Maxon EPOS 2

Dr. *Urs Kafader*
Head of Training
maxon motor Ag,
Sachseln, Switzerland
info.in@maxonmotor.com

I. EPOS2 — A NEW GENERATION OF THE SUCCESSFUL MOTION CONTROLLER

maxon's group of small, intelligent and compact EPOS positioning controllers has acquired a new member with even better performance and additional features. Complete drive solutions for accurate positioning and regulated rotary motions are now even easier to create when combined with maxon motors.

EPOS is a family of modular digital positioning controllers based on CANopen standard for DC and EC motors with an incremental encoder in the 1 – 700 watt power range. They can all be run in position, speed and current regulation mode, and configured to run with both DC and EC motors as per software commands. A number of operating modes means they can be used flexibly in a wide range of drive systems in automation technology and mechatronics.

The EPOS2 50/5 is the next generation in the successful EPOS family, fully upgraded and featuring additional functionality, but still retaining compatibility with the existing program. With a supply voltage of up to 50 VDC and 5 A continuous current – or 250 W constant output – the EPOS2 50/5 fills the gap in the EPOS 24/5 (120W) and EPOS 70/10 (700W) performance range. Built-in chokes ensure smoothness of operation, even for low-impedance motors. Sinusoidal commutation of current and space vector PWM is used for brushless EC motors. This improves motor efficiency, but minimizes moment ripple and noise. The latest 32-bit digital signal processor technology provides greater processing power. Top-quality motion control functionalities are produced in conjunction with the additional memory. Complex mathematical algorithms are carried out more efficiently, producing even better control system characteristics.

The motion controllers in the EPOS family obey the CANopen standard CiA DS-301 and DSP-402. Communication between all CAN bus participants, particularly with the superior master, and all drive motion control functions are defined by these standard profiles, e.g. all possible positioning modes, referencing types and axis synchronisation. This simplifies integration into existing CANopen systems, provides greater compatibility with other drive manufacturers and networking with other CANopen modules. CANopen is supported by all major SPS manufacturers. The databus's widespread use in the automotive industry means that it is extremely well positioned in the automation sector as a fieldbus and instrument bus. This is characterised by excellent performance for motion control applications, top reliability, security and low switching costs per bus joints.

Alternatively, EPOS controllers can be controlled through serial interface RS232, and the EPOS2 50/5 also via USB. Another feature of these two serial interfaces is that an RS232 protocol converter (gateway) or USB to CANopen has been implemented as standard, enabling drives to be networked via these interfaces as well. Every EPOS module can be used immediately as a gateway without the need for configuration, simplifying the diagnosis of all axes in a CAN network. Detailed information on this extremely interesting function can be found in the relevant application notes.

EPOS motion controllers are point-to-point positioning drives, which means that motions always go from a start to an end point. Interim positions are calculated independently by the EPOS path generator, taking account of the selected motion profile as well as the acceleration and maximum speed parameters. Typical applications with independent axes are end stop adjustments in complicated processing machinery, sorting machines, production machines etc. Synchronously coupled multi-axis systems with 2 – 6 axes per CAN bus can also be constructed with a suitable CAN master (e.g. a programmable EPOS P 24/5) and a certain amount of programming input. Typical applications for this would be winding machinery, printing machines, electronic gearheads, cam disks and robots. With dynamic synchronisation involving short cycle times of mere milliseconds however, the bus system soon reaches the limits of its capacity. As different axis positions are adjusted in the master, point-to-point positioning requires positioning commands to be sent constantly, and positions of the various axes to be picked out. This is where EPOS2 50/5's recently implemented interpolated position mode helps. The motion is parameterized in advance for several axes in the form of support points (position, speed, time) and loaded into the motion controller. The different axes interpolate independently between the support points and process the motion profile synchronously. This means that the EPOS2 is able to traverse a path set by support points. With a suitable master, coordinated multi-axis movements and any profile can be carried out in a 1-axis system.

The EPOS family features diverse, freely configurable digital and analog inputs and outputs, enabling signals in the drive periphery to be directly imported and a functionality allocated, e.g. as a reference or end switch.

EPOS's digital inputs can be configured so that the current position value can be saved whenever a positive and/or negative edge of an input appears, known as capture inputs or position markers. Similarly EPOS2's digital outputs can be set as trigger output or position compare: a digital signal sounds when a specific position value is selected.

With the new EPOS2 50/5, specific attention was paid to interference resistance and effective protection against electromagnetic interference signals. Digital inputs and outputs are carried out accordingly on an opto-decoupled basis.

Four quick differential inputs based on RS422 are also available, providing many opportunities for signal processing.

Analog inputs also feature which, thanks to the 12-bit analog digital converters, provide high resolution and therefore good quality analog signal recording.

A Windows® based, intuitively easy-to-use graphic user interface – the EPOS studio - is available for configuring, setting up and autotuning control parameters. Various wizards (electronic assistants) and functions help ensure an easy drive set-up procedure, e.g. for configuring the drive and inputs/outputs, and for securing and cloning the drive axis parameters. Dynamic signals can easily be created and analysed through the in-built data recorder. The "regulation tuning" functionality which provides users with an effective and time-saving tool for optimum set-up and also supports current, speed or position control, has been completely redesigned. Regulation tuning takes place in three stages: section identification, feed forward and controller parameterisation, as well as control verification. For identification, the application's control section is supplemented by a feedback structure where controlled continuous oscillations develop. Their characteristics represent significant section features. Suitable feed forward and controller parameters are calculated from these section features as well as from quality application requirements. Final verification is designed to control the overall system.

Numerous prepared IEC 61131-3 libraries for CAN-master units of various SPS manufacturers (Beckhoff, Siemens/Helmholz, VIPA) and 32-bit Windows-DLLs for PC Master (IXXAT, Vector and National Instruments) are available for simple programming. Various programming examples for MS Visual C++, MS Visual Basic, Borland C++, Borland Delphi, National Instruments Lab VIEW and National Instruments LabWindows/CVI are freely available.

The operating instructions and software can be downloaded free of charge from maxon's homepage at www.maxonmotor.com.

maxon motor ag has specialised in developing, manufacturing and marketing high-powered drive components and systems under the maxon motor brand name since 1970. The company employs around 2,077 staff worldwide.

IMPORTANT EXPLANATIONS:

A. *Point to point control*

Released by a motion command, a complete path/time profile from point A to B will be generated. Usually a modification of the motion parameters (end point, acceleration, speed) is possible, also during execution of the command.

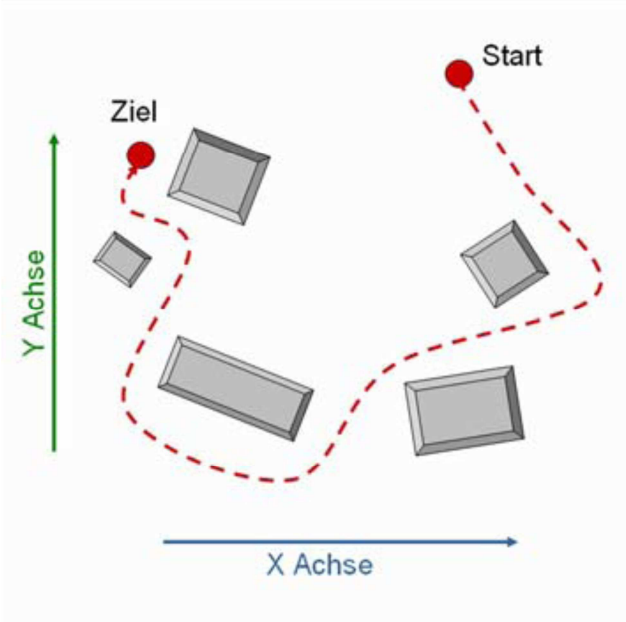

Fig. 1. typical motion task: to traverse a two-dimensional path (e.g. around obstacles) with an XY counter.

B. *Path generator*

Internal calculation routine that automatically calculates new set value positions for the control circle, taking into consideration the current position, end point, acceleration and speed in a certain pulse.

C. *Interpolated position mode*

A path set by support points is synchronously traversed. In doing so, the support points set the position and speed at a given time. The controller interpolates the interim points independently. With a suitable master, coordinated multi-axis movements and any profile can be carried out in a 1-axis system.

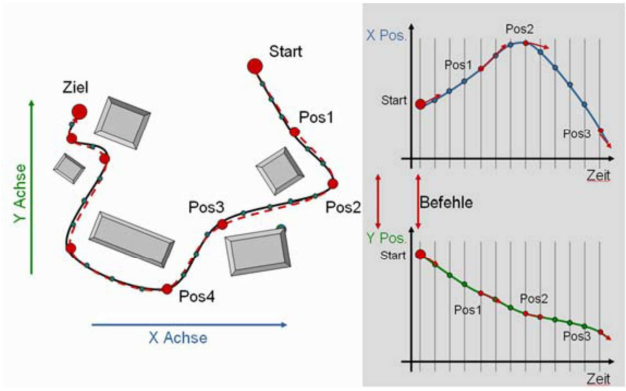

Figure 2. solution with interpolated position mode (IPM): the support points of the entire motion are sent in advance to the axes. IPM interpolates the necessary interim positions of the entire motion. In doing so, the speed values on the support points are also taken into account so that the motion is processed fluently. The motion is started on all axes by one single short start command

D. Speed profile

Automatically calculated speed process during a motion. Usually a trapezoidal speed profile is used that can be divided into three sub-ranges (constant acceleration, uniform motion, braking). Gentler starting and braking behaviour (without torque impacts) can be obtained by profiles with sinusoidal acceleration.

Figure 3 the EPOS 2 is an upgraded positioning controller. Thanks to interpolated position mode (IPM), the EPOS2 is able to synchronously traverse a path set by support points.

Figure 4 the EPOS2 50/5 (with USB) is tuned to DC brush motors with encoder or brushless EC motors with Hall sensors and encoder, from 5 to 250 watts.