YASKAWA

How Does an AC VFD Work? An ac variable frequency drive must simultaneously control output frequency and voltage to efficiently control the speed of a three phase induction motor.

Frequency controls the motor's speed Common 60Hz induction motors are typically offered at no load speeds of 3600rpm (2 pole), 1800rpm (4pole), and 1200rpm (6 pole). Applying 60Hz to a 4 pole motor will produce a motor speed of 1800rpm at no load. Actual speed at any applied frequency is influenced by motor load requirements. If frequency is cut in half (30Hz), then motor speed is cut in half.

Voltage is applied in proportion to frequency to achieve rated motor torque. If the motor is running half speed (30Hz), the voltage applied is also cut in half. Failure to reduce applied voltage with reduced speed will result in excessive current draw and motor overheating.

Pulse Width Modulation (PWM) is the present state of the art method used to control frequency and voltage. An AC power source is connected to the drive rectifier, converted to DC, and then "inverted" in a logic controlled output of DC pulses of varying width (voltage) and polarity (frequency). A motor is an inductive device constructed of coils of wire embedded in iron. The motor's inductance resists the rapid voltage changes, averaging (smoothing) the pulses and making them appear to the motor as a 3 phase sine wave.

There are three major elements in the PWM process:
Rectifier - converts AC power source to DC.
DC Bus - pulsating DC is smoothed by large capacitors. A measurement at the output of this section indicates a DC voltage equal to the AC peak value of approx. 1.4 times the AC input.
Inverter - receives instructions from control logic; converts DC to variable frequency variable voltage 3 phase PWM output.