INSTALLATION MANUAL

R-454B
KB Series W/Smart Equipment
6.5 ton - 12.5 ton
60 Hz

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General

KB078-150 units are single package air conditioners with optional gas heating designed for outdoor installation on a rooftop or slab and for non-residential use. The units can be equipped with factory or field-installed electric heaters for heating applications.

The units are completely assembled on rigid, permanently attached base rails. All piping, refrigerant charge, and electrical wiring is factory installed and tested. The units require electric power, gas supply (where applicable), and duct connections. The electric heaters have nickel-chrome elements and use single-point power connection.

GoTemp Pro (formerly DS Solutions)

BHC Group Heat & Cooling believes in empowering our customers with up-to-date, unit-specific information. Download GoTemp Pro app, a powerful-comprehensive app designed for contractors on the jobsite, available now in the App Store for iOS and Google Play for Android. Use the App to scan the unique QR code on the unit rating plate for easy access to product information and resources such as nomenclature, technical guide, installation manual, wiring diagrams, parts list, product registration, warranty and much more. Simplify your tasks, save time, and stay ahead with the most comprehensive app built for professionals.

GoTemp Pro integrates functionality previously provided by CWa and MAP, allowing you to utilize the on-board communication card or simply plug in the CWCVT to enable Bluetooth connectivity.

Safety considerations

⚠ This is a safety alert symbol. When you see this symbol on labels or in manuals, be alert to the potential for personal injury.

Understand and pay particular attention the signal words **DANGER**, **WARNING** or **CAUTION**.

DANGER indicates an **imminently** hazardous situation, which, if not avoided, **will result in death or serious injury.**

WARNING indicates a **potentially** hazardous situation, which, if not avoided, **could result in death or serious injury.**

CAUTION indicates a potentially hazardous situation, which, if not avoided **may result in minor or moderate injury.** It is also used to alert against unsafe practices and hazards involving only property damage.

⚠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.

⚠ CAUTION

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

⚠WARNING

Before you perform service or maintenance operations on the unit, turn off the 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

If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

What to do if you smell gas

- Do not try to light any appliance.
- Do not touch any electrical switch.
- Do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

Installation and service must be performed by a qualified installer, service agency, or the gas supplier.

Due to system pressure, moving parts, and electrical components, the installation and servicing of air conditioning

equipment can be hazardous. Only qualified, trained service personnel must install, repair, or service this equipment. Untrained personnel can perform basic maintenance functions of cleaning coils and filters, and replacing filters.

Observe all the precautions in the literature, labels, and tags that accompany the equipment whenever you work on air conditioning equipment. Be sure to follow all other applicable safety precautions and codes including ANSI Z223.1 or CSA-B149.1- latest edition.

Wear safety glasses and work gloves. Use quenching cloth and have a fire extinguisher available during brazing operations.

Inspection

As soon as you receive a unit, you must inspect it for possible damage during transit. If damage is evident, note the extent of the damage on the carrier's freight bill. You must 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.

The furnace and its individual shut-off valve must be disconnected from the gas supply piping system during any pressure testing at pressures in excess of 1/2 PSIG.

Pressures greater than 1/2 PSIG will cause gas valve damage resulting in a hazardous condition. If it is subjected to a pressure greater than 1/2 PSIG, the gas valve must be replaced.

The furnace must be isolated from the gas supply piping system by closing its individual manual shut-off valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 PSIG.

Reference

Additional information is available in the following reference forms:

- Technical Guide - KT/KB 037-150
- General Installation - KB078-150
- Smart Equipment Control Quick Start Guide
- Economizer Accessory -

  Downflow Factory Installed
  Downflow Field Installed
  Horizontal Field Installed
- Motorized Outdoor Air Damper
- Manual Outdoor Air Damper (0-100%)
- Manual Outdoor Air Damper (0-35%)
- Gas Heat Propane Conversion Kit
- Gas Heat High Altitude Kit (Natural Gas)
- Gas Heat High Altitude Kit (Propane)
- –60°F Gas Heat Kit
- Electric Heater Accessory

Renewal parts

Contact your local Ducted Systems parts distribution center for authorized replacement parts.

Approvals

The design is certified by CSA as follows:

- For use as a cooling only unit, cooling unit with supplemental electric heat or a forced air furnace.
- For outdoor installation only.
- For installation on combustible material and may be installed directly on combustible flooring or, in the U.S., on wood flooring or Class A, Class B or Class C roof covering materials.
- For use with natural gas. The unit can be converted to LP with a kit.

⚠ 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.

⚠WARNING

Improper installation may create a condition where the operation of the product could cause personal injury or property damage.

Nomenclature

6.5-12.5 Ton Model Number Nomenclature

K	B	078	C	00	A	2	A	1	A	A	A	1	A	1

Product Category
K = A/C, Single Pkg., R-454B

Product Identifier
B = Pkg AC High Eff 3-Stage

Nominal Cooling Capacity
078 = 6.5 Ton
090 = 7.5 Ton
102 = 8.5 Ton
120 = 10 Ton
150 = 12.5 Ton

Heat Type
C = Cooling Only
E = Electric Heat

Two Stage Natural Gas Heat Options
N = 2 Stage Gas Aluminized Steel
S = 2 Stage Gas Stainless Steel

Heat Capacity
00 = Cooling Only

Gas MBH Input (Unit Size Allowed)
12 = 120 MBH Input (078, 090, 102)
18 = 180 MBH Input (078,090,102,120,150)
24 = 240 MBH Input (078,090,102,120,150)

Electric Heat (Unit Size Allowed)
09 = 9 KW (078,090,102)
18 = 18 KW (078,090,102,120,150)
24 = 24 KW (078,090,102,120,150)
36 = 36 KW (078,090,102,120,150)
54 = 54 KW (120,150)

Blower Option
E = VFD/VAV Std Static
G = VFD/VAV High Static
H = VFD/VAV w/Bypass Std Static
K = VFD/VAV w/Bypass High Static
P = VFD IntelliSpeed Std Static
R = VFD IntelliSpeed High Static
S = VFD w/Byp IntelliSp Std Static
U = VFD w/Byp IntelliSp Hi Static

Voltage
2 = 208/230-3-60
4 = 460-3-60
5 = 575-3-60

Outdoor Air Option
A = No Economizer
B = Economizer w/Barometric RLF
D = Economizer w/Power EXH
H = Motorized Damper

Product Generation
1 = First Generation

Cabinet Options
A = Std Cabinet
B = Condensate Overflow Switch (COF)
C = French Canada Shipment (FCS)
D = COF, FCS
E = SSD (SST Drain Pan)
F = COF, SSD
G = FCS, SSD
H = COF, SSD, FCS
R = Reverse Drain Pan
S = COF, RDP
T = FCS, RDP
U = COF, FCS, RDP

Additional Options
1 = STD Throwaway Filter
2 = MERV 8
3 = MERV 13
4 = Coil Guard (CG), STD Filter
5 = MERV 8 Filter,CG
6 = MERV 13 Filter,CG
S = VFD Shaft Grounding Device (SGD), STD Filter
U = SGD, MERV 8
V = SGD, MERV 13
W = SGD, CG, STD Filter
X = SGD, MERV 8, CG
Y = SGD, MERV 13, CG

Refrigeration
A = Standard Refrigeration
B = ECC (E-Coat Cond Coil)
C = EEC (E-Coat Evap Coil)
D = HGBP (Hot Gas Bypass)
E = REH (Hot Gas Reheat)
F = ECC, EEC
G = ECC, EEC, HGBP
H = ECC, EEC, REH
J = ECC, HGBP
L = ECC, REH
M = EEC, HGBP
P = EEC, REH

Controls Option
A = Stand Alone Smart Equipment
C = BACnet MSTP,Mdbs,N2 COM Card
U = SkyQ Single Zone w/ Bluetooth
V = SkyQ Changeover Bypass w/ Bluetooth
W = SkyQ VAV w/ Bluetooth

Sensors
A = No Sensors
B = PHM (Phase Monitor)
C = DFS (Dirty Filter Switch)
D = SSD (Supply Air Smoke DET)
E = RSD (Return Air Smoke DET)
F = PHM,DFS
G = PHM,SSD
H = PHM,RSD
J = DFS,SSD
K = DFS,RSD
L = SSD,RSD
M = PHM,DFS,SSD
N = PHM,DFS,RSD
P = PHM,SSD,RSD
Q = DFS,SSD,RSD
R = PHM,DFS,SSD,RSD

Service Options
1 = No Service Options
2 = DSC (Disconnect Switch)
3 = NCO (Non-PWR Conv. Outlet)
4 = PCO (Powered Conv. Outlet)
5 = DSC,NCO
6 = DSC,PCO

RDS Options
A = Refrigerant Detection System (RDS)
B = RDS and DSC
C = RDS and NCO
D = RDS and PCO
E= RDS, DSC and NCO
F = RDS, DSC and PCO

Installation

Installation safety information

Read the following instructions before you install this appliance. This is an outdoor combination heating and cooling unit. The installer must assure that these instructions are made available to the consumer. The installer must instruct the consumer to retain the instructions for future reference.

- Refer to the unit rating plate for the approved type of gas for this product.
- Install this unit only in a location and position as specified on Page 8 of these instructions.
- Never test for gas leaks with an open flame. Use commercially available soap solution made specifically for the detection of leaks when you check all connections. See Pages 5, 40, 40 and 71 of these instructions.
- Always install the furnace to operate within the furnace's intended temperature-rise range with the duct system and within the allowable external static pressure range. This information is specified on the unit name/rating plate and specified on Page 73 of these instructions.
- This equipment is not to be used for the temporary heating of buildings or structures under construction.

It is permitted to use the unit for heating and cooling of buildings or structures under construction where the application and use must comply with all manufacturer's installation instructions including the following:

- Proper installation of vent outlet air and combustion air intake hoods.
- The unit must be operated under thermostatic control.
- Return and supply air ducts must be sealed to the unit.
- Air filters in place;
- The unit furnace input rate and temperature rise must be set according to the rating plate marking.
- The return air temperature must be maintained between 55ºF (13ºC) and 80ºF (27ºC).
- When the construction phase is completed and before formal start up and commissioning, the unit, duct work and components must be thoroughly cleaned and inspected. This is to ensure that the operation of the unit during construction did not contaminate the unit.

Note: If the unit is used during the construction phase, the standard limited warranty provisions go into effect when the unit is placed into operation.

⚠WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warning exactly could result in serious injury, death, or property damage.

Never test for gas leaks with an open flame. Use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury, or loss of life.

Preceding installation

1. Remove the two screws that hold the brackets in the front, rear, and compressor side fork-lift slots. See Figure 1

Item	Description
A	Bracket screws
B	Bracket

Figure 1: Unit shipping bracket

2. Turn each bracket toward the ground. The protective plywood covering drops to the ground.
3. Remove the toolless doorknobs and instruction packet, see Figure 3.

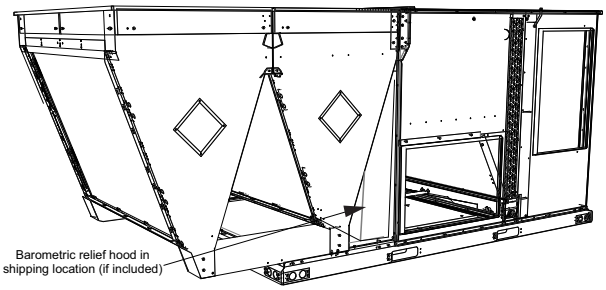


Figure 2: Barometric relief hood - shipping location

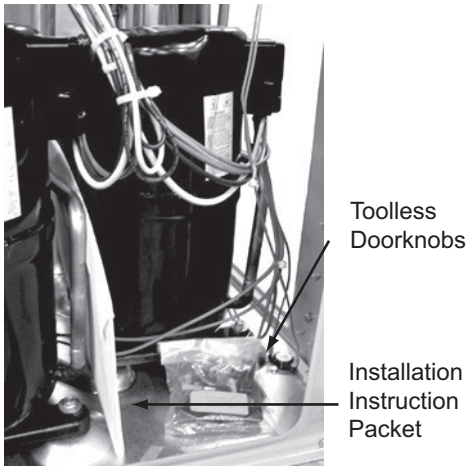


Figure 3: Compressor section

4. If a factory option convenience outlet is installed, you must install the weatherproof outlet in the field. The cover is located behind the filter access panel.
   a. Remove the shipping label that covers the convenience outlet.
   b. Follow the instructions on the back of the weatherproof cover box.
   c. Attach the cover to the unit with the four (4) screws provided.

⚠ CAUTION

208/230-3-60 units with a factory installed powered convenience outlet option are wired for a 230v power supply. Change the tap on the transformer for 208-3-60 operation. See the unit wiring diagram.

Limitations

These units must be installed in accordance with the following:

In the U.S.A.:

1. National Electrical Code, ANSI/NFPA No. 70 - Latest Edition
2. National Fuel Gas Code, ANSI Z223.1 - Latest Edition
3. Gas-Fired Central Furnace Standard, ANSI Z21.47a. - Latest Edition
4. Local building codes, and
5. Local gas utility requirements

In Canada:

1. Canadian Electrical Code, CSA C22.1
2. Installation Codes, CSA - B149.1.
3. Local plumbing and waste water codes, and
4. Other applicable local codes.

Refer to the unit application data found in this document.

After installation is complete, you must adjust gas fired units to obtain a temperature rise within the range specified on the unit rating plate.

If components are added to a unit to meet local codes, they are installed at the dealer's and/or customer's expense.

The size of the unit for the proposed installation must be based on a heat loss/heat gain calculation made according to the methods of the Air Conditioning Contractors of America (ACCA).

This furnace is not to be used for temporary heating of buildings or structures under construction.

⚠ CAUTION

The Smart Equipment control board used in this product can effectively operate the cooling system down to 0°F when this product is applied in a comfort cooling application for people. An economizer is typically included in this type of application. When you apply this product for process cooling applications (such as computer rooms or switchgear), please call the applications department for Ducted Systems @ 1-877-874-SERV for guidance. Additional accessories may be needed for stable operation at temperatures below 30°F.

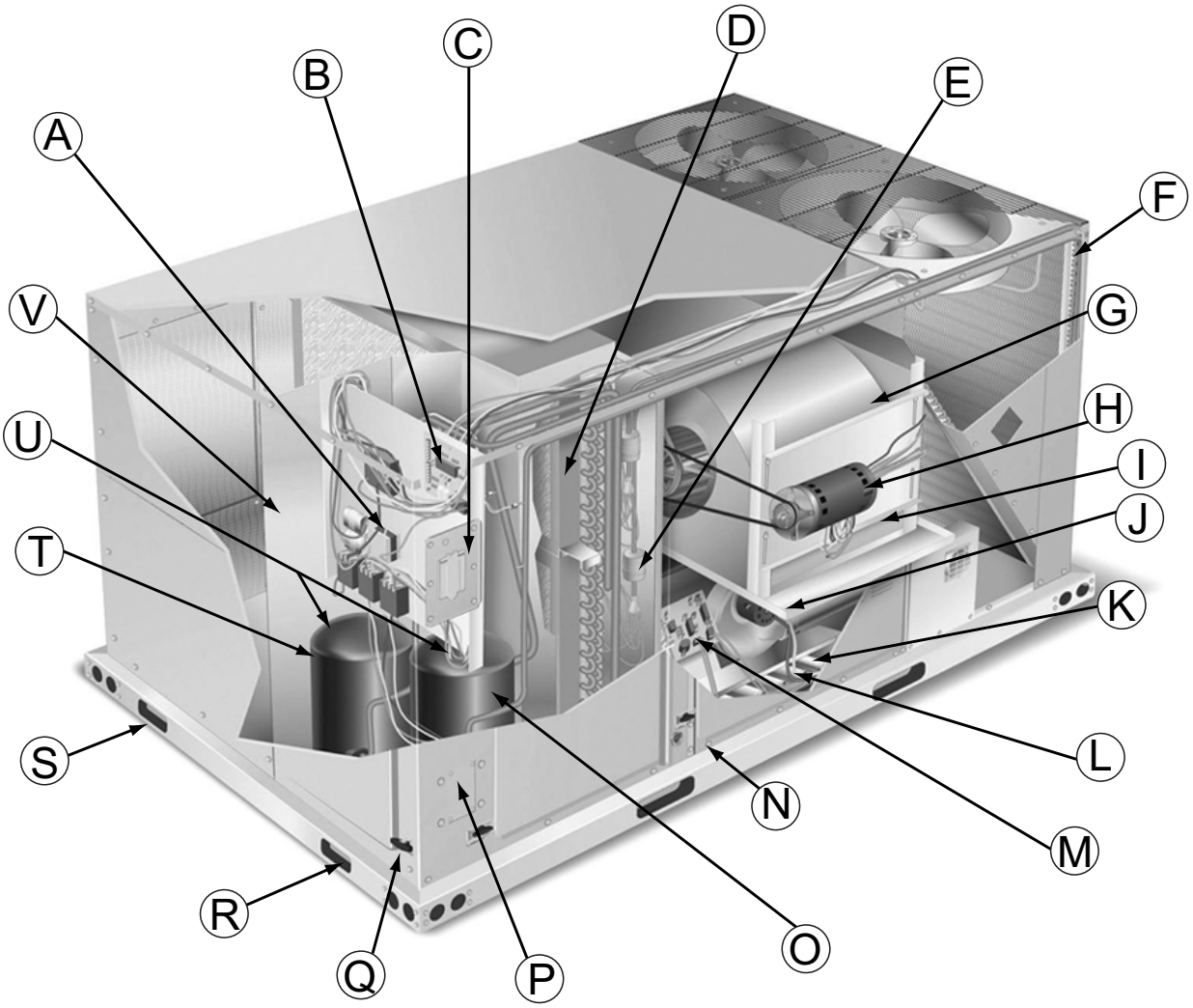


Figure 4: Component location

Figure 4 shows the KB120 model. Table 1 lists the components of the unit.

Table 1: Component location table

Item	Description
A	Terminal block for high-voltage connection
B	Smart Equipment control board with screw connector for thermostat wiring and network connections
C	Disconnect location (optional disconnect switch)
D	Filter access (2 in. filter option)
E	Filter drier (solid core)
F	Micro-channel aluminum tube/aluminum fin condenser
G	Slide-out motor and blower assembly for easy adjustment and service
H	Belt-drive blower motor
I	VFD Location
J	Power ventor motor
K	20-gauge aluminized steel tubular heat exchanger for long life (stainless steel option)

Item	Description
L	Two-stage gas heating to maintain warm, comfortable temperature
M	Intelligent control board for safe and efficient operation
N	Slide out drain pan with 1 inch NPT, female connection
O	Compressor #1 access
P	Side entry power and control knockouts
Q	Toolless door latch
R	Roof curbs in eight-inch and fourteen-inch heights[1]
S	Base rails with forklift slots (three sides) and lifting holes
T	Compressor #2 access
U	Three stage cooling for maximum comfort
V	Second model nameplate inside hinged access panel

1. Roof curbs for transitioning from Sunline™ footprint to the KB Series footprints are also available (field-installed accessory).

Table 2: KB078-150 unit limitations

Size (tons)	Model	Unit voltage	SCCR (kVA	Unit limitations		
				Applied voltage		Outdoor DB temp
				Minimum	Maximum	Maximum (°F)
078 (6.5)	KB	208/230-3-60	5	187	252	125
		460-3-60	5	432	504	125
		575-3-60	5	540	630	125
090 (7.5)	KB	208/230-3-60	5	187	252	125
		460-3-60	5	432	504	125
		575-3-60	5	540	630	125
102 (8.5)	KB	208/230-3-60	5	187	252	125
		460-3-60	5	432	504	125
		575-3-60	5	540	630	125
120 (10)	KB	208/230-3-60	5	187	252	125
		460-3-60	5	432	504	125
		575-3-60	5	540	630	125
150 (12.5)	KB	208/230-3-60	5	187	252	125
		460-3-60	5	432	504	125
		575-3-60	5	540	630	125

Location

Use the following guidelines to select a suitable location for these units:

- The unit is designed for *outdoor installation only*.
- Condenser coils must have an unlimited supply of air. Where a choice of location is possible, position the unit on either the north or east side of the building.
- Suitable for mounting on roof curb.
- For ground level installation, use a level concrete slab with a minimum thickness of 4 inches. The length and width must be at least 6 inches greater than the unit base rails. Do not tie the slab to the building foundation.
- Roof structures must be able to support the weight of the unit and its options and accessories. The unit must be installed on a solid, level roof curb or appropriate angle iron frame.
- Maintain level tolerance to 1/2 inch across the entire width and length of the unit.

⚠WARNING

Excessive exposure of the furnace to contaminated combustion air may result in equipment damage or personal injury. Typical contaminates include the following items:

- Permanent wave solution
- Chlorinated waxes and cleaners
- Chlorine based swimming pool chemicals
- Water softening chemicals
- Carbon tetrachloride
- Halogen type refrigerants
- Cleaning solvents (for example, perchloroethylene)
- Printing inks
- Paint removers
- Varnishes
- Hydrochloric acid
- Cements and glues
- Anti static fabric softeners for clothes dryers
- Masonry acid washing materials

Clearances

All units require particular clearances for proper operation and service. The installer must make provisions for adequate combustion and ventilation air in accordance with section 5.3 of Air for Combustion and Ventilation of the National Fuel Gas Code, ANSI Z223.1 – Latest Edition (in U.S.A.), or Sections 7.2, 7.3, or 7.4 of Gas Installation Codes, CSA-B149.1 (in Canada) - Latest Edition, and/or applicable provisions of the local building codes. Refer to Table 7 for the clearances required for combustible construction, servicing, and proper unit operation.

⚠ WARNING

Do not permit overhanging structures or shrubs to obstruct the condenser air discharge outlet, combustion air inlet, or vent outlets.

Rigging and handling

Exercise care when you move the unit. Do not remove any packaging until the unit is near the place of installation. To rig the unit, attach chain or cable slings to the lifting holes provided in the base rails. You must use spreader bars across the top of the unit. The spreader bars must have a length that exceeds the largest dimension across the unit.

⚠ CAUTION

If a unit is installed on a roof curb other than a Ducted Systems roof curb, you must apply gasketing to all surfaces that come in contact with the unit underside.

⚠ CAUTION

Before lifting the unit, make sure that the unit weight is distributed equally on the rigging cables so that it lifts evenly.

Units may be moved or lifted with a forklift. Slotted openings in the base rails are provided for this purpose.

THE LENGTH OF THE - FORKS MUST BE A MINIMUM OF 60 INCHES.

⚠ CAUTION

All panels must be secured in place when the unit is lifted.

The condenser coils must be protected from rigging cable damage with plywood or another suitable material.

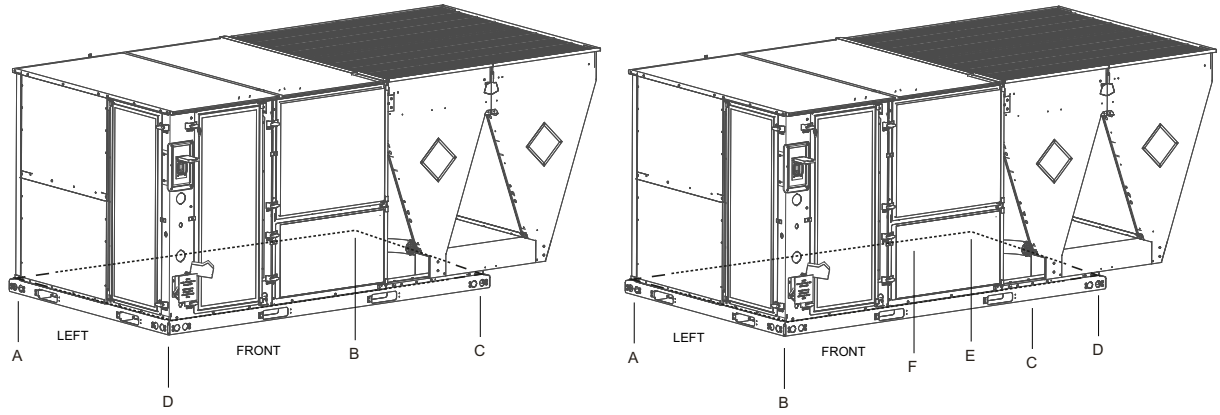


Figure 5: 4 point and 6 point load weight for KB150 units

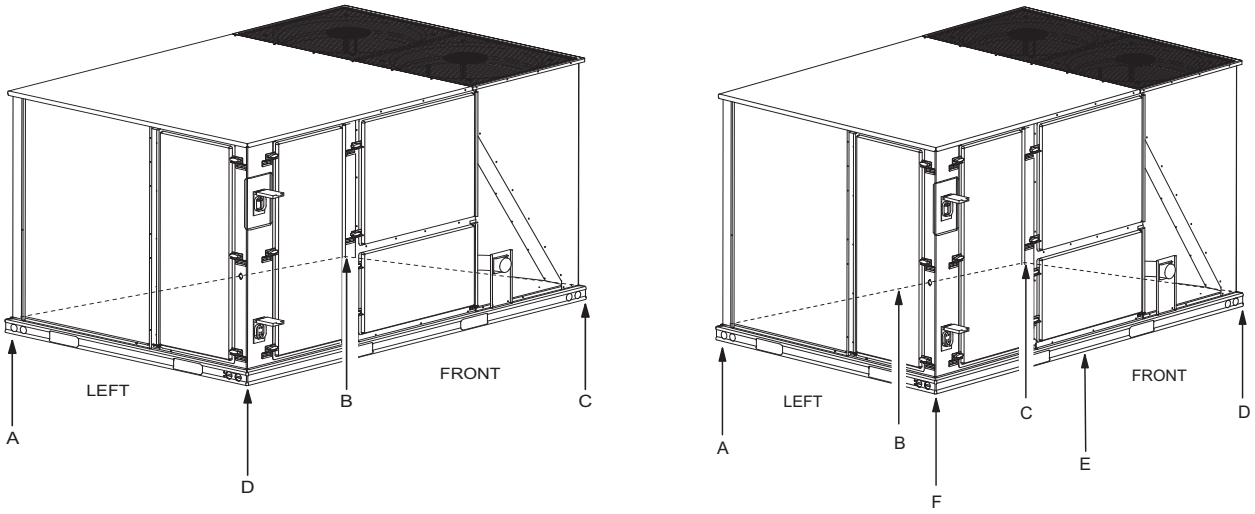


Figure 6: 4 point and 6 point load weight for KB078-120 units

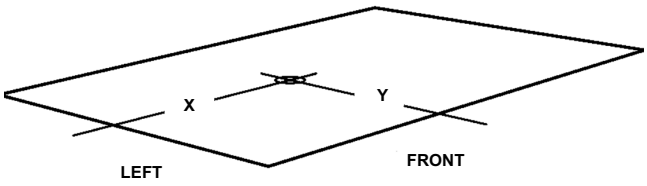


Figure 7: Center of gravity

Table 3: KB078-150 standard unit weights

Size (Tons)	Model	Weight (lbs.)		Center of Gravity		4 point Load Location (lbs.)				6 point Load Location (lbs.)					
		Shipping	Operating	X	Y	A	B	C	D	A	B	C	D	E	F
078 (6.5)	KB	1035	1030	39.6	25.3	245	197	262	327	170	146	126	168	194	226
090 (7.5)	KB	1085	1080	38.7	23.7	245	189	281	365	171	142	121	180	212	255
102 (8.5)	KB	1089	1084	38.4	24.4	255	193	274	361	178	147	123	175	208	252
120 (10)	KB	1090	1085	38.8	24.8	257	199	274	355	179	150	127	175	207	247
150 (12.5)	KB	1285	1280	49.6	24.1	231	291	422	335	149	172	202	292	249	215

Table 4: KB078-150 with MagnaDry option unit weights

Size (Tons)	Model	Weight (lbs.)		Center of Gravity		4 point Load Location (lbs.)				6 point Load Location (lbs.)					
		Shipping	Operating	X	Y	A	B	C	D	A	B	C	D	E	F
078 (6.5)	KB	1085	1080	40	25	257	206	274	342	178	153	133	177	203	237
090 (7.5)	KB	1123	1118	38	24	261	194	283	380	183	149	123	180	217	266
102 (8.5)	KB	1140	1135	38	24	267	203	287	378	186	154	129	183	218	264
120 (10)	KB	1125	1120	39	25	266	205	283	366	185	155	131	181	213	255
150 (12.5)	KB	1400	1395	50	24	252	318	460	365	162	188	220	319	272	235

Table 5: KB078-150 unit accessory weights

Unit accessory	Weight (lbs.)	
	Shipping	Operating
Economizer	90	85
Power exhaust	40	35
Electric heat[1]	49	49
Gas heat[2]	110	110

1. The weight given is for the maximum heater size available (54KW).
2. The weight given is for the maximum number of tube heat exchangers available (8 tubes).

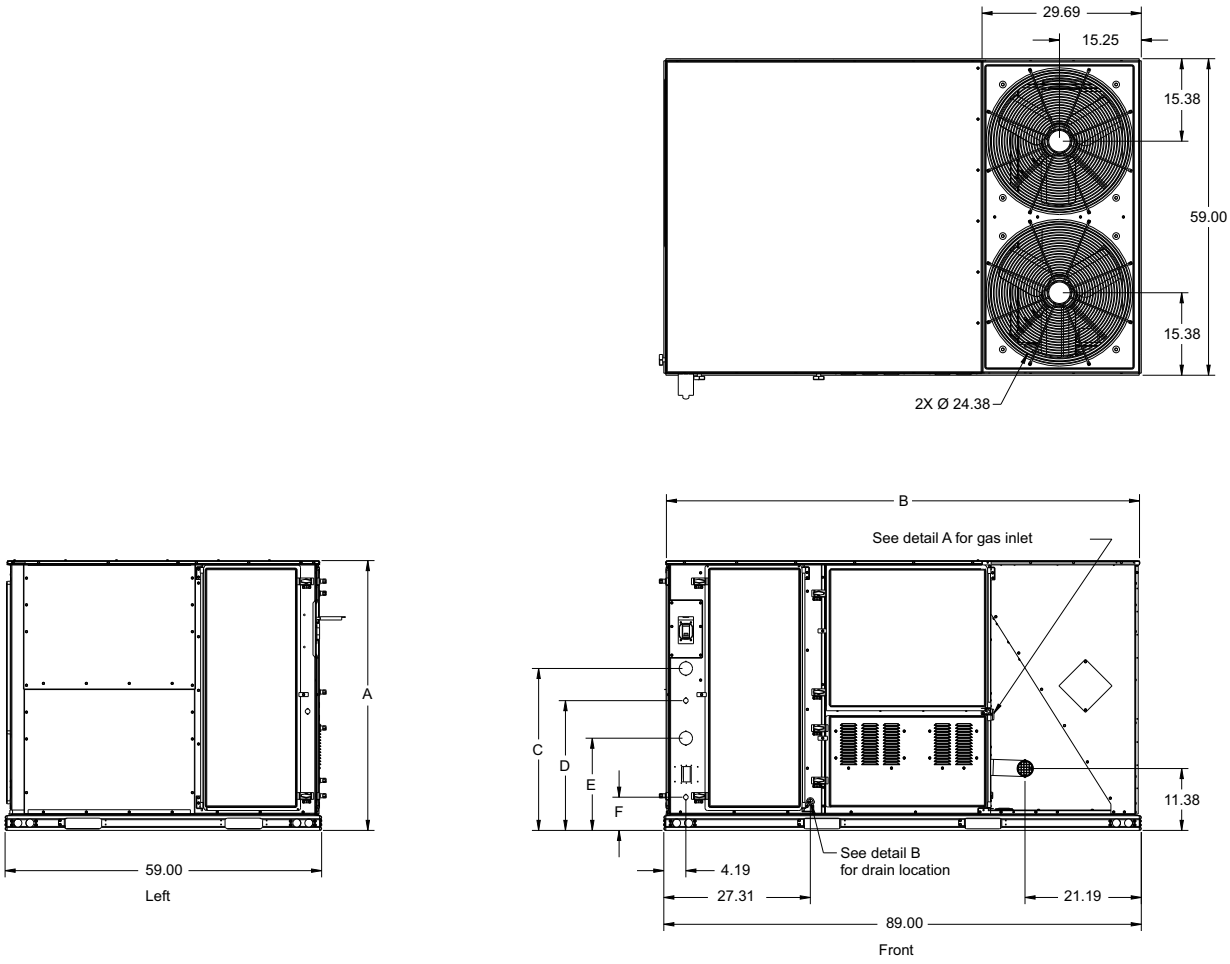


Figure 8: KB078-120 physical dimensions

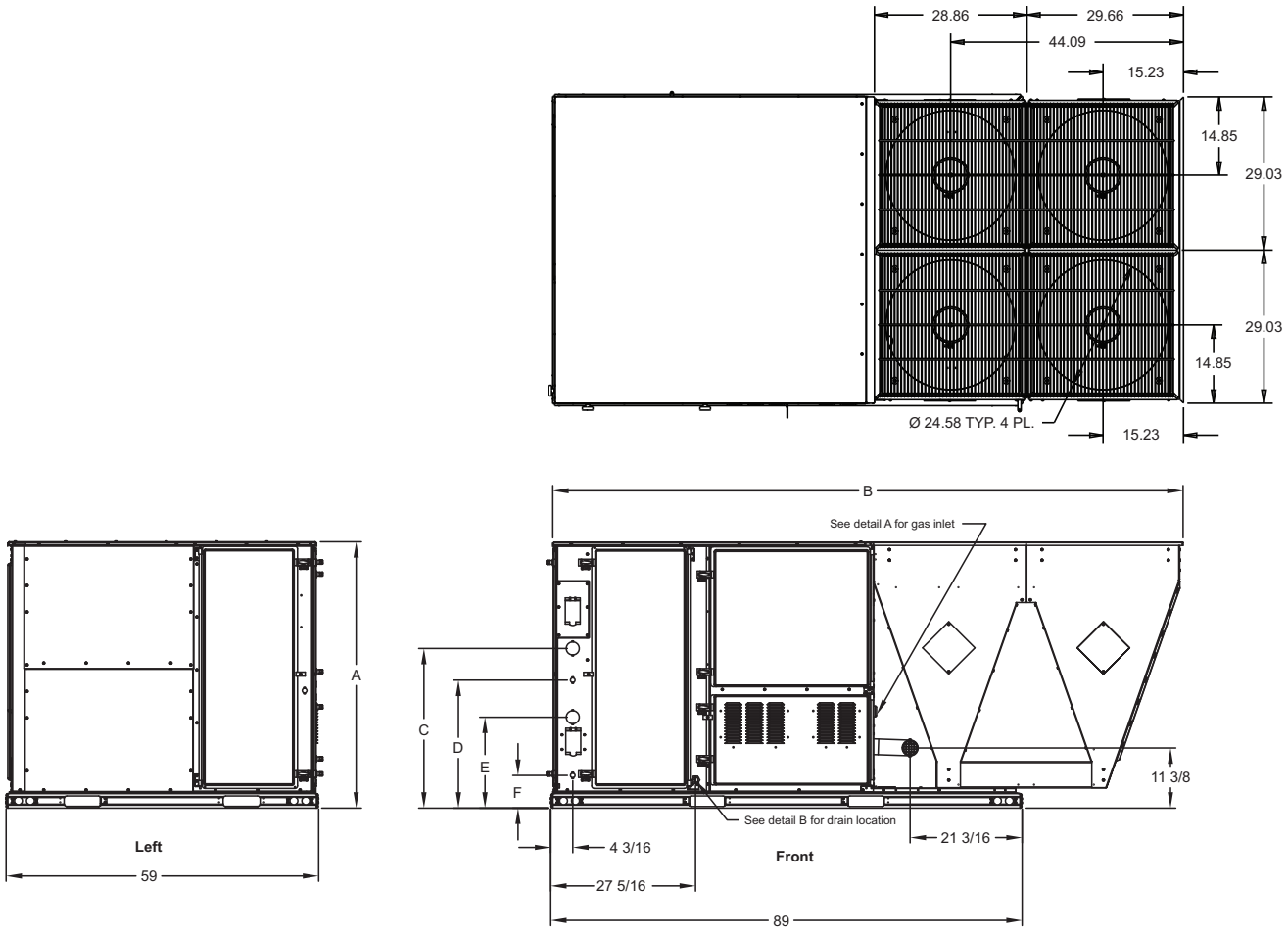
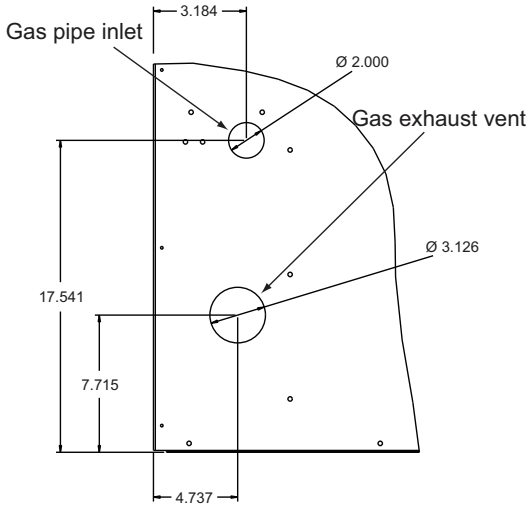


Figure 9: KB150 physical dimensions

Table 6: KB078-150 unit physical dimensions

Unit model number	Dimension (in.)					
	A	B	C	D	E	F
KB078, 090, 102, 120	50 3/4	89	30 3/16	24 3/16	17 3/16	6 3/16
KB150	50 3/4	119 1/2	30 3/16	24 3/16	17 3/16	6 3/16

Detail A



50 3/4 in. cabinet

Detail B

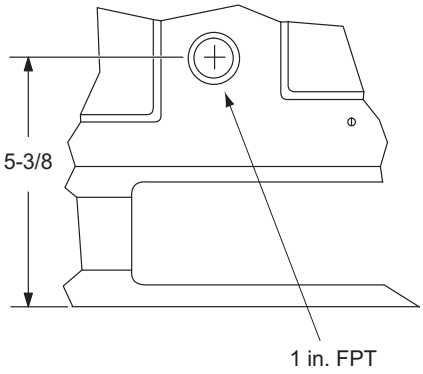
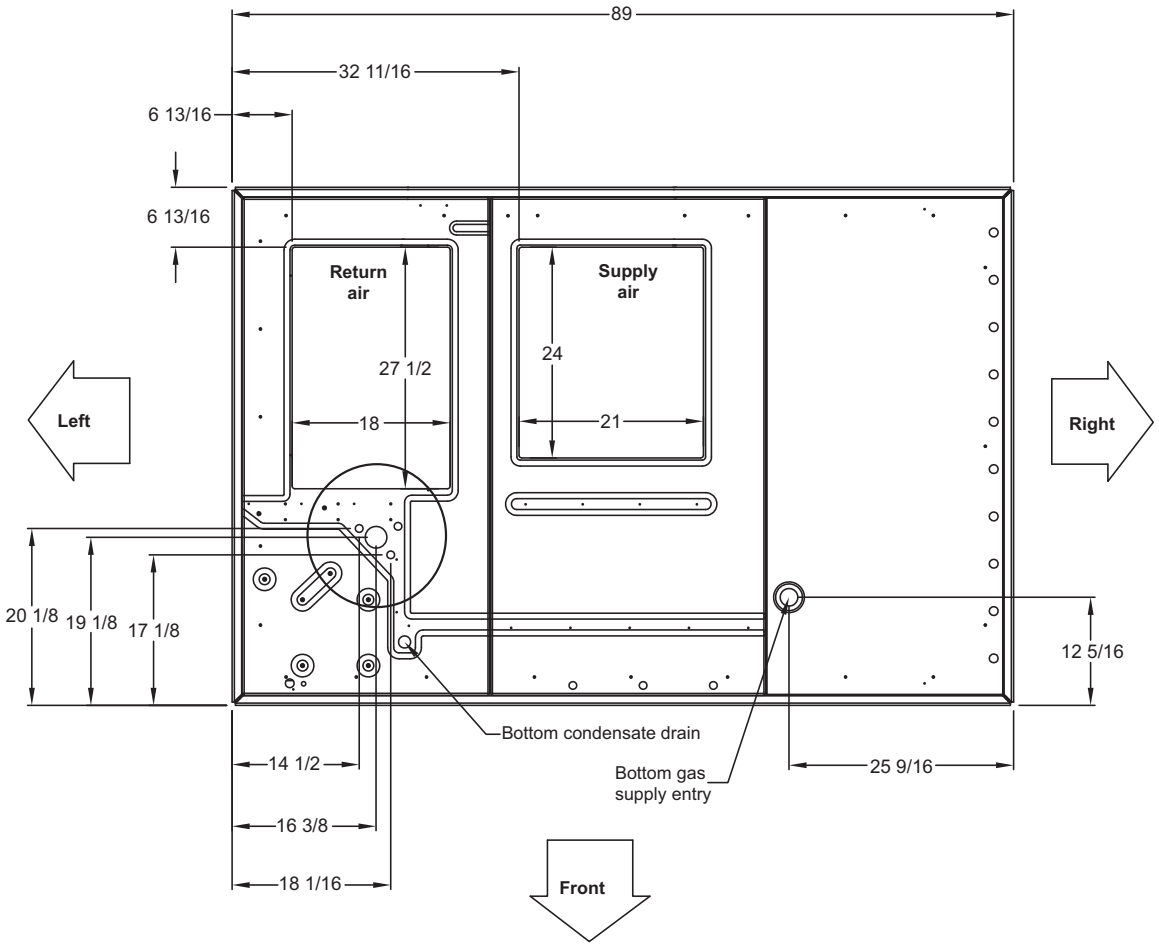


Table 7: KB078-150 unit clearances

Direction	Distance (in.)	Direction	Distance (in.)
Top[1]	72	Right	12
Front	48	Left	36
Rear	36	Bottom[2]	0

1. Units must be installed outdoors. Make sure that overhanging structures or shrubs do not obscure the condenser air discharge outlet.
2. Units may be installed on combustable floors made from wood or class A, B or C roof covering materials.



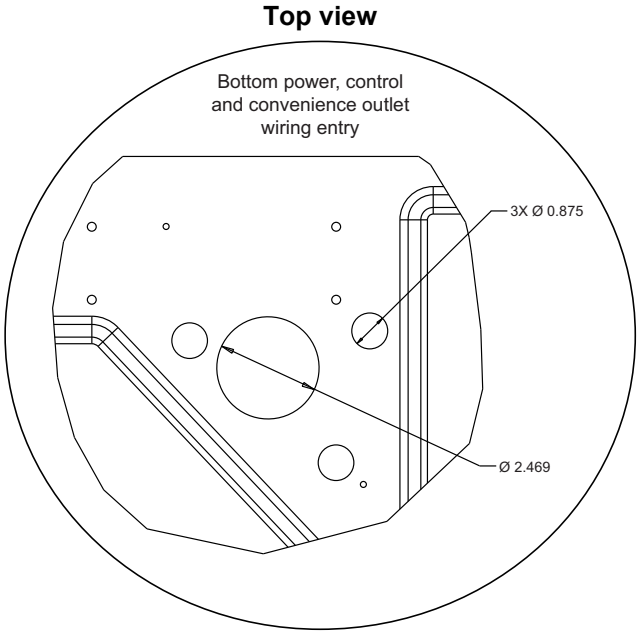


Figure 10: KB078-150 unit bottom duct openings

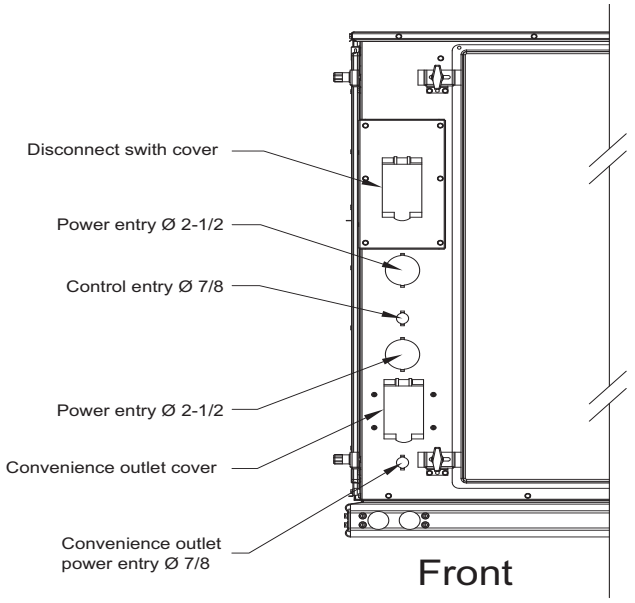


Figure 11: KB078-150 unit electrical entry

KB078-120 unit side duct openings

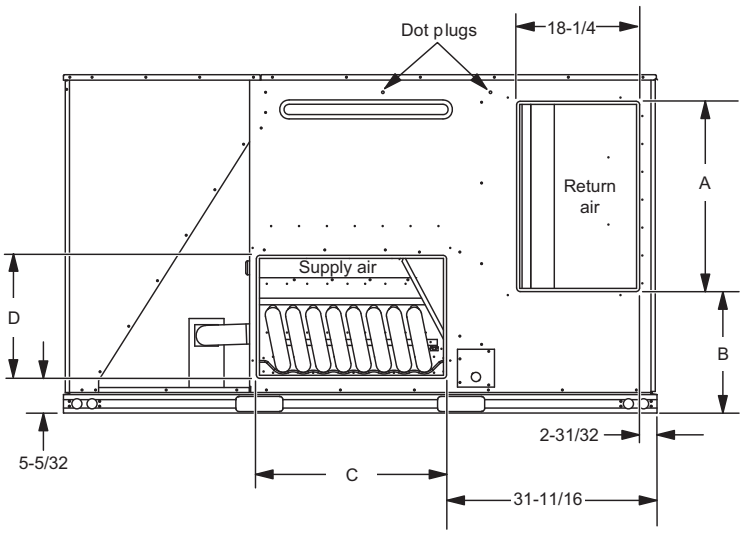


Table 8: KB078-120 side duct dimensions

Unit model number	Dimension (in.)			
	A	B	C	D
KB078, 090, 102, 120	28 1/4	18 1/16	28 1/4	18 1/4

KB120-150 unit side duct openings

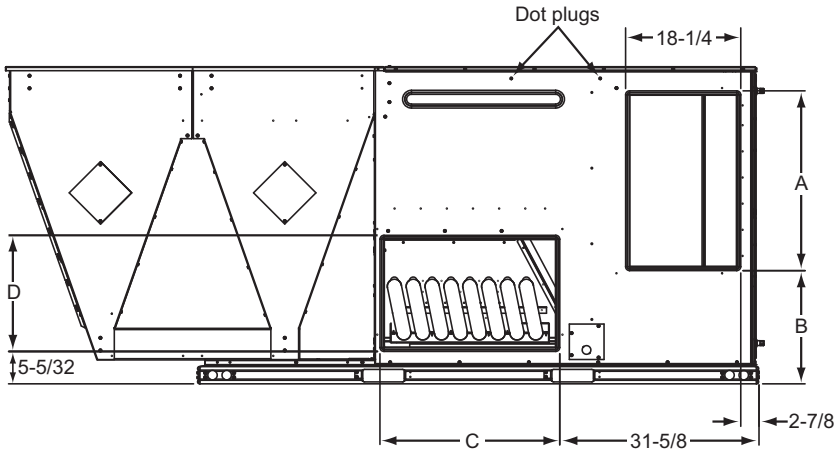


Table 9: KB150 side duct dimensions

Unit model number	Dimension (in.)			
	A	B	C	D
KB150	28 1/4	18 1/16	28 1/4	18 1/4

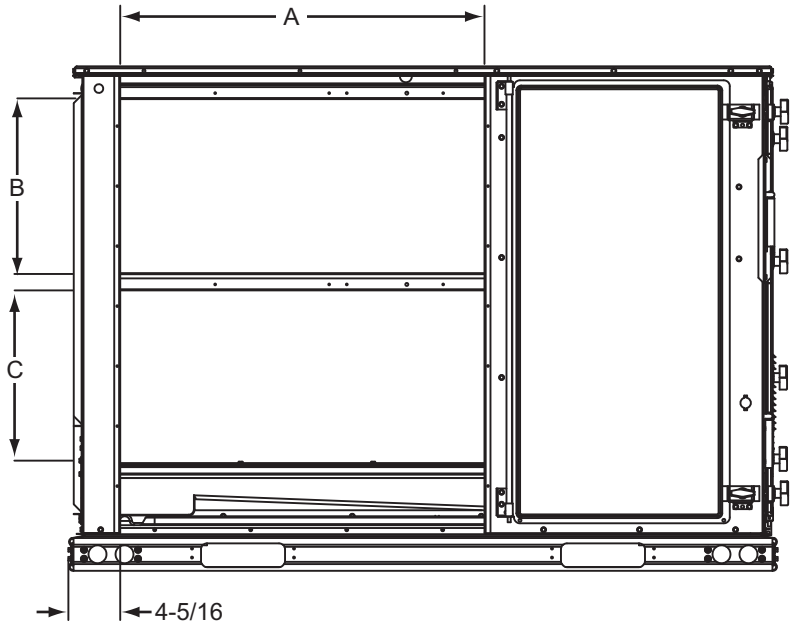


Figure 12: KB078-150 unit left/end duct opening

Table 10: Left/end duct dimensions

Unit model number	Dimension (in.)		
	A	B	C
KB078, 090, 102, 120	30.358	22.580	22.330
KB150	30.358	22.580	22.330

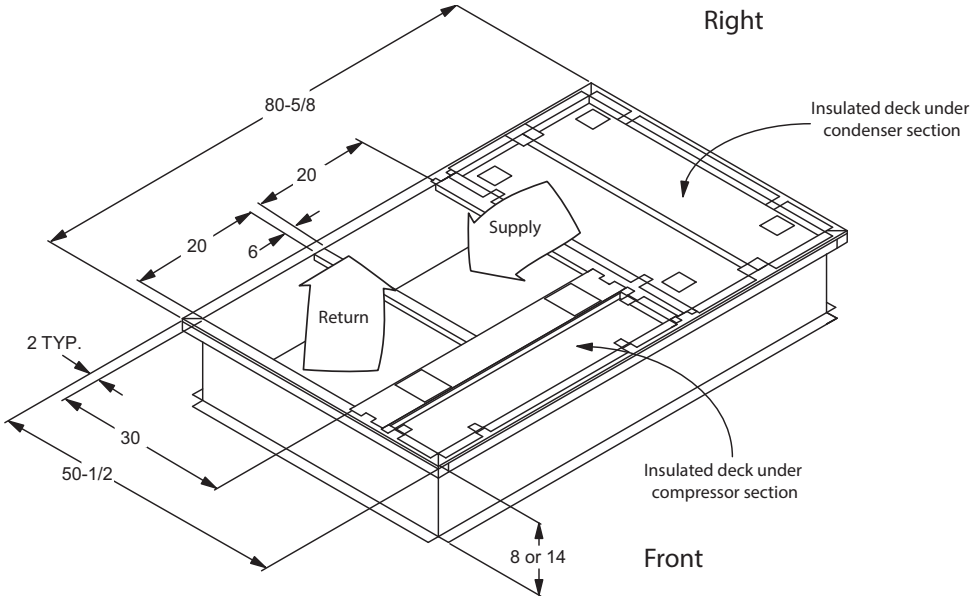


Figure 13: KB078-150 roof curb

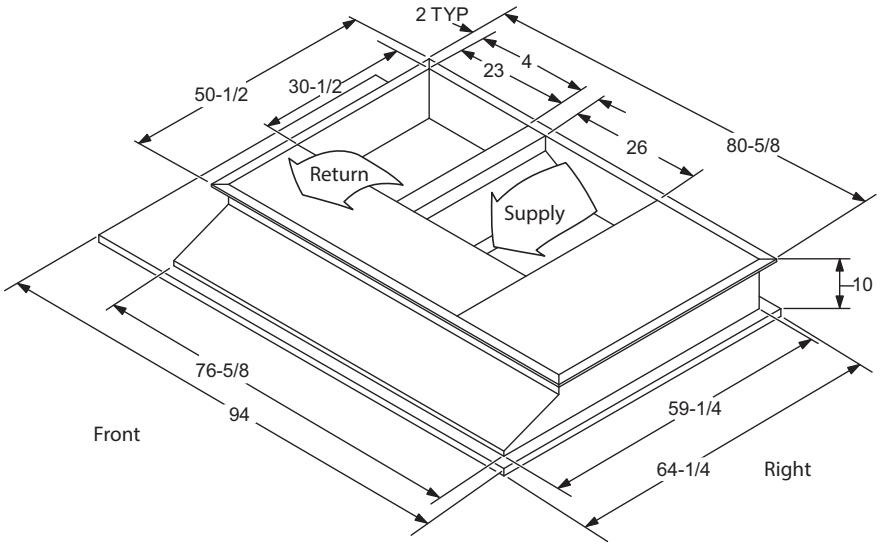


Figure 14: KB078-150 transition roof curb

Ductwork

You must design and size ductwork according to the methods in Manual D of the Air Conditioning Contractors of America (ACCA) or as recommended by any other recognized authority such as ASHRAE or SMACNA. When you design the duct system, apply the following recommendations.

- Use a closed return duct system. This does not preclude the use of economizers or outdoor fresh air intake.
- Make the supply and return air duct connections at the unit with flexible joints to minimize noise.
- Design the supply and return air duct systems for the CFM and static pressure requirements of the job. Do not size them to match the dimensions of the duct connections on the unit.

See Figure 10 for bottom air duct openings. See Figure ,12 and Tables 8 and 9 for side air duct openings.

Duct covers

Units are shipped with the side duct openings covered.

For a bottom duct application, no duct cover changes are necessary.

For a side duct application, complete the following steps.

1. Remove the side duct covers.
2. Orient the supply panel with the painted surface up.
3. Slide the supply panel between the heat exchanger and the unit bottom. The painted surface must face the heat exchanger. The space is narrow but there is adequate room to install the panel.
4. Secure the supply panel with the factory-installed bracket and two screws.
5. Orient the return panel with the painted surface down.
6. Install the return panel over the corresponding side duct. the painted surface must face the down flow duct opening.
7. Secure the return panel with four screws.

⚠ CAUTION

When you fasten ductwork to the side duct flanges on the unit, insert the screws through duct flanges only. DO NOT insert the screws through the casing. You must insulate and water-proof outdoor ductwork.

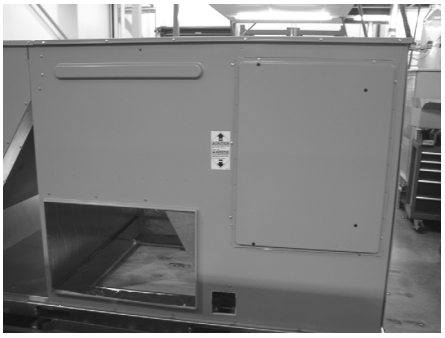


Figure 15: Side panels with hole plugs

Note: Note the orientation of the panel with the insulation side facing up.

Figure 16: Return down flow plenum with panel

Figure 17: Discharge panel in place

Side panels

Units are shipped with side panels to cover the area where an economizer or motorized damper may be installed. YOu must keep these panels to use them as tops for the economizer rain hoods (see Figure 18).

Figure 18: Side panels for economizer hood tops

Condensate drain

The side condensate drain can be ordered re-oriented to the rear of the cabinet to facilitate condensate piping. A condensate drain connection is available through the base pan for piping inside the roof curb.

Note: Plumbing must conform to local codes.

To install the connection, complete the following steps.

1. Trap the connection according to Figure 19.

Note: You must protect the trap and drain lines from freezing.

2. Install the condensate drain line from the 1 inch NPT female connection on the unit to an open drain. Use a sealing compound on male pipe threads.

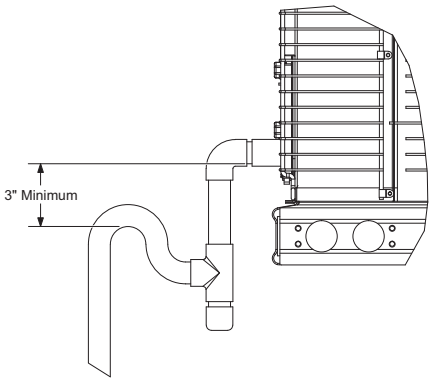


Figure 19: Condensate drain

Compressors

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

The compressors also use a polyolester (POE oil), Mobil 3MA POE. This oil is extremely hygroscopic, 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 the 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 (polyolester) 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 you perform any service that may risk exposure of compressor oil to the roof, take precautions to protect the roofing.

Procedures that risk oil leakage include, but are not limited to the following:

- Compressor replacement
- Repairing refrigerant leaks
- Replacing refrigerant components such as the filter drier, pressure switch, metering device or coil

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

⚠ CAUTION

Do not loosen the compressor mounting bolts.

Refrigerant Detection System (RDS)

Units with the optional factory installed RDS come with the refrigerant detection sensor capable of detecting a refrigerant leak, according to UL60335-2-40 4th edition, with an accuracy of +/- 5% LFL across operating range, with a response time <15 seconds.

Filters

Two-inch filters are supplied with each unit. One-inch filters may be used with no modification to the filter racks.

Always install filters ahead of evaporator coil. Keep the filters clean and replace them with filters of the same size and type. Dirty filters reduce the capacity of the unit and result in frosted coils or safety shutdown. See the physical data tables for the number and size of filters needed for the unit.

Do not operate the unit without filters properly installed.

⚠ CAUTION

Make sure that panel latches are properly positioned on the unit to maintain an airtight seal.

Power and control wiring

Field wiring to the unit, fuses, and disconnects must conform to provisions of National Electrical Code (NEC), ANSI/NFPA No. 70 – Latest Edition (in U.S.A.), current Canadian Electrical Code C221, and/or local ordinances. The unit must be electrically grounded in accordance with NEC and CEC as specified above and/or local codes.

Voltage tolerances must be maintained at the compressor terminals during starting and running conditions. The voltage tolerances are indicated on the unit rating plate and in Table 2.

⚠ CAUTION

208/230-3-60 units control transformers are factory wired for 230v power supply. Change the tap on the transformer for 208-3-60 operation. See the unit wiring diagram.

The internal wiring harnesses furnished with this unit are an integral part of the design certified unit. Field alteration to comply with electrical codes is not required.

If any of the wire supplied with the unit must be replaced, replacement wire must be of the type shown on the wiring diagram and the same minimum gauge as the replaced wire.

A disconnect must be used for these units. Factory-installed disconnects are available. If you install a disconnect, you must use a field supplied accessory. See Figure 4 for the recommended mounting location.

⚠ CAUTION

Avoid damage to internal components if you drill holes to install a disconnect.

Note: Not all local codes allow the installation of a disconnect on the unit. Confirm compliance with local code before you install a disconnect on the unit.

Electrical line must be sized properly to carry the load.

Note: Use copper conductors only.

Each unit must be wired with a separate branch circuit fed directly from the meter panel and properly fused.

See Figures 20 and 21 for typical field wiring. Refer to the appropriate unit wiring diagram mounted inside the control doors for control circuit and power wiring information.

⚠ CAUTION

When you connect electrical power and control wiring to the unit, you must use water-proof connectors so that water or moisture cannot be drawn into the unit during normal operation. These water-proofing conditions also apply when you install a field-supplied disconnect switch.

Power wiring detail

Units are factory wired for the voltage shown on the unit nameplate. See Table , *Electrical data,* on page 24 to size power wiring, fuses, and the disconnect switch.

Power wiring is brought into the unit through the side of the unit or the basepan inside the curb.

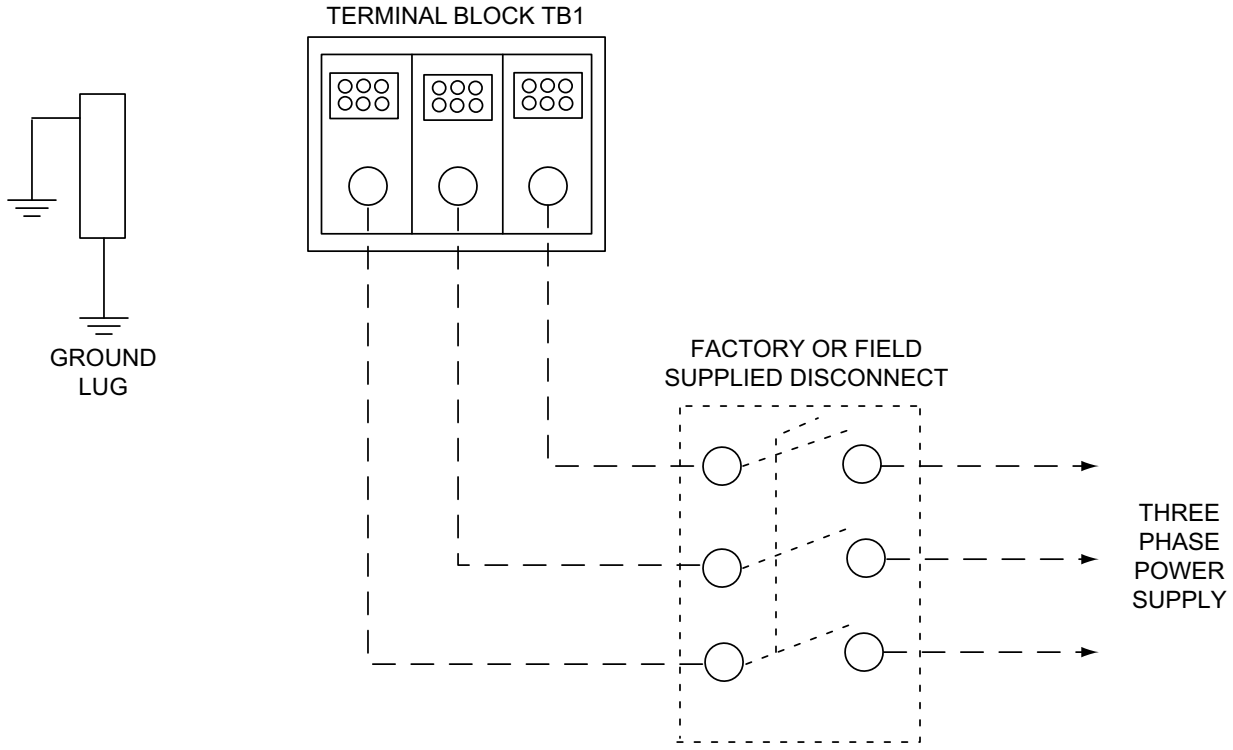


Figure 20: Field wiring disconnect

Thermostat wiring

Install the thermostat on an inside wall approximately 56 inches above the floor. The thermostat must not be subject to drafts, sun exposure, or heat from electrical fixtures or appliances.

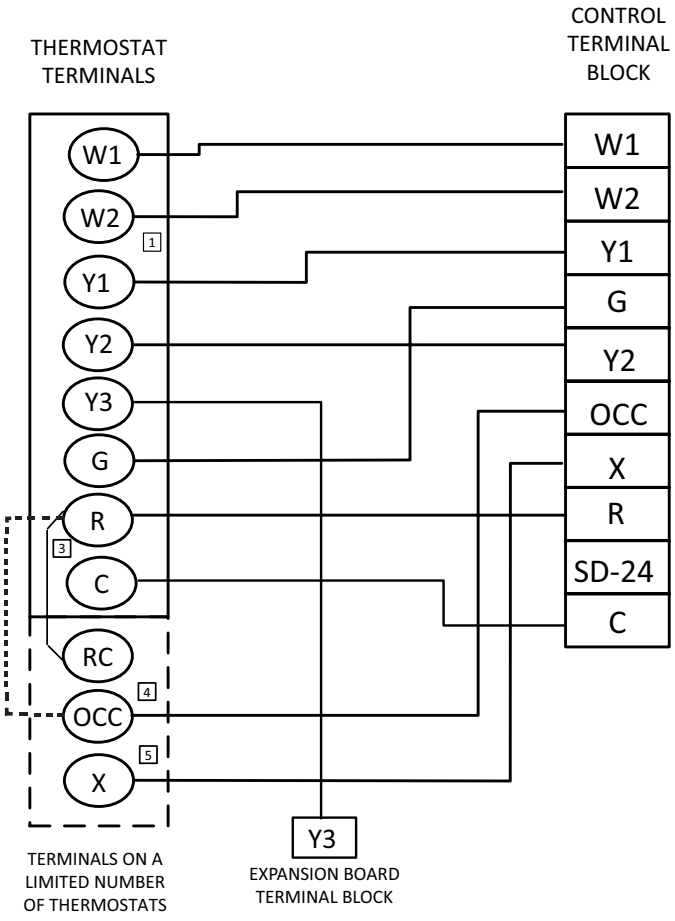
Follow the manufacturer's instructions enclosed with thermostat for the general installation procedure. Use color-coded, insulated wires to connect the thermostat to the unit. See Table 11 for control wire sizing and maximum length.

Table 11: Control wire sizes

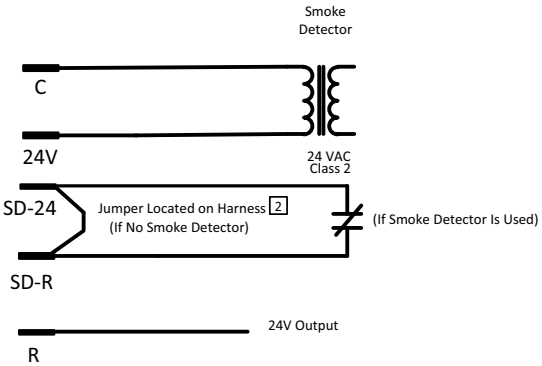
Wire size	Maximum length[1]
20 AWG	< 150 feet
18 AWG	150-250 feet
16 AWG	250-500 feet

1. From the unit to the thermostat and back to the unit.

Typical control wiring detail



R~Occ Jumper:
Smart Equipment Control boards come from the factory with a jumper wire between R and OCC terminals on the thermostat terminal strip. Failure to remove this jumper will place the unit into the Occupied mode no matter what the occupancy demand is from the thermostat or EMS system. To allow Thermostat or EMS control of the Occupied mode for the unit, this jumper must be removed during commissioning.



1 Second stage heating not required on single stage heating units.

2 Jumper is required if there is no Smoke Detector circuit.

3 Jumper is required for any combination of R, RC, or RH.

4 OCC is an output from the thermostat to indicate the Occupied condition.

5 X is an input to the thermostat to display Error Status conditions.

Figure 21: Typical control wiring

Electrical data

KB078-150 Standard indoor blower - without powered convenience outlet

Size (ton)	Volt	Compressors (each)						OD fan motors (each)	Supply blower motor	Power exhaust motor	Power convenience outlet	Electric heat option				MCA[1] (Amp)	MCA[1] with power exhaust (Amp)	Max fuse[2]/ breaker[3] size (Amp)	Max fuse[2]/ breaker[3] size with power exhaust (Amp)
		RLA		LRA		MCC													
		C1	C2	C1	C2	C1	C2	FLA	FLA	FLA	FLA	Model	kW	Stages	Amp				
078 (6)	208-3-60	9.9	12.8	82	102.8	15	20	2.8	9	5.5		None	-	-	-	40.5	46	50	50
												E09	6.8	1	18.9	40.5	46	50	50
												E18	13.5	2	37.5	58.1	65	60	70
												E24	18	2	50	73.8	80.6	80	90
												E36	25.5	2	70.8	99.8	106.6	100	110
	230-3-60	9.9	12.8	82	102.8	15	20	2.8	9	5.5		None	-	-	-	40.5	46	50	50
												E09	9	1	21.7	40.5	46	50	50
												E18	18	2	43.3	65.4	72.3	70	80
												E24	24	2	57.7	83.4	90.3	90	100
												E36	34	2	81.8	113.5	120.4	125	125
	460-3-60	4.8	5.8	44.3	50	8	9	1.6	4.6	2.2		None	-	-	-	19.9	22.1	25	25
												E09	9	1	10.8	19.9	22.1	25	25
												E18	18	2	21.7	32.9	35.6	35	40
												E24	24	2	28.9	41.9	44.6	45	45
												E36	34	2	40.9	56.9	59.6	60	60
	575-3-60	3.5	5.1	28.7	41	6	8	1.2	3.5	1.8		None	-	-	-	15.8	17.6	20	20
												E09	9	1	8.7	15.8	17.6	20	20
												E18	18	2	17.3	26	28.3	30	30
												E24	24	2	23.1	33.3	35.5	35	40
												E36	34	2	32.7	45.3	47.5	50	50
090 (7.5)	208-3-60	11.9	12.8	112	102.8	19	20	2.8	9	5.5		None	-	-	-	42.5	48	50	60
												E09	6.8	1	18.9	42.5	48	50	60
												E18	13.5	2	37.5	58.1	65	60	70
												E24	18	2	50	73.8	80.6	80	90
												E36	25.5	2	70.8	99.8	106.6	100	110
	230-3-60	11.9	12.8	112	102.8	19	20	2.8	9	5.5		None	-	-	-	42.5	48	50	60
												E09	9	1	21.7	42.5	48	50	60
												E18	18	2	43.3	65.4	72.3	70	80
												E24	24	2	57.7	83.4	90.3	90	100
												E36	34	2	81.8	113.5	120.4	125	125
	460-3-60	6.8	5.8	61.8	50	11	9	1.6	4.6	2.2		None	-	-	-	22.1	24.3	25	30
												E09	9	1	10.8	22.1	24.3	25	30
												E18	18	2	21.7	32.9	35.6	35	40
												E24	24	2	28.9	41.9	44.6	45	45
												E36	34	2	40.9	56.9	59.6	60	60
	575-3-60	4.8	5.1	39	41	8	8	1.2	3.5	1.8		None	-	-	-	17.1	18.9	20	20
												E09	9	1	8.7	17.1	18.9	20	20
												E18	18	2	17.3	26	28.3	30	30
												E24	24	2	23.1	33.3	35.5	35	40
												E36	34	2	32.7	45.3	47.5	50	50

KB078-150 Standard indoor blower - without powered convenience outlet

Size (ton)	Volt	Compressors (each)						OD fan motors (each)	Supply blower motor	Power exhaust motor	Power convenience outlet	Electric heat option				MCA[1] (Amp)	MCA[1] with power exhaust (Amp)	Max fuse[2]/ breaker[3] size (Amp)	Max fuse[2]/ breaker[3] size with power exhaust (Amp)
		RLA		LRA		MCC													
		C1	C2	C1	C2	C1	C2	FLA	FLA	FLA	FLA	Model	kW	Stages	Amp				
102 (8.5)	208-3-60	11.9	12.2	112	120.4	19	19	2.8	9	5.5		None	-	-	-	41.8	47.3	50	50
												E09	6.8	1	18.9	41.8	47.3	50	50
												E18	13.5	2	37.5	58.1	65	60	70
												E24	18	2	50	73.8	80.6	80	90
												E36	25.5	2	70.8	99.8	106.6	100	110
	230-3-60	11.9	12.2	112	120.4	19	19	2.8	9	5.5		None	-	-	-	41.8	47.3	50	50
												E09	9	1	21.7	41.8	47.3	50	50
												E18	18	2	43.3	65.4	72.3	70	80
												E24	24	2	57.7	83.4	90.3	90	100
												E36	34	2	81.8	113.5	120.4	125	125
	460-3-60	6.8	6.4	61.8	50	11	10	1.6	4.6	2.2		None	-	-	-	22.7	24.9	25	30
												E09	9	1	10.8	22.7	24.9	25	30
												E18	18	2	21.7	32.9	35.6	35	40
												E24	24	2	28.9	41.9	44.6	45	45
												E36	34	2	40.9	56.9	59.6	60	60
	575-3-60	4.8	5.1	39	41	8	8	1.2	3.5	1.8		None	-	-	-	17.1	18.9	20	20
												E09	9	1	8.7	17.1	18.9	20	20
												E18	18	2	17.3	26	28.3	30	30
												E24	24	2	23.1	33.3	35.5	35	40
												E36	34	2	32.7	45.3	47.5	50	50
120 (10)	208-3-60	14	16	150	156.4	22	25	2.8	9	5.5		None	-	-	-	48.6	54.1	60	70
												E18	13.5	2	37.5	58.1	65	60	70
												E24	18	2	50	73.8	80.6	80	90
												E36	25.5	2	70.8	99.8	106.6	100	110
												E54	40.6	2	112.7	152.1	159	175	175
	230-3-60	14	16	150	156.4	22	25	2.8	9	5.5		None	-	-	-	48.6	54.1	60	70
												E18	18	2	43.3	65.4	72.3	70	80
												E24	24	2	57.7	83.4	90.3	90	100
												E36	34	2	81.8	113.5	120.4	125	125
												E54	54	2	129.9	141.2	148	175	175
	460-3-60	6.3	7.7	58	69	10	12	1.6	4.6	2.2		None	-	-	-	23.7	25.9	30	30
												E18	18	2	21.7	32.9	35.6	35	40
												E24	24	2	28.9	41.9	44.6	45	45
												E36	34	2	40.9	56.9	59.6	60	60
												E54	54	2	65	70.8	73.5	80	80
	575-3-60	5.8	6.4	47.8	47.8	9	10	1.2	3.5	1.8		None	-	-	-	19.7	21.5	25	25
												E18	18	2	17.3	26	28.3	30	30
												E24	24	2	23.1	33.3	35.5	35	40
												E36	34	2	32.7	45.3	47.5	50	50
												E54	54	2	52	56.4	58.6	60	70

KB078-150 Standard indoor blower - without powered convenience outlet

Size (ton)	Volt	Compressors (each)						OD fan motors (each)	Supply blower motor	Power exhaust motor	Power convenience outlet	Electric heat option				MCA[1] (Amp)	MCA[1] with power exhaust (Amp)	Max fuse[2]/ breaker[3] size (Amp)	Max fuse[2]/ breaker[3] size with power exhaust (Amp)
		RLA		LRA		MCC													
		C1	C2	C1	C2	C1	C2	FLA	FLA	FLA	FLA	Model	kW	Stages	Amp				
150 (12.5)	208-3-60	19.2	22.4	162.3	166.2	30	35	1.65	13.2	5.5		None	-	-	-	67	72.5	80	90
												E18	13.5	2	37.5	67	72.5	80	90
												E24	18	2	50	79	85.9	80	90
												E36	25.5	2	70.8	105	111.9	110	125
												E54	40.6	2	112.7	157.4	164.3	175	175
	230-3-60	19.2	22.4	162.3	166.2	30	35	1.65	13.2	5.5		None	-	-	-	67	72.5	80	90
												E18	18	2	43.3	70.6	77.5	80	90
												E24	24	2	57.7	88.6	95.5	90	100
												E36	34	2	81.8	118.8	125.6	125	150
												E54	54	2	129.9	146.4	153.3	175	175
	460-3-60	9.1	8.8	70.8	74.6	14	14	1.1	6.1	2.2		None	-	-	-	30.7	32.9	35	40
												E18	18	2	21.7	34.8	37.5	35	40
												E24	24	2	28.9	43.8	46.5	45	50
												E36	34	2	40.9	58.8	61.5	60	70
												E54	54	2	65	72.6	75.4	80	90
	575-3-60	6.2	7.2	58.2	54	10	11	0.65	4.9	1.8		None	-	-	-	22.7	24.5	25	30
												E18	18	2	17.3	27.8	30	30	30
												E24	24	2	23.1	35	37.3	35	40
												E36	34	2	32.7	47	49.3	50	50
												E54	54	2	52	58.1	60.4	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

KB078-150 Standard indoor blower - with powered convenience outlet

Size (ton)	Volt	Compressors (each)						OD fan motors (each)	Supply blower motor	Power exhaust motor	Power convenience outlet	Electric heat option				MCA[1] (Amp)	MCA[1] with power exhaust (Amp)	Max fuse[2]/ breaker[3] size (Amp)	Max fuse[2]/ breaker[3] size with power exhaust (Amp)
		RLA		LRA		MCC													
		C1	C2	C1	C2	C1	C2	FLA	FLA	FLA	FLA	Model	kW	Stages	Amp				
078 (6)	208-3-60	9.9	12.8	82	102.8	15	20	2.8	9	5.5	20	None	-	-	-	50.5	56	60	60
												E09	6.8	1	18.9	50.5	56	60	60
												E18	13.5	2	37.5	70.6	77.5	80	80
												E24	18	2	50	86.3	93.1	90	100
												E36	25.5	2	70.8	112.3	119.1	125	125
	230-3-60	9.9	12.8	82	102.8	15	20	2.8	9	5.5	20	None	-	-	-	50.5	56	60	60
												E09	9	1	21.7	50.9	57.8	60	60
												E18	18	2	43.3	77.9	84.8	80	90
												E24	24	2	57.7	95.9	102.8	100	110
												E36	34	2	81.8	126	132.9	150	150
	460-3-60	4.8	5.8	44.3	50	8	9	1.6	4.6	2.2	20	None	-	-	-	24.9	27.1	30	30
												E09	9	1	10.8	25.5	28.3	30	30
												E18	18	2	21.7	39.1	41.9	40	45
												E24	24	2	28.9	48.1	50.9	50	60
												E36	34	2	40.9	63.1	65.9	70	70
	575-3-60	3.5	5.1	28.7	41	6	8	1.2	3.5	1.8	20	None	-	-	-	19.8	21.6	20	25
												E09	9	1	8.7	20.3	22.5	25	25
												E18	18	2	17.3	31	33.3	35	35
												E24	24	2	23.1	38.3	40.5	40	45
												E36	34	2	32.7	50.3	52.5	60	60
090 (7.5)	208-3-60	11.9	12.8	112	102.8	19	20	2.8	9	5.5	20	None	-	-	-	52.5	58	60	70
												E09	6.8	1	18.9	52.5	58	60	70
												E18	13.5	2	37.5	70.6	77.5	80	80
												E24	18	2	50	86.3	93.1	90	100
												E36	25.5	2	70.8	112.3	119.1	125	125
	230-3-60	11.9	12.8	112	102.8	19	20	2.8	9	5.5	20	None	-	-	-	52.5	58	60	70
												E09	9	1	21.7	52.5	58	60	70
												E18	18	2	43.3	77.9	84.8	80	90
												E24	24	2	57.7	95.9	102.8	100	110
												E36	34	2	81.8	126	132.9	150	150
	460-3-60	6.8	5.8	61.8	50	11	9	1.6	4.6	2.2	20	None	-	-	-	27.1	29.3	30	35
												E09	9	1	10.8	27.1	29.3	30	35
												E18	18	2	21.7	39.1	41.9	40	45
												E24	24	2	28.9	48.1	50.9	50	60
												E36	34	2	40.9	63.1	65.9	70	70
	575-3-60	4.8	5.1	39	41	8	8	1.2	3.5	1.8	20	None	-	-	-	21.1	22.9	25	25
												E09	9	1	8.7	21.1	22.9	25	25
												E18	18	2	17.3	31	33.3	35	35
												E24	24	2	23.1	38.3	40.5	40	45
												E36	34	2	32.7	50.3	52.5	60	60

KB078-150 Standard indoor blower - with powered convenience outlet

Size (ton)	Volt	Compressors (each)						OD fan motors (each)	Supply blower motor	Power exhaust motor	Power convenience outlet	Electric heat option				MCA[1] (Amp)	MCA[1] with power exhaust (Amp)	Max fuse[2]/ breaker[3] size (Amp)	Max fuse[2]/ breaker[3] size with power exhaust (Amp)
		RLA		LRA		MCC													
		C1	C2	C1	C2	C1	C2	FLA	FLA	FLA	FLA	Model	kW	Stages	Amp				
102 (8.5)	208-3-60	11.9	12.2	112	120.4	19	19	2.8	9	5.5	20	None	-	-	-	51.8	57.3	60	60
												E09	6.8	1	18.9	51.8	57.3	60	60
												E18	13.5	2	37.5	70.6	77.5	80	80
												E24	18	2	50	86.3	93.1	90	100
												E36	25.5	2	70.8	112.3	119.1	125	125
	230-3-60	11.9	12.2	112	120.4	19	19	2.8	9	5.5	20	None	-	-	-	51.8	57.3	60	60
												E09	9	1	21.7	51.8	57.8	60	60
												E18	18	2	43.3	77.9	84.8	80	90
												E24	24	2	57.7	95.9	102.8	100	110
												E36	34	2	81.8	126	132.9	150	150
	460-3-60	6.8	6.4	61.8	50	11	10	1.6	4.6	2.2	20	None	-	-	-	27.7	29.9	30	35
												E09	9	1	10.8	27.7	29.9	30	35
												E18	18	2	21.7	39.1	41.9	40	45
												E24	24	2	28.9	48.1	50.9	50	60
												E36	34	2	40.9	63.1	65.9	70	70
	575-3-60	4.8	5.1	39	41	8	8	1.2	3.5	1.8	20	None	-	-	-	21.1	22.9	25	25
												E09	9	1	8.7	21.1	22.9	25	25
												E18	18	2	17.3	31	33.3	35	35
												E24	24	2	23.1	38.3	40.5	40	45
												E36	34	2	32.7	50.3	52.5	60	60
120 (10)	208-3-60	14	16	150	156.4	22	25	2.8	9	5.5	20	None	-	-	-	58.6	64.1	70	80
												E18	13.5	2	37.5	70.6	77.5	80	80
												E24	18	2	50	86.3	93.1	90	100
												E36	25.5	2	70.8	112.3	119.1	125	125
												E54	40.6	2	112.7	164.6	171.5	175	175
	230-3-60	14	16	150	156.4	22	25	2.8	9	5.5	20	None	-	-	-	58.6	64.1	70	80
												E18	18	2	43.3	77.9	84.8	80	90
												E24	24	2	57.7	95.9	102.8	100	110
												E36	34	2	81.8	126	132.9	150	150
												E54	54	2	129.9	153.7	160.5	175	175
	460-3-60	6.3	7.7	58	69	10	12	1.6	4.6	2.2	20	None	-	-	-	28.7	30.9	35	35
												E18	18	2	21.7	39.1	41.9	40	45
												E24	24	2	28.9	48.1	50.9	50	60
												E36	34	2	40.9	63.1	65.9	70	70
												E54	54	2	65	77	79.8	90	90
	575-3-60	5.8	6.4	47.8	47.8	9	10	1.2	3.5	1.8	20	None	-	-	-	23.7	25.5	30	30
												E18	18	2	17.3	31	33.3	35	35
												E24	24	2	23.1	38.3	40.5	40	45
												E36	34	2	32.7	50.3	52.5	60	60
												E54	54	2	52	61.4	63.6	70	70

KB078-150 Standard indoor blower - with powered convenience outlet

Size (ton)	Volt	Compressors (each)						OD fan motors (each)	Supply blower motor	Power exhaust motor	Power convenience outlet	Electric heat option				MCA[1] (Amp)	MCA[1] with power exhaust (Amp)	Max fuse[2]/ breaker[3] size (Amp)	Max fuse[2]/ breaker[3] size with power exhaust (Amp)
		RLA		LRA		MCC													
		C1	C2	C1	C2	C1	C2	FLA	FLA	FLA	FLA	Model	kW	Stages	Amp				
150 (12.5)	208-3-60	19.2	22.4	162.3	166.2	30	35	1.65	13.2	5.5	20	None	-	-	-	77	82.5	90	100
												E18	13.5	2	37.5	77	82.8	90	100
												E24	18	2	50	91.5	98.4	100	100
												E36	25.5	2	70.8	117.5	124.4	125	125
												E54	40.6	2	112.7	169.9	176.8	175	200
	230-3-60	19.2	22.4	162.3	166.2	30	35	1.65	13.2	5.5	20	None	-	-	-	77	82.5	90	100
												E18	18	2	43.3	83.1	90	90	100
												E24	24	2	57.7	101.1	108	110	110
												E36	34	2	81.8	131.3	138.1	150	150
												E54	54	2	129.9	158.9	165.8	175	175
	460-3-60	9.1	8.8	70.8	74.6	14	14	1.1	6.1	2.2	20	None	-	-	-	35.7	37.9	40	45
												E18	18	2	21.7	41	43.8	45	45
												E24	24	2	28.9	50	52.8	50	60
												E36	34	2	40.9	65	67.8	70	70
												E54	54	2	65	78.9	81.6	90	90
	575-3-60	6.2	7.2	58.2	54	10	11	0.65	4.9	1.8	20	None	-	-	-	26.7	28.5	30	35
												E18	18	2	17.3	32.8	35	35	35
												E24	24	2	23.1	40	42.3	40	45
												E36	34	2	32.7	52	54.3	60	60
												E54	54	2	52	63.1	65.4	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

KB078-150 Hi-static indoor blower - without powered convenience outlet

Size (ton)	Volt	Compressors (each)						OD fan motors (each)	Supply blower motor	Power exhaust motor	Power convenience outlet	Electric heat option				MCA[1] (Amp)	MCA[1] with power exhaust (Amp)	Max fuse[2]/ breaker[3] size (Amp)	Max fuse[2]/ breaker[3] size with power exhaust (Amp)
		RLA		LRA		MCC													
		C1	C2	C1	C2	C1	C2	FLA	FLA	FLA	FLA	Model	kW	Stages	Amp				
078 (6)	208-3-60	9.9	12.8	82	102.8	15	20	2.8	9	5.5		None	-	-	-	40.5	46	50	50
												E09	6.8	1	18.9	40.5	46	50	50
												E18	13.5	2	37.5	58.1	65	60	70
												E24	18	2	50	73.8	80.6	80	90
												E36	25.5	2	70.8	99.8	106.6	100	110
	230-3-60	9.9	12.8	82	102.8	15	20	2.8	9	5.5		None	-	-	-	40.5	46	50	50
												E09	9	1	21.7	40.5	46	50	50
												E18	18	2	43.3	65.4	72.3	70	80
												E24	24	2	57.7	83.4	90.3	90	100
												E36	34	2	81.8	113.5	120.4	125	125
	460-3-60	4.8	5.8	44.3	50	8	9	1.6	4.6	2.2		None	-	-	-	19.9	22.1	25	25
												E09	9	1	10.8	19.9	22.1	25	25
												E18	18	2	21.7	32.9	35.6	35	40
												E24	24	2	28.9	41.9	44.6	45	45
												E36	34	2	40.9	56.9	59.6	60	60
	575-3-60	3.5	5.1	28.7	41	6	8	1.2	3.5	1.8		None	-	-	-	15.8	17.6	20	20
												E09	9	1	8.7	15.8	17.6	20	20
												E18	18	2	17.3	26	28.3	30	30
												E24	24	2	23.1	33.3	35.5	35	40
												E36	34	2	32.7	45.3	47.5	50	50
090 (7.5)	208-3-60	11.9	12.8	112	102.8	19	20	2.8	13.2	5.5		None	-	-	-	46.8	52.3	60	60
												E09	6.8	1	18.9	46.8	52.3	60	60
												E18	13.5	2	37.5	63.4	70.3	70	80
												E24	18	2	50	79	85.9	80	90
												E36	25.5	2	70.8	105	111.9	110	125
	230-3-60	11.9	12.8	112	102.8	19	20	2.8	13.2	5.5		None	-	-	-	46.8	52.3	60	60
												E09	9	1	21.7	46.8	52.3	60	60
												E18	18	2	43.3	70.6	77.5	80	80
												E24	24	2	57.7	88.6	95.5	90	100
												E36	34	2	81.8	118.8	125.6	125	150
	460-3-60	6.8	5.8	61.8	50	11	9	1.6	6.1	2.2		None	-	-	-	23.6	25.8	30	30
												E09	9	1	10.8	23.6	25.8	30	30
												E18	18	2	21.7	34.8	37.5	35	40
												E24	24	2	28.9	43.8	46.5	45	50
												E36	34	2	40.9	58.8	61.5	60	70
	575-3-60	4.8	5.1	39	41	8	8	1.2	4.9	1.8		None	-	-	-	18.5	20.3	20	25
												E09	9	1	8.7	18.5	20.3	20	25
												E18	18	2	17.3	27.8	30	30	30
												E24	24	2	23.1	35	37.3	35	40
												E36	34	2	32.7	47	49.3	50	50

KB078-150 Hi-static indoor blower - without powered convenience outlet

Size (ton)	Volt	Compressors (each)						OD fan motors (each)	Supply blower motor	Power exhaust motor	Power convenience outlet	Electric heat option				MCA[1] (Amp)	MCA[1] with power exhaust (Amp)	Max fuse[2]/ breaker[3] size (Amp)	Max fuse[2]/ breaker[3] size with power exhaust (Amp)
		RLA		LRA		MCC													
		C1	C2	C1	C2	C1	C2	FLA	FLA	FLA	FLA	Model	kW	Stages	Amp				
102 (8.5)	208-3-60	11.9	12.2	112	120.4	19	19	2.8	13.2	5.5		None	-	-	-	46.2	51.7	50	60
												E09	6.8	1	18.9	46.2	51.7	50	60
												E18	13.5	2	37.5	63.4	70.3	70	80
												E24	18	2	50	79	85.9	80	90
												E36	25.5	2	70.8	105	111.9	110	125
	230-3-60	11.9	12.2	112	120.4	19	19	2.8	13.2	5.5		None	-	-	-	46.2	51.7	50	60
												E09	9	1	21.7	46.2	51.7	50	60
												E18	18	2	43.3	70.6	77.5	80	80
												E24	24	2	57.7	88.6	95.5	90	100
												E36	34	2	81.8	118.8	125.6	125	150
	460-3-60	6.8	6.4	61.8	50	11	10	1.6	6.1	2.2		None	-	-	-	24.2	26.4	30	30
												E09	9	1	10.8	24.2	26.4	30	30
												E18	18	2	21.7	34.8	37.5	35	40
												E24	24	2	28.9	43.8	46.5	45	50
												E36	34	2	40.9	58.8	61.5	60	70
	575-3-60	4.8	5.1	39	41	8	8	1.2	4.9	1.8		None	-	-	-	18.5	20.3	20	25
												E09	9	1	8.7	18.5	20.3	20	25
												E18	18	2	17.3	27.8	30	30	30
												E24	24	2	23.1	35	37.3	35	40
												E36	34	2	32.7	47	49.3	50	50
120 (10)	208-3-60	14	16	150	156.4	22	25	2.8	13.2	5.5		None	-	-	-	52.8	58.3	60	70
												E18	13.5	2	37.5	63.4	70.3	70	80
												E24	18	2	50	79	85.9	80	90
												E36	25.5	2	70.8	105	111.9	110	125
												E54	40.6	2	112.7	157.4	164.3	175	175
	230-3-60	14	16	150	156.4	22	25	2.8	13.2	5.5		None	-	-	-	52.8	58.3	60	70
												E18	18	2	43.3	70.6	77.5	80	80
												E24	24	2	57.7	88.6	95.5	90	100
												E36	34	2	81.8	118.8	125.6	125	150
												E54	54	2	129.9	146.4	153.3	175	175
	460-3-60	6.3	7.7	58	69	10	12	1.6	6.1	2.2		None	-	-	-	25.2	27.4	30	35
												E18	18	2	21.7	34.8	37.5	35	40
												E24	24	2	28.9	43.8	46.5	45	50
												E36	34	2	40.9	58.8	61.5	60	70
												E54	54	2	65	72.6	75.4	80	90
	575-3-60	5.8	6.4	47.8	47.8	9	10	1.2	4.9	1.8		None	-	-	-	21.1	22.9	25	25
												E18	18	2	17.3	27.8	30	30	30
												E24	24	2	23.1	35	37.3	35	40
												E36	34	2	32.7	47	49.3	50	50
												E54	54	2	52	58.1	60.4	70	70

KB078-150 Hi-static indoor blower - without powered convenience outlet

Size (ton)	Volt	Compressors (each)						OD fan motors (each)	Supply blower motor	Power exhaust motor	Power convenience outlet	Electric heat option				MCA[1] (Amp)	MCA[1] with power exhaust (Amp)	Max fuse[2]/ breaker[3] size (Amp)	Max fuse[2]/ breaker[3] size with power exhaust (Amp)
		RLA		LRA		MCC													
		C1	C2	C1	C2	C1	C2	FLA	FLA	FLA	FLA	Model	kW	Stages	Amp				
150 (12.5)	208-3-60	19.2	22.4	162.3	166.2	30	35	1.65	20.4	5.5		None	-	-	-	74.2	79.7	90	100
												E18	13.5	2	37.5	74.2	79.7	90	100
												E24	18	2	50	88	94.9	90	100
												E36	25.5	2	70.8	114	120.9	125	125
												E54	40.6	2	112.7	166.4	173.3	175	175
	230-3-60	19.2	22.4	162.3	166.2	30	35	1.65	20.4	5.5		None	-	-	-	74.2	79.7	90	100
												E18	18	2	43.3	79.6	86.5	90	100
												E24	24	2	57.7	97.6	104.5	100	110
												E36	34	2	81.8	127.8	134.6	150	150
												E54	54	2	129.9	155.4	162.3	175	175
	460-3-60	9.1	8.8	70.8	74.6	14	14	1.1	9.9	2.2		None	-	-	-	34.7	36.9	40	45
												E18	18	2	21.7	39.5	42.3	40	45
												E24	24	2	28.9	48.5	51.3	50	60
												E36	34	2	40.9	63.5	66.3	70	70
												E54	54	2	65	77.4	80.1	90	90
	575-3-60	6.2	7.2	58.2	54	10	11	0.65	7.7	1.8		None	-	-	-	25.6	27.4	30	35
												E18	18	2	17.3	31.3	33.5	35	35
												E24	24	2	23.1	38.5	40.8	40	45
												E36	34	2	32.7	50.5	52.8	60	60
												E54	54	2	52	61.6	63.9	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

KB078-150 Hi-static indoor blower - with powered convenience outlet

Size (ton)	Volt	Compressors (each)						OD fan motors (each)	Supply blower motor	Power exhaust motor	Power convenience outlet	Electric heat option				MCA[1] (Amp)	MCA[1] with power exhaust (Amp)	Max fuse[2]/ breaker[3] size (Amp)	Max fuse[2]/ breaker[3] size with power exhaust (Amp)
		RLA		LRA		MCC													
		C1	C2	C1	C2	C1	C2	FLA	FLA	FLA	FLA	Model	kW	Stages	Amp				
078 (6)	208-3-60	9.9	12.8	82	102.8	15	20	2.8	9	5.5	20	None	-	-	-	50.5	56	60	60
												E09	6.8	1	18.9	50.5	56	60	60
												E18	13.5	2	37.5	70.6	77.5	80	80
												E24	18	2	50	86.3	93.1	90	100
												E36	25.5	2	70.8	112.3	119.1	125	125
	230-3-60	9.9	12.8	82	102.8	15	20	2.8	9	5.5	20	None	-	-	-	50.5	56	60	60
												E09	9	1	21.7	50.9	57.8	60	60
												E18	18	2	43.3	77.9	84.8	80	90
												E24	24	2	57.7	95.9	102.8	100	110
												E36	34	2	81.8	126	132.9	150	150
	460-3-60	4.8	5.8	44.3	50	8	9	1.6	4.6	2.2	20	None	-	-	-	24.9	27.1	30	30
												E09	9	1	10.8	25.5	28.3	30	30
												E18	18	2	21.7	39.1	41.9	40	45
												E24	24	2	28.9	48.1	50.9	50	60
												E36	34	2	40.9	63.1	65.9	70	70
	575-3-60	3.5	5.1	28.7	41	6	8	1.2	3.5	1.8	20	None	-	-	-	19.8	21.6	20	25
												E09	9	1	8.7	20.3	22.5	25	25
												E18	18	2	17.3	31	33.3	35	35
												E24	24	2	23.1	38.3	40.5	40	45
												E36	34	2	32.7	50.3	52.5	60	60
090 (7.5)	208-3-60	11.9	12.8	112	102.8	19	20	2.8	13.2	5.5	20	None	-	-	-	56.8	62.3	70	70
												E09	6.8	1	18.9	56.8	62.3	70	70
												E18	13.5	2	37.5	75.9	82.8	80	90
												E24	18	2	50	91.5	98.4	100	100
												E36	25.5	2	70.8	117.5	124.4	125	125
	230-3-60	11.9	12.8	112	102.8	19	20	2.8	13.2	5.5	20	None	-	-	-	56.8	62.3	70	70
												E09	9	1	21.7	56.8	63	70	70
												E18	18	2	43.3	83.1	90	90	90
												E24	24	2	57.7	101.1	108	110	110
												E36	34	2	81.8	131.3	138.1	150	150
	460-3-60	6.8	5.8	61.8	50	11	9	1.6	6.1	2.2	20	None	-	-	-	28.6	30.8	35	35
												E09	9	1	10.8	28.6	30.8	35	35
												E18	18	2	21.7	41	43.8	45	45
												E24	24	2	28.9	50	52.8	50	60
												E36	34	2	40.9	65	67.8	70	70
	575-3-60	4.8	5.1	39	41	8	8	1.2	4.9	1.8	20	None	-	-	-	22.5	24.3	25	25
												E09	9	1	8.7	22.5	24.3	25	25
												E18	18	2	17.3	32.8	35	35	35
												E24	24	2	23.1	40	42.3	40	45
												E36	34	2	32.7	52	54.3	60	60

KB078-150 Hi-static indoor blower - with powered convenience outlet

Size (ton)	Volt	Compressors (each)						OD fan motors (each)	Supply blower motor	Power exhaust motor	Power convenience outlet	Electric heat option				MCA[1] (Amp)	MCA[1] with power exhaust (Amp)	Max fuse[2]/ breaker[3] size (Amp)	Max fuse[2]/ breaker[3] size with power exhaust (Amp)
		RLA		LRA		MCC													
		C1	C2	C1	C2	C1	C2	FLA	FLA	FLA	FLA	Model	kW	Stages	Amp				
102 (8.5)	208-3-60	11.9	12.2	112	120.4	19	19	2.8	13.2	5.5	20	None	-	-	-	56.2	61.7	60	70
												E09	6.8	1	18.9	56.2	61.7	60	70
												E18	13.5	2	37.5	75.9	82.8	80	90
												E24	18	2	50	91.5	98.4	100	100
												E36	25.5	2	70.8	117.5	124.4	125	125
	230-3-60	11.9	12.2	112	120.4	19	19	2.8	13.2	5.5	20	None	-	-	-	56.2	61.7	60	70
												E09	9	1	21.7	56.2	63	60	70
												E18	18	2	43.3	83.1	90	90	90
												E24	24	2	57.7	101.1	108	110	110
												E36	34	2	81.8	131.3	138.1	150	150
	460-3-60	6.8	6.4	61.8	50	11	10	1.6	6.1	2.2	20	None	-	-	-	29.2	31.4	35	35
												E09	9	1	10.8	29.2	31.4	35	35
												E18	18	2	21.7	41	43.8	45	45
												E24	24	2	28.9	50	52.8	50	60
												E36	34	2	40.9	65	67.8	70	70
	575-3-60	4.8	5.1	39	41	8	8	1.2	4.9	1.8	20	None	-	-	-	22.5	24.3	25	25
												E09	9	1	8.7	22.5	24.3	25	25
												E18	18	2	17.3	32.8	35	35	35
												E24	24	2	23.1	40	42.3	40	45
												E36	34	2	32.7	52	54.3	60	60
120 (10)	208-3-60	14	16	150	156.4	22	25	2.8	13.2	5.5	20	None	-	-	-	62.8	68.3	70	80
												E18	13.5	2	37.5	75.9	82.8	80	90
												E24	18	2	50	91.5	98.4	100	100
												E36	25.5	2	70.8	117.5	124.4	125	125
												E54	40.6	2	112.7	169.9	176.8	175	200
	230-3-60	14	16	150	156.4	22	25	2.8	13.2	5.5	20	None	-	-	-	62.8	68.3	70	80
												E18	18	2	43.3	83.1	90	90	90
												E24	24	2	57.7	101.1	108	110	110
												E36	34	2	81.8	131.3	138.1	150	150
												E54	54	2	129.9	158.9	165.8	175	175
	460-3-60	6.3	7.7	58	69	10	12	1.6	6.1	2.2	20	None	-	-	-	30.2	32.4	35	40
												E18	18	2	21.7	41	43.8	45	45
												E24	24	2	28.9	50	52.8	50	60
												E36	34	2	40.9	65	67.8	70	70
												E54	54	2	65	78.9	81.6	90	90
	575-3-60	5.8	6.4	47.8	47.8	9	10	1.2	4.9	1.8	20	None	-	-	-	25.1	26.9	30	30
												E18	18	2	17.3	32.8	35	35	35
												E24	24	2	23.1	40	42.3	40	45
												E36	34	2	32.7	52	54.3	60	60
												E54	54	2	52	63.1	65.4	70	70

KB078-150 Hi-static indoor blower - with powered convenience outlet

Size (ton)	Volt	Compressors (each)						OD fan motors (each)	Supply blower motor	Power exhaust motor	Power convenience outlet	Electric heat option				MCA[1] (Amp)	MCA[1] with power exhaust (Amp)	Max fuse[2]/ breaker[3] size (Amp)	Max fuse[2]/ breaker[3] size with power exhaust (Amp)
		RLA		LRA		MCC													
		C1	C2	C1	C2	C1	C2	FLA	FLA	FLA	FLA	Model	kW	Stages	Amp				
150 (12.5)	208-3-60	19.2	22.4	162.3	166.2	30	35	1.65	20.4	5.5	20	None	-	-	-	84.2	89.7	100	110
												E18	13.5	2	37.5	84.9	91.8	100	110
												E24	18	2	50	100.5	107.4	110	110
												E36	25.5	2	70.8	126.5	133.4	150	150
												E54	40.6	2	112.7	178.9	185.8	200	200
	230-3-60	19.2	22.4	162.3	166.2	30	35	1.65	20.4	5.5	20	None	-	-	-	84.2	89.7	100	110
												E18	18	2	43.3	92.1	99	100	110
												E24	24	2	57.7	110.1	117	125	125
												E36	34	2	81.8	140.3	147.1	150	150
												E54	54	2	129.9	167.9	174.8	175	175
	460-3-60	9.1	8.8	70.8	74.6	14	14	1.1	9.9	2.2	20	None	-	-	-	39.7	41.9	45	50
												E18	18	2	21.7	45.8	48.5	50	50
												E24	24	2	28.9	54.8	57.5	60	60
												E36	34	2	40.9	69.8	72.5	70	80
												E54	54	2	65	83.6	86.4	90	90
	575-3-60	6.2	7.2	58.2	54	10	11	0.65	7.7	1.8	20	None	-	-	-	29.6	31.4	35	35
												E18	18	2	17.3	36.3	38.5	40	40
												E24	24	2	23.1	43.5	45.8	45	50
												E36	34	2	32.7	55.5	57.8	60	60
												E54	54	2	52	66.6	68.9	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

Electric heat multipliers

Voltage		kW capacity multipliers[1]
Nominal	Applied	
240	208	0.75
	230	0.92
480	460	0.92
600	575	0.92

1. Electric heaters are rated at nominal voltage. Use this table to determine the electric heat capacity for heaters applied at lower voltages.

KB078-150 physical data

Component	Models									
	KB078		KB090		KB102		KB120		KB150	
Nominal Tonnage	**6.5**		**7.5**		**8.5**		**10**		**12.5**	
AHRI cooling performance										
Gross Capacity @ AHRI A point (Btu)	82000		92000		103000		121000		145000	
AHRI net capacity (Btu)	80000		89000		100000		117000		142000	
EER	12.6		12.4		12.4		12.4		12.2[1]/12[2]	
IEER with Intellispeed	16.5		16		16		15.8		16.0	
IEER with VAV	16.5		16		15.5		15.8		16.0	
CFM	2400		2400		3000		3200		3300	
System power (KW)	6.2		7.2		7.8		9.4		11.5	
Refrigerant type	R-454B		R-454B		R-454B		R-454B		R-454B	
Refrigerant charge (lb-oz)										
System 1	6-6		6-6		7-2		6-12		8-0	
System 2	6-2		6-8		7-4		6-8		7-14	
Refrigerant charge (lb-oz) with MagnaDry option										
System 1	6-6		7-10		7-6		6-12		8-12	
System 2	6-2		6-8		7-4		6-8		7-14	
AHRI heating performance										
Heating model	N12	N18	N12	N18	N12	N18	N18	N24	N18	N24
Heat input (K Btu)	120	180	120	180	120	180	180	240	180	240
Heat output (K Btu)	97	146	97	146	97	146	146	194	146	194
AFUE %	-	-	-	-	-	-	-	-	-	-
Steady state efficiency (%)	81	81	81	81	81	81	81	81	81	81
No. burners	5	7	5	7	5	7	7	8	7	8
No. stages	2[3]	2[3]	2[3]	2[3]	2[3]	2[3]	2[3]	2[3]	2[3]	2[3]
Temperature Rise Range (ºF)	20-50	20-65	20-50	20-65	20-50	20-65	20-65	30-60	20-65	30-60
Gas piping connection (in.)	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
Dimensions (in.)										
Length	89		89		89		89		119-1/2	
Width	59		59		59		59		59	
Height	50-3/4		50-3/4		50-3/4		50-3/4		50-3/4	
Operating wt. (lb.)	1033		1035		1044		1070		1280	
Operating wt. (lb.) MagnaDry option	1080		1080		1135		1135		1395	
Compressors[4]										
Type	2-Stage Scroll/Scroll		2-Stage Scroll/Scroll		2-Stage Scroll/Scroll		2-Stage Scroll/Scroll		2-Stage Scroll/Scroll	
Quantity	2		2		2		2		2	
Unit Capacity Steps (%)	34/67/100		34/67/100		34/67/100		34/67/100		34/67/100	
Condenser coil data										
Face area (Sq. Ft.)	23.8		23.8		29.0		29.0		47.5	
Rows	1		1		1		1		1	
Fins per inch	23		23		23		23		23	
Tube diameter (in./MM)	1/25		1/25		1/25		1/25		.71/18	
Circuitry Type	2-pass Microchannel		2-pass Microchannel		2-pass Microchannel		2-pass Microchannel		2-pass Microchannel	
Evaporator coil data										
Face area (Sq. Ft.)	13.2		13.2		13.2		13.2		13.2	
Rows	4		4		4		4		4	
Fins per inch	15		15		15		15		15	
Tube diameter	0.375		0.375		0.375		0.375		0.375	
Circuitry Type	Intertwined		Intertwined		Intertwined		Intertwined		Intertwined	
Refrigerant control	TXV		TXV		TXV		TXV		TXV	
Reheat option coil data										
Face area (sq. ft.)	10		10		10		10		10	

Component	Models									
	KB078		KB090		KB102		KB120		KB150	
Nominal Tonnage	**6.5**		**7.5**		**8.5**		**10**		**12.5**	
Rows	2		2		2		2		2	
Fins per inch	13		13		13		13		13	
Tube diameter	3/8		3/8		3/8		3/8		3/8	
Condenser fan data										
Quantity of fans	2		2		2		2		4	
Fan diameter (Inch)	24		24		24		24		24	
Type	Prop		Prop		Prop		Prop		Prop	
Drive type	Direct		Direct		Direct		Direct		Direct	
Quantity of motors	2		2		2		2		4	
Motor HP each	3/4		3/4		3/4		3/4		1/3	
No. speeds	1		1		1		1		1	
RPM	1110		1110		1110		1110		850	
Total CFM	8000		8000		9000		9400		14000	
Belt drive evap fan data										
Quantity	1		1		1		1		1	
Fan Size (Inch)	15 x 15		15 x 15		15 x 15		15 x 15		15 x 15	
Type	Centrifugal		Centrifugal		Centrifugal		Centrifugal		Centrifugal	
Motor Sheave	1VL40	1VM50	1VL40	1VM50	1VM50	1VM50	1VM50	1VM50	1VM50	1VP56
Blower Sheave	AK74	AK74	AK69	AK69	AK89	AK74	AK84	AK74	AK74	BK77
Belt	A53	A54	A52	A54	A56	A54	A56	A54	A54	BX56
Motor HP each	1-1/2	2	1-1/2	3	2	3	2	3	3	5
RPM	1725	1725	1725	1725	1725	1725	1725	1725	1725	1725
Frame size	56	56	56	56	56	56	56	56	56	184T
Filters										
Quantity - Size	4 - (24 x 20 x 2)		4 - (24 x 20 x 2)		4 - (24 x 20 x 2)		4 - (24 x 20 x 2)		4 - (24 x 20 x 2)	

1. Cooling Only Unit or Cooling Unit with Electric Heat
2. Cooling Unit with Gas Heat
3. 1st Stage 60% of 2nd stage
4. KB078 through KB150 have crankcase heaters standard

Optional electric heat

The factory-installed heaters are wired for single point power supply. You only need to bring the power supply into the single point terminal block.

These CSA approved heaters are located within the central compartment of the unit with the heater elements extending in to the supply air chamber.

Fuses are supplied, where required, by the factory. Some kW sizes require fuses and others do not. See Table 12 for minimum CFM limitations.See Table for electrical data.

Table 12: Electric heat minimum supply air

Size (tons)	Model	Voltage	Minimum supply air (CFM)				
			Heater kW				
			9	18	24	36	54
078 (6.5)	KB	208/230-3-60	1950	1950	1950	1950	-
		460-3-60	1950	1950	1950	1950	-
		600-3-60	1950	1950	1950	1950	-
090 (7.5)	KB	208/230-3-60	2250	2250	2250	2250	-
		460-3-60	2250	2250	2250	2250	-
		600-3-60	2250	2250	2250	2250	-
102 (8.5)	KB	208/230-3-60	2550	2550	2550	2550	-
		460-3-60	2550	2550	2550	2550	-
		600-3-60	2550	2550	2550	2550	-
120 (10)	KB	208/230-3-60	-	3000	3000	3000	3500
		460-3-60	-	3000	3000	3000	3000
		600-3-60	-	3000	3000	3000	3500
150 (12.5)	KB	208/230-3-60	-	3750	3750	3750	4000
		460-3-60	-	3750	3750	3750	3750
		600-3-60	-	3750	3750	3750	3750

Optional gas heat

The optional gas-fired heaters have aluminized-steel or optional stainless steel, tubular heat exchangers with spark ignition.

Gas piping

Proper sizing of gas piping depends on the cubic feet per hour of gas flow required, specific gravity of the gas, and the length of run.

Follow the “National Fuel Gas Code” Z223.1 (in U.S.A.) or the current Gas Installation Codes CSA-B149.1 (in Canada) in all cases unless they are superseded by local codes or gas utility requirements.

See Table 13, *Gas pipe sizing - capacity of pipe,* on page 39. The heating value of the gas may vary by locality. You must check the value with the local gas utility.

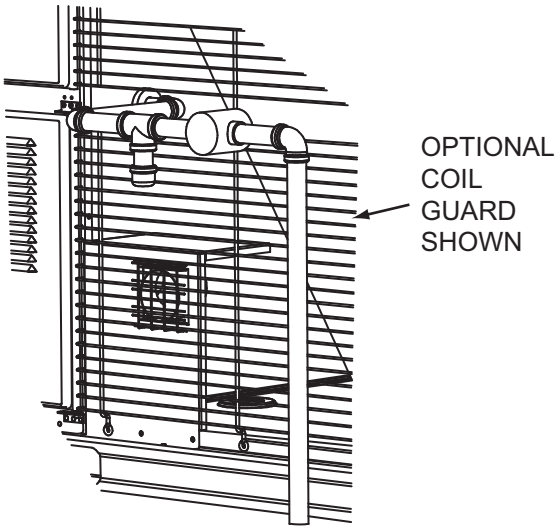


Figure 22: Side entry gas piping

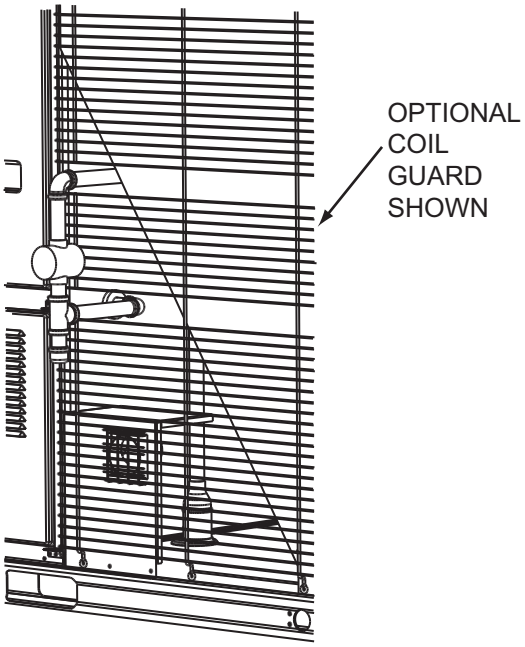


Figure 23: Bottom entry gas piping

Table 13: Gas pipe sizing - capacity of pipe

Length of pipe (ft.)	Nominal iron pipe size		
	3/4 in.	1 in.	1-1/4 in.
10	278	520	1050
20	190	350	730
30	152	285	590
40	130	245	500
50	115	215	440
60	105	195	400
70	96	180	370
80	90	170	350
90	84	160	320
100	79	150	305

Note: Maximum capacity of pipe in cubic feet of gas per hour based upon a pressure drop of 0.3 inch W.C. and 0.6 specific gravity gas.

Note: There may be a local gas utility requirement specifying a minimum diameter for gas piping. All units require a 3/4 inch pipe connection at the entrance fitting. Line should not be sized smaller than the entrance fitting size.

Table 14: Gas heat minimum supply air

Size (tons)	Model	Heat size	Supply air (CFM) Heating	
			Minimum	Maximum
078 (6.5)	KB	N12	1800	3250
		N18	2080	3250
090 (7.5)	KB	N12	1800	3750
		N18	2080	3750
102 (8.5)	KB	N12	1800	4250
		N18	2080	4250
120 (10)	KB	N18	2080	5000
		N24	3000	5000
150 (12.5)	KB	N18	2080	6250
		N24	3000	6250

Gas connection

Route the gas supply line within the space and roof curb with the exit through the unit's basepan. See Figures 22 and 23 for the gas piping inlet location. Typical supply piping arrangements are shown in Figures 22 and 23.

Apply the following gas piping recommendations.

- You must install a drip leg and a ground joint union in the gas piping.
- When required by local codes, install a manual shut-off valve outside of the unit.
- Use wrought iron or steel pipe for all gas lines. Apply pipe dope sparingly to male threads only.

⚠WARNING

Natural gas may contain some propane. Propane is an excellent solvent and will quickly dissolve white lead and most standard commercial compounds. A special pipe dope must be used when assembling wrought iron or steel pipe. Shellac based compounds such as Gaskolac or Stalastic, and compounds such as Rectorseal #5, Clydes's or John Crane may be used.

- Clean all piping of dirt and scale. Hammer on the outside of the pipe and blow out loose particles. Before initial start-up, make sure that all gas lines external to the unit are purged of air.
- The gas supply must be a separate line and installed in accordance with all safety codes as prescribed under Limitations.

- You must install a 1/8-inch NPT plugged tapping, accessible for test gage connection, immediately upstream of the gas supply connection to the unit.
- After the gas connections are complete, open the main shut-off valve admitting *normal gas pressure* to the mains. *Check all joints for leaks with soap solution or other material suitable for the purpose.* **Never use a flame.**

⚠WARNING

Fire or explosion hazard

Failure to follow the safety warning exactly could result in serious injury, death, or property damage.

Never test for gas leaks with an open flame. Use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury, or loss of life.

⚠ CAUTION

The furnace and its individual shut-off valve must be disconnected from the gas supply piping system during any pressure testing at pressures greater than 1/2 PSIG.

Pressures greater than 1/2 PSIG cause gas valve damage resulting in a hazardous condition. If the gas valve is subjected to a pressure greater than 1/2 PSIG, it must be replaced.

The furnace must be isolated from the gas supply piping system by closing its individual manual shut-off valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 PSIG.

⚠WARNING

Threaded joints must be coated with a sealing compound that is resistant to the action of liquefied petroleum gases. **Do not use Teflon tape.**

Propane Units, Tanks And Piping

All gas heat units are shipped from the factory equipped for natural gas use only. The unit may be converted in the field for use with propane gas with an accessory kit.

All propane gas equipment must conform to the safety standards of the National Fire Protection Association.

For satisfactory operation, propane gas pressure must at the proper inlet pressure. See conversion kit instructions for minimum and maximum supply inlet pressure. Maintaining proper gas pressure depends on three main factors:

1. The vaporization rate which depends on the temperature of the liquid and the “wetted surface” area of the container(s).
2. The proper pressure regulation. (Two-stage regulation is recommended).
3. The pressure drop in the lines between regulators and between the second stage regulator and the appliance. Pipe size required will depend on the length of the pipe run and the total load of all appliances.

Complete information regarding tank sizing for vaporization, recommended regulator settings, and pipe sizing is available from most regulator manufacturers and propane gas suppliers.

⚠WARNING

Propane gas is an excellent solvent and will quickly dissolve white lead and most standard commercial compounds. A special pipe dope must be used when assembling wrought iron or steel pipe for propane. Shellac base compounds such as Gaskolac or Stalastic, and compounds such as Rectorseal #5, Clyde’s, or John Crane may be used.

Check all connections for leaks when piping is completed using a soap solution. **NEVER USE A FLAME.**

⚠WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warning exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

Vent and combustion air

Venting slots in the heating compartment access panel remove the need for a combustion air hood. The gas heat flue exhaust is routed through the factory-installed exhaust piping with a screen. If necessary, a flue exhaust extension may be installed at the point of installation.

Options and accessories

Electric heat

Electric heaters are available as factory-installed options or field-installed accessories. Refer to the electric heat instructions for installation. These heaters mount in the heat compartment with the heating elements extending into the supply air chamber. All electric heaters are fused and intended for use with single point power supply.

Smoke detectors

⚠WARNING

The use of duct smoke detectors have specific limitations as established by the National Fire Protection Association. Note that duct smoke detectors are not a substitute for other fire detection systems, including the following.

- An open area smoke detector
- Early warning detection
- A building's regular fire detection system.

Refer to NFPA Code 72 and Standard 90A for additional information.

The factory-installed smoke detector shuts down operation of the unit by interrupting power to the UCB when smoke is detected within its mounting compartment. The smoke detector option is available for both supply and return air configurations. Be aware that the supply air configuration has the sensor component mounted in the blower section with its control module mounted in the return air compartment.

⚠WARNING

Factory-installed smoke detectors may be subjected to extreme temperatures during off times due to outside air infiltration. These smoke detectors have an operational limit of -4°F to 158°F. To prevent false alarms, you must relocate smoke detectors installed in areas that could be outside this range.

⚠WARNING

To ensure that adequate airflow reaches the smoke detector's sensor, make sure that the holes of the sampling tube face into the air stream, and that the far-end of the sampling tube is sealed with the plastic end cap.

The unit's supply airflow must be adjusted to provide a pressure differential across the smoke detector's sampling and exhaust ports of at least 0.01 inches of water and no more than 1.11 inches of water, as measured by a manometer.

You must test and maintain the detector on a regular basis according to NFPA 72 requirements. You must clean the detector at least once a year. For specific troubleshooting and maintenance procedures, refer to the smoke detector's installation instructions that accompany the unit.

Motorized outdoor damper

The motorized outdoor damper can be a factory-installed option or a field-installed accessory. If factory installed, refer to the instructions included with the outdoor air hood to complete the assembly. Field-installed motorized outdoor damper accessories include complete instructions for installation.

Economizer

The economizer can be a factory-installed option or a field-installed accessory. If factory installed, refer to the instructions included with the economizer to complete the assembly. Field-installed economizer accessories include complete instructions for installation.

There are two economizer options:

1. Down flow, end return horizontal applications that include a fresh air hood and exhaust hood with barometric relief.
2. Horizontal flow application (field-installed kit only) that requires the purchase of a barometric relief hood.

Note: For the down flow, end return horizontal application, you must keep the two side panels for the economizer hood tops (See Figure 18).

Power exhaust

The power exhaust can be a factory installed-option or a field-installed accessory. If factory installed, refer to the instructions included with the power exhaust to complete the assembly. Field-installed power exhaust accessories include complete instructions for installation.

The power exhaust factory-installed option is for down flow application only.

There are two field-installed power exhaust accessories:

1. Down flow application.
2. Horizontal flow application that requires the purchase of a barometric relief hood.

Rain hood

For factory-installed options, all of the hood components, including the filters, the gasketing, and the hardware for assembling, are packaged and located between the condenser coil section and the main unit cabinet. For field-installed accessories, all parts necessary for the installation come in the accessory kit.

Factory-installed VFD (standard)

The factory-installed VFD is mounted in the blower access compartment. The drive comes wired from the factory to include both 3-phase power and control connections (run permit signal, speed reference signal, and fault signal). All required drive parameters are pre-programmed at the factory, except in the case of 208-volt applications.

For 208-volt applications, you must change the following parameters.

- Change the parameter that defines the motor nameplate voltage to a value of 208.00
- Change th parameter that defines motor-rated current to the appropriate value available on the motor's nameplate.

Refer to the enclosed drive material for instructions on changing parameter settings.

VFD Shaft Grounding Device (factory- or field-installed option)

Available on units with a VFD, the shaft grounding device helps prevent electrical bearing fluting damage to the blower motor shaft by safely diverting harmful shaft voltages and bearing currents to ground, increasing the motor longevity.

Condensate overflow switch (factory- or field-installed option)

Mounted to the unit drain pan, the condensate overflow switch is a float switch that monitors the level of water in the drain pan to shut down unit operation and prevent drain pan overflow within the unit.

Manual bypass

An optional, factory-installed manual bypass switch is available with factory-installed VFD. The manual bypass switch is located in the blower motor access compartment. The manual bypass has the following three positions:

- **Drive** - routes power through the VFD for modulating control of the indoor blower motor.
- **Line (or bypass)** - routes power directly to the motor that provides full-speed motor operation and complete electrical isolation of the drive.
- **Test** - routes power to the VFD but not to the motor to allow for drive programming and diagnostics.

If a drive failure occurs, the unit does not automatically switch to bypass mode. You must set the manual bypass switch to the Line position. If there is a call for the fan, the indoor blower motor runs at full-speed while in the bypass mode.

⚠ WARNING

Before you begin any service, disconnect all power to the drive. Be aware that high voltages are present in the drive even after power is disconnected. Allow the capacitors within the drive to discharge before you begin service.

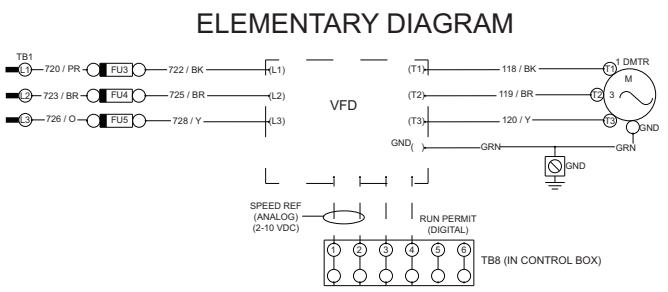


Figure 24: Simplified VFD wiring

⚠ CAUTION

Do not connect AC power to the T1, T2, T3 drive terminals to prevent damage to the VFD.

⚠ CAUTION

The fuses (FU3, FU4, FU5) supplied with the unit are sized according to the electrical load of the blower motor, but may not provide adequate protection to the customer-installed drive, depending upon its specifications. When a drive is selected and installed, refer to the drive manufacturer's recommendations for proper fuse sizing.

Economizer sequences

Several functions can drive the economizer, including: minimum position, free cooling, economizer loading, and minimum outdoor air supply.

Economizer minimum position sequences

The six minimum position sequences are minimum position, VAV economizer minimum position reset, fixed variable, low ambient minimum position, air monitoring station reset, and demand ventilation.

Minimum position

When the control is in the occupied mode and the FAN output is energized, the economizer is positioned to the minimum position setpoint unless another economizer function commands it open or closed. When the control is in the unoccupied mode, there is no minimum position.

VAV economizer minimum position reset

When the control is in the occupied mode and the FAN output energizes and the VFD output reaches the high-fan speed setting, the economizer damper position is the economizer minimum position setpoint.

When the VFD output reaches then fan low-speed setting, the economizer damper position is the economizer damper minimum position low speed fan.

When the VFD output is between the fan high speed and fan low speed settings, the economizer damper is position proportionally between the economizer minimum position setpoint and the economizer damper minimum position low speed fan.

Note: To disable the VAV economizer minimum position reset, set the economizer minimum position setpoint and the economizer damper minimum position low speed fan to the same value.

Fixed variable

When the control is in the occupied mode and the FAN output energizes and the VFD output reaches 100%, the economizer damper position is the economizer minimum position setpoint.

When the VFD output reaches the lowest percent command of the parameters above, the economizer damper position is the economizer damper minimum position low speed fan.

When the VFD output is between 100% and the lowest percent command, the economizer damper is positioned proportionally between the economizer minimum position setpoint and the economizer damper minimum position low speed fan.

Note: To disable the fixed variable economizer minimum position reset, set the economizer minimum position setpoint and the economizer damper minimum position low speed fan to the same value.

Low ambient minimum position

The low ambient economizer minimum position overrides all other minimum position functions.

When the control is in the occupied mode, the FAN output is energized, and the operational OAT is below the low ambient economizer setpoint, the economizer is positioned to the low ambient economizer minimum position. When the Operational OAT is equal to or above the low ambient economizer setpoint, it exits the low ambient economizer setpoint mode.

Air monitoring station reset

The input for air monitoring station reset is **Fr-Air**.

The fresh air max sensor range must match the range of the air monitoring station on the unit.

When the fresh air intake value falls below the fresh air intake setpoint the economizer damper position increases above minimum position until the fresh air intake value equals the fresh air intake setpoint +/- 40 CFM.

When the fresh air intake value rises above fresh air intake setpoint the economizer damper position decreases until the fresh air intake value equals the fresh air intake setpoint or it reaches minimum position setpoint.

Note: The low ambient minimum position may force the damper position below the current setpoint and disables the air monitoring station reset.

Demand ventilation

The output for demand ventilation is 2 to 10 VDC from the ECON terminal to the economizer actuator.

The control must be in occupied status with the indoor fan operating. If the low ambient minimum position is in effect, it overrides the demand ventilation operation.

If the demand ventilation mode of operation is set to enabled and the operational indoor CO_2 level is greater than the demand ventilation setpoint +100 ppm, the current operating minimum position increases as follows.

- With a CO_2 level between the demand ventilation setpoint +101 ppm and +200 ppm, the operating minimum position increases 1% per minute.
- With a CO_2 level greater than the demand ventilation setpoint +200 ppm, the operating minimum position increases 2% per minute.

When the CO_2 levels drop to equivalent values below the demand ventilation setpoint, the current operating minimum position decreases at the same rates.

While in a demand ventilation mode, if the supply air temperature drops below 49°F, the economizer outside air dampers close until the supply air temperature rises above 49°F but does not go below the current economizer operating minimum position. The economizer then modulates to control the supply air temperature at 50°F.

Note: The exception to this rule occurs when hydronic heat enable and SAT tempering with hydronic heat enable (40°F default) are both on. Hydronic heat is used to control the supply air temperature in this situation and the hydronic heat tempering setpoint is above 45°F.

If differential AQ enable is on and the OAQ is greater than or equal to the IAQ by more than the demand ventilation differential setpoint, the outside air dampers close completely and override all other minimum position functions.

Free cooling changeover options

Four types of free cooling selection options are available: dry bulb temperature, single enthalpy, dual enthalpy, and auto.

Auto

The control determines the type of free cooling changeover based on which sensors are present and reliable. Conditions include the following items:

- Operational space temperature and operational outdoor temperature = dry bulb changeover
- Operational space temperature, operational outdoor temperature, and operational outdoor humidity = single enthalpy
- Operational space temperature, operational outdoor temperature, operational outdoor humidity, and operational space humidity = dual enthalpy
- If the operational outdoor air temperature value is unreliable, free cooling is not available.

Dual enthalpy

The control determines the type of free cooling changeover based on which sensors are present and reliable. Conditions include the following items:

- Operational space temperature and operational outdoor temperature = dry bulb changeover
- Operational space temperature, operational outdoor temperature and operational outdoor humidity = single enthalpy
- Operational space temperature, operational outdoor temperature, operational outdoor humidity, and operational space humidity = dual enthalpy
- If the operational outdoor air temperature value is unreliable, free cooling is not available.

Single enthalpy

The control determines the type of free cooling changeover based on which sensors are present and reliable. Conditions include the following items:

- Operational outdoor air temperature = dry bulb changeover
- Operational outdoor air temperature and outdoor air humidity = single enthalpy
- If either the operational space temperature or the outdoor air dry bulb value is unreliable, free cooling is not available.

Dry bulb

The control determines the type of free cooling changeover based on which sensors are present and reliable. Conditions include the following items:

- Return and operational outdoor air temperature = dry bulb changeover
- If either the return or outside air dry bulb value is unreliable, free cooling is not available.

Changeover methods

Dry bulb changeover

This section applies when the free cooling current mode is dry bulb.

For dry bulb economizer operation, the outside air is suitable for free cooling if the operational outdoor air temperature is 1°F below the economizer OAT enable setpoint and 1°F below the return air temperature.

Free cooling is no longer available if the operational outdoor air temperature rises above either the economizer OAT enable setpoint or the return air temperature.

Single enthalpy changeover

This section applies when the free cooling current mode is single enthalpy.

For single enthalpy economizer operation, the outdoor air is suitable for free cooling if the outdoor air enthalpy is at least 1 BTU/lb below the economizer outdoor air enthalpy setpoint and the operational outdoor air temperature is no greater than the RAT plus 9°F.

Free cooling is no longer available if the operational outdoor air temperature rises above the RAT plus 10°F or the outdoor air enthalpy rises above the economizer outside air enthalpy setpoint.

Dual enthalpy changeover

This section applies when free cooling current mode is dual enthalpy.

For dual enthalpy economizer operation, the outdoor air enthalpy must be lower than the return air enthalpy by 1 BTU/lb and the operational outdoor air temperature is no greater than the RAT plus 9°F.

Free cooling is no longer available if the operational outdoor air temperature rises above the RAT plus 10°F or the outdoor air enthalpy rises above the return air enthalpy setpoint.

Cooling stages set to three for a two compressor unit

With a stage 1 cooling demand (Y1 input), the economizer modulates to get the SAT to the upper SAT setpoint +/-5°F.

With a stage 2 cooling demand (Y2 input), the economizer opens to 100% and the first compressor output energizes.

With a stage 3 cooling demand (Y3 input), a second compressor output energizes.

When each cooling demand is removed, the compressor outputs de-energize in reverse order without time delays. When

only a Y1 input remains, the economizer controls the SAT to the upper SAT setpoint +/- 5°F.

Note: If the SAT limit for cooling enabled is turned on, the 20 minute timer reapplies when appropriate to re-energize the compressor output.

Cooling stages set to two or more for multiple compressor units

With a stage 1 cooling demand (Y1 input) the economizer modulates to get the SAT to the upper SAT setpoint +/- 0.5°F.

With a stage 2 cooling demand (Y2 input), the economizer modulates to get the SAT to the lower SAT setpoint +/-.0.5°F.

If the stage 2 cooling demand (Y2 input) remains on, the economizer remains at 100% for 5 minutes and the SAT is greater than the lower SAT setpoint + 5°F, the compressor output energizes.

If the economizer position remains at 100% for another 5 minutes, the next available compressor turns on. This process repeats every 5 minutes until all the compressors energize.

If the economizer position drops below 100% and does not reach the minimum position then returns to 100% and remains at 100% for 5 minutes, the next available compressor energizes. If the economizer position remains at 100%, the process repeats every 5 minutes until all the compressors energize.

Any time the economizer remains at the minimum position for 5 consecutive minutes, the last energized compressor turns off. If it remains at the minimum position, the compressors de-energize every 5 minutes until all the compressor are off.

Y3 and Y4 inputs have no additional impact on economizer operation.

Sensor

VAV unit sensor option A

The operating VAV SAT setpoint is determined by the reset function not by the number of compressors operating.

When free cooling available and the SAT is above the operating VAV SAT setpoint, the dampers modulate to control the operating, upper or lower, SAT setpoint +/-0.5°F.

If the economizer output is at 100% for 5 consecutive minutes and the operating space temperature is 0.6°F or greater than the operating cooling setpoint, the control starts to energize compressors. See for additional information.

As soon as the staged percent command begins to increase, the economizer remains at 100%. If the SAT drops to less than the operating VAV SAT setpoint +1.8F, the staged percent command holds the current value.

If the SAT drops to less than the operating VAV SAT setpoint -1.8°F, the staged percent command begins to decrease.

If the staged percent command remains at 0% for 5 consecutive minutes, the economizer modulates to control to the upper SAT setpoint +/-0.5°F.

VAV unit sensor option B

When free cooling available and the SAT is greater than the operating VAV SAT setpoint, the dampers modulate to control the operating VAV SAT setpoint +/-0.5°F.

If the economizer position remains at 100% for 10 consecutive minutes and the SAT is greater than the operating VAV SAT setpoint +5°F, the first compressor output energizes. If the economizer position remains at 100% for another 5 minutes and the SAT is greater than the operating VAV SAT setpoint +5°F, the second compressor output energizes. If the economizer position remains at 100%, the process repeats every 5 minutes until all the compressors energize.

If the economizer position drops below 100% and does not reach the minimum position then returns to 100%, remains at 100% for 5 minutes, and the SAT is greater than the operating VAV SAT setpoint +5°F, the next available compressor energizes. If the economizer position remains at 100%, the process repeats every 5 minutes until all the compressors energize.

Any time the economizer remains at the minimum position for 5 consecutive minutes or the SAT is lower than the operating VAV SAT setpoint -5°F, the last energized compressor turns off. If it remains at the minimum position or the SAT remains lower than the operating VAV SAT setpoint -5°F, the compressors de-energize every 5 minutes until all the compressors are off.

If all compressor outputs de-engerize, the economizer modulates to control to operating VAV SAT Setpoint +/-0.5°F.

When the cooling demand ends the compressors de-energize immediately and the dampers return to operating minimum position.

Economizer loading

The economizer loading function only works when only one compressor is operating.

If the SAT is less than the SAT low limit setpoint and the operating OAT is greater than 60°F, the economizer output increases to control the SAT to the operating SAT setpoint +/- 0.5°F.

Power exhaust

Setpoints

- Economizer enable ON
- Power exhaust enable ON
- Modulating power exhaust OFF
- Exhaust VFD installed OFF
- Building pressure sensor enabled OFF
- Econo damper position for exh fan ON Percent
- Econo damper position for exh fan OFF Percent

Inputs

No inputs are present for non-modulating power exhaust.

Outputs

- 2-10 VDC from ECON on the economizer expansion module
- 24 VAC from EX-FAN to energize the exhaust fan on the economizer expansion module

Operation

Operation details include the following items:

a. Compares the economizer output to the economizer damper position for exhaust fan on and off

b. Energizes the exhaust fan when the economizer output is above the economizer damper position for exhaust fan on

c. De-energizes the exhaust fan when the economizer output is below the economizer damper position for exhaust fan off

Smart Equipment economizer board

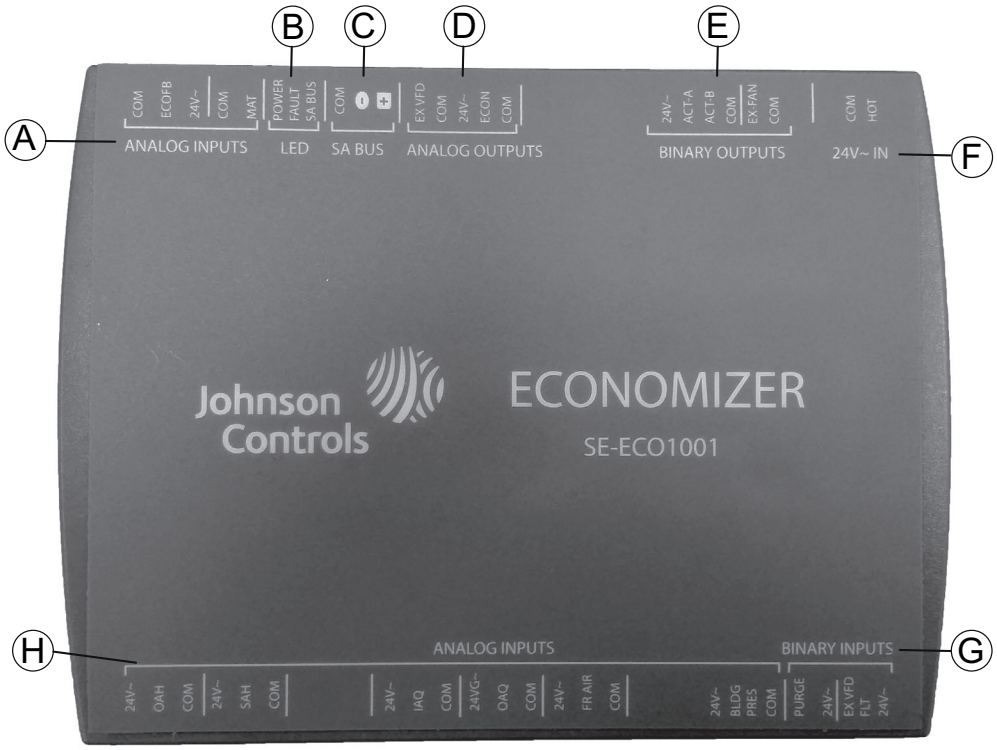


Figure 25: SE-ECO1001-0 economizer controller

The following tables describe the details of the economizer board. See Figure 25 for connection locations.

Smart Equipment economizer board - analog inputs

Location	Board label	Cover label	Description	Function and comments
A	**C**	COM	24 VAC common/0-10 VDC negative for economizer actuator position feedback	Connects through circuit trace to 24V~ IN pin COM
	IN2	ECOFB	0-10 VDC positive input from economizer actuator position feedback	The EconDampPos parameter reports input status (0-100%). Used to meet California Title 24 requirements for economizer actuator position feedback.
	R	24V~	24 VAC hot supplied for economizer actuator position feedback	Connects through circuit trace to 24V~ IN pin **HOT**
	C	COM	Mixed air temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	The MAT parameter reports input status (°F/°C), 3.65 VDC reading MAT (+) to COM (−) with open circuit. Read-only use in current control revision.
	IN1	MAT		
H	**R**	24V~	24 VAC hot supplied for the outdoor air humidity sensor	Connects through circuit trace to 24V~ IN pin HOT
	IN3	OAH	0-10 VDC positive input from the Outdoor Air Humidity sensor	OAH parameter reports input status (0-100%H). Used in outdoor air enthalpy calculation for dual enthalpy economizer free cooling changeover.
	C	COM	24 VAC common/0-10 VDC negative for the outdoor air humidity sensor	Connects through circuit trace to 24V~ IN pin COM
	R	24V~	24 VAC hot supplied for the supply air humidity sensor	Connects through circuit trace to 24V~ IN pin HOT
	IN4	SAH	0-10 VDC positive input from the Supply Air Humidity sensor	SAH parameter reports input status (0-100%H). Unused in current control revision.

Smart Equipment economizer board - analog inputs (Continued)

Location	Board label	Cover label	Description	Function and comments
H	**C**	COM	24 VAC common/0-10 VDC negative for the supply air humidity sensor	Connects through circuit trace to 24V~ IN pin COM
	R	24V~	24 VAC hot supplied for the indoor air quality sensor	Connects through circuit trace to 24V~ IN pin HOT
	IN5	IAQ	0-10 VDC positive input from the Indoor Air Quality sensor	IAQRange parameter sets the CO2 parts per million measured by the indoor air quality sensor when it outputs 10 VDC; IAQ parameter reports input status (0-5000ppm). Used for demand ventilation functions if the NetIAQ parameter indicates ?Unrel.
	C	COM	24 VAC common/0-10 VDC negative for the indoor air quality sensor	Connects through circuit trace to 24V~ IN pin COM
	R	24V~	24 VAC hot supplied for the outdoor air quality sensor	Connects through circuit trace to 24V~ IN pin HOT
	IN6	OAQ	0-10 VDC positive input from the Outdoor Air Quality sensor	OAQRange parameter sets the CO2 parts per million measured by the outdoor air quality sensor when it outputs 10 VDC; OAQ parameter reports input status (0-5000ppm). Used for demand ventilation function when DVent-Mode selection is Diff between IAQ and OAQ and the NetOAQ parameter indicates ?Unrel.
	C	COM	24 VAC common/0-10 VDC negative for the outdoor air quality sensor	Connects through circuit trace to 24V~ IN pin COM
	R	24V~	24 VAC hot supplied for the air monitoring station sensor	Connects through circuit trace to 24V~ IN pin HOT
	IN7	FR AIR	0-10 VDC positive input from the air monitoring station sensor	MOA-Range parameter sets the cubic feet per minute/liters per second measured by the air monitoring station sensor when it outputs 10 VDC; Fr Air parameter reports input status (0-50000CFM/23595lps). Used for economizer minimum position reset in speed-controlled indoor blower applications.
	C	COM	24 VAC common/0-10 VDC negative for the air monitoring station sensor	Connects through circuit trace to 24V~ IN pin COM
	R	24V~	24 VAC hot supplied for the building pressure sensor	Connects through circuit trace to 24V~ IN pin HOT
	IN8	BLDG PRES	0-5 VDC positive input from the Building Pressure sensor	BldgPres parameter reports input status (-.250-.250”/w/-.062-.062kPa). Used for modulating power exhaust functions when ExFType selection is Modulating Damper or Variable Frequency Fan.
	C	COM	24 VAC common/0-5 VDC negative for the building pressure sensor	Connects through circuit trace to 24V~ IN pin COM

Smart Equipment economizer board - LED details

Location	Board label	Cover label	Description	Function and comments
B	**POWER**	POWER	Green UCB power indicator	Lit indicates 24 VAC is present at 24V~ IN **COM** and **HOT** pins
	FAULT	FAULT	Red networking error and firmware error indicator	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	SA BUS	Green UCB SA bus communication transmission indicator	Lit/flickering indicates UCB-to-economizer board SA bus communication is currently active, off indicates the economizer board is awaiting SA bus communication

Smart Equipment economizer board - SA bus details

Location	Board label	Cover label	Description	Function and comments
C[1]	C	COM	Common for SA BUS power and communication circuits	EconCtrlr parameter reports UCB-to-economizer board SA bus communication status. Negative of the SA BUS communication circuit to the UCB. Through the unit wiring harness, may continue on to the 4-stage board and/or fault detection & diagnostics board
	–	–	Communication for SA BUS devices	EconCtrlr parameter reports UCB-to-economizer board SA BUS communication status. 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 the UCB. Through the unit wiring harness, may continue on to the 4-stage board and/or fault detection & diagnostics board
	+	+	Communication for SA BUS devices	EconCtrlr parameter reports UCB-to-economizer board SA BUS communication status. 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 the UCB. Through the unit wiring harness, may continue on to the 4-stage board and/or fault detection & diagnostics board

1. When wiring the unit and other devices using the SA Bus and FC Bus, see Table 28.

Smart Equipment economizer board - analog outputs

Location	Board label	Cover label	Description	Function and comments
D	J4	EX VFD	2-10 VDC positive output for the modulating power Exhaust fan Variable Frequency Drive/ discharge damper modulating power exhaust actuator	ExFanVFD parameter reports output status (0-100%) when ExFType selection is Variable Frequency Fan; EAD-O parameter reports output status (0-100%) when ExFType selection is Modulating Damper. Used to ramp the power exhaust fan VFD/ position the discharge damper actuator.
		COM	24 VAC common/0-10 VDC negative for the power exhaust variable frequency drive/ discharge damper modulating power exhaust actuator	Connects through circuit trace to 24V~ IN pin COM
		24V~	24 VAC hot supplied for the discharge damper modulating power exhaust actuator and economizer actuator	Connects through circuit trace to 24V~ IN pin HOT
		ECON	2-10 VDC output for the Economizer actuator	Econ parameter reports output status (0-100%). Used to position the economizer actuator for minimum position, free cooling, demand ventilation, cooling economizer loading and purge functions
		COM	24 VAC common/0-10 VDC negative for economizer actuator	Connects through circuit trace to 24V~ IN pin COM

Smart Equipment economizer board - binary outputs

Location	Board label	Cover label	Description	Function and comments
E	J3	24V~	24 VAC hot supplied for an incremental (floating control) economizer actuator	Connects through circuit trace to 24V~ IN pin HOT
		ACT-A	24 VAC hot outputs to position an incremental (floating control) economizer actuator	Unused in current control revision
		ACT-B	24 VAC return	Unused in current control revision
		COM	24 VAC common for an incremental (floating control) economizer actuator	Connects through circuit trace to 24V~ IN pin COM
		EX-FAN	24 VAC hot output to energize power exhaust fan contactor coil/VFD enable relay coil	ExFan parameter reports output status (Off-On) when ExFType selection is Non-Modulating, Modulating Damper or Variable Frequency Fan. Used to turn on/enable the power exhaust fan motor.
		COM	24 VAC common/0-10 VDC negative for economizer actuator	Connects through circuit trace to 24V~ IN pin COM

Smart Equipment economizer board - 24V~ IN connections

Location	Board label	Cover label	Description	Function and comments
F	C	COM	24 VAC transformer Common referenced to cabinet ground	24 VAC common connection to power the economizer board. Connects through circuit traces to C/COM terminals and pins distributed on the economizer board.
	R	HOT	24 VAC transformer HOT	24 VAC hot connection to power the economizer board. Connects through circuit traces to R/24V~ terminals and pins distributed on the economizer board.

Smart Equipment economizer board - binary inputs

Location	Board label	Cover label	Description	Function and comments
G	IN9	PURGE	24 VAC hot input from the PURGE dry contact	Purge parameter reports input status (False with 0 VAC input-True with 24 VAC input). When Purge status is True, heating and cooling operation is prevented, the indoor blower and power exhaust fan operate, the economizer actuator is positioned to 100%.
		24V~	24 VAC hot supplied for the purge dry contact	Connects through circuit trace to 24V~ IN pin HOT
	IN10	EX VFD FLT	24 VAC hot input from the power Exhaust Variable Frequency Drive Fault contact	ExFanVFDFlt parameter reports input status (Normal with 0 VAC input-Alarm with 24 VAC input) when ExFType selection is Variable Frequency Fan. When ExFanVFDFlt status is Alarm, EX-FAN fan output is prevented.
		24V~	24 VAC hot supplied for the power exhaust variable frequency drive fault contact	Connects through circuit trace to 24V~ IN pin HOT

Indoor air quality

Indoor air quality (IAQ) is regulated by an indoor sensor input. The IAQ sensor is connected to the economizer board through the IAQ analog input terminal and the associated COM and 24V~ inputs on the economizer board. Terminal IAQ accepts a 0 to +10 VDC signal with respect to the IAQ terminal. When the signal is below its setpoint, the actuator is allowed to modulate normally in accordance with the enthalpy and mixed air sensor inputs. When the IAQ signal exceeds its setpoint setting and there is no call for free cooling, the actuator is proportionately modulated from the 0 to 10 VDC signal, with 0 VDC corresponding to full closed and 10 VDC corresponding to full open. When there is no call for free cooling, the damper position is limited by the IAQ max. damper position setting. When the signal exceeds its setpoint (demand control ventilation setpoint) setting and there is a call for free cooling, the actuator modulates from the minimum position to the full open position based on the highest call from either the mixed air sensor input or the IAQ voltage input.

- Optional CO^2 space sensor kit - part no. 2AQ04700524
- Optional CO^2 sensor kit - part no. 2AQ04700624

Phasing

KB078-150 units are properly phased at the factory. Check for proper compressor rotation. If the blower or compressors rotate in the wrong direction at start-up, the electrical connection to the unit is misphased. Change the phasing of the field line connection at the factory or field supplied disconnect to obtain proper rotation. Scroll compressors operate in only one direction. The scroll is misphased if it is drawing low amperage, has similar suction and discharge pressures, or it produces a high noise level.

⚠ CAUTION

Scroll compressors require proper rotation to operate correctly. Units are properly phased at the factory. Do not change the internal wiring to make the blower condenser fans or compressor rotate correctly.

Blower rotation

Check for proper supply air blower rotation. If the blower is rotating backwards, the line voltage at the unit point of power connection is misphased. See *Phasing* on page 51.

Table 15: Supply air limitations

Unit Size (Ton)	Minimum	Maximum
078 (6.50)	1950	3250
090 (7.5)	2250	3750
102 (8.5)	2550	4250
120 (10.0)	3000	5000
150 (12.5)	3750	6250

Adjusting the belt tension

To adjust the belt tension complete the following steps.

1. Loosen the six belts nuts at the top and bottom. See Figure 26

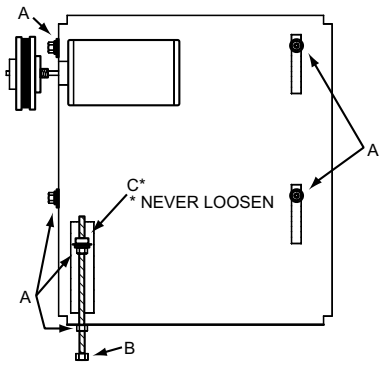
Note: Never loosen the static nut at the top of the adjustment bolt.

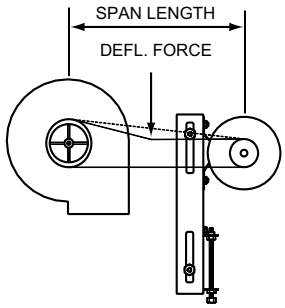
2. Turn the adjustment bolt.
3. Use a belt tension checker to apply a perpendicular force to one belt at the midpoint of the span shown in Figure 26. A deflection distance of 4 mm (5/32 in.) is obtained.
4. To determine the deflection distance from normal position, use a straight edge from sheave to sheave as a reference line.

   The recommended deflection force is as follows:

   Tension new belts at the max. deflection force recommended for the belt section.

5. Re-tighten the belt nuts.





Item	Component
A	Belt nuts
B	Adjustment bolt
C	Static nut

Figure 26: Belt adjustment

⚠ CAUTION

Check the belt tension at least two times during the first 24 hours of operation. Any retensioning must fall between the min. and max. deflection force values.

CFM static pressure and power-altitude and temperature corrections

Use the information below to assist in the application of the product at altitudes at or exceeding 1000 feet above sea level.

The air flow rates listed in the standard blower performance tables are based on standard air at sea level. As the altitude or temperature increases, the density of air decreases. In order to use the indoor blower tables for high altitude applications, certain corrections are necessary.

A centrifugal fan is a constant volume device. This means that, if the RPM remains constant, the CFM delivered is the same regardless of the density of the air. However, since the air at high altitude is less dense, less static pressure is generated and less power is required than a similar application at sea level. Air density correction factors are shown in Table 16 and Figure 27.

Table 16: Altitude/temperature correction factors

Air temp.	Altitude (ft.)										
	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
40	1.060	1.022	0.986	0.950	0.916	0.882	0.849	0.818	0.788	0.758	0.729
50	1.039	1.002	0.966	0.931	0.898	0.864	0.832	0.802	0.772	0.743	0.715
60	1.019	0.982	0.948	0.913	0.880	0.848	0.816	0.787	0.757	0.729	0.701
70	1.000	0.964	0.930	0.896	0.864	0.832	0.801	0.772	0.743	0.715	0.688
80	0.982	0.947	0.913	0.880	0.848	0.817	0.787	0.758	0.730	0.702	0.676
90	0.964	0.929	0.897	0.864	0.833	0.802	0.772	0.744	0.716	0.689	0.663
100	0.946	0.912	0.880	0.848	0.817	0.787	0.758	0.730	0.703	0.676	0.651

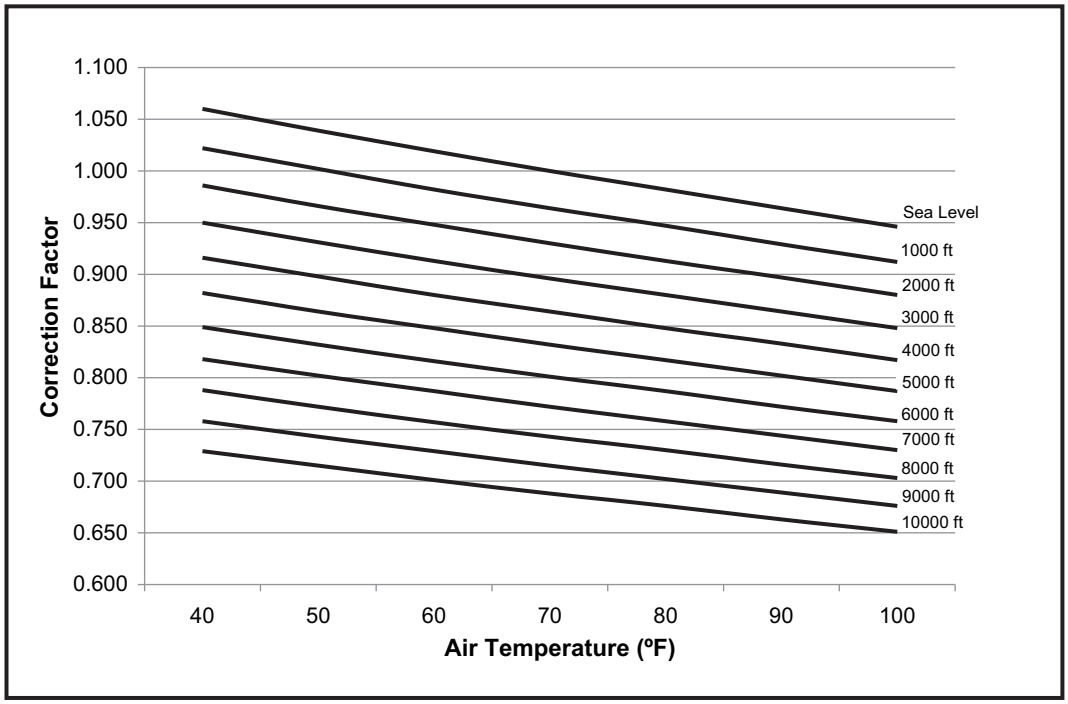


Figure 27: Altitude/temperature correction factors

Use the examples below to assist in determining the airflow performance of the product at altitude.

Example 1: What are the corrected CFM, static pressure, and BHP at an elevation of 5,000 ft. if the blower performance data is 1,400 CFM, 0.6 IWC and 0.67 BHP?

Solution: At an elevation of 5,000 ft. the indoor blower will still deliver 1,400 CFM if the RPM is unchanged. However, you must use Table 17 to determine the static pressure and BHP. We assume an air temperature of 70°F because no temperature data is given, Table 16 shows the correction factor to be 0.832.

Corrected static pressure = 0.6 x 0.832 = 0.499 IWC

Corrected BHP = 0.67 x 0.832 = 0.56

Example 2: A system, located at 5,000 feet of elevation, is to deliver 1,400 CFM at a static pressure of 1.5 in. Use the unit blower tables to select the blower speed and the BHP requirement.

Solution: As in the example above, no temperature information is given so 70°F is assumed.

The 1.5 in. static pressure given is at an elevation of 5,000 ft. The first step is to convert this static pressure to equivalent sea level conditions.

Sea level static pressure = 0.6 / .832 = 0.72 in.

Enter the blower table at 1,400 sCFM and static pressure of 0.72 in. The RPM listed is the same RPM needed at 5,000 ft.

Suppose that the corresponding BHP listed in the table is 0.7. This value must be corrected for elevation.

BHP at 5,000 ft. = 0.7 x .832 = 0.58

Drive selection

1. Determine side or bottom supply duct application.
2. Determine desired airflow.
3. Calculate or measure the amount of external static pressure.
4. With the operating point determined from steps 1, 2, and 3, locate this point on the appropriate supply air blower performance table. Linear interpolation may be necessary.
5. Note the RPM and BHP from step 4 and locate the appropriate motor and/or drive.
6. Review the BHP compared to the motor options available. Select the appropriate motor and/or drive.
7. Review the RPM range for the motor options available. Select the appropriate drive if multiple drives are available for the chosen motor.
8. Determine the turns open to obtain the desired operation point.

Example

1. 2400 CFM
2. 1.6 IWC
3. Using the supply air blower performance table below, the following data point was located: 1230 RPM and 1.62 BHP.
4. Using the RPM selection table below, Size X and Model Y is found.
5. 1.62 BHP exceeds the maximum continuous BHP rating of the 1.5 HP motor. The 2 HP motor is required.
6. 1230 RPM is within the range of the 2 HP drives.
7. Using the 2 HP motor and drive, .5 turns open achieves 1230 RPM.

Example supply air blower performance

Air flow (CFM)	Available external static pressure - IWG																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	1.5 HP & Field Supplied Drive						Standard 1.5 HP & Drive								Hi Static 2 HP & Drive					
2100	759	0.65	819	0.77	881	0.87	943	0.98	1005	1.08	1065	1.18	1121	1.28	1172	1.38	1217	1.48	1254	1.59
2200	778	0.73	838	0.84	900	1.95	962	1.05	1024	1.15	1083	1.25	1139	1.35	1191	1.45	1236	1.56	1273	1.66
2300	797	0.81	857	0.92	919	1.03	981	1.13	1043	1.23	1103	1.33	1159	1.43	1210	1.53	1255	1.64	1292	1.74
2400	817	1.90	877	1.01	939	1.12	1002	1.22	1063	1.32	1123	1.42	1179	1.52	1230	1.62	1275	1.73	1312	1.83

Table X: RPM selection

Size (tons)	Model	HP	Max BHP	Motor sheave	Blower sheave	6 turns open	5 turns open	4 turns open	3 turns open	2 turns open	1 turn open	Fully closed
X	Y	1.5	1.73	1VL40	AK61	N/A	787	847	908	968	1029	1089
		2	2.30	1VP56	AK74	N/A	1035	1084	1134	1183	1232	1281

Airflow performance

Table 17: Airflow performance - side duct application

KB078 (6.5 ton) side duct

Air flow (CFM)	Available external static pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Field supplied drive				Standard 1.5 HP and drive										High static 2 HP and drive					
1800	613	0.21	674	0.44	730	0.64	784	0.82	837	0.99	890	1.16	945	1.32	1003	1.49	1066	1.67	1135	1.86
2000	620	0.28	680	0.51	737	0.71	791	0.90	844	1.07	897	1.23	952	1.39	1010	1.56	1073	1.74	1142	1.94
2200	626	0.38	686	0.60	743	0.81	797	0.99	850	1.16	903	1.32	958	1.49	1016	1.65	1079	1.83	1148	2.03
2400	632	0.49	693	0.71	750	0.92	804	1.10	856	1.27	910	1.43	964	1.59	1023	1.76	1085	1.94	1154	2.14
2600	640	0.61	701	0.84	758	1.04	812	1.22	864	1.39	917	1.56	972	1.72	1030	1.89	1093	2.07	1162	2.27
2800	650	0.75	711	0.98	767	1.18	821	1.36	874	1.53	927	1.70	982	1.86	1040	2.03	1103	2.21	-	-
3000	662	0.90	723	1.13	779	1.33	833	1.51	886	1.68	939	1.85	994	2.01	1052	2.18	-	-	-	-
3200	677	1.07	737	1.29	794	1.50	848	1.68	901	1.85	954	2.01	1009	2.18	-	-	-	-	-	-
3400	694	1.24	754	1.47	811	1.67	865	1.86	918	2.03	971	2.19	-	-	-	-	-	-	-	-

1. Blower performance includes gas heat exchangers and 2-in. filters. See the static resistance table for additional applications.
2. See the RPM selection table to determine the required motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

KB090 (7.5 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	FS[4]				Standard 1.5 HP & Drive										Hi Static 3 HP & Drive					
2000	-	-	656	0.24	711	0.48	768	0.73	826	0.96	886	1.19	945	1.41	1003	1.61	1058	1.79	1110	1.95
2200	619	0.07	670	0.32	724	0.57	781	0.81	840	1.04	899	1.27	959	1.49	1016	1.69	1072	1.87	1124	2.04
2400	631	0.16	682	0.41	736	0.66	793	0.90	852	1.14	911	1.36	970	1.58	1028	1.78	1084	1.97	1136	2.13
2600	642	0.27	692	0.52	747	0.76	804	1.01	862	1.24	922	1.47	981	1.69	1039	1.89	1094	2.07	1146	2.24
2800	652	0.39	703	0.64	757	0.88	814	1.13	873	1.36	932	1.59	992	1.81	1049	2.01	1105	2.19	1157	2.36
3000	663	0.53	714	0.77	768	1.02	825	1.26	884	1.50	943	1.73	1003	1.94	1060	2.14	1116	2.33	1168	2.49
3200	675	0.68	726	0.92	780	1.17	837	1.41	896	1.65	955	1.88	1014	2.09	1072	2.29	1128	2.48	1180	2.64
3400	688	0.84	739	1.09	793	1.34	850	1.58	909	1.82	968	2.04	1027	2.26	1085	2.46	1141	2.65	1193	2.81
3600	703	1.03	753	1.28	807	1.52	864	1.76	923	2.00	983	2.23	1042	2.44	1100	2.64	1155	2.83	-	-
3800	718	1.23	769	1.47	823	1.72	880	1.96	939	2.20	998	2.43	1058	2.64	1115	2.84	1171	3.03	-	-

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.
4. Field Supplied Drive.

KB102 (8.5 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Field Supplied Drive				Standard 2 HP & Drive								Hi Static 3 HP & Drive							
2200	654	0.32	706	0.53	755	0.73	803	0.92	849	1.10	893	1.27	937	1.44	979	1.62	1020	1.79	1061	1.96
2400	664	0.43	716	0.64	765	0.83	813	1.02	859	1.20	904	1.38	947	1.55	989	1.72	1030	1.89	1071	2.07
2600	675	0.53	726	0.74	776	0.94	824	1.12	870	1.30	914	1.48	957	1.65	1000	1.82	1041	1.99	1082	2.17
2800	686	0.63	738	0.84	787	1.04	835	1.23	881	1.41	925	1.58	969	1.76	1011	1.93	1052	2.10	1093	2.27
3000	699	0.75	750	0.96	800	1.16	847	1.34	893	1.52	938	1.70	981	1.87	1024	2.04	1065	2.21	1106	2.39
3200	713	0.88	764	1.09	814	1.28	861	1.47	907	1.65	952	1.83	995	2.00	1037	2.17	1079	2.34	1119	2.52
3400	728	1.02	779	1.23	829	1.43	877	1.61	923	1.79	967	1.97	1010	2.14	1053	2.31	1094	2.48	1135	2.66
3600	745	1.18	796	1.39	846	1.59	893	1.77	939	1.95	984	2.13	1027	2.30	1069	2.47	1111	2.64	1152	2.82
3800	763	1.36	815	1.57	864	1.76	912	1.95	958	2.13	1002	2.31	1046	2.48	1088	2.65	1129	2.82	1170	3.00
4000	783	1.55	835	1.76	884	1.96	932	2.15	978	2.33	1022	2.50	1066	2.67	1108	2.84	1149	3.02	1190	3.19
4200	805	1.77	856	1.98	906	2.17	953	2.36	999	2.54	1044	2.72	1087	2.89	1129	3.06	1171	3.23	1211	3.41
																	3 HP & Field Supplied Drive			

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

KB120 (10 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Field Supplied Drive				Standard 2 HP & Drive										Hi Static 3 HP & Drive					
2600	675	0.53	726	0.74	776	0.94	824	1.12	870	1.30	914	1.48	957	1.65	1000	1.82	1041	1.99	1082	2.17
2800	686	0.63	738	0.84	787	1.04	835	1.23	881	1.41	925	1.58	969	1.76	1011	1.93	1052	2.10	1093	2.27
3000	699	0.75	750	0.96	800	1.16	847	1.34	893	1.52	938	1.70	981	1.87	1024	2.04	1065	2.21	1106	2.39
3200	713	0.88	764	1.09	814	1.28	861	1.47	907	1.65	952	1.83	995	2.00	1037	2.17	1079	2.34	1119	2.52
3400	728	1.02	779	1.23	829	1.43	877	1.61	923	1.79	967	1.97	1010	2.14	1053	2.31	1094	2.48	1135	2.66
3600	745	1.18	796	1.39	846	1.59	893	1.77	939	1.95	984	2.13	1027	2.30	1069	2.47	1111	2.64	1152	2.82
3800	763	1.36	815	1.57	864	1.76	912	1.95	958	2.13	1002	2.31	1046	2.48	1088	2.65	1129	2.82	1170	3.00
4000	783	1.55	835	1.76	884	1.96	932	2.15	978	2.33	1022	2.50	1066	2.67	1108	2.84	1149	3.02	1190	3.19
4200	805	1.77	856	1.98	906	2.17	953	2.36	999	2.54	1044	2.72	1087	2.89	1129	3.06	1171	3.23	1211	3.41
4400	828	2.00	879	2.21	929	2.41	976	2.59	1022	2.77	1067	2.95	1110	3.12	1152	3.29	-	-	-	-
4600	852	2.25	904	2.46	953	2.66	1001	2.85	1047	3.03	1092	3.20	1135	3.37	-	-	-	-	-	-
4800	879	2.52	930	2.73	980	2.93	1027	3.12	1073	3.30	-	-	-	-	-	-	-	-	-	-
5000	906	2.81	958	3.02	1007	3.22	1055	3.41	-	-	-	-	-	-	-	-	-	-	-	-
																	3 HP & Field Supplied Drive			

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

KB150 (12.5 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Field Supplied Drive								Standard 3 HP & Drive											
3200	713	0.88	764	1.09	814	1.28	861	1.47	907	1.65	952	1.83	995	2.00	1037	2.17	1079	2.34	1119	2.52
3400	728	1.02	779	1.23	829	1.43	877	1.61	923	1.79	967	1.97	1010	2.14	1053	2.31	1094	2.48	1135	2.66
3600	745	1.18	796	1.39	846	1.59	893	1.77	939	1.95	984	2.13	1027	2.30	1069	2.47	1111	2.64	1152	2.82
3800	763	1.36	815	1.57	864	1.76	912	1.95	958	2.13	1002	2.31	1046	2.48	1088	2.65	1129	2.82	1170	3.00
4000	783	1.55	835	1.76	884	1.96	932	2.15	978	2.33	1022	2.50	1066	2.67	1108	2.84	1149	3.02	1190	3.19
4200	805	1.77	856	1.98	906	2.17	953	2.36	999	2.54	1044	2.72	1087	2.89	1129	3.06	1171	3.23	1211	3.41
4400	828	2.00	879	2.21	929	2.41	976	2.59	1022	2.77	1067	2.95	1110	3.12	1152	3.29	1194	3.46	1235	3.64
4600	852	2.25	904	2.46	953	2.66	1001	2.85	1047	3.03	1092	3.20	1135	3.37	1177	3.54	1219	3.72	1259	3.89
4800	879	2.52	930	2.73	980	2.93	1027	3.12	1073	3.30	1118	3.47	1161	3.65	1203	3.82	1245	3.99	1285	4.16
5000	906	2.81	958	3.02	1007	3.22	1055	3.41	1101	3.59	1146	3.76	1189	3.94	1231	4.11	1273	4.28	1313	4.45
5200	936	3.12	987	3.33	1037	3.53	1084	3.72	1130	3.90	1175	4.07	1218	4.24	1260	4.42	1302	4.59	1343	4.76
5400	966	3.45	1018	3.66	1067	3.86	1115	4.05	1161	4.23	1206	4.40	1249	4.57	1291	4.74	1333	4.91	1373	5.09
5600	999	3.80	1050	4.01	1100	4.20	1147	4.39	1193	4.57	1238	4.75	1281	4.92	1323	5.09	1365	5.26	1405	5.44
5800	1032	4.16	1084	4.37	1133	4.57	1181	4.75	1227	4.93	1271	5.11	1315	5.28	1357	5.45	1398	5.62	-	-
6000	1067	4.54	1119	4.75	1168	4.95	1216	5.13	1262	5.31	1306	5.49	1350	5.66	-	-	-	-	-	-
6200	1103	4.94	1155	5.15	1204	5.34	1252	5.53	1298	5.71	-	-	-	-	-	-	-	-	-	-
	Hi Static 5 HP & Drive								5 HP & Field Supplied Drive											

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

Table 18: Airflow performance - bottom duct application

KB078 (6.5 ton) bottom duct

Air flow (CFM)	Available external static pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Field supplied drive				Standard 2 HP and drive						High static 2 HP and drive									
1800	637	0.39	692	0.58	750	0.75	809	0.89	870	1.04	929	1.18	987	1.34	1043	1.53	1094	1.74	1141	2.00
2000	647	0.50	702	0.69	760	0.86	820	1.00	880	1.15	939	1.29	997	1.45	1053	1.64	1104	1.85	1151	2.11
2200	659	0.63	715	0.82	772	0.98	832	1.13	892	1.27	952	1.42	1010	1.58	1065	1.76	1117	1.98	1163	2.23
2400	675	0.76	730	0.95	788	1.12	847	1.26	907	1.41	967	1.55	1025	1.71	1081	1.90	1132	2.11	-	-
2600	694	0.91	749	1.10	807	1.27	866	1.41	926	1.56	986	1.70	1044	1.86	1100	2.05	1151	2.26	-	-
2800	717	1.08	772	1.26	830	1.43	889	1.58	949	1.72	1009	1.87	1067	2.03	1122	2.21	-	-	-	-
3000	744	1.25	799	1.44	857	1.60	916	1.75	976	1.89	1036	2.04	1094	2.20	-	-	-	-	-	-
3200	775	1.43	830	1.62	888	1.78	947	1.93	1008	2.07	1067	2.22	-	-	-	-	-	-	-	-
3400	810	1.62	865	1.81	923	1.98	983	2.12	1043	2.27	-	-	-	-	-	-	-	-	-	-

1. Blower performance includes gas heat exchangers and 2-in. filters. See the static resistance table for additional applications.
2. See the RPM selection table to determine the required motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

KB090 (7.5 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	FS[4]		Standard 1.5 HP & Drive										Hi Static 3 HP & Drive							
2000	644	0.11	698	0.38	755	0.62	814	0.85	874	1.06	933	1.26	990	1.46	1043	1.66	1090	1.87	1131	2.09
2200	666	0.26	720	0.53	777	0.77	836	1.00	896	1.21	956	1.41	1012	1.61	1065	1.81	1113	2.02	1153	2.24
2400	689	0.42	743	0.69	800	0.93	859	1.16	919	1.37	978	1.57	1035	1.77	1088	1.97	1135	2.18	1176	2.40
2600	712	0.60	766	0.87	823	1.11	882	1.34	942	1.55	1002	1.75	1058	1.95	1111	2.15	1159	2.36	1199	2.58
2800	736	0.80	790	1.06	847	1.31	906	1.53	967	1.74	1026	1.94	1082	2.14	1135	2.34	1183	2.55	1223	2.78
3000	761	1.00	815	1.27	872	1.52	931	1.74	991	1.95	1051	2.15	1107	2.35	1160	2.55	1208	2.76	1248	2.98
3200	787	1.22	840	1.49	898	1.74	957	1.96	1017	2.17	1076	2.37	1133	2.57	1186	2.77	1233	2.98	1274	3.20
3400	813	1.46	867	1.73	924	1.97	984	2.19	1044	2.40	1103	2.61	1160	2.80	1212	3.01	1260	3.21	-	-
3600	841	1.70	894	1.97	952	2.21	1011	2.44	1071	2.65	1130	2.85	1187	3.05	-	-	-	-	-	-
3800	869	1.96	923	2.22	980	2.47	1039	2.69	1099	2.90	1158	3.10	1215	3.30	-	-	-	-	-	-
															3 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.
4. Field Supplied Drive.

KB102 (8.5 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	FS[4]		Standard 2 HP & Drive								Hi Static 3 HP & Drive									
2200	685	0.59	739	0.74	791	0.88	841	1.01	889	1.14	936	1.27	981	1.39	1025	1.51	1069	1.63	1111	1.75
2400	702	0.70	756	0.85	808	0.99	858	1.12	906	1.25	953	1.37	999	1.49	1043	1.62	1086	1.74	1129	1.86
2600	722	0.83	776	0.97	828	1.11	878	1.25	926	1.37	973	1.50	1018	1.62	1063	1.74	1106	1.86	1149	1.99
2800	744	0.97	798	1.12	850	1.26	900	1.39	949	1.52	995	1.64	1041	1.76	1085	1.88	1128	2.00	1171	2.13
3000	769	1.13	823	1.28	875	1.42	925	1.55	974	1.68	1020	1.80	1066	1.92	1110	2.05	1153	2.17	1196	2.29
3200	797	1.32	851	1.46	903	1.60	953	1.74	1001	1.86	1048	1.99	1093	2.11	1138	2.23	1181	2.35	1224	2.48
3400	828	1.52	882	1.67	934	1.81	983	1.94	1032	2.07	1078	2.19	1124	2.32	1168	2.44	1212	2.56	1254	2.68
3600	861	1.75	915	1.90	967	2.04	1017	2.17	1065	2.30	1112	2.42	1157	2.54	1201	2.67	1245	2.79	1287	2.91
3800	897	2.00	951	2.15	1002	2.29	1052	2.42	1101	2.55	1147	2.67	1193	2.80	1237	2.92	1280	3.04	1323	3.16
4000	935	2.27	989	2.42	1041	2.56	1091	2.69	1139	2.82	1186	2.95	1231	3.07	1275	3.19	1319	3.31	1362	3.43
4200	976	2.57	1030	2.72	1082	2.86	1132	2.99	1180	3.12	1227	3.24	1272	3.36	-	-	-	-	-	-
															3 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.
4. Field Supplied Drive.

KB120 (10 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Field Supplied Drive		Standard 2 HP & Drive										Hi Static 3 HP & Drive							
2600	722	0.83	776	0.97	828	1.11	878	1.25	926	1.37	973	1.50	1018	1.62	1063	1.74	1106	1.86	1149	1.99
2800	744	0.97	798	1.12	850	1.26	900	1.39	949	1.52	995	1.64	1041	1.76	1085	1.88	1128	2.00	1171	2.13
3000	769	1.13	823	1.28	875	1.42	925	1.55	974	1.68	1020	1.80	1066	1.92	1110	2.05	1153	2.17	1196	2.29
3200	797	1.32	851	1.46	903	1.60	953	1.74	1001	1.86	1048	1.99	1093	2.11	1138	2.23	1181	2.35	1224	2.48
3400	828	1.52	882	1.67	934	1.81	983	1.94	1032	2.07	1078	2.19	1124	2.32	1168	2.44	1212	2.56	1254	2.68
3600	861	1.75	915	1.90	967	2.04	1017	2.17	1065	2.30	1112	2.42	1157	2.54	1201	2.67	1245	2.79	1287	2.91
3800	897	2.00	951	2.15	1002	2.29	1052	2.42	1101	2.55	1147	2.67	1193	2.80	1237	2.92	1280	3.04	1323	3.16
4000	935	2.27	989	2.42	1041	2.56	1091	2.69	1139	2.82	1186	2.95	1231	3.07	1275	3.19	1319	3.31	1362	3.43
4200	976	2.57	1030	2.72	1082	2.86	1132	2.99	1180	3.12	1227	3.24	1272	3.36	-	-	-	-	-	-
4400	1019	2.88	1073	3.03	1125	3.17	1175	3.30	1223	3.43	-	-	-	-	-	-	-	-	-	-
4600	1065	3.22	1119	3.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3 HP & Field Supplied Drive																			

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

KB150 (12.5 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Field Supplied Drive				Standard 3 HP & Drive										Hi Static 5 HP & Drive					
3200	797	1.32	851	1.46	903	1.60	953	1.74	1001	1.86	1048	1.99	1093	2.11	1138	2.23	1181	2.35	1224	2.48
3400	828	1.52	882	1.67	934	1.81	983	1.94	1032	2.07	1078	2.19	1124	2.32	1168	2.44	1212	2.56	1254	2.68
3600	861	1.75	915	1.90	967	2.04	1017	2.17	1065	2.30	1112	2.42	1157	2.54	1201	2.67	1245	2.79	1287	2.91
3800	897	2.00	951	2.15	1002	2.29	1052	2.42	1101	2.55	1147	2.67	1193	2.80	1237	2.92	1280	3.04	1323	3.16
4000	935	2.27	989	2.42	1041	2.56	1091	2.69	1139	2.82	1186	2.95	1231	3.07	1275	3.19	1319	3.31	1362	3.43
4200	976	2.57	1030	2.72	1082	2.86	1132	2.99	1180	3.12	1227	3.24	1272	3.36	1316	3.48	1360	3.60	1402	3.73
4400	1019	2.88	1073	3.03	1125	3.17	1175	3.30	1223	3.43	1270	3.55	1315	3.67	1360	3.80	1403	3.92	1446	4.04
4600	1065	3.22	1119	3.36	1171	3.50	1221	3.64	1269	3.76	1316	3.89	1361	4.01	1405	4.13	1449	4.25	1491	4.38
4800	1113	3.57	1167	3.72	1219	3.86	1269	3.99	1317	4.12	1364	4.24	1409	4.36	1453	4.48	1497	4.61	1540	4.73
5000	1163	3.94	1217	4.09	1269	4.23	1319	4.36	1367	4.49	1414	4.62	1459	4.74	1504	4.86	1547	4.98	1590	5.10
5200	1216	4.34	1270	4.48	1321	4.62	1371	4.76	1420	4.88	1466	5.01	1512	5.13	1556	5.25	1600	5.37	1642	5.50
5400	1270	4.75	1324	4.89	1376	5.03	1426	5.17	1474	5.29	1521	5.42	1566	5.54	1611	5.66	-	-	-	-
5600	1327	5.17	1381	5.32	1433	5.46	1483	5.59	1531	5.72	-	-	-	-	-	-	-	-	-	-
5800	1385	5.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5 HP & Field Supplied Drive																			

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

Table 19: RPM selection

Size (tons)	Model	Airflow option	HP	Max BHP	Motor sheave	Blower sheave	6 turns open	5 turns open	4 turns open	3 turns open	2 turns open	1 turn open	Fully closed
078 (6.5)	KB	Standard	1.5	1.725	1VL40	AK69	N/A	714	761	799	852	905	955
		High static	2	2.30	1VM50	AK69	N/A	952	1002	1043	1104	1140	1202
090 (7.5)	KB	Std.	1.5	1.73	1VL40	AK69	N/A	690	743	796	849	902	955
		H. Static	3	3.45	1VM50	AK69	N/A	955	1008	1062	1115	1168	1221
102 (8.5)	KB	Std.	2	2.30	1VM50	AK89	N/A	731	771	812	852	893	934
		H. Static	3	3.45	1VM50	AK74	N/A	887	936	986	1035	1084	1134
120 (10)	KB	Std.	2	2.30	1VM50	AK84	N/A	776	819	863	906	949	992
		H. Static	3	3.45	1VM50	AK74	N/A	887	936	986	1035	1084	1134
150 (12.5)	KB	Std.	3	3.45	1VM50	AK74	N/A	887	936	986	1035	1084	1134
		H. Static	5	5.75	1VP56	BK77	1052	1095	1136	1175	1216	1272	N/A

Table 20: Indoor blower specifications

Size (tons)	Model	Motor					Motor sheave			Blower sheave			Belt
		HP	RPM	Eff.	SF	Frame	Datum dia. (in.)	Bore (in.)	Model	Datum dia. (in.)	Bore (in.)	Model	
078 (6.5)	KB	1-1/2	1725	0.8	1.15	56	2.6 - 3.6	7/8	1VL40	7.0	1	AK74	A53
		2	1725	0.8	1.15	56	3.6 - 4.6	7/8	1VM50	7.0	1	AK74	A54
090 (7.5)	KB	1-1/2	1725	0.8	1.15	56	2.6 - 3.6	7/8	1VL40	6.5	1	AK69	A53
		3	1725	0.8	1.15	56	3.6 - 4.6	7/8	1VM50	6.5	1	AK69	A54
102 (8.5)	KB	2	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	8.5	1	AK89	A56
		3	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	7.0	1	AK74	A54
120 (10)	KB	2	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	8.0	1	AK84	A56
		3	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	7.0	1	AK74	A54
150 (12.5)	KB	3	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	7.0	1	AK74	A54
		5	1725	0.87	1.15	184T	4.3 - 5.3	1-1/8	1VP56	6.7	1	BK77	BX55

Table 21: Power exhaust specifications

Model	Voltage	Motor			Unit (per circuit)			Fuse size	CFM @ 0.1 ESP
		HP	RPM[1]	QTY	LRA	FLA	MCA		
2PE04704706	208/230-1-60	3/4	1075	1	24.9	5	6.3	10	4800
2PE04704746	460-1-60	3/4	1075	1	N/A	2.2	2.8	5	4800
2PE04704758	575-1-60	3/4	1050	1	N/A	1.5	1.9	4	4800

1. Motors are multi-tapped and factory wired for high speed.

Air balance

Start the supply air blower motor. Adjust the resistances in both the supply and the return air duct systems to balance the air distribution throughout the conditioned space. The job specifications may require that this balancing be done by someone other than the equipment installer.

⚠ CAUTION

You must adjust the belt drive blower systems to the specific static and CFM requirements for the application.

The belt drive blowers are not set at the factory for any specific static or CFM. You must adjust the blower speed and belt tension.

Verify proper sheave alignment. Tighten the blower pulley and motor sheave set screws after these adjustments. Re-check the set screws after 10-12 hours of run time.

Checking air quantity

Method one

1. Remove the dot plugs from the duct panel.
2. Insert eight-inches of 1/4 inch metal tubing into the airflow on both sides of the indoor coil.

Note: You must insert the tubes and hold them in a position perpendicular to the air flow so that velocity pressure does not affect the static pressure readings.

3. Use an inclined manometer or Magnehelic® to determine the pressure drop across a dry evaporator coil. The moisture on an evaporator coil can vary greatly, measuring the pressure drop across a wet coil under field conditions could be inaccurate. To ensure that the coil is dry, de-activate the compressors de-activated while the test is being run.

Note: De-energize the compressors before you take any test measurements to ensure that the evaporator coil is dry.

4. Use the pressure drop indicated by the manometer and the graph in Figure 28 to determine the unit CFM. In order to obtain an accurate measurement, verify that the air filters are clean.
5. To adjust measured CFM to required CFM, see *Supply air drive adjustment* on page 61.
6. After you note the readings, remove the tubes and replace the dot plugs.
7. Tighten the blower pulley and motor sheave set screws after any adjustments. Re-check the set screws after 10-12 hours run time.

⚠WARNING

Failure to properly adjust the total system air quantity can result in extensive blower damage.

Method two

1. Drill two 5/16 inch holes, one in the return air duct as close to the inlet of the unit as possible, and another in the supply air duct as close to the outlet of the unit as possible.
2. Using the hole drilled in step 1, insert eight inches of 1/4 inch metal tubing into the airflow of the return and supply air ducts of the unit.

Note: You must insert the tubes and hold them in a position perpendicular to the air flow so that velocity pressure does not affect the static pressure readings.

3. Use an inclined manometer or Magnehelic® to determine the pressure drop across the unit. This is the external static pressure (ESP). In order to obtain an accurate measurement, verify that the air filters are clean.
4. Determine the number of turns the variable motor sheave is open.
5. Select the correct blower performance table for the unit from Tables 17 and 18. Tables are presented for side and bottom duct configuration.
6. Determine the unit measured CFM from the blower performance table, external static pressure, and the number of turns the variable motor sheave is open.
7. To adjust measured CFM to required CFM, see *Supply air drive adjustment* on page 61.
8. After you note the reading, remove the tubes and seal the holes.
9. Tighten the blower pulley and motor sheave set screws after any adjustments. Re-check the set screws after 10-12 hours run time.

Note: You must repeat this procedure with the addition of field-installed accessories.

⚠WARNING

Failure to properly adjust the total system air quantity can result in extensive blower damage.

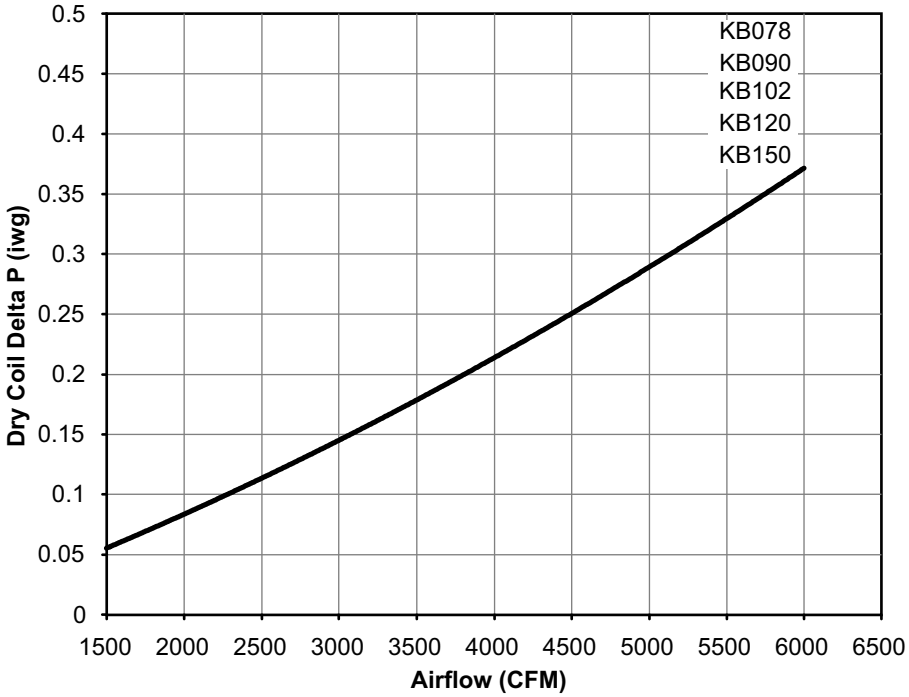


Figure 28: Dry coil delta P

Supply air drive adjustment

⚠ CAUTION

Before you make any blower speed changes, review the installation for any installation errors, leaks, or undesirable systems effects that can result in loss of airflow.

Even small changes in blower speed can result in substantial changes in static pressure and BHP. BHP and AMP draw of the blower motor increase by the cube of the blower speed. Static pressure increases by the square of the blower speed. Only qualified personnel can make blower speed changes, strictly adhering to the fan laws.

At unit start-up, the measured CFM may be higher or lower than the required CFM. To achieve the required CFM, you may need to adjust the speed of the drive by changing the datum diameter (DD) of the variable pitch motor sheave as described below:

$$\left(\frac{1{,}700\ \text{CFM}}{1{,}400\ \text{CFM}}\right) \bullet 1.88\ \text{in.} = 2.28\ \text{in.}$$

Use the following tables and the DD calculated according to the above equation to adjust the motor variable pitch sheave.

Example

A 4 ton unit was selected to deliver 1,700 CFM with a 1.5 HP motor, but the unit is delivering 1,400 CFM. The variable pitch motor sheave is set at 3 turns open.

Use the equation to determine the required DD for the new motor sheave.

$$\left(\frac{\text{Required CFM}}{\text{Measured CFM}}\right) \bullet \text{Existing DD} = \text{New DD}$$

Use Table 22 to locate the DD nearest to 2.28 in. Close the sheave to 2 turn open.

New BHP

= (Speed increase)^3 • BHP at 1,400 CFM

= (Speed increase)^3 • Original BHP

= New BHP

New motor Amps

= (Speed increase)^3 • Amps at 1,400 CFM

= (Speed increase)^3 • Original Amps

= New Amps

Table 22: Motor sheave datum diameters

1VL34x7/8 (1-1/2 HP motor)		1VL44x7/8 (1-1/2 HP motor)		1VL40x7/8 (1-1/2 HP motor)		1VM50x7/8 (2 HP motor)	
Turns open	Datum diameter	Turns open	Datum diameter	Turns open	Datum diameter	Turns open	Datum diameter
0	2.9	0	4.0	0	3.6	0	4.4
1/2	2.8	1/2	3.9	1/2	3.5	1/2	4.3
1	2.7	1	3.8	1	3.4	1	4.2
1-1/2	2.6	1-1/2	3.7	1-1/2	3.3	1-1/2	4.1
2	2.3	2	3.6	2	3.2	2	4.0
2-1/2	2.4	2-1/2	3.5	2-1/2	3.1	2-1/2	3.9
3	2.3	3	3.4	3	3.0	3	3.8
3-1/2	2.2	3-1/2	3.3	3-1/2	2.9	3-1/2	3.7
4	2.1	4	3.2	4	2.8	4	3.6
4-1/2	2.0	4-1/2	3.1	4-1/2	2.7	4-1/2	3.5
5	1.9	5	3.0	5	2.6	5	3.4

⚠ CAUTION

You must adjust the belt drive blower systems to the specific static and CFM requirements for the application.

The belt drive blowers are not set at the factory for any specific static or CFM. You must adjust the blower speed and belt tension.

Verify proper sheave alignment. Tighten the blower pulley and motor sheave set screws after these adjustments. Re-check the set screws after 10-12 hours of run time.

Additional static resistance - KB078-150

Size (ton)	Model	CFM	Cooling Only[1]	Reheat coil	Economizer[2,3]	MERV 13 filter[2]	Electric Heat kW[2]				
							9	18	24	36	54
078 (6.5) 090 (7.5) 102 (8.5) 120 (10) 150 (12.5)	KB	1900	0.06	0.07	0.02	0.08	0.05	0.06	0.07	0.08	0.10
		2100	0.07	0.08	0.02	0.09	0.06	0.07	0.08	0.09	0.11
		2300	0.08	0.09	0.04	0.10	0.07	0.08	0.09	0.10	0.13
		2500	0.09	0.10	0.11	0.11	0.08	0.09	0.10	0.11	0.14
		2700	0.11	0.11	0.18	0.12	0.09	0.10	0.12	0.13	0.16
		2900	0.12	0.12	0.25	0.13	0.10	0.11	0.13	0.14	0.18
		3100	0.14	0.13	0.31	0.15	0.12	0.13	0.15	0.16	0.20
		3300	0.16	0.14	0.37	0.16	0.13	0.14	0.17	0.18	0.22
		3500	0.18	0.15	0.43	0.17	0.15	0.16	0.19	0.20	0.24
		3700	0.20	0.17	0.49	0.18	0.17	0.18	0.21	0.22	0.26
		3900	0.23	0.18	0.54	0.19	0.19	0.20	0.23	0.24	0.28
		4100	0.25	0.19	0.58	0.21	0.21	0.22	0.25	0.26	0.31
		4300	0.28	0.20	0.65	0.22	0.23	0.24	0.28	0.29	0.34
		4500	0.30	0.21	0.69	0.24	0.25	0.26	0.30	0.31	0.37
		4700	0.33	0.22	0.74	0.25	0.28	0.29	0.33	0.34	0.40
		4900	0.36	0.24	0.78	0.27	0.30	0.31	0.35	0.37	0.43
		5100	0.39	0.25	0.82	0.28	0.33	0.34	0.38	0.40	0.46
		5300	0.42	0.26	0.86	0.30	0.35	0.37	0.41	0.43	0.49
		5500	0.45	0.27	0.89	0.31	0.38	0.40	0.44	0.46	0.53
		5700	0.48	0.28	0.93	0.33	0.41	0.43	0.47	0.49	0.56
		5900	0.52	0.30	0.96	0.35	0.44	0.46	0.50	0.53	0.59
		6100	0.56	0.31	0.98	0.36	0.47	0.49	0.53	0.56	0.62
		6300	0.60	0.32	1.01	0.38	0.50	0.53	0.56	0.59	0.65

1. Add these values to the available static resistance in the respective Blower Performance Tables.
2. Deduct these values from the available external static pressure shown in the respective Blower Performance Tables.\
3. The pressure drop through the economizer is greater for 100% outdoor air than for 100% return air. If the resistance of the return air duct is less than 0.25 IWG, the unit will deliver less CFM during full economizer operation.

Operation

Cooling operation 2 fan cooling operation

- A Y1 call for the first stage of cooling is passed to the unit control board (UCB). The UCB then determines whether the requested operation is available and if so, which components to energize. With a Y1 call for first stage cooling, the UCB determines if a first stage cooling output is valid as long as all safeties and time-delays allow a C1 output for cooling. The C1 relay on the UCB closes and sends 24 volts to the M1 relay. This starts compressor #1 on low and energizes fan #1 and cond. fan #2. The UCB energizes the VFD-equipped blower at the first stage speed as set in the Smart Equipment control.
- If a Y2 call is present, it is passed to the UCB. The UCB then determines whether the requested operation is available and if so, which components to energize. With a Y2 call for second stage cooling, the UCB determines if a second stage cooling output is valid as long as all safeties and time-delays allow a C2 output for cooling. The C2 relay on the UCB closes and sends 24 volts to the M2 relay. This energizes compressor #2. The UCB energizes the VFD-equipped blower at the second stage speed as set in the Smart Equipment control.
- If a Y3 call is present, it is passed to the UCB. The UCB then determines whether the requested operation is available and if so, which components to energize. With a Y3 call for third stage cooling, the UCB determines if a third stage cooling output is valid as long as all safeties and time-delays allow a C3 output for cooling. The C3 relay on the 4 stage board closes and sends 24 volts to the terminal block which energizes compressors #1 & #2 on high speed and also cond. fan #1, cond. fan #2, M2 relay. The UCB energizes the VFD-equipped blower at the third stage speed as set in the Smart Equipment control.

Cooling operation 4 fan cooling operation

- A Y1 call for the first stage of cooling is passed to the unit control board (UCB). The UCB then determines whether the requested operation is available and if so, which components to energize. With a Y1 call for first stage cooling, the UCB determines if a first stage cooling output is valid as long as all safeties and time-delays allow a C1 output for cooling. The C1 relay on the UCB closes and sends 24 volts to the M1 relay. This starts compressor #1 on low and energizes cond. fan #1 and cond. fan #2. The UCB energizes the VFD-equipped blower at the first stage speed as set in the Smart Equipment control.
- If a Y2 call is present, it is passed to the UCB. The UCB then determines whether the requested operation is available and if so, which components to energize. With a Y2 call for second stage cooling, the UCB determines if a second stage cooling output is valid as long as all safeties and time-delays allow a C2 output for cooling. The C2 relay on the UCB closes and sends 24 volts to the M2 relay. This starts compressor #2 and also energizes cond. fan #3 and cond. fan #4 on. The UCB energizes the VFD-equipped blower at the second stage speed as set in the Smart Equipment control.
- If a Y3 call is present, it is passed to the UCB. The UCB then determines whether the requested operation is available and if so, which components to energize. With a Y3 call for third stage cooling, the UCB determines if a third stage cooling output is valid as long as all safeties and time-delays allow a C3 output for cooling. The C3 relay on the 4 stage board closes and sends 24 volts to the M2 relay which energizes compressors #1 & #2 on high speed and also cond. fan #1, cond. fan #2, cond. fan #3, and cond. fan #4. Fans are not staged. The UCB energizes the VFD-equipped blower at the third stage speed as set in the Smart Equipment control.

Free cooling operation with economizer

- With a demand for first stage cooling either from a thermostat or space sensor and the outside air is suitable for free cooling, the dampers are modulated to maintain supply air temperature to within +/- 1 degree of the free cooling SAT upper setpoint. If the output to the economizer actuator is at 10 VDC and the supply air temperature cannot be controlled to within 5 degrees of the free cooling SAT upper setpoint, one compressor is energized. The economizer is then modulated to maintain supply air temperature to within +/- 1 degree of the free cooling SAT upper setpoint.
- If a demand for second stage cooling occurs and the economizer is already modulating to maintain the supply air temperature to the cooling SAT upper setpoint, the setpoint is changed to the free cooling SAT lower setpoint. Any compressors that are energized remain energized and the economizer dampers are modulated to maintain supply air temperature to within +/- 1 degree of the cooling SAT lower setpoint. If the output to the economizer actuator is at 10 VDC and the supply air temperature cannot be controlled to within 5 degrees of the cooling SAT lower setpoint, compressor stage 2 is energized. The economizer is then modulated to maintain supply air temperature to within +/- 1 degree of the cooling SAT lower setpoint.
- If the output to the economizer actuator is at minimum position and the supply air temperature drops more than 5 degrees below the current economizer SAT setpoint, the highest stage compressor is de-energized as long as the minimum run time has elapsed.

Economizer with single enthalpy sensor

When the room thermostat calls for cooling, the low voltage control circuit from R to G and Y1 is completed. The UCB energizes the blower motor (if the fan switch on the room thermostat is set to AUTO position) and drives the economizer dampers from fully closed to their minimum position. If the enthalpy of the outdoor air is below the setpoint of the enthalpy controller (previously determined), Y1 energizes the economizer. The dampers modulate to maintain a constant supply air temperature as monitored by the discharge air sensor. If the outdoor air enthalpy is above the setpoint, Y1 energizes the compressor and condenser fan motor only.

When the thermostat has been satisfied, it de-energizes Y1. If the compressor has satisfied its minimum run time, the compressor and condenser fan are de-energized. Otherwise, the unit operates the cooling system until the minimum run times for the compressor are completed. After the compressor de-energizes, the blower is stopped following the elapse of the fan off delay for cooling, and the economizer damper goes to the closed position. If the unit continues fan operation, the economizer damper goes to the min. position.

Economizer with dual enthalpy sensors

The operation with the dual enthalpy sensors is identical to the single sensor except that a second enthalpy sensor is mounted in the return air. This return air sensor allows the economizer to choose between outdoor air and return air, whichever has the lowest enthalpy value, to provide maximum operating efficiency.

Economizer with power exhaust

A unit equipped with an economizer (single or dual enthalpy) and a power exhaust operates as specified above with one addition. The power exhaust motor is energized 45 seconds after the actuator position exceeds the exhaust fan setpoint on the economizer control. The R to G connection provides minimum position but does not provide power exhaust operation.

Motorized outdoor air dampers

This system operation is the same as the units with no outdoor air options with one exception. When the R to G circuit is complete, the motorized damper drives open to a desired minimum damper position set by AUX selection dial (Mode selection dial shall be set to 4).

Actuator settings:

1. Set the Mode dial to 4 for minimum position
2. Set the AUX selection dial to 10 for minimum damper position

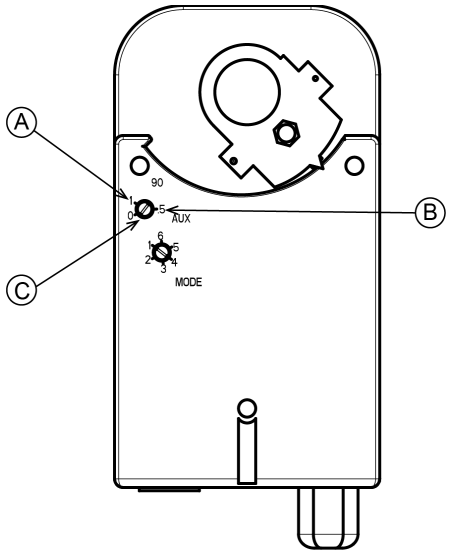


Figure 29: Actuator settings

Callout	Description
A	AUX dial set to 100%
B	AUX dial set to 50%
C	AUX dial set to 10%

Secure the bolt to the damper shaft. Tighten to a torque of 240 lb-in.

Refrigerant Detection System (RDS) (optional)

The A2L sensor is used to detect R-454B refrigerant. When R-454B refrigerant leak is detected, it is considered an alarm condition. When an A2L alarm is detected, the unit will shut down any cooling and heating outputs and the supply fan will turn on (if not already on) at 50%. Heating and cooling will remain off and the supply fan will remain on as long as the A2L sensor is in the alarm condition, plus an additional 5 minutes after the sensor returns to the normal condition. If the alarm happens three times within two hours, the unit will lockout and will require a reset (ResetLO) to go back to normal operation.

Cooling Operation Errors

Each cooling system is monitored for operation outside of the intended parameters. Errors are handled as described below. All system errors override minimum run times for compressors.

Note: The following components are needed to access the control points in the Smart Equipment control.

1. Local LCD on Unit Control Board.
2. GoTemp Pro mobile app
3. Mobile Access Portal (MAP) Gateway (Portable).
   - Source 1 P/N S1-JC-MAP1810-OP
   - MAP Gateway Quick Start Guide P/N 24-10737-16
   - MAP Gateway Instruction P/N 24-10737-8

High-pressure limit switch

During cooling operation, if a high-pressure limit switch opens, the UCB de-energizes the compressor, initiates the ASCD (anti-short cycle delay), and stops the condenser fans. If the call for cooling is still present at the conclusion of the ASCD, the UCB re-energizes the halted compressor.

If a high-pressure switch opens three times within two hours of operation, the UCB locks out the compressor.

Low-pressure limit switch

The low-pressure limit switch is not monitored during the initial 30 seconds of a cooling system's operation. For the following 30 seconds, the UCB monitors the low-pressure switch to ensure that it closes. If the low-pressure switch fails to close after the 30-second monitoring phase, the UCB de-energizes the compressor, initiates the ASCD, and stops the condenser fans.

When the low-pressure switch is proven (closed during the 30-second monitor period described above), the UCB monitors the low-pressure limit switch for any openings. If the low-pressure switch opens for greater than 5 seconds, the UCB de-energizes the compressor, initiates the ASCD, and stops the condenser fans.

If the call for cooling is still present at the conclusion of the ASCD, the UCB re-energizes the halted compressor.

If a low-pressure switch opens three times within one hour of operation, the UCB locks out the compressor.

Evaporator low limit

The evaporator low limit sensor (EC1) is located on the suction line at the evaporator coil. During cooling operation, if the evaporator low limit sensor detects a temperature below 26°F (default), the UCB de-energizes the compressor, initiates the ASCD, and stops the condenser fans. If the call for cooling is still present at the conclusion of the ASCD, the UCB re-energizes the halted compressor.

If the UCB detects the evaporator low limit sensor **(EC1)** falling below 26°F (default) three times within two hours of operation, the UCB locks out the compressor.

Low ambient cooling

To determine when to operate in low ambient mode, the UCB has an outdoor air temperature sensor (OAT) with a low ambient setpoint at 45ºF (default). When the OAT sensor senses a temperature below the low ambient setpoint and the thermostat is calling for cooling, the UCB operates in the low ambient mode.

Low ambient mode operates the compressors in this manner: 10 minutes on, 5 minutes off. The indoor blower is operated throughout the cycle. The 5-minute off period is necessary to defrost the indoor coil.

Low ambient mode always begins with compressor operation. Compressor minimum run time may extend the minutes of compressor operation. The off cycle begins immediately following the elapse of the minimum run time.

When operating in low ambient mode, an evaporator low limit sensor (EC1) temperature below 26ºF de-energizes the compressor. If the call for cooling is still present at the end of the ASCD and the evaporator temperature sensor (EC1) temperature is above 26°F, the unit resumes operation.

Safety controls

The unit control board monitors the following inputs for each cooling system:

1. An evaporator low limit sensor (EC1) to protect against low evaporator temperatures due to a low airflow or a low return air temperature, set at 26°F. The evaporator low limit sensor is located on the suction line at the evaporator coil.
2. A high-pressure switch to protect against excessive discharge pressures due to a blocked condenser coil or a condenser motor failure. The switch opens at 625 ± 25 psig.
3. A low-pressure switch to protect against loss of refrigerant charge. the switch opens at opens at 50 ± 5 psig.

The above pressure switches are hard-soldered to the unit. The refrigeration systems are independently monitored and controlled. On any fault, only the associated system is affected by any safety or preventive action.

The UCB monitors the temperature limit switch of electric heat units and the temperature limit switch and the gas valve of gas furnace units.

Compressor protection

In addition to the external pressure switches, the compressors also have inherent (internal) protection. If there is an abnormal temperature rise in a compressor, the protector opens to shut down the compressor. The UCB incorporates features to minimize compressor wear and damage. An anti-short cycle delay (ASCD) is used 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.

The ASCD is initiated on unit start-up and on any compressor reset or lock-out.

Reheat mode sequence of operation

The MagnaDRY reheat mode of operation is designed to remove latent heat (humidity) from a space when there are low load conditions and the air conditioning unit is not used to cool the space. The general sequence of operation of the patented MagnaDRY reheat is outlined in the following paragraphs.

The user can select three different modes of operation from the unit control board (UCB) within the Smart Equipment controller menu. The available modes are normal, alternate, and aux. The following sections describe each mode.

Normal occupied operation mode

If the return humidity is greater than or equal to the hot gas reheat humidity setpoint, and there is no demand for cooling, the C1 output energizes and the AUX-HGR output energizes.

If there is a demand for one stage of cooling and the return humidity is greater than or equal to the hot gas reheat (HGR) humidity setpoint, the C1 output energizes but the AUX-HGR output de-energizes.

Any additional cooling demands energize compressor outputs, but do not change the status of the AUX-HGR output.

When the return humidity falls to 3% or more below the setpoint, the C1 and AUX-HGR outputs de-energize.

Note: If HGR enabled for unoccupied operation is enabled, during unoccupied mode the control works the same as described above, except it uses the HGR unoccupied humidity setpoint instead.

Normal cooling mode

When there is a call for first stage cooling, with or without a call for dehumidification, the UCB de-energizes the HGR relay de-energizing SOL 2, SOL 3 (HGRH) and energizes SOL 1, engaging cooling circuit #1 resulting in circuit #1 cooling mode operation. The unit is now in first stage cooling without HGRH. When there is a call for second stage cooling, the UCB engages both circuit #1 and circuit #2 in cooling mode.

The indoor blower operation is always initiated upon a call for first stage cooling, second stage cooling or dehumidification (HGRH). The unit does not operate in the reheat mode if there is any call for heating.

On units with economizers, the unit does not operate in the reheat mode if there is a call for cooling and the economizer is operating as first stage of cooling. All safety devices function as previously described.

Normal reheat mode

When the UCB detects a need for dehumidification through the field installed return/space humidity sensor and there is not a call for cooling, the UCB energizes solenoids SOL 3 (HGRH), SOL 2 and the reheat relay (RHR), which de-energizes SOL 1. The unit then operates with refrigerant flow in the evaporator reheat coil and condenser coil circuit # 1. See Figure 31.

Alternate mode

If the return humidity is greater than or equal to the hot gas reheat humidity setpoint, and there is no demand for cooling, C1 and AUX-HGR outputs energize, and C2 energizes.

If there is a demand for one stage of cooling and the return humidity is greater than or equal to the hot gas reheat humidity setpoint, C1 and AUX-HGR outputs energize, and C2 energizes.

If there is a demand for both first and second cooling stages and the return humidity is greater than or equal to the hot gas reheat humidity setpoint, C1 and C2 outputs energize and AUX-HGR de-energizes.

Any additional cooling demands energize compressor outputs, but do not change the status of the AUX-HGR output.

When the UCB detects a need for dehumidification through the field installed return/space humidity sensor and there is not a call for cooling, the UCB energizes SOL 3, SOL 2, and de-energizes SOL 1. In the KT150, SOL 4 is only energized when the discharge pressure in circuit #1 rises above 400 psig and de-energizes SOL 4 after the discharge pressure falls below 320 psig. The unit then operates with circuit #1 in reheat mode and circuit #2 in cooling mode.

When there is a call for first stage cooling while there is still a call for dehumidification, no operational change is made. The call for cooling is ignored and the unit continues to operate with circuit #1 in reheat mode and circuit #2 in cooling mode.

When there is a call for second stage cooling, the UCB de-energizes the HGR, which de-energizes SOL 3 and SOL 2, and energizes SOL 1. Both circuits now operate in the cooling mode.

The indoor blower operation is always initiated on a call for first stage cooling, second stage cooling or dehumidification (HGRH). The unit does not operate in the reheat mode if there is any call for heating or two stage cooling.

On units with economizers, the unit does not operate in the reheat mode if there is a call for cooling and the economizer is operating as first stage of cooling. All safety devices function as previously described.

Table 23: 3 stage dehumidification sequence in normal and alternate mode

Request	Normal mode				Alternate mode			
	HGR	C1	C2	C3	HGR	C1	C2	C3
Dehumidification	On	On	Off	Off	On	On	On	Off
One stage of cooling (Y1)	Off	On	Off	Off	On	On	On	Off
Two stages of cooling (Y2)	Off	On	On	Off	Off	On	On	Off
Three stages of cooling (Y3)	Off	On	On	On	Off	On	On	On

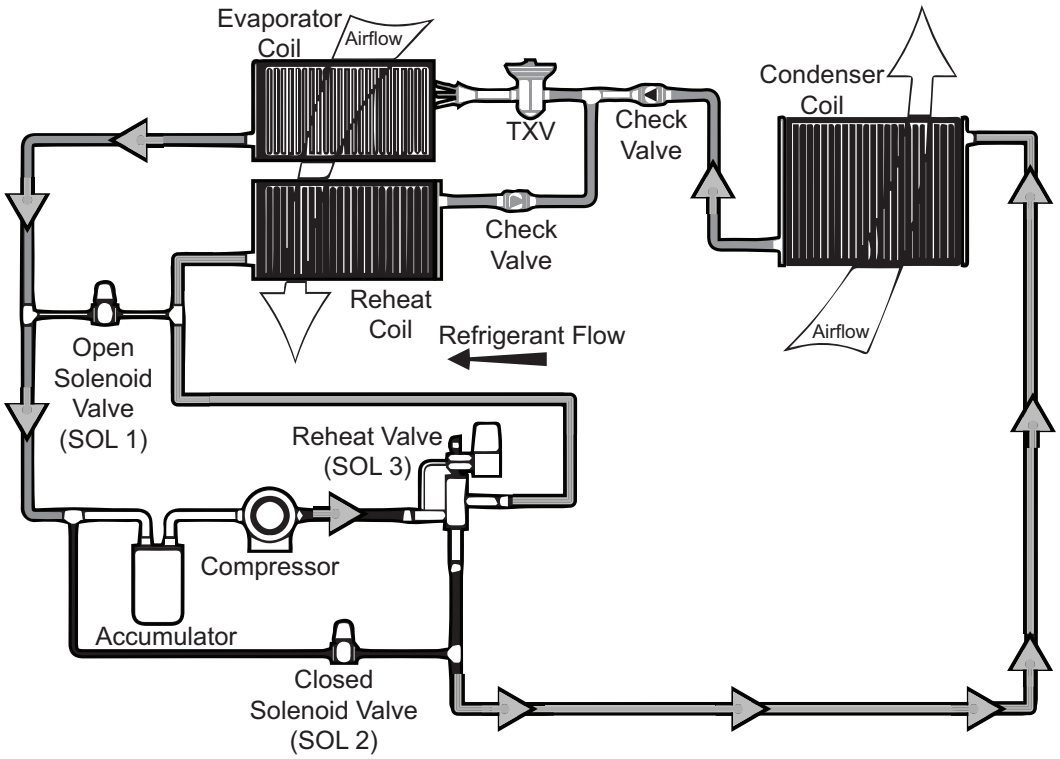


Figure 30: Cooling operation piping schematic - circuit no. 1

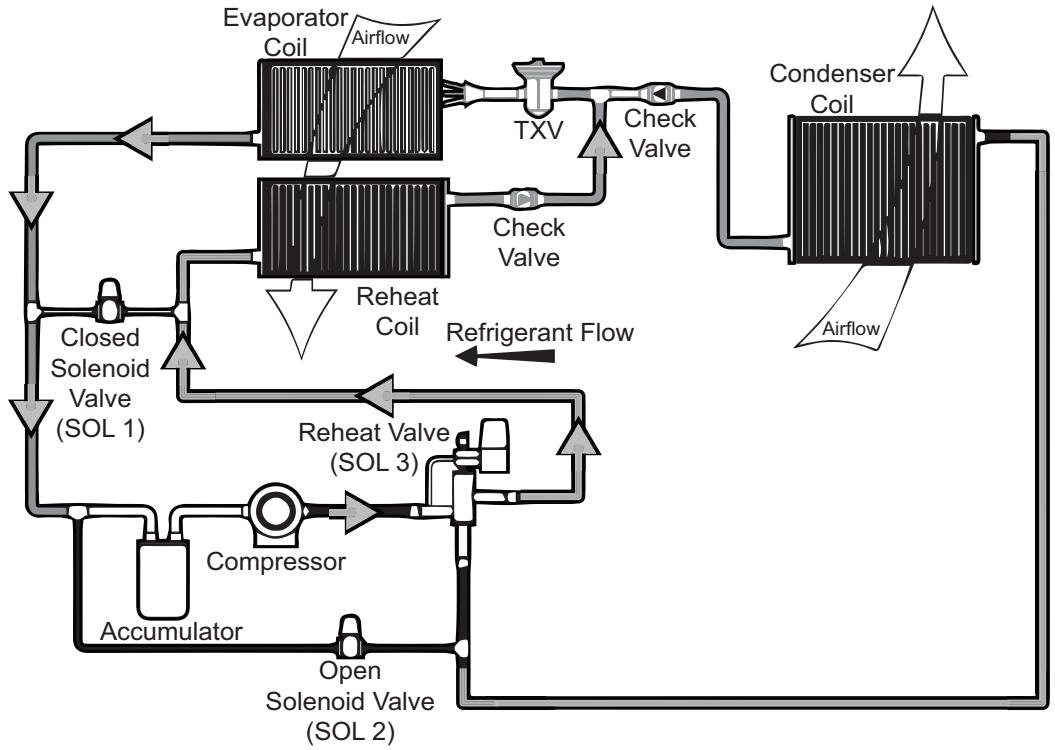


Figure 31: Reheat operation piping schematic - circuit no. 1

Optional aux mode

The aux mode available with hot gas reheat units introduces an operating mode that considers the dry bulb temperature in the space when choosing hot gas reheat staging. The aux mode reduces the amount of over cooling while maintaining humidity control in the space. The aux mode is only applicable when the unit is set up in the alternate reheat mode.

If there is a call for dehumidification and no call for cooling, the unit automatically reverts back to the normal hot gas reheat mode only allowing refrigerant stage one to run in reheat mode and refrigerant stage two remains off.

If there is a call for dehumidification and a call for cooling, the unit remains in the alternate hot gas reheat mode allowing refrigerant stage one to run in hot gas reheat or dehumidification mode and refrigerant stage two runs in cooling.

Electric heating sequence of operations

The following sequence describes the operation of the electric heat section.

Two-stage heating:

a. When there is a call for first stage heat by the thermostat, the heater relay (RA) is energized. After completing the specified fan on delay for heating, the UCB energizes the blower motor. If the second stage of heat is required, heater relay (RB) is energized. After completing the specified fan on delay for heating, the UCB energizes the blower motor.

b The thermostat cycles the electric heat to satisfy the heating requirements of the conditioned space.

Electric heat operation errors

Temperature limit

If the UCB senses zero volts from the high temperature limit, the indoor blower motor is immediately energized.

This limit is monitored regardless of unit operation status, that is, the limit is monitored at all times.

If the temperature limit opens three times within one hour, it locks on the indoor blower.

Safety controls

The UCB monitors the temperature limit switch of electric heat units.

The control circuit includes the following safety controls:

Limit switch

The limit switch (LS) is located inside the heater compartment and is set to open at the temperature indicated in Table 26, *Electric heat limit setting,* on page 64. It resets automatically. The limit switch operates when a high temperature condition caused by inadequate supply air flow occurs. This shuts down the heater and energizes the blower.

Table 24: Electric Heat Limit Setting

UNIT (TONS)	VOLTAGE	HEATER kW	LIMIT SWITCH OPENS °F
KB078, 090 (6.5, 7.5)	208/230	9	150
		18	150
		24	150
		34	150
KB102, 120, 150 (8.5,10, 12.5)		18	150
		24	150
		34	150
		54	130
KB078, 090 (6.5, 7.5)	480	9	150
		18	150
		24	150
		34	150
KB102, 120, 150 (8.5, 10, 12.5)		18	150
		24	150
		34	150
		54	130
KB078, 090 (6.5, 7.5)	600	9	150
		18	150
		24	150
		34	150
KB102, 120, 150 (8.5, 10, 12.5)		18	150
		24	150
		34	150
		54	130

Reset

Reset removes the call for heating by lowering the thermostat setting lower than the conditioned space temperature.

Electric heat anticipator setpoints

The anticipator setpoint must be correct. Too high of a setting results in longer heat cycles and a greater temperature swing in the conditioned space. Reducing the value below the correct setpoint gives shorter ON cycles and may result in the lowering of the temperature within the conditioned space. See Table 25 for the required electric heat anticipator setting.

Table 25: Electric heat anticipator setpoints

Setting, Amps	
W1	W2
0.13	0.1

Gas heating sequence of operations

When the thermostat calls for the first stage of heating, the low-voltage control circuit from R to W1 is completed. A call for heat passes through the UCB to the ignition control board (ICB). The UCB monitors the W1 call and acts on any call for heat by monitoring the gas valve (GV). When voltage is sensed at the GV, the UCB initiates the fan on delay for heating, energizing the indoor blower the specified delay has elapsed.

When the thermostat is satisfied, heating calls are ceased. The GV is immediately closed. The blower is de-energized after the fan off delay for heating has elapsed. The draft motor performs a 30-second post purge.

Ignition control board

First stage of heating

When the ICB receives a call for first stage of heating, “W1,” the draft motor is energized. Once the draft motor has been proven, a 30-second purge is initiated. At the end of the purge, the GV is opened and the spark igniter is energized for 10 seconds. The ICB then checks for the presence of flame. If flame is detected, the ICB enters a flame stabilization period. If flame is not detected, the GV closes and a retry operation begins.

During the flame stabilization period, a loss of the flame for 2 seconds causes the GV to close and the retry operation to begin. After the flame stabilization period, a loss of flame for 3/4 second causes the GV to close and the retry operation to begin.

At the conclusion of the flame stabilization period, the ICB operates the gas heat in high fire for an additional 60 seconds, for a total for 120 seconds of high fire operation. After this 60 seconds, the ICB then uses the call for the second stage of heat to control second stage operation of the GV.

When W1 is satisfied, both valves are closed.

Second stage of heating

When the ICB receives a call for the second stage of heating, W2, the ICB conducts a complete first stage ignition sequence. If this sequence is satisfied, the second main valve of the GV is opened.

When W2 is satisfied, the second main valve is closed.

Retry operation

When a flame is lost or is not detected during an attempt to achieve ignition, a retry operation occurs. A 30-second purge is performed between ignition attempts.

If the unit fails after three ignition attempts, the furnace is locked out for one hour. The furnace is monitored during this one-hour period for unsafe conditions.

Recycle operation

When a flame is lost after the flame stabilization period, a recycle operation occurs. If the unit fails after five recycle attempts, the furnace is locked out for one hour.

Gas heating operation errors

Lockout

A one-hour lockout occurs following three retries or five recycles. During the one-hour lockout, flame detection, limit conditions, and main valves are tested. Any improper results will cause the appropriate action to occur. Recycling the low voltage power cancels the lockout.

Temperature limit

If the UCB senses zero volts from the high temperature limit, the indoor blower motor is immediately energized. When the UCB again senses 24 volts from the temperature limit, the draft motor performs a 15-second post-purge and the indoor blower is de-energized following the elapse of the fan off delay for heating.

This limit is monitored regardless of unit operation status, that is, this limit is monitored at all times.

If the temperature limit opens three times within one hour, it locks on the indoor blower motor.

Flame sense

Flame sensing occurs at all times. If W1 is not present and a flame is sensed for 2 seconds, the draft motor is energized and the GV is kept off. The ICB halts any operation until a flame is not detected. Once the flame detection is lost, the ICB performs a post-purge. Normal operation is allowed concurrently with the purge. That is, this purge can be considered the purge associated with a call for W1.

If W1 is present, a flame is sensed but the GV is not energized and the draft motor is energized until the flame detection is lost. Normal operation is now allowed.

The flame detection circuitry continually tests itself. If the ICB finds the flame detection circuitry to be faulty, the ICB does not permit an ignition sequence and the draft motor is energized. If this failure occurs during an ignition cycle, the failure is counted as a recycle.

Gas valve

The UCB and ICB continuously monitor the GV.

If the ICB senses voltage at the GV when not requested, the ICB energizes the draft motor. The ICB does not operate the furnace until voltage is no longer sensed at the GV. The draft motor is stopped when voltage is not sensed at the GV.

Any time the UCB senses voltage at the GV without a call for heat for a continuous five-minute period, the UCB locks on the indoor blower. When voltage is no longer sensed at the GV, the UCB de-energizes the indoor blower following the elapse of the fan off delay for heating.

If voltage is sensed at the GV for at least 15 seconds during the fan on delay for heating and GV voltage or W1 is lost, the indoor blower is forced on for the length of the fan off delay for heating.

During a call for heat, if the UCB does not sense voltage at the GV for a continuous five-minute period, the UCB initiates a error message. The indoor blower motor is not locked on while there is no GV voltage.

Safety controls

The ICB and UCB monitors the temperature limit switch of gas heat units.

The control circuit includes the following safety controls:

Limit switch

This control is located inside the gas heat compartment and is set to open at its temperature setting. It resets automatically. The limit switch operates when a high temperature condition,

caused by inadequate supply air flow occurs. This shuts down the heater and energizes the blower.

If LS is open for more than 3 minutes and 20 seconds continuously during a call for heat, it is assumed that the indoor blower has failed and the ICB will enter a hard lockout. The control will remain locked out until power is reset.

Auxiliary limit switch

The auxiliary limit switch is wired in series with the limit switch. As such, the UCB cannot distinguish the auxiliary limit and the gas heat limit switch operation except the auxiliary is manual reset. Consequently, the control will respond in the same manner as outlined above under Limit Switch.

The ICB monitors the pressure and roll out switches of gas heat units.

The control circuit includes the following safety controls:

Pressure switch

When the draft motor has reached full speed and closes the pressure switch (PS) during a normal ignition sequence, if the pressure switch opens for 2 seconds, the GV is de-energized, the ignition cycle is aborted, and the ICB flashes the appropriate code. For information on the ignition control flash codes, see Table 29 on page 74. The draft motor is energized until the pressure switch closes or W1 is lost.

Roll-out switch

The roll-out switch (ROS) is wired in series with the pressure switch. As such, the ICB cannot distinguish the roll-out switch operation from that of the pressure switch.

Consequently, the control only responds in the same manner as outlined in *Pressure switch* on page 70. An open roll-out inhibits the gas valve from actuating.

Internal microprocessor failure

If the ICB detects an internal failure, it ceases all outputs, ignores inputs, and displays the proper flash code for control replacement. The ICB remains in this condition until it is replaced.

Flash codes

The ICB initiates a flash code associated with errors within the system, Table 29 on page 74.

Resets

Resets remove the call for heating by lowering the thermostat setting lower than the conditioned space temperature. This resets any flash codes.

Gas heat anticipator setpoints

The anticipator setpoint must be correct. Too high of a setting results in longer heat cycles and a greater temperature swing in the conditioned space. Reducing the value below the correct setpoint gives shorter ON cycles and may result in the lowering of the temperature within the conditioned space. See Table 26 for the required gas heat anticipator setting.

Table 26: Gas heat anticipator setpoints

Setting, amps	
W1	**W2**
0.65	0.1

Cooling start-up

Pre-start checklist

When the installation is complete, perform the following checks:

1. Check the electrical supply voltage being supplied. Verify that it is the same as the voltage listed on the unit nameplate.
2. Set the room thermostat to the off position.
3. Turn on electrical power to the unit.
4. Set the room thermostat fan switch to on.
5. Check the indoor blower rotation.
   - If the blower rotation is in the wrong direction, see *Phasing* on page 51.

   Check the blower drive belt tension.
6. Check the unit supply air (CFM).
7. Measure the evaporator fan motor's amp draw.
8. Set the room thermostat fan switch to off.
9. Turn off electrical power to the unit.

Operating the unit

1. Turn on electrical power to the unit.

Note: Before each cooling season, you must energize the crankcase heaters at least 10 hours before the system is put into operation.

2. Set the room thermostat setting lower than the room temperature.

   First stage compressors energize after the built-in time delay of five minutes.

   The second stage of the thermostat energizes the second stage compressor if needed.

Post-start checklist

1. Verify proper system pressures for both circuits.
2. Measure the temperature drop across the evaporator coil.

Gas heat start-up

Pre-start checklist

When the installation is complete, perform the following checks.

1. Check the type of gas supply. Verify that it is the same as the gas supply listed on the unit nameplate.

2. Verify that the vent outlet and combustion air inlet are free of any debris or obstruction.

Operating instructions

⚠ CAUTION

This furnace is equipped with an automatic re-ignition system. Do not attempt to manually light the pilot.

Lighting the main burners

1. Turn off electrical power to unit.
2. Set the room thermostat to lowest setting.
3. Turn the gas valve counter-clockwise to the ON position (see Figure 33).
4. Turn on electrical power to unit.

   If the set temperature on the thermostat is above room temperature, the main burners ignite. If a second stage of heat is called for, the main burners for second stage heat ignite for the second stage heat.

Post-start checklist

After the entire control circuit is energized and the heating section is operating, perform the following checks:

1. Check for gas leaks in the unit piping and the supply piping.

⚠ WARNING

Fire or explosion hazard

Failure to follow the safety warning exactly could result in serious injury, death, or property damage.

Never test for gas leaks with an open flame. Use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury, or loss of life.

2. Check for the correct manifold gas pressures. See *Checking gas heat input* on page 71.
3. Check the supply gas pressure. It must be within the limits shown on the rating nameplate.

Note: You must check the supply pressure with all gas appliances in the building at full fire. The standby gas pressure must never exceed 10.5 in. or the operating pressure drop below 4.5 in. for natural gas units. If the gas pressure is outside these limits, contact the local gas utility or propane supplier for corrective action.

Shutting down the unit

1. Set the thermostat to the lowest temperature setting.
2. Turn off electrical power to unit.
3. Open the gas heat access panel.
4. Turn the gas valve clockwise to the OFF position (see Figure 33).

Checking gas heat input

This unit has two stages of gas heat. Input rate should be checked at full input and minimum input. The intended input for each furnace is shown on the unit rating plate.

To determine the rate of gas flow (Second Stage).

1. Turn off all other gas appliances connected to the gas meter.
2. Turn on the furnace and make sure the thermostat is calling for Second stage (100% input) heat.
3. Measure the time needed for one revolution of the hand on the smallest dial on the meter. A typical gas meter has a 1/2 or a 1 cubic foot test dial.
4. Using the number of seconds it takes for one revolution of the dial, calculate the cubic feet of gas consumed per hour. (See example below).
5. If necessary, adjust the high pressure regulator as discussed in the section “Manifold Gas Pressure Adjustment”. **Be sure not to over-fire** the furnace on Second stage. If in doubt, it is better to leave the Second stage of the furnace slightly under-fired. Repeat Steps 1-5.

To determine the rate of gas flow (First Stage)

1. Turn off all other gas appliances connected to the gas meter.
2. Turn on the furnace and make sure the thermostat is calling for first stage (minimum input) heat.
3. Even when the thermostat is calling for first stage heat, the unit will light on second stage and will run on Second stage for 1 minute. Allow this one-minute time period to expire and be certain the unit is running on first stage.
4. Measure the time needed for one revolution of the hand on the smallest dial on the meter. A typical gas meter has a 1/2 or a 1 cubic foot test dial.
5. Using the number of seconds it takes for one revolution of the dial, calculate the cubic feet of gas consumed per hour (See example below).
6. If necessary, adjust the low pressure regulator as discussed in the section “Manifold Gas Pressure Adjustment”. **Be sure not to under-fire** the furnace on first stage. If in doubt, it is better to leave the first stage of the furnace slightly over-fired. Repeat Steps 1-6.

Table 27: Gas Rate Cubic Feet Per Hour

Seconds for One Rev.	Size of Test Dial	
	1/2 cu. ft.	1 cu. ft.
10	180	360
12	150	300
14	129	257
16	113	225
18	100	200
20	90	180
22	82	164

Table 27: Gas Rate Cubic Feet Per Hour

Seconds for One Rev.	Size of Test Dial	
	1/2 cu. ft.	1 cu. ft.
24	75	150
26	69	138
28	64	129
30	60	120
32	56	113
34	53	106
36	50	100
38	47	95
40	45	90
42	43	86
44	41	82
46	39	78
48	37	75
50	36	72
52	35	69
54	34	67
56	32	64
58	31	62
60	30	60

NOTE: To find the Btu input, multiply the number of cubic feet of gas consumed per hour by the Btu content of the gas in your particular locality (contact your gas company for this information as it varies widely from area to area).

EXAMPLE

By actual measurement, it takes 46 seconds for the hand on a 1 cubic foot dial to make a revolution with a 80,000 Btuh furnace running. To determine rotations per minute, divide 60 by 46 = 1.30. To calculate rotations per hour, multiply 1.30 • 60 = 78. Multiply 78 • 1 (0.5 if using a 1/2 cubic foot dial) = 78. Multiply 78 • (the Btu rating of the gas). For this example, assume the gas has a Btu rating of 1050 Btu/ft.^{3}. The result of 81,900 Btuh is within 5% of the 80,000 Btuh rating of the furnace.

Manifold Gas Pressure Adjustment

This gas furnace has two heat stages. Therefore, the gas valve has two adjustment screws located under a plastic protective cover. The second stage adjustment screw is adjacent to the “HI” marking on the valve and the first stage adjustment screw is located adjacent to the “LO” marking on the valve (See Figure 33).

Manifold pressure adjustment procedure.

Adjust second stage pressure first, then adjust first stage pressure.

1. Turn off all power to the unit.
2. Using the outlet pressure port on the gas valve, connect a manometer to monitor the manifold pressure.
3. Remove plastic cap covering HI and LO pressure adjustment screws.
4. Turn on power to the unit.
5. Set thermostat to call for second stage heat and start furnace.
6. If necessary, using a screwdriver, turn the second stage adjustment screw (adjacent to the “HI” marking on the valve) clockwise to increase manifold pressure or counterclockwise to decrease manifold pressure. **Be sure not to over-fire the unit on second stage**.
7. After the high manifold pressure has been checked, adjust the thermostat to call for first stage heat.
8. If necessary, using a screwdriver, turn the first stage adjustment screw (adjacent to the “LO” marking on the valve) clockwise to increase manifold pressure or counterclockwise to decrease manifold pressure. **Be sure not to under-fire the unit on first stage**.
9. Once pressure has been checked, replace the plastic cap covering the HI and LO pressure adjustment screws.

NOTE: Refer to unit rating plate for typical manifold pressure settings. Pressure may need to be adjusted to achieve input rate depending on local heating value.

Table 28: Gas heat stages

Number of burner tubes	2nd stage input (100% Btu/h)	1st stage input (60% Btu/h)
5	120,000	72,000
7	180,000	108,000
8	240,000	144,000

Adjustment Of Temperature Rise

The temperature rise (the difference of temperature between the return air and the heated air from the furnace) must lie within the range shown on the unit rating plate and the data in Table 10.

After the temperature rise has been determined, the CFM can be calculated as follows:

$$CFM = \text{Btu Input} \bullet \frac{0.8}{(1.08 \cdot \Delta°F)}$$

After about 20 minutes of operation, determine the furnace temperature rise. Take readings of both the return air and the heated air in the ducts (about 6 feet from the furnace) where they will not be affected by radiant heat. Increase the blower CFM to decrease the temperature rise; decrease the blower CFM to increase the rise (See SUPPLY AIR DRIVE ADJUSTMENT).

NOTE: Each gas heat exchanger size has a minimum allowable CFM. Below this CFM, the limit will open.

Burners/Orifices Inspection/Servicing

Before checking or changing burners, pilot or orifices, CLOSE MAIN MANUAL SHUT-OFF VALVE AND SHUT OFF ALL POWER TO THE UNIT.

1. Open the union fitting just upstream of the unit gas valve and downstream from the main manual shut-off valve in the gas supply line.
2. Remove the screws holding each end of the manifold to the manifold supports.
3. Disconnect wiring to the gas valves and spark igniter(s). Remove the manifold & gas valve assembly. Orifices can now be inspected and/or replaced.

To service burners, complete step 4.

4. Remove the heat shield on top of the manifold supports. Burners are now accessible for inspection and/or replacement.

NOTE: Reverse the above procedure to replace the assemblies.

Make sure that burners are level and seat at the rear of the gas orifice.

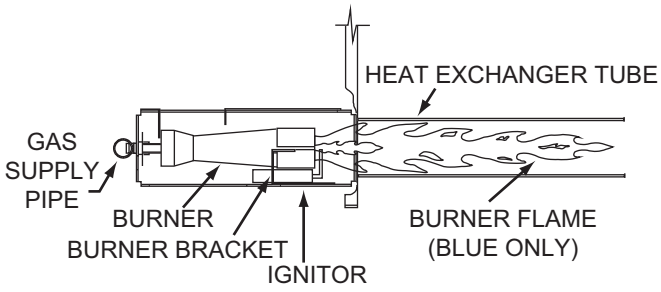


Figure 32: Typical Flame

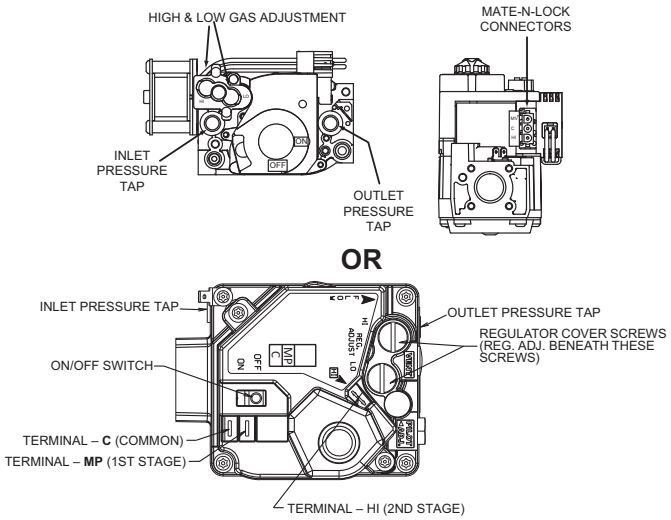


Figure 33: Typical Two Stage Gas Valve

Control board navigation components

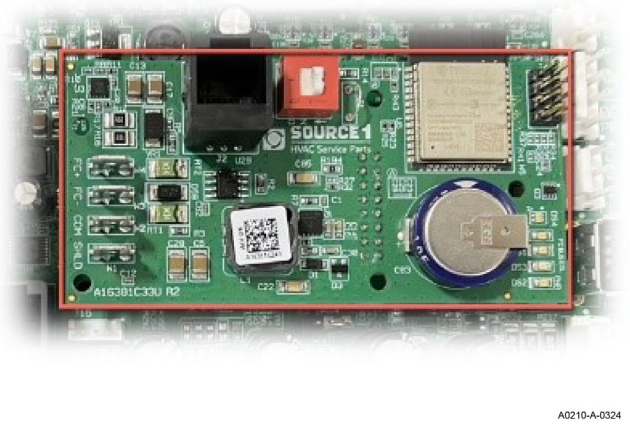
You need the following components to access the control points in the Smart Equipment control.

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. GoTemp Pro app (available for iOS or Android).
  Note: You can connect the GoTemp Pro app 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

Figure 34: CWCVT (S1-TL-CWCVT-0)

Figure 35: Communication card



  b. Mobile Access Portal (MAP) Gateway (portable)
  - Source 1 part no. S1-YK-MAP1810-0P (no longer available for purchase - we strongly recommend that GoTemp Pro be used for all R-454B units for the best user experience).

Note: Although the MAP is no longer available for purchase, it continues to work with the UCB. We strongly recommend that GoTemp Pro is used for all R-454B units for the best user experience. 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.

Smart Equipment unit control board

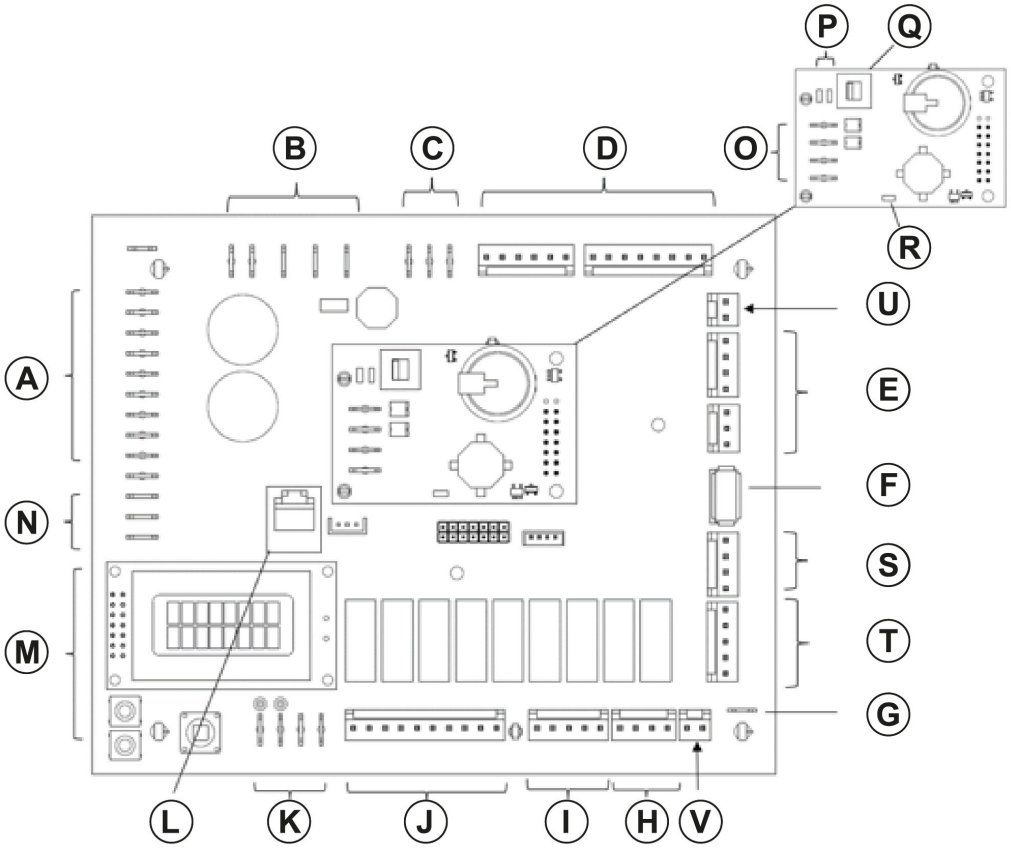


Figure 36: Unit control board

The following tables describe the details of the UCB, see Figure 36 for the connection locations.

Smart Equipment UCB - thermostat connection strip

Location	Label	Description	Function and comments
A	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	
	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 overflow 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 thermostat connection strip SD-24 and R
	C	24 VAC common for thermostat power	
	+	MOD BUS	
	-	MOD BUS	
	C	MOD BUS	

Smart Equipment UCB - limit, 24 VAC power, and shutdown connections

Location	Label	Description	Function and comments
B	LIMIT	Monitored 24 VAC input through heat section limit switch(es)	If voltage is absent, indicating the heat section is over-temperature, the UCB will bring 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, condensate overflow and user shutdown relay switching in series	Connects through circuit trace to the R terminal on the upper left of the board
	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

Smart Equipment UCB - space temperature sensor connections

Location	Label	Description	Function and comments
C	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 “Thermo- stat-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
	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

Smart Equipment UCB - temperature sensor connections

Location	Label	Description	Function and comments
D	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 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 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.

Smart Equipment UCB - pinned connections

Location	Label	Description	Function and comments
E	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 0-5 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.
	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

Smart Equipment UCB - USB connector

Location	Label	Description	Function and comments
F	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
	J15	Factory wired SA Bus connector	

Smart Equipment UCB - 24 V terminal

Location	Label	Description	Function and comments
G	24V FOR OUTPUTS	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

Smart Equipment UCB - heat section connections

Location	Label	Description	Function and comments
H	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
	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

Smart Equipment UCB - pin cooling and fan output

Location	Label	Description	Function and comments
I	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

Smart Equipment UCB - refrigerant circuit safety switch and indoor blower overload connections

Location	Label	Description	Function and comments
J	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.
J	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.
	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.

Smart Equipment UCB - SA BUS[1] connections

Location	Label	Description	Function and comments
K	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
L	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

1. When wiring unit and other devices using the SA Bus and FC Bus, see Table 32.

Smart Equipment UCB - user interface

Location	Label	Description	Function and comments
M	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	

Smart Equipment UCB - LEDs

Location	Label	Description	Function and comments
N	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

Smart Equipment UCB - optional communication sub-board

Location	Label	Description	Function and comments
O[1] Terminal FC BUS connections	**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
	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
Q	**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”
P	**EOL**	Green End Of Line indicator	Lit indicates the EOL switch is selected ON
	FC BUS	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
R	**ISO PWR**	Green communication board Isolated Power indicator	Lit indicates the UCB is supplying power to the communication sub-board

Smart Equipment - pinned connections

Location	Label	Description	Function and comments
S	COS	Condensate Overflow Switch	COS is 24V input that senses the switch is closed if 24V is present. Binary Input – just senses 24V on/off. If COS opens, the compressor outputs are disabled. When COS is closed, compressors run normally. COS can be enabled/disabled by a menu option on the control board
	R	R pin is 24V supply to the switch	Connects through circuit trace to the R terminal
	RDS	Refrigerant Detection System or Switch	If the switch opens, the control shuts off all outputs, except the indoor blower. Energizes the indoor blower, if it was off at the time. If the switch recloses, there will be a five minute delay, then return to normal operation. For products without an RDS, these pins must be jumpered. There are no menu options to turn this function off
	R	R pin is 24V supply to the Sensor	Connects through circuit trace to the R terminal
T	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 indoor 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
U	AI1 +	Green End Of Line indicator	Lit indicates the EOL switch is selected ON
	AI1 -	Not used	Not used
V	BO1	Not used	Not used
	BO2	Not used	Not used

Table 29: 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[1]	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.

Table 29: 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.
SA Bus (Modular Jack): 26 AWG Solid 6-Wire, 3 Twisted-Pair Cable[2]	—	—	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. We strongly recommend 3-wire (for FC bus) and 4-wire, 2 twisted-pair (for SA bus), 22 AWG stranded, shielded cable. A 22 gauge cable offers the best performance for various baud rates, cable distances, and number of trunk devices primarily due to lower conductor-to-conductor capacitance. Shielded cable offers better overall electrical noise immunity than non-shielded cable. Observe the shield grounding requirements.
2. We recommend 26 AWG solid, 6-wire (3 twisted pairs) cable as the best fit for fabricating modular cables with the modular jack housing assembly. Be sure the cable you use fits the modular jack housing. The preassembled cables that are available from Anixter (Part No. CBL-NETWORKxxx) use 24 gauge wire.

Table 30: Ignition control flash codes

Flashes	Fault conditions	Check
Steady on	Control failure	Control
Heartbeat	Normal operation	
1	Not applicable	
2	Pressure switch Stuck closed	Pressure switch
3	Pressure switch failed to close	Venter pressure switch vent blocked
4	Limit switch open	Main limit aux limit
5	Flame present with gas off first stage gas valve energized with w1 off second stage gas valve energized with first stage gas valve off	Gas valve
6	Ignition lockout	Gas flow gas pressure gas valve flame sensor
7	Lockout, limit switch open too long	Indoor blower, main limit, aux limit
8	Line frequency fault	Supply power frequency
Steady off	No power or control failure	24vac or control

Charging the unit

Charge unit by weight using name plate data or use charging tables.

Table 31: KB078 charging table - system 1

Air Flow Indoor Db/Wb	Outdoor DB	Suction Pressure	Suction Temp.	Liquid Pressure	Liquid Temp.	Delta T Db	Compr. amps
300 Cfm/Ton 80/62	75	138	65	252	82	-25	6.0
	85	135	63	295	91	-26	6.6
	95	133	61	338	101	-27	7.3
300 Cfm/Ton 80/67	75	137	63	252	84	-25	6.0
	85	140	64	297	93	-24	6.7
	95	142	64	342	101	-23	7.4
300 Cfm/Ton 80/72	75	136	62	253	86	-25	6.0
	85	144	65	299	94	-22	6.7
	95	152	68	345	102	-20	7.4
300 Cfm/Ton 75/62	75	131	61	251	81	-23	6.0
	85	131	60	295	90	-23	6.6
	95	131	59	339	99	-23	7.3
400 Cfm/Ton 80/62	75	142	66	254	83	-23	6.0
	85	142	65	298	92	-23	6.6
	95	143	64	342	102	-23	7.3
400 Cfm/Ton 80/67	75	143	66	255	84	-23	6.0
	85	146	65	299	93	-22	6.7
	95	148	65	343	102	-21	7.4
400 Cfm/Ton 80/72	75	145	65	256	86	-22	6.0
	85	149	65	300	94	-20	6.7
	95	154	66	345	103	-19	7.4
400 Cfm/Ton 75/62	75	136	63	254	81	-20	6.0
	85	138	62	298	91	-20	6.6
	95	139	61	342	100	-19	7.3

Table 32: KB078 charging table - system 2

Air Flow Indoor Db/Wb	Outdoor DB	Suction Pressure	Suction Temp.	Liquid Pressure	Liquid Temp.	Delta T Db	Compr. amps
300 Cfm/Ton 80/62	75	133	63	263	86	-25	6.7
	85	131	61	306	94	-26	7.5
	95	128	60	349	101	-27	8.4
300 Cfm/Ton 80/67	75	131	61	263	84	-25	6.7
	85	134	62	308	93	-24	7.5
	95	137	63	353	102	-23	8.4
300 Cfm/Ton 80/72	75	129	59	264	83	-25	6.7
	85	138	63	311	93	-22	7.5
	95	146	66	357	103	-20	8.3
300 Cfm/Ton 75/62	75	127	59	262	84	-23	6.7
	85	127	59	306	92	-23	7.5
	95	126	58	351	100	-23	8.4
400 Cfm/Ton 80/62	75	138	65	265	87	-23	6.7
	85	138	64	309	95	-23	7.5
	95	139	63	353	104	-23	8.4
400 Cfm/Ton 80/67	75	139	64	266	87	-23	6.7
	85	141	64	310	96	-22	7.5
	95	144	64	355	105	-21	8.4
400 Cfm/Ton 80/72	75	140	63	267	87	-22	6.7
	85	144	64	312	96	-20	7.5
	95	149	64	357	106	-19	8.3
400 Cfm/Ton 75/62	75	132	61	264	85	-20	6.7
	85	134	61	309	94	-20	7.5
	95	135	61	353	102	-19	8.4

Table 33: KB090 charging table - system 1

Air Flow Indoor Db/Wb	Outdoor DB	Suction Pressure	Suction Temp.	Liquid Pressure	Liquid Temp.	Delta T Db	Compr. amps
300 Cfm/Ton 80/62	75	133	66	265	82	-25	8.1
	85	131	64	306	91	-27	8.9
	95	129	61	348	101	-28	9.8
300 Cfm/Ton 80/67	75	133	66	266	83	-26	8.1
	85	134	64	310	92	-23	9.0
	95	136	62	354	101	-20	9.9
300 Cfm/Ton 80/72	75	132	65	267	83	-26	8.1
	85	137	64	313	92	-20	9.0
	95	142	63	359	100	-13	9.9
300 Cfm/Ton 75/62	75	127	63	263	81	-23	8.1
	85	127	61	307	90	-23	8.9
	95	127	60	350	99	-23	9.8
400 Cfm/Ton 80/62	75	138	69	268	82	-23	8.2
	85	139	67	311	92	-23	9.0
	95	140	65	354	102	-23	9.9
400 Cfm/Ton 80/67	75	138	69	270	81	-23	8.2
	85	141	67	313	91	-21	9.0
	95	143	65	357	101	-19	9.9
400 Cfm/Ton 80/72	75	139	69	271	80	-22	8.2
	85	143	67	316	90	-19	9.1
	95	147	65	360	100	-15	9.9
400 Cfm/Ton 75/62	75	132	66	267	81	-21	8.1
	85	134	64	311	90	-20	9.0
	95	136	62	354	99	-20	9.9

Table 34: KB090 charging table - system 2

Air Flow Indoor Db/Wb	Outdoor DB	Suction Pressure	Suction Temp.	Liquid Pressure	Liquid Temp.	Delta T Db	Compr. amps
300 Cfm/Ton 80/62	75	134	64	266	84	-25	6.8
	85	132	62	307	93	-27	7.7
	95	129	59	349	101	-28	8.5
300 Cfm/Ton 80/67	75	134	63	266	87	-26	6.8
	85	135	61	313	94	-23	7.8
	95	136	59	359	101	-20	8.7
300 Cfm/Ton 80/72	75	134	63	266	91	-26	6.8
	85	138	61	317	96	-20	7.9
	95	142	58	369	101	-13	8.9
300 Cfm/Ton 75/62	75	128	60	264	83	-23	6.8
	85	128	59	308	91	-23	7.7
	95	128	57	352	99	-23	8.6
400 Cfm/Ton 80/62	75	139	67	268	86	-23	6.8
	85	139	65	312	94	-23	7.7
	95	139	64	355	102	-23	8.6
400 Cfm/Ton 80/67	75	141	66	269	87	-23	6.8
	85	142	64	315	95	-21	7.8
	95	143	63	361	102	-19	8.7
400 Cfm/Ton 80/72	75	142	66	270	89	-22	6.8
	85	144	64	318	95	-19	7.8
	95	146	61	366	101	-15	8.8
400 Cfm/Ton 75/62	75	134	63	267	85	-21	6.8
	85	135	62	311	92	-20	7.7
	95	135	61	356	100	-20	8.6

Table 35: KB102 charging table - system 1

Air Flow Indoor Db/Wb	Outdoor DB	Suction Pressure	Suction Temp.	Liquid Pressure	Liquid Temp.	Delta T Db	Compr. amps
300 Cfm/Ton 80/62	75	130	71	257	76	-24	7.9
	85	130	67	297	85	-25	8.8
	95	129	62	337	95	-26	9.6
300 Cfm/Ton 80/67	75	131	67	256	76	-24	8.0
	85	134	65	298	86	-23	8.8
	95	137	63	339	95	-22	9.7
300 Cfm/Ton 80/72	75	131	64	255	76	-24	8.1
	85	138	64	298	86	-22	8.9
	95	145	64	342	95	-19	9.7
300 Cfm/Ton 75/62	75	123	67	256	75	-22	7.9
	85	125	64	297	85	-22	8.8
	95	127	61	338	94	-22	9.6
400 Cfm/Ton 80/62	75	133	73	261	76	-22	8.0
	85	136	70	302	85	-22	8.8
	95	138	67	343	95	-22	9.7
400 Cfm/Ton 80/67	75	135	72	260	76	-21	8.0
	85	139	69	302	86	-21	8.9
	95	143	66	343	96	-20	9.7
400 Cfm/Ton 80/72	75	136	70	260	76	-21	8.1
	85	142	67	302	86	-19	8.9
	95	148	64	344	96	-18	9.7
400 Cfm/Ton 75/62	75	128	69	259	75	-19	8.0
	85	131	67	301	85	-19	8.8
	95	134	64	343	94	-18	9.7

Table 36: KB102 charging table - system 2

Air Flow Indoor Db/Wb	Outdoor DB	Suction Pressure	Suction Temp.	Liquid Pressure	Liquid Temp.	Delta T Db	Compr. amps
300 Cfm/Ton 80/62	75	135	73	271	80	-24	7.6
	85	134	69	310	90	-25	8.4
	95	134	64	349	101	-26	9.3
300 Cfm/Ton 80/67	75	134	72	269	80	-24	7.5
	85	138	67	310	91	-23	8.4
	95	141	62	352	101	-22	9.3
300 Cfm/Ton 80/72	75	134	70	267	80	-24	7.5
	85	141	65	311	91	-22	8.4
	95	148	59	355	102	-19	9.3
300 Cfm/Ton 75/62	75	128	69	269	79	-22	7.6
	85	130	66	310	89	-22	8.4
	95	131	63	350	99	-22	9.3
400 Cfm/Ton 80/62	75	139	75	275	80	-22	7.6
	85	141	72	316	90	-22	8.5
	95	143	69	356	100	-22	9.3
400 Cfm/Ton 80/67	75	140	75	275	80	-21	7.6
	85	143	70	316	91	-21	8.5
	95	147	65	356	101	-20	9.3
400 Cfm/Ton 80/72	75	141	74	275	80	-21	7.6
	85	146	68	316	91	-19	8.5
	95	151	62	357	102	-18	9.3
400 Cfm/Ton 75/62	75	132	71	273	79	-19	7.6
	85	135	68	314	89	-19	8.5
	95	138	65	356	99	-18	9.4

Table 37: KB120 charging table - system 1

Air Flow Indoor Db/Wb	Outdoor DB	Suction Pressure	Suction Temp.	Liquid Pressure	Liquid Temp.	Delta T Db	Compr. amps
300 Cfm/Ton 80/62	75	133	64	266	79	-25	10.4
	85	132	62	310	89	-26	11.5
	95	130	59	354	98	-27	12.5
300 Cfm/Ton 80/67	75	133	63	267	80	-25	10.5
	85	136	63	311	89	-24	11.5
	95	138	62	355	98	-23	12.6
300 Cfm/Ton 80/72	75	133	62	267	81	-25	10.5
	85	139	64	312	89	-22	11.6
	95	146	66	357	98	-20	12.7
300 Cfm/Ton 75/62	75	127	61	265	78	-23	10.4
	85	127	60	310	88	-23	11.5
	95	127	58	355	97	-22	12.6
400 Cfm/Ton 80/62	75	138	67	268	80	-23	10.5
	85	139	65	315	89	-23	11.6
	95	140	62	362	99	-22	12.7
400 Cfm/Ton 80/67	75	138	67	269	79	-22	10.5
	85	141	65	316	89	-21	11.7
	95	144	64	363	99	-21	12.8
400 Cfm/Ton 80/72	75	139	66	271	79	-21	10.5
	85	144	66	318	88	-20	11.7
	95	148	65	365	98	-19	12.9
400 Cfm/Ton 75/62	75	132	63	267	78	-20	10.4
	85	134	62	314	88	-20	11.6
	95	136	60	362	98	-19	12.7

Table 38: KB120 charging table - system 2

Air Flow Indoor Db/Wb	Outdoor DB	Suction Pressure	Suction Temp.	Liquid Pressure	Liquid Temp.	Delta T Db	Compr. amps
300 Cfm/Ton 80/62	75	133	63	278	86	-25	10.4
	85	132	60	321	94	-26	11.5
	95	131	57	365	102	-27	12.6
300 Cfm/Ton 80/67	75	134	61	278	87	-25	10.4
	85	136	61	323	95	-24	11.5
	95	138	60	368	102	-23	12.6
300 Cfm/Ton 80/72	75	135	60	277	89	-25	10.4
	85	139	62	325	95	-22	11.5
	95	144	64	372	102	-20	12.7
300 Cfm/Ton 75/62	75	127	59	277	84	-23	10.4
	85	128	57	321	92	-23	11.5
	95	128	55	366	100	-22	12.7
400 Cfm/Ton 80/62	75	139	66	280	86	-23	10.4
	85	140	63	325	95	-23	11.6
	95	140	61	371	104	-22	12.7
400 Cfm/Ton 80/67	75	140	65	280	88	-22	10.4
	85	142	63	327	96	-21	11.6
	95	144	62	373	104	-21	12.7
400 Cfm/Ton 80/72	75	141	63	281	89	-21	10.5
	85	145	63	328	96	-20	11.6
	95	148	63	376	103	-19	12.8
400 Cfm/Ton 75/62	75	133	61	278	85	-20	10.4
	85	134	60	325	93	-20	11.6
	95	136	58	371	102	-19	12.7

Table 39: KB150 charging table - system 1

Air Flow Indoor Db/Wb	Outdoor DB	Suction Pressure	Suction Temp.	Liquid Pressure	Liquid Temp.	Delta T Db	Compr. amps
300 Cfm/Ton 80/62	75	130	61	259	78	-24	11.5
	85	127	59	301	86	-26	12.7
	95	124	58	343	94	-27	14.0
300 Cfm/Ton 80/67	75	130	60	257	78	-25	11.4
	85	132	60	302	86	-24	12.8
	95	135	61	347	94	-23	14.1
300 Cfm/Ton 80/72	75	129	59	255	78	-25	11.3
	85	137	62	303	86	-22	12.7
	95	145	65	351	95	-19	14.2
300 Cfm/Ton 75/62	75	124	58	257	77	-22	11.5
	85	124	57	300	85	-22	12.7
	95	123	56	343	93	-22	14.0
400 Cfm/Ton 80/62	75	135	63	260	78	-22	11.6
	85	134	62	303	86	-22	12.9
	95	134	61	345	95	-22	14.1
400 Cfm/Ton 80/67	75	136	62	259	78	-21	11.6
	85	138	62	304	86	-21	12.9
	95	140	62	348	95	-20	14.2
400 Cfm/Ton 80/72	75	136	61	259	78	-21	11.5
	85	141	62	304	86	-19	12.9
	95	146	64	350	95	-18	14.3
400 Cfm/Ton 75/62	75	129	59	259	77	-19	11.5
	85	130	59	302	85	-19	12.8
	95	130	58	345	93	-19	14.1

Table 40: KB150 charging table - system 2

Air Flow Indoor Db/Wb	Outdoor DB	Suction Pressure	Suction Temp.	Liquid Pressure	Liquid Temp.	Delta T Db	Compr. amps
300 Cfm/Ton 80/62	75	130	63	265	85	-24	12.9
	85	128	60	304	93	-26	14.4
	95	126	57	343	101	-27	16.0
300 Cfm/Ton 80/67	75	128	63	262	84	-25	12.8
	85	131	62	302	93	-24	14.4
	95	134	60	342	101	-23	15.9
300 Cfm/Ton 80/72	75	127	62	260	84	-25	12.8
	85	135	63	301	92	-22	14.3
	95	143	64	342	101	-19	15.8
300 Cfm/Ton 75/62	75	124	59	263	84	-22	12.9
	85	124	56	304	93	-22	14.5
	95	125	54	345	102	-22	16.0
400 Cfm/Ton 80/62	75	133	66	267	85	-22	12.9
	85	134	64	308	94	-22	14.5
	95	135	61	349	102	-22	16.1
400 Cfm/Ton 80/67	75	134	66	265	85	-21	12.8
	85	137	65	307	94	-21	14.5
	95	140	63	349	102	-20	16.1
400 Cfm/Ton 80/72	75	135	66	264	84	-21	12.8
	85	140	66	307	94	-19	14.4
	95	145	66	349	103	-18	16.1
400 Cfm/Ton 75/62	75	126	65	266	77	-21	12.6
	85	131	64	311	120	-20	14.1
	95	135	62	355	162	-19	15.6

Start-Up sheet

Start-up & Service Data Instruction

Commercial Package Units

3.0 To 50.0 tons

Start-up Checklist

Date: _____

Job Name: _____

Customer Name: _____

Address: _____

City: _____ State: _____ Zip: _____

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

BHC Residential & Light Commercial LLC 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 BHC Residential & Light Commercial LLC 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 BHC Residential & Light Commercial LLC 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 GoTemp Pro mobile application 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:

BHC Residential & Light Commercial LLC
Technical Services Department
5005 York Drive
Norman, OK 73069

Safety Warnings

The inspections and recording of data outlined in this procedure are required for start-up of BHC Residential & Light Commercial LLC' 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: _____

Outside Air Dilution: Economizer Position Percentage: _____ CFM: _____

Supply Gas Pressure After Regulator W/o Heat Active _____ Inches_____

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	☐	☐
Economizer hoods installed in operating position	☐	☐
Condensate drain trapped properly, refer to Installation Manual	☐	☐
Economizer damper linkage tight	☐	☐
Gas Heat vent hood installed	☐	☐
All field wiring (power and control) complete	☐	☐

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	☐	☐

Exhaust Inspection Powered ☐ Barometric Relief ☐	Completed	See Notes
Check hub for tightness	☐	☐
Check fan blade for clearance	☐	☐
Check for proper rotation	☐	☐
Check for proper mounting (screen faces towards unit)	☐	☐
Prove operation by increasing minimum setting on economizer	☐	☐

Economizer Inspection Standard ☐ BAS ☐	Completed	See Notes
CO_2 sensor installed Yes ☐ No ☐	☐	☐
Check economizer setting (Reference Smart Equipment Control Board LCD menu location)	☐	☐
Prove economizer open/close through Smart Equipment Board Setting	☐	☐

Reheat Mode Normal ☐ or Alternate ☐ Not Applicable ☐
Humidity Sensor (2SH0401) _____

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
Exhaust Motor (Dampers 100%)	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.

Refrigerant Safeties

Action	Completed	See Notes
Prove Compressor Rotation (3 phase only) by gauge 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 - Cooling

Stage	Discharge Pressure	Discharge Temp.	Liquid Line Temp.[1]	Subcooling[2]	Suction Pressure	Suction Temp.	Superheat
First	#	°	°	°	#	°	°
Second (if equipped)	#	°	°	°	#	°	°
Third (if equipped)	#	°	°	°	#	°	°
Fourth (if equipped)	#	°	°	°	#	°	°
Reheat 1st Stage	#	°	°	°	#	°	°

1. Liquid temperature should be taken before filter/drier.
2. Subtract 10 psi from discharge pressure for estimated liquid line pressure

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

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Operating Measurements - Gas Heating

Fuel Type: ☐ Natural Gas ☐ LP Gas

Action		Completed	See Notes
Check for gas leaks		☐	☐
Prove Ventor Motor Operation		☐	☐
Prove Primary Safety Operation		☐	☐
Prove Auxiliary Safety Operation		☐	☐
Prove Rollout Switch Operation		☐	☐
Prove Smoke Detector Operation		☐	☐
Manifold Pressure	Stage 1	IWC	☐
	Stage 2 (If Equipped)	IWC	☐
	Stage 3 (If Equipped)	IWC	☐
Supply gas pressure at full fire		IWC	☐
Check temperature rise[1]	☐ measured at full fire	°F	☐

1. Input X Eff. (BTU output)
   1.08 X Temp. Rise

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 ☐	

Operating 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.	☐

Observed Product Deficiencies & Concerns:

_____

_____

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1034349-UCL-L-0426
Supersedes: 1034349-UCL-K-0126

BHC Residential & Light Commercial LLC
5005 York Drive
Norman, OK 73069

NOTES

6525407-UIM-F-0526
Supersedes: 6525407-UIM-E-0825

BHC Residential & Light Commercial LLC
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