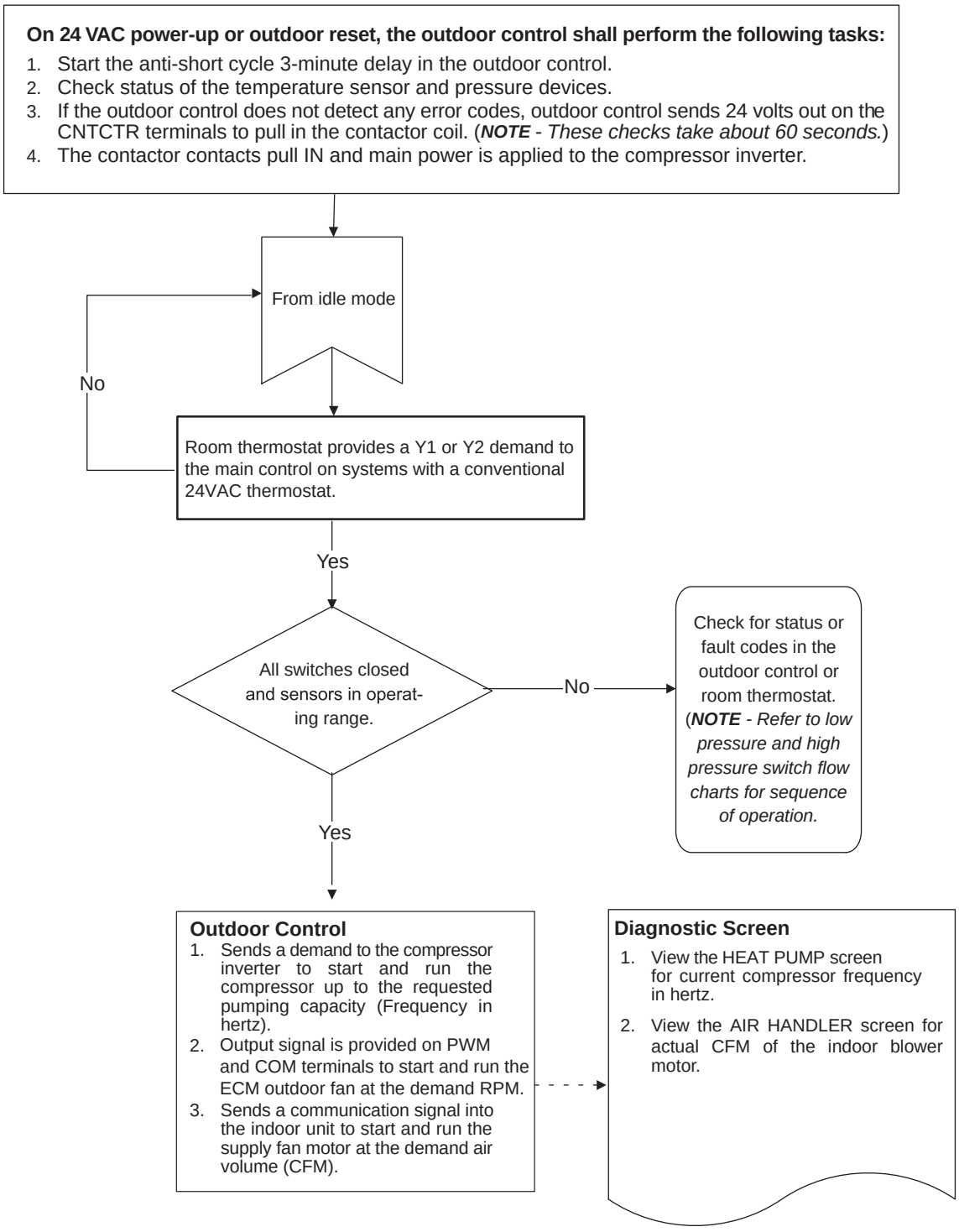


Figure 27. 24 Volt Power-Up or Outdoor Reset

Unit Sequence of Operation

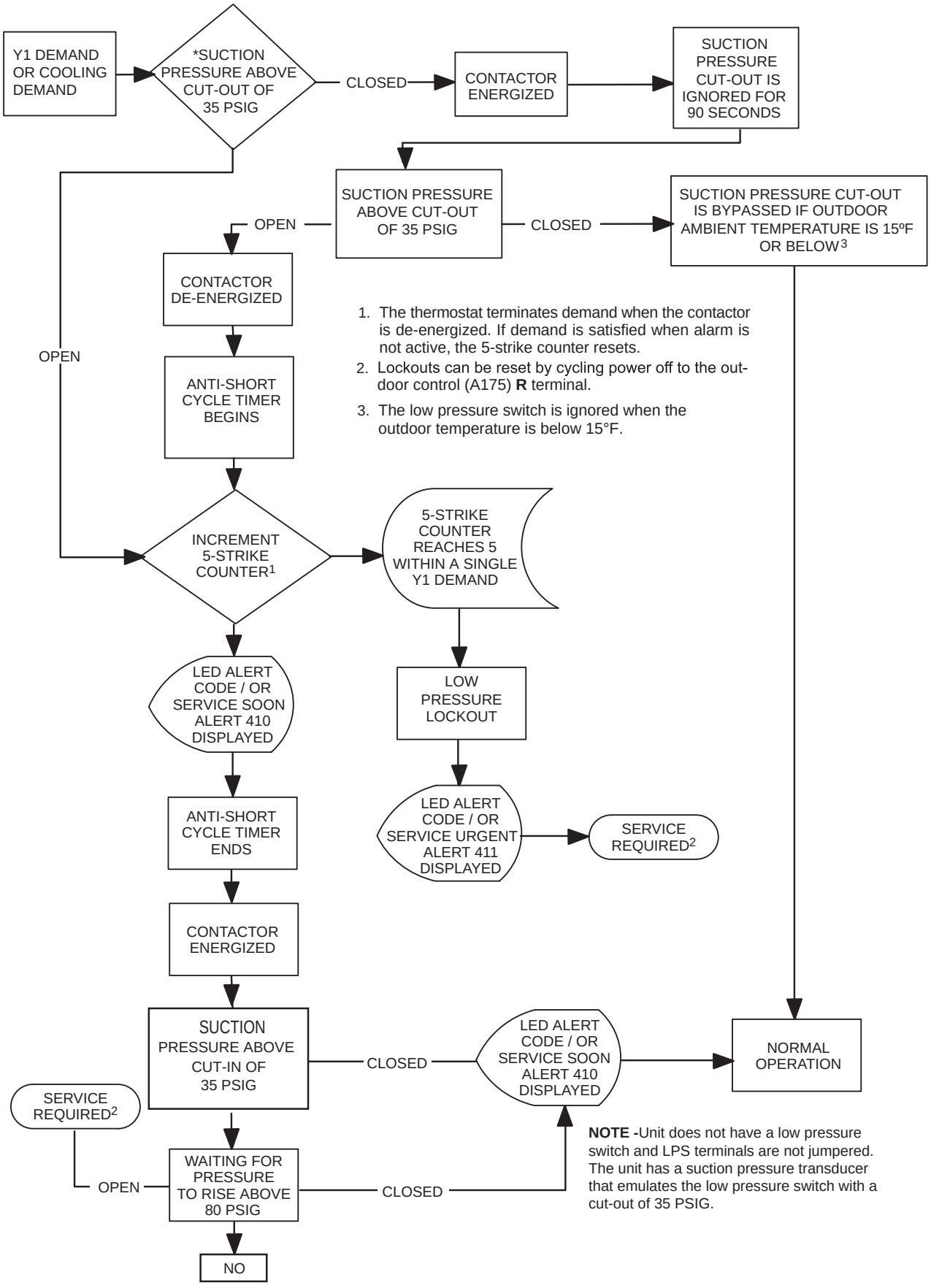


Figure 28. Low Pressure Switch Emulation by Suction Pressure Transducer Logic Sequence of Operations

Unit Sequence of Operation

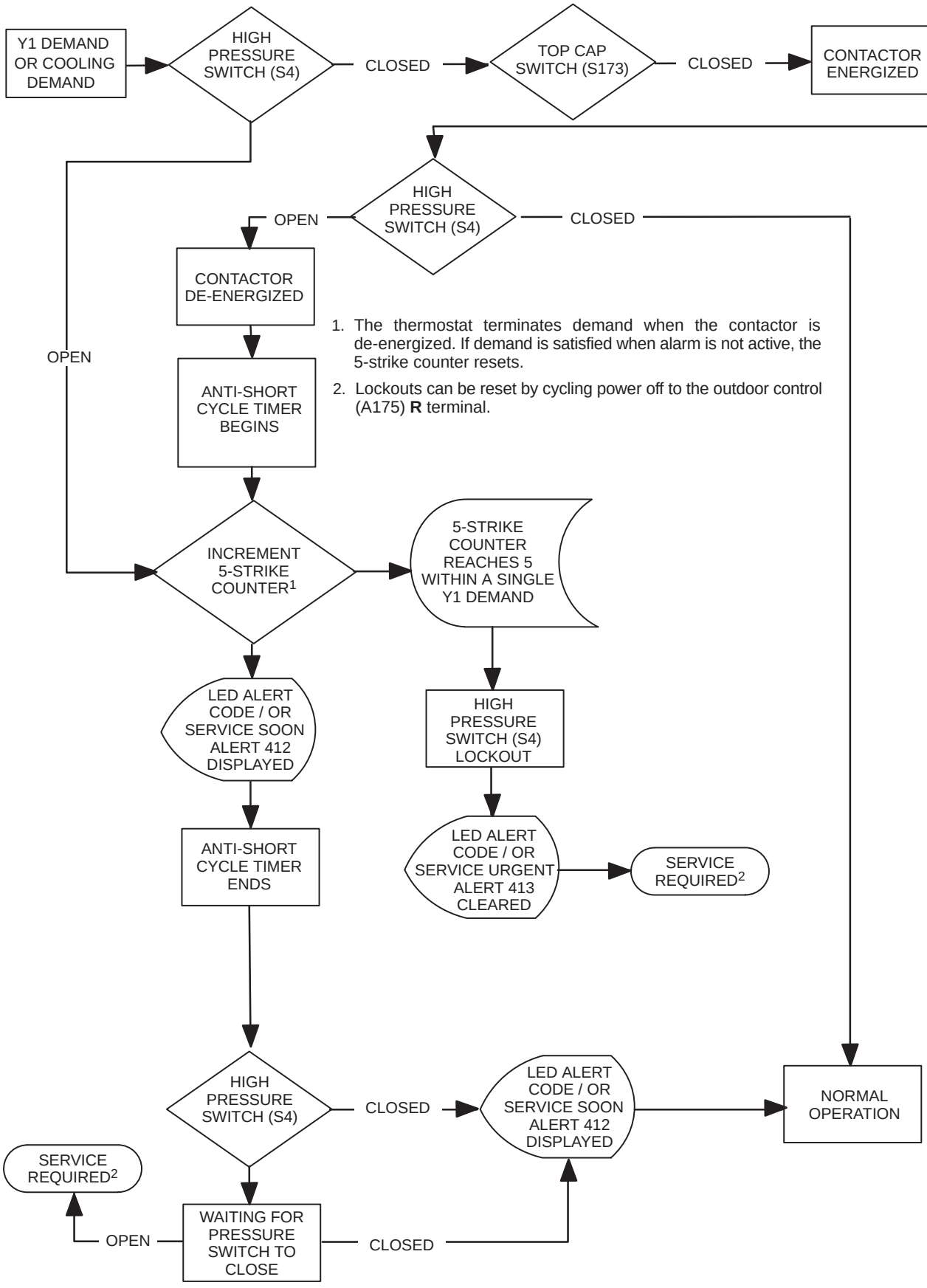


Figure 29. High Pressure Switch (S4) Sequence of Operation (All Versions)

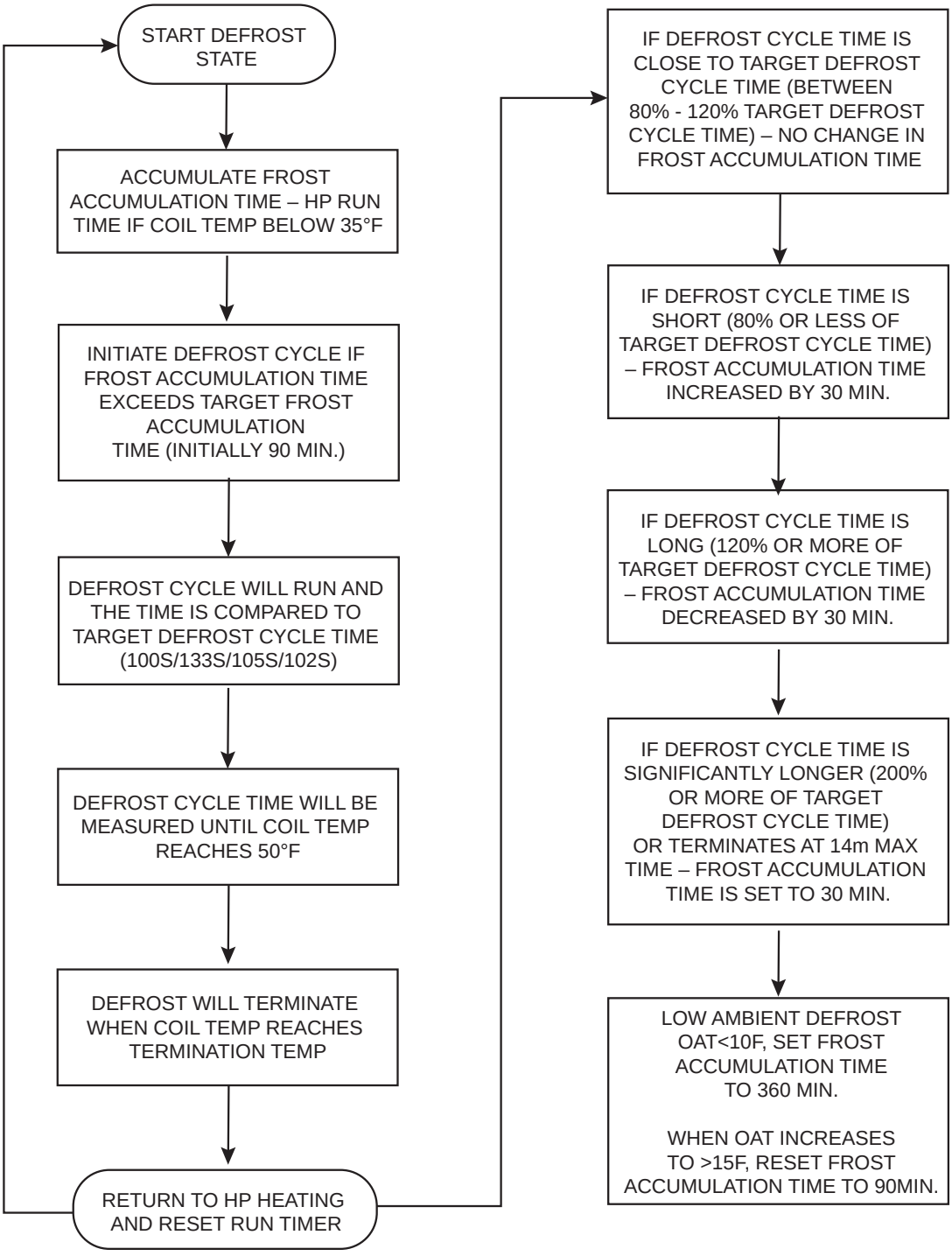


Figure 30. Low Pressure Switch Emulation by Suction Pressure Transducer Logic Sequence of Operations

VERIFYING HIGH PRESSURE SWITCH AND LOW PRESSURE PROTECTION OPERATION

Operation:

The unit's high pressure switch (HPS-S4) is wired in the control HPS terminals.

The unit does not have a low pressure switch and LPS terminals are not jumpered. The unit has a suction pressure transducer (A168) that emulates the low pressure switch with a cut-out of 35 PSIG and a cut-in of 80 PSIG. This provides the same protection as a tradition low pressure switch. In the event the suction pressure transducer fails, back up protection is provided by the suction temperature sensor and will open at 25°F.

Low Suction Pressure Protection (LPS) – See **Figure 28** for low suction pressure protection sequence of operation.

High Pressure Switch (HPS) – See **Figure 29** for high pressure switch sequence of operation.

Pressure Switch Event Settings

The following pressures are the auto-reset event value triggers for low and high pressure thresholds:

• High Pressure (auto-reset) - trip at 590 psig; reset at 418.

• Low Pressure (auto-reset) – trip at 35 psig; reset at 80.

Checkout – S4 High Pressure Switch

Using a multimeter set to ohms with the terminals disconnected from the control board, check the resistance between the two terminals of the pressure switch. If the resistance reading is 0 ohms, the switch is closed.

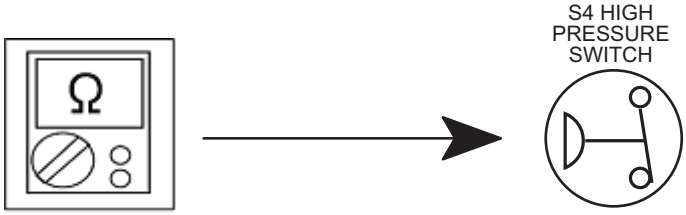


Figure 31. Low Pressure Switch Emulation by Suction Pressure Transducer Logic Sequence of Operations

Verifying Suction Pressure Transducer Operation

Using a multimeter set to VDC with the Suction Pressure Transducer connected to the "Suct P" 3-pin connector on the control board. Pin 1 (Red wire +5VDC) to Pin 3 (Black wire - GND) should read 5 VDC continuous. Pin 2 (Blue wire output from transducer) to Pin 3 (Black - GND) should read 0.5 to 4.5 VDC and will vary depending on suction pressure measured. See **Table 12**.

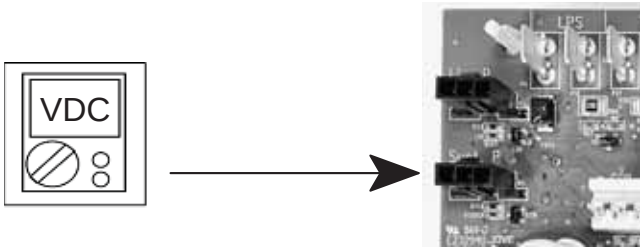


Figure 32. Suction Pressure Transducer Voltage

Table 12. Suction Pressure Transducer Output Voltage

Suction Pressure (PSIG)	DC Voltage Output (Pin 2 to Pin 3)	Suction Pressure (PSIG)	DC Voltage Output (Pin 2 to Pin 3)
0	0.49	110	2.69
10	0.69	120	2.89
20	0.89	130	3.09
30	1.09	140	3.29
40	1.29	150	3.49
50	1.49	160	3.69
60	1.69	170	3.89
70	1.89	180	4.09
80	2.09	190	4.29
90	2.29	200	4.49
100	2.49	210	4.50

Component Testing

VERIFYING HIGH PRESSURE SWITCH AND LOW PRESSURE PROTECTION OPERATION (Cont.)

Verifying Suction Pressure Transducer Operation

Using a multimeter set to VDC with the Liquid Pressure Transducer connected to the “Liq P” 3-pin connector on the control board. Pin 1 (Red wire +5VDC) to Pin 3 (Black wire - GND) should read 5 VDC continuous. Pin 2 (Blue wire output from transducer) to Pin 3 (Black - GND) should read 0.5 to 4.5 VDC and will vary depending on liquid~ pressure measured. See **Table 13**.

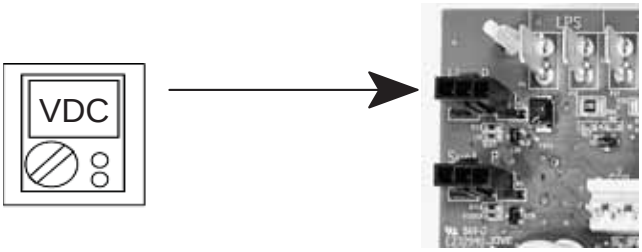


Figure 33. Suction Pressure Transducer Voltage

Table 13. Suction Pressure Transducer Output Voltage

Liquid Pressure (PSIG)	DC Voltage Output (Pin 2 to Pin 3)	Liquid Pressure (PSIG)	DC Voltage Output (Pin 2 to Pin 3)	Liquid Pressure (PSIG)	DC Voltage Output (Pin 2 to Pin 3)
0	0.50	210	1.90	420	3.30
10	0.57	220	1.97	430	3.37
20	0.63	230	2.03	440	3.43
30	0.70	240	2.10	450	3.50
40	0.77	250	2.17	460	3.57
50	0.83	260	2.23	470	3.63
60	0.90	270	2.30	480	3.70
70	0.97	280	2.37	490	3.77
80	1.03	290	2.43	500	3.83
90	1.10	300	2.50	510	3.90
100	1.17	310	2.57	520	3.97
110	1.23	320	2.63	530	4.03
120	1.30	330	2.70	540	4.10
130	1.37	340	2.77	550	4.17
140	1.43	350	2.83	560	4.23
150	1.50	360	2.90	570	4.30
160	1.57	370	2.97	580	4.37
170	1.63	380	3.03	590	4.43
180	1.70	390	3.10	600	4.50
190	1.77	400	3.17		
200	1.83	410	3.23		

Component Testing

HIGH PRESSURE SWITCH AND LOW PRESSURE PROTECTION ERRORS

Table 14. Outdoor Control 7-Segment Display Alert Codes

System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed.			
Alert Codes	**Priority**	**Alarm Description**	**Possible Causes and Clearing Alarm**
E 410	Service Soon	The outdoor unit cycled off due to low pressure switch opening.	Unit pressure is below the lower limit. The system is shutdown. The low pressure switch closes above 80 PSIG and opens below 35 PSIG. Confirm that the system is properly charged with refrigerant. Check TXV, indoor unit blower motor, dirty filters or clogged refrigerant filter. Confirm that the evaporator coil is clean. The alarm clears after the pressure switch opens or after a power reset.
E 411	Service Urgent	The low pressure switch has opened 5 times within one hour. As a result, the outdoor unit is locked out.	Low pressure switch error count reached 5 strikes. The low pressure switch for R454B opens at 35 PSIG and resets at 80 PSIG. Confirm that the system is properly charged with refrigerant. Check for clogged TXV, blockage to indoor unit blower motor, dirty filters or clogged refrigerant filter. Confirm that the evaporator coil is clean. The alarm clears after a power reset.
E 412	Service Soon	The outdoor unit high pressure switch has opened.	Unit pressure is above the upper limit. System is shut down. The high pressure switch opens at 590 PSIG and closes at 418 PSIG. Confirm that the system is properly charged with refrigerant. Check for clogged TXV, blockage to indoor unit blower motor, clogged refrigerant filter. Confirm that the outdoor unit is clean. The alarm clears after the pressure switch closes or a power reset. For heating, indoor CFM may be set too low. For zoning system, zone CFM may be set too low.
E 413	Service Urgent	The high pressure switch has opened 5 times within one hour. As a result, the outdoor unit is locked out.	Open high pressure switch error count reached 5 strikes. System is shut down. The high pressure switch for R454B will open at 590 PSIG and close at 418 PSIG. Confirm that the system is properly charged with refrigerant. Check condenser fan motor, clogged TXV, blockage to indoor unit blower motor, stuck reversing valve or clogged refrigerant filter. Confirm that the outdoor unit is clean. The alarm clears after indoor power reset (24VAC power source to Outdoor Control)

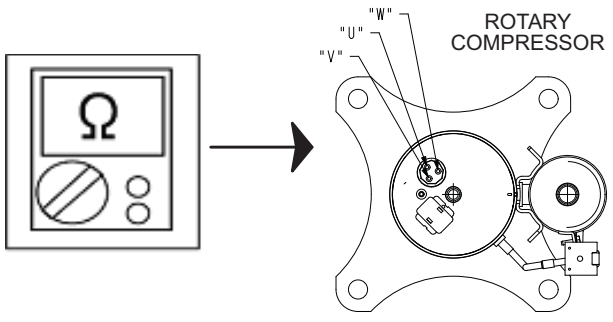
COMPRESSOR OPERATION, CHECKOUT AND STATUS / ERROR CODES

Operation:

The unit uses a 380VAC three phase variable capacity rotary compressor specifically designed for unitary splits system and is approved for use with R454B refrigerant. The compressor, when connected to an inverter, is capable of operating in a running frequency range from 20 hertz up to a maximum of 110 hertz (maximum hertz is dependent on compressor size). The compressor speed is determined by thermostat demand and suction pressure when installed with a conventional 24VAC non-communicating thermostat.

Checkout:

NOTE - The compressor motor winding resistance is the nominal resistance at 77°F. When measuring compressor motor winding resistance, the primary concern is the winding resistance between the different sets of terminals is within 10% of each other. The actual winding resistance is impacted by temperature, refrigerant and oil. Do not automatically condemn a compressor because the measured resistance is slightly higher or lower than the nominal resistance. Check for shorted/open windings and for shorts to ground during testing.



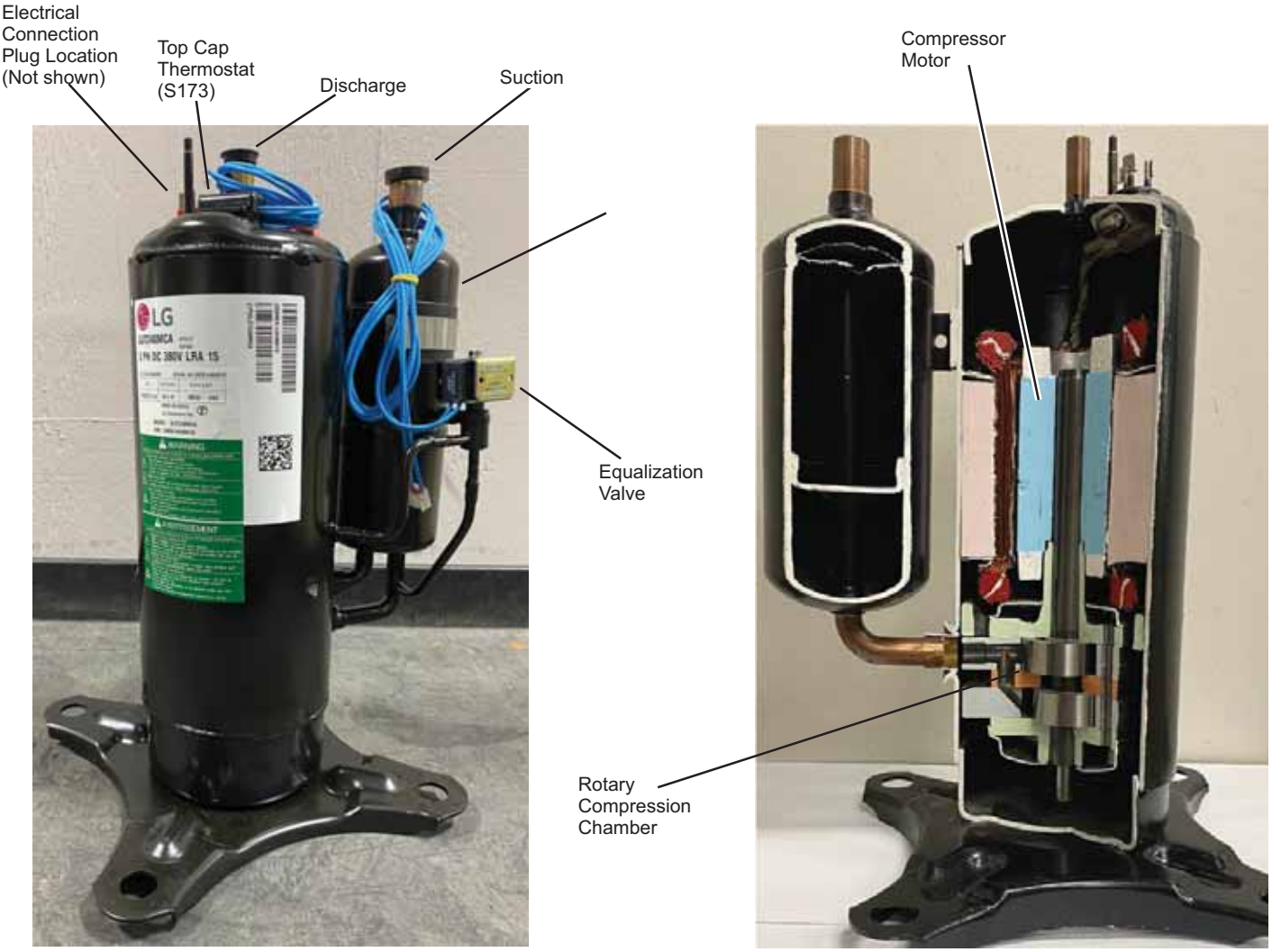
MOTOR WINDING RESISTANCE AT 77° (±7%)			
UNIT	**U-V/T1-T2**	**V-W/T2-T3**	**W-U/T3-T1**
NS21H24M	0.883Ω	0.883Ω	0.883Ω
NS21H36M	0.883Ω	0.883Ω	0.883Ω
NS21H48M	0.705Ω	0.705Ω	0.705Ω
NS21H60M	0.705Ω	0.705Ω	0.705Ω

Figure 34. Compressor Operation, Checkout and Status/Error Codes

Component Testing

COMPRESSOR OPERATION, CHECKOUT AND STATUS / ERROR CODES (Cont.)

IMPORTANT: If compressor replacement is required, remove the compressor through the top of the unit. Removal through the access panel is not possible.



ROTARY COMPRESSOR

CUTAWAY OF TYPICAL ROTARY COMPRESSOR **(Not actual compressor)**

Figure 35. Rotary Compressor Detail

COMPRESSOR EQUALIZATION VALVE

The compressor equalization valve equalization solenoid equalizes the pressure across the rotary compression chamber allowing the compressor to start unloaded. The 240 VAC solenoid coil is controlled by the inverter.

The solenoid coil is powered when the compressor is off to equalize the pressure and is de-energized when the compressor is operating

Status Codes

When the compressor is running, the 7-segment display will show the compressor capacity. When the unit is installed with a conventional 24VAC non-communicating thermostat the display will show C 1 or C 2.

COMPRESSOR EQUALIZATION VALVE (Cont.)

Status Codes (Cont)

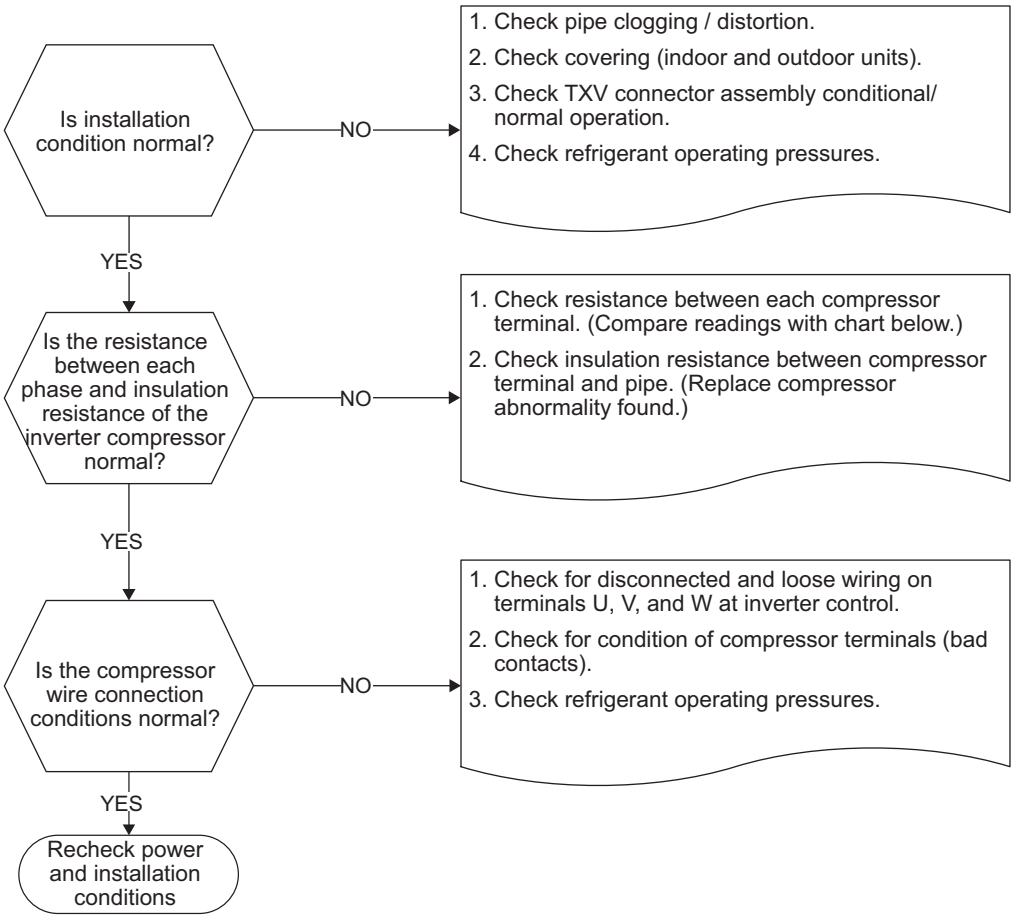


Figure 36. Compressor Operation, Checkout and Status/Error Codes

ERROR CODES:

Table 15. Outdoor Control 7-Segment Display Alert Codes - Compressor

System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed.						
Alert Codes	**Inverter Code**	**Inverter LED Flash Code (number of flashes)**		**Priority**	**Alarm Description**	**Possible Causes and Clearing Alarm**
		Red LED	**Green LED**			
E 430	26	2 flashes	6 flashes	Service Soon / Service Urgent	Compressor start failure	If condition is detected, outdoor unit compressor and fan stop. Antishort cycle is initiated. If condition occurs 10 times within an hour, system is locked out. Indicates poor connection at compressor harness, improper winding resistance, locked compressor rotor, or flooded compressor. To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter and then re-apply power.

Component Testing

ERROR CODES (Cont.):

Table 15. Outdoor Control 7-Segment Display Alert Codes - Compressor

System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed.						
Alert Codes	**Inverter Code**	**Inverter LED Flash Code (number of flashes)**		**Priority**	**Alarm Description**	**Possible Causes and Clearing Alarm**
		Red LED	**Green LED**			
E 433	29	2 flashes	9 flashes	Service Soon / Service Urgent	The inverter has detected a compressor overcurrent condition.	Error occurs when compressor peak phase current is greater than 28A. Inverter issues code 14 first and slows down to try to reduce the current. If the current remains high, outdoor unit compressor and fan stop. Antishort cycle is initiated. If condition occurs five times within an hour, the Unitary Control will cycle the contactor to prevent the unit from locking out. To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter and then re-apply power.
E 439	12	1 flash	2 flashes	Service Soon	Compressor slowdown due to high input current.	Input current is approaching a high limit. Compressor speed automatically slows. The control continues sending the inverter speed demanded by the thermostat. The control sets indoor CFM and outdoor RPM to values according to demand percentage rather than the actual Hz. Alarm is automatically clear.
E 440	13	1 flash	3 flashes	Information Only - Dealer	Heat sink temperature is approaching limit. The compressor speed automatically slows to reduce heat sink temperature. The control sets indoor CFM and outdoor RPM to values according to demand percentage rather than the actual Hz. Alarm is automatically cleared.	This error code is primarily for informational purposes as the inverter controls the compressor speed to operate within design parameters. Typically the inverter will make a minor speed reduction of 4 Hz (approximately a 5-6% speed reduction) for a brief period of time and to reduce the heat sink temperature and will then resume normal operation. This may occur at high outdoor temperatures (above 110ºF) for brief periods of time (3 – 4 minutes) and is normal and expected operation of the inverter controlling the compressor safely within design parameters. The inverter finned aluminum heat sink is located on the back side of the inverter in the condenser air stream. If the alert code 440 occur frequently, especially at lower outdoor temperatures, check the heat sink for debris that may reduce heat transfer or possible obstructions that may impact air flow across the heat sink. The inverter will begin to briefly reduce the compressor speed when the heat sink temperature rises above 167ºF and will allow the inverter to resume the requested compressor demand speed once the inverter heat sink reaches 150ºF.
E 441	14	1 flash	4 flashes	Information Only - Dealer	Compressor slowdown due to high compressor current. Compressor current is approaching limit. The compressor speed automatically slows. The control sets indoor CFM and outdoor RPM to values according to demand percentage rather than the actual Hz. Alarm is automatically cleared.	This error code is primarily for informational purposes as the inverter controls the compressor to operate within design parameters. Alert code 441 typically occurs at startup as the compressor as the currently increases rapidly during startup. The inverter will reduce the compressor speed by 4 hz and slow the compressor ramp up speed to the requested compressor demand (capacity). This is normal and expected operation of the inverter to control the compressor within design parameters. In most cases the alert code 441 does not require any additional service or diagnostic procedures. E441 may also occur if the system is operating at high pressures.

CRANKCASE HEATER, CHECKOUT AND STATUS / ERROR CODES

OPERATION:

Crankcase Heater (HR1)

Compressors in all units are equipped with a 40 watt belly-band type crankcase heater. The heater prevents liquid from accumulating in the compressor. The heater is controlled by the crankcase heater thermostat.

Crankcase Heater Thermostat (S40)

Crankcase heater thermostat S40 controls the crankcase heater in all units and is located on the liquid line (see **Figure 2** and **Figure 3** for locations).

1. When liquid line temperature drops below 50°F the thermostat closes which results in the heater being energized.
2. When liquid line temperature rises above 70°F the thermostat opens which results in the heater being de-energized.

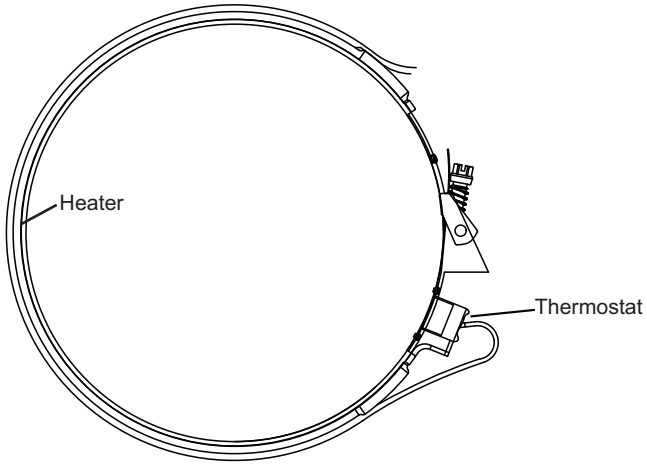


Figure 37. Belly-Band Crankcase Heater Thermostat

CHECKOUT:

Belly-Band Crankcase Heater: Using meter set on ohms, check crankcase heater resistance. If resistance is 0 ohms or infinite, replace the crankcase heater.

NOTE - Crankcase heater thermostat must be closed (above 70°F, 21°C) when checking the crankcase heater.

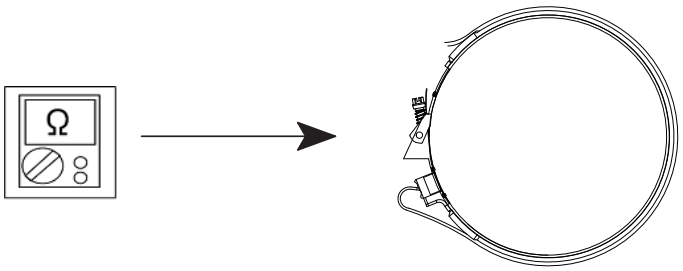


Figure 38. Checking Belly-Band Crankcase Heater

Crankcase Heater Thermostat: As the detected temperature changes, the resistance across the sensor changes.

STATUS CODE:
None

ERROR CODES:
None

Compressor Sound Cover

All units come with a soft-sided polyethylene molded outer shell compressor sound cover. The cover helps reduce any unwanted operating sounds from the compressor. The cover features a hook/loop closure system for ease of installation on the compressor.

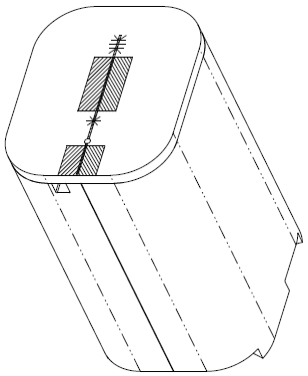


Figure 39. Compressor Sound Cover

Suction Line Filter Drier

The units have a rotary compressor and have a factory installed suction line filter drier installed in the suction line. Liquid drier is not required, but may be field installed. The filter drier is designed to remove moisture and foreign matter, which can lead to compressor failure.

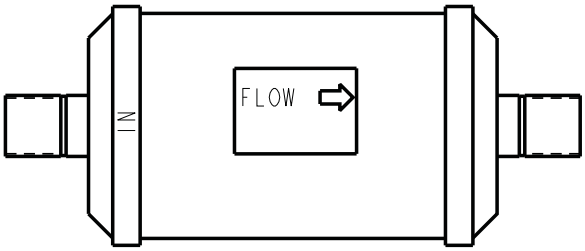


Figure 40. Suction line filter drier

Component Testing

TOP CAP SWITCH OPERATION, CHECKOUT AND STATUS / ERROR CODES

OPERATION:

Top Cap Thermal Sensor Switch (S173)

Some units are equipped with a compressor-mounted normally closed temperature switch that prevents compressor damage due to overheating caused by internal friction. The switch is located on top of the compressor casing. This switch senses the compressor casing temperature and opens at 221 - 239°F. The auto-reset switch closes when the compressor casing temperature falls to 140 - 176°F and the compressor is re-energized. This is a single-pole, single-throw (SPST) bi-metallic switch.

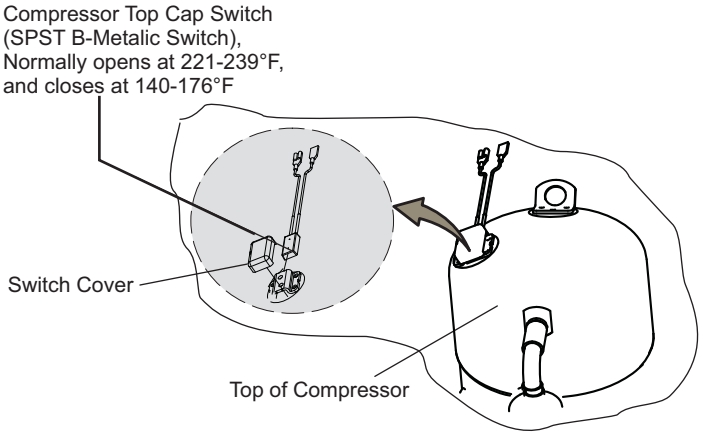


Figure 41. Top Cap Thermal Sensor Switch

CHECKOUT:

Using a multimeter set to ohms, with the terminals disconnected from the system, check the resistance between the two terminals of the top cap switch. If the meter display goes to infinite, the switch is open. If the meter display goes to zero ohms, the switch is closed.

STATUS:
None

ERROR:

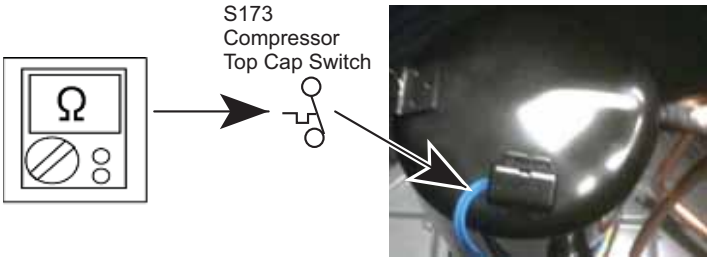


Figure 42. Top Cap Thermal Sensor Switch

Table 16. Outdoor Control 7-Segment Display Alert Codes - Top Cap Switch

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed.			
Alert Codes	**Priority**	**Alarm Description**	**Possible Causes and Clearing Alarm**
E 422	Service Soon	Compressor top cap switch exceeding thermal limit.	The top of the compressor is hot. Refrigerant charge may be low, or low mass flow of refrigerant. Check TXV, clogged filter drier, condenser fan motor, indoor blower motor, confirm indoor coil is clean. Check to make sure the blue wires from the top thermostat did not get pulled off one of the TP terminal on the outdoor control board.
E 442	Service Urgent	The top cap switch has opened 5 times within one hour. As a result, the outdoor unit is locked out.	When compressor thermal protection sensor opens 5 times within 1 hour, outdoor stops working. To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter and then re-apply power.

Component Testing

REACTOR OPERATIONS, CHECKOUT AND STATUS / ERROR CODES

OPERATION:

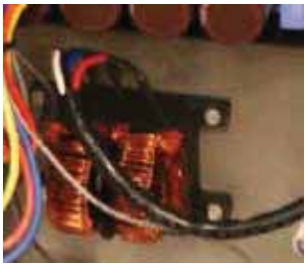
Reactor (Inductor or choke) is a passive two-terminal electrical component that stores energy in its magnetic field. Reactors are one of the basic components used in electronics where current and voltage change with time, due to the ability of inductors to delay and reshape alternating currents.

CHECKOUT:

Main Power ON – Voltage IN reactor should be the same as the voltage OUT. With main power OFF and reactor disconnected from system; resistance between leads should be the same

STATUS CODE:
None

ERROR CODES:
None



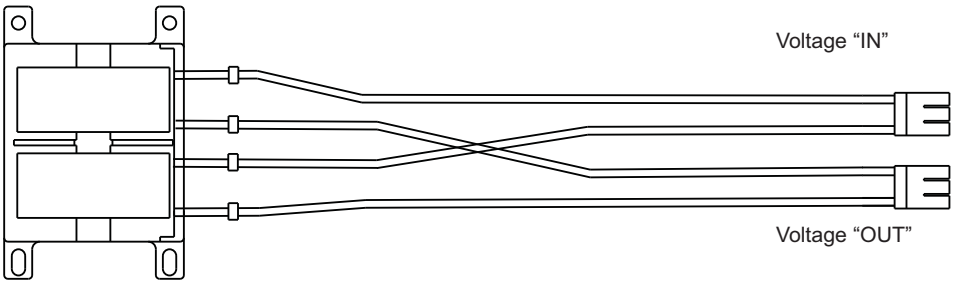


Figure 43. Reactor

OUTDOOR FAN OPERATION AND CHECKOUT

OPERATION:

THE units have a variable speed ECM fan motor. The variable speed ECM fan motor is controlled by PWM fan output when the compressor is running and will vary the fan speed to match the compressor capacity.

LOW AMBIENT OPERATION:

The units have factory installed low ambient cooling mode operation that will control the condenser fan motor based upon liquid line temperature.

The units have a variable speed ECM fan motor. The outdoor control will begin to modulate the outdoor fan motor speed is below 65°F to maintain a liquid line sensor temperature between 58°F and 70°F. If the liquid line sensor drops below 55°F the control will cycle the fan off until liquid temperature rises above 58°F.

CHECKOUT:

VAC Voltage Check

Check for 208/240 VAC power at inverter contactor (red wires) (see **Figure 44**).

1. With the unit running, check for 230VAC at the red outdoor fan motor wires at the contactor. If no voltage is present check main power at the contactor.
2. Perform a DC voltage check between the FPWM and Fan C terminal.
3. Using the push button on the control, enter the “fan test mode” in the “field test mode” by pushing and holding the button until solid “-” appears, release the button. Display will start flashing, within 10 seconds, push and hold the button until the “F” symbol displays then release the button. Display will begin to flash “F”, within 10 seconds, push and hold the button until it stops flashing, release the button. Outdoor fan motor will cycle on for 10 minutes. To exit, push and hold the button until three horizontal bars display. Release the button and the outdoor fan will cycle off.

Component Testing

OUTDOOR FAN OPERATION AND CHECKOUT (Cont.)

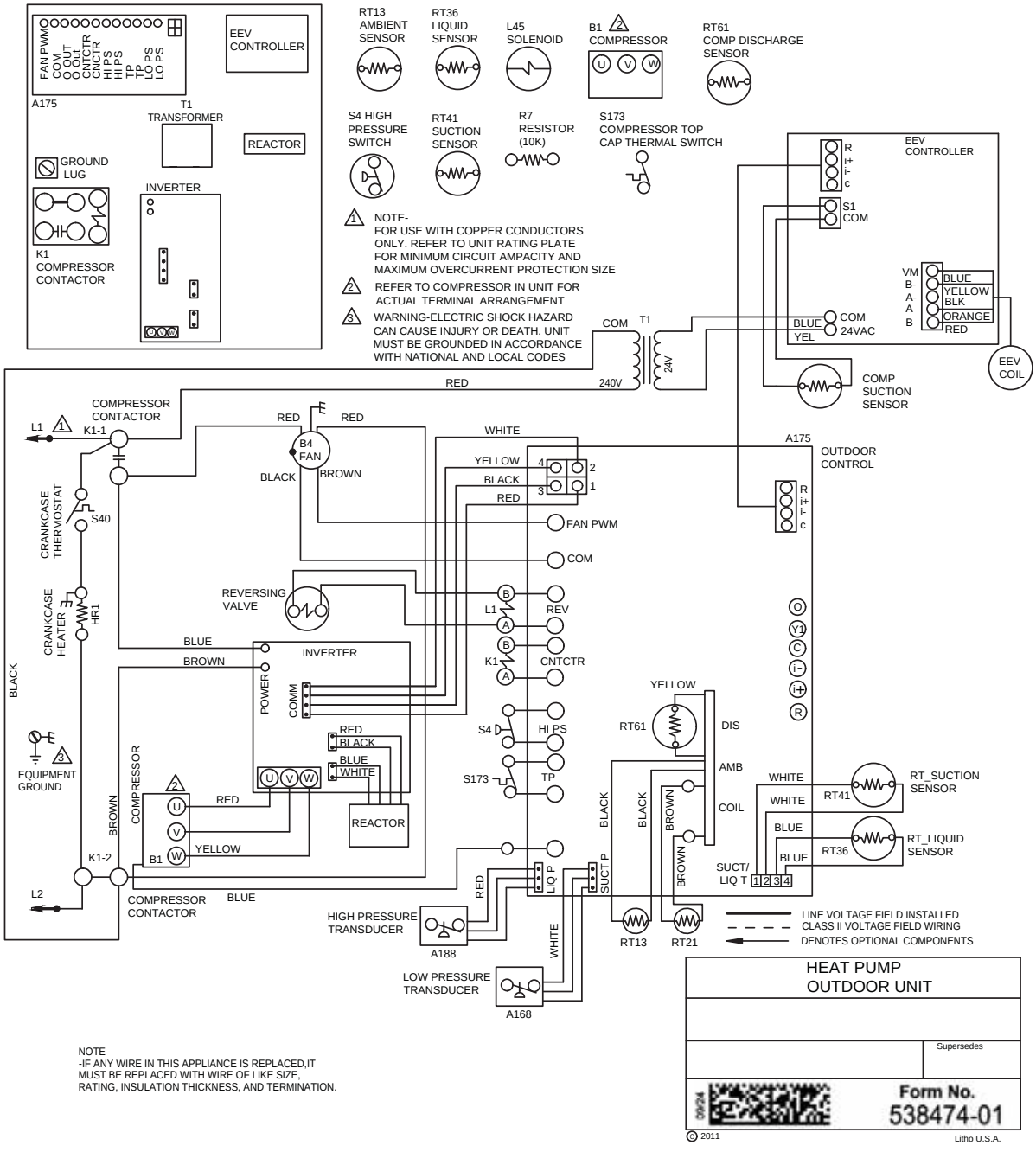


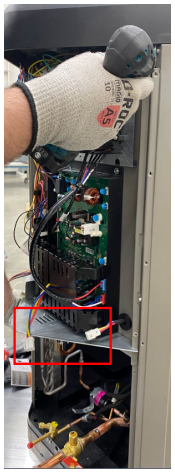
Figure 44. VAC Voltage Check

Outdoor Fan Motor Servicing

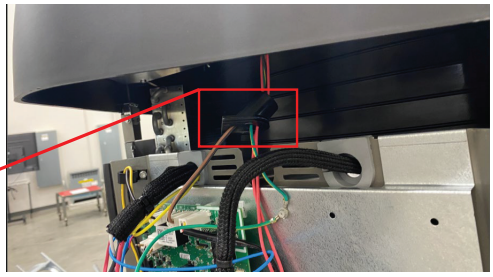
SERVICING FAN WITHOUT REMOVING COMPOSITE TOP

To remove the fan motor assembly without removing the Composite top see steps below:

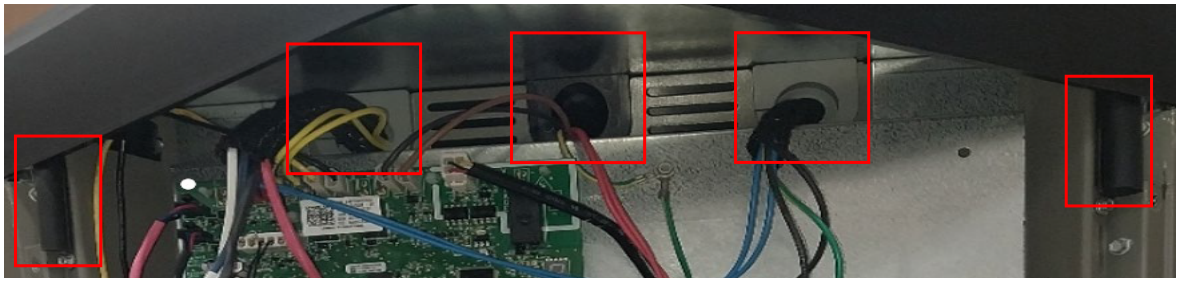
1. Turn off all power to the outdoor unit low and high voltage. Remove the Control Panel.
2. Disconnect compressor harness from plug.



3. Remove (4) screws that secure the unit patch plate, remove patch plate and set to the side.
4. Remove (4) screws that secure the control panel to the corner posts. Drop the control panel approximately 2” and screw the bottom of control panel into the top holes for the patch plate.
5. Disconnect fan wires from control board, contactor, and fan ground wire. Slide the wires through the angled grommet.
6. Remove fan grille screws from the top panel. Motor/fan can now be serviced.

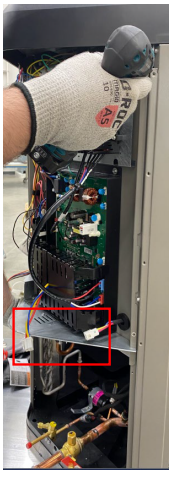


REINSTALLING FAN MOTOR



Reinstalling Fan Motor

1. Secure fan assembly back into the top panel using screws that were removed.
2. Route fan wires through the Angle grommet first.
3. Remove (2) screws from control panel and slide the control panel up. Slide all grommets and gaskets back into the top of the control panel. See red boxes above.
4. Once panel is lined up, secure into place Reinstalling Fan Motor with (4) screws.
5. Attach fan motor wires to contactor, control board and ground screw. Reattach compressor harness to the plug.
6. Reinstall patch plate at the bottom.
7. Check all wiring, then turn power back on and check fan motor operation.



Outdoor Control Operation, Checkout and Status / Error Codes

OPERATION:

The outdoor control is a microprocessor-based device for use with variable-capacity compressors up to 5-tons in capacity operating on 24VAC residential power. The outdoor control integrates the functionality of maintaining compressor speed, and outdoor fan control of ECM motors. The outdoor control is self-configuring. During start-up the outdoor control selects one of two configurations: variable-capacity air conditioner or variable-capacity heat pump.

The outdoor control provides application flexibility. The unit may be installed with a conventional 24VAC non-communicating single or two stage heat pump thermostat.

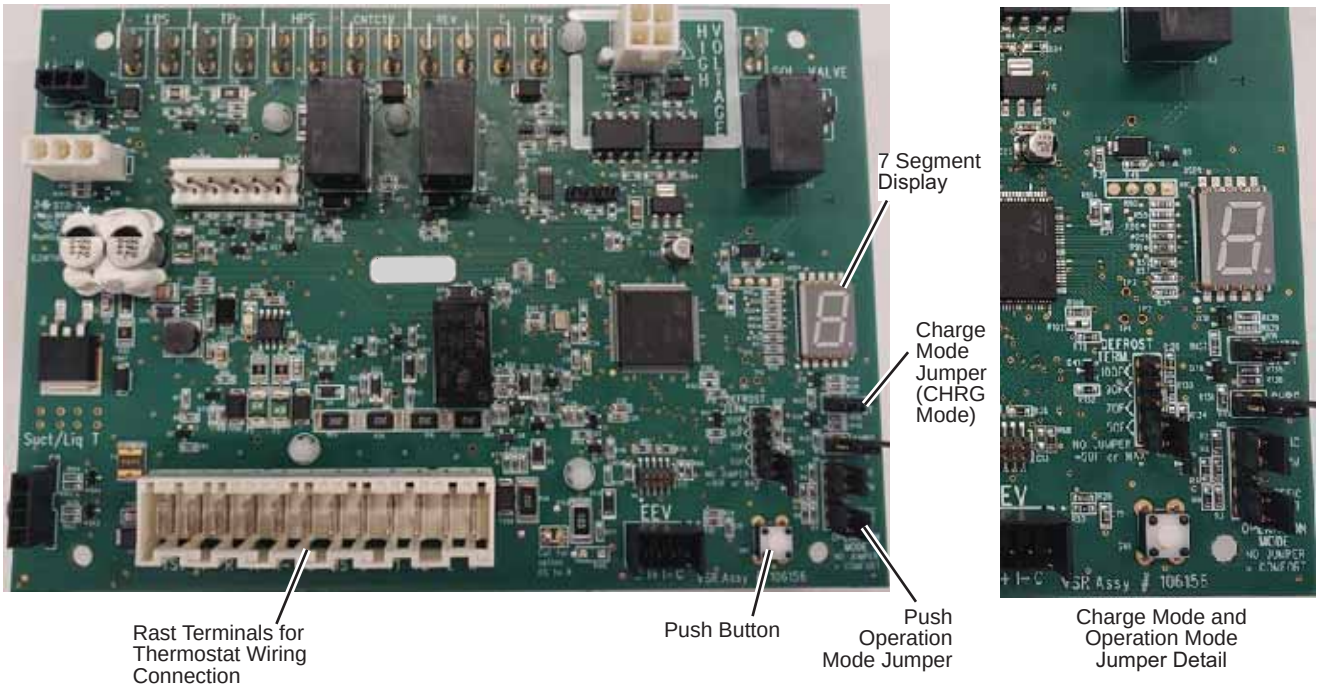


Figure 45. Outdoor Control Unit

STATUS CODES:

Table 17. Outdoor Control 7-Segment Display Alert Codes - Outdoor Control Status

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed.

Alert Codes	Priority	Alarm Description	Possible Causes and Clearing Alarm
E 600	Service Urgent	Compressor has been cycled OFF on utility load shedding	Load shedding function: Provides a method for a local utility company to limit the maximum power level usage of the outdoor unit. The feature is activated by applying 24 volts AC power to the L and C terminals on the outdoor control.
E 601	Service Urgent	Outdoor unit has been cycled OFF on low temperature protection.	Low temperature Protection: Outdoor unit will not operate when the outdoor temperature is at or below -4° F (-20°C). If the unit is operating and the outdoor temperature drops below -4°F (-20°C), the unit will continue to operate until the room thermostat is satisfied or the outdoor temperature drops to -15°F (-26°C). (Outdoor unit ambient sensor provides temperature readings.)

System Configuration

THERMOSTAT CONTROL OPTIONS

Conventional 24VAC Non-Communicating Heat Pump Thermostat Control

The variable capacity unit may be installed using a conventional 24VAC non-communicating two-stage cooling or single-stage heat pump thermostat.

NOTE – The conventional 24VAC non-communicating thermostat must have a compressor minimum on time of three minutes to prevent compressor short cycling.

The unit will provide full variable capacity operation when installed with a conventional 24VAC non-communicating two stage or single-stage heat pump thermostat. The outdoor control has advanced control algorithms using the suction pressure sensor in the cooling mode and liquid pressure sensor in the heating mode to provide true variable capacity compressor operation.

When utilizing a two-stage conventional 24VAC non-communicating heat pump thermostat, six wires are required to control the outdoor unit (R, C, Y1, Y2, O and W). Refer to the field wiring diagram for a conventional 24VAC non-communicating 2-stage heat pump thermostat.

Thermostat Control Options

Thermostat Type	Indoor Unit Type	Qty. of Wires to Unit	Terminal Strip Connections	Unit Operation	Field Wiring Diagram
Conventional 24VAC 2-Stage Heat Pump Thermostat (non-communicating)	Any Furnace or Air Handler (non-communicating or communicating)	6	R, C, Y1, Y2, O, W	Full Variable Capacity Operation Controlled by NS21H Unitary Control Using Suction Pressure in Cooling Mode and Liquid Pressure in Heating Mode	Figure 25

COOLING OPERATION MODE JUMPER

The Cooling Operation Mode Jumper is only used on applications installed with a conventional 24VAC non-communicating heat pump thermostat. In applications with a conventional 24VAC non-communicating heat pump thermostat, the compressor capacity is controlled to maintain the target suction pressure setpoint. The Cooling Operation Mode Jumper has three selectable cooling modes. The three modes are Efficiency (Jumper installed on Pins 1 & 2), Normal Mode (Jumper installed on Pins 2 & 3) and Comfort Mode (Jumper Removed). The factory default position is the Efficiency Mode. The Efficiency mode has a variable suction pressure setpoint that will vary with the outdoor temperature; as the outdoor temperature increases the suction pressure setpoint will decrease. When the Cooling Operation Mode jumper is installed in the “Normal Mode” the suction pressure setpoint is 135 psig.

When the Cooling Operation Mode jumper is installed in the “Comfort Mode” the suction pressure setpoint is 125 psig.

HEATING OPERATION MODE JUMPER

The Heating Operation Mode Jumper is only used on applications installed with a conventional 24VAC non-communicating heat pump thermostat. In applications with a conventional 24VAC non-communicating heat pump thermostat, the compressor capacity is controlled to maintain the target liquid pressure setpoint. The Heating Operation Mode Jumper has two selectable heating modes. The two modes are Efficiency (Jumper installed on Pins 1 & 2) and Comfort Mode (Jumper Removed). The factory default position is the Efficiency Mode. The Efficiency mode has a variable liquid pressure setpoint that will vary with the outdoor temperature; as the outdoor temperature decreases, the liquid pressure setpoint will increase. When the Operation Mode jumper is installed in the “Comfort Mode” the liquid pressure setpoint is 425 psig.

Heating Operation Mode Jumper (Conventional 24VAV Thermostats Only)

Operation Mode Jumper	Jumper Position	Target Suction Pressure Setting
Efficiency (default)	Pin 4 to Pin 25	Variable based on OAT
Comfort	Jumper Offr	425 PSIG

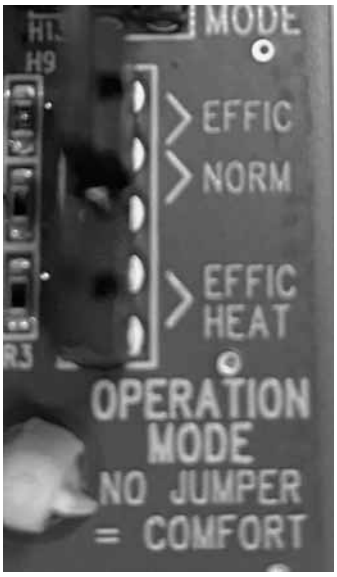


Figure 46. Operation Mode Jumper

UNIT OPERATION

Unit Operation with a Conventional 24VAC Non-Communicating 2-Stage Heat Pump Thermostat – Cooling Mode

When the nit is installed with a conventional 24VAC non-communicating 2-stage heat pump thermostat, the O terminal on the thermostat will energize the unit reversing valve to place the unit in the cooling mode. A Y1 first stage cooling demand will initiate cooling operation and first stage indoor blower operation. The compressor will be controlled in the variable capacity mode by varying the compressor capacity to obtain the target suction pressure set point. The Y2 second stage cooling demand will initiate second stage blower operation. Increased air volume will increase the load on the indoor coil and increase the suction pressure. The compressor capacity will continue to be controlled based upon the suction pressure. The unit capacity will be controlled in the variable capacity mode throughout the range of capacity from minimum capacity to maximum capacity. If the Y2 demand remains after 20 minutes, the control will begin to ramp up the compressor capacity until maximum capacity is achieved. The unit will cycle off once the thermostat demand is satisfied.

Unit Operation with a Conventional 24VAC Non-Communicating 2-Stage Heat Pump Thermostat - Heating Mode

When the unit is installed with a conventional 24VAC non-communicating 2-stage heat pump thermostat, O terminal is not powered during the heating mode and the reversing valve is de-energized placing hte unit in the heating mode. A Y1 first stage compressor demand will initiate compressor operation and first stage indoor blower operation. The compressor will be controlled in the variable capacity mode by varying the compressor capacity to obtain the target liquid pressure set point. The Y2 second stage compressor demand will initiate second stage blower operation. Increased air volume will increase heat transfer on the indoor coil and degrease the liquid pressure. if the liquid pressure drops below the target setpoint, the compressor capacity will be increased. The compressor capacity will continue to be controlled based upon the liquid pressure. The unit capacity will be controlled in the variable capacity mode throughout the range of capacity from minimum capacity to maximum capacity. If the Y2 demand remains after 20 minutes, the control will begin to ramp up the compressor capacity until maximum capacity is achieved. The unit will cycle off once the thermostat demand is satisfied.

Emergency 24VAC System Operation

Emergency 24VAC Operation with Conventional 24VAC Thermostat

The variable capacity heat pump Emergency Operation will operate as single-stage unit at 100% capacity using a 24VAC input. The Emergency Operation is accomplished by providing (4) 24VAC wires (R, C, Y1 and O) to the heat pump. The thermostat used for Emergency Operation requires a single-stage heat pump thermostat.

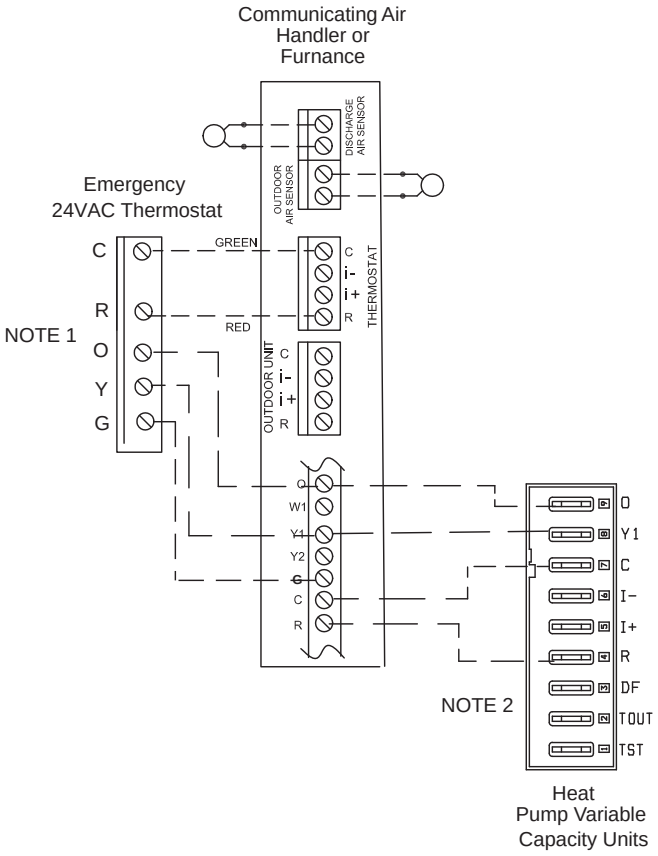
When Emergency Operation is initiated, the blower air volume must be checked to verify blower operation at full air volume during a cooling demand or heat pump demand. Adjustments to the blower air volume settings can be made using the indoor blower speed DIP switches or jumpers on the indoor unit iComfort control. The Emergency 24VAC thermostat operation wiring detail is provided below.

Emergency 24VAC Thermostat Operation (Non-Communicating Mode)

NOTES:

1 - For Emergency 24VAC thermostat operation, install 24VAC conventional single stage heat pump thermostat. Wire the emergency thermostat as shown on the Emergency 24VAC wiring diagram. The outdoor unit will operate at 100% output in this configuration.

2 - For Emergency 24 VAC thermostat operation, make the following outdoor unit wiring changes. Move the wire on both indoor and outdoor controls from terminals i+ to Y1. On heat pumps move the wire from i- to O on both the indoor and outdoor control.



Emergency 24VAC System Operation

ERROR CODES:

Table 18. Outdoor Control 7-Segment Display Alert Codes - Outdoor Control Errors

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed.

Alert Codes	Priority	Alarm Description	Possible Causes and Clearing Alarm
E 105	Service Soon	The outdoor control has lost communication with either the thermostat or indoor unit.	Equipment is unable to communicate. Indicates numerous message errors. In most cases errors are related to electrical noise. Make sure high voltage power is separated from RS Bus. Check for miswired and/or loose connections between the stat, indoor unit and outdoor unit. Check for a high voltage source of noise close to the system. Fault clears after communication is restored.
E 120	Service Soon	Unresponsive device	There is a delay in the system component responding to the system. Typically this alert code does not cause any operational issues and will clear on its own. • This alert code is usually caused by a delay in the outdoor unit responding to the thermostat. • Leaking voltage from strands within the bundle. > Land only the R wire on the R terminal to load the bundle with 24VAC. ► Typically only the R wire needs to be landed to identify if voltage is leaking. ► If voltage is present checking the other wires is informational only but not needed. ► If voltage is not present checking the other wires one at a time would be needed. > Check each loose wire in AC mode to C on circuit board. ► Good voltage is .03 -.3VAC leaking voltage is not the issue. ► Acceptable can be up to .7VAC with moderate success. ► Some units have worked with up to 1.2VAC with occasional success. ► Voltage over 1.2VAC needs to be addressed.
E 124	Service Urgent	Equipment lost communicationt	The thermostat has lost communication with a system component for more than three minutes. System component has lost communication with the thermostat. • Check the wiring connections between components. • Ohm wires. • Cycle power. • Any component that is miss-wired may cause a false component code to be shown on system component. • Disconnect all wiring to other system components and check communication one at a time. **NOTE:** When using a float switch, use isolation relay to break common wire to outdoor unit. For testing purposes, remove float switch from the circuit This alert code stops all associated system operations and waits for a heartbeat message from the system component that is not communicating.
E 125	Service Urgent	There is a hardware problem with the outdoor control.	There is a control hardware problem. Replace the outdoor control if the problem prevents operation and is persistent. The alarm / fault is cleared 300 seconds after the fault recovers
E 131	Service Urgent	The outdoor unit control parameters are corrupted	Reconfigure the system. Replace the control if heating or cooling is not available.
E 132	Service Urgent	Internal software error	Replace outdoor control.

Unit Sensor Operation, Checkout and Status /Error Codes

OPERATION:

6-Pin Sensor Harness (DIS, AMB, COIL)

Discharge Sensor (DT61)
The discharge temperature sensor is connected to the discharge line below the discharge check valve and is connected to pins 1 and 2. See **Figure 48** for specific sensor location on discharge line.

Ambient Temperature Sensor (RT13)
Ambient temperatures, as read by the ambient temperature sensor connected to pin 3 and pin 4, which are below -35°F (-37°C) or above 120°F (48°C) trigger a fault condition. If the ambient sensor is open, shorted, or out of the temperature range of the sensor, the control displays the appropriate alert code. Heating and cooling operation is allowed in this fault condition.

Coil Temperature Sensor (RT21)
The liquid temperature sensor is located on the outlet of the outdoor EEV and is connected to pins 5 and 6.

SENSOR	TEMP RANGE °F(°C)	RESISTANCE VALUES RANGE (OHMS)	PIN# / WIRE SLEEVE COLOR
COIL	-40 (-40) TO 140 (60)	336,000 to 2,487 (see table 19 on page 83 for exact temperature to ohm readings)	6 AND 5 (BROWN)
OUTDOOR AMBIENT	-40 (-40) TO 140 (60)	336,000 to 2,487 (see table 19 on page 83 for exact temperature to ohm readings)	4 AND 3 (BLACK)
DISCHARGE	40 (-40) TO 140 (60)	336,000 to 2,487 (see table 19 on page 83 for exact temperature to ohm readings)	2 AND 1 (YELLOW)

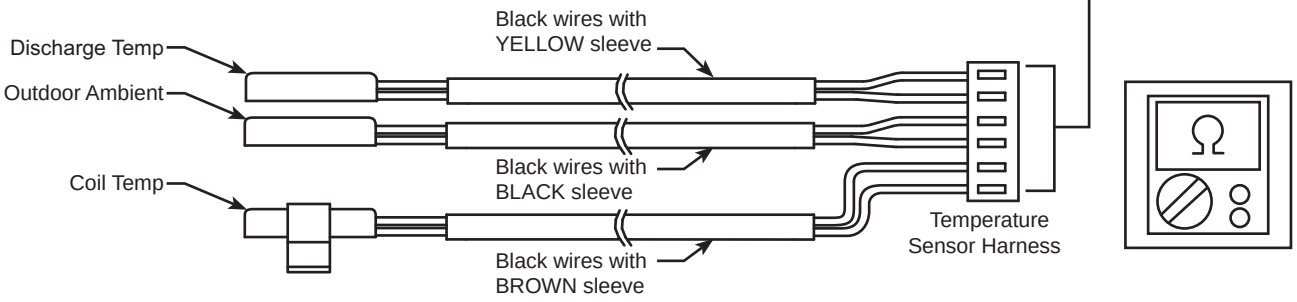


Figure 47. Temperature Sensor Specification

4-Pin Suction Temperature Sensor / Liquid Temperature Sensor Harness

Suction Line Sensor (RT41)
Suction line temperature is read by the suction line temperature sensor between Pins 1 and Pin 2 of the 4-pin sensor harness. Nominal Resistance of the sensor is 10K ohms at 77°F. The control will display an E182 error code if the sensor reads open or shorted for 24 hours. Cooling operation is allowed with this fault.

Liquid Line Temperature Sensor (RT36)
Liquid line temperature is read by the liquid line temperature sensor between Pins 3 and Pin 4 of the 4-pin sensor harness. Nominal Resistance of the sensor is 10K ohms at 77°F. The control will display are E184 error code if the sensor reads open or shorted for 24 hours. Cooling operation is allowed with this fault.

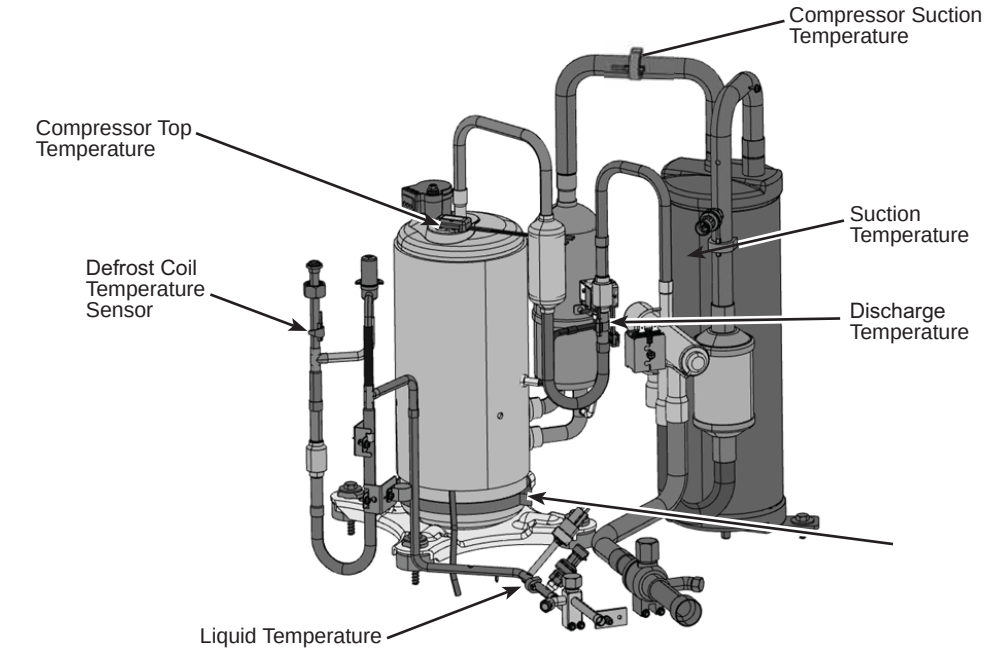
CHECKOUT:

Sensors connect to the outdoor control through a field-replaceable harness assembly that plugs into the outdoor control. Through the sensors, the control detects outdoor ambient, coil and liquid temperature fault conditions. As the detected temperature changes, the resistance across the sensor changes. Check sensor operation by reading ohms across pins shown in **Figure 48**.

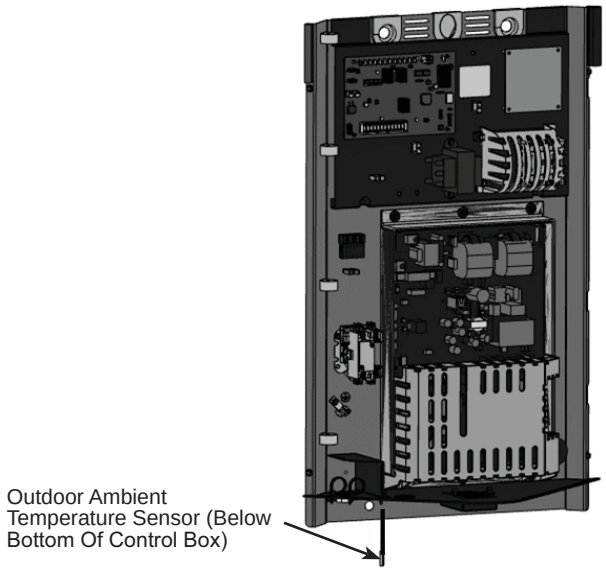
NOTE – When checking the ohms across a sensor, be aware that a sensor showing a resistance value that is not within the range shown in **Figure 47**, may be performing as designed. However, if a shorted or open circuit is detected, then the sensor may be faulty and the sensor harness will need to be replaced.

4-Pin Suction Temperature Sensor / Liquid Temperature Sensor Harness

CHECKOUT (Cont.) :



Prior to startup, ensure each temperature sensor is in the correct locaon. Ensure thermistors clipped on to piping are not loose.



Sensor	Sleeve Color
Coil Temperature	Brown
Compressor Suction Temperature	White
Suction Temperature	White
Discharge Temperature	Yellow
Crankcase Heater Thermostat	Black
Ambient Temperature	Black
Liquid Temperature	Blue
Compressor Top Temperature	Blue

Figure 48. Temperature Sensor Locations

4-Pin Suction Temperature Sensor / Liquid Temperature Sensor Harness

CHECKOUT (Cont.) :

Table 19. Coil, Ambient and Liquid Line Sensors Temperature / Resistance Range

Degrees F	Resis. Ohms	Degrees F	Resis. Ohms	Degrees F	Resis. Ohms	Degrees F	Resis. Ohms	Degrees F	Resis. Ohms
136.3	2680	66.9	12847	32.4	32273	2.3	79465	-33.2	262482
133.1	2859	66.0	13122	29.6	34918	1.7	80873	-34.1	271655
130.1	3040	65.2	13400	29.1	35471	1.2	82314	-35.1	281400
127.3	3223	64.4	13681	28.6	36031	0.6	83790	-36.1	291774
124.7	3407	63.6	13964	28.0	36600	0.0	85302	-37.1	302840
122.1	3592	62.8	14251	27.5	37177	-0.5	86852	-38.2	314669
119.7	3779	62.0	14540	26.9	37764	-1.1	88440	-39.2	327343
117.5	3968	56.8	16657	26.4	38359	-1.7	90068		
115.3	4159	56.0	16973	25.8	38963	-2.2	91738		
113.2	4351	55.3	17293	25.3	39577	-2.8	93452		
111.2	4544	54.6	17616	21.6	44154	-3.4	95211		
109.3	4740	53.9	17942	21.0	44851	-4.0	97016		
107.4	4937	53.2	18273	20.5	45560	-4.6	98870		
105.6	5136	52.5	18607	20.0	46281	-5.2	100775		
103.9	5336	51.9	18945	19.4	47014	-5.7	102733		
102.3	5539	51.2	19287	18.9	47759	-6.3	104746		
100.6	5743	50.5	19633	18.4	48517	-6.9	106817		
99.1	5949	49.9	19982	17.8	49289	-11.3	123152		
97.6	6157	49.2	20336	17.3	50074	-11.9	125787		
96.1	6367	48.5	20695	16.8	50873	-12.6	128508		
94.7	6578	47.9	21057	16.3	51686	-13.2	131320		
93.3	6792	47.3	21424	15.7	52514	-13.9	134227		
92.0	7007	46.6	21795	15.2	53356	-14.5	137234		
90.6	7225	46.0	22171	14.7	54215	-15.2	140347		
89.4	7444	45.4	22551	14.1	55089	-15.9	143571		
88.1	7666	44.7	22936	13.6	55979	-16.5	146913		
86.9	7890	44.1	23326	13.1	56887	-17.2	150378		
85.7	8115	43.5	23720	12.5	57811	-17.9	153974		
84.5	8343	42.9	24120	12.0	58754	-18.6	157708		
83.4	8573	42.3	24525	11.5	59715	-19.3	161588		
82.3	8806	41.7	24934	11.0	60694	-20.1	165624		
81.2	9040	41.1	25349	10.4	61693	-20.8	169824		
80.1	9277	40.5	25769	9.9	62712	-21.5	174200		
79.0	9516	39.9	26195	9.3	63752	-22.3	178762		
78.0	9757	39.3	26626	8.8	64812	-23.0	183522		
77.0	10001	38.7	27063	8.3	65895	-23.8	188493		
76.0	10247	38.1	27505	7.7	67000	-24.6	193691		
75.0	10496	37.5	27954	7.2	68128	-25.4	199130		
74.1	10747	37.0	28408	6.7	69281	-26.2	204829		
73.1	11000	36.4	28868	6.1	70458	-27.0	210805		
72.2	11256	35.8	29335	5.6	71661	-27.8	217080		
71.3	11515	35.2	29808	5.0	72890	-28.7	223677		
70.4	11776	34.7	30288	4.5	74147	-29.5	230621		
69.5	12040	34.1	30774	3.9	75431	-30.4	237941		
68.6	12306	33.5	31267	3.4	76745	-31.3	245667		
67.7	12575	33.0	31766	2.8	78090	-32.2	253834		

4-Pin Suction Temperature Sensor / Liquid Temperature Sensor Harness

CHECKOUT (Cont.) :

Discharge Line Sensor Temperature Resistance Table

Degrees F	Resis. Ohms	Degrees F	Resis. Ohms	Degrees F	Resis. Ohms	Degrees F	Resis. Ohms	Degrees F	Resis. Ohms	Degrees F	Resis. Ohms
0	85,407	45	22,765	90	7334	135	2752	180	1170	225	551
1	82,739	46	22,156	91	7165	136	2696	181	1149	226	543
2	80,163	47	21,567	92	7000	137	2642	182	1129	227	534
3	77,677	48	20,994	93	6840	138	2590	183	1109	228	526
4	75,276	49	20,439	94	6683	139	2538	184	1090	229	518
5	72,957	50	19,901	95	6531	140	2488	185	1071	230	510
6	70,718	51	19378	96	6383	141	2439	186	1052	231	502
7	68,555	52	18871	97	6239	142	2390	187	1034	232	495
8	66,466	53	18378	98	6098	143	2343	188	1016	233	487
9	64,447	54	17900	99	5961	144	2297	189	999	234	480
10	62,497	55	17437	100	5827	145	2253	190	982	235	473
11	60,613	56	16986	101	5697	146	2209	191	965	236	465
12	58,791	57	16549	102	5570	147	2166	192	948	237	458
13	57,031	58	16124	103	5447	148	2124	193	932	238	452
14	55,329	59	15712	104	5326	149	2083	194	916	239	445
15	53,684	60	15311	105	5209	150	2043	195	901	240	438
16	52,093	61	14923	106	5094	151	2003	196	885	241	432
17	50,555	62	14545	107	4982	152	1965	197	871	242	425
18	49,067	63	14178	108	4873	153	1927	198	856	243	419
19	47,628	64	13821	109	4767	154	1891	199	842	244	413
20	46,236	65	13475	110	4664	155	1855	200	827	245	407
21	44,890	66	13138	111	4563	156	1820	201	814	246	401
22	43,587	67	12811	112	4464	157	1785	202	800	247	395
23	42,327	68	12493	113	4368	158	1752	203	787	248	389
24	41,107	69	12183	114	4274	159	1719	204	774	249	384
25	39,926	70	11883	115	4183	160	1687	205	761	250	378
26	38,783	71	11591	116	4094	161	1655	206	749		
27	37,677	72	11307	117	4007	162	1624	207	736		
28	36,606	73	11031	118	3922	163	1594	208	724		
29	35,569	74	10762	119	3839	164	1565	209	712		
30	34,565	75	10501	120	3758	165	1536	210	701		
31	33,592	76	10247	121	3679	166	1508	211	690		
32	32,650	77	10000	122	3602	167	1480	212	678		
33	31,738	78	9760	123	3527	168	1453	213	667		
34	30,855	79	9526	124	3453	169	1427	214	657		
35	29,999	80	9299	125	3382	170	1401	215	646		
36	29,170	81	9077	26	3312	171	1376	216	636		
37	28,366	82	8862	127	3244	172	1351	217	626		
38	27,588	83	8652	128	3177	173	1327	218	616		
39	26,833	84	8448	129	3112	174	1303	219	606		
40	26,101	85	8250	130	3048	175	1280	220	597		
41	25,392	86	8057	131	2986	176	1257	221	587		
42	24,705	87	7869	132	2925	177	1234	222	578		
43	24,038	88	7685	133	2866	178	1212	223	569		
44	23,392	89	7507	134	2808	179	1191	224	560		

4-Pin Suction Temperature Sensor / Liquid Temperature Sensor Harness

CHECKOUT (Cont.) :

Table 20. Outdoor Control 7-Segment Display Alert Codes – Outdoor Control Errors

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/ dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed.			
Alert Codes	**Priority**	**Alarm Description**	**Possible Causes and Clearing Alarm**
E 182	Service Soon	Suction Temperature Sensor has malfunctioned	Sensor is open or shorted. Replace the Sensor.
E 183	Service Soon	Liquid Pressure Transducer Fault	Liquid pressure transducer is out of range. The signal should be between 0.5 VDC and 4.5 VDC between Blue and Black. The error code will be cleared when the proper signal is provided. Systems controlled by a conventional 24VAC heat pump thermostat will operate in stage mode.
E 184	Service Soon	Faulty outdoor liquid line sensor	Sensor is open or shorted. Replace the sensor.
E 186	Service Soon	Discharge temperature too low	Discharge temperature reading too low. Heat pump heating operation can continue. Check discharge temperature sensor location and verify the sensor is secure on the discharge line.
E 187	Service Soon / Service Critical	Discharge temperature/ pressure too high	Discharge temperature or pressure ratio exceeded upper limit. Heat pump heating stopped.

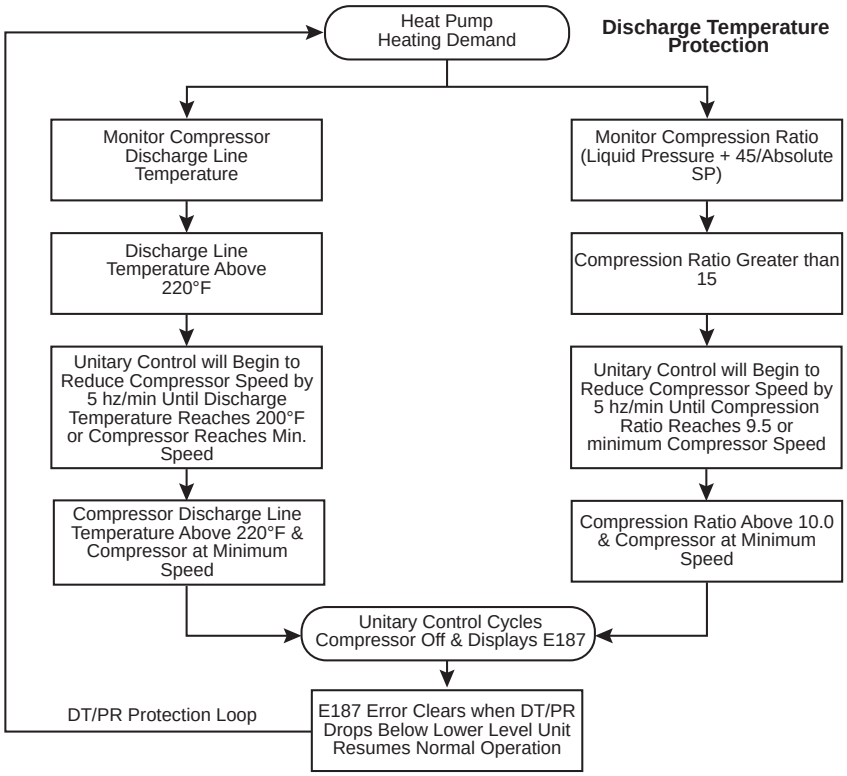


Figure 49.

DC Inverter Control Operation, Checkout, Status / Error Codes

OPERATION OF COMPONENTS:

Electromagnetic compatibility circuit (EMC): EMC ensures the correct operation of different equipment items which use or respond to electromagnetic phenomena. It also helps to negate the effects of interference.

CONVERTER:

Converts AC (alternating current) to DC (direct current).

POWER FACTOR CORRECTION (PFC) CIRCUIT:

The PFC module is an integrated part of the outdoor inverter that monitors the DC bus for high, low and abnormal voltage conditions. If any of these conditions are detected, the PFC function and compressor will stop.

INTELLIGENT (INVERTER) POWER MODULE (IPM):

The IPM converts DC power into AC power. The control method is known as pulse width modulation (PWM). This means the DC is switched on and off very quickly (chopped) by the transistor switches to make simulated AC at required frequency and voltage.

COMMUNICATION CONTROL CIRCUIT:

Receives and sends message between the inverter and the outdoor control.

STATUS CODES:

Table 21. Outdoor Control 7-Segment Display Alert Codes and Inverter LED Flash Codes

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed.					
Alert Codes	**Inverter LED Flash Code (number of flashes)**		**Priority**	**Alarm Description**	**Possible Causes and Clearing Alarm**
	Red LED	**Green LED**			
N/A	ON	OFF	N/A	NS21H24, NS21H36 only: Indicates inverter is operating normally.	
N/A	ON	ON	N/A	NS21H48, NS21H60 only: Indicates inverter is operating normally.	
N/A	OFF	OFF	N/A	Indicates inverter is NOT energized.	

DC Inverter Control Operation, Checkout, Status / Error Codes

ERROR CODES:

Table 22. Outdoor Control 7-Segment Display Alert Codes and Inverter LED Flash Codes

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed.

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
E 423	40	4 flashes	OFF	Service Soon / Service Urgent	The inverter has detected a circuit problem.	Control will lock out after 10 strikes within an hour. To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter and then re-apply power.
E 427	21	2 flashes	1 flash	Service Soon / Service Urgent	The inverter has detected a DC peak fault condition.	If condition (55A or higher) is detected, outdoor unit will stop (compressor and fan). Antishort cycle is initiated. If peak current (55A or higher) occurs 10 times within an hour, system will lock out. Indicates high pressure, condenser fan failure, locked compressor rotor or overcharge. To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter and then re-apply power.
E 428	22	2 flashes	2 flashes	Service Soon / Service Urgent	The inverter has detected a high main input current condition	If condition is detected, outdoor unit will stop (compressor and fan). Antishort cycle is initiated. If condition occurs 5 times within an hour, the Unitary Control will cycle the contactor to prevent the unit from locking out. Indicates high pressure, condenser fan failure or overcharge. To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter and then re-apply power.
E 429	23	2 flashes	3 flashes	Service Soon / Service Urgent	On a call for compressor operation, if DC link power in inverter does not rise above 180 VDC for 2 and 3 ton models, 250 VDC for 4 and 5 ton models, within 30 seconds, the control will display a service soon code. If condition is detected, outdoor unit will stop (Compressor and fan). Antishort cycles is initiated. If condition occurs 10 times within a 60 minute rolling time period, system will lock out and display a service urgent code.	**Issues:** (1) If DC link power in inverter does not rise above 180 VDC for 2- and 3-ton models, 250 VDC for 4- and 5-ton models, within 30 seconds, the outdoor control will display a service soon code. (2) Capacitors on inverter do not properly charge. **Corrective Actions:** (1) Check for proper main power to outdoor unit and for any loose electrical connections.
E 430	26	2 flashes	6 flashes	Service Soon / Service Urgent	Compressor start failure.	If condition is detected, outdoor unit will stop (compressor and fan). Antishort cycle is initiated. If condition occurs 10 times within an hour, system will lock out. Indicates poor connection at compressor harness, improper winding resistance, locked compressor rotor, or flooded compressor. To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter and then re-apply power.

ERROR CODES (Cont.):

Table 22. Segment Display Alert Codes and Inverter LED Flash Codes

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed.

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
E 431	27	2 flashes	7 flashes	Service Soon / Service Urgent	Error occurs when PFC detects an over-current condition of 100A, the control will display a service soon code. If condition is detected, outdoor unit will stop (Compressor and fan). Anti-short cycle is initiated. Inverter is unavailable to communicate with the outdoor control for 3 minutes. If condition occurs 10 times within a 60 minute rolling time period, system will lock out and display a service urgent code.	**Issues:** (1) Indicates power interruption, brownout, poor electrical connection or loose inverter input wire. (2) System testing was set up and code was generated when the reversing valve is de-energized coming out of defrost (code appears with or without 30 compressor delay). **Corrective Actions:** (1) Check for proper main power to outdoor unit and for any loose electrical connections.
E 432	28	2 flashes	8 flashes	Service Soon / Service Urgent	The inverter has detected a DC link high voltage condition.	Error occurs when the DC link capacitor voltage is greater than 480VDC. If condition is detected, outdoor unit will stop (compressor and fan). Antishort cycle is initiated. If condition occurs 10 times within an hour, system will lock out. System will stop. To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter and then re-apply power.
E 433	29	2 flashes	9 flashes	Service Soon / Service Urgent	The inverter has detected a compressor overcurrent condition	Error occurs when compressor peak phase current is greater than 28A. Inverter will issue code 14 first and slow down to try to reduce the current. If the current remains high, outdoor unit will stop (compressor and fan). Antishort cycle is initiated. If condition occurs 5 times within an hour, the Unitary Control will cycle the contactor to prevent the unit from locking out. To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter and then re-apply power.
E 434	53	5 flashes	3 flashes	Service Soon / Service Urgent	Outdoor control has lost communications with the inverter for greater than 3 minutes. Outdoor unit will stop all compressor demand. Outdoor control will attempt to establish communication multiple times and will automatically clear when the error clears. Unit will lock out after 60 minutes if communication is not established and will display a service urgent error code.	**Issues:** (1) Outdoor disconnect is off or outdoor power is off, when indoor power is on (source for 24VAC) (2) Loose electrical power connections (3) Interruption of main power to the inverter (4) Generator powers indoor unit, but not the outdoor unit. **Corrective Actions:** (1) To reset, cycle the indoor power off (source of 24VAC to outdoor unit) and back on. This will de-energize outdoor control and inverter by cycling the contactor. (2) Make sure the disconnect is on (3) Check electrical power supply connections (4) Check for proper main 230V power supply

ERROR CODES (Cont.):

Table 22. Segment Display Alert Codes and Inverter LED Flash Codes

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed.

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
E 435	60	6 flashes	OFF	Service Soon / Service Urgent	Inverter internal error.	When this error occurs, the outdoor control will cycle power to the inverter by opening the contactor for 2 minutes. Check that the EEPROM is properly seated. After power is cycled to the inverter 3 times, the outdoor unit is locked out.
E 436	62	6 flashes	2 flashes	Service Soon / Service Urgent	Inverter heat sink temperature exceeded limit. Occurs when the heat sink temperature exceeds the inverter limit. Inverter issues code 13 first, then slows down to allow the heat sink to cool. If temperature remains high, outdoor unit stops (compressor and fan). Anti-short cycle is initiated. If condition occurs 5 times within an hour, the Unitary Control will cycle the contactor to prevent the unit from locking out. To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter and then re-apply power.	The inverter finned aluminum heat sink is located on the back side of the inverter in the condenser air stream. If this alert code occurs frequently, especially at lower outdoor temperatures, check the heat sink for debris that may reduce heat transfer or possible obstructions that may impact air flow across the heat sink. Alert code 436 may also occur if the unit is operating at high pressures.
E 437	65	6 flashes	5 flashes	Service Soon / Service Urgent	Heat sink temperature sensor fault has occurred (temperature less than 4 ºF or greater than 264ºF after 10 minutes of operation).	This occurs when the temperature sensor detects a temperature less than 0.4ºF or greater than 264ºF after 10 minutes of operation. If condition is detected, outdoor unit will stop (compressor and fan). Antishort cycle is initiated. If condition occurs 5 times within an hour, system will lock out. To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter and then re-apply power.

ERROR CODES (Cont.):

Table 22. Segment Display Alert Codes and Inverter LED Flash Codes

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed.

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
E 438	73	7 flashes	3 flashes	Service Soon / Service Urgent	The inverter has detected a PFC over current condition. This would be caused by a high load condition, high pressure, or outdoor fan failure. Outdoor control will display the code when the inverter has the error. After 3 minutes, the inverter will reset and the compressor will turn on again. If it happens 10 times within a 60 minute rolling time period, the OD control will lock out operation of the outdoor unit and display a service urgent code.	**Issue:** Possible issue is system running at high pressures. Check for high pressure trips or other alert codes in room thermostat and outdoor control. To clear, disconnect power to the indoor unit (24VAC power source to the outdoor control) which will power off the outdoor control and will open the outdoor unit contactor, which interrupts power to the inverter and then re-apply power.
E 439	12	1 flash	2 flashes	Information Only - Dealer	Compressor slowdown due to high input current.	This error code is primarily for informational purposes as the inverter controls the compressor to operate within design parameters. Typically the inverter will make a minor speed reduction of 4 Hz (approximately a 5-6% speed reduction) for a brief period of time and to reduce the input current and will then resume normal operation.
E 440	13	1 flash	3 flashes	Information Only - Dealer	Heat sink temperature is approaching limit. The compressor speed automatically slows to reduce heat sink temperature. The control sets indoor CFM and outdoor RPM to values according to demand percentage rather than the actual Hz. Alarm is automatically cleared.	This error code is primarily for informational purposes as the inverter controls the compressor speed to operate within design parameters. Typically the inverter will make a minor speed reduction of 4 Hz (approximately a 5-6% speed reduction) for a brief period of time and to reduce the heat sink temperature and will then resume normal operation. This may occur at high outdoor temperatures (above 110ºF) for brief periods of time (3 – 4 minutes) and is normal and expected operation of the inverter controlling the compressor safely within design parameters. The inverter finned aluminum heat sink is located on the back side of the inverter in the condenser air stream. If he alert code 440 occurs frequently, especially at lower outdoor temperatures, check the heat sink for debris that may reduce heat transfer or possible obstructions that may impact air flow across the heat sink. The inverter will begin to briefly reduce the compressor speed when the heat sink temperature rises above 167ºF and will allow the inverter to resume the requested compressor demand speed once the inverter heat sink reaches 150ºF.

ERROR CODES (Cont.):

Table 22. Segment Display Alert Codes and Inverter LED Flash Codes

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed.

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
E 441	14	1 flash	4 flashes	Information Only - Dealer	Compressor slowdown due to high compressor current. Compressor current is approaching limit. The compressor speed automatically slows. The control sets indoor CFM and outdoor RPM to values according to demand percentage rather than the actual Hz. Alarm is automatically cleared.	This error code is primarily for informational purposes as the inverter controls the compressor to operate within design parameters. Alert code 441 typically occurs at startup as the compressor as the currently increases rapidly during startup. The inverter will reduce the compressor speed by 4 hz and slow the compressor ramp up speed to the requested compressor demand (capacity). This is normal and expected operation of the inverter to control the compressor within design parameters. In most cases the alert code 441 does not require any additional service or diagnostic procedures. E441 may also occur if the system is operating at high pressures. This error code is primarily for informational purposes as the inverter controls the compressor to operate within design parameters. Alert code 441 typically occurs at startup as the compressor as the currently increases rapidly during startup. The inverter will reduce the compressor speed by 4 hz and slow the compressor ramp up speed to the requested compressor demand (capacity). This is normal and expected operation of the inverter to control the compressor within design parameters. In most cases the alert code 441 does not require any additional service or diagnostic procedures. E441 may also occur if the system is operating at high pressures.

System Refrigerant

⚠IMPORTANT The system must be operating at full capacity during charging. Using the Charge Mode Jumper on the outdoor control ensures the unit is running at 100% capacity. Confirm outdoor unit running capacity.

This section outlines the procedures to:

1. Connect a gauge set for testing and charging as illustrated in **Figure 50**.
2. Check and adjust indoor airflow as described in **Figure 52**.
3. Add or remove refrigerant using the weigh-in method shown in **Figure 53**.
4. Verify the charge using the subcooling method described in **Figure 54**.

IMPORTANT: Unit must be operating at 100% capacity to be charged properly.

Adding or Removing Refrigerant

This system uses R454B refrigerant which operates at much higher pressures than HFC-410A.

Indoor Airflow Check

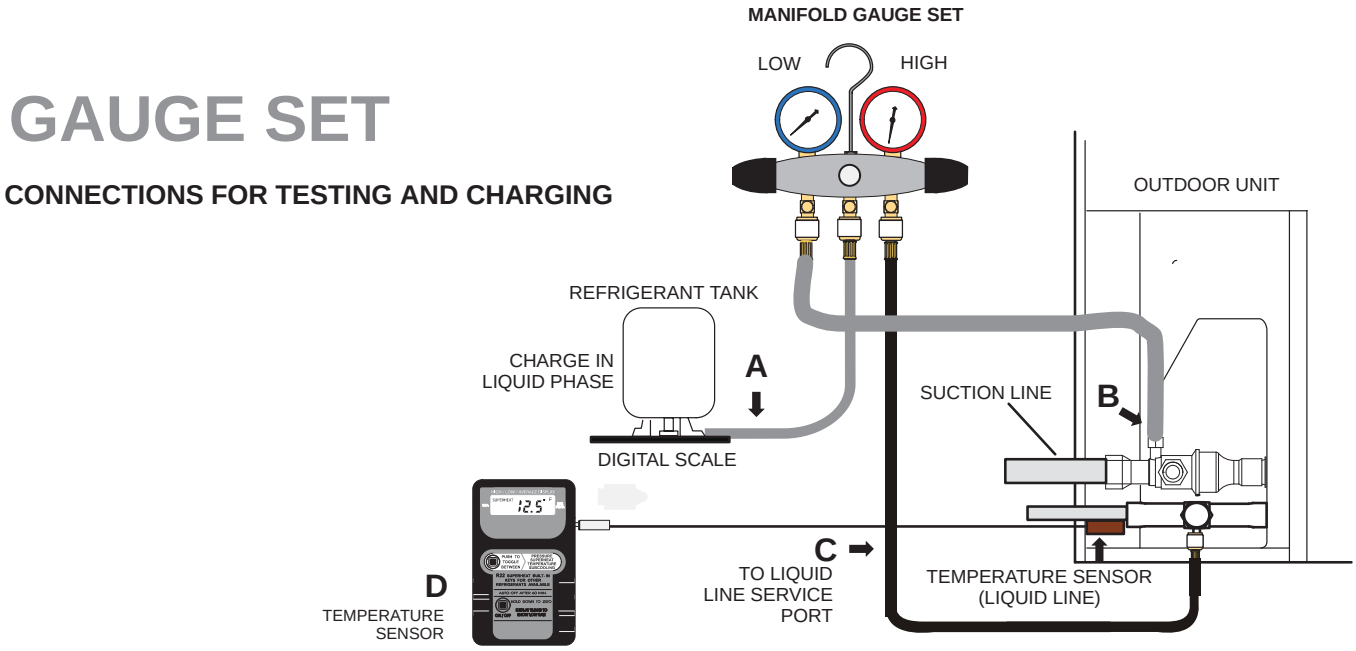
Check airflow using the Delta-T (DT) process using the illustration in **Figure 52**.

Charge Mode Jumper

To initiate the Charge Mode function, install the jumper across the two Charge Mode Pins (CHRG MODE) on the outdoor control. The Charge Mode can be used when charging the system with refrigerant, checking the refrigerant charge, pumping down the system and performing other service procedures that requires outdoor unit operation at 100% capacity.

Charge Mode Operation with a Conventional 24VAC Non-Communicating Heat Pump Thermostat

On applications with a conventional 24VAC non-communicating thermostat, the charge mode jumper must be installed on the Charge Mode Pins after providing a Y1 compressor demand to the NS21H to initiate the Charge Mode. When using the Charge Mode in the cooling mode,the “O” must also be provided with a 24V signal to place the reversing valve in the cool position. In the heating mode only a Y1 compressor demand is required along with the blower demand for the full cooling air volume. A cooling blower demand must also be provided to initiate blower operation on the cooling speed on the indoor unit. The compressor and outdoor fan motor will operate at 100% capacity. To exit the charging mode, remove the Charge Mode Jumper and remove the Y1 Cooling demand and indoor blower demand. The Charge Mode has a maximum time of 60 minutes and will automatically exit the charge mode after 60 minutes is the charge mode jumper is left in place.



A. CLOSE MANIFOLD GAUGE SET VALVES AND CONNECT THE CENTER HOSE TO A CYLINDER OF HFC-410A SET FOR LIQUID PHASE CHARGING.
B. CONNECT THE MANIFOLD GAUGE SET'S LOW PRESSURE SIDE TO THE SUCTION LINE SERVICE PORT.
C. CONNECT THE MANIFOLD GAUGE SET'S HIGH PRESSURE SIDE TO THE LIQUID LINE SERVICE PORT.
D. POSITION TEMPERATURE SENSOR ON LIQUID LINE NEAR LIQUID LINE SERVICE PORT.

Figure 50. Gauge Set Connections

Charge Mode Jumper

Verify the unit is electrically grounded before charging the system. Extreme care shall be taken not to overfill the refrigerating system.

Charge should be checked and adjusted using information outlined in this section and in the tables provided on the charging label on the unit's control access panel.

R-454B is a zeotropic blend of two refrigerants. At any given refrigerant pressure, R-454B will have two saturation temperatures, a saturated liquid temperature and a saturated vapor temperature. See R-454B Refrigerant Pressure Temperature Chart in the installation and service manual for saturation temperatures.

R-454B units must be charged with liquid refrigerant. Follow conventional charging procedures when charging the system. The technician is required to mark the total charge of the installed system on the unit nameplate, which includes the nameplate charge (factory charge) and additional charge that is added to the system at the time of installation.

The R-454B refrigerant cylinders are provided with a ¼" LH flare connection, therefore a ¼" LH female flare adapter will be required. Connect manifold gauges and hoses following conventional charging procedures. Position the R-454B refrigerant cylinder to deliver liquid refrigerant.

The unit is factory-charged with R454B. Refer to unit charging label for baseline line set length for factory unit charge and additional charge guidelines. For line lengths over baseline line set length, add 3 oz of refrigerant for every 5 feet of piping beyond baseline charge.

Initiate a call for cooling and allow the refrigerant pressures and temperatures to stabilize. Adjust the charge to using the subcooling method. The unit charging label provides the target Subcooling Values. Record the liquid line temperature. Measure the liquid line pressure and use the value to determine the Saturated Liquid Temperature. Calculate subcooling by subtracting the liquid line temperature from the Saturated liquid temperature.

Subcooling = Saturated Liquid Temperature – Liquid Line Temperature

Compare the results with the unit charging label.

Once system charging has been completed, the additional charge and total charge must be marked on the unit nameplate. Total Charge = Factory Charge + Additional charge. The total charge is marked on the space adjacent to "Total Charge". See nameplate below.

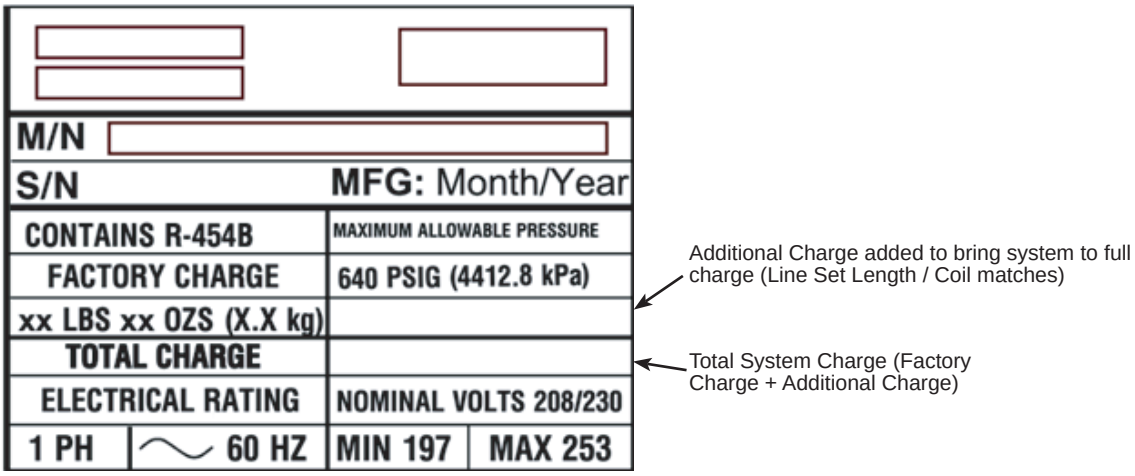
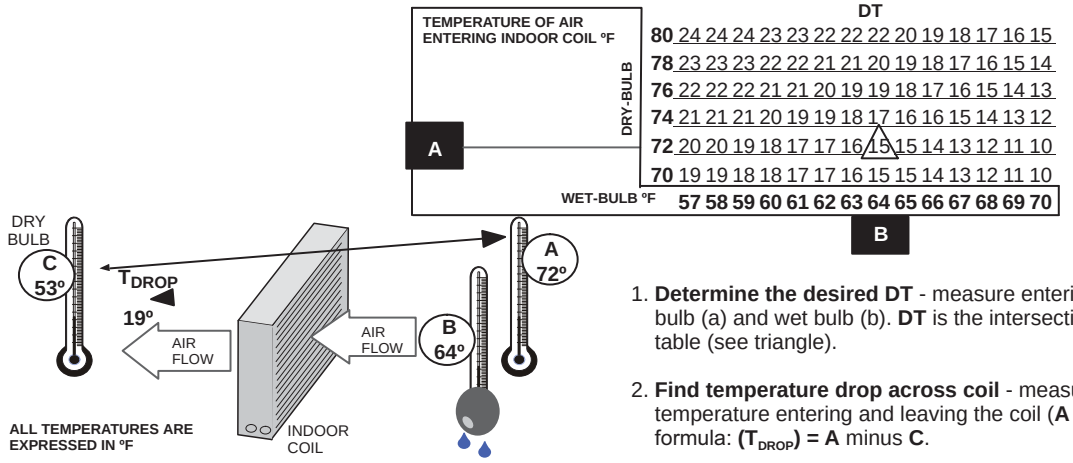


Figure 51. Charging Label

Charge Mode Jumper

AIRFLOW - INDOOR COIL



ASSUME **DT** = 15 AND **A** TEMP. = 72°, BELOW **C** TEMPERATURES REQUIRE ACTION:

C°	T_{DROP}	–	DT	=	°F	*ACTION*
53°	19	–	15	=	4	*INCREASE THE AIRFLOW*
58°	14	–	15	=	-1	*(WITHIN ±3° RANGE) NO CHANGE*
62°	10	–	15	=	-5	*DECREASE THE AIRFLOW*

1. **Determine the desired DT** - measure entering air temperature using dry bulb (a) and wet bulb (b). **DT** is the intersecting value of a and b in the table (see triangle).
2. **Find temperature drop across coil** - measure the dry bulb air temperature entering and leaving the coil (**A** and **C**). Temperature drop formula: **(T_{DROP}) = A** minus **C**.
3. **Determine if fan needs adjustment** - if the difference between the measured **(T_{DROP})** and the desired **DT (T_{DROP}-DT)** is within ±3°, no adjustment is needed. See example at left.
4. **Adjust the fan speed** - see indoor unit instructions to increase/decrease fan speed.

NOTE: Changing air flow affects all temperatures; recheck temperatures to confirm that the temperature drop and dt are within ±3°.

Figure 52. Checking Indoor Airflow over Evaporator Coil using Delta-T Chart

WEIGH-IN - CHARGING METHOD

64°F (17.7°C) and Below

Amount specified on nameplate

Adjust amount for variation in line set length and liquid line diameter using table below.

Total charge

_____ ± _____ = _____

Liquid Line Set Diameter	R454B (ounces per foot)
5/16”	3/8”
1/2”	0.40
0.60	1.00

NOTE - Insulate liquid line when it is routed through areas where the surrounding ambient temperature could become higher than the temperature of the liquid line or when pressure drop is equal to or greater than 20 psig.

NOTE - The nameplate is shown for illustration purposes only. Go to actual nameplate on outdoor unit for charge information.

Charging Formula for Liquid Line Charge Adjustments

[Line set oz./ft. x total length) - (factory charge for line set)] = charge adjustment

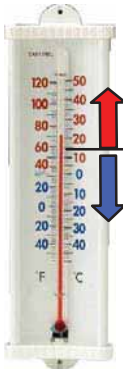
Example: Units are factory-charged for 15 feet (4.6 meters) of 3/8” line set. Factory charge for 3/8” is 0.60 oz./ft. x 15 = 9.0 ounces.

Figure 53. Using R454B Weigh-In Method

Charge Mode Jumper

SUBCOOLING CHARGING METHOD

*(All charging **MUST** be performed while system is operating either at maximum speed or 100% demand.)*



USE COOLING MODE

60ºF (15ºC)

USE HEATING MODE

SATº _____

LIQº – _____

SCº = _____

1. THE DIAGNOSTIC SCREEN ON THE THERMOSTAT OR OUTDOOR CONTROL 7-SEGMENT DISPLAY WILL SHOW INDOOR AND OUTDOOR MOTOR CFMS OR RPMS.
2. MEASURE OUTDOOR AMBIENT TEMPERATURE.
3. CONNECT GAUGE SET.
4. CHECK LIQUID AND VAPOR LINE PRESSURES. COMPARE PRESSURES WITH COOLING MODE NORMAL OPERATING PRESSURES IN THE APPLICABLE CHARGING STICKER, NORMAL OPERATING PRESSURES AT MAXIMUM CAPACITY.

   NOTE - THE REFERENCE TABLE IS A GENERAL GUIDE. EXPECT MINOR PRESSURE VARIATIONS. SIGNIFICANT DIFFERENCES MAY MEAN IMPROPER CHARGE OR OTHER SYSTEM PROBLEM.
5. SET THERMOSTAT FOR HEAT/COOL DEMAND, DEPENDING ON MODE BEING USED:

   USING COOLING MODE — WHEN THE OUTDOOR AMBIENT TEMPERATURE IS 60°F (15°C) AND ABOVE. TARGET SUBCOOLING VALUES (MAXIMUM / 100% CAPACITY) IN APPLICABLE CHARGING STICKER ARE BASED ON 70 TO 80°F (21-27°C) INDOOR RETURN AIR TEMPERATURE; IF NECESSARY, OPERATE HEATING TO REACH THAT TEMPERATURE RANGE; THEN SET THE INITIAL COOLING DEMAND AT MAXIMUM CAPACITY. THE PREFERRED METHOD IS TO USE THE “CHARGE MODE” JUMPER ON THE OUTDOOR CONTROL. SEE CHARGE MODE JUMPER SECTION ON PAGE 80. WHEN PRESSURES HAVE STABILIZED, CONTINUE WITH STEP 6.
6. READ THE LIQUID LINE TEMPERATURE; RECORD IN THE LIQº SPACE.
7. READ THE LIQUID LINE PRESSURE; THEN FIND ITS CORRESPONDING TEMPERATURE IN THE TEMPERATURE/ PRESSURE CHART LISTED IN THE APPLICABLE CHARGING STICKER AND RECORD IT IN THE SATº SPACE.
8. SUBTRACT LIQº TEMPERATURE FROM SATº TEMPERATURE TO DETERMINE SUBCOOLING; RECORD IT IN SCº SPACE.
9. COMPARE SCº RESULTS WITH APPLICABLE CHARGING STICKER, BEING SURE TO NOTE ANY ADDITIONAL CHARGE FOR LINE SET AND/OR MATCH-UP.
10. IF SUBCOOLING VALUE IS GREATER THAN SHOWN IN APPLICABLE CHARGING STICKER FOR THE APPLICABLE UNIT, REMOVE REFRIGERANT; IF LESS THAN SHOWN, ADD REFRIGERANT.
11. IF REFRIGERANT IS ADDED OR REMOVED, REPEAT STEPS 6 THROUGH 10 TO VERIFY CHARGE.
12. DISCONNECT GAUGE SET AND RE-INSTALL BOTH THE LIQUID AND SUCTION SERVICE VALVE CAPS.

Figure 54. Using R454B Subcooling Method - High Speed (High Capacity)

Charge Mode Jumper

Table 23. R454B Temperature (°F) - Pressure (Psig)

Pressure (psig)	Saturated Liquid Temp (°F)	Saturated Vapor Temp (°F)	Pressure (psig)	Saturated Liquid Temp (°F)	Saturated Vapor Temp (°F)	Pressure (psig)	Saturated Liquid Temp (°F)	Saturated Vapor Temp (°F)	Pressure (psig)	Saturated Liquid Temp (°F)	Saturated Vapor Temp (°F)
0	-58.9	-57.1	158	58.9	61.5	272	93.0	95.4	362	113.4	115.6
25	-19.2	-17.2	160	59.6	62.0	274	93.5	95.9	364	113.8	116.0
30	-13.9	-11.8	165	61.4	63.8	276	94.0	96.4	366	114.2	116.4
35	-9.0	-6.9	170	63.1	65.5	278	94.5	96.9	368	114.6	116.8
40	-4.4	-2.3	175	64.9	67.3	280	95.0	97.4	370	115.0	117.2
45	-0.2	1.9	180	66.6	69.0	282	95.5	97.9	372	115.4	17.6
50	3.7	5.9	185	68.2	70.6	284	96.0	98.4	374	115.8	118.0
55	7.5	9.7	190	69.8	72.2	286	96.5	98.8	376	116.2	118.4
60	11.0	13.2	195	71.4	73.8	288	97.0	99.3	378	116.6	118.8
65	14.4	16.6	200	73.0	75.4	290	97.5	99.8	380	117.0	119.2
70	17.6	19.8	202	73.6	76.0	292	97.9	100.5	382	117.4	119.5
75	20.6	22.9	204	74.2	76.6	294	98.4	100.7	384	117.7	119.9
80	23.6	25.9	206	74.9	77.3	296	98.9	101.2	386	118.1	120.3
85	26.4	28.7	208	75.5	77.9	298	99.4	101.7	388	118.5	120.7
90	29.1	31.4	210	76.1	78.5	300	99.8	102.2	390	118.9	121.1
95	31.7	34.0	212	76.7	79.1	302	100.3	102.6	392	119.3	121.5
100	34.3	36.6	214	77.3	79.7	304	100.8	103.1	394	119.7	121.9
102	35.3	37.6	215	77.9	80.2	306	101.2	103.5	396	120.1	122.2
104	36.2	38.6	216	78.4	80.8	308	101.7	104.0	398	120.5	122.5
106	37.2	30.5	220	79.0	81.4	310	102.1	104.4	400	120.8	123.0
108	38.1	40.5	222	79.6	82.0	312	102.8	104.9	405	121.8	123.9
110	59.1	41.4	224	80.2	82.6	314	103.0	105.4	410	122.7	124.9
112	40.0	42.4	226	80.8	83.1	316	103.5	105.8	415	123.6	125.8
114	40.9	43.3	228	81.3	83.7	318	103.9	106.2	420	124.6	126.7
116	41.8	44.2	230	81.9	84.3	320	104.4	106.7	425	125.5	127.6
118	42.7	45.1	232	82.4	84.8	322	104.8	107.1	430	126.4	128.5
120	43.6	46.0	234	83.0	85.4	324	105.3	107.6	435	127.3	129.4
122	44.5	46.9	236	83.6	86.0	326	105.7	108.0	440	128.2	130.2
124	45.4	46.9	238	84.1	86.5	328	106.2	108.5	445	129.0	131.1
126	46.2	48.6	240	84.7	87.1	330	106.6	108.9	450	129.9	132.0
128	4701	49.4	242	85.2	87.6	332	107.0	109.5	460	131.6	133.7
130	47.9	50.5	244	85.8	88.1	334	107.5	109.7	470	133.3	135.3
132	48.8	51.1	246	86.3	88.7	336	107.9	110.0	480	135.0	137.0
134	49.6	51.9	248	86.8	89.2	338	108.3	110.6	490	136.7	138.6
136	50.4	52.8	250	87.4	89.7	340	108.8	111.0	500	138.3	140.2
138	51.2	53.6	252	87.9	90.3	342	109.2	111.5	510	139.9	141.8
140	52.0	54.4	254	88.4	90.8	344	109.6	111.9	520	141.5	143.3
142	52.8	55.2	256	88.9	91.3	346	110.0	112.3	530	143.0	144.8
144	53.6	56.0	258	89.5	91.8	348	110.5	112.7	540	144.5	146.3
146	54.3	56.7	260	90.0	92.4	350	110.9	113.1	550	146.1	147.8
148	55.14	57.5	262	90.5	92.9	352	111.3	113.5	560	147.5	149.2
150	55.9	58.5	264	91.0	93.4	354	111.7	114.0	570	149.0	150.7
152	56.6	59.0	266	91.5	93.9	356	112.1	114.4	580	150.5	152.1
154	57.4	59.38	268	92.0	94.4	358	112.5	114.8	590	151.9	153.5
156	58.1	60.5	270	92.5	94.9	360	112.9	115.2	600	153.3	154.8

Charge Mode Jumper

R454B CHARGING INFORMATION – FOR COMPLETE CHARGING DETAILS, REFER TO THE OUTDOOR UNIT INSTALLATION AND SERVICE PROCEDURE

Maintenance checks using the Normal Operating Pressures table

The charge label on the unit may be used to help perform maintenance checks. This is not a procedure for charging the system and any minor variations in the pressures may be expected due to differences in installations. However, significant deviations could mean that the system is not properly charged or that a problem exists with some component in the system

Charge Using the Subcooling Method

Cooling Mode – When the outdoor ambient temperature is 60°F (15°C) and above, use the cooling mode to adjust the charge using the subcooling method. Target subcooling values in the table below are based on 70 to 80°F (21-27°C) indoor return air temperature.

Heating Mode – When the outdoor ambient temperature is below 60°F (15°C), use the heating mode to adjust the charge using the subcooling charge levels. Target subcooling values in the table below are based on 65-75°F (18-24°C) indoor return air temperature.

(Subcooling Value = Saturated Liquid Temperature - Liquid Line Temperature)

IMPORTANT: R-454B is a zeotropic blend. Use saturated liquid temperature to calculate liquid subcooling. Charge unit with liquid only.

Matchups/Charge Levels and Line Set Lengths

The charge label on the unit lists all recommended indoor unit matchups along with the charge levels for the various sizes of outdoor units. Charge levels on the unit nameplate are based on installations with either 15ft. (4.6m) or 30ft. (9.sm) line sets; on line sets with 3/8”(9.5mm) liquid line, add 3oz. additional refrigerant for every 5ft. longer than factory charge length. If line length is less that factory charge length, subtract this amount (see Installation Instructions for more details).

Charge Using the Weigh-in Method

If the system is void of refrigerant, locate and repair any leaks and then weigh in the refrigerant charge into the unit. For charge adjustments, be sure to consider line set length differences and, referring to the table, adjust for the matchup difference.

1 - Recover the refrigerant from the unit.
2 - Conduct leak check; evacuate as previously outlined.
3 - If weighing facilities are not available use the Subcooling method.

Normal Operating Pressures (Liquid ±10 and Vapor ±5 psig)				
Temperature	**Cooling Operation – Liquid Line Pressure / Vapor Line Pressure**			
°F (°C)*	-024	-036	-048	-060
65 (18.3)	233 / 132	247 / 126	238 / 126	233 / 122
75 (23.9)	270 / 134	287 / 129	279 / 128	251 / 123
85 (29.4)	313 / 136	332 / 131	323 / 129	314 / 126
95 (35.0)	361 / 138	393 / 133	371 / 131	367 / 129
105 (40.6)	409 / 141	440 / 136	413 / 135	414 / 131
115 (46.1)	460 / 142	489 / 138	459 / 139	464 / 136
Temperature	**Heating Operation – Liquid Line Pressure / True Suction Pressure**			
20 (-6.6)	303 / 52	336 / 47	301 / 39	278 / 46
40 (4.4)	317 / 83	333 / 80	320 / 73	323 / 72
50 (10)	324 / 102	332 / 98	336 / 91	334 / 89
60 (15.5)	341 / 121	349 / 116	357 / 109	352 / 107

Decommissioning

Before carrying out this procedure, it is essential that the technician is completely familiar with the equipment and all its detail. It is recommended good practice that all refrigerants are recovered safely.

Prior to the task being carried out, an oil and refrigerant sample shall be taken in case analysis is required prior to re-use of recovered refrigerant. It is essential that electrical power is available before starting decommissioning.

a) Become familiar with the equipment and its operation.

b) Isolate system electrically.

c) Before attempting the procedure, ensure that:

- mechanical handling equipment is available, if required, for handling refrigerant cylinders;
- all personal protective equipment is available and being used correctly;
- the recovery process is supervised at all times by a competent person;
- recovery equipment and cylinders conform to the appropriate standards.

d) Pump down refrigerant system, if possible.

e) If a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system.

f) Make sure that cylinder is situated on the scales before recovery takes place.

g) Start the recovery machine and operate in accordance with instructions.

h) Do not overfill cylinders (no more than 80% volume liquid charge).

i) Do not exceed the maximum working pressure of the cylinder, even temporarily.

j) When the cylinders have been filled correctly and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.

k) Recovered refrigerant shall not be charged into another REFRIGERATING SYSTEM unless it has been cleaned and checked.

⚠IMPORTANT Equipment shall be labeled stating that it has been decommissioned and emptied of refrigerant. The label shall be signed and dated. Ensure that there are labels on the equipment that state the flammability of the refrigerant used.

Notes

GE APPLIANCES

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