Electronics in Drive Technology

Product Range 2004/05

maxon motor control

maxon

maxon motor ag

Electronics for maxon DC motor

4-Q-DC Servoamplifier LSC
- Five operating modes: IxR compensation, DC tacho operation, regulator operation, encoder and current regulator
- Thanks to linear power stage, practically no electrical interference
- No motor choke necessary
- Stand alone - easy start up procedure
- Continuous output current max. 2 A, $I_{cont} = I_{max}$
- Supply voltage V_{CC} 12 - 30 VDC
- **Order number 250521**

ADS 50/5

ADS 50/10

4-Q-DC Servoamplifier ADS
- Four operating modes: IxR compensation, DC tacho / encoder speed control, current control
- Pulse width modulated power stage
- Module housing with screw terminals
- Supply voltage V_{CC} 12 - 50 VDC

	Standard version ADS 50/5	Power version ADS 50/10
Max. output current I_{max}	10 A	20 A
Cont. output current I_{cont}	5 A	10 A
Built-in motor choke	yes	no
Order number	**145391**	**201583**

ADS_E 50/5

ADS_E 50/10

4-Q-DC Servoamplifier ADS_E
- Four operating modes: IxR compensation, DC tacho / encoder speed control, current control
- Pulse width modulated power stage
- Eurocard format
- Supply voltage V_{CC} 12 - 50 VDC

	Standard version ADS_E 50/5	Power version ADS_E 50/10
Max. output current I_{max}	10 A	20 A
Cont. output current I_{cont}	5 A	10 A
Built-in motor choke	yes	no
Order number	**166143**	**168049**

Electronics for maxon EC motor

1-Q-EC Amplifier Sensorless AECS 35/3

- Analog speed controller with Back-EMF
- Motor speed can be regulated with the built-in potentiometer or an externally predetermined set value
- Brake, direction and disable input
- Ready to connect electronic circuit board
- Max. output current I_{max} 5 A
- Continuous output current I_{cont} 3 A
- Supply voltage V_{CC} 8 - 35 VDC
- **Order number 215738**

DIGITAL

1-Q-EC Amplifier DEC 24/1

- Digital speed controller with Hall sensors
- Motor speed can be regulated with the built-in potentiometer or an externally predetermined set value
- Brake, direction and disable input
- Ready to connect electronic circuit board
- Max. output current I_{max} 2 A
- Continuous output current I_{cont} 1 A
- Supply voltage V_{CC} 5 - 24 VDC
- **Order number**
  DEC 24/1 with FPC RM 0.5 mm **249629**
  DEC 24/1 with FPC RM 1.0 mm **249630**
  DEC 24/1 with pin connector **249631**
  DEC 24/1 with screw terminal **249632**

249629   249630   249631   249632

DIGITAL

1-Q-EC Amplifier DEC 50/5

- Digital speed controller with Hall sensors
- Motor speed can be regulated with the built-in potentiometer or an externally predetermined set value
- Brake, direction and disable input
- Connection ready module
- Max. output current I_{max} 10 A
- Continuous output current I_{cont} 5 A
- Supply voltage V_{CC} 10 - 50 VDC
- **Order number 230572**

Electronics for maxon EC motor

DES 50/5

DES 70/10

DIGITAL　CAN　RS232　GUI
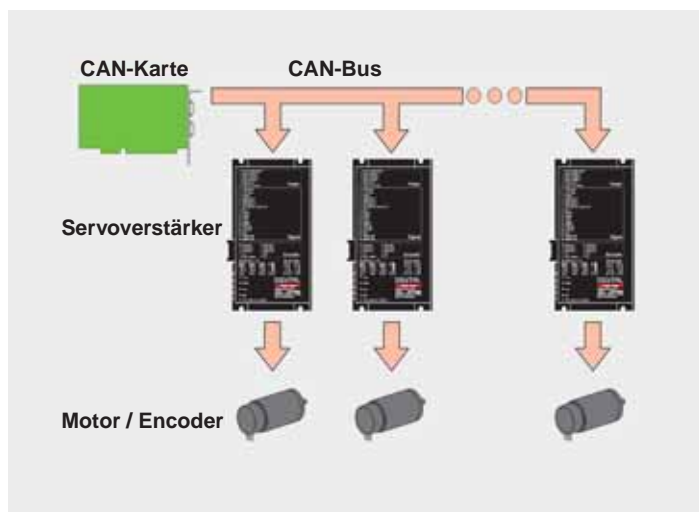
4-Q-EC Servoamplifier DES

- High quality digital regulation of speed and torque with encoders and Hall sensors
- Sinusoidal current commutation
- Suitable for positioning applications
- 4-Q operation
- Communication possible by RS232 or CAN
- Connection ready module

	Standard version DES 50/5	Power version DES 70/10
Max. output current I_{max}	15 A	30 A
Cont. output current I_{cont}	5 A	10 A
Supply voltage V_{CC}	12 - 50 VDC	24 - 70 VDC
Built-in motor choke	yes	no
Order number	**205679**	**228597**
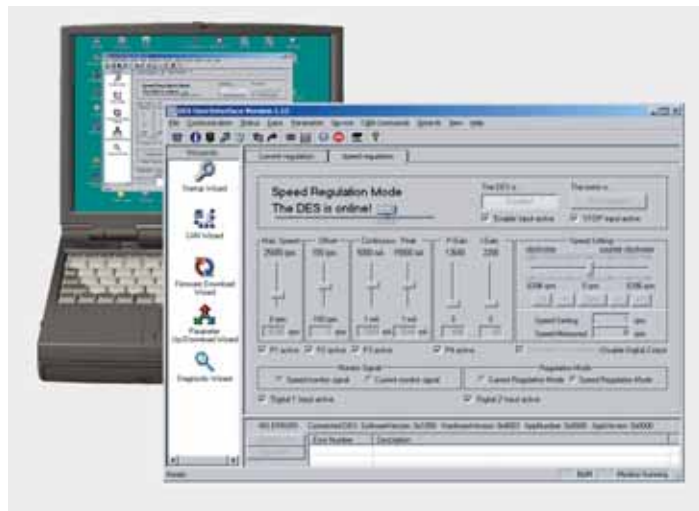
Grafical User Interface (GUI)

User-friendly - the servoamplifier can be easily adjusted with a potentiometer or PC. The use of software is particularly beneficial for series application, as all settings and parameters can be quickly adjusted for easy numerical reproduction.
The software and operating instructions can be downloaded from www.maxonmotor.com in the "Service" section under "Downloads".

CAN bus

The DES servoamplifier can be attached in a wide variety of ways: analogue with potentiometers or via serial interfaces.
The CAN field bus means that the DES servoamplifier can be attached modularly into industrial applications.

CAN-Karte　　**CAN-Bus**

Servoverstärker

Motor / Encoder

Online-Commanding

EPOS
- Point to point control unit
- 1-axis controller
- Multiple axis systems by networking via CAN Bus
- CANopen
- For DC and EC motors
- Digital inputs/outputs
- Analog inputs
- Modular design

EPOS 24/1	24 V, 1 A
EPOS 24/5	24 V, 5 A
EPOS 70/10	70 V, 10 A

Operation with online commanding by PC through RS232 or by CAN Bus Master (PC, SPS, Soft SPS)

Typical applications:
Automation tasks
Production machinery
Work equipment manufacturing

"stand-alone" version in preparation

Online-Commanding

MIP 10
- Point to point control unit
- 1-Axis controller
- Multiple axis systems by networking over serial data bus
- For DC motors
- Continuous output current I_{cont} up to 1.8 A
- 8 digital inputs
- 4 digital outputs

Operation with online commanding by PC or PLC
Programming knowledge necessary

Typical applications for DC motors up to 50 Watt:
Experimental setups
Work equipment and examination equipment manufacturing

MIP 50 / MIP 100
- Point to point control unit
- 1-Axis controller
- Multiple axis systems by networking over serial data bus
- Software configurable for DC motors and EC motors
- Continuous output current I_{cont} up to 5/10 A
- 8 digital inputs
- 6 digital outputs
- Eurocard format

Operation with online commanding by PC or PLC
Programming knowledge necessary

Typical applications for DC motors and EC motors up to 250 / 500 Watt:
Work equipment and examination equipment manufacturing
Machine tool industry

Important notes:

- Standalone operation

  Independent process cycle control without superior system.
  The process cycle must be programmed into the positioning control in advance.

- Online commanding

  Single motion and I/O commands from the process cycle control are transmitted to the positioning control by a superior system. For that purpose product specific commands are available.

- Point to point control unit

  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 the execution of the command.

- Path generator

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

- Speed profile

  Automatically calculated speed process during a motion. Usually a trapezoidal speed profile is used, which can be divided into three sub-ranges (constant acceleration, uniformed motion, braking).
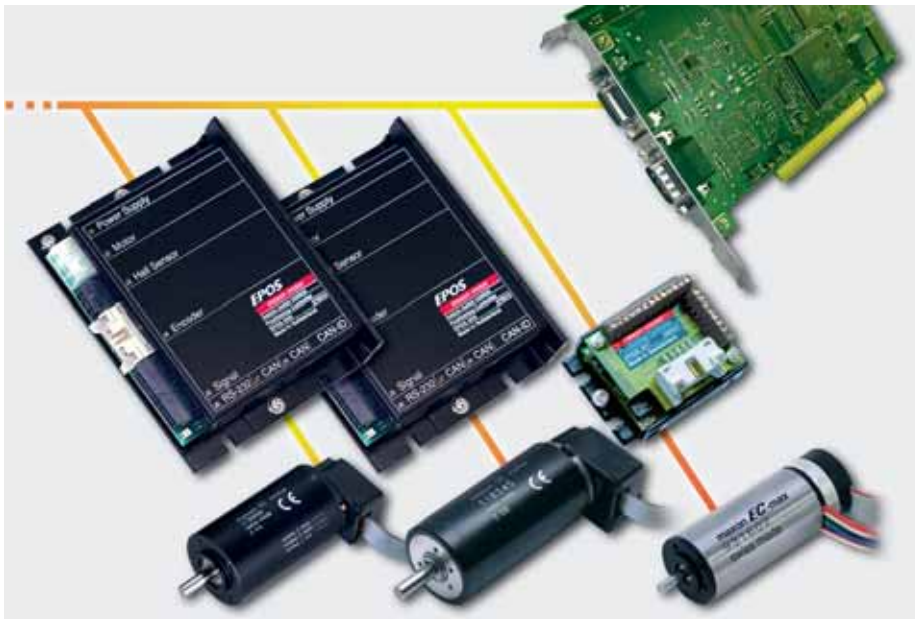 A gentler starting and brake behavior (without torque impacts) can be obtained by profiles with sinusoidal acceleration

- Position detector

  Digital encoder or linear measuring systems. Due to control-technical reasons an encoder which is directly mounted to the motor is preferable. With incremental encoders the current position is determined by the positioning control by continuing counting of the impulses. With the start-up of the system a reference run must be made on a defined point (index or reference switch) for absolute defined position.

- Accuracy and resolution

  As a result of the flank analysis of the signals from the position detector a four times higher resolution arises in relation to the number of impulses.
  The attainable absolute accuracy is frequently clearly worse and is determined by the reference switch as well as by the play of all mechanical components.

EPOS positioning control unit

Function description

EPOS is a modular-designed digital positioning system suitable for DC and EC motors with incremental encoder. The performance range of these compact positioning controllers starts at a few Watt and goes up to 700 Watt.

A variety of operating modes means that all kinds of drive and automation systems can be flexibly assembled using positioning, speed and current regulation. The in-built CANopen interface allows networking to multiple axis drives, with additional I/O modules and online commanding by CAN Bus master units.

- CANopen profile position-, profile velocity- and homing mode
- Position, velocity and current mode
- Digital Position Reference by Pulse/Direction or Master Encoder
- Sinusoidal or Trapezoid Commutation for EC motors
- Smart multi-purpose digital I/O's configurable as: Positive and negative limit switches, Home switch, Brake output
- General purpose digital I/O's and analogue inputs
- Communication through CAN and/or RS-232
- Gateway RS232 to CAN
- Windows-based Graphical User Interface for set-up, start-up and auto-tuning

Extensive software assistance and a graphic user interface support the start-up procedure, regulator adjustment and adapting to the PC world or other CANopen equipment.

| Advantages	Features
● digital	Full digital position, speed and current-torque control
● flexible, modular	Versions for brush and brushless DC drives, from the smallest micro-drive up to 700 Watt motors
● extendable	Networking of up to 127 drive units in one CAN Bus
● easy start-up procedure	Cable available Numerous prepared IEC-1131 libraries for CAN Master units, Windows DLL for RS232 and PC-CAN card with several programming examples, support through Graphical User Interface, start-up wizard, diagnosis help, automatic regulator settings
● standardised	CANopen standard CiA DS-301 and DS-402
	Broad spectrum of controllers, I/O modules and controllers of third-party suppliers available that can easily be used with EPOS
● excellent price/ performance ratio	Cutting-edge technology helps provide wide-ranging sophisticated functionality, sinusoidal commutation for the lowest torque ripple in EC motors. Motor chokes are already built into EPOS

Available documentation and software

- Getting Started
- Cable Starting Set (only for EPOS 24/5 and EPOS 70/10)
- Hardware Reference
- Graphical User Interface GUI
- Windows DLL
- IEC1131 Libraries
- Firmware Specification
- Communication Guide
- Application Notes
- Application Samples

Cable accessories (option)

A comprehensive range of cables is available as an option.
Details can be found in the catalogue 2004/05 on page 266.

maxon – everything from one source
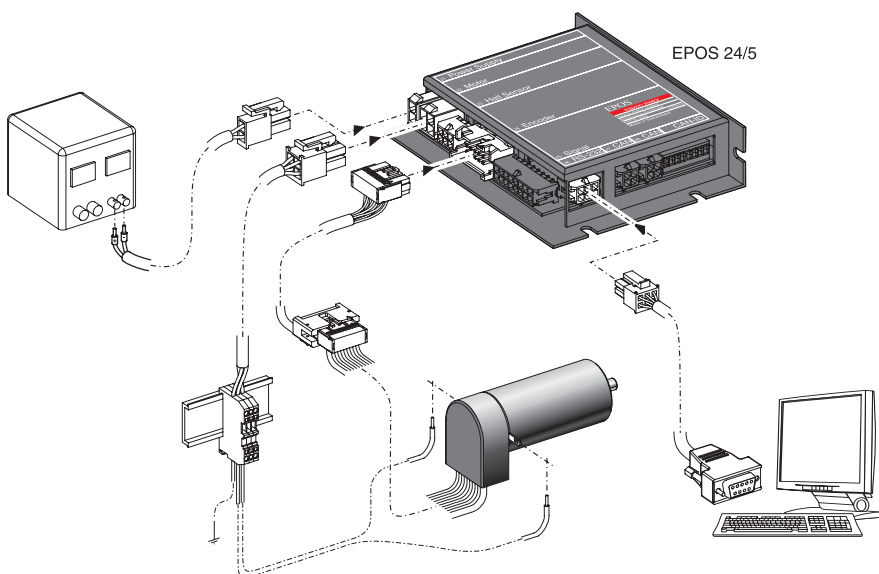
EPOS 24/5

EPOS 24/1

Matched with DC brush motors with MR encoder up to 20 Watts and brushless EC 6 motor with Hall sensors and MR encoder.

EPOS 24/1 for DC motors

EPOS 24/1 for EC 6 motor

EPOS 24/5

Matched with DC brush motors with MR encoder and brushless EC motors with Hall sensors and MR encoder, from 5 to 120 Watts.

EPOS 70/10

Matched with DC brush motors with MR encoder and brushless EC motors with Hall sensors and MR encoder, from 80 to 700 Watts.

maxon motor control

Electrical Data
- Supply voltage V_{CC} (Ripple < 10%)

EPOS 24/1	9 - 24 VDC
EPOS 24/5	11 - 24 VDC
EPOS 70/10	11 - 70 VDC

- Max. output voltage

EPOS 24/1	0.98 x V_{CC}
EPOS 24/5	0.9 x V_{CC}
EPOS 70/10	0.9 x V_{CC}

- Max. output current I_{max} (<1 s)

EPOS 24/1	2 A
EPOS 24/5	10 A
EPOS 70/10	25 A

- Continuous output current I_{cont}

EPOS 24/1	1 A
EPOS 24/5	5 A
EPOS 70/10	10 A

- Sample rate of PI - current controller   10 kHz
- Sample rate of PI - speed controller   1 kHz
- Sample rate of PID - positioning control   1 kHz
- Max. speed (motor with 2 poles)   25 000 rpm
- Built-in motor choke per phase

EPOS	150 µH / 5 A (DC-motor)
	300 µH / 0.7 A (EC 6-motor)
EPOS 24/5	15 µH / 5 A
EPOS 70/10	25 µH / 10 A

Input
- Hall sensor signals   H1, H2, H3
- Encoder signals   A, A\, B, B\, I, I\ (max. 1 MHz)
- Digital inputs

EPOS 24/1	6 digital inputs
EPOS 24/5	6 digital inputs
EPOS 70/10	8 digital inputs

- 2 analogue inputs   10-bit resolution, 0 … +5 V
- CAN-ID (CAN node identification)

EPOS 24/1	configurable with DIP Switch 1 … 4
EPOS 24/5	configurable with DIP Switch 1 … 7
EPOS 70/10	configurable with DIP Switch 1 … 7

Output
- Digital outputs

EPOS 24/1	2 digital outputs
EPOS 24/5	4 digital outputs
EPOS 70/10	4 digital outputs

Voltage outputs
- Supply voltage ENCODER   +5 VDC, max 100 mA
- Hall sensors supply voltage   +5 VDC, max. 30 mA
- Auxiliary voltage

EPOS 24/1	+5 VDC, max. 10 mA
EPOS 24/5	VCC, max. 1300 mA
EPOS 70/10	+5 VDC (Ri = 1 kΩ)

Interface
- RS232   RxD; TxD (max. 115 200 bit/s)
- CAN   high; low (max. 1 Mbit/s)

Status indicator
- LED

EPOS 24/1	red LED, green LED
EPOS 24/5	2 colours LED
EPOS 70/10	2 colours LED
green = READY, red = ERROR	

Ambient temperature-/humidity range
- Operation   -10 ... +45 °C
- Storage   -40 ... +85 °C
- No condensation   20 ... 80 %

Order numbers

280937	EPOS 24/1 for DC motors
280938	EPOS 24/1 for EC 6 motor
275512	EPOS 24/5
300583	EPOS 70/10

Mechanical data
- Weight

EPOS 24/1	approx. 45 g
EPOS 24/5	approx. 170 g
EPOS 70/10	approx. 330 g

- Dimensions (L x W x H)

EPOS 24/1	55 x 40 x 25 mm
EPOS 24/5	105 x 83 x 24 mm
EPOS 70/10	150 x 93 x 27 mm

- Fastening   Flange for M3-screws

MIP Technology

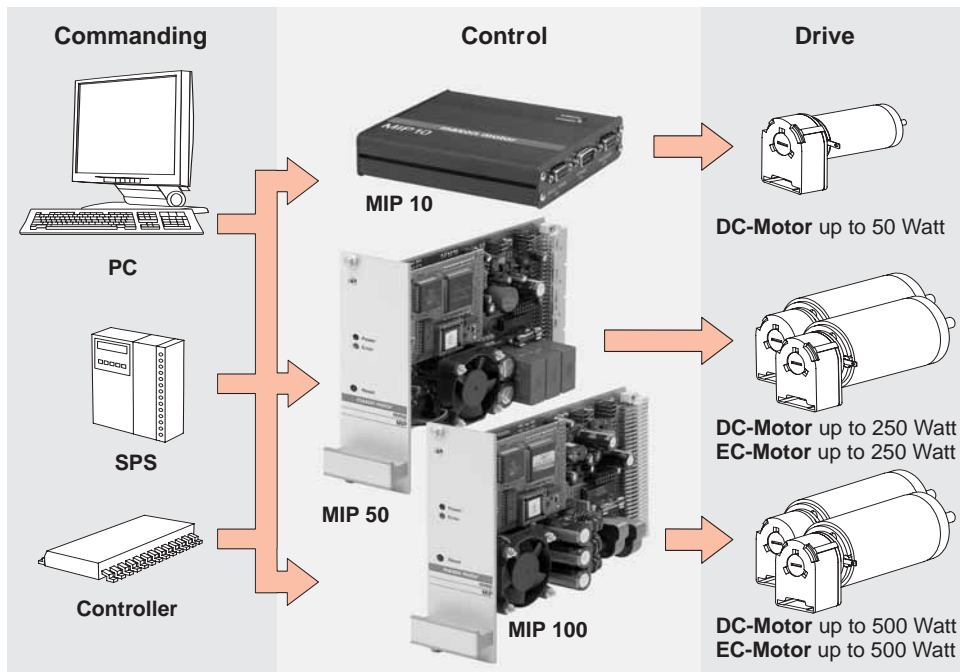**MIP 50**   **MIP 100**   **MIP 10**

Application

MIP Positioning Controllers are used for the setting up of flexible, full digital drive solutions, for measuring-, analysis- and handling devices as well as for the positioning of workpieces, tools and end stop positioning in machine tool industry.

Advantages	Features
● Digital	Full digital position speed and current / torque control Fully digital trimming without potentiometers
● Flexibe	Versions for electronically or mechanically commutated DC drives
● Extendable	Networks of up to 64 drives are possible with a RS485 interface
● User friendly	Control concept and commanding of all components are uniform
● Interfaces	Digital and analog inputs and outputs for process control Commanding by digital inputs / outputs, RS232 or RS485 interface
● Software compatible	Microsoft Windows®, 32-bit DLLs , Tools, as well as sample programs for Visual C++®, Visual Basic®, DELPHI® and LabView® are available

Commanding	Control	Drive

PC

SPS

Controller

MIP 10

MIP 50

MIP 100

DC-Motor up to 50 Watt

DC-Motor up to 250 Watt
EC-Motor up to 250 Watt

DC-Motor up to 500 Watt
EC-Motor up to 500 Watt

| Order numbers	MIP 10	MIP 50	MIP 100
Max. output current I_{max}	2 A	13 A	20 A
Continuous output current I_{cont}	1.8 A	5 A	10 A
Built in motor choke	yes	yes	no
MIP Eurocard format		200629	246244
MIP Front panel (3 HE / 8 TE)		200640	200640
MIP Set incl. cable	111091		
MIP Set without cable	108871		

MIP Operating Modes

MIP-Studio

RS 232 / RS 485
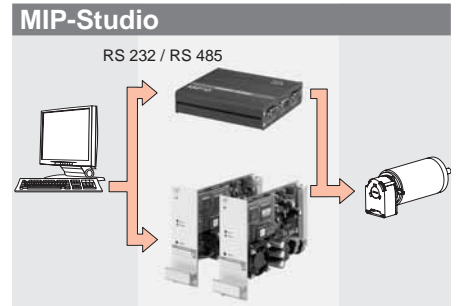
● Graphic tool for start-up procedure with user navigation for configuring the drive unit
● Support from automatic determination of motor parameters
● Autotuning the controller parameters
● Data recorder function
● Commanding of the motion sequences

ASCII-Mode

RS 232 / RS 485
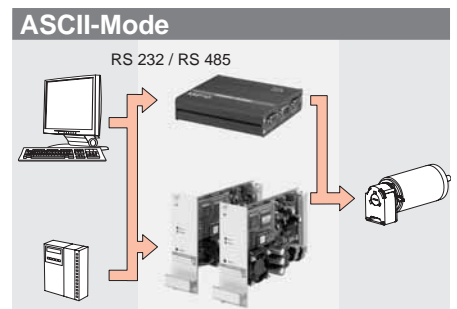
● Simple communication profile and commands for 1-Axis systems in connection with a PLC ora PC

I/O-Mode

I/O
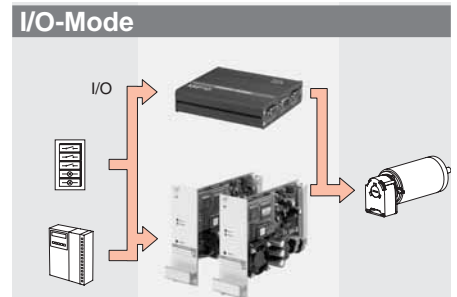
● Direct process control via tracer or a digital I/O of a small PLC
● For simple and economically priced 1-Axis positioning systems without superior process control or in combination with a PLC

MIP Bus-Mode

RS 232 / RS 485
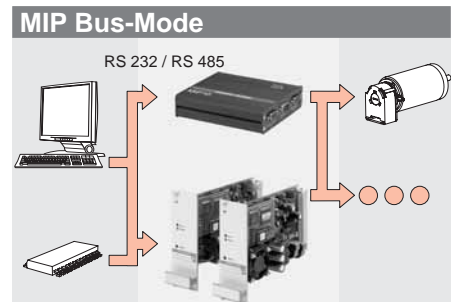
● Complex communication profile and extensive commands
● For 1- and multiple-axis systems with a superior system (for ex. PC or micro controller) for process control

maxon motor control

Special Versions

Customer
● Drive problems
● Requirements
● Expectations
● Process Information

maxon Technology Center
● Control, regulation
● Drives
● Sensors
● Know-how in drive and control technology
● Advice
● Quality - ISO 9001

Partnership

Our know-how in drive technology and drive electronics is also reflected in the manufacture of special customerspecific versions. We develop special versions to your specifications and supply drive electronics that are compatible with maxon motors and are competitively priced, from the prototype to full-scale production.

We will design and develop tailor made solutions

Communication
● Analysis
● Defining goals
● Possible solutions
● Evaluation
● Specifications

Technology

We use the most up-to-date technology on a case-by-case basis for designing and manufacturing customer-specific servoamplifiers and positioning drive units.
● Analogue
● Digital with . . .
. . . microprocessors
. . . signal processors
. . . software
● SMD modules
● Hybrid technology
● Chip on Board

System supplier
● Implementation
● Integration
● Modification
● Submitting tenders

Facts
● Samples
● Joint tests
● Optimisation
● Process supervision
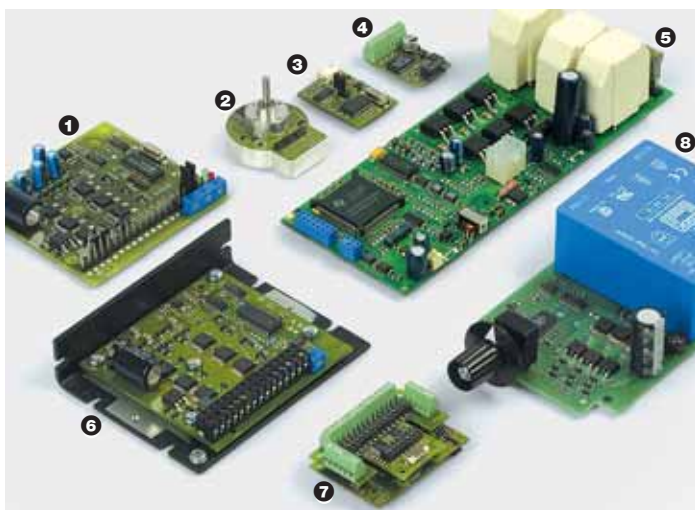
Examples

maxon's particular strength is configuring special products to meet customer requirements:

❶ 4-Q-EC amplifier – low-cost option

❷ 1-Q-EC amplifier – integrated into the motor

❸ 1-Q-EC amplifier – sensorless miniature version for the maxon EC 6 flat motor

❹ Interface transformer

❺ 4-Q-EC servoamplifier for battery operation

❻ 1-Q position control for EC motors

❼ 4-Q-EC servoamplifier – precision servo for miniature positioning drive units

❽ 1-Q-EC amplifier – sensorless – with mains connection

High-end Motion Control

www.maxonmotor.com
www.nyquist.com

NYCeLauncher
(NYCeConfigurator, NYCeTuner, NYCeTalk)

FireWire®

MX3000   **FirePoint I/O**   **Vision**

High-end motion control

maxon motor collaborates with competent partners for complete solutions. maxon motor and Nyquist Industrial Control have developed high-performance contouring control systems, such as the MX3000/DNA motion controller which is suitable for customer-specific solutions.

This high-end motion control is an open PC-based platform that accommodates installation concepts with motion control units, I/O modules, camera systems (vision) with the support of a comprehensive application development tool.

The software runs on a standard operating system such as Microsoft Windows 2000 or XP.

The FireWire® 1394 real-time data bus guarantees an impressive band width. Pulse-synchronous communication between PC and drives is possible, with the PC's function remaining intact (clean PC concept).

Highlights

- "Smartdrive" motion control with integtrated servoamplifier
- Full digital concept, no analogue interfaces and minimal cabling
- Available for maxon DC and EC motors from 10 to 250 Watts
- Industry standard IEEE-1394 FireWire network connection
- 400 Mbit / s minimal communication speed
- Motion, I/O and picture processing on a FireWire network
- Real-time and deterministic communication between junctions

Software

Equipment and its configuration can easily be set up with Nyquist NYCE3000 software. The Motion Controller MX3000/DNA is fully integrated in the software.
A range of optimisation and analysis tools is available.

Overview of software functions:

- Single and group axis commands
- Motion commands such as homing, jogging, point to point positioning and contouring
- Single or coordinated motion
- Feed override - speed change for all axes with a single parameter
- Electronic camming and gearing in all variations
- S-curve acceleration and deceleration
- "On the fly" speed adjustment end position correction and parameter changes
- Cubic spline set point calculations (position, speed and time)
- Programmable master slave offset

maxon motor is member of

1394automation
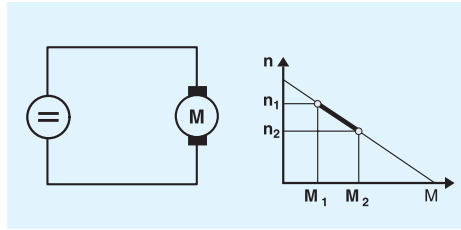FireWire® for the Industry
www.1394automation.org

FireWire®, the FireWire symbol and logo are trademarks of Apple Computer, Inc., registered in the U.S. and other countries.
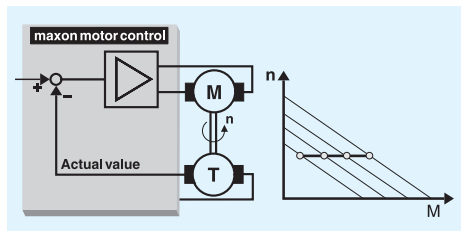
maxon motor control

Important characteristics:
Motor **without** speed controller:
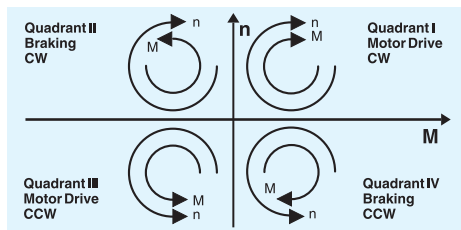Speed decreases with increasing load.

Motor **with** speed controller:
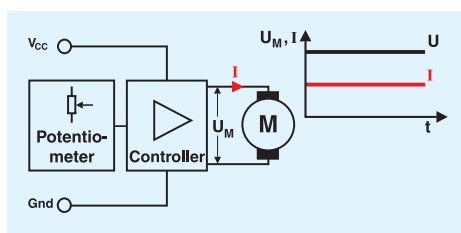Speed remains stable.

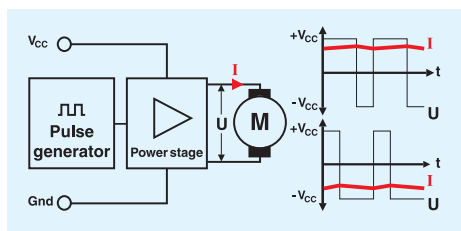**1-Q Mode:** accelerates only, pure motor mode
4-Q Mode: controlled acceleration and braking in both directions.

Linear power stage: simple, but effective
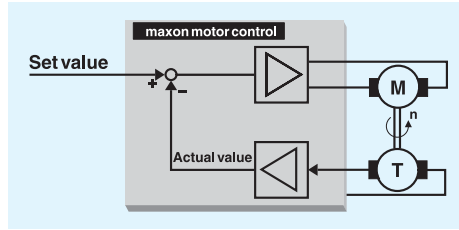controller. Recommended for low power applications.

Chopped (resp. pulse width modulated,
PWM) **power stage**: The controller cuts the motor voltage in short intervals. High efficiency.

DC tacho feedback
The classical solution for very precise speed control.

Digital encoder speed control
The ideal solution for a good speed control with a long life expectancy.
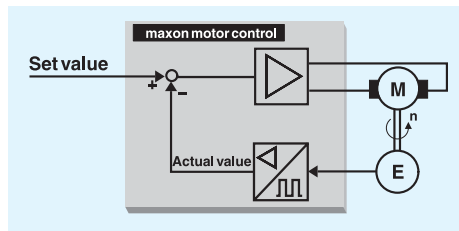
IxR compensation
Solution for low cost applications that do not demand precise speed control.
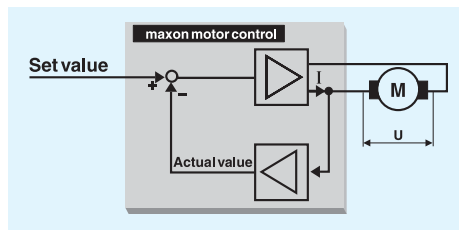
Current control
For applications with a master positioning control unit.
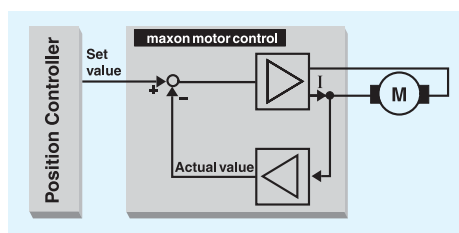

Position control
The positioning controller ensures a match between the currently measured position with a target position by providing the motor with the corresponding correction values.

Commutation of EC motors
In contrast to maxon DC motors, the ironless winding ① is stationary, whereas the permanent magnet ② rotates in the field of the three-phase electronically commutated winding ③. Rotor position detection is accomplished by using hall sensors ④.
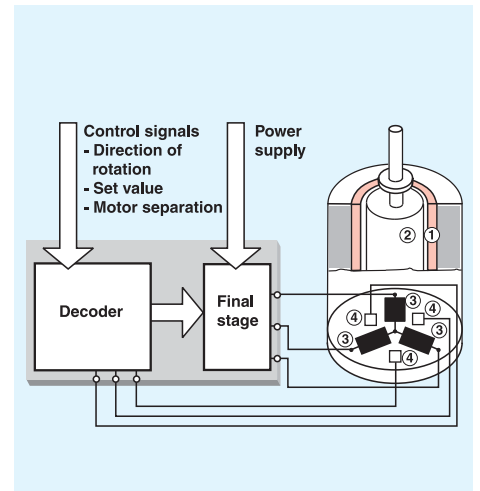
The primary task of the electronic, is to commutate the brushless motor. The rotary field precedes the rotor by 90° and therefore produces maximum torque.
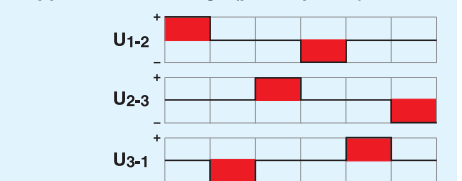The built in hall sensors allow simple speed control. For high performance, a digital encoder is often used additionally.
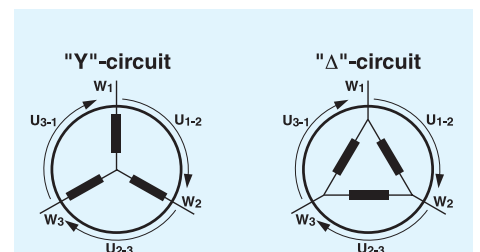
The maxon group is perfoming well despite the worldwide economic turbulence.

With a global workforce of around 1000, this company is a leading supplier of high-precision drive technology up to 500 W output power.

Back on Mars! Yes, and again with maxon motors. After the successful mission with "Sojourner" in 1997, in 2004 both the rovers "Spirit" and "Opportunity" are driven by 39 maxon motors.

maxon motor – at a glance!

maxon DC motors are high quality DC micromotors. The patented moving coil rotor represents the heart of the motor.

Electronically commutated DC servomotors with no detent for maximum service life.

The innovative DC motor program with even greater performance and quality data at impressive conditions.

The new EC motor program picks up the ideology of the successful A-max and RE-max motors. Modular system with gearheads, sensors and brakes.

The high-power range DC motor, with top performance and convincing quality. Same design as the innovative and award winning A-max range.

EC flat motors are brushless motors with a flat design for when space is limited.

Precision spur and planetary gearheads matched to maxon motors.

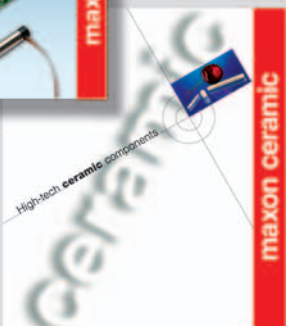An extensive range of electronic control systems meets your every need in terms of performance and speed accuracy.

Micro drives less than 10 mm in diameter

High resolution analog and digital tachos through to absolute trans-mitters guarantee highly dynamic control systems with our precision motors.

High-tech ceramic components – MIM/CIM technology

Order the new maxon catalogue 04/05 with CD-ROM and maxon selection program. 288 pages of comprehensive information on motors, gearheads, tachos and controls.