Hoffman|Controls

Product Data

706-FFS (TB) Series

VariFlow™ Furnace Fan Speed Controller

Patent Pending

706-FFS (TB) Series
Furnace Fan Speed Controller
(Patent Pending)

Purpose

The VariFlow™ FFS Controller is an electronic special purpose variable motor speed control that increases system efficiency, improves comfort and indoor air quality by varying the flow rate of a central air conditioning system.

The Controller functions to reduce fuel, electrical consumption and operating cost by varying the flow of warm and cold air to provide a quieter operating system, improved filtration, and overall Indoor Air Quality (IAQ).

The objective is to recover the residual heat left in the system and deliver it to the space combined with the de-stratified air, to obtain a higher (heating) or lower (cooling) mean effective space temperature. This higher/lower mean effective temperature extends the off cycles and precludes an earlier requirement for heating or cooling in the space.

An additional important function is to preclude stratification of warm and cold air in the space typically encountered when the furnace or fan coil blower is not operating. The programmed variable reduction in the flow rate, at the end of each heating or cooling cycle, is intended to minimize stratification, cold drafts during heating, while reclaiming the energy remaining in the system after the heating or cooling cycle ends.

Description

VariFlow™ automatically varies the flow of air to the space, before and after each cycle, to achieve the optimum comfort level and system efficiency. The Controller adjusts (increases and decreases) the flow by modulating the fan speed as the burner or compressor cycles "On" and "Off". An ideal balance of air temperature and air flow (velocity) to the space results, precluding cold drafts and stratified air in the space. Increased efficiency is obtained by assuring all the residual energy, retained in the heat exchanger, cooling coil, cabinet, and air distribution system is delivered at a decreasing variable flow rate to the space once the burner or compressor is de-energized.

Method — *Time Based* — This method determines the time periods for increasing and decreasing the fan speed. *Up Ramp* and *Down Ramp* time periods are pre-programmed to provide the optimum performance of flow and temperature for typical warm air furnace and/or DX cooling coil applications. This method of control is identified by "TB" in the model number.

Functions — The Controller has two separate ramps that independently increase and decrease the flow rate when the burner or compressor is energized and de-energized.

On the heating cycle, the *Start/Up Ramp* soft starts the furnace fan at minimum speed quietly, and ramps the fan speed to the full flow (medium speed) as the heat exchanger increases the supply air temperature to the space. On the cooling cycle, the fan is started at full flow (high speed) when the compressor is energized. The *Start/Up Ramp* takes approximately 1 minute. (See Fig. 1, p.3).

The fan remains at full high or medium speed as long as the compressor or burner remains energized (See Fig. 1, p.3).

Once the burner or compressor de-energizes, the *Ramp Down* begins to slowly decrease the fan speed until minimum speed is once again obtained. The *Ramp Down* is programmed to reclaim all of the residual energy (heating or cooling) retained in the furnace heat exchanger, cooling coil (if installed), cabinet and air distribution system. The *Ramp Down* time to minimum speed is up to 5 times longer than the standard 2 minute time delay, typically found in conventional heating fan control systems. Blowers de-energize at the same time the compressor de-energizes when the thermostat fan switch is in "auto" position (See Fig. 1, p.3).

The extended *Ramp Down* cycle assures that the reclaimed residual energy mixed with the space air is delivered at a decreasing flow rate. This precludes air stratification and cold drafts/warm air pockets, that typically occur in conventional constant volume systems when fan operation is not available at all, or is at full flow.

Optional Programming Feature

At the end of the *Ramp Down* cycle the controller may be programmed to provide one of two fan functions. These optional functions are:

a) ***fan cycles off*** at end of *Ramp Down*, or

b) ***fan continues at minimum speed*** until next heating or cooling cycle initiates.

The two functions may be obtained by either of two methods. The control is furnished standard with a "jumper tab" that:

a) when installed – ***fan cycles off*** at end of *Ramp Down*

b) when removed – ***fan continues at minimum speed***

The controller is furnished with the "jumper tab" in place; access to the controller is required for changing these functions.

An optional Remote Switch/Wiring Harness (Part No. 100-0020-000) is available as an accessory if a more convenient operating location is desired for the user. This accessory allows for field wiring of an on-off switch to a remote accessible location for conveniently changing the end of *Ramp Down* cycle fan operation mode.

Function Interruption

Should the burner/compressor de-energize during the *Start/Up Ramp*, or energize during the *Ramp Down*, the fan speed will automatically modulate and return to its original off, minimum speed or full speed status.

Filtration

Filtration efficiency increases greatly when flow is reduced across the filtering media. Noise is reduced during operation and at starting and stopping.

Summary — All of these functions combined, dramatically improve the comfort level (IAQ) and substantially increase the system efficiency.

For additional technical, performance or statistical data request VariFlow™ 706-FFS (TB) Series Installation & Operating Instructions.

Application

The 706-FFS Series is for use in conventional warm air furnaces with DX cooling coil, for either single or multi-stage heating thermostats.

Furnace fuel may be natural gas, propane, butane, oil or fossil type fuels where the warm air supply and primary flue gases are separated by a heat exchanger. Furnace and DX cooling coil configuration may be vertical, counterflow or horizontal; venting may be natural, forced, condensing or non-condensing types.

Blower motors must be direct drive, PSC or Shaded Pole types. Furnaces utilizing Fan Switch sensing, Fan Timers or Integrated Furnace Controls, may be used with the VariFlow™ Furnace Fan Speed Controller.

IMPORTANT

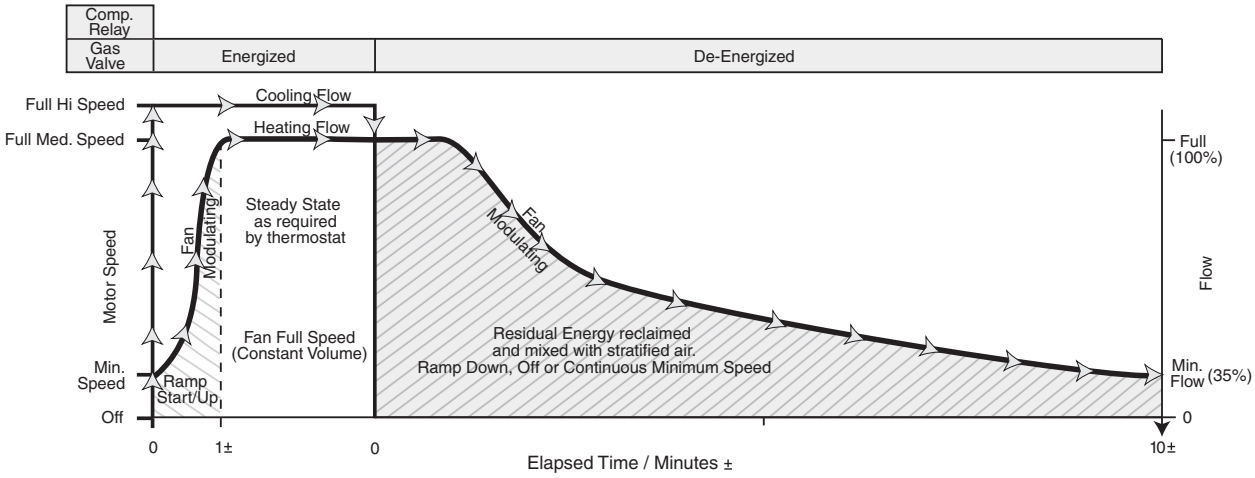
FFS Series Controllers are intended for installation as a secondary control function and do not replace the original equipment manufacturer's primary control functions (see Installation & Operating Instruction for proper application, installation and wiring instructions).

Features and Benefits

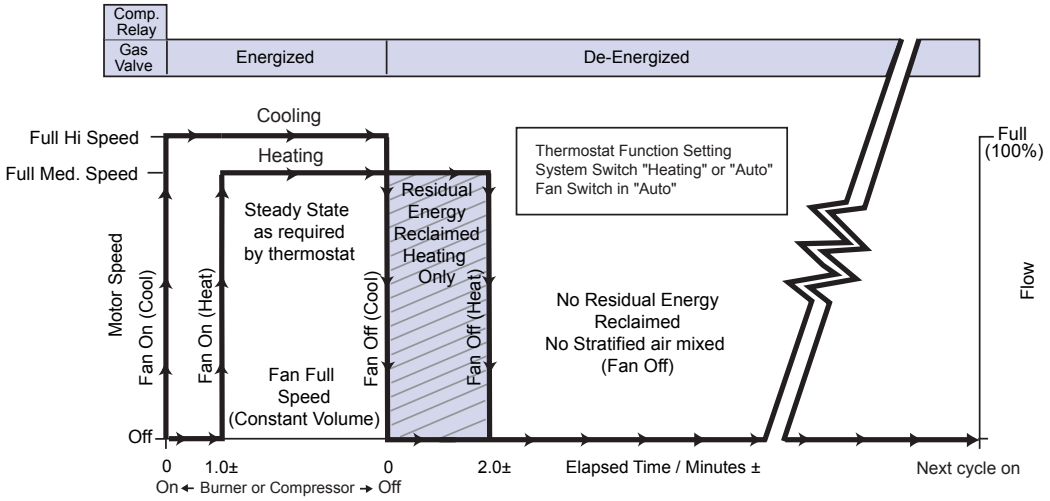
- Improves system operating efficiency
  - Furnishes warm air immediately on start at a reduced flow rate.
  - Extracts residual energy from the system heat exchanger, cooling coil, cabinet and duct system and delivers it to the space at the end of each cycle.
  - Residual energy becomes available as useful energy to the space.
  - Residual energy and stratified air are mixed to maintain a higher or lower mean effective space temperature extending the "off cycle".
  - Soft starts the motor and reduces motor operating cost during VariFlow™ operation.
  - More useable energy is delivered to the space, fuel is conserved and energy is saved.
- Increases comfort level
  - Provides the optimum flow rate for the energy (air temperature) available.
  - Minimizes stratified air within the space.
  - Minimizes cold drafts when warm air is not available.
  - Quiet start/stop of blower operation.
  - Improved efficiency for all types of filtration methods during VariFlow™ operation.
  - Improves IAQ.

Specifications

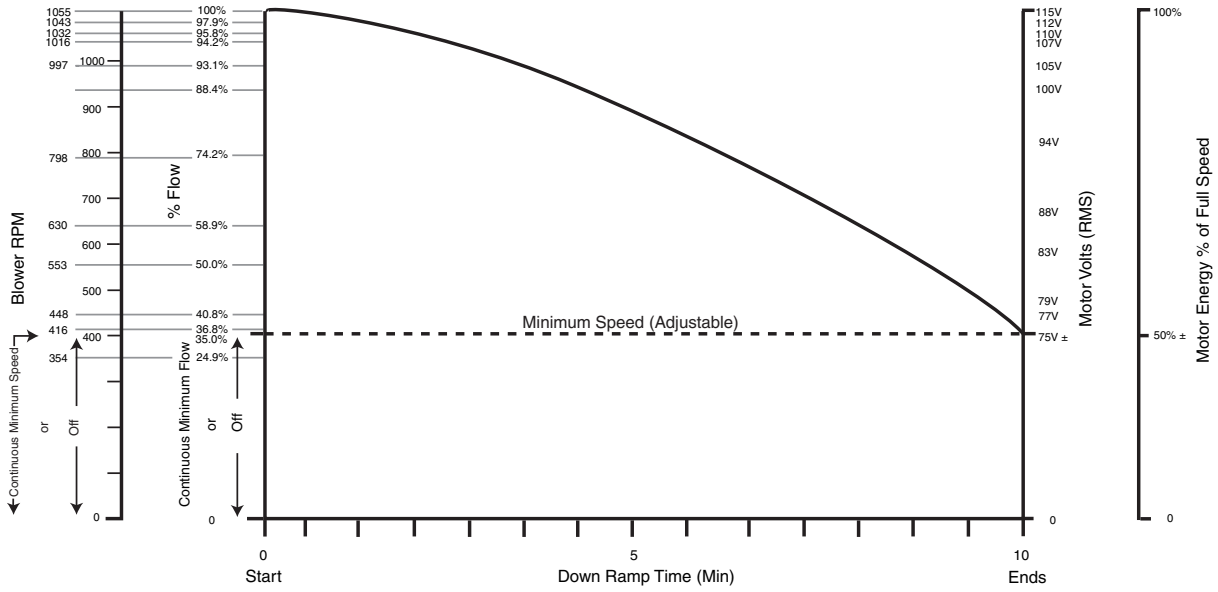
706-FFS (TB) 1	7.5 Amps
706-FFS (TB) 2	12.0 Amps
Voltage	
Nominal	120V AC
Tolerance	+10% –15%
Frequency	60 Hz
Input	
Gas Valve	24V AC
Compressor Relay	24V AC
Output	
Motor (variable, as required)	120 to 65V AC
Ambient	
Operating	32°F to 100°F
Storage	–40°F to 175°F
Wiring — Flying Leads, 12" long, stripped	UL 1015
Typical Blower Speeds Used	Med (Ht) or Hi (Cool)
Min. Speed (FFS) — Factory set, adjustable	450 ± RPM



VariFlow™ FFS Furnace Fan Speed
Figure 1



Typical / Standard Constant Volume Constant Speed Furnace
Figure 2



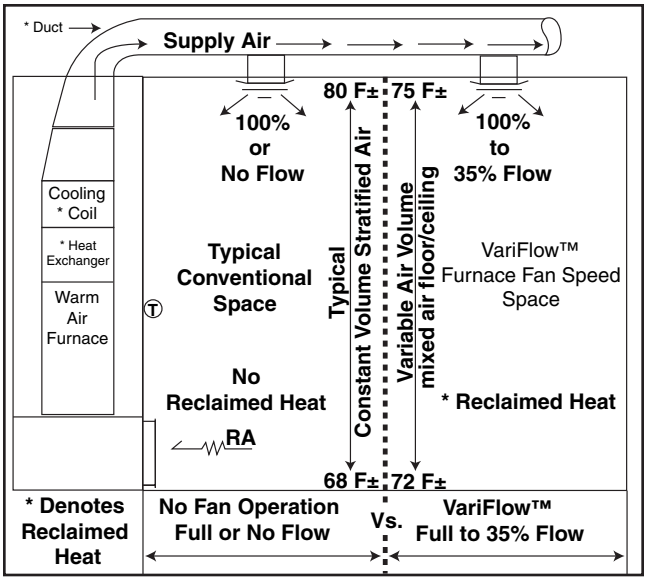
Typical Blower RPM & % of Flow vs. Motor Volts & % of Energy
706-FFS (TB) Series
Figure 3

System Performance Evaluation

In an effort to improve comfort (IAQ) and deliver more useable energy to the space it is important the Installer/ Consumer understand the important aspects, benefits and features of the VariFlow™ Furnace Fan Speed as compared to a conventional constant volume furnace control system.

Typical Warm Air Furnace Systems — are controlled by a single stage "on-off" thermostat that simply limits the temperature from falling or rising above/below a selectable (adjustable) set point, and limits the rise or fall in temperature to the space before turning "off". Once energized, cooling or heating functions at full capacity until de-energized. This primitive "on-off" method of supplying heating or cooling, and the resulting delayed or off operation of the fan, from full air flow, produces undesirable and inefficient operating abnormalities. Some of the undesirable conditions are:

- cool air is initially delivered at the beginning of each heat-ing start up cycle at full flow.
- delayed delivery of available warm air once heating is required.
- excessive flow (velocity) of air on the occupants before the air becomes warm.
- cool air delivery before the fan cycles "off," after the burner is de-energized.
- fan operation typically de-energizes with compressor.
- air stratifies within the space after the fan "cycles off."
- significant energy (residual heating/cooling) remains in the system (heat exchanger/DX cooling coil/cabinet ducts) undelivered to the space, once the fan is de-energized.



VariFlow™ Space vs. Conventional Space
Figure 4-

Note: For Typical Conventional Space operating characteristics, see Figure 4, left side of dotted line.

These undesirable conditions are further amplified as a result of the conventional, constant volume air flow delivery as the air slowly warms up and cools down during and after a heating or cooling cycle.

When the fan starts at full flow, as the heat exchanger is warming up, cool air is initially delivered to the space. Conversely, when the heating cycle ends, the fan delivers cool (drafty) air before the fan cycles "off."

Additionally, a significant amount of energy remains in the heat exchanger and system, and is not delivered to the space as a result of the premature cycling "off" of the fan. Because this air is not available to the space, energy produced by the heating and cooling cycles is lost, and not recovered to benefit the occupants and/or space.

To improve Indoor Air Quality (IAQ), it is necessary to provide the optimum air circulation and maximum filtration. VariFlow™ extends Fan operation at the optimum variable flow rate for comfort and operating efficiency.

The VariFlow™ Electronic Control Air System — adjusts (increases and decreases) the flow by modulating the fan speed during and after the "on-off" heating and cooling cycle. *This provides an ideal balance of air temperature and air flow/velocity for the energy produced during the cycle.*

Note: For VariFlow™ Space operating characteristics, see Figure 4, Right side of dotted line.

At the start of a heating cycle, when the air is cool, the Controller initiates flow at minimum speed to provide air movement, but not cold drafts. Air velocity is gradually increased (modulated) to full flow only as warm air becomes available and is heated to a temperature that is not uncomfortable, (cold or drafty) to the occupant. At the start of a cooling cycle, the Controller allows flow at high speed at the same time the compressor is energized.

Conversely, once the burner cycles off, fan operation is extended for up to 10 minutes (5 times longer than normal). When the compressor cycles off, fan operation is also extended to reclaim all the residual energy in the DX cooling coil. The air flow decreases proportionately as the residual energy is delivered to the space. As a result, an ideal balance of flow and temperature occur. Drafts are minimized as the flow rate reduces to minimum speed. Air temperature and flow simultaneously decrease (heat mode) as the residual energy is extracted; efficiently delivering reclaimed (otherwise lost) energy. This occurs during the extended fan cycle period, precluding warm/cold air stratification when the fan would have cycled "off".

By maintaining a mixture of warm (ceiling) and cold (floor) air, with the reclaimed energy, a higher or lower mean effective temperature results in the space. When added together, the space continues to receive additional useful energy (heated or cooled air), extending the "off cycle" precluding an earlier start of the thermostat.

In the heating cycle, actual test results indicate an increase in temperature occurs in the space for up to 10 minutes after the thermostat cycles the burner "off". This occurs during a period when the space temperature would normally decrease (decline).

Performance tests validate that the VariFlow™ Furnace Fan Speed Controller effectively improves comfort levels and increases system efficiency.

Hoffman|Controls

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