

INSTALLATION, OPERATING and SERVICE MANUAL

THE INSTALLATION OF THE UNIT SHALL BE IN ACCORDANCE WITH THE REGULATIONS OF THE AUTHORITIES HAVING JURISDICTION.

SUPPLEMENTARY AND VSM CONTROL INSTRUCTIONS

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**NOTICE TO HOMEOWNER:
READ AND SAVE THESE INSTRUCTIONS**

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FIGURE 1 - GENERAL INSTRUCTIONS

MODEL	BECKETT BURNER	B.T.U.H. OUTPUT	B.T.U.H. INPUT (USGPH)	AFUE %	NOZZLE	PUMP p.s.i.	INSERTION inches	BURNER AIR SETTING		CHIMNEY FLUE PRESSURE (in. w.c.)	DESIGN GROSS STACK F ²	FILTER SIZE (QTY)	VSM	DIRECT DRIVE SPEED TAP		BELT DRIVE		EXTERNAL STATIC PRESSURE (in. w.c.)
								SHUTTER	AIR BAND					12" BLOWER	10" BLOWER	PULLEY COMBINATION	TURNS OPEN	
NL2-118V	AF81WPHS	120,000	139,400 (1.00)	85.0	Delevan Monarch 1.00 X 70" A	100	6-7/8"	7.0	0	-0.02	425	16" X 24" (2)	SEE INSTRUCTIONS	MED	MED-HI	3-1/4" X 7"	1/2	0.20
NL2-101V	AF81WPHS	104,000	118,490 (0.85)	85.0	Delevan Monarch 0.85 X 70" A	100	6-7/8"	6.0	0	-0.02	375	16" X 24" (2)	SEE INSTRUCTIONS	MED-LO	HI	3-1/2" X 6"	2	0.50
NL2-88V	AF81WPHS	92,000	104,550 (0.75)	85.0	Delevan Monarch 0.75 X 70" A	100	6-7/8"	5.0	0	-0.02	360	16" X 24" (2)	SEE INSTRUCTIONS	MED-LO	MED-HI	3-1/2" X 6"	3	0.50
NL2-77V	AF81WPHS	79,000	90,610 (0.65)	85.0	Delevan Monarch 0.75 X 70" NS	100	6-7/8"	4.0	0	-0.02	350	16" X 24" (2)	SEE INSTRUCTIONS	MED-LO	MED-LO	3-1/4" X 7"	3-1/2	0.50
					Delevan Monarch 0.65 X 70" A	100	6-7/8"							LO	LO	3-1/4" X 7"	3-1/2	0.20
					Delevan Monarch 0.65 X 70" NS	100	6-7/8"							LO	LO	3-1/2" X 6"	4	0.50

MODEL	RIELLO BURNER	B.T.U.H. OUTPUT	B.T.U.H. INPUT (USGPH)	AFUE %	NOZZLE	PUMP p.s.i.	INSERTION inches	BURNER AIR SETTING		CHIMNEY FLUE PRESSURE (in. w.c.)	GROSS STACK F ²	FILTER SIZE (QTY)	VSM	DIRECT DRIVE SPEED TAP		BELT DRIVE		EXTERNAL STATIC PRESSURE (in. w.c.)
								TURBULATOR	AIR DAMPER					12" BLOWER	10" BLOWER	PULLEY COMBINATION	TURNS OPEN	
NL2-118	40F3	126,000	144,976 (1.04)	85.0	Delevan 0.85 X 60" W	150	6-3/4"	3	5.5	-0.02	520	16" X 24" (2)	SEE INSTRUCTIONS	MED-HI	HI	3-1/4" X 7"	0	0.20
NL2-101	40F3	112,000	128,248 (0.92)	85.0	Delevan 0.75 X 60" W	150	6-3/4"	3	4.3	-0.02	480	16" X 24" (2)	SEE INSTRUCTIONS	MED-LO	MED-LO	3-1/2" X 6"	1	0.50
NL2-89	40F3	98,000	111,520 (0.80)	85.0	Delevan 0.65 X 60" W	150	6-3/4"	3	3.6	-0.02	450	16" X 24" (2)	SEE INSTRUCTIONS	MED-LO	MED-HI	3-1/2" X 6"	2	0.50
NL2-77	40F3	90,000	101,762 (0.73)	85.0	Delevan 0.60 X 60" W	150	6-3/4"	3	3.4	-0.02	425	16" X 24" (2)	SEE INSTRUCTIONS	MED-LO	MED-LO	3-1/4" X 7"	3	0.50
					Delevan 0.60 X 60" W	150	6-3/4"							MED-LO	MED-LO	3-1/2" X 6"	3	0.20

MODEL	RIELLO BURNER	B.T.U.H. OUTPUT	B.T.U.H. INPUT (USGPH)	AFUE %	NOZZLE	PUMP p.s.i.	INSERTION inches	BURNER AIR SETTING		CHIMNEY FLUE PRESSURE (in. w.c.)	GROSS STACK F ²	FILTER SIZE (QTY)	VSM	DIRECT DRIVE SPEED TAP		BELT DRIVE		EXTERNAL STATIC PRESSURE (in. w.c.)
								TURBULATOR	AIR DAMPER					12" BLOWER	10" BLOWER	PULLEY COMBINATION	TURNS OPEN	
NL2-101V	BF3	110,000	125,460 (0.90)	85.0	Delevan 0.75 X 60" W	145	6-3/4"	3	7	-0.02	480	16" X 24" (2)	SEE INSTRUCTIONS	MED	MED-LO	3-1/4" X 7"	1	0.20
NL2-88V	BF3	97,000	108,732 (0.78)	85.0	Delevan 0.65 X 60" W	145	6-3/4"	3	5	-0.02	450	16" X 24" (2)	SEE INSTRUCTIONS	MED-LO	MED-HI	3-1/2" X 6"	2	0.50
NL2-77V	BF3	89,000	100,368 (0.72)	85.0	Delevan 0.60 X 60" W	145	6-3/4"	3	4.4	-0.02	425	16" X 24" (2)	SEE INSTRUCTIONS	MED-LO	MED-LO	3-1/2" X 6"	3	0.50
					Delevan 0.60 X 60" W	145	6-3/4"							MED-LO	MED-LO	3-1/4" X 7"	3	0.20
					Delevan 0.60 X 60" W	145	6-3/4"							MED-LO	MED-LO	3-1/2" X 6"	3	0.50

MODEL	CARLIN BURNER	B.T.U.H. OUTPUT	B.T.U.H. INPUT (USGPH)	AFUE %	NOZZLE	PUMP p.s.i.	INSERTION inches	BURNER AIR SETTING		CHIMNEY FLUE PRESSURE (in. w.c.)	GROSS STACK F ²	FILTER SIZE (QTY)	VSM	DIRECT DRIVE SPEED TAP		BELT DRIVE		EXTERNAL STATIC PRESSURE (in. w.c.)
								POSITIONING BAR	AIR BAND					12" BLOWER	10" BLOWER	PULLEY COMBINATION	TURNS OPEN	
NL2-118V	EZ-1	119,000	139,400 (1.00)	85.0	Delevan 1.00 X 70" A	100	6-7/8"	0.85-1.00 GPH	1.00	-0.02	510	16" X 24" (2)	SEE INSTRUCTIONS	MED	MED-HI	3-1/4" X 7"	1/2	0.20
NL2-101V	EZ-1	102,000	118,490	85.0	Delevan 0.85 X 70" A	100	6-7/8"	0.85-1.00 GPH	0.85	-0.02	460	16" X 24" (2)	SEE INSTRUCTIONS	MED-LO	HI	3-1/2" X 6"	2	0.50
NL2-88V	EZ-1	91,000	104,550 (0.75)	85.0	Delevan 0.75 X 70" A	100	6-7/8"	0.75 GPH	0.75	-0.02	430	16" X 24" (2)	SEE INSTRUCTIONS	MED-LO	MED-HI	3-1/2" X 6"	3	0.50
NL2-77V	EZ-1	79,000	90,610 (0.65)	85.0	Delevan 0.65 X 70" A	100	6-7/8"	0.60-0.65 GPH	0.65	-0.02	400	16" X 24" (2)	SEE INSTRUCTIONS	MED-LO	MED-LO	3-1/4" X 7"	3-1/2	0.20
					Delevan 0.65 X 70" A	100	6-7/8"							LO	LO	3-1/2" X 6"	3-1/2	0.50
					Delevan 0.65 X 70" A	100	6-7/8"							LO	LO	3-1/2" X 6"	4	0.50

Use burner air settings as a guide only. Set burner air to give a trace of smoke. Re-adjust burner air to reduce CO₂ by 1 to 1.5 percent. Take measurements with the burner cover & air ducts installed (if any). The maximum allowable temperature rise is 85° F. Select speed to suit specific installation requirements. Air temperature can be lowered by increasing the blower speed, lowering the firing rate, or increasing supply & return outlets. The minimum recommended temperature rise is 65° F.

FIGURE 2A - NL2 VSM BLOWER PERFORMANCE

DIRECT DRIVE BLOWER	VARIABLE SPEED BLOWER MOTOR	SPEED	RPM	POWER (watts)	AMPS	EXTERNAL STATIC PRESSURE (IN W.C.)	CFM	A/C TONS
DELHI G10 DD OR AIRDEX DC1020 1020-5	EMERSON ½ HP VSM	VARIABLE	1,080	510	5.9	0.50	1,490	REFER TO AC TONNAGE SELECTION CHART
			1,030	410	4.8		1,400	
			980	315	3.8		1,250	
		VARIABLE	850	275	3.7	0.20	1,560	
			725	150	2.3		1,100	
			640	98	1.5		875	
DELHI G12-10 DD	EMERSON 3/4HP VSM	VARIABLE	721	254	3.42	0.5	1,478	
		VARIABLE	645	225	3.06	0.2	1,610	
				89	1.38		1,000	

FIGURE 2B - NL2 DD BLOWER PERFORMANCE

DIRECT DRIVE BLOWER	BLOWER MOTOR	SPEED TAP	RPM	POWER (watts)	AMPS	EXTERNAL STATIC PRESSURE (IN W.C.)	CFM	A/C TONS
DELHI G10-8 DD OR AIRDEX DC1020-800-5 OR DELHI G10 DD OR AIRDEX DC1020-1020-5	½ HP 4 SPD	HIGH	1,050		7	0.50	1,400	3.50
		MED-HI	950		6.4		1,200	3.00
		MED-LO	880		5.6		1,000	2.50
		LO	810		4.6		800	2.00
	½ HP 4 SPD	HIGH	1,030			0.20	1,600	
		MED-HI	950	655	6.7		1,400	
		MED-LO	800		6.2		1,175	
		LO	650		5.2		875	

FIGURE 2C - NL2 BD BLOWER PERFORMANCE

BELT DRIVE BLOWER	BLOWER MOTOR/ PULLEY COMBINATION	PULLEY TURNS OPEN	RPM	WATTS	AMPS	EXTERNAL STATIC PRESSURE (IN W.C.)	CFM	A/C TONS
DELHI G10 OR LAU 1010 OR TORIN BC1020	½ HP 6 X 3-1/2"	1	965			0.50	1,450	3.50
		2	925				1,275	3.00
		3	875		4.8		1,125	2.75
		4	830				925	2.00
DELHI G10 OR LAU 1010 OR TORIN BC1020	1/3 HP 7 X 3-1/4"	0	790		5.4	0.20	1,375	
		1	750		5.2		1,250	
		2	710		5		1,050	
		3	670		4.7		950	
		4	610		4.5		800	

VSM furnace models are certified for use with the Emerson Perfect Speed motor.

VSM CONTROL LOCATION

The VSM control is located on the junction box for all furnace models.

ELECTRICAL CONNECTIONS

VSM models are rated at 120V, 60Hz, 1-Phase, 15 Amp fuse.

THERMOSTAT

For VSM models, a digital thermostat is recommended. Mechanical thermostats if used should be the non-mercury type.

FIGURE 3 - THERMOSTAT FAN AND ROCKER SWITCH SPEED SELECTION CHART

THERMOSTAT FAN	FURNACE ROCKER SWITCH	BLOWER MODEL	MOTOR H.P.	MOTOR AMPS	MOTOR WATTS	RPM
OFF	OFF	G10 DD AIRDEX DC1020 1020-5	½			0
ON	OFF	G10 DD AIRDEX DC1020 1020-5	½	1.7	116	600
OFF	ON	G10 DD AIRDEX DC1020 1020-5	½	0.6	38	400
ON	ON	G10 DD AIRDEX DC1020 1020-5	½	5.9	510	1085

Heat Only Thermostat

Refer to Wiring Schematic Figure 7.

Heat / Cool Thermostat Fan Mode

For thermostats equipped with a manual fan switch see Figure 3. Thermostat Fan Switch and Furnace Rocker Switch Speed Selection Chart. With the furnace rocker switch set to ON, the blower will operate in response to the thermostat's fan switch at the CFM associated with the A/C tonnage selected on the VSM control. With the furnace rocker switch set to OFF, the blower will operate in response to the thermostat's fan switch at the intermediate CFM indicated in the chart.

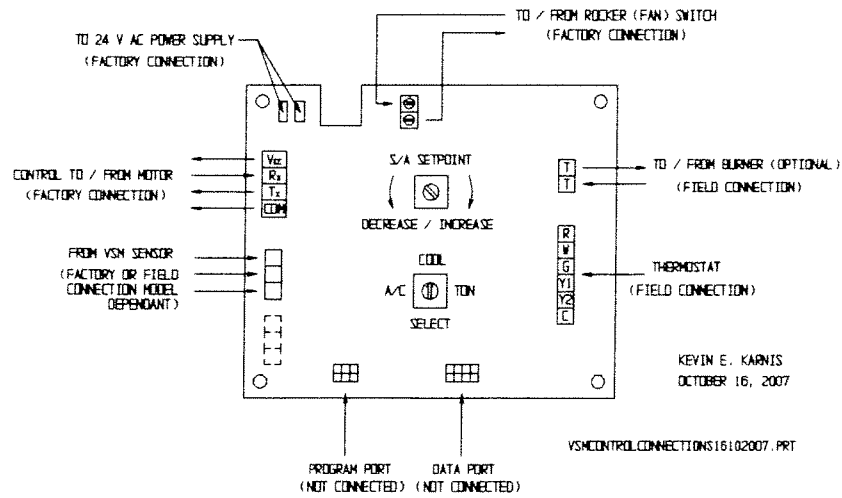
FAN & LIMIT CONTROL

VSM furnace models use only the limit side of the fan & limit control.

VSM CONTROL OPERATION AND FURNACE SET UP

The VSM control operates on 24V AC. Refer to Figure 4. The supply air setpoint is factory set. It can be field adjusted by the service technician to increase or decrease airflow.

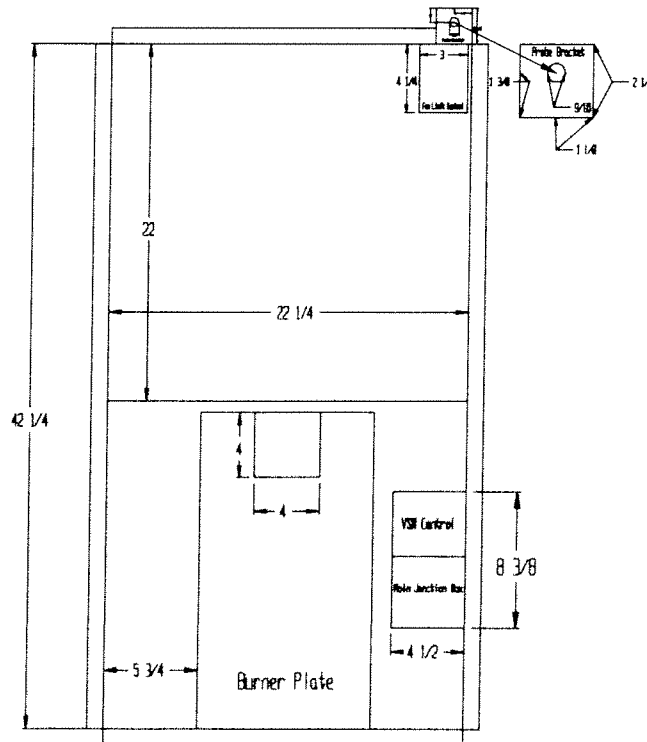
FIGURE 4 - VSM CONTROLLER WIRING CONNECTIONS



Remove cover to make adjustments to controls. Insure probe is installed using bracket as indicated in Figure 5.

Refer to Figure 5. The VSM sensor is factory or field mounted depending on the furnace model. For field mounting, a bracket is provided to ensure the location is correct. The VSM sensor is located near the fan & limit control. Mount the bracket (if equipped) using the two screws provided using the pre-punched mounting holes. Use the mounting bracket as a template. Make a 1/2" hole for the sensor probe and drill two 1/8" screw clearance holes in the plenum. Mount the VSM sensor assembly on the bracket with two screws.

FIGURE 5 - SENSOR LOCATION



Heating

The S/A Setpoint is factory set but may require adjustments to attain desired temperature rise. The typical temperature rise should be 75°F, plus or minus 5°F. The unit is designed for a maximum temperature rise through the furnace of 85°F at a maximum external static pressure of 0.50 inches of water column. However, due to the wide range of static pressures in duct systems, it is the responsibility of the installer to verify that the temperature rise does not exceed 85°F. To measure the actual temperature rise let the unit operate for at least five minutes. Insert a thermometer and note the temperature of the warm air supply at a point at least 24 inches upstream from the heat exchanger surface. Next measure the temperature at the return air grill and take the difference.

Air temperature rise can be lowered by increasing the blower speed; lowering the firing rate; or increasing undersized supply and return air free area. The furnace will not operate properly and its life will be decreased if insufficient air quantity passes over the heat exchanger. Similarly, too much air during heating mode resulting in a temperature rise of less than 65°F may cause heat exchanger degradation due to condensation.

Note: Counter clockwise rotation of Temperature Rise dial speeds motor up and decreases temperature rise. A clockwise rotation decreases motor speed and increases temperature rise.

Probe Installation

Using the bracket supplied insures that the probe is installed in the correct position. See Figure 5.

Set Up Procedure / Blower Adjustment:

1. Turn thermostat to ON position. The first heat cycle will permit first adjustment of blower speed. Several cycles may be required to obtain final adjustment.
2. The burner will turn ON.
3. Within several seconds the VSM motor will start to ramp up.
4. Blower Motor will take several minutes to reach steady state.
5. Measure temperature rise.
6. Adjust blower speed towards 85°F temperatures rise using Temperature Rise Dial (See Note in Section A)

Note: Air temperature in house should be less than comfort setting (eg. 70°F) to prevent burner from shutting off.

VSM Motor / Blower

The motor is variable speed and automatic in operation. Heating mode temperature rise can be decreased or increased by adjusting the S/A setpoint. See Figure 4. It may take several minutes or more following adjustment of the S/A setpoint for the furnace to reach the new steady state condition.

Cooling

This appliance is designed to accommodate air conditioning equipment. VSM furnace models are A/C ready. Cooling mode CFM'S can be decreased or increased by adjusting the A/C Ton selection switch. Recommended A/C tonnage switch settings are shown in Figure 6 for various furnace models.

Three non-heating speeds can be selected if the thermostat has a "Fan" switch. One continuous non-heating speed can be selected if the thermostat does not have a "Fan" switch. See Figure 3.

FIGURE 6 - AIR CONDITIONING TONNAGE SELECTION CHART

A/C TONNAGE SWITCH SETTING	BLOWER MODEL	MOTOR H.P.	MOTOR AMPS	MOTOR WATTS	RPM	CFM	A/C TONS
0	G10 DD	1/2	1.6	130	850	540	1.3
	AIRDEX DC1020 1020-5					1712	4.2
1	G10 DD	1/2	2.2	165	875	835	2.1
	AIRDEX DC1020 1020-5					1800	4.5
2	G10 DD	1/2	2.5	195	900	930	2.3
	AIRDEX DC1020 1020-5					1862	4.6
3	G10 DD	1/2	3.1	240	925	1040	2.6
	AIRDEX DC1020 1020-5					1966	4.9
4	G10 DD	1/2	3.4	270	950	1130	2.8
	AIRDEX DC1020 1020-5					2000	5
5	G10 DD	1/2	3.8	315	975	1250	3.1
	AIRDEX DC1020 1020-5					2000	5
6	G10 DD	1/2	4.4	365	1000	1265	3.2
	AIRDEX DC1020 1020-5					950	2000
7	G10 DD	1/2	4.8	410	1025	1415	3.5
	AIRDEX DC1020 1020-5					950	2000
8	G10 DD	1/2	5.3	450	1050	1435	3.6
	AIRDEX DC1020 1020-5					950	2000
9	G10 DD	1/2	5.9	510	1075	1495	3.7
	AIRDEX DC1020 1020-5					950	2000

FURNACE SET UP AND MAINTENANCE

Blower Motors

The Emerson Perfect Speed Motor is permanently lubricated.

Blower Removal

Disconnect power before removing or servicing the blower. Remove the blower access panel. Remove or move air filters for access to the blower.

The Emerson Perfect Speed Motor is equipped with AMP Mate-n-Lock connectors. Disconnect the 5 pin AC input connector power and the 4 pin control connector.

FIGURE 7- THERMOSTAT WIRING SCHEMATIC - VSM MOTOR

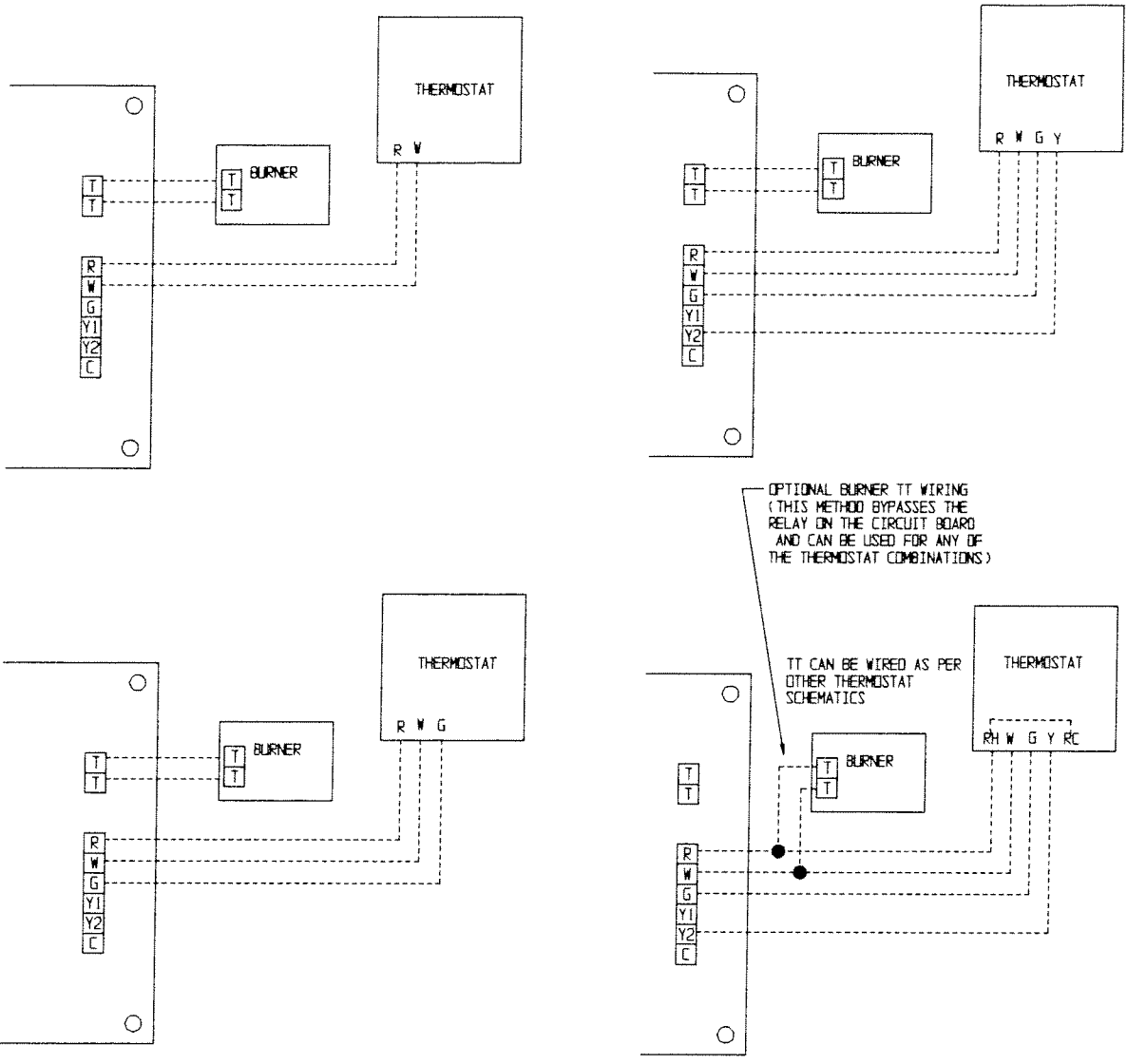


FIGURE 8 - FURNACE WIRING SCHEMATIC - VSM MOTOR

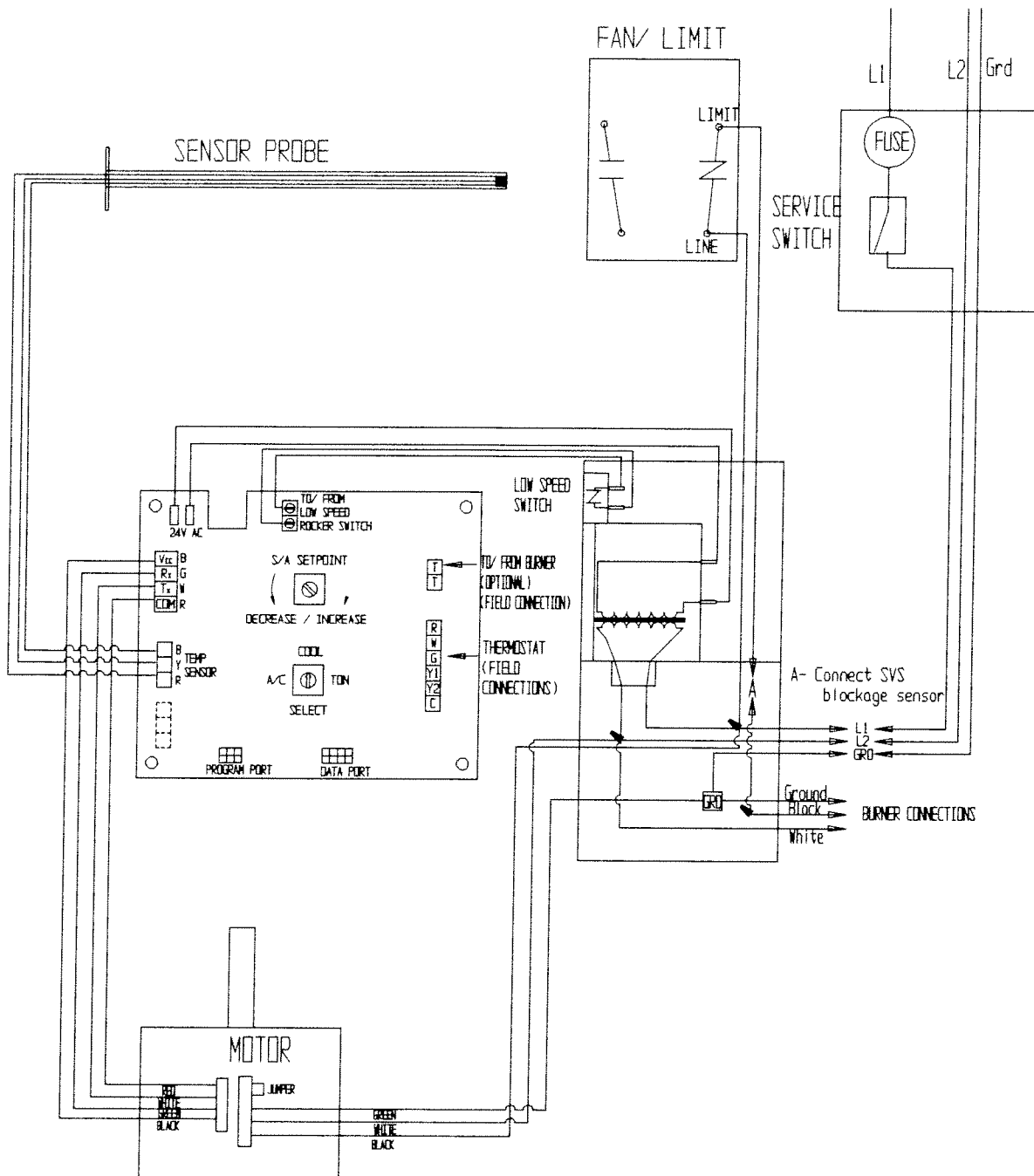
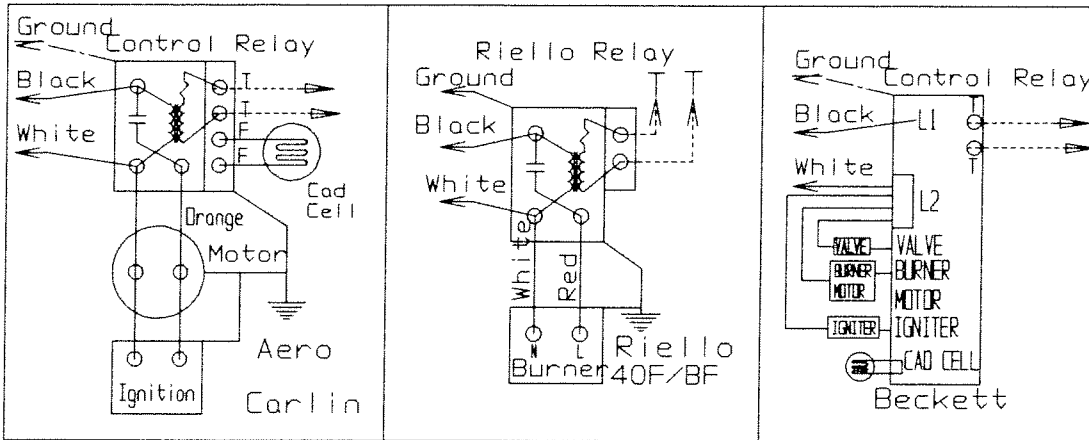
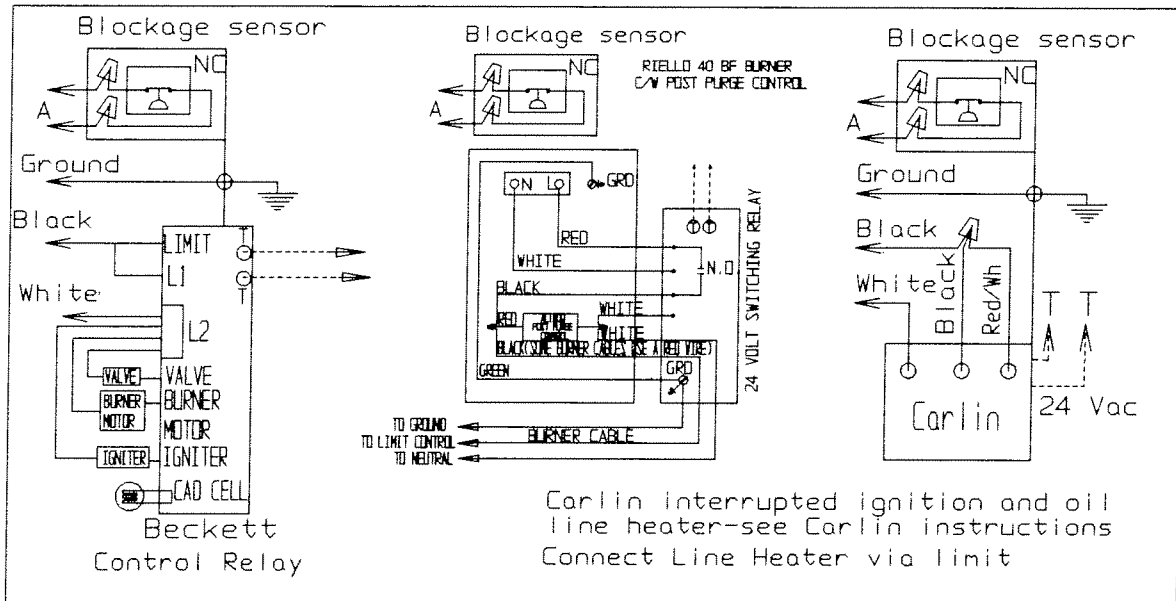


FIGURE 9 - FURNACE WIRING SCHEMATIC - VSM MOTOR

STANDARD BURNERS



Alternate Burners SVS System



SVS Sealed Vent System Models with suffix -V
See SVS Installation Instructions

NOTE: POST PURGE AND POWER CONNECTIONS VIA LIMIT

FIGURE 10 - VSM PARTS LIST

ITEM	PART NO.	DESCRIPTION
1	2020026	EMERSON VSM 1/2 H.P. MOTOR
2	2040149	BELLY BAND
w	2040148	ARMS MOTOR MOUNT
4	2200082	POWER WIRE HARNESS
5	2200083	CONTROL WIRE HARNESS
6	2010086	VSM CONTROLLER
7		VSM CONTROL COVER

ITEM	PART NO.	DESCRIPTION
8	2200084	VSM SENSOR c/w WIRE HARNESS
9	2010021	24 V AC TRANSFORMER
10		TRANSFORMER MOUNTING BRACKET
11		SENSOR MOUNTING BRACKET
12		SENSOR COVER
13	2120002	SENSOR MOUNTING SCREWS #10 X 1/2
14		

FIGURE 11 - WIRING SCHEMATIC - EMERGENCY "NO HEAT" CONTROL

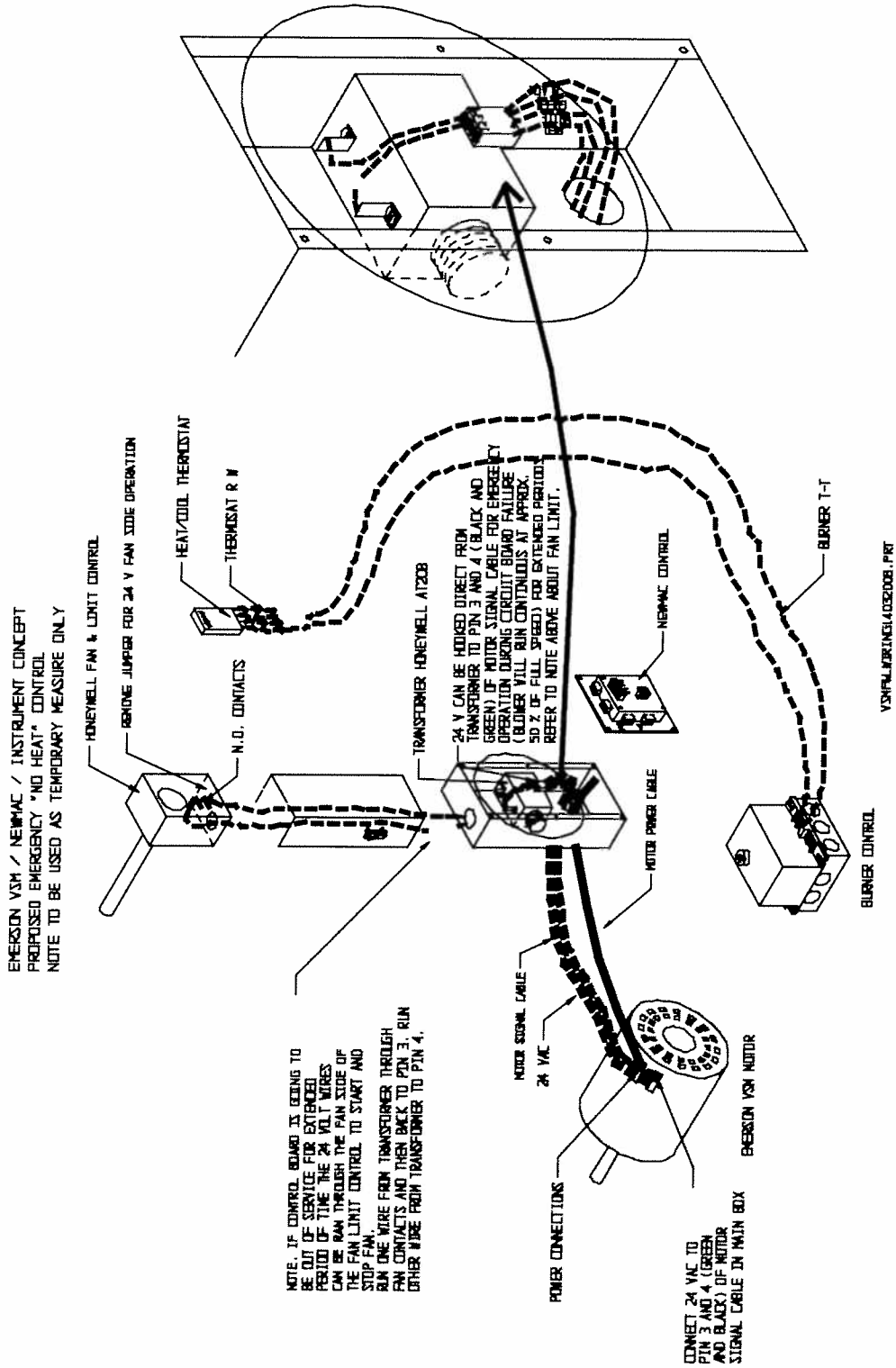


FIGURE 12 - TROUBLE SHOOTING

PROBLEM	CAUSE	CORRECTION
VSM Blower Motor Fails to Start		
Blower Motor Does Not Vary Speed	Disconnected VSM Sensor	Check connection
CONTROL	STATUS	CORRECTION
On Solid *****	No flashing Unit is powered, no demand for heat or fan All status is good	
Double Flash * * - * - - -	(2 - ¼ sec flashes followed by 1 sec off) Overtemp detected by sensor Burner relay is off, fan is max speed	Check air filters. Check for blockages of return air or supply ducts.
Triple Flash * * * - * * - -	(3 - ¼ sec flashes followed by ½ sec off) Sensor failure Likely cause, sensor not connected	Check sensor wiring and connections.
Single Flash * - * - - -	(1/4 sec flash followed by 1 sec off) Fan is on, for fan operation of cooling	
Quick Flash * * * * * - - - - -	(constant ¼ sec flashes) Heating in servo mode	
Quick/slow flash _* _____	(1 sec flash followed by ¼ sec flash) In heat rise mode. Air not warm enough to servo	
Long Flash ***** - _____	(1.5 sec on followed by ½ sec off) Motor fault Likely cause is motor has no power, or cable to motor not connected	Turn power off to furnace. Check motor power and signal wires for proper connection. Turn power back on.