INSTALLATION MANUAL

R-454B
Models: KD360 to 600
30 - 50 ton
60 Hertz

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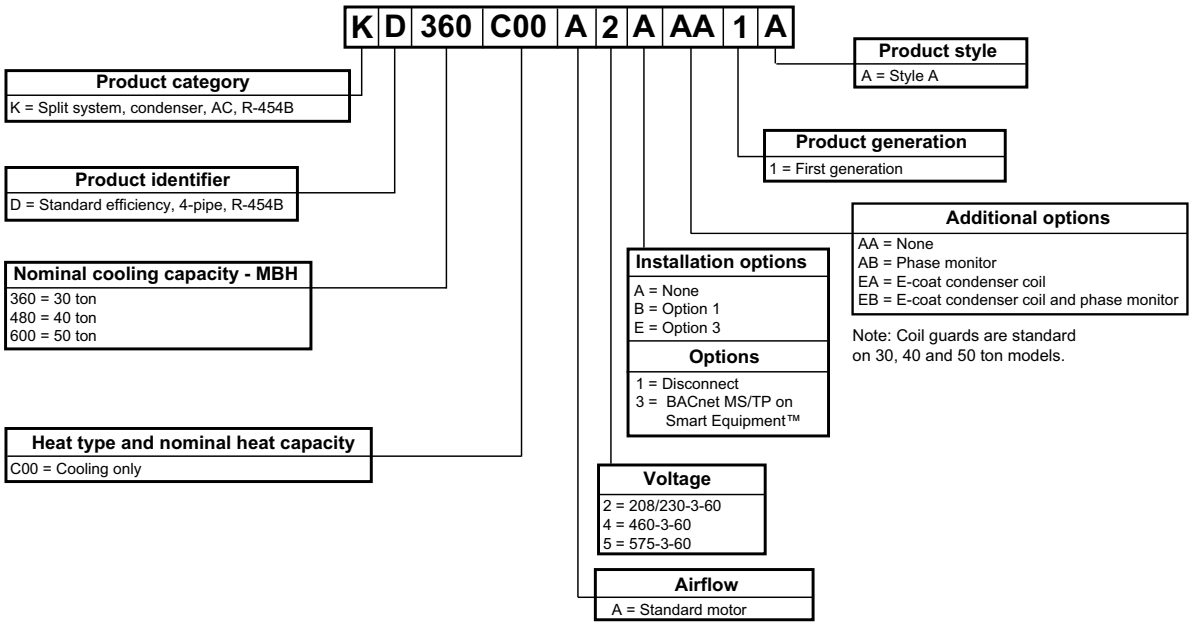
Nomenclature

Configured split condenser model number nomenclature



General

These condensing units are designed for outdoor installation on a roof or at ground level. Every unit is completely piped and wired at the factory and is shipped ready for immediate installation. Only the liquid and suction lines to the evaporator coil, the filter drier, the thermostat wiring, and the main power wiring are required to complete the installation. Each unit is dehydrated, evacuated, leak tested, and pressure tested at 450 psig before being pressurized with a holding charge of nitrogen for shipment or storage.

All controls are located in the front of the unit and are readily accessible for maintenance, adjustment and service. All wiring, both power and control, can be made through the front of the unit.

⚠ CAUTION

This split-system (air condensing / air handling) unit is one component of an entire system. As such it requires specific application considerations with regard to the rest of the system (air handling unit, duct design, condensing unit, refrigerant piping and control scheme).

Failure to properly apply this equipment with the rest of the system may result in premature failure and/or reduced performance / increased costs. Warranty coverage specifically excludes failures due to improper application and ducted systems specifically disclaims any liability resulting from improper application.

Please refer to the equipment technical guide, installation manual and the piping applications bulletin 247077 or call the applications department for ducted systems @ 1-877-874-SERV for guidance.

DS Solutions App

Johnson Controls believes in empowering our customers with unit-specific information at all times, even on the roof. Download the DS Solutions application, available through the Apple App Store and the Google Play store. Users can use DS Solutions to scan the QR code located on the rating plate that is unique to each unit and provides information specific to the product. Take advantage of the features available for all units: Nomenclature, Literature (Technical Guide, Installation Manual and Wiring Diagrams), Parts list, Product Registration, Claims Tracking, and more.

Safety considerations

Pay particular attention to the words: *NOTE*, *CAUTION*, and *WARNING*. **Notes** clarify or make the installation easier. **Cautions** prevent equipment damage. **Warnings** alert the installer that personal injury or equipment damage may occur if installation procedure is not handled properly.

⚠WARNING

Improper installation may create a condition where the operation of the product could cause personal injury or property damage. Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to this manual for assistance or for additional information, consult a qualified contractor, installer or service agency.

⚠WARNING

Before performing service or maintenance operations on unit, turn off main power switch to unit. Electrical shock could cause personal injury. Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to this manual. For assistance or additional information consult a qualified installer, service agency or the gas supplier.

⚠WARNING

Unit is pressurized with a nitrogen holding charge. Vent through service valves before removing refrigerant line caps.

Reference

This manual covers the installation and operation of the basic condensing unit. For refrigerant piping installation instructions refer to document 247077 *Application Data - General Piping Recommendations for Split System Air Conditioning and Heat Pumps*. For information on the installation and operation of the evaporator blower units, refer to the installation manual that comes with the unit**.**

All accessories come with a separate installation manual.

Renewal parts

Contact your local Source1 distribution center for authorized replacement parts.

Agency approvals

Design certified by CSA as follows:

- For use as a cooling unit.
- For outdoor installation only.

Inspection

As soon as you receive the unit, inspect it for possible damage during transit. If damage is evident, note the extent of the damage on the carrier's freight bill. Make a separate request for inspection by the carrier's agent in writing.

⚠ CAUTION

This product must be installed in strict compliance with the enclosed installation instructions and any applicable local, state and national codes including, but not limited to, building, electrical, and mechanical codes.

Physical data

KD360 - 600 Physical data

Component		Models		
		KD360	KD480	KD600
Nominal tonnage		**30**	**40**	**50**
Refrigerant				
Refrigerant type		R-454B	R-454B	R-454B
Operating charge (lb)[1]	System #1	33.75	43.38	50.50
	System #2	33.50	43.38	50.50
Holding charge		Nitrogen		
Dimensions (in.)				
Length		128.5	128.5	128.5
Width		88.5	88.5	88.5
Height		37.5	57.7	57.7
Weights (lb)				
Shipping		1853	2233	2345
Operating		1850	2230	2381
Compressors				
Type		Tandem scroll	Tandem scroll	Tandem scroll
Quantity		2	2	2
Cooling				
Nominal capacity (ton)	System #1	15	20	25
	System #2	15	20	25
Capacity stages	System #1	2	2	2
	System #2	2	2	2
System data				
Number of refrigeration circuits		2	2	2
Suction line OD (in.)		1 5/8	1 5/8	1 5/8
Liquid line OD (in.)		7/8	7/8	7/8
Outdoor coil data				
Face area (sq. ft.)	System #1	32.5	45.5	52.0
	System #2	32.5	45.5	52.0
Rows		2	2	2
Fins per in.		16	16	16
Tube diameter (in.)		3/8	3/8	3/8
Circuitry type		Interlaced	Interlaced	Interlaced
Refrigerant control		---	---	---
Condenser fan data				
Number of fans / diameter (in.)		4/30	4/30	4/30
Type		Axial	Axial	Axial
Drive type		Direct	Direct	Direct
No. speeds		1	1	1
Number of motors	System #1	2	2	2
	System #2	2	2	2
Motor hp (ea.)		1 1/2	1 1/2	1 1/2
Rotation[2]		CW	CW	CW
rpm		1140	1140	1140
Nominal cfm	System #1	15400	19400	19900
	System #2	15400	19400	19900

1. Includes matched evaporator unit with 25 ft of piping.
2. When viewing the shaft end of the motor.

Table 1: Unit application data

Voltage variation[1] min. / max.	208/230-3-60	187/252
	460-3-60	432/504
	575-3-60	540/630
Ambient air on condenser coil min. /max.		40°F/125 °F[2]
Suction pressure at compressor and corresponding temp. at saturation min. / max.		106.6 psig / 156.6 psig 32.0 ºF / 55.0 ºF

1.Utilization range A in accordance with AHRI Standard 110.
2.These units can operate in an ambient temperature of 125°F providing the wet bulb temperature of the air entering the evaporator coil does not exceed 67°F. Unit can operate to 0°F if equipped with a low ambient kit.

Installation

Limitations

These units must be installed in accordance with all national and local safety codes. If no local codes apply, installation must conform to the appropriate national codes. Units are designed to meet National Safety Code Standards. If components are added to a unit to meet local codes, they are installed at the dealer's or the customer's expense.

Location

Adhere to the following guidelines to select a suitable location for both the condensing unit and the evaporator:

- The condensing unit is designed for outdoor installation only.
- The condenser fans are the propeller type and are not suitable for use with ductwork in the condenser air stream.
- Position the condensing unit and the evaporator to minimize the number of bends in the refrigerant piping.
- Position the condensing unit as close to the evaporator as practical.
- Do not install the condensing unit where normal operating sounds are objectionable.
- Locate the evaporator within the building, either outside or inside the conditioned space.

Rooftop locations

Do not to damage the roof.

Consult the building contractor or architect if the roof is bonded.

Choose a location with adequate structural strength to support the unit.

Mount the condensing unit on level supports. The supports can be channel iron beams or wooden beams treated to reduce deterioration.

A minimum of two beams are required to support each unit. The beams should:

- Be positioned perpendicular to the roof joists.
- Extend beyond the dimensions of the section to distribute the load on the roof.
- Be capable of adequately supporting the concentrated loads at the corners.

These beams can usually be set directly on the roof. Flashing is not required.

Note: On bonded roofs, check for special installation requirements.

Ground level locations

It is important that the units be installed on a substantial base that will not settle, causing strain on the refrigerant lines and possible leaks.

Use a one-piece concrete slab with footers that extend below the frost line or similar.

Do not tie the slab to the building foundation, as the noise will telegraph through the slab.

Table 2: Corner weight and center of gravity (in.)

Size (Tons)	Model	Weight (lbs.)		Center of Gravity		4 point Load Location (lbs.)			
		Shipping	Operating	X	Y	A	B	C	D
30	KD360	1853	1850	55.15	44.6	390	519	537	404
40	KD480	2233	2230	55.375	44	478	631	638	483
50	KD600	2393	2390	53	44	490	698	706	496

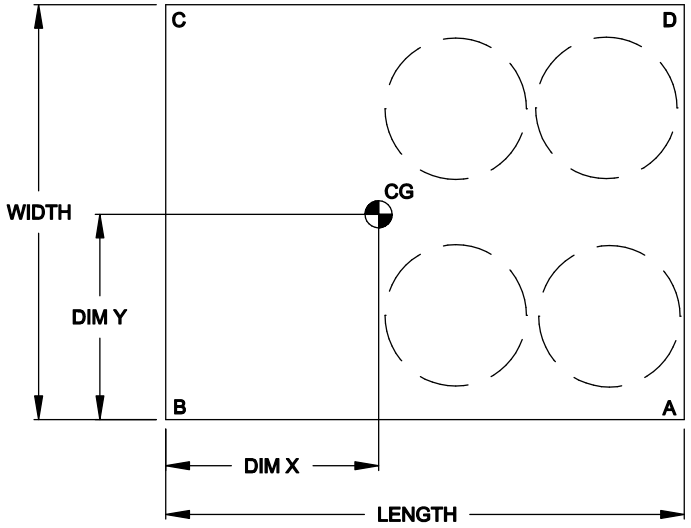


Figure 1: Corner weights and center of gravity

Note: The front of unit is the side that has the unit control box.

Concrete piers can also support ground level units. These piers should:

- Extend below the frost line.
- Be located under each of the section's four corners.
- Be sized to carry the load of the corner it supports.

On either rooftop or ground level installations, you can apply rubber padding under the unit to lessen any transmission of vibration.

For ground level installations, take precautions to protect the unit from tampering and unauthorized persons from injury.

Screws on access panels prevent casual tampering.

Further safety precautions such as a fenced enclosure or locking devices on the panels may be advisable.

Check local authorities for safety regulations.

Clearances

Install the unit with sufficient clearance for air to enter the condenser coil, for air discharge and for servicing access. See Table 3 for clearances.

Table 3: Minimum clearances

Clearance description	Distance (in.)
Overhead (top)	120
Front	36
Rear	36
Left side	30
Right side	30
Bottom[1]	0

1. In all installations where snow accumulates and winter operation is expected, additional height must be provided to insure normal condenser airflow.

⚠ WARNING

Do not permit overhanging structures or shrubs to obstruct condenser air discharge.

Rigging the unit

Exercise care when moving the unit.

Do not remove any packaging until the unit is near the place of installation.

To rig the unit, attach the chain or the cable slings to the lifting holes provided in the base rails.

⚠ CAUTION

Spreaders, longer than the largest dimension across the unit must be used across the top of the unit.

When preparing to move the unit see Table 3 and Figure 1 to determine the center of gravity of the unit in order to equally distribute the weight.

Slings connected to the compressor end of a unit will usually have to be made shorter, so the unit will lift evenly. See Figure 2.

⚠ WARNING

Before lifting a unit, make sure that its weight is distributed equally on the cables so that it will lift evenly.

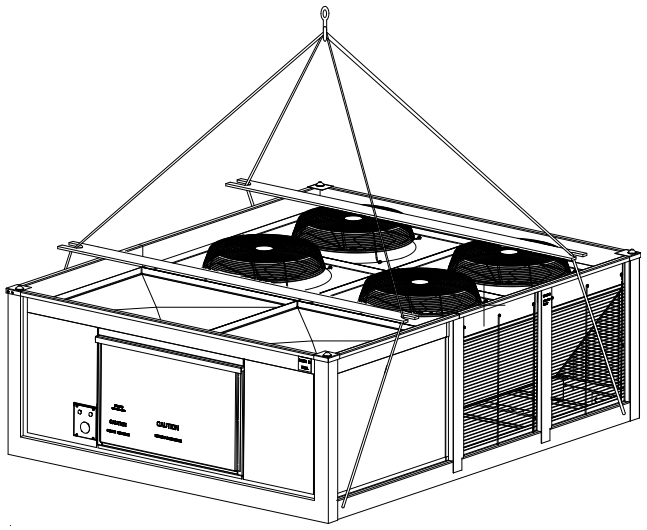


Figure 2: Typical rigging

To rig units, attach chain or cable hooks to the holes provided on the base rail. See Figure 2 for details on rigging holes.

The length of the spreader bars must exceed the width of the unit. Refer to Table 3 for unit weights.

Note: If planning to handle the 30 ton to 50 ton condenser with a fork truck, use 1WS0408 or 410 skids.

⚠ CAUTION

If handling a unit equipped with a 1WS skid, length of forks must be a minimum of 96 in.. Fork lengths less than 96 in. will not span the required width of the skid and can cause damage to the unit's base rails or condenser coils.

Power wiring

- Check the available power and the unit nameplate for correct voltage.
- Run the necessary number of properly sized wires to the unit.
- Provide a disconnect switch, if it is not included with the unit, and the fusing as required.
- Route the conduit through the large knockout located on the front of the electrical box. See Table 4 for electrical data.

The disconnect switch can be bolted to the side of the unit but not to any of the removable panels; this would interfere with access to the unit.

- Check that no refrigerant lines are punctured when mounting the disconnect switch, and ensure that it is suitable for outdoor installation.

⚠WARNING

All power and control wiring must be in accordance with National and Local electrical codes.

Control wiring

Route the necessary low voltage control wires from the Smart Equipment™ control board to the thermostat and also from the low voltage condenser unit control box to the terminal block inside the evaporator unit. See Figures 3 through 5 for field wiring diagrams.

Compressors

The scroll compressors used in this product are specifically designed to operate with R-454B Refrigerant and cannot be interchanged.

The compressor also uses a polyolester (POE oil), Mobil 3MA POE. This oil is extremely hydroscopic, meaning it absorbs water readily. POE oil can absorb 15 times as much water as other oils designed for HCFC and CFC refrigerants. Take all necessary precautions to avoid exposure of the oil to the atmosphere.

⚠ CAUTION

Do not leave the system open to the atmosphere. Unit damage could occur due to moisture being absorbed by the **POE oil** in the system. This type of oil is highly susceptible to moisture absorption.

POE compressor lubricants are known to cause long term damage to some synthetic roofing materials.

⚠ CAUTION

Exposure, even if immediately cleaned up, may cause embrittlement (leading to cracking) to occur in one year or more. When performing any service that may risk exposure of compressor oil to the roof, take precautions to protect roofing.

Procedures which risk oil leakage include, but are not limited to, compressor replacement, repairing refrigerant leaks, replacing refrigerant components such as filter drier, pressure switch, metering device or coil.

Units are shipped with compressor mountings which are factory adjusted and ready for operation.

⚠ CAUTION

Do not loosen compressor mounting bolts.

Compressor crankcase heaters

The compressors are equipped with crankcase heaters to prevent the migration of refrigerant to the compressors. The heaters are energized only when the unit is not running.

If the main switch is disconnected for long periods of shut down, do not attempt to start the unit for 8 hr after the switch has been re-connected. This will allow sufficient time for all liquid refrigerant to be driven out of the compressor.

Phasing

Three-phase, scroll compressors operate in only one direction. If the scroll is drawing low amperage, has similar suction and discharge pressures, or is producing a high noise level, the scroll is misphased. Change the incoming line connection phasing to obtain the proper rotation.

⚠ CAUTION

Scroll compressors require proper rotation to operate properly. Failure to check and correct rotation may result in property damage.

Electrical data

Table 4: Electrical data - outdoor unit

Model	Compressors					Outdoor fan motor				Minimum circuit ampacity[1]	Maximum fuse size (A)[2]
	Power supply	Quantity	RLA (each)	MCC (each)	LRA (each)	Power supply	HP	Quantity	FLA (each)		
KD360	208/230-3-60	4	27.7	43	178.5	208/230-1-60	1 1/2	4	5.80	140.9	150
	460-3-60	4	11.5	18	103	460-1-60	1 1/2	4	2.9	60.5	70
	575-3-60	4	9	14	78	575-1-60	1 1/2	4	2.20	47.1	50
KD480	208/230-3-60	4	28.5	45	255	208/230-1-60	1 1/2	4	5.80	144.3	150
	460-3-60	4	13.5	21	123	460-1-60	1 1/2	4	2.9	69	80
	575-3-60	4	10.7	17	93.7	575-1-60	1 1/2	4	2.20	54.3	60
KD600	208/230-3-60	4	40.8	64	270	208/230-1-60	1 1/2	4	5.80	196.6	225
	460-3-60	4	19.4	30	147	460-1-60	1 1/2	4	2.9	94.1	110
	575-3-60	4	13.7	21	109	575-1-60	1 1/2	4	2.20	67	80

1. Maximum fuse or maximum circuit breaker (HACR type per NEC).
2. Based on three, 75°C insulated copper conductors in conduit and ambient of 30°C.

Refrigerant mains

⚠ CAUTION

This split-system (air condensing / air handling) unit is one component of an entire system. As such it requires specific application considerations with regard to the rest of the system (air handling unit, duct design, condensing unit, refrigerant piping and control scheme).

Failure to properly apply this equipment with the rest of the system may result in premature failure and/or reduced performance / increased costs. Warranty coverage specifically excludes failures due to improper application and ducted systems specifically disclaims any liability resulting from improper application.

Please refer to the equipment technical guide, installation manual and the piping applications bulletin 247077 or call the applications department for Ducted Systems @ 1-877-874-SERV for guidance.

Line sizing

When sizing refrigerant pipe for a split-system air conditioner, check the following:

- Suction line pressure drop due to friction.
- Liquid line pressure drop due to friction.
- Suction line velocity for oil return.
- Liquid line pressure drop due to vertical rise: For certain piping arrangements, different sizes of suction line pipe may have to be used. The velocity of the refrigerant vapor must always be great enough to carry the oil back to the compressor.
- Evaporator located below the condenser: On a split system where the evaporator blower is located below the condenser, the suction line must be sized for both pressure drop and for oil return.
- Condenser located below the evaporator: When the condenser is located below the evaporator blower, the liquid line must be designed for the pressure drop due to both friction loss and vertical rise. If the pressure drop due to vertical rise and friction exceeds 60 psi, some refrigerant will flash before it reaches the thermal expansion valve.

Flash gas:

- Increases the liquid line pressure loss due to friction that in turn causes further flashing.
- Reduces the capacity of the refrigerant control device which starves the evaporator.
- Erodes the seat of the refrigerant control device.
- Causes erratic control of the refrigerant entering the evaporator.

break a brazed joint is high enough to cause oxidation

Taking adequate precautions

⚠ WARNING

Unit is pressurized with a nitrogen holding charge. Vent through service valves before removing refrigerant line caps.

You can avoid many service problems by taking adequate precautions to provide an internally clean and dry system and by using procedures and materials that conform to established standards.

Take the following precautions:

- Use hard drawn copper tubing where no appreciable amount of bending around pipes or other obstructions is necessary.
- If soft copper is used, avoid sharp bends that may cause a restriction.
- Pack fiberglass insulation and a sealing material such as permagum around refrigerant lines where they penetrate a wall, to reduce vibrations and to retain some flexibility.
- Support all tubing at minimum intervals with suitable hangers, brackets or clamps.
- Braze all copper-to-copper joints with Silfos-5 or equivalent brazing material.
- Do not use soft solder.
- Insulate all suction lines with a minimum of 1/2 in. ARMAFLEX or equivalent that meets local codes.
- Liquid lines exposed to direct sunlight or high temperatures must also be insulated.
- Never solder suction and liquid lines together. They can be taped together for convenience and support purposes, but they must be completely insulated from each other.
- Before beginning installation of the main lines, be sure that the evaporator section has not developed a leak in transit.
- Check the pressure at the Schrader valve located on the header of each coil.
- If pressure still exists in the system, it can be assumed to be leak free.
- If pressure **does not** exist repair the section before evacuation and charging is performed.
- A filter-drier **must** be field-installed in the liquid line of every system to prevent dirt and moisture from damaging the system. Properly sized filter-driers are shipped with each condensing section.

Note: Installing a filter-drier does not eliminate the need for the correct evacuation of a system before it is charged.

- Install a field-installed moisture indicating sight-glass in the liquid lines between the filter-drier and the evaporator coil. The moisture indicating sight-glass can be used to check for excess moisture in the system.

Note: Both condenser and evaporator sections have copper sealing disks brazed over the end of liquid and suction connections. The temperature required to make or of the copper unless an inert atmosphere is provided.

Note: Dry nitrogen should flow through the system at all times when heat is being applied and until the joint has cooled. The flow of nitrogen will prevent oxidation of the copper lines during installation.

- Always punch a small hole in sealing disks before unbrazing to prevent the pressure in the line from blowing them off.
- Do not use a drill as copper shavings can enter system.

Note: Solenoid and hot gas bypass valves (if used) should be opened manually or electrically during brazing or evacuating.

Note: Schrader valves located on unit service valves should have their stem removed during brazing to prevent damage to the valve.

Installing the main lines

⚠WARNING

Unit is pressurized with a nitrogen holding charge. Vent through service valves before removing refrigerant line caps.

To install the main lines, complete the following steps:

1. Start the installation of main lines at the condenser unit.
2. Verify the service valves are fully seated by screwing the stem of both valves down into the valve body until it stops.
3. Remove the Schrader valve stem and connect a low-pressure nitrogen source to the service port on the suction line valve body.
4. Punch a small hole in the sealing disk; the flow of nitrogen will prevent any debris from entering the system.
5. Wrap the valve body with a wet rag to prevent overheating during the brazing process.

Note: Overheating the valve will damage the valve seals.

6. Unbraze the sealing disk, cool the valve body and prepare the joint for connections of the main lines.
7. Repeat for the liquid line valve body.

⚠WARNING

Never remove a cap from an access port unless the valve is fully back-seated with its valve stem in the maximum counter-clockwise position because the refrigerant charge will be lost. Always use a refrigeration valve wrench to open and close these service valves.

8. Connect the main liquid line to the liquid line service valve on the condenser section, while maintaining a flow of nitrogen.
9. Cool the valve body and replace the Schrader valve stem on the service port of the liquid line service valve.
10. Install the liquid line from the condenser unit to the evaporator liquid connection, maintaining a flow of nitrogen during all brazing operations.

Note: The filter-drier and sight glass must be located in this line, leaving the outdoor unit.

11. Connect a low-pressure nitrogen source to the Schrader valve located on the evaporator unit coil headers.
12. Punch a small hole in the sealing disks, the flow of nitrogen will prevent any debris from entering the system.
13. Unbraze both liquid and suction sealing disks and prepare the joints for connections of the main lines.
14. Connect the main liquid line to the liquid line connection on the evaporator unit, while maintaining a flow of nitrogen.
15. Make the suction line connection at the evaporator and run the line to the condenser unit.
16. Connect the main suction line to the suction line service line on the condenser unit, while maintaining a flow of nitrogen.
17. Cool the valve body and replace the Schrader valve stem on the service port of the suction line service valve.
18. Once the brazing process is complete, perform leak testing on all interconnecting piping and the evaporator before the proper evacuation to 500 microns is performed.

Once the line set and evaporator unit is properly evacuated the service valves can be opened and the condenser unit is now ready to charge with the appropriate weight of refrigerant.

19. Calculate the correct system charge for the condenser unit, the evaporator unit and the field line set.
20. Charge the system by introducing liquid refrigerant into the liquid line through the liquid port connection.
21. Complete adding the refrigerant in vapor form into the suction port when the compressor is started.

The correct refrigerant pressures are indicated as shown in Figures 16 through 18.

⚠WARNING

Wear safety glasses and gloves when handling refrigerants. Failure to follow this warning can cause serious personal injury.

Note: This instruction covers the installation and operation of the basic condenser unit. For refrigerant piping installation instructions refer to document 247077 *Application Data - General Piping Recommendations for Split System Air Conditioning and Heat Pumps.*

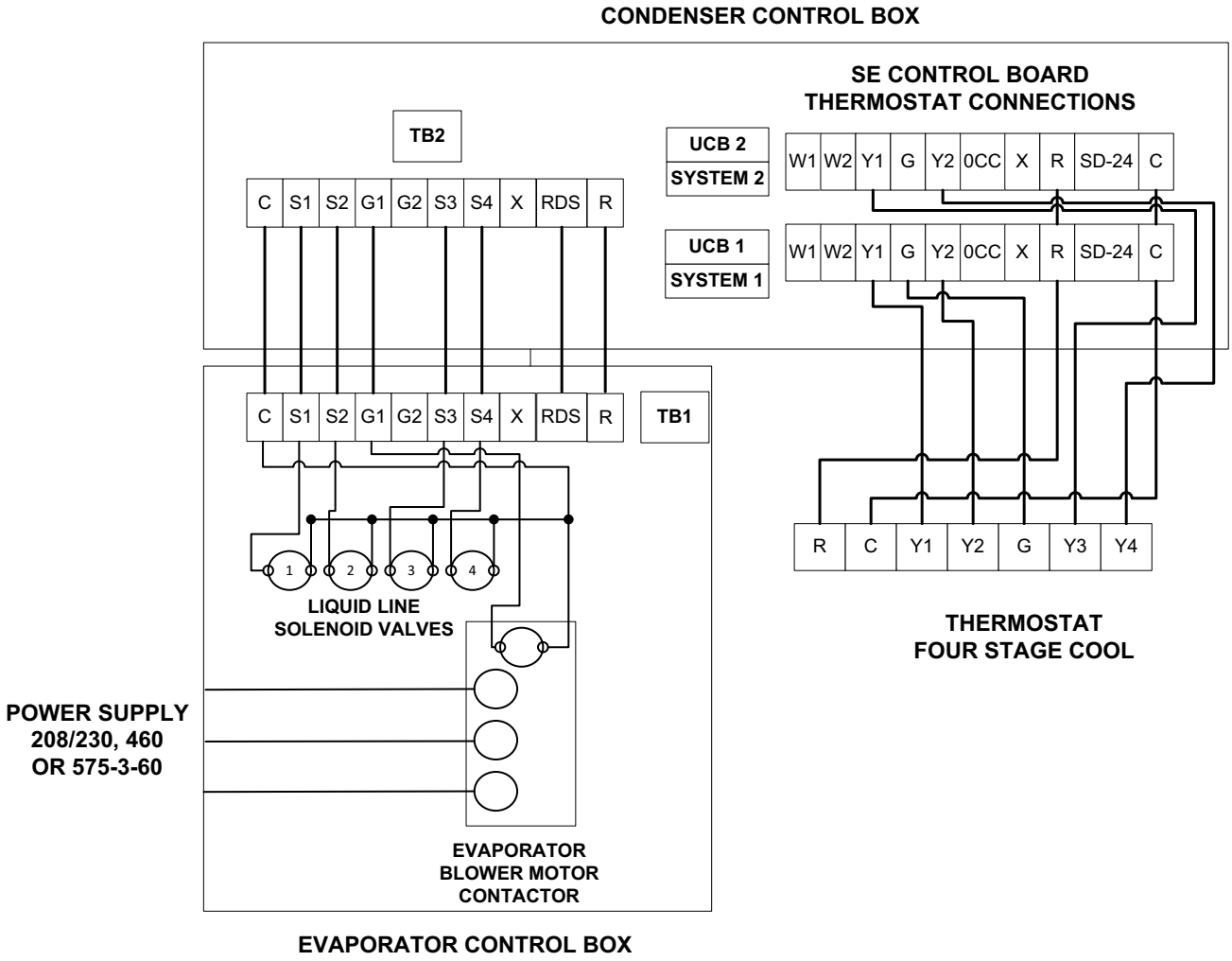


Figure 3: Typical field wiring diagram GD360/480 evaporator units, GD600 air handler and M2CZ600A evaporator coil when matched with KD360/480/600 condenser

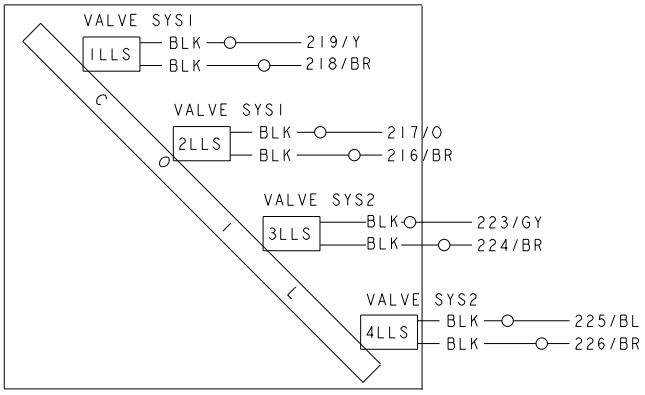
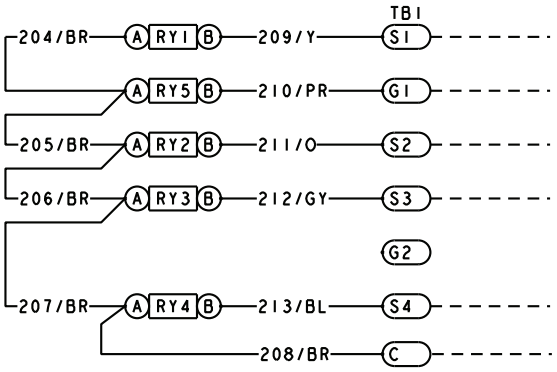
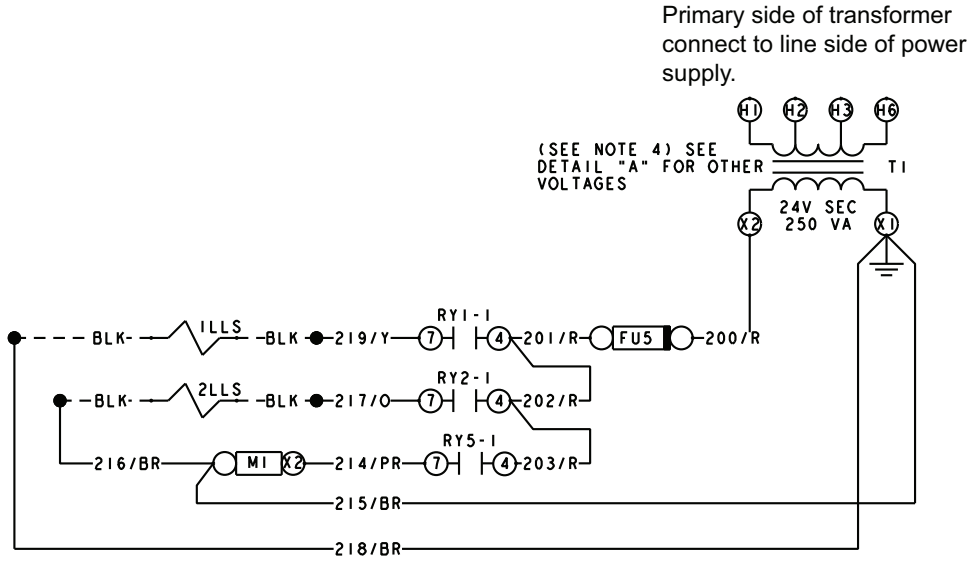


Figure 4: Typical GD360/480 and M2CZ600A liquid line solenoid wiring



Standard Terminal Block on GD360/480 and GD600 with M2CZ600A models. On non GD models isolation relays must be installed to avoid overloading on 75 VA transformer on condensing unit.



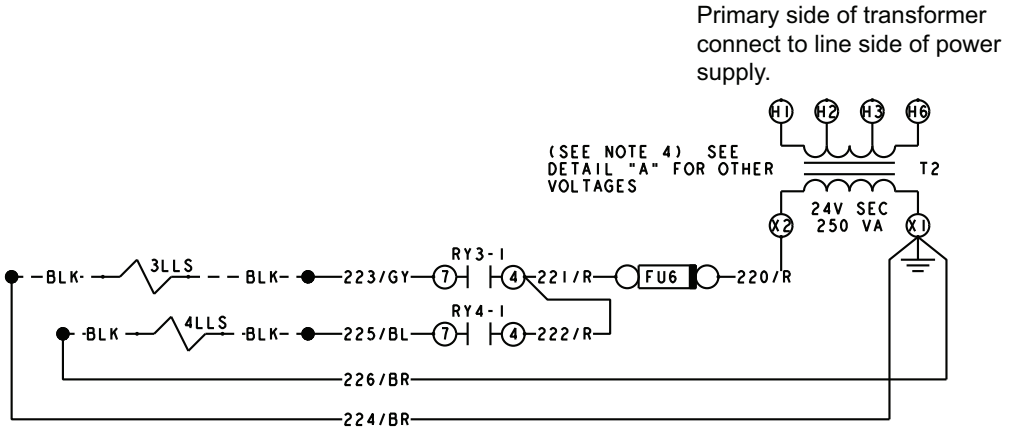


Figure 5: Typical liquid line solenoid wiring

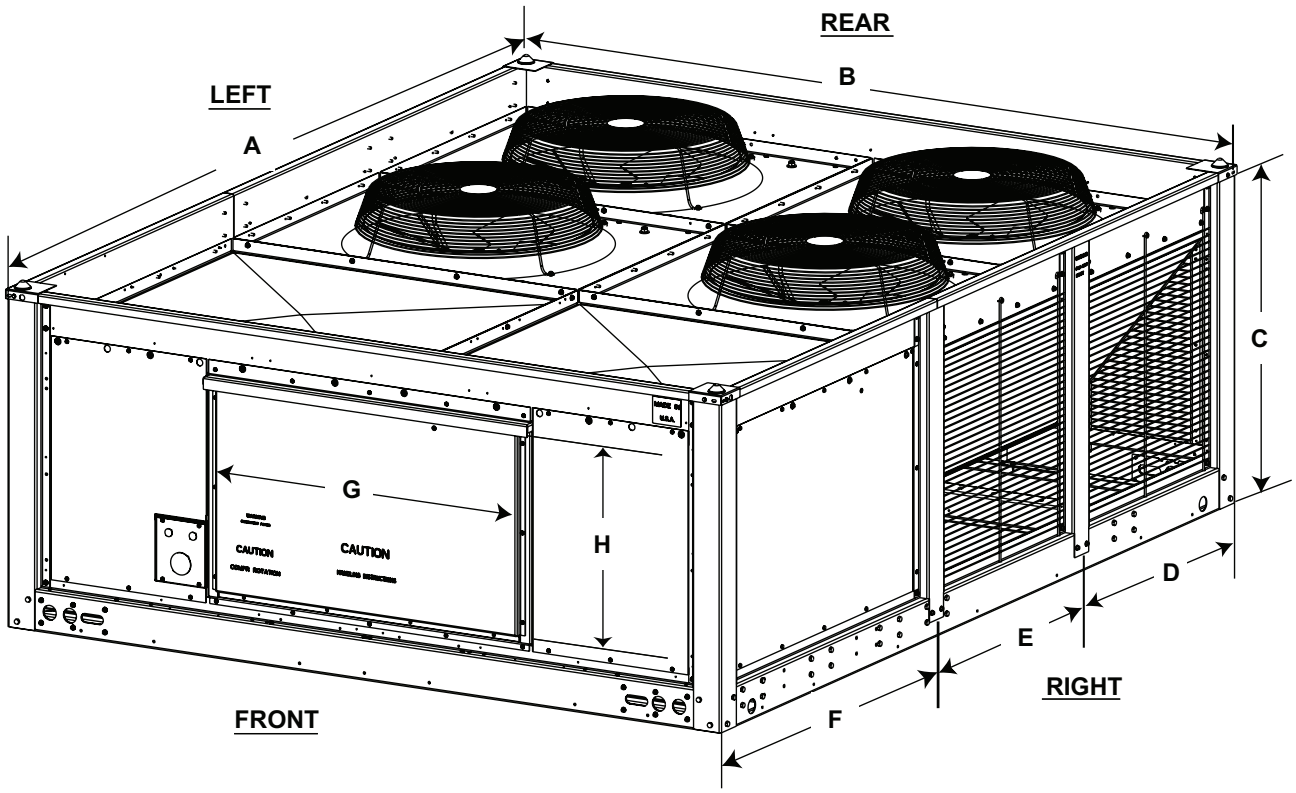


Figure 6: KD unit dimensions

Table 5: Unit dimensions (in.)

Model	A	B	C	D	E	F	G	H
KD360	128.5	88.5	37.5	41.8	40.0	46.1	37.1	23.6
KD480	128.5	88.5	57.7	41.8	40.0	46.1	37.1	23.6
KD600	128.5	88.5	57.7	41.8	40.0	46.1	37.1	23.6

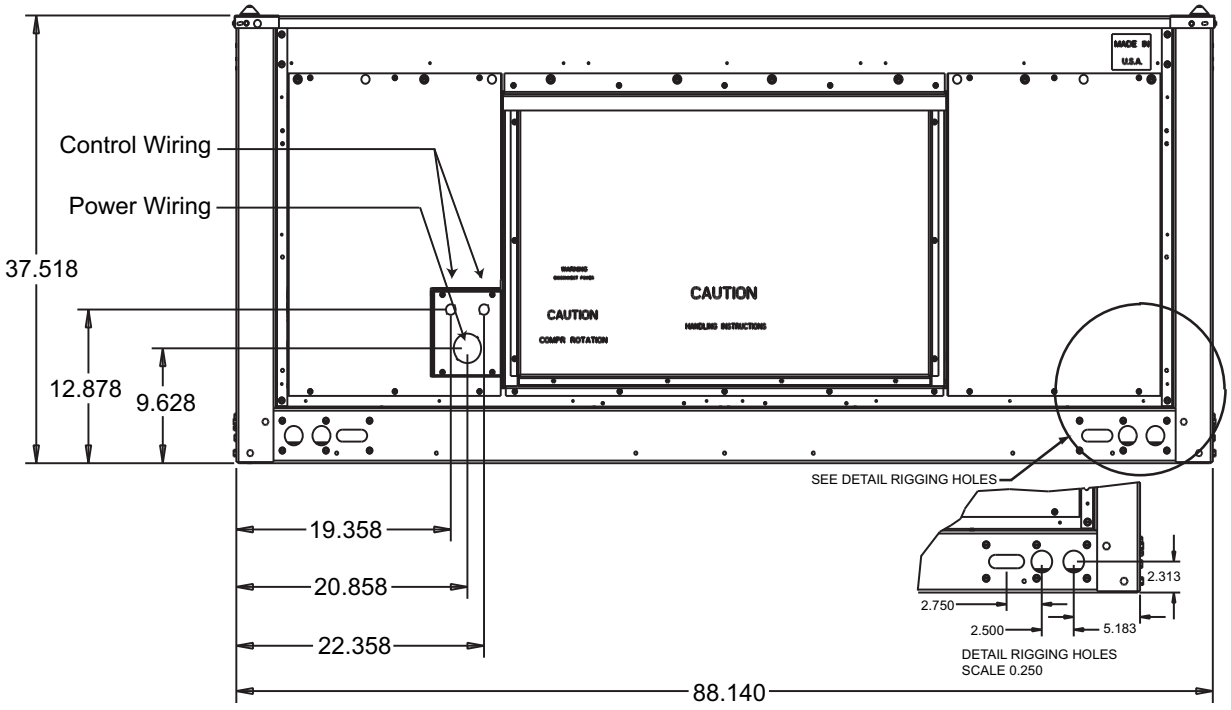


Figure 7: 30 ton power and control wiring connections (in.)

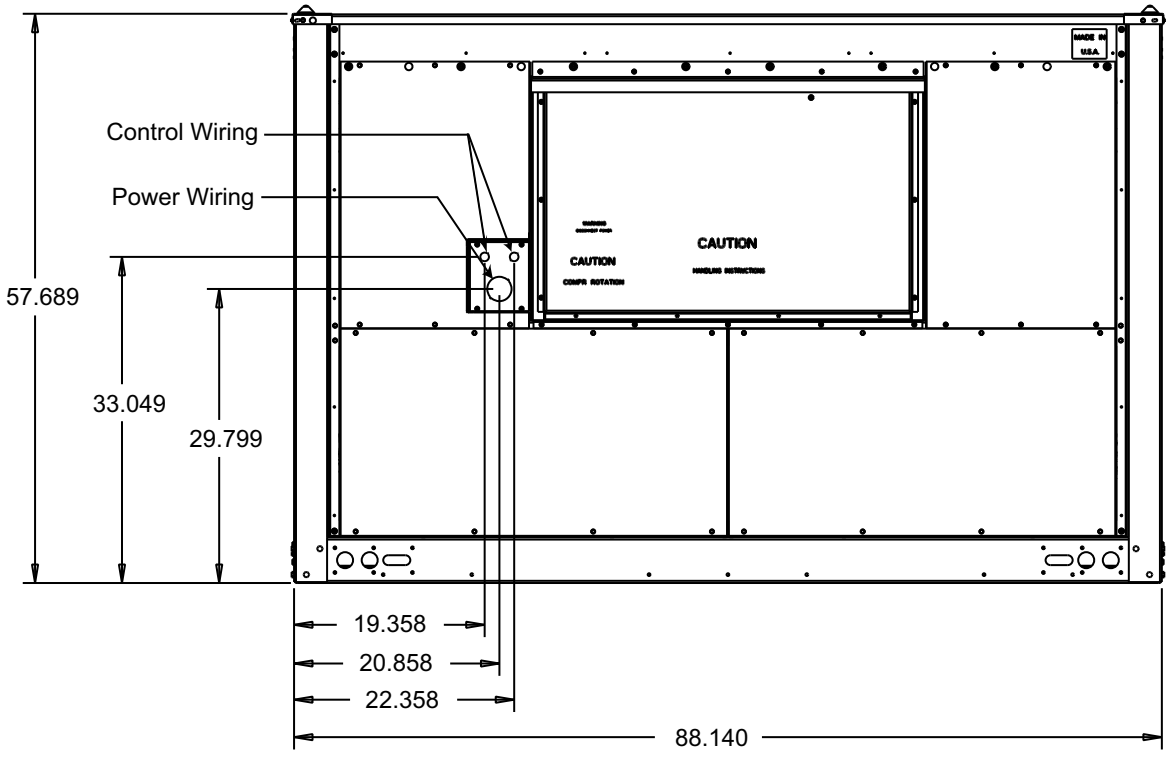


Figure 8: 40 and 50 ton power and control wiring connections (in.)

Piping and electrical connection sizes

Table 6: Piping and electrical connection sizes (30/40/50t) (in.)

Connection entry	Size
Suction line sys #1	1-5/8 outdoor
Liquid line sys #1	7/8 outdoor
Suction line sys #2	1-5/8 outdoor
Liquid line sys #2	7/8 outdoor
Power wiring knockout	See table 8
Control wiring	7/8 hole

Table 7: Electrical power knockout sizes (in.)

Connection entry	30-40-50T/230 V	30-40-50T/460-575 V
Power wiring	2-1/2 in.	1-1/2 in.

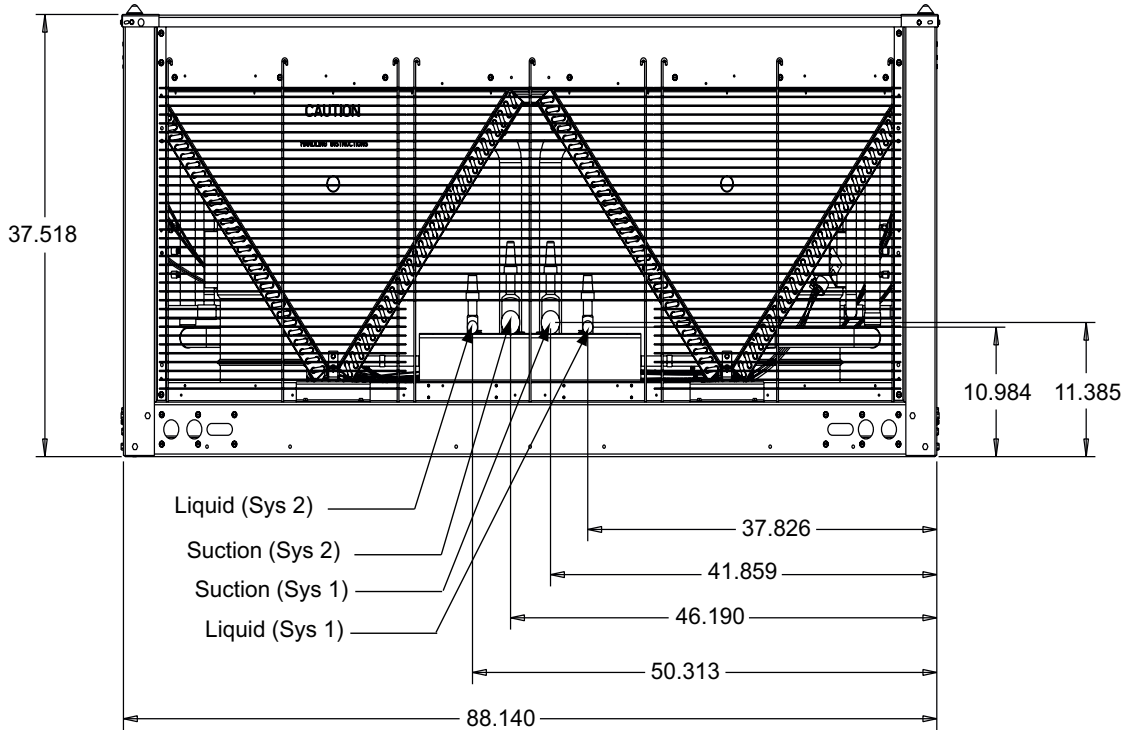


Figure 9: 30 ton piping connections (in.)

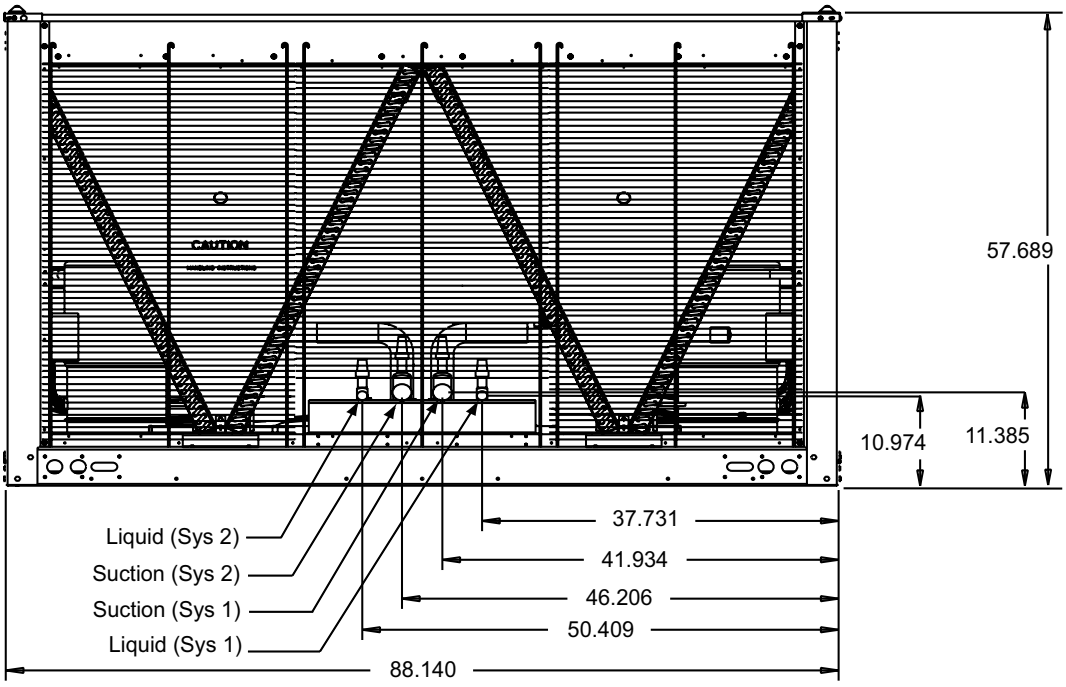


Figure 10: 40 and 50 ton piping connections (in.)

Piping and electrical connections

Piping connections are made from the rear of units. Connections can be made directly to the suction and liquid line service valves. Piping can be routed to the units from the left or right side.

Electrical connections for power and control wiring are made from the front of all units, left of the electrical control box access. See Tables 6 and 7 and Figures 7 through 10 and for piping sizes and electrical knockout details.

Start-up

Crankcase heater

The crankcase heater must be energized at least 8 hr before starting the compressor.

To energize the crankcase heater, the main disconnect switch must be closed. During this 8 hr period, the system switch on the room thermostat must be off to prevent the compressor from starting.

Make sure that the bottom of the compressor is warm to the touch to prove crankcase heater operation.

⚠ CAUTION

Do not attempt to start the compressor without at least 8 hours of crankcase heat or compressor damage can occur.

Pre-start check

Before starting the unit, complete the following check list:

1. Have sufficient clearances been provided?
2. Has all foreign matter been removed from the interior of the unit (tools, construction or shipping materials, etc.)?
3. Have the condenser fans been rotated manually to check for free rotation?
4. Are all wiring connections tight?
5. Does the available power supply agree with the nameplate data on the unit?
6. Is the control circuit transformer set for the proper voltage?
7. Have the fuses, disconnect switch and power wire been sized properly?
8. Are all compressor hold-down nuts properly secured?
9. Are any refrigerant lines touching each other or any sheet metal surface? Rubbing due to vibration could cause a refrigerant leak.
10. Are there any visible signs of a refrigerant leak, such as oil residue?
11. Has the refrigerant system been leak checked, evacuated and had the correctly calculated charge weighted in?
12. Is any electrical wire laying against a hot refrigerant line?

Initial start-up

1. Supply power to the unit through the disconnect switch at least 8 hr prior to starting the compressor.

2. Move the system switch on the thermostat to the AUTO or COOL position.
3. Reduce the setting of the room thermostat to energize the compressor.
4. Check the operation of the evaporator unit per the manufacturer's recommendations.
5. With an ammeter, check the compressor amps against the unit data plate.
6. Check for refrigerant leaks.
7. Check for any abnormal noises or vibrations, and make the necessary adjustments to correct fan blade(s) touching shroud, refrigerant lines hitting on sheet metal, etc.
8. After the unit has been operating for several minutes, shut off the main power supply at the disconnect switch and inspect all factory wiring connections and bolted surfaces for tightness.

Operation

Unit control overview

This series of condenser units, comes factory equipped with Smart Equipment™ controls to monitor all unit functionality and safety controls. (2 Smart Equipment™ controls per system on 30, 40 and 50 ton condensers.)

Safety controls

The Smart Equipment™ control board incorporates features to monitor safety circuits as well as minimize compressor wear and damage. An anti-short cycle delay (ASCD) is utilized to prevent operation of a compressor too soon after its previous run. Additionally, a minimum run time is imposed any time a compressor is energized to allow proper oil return to the compressor. The ASCD is initiated on unit start-up and on any compressor reset or lockout.

The Smart Equipment™ control board monitors the following inputs for each cooling system:

- A high-pressure switch is factory installed to protect against excessive discharge pressure due to a blocked condenser coil or a condenser fan motor failure. During cooling operation, if a high-pressure limit switch opens, the Smart Equipment™ control board de-energizes the associated compressors and initiates the 5 min ASCD. If the call for cool is still present at the end of the ASCD, the control board re-energizes the halted compressor. If a high-pressure switch opens three times within 2 hr of operation, the Smart Equipment™ control board locks out the associated system compressors and dsiplays the fault on the on board LCD display.
- A low-pressure switch to protect the unit against excessively low suction pressure is standard on all condensing units. If the low-pressure switch opens during normal operation, the Smart Equipment™ control board de-energizes the compressor, initiates the ASCD, and shuts down the condenser fans. On startup, if the low-pressure switch opens, the Smart Equipment™ control board monitors the low-pressure switch to make sure it closes within 1 min. If it fails to close, the unit shuts down the associated compressor and begin an ASCD. If the call for cool is still present at the end of the anti-short cycle time delaying, the control board re-energizes the halted compressor. If a low-pressure switch opens three times within 2 hrs of operation, the Smart Equipment™ control board locks out the associated system compressors and will display the fault on the on board LCD display.
- An ambient air sensor locks out mechanical cooling at 45°F. Use the available field installed low ambient kit to operate the unit down to 0°F.

The refrigerant systems are independently monitored and controlled. On any fault, only the associated system will be affected by any safety/preventive action. The other refrigerant system will continue to operate unless it is affected by the fault as well.

Pump out

The pump-out on start-up function is a standard feature on the 30 to 50 ton matched split systems. These systems have dual circuit indoor evaporator refrigerant circuits. Each circuit includes 2 TXVs and 2 normally closed solenoid valves that are utilized for the pump-out on start-up sequence of operation. The pump-out sequence is designed to prevent liquid refrigerant flooding of the compressors during startup.

The pump-out circuit is activated each time the first stage (Y1 of UCB 1), or third stage (Y1 of UCB 2) compressors are called for from the thermostat. On initial startup, the pump-out circuitry does not allow the 1LLS (Pump-Out Solenoid System 1) or 3LLS (Pump-Out Solenoid System 2) located in the liquid line just ahead of the TXVs to open, thus not allowing refrigerant flow, or liquid refrigerant to enter the evaporator during startup.

The 1LLS or 3LLS remains closed and refrigerant cannot flow through the system until the active refrigerant circuit's low pressure switch (LPS 1 on UCB 1) or (LPS 1 on UCB 2) opens.

Once the low pressure switch opens or 5 min elapses, the SE boards energizes the PR1 (Pump-Out Relay System 1) or PR2 (Pump-Out Relay System 2), which then opens the 1LLS or 3LLS (Pump-Out Solenoids) and refrigerant begins to flow through the active refrigerant circuit.

The active systems' low pressure switch is ignored for approximately 1 min while the systems suction pressure rises above its cut in point of 71 psi at which point the LPS closes again for normal operation and LPS function.

The UCB - CN-fan output controls the pump out relay function. Pump out function is also possible with lead-lag disabled. turn off the lead lag function anytime the hot gas bypass (HGBP) is installed.

Sequence of operation

Note: The timing intervals described in the following procedures are nominal. Some variations naturally occur due to differences in individual components, or due to variations in ambient temperature or line/control

voltage. Refer to the wiring labels inside of the unit control access panel for additional information.

Continuous blower

By setting the room thermostat to on, the low voltage control circuit from the R to G is completed and the supply air blower will operate continuously.

Intermittent blower

With the room thermostat fan switch set to AUTO and the system switch set to either the AUTO or HEAT settings, the blower is energized whenever a cooling or heating operation is requested. The blower is energized after any specified delay associated with the operation.

When energized in cooling mode, the indoor blower has a minimum run time of 30 s. Additionally, the indoor blower has a delay of 10 s between operations.

Cooling sequence of operation

When the thermostat calls for the first stage of cooling, the low-voltage control circuit from the R to Y1 (UCB 1 Y1) and G is completed and the first stage of cooling by energizing the M1 contactor of Compressor 1 and the RY1 (outdoor fan relay) for both condenser fans FM1 and FM2 of System 1. When the LPS of UCB-1 falls below its cut-out point the CN-fan output brings on the PR1 and 1LLS (solenoid) and the refrigerant in system 1 flows for normal mechanical cooling function. After completing the specified fan on delay for cooling, the UCB 1 energizes FR1 (indoor fan relay), energizing the indoor blower motor via G1 output.

When the thermostat calls for the second stage of cooling, the low-voltage control circuit from R to Y2 (UCB 1 Y2) is completed. The UCB 1 energizes the M2 contactor of Compressor 2 and the RY2 (staging relay) for the 2LLS (solenoid) and both condenser fans FM1 and FM2 of System 1. FM2 is controlled by pressure.

If there is an initial call for both stages of cooling, the SE control board (UCB 1) will delay energizing compressor two by 30 s in order to avoid an excessive power rush.

When the thermostat calls for the third stage of cooling, the low-voltage control circuit from the R replicate Y1 sequence into Y2 as above to Y3 (UCB 2 Y1) is completed. The SE control board (UCB 2) activates the pump-out on start-up function and the third stage of cooling by energizing the M3 contactor of Compressor 3 and the RY3 (outdoor fan relay) for both condenser fans FM3 and FM4 of System 2. When the LPS of UCB-2 falls below its cut-out point the PR2 relay brings on the 3LLS (Solenoid) and the refrigerant in system 2 returns the flow to the compressor for normal mechanical cooling function. FR2 relay also energizes, providing a G2 output as needed in some applications.

When the thermostat calls for the fourth stage of cooling, the low-voltage control circuit from R to Y4 (UCB 2 Y2) is completed. The UCB 2 energizes the M4 contactor of Compressor 4 and the RY4 (staging relay) for 4LLS (solenoid) and both condenser fans FM3 and FM4 of System 2.

Once the thermostat has been satisfied, the SE control boards will de-energize Y1, Y2, Y3 and Y4. If the compressors have satisfied their minimum run times, the compressors and condenser fans are de-energized. Otherwise, the unit operates each cooling stage until the ASCD has elapsed. Upon the completion of first stage cooling, the blower is stopped following the completion of the fan off delay cycle.

Condenser fan operation

These condensing units are factory equipped with fan cycling switches (PS1 System1 and PS2 System 2) to regulate system head pressure. When outdoor ambient conditions are cool, the head pressure of any air conditioning system may drop too low for optimal performance. These condensing units maximize system performance in a variety of ambient conditions by incorporating fan cycling switches to maintain proper system head pressure.

On these condensing units, the condenser fans of a given system (1 or 2) are powered when a compressor call is made (C1, C2 (UCB1) C1, C2 (UCB2)) and the respective compressor is energized. Fan FM1 (System 1) or Fan FM3 (System 2) will start immediately upon a call for first or third stage cooling.

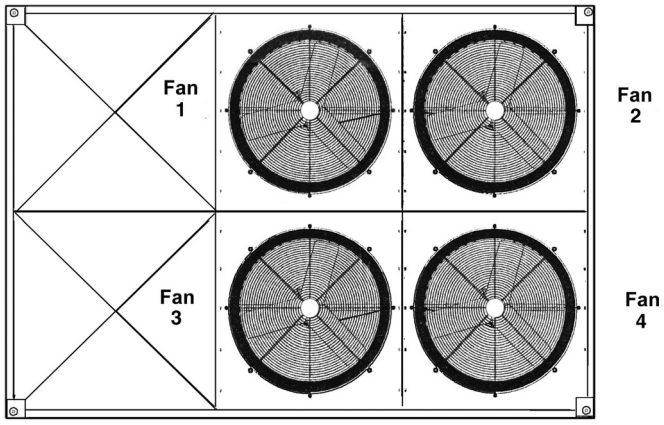


Figure 11: Fan orientation control box end

However, Fan FM2 (System 1) or Fan FM4 (System 2) is equipped with a fan cycling switch (PS1 or PS2) and does not start until the system head pressure reaches 480 psig. Fan 2 or 4 operates until the system head pressure drops below 300 psig where the fan cycling switch will shut the fan down. The unit will continue to operate Fan FM1 or FM3 until the system head pressure again reaches 480 psig at which time Fan FM2 or FM4 will restart. Condenser fans operate as above regardless of lead-lag preference.

Operation with a four-stage thermostat

If the total system is to be controlled with a 4-stage thermostat:

1. Connect terminals Y1 and Y2 of the Smart Equipment™ control board (UCB 1) controlling System 1, to stages 1 and 2 of the 4-stage thermostat.

2. Connect terminals Y1 and Y2 of the Smart Equipment™ control board (UCB 2) controlling System 2, to stages 3 and 4 of the 4 stage thermostat.

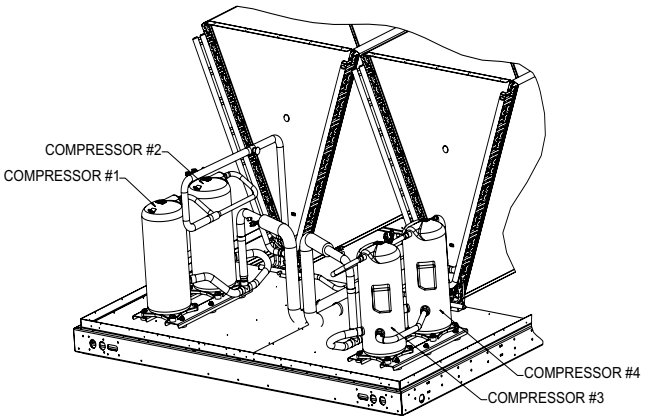


Figure 12: Compressor Location

Control board navigation components

You need the following components to access the control points in the Smart Equipment control.

Note: Installation and operational guides are available from your equipment dealer or distributor.

- Local LCD on Unit Control Board.
- Tools to interact with the UCB.

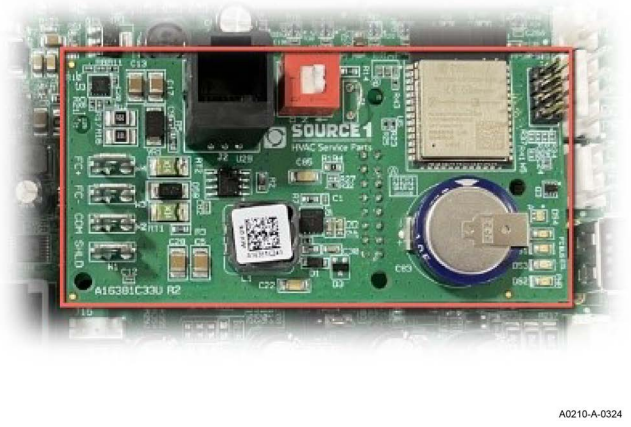
a Connected Workflow app (CWa) (available for iOS or Android).

Note: You can connect the CWa to the controller via bluetooth through the Connected Workflow Converter (CWCVT) or directly to the UCB if the controller has a communication card.

- CWCVT Wireless MS/TP Converter User Guide, literature part no. 12014120
- Connected Workflow Applications User Guide, literature part no. 12014106

Figure 13: CWCVT (S1-TL-CWCVT-0)

Figure 14: Communication card



b Mobile Access Portal (MAP) Gateway (portable)

- Source 1 part no. S1-YK-MAP1810-0P (no longer available for purchase).

Note: Although the MAP is no longer available for purchase, it continues to work with the UCB. The MAP does not receive firmware updates, so as additional points are added to the UCB those points will not render properly. However, the MAP will continue to work for the majority of typical applications.

- MAP Gateway Quick Start Guide, part no. 24-10737-16
- MAP Gateway Instruction, part no. 24-10737-8

For more information on the Smart Equipment™ unit control board navigation, refer to the *Smart Equipment™ Quick Start Guide*.

Note: For more in-depth sequence of operation of the Smart Equipment™ control, refer to the *Smart Equipment™ Controls Sequence of Operation Overview* LIT-12011950.

Normal maintenance

⚠WARNING

Prior to any of the following maintenance procedures, shut off all power to the unit, to avoid personal injury.

Periodic maintenance consists of changing or cleaning filters and general cleaning of the outdoor coil.

Motors - Outdoor fan motors are permanently lubricated and require no maintenance.

Outdoor coil - Do not allow dirt to accumulate on the outdoor coil surface or other parts in the air circuit. Clean as often as necessary to keep the coil clean. Use a brush, or other suitable means. Disconnect power to the unit prior to cleaning.

⚠ CAUTION

Exercise care when cleaning the coil so that the coil fins are not damaged.

Do not permit the hot condenser air discharge to be obstructed by overhanging structures or shrubs.

Troubleshooting

⚠WARNING

Troubleshooting of components necessarily requires opening the electrical control box with the power connected to the unit. Use extreme care when working with live circuit! Check the unit nameplate for the correct range before making any connections with line terminals.

⚠ CAUTION

The wire number or color and terminal designations referred to may vary. Check the wiring label inside the control box access panel for the correct wiring.

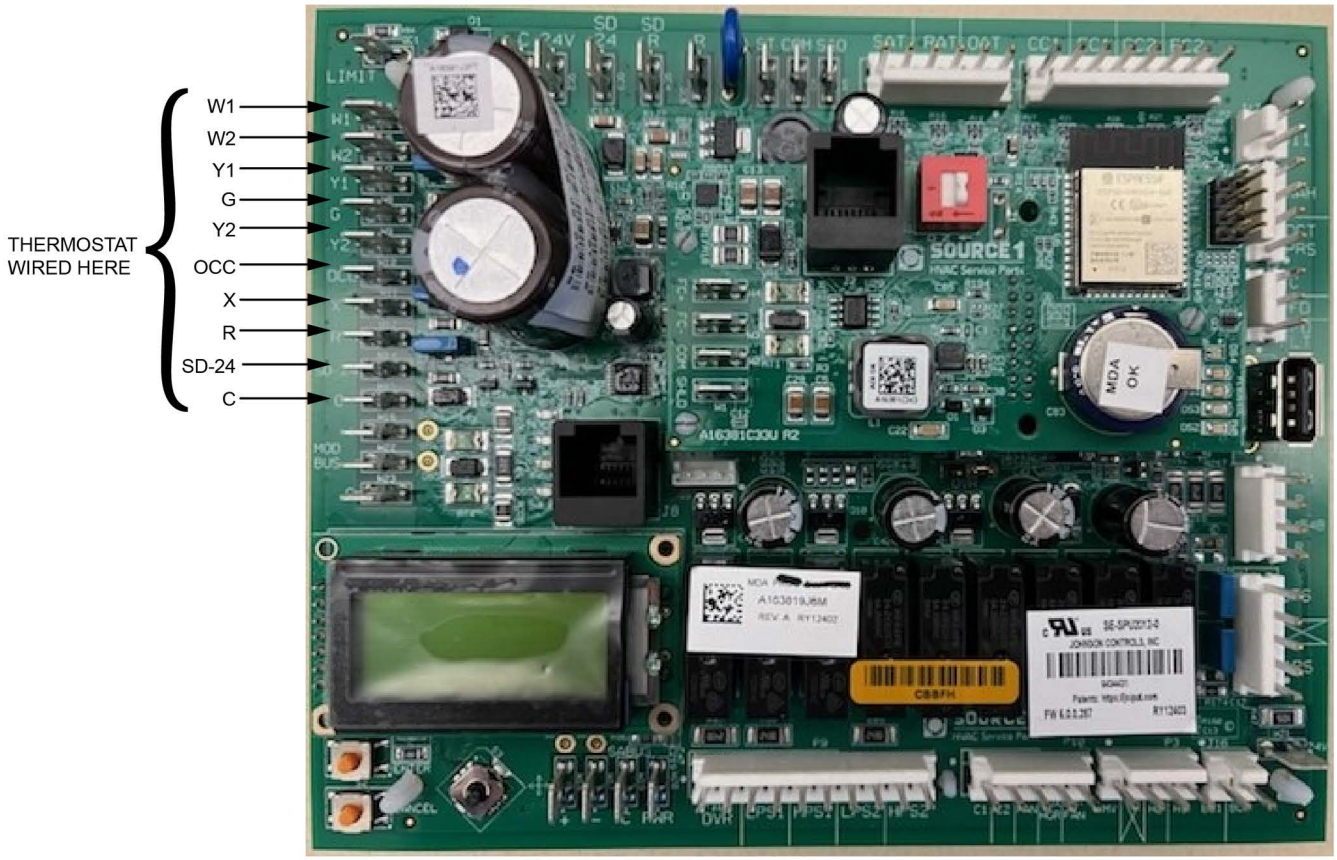


Figure 15: Unit control board

Table 8: Smart Equipment™ UCB details (Version 5 hardware)

Description		Function and Comments
Terminal Directional orientation: viewed with silkscreen labels upright		
Limit, 24 VAC power and shutdown connections from unit wiring harness at left on upper edge of UCB		
LIMIT	Monitored 24 VAC input through heat section limit switches	If the voltage is absent, indicating the heat section is over-temperature, the UCB brings on the indoor blower
C	24 VAC, 75 VA transformer common referenced to cabinet ground	Connects through circuit traces to thermostat connection strip C and indoor blower VFD pin C
24V	24 VAC, 75 VA transformer hot	Powers the UCB microprocessor, connects through circuit trace to the SD 24 terminal
SD 24	24 VAC hot out for factory accessory smoke detector, condensate overflow and/or user shutdown relay switching in series	Connects through circuit trace to thermostat connection strip SD-24. A wiring harness jumper plug connecting SD 24 to SD R is in place if factory accessories for unit shutdown are not used - this jumper plug must be removed if the switching of field-added external accessories for unit shutdown are wired between thermostat connection strip SD-24 and R
SD R	24 VAC hot return from factory accessory smoke detector and user shutdown relay switching in series	Connects through circuit trace to the R terminal on the upper left of the board

Table 8: Smart Equipment™ UCB details (Continued)(Version 5 hardware)

Description		Function and Comments
R	24 VAC hot for switched inputs to the UCB	Connects through circuit trace to the thermostat connection strip R terminal, right FAN OVR pin, right HPS1 pin, right HPS2 pin, lower DFS pin and lower APS pin
Terminal Thermostat connection strip on left edge of UCB		
W1	1st stage heating request, 24 VAC input switched from R	Not effective for cooling-only units
W2	2nd stage heating request, 24 VAC input switched from R	Not effective for cooling-only units or units with single-stage heat sections
Y1	1st stage cooling request, 24 VAC input switched from R	
Y2	2nd stage cooling request, 24 VAC input switched from R	Visible in the display menu when the #ClgStgs parameter is set for 2 or more, also effective for economizer free cooling supply air temperature reset when the #ClgStgs parameter is set for 1 or more
G	Continuous indoor blower request, 24 VAC input switched from R	
OCC	Occupancy request, 24 VAC input switched from R	Must have the OccMode parameter set for External to be effective
X	Hard lockout indicator, 24 volt output to a light thermostat LED	24V positive half-wave rectified
R	24 VAC hot for thermostat switching and power	If field-added external accessories for unit shutdown are used, 24 VAC hot return from smoke detector, condensate overflow and/or user shutdown relay switching in series
SD-24	If field-added external accessories for unit shutdown are used, 24 VAC hot out for smoke detector, condensate over- flow and/or user shutdown relay switching in series	Unit wiring harness jumper plug for factory shutdown accessories must be removed if the switching of field-added external accessories for unit shutdown are wired between thermo- stat connection strip SD-24 and R
C	24 VAC common for thermostat power	
+	Modbus Terminal +	N/A - Future
-	Modbus Terminal -	N/A - Future
C	Modbus Terminal C	N/A - Future
LEDs on left edge of UCB		
Power	Green UCB power indicator	Lit indicates 24 VAC is present at C and 24V terminals
Fault	Red hard lockout, networking error and firmware error indicator	1/2 second on/off flashing indicates one or more alarm is currently active, 1/10th second on/off flashing indicates a networking error (polarity, addressing, etc.) or a firmware error (likely correctable with re-loading from USB flash drive)
SA BUS	Green UCB SA bus communication transmission indicator	Lit/flickering indicates UCB SA bus communication is currently active, off indicates the UCB is awaiting SA bus communication
Terminal Space temperature sensor connections at center on upper edge of UCB		
ST	Space Temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Positive of VDC circuit (3.625 VDC reading to COM with open circuit), effective if “Thermostat-only Control” parameter is set OFF, space sensor override momentary shorts ST to COM to initiate/terminate temporary occupancy
COM	Common for ST and SSO inputs	Negative of VDC circuit for ST and SSO inputs

Table 8: Smart Equipment™ UCB details (Continued)(Version 5 hardware)

Description		Function and Comments
SSO	Space Sensor Offset input from 0 to 20KΩ potentiometer	Positive of VDC circuit (3.625 VDC reading to COM with open circuit), 10KΩ/2.5 VDC is 0°F offset, 0Ω/0 VDC is maximum above offset and 20KΩ/3.4 VDC is maximum below offset from active space temperature setpoint
Pin Temperature sensor connections at right on upper edge of UCB		
SAT+	Supply Air Temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Input required for operation; 3.625 VDC reading SAT+ to SAT– with open circuit. Used in heat/cool staging cutouts, free cooling operation, demand ventilation operation, comfort ventilation operation, economizer loading operation, VAV cooling operation, hydronic heat operation.
RAT+	Return Air Temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Input required for operation; 3.625 VDC reading RAT+ to RAT– with open circuit. Used in return air enthalpy calculation. Substitutes for space temperature if no other space temperature input is present.
OAT+	Outside Air Temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Input required for operation but may be a communicated value; 3.625 VDC reading OAT+ to OAT– with open circuit. Used in heat/cool cutouts, low ambient cooling determination, dry bulb free cooling changeover, outside air enthalpy calculation, economizer loading operation, heat pump demand defrost calculation.
CC1+	#1 refrigerant circuit Condenser Coil temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Input required for heat pump units, not required for A/C units; 3.625 VDC reading CC1+ to CC1– with open circuit. Used in heat pump demand defrost calculation.
EC1+	#1 refrigerant circuit Evaporator Coil/Suction line temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Input required for operation; 3.625 VDC reading EC1+ to EC1– with open circuit. Used in suction line temperature safety.
CC2+	#2 refrigerant circuit Condenser Coil temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Input required for 2-compressor heat pump units, not required for 2-compressor A/C units, not active for 1-compressor units; 3.625 VDC reading CC2+ to CC2– with open circuit. Used in heat pump demand defrost calculation.
EC2+	#2 refrigerant circuit Evaporator Coil/Suction line temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Input required for operation of 2-compressor units, not active for 1-compressor units; 3.625 VDC reading EC2+ to EC2– with open circuit. Used in suction line temperature safety.
Pinned connections on right edge of UCB		
AI1	Analog Input 1	Future - 0-10 VDC input
RAH+	Return Air Humidity input from 0-10 VDC @ 0-100% RH sensor	Input required for reheat units, optional in all other units, may be a communicated value. Used in return air enthalpy calculation, temperature/humidity setpoint reset, reheat operation.
DCT PRS+	Supply Duct Pressure input from 0-10 VDC @ 0-5” w.c. sensor	Input required for variable air volume units. Used in VAV indoor blower operation.
C	Common for the VFD output	Negative of the VDC circuit for the VFD output
VFD	2-10 VDC (0-100%) output for the indoor blower Variable Frequency Drive	Output is active with indoor blower operation. For CV units: this output provides stepped IntelliSpeed control of the indoor blower VFD based on fan-only, cooling stage and heating stage outputs. For VAV units: this output provides control of the indoor blower VFD based on supply duct static pressure input and setpoint.

Table 8: Smart Equipment™ UCB details (Continued)(Version 5 hardware)

Description		Function and Comments
VFDFLT	24 VAC hot input from the normally open VFD alarm contact	The VFD alarm contact switches from R within the unit wiring harness. 24 VAC input results in unit shutdown and a “VFD fault” alarm
J10	Type A female Universal Serial Bus connector	Used for backup, restoration, & copying of board parameters as well as board software updating through a flash drive
COS	24 VAC hot return from Condensate Overflow Switch	Optional input; switch opening will disable the control outputs to the unit compressors. Upon closure, the compressors will begun unit operation after off delay expires
R	24 VAC hot out for COS	Connects through circuit trace to the R terminal
RDS	24 VAC hot return from Refrigerant Detection System	Required input for RDS; when flammable refrigerant is used and RDS is required, the unit will monitor this input and enter mitigation mode if unit RDS contact opens
R	24 VAC hot out for COS	Connects through circuit trace to the R terminal
DFS (upper pin)	24 VAC hot return from Dirty Filter Switch	Optional input; switch closure for greater than 15 seconds during indoor blower operation initiates a notification alarm
DFS (lower pin)	24 VAC hot out for Dirty Filter Switch	Connects through circuit trace to the R terminal
APS (upper pin)	24 VAC hot return from Air Proving Switch	When this optional input is enabled: the air proving switch must close within 30 seconds of initiation of indoor blower operation and not open for greater than 10 seconds during in- door blower operation to allow heat/cool operation and prevent an “APS open” alarm; the air proving switch must open within 30 seconds of termination of indoor blower operation to prevent an “APS stuck closed” notification alarm
APS (lower pin)	24 VAC hot out for Air Proving Switch	Connects through circuit trace to the R terminal
Terminal at lower right corner of UCB		
24V	24 VAC hot for H1, H2, CN-FAN, AUX HGR, FAN C1 and C2 output relay contact switching	Output relay circuitry is isolated from other UCB components and the 24 VAC hot source may be from a second transformer in the unit
Pin Heat section connections at right on lower edge of UCB		
BO2	Binary output 2	Future
BO1	Binary output 2	Future
H1	24 VAC hot output for heat section stage 1	Not effective for cooling-only units. Output if demand is present and permissions allow one stage or two stages of heat section operation
H2	24 VAC hot output for heat section stage 2	Not effective for cooling-only units or units with single-stage heat sections. Output if demand is present and permissions allow two stages of heat section operation

Table 8: Smart Equipment™ UCB details (Continued)(Version 5 hardware)

Description		Function and Comments
MV	24 VAC hot input confirming heat section operation	Sourced from gas valve in gas heat units or first stage heat contactor in electric heat units. Input within 5 minutes from initiation of H1 output initiates the “Heat On Fan Delay” timer, loss of input following the termination of H1 output initiates the “Heat On Fan Delay” timer, no input within 5 minutes from initiation of H1 output initiates an “Ignition Failure” alarm, input for longer than 5 minutes without H1 output initiates a “Gas Valve Mis-wire” alarm
Pin Cooling and fan output connections at right on lower edge of UCB		
CN-FAN	24 VAC hot output for the condenser fan contactor coil	Output with either C1 or C2 output; interrupted during defrost cycle for heat pump units
AUX HGR	24 VAC hot output for hot gas reheat components	Effective only for reheat units, output with reheat operation
FAN	24 VAC hot output for indoor blower contactor coil/ indoor blower VFD enable relay coil	Output with heat/cool operation, G input or schedule demand
C1	24 VAC hot output for compressor 1	If demand is present and permissions allow compressor 1 operation; output with compressor cooling, comfort ventilation cooling, reheat or heat pump heating demands
C2	24 VAC hot output for compressor 2	Not effective for one stage compressor UCBs. If demand is present and permissions allow compressor 2 operation; output with compressor cooling, comfort ventilation cooling or heat pump heating demands
Pin Refrigerant circuit safety switch and indoor blower overload connections at center on lower edge of UCB		
HPS1 (right pin)	24 VAC hot out for refrigerant circuit 1 High Pressure Switch	Connects through circuit trace to the R terminal
HPS1 (left pin)	24 VAC hot return from refrigerant circuit 1 High Pressure Switch	Input is only considered if C1 output is needed; input must be present to allow C1 output. Three HPS1 trips in a two hour period cause a “High Pressure Switch 1 Lockout” and C1 output is then prevented until alarm reset. Connects through circuit trace to the right LPS1 pin.
LPS1 (right pin)	24 VAC hot out for refrigerant circuit 1 Low Pressure Switch	Connects through circuit trace to the left HSP1 pin
LPS1 (left pin)	24 VAC hot return from refrigerant circuit 1 Low Pressure Switch	Input is only considered after 30 seconds of C1 output; afterwards, input must be present to allow C1 output. Three LPS1 trips in a one hour period cause a “Low Pressure Switch 1 Lockout” and C1 output is then prevented until alarm reset.
HPS2 (right pin)	24 VAC hot out for refrigerant circuit 2 High Pressure Switch	Not effective for one stage compressor UCBs. Connects through circuit trace to the R terminal
HPS2 (left pin)	24 VAC hot return from refrigerant circuit 2 High Pressure Switch	Not effective for one stage compressor UCBs. Input is only considered if C2 output is needed; input must be present to allow C1 output. Three HPS2 trips in a two hour period cause a “High Pressure Switch 1 Lockout” and C2 output is then prevented until alarm reset. Connects through circuit trace to the right LPS2 pin.
LPS2 (right pin)	24 VAC hot out for refrigerant circuit 2 Low Pressure Switch	Not effective for one stage compressor UCBs. Connects through circuit trace to the left HSP2 pin
LPS2 (left pin)	24 VAC hot return from refrigerant circuit 2 Low Pressure Switch	Not effective for one stage compressor UCBs. Input is only considered after 30 seconds of C2 output; afterwards, input must be present to allow C2 output. Three LPS2 trips in a one hour period cause a “Low Pressure Switch 2 Lockout” and C2 output is then prevented until alarm reset.

Table 8: Smart Equipment™ UCB details (Continued)(Version 5 hardware)

Description		Function and Comments
FAN OVR (right pin)	24 VAC hot out for indoor blower FAN Overload relay contact/motor protector switch	Connects through circuit trace to the R terminal
FAN OVR (left pin)	24 VAC hot return from indoor blower FAN Overload relay contact/motor protector switch	Input is only considered if FAN output is needed; input must be present to allow FAN output and unit operation. One FAN OVR trip lasting longer than 5 minutes or three FAN OVR trips in a two hour period cause a “Fan Overload Lockout” and unit operation is then prevented until alarm reset.
Terminal SA BUS connections on at left on lower edge and center of UCB		
PWR	Power for SA (“Sensor-Actuator”) BUS devices	Also incorporated in the J8 6-pin phone jack connector at the left-center of the board. Positive of the 15 VDC (reading to C) circuit for powering an optional netstat and/or Multi Touch gateway
C	Common for SA BUS power and communication circuits	Also incorporated in the J8 6-pin phone jack connector at the left-center of the board. Negative of the SA BUS circuits
–	Communication for SA BUS devices	Also incorporated in the J8 6-pin phone jack connector at the left-center of the board. Positive of the VDC (typically, a fluctuating 1.5 to 3.5 volts reading to C; at least 0.25 volts lower than +) SA BUS communication circuit to optional economizer board, 4-stage board, fault detection & diagnostics board, netstat and/or Multi Touch gateway
+	Communication for SA BUS devices	Also incorporated in the J8 6-pin phone jack connector at the left-center of the board. Positive of the VDC (typically, a fluctuating 1.5 to 3.5 volts reading to C; at least 0.25 volts higher than –) SA BUS communication circuit to optional economizer board, 4-stage board, fault detection & diagnostics board, netstat and/or Multi Touch gateway
J8	6-pin phone jack connector	Incorporates the SA BUS terminals for convenience/alternate connection of SA BUS devices, primarily used for temporary service connection of the Multi Touch gateway
Item Integrated user interface at lower left corner of UCB		
Display	On-board, 2-line x 8-character back-lit display	On-board display, buttons and joystick allow access to UCB, economizer, 4-stage and FDD board parameters
ENTER	Button for display menu acknowledgment and navigation	
CANCEL	Button for display menu navigation and zeroing of active compressor ASCD timer	
JOY	4-way Joystick for display menu navigation	
Item USB connector at right of UCB		
J15	Factory wired SA Bus connector	
Optional communication sub-board at center of UCB		
Terminal FC BUS connections on left edge of the communication board		
FC+	FC (“Field Connected”) BUS BACnet MSTP communication	Positive of the VDC (typically, a fluctuating 1.5 to 3.5 volts reading to COM; at least 0.25 volts higher than –) FC bus BACnet MSTP communication circuit
FC–	FC (“Field Connected”) BUS BACnet MSTP communication	Positive of the VDC (typically, a fluctuating 1.5 to 3.5 volts reading to COM; at least 0.25 volts lower than +) FC bus BACnet MSTP communication circuit
COM	Common for the FC (“Field Connected”) BUS BACnet MSTP communication circuit	Negative of the VDC FC bus BACnet MSTP communication circuit

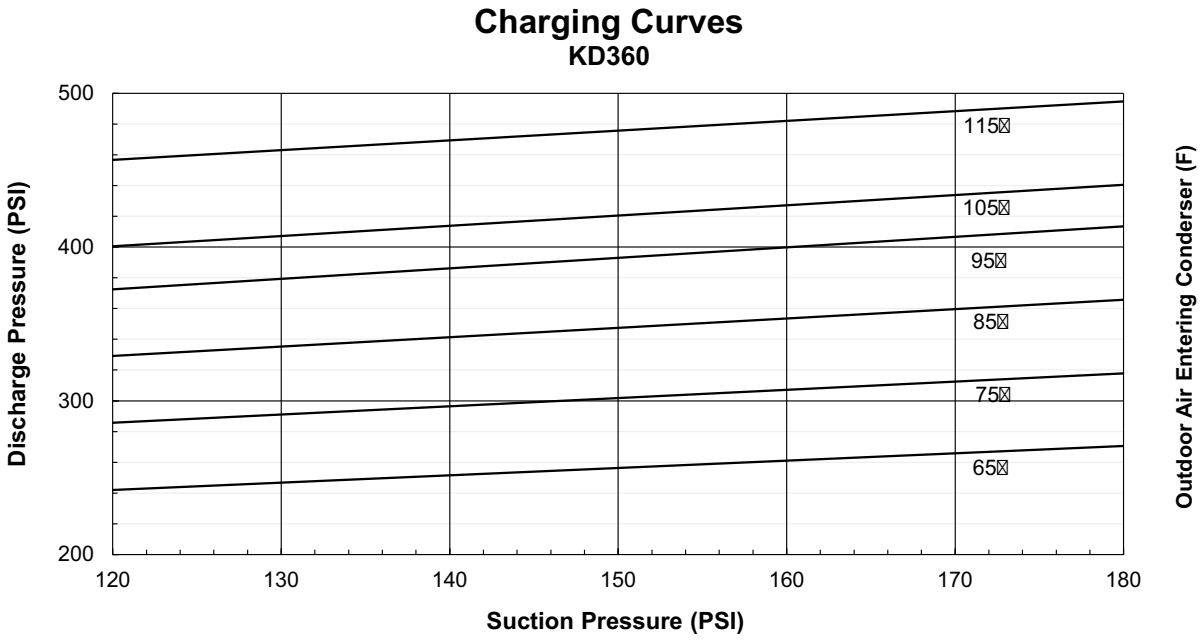
Table 8: Smart Equipment™ UCB details (Continued)(Version 5 hardware)

Description		Function and Comments
SHLD	Shield for the FC (“Field Connected”) BUS BACnet MSTP communication circuit	Earth ground reference of the cable to prevent interference on the FC bus BACnet MSTP communication circuit
Item Selector in red housing at left on top edge of the communication board		
EOL switch	End Of Line selector switch for the FC BUS BACnet MSTP communication circuit	ON selected only for the UCB that is the terminus of the FC bus BACnet MSTP communication cable to prevent signal “bounce-back”
RJ12	Connection to the TMR	Connection used for the wireless Transparent MS/TP Repeater (TMR)
LEDs on the communication board		
Bluetooth (DS4)	Bluetooth signal	Solid OFF means bluetooth disabled. Flashing means the bluetooth is available for a connection. Solid ON means a connection has been made
N/A (DS5)	N/A - no function defined	
FC BUS (DS1)	Green FC bus communication transmission indicator	Lit/flickering indicates outgoing UCB FC bus communication is currently active, off indicates the UCB is awaiting incoming FC bus communication
EOL (DS2)	Green End Of Line indicator	Lit indicates the EOL switch is selected ON
ISO PWR (DS3)	Green communication board Isolated Power indicator	Lit indicates the UCB is supplying power to the communication sub-board

Note: When wiring the unit and other devices using the SA Bus and FC Bus, see *Cable for FC Buses and SA buses in order of preference.*

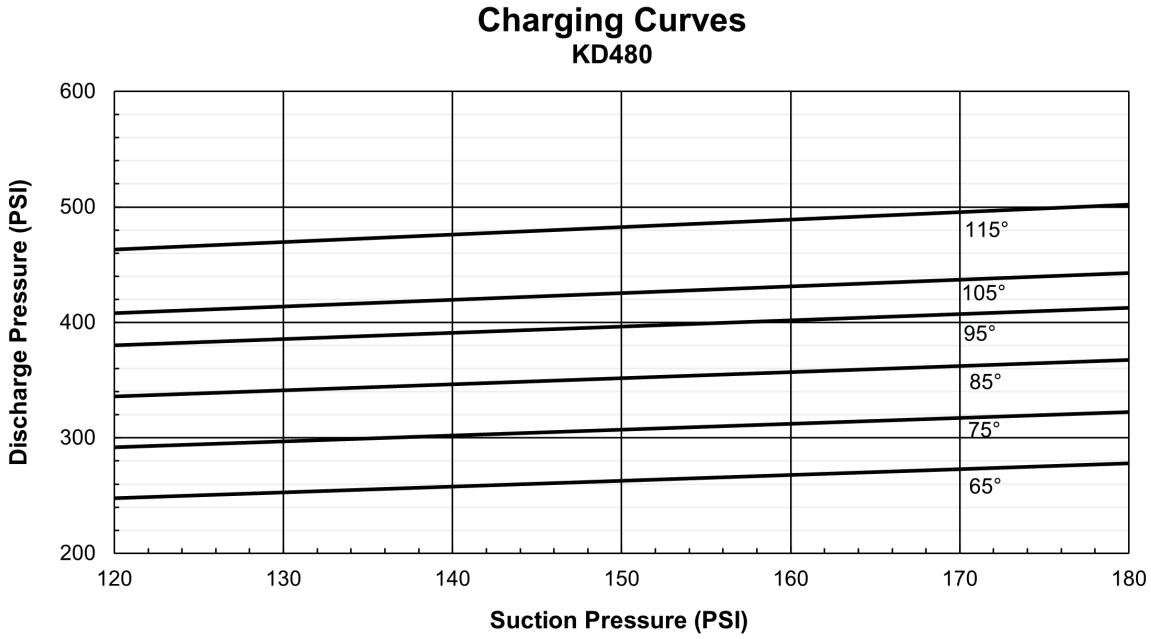
Table 9: Cable for FC buses and SA buses in order of preference

Bus and Cable Type	Non-plenum applications		Plenum applications	
	Part number	**O.D.**	**Part number**	**O.D.**
FC Bus: 22 AWG Stranded, 3-Wire Twisted Shielded Cable	Anixter: CBL-22/3-FC-PVC Belden: B5501FE	0.138 in.	Anixter: CBL-22/3-FC-PLN Belden: B6501FE	0.140 in.
SA Bus (Terminal Block): 22 AWG Stranded, 4-Wire, 2 Twisted-Pair Shielded Cable	Anixter: CBL-22/2P-SA-PVC Belden: B5541FE	0.209 in.	Anixter: CBL-22/2P-SA-PLN Belden: B6541FE	0.206 in.
SA Bus (Modular Jack): 26 AWG Solid 6-Wire, 3 Twisted-Pair Cable2	—	—	Anixter preassembled: CBL-NETWORK25 CBL-NETWORK50 CBL-NETWORK75 CBL-NETWORK100	0.15 in.
FC Bus: 22 AWG Stranded, 3-Wire Twisted Non-Shielded Cable	Belden: B5501UE	0.135 in.	Belden: B6501UE	0.131 in.
SA Bus (Terminal Block): 22 AWG Stranded, 4-Wire, 2 Twisted-Pair Non-Shielded Cable	Belden: B5541UE	0.206 in.	Belden: B6541UE	0.199 in.



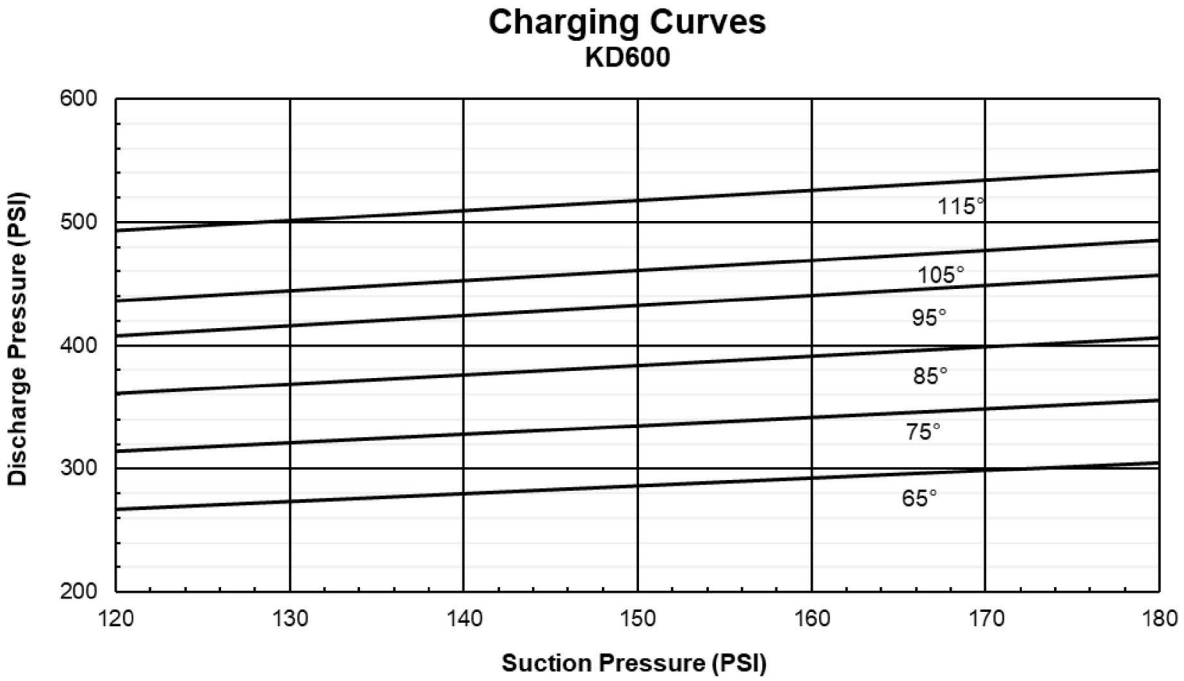
1. Make sure that all condenser fans are running when charging.
2. This chart is applicable to unit with the TXV's left to the factory setting. If the TXV's have been adjusted in the field, the charging chart may no longer apply.

Figure 16: KD360 charging curves



1. Make sure that all condenser fans are running when charging.
2. This chart is applicable to unit with the TXV's left to the factory setting. If the TXV's have been adjusted in the field, the charging chart may no longer apply.

Figure 17: KD480 charging curves



1. Make sure that all condenser fans are running when charging.
2. This chart is applicable to unit with the TXV's left to the factory setting. If the TXV's have been adjusted in the field, the charging chart may no longer apply.

Figure 18: KD600 charging curves

Start-Up Sheet

START-UP & SERVICE DATA INSTRUCTION

COMMERCIAL SPLIT SYSTEMS

7.5 To 50.0 TON

START-UP CHECKLIST

Date: _____

Job Name: _____

Customer Name: _____

Address: _____

City: _____ State: _____ Zip: _____

Evaporator Model Number: _____ Serial Number: _____

Condenser Model Number: _____ Serial Number: _____

Qualified Start-up Technician: _____ Signature: _____

HVAC Contractor: _____ Phone: _____

Address: _____

Contractor's E-mail Address: _____

Electrical Contractor: _____ Phone: _____

Distributor Name: _____ Phone: _____

WARRANTY STATEMENT

Johnson Controls/Ducted Systems is confident that this equipment will operate to the owner's satisfaction if the proper procedures are followed and checks are made at initial start-up. This confidence is supported by the 30 day dealer protection coverage portion of our standard warranty policy which states that Johnson Controls/ Ducted Systems will cover parts and labor on new equipment start-up failures that are caused by a defect in factory workmanship or material, for a period of 30 days from installation. Refer to the current standard warranty policy and warranty manual for details.

In the event that communication with Johnson Controls/Ducted Systems is required regarding technical and/or warranty concerns, all parties to the discussion should have a copy of the equipment start-up sheet for reference. A copy of the original start-up sheet should be filed with the Technical Services Department.

The packaged unit is available in constant or variable air volume versions with a large variety of custom options and accessories available. Therefore, some variation in the startup procedure will exist depending upon the products capacity, control system, options and accessories installed.

This start-up sheet covers all startup check points common to all package equipment. In addition it covers essential startup check points for a number of common installation options. Depending upon the particular unit being started not all sections of this startup sheet will apply. Complete those sections applicable and use the notes section to record any additional information pertinent to your particular installation.

Warranty claims are to be made through the distributor from whom the equipment was purchased.

EQUIPMENT STARTUP

Use the local LCD or Mobile Access Portal (MAP) Gateway to complete the start-up.

A copy of the completed start-up sheet should be kept on file by the distributor providing the equipment and a copy sent to:

Johnson Controls/Ducted Systems
Technical Services Department
5005 York Drive
Norman, OK 73069

1034350-UCL-F-0924

SAFETY WARNINGS

The inspections and recording of data outlined in this procedure are required for start-up of Johnson Controls/Ducted Systems' packaged products. Industry recognized safety standards and practices must be observed at all times. General industry knowledge and experience are required to assure technician safety. It is the responsibility of the technician to assess all potential dangers and take all steps warranted to perform the work in a safe manner. By addressing those potential dangers, prior to beginning any work, the technician can perform the work in a safe manner with minimal risk of injury.

⚠WARNING

Lethal voltages are present during some start-up checks. Extreme caution must be used at all times.

⚠WARNING

Moving parts may be exposed during some startup checks. Extreme caution must be used at all times.

NOTE: Read and review this entire document before beginning any of the startup procedures.

DESIGN APPLICATION INFORMATION

This information will be available from the specifying engineer who selected the equipment. If the system is a VAV system the CFM will be the airflow when the remote VAV boxes are in the full open position and the frequency drive is operating at 60 HZ. **Do not proceed with the equipment start-up without the design CFM information.**

Design Supply Air CFM: _____ Design Return Air CFM:_____

Design Outdoor Air CFM At Minimum Position: _____

Total External Static Pressure: _____

Supply Static Pressure: _____

Return Static Pressure: _____

Design Building Static Pressure: _____

ADDITIONAL APPLICATION NOTES FROM SPECIFYING ENGINEER:

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REFERENCE

General Inspection	Completed	See Notes
Unit inspected for shipping, storage, or rigging damage	☐	☐
Unit installed with proper clearances	☐	☐
Unit installed within slope limitations	☐	☐
Refrigeration system checked for gross leaks (presence of oil)	☐	☐
Terminal screws and wiring connections checked for tightness	☐	☐
Filters installed correctly and clean	☐	☐
Condensate drain trapped properly, refer to Installation Manual	☐	☐
All field wiring (power and control) complete	☐	☐

Refrigerant Line Inspection	System 1		System 2	
Is Condenser below Evaporator?	Yes ☐	No ☐	Yes ☐	No ☐
Total Line Length end to end.	_____ Ft.		_____ Ft.	
Vertical Lift in Ft.	_____ Ft.		_____ Ft.	
Vertical Fall in Ft.	_____ Ft.		_____ Ft.	
Number of Elbows?	_____ Ea.		_____ Ea.	
Liquid Line Size	_____ Ea.		_____ Ea.	
Suction Line Size	_____ Ea.		_____ Ea.	
Solenoid Valve?	Yes ☐	No ☐	Yes ☐	No ☐
Check Valves?	Yes ☐	No ☐	Yes ☐	No ☐
Check Valves / Solenoid arrangements installed as per the Ducted Systems Piping Guide	Yes ☐	No ☐	Yes ☐	No ☐
Oil Separator ?	Yes ☐	No ☐	Yes ☐	No ☐
Accumulator ?	Yes ☐	No ☐	Yes ☐	No ☐
TXV - Hard shutoff	Yes ☐	No ☐	Yes ☐	No ☐
Heatpump	Yes ☐	No ☐	Yes ☐	No ☐

Air Moving Inspection	Completed	See Notes
Alignment of drive components	☐	☐
Belt tension adjusted properly	☐	☐
Blower pulleys tight on shaft, bearing set screws tight, wheel tight to shaft	☐	☐
Pressure switch or transducer tubing installed properly	☐	☐

Operating Measurements - Air Flow

Fan operates with proper rotation (All VFD equipped units with the optional Manual Bypass must be phased for correct blower rotation with the Bypass switch set in the LINE position) ID Fans ☐ Exh. Fans ☐ Cond. Fans ☐	
Pressure drop across dry evaporator coil (At maximum design CFM) [1]	IWC
External Static Pressure	IWC
Return Static Pressure	IWC
Supply Static Pressure	IWC
Supply Air CFM Using Dry Coil Chart	CFM
Final Adjusted Supply Air CFM[2]	CFM

1. Consult the proper airflow to pressure drop table to obtain the actual airflow at the measured pressure differential.
2. Was a motor pulley adjustment or change required to obtain the correct airflow?
   Was it necessary to increase of decrease the airflow to meet the design conditions?
   If the motor pulley size was changed, measure the outside diameters of the motor and blower pulleys and record those diameters here;

Blower Motor HP _____ FLA_____ RPM_____

Pulley Pitch Diameter _____Turns Out_____ Final Turns Out_____

Blower Pulley Pitch Diameter _____ Fixed Sheave_____

ELECTRICAL DATA

T1 - T2 _____ Volts T2 - T3 _____ Volts

Control Voltage _____ Volts T1 - T3 _____ Volts

Device	Nameplate	Measured List All Three Amperages
Supply Fan Motor[1,2]	AMPS	AMPS
Condenser Fan #1	AMPS	AMPS
Condenser Fan #2 (if equipped)	AMPS	AMPS
Condenser Fan #3 (if equipped)	AMPS	AMPS
Condenser Fan #4 (if equipped)	AMPS	AMPS
Compressor #1	AMPS	AMPS
Compressor #2 (if equipped)	AMPS	AMPS
Compressor #3 (if equipped)	AMPS	AMPS
Compressor #4 (if equipped)	AMPS	AMPS

1. VAV units with heat section - simulate heat call to drive VAV boxes and VFD/IGV to maximum design airflow position.
2. VAV units without heat section - VAV boxes must be set to maximum design airflow position.
   Notes above apply for 3rd party application only.

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OPERATING MEASUREMENTS - COOLING

Stage	Discharge Pressure	Discharge Temp.	Liquid Line Pressure At Service Valve	Liquid Line Temp.[1]	Subcooling[2]	Suction Pressure	Suction Temp.	Superheat
First[3]	#	°	#	°	°	#	°	°
Second (if equipped)	#	°	#	°	°	#	°	°
Third (if equipped)	#	°	#	°	°	#	°	°
Fourth (if equipped)	#	°	#	°	°	#	°	°
Heat Pump 1st Stage	#	°	#	°	°	#	°	°

1. Liquid line temperature should be taken before filter/drier.
2. Subtract 10 psi from discharge pressure for estimated liquid line pressure
3. If Rawal valve installed, contact Technical Service.

Outside air temperature	_____	db °F	_____	wb °F	_____ RH%
Return Air Temperature	_____	db °F	_____	wb °F	_____ RH%
Mixed Air Temperature	_____	db °F	_____	wb °F	_____ RH%
Supply Air Temperature	_____	db °F	_____	wb °F	_____ RH%

REFRIGERANT SAFETIES

Action	Completed	See Notes
Prove Compressor Rotation (3 phase only) by guage pressure	☐	☐
Prove High Pressure Safety, All Systems	☐	☐
Prove Low Pressure Safety, All Systems	☐	☐

REFRIGERANT DETECTION SYSTEM (RDS) SAFETY TEST

Action	Completed	See Notes
Does the System have a Refrigerant Detection System (RDS) installed for R-454B?	☐	☐
Does Control Board Show any RDS alarms?	☐	☐
Are all available RDS Sensors pulsing with a green light?	☐	☐
Caution do not continue until any RDS alarms are resolved		
Prove Refrigerant Detection System Alarm Mitigation (Heating Units) – Shuts Down Active Heat Call[1]	☐	☐
Prove Refrigerant Detection System Alarm Mitigation (Cooling Mode) – Shuts Down Active Cooling Call[1]	☐	☐

1. Complete the above steps by pulling the J1 harness off the UCB during an active call for heat/cooling

OPERATING MEASUREMENTS ELECTRIC HEATING

Heater kW _____kW Heater Voltage, Nameplate _____ Volts

Heater Model Number: _____

Serial Number: _____

Heater	Nameplate	Measured List All Three Amperages		
Stage 1	_____AMPS	_____AMPS	_____AMPS	_____AMPS
Stage 2	_____AMPS	_____AMPS	_____AMPS	_____AMPS
Stage 3	_____AMPS	_____AMPS	_____AMPS	_____AMPS
Stage 4	_____AMPS	_____AMPS	_____AMPS	_____AMPS
Checked Heater Limit			Yes ☐	No ☐
Air Moving Switch Installed?			Yes ☐	No ☐

OPERATIONAL MEASUREMENTS - STAGING CONTROLS

Verify Proper Operation of Heating/Cooling Staging Controls	
Create a cooling demand at the Thermostat, BAS System or Smart Equipment™ Verify that cooling/economizer stages are energized.	☐
Create a heating demand at the Thermostat, BAS System or Smart Equipment™ Verify that heating stages are energized.	☐
Verify Proper Operation of the Variable Frequency Drive (If Required)	
Verify that motor speed modulates with duct pressure change.	☐

FINAL - INSPECTION

Verify that all operational control set points have been set to desired value Scroll through all setpoints and change as may be necessary to suit the occupant requirements.	☐
Verify that all option parameters are correct Scroll through all option parameters and ensure that all installed options are enabled in the software and all others are disabled in the software. (Factory software settings should match the installed options)	☐
Verify that all access panels have been closed and secured	☐
Save a backup file from the unit control board onto a USB flash drive.	☐

6568405-UIM-C-0525
Supersedes: 6568405-UIM-B-0225

York International Corporation
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Norman, OK 73069