

Service Manual

VERT-I-PAK[™] A SERIES

**Single Package
Vertical Air Conditioning System
A – H Suffix Models**

MODELS

V(E,H)A09K25***	V(E,H)A09K34***	V(E,H)A09K50***
V(E,H)A12K25***	V(E,H)A12K34***	V(E,H)A12K50***
V(E,H)A18K25***	V(E,H)A18K34***	V(E,H)A18K25***
V(E,H)A24K25***	V(E,H)A24K34***	V(E,H)A24K50***
V(E,H)A24K75***	V(E,H)A24K10***	V(E,H)A24K00***

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Introduction

This service manual is designed to be used in conjunction with the installation manuals provided with each air conditioning system component. Air conditioning systems consist of **BOTH** an **evaporator** (indoor section) and a **condenser** (outdoor section) in one closed system, and a room thermostat. When so equipped, accessories such as electric strip heaters are also considered part of the system.

This service manual was written to assist the professional HVAC service technician to quickly and accurately diagnose and repair any malfunctions of this product.

This manual, therefore, will deal with all subjects in a general nature. (i.e. All text will pertain to all models).

IMPORTANT: It will be necessary for you to accurately identify the unit you are servicing, so you can be certain of a proper diagnosis and repair. (See Unit Identification.)

WARNING

The information contained in this manual is intended for use by a qualified service technician who is familiar with the safety procedures required in installation and repair, and who is equipped with the proper tools and test instruments.

Installation or repairs made by unqualified persons can result in hazards subjecting the unqualified person making such repairs to the risk of injury or electrical shock which can be serious or even fatal not only to them, but also to persons being served by the equipment.

If you install or perform service on equipment, you must assume responsibility for any bodily injury or property damage which may result to you or others. Friedrich Air Conditioning Company will not be responsible for any injury or property damage arising from improper installation, service, and/or service procedures.

Model Identification Guide

MODEL NUMBER	V	E	A	24	K	50	RT	A	
SERIES V=Vertical Series									ENGINEERING CODE
E=Cooling with or without electric heat H=Heat Pump								OPTIONS RT = Standard Remote Operation SP = Seacoast Protected	
DESIGN SERIES A = 32" and 47" Cabinet									
NOMINAL CAPACITY <u>A-Series (Btu/h)</u> 09 = 9,000 12 = 12,000 18 = 18,000 24 = 24,000								ELECTRIC HEATER SIZE <u>A-Series</u> 00 = No electric heat 25 = 2.5 KW 34 = 3.4 KW 50 = 5.0 KW 75 = 7.5 KW 10 = 10 KW	
VOLTAGE K = 208/230V-1Ph-60Hz									

Serial Number Identification Guide

SERIAL NUMBER Decade Manufactured J = 9 K = Not Used L = 0	L	K	A	V	00001	
						PRODUCTION RUN NUMBER
YEAR MANUFACTURED A = 1 E = 5 J = 9 B = 2 F = 6 K = 0 C = 3 G = 7 D = 4 H = 8						PRODUCT LINE R = RAC P = PTAC E = EAC V = VPAK H = SPLIT
MONTH MANUFACTURED A = Jan D = Apr G = Jul K = Oct B = Feb E = May H = Aug L = Nov C = Mar F = Jun J = Sep M = Dec						

VERT-I-PAK® H SUFFIX CHASSIS SPECIFICATIONS

VEA/VHA9K-24K								
	VEA09K	VEA12K	VEA18K	VEA24K	VHA09K	VHA12K	VHA18K	VHA24K
C O O L I N G D A T A								
Cooling Btu/h	9500/9300	11800/11500	18000/17800	24000	9500/9300	11800/11500	18000/17800	23500
Cooling Power (W)	880	1093	2070	2526	905	1124	2070	2474
EER	10.8	10.8	8.7	9.5	10.5	10.5	8.7	9.5
Sensible Heat Ratio	0.74	0.72	0.70	0.70	0.74	0.72	0.70	0.70
H E A T P U M P D A T A								
Heating Btu/h	N/A	N/A	N/A	N/A	8500/8300	10600/10400	15700/15500	22500
COP @ 47°F	N/A	N/A	N/A	N/A	3.0	3.2	3.0	3
Heating Power (W)	N/A	N/A	N/A	N/A	830	971	1705	2200
Heating Current (A)	N/A	N/A	N/A	N/A	4.4/4.9	5.5/6.1	9.2/10.2	11.4
E L E C T R I C A L D A T A								
Voltage (1 Phase, 60 Hz)	230/208	230/208	230/208	230/208	230/208	230/208	230/208	230/208
Volt Range	253-198	253-198	253-198	253-198	253-198	253-198	253-198	253-198
Cooling Current (A)	4.1/4.3	4.9/5.3	9.2/10.2	11.2/12.4	4.2/4.4	5.0/5.5	9.2/10.2	11.2/12.4
Amps L.R.	21	21	47	68	21	21	47	68
Amps F.L.	3.7	4.5	7.9	10.2	3.7	4.5	7.9	10.2
Indoor Motor (HP)	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
Indoor Motor (A)	1.2	1.2	1.4	2	1.2	1.2	1.4	2
Outdoor Motor (HP)	N/A	N/A	N/A	1/4	N/A	N/A	N/A	1/4
Outdoor Motor (A)	N/A	N/A	N/A	2	N/A	N/A	N/A	2
A I R F L O W D A T A								
Indoor CFM*	300	350	550	750	300	375	550	750
Vent CFM	60	60	60	80	60	60	60	80
Max. ESP	.3"	.3"	.3"	.3"	.3"	.3"	.3"	.3"
P H Y S I C A L D A T A								
Dimensions (W x D x H)	23 x 23 x 32	23 x 23 x 32	23 x 23 x 32	23 x 23 x 47	23 x 23 x 32	23 x 23 x 32	23 x 23 x 32	23 x 23 x 47
Net Weight (Lbs)	114	124	144	167	114	125	144	167
Shipping Weight (Lbs)	125	135	155	180	125	135	155	180
R-22 Charge	25	29	42	68.5	23.5	27	42	63.5

* Normal Value Wet Coil @ .1" ESP.

ELECTRIC HEAT DATA

VEA/VHA09,12								
	VE/VHA09			VE/VHA12				
Heater Watts	2500/2050	3400/2780	5000/4090	2500/2050	3400/2780	5000/4090		
Voltage	230/208			230/208				
Heating Btu/h	8500/7000	11600/9500	17000/13900	8500/7000	11600/9500	17000/13900		
Heating Current (Amps)	10.6/9.3	14.5/12.5	20.9/18.2	10.6/9.3	14.5/12.5	20.9/18.2		
Minimum Circuit Ampacity	15	19.9	27.9	15	19.9	27.9		
Branch Circuit Fuse (Amps)	15	20	30	15	20	30		
Basic Heater Size	2.5 Kw	3.4 Kw	5.0 Kw	2.5 Kw	3.4 Kw	5.0 Kw		
VEA/VHA18,24								
	VE/VHA18			VE/VHA24				
Heater Watts	2500/2050	3400/2780	5000/4090	2500/2050	3400/2780	5000/4090	7500/6135	10000/8180
Voltage	230/208			230/208				
Heating Btu/h	8500/7000	11600/9500	17000/13900	8500/7000	11600/9500	17000/13900	25598/20939	34130/27918
Heating Current (Amps)	10.6/9.3	14.5/12.5	20.9/18.2	10.9/9.9	14.8/13.4	21.7/19.7	32.6/29.5	43.5/39.3
Minimum Circuit Ampacity	15	19.9	27.9	17.2/15.9	22.1/20.3	30.7/28.1	44.3/40.4	57.9/52.7
Branch Circuit Fuse (Amps)	15	20	30	25/25	25/25	35/30	45/45	60/60
Basic Heater Size	2.5 Kw	3.4 Kw	5.0 Kw	2.5 Kw	3.4 Kw	5.0 Kw	7.5 Kw	10.0 Kw

VERT-I-PAK® E & G SUFFIX CHASSIS SPECIFICATIONS

Model	V(E,H)A09	V(E,H)A12	V(E,H)A18	V(E,H)A24
Voltage (V)	230 / 208	230 / 208	230 / 208	230 / 208
Refrigerant	R-22	R-22	R-22	R-22
Chassis Width	23.125"	23.125"	23.125"	23.125"
Chassis Depth	23.125"	23.125"	23.125"	23.125"
Chassis Height **	32.25"	32.25"	32.25"	47.25"
Shipping W x D x H	26" x 28.5" x 35.0"	26" x 28.5" x 35"	26" x 28.5" x 35"	26" x 28.5" x 50"
Supply Duct Collar ***	10"	10"	10"	10"
Drain Connection	3/4" FPT	3/4" FPT	3/4" FPT	3/4" FPT
Min. Circuit Amps	See Chassis Nameplate			
CFM Indoor	Page 11			
Max. Duct ESP	.3 in. water	.3 in. water	.3 in. water	.3 in. water

** Height includes 2" duct collar & isolators under unit. *** Factory collar accepts 10" flex duct.

VEA/VHA9K-24K								
	VEA09K	VEA12K	VEA18K	VEA24K	VHA09K	VHA12K	VHA18K	VHA24K
C O O L I N G D A T A								
Cooling Btu/h	9500/9300	11800/11500	18000/17800	24000	9500/9300	11800/11500	18000/17800	23500
Cooling Power (W)	880	1093	2070	2526	905	1124	2070	2474
EER	10.8	10.8	8.7	9.5	10.5	10.5	8.7	9.5
Sensible Heat Ratio	0.74	0.72	0.70	0.70	0.74	0.72	0.70	0.70
H E A T P U M P D A T A								
Heating Btu/h	N/A	N/A	N/A	N/A	8500/8300	10600/10400	15700/15500	22500
COP @ 47°F	N/A	N/A	N/A	N/A	3.0	3.2	3.0	3
Heating Power (W)	N/A	N/A	N/A	N/A	830	971	1705	2200
Heating Current (A)	N/A	N/A	N/A	N/A	4.4/4.9	5.5/6.1	9.2/10.2	11.4
E L E C T R I C A L D A T A								
Voltage (1 Phase, 60 Hz)	230/208	230/208	230/208	230/208	230/208	230/208	230/208	230/208
Volt Range	253-198	253-198	253-198	253-198	253-198	253-198	253-198	253-198
Cooling Current (A)	4.1/4.3	4.9/5.3	9.2/10.2	11.2/12.4	4.2/4.4	5.0/5.5	9.2/10.2	11.2/12.4
Amps L.R.	21	21	47	68	21	21	47	68
Amps F.L.	3.7	4.5	7.9	10.2	3.7	4.5	7.9	10.2
Indoor Motor (HP)	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
Indoor Motor (A)	1.2	1.2	1.4	2	1.2	1.2	1.4	2
Outdoor Motor (HP)	N/A	N/A	N/A	1/4	N/A	N/A	N/A	1/4
Outdoor Motor (A)	N/A	N/A	N/A	2	N/A	N/A	N/A	2
A I R F L O W D A T A								
Indoor CFM*	300	350	550	750	300	375	550	750
Vent CFM	60	60	60	80	60	60	60	80
Max. ESP	.3"	.3"	.3"	.3"	.3"	.3"	.3"	.3"
P H Y S I C A L D A T A								
Dimensions (W x D x H)	23x23x32	23x23x32	23x23x32	23x23x47	23x23x32	23x23x32	23x23x32	23x23x47
Net Weight (Lbs)	114	124	144	167	114	125	144	167
Shipping Weight (Lbs)	125	135	155	180	125	135	155	180
R-22 Charge	25	29	42	68.5	23.5	27	42	63.5

* Normal Value Wet Coil @ .1" ESP.

ELECTRIC HEAT DATA

VEA/VHA09,12								
	VE/VHA09			VE/VHA12				
Heater Watts	2500/2050	3400/2780	5000/4090	2500/2050	3400/2780	5000/4090		
Voltage	230/208			230/208				
Heating Btu/h	8500/7000	11600/9500	17000/13900	8500/7000	11600/9500	17000/13900		
Heating Current (Amps)	10.6/9.3	14.5/12.5	20.9/18.2	10.6/9.3	14.5/12.5	20.9/18.2		
Minimum Circuit Ampacity	15	19.9	27.9	15	19.9	27.9		
Branch Circuit Fuse (Amps)	15	20	30	15	20	30		
Basic Heater Size	2.5 Kw	3.4 Kw	5.0 Kw	2.5 Kw	3.4 Kw	5.0 Kw		
VEA/VHA18,24								
	VE/VHA18			VE/VHA24				
Heater Watts	2500/2050	3400/2780	5000/4090	2500/2050	3400/2780	5000/4090	7500/6135	10000/8180
Voltage	230/208			230/208				
Heating Btu/h	8500/7000	11600/9500	17000/13900	8500/7000	11600/9500	17000/13900	25598/20939	34130/27918
Heating Current (Amps)	10.6/9.3	14.5/12.5	20.9/18.2	10.9/9.9	14.8/13.4	21.7/19.7	32.6/29.5	43.5/39.3
Minimum Circuit Ampacity	15	19.9	27.9	17.2/15.9	22.1/20.3	30.7/28.1	44.3/40.4	57.9/52.7
Branch Circuit Fuse (Amps)	15	20	30	25/25	25/25	35/30	45/45	60/60
Basic Heater Size	2.5 Kw	3.4 Kw	5.0 Kw	2.5 Kw	3.4 Kw	5.0 Kw	7.5 Kw	10.0 Kw

VERT-I-PAK® A - D SUFFIX CHASSIS SPECIFICATIONS

Model	V(E,H)A09	V(E,H)A12	V(E,H)A18
Voltage (V)	230 / 208	230 / 208	230 / 208
Refrigerant	R-22	R-22	R-22
Chassis Width	23.125"	23.125"	23.125"
Chassis Depth	23.125"	23.125"	23.125"
Chassis Height **	32.25"	32.25"	32.25"
Shipping W x D x H	26" x 28" x 35"	26" x 28" x 35"	26" x 28" x 35"
Supply Duct Collar ***	10"	10"	10"
Drain Connection	1/2" MPT	1/2" MPT	1/2" MPT
Drain Hose ****	12" long	12" long	12" long
Thermostat Harness	36" long	36" long	36" long
Power Cord	60" long	60" long	60" long
Min. Circuit Amps	See Chassis Nameplate		
CFM Indoor	Page 15		
Fan Speeds	2	2	2
Max. Duct ESP	.3 in. water	.3 in. water	.3 in. water

NOTES: ** Height includes 2" duct collar & isolators under unit. *** Factory collar accepts 10" flex duct.

MODELS	V(E,H)A09K25	V(E,H)A09K34	V(E,H)A09K50	V(E,H)A12K25	V(E,H)A12K34	V(E,H)A12K50	V(E,H)A18K25	V(E,H)A18K34	V(E,H)A18K50
Cooling Cap. (Btu/h)	9500/9300	9500/9300	9500/9300	11500/11300	11500/11300	11500/11300	17200/17000	17200/17000	17200/17000
Cooling Power (W)	950	950	950	1200	1200	1200	1911	1911	1911
SEER	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Water Removal (Pts/h)	2.1	2.1	2.1	2.8	2.8	2.8	4.0	4.0	4.0
Cooling SHR	0.77	0.77	0.77	0.76	0.76	0.76	0.75	0.75	0.75
Heater Size (KW)	2.5	3.4	5.0	2.5	3.4	5.0	2.5	3.4	5.0
Heating Cap. (Btu/h)	8500/7000	11600/9500	17000/13900	8500/7000	11600/9500	17000/13900	8500/7000	11600/9500	17000/13900
Heating Power (W)	2500/2050	3500/2780	5000/4090	2500/2050	3500/2780	5000/4520	2500/2050	3500/2780	5000/4520
Heating Current (A)	11.9/11.2	15.9/14.6	22.6/20.6	11.9/11.2	15.9/14.6	22.6/20.6	11.9/11.2	15.9/14.6	22.6/20.6
Heating Cap. (Btu/h)	8000/7800	8000/7800	8000/7800	11200/11000	11200/11000	11200/11000	15700/15500	15700/15500	15700/15500
Heating Power (W)	950	950	950	1200	1200	1200	1830	1830	1830
Heating Current (A)	4.4/4.9	4.4/4.9	4.4/4.9	5.2/6.0	5.2/6.0	5.2/6.0	9.0/10.0	9.0/10.0	9.0/10.0
COP @ 47°F	3.0	3.0	3.0	3.0	3.0	3.0	2.4	2.4	2.4
Voltage (V)	230/208	230/208	230/208	230/208	230/208	230/208	230/208	230/208	230/208
LRA - Comp. (A)	20	20	20	26.3	26.0	26.3	45	45	45
Cooling Current (A)	4.4/4.9	4.4/4.9	4.4/4.9	5.5/6.1	5.2/6.0	5.2/6.0	7.6	7.6	7.6
MIN. Ckt. Amps (A)	15	20	30	15	20	30	15	20	30
Power Connection	POWER CORD			POWER CORD			POWER CORD WITH OPTION TO HARD WIRE		
Refrigerant	R-22	R-22	R-22	R-22	R-22	R-22	R-22	R-22	R-22
Unit Width (in.)	23.125	23.125	23.125	23.125	23.125	23.125	23.125	23.125	23.125
Unit Depth (in.)	23.125	23.125	23.125	23.125	23.125	23.125	23.125	23.125	23.125
Unit Height* (in.)	32.25	32.25	32.25	32.25	32.25	32.25	32.25	32.25	32.25
Shipping Weight (lbs.)	125	125	125	135	135	135	155	155	155
Indoor CFM **	300	300	300	375	375	375	550	550	550
Fresh Air CFM**	60	60	60	60	60	60	60	60	60
Motor	230V, 1/4 HP	230V, 1/4 HP	230V, 1/4 HP	230V, 1/4 HP	230V, 1/4 HP	230V, 1/4 HP	230V, 1/4 HP	230V, 1/4 HP	230V, 1/4 HP
Motor Amps**	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4

*Height includes 2" high duct collar and 5/8" isolators under unit.

**Normal Value Dry Coil on High Speed @ .3" ESP.

Due to continuing research in new energy-saving technology, specifications are subject to change without notice.

Capacity rated at standard conditions:

COOLING—

95°F DB/75°F WB outdoor, 80°F DB/67°F WB indoor

HEATING— (reverse cycle)

47°F DB/43°F WB outdoor, 70°F DB/60°F WB indoor

Sequence of Operation

A good understanding of the basic operation of the refrigeration system is essential for the service technician. Without this understanding, accurate troubleshooting of refrigeration system problems will be more difficult and time consuming, if not (in some cases) entirely impossible. The refrigeration system uses four basic principles (laws) in its operation they are as follows:

1. "Heat always flows from a warmer body to a cooler body."
2. "Heat must be added to or removed from a substance before a change in state can occur"
3. "Flow is always from a higher pressure area to a lower pressure area."
4. "The temperature at which a liquid or gas changes state is dependent upon the pressure."

The refrigeration cycle begins at the compressor. Starting the compressor creates a low pressure in the suction line which draws refrigerant gas (vapor) into the compressor. The compressor then "compresses" this refrigerant, raising its pressure and its (heat intensity) temperature.

The refrigerant leaves the compressor through the discharge line as a HOT high pressure gas (vapor). The refrigerant enters the condenser coil where it gives up some of its heat. The condenser fan moving air across the coil's finned surface facilitates the transfer of heat from the refrigerant to the relatively cooler outdoor air.

When a sufficient quantity of heat has been removed from the refrigerant gas (vapor), the refrigerant will "condense" (i.e.) change to a liquid. Once the refrigerant has been condensed (changed) to a liquid it is cooled even further by the air that continues to flow across the condenser coil.

The Vert-I-Pak design determines at exactly what point (in the condenser) the change of state (i.e. gas to a liquid) takes place. In all cases, however, the refrigerant must be totally condensed (changed) to a liquid before leaving the condenser coil.

The refrigerant leaves the condenser coil through the liquid line as a WARM high pressure liquid. It next will pass through the refrigerant drier (if so equipped). It is the function of the drier to trap any moisture present in the system, contaminants, and LARGE particulate matter.

The liquid refrigerant next enters the metering device. The metering device is a capillary tube. The purpose of the metering device is to "meter" (i.e. control or measure) the quantity of refrigerant entering the evaporator coil.

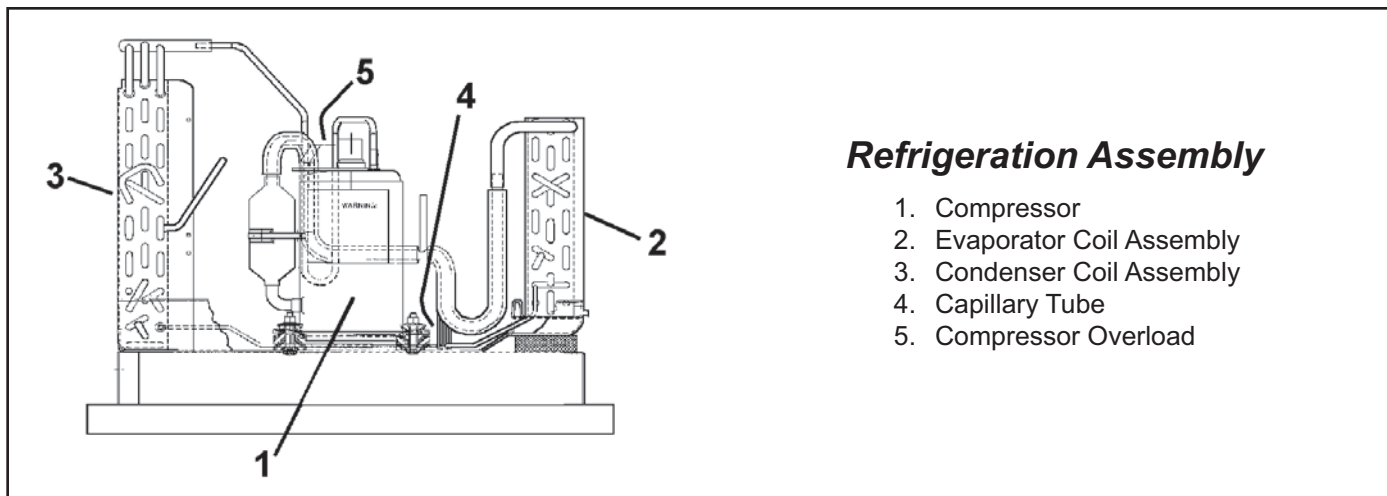
In the case of the capillary tube this is accomplished (by design) through size (and length) of device, and the pressure difference present across the device.

Since the evaporator coil is under a lower pressure (due to the suction created by the compressor) than the liquid line, the liquid refrigerant leaves the metering device entering the evaporator coil. As it enters the evaporator coil, the larger area and lower pressure allows the refrigerant to expand and lower its temperature (heat intensity). This expansion is often referred to as "boiling". Since the unit's blower is moving indoor air across the finned surface of the evaporator coil, the expanding refrigerant absorbs some of that heat. This results in a lowering of the indoor air temperature, hence the "cooling" effect.

The expansion and absorbing of heat cause the liquid refrigerant to evaporate (i.e. change to a gas). Once the refrigerant has been evaporated (changed to a gas), it is heated even further by the air that continues to flow across the evaporator coil.

The particular system design determines at exactly what point (in the evaporator) the change of state (i.e. liquid to a gas) takes place. In all cases, however, the refrigerant must be totally evaporated (changed) to a gas before leaving the evaporator coil.

The low pressure (suction) created by the compressor causes the the refrigerant to leave the evaporator through the suction line as a COOL low pressure vapor. The refrigerant then returns to the compressor, where the cycle is repeated.



Electrical Supply

WARNING: Electrical shock hazard.

Turn OFF electric power at fuse box or service panel before making any electrical connections and ensure a proper ground connection is made before connecting line voltage.

All electrical connections and wiring **MUST** be installed by a qualified electrician and conform to the National Electrical Code and all local codes which have jurisdiction.




Failure to do so can result in property damage, personal injury and/or death.

Supply Circuit

The system cannot be expected to operate correctly unless the system is properly connected (wired) to an adequately sized single branch circuit. Check the installation manual and/or technical data for your particular unit and/or strip heaters to determine if the circuit is adequately sized.

Electrical Rating Tables

NOTE: Use copper conductors **ONLY**
Wire sizes are per NEC. Check local codes for overseas applications

A through D Suffix Units Only			
250 V Receptacles and Fuse Types			
AMPS	15	20 *	30
RECEPTACLE			
MANUFACTURER	PART NUMBERS		
Hubbell	5661	5461	9330
P & S	5661	5871	5930
GE	GE4069-1	GE4182-1	GE4139-3
Arrow-Hart	5661	5861	5700
TIME-DELAY TYPE FUSE (or HACR circuit breaker)	15	20	30
HACR — Heating, Air Conditioning, Refrigeration * May be used for 15 Amp applications if fused for 15 Amp			

Recommended branch circuit wire sizes*	
Nameplate maximum circuit breaker size	AWG Wire size**
15A	14
20A	12
30A	10
AWG — American Wire Gauge * Single circuit from main box ** Based on copper wire, single insulated conductor at 60°C	

Supply Voltage

To insure proper operation, supply voltage to the system should be within five (5) percent (plus or minus) of listed rating plate voltage.

Control (Low) Voltage

To insure proper system operation, the transformer secondary output must be maintained at a nominal 24 volts. The control (low) voltage transformer is equipped with multiple primary voltage taps. Connecting the primary, (supply) wire to the tap (i.e., 208 and 240 volts) that most closely matches the MEASURED supply voltage will insure proper transformer secondary output is maintained.

Supply Voltage

Supply voltage to the unit should be a nominal 208/230 volts. It must be between 197 volts and 253 volts. Supply voltage to the unit should be checked WITH THE UNIT IN OPERATION. Voltage readings outside the specified range can be expected to cause operating problems. Their cause MUST be investigated and corrected.

Electrical Ground

GROUNDING OF THE ELECTRICAL SUPPLY TO ALL UNITS IS REQUIRED for safety reasons.

Electrical Requirements

NOTE: All field wiring must comply with NEC and local codes. It is the responsibility of the installer to insure that the electrical codes are met.

Wire Size Use **ONLY** wiring size recommended for single outlet branch circuit.

Fuse/Circuit Use **ONLY** type and size fuse or HACR circuit breaker

Breaker Indicated on unit's rating plate (See sample on page 6).
Proper current protection to the unit is the responsibility of the owner.

Grounding Unit **MUST** be grounded from branch circuit to unit, or through separate ground wire provided on permanently connected units. Be sure that branch circuit or general purpose outlet is grounded.

Wire Sizing Use recommended wire size given in the tables below and install a single branch circuit. All wiring must comply with local and national codes. **NOTE:** Use copper conductors only.

Room Thermostats

Room thermostats are available from several different manufacturers in a wide variety of styles. They range from the very simple Bimetallic type to the complex electronic set-back type. In all cases, no matter how simple or complex, they are simply a switch (or series of switches) designed to turn equipment (or components) "ON" or "OFF" at the desired conditions.

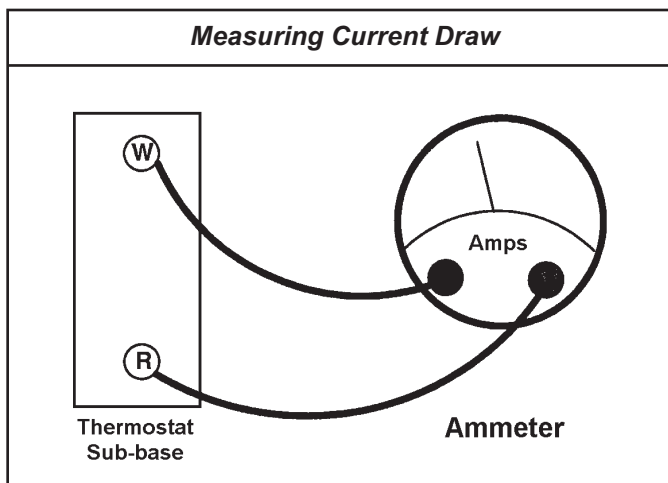
An improperly operating, or poorly located room thermostat can be the source of perceived equipment problems. A careful check of the thermostat and wiring must be made then to insure that it is not the source of problems.

Location

The thermostat should not be mounted where it may be affected by drafts, discharge air from registers (hot or cold), or heat radiated from the sun or appliances.

The thermostat should be located about 5 Ft. above the floor in an area of average temperature, with good air circulation. Close proximity to the return air grille is the best choice.

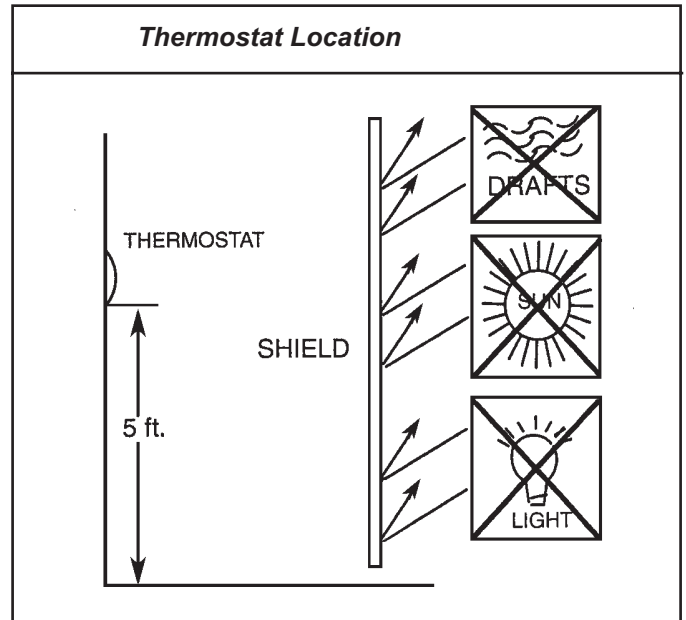
Mercury bulb type thermostats **MUST** be level to control temperature accurately to the desired set-point. Electronic digital type thermostats **SHOULD** be level for aesthetics.



Heat Anticipators

Heat anticipators are small resistance heaters (wired in series with the "W" circuit) and built into most electromechanical thermostats. Their purpose is to prevent wide swings in room temperature during system operation in the HEATING mode. Since they are wired in series, the "W" circuit will open if one burns out preventing heat operation.

The heat anticipator provides a small amount of heat to the thermostat causing it to cycle (turn off) the heat source just prior to reaching the set point of the thermostat. This prevents exceeding the set point.



In order to accomplish this, the heat output from the anticipator must be the same regardless of the current flowing through it. Consequently, some thermostats have an adjustment to compensate for varying current draw in the thermostat circuits.

The proper setting of heat anticipators then is important to insure proper temperature control and customer satisfaction. A Heat anticipator that is set too low will cause the heat source to cycle prematurely possibly never reaching set point. A heat anticipator that is set too high will cause the heat source to cycle too late over shooting the set point.

The best method to obtain the required setting for the heat anticipator, is to measure the actual current draw in the control circuit ("W") using a low range (0-2.0 Amps) Ammeter. After measuring the current draw, simply set the heat anticipator to match that value.

If a low range ammeter is not available, a "Clamp-on" type ammeter may be used as follows:

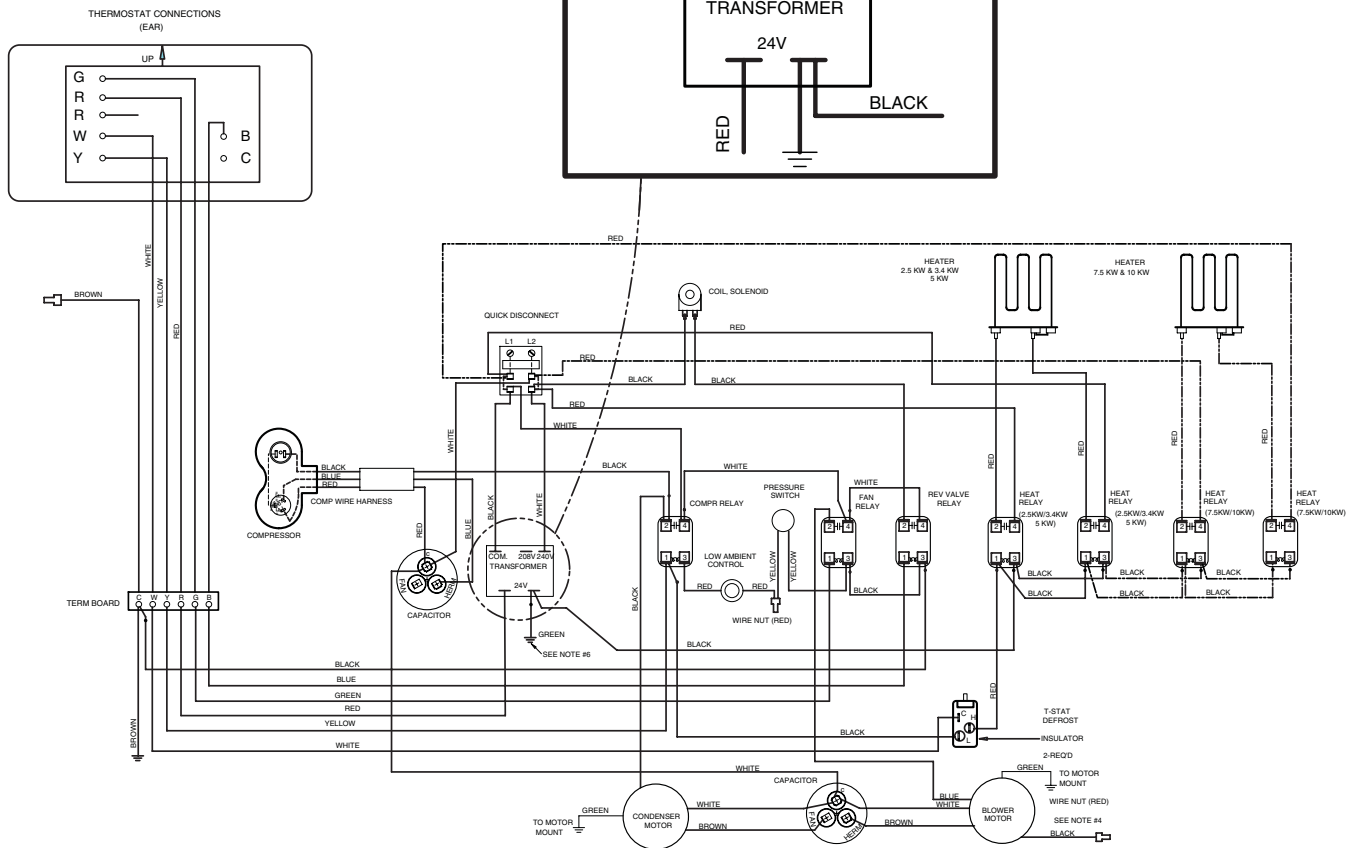
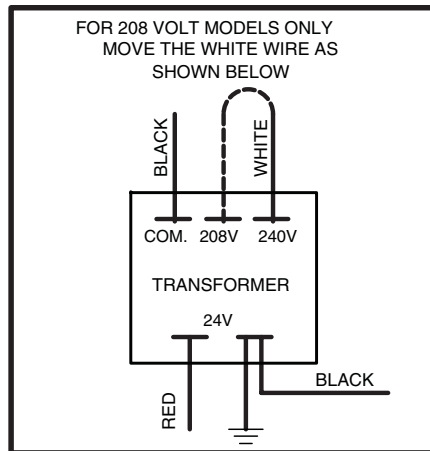
1. Wrap EXACTLY ten (10) turns of wire around the jaws of a clamp-on type ammeter.
2. Connect one end of the wire to the "W" terminal of the thermostat sub-base, and the other to the "R" terminal.
3. Turn power on, and wait approximately 1 minute, then read meter.
4. Divide meter reading by 10 to obtain correct anticipator setting.

Electronic thermostats do not use a resistance type anticipator. These thermostats use a microprocessor (computer) that determines a cycle rate based on a program loaded into it at the factory.

Typical Electrical & Thermostat Wiring Diagrams VEA/VHA 24K

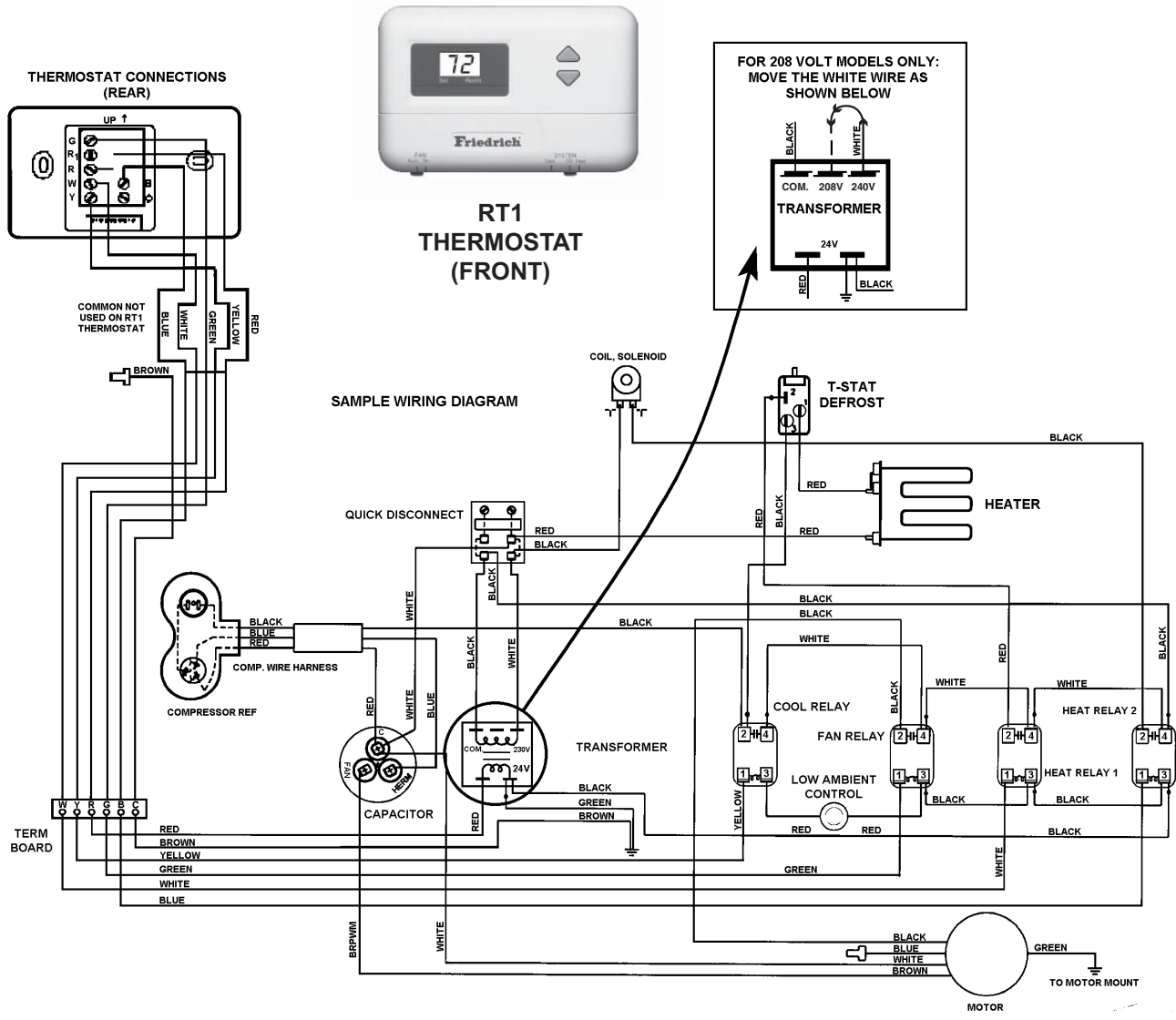


**RT2
THERMOSTAT
(FRONT)**



NOTE: THE DIAGRAM ABOVE ILLUSTRATES THE TYPICAL THERMOSTAT WIRING AND 208 VOLT TRANSFORMER WIRING. SEE THE UNIT CONTROL PANEL FOR THE ACTUAL UNIT WIRING DIAGRAM AND SCHEMATIC.

Typical Electrical & Thermostat Wiring Diagrams G & H Suffix

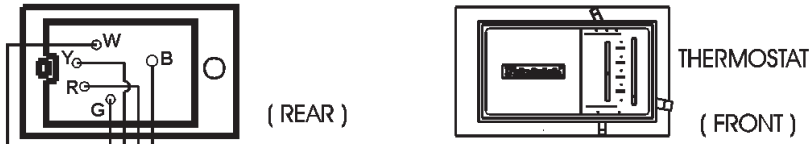


NOTE: THE DIAGRAM ABOVE ILLUSTRATES THE TYPICAL THERMOSTAT WIRING AND 208 VOLT TRANSFORMER WIRING. SEE THE UNIT CONTROL PANEL FOR THE ACTUAL UNIT WIRING DIAGRAM AND SCHEMATIC.

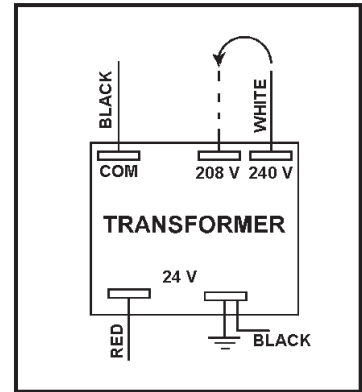
Typical Electrical & Thermostat Wiring Diagrams

A – E Suffix

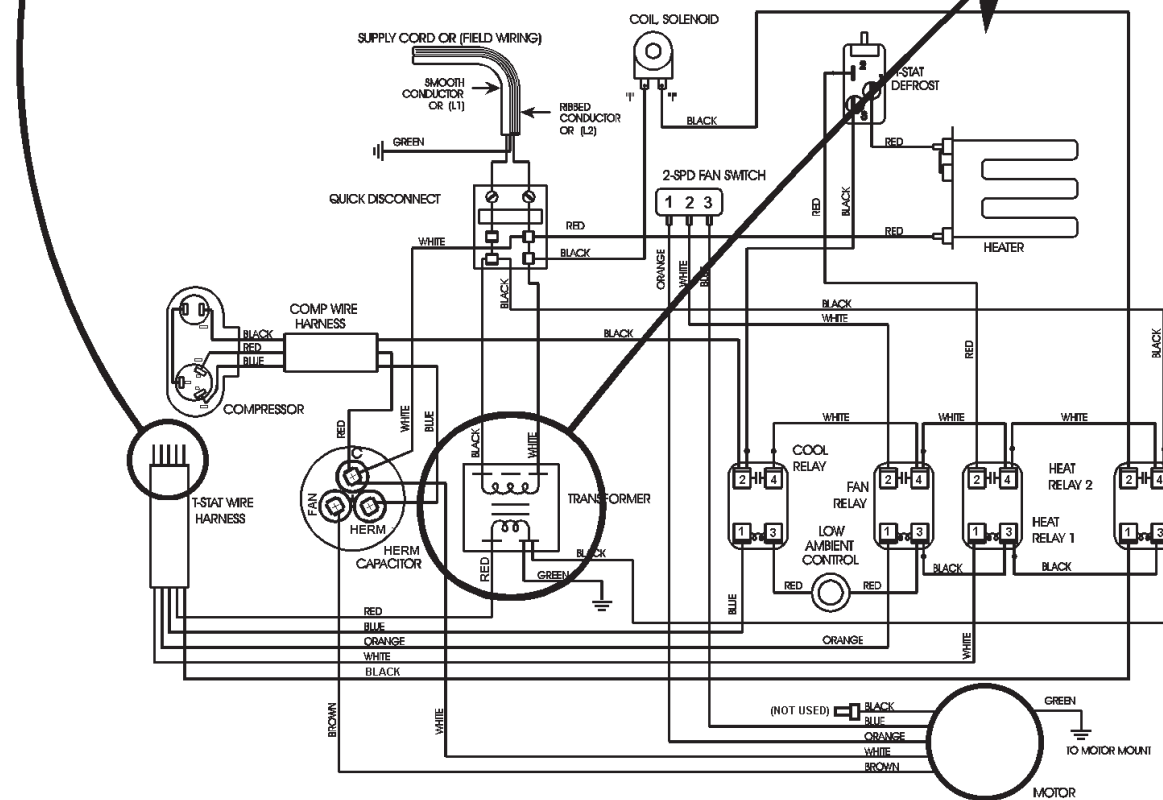
THERMOSTAT CONNECTIONS:



FOR 208 VOLT MODELS ONLY:
MOVE THE WHITE WIRE AS
SHOWN BELOW.



SAMPLE WIRING DIAGRAM



Indoor Blower - Airflow

The current Vert-I-Pak 9, 12, & 18 use a dual shaft, permanent split capacitor, single speed motor to drive indoor blower and outdoor fan. Earlier model VERT-I-Pak units used 2-speed motors. The Vert-I-Pak 24 uses an individual, single shaft, permanent split capacitor, single speed motor for the indoor blower, and a separate motor drives the outdoor fan.

Different size (HP) motors and/or different diameter blower wheels are used in different models to obtain the required airflow.

Indoor Blower - Airflow

The current Vert-I-Pak 9, 12, & 18 use a dual shaft, permanent split capacitor, single speed motor to drive indoor blower and outdoor fan. Earlier model VERT-I-Pak units used 2-speed motors. The Vert-I-Pak 24 uses an individual, single shaft, permanent split capacitor, single speed motor for the indoor blower, and a separate motor drives the outdoor fan.

Different size (HP) motors and/or different diameter blower wheels are used in different models to obtain the required airflow.

Condenser Fan Motors

The current Vert-I-Pak 9, 12, & 18 units use a dual shaft, permanent split capacitor, single speed motor to drive indoor and outdoor fan. Earlier models used a 2-speed motor. The Vert-I-Pak 24 uses an individual, single shaft, permanent split capacitor, single speed motor for the outdoor fan, with a separate motor driving the indoor blower.

Blower Wheel Inspection

Visually inspect the blower wheel for the accumulations of dirt or lint since they can cause reduced airflow. Clean the blower wheel of these accumulations. If accumulation cannot be removed, it will be necessary to remove the blower assembly from the unit for proper wheel cleaning.

Cooling

A nominal 400 (350-450 allowable) CFM per ton of airflow is required to insure proper system operation, capacity, and efficiency. Factory-set blower speeds should provide the proper airflow for the size (Cooling capacity) of the unit when connected to a properly sized duct system.

Cooling (VEA/VHA 24)

When the thermostat is set for cooling mode (SYSTEM switch set to COOL and FAN switch to AUTO) a rise in room temperature will make it also cause a 24-volt signal on the "Y" thermostat conductor through the high pressure and low ambient switches energizing the compressor relay, turning on the compressor and outdoor fan motor. A 24-volt signal on the "G" thermostat terminal to the Fan Relay, turning on the indoor blower motor.

Heating (Electric)

When using electric heaters, select the blower speed that provides adequate airflow across the elements to prevent overheating and cycling on limit and/or premature failure. CHECK THE EXTERNAL STATIC PRESSURE, and then consult the AIR FLOW DATA to determine the ACTUAL air flow delivered for the factory selected fan speed. This will be especially important on change-outs using an existing duct system that may not have been properly sized to begin with.

Heating (VEA/VHA 24)

When the thermostat is set for heating mode (System switch set to HEAT and FAN switch to AUTO) it will make a 24-volt signal on the "B" thermostat terminal to energize the Reversing Valve Relay. A drop in room temperature, will make a 24-volt signal on the "W" thermostat terminal to the Defrost Thermostat, and "G" thermostat terminal to the Fan Relay. The Defrost Thermostat will determine whether the unit should run in Heat Pump, or Electric Heat, based on the outdoor temperature. (See Defrost Thermostat page 24)

External Static Pressure

External Static Pressure can best be defined as the pressure difference (drop) between the Positive Pressure (discharge) and the Negative Pressure (intake) sides of the blower. External Static Pressure is developed by the blower as a result of resistance to airflow (Friction) in the air distribution system EXTERNAL to the VERT-I-PAK cabinet.

Resistance applied externally to the VERT-I-PAK (i.e. duct work, coils, filters, etc.) on either the supply or return side of the system causes an INCREASE in External Static Pressure accompanied by a REDUCTION in airflow.

External Static Pressure is affected by two (2) factors.

1. Resistance to Airflow as already explained.
2. Blower Speed. Changing to a higher or lower blower speed will raise or lower the External Static Pressure accordingly.

These affects must be understood and taken into consideration when checking External Static Pressure/Airflow to insure that the system is operating within design conditions.

Operating a system with insufficient or excessive airflow can cause a variety of different operating problems. Among these are reduced capacity, freezing evaporator coils, premature compressor and/or heating component failures. etc.

System airflow should always be verified upon completion of a new installation, or before a change-out, compressor replacement, or in the case of heat strip failure to insure that the failure was not caused by improper airflow.

Checking External Static Pressure

The airflow through the unit can be determined by measuring the external static pressure of the system, and consulting the blower performance data for the specific VERT-I-PAK.

1. Set up to measure external static pressure at the supply and return air.
2. Drill holes in the supply duct for pressure taps, pilot tubes or other accurate pressure sensing devices.
3. Connect these taps to a level inclined manometer or Magnehelic gauges.
4. Ensure the coil and filter are clean, and that all the registers are open.
5. Determine the external static pressure with the blower operating.
6. Refer to the Air Flow Data for your VERT-I-PAK system to find the actual airflow for factory-selected fan speeds.
7. If the actual airflow is either too high or too low, the blower speed will need to be changed.
8. Select a speed, which most closely provides the required airflow for the system.
9. Recheck the external static pressure with the new speed. External static pressure (and actual airflow) will have changed to a higher or lower value depending upon speed selected. Recheck the actual airflow (at this "new" static pressure) to confirm speed selection.
10. Repeat steps 8 and 9 (if necessary) until proper airflow has been obtained.

EXAMPLE: Airflow requirements are calculated as follows: (Having a wet coil creates additional resistance to airflow. This additional resistance must be taken into consideration to obtain accurate airflow information.

1 ½ TON SYSTEM (18,000 Btu)

Operating on high speed @ 230 volts with dry coil
measured external static pressure .20

Air Flow = 500 CFM

In the same SYSTEM used in the previous example but having a WET coil you must use a correction factor of .94 (i.e. 500 x .94=470 CFM) to allow for the resistance (internal) of the condensate on the coil.

It is important to use the proper procedure to check external Static Pressure and determine actual airflow. Since in

the case of the VERT-I-PAK, the condensate will cause a reduction in measured External Static Pressure for the given airflow.

It is also important to remember that when dealing with VERT-I-PAK units that the measured External Static Pressure increases as the resistance is added externally to the cabinet. Example: duct work, filters, grilles.

Checking Approximate Airflow

If an inclined manometer or Magnehelic gauge is not available to check the External Static Pressure, or the blower performance data is unavailable for your unit, approximate air flow can be calculated by measuring the temperature rise, then using the following criteria.

$$\frac{\text{KILOWATTS} \times 3413}{\text{Temp Rise} \times 1.08} = \text{CFM}$$

Electric Heat Strips

The approximate CFM actually being delivered can be calculated by using the following formula:

DO NOT simply use the Kilowatt Rating of the heater (i.e. 2.5, 3.4, 5.0) as this will result in a less-than-correct airflow calculation. Kilowatts may be calculated by multiplying the measured voltage to the unit (heater) times the measured current draw of all heaters (ONLY) in operation to obtain watts. Kilowatts are then obtained by dividing by 1000.

EXAMPLE: Measured voltage to unit (heaters) is 230 volts. Measured Current Draw of strip heaters is 11.0 amps.

$$\begin{aligned} 230 \times 11.0 &= 2530 \\ 2530/1000 &= 2.53 \text{ Kilowatts} \\ 2.53 \times 3413 &= 8635 \end{aligned}$$

Supply Air	95°F
Return Air	- 75°F
Temperature Rise	20°

$$20 \times 1.08 = 21.6$$

$$\frac{8635}{21.6} = 400 \text{ CFM}$$

! CAUTION!

IMPORTANT: FLEX DUCT CAN COLLAPSE AND CAUSE AIRFLOW RESTRICTIONS. DO NOT USE FLEX DUCT FOR: 90 DEGREE BENDS, OR UNSUPPORTED RUNS OF 5 FT. OR MORE.

Airflow Charts A – D Suffix

Chart A CFM @ 230 Volts - DRY COIL				
Model →	V(E,H)A09/A12		V(E,H)A18	
	High CFM	Low CFM	High CFM	Low CFM
Fan Speed →				
ESP (in water)				
0.00	N/A	427	N/A	517
0.10	411	387	510	480
0.20	373	347	500	470
0.30	327	310	490	460

Chart B Correction Factors	
To Correct for:	Correction Factor
230 Volts	1.00
208 Volts	0.97
Dry Coil	1.00
Wet Coil	0.94

Ductwork Preparation

Pull the flex duct tight. Extra flex duct slack can greatly increase static pressure

Explanation of charts

Chart A is the nominal dry coil VERT-I-PAK CFMs. Chart B is the correction factors beyond nominal conditions.

Chart A – CFM		
Model	18000	12000 / 9000
.00	520	420
.10	510	410
.20	500	370
.30	490	330

Chart B – Correction Multipliers	
Correction Multipliers for:	
230V	1.00
208V	0.97
Heating	1.00
Cooling	0.95

Chart C – VE/VHA CFM		
	VEA/VHA24K	
	Low	High
.1" ESP	750	815
.2" ESP	725	780
.3" ESP	700	745
.4" ESP	675	700

All values listed are inches W.C. with a wet indoor coil with filter installed.

Refrigerant Charging

Note: Because the earlier model Vert-I- Paks are sealed systems, service process tubes will have to be installed. First install a line tap and remove refrigerant from system. The H suffix model Vert-I-Paks have factory installed service valves. Make necessary sealed system repairs and vacuum system. Weigh in charge according to the unit data plate. Crimp process tube line and solder end shut. Do not leave a service valve in the sealed system.

Proper refrigerant charge is essential to proper unit operation. Operating a unit with an improper refrigerant charge will result in reduced performance (capacity) and/or efficiency. Accordingly, the use of proper charging methods during servicing will insure that the unit is functioning as designed and that its compressor will not be damaged.

Too much refrigerant (overcharge) in the system is just as bad (if not worse) than not enough refrigerant (undercharge). They both can be the source of certain compressor failures if they remain uncorrected for any period of time. Quite often, other problems (such as low air flow across evaporator, etc.) are misdiagnosed as refrigerant charge

problems. The refrigerant circuit diagnosis chart will assist you in properly diagnosing these systems.

An overcharged unit will at times return liquid refrigerant (slugging) back to the suction side of the compressor eventually causing a mechanical failure within the compressor. This mechanical failure can manifest itself as valve failure, bearing failure, and/or other mechanical failure. The specific type of failure will be influenced by the amount of liquid being returned, and the length of time the slugging continues.

Not enough refrigerant (Undercharge) on the other hand, will cause the temperature of the suction gas to increase to the point where it does not provide sufficient cooling for the compressor motor. When this occurs, the motor winding temperature will increase causing the motor to overheat and possibly cycle open the compressor overload protector. Continued overheating of the motor windings and/or cycling of the overload will eventually lead to compressor motor or overload failure.

Method Of Charging

The acceptable method for charging the Vert-I-Pak system is the Weighed in Charge Method. The weighed in charge method is applicable to all units. It is the preferred method to use, as it is the most accurate.

The weighed in method should always be used whenever a charge is removed from a unit such as for a leak repair, compressor replacement, or when there is no refrigerant charge left in the unit. To charge by this method, requires the following steps:

1. Install a piercing valve to remove refrigerant from the sealed system. (Piercing valve must be removed from the system before recharging.)
2. Recover Refrigerant in accordance with EPA regulations.
3. Install a process tube to sealed system.
4. Make necessary repairs to system.
5. Evacuate system to 300 microns or less.
6. Weigh in refrigerant with the property quantity of R-22 refrigerant.
7. Start unit, and verify performance.
8. Crimp the process tube and solder the end shut.

NOTE: In order to access the sealed system it will be necessary to install Schrader type fittings to the process tubes on the discharge and suction of the compressor. Proper recovery refrigerant procedures need to be adhered to as outlined in EPA Regulations. THIS SHOULD ONLY BE ATTEMPTED BY QUALIFIED SERVICE PERSONNEL.

Undercharged Refrigerant Systems

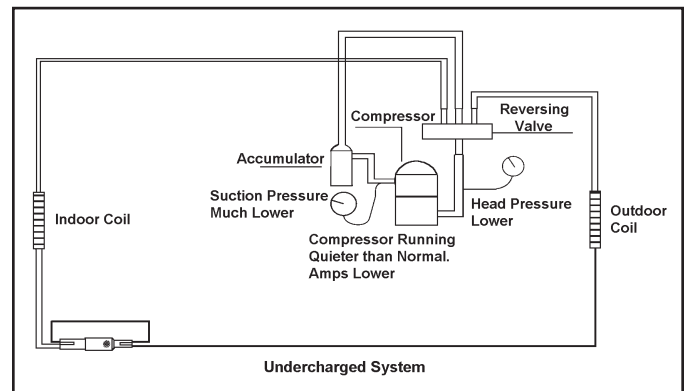
An undercharged system will result in poor performance (low pressures, etc.) in both the heating and cooling cycle.

Whenever you service a unit with an undercharge of refrigerant, always suspect a leak. The leak must be repaired before charging the unit.

To check for an undercharged system, turn the unit on, allow the compressor to run long enough to establish working pressures in the system (15 to 20 minutes).

During the cooling cycle you can listen carefully at the exit of the metering device into the evaporator; an intermittent hissing and gurgling sound indicates a low refrigerant charge. Intermittent frosting and thawing of the evaporator is another indication of a low charge, however, frosting and thawing can also be caused by insufficient air over the evaporator.

Checks for an undercharged system can be made at the compressor. If the compressor seems quieter than normal,



it is an indication of a low refrigerant charge. A check of the amperage drawn by the compressor motor should show a lower reading. (Check the Unit Specification.) After the unit has run 10 to 15 minutes, check the gauge pressures.

Gauges connected to system with an undercharge will have low head pressures and substantially low suction pressures.

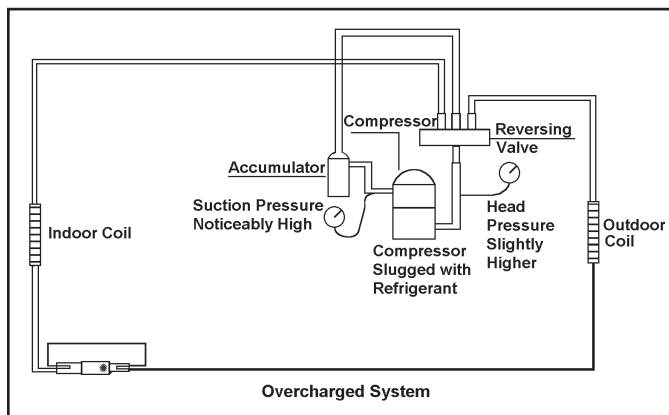
Overcharged Refrigerant Systems

Compressor amps will be near normal or higher. Noncondensables can also cause these symptoms. To confirm, remove some of the charge, if conditions improve, system may be overcharged. If conditions don't improve, Noncondensables are indicated.

Whenever an overcharged system is indicated, always make sure that the problem is not caused by air flow problems. Improper air flow over the evaporator coil may indicate some of the same symptoms as an overcharged system.

An over charge can cause the compressor to fail, since it would be "slugged" with liquid refrigerant.

The charge for any system is critical. When the compressor is noisy, suspect an overcharge, when you are sure that the air quantity over the evaporator coil is correct. Icing



of the evaporator will not be encountered because the refrigerant will boil later if at all. Gauges connected to system will usually have higher head pressure (depending upon amount of overcharge). Suction pressure should be slightly higher.

Restricted Refrigerant Systems

A quick check for either condition begins at the evaporator. With a partial restriction, there may be gurgling sounds at the metering device entrance to the evaporator. The evaporator in a partial restriction could be partially frosted or have an ice ball close to the entrance of the metering device. Frost may continue on the suction line back to the compressor.

Often a partial restriction of any type can be found by feel, as there is a temperature difference from one side of the restriction to the other.

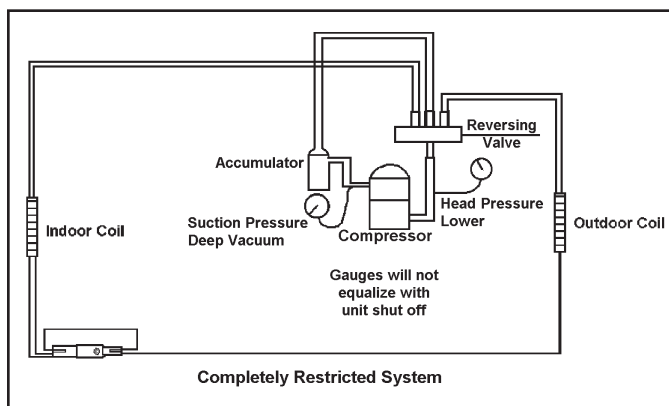
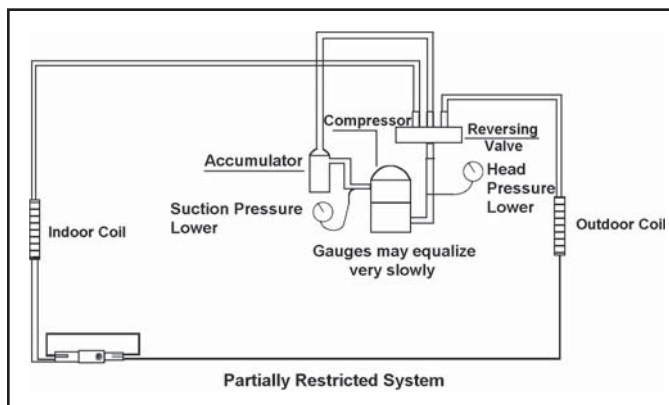
With a complete restriction, there will be no sound at the metering device entrance. An amperage check of the compressor with a partial restriction may show normal current when compared to the unit specification. With a complete restriction the current drawn may be considerably less than normal, as the compressor is running in a deep vacuum (no load.) Much of the area of the condenser will be relatively cool since most or all of the liquid refrigerant will be stored there.

The following conditions are based primarily on a system in the cooling mode.

Troubleshooting a restricted refrigerant system can be difficult. The following procedures are the more common problems and solutions to these problems. There are two types of refrigerant restrictions: Partial restrictions and complete restrictions.

A partial restriction allows some of the refrigerant to circulate through the system.

With a complete restriction there is no circulation of refrigerant in the system.



Restricted refrigerant systems display the same symptoms as a "low-charge condition." When the unit is shut off, the gauges may equalize very slowly. Gauges connected to a completely restricted system will run in a deep vacuum. When the unit is shut off, the gauges will not equalize at all.

Metering Device - Capillary Tube Systems

All units are equipped with capillary tube metering devices.

Checking for restricted capillary tubes.

1. Connect pressure gauges to unit.
2. Start the unit in the cooling mode. If after a few minutes of operation the pressures are normal, the check valve and the cooling capillary are not restricted.
3. Switch the unit to the heating mode and observe the gauge readings after a few minutes running time. If the system pressure is lower than normal, the heating capillary is restricted.
4. If the operating pressures are lower than normal in both the heating and cooling mode, the cooling capillary is restricted.

Reversing Valve Description/Operation

The Reversing Valve controls the direction of refrigerant flow to the indoor and outdoor coils. It consists of a pressure-operated, main valve and a pilot valve actuated by a solenoid plunger. The solenoid is energized during the heating cycle only. The reversing valves used in the Vert-I-Pak system is a 2-position, 4-way valve

The single tube on one side of the main valve body is the high-pressure inlet to the valve from the compressor. The center tube on the opposite side is connected to the low pressure (suction) side of the system. The other two are connected to the indoor and outdoor coils. Small capillary tubes connect each end of the main valve cylinder to the "A" and "B" ports of the pilot valve. A third capillary is a common return line from these ports to the suction tube on the main valve body. Four-way reversing valves also have a capillary tube from the compressor discharge tube to the pilot valve.

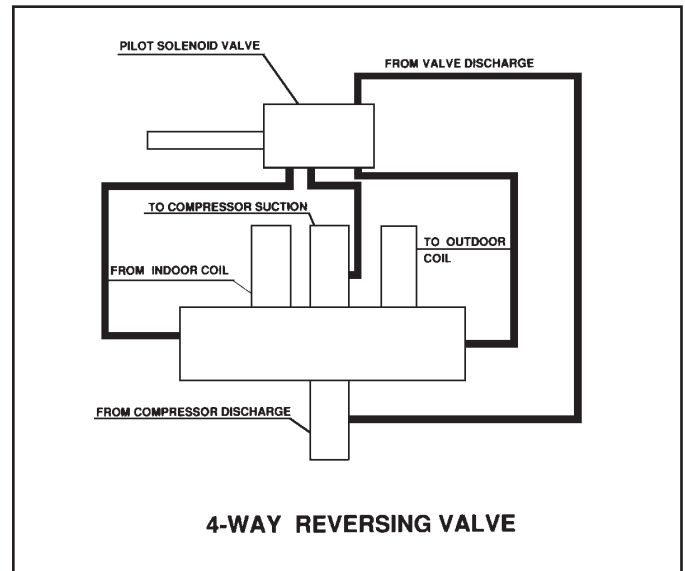
The piston assembly in the main valve can only be shifted by the pressure differential between the high and low sides of the system. The pilot section of the valve opens and closes ports for the small capillary tubes to the main valve to cause it to shift.

NOTE: System operating pressures must be near normal before valve can shift.

WARNING

**DANGER OF BODILY INJURY OR DEATH
FROM ELECTRICAL SHOCK**

The reversing valve solenoid is connected to high voltage. Turn off electrical power before disconnecting or connecting high voltage wiring or servicing valve.



Electrical Circuit and Coil

(Reversing valve coil is energized in the heating cycle only).

1. Set controls for heating; valve should shift.
2. Check for line voltage at the heat relay, terminal #2 and L2 at the quick disconnect. If line voltage is not present check the power supply.

Testing Coil

1. Turn off high voltage electrical power to unit.
2. Unplug line voltage lead from reversing valve coil.
3. Check for electrical continuity through the coil. If you do not have continuity replace the coil.
4. Check from each lead of coil to the copper liquid line as it leaves the unit or the ground lug. There should be no continuity between either of the coil leads and ground; if there is, coil is grounded and must be replaced.
5. If coil tests okay, reconnect the electrical leads .
6. Make sure coil has been assembled correctly.

Checking Reversing Valve

NOTE: You must have normal operating pressures before the reversing valve can shift.

Check for proper refrigerant charge. Sluggish or sticky reversing valves can sometimes be remedied by reversing the valve several times with the airflow restricted to increase system pressure.

To raise head pressure during the cooling season the airflow through the outdoor coil can be restricted. During heating the indoor air can be restricted by blocking the return air.

Dented or damaged valve body or capillary tubes can prevent the main slide in the valve body from shifting.

If you determine this is the problem, replace the reversing valve.

After all of the previous inspections and checks have been made and determined correct, then perform the "Touch Test" on the reversing valve.

CAUTION

Never energize the coil when it is removed from the valve, as a coil burnout will result.

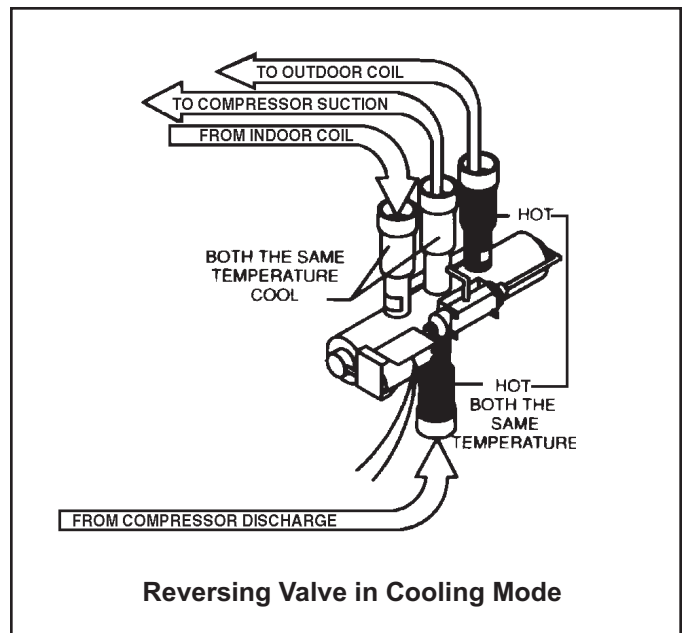
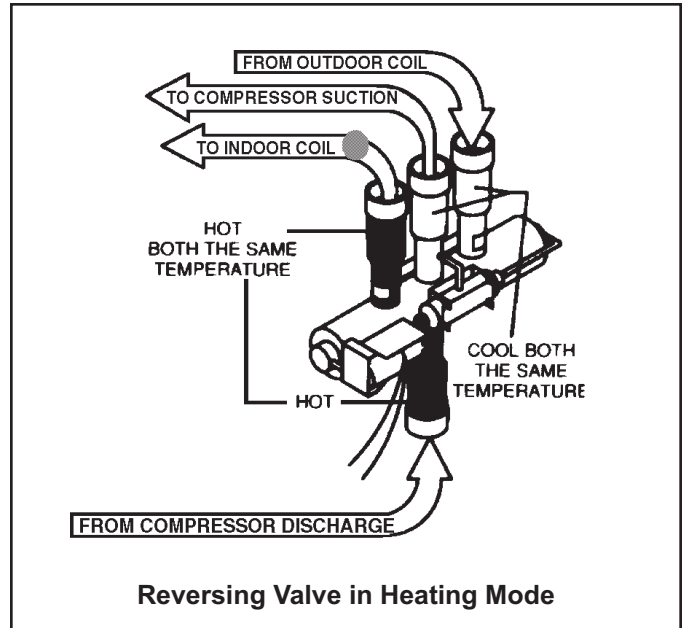
Touch Test in Heating/Cooling Cycle

The only definite indications that the slide is in the mid-position is if all three tubes on the suction side of the valve are hot after a few minutes of running time.

NOTE: A condition other than those illustrated above, and on page 19, indicate that the reversing valve is not shifting properly. Both tubes shown as hot or cool must be the same corresponding temperature.

Procedure For Changing Reversing Valve

1. Install Process Tubes. Recover refrigerant from sealed system. **PROPER HANDLING OF RECOVERED REFRIGERANT ACCORDING TO EPA REGULATIONS IS REQUIRED.**
2. Remove solenoid coil from reversing valve. If coil is to be reused, protect from heat while changing valve.
3. Unbraid all lines from reversing valve.
4. Clean all excess braze from all tubing so that they will slip into fittings on new valve.
5. Remove solenoid coil from new valve.
6. Protect new valve body from heat while brazing with plastic heat sink (ThermoTrap) or wrap valve body with wet rag.
7. Fit all lines into new valve and braze lines into new valve.
8. Pressurize sealed system with a combination of R-22 and nitrogen and check for leaks, using a suitable leak detector. Recover refrigerant per EPA guidelines.
9. Once the sealed system is leak free, install solenoid coil on new valve and charge the sealed system by weighing in the proper amount and type of refrigerant as shown on rating plate. Crimp the process tubes and solder the ends shut. Do not leave schrader or piercing valves in the sealed system.



WARNING

DANGER OF BODILY INJURY OR DEATH FROM ELECTRICAL SHOCK

When working on high voltage equipment - turn the electrical power off before attaching test leads.

Use test leads with alligator type clips - clip to terminals, turn power on, take reading - turn power off before removing leads.

Compressor Checks

Locked Rotor Voltage (L.R.V.) Test

Locked rotor voltage (L.R.V.) is the actual voltage available at the compressor under a stalled condition.

Single Phase Connections

Disconnect power from unit. Using a voltmeter, attach one lead of the meter to the run "R" terminal on the compressor and the other lead to the common "C" terminal of the compressor. Restore power to unit.

CAUTION

Make sure that the ends of the lead do not touch the compressor shell since this will cause a short circuit.

Determine L.R.V.

Start the compressor with the voltmeter attached; then stop the unit. Attempt to restart the compressor within a couple of seconds and immediately read the voltage on the meter. The compressor under these conditions will not start and will usually kick out on overload within a few seconds since the pressures in the system will not have had time to equalize. Voltage should be at or above minimum voltage of 197 VAC, as specified on the rating plate. If less than minimum, check for cause of inadequate power supply; i.e., incorrect wire size, loose electrical connections, etc.

Amperage (L.R.A.) Test

The running amperage of the compressor is the most important of these readings. A running amperage higher than that indicated in the performance data indicates that a problem exists mechanically or electrically.

Single Phase Running and L.R.A. Test

NOTE: Consult the specification and performance section for running amperage. The L.R.A. can also be found on the rating plate.

Select the proper amperage scale and clamp the meter probe around the wire to the "C" terminal of the compressor.

Turn on the unit and read the running amperage on the meter. If the compressor does not start, the reading will indicate the locked rotor amperage (L.R.A.).

External Overload

Some compressors are equipped with an external overload which senses both motor amperage and winding temperature. High motor temperature or amperage heats the overload causing it to open, breaking the common circuit within the compressor.

Heat generated within the compressor shell, usually due to recycling of the motor, is slow to dissipate. It may take anywhere from a few minutes to several hours for the overload to reset.

Checking the External Overload

With power off, remove the leads from compressor terminals. If the compressor is hot, allow the overload to cool before starting check. Using an ohmmeter, test continuity across the terminals of the external overload. If you do not have continuity; this indicates that the overload is open and must be replaced.

Internal Overload

Some compressors are equipped with an internal overload which senses both motor amperage and winding temperature. High motor temperature or amperage heats the overload causing it to open, breaking the common circuit within the compressor. Heat generated within the compressor shell, usually due to recycling of the motor, is slow to dissipate. It may take anywhere from a few minutes to several hours for the overload to reset.

Checking the Internal Overload

A reading of infinity (∞) between any two terminals MAY indicate an open winding. If, however, a reading of infinity (∞) is obtained between C & R and C & S, accompanied by a resistance reading between S & R, an open internal overload is indicated. Should you obtain this indication, allow the compressor to cool (May take up to 24 hours) then recheck before condemning the compressor. If an open internal overload is indicated, the source of its opening must be determined and corrected. Failure to do so will cause repeat problems with an open overload and/or premature compressor failure. Some possible causes of an open internal overload include insufficient refrigerant charge, restriction in the refrigerant circuit, and excessive current draw.

Single Phase Resistance Test

Remove the leads from the compressor terminals and set the ohmmeter on the lowest scale (R x 1).

Touch the leads of the ohmmeter from terminals common to start ("C" to "S"). Next, touch the leads of the ohmmeter from terminals common to run ("C" to "R").

Add values "C" to "S" and "C" to "R" together and check resistance from start to run terminals ("S" to "R"). Resistance "S" to "R" should equal the total of "C" to "S" and "C" to "R."

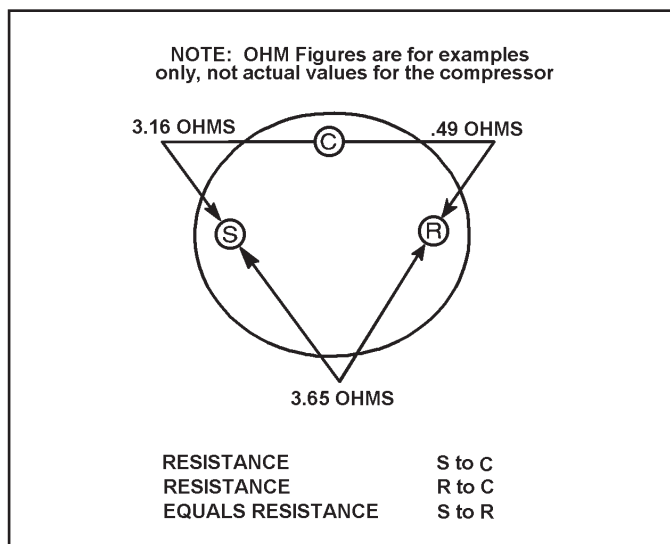
In a single phase PSC compressor motor, the highest value will be from the start to the run connections ("S" to "R"). The next highest resistance is from the start to the common connections ("S" to "C"). The lowest resistance is from the run to common. ("C" to "R") Before replacing a compressor, check to be sure it is defective.

Check the complete electrical system to the compressor and compressor internal electrical system, check to be certain that compressor is not out on internal overload.

Complete evaluation of the system must be made whenever you suspect the compressor is defective. If the compressor has been operating for sometime, a careful examination must be made to determine why the compressor failed.

Many compressor failures are caused by the following conditions.

1. Improper air flow over the evaporator.
2. Overcharged refrigerant system causing liquid to be returned to the compressor.
3. Restricted refrigerant system.
4. Lack of lubrication.
5. Liquid refrigerant returning to compressor causing oil to be washed out of bearings.
6. Noncondensables such as air and moisture in the system. Moisture is extremely destructive to a refrigerant system.



Recommended Procedure for Compressor Replacement

NOTE: Be sure power source is off, then disconnect all wiring from the compressor.

1. Be certain to perform all necessary electrical and refrigeration tests to be sure the compressor is actually defective before replacing .
2. Recover all refrigerant from the system though the process tubes. **PROPER HANDLING OF RECOVERED REFRIGERANT ACCORDING TO EPA REGULATIONS IS REQUIRED.** Do not use gauge manifold for this purpose if there has been a burnout. You will contaminate your manifold and hoses. Use a Schrader valve adapter and copper tubing for burnout failures.
3. After all refrigerant has been recovered, disconnect suction and discharge lines from the compressor and remove compressor. Be certain to have both suction and discharge process tubes open to atmosphere.
4. Carefully pour a small amount of oil from the suction stub of the defective compressor into a clean container.
5. Using an acid test kit (one shot or conventional kit), test the oil for acid content according to the instructions with the kit.
6. If any evidence of a burnout is found, no matter how slight, the system will need to be cleaned up following proper procedures.
7. Install the replacement compressor.
8. Pressurize with a combination of R-22 and nitrogen and leak test all connections with an electronic or Halide leak detector. Recover refrigerant and repair any leaks found.

Repeat Step 8 to insure no more leaks are present.

9. Evacuate the system with a good vacuum pump capable of a final vacuum of 300 microns or less. The system should be evacuated through both liquid line and suction line gauge ports. While the unit is being evacuated, seal all openings on the defective compressor. Compressor manufacturers will void warranties on units received not properly sealed. Do not distort the manufacturers tube connections.
10. Recharge the system with the correct amount of refrigerant. The proper refrigerant charge will be found on the unit rating plate. The use of an accurate measuring device, such as a charging cylinder, electronic scales or similar device is necessary.

WARNING

HAZARD OF SHOCK AND ELECTROCUTION. A CAPACITOR CAN HOLD A CHARGE FOR LONG PERIODS OF TIME. A SERVICE TECHNICIAN WHO TOUCHES THESE TERMINALS CAN BE INJURED. NEVER DISCHARGE THE CAPACITOR BY SHORTING ACROSS THE TERMINALS WITH A SCREWDRIVER.

Capacitors

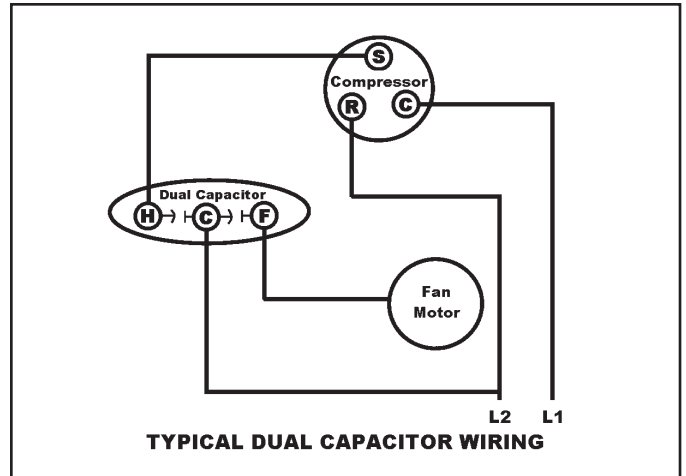
Many motor capacitors are internally fused. Shorting the terminals will blow the fuse, ruining the capacitor. A 20,000 ohm 2 watt resistor can be used to discharge capacitors safely. Remove wires from capacitor and place resistor across terminals. When checking a dual capacitor with a capacitor analyzer or ohmmeter, both sides must be tested.

Capacitor Check With Capacitor Analyzer

The capacitor analyzer will show whether the capacitor is "open" or "shorted." It will tell whether the capacitor is within its microfarads rating and it will show whether the capacitor is operating at the proper power-factor percentage. The instrument will automatically discharge the capacitor when the test switch is released

Capacitor Connections

The starting winding of a motor can be damaged by a shorted and grounded running capacitor. This damage usually can be avoided by proper connection of the running capacitor terminals.



From the supply line on a typical 230 volt circuit, a 115 volt potential exists from the "R" terminal to ground through a possible short in the capacitor. However, from the "S" or start terminal, a much higher potential, possibly as high as 400 volts, exists because of the counter EMF generated in the start winding. Therefore, the possibility of capacitor failure is much greater when the identified terminal is connected to the "S" or start terminal. The identified terminal should always be connected to the supply line, or "R" terminal, never to the "S" terminal.

When connected properly, a shorted or grounded running-capacitor will result in a direct short to ground from the "R" terminal and will blow the line fuse. The motor protector will protect the main winding from excessive temperature.

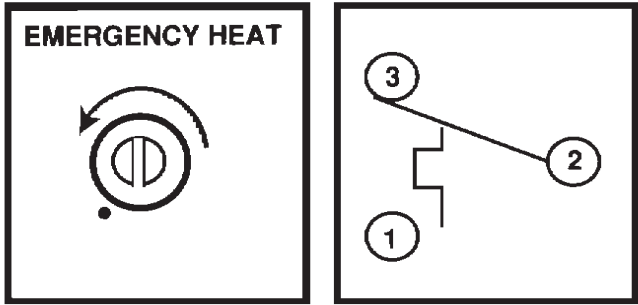
Emergency Heat Switch (Defrost Thermostat) Continuity Check

Electric Heat Switch Operation (Heat Pumps Only)

The electric heat switch is a dual function control and is shown on the wiring diagram as a defrost thermostat. It may be adjusted using a screwdriver. As the control shaft is rotated counter clockwise a detent will be encountered. Turning the control past the detent will lock out the compressor and acts as an emergency heat switch. Turning the control shaft clockwise will lower the change over point for compressor operation. The control itself is a double throw, single pole switch operated by a bellows and a gas filled capillary tube. The capillary tube senses a combination of outdoor coil temperature and outdoor air temperature. As the combined temperatures reach a point that the outdoor coil is iced, where heat pump operation is no longer efficient, the control shuts off the compressor and turns on the electric heat. At its lowest setting the cut off point is approximately 25 degrees, the highest setting is 52 degrees, with a 10 degree differential. It is possible, under certain conditions, for the unit to cycle between compressor and electric heat operation.

Electric Heat Switch Check Out

The switch may be checked out with an ohmmeter. Remove and label the three wires from the switch. Terminal 2 is common and the contacts make to Terminal 3 on temperature rise and to Terminal 1 on temperature fall. With the control set in the emergency heat position continuity should be read between Terminal 2 and Terminal 1 regardless of coil temperature. As the control shaft is rotated clockwise, through the adjustment range, continuity will be read between Terminal 2 and Terminal 3, providing the temperature of the capillary tube is above 25° (± 5%). If the temperature at the capillary tube is above approximately 52 degrees it may be necessary to place the end of the capillary tube in ice water to determine if the control is sensing temperature changes. Should the control lose the gas charge in the capillary tube it will fail to the electric heat position and the compressor will not operate.



Emergency Heat Switch

SWITCH POSITION	TEMPERATURE AT CAPILLARY	CONTINUITY READ
EMERGENCY HEAT	N/A	1 and 2 = Electric Heat
ANYWHERE IN ADJUSTMENT RANGE	ABOVE SET POINT	2 and 3 = Compressor
ANYWHERE IN ADJUSTMENT RANGE	BELOW SET POINT	1 and 2 = Electric Heat

Wiring Diagram Index

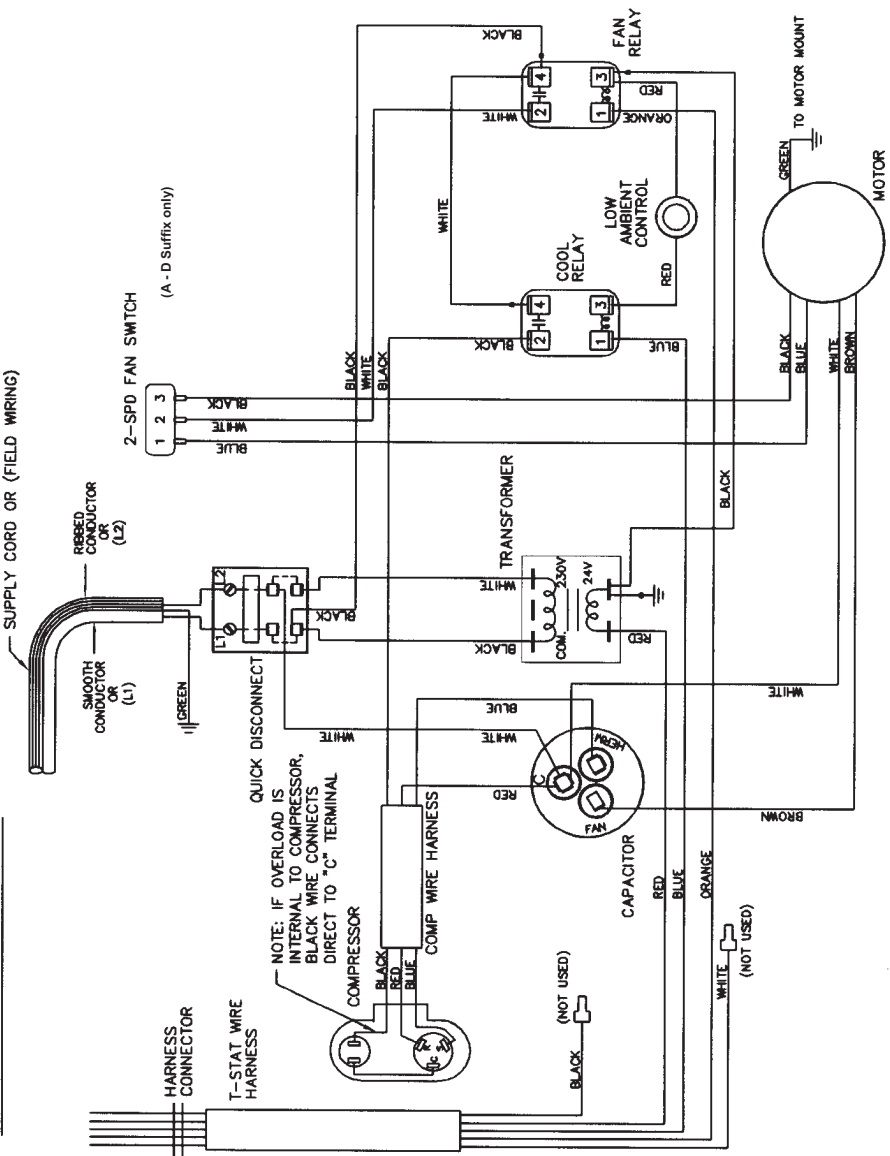
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VEA09K00 RTA.....	80004910	28
VEA09K00RTB	80004910	28
VEA09K00RTE	80004910	28
VEA09K00RTG	80004922	34
VEA09K00RTH	80004922	34
VEA09K25 RTA	80004911.....	30
VEA09K25RTB	80004911.....	30
VEA09K25RTE	80004911.....	30
VEA09K25RTG	80004923	35
VEA09K25RTH	80004923	35
VEA09K34RTA.....	80004911.....	30
VEA09K34RTB	80004911.....	30
VEA09K34RTE	80004911.....	30
VEA09K34RTG	80004923	35
VEA09K34RTH	80004923	35
VEA09K50RTA.....	80004911.....	30
VEA09K50RTB	80004911.....	30
VEA09K50RTE	80004911.....	30
VEA09K50RTG	80004923	35
VEA09K50RTH	80004923	35
VEA12K00RTA.....	80004910	28
VEA12K00RTB.....	80004910	28
VEA12K00RTE.....	80004910	28
VEA12K00RTG.....	80004919	31
VEA12K00RTH.....	80004919	31
VEA12K25RTA.....	80004911.....	30
VEA12K25RTB.....	80004911.....	30
VEA12K25RTE.....	80004911.....	30
VEA12K25RTG	80004920	32
VEA12K25RTH.....	80004920	32
VEA12K34RTA.....	80004911.....	30
VEA12K34RTB.....	80004911.....	30
VEA12K34RTE.....	80004911.....	30

MODEL	DIAGRAM	PAGE
VEA12K34RTG.....	80004920	32
VEA12K34RTH.....	80004920	32
VEA12K50RTA	80004911.....	30
VEA12K50RTB.....	80004911.....	30
VEA12K50RTE.....	80004911.....	30
VEA12K50RTG.....	80004920	32
VEA12K50RTH.....	80004920	32
VEA18K00RTA.....	80004910	28
VEA18K00RTB.....	80004910	28
VEA18K00RTC.....	80004910	28
VEA18K00RTD.....	80004910	28
VEA18K00RTE.....	80004910	28
VEA18K00RTG	80004919	31
VEA18K00RTH.....	80004919	31
VEA18K25RTA.....	80004911.....	30
VEA18K25RTB.....	80004911.....	30
VEA18K25RTC.....	80004911.....	30
VEA18K25RTD	80004911.....	30
VEA18K25RTE.....	80004911.....	30
VEA18K25RTG	80004920	32
VEA18K25RTH	80004920	32
VEA18K34RTA.....	80004911.....	30
VEA18K34RTB.....	80004911.....	30
VEA18K34RTC.....	80004911.....	30
VEA18K34RTD.....	80004911.....	30
VEA18K34RTE.....	80004911.....	30
VEA18K34RTG	80004920	32
VEA18K34RTH.....	80004920	32
VEA18K50RTA.....	80004911.....	30
VEA18K50RTB.....	80004911.....	30
VEA18K50RTC.....	80004911.....	30
VEA18K50RTD.....	80004911.....	30
VEA18K50RTE.....	80004911.....	30

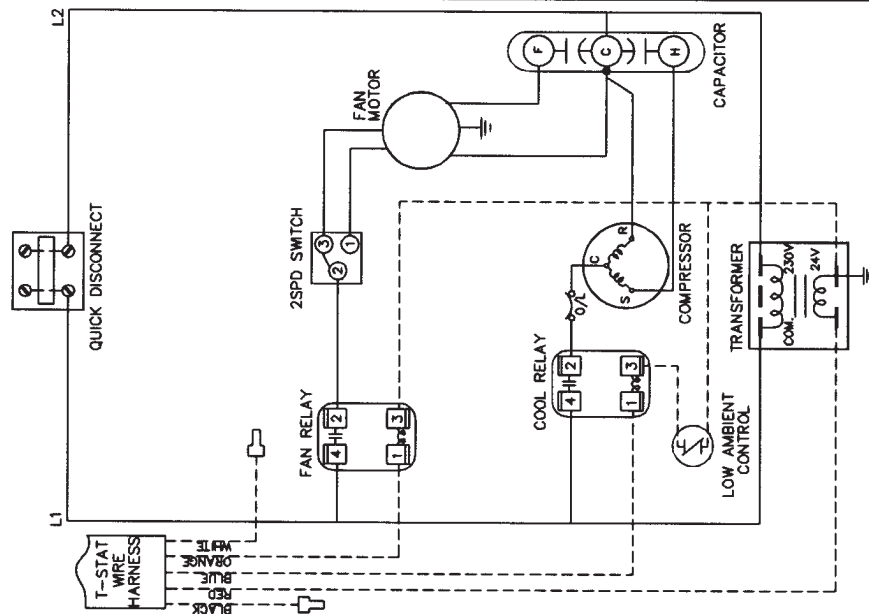
MODEL	DIAGRAM	PAGE
VEA18K50RTG	80004920	32
VEA18K50RTH	80004920	32
VEA24K00RTH	80110500	37
VEA24K10RTH	80108800	38
VEA24K25RTH	80108800	38
VEA24K34RTH	80108800	38
VEA24K50RTH	80108800	38
VEA24K75RTH	80108800	38
VHA09K25RTA	800004912	29
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VHA09K25RTE	800004912	29
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VHA09K34RTG	800004924	36
VHA09K34RTH	800004924	36
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VHA12K25RTH	80004921	33
VHA12K34RTA	80004912	29
VHA12K34RTB	80004912	29
VHA12K34RTE	80004912	29
VHA12K34RTG	80004921	33

MODEL	DIAGRAM	PAGE
VHA12K34RTH	80004921	33
VHA12K50RTA	80004912	29
VHA12K50RTB	80004912	29
VHA12K50RTE	80004912	29
VHA12K50RTG	80004921	33
VHA12K50RTH	80004921	33
VHA18K25RTA	80004912	29
VHA18K25RTB	80004912	29
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VHA18K50RTE	80004912	29
VHA18K50RTG	80004921	33
VHA18K50RTH	80004921	33
VHA24K10RTH	80110300	39
VHA24K25RTH	80110300	39
VHA24K34RTH	80110300	39
VHA24K50RTH	80110300	39
VHA24K75RTH	80110300	39

WIRING DIAGRAM



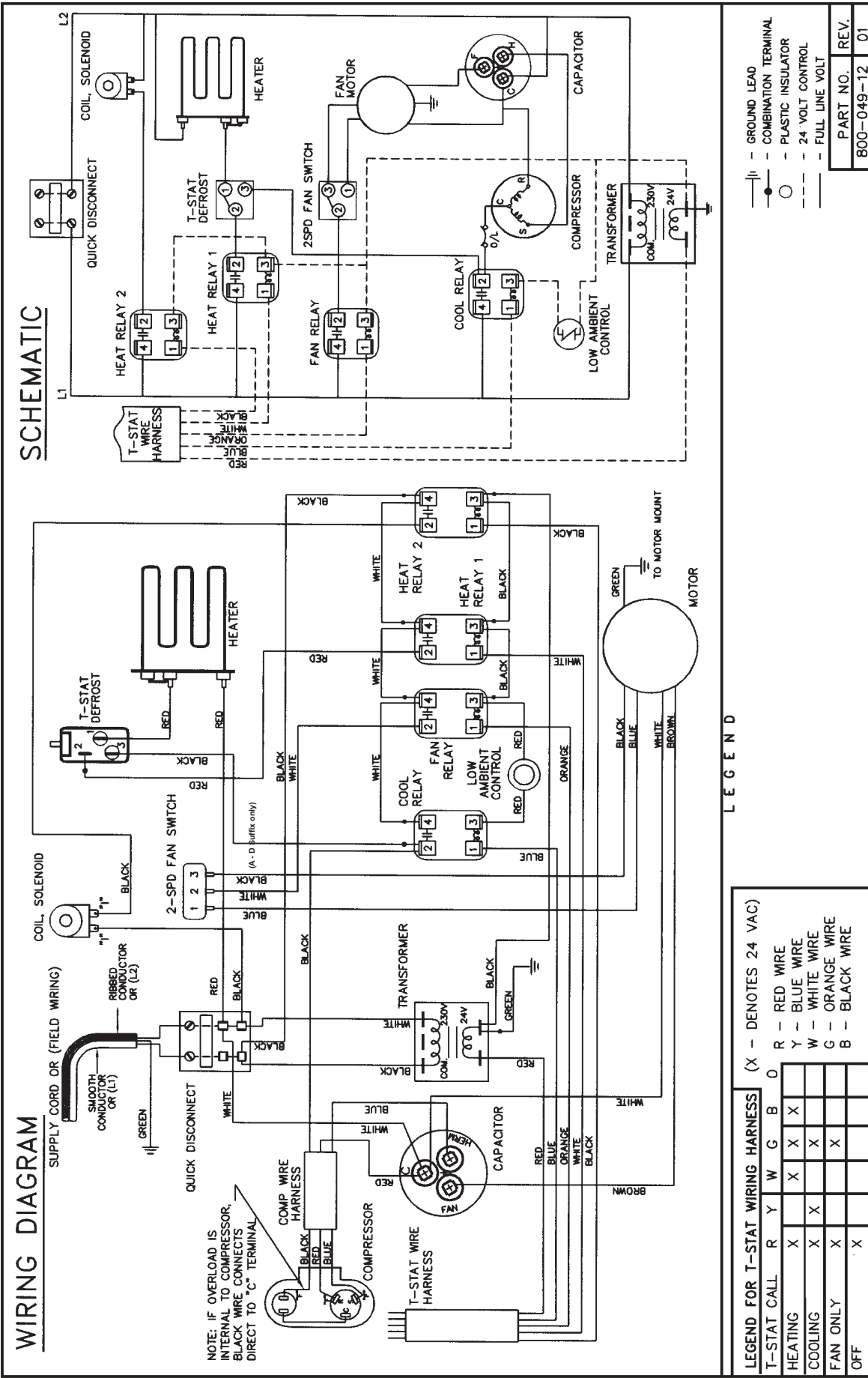
SCHEMATIC



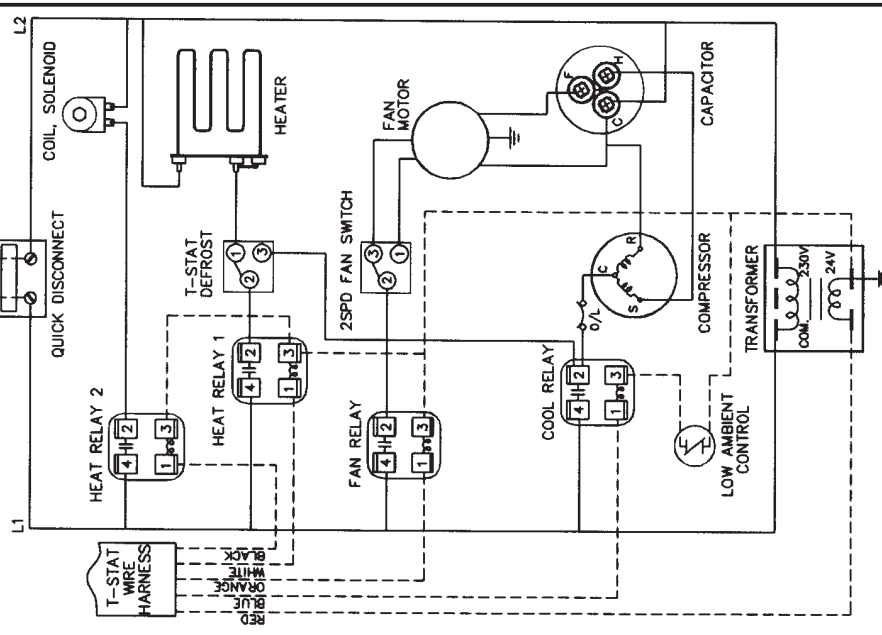
LEGEND

- GROUND LEAD
- COMBINATION TERMINAL
- PLASTIC INSULATOR
- 24 VOLT CONTROL
- FULL LINE VOLT

PART NO.	REV.
800-049-10	01

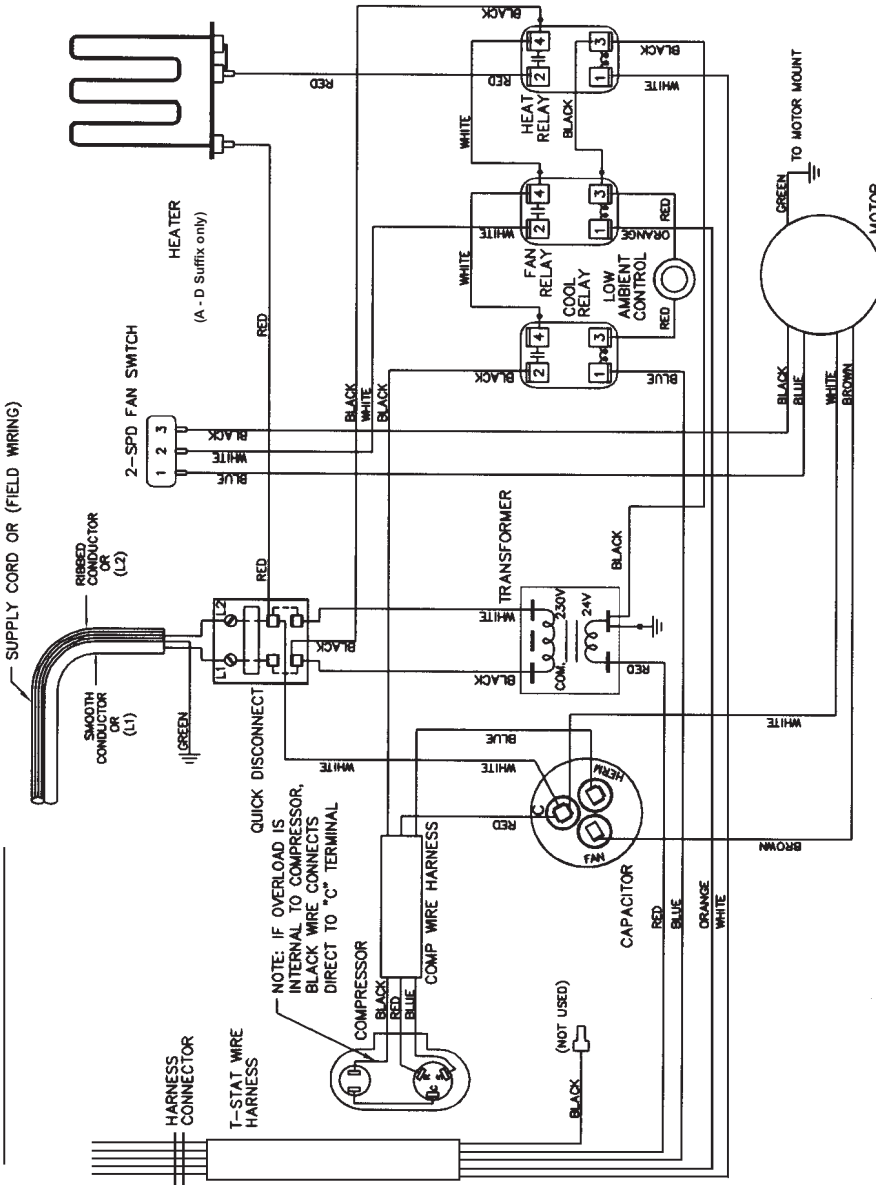


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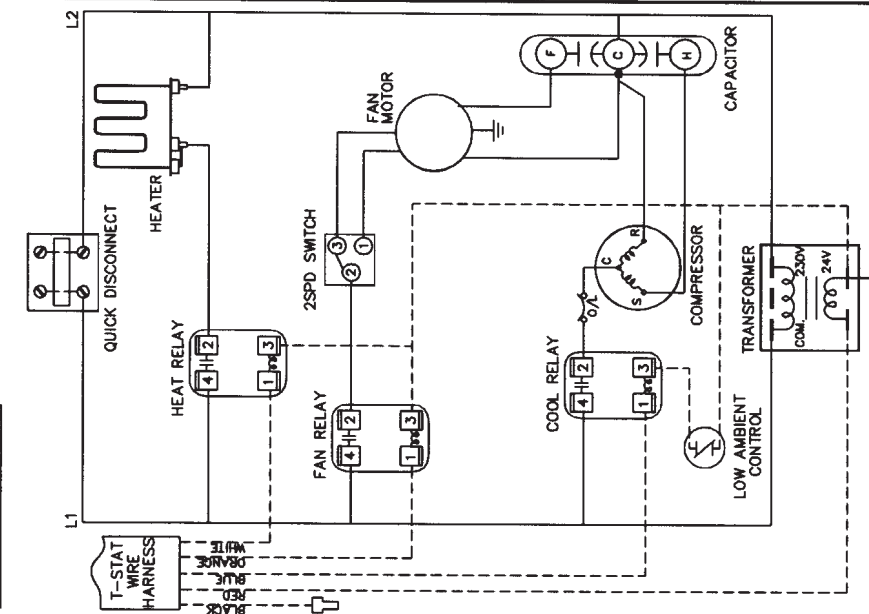


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800-049-12	01

WIRING DIAGRAM



SCHEMATIC



LEGEND

LEGEND FOR T-STAT WIRING HARNESS (X - DENOTES 24 VAC)

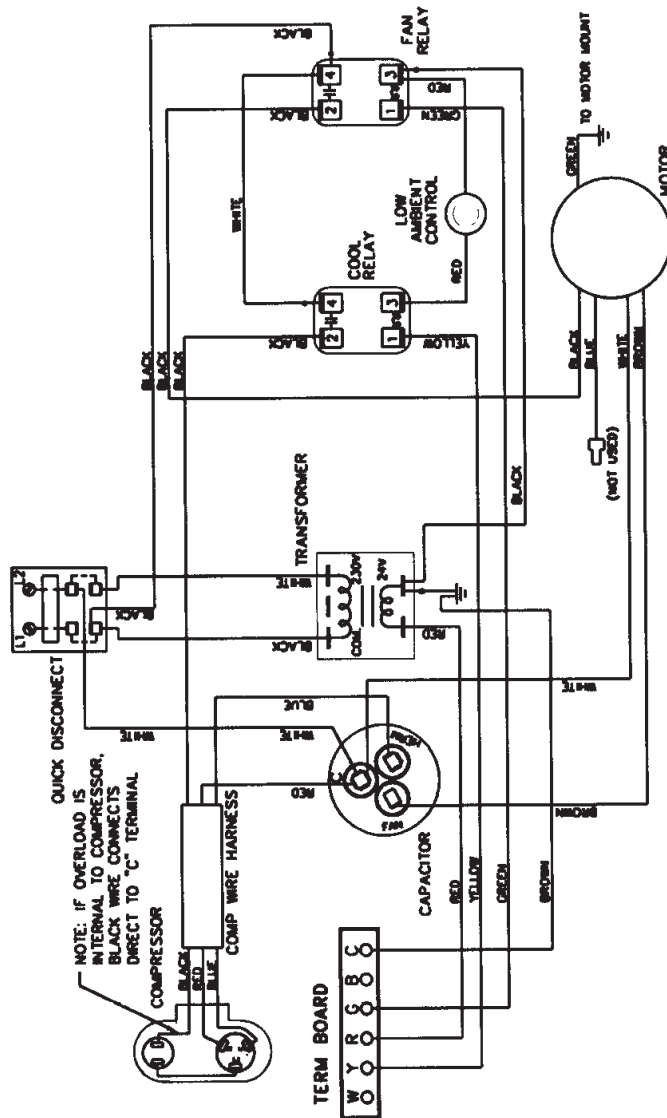
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HEATING	X	X	X	X	X	X
COOLING	X	X	X	X	X	X
FAN ONLY	X	X	X	X	X	X
OFF	X					

X - DENOTES 24 VAC
 R - RED WIRE
 Y - BLUE WIRE
 W - WHITE WIRE
 G - ORANGE WIRE
 B - BLACK WIRE

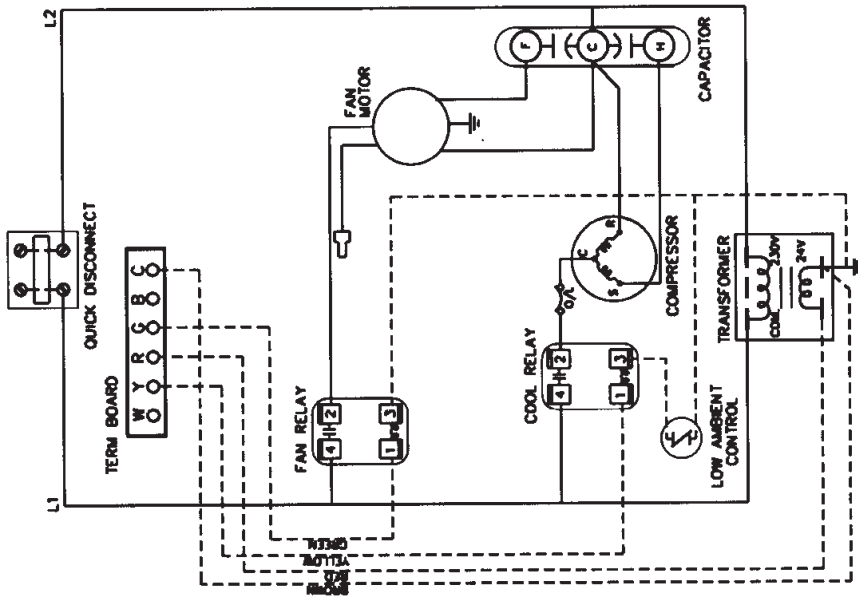
— —	GROUND LEAD
—●—	COMBINATION TERMINAL
○	PLASTIC INSULATOR
—	24 VOLT CONTROL
---	FULL LINE VOLT

PART NO.	REV.
800-049-11	01

WIRING DIAGRAM



SCHEMATIC



LEGEND

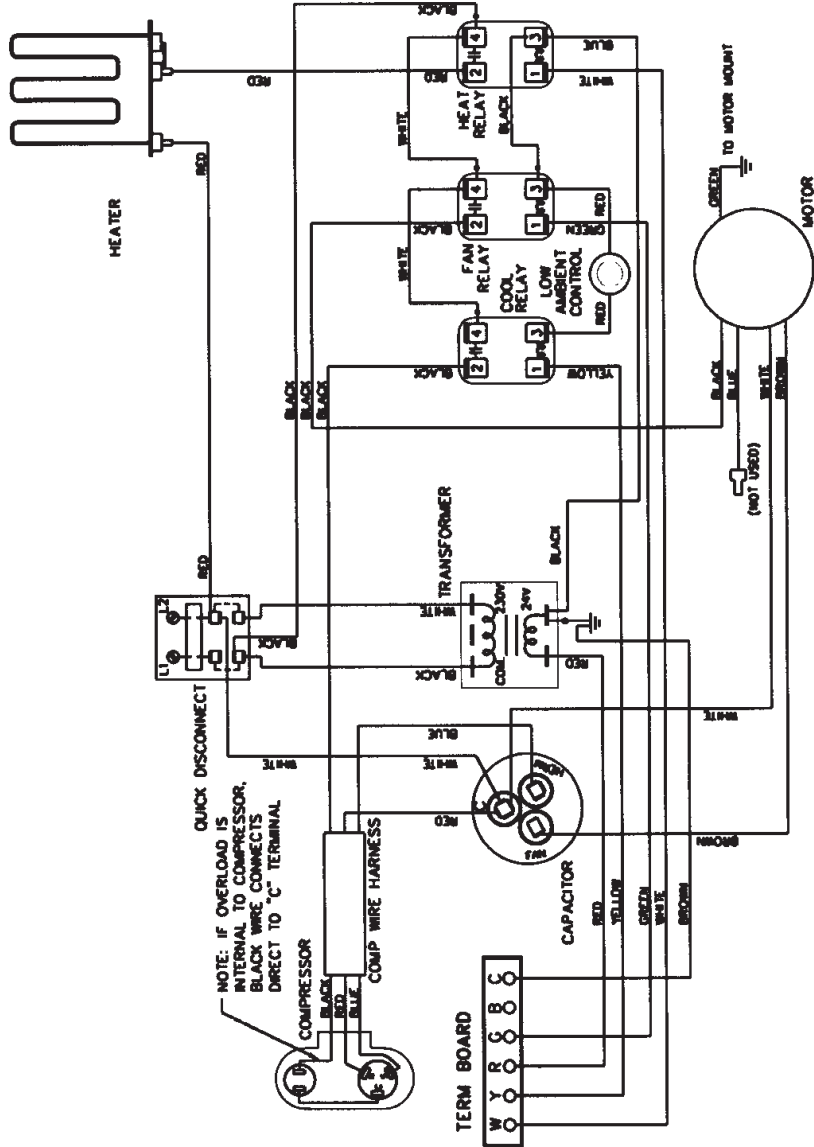
- GROUND LEAD
- COMBINATION TERMINAL
- PLASTIC INSULATOR
- - - 24 VOLT CONTROL
- - - FULL LINE VOLT

LEGEND FOR T-STAT WIRING HARNESS (X - DENOTES 24 VAC)

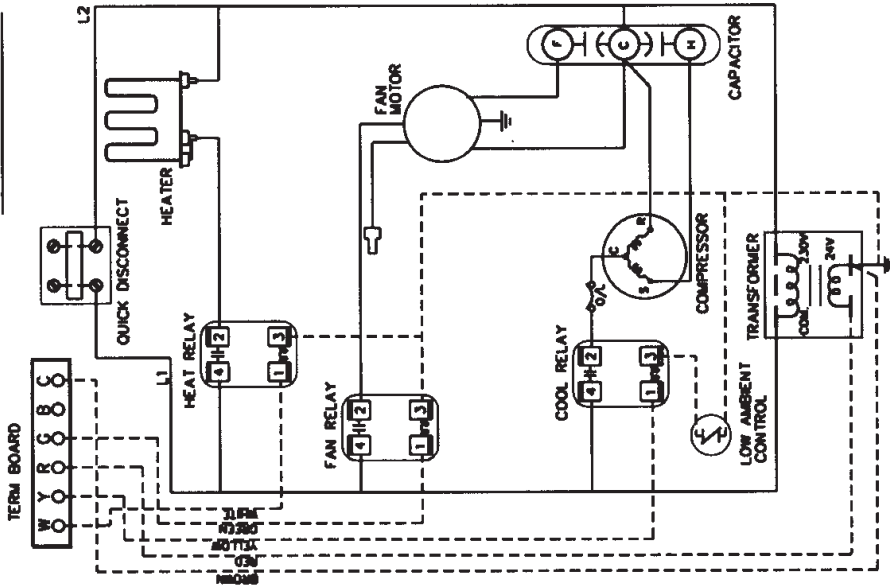
T-STAT CALL	R	Y	W	G	B	O	C
COOLING	X	X	X	X	X	X	X
FAN ONLY	X	X	X	X	X	X	X
OFF	X	X	X	X	X	X	X

PART NO.	REV.
800-049-19	00

WIRING DIAGRAM



SCHEMATIC



LEGEND

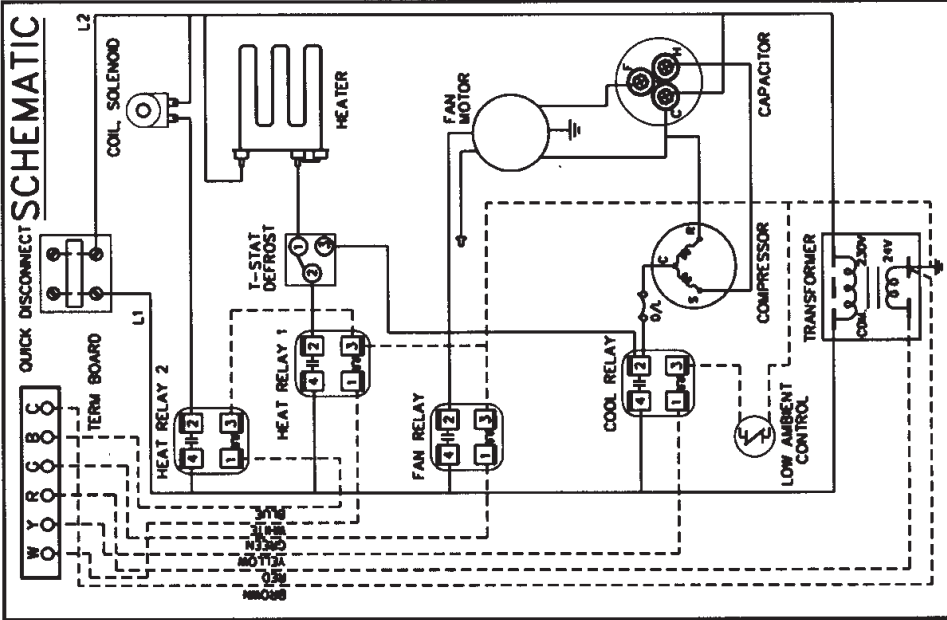
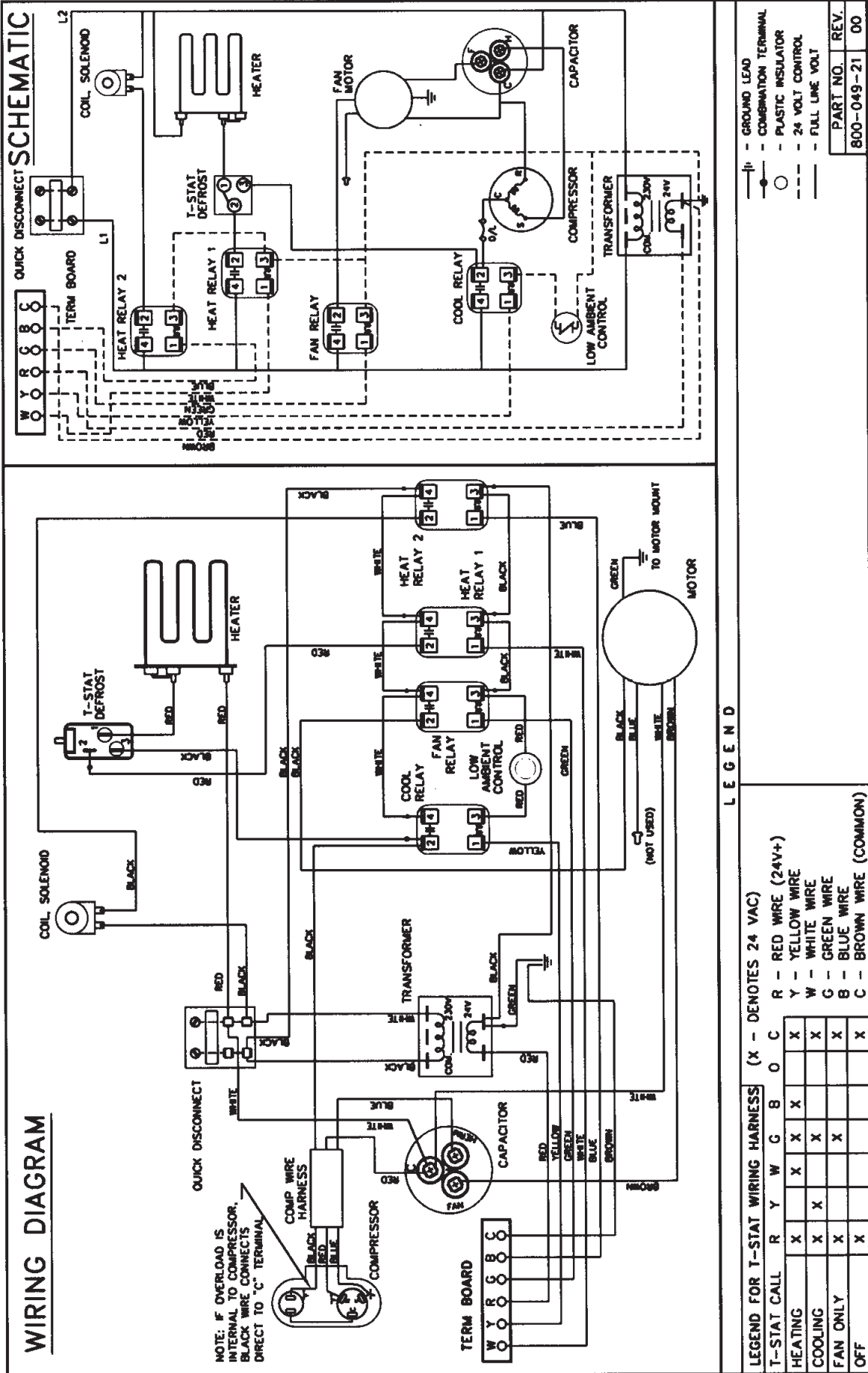
- GROUND LEAD
- COMBINATION TERMINAL
- PLASTIC INSULATOR
- 24 VOLT CONTROL
- FULL LINE VOLT

LEGEND FOR T-STAT WIRING HARNESS (X - DENOTES 24 VAC)

T-STAT CALL	R	Y	W	G	B	O	C
HEATING	X	X	X	X	X		X
COOLING	X	X	X	X	X		X
FAN ONLY	X	X	X	X	X		X
OFF	X						X

R - RED WIRE (24V+)
 Y - YELLOW WIRE
 W - WHITE WIRE
 G - GREEN WIRE
 B - BLUE WIRE
 C - BROWN WIRE (COMMON)

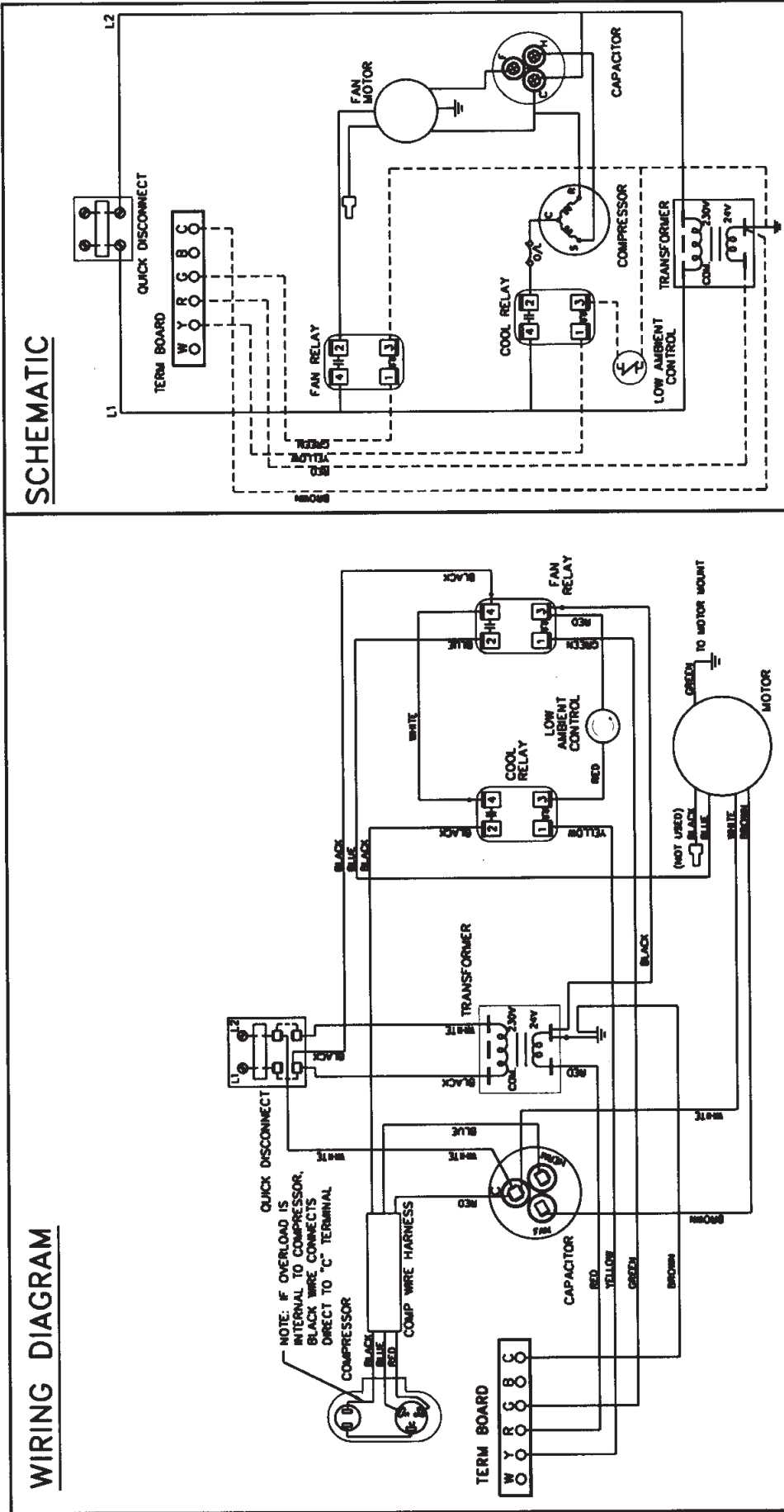
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800-049-20	00



PART NO.	REV.
800-049-21	00

WIRING DIAGRAM

SCHEMATIC



LEGEND FOR T-STAT WIRING HARNESS (X - DENOTES 24 VAC)

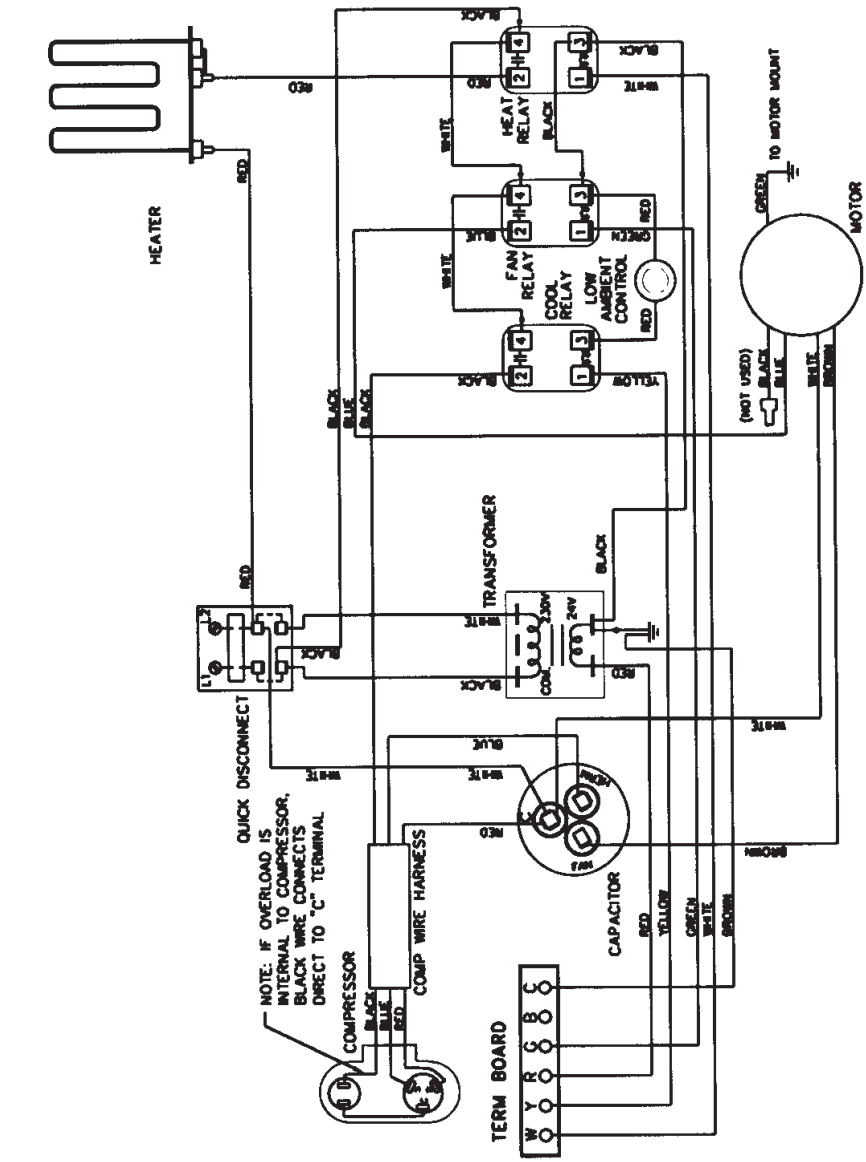
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FAN ONLY	X		X				X
OFF			X				X

LEGEND

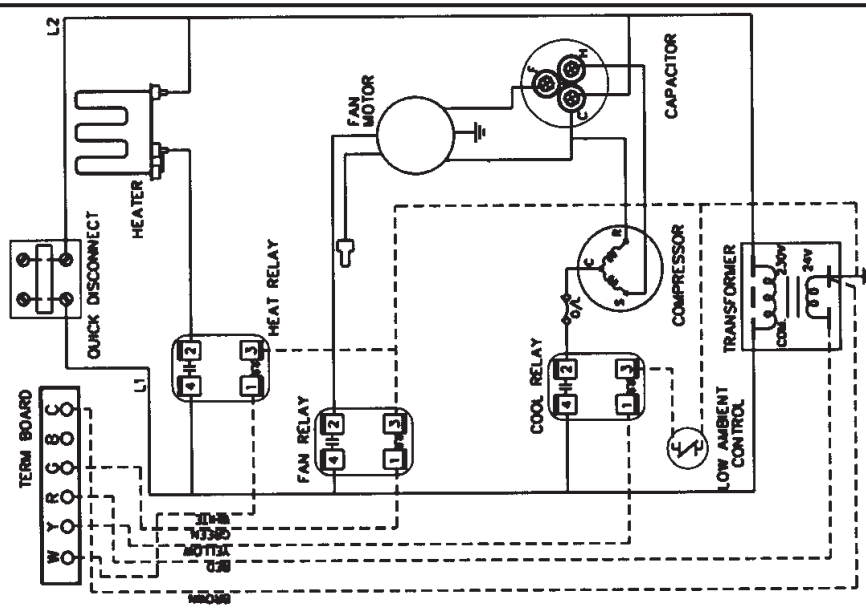
- R - RED WIRE (24V+)
- Y - YELLOW WIRE
- W - WHITE WIRE
- G - GREEN WIRE
- B - BLUE WIRE
- C - BROWN WIRE (COMMON)

PART NO. REV.
800-049-22 00

WIRING DIAGRAM



SCHEMATIC



LEGEND

— GROUND LEAD
— COMBINATION TERMINAL
— PLASTIC INSULATOR
— 24 VOLT CONTROL
— FULL LINE VOLT

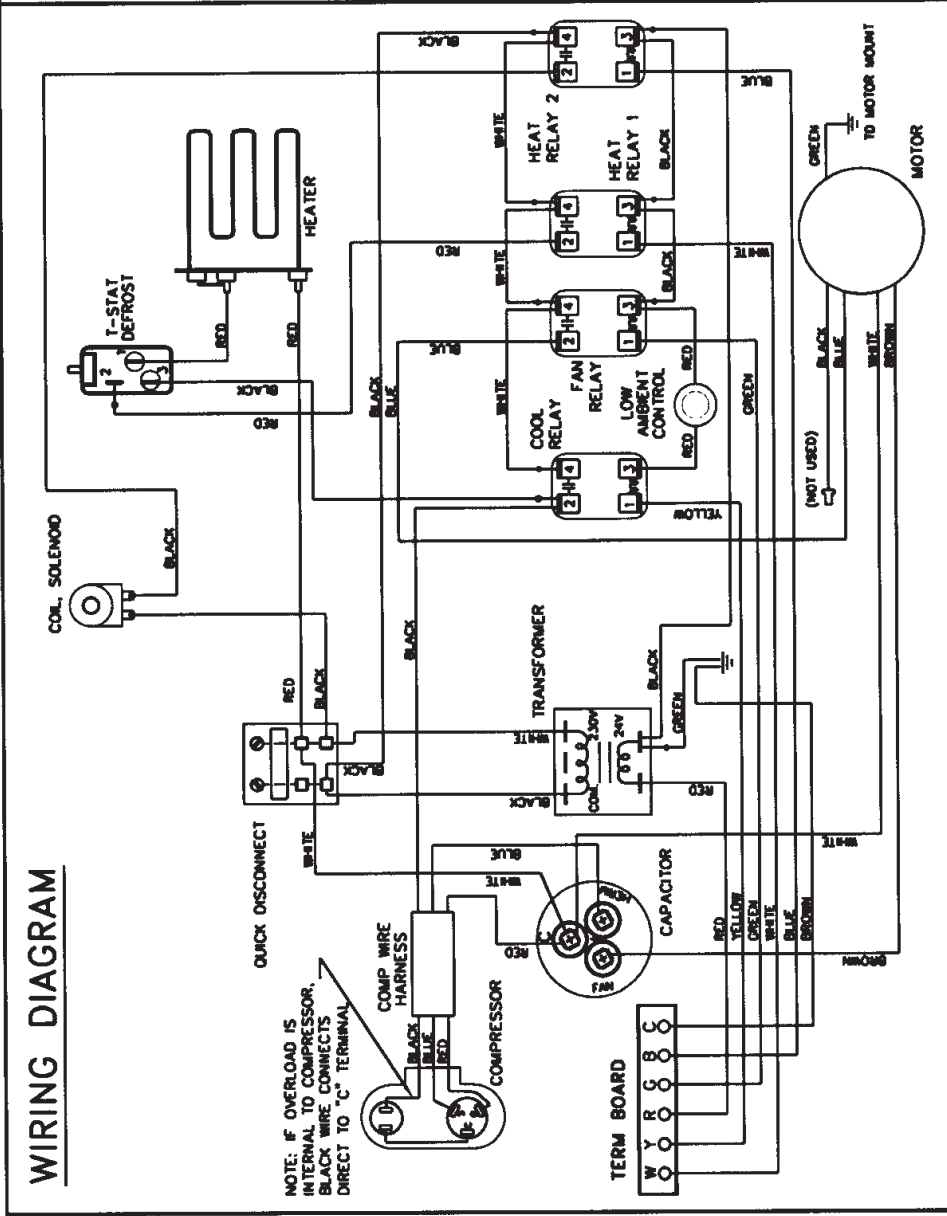
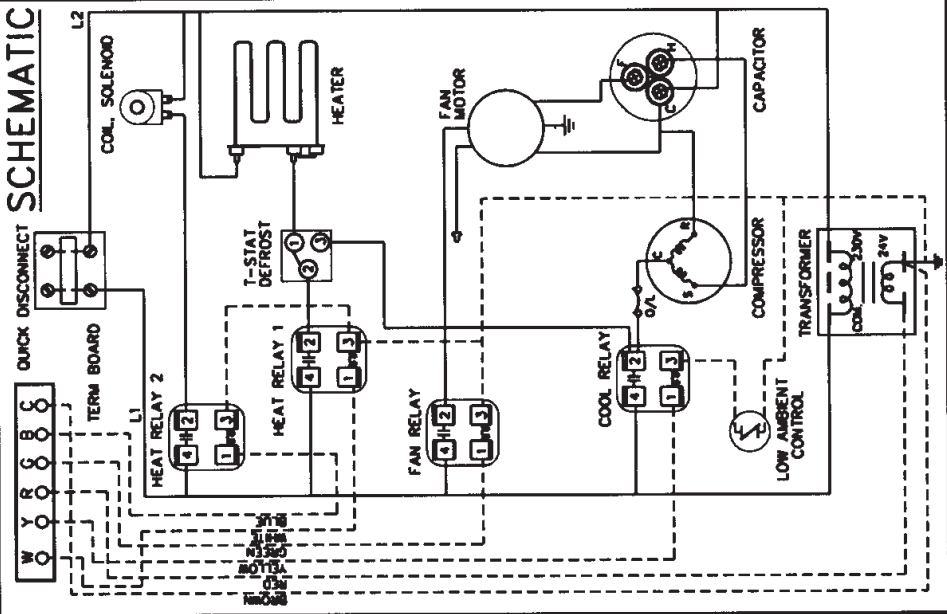
LEGEND FOR T-STAT WIRING HARNESS (X - DENOTES 24 VAC)

T-STAT CALL	R	Y	W	G	B	O	C
HEATING	X	X	X	X			X
COOLING	X	X		X			X
FAN ONLY	X			X			X
OFF	X						X

LEGEND

— GROUND LEAD
— COMBINATION TERMINAL
— PLASTIC INSULATOR
— 24 VOLT CONTROL
— FULL LINE VOLT

PART NO. 800-049-23
REV. 00



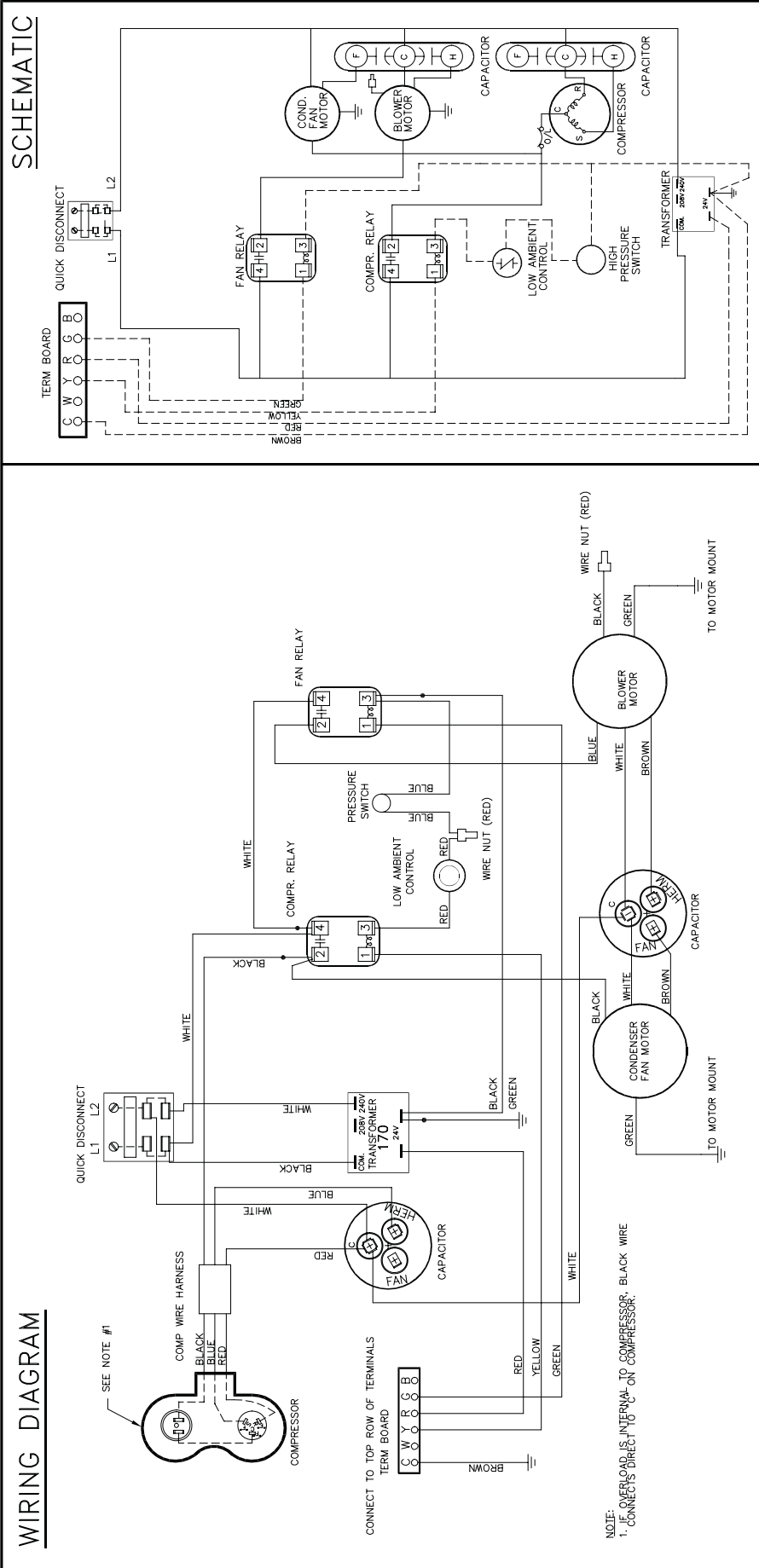
LEGEND

--- GROUND LEAD
 --- COMBINATION TERMINAL
 --- PLASTIC INSULATOR
 --- 24 VOLT CONTROL
 --- FULL LINE VOLT

LEGEND FOR T-STAT WIRING HARNESS (X - DENOTES 24 VAC)						
T-STAT CALL	R	Y	W	G	B	C
HEATING	X	X	X	X	X	X
COOLING	X	X	X	X	X	X
FAN ONLY	X	X	X	X	X	X
OFF	X	X	X	X	X	X

R - RED WIRE (24V+)
 Y - YELLOW WIRE
 W - WHITE WIRE
 G - GREEN WIRE
 B - BLUE WIRE
 C - BROWN WIRE (COMMON)

PART NO.	REV.
800-049-24	00



WIRING DIAGRAM

SCHEMATIC

LEGEND FOR T-STAT WIRING HARNESS (X - DENOTES 24 VAC)

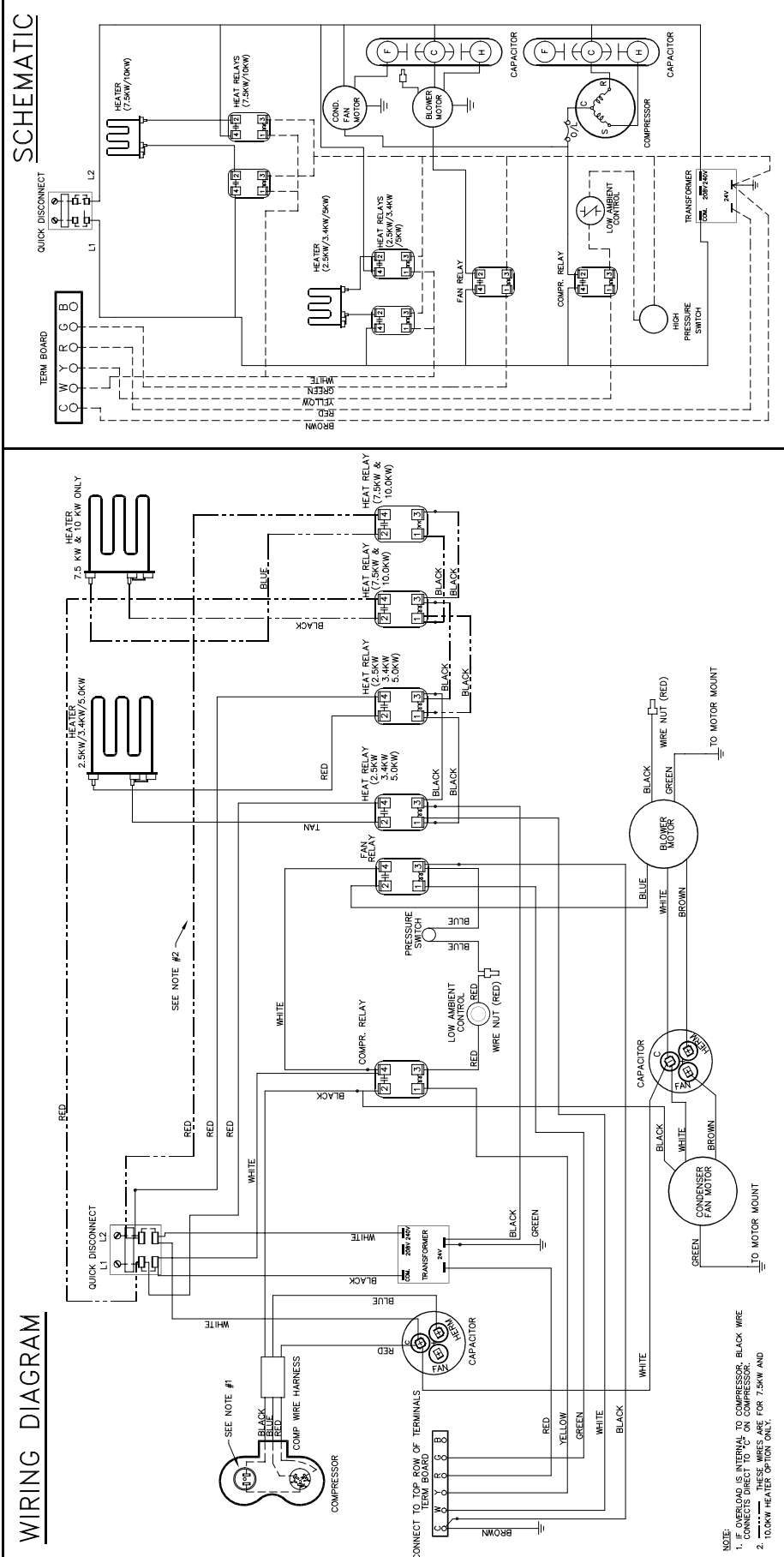
T-STAT CALL	R	Y	W	G	B	O	C
COOLING	X	X	X	X			X
FAN ONLY	X		X	X			X
OFF		X					X

X - DENOTES 24 VAC
 R - RED WIRE (24V+)
 Y - YELLOW WIRE
 W - WHITE WIRE
 G - GREEN WIRE
 B - BLUE WIRE
 C - BROWN WIRE (COMMON)

LEGEND

- GROUND LEAD
- COMBINATION TERMINAL
- PLASTIC INSULATOR
- 24 VOLT CONTROL
- FULL LINE VOLT

PART NO.	REV.
801-105-00	03



WIRING DIAGRAM

SCHEMATIC

LEGEND

NOTE: 1. IF OVERLOAD IS INTERNAL TO COMPRESSOR, BLACK WIRE CONNECTS DIRECT TO 'C' ON COMPRESSOR.
2. 10.0KW HEATER OPTION ONLY.

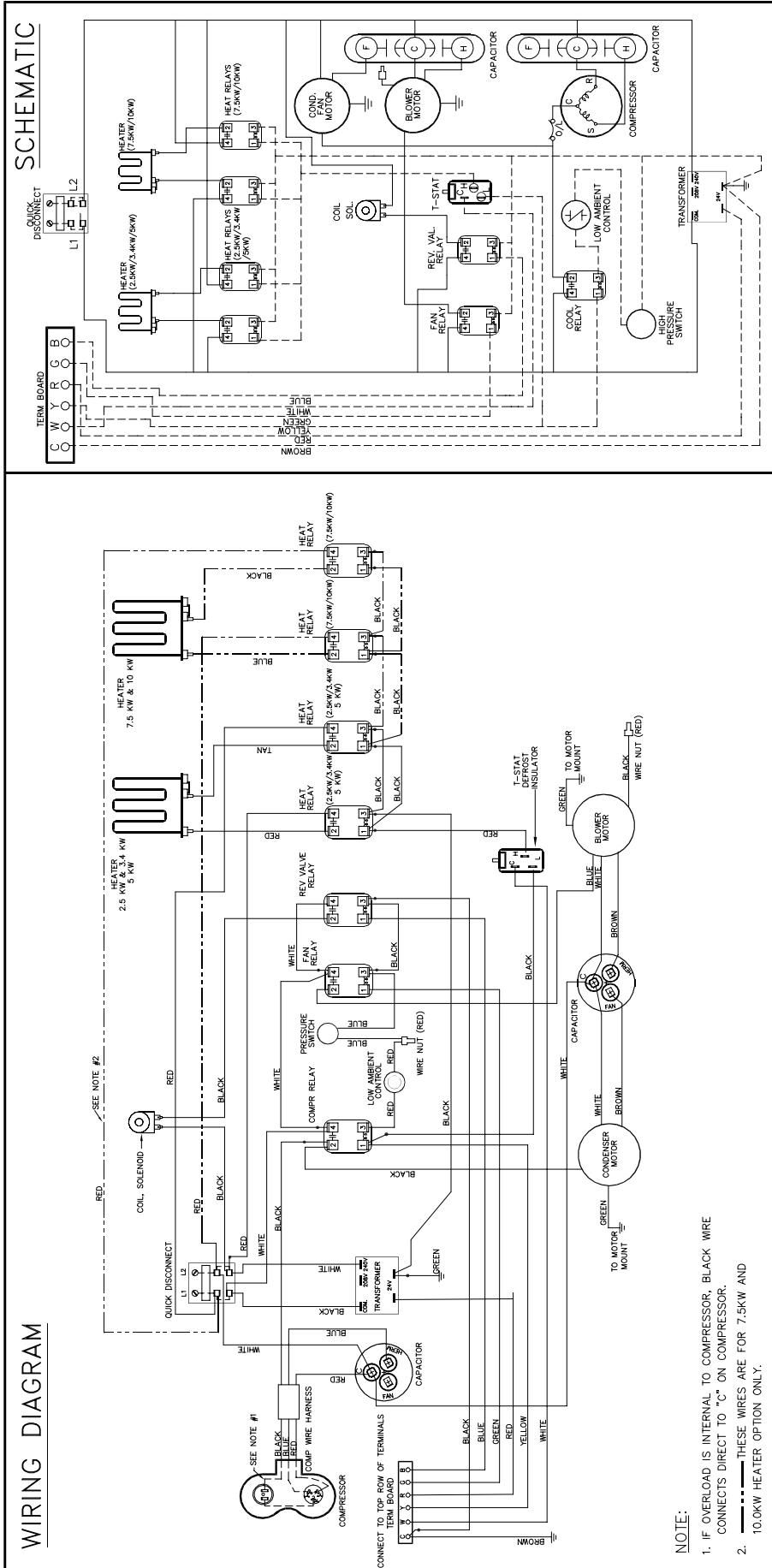
LEGEND FOR T-STAT WIRING HARNESS (X - DENOTES 24 VAC)

T-STAT CALL	R	Y	W	G	B	O	C
HEATING	X	X	X	X	X		X
COOLING	X	X	X	X	X		X
FAN ONLY	X	X	X	X	X		X
OFF	X						X

LEGEND

- GROUND LEAD
- COMBINATION TERMINAL
- PLASTIC INSULATOR
- 24 VOLT CONTROL
- FULL LINE VOLT

PART NO. 801-088-00
REV. 04



WIRING DIAGRAM

SCHEMATIC

NOTE:

1. IF OVERLOAD IS INTERNAL TO COMPRESSOR, BLACK WIRE CONNECTS DIRECT TO "C" ON COMPRESSOR.
2. THESE WIRES ARE FOR 7.5KW AND 10.0KW HEATER OPTION ONLY.

LEGEND

- GROUND LEAD
- COMBINATION TERMINAL
- PLASTIC INSULATOR
- 24 VOLT CONTROL
- FULL LINE VOLT

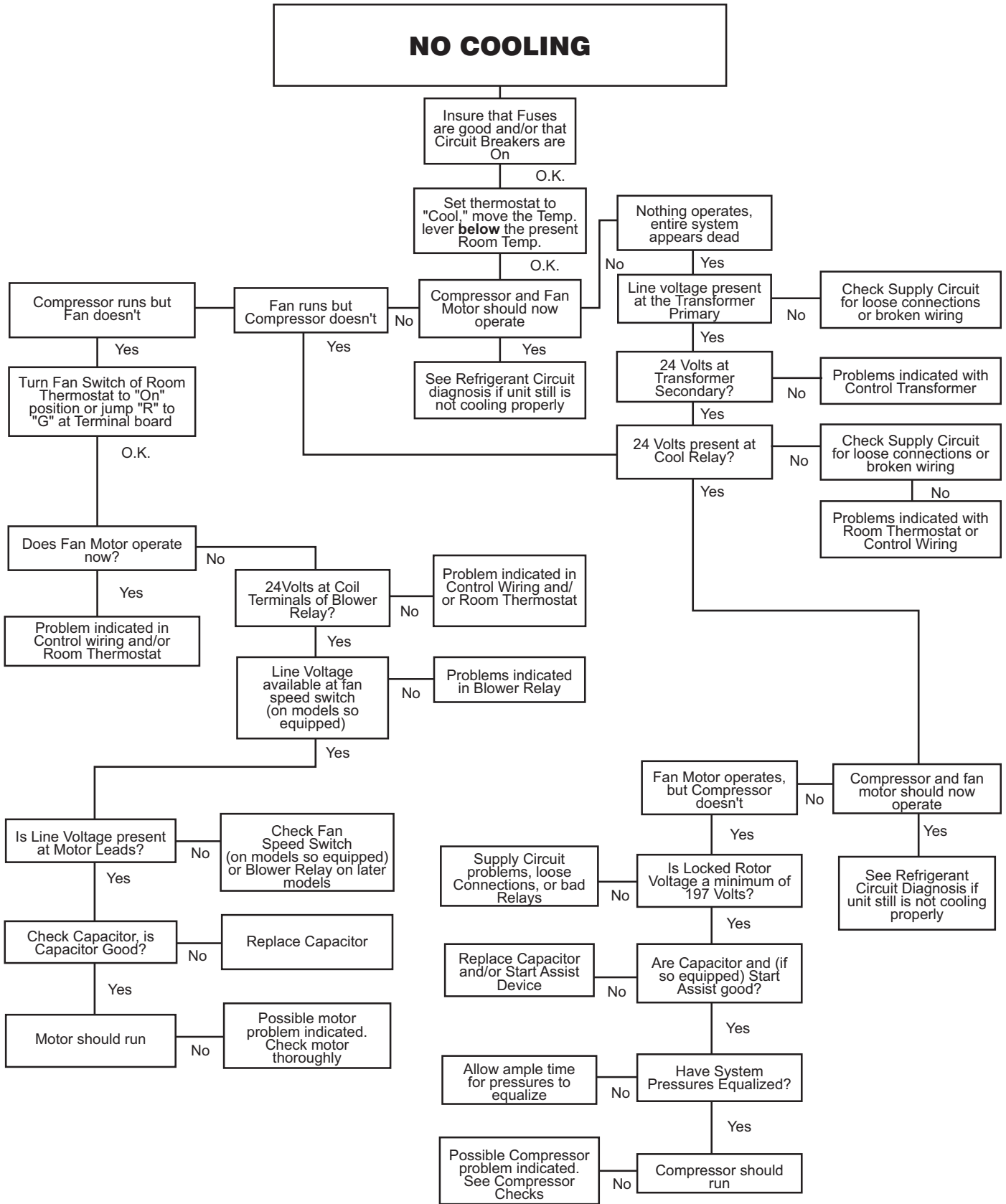
LEGEND FOR T-STAT WIRING HARNESS (X - DENOTES 24 VAC)

T-STAT CALL	R	Y	W	G	B	C
HEATING	X	X	X	X	X	X
COOLING	X	X	X	X	X	X
FAN ONLY	X	X	X	X	X	X
OFF	X	X	X	X	X	X

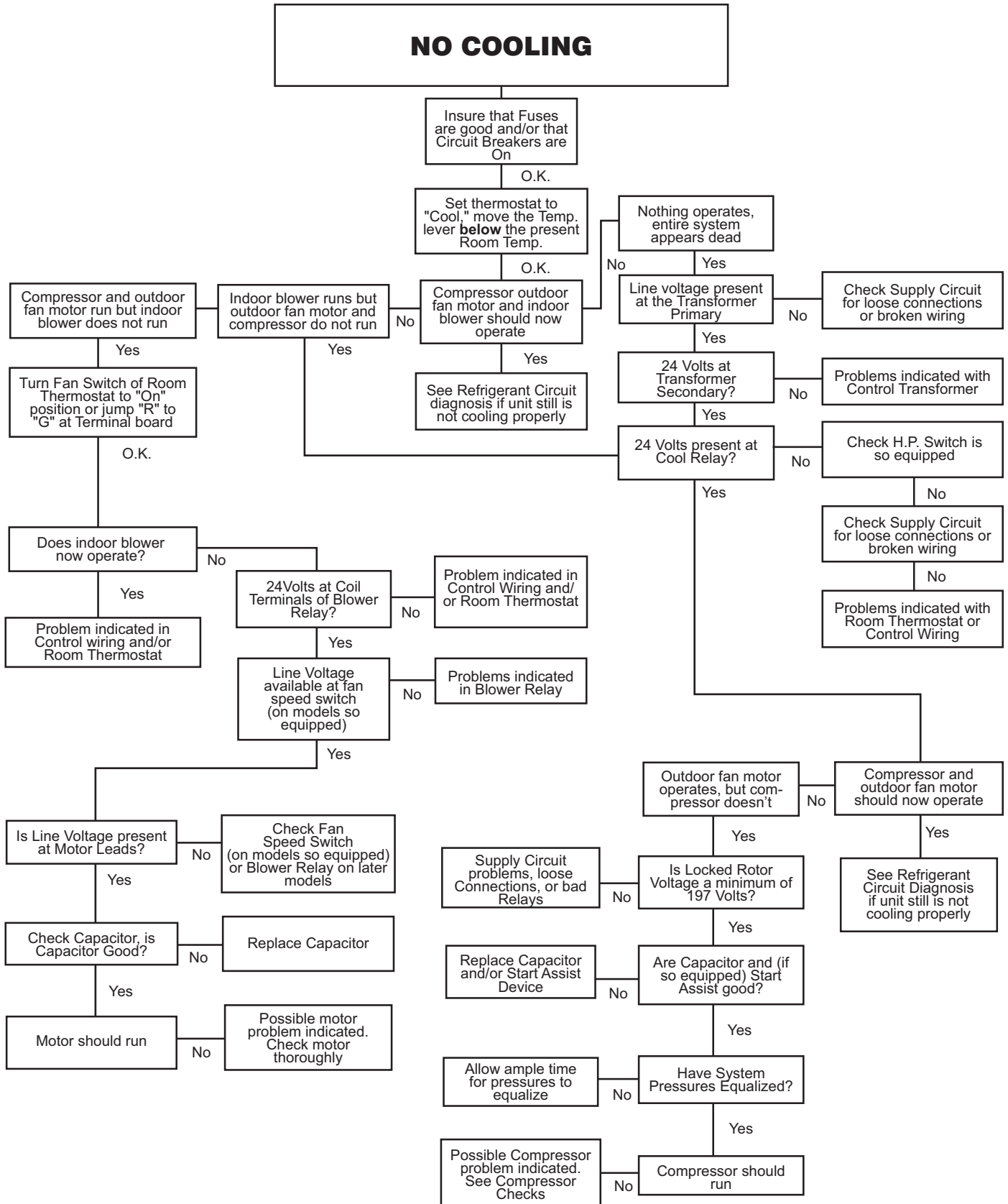
R - RED WIRE (24V+)
 Y - YELLOW WIRE
 W - WHITE WIRE
 G - GREEN WIRE
 B - BLUE WIRE
 C - BROWN WIRE (COMMON)

PART NO.	801-103-00
REV.	05

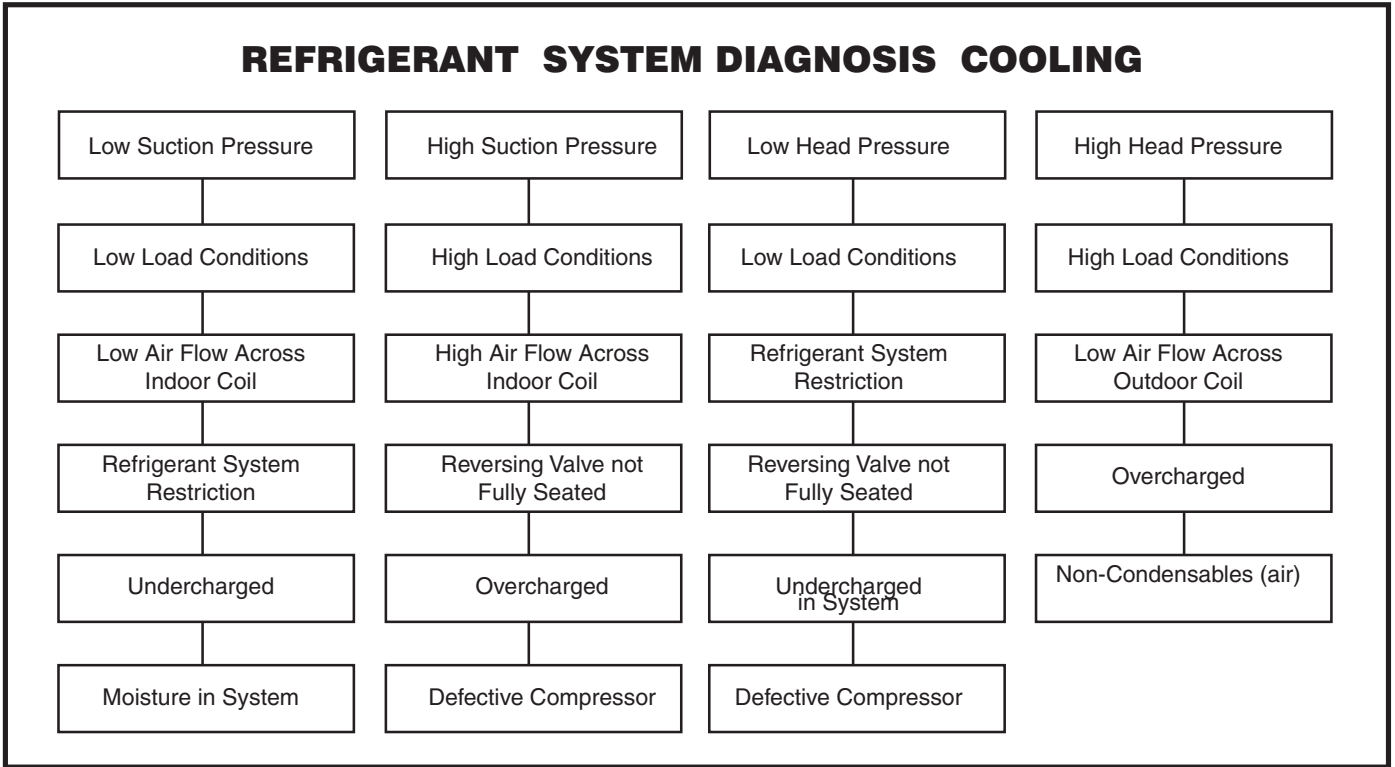
9-18 ELECTRICAL TROUBLESHOOTING CHART — COOLING



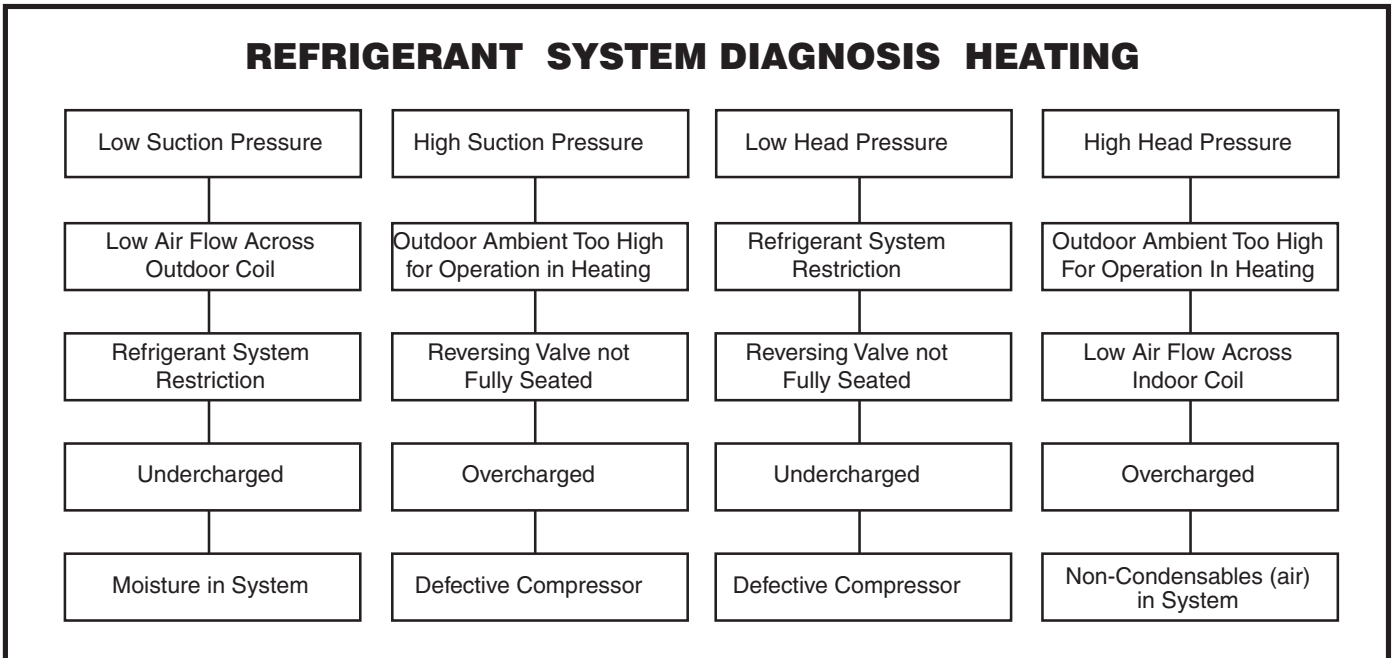
2-TON ELECTRICAL TROUBLESHOOTING CHART — Cooling



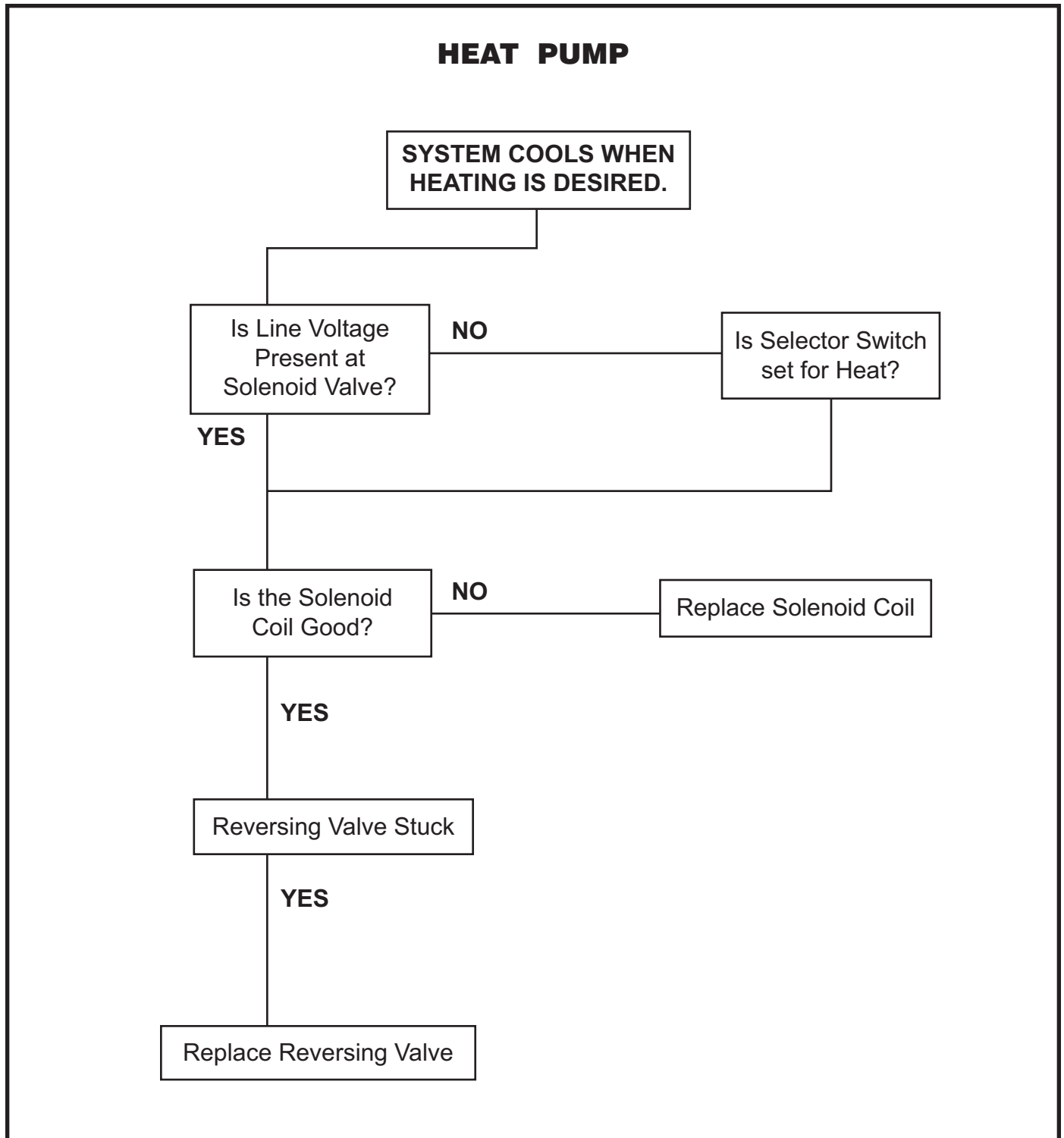
TROUBLESHOOTING CHART — COOLING



TROUBLESHOOTING CHART — HEATING



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