



## **Packaging Profile Improves the Interoperability of Controls and Drives**

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The SERCOS interface meets the following OPW Guidelines for Pack Connect:

- Motion Control and Servodrive Interoperability via the SERCOS Packaging Profile
- Controller-to-Controller Network Requirements
- Controller-to-Controller Motion Bus Structures

The North American OMAC<sup>1</sup> Packaging Workgroup published a recommendation in November 2001 to use the 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).

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<sup>1</sup> OMAC = Open Modular Architecture Controls

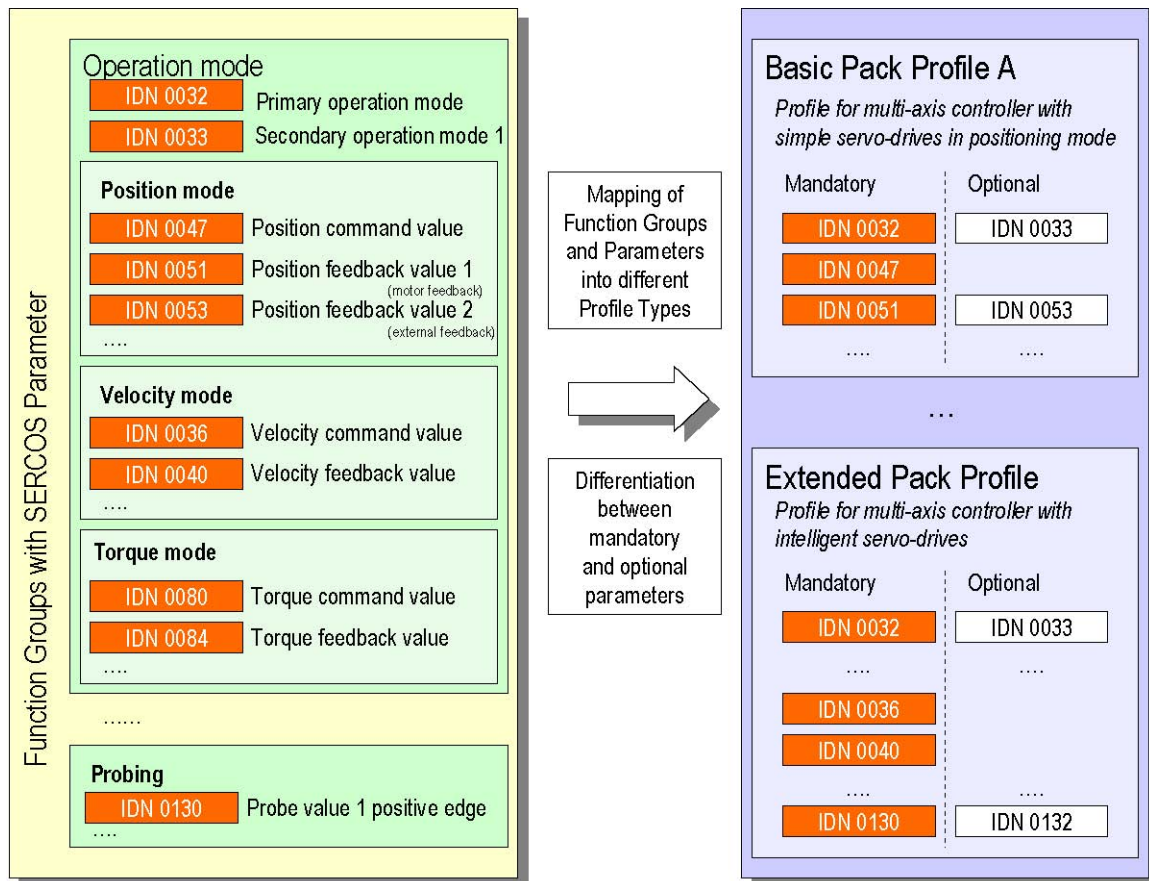


Figure 1: Example of Mapping SERCOS Parameters into Different Profile Types

In May 2002, SERCOS International 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 were 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
<b>Synchronization</b>	No	Yes	Yes	Yes	Yes	Yes
<b>Mode of Operation of Drive</b>	Positioning Mode	Positioning Mode	Position Mode	Velocity Mode	Torque Mode	Electronic Gearing in the drive
<b>Position Loop Location</b>	In the drive	In the drive	In the drive	In the control	In the control	In the drive
<b>Velocity Loop Location</b>	In the drive	In the drive	In the drive	In the drive	In the control	In the drive
<b>Covered by SERCOS Pack Profile</b>	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

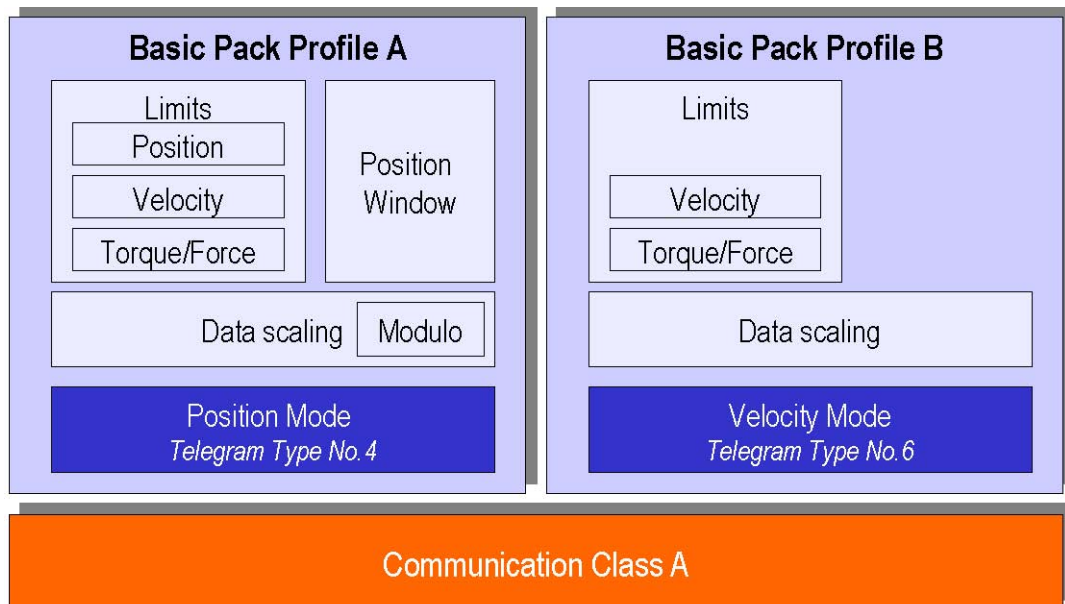


Figure 2: Structure of the Basic Pack Profile

**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.

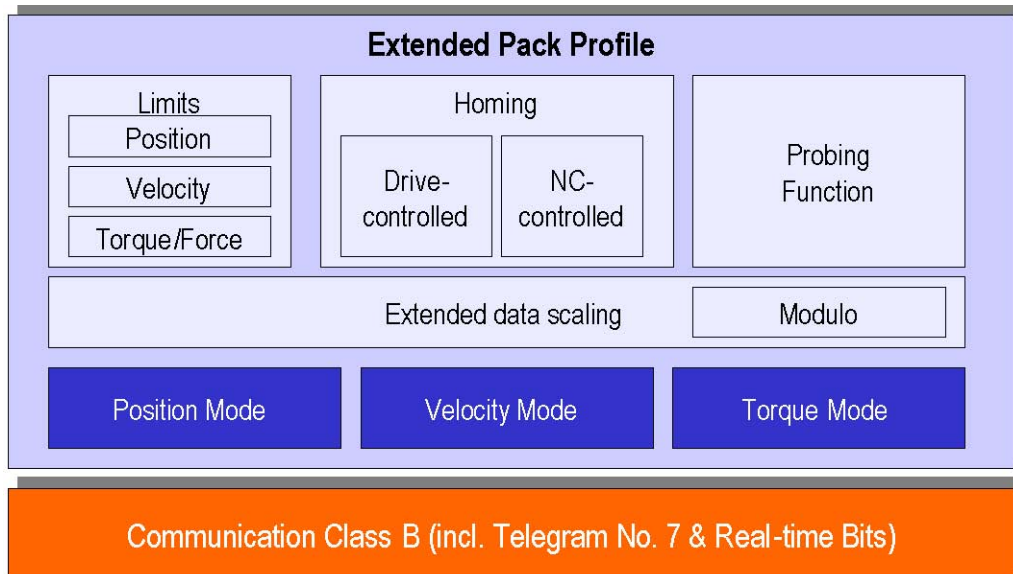


Figure 3: Structure of the Extended Pack Profile

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 published by the technical working groups of the SERCOS organization in December 2003. Currently the profile is implemented within controls and drives of a number of suppliers. Based on feedback from field experience, a number of updates have been made to the Pack Profile. The latest version is V1.3a, dated July 27, 2006.

In parallel with development of the profile, 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 proven.

Further information:

[www.omac.org](http://www.omac.org)  
[www.sercos.de](http://www.sercos.de)

## OMAC Background:

The OMAC Packaging Workgroup 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:

1. Specification – SERCOS interface, Version 2.2, November 2001 – Available from SERCOS International, [www.sercos.de](http://www.sercos.de).
2. Guidelines for Packaging Machinery Automation Version 3.1, OMAC Packaging Workgroup, <http://www.omac.org/Content/ContentGroups/OMAC2/Documents67/Packaging1/OPWGuidelinesv31R2.pdf>
3. Architecture Diagrams, OMAC Packaging Workgroup, [http://www.omac.org/filestore/omac/packaging/System\\_Architecture.doc](http://www.omac.org/filestore/omac/packaging/System_Architecture.doc)
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.
6. Technical Specification – Pack Profile Specification, Version 1.3a, July 27, 2006