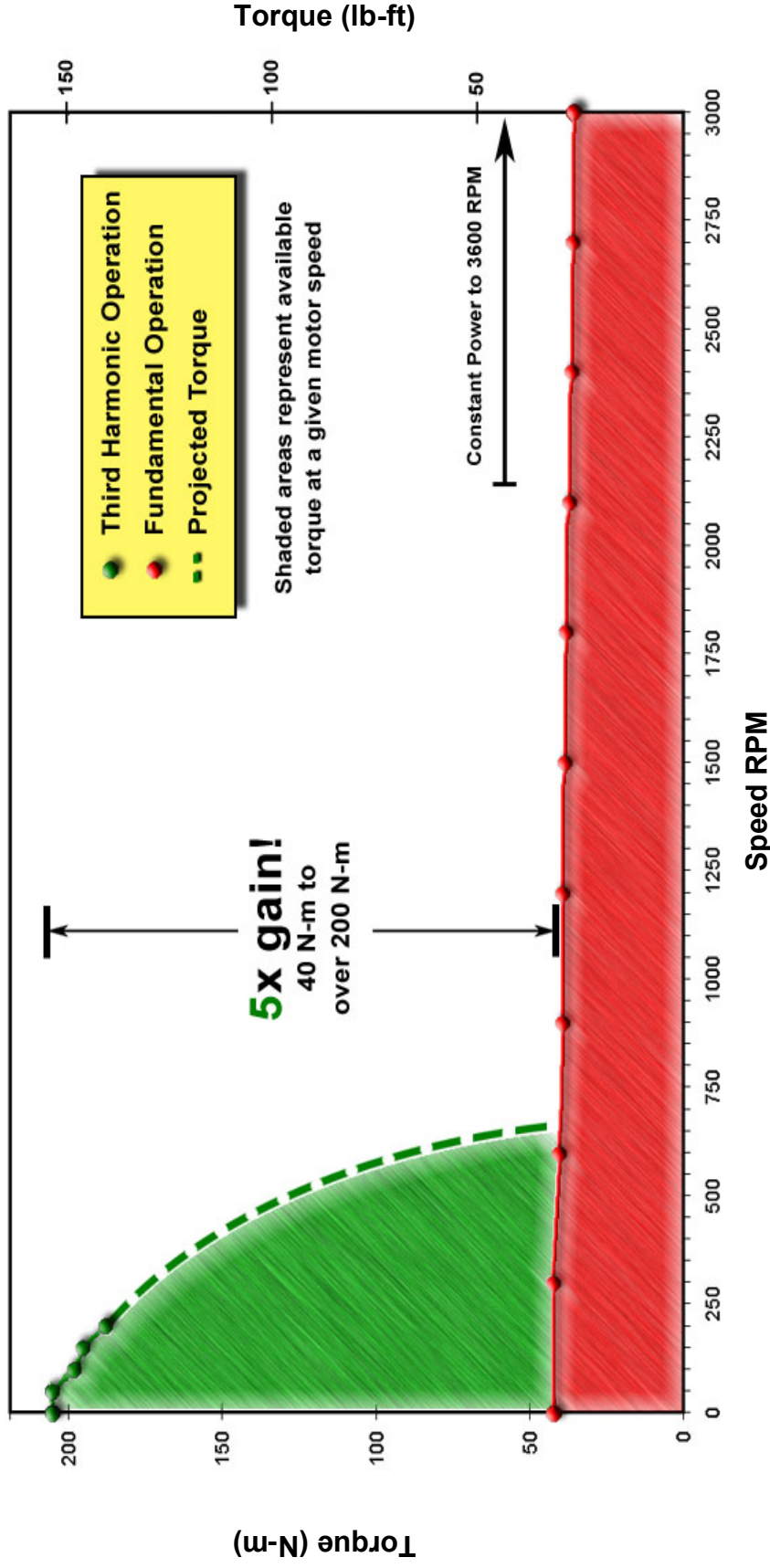


CHORUS MOTORS

Torque vs. Speed at Fixed 125A Operation



This torque-speed curve for a 20 hp Chorus Meshcon machine illustrates two important concepts. First, with an inverter sized for continuous high speed application, low speed torque is more than 5 times greater than three phase or brushless machine performance (which are comparable to a Chorus Meshcon machine operating at fundamental frequency). Second, by transitioning between operation at harmonic and fundamental frequencies the Chorus Meshcon machine can realize this increase in low-speed torque without sacrificing high-speed performance.



How Chorus Meshcon Works

The harmonic mesh effect is used to dynamically change the V/Hz ratio needed to properly drive an induction motor. This lets the full capabilities of the inverter be used over a wider speed range, decreasing the cost of the inverter substantially when low speed starting torque is required.

By increasing the required V/Hz ratio the current required for a given mechanical output state is reduced, but the voltage required is increased. Similarly, by reducing the required V/Hz ratio, the current required for a given mechanical output state is increased, but the voltage is reduced. The normal way to change the V/Hz ratio is to change the number of turns of wire electrically connected in series to make the windings of the motor. The greater the number of series turns, the greater the V/Hz ratio, and the higher the voltage rating of the motor. Many motors are manufactured as dual voltage

motors, where each phase winding consists of a pair of windings which are magnetically in parallel. Depending upon the series or parallel electrical connection of these windings, one of two voltage ratings may be used.

In a standard 3 phase drive, when high torque overload is required at low speed, combined with high speed operating capability, the current capabilities of the inverter can be quite large, and can dominate the cost of the motor. In other words, conventional drives capable of starter-generator performance are very expensive because of dominant power silicon costs.

Chorus Meshcon dynamically changes the V/Hz ratio of the motor, in essence "changing" the number of series turns by changing the harmonic being fed to the motor. At low speed, an extremely high V/Hz ratio can be developed, causing the motor to use the full output voltage capability of the inverter at reduced

current. The harmonic fed to the motor is then changed, reducing the V/Hz ratio and permitting full speed operation. To operate at high speed, we then switch to fundamental (low V/Hz) operation.

The Meshcon theory is validated by measuring the current required by the motor to produce torque. For the above graph, we use a fixed inverter output current value, representing the maximum output of an example inverter. Then at various speeds we find the motor operating state (combination of rotor slip and drive voltage) which produces the highest torque at this target current. We find the peak torque rating for that current level for operation in both the fundamental drive and third harmonic drive.

Low speed torque improvement varies in proportion to motor size, with larger motors able to realize greater benefit from the Meshcon effect.



**To learn more about the Chorus Meshcon technology,
please visit us at www.chorusmotors.gi.**

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