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A User's Guide to VFD Terminology

Keeping up on all the terminology surrounding the usage of variable frequency drives can be daunting, so we've prepared a guide to help explain some basic terminology so that you can be a power user of variable frequency drives (VFDs).

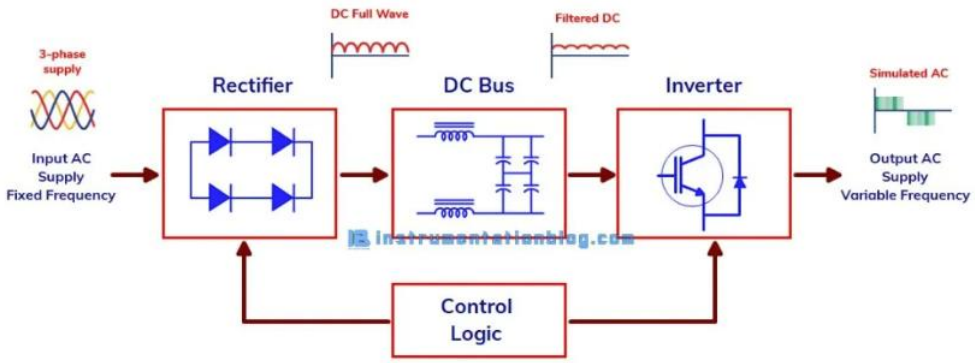
A VFD is a device that controls the speed of an electrical motor by varying the frequency and voltage of its power supply. The VFD also has ramp-up and ramp-down capabilities to start and stop the electrical motor smoothly.

Why do we need to control the speed of an electrical motor? Well, there are multiple reasons, most of these that you already know:

- Save energy and improve system efficiency
- Reach the desired torque or power for the process requirements
- Lower the noise levels of pumps, blowers, fans, compressors, etc.
- Reduce mechanical stress on the machines and improve their life cycle
- Improve the working environment

There are also new features on today's VFDs such as CIP safety, preventative maintenance monitoring of drive data to alert maintenance before failure and automatic PID tuning for system changes.

A VFD consists of 3 primary sections: the rectifier/converter, the DC Bus, and the inverter.



The **rectifier/converter** is the first of the three sections of a VFD's main power circuit, and first in terms of power flow. Incoming AC line voltage is rectified or converted to DC voltage in the converter section, which consists of diodes, silicon-controlled rectifiers (SCRs), or insulated gate bipolar transistors (IGBTs)

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connected in a full-wave bridge configuration. One rectifier will allow power to pass through only when the voltage is positive. A second rectifier will allow power to pass through only when the voltage is negative. Two rectifiers are required for each phase of power.

The **DC Bus** is the 2nd section of a VFDs main power circuit. The main function of this link is to store, smooth and deliver the DC voltage. The incoming power from the rectifier contains voltage ripples which need to be smoothed using capacitors.

The 3rd section of a VFD power circuit is the **Inverter**. The inverter section of a VFD is the primary difference between an AC drive and a DC driver. This section is comprised of Insulated Gate Bipolar Transistors (IGBTs) which convert the DC voltage back into AC voltage to feed the motor. IGBTs are very fast and very small semiconductor switches that are actuated electronically, thus creating a sinusoidal output current.

The technique used to convert AC voltage and vary the output frequency is **Pulse Width Modulation (PWM)**. PWM is a VFD control scheme in which a constant DC voltage is used to reconstruct a pseudo-AC voltage waveform using a set of six power switches, usually IGBTs. Varying the width of the fixed amplitude pulses controls effective voltage. This pulse width modulation scheme works because the motor is a large inductor that does not allow current to pulse like the voltage. Sequenced correctly, PWM outputs motor current in a nearly perfect sinusoidal waveform

All three of these are controlled by a microprocessor unit that performs numerous functions such as controlling the speed, monitoring the alarms and faults and interfacing the AC drive with different devices using a communication protocol. This means that the user can now control the start/stop function, motor speed control and receive feedback about current, speed, and other motor or device variables.

Soft Starter vs VFD

What's the difference between a soft starter and a VFD? While the VFD can vary the speed of the motor, a soft starter only controls the starting and stopping of the motor. A soft starter will be cheaper and smaller, however a VFD should be used when a high starting torque is required, or speed control is required.

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