ESCON Overview

The ESCON servo controllers are small-sized, powerful 4-quadrant PWM servo controller for the highly efficient control of permanent magnet-activated DC motors.

The featured operating modes – speed control (closed loop), speed control (open loop), and current control – meet the highest requirements. The ESCON servo controllers are designed being commanded by an analog set value and features extensive analog and digital I/O functionality and are being configured via USB interface using the graphical user interface "ESCON Studio".

ESCON Module 24/2
466023

ESCON 36/2 DC
403112

ESCON 36/3 EC
414533

ESCON Module 50/4 EC-S
446925

ESCON Module 50/5
438725

ESCON 50/5
409510

ESCON Module 50/8 (HE)
532872
586137

ESCON 70/10
422969

Depending on the ESCON variant, the following **motor types** can be operated
– **DC motor:** Permanent-magnet DC motor
– **EC motor:** Brushless, electronically commutated permanent-magnet DC motor (BLDC) with and without Hall sensors.

Various **operating modes** allow an adaptable use in a wide range of drive systems
– **Current controller:** The current controller compares the actual motor current (torque) with the applied set value. In case of deviation, the motor current is dynamically readjusted.
– **Speed controller (closed loop):** The closed loop speed controller compares the actual speed signal with the applied set value. In case of deviation, the speed is dynamically readjusted.
– **Speed controller (open loop):** The open loop speed controller feeds the motor with a voltage proportional to the applied speed set value. Changes in load are compensated using the IxR methodology.

Speed measurement by
– **Digital incremental encoder:** The encoders deliver simple square signals for further processing. Their impulses are counted to determine the speed. Channels A and B are phase-shifted signals, which are being compared to determine the direction of rotation.
– **DC tacho:** The DC tacho delivers a speed-proportional analog voltage.
– **Available Hall sensors:** The Hall sensors deliver six different combinations of switching impulses per electrical turn which are counted to determine speed. They also deliver phase-shifted signals that are being compared to determine the direction of rotation.
– **Sensorless EC:** The speed is determined by the progression of the induced voltage. The electronics evaluates the zero crossing of the induced voltage (EMF).

To the numerous **inputs** and **outputs**, various functionalities can be assigned to.

Set value (speed or current), **current limitation,** as well as **offset** can be assigned as follows.
– **Analog value:** The value is defined by an analog voltage set via external or internal potentiometer.
– **PWM value:** The value is defined by fixed frequency and amplitude. The desired change is achieved by variation of the duty cycle of 10...90%.
– **RC Servo Value:** The value is set with a signal pulse with a duration of 1.0...2.0 ms.
– **Fixed value:** The value is defined by a fixed preset value.
– **2 fixed values:** Value 1 is defined by a fixed preset value 1. Value 2 is defined by a fixed preset value 2. A digital input is used to switch between the two preset values.

Various functionalities are available to **enable** the power stage.
– **Enable:** Enables or disables the power stage.
– **Enable & Direction:** Enables or disables the power stage and determines the motor shaft's direction of rotation.

Software
Installation Program: ESCON Setup
Graphical User Interface: ESCON Studio
✓ Startup Wizard
✓ Regulation Tuning
✓ Diagnostic
✓ Firmware Update
✓ Controller Monitor
✓ Parameters
✓ Data Recording
✓ Online Help
Language: German, English, French, Italian, Spanish, Japanese, Chinese
Operating System: Windows 10, Windows 8, Windows 7, Windows XP SP3
Communication interface: USB 2.0/3.0 (full speed)
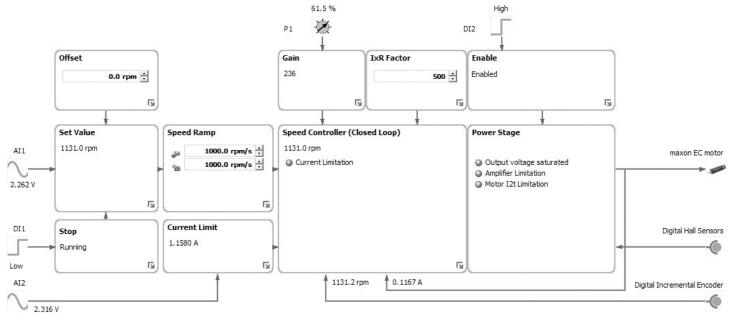
Easy startup
Startup and parameterization are performed using the intuitive graphical user interface "ESCON Studio" with the help of simple to use, menu-guided wizards. The following wizards are available: Startup, Regulation Tuning, Firmware Update, Controller Monitor, Parameters, Data Recording, and Diagnostics.

Protective equipment
The servo controller has protective circuits against overcurrent, excess temperature, under- and overvoltage, against voltage transients, and against short-circuits in the motor cable. Furthermore it is equipped with protected digital inputs and outputs and an adjustable current limitation for protecting the motor and the load. The motor current and the actual speed of the motor shaft can be monitored by means of the analog output voltage.

Comprehensive documentation
Using the "Feature Comparison Chart", the suitable ESCON servo controller can easily be determined. The "Hardware Reference" comprises the specifications of the hardware in detail. The documents "Firmware Version" and "Release Notes" describe changes and improvements of firmware and software. In addition, the graphical user interface "ESCON Studio" features a comprehensive online help.

ESCON Studio (Controller Monitor)

P1 — 61.5 %
DI2 — High

Offset: 0.0 rpm

Gain: 236
IxR Factor: 500
Enable: Enabled

AI1 — 2.262 V
Set Value: 1131.0 rpm
Speed Ramp: 1000.0 rpm/s / 1000.0 rpm/s
Speed Controller (Closed Loop): 1131.0 rpm — Current Limitation
Power Stage: Output voltage saturated / Amplifier Limitation / Motor I2t Limitation — maxon EC motor

DI1 — Low
Stop: Running
Current Limit: 1.1580 A

AI2 — 2.316 V

1131.2 rpm   0.1167 A

Digital Hall Sensors
Digital Incremental Encoder

– **Enable CW:** Enables or disables the power stage in direction of rotation-dependent sense. The rotor can only turn clockwise (CW).
– **Enable CCW:** Enables or disables the power stage in direction of rotation-dependent sense. The rotor can only turn counterclockwise (CCW).
– **Enable CW & CCW:** Enables or disables the power stage in direction of rotation-dependent sense. The rotor can only turn in defined direction. The signals are interlocked against each other.

The **ramp function** permits controlled acceleration/deceleration of the motor shaft in both, open loop and closed loop speed controller mode.
– **Analog ramp:** The ramp is defined by a variable analog value.
– **Fixed ramp:** The ramp is defined by a fixed preset value.

Stop: The motor shaft decelerates with preset speed ramp until complete standstill.

Ready: The Ready signal can be used to transmit the operational status (respectively fault) to a superior control.

Speed and Current Comparator: The digital output is set depending on the actual value.
– **Limit:** The digital output is set as soon as the preset value is reached. It remains set as long as the value is exceeded.
– **Range:** The digital output is set as soon as the preset value range is reached. It remains set as long as the value remains in range.
– **Deviation:** The digital output is set as soon as the preset value deviation (based on the set value) is in range.

With the integrated **potentiometers** the additional following functions can be adjusted
– **Current Gain:** Adjustment of the current controller gain.
– **Speed Gain:** Adjustment of the speed controller gain.
– **IxR Factor:** The voltage drop caused by terminal resistance will be compensated in the range of [0...1000...2000].

Analog outputs allow monitoring of
– **Actual current:** Actually measured motor winding current.
– **Actual current averaged:** Actually measured motor winding current filtered by first order digital low-pass filter with a cut-off frequency of 5 Hz.
– **Actual speed:** Actually measured motor speed.
– **Actual speed averaged:** Actually measured motor speed filtered by 1st order digital low-pass filter with a cut-off frequency of 5 Hz.
– **Demand Current:** Demanded motor winding current.
– **Demand Speed:** Demanded motor speed.
– **Temperature Power Stage:** Actually measured power stage temperature.
– **Fixed value:** The output voltage is said fixed to the preset value.

Accessories ESCON (not included in delivery)		466023 Module 24/2	403112 36/2 DC	414533 36/3 EC	446925 Module 50/4 EC-S	438725 Module 50/5	532872 Module 50/8	586137 Module 50/8 HE	409510 50/5	422969 70/10
404404	ESCON 36/2 DC Connector Set	✓								
425255	ESCON 36/3 EC Connector Set		✓							
403962	DC Motor Cable	✓								
403964	I/O Cable 7core (analog I/O's)	✓	✓							
403965	I/O Cable 6core (digital I/O's)	✓	✓							
275934	Encoder Cable	✓						✓	✓	
403957	Power Cable	✓	✓							
403968	USB Type A - micro B Cable	✓	✓	✓	✓	✓	✓	✓	✓	✓
418719	Adapter BLACK FPC11poles		✓							
418723	Adapter BLUE FPC8poles		✓							
418721	Adapter GREEN FPC8poles		✓							
486400	ESCON Module 24/2 Motherboard	✓								
438779	ESCON Module Motherboard				✓					
586048	ESCON Module 50/8 Motherboard						✓	✓		
450237	ESCON Module Motherboard Sensorless			✓						
586142	ESCON Module 50/8 Thermal Pad						✓			

ESCON Feature Comparison Chart

	ESCON Module 24/2	ESCON 36/2 DC
DC motors up to (continuous / maximum)	48 W / 144 W	72 W / 144 W
EC motors up to (continuous / maximum)	48 W / 144 W	–
Sensors		
	Digital Incremental Encoder (2 channel with or without Line Driver)	Digital Incremental Encoder (2 channel with or without Line Driver)
	DC Tacho	DC Tacho
	Without sensor (DC motors)	Without sensor (DC motors)
	Digital Hall Sensors (EC motors)	–
Operating mode		
	Current controller (torque control), Speed controller (closed and open loop)	Current controller (torque control), Speed controller (closed and open loop)
Electrical data		
Nominal operating voltage V_{CC}	10 – 24 VDC	10 – 36 VDC
Max. output voltage	$0.98 \times V_{CC}$	$0.98 \times V_{CC}$
Max. output current	6 A (<4 s)	4 A (<60 s)
Continuous output current	2 A	2 A
Pulse width modulation frequency	53.6 kHz	53.6 kHz
Sampling rate PI current controller	53.6 kHz	53.6 kHz
Sampling rate PI speed controller	5.36 kHz	5.36 kHz
Max. efficiency	92%	95%
Max. speed (DC)	limited by max. speed (motor) and max. output voltage (controller)	limited by max. speed (motor) and max. output voltage (controller)
Max. speed (EC; 1 pole pair)	150 000 rpm	–
Built-in motor choke	–	300 µH / 2 A
Inputs/Outputs		
Hall sensor signals	H1, H2, H3	–
Encoder signals	A, A\, B, B\	A, A\, B, B\
Max. encoder input frequency differential (single–ended)	1 MHz (100 kHz)	1 MHz (100 kHz)
Potentiometers	–	1
Digital inputs	2	2
Digital inputs/outputs	2	2
Analog inputs	2	2
Resolution, Range, Circuit	12-bit, –10...+10 V, differential	12-bit, –10...+10 V, differential
Analog outputs	2	2
Resolution, Range, Max. output current	12-bit, –4...+4 V, 1 mA	12-bit, –4...+4 V, 1 mA
Auxiliary voltage output	+5 VDC (IL ≤10 mA)	+5 VDC (IL ≤10 mA)
Hall sensor supply voltage	+5 VDC (IL ≤30 mA)	–
Encoder supply voltage	+5 VDC (IL ≤70 mA)	+5 VDC (IL ≤70 mA)
Status Indicators	Operation: green LED / Error: red LED	Operation: green LED / Error: red LED
Environmental conditions		
Temperature – Operation	–30...+60°C	–30...+45°C
Temperature – Extended range	+60...+80°C; Derating: –0.100 A/°C	+45...+81°C; Derating: –0.056 A/°C
Temperature – Storage	–40...+85°C	–40...+85°C
Humidity (condensation not permitted)	5...90%	5...90%
Mechanical data		
Weight	Approx. 7 g	Approx. 30 g
Dimensions (L x W x H)	35.6 x 26.7 x 12.7 mm	55.0 x 40.0 x 16.1 mm
Mounting holes	Plugable (socket headers with 2.54 mm pitch)	for screws M2.5
Part numbers		
	466023 ESCON Module 24/2	**403112** ESCON 36/2 DC
	Order accessories separately, from page 513	Order accessories separately, from page 513

ESCON Feature Comparison Chart

	ESCON 36/3 EC	ESCON Module 50/4 EC-S	ESCON Module 50/5
		–	250 W / 750 W
	97 W / 324 W	200 W / 600 W	250 W / 750 W
Sensors			
	–	–	Digital Incremental Encoder (2 channel with or without Line Driver)
	–	–	DC Tacho
	–	Without sensor (EC motors)	Without sensor (DC motors)
	Digital Hall Sensors (EC motors)	–	Digital Hall Sensors (EC motors)
Operating mode			
	Current controller (torque control), Speed controller (closed and open loop)	Speed controller (closed and open loop)	Current controller (torque control), Speed controller (closed and open loop)
Electrical data			
	10 – 36 VDC	10 – 50 VDC	10 – 50 VDC
	$0.98 \times V_{CC}$	$0.96 \times V_{CC}$	$0.98 \times V_{CC}$
	9 A (<4 s)	12 A (<30 s)	15 A (<20 s)
	2.7 A	4 A	5 A
	53.6 kHz	53.6 kHz	53.6 kHz
	53.6 kHz	–	53.6 kHz
	5.36 kHz	5.36 kHz	5.36 kHz
	95%	97%	98%
	–	–	limited by max. speed (motor) and max. output voltage (controller)
	150 000 rpm	120 000 rpm	150 000 rpm
	3 x 47 µH / 2.7 A	–	–
Inputs/Outputs			
	H1, H2, H3	–	H1, H2, H3
	–	–	A, A\, B, B\
	–	–	1 MHz (100 kHz)
	1	1	1
	2	2	2
	2	2	2
	2	2	2
	12–bit, –10...+10 V, differential	12–bit, –10...+10 V, differential	12–bit, –10...+10 V, differential
	2	2	2
	12–bit, –4...+4 V, 1 mA	12–bit, –4...+4 V, 1 mA	12–bit, –4...+4 V, 1 mA
	+5 VDC (IL ≤10 mA)	+5 VDC (IL ≤110 mA)	+5 VDC (IL ≤10 mA)
	+5 VDC (IL ≤30 mA)	–	+5 VDC (IL ≤30 mA)
	–	–	+5 VDC (IL ≤70 mA)
	Operation: green LED / Error: red LED	Operation: green LED / Error: red LED	Operation: green LED / Error: red LED
Environmental conditions			
	–30...+45°C	–30...+45°C	–30...+45°C
	+45...+78°C; Derating: –0.082 A/°C	+45...+65°C; Derating –0.200 A/°C	+45...+75°C; Derating: –0.167 A/°C
	–40...+85°C	–40...+85°C	–40...+85°C
	5...90%	5...90%	5...90%
Mechanical data			
	Approx. 36 g	Approx. 11 g	Approx. 12 g
	55.0 x 40.0 x 19.8 mm	43.2 x 31.8 x 12.7 mm	43.2 x 31.8 x 12.7 mm
	for screws M2.5	Plugable (socket headers with 2.54 mm pitch)	Plugable (socket headers with 2.54 mm pitch)
Part numbers			
	414533 ESCON 36/3 EC	**446925** ESCON Module 50/4 EC-S	**438725** ESCON Module 50/5
	Order accessories separately, from page 513	Order accessories separately, from page 513	Order accessories separately, from page 513

ESCON Feature Comparison Chart

	ESCON Module 50/8	ESCON Module 50/8 HE
DC motors up to (continuous / maximum)	400 W / 750 W	400 W / 750 W
EC motors up to (continuous / maximum)	400 W / 750 W	400 W / 750 W
Sensors		
	Digital Incremental Encoder (2 channel with or without Line Driver)	Digital Incremental Encoder (2 channel with or without Line Driver)
	DC Tacho	DC Tacho
	Without sensor (DC motors)	Without sensor (DC motors)
	Digital Hall Sensors (EC motors)	Digital Hall Sensors (EC motors)
Operating mode		
	Current controller (torque control), Speed controller (closed and open loop)	Current controller (torque control), Speed controller (closed and open loop)
Electrical data		
Nominal operating voltage V_{CC}	10 - 50 VDC	10 - 50 VDC
Max. output voltage	$0.98 \times V_{CC}$	$0.98 \times V_{CC}$
Max. output current	15 A (<20 s)	15 A (<20 s)
Continuous output current	8 A	8 A
Pulse width modulation frequency	53.6 kHz	53.6 kHz
Sampling rate PI current controller	53.6 kHz	53.6 kHz
Sampling rate PI speed controller	5.36 kHz	5.36 kHz
Max. efficiency	99%	99%
Max. speed (DC)	limited by max. speed (motor) and max. output voltage (controller)	limited by max. speed (motor) and max. output voltage (controller)
Max. speed (EC; 1 pole pair)	150 000 rpm	150 000 rpm
Built-in motor choke	–	–
Inputs/Outputs		
Hall sensor signals	H1, H2, H3	H1, H2, H3
Encoder signals	A, A\, B, B\	A, A\, B, B\
Max. encoder input frequency differential (single-ended)	1 MHz (100 kHz)	1 MHz (100 kHz)
Potentiometers	–	–
Digital inputs	2	2
Digital inputs/outputs	2	2
Analog inputs	2	2
Resolution, Range, Circuit	12-bit, –10...+10 V, differential	12-bit, –10...+10 V, differential
Analog outputs	2	2
Resolution, Range, Max. output current	12-bit, –4...+4 V, 1 mA	12-bit, –4...+4 V, 1 mA
Auxiliary voltage output	+5 VDC (IL ≤10 mA)	+5 VDC (IL ≤10 mA)
Hall sensor supply voltage	+5 VDC (IL ≤30 mA)	+5 VDC (IL ≤30 mA)
Encoder supply voltage	+5 VDC (IL ≤70 mA)	+5 VDC (IL ≤70 mA)
Status Indicators	Operation: green LED / Error: red LED	Operation: green LED / Error: red LED
Environmental conditions		
Temperature – Operation	–40...+45°C	–40...+65°C
Temperature – Extended range	+45...+85°C; Derating: see device reference	+65...+92°C; Derating: see device reference
Temperature – Storage	–40...+85°C	–40...+85°C
Humidity (condensation not permitted)	5...90%	5...90%
Mechanical data		
Weight	Approx. 16 g	Approx. 84 g
Dimensions (L x W x H)	53.3 x 37.5 x 14.5 mm	53.3 x 37.5 x 30.6 mm
Mounting holes	Plugable (socket headers with 2.54 mm pitch)	Plugable (socket headers with 2.54 mm pitch)
Part numbers		
	532872 ESCON Module 50/8	**586137** ESCON Module 50/8 HE
	Order accessories separately, from page 513	Order accessories separately, from page 513

ESCON Feature Comparison Chart

	ESCON 50/5	ESCON 70/10
DC motors up to (continuous / maximum)	250 W / 750 W	700 W / 2100 W
EC motors up to (continuous / maximum)	250 W / 750 W	700 W / 2100 W
Sensors		
	Digital Incremental Encoder (2 channel with or without Line Driver)	Digital Incremental Encoder (2 channel with or without Line Driver)
	DC Tacho	DC Tacho
	Without sensor (DC motors)	Without sensor (DC motors)
	Digital Hall Sensors (EC motors)	Digital Hall Sensors (EC motors)
Operating mode		
	Current controller (torque control), Speed controller (closed and open loop)	Current controller (torque control), Speed controller (closed and open loop)
Electrical data		
Nominal operating voltage V_{CC}	10 - 50 VDC	10 - 70 VDC
Max. output voltage	0.98 x V_{CC}	0.95 x V_{CC}
Max. output current	15 A (<20 s)	30 A (<20 s)
Continuous output current	5 A	10 A
Pulse width modulation frequency	53.6 kHz	53.6 kHz
Sampling rate PI current controller	53.6 kHz	53.6 kHz
Sampling rate PI speed controller	5.36 kHz	5.36 kHz
Max. efficiency	95%	98%
Max. speed (DC)	limited by max. speed (motor) and max. output voltage (controller)	limited by max. speed (motor) and max. output voltage (controller)
Max. speed (EC; 1 pole pair)	150 000 rpm	150 000 rpm
Built-in motor choke	3 x 30 µH / 5 A	3 x 15 µH / 10 A
Inputs/Outputs		
Hall sensor signals	H1, H2, H3	H1, H2, H3
Encoder signals	A, A\, B, B\	A, A\, B, B\
Max. encoder input frequency differential (single-ended)	1 MHz (100 kHz)	1 MHz (100 kHz)
Potentiometers	2	2
Digital inputs	2	2
Digital inputs/outputs	2	2
Analog inputs	2	2
Resolution, Range, Circuit	12-bit, –10...+10 V, differential	12-bit, –10...+10 V, differential
Analog outputs	2	2
Resolution, Range, Max. output current	12-bit, –4...+4 V, 1 mA	12-bit, –4...+4 V, 1 mA
Auxiliary voltage output	+5 VDC (IL ≤10 mA)	+5 VDC (IL ≤10 mA)
Hall sensor supply voltage	+5 VDC (IL ≤30 mA)	+5 VDC (IL ≤30 mA)
Encoder supply voltage	+5 VDC (IL ≤70 mA)	+5 VDC (IL ≤70 mA)
Status Indicators	Operation: green LED / Error: red LED	Operation: green LED / Error: red LED
Environmental conditions		
Temperature – Operation	–30...+45°C	–30...+45°C
Temperature – Extended range	+45...+85°C; Derating: –0.111 A/°C	+45...+82°C; Derating: –0.270 A/°C
Temperature – Storage	–40...+85°C	–40...+85°C
Humidity (condensation not permitted)	5...90%	5...90%
Mechanical data		
Weight	Approx. 204 g	Approx. 259 g
Dimensions (L x W x H)	115 x 75.5 x 24 mm	125 x 78.5 x 27 mm
Mounting holes	for screws M4	for screws M4
Part numbers		
	409510 ESCON 50/5	**422969** ESCON 70/10
	Order accessories separately, from page 513	Order accessories separately, from page 513