Veris Application Note

Using Variable Frequency Drives to Save Energy

Introduction

In a commercial building, large fans move air through ventilation ducts to maintain comfortable conditions throughout the interior. These fans are controlled by motors that switch the fans on or off as air quality needs change during the work day. However, this conventional setup has room for optimization. Turning a motor on by applying the mains voltage causes a high inrush current and a high initial torque. This consumes a lot of energy and creates wear and tear on the motor as the motor is switched on and off repeatedly throughout the day. Additionally, running the motor at full speed consumes excess energy at times when comfort requirements do not necessitate that much air flow. Finally, the motor also generates a lot of noise when it is on at full power, which can be distracting to the people working in the area.

A variable frequency drive (VFD) connected in series between the power source and the motor controls motor speed by varying the frequency of the signal supplying that motor, eliminating the need to turn the mains voltage on and off. This is known as a "soft start." The motor speed is gradually increased or decreased as needed, avoiding the inrush current and the initial torque.

In an HVAC system, a VFD combined with a pressure sensor saves energy by matching the speed of ventilation fans to the needs of the building. Since the fans are rarely fully powered, costs and noise are both reduced. The addition of a current switch and an energy meter offers a complete picture of HVAC equipment performance, allowing a building administrator to make smart decisions regarding power use and savings.

Air Pressure in the Ducts

Air pressure in the ventilation ducts varies according to the air flow speed and the number of air vents that open into rooms throughout the building. Vents open and close as needed to maintain interior comfort, lowering and raising the duct air pressure accordingly. A duct-mounted dry pressure sensor continuously measures the pressure and converts this to an analog output signal.

Controlling the Fan Speed Using Air Pressure as a Guide

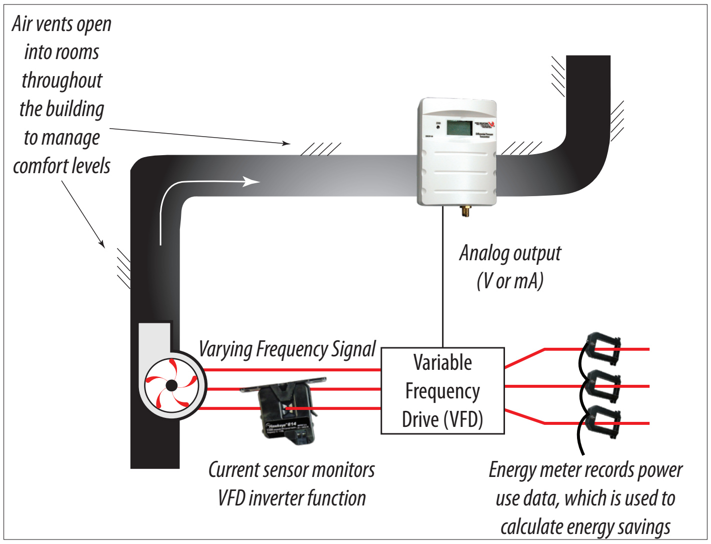
When the duct pressure sensor is connected to the VFD, a useful means of comfort control emerges. The pressure sensor's analog output is sent to the VFD, which is programmed with threshold values for air pressure. A drop in duct pressure triggers the VFD to increase air flow. The VFD responds by increasing the frequency signal to the motor, increasing air flow and raising duct pressure. This cycle continues throughout the work day to maintain comfortable interior comfort with a minimum power draw by the fans.

Current and Energy Monitoring

To further increase awareness of a building's energy consumption patterns, connect a Veris Enercept energy meter to the conductors powering the fan. Collect data in this conventional setup for a time. After installing a VFD to control fan speed according to duct air pressure, reconnect the Enercept meter on the line side of the VFD, and collect energy use data for a similar time period. Compare the baseline consumption data after adding the VFD to the data from the conventional power system to quantify savings.

Additionally, a Veris H614 current switch designed for use with VFDs can be connected to a single phase of the conductor between the VFD and the fan motor. This current sensor learns the normal operating conditions for a VFD system and monitors the system for any deviation from that pattern. This provides confirmation that the system is functioning as desired. A sudden change in the frequency/current profile within the monitored conductor sends an alarm to the control system, alerting the building administrator to the problem. The H614 has the advantage over standard current switches, because it examines performance at 20 discrete points over the entire frequency range of 12 to 115 Hz.

The diagram below shows a suggested configuration for these sensors connected to a VFD.



Using a VFD in HVAC monitoring allows smart control of the entire system. The peripheral devices offer a total picture of the system status and the power usage profile. Optimum conditions are maintained, while equipment operation costs are kept to a minimum, ensuring long-term cost savings.

For more information about VFD related topics, see Veris Application Note VN07 and Veris White Paper VWP13.