

The drive for simplicity: a paper defining trends in motor drives

(Progress in AC drives technology is making life ever easier for operators)

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ZURICH, SWITZERLAND, June 6, 2007 . . . ABB offers one of the world's largest portfolios of AC drives, serving an expanding horizon of applications. With increasing demands for flexibility, reliability and ease of use, ABB has come up with a number of solutions to make life simpler and cheaper for its customers.

By combining functions and cutting part counts, ABB has reduced the size of its drives while enhancing their reliability. The company has also developed a simplified set-up procedure using a harmonized keypad and software wizards that can be used across the ABB drive family. More complex programming can be carried out using ABB's Adaptive Programming utility and parameters can be transferred between drives using ABB's patented FlashDrop technology.

All these advances are part of an on-going effort at ABB to offer cutting edge technology in high performance, yet user-friendly systems.

Traditionally, the primary use of drives has been in such applications as powering pumps, fans and conveyors. And while they will continue to be used in these applications, today's end-users have a very different approach to that of a decade ago.

Drives are now fully developed and are therefore more widely accepted as a product. The need to answer the question, "what does it do?" has been replaced by the expectation that the drive will "just do it." This shift in attitude brings with it the assumption that the drives are simple to buy, simple to install, simple to start-up, simple to commission and simple to own and run.

At the same time, drives are finding new applications: in exercise machines, pizza ovens, honey centrifuges and car washes. In these applications, the drive is very definitely considered a commodity, and the original equipment manufacturers (OEMs), who may not traditionally have used drives, are once again demanding pure simplicity. In fact, a recent survey showed that simple controls and set-ups (70 percent) and convenient operator interfaces (53 percent) were rated as "very important" by AC drives users.

The quest for miniaturization

Simplicity and ease of use manifest themselves in many ways. The mere fact that drives can now be used in domestic washing machines is a testimony to their extreme compactness. Drives have become smaller, more capable, easier to use and cheaper, by orders of magnitude.

Smaller drives are easier to install. Panel builders are able to fit more drives into a standard cubicle, so the whole panel can be smaller. This allows the use of smaller and less costly control rooms. It also becomes easier for OEMs to fit drives into their equipment. A classic example of this is in cranes, an application that has always had very limited space for the drive.

The reductions in drive size have resulted from the use of fewer components, greater packing density,



improvements in semiconductor technology and improved cooling techniques. In fact, there has been a ten-fold decrease in the size of drives over the past 10 years.

Driving down cost

An additional benefit of reducing the component count in a drive is that it cuts costs. ABB predicts that, over the next few years, the parts count of its drives will be reduced by approximately 20 percent through the use of integrated electronics to eliminate separate components such as external flash and RAM memories and analog/digital converters. Mechanical parts are also being integrated, for example, by combining frames and enclosures, allowing them to perform multiple functions.

Reducing part count also enhances reliability: fewer parts mean fewer interfaces and fewer mechanical fixings, which are often a source of failures.

Improved cooling

Advances in the development of power semiconductors have also helped to improve drives. A reduction in the power losses per-unit-area-of-silicon used means that the same silicon area is able to handle more power. This has enabled smaller semiconductors and reduced the need for cooling within the drive. This, in turn, allows the use of smaller heat sinks and reduced air volumes inside the drive – the result is smaller and smaller drives. The only limitations are the terminals because these must accommodate cables that are large enough to carry sufficient current to the drive.

But it is not just the development of power semiconductors that has enabled miniaturization of drives. Of prime importance is the technology used for cooling. Considerable R&D effort is being put into developing new cooling techniques, as well as into reducing the need for cooling.

While air cooling is likely to remain the dominant technique, liquid cooling is finding increasing use in areas such as wind power, transportation and marine applications, as reflected by the recently launched, liquid-cooled ABB industrial drive.

Increased functionality

These ever-shrinking drives contain ever-expanding functionality – thanks to developments in software. Today's software monitors, diagnoses, configures and archives information and -parameters concerning drives in industrial plants.

Set-ups are performed entirely using software functions, and then downloaded to the appropriate drives. The set-up information is archived for future retrieval. To obtain the full benefit of this technology, however, operators must still refer to the user manual. ABB is striving to develop -intelligent control panels that will -significantly decrease the need for -paper-based manuals. The secret, though, is to find an easy way of accessing this kind of functionality. Enter the keypad.

The ideal keypad

ABB's R&D team scrutinized every -aspect of how a user interfaces with a drive and developed what it believes is the most user-friendly keypad ever. The keypad for the ABB standard drive features only eight soft keys, through which all parameters, functionality and set-ups can be accessed.



Even the actual buttons on the keypad were carefully selected to ensure that just the right level of built-in resistance gives the user the feeling of stability and accurate key-press detection.

To develop the keypad, ABB compiled 11 guiding usability principles that consider all aspects of visibility and readability; the type of text and terminology, and the icons used. Based on this, ABB is now harmonizing the keypads of all of its drives. A common look and feel allows the users to switch between different ABB products easily, without having to go through a time-consuming learning process for each new product.

The true value of the keypad

The advantages are not all aesthetic. There is a real financial incentive for customers to choose this keypad and its intuitive commands. Most equipment investment decisions now carry a proviso for fast installation to ensure that production will start rapidly and smoothly. Paramount is the speed with which a machine can be up and running after the installation of new equipment or after a maintenance shut down. If a machine breaks down, it can cost the operator \$20,000 per hour, so easy set-up and commissioning are a priority. Such urgency increases the risk of errors in installation and commissioning. These can be overcome by eliminating manual intervention wherever possible; the keypad is central to this aim.

These guiding principles, and the fact that there are only eight keys on the keypad, suggested the need for intuitive assistance. ABB developed a -series of “wizards” aimed at guiding the user through various procedures. There are “maintenance assistants,” “diagnostic assistants,” and, one of the most widely used, a “start-up assistant.”

The magic of wizards

With the start-up assistant, ABB provides a tool that guides the user through both start-up and commissioning by asking questions in plain text language. There are no complex parameter numbers or codes. The product’s intelligence helps the user through the commissioning process.

For an OEM, who might buy 4,000 AC drives per year, the time saved by using an easy start-up system such as ABB’s wizard can be significant. It can cut 15 minutes from the commissioning time of each drive, equating to a time saving of 1,000 hours per year. For an engineer working 2,000 hours per year, this is half a man-year.

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Specialist HMI

Another tool that makes life easier for the OEM is a hand-held human-machine interface (HMI) that allows drive parameters to be installed in seconds. Called FlashDrop and available with selected ABB drives, the device can be used to select and set parameters, and to copy configurations between drives, without even powering up the drive.

FlashDrop is a patented new technology from ABB that streamlines the drive configuration process, allowing users to download a set of parameters in just two seconds. No specialized knowledge is required to use FlashDrop and the user interface will be familiar to users of ABB drives.

While the HMI is clearly important, ABB has also been looking at ways to simplify customer applications using the functionality packed into a drive. One of the drivers is the customer’s interest in total cost of ownership, which includes commissioning, swap-outs and maintenance.



Application-specific solutions

AC drive users can now reduce costs even more by employing application-specific drive solutions. These drives incorporate incremental functionality that supports specific applications such as fan and pump control, mixers, or crane controls. They can reduce the total cost of ownership through shorter start-up times, lower integration costs, and improved machine productivity.

Time savings during commissioning can range from one to several hours. The process does not require expert programmers and, therefore, saves the considerable expense of sending commissioning engineers around the globe to fine-tune individual drives.

Take, for example, ABB's new pump control software module, Intelligent Pump Control (IPC), which eliminates the need for an external PLC (programmable logic controller) and can help to save energy, reduce downtime and prevent pump jamming and pipeline blocking.

The IPC is a software add-on for ABB industrial drives. It contains all the common functions needed by water and waste utilities, industrial plants and other pump users through six pump control functions.

The software also incorporates ABB's adaptive programming utility, enabling users to customize drives for specific applications. This utility consists of a set of simple to use blocks that can be programmed to perform any operation from a predefined set of functions. All common mathematical and logical functions as well as switches, comparators, filters and -timers are available. These days, users can have the power of a small PLC - inside their drive in the form of ABB's Adaptive Programming.

A further breakthrough is that programming can be carried out using the standard control panel. No special hardware or software programming tools are needed. As a result, the programming takes only a few minutes and can be carried out on-site, during commissioning.

Technology that stands the test of time

Even well established technology does not stand still. It is now 11 years since ABB launched its revolutionary motor control platform, Direct Torque Control (DTC). Now the algorithms have been tweaked in order to move standard AC drive technology into the servo arena. The result is the launch of the ABB machinery drive.

The drive uses standard AC drive technology, but, by tuning DTC to include a motor model designed for servo motors, and by using very fast torque control loops within DTC – along with some other clever design work – the drive can now reach servo drive performance levels. It can control synchronous or asynchronous motors, either open- or closed-loop. With the new drive, depending on the application, machinery builders need specify only one drive for a variety of motor types along with an appropriate feedback device.

Three modules

Despite their significance, the advances described so far are only half the story. The ABB machinery drive features another significant major breakthrough aimed at meeting head-on the challenges faced by OEMs. This is the use of three plug-in modules that house the heart and brains of the drive. On the hardware side, there is a power module and a control interface module, while the software module provides easy programming of the relay logic or PLC routines that an OEM may require for its own applications. It is the way in which these modules are used that will reduce commissioning times, eliminate the need for external maintenance engineers and minimize unpredicted production line stoppages.



By providing separate units, both the power module and control interface can be shipped to site and installed ahead of the software memory unit. When the installation is complete, the memory unit, which can be programmed on the OEM's own premises with specific application code, can be delivered and simply plugged into the control interface on site.

The modular approach also allows the number of product components and variants to be reduced.

Since there is no need for on-site programming or the connection of any communication cables to PCs, time savings during commissioning can range from one to several hours. The process does not require expert programmers and therefore saves the considerable expense of sending commissioning engineers around the globe to fine tune individual drives.

The future

AC drives are set to be smaller, more intelligent, easier to install and control, have better communications, and be suitable for many more applications – particularly at the low power end of the range – all at a constantly reducing price. What better future could drive users ask for?



The drives family from ABB extends from fractional horsepower to those that control 135,000 Hp motors.



Eight soft keys set all functions and parameters on ABB drives



FlashDrop technology streamlines the drive configuration process; loads parameters to multiple drives in seconds.

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