

12.3 HS11 SERIES UNITS WITH "L7" TWO SPEED COMPRESSOR

I - INTRODUCTION

The HS11 features the Lennox "L7" two speed compressor which shifts speeds to match load requirements. At low speed it cuts energy consumption by nearly 50% over a single speed compressor. Figure 1 shows a cutaway of the unit. In addition, the HS11 can be applied to cooling loads in which the unit is wired for low speed only. The heat transfer surfaces become oversized causing increased capacity and efficiency. The following table lists the units to tonnage.

Unit	Tonnage At Low Speed	Tonnage At High Speed
HS11-311-511V	2-1/2	4
HS11-413/653V	3	5
HS11-411/651V	3	5

HS11 CONDENSING UNIT
WITH L7 TWO SPEED COMPRESSOR

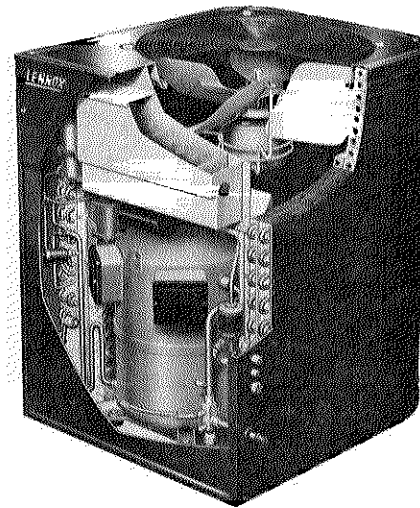


FIGURE 1

II - UNIT INFORMATION

A - Specifications

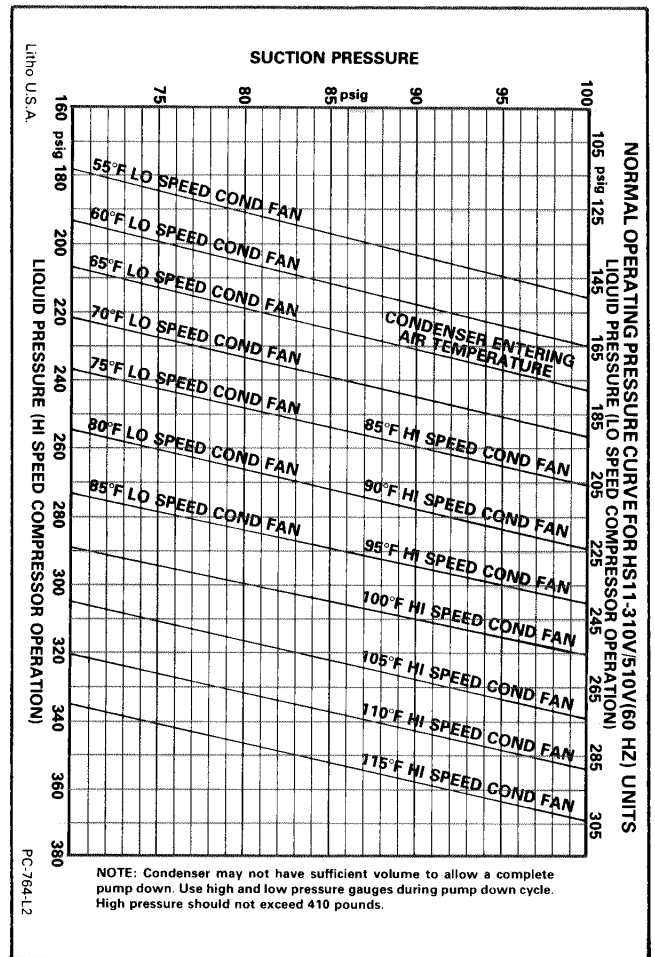
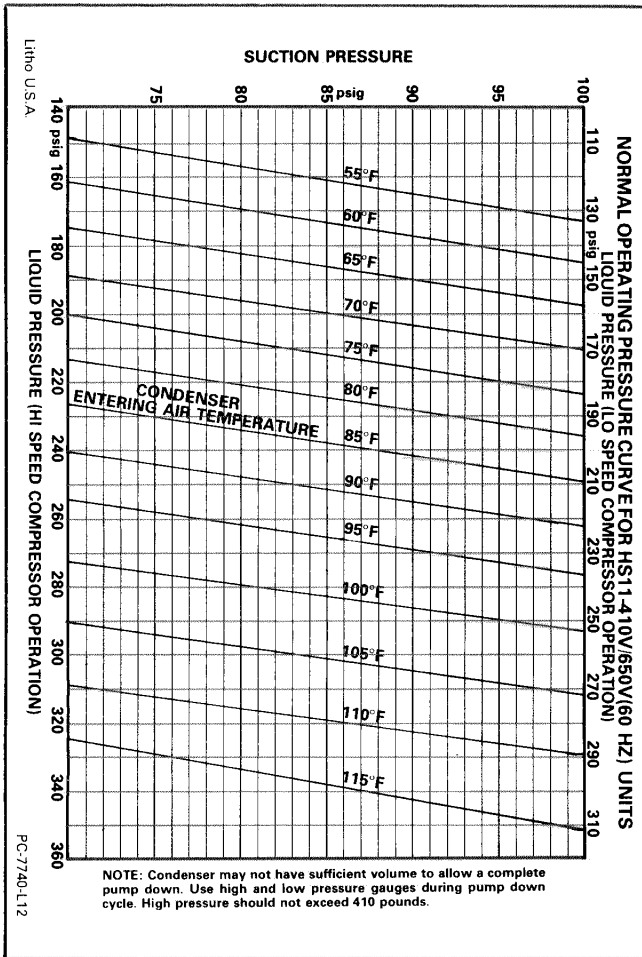
Model No.			HS11-311/511V	HS11-411/651V
Condenser	Net face area (sq. ft.)	Outer coil	15.1	18.3
		Inner coil	7.2	17.6
	Tube diameter (in.) & No. of rows		3/8 — 1.48	3/8 — 2.00
	Fins per inch		20	20
Condenser Fan	Diameter (in.) & No. of blades		20 — 4	24 — 4
	Motor hp		1/4	1/4
	Cfm (factory setting)		3200	4100
	Rpm (factory setting)		1075	825
	Watts (factory setting)		310	350
**Refrigerant — 22 charge furnished			8 lbs. — 0 oz.	13 lbs. — 12 oz.
Liquid line (o.d. in.) connection (compression)			3/8	3/8
Suction line (o.d. in.) connection (sweat)			*1-1/8	*1-1/8
Shipping weight (lbs.) 1 Package			275	350

B - Electrical Data

Model No.		HS11-311/511V	HS11-411/651V	HS11-413/653V
Line voltage data		230v/60hz/1ph	230v/60hz/1ph	230v/60hz/1ph
Compressor	Rated load amps	21.6	32.1	17.2
	Power factor	.97	.97	
	Locked rotor amps	133.0	163.0	144.0
Outdoor Coil	Full load amps	1.4	1.9	1.9
	Locked rotor amps	2.4	3.3	3.3
*Minimum circuit ampacity		28.4	42.2	23.6

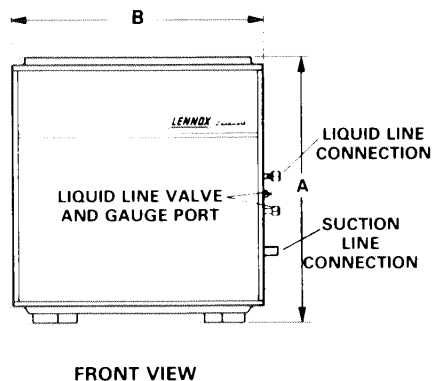
*Refer to National Electrical Code manual to determine wire, fuse and disconnect size requirements.
NOTE — Extremes of operating range are plus and minus 10% of line voltage.

C - Pressure Curves

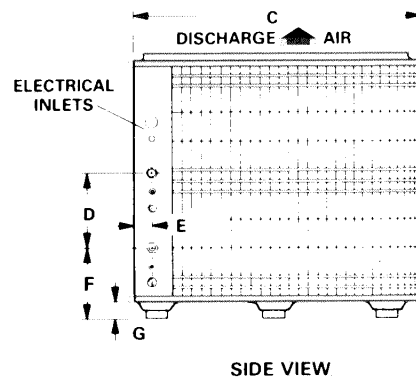
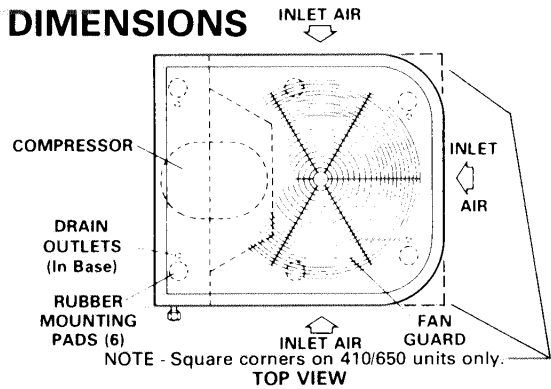


D - Dimensions

MODEL NO.	HS11-310V/510V	HS11-410V/650V
A	34-1/16 in. 865 mm	33-7/8 in. 860 mm
B	25-7/8 in. 657 mm	32-1/8 in. 816 mm
C	29-7/8 in. 759 mm	34-1/16 in. 865 mm
D	6-7/8 in. 175 mm	6-7/8 in. 175 mm
E	2-1/16 in. 52 mm	2-1/16 in. 52 mm
F	8-1/4 in. 210 mm	8-1/4 in. 210 mm
G	1-3/4 in. 44 mm	1-3/4 in. 44 mm



UNIT DIMENSIONS



E - Approved Match-Ups

Refer to the Lennox Engineering Handbook for approved system match-ups. The correct expansion valve kit is listed with the evaporator coil information. The following table lists the line sets for the HS11. A reducer fitting is required at suction line fitting to drop from 1-1/8 in. down to 7/8 in.

However, for maximum efficiency, remove the 3/4 in. suction flare at evaporator and connect to field fabricated 1-1/8 in. suction line.

Condensing Unit Model No.	Line Set Model No.	Length Suction & Liquid Lines (ft.)	Liquid Line (o.d. in.)	Suction Line (o.d. in.)
HS11-311/511V	L10-65-30	30	3/8	7/8
HS11-411/651V	L10-65-40	40		
	L10-65-50	50		

Since the HS11 is a dual capacity unit, the refrigerant piping must be properly designed and installed to achieve satisfactory oil return.

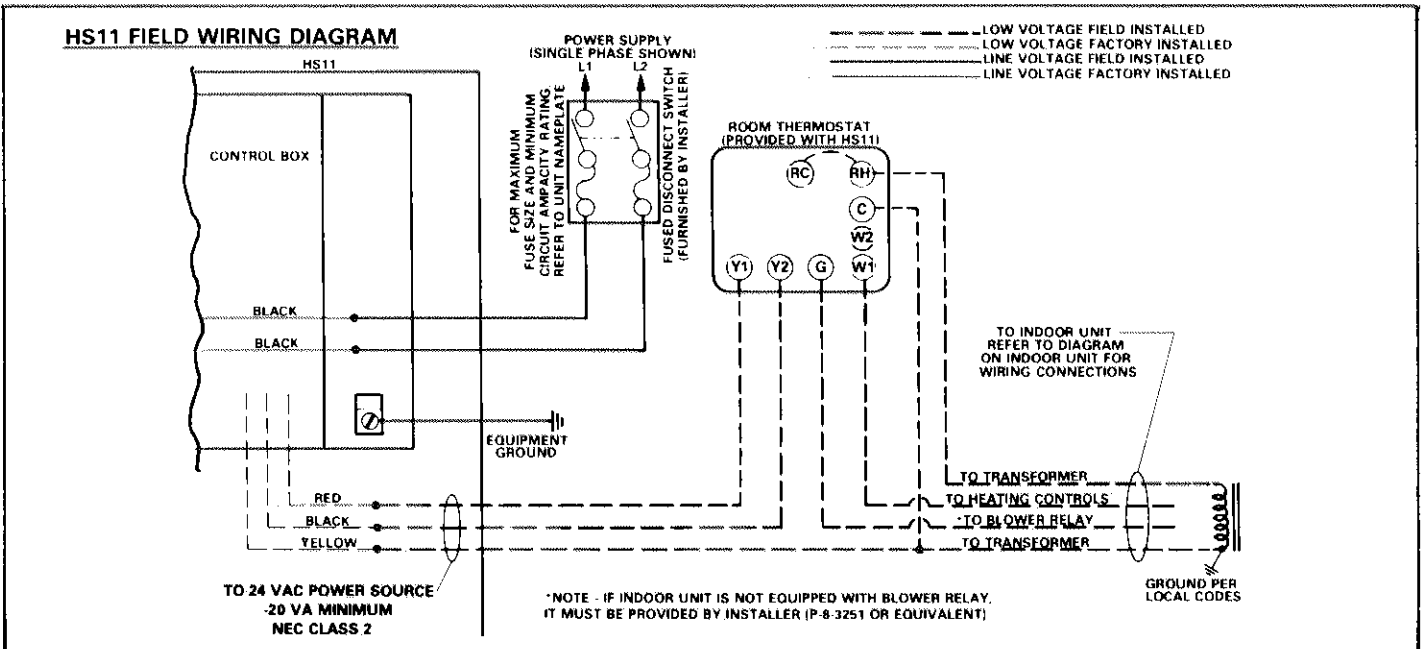


FIGURE 2

G - Optional Latent Load Discriminator (LB-34857BA)

The optional Latent Load Discriminator Kit controls the speed of the indoor blower motor to obtain maximum dehumidification during low speed compressor operation. The kit has a dehumidistat which switches blower to low speed at high humidity conditions for latent cooling. During low humidity conditions, blower operates at high speed for maximum sensible cooling. The indoor blower motor automatically runs at high speed whenever compressor operates at high speed. Figure 3 shows the field wiring for the Latent Load Discriminator.

The dehumidistat mounts in the conditioned space. It is adjustable. The recommended setting is 50%.

With dehumidistat contacts closed (high humidity), the Latent Load Relay is energized through the N.C. contacts of the High Speed Relay. The blower motor runs at low speed.

The HS11 is applicable to the ZoneMaster system. This is a direct expansion valve refrigerant system using multiple evaporators, a HS11 condensing unit and an RTM1-65 Tank Module to couple the system together. Refer to the ZoneMaster application manual for further details.

F - Typical Field Wiring Diagram

High voltage leads provided in make-up area of control box for connection to power supply. Refer to Figure 2. Ground lug provided in high voltage make-up area.

Note on unit wire sizing & fuse selection - Minimum circuit ampacity and maximum fuse size are listed on the unit rating plate and Engineering Handbook. The unit supply wire size must be obtained from the appropriate Table 310 in the National Electric Code Book. Lennox recommends using the Maximum Fuse Size listed to prevent nuisance trippouts.

Low voltage connections are made just below the control box.

With dehumidistat contacts open (low humidity), the Latent Load Relay is de-energized and the blower motor runs at high speed.

A high speed demand will energize the High Speed Relay to consequently de-energize the Latent Load Relay and run the blower motor at high speed.

III - REFRIGERANT SYSTEM

Service gauge ports are located on the discharge line, suction line and liquid line. See Figure 4. The suction service valve located inside cabinet is both front and back seating. Suction line connection is 1-1/8 in. sweat.

Liquid line valve access is external to cabinet. The valve is not a back seating valve. A 3/16 in. hex wrench is required for valve. Liquid line connection is 3/8 in. compression fitting.

The HS11 must run at high speed when checking the charge.

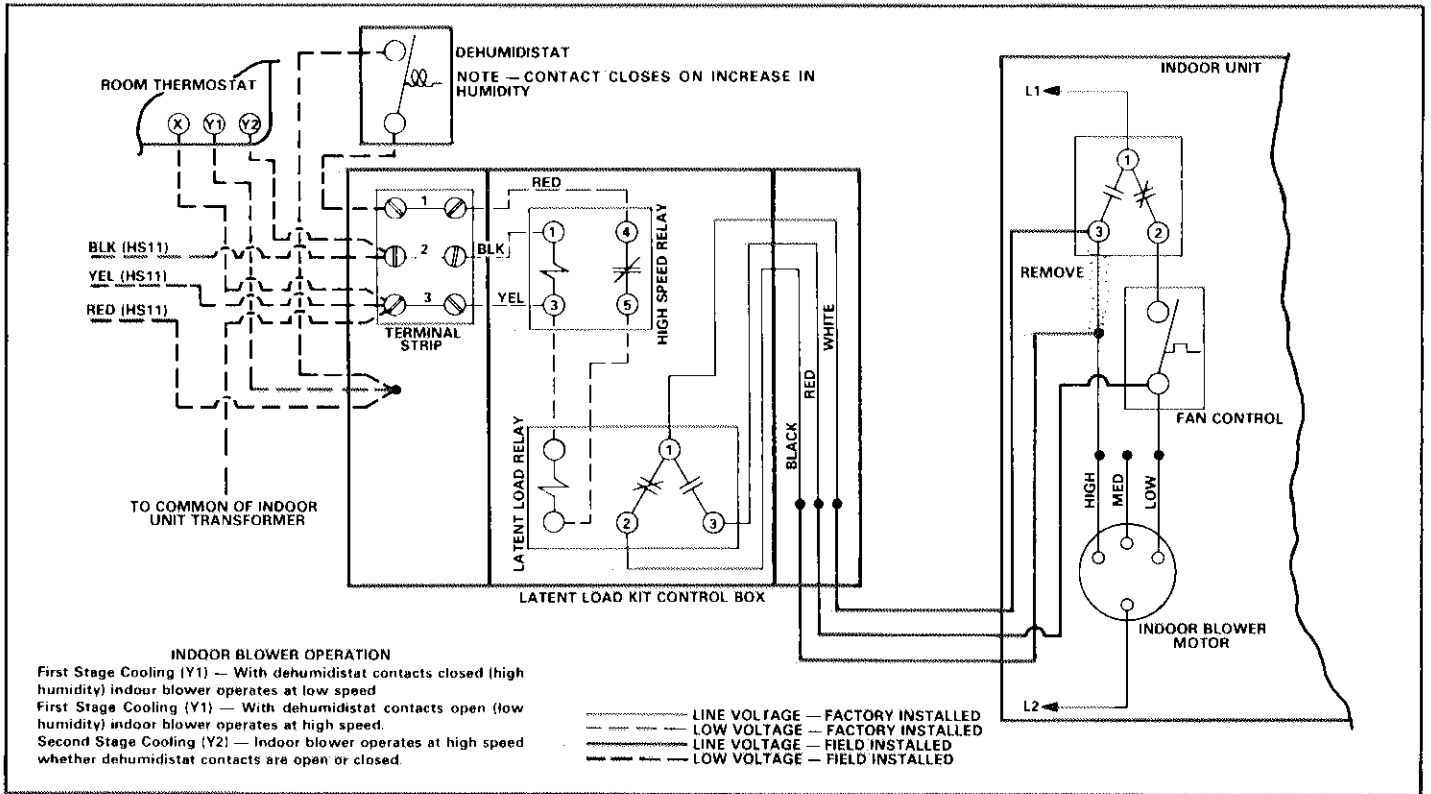


FIGURE 3

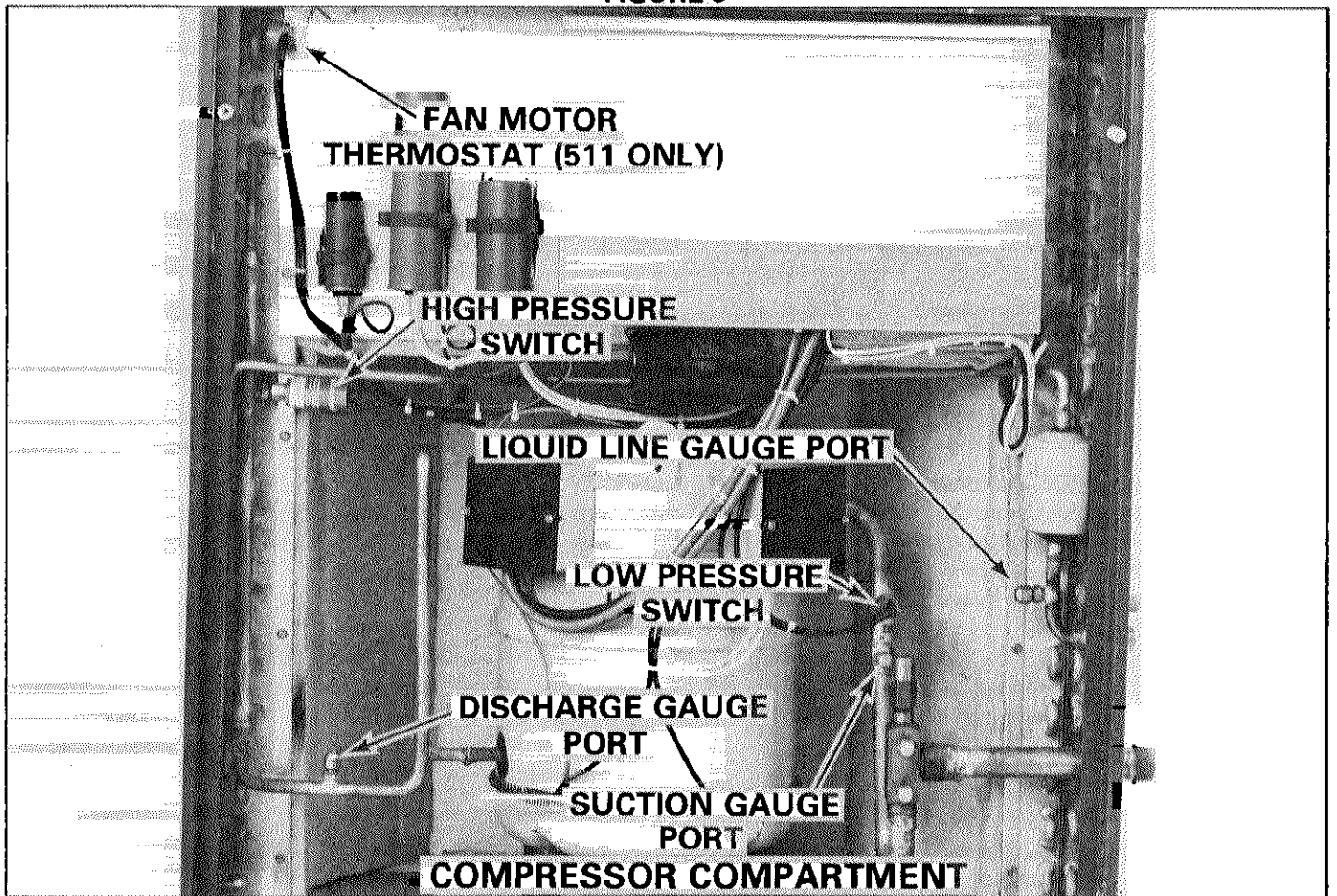


FIGURE 4

IV - HS11 COMPONENTS

Figure 5 shows an exploded view of the HS11 unit.

A - Control Box (Figure 6)

1 - Protection Module

Module is wired to sensors (S1 & S2 connections) buried

in compressor. Opens compressor circuit when abnormal winding temperatures are detected. Auto reset, P1 & P2 are 24V power terminals. K1 & K2 switch the compressor control circuit. The module checkout is discussed later.

2 - Current Limiting Device (1Ø units only) (RT-2)

The device prevents potential relay contracts from weld-

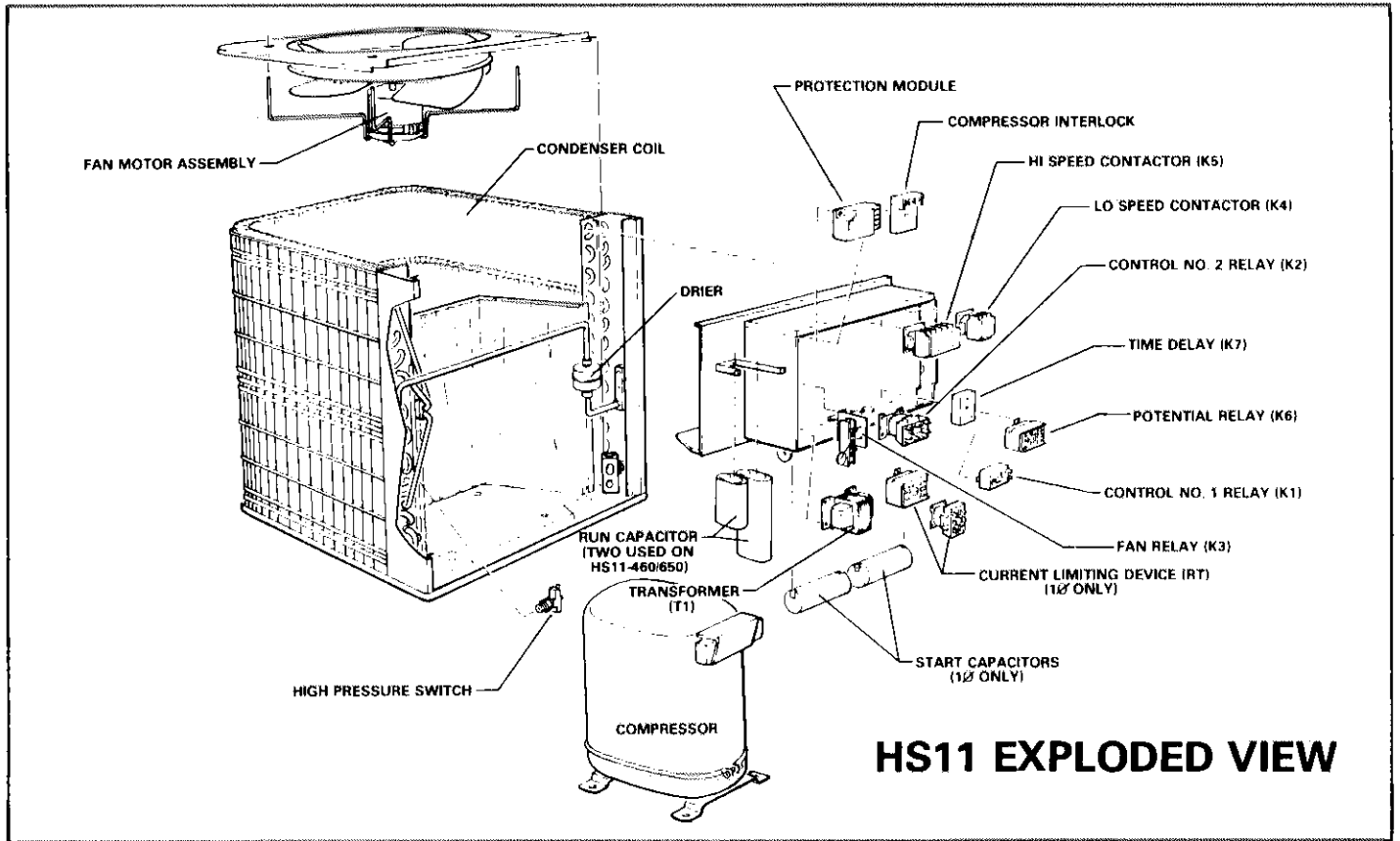


FIGURE 5

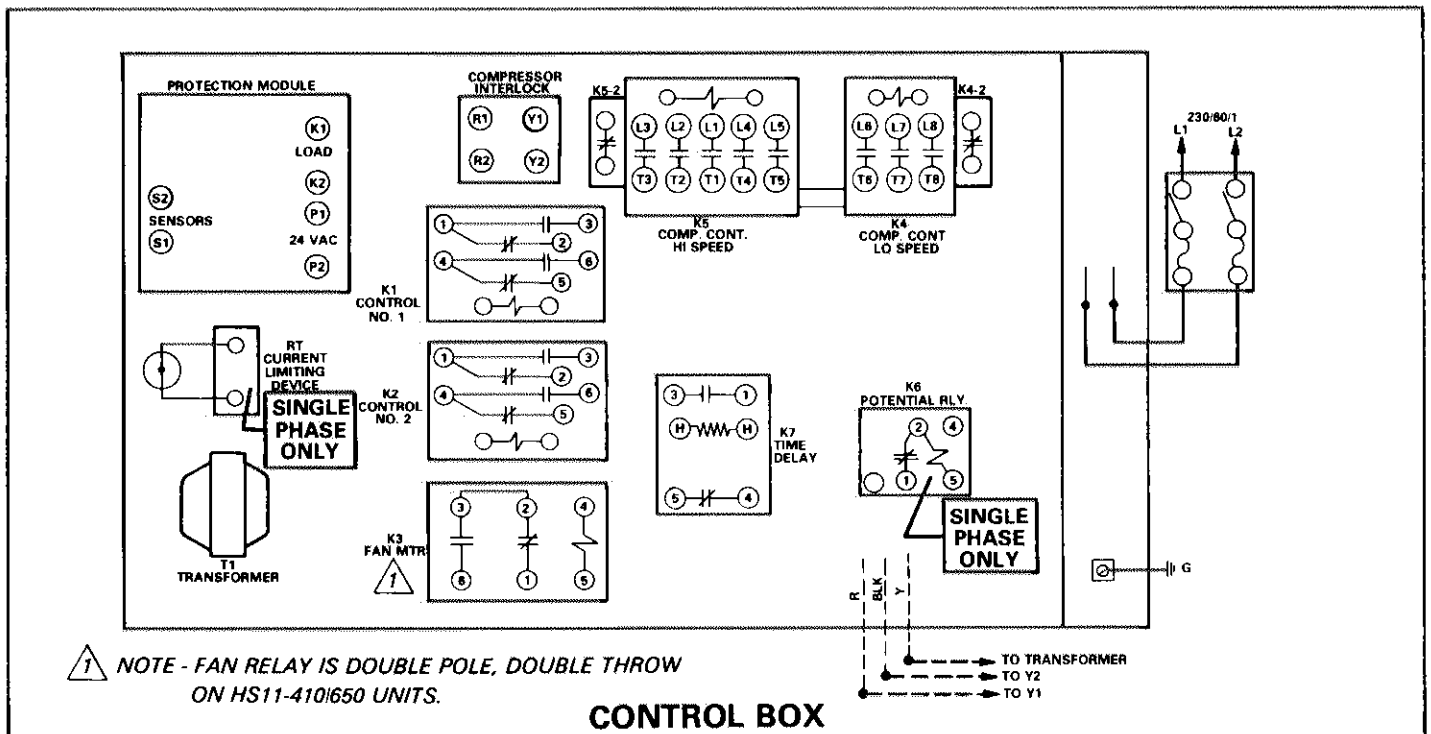


FIGURE 6

ing. As compressor slows to a stop at the end of a cycle, the device absorbs any momentary power surge from the run capacitor (s). Device is an NTC (negative temperature coefficient) type of thermistor (increase in temperature = decrease in resistance). Resistance at 25°C = 5 ohms + 10%.

3 - Transformer

208/230V primary / 24V secondary - 70VA

3.2 Amp (type C) fuse on secondary

4 - Compressor Interlock

Prevents compressor fast cycling. There is a 71 second time delay between cycles. Voltage input is 20 VAC minimum to 30 VAC maximum. Reset time is 1-1/2 seconds.

5 - Control Relays (K1 & K2)

Used in 24 volt control circuit for low and high speed compressor operation.

6 - Fan Relay (K3)

Used to control fan motor and crankcase heater. The relay energizes the heater when the unit is not operating.

7 - Compressor Contactor Hi Speed (K5) & Low Speed (K4)

8 pole with 2 Aux. (5 pole & 3 pole interlocked) 24 volt coil.

8 - Time Delay (K7)

Provides time delay between compressor speeds. Compressor will stop. The time on is 30 to 50 seconds while the time off is 20 to 40 seconds.

9 - Potential Relay (1Ø only) (K3)

Used in conjunction with start capacitors to bring compressor to operating speed.

Approximate pick-up volts (cold) Max - 275V/Min - 245V

Approximate dropout volts (cold) Max - 125V/Min - 70V

B - Compressor Compartment (See Figure 4).

1 - High Pressure Switch (S1)

Switch is mounted in discharge line. This switch has a cutout pressure of 410 psig; reset 180 psig - Manual Reset.

2 - Low Pressure Switch (S2)

Switch is mounted in suction line. It has a cutout pressure of 25 psi ± 5 and an automatic cut in pressure of 55 psi ± 5.

3 - Crankcase Heater Thermostat (S6)

Thermostat opens at 101°F and closes at 81°F. De-energizes crankcase heater at temperatures above set-point.

4 - Fan Motor Thermostat (511 units only)

A refrigerant temperature sensing thermostat attached to the condenser coil controls the two speed fan motor used on the HS11-311/511 unit. The thermostat (non-adjustable) switches fan motor at approximately the following temperatures:

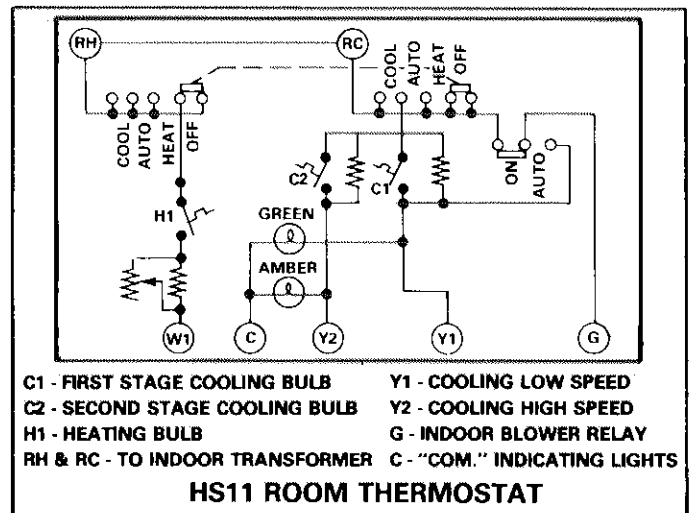
HS11 Model	High		Low	
	Ambient	Refrigerant	Ambient	Refrigerant
310/510	90F (32, 1C)	110F (43, 3C)	75F (23, 8C)	95F (35, 0C)

Motor switching will vary between these temperatures, depending whether outdoor temperature is on a rise or fall condition.

The HS10-410/650 uses a single speed motor.

D - Room Thermostat

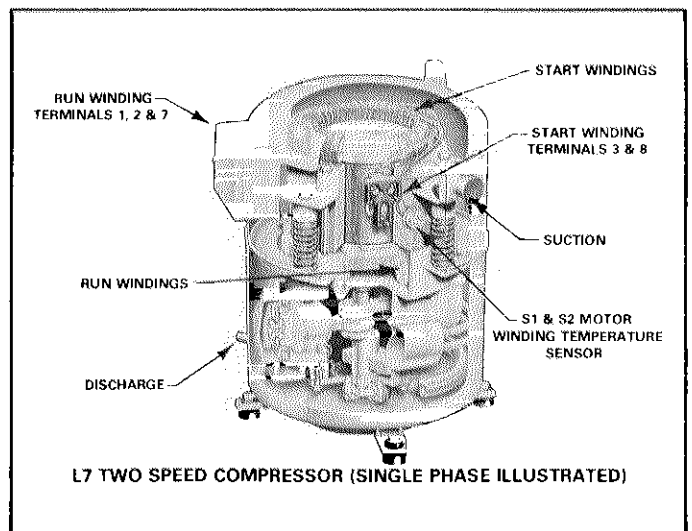
HS11 units use a two stage cooling - single stage heating thermostat. Mode of operation indicator lights give visual readout of "Low" and "High" speed compressor operation. The green light comes on during low speed and the amber light comes on during high speed. Thermostat is equipped with a temperature setting dial, system selector switch (Off - Heat - Auto - Cool) and fan control switch (Auto - On). One additional wire is required for common side of indoor unit transformer to terminal C on thermostat. See Figure 7.



E - "L7" Compressor (Figure 8)

The compressor runs at 1750 RPM on low speed and 3500 RPM on high speed. Figures 9 and 10 show the motor windings for both single phase and three phase compressors. The high and low speed contactors each have an auxiliary contact which serves as a positive interlock between speeds thus preventing both speeds from being energized simultaneously. The compressor "timed-on" control provides a time delay between speeds.

The compressor has two sensors buried within the windings which link to the compressor protection module. An external crankcase heater is standard.



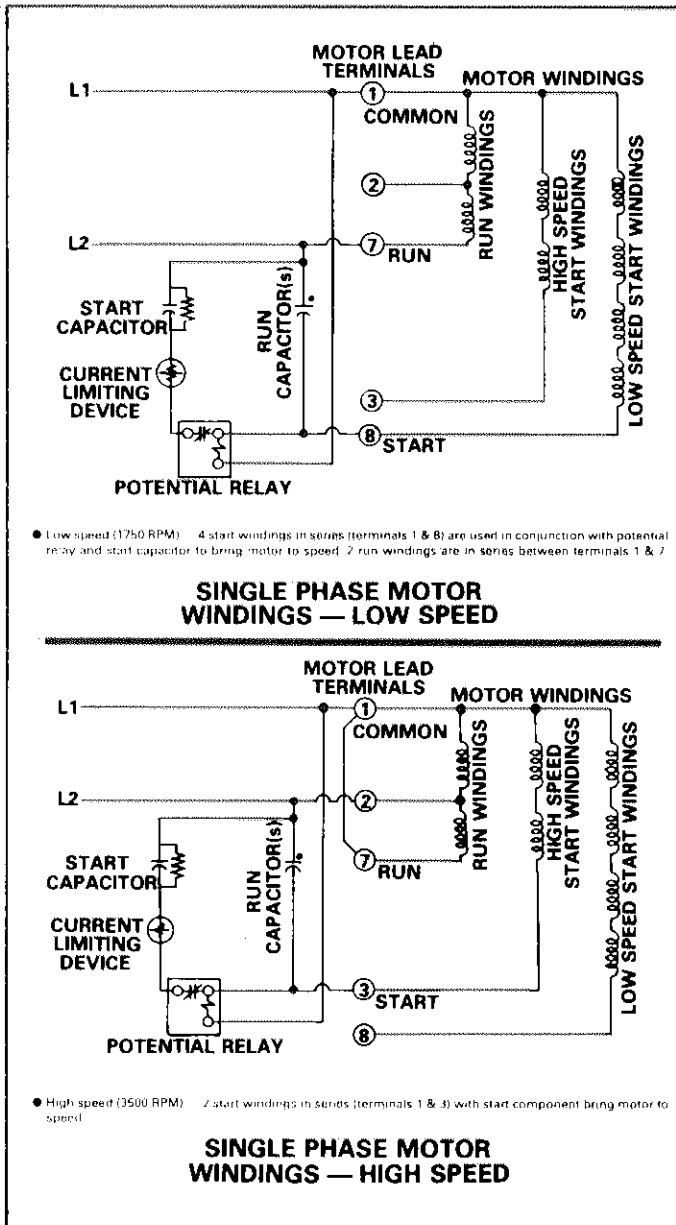


FIGURE 9

V - COMPRESSOR PROTECTION MODULE CHECKOUT

Thermal sensors embedded within the compressor windings change resistance in direct relationship to temperature change. The trip setting ranges from 16K to 24K while reset setting ranges from 5.5K to 6.9K.

Provide a cooling demand and check K1 and K2. Power indicates another component is open. Check power to module. Remove thermal sensor leads and check their resistance. Use resistors to check module operation. Refer to Figure 11.

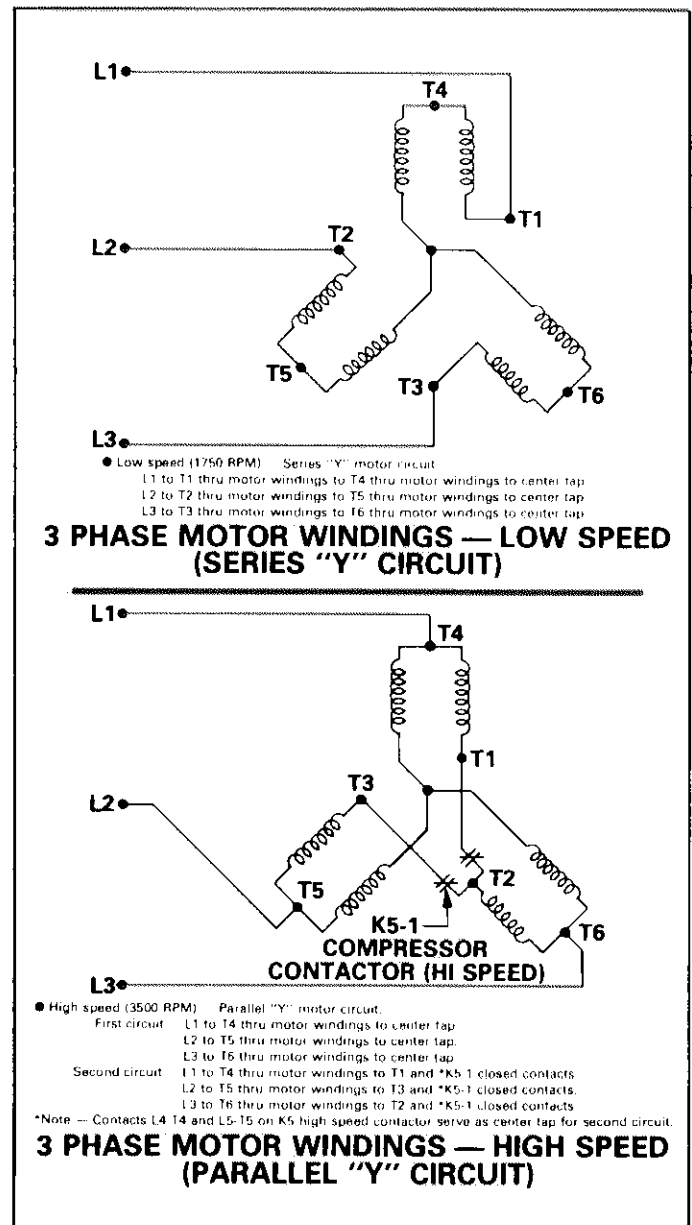


FIGURE 10

VI - CHECKING L7 COMPRESSOR WINDINGS

Turn off power to unit and remove all wiring from compressor terminals. Using an ohm meter set on scale R x 10K, check windings for grounds and open circuits. Refer to Figures 12 and 13.

TEXAS INSTRUMENTS SOLID STATE COMPRESSOR PROTECTION

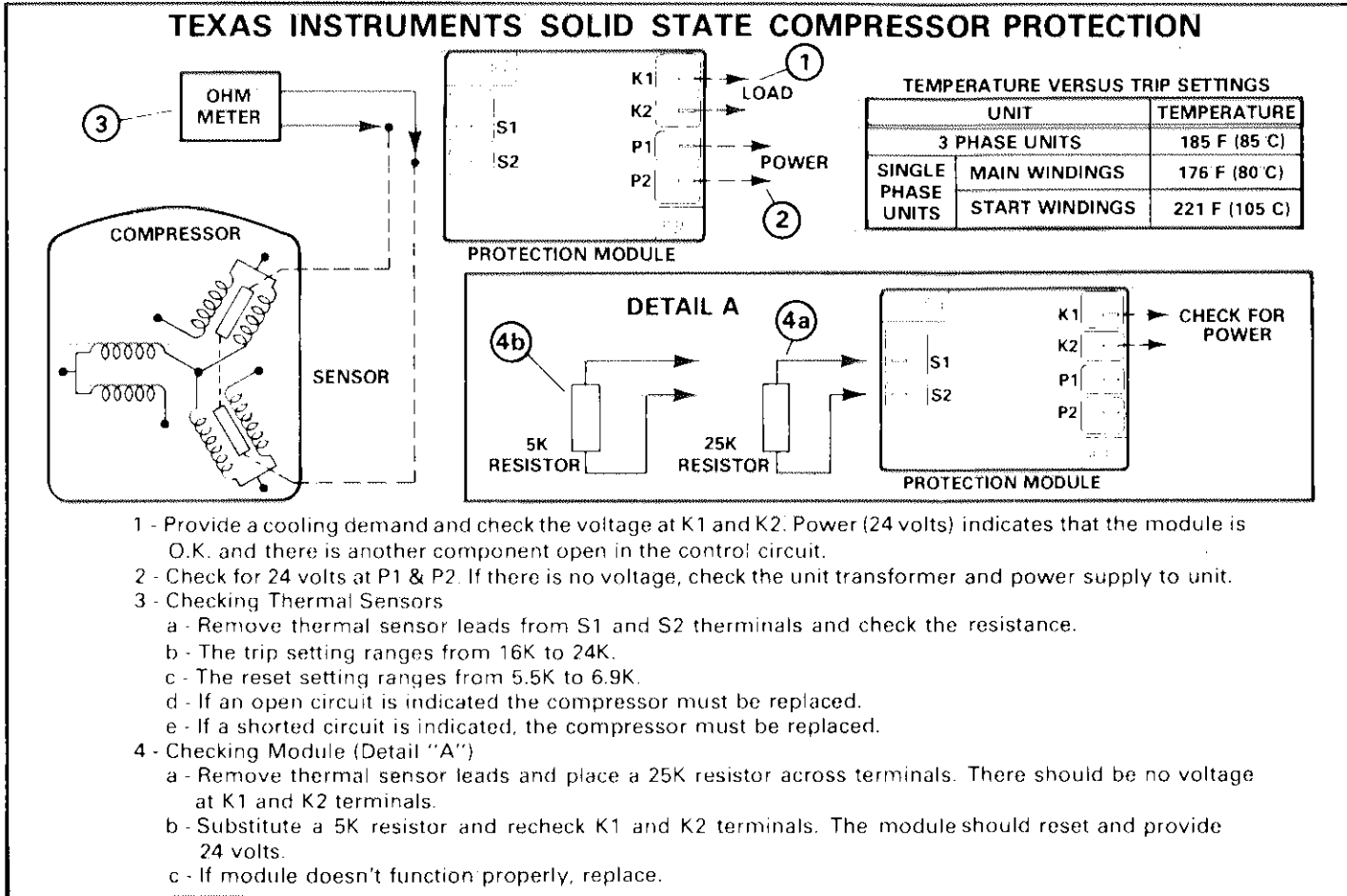


FIGURE 11

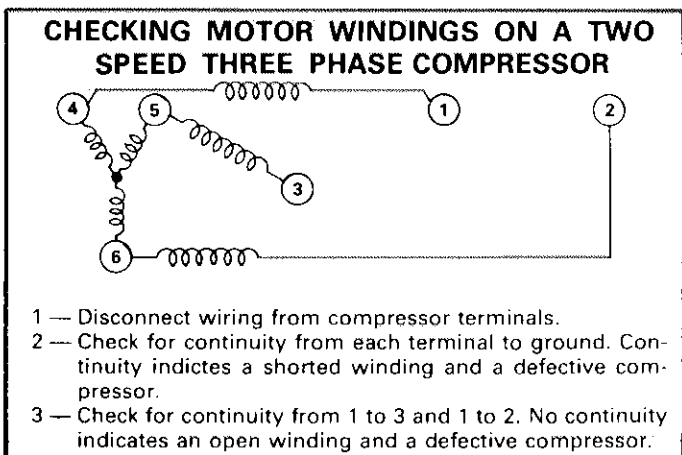


FIGURE 12

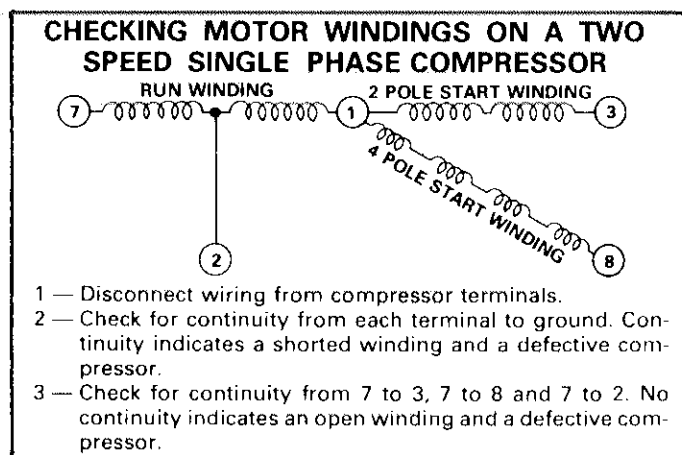


FIGURE 13

VII - SCHEMATIC WIRING DIAGRAM OPERATING SEQUENCE

Each of the following steps within this section are labeled in the corresponding diagram.

LOW SPEED OPERATION

A - 24 Volt Control Circuit - Low Speed (Figure 14)

- 1 - Thermostat demand on first stage (Y1) energizes Control Relay No. 1 (K1) through N.C. K7-2 contact.
- 2 - The green light also comes on at thermostat.
- 3 - The N.O. K1-1 contact closes to energize the Fan Motor Relay (K3) and Compressor Interlock through:
 - S1 - High Pressure Switch
 - S2 - Low Pressure Switch
 - N.C. K2-1 Control Relay No. 2
 - K5-2 Hi Compressor Contactor
- 4 - The circuit continues through Compressor Interlock providing the 70 second timing period has elapsed. The Low Speed Contactor (K4) is energized through the N.C. K2-2 contact.

If the unit has optional Latent Load Discriminator, refer to the following steps.

- 5 - The Indoor Blower Relay is energized through the thermostat on a cooling demand.
- 6 - Under normal operating conditions the Blower Motor is energized on high speed through the N.O. Indoor Blower Relay contact and N.C. Latent Load Relay contact.
- 7 - The Dehumidistat closes its contacts when humidity exceeds setpoint.
- 8 - The Latent Load Relay is energized through the Dehumidistat and the N.C. High Speed Relay contact.
- 9 - The Blower Motor is powered on low speed through the N.O. Indoor Blower Relay contact and N.O. Latent Load Relay contact.

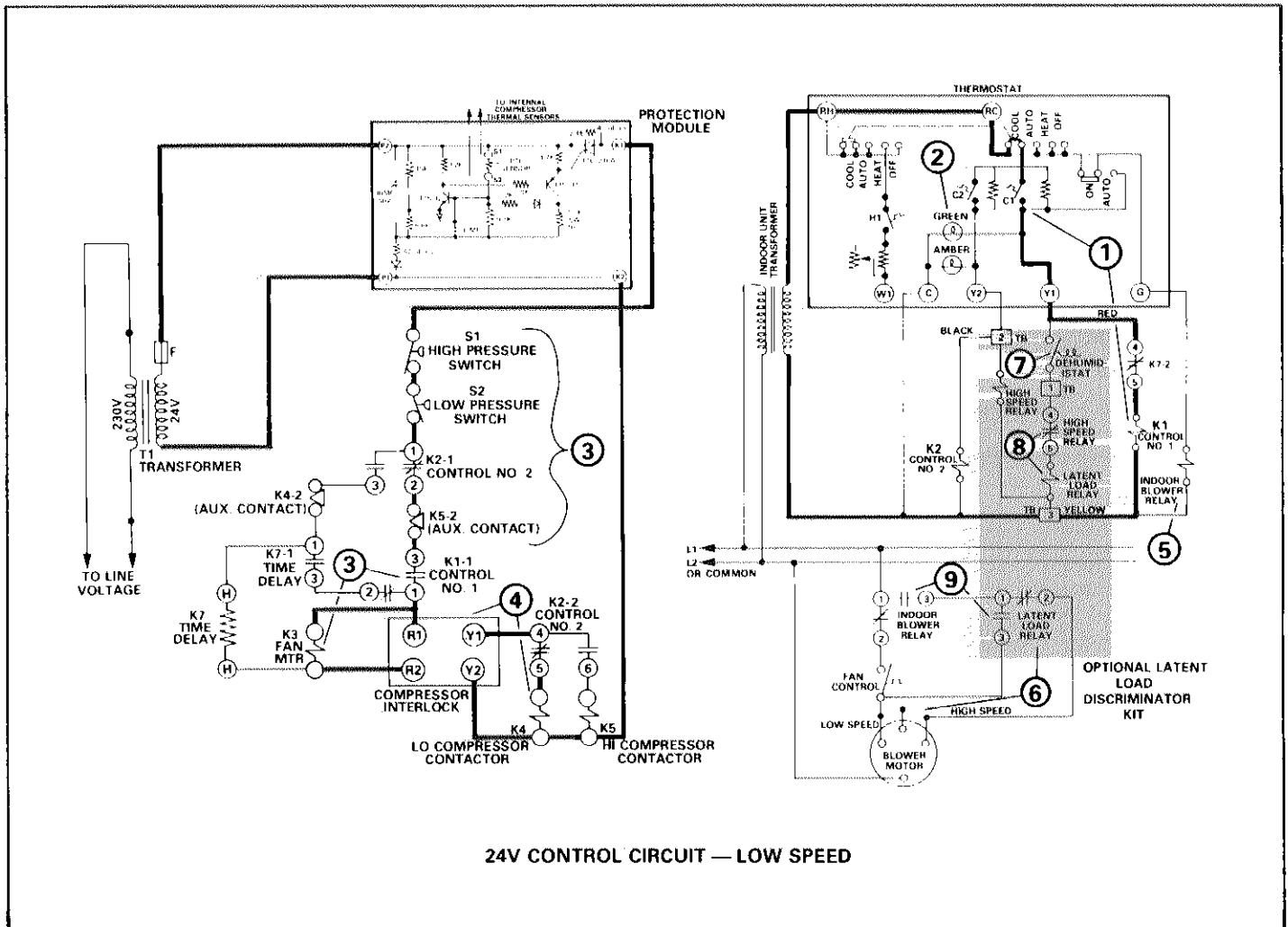


FIGURE 14

**B - Single Phase Compressor Circuit - Low Speed
(Figure 15)**

- 1 - Low Speed Compressor Contactor (K4) and Fan Motor Relay (K3) are energized by low voltage control circuit.
- 2 - N.C. K3-1 contact opens to cutout crankcase heater operation.
- 3 - The Fan Motor is energized through N.O. K3-2. On HS11-311/511 units the fan speed is determined by Fan Thermostat.
- 4 - The compressor run windings (terminals 1 & 7) are ener-

gized through contacts "T6" and "T7" of Low Speed Compressor Contactor (K4-1).

- 5 - K4-1 contact "T8" closes to energize the 4 pole start winding at terminal 8.
- 6 - The start and run capacitors are in series through "T8" contact to compressor start winding.
- 7 - The start capacitor circuit (shaded area) is de-energized by Potential Relay (K6) when compressor comes up to speed. The contact opens at approximately 324V generated voltage from compressor windings (EMF Electro-Motive Force).

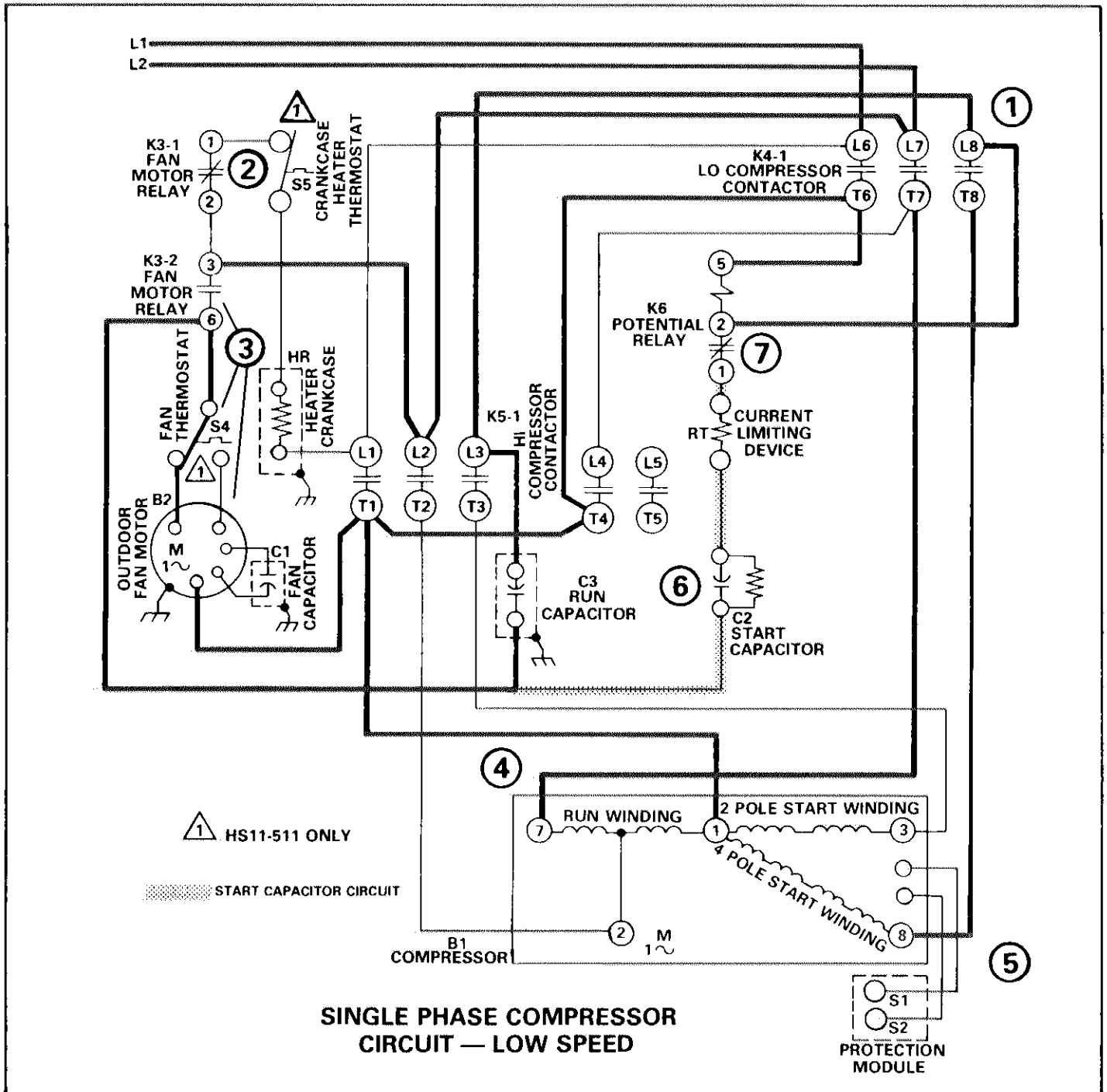


FIGURE 15

C - Three Phase Compressor Circuit - Low Speed (Figure 16)

- 1 - Lo Compressor Contactor (K4) and Fan Motor Relay (K3) are energized by low voltage control circuit.
- 2 - N.C. K3-1 contact opens to cutout crankcase heater operation.

- 3 - The Fan Motor is energized through N.O. K3-2.
- 4 - Compressor terminals 1, 2 and 3 are energized through K4-1 contacts ("T6", "T7" and "T8").

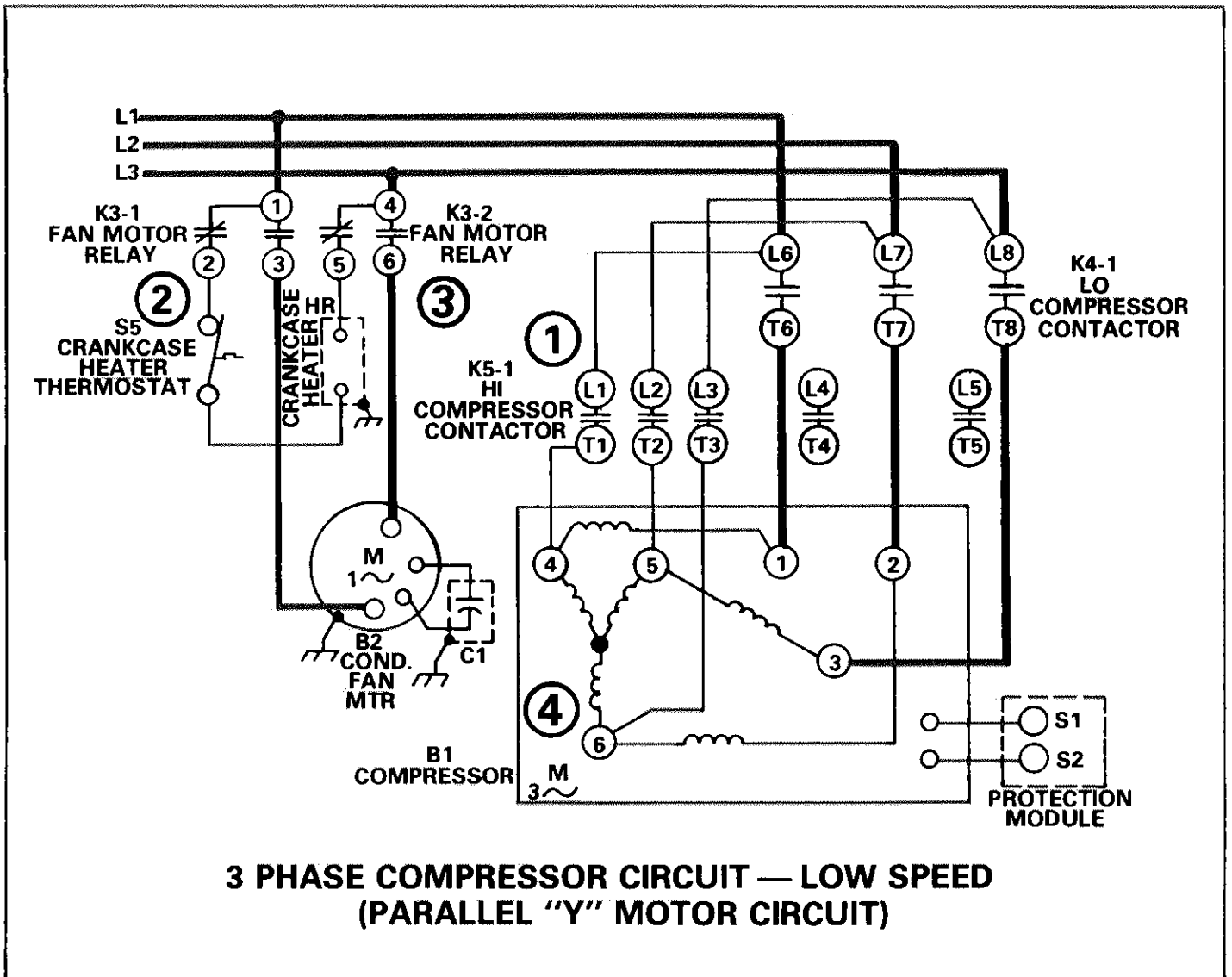


FIGURE 16

HIGH SPEED OPERATION

A - 24 Volt Control Circuit - High Speed (Figure 17)

- 1 - Thermostat demand on second stage (Y2) energizes Control Relay No. 2 (K2).
- 2 - The amber light comes on at thermostat.
- 3 - N.O. K2-1 contact closes to energize Time Delay relay (K7) through:
 - S1 - High Pressure Switch
 - S2 - Low Pressure Switch
 - K4-2 Lo Compressor Contactor
- 4 - N.C. K7-2 contact opens in approximately 30 to 50 seconds to de-energize Control Relay No. 1 (K1).
- 5 - At the same time N.O. K7-1 contact opens to energize the Fan Motor Relay (K3) and Compressor Interlock through N.C. K1-1.
- 6 - The circuit continues through Compressor Interlock and N.C. K2-2 contact to energize High Speed Contactor (K5).

IMPORTANT — The K7 time delay and compressor interlock give the following timing sequence.

- *Initial Demand First Stage* — No delay.
- *Initial Demand Second Stage* — There is a 30 to 50 second (timed-in) delay thru K7, providing over 70 seconds

have expired from end of cycle.

- *Changing from First to Second Stage* — There is a 30 to 50 second (time-in) delay at K7 plus an approximate 20 second remainder at compressor interlock. Compressor and *condenser fan will stop.
- *Changing from Second to First Stage* — There is a 20 to 40 second (time-out) delay at K7 plus an approximate 30 second remainder at compressor interlock. Compressor and *condenser fan will stop.

**Note - Condenser fan will start at end of K7 timing.*

If the unit has optional Latent Load Discriminator, refer to the following steps:

- 7 - The High Speed Relay is energized when the second stage cooling bulb makes.
- 8 - The High Speed Relay opens its N.C. contact to de-energize the Latent Load Relay.
- 9 - The Indoor Blower Relay is energized through the thermostat on a cooling demand.
- 10 - The Blower Motor is energized on high speed through the N.O. Indoor Blower Relay contact and N.C. Latent Load Relay contact.

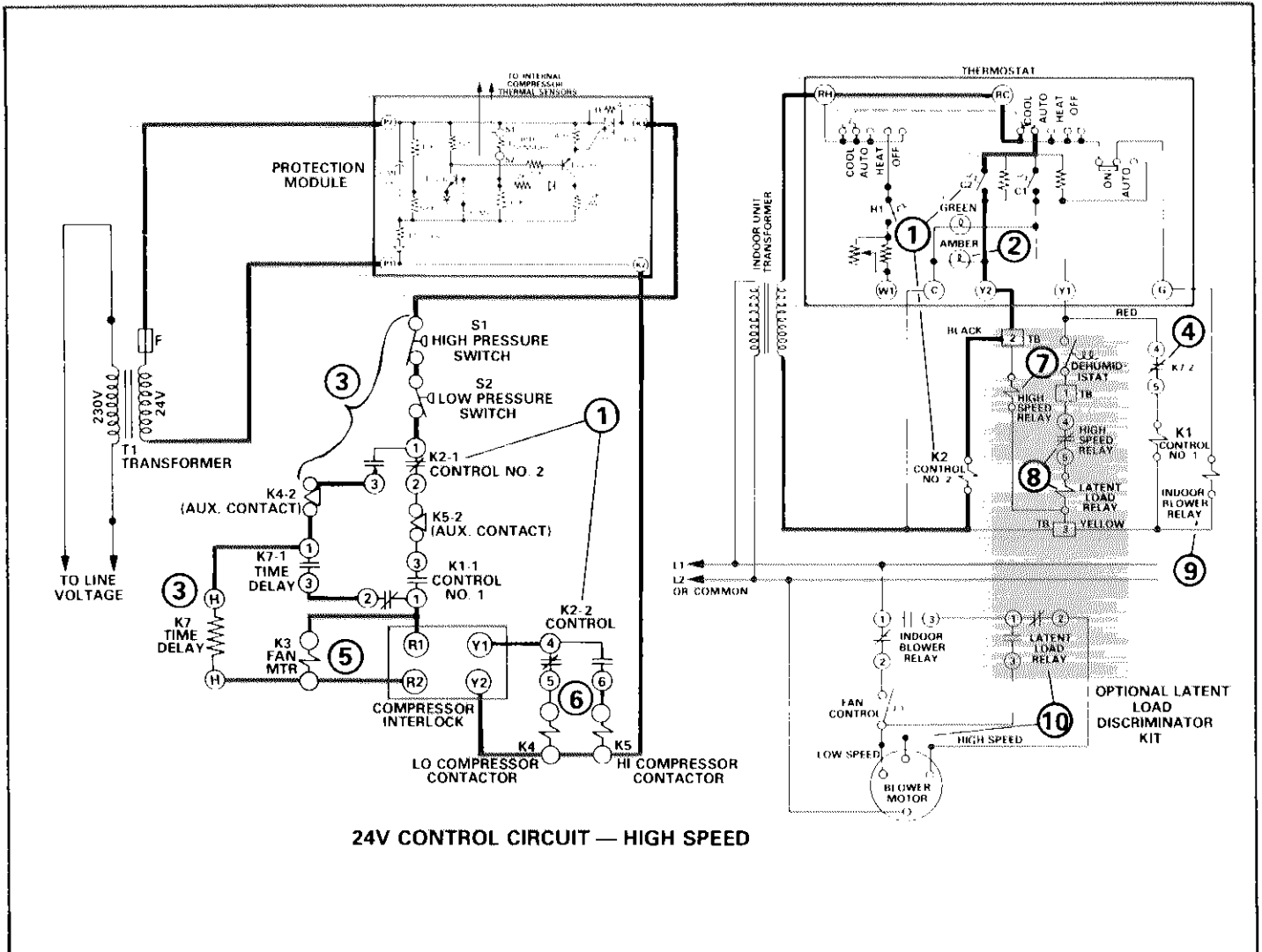


FIGURE 17

B - Single Phase Compressor Circuit - High Speed (Figure 18)

- 1 - High Speed Compressor Contactor (K5) and Fan Motor Relay (K3) are energized by low voltage control circuit.
- 2 - N.C. K3-1 contact opens to cutout crankcase heater operation.
- 3 - The Fan Motor is energized through N.O. K3-2. On HS11-311/511 units the fan speed is determined by Fan Thermostat.

- 4 - The compressor run windings (terminals 1, 2 & 7) are energized through contacts "T1", "T2" and "T4" of High Speed Compressor Contactor (K5-1).
- 5 - K5-1 contact "T3" closes to energize the 2 pole start winding (terminal 3).
- 6 - The start and run capacitors are in series through "T3" contact to compressor start winding.
- 7 - The start capacitor circuit (shaded area) is de-energized by potential relay when compressor comes up to speed.

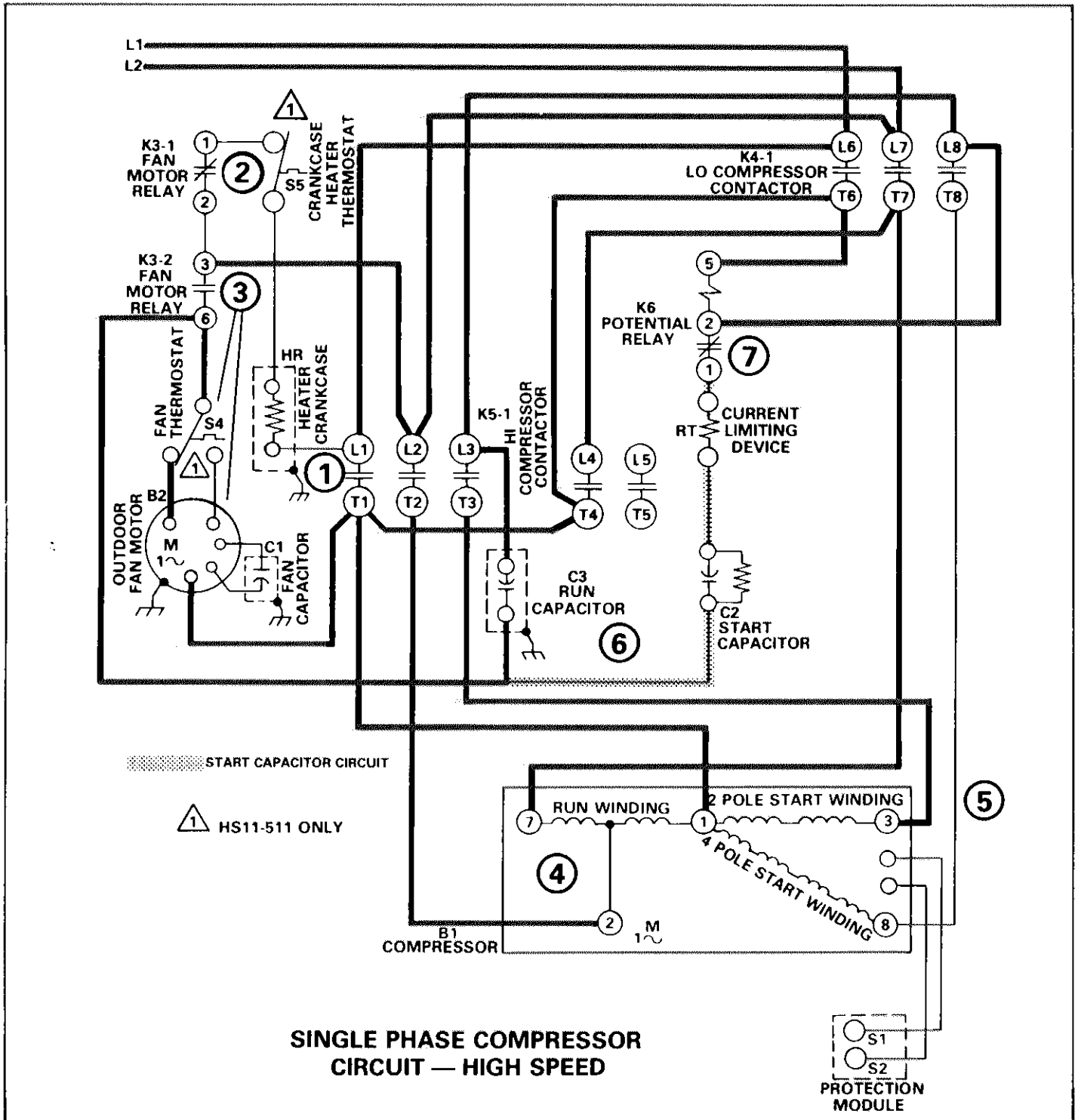


FIGURE 18

C - Three Phase Compressor Circuit - High Speed (Figure 19)

- 1 - High Speed Compressor Contactor (K5) and Fan Motor Relay (K3) are energized by low voltage control circuit.
- 2 - N.C. K3-1 contact opens to cutout crankcase heater operation.

3 - The Fan Motor is energized through N.O. K3-2.

- 4 - Compressor terminals 4, 5 and 6 are energized through K4-1 contacts "T1", "T2" and "T3" to form a parallel "Y" motor winding circuit.

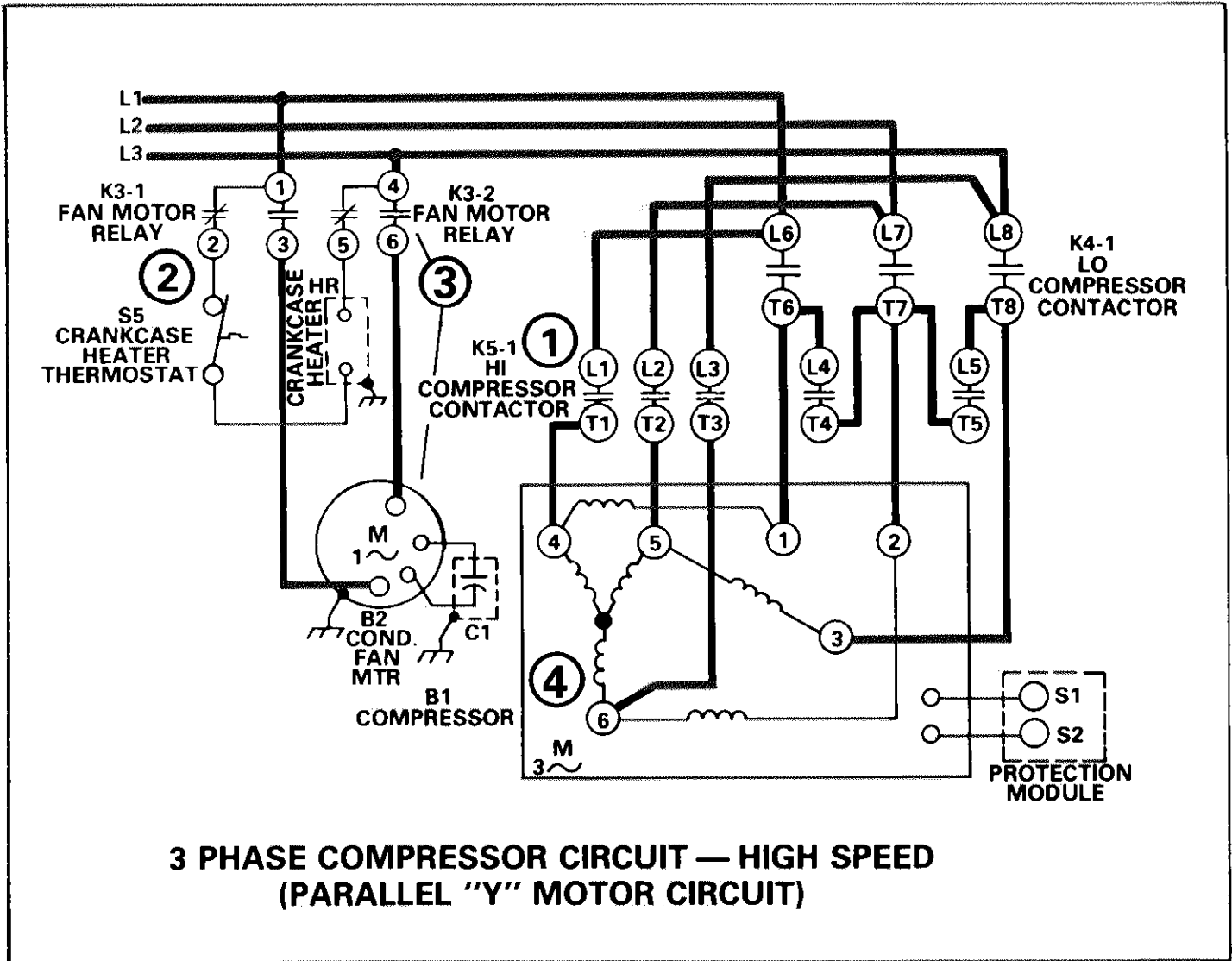


FIGURE 19