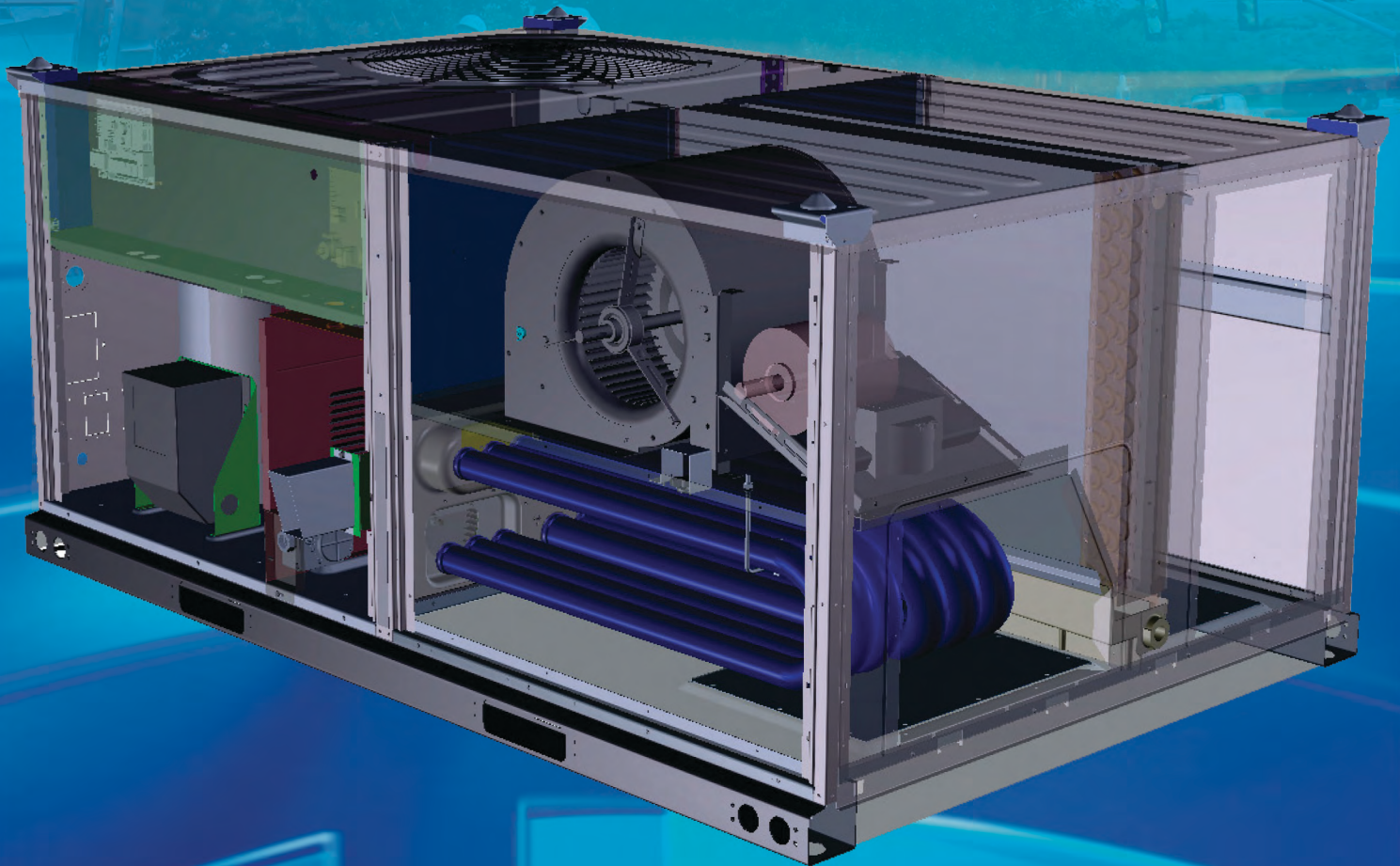


COMMERCIAL DIRECT REPLACEMENT UNIT TECHNICAL TRAINING



FAN-1512

Johnson Controls Unitary Products Commercial Direct Replacement Package Unit Technical Training

This manual presents information and guidelines for proper installation, adjustment, operation, and maintenance of Johnson Controls Unitary Products Commercial Direct Replacement package systems.

Read the Installation Manual, Technical Guide, and all available product information before attempting assembly, installation, start up, adjustment, or operation of any system. This manual does NOT replace these critical documents.

This information is NOT for unqualified personnel. It is intended for HVAC service and installation technicians that have had the proper industry training, as well as safety and operations training regarding electrical and gas systems.

This manual is intended as a general guide, and may not reflect exactly the current designs, or all of the options available to our customers. Please contact your local technical support representative regarding specific details of a particular model, configuration, or installation.

Every effort has been made to ensure the accuracy of the information in this manual. The information and specifications contained in this manual are subject to change without notice. Johnson Controls Unitary Products reserves the right to change such specifications at any time without incurring obligation.

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Chapter 1 - Introduction

Description



Figure 1 -1 Single compressor model

These units are available in 3 through 12-½ ton cooling capacities and are primarily intended for direct replacement of common United Technologies branded package units.

The unit dimensions and bottom duct openings are designed for reuse of existing United Technologies branded package unit roof curbs. In addition, side duct connections are identical and utility connections also closely align with that of the United Technologies branded package units for ease of retrofit unit installation.

A replacement matrix which cross-references models between brands is located in the Appendix of this manual.

The product line has two footprint sizes with two cabinet heights for each footprint. Cooling capacity and efficiency are determining factors for the unit cabinet that is used. Of note is that the 6 ton cooling capacity uses the small footprint for standard efficiency units and uses the large footprint for medium efficiency units.

Cooling Capacity	Efficiency	Cabinet	
		Footprint	Height
3 ton	std	small	short
	med	small	short
4 ton	std	small	short
	med	small	tall
5 ton	std	small	short
	med	small	tall
6 ton	std	small	tall
	med	large	short
7.5 ton	std	large	short
	med	large	tall
8.5 ton	std	large	tall
	med	large	tall
10 ton	std	large	tall
	med	large	tall
12.5 ton	std	large	tall

Table 1-1

Three phase, 60 Hz power supply options for 208/230, 460 or 575 VAC are available throughout the product line. 3 through 5 ton cooling capacity units also have power supply options for single phase 208/230 VAC, 60 Hz.

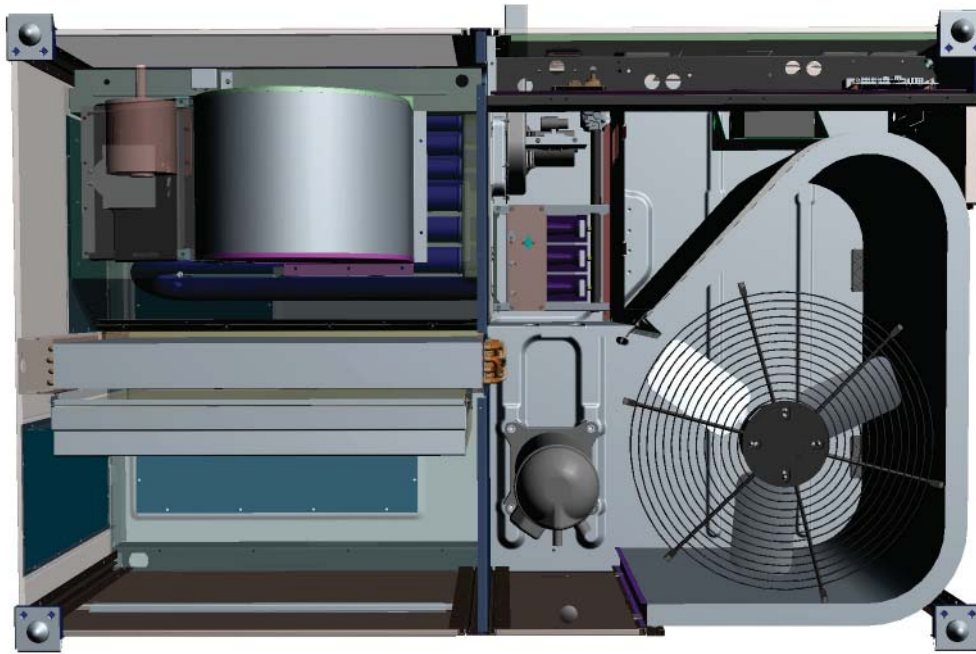


Figure 1 -2 Single compressor model top view

Belt drive blower options are available throughout the product line. The 3 through 5 ton cooling capacity units also have direct drive blower options.

R-410A and Copeland scroll compressors are utilized throughout the product line. 3 through 6 ton cooling capacity units have a single refrigerant circuit and 7½ through 12½ ton cooling capacity units have two refrigerant circuits. Depending on unit capacity and efficiency, thermal expansion valves or orifices are used for refrigerant metering.

Units are factory built in both cooling with gas heat or cooling-only configurations. 3 through 5 ton cooling capacity units have options for single or two-stage gas heat. Gas heat options for 7½ through 12½ ton cooling capacity units are all two-stage. Field-added electric heat accessories are available for cooling-only units. Heat pump and hot gas reheat configurations are not available in the initial release of this product line.

Because of the retrofit/replacement nature of this product line, there are fewer factory-installed options and accessories when compared to other Unitary Products product lines. Tool-less access cabinet, low NOx gas heat, coil coating, and electrical options are only available through factory built order. Downflow economizer, sensor and louvered condenser panel options are available either through factory built order or as field installed accessory kits. All other accessories are field installed to meet application needs.

3-12.5 Ton Model Number Nomenclature

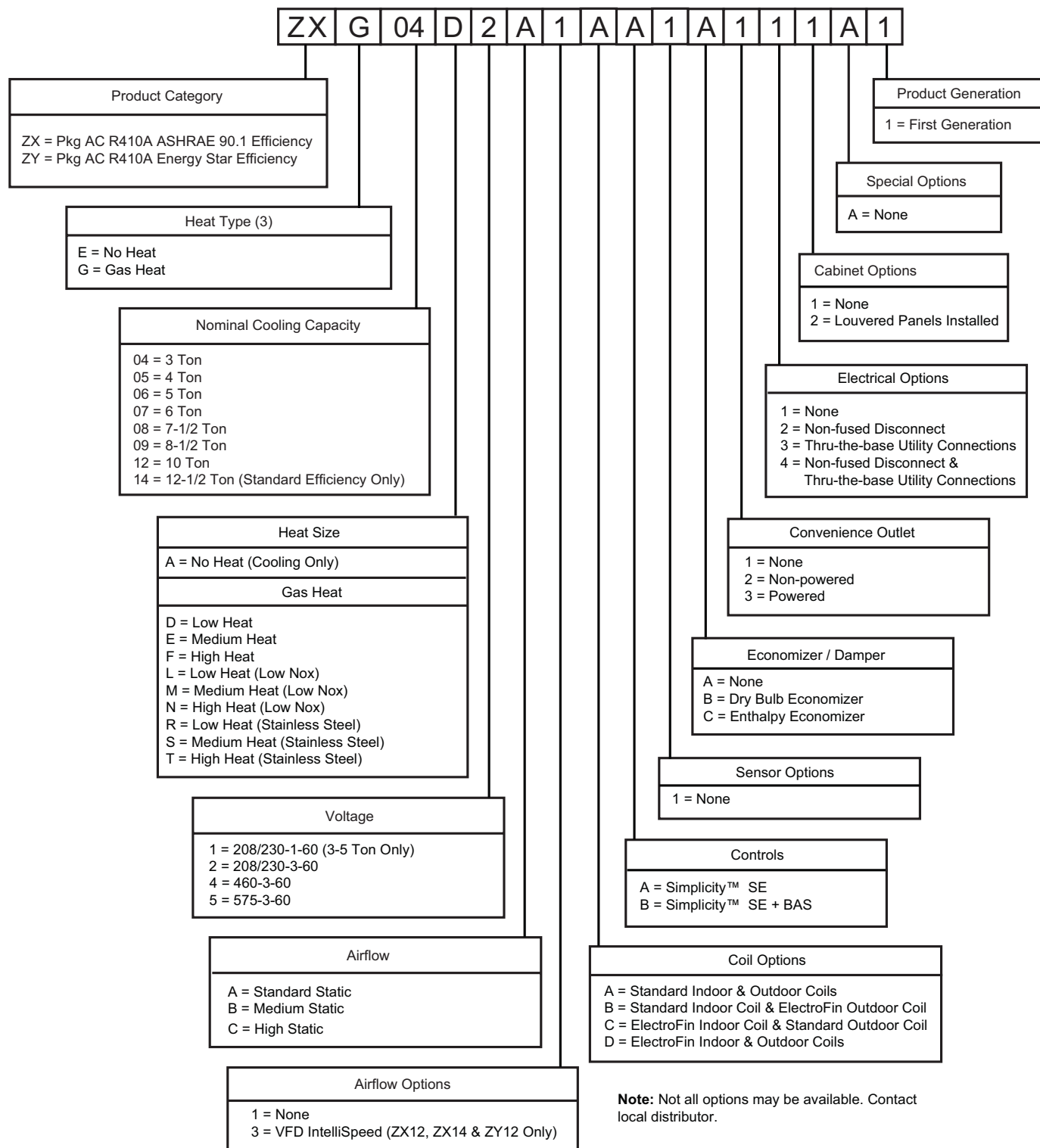


Figure 1 -3 Nomenclature

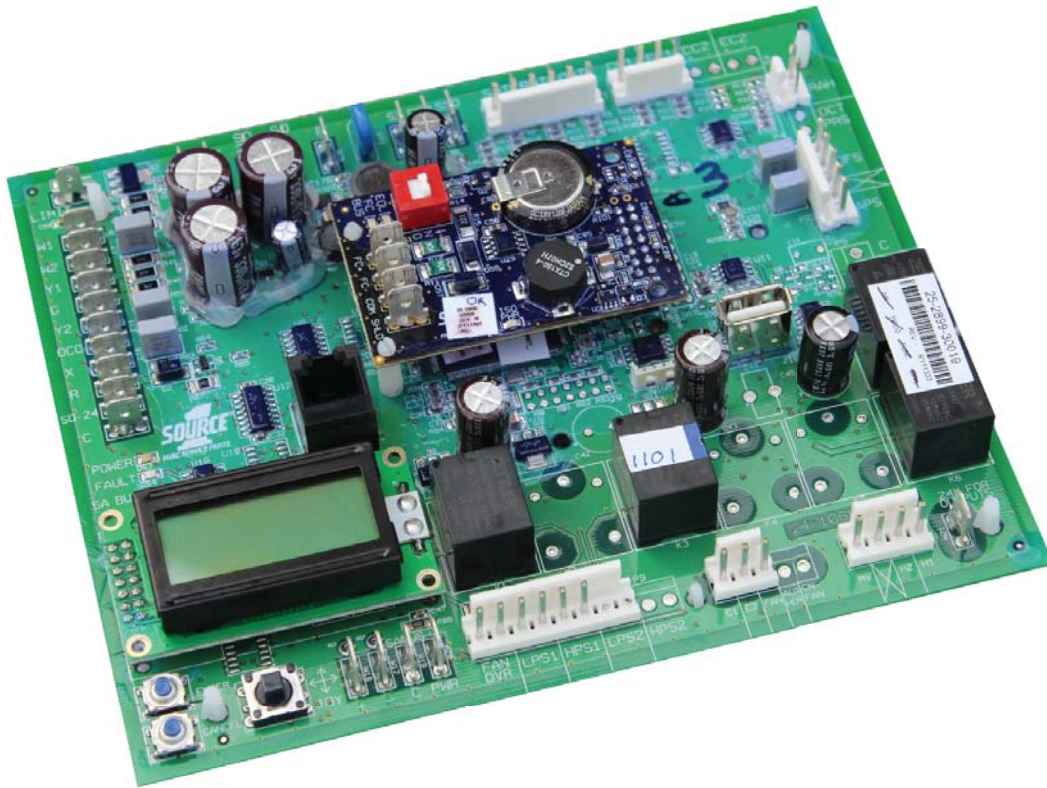


Figure 1 -4 Simplicity SE control

Smart Equipment is a unified platform for controllers in commercial unitary, chiller and air handling products manufactured by Johnson Controls. This product line introduces the Simplicity SE unit control board (UCB) as the primary system control. This controller incorporates basic compressor protection, indoor blower control and advanced features such as integration of ventilation control.

The Simplicity SE control board allows flexibility for comfort control input from:

- a wall thermostat
- thermistor sensors included with the unit
- a communicating NetSensor
- communicated sensor values when BAS integration is utilized

Basic technician access to the control parameters of individual Simplicity SE boards is made through the on-board joystick, enter or cancel buttons and the 2-line by 8-character display. For the technician and end-user, the use of the MAP Gateway device permits web browser access to individual and networked Simplicity SE boards. An on-board USB port for flash drive connection allows back-up and restoration of control parameters as well as Simplicity SE board firmware upgrade.

Networking-capable options for unit integration to building automation systems have a communication sub-board added to the UCB, this sub-board is the termination point for the network cable. BACnet MSTP is the standard communication protocol for networking-capable Simplicity SE board options.

Chapter 2 - Safety

This manual must be used in conjunction with and Does Not Supersede the Installation Manual and the Tech Guide provided with the equipment. Always read and follow all instructions before installing equipment. Understand and pay particular attention to the signal words DANGER, WARNING, and CAUTION.

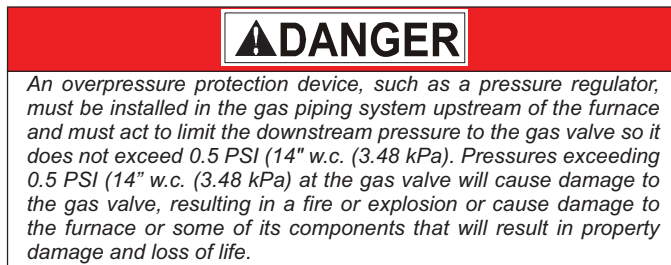


Figure 2-1 - Danger label

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

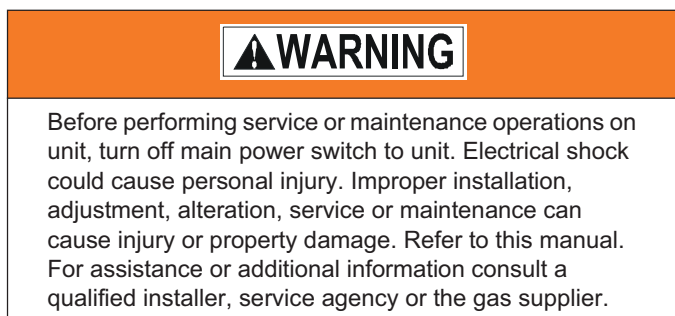


Figure 2-2 - Warning label

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

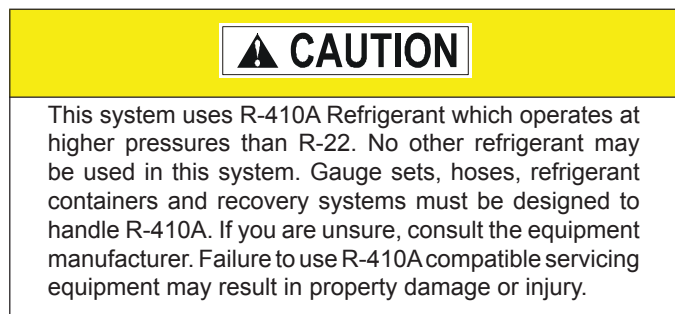


Figure 2-3 - Caution label

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.

Safety Alert Symbol



When this symbol is identified within this manual, the technician should be alert to the potential for personal injury.

Figure 2-4 - Safety alert symbol

Specific Safety Rules

Follow these specific safety rules for a safe application.

- Air conditioning systems utilizing gas heating can only use natural gas or propane (LP) gases as an approved fuel. LP applications require installation of the appropriate LP conversion kit. Refer to the unit rating plate or Installation Manual for information on proper inlet and manifold pressures.
- Install commercial package systems only in locations and positions as specified in the Installation Manual.
- Provide adequate clearances for service, combustion and ventilation air to the unit. The recommended clearances are specified in the Installation Manual.
- Test for gas leaks as specified in the Installation Manual.
- Only connect the equipment to a duct system which has an external static pressure within the allowable range as specified in the Installation Manual.
- These units are not to be used for temporary heating or cooling of buildings or structures under construction. Improper installation will shorten equipment life, reduce product efficiency, and void the warranty.
- Always install the system to operate within the equipment's intended temperature and operating ranges.
- The size of the unit should be based on an acceptable and approved heat load calculation for the structure being conditioned.

Safety Requirements

Follow these safety requirements for a safe application.

- All equipment should be installed in accordance with all national and local building/safety codes and requirements, local plumbing or waste water codes, and other applicable codes. In the absence of local codes, install in accordance with the most recent National Electrical Code, National Fuel Gas Code, and/or Natural Gas and Propane Installation Code (latest editions).
- Only approved heat accessories shall be installed on these air conditioning units.
- Refer to the unit rating plate for the equipment model number, and refer to the Installation Manual for proper air plenum dimensions.
- Provide clearances from combustibles as listed under Clearances to Combustibles in the Installation Manual and the equipment rating plate.
- Provide clearances for servicing.

- Failure to carefully read and follow all instructions in this manual and the equipment Installation Manual can result in equipment malfunction, death, personal injury and/or property damage.
- Check the rating plate and power supply to be sure that the electrical characteristics match. All commercial 3 through 12.5 ton units use nominal 208/230 volts AC or nominal 460 volts AC, 60-Hertz power supply. **DO NOT CONNECT THIS APPLIANCE TO A 50 HZ POWER SUPPLY OR A VOLTAGE OTHER THAN THE RANGE SPECIFIED ON THE UNIT DATA TAG.**
- The equipment shall be installed so the access panels are readily available and the electrical components are protected from water infiltration.
- Installing and servicing HVAC equipment can be hazardous due to the electrical and mechanical components. Only trained and qualified personnel should install, repair, or service HVAC equipment. When working on equipment, observe precautions in the manuals and on the labels attached to the unit and other safety precautions that may apply.
- The Installation Manual covers minimum requirements needed to conform to existing national standards and safety codes. In some instances, these instructions exceed certain local codes and ordinances. These instructions are required as a minimum for safe installation and operation.

The following safety precautions are related to Variable Frequency Drives (VFD) used in some models.

- There is electric shock risk on a de-energized VFD due to the large capacitors used internally for AC to DC rectification. Before opening VFD covers disconnect all power to the VFD and allow at least 10 minutes for the capacitors to discharge.
- High energy flows through the VFD and the VFD is mounted near the rotating blower. Service procedures done on energized VFDs require keypad removal and remote access using an extension cable.
- If improperly set, VFD parameters and settings have the potential to create a hazard in an HVAC blower application. Factory-installed and replacement part VFDs have all parameters pre-set for the specific unit model. Only parameters related to frequency output and ramping times are conceivable to adjust for field needs.
- Refer to the VFD vendor documentation supplied with the unit for additional safety precautions specific to the model of VFD used in the application.

General Awareness

Safety is ALWAYS the primary concern for everyone. On the job injuries can be significantly reduced when proper guidelines are followed. Always be aware of all company, local, state and/or OSHA (Occupational Safety and Health Administration) regulations.

Job Site Safety

Keeping the job site clean of trash, extra tools and equipment will significantly reduce the chance for injuries. Since each job is unique and has its own hazards, all new workers to the area should be made aware of the location of fire and first-aid equipment, fire escape routes, and other dangers.

Hazardous Materials

Many different chemicals and compounds are used in the service and installation of HVAC systems. Please read the directions and use caution along with PPDs whenever handling these materials. Read and understand the MSDS (Material Safety Data Sheets) for all materials used.

Confined spaces

Never enter or work in a confined space without taking the appropriate precautions. Have someone available outside the space ready to assist or summon help if necessary. Even spaces that seem relatively safe can quickly become hazardous if a pipe were to break and fill the space with refrigerant, steam, poisonous fumes or other gases. Welding or brazing in a confined space is especially hazardous.

Pressure

High pressures have always been part of the HVAC profession. With the new refrigerants, such as R-410A, it is even more crucial that technicians realize the dangers of these gases. Wear the proper personal protective devices including safety glasses and gloves. Proper hose ratings and manifolds are required for the new high pressure refrigerants.

Electrical Safety

Jewelry should be removed prior to any electrical work being performed. Ensure that the equipment disconnect switch removes the primary power source prior to taking resistance readings or disconnecting any wires or connections. Removal of system power should be verified with the voltage function of a multi-meter. All electrical safety guidelines should be followed at all times. Only trained, qualified technicians should perform electrical maintenance, installation, inspections and troubleshooting of electrical equipment.

Electrocution occurs when a current as low as 6 to 200mA flows through the heart, disrupting its normal operation and causing death. Electrical shock is an injury that occurs as a result of exposure to an electrical current. Inspect all extension cords and power tools regularly. Fuses and circuit breakers are designed to protect equipment, not people. For personal electrical protection, GFCI or Ground Fault Circuit Interrupters are highly recommended.

Lock-Out Tag-Out



OSHA Standards cover the servicing and maintenance of machines and equipment, in which unexpected energizing or start up of the machines or equipment, or release of stored energy, could cause injury to employees.

These standards establish minimum requirements for the control of such hazardous energy. To ensure safety, put a lock that is tagged with the technician's name on the electrical disconnect or breaker of the equipment or circuit which is being serviced.

Be aware of others who may be working on the same circuit or other circuits served by the same electrical panel. The technician should also be aware that other technicians may not have used the proper Lock-Out, Tag-Out procedures.

Figure 2-5 - Lockout device

Fire Safety and Burns

While brazing, keep the area clear of combustible material or use a heat shield to help reduce risk of fire.

Check equipment regularly and never try to modify or repair regulators.

When servicing the refrigeration circuit, improper use of equipment and tools can result in serious burns that are associated with refrigerants. This may include frostbite, which is a deep tissue injury. Proper personal protection devices must be in use when servicing the refrigeration system.

Personal Safety

Personal safety includes remaining aware of the surroundings at all times, using properly maintained tools, and correct use of items designed for personal protection.

Personal Protection Devices (PPD)

Hard Hat: Hard hats must be worn when there is a danger of head injury.

Safety Glasses: Eye protection should be worn at all times while on a job site.

Gloves: Assist in the prevention of serious injury to the hands from serious cuts as well as injuries from high pressure gases such as refrigerants.

Rubber gloves can protect the technician's hands from chemicals when inspected and worn properly.

Safety Shoes: Work shoes with steel toes for foot protection. There are also electrical safety shoes that can aid in protecting the technician against electrical shock and/or electrocution. At a minimum, leather work shoes with rubber soles are required.

Respirator: Used in a confined space where the air can be dissipated by refrigerant which can cause asphyxiation.

Safety Harness: Used when working above grade level. Ladders must be tied down. Ensure that PPDs provide the intended protection. They should be inspected regularly, used properly and never altered or modified in any way.

Clothing

Rotating and moving components pose a serious risk. Loose fitting clothing and ties should not be worn when servicing rotating equipment. If any clothing becomes entangled in moving parts, serious injury or death is a likely result.

Jewelry

Serious injury or death can result if jewelry makes contact with an energized circuit or is caught in moving parts. Leave jewelry at home or in your service bag or service vehicle.

Lifting

To avoid back injuries, always adhere to proper lifting techniques. Be aware of personal limitations and seek help with items that are too heavy to safely lift. A back support belt may provide additional protection.

Chapter 3 – Component Familiarization

Cabinet Features

Extrusion forming and powder paint are used for exposed panels on the product line; therefore, the bulk of the unit a technician will come in contact with has rounded corners and the sheared edges of the sheet metal are covered. The tool-less access option eases access to the compartments that the technician will need to use for service or maintenance. Slots in the permanently attached baserails allow forklift handling from either the front side, back side or left end. Holes in the baserails at the unit corners are to anchor clevises to work in conjunction with field-provided spreader bars for crane lifting.

A single-piece roof panel is used throughout the product line. Small footprint units have a single condenser fan assembly mounted to the roof panel. Large footprint units through 10 ton cooling capacity have two condenser fan assemblies mounted to the roof panel. 12½ ton cooling capacity units have a single, 30" blade condenser fan assembly mounted to the roof panel.

All product literature uses the reference orientation for the unit as facing the control panel. Access for the control compartment, heat section and blower section are made from the front side of the unit. The condenser is located on the left end of the unit. Condensate drain line and side duct connections are located on the right end of the unit. Filter access and fresh air accessories are located on the back side of the unit. Filter racks are field convertible for either 2" or 4" depth filters.



Figure 3 -1 Small footprint model: front left view



Figure 3 -2 Large footprint model: back right view

Units are factory-shipped for through-the-curb bottom duct connections. The bottom duct connections have raised openings to prevent inadvertent water entry through the basepan. Removal of the side duct connection covers and relocation of the covers over the bottom duct openings is made for field conversion of units in horizontal duct applications.

The front side, left panel allows control compartment access. Gas heat units have a removable inner divider panel behind the front side, left panel for full access to the gas heat components. Compressor access is also through the front side, left panel on large footprint units. Small footprint units have a compressor access panel located on the back side of the unit.

The gas heat flue is located low on the center of the front side of the unit. The flue discharges horizontally and field-installed flue shield accessories are available for applications where prevention of personnel contact with hot surfaces is desirable. Flue extension accessories that redirect the flue gasses upwards are available for applications where there is marginal front side clearance or another unit fresh air intake is nearby.

The front side, right panel allows blower compartment access in the upper section. Gas heat units have a removable inner panel behind the front side, right panel for inspection of the gas heat exchanger in the lower section. The front side, right panel allows installation and access to electric heat accessories in the lower section of cooling-only units.

Coils

The condenser and evaporator coils are a draw through design where the coils are located on the suction side of the fan or blower. Both condenser and evaporator have factory-coated options available for corrosion resistance in harsh environments.

Evaporator coils are rifled tubing and sinewave fin construction. The height, number of rows, and depth of the coils vary by model. Refrigerant metering by either fixed orifice or thermal expansion valve is used in the various models of the product line. Distributor tubes of evaporators without coating options are sleeved to prevent leaks due to rubbing.

Evaporator coils on 7-½ through 12-½ ton cooling capacity units have intertwined circuitry for the two refrigerant circuits. In other words, the tubes alternate between refrigerant circuit #1 and refrigerant circuit #2 throughout the evaporator assembly. Intertwined evaporator circuitry allows the compressor equalized run time (“lead lag”) feature to be used without a negative impact on cooling humidity control performance.

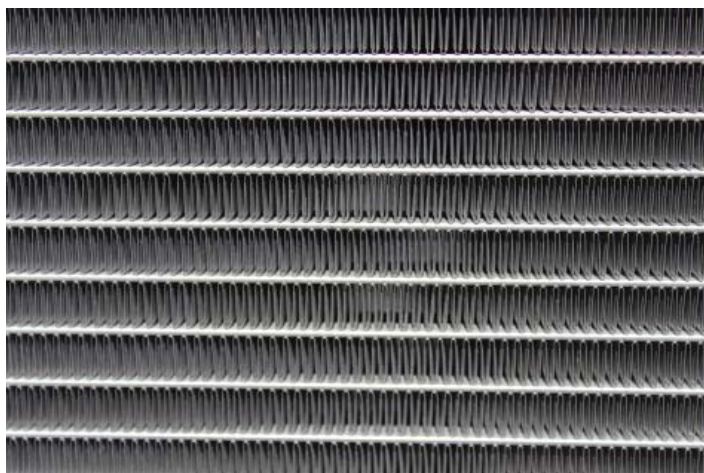


Figure 3 -3 MicroChannel coil

The all-aluminum construction of MicroChannel is more corrosion-resistant than the copper / aluminum of a fin and tube condenser.

Microchannel coils can be repaired, if needed, through the use of required solder and instructions provided in the Source 1 Microchannel Repair Kit.

The product line utilizes 2-pass MicroChannel condenser coils. The “2-pass” term refers to the circuitry of the coil. The first pass, through the top 2/3 of the MicroChannel condenser coil, has parallel refrigerant flow in the tubes from the discharge header to the intermediate header. The second pass, through the bottom 1/3 of the MicroChannel condenser coil, has parallel refrigerant flow in the tubes from the intermediate header to the liquid header. The multiple refrigerant paths within each of the flat tubes of MicroChannel offer improved heat transfer and unit efficiency in a smaller physical size than a fin and tube condenser.

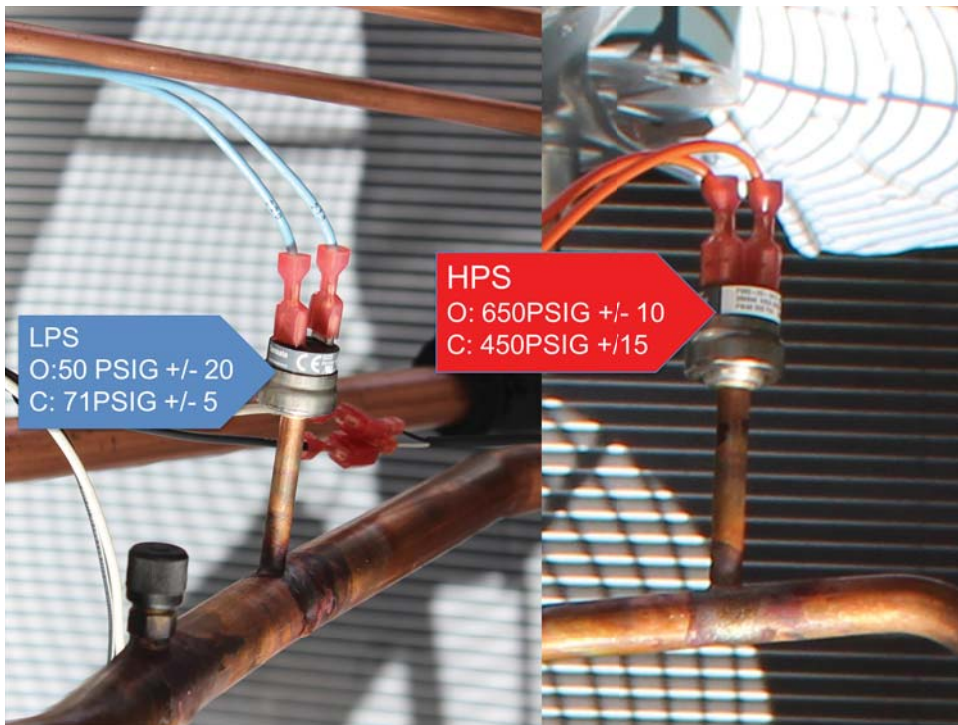
Liquid Line Filter Driers



Accessed through the compressor compartment, a solid core filter-drier is placed near the inlet of the metering device. Two circuit systems contain two filter driers, one for each circuit.

Figure 3 -4 Filter-drier

Low and High Pressure Switches



Low and high pressure switches are provided for each refrigerant circuit. The low pressure switch (LPS) opens at 50 PSIG +/- 20, reclosing at 71 PSIG +/- 5 PSIG. The high pressure switch (HPS) opens at 650 PSIG +/- 10 PSIG, reclosing at 450 PSIG +/- 15 PSIG.

Figure 3 -5 Pressure switches

Condensate Drain



Figure 3 -6 Condensate drain connection

The product line uses compression molded composite material condensate drain pans. The drain pan outlets are $\frac{3}{4}$ " female IPT and are positioned for line connection on the right end of the unit or through-the-curb. The through-the-curb connection is plugged as shipped from the factory; removal of the plug and re-installation of the plug in the side connection is needed for field-conversion of the drain line connections.

The condensate line fitting field-connected to the drain pan outlet is tightened no greater than the maximum torque value published in the Installation Instructions. Pipe thread sealants are not recommended for use on the fitting connected to the drain pan outlet. A trap with a minimum depth of 3" must be included in construction of the condensate line. The condensate line must be supported so that condensate pan breakage is avoided.

The drain pans also provide support for the evaporator coil and are not removable for service.

Indoor Blower

The indoor blower assembly is accessed through the upper right panel on the front side of the unit.

Smaller capacity models have factory order options for a direct drive or a belt drive indoor blower. 6 through 12½ ton models only have belt drive blower factory order options. Standard, medium and high static belt drive options increase the range of blower wheel speed through changes to pulley size and motor horsepower requirements.

Belt Drive Blower Models

A single "A" profile belt is used in all units with a belt drive indoor blower. Blower bearings are sealed and require no additional lubrication over their lifetime.

Proper rotation for the blower wheel is counter-clockwise viewed from the belt side of the blower assembly.

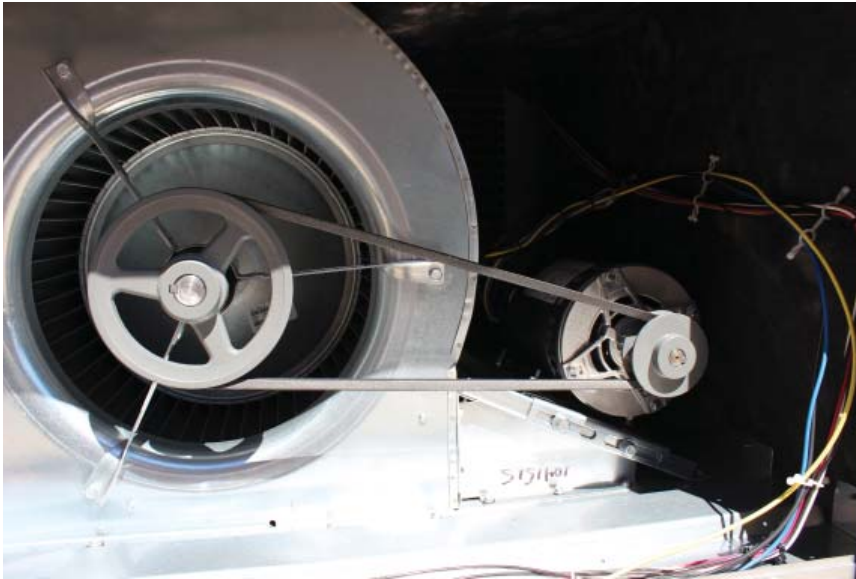


Figure 3 -7 Belt drive blower assembly

Prior to unit start up and periodically with maintenance checks, set-screws for the blower assembly pulleys, bearings and blower wheel should be checked for proper torque. Belt alignment should be verified as well.

The variable pitch motor pulley allows adjustment of the blower speed. Closing the variable pitch pulley, by turning the adjustable half, increases the pitch diameter of the pulley, which increases the blower wheel speed and the airflow.

The set screw for the adjustable half should only be set to the flat areas on the fixed half of the pulley. Belt alignment should be verified once blower speed adjustments are complete.

Direct Drive Blower: X-13



Figure 3 -8 X-13 blower motor

The X-13 motor is used on 3 through 5 ton models with the direct drive blower option. Because the X-13 motor consumes less power to produce airflow than a comparable PSC motor, equipment efficiency needs are satisfied by the usage of this motor.

Externally, the X-13 motor is the same diameter but is somewhat longer than a traditional PSC blower motor. The X-13 motor is mounted within the blower assembly in the same manner as a PSC motor with the following exceptions:

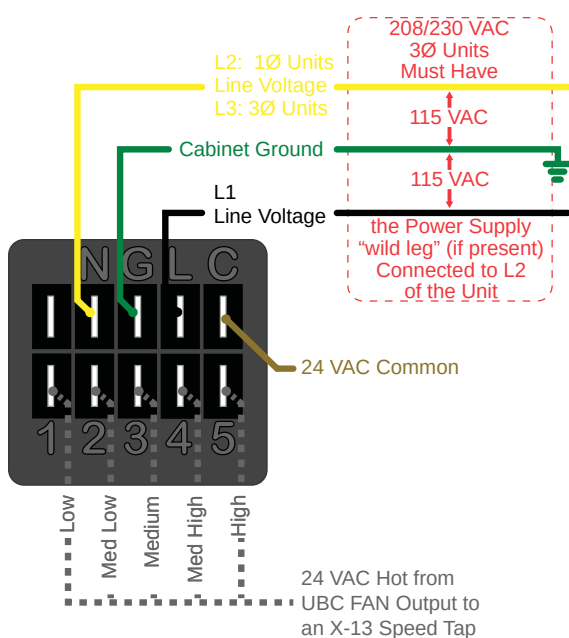
- The bellyband of the mounting bracket must be located in the area between 2- $\frac{3}{4}$ " from the control end of the motor and the ventilation slots on the shaft end of the motor
- Water must be prevented from entering the motor. The horizontally mounted motor must be oriented so the wiring connections are downward, and a drip loop is formed in the wiring harness near the motor connections to prevent water entry

Unlike a PSC motor, the X-13 motor is continuously powered by 208/230 VAC and a separate input of 24 VAC provides the X-13 motor an enable / run command.

Internally, the controls housed in the end of the X-13 invert AC power to DC power and manipulate the DC power to the permanent magnet motor portion of the X-13. The X-13 controller monitors internal feedback and varies motor speed to maintain a motor torque setting that correlates to an airflow profile for the unit application. The torque settings are determined by the profiles programmed in manufacturing for the unit application and the 24 VAC enable / run command input from the unit controls. Similar in function to “speed taps”, each of the five terminals for 24 VAC enable / run command input on the X-13 have a different torque setting for field adjustment of unit airflow.

While performance is better than a comparable PSC motor, static pressure remains an influence on airflow delivery for a blower with an X-13 motor. For a given motor setting, less airflow is delivered when the blower works against increased static pressure and more airflow is delivered when the blower works against decreased static pressure. In a commercial package unit, both the external static pressure of the duct system and the internal static pressure of components within the cabinet contribute to the static pressure the blower works against to produce airflow. Other notable characteristics of X-13 motors and their usage in commercial package units:

- It is normal for the rotor to rock back and forth briefly at initiation of the enable / run command
- Soft start & stop features:
 - A short period of ramped motor speed occurs when the enable / run command is initiated or terminated
 - It is normal for the motor to speed up or slow down with changes to the static pressure that the blower works against (typically observed during service when unit panels are opened or closed)



The 208/230 VAC connections are 3/16" push-on terminals, and are assigned as follows:

- L = line 1
- G = cabinet ground
- N = line 2 (1Ø units) or line 3 (3Ø units)

Figure 3 -9 X-13 Motor Connections

The 24 VAC connections are 1/4" push-on terminals:

- C = 24 VAC common
- The 24 VAC hot enable / run command connects to one (or more) of the input terminals (speed taps) numbered 1 through 5:
 - 1 = low setting
 - 2 = medium low setting
 - 3 = medium setting (factory connected)
 - 4 = medium high setting
 - 5 = high setting

If more than one enable / run command is present the motor operates to the higher setting. If the motor must be replaced, only a direct replacement must be used. This ensures the airflow profiles programmed in manufacturing are correct for the unit application.

Basic electrical troubleshooting for the X-13 motor consists of:

- Ensure 208/230 or 460 VAC is present at the L and N terminals depending on model
- Ensure 24 VAC is present from C to one of the 1 through 5 terminals

The X-13 motor has failed if both line voltage and the enable / run command are present and the motor does not operate. Water entry to the motor and over-voltage conditions are common causes for X-13 electrical failure, these causes should be investigated and corrected before a direct replacement motor is installed.

Although less common due to the usage of sealed ball bearings, the X-13 motor is still subject to mechanical issues such as bearing failure. Water entry to the motor and blower wheel imbalance are common causes for direct drive motor mechanical failure. These causes should be investigated and corrected before a direct replacement motor is installed.

Gas Heat Section

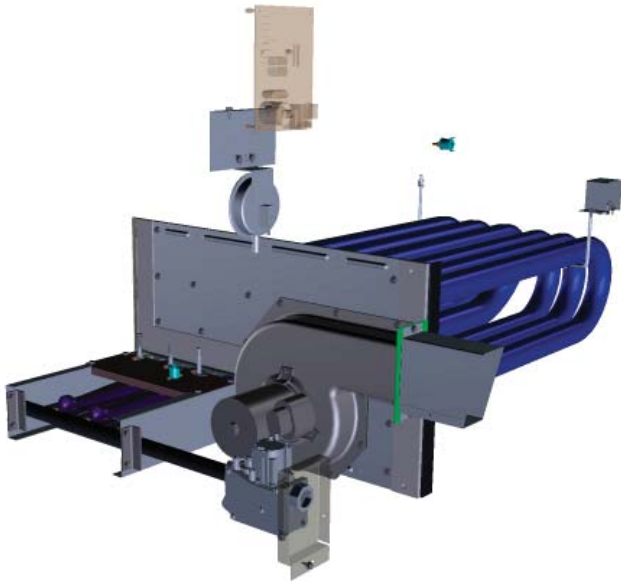


Figure 3 -10 Gas heat section

This product uses a single gas valve, manifold and burner rack. A two stage gas valve is used in units having standard or optional 2-stage gas heat. First stage capacity is 70% of full capacity for 2-stage gas heat sections having 180 K Btu or less rated maximum input. First stage capacity is 80% of full capacity for 2-stage gas heat sections having 220 K Btu rated maximum input..

The gas supply inlet connection is $\frac{1}{2}$ " IPT on small footprint units and $\frac{3}{4}$ " IPT on large footprint units. The gas supply line must include a drip leg and be constructed in accordance with applicable mechanical codes. Gas inlet pressure cannot exceed 14" water column (0.5 PSI). For natural gas, minimum gas inlet pressure for safe operation is 4.5" water column and minimum gas inlet pressure for full capacity heating operation is 6.0" water column. For units field-converted to use propane, minimum gas inlet pressure is 11.0" water column.

Based on natural gas with 1030 BTU per cubic foot heat content and altitudes below 4000 feet, initial settings are as follows:

- For single stage gas heat sections the manifold pressure is 3.5" water column
- For two-stage heat sections the high fire manifold pressure is 3.5" water column and the low fire manifold pressure is 1.5" water column

Because the heat content of the natural gas supplied varies by location, field confirmation of actual firing rate using the method described in the unit Installation Manual is required.

Adjustments of up to +/- 0.3 inches water column to the initial manifold pressure settings are permitted to achieve the proper firing rate.

Using the propane conversion kit at altitudes below 4000 feet, initial settings are as follows:

- For single stage gas heat sections the manifold pressure is 10" water column
- For two-stage heat sections the high fire manifold pressure is 10" water column and the low fire manifold pressure is 4.5" water column

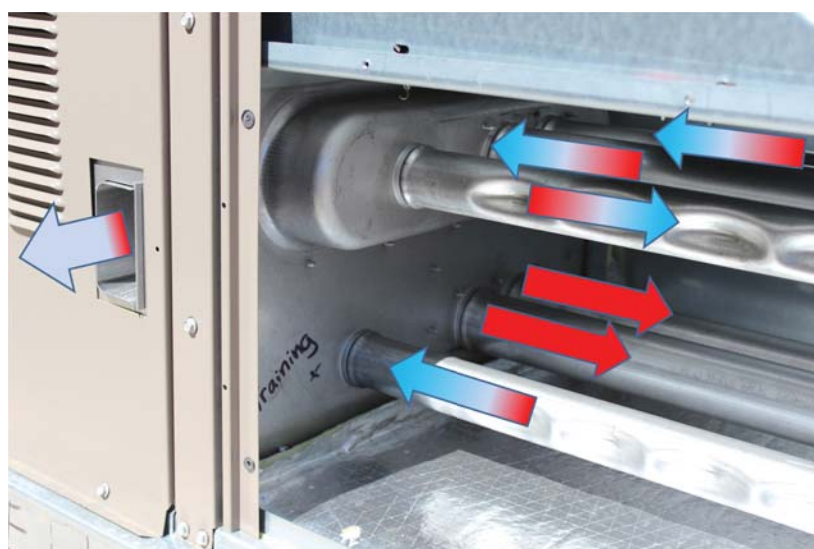
Gas heat unit application at altitudes above 4000 feet requires field-installation of a natural gas or propane high altitude conversion accessory kit. Manifold pressures required at high altitude are detailed in the accessory kit installation instruction document.



Depending on model, two to five inshot burners with integrated flame carryover slots are used. The top cover plate over the burner rack is removable for service access to the burners. The spark ignitor, flame sensor and rollout switch also mount to the top cover plate over the burner rack. By removing two screws through angled brackets at each end, the gas manifold is removable for service access to the orifices.

Figure 3 -11 Gas heat section components

Heat Exchanger



The standard heat exchanger uses aluminized steel for the tube material and the collector box / vestibule panel. Low NOx and stainless steel heat exchanger options use stainless steel for the tube material and the collector box / vestibule panel. For either material, the tubular heat exchanger is constructed with two sets of horizontally oriented U-shaped tubes. Both sets of tubes are vertically offset within the airstream from the blower discharge. The first set of heat exchanger tubes are 2¼" diameter.

Figure 3 -12 Heat exchanger flow

The burner flames enter the bottom segment of the tubes in the first set and flue gases are passed through to the top segment of the tubes connected to an intermediate collector box. The second set of heat exchanger tubes are 1¾" diameter. Depending on model, the number of tubes in the second set is equal to or less than the number of burners / tubes in the first set. Flue gases from the intermediate collector box enter the top segment of the tubes in the second set and exit the bottom segment of the tubes to the final collector box.

The burner flames enter the bottom

Inducer

A single-speed induced draft blower is mounted to the final collector box and provides flow through the heat exchanger. A common induced draft assembly is used throughout the product line and the plate between the final collector box and the induced draft wheel meters the combustion flow needed for the different gas heat firing rates. Draft is proven by closure of a pressure switch when the pressure in the final collector box reaches $-.33''$ w.c..

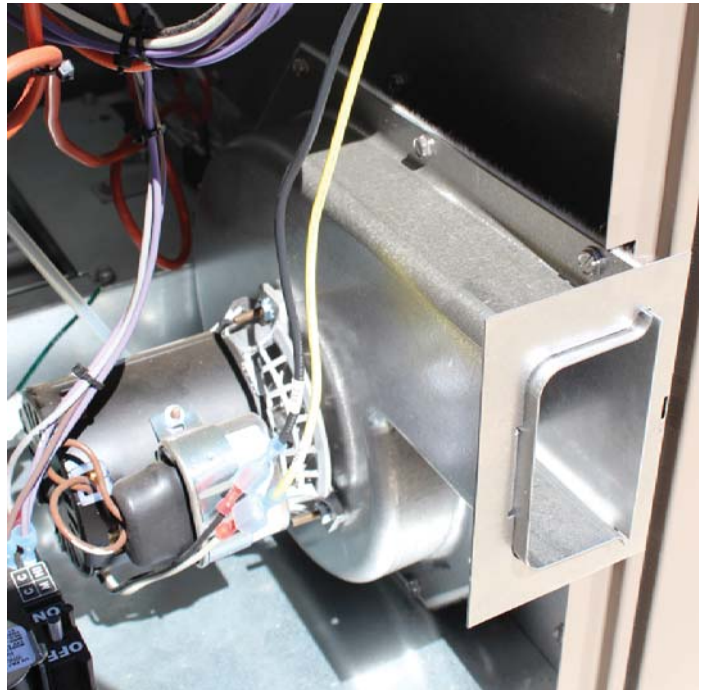


Figure 3 -13 Inducer

Limits

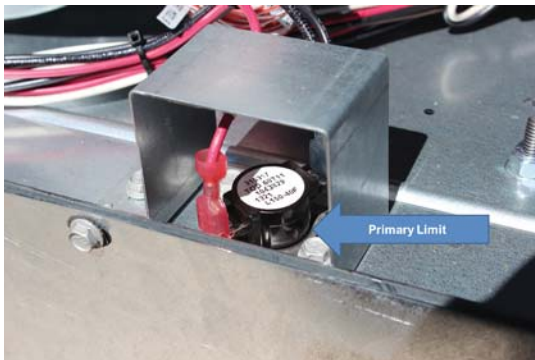


Figure 3 -14 Primary limit

There are three temperature safety switches for gas heat. The manual reset rollout switch is mounted to the access plate above the burners and provides protection from burner flame rollout or backwards combustion flow. The automatic reset primary limit switch is mounted to the blower deck and provides protection from inadequate indoor airflow or extreme over-firing of the gas heat. The manual reset auxiliary limit switch is mounted near the blower outlet and provides protection from backwards indoor airflow, blower failure or inadequate cool-down of the heat exchanger at the termination of the heating cycle.

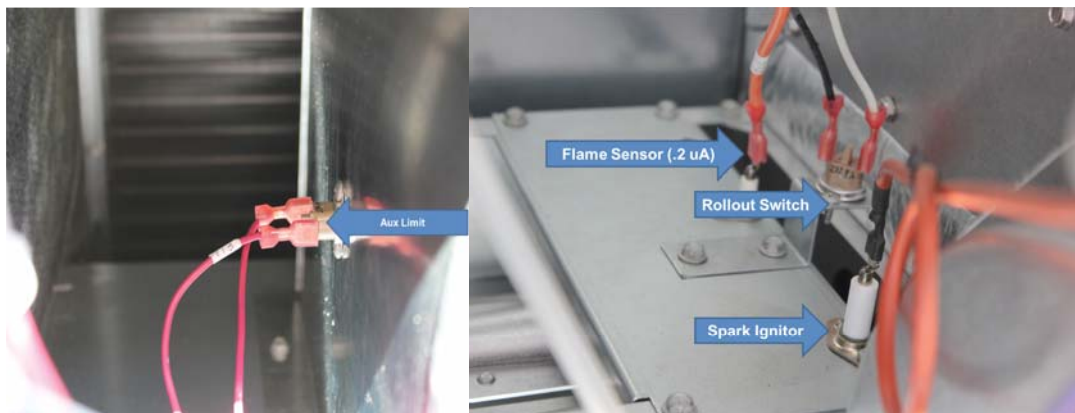


Figure 3 -15 Auxilliary limit, flame sensor, rollout switch, spark ignitor

Spark Ignitor

During a trial for ignition, the spark ignitor is energized, providing spark to ignite the gas flowing through the burners.

Burners

The burners in this product family are inshot-type. The flame carryover is integral to each burner, allowing flame to move from burner to burner, assuring smooth ignition.

Flame Sensor

The flame sensor provides 24 volts AC, which is rectified to DC through the burner flame. The minimum flame signal required for flame proof is .2 uA, with .4 uA or more typical under normal conditions. The DC uA signal may be measured by placing a digital multimeter (set to DC uA) in series with the flame sensor. Dirty or oxidized flame sensors are the most common cause of flame signal loss. Flame sensor cleaning must be part of routine equipment maintenance. Cracked porcelain, improper gas pressure, and improper flame patterns will also disrupt proper flame sensing.

Ignition Control

The ignition control provides coordination for the gas heat operating sequence. The ignition control receives the heat staging command output(s) from the Simplicity SE control board and confirms over-temperature safety switches are / remain closed to allow heating operation. The ignition control initiates induced draft operation directly through closure of an external relay (DMR) that switches line voltage to the motor. The ignition control confirms that the draft pressure switch is functioning properly to verify combustion flow. The ignition control utilizes direct spark ignition to light the burners and flame rectification for proof of ignition. Through the on-board LED, the ignition control announces status or alarm conditions for the heat section.

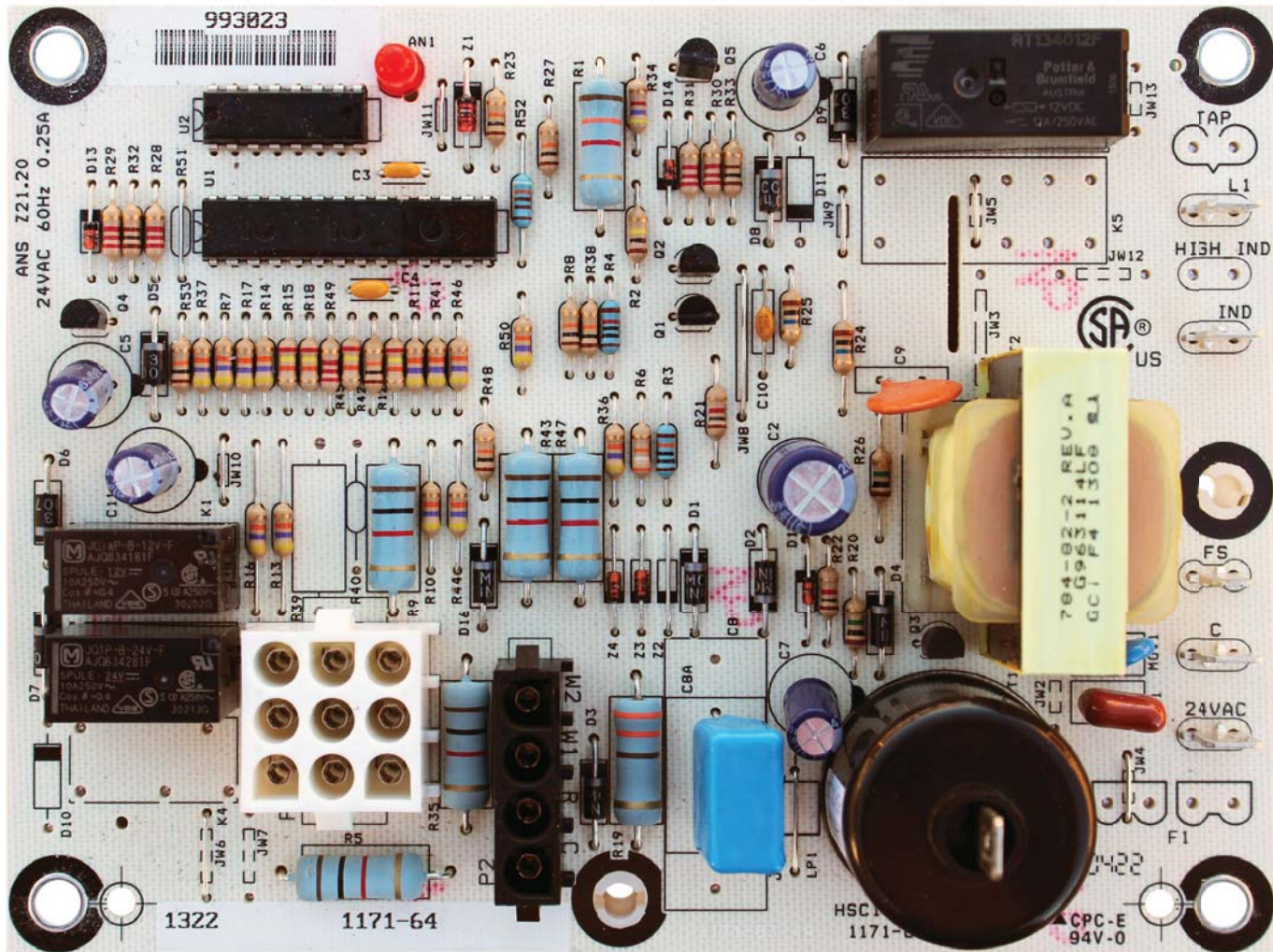


Figure 3 -16 Ignition control board

Ignition Control Terminal / Pin Function

Nine Pin Plug

- **Pin 2** 24 volt AC common to C on gas valve
- **Pin 3** 24 volt AC output to pressure switch
- **Pin 4** 24 volt AC output to H on gas valve (second stage)
- **Pin 6** 24 volt AC input from limit string (ALS, LS, ROS).
- **Pin 7** 24 volt AC output to M (first stage) on gas valve
- **Pin 8** 24 volt ac input from pressure switch circuit
- **Pin 9** 24 volt AC input from ALS/LS circuit. Also ties to LIMIT terminal on UCB.

Four Pin Plug

- **Pin 1** 24 volt AC input to the board
- **Pin 2** 24 Volt AC input for limit string from UCB. Output to limit string.
- **Pin 3** 24 volt AC input from H1 terminal on UCB. Signifies first stage heat call.
- **Pin 4** 24 volt AC input from H2 terminal on UCB. Signifies second stage heat call.

Terminal Connections

- **L1:** Connected to 24VAC (line voltage components are controlled via relay)
- **IND:** Connection to DMR (Draft Motor Relay)
- **FS:** 24 VAC voltage output to the Flame Sensor during ignition trial.
- **C:** Connection to DMR (Draft Motor Relay)
- **24VAC:** Connected to L1 (board receives 24 volts AC at Pin 1 of the four pin plug)
- **S:** Spark ignitor connection. High voltage output during trial for ignition.

Smoke Detectors

Smoke detectors may be field-installed within the unit. Field selected, duct-mounted smoke detectors, or remote fire/smoke panel shutdown may also be integrated from the Simplicity SE board's terminal strip. In all cases, the open-on-alarm contacts interrupt the 24 volt AC circuit from SD to R terminals of the Simplicity SE board to provide instant shut down of the unit.

It is important to note that for a field-installed smoke detector or fire/smoke panel contact to be effective when connected to the Simplicity SE board's SD and R terminals, the wiring harness jumper-plug at the location for the factory-mounted smoke detector controller must be removed from the unit.

Electric Heat Accessories

Electric heat accessories are not available with the initial product release. Unit-mounted third party electric heat accessories are NOT approved for use with this product line.

Unit Control Board

This product line utilizes the Simplicity SE unit control board (UCB) as the primary control board. 7½ through 12½ ton cooling capacity units use a two compressor version of the UCB. 3 through 6 ton cooling capacity units use a single compressor version of the UCB that omits items for compressor 2 (refrigerant circuit safety inputs and contactor coil outputs) and duct pressure input for VAV indoor blower control. Both the single and two compressor versions of the UCB share a common design and features. Other than details surrounding the number of compressors supported, both versions of the UCB function the same.

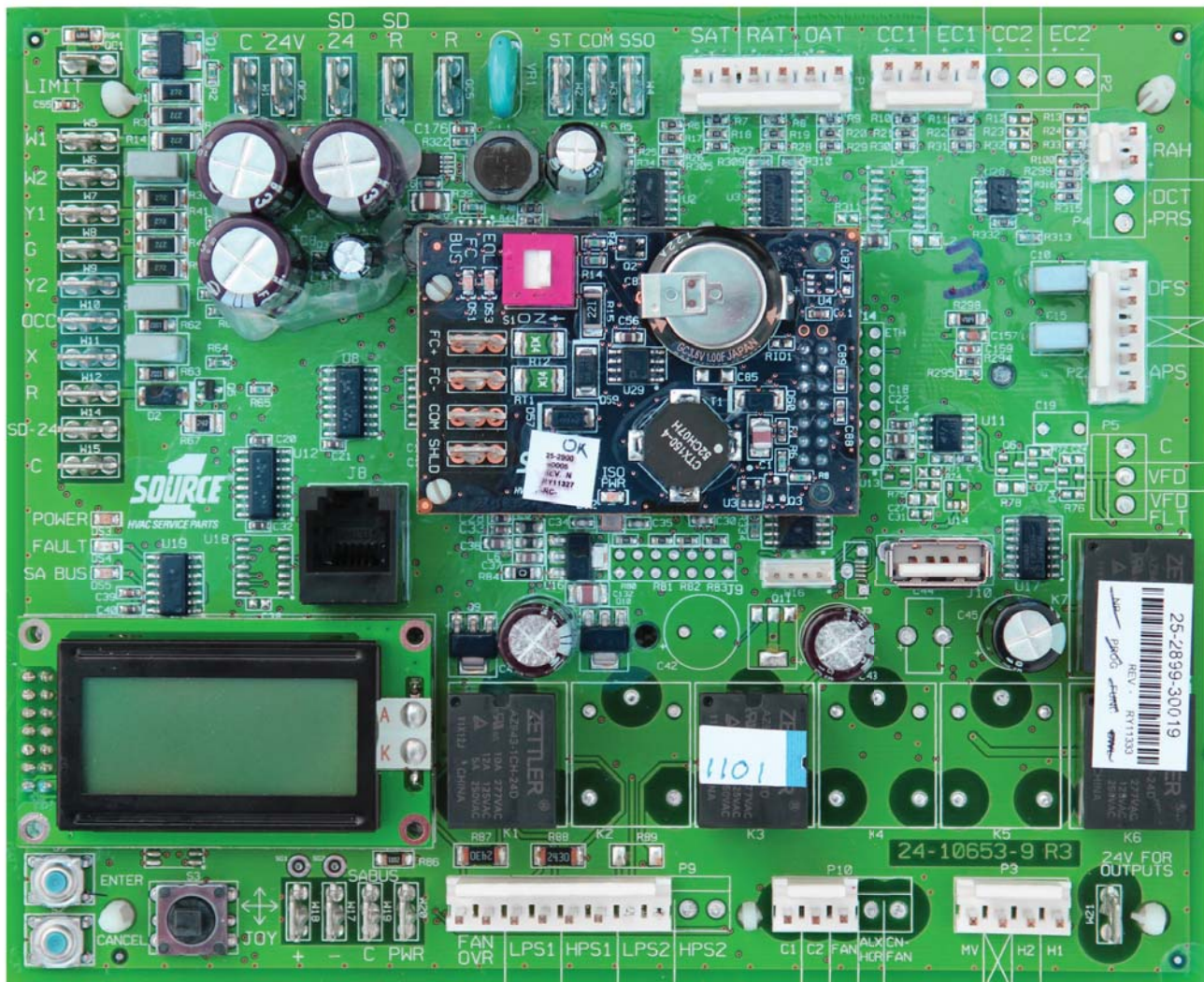


Figure 3 -17 Single compressor Simplicity SE control with communication option

The UCB performs compressor protection, indoor blower control and heat / cool staging functions. The UCB can also perform control functions for heat pump defrost, hot gas reheat and VAV unit control used in other product lines.

Basic technician access to the control parameters of individual Simplicity SE boards is made through the on-board joystick, enter or cancel buttons and 2-line by 8-character display. An on-board USB port for flash drive connection allows back-up and restoration of control parameters as well as Simplicity SE board firmware update.

The UCB can be ordered options for networking-capable with the addition of a communication sub-board located near the center of the UCB. For the initial release of the product line, networking-capable boards will use the BACnet MSTP communication protocol. The use of different communication sub-boards will allow operation with other communication protocols and is planned for future release.

BACnet communication is also present on the SA (Sensor Actuator) bus of the UCB. The SA bus permits optional controllers and devices to be integrated with the UCB. The economizer board is the optional SA bus controller available at initial release of this product line. The fault detection and diagnostics board, NetSensors and MAP Gateway WiFi access point are SA bus controllers and devices for the product line planned for later release.

Economizers – Overview

The economizer options for the product line have two physical configurations to meet application needs. Horizontal economizers are field-installed accessories and are used for applications utilizing side duct connections. Downflow economizers are available as either factory or field-installed accessories and are used for through the curb duct applications. Downflow economizers have provisions for exhaust recovery ventilator integration.

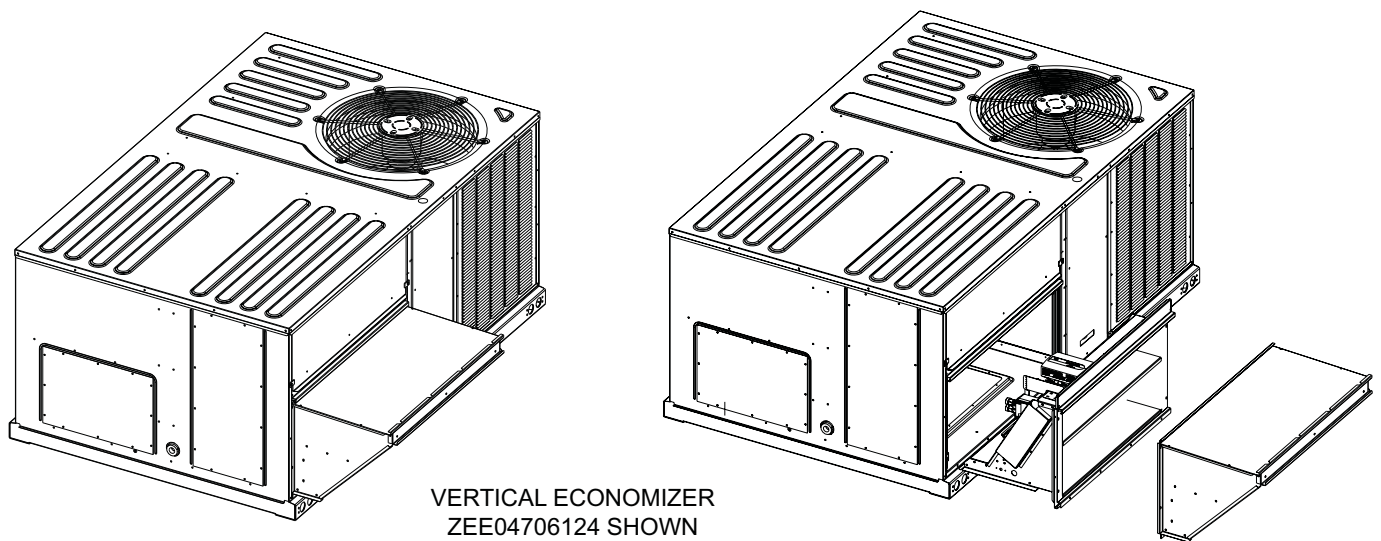
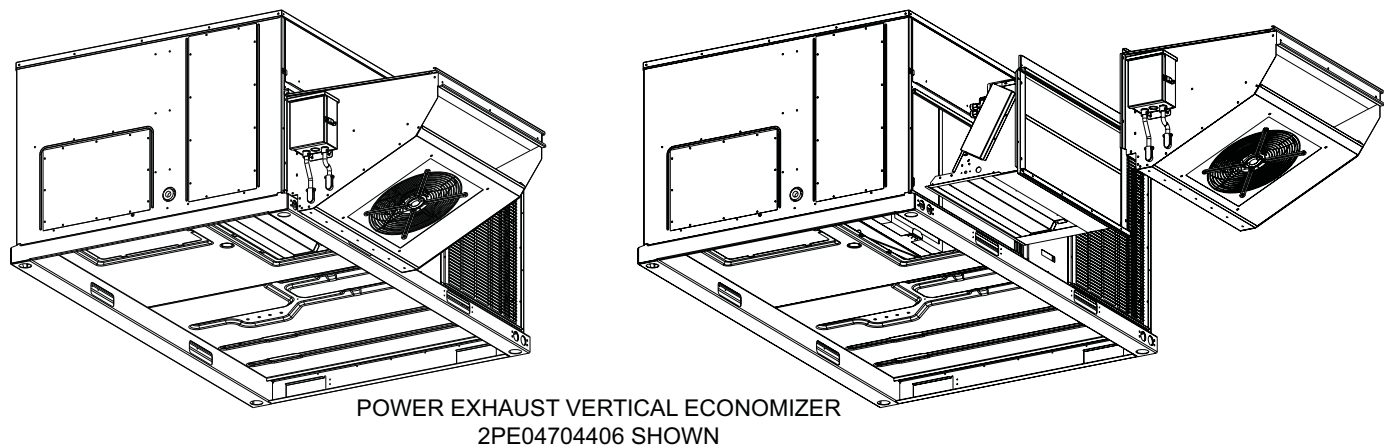


Figure 3 -18 Vertical economizer

Field Installed Vertical Flow Economizer W/Power Exhaust



Field Installed Horizontal Flow Economizer

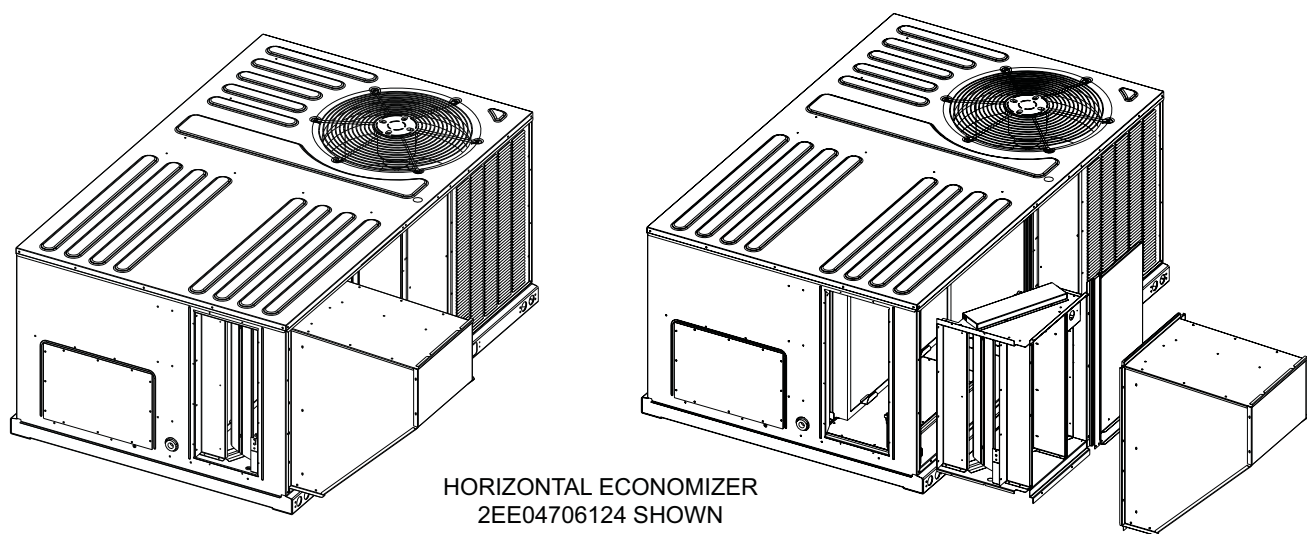


Figure 3 -19 Vertical power exhaust and horizontal economizers

All economizer configurations have return air and outside air dampers that open / close in opposition. If the return air damper opens the outside air damper closes and vice versa; so that air entering the unit may be 100% return air, or 100% outside air, or a mix of both. A single actuator is used to position both dampers. In the event of a power loss or unit shut down, the actuator's spring-return feature positions the dampers so that the return air is fully open and the outside air is fully closed. Barometric relief dampers and power exhaust may also be used in all economizer configurations to relieve the space of excess pressure.

Chapter 4 – Controls

Unit Control Board

This product line utilizes the Simplicity SE unit control board (UCB) as the primary control board. 7½ through 12½ ton cooling capacity units use a 2-compressor version of the UCB. 3 through 6 ton cooling capacity units use a 1-compressor version of the UCB that omits items for compressor 2 (refrigerant circuit safety inputs and contactor coil outputs) and duct pressure input for VAV indoor blower control. Both the 1-compressor and 2-compressor versions of the UCB share a common design and features. Other than details surrounding the number of compressors supported, both versions of the UCB function the same.

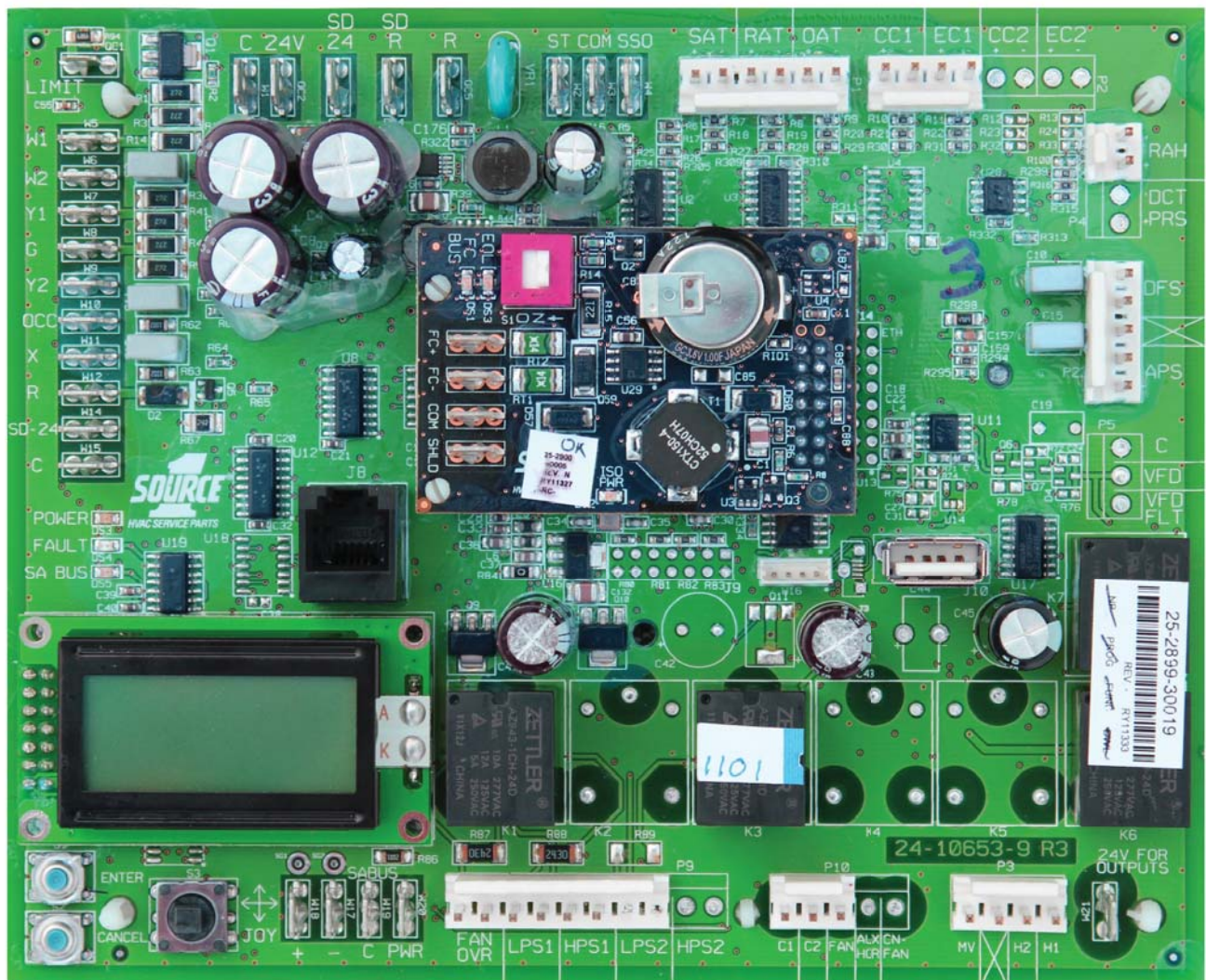


Figure 4-1 Single compressor Simplicity SE control with communication option

The UCB performs compressor protection, indoor blower control and heat/cool staging functions. The UCB can also perform control functions for heat pump defrost, hot gas reheat and VAV unit control used in other product lines.

Basic technician access to the control parameters of individual Simplicity SE boards is made through the on-board joystick, buttons and 2-line by 8-character display.

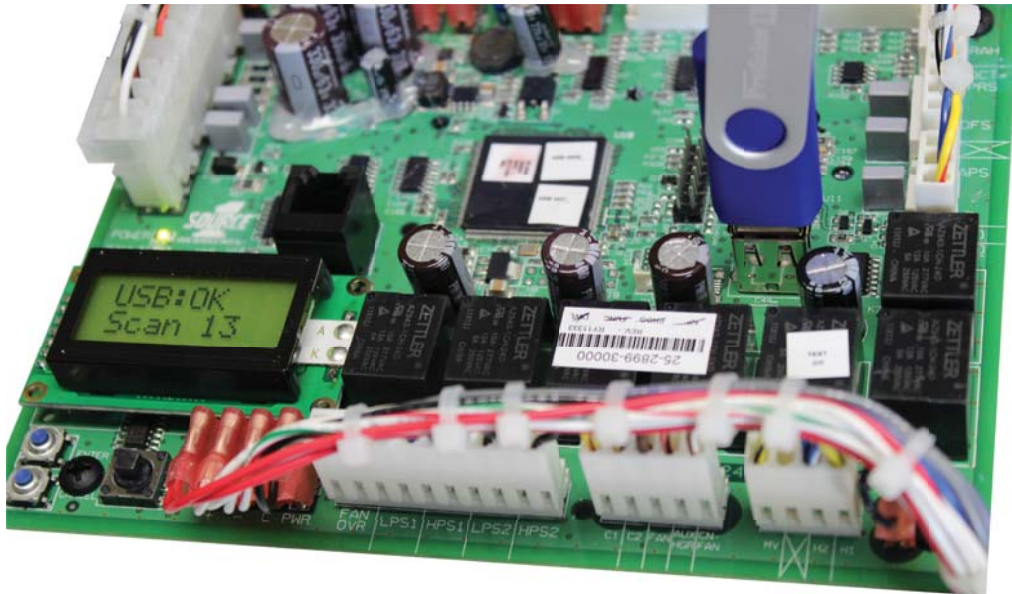


Figure 4-2 UCB with USB flash drive

An on-board USB port for flash drive connection allows back-up and restoration of control parameters as well as Simplicity SE board firmware update.

Networking-capable options add a communication sub-board near the center of the UCB. For networking-capable options at the initial release of the product line, the communication protocol is BACnet MSTP. Utilizing different communication sub-boards, other communication protocols are planned for later networking-capable option releases.

BACnet communication is also present on the SA (Sensor Actuator) bus of the UCB. The SA bus permits optional controllers and devices to be integrated with the UCB. The economizer board is the optional SA bus controller available at initial release of this product line. The fault detection and diagnostics board, NetSensors and MAP Gateway WiFi access point are SA bus controllers and devices for the product line planned for later release.

UCB Power and SD Circuits

Through the unit wiring harness connected to terminals on the upper edge of the board, the UCB receives 24 volts AC power from the 75 VA T1 transformer. The cabinet ground-referenced 24 volts AC common of the transformer connects to the UCB C terminal. 24 volts AC common is then distributed to the microprocessor power supply, thermostat connection strip C terminal and other points through circuit traces on the UCB. After passing through the 3.2 amp circuit breaker, the 24 volts AC hot of the transformer connects to the UCB 24V terminal. 24 volts AC hot is then distributed to the microprocessor power supply, SD 24 terminal, and thermostat connection strip SD-24 terminal through circuit traces on the UCB.

The UCB microprocessor and optional communication sub-board are powered, on-board LED indicators and the display will function with 24 volts AC present at C and 24V terminals. However, outputs to operate the indoor fan, compressors or heat section are only permitted if the SD circuit is complete.

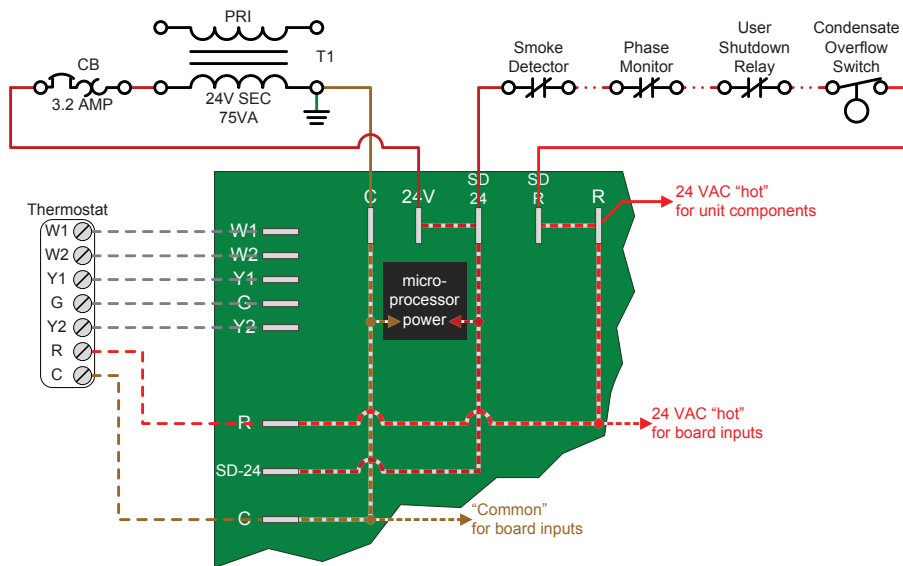


Figure 4-3 SD factory wiring

As shipped, the unit wiring harness connected to the UCB SD 24 and SD R terminals places a jumper plug in the SD circuit. For factory accessory smoke detector, phase monitor, shutdown relay and/or condensate overflow switch; the series of normally closed contacts are placed between the UCB SD 24 and SD R terminals through the unit wiring harness. For field-selected accessory smoke detectors, phase monitor, shutdown relay and/or condensate overflow switch; the series of normally closed contacts are placed between the thermostat connection strip SD-24 and R terminal. Also for field-selected SD circuit accessories, the jumper plug in the unit wiring harness between UCB SD 24 and SD R terminals must be removed.

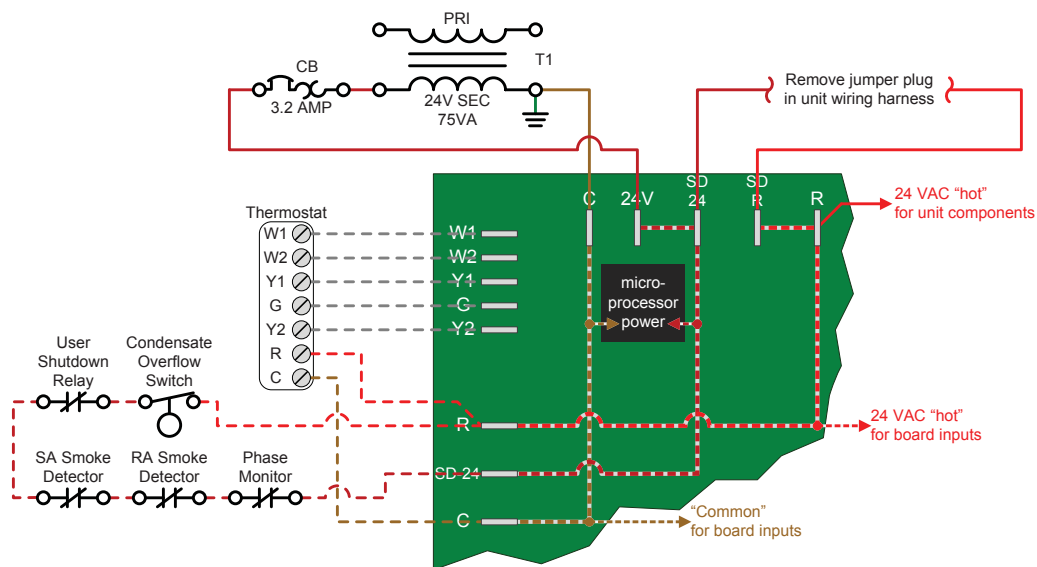


Figure 4-4 SD field wiring

With the SD circuit complete, 24 volts AC hot is applied to the SD R terminal and distributed through circuit traces on the UCB to both R terminals, output relays for heat staging and for board inputs that require a 24 volts AC hot source. During operation, if the switching of any one SD circuit accessory opens to remove 24 volts AC hot from the SD R terminal; outputs to operate the indoor fan, compressors and heat section are immediately turned off (“instant shutdown”) and a “Unit is shut down due to Smoke/Phase Monitor/Condensate input” message will be shown on the UCB display.

The UCB also monitors the voltage applied to the SD R terminal and distributed to both R terminals. Unit operation will be prevented if the voltage applied is less than 19 volts and a “UCB 24 VAC Supply Input has failed open or shorted” message will be shown on the UCB display.

UCB LEDs, Display, ENTER button, CANCEL button and JOYstick: Boot-up Sequence

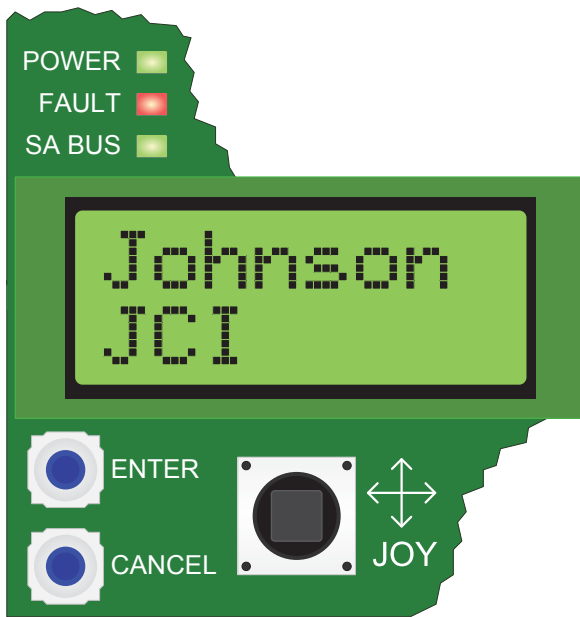


Figure 4-5 Boot-up

On the initiation of 24 volts AC power to the C and 24V terminals, the UCB begins a “boot-up” sequence. At the start of the boot-up sequence:

- The display backlight is lit and will remain lit, other than during adjustment of settings, as long as 24 volts AC power is applied to the UCB C and 24V terminals
- The display will show side-scrolling “Johnson Controls” text on the top line and “JCI” text on the bottom line
- The green POWER LED is lit and will remain lit as long as 24 volts AC power is applied to the UCB C and 24V terminals
- The red FAULT LED will be lit, go off briefly and then flash throughout the boot-up sequence
- The green SA BUS LED will be briefly lit and go off
- Throughout the boot-up sequence, JOYstick actions and presses of the ENTER and CANCEL buttons have no effect

As the boot-up sequence continues:

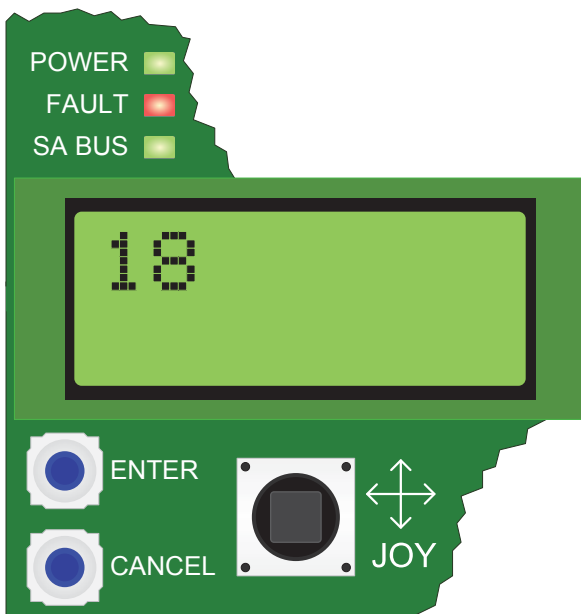


Figure 4-6 Countdown sequence

- The display will show a countdown on the top line
- At about 15 to 30 seconds from the start of the boot-up sequence, the green SA BUS LED will be either:
 - Lit to indicate that the UCB has not found and is awaiting communication from SA BUS devices (economizer board, NetSensor, etc)
 - Flashing to indicate that the UCB has established communication with SA BUS devices (economizer board, NetSensor, etc)

From this point forward, the indication of the green SA BUS LED remains active as long as 24 volts AC power is applied to the UCB C and 24V terminals:

- Lit to indicate that the UCB has not found or lost communication from SA BUS devices and is awaiting communication from SA BUS devices
- Flashing to indicate that the UCB has established communication with SA BUS devices

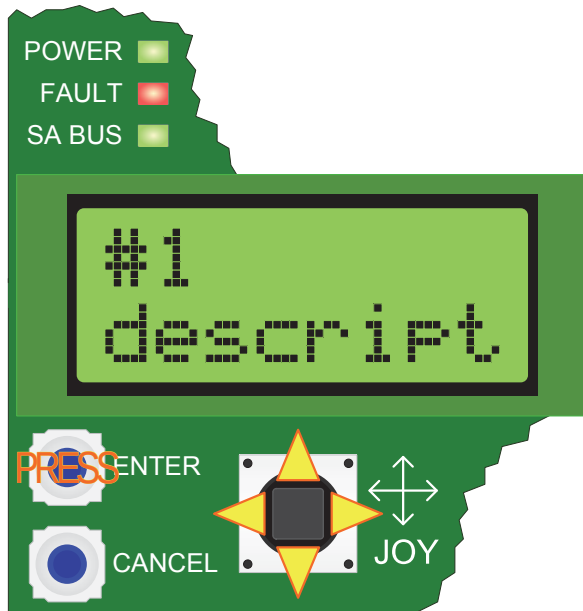


Figure 4-7 Level 0

At the completion of the boot-up sequence:

- The display will show Level 0 of the display parameter menu
- If no alarms are active the backlit display will be blank
- If alarms are active, the display will show “#1” text on the top line and a side-scrolling text description of the most recent alarm to enter the active alarm register on the bottom line
- If additional alarms are active, the display will then scroll through each alarm in the active alarm register in sequence of the next most recent to oldest
- Up to four additional active alarms will be shown in 10 to 15 second intervals with “#2” through “#5” text on the top line and a side-scrolling text description on the bottom line
- The red FAULT LED will go off if no alarms are active
- Will continue flashing if any alarms are active
- Any JOYstick actions or press of the ENTER button will begin navigation of the display parameter menu at Level 1



If less than five alarms are active, the display will be blank during the 10 to 15 second intervals allotted for indication of each alarm in the active alarm register.

UCB Display, ENTER button, CANCEL button and JOYstick: Parameter Menu Navigation

From the display parameter menu at Level 1:

Up and down movements of the JOYstick move the > cursor and scroll through the selections in the section of the display menu at the current navigation level. (Level 1 shown in the illustration on the right)

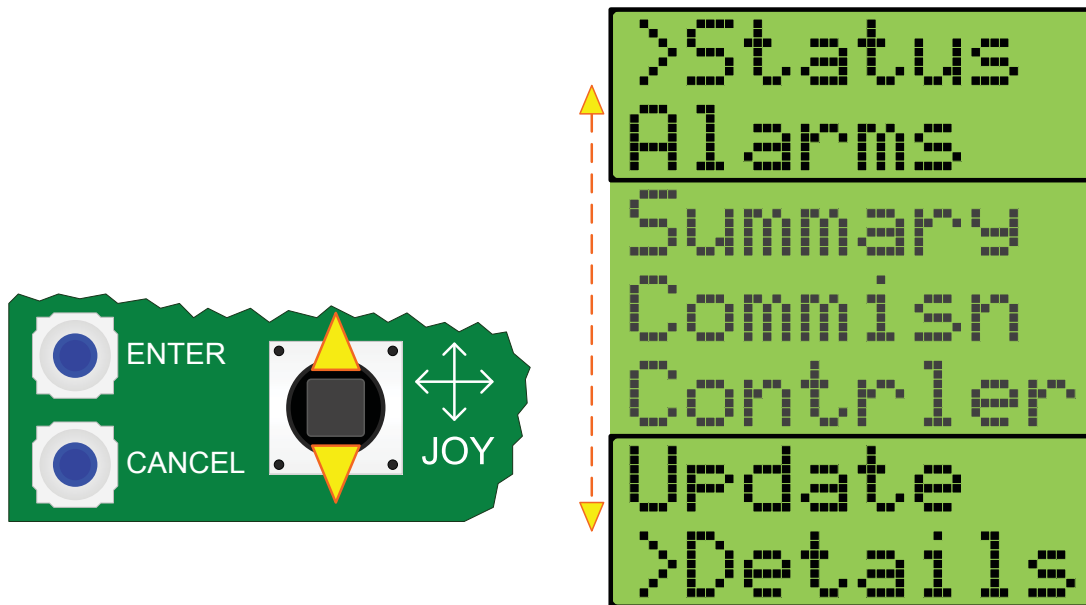


Figure 4-8 Level 1 joystick navigation

Up and down movements of the JOYstick are represented as $\uparrow \square \downarrow$ in the accompanying "Display Menu Guide"

Each press of the ENTER button navigates to the next (higher numbered in the “Display Menu Guide”) navigation level.

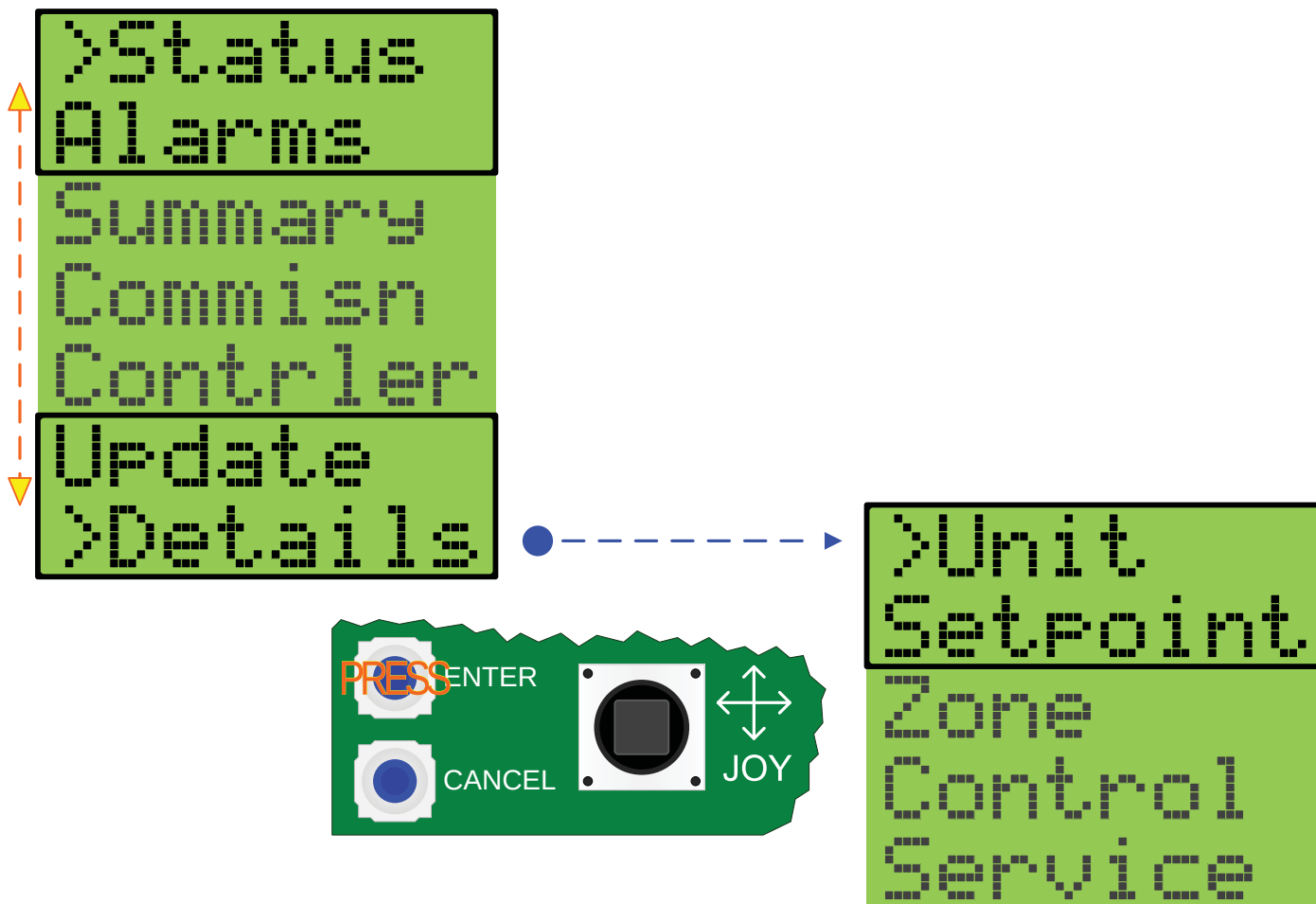
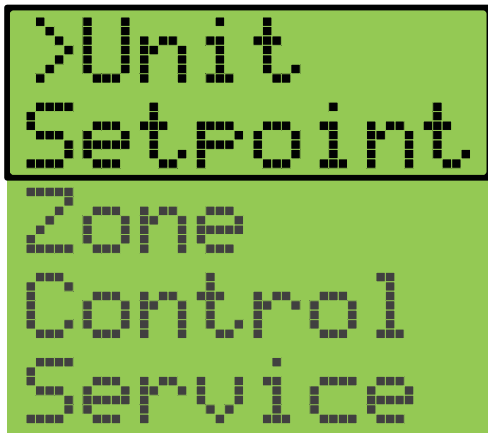


Figure 4-9 Changing navigation level

In the example illustrated: With the > cursor at the navigation Level 1 Details selection, a press of the ENTER button navigates to the Details section, navigation Level 2 of the display menu.

A press of the ENTER button is represented as E in the accompanying “Display Menu Guide”



Again, up and down movements of the JOYstick move the > cursor and scroll through the selections in the section of the display menu at the current navigation level.

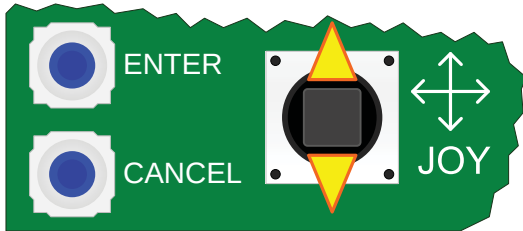


Figure 4-10 Display menu navigation

In the example illustrated: With the > cursor at the Unit selection of the Details section (navigation Level 2), a press of the ENTER button navigates to the Name, Model# and Serial# section, navigation Level 3 of the display menu.

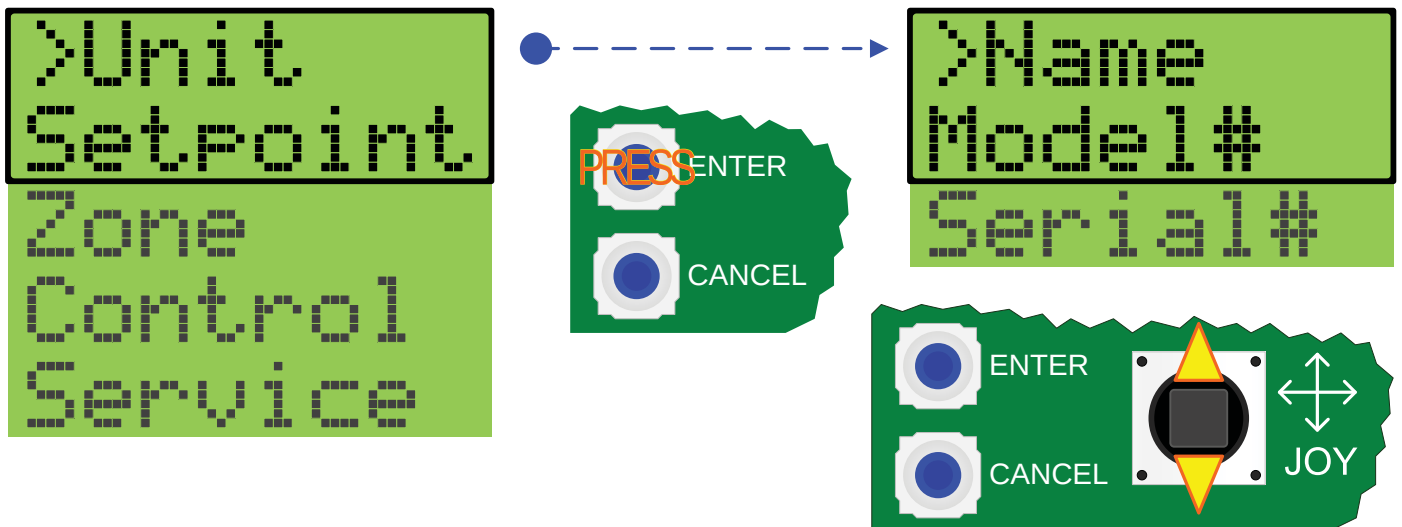


Figure 4-11 Changing to navigation Level 3



Once again, up and down movements of the JOYstick move the > cursor and scroll through the selections in the section of the display menu at the current navigation level.

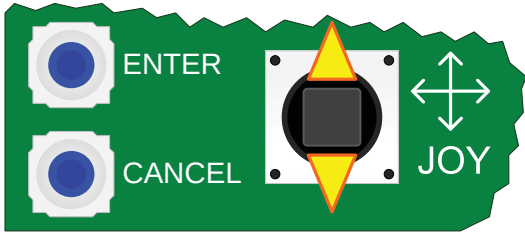


Figure 4-12 Display menu navigation

In the example illustrated: From the Name, Model# and Serial# section, navigation Level 3 of the display menu, a press of the CANCEL button navigates to the Details section (navigation Level 2) with the > cursor at the Unit selection.

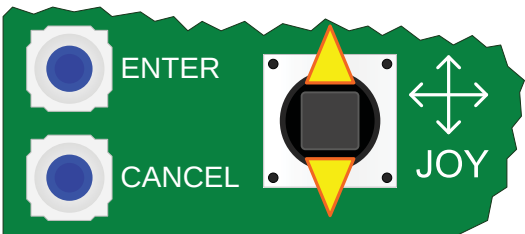
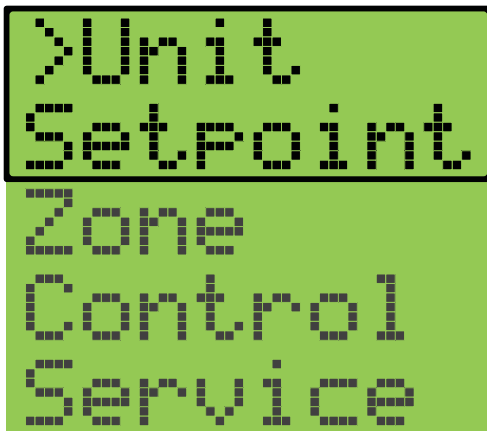
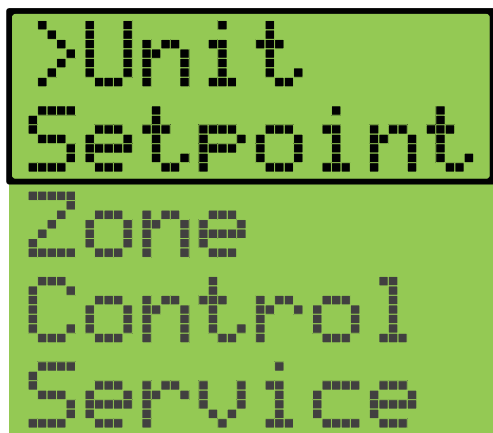


Figure 4-13 Reverse navigation to previous level



Again, up and down movements of the JOYstick move the > cursor and scroll through the selections in the section of the display menu at the current navigation level.

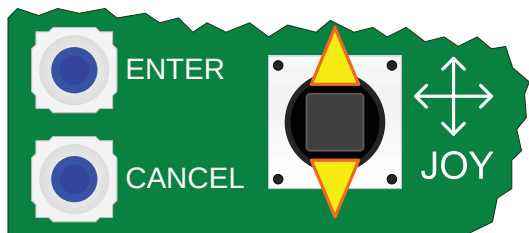


Figure 4-14 Display menu navigation

Each press of the CANCEL button navigates to the previous (lower numbered in the “Display Menu Guide”) navigation level. Other than Level 0, the > cursor position will then indicate the menu section that was exited by the CANCEL button press.

In the example illustrated: From the Details section, navigation Level 2 of the display menu, a press of the CANCEL button navigates to Level 1 with the > cursor at the Details selection.

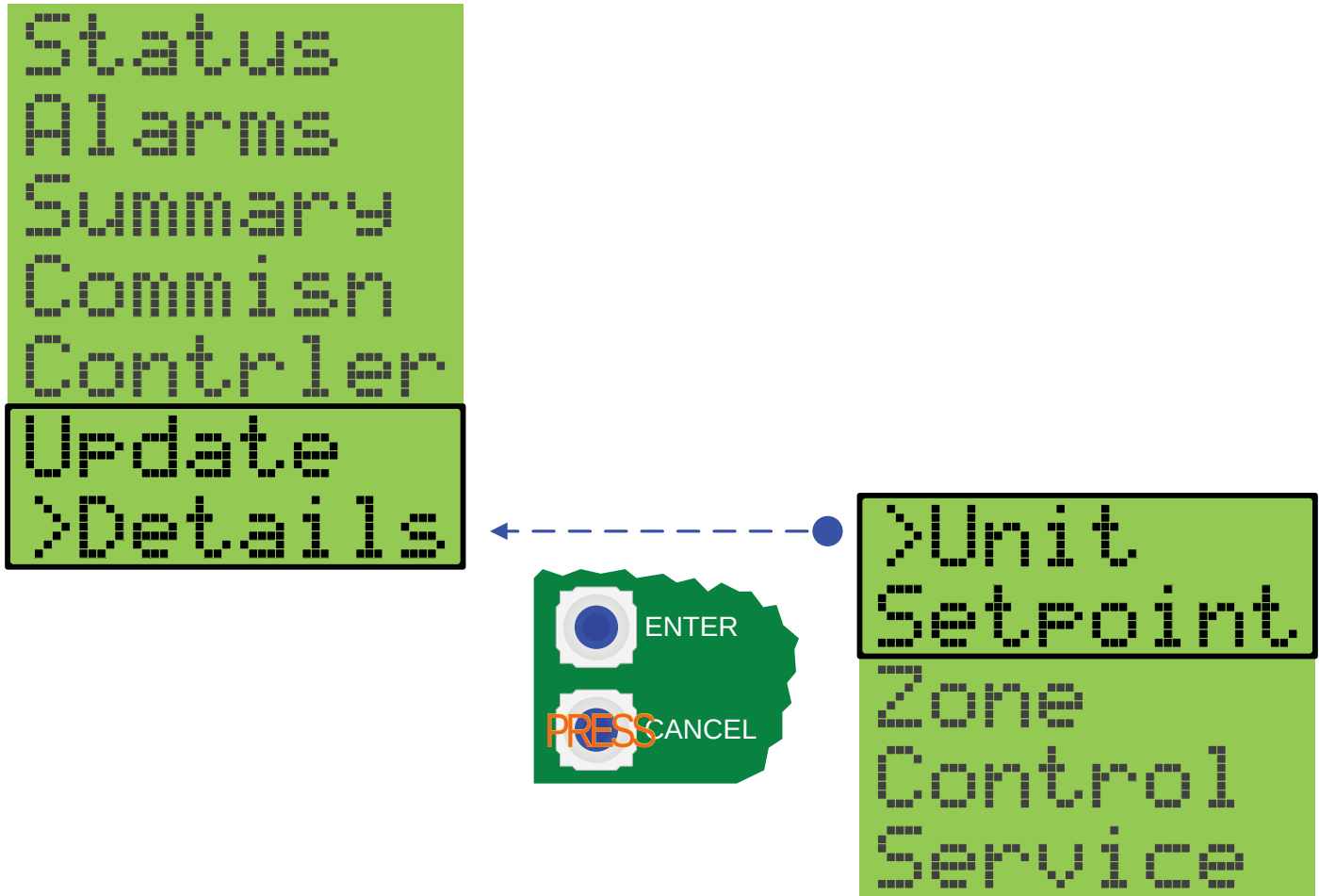
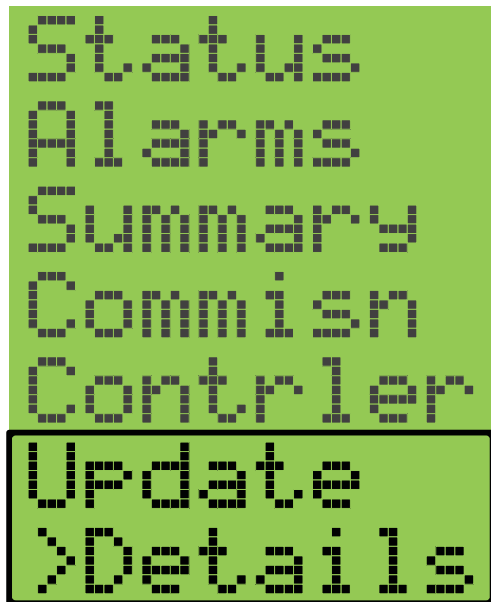


Figure 4-15 Reverse navigation to previous level



Once again, up and down movements of the JOYstick move the > cursor and scroll through the selections in the section of the display menu at the current navigation level.

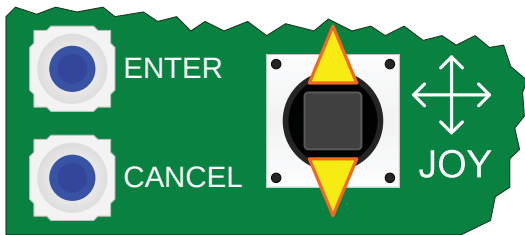


Figure 4-16 Display menu navigation

From navigation Level 1 a press of the CANCEL button navigates to navigation Level 0. Since there is no cursor used in Level 0, the > cursor indication of other menu levels is absent in Level 0.

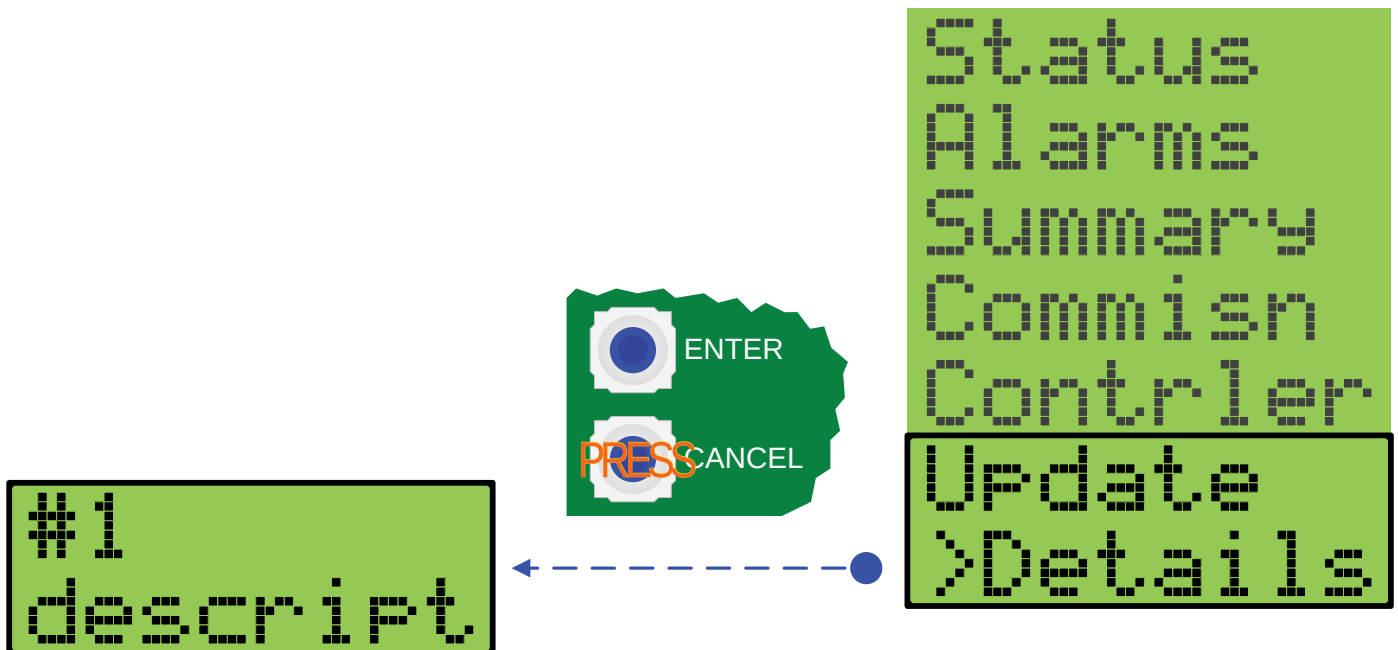


Figure 4-17 Reverse navigation to previous level

UCB Display, ENTER button, CANCEL button and JOYstick: Setting Change

Configuration parameter settings within the display menu are typically shown as “On” / “Off” or as a list of available selections.



Figure 4-18 ClgOcc-Sp parameter display

Setpoint parameter settings within the display menu, like the “ClgOcc-Sp” example shown, are typically a numeric value with appropriate limits on the available range.

The range or available selections is to the right of configuration and setpoint parameters listed in the “Display Menu Guide”



Changes to the settings of display menu configuration and setpoint parameters are initiated by left or right movement of the JOYstick. The display backlight will then flash on and off to indicate setting change activity is in progress.

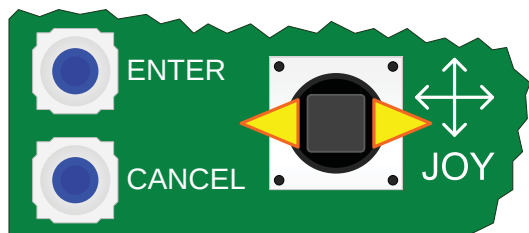


Figure 4-19 Changing parameter settings via JOYstick



Menu navigation through up and down movements of the JOYstick is disabled while setting change activity is in progress.

With setting change activity in progress, moving the JOYstick to the left decreases the numeric setting or scrolls through the list of available settings. Moving the JOYstick to the right increases the numeric setting or scrolls through the list of available settings.

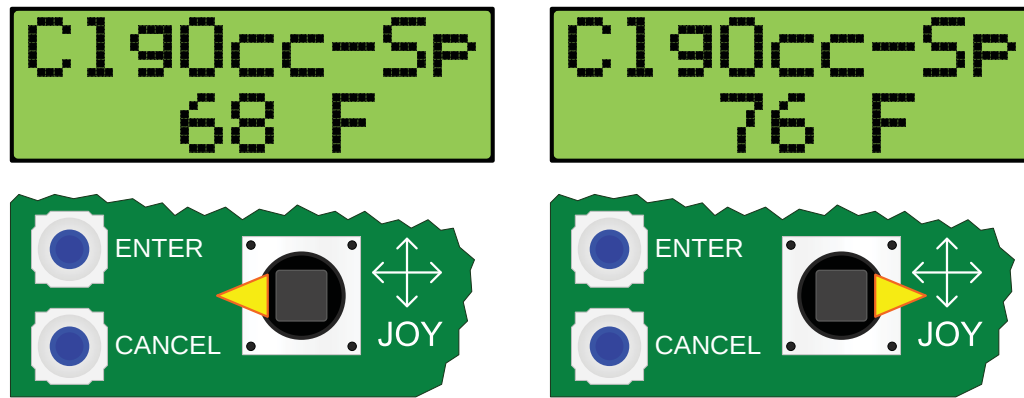


Figure 4-20 Increasing and decreasing parameter settings via JOYstick

A press of the ENTER button stores the new setting in the UCB for immediate use and the display backlight will then stop flashing to indicate setting change activity has ended.

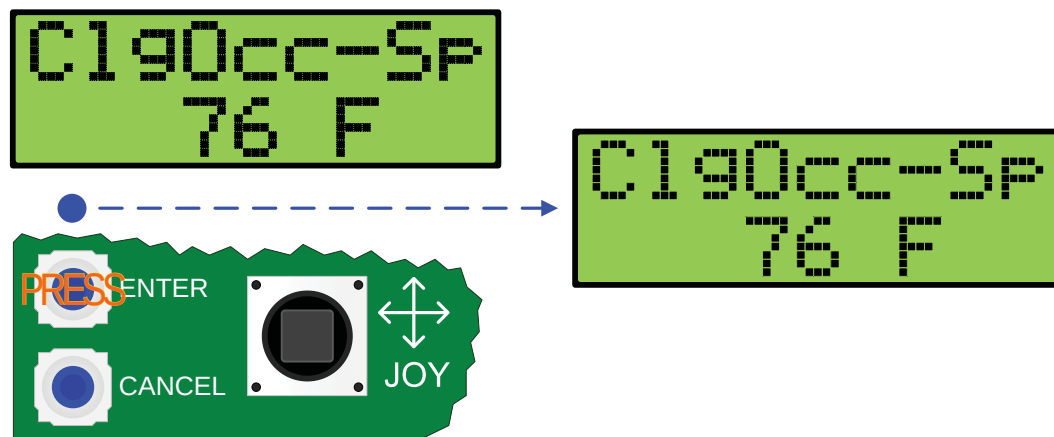


Figure 4-21 Storing new settings in UCB



Allow a few seconds for the display to refresh with the new setting following a setting change.

A press of the CANCEL button retains the existing setting in the UCB and the display backlight will then stop flashing to indicate setting change activity has ended.

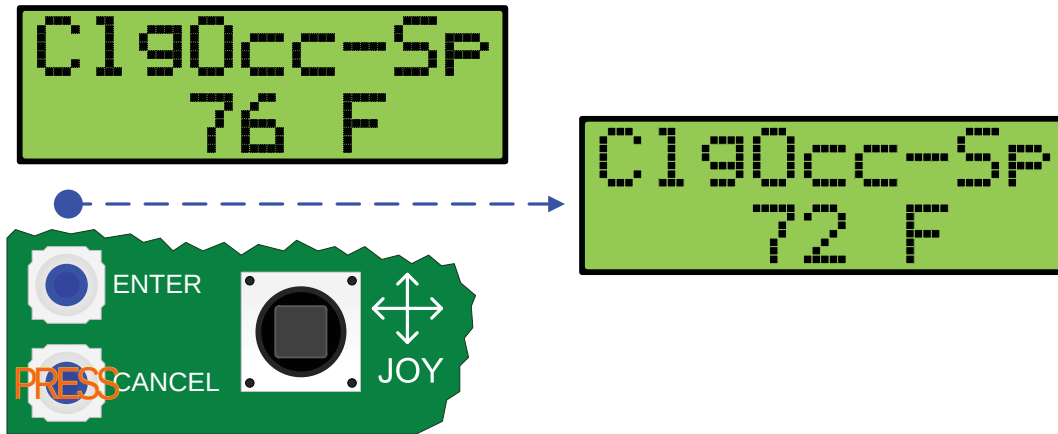


Figure 4-22 Cancelling changes and retaining original settings in UCB

USB Drive Functions

If the sequence that follows does not occur when the flash drive is connected to the UCB USB port it is likely that the flash drive is partitioned or otherwise not compatible with UCB flash drive functions.

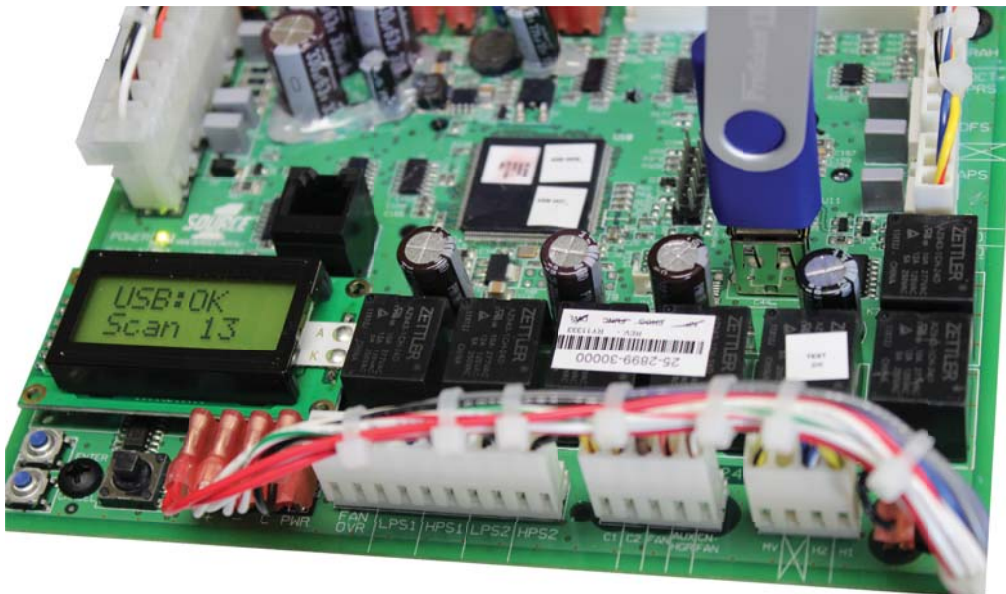


Figure 4-23 UCB with USB flash drive

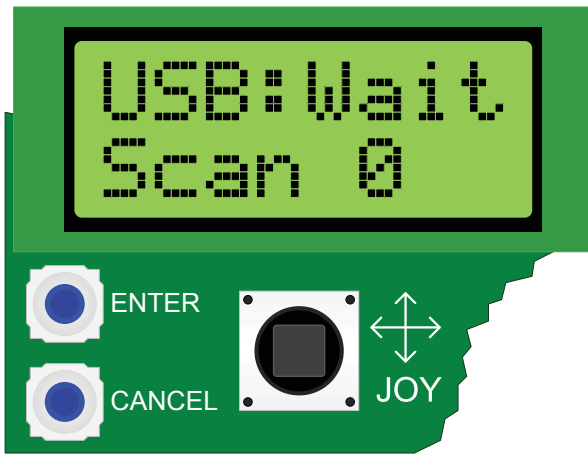


Figure 4-24 USB:Wait display

Each time a compatible flash drive is connected to the USB port, “USB:Wait” will initially be shown on the top line of the UCB display.

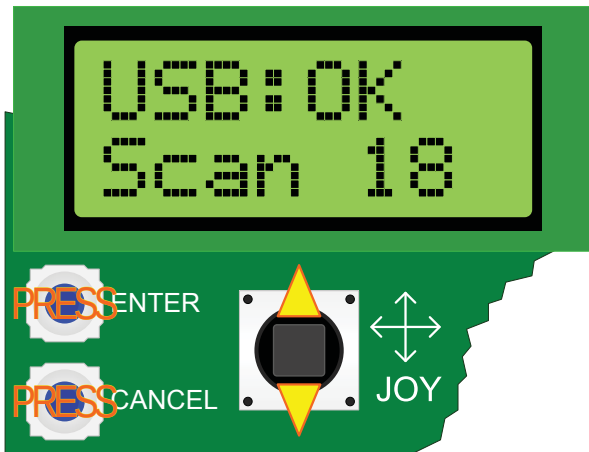


Figure 4-25 USB:OK display with file scan in progress

After a few seconds, the top line of the UCB display will show “USB:OK”. The number following “Scan” on the bottom line of the display indicates the number of files and folders in the top level of the flash drive storage.

Once the scan is complete, the flash drive is left connected to the USB port so it will be available for other functions. A press of the ENTER button, a press of the CANCEL button or up/down movement of the JOYstick will resume display menu navigation.

Backup Function

With a compatible flash drive connected to the USB port, the ENTER button is pressed when at (Level 1) “Update” > (Level 2) “Backup” location of the display menu.

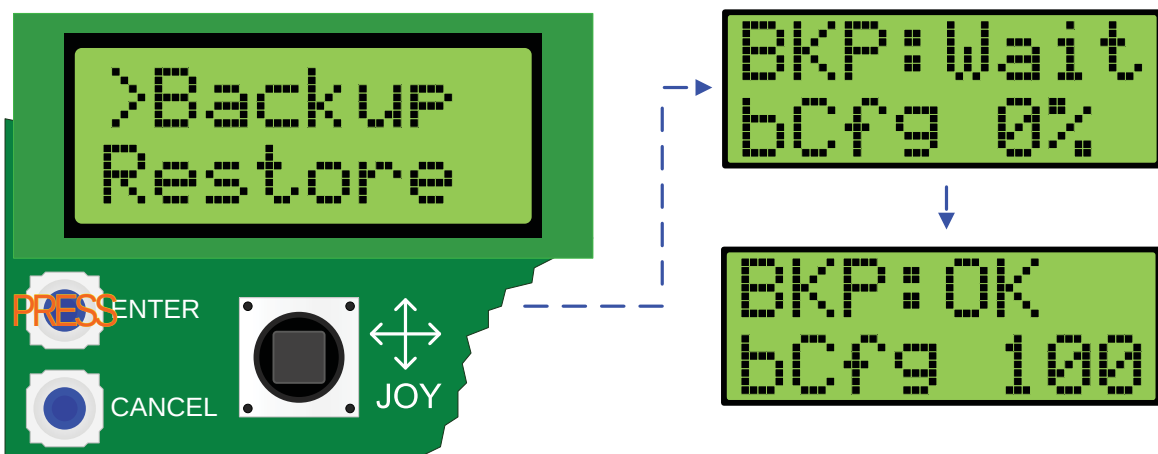


Figure 4-26 USB backup with BKP:Wait display and completion percentage

While the backup is in progress, “BKP:Wait” with the “:” flashing will be shown on the upper line and an increasing percentage following “bCf9” will be shown on the lower line of the display.

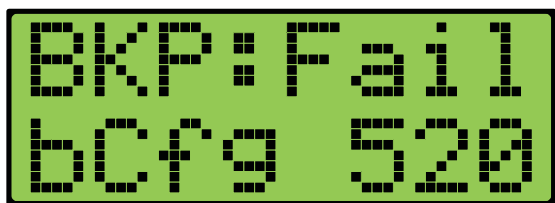


Figure 4-27 BKP:Fail display and error code

If an incompatible flash is used, “BKP:Fail” will be shown on the upper line and an error code following “bCf9” will be shown on the lower line of the display immediately after the ENTER button is pressed.

The backup will be completed in approximately 30 seconds; “BKP:OK” will be shown on the upper line and “bCf9 100” will be shown on the lower line of the display to indicate the process is finished. The flash drive can then be removed from the USB port.

A comma separated value (.csv) restoration file is created in the top level of the flash drive storage. The restoration file is a “snapshot” of all menu parameters stored in the UCB and expansion boards at the moment the restoration file was created. The file name is drawn from the date and time settings in the UCB at the moment the restoration file was created. The restoration file size is typically less than 30 KB.

Restoration File Name Structure

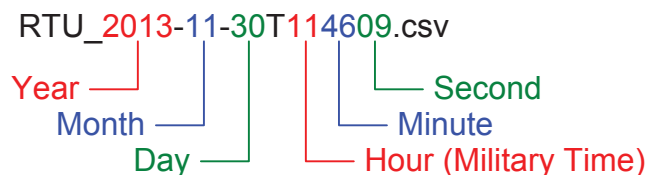


Figure 4-28 Restoration Name File Structure

Restore Function

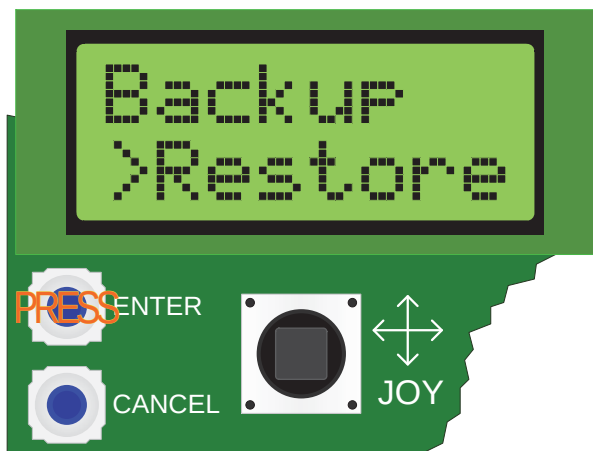


Figure 4-29 Restore function display

Restoration files must be placed in the top level of the flash drive storage. The unit serial number value in the restoration file must match the unit serial number of the UCB to be restored.

```
serialflash/BackupConfig
RTU_2014-02-14T145857.csv
>RTU_2013-11-30T114609.csv
```

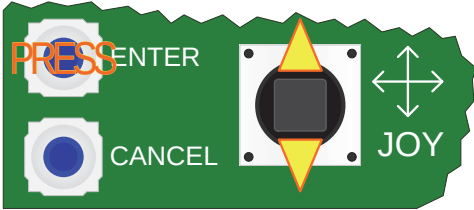


Figure 4-30 Navigating to appropriate restore file

With a compatible flash drive containing restoration file(s) connected to the USB port, the ENTER button is pressed when at (Level 1) “Update” > (Level 2) “Restore” location of the display menu.

The JOYstick is used to select the desired restoration file and the ENTER button is pressed.



If “serialflash/BackupConfig” is selected and the ENTER button is pressed a backup is performed and another restoration file is created on the flash drive.

```
RTU_2013-11-30T114609.csv
Confirm
```

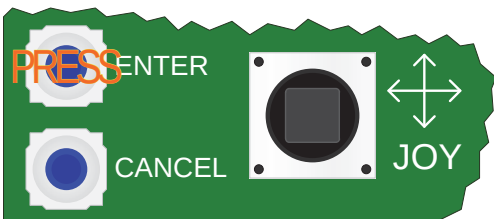


Figure 4-31 Confirming restore file selection

The ENTER button is pressed to confirm the restoration file selection.

```
RTR:Wait
rCfg 0%
```

While the restore is in progress, “RTR:Wait” with the “:” flashing will be shown on the upper line and an increasing percentage following “rCfg” will be shown on the lower line of the display.

Figure 4-32 RTR:Wait display



Figure 4-33 RTR:Fail display

If the unit serial number value in the restoration file does not match the unit serial number of the UCB being restored, “RTR:Fail” will be shown on the upper line and an error code following “rCf9” will be shown on the lower line of the display shortly after the ENTER button is pressed.

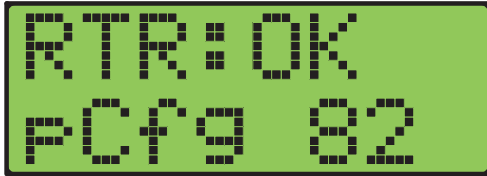


Figure 4-34 RTR:OK display

The restore will be completed in approximately 10 seconds for a UCB alone and slightly longer when economizer or other expansion boards are present; “RTR:OK” will be shown on the upper line and “pCf9” followed by a number will be shown on the lower line of the display to indicate the process is finished. The flash drive can then be removed from the USB port.

Full Clone Function

The Full Clone function is intended for “copy-n-paste” setup of multiple similar units. This process copies to the UCB all values from the flash drive restoration file except model and serial number.

Restoration files must be placed in the top level of the flash drive storage.

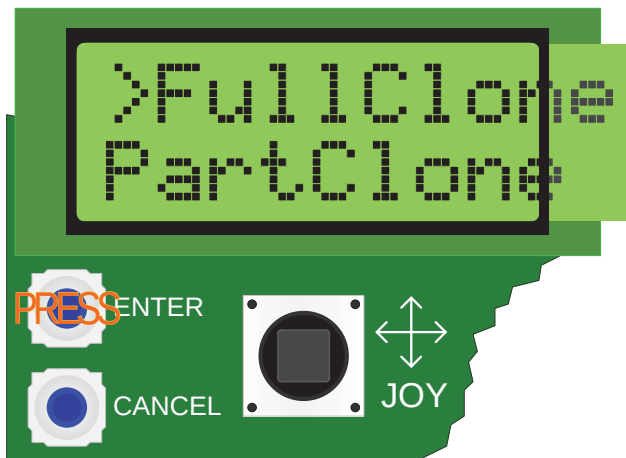


Figure 4-35 Full clone function display

With a compatible flash drive containing restoration file(s) connected to the USB port, the ENTER button is pressed when at (Level 1) “Update” > (Level 2) “FullClone” location of the display menu.

```

serialflash/BackupConfig
RTU_2014-02-14T145857.csv
>RTU_2013-11-30T114609.csv

```

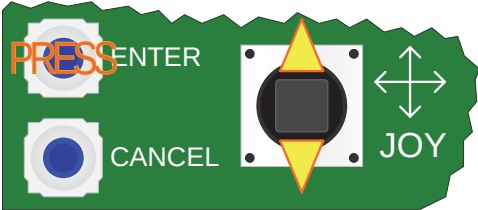


Figure 4-36 Navigating to appropriate clone file

The JOYstick is used to select the desired restoration file and the ENTER button is pressed.



If “serial/BackupConfig” is selected and the ENTER button is pressed, a backup is performed and another restoration file is created on the flash drive.

```

RTU_2013-11-30T114609.csv
Confirm

```

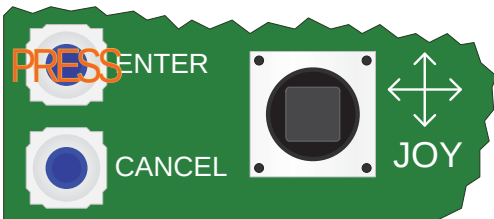


Figure 4-37 Confirming clone file selection

The ENTER button is pressed to confirm the restoration file selection.

```

CLN:Wait
... 0%

```

While the full clone function is in progress, “CLN:Wait” with the “:” flashing will be shown on the upper line and process progress will be shown on the lower line of the display.

Figure 4-38 CLN:Wait display



Figure 4-39 CLN:OK display

The full clone function will be completed in approximately 10 seconds for a UCB alone and slightly longer when economizer or other expansion boards are present; “CLN:OK” will be shown on the upper line and “pCfg” followed by a number will be shown on the lower line of the display to indicate the process is finished. The flash drive can then be removed from the USB port.

Part Clone Function

The Part Clone function is intended for “copy-n-paste” setup of multiple similar units. This process copies to the UCB all values from the flash drive restoration file except model and serial number. Restoration files must be placed in the top level of the flash drive storage.

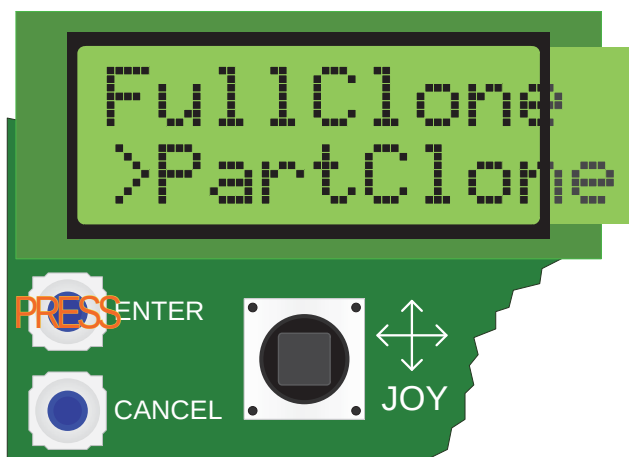


Figure 4-40 Part clone function display

With a compatible flash drive containing restoration file(s) connected to the USB port, the ENTER button is pressed when at (Level 1) “Update” > (Level 2) “PartClone” location of the display menu.



Figure 4-41 Navigating to the appropriate clone file

The JOYstick is used to select the desired restoration file and the ENTER button is pressed.



If “serial/BackupConfig” is selected and the ENTER button is pressed, a backup is performed and another restoration file is created on the flash drive.

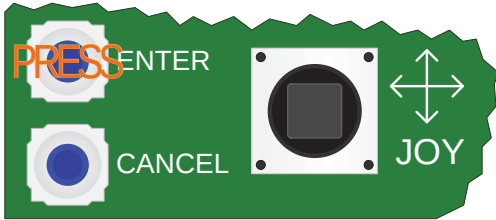


Figure 4-42 Confirming clone file selection

The ENTER button is pressed to confirm the restoration file selection.



Figure 4-43 CLN:Wait display

While the full clone function is in progress, “CLN:Wait” with the “:” flashing will be shown on the upper line and process progress will be shown on the lower line of the display.



Figure 4-44 CLN:OK display

The part clone function will be completed in approximately 10 seconds for a UCB alone and slightly longer when economizer or other expansion boards are present; “CLN:OK” will be shown on the upper line and “pCfg” followed by a number will be shown on the lower line of the display to indicate the process is finished. The flash drive can then be removed from the USB port.

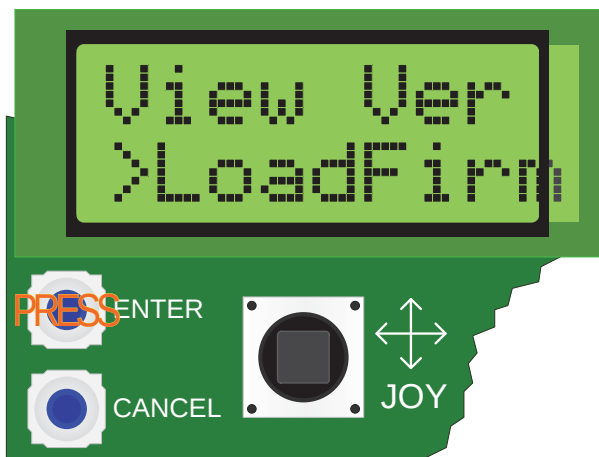
Firmware Update

Since the firmware update process will return settings to default values, it is recommended that a backup is performed prior to an update. The settings can then be restored once the firmware update process is complete.

Firmware update is only necessary if updated features are desired or to address specific issues with earlier revisions of the firmware. Access to firmware update files and documentation of revisions is available through links on upgnet.com.

The firmware update will also update the expansion boards that are present and communicating on the SA BUS.

Firmware update files must be placed in the top level of the flash drive storage.



With compatible flash drive containing firmware update file(s) connected to the USB port, the ENTER button is pressed when at (Level 1) “Update” > (Level 2) “LoadFirm” location of the display menu.

Figure 4-45 Load firmware display



Figure 4-46 Navigating to the appropriate firmware file

The JOYstick is used to select the desired update file and the ENTER button is pressed.



The firmware update process does not automatically select the latest update revision file. Earlier revisions can be used for firmware update.



Figure 4-47 Confirming firmware file selection

The ENTER button is pressed to confirm the update file selection.

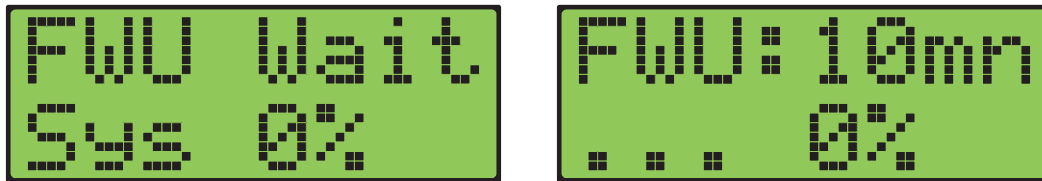


Figure 4-48 FWU Wait and time remaining displays

While the firmware update is in progress, “FWU Wait” alternating with “FWU:” followed by an estimate of time remaining in the process will be shown on the upper line and process progress for each firmware module will be shown on the lower line of the display.

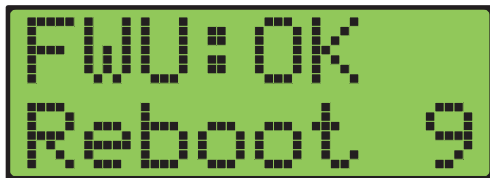


Figure 4-49 FWU:OK and reboot display

The time required for the firmware update to be completed varies depending on how extensive the update is, expansion board presence, etc. Once the firmware update process nears completion, “FWU:OK” will be shown on the upper line and “Reboot” followed by a countdown will be shown on the lower line of the display. The UCB will then reboot to complete the firmware update.

Once the boot-up sequence is complete, the restore function can then be used to return settings from the restoration file saved during the backup prior to starting the firmware update process.



Figure 4-50 Firmware up-to-date display

If the update file selected matches the firmware present in the board(s), the firmware update process will be completed in approximately 1 minute. “FWU:OK” will then be shown on the upper line and “...” followed by a number will be shown on the lower line of the display to indicate no firmware change was made in the update process. Since no changes to firmware or settings were made, reboot is not required and the flash drive can then be removed from the USB port.

UCB Comfort Control Input

The UCB is shipped with screw terminal adapters for thermostat wiring connection at the left edge of the board. The screw terminal adapters are relocated to the ¼” push-on connections for thermistor space sensor, SA bus or communication sub-board FC bus when comfort control input other than a thermostat is utilized.

On initial release of this product line, the UCB accepts comfort control input from a wall thermostat. Later UCB updates will allow scheduling access and accept comfort control input from either thermistor sensors, or from a NetSensor or from communicated sensor values when BAS integration is utilized.

UCB Comfort Control Temperature Input by Thermostat

The thermostat inputs on the left edge of the UCB are always active for comfort control. Use of the “Thermostat Only Control Enabled” control parameter is recommended when a thermostat is utilized to provide comfort control input. While sensor inputs remain effective for other control processes, the “Thermostat Only Control Enabled” control parameter disables scheduling and comfort control by sensor inputs. When comfort control by sensor inputs is desired, the thermostat inputs are effectively disabled with no field connected wiring landed on the terminals.

Switched from the R terminal, the thermostat inputs for comfort control provide 24 volts AC hot inputs for the UCB microprocessor. Definitions of function for constant volume units when is input received for each terminal:

Input	Status
G	request for indoor blower operation
W1 (A/C unit)	request for first stage heating operation (mechanical thermostat heat anticipator setting 0.03 amps)
W1 (heat pump unit)	request for compressor heating operation
W2 (A/C unit)	request for two stage heating operation (mechanical thermostat heat anticipator setting 0.005 amps)
W2 (heat pump unit)	request for supplemental heating operation
Y1	request for single stage cooling operation
Y2	request for two stage cooling operation
OCC (Thermostat Only Control Enabled)	request for economizer minimum position and enabling of economizer demand ventilation function
OCC (Occupancy Input Enabled)	enables occupied heating and cooling setpoints for comfort control from sensor inputs, “Continuous Supply Fan Operation in Occupied Mode”, economizer minimum position and economizer demand ventilation function

As thermostat inputs for comfort control are requests for unit operation, it is important to understand that control permissions must be satisfied to allow the requested operation. The anti-short cycle delay, refrigerant circuit safeties and economizer free cooling availability are examples of permissions that can prevent a compressor output if cooling operation is requested.

Also, thermostat inputs for comfort control are not the only source of requests for unit operation. Examples where the UCB internally requests indoor blower operation even without input present to the G terminal are when the heat section operates, cooling operates or the “Indoor Fan Minimum Runtime” is active. When enabled, the comfort ventilation function of Simplicity SE can also produce requests for unit operation. Details of comfort ventilation function are discussed in the Economizers section.

Definitions of other terminals for thermostat connection to the UCB:

Input	Status
C	24 volts AC common for thermostat power
SD-24	24 volts AC hot out for switching of field-selected SD circuit accessories (unit wiring harness jumper plug removed)
R	24 volts AC hot out return from switching of field-selected SD circuit accessories / 24 volts AC hot for thermostat power / 24 volts AC hot for thermostat switching
X	nominal 24 volt output to light the thermostat LED indicator for unit hard lockout alarm

UCB Comfort Control Temperature Input by Sensors

Comfort control by sensors sources the space (or zone) temperature input from either the Return Air Temperature (RAT) sensor, Space Temperature (ST) sensor, NetSensor or a value communicated by a Building Automation System (BAS).

The RAT sensor is a 10,000 Ω at 77°F negative temperature coefficient type 3 thermistor. The RAT sensor is the “default” source of space (or zone) temperature input since it is factory-connected to the UCB through the unit wiring harness and other possible sources are field-connected options. Also, the RAT sensor serves as an automatic backup source of space (or zone) temperature input if the optional ST / NetSensor / BAS value fails.

The optional ST sensor is a 10,000 Ω at 77°F negative temperature coefficient type 3 thermistor connected between the ST and COM terminals at the upper edge of the UCB. Once the ST sensor is connected, the UCB is automatically configured to use ST as the source of space (or zone) temperature input. Order options may include an override button and/or offset adjustment in the space temperature sensor assembly. The contact of the override button momentarily shorts the circuit between ST and COM terminals. During unoccupied periods, one press of the override button causes the UCB to enter occupied operation for the amount of time selected in the “Temporary Occupancy Timeout” parameter. During temporary occupancy, two presses of the override button causes the UCB to return to unoccupied operation. The offset adjustment is a 0 to 20,000 Ω potentiometer connected between the SSO and COM terminals at the upper edge of the UCB. Through the offset adjustment, occupants can modify heating and cooling space (or zone) temperature setpoints up to the amount selected in the “Zone Temperature Setpoint Offset” parameter (up to $\pm 5^\circ\text{F}$). When the offset adjustment potentiometer is set for 0 Ω , heating and cooling space (or zone) temperature setpoints are set lower to the amount selected in the “Zone Temperature Setpoint Offset” parameter. There is linear change in the offset amount throughout the range of the potentiometer. When the offset adjustment potentiometer is set for 10,000 Ω the offset is 0 and heating and cooling space (or zone) temperature setpoints are unaffected. When the offset adjustment potentiometer is set for 20,000 Ω , heating and cooling space (or zone) temperature setpoints are set higher to the amount selected in the “Zone Temperature Setpoint Offset” parameter.

Depending on order options selected; NetSensors communicate space (or zone) temperature, offset adjustment, temporary occupancy, humidity and/or CO2 values to the UCB by way of the SA bus. The NetSensor, or daisy chain of multiple NetSensors, connects to the SA bus +, –, C and PWR terminals at the lower edge of the UCB. Once the NetSensor sensor is connected, the UCB

is automatically configured to use the NetSensor as the source of space (or zone) temperature input, offset adjustment, temporary occupancy, humidity and/or CO2 values. Details of NetSensor use are discussed in a later section of this manual.

Sensor values communicated by a BAS first requires selection of networking-capable options for the UCB. A BAS can then communicate space (or zone) temperature, offset adjustment, temporary occupancy, humidity and/or CO2 values to the UCB by way of the FC bus. The daisy chain of networking cable connects to the communication sub-board FC+, FC-, COM and SHLD terminals. Once BAS communicated sensor values are received, the UCB is automatically configured to use those values as the source of space (or zone) temperature input, offset adjustment, temporary occupancy, humidity and/or CO2 values. Details of BAS communication use are discussed in a later section of this manual.

The occupancy status, “Occupied” or “Unoccupied”, determines the temperature setpoints that are used for comfort control. The internal UCB schedule is effective for occupancy status if “Schedule” is selected as the occupancy source. 24 volts AC input to the OCC terminal or network communicated occupancy command is effective for occupancy status if “Occupancy Input Enabled” is selected as the occupancy source.

“Standby” occupancy status is available if a NetSensor with infrared motion detector order option is utilized. The UCB enters “Standby” occupancy status when occupancy status is otherwise “Occupied” and there has been no motion detected for the period selected in the “Standby Timer” parameter. The UCB exits “Standby” occupancy status once motion is detected or when occupancy status is otherwise “Unoccupied”.

The Space Sensor Offset (SSO) adjusts all space (or zone) temperature setpoints higher/lower by the amount of the “Space Sensor Offset Input”. Space (or zone) temperature setpoints for cooling can also be adjusted lower by the “Temperature/Humidity Offset” amount. The use Temperature/Humidity control requires a space humidity input and selection of the “Temperature/Humidity (Return) Control Enable” parameter. Then, when space humidity rises above the “Temperature/Humidity Setpoint” the cooling temperature setpoints will be lowered per the ratio set in the “Temperature/Humidity Value per Degree Offset” up to the amount set in the “Maximum Temperature/Humidity Setpoint Offset”.

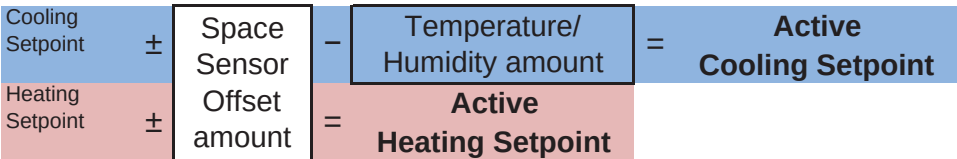


Figure 4-51 Setpoints

For comfort control by sensors, requests for heating operation begin once the space (or zone) sensor temperature falls below the active heating setpoint and requests for cooling operation begin once the space (or zone) sensor temperature rises above the active cooling setpoint.

Based on continuously updated trend data, control algorithms (mathematical calculations) determine the space (or zone) sensor temperature difference from the active temperature setpoints needed to begin and end requests for unit operation for comfort control by sensors. Data for rate of space (or zone) temperature change over time is factored in these algorithms. The amount of temperature difference from setpoint to begin unit heating or cooling operation is

variable. Rapidly falling or rising space (or zone) temperature will influence the algorithms to begin the requests for operation nearer to the active setpoint. Likewise, slowly falling or rising space (or zone) temperature will influence the algorithms to begin the requests for operation further from the active setpoint.

The control algorithms anticipate the results of unit operation to prevent “overshooting” or “undershooting” of temperature setpoints when ending the request for operation. This anticipation is evident as the request for operation ending slightly prior to the active setpoint being achieved (example shown in the accompanying illustration).

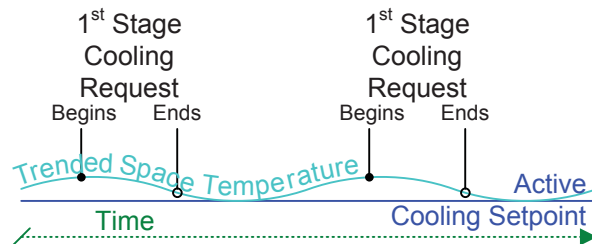


Figure 4-52 Trended space temperature

- A request for one stage cooling operation begins when the space (or zone) temperature rises 1.5°F above the active cooling setpoint and ends when the space (or zone) temperature falls to the active cooling setpoint.
- A request for two stage cooling operation begins when the space (or zone) temperature rises 2.0°F above the active cooling setpoint and ends when the space (or zone) temperature falls to 0.5°F above the active cooling setpoint.
- A request for A/C unit first stage heating operation [heat pump unit (later release): request for compressor heating operation] begins when the space (or zone) temperature falls 1.5°F below the active heating setpoint and ends when the space (or zone) temperature rises to the active heating setpoint.
- A request for A/C unit two stage heating operation [heat pump unit (later release): request for supplemental heating operation] begins when the space (or zone) temperature falls 2.0°F below the active heating setpoint and ends when the space (or zone) temperature rises to 0.5°F below the active heating setpoint.

The control algorithms for comfort control by sensors perform the most accurately, defined as more time at or near setpoint, with stable unit operation. Because these algorithms accumulate data over time, lack of recent data or drastic changes from recent trends can temporarily influence the accuracy of comfort control. Initial unit startup and re-start after an extended shutdown are examples where the lack of recent data will temporarily influence the accuracy of comfort control.

Rapid variation in the space heating/cooling load, equipment issues that vary the unit heating/cooling performance and drastic alteration of setpoints are examples where the changes from recent trends can temporarily influence the accuracy of comfort control. During the period the control algorithms accumulate trend data it may be observed that there are unusual heating/cooling cycle rates or that the setpoint is overshoot/undershot somewhat.

A request for indoor blower operation begins with heating operation once the “Fan On Delay for Heat” timer expires or with cooling operation once the “Fan On Delay for Cool” timer expires. A request for indoor blower operation can also begin with occupied occupancy status if “Continuous Supply Fan Operation in Occupied Mode” is selected. A request for indoor blower operation ends once the “Fan Off Delay for Heat” timer expires or once the “Fan Off Delay for Cool” timer expires or with unoccupied occupancy status if “Continuous Supply Fan Operation in Occupied Mode” is selected.

For hot gas reheat units (not included in the initial release of this product line), a request for reheat operation begins when the space humidity rises 5% above the “Hot Gas Reheat Humidity Setpoint” and ends when the space humidity falls to the “Hot Gas Reheat Humidity Setpoint”. When enabled, the comfort ventilation function of Simplicity SE can also produce requests for unit operation. Details of comfort ventilation function are discussed in the Economizers section.

UCB Heat Staging Operation

With requests for heating operation present, UCB control permissions must be satisfied to allow staging outputs for the heat section. These control permissions can be categorized as:

- General items that permit UCB staging outputs
- UCB configuration items for heating
- UCB operational items for heating

General items must all be satisfied to permit UCB staging outputs:

- SD circuit complete
- Greater than 19 volts applied to the UCB R terminal
- A purge command must not be active
- FAN OVR input trip or lockout must not be active
- VFD FLT input must not be present or lockout active
- When enabled, APS input must be present
- A duct pressure shutdown alarm must not be active

UCB configuration items to permit heat staging output for air conditioning units with gas or electric heat:

- “Yes” must be selected for the “Heating Mode Enabled For Operation” parameter
- “Staged” must be selected for the “Heating Control Type” parameter
- “Number of Heating Stages Installed” parameter selection must be appropriate for the heat section

- A selection of “1” to allow H1 output for single-stage capacity heat sections
- A selection of “2” to allow H1 and H2 outputs for two-stage capacity heat sections
- A selection of “3” to allow H1, H2 outputs from the UCB and H3 from the 4-stage board is only available if the 4-stage board is detected through SA bus communication

UCB operational items to permit heat staging output for air conditioning units with gas or electric heat:

- LIMIT input trip or lockout must not be active
- A gas valve miss-wire lockout must not be active
- OAT sensor input must be above the “Outdoor Air Temp Heating Lockout Setpoint”
- When enabled, SAT sensor input must be below the “SAT Air Temp Limit For Heating Setpoint”
- The 5 minute cooling-to-heating mode changeover timer must be expired
- The 5 minute heating anti short cycle delay timer must be expired

In air conditioning units having gas or electric heat, with the above permissions satisfied a first stage heating request initiates first stage heat section operation by energizing the H1 output. The H1 output remains energized until:

- Any one of the above permissions is not satisfied
- The first stage heating request ends and the “Heating Min On Time” timer expires

24 volts AC input to the UCB MV terminal confirms heat section operation. For gas heat units, the MV pin is connected to the gas valve so MV input is received once the ignition control allows gas valve operation. For electric heat units, the MV pin is connected to the UCB H1 output so MV input is received once the H1 output is energized. An MV input received within 5 minutes from the time the H1 output is energized.

In normal heating operation, an MV input is received within 5 minutes from the time the H1 output is energized. The MV input then initiates the “Heating Fan On Delay” timer and the FAN output for the indoor blower contactor coil is turned on at the expiration of the “Heating Fan On Delay” timer. The MV input is lost when heat section operation ends. This initiates the “Heating Fan Off Delay” timer and the FAN output for the indoor blower contactor coil is turned off at the expiration of the “Heating Fan Off Delay” timer if no other request for indoor blower operation is present.

An “Ignition Failure” alarm occurs if an MV input is not received within 5 minutes from the time the H1 output is energized.

A “Gas Valve Miswire” alarm occurs if an MV input is received without a request for heating operation or for a 5 minute period where the H1 output is de-energized. The FAN output for the

indoor blower contactor coil is turned on and heat staging outputs are not permitted while a “Gas Valve Miswire” alarm is active.

In air conditioning units having gas or electric heat, with the permissions for first stage heat section operation satisfied a second stage heating request initiates second stage heat section operation by energizing the H2 output. The H2 output remains energized until:

- Any one of the permissions for first stage heat section operation is not satisfied
- The first stage heating request ends and the “Heating Min On Time” timer expires – only possible with abnormal circumstances when Thermostat Only Control is used
- The second stage heating request ends and the “Heating Min On Time” timer expires

In addition to breaking the circuit to the heat section controls, over-temperature conditions that trip (open) the main or auxiliary limit switches result in the loss of 24 volts AC to the UCB LIMIT input.

The initial and second LIMIT input trip in any two hour period result in a “soft” lockout:

- While the limit circuit is open – UCB H1 and H2 staging outputs to the heat section remain energized (however, the heat section does not operate since the limit circuit to the heat section controls is open), the FAN output for the indoor blower contactor coil is turned on and the UCB displays an “HS1 Shutdown Due to Limit Switch” alarm
- When the limit circuit is again complete – the FAN output for the indoor blower contactor coil remains on until the “Heating Fan Off Delay” timer expires
- When the limit circuit is again complete and the “Heating Fan Off Delay” timer expires – The FAN output for the indoor blower contactor coil will cycle off if no other requests for indoor blower operation are present and the “HS1 Shutdown Due to Limit Switch” alarm is removed the UCB active alarm list

The third LIMIT input trip in any two hour period results in a “hard” lockout:

- Once the limit circuit is open, the “hard” lockout remains in effect even if the limit circuit is again complete – H1 and H2 staging outputs to the heat section are not permitted, the FAN output for the indoor blower contactor coil is turned on, the UCB displays an “HS1 Shutdown Due to Limit Switch” alarm and an “HS1 Shutdown Due to Limit Switch” alarm is recorded in the alarm history register of the UCB

Assuming the limit circuit is again complete, a “hard” lockout due to three LIMIT input trips in a two hour period can be reset by:

- Cycling the request for heating operation – this method sets the soft-to-hard lockout trip count stored in the UCB to two
- Cycling power to the UCB or a network reset command – both methods set the soft-to-hard lockout trip count stored in the UCB to zero

UCB Compressor Cooling Staging Output Operation

Details of the interaction of compressor cooling staging with economizer free cooling are covered later in this manual. With requests for cooling operation present, UCB control permissions must be satisfied to allow staging outputs for the compressors. These control permissions can be categorized as:

- General items that permit UCB staging outputs
- UCB configuration items for cooling
- UCB operational items for cooling

General items must all be satisfied to permit UCB staging outputs:

- SD circuit complete
- Greater than 19 volts applied to the UCB R terminal
- LIMIT input trip or hard lockout must not be active
- A purge command must not be active
- FAN OVR input trip or lockout must not be active
- VFD FLT input must not be present or lockout active
- When enabled, APS input must be present
- A duct pressure shutdown alarm must not be active

UCB configuration items to permit compressor cooling staging output for air conditioning units with gas or electric heat:

- “Yes” must be selected in the “Cooling Mode Enabled For Operation” parameter
- “Number of Cooling Stages Installed” parameter selection must be appropriate for the compressor cooling stages
- A selection of “1” to allow C1 output for single-stage capacity, single compressor units
- A selection of “2” to allow C1 and C2 outputs for two compressor units or two-stage capacity, single compressor units
- A selection of “3” to allow C1, C2 outputs from the UCB and C3 output from the 4-stage board is only available if the 4-stage board is detected through SA bus communication

- A selection of “4” to allow C1, C2 outputs from the UCB and C3, C4 outputs from the 4-stage board is only available if the 4-stage board is detected through SA bus communication
- “Yes” must be selected in the “C1 Enabled For Operation” parameter
- “Yes” must be selected in the “C2 Enabled For Operation” parameter for two compressor units

UCB operational items to permit compressor cooling staging output:

- A gas valve miswire lockout must not be active
- OAT sensor input must be above the “Outdoor Air Temp Cooling Lockout Setpoint”
- Economizer free cooling interaction must not prevent compressor operation
- When the “SAT Air Temp Limit For Cooling” is enabled, SAT sensor input must be above the “SAT Air Temp Limit For Cooling Setpoint”
- The 5 minute heating-to-cooling mode changeover timer must be expired
- The 5 minute cooling anti short cycle delay timer must be expired

Additional UCB operational items to permit individual compressor cooling output:

- Greater than 19 volts applied to the UCB 24V FOR OUTPUTS terminal at initiation of output
- Greater than 16 volts applied to the UCB 24V FOR OUTPUTS terminal to maintain output
- HPS input trip or lockout must not be active
- LPS input trip or lockout must not be active
- An EC input freeze trip or lockout must not be active
- The 5 minute compressor anti short cycle delay timer must be expired
- The 30 second compressor inter-stage delay timer must be expired (does not apply to the first compressor contactor output energized)

With the above permissions satisfied a first stage cooling request initiates operation of one compressor:

- In single compressor units, C1 output is energized
- In two compressor units, C1 output is energized with “Lead/Lag – Compressor Equalized Runtime” disabled and no HPS1, LPS1 or EC1 lockout active

- If an HPS1, LPS1 or EC1 lockout is active, the C2 output is energized in substitution
- The C(1 or 2) output with the lower accumulated runtime is energized with “Lead/Lag – Compressor Equalized Runtime” enabled and no HPS, LPS or EC lockout active
- If an HPS, LPS or EC lockout is active for the C(1 or 2) output with the lower accumulated runtime, the other C(1 or 2) output is energized in substitution

The C(1 or 2) output for first stage cooling remains energized until:

- Any one of the above permissions is not satisfied
- The first stage cooling request ends and the “Cooling Min On Time” timer for C(1 or 2) output expires

The “Cooling Min On Time” timer can be selected for 3 to 10 minutes in 1 minute increments. The timer begins at the initiation of the C# output. The “Cooling Min On Time” timer is not effective when less than 16 volts is applied to the UCB 24V FOR OUTPUTS terminal, with refrigerant circuit safety trips or with LIMIT input trips.

The 5 minute compressor anti short cycle delay timer begins when the C# output is turned off and at the completion of the UCB boot-up sequence.

With C(1 or 2) output for first stage cooling, the “Cooling Fan On Delay” timer is initiated and the FAN output for the indoor blower contactor coil is turned on at the expiration of the “Cooling Fan On Delay” timer. When cooling operation ends, the “Cooling Fan Off Delay” timer is initiated and the FAN output for the indoor blower contactor coil is turned off at the expiration of the “Cooling Fan Off Delay” timer if no other request for indoor blower operation is present.

With either C1 or C2 output, the CN-FAN output for the condenser fan contactor coil is turned on. The CN-FAN output for the condenser fan contactor coil is turned off only when both C1 and C2 outputs are off.

In two compressor units, with the operational items to permit compressor cooling staging output satisfied a second stage cooling request initiates second stage cooling operation by energizing both the C1 and C2 outputs. The C1 and C2 outputs remain energized until:

- Any one of the operational items to permit compressor cooling staging output is not satisfied
- The second stage cooling request ends – typically, a first stage cooling request then remains
- The “Cooling Min On Time” timer for C(1 or 2) output must then expire



Only the associated output (C1 or C2) is affected if any one of the above UCB operational items to permit individual compressor cooling output is not satisfied.

The operational items to permit individual compressor cooling output include the high pressure switch (HPS), low pressure switch (LPS) and evaporator coil temperature (EC) refrigerant circuit safeties. The refrigerant circuit safety permissions apply only to the associated output:

- HPS1, LPS1 and EC1 permissions apply only to the C1 output
- HPS2, LPS2 and EC2 permissions apply only to the C2 output
- While continuously monitored by UCB, the refrigerant circuit safety inputs are only effective if the request for operation and other permissions would allow the C# output

Refrigerant discharge pressure above 650 ± 10 PSI trips (opens) the HPS that results in the loss of 24 volts AC to the associated UCB input pin.

The initial and second HPS input trip in any two hour period result in a “soft” lockout:

- While the HPS circuit is open – C# staging output to the compressor contactor coil is not permitted and the UCB displays a “C# Shutdown Due to High Pressure” alarm
- When the HPS circuit is again complete – the C# staging output to the compressor contactor coil remains off until the “C# ASCD” timer expires
- When the HPS circuit is again complete and the “C# ASCD” timer expires – C# staging output to the compressor contactor coil is permitted and the “C# Shutdown Due to High Pressure” alarm is removed the UCB active alarm list

The third HPS input trip in any two hour period results in a “hard” lockout:

- Once the HPS circuit is open, the “hard” lockout remains in effect even if the HPS circuit is again complete – C# staging output to the compressor contactor coil is not permitted, the UCB displays a “C# Shutdown Due to High Pressure” alarm and a “C# Shutdown Due to High Pressure” alarm is recorded in the alarm history register of the UCB

Assuming the HPS circuit is again complete, a “hard” lockout due to three HPS input trips in a two hour period can be reset by:

- Cycling the request for cooling operation – this method sets the soft-to-hard lockout trip count stored in the UCB to two
- Cycling power to the UCB or a network reset command – both methods set the soft-to-hard lockout trip count stored in the UCB to zero

Refrigerant suction pressure below 50 ± 20 PSI trips (opens) the LPS that results in the loss of 24 volts AC to the associated UCB input pin.

The initial and second LPS input trip in any one hour period result in a “soft” lockout:

- While the LPS circuit is open – C# staging output to the compressor contactor coil is not permitted and the UCB displays a “C# Shutdown Due to Low Pressure” alarm
- When the LPS circuit is again complete – the C# staging output to the compressor contactor coil remains off until the “C# ASCD” timer expires
- When the LPS circuit is again complete and the “C# ASCD” timer expires – C# staging output to the compressor contactor coil is permitted and the “C# Shutdown Due to Low Pressure” alarm is removed the UCB active alarm list

The third LPS input trip in any one hour period results in a “hard” lockout. When the LPS circuit is open, the “hard” lockout remains in effect even if the LPS circuit is again complete – C# staging output to the compressor contactor coil is not permitted, the UCB displays a “C# Shutdown Due to Low Pressure” alarm and a “C# Shutdown Due to Low Pressure” alarm is recorded in the alarm history register of the UCB.

Assuming the LPS circuit is again complete, a “hard” lockout due to three LPS input trips in a two hour period can be reset by:

- Cycling the request for cooling operation – this method sets the soft-to-hard lockout trip count stored in the UCB to two
- Cycling power to the UCB or a network reset command – both methods set the soft-to-hard lockout trip count stored in the UCB to zero

The EC freeze protection refrigerant circuit safety inputs are from thermistor temperature sensors mounted to each refrigerant circuit suction line. Suction line temperature below the “EC Freeze Setpoint” counts as a freeze protection trip.

The initial and second EC input trip in any two hour period result in a “soft” lockout:

- While the EC trip is active – C# staging output to the compressor contactor coil is not permitted and the UCB displays a “C# Shutdown Due to Coil Freeze” alarm
- When the EC temperature rises 20°F above the “EC Freeze Setpoint” – the C# staging output to the compressor contactor coil remains off until the “C# ASCD” timer expires
- When the EC temperature rises 20°F above the “EC Freeze Setpoint” and the “C# ASCD” timer expires – C# staging output to the compressor contactor coil is permitted and the “C# Shutdown Due to Coil Freeze” alarm is removed the UCB active alarm list

The third EC input trip in any two hour period results in a “hard” lockout:

- Once the the EC trip is active, the “hard” lockout remains in effect even if the EC temperature rises 20°F above the “EC Freeze Setpoint” – C# staging output to the compressor contactor coil is not permitted, the UCB displays a “C# Shutdown Due to

Coil Freeze” alarm and a “C# Shutdown Due to Coil Freeze” alarm is recorded in the alarm history register of the UCB

Assuming the EC temperature rises 20°F above the “EC Freeze Setpoint”, a “hard” lockout due to three EC input trips in a two hour period can be reset by:

- Cycling the request for cooling operation – this method sets the soft-to-hard lockout trip count stored in the UCB to two
- Cycling power to the UCB or a network reset command – both methods set the soft-to-hard lockout trip count stored in the UCB to zero

SA BUS

The SA BUS allows connection of satellite Smart Equipment boards and controllers to the base UCB for expansion of features and capabilities. The UCB display is the basic point of access to SA BUS devices and the display menu will add related parameters with the presence of SA BUS devices.

Other than the UCB, SA BUS devices include:

- The economizer board – used in economizer accessories, available on initial release of this product line
- MAP Gateway – optional usage in this product line, available in later releases of Smart Equipment development
- NetSensors – optional usage in this product line, available in later releases of Smart Equipment development
- Fault Detection and Diagnostic (FDD) board – optional usage in this product line, available in later releases of Smart Equipment development
- 4-stage board – potential usage in this product line if hydronic heat or variable speed compressor options are offered, available in later releases of Smart Equipment development

The four SA BUS terminals on the lower edge of the UCB are daisy-chain connected to other factory-installed or field added SA BUS devices. Dedicated for convenience connection of the MAP gateway, the 6-pin phone jack-style connector above the UCB display also has SA BUS connection. The “C” to “+” and “–” is the communication circuit for the SA BUS. The “C” to “PWR” circuit is available to provide 15 volts DC, sourced from the UCB, to power NetSensors and the MAP gateway.

The green SA BUS LED above the UCB display indicates the status of SA BUS communication:

- Lit to indicate that the UCB has not found or lost communication from SA BUS devices and is awaiting communication from SA BUS devices
- Flashing to indicate that the UCB has established communication with one or more SA BUS devices

Similarly, the green SA BUS LED on the economizer, FDD and 4-stage boards indicates the status of SA BUS communication:

- Lit to indicate that the SA BUS device has not found or lost communication from the UCB and is awaiting communication from the UCB
- Flashing to indicate that the SA BUS has established communication with the UCB

Additional indication of the SA BUS communication status is found within the display parameter menu location Contrler > SysCntlrs > Misc

- The quantity under #NetSensors indicates the current number of NetSensors in SA BUS communication with the UCB
- “Not Present” indicates that the UCB has not established SA BUS communication for (or relearned away) that SA BUS board
- “Online” indicates that the UCB has established SA BUS communication for that SA BUS board
- “Offline” indicates that the UCB has once established SA BUS communication for that SA BUS board and has currently lost communication for that SA BUS board

Once communication to SA BUS devices is established, the UCB retains a list of the devices in its non-volatile memory. “Offline” indication and an alarm then occur if communication is lost to the SA BUS device listed in the UCB memory. The relearn feature, done by selecting “Yes” at display parameter menu location Contrler > SysCntlrs > Misc > Relearn, clears the list of SA BUS devices in the UCB memory.

Economizers

Control parameters describe the 2-10 volt DC output to the economizer actuator as a percentage of the outside air damper position:

- 0% = 2 volts DC output to the actuator / OA damper fully closed / RA damper fully open
- 100% = 10 volts DC output to the actuator / OA damper fully open / RA damper fully closed

Economizer functions are controlled by the Smart Equipment economizer expansion board mounted within the economizer. Through SA BUS communication, the economizer expansion board is integrated to the base unit UCB. Access to the economizer control parameters is made through the UCB; either by way of the UCB display, MAP gateway access or BAS communication for UCBs with communication-ready options.

Economizers have three base ventilation functions: minimum position, free cooling, and demand ventilation. These functions may be active concurrently to position the economizer actuator. The active ventilation function requiring the greatest amount of outside air determines the 2-10 volt DC output from the economizer board to position the economizer actuator.

The minimum position function is active if the unit is in occupied mode and the indoor blower is operating. Low ambient minimum position and low speed fan minimum position functions have additional conditions to be active. Requiring the addition of 3rd-party accessories, the provisions for the air monitoring function resets minimum position to maintain a consistent volume of outdoor airflow in speed controlled indoor blower applications. Details of the minimum position functions are found in the Economizer Minimum Positions section later in this manual.

The free cooling function is active when there is a request for cooling operation and the outdoor air is suitable to use for cooling. Free cooling may be initiated by outside air dry bulb temperature, outside air (single) enthalpy, or a comparison of return and outside air (dual) enthalpy. Details of the free cooling functions are found in the Economizer Free Cooling section later in this manual.

Detailed in the Compressor Interaction with Free Cooling section, selections for compressor operation to supplement free cooling are available within the control parameters. An application item of note is that single-compressor units with economizers and thermostat comfort control require a 2-stage cooling thermostat if compressor operation to supplement free cooling is desired.

If enabled, the demand ventilation function is active if the unit is in occupied mode and when indoor CO² levels are high. Depending on CO² sensor input and control parameter selection, demand ventilation may be initiated from either indoor CO² sensor input only or from a differential between indoor and outdoor CO² sensor inputs. Details of the demand ventilation functions are found in the Economizer Demand Ventilation section later in this manual.

Detailed in the Purge Functions section, purge functions are available with the presence of the economizer expansion board. Purge is an override function that has priority over other ventilation, indoor blower and heating/cooling function.

Detailed in the Other Economizer Functions section, comfort ventilation functions, economizer loading and hydronic heat integrate aspects of heating/cooling operation with economizer operation.



The economizer board output to position the economizer actuator has a maximum rate of change of 1% every two seconds. This, coupled with the actuators that are rated for up to 150 seconds to complete their 90° stroke, require the technician to exercise patience when adjusting or servicing the economizer section.

Economizer Minimum Positions

The minimum position function positions the economizer actuator to the setting selected for the “Econ-MinPos” control parameter if the unit is in occupied mode and the indoor blower is operating. Minimum position is not effective if low ambient minimum position is active. In units with IntelliSpeed options, minimum position is fully active when the unit is in occupied mode and the indoor blower is operating at the highest IntelliSpeed VFD output. At lower IntelliSpeed VFD outputs, minimum position remains a factor in determining economizer actuator position.

There is no specific parameter for enabling/disabling the minimum position function. However, minimum position is effectively disabled if a “0%” setting is selected for the “Econ-MinPos” control parameter.

The low ambient minimum position is typically set to provide less outside air than minimum position. The low ambient minimum position function positions the economizer actuator to the setting selected for the “LowAmb-MinPos” control parameter if the unit is in occupied mode, the indoor blower is operating and the outdoor air temperature is below the setting selected for the “LowAmb-Sp” control parameter.

Used for units with IntelliSpeed options for indoor blower speed control, the low speed fan minimum position function is set to maintain outside air volume when the blower operates at the lowest speed. The low speed fan minimum position setting will be for a greater economizer actuator position than the minimum position setting. The low speed minimum position function positions the economizer actuator to the setting selected for the “LowSpeedFan-MinPos” control parameter if the unit is in occupied mode and the indoor blower is operating at the lowest IntelliSpeed VFD output. The minimum position function then positions the economizer actuator to the setting selected for the “Econ-MinPos” control parameter if the unit is in occupied mode and the indoor blower is operating at the highest IntelliSpeed VFD output. When the indoor blower operates between the lowest and highest IntelliSpeed VFD outputs, the economizer actuator is positioned proportionately between the “LowSpeedFan-MinPos” and “Econ-MinPos” settings. Details of low speed fan minimum position setup are discussed in the IntelliSpeed VFD Indoor Blower Speed Control section of this manual.

Typically used in variable air volume units and requiring the addition of 3rd-party accessories, the air monitoring function resets minimum position to maintain a consistent volume of outdoor airflow in speed controlled indoor blower applications. The air monitoring function utilizes the 0-10 volt DC FR AIR input on the economizer board connected to the 0-10 volt DC output of the 3rd-party air monitoring station. The airflow volume measured by the 3rd-party air monitoring station at 10 volts DC is entered in the “MOA-Range” control parameter setting. The desired outside airflow volume is then entered in the “MOAFlow-Sp” control parameter setting. Economizer actuator position for minimum position increases when outside airflow volume falls below the “MOAFlow-Sp” setting and decreases when outside airflow volume rises above the “MOAFlow-Sp” setting.

Economizer Free Cooling

Economizer free cooling is enabled by selecting “Yes” for the “Econ-En” control parameter. Then, the free cooling function is active when there is a request for cooling operation and the outdoor air is suitable to use for cooling.

Determination if the outdoor air is suitable to use for cooling, termed “free cooling changeover”, on the sensor inputs present and/or on the selection for the “FreeClg-Sel” control parameter. The free cooling changeover method may be from outside air dry bulb temperature, outside air (single) enthalpy, or a comparison of return and outside air (dual) enthalpy.

Dry bulb free cooling changeover is based on the factory-installed OAT sensor (or communicated OAT value) and does not require optional sensors. With dry bulb changeover, free cooling is available when OAT is below the “EconOAT-SpEn” control parameter selection.

Single enthalpy free cooling changeover is based on the outdoor air enthalpy calculated from the factory-installed OAT sensor (or communicated OAT value) and optional OAH sensor (or communicated OAH value). With single enthalpy changeover, free cooling is available when “OA-Enth” is below the “EconOAEnth-Sp” control parameter selection.

Dual enthalpy free cooling changeover is based on a comparison of the outdoor air enthalpy to the return air enthalpy. Outdoor air enthalpy is calculated from the factory-installed OAT sensor (or communicated OAT value) and optional OAH sensor (or communicated OAH value). Return air enthalpy is calculated from the factory-installed RAT sensor and optional RAH sensor (or communicated SH value). With dual enthalpy changeover, free cooling is available when “OA-Enth” is below “RA-Enth”.

The selection for the “FreeClg-Sel” control parameter determines the desired free cooling changeover method. With a selection of “Auto” – the free cooling changeover method is determined by the presence of optional humidity sensor inputs. Dual enthalpy changeover is used if RAH and OAH inputs are present.

With a selection of “Dry Bulb” – dry bulb free cooling changeover is used. Dry bulb changeover is used if OAH input is not present (reversion if OAH input is present and then lost)

With a selection of “Dual Enthalpy” – dual enthalpy is the desired free cooling changeover method, the free cooling changeover method remains determined by the presence of optional humidity sensor inputs. Dual enthalpy changeover is used if RAH and OAH inputs are present

With a selection of “Single Enthalpy” – single enthalpy is the desired free cooling changeover method, the single enthalpy or dry bulb free cooling changeover method remains determined by the presence of optional OAH sensor input:

- Single enthalpy changeover is used if OAH input is present
- Dry bulb changeover is used if OAH input is not present (reversion)

Reversion of the free cooling changeover method, and associated sensor alarms, occurs if required sensor inputs are not present. Dual enthalpy changeover reverts to single enthalpy changeover if RAH input is not present. Dual enthalpy changeover and single enthalpy

changeover revert to dry bulb changeover if OAH input is not present. Also, economizer free cooling is not permitted if OAT input is not present.

To prevent excessively cool air from being delivered during cold outdoor conditions with free cooling, the supply air temperature sensor is used as a limiting device. Outdoor air dampers are closed to reduce the amount of cooler air, and return air dampers are opened to mix warmer air until the supply air temperature reaches the following:

- 55°F SAT with a first stage cooling request
- 50°F SAT with a second stage cooling request



For a second stage cooling request, single-compressor units with economizers and thermostat comfort control require a 2-stage cooling thermostat.

If the supply air temperature does not rise to the above temperatures during free cooling operation, the economizer will close to minimum position when the unit is in occupied mode or will close fully (0%) when the unit is in unoccupied mode.

If the supply air temperature does not fall to the above temperatures during free cooling operation, the economizer will open fully (100%).

Compressor Interaction with Free Cooling

Compressor operation with economizer free cooling is not permitted when “No” is selected for the “AllClgOff-Econ” control parameter.

Compressor operation to supplement economizer free cooling is permitted when “Yes” is selected for the “AllClgOff-Econ” control parameter. The anti-short cycle delay, minimum run time delay, OAT and SAT cutout permissions for compressors remain effective for compressor operation to supplement economizer free cooling.

If permitted in single-compressor units, compressor operation to supplement free cooling begins with the following conditions:

- SAT is above 55°F for more than 20 minutes, continuously, after the initiation of a first stage cooling request
- SAT is above 50°F for more than 20 minutes, continuously, after the initiation of a second stage cooling request



For a second stage cooling request, single-compressor units with economizers and thermostat comfort control require a 2-stage cooling thermostat.

In single-compressor units, compressor operation to supplement free cooling ends with the following conditions:

- The first stage cooling request ends
- SAT is below 50°F with a first stage cooling request
- SAT is below 45°F with a second stage cooling request

If permitted in two-compressor units, operation of the first compressor to supplement free cooling begins with the following conditions:

- SAT is above 55°F for more than 20 minutes, continuously, after the initiation of a first stage cooling request
- SAT is above 50°F with a second stage cooling request

In two-compressor units, operation of the second compressor to supplement free cooling begins with the following conditions:

- SAT is above 50°F for more than 20 minutes, continuously, after the initiation of a second stage cooling request

In two-compressor units, operation of the second compressor to supplement free cooling ends with the following conditions:

- The second stage cooling request ends
- SAT is below 45°F

In two-compressor units, operation of the first compressor to supplement free cooling ends with the following conditions:

- The first stage cooling request ends
- SAT is below 50°F

Economizer Demand Ventilation

If enabled, the demand ventilation function is active if the unit is in occupied mode, the indoor blower is operating and when indoor CO² levels are high. Alone, demand ventilation does not create a request for indoor blower operation; indoor blower operation must be initiated by request from another function such as G thermostat input or “Continuous Fan Operation in Occupied Mode”.

The demand ventilation function is not permitted when “Disabled” is selected for the “DVent-Mode” control parameter.

Single-input demand ventilation function is permitted when “Controlled by IAQ” is selected for the “DVent-Mode” control parameter.

Single-input demand ventilation utilizes either the 0-10 volt DC IAQ input on the economizer board connected to the 0-10 volt DC output of the indoor CO² sensor or a communicated IAQ value. The CO² ppm measured by the indoor CO² sensor at 10 volts DC is entered in the “IAQRange” control parameter setting (not required if a communicated IAQ value is used). The desired maximum economizer damper position for the demand ventilation function is then entered in the “DVentMaxEconPos” control parameter setting.

Single-input demand ventilation operation with SAT between 45°F and 85°F:

- The economizer actuator position will increase from minimum position up to the “DVentMaxEconPos” when the indoor CO² level rises above the outdoor “DVentIAQ-Sp” setting
- The economizer actuator position will be held when the indoor CO² level is equal to the “DVentIAQ-Sp” setting
- The economizer actuator will close to minimum position when the indoor CO² level is below the “DVentIAQ-Sp” setting

Single-input demand ventilation operation with SAT below 45°F or above 85°F:

- The economizer actuator will close to minimum position

Dual-input demand ventilation function is permitted when “Diff between IAQ and OAQ” is selected for the “DVent-Mode” control parameter.

For indoor air quality input, dual-input demand ventilation utilizes either the 0-10 volt DC IAQ input on the economizer board connected to the 0-10 volt DC output of the indoor CO² sensor or a communicated IAQ value. The CO² ppm measured by the indoor CO² sensor at 10 volts DC is entered in the “IAQRange” control parameter setting (not required if a communicated IAQ value is used). For outdoor air quality input, dual-input demand ventilation utilizes either the 0-10 volt DC OAQ input on the economizer board connected to the 0-10 volt DC output of the indoor CO² sensor or a communicated OAQ value. The CO² ppm measured by the indoor CO² sensor at 10 volts DC is entered in the “OAQRange” control parameter setting (not required if a communicated IAQ value is used). The desired maximum economizer damper position for the demand ventilation function is then entered in the “DVentMaxEconPos” control parameter setting.

Single-input demand ventilation operation with SAT between 45°F and 85°F:

- The economizer actuator position will increase from minimum position up to the “DVentMaxEconPos” when the indoor CO² level rises above the outdoor CO² level plus the “DVentDiff-Sp” setting
- The economizer actuator position will be held when the indoor CO² level is equal to the outdoor CO² level plus the “DVentDiff-Sp” setting
- The economizer actuator will close to minimum position when the indoor CO² level is below the outdoor CO² level plus the “DVentDiff-Sp” setting

Dual-input demand ventilation operation with SAT below 45°F or above 85°F:

- The economizer actuator will close to minimum position

Purge Functions

Purge is an override function that has priority over other ventilation, indoor blower and heating/cooling functions. The purpose of the purge function is to exchange the air in the space with outdoor air either for ventilation purposes or in response to a zoned smoke & fire protection system.

A purge may be initiated by either 24 volts AC input to the PURGE terminal on the economizer board or by communicated command. Following initial release, further revisions to Smart Equipment controllers will include a ventilation purge by schedule.

While a purge command is active:

- The indoor blower operates
- Heating and cooling operation is not permitted
- The economizer actuator is positioned to 100%
- If present, power exhaust operates

Economizer Loading

Economizer loading is a feature of economizer control that prevents compressor freeze protection safety trips in circumstances of low evaporator loading. For economizer loading to be effective “Yes” is selected for both the “SATCoolLimit-En” and “EconLoad-En” control parameters. Economizer loading is initiated if outdoor air temperature is above 60°F and when operation of all but one compressor has been terminated due to supply air temperature below the “SATCoolLimit-Sp” setting. With one compressor operating, economizer loading will modulate the outside air damper to maintain supply air temperature between the “SATCoolLimit-Sp” setting and the “SATCoolLimit-Sp” setting plus 5°F.

Chapter 5 – Gas Heat Service

Service Procedures

Common service procedures for the gas heat section of the 3 through 12 ½ ton product line include measurement of gas pressure, induced draft pressure, flame signal and heat section temperature rise. These measurements, coupled with the diagnostic information of ignition control flash codes, provide information for setup and troubleshooting of the gas heat section.

Gas Valves

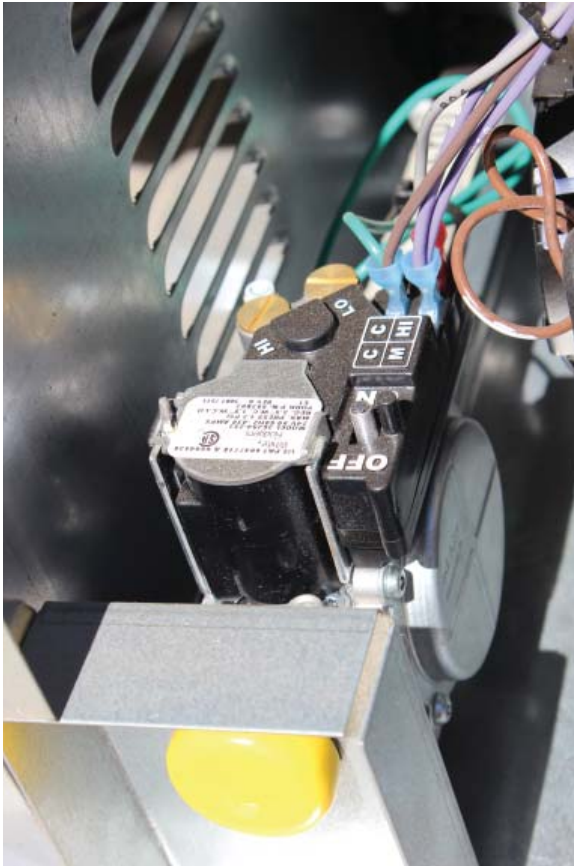


Figure 5 - 1 Gas valve

Two styles of White-Rogers gas valves are used in the 3 through 12 ½ ton product line. The “G” style gas valve is used on small footprint units and the “H” style gas valve is used on large footprint units. Both styles of gas valves have single-stage and two-stage versions used in the 3 through 12 ½ ton product line.

A service aspect of note is the difference between gas pressure taps of the two gas valve styles. The gas inlet and manifold pressure taps of the “G” style gas valve are within posts on the top side of the valve. The stop screw in the post is turned counterclockwise 1 turn with a 3/32” hex key (Allen wrench) to open the pressure tap and a 5/16” I.D. hose slips over the post for pressure measurement. To close the tap after measurement is complete, the stop screw in the post is turned clockwise until re-seated. The gas inlet and manifold pressure taps of the “H” style gas valve are on the ends of the valve. The 1/8” I.P.T. plug is removed from the tap with a 3/16” hex key (Allen wrench) and a 1/8” I.P.T.-to-hose adapter is needed for pressure measurement. To close the tap after measurement is complete, the 1/8” I.P.T. plug is reinserted and tightened in the tap.

Manifold Pressure Adjustment

Gas manifold pressure adjustment is identical for both valve styles. Beneath a brass cap-screw, a plastic regulator adjustment screw is turned clockwise to increase and counterclockwise to decrease manifold pressure. Two-stage gas valves have independent regulators and adjustment for high and low fire manifold pressures, and it is recommended to adjust the high fire regulator first. Always consult the Installation Instructions and LP conversion kit instructions (if applicable) to determine appropriate first and second stage manifold pressures. During propane conversion, the plastic regulator adjustment screw is removed to change the regulator spring beneath.

Inducer Pressure Measurement

Measurement of the induced draft pressure is needed when troubleshooting issues related to the pressure switch. To perform induced draft pressure measurement, the tube from the collector box tap to the pressure switch is disconnected at the switch and a hose-barb tee with a length of 3/16" I.D. tubing is inserted. The remaining hose-barb tee connection is connected to the port of an incline manometer, digital manometer or Manehelic® gauge of the proper pressure range.



Figure 5 - 2 Combustion air pressure switch

An induced draft pressure switch setting of -0.33" W.C. is used throughout the product line. Other than a brief surge following burner light-off, the negative pressure at the induced draft collector box tap is typically about 1-½ times lower than the pressure switch setting during operation.

Reduced or insufficient induced draft pressure can be caused by:

- Restriction in the induced draft outlet
- A degraded induced draft blower wheel
- The induced draft motor not operating at full speed
- Breaches in the heat exchanger – particularly if the reduced or insufficient induced draft pressure coincides with indoor blower operation

Flame Signal Measurement

The ignition control uses flame rectification to confirm the presence of burner flame. The flame sensing circuit originates with a nominal 24 volts AC from the ignition control FS terminal to the flame sensor. The flame sensor rod is positioned to have $\approx 1/8$ " gap to the burner outlet. The flame passes a small amount of rectified current and completes the circuit to cabinet ground by bridging the flame sensor rod to burner outlet gap. The ignition control monitors this circuit and considers flame to be present if the DC current flow, also termed "flame signal", is 0.2 microamperes (μA) or greater.

Measurement of flame signal requires a meter with a DC μA scale. For DC μA flame signal measurement, the meter is placed in the flame rectification circuit as an inline ammeter. The flame sensor wire is disconnected at the FS terminal of the ignition control and the meter leads are connected between the ignition control FS terminal and the disconnected flame sensor wire.

In normal operation, the flame signal will be greater than 0.4 μA DC. Low or absent flame signal can be caused by:

- Poor quality burner flame
- Reduced flame conductivity due to low manifold gas pressure
- Disconnection of the flame from the burner due to excessive manifold gas pressure
- Poor contact of the flame to the sensor due to fouled burners, misaligned burners, cabinet supply air leakage, etc.
- Poor conductivity or interruption of the flame sensing electrical circuit
- Poor electrical grounding of the cabinet
- Corrosion or other issues causing poor grounding of the burner assembly or ignition control
- Open or poor connections in the flame sensor wiring
- Reduced conductivity of the flame sensor due airborne contaminants, such as silicates (dust, sand) or other chemicals, reacting within the flame to coat the rod
- The cause of airborne contamination should be investigated and corrected
- Repair requires replacement of the flame sensor or cleaning the rod with 000 steel wool

Temperature Rise

Temperature rise is the difference in air temperature through the heat section during heating operation. A product of heating capacity and indoor air volume, gas heat section temperature rise at full capacity operation must be within the range shown on the unit data tag.

To ensure stable readings, measurement of temperature rise is done after 10 minutes of full capacity heating operation. Then, the return air temperature for units without economizer/mixed air temperature for units with economizer is subtracted from the supply air temperature to find the temperature rise. It is acceptable to obtain return air/mixed air and supply air temperature measurements from either Simplicity SE sensor readings or by independent temperature probes.

When other measurements are taken, heat section temperature rise is useful to confirm those measurements through the following formulas:

To confirm indoor airflow volume when heating output capacity is known:

$$\text{Full Capacity Heating Output BTUs} = \text{CFM Indoor Airflow} \times \text{Temperature Rise } ^\circ\text{F} \times 1.08$$

To confirm heating output capacity when indoor airflow volume is known:

$$\text{Temperature Rise } ^\circ\text{F} \times 1.08 \times \text{CFM Indoor Airflow} = \text{Full Capacity Heating Output BTUs}$$



The above formulas, using the 1.08 factor, are valid at normal altitudes. Consult Unitary Products Technical Services for high altitude applications.

Ignition Control Flash Codes

Ignition control flash codes provide status and diagnostic information for the gas heat section. The following table lists the description, actions to correct faults, ignition control response and method to reset each flash code.

Steady On

The ignition control's microprocessor has not passed its self-check.

Cycle power to the control to eliminate the possibility that transient voltage conditions such as surges, brownouts, etc. have not created a false indication. If the steady on LED indication repeats, the control will need to be replaced and potential causes for failure, such as excessive voltage, RF interference, etc. should be investigated. The output relay contacts open so inducer and gas valve operation is not permitted. Cycling 24 VAC power to the ignition control or expiration of the 60 minute "watchdog" timer.

2 Flashes

The Induced Draft Pressure Switch Did Not Close - 24 VAC was not received to the ignition control's pressure switch input (P1-8 pin) within 10 seconds of the ignition control energizing the induced draft motor or 24 VAC was later lost to the control's pressure switch input while the ignition control energized the induced draft motor.

Verify that the induced draft motor is operable, the ignition control's L1 to IND contacts are not open, the induced draft blower wheel is intact and there are no blockages in the combustion air or induced draft path. Verify that the induced draft pressure switch sensing tubing is intact. With an incline manometer, digital manometer or Magnehelic® gauge teed into the pressure switch sensing line verify that the negative pressure exceeds the setting listed on the induced draft pressure switch label and the switch's contacts correctly close at the setting listed.

Gas valve operation is not permitted/ends when the induced draft pressure switch input is not present. The ignition control's L1 to IND output relay contact will cycle closed for 5 minutes/open for 30 seconds until 24 VAC is received to the pressure switch input or the heating demand ends. Closure of the pressure switch (24 VAC input to P1-8 pin), cycling first stage heat input or cycling 24 VAC power to the ignition control.

3 Flashes

The Induced Draft Pressure Switch is Stuck Closed - 24 VAC is received to the control's pressure switch input (P1-8 pin) at the same time as 24 VAC to initiate heating operation is received at the control's W1 input (P2-3 pin).

Verify that the induced draft pressure switch contacts are not stuck or welded closed. Verify that the ignition control's L1 to IND contacts are not stuck or welded closed causing the induced draft motor to run continuously. Verify that the wiring from the ignition control's P1-3 pin through the induced draft pressure switch to the ignition control's pressure switch input (P1-8 pin) is not shorted.

The output relay contacts open so inducer and gas valve operation is not permitted. Opening of the pressure switch (loss of 24 VAC input to P1-8 pin) then cycling first stage heat input or cycling 24 VAC power to the ignition control.

4 Flashes

Flame Could Not Be Established - a flame signal of $0.2\mu\text{a}$ or greater could not be established in three consecutive attempts for ignition at the initiation of the heating cycle.

Verify that the unit has proper electrical grounding. Verify the 24 VAC common and ignition control cabinet ground references are intact. Monitor the flame signal. Verify that combustion air openings are without blockages and that the unit has proper clearance to the structure and adjacent units. Verify that the burners are clean and without blockages that could interfere with gas flow. Verify that the ignitor sparks with an $\approx 1/8$ " gap to the crossover area of the left burner. Verify that the flame sensor is intact and positioned with an $\approx 1/8$ " gap to the right burner. Verify that the gas lines have been purged of air and provide proper gas inlet pressure. Verify that the gas valve is opening and adjusted to provide proper manifold pressure. Verify that the wiring to the gas valve is intact. Verify that there is no wind, rain or snow entering the heat compartment to interfere with ignition or the burners. Verify that there are no conditioned air leaks or heat exchanger breaches to interfere with ignition or the burners.

Immediately after the third ignition trial: the gas valve output relay contact opens so gas valve operation is not permitted, following a 5 second inducer post purge the induced draft output relay contact opens so inducer operation is not permitted.

Cycling first stage heat input, cycling 24 VAC power to the ignition control or expiration of the 60 minute "watchdog" timer.

5 Flashes

Flame Loss - after being established during ignition trials, flame signal dropped below $0.2\mu\text{a}$ five times during one heating cycle.

Verify that the unit has proper electrical grounding. Verify the 24 VAC common and ignition control cabinet ground references are intact. Monitor the flame signal. Verify that combustion air openings are without blockages and that the unit has proper clearance to the structure and adjacent units. Verify that the burners are clean and without blockages that could interfere with gas flow. Verify

that the flame sensor is intact and positioned with an $\approx 1/8$ " gap to the right burner. Verify that the gas lines have been purged of air and provide proper gas inlet pressure. Verify that the gas valve provides proper manifold pressure. Verify that the wiring to the gas valve is intact. Verify that there is no wind, rain or snow entering the heat compartment to interfere with ignition or the burners. Verify that there are no conditioned air leaks or heat exchanger breaches to interfere with ignition or the burners.

Immediately after the fifth flame loss: the gas valve output relay contact opens so gas valve operation is not permitted, following a 5 second inducer post purge the induced draft output relay contact opens so inducer operation is not permitted.

Cycling first stage heat input, cycling 24 VAC power to the ignition control or expiration of the 60 minute "watchdog" timer.

6 Flashes

Open Limit - 24 VAC has been lost to the control's limit switch input (P1-9 pin).

Verify proper gas manifold pressure. Correct the inadequate indoor airflow condition. Verify filters, indoor coil and blower wheel are clean. Verify that the blower belt is properly maintained and adjusted; the blower motor fuses are intact, contactor and motor are operable and wheel has the correct rotation. Verify that the ducting is not restrictive. Verify indoor air volume is at least the minimum required for the heat section by measuring the indoor coil pressure drop and comparing the reading to the chart in the Installation Manual. Verify heating mode blower on/off delays are proper for the heat type and provide adequate heat section cooling at the termination of the heating cycle. Verify wiring for main and auxiliary limit switches is intact.

The gas valve output relay contact opens so gas valve operation is not permitted, the induced draft output relay contact closes to operate the inducer.

7 Flashes

Open Rollout - 24 VAC has been lost to the control's rollout switch input (P1-6 pin).

Verify that combustion air openings are without blockages and that the unit has proper clearance to the structure and adjacent units. Verify that the burners are clean and without blockages that could interfere with gas flow. Verify that the ignitor sparks with an $\approx 1/8$ " gap to the crossover area of the left burner. Verify that the gas lines provide proper gas inlet pressure. Verify that the gas valve is adjusted to provide proper manifold pressure. Verify that there is no wind, rain or snow entering the heat compartment to interfere with ignition or the burners. Verify that there are no conditioned air leaks or heat exchanger breaches to interfere with ignition or the burners. Verify wiring for the rollout switch is intact.

The gas valve output relay contact opens so gas valve operation is not permitted, following a 5 second inducer post purge the induced draft output relay contact opens so inducer operation is not permitted.

Closure of the rollout switch (24 VAC input to P1-6 pin) then cycling first stage heat input or cycling 24 VAC power to the ignition control.

8 Flashes

The Gas Valve Failed To Shut Off - flame has been sensed for longer than 2 seconds when the first stage gas valve output is off.

Verify that the gas valve is not slow to shut off, leaks by or otherwise does not completely shut off gas flow when de-energized. Verify the gas valve wiring to is intact and not shorted in a manner that would improperly allow 24 VAC from another circuit to be applied to the gas valve.

The gas valve output relay contact opens so gas valve operation is not permitted, the induced draft output relay closes to operate the inducer. Cycle 24 VAC power to the ignition control.

10 Flashes

a. Gas Valve Miswire - 24 VAC has been present for longer than 1 second at the first stage and/or second stage gas valve output (P1-7 pin and/or P1-4 pin) when the gas valve is commanded off by the ignition control.

Verify gas valve wiring from the ignition control to the gas valve is intact and not shorted in a manner that would improperly allow 24 VAC from another circuit to be applied to the control's P1-7 and/or P1-4 gas valve output pins. Verify the control's gas valve output relay contacts for first stage (P1-8 to P1-7) and second stage (P1-7 to P1-4) are not shorted or fail to close when commanded on.

Initially, the output relay contacts open. Then, if 24 VAC remains present at the P1-7 pin after 15 seconds, the induced draft output relay contact closes to operate the inducer.

b. Ignition Control Gas Valve Relay Contact Failed to Close - 24 VAC has not been sensed for longer than 1 second at the first stage and/or second stage gas valve output (P1-7 pin and/or P1-4 pin) when the gas valve is commanded on by the ignition control.

Operation Details for All Gas Heat Section Options

The ignition control is powered by 24 VAC from the 75 VA transformer. The cabinet ground-referenced 24 VAC common connects to the P2-1 pin of the ignition control. The P2-1 pin connects through a circuit trace on the ignition control board to the P1-2 pin to provide 24 VAC common for the gas valve. The 24 VAC common circuit trace also connects to the ignition control mounting standoff for additional ground reference. 24 VAC hot from the transformer connects to the P2-2 pin of the ignition control. When the ignition control is powered, its LED indicator will provide a flash code for the gas heat section status.

The ignition control sequences the induced draft motor through an on-board relay contact. One leg of line voltage to the induced draft motor is switched by the contact between L1 and IND terminals of the ignition control.

24 VAC hot, through closed main and auxiliary limit switches wired in series, is applied to the ignition control P1-9 pin and to the LIMIT terminal of the Simplicity SE unit control board (UCB). When trips of either limit switch remove 24 VAC hot from the P1-9 pin of the ignition control and the LIMIT terminal of the UCB:

- The ignition control does not permit output to the gas valve
- The ignition control operates the induced draft motor
- The ignition control displays a flash code 6 on its LED
- The UCB operates the indoor blower
- The UCB does not permit compressor operation
- The UCB displays an *alarm message* on its screen

Restoration of 24 VAC to the ignition control P1-9 pin by limit switch cool-down and reset allows normal operation of the gas heat section to resume. If there are fewer than 3 limit trips in a 2 hour period, restoration of 24 VAC to the LIMIT terminal of the UCB by limit switch cool-down and reset allows normal operation of the compressor(s) and blower to then resume following the expiration of the Heat: Fan Off Delay. Three limit trips in a two hour period initiate a UCB hard lockout.

During a UCB hard lockout due to limit trips:

- The UCB operates the indoor blower
- The UCB does not permit compressor operation
- The UCB displays an *alarm message* on its screen
- The UCB records the hard lockout due to limit trips in its alarm history
- There is output at the UCB X terminal
- The UCB announces the limit trips alarm to the communication network
- Reset of a UCB hard lockout due to limit trips requires:
 - Restoration of 24 VAC to the LIMIT terminal of the UCB by limit switch cool-down and reset
- And one of the following:
 - A communicated active alarm reset command
 - Interruption of 24 VAC power to the UCB

Normal operation of the compressor(s) and blower can then resume following the expiration of the Heat: Fan Off Delay.

24 VAC hot, first through the limit switches then through the closed rollout switch, is applied to the ignition control P1-6 pin. When trips of the rollout switch remove 24 VAC hot from the P1-6 pin:

- The ignition control does not permit output to the gas valve
- The ignition control switches off the induced draft motor following a 5 second post purge period
- The ignition control displays a flash code 7 on its LED

Restoration of 24 VAC to the P1-6 pin by manual reset of the rollout switch and interruption of either the first stage heating demand or 24 VAC power to the ignition control allows normal operation of the gas heat section to then resume.

The ignition control also continuously monitors the flame signal input. A flame signal of 0.2 μ A DC or greater through the ignition control FS circuit is needed for flame detection. When flame is detected for longer than 2 seconds at times when the ignition control commands the gas valve off:

- The ignition control does not permit output to the gas valve
- The ignition control operates the induced draft motor
- The ignition control displays a flash code 8 on its LED

Interruption of 24 VAC power to the ignition control allows normal operation of the gas heat section to then resume.

The ignition control continuously monitors the status of the P1-7 and P1-4 pins connected to the gas valve as well. When voltage is not sensed at the P1-7 pin and/or P1-4 pin for longer than 1 second at times when the ignition control commands the output on:

- The ignition control does not permit output to the gas valve
- The ignition control does not permit output the induced draft motor
- The ignition control displays a flash code 10 on its LED

Interruption of 24 VAC power to the ignition control allows normal operation of the gas heat section to then resume.

When voltage is sensed at the P1-7 pin (main gas valve output) for longer than 1 second at times when the ignition control commands the output off and flame is detected:

- The ignition control does not permit output to the gas valve (redundant off command for the gas valve output relays)
- The ignition control operates the induced draft motor
- The ignition control displays a flash code 10 on its LED

Interruption of 24 VAC power to the ignition control allows normal operation of the gas heat section to then resume.

- When voltage is sensed at the P1-7 pin (main gas valve output) for longer than 1 second at times when the ignition control commands the output off and flame is not detected:
 - The ignition control does not permit output to the gas valve (redundant off command for the gas valve output relays)
 - The ignition control does not permit output to the induced draft motor
 - The ignition control then operates the induced draft motor if voltage remains sensed at the P1-7 pin after 15 seconds with the induced draft motor off
 - The ignition control displays a flash code 10 on its LED

Interruption of 24 VAC power to the ignition control allows normal operation of the gas heat section to then resume.

The ignition control can respond to heating demand when 24 VAC power is applied, the heat section over-temperature safety switch inputs are present, flame detection input and gas valve outputs are properly coordinated. The source of heating demand depends on the unit control board (UCB) comfort control features used, which are described below.

Units with Simplicity SE Configured for Thermostat Inputs

24 VAC thermostat input to the W1 terminal provides first stage heating demand input to the microprocessor. After expiration of the heating anti-short cycle delay, and with permission from associated configuration and limiting setpoint parameters; H1 output (switched from the UCB R terminal) is then allowed. H1 output ends when the W1 input is removed and the heating minimum run timer expires or when a limiting setpoint is exceeded.

24 VAC thermostat input to the W2 terminal provides second stage heating demand input to the microprocessor. After expiration of the heating anti-short cycle and inter-stage delays, and with permission from associated configuration and limiting setpoint parameters; H2 output (switched from the UCB R terminal) is then allowed. H2 output ends when the W2 input is removed and the heating minimum run timer expires or when a limiting setpoint is exceeded.



If there is W2 input without W1 input; the Simplicity SE will turn on the H1 output, have an inter-stage delay and then turn on the H2 output. Both H1 and H2 outputs end when the W2 input is removed. The other conditions described above for H1 and H2 output remain effective.

Units with Simplicity SE Configured for Sensor Inputs

A first stage heating demand is present when the temperature of the sensor effective for comfort control (RAT, ST or communicated) falls more than 1°F below the active heating setpoint. After expiration of the heating anti-short cycle delay, and with permission from associated configuration and limiting setpoint parameters; H1 output (switched from the UCB R terminal) is then allowed. H1 output ends when the temperature of the sensor effective for comfort control rises to the active heating setpoint and the heating minimum run timer expires or when a limiting setpoint is exceeded.

A second stage heating demand is present when the temperature of the sensor effective for comfort control falls more than 1.5°F below the active heating setpoint. After expiration of the heating anti-short cycle and inter-stage delays, and with permission from associated configuration and limiting setpoint parameters; H2 output (switched from the UCB R terminal) is then allowed. H2 output ends when the temperature of the sensor effective for comfort control rises to 0.5°F below the active heating setpoint and the heating minimum run timer expires or when a limiting setpoint is exceeded.

When enabled, the comfort ventilation function of Simplicity SE can also produce H1 and H2 output. Details of comfort ventilation function are discussed in the Economizers section.

For all gas heat options and control features used, output from the UCB H1 pin wired to the ignition control P2-3 pin provides 24 VAC hot to initiate gas heat section operation. For units with 2-stage gas heat sections, output from the UCB H2 pin wired to the ignition control P2-4 pin provides 24 VAC hot for comfort temperature control staging of the gas valve high fire operation.

In cases where a 1-stage heating thermostat is applied to a unit with a 2-stage gas heat section the wiring to the ignition control P2-4 pin is field-modified so that 24 VAC hot is continuously present (method?). This permits the ignition control feature for timed staging of the gas valve high fire operation to be used. This topic is further covered under the 2-stage Gas Heat Section Options with 1-stage Heating Thermostats heading.

Also for all gas heat options and control features used, the UCB monitors the operation of the gas valve. The ignition control P1-7 pin 24 VAC output to the main gas valve also connects to the MV pin of the UCB to indicate gas valve operation. Coupled with the H1 output that initiates gas heat section operation, the UCB responds to the MV input as follows:

- When the MV input is received within 5 minutes of the initiation of the H1 output
- The UCB operates the indoor blower following the expiration of the Heat: Fan On Delay
- When the MV input is lost
- The UCB terminates indoor blower operation following the expiration of the Heat: Fan Off Delay
- When the MV input is not present within 5 minutes of the initiation of the H1 output
- The UCB displays an *alarm message* on its screen

- The UCB records the lockout due to ignition failure in its alarm history
- There is output at the UCB X terminal
- The UCB announces the ignition failure alarm to the communication network
- Reset of a UCB lockout due to ignition failure requires one of the following:
 - Input to the MV pin of the UCB (if H1 output has remained on)
 - Interruption of the heating demand
 - *alarm reset method*
 - A communicated active alarm reset command
 - Interruption of 24 VAC power to the UCB

When the MV input is received without the H1 output present:

- The UCB operates the indoor blower
- When the MV input is received for longer than 5 minutes without the H1 output present
- The UCB displays an *alarm message* on its screen (FPC/SES1)
- The UCB records the lockout due to gas valve miss-wire in its alarm history
- There is output at the UCB X terminal
- The UCB announces the gas valve miss-wire alarm to the communication network
- Reset of a UCB lockout due to gas valve miss-wire requires one of the following:
 - Removal of the input to the MV pin of the UCB *alarm reset method*
 - A communicated active alarm reset command
 - Interruption of 24 VAC power to the UCB

Output from the UCB H1 pin wired to the ignition control P2-3 pin provides 24 VAC hot to initiate gas heat section operation. The P2-3 pin connects through a circuit trace on the ignition control board to the P1-3 pin to provide 24 VAC hot to the one terminal of the induced draft pressure switch. The other terminal of the induced draft pressure switch is wired to the ignition control P1-8 pin. For operation to continue, 24 VAC hot input through the induced draft pressure switch to the ignition control P1-8 pin must not be received at the same time as input to the P2-3 pin to initiate gas heat section operation. If 24 VAC hot input to ignition control P1-8 pin is received at the same time as input to the P2-3 pin:

- The ignition control does not permit output to the gas valve
- The ignition control does not permit output the induced draft motor
- The ignition control displays a flash code 3 on its LED

Removal of 24 VAC to the P1-8 pin through opening of the induced draft pressure switch and interruption of either the first stage heating demand or 24 VAC power to the ignition control allows normal operation of the gas heat section to then resume.

With 24 VAC hot input to the P2-3 pin to initiate gas heat section operation and an open induced draft pressure switch, the ignition control closes the line voltage contact between the L1 and IND terminals to operate the induced draft motor. If the induced draft pressure switch does not close to apply 24 VAC hot input to the ignition control P1-8 pin within the first 10 seconds of induced draft motor operation:

- The ignition control does not permit output to the gas valve
- The ignition control displays a flash code 2 on its LED
- If the induced draft pressure switch remains open, the ignition control will repeat a cycle of:
 - The induced draft motor operates for 5 minutes
 - The induced draft motor is off for 30 seconds
 - 24 VAC to the P1-8 pin through closure of the induced draft pressure switch, interruption of the first stage heating demand or 24 VAC power to the ignition control allows normal operation of the gas heat section to then resume

With the induced draft pressure switch open at the initiation of gas heat section operation and then closed with induced draft motor operation, input to P1-8 pin initiates the ignition cycle and provides 24 VAC hot to the first stage gas valve contact of the ignition control.

The ignition cycle begins with a 15 second pre-purge where only the induced draft motor operates followed by the ignition trial. The ignition trial lasts the shorter of 10 seconds or until flame is detected by the ignition control. During the ignition trial:

- The ignition control energizes the spark igniter

The ignition control closes the first stage gas valve contact between the P1-8 pin and P1-7 pin for 24 VAC output to:

- Enable/operate the gas valve at low fire for units with a 2-stage gas heat section
- Operate the gas valve for units with a 1-stage gas heat section

The ignition control closes second stage gas valve contact between the P1-7 pin and P1-4 pin for 24 VAC output to:

- Operate the gas valve at high fire for units with a 2-stage gas heat section

If the induced draft pressure switch opens during the ignition trial:

- The ignition control does not permit output to the gas valve
- The ignition control displays a flash code 2 on its LED
- The ignition control operates the induced draft motor for a 5 second post-purge
- The induced draft motor is then turned off and re-started
- 24 VAC to the P1-8 pin through closure of the induced draft pressure switch, interruption of the first stage heating demand or 24 VAC power to the ignition control allows normal operation of the gas heat section to then resume

A flame signal of 0.2 μ A DC or greater through the ignition control FS circuit is needed for flame detection. If flame is not detected through the 10 seconds of ignition trial:

- The ignition control de-energizes the spark igniter
- The ignition control opens both first and second stage gas valve contacts to turn off the gas valve
- The ignition control continues to operate the induced draft motor for a 30 second inter-purge
- Another ignition trial then begins

When flame is not detected through three consecutive ignition trials:

- The ignition control de-energizes the spark igniter
- The ignition control opens both first and second stage gas valve contacts to turn off the gas valve
- The ignition control turns off the induced draft motor following a 5 second post-purge
- The ignition control displays a flash code 4 on its LED
- Interruption of either the first stage heating demand or 24 VAC power to the ignition control allows normal operation of the gas heat section to then resume

When flame is detected in the ignition trial, the spark igniter is de-energized and the ignition control begins a 10 second flame stabilization period. The ignition control continues to operate the gas valve at high fire for units with a 2-stage gas heat section throughout the flame stabilization period unless there is flame loss. During the flame stabilization period, 2 seconds with a flame

signal of less than 0.2 μ A DC counts as a flame loss. After the flame stabilization period, 3/4 second with a flame signal of less than 0.2 μ A DC counts as a flame loss. If flame loss occurs:

- The ignition control opens both first and second stage gas valve contacts to turn off the gas valve
- The ignition control continues to operate the induced draft motor for a 30 second inter-purge
- Another ignition trial then begins
- When flame loss occurs five times in one heating cycle:
 - The ignition control opens both first and second stage gas valve contacts to turn off the gas valve
 - The ignition control turns off the induced draft motor following a 5 second post-purge
 - The ignition control displays a flash code 5 on its LED

Interruption of either the first stage heating demand or 24 VAC power to the ignition control allows normal operation of the gas heat section to then resume.

Following the flame stabilization period, the ignition control begins a 30 second heat exchanger warm up period where it continues to operate the gas valve at high fire. The heat exchanger warm up period is only valid for a 2-stage gas heat section.

At the end of the heat exchanger warm up period for a 2-stage gas heat section, the ignition control operates the gas valve at high fire when there is second stage heating output from the UCB to the P2-4 pin or when there is use of the ignition control feature for timed staging of gas valve high fire operation for 2-stage gas heat section options with 1-stage heating thermostats.

For the remainder of the heating cycle, the ignition control first stage gas valve contact output to...

- Enable/operate the gas valve at low fire for units with a 2-stage gas heat section
- Operate the gas valve for units with a 1-stage gas heat section
- ...remains on as long as the ignition control P2-3 pin continues to receive input from the UCB H1 pin and operation is permitted by limit switch, rollout switch, pressure switch and flame signal inputs

The heating cycle ends when output from the UCB H1 pin and input to the ignition control P2-3 pin is removed:

- The ignition control opens both first and second stage gas valve contacts to turn off the gas valve
- The ignition control turns off the induced draft motor following a 5 second post-purge

Chapter 6 – Troubleshooting

As with other HVAC equipment, detection of mechanical and electrical faults follows troubleshooting procedures that provide the technician with information to both recognize symptoms and properly identify the “root-cause” source of the fault.

Before power is disconnected to the unit, during inspection or troubleshooting, the UCB and ignition control should be checked for active flash code indicators.

Prior to beginning troubleshooting, a general inspection of the unit should be made to assess and correct any maintenance-related items such as:

- Dirty filters should be replaced
- Fouled indoor and outdoor coils should be cleaned
- Obvious refrigerant leaks should be repaired
- Blockages in condensate drainage should be cleared
- The heat compartment should be inspected
- Worn items on the belt-drive indoor blower should be corrected
- Outdoor fans should turn freely

Correction of maintenance-related items is often the solution for many trouble calls, and is needed before in-depth troubleshooting can proceed.

When beginning troubleshooting, do not assume that the direction of rotation for the indoor blower and scroll compressors is correct. Reverse rotation of the indoor blower is indicated by inadequate indoor airflow or low current draw of the motor, and can be visually confirmed as the blower wheel coasts down after power disconnection. Reverse rotation of a scroll compressor is indicated by little or no difference in suction and discharge pressures, low current draw of the motor, and noisy operation (experienced technicians may recognize the distinct noise).

On initial startup, the reverse rotation is corrected by swapping two incoming power leads to the unit. If reverse rotation of the 3Ø components in the unit occurs at a point after proper rotation is established during initial startup, then the power supply should be examined for reverse phasing issues. The immediate correction for reverse phasing of the power supply, is to swap two incoming power leads to the unit. The addition of a phase monitor to the unit is the long-term solution to prevent unit damage due to reverse phasing of an unreliable power supply. If only a single 3Ø component is found to have reverse rotation, it is likely that the previous servicer’s practices are at fault, and two power leads must be swapped to the component.

Measurement of indoor airflow volume should be the initial information that the technician gathers for troubleshooting of CDR units. Indoor airflow volume is often overlooked as a factor in unit performance issues and faults.

Indoor airflow volume can be easily measured by:

- Removing the plastic plugs from the pressure drop taps located on the rear of the unit
- Using an incline manometer, Magnehelic gauge or digital manometer to measure the pressure difference at the taps
- Referencing the dry-coil pressure drop tables in the Installation Manual. The technician should read 400±50 CFM per ton of cooling capacity on 100% return air applications



While unit performance is rated at indoor airflows as low as 300 CFM/ton or as high as 500 CFM/ton, operation at these extremes tends to be unforgiving of minor system deficiencies and produces troubleshooting readings that approach abnormal. The recommendation in this manual of 400±50 CFM per ton of cooling capacity on 100% return air applications is intended for best stability of unit operation and reliability of troubleshooting readings.

While dry-coil evaporator pressure drop is a convenient way to measure indoor airflow volume, it can be of benefit to supplement or verify the reading with other methods:

- **External static pressure:** Measured and used with blower performance data from the unit literature to find indoor airflow volume. For this method to be accurate, the unit must be clean and an account of blower wheel speed, unit options and accessories be made.
- **Heating temperature rise:** With confirmed gas or electric heat output capacity, this method can be used with the sensible heat formula to calculate airflow volume. In cases where dirt is fouling the coil, causing the evaporator pressure drop to be elevated, the temperature rise calculation will show less airflow volume than the evaporator pressure drop indicates.
 - **Sensible heat formula:** (valid for altitudes below 4000 feet)
 - $CFM = \text{Heating output BTUs} \div (\text{Temperature Rise} \times 1.08)$
 - 80% AFUE gas heat heating output BTUs =
Measured input BTUs x 0.8
 - 3-phase electric heat Heating Output BTUs = Voltage at elements x single-leg amperage draw of elements x 5.91
- **Cooling mode leaving air temperature chart:** Instead of a direct measurement of airflow volume, the information in the cooling mode leaving air temperature chart (in appendix) shows a ratio of 400 CFM per ton of cooling capacity produced. In cases where 400 CFM/ton is indicated by the evaporator pressure drop, but dirt is fouling the coil, supply air temperatures will be below the figures in the chart. In cases

where 400 CFM/ton is established by the evaporator pressure drop but cooling capacity is reduced, supply air temperatures will be above the figures in the chart. The cooling mode leaving air temperature chart can also help confirm the range of indoor airflow. If the supply air temperatures are 3°F below the figures in the chart, the airflow is approximately 350 CFM/ton. If supply air temperatures are 3°F above the figures in the chart, the airflow is approximately 450 CFM/ton.

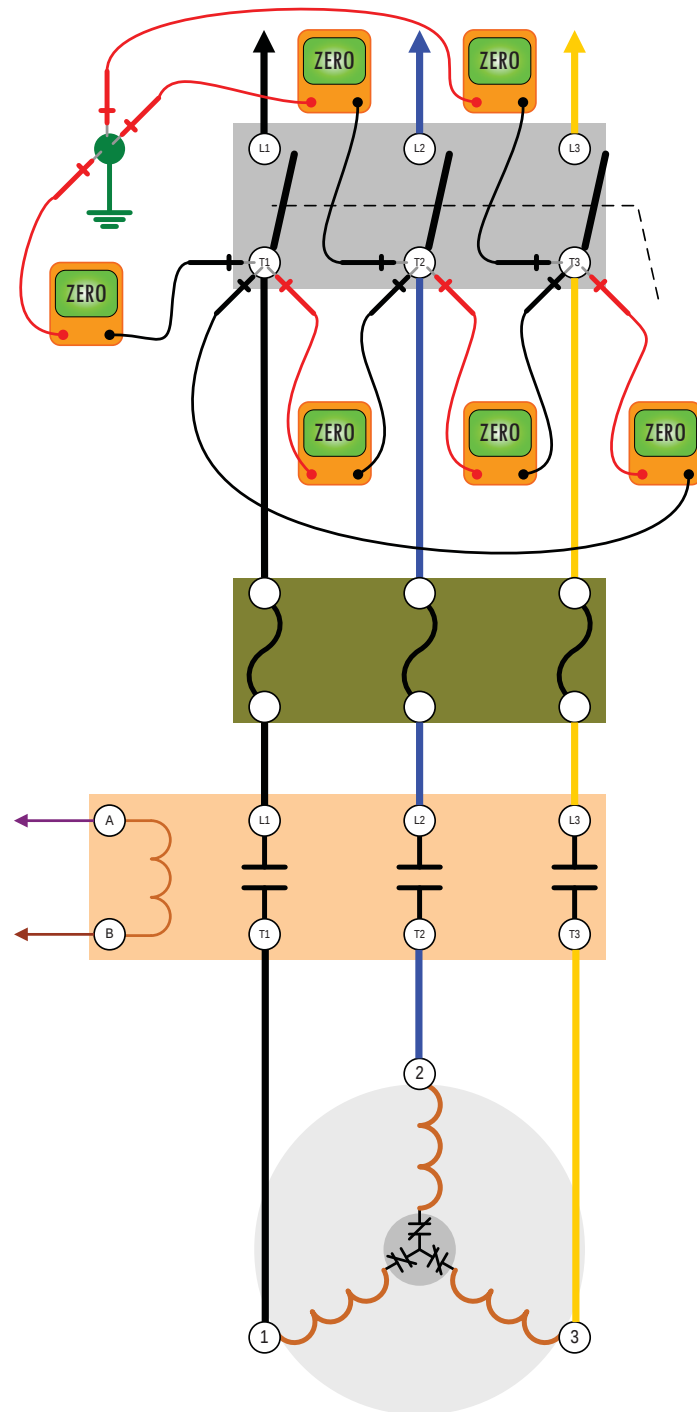
- **Air outlet measurement:** Air outlet measurements are taken using a balometer or other device to find indoor airflow volume. Duct leakage problems should be investigated in cases where the air volume of outlet measurements is lower than that measured through the unit by evaporator pressure drop, temperature rise or external static methods.

Proper indoor airflow volume is essential to troubleshooting both electrical and mechanical faults. Refrigerant circuit performance readings, such as superheat and subcooling, should only be considered valid if indoor airflow is in the correct range.

Electrical Troubleshooting

Electrical troubleshooting of 3 through 12 ½ ton units falls in two basic categories: high voltage troubleshooting and UCB based troubleshooting.

High Voltage Troubleshooting



High voltage troubleshooting is relatively uncomplicated since the circuitry is limited to disconnect, fuses, contactor, motor and the associated wiring.

Many troubleshooting procedures require that power remain on to the unit for valid readings. The technician must be attentive to his/her personal safety when working on a unit that is powered. Other procedures for maintenance, service and repair require that the unit power be disengaged. To prevent electrical shock, the technician should ensure line voltage is fully disengaged any time that the disconnect handle is placed in the “off” position.

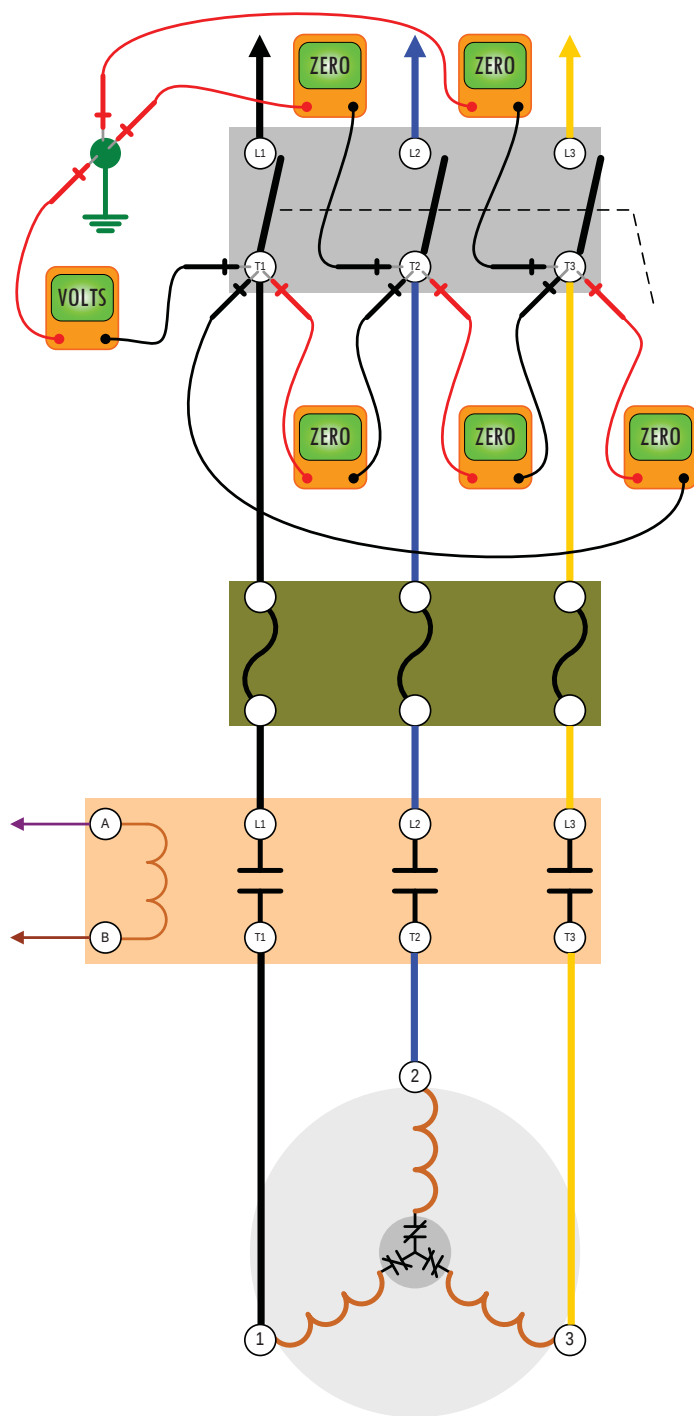
With a trusted AC voltmeter, make the following readings from the outgoing side (or unit side) of the disconnect:

- T1 to T2
- T2 to T3
- T1 to T3
- T1 to cabinet ground
- T2 to cabinet ground
- T3 to cabinet ground

As illustrated, all readings should be zero volts with the disconnect in the “off” position to ensure that line voltage is disengaged.

Also note that some units, most frequently those with electric heat, may have more than one line voltage power supply. In these cases all disconnects will need to be placed in the “off” position, and individually checked as described above to ensure that all line voltage has been disengaged from the unit.

Figure 6-1



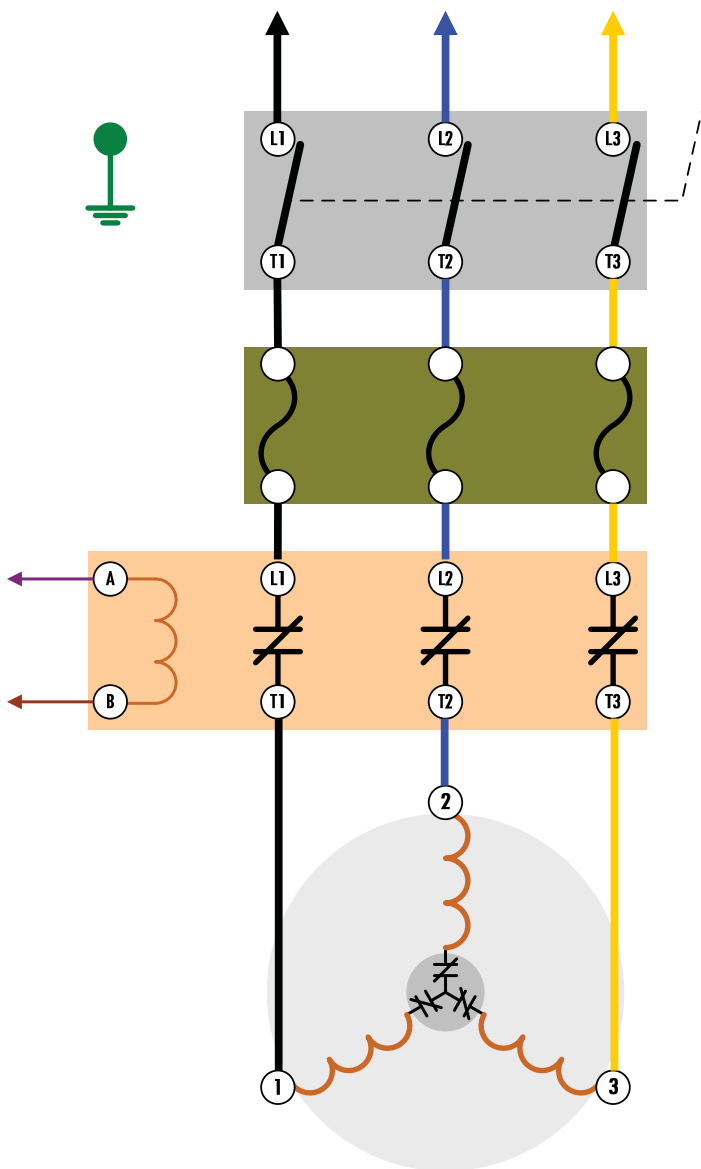
If any of the following readings, from the outgoing side (or unit side) of the disconnect, show voltage, there is risk of electrical shock to the technician since line voltage is still present to the unit.

- T1 to T2
- T2 to T3
- T1 to T3
- T1 to cabinet ground
- T2 to cabinet ground
- T3 to cabinet ground

The example illustrated shows all readings to be zero volts except for T1 to cabinet ground. This is an indication that, even though the disconnect handle is in the “off” position, the L1 to T1 knife-blade of the disconnect has not disengaged line voltage to the unit.

The power to the unit must be shut off from the main power-panel if the disconnect will not fully disengage line voltage. A qualified electrician should then replace the failed disconnect.

Figure 6-2



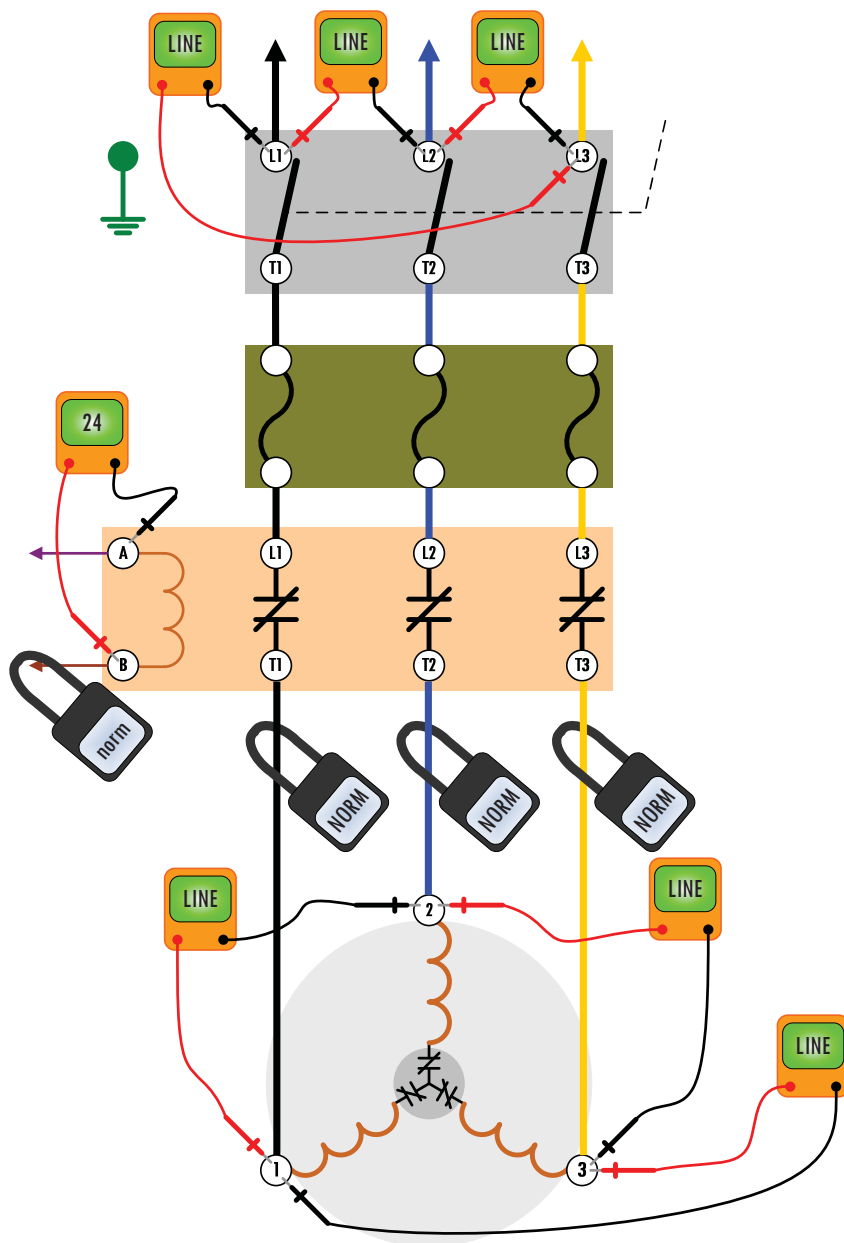
A systematic approach to line voltage component electrical troubleshooting will provide the greatest diagnostic accuracy. The following method requires that the equipment be powered. The technician must exercise care and caution to avoid electrical shock and other personal safety hazards.

The accompanying diagram is a simplified version representing the line voltage components which connect to the 3Ø compressor or indoor blower motor. (1Ø PSC condenser fan and power exhaust motors are covered separately)

From the top, the items diagrammed are:

- Up-arrows represent the connection to the power-panel.
- A factory-installed or field-mounted power disconnect switch (gray rectangle).
- A fuse block (olive rectangle); may be integral to the disconnect, factory-installed in the unit, a portion of a field-installed accessory or omitted depending on circumstances.
- A 3-pole contactor (tan rectangle).
- 3Ø, internally-protected motor; either compressor or indoor blower motor. (gray circle).

Figure 6-3



Electrical troubleshooting of the line voltage components use:

- Voltage readings of the 3Ø line voltage circuit.
- Amperage readings of the 3Ø line voltage circuit.
- Confirmation that the 24 volt contactor coil circuit is complete and enabled.

The technician's understanding of readings that are normal, as well as recognition of abnormal readings, is key to electrical troubleshooting.

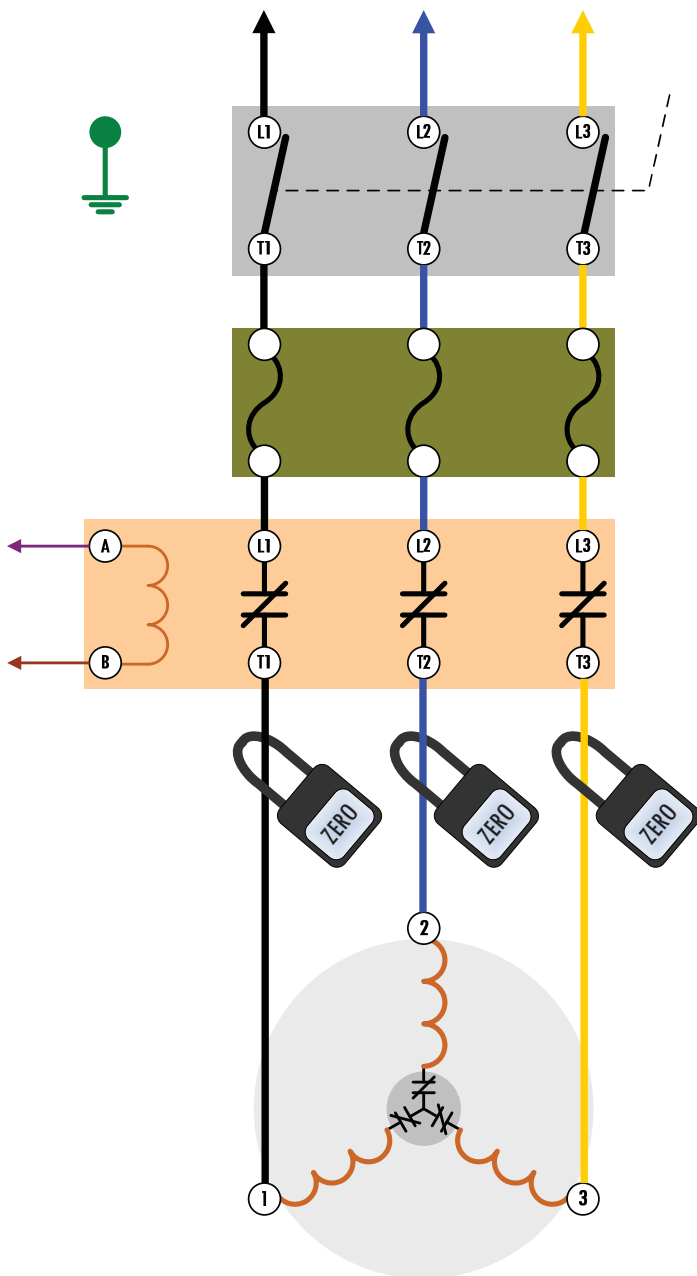
The illustration shows normal readings for an operating 3Ø motor circuit:

- The presence of 24 volts, and normal current draw (typically 1 amp or less) at the contactor coil will confirm the 24 volt circuit is complete and enabled.
- The current draw of the motor is NORMAL (reasonably close to the motor's R.L.A.) on all three "legs".

Figure 6-4

Line voltage is read throughout the circuit from any combination of two "legs" (or phases):

- Leg 1 (black) to Leg 2 (blue)
- Leg 2 (blue) to Leg 3 (yellow)
- Leg 1 (black) to Leg 3 (yellow)



The following diagrams and descriptions discuss troubleshooting methods used to identify a variety of problem conditions. While each condition is discussed in isolation, there may be multiple problems existing on a circuit at the same time.

When beginning the electrical troubleshooting process, find the motor's R.L.A. and L.R.A. on the unit/motor data plate. Then read the current draw of each of the 3Ø "legs" of the line voltage circuit. These readings are used to indicate the type of problem, as well as the urgency and care needed for troubleshooting.

If each leg of the circuit reads NORMAl, as shown in the previous illustration, the 3Ø line voltage circuit is complete and the motor should be operating. If this reading is taken when the motor is supposed to be off, further electrical troubleshooting will be required.

If each leg of the circuit reads zero, as illustrated in Figure 6-5, the 3Ø line voltage circuit is currently open. The open circuit may be temporary, if the motor's internal overload tripped due to overheating. In this case, the open circuit may be a secondary result of another condition. However, during periods with zero current draw there is little chance of further damage to the 3Ø line voltage circuit or equipment.

If each leg of the circuit reads significantly lower than R.L.A. the 3Ø line voltage circuit is complete, but the motor is likely operating at a reduced load. Potential causes for reduced load include reverse rotation or mechanical problems.

Figure 6-5

is complete, but the motor is likely operating at a reduced load. Potential causes for reduced load include reverse rotation or mechanical problems.

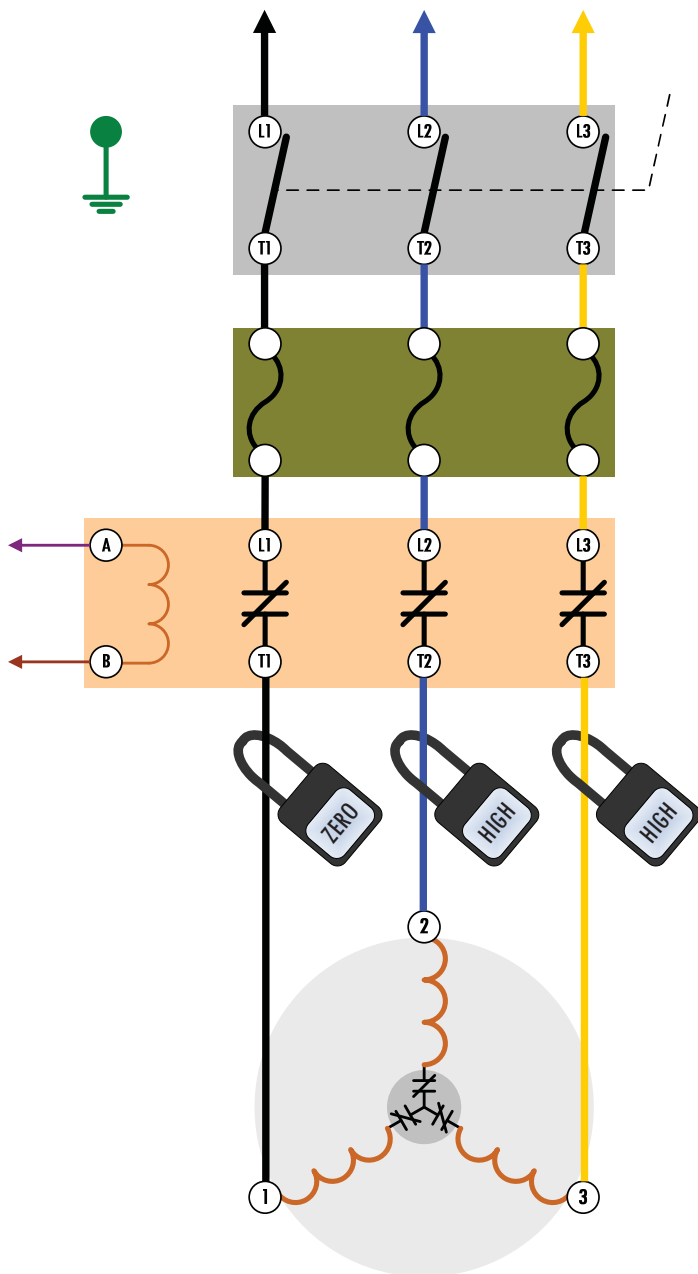


Figure 6-6

A HIGH current draw condition, significantly greater than R.L.A., on any of the 3Ø “legs” of the line voltage circuit requires greater urgency and care for troubleshooting. In this situation, abnormal conditions exist that can be hazardous to the technician or cause further damage to the equipment.

Troubleshooting readings should be made with the motor energized only for the brief periods needed for the readings to register if HIGH current draw exists on any of the 3Ø “legs” of the line voltage circuit. This can be accomplished by quick off-on-off cycling of the disconnect or 24 volts to the the contactor coil; whichever is practical.

Avoid manually “pushing in the contactor” because of the following:

- The potential for electrical burns exists due to the compromised contactor arc shielding.
- The close proximity to live voltage components increases the risk of electrical shock.
- Unit safeties are effectively bypassed.

If only one leg of the circuit reads HIGH current draw, a component of the 3Ø line voltage circuit very likely has a fault to cabinet ground. There is a great risk of electric shock to the technician in this situation. For safety, the disconnect should be turned off and the 3Ø line voltage circuit be checked for faults to ground with an ohmmeter to identify the problem.

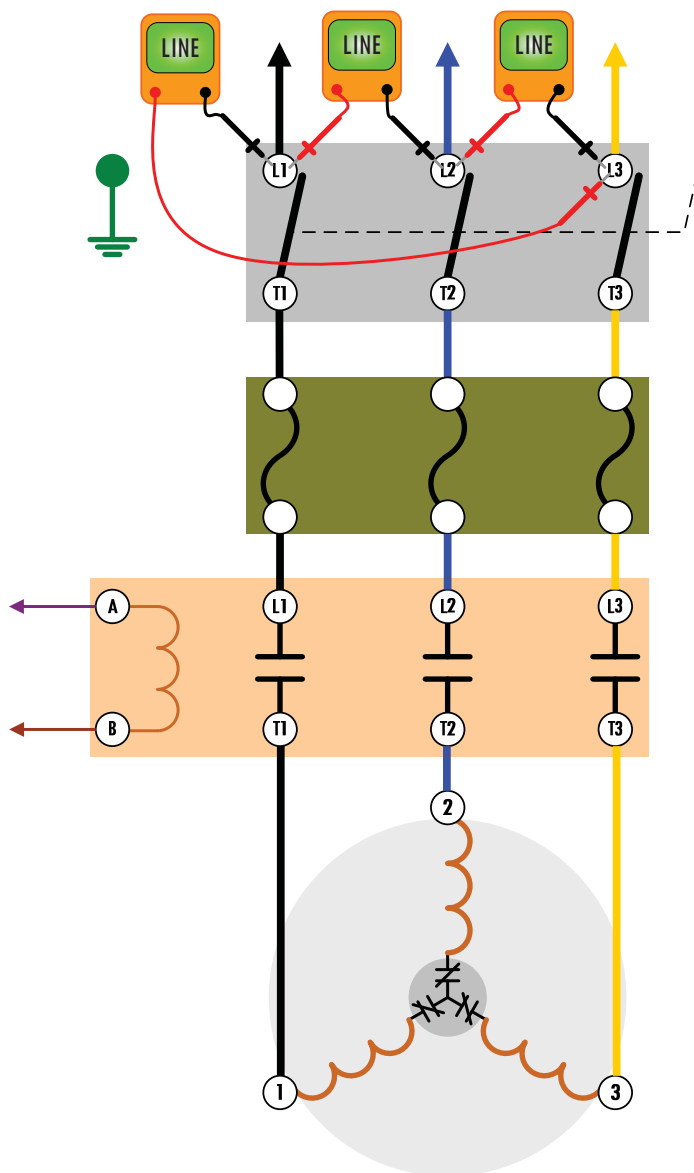
If two legs of the circuit read HIGH current draw, and the remaining leg reads ZERO current draw, as seen in Figure 6-6, one leg of the 3Ø line voltage circuit is incomplete (or lost). This condition is also referred to as a “single phased” circuit. If this condition exists, even for a short time period, the following (which add greater complexity to the troubleshooting process) may occur:

- The motor’s internal protector may trip.
- Fuses may blow.
- The circuit breaker in the power panel may trip.
- Equipment damage may result.

If all three legs of the circuit read HIGH current draw, the 3Ø line voltage circuit is complete; however, if L.R.A. is read, the motor cannot start or is locked due to mechanical failure. If higher than L.R.A. is read at any one or combination of legs, there is a short present.

When all three legs of the circuit read HIGH current draw extreme energies are present that can quickly cause failures that pose safety hazards to the technician. Additionally, the following conditions (which add greater complexity to the troubleshooting process) may occur:

- The motor's internal protector may trip.
- Fuses may blow.
- The circuit breaker in the power panel may trip.
- Equipment damage may result.



After the current draw of each of the 3Ø “legs” of the line voltage circuit has been measured, then a series of voltage readings, done briefly if any legs read HIGH current draw, are the next step in systematic electrical troubleshooting.

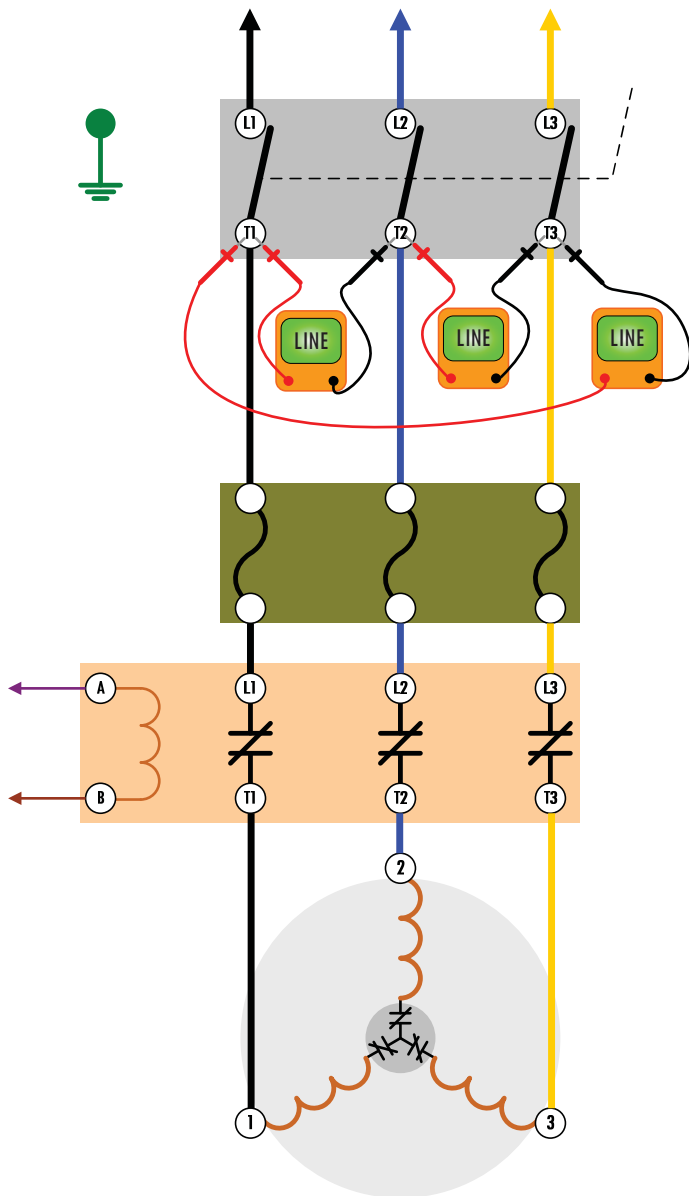
The voltage readings begin with confirmation that 3Ø line voltage is available to the unit.

Line voltage appropriate to the unit's rating must be read from the incoming lugs of the disconnect to the following:

- L1 to L2
- L2 to L3
- L1 to L3

If these readings are not present, refer to Figure 6-14 through Figure 6-20 for further troubleshooting procedures.

Figure 6-7



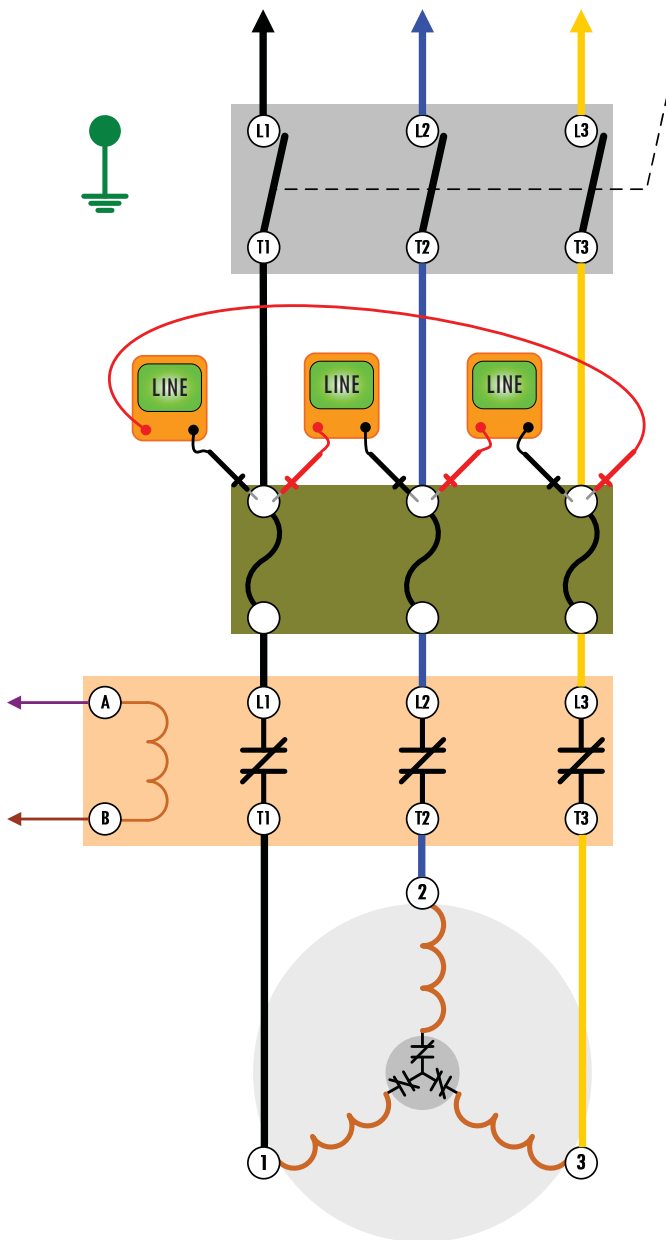
Next is confirmation that the switch-gear of the disconnect is intact.

Line voltage should be read from the outgoing lugs of the disconnect:

- T1 to T2
- T2 to T3
- T1 to T3

If these readings are not present, refer to Figure 6-21 for further troubleshooting procedures.

Figure 6-8



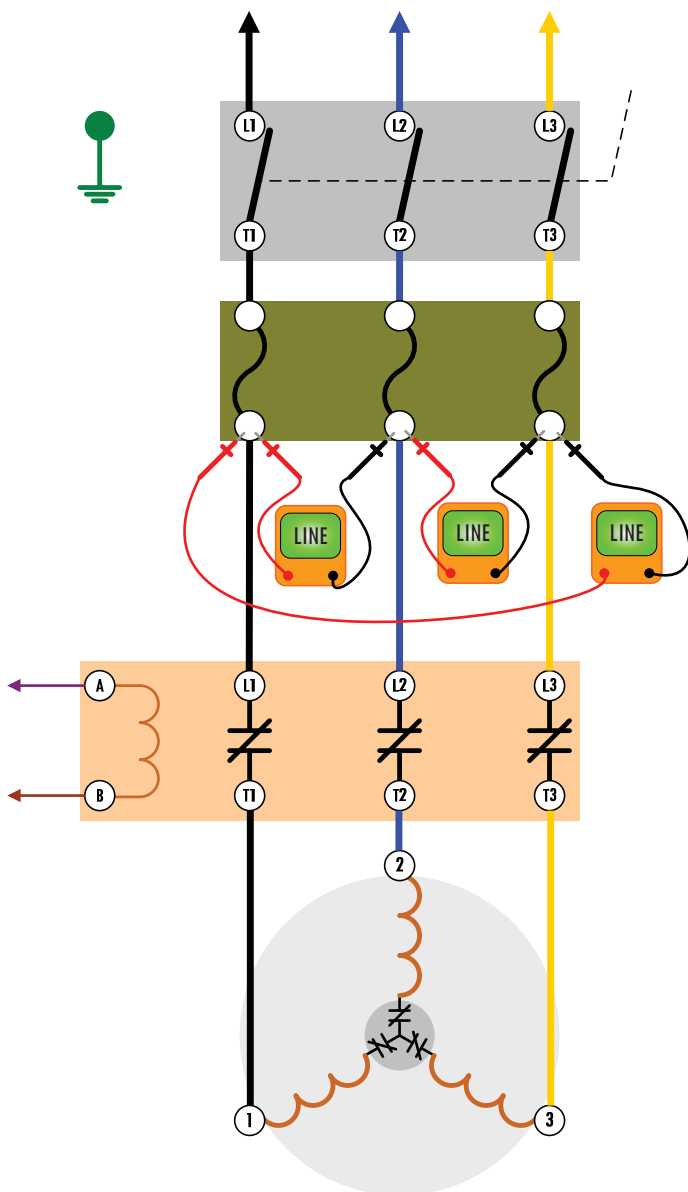
Next is confirmation that the disconnect to fuse-block wiring, and connections are intact.

Line voltage should be read from the incoming lugs of the fuse-block:

- Leg 1 (black) to Leg 2 (blue)
- Leg 2 (blue) to Leg 3 (yellow)
- Leg 1 (black) to Leg 3 (yellow)

If these readings are not present, refer to Figure 6-22 for further troubleshooting procedures.

Figure 6-9



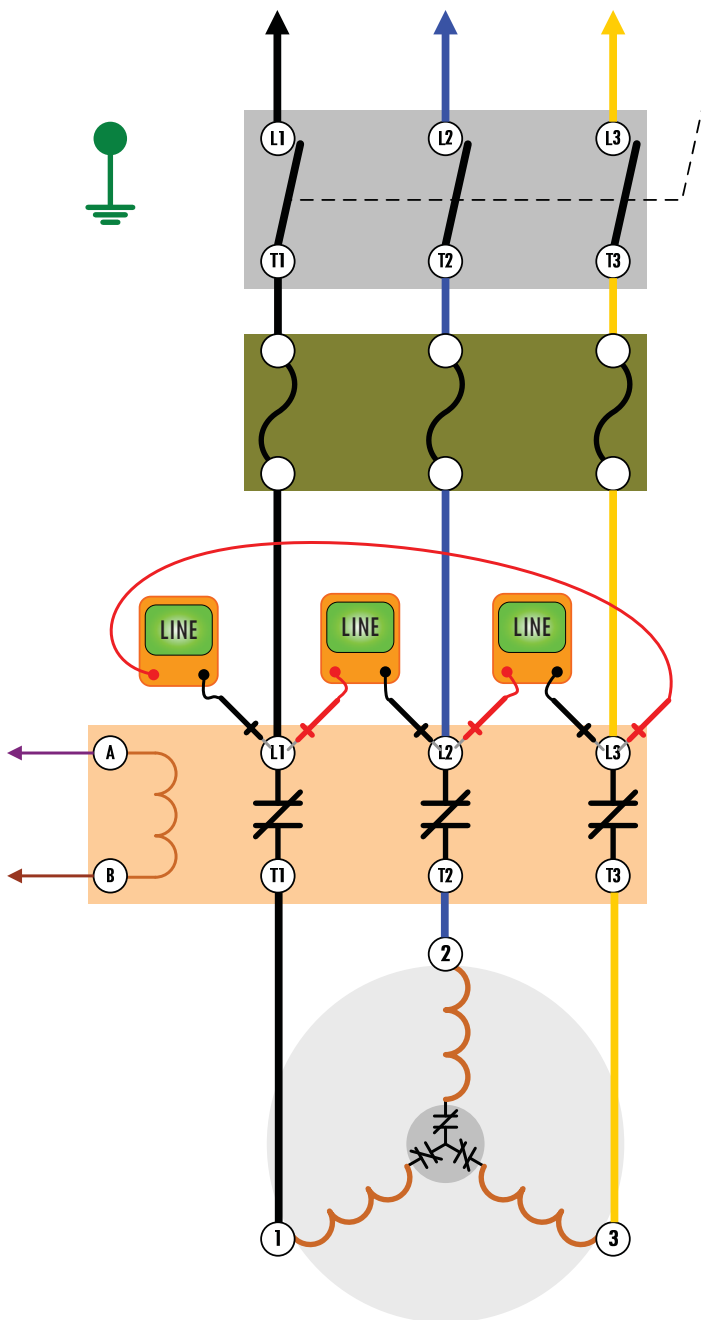
Next is confirmation that there are no blown fuses, and that the fuse-holders and connections are intact.

Line voltage should be read from the outgoing lugs of the fuse-block:

- Leg 1 (black) to Leg 2 (blue)
- Leg 2 (blue) to Leg 3 (yellow)
- Leg 1 (black) to Leg 3 (yellow)

If these readings are not present, refer to Figures 6-23 and 6-24 for further troubleshooting procedures.

Figure 6-10



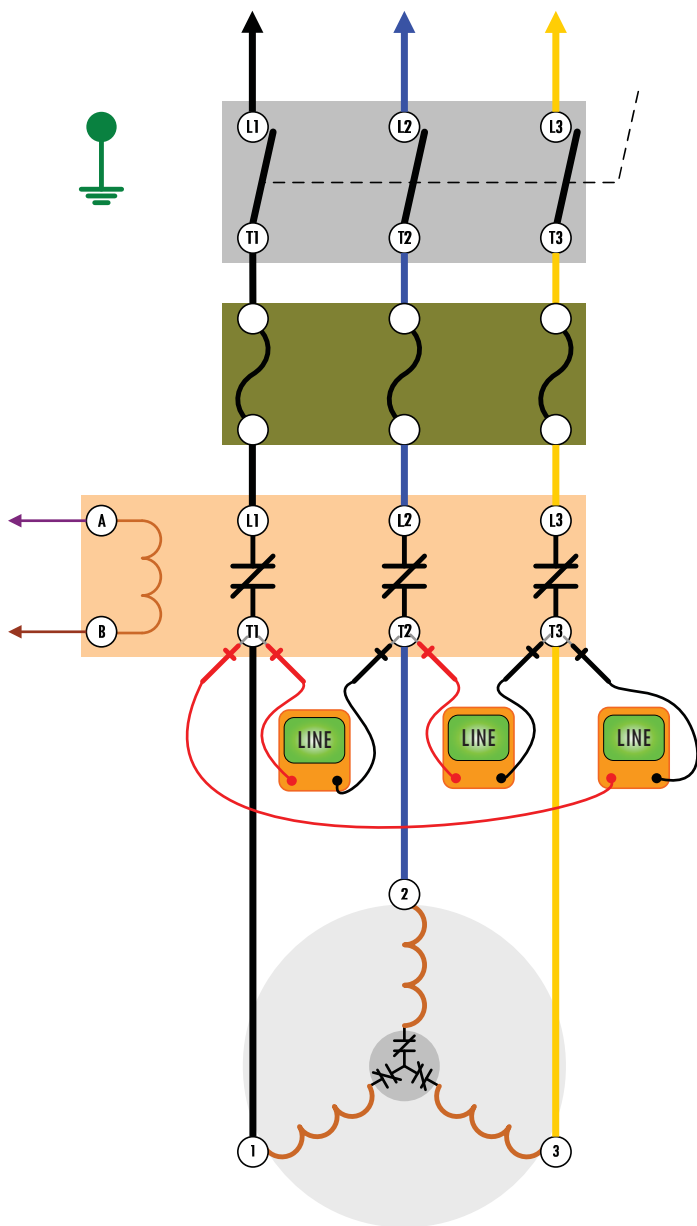
Next is confirmation that the fuse-block to contactor wiring and connections are intact.

Line voltage should be read from the incoming lugs of the contactor:

- L1 to L2
- L2 to L3
- L1 to L3

If these readings are not present, refer to Figure 6-25 for further troubleshooting procedures.

Figure 6-11



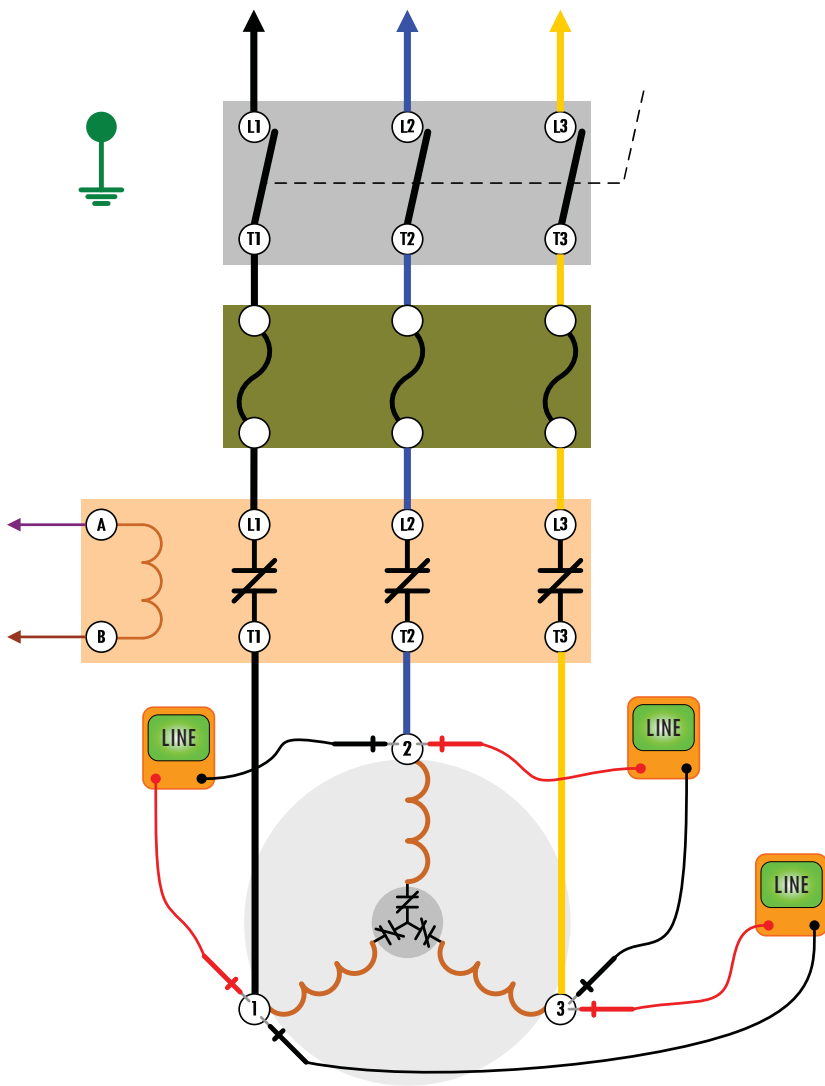
Next is confirmation that the contactor is energized, and its contacts are engaged.

Line voltage should be read from the outgoing lugs of the contactor:

- T1 to T2
- T2 to T3
- T1 to T3

If these readings are not present, refer to Figures 6-26 and 6-27 for further troubleshooting procedures.

Figure 6-12



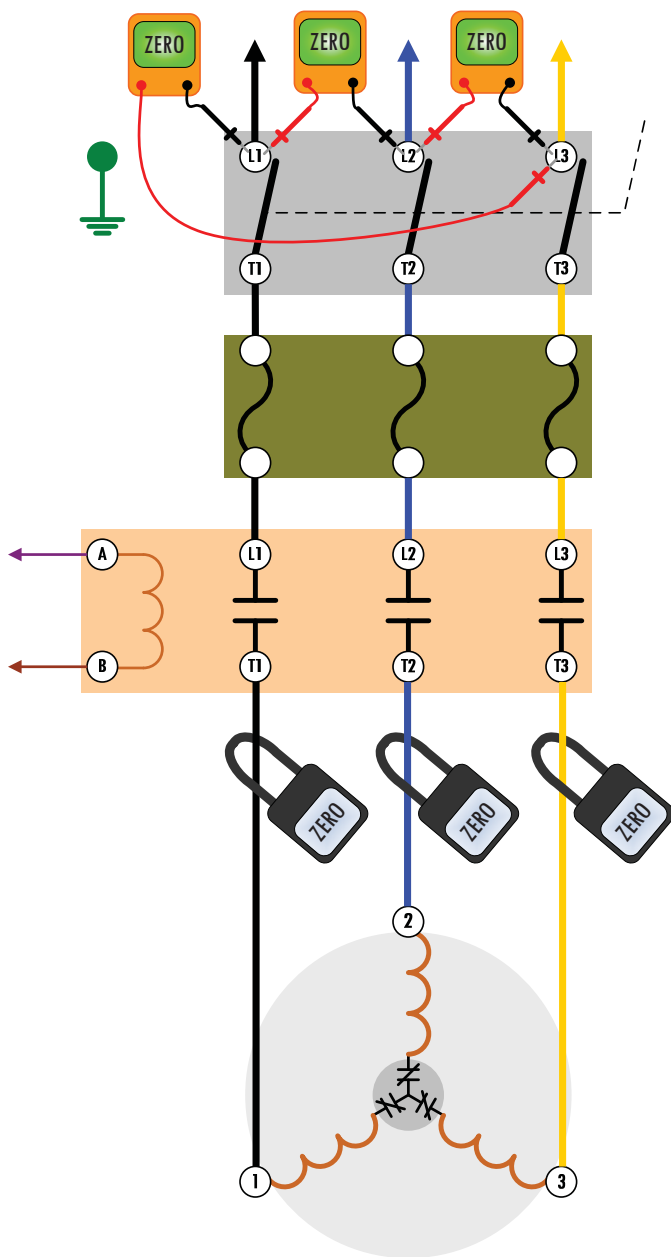
The final voltage reading confirms that the wiring and connections to the motor are intact.

Line voltage should be read from the terminals of the motor:

- Leg 1 (black) to Leg 2 (blue)
- Leg 2 (blue) to Leg 3 (yellow)
- Leg 1 (black) to Leg 3 (yellow)

If these readings are not present, refer to Figure 6-28 through Figure 6-37 for further troubleshooting procedures.

Figure 6-13



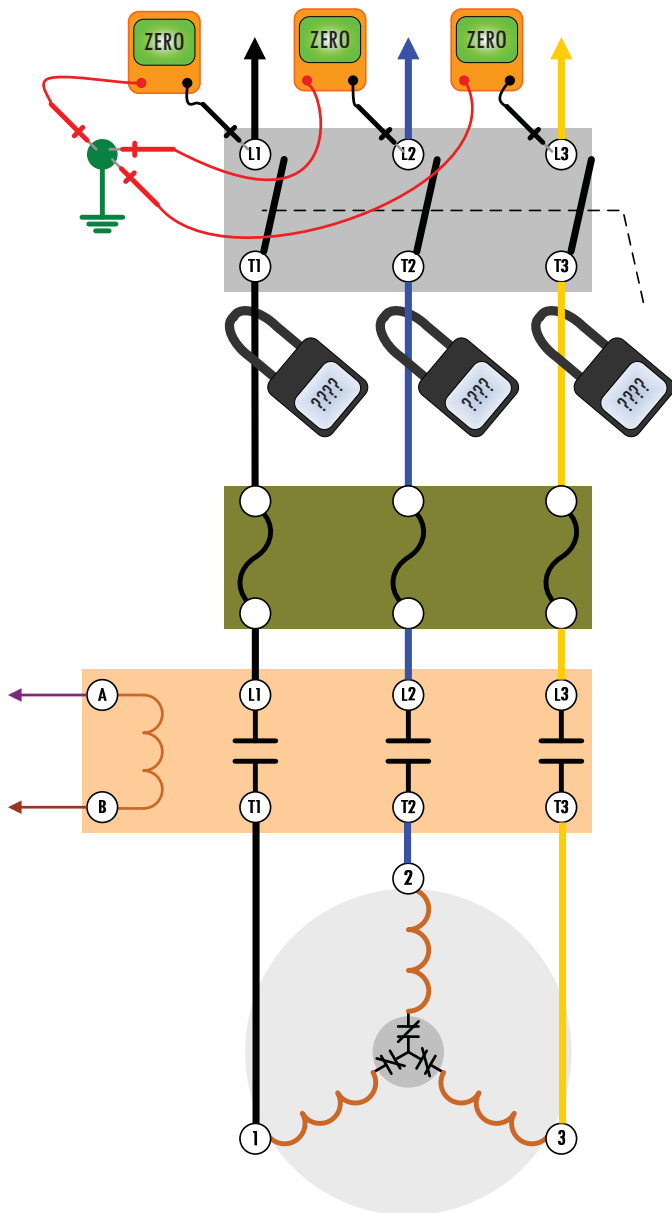
If ZERO voltage is read from all combinations of the incoming lugs of the disconnect:

- L1 to L2
- L2 to L3
- L1 to L3

Then at least two legs of the 3Ø circuit from the power panel have been lost.

The next step is to determine whether only two legs or all three legs of the 3Ø circuit from the power panel have been lost.

Figure 6-14



With the disconnect “off”, if ZERO voltage is read from all combinations of the incoming lugs of the disconnect to cabinet ground:

- L1 to cabinet ground
- L2 to cabinet ground
- L3 to cabinet ground

Then all three legs of the 3Ø circuit from the power panel have been lost.

This condition may be caused by a lack of power to the power panel or incomplete wiring to the disconnect. Correction of power issues of this type and are not typically the HVAC technician’s responsibility, and a qualified electrician should be consulted.

The technician may be able to restore the 3Ø line voltage if this condition is due to a turned “off” or tripped breaker or if all three fuses of a fused power panel are blown.

With the disconnect remaining “off”, use an ohmmeter to check for shorted or grounded components. This should be done prior to restoring power to the unit.

Once corrections have been made to restore power, before turning on the disconnect, the 3Ø line voltage to the incoming lugs of the disconnect should be confirmed as follows:

- L1 to L2 reads line voltage
- L2 to L3 reads line voltage
- L1 to L3 reads line voltage

Figure 6-15

When the disconnect is turned “on”, overall current draw of the unit should be monitored to determine if a unit fault is causing high current draw (amp-meter segment of the illustration).

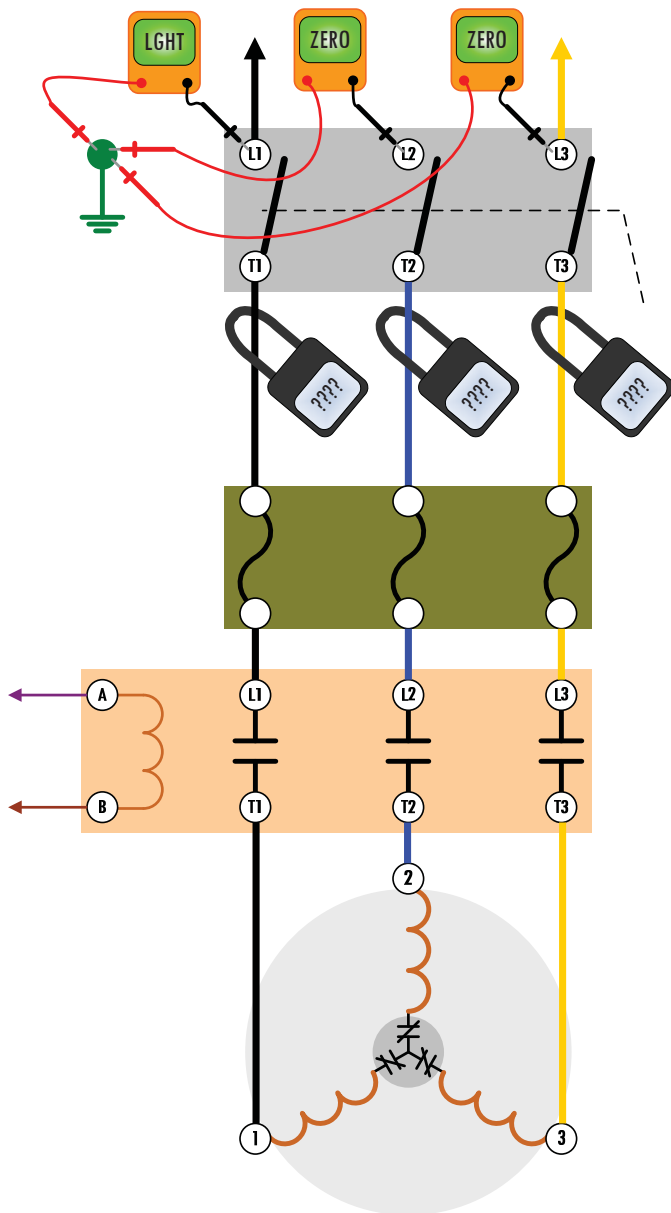


Figure 6-16

With the disconnect “off”, if voltage (LiGHtIng circuit typically.) is read from any one of the incoming lugs of the disconnect to cabinet ground:

- L1 to cabinet ground
- L2 to cabinet ground
- L1 to cabinet ground

Then two legs of the 3Ø circuit from the power panel have been lost. (L1-black remains, L2-blue & L3-yellow lost in the illustration)

This condition poses the risk of a hazardous electric shock because the presence of live voltage is not apparent until the second level of voltage readings to cabinet ground are performed. With this condition the disconnect should be locked and tagged out until repairs to the incoming power supply are complete.

This condition may be caused by the following issues:

- Incomplete power to the power panel
- Incomplete power wiring to the disconnect
- A failed circuit breaker

Correction of power issues of this type are not typically the HVAC technician’s responsibility, and a qualified electrician should be consulted.

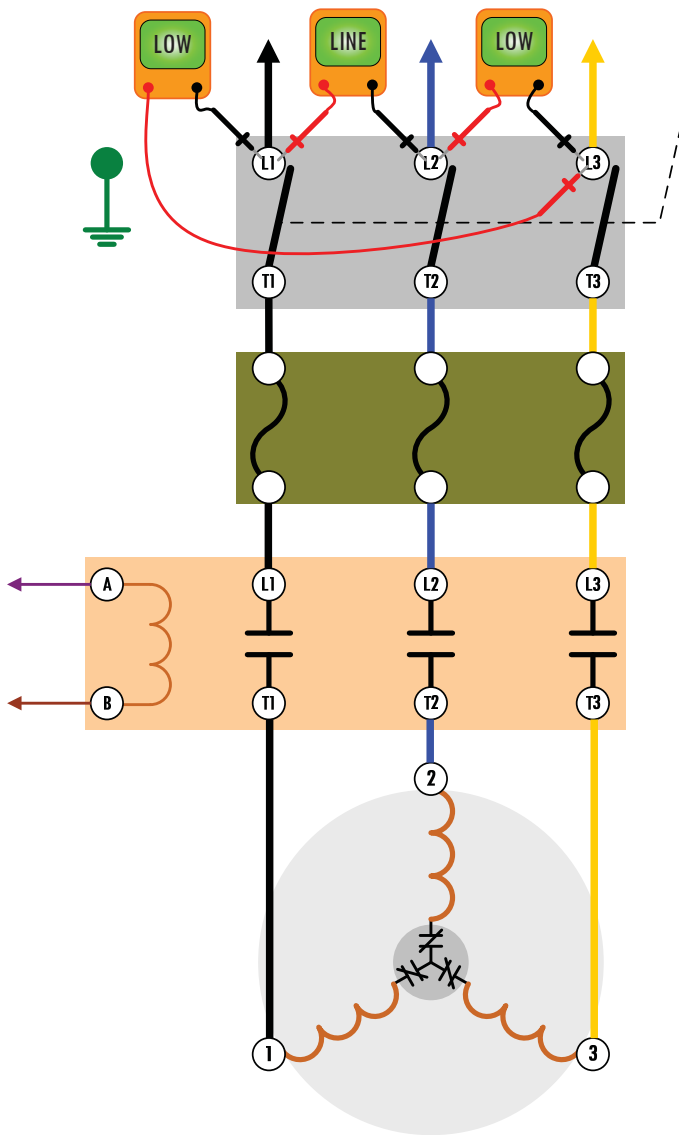
The technician may be able to restore the 3Ø line voltage if this condition is caused by failure of two of the three fuses of a fused power panel.

With the disconnect remaining “off”, an ohmmeter check for shorted or grounded components should be completed prior to restoring power to the unit.

Once corrections have been made to restore power, before turning on the disconnect, the 3Ø line voltage to the incoming lugs of the disconnect must be confirmed as follows:

- L1 to L2 reads line voltage
- L2 to L3 reads line voltage
- L1 to L3 reads line voltage

When the disconnect is turned “on”, overall current draw of the unit should be monitored to determine if a unit fault is causing high current draw (amp-meter segment of the illustration).



If less than line voltage is read from any combination of the incoming lugs of the disconnect:

- L1 to L2
- L2 to L3
- L1 to L3

Then the 3Ø circuit is not complete from the power panel. This condition is often referred to as “single phasing”.

The illustration depicts the loss of the yellow, phase 3 leg from the power panel where:

- L1 to L2 reads line voltage
- L2 to L3 reads “LOW” (significantly below line voltage)
- L1 to L3 reads “LOW” (significantly below line voltage)

“LOW” readings can be present when circuits on the leaving side of the disconnect produce “feedback” voltage to the lost leg.

Figure 6-17

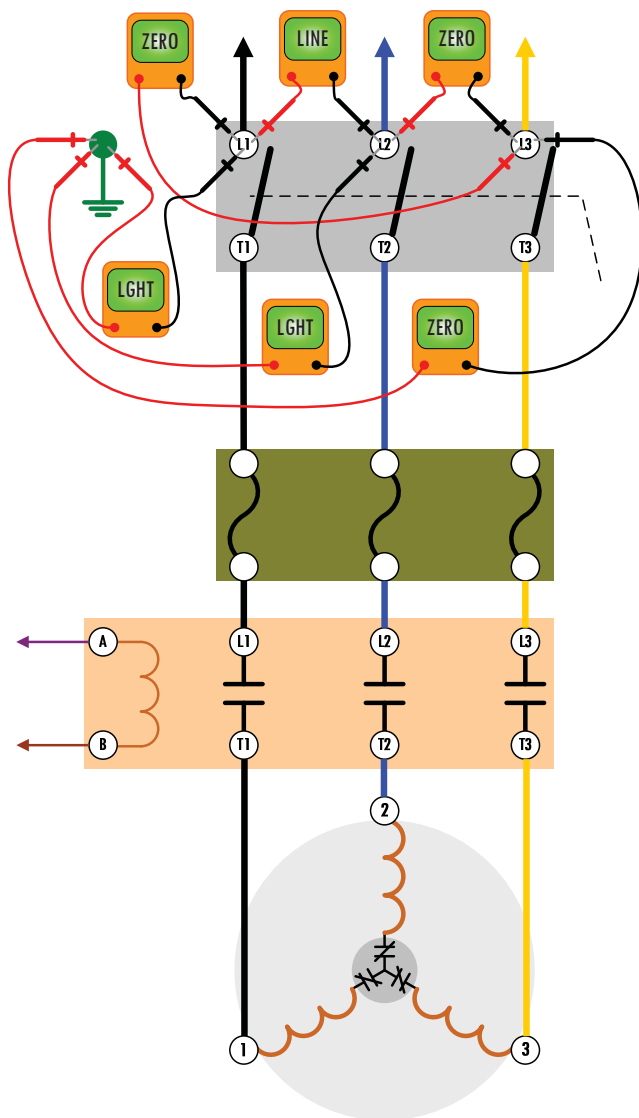


Figure 6-18

- There will be 277 volts read when 460 volts is supplied from wye-wound power supply transformers.

In the example illustrated:

- L1 to cabinet ground reads lighting circuit voltage
- L2 to cabinet ground reads lighting circuit voltage
- L3 to cabinet ground reads zero volts

These voltage readings confirm that the yellow, phase 3 leg of the incoming 3Ø circuit has been lost.

At locations other than those with a fused power panel, a qualified electrician should be consulted if the incoming 3Ø circuit is incomplete in the manner described above.

To eliminate the path for feedback voltage, the disconnect is placed in the “off” position to allow clarification of the voltage readings. With the disconnect “off”, the readings are:

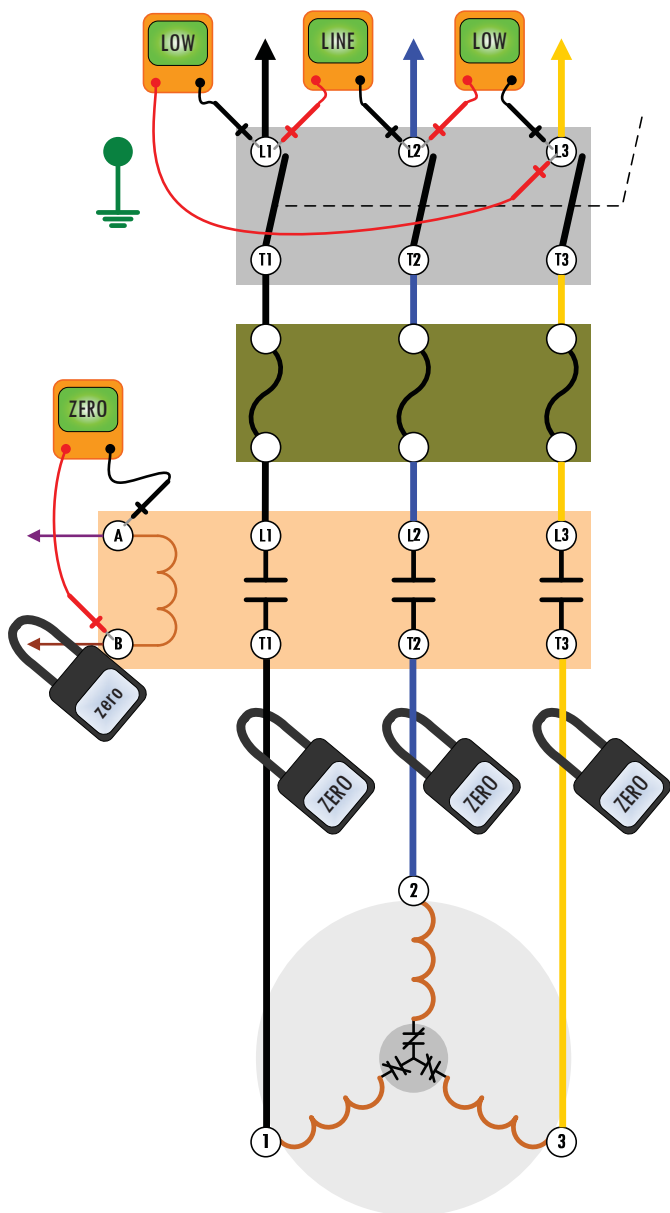
- L1 to L2 reads line voltage
- L2 to L3 reads ZERO
- L1 to L3 reads ZERO

In most troubleshooting situations, voltage readings to cabinet ground on a 3Ø circuit can be misleading due to feedback voltage. However, the situation illustrated is an exception.

Because feedback voltage is eliminated to the incoming 3Ø circuit with the disconnect “off”, further confirmation of the loss of a leg to the incoming 3Ø circuit can be made through voltage readings to cabinet ground.

Legs that remain “live” will indicate lighting circuit voltage (LGHT) to cabinet ground:

- There will be 115 volts read when 208 volts is supplied from wye-wound power supply transformers.
- There will be 120 volts read on two legs when 240 volts is supplied from delta-wound power supply transformers, and the remaining “wild” leg will read ≈190 volts.

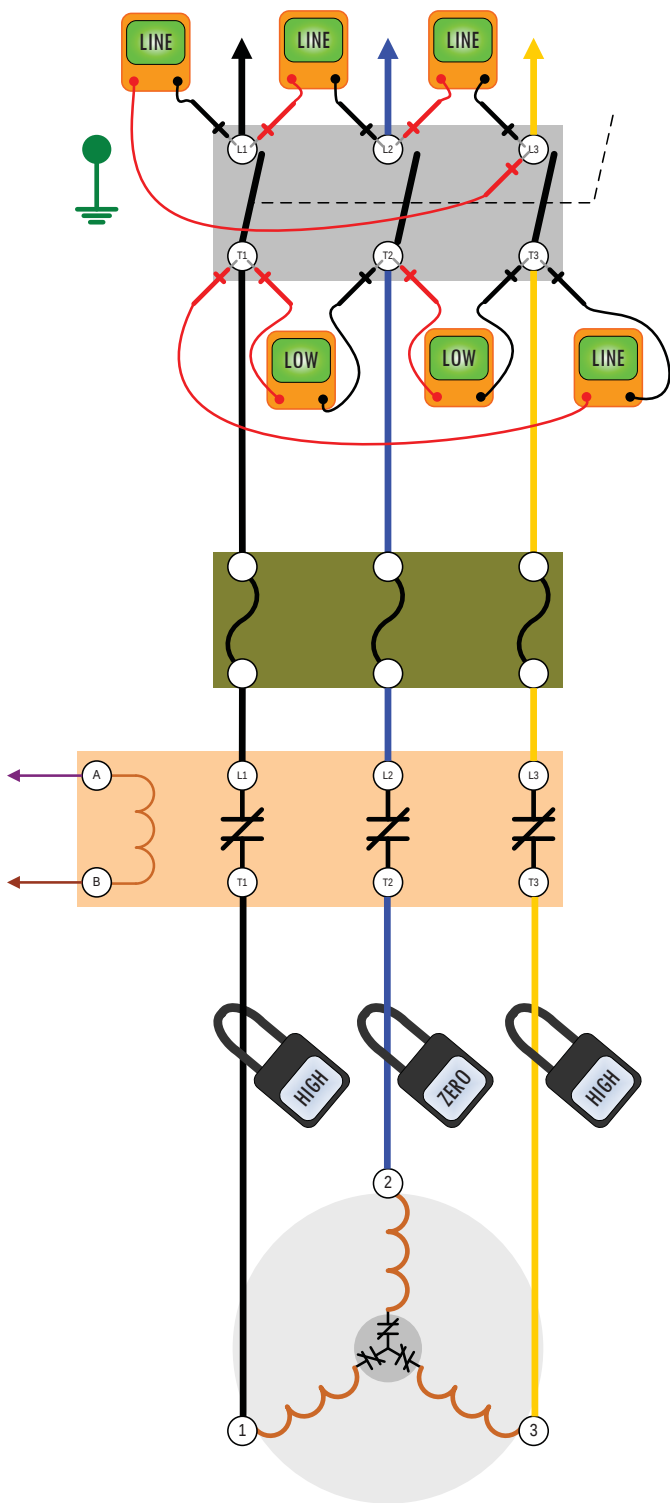


The control transformer primary is factory-wired to black (phase 1) and yellow (phase 3) within the unit.

If either of these legs are lost from the incoming 3Ø circuit or at any point prior to the connection to the control transformer primary, then 24 volts will not be available.

Without 24 volts, the unit's controls cannot function, the contactor coil will not be energized (illustrated) and the unit will be idle.

Figure 6-19



If the 3Ø line voltage is complete at the incoming lugs of the disconnect, but is not complete at the outgoing lugs of the on-positioned disconnect, then the connections or switch-gear of the disconnect are faulty.

In most cases where the disconnect is faulty, a qualified electrician will need to be consulted for repairs.

The readings illustrated show that the L2 to T2 switch-gear or connections of the disconnect are electrically open, and the line voltage circuit is “single-phased”.

Power panel breaker trips, blown fuses and motor protector trips are typical related damage when the line voltage circuit is “single-phased”.

Figure 6-21

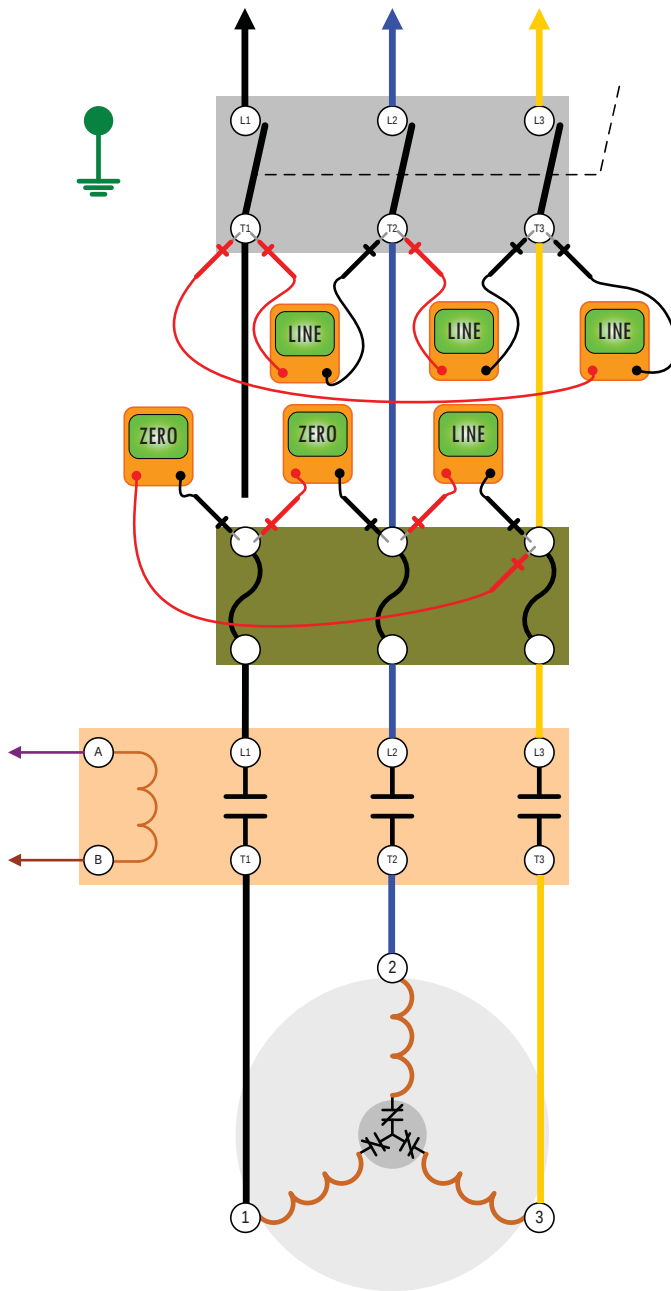


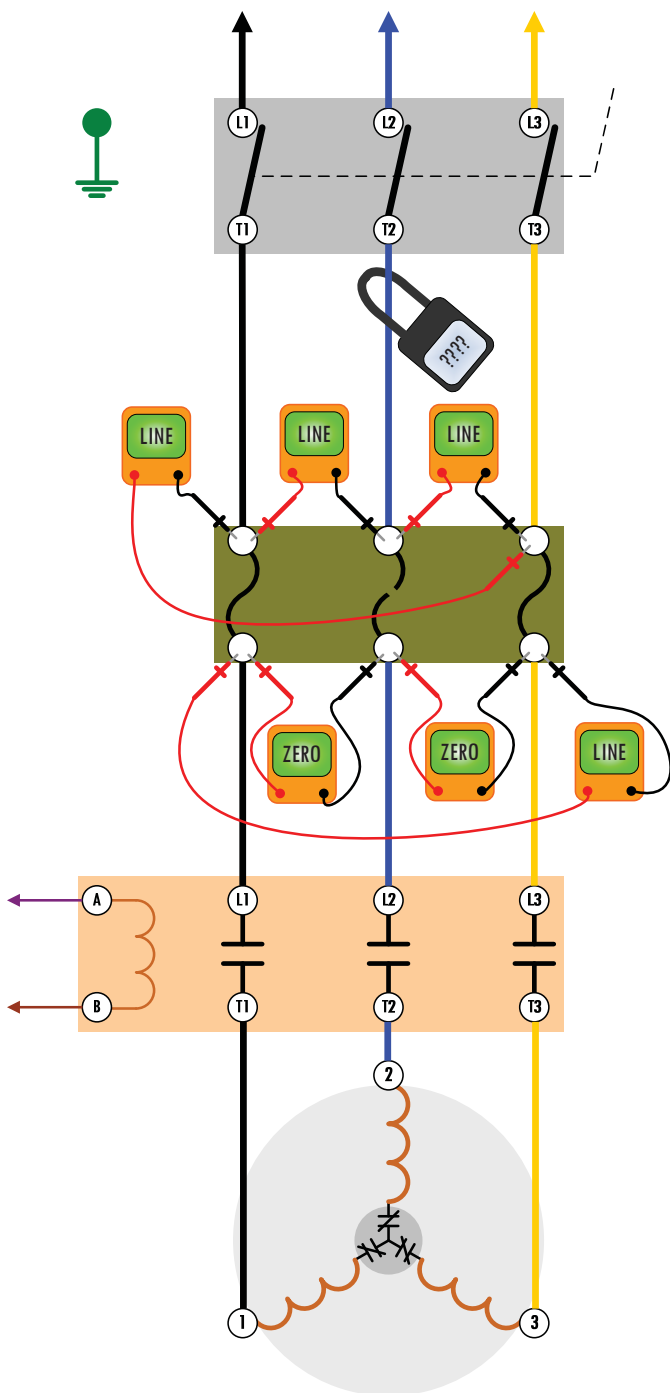
Figure 6-22

If the 3Ø line voltage is complete at the outgoing lugs of the disconnect, but is not complete at the incoming lugs of the fuse block, then the connections or wiring between the disconnect and fuse block are faulty.

Often when these readings are found there will be visible discoloration or damage to the connections or wiring terminations. Typically, the component damage originates with loose connections.

The readings illustrated show that the disconnect T1 to fuse block Leg 1 (black) wiring or connections are electrically open, and the line voltage circuit is “single-phased”.

Power panel breaker trips, blown fuses and motor protector trips are typical related damage when the line voltage circuit is “single-phased”.



If the 3Ø line voltage is complete at the incoming lugs of the fuse block, but is not complete at the outgoing lugs of the fuse block, then at least one fuse has blown or the connections of the fuse block are faulty.

The readings illustrated show that the fuse block Leg 2 (blue) fuse is blown (open), and the line voltage circuit is “single-phased”.

Power panel breaker trips, blown fuses and motor protector trips are typical related damage when the line voltage circuit is “single-phased”.

In cases where blown fuses are found, the fuses and fuse holders should be inspected for loose connections that will lead to repeat failures. Visible discoloration or damage due to heating, and arc traces are indicators of loose fuse holders. The fuse block will need to be replaced if the fuse holders are faulty. In cases where the faulty fuse holder is integral to the disconnect, a qualified electrician will need to be consulted for repairs.

Once corrections have been made to replace the fuse or fuse block and power is restored, the current draw of the unit, with emphasis on the leg that had the blown fuse, should be monitored to determine if a unit fault is causing high current draw (amp-meter segment of the illustration).

Figure 6-23

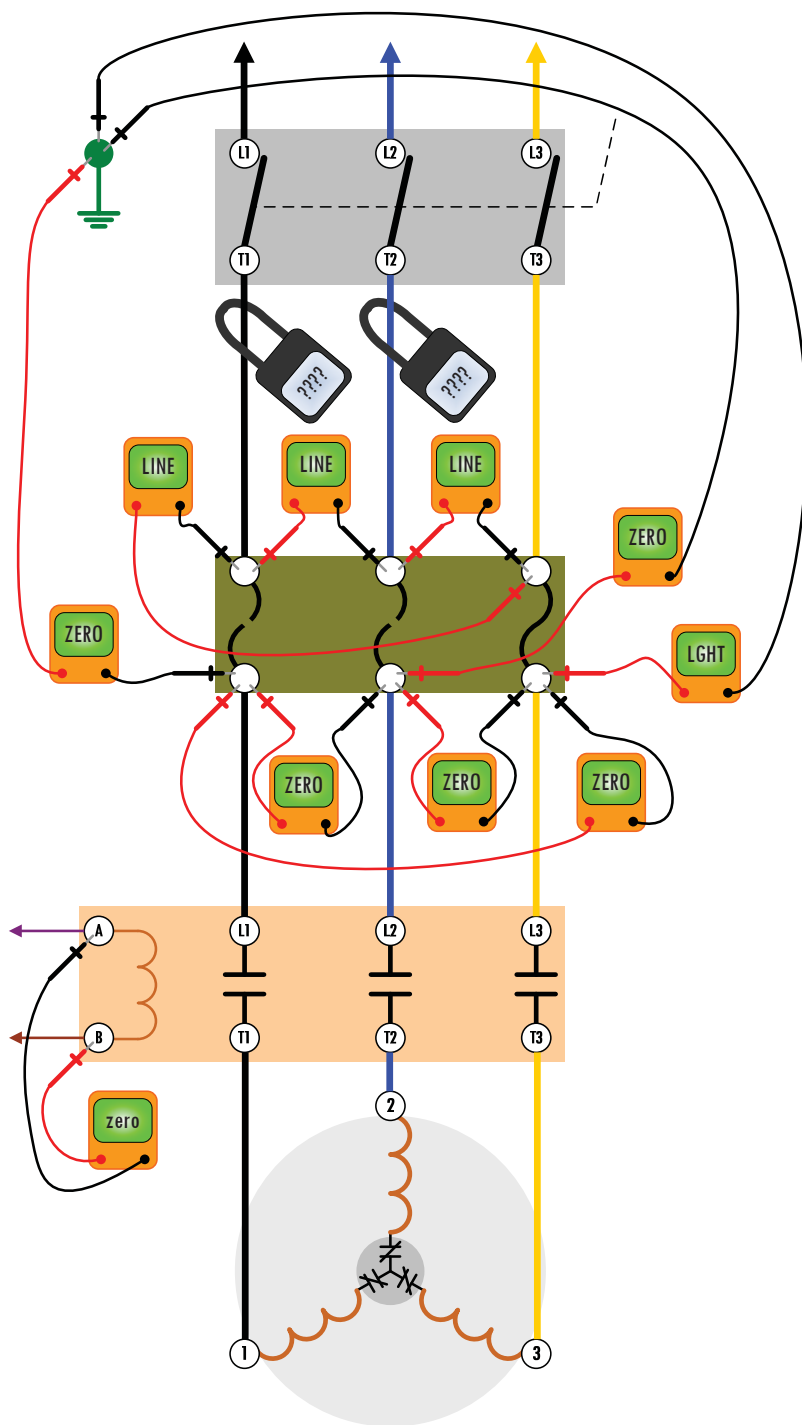


Figure 6-24

Once the blown fuses have been replaced and power is restored, the current draw of the unit, with emphasis on the legs that had blown fuses, should be monitored to determine if a unit fault is causing high current draw (amp-meter segment of the illustration).

Often, two fuses will blow when the 3Ø line voltage is complete at the incoming lugs of the fuse block, but is not complete at the outgoing lugs of the fuse block.

The readings illustrated show that both the fuse block Leg 1 (black), and the Leg 2 (blue) fuses are blown.

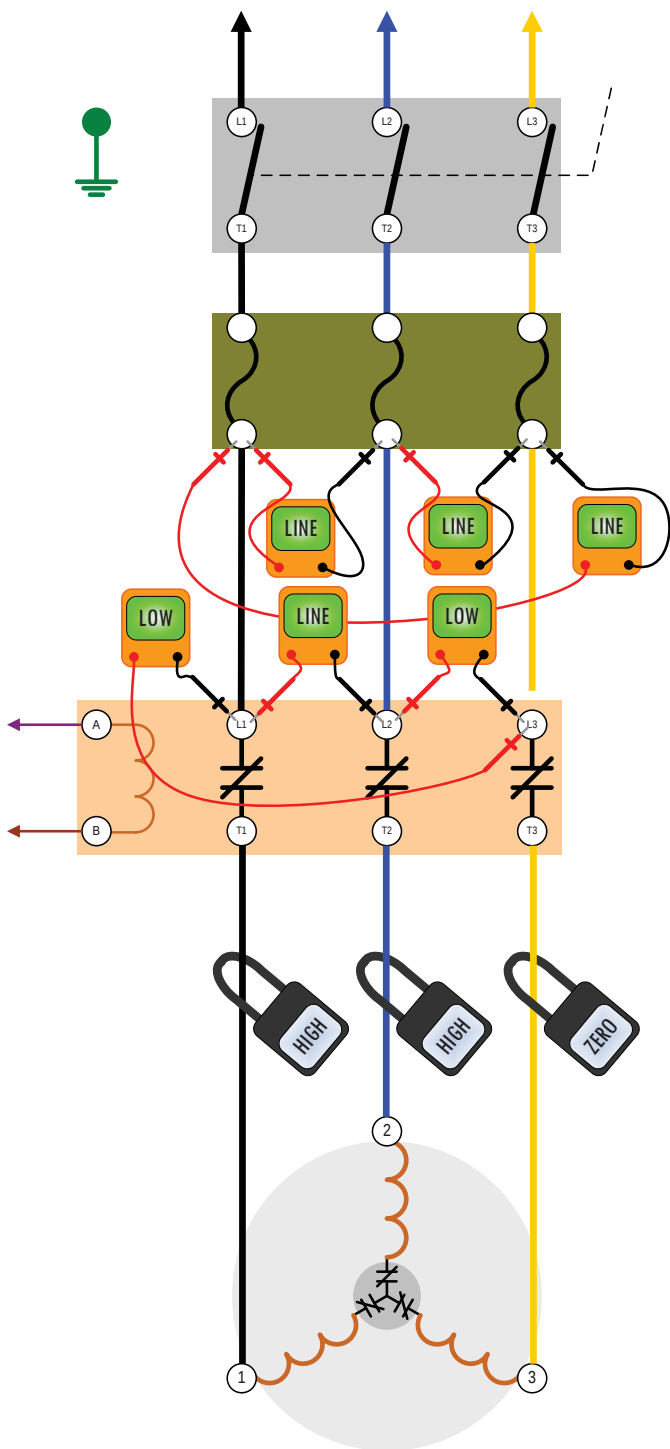
To determine which fuses are blown, and to prevent “feedback”, the technician should ensure that the contactor is de-energized (voltmeter at the contactor segment of the illustration).

In this scenario, if “feedback” is present with the contactor coil de-energized it is likely that the contactor contacts are not disengaged.

Next, readings to cabinet ground are made from each outgoing lug of the fuse block:

- Leg 1 (black) to cabinet ground
- Leg 2 (blue) to cabinet ground
- Leg 3 (yellow) to cabinet ground

The leg with the intact fuse will read the lighting circuit voltage to cabinet ground, while each leg with a blown fuse will indicate zero volts to cabinet ground.



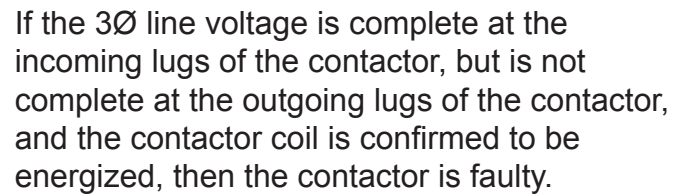
If the 3Ø line voltage is complete at the outgoing lugs of the fuse block, but is not complete at the incoming lugs of the contactor, then the connections or wiring the connecting between the fuse block and contactor are faulty.

Often when these readings are found there will be visible discoloration or damage to the connections or wiring terminations. Typically, the component damage originates with loose connections.

The illustration shows that the fuse block Leg 3 (black) to contactor L3 wiring or connections are electrically open, and the line voltage circuit is “single-phased”.

Power panel breaker trips, blown fuses and motor protector trips are typical related damage when the line voltage circuit is “single-phased”.

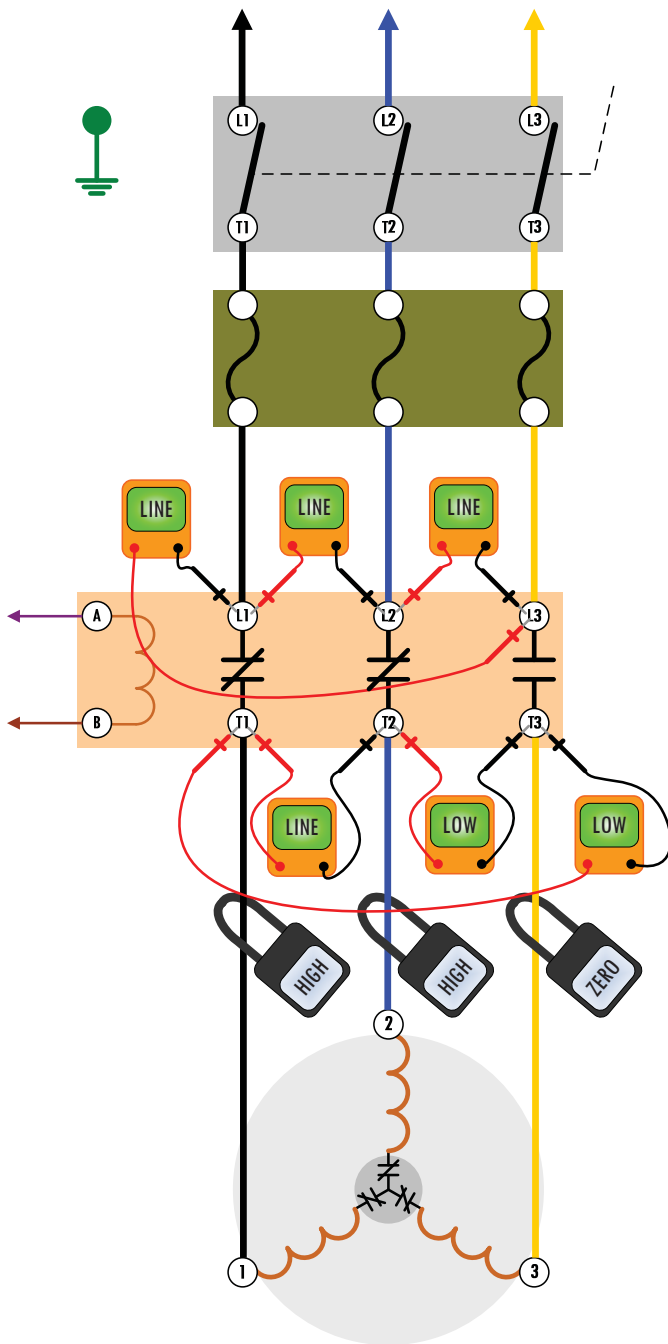
Figure 6-25



If inspection indicates that the faulty contactor has evidence of excessive current draw through the contact points, then particular attention should be paid to the current draw through the contactor after the fault has been corrected.

When power is restored after repairs are made, overall current draw of the unit should be monitored to determine if a unit fault is causing high current draw (amp-meter segment of the illustration).

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This illustration shows a faulty contactor's Leg 1 and Leg 2 contacts engaged (closed), but the leg 3 contacts are disengaged (open) as follows:

- T1 to T2: LINE
- T1 to T3: LOW (feedback)
- T2 to T3: LOW (feedback)

The line voltage circuit is "single-phased".

Power panel breaker trips, blown fuses and motor protector trips are typical related damage when the line voltage circuit is "single-phased".

If the contactor coil was energized while the illustrated readings were taken, then the L3-T3 set of contacts have failed open. If the contactor coil was de-energized while these readings were taken, then both the L1-T1 and L2-T2 sets of contacts are shorted. Regardless of whether the coil is energized, when readings like those illustrated occur, the contactor is faulty.

As discussed in Figure 6-26, the technician should inspect the faulty contactor for indications of the cause of failure in order to make proper repairs.

Figure 6-27

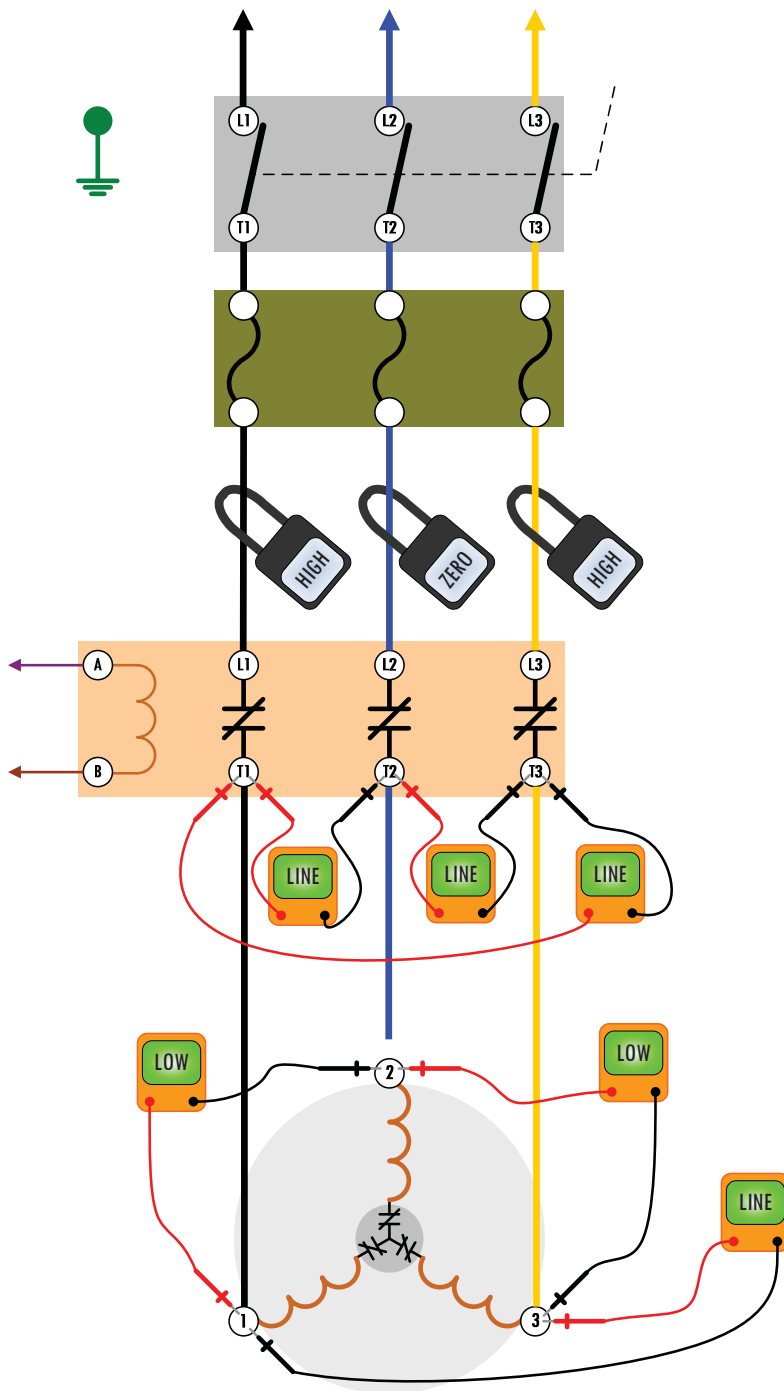


Figure 6-28

If the 3Ø line voltage is complete at the outgoing lugs of the contactor, but is not complete at the motor lugs, then the connections or wiring are faulty.

The readings illustrated show that the contactor T2 to motor terminal 2 connections or wiring are electrically open, and the line voltage circuit is “single-phased”.

Often, when these readings are found there will be visible discoloration or damage to the connections or wiring terminations. Typically, the component damage originates with loose connections.

Power panel breaker trips, blown fuses and motor protector trips are typical related damage when the line voltage circuit is “single-phased”.

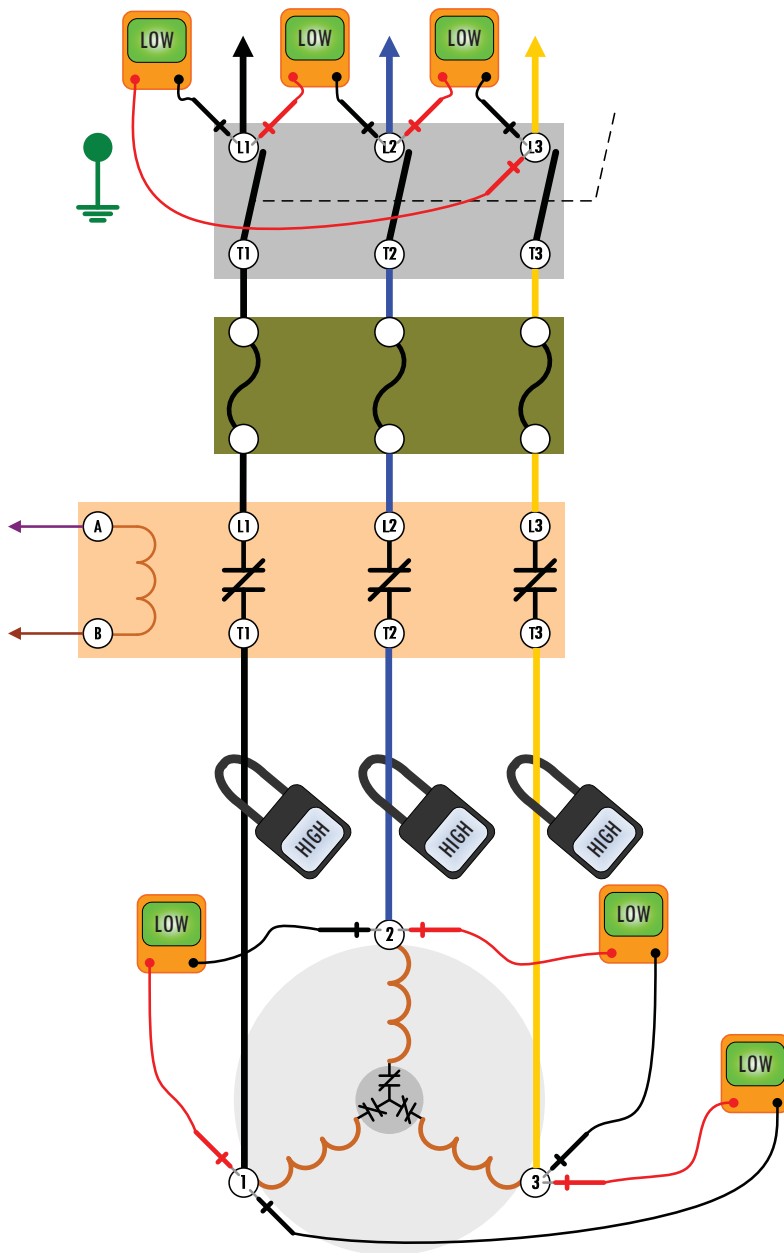


Figure 6-30

If the 3Ø line voltage circuit is complete, but the voltage to any or all of the motor terminals is below the nameplate minimum, then the motor will either not start or will run with excessively high current draw.

The best indication of this issue occurs when the line voltage circuit is loaded (the motor is drawing current).

The readings illustrated show the line voltage circuit is loaded, and the voltage present throughout the circuit on all three legs is lower than nameplate minimum voltage required. When readings similar to these are found, it is typically due to low line voltage to the building or inadequate electrical supply to the unit. In most circumstances, these issues will require that a qualified electrician be consulted for repairs.

Power panel breaker trips, blown fuses and motor protector trips are typical related damage when the voltage to the motor terminals is below the nameplate minimum.

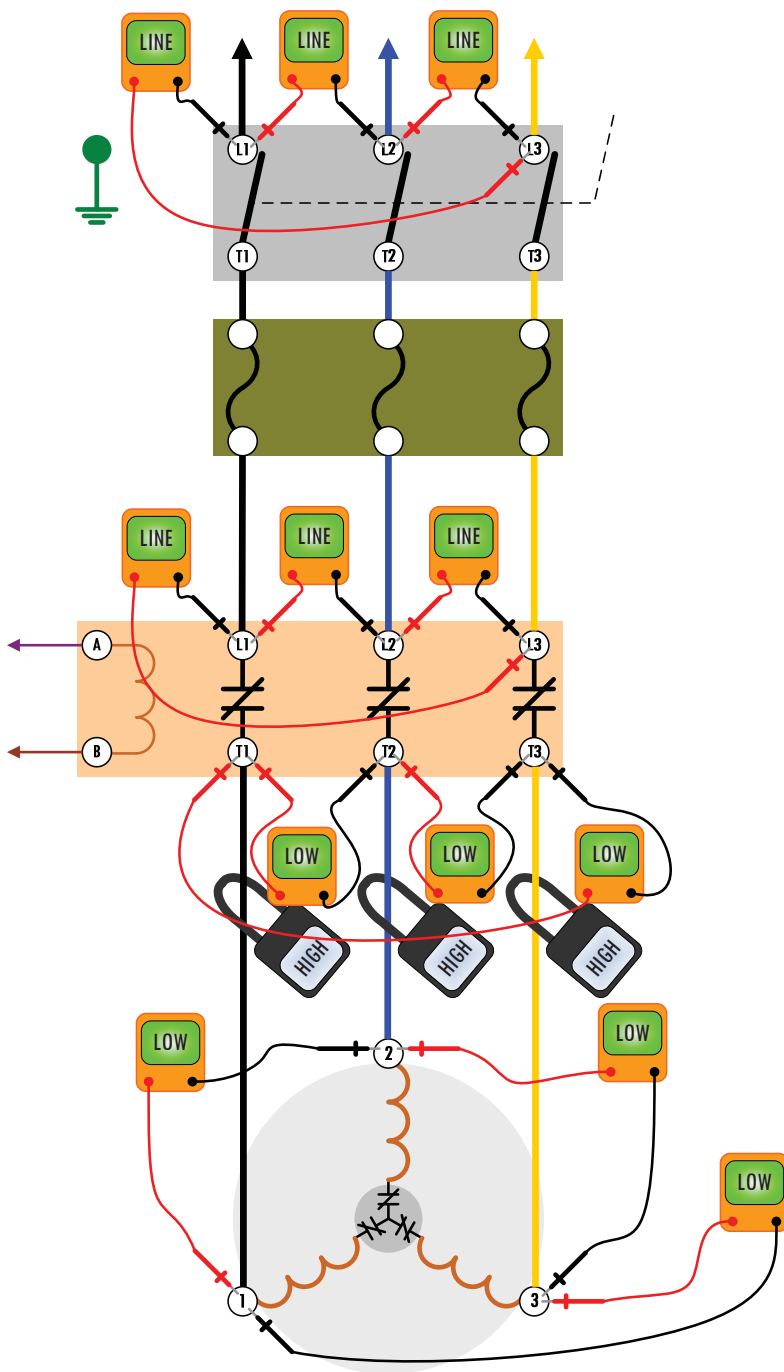


Figure 6-31

If the 3Ø line voltage circuit is complete with full line voltage supplied to the incoming lugs of the disconnect, but the voltage to any or all of the motor terminals is below the nameplate minimum, then components within the circuit have issues which result in voltage drop. The drop in voltage can be due to poor connections, inadequately sized wire or damaged components.

If the voltage to any or all of the motor terminals is below the nameplate minimum, the motor will either not start or will run with excessively high current draw.

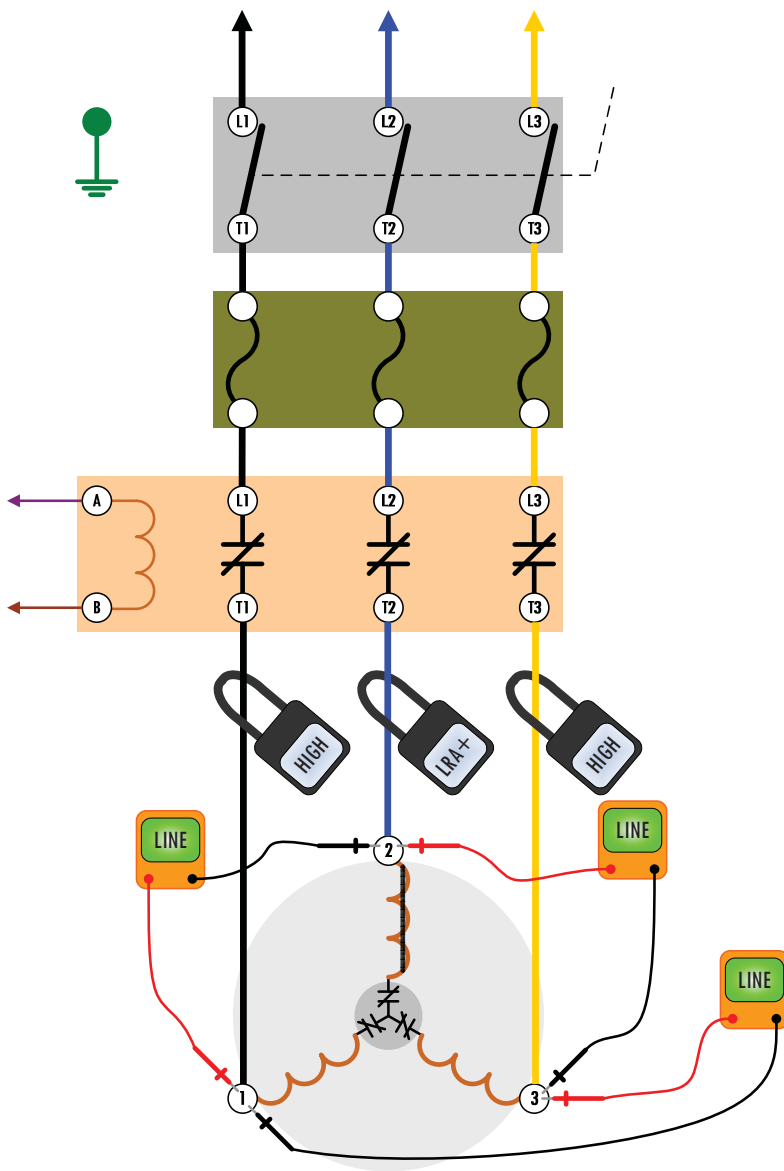
The best indication of this issue occurs when the line voltage circuit is loaded (the motor is drawing current).

The readings illustrated show the line voltage circuit is loaded, and the contactor is the component in the circuit that is causing the drop in voltage. Full line voltage is present to the incoming lugs of the contactor, but lower than name plate minimum voltage is present in the circuit at the outgoing lugs of the contactor and to the motor terminals. When readings such as these are found, where voltage drops through a component, it is typically due to either a poor connections at the component or a faulty component.

Power panel breaker trips, blown fuses and motor protector trips are typical related damage when the voltage to the motor terminals is below the nameplate minimum.



Power panel breaker trips, blown fuses and motor protector trips are typical related damage when the motor has failed with an open winding.



If the 3Ø line voltage circuit is complete to the motor terminals, but the current draw is HIGH on two legs, and LRA+ on the remaining leg, then the motor is likely to have failed with a shorted winding.

The technician must exercise extreme caution when working around equipment that has shorted components. Very high energies exist and the potential for ground-faults pose safety risks.

With the power off, the technician should confirm the motor winding short with ohmmeter continuity checks.

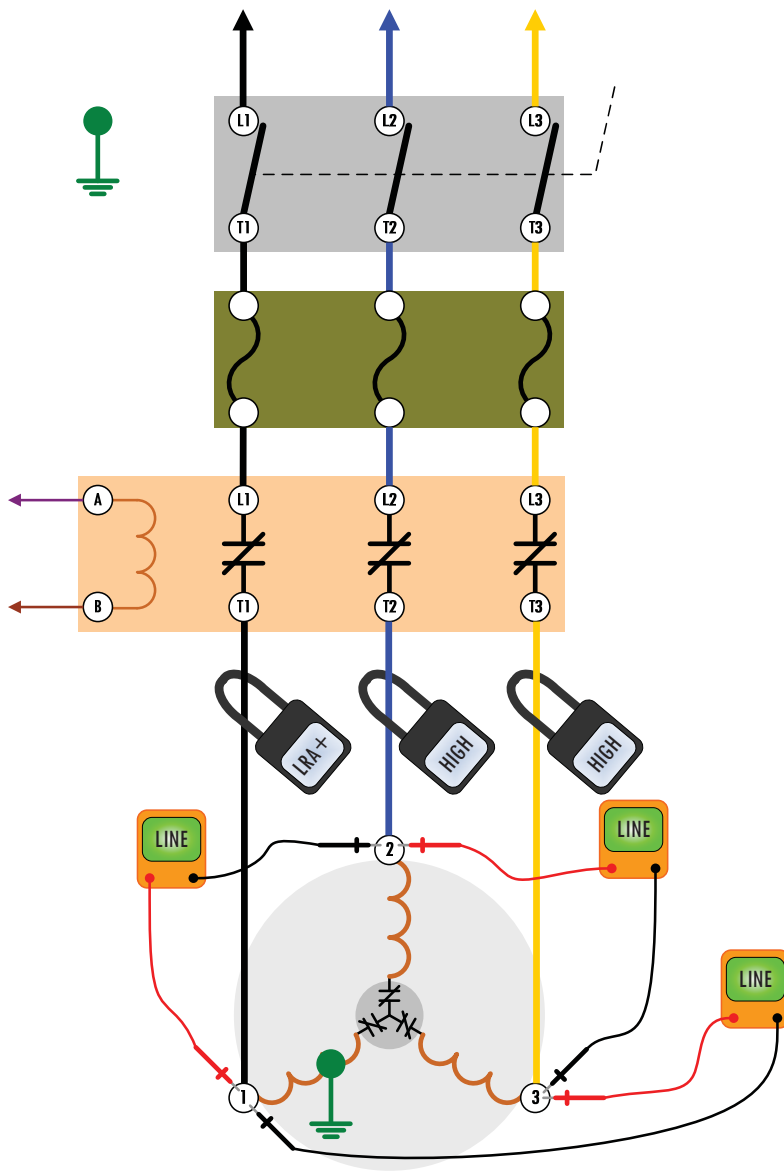
The readings illustrated show the winding attached to terminal 2 has shorted. When these readings are found, the technician should further investigate for electrical and mechanical faults that likely contributed to the motor winding failure.

Power panel breaker trips, blown fuses and motor protector trips are typical related damage when the motor has failed with a shorted winding.

Figure 6-33



There is no distinct difference in current draw and voltage readings for “cross-winding” shorts, winding-to-winding shorts or winding shorts to cabinet ground.



If the 3Ø line voltage circuit is complete to the motor terminals, but the current draw is HIGH on two legs, and LRA+ on the remaining leg, then the motor is likely to have failed with a shorted winding.

The technician must exercise extreme caution when working around equipment that has shorted components. Very high energies exist, and the potential for ground-faults pose safety risks.

With the power off, the technician should confirm the motor winding short with ohmmeter continuity checks.

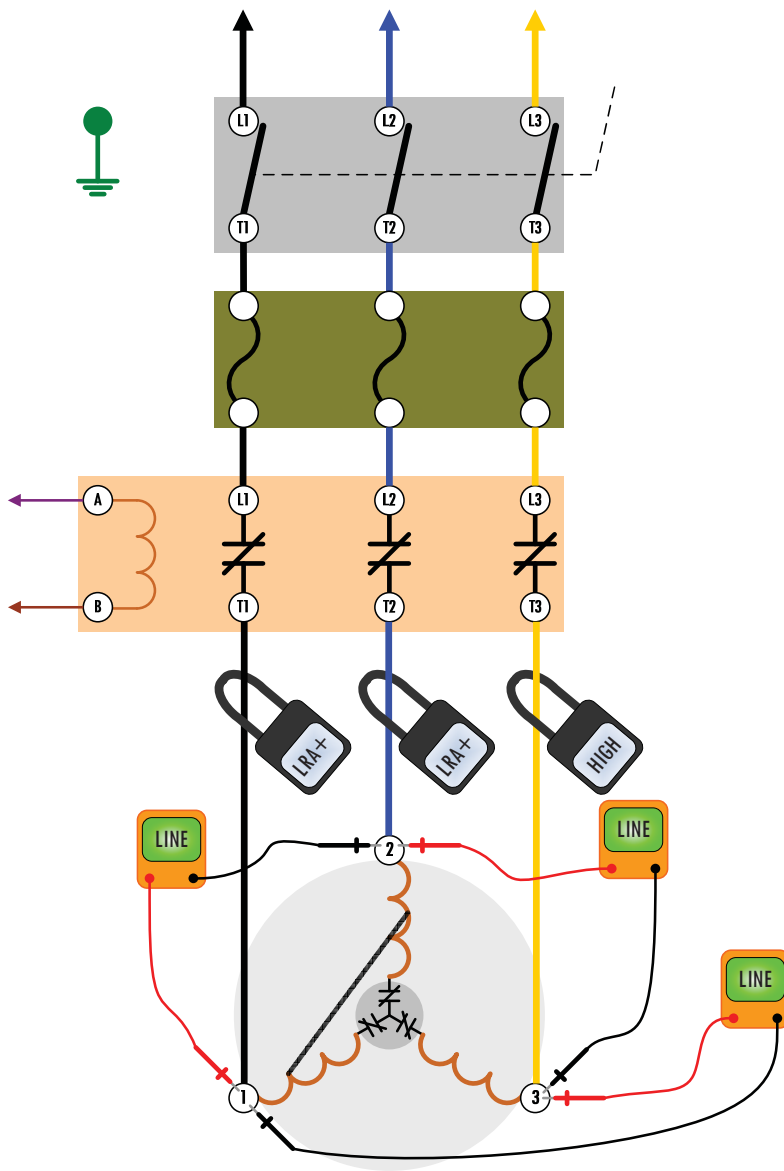
The measurements illustrated show the winding attached to terminal 1 has shorted to cabinet ground. When these indications are found, the technician should further investigate for electrical and mechanical faults that likely contributed to the motor winding failure.

Power panel breaker trips, blown fuses and motor protector trips are typical related damage when the motor has failed with a shorted winding.

Figure 6-34



There is no distinct difference in current draw and voltage readings for “cross-winding” shorts, winding-to-winding shorts or winding shorts to cabinet ground.



If the 3Ø line voltage circuit is complete to the motor terminals, but the current draw is LRA+ on two legs, and HIGH on the remaining leg, then the motor is likely to have failed with a winding-to-winding short.

The technician must exercise extreme caution when working around equipment that has shorted components. Very high energies exist, and the potential for ground-faults pose safety risks.

With the power off, the technician should confirm the motor winding short with ohmmeter continuity checks.

The readings illustrated show a winding-to-winding short between the winding attached to terminal 1 and the winding attached to terminal 2. When these readings are found, the technician should further investigate for electrical and mechanical faults that likely contributed to the motor winding failure.

Power panel breaker trips, blown fuses and motor protector trips are typical related damage when the motor has failed with a shorted winding.

Figure 6-35



There is no distinct difference in current draw and voltage readings for “cross-winding” shorts, winding-to-winding shorts or winding shorts to cabinet ground.

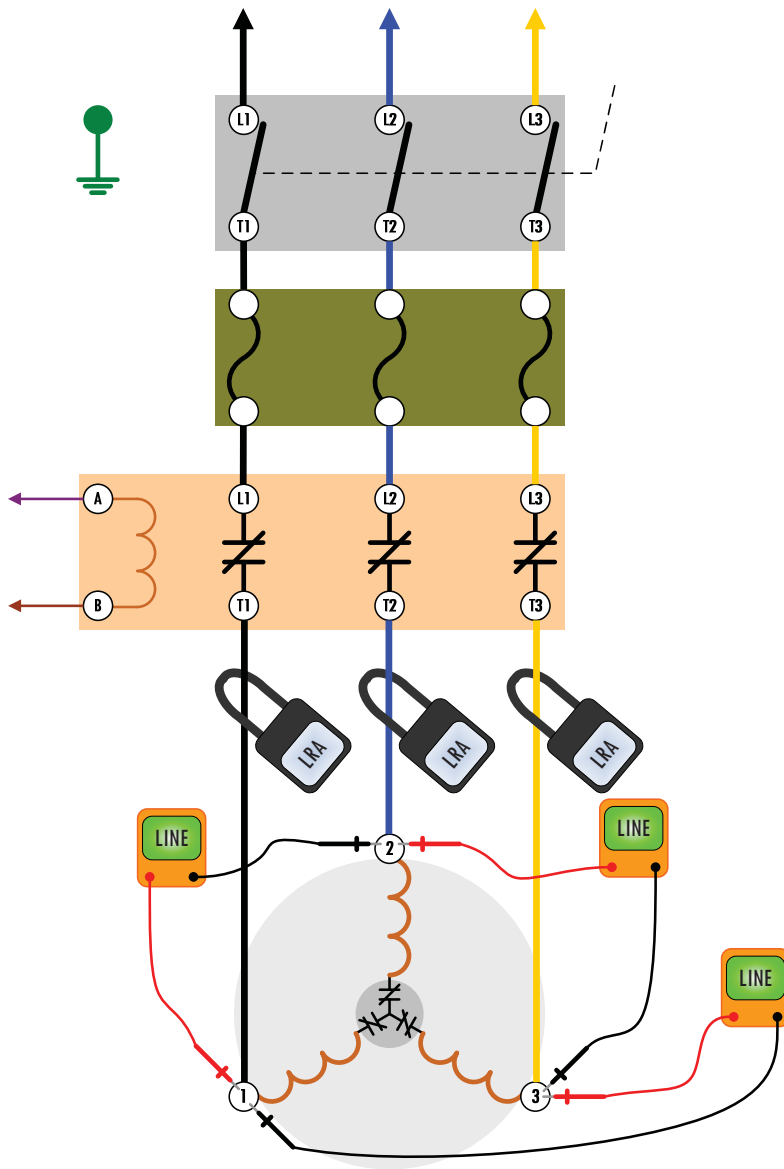


Figure 6-36

If the 3Ø line voltage circuit is complete to the motor terminals, and the current draw is LRA on all three legs, then the motor is locked.

The readings illustrated show the motor locked. When these readings are found, the technician should further investigate for mechanical faults that likely contributed to the motor locking.

Power panel breaker trips, blown fuses and motor protector trips are typical related damage when the motor is locked.

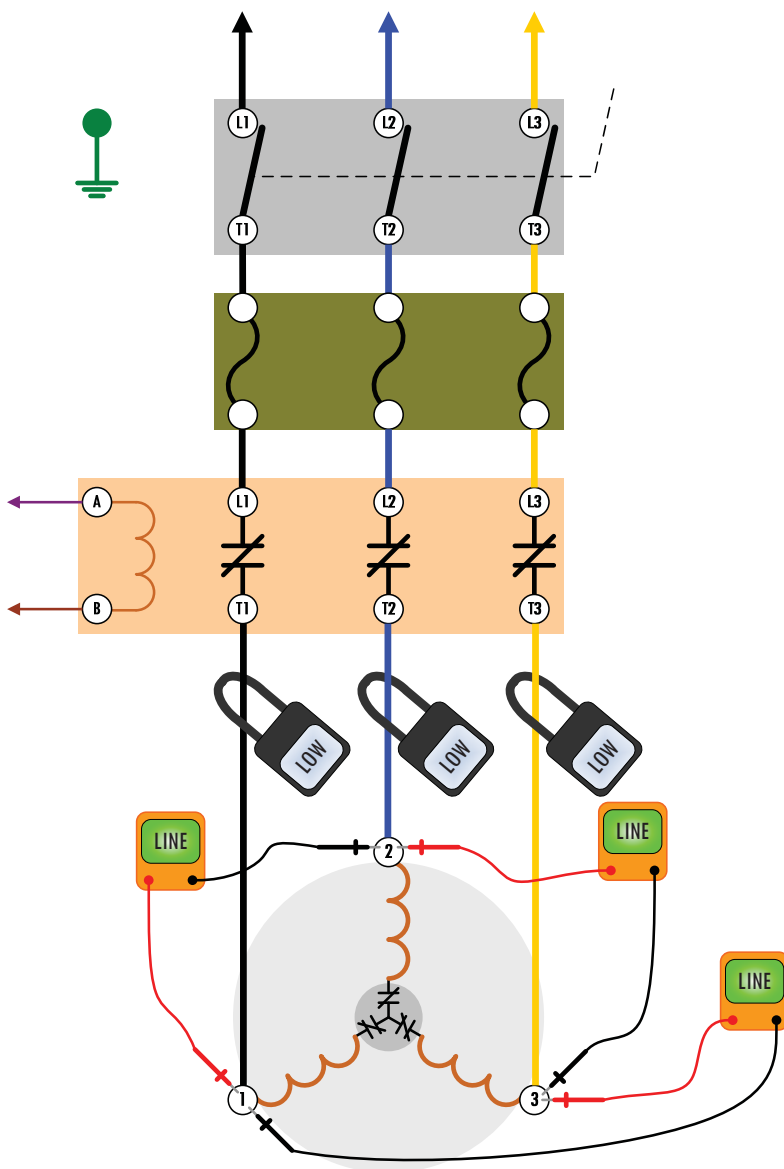


Figure 6-37

If the 3Ø line voltage circuit is complete to the motor terminals, and the current draw is LOW on all three legs, then the motor is lightly loaded.

This may not be an abnormal condition if circumstances exist where light motor loading is expected. However, this is an abnormal condition if circumstances exist where moderate to high motor loading is expected. Also, adequate time should be allowed for system stabilization after startup when observing compressor motor loading.

The readings illustrated show the motor lightly loaded. When readings such as these are found the technician should further investigate for reverse rotation, abnormally low load conditions or mechanical faults that were likely to have contributed to the light motor loading.

PSC fan motor troubleshooting

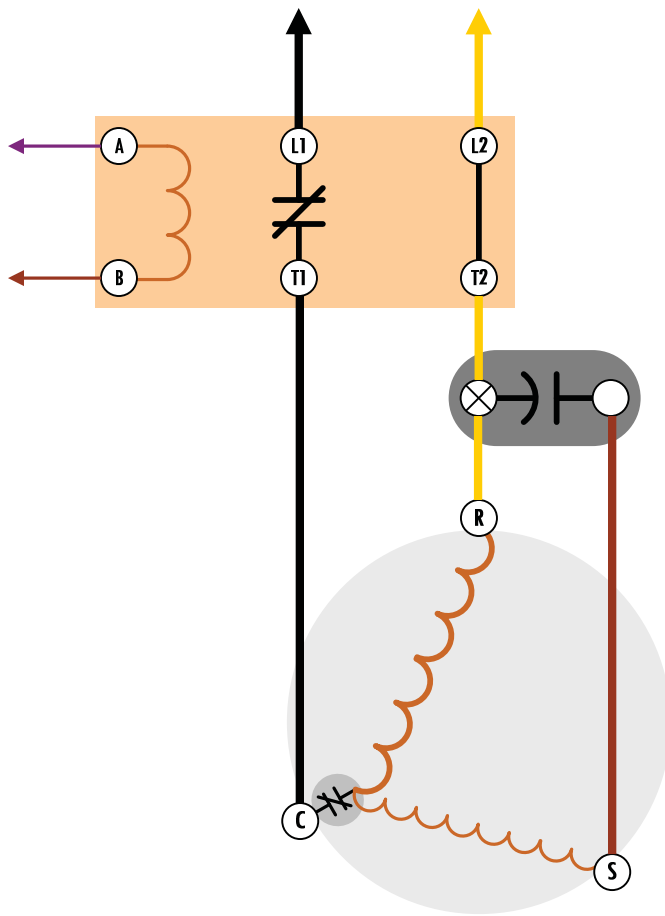


Figure 6-38

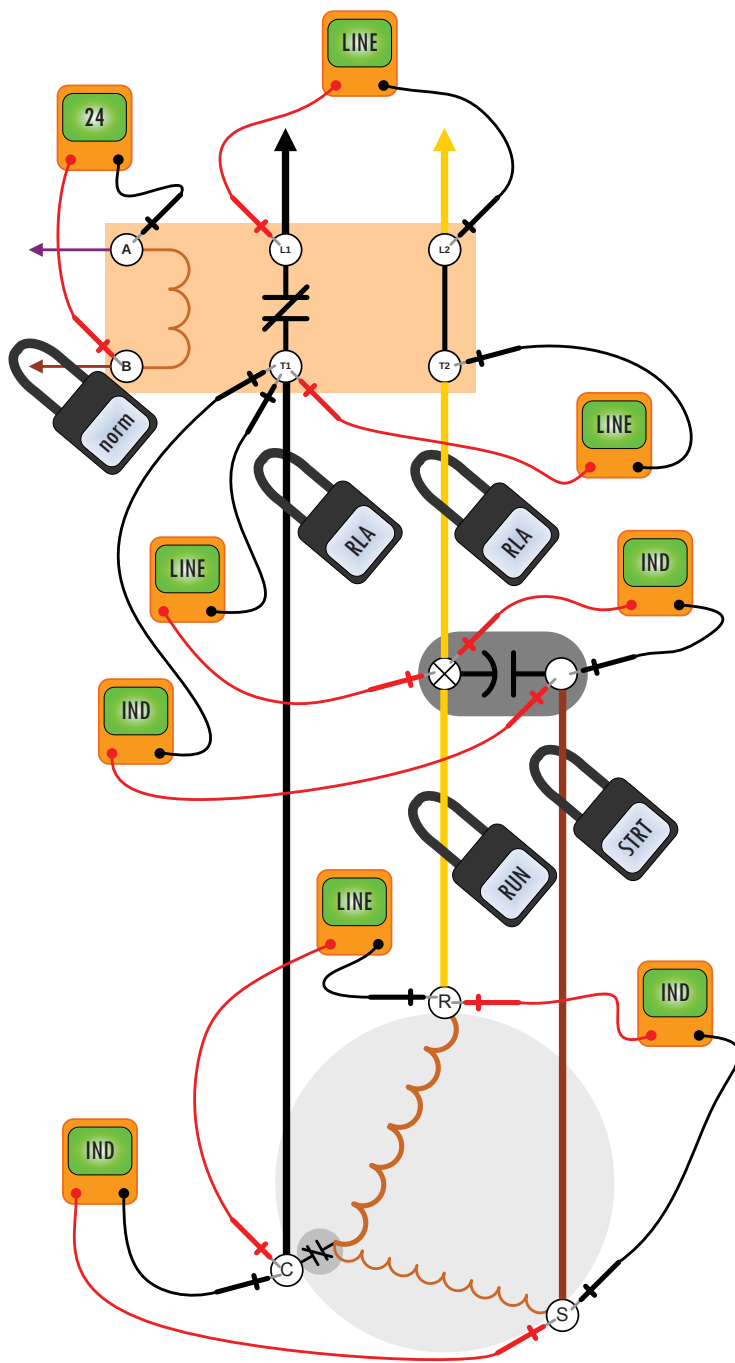
A systematic approach to line voltage component electrical troubleshooting will provide the greatest diagnostic accuracy. The following method requires that the equipment be powered. The technician must exercise care and caution to avoid electrical shock and other personal safety hazards.

The accompanying diagram is a simplified version representing the line voltage components which connect to the 1Ø PSC condenser fan or power exhaust motors.

Component and wiring details may vary, but the principles of 1Ø PSC motor troubleshooting remain the same.

From the top, the items diagrammed are:

- Up arrows represent the connection to the unit's power connection for the 1Ø PSC motor.
- A contactor (tan rectangle), single-pole shown. Two-pole contactors are also used in some applications.
- A run capacitor (dark gray oval).
- 1Ø PSC, internally-protected motor; either condenser fan or power exhaust fan motor (light gray circle).



Electrical troubleshooting of the line voltage components uses:

- Voltage readings of the 1Ø PSC motor line voltage circuit.
- Amperage readings of the 1Ø PSC motor line voltage circuit.
- Confirmation that the 24 volt contactor coil circuit is complete and enabled.

The technician's understanding of what readings are normal, as well as recognition of abnormal readings, is key to electrical troubleshooting.

The illustration shown depicts normal readings for an operating 1Ø PSC motor line voltage circuit as follows:

- The presence of 24 volts and normal current draw (typically 1 amp or less) at the contactor coil confirms that the 24 volt circuit is complete and enabled.
- Current draw of the motor is reasonably close to the motor's R.L.A. through the motor Common (black wire), and the incoming terminal of the capacitor (yellow wire –contactor T2 to X-identified capacitor terminal).
- The motor's current draw through the RUN winding (yellow wire – incoming X-identified terminal of the capacitor to motor Run) is somewhat less than the current draw through the motor common.

- The motor's current draw through the STaRT winding (brown wire – outgoing unidentified terminal of the capacitor to motor Start) is somewhat less than the current draw the motor run winding.

Figure 6-39



Due to the operating characteristics of 1Ø PSC motors, and the measurement capabilities of meters, it is not necessarily abnormal for the sum of the run and start winding current draw readings to not exactly equal the current draw of the motor common. For most circumstances, the current draw reading of motor common should be used to determine the motor's true current draw.

Line voltage is read at the following points in the circuit:

- Incoming lugs of the contactor – L1 to L2
- Outgoing lugs of the contactor – T1 to T2
- At any points from contactor T1 through motor C (black) to any points from contactor T2 through motor R (yellow)

INDuced voltage is read at any point in the circuit from contactor T2 through motor R (yellow) to the outgoing unidentified terminal of the capacitor through motor S (brown wire).

A differing INDuced voltage is read at any points in the circuit from contactor T1 through motor C (black) to the outgoing unidentified terminal of the capacitor through motor S (brown wire).



Induced voltage reading will vary due to variations in applied line voltage and the operating characteristics of particular 1Ø PSC motors.

Reference readings (provided for example only) for induced voltages of the 1Ø PSC condenser motors with 230 volts applied to 208/230 volt units, and 480 volts applied to 460 volt units:

R to S

- 208/230v, 1/3 HP: 333 volts
- 460v, 1/3 HP: 373 volts

C to S

- 208/230v, 1/3 HP: 247 volts
- 460v, 1/3 HP: 390 volts

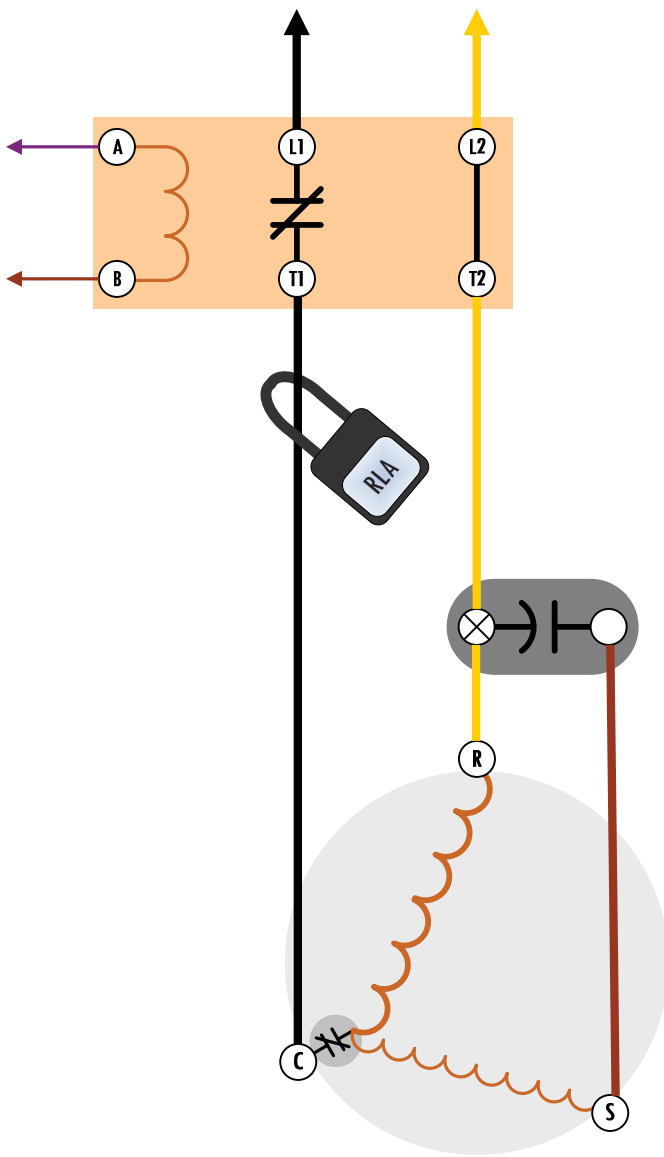


Figure 6-40

A starting point for electrical troubleshooting is to find the motor's R.L.A. and L.R.A. on the unit or motor data plate. Next, readings of the current draw of the motor common, the run winding and the start winding are taken. These readings are used to indicate the type of problem, as well as the urgency and care needed for troubleshooting.

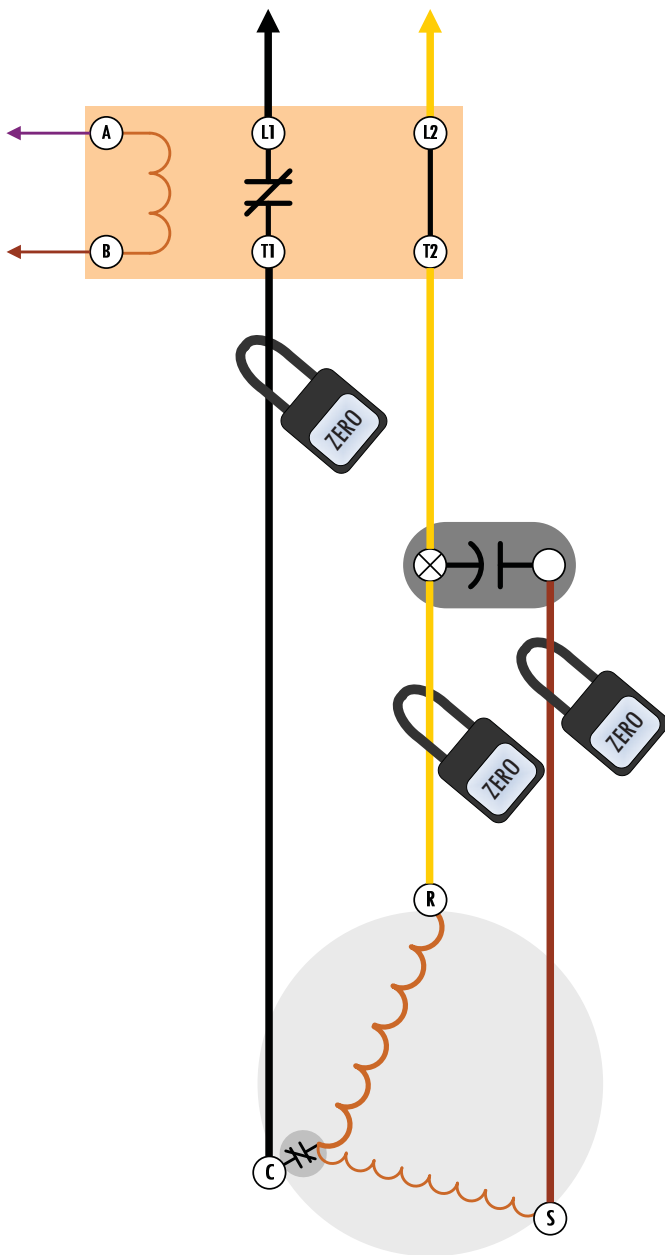
When HIGHER than normal current draw exists on any portion of the line voltage circuit, extreme energies are present that can quickly cause failures that pose safety hazards to the technician.

Troubleshooting readings should be made with the motor energized only for the brief periods needed for the readings to register if HIGHER than normal current draw exists on any portion of the line voltage circuit. This can be accomplished by quick off-on-off cycling of the disconnect or 24 volts to the the contactor coil; whichever is practical.

Avoid manually "pushing in the contactor" because of the following:

- The potential for electrical burns exists due to the compromised contactor arc shielding.
- The close proximity to live voltage components increases the risk of electrical shock.
- Unit safeties are effectively bypassed.

If the current draw of the motor common reads reasonably close to the motor's R.L.A., as illustrated, the line voltage circuit is complete and the motor should be operating. If this reading is taken at times when the motor is supposed to be off, further electrical troubleshooting will be required.



If the current draw readings are:

- motor Common: ZERO
- Run winding: ZERO
- Start winding: ZERO

Then the line voltage circuit is currently open.

The open circuit may be temporary, such as in the case when the motor internal protector has tripped due to overheating, and a secondary result of another condition. However, during periods with zero current draw there is little chance of further damage to the line voltage circuit or equipment.

If the current draw of motor common reads significantly lower than R.L.A., the line voltage circuit is complete, but the motor is likely operating at a reduced load. Causes for reduced load typically stem from mechanical problems.

Figure 6-41

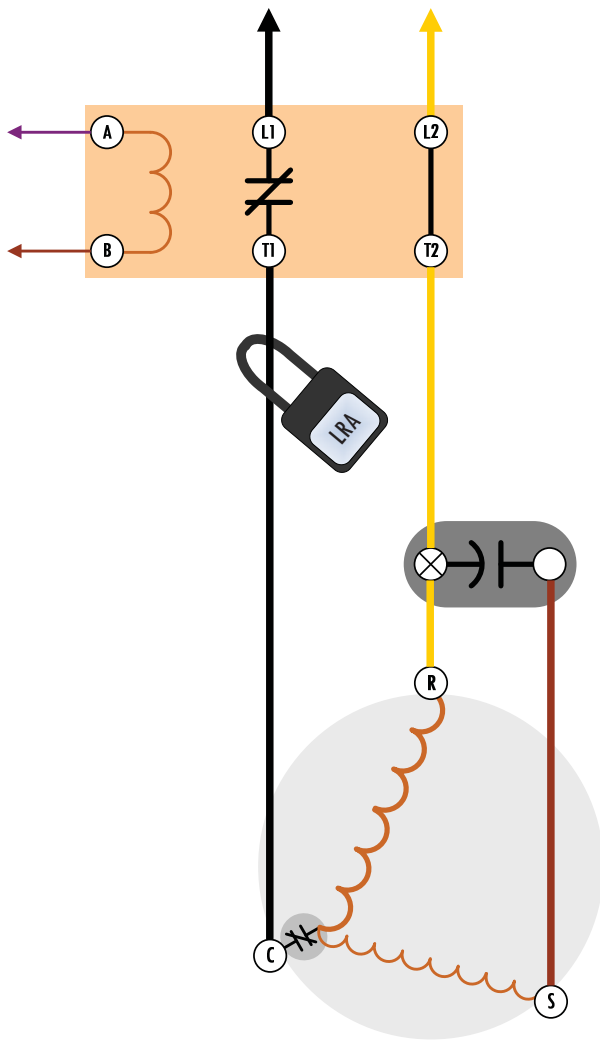
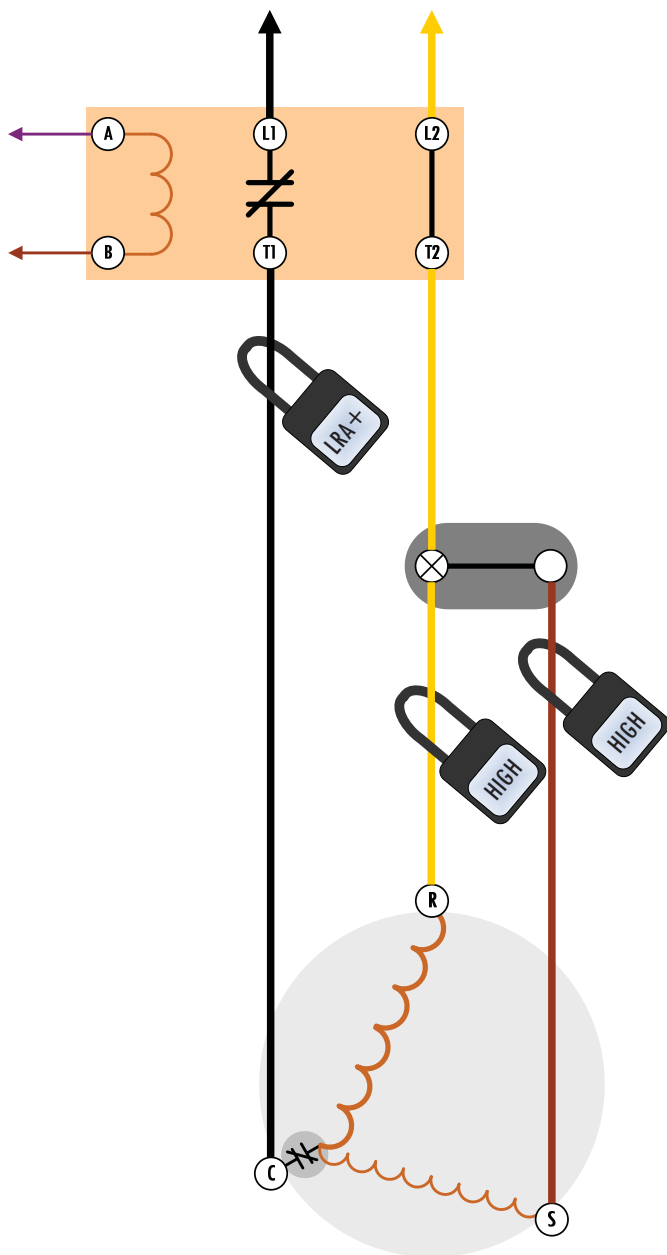


Figure 6-42



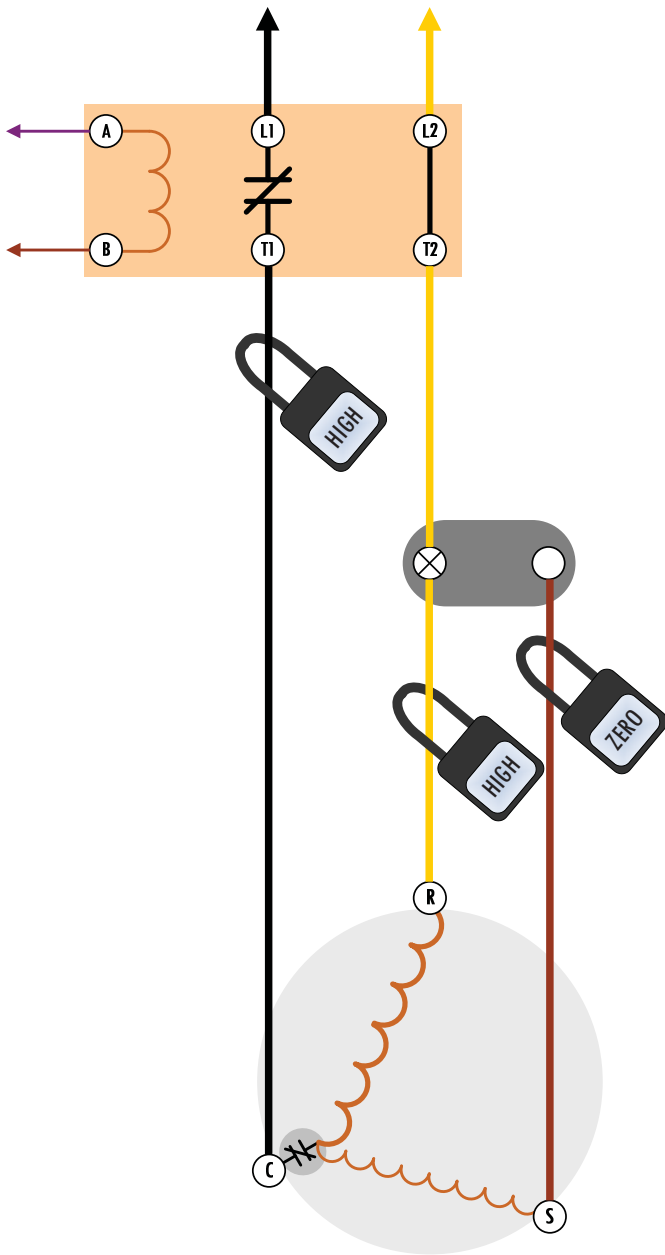
If the current draw readings are:

- motor Common: above L.R.A.
- Run winding: HIGH
- Start winding: HIGH

Then the capacitor or motor windings are likely shorted.

When the capacitor is shorted, the excessive current through the motor's start winding can directly result in damage to the winding. Additionally, the motor's internal protector may trip, fuses may blow, the circuit protection may trip or equipment damage may result. All of these issues add greater complexity to the electrical troubleshooting process.

Figure 6-43



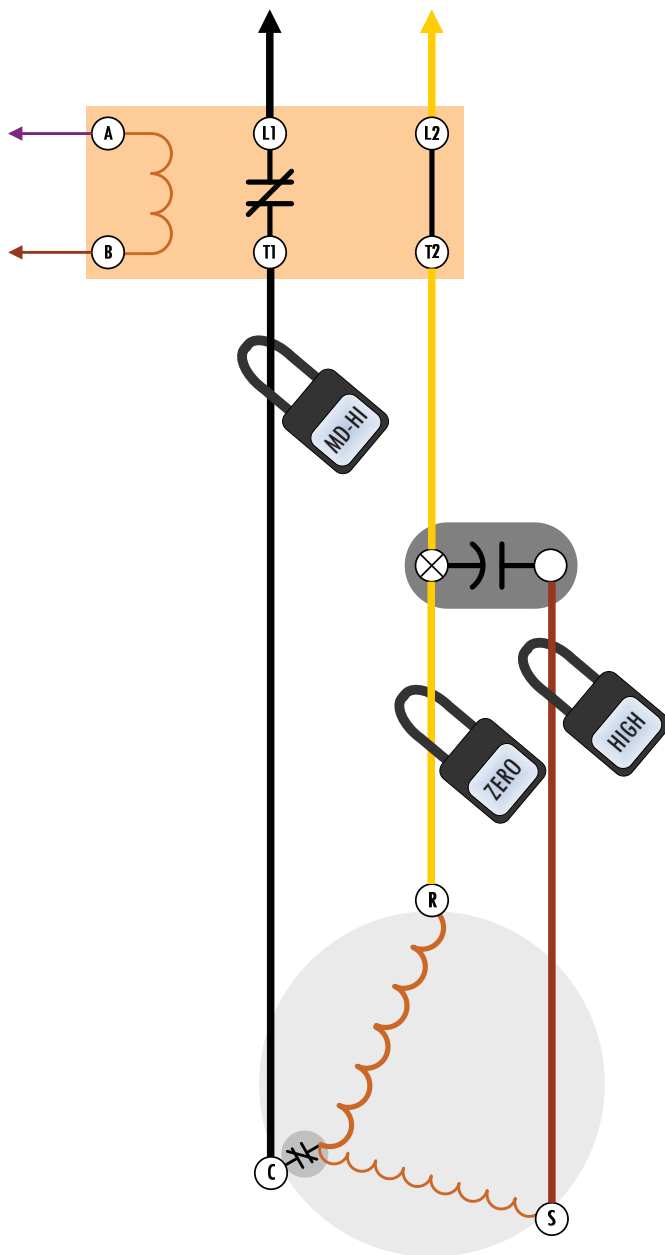
If the current draw readings are:

- motor Common: HIGH
- Run winding: HIGH
- Start winding: ZERO

Then the capacitor, motor start winding or connecting wiring is likely open.

When the circuit through the start winding is open, the excessive current through the motor's run winding can directly result in damage to the winding. Additionally, the motor's internal protector may trip, fuses may blow, the circuit protection may trip or equipment damage may result. All of these issues add greater complexity to the electrical troubleshooting process.

Figure 6-44



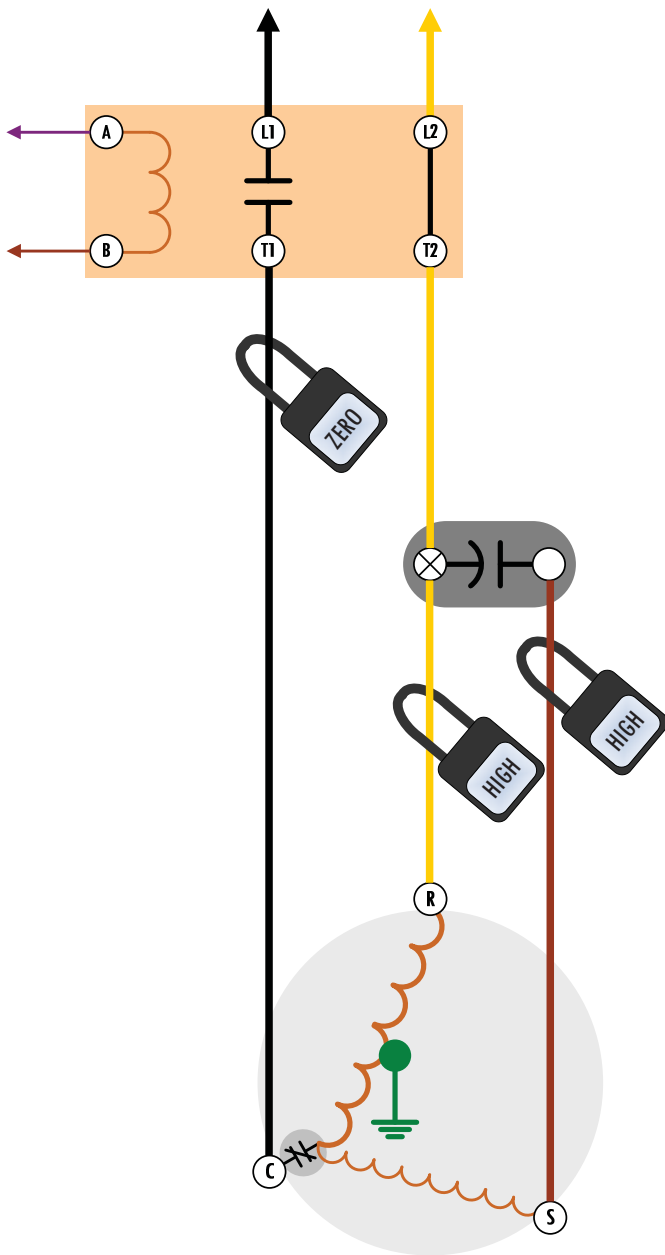
If the current draw readings are:

- motor Common: MoDerate to Hlgh
- Run winding: ZERO
- Start winding: HIGH

Then the wiring connecting the X-identified capacitor terminal to the motor R terminal is open or the motor run winding is open.

When the circuit through the run winding is open, the excessive current through the motor's start winding can directly result in damage to the winding. Additionally, the motor's internal protector may trip, fuses may blow, the circuit protection may trip or equipment damage may result. All of these issues add greater complexity to the electrical troubleshooting process.

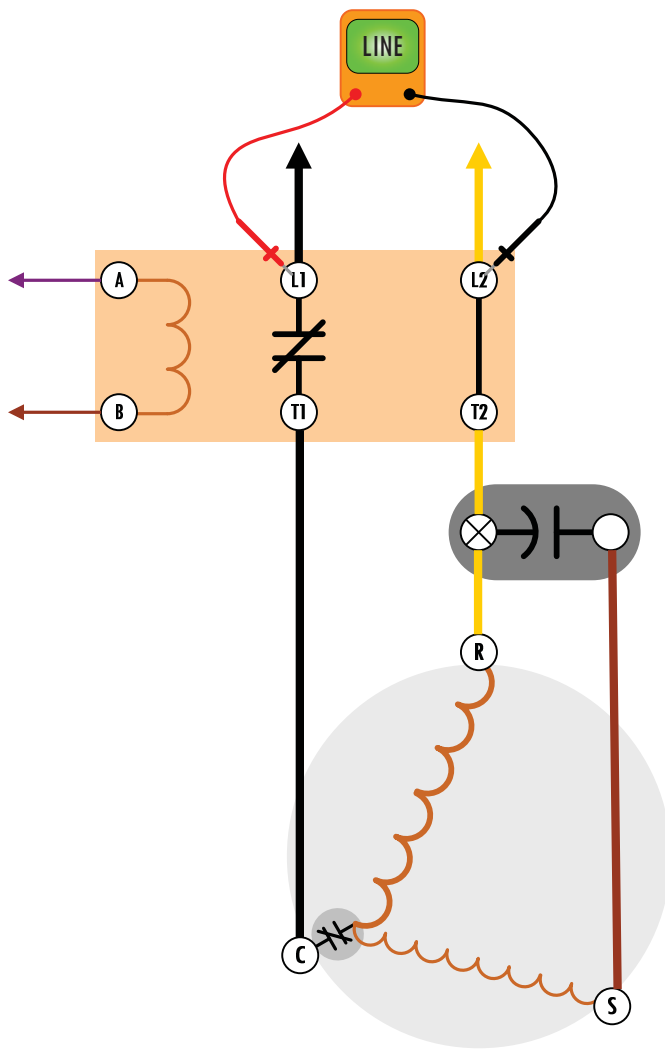
Figure 6-45



If there is current draw at times when the contactor is de-energized, and its contacts are known to be open, then the circuit has a fault to cabinet ground.

There is a great risk of electric shock to the technician in this scenario. For safety, the disconnect should be turned off, and the line voltage circuit be checked for faults to ground with an ohmmeter to identify the problem.

Figure 6-46



Once the current draw of motor common, the run winding and the start winding of the 1Ø PSC motor circuit has been read, a series of voltage readings, done briefly if any any portion of the circuit reads HIGH current draw, are the next step in systematic electrical troubleshooting.

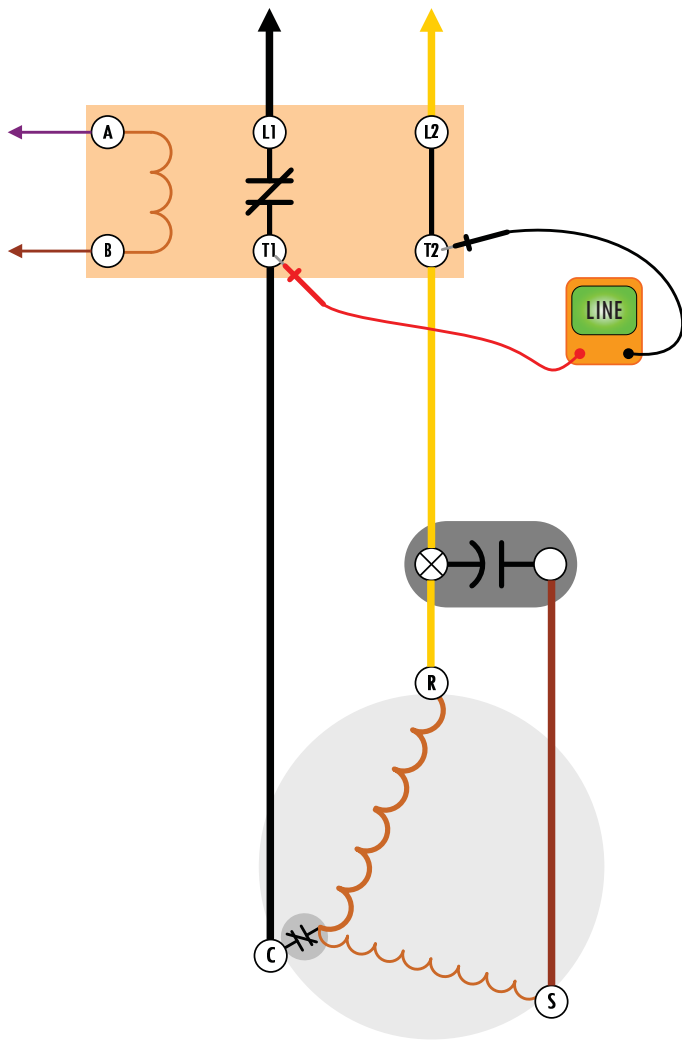
The voltage readings begin with confirmation that line voltage is available to the 1Ø PSC motor circuit.

Line voltage appropriate to the unit's rating should be read from the incoming lugs of the contactor:

- L1 to L2

If this reading is not present, then troubleshooting of the power supply is needed before proceeding further.

Figure 6-47



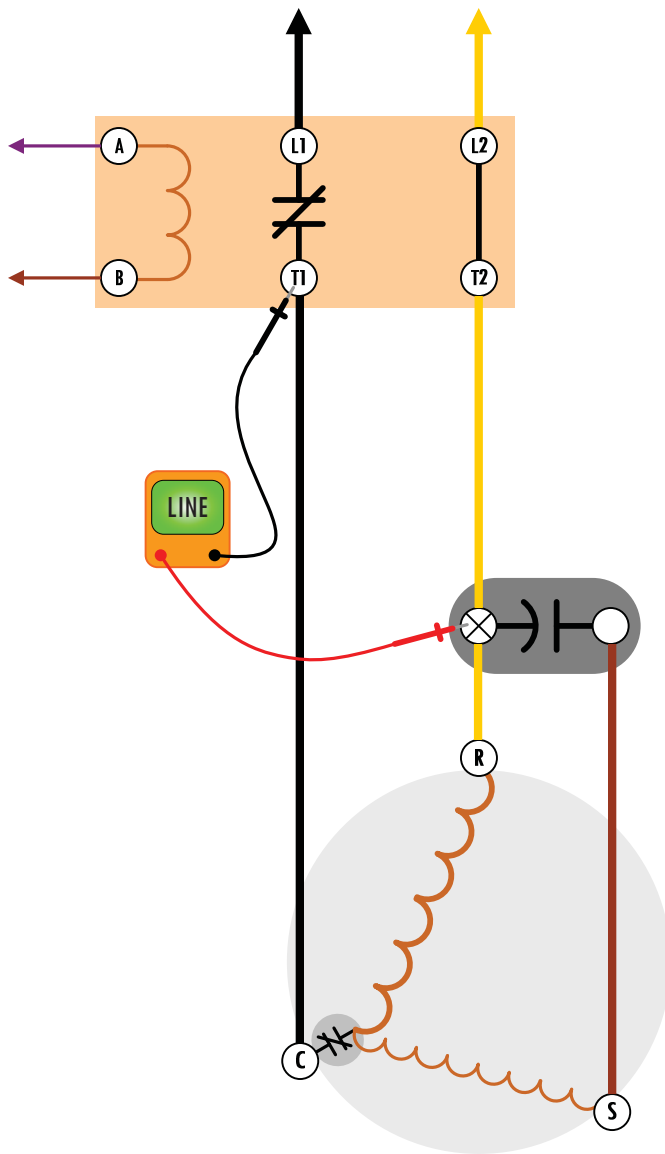
Next is confirmation that the contactor is energized, and its contacts are engaged.

Line voltage should be read from the outgoing lugs of the contactor:

- T1 to T2

If this reading is not present, refer to Figure 6-51 for discussion.

Figure 6-48



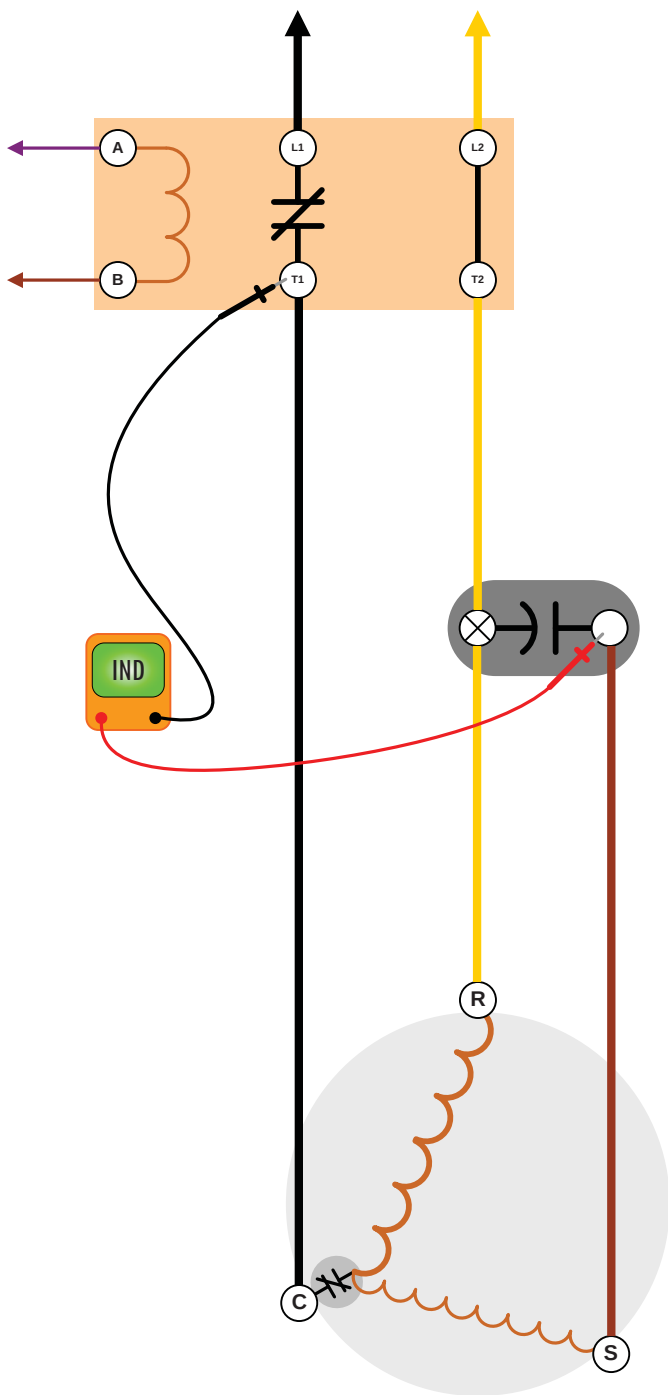
Next is confirmation that the line voltage circuit is complete at the incoming X-identified terminal of the capacitor.

Line voltage should be read from:

- Contactor T1 to the incoming X-identified terminal of the capacitor.

If this reading is not present, refer to Figure 6-52 for troubleshooting procedures.

Figure 6-49



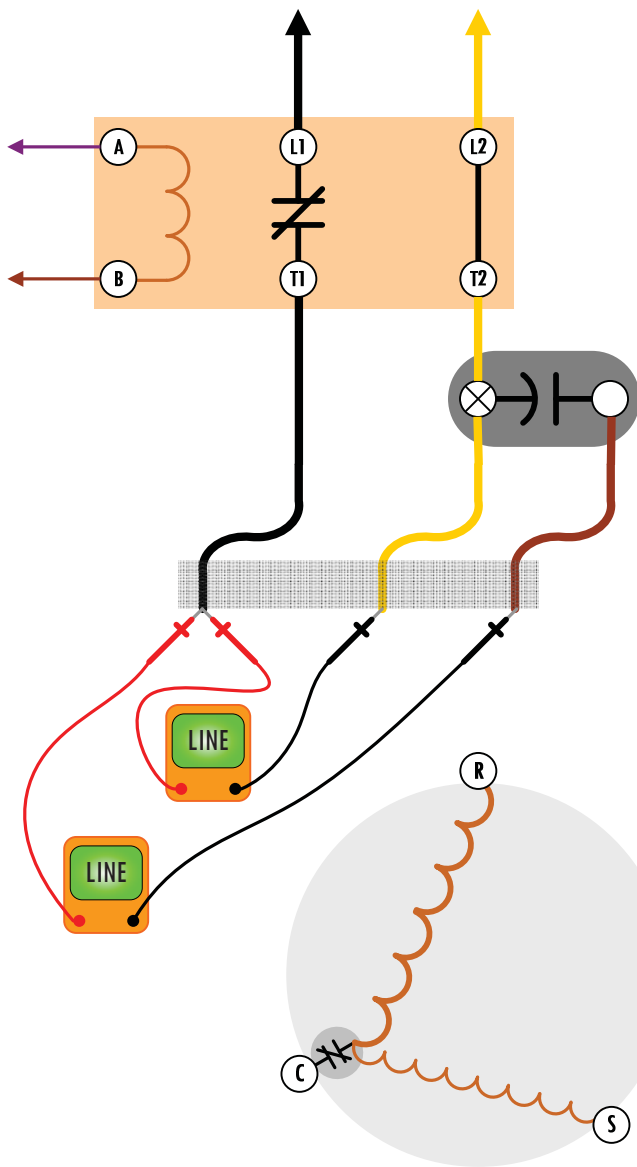
Next is confirmation that induced voltage is present at the outgoing unidentified terminal of the capacitor.

Induced voltage should be read from:

- Contactor T1 to the outgoing unidentified terminal of the capacitor.

If this reading is not present, refer to Figure 6-54 through Figure 6-58 for troubleshooting procedures.

Figure 6-50



Taking “live circuit” voltage readings at the unit’s condenser fan motors is not practical because of the extended wiring harness and weather-resistant plug terminal connection at the motor.

With the power disconnected to the unit, access the motor plug after removing the top condenser fan grille. The wire tie, used to secure the harness to the motor, is removed to separate the plug. While the plug is disconnected from the motor, the harness and motor terminations should be inspected for arcing, corrosion, damage from excessive heat, and other signs of loose connection.

Ohmmeter continuity checks of the motor can also be made at this point to determine if the motor windings are intact.

With the harness still disconnected, and the technician taking care to avoid electrical shock or shorts from the loose harness, power can be re-applied to the unit. Line voltage should be read from:

- Black harness wire to the yellow harness wire
- Black harness wire to the brown harness wire

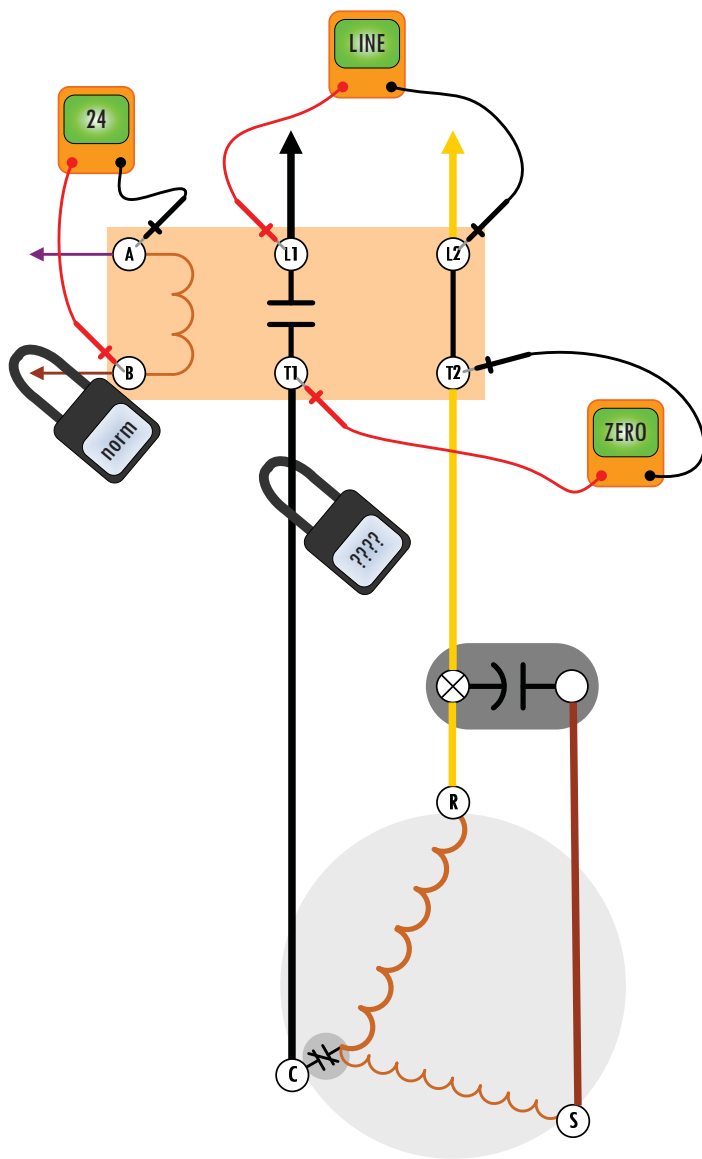
Figure 6-51



Induced voltage will not be read at the brown wire because the source of the induced voltage, the start winding of an operating PSC motor, is disconnected.

If line voltage is not present, then at least one of the harness wires is open.

If line voltage is present as illustrated, it is likely, but not absolute, that the wiring harness is intact. Because the circuit is not under load, the readings will not detect poor or loose connections.



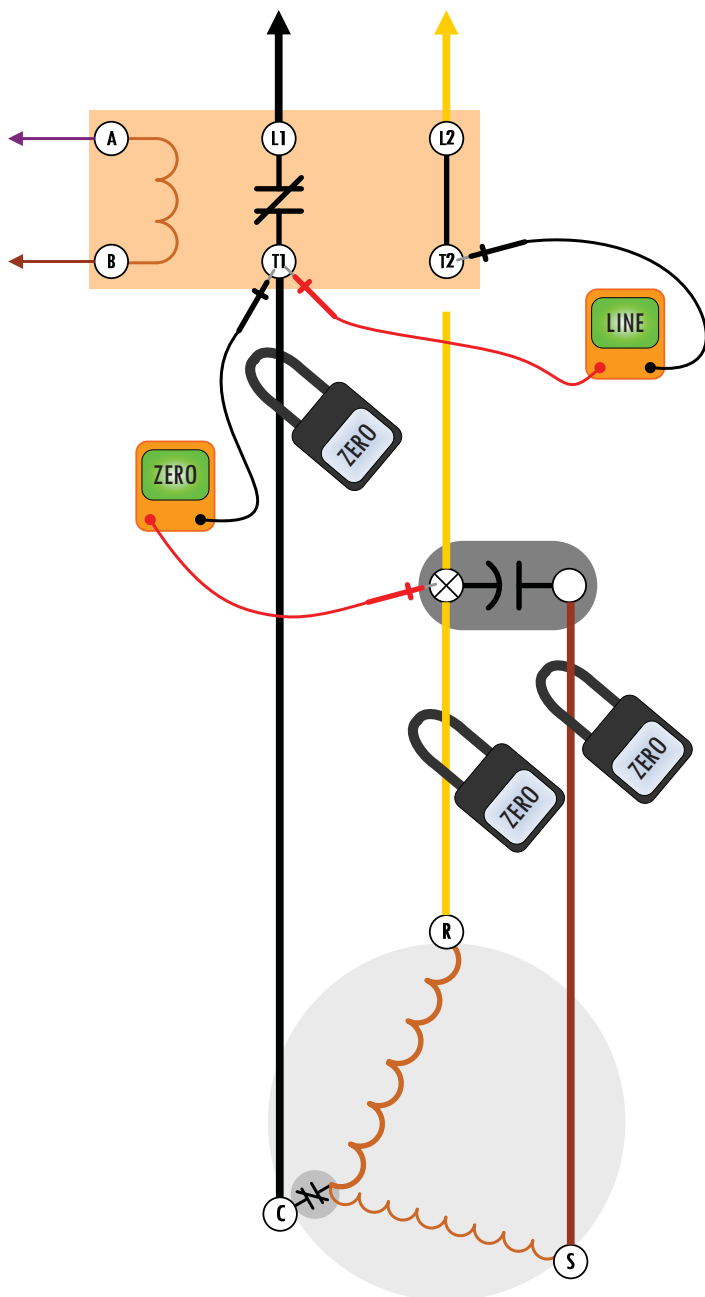
If line voltage is complete at the incoming lugs of the contactor, but is not complete at the outgoing lugs of the contactor, and the contactor coil is confirmed to be energized, then the contactor is faulty.

The technician should inspect the faulty contactor for indications of mechanical binding, such as water damage, corrosion or animals entering the contactor. Typically, these issues are corrected by properly sealing the unit's control compartment. Inspection of the faulty contactor can reveal failure due to excessively low control circuit voltage, such as overheating damage in the area of the contactor coil or contact point damage due to chattering.

If inspection shows the faulty contactor has evidence of excessive current draw through the contact points, then particular attention should be paid to the current draw through the contactor after corrections have been made.

When power is restored after repairs are made, overall current draw of the motor should be monitored to determine if a fault is causing high current draw (amp-meter segment of the illustration).

Figure 6-52



If line voltage is complete at the outgoing lugs of the contactor, but is not complete from contactor T1 to the incoming X-identified terminal of the capacitor, then the connections or wiring are faulty.

The readings illustrated show that either the contactor T2 to the incoming X-identified terminal of the capacitor connections or the wiring is electrically open. This fault also opens the line voltage circuit to the 1Ø PSC motor.

In many cases when these readings are found there will be visible discoloration or damage to the connections or wiring terminations. Typically, the component damage originates with loose connections.

Figure 6-53

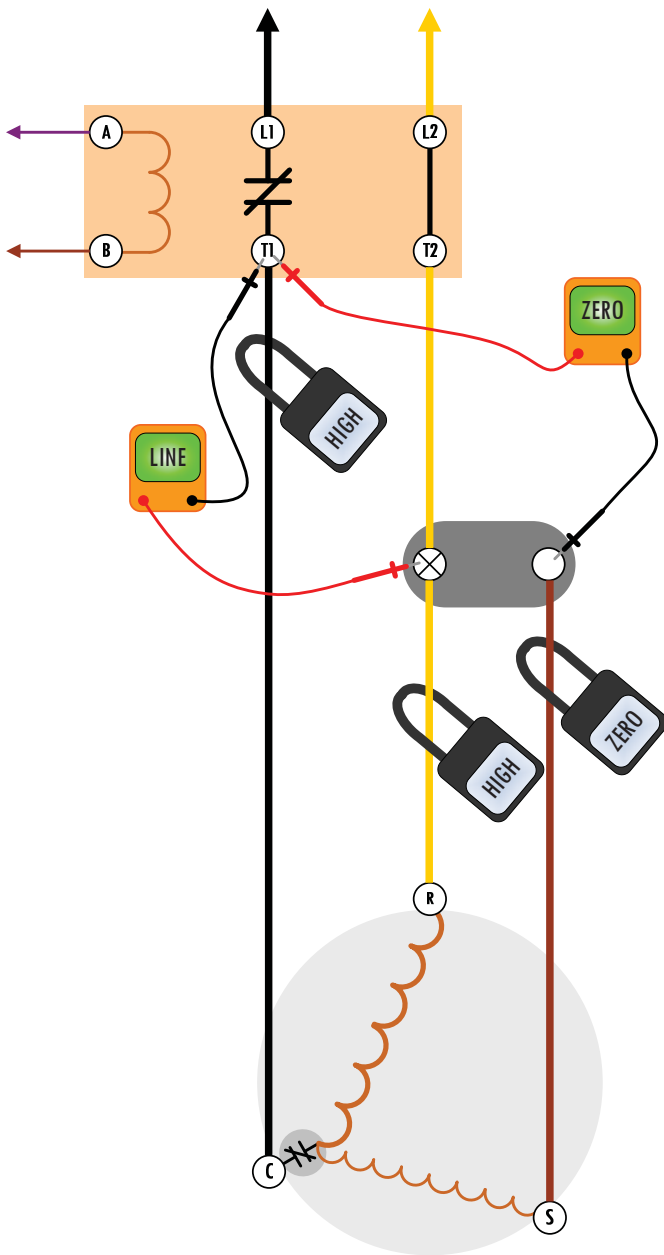


Figure 6-54

If line voltage is complete from contactor T1 to the incoming X-identified terminal of the capacitor, and the voltage from contactor T1 to the outgoing unidentified terminal of the capacitor is zero (or very low due to induced feedback from the start winding), then the capacitor is open.

The readings illustrated show an open capacitor. Along with the voltage readings, as described above, the current draw readings indicate the capacitor is open:

- motor Common: HIGH
- Run winding: HIGH
- Start winding: ZERO

With an open capacitor the PSC motor can not start on its own. If influences, such as wind blowing the fan blade, start the rotor turning, the PSC motor may run at reduced horsepower in either rotational direction. However, the increased current draw will shortly result in trips of the motor's internal thermal protector.

In many capacitor failure situations, there will be visible bulging or swelling of the capacitor's body. Often, the capacitor failure originates when voltage in excess of the nameplate maximum is applied to the circuit. Random, isolated cases of capacitor failures are usually attributed to "spikes" in voltage due to lightning storms. Chronic cases of capacitor failure may be attributed to excess voltage supplied to the building, which is the electric utility's or a qualified electrician's responsibility to correct.

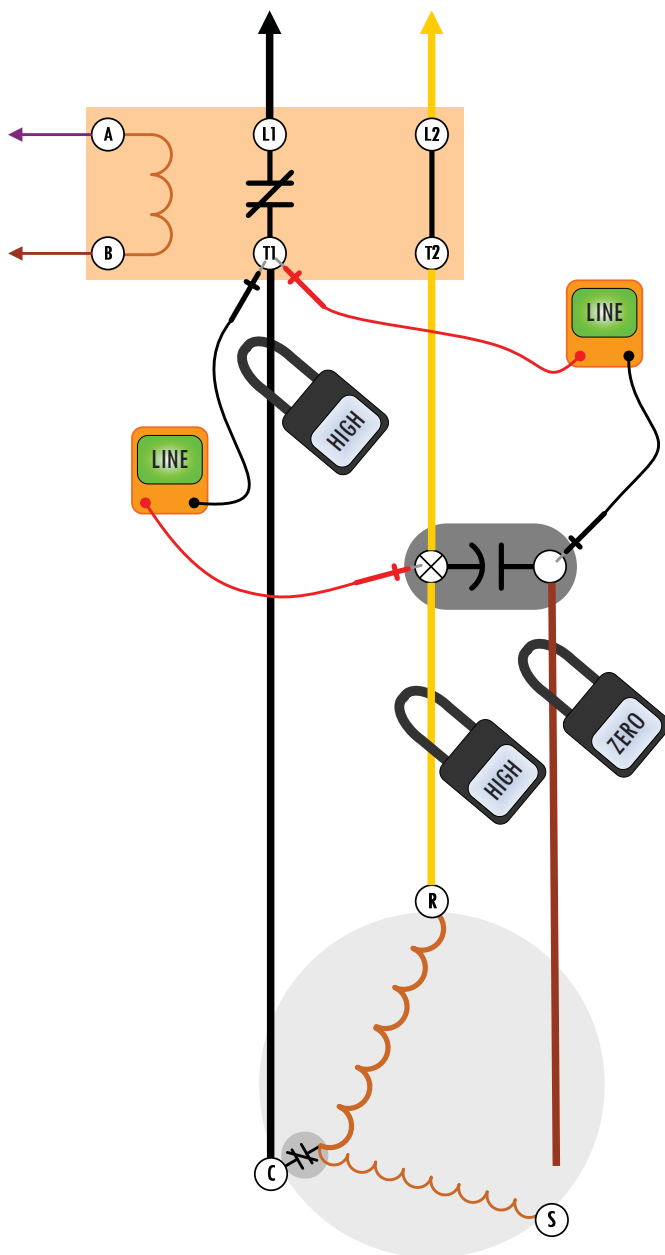


Figure 6-55

If the line voltage is complete from contactor T1 to the incoming X-identified terminal of the capacitor, and line voltage (not induced voltage) is read from contactor T1 to the outgoing unidentified terminal of the capacitor, and the current draw readings are:

- motor Common: HIGH
- Run winding: HIGH
- Start winding: ZERO

Then the circuit through the start winding is open. Either the connection to the outgoing unidentified terminal of the capacitor, the (brown) wire, the connection to the motor's S terminal, or the motor's start winding is open.

With an open start winding circuit the PSC motor can not start on its own. If influences, such as wind blowing the fan blade, start the rotor turning, the PSC motor may run at reduced horsepower in either rotational direction. However, the increased current draw will shortly result in trips of the motor's internal thermal protector.

The inspection, harness plug readings and motor continuity checks discussed in Figure 6-51 should be made to determine the point where the start winding circuit is open.

If the connections or wire is found to be open (illustrated), then re-termination/harness replacement will be needed for repair.

If the motor's start winding is open, it is likely due to either mechanical problems or a shorted capacitor. Motor replacement will be needed for repair, the capacitor should be checked for shorting, and the current draw of the replacement motor should be monitored.

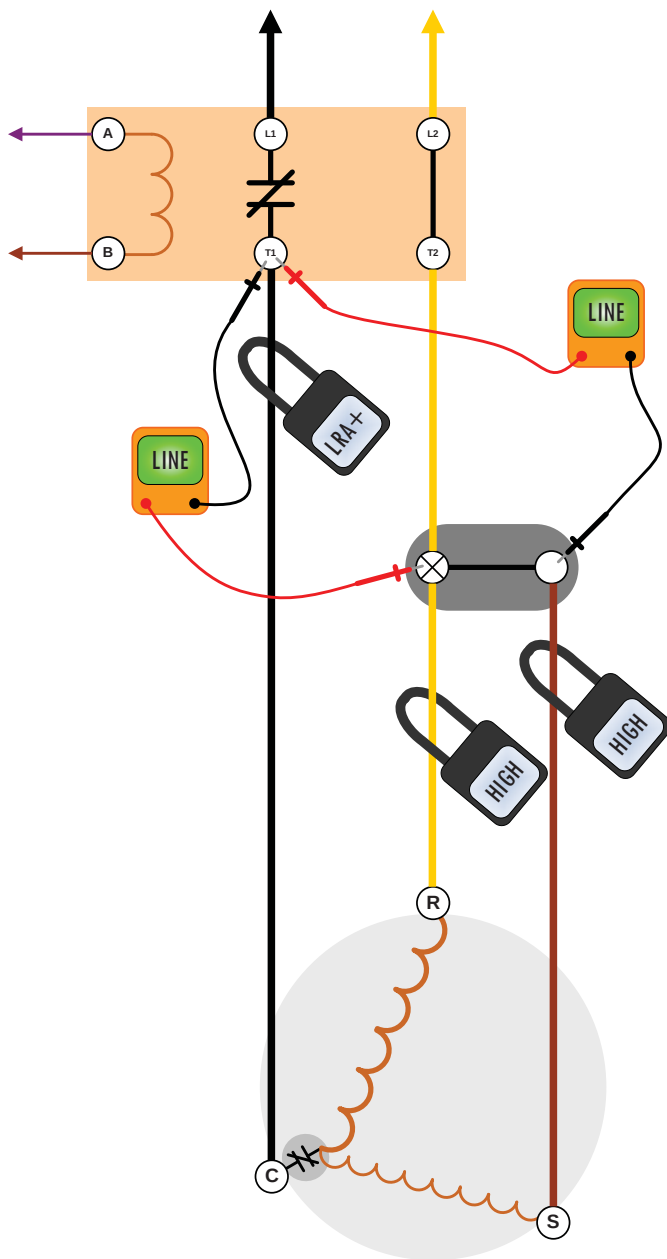


Figure 6-57

If line voltage is complete from contactor T1 to the incoming X-identified terminal of the capacitor, and line voltage (not induced voltage) is read from contactor T1 to the outgoing unidentified terminal of the capacitor, and the current draw readings are:

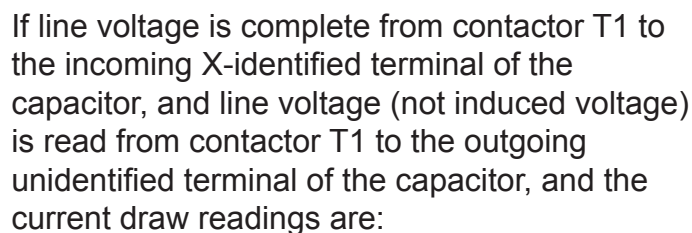
- motor Common: LRA+
- Run winding: HIGH
- Start winding: HIGH

Then either the capacitor or motor windings are shorted.

With either the the capacitor or motor windings shorted the PSC motor can not start on its own. If influences, such as wind blowing the fan blade, start the rotor turning, the PSC motor may run at reduced horsepower in either rotational direction. However, the increased current draw will shortly result in trips of the motor's internal thermal protector.

Continuity checks with an ohmmeter will be needed to determine whether the capacitor or motor windings are shorted.

If the capacitor is found to be shorted, there may also be visible bulging or swelling of the capacitor's body. Often, the capacitor failure originates when voltage in excess of the nameplate maximum is applied to the circuit. Random, isolated cases of capacitor failures are usually attributed to "spikes" in voltage due to lightning storms. Chronic cases of capacitor failures may be attributed to excess voltage supplied to the building, which is the electric utility's or a qualified electrician's responsibility to correct.

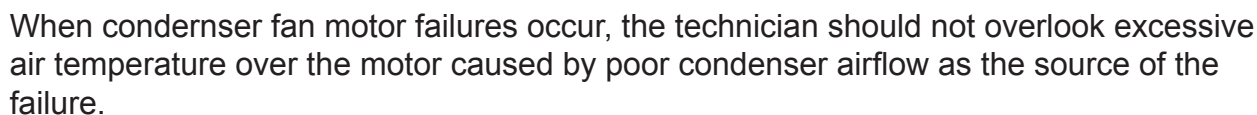


- Then the circuit through the motor is open.

If the readings listed above are measured, and the motor is cool, then one of the following conditions exists:

- The black wire connection to the motor's C terminal is open.
- Both the brown wire connection to the motor's S terminal, and the yellow wire connection to the motor's R terminal are open.
- Both motor windings are open.
- The internal thermal protector has failed.

The inspection of harness plug readings and motor continuity checks discussed in Figure 6-51 should be made to determine the point where the motor circuit is open. If the connections or wire is found to be open, then re-termination or harness replacement will be needed for repair.



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Refrigerant Circuit Troubleshooting

This section focuses on cooling operation. Heat pump heating mode and the reheat mode of reheat units are not specifically covered. The principles discussed in this section can be adapted to heat pump reverse-cycle operation in heating mode, and the condenser in the indoor airstream of a reheat unit.

Before beginning refrigerant circuit troubleshooting, assess and correct any maintenance-related items; ensure indoor airflow volume is in the proper range; and confirm that outdoor air, evaporator entering air dry bulb and wet bulb temperatures are within the limitations published for the unit. Valid information for refrigerant circuit troubleshooting can only be obtained if these conditions are correct.

Performance will be impacted if the refrigerant charge of the circuit is a few ounces too low or too high. The pressure taps should be accessed only when necessary, and low-loss gauge hoses used to prevent the refrigerant circuit from being undercharged. High-quality electronic leak detectors, capable of detecting R-410A at leak rates of 1/10 ounce per year, should be used when the refrigerant circuit is leak tested. Recovery, evacuation to 500 microns, and re-charging to the weight listed on the unit data plate is the primary method to ensure the circuit operates with an accurate refrigerant charge. A complete recharge by weight is the only approved method of “charge adjustment” for heat pump units in the heating mode or for cooling units in low ambient conditions.

Subcooling charge verification methods may be used when a complete recharge by weight is not practical, and conditions are within limitations that permit cooling operation.

Both subcooling and superheat measurements are significant to troubleshooting the refrigerant circuit. The range of conditions the unit may normally operate in will result in variations from the subcooling and superheat values listed in the Installation Manual. Abnormal subcooling and superheat values are indicators of deficiencies affecting the refrigerant circuit. Both acceptable and abnormal superheat and subcooling values for troubleshooting circumstances are detailed throughout this section.

Simplicity control boards protect the unit from damage due to major deficiencies affecting the refrigerant circuit. Refrigerant circuit troubleshooting and corrective actions based on the Simplicity board flash code indicators, and fault shutdown history are relatively straightforward since only gross system errors will cause the safety trips that trigger fault indication. The appendix table describes the conditions that initiate flash codes and action for correction.

More subtle deficiencies in the refrigerant circuit may not trip safeties, but are equally important since occupant comfort and the long-term reliability of the unit are adversely affected.

Measurements that assess the condition of the refrigerant circuit will be needed for troubleshooting:

- Suction pressure - indicates the evaporator saturation temperature.
- Suction line temperature - used to find the suction superheat.
- Discharge pressure - indicates the condenser saturation temperature.
- Liquid line temperature - used to find the liquid subcooling.
- Compressor current draw - indicates the loading (work) of the compressor.

- Discharge line temperature - indicates extremes of suction superheat (primarily used for heat pumps in the heating mode).

Two significant indicators that are calculated from these measurements:

Suction superheat

Calculated by subtracting the evaporator saturation temperature from the suction line temperature.

$$\text{Suction line temperature} - \text{Evaporator saturation temperature} = \text{Suction superheat}$$

Liquid subcooling

Calculated by subtracting the liquid line temperature from the condenser saturation temperature.

$$\text{Condenser saturation temperature} - \text{Liquid line temperature} = \text{Liquid subcooling}$$

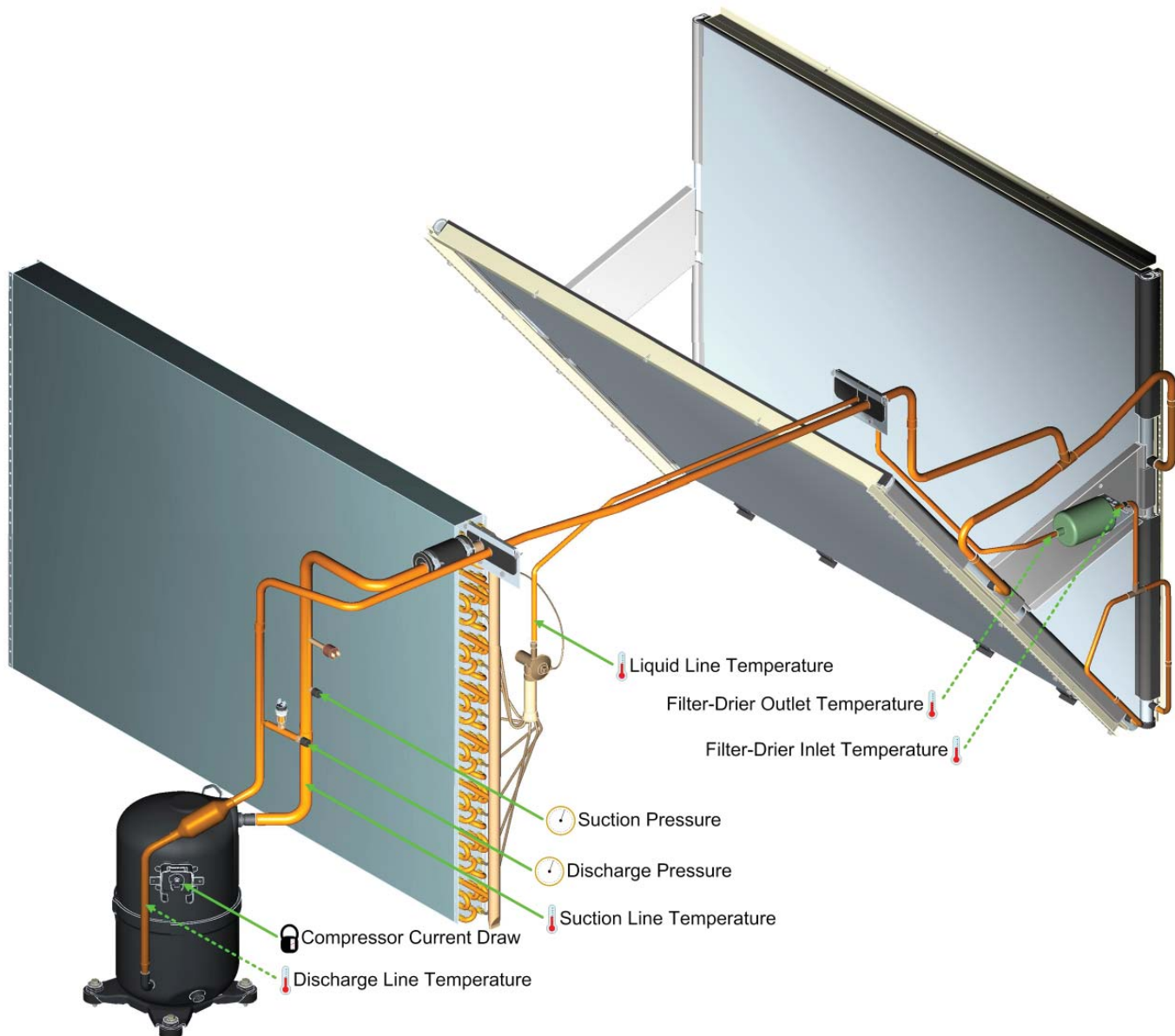


Figure 6-59 Refrigerant circuit troubleshooting measurements (general locations)

For best accuracy, these readings are taken after 10 minutes of compressor operation. “Normal” values for the above measurements and indicators change with the variations throughout the product line. Also, the dynamics of system operation produce change in the measurements and indicators. These readings should be considered when making a troubleshooting diagnosis.

Normal Measurements

While none of the measurements and indicators stand alone or are firmly fixed, some tendencies, limits and ranges can be expected as follows:

Suction pressure	Along with discharge pressure, this contributes to the loading of the compressor.
Evaporator saturation temperature	Extended operation below 32° F will cause evaporator icing and frezestat trips. Operation above 50° F results in little or no humidity removal.
Suction line temperature	Extended operation above 60° F can cause compressor overheating and motor protector trips.
Discharge pressure	Along with suction pressure, contributes to the loading of the compressor
Liquid line temperature	Should be at or above outdoor temperature. A restriction exists upstream if liquid line temperature is below outdoor temperature.
Compressor current draw	Operation below RLA can be expected for most unit loading conditions. Operation at RLA occurs at maximum unit loading conditions. RLA may be briefly exceeded following startup under high unit loading conditions. Extended operation above RLA will cause compressor overheating and motor protector trips.
Discharge line temperature	If above 250° F damage to the refrigeration oil will occur, and is an indicator of excessive suction superheat. If below 120° F it is an indicator of extremely low suction superheat.
Suction superheat	Typically, ranges from 5° to 15° F on units equipped with TXVs. A superheat of 0° F indicates imminent compressor damage due to liquid slugging. A superheat exceeding 25° F can cause compressor overheating and motor protector trips.
Liquid subcooling	Typically, ranges from 5° to 15° on units equipped with TXVs. A subcooling of 0° F indicates there is not completely liquid entering the metering device.

The rate of refrigerant flow through the circuit influences both suction superheat and liquid line subcooling. Variances in the discharge to suction pressure differential, which varies compressor pumping rates to a degree, and the opening of the metering device are factors that affect the refrigerant flow rate in the circuit. In regard to only refrigerant flow rates, it can be said that increased flow rates result in lower suction superheat and liquid line subcooling, and decreased flow rates result in greater suction superheat and liquid line subcooling.

The heat transfer done at the coils also influences suction superheat and liquid line subcooling. Specifically, the heat rejection of the condenser affects liquid subcooling, and the loading (indoor airflow volume and entering air wet bulb temperature) of the evaporator affects suction superheat. In regard to coil heat transfer, it can be said that increased heat transfer results in greater suction

superheat and liquid line subcooling, and decreased heat transfer results in lower suction superheat and liquid line subcooling.

In the dynamics of system operation, the rate of refrigerant flow and the heat transfer of the coils are factors that are not separable. Suction superheat and liquid line subcooling essentially summarize these factors. An understanding of the factors that influence suction superheat and liquid line subcooling is important to how this summarized information is used in troubleshooting diagnosis.

The relationship of the rate of refrigerant flow, and heat transfer of the coils with the resulting suction superheat and liquid line subcooling indications are most evident in refrigerant circuits with fixed orifice metering devices. The refrigerant flow rate of a circuit with a fixed orifice metering device is primarily determined by the discharge to suction pressure differential. The extremes of the normal operation range for the unit are the clearest examples of what suction superheat and liquid line subcooling indications can be expected:

- Operation under conditions of maximum outdoor temperature and minimal evaporator loading elevates the discharge to suction pressure differential. This increases the refrigerant flow rate, and lowers the heat transferred at the coils resulting in the lowest suction superheat and liquid line subcooling indicators.
- Operation under conditions of minimum outdoor temperature and maximum evaporator loading reduces the discharge to suction pressure differential. This reduces the refrigerant flow rate, the raises the heat transferred at the coils resulting in the highest suction superheat and liquid line subcooling indicators.

Suction superheat is the indicator for the fixed orifice charging because it is better defined, and more precise over the operating range of the unit. The superheat figures follow the relationship of the rate of refrigerant flow and the heat transfer of the coils. For a given evaporator entering air wet bulb temperature, as outdoor temperature increases, superheat decreases. For a given outdoor temperature, as evaporator entering air wet bulb temperature increases, superheat increases.

The relationship of the rate of refrigerant flow and the heat transfer of the coils with the resulting suction superheat and liquid line subcooling indications also applies to refrigerant circuits with thermal expansion valve metering devices. However, the refrigerant flow rate of the circuit is actively modulated by the TXV opening and closing to maintain the setting for suction superheat at the TXV bulb. This results in much smaller changes to suction superheat and liquid line subcooling indicators over the operating range of the unit than is seen with fixed orifice metering devices. The nominal 10°F subcooling value listed in the Installation Manuals should vary no more than $\pm 5^\circ\text{F}$ over the full operating range of the unit. The superheat setting of TXVs differs slightly from model to model and typically is 8 to 12°F. Superheat measured at the compressor suction line connection should read 5 to 15°F over the full operating range of the unit.

Guidelines related to TXVs and troubleshooting:

- TXVs require that the refrigerant entering the valve be completely liquid. TXV performance cannot be assessed when liquid line subcooling is zero degrees.
- TXVs require a true reading of suction line temperature to accurately maintain superheat. The TXV sensing bulb must make firm contact with the suction line and be insulated. Excessively low suction superheat leading to compressor damage will occur if the TXV sensing bulb is not making firm contact with the suction line. For units having two or more refrigerant circuits, confirm that the sensing bulb is placed on the suction line of the proper circuit.
- TXVs tend to “over-control” under most operating conditions. A TXV will continuously adjust the position it is open to maintain the suction superheat setting. Suction superheat and liquid line subcooling readings will normally be seen to oscillate slightly as the TXV modulates refrigerant flow in the circuit. When TXV “hunting” (more rapid opening and closing of the valve) occurs, suction superheat and liquid line subcooling will be seen to have greater oscillation. “Hunting” is typically not the fault of the TXV. This abnormal condition is primarily caused by excessively low evaporator loading, and will worsen if refrigerant flow rates are also low.
- TXVs can only open so far. If exposed to extremely high evaporator loading and high suction superheat, the TXV will be forced to its maximum open position. Under these conditions, the TXV will not modulate to maintain suction superheat. TXV performance cannot be assessed until the evaporator loading (indoor airflow volume and entering air wet bulb temperature) is within the limitations for the unit.

Refrigerant Circuit Deficiencies

The principles for understanding the tendencies and dynamics of system operation over the operating range of the unit also applies to troubleshooting deficiencies. Refrigerant circuit deficiencies can be categorized as follows:

Coil airflow

- Inadequate condenser airflow
- Inadequate evaporator airflow
- Excessive evaporator airflow

Refrigerant

- Undercharged
- Overcharged
- Non-condensibles

Restriction to refrigerant flow

Reduced compressor pumping capacity

Each deficiency is indicated by abnormalities in the following troubleshooting measurements:

- Suction pressure
- Suction line temperature
- Discharge pressure
- Liquid line temperature
- Compressor current draw
- Discharge line temperature
- Suction superheat
- Liquid subcooling

Coil Airflow

Inadequate Condenser Airflow

Indicator	Measurement	Notes
Discharge pressure	Elevated	
Liquid line temperature	Significantly above outdoor temperature	At higher ambient operation “significant” would be liquid line temperature more than 25° F above outdoor temperature.
Compressor current draw	Elevated	
Suction superheat	Reduced / no change	Lowered for circuits with fixed orifice metering devices if liquid line subcooling is present. Circuits with TXV metering devices will have little noticeable difference if liquid line subcooling is present.
Liquid subcooling	Reduced or zero	

Other indications:

- High pressure switch trips and lockouts.
- Elevated discharge air temperature from the condenser.
- Overheating of condenser fan motors. Motor thermal protection trips and bearing lubricant “cooked out” of motor. Compressor motor thermal protection trips and eventual compressor damage.

Inadequate condenser airflow and diminished heat transfer of the coil increases in severity as outdoor temperatures become warmer. Troubleshooting indications will also be more pronounced as outdoor temperatures become warmer.

Possible causes:

- Dirt fouling the condenser coil. Thoroughly clean the coil using a non-acid condenser coil detergent and adequately rinse with water.
- Inadequate clearance for condenser air intake or discharge.
- Condenser fan motor failure including failure of the associated wiring, capacitor, contactor and low ambient controls.
- Miss-positioned or improper condenser fan blade.

Inadequate Evaporator Airflow

Indicator	Measurement	Notes
Suction pressure	Reduced	Saturation temperature at or below 32° F.
Suction line temperature	Reduced	
Compressor current draw	Reduced	
Discharge line temperature	Reduced	
Suction superheat	Reduced or Zero	
Liquid subcooling	Elevated	Due to overall reduction in circuit heat transfer.

Other indications:

- Freezestat trips and lockouts.
- Low pressure switch trips and lockouts.
- Evaporator icing.
- Reduced supply air temperature.
- Liquid slugging of the compressor. Compressor damage is imminent.

Inadequate evaporator airflow, and diminished heat transfer of the coil increases in severity as evaporator coil loading lessens. Troubleshooting indications will also be more pronounced as evaporator coil loading lessens.

Possible causes:

- Dirt fouling of the air filters. Replace or clean as needed.
- Dirt fouling of the evaporator coil. Thoroughly clean using a non-acid evaporator coil detergent.
- Restriction of the duct system including inadequately sized or collapsed ducts, closed fire or balancing dampers.
- Improper blower setup. The blower wheel speed is adjusted too low.
- Blower belt loose or broken.
- Blower motor failure including failure of the associated wiring and contactor.
- Blower wheel dirty, misaligned or has failed.

Excessive Evaporator Airflow

Indicator	Measurement	Notes
Suction pressure	Elevated	Saturation temperature above 50° F.
Suction line temperature	Elevated	Exceeds 60° F.
Compressor current draw	Elevated	
Discharge line temperature	Elevated	
Suction superheat	Elevated	
Liquid subcooling	Reduced	Due to overall increase in circuit heat transfer.

Other indications:

- Little or no humidity removal or condensate.
- Increased supply air temperature.
- Blower motor thermal protection trips.
- Overheating of the compressor. Compressor motor thermal protection trips, and eventual compressor damage.

Excessive evaporator airflow and increased heat transfer of the coil increases in severity as evaporator coil loading increases.

Troubleshooting indications will also be more pronounced as evaporator coil loading increases.

Possible causes:

- Improper blower setup. The blower wheel speed is adjusted too high.
- Improper setup of fresh air accessories.
- Ductwork that has broken open.

Refrigerant Charge

Undercharged

Indicator	Measurement	Notes
Suction pressure	Reduced	
Suction line temperature	Elevated	
Discharge pressure	Reduced	
Liquid line temperature	Reduced	At or near outdoor ambient temperature.
Compressor current draw	Reduced	
Discharge line temperature	Elevated	
Suction superheat	Elevated	
Liquid subcooling	Reduced	At or near zero.

Other indications:

- Little or no humidity removal or condensate.
- Increased supply air temperature.
- Low pressure switch trips.
- Partial evaporator icing with eventual freezestat trips after longer run times.
- Overheating of the compressor. Compressor motor thermal protection trips, and eventual compressor damage.

Troubleshooting indications will be more pronounced as the severity of the undercharge increases.

Possible causes:

- Refrigerant leak. Identify location of leak with electronic detector.
- Service practices. Improper or excessive attachment of gauge set to pressure taps, and omission or poor sealing of pressure tap caps.

Overcharged

Indicator	Measurement	Notes
Suction pressure	Slightly Elevated	
Suction line temperature	Reduced	
Discharge pressure	Slightly Elevated	
Liquid line temperature	Reduced	At or near outdoor ambient temperature.
Compressor current draw	Slightly Elevated	
Discharge line temperature	Reduced	
Suction superheat	Reduced or Zero	
Liquid subcooling	Elevated	Exceeds 15° F on circuits with TXV.

Other indications:

- Little or no humidity removal or condensate.
- Increased supply air temperature.
- High pressure switch trips and lockouts if severely overcharged.
- Slugging of the compressor. Compressor damage is imminent.

Troubleshooting indications will be more pronounced as the severity of the overcharge increases, and outdoor temperature increases. Key indicators are suction superheat and liquid subcooling; suction and discharge pressure will not noticeably increase until the refrigerant storage capacity of the coils is exceeded.

Possible causes:

- Service practices. Review indoor airflow volume. Overcharging is often done in an attempt to compensate for inadequate indoor airflow.

Non-Condensibles

Indicator	Measurement	Notes
Suction pressure	Normal or Reduced	
Suction line temperature	Elevated	
Discharge pressure	Elevated	
Liquid line temperature	Reduced	At or near outdoor ambient temperature
Compressor current draw	Elevated	
Discharge line temperature	Elevated	
Suction superheat	Elevated	
Liquid subcooling	Elevated	

Other indications:

- Little or no humidity removal or condensate.
- Increased supply air temperature.
- Partial evaporator icing and eventual freezestat trips after longer run times.
- High pressure switch trips and lockouts if severe condition exists.
- Overheating of the compressor. Compressor motor thermal protection trips, and eventual compressor damage.

Troubleshooting indications will be more pronounced as the severity of the non-condensibles increases and outdoor temperature increases. Non-condensibles tend to “settle” in the condenser, reducing coil heat transfer and artificially increasing discharge pressure while the rest of the circuit is effectively undercharged.

Possible causes:

- Service practices. Air, water vapor, nitrogen, etc. left in the circuit from improper evacuation.

Restriction to Refrigerant Flow

Indicator	Measurement	Notes
Suction pressure	Reduced	
Suction line temperature	Elevated	
Discharge pressure	Briefly Elevated	Immediately following compressor start, saturation temperature at or near outdoor ambient temperature afterwards.
Liquid line temperature	---	At or near outdoor ambient temperature at points upstream of the restriction, lower than outdoor ambient temperature at points downstream of the restriction.
Compressor current draw	Briefly Elevated	Immediately following compressor start, lowered afterwards.
Discharge line temperature	Elevated	
Suction superheat	Elevated	
Liquid subcooling	Elevated	

Other indications:

- Little or no humidity removal or condensate.
- Increased supply air temperature.
- Partial evaporator icing and eventual freezestat trips after longer run times.
- Overheating of the compressor. Compressor motor thermal protection trips, and eventual compressor damage.

Restriction to refrigerant flow is most likely to be in the liquid line components: the tubing of the liquid line, filter-drier or metering device. Liquid line temperature should drop no more than 3°F from condenser outlet to the metering device inlet. No more than 2°F drop should be measured from inlet to outlet of the filter-drier. Clogging of the metering device inlet screen, loss of the TXV bulb charge or the TXV failing to open all result in troubleshooting indicators for restricted refrigerant flow with no significant temperature drop from condenser outlet to metering device inlet.

Possible causes:

- Service practices. Clogging of the components from particulates left in the circuit from poor cleanliness, and water vapor left in the circuit from improper evacuation.
- Clogging of the filter-drier.

- Compressor damage. Clogging of the components from particulates in the circuit due to mechanical or electrical damage to the compressor.
- TXV failure. Loss of bulb charge from sensing line breakage, overheating of the TXV due to torch-work in the vicinity.

Reduced Compressor Pumping Capacity

Indicator	Measurement	Notes
Suction pressure	Elevated	
Suction line temperature	Elevated	
Discharge pressure	Reduced	
Liquid line temperature	Reduced	At or near outdoor ambient temperature.
Compressor current draw	Elevated / Reduced	Elevated if internal pressure relief is triggered, reduced if scroll reverse rotation, reduced if the pumping unit is damaged, elevated if compressor bearings are also damaged.
Discharge line temperature	Elevated	
Suction superheat	Elevated	
Liquid subcooling	Elevated	

Other indications:

- Little or no humidity removal or condensate.
- Increased supply air temperature.
- Overheating of the compressor. Compressor motor thermal protection trips.
- Unusual compressor noise. Mechanical clatter or gas bypass within the compressor.

Reduced compressor pumping capacity does not always indicate the compressor has failed, and is a secondary result of other refrigerant circuit deficiencies. In cases of reverse scroll rotation or triggering of the internal pressure relief, the compressor will remain functional if timely corrections are made to the system. Liquid slugging should be suspected if the pumping unit is damaged (the scroll or reciprocating valves are broken), the compressor has seized or otherwise failed. The other refrigerant circuit deficiencies may not be evident until the failed compressor has been replaced. Care must then be taken to examine the troubleshooting indicators, particularly indoor airflow and suction superheat, to prevent repeat failures.

Possible causes:

- All those listed under other refrigerant circuit deficiencies.

Appendix

Replacement Matrix

Air Conditioning with Natural Gas Heating	
Unit to be Replaced	New Unitary Products Unit
Bryant	
580J 04-14	ZXG 04-14
581J 04-12	ZYG 04-12
581C 036-060	ZYG 04-12
581B 036-150	ZXG 04-14
580F 036-151	ZXG 04-14
580C 036-150	ZXG 04-14
580D 036-150	ZXG 04-14
581A 090-150	ZXG 04-14
ICP Commercial	
RGS036-150	ZXG 04-14
RGH036-150	ZYG 04-12
PGE036-150	ZXG04-14
PGH036-150	ZXG 04-14
PGS036-150	ZXG 04-14
Carrier	
48TC 04-14	ZXG 04-14
48HC 04-12	ZYG 04-12
48HE 04-06	ZYG 04-12
48HJ 04-14	ZXG 04-14
48TM 04-14	ZXG 04-14
48TF 04-14	ZXG 04-14
48TJ 04-14	ZXG 04-14
48DJ 04-14	ZXG 04-14
48LJ 04-14	ZXG 04-14
48GJ 06-12	ZXG 06-12
48HM 07	ZXG 07

Air Conditioning with Electric Heat

Unit to be Replaced	New Unitary Products Unit
Bryant	
558J 04-14	ZXE 04-14
551J 04-12	ZYE 04-12
551C 036-060	ZYE 04-12
551B 036-150	ZXE 04-14
558F 036-151	ZXE 04-14
558C 036-150	ZXE 04-14
558D 036-150	ZXE 04-14
551A 090-150	ZXE 04-14
ICP Commercial	
RAS036-150	ZXE 04-14
RAH036-150	ZYE 04-12
PAE036-150	ZXE 04-14
PAH036-150	ZXE 04-14
PAS036-150	ZXE 04-14
Carrier	
50TC 04-14	ZXE 04-14
50HC 04-12	ZYE 04-12
50HE 04-06	ZYE 04-12
50HJ 04-14	ZXE 04-14
50TM 04-14	ZXE 04-14
50TF 04-14	ZXE 04-14
50TJ 04-14	ZXE 04-14
50DJ 04-14	ZXE 04-14
50LJ 04-14	ZXE 04-14
50GJ 06-12	ZXE 06-12
50HM 07	ZXE 07

Simplicity SE UCB Details

Directional orientation: viewed with silkscreen labels upright		
Limit, 24 VAC power and shutdown connections from unit wiring harness at left on upper edge of UCB		
Terminal	Description	Function & Comments
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
Thermostat connection strip on left edge of UCB		
Terminal	Description	Function & Comments
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 #CigStgs parameter is set for 2 or more, also effective for economizer free cooling supply air temperature reset when the #CigStgs 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	
LEDs on left edge of UCB		
LED	Description	Function & Comments
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
Space temperature sensor connections at center on upper edge of UCB		
Terminal	Description	Function & Comments
ST	Space Temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Positive of VDC circuit (3.625 VDC reading to COM with open circuit), effective if "Thermostat-only Control" parameter is set OFF, space sensor override momentary shorts ST to COM to initiate/terminate temporary occupancy
COM	COMMON for ST and SSO inputs	Negative of VDC circuit for ST and SSO inputs
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
Temperature sensor connections at right on upper edge of UCB		
Pin	Description	Function & Comments
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.
SAT-		
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.
RAT-		

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.
OAT–		
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.
CC1–		
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.
EC1–		
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.
CC2–		
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.
EC2–		
Pinned connections on right edge of UCB		
Pin	Description	Function & Comments
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.
RAH–		
DCT PRS+	Supply DuCT PRessure input from 0-10 VDC @ 0-5" w.c. sensor	Input required for variable air volume units. Used in VAV indoor blower operation.
DCT PRS–		
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

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
Terminal		Terminal at lower right corner of UCB
24V FOR OUTPUTS		Function & Comments
	Description	
	24 VAC hot for H1, H2, CN-FAN, AUX HGR, FAN C1 and C2 output relay contact switching	Output relay circuitry is isolated from other UCB components and the 24 VAC hot source may be from a second transformer in the unit
Pin		Function & Comments
H1		Heat section connections at right on lower edge of UCB
	Description	
	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
	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 Miswire" alarm
Pin		Function & Comments
CN-FAN		Cooling and fan output connections at right on lower edge of UCB
	Description	
	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
Refrigerant circuit safety switch and indoor blower overload connections at center on lower edge of UCB		
Pin	Description	Function & Comments
HPS1 (right pin)	24 VAC hot out for refrigerant circuit 1 High Pressure Switch	Connects through circuit trace to the R terminal
HPS1 (left pin)	24 VAC hot return from refrigerant circuit 1 High Pressure Switch	Input is only considered if C1 output is needed; input must be present to allow C1 output. Three HPS1 trips in a two hour period cause a "High Pressure Switch 1 Lockout" and C1 output is then prevented until alarm reset. Connects through circuit trace to the right LPS1 pin.
LPS1 (right pin)	24 VAC hot out for refrigerant circuit 1 Low Pressure Switch	Connects through circuit trace to the left HSP1 pin
LPS1 (left pin)	24 VAC hot return from refrigerant circuit 1 Low Pressure Switch	Input is only considered after 30 seconds of C1 output; afterwards, input must be present to allow C1 output. Three LPS1 trips in a one hour period cause a "Low Pressure Switch 1 Lockout" and C1 output is then prevented until alarm reset.
HPS2 (right pin)	24 VAC hot out for refrigerant circuit 2 High Pressure Switch	Not effective for one stage compressor UCBs. Connects through circuit trace to the R terminal
HPS2 (left pin)	24 VAC hot return from refrigerant circuit 2 High Pressure Switch	Not effective for one stage compressor UCBs. Input is only considered if C2 output is needed; input must be present to allow C1 output. Three HPS2 trips in a two hour period cause a "High Pressure Switch 1 Lockout" and C2 output is then prevented until alarm reset. Connects through circuit trace to the right LPS2 pin.
LPS2 (right pin)	24 VAC hot out for refrigerant circuit 2 Low Pressure Switch	Not effective for one stage compressor UCBs. Connects through circuit trace to the left HSP2 pin
LPS2 (left pin)	24 VAC hot return from refrigerant circuit 2 Low Pressure Switch	Not effective for one stage compressor UCBs. Input is only considered after 30 seconds of C2 output; afterwards, input must be present to allow C2 output. Three LPS2 trips in a one hour period cause a "Low Pressure Switch 2 Lockout" and C2 output is then prevented until alarm reset.
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.

SA BUS connections on at left on lower edge and center of UCB		
Terminal	Description	Function & Comments
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 MultiTouch 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 MultiTouch 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 MultiTouch gateway
J8	6-pin phone jack connector	Incorporates the SA BUS terminals for convenience/alternate connection of SA BUS devices, primarily used for temporary service connection of the MultiTouch gateway
Integrated user interface at lower left corner of UCB		
Item	Description	Function & Comments
Display	On-board, 2-line x 8-character backlit display	On-board display, buttons and joystick allow access to UCB, economizer, 4-stage and FDD board parameters
ENTER	Button for display menu acknowledgement and navigation	
CANCEL	Button for display menu navigation and zeroing of active compressor ASCD timer	
JOY	4-way JOYstick for display menu navigation	
USB connector at right of UCB		
Item	Description	Function & Comments
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

Optional communication sub-board at center of UCB		
FC BUS connections on left edge of the communication board		
Terminal	Description	Function & Comments
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
Selector in red housing at left on top edge of the communication board		
Item	Description	Function & Comments
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"
LEDs on the communication board		
LED	Description	Function & Comments
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
ISO PWR	Green communication board ISOlated PoWeR indicator	Lit indicates the UCB is supplying power to the communication sub-board

Simplicity SE Economizer Board Details

Directional orientation: viewed with the center text of the cover label upright				
ANALOG INPUTS at left on upper edge of economizer board				
Terminal		Cover label	Description	Function & Comments
Board Silkscreen				
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 ECOmizer actuator position FeedBack	EconDampPos parameter reports input status (0-100%). Used to meet Cali. 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	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		
LEDs at left on upper edge of economizer board				
Terminal		Cover label	Description	Function & Comments
Board Silkscreen				
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
SA BUS connections at left on upper edge of economizer board				
Pin		Cover label	Description	Function & Comments
Board Silkscreen				
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
ANALOG OUTPUTS at center on upper edge of economizer board			
Board Silkscreen	Pin	Description	Function & Comments
	Cover label		
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

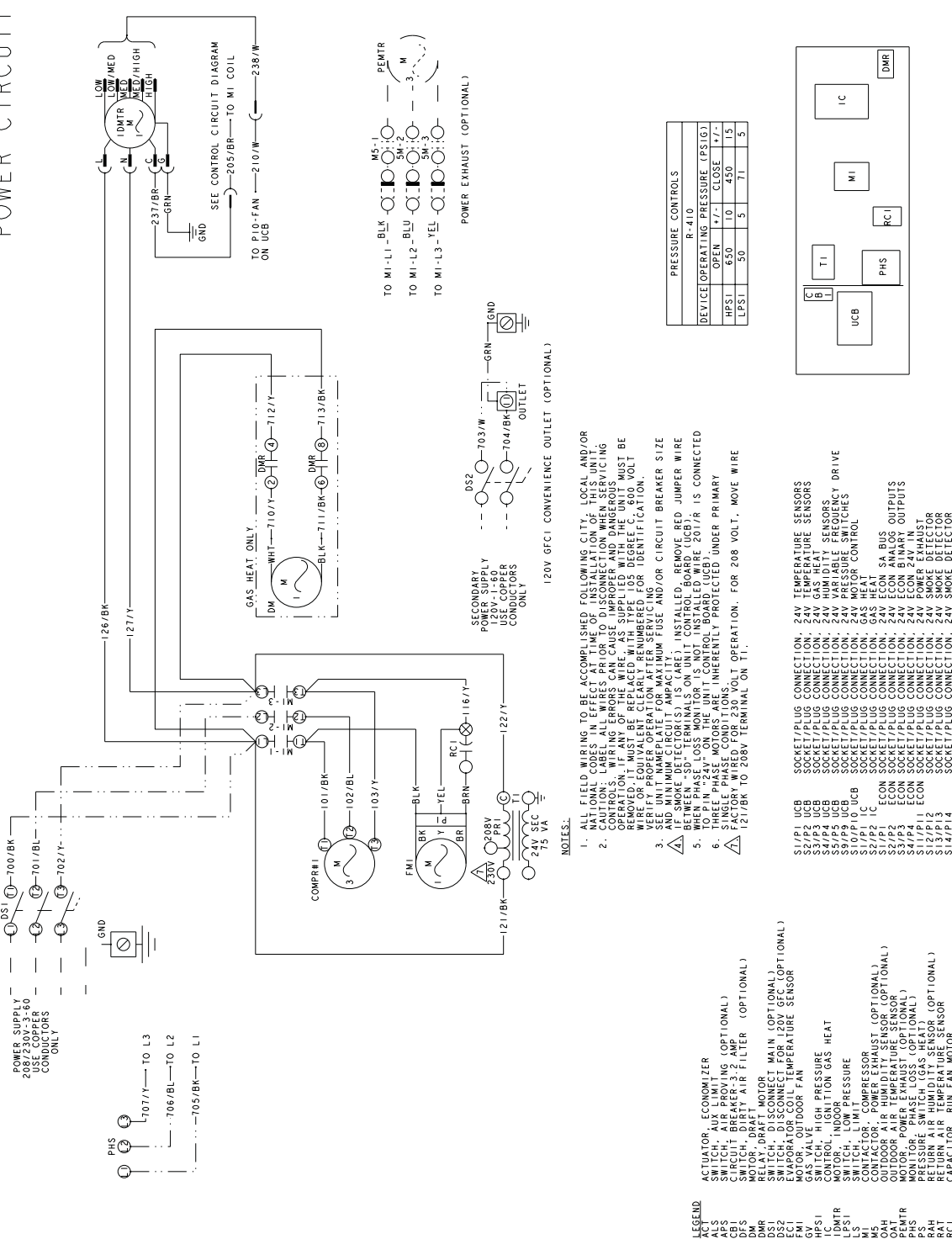
BINARY OUTPUTS at right on upper edge of economizer board				
Pin		Description	Function & Comments	
Board Silkscreen	Cover label			
J3	24V~	24 VAC hot supplied for an incremental (floating control) economizer actuator	Connects through circuit trace to 24V~ IN pin HOT	
	ACT-A	24 VAC hot outputs to position an incremental (floating control) economizer actuator	Unused in current control revision	
	ACT-B			
	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	
24V~ IN connections at right on upper edge of economizer board				
Pin		Description	Function & Comments	
Board Silkscreen	Cover label			
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.	
ANALOG INPUTS on lower edge of economizer board				
Terminal		Description	Function & Comments	
Board Silkscreen	Cover label			
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.	

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	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	OAH	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

BINARY INPUTS at right on lower edge of economizer board				
Terminal		Cover label	Description	Function & Comments
Board Silkscreen				
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

Typical ZX/ZY04-06 Cooling Unit w/wo Gas Heat 208/230-1-60 Direct Drive Elementary Diagram Power Circuit



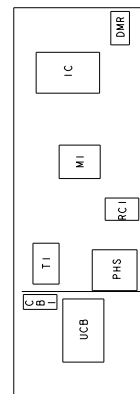


CAUTION - OPEN ALL DISCONNECTS
BEFORE SERVICING THIS UNIT
G1050427A REV B

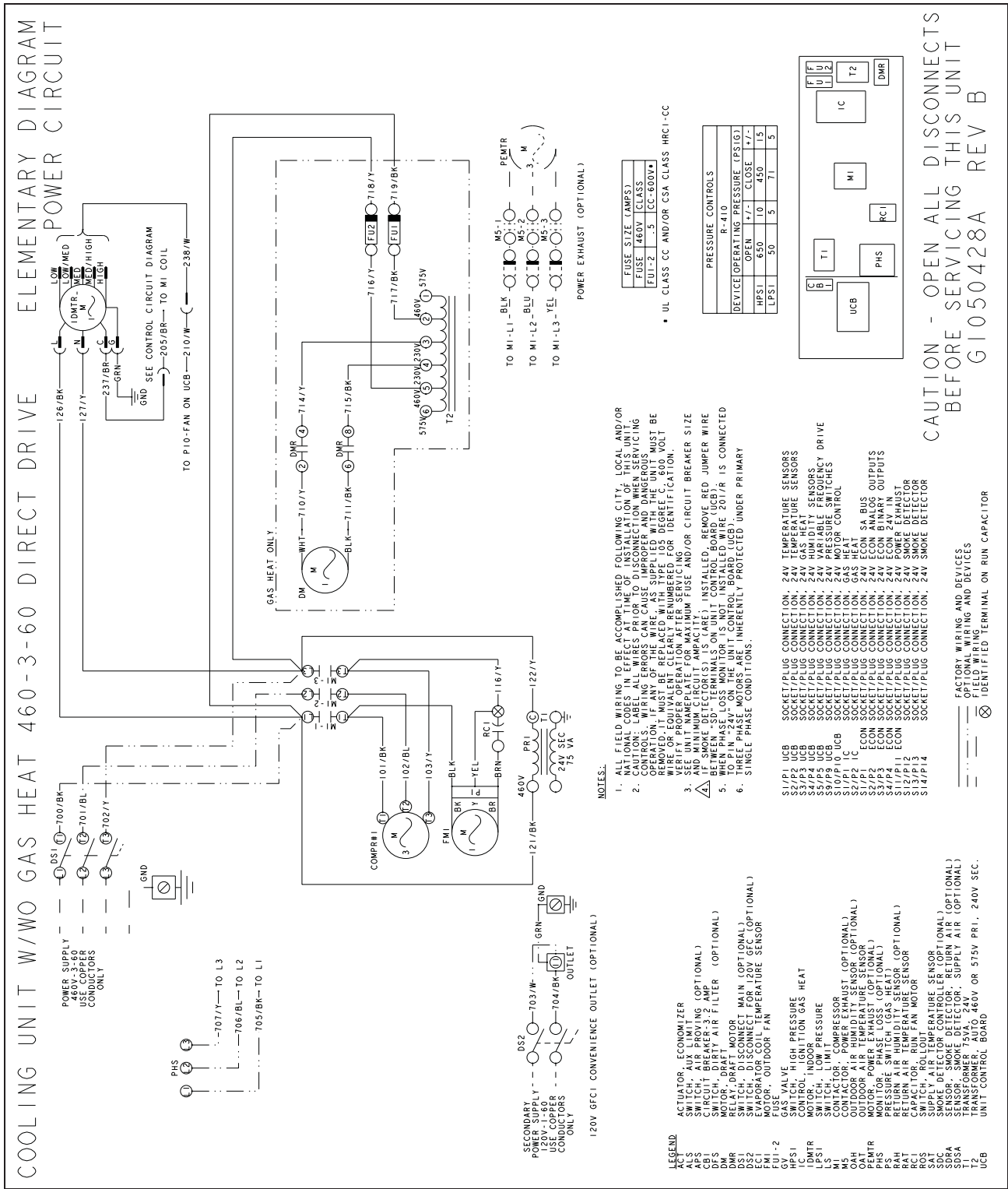
—	—	FACTORY WIRING AND DEVICES
—	—	OPTIONAL WIRING AND DEVICES
—	—	FIELD WIRING
—	—	IDENTIFIED TERMINAL ON RUN CAPACITOR

SUPPLY AIR TEMPERATURE SENSOR (OPTIONAL)
SMOKE DETECTOR CONTROLLER (OPTIONAL)
SENSOR, SMOKE DETECTOR, RETURN AIR (OPTIONAL)
SENSOR, SMOKE DETECTOR, SUPPLY AIR (OPTIONAL)
TRANSFORMER 75VA, 24V
UNIT CONTROL BOARD

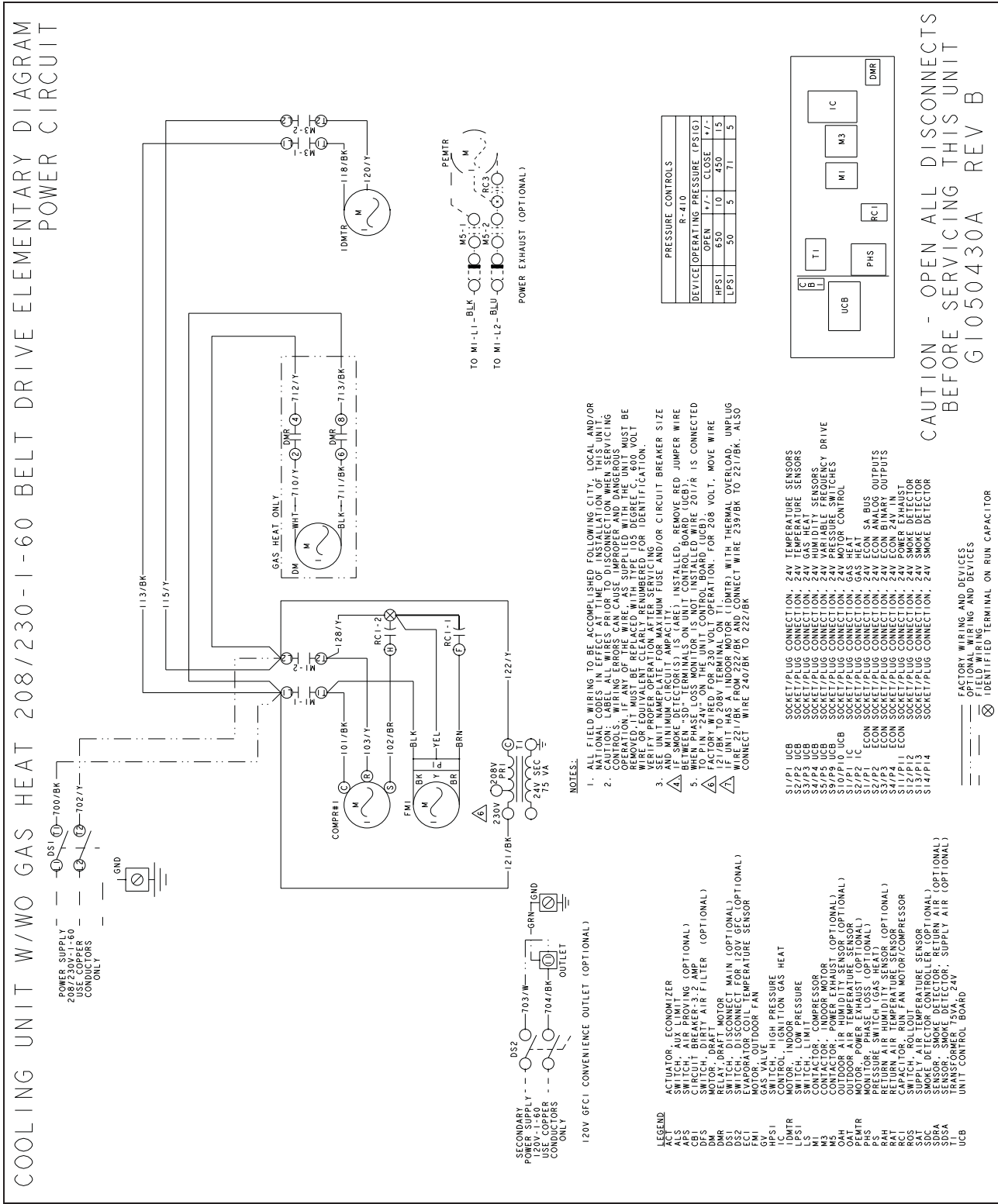
PRESSURE CONTROLS			
R-410			
DEVICE	OPERATING PRESSURE (PSIG)	+/-	CLOSE +/-
HPSI	650	10	450
PSI	50	5	21



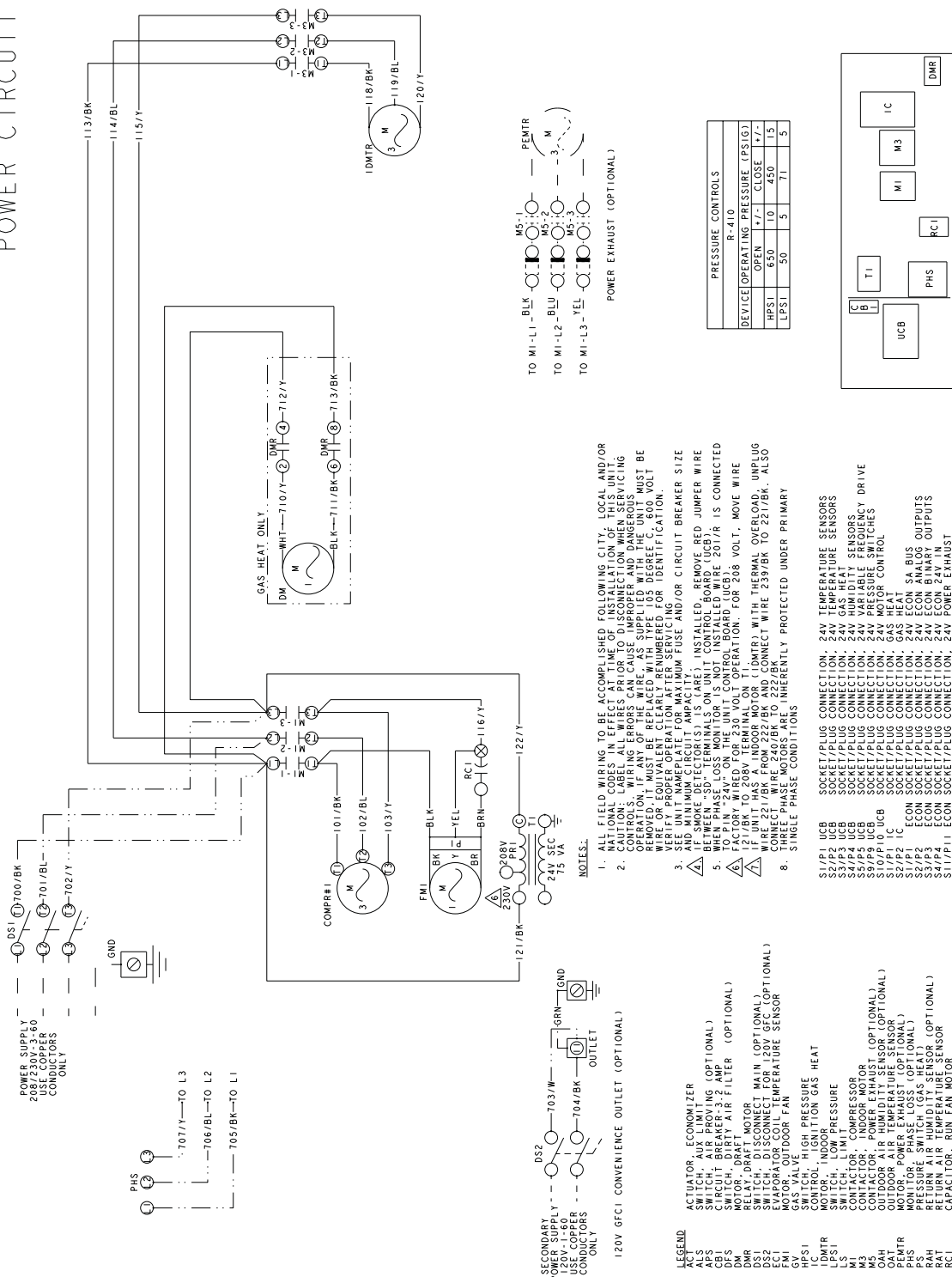
Typical ZX/ZY04-06 Cooling Unit w/wo Gas Heat 460-3-60 Direct Drive Elementary Diagram Power Circuit



Typical ZX/ZY04-06 Cooling Unit w/wo Gas Heat 208/230-1-60 Belt Drive Elementary Diagram Power Circuit



COOLING UNIT W/WO GAS HEAT 208/230-3-60 BELT DRIVE ELEMENTARY DIAGRAM
POWER CIRCUIT

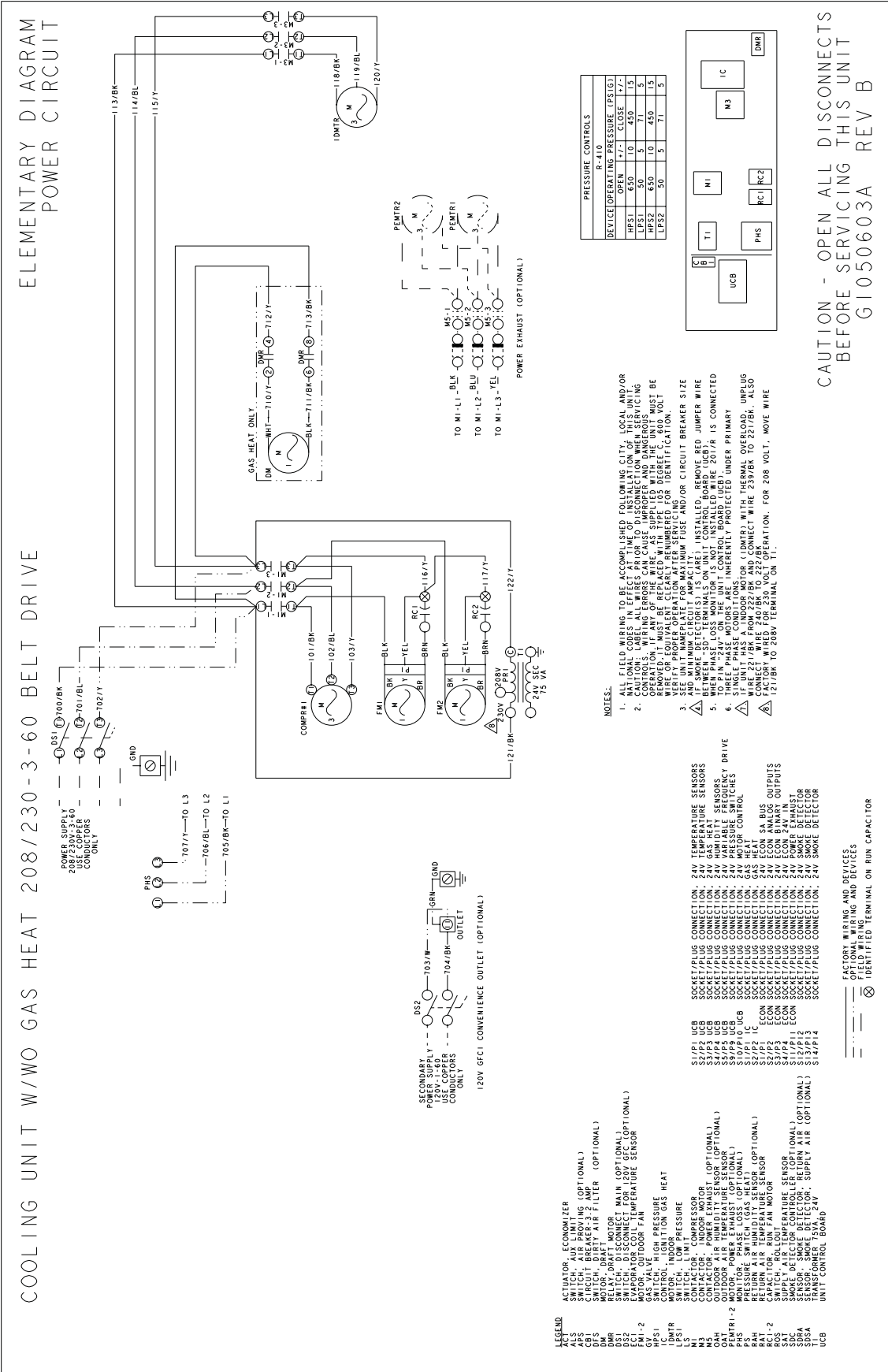


CAUTION - OPEN ALL DISCONNECTS
BEFORE SERVICING THIS UNIT
G1050601A REV B

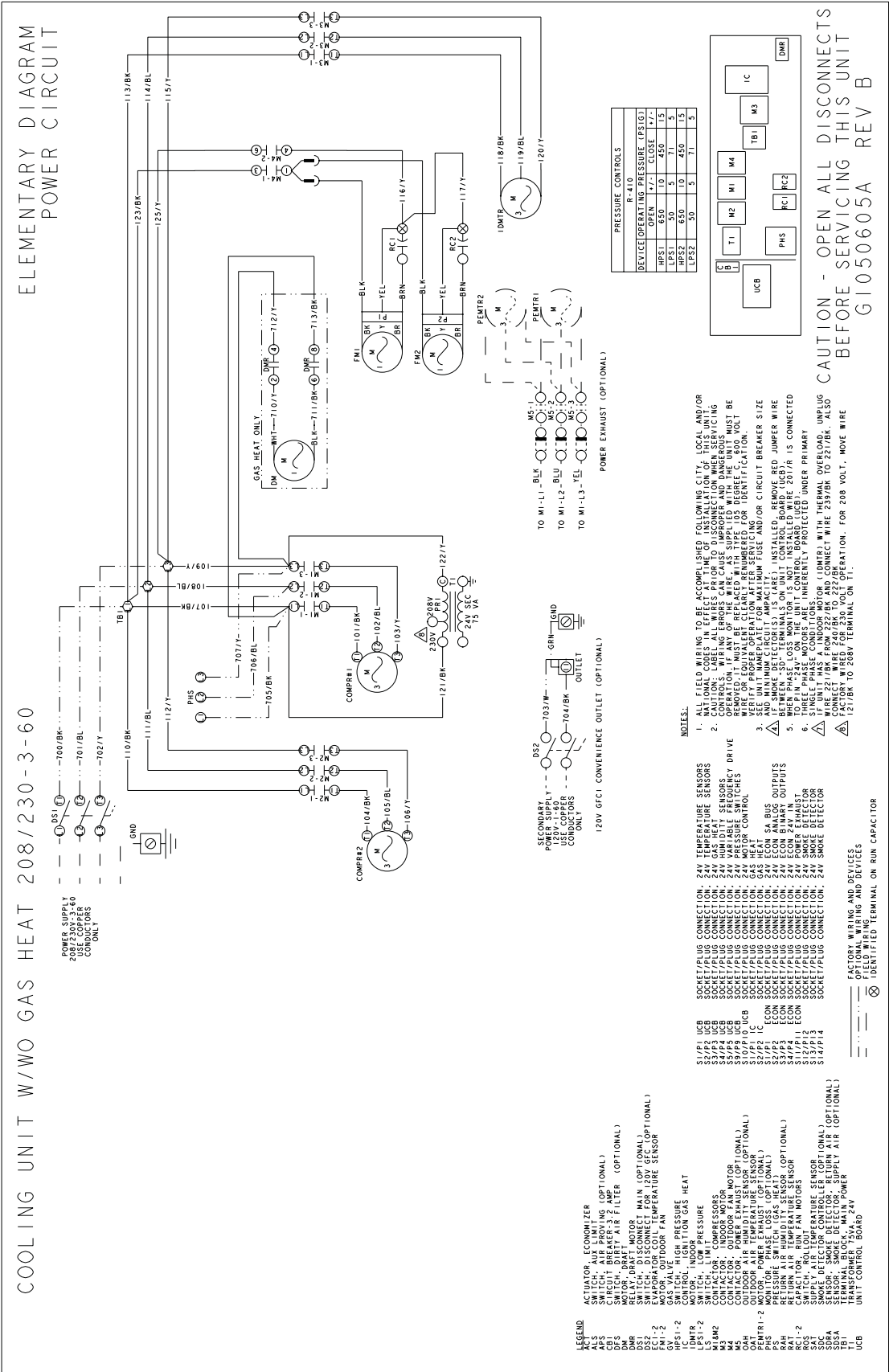
—	FACTORY WIRING AND DEVICES
—	OPTIONAL WIRING AND DEVICES
—	FIELD WIRING

OPTIONAL WIRING AND DEVICES
FIELD WIRING

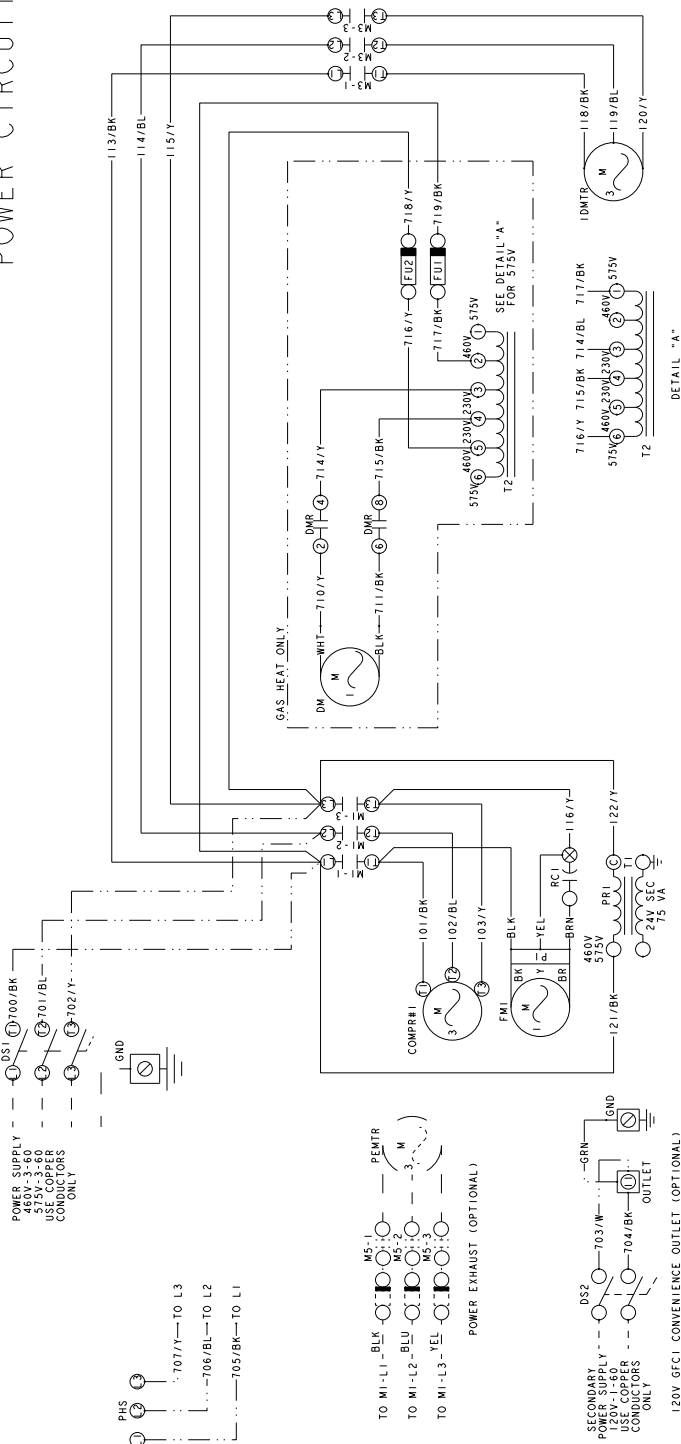
Typical ZX09/ZY07 Cooling Unit w/wo Gas Heat 208/230-3-60 Belt Drive Elementary Diagram Power Circuit



Typical ZX12/ZY08, 09 Cooling Unit w/wo Gas Heat 208/230-3-60 Belt Drive Elementary Diagram Power Circuit



COOLING UNIT W/WO GAS HEAT 460/575-3-60 BELT DRIVE ELEMENTARY POWER CIRCUIT DIAGRAM

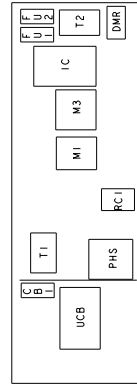


FUSE SIZE (AMPS)	
FUSE	460V 575V CLASS
FUI-2	.5 .5 CC-600V*

101	2	.5	.5	CC 0001
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• UL CLASS CC AND/OR CSA CLASS HRC1-CC

PRESSURE CONTROLS				
R-4110				
DEVICE	OPERATING PRESSURE (PSIG)	+/-	CLOSE	+/-
HPSI	650	10	450	15
IPSI	50	5	71	5



CAUTION - OPEN ALL DISCONNECTS
BEFORE SERVICING THIS UNIT
G1050602A REV B

NOTES:

1. ALL GROUND WIRING TO BE ACCOMPLISHED FOLLOWING CITY, LOCAL AND/OR NATIONAL ELECTRICAL CODES.
2. CAUTION: LABEL ALL WIRES PRIOR TO DISCONNECTION WHEN SERVICING CONTROLS. WIRING ERRORS CAN CAUSE IMPROPER AND DANGEROUS WIRE REMOVAL. IT MUST BE REPLACED WITH TYPE 105 DEGREE C, 600 VOLT WIRE OF EQUIVALENT CLEARLY RENUMBERED FOR IDENTIFICATION.
3. SEE UNIT NAMEPLATE FOR MAXIMUM FUSE AND/OR CIRCUIT BREAKER SIZE AND MINIMUM CIRCUIT CAPACITY.
4. WHEN THE ELECTRICAL SYSTEM IS SHUT IN, NOTCHED REMOVE RED JUMPER WIRE BETWEEN PHASE LOSS MONITOR AND NOT INSTALLED WIRE 201/R IS CONNECTED TO PHASE LOSS MONITOR (NOT INSTALLED WIRE 201/R CONNECTED TO PHASE LOSS MONITOR ON THE UNIT CONTROL BOARD, UCB).
5. SINGLE PHASE MONITORING IS CURRENTLY PROTECTED UNDER PRIMARY.
6. SINGLE PHASE CONDITIONS.
7. IF UNIT HAS A 1000V MOTOR (1 DMTR) WITH THERMAL OVERLOAD, UNPLUG CONNECT WIRE 240/167 TO 222/168.

[illegible]

— FACTORY WIRING AND DEVICES
— OPTIONAL WIRING AND DEVICES
— FIELD WIRING
— ⊗ IDENTIFIED TERMINAL ON RUN

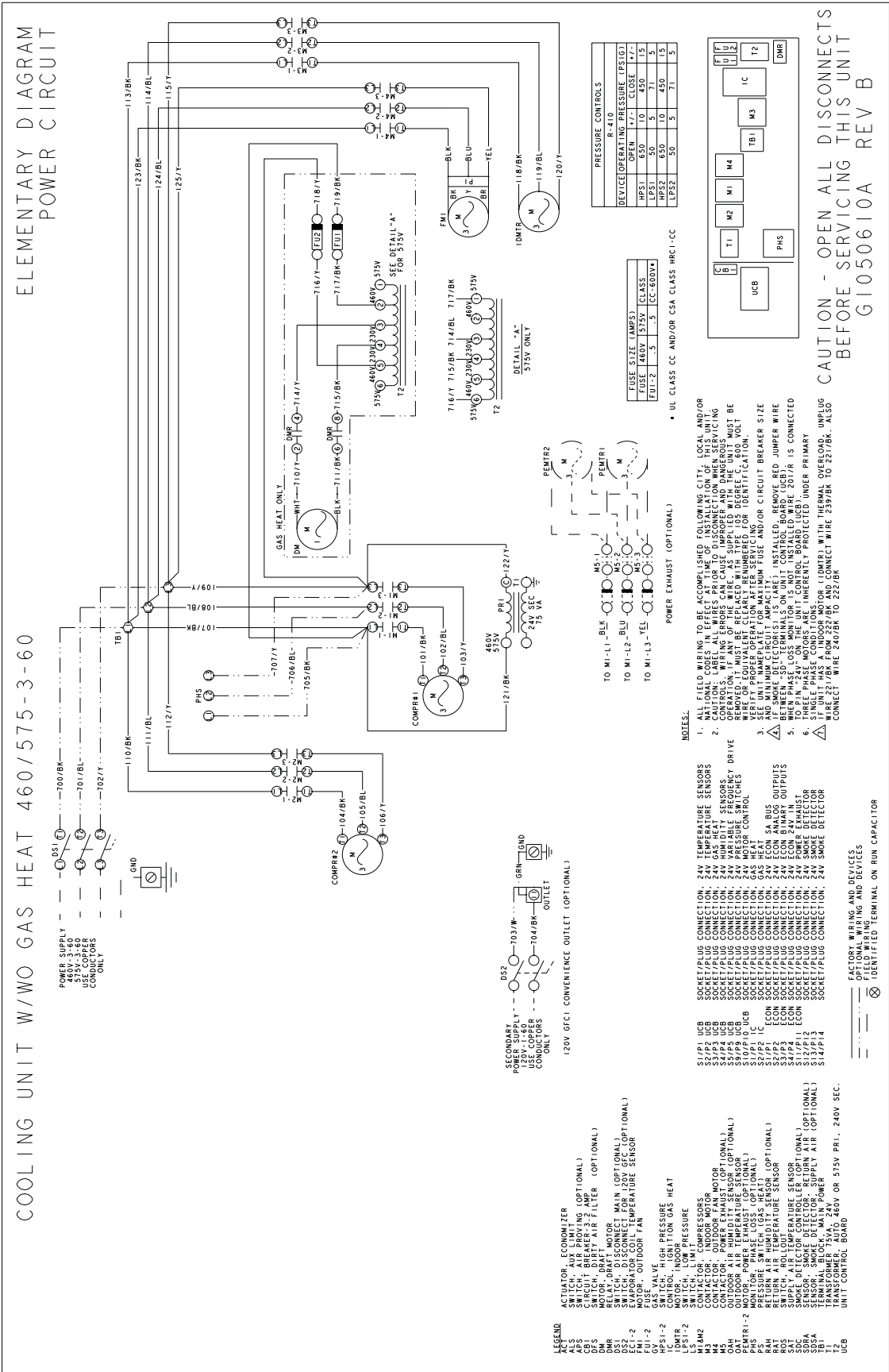
LEGEND

- [illegible]

COOLING UNIT W/WO GAS HEAT 460/575-3-60

[illegible]

Typical ZX14/ZY12 Cooling Unit w/wo Gas Heat 460/575-3-60 Belt Drive Elementary Diagram Power Circuit



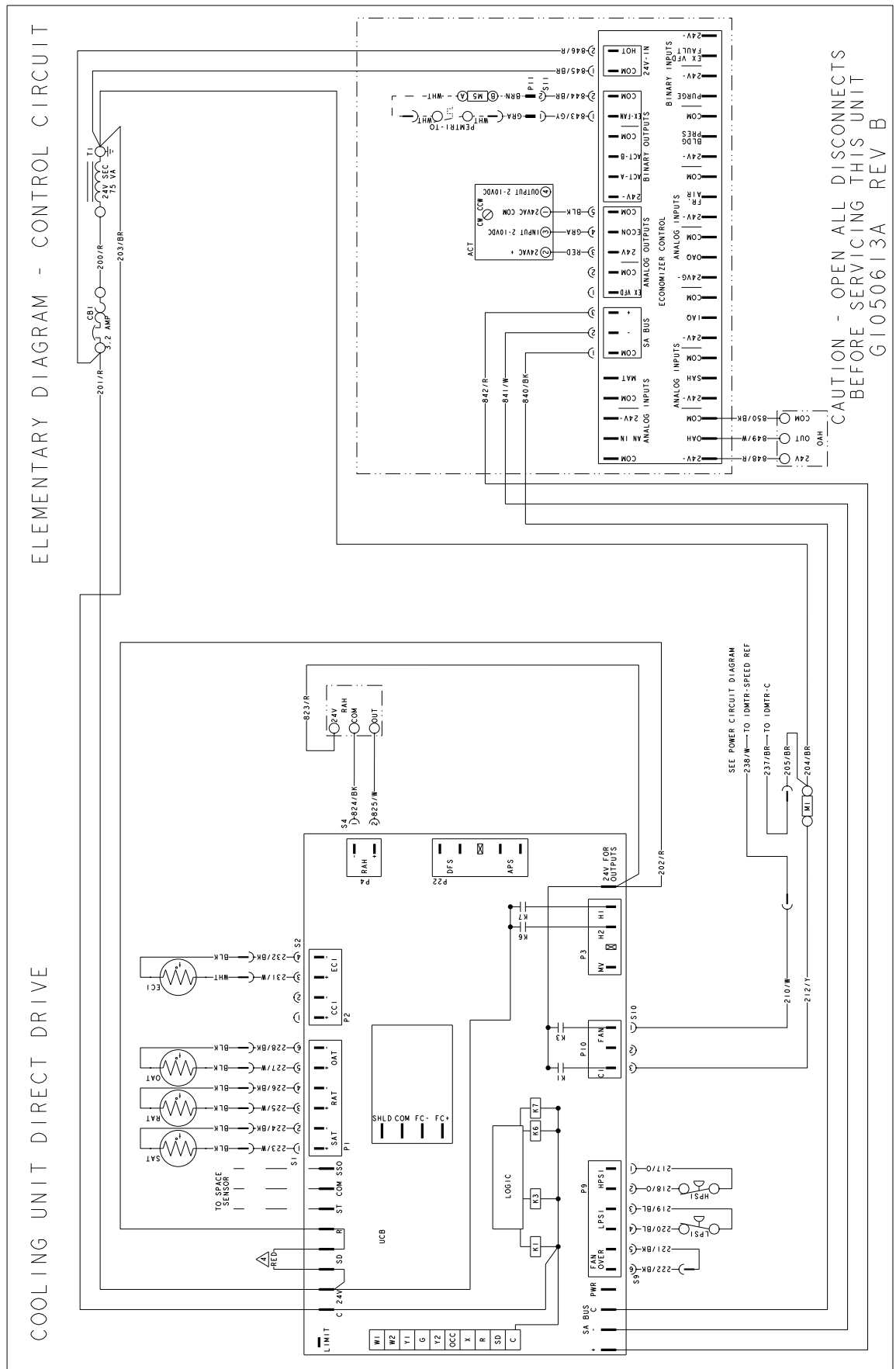
ELEMENTARY DIAGRAM POWER CIRCUIT



ELEMENTARY DIAGRAM POWER CIRCUIT

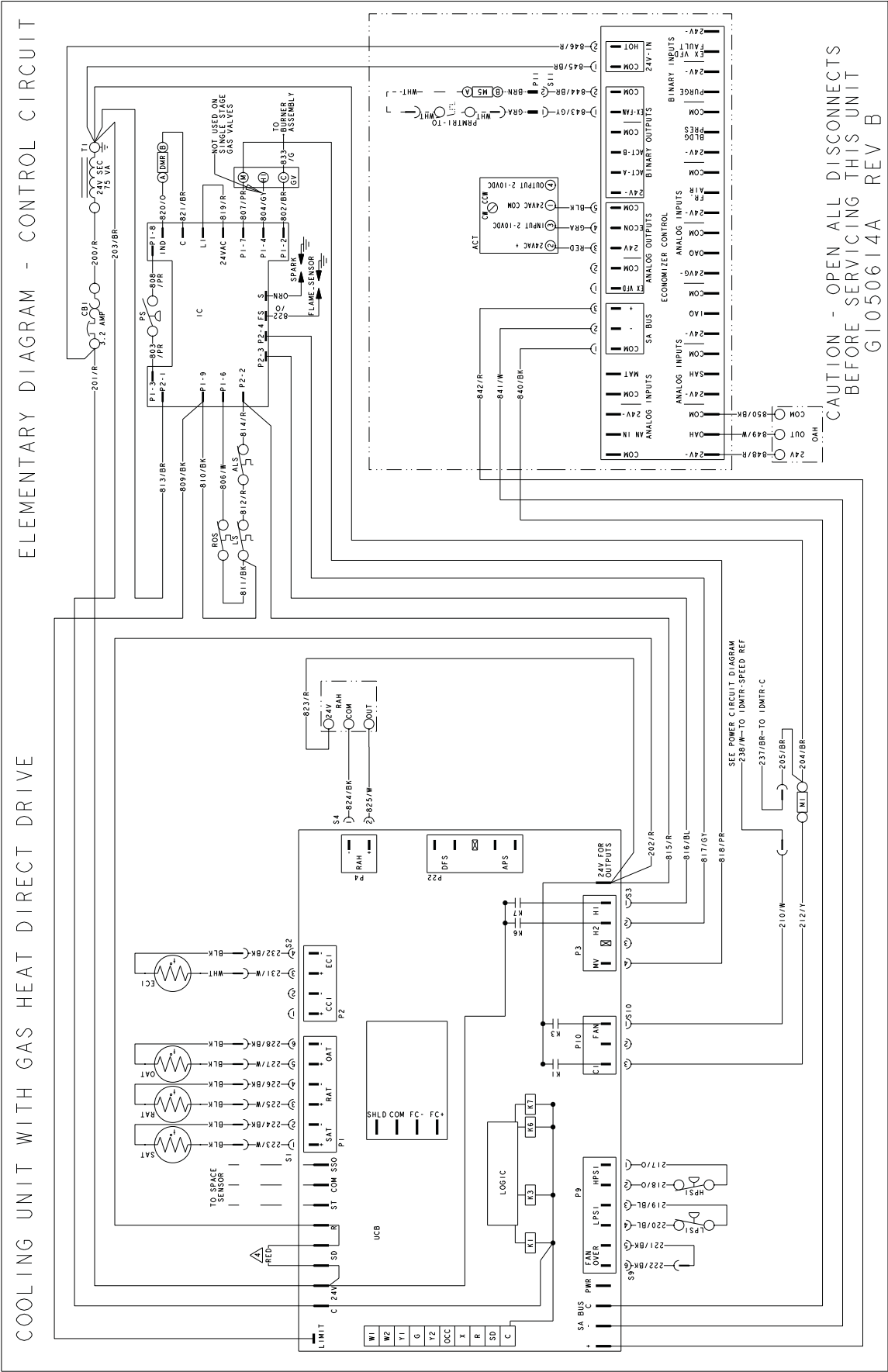


ELEMENTARY DIAGRAM - CONTROL CIRCUIT

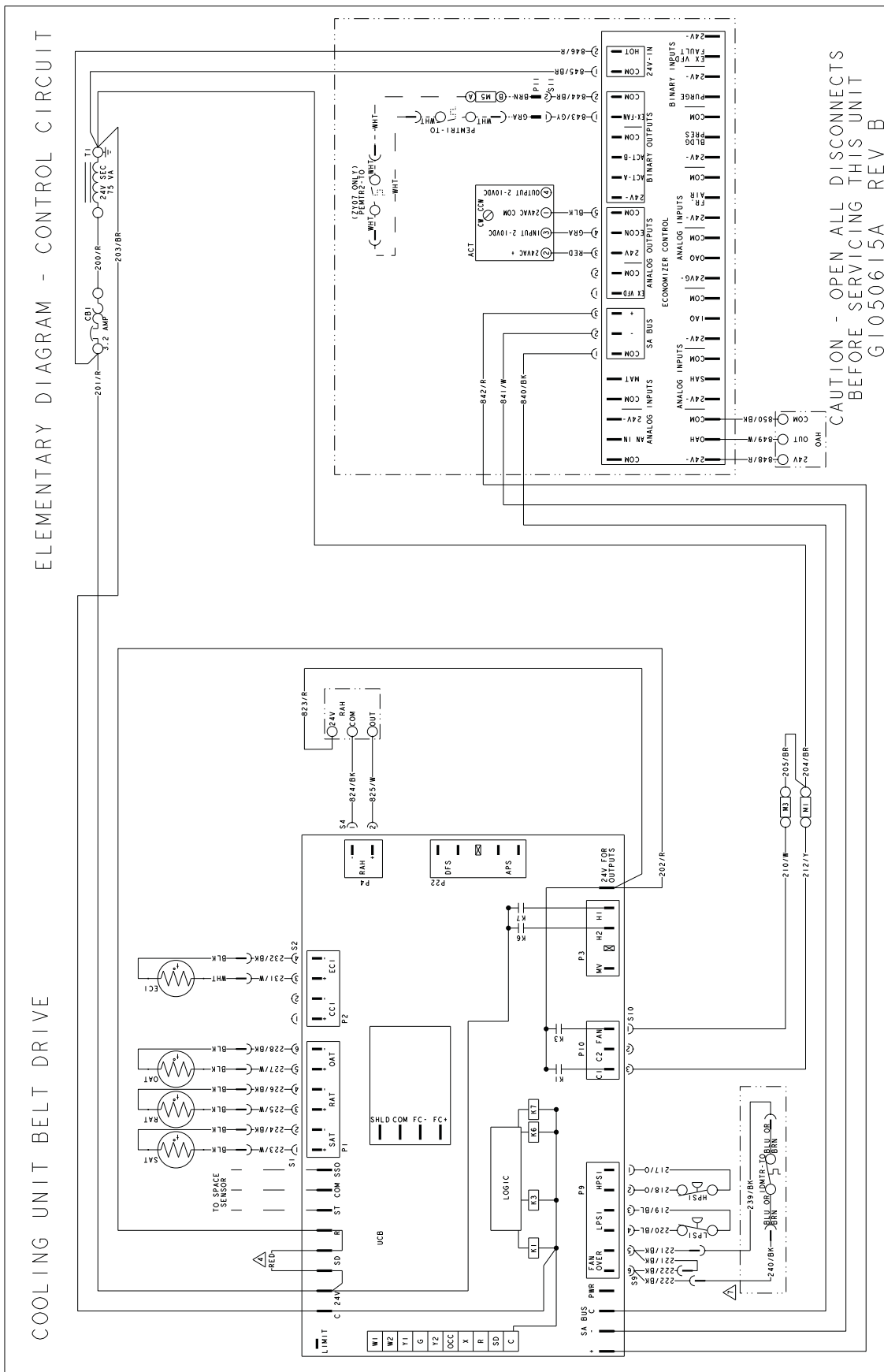


CAUTION - OPEN ALL DISCONNECTS
BEFORE SERVICING THIS UNIT
G1050613A REV B

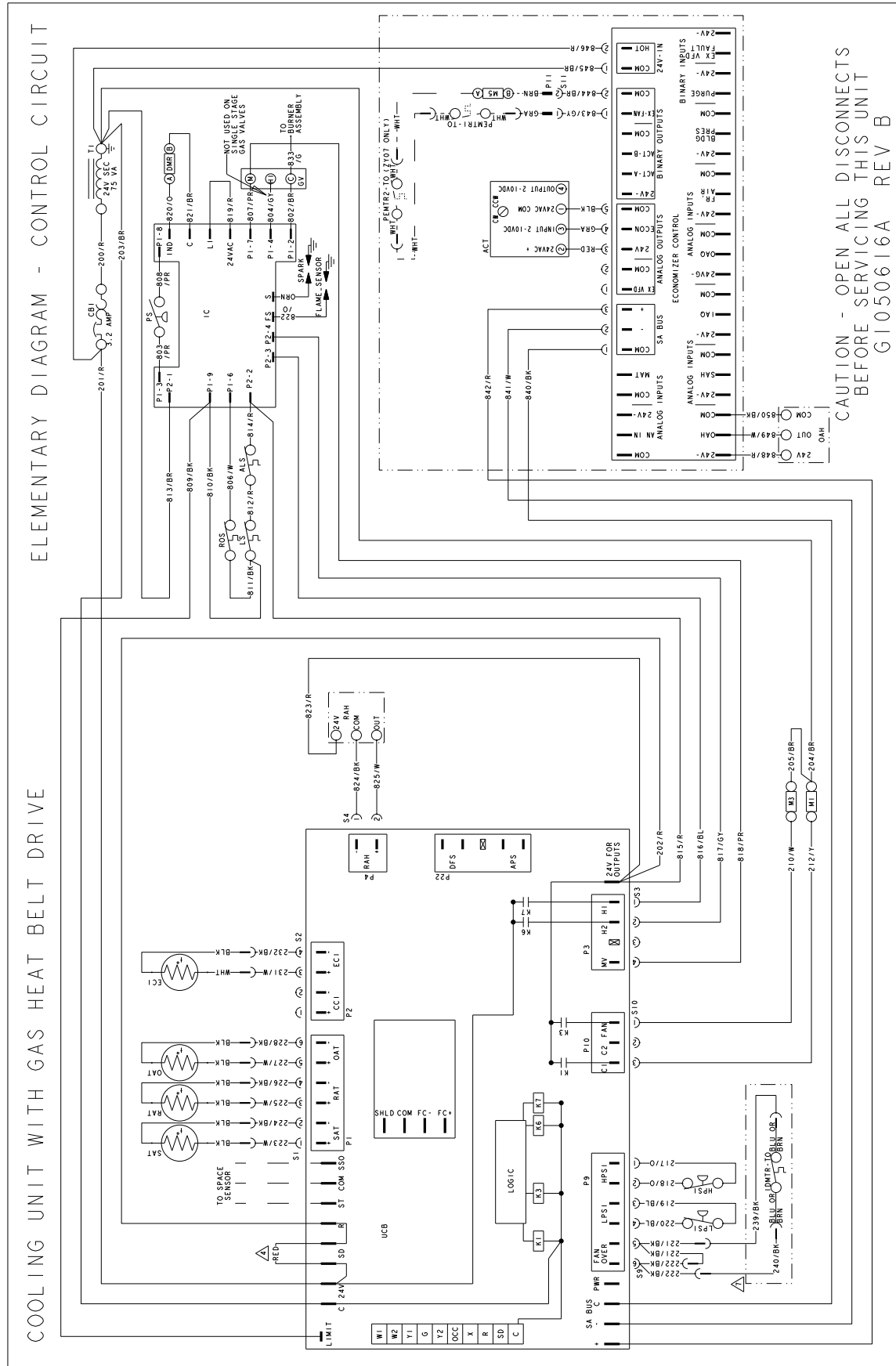
Typical ZX/ZY04-06 Cooling Unit with Gas Heat Direct Drive Elementary Diagram Control Circuit



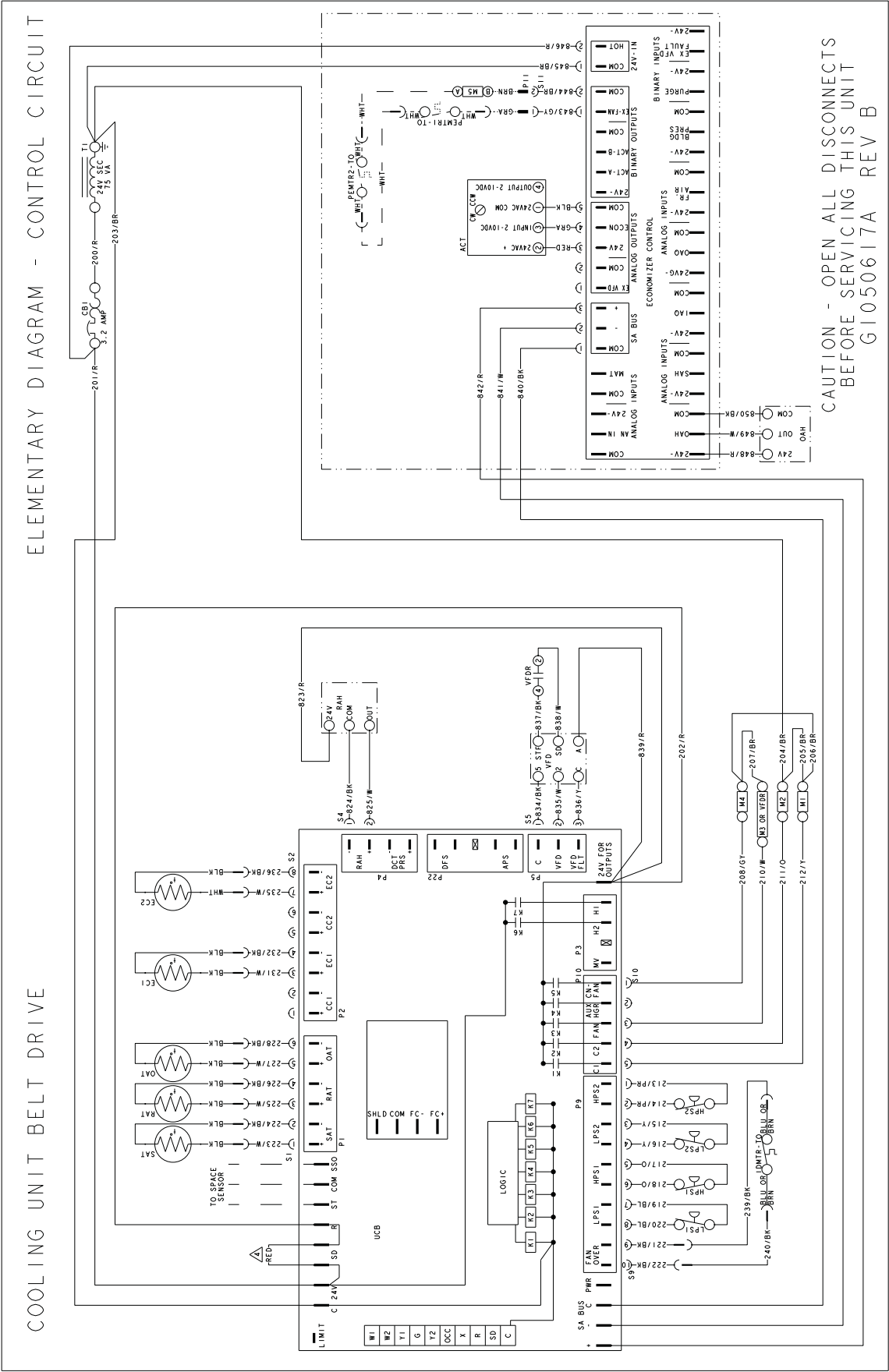
Typical ZX04-09/ZY04-07 Cooling Unit Belt Drive Elementary Diagram Control Circuit



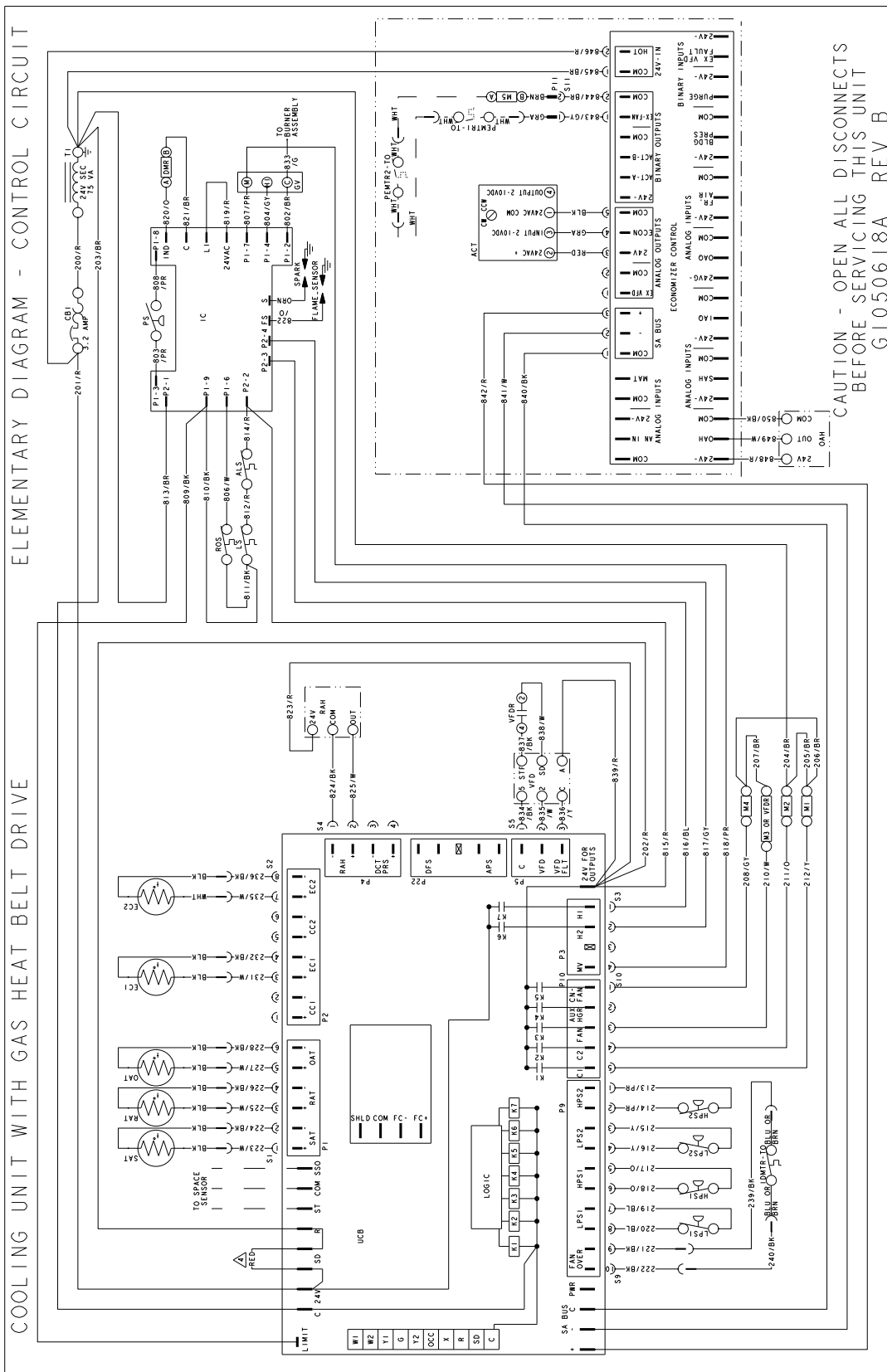
Typical ZX04-09/ZY04-07 Cooling Unit with Gas Heat Belt Drive Elementary Diagram Control Circuit



Typical ZX12, 14/ZY09-12 Cooling Unit Belt Drive w/wo VFD Elementary Diagram Control Circuit



Typical ZX12, 14/ZY09-12 Cooling Unit with Gas Heat Belt Drive w/wo VFD Elementary Diagram Control Circuit



Gas Heat Ignition Control Flash Codes				
Flash Code	Description	Technician Corrective Action	Ignition Control Response	Method for Reset
Heartbeat	Normal Operation - no status or error information currently needs to be displayed	None	All functions available to respond to heating demand	None
Steady Off	No power to the control - less than 18 VAC is present at the ignition control's R (P2-2 pin) and C (P2-1 pin) connections	Verify line voltage is present at the primary of the 75 VA transformer, verify 24 VAC is present at the secondary of the 75 VA transformer. Verify 24 VAC is present from the UCB's C and SD terminals indicating the 3.2 A control circuit breaker and phase monitor contacts are closed. Verify 24 VAC is present at the ignition control's R (P2-2 pin) and C (P2-1 pin) connections indicating the unit to ignition control wiring is intact.	The output relay contacts open so inducer and gas valve operation is not permitted	Restoration of 24 VAC power to the ignition board
	The ignition control has catastrophic damage that will not allow the LED display (visible physical damage likely)			None
Steady On	The Ignition Control's microprocessor has not passed its self check	Cycle power to the control to eliminate the possibility that transient voltage conditions such as surges, brownouts, etc. have not created a false indication. If the steady on LED indication repeats, the control will need to be replaced and potential causes for failure, such as excessive voltage, RF interference, etc. should be investigated.	The output relay contacts open so inducer and gas valve operation is not permitted	Cycling 24 VAC power to the ignition control or expiration of the 60 minute "watchdog" timer
2 Flashes	The induced draft pressure switch did not close - 24 VAC was not received to the ignition control's pressure switch input (P1-8 pin) within 10 seconds of the ignition control energizing the induced draft motor or 24 VAC was later lost to the control's pressure switch input while the ignition control energized the induced draft motor	Verify that the induced draft motor is operable, the ignition control's L1 to IND contacts are not open, the induced draft blower wheel is intact and there are no blockage in the combustion air / induced draft path. Verify that the induced draft pressure switch sensing tube is intact. With an incline manometer, digital manometer or Magnehelic® gauge teed into the pressure switch sensing line verify that the negative pressure exceeds the setting listed on the induced draft pressure switch label and the switch's contacts correctly close at the setting listed.	Gas valve operation is not permitted/ends when the induced draft pressure switch input is not present. The ignition control's L1 to IND output relay contact will cycle closed for 5 minutes/open for 30 seconds until 24 VAC is received to the pressure switch input or the heating demand ends.	Closure of the pressure switch (24 VAC input to P1-8 pin), cycling first stage heat input or cycling 24 VAC power to the ignition control.
3 Flashes	The induced draft pressure switch is stuck closed - 24 VAC is received to the control's pressure switch input (P1-8 pin) at the same time as 24 VAC to initiate heating operation is received at the control's W1 input (P2-3 pin)	Verify that the draft pressure switch contacts are not stuck or welded closed. Verify that the ignition control's L1 to IND contacts are not stuck or welded closed causing the induced draft motor to run continuously. Verify that the wiring from the ignition control's (P1-3 pin) through the induced draft pressure switch to the ignition control's pressure switch input (P1-8 pin) is no shorted.	The output relay contacts open so inducer and gas valve operation is not permitted.	Opening of the pressure switch (loss of 24 VAC input to P1-8 pin) then cycling first stage heat input or cycling 24 VAC power to the ignition control.

4 Flashes	Flame could not be established - a flame signal of 0.2 µa or greater could not be established in three consecutive attempts for ignition at the initiation of the heating cycle.	Verify that the unit has proper electrical grounding. Verify the 24 VAC common and ignition control cabinet ground references are intact. Monitor the flame signal. Verify that combustion air openings are without blockages and that the unit has proper clearance to the structure and adjacent units. Verify that the burners are clean and without blockages that could interfere with gas flow. Verify that the ignitor sparks with an 1/8" gap to the crossover area of the left burner. Verify that the flame sensor is intact and positioned with an 1/8" gap to the right burner. Verify that the gas lines have been purged of air and provide proper gas inlet pressure. Verify that the gas valve is opening and adjusted to provide proper manifold pressure. Verify that the wiring to the gas valve is intact. Verify that there is no wind, rain or snow entering the heat compartment to interfere with ignition or the burners. Verify that there are no conditioned air leaks or heat exchanger breaches to interfere with ignition or the burners.	Immediately after the third ignition trial; the gas valve output relay contact opens so gas valve operation is not permitted, following a 5 second inducer post purge the induced draft output relay contact opens so inducer operation is not permitted.	Cycling first stage heat input, cycling 24 VAC power to the ignition control or expiration of the 60 minute "watchdog" timer.
5 Flashes	Flame loss - after being established during ignition trials, flame signal dropped below 0.2 µa five times during one heating cycle.	Verify that the unit has proper electrical grounding. Verify the 24 VAC common and ignition control cabinet ground references are intact. Monitor the flame signal. Verify that combustion air openings are without blockages and that the unit has proper clearance to the structure and adjacent units. Verify that the burners are clean and without blockages that could interfere with gas flow. Verify that the flame sensor is intact and positioned with an 1/8" gap to the right burner. Verify that the gas lines have been purged of air and provide proper gas inlet pressure. Verify that the gas valve provides proper manifold pressure. Verify that the wiring to the gas valve is intact. Verify that there is no wind, rain or snow entering the heat compartment to interfere with ignition or the burners. Verify that there are no conditioned air leaks or heat exchanger breaches to interfere with ignition or the burners.	Immediately after the fifth flame loss; the gas valve output relay contact opens so gas valve operation is not permitted, following a 5 second inducer post purge the induced draft output relay contact opens to inducer operation is not permitted.	Cycling first stage heat input, cycling 24 VAC power to the ignition control or expiration of the 60 minute "watchdog" timer.
6 Flashes	Open limit - 24 VAC has been lost to the control's limit switch input (P1-9 pin)	Verify proper gas manifold pressure. Correct the inadequate indoor airflow condition. Verify filters, indoor coil and blower wheel are clean. Verify that the blower belt is properly maintained and adjusted; the blower motor fuses are intact, contactor and motor are operable and wheel has the correct rotation. Verify that the ducting is not restrictive. Verify indoor air volume is at least the minimum required for the heat section by measuring the indoor coil pressure drop and comparing the reading to the chart in the Installation Manual. Verify heating mode blower on/off delays are proper for the heat type and provide adequate heat section cooling at the termination of the heating cycle. Verify wiring for main and auxiliary limit switches is intact.	The gas valve output relay contact opens so gas valve operation is not permitted, the induced draft output relay contact closes to operate the inducer.	Closure of the limit switch(es) (24 VAC input to P1-9)
7 Flashes	Open rollout - 24 VAC has been lost to the control's rollout switch input (P1-6 pin)	Verify that combustion air openings are without blockages and that the unit has proper clearance to the structure and adjacent units. Verify that the burners are clean and without blockages that could interfere with gas flow. Verify that the ignitor sparks with an 1/8" gap to the crossover area of the left burner. Verify that the gas lines provide proper gas inlet pressure. Verify that the gas valve is adjusted to provide proper manifold pressure. Verify that there is no wind, rain or snow entering the heat compartment to interfere with ignition or the burners. Verify that there are no conditioned air leaks or heat exchanger breaches to interfere with ignition or the burners. Verify wiring for the rollout switch is intact.	The gas valve output relay contact opens so gas valve operation is not permitted, following a 5 second inducer post purge the induced draft output relay contact opens so inducer operation is not permitted.	Closure of the rollout switch (24 VAC input to P1-6 pin) then cycling first stage heat input or cycling 24 VAC power to the ignition control.

8 Flashes	The gas valve failed to shut off - flame has been sensed for longer than 2 seconds when the first stage gas valve output is off	Verify that the gas valve is not slow to shut off, leaks by or otherwise does not completely shut off gas flow when de-energized. Verify the gas valve wiring to is intact and not shorted in a manner that would improperly allow 24 VAC from another circuit to be applied to the gas valve.	The gas valve output relay contact opens so gas valve operation is not permitted, the induced draft output relay closes to operate the inducer.	Cycling 24 VAC power to the ignition control.
	Gas valve miss-wire - 24 VAC has been present for longer than 1 second at the first stage and/or second stage gas valve output (P1-7 pin and/or P1-4 pin) when the gas valve is commanded off by the ignition control	Verify gas valve wiring from the ignition control to the gas valve is intact and not shorted in a manner that would improperly allow 24 VAC from another circuit to be applied to the control's P1-7 and/or P1-4 gas valve output pins. Verify the control's gas valve output relay contacts for first stage (P1-8 to P1-7) and second stage (P1-7 to P1-4) are not shorted or fail to close when commanded on.	Initially, the output relay contacts open. Then, if 24 VAC remains present at the P1-7 pin after 15 seconds, the induced draft output relay contact closes to operate the inducer.	Cycling 24 VAC power to the ignition control.
10 Flashes	Ignition control gas valve relay contact failed to close - 24 VAC has not been sensed for longer than 1 second at the first stage and/or second stage gas valve output (P1-7 pin and/or P1-4 pin) when the gas valve is commanded on by the ignition control			

Humidity Sensor Volts DC

Relative Humidity	Volts DC
10%	1
20%	2
30%	3
40%	4
50%	5
60%	6
70%	7
80%	8
90%	9
100%	10

CO2 Sensor (Default Range) Volts DC

PPM CO2	Volts DC
200	1
400	2
600	3
800	4
1000	5
1200	6
1400	7
1600	8
1800	9
2000	10

VFD 2-10 Volt DC Output

Volts DC	Output %	90° Actuator Position	VFD Output to Motor (default settings)
2	0%	0°	25.00Hz
3	12.50%	11.25°	29.38Hz
4	25%	22.5°	33.75Hz
5	37.50%	33.75°	38.13Hz
6	50%	45°	42.50Hz
7	62.50%	56.25°	46.88Hz
8	75%	67.5°	51.25Hz
9	87.50%	78.25°	55.63Hz
10	100%	90°	60.00Hz

Proper Cooling Mode Leaving Air Temperature

Proper Leaving Air Temperature								
Cooling Mode +/- 3°F								
ID Entering Air WB (°F)	ID Entering Air DB (°F)							
	70	72	74	76	78	80	82	84
57	51	52	53	54	55	56	57	
58	51	52	53	54	55	56	57	58
59	52	53	53	54	55	56	57	59
60	52	53	54	55	56	56	57	59
61	53	54	55	55	56	57	58	60
62	53	55	55	56	57	58	59	60
63	54	55	56	57	57	58	60	61
64	55	56	57	57	58	59	60	61
65	55	57	58	58	59	60	61	62
66	56	57	58	59	60	61	62	63
67	57	58	59	60	61	62	63	63
68	58	59	60	61	62	63	64	64
69	59	60	61	62	63	64	65	65
70	60	61	62	63	64	65	66	66
71		62	63	64	65	66	67	67
72		63	64	65	66	67	68	68
73			65	66	67	68	69	69
74				67	68	69	70	70
75					69	69	71	71

Level 1 - STATUS

Level 1	Level 2	Level 3	Setting range / alternate text indication	Condition(s) for parameter to be displayed	Parameter description / comments
			default setting		
Status	DVent-Mode	DVent-Mode Disabled	Controlled by IAQ Diff between IAQ and OAQ	economizer board present	Demand Ventilation mode selection; Disabled permits no demand ventilation function, Controlled by IAQ requires IAQ input, Diff between IAQ and OAQ requires IAQ and OAQ inputs
	OprST	OprST 73.0 F			the buffered space temperature in use; may be from UCB RAT thermistor or ST thermistor input, SA BUS NetSensor or FC BUS communicated value sources
	SAT	SAT 60.7 F			the buffered UCB SAT thermistor input
	RAT	RAT 73.0 F			the buffered UCB RAT thermistor input
	OprSH	OprSH 49,6 %H ?Unrel		input to the UCB RAH pins, humidity from Net-Sensor or communicated value	the buffered space humidity in use; may be from UCB RAH 0-10 VDC input, SA BUS NetSensor or FC BUS communicated value sources; ?Unrel indicates RAH input was once detected and is currently lost
	RAH	RAH 49,6 %H ?Unrel		input to the UCB RAH pins	the buffered UCB RAH 0-10 VDC input; ?Unrel indicates UCB RAH 0-10 VDC input was once detected and is currently lost
	OprOAT	OprOAT 73.0 F			the buffered outdoor air temperature in use; may be from UCB OAT thermistor input or FC BUS communicated value sources
	OprOAH	OprOAH 71 %H ?Unrel		economizer board present	the buffered outdoor air humidity in use; may be from economizer board OAH 0-10 VDC input or FC BUS communicated value sources; ?Unrel indicates OAH input is currently not present
	OprOAQ	OprOAQ 989ppm ?Unrel		economizer board present	the buffered outdoor air quality in use; may be from economizer board OAQ 0-10 VDC input or FC BUS communicated value sources; ?Unrel indicates OAQ input is currently not present
	OprIAQ	OprIAQ 477ppm ?Unrel		economizer board present	the buffered indoor air quality in use; may be from economizer board IAQ 0-10 VDC input, SA BUS NetSensor or FC BUS communicated value sources; ?Unrel indicates IAQ input is currently not present

Level 1 - ALARM

Level 1	Level 2	Setting range / alternate text indication	Condition(s) for parameter to be displayed	Parameter description and comments
		default setting		
Alarms	No Events		no alarms in the active alarm register	no notification in the active alarm register
	Alarm Description		1 or more alarms in the active alarm register	most recent notification in the active alarm register
	Alarm Description		2 or more alarms in the active alarm register	2nd most recent notification in the active alarm register
	Alarm Description		3 or more alarms in the active alarm register	3rd most recent notification in the active alarm register
	Alarm Description		4 or more alarms in the active alarm register	4th most recent notification in the active alarm register
	Alarm Description		5 or more alarms in the active alarm register	5th most recent notification in the active alarm register

Level 1		Level 2		Level 3		Level 4		Condition(s) for parameter to be displayed		Parameter description and comments		
		default setting		setting range/alternate text indication								
Summary	HVAC Zone	OccSrc	OccSrc	Local Input	BAS Network Req	the source of occupied/unoccupied status; Local Input is 24 VAC input to the UCB OCC terminal, (Schedule is from the UCB schedule), BAS Network Req is from FC BUS communicated value						
		OprCVClg-Sp	OprCVClg-Sp	72 F	FanCtl-Type = Variable Speed	effective if TSTstatTAT-Only = No; the CV cooling setpoint in use; depending on occupied/unoccupied status, is either ClgOcc-Sp ± OprSSO or ClgUnocc-Sp ± OprSSO; cooling operation requests are initiated when OprST rises above this setpoint						
		CVO-prHtg-Sp	CVO-prHtg-Sp	68 F	FanCtl-Type = Variable Speed	effective if TSTstatTAT-Only = No; the CV heating setpoint in use; depending on occupied/unoccupied status, is either CVHtgOcc-Sp ± OprSSO or CVHtgUnocc-Sp ± OprSSO; heating operation requests are initiated when OprST falls below this setpoint						
		OprVAV-Clg-Sp	OprVAV-Clg-Sp	60 F	FanCtl-Type = Variable Speed	the VAV cooling SAT setpoint in use; with OprST above SATrst-Sp is SATLo-Sp, with OprST below SATrst-Sp is SATUp-Sp; cooling operation requests are initiated when OprST rises above this setpoint						
		VAVO-prHtg-Sp	VAVO-prHtg-Sp	68 F	FanCtl-Type = Variable Speed	the VAV space heating setpoint in use; depending on occupied/unoccupied status and enabled VAV heating modes, is either MornWRAT-Sp or VAVHtgUnocc-Sp or VAVHtgOcc-Sp; heating operation requests are initiated when OprST falls below this setpoint						
		Opr ST	Opr ST	73.0 F		the buffered space temperature in use; may be from UCB RAT thermistor or ST thermistor input, SA BUS NetSensor or FC BUS communicated value sources						
		Opr SH	Opr SH	49.6 %H ?Unrel	input to the UCB RAH pins, humidity from NetSensor or communicated value	the buffered space humidity in use; may be from UCB RAH 0-10 VDC input, SA BUS NetSensor or FC BUS communicated value sources; ?Unrel indicates RAH input was once detected and is currently lost						
		OprIAQ	OprIAQ	477ppm ?Unrel	economizer board present	the buffered indoor air quality in use; may be from economizer board IAQ 0-10 VDC input, SA BUS NetSensor or FC BUS communicated value sources; ?Unrel indicates IAQ input is currently not present						
Summary	Fan	Fan Off	Fan Off	On	UCB FAN 24 VAC output status							
		FanCtl-Type	FanCtl-Type	Single Speed	Two Speed	Fixed Variable	indoor blower and unit operating mode selection; Single Speed = CV unit w/o indoor blower VFD, (Two Speed = CV unit w/2-step indoor blower VFD speed control), Fixed Variable = CV unit w/IntelliSpeed indoor blower VFD speed control, Variable Speed = VAV unit w/indoor blower VFD speed control by DCT PRS input					
		FanOn Occ	FanOn Occ	Yes	No	effective for CV units; Yes = UCB FAN output is on during occupied status, cycles with heating/cooling operation and fan request during unoccupied status; No = UCB FAN output cycles with heating/cooling operation and fan request						

Summary	Fan	FanVFD	FanVFD	0 %		FanCtl-Type = Single Speed	UCB VFD 2-10 VDC output status
		DctPrs-Sp	DctPrs-Sp	1.50" /w	.00" /w through	FanCtl-Type = Variable Speed	effective for VAV units; supply duct pressure setpoint for indoor blower speed control; 1/100th adjustment increments
		DctPrs	DctPrs	1.50" /w		FanCtl-Type = Variable Speed	effective for VAV units; the buffered UCB DCT PRS 0-5 VDC input
Summary	Clg	C1	C1	Off	On		UCB C1 24 VAC output status
		C2	C2	Off	On	#ClgStgs = 2 or more	effective for units with 2 or more compressor cooling stages; UCB C2 24 VAC output status
		Empty				#HtgStgs = 0	
Summary	Htg	H1	H1	Off	On	#HtgStgs = 1 or more	effective for units with 1 or more heating stages; UCB H1 24 VAC output status
		H2	H2	Off	On	#HtgStgs = 2 or more	effective for units with 2 or more heating stages; UCB H2 24 VAC output status
Summary	Econ	Econ-Free	Econ-Free	No	Yes	economizer board present	Yes indicates economizer free cooling is available, No indicates economizer free cooling is not available; indication depends on FreeClg-Mode effective and current outdoor/indoor conditions
		FreeClg-Mode	FreeClg-Mode	Dry Bulb Tempe	Single Enthalpy	Dual Enthalpy	free cooling changeover method currently effective; indication depends on FreeClg-Sel setting, presence of OAH 0-10 VDC input to the economizer board and presence of RAH 0-10 VDC input to the UCB
		Econ	Econ	0 %		economizer board present	economizer board ECON 2-10 VDC output status
		LowAmb-MinPos	LowAmb-MinPos	0 %	0 %	economizer board present	economizer minimum position effective with occupied status, indoor blower operation and when OAT is below LowAmb-Sp; typically set less than Econ-MinPos
		EconOAT-SpEn	EconOAT-SpEn	55 F	40 F	economizer board present	dry bulb free cooling changeover setpoint; with FreeClg-Mode = Dry Bulb Tempe, economizer free cooling is available when OAT is below this setpoint
		EconO-AEnth-Sp	EconO-AEnth-Sp	27 B/#	10 B/#	economizer board present	single enthalpy free cooling changeover setpoint; with FreeClg-Mode = Single Enthalpy, economizer free cooling is available when OA-Enth is below this setpoint
		OA-Enth	OA-Enth	20B/#	0 B/#	economizer board present	enthalpy calculated from OAH 0-10 VDC input to the economizer board and OprOAT; 0B/# indicated if OAH 0-10 VDC input to the economizer board is not present

Summary	OprOAH	19 %H ?Unrel		economizer board present	the buffered outdoor air humidity in use; may be from economizer board OAH 0-10 VDC input or FC BUS communicated value sources; ?Unrel indicates OAH input is currently not present
	Opr OAT	70.7 F		economizer board present	the buffered outdoor air temperature in use; may be from UCB OAT input or communicated value sources
	RA-Enth	20B/#	0 B/#	economizer board present	enthalpy calculated from RAH 0-10 VDC input to the UCB and RAT thermistor input to the UCB; 0B/# indicated if RAH 0-10 VDC input to the UCB is not present
	RAH	19.4 %H ?Unrel		economizer board present and input to the UCB RAH pins	the buffered UCB RAH 0-10 VDC input; ?Unrel indicates UCB RAH 0-10 VDC input was once detected and is currently lost
	RAT	70.4 F		economizer board present	the buffered UCB RAT thermistor input
Summary	DVent-Mode	Disabled	Controlled by IAQ	economizer board present	Demand Ventilation mode selection; Disabled permits no demand ventilation function, Controlled by IAQ requires IAQ input, Diff between IAQ and OAQ requires IAQ and OAQ inputs
	DVentIAQ-Sp	1000ppm	0ppm	economizer board present	effective when DVent-Mode = Controlled by IAQ; with occupied status and indoor blower operation, demand ventilation operation the economizer is initiated if OprIAQ rises above this setpoint; adjustment increments of 1s
	DVentDiff-Sp	600ppm	0ppm	economizer board present	effective when DVent-Mode = Diff between IAQ and OAQ; with occupied status and indoor blower operation, demand ventilation operation the economizer is initiated if OprIAQ rises above OprOAQ plus this setpoint; adjustment increments of 1s
	OprIAQ	477ppm ?Unrel		economizer board present	the buffered indoor air quality in use; may be from economizer board IAQ 0-10 VDC input, SA BUS NetSensor or FC BUS communicated value sources; ?Unrel indicates IAQ input is currently not present
	OprOAQ	989ppm ?Unrel		economizer board present	the buffered outdoor air quality in use; may be from economizer board OAH 0-10 VDC input or FC BUS communicated value sources; ?Unrel indicates OAH input is currently not present
Summary	ExFType	None	Non-Modulating	economizer board present	power exhaust fan mode selection; None = no power exhaust fan installed, Non-Modulating = power exhaust fan on/off by economizer position, (Modulating Damper = power exhaust fan on/off by exhaust damper position, exhaust damper position by BLDG PRES input), (Variable Frequency Fan = power exhaust fan VFD speed control by BLDG PRES input)
	ExFan	Off	On	economizer board present	economizer board EX-FAN 24 VAC output status
	Bldg-Sp	.100"/w	-.249"/w	economizer board present and ExFType # Non-Modulating	effective for Modulating Damper and Variable Frequency Fan power exhaust; building pressure setpoint for exhaust damper position/exhaust fan VFD speed control; 1/100th adjustment increments
	BldgPres	.164"/w ?Unrel		economizer board present and ExFType # Non-Modulating	effective for Modulating Damper and Variable Frequency Fan power exhaust; the buffered economizer board BLDG PRES 0-5 VDC input; ?Unrel indicates BLDG PRES input is currently not present

Summary	Econ	Econ	0 %		economizer board present	economizer board ECON 2-10 VDC output status
	EconDmp-PosFanOn	EconDmpPosFanOn	60 %	20 % through	economizer board present and ExFType = Non-Modulating	effective for Non-Modulating power exhaust; the Econ position where the economizer board EX-FAN 24 VAC output is turned On; must be set greater than EconDmpPos-FanOff
	EconDmp-PosFanOff	EconDmpPosFanOff	20 %	10 % through	economizer board present and ExFType = Non-Modulating	effective for Non-Modulating power exhaust; the Econ position where the economizer board EX-FAN 24 VAC output is turned Off; must be set greater than Econ-MinPos and less than EconDmpPosFanOff
	EAD-O	EAD-O	0 %		economizer board present and ExFType = Modulating Damper	effective for Modulating Damper power exhaust; the economizer board EX VFD 2-10 VDC output status
	ExFanVFD	ExFanVFD	0 %		economizer board present and ExFType = Variable Frequency Fan	effective for Variable Frequency Fan power exhaust; the economizer board EX VFD 2-10 VDC output status
Summary	SAT	SAT	60.7 F			the buffered UCB SAT thermistor input
	RAT	RAT	73.0 F			the buffered UCB RAT thermistor input
	RAH	RAH	49.6 %H ?Unrel		input to the UCB RAH pins	the buffered UCB RAH 0-10 VDC input; ?Unrel indicates UCB RAH 0-10 VDC input was once detected and is currently lost
	Opr OAT	Opr OAT	73.0 F			the buffered outdoor air temperature in use; may be from UCB OAT thermistor input or FC BUS communicated value sources
	OprOAH	OprOAH	19 %H ?Unrel		economizer board present	the buffered outdoor air humidity in use; may be from economizer board OAH 0-10 VDC input or FC BUS communicated value sources; ?Unrel indicates OAH input is currently not present
	OprOAQ	OprOAQ	989ppm ?Unrel		economizer board present	the buffered outdoor air quality in use; may be from economizer board OAQ 0-10 VDC input or FC BUS communicated value sources; ?Unrel indicates OAQ input is currently not present
Summary	Comm-S	Comm-S	Waiting For Pol	Active		effective when an optional communication sub-board is present; Waiting For Pol indicates FC BUS network communication is not present, Active indicates FC BUS network communication is present

Level 1 - COMMISN

Level 1	Level 2	Level 3	Level 4	setting range / alternate text indication	Condition(s) for parameter to be displayed	Parameter description / comments
Commisn	HVAC Zone	OccMode	OccMode	External		sets occupied/unoccupied status initiation method; External permits occupied/unoccupied status initiation by 24 VAC input to the UCB OCC terminal or by FC BUS communicated value, (not to be used until schedule access provisions are made in later control revisions, Schedule permits occupied/unoccupied status initiation by the schedule held in the UCB)
				Schedule		
Commisn	IndoorFan	FanOn Occ	FanOn Occ	Yes		effective for CV units; Yes = UCB FAN output is on during occupied status; cycles with heating/cooling operation and fan request during unoccupied status; No = UCB FAN output cycles with heating/cooling operation and fan request
		DctPrs-Sp	DctPrs-Sp	1.50"/w	.00"/w through 4.99"/w	effective for VAV units; supply duct pressure setpoint for indoor blower speed control; 1/100th adjustment increments
		Fan Only-% Cmd	Fan Only-% Cmd	50 %	0 % through 100 %	effective for CV units with IntelliSpeed indoor blower VFD speed control; the UCB VFD 2-10 VDC output during indoor blower-only operation
		1ClgStg-% Cmd	1ClgStg-% Cmd	70 %	0 % through 100 %	effective for CV units with IntelliSpeed indoor blower VFD speed control; the UCB VFD 2-10 VDC output during 1-stage cooling operation
		2ClgStg-% Cmd	2ClgStg-% Cmd	80 %	0 % through 100 %	effective for CV units with IntelliSpeed indoor blower VFD speed control; the UCB VFD 2-10 VDC output during 2-stage cooling operation
		3ClgStg-% Cmd	3ClgStg-% Cmd	90 %	0 % through 100 %	effective for CV units with IntelliSpeed indoor blower VFD speed control; the UCB VFD 2-10 VDC output during 3-stage cooling operation
		4ClgStg-% Cmd	4ClgStg-% Cmd	100 %	0 % through 100 %	effective for CV units with IntelliSpeed indoor blower VFD speed control; the UCB VFD 2-10 VDC output during 4-stage cooling operation
		1HtgStg-% Cmd	1HtgStg-% Cmd	100 %	0 % through 100 %	effective for CV units with IntelliSpeed indoor blower VFD speed control; the UCB VFD 2-10 VDC output during 1-stage heating operation
		2HtgStg-% Cmd	2HtgStg-% Cmd	100 %	0 % through 100 %	effective for CV units with IntelliSpeed indoor blower VFD speed control; the UCB VFD 2-10 VDC output during 2-stage heating operation
		3HtgStg-% Cmd	3HtgStg-% Cmd	100 %	0 % through 100 %	effective for CV units with IntelliSpeed indoor blower VFD speed control; the UCB VFD 2-10 VDC output during 3-stage heating operation

Commisn	Cig	Cig-En	Cig-En Yes	No	sets permission to allow UCB C1 and C2, (4-stage board C3 and C4) 24 VAC outputs for compressor contactor coils; Yes permits C1, C2 (C3 & C4) output, No does not permit C1, C2 (C3 & C4) output	
		LeadLag-En	LeadLag-En No	Yes	effective for 2 or more compressor stages; Yes permits compressor equalized runtime where the C# output with the least C#RunTim operates first, the C# output with the next least C#RunTim operates second, etc. No operates the C1 output first, the C2 output second, etc.	
		CigOcc-Sp	CigOcc-Sp	72 F	45 F through 98 F	effective for CV units if TSTstatTAT-Only = No; the base cooling comfort temperature setpoint in use with occupied status; must be set equal to or less than CigUnocc-Sp and equal to or greater than CVHtgOcc-Sp
		CigUnocc-Sp	CigUnocc-Sp	80 F	46 F through 99 F	effective for CV units if TSTstatTAT-Only = No; the base cooling comfort temperature setpoint in use with unoccupied status; must be set equal to or greater than CigOcc-Sp
		SATUp-Sp	SATUp-Sp	60 F	41 F through 70 F	effective for VAV units with occupied status; the cooling SAT setpoint in use when OpST falls below SATRst-Sp; must be set greater than SATLo-Sp
		SATLo-Sp	SATLo-Sp	55 F	40 F through 69 F	effective for VAV units with occupied status; the cooling SAT setpoint in use when OpST falls below SATRst-Sp; must be set less than SATUp-Sp
		SATRst-Sp	SATRst-Sp	72 F	40 F through 85 F	effective for VAV units with occupied status; SATUp-Sp in use when OpST falls below this setpoint, SATLo-Sp in use when OpST rises above this setpoint,
		Htg-En	Htg-En Yes	No	sets permission to allow UCB H1 and H2, (4-stage board H3) 24 VAC outputs for heat stages; Yes permits H1, H2 (& H3) output, No does not permit H1, H2 (& H3) output	
		CVHtgOcc-Sp	CVHtgOcc-Sp	68 F	46 F through 99 F	effective for CV units if TSTstatTAT-Only = No; the base heating comfort temperature setpoint in use with occupied status; must be set equal to or less than CigOcc-Sp and equal to or greater than CVHtgUnocc-Sp
Commisn	Htg	CVHtgUnocc-Sp	CVHtgUnocc-Sp	60 F	45 F through 98 F	effective for CV units if TSTstatTAT-Only = No; the base heating comfort temperature setpoint in use with unoccupied status; must be set equal to or less than CVHtgOcc-Sp
		HtgOcc-En	HtgOcc-En Yes	No		Yes sets permission to allow VAV unit heating operation with occupied status
		VAVHtgOcc-Sp	VAVHtgOcc-Sp	68 F	40 F through 85 F	the heating space temperature setpoint in use for VAV units with occupied status and HtgOcc-En = Yes; requests for heating operation are initiated when OpST falls below this setpoint
		HtgUnocc-En	HtgUnocc-En No	Yes		Yes sets permission to allow VAV unit heating operation with unoccupied status
		VAVHtgUnocc-Sp	VAVHtgUnocc-Sp	60 F	45 F through 98 F	the heating space temperature setpoint in use for VAV units with unoccupied status and HtgUnocc-En = Yes; requests for heating operation are initiated when OpST falls below this setpoint

Commisn	Econ-En	Econ-En Yes	No	economizer board present			Yes sets permission to allow economizer free cooling operation, No does not permit economizer free cooling operation
	FreeClg-Sel	FreeClg-Sel Auto		Dry Bulb	Single Enthalpy	Dual Enthalpy	sets the desired economizer free cooling changeover method; Auto sets the changever method based on the presence of economizer board OAH 2-10 VDC input and UCB RAH 2-10 VDC input, Dual Enthalpy requires OAH and RAH inputs to be effective, Single Enthalpy requires OAH input to be effective
	EconOAT-SpEn	EconOAT-SpEn	55 F	40 F	through	80 F	dry bulb free cooling changeover setpoint; with FreeClg-Mode = Dry Bulb Tempe, economizer free cooling is available when OAT is below this setpoint
	EconO-AEnth-Sp	EconOAEnth-Sp	27 B/#	10 B/#	through	50 B/#	single enthalpy free cooling changeover setpoint; with FreeClg-Mode = Single Enthalpy, economizer free cooling is available when OA-Enth is below this setpoint
	LowAmb-Sp	LowAmb-Sp	0 F	0 F	through	60 F	with OprOAT below this setting LowAmb-MinPos is the effective economizer minimum position, with OprOAT below this setting Econ-MinPos is the effective economizer minimum position
	LowAmb-MinPos	LowAmb-MinPos	0 %	0 %	through	100 %	economizer minimum position effective with occupied status, indoor blower operation and when OAT is below LowAmb-Sp; typically set less than Econ-MinPos
	IAQEcon-MaxPos	IAQEcon-MaxPos	50 %	0 %	through	100 %	the maximum economizer actuator position for demand ventilation operation; termed "DVentMaxEconPos" elsewhere
	DVent-Mode	DVent-Mode Disabled		Controlled by IAQ	Diff between IAQ and OAQ		Demand Ventilation mode selection; Disabled permits no demand ventilation function, Controlled by IAQ requires IAQ input, Diff between IAQ and OAQ requires IAQ and OAQ inputs
	DVentMaxEconPos	DVentMaxEconPos	50 %	0 %	through	100 %	the maximum economizer actuator position for demand ventilation operation; termed "IAQEconMaxPos" elsewhere
Dvent	DVentIAQ-Sp	DVentIAQ-Sp	1000ppm	0ppm	through	5000ppm	effective when DVent-Mode = Controlled by IAQ; with occupied status and indoor blower operation, demand ventilation operation the economizer is initiated if OprIAQ rises above this setpoint; adjustment increments of 1s
	DVentDiff-Sp	DVentDiff-Sp	600ppm	0ppm	through	5000ppm	effective when DVent-Mode = Diff between IAQ and OAQ; with occupied status and indoor blower operation, demand ventilation operation the economizer is initiated if OprIAQ rises above OprOAQ plus this setpoint; adjustment increments of 1s
	IAQRange	IAQRange	2000ppm	0ppm	through	5000ppm	setting only required when a CO ₂ sensor is connected to the economizer board IAQ 0-10 VDC input; set for the CO ₂ ppm measured at 10 VDC IAQ sensor output; adjustment increments of 1s
	OAQRange	OAQRange	2000ppm	0ppm	through	5000ppm	setting only required when a CO ₂ sensor is connected to the economizer board OAQ 0-10 VDC input; set for the CO ₂ ppm measured at 10 VDC OAQ sensor output; adjustment increments of 1s

Commisn	EconDmp-PosFanOn	EconDmpPosFanOn	60 %	20 %	through	99 %	economizer board present and ExFType = Non-Modulating	effective for Non-Modulating power exhaust; the Econ position where the economizer board 24 VAC output is turned On; must be set greater than EconDmpPosFanOff	EX-FAN
	EconDmp-PosFanOff	EconDmpPosFanOff	20 %	10 %	through	89 %	economizer board present and ExFType = Non-Modulating	effective for Non-Modulating power exhaust; the Econ position where the economizer board 24 VAC output is turned Off; must be set greater than Econ-MinPos and less than EconDmpPosFanOff	EX-FAN
	Bldg-Sp	Bldg-Sp	.100"/w	-.249"/w	through	.249"/w	economizer board present and ExFType ≠ Non-Modulating	effective for Modulating Damper and Variable Frequency Fan power exhaust; building pressure set-point for exhaust damer position/exhaust fan VFD speed control; 1/100th adjustment increments	
	ExDmpPos-FanOn	ExDmpPosFanOn	80 %	20 %	through	99 %	economizer board present and ExFType = Modulating Damper	effective for Modulating Damper power exhaust; the EAD-O position where the economizer board EX-FAN 24 VAC output is turned On; must be set greater than ExDmpPosFanOff	
	ExDmpPos-FanOff	ExDmpPosFanOff	20 %	10 %	through	89 %	economizer board present and ExFType = Modulating Damper	effective for Modulating Damper power exhaust; the EAD-O position where the economizer board EX-FAN 24 VAC output is turned Off; must be set less than ExDmpPosFanOn	
	ERV-En	ERV-En	No	Yes			economizer board present	Yes sets economizer and power exhaust operation to integrate an exhaust recovery ventilator	
	DevName	DevName	UCBApp					device name that appears on the FC BUS BACnet network	
	BASCom	BASCom	BACnet	Not Installed				BACnet indicated with communication sub-board option	
	Address	Address	4	0	through	127		effective with communication sub-board option; FC BUS BACnet network address	
Commisn	Network	Network							

[illegible]

Contrtler	Misc	Language	English	French	Spanish	language used in the UCB parameter display	
		Units	IP	SI		IP uses Imperial units of measure in the UCB parameter display (°F, “wc, etc.). SI uses metric units of measure in the UCB parameter display (°C, kPA, etc.)	
Contrtler	SysCntlrs		Relearn	False	True	a setting entry of True is a one-time clearing of the list of SA BUS devices in the UCB memory	
			#NetSensors	0		(not active for this software revision; the number of NetSensors currently in SA BUS communication with the UCB)	
			EconCntlr	Not Present	Offline	Online	status of the economizer board SA BUS communication to the UCB; Not Present indicates SA BUS communication has not been established or relearned away, Online indicates SA BUS communication is established, Offline indicates SA BUS communication was once established and is currently lost
		Misc	4StgCntlr	Not Present	Offline	Online	status of the 4-stage board SA BUS communication to the UCB; Not Present indicates SA BUS communication has not been established or relearned away, Online indicates SA BUS communication is established, Offline indicates SA BUS communication was once established and is currently lost
			FDD-MCntlr	Not Present	Offline	Online	status of the refrigerant circuit #1 & #2 FDD board SA BUS communication to the UCB; Not Present indicates SA BUS communication has not been established or relearned away, Online indicates SA BUS communication is established, Offline indicates SA BUS communication was once established and is currently lost
			FDDSCntlr	Not Present	Offline	Online	status of the refrigerant circuit #3 & #4 FDD board SA BUS communication to the UCB; Not Present indicates SA BUS communication has not been established or relearned away, Online indicates SA BUS communication is established, Offline indicates SA BUS communication was once established and is currently lost
	UCB		UCBMainVer	1.0.0.1101		UCB firmware revision	
			UCBAp-pVer	11.0.0.1017_20		UCB software application revision	
			UCBHardVer			UCB hardware revision	
		Econ-	EconMainVer	1.0.0.1101	economizer board present	economizer board firmware revision	
		Econ	EconAppVer	11.0.0.1017_20	economizer board present	economizer board software application revision	
	EconHardVer		economizer board present	economizer board hardware revision			

Level 1 - UPDATE

Level 1			Level 2			Level 3			Setting range / alternate text indication	Condition(s) for parameter to be displayed	Parameter description and comments

Update	DateTime	>Hour	1	0	through	23	Military (24 hour) time format
		Minute	1	0	through	59	
		Day	1	1	through	28	
		11	29	30	31		
		Month	1	1	through	12	
		Year	2000	1900	through	2155	

maximum Day depends on Month & Year selected

Level 1 - DETAILS

Level 1		Level 2	Level 3	Level 4	Level 5	Level 6	Setting range / alternate text indication	Parameter description and comments
Details	Unit	Name	RTUxxxx	Name	RTUxxxx			14 character maximum
		Model#	RTUxxxx	Model#	RTUxxxx			14 character maximum
		Serial#	DEFAULT_SERIAL	Serial#	DEFAULT_SERIAL			14 character maximum
		ResetLO	Off	ResetLO	Off	On		a setting entry of On resets active hard lockout alarms
Details	Setpoints	Opr ST	73.0 F	Opr ST	73.0 F			the buffered space temperature in use; may be from UCB RAT thermistor or ST thermistor input, SA BUS NetSensor or FC BUS communicated value sources
		OprOcc	UnOccupied	OprOcc	UnOccupied	Occupied		occupancy status in use; the OccSrc parameter lists the source of occupied/unoccupied status; the OccMode parameter sets the occupied/unoccupied status initiation method
		RAT	73.0 F	RAT	73.0 F			the buffered UCB RAT thermistor input
		OprCVClg-Sp	72 F	OprCVClg-Sp	85 F			effective if TSTstatTAT-Only = No; the CV cooling setpoint in use; depending on occupied/unoccupied status, is either ClgOcc-Sp $\pm$ OprSSO or ClgUnocc-Sp $\pm$ OprSSO; cooling operation requests are initiated when OprST rises above this setpoint
		CVOprHtg-Sp	68 F	CVOprHtg-Sp	60 F			effective if TSTstatTAT-Only = No; the CV heating setpoint in use; depending on occupied/unoccupied status, is either CVHtgOcc-Sp $\pm$ OprSSO or CVHtgUnocc-Sp $\pm$ OprSSO; heating operation requests are initiated when OprST falls below this setpoint
		ClgOcc-Sp	72 F	ClgOcc-Sp	45 F through 98 F			effective for CV units if TSTstatTAT-Only = No; the base cooling comfort temperature setpoint in use with occupied status; must be set equal to or less than ClgUnocc-Sp and equal to or greater than CVHtgOcc-Sp
		ClgUnocc-Sp	80 F	ClgUnocc-Sp	46 F through 99 F			effective for CV units if TSTstatTAT-Only = No; the base cooling comfort temperature setpoint in use with unoccupied status; must be set equal to or greater than ClgOcc-Sp

Details	Setpoints	CVHtgOcc-SP	CVHtgOcc-SP	68 F		46 F through 99 F	FanCtl-Type = Variable Speed	effective for CV units if TStatTAT-Only = No; the base heating comfort temperature setpoint in use with occupied status; must be set equal to or less than CtgOcc-Sp and equal to or greater than CVHtgUnocc-Sp
		CVHtgUnocc-SP	CVHtgUnocc-SP	60 F		45 F through 98 F	FanCtl-Type = Variable Speed	effective for CV units if TStatTAT-Only = No; the base heating comfort temperature setpoint in use with unoccupied status; must be set equal to or less than CVHtgOcc-Sp
		SAT	SAT	60.7 F				the buffered UCB SAT thermistor input
		DctPrs	DctPrs	1.50" /w			FanCtl-Type = Variable Speed	effective for VAV units; the buffered UCB DCT PRS 0-5 VDC input
		OprVAV-Clg-Sp	OprVAVCg-Sp	60 F	85 F		FanCtl-Type = Variable Speed	the VAV cooling SAT setpoint in use; with OprST above SATRst-Sp is SATLo-Sp, with OprST below SATRst-Sp is SATUp-Sp; cooling operation requests are initiated when OprST rises above this setpoint
		VAVOprHtg-Sp	VAVOprHtg-Sp	68 F	60 F		FanCtl-Type = Variable Speed	the VAV space heating setpoint in use; depending on occupied/unoccupied status and enabled VAV heating modes, is either MornWRAT-Sp or VAVHtgUnocc-Sp or VAVHtgOcc-Sp; heating operation requests are initiated when OprST falls below this setpoint
		DctPrs-Sp	DctPrs-Sp	1.50" /w	.00" /w	4.99" /w	FanCtl-Type = Variable Speed	effective for VAV units; supply duct pressure setpoint for indoor blower speed control; 1/100th adjustment increments
		SATUp-Sp	SATUp-Sp	60 F	41 F through 70 F		FanCtl-Type = Variable Speed	effective for VAV units with occupied status; the cooling SAT setpoint in use when OpST falls below SATRst-Sp; must be set greater than SATLo-Sp
		SATLo-Sp	SATLo-Sp	55 F	40 F through 69 F		FanCtl-Type = Variable Speed	effective for VAV units with occupied status; the cooling SAT setpoint in use when OpST falls below SATRst-Sp; must be set less than SATUp-Sp
		SATRst-Sp	SATRst-Sp	72 F	40 F through 85 F		FanCtl-Type = Variable Speed	effective for VAV units with occupied status; SATUp-Sp in use when OpST falls below this setpoint, SATLo-Sp in use when OpST rises above this setpoint,
		HtgOcc-En	HtgOcc-En	Yes	No		FanCtl-Type = Variable Speed	Yes sets permission to allow VAV unit heating operation with occupied status
		VAVHtgOcc-Sp	VAVHtgOcc-Sp	68 F	40 F through 85 F		FanCtl-Type = Variable Speed	the heating space temperature setpoint in use for VAV units with occupied status and HtgOcc-En = Yes; requests for heating operation are initiated when OpST falls below this setpoint
		HtgUnocc-En	HtgUnocc-En	No	Yes		FanCtl-Type = Variable Speed	Yes sets permission to allow VAV unit heating operation with unoccupied status
		VAVHtgUnocc-Sp	VAVHtgUnocc-Sp	60 F	45 F through 98 F		FanCtl-Type = Variable Speed	the heating space temperature setpoint in use for VAV units with unoccupied status and HtgUnocc-En = Yes; requests for heating operation are initiated when OpST falls below this setpoint

Details		Zone	Indoor	
Opr ST	73.0 F	Opr ST	the buffered space temperature in use; may be from UCB RAT thermostat or ST thermostat input, SA BUS NetSensor or FC BUS communicated value sources	
OprOcc	UnOccupied	OprOcc	Occupied	occupancy status in use; the OccSrc parameter lists the source of occupied/unoccupied status; the OccMode parameter sets the occupied/unoccupied status initiation method
OprIAQ	477ppm	OprIAQ	?Unrel	economizer board present
Opr SH	49.6 %H	Opr SH	?Unrel	input to the UCB RAH pins, humidity from NetSensor or communicated value
OprFanReq	On	OprFanReq	Off	indoor blower operation request status; source of request may be 24 VAC input to the UCB G terminal, heating operation, cooling operation, occupied status, heating limit trip, purge input or FC BUS communicated command
OprSSO	.0 F	OprSSO	?Unrel	input to the UCB SSO terminal, SSO from NetSensor or communicated value
SSO	.0 F	SSO	?Unrel	input to the UCB SSO terminal
SSORange	3.0 F	SSORange	.0 F through 5.0 F	the maximum above/below alteration permitted for space setpoint offset to adjust CV comfort setpoints; 1/10th adjustment increments
STSrc	Return Air Tem	STSrc	Local Input	the source of the space temperature input in use; Return Air Tem is from UCB RAT thermostat input, Local is from UCB ST thermostat input, Network Sensor is from SA BUS NetSensor, BAS Override is from FC BUS communicated value
STAlarmOffset	5 F	STAlarmOffset	0 F through 25 F	effective for CV units; the temperature amount above OprCVClg-Sp or below CVOprHtg-Sp for Opr ST to begin the STAlarmDelay timer
STAlarmDelay	60min	STAlarmDelay	0min through 120min	effective for CV units; the continuous time with STAlarmOffset exceeded to generate space temperature alarm notification
OccSrc	Local Input	OccSrc	BAS Network Req	the source of occupied/unoccupied status; Local Input is 24 VAC input to the UCB OCC terminal, (Schedule is from the UCB schedule), BAS Network Req is from FC BUS communicated value
TempOccTimeout	120min	TempOccTimeout	30min through 480min	the maximum time from initiation for temporary occupancy to be in effect; temporary occupancy may be initiated from UCB ST thermostat input (momentarily shorted), SA BUS NetSensor or FC BUS communicated value sources

		Fan	Fan Off	On	UCB FAN 24 VAC output status	
	Fan VFD	Fan VFD	0%		FanCtl-Type ≠ Single Speed	UCB VFD 2-10 VDC output status
	FanCtl-Type	FanCtl-Type	Single Speed Two Speed Fixed Variable Variable Speed			indoor blower and unit operating mode selection; Single Speed = CV unit w/o indoor blower VFD, (Two Speed = CV unit w/2-step indoor blower VFD speed control), Fixed Variable = CV unit w/IntelliSpeed indoor blower VFD speed control, Variable Speed = VAV unit w/supply duct static/indoor blower VFD speed control
	APS	APS	Off	On		UCB APS 24 VAC input status; Off indicates 0 VAC input to the APS pin, On indicates 24 VAC input to the APS pin
	DctPrs	DctPrs	1.50"/w		FanCtl-Type = Variable Speed	effective for VAV units; the buffered UCB DCT PRS 0-5 VDC input
	SAT	SAT	60.7 F			the buffered UCB SAT thermistor input
	FanOverload	FanOverload	Normal	Alarm		UCB FAN OVR 24 VAC input status; Normal indicates 24 VAC input to the FAN OVR pin, Alarm indicates 0 VAC input to the FAN OVR pin
	FanVDFIt	FanVDFIt	Normal	Alarm		UCB VFD FLT 24 VAC input status; Normal indicates 0 VAC input to the VFD FLT pin, Alarm indicates 24 VAC input to the VFD FLT pin
	Fan-RT	Fan-RT	.0 hr .0 sec through ????			accumulated run time of UCB FAN 24 VAC output; resetable in 1/10th adjustment increments; ????? shown on UCB display indicates greater than 999.9 hours of accumulated run time
	DFS	DFS	Normal	Alarm		UCB DFS 24 VAC input status; Normal indicates 0 VAC input to the DFS pin, Alarm indicates 24 VAC input to the DFS pin
	LowAmbFan-PrerunCool	LowAmbFan-PrerunCool	60 sec	0 sec through 255 sec		the amount of time the indoor blower must operate before compressor operation is permitted when OproAT is below LowAmb10On5OffSp
	FanOnDlyCool	FanOnDlyCool	0sec	0sec through 30sec		the amount of time indoor blower operation is delayed following the initiation of cooling operation
	FanOffDlyCool	FanOffDlyCool	30sec	0sec through 255sec		the amount of time indoor blower operation is maintained following the termination of cooling operation
	FanOnDlyHeat	FanOnDlyHeat	30sec	0sec through 30sec	#HtgStgs = 1 or more	the amount of time indoor blower operation is delayed following 24 VAC input to the UCB MV pin being received; must be set to 0 for unit with electric heat
	FanOffDlyHeat	FanOffDlyHeat	60sec	0sec through 255sec	#HtgStgs = 1 or more	the amount of time indoor blower operation is maintained following 24 VAC input to the UCB MV pin being lost

Details		Control	Indoor Fan	Setup				
FanOn Occ	FanOn Occ	Yes	No				FanCtl-Type ≠ Variable Speed effective for CV units; Yes = UCB FAN output is on during occupied status, cycles with heating/cooling operation and fan request during unoccupied status; No = UCB FAN output cycles with heating/cooling operation and fan request	
FanOffStartHeat	FanOffStartHeat	Yes	No				Yes interrupts an existing indoor blower operation request from the initiation of a 1st stage heating operation request until the UCB receives 24 VAC input to the MV pin and the FanOnDlyHeat expires, No does not interrupt an existing indoor blower operation request at the initiation of heating operation	
Fan Only-% Cmd	Fan Only-% Cmd			50 %	0 % through	100 %	effective for CV units with IntelliSpeed indoor blower VFD speed control; the UCB VFD 2-10 VDC output during indoor blower-only operation	
1ClgStg-% Cmd	1ClgStg-% Cmd			1ClgStg-% Cmd			effective for CV units with IntelliSpeed indoor blower VFD speed control; the UCB VFD 2-10 VDC output during 1-stage cooling operation	
2ClgStg-% Cmd	2ClgStg-% Cmd			70 %	0 % through	100 %	effective for CV units with IntelliSpeed indoor blower VFD speed control; the UCB VFD 2-10 VDC output during 2-stage cooling operation	
3ClgStg-% Cmd	3ClgStg-% Cmd			80 %	0 % through	100 %	effective for CV units with IntelliSpeed indoor blower VFD speed control; the UCB VFD 2-10 VDC output during 3-stage cooling operation	
4ClgStg-% Cmd	4ClgStg-% Cmd			90 %	0 % through	100 %	effective for CV units with IntelliSpeed indoor blower VFD speed control; the UCB VFD 2-10 VDC output during 4-stage cooling operation	
1HtgStg-% Cmd	1HtgStg-% Cmd			100 %	0 % through	100 %	effective for CV units with IntelliSpeed indoor blower VFD speed control; the UCB VFD 2-10 VDC output during 1-stage heating operation	
2HtgStg-% Cmd	2HtgStg-% Cmd				0 % through	100 %	effective for CV units with IntelliSpeed indoor blower VFD speed control; the UCB VFD 2-10 VDC output during 2-stage heating operation	
3HtgStg-% Cmd	3HtgStg-% Cmd				0 % through	100 %	effective for CV units with IntelliSpeed indoor blower VFD speed control; the UCB VFD 2-10 VDC output during 3-stage heating operation	
DctPrs-Sp	DctPrs-Sp			1.50" /w	.00" /w through	4.99" /w	effective for VAV units; supply duct pressure setpoint for indoor blower speed control; 1/100th adjustment increments	
DctShutdownSp	DctShutdownSp			4.50" /w	.01" /w through	4.99" /w	effective for VAV units; supply duct pressure unit shutdown setpoint; indoor blower and unit operation terminated if DctPrs rises above this setpoint: 1/100th adjustment increments	
#ClgStgs	#ClgStgs	2	1 through	4	number of compressor cooling stages; 1 or more enables the UCB C1 24 VAC output, 2 or more enables the UCB C2 24 VAC output, (3 or more enables the 4-stage board C3 24 VAC output, 4 enables the 4-stage board C4 24 VAC output)			
SAT	SAT	60.7 F	the buffered UCB SAT thermistor input					

Details	Control	Clg	Stage 1	C1	C1 Off	On	UCB C1 24 VAC output status
				C1-En	Yes	No	Yes permits UCB C1 24 VAC output; independent of #ClgStgs selection, No does not permit UCB C1 24 VAC output
				C1OnTmr	0 min		active number of minutes remaining for C1 minimum run timer expiration
				C1ASCDTmr	0 min		active number of minutes remaining for C1 anti-short cycle delay timer expiration
				C1RunTim	.0 hr	.0 hr through ????	accumulated run time of UCB C1 24 VAC output; resettable in 1/10th adjustment increments; ????? shown on UCB display indicates greater than 999.9 hours of accumulated run time
				EC1	42 F		the buffered UCB EC1 thermistor input
				CC1	96 F		the buffered UCB CC1 thermistor input
				C2	Off	On	effective for units with 2 or more compressor cooling stages; UCB C2 24 VAC output status
				C2-En	Yes	No	Yes permits UCB C2 24 VAC output; independent of #ClgStgs selection, No does not permit UCB C1 24 VAC output
				C2OnTmr	0 min		active number of minutes remaining for C2 minimum run timer expiration
				C2ASCDTmr	0 min		active number of minutes remaining for C2 anti-short cycle delay timer expiration
				C2RunTim	.0 hr	.0 hr through ????	accumulated run time of UCB C2 24 VAC output; resettable in 1/10th adjustment increments; ????? shown on UCB display indicates greater than 999.9 hours of accumulated run time
				EC2	42 F		the buffered UCB EC2 thermistor input
				CC2	96 F		the buffered UCB CC2 thermistor input
Details	Control	Clg	Setup	Clg-En	Yes	No	sets permission to allow UCB C1 and C2, (4-stage board C3 and C4) 24 VAC outputs for compressor contactor coils; Yes permits C1, C2 (C3 & C4) output, No does not permit C1, C2 (C3 & C4) output

Details	Control	Clg	Setup						
MinRtCoolStg	MinRtCoolStg				3min	3min	through	10min	sets the minimum run time for C# outputs; individual C# minimum run time begins when the output is turned on ; unless interrupted by safety shutdown, output is maintained until the individual C# minimum run time expires
LeadLag-En	LeadLag-En				No	Yes			effective for 2 or more compressor stages; Yes permits compressor equalized runtime where the C# output with the least C#RunTim operates first, the the C# output with the next least C#RunTim operates second, etc. No operates the C1 output first, the C2 output second, etc.
LowAmbFan-PrerunCool	LowAmbFan-PrerunCool				60 sec	0 sec	through	255 sec	the amount of time the indoor blower must operate before compressor operation is permitted when OprOAT is below LowAmb100On5OffSp
ClgOATCutout-En	ClgOATCutout-En				Yes	No			Yes does not permit C# output if OprOAT falls below ClgOATCutout, No permits C# output at any OprOAT
ClgOATCutout	ClgOATCutout				45 F	0 F	through	100 F	if ClgOATCutout-En = Yes, C# output is not permitted if OprOAT falls below this setpoint
SATCoolLimit-En	SATCoolLimit-En				Yes	No			Yes does not permit C# output if SAT falls below SATCoolLimit-Sp, No permits C# output at any SAT
SATCoolLimit-Sp	SATCoolLimit-Sp				50 F	40 F	through	65 F	if SATCoolLimit-En = Yes, C# output is not permitted if SAT falls below this setpoint
EconLoad-En	EconLoad-En				No	Yes			No does not permit economizer loading; effective if SATCoolLimit-En = Yes and OAT is above 60°F, Yes permits increased Econ position when all but one C# output has been cutoff due to SAT below SATCoolLimit-Sp
AllClgOff-Econ	AllClgOff-Econ				No	Yes			No does not permit C# output if Econ-Free = Yes; Yes permits C# output to supplement economizer free cooling operation if SAT is above 55°F with a 1st stage cooling request or if SAT is above 50°F with a 2nd stage cooling request
LowAmb100-n5OffSp	LowAmb100-n5OffSp				45 F	0 F	through	60 F	if compressor operation otherwise is permitted, C# output cycled on 10 minutes/off 5 minutes with OprOAT below this setpoint
TempHumCtrl-En	TempHumCtrl-En				No	Yes			No does not permit OprSH above TempHum-Sp to decrease OprCVClg-Sp, Yes permits OprSH above TempHum-Sp to decrease OprCVClg-Sp up to the amount set for MaxTempHumSpOff
TempHum-Sp	TempHum-Sp				50 %H	20 %H	through	80 %H	effective if TempHumCtrl-En = Yes; OprSH above this setpoint decreases OprCVClg-Sp up to the amount set for MaxTempHumSpOff

Details	Control	Clg	Setup	MaxTempHum-SpOff	MaxTempHum-SpOff	TempHumCtrl = Yes	effective if TempHumCtrl-En = Yes; maximum amount OprSH above TempHum-Sp decreases OprCVCig-Sp; 1/10th adjustment increments
				TempHumValP-erDegOff	TempHumValP-erDegOff	TempHumCtrl = Yes	effective if TempHumCtrl-En = Yes; sets humidity increments of OprSH above TempHum-Sp to decrease OprCVCig-Sp by 1°F; up to the amount set for MaxTempHumSpOff; adjustment increments of 1s
Details	Control	Htg	Status	Htg-Type	Htg-Type		sets heating control method; Staged permits UCB H1, H2 (& 4-stage board H3) 24 VAC outputs, (not to be used until provisions are made in later control revisions, Proportional permits 4-stage board MOD HT 2-10 VDC output)
				#HtgStgs	#HtgStgs	Htg-Type = Staged	number of heating stages; 1 or more enables the UCB H1 24 VAC output, 2 or more enables the UCB H2 24 VAC output, (3 enables the 4-stage board H3 24 VAC output)
				Empty		#HtgStgs = 0	
				H1	H1	#HtgStgs = 1 or more	effective for units with 1 or more heating stages; UCB H1 24 VAC output status
				H1OnTmr	H1OnTmr	#HtgStgs = 1 or more	active number of minutes remaining for H1 minimum run timer expiration
				H1ASCDTmr	H1ASCDTmr	#HtgStgs = 1 or more	active number of minutes remaining for H1 anti-short cycle delay timer expiration
				H1RunTim	H1RunTim	#HtgStgs = 1 or more	accumulated run time of UCB H1 24 VAC output; resettable in 1/10th adjustment increments; ??? shown on UCB display indicates greater than 999.9 hours of accumulated run time
				H2	H2	#HtgStgs = 2 or more	effective for units with 2 or more heating stages; UCB H2 24 VAC output status
				H2OnTmr	H2OnTmr	#HtgStgs = 2 or more	active number of minutes remaining for H2 minimum run timer expiration
				H2ASCDTmr	H2ASCDTmr	#HtgStgs = 2 or more	active number of minutes remaining for H2 anti-short cycle delay timer expiration
				H2RunTim	H2RunTim	#HtgStgs = 2 or more	accumulated run time of UCB H2 24 VAC output; resettable in 1/10th adjustment increments; ??? shown on UCB display indicates greater than 999.9 hours of accumulated run time

Details		Control	Htg	Setup	Htg			Details		
Htg-En	Htg-En	Yes	No							sets permission to allow UCB H1 and H2, (4-stage board H3) 24 VAC outputs for heat stages; Yes permits H1, H2 (& H3) output, No does not permit H1, H2 (& H3) output
SAT HtgLimit-En	SAT HtgLimit-En	Yes	No							Yes does not permit H# output if SAT rises above SATHtgLimit-Sp, No permits H# output at any SAT
SAT HtgLimit-Sp	SAT HtgLimit-Sp	135 F	100 F through	180 F						if SAT HtgLimit-En = Yes H# output is not permitted if SAT rises above this setpoint
HtgOATCutout-Sp	HtgOATCutout-Sp	75 F	0 F through	100 F						H# output (and hydronic heat operation) is not permitted if OprOAT rises above this setpoint
HydH1SA-Sp	HydH1SA-Sp	120 F	80 F through	180 F						SAT setpoint for hydronic heat operation with a 1st stage heating request
HydH2SA-Sp	HydH2SA-Sp	150 F	80 F through	180 F						SAT setpoint for hydronic heat operation with a 2nd stage heating request
SATTempHydHT-En	SATTempHydHT-En	No	Yes							(not to be used until provisions are made in later control revisions, Yes permits hydronic heat supply air tempering)
HydReverse	HydReverse	No	Yes							sets action of 4-stage board MOD HT 2-10 VDC output; No sets MOD HT output at 2 VDC is 0%/closed and at 10 VDC is 100%/open, Yes sets MOD HT output at 10 VDC is 0%/closed and at 2 VDC is 100%/open
MornW-En	MornW-En	No	Yes							Yes permits VAV unit heating operation for morning warm up
MornWRAT-Sp	MornWRAT-Sp	71 F	50 F through	85 F						If MornW-En = Yes, VAV unit heating will operate during morning warm up until RAT reaches this setpoint
		Econ	0 %							economizer board ECON 2-10 VDC output status
		Econ-Free	No	Yes						Yes indicates economizer free cooling is available, No indicates economizer free cooling is not available; indication depends on FreeClg-Mode effective and current outdoor/indoor conditions
		FreeClg-Mode	Dry Bulb Tempe							free cooling changeover method currently effective; indication depends on FreeClg-Sel setting, presence of OAH 0-10 VDC input to the economizer board and presence of RAH 0-10 VDC input to the UCB

		Details		Control		Econ		Status			
		MAT	MAT	MAT	71 F ?Unrel	economizer board present and input to the economizer MAT terminals	the buffered economizer board mat thermistor input; ?Unrel indicates MAT input was once detected and is currently lost				
		OA-Enth	OA-Enth	OA-Enth	20 B/#	economizer board present	enthalpy calculated from OAH 0-10 VDC input to the economizer board and OprOAT; 0B/# indicated if OAH 0-10 VDC input to the economizer board is not present				
		OprOAH	OprOAH	OprOAH	19 %H ?Unrel	economizer board present	the buffered outdoor air humidity in use; may be from economizer board OAH 0-10 VDC input or FC BUS communicated value sources; ?Unrel indicates OAH input is currently not present				
		Opr OAT	Opr OAT	Opr OAT	73.0 F	economizer board present	the buffered outdoor air temperature in use; may be from UCB OAT thermistor input or FC BUS communicated value sources				
		RA-Enth	RA-Enth	RA-Enth	20 B/#	economizer board present	enthalpy calculated from RAH 0-10 VDC input to the UCB and RAT thermistor input to the UCB; 0B/# indicated if RAH 0-10 VDC input to the UCB is not present				
		RAH	RAH	RAH	19.4 %H ?Unrel	economizer board present and input to the UCB RAH pins	the buffered UCB RAH 0-10 VDC input; ?Unrel indicates UCB RAH 0-10 VDC input was once detected and is currently lost				
		RAT	RAT	RAT	70.4 F	economizer board present	the buffered UCB RAT thermistor input				
		SAH	SAH	SAH	71 %H ?Unrel	economizer board present	the buffered economizer board SAH 0-10 VDC input; ?Unrel indicates SAH input is currently not present				
		Econ-En	Econ-En	Econ-En	No	economizer board present	Yes permits economizer free cooling operation, No does not permit economizer free cooling operation				
		FreeCig-Sel	FreeCig-Sel	FreeCig-Sel		economizer board present	sets the desired economizer free cooling changeover method; Auto sets the changeover method based on the presence of economizer board OAH 2-10 VDC input and UCB RAH 2-10 VDC input, Dual Enthalpy requires OAH and RAH inputs to be effective, Single Enthalpy requires OAH input to be effective				
		Econ-MinPos	Econ-MinPos	Econ-MinPos	20 %	economizer board present	economizer minimum position effective with occupied status, indoor blower operation and when OAT is above LowAmb-Sp				
		EconOAT-SpEn	EconOAT-SpEn	EconOAT-SpEn	55 F	economizer board present	dry bulb free cooling changeover setpoint; with FreeCig-Mode = Dry Bulb Tempe, economizer free cooling is available when OAT is below this setpoint				
		EconOAEnth-Sp	EconOAEnth-Sp	EconOAEnth-Sp	27 B/#	economizer board present	single enthalpy free cooling changeover setpoint; with FreeCig-Mode = Single Enthalpy, economizer free cooling is available when OA-Enth is below this setpoint				
		LowAmb-Sp	LowAmb-Sp	LowAmb-Sp	0 F	economizer board present	with OprOAT below this setting LowAmb-MinPos is the effective economizer minimum position, with OprOAT below this setting Econ-MinPos is the effective economizer minimum position				

Details	Control	Econ	Setup	LowAmb-MinPos	LowAmb-MinPos	0 %	0 % through 100 %	economizer board present	economizer minimum position effective with occupied status, indoor blower operation and when OAT is below LowAmb-Sp; typically set less than Econ-MinPos
				IAQEcon-MaxPos	IAQEcon-MaxPos	50 %	0 % through 100 %	economizer board present	the maximum economizer actuator position for demand ventilation operation; termed "DventMaxEconPos" elsewhere
				LowSpeedFan-MinPos	LowSpeedFan-MinPos	25 %		economizer board present	not to be used until setting access provisions are made in later control revisions, economizer minimum position effective with occupied status and when the VFD speed controlled indoor blower operates at the lowest setting; typically set greater than Econ-MinPos
Details	Control	PowerEx	Status	ExFan	ExFan	Off On		economizer board present	economizer board EX-FAN 24 VAC output status
				ExFanVFD	ExFanVFD	0%		economizer board present and ExFType = Variable Frequency Fan	effective for Variable Frequency Fan power exhaust; the economizer board EX VFD 2-10 VDC output status
				ExFanVFDFlt	ExFanVFDFlt	Normal	Alarm	economizer board present and ExFType = Variable Frequency Fan	economizer board EX VFD FLT 24 VAC input status; Normal indicates 0 VAC input to the EX VFD FLT pin, Alarm indicates 24 VAC input to the EX VFD FLT pin
				ExFan-RT	ExFan-RT	.0 hr	.0 hr through ????	economizer board present	accumulated run time of economizer board EX-FAN 24 VAC output; resettable in 1/10th adjustment increments; ??? shown on UCB display indicates greater than 999.9 hours of accumulated run time
Details	Control	PowerEx	Status	EAD-O	EAD-O	0 %		economizer board present and ExFType = Modulating Damper	effective for Modulating Damper power exhaust; the economizer board EX VFD 2-10 VDC output status
				BldgPres	BldgPres	.164"/w ?Unrel		economizer board present and ExFType ≠ Non modulating	effective for Modulating Damper and Variable Frequency Fan power exhaust; the buffered economizer board BLDG PRES 0-5 VDC input; ?Unrel indicates BLDG PRS input is currently not present
				Bldg-Sp	Bldg-Sp	.100"/w	-.249"/w through .249"/w	economizer board present and ExFType ≠ Non modulating	effective for Modulating Damper and Variable Frequency Fan power exhaust; building pressure setpoint for exhaust damper position/exhaust fan VFD speed control; 1/100th adjustment increments
Details	Control	PowerEx	Setup	ExFType	ExFType	None	Non-Modulating Damper	economizer board present	power exhaust fan mode selection; None = no power exhaust fan installed, Non-Modulating = power exhaust fan on/off by economizer position, (Modulating Damper = power exhaust fan on/off by exhaust damper position, exhaust damper position by BLDG PRES input), (Variable Frequency Fan = power exhaust fan VFD speed control by BLDG PRES input)
				EconDmpPos-FanOn	EconDmpPos-FanOn	60 %	20 % through 99 %	economizer board present and ExFType ≠ Non modulating	effective for Non-Modulating power exhaust; the Econ position where the economizer board EX-FAN 24 VAC output is turned On; must be set greater than EconDmpPosFanOff

Details	Control	AirMon-Station	MOAFlow-Sp	MOAFlow-Sp	10CFM				economizer board present	3rd-party air monitoring station accessory required; the minimum outdoor air flow setpoint, effective with occupied status and indoor blower operation; economizer actuator position increased if Fr Air falls below this setpoint and decreased if Fr Air rises above this setpoint; adjustment increments of 1s
			Fr Air	Fr Air	7129CFM		0CFM	through	100CFM	the buffered economizer board FR AIR 0-10 VDC input; ?Unrel indicates FR AIR input is currently not present
			MOA-Range	MOA-Range	10000CFM		0CFM	through	50000CFM	set for the CFM measured at 10 VDC MOA sensor output; adjustment increments of 1s
Details	Control	SmokeCtrl	OprPurgeCmd	OprPurgeCmd	False		True		economizer board present	False indicates a purge command is not currently active, True indicates a purge command is currently active
			PurgeCmdSrc	PurgeCmdSrc	Return Air Temp		BAS Override		economizer board present	Return Air indicates the purge command source is 24 VAC input to the economizer board PUR terminal, BAS Override is from FC BUS communicated command
			Purge	Purge	False		True		economizer board present	economizer board PUR input status; True indicates 24 VAC input to the PUR terminal, False indicates 0 VAC input to the PUR terminal
Details	Service	Inputs	NetPurge	NetPurge	?Unrel		True	False	economizer board present	status of the FC BUS communicated purge command; True indicates a communicated purge command is active, False indicates a communicated purge command is not active but FC BUS communication is present, ?Unrel indicates FC BUS communication for the purge command is not present
			SD	SD	Normal		Alarm			UCB SD 24 VAC input status; Normal indicates 24 VAC input to the SD terminal, Alarm indicates 0 VAC input to the SD terminal
Details	Service	Sensors	ST	ST	60.5 F ?Unrel				input to the UCB ST terminal	the buffered UCB ST thermistor input
			SSO	SSO	.0 F ?Unrel				input to the UCB SSO terminal	the buffered UCB SSO 0-20,000 Ω input
			IAQ	IAQ	477ppm ?Unrel				economizer board present	the buffered economizer board IAQ 0-10 VDC input; ?Unrel indicates IAQ input is currently not present
			RAH	RAH	49.6 %H ?Unrel				input to the UCB RAH pins	the buffered UCB RAH 0-10 VDC input; ?Unrel indicates UCB RAH 0-10 VDC input was once detected and is currently lost
			OAT	OAT	73.0 F					the buffered UCB OAT thermistor input

Details		Service	Inputs	Sensors
OAH	OAH	49.6 %H ?Unrel	economizer board present	the buffered economizer board OAH 0-10 VDC input; ?Unrel indicates OAH input is currently not present
OAQ	OAQ	477ppm ?Unrel	economizer board present	the buffered economizer board OAQ 0-10 VDC input; ?Unrel indicates OAQ input is currently not present
SAT	SAT	60.7 F		the buffered UCB SAT thermistor input
RAT	RAT	73.0 F		the buffered UCB RAT thermistor input
SAH	SAH	49 %H ?Unrel	economizer board present	the buffered economizer board SAH 0-10 VDC input; ?Unrel indicates SAH input is currently not present
DctPrs	DctPrs	1.50"/w	FanCtl-Type = Variable Speed	effective for VAV units; the buffered UCB DCT PRS 0-5 VDC input
BldgPres	BldgPres	.164"/w ?Unrel	economizer board present and ExFType ≠ Non modulating	effective for Modulating Damper and Variable Frequency Fan power exhaust; the buffered economizer board BLDG PRES 0-5 VDC input; ?Unrel indicates BLDG PRS input is currently not present
MAT	MAT	71 F ?Unrel	economizer board present and input to the economizer MAT terminals	the buffered economizer board mat thermistor input; ?Unrel indicates MAT input was once detected and is currently lost
Fr Air	Fr Air	7129CFM ?Unrel	economizer board present	the buffered economizer board FR AIR 0-10 VDC input; ?Unrel indicates FR AIR input is currently not present
UCB24VForOutputs	UCB24VForOutputs	24.0 VAC		the VAC measured at the UCB 24V FOR OUTPUTS terminal
EconDampPos	EconDampPos	49% ?Unrel	economizer board present	the economizer board AI-IN 0-10 VDC input; ?Unrel indicates AI-IN input is currently not present
EC1	EC1	42 F		the buffered UCB EC1 thermistor input
CC1	CC1	96 F	input to the UCB CC1 pins	the buffered UCB CC1 thermistor input
EC2	EC2	41 F	#ClgStgs = 2 or more	the buffered UCB EC2 thermistor input
CC2	CC2	117 F	#ClgStgs = 2 or more and input to the UCB CC2 pins	the buffered UCB CC2 thermistor input
Details		Service	Inputs	CoilSensors

Details	Service	Inputs	Thermostat			
		Y1-Tstat	Y1-Tstat Off	On	UCB Y1 24 VAC input status; On indicates 24 VAC input to the Y1 terminal, Off indicates 0 VAC input to the Y1 terminal	
		Y2-Tstat	Y2-Tstat Off	On	#CtgStgs = 2 or more	UCB Y2 24 VAC input status; On indicates 24 VAC input to the Y2 terminal, Off indicates 0 VAC input to the Y2 terminal; though this parameter is not displayed if #CtgStgs = 1, Y2 input remains effective to initiate compressor operation to supplement free cooling for single-compressor units
		W1-Tstat	W1-Tstat Off	On		UCB W1 24 VAC input status; On indicates 24 VAC input to the W1 terminal, Off indicates 0 VAC input to the W1 terminal
		W2-Tstat	W2-Tstat Off	On	#HtgStgs = 2 or more	UCB W2 24 VAC input status; On indicates 24 VAC input to the W2 terminal, Off indicates 0 VAC input to the W2 terminal
		G-Tstat	G-Tstat Off	On		UCB G 24 VAC input status; On indicates 24 VAC input to the G terminal, Off indicates 0 VAC input to the G terminal
		TSTstatTAT-Only	TSTstatTAT-Only Yes	No		Yes permits only thermostat inputs to initiate comfort control requests for heating, cooling and indoor blower operation; scheduling and comfort control by sensor inputs are disabled
		Limit	Limit Normal	Alarm		UCB LIMIT 24 VAC input status; Normal indicates 24 VAC input to the LIMIT terminal, Alarm indicates 0 VAC input to the LIMIT terminal
		MV	MV No	Yes		UCB MV 24 VAC input status; Yes indicates 24 VAC input to the MV pin, No indicates 0 VAC input to the MV pin
		HPS1	HPS1 Normal	Alarm		UCB HPS1 24 VAC input status; Normal indicates 24 VAC input to the HPS1 pin, Alarm indicates 0 VAC input to the HPS1 pin
		LPS1	LPS1 Normal	Alarm		UCB LPS1 24 VAC input status; Normal indicates 24 VAC input to the LPS1 pin, Alarm indicates 0 VAC input to the LPS1 pin
		FS1	FS1 Normal	Alarm		refrigerant circuit #1 evaporator coil freeze protection status; Normal indicates EC1 above Freeze-Sp, Alarm indicates EC1 below Freeze-Sp
		HPS2	HPS2 Normal	Alarm	#CtgStgs = 2 or more	UCB HPS2 24 VAC input status; Normal indicates 24 VAC input to the HPS2 pin, Alarm indicates 0 VAC input to the HPS2 pin
		LPS2	LPS2 Normal	Alarm	#CtgStgs = 2 or more	UCB LPS2 24 VAC input status; Normal indicates 24 VAC input to the LPS2 pin, Alarm indicates 0 VAC input to the LPS2 pin
		FS2	FS2 Normal	Alarm	#CtgStgs = 2 or more	refrigerant circuit #2 evaporator coil freeze protection status; Normal indicates EC2 above Freeze-Sp, Alarm indicates EC2 below Freeze-Sp

Details		Service	Inputs	Binary/Inputs	
FanOvrload	FanOvrload	FanOvrload Normal	Alarm		UCB FAN OVR 24 VAC input status; Normal indicates 24 VAC input to the FAN OVR pin, Alarm indicates 0 VAC input to the FAN OVR pin
APS	APS	APS Off	On		UCB APS 24 VAC input status; Off indicates 0 VAC input to the APS pin, On indicates 24 VAC input to the APS pin
DFS	DFS	DFS Normal	Alarm		UCB DFS 24 VAC input status; Normal indicates 0 VAC input to the DFS pin, Alarm indicates 24 VAC input to the DFS pin
SD	SD	SD Normal	Alarm		UCB SD 24 VAC input status; Normal indicates 24 VAC input to the SD terminal, Alarm indicates 0 VAC input to the SD terminal
Purge	Purge	Purge False	True		economizer board PUR input status; True indicates 24 VAC input to the PUR terminal, False indicates 0 VAC input to the PUR terminal
ExFanVDFIt	ExFanVDFIt	ExFanVDFIt Normal	Alarm		economizer board EX VFD FLT 24 VAC input status; Normal indicates 0 VAC input to the EX VFD FLT pin, Alarm indicates 24 VAC input to the EX VFD FLT pin
FanVDFIt	FanVDFIt	FanVDFIt Normal	Alarm		UCB VFD FLT 24 VAC input status; Normal indicates 0 VAC input to the VFD FLT pin, Alarm indicates 24 VAC input to the VFD FLT pin
OCC	OCC	OCC Unoccupied	Occupied		effective if OccMode = External, UCB OCC 24 VAC input status; Occupied indicates 24 VAC input to the OCC terminal, Unoccupied indicates 0 VAC input to the OCC terminal
HPS1-LO	HPS1-LO	HPS1-LO Normal	Lockout		status of refrigerant circuit #1 high pressure hard lockout; Normal indicates a hard lockout is not active, Lockout indicates a hard lockout is active
LPS1-LO	LPS1-LO	LPS1-LO Normal	Lockout		status of refrigerant circuit #1 low pressure hard lockout; Normal indicates a hard lockout is not active, Lockout indicates a hard lockout is active
FS1-LO	FS1-LO	FS1-LO Normal	Lockout		status of refrigerant circuit #1 evaporator freeze protection hard lockout; Normal indicates a hard lockout is not active, Lockout indicates a hard lockout is active
HPS2-LO	HPS2-LO	HPS2-LO	Lockout	#ClgStgs = 2 or more	status of refrigerant circuit #2 high pressure hard lockout; Normal indicates a hard lockout is not active, Lockout indicates a hard lockout is active
LPS2-LO	LPS2-LO	LPS2-LO	Lockout	#ClgStgs = 2 or more	status of refrigerant circuit #2 low pressure hard lockout; Normal indicates a hard lockout is not active, Lockout indicates a hard lockout is active
FS2-LO	FS2-LO	FS2-LO	Lockout	#ClgStgs = 2 or more	status of refrigerant circuit #2 evaporator freeze protection hard lockout; Normal indicates a hard lockout is not active, Lockout indicates a hard lockout is active
LimitLO	LimitLO	LimitLO Normal	Lockout		status of heat setion limit trip hard lockout; Normal indicates a hard lockout is not active, Lockout indicates a hard lockout is active

Details		Service	Inputs	NetworkInputs									
Details	NetST	NetST ?Unrel		40.0 F	through	100.0 F	FC BUS communicated space temperature value; ?Unrel indicates FC BUS communication for the space temperature value is not present						
	NetSSO	NetSSO ?Unrel		-5.0 F	through	5.0 F	FC BUS communicated space setpoint offset value; ?Unrel indicates FC BUS communication for the space setpoint offset value is not present						
	NetSH	NetSH ?Unrel		.0 %H	through	100.0 %H	FC BUS communicated space humidity value; ?Unrel indicates FC BUS communication for the space humidity value is not present						
	NetOcc	NetOcc Not Set	Occupied	UnOccupied	FC BUS communicated occupancy status; Occupied indicates a communicated occupied value is active, UnOccupied indicates a communicated unoccupied value is active, Not Set indicates an FC BUS communicated occupied/unoccupied value is not present								
	NetTempOcc	NetTempOcc False	True	FC BUS communicated temporary occupancy command; True indicates a communicated temporary occupancy command is active, False indicates a communicated temporary occupancy command is not active									
	NetIAQ	NetIAQ ?Unrel	0ppm	through	5000ppm	economizer board present	FC BUS communicated indoor air quality value; ?Unrel indicates FC BUS communication for the indoor air quality value is not present						
	NetFanReq	NetFanReq ?Unrel	On	Off	status of the FC BUS communicated request for indoor blower operation; On indicates a communicated request is active, Off indicates a communicated request is not active but FC BUS communication is present, ?Unrel indicates FC BUS communication for the request for indoor blower operation is not present								
	NetOAT	NetOAT ?Unrel	.0 F	through	125.0 F	FC BUS communicated outdoor air temperature value; ?Unrel indicates FC BUS communication for the outdoor air temperature value is not present							
	NetOAH	NetOAH ?Unrel	.0 %H	through	100.0 %H	economizer board present	FC BUS communicated outdoor air humidity value; ?Unrel indicates FC BUS communication for the outdoor air humidity value is not present						
	NetOAQ	NetOAQ ?Unrel	0ppm	through	5000ppm	economizer board present	FC BUS communicated outdoor air quality value; ?Unrel indicates FC BUS communication for the outdoor air quality value is not present						
NetPurge	NetPurge ?Unrel	True	False	status of the FC BUS communicated purge command; True indicates a communicated purge command is active, False indicates a communicated purge command is not active but FC BUS communication is present, ?Unrel indicates FC BUS communication for the purge command is not present									
Details	C1	C1 Off	On	UCB C1 24 VAC output status									
	C2	C2 Off	On	#ClgStgs = 2 or more	effective for units with 2 or more compressor cooling stages; UCB C2 24 VAC output status								

Details	Service	Outputs	Relay	H1	H1 Off	On	#HtgStgs = 1 or more	effective for units with 1 or more heating stages; UCB H1 24 VAC output status
				H2	Off	On	#HtgStgs = 2 or more	effective for units with 2 or more heating stages; UCB H2 24 VAC output status
				ExFan	Off	On	economizer board present	economizer board EX-FAN 24 VAC output status
				CN-Fan	Off	On		UCB CN-FAN 24 VAC output status
				Fan	Off	On		UCB FAN 24 VAC output status
				X-Out	Off	On		UCB X terminal 24 VAC output status
				Empty			FanCtl-Type = Single Speed and economizer board is not present	
				FanVFD	0%		FanCtl-Type ≠ Single Speed	UCB VFD 2-10 VDC output status
				Econ	0%		economizer board present	economizer board ECON 2-10 VDC output status
				ExFanVFD	0%		economizer board present and ExFType = Variable Frequency Fan	effective for Variable Frequency Fan power exhaust; the economizer board EX VFD 2-10 VDC output status
				#ClgStgs	2	1	through 4	number of compressor cooling stages; 1 or more enables the UCB C1 24 VAC output, 2 or more enables the UCB C2 24 VAC output, (3 or more enables the 4-stage board C3 24 VAC output, 4 enables the 4-stage board C4 24 VAC output)
				#HtgStgs	0	0	through 3	number of heating stages; 1 or more enables the UCB H1 24 VAC output, 2 or more enables the UCB H2 24 VAC output, (3 enables the 4-stage board H3 24 VAC output)
				Htg-Type	Staged	Proportional		sets heating control method; Staged permits UCB H1, H2 (& 4-stage board H3) 24 VAC outputs, (not to be used until provisions are made in later control revisions, Proportional permits 4-stage board MOD HT 2-10 VDC output)

List of Parameter Terms

Display Name	Parameter Long Name
CC1	Condenser Coil Temp 1
CC2	Condenser Coil Temp 2
EC1	Evaporator Coil Temp 1
EC2	Evaporator Coil Temp 2
Fan VFD	Fan % Command
SAT	Supply Air Temperature
#ClgStgs	Number of Cooling Stages Installed
#HtgStgs	Number of Heating Stages Installed
#NetSensors	Number of Network Sensors Online
>Hour	Time
1ClgStg-% Cmd	Occupied: One Stage of Cool % Command
1HtgStg-% Cmd	Occupied: One Stage of Heat % Command
2ClgStg-% Cmd	Occupied: Two Stage of Cool % Command
2HtgStg-% Cmd	Occupied: Two Stage of Heat % Command
3ClgStg-% Cmd	Occupied: Three Stage of Cool % Command
3HtgStg-% Cmd	Occupied: Three Stage of Heat % Command
4ClgStg-% Cmd	Occupied: Four Stage of Cool % Command
4StgCntlr	4 Stage Controller
Address	Address
AllClgOff-Econ	All Stages of Cooling Off in Free Cooling
APS	Air Proving Switch
APSSetup	Air Proving Switch Setup
BASCom	BAS Communication
BaudRate	Baud Rate
BldgPres	Building Static Pressure
Bldg-Sp	Building Pressure Setpoint
C1	Compressor Stage Command 1
C1ASCDTmr	Anti-Short Cycle Delay Time Remaining 1
C1-En	Compressor Stage 1 Enabled
C1OnTmr	Min On Time Remaining 1
C1RunTim	Compressor Stage Accumulated Runtime 1
C2	Compressor Stage Command 2
C2ASCDTmr	Anti-Short Cycle Delay Time Remaining 2
C2-En	Compressor Stage 2 Enabled
C2OnTmr	Min On Time Remaining 2
C2RunTim	Compressor Stage Accumulated Runtime 2
Clg-En	Cooling Mode Enabled For Operation
ClgOATCutout	OAT Cooling Cutout
ClgOATCutout-En	OAT Cooling Cutout Enabled
ClgOcc-Sp	CV Occupied Cooling Setpoint
ClgUnocc-Sp	CV Unoccupied Cooling Setpoint

CN-Fan	Condenser Fan 1
Comm-S	Communication Status
CVHtgOcc-SP	CV Occupied Heating Setpoint
CVHtgUnocc-Sp	CV Unoccupied Heating Setpoint
CVOprHtg-Sp	CV Operating Heating Setpoint
Day	Date
DctPrs	Duct Static Pressure
DctPrs-Sp	Duct Pressure Setpoint
DctShutdownSp	Duct Pressure Shutdown Setpoint
DeviceId	Device Oid
DevName	Device Name
DevName	Device Name
DFS	Dirty Filter Switch
DVentDiff-Sp	Demand Ventilation Differential Setpoint
DVentIAQ-Sp	Demand Ventilation Indoor Air Quality Setpoint
DVentMaxEconPos	Demand Ventilation Maximum Economizer Position
DVent-Mode	Demand Ventilation Mode of Operation
EAD-O	Exhaust Damper % Command
Econ	Economizer Damper % Command
EconAppVer	Application version
EconCntlr	Econ Controller
EconDampPos	Economizer Damper Position
EconDmpPosFanOff	Economizer Damper Position for Exhaust Fan to Turn Off
EconDmpPosFanOn	Economizer Damper Position for Exhaust Fan to Turn On
Econ-En	Economizer Enabled For Operation
Econ-Free	Econ Free Cooling Available
EconHardVer	Hardware Version
EconLoad-En	Economizer Loading Enabled
EconMainVer	Firmware Main version
Econ-MinPos	Economizer Minimum Position Setpoint
EconOAEnth-Sp	Economizer Outdoor Air Enthalpy Setpoint
EconOAT-SpEn	Economizer Outdoor Air Temp Enable Setpoint
empOccTimeout	Temporary Occupancy Timeout
ERV-En	ERV Enabled
ExDmpPosFanOff	Exhaust Damper Position for Exhaust Fan to Turn
ExDmpPosFanOn	Exhaust Damper Position for Exhaust Fan to Turn On
ExFan	Exhaust Fan Command
ExFan-RT	Exhaust Fan Accumulated Runtime
ExFanVFD	Exhaust Fan VFD % Command
ExFanVFDFlt	Exhaust Fan VFD Fault
ExFType	Exhaust Type
Fan	Fan Command
Fan Only-% Cmd	Occupied: No Heat or Cool % Command
FanCtl-Type	Fan Control Type
FanOffDlyCool	Fan Off Delay for Cool

FanOffDlyHeat	Fan Off Delay for Heat
FanOffStartHeat	Turn Off Continuous Fan Operation When Starting Heat
FanOn Occ	Continuous Fan Operation in Occupied Mode
FanOnDlyCool	Fan On Delay for Cool
FanOnDlyHeat	Fan On Delay for Heat
FanOvrload	Fan Overload
FanReqSrc	Fan Request Source
Fan-RT	Fan Accumulated Runtime
FanVFD	Fan % Command
FanVFDFlt	Fan VFD Fault
FDDMCntlr	FDD Master Controller
FDDSCntlr	FDD Slave Controller
Firm-S	Firmware Status
FirmVer	Firmware Version
Fr Air	Fresh Air Intake Value
FreeClg-Mode	Free Cooling Current Mode
FreeClg-Sel	Free Cooling Selection
Freeze-Sp	Freeze Condition Setpoint
FS1	Freeze Condition 1
FS1-LO	Freeze Condition Lockout 1
FS2	Freeze Condition 2
FS2-LO	Freeze Condition Lockout 2
G-Tstat	G - Thermostat
H1	Heat Stage Command 1
H1ASCDTmr	Heating Stage 1 Anti-Short Cycle Delay Time Remaining
H1OnTmr	Heating Stage 1 Min On Time Remaining
H1RunTim	Heat Stage 1 Accumulated Runtime
H2	Heat Stage Command 2
H2ASCDTmr	Heating Stage 2 Anti-Short Cycle Delay Time Remaining
H2OnTmr	Heating Stage 2 Min On Time Remaining
H2RunTim	Heat Stage 2 Accumulated Runtime
HGP-Inst	Hot Gas Bypass Present
HPS1	High Pressure Limit 1
HPS1-LO	High Pressure Lockout 1
HPS2	High Pressure Limit 2
HPS2-LO	High Pressure Lockout 2
Htg-En	Heating Mode Enabled For Operation
HtgOATCutout-Sp	Outdoor Air Temp Heating Cutout Setpoint
HtgOcc-En	VAV Occupied Heating Enabled
Htg-Type	Heating Control Type
HtgUnocc-En	VAV Unoccupied Heating Enabled
HydH1SA-Sp	Hydronic Heating Stage #1 Supply Air Setpoint
HydH2SA-Sp	Hydronic Heating Stage #2 Supply Air Setpoint
HydReverse	Hydronic Heat Valve Reverse Acting
IAQ	Indoor Air Quality

IAQEcon-MaxPos	Maximum IAQ Ventilation Economizer Position
IAQRange	Indoor Air Quality Sensor Range
IAQSrc	Indoor Air Quality Source
Language	Language
LeadLag-En	Lead/Lag Equalize Cooling Stage Runtime Enabled
Limit	Heat Limit1 Switch
LimitLO	Heat Limit1 Switch Lockout
LowAmb10On5OffSp	Low Ambient Cooling Stages 10 on 5 off Setpoint
LowAmbFanPrerunCool	Low Ambient Fan Pre-run Time For Cooling
LowAmb-MinPos	Low Ambient Economizer Minimum Position
LowAmb-Sp	Low Ambient Economizer Setpoint
LowSpeedFan-MinPos	Economizer Damper Minimum Position Low Speed Fan
LPS1	Low Pressure Limit 1
LPS1-LO	Low Pressure Lockout 1
LPS2	Low Pressure Limit 2
LPS2-LO	Low Pressure Lockout 2
MAT	Mixed Air Temperature
MaxTempHumSpOff	Maximum Temperature / Humidity Setpoint Offset
MinRtCoolStg	Minimum Runtime for a Cooling Stage
Minute	Time
MOAFlow-Sp	Fresh Air Intake Setpoint
MOA-Range	Fresh Air Intake Max Sensor Range
Model#	Unit Model Number
Month	Date
MornW-En	Morning Warmup Enabled
MornWRAT-Sp	Morning Warmup/Return Air Temp Setpoint
MV	Gas Valve1 Input
Name	Unit Name
NetFanReq	Network Override Fan Request
NetIAQ	Network Override Indoor Air Quality
NetOAH	Network Override Outdoor Air Humidity
NetOAQ	Network Override Outdoor Air Quality
NetOAT	Network Override Outdoor Air Temperature
NetOcc	Network Occupancy Request
NetPurge	Network Override Purge Command
NetSH	Network Override Zone Humidity
NetSSO	Network Override Space Setpoint Offset
NetST	Network Override Space Temperature
NetTempOcc	Network Temporary Occupancy Request
OA-Enth	Outdoor Air Enthalpy
OAH	Outdoor Air Humidity Input
OAHSrc	Outdoor Air Humidity Source
OAQ	Outdoor Air Quality Input
OAQRange	Outdoor Air Quality Sensor Range
OAQSrc	Outdoor Air Quality Source

OAT	Outdoor Air Temperature Input
OATSrc	Outdoor Air Temperature Source
OCC	Occupancy Input
OccMode	Occupancy Mode
OccSrc	Occupancy Input Source
Opr OAT	Operational Outdoor Air Temperature
Opr SH	Operational Space Humidity
Opr ST	Operational Space Temperature
OprBaudRate	Operating Baud Rate
OprCVClg-Sp	CV Operating Cooling Setpoint
OprFanReq	OperatingFan Request
OprIAQ	Operational Indoor Air Quality
OprOAH	Operational Outdoor Air Humidity
OprOAQ	Operational Outdoor Air Quality
OprOAT	Operational Outdoor Air Temperature
OprOcc	Operational Occupancy
OprPurgeCmd	Operating Purge Command
OprSH	Operational Space Humidity
OprSSO	Operational Space Temperature Setpoint Offset
OprST	Operational Space Temperature
OprVAVClg-Sp	VAV Operating Cooling Supply Air Temp Setpoint
Purge	Local Purge Command Input
PurgeCmdSrc	Purge Command Source
RA-Enth	Return Air Enthalpy
RAH	Space Humidity RAH Input
RAT	Return Air Temperature
Relearn	Relearn System
ResetLO	Reset Lockouts
SAH	Supply Air Humidity
SATCoolLimit-En	SAT Limit for Cooling Enable
SATCoolLimit-Sp	SAT Limit for Cooling Setpoint
SATHTgLimit-En	SAT Air Temp Limit for Heating Enabled
SATHTgLimit-Sp	SAT Air Temp Limit For Heating Setpoint
SATLo-Sp	VAV Cooling Supply Air Temp Lower Setpoint
SATRst-Sp	VAV Supply Air Temp Reset Setpoint
SATTempHydHT-En	Hydronic Heat SAT Tempering Enabled
SATUp-Sp	VAV Cooling Supply Air Temp Upper Setpoint
SD	Shutdown Input/Smoke Detector
Serial#	Unit Serial Number
SH Source	Space Humidity Source
SSO	Space Temp Setpoint Offset Input
SSO Src	Space Temperature Setpoint Offset Source
SSORange	Space Temperature Setpoint Offset Range
ST	Space Temperature Input
STAlarmDelay	Space Temperature Alarm Time Delay

STAlarmOffset	Space Temperature Alarm Setpoint Offset
STSrc	Space Temperature Source
TempHumCtrl-En	Temperature/Humidity (Return) Control Enable
TempHum-Sp	Temperature/Humidity Setpoint
TempHumValPerDegOff	Temperature / Humidity Value per Degree Offset
TimeZone	Time Zone
TSTstatTAT-Only	Thermostat Only Control Enabled
UCB24VForOutputs	UCB 24VAC Input
UCBAppVer	Application version
UCBHardVer	Hardware Version
UCBMainVer	Firmware Main version
Units	Units
VAVHtgOcc-SP	VAV Occupied Heating Setpoint
VAVHtgUnocc-Sp	VAV Unoccupied Heating Setpoint
VAVOprHtg-Sp	VAV Operating Heating Setpoint
W1-Tstat	W1 - Thermostat
W2-Tstat	W2 - Thermostat
X-Out	X-OUT
Y1-Tstat	Y1 - Thermostat
Y2-Tstat	Y2 - Thermostat
Year	Date

INVERTERS

DRIVE SYSTEMS

Quick start and reference guide

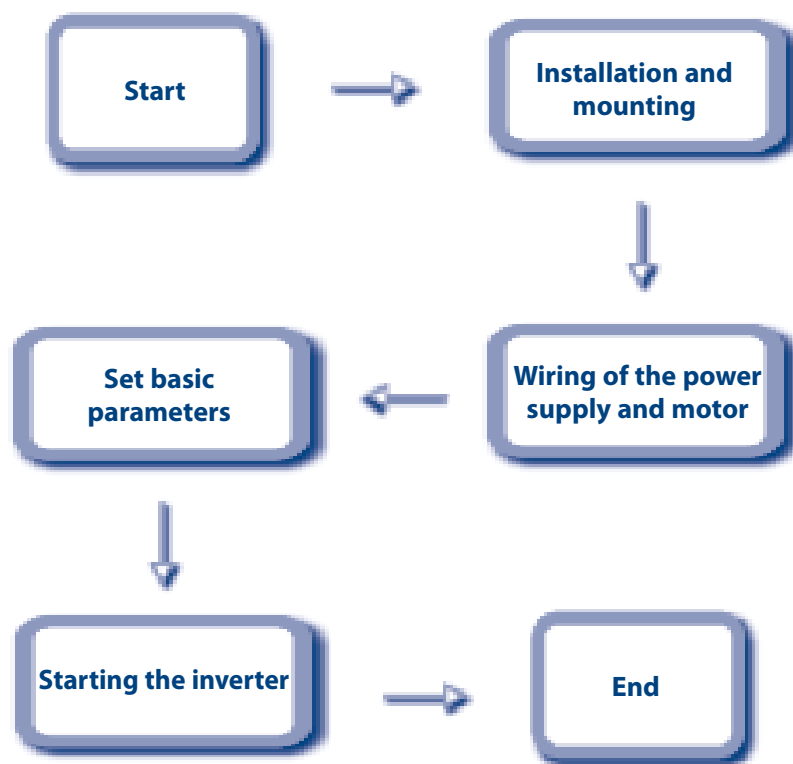


Installation /// Wiring /// Settings ///
Basic parameters /// Simple error codes ///
Regular maintenance ///

Contents

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Know your inverter	5
Mitsubishi inverter ranges	5/6
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Inverter programming panels	7/8
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Start-up route map

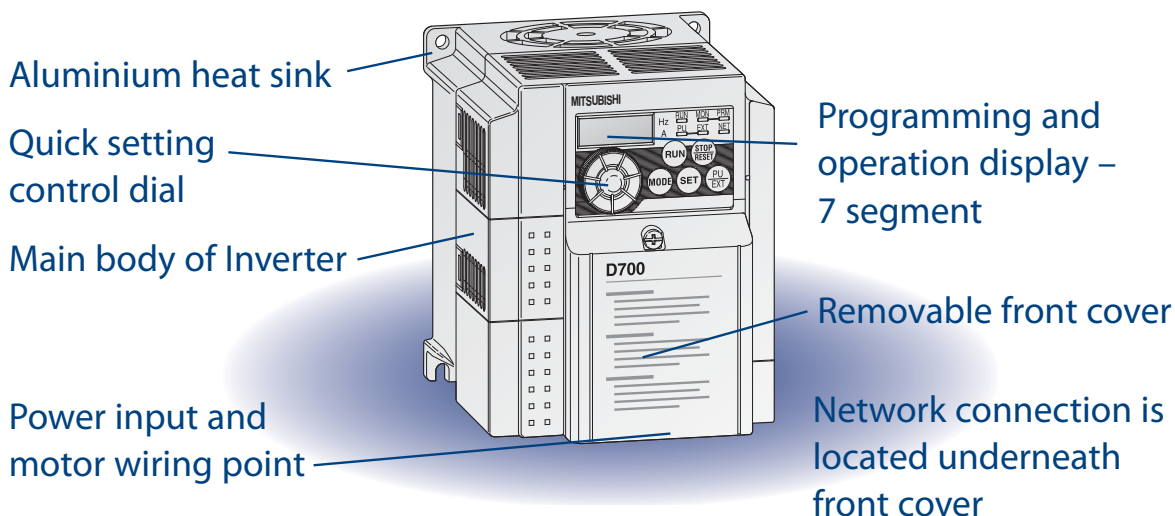


REGULAR MAINTENANCE

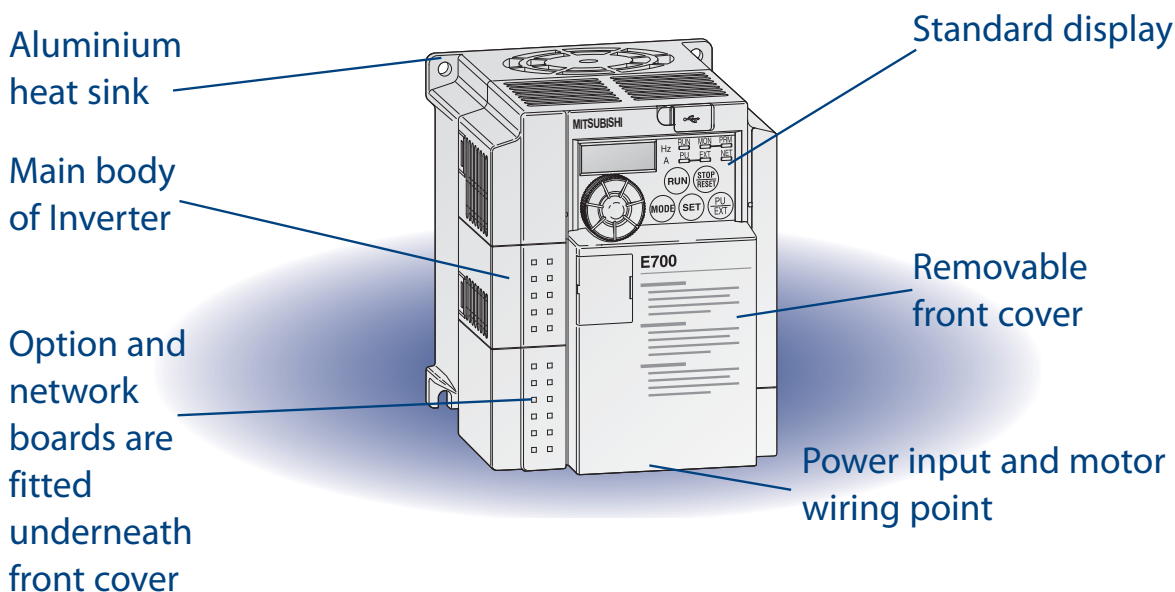
Once the Inverter has been set-up and commissioned a series of regular maintenance checks should be performed to monitor the Inverter and motor performance is still at an optimum.

Mitsubishi Inverter Ranges

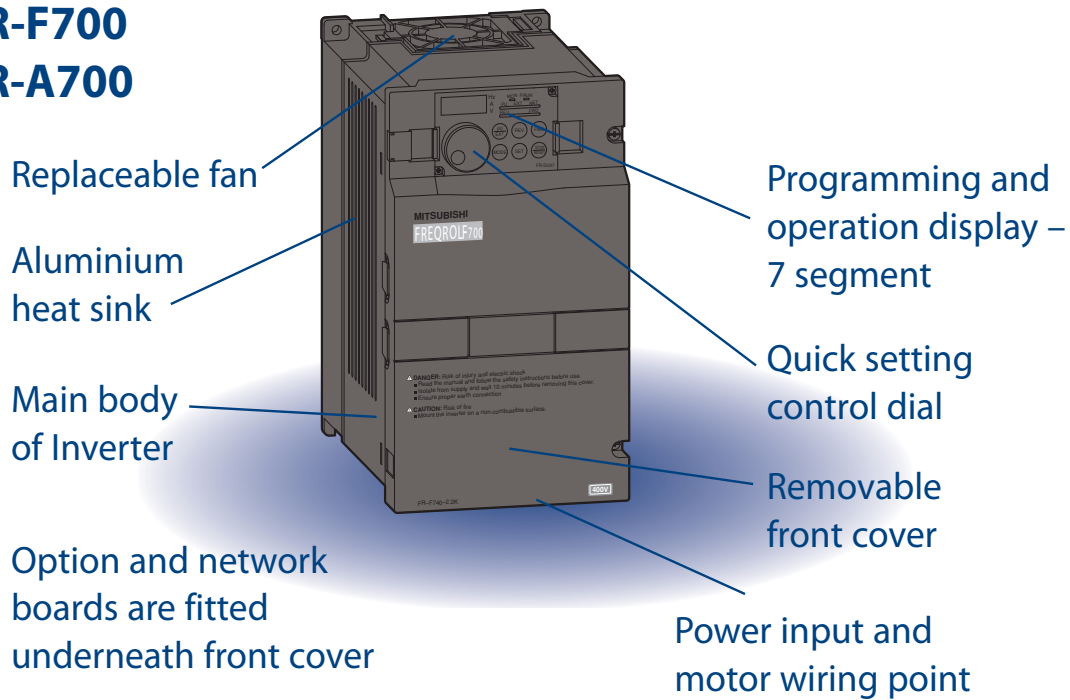
FR-D700



FR-E700

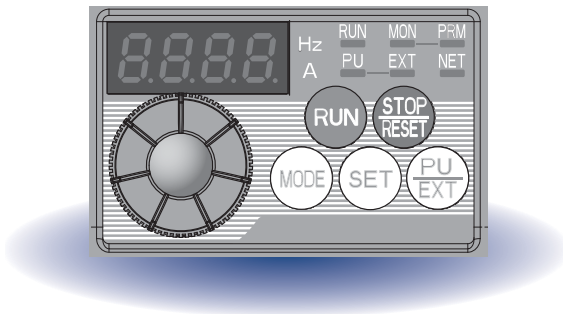


FR-F700 FR-A700

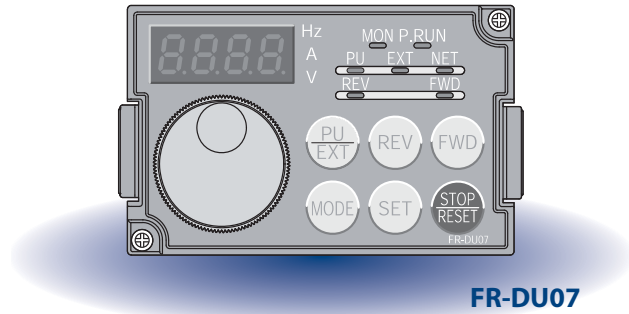


Control Panels

FR-D700/E700
embedded control panel



FR-F700/A700
removable control panel



Using the digital dial



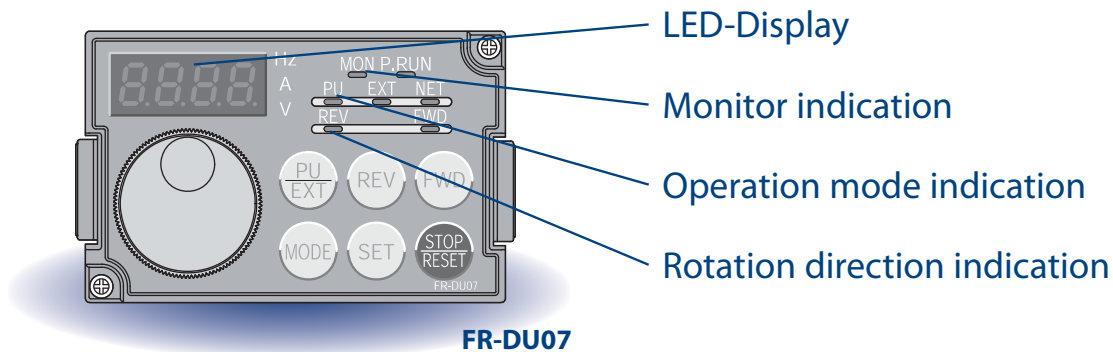
The digital setting dial allows quick and easy selection of parameters and the setting of parameter values.

The digital setting dial performs the function of the traditional   keys as found on the FR-PU04 and FR-PU07 etc. All other buttons operate in a similar way to those found on traditional control units.

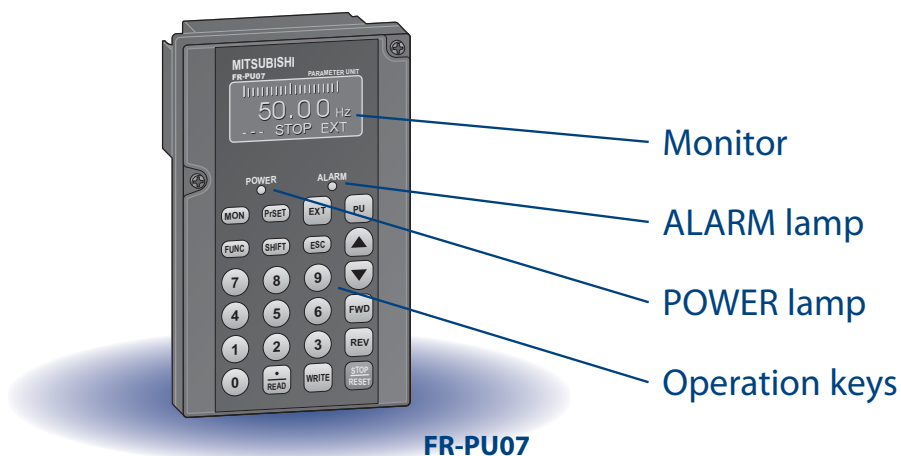
Using the setting key

At power-on the inverter is put in the external operation mode. The operation mode can be changed between the PU and External operation mode by pressing the  key or the   key (dependent on control panel model)

Standard FR-F700/A700 removable control panel



Optional removable control panel



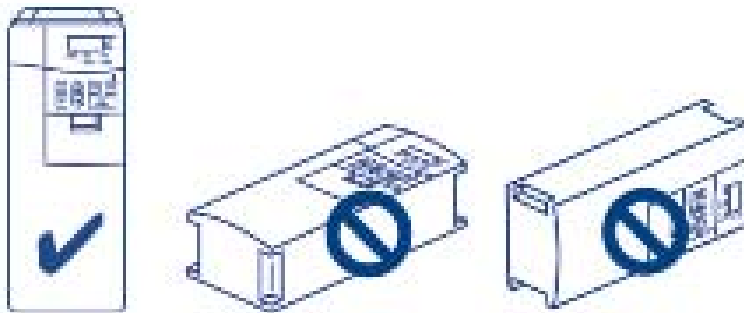
Optional comprehensive control panel for use with FR-D, FR-E, FR-F and FR-A series inverters. This unit can operate in 8 languages.

General Precautions

A major component of an Inverter's design is a capacitor bank. The capacitors used can hold their charge for up to 15 minutes after power down. For your own protection from electrical shock please wait at least 15 minutes before checking the residual voltage level by placing a meter between terminals P/+ and N/- (resp. + and - for FR-D700 series). The voltage measured should not be more than 30 V DC.

General installation notes

- Install the inverter securely, using bolts, in a vertical plane



- Install the inverter on a non combustable surface

NOTE

For specific installation information please refer to the dedicated installation, hardware or operation manual for your inverter

Installation and mounting /// Installation and mounting ///

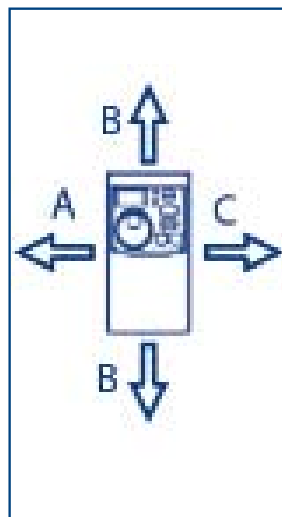
- Avoid installing the inverter in places where it will be exposed to direct sunlight, high temperatures or high humidity/moisture

Ambient temperature	-10 °C to +50 °C, 14 °F to 122 °F (non freezing) see note 1
Ambient humidity	90 % RH or less (non condensating)
Storage temperature	-20 °C to +65 °C (-4 °F to 149 °F) for short time e.g. during transit
Ambience	Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)
Altitude	Up to 1000 m (3280 ft). Above this level de-rate by 3 % for every 500 m (1690 ft) upto a maximum 2500 m (8202 ft) or 91 % of operation
Vibration	5.9 m/s ² or less

- Leave enough clearance around the inverter to allow it to self-cool

	Model	A	B	C
D700	< 5.5 kW	1	10	1
	>= 5.5 kW	5	10	5
E700	< 5.5 kW	1	10	1
	>= 5.5 kW	5	10	5
F700/A700	<= 00083	1	10	10
		5	10	10
	>= 01800	10	20	20

Clearance in cm

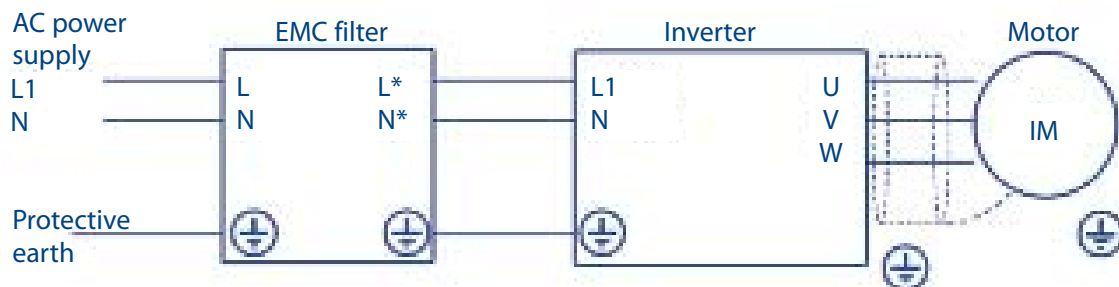


Note 1: This temperature may vary if the inverter is de-rated.
Please refer to the full instruction manual for details.

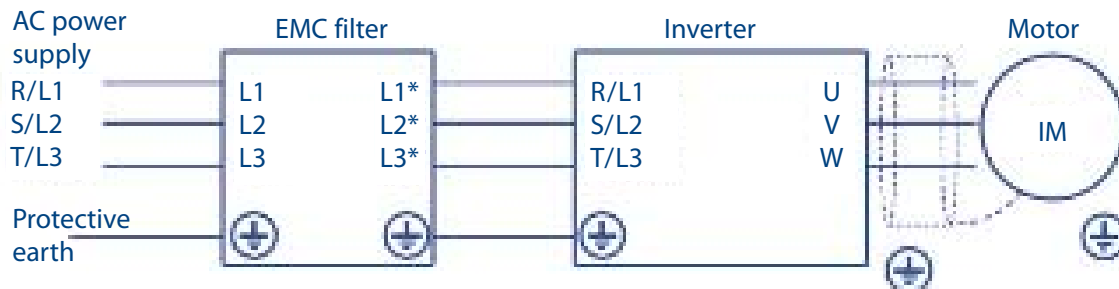
General Wiring

All electrical products have to comply with European EMC regulations, but an important part of keeping that compliance is to use good wiring practice. The wiring schematics used in this section are shown demonstrating some of these practises, i.e the use of good earthing, and where required the use of filters.

General wiring for single-phase inverter



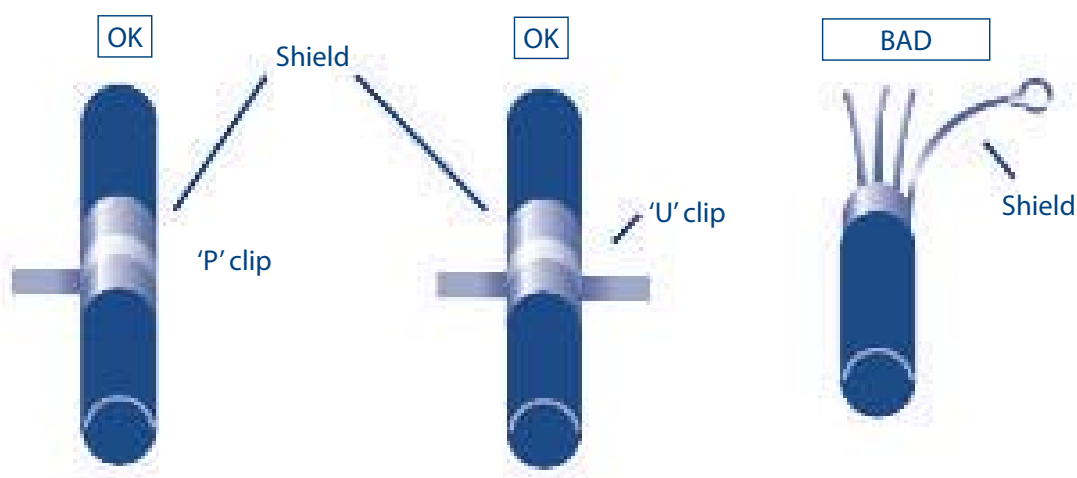
General wiring for three-phase inverter



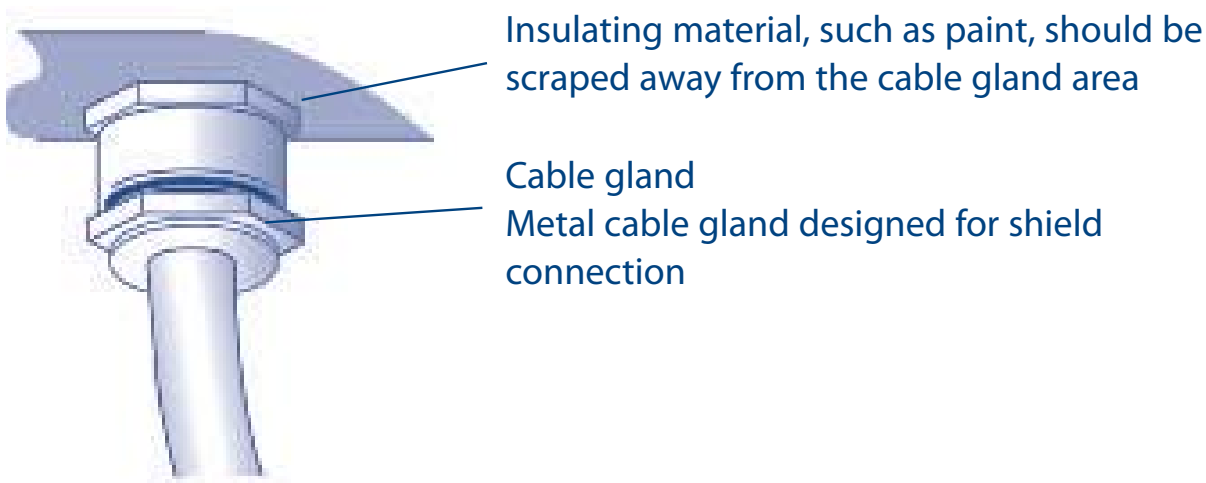
Good earthing practice

From both LVD and EMC and a safety point of view it is essential that earthing connections are always made in the most thorough way possible. See below for examples of good EMC grounding.

Using 'P' and 'U' clips for maximum surface contact and stable connection



Ensure that paint or other surface treatments are removed where a cable gland connects to the body of an enclosure.



Note regarding symbols used

When a value or parameter needs to be set, the following symbol has been used. For inverters without a digital setting dial, the value should be set using their   keys.



Setting a frequency

1. Press the  to put the inverter into PU operation – this is indicated by the PU LED being lit e.g.



2. Adjust the frequency value with the setting dial/keys. When the desired value is found press . The display will alternate between 'F' for frequency and the value set in Hz, e.g.



3. Press the  or   keys to start the inverter/motor rotation
4. Press the  key to stop rotation

6.2 Setting a parameter

1. Ensure step #1 is completed as before.
2. Press the  key to put the inverter into parameter mode – the display will change like this

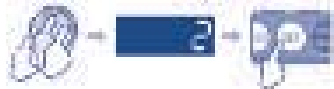


3. Select the desired parameter with the setting  dial/keys.

When the desired parameter is found press the  key to see the current value for the selected parameter, e.g.



To adjust the setting, move the setting dial/keys  to the required value. To set the value, press the , key, e.g.



The display will alternate between the parameter number  and its new set value, e.g. 

6.3 Monitoring operation

1. Ensure step #1 is completed.
2. Press the  key, current being drawn by the motor in Amps and present voltage level in Volts, e.g.



Each inverter has a wide range of parameters that can be set to tune the inverter-motor system to the very best performance necessary, but to get an inverter working and to check it is installed correctly etc. you only need a handful of parameters.

Basic parameters for FR-D700 and FR-E700

Parameter	Factory setting	Description
0	6/4/3/2 % *1	Torque boost
1	120 Hz	Maximum frequency
2	0 Hz	Minimum frequency
3	50 Hz	Base frequency
4	50 Hz	Multi-speed setting (high speed)
5	30 Hz	Multi-speed setting (middle speed)
6	10 Hz	Multi-speed setting (low speed)
7	5/10 s *1	Acceleration time
8	5/10 s *1	Deceleration time
9	Rated inverter output current	Electronic thermal O/L relay
19	8888	Base frequency voltage
20	50 Hz	Acceleration/deceleration reference frequency
79	0	Operation mode selection

*1 – differ according to capacities

Basic parameters for FR-F700 and FR-A700

Parameter	Factory setting	Description
0	6/4/3/2/ 1.5/1 % *1	Torque boost
1	60/120 Hz	Maximum frequency
2	0 Hz	Minimum frequency
3	50 Hz	Base frequency
4	50 Hz	Multi-speed setting (high speed)
5	30 Hz	Multi-speed setting (middle speed)
6	10 Hz	Multi-speed setting (low speed)
7	5/15 s *1	Acceleration time
8	10/30 s *1	Deceleration time
9	Rated inverter output current	Electronic thermal O/L relay
19	8888	Base frequency voltage
20	50 Hz	Acceleration/deceleration reference frequency
79	0	Operation mode selection

* 1 – differ according to capacities, 1.5 % for FR-F700 only

Model	Error code
FR-D700, FR-E700, FR-F700, FR-A700	E.OC[]
Error A) The output current of the inverter has reached or exceeded 200 % of the rated current. B) The temperature of the main circuits of the inverter rises rapidly.	Remedy Look for one of the following faults: A) A short circuit or ground fault across the main outputs. B) An excessive moment of inertia from the Load. C) Acceleration or deceleration times are too short. D) A restart during motor idling occurred. E) A motor with an excessive capacity has been used. F) Over heating occurred due to insufficient cooling (defective cooling fan or choked heat sink)

Model	Error code
FR-D700, FR-E700, FR-F700, FR-A700	E.OV[]
Error The converter voltage has increased highly due to regenerative energy. The overvoltage limit was exceeded during acceleration, constant speed or deceleration.	Remedy In most cases the protective function is activated due to a too short deceleration time preset causing a regenerative overload. Increase the deceleration time or connect an external brake unit. An overvoltage in the mains power supply activates this protective function.

The number in the parenthesis, indicates

[] = 1 – acceleration, 2 – constant speed, 3 – deceleration

Model	Error code
FR-D700, FR-E700, FR-F700, FR-A700	E.THM
Error The electronic motor protection switch continually detects the motor current and the output frequency of the inverter. If a self-cooling motor operates over a long period at low speed but high torque, the motor is thermally overloaded and the protective function is activated. If several motors are operated by one inverter, use independent motor thermal protection.	Remedy Decrease the motor load to avoid fault activation. Check whether the performance range of the motor and inverter correspond. Increase the thermal setting in Pr. 9

An inverter is a static unit mainly consisting of semiconductor devices processing high voltages and currents. Daily inspection should be performed to prevent faults from occurring due to adverse effects of the operating environment and to monitor the service life of the inverter. Other specific inspections should be carried out periodically.

General

- Check there is no change in the ambient environment and that it remains within the specified levels (see installation & mounting)
- Check for unusual vibration and audible noise
- Check that the main circuit voltages are normal – measure across inverter terminals R/L1, S/L2 and T/L3 (values should be in accordance with those specified in the specific product manual)

Cooling system

- Check the cooling fan (where fitted) for unusual vibration and noise – turn by hand with the power off and perform a visual check

Display

- Check for blown LED lamps
- Display-meter: check that readings of the current and voltage meters are within specified limits

Motor

- Check for unusual vibration and noise
- Check for unusual odour

Don't guess!

If you do not know or you are not sure check the manual or ask!

Get the right voltage!

Always check the voltage requirements of the inverter before wiring it to the supply. A simple check of the model name will identify the required input voltage.

40 = 400 V, three phase ... e.g. FR-F740

20S = 200 V, single phase ... e.g. FR-D720S

Don't forget to connect the earth!

It's for your safety and it's good EMC practice

Installing brake units

Some form of braking may be needed to help the application's performance. In these cases please be aware of the following "brake" configuration rules.

- FR-D700/E700 series – A brake resistor can be fitted (not for FR-D720S-008/014). Alternatively a full brake unit can be added.
- FR-F700 series – A full brake unit can be added.
- FR-A700 series – A brake transistor and low duty resistor is included on units up to 00250. Transistors are fitted from 00310 to 00620 activated by an additional resistor. A full brake unit can be added to any size.

Mitsubishi Electric makes all possible efforts to provide only the highest quality automation products, meeting appropriate European legislation and requirements for Safety, EMC and hazardous materials etc. Before using any Mitsubishi automation product, installers and users should read the appropriate related installation, hardware, users and operation manuals where available.

IMPORTANT SAFETY WARNINGS

- You should only be installing electrical equipment if you have been trained to do so.
- All installations should be made in accordance to the specific manufacturers installation, hardware and operation manuals and be compliant to local wiring rules and regulations.
- If you have any doubt about how to install and commission an inverter – stop immediately and seek advice from a trained and qualified installer.

My drive settings

Note:
.....

Parameter	Description	Setting

