What is Vector Control?

FREQUENTLY ASKED QUESTIONS

Reliance GV3000 AC drives offer simple and low-cost yet powerful closed-loop flux vector operation. These next generation devices are ideal for applications which require precise, high-performance control of AC motor speed, torque and shaft direction.

The GV F.A..Q.'s series of fact sheets are written to provide easy-to-understand answers to commonly asked questions about the operation and application of GV3000 AC drives. They're answers that can help you receive maximum value from these innovative electronic drive controllers.

Q. What makes the VECTOR inside the GV3000 AC drive?

A. The GV3000 utilizes two independent control loops to provide simultaneous control of motor speed and flux. A speed/torque loop for closed loop control of motor speed or shaft torque and a flux loop to provide constant magnetizing amps throughout the motor's speed range. These control loops are capable of providing:

- Tight Speed Regulation - 0.05% steady state error
- Direct Torque Regulation - torque setpoint control from 0 to 100% rated torque
- Control at Zero Speed - generate 150% torque for high breakaway torque applications
- High Dynamic Response - 15 Hz bandwidth response is ideal for rapid load changes

Q. What's the difference in torque control of the GV3000 compared to drives without vector control?

A. Variable Voltage, Variable Frequency AC controllers like the Reliance GP2000, rely on a volts M per Hertz (Hz) curve to develop constant stator flux. The relationship between applied voltage and frequency provided by these controllers works fine for speeds above 5 Hz. Often however, their use results in a reduction in peak torque in applications where required speeds are less than 5 Hz.

As you can see in this Torque vs Speed Curve, the ability of a typical VVVF controller to provide peak motor torque decreases at lower speeds. This reduction in torque is due to the non-linearity of voltage to frequency (Hz) during low frequency operation. The non-linearity I s caused by stator voltage drop which in turn requires a larger percentage of overall terminal voltage. To compensate for the loss of peak torque at low speeds, voltage boost is often added to VVVF controllers.

Q. How does the GV3000 compensate for peak torque reduction at low speeds?

A. The GV3000 regulates the magnitude of motor flux at a peak level throughout the entire speed range. A self -tuning feature within the drive measures the required amount of magnetizing (flux producing) amps. By regulating this value throughout the speed range, constant motor flux is maintained. As a result, the GV3000 is capable of providing constant torque from zero to the motor's base speed.

Q.Does the GV3000 regulate speed any better than a typical VVVF drive

A. Yes. Typical VVVF controllers are usually not able to regulate speed on their own. These controllers suffer what's known as speed "droop" as the motor's load increases.

This droop or loss in speed when load increases is caused by motor slip. Slip occurs in every induction motor. It is the difference between the rotor's mechanical speed and the motor's rotational electrical field.

Slip is necessary since a difference in elctrical and mechanical speeds is needed to cause the proper amount of rotor current to flow. The resulting torque is then sufficient to overcome friction an dwindage losses, and to drive the load.

The speed Regulation function in the GV3000's Control Loop performs precise speed regulation. Its speed feedback automatically compensates the field's rotational speed as load increases to eliminate the effect of slip common to VVVF controllers.

In fact, the GV3000 AC drive can provide 0.1% speed regulation within a 100 millisecond recovery time period.

Q. What makes the vector control in the Gv3000 different from other types available?

A. Other drives, sometimes calles sensorless or tachless vector control do not provide independent control of motor speed and flux. These methods of vector control will show better performance characteristics when compared to Variable Voltage, Variable Frequency (VVVF) drives, but they are not capable of providing the performance offered in the GV3000. Typical limitations of other vector drives include:

- Constant torque is limited to speed ranges above 1 Hz
- Speed regulation is improved to only 1%
- Zero speed operation without motor cogging is not possible