Hoffman|Controls

Preliminary Data

220-SLH VariFlow™ Interface for DX Cooling & Warm Air Heating

Patent Pending

Introduction

HCC offers a "First In The Industry" Comprehensive Environmental Control System for providing the optimum Sensible Heat/Latent Heat (SH/LH) Ratios for all aspects of Comfort for an Air Conditioning System. The NEW 220-SLH Variflow™ Microprocessor Interface optimizes and tailors the output performance of the equipment to the specific loads encountered during the Cycle, as determined by the indoor Sensible/Latent Heat loads. (See SH/LH Ratios (%) for various conditions on Page 2).

The SLH Interface monitors and records Temperature, Humidity, Span, Cycle start and end Temperatures to continuously develop the optimum SH/LH Ratio in order to assure that all possible conditions are met during and before the Cycle ends. This SH or LH Ratio can impose flow rates above and below typically normal CFM/Ton flow rates to maximize the Sensible and/or Latent Heat removal as determined and required by the varying space conditions. The functions of this all encompassing control system are accomplished by using any typical existing or new Heating/Cooling Thermostat (Electromechanical or Digital), together with the Digital (Microprocessor) SLH VariFlow™ Interface control. The SLH expands the basic control of temperature (db) to include Humidity (RH) and Efficiency during a Cycle: and Air movement, Air Stratification, Filtration, and Purification requirements during the OFF Cycle.

The SLH Interface can regulate Single Phase PSC or Three phase Induction AC motors when controlled by a VSD (Variable Speed Drive). ECM motors can be controlled directly, less the VSD controller.

The SLH Interface builds on the success of the Patented Variflow™ Furnace Fan Speed (FFS) and Heat Pump Fan Speed (HPFS) designs that function only during the Cooling and Heating OFF Cycles. The NEW SLH extends these functions to include Variable Air Volume flow rates for Cooling and Heating Cycles. This comprehensive control for both the ON & OFF Cycles completes the total comfort solution for simultaneously controlling both Sensible Heat (Temperature) and Latent Heat (Humidity) efficiently during the cycle, and additionally provides OFF Cycle Flow Rates for maintaining Air Movement, Air Stratification, Filtration, and Purification requirements.

SLH VariFlow™ Heating Cycle

The NEW SLH VariFlow™ Interface Control provides the patented pre and post Heating Cycle operation that was certified by AGA to provide up to 8% more residual energy from each 8 minute Burner ON and OFF Cycle. (See VariFlow™ Brochure Form 171-0103-000)

When demand for heat is detected, the SLH Interface function will prevent the blower motor from coming on at full RPM and introducing as yet unheated air into the space. Instead, the Blower speed is slowly ramped up to full RPM allowing air flow to be increased over 45 seconds while the heating system develops warm air for the space. Once the ramp up is completed, the Heating cycle continues at constant air flow without motor modulation to provide a specific Delta Temperature for the Net BTU Heating capacity selected.

During the Cycle, a Relative Humidity RH% value can be selected to provide Humidification from a low voltage SPNO contact closure, when required.

At the end of the Heating cycle the SLH VariFlow™ function will ramp the blower motor speed, and resulting air flow down, over time. This procedure expels all of the residual heat from the heat exchangers, air distribution system, components & materials into the space. This is accomplished by bringing all components of the system back to room temperature during an 8 minute Burner OFF Cycle. OFF Cycles shorter than 7 minutes will reclaim heat proportionately.

After the declining flow ramp down of the Heating cycle, the VariFlow™ function may remain in a continuous minimum flow (25%±), or Cycle OFF. A continuous minimum flow will prevent stratification of air in the conditioned space, and provides air flow required for filtration and purification. This end of the ramp down state is a user selectable option. (See Figure 3)

SLH VariFlow™ Cooling Cycle

The NEW SLH VariFlow™ Interface control also provides a 45 second ramp up at the start of the Cooling Cycle. At the end of a Cooling Cycle, a modified 10 second ramp down function occurs. The modified fast ramp down function precludes re-evaporation of moisture into the air. However, it can provide the same optional continuous 25%± flow, or remain OFF when indoor and outdoor geographic conditions allow.

The TRH Interface provides a controlled comprehensive function within the Cooling cycle to continuously provide the optimum SH/LH Ratio to assure that both temperature & de-humidification parameters are met in the space during or before the Cycle ends.

The flow of air is modulated to simultaneously accomplish a continuous optimum specific ratio of both sensible and latent heat rejection for Direct Expansion (DX) evaporators.

The HCC 709 Series VSD (Variable Speed Drive) regulates the speed of a Single Phase PSC motor, shown in Figure 4 & 7. ECM motors are controlled directly from the SLH Interface, less the VSD control Figure 4 & 8. This results in the SLH Interface / ECM motor combination being more effective, efficient, and simpler to install.

The SLH Interface evaluates both the temperature and humidity at the beginning and end of each cycle. It also determines if the space temperature is at an initial higher or lower value than normal at each "start up", precluding control of SH/LH Ratio until the space comes under control inside the span.

When conditions at the start of a Cycle indicate a greater demand for Sensible Heat, than Latent Heat , the controller can provide a Maximum Flow rate until SH and LH Ratio are in balance. When applicable, the control can provide a measured flow rate of up to 15% more than the typical 400 CFM/Ton. This "Super Flow Rate" can increase the total BTU/Ton by 1000 BTU (8.33%), or to 13,000 BTU/Hr.. This can occur when ECM motors are used, or PSC motors are selected and designed to accomplish this Super Flow rate. This additional capacity is accomplished by increasing the Heat Transfer capacity, resulting coil temperature, and compressor COP. The results provide a greater total BTU capacity, efficiency, and increases total Sensible Heat removal. (See Temperature and Humidity chart below, 12,000 BTU/Hr., Total/Sensible/Latent values, compare "A & B", and 13,000 BTU/HR to "G & H").

Conversely, when Latent Heat demand is greater than Sensible Heat demand, flow rates are decreased below typical 400 CFM/Ton to provide greater LH Ratios to bring Humidity into control (Figure 4). A separate adjustable Minimum Flow rate (85% of Max Flow is recommended) and a DX coil temperature sensor is provided to increase and override flow instructions to assure the coil does not freeze.

Initiation of the LH Signal can be adjusted to begin at any % of SH Span, thereby allowing the Interface to determine the potential demand for LH removal, as required for the specific geographic location encountered. This feature optimizes the control to function as efficiently as possible within the Cycle. (Figure 4).

The purpose of the Interface during the Cooling Cycle, is to maintain a "Balanced" Ratio of Sensible and Latent Heat removal as the Temperature decreases to the Thermostats Cooling Set Point. When this occurs, both Temperatures and Relative Humidity are satisfied at optimum efficiency.

Summary

In conclusion, these all encompassing functions are accomplished by monitoring the typical commands of the ON/OFF Thermostat and continuously regulating SH/LH Ratios for all aspects of comfort and efficiency. The 220-SLH Variflow™ performance is dependent on the integrity of the structure, and the proper selection of the Equipment installed therein. The System Thermostat's db always determines the Start and end of both the Heating and Cooling Cycles.

Temperature and Humidity

Standard ARI Capacities at *95ºF Ambient - 12,000 BTU Total / Sensible / Latent - 80 db

	SPACE CONDITIONS			BTU CAPACITY VARIATION AT DB/WB/RH%					
CFM (% nominal)				TOTAL	SENSIBLE		LATENT		
	DB	WB	RH%	MBH	MBH	%	MBH	%	
315 (-22%)	80	72	70%	12	6	50%	6	50%	F
	80	67	50%	11	7	64%	4	36%	E
	80	62	42%	9	9	100%	0	0%	
	80	57	22%	8	8	100%	0	0%	
360 (-10%)	80	72	70%	12	6	50%	6	50%	D
	80	67	50%	11	7	64%	4	36%	C
	80	62	42%	9	9	100%	0	0%	
	80	57	22%	8	8	100%	0	0%	
405 (0%)	80	72	70%	13	6	46%	7	54%	B
	80	67	50%	12	8	67%	4	33%	A
	80	62	42%	10	10	100%	0	0%	
	80	57	22%	9	9	100%	0	0%	
450 (+10%)	80	72	70%	14	7	50%	7	50%	G
	80	67	50%	13	9	69%	4	31%	H
	80	62	42%	11	11	100%	0	0%	
	80	57	22%	10	10	100%	0	0%	
495 (+22%)	80	72	70%	14	7	50%	7	50%	
	80	67	50%	13	9	69%	4	31%	
	80	62	42%	11	11	100%	0	0%	
	80	57	22%	10	10	100%	0	0%	
					SH/TH= SH Ratio(%)		LH/TH= LH Ratio(%)		

*System Capacities are avaliable for other ambients.

Note: WB < 62º results in 100% Sensible Heat.

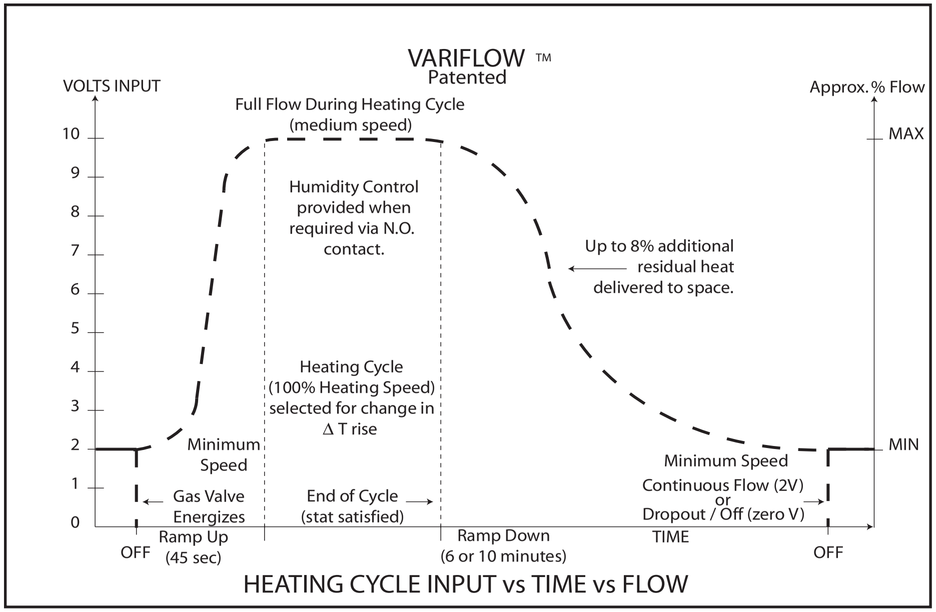

Figure 3 - Heating Mode Flow Response

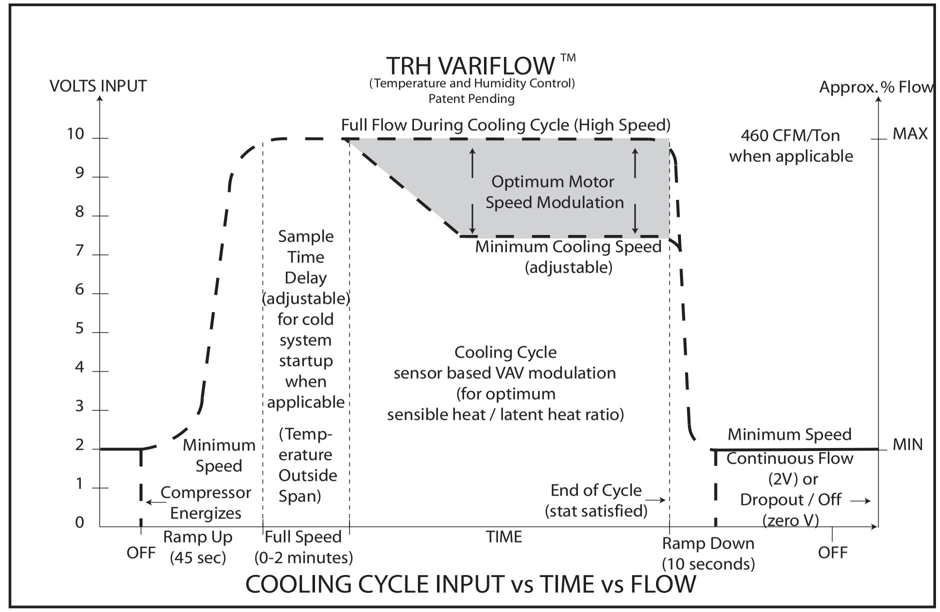

Figure 4 - Cooling Mode Flow Response

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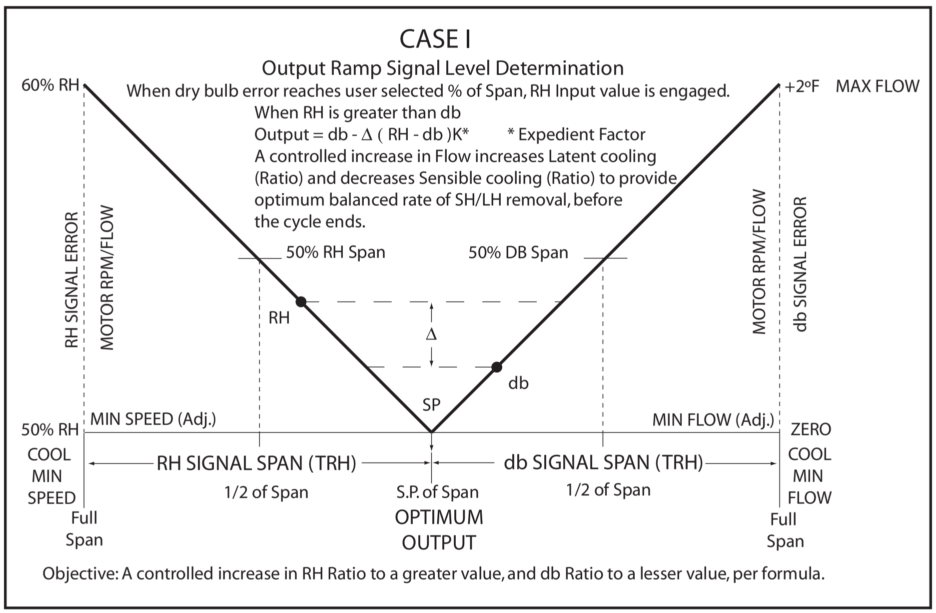

Figure 5 - RH Demand During Cooling Cycle

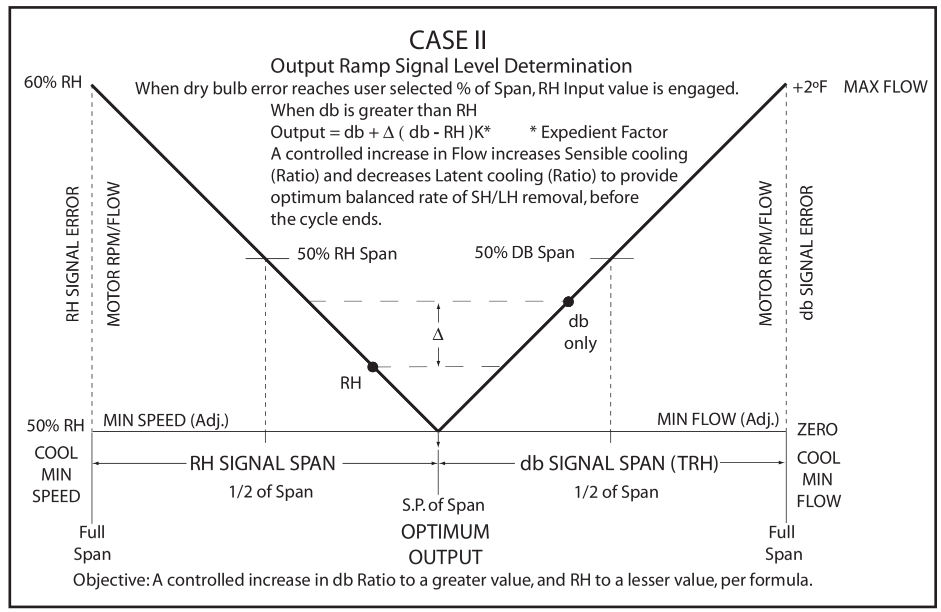

Figure 6 - DB Demand During Coolin Cycle

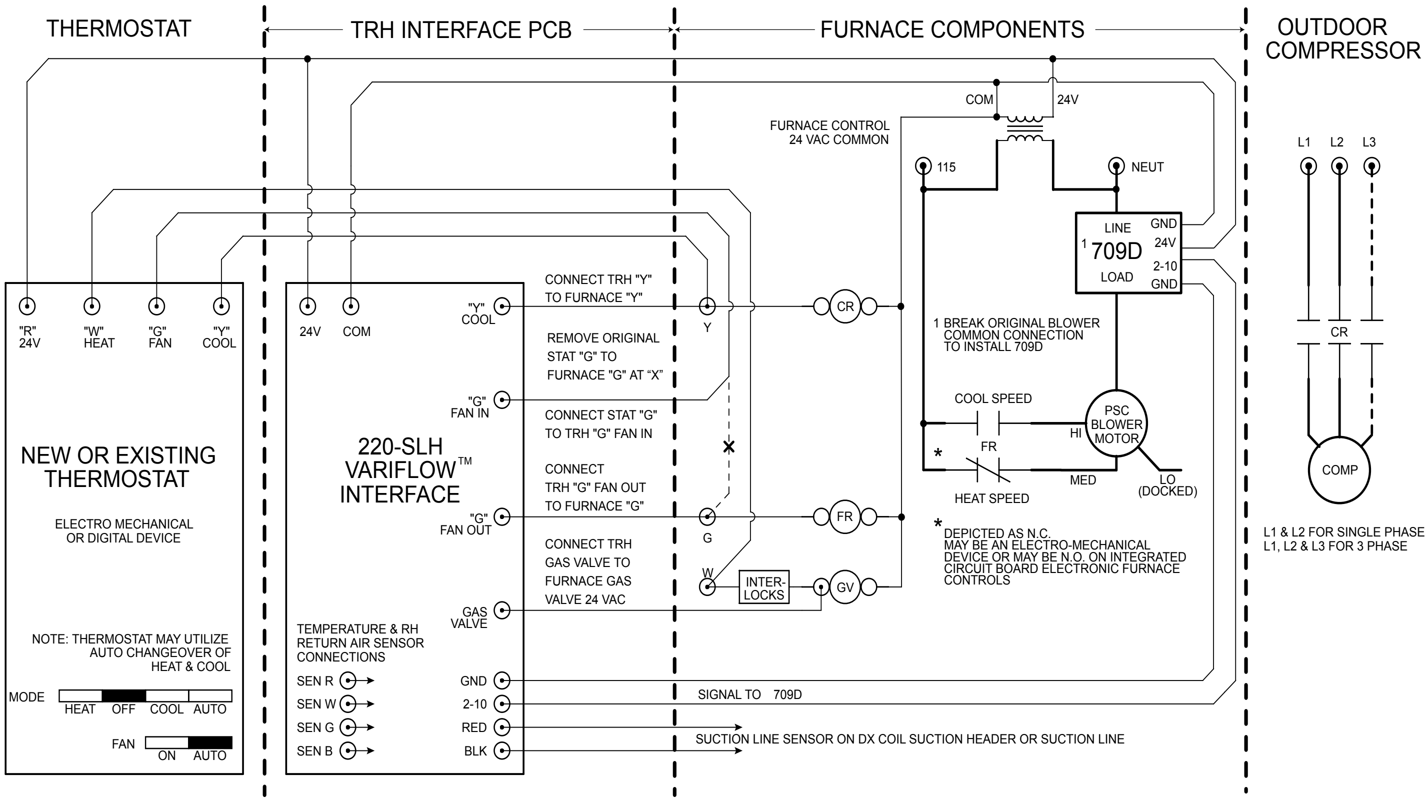

Figure 7 - SLH & 709D Connections to PSC Motor

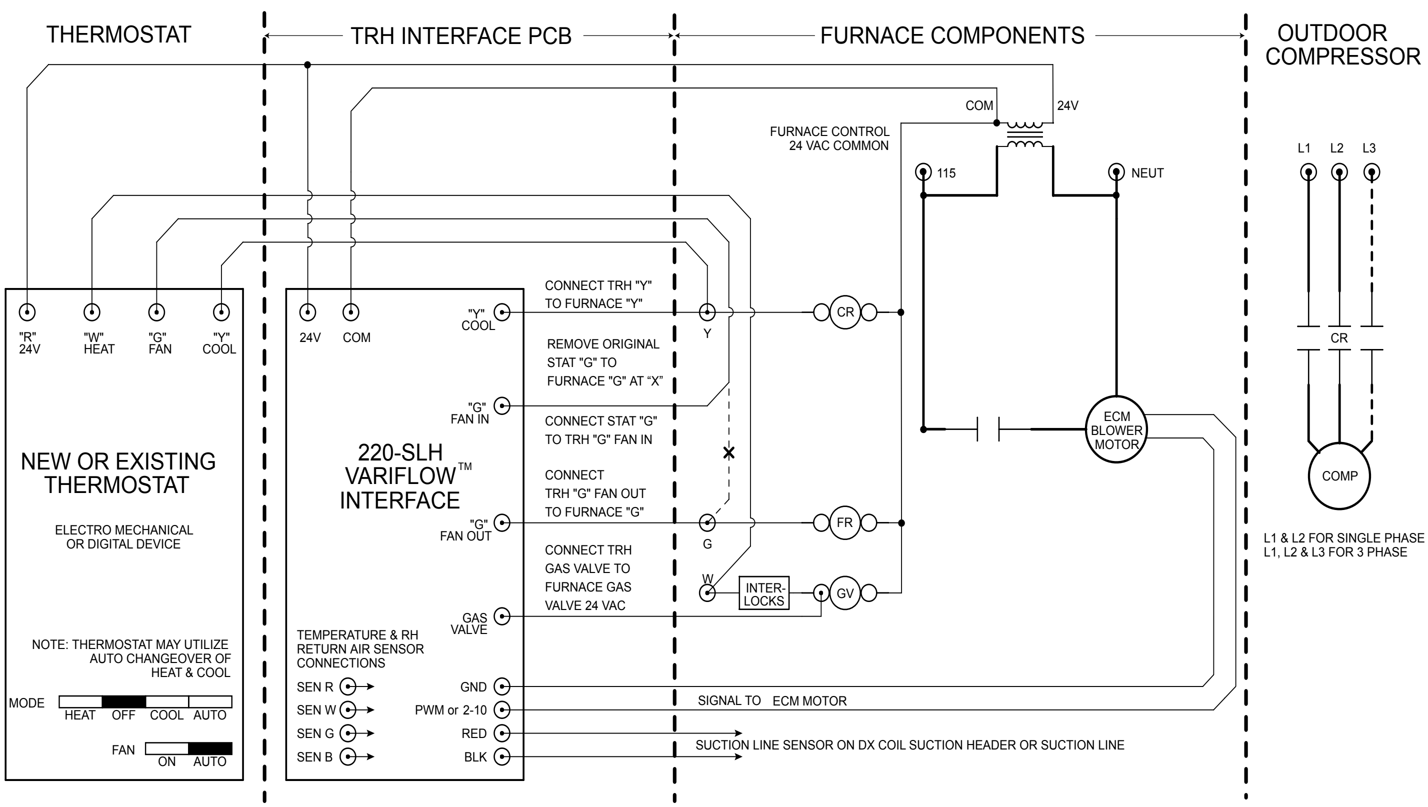

Figure 8 - SLH Connections to ECM Motor (no 709D)