

maxon motor control

Technology – short and to the point

The **maxon motor control** program contains servo amplifiers for controlling the fast reacting maxon DC and EC motors.

Program

- **ESCON: 4-Q speed and current controller for DC and EC motors**
- **EPOS: Position controller for DC and EC motors**

Motor type

- maxon DC motor
- maxon EC motor with or without sensor

Type of control

- Speed
- Position
- Current

Feedback

- Encoder
- DC Tacho
- IxR compensation
- Hall sensors

Set value specification

- Analog voltage
- Digitally via field bus

Controlled variables

Speed control

The function of the speed servo amplifier is to keep the prescribed motor speed constant and independent of load changes. To achieve this, the set value (desired speed) is continuously compared with the actual value (actual speed) in the control electronics of the servo amplifier. The controller difference determined in this way is used by the controller to regulate the power stage of the servo amplifier in such a manner that the motor reduces the controller difference. This represents a closed speed regulating circuit.

Position control

The positioning control ensures a match between the currently measured position with a target position, by providing the motor with the corresponding correction values, as with a speed controller. The position data are usually obtained from a digital encoder.

Current control

The current control provides the motor with a current proportional to the set value. Accordingly, the motor torque changes proportionally to the set value.

The current controller also improves the dynamics of a superior positioning or speed control circuit.

Digital encoder control

The motor is equipped with a digital encoder that provides a certain number of pulses per revolution. The turning direction is detected with the square pulses of channels A and B offset by 90 electric degrees.

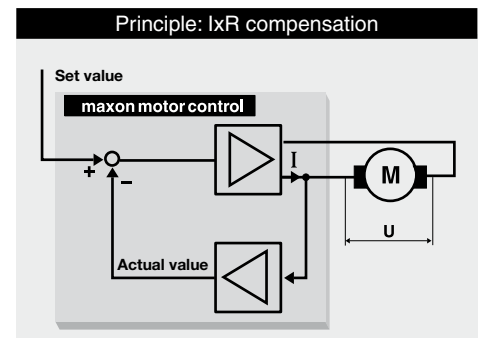
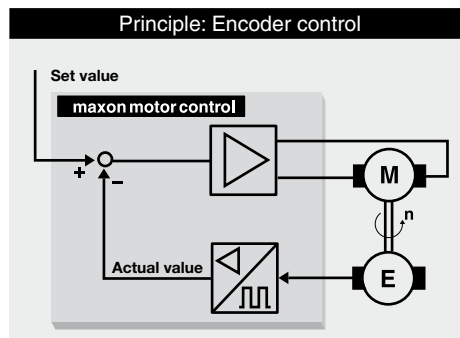
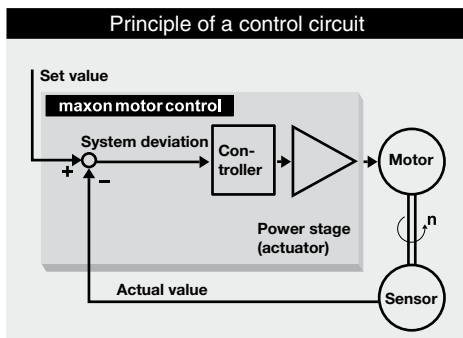
- Digital encoders are often found in positioning controls, in order to derive and measure the travel or angle.
- Digital encoders are not subject to mechanical wear.
- In conjunction with digital controllers there are no drift effects.
- If Hall sensor signals of an EC motor are used for control, this corresponds to an encoder with low resolution.

IxR compensation

The motor is provided with a voltage that is proportional to the applied speed set value. The speed would drop with increasing motor load. The compensation circuitry increases the output voltage with increasing motor current. The compensation must be adjusted to the terminal resistance of the motor which depends on temperature and load.

The attainable speed precision of such a system is subject to limits in the percent range.

- Favorably priced and space-saving
- No tacho-generator or encoder required
- Less precise control when there is a load change
- Only analog speed control possible
- Ideal for low-cost applications without high demands on speed accuracy





DC tacho control

The motor must be equipped with a DC tachometer that provides a speed proportional signal. In the maxon modular system, the tachometer rotor is mounted directly on the through motor shaft, resulting in a high resonant frequency.

- Classical solution of a very precise control
- Limited service life of the DC tacho generator
- Not suitable for positioning tasks
- Only for analog controllers
- Analog feedback signal
- Ideal for stringent demands on speed dynamics

Set value specification

Servo controllers (speed and current controllers) are usually designed for analog specification of set values. Alternatively, PWM signals or fixed set values are also possible.

In the case of position controllers (motion controllers), the set values are usually specified by means of digital commands that are transmitted to the controller using a field bus telegram (e.g. RS232, USB, CANopen, EtherCAT).

Operating quadrants

4-Q operation

- Controlled motor operation and braking operation in both rotation directions
- A must for positioning tasks

1-Q operation

- Only motor operation (Quadrant I or Quadrant III)
- Direction reverse via digital signal
- Typical: amplifier for EC motors

Timed 4-Q power stages

To control the power stage transistors, the maxon controllers use a 3-level pulse width modulation (PWM). The voltage present at the motor switches between the supply voltage and 0 V at short intervals (50 kHz and more). If the Off interval gets larger at the cost of the On interval, the decisive average voltage value (pulse width modulation) and motor speed drops. If the motor voltage is negative, the supply voltage is applied with reversed polarity.

Properties of the 3-level PWM power stage in contrast to linear control

- More complex power stage
- Smoothing of the current ripple by means of auxiliary chokes (integrated into maxon controllers)
- Only a small amount of energy is converted to heat.
- High efficiency

The 4-quadrant operation allows controlled and dynamic motor operation and brake operation in two directions of rotation (all 4 quadrants). 4-quadrant operation is a prerequisite for positioning tasks.

For further explanations, please see page 365.

