

Packaging Profile to improve the interoperability of controls and drives

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The Packaging Machinery Working Group of the North American OMAC (Open Modular Architecture Controls) Users Group published a recommendation in November 2001 to use SERCOS interface (IEC 61491) as an open drive interface for packaging machines. In this context, the group challenged the SERCOS organization to further improve the multi-vendor interoperability of servo controls and drives on the basis of a packaging profile.

SERCOS already specifies more than 500 standardized parameters that define the interaction between controls and drives in a vendor-independent manner. The SERCOS specification supports the interoperability of controls, drives and I/O devices from different manufacturers on the basis of an open real-time communication system. For example, SERCOS parameter IDN 00036 (IDN = Identifier Number) transfers the specified velocity command value as a 32 bit value to the drive. Parameter IDN 00040 communicates the actual velocity feedback value back to the control. Other parameters can be used to command drives or to send diagnostic information to higher-level controls.

However, in practice, issues arise which make the idea of “plug and play” more difficult to implement. In most cases, only a subset of all existing parameters is needed to run an application. Some parameters have been designed for very specific use only (e.g., spindle positioning in machine tools), or they deal with optional interfaces (e.g., position feedback value of an external feedback).

Another issue is that motion control functions can be integrated centrally in the control as well as decentrally in the drives. This depends on the functionality of the servo drives, which may vary from manufacturer to manufacturer. Machine builders have different philosophies and preferences with regard to control architecture.

Operation modes have a substantial influence on the characteristics of the drive interface. With SERCOS, the control loops (position, velocity, torque) can be closed in the control as well as in the drive. Closing the position loop in the drive is much more advantageous than the common method used by other digital drive buses since only this method ensures stability and thus full performance, irrespective of transfer speed or cycle time and the included reaction times.

Depending on the drive functions that are used by a control, a different set of SERCOS parameters is required. To keep complexity manageable and to ensure the highest interoperability of controls and drives despite the great variety of options and variants, an implementation of application-specific profiles as subsets to the SERCOS specification makes sense (figure 1).

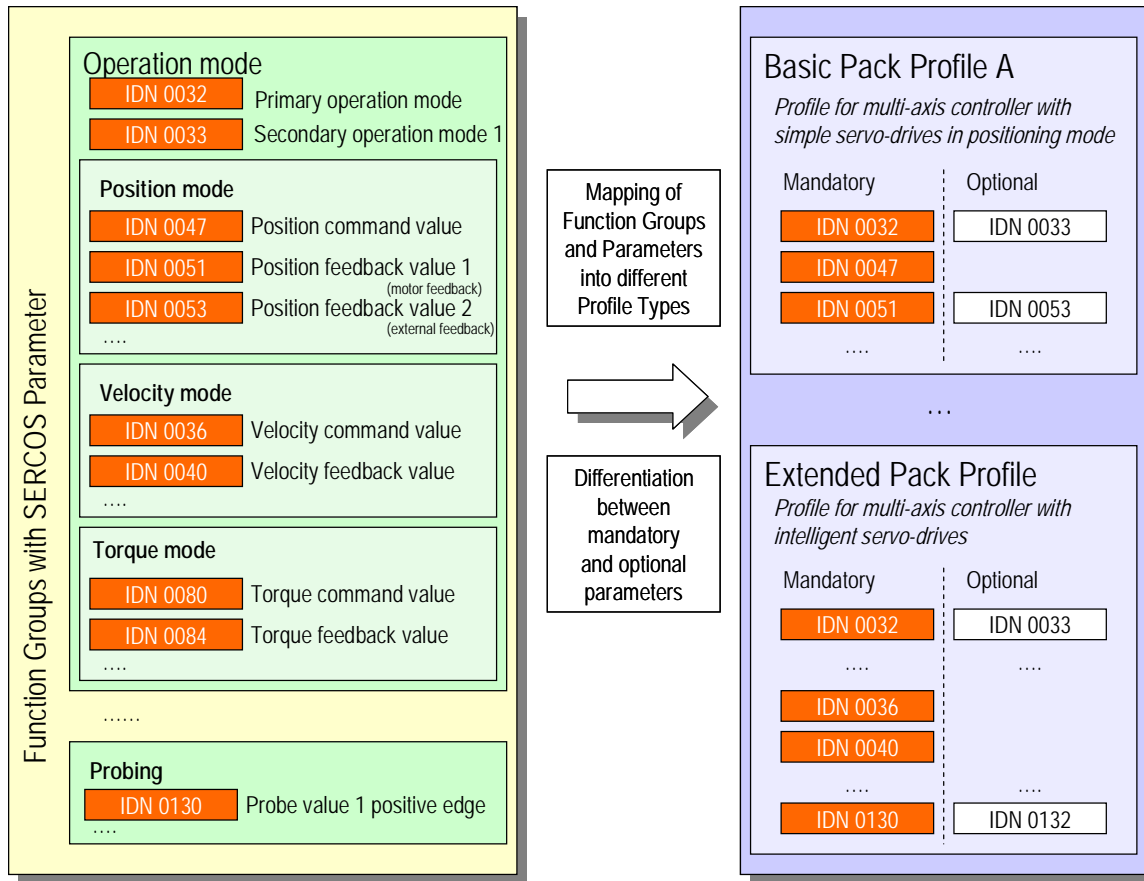


Figure 1: Example of mapping SERCOS parameters into different profile types

In May 2002, the Interests Group SERCOS interface (IGS) formed a technical working group to define such a profile for packaging machines. Work was based on the current SERCOS specification and a document was drawn up by a working group in North America which divided the SERCOS parameters into a total of 17 function groups. In the first step, the respective profiles have been defined for three of the six OMAC-defined application classes (Motion Control Interface Types C, D and E.) See table 1.

The existing function groups and the corresponding parameters were mapped in the profile types. The profiles consist of mandatory and optional parameters.

	Application classes according to OMAC (Motion Control Interface Types)					
	Single-Axis Drive		Multi-Axis Motion Control			
	Type A	Type B	Type C	Type D	Type E	Type F
Synchronization	No	Yes	Yes	Yes	Yes	Yes
Mode of Operation of Drive	Positioning Mode	Positioning Mode	Position Mode	Velocity Mode	Torque Mode	Electronic Gearing in the drive
Position Loop Location	In the drive	In the drive	In the drive	In the control	In the control	In the drive
Velocity Loop Location	In the drive	In the drive	In the drive	In the drive	In the control	In the drive
Covered by SERCOS Pack Profile	No	No	Yes	Yes	Yes	No

Table 1: Application Classes according to OMAC

For simple servo drives and frequency converters, a basic profile was defined (see figure 2). This profile consists of Communication Class A covering the following functions:

- ring configuration for phase run-up & timing
- cyclic communication with standard telegrams
- diagnostic information
- status and control signals

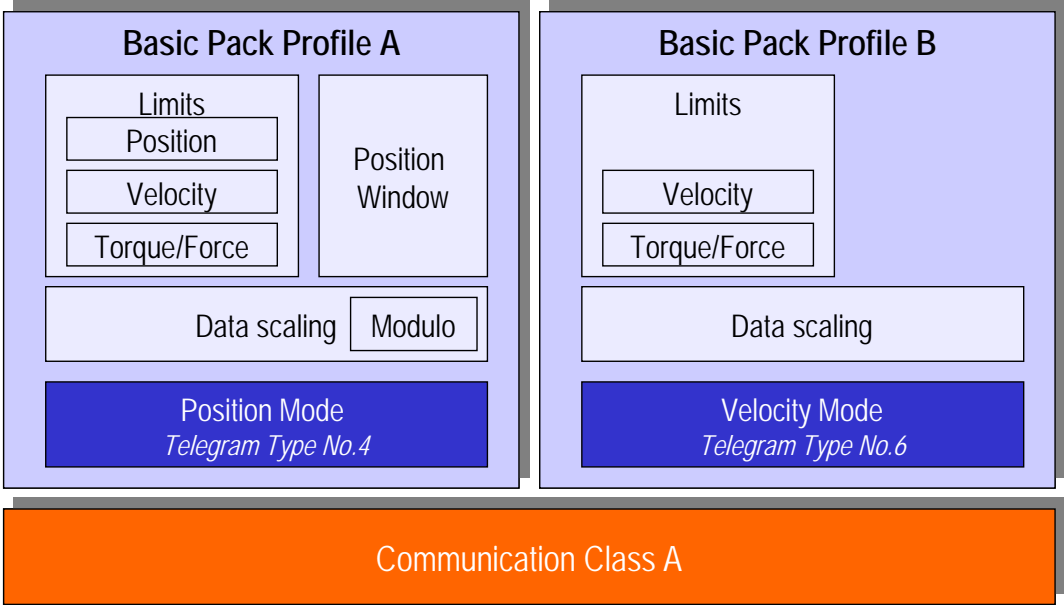


Figure 2: Structure of the Basic Pack Profile

Basic Pack Profile A defines the parameters that are required to send cyclical position command values to a simple servo drive (telegram type no. 4). The data scaling of the position command values is rotational, measured in degrees, and is processed either in an absolute or a modulo value. The position loop is closed in the drive; the position feedback value is transmitted back to the control. The profile allows limit values to be defined for torque/force, velocity and position. The scaling of velocity data is in revolutions per minute. Torque and force data is scaled in percentage.

Basic Pack Profile B defines the parameters that are required to send cyclical velocity command values to a frequency converter (telegram type no. 6). The profile allows limit values to be defined for torque/force and velocity. The scaling of velocity data is in revolutions per minute. Torque and force data is scaled in percentage.

For intelligent servo drives, an extended profile was defined, as shown in Figure 3, Extended Pack Profile.

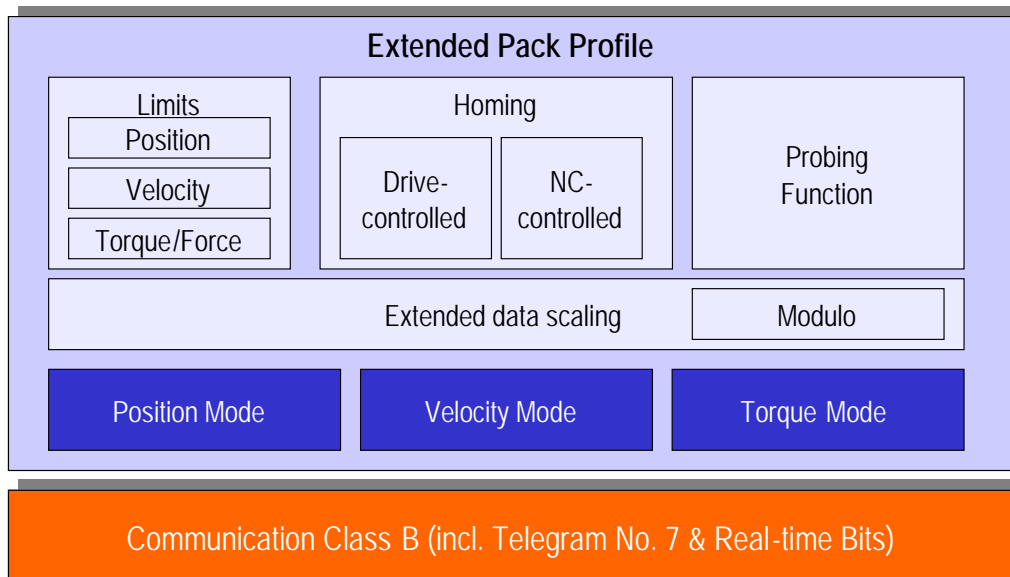


Figure 3: Structure of the Extended Pack Profile

This profile is based on the basic profile for simple servo drives and frequency converters as described above. In addition, it defines additional functions which are realized in the drive and can be used by higher-level controls. Drives that support this extended profile can be commanded by any of position, velocity or torque values. For acceleration and torque data, a preferred scaling is supported, whereas the scaling of position and velocity data can be configured very flexibly. Additional parts of the profile are the drive- and the NC-controlled homing, as well as a powerful function for high-speed probing. The Extended Pack Profile requires the SERCOS Communication Class B which contains all functions of Class A, plus the following functions:

- configurable telegram (telegram type no. 7)
- extended diagnostic information and
- configurable real-time control and status bits.

In addition to the mandatory parameters defined by the profiles, optional parameters and additional functions (e.g., automatic baud rate recognition, detection of the physical order and firmware up-/download) can be supported per the SERCOS specification.

The profiles were approved by the technical working groups of the SERCOS organization in December 2003 and published as Version 1.1. Currently the profile is implemented within controls and drives of several suppliers. In parallel, the SERCOS Conformizer, the certification tool for the SERCOS interface, has been extended so that the conformance of control and drive devices to the packaging profile can easily be tested and proved. The updated conformance test is available now.

Further information:

www.omac.org
www.sercos.de

OMAC Background:

[The Packaging Machinery Working Group of OMAC](#) (Open Modular Architecture Controls) was founded by large North American end users (e.g., Procter & Gamble, Nabisco, Hershey Foods, Kraft Foods, Heineken, General Mills, Anheuser Busch, M&M Mars, Ralston Purina, Philip Morris). The goals of that group include the elaboration of recommendations and guidelines for the automation of packaging machines.

The aim is to improve the following aspects: delivery time, commissioning time, machine dimensions, machine capacity, format changing time, flexibility, machine modularity, machine standstill time. These enormous requirements can only be reached via modern, flexible automation solutions.

References :

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4. Packaging Specific Profile - OEM Requirements, PackConnect SubTeam, Working Draft, Revision 5.
5. Function Groups for SERCOS interface, Working Draft, SERCOS NA Technical Working Group.
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