The SERCOS Interface Standard

Standardized digital interfaces drive ahead.

Scott Hibbard

Today motion control systems are migrating from analog to digital technology at an ever-increasing rate because digital drives provide performance equal to or exceeding that of analog drives, plus information to run your machine more effectively and manage your quality program and your business. Most of this data is simply not available from analog drives.

The Interfacing Problem

For the past 30 years, the motion control industry has relied on a de facto ± 10V interface standard between analog controls and drives, where 10V equals full speed of the drive, and + or - determines the direction of motor rotation. Although it was fine for analog systems, this interface is totally inadequate for new, more complex digital technologies. The digital servo drive technology incorporates low-cost, high-performance digital signal processors (DSPs) to provide capabilities well beyond those of analog drives. However, in order to fully exploit the potential of digital drives, a well-defined digital interface must also be specified.

Some early digital drives did interface to a digital motion controller via an analog signal, but resolution was sacrificed, and noise sensitivity was a serious problem. Proprietary, vendor-specific digital interfaces have existed since the 1980s. However, they restrict the user to a single source for both drives and control and often limit flexibility for future expansion and use of newer technologies. Thus, the user's ability to select components based on application need is limited, and a substantial support burden is created when attempting to maintain non-complementary equipment from a number of suppliers.

Enter The SERCOS Interface Standard

The SERCOS (acronym for SErial Real time COmmunications System) interface standard was initiated by a group of European machine builders, control builders and drive manufacturers who were concerned about the impending problems of multiple digital interfaces. They foresaw the benefits of a digital interface standard that would allow many manufacturers' drives and controls to communicate. Since its inception, the interface has been endorsed by other European and American manufacturers.

The SERCOS interface will allow any manufacturer's SERCOS-compatible digital NC to talk to any other SERCOS-compatible digital servo drive, digital spindle drive or digital I/O over a well-defined fiber-optic link.

With an open-architecture interface, the machine builder or user has the flexibility to configure multi-vendor control systems, choosing the best controls, servo drives, spindle drives and digital I/O for the

SERCOS IS TO THE MACHINE CONTROL WHAT THE CLIENT-SERVER IS TO OFFICE AUTOMATION.

This column will answer your questions about gear machinery controls and electrical systems. Send your questions to Mission: Controls, P. O. Box 1426, Elk Grove, IL 60009, or fax them to 708-437-6618.

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operation. Controls and drives can be independently selected based on the required performance criteria. No compromises need be made by being locked into purchasing all digital systems components from only one manufacturer. SERCOS provides the user with options, both at initial purchase and for future expansion.

General Motors Corporation has recognized the benefits provided by such an open interface standard. In May 1995, two GM groups issued a joint letter to suppliers which states, "General Motors Powertrain and General Motors Europe are working together to develop common standards for powertrain equipment. [We] have jointly agreed that an open digital CNC and drive system interface is required for future equipment purchases . . . the only existing standard that complies is the defined SERCOS interface. Therefore, products utilizing a SERCOS interface are required by October 1, 1995, to meet current power train requirements."

About the Interface

The interface is not a product to be purchased. Rather it is a set of standard specifications that may be incorporated into any company's products. Each control or drive maintains its own functions and features.

SERCOS interface compatibility provides additional capabilities because the controls and drives comply with a standard medium for transmission, topology, connection techniques, signal levels, message structure, timing and data formats.

The SERCOS interface allows manufacturers to use any product-specific features on their machines, as long as the controls or drives are SERCOS interface-compatible.

The interface unlocks the door to great expansion potential as new manufacturing challenges unfold. In addition to allowing widespread use of today's digital technology, it allows communication with digital drives that may be developed in the future.

Interface Features

With the SERCOS interface, one fiber-optic ring is used to exchange data between NC controls and drives. The fiber optics provide inherent noise immunity and eliminate the immense requirements for conduit, wiring and terminations normally required with an analog interface between the CNC and the drives.

Standardized message formats are used for entry and display of operating data and parameters. In addition, the interface allows extensive real time servo and machine diagnostics and performance data to be monitored. For example, the Indramat DDS intelligent digital servo drive has a built-in digital oscilloscope capability, allowing it to capture a snapshot of drive performance which can be transmitted over the SERCOS interface to a CNC or higher level plant control for analysis.

Precise timing and synchronization of commands and interpolation for multiple drives is achieved with the interface. All operating data (command values, feedback values, etc.) are simultaneously updated between the drives in each cycle.

The specification provides two groups of parameters. The first set of 32,000 parameters is predefined for CNCs and drives, although no

control system must use all of them. A second set of 32,000 freely definable parameters is allotted, providing the flexibility for manufacturers to include unique capabilities in their products, yet still conform to the specification. It also leaves room to accommodate future developments.

But What About Drawbacks?

Concerns about SERCOS have appeared in the trade media. One misconception is the number of drives allowed on a ring. A system with eight drives has been described as an example to illustrate timing. Certain writers have seized on this as a limitation, where, in fact, SERCOS can support up to 254 devices per fiber optic ring, with multiple rings available.

Another misconception is that SERCOS, as a serial interface, is too slow. SERCOS can support tightly synchronized multi-axis motion, as proven by existing applications in the machine tool, converting and packaging industries. Manufacturers offering the SERCOS interface generally find that this objection is raised by other manufacturers who have a history of investment in central control. It is important to note that SERCOS was developed in response to the emergence of intelligent digital drives. Intelligent drives perform many of the tasks that were handled by the machine control in previous generation systems.

A parallel can be drawn to the emergence of personal computers in the 1980s. At first, mainframe computer suppliers were very resistant to using PCs for anything more than terminal emulators, ignoring the potential to download mainframe tasks to PCs. In time, they realized that the PC could perform many of the mainframe's tasks, allowing the mainframe to handle additional tasks, to be downsized or perhaps to become nothing more than another PC acting as a client-server. This fact didn't bode well for those with an investment in "big iron" mainframes, but opened up a host of new opportunities for smaller server manufacturers.

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Intelligent digital drives and SERCOS offer much the same situation. Similar to the PC used as a terminal emulator, an intelligent digital drive can be used to just close current or velocity loops, as did the previous generation of drives. Their speed and synchronization capabilities, plus their noise immune characteristics, offer an advantage over the ±10V analog interface. The potential of the intelligent digital drive is not realized, however, until its power is used to perform axis-specific tasks. In addition to position loop closure, SERCOS allows the intelligent drive to capture registration marks, perform homing sequences, provide cam table functionality, switch performance parameters in real time, capture actual motor temperature and motor parameters, provide backlash compensation, leadscrew error compensation, adaptive positioning and torque monitoring, thereby tending to lower the complexity and motion control overhead of the machine control.

The use of SERCOS allows the migration to true PC-based NC designs and easier programming methods. SERCOS-based controls differ from their analog-interface forefathers. Thus, the SERCOS standard is to machine control what the client-server is to office automation.

SERCOS also offers easy adaptation to different applications. A control that is tightly coupled with its interfaces is less adaptable to different applications and less able to take advantage of technological innovations in drives, feedbacks or sensors. The use of SERCOS with intelligent digital drives improves system flexibility, as one identical drive can handle multiple prime movers, such as permanent magnet servomotors, high horsepower induction servomotors (vector drives) and linear motors.

The SERCOS Interface—A Reality In The Marketplace

SERCOS is an internationally accepted standard. Thousands of systems have been shipped by manufacturers in Europe and North America on applications including high-speed transfer lines, multi-axis dial machines and stand-alone milling, drilling, turning and grinding machines. Multi-axis applications such as packaging machines, converting and printing machines, material handling systems, robots, woodworking machines and assembly and test machines are providing worldwide manufacturing with the benefits of the SERCOS interface.

Currently over 25 drives and controls suppliers offer SERCOS-compliant products worldwide. In North America, a number of suppliers support SERCOS N.A., a SERCOS promotional alliance based in Lincolnshire, IL. Current SERCOS N.A. members include Lutze, Inc., Indramat Division of Mannesmann Rexroth Corp., Motion Engineering, Inc., Pacific Scientific Motion Technology Division and Automation Intelligence, Inc., a Pacific Scientific Company. For more information, contact SERCOS N.A. at 1-800-5-SERCOS or the author, Scott Hibbard, at 708-645-3600. ○

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