

## ESCON2 and it's running smoothly

In sports as well as in drive technology success is based on power, speed and precision.

The new ESCON2 series of maxon servo controllers with CANopen and I/O commanding achieves a new level of smoothness, dynamics and precision in machines and devices with an innovative process for Hall sensor-based speed control and FOC commutation.

### ESCON2 – One product line for a wide range of applications

The ESCON2 platform offers speed and current/torque control combined with highly integrated, powerful power stages, making it the perfect combination for BLDC and DC motors in industrial, robotics, medical and analytical applications.

- ESCON2 "Nano", "Micro", and "Module" can be directly integrated into the electronic design of small and hand-held devices.



Figure 1:

«ESCON2 Nano 24/2» (P/N 809635) 23 × 16 × 4.5 mm, 2.5 g  
«ESCON2 Micro 60/5» (P/N 809631), 36.8 × 23.8 × 6.5 mm, 6 g  
«ESCON2 Module 60/12» (P/N 854796), 49.5 × 31 × 12.4 mm, 12 g  
«ESCON2 Module 60/30» (P/N 783722), 67 × 43 × 7.8 mm, 19 g

- ESCON2 "Compact" and "Housed" controllers are ready-to-connect solutions that can be placed in a control cabinet or close to the motor.

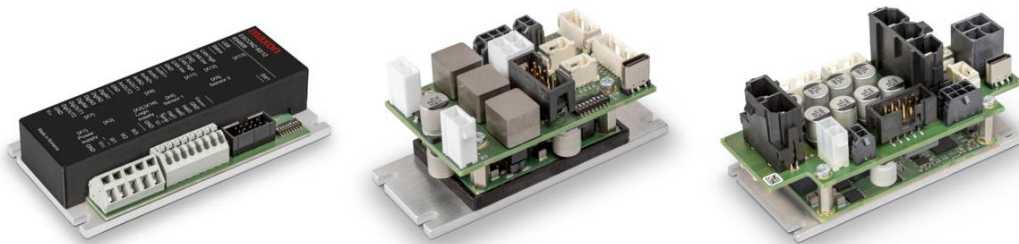


Figure 2:

«ESCON2 60/12» (P/N 854806), «ESCON2 Compact 60/12» (P/N 854801),  
«ESCON2 Compact 60/30» (P/N 783734)

The flexible command and monitoring of the ESCON2 allows both the use of simple, preconfigured I/O functions and integration into CANopen systems based on CiA402 "Device Profile for Drives and Motion Control".

## High performance control and high power density in a compact design

The ESCON2 is characterized by "maximum performance in minimum size". This approach is confirmed by repeated feedback from maxon customers' development teams:

*"Despite their small size, the ESCON2 solutions are very powerful and achieve the specified motor currents, torques and speeds, even in continuous operation with high energy efficiency."*

10 kHz speed control rate, 50 kHz current control rate, field-oriented control (FOC), combined with the latest control algorithms and overload-resistant power stages, enable motors to follow high accelerations and precise motion profiles. For machines and equipment, this means faster cycles and increased throughput with high quality and dimensional accuracy of the products produced.

Figure 3 shows the increase in speed and motor current and the precise control and motor response in the millisecond range when there is an abrupt speed set value change applied. Limiting factors for even higher dynamics is the supply voltage and the electrical and mechanical time constants of the motor and driven load.

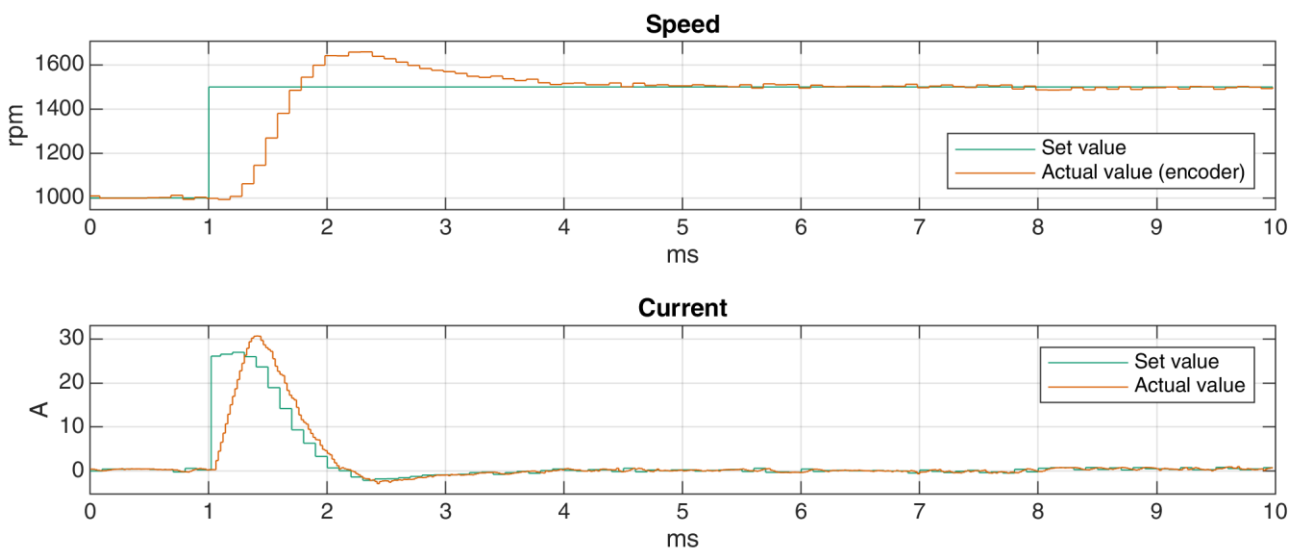


Figure 3: Speed and current response (orange curves) to a sudden step change of the speed set value.

## Perfect commutation and smooth operation even without an encoder

The field-oriented control generates sinusoidal motor currents over the entire speed range up to 120,000 rpm. Even for BLDC motors with Hall sensors only (without encoders), a new maxon method (patent pending) allows much more precise speed measurement than was previously possible. Due to their operating principle, Hall sensors only provide a low resolution per rotor revolution and the switching edges are not perfectly distributed over one revolution of the motor shaft due to manufacturing tolerances. The maxon method used for the first time in the ESCON2 analyzes the switching edge distribution of the Hall sensors during the first few motor revolutions and generates virtual, precise sensor information from this. From a speed of just a few hundred rpm, the speed stability and smooth operation of the motor is comparable to systems based on encoder feedback.

Figure 4 compares the speed stability of a common modern speed controller (blue curve) with that of an ESCON2 (orange curve) operated with Hall sensor feedback only. The speed measurement for the evaluation of the result was performed independently using a high-resolution encoder with 16384 CPT, which is not used for ESCON2's control or commutation. The measured speed of the ESCON2 (orange curve) shows a significantly lower fluctuation and thus a better smoothness along the set value than the other controller (blue curve).

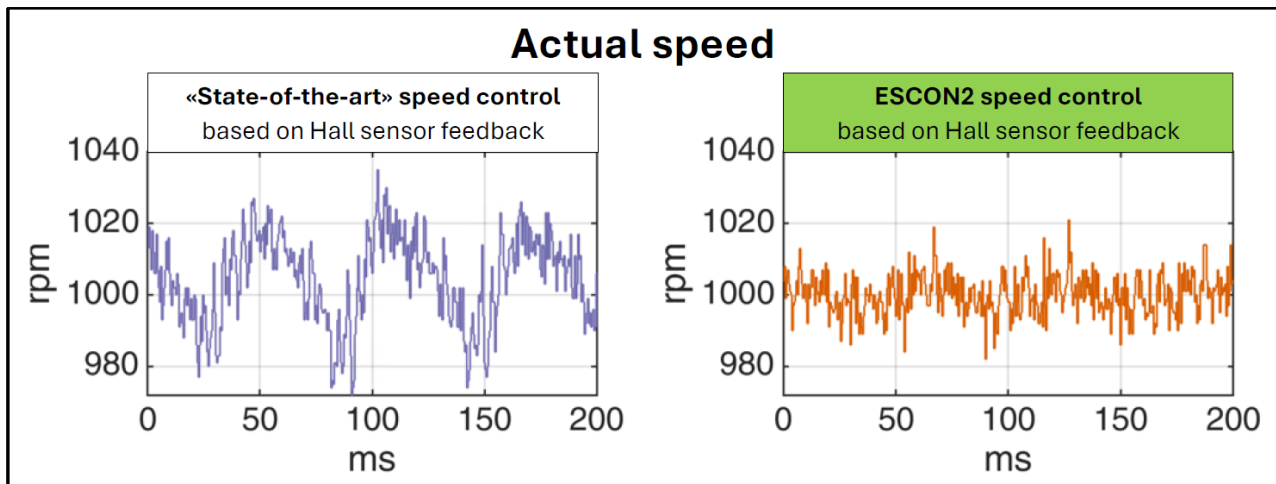


Figure 4: Comparison of the speed stability between a typical motor controller and an ESCON2 in speed controlled operation of a BLDC motor with Hall sensor feedback.

Figure 5 shows a comparison of the smooth running in terms of the motor current. The actual motor current of a typical controller (blue curve) shows significantly larger current fluctuations than the motor current of the ESCON2 (orange curve), which is very smooth and free of cyclic oscillations.

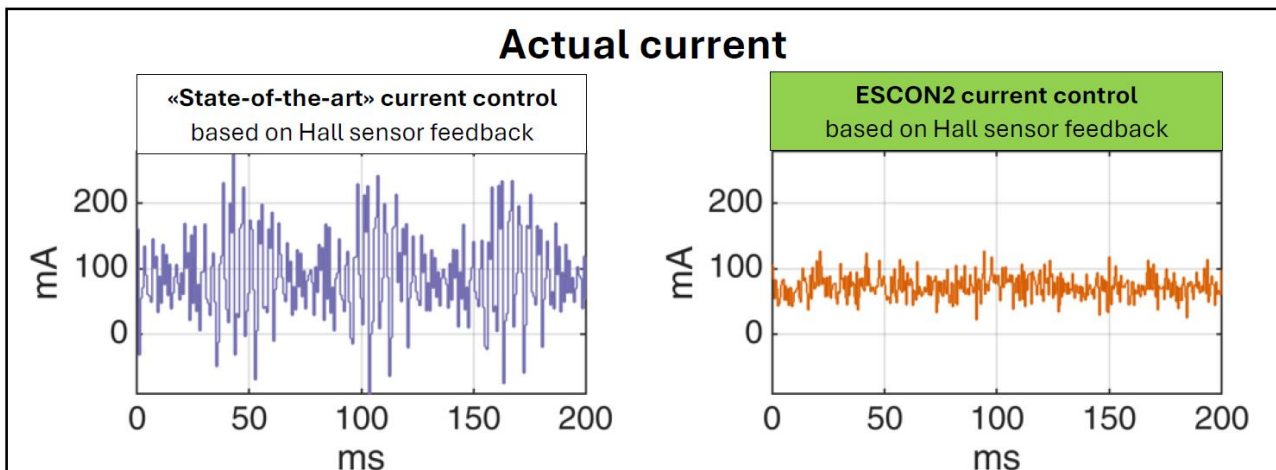


Figure 5: Comparison of the motor current between a typical controller and an ESCON2 in the speed control mode of a BLDC motor with Hall sensor feedback.

In practice, this means that the speed control of the ESCON2 with Hall sensor feedback is significantly smoother than that of other servo controllers, even at speeds as low as a few 100 rpm. This difference also results in higher energy efficiency. Last but not least, the potential elimination of the encoder means cost savings and a reduction in the amount of wiring required.

## Open interfaces for commanding and data exchange

ESCON2 offers a wide range of analog and digital inputs/outputs and bus interfaces such as USB, serial interface / RS232 and CAN (CiA402) for configuration, precise commanding and access to data for process monitoring, IoT and predictive maintenance.

Based on the CiA402 CANopen device profile, “PVM – Profile Velocity Mode,” “CSV – Cyclic Synchronous Velocity,” and “CST – Cyclic Synchronous Torque” modes are supported. In addition, two maxon-specific operating modes are available with “IOVM - I/O Velocity Mode” and “IOCM - I/O Current Mode” which combine control via analog and digital inputs/outputs with high-performance data exchange and process feedback via fieldbus. This guarantees maximum flexibility, compatibility, and scalability for use in simple devices with analog control up to fully digital systems based on CANopen.

As a system integrator put it:

*“The standardized CiA402 CANopen device profile used by the ESCON2 reduces integration and development efforts and the risk of incompatibility when using mixed system components.”*

## Updates and application-specific add-ons

User feedback and requests for functional enhancements are consistently collected and prioritized by maxon. The ESCON2 functionality is expanded free of charge through regular updates.

For series customers, maxon offers fast and efficient development of cost- and function-optimized individual solutions, which is reflected in the statements of developers and users:

*“The ESCON2 platform is a solid foundation for easy integration of even complex additional features and requirements.”*

## Motion Studio makes it fast and easy

maxon's "Motion Studio" software uses a "Startup" wizard to guide the user through the basic configuration of the drive unit and the desired I/O functions. The "Regulation Tuning" wizard automatically determines all control parameters.

Successful commissioning of new drives is completed with just a few entries and clicks. The created system configuration can be saved and transferred to other ESCON2 controllers.

The "Data Recorder" integrated in "Motion Studio", which can record four channels, is particularly helpful for system developers or service staff.

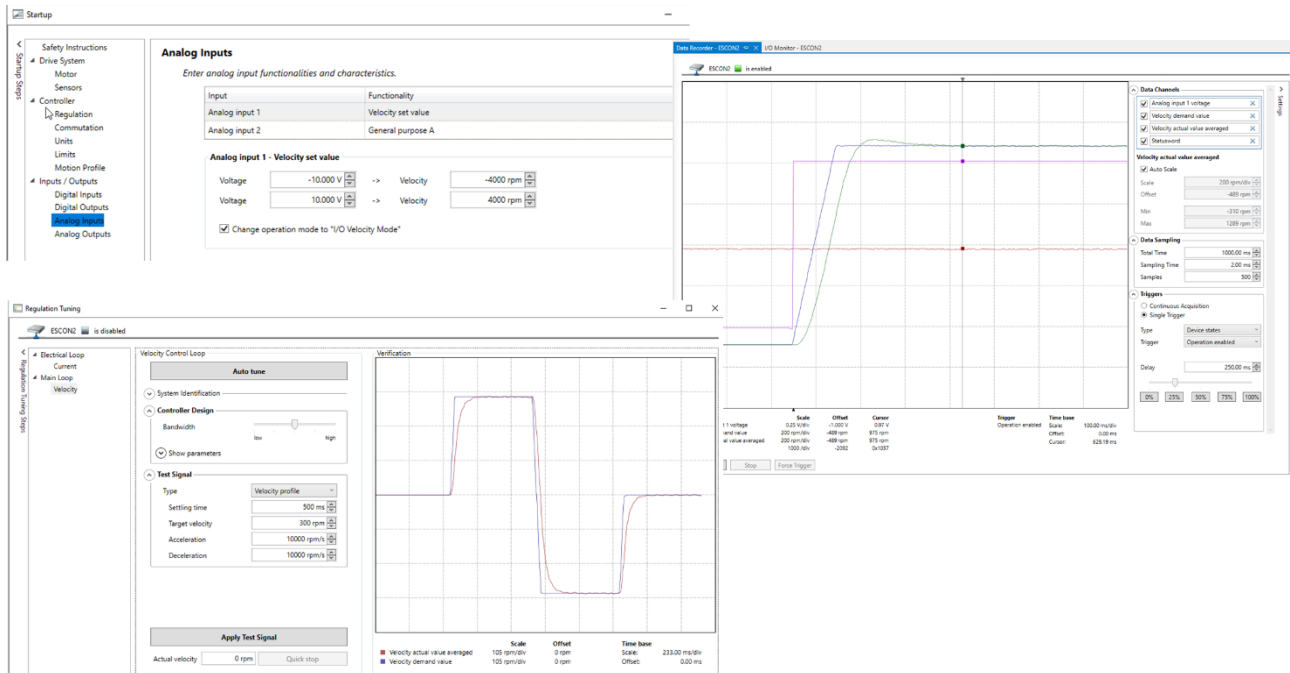


Figure 6: Motion Studio's "Startup", "Regulation Tuning" and "Data Recorder"

## ESCON2 – In a nutshell

- High performance speed and current/torque control.
- FOC commutation up to 120,000 rpm (1 pole pair BLDC).
- New maxon method (patent pending) for unprecedented speed stability and smooth operation of BLDC motors with Hall sensors (even without an encoder).
- Commanding and feedback via I/O, USB, serial interface (RS232), or CANopen (CiA402).
- CiA402 operating modes PVM, CSV, CST, and maxon-specific modes IOVM and IOCM for mixed operation via I/Os and CANopen.
- Wide range of product designs and output power.
- Easy commissioning through intuitive GUI with automatic "Regulation Tuning".
- Future-proof thanks to functional, free updates.
- Customer-specific function extensions and hardware designs for OEMs.

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