



# LIMITROL<sup>+</sup> Floating Head Pressure Control System

Supplement to  
Condensing Unit Installation  
and Maintenance Manual

Bulletin B40-LIMITROL-AG-2  
Part # 1101115



PRODUCT SUPPORT  
web: [b-rp.ca/limitrol](http://b-rp.ca/limitrol)  
email: [smcu@b-rp.ca](mailto:smcu@b-rp.ca)  
call: 1-844-893-3222 x521

scan:



For use on select Air Cooled  
Condensing Units matched with Low,  
Medium or High Profile Evaporators

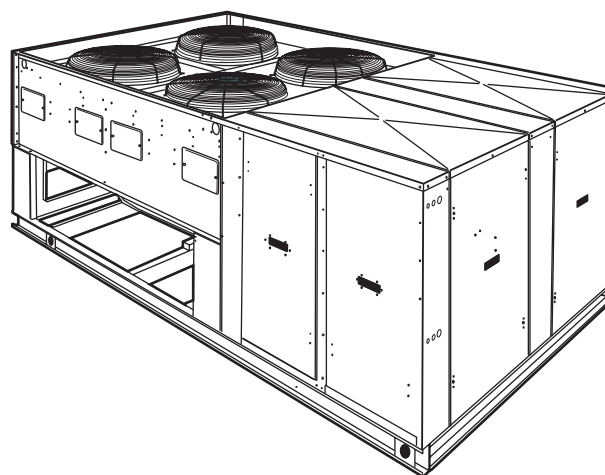
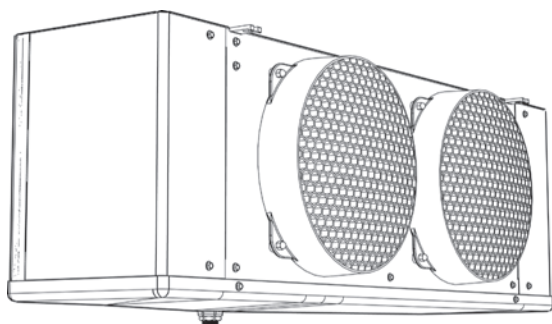
**R407A R407C R448A R404A R507**

**5-100 HP**

**-30°F to +40°F Room Temperatures**



**WARNING:** This equipment requires special attention on field adjustments with the head pressure operating controls. Please carefully review the Application Guideline and Limitrol+ Control Settings sections for details.



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# LIMITROL<sup>+</sup> APPLICATION GUIDELINE

When air-cooled condensers or condensing units are installed outdoors, they will be subjected to varying ambient temperatures. This variance could be as much as 120°F (48.9°C) of swing throughout the summer and winter seasons and will have a major impact on the performance of the condenser. As the ambient temperature drops, the condenser capacity will increase due to the wider temperature difference between ambient and condensing temperature. As this happens, the condensing temperature will also drop as the system finds a new balance point. Although overall system capacity will increase, other problems can occur. The capacity of an expansion valve is affected by both the liquid temperature entering the valve and the pressure drop across it. As the condensing temperature decreases, the pressure drop across the metering device also decreases. This lower pressure drop will then decrease the capacity of the valve. Although lower liquid temperatures increase the capacity of the metering device, the increase is not large enough to offset the loss due to the lower pressure drop. To provide adequate pressure drop, some form of head pressure control is required.

Many methods are available for controlling head pressure and are each suited to meet the user requirement and climatic conditions. Some systems can achieve effective

control with just simply cycling the condenser fans, however at colder ambients other systems are required such as the use of flooding valves and added refrigerant charge. See Table 3 overview on page 6 covering alternative methods of control at the various ambient ranges.

**LIMITROL<sup>+</sup>** (Limitrol Plus) has been specifically designed for Air-cooled condensing units and combines various technologies into a responsive system that floats the head pressure below 90°F (32°C) condensing temperatures, saving energy and reducing environmental impact. Unlike previous head pressure flooding valve applications, this system uses EC motor technology and condenser portioning control to provide reduced operating refrigerant charges without the need for a flooding valve and oversized receiver. As a result, this non-flooding system can provide control at much colder ambient temperatures where previous designs have proven ineffective.

**LIMITROL<sup>+</sup>** systems are most suited for colder ambient locations and are designed to reduce energy consumption and replace any flooded valve type application operating down to -20°F (-29°C) outdoor ambient temperatures.

## LIMITROL<sup>+</sup>

FLOATING HEAD PRESSURE CONTROL SYSTEM

- **Reduces compressor energy consumption and run time**
  - **EC motor technology further saves energy and reduces electrical requirements**
- **Lowered environmental impact through reduced refrigerant use**
  - **Stable system performance in lower ambients**

To see how much **LIMITROL<sup>+</sup>** can save on energy and refrigerant, compared to conventional flooded valve systems, refer to Tables 1 and 2.


# LIMITROL POTENTIAL SAVINGS


**Table 1 - Percentage & Dollar kWh Savings over Flooded Valve Systems \***


| MODEL          | Philadelphia, PA |       | New York, NY |       | Boston, MA |       | Charlotte, NC |       | Atlanta, GA |       | Los Angeles, CA |       | St Louis, MO |       | St. Paul, MN |       | Toronto, ON |       |
|----------------|------------------|-------|--------------|-------|------------|-------|---------------|-------|-------------|-------|-----------------|-------|--------------|-------|--------------|-------|-------------|-------|
|                | %                | \$    | %            | \$    | %          | \$    | %             | \$    | %           | \$    | %               | \$    | %            | \$    | %            | \$    | %           | \$    |
| 5 HP Cooler    | 22               | 616   | 23           | 1,099 | 25         | 1,081 | 18            | 474   | 16          | 521   | 16              | 835   | 20           | 624   | 25           | 798   | 27          | 638   |
| 7.5 HP Cooler  | 21               | 1,008 | 22           | 1,805 | 23         | 1,707 | 18            | 843   | 17          | 954   | 17              | 1,499 | 19           | 1,053 | 24           | 1,270 | 25          | 1,000 |
| 10 HP Cooler   | 18               | 1,204 | 18           | 2,131 | 20         | 2,095 | 15            | 975   | 14          | 1,089 | 18              | 2,446 | 16           | 1,227 | 20           | 1,529 | 21          | 1,223 |
| 15 HP Cooler   | 19               | 1,852 | 20           | 3,300 | 21         | 3,170 | 16            | 1,567 | 15          | 1,767 | 19              | 3,570 | 17           | 1,916 | 22           | 2,337 | 22          | 1,834 |
| 6 HP Freezer   | 24               | 903   | 25           | 1,621 | 26         | 1,548 | 21            | 753   | 20          | 848   | 23              | 1,548 | 22           | 928   | 26           | 1,119 | 27          | 891   |
| 7.5 HP Freezer | 21               | 994   | 21           | 1,783 | 23         | 1,726 | 17            | 800   | 16          | 891   | 18              | 1,591 | 19           | 1,012 | 23           | 1,255 | 24          | 1,004 |
| 13 HP Freezer  | 19               | 1,425 | 19           | 2,535 | 21         | 2,450 | 16            | 1,150 | 15          | 1,286 | 15              | 2,110 | 17           | 1,471 | 21           | 1,798 | 22          | 1,428 |
| 15 HP Freezer  | 18               | 1,602 | 19           | 2,846 | 20         | 2,717 | 16            | 1,312 | 15          | 1,479 | 14              | 2,224 | 17           | 1,672 | 20           | 2,009 | 21          | 1,587 |


\* The above is a BIN Hour Analysis. Weather data was used from ASHRAE Weather Data Viewer and electrical rates for each city are based on data from EIA (U.S. Energy Information Administration). Above numbers do not include refrigerant savings, and further cost savings can be expected.

**Table 2 - Refrigerant Savings over Flooded Valve Systems\***

| BE Model HP      | Flood Valve<br>-20°F Ambient | LIMITROL <br>-20°F Ambient | % Charge Savings |
|------------------|------------------------------|---|------------------|
| 3 M              | 8.6                          | 6   | 30%              |
| 3, 3.5, 4 L      | 9.3                          | 6.4   | 31%              |
| 5 H,M            | 18.1                         | 11.9  | 34%              |
| 6, 7.5 L         | 20.0                         | 12.9  | 36%              |
| 7.5 H            | 18.2                         | 12  | 34%              |
| 7.6, 8, 10 H     | 20.1                         | 15.9  | 21%              |
| 9, 10 L          | 22.2                         | 17  | 23%              |
| 12, 15, 20 H     | 33.0                         | 25.8  | 22%              |
| 12, 13, 15, 22 L | 36.6                         | 27.6  | 25%              |

| BMS Model HP | Flood Valve<br>-20°F Ambient | LIMITROL <br>-20°F Ambient | % Charge Savings |
|--------------|------------------------------|---|------------------|
| 7.5, 7.6 M,H | 22.6                         | 15.5  | 31%              |
| 7.5 L        | 24.6                         | 16.5  | 33%              |
| 8 H,M        | 21.4                         | 17.2  | 20%              |
| 10 H,M       | 29.3                         | 22.9  | 22%              |
| 10 L         | 23.5                         | 18.2  | 23%              |
| 12L          | 32.4                         | 24.5  | 24%              |
| 12, 15 H,M   | 37.4                         | 29.2  | 22%              |
| 22L          | 41.4                         | 31.2  | 25%              |

| BVS Standard Model HP | Flood Valve<br>-20°F Ambient | LIMITROL <br>-20°F Ambient | % Charge Savings |
|-----------------------|------------------------------|---|------------------|
| 8 V, 10L, 12 L        | 30                           | 19.8  | 34%              |
| 12V, 16V, 15L         | 37.2                         | 24.4  | 34%              |
| 15 M, H               | 34.2                         | 26.8  | 22%              |
| 20, 22, 25 M,H        | 44.9                         | 34.9  | 22%              |
| 20, 22 L              | 37.8                         | 28.7  | 24%              |
| 20V, 25V, 27L, 30L    | 49.9                         | 37.4  | 25%              |
| 30 M,H                | 56.9                         | 44.2  | 22%              |
| 30V, 40 L             | 63.2                         | 44.1  | 30%              |
| 35 M,H                | 66.6                         | 51.9  | 22%              |
| 40 M,H                | 81.8                         | 62.4  | 24%              |
| 50 M,H                | 88.3                         | 67.4  | 24%              |

| BVS Hi-Eff. Model HP | Flood Valve<br>-20°F Ambient | LIMITROL <br>-20°F Ambient | % Charge Savings |
|----------------------|------------------------------|---|------------------|
| 11, 13L              | 41.4                         | 28.6  | 31%              |
| 16, 21, 23L          | 49.9                         | 37.2  | 25%              |
| 16M,H                | 44.9                         | 34.9  | 22%              |
| 21, 23M,H            | 56.9                         | 44.2  | 22%              |
| 26, 28, 31L          | 63.2                         | 47.4  | 25%              |
| 31M,H                | 81.8                         | 62.4  | 24%              |
| 36M,H                | 131.6                        | 98.9  | 25%              |
| 41, 51, M,H          | 163.4                        | 120.9   | 26%              |

\* Note: Does not include evaporator and liquid line charge

Shaded area has multiple fans with applicable fans cycled off.

BMD Double compressor models are 2 x above BMS single model. BVD Double compressor models are 2 x above BVS single model  
The above is a BIN Hour Analysis. Weather data was used from ASHRAE Weather Data Viewer and electrical rates for each city are based on data from EIA (U.S. Energy Information Administration).

**For more information, use our handy Energy Savings Calculator:**  
**[b-rp.ca/limitrol](http://b-rp.ca/limitrol)**

# LIMITROL<sup>+</sup> THEORY OF OPERATION

Refer to the following Limitrol+ condensing unit piping diagram FIG. 1 shown below.

The **LIMITROL<sup>+</sup>** standard design includes the following four main components:

- Portion controlled Air-cooled Condenser- **(A)**.
- EC (Electronically commutated) condenser fan motor(s)-**(B)**.
- Electronic programmable logic controller w/pressure transducer- **(C)**.
- Suction accumulator with Liquid heat-exchanger-**(D)**.

Also included are the following optional (application related) components:

- Heated and insulated receiver-**(E)**
- Wind guard for horizontal air flow units -**(F)**

The **LIMITROL<sup>+</sup>** provides optimized compressor and condenser fan energy savings by lowering the condensing pressure and power consumption during low operating loads and cooler ambient temperature conditions.

An electronic logic controller **(C)** senses the discharge pressure (from the pressure transducer) and targets a factory pre-set 70°F(21°C) floating condensing temperature. The condenser EC fan motor **(B)** responds to a DC voltage signal input that directly controls the fan speed. The DC signal is primarily based upon the discharge transducer pressure which is affected by the evaporator load and condensing unit ambient temperature. At peak ambient temperatures the condenser will be required to operate at full capacity using maximum condenser fan speeds. As the ambient becomes cooler less condenser capacity is required. The condensing temperature can then float down towards the minimum condensing temperature by the fan starting to slow down.

Once the condenser fan has reached its lowest functional minimum speed (when the ambient becomes much colder) a section of the condenser surface **(A)** can be removed (staged) in order to continue to provide the minimum condensing temperature set point. Note that in a conventional system this is normally accomplished by adding a head pressure control flooding valve and adding extra liquid refrigerant into the receiver allowing liquid to back up into the condenser displacing the active condenser surface. During the initial transition with the new condenser staging (smaller portioning) the fan motor must then respond to an increased air flow requirement. The electronic logic controller **(C)** will accordingly send a new signal to increase the EC motor **(B)** RPM. From this point the EC motor can vary its range of RPM in order to further control the head pressure at the lower ambient.

During the lower ambient stage if the load or ambient temperature increases and the condenser fan reaches its functional maximum speed a portion of the condenser **(A)** is then added back (staged) providing added necessary capacity to maintain the required control setpoint. Note that in a conventional head pressure control valve system, the extra liquid that had been previously required to be backed up in the condenser would then need to be transferred and stored back into the receiver (requiring oversizing). During the initial transition with the new condenser staging (larger portioning) the fan motor must then respond to a decreased air flow requirement. The electronic logic controller **(C)** will then send a new signal to decrease the EC motor **(B)** RPM.

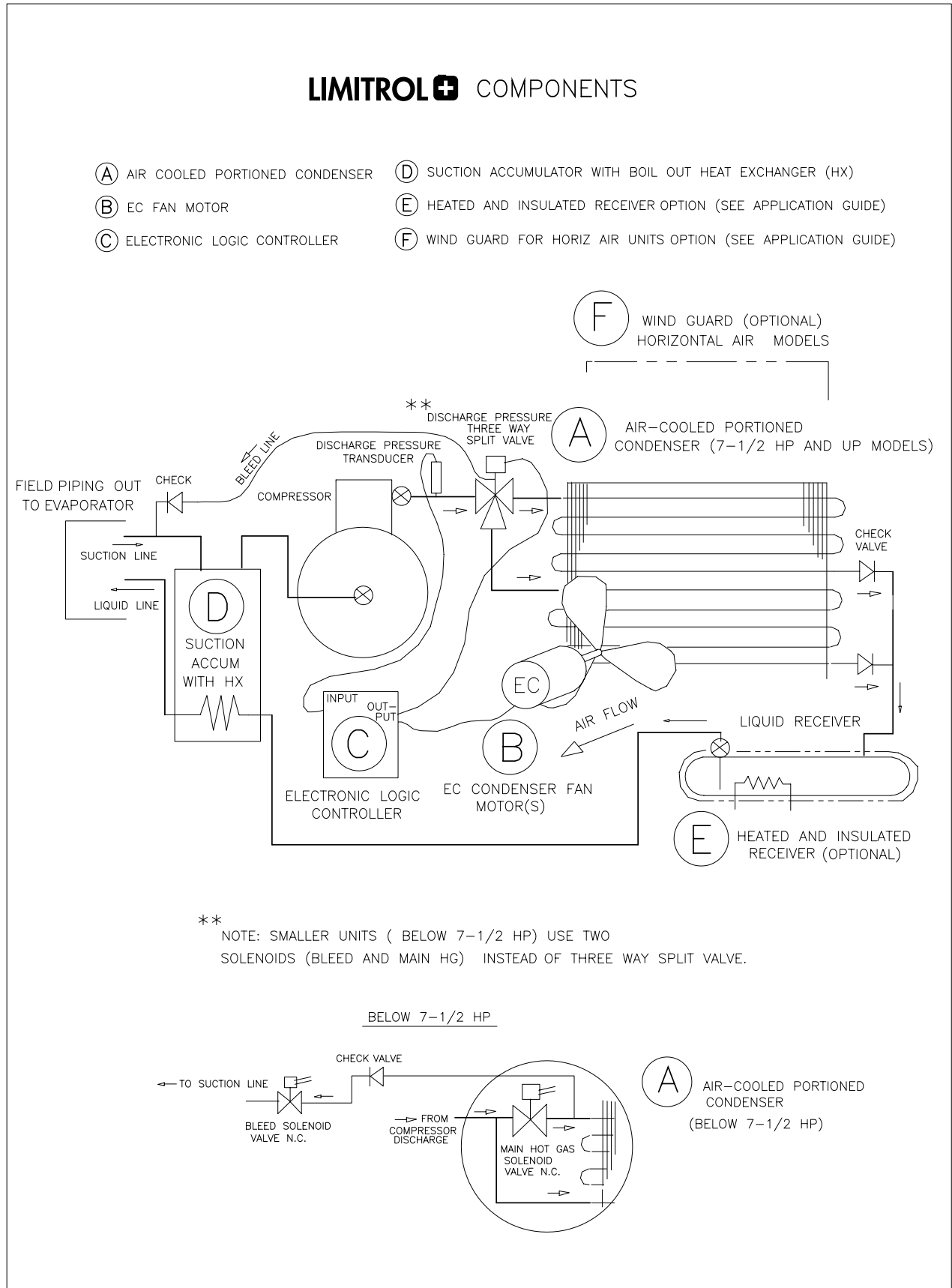
**LIMITROL<sup>+</sup>** Logic Controller and Condensing unit wiring  
Logic control, EC motor and condenser staging wiring are covered in FIG. 2 and 3 (below 7.5 HP units) and FIG. 4-9 (7.5 HP and larger units) wiring diagrams.

Logic control is provided by the electronic controller which senses the discharge pressure through the pressure transducer. The controller provides condenser portioning control (through output relays) and DC signal control (though analog outputs) for the EC motor speed. There are two different analog signals (0-10VDC output) for the EC motor. The first analog signal is activated during the cold ambient when the condenser has been staged (portioned) and the second analog signal is activated during the warm ambient when the condenser has not been staged (not portioned). The 0-10V DC signal output directly controls the fan speed (RPM). Refer to the control manufacturer's operating instructions and the condensing unit QSU (quick set up) set point instruction sheet for details on operation and programming.

The wiring method for Condenser staging varies with the unit model. The smaller units (below 7.5 HP) close off the condenser portion during the cold ambient by a discharge line solenoid valve (NC normally closed). Also another smaller bleed line solenoid valve (NC) is used to purge any refrigerant or oil from the idle condenser portion over to the suction side. Both are wired through the controller output relays. The Larger units (7.5 HP and above) use a special three way splitting valve (with internal bleed function) to replace the discharge solenoid valve and bleed/purge valve function. The use of check valves prevent any migration/logging of refrigerant and oil into the idle condenser portion during the cold ambient stage.

# LIMITROL+ PIPING SCHEMATIC

Figure 1 - LIMITROL+ Piping Schematic



# LIMITROL<sup>+</sup> APPLICATION

Under colder ambient temperatures there could exist limitations on the effective control of the minimum condensing pressure. Proper design of the evaporator must be reviewed to ensure circuiting, distributor nozzles, distributor tubes, and expansion valve type (balanced port required) and size are properly designed to operate at the lower pressures and liquid temperatures. The use of the following optional components should be considered. For an overall summary of recommended ambient ranges and comparisons to other head pressure control methods, refer to Table 1.

## LIMITROL<sup>+</sup> Heated and Insulated Receiver

For colder 10°F (-12°C) and lower ambient temperatures the addition of a heated and insulated receiver option is recommended (this ensures adequate pressure is available during start-up after any prolonged off cycle).

## LIMITROL<sup>+</sup> Wind Guard (Horizontal Air Flow Units)

On smaller condensing units that use horizontal air flow condensers, special attention to the unit site location must be considered. Unprotected, strong cold winds blowing directly on the condenser face can affect the control of the condensing temperature. In colder, northern climates at temperatures of 0°F (-18°C) and lower the use of an optional wind guard should be considered or where feasible consider locating the unit beside a building structure or barrier where it may be protected from the wind.

## LIMITROL<sup>+</sup> with installed Flooding Valve (for extreme cold temperatures)

If extreme cold -20°F (-29°C) and below ambient temperatures and excessive winds exist, the use of an adjustable flooding valve (with added refrigerant charge) should be considered. The valve must be adjusted to a lower setting than the logic controller set point and must be installed at the condenser common liquid line downstream of the liquid lines (and check valve(s) of the two condenser staging circuits. LIMITROL<sup>+</sup> still offers an advantage over conventional flooding systems due to the fact that only the portioned half of the condenser will need to be flooded minimizing the refrigerant charge.

## LIMITROL<sup>+</sup> with Capacity Control – compressor unloading

During the cold ambient stage system power consumption is reduced and compressor efficiency is increased (from the lower condensing temperatures). Also system capacity is further increased from the net refrigeration effect of the colder sub-cooled liquid temperatures. This increase of capacity will affect the summer design rating of the compressor/evaporator balance (evaporator TD). Optional compressor unloading or other control methods (i.e. hot gas bypass) may be required on any medium or high temperature application requiring specific humidity control. The use of compressor unloading will also result in further kWh energy savings (reducing the power consumption and increasing compressor efficiency).

**Table 3 - Head Pressure Control Method Comparison And Application Guide**

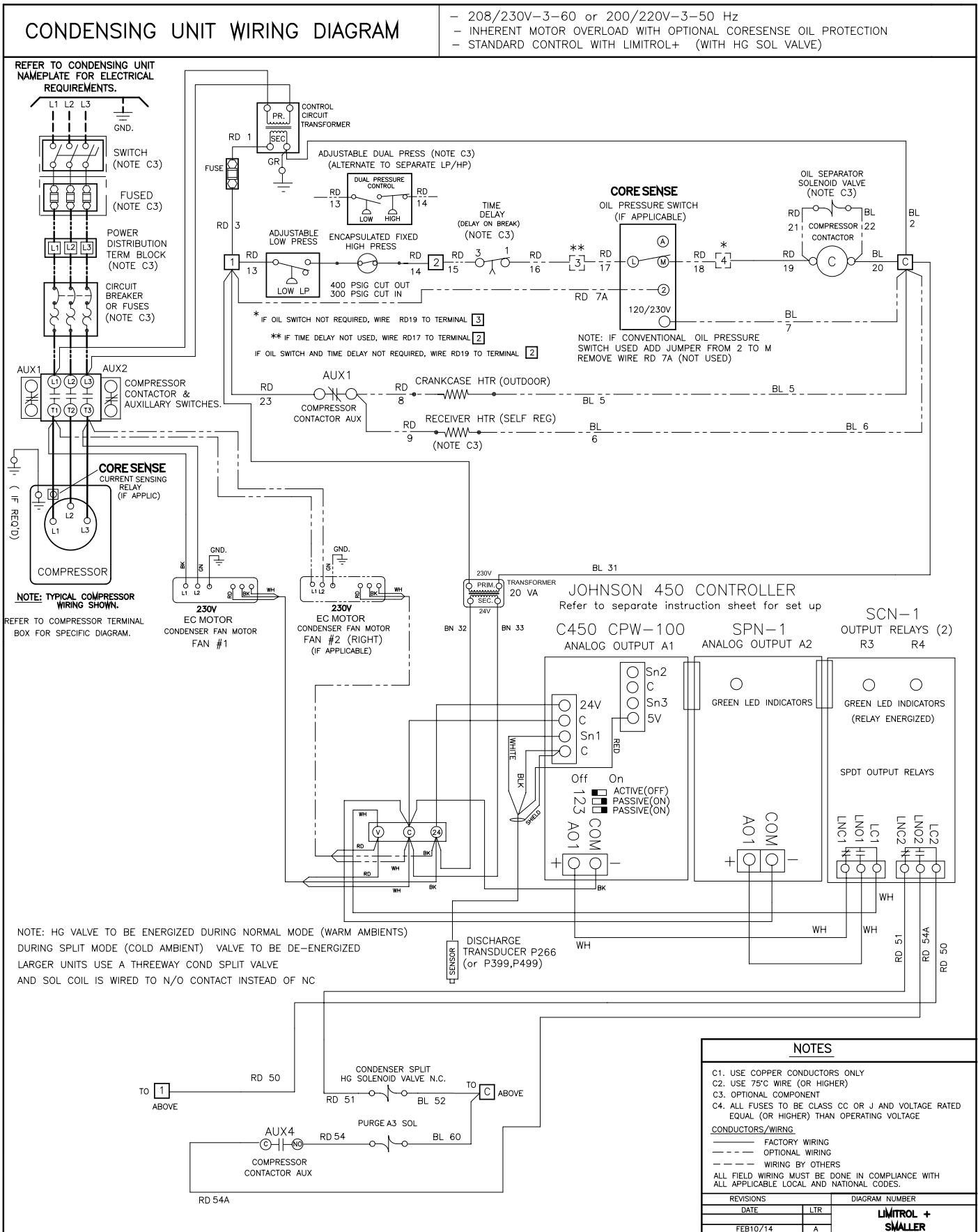
| METHOD OF HEAD PRESSURE  | ENERGY SAVINGS | RELIABILITY/ PERFORMANCE | REFRIGERANT SAVINGS | AMBIENT RANGE** 120°F to... |
|--|----------------|--------------------------|---------------------|-----------------------------|
| FAN CYCLING ONLY   | POOR           | FAIR                     | FAIR                | 50°F                        |
| FAN CYCLING w/VARIABLE SPEED ON HEADER FAN   | FAIR           | FAIR                     | GOOD                | 20°F                        |
| FLOODING VALVE w/FAN CYCLING   | POOR           | GOOD                     | POOR                | -40°F                       |
| VARIABLE SPEED EC MOTORS (ONLY)<br>NO WIND PROTECTION*   | VERY GOOD      | GOOD                     | VERY GOOD           | 10°F                        |
| VARIABLE SPEED EC MOTORS (ONLY)<br>w/WIND PROTECTION (GUARD OR WALL)*                          | VERY GOOD      | VERY GOOD                | VERY GOOD           | 0°F                         |
| LIMITROL <sup>+</sup> STANDARD PACKAGE*<br>HORIZONTAL CU w/NO WIND PROTECTION                  | EXCELLENT      | EXCELLENT                | EXCELLENT           | -10°F                       |
| LIMITROL <sup>+</sup> STANDARD PACKAGE*<br>VERTICAL UNITS & HORIZONTAL UNITS w/WIND PROTECTION | EXCELLENT      | EXCELLENT                | EXCELLENT           | -20°F                       |
| LIMITROL <sup>+</sup> w/FLOODING VALVE ON 1/2 COND<br>HORIZONTAL & VERTICAL UNITS              | EXCELLENT      | EXCELLENT                | GOOD                | -40°F                       |

\* HEATED AND INSULATED RECEIVER REQUIRED ON UNITS OPERATING IN AMBIENTS <10°F

\*\* These are recommended temperature application ranges only and all facets of each installation need to be considered when deciding which method of head pressure control to use. Location, mounting orientations, prevailing winds, wall/barriers, etc., will have an impact on which method is appropriate for the application.

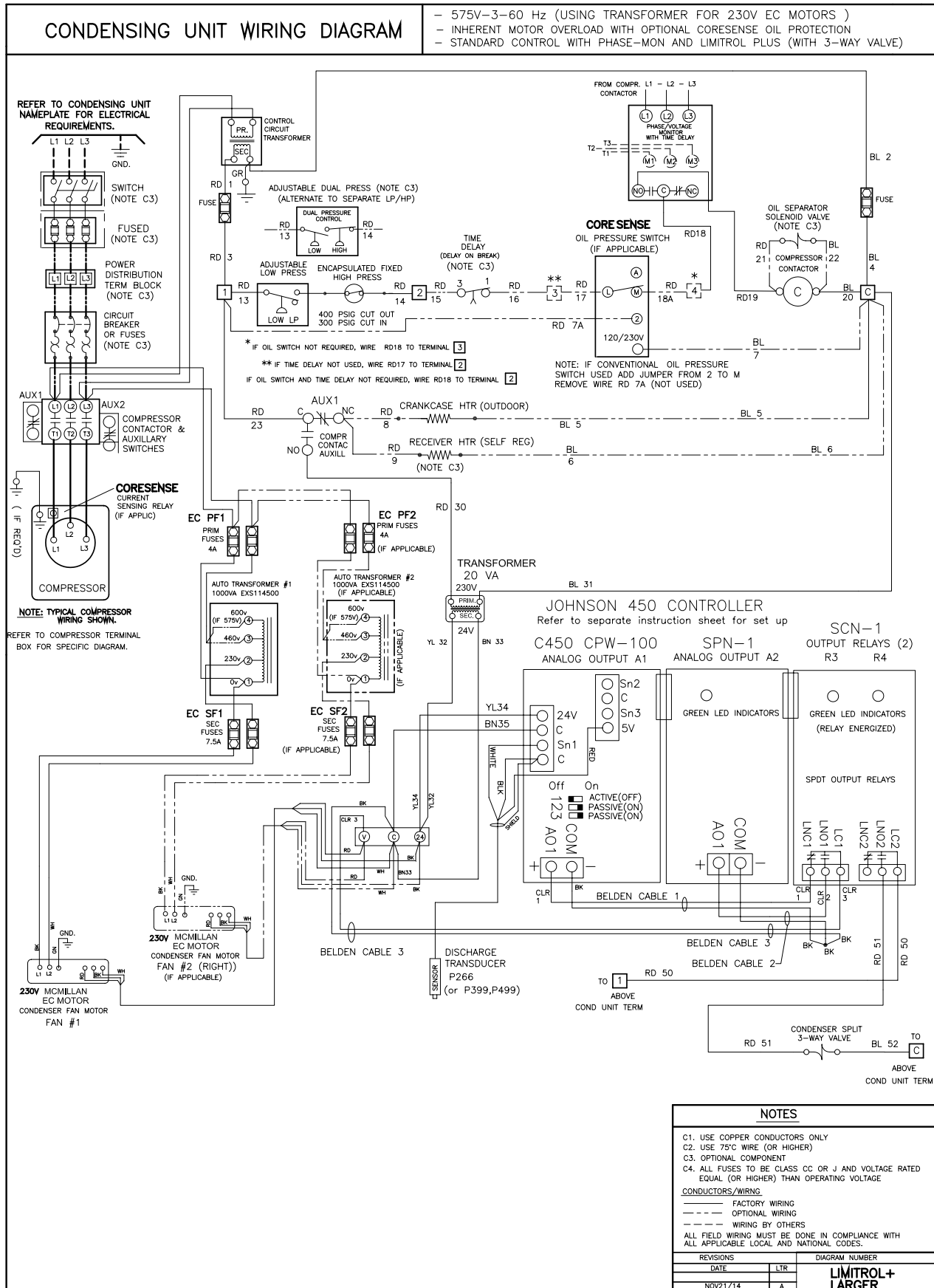
# LIMITROL+ WIRING DIAGRAMS

**Figure 2 - LIMITROL+ Wiring Diagram (BE Units below 7.5 HP w/ COPELAND Compressor)**



# LIMITROL+ WIRING DIAGRAMS

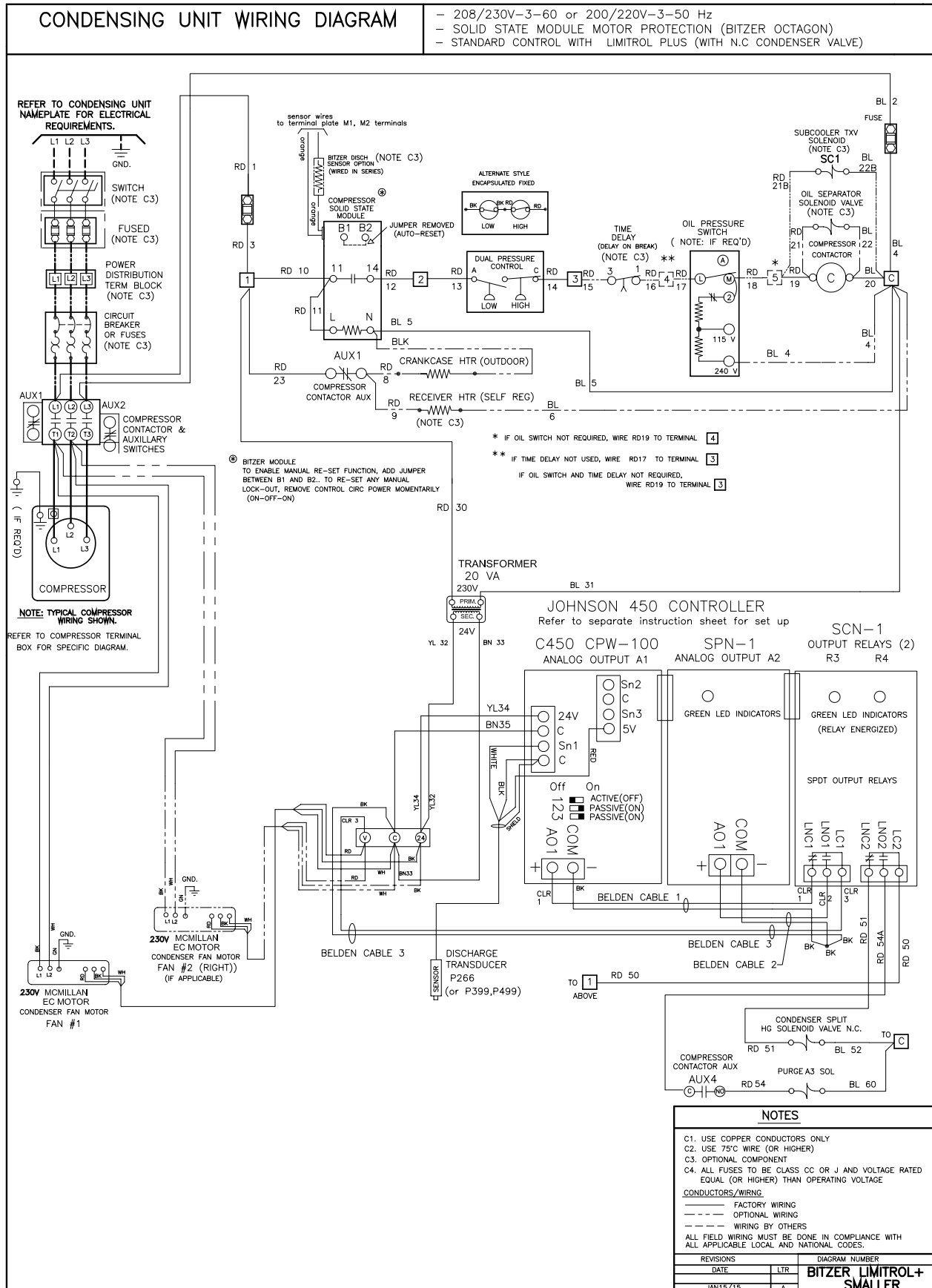
Figure 3 - LIMITROL+ Wiring Diagram (BE Units 7.5 HP and above w/ COPELAND Compressor)





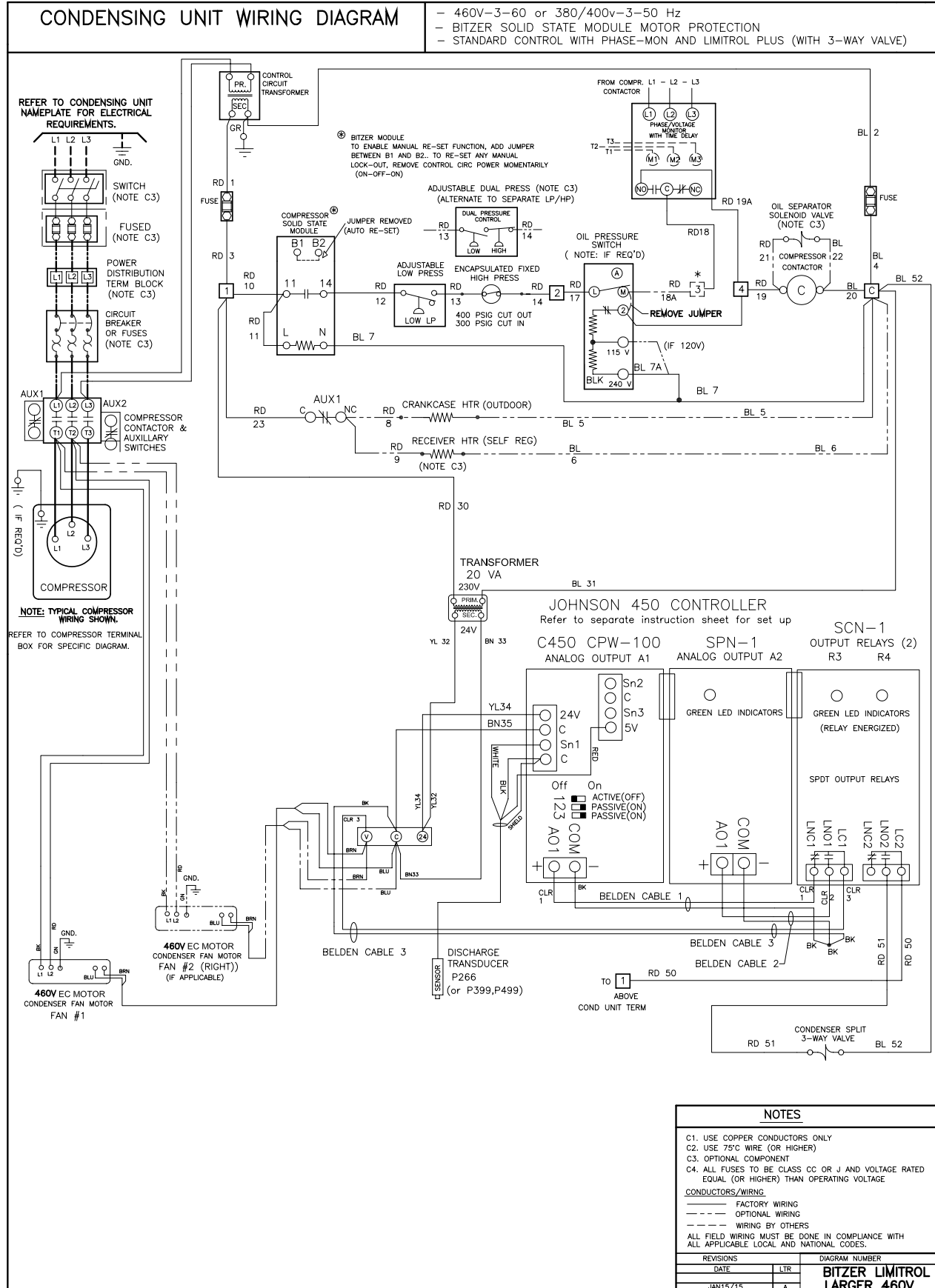
# LIMITROL WIRING DIAGRAMS

Figure 4 - LIMITROL  Wiring Diagram (BE Units below 7.5 HP w/ BITZER Compressor)



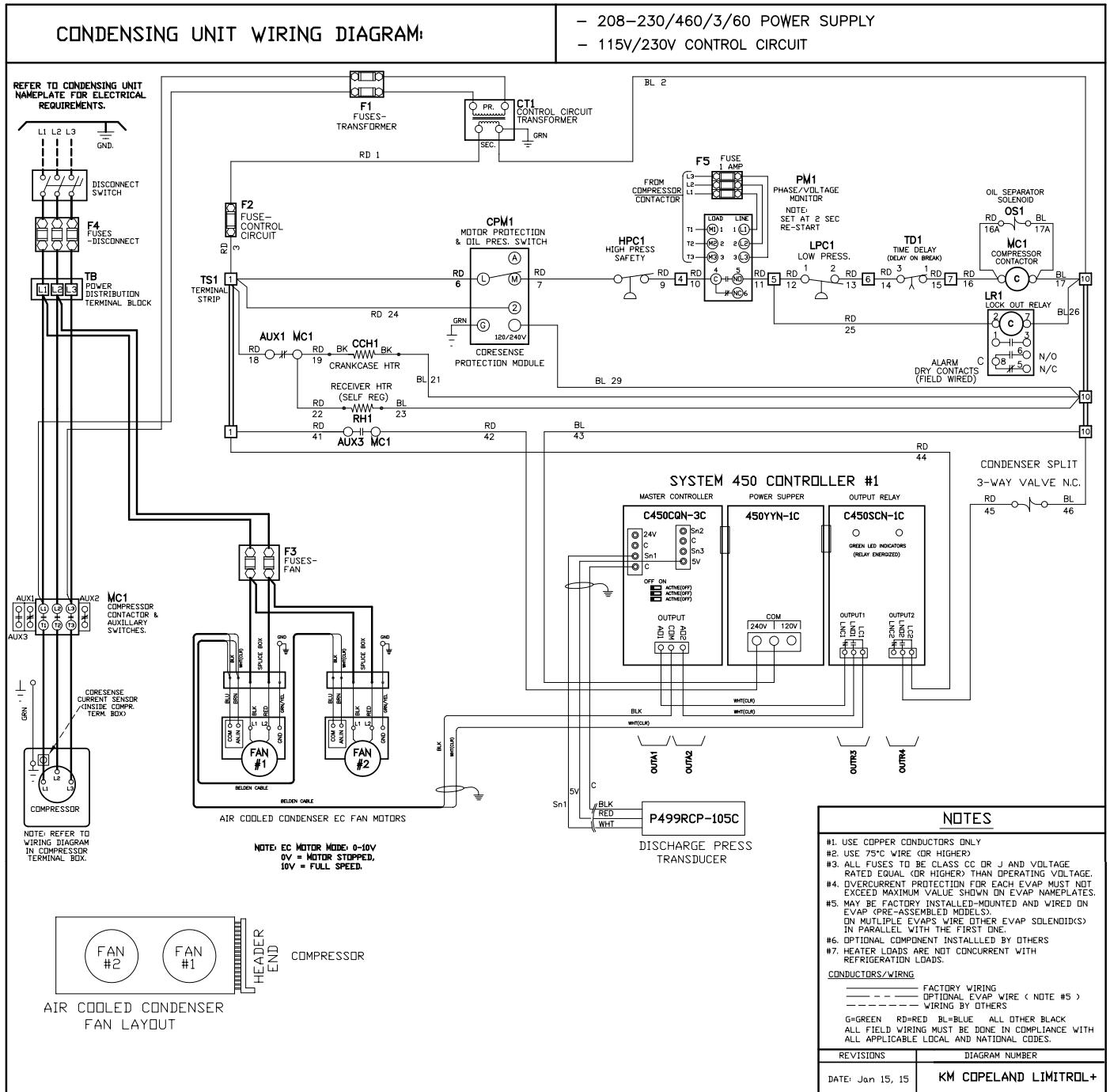
# LIMITROL<sup>+</sup> WIRING DIAGRAMS

Figure 5 - LIMITROL<sup>+</sup> Wiring Diagram (BE Units 7.5 HP and above w/ BITZER Compressor)



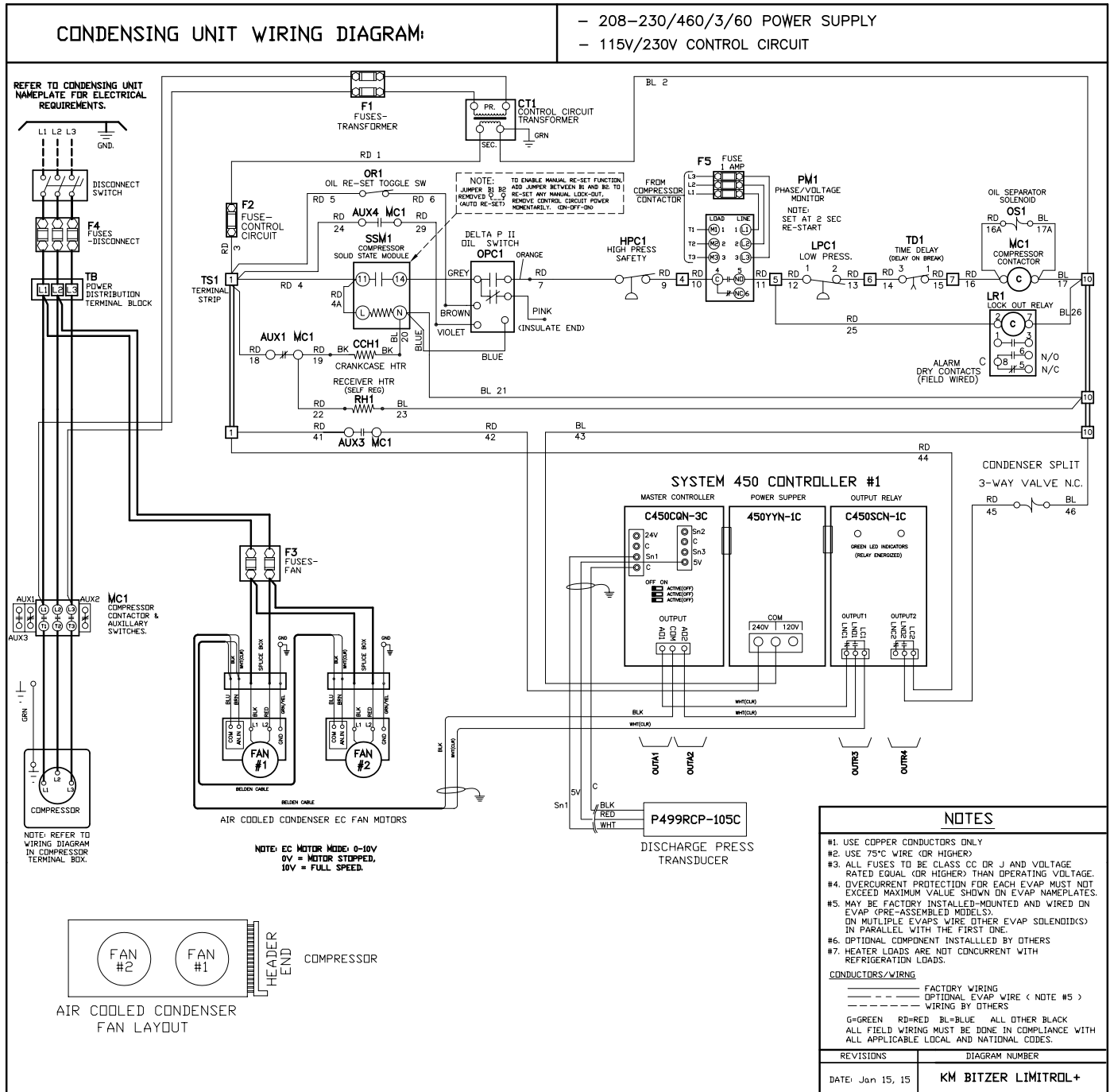
# LIMITROL+ WIRING DIAGRAMS

Figure 6 - LIMITROL+ Wiring Diagram (BM Units w/ COPELAND Compressor(s))



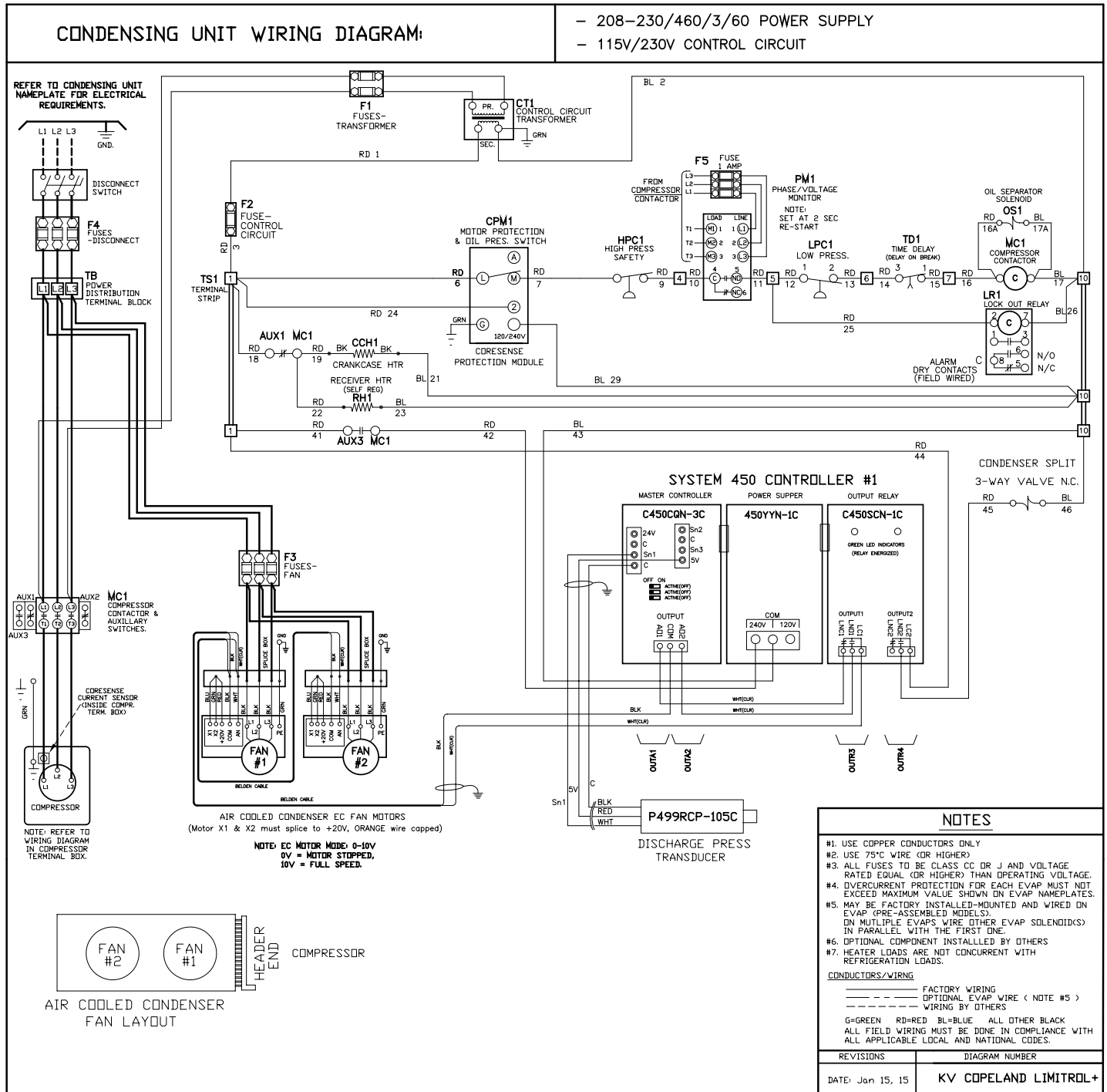
# LIMITROL+ WIRING DIAGRAMS

Figure 7 - LIMITROL+ Wiring Diagram (BM Units w/ BITZER Compressor(s))



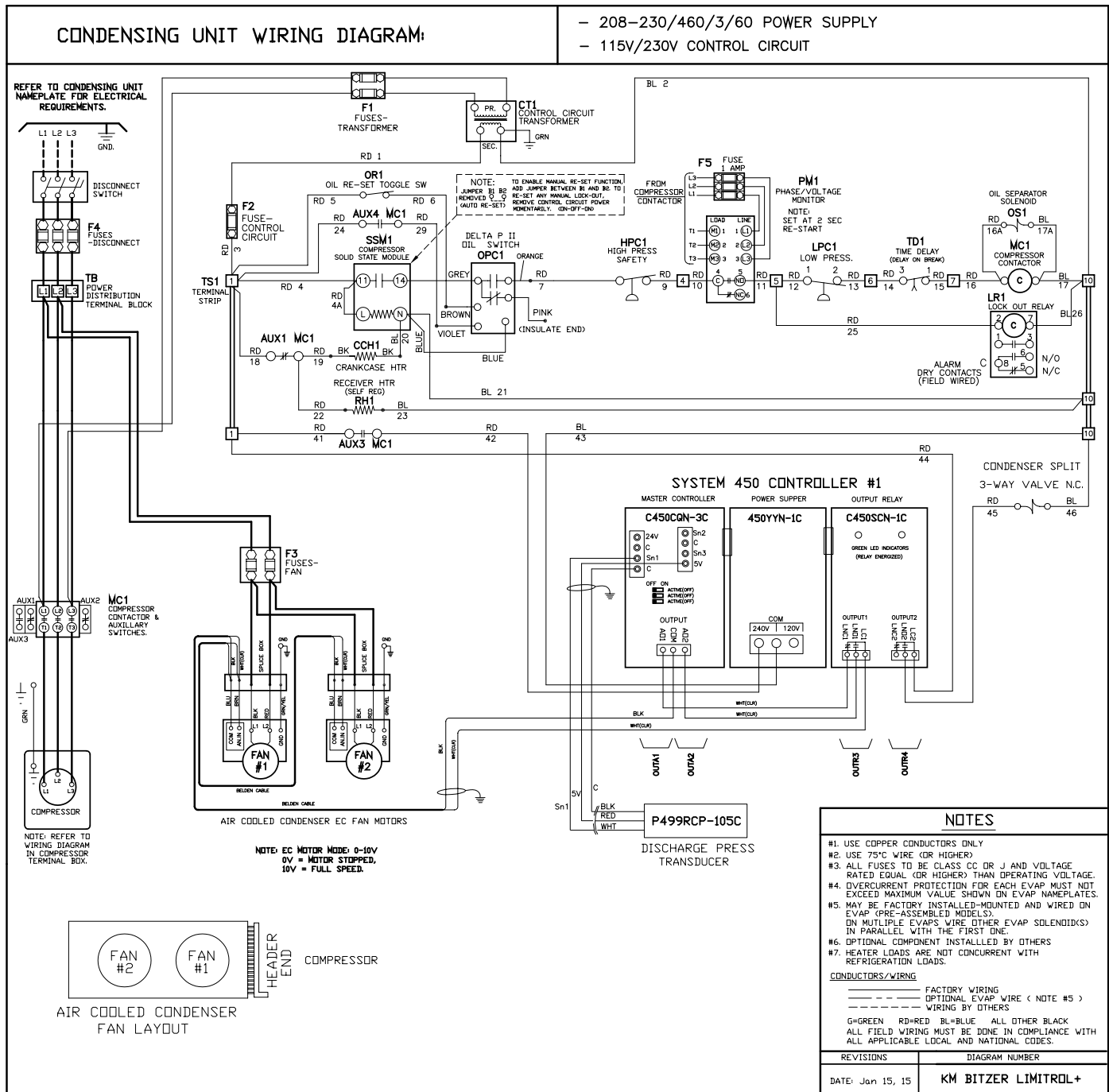
# LIMITROL+ WIRING DIAGRAMS

Figure 8 - LIMITROL+ Wiring Diagram (BV Units w/ COPELAND Compressor(s))



# LIMITROL<sup>+</sup> WIRING DIAGRAMS

### Figure 9 - LIMITROL<sup>®</sup> Wiring Diagram (BV Units w/ BITZER Compressor(s))



# LIMITROL INSTALLATION

For general installation procedures refer to the Condensing Unit Installation and Maintenance instructions included with the unit.

## LIMITROL Control Valve Settings

The following controls should be initially set as listed below and then re-adjusted to suit local field conditions. Refer to the applicable section according to the condensing unit design method. Smaller units (below 7.5 HP) use a NC Solenoid valve condenser portioning method and larger condensing units (7.5 HP and above) use a three-way split valve portioning valve method. Both methods use the same operating principles however specific piping, wiring diagram and controls settings are different. Refer to the applicable unit type piping and wiring diagram and follow the applicable section below.

### NC Solenoid Portion Valve Method (Units Below 7.5 HP)

At warmer outdoor ambient conditions full condenser surface must be utilized requiring the NC (normally closed) Solenoid valve to be ENERGIZED, allowing full refrigerant flow to both sections of the condenser. The solenoid valve coil is wired through the NC (normally closed) relay contact on the SYS 450 controller. A check-valve is installed on the outlet of the idle condenser portion to prevent any reverse backflow into the idle portion. An additional smaller NC solenoid valve is provided to allow refrigerant to be purged from the idle portion of the condenser. The solenoid coil is wired through the NO (normally open) side of the SYS 450 relay contact. To avoid short-cycling from pressure building up in the suction during the compressor's off-cycle the solenoid is wired through the compressor's control circuit using the contactor NO auxiliary switch. The purge line also includes a small check valve to prevent backflow (from migration) to the condenser during colder ambients.

### Three-Way Split Condenser Portion Valve Method (Units 7.5 HP and larger)

At warmer outdoor ambient conditions the three-way split valve provides full flow to both condenser sections when DE-ENERGIZED. Both condenser portions include an outlet check valve (maintains balanced pressure drop during full condenser mode and prevents reverse flow to idle circuit when portioned). The valve includes a port to allow the idle portion of the condenser to be purged and has a check valve in the line to prevent backflow (from migration) to the condenser during colder ambients.


### Flood Valve ORI/ORD (Option for Colder Ambients below -20°F)

For special situations where extreme (below -20°F ambient) outdoor colder temperatures exist, an optional flooding valve should be used. This only needs to flood 1/2 of the condenser (still saving refrigerant) Normal fixed setting valves are not suitable as the valve needs operate at a lower operating pressure than that the setting normally recommended by the valve manufacturer. For use with Limitrol + systems an adjustable type must be used. The supplier factory setting on the adjustable ORI valve is set to start closing at 120 PSIG. To avoid any conflict with the electronic controller settings and to avoid adding unnecessary extra refrigerant charge, do not adjust the ORI valve setting beyond 145 PSIG (for R404A or equivalent refrigerants). Note that each full CLOCKWISE turn on the valve

stem represents approximately 16 psig rise in the setting. E.g. for a 145 psig setting, this would require one and a half clockwise turns. Use manifold gauges to accurately confirm the desired setting. If local field conditions require the setting to be higher than 145 PSIG (160 psig max) then increase the electronic controller set point from 70°F (factory setting) to 75°F condensing temperature. Contact factory for any further assistance. Note that raising the ORI and electronic controller condensing temp setpoints will increase energy usage and require additional refrigerant charge (flooded valve).

## Electronic Controller (Johnson SYS 450)

Refer to the wiring diagrams on pgs. 7-14. and the piping layout (p.5). The SYS 450 programmable controller senses discharge pressure from the transducer located on the discharge line next to the compressor. Based on the sensed pressure and the programmed setpoints, the control activates output relays and generates 0-10V DC signals from the Analog outputs. The output relays activate (or de-activate) condenser portion solenoid valve(s) and divert analog outputs (1-10V DC) to the condenser fan EC motor. At cooler ambient conditions the condenser is portioned and the condenser fan is running at a slower speed. As the ambient becomes warmer and the pressure rises the condenser fan will increase speed to maintain a pre-programmed set point (Factory sets at 70°F set point. see settings Table 2) if the condensing temperature cannot be maintained due to further ambient increases then the fan will speed up to certain point where the condenser portioning is removed (three-way valve solenoid de-energized on larger systems or NC solenoid valve energized on smaller system). The fan speed is then regulated accordingly. As the ambient temperature rises above 70°F and when the condensing temperature cannot be regulated to maintain lower condensing temperatures the fan is then forced to run at full speed. Floating head pressure control is then no longer available. (Ambient is too warm).

The LIMITROL  system 450 controller consists of three modules. The first C450 CPW-100 Module is the master input and programming module. This module is powered from a 24V AC transformer source. This module has one analog output (OutA1) and up to three sensor inputs. The discharge transducer is connected to the sensor input terminals (Sn1). The second Sn2 and third Sn3 inputs are not used. The second SPN module (second analog output OutA2) and third SCN module (two relays OutR3 and OutR4) are then all attached (communicate and powered) through snap-in connectors and din rail mounts. As shown in the wiring diagram the 0-10V DC signal output OutA1 and OutA2 are staged accordingly though the OutR3 relay and feed the EC motor with a 0-10V DC signal based on the operating pressure sensed by the transducer and the program set points. During the warmer ambients the staged analog output OutA2 feeds the 2-10V DC signal (through the OutR3 relay) to the EC motor and the OutR4 relay de-activates the condenser portioning (through solenoid valves). During the colder ambients when the discharge pressure drops the OutR3 relay stages the OutA1 0-10V DC signal and activates the condenser portioning (though solenoid valves).

*Continues on next page --->*

# LIMITROL INSTALLATION (cont'd)

## Electronic Controller (Johnson SYS 450) (cont'd)

The controller output relays include adjustable ON and OFF timers to prevent short cycling.

The analog outputs have a more complex but versatile control operating feature.

In order to maintain and regulate pressure to an established set point (SP) an operating bandwidth or throttle range must be established (also known as grey zone). An end point value (EP) setting needs to be established. The pressure difference between these two settings (SP and EP) becomes the regulating and operating throttling range. These settings should not normally be field adjusted. If flooding valves are used and 70°F floating head set points are not acceptable contact the factory for assistance. The actual DC voltage output required is adjustable and determined by the output set point percentage (OSP) and

output end point percentage (OEP). The set points 100% reflects 10V, 50% is 5 V, 0 % is 0V etc. .These settings should not normally be field adjusted. Consult factory for further assistance.

Proportional plus Integral Algorithms exist in the program allowing adjustment on the control reaction time. These are set up using the Integration Constant (IC) values (0 to 4). These settings should not normally be field adjusted. Consult factory for further assistance.

The analog out OutA1 includes a pulse function that allows the motor to be jogged on and off at set intervals to maintain steady condensing pressures at very cold ambients (-20°F) .

See Table 4 for initial settings.

**Table 4 - SYS 450 Initial Settings**

| <b>R407A R448A R404A R507</b> |       |       |
|-------------------------------|-------|-------|
| Analog Outputs                |       |       |
| SETTING                       | OUTA1 | OUTA2 |
| SP                            | 145   | 155   |
| EP                            | 165   | 175   |
| OSP                           | 0     | 20    |
| OEP                           | 100   | 100   |
| IC                            | 4     | 4     |
| SNF                           | ON    | ON    |
| SENS                          | Sn1   |       |
| PULS LEV                      | 22    |       |
| PULS PER                      | 2     |       |

| Relay Outputs |       |       |
|---------------|-------|-------|
| SETTING       | OUTR3 | OUTR4 |
| ON            | 165   | 150   |
| OFF           | 150   | 165   |
| ON T          | 60    | 60    |
| OFF T         | 30    | 30    |
| SENS          | Sn1   | Sn1   |
| SNF           | OFF   | OFF   |

- For R449A, use R448A data.

| <b>R407C</b>   |       |       |
|----------------|-------|-------|
| Analog Outputs |       |       |
| SETTING        | OUTA1 | OUTA2 |
| SP             | 135   | 145   |
| EP             | 155   | 165   |
| OSP            | 0     | 20    |
| OEP            | 100   | 100   |
| IC             | 4     | 4     |
| SNF            | ON    | ON    |
| SENS           | Sn1   |       |
| PULS LEV       | 22    |       |
| PULS PER       | 2     |       |

| Relay Outputs |       |       |
|---------------|-------|-------|
| SETTING       | OUTR3 | OUTR4 |
| ON            | 155   | 140   |
| OFF           | 140   | 155   |
| ON T          | 60    | 60    |
| OFF T         | 30    | 30    |
| SENS          | Sn1   | Sn1   |
| SNF           | OFF   | OFF   |



## LEGEND

### ANALOG OUTPUTS

|                 |                              |
|-----------------|------------------------------|
| <b>SP</b>       | Target Set Point             |
| <b>EP</b>       | End Point                    |
| <b>OSP</b>      | Output Signal (%)            |
| <b>OEP</b>      | Output End (%)               |
| <b>IC</b>       | Integration Constant         |
| <b>SNF</b>      | Sensor Failure Mode (10V dc) |
| <b>SENS</b>     | Assigned Sensor              |
| <b>PULS LEV</b> | Pulse Mode Level (%)         |
| <b>PULS PER</b> | Pulse Period (sec)           |

### RELAY OUTPUTS

|              |                                       |
|--------------|---------------------------------------|
| <b>ON</b>    | Relay Energized                       |
| <b>OFF</b>   | Relay de-energized                    |
| <b>ON T</b>  | On time delay (sec)                   |
| <b>OFF T</b> | Off time delay (sec)                  |
| <b>SENS</b>  | Assigned sensor                       |
| <b>SNF</b>   | Sensor failure mode (relay on or off) |

**LIMITROL  TROUBLESHOOTING and  
LIMITROL  SERVICE PARTS,  
consult factory.**



## PROJECT INFORMATION

|                   |                    |
|-------------------|--------------------|
| System            |                    |
| Model Number      | Date of Start-Up   |
| Serial Number     | Service Contractor |
| Refrigerant       | Phone              |
| Electrical Supply | Email              |

# NOTES

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## PRODUCT SUPPORT RESOURCES



PRODUCT SUPPORT

*web:* [b-rp.ca/limitrol](http://b-rp.ca/limitrol)  
*email:* [smcu@b-rp.ca](mailto:smcu@b-rp.ca)  
*call:* 1-844-893-3222 x521



TROUBLESHOOTING

*email:* [troubleshooting@b-rp.ca](mailto:troubleshooting@b-rp.ca)  
*call:* 1-844-893-3222 x529



SERVICE PARTS

*web:* [b-rp.ca/parts](http://b-rp.ca/parts)  
*email:* [parts@b-rp.ca](mailto:parts@b-rp.ca)  
*call:* 1-844-893-3222 x501



WARRANTY

*web:* [b-rp.ca/warranty](http://b-rp.ca/warranty)  
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