SERCOS interface

Digital interface for communication between controls and drives

in numerically controlled machines

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The efficient use of digitally controlled drives is only possible through the use of a suitable digital interface.

Such an interface must:
- enable the use of performance capabilities provided by intelligent digital drives, including new functions and types of operation with expanded data ranges,
- support parametric adaptation, diagnostics, and
- provide a problem-free interface of the products from different manufacturers.

In order to accomplish these requirements, manufacturers of machine tools, drives, and numerical controls convened in a joint working group of the VDW (German Machine Tool Builders Association) and ZVEI (German Electrical Standards Association) and developed the Serial Real-Time Communication System

"SERCOS interface"

as a proposed standard for a uniform communication interface between numerical controls and drives.

The SERCOS interface has been a European Preliminary Standard since 31 October, 1991.

The international standardization work is being done in a joint working group of the IEC and ISO and should be available in the first quarter of 1993.

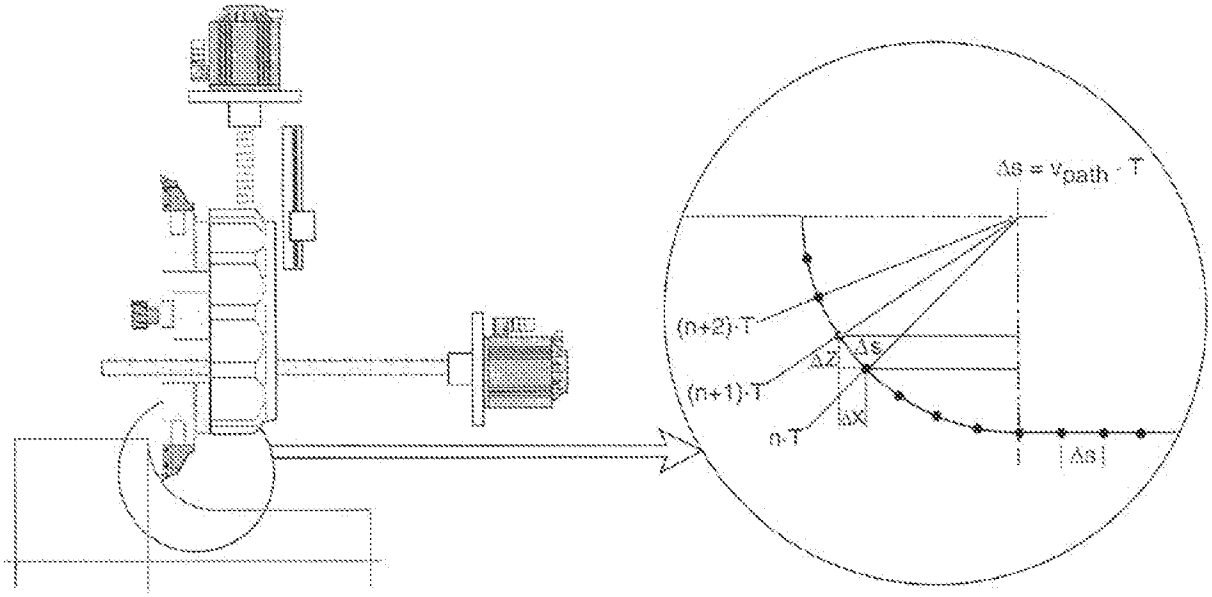
The SERCOS interface was created after a comprehensive analysis of the requirements and possible solutions.

Practical implementation and testing were carried out parallel to the theoretical development.

The facts about NC applications

The movements of the axes of numerical control machines are accomplished by position control.

CNC axes control



T [ms]	Δs [mm]
10	5
2	1
0,5	0,25
0,25	0,125
0,1	0,05

Mathematical example for high-speed machining
v_{path} = 30m/min ≙ 500 mm/s ≙ 0,5 mm/ms

The numerical control interpolates the commanded position values for all axes in cycles (fixed time-slot samples).

This interpolation must be done with short cycle times to insure a sufficient density of path waypoints in the movement.

The task of the position control is to convert these position command values, applicable only to the path position in the defined point in time, into actual position values. This conversion must be performed synchronously for all drives.

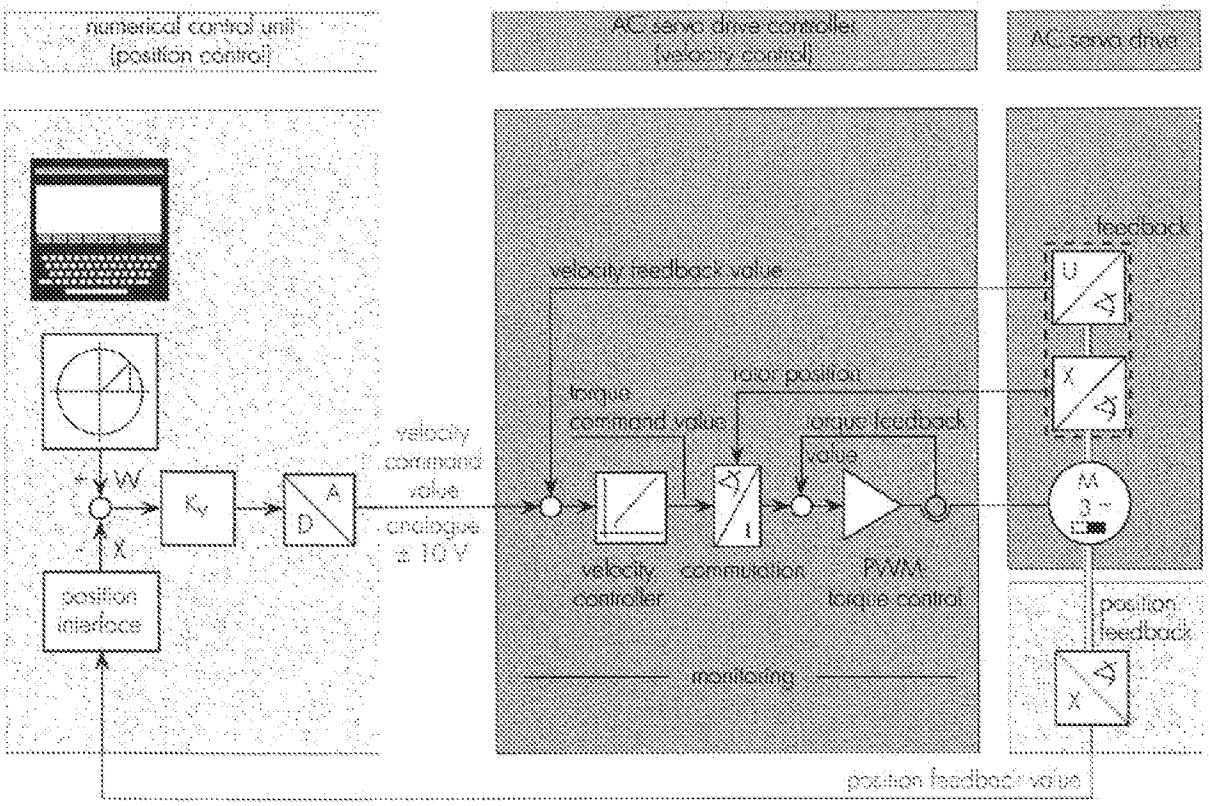
The point in time at which the actual position values are read and the point in time at which the commanded position values become effective are just as important to the precision of the path movement as is the accuracy of the commanded position itself.

In the example presented here, a measurement precision of 1 micrometer corresponds to a time precision of 2 microseconds.

The NC axis drives

In past years, NC control and drive technology has accomplished a high performance standard with analogue regulated drives.

CNC axis with analogue AC servo drive and ± 10 V interface

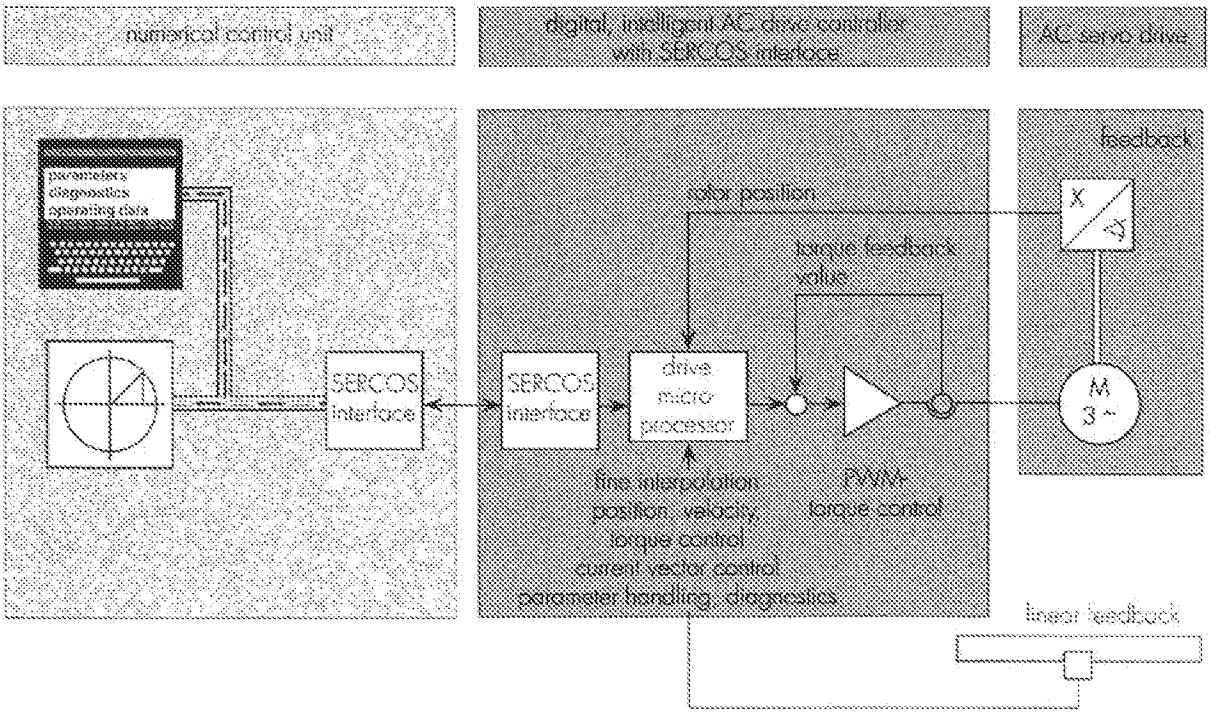


The position loop is closed within the traditional NC control.

An analogue ± 10 V velocity command interface between the control and drive is the international standard and offers a problem-free commissioning and operation of controls and drives from different manufacturers.

However, the digital-to-analog conversion limits the resolution of an analogue interface to a maximum of 16 bits, which restricts the position resolution with respect to the maximum speed.

Axis with intelligent digital AC servo drive and SERCOS interface



The expectations for digital NC drives are better noise immunity, finer position resolution, and higher path velocities with higher path accuracy.

Digital NC drives accomplish the entire drive control, monitoring, and diagnosis using a microcomputer and an extremely high-resolution measurement of the rotor position.

The dynamics of the drive control requires short sampling times of 125-250 microseconds. Extremely fine position resolution is required in order to derive velocity and acceleration data with appropriate resolution from the rotor position measurement.

The internal computing capacity of the digital drive, together with high-resolution position information, short sampling times, and the minimization of the dead times in the entire control loop, allows position loop closure within the drive with outstanding performance specifications and other new and supplementary functions.

However, this can only be utilized with a suitable interface to the control.

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