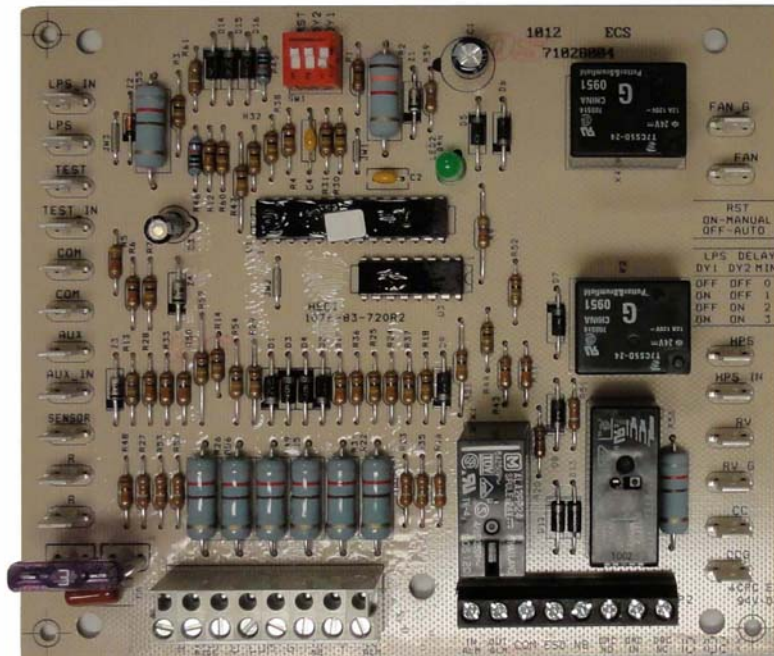


# HP 5 Microprocessor Control for Mammoth Water Source Heat Pumps

*Operation and Maintenance Manual*



**Model:** 71028004  
**Applies to:** Single Circuit  
Water-to-Water  
Twin Circuit Units Without DDC Controls



## HP 5 Microprocessor Control

### Important!

These instructions are for use by qualified personnel specially trained and experienced in the installation of this type of equipment and related system components. Some states require installation and service personnel to be licensed. Unqualified individuals should not attempt to interpret these instructions or install this equipment. Read these instructions carefully before opening (unpacking), installing and operating this heat pump unit.

### Definition

The HP 5 Microprocessor unit is designed to operate with Mammoth's existing series of wall thermostats:

- Manual Changeover
- Auto Changeover with Night Setback, Night Setup and Override

This unit can be used with other heat pump thermostats, but some features may not be available.

### Features

- Low and high voltage protection.
- Check microprocessor at startup – self-diagnostic
- Random start time delay from 5 to 35 seconds
- Compressor anti-short cycle protection for 300 seconds (5 minutes)
- Compressor, fan and reversing valve control
- Condensate overflow protection
- Compressor lockout with selectable intelligent/manual reset
- LED status on the board
- Lockout alarm signal to an LED in the wall thermostat in the event of a safety circuit fault
- Fan interlock to automatically energize the fan whenever the compressor is on
- Board operable on 50 and 60 cycle power
- Emergency shutdown from a field-supplied signal

- Unoccupied (night setback and night setup) mode from a field-supplied signal.
- Dry contact alarm signal for connection of a fault signal to a DDC controller.
- Auxiliary dry contact for tie-in of a motorized valve when the compressor is on (or optional compressor status)
- Night heating or cooling operation from the wall thermostat (71117203, 71117204 or 71117205 thermostat required)
- Override of the unoccupied mode from the thermostat for 2 hours (71117204 or 7111205 thermostat required)
- Low and high pressure compressor protection
- Low pressure bypass with 0, 1, 2 and 3 minute selections.

### Operation

**INITIAL POWER-UP:** When power is applied to the controller from unit's 24-volt transformer, a "green" LED will be illuminated and a 120 second time delay will occur before the fan, reversing valve and compressor are able to operate. The controller will perform a self-diagnostic and voltage check.

**LOSS OF POWER:** On a loss of 24-volt power to the board, all the outputs are de-activated. On return of power, a 120 second time delay will occur before the fan, reversing valve and compressor are able to operate. After 120 seconds, the fan, reversing valve and compressor are able to operate after a short time delay.

**RANDOM START:** A 5 to 35 second time delay of fan, reversing valve and compressor operation will occur each time the unit comes off shutdown mode, unoccupied mode and low/high voltage mode. The random start time varies each time it is activated; for example, the time delay may be 5 seconds, then 12, then 30, then 17, then 32, then 6, etc.

***The following descriptions assume Initial Power-up and Random Start functions have occurred.***

**FAN OPERATION:** On a call for fan operation from the wall thermostat “fan on” switch or from a call for compressor operation, fan operation is delayed for 2 seconds.

**REVERSING VALVE:** On a call for cooling from the wall thermostat, the reversing valve is energized after 4 seconds. Once the cooling demand is satisfied, the reversing valve is held on for 4 seconds before it is de-energized.

**COMPRESSOR OPERATION:** On a call for cooling or heating from the wall thermostat, the compressor is energized from the compressor output terminal after 6 seconds. Once the call for cooling or heating is satisfied, the compressor shuts off immediately. At that time, a 300 second (5 minute) timer begins to prevent the compressor from re-starting even though the wall thermostat may again call for cooling or heating. During this 300 second interval, the compressor will not be allowed to restart. After the 300 second time delay elapses, the compressor is allowed to start if the wall thermostat calls for cooling or heating.

**FAN INTERLOCK OPERATION:** When compressor operation is required, the fan is automatically enabled 4 seconds before the compressor, even if the wall thermostat is not calling for fan operation. This makes sure the fan will be on whenever the compressor is on.

**SAFETY CIRCUIT OPERATION:** The unit has up to 4 safety circuits to prevent the compressor from operating during abnormal conditions.

- **High Pressure Switch:** If the refrigerant pressure exceeds the high pressure set-point, the high pressure switch opens immediately and the unit goes into the lockout mode
- **Low Pressure Switch:** If the refrigerant pressure falls below the low pressure set-point, the low pressure switch closes immediately and the unit goes into the lockout mode after the amount of low pressure bypass has been satisfied.
- **Optional Freezestat Switch:** If the leaving fluid temperature falls to 32°F, the freezestat switch opens. After 10 seconds, the unit goes into lockout mode.
- **Condensate Overflow Protection:** If the drain pan sensor comes in contact with moisture for more than 30 seconds, the unit goes into lockout mode.

**LED STATUS:**

ON	Normal operating mode
1 Flash	High pressure fault
2 Flashes	Emergency shutdown mode
3 Flashes	Freezestat switch
4 Flashes	Condensate overflow fault
5 Flashes	Low voltage fault
6 Flashes	High voltage fault
7 Flashes	Low pressure fault

**LOCKOUT MODE:** Lockout mode will occur if any of the safety circuits are activated. In this condition the compressor is de-energized, but the fan operates if the wall thermostat is calling for cooling or heating. The two lockout alarm circuits are also enabled.

**LOW AND HIGH VOLTAGE PROTECTION:** If voltage conditions are good, the unit performs a self-diagnostic check for faults. If no faults are identified, the “green” LED comes on with no flashes. If the supply voltage falls below the minimum or above the maximum, the reversing valve, fan and compressor are de-energized. LED lights will indicate the fault. Once the voltage falls within an acceptable range, the unit will restart without requiring a reset. All time delays required for start-up of the fan, compressor and reversing valve will take place before the unit is re-started. The low voltage cut-out is 21.6 VAC and the cut-in is 24.0 VAC. The high voltage cut-out is 34.0 VAC and the cut-in is 29.7 VAC. These high and low voltages are monitored at terminals “R” and “COM”.

**LOCKOUT ALARM (CIRCUIT) SIGNAL:** This is the first lockout alarm circuit. In the lockout mode, the circuit provides a 24-volt power (+) signal at the “LO ALM” terminal of the terminal block which is wired to the LED on the wall thermostat to indicate a lockout condition.

**DRY CONTACTS LOCKOUT ALARM (CIRCUIT) SIGNAL:** This is the second lockout alarm circuit. In the lockout mode, this circuit provides a signal at the terminal block. The signal is a set of normally open contacts at terminals “IN ALM” and “OUT ALM” of the unit terminal strip. The contacts close in the lockout mode, allowing connection of a remote alarm.

**RESET OF A LOCKOUT:** The controller can be selected to manual or intelligent reset of a lockout mode through an on-board dip switch labeled as “RST”. When a manual reset is selected, the unit stays in lockout until it is

manually reset by interrupting power or by removing the call for mechanical heating or cooling. Intelligent reset automatically terminates the lockout mode 5 minutes after a lockout condition occurs. The purpose of intelligent reset is to allow the unit to attempt to reset itself if the condition that caused the original lockout corrects itself. After 3 attempts in a 6000 second (100 minute) period after the first lockout, the intelligent reset feature is terminated and the unit stays in lockout until the unit is manually reset. The number of reset attempts is limited to protect the unit from severe damage.

**UNOCCUPIED (NIGHT SETBACK AND/OR NIGHT SETUP) MODE:** This mode is functional with the auto changeover with night setback wall thermostat and the auto changeover with night setback/setup and override wall thermostat only. The unoccupied mode allows the space to be controlled at different settings. The unoccupied mode can be activated in two ways:

- By closing the circuit between terminals "COM" and "NS" via a field supplied switch or time clock contacts (see Figure 1).
- By supplying 24 volts to terminals "COM" and "NS".

In the unoccupied mode, the controller ignores the normal fan and compressor signals from the wall thermostat and only accepts a call for compressor operation from the night setback/setup portion of the wall thermostat. The signal at terminals "COM" and "NS" can be "daisy-chained" between many units. When the signal to terminals "COM" and "NS" is removed, the random start timing function is activated.

**NIGHT SETBACK/SETUP INPUT FROM THE THERMOSTAT:**

Once the unoccupied mode is activated and the occupied mode operation of the fan and compressor are terminated, the controller can only activate compressor operation from the wall thermostat at terminal "3" (see Figure 2). Night setback compressor operation occurs if the space temperature falls to 12°F below the occupied heating set point or if the space temperature rises to 8°F above the occupied cooling set point. The fan will automatically operate and cycle with the compressor due to the fan interlock feature.

**OVERRIDE:** The override feature is available with the wall thermostat and is activated by the push button on the face of the wall thermostat (see Figure 3). When pushed, the unit will switch

back to its normal occupied temperature set points on the wall thermostat for 2 hours. After 2 hours, the unit will resume its unoccupied mode operation until the unoccupied mode signal is removed from terminals "COM" and "NS". The push button is only operable when the unit is in the unoccupied mode.

**EMERGENCY SHUTDOWN MODE:** Emergency shutdown allows the unit to be made inoperable via a remote signal. The emergency shutdown mode can be activated in two ways:

- By closing the circuit between terminals "COM" and "ESD" via a field supplied set of contacts (see Figure 4).
- By supplying 24 volts to terminals "COM" and "ESD".

In shutdown mode, the reversing valve, fan and compressor are inoperable, the lockout alarm circuits are activated and the green LED flashes repeatedly 2 times (quick ON and one long OFF). The unit does not need to be reset. The signal at terminals "COM" and "ESD" can be "daisy-chained" between many units. When the signal to terminals "COM" and "ESO" is removed, the random start timing function is activated.

**AUXILIARY DRY CONTACTS:** A pair of normally open contacts at terminals "DRC IN" and "DRC OUT" shall close and a pair of normally closed contacts at terminals "DRC IN" and "DRC OUT" shall open when the compressor is energized. This will allow connection of 24-volt power to the normally closed contacts to supply power to a normally open (powered close) motorized valve when the compressor is on.

**TEST PIN JUMPER:** An on-board pair of male terminals provides for an optional mode of operation which defeats both forms of compressor time delays. If a hard-wired jumper is placed across the "TEST" and "TEST IN" terminals, the random start time delay and the compressor's five minutes of anti-short cycle time delay will be ignored. However, the two, four and six second time delays on the fan, reversing valve and compressor remain in place.

**LOW PRESSURE BYPASS:** The dip switches labeled "DY1" and "DY2" allow for four different amounts of low pressure switch bypass: zero, one, two and 3 minutes. The low pressure bypass timer logic occurs anytime the board senses a low pressure switch fault.

Figure 1 – Thermostat wiring with night setback/night setup and emergency shutdown

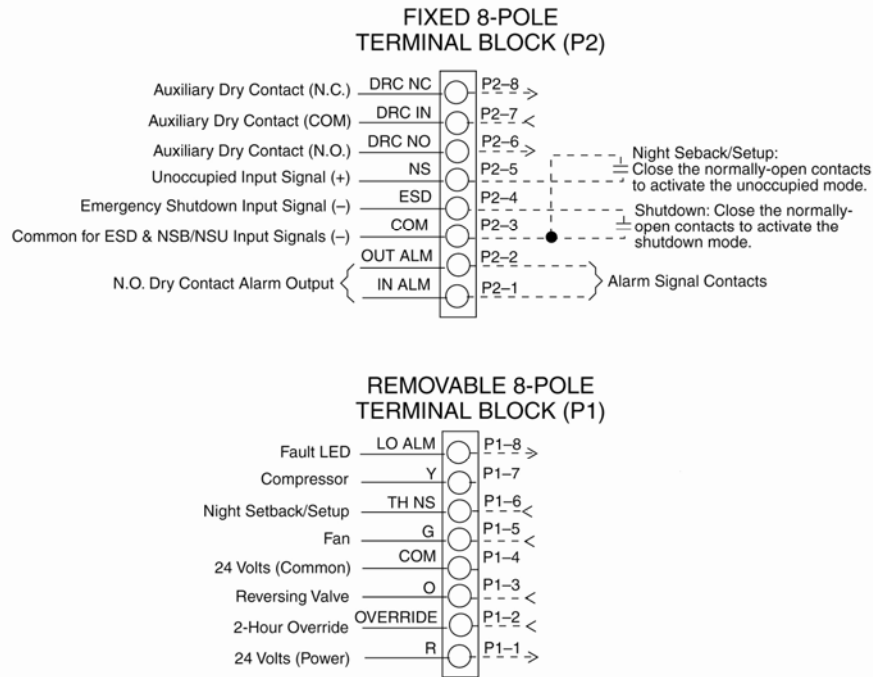


Figure 2 – Thermostat wiring with override and night setback

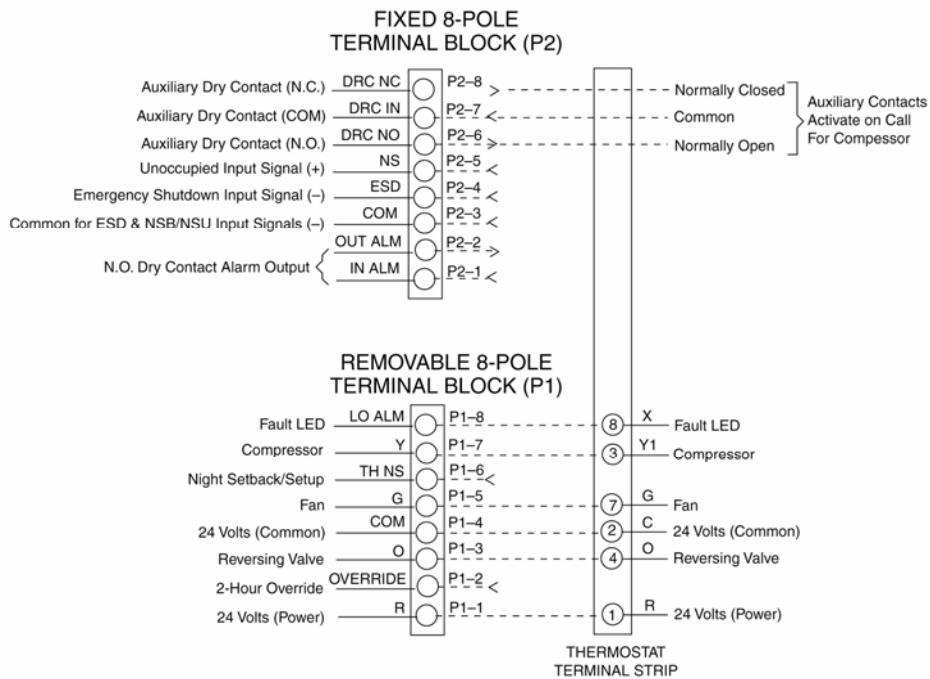


Figure 3 – Thermostat wiring emergency shutdown mode with override

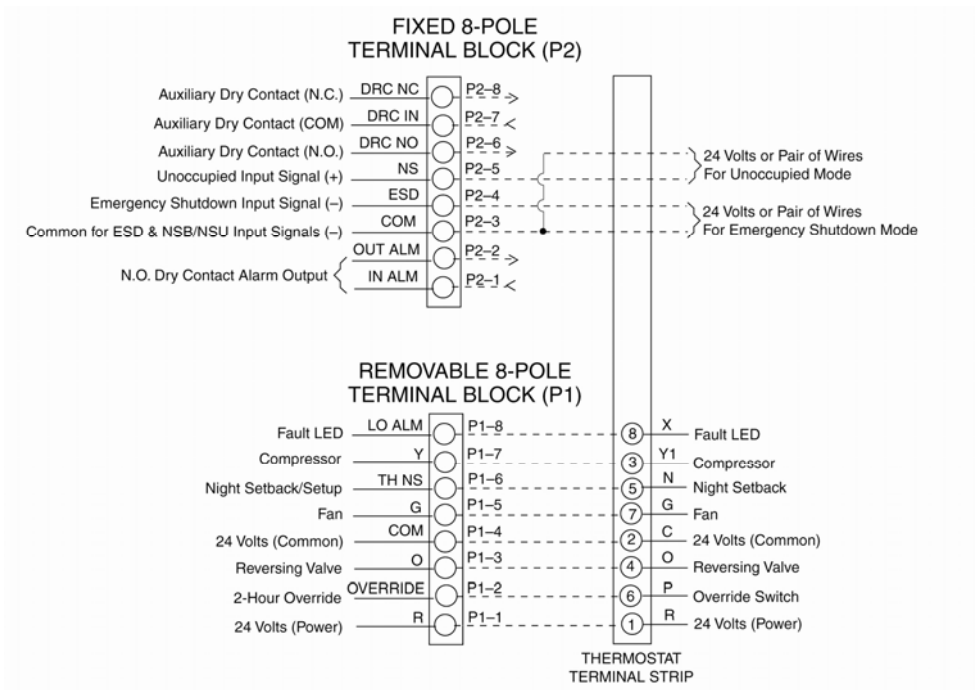


Figure 4 – Thermostat wiring emergency shutdown mode without override

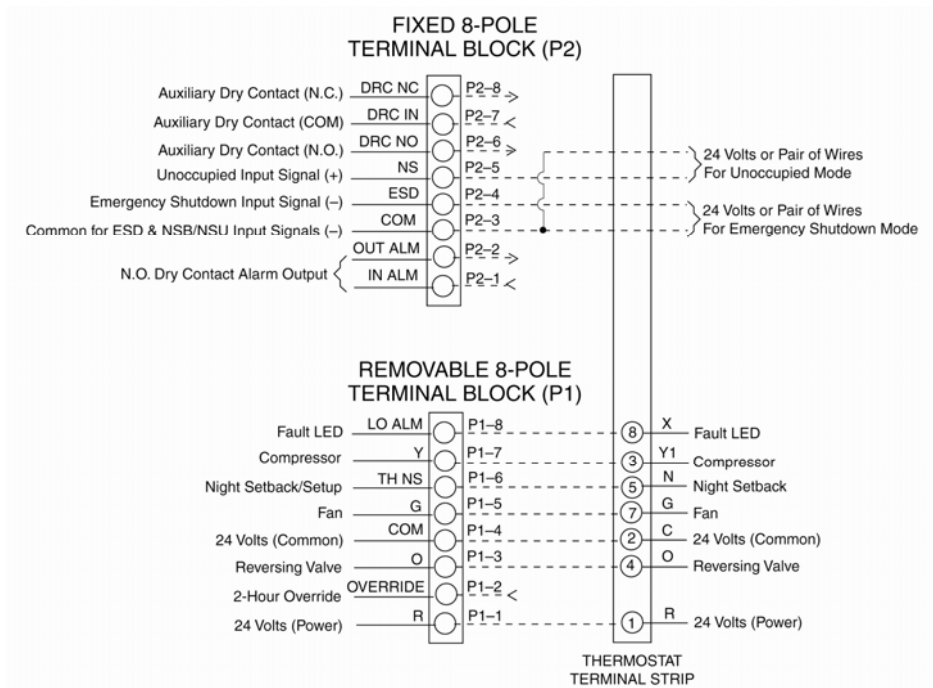
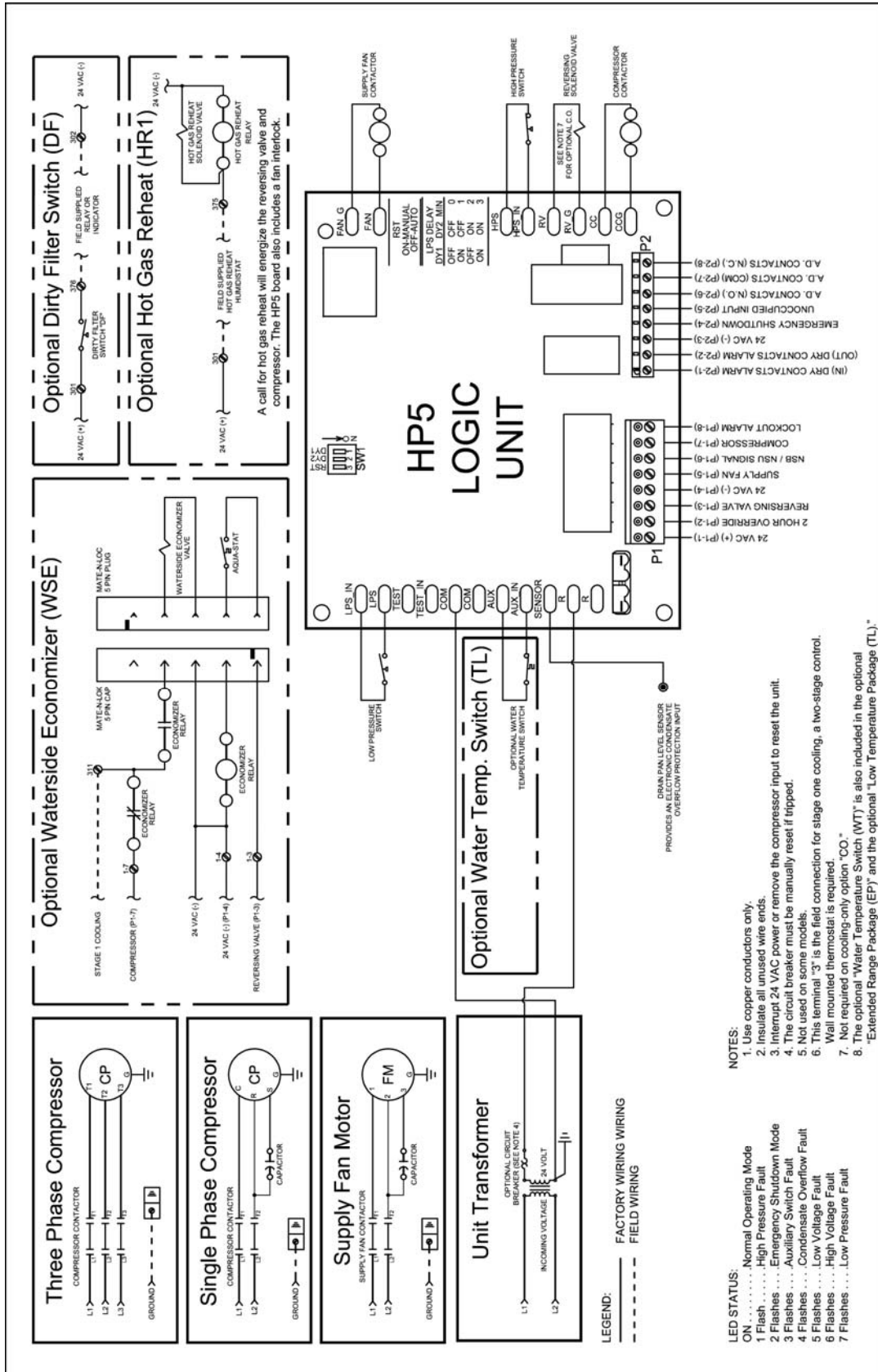


Figure 5 – Typical unit wiring



## Testing

### FIELD TEST MODE

If the two "TEST" quick connect terminals are connected, there will be no random start delay, no anti-short cycle delay, and no power to delay present. The normal fan, reversing valve, and compressor on delays of two, four, and six seconds will still be present, as well as the four second reversing off delay.

### FACTORY TEST MODE

The factory mode is entered by applying the correct combination of inputs to the control at power up. The factory test mode operates the control by associating control outputs with inputs. The factory test mode is automatically canceled after 30 seconds after control power up, and may not be run again until power is removed from the control.

**Factory Test Mode Initiation:** The control checks the control inputs during the first 1.0 seconds after power up, looking for the factory speedup input combination. To initiate the factory test mode, at some point during the first 1.0 seconds after power up, the high pressure switch input must be active, the "SENSOR" input must have 470 kΩ connected, the two "TEST" quick-connect terminals connected, voltage source must be between 22 to 29 VAC, and all of the other inputs must be inactive.

**Factory Test Mode Operation:** While in the factory test mode, the following combinations of inputs will result in the operation of the corresponding output conditions:

- LED stays active.
- "O" thermostat input active and night setback input inactive - Reversing valve output active.
- "G" thermostat input active and emergency shutdown input inactive - Fan output active.
- "Y" thermostat input active and high pressure switch input active - Compressor output active.
- Thermostat night setback input active and override input inactive - Alarm output active.



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