Veris White Paper

Variable Frequency Drives: An Explanation

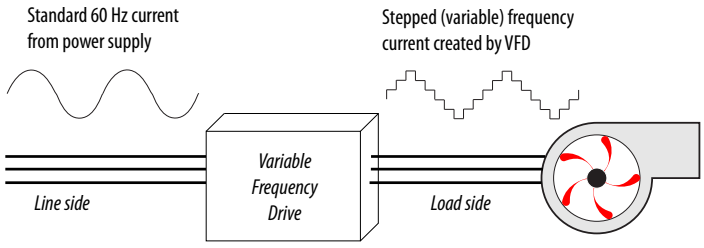
Introduction

Conventionally, motors are connected directly to a power source with switches that determine on/off functionality. When the motor is needed, the power source turns the motor on abruptly. This leads to a high initial current surge, or inrush current, and a high torque that, over time, adds to wear and tear on the motor. Repeating this action many times a day reduces the motor's operational lifetime. To reduce wear and tear, to lower energy costs, and to lower operation and maintenance costs, mechanical systems often incorporate a variable frequency drive (VFD) to control motors.

VFD Operation

A VFD is an electronic control device that allows efficient control of fans and motors, such as those in an HVAC system, by varying the frequency applied to the motor. The VFD is connected in series between the power source and the motor, and the VFD continuously adjusts the power level applied to the motor to, continuously matching the power usage level to the immediate demands of the system.

The most common type of VFD is configured for a three-phase motor. The VFD line side input is AC. The VFD converts this to DC power, and then uses pulse width modulation to convert the signal to a simulated AC waveform. This stepped wave output is sent to the motor.



An embedded microprocessor controls the overall function of the VFD, while user programming governs the parameters the VFD uses to control the motor on the load side.

VFDs in an HVAC System

VFDs are an excellent way to increase the efficiency of a commercial building HVAC system. When starting an HVAC fan motor in a VFD system, the VFD initially applies a low frequency and voltage, avoiding the high inrush current and torque associated with a direct start. As the building requires more air to maintain interior comfort levels, the VFD gradually ramps up the frequency and voltage signal, slowly increasing the fan speed to circulate sufficient air throughout the system. This method is known as a "soft start." When the building needs less air circulation, the VFD gradually decreases the voltage and frequency, slowing the fan at a controlled rate until it stops. In most building applications, the fan rarely turns at full speed, because the VFD is continuously adjusting the fan to the minimum speed needed in order to reduce costs and lower energy consumption.

This system has several benefits. The elimination of the inrush current and the reduced use of the motor lower energy costs for the system. The reduced wear on the motor lowers maintenance costs and extends equipment life. Also, since the fan does not run at full power, the noise level is greatly reduced, increasing tenant comfort. For HVAC systems, VFDs offer a valuable way to improve overall efficiency.

For more information about VFD related topics, see Veris Application Notes VN07 and VN51.