Fuji Electric

Next Generation Variable Frequency Drives

Modern variable frequency drives are already good–but they're getting even better.

Variable frequency drives have emerged as a surefire way to reduce energy costs in induction motor systems. From pumps and fans to material handling and industrial processes, VFDs help save many millions of kilowatt-hours around the world each and every year.

And energy savings are only part of the VFD value proposition. VFDs can help extend the working life of induction motors–by allowing them to operate at lower speeds for significant portions of their lifecycle. VFDs can also improve process control capabilities. In fact, the most advanced vector controlled drives, when paired with appropriate feedback devices in a closed-loop control system, can offer positioning performance close to that of servo systems.

Classification	Overload current rating	Major use
HD (High duty) spec	200% for 3 sec, 150% for 1 min	Operation under heavy load
MD (Middle duty) spec	150% for 1 min	Operation under constant torque load
LD (Low duty) spec	120% for 1 min	Operation under light load

One thing speeding the adoption of VFD technology is the fact that it continues to grow more efficient and reliable due to continuous improvements in the underlying power electronics, such as the insulated gate bipolar transistor (IGBT) technologies developed and employed by Fuji Electric. IGBTs have also seen dramatic improvements in power densities, allowing VFDs to become more compact.

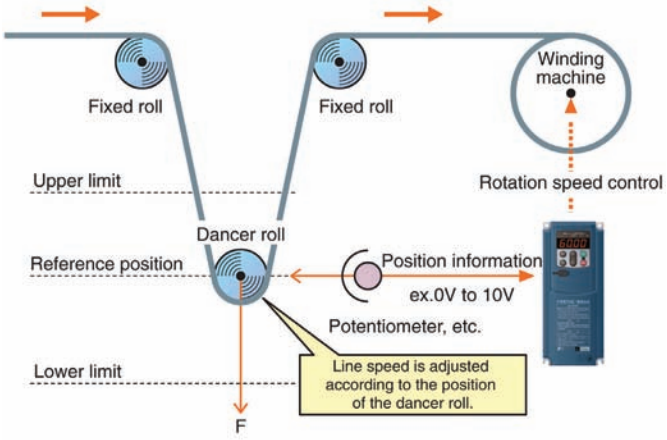

Figure 1. Better Winding Control

FRENIC-MEGA's fast response and accuracy can make a difference in winder applications. In this case, the fast response allows the use of an aggressive PID gain, and the enhanced positioning accuracy enables line speed adjustments to be made from the position of the dancer roll.

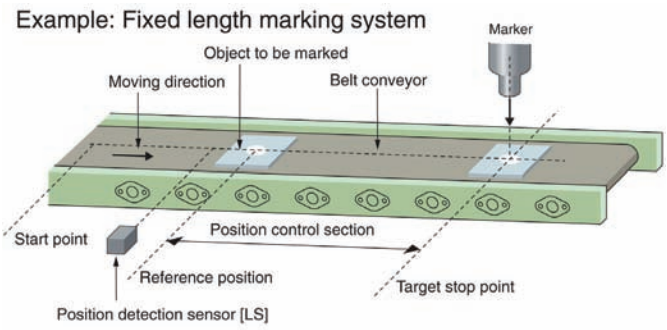

Figure 2. Fast, Accurate Assembly Systems

FRENIC-MEGA improves the speed and accuracy of assembly systems in two ways:

- *With the use of an optional PG Vector Control card and automatic position regulator (APR) functionality, the FRENIC-MEGA can achieve improved positioning accuracy.*
- *When used with the optional PG card, FRENIC-MEGA also provides a servo-lock function, which can accurately adjust the stop timing or braking torque of assembly systems. This feature can reduce deceleration time, which in turn reduces overall assembly cycle time.*

A related technology trend that's helping VFDs get better all the time involves the ready availability of low-cost, high-performance processors. More computing muscle allows VFD to run more complex control algorithms at higher speeds, which further enhances the control capabilities of VFDs.

Taken together, technological advances in power electronics and computing power will take VFDs to new levels of performance and cost effectiveness in the coming years. Here's a look at how these technology trends have transformed some of Fuji Electric's newly developed VFDs:

GENERAL PURPOSE PERFORMANCE BOOST

In some ways, today's VFD technology has already progressed to the point that it meets the vast majority of general purpose application needs. Fluid control applications, such as pumps and fans, are already well served by existing drives. So are many material handling and process control applications.

VFDs have also become much more reliable and efficient over the years. Today's low-voltage drives routinely offer efficiencies in excess of 95% up from efficiencies as low as 80% just a decade ago.

As for reliability, modern VFDs typically outlast other components of a motor-driven system. At Fuji Electric, for example, our general purpose VFDs exhibit a failure rate below 0.1% even after more than a hundred thousand hours at 40 C.

To say that most applications are well-served by existing VFD technology, however, is not to say that there is no room for improvement. There are a growing number of applications that can benefit from improved control performance–in terms of response times or the ability to control speed and torque accurately. Applications that push the envelope for general purpose drives tend to be those that have fast process speeds, braking requirements or impact loads (see Figures 1-5).

Fuji Electric's latest general purpose VFD, the FRENIC-MEGA Series, fills the performance void between lower performing general purpose drives of years past and much more costly servo systems that would be engineering overkill. Think of the FRENIC-MEGA as the high-performance general purpose drive.

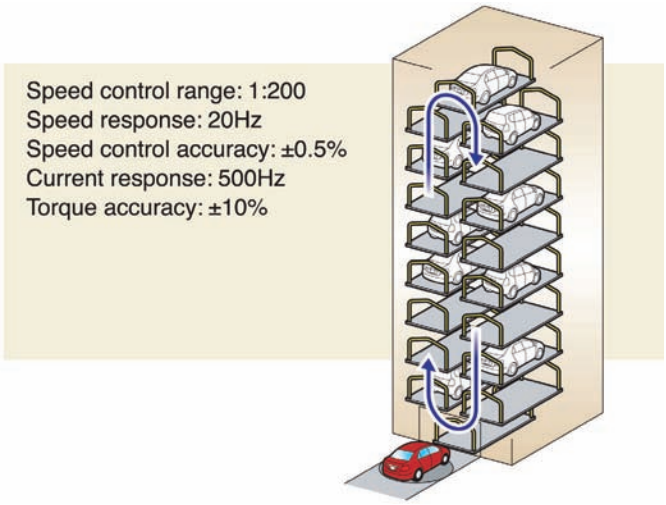

Figure 3. Sensorless Vector Control

While the best positioning control is available in applications that use the optional PG card, the FRENIC-MEGA also operates in a sensorless vector mode that offers a speed control range of 1:200, a speed response of 20 Hz, a speed control accuracy of ±0.5%, a current response of 500 Hz and a torque accuracy of ±10%. This mode of control is particularly useful in applications that require a high starting torque–such as a multi-level car parking system.provides a servo-lock function, which can accurately adjust the stop timing or braking torque of assembly systems. This feature can reduce deceleration time, which in turn reduces overall assembly cycle time.

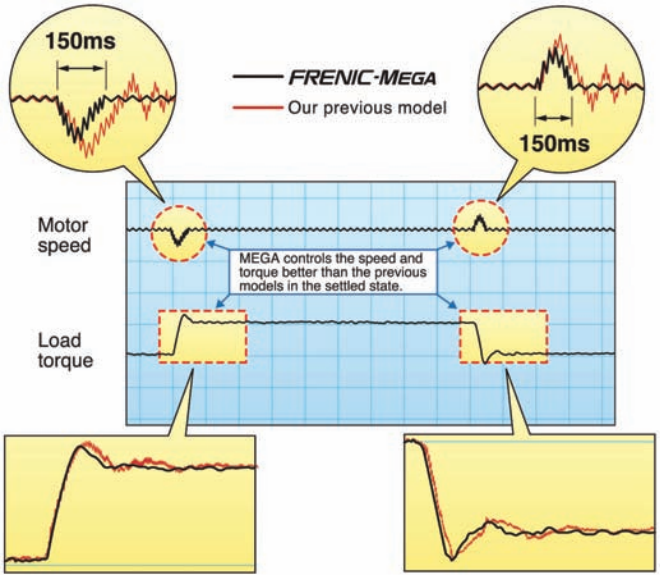

Figure 4. Impact Loads No Problem

FRENIC-MEGA smooths the effects of impact loads by providing a tight flux control that minimizes fluctuations in motor speed. Vibration suppression results. This ability to control impact loads is particularly helpful in applications that require stable operating speeds, such as a cutting machine.

Compared to earlier general purpose drives, FRENIC-MEGA dramatically improves control performance and application flexibility with support for not just traditional v/f control but also for three different three types of vector control–PG, sensorless and dynamic torque. When used with the optional PG vector control, the drive's performance far exceeds what many engineers would expect from a general purpose drive.

FRENIC-MEGA also ups the ante on reliability with enhanced durability in overload conditions. In fan and pump applications, it can operate for up to one minute at 120%. In constant torque applications, it can operate at 150% for one minute. In heavy-duty industrial applications, it can operate at 200% for three seconds and 150% for one minute. This ability to withstand overload conditions substantial reductions in drive-related downtime.

Because it's intended as a multi-function drive, the FRENIC-MEGA does support user-customizable, sequential logic functions. While not a replacement for dedicated PLC in applications with high I/O counts, the built in logic capabilities can close high-speed control loops and execute time-critical logic that is closely related to the drive application.

Other FRENIC-MEGA features include integrated braking transistor for models up to 40 hp and a wide range of connectivity options.

FUTURE DRIVES APPROACHING SERVO PERFORMANCE

Moving a notch up the performance spectrum, Fuji Electric has also developed next-generation high-performance drives that boost positioning and control functionality even further. These FRENIC-VG Series drives have a speed response of 600 HZ, or six times better than previous high performance models (See Table 1). Accuracy has improved too. Torque control accuracy is ±3 %, while speed control accuracy is ±0.005 percent when using a PG card.

The performance gains are due in part to the VG Series' use of dual processors, which doubled the processing power available to crunch control algorithms quickly. The previous high-performance drives, by contrast, had a single processor.

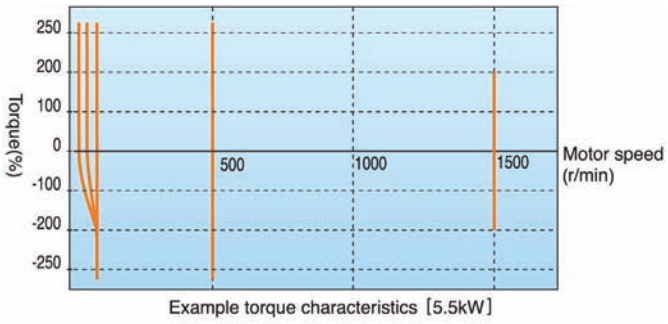

Figure 5. Handles High Starting Torques

FRENIC-MEGA offers a constant tuning mode that compensates for voltage errors in the main circuit devices. And it employs a new magnetic flux observer for more precise operation. These features permit high starting torques of up to 200 % even at speeds as low as 0.3 Hz.

To make the VG Series as adaptable as possible, it supports a lineup of interface cards, including the E-SX high-speed synchronized communications card and a PG interface card. A safety card will be added to the lineup soon as will integrated servo functions. The VG Series conforms with common safety standards, including ISO 13849-1 safety standards for EN terminals of inverters and IEC 61508 SIL2 for the optional cards,

The FRENIC-VG Series is intended for applications that need tighter control than possible with a general-purpose VFD but still less than a full-blown servo system. Among these applications are those, like steel making equipment, that require precise torque control across the entire speed range. Cranes and heavy-duty material handling systems are also a good fit for the VG Series, which can accommodate rapidly changing torque requirements. Additional applications involve industrial machines, such as stamping presses or automotive testing equipment, which require responsiveness at high speeds.

Already introduced in Japan, the VG Series will soon be available in the U.S. market.

For more information visit: **www.fujielectric.com/fecoa/**