



## Open Loop Inverter Control Modes

### MCW Hints and Tips 0003

Most simple applications are controlled by open loop drives i.e. no feedback device such as an encoder or resolver.

In most simple open loop drives there can be one or more control modes. These modes can have names such as:

Voltage to frequency mode

Fixed boost mode

Open loop vector mode

The main function of any of these modes is to provide the necessary starting torque for high starting torque applications. If the drive is used on a low starting torque application such as a fan or pump, then there is probably limited if any benefit from using one mode over another. Above approximately half base motor speed, the voltage to frequency profile applied to the motor will be a standard profile and therefore any special software helping with starting torque will be phased out.

#### **Voltage to frequency mode - Fixed boost mode**

Voltage to frequency - fixed boost mode is the simplest form of motor control for an AC inverter drive. The drive outputs a voltage to frequency profile to the motor based on the set motor rated frequency, motor rated voltage and the set low frequency boost level.

At low speeds, the motors stator resistance increases and therefore the voltage drop within the motor increases which results in reduced motor torque. To try to maintain constant flux within the motor, the motor terminal voltage must be increased at low speeds to compensate for the increase in stator resistance. This is particularly important in high starting torque applications where the stator voltage drop will be greater due to the increase in stator current.



In a voltage to frequency - fixed boost control mode inverters, a parameter, usually called 'low frequency boost' can be set to increase the motor voltage at low speed.

Setting of this parameter can be trial and error - too low a value and the motors speed will not increase due to lack of torque, too high a value can cause the motor to stall because it is over-fluxed. This additional voltage at low motor speeds is usually only active up to half motor base speed. Above this speed, the voltage to frequency profile applied to the motor is back to the standard curve.

In some AC inverters, parameters maybe available to set a more complex voltage to frequency profile depending on the motor characteristics and application requirements.

### **Open loop vector mode**

The AC inverter uses the set motor map parameters and various parameters measured during an auto tune to calculate the correct voltage to frequency profile to apply to the motor to keep it correctly fluxed over the motors speed range. There is no 'boost' parameter to set.

The motor parameters that are set are:

- Motor rated frequency
- Motor rated voltage
- Motor rated speed
- Motor power factor

These can be taken straight from the motors nameplate.

If it's not a standard 50/60Hz motor then it may be necessary to set the following parameters:

- Motor maximum speed
- Motor rated frequency
- Number of motor poles

It is usual for an open loop vector drive to carry out either a non-rotating or rotating auto tune. A non-rotating autotune does not turn the motor and this measures the motor stator resistance. A rotating auto tune must be done with the motor disconnected from the load. Obviously in many applications this is not possible or impractical so therefore a non-rotating autotune must be carried out.



## Voltage to frequency profile for an open loop AC inverter

