Installation Operation Maintenance

BULLDOG SpaceKeeper
Vertical Heat Pump

SpaceKeeper Vertical
Models: SKV008- SKV320

www.bulldogheatpump.com

No other heat pump does more, with less.

 Installation Operation Maintenance Manual is Subject to Change without Notice. Last Modified November 2019

Table of Contents

BULLDOG HEAT PUMP

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INFORMATION

Handling

Care must be taken in handling the floor mount unit and other accessories to ensure that this equipment does not sustain any damage. It is recommended that the floor mount unit(s) be transported individually on a two-wheel cart where size permits.

The protective shipping and packaging should remain on the unit until it is ready for installation. During construction, the unit must not be run and shall be sheltered from contaminants and debris such as drywall dust, wood chips, and paint that could damage the fan or block the cooling/heating coil which may result in diminished performance.

Storage

The unit must at all times be stored in an upright position with the compressor section down and the fan section oriented up.

Failure to maintain the unit in an upright position may result in permanent damage to the unit. Dropping the heat pump or exposing it to extreme shock or vibration may also result in permanent damage to the interior components and piping.

The unit should be stored in a non-corrosive environment sheltered from conditions of extreme temperature or humidity. Subjecting the unit to conditions of this nature may result in significantly reduced performance, reliability, and operational life.

The unit is intended for interior use only and should be stored indoors at all times to protect it from the elements and to help eliminate the potential growth of indoor air quality (IAQ) contaminants. If indoor storage is not possible, the equipment may be stored outdoors during the summer months only, if the following provisions are met:

1. The equipment must be placed on a dry surface, or raised off the ground in a manner which allows for air-circulation beneath the unit.
2. A waterproof tarp must be used to cover the equipment in order to provide protection from the elements.
3. Continuous ventilation to the units must be provided to help prevent moisture accumulation on the interior and exterior surfaces. Moisture buildup on, or within the unit's insulation may result in microbial growth that can lead to odors and serious health-related IAQ problems.
4. The units must be stored in their original packaging.
5. The individual units shall not be stacked on top of one another.
6. If the unit was previously in use, ensure that all water in the coil has been blown out and that all hose connections are plugged during storage.

REFRIGERANT CHARGE

Unit Model	008	010	012	015	018	020	024	030	036	042	048	060
R410A Charge (oz.)	27	27	30	35	45	35	40	45	50	50	60	70

Unit Model		070	080	100
R410A Charge (oz.) per circuit	Single circuit - Standard	80	90	100
	Dual compressors	50	55	55

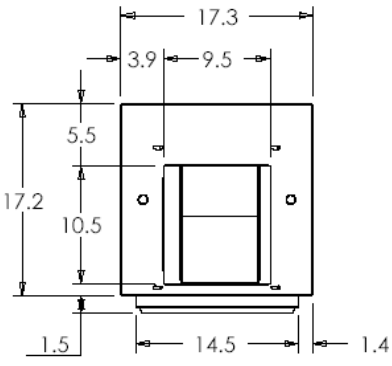
Weight/Dimensions/Clearance

Weight:

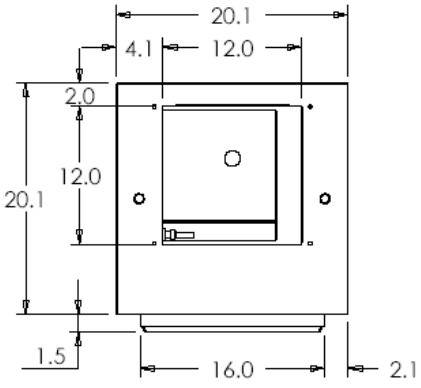
SKV1		SKV2		SKV3		SKV4		SKV5		SKV6		SKV7	
Model	Weight (lb)	**Model**	Weight (lb)	**Model**	Weight (lb)	**Model**	Weight (lb)	**Model**	Weight (lb)	**Model**	Weight (lb)	**Model**	Weight (lb)
008	150	**020**	225	**042**	275	**070**	590	**120**	830	**180**	N/A	**280**	N/A
010	150	**024**	245	**048**	320	**080**	625	**150**	850	**240**	N/A	**320**	N/A
012	155	**030**	245	**060**	350	**100**	700						
015	175	**036**	245										
018	175												

Unit Dimensions:

Models 008 – 018



Models 020 – 036



Models 042 – 060

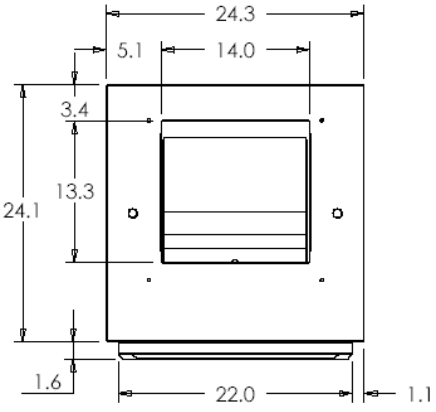
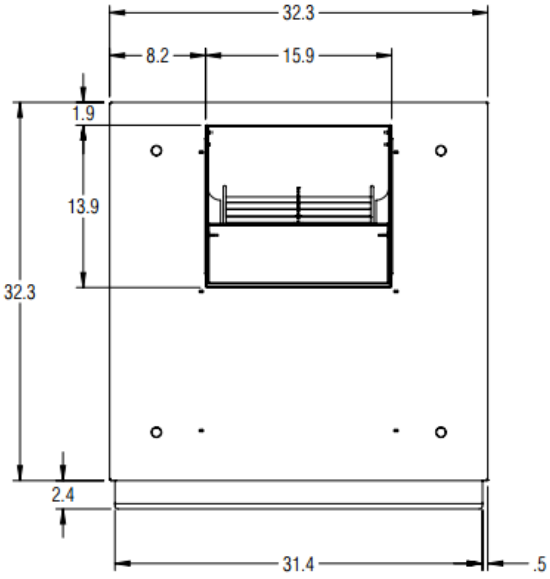


Table 1

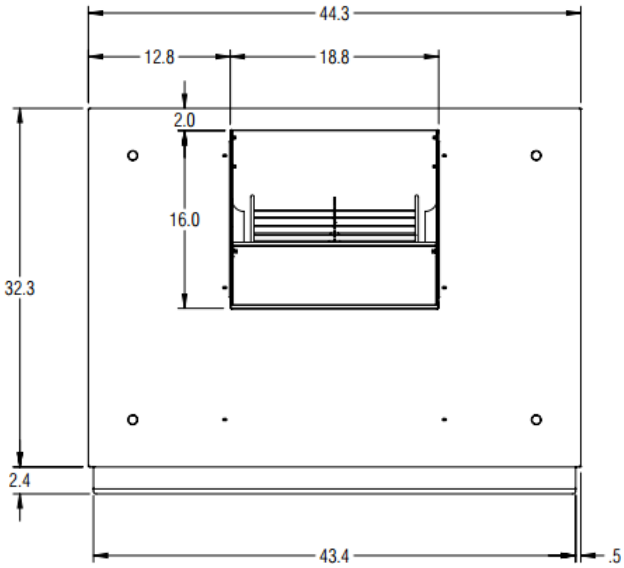
SIDE	CLEARANCE (in)
Front (Compressor/ Fan section)	36
Filter (Left or Right)	6*
Rear	2
Opposite Filter Side	2

* 6” if return is not ducted.

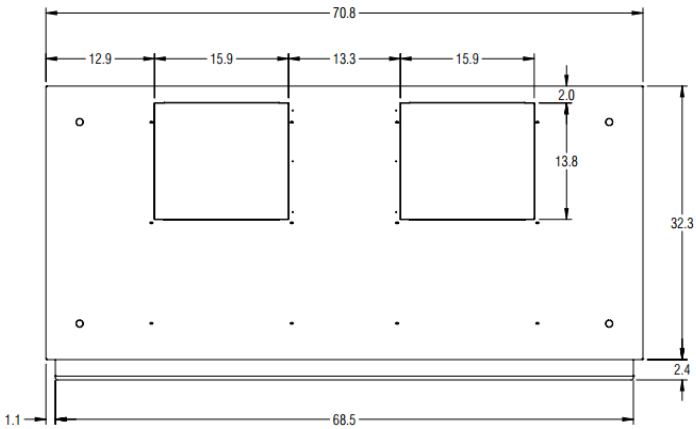
Models 070 – 100



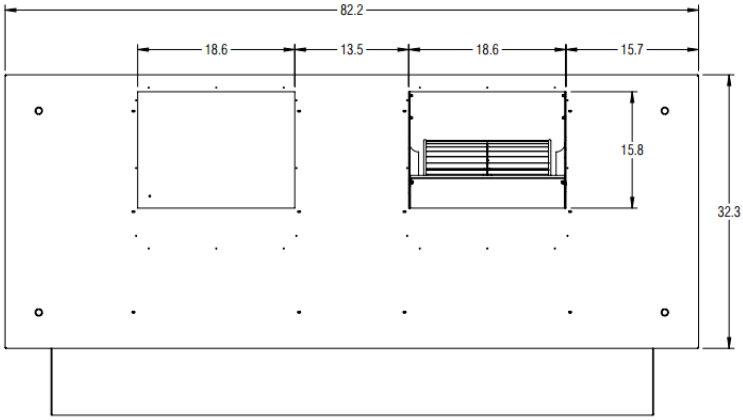
Models 120 – 150



Models 180 – 240



Models 280 – 320



Unit Clearance:

The Vertical product requires minimum clearances as indicated in the table below:

Table 2

SIDE	CLEARANCE (in)
Front (Compressor/ Fan section)	36
Filter (Left or Right)	6*
Rear	30
Opposite Filter Side	2

* 6” if return is not ducted.

INSTALLATION

The installation of all vertical units and components and accessories must be in accordance with local codes and all regulations of all governing authorities having jurisdiction. The manufacturer recommends the following installation procedures. It is the responsibility of the installing contractor to comply with all applicable codes and regulations.

It is the responsibility of the installing contractor to comply with all applicable codes and regulations. It is the responsibility of the installing contractor to ensure adequate service clearance for regular maintenance or for repair in place is exercised. The installing contractor will be responsible for removing the unit if it is not serviceable in place.

GENERAL INSTALLATION CHECK

The list below summarizes the steps required to successfully install a BULLDOG SpaceKeeper Vertical unit.

1. Remove packaging and inspect the unit. Check for shipping damage or material shortage; file a freight claim and notify appropriate sales representative, if damage is found.

2. Verify the correct model and voltage.

3. Verify the power supply complies with the nameplate specification.

4. Connect properly sized and protected power supply wiring to the disconnect (not supplied).

5. Install proper grounding wires to an earth ground.

LOCATION

1. Determine floor mount location with clearances as shown in Table 1 on page 3.
2. Locate the unit in an indoor area. The ambient temperature surrounding the unit must not be less than 45°F (7C°). Do not locate the unit in areas subject to freezing.

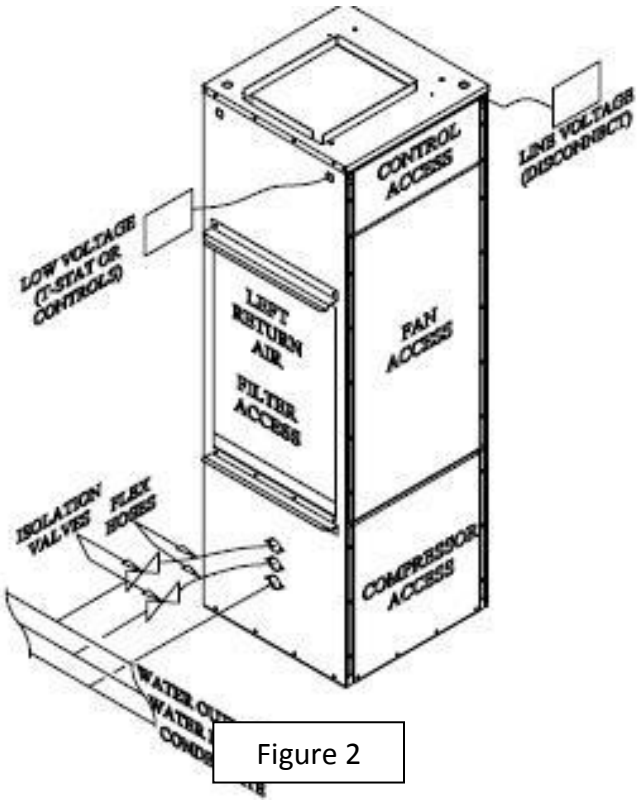


Figure 2

PLACEMENT

1. Position the unit ensuring the unit is level.
2. Meet specified clearances to provide room for removal of all access panels (see Table 1 for details).
3. Provide access to water shut off valves and fittings. Provide screwdriver access to the unit side panels, discharge collar, and all electrical connections.

PIPING

CAUTION: Piping must comply with all applicable codes.

1. Install shut off valves at each unit to permit unit removal.
2. DO NOT bend or kink supply lines or hoses (if supplied). Supply and return hoses (available from factory) are fitted with swivel joint fittings at one end to allow removal for future servicing.
3. The SpaceKeeper Vertical units are internally trapped. Do not install another trap on the condensate pipe that leaves the SpaceKeeper unit.

NOTE: Insulation of the water piping loop is not required except where piping runs through unheated areas or areas on the exterior of the building. The normal loop operating temperature range is 85°F (29°C) to 120°F (49°C).

Wiring

1. Wire room temperature thermostat to electrical panel as indicated by the wiring diagram.
2. Connect power.

UNIT OPERATION

CAUTION:

To avoid fouled machinery, extensive unit clean up, and void warranty, do not operate units without air filters in place, and do not operate units during the construction process.

The BULLDOG Heat Pump provides year round cooling and heating.

The BULLDOG Heat Pump provides DX cooling with a water-cooled refrigeration circuit, and hydronic heating with a hot water coil. The compressor operates in the cooling mode only and shuts down during the heating mode, providing for quieter operation, extended compressor life, and a reduction in energy consumption.

To ensure correct operation, centralized equipment located within the building mechanical room is automatically controlled to provide each heat pump unit with water that is at the proper temperature and flow rate.

Fan Operation:

Each heat pump has two-speed fan operation. The fan operates as follows:

LOW Speed -First stage of heating mode (Thermostat Setting: Fan Automatic)
-Fan only operation (Thermostat Setting: Fan On)

HIGH Speed -The second stage of heating mode
-Cooling mode

Standard Heating Operation:

Each heat pump has two stages of heat operation. The compressor does not operate in either stage. To enable heating operation, Manual Change Over thermostats (MCO) must be set to “Heat” mode. Automatic Change Over (ACO) thermostats should be set to “Auto” or heat mode. To start heating operation, the suite temperature must fall below the heat set-point temperature.
The thermostat will automatically stop heating operation once the space temperature rises up to the heat set-point temperature.

Stage 1 Heating: Fan operates at low speed for 10 minutes with minimal noise in an attempt to elevate suite temperature to desired level.
Stage 2 Heating: After 10 minutes, if set-point temperature is not reached, fan will automatically step up and operate at high speed

Cooling Operation:

Each heat pump has a water cooled refrigeration circuit that operates only during the cooling mode.

To enable cooling operation, MCO thermostats must be set to “Cool” mode. The ACO thermostats should be set to “Auto” or cool mode. In order for the cooling operation to become activated, the suite temperature must rise above the cool set-point temperature.

The thermostat will automatically stop cooling once the space temperature drops below the cool set-point temperature.

Cooling: The fan always operates at high speed during the cooling operation.
The compressor also operates during the cooling operation.

Time Delays:

- Thermostat time delay up to 5 minutes upon initial power up.
- Thermostat time delay up to 5 minutes when switching between heat/cool/off modes.
- Heat pump time delay up to 5 minutes upon initial start up.
- Heat pump time delay up to 5 minutes from the end of a cooling operation to the start of the next cooling operation.

Recommendations:

1. Set the thermostat fan to ON for continuous fan operation while your suite is occupied. This will help to ensure that the temperature is uniform throughout the suite.

2. In order to provide space conditioning while you are away, keep the thermostat system switch in the appropriate heat or cool mode. The heat pump will not heat or cool if the thermostat system switch is set to the "OFF" position.

3. When away for a short duration, set the thermostat as follows:
    a. Set fan to AUTO
    b. Set thermostat to appropriate heat or cool mode (based on seasonal conditions).
    c. Set heat or cool set-point to your desired suite temperature (ie. 72°F or 22°C).

4. When away for an extended period, set the thermostat as follows:
    a. Set fan to AUTO
    b. Set thermostat to appropriate heat or cool mode (based on seasonal conditions).
    c. During cooler seasons set your thermostat to a minimum set point of 65°F (18°C)
    d. During warmer seasons set your thermostat to a maximum set point of 78°F (26°C)

5. It is recommended that you maintain the same set points throughout the day regardless if you are in your suite or not. This provides maximum comfort for occupants. If you must adjust the set-point during the night or during away periods in the day it is recommended that heating setback be limited to 2 degrees and cooling to 4 degrees. This will help to ensure the unit operates minimally; preventing your suite from becoming excessively cold or hot.

OPERATION (Detailed)

CAUTION:

To avoid fouled machinery, extensive unit clean up, and to maintain warranty, do not operate units without air filters in place, and do not operate units during the construction process.

The BULLDOG Heat Pump provides year round cooling and heating as controlled by the unit thermostat.

The BULLDOG Heat Pump provides cooling with a water-cooled refrigeration circuit, and provides heating using a hydronic coil. The compressor operates in the cooling mode only and shuts down during the heating mode providing for quieter operation, extended compressor life, and a reduction in energy consumption.

To ensure correct operation, centralized equipment located within the building mechanical room is automatically controlled to provide each heat pump unit with water that is at the appropriate temperature and flow rate.

The unit circuit board incorporates six relay outputs with the following uses:

- K1 – Auxiliary relay for cooling valve on a two valve unit or heat valve on a dehumidification unit.
- K2 – Heating Relay
- K3 – Alarm Relay
- K4 – Compressor Relay
- K5 – Low Fan or Fan Relay for belt drive units
- K6 – High Fan or Compressor #2 on belt drive units

Each of these relays have, in parallel, a *green* LED indicator that lights up when the relay is energized.

The board incorporates digital inputs that are opto-coupled to a 24V AC source. These too have *amber* LED indicators located near the input locations that light up when the input is closed. These inputs include:

- High Pressure Switch
- Low Pressure Switch
- Heat Call (W on thermostat terminal)
- Cool Call (Y on thermostat terminal)
- Fan Call (G on thermostat terminal)
- Auxiliary (A on thermostat terminal)
- Compressor shutdown (24V AC signal thru O/O).
  Providing a continuous 24V potential to O/O will terminate and prevent compressor operation. This can be used for duty cycling, or for minimizing power consumption during a power failure while maintaining the heating function.
- Unit shutdown (24V AC signal thru A/O). Providing a continuous 24V AC potential to A/O will terminate and prevent unit operation. This can be used for a simple night shutdown. On both arrangements a single small 24V AC can shutdown many units. ¼ VA is required per unit.

Finally, the board has four analog inputs provided via thermistors. These inputs are as follows:

- Ta – Discharge Air Temperature
- Tr – Refrigerant Temperature
- Tw – Outgoing Water Temperature
- Co – Condensate Level

Ta, Tr, And Tw are 10k Ohm NTP thermistors, while Co is a 100 Ohm NPT thermistor. These Inputs do not have LED displays.

FAN OPERATION

1. A call on "G" for fan on the thermostat terminal strip will cause the fan to operate continuously on low fan speed through K5 on multi speed units.
2. A call on "W" for heat on the thermostat terminal strip will also cause the fan to operate on low speed. If the heating call is still present after a 10 minute period, the multi speed units will switch the fan to high speed through Relay K6.
3. A call on "Y" for cooling on the thermostat terminal strip will cause the fan on multi speed units to advance to high speed through Relay K6.
4. Fan operation will terminate whenever all calls are dropped.
5. When the fan is operating at high speed, both relays are energized along with their associated LED indicators.

Note: *- 460 and 575 volt units and belt drive units are single speed and K5 is used as a pilot relay operating a separate fan contactor.*
Note: *On belt drive units with dual compressors, Relay K6 is used to operate second compressor*.

HEATING OPERATION

1. A call on "W" for heat will activate the fan at low speed. It will also simultaneously energize the heat relay K2 and its associated LED. The relay K2 will provide 24V AC fused power directly to the heat valve.

COOL START UP

1. A call on "Y" for cooling initiates a series of checks prior to the start up of the compressor. These are:
    a. Power ON timer – Compressor operation is delayed for approximately 5 minutes after restoration of power. This prevents all units from coming on line at the same time when power is restored. It also prevents compressor jolting with intermittent power.
    b. Anti-Recycle timer – There is a 5-minute anti-recycle delay timer that allows the refrigeration cycle to achieve pressure equalization so that the compressor is unloaded upon start up.
    c. High Pressure Switch – The high refrigerant pressure switch must be closed prior to start up. LED 11 will be ON. High pressure switch opens at 600 ± 10 psi and closes at 450 ± 10 psi.
    d. Low Pressure Switch – The low pressure switch operates primarily as a loss of charge protector. It must be closed for compressor start up and its LED 12 will be ON. Upon start up, the signal from the low pressure switch is ignored for 5 minutes. In some situations, particularly when the unit is cold, the pressure switch will open during start-

up. If the switch does not close within the 5 minute ignore period, the compressor will immediately be turned off. Low pressure switch opens at 60 ± 3 psi and closes at 90 ± 3 psi.

e. Air temperature sensor Ta – Sensor Ta will prevent compressor start-up if the air flowing through the unit is below 55°F. The sensor will also prevent the compressor startup or discontinue compressor operation if the air temperature is above 140°F and will reset at 135°F. A flash code of 4 will be initiated on the red diagnostic LED 15.
f. Water temperature sensor Tw – Sensor Tw will prevent compressor start-up and trip an alarm (a flash code of 3) if the outgoing fluid temperature is above 125°F and will reset the alarm at 120°F. The sensor will also trip at startup and during operation if the water temperature is below 55°F and will reset at 60°F.
g. Refrigerant temperature sensor Tr – Sensor Tr will prevent compressor start-up if the coil temperature is below 40°F and resets at 65°F. A flash code of 2 will be initiated on the red diagnostic LED 15.

Any of the above faults will be indicated via the diagnostic LED and the appropriate diagnostic flash code. Please note the temperatures provided might vary by ±5°F.

COOL OPERATION

2. Monitoring of the refrigerant cycle continues during operation of the compressor. The following malfunctions will cause the compressor to shutdown:
    a. If the head pressure exceeds the set point of the high pressure switch, the switch will open and the control board will terminate the compressor operation within 10 seconds. At this time a flash code of 6 will be initiated on the red diagnostic LED 15. Compressor operation will be restored in accordance with the “Intelligent Reset Algorithm” (see below).
    b. If the suction pressure drops below the set point of the low pressure switch, the switch will open and if it remains open beyond the 5 minute ignore period after start up, compressor operation will be terminated within 10 seconds. Compressor operation will be restored in accordance with the “Intelligent Reset Algorithm”. A flash code of 5 on the red diagnostic LED will be initiated at this time.
    c. ***Intelligent Reset Algorithm*** – If a low or high pressure switch opens and remains open for more than 10 minutes, a hard lockout will be initiated and the cooling mode will be locked off until the controls are manually reset. At the same time the fault relay K3 will be set to alarm; however, if the open switch closes within 10 minutes, a restart cycle is initiated. The restart cycle begins with a 10 minute delay after which if there is a cool call in place and all other enablers are within the start parameters, the compressor will again be put into operation. Should either of the pressure switches open again, the shutdown procedure will cycle again, followed by a restart. The intelligent reset will allow two open switch shutdowns and restarts in a 24 hour period and a third

shutdown within 24 hours will put the refrigeration system into a full and hard lockout, requiring a power down to reset. If two or less switch open shutdowns occur within a 24 hour period, they will be erased from memory and will not contribute to a future hard lockout. (A hard lockout will prevent compressor operation until the controls are powered down for at least 20 seconds, and the green power light goes out. A soft lockout is a compressor shutdown that will be restored once the condition causing the shutdown returns to normal.)

d. During compressor operation, refrigerant temperature, system fluid temperature, and discharge air temperature are continuously monitored. If the ***refrigerant temperature*** drops below 40°F, compressor operation will be disabled. After 10 minutes, an auto reset occurs and the compressor will be enabled as soon as the temperature rises above 65°F. Actual compressor restart will be delayed a minimum of 5 minutes by the anti-recycle timer. A flash code of 2 will be initiated upon a low refrigerant temperature shutdown.
e. During compressor operation, if the ***condenser leaving temperature*** rises above 140°F, compressor operation will be disabled. The compressor will be enabled as soon as the temperature drops below 120°F. The outgoing system fluid sensor is mounted on the leaving fluid pipe. Actual compressor restart will be delayed a minimum of 5 minutes by the anti-recycle timer. A flash code of 3 will be initiated upon a high outgoing system fluid temperature shutdown.
f. If the ***discharge air temperature*** drops below 40°F, compressor operation will be disabled. The compressor will be enabled as soon as the temperature rises above 55°F. The discharge air temperature sensor is mounted on the fan housing. Actual compressor restart will be delayed a minimum of 5 minutes by the anti-recycle timer. A flash code of 4 will be initiated upon a low discharge air temperature shutdown.
g. The condensate level sensor is a 100 ohm thermistor that is heated for 15 seconds every 4 minutes. Its temperature is measured at the beginning of the heat cycle, and again at the end of the heating cycle. If the condensate level rises above the sensor it will not warm up during the warm up cycle, and the temperature change will be insignificant. It is this lack of temperature change that the controller sees as an impending condensate overflow. When high condensate level is detected, compressor operation is immediately terminated, and at the same time the fan is stopped for 30 seconds, and then restarted. At this time a flash code of 7 will be initiated. The 4 minute cycle will continue until the cooling call is no longer in place. If the condensate level drops below the sensor, compressor operation will be returned to normal. However, if the condensate level stays above the sensor for more than 15 minutes, the fault alarm will be triggered. This fault signal will automatically reset once the condensate level goes below the sensor.

Note: The last flash code will be maintained in memory for one week or until the unit controls are powered down. The flash code will continue until the problem has cleared and the compressor has been

put into operation. If a cooling call is in place, it must be disengaged before the cause of the last alarm shutdown can be identified.

OPERATION ALGORITHM

There are several control algorithms to prevent cycling and problematic operation. These are:

1. Double Call – If thermostat connections or set up is incorrect resulting in a simultaneous call for both heating and cooling, the unit will not operate. This condition can be observed on the thermostat connection LEDs. (Note: A heat pump thermostat will present this scenario).
2. Reverse Cycle Call – Poorly located automatic changeover thermostats (ie. thermostats mounted on a wall opposite a discharge grill, or a thermostat in a doorway to outside) can trigger heating and cooling mode changes many times an hour. The CGC controller has a 10-minute anti-mode change timer when changing from cooling to heating operation. The controller will not accept a change in mode until 10 minutes have elapsed since termination of the opposite call.

THERMOSTAT CONNECTIONS

The CGC control board has been designed to operate with most standard 24V AC thermostats. These are powered from the CGC board with 24V AC and simply switch power ON to each of the Heat (W), Cool (Y), Fan (G) or Aux (A). While most present day thermostats operate in this manner there are others that may or may not work properly. The following should be checked out for satisfactory performance prior to installing:

1. Heat Pump Thermostat – Some heat pump units do not have heat relays (therefore are not compatible with standard thermostats) and require “Heat Pump Thermostats”. These thermostats call for both heating and cooling on one of the signal wires. These thermostats are completely incompatible with CGC’s controller.
2. Battery Powered Thermostats – These thermostats were developed as replacements for old mercury bulb thermostats that had 4 wire connections while 24V electronic thermostats required 5 wires. These will work with a CGC board, although CGC does not recommend them. They require periodic battery replacement, which is something that should be avoided if possible.
3. Power Stealing Thermostats – This type of thermostat is electronic and was also developed as a replacement for old mercury bulb thermostats. These too are problematic in that they bleed a small amount of current down the signal wires and this may be interpreted as a signal for heat or cool.
4. Triac Switched Controllers – This is a commonly used switching device and all controllers tested to date have functioned flawlessly. CGC recommends that prior to installation of a third party supplied controller, it be checked for compatibility. CGC can confirm this.
5. Relay Switched Controllers – This type of controller works well with CGC devices.

SHUTDOWN OUTPUT

The CGC board has an optional input terminal strip that allows for two types of remote shutdown. These are a) compressor shutdown and b) unit shutdown.
The advantage of these inputs is that many units can be connected in parallel and when powered by an independent 24V AC signal, one or both of these actions can be implemented. Common uses are:

a. Duty cycling for demand control
b. Global night setback
c. Heating-only mode during emergency power periods

The CGC controller is also set up so these shutdown functions can be initiated individually with on board 24V power. This capability allows unit or compressor shutdown based on a door switch, a light switch, or occupancy switch. A separate 24V power supply is required if two or more units are being shutdown.

FAULT ALARM OUTPUT

The CGC board is provided with a fault alarm indication and output. The fault alarm relay provides normally open and normally closed contacts for use in transmitting fault conditions. NOTE: The fault alarm is energized for NORMAL, and de-energized for fault. As such if the unit is not powered, if the board fuse is blown, or if the electronics are damaged, a fault condition will be indicated.

The fault relay is paralleled with the Fault LED which will be ON when no fault condition exists.
Other fault conditions are:

- Hard lockout due to high or low pressure switch being open for 10 minutes or longer.
- Hard lockout due to three high or low pressure shutdowns in a 24 hour period.
- High level condensate for in excess of 15 minutes.

ALTERNATE FUNCTIONS

Dehumidification cycle – When provided with an appropriate thermostat/humidistat, as well as dehumidification software and additional components, the CGC unit will provide space dehumidification. This is an optional feature.

Two compressor units – All units larger than 5 tons include single speed belt drive fans. Twin tandem compressors are standard on units 15 tons (SKV180) and larger, and optional on units between 6 (SKV070) and 12.5 (SKV150) ton units. These twin compressor units are controlled individually through on board relays K4 and K6 (this is a specially programmed board that uses relay K6 to activate the second compressor, rather than it being used to activate high fan speed). The control algorithms for these types of units will alternate which compressor is activated first, thereby allowing for equally distributed wear. Because tandem compressors share a refrigeration circuit, the standard single compressor algorithms are used to monitor and protect the compressors.

COMMISION & START UP

System Flushing:

Proper system cleaning and flushing is an important aspect of the commissioning and start up procedure for the units. Ensure the system has been flushed properly. This prevents fouling of the unit's heat exchangers. It is common for debris to settle out in areas of the system where there is low flow or low fluid velocity. This causes nuisance alarms as a result of a fouling heat pump. It is necessary to flush these units out as they appear to contain debris build up. This is the responsibility of the contractor and not a heat pump defect.

NOTE: Hydronic coils are not 100% drainable.

System Fluid:

Ensure that system water temperature is within an acceptable range to facilitate start-up (80°F - 120°F) for cooling and (100°F – 140°F) for heating.

System Water pH:

System water should have a neutral pH balance of approximately 7.5 which will extend the life of the hoses, heat exchangers, and other water side accessories.

Water Flow Rate:

Open all isolation valves to the unit. Ensure that the entering and leaving fluid temperatures of the BULLDOG unit in operation are acceptable. There is typically an 8 to 12 degree drop or rise in temperature, depending on whether the unit is in cooling or heating. Under extreme conditions, slight variances in the temperature may be noted.

Freeze Protection from water System:

Ensure that freeze protection is provided for the outdoor portion of the loop water system. Inadequate freeze protection can lead to coil damage.

NOTE: A potential issue may arise during construction where the system fluid loop is drained after being cleaned, flushed and tested. BULLDOG units will not completely drain and may hold fluid in the condenser or heating coil. Extensive damage may result to internal components if the system fluid freezes unless adequate glycol is added.

Remove Air from System fluid Loop:

Air in the system impairs unit operation and can cause erosion in the system piping.

Clean Unit Filters:

Confirm that the unit filters that are being used are clean. This contributes to the proper operation of the unit by ensuring that there is adequate air flow across the coil.

Air Balancing:

Air balancing of the system should be performed while the unit's fan is operating at high-speed. In order to ensure the fan is operating at high-speed, the unit must be placed into cool mode.

SAFETY NOTE:

In the following part of the procedure it will be necessary to access the areas around the electrical wiring and the circuit board. Do not adjust or remove any board connections or wiring connections to other components without first powering down the unit. Disconnects are usually within reach of the unit. **Exercise caution at all times.**

Verify Fan Rotation & Compressor Operation (3-Phase):

With the power OFF or open disconnect, inspect the fan section to ensure that it is clear of any debris and that the fan rotates freely. Remove the front panel and the electrical panel cover. Remove any thermostat block and turn power ON to the unit with the electrical disconnect. Ensure that the correct standby protocol is in place - the following board lights will come on in standby: *Power, HP, LP, and Alarm.*

Inspect the fan section to ensure that it is clear of any debris and that the fan rotates freely.

BULLDOG (008-060) SpaceKeeper Vertical units come equipped with a single-phase fan and single phase compressors that are matched to each other as well as the other internal components.

BULLDOG (024-060) SpaceKeeper Vertical units can be ordered with a single phase fan and a 3-phase compressor.

BULLDOG (070-320) SpaceKeeper Vertical units come equipped with a 3-phase fan and compressor that are matched to each other as well as the other internal components.

Although internal connections to the fan and compressor are made at the factory, variances in power supply in the field will require that components be tested for correct operation. The procedure is outlined below:

- Single phase fan motors will always turn in the right direction and are not phase rotation sensitive.

- 3 phase fan motors and compressors are matched at the factory. If the fan rotates backwards, so too will the compressor. Jog fan contactor to verify rotation. If the rotation is wrong, interchange two of the 3 wires at the power entering point.

- All 3 phase compressors have phase rotation monitors (Emerson Comfort Alert modules). If the rotation is reversed on a call for cooling, the phase monitor will trip a phase rotation alarm. If the rotation is wrong, interchange two of the 3 wires at the power entering point.

- Digital compressor units (3 phase) have a phase rotation monitor (Emerson Comfort Alert modules) on the incoming power or on the individual compressor. The monitor at incoming power will not allow the control voltage to reach the microprocessor unless phases are in correct rotation. The Emerson Comfort Alert modules will trigger an alarm will appear if rotation is wrong when the compressor is commanded to start.

If the operation is correct, power OFF the unit and replace the thermostat block, the electrical panel cover, and the front panel of the unit.

NOTE: This equipment is designed for indoor installation ONLY.

Start-up

To register the unit warranty proper start-up is required by a factory approved technician. The following items must be recorded and returned to the factory to register the warranty. The factory reserves the right to refuse warranty if these details are not provided.

Start Up Record

Page ____________

Project: ______________________________ Date: _______________ Tech: __________________________________

Location	____________	H	EWT	______	C	EWT	________	Fan Amps ____________
Model No.	____________	E	EAT	______	O	LWT	________	Compr Amps ____________
Serial No.	____________	A	LAT	______	O	EAT	________	Cond.Trap ____________
Voltage	____________	T	Valve	☐	L	LAT	________	S/R Correct ☐
						Sight Glass	☐	Fan Rotation ☐
Remarks						Belt Tension	☐	Comp Rotation ☐

S/R = Supply and Return

Location	____________	H	EWT	______	C	EWT	________	Fan Amps ____________
Model No.	____________	E	EAT	______	O	LWT	________	Compr Amps ____________
Serial No.	____________	A	LAT	______	O	EAT	________	Cond.Trap ____________
Voltage	____________	T	Valve	☐	L	LAT	________	S/R Correct ☐
						Sight Glass	☐	Fan Rotation ☐
Remarks						Belt Tension	☐	Comp Rotation ☐

S/R = Supply and Return

Location	____________	H	EWT	______	C	EWT	________	Fan Amps ____________
Model No.	____________	E	EAT	______	O	LWT	________	Compr Amps ____________
Serial No.	____________	A	LAT	______	O	EAT	________	Cond.Trap ____________
Voltage	____________	T	Valve	☐	L	LAT	________	S/R Correct ☐
						Sight Glass	☐	Fan Rotation ☐
Remarks						Belt Tension	☐	Comp Rotation ☐

S/R = Supply and Return

MAINTENANCE

WARNING:

To prevent injury or death due to electrical shock or contact with moving parts, disable the unit using the disconnect before servicing.

Inspect Filters:

Establish a regular maintenance schedule. Clean filters frequently and replace as required. A vacuum can be used to clean filters as well as the surface of coil components.

To remove the filter from the unit lift the filter up and pull it out of the unit from the bottom. Replace the old filter by sliding the top edge of a new filter up into the rack, then pushing in the bottom of the filter until it drops into place. In some cases, filters can also be slid horizontally for removal.

Check Fan motors annually:

All BULLDOG Heat Pumps are permanently lubricated when shipped from the factory. Do not oil fan motors. Check belt tensions (if applicable), ensure the wheel spins freely and that the components are free from dirt and debris.

Visual Inspection:

Visually inspect units and give special attention to hose assemblies. Note any signs of deterioration or cracking, and repair leaks immediately.

Amperage Check on compressor and fan motor:

Check that all electrical connects are tight. Current draw on this equipment should not exceed normal full load or rated load amps by more than 10 percent of the values noted on the unit nameplate.

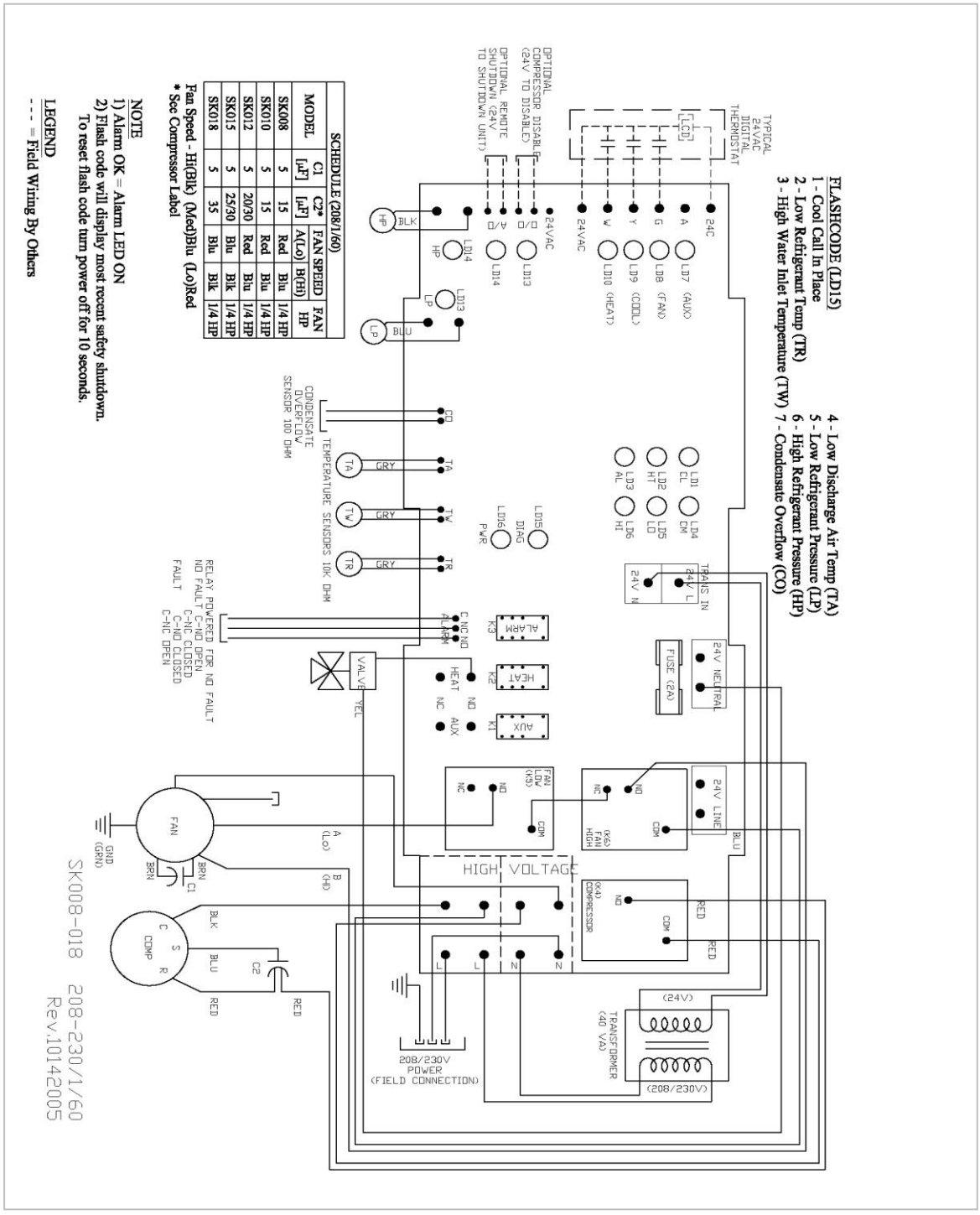
Safety Control Reset:

All BULLDOG Heat Pumps include high and low pressure switches to prevent the machine from operating under abnormal conditions of temperature or water flow. If multiple pressure alarms occur in 24 hours, the compressor operation will be permanently locked out until the unit is reset, or power is disconnected for 20 seconds.

NOTE: If the heat pump must be reset more than twice, check the unit for a dirty air filter, abnormal entering water temperature, inadequate water flow (ΔT method), or internal malfunctions that may be causing high or low pressure conditions. If the unit continues to alarm, contact a trained service technician and ensure the problems are resolved before continuing use of the unit.

ΔT Method: The **normal water temperature differential** for a BULLDOG Heat Pump is 8-15°F (4.4-8.3°C) in heating and 10-15°F (5.5-8.3°C) in cooling.

MAINTENANCE – STANDARD WIRING DIAGRAM



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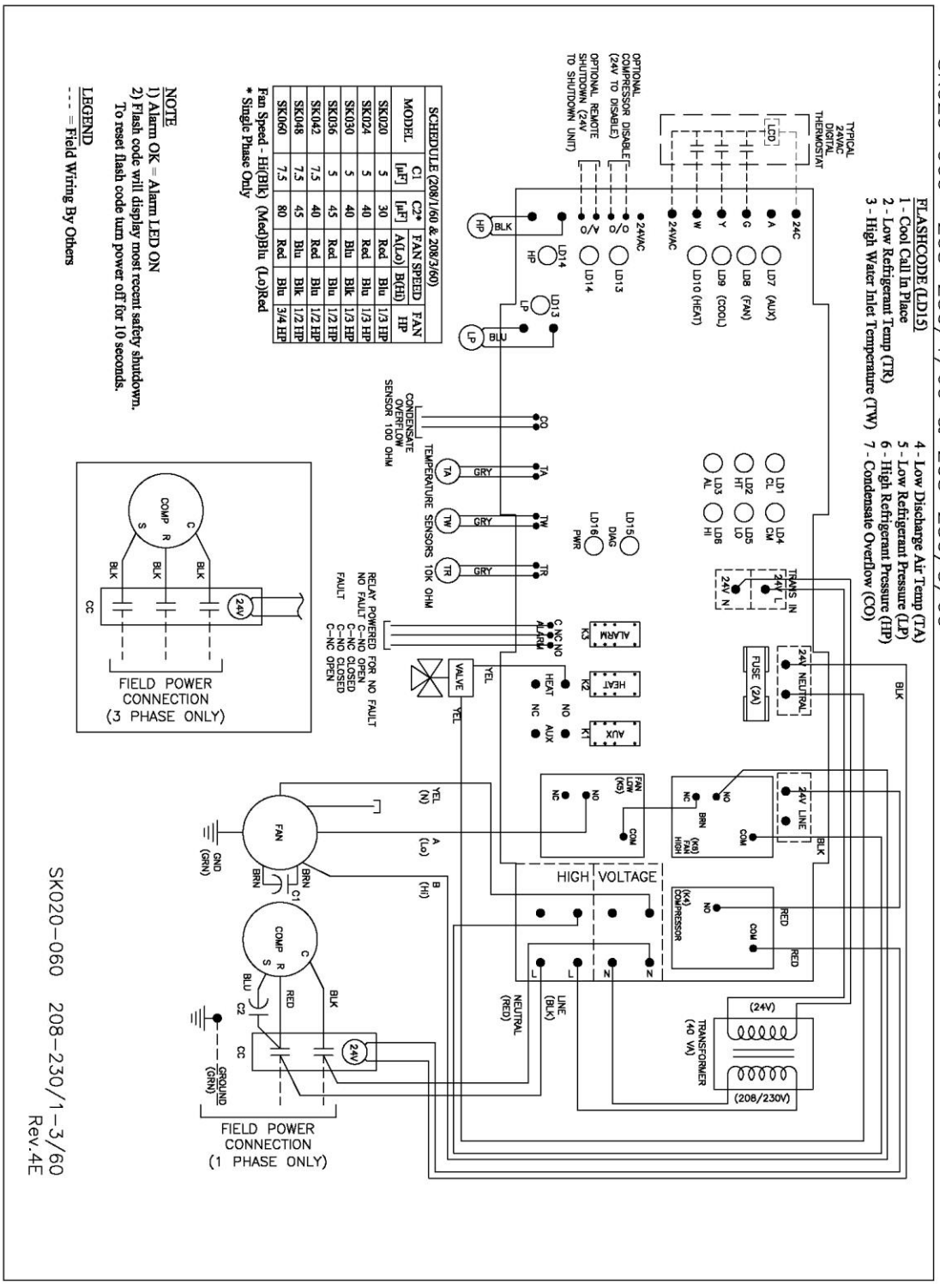

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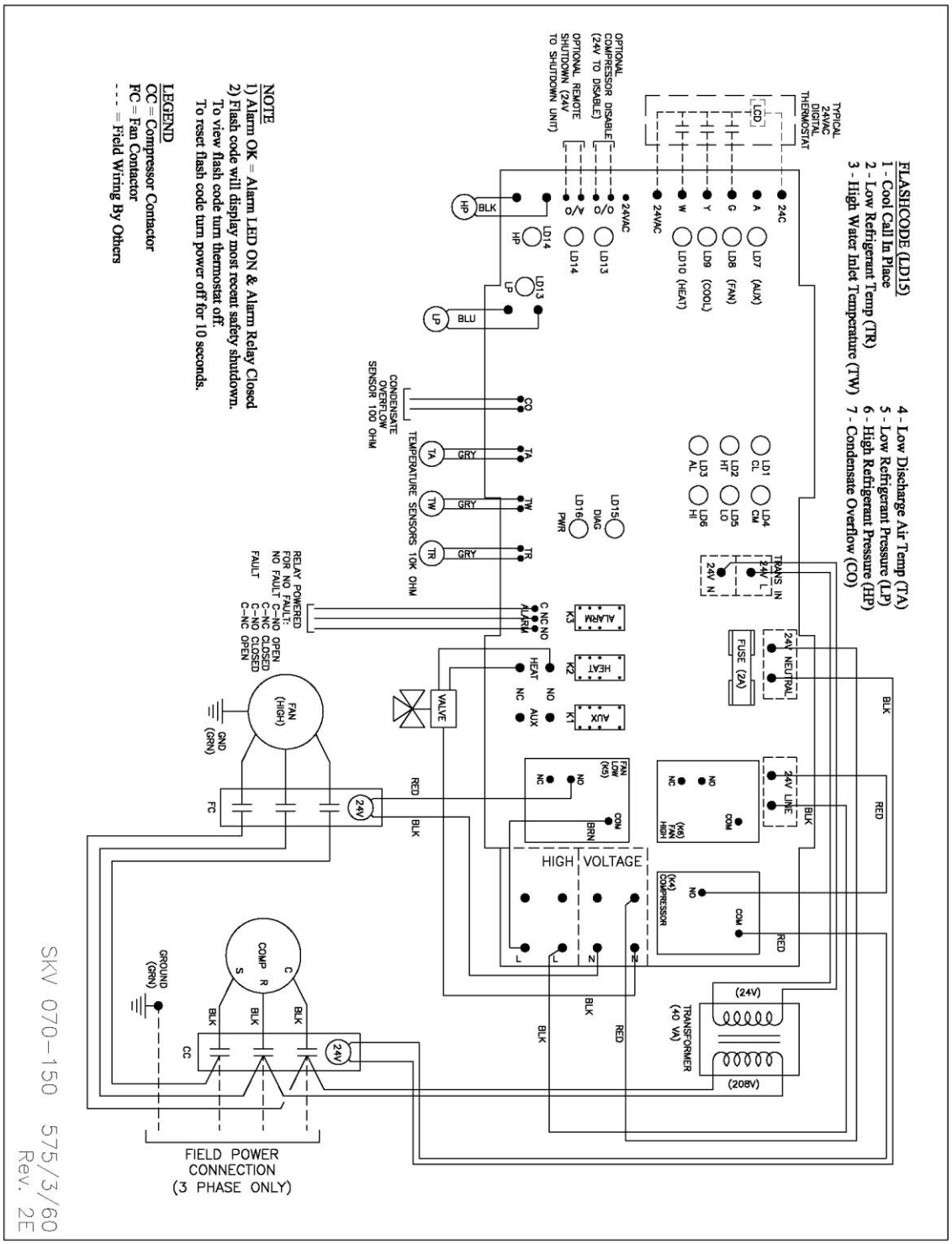

Typical