maxon

ESCON 50/5

Hardware Reference

escon.maxongroup.com

ESCON 50/5 Servo Controller | P/N 409510
Hardware Reference
CCMC | Edition 2021-08 | DocID rel9042

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READ THIS FIRST

These instructions are intended for qualified technical personnel. Prior commencing with any activities ...

- *you must carefully read and understand this manual and*
- *you must follow the instructions given therein.*

The ESCON 50/5 is considered as partly completed machinery according to EU Directive 2006/42/EC, Article 2, Clause (g) and **is intended to be incorporated into or assembled with other machinery or other partly completed machinery or equipment**.

Therefore, you must not put the device into service, ...

- *unless you have made completely sure that the other machinery fully complies with the EU directive's requirements!*
- *unless the other machinery fulfills all relevant health and safety aspects!*
- *unless all respective interfaces have been established and fulfill the herein stated requirements!*

1 ABOUT

1.1 About this Document

1.1.1 Intended Purpose

The purpose of the present document is to familiarize you with the ESCON 50/5 Servo Controller. It will highlight the tasks for safe and adequate installation and/or commissioning. Follow the described instructions …

- to avoid dangerous situations,
- to keep installation and/or commissioning time at a minimum,
- to increase reliability and service life of the described equipment.

The document contains performance data and specifications, information on fulfilled standards, details on connections and pin assignment, and wiring examples.

1.1.2 Target Audience

The present document is intended for trained and skilled personnel. It conveys information on how to understand and fulfill the respective work and duties.

1.1.3 How to use

Take note of the following notations and codes which will be used throughout the document.

Notation	Meaning
(n)	refers to an item (such as order number, list item, etc.)
➔	denotes “see”, “see also”, “take note of” or “go to”

Table 1-1 Notation used

1.1.4 Symbols & Signs

In the course of the present document, the following symbols and signs will be used.

Type	Symbol	Meaning	
Safety Alert	 (typical)	DANGER	Indicates an **imminent hazardous situation**. If not avoided, it **will result in death or serious injury**.
		WARNING	Indicates a **potential hazardous situation**. If not avoided, it **can result in death or serious injury**.
		CAUTION	Indicates a **probable hazardous situation** or calls the attention to unsafe practices. If not avoided, it **may result in injury**.
Prohibited Action	 (typical)	Indicates a dangerous action. Hence, **you must not**!	
Mandatory Action	 (typical)	Indicates a mandatory action. Hence, **you must**!	
Information		Requirement / Note / Remark	Indicates an activity you must perform prior continuing, or gives information on a particular item you need to observe.
		Best Practice	Indicates an advice or recommendation on the easiest and best way to further proceed.
		Material Damage	Indicates information particular to possible damage of the equipment.

Table 1-2 Symbols & Signs

1.1.5 Trademarks and Brand Names

For easier legibility, registered brand names are listed below and will not be further tagged with their respective trademark. It must be understood that the brands (the list below is not necessarily concluding) are protected by copyright and/or other intellectual property rights even if their legal trademarks are omitted in the later course of this document.

Brand Name	Trademark Owner
Windows®	© Microsoft Corporation, USA-Redmond, WA

Table 1-3 Brand Names and Trademark Owners

1.1.6 Copyright

CCMC | ESCON 50/5 Hardware Reference | Edition 2021-08 | DocID rel9042

maxon motor ag
Brünigstrasse 220 +41 41 666 15 00
CH-6072 Sachseln www.maxongroup.com

1.2 About the Device

The ESCON 50/5 is a small-sized, powerful 4-quadrant PWM servo controller for the highly efficient control of permanent magnet-activated brushed DC motors or brushless EC motors up to approximately 250 Watts.

The featured operating modes – speed control (closed loop), speed control (open loop), and current control – meet the highest requirements. The ESCON 50/5 is designed being commanded by an analog set value and features extensive analog and digital I/O functionality.

The device is designed to be configured via USB interface using the graphical user interface «ESCON Studio» for Windows PCs.

You can download the latest ESCON software version (as well as the latest edition of the documentation) from the internet under ➔http://escon.maxongroup.com.

1.3 About the Safety Precautions

- Make sure that you have read and understood the note “READ THIS FIRST” on page A-2!
- Do not engage with any work unless you possess the stated skills (➔chapter “1.1.2 Target Audience” on page 1-3)!
- Refer to ➔chapter “1.1.4 Symbols & Signs” on page 1-4 to understand the subsequently used indicators!
- You must observe any regulation applicable in the country and/or at the site of implementation with regard to health and safety/accident prevention and/or environmental protection!

DANGER

High Voltage and/or Electrical Shock
Touching live wires causes death or serious injuries!

- *Consider any power cable as connected to live power, unless having proven the opposite!*
- *Make sure that neither end of cable is connected to live power!*
- *Make sure that power source cannot be engaged while work is in process!*
- *Obey lock-out/tag-out procedures!*
- *Make sure to securely lock any power engaging equipment against unintentional engagement and tag it with your name!*

Requirements

- *Make sure that all associated devices and components are installed according to local regulations.*
- *Be aware that, by principle, an electronic apparatus can not be considered fail-safe. Therefore, you must make sure that any machine/apparatus has been fitted with independent monitoring and safety equipment. If the machine/apparatus should break down, if it is operated incorrectly, if the control unit breaks down or if the cables break or get disconnected, etc., the complete drive system must return – and be kept – in a safe operating mode.*
- *Be aware that you are not entitled to perform any repair on components supplied by maxon.*

Electrostatic Sensitive Device (ESD)

- *Make sure to wear working cloth in compliance with ESD.*
- *Handle device with extra care.*

2 SPECIFICATIONS

2.1 Technical Data

ESCON 50/5 (409510)		
Electrical Rating	Nominal operating voltage +V_{CC}	10…50 VDC
	Absolute operating voltage +$V_{CC\ min}$ / +$V_{CC\ max}$	8 VDC / 56 VDC
	Output voltage (max.)	0.98 x +V_{CC}
	Output current I_{cont} / I_{max} (<20 s)	5 A / 15 A
	Pulse Width Modulation frequency	53.6 kHz
	Sampling rate PI current controller	53.6 kHz
	Sampling rate PI speed controller	5.36 kHz
	Max. efficiency	95%
	Max. speed DC motor	limited by max. permissible speed (motor) and max. output voltage (controller)
	Max. speed EC motor	150’000 rpm (1 pole pair)
	Built-in motor choke	3 x 30 µH; 5 A
Inputs & Outputs	Analog Input 1 Analog Input 2	resolution 12-bit; −10…+10 V; differential
	Analog Output 1 Analog Output 2	resolution 12-bit; −4…+4 V; referenced to GND
	Digital Input 1 Digital Input 2	+2.4…+36 VDC (R_i = 38.5 kΩ)
	Digital Input/Output 3 Digital Input/Output 4	+2.4…+36 VDC (R_i = 38.5 kΩ) / max. 36 VDC (I_L <500 mA)
	Hall sensor signals	H1, H2, H3
	Encoder signals	A, A\, B, B\, (max. 1 MHz)
Voltage Outputs	Auxiliary output voltage	+5 VDC (I_L ≤10 mA)
	Hall sensor supply voltage	+5 VDC (I_L ≤30 mA)
	Encoder supply voltage	+5 VDC (I_L ≤70 mA)
Potentiometers	Potentiometer P1 (on board) Potentiometer P2 (on board)	240°; linear
Motor Connections	DC motor	+ Motor, − Motor
	EC motor	Motor winding 1, Motor winding 2, Motor winding 3
Interface	USB 2.0 / USB 3.0	full speed
Status Indicators	Operation	green LED
	Error	red LED

ESCON 50/5 (409510)			
Physical	Weight	approx. 204 g	
	Dimensions (L x W x H)	115 x 75.5 x 24 mm	
	Mounting holes	for M4 screws	
Environmental Conditions	Temperature	Operation	−30…+45 °C
		Extended range *1)	+45…+85 °C Derating ➔Figure 2-1
		Storage	−40…+85 °C
	Altitude *2)	Operation	0…10'000 m MSL
	Humidity	5…90% (condensation not permitted)	

*1) Operation within the extended range (temperature and altitude) is permitted. However, a respective derating (declination of output current I_{cont}) as to the stated values will apply.
*2) Operating altitude in meters above Mean Sea Level, MSL.

Table 2-4 Technical Data

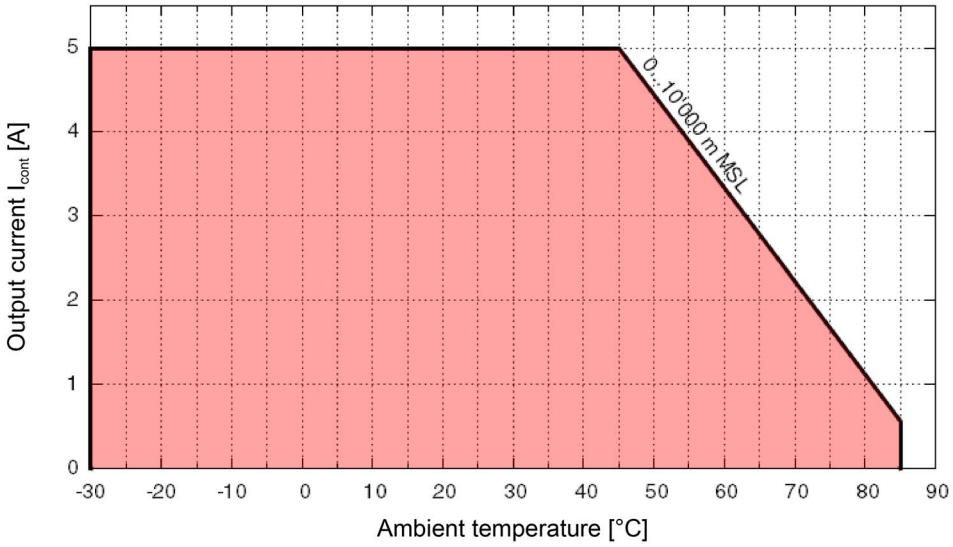


Figure 2-1 Derating Output Current

Protection functionality	Switch-off threshold	Recovery threshold
Undervoltage	7.2 V	7.4 V
Overvoltage	58 V	55 V
Overcurrent	22.5 A	—
Thermal overload	100 °C	90 °C

Table 2-5 Limitations

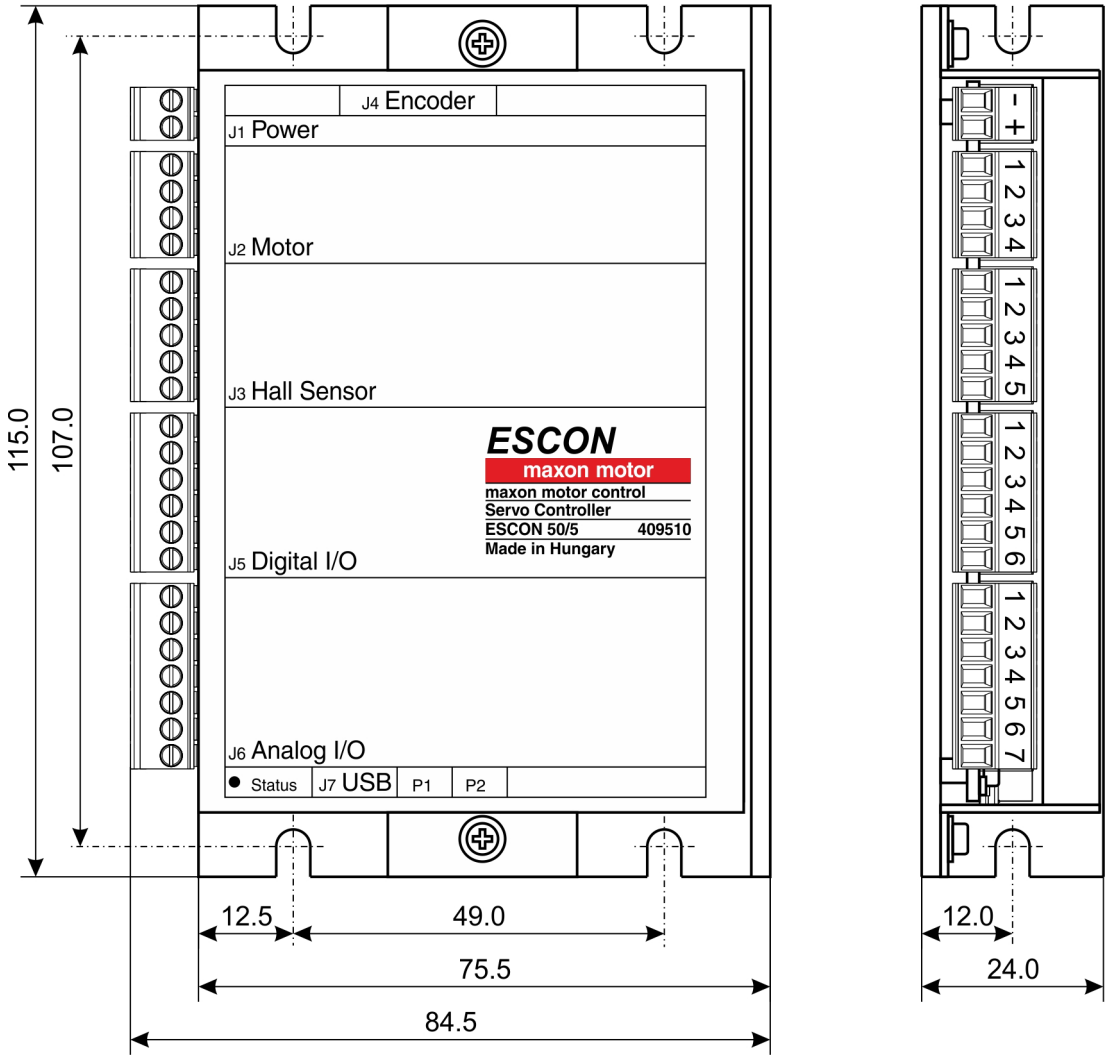


Figure 2-2 Dimensional Drawing [mm]

2.2 Standards

The described device has been successfully tested for compliance with the below listed standards. In practical terms, only the complete system (the fully operational equipment comprising all individual components, such as motor, servo controller, power supply unit, EMC filter, cabling etc.) can undergo an EMC test to ensure interference-free operation.

Important Notice

The device's compliance with the mentioned standards does not imply its compliance within the final, ready to operate setup. In order to achieve compliance of your operational system, you must perform EMC testing of the involved equipment as a whole.

Electromagnetic Compatibility		
Generic Standards	IEC/EN 61000-6-2	Environmental testing – Test Fc: Vibration (sinusoidal, 10…500 Hz, 20 m/s^2)
	IEC/EN 61000-6-3	Emission standard for residential, commercial and light-industrial environments
Applied Standards	IEC/EN 61000-6-3 IEC/EN 55022 (CISPR22)	Radio disturbance characteristics / radio interference
	IEC/EN 61000-4-2	Electrostatic discharge immunity test 8 kV/6 kV
	IEC/EN 61000-4-3	Radiated, radio-frequency, electromagnetic field immunity test >10 V/m
	IEC/EN 61000-4-4	Electrical fast transient/burst immunity test ±2 kV
	IEC/EN 61000-4-6	Immunity to conducted disturbances, induced by radio-frequency fields 10 Vrms

Others		
Environmental Standards	IEC/EN 60068-2-6	Environmental testing – Test Fc: Vibration (sinusoidal)
	MIL-STD-810F	Random transport (10…500 Hz up to 2.53 g_{rms})
Safety Standards	UL File Number E207844; unassembled printed circuit board	
Reliability	MIL-HDBK-217F	Reliability prediction of electronic equipment Environment: Ground, benign (GB) Ambient temperature: 298 K (25 °C) Component stress: In accordance with circuit diagram and nominal power Mean Time Between Failures (MTBF): 398'363 hours

Table 2-6 Standards

3 SETUP

IMPORTANT NOTICE: PREREQUISITES FOR PERMISSION TO COMMENCE INSTALLATION

The ESCON 50/5 is considered as partly completed machinery according to EU Directive 2006/42/EC, Article 2, Clause (g) and **is intended to be incorporated into or assembled with other machinery or other partly completed machinery or equipment**.

WARNING

Risk of Injury
Operating the device without the full compliance of the surrounding system with EU Directive 2006/42/EC may cause serious injuries!

- *Do not operate the device, unless you have made completely sure that the other machinery fully complies with the EU directive's requirements!*
- *Do not operate the device, unless the other machinery fulfills all relevant health and safety aspects!*
- *Do not operate the device, unless all respective interfaces have been established and fulfill the requirements stated in this document!*

3.1 Generally applicable Rules

Maximal permitted Supply Voltage

- *Make sure that supply power is between 10…50 VDC.*
- *Supply voltages above 56 VDC, or wrong polarity will destroy the unit.*
- *Note that the necessary output current is depending on the load torque. Yet, the output current limits of the ESCON 50/5 are as follows; continuous max. 5 A / short-time (acceleration) max. 15 A.*

Hot plugging the USB interface may cause hardware damage

If the USB interface is being hot-plugged (connecting while the power supply is on), the possibly high potential differences of the two power supplies of controller and PC/Notebook can lead to damaged hardware.

- *Avoid potential differences between the power supply of controller and PC/Notebook or, if possible, balance them.*
- *Insert the USB connector first, then switch on the power supply of the controller.*

3.2 Determination of Power Supply

Basically, any power supply may be used, provided it meets the minimal requirements stated below.

Power Supply Requirements	
Output voltage	$+V_{CC}$ 10…50 VDC
Absolute output voltage	min. 8 VDC; max. 56 VDC
Output current	Depending on load • continuous max. 5 A • short-time (acceleration, <20 s) max. 15 A

1) Use the formula below to calculate the required voltage under load.
2) Choose a power supply according to the calculated voltage. Thereby consider:
   a) During braking of the load, the power supply must be capable of buffering the recovered kinetic energy (for example, in a capacitor).
   b) If you are using an electronically stabilized power supply, make sure that the overcurrent protection circuit is configured inoperative within the operating range.

Note
The formula already takes the following into account:
- *Maximum PWM duty cycle of 98%*
- *Controller's max. voltage drop of 1 V @ 5 A*

KNOWN VALUES:
- Operating torque M [mNm]
- Operating speed n [rpm]
- Nominal motor voltage U_N [Volt]
- Motor no-load speed at U_N, n_0 [rpm]
- Speed/torque gradient of the motor $\Delta n/\Delta M$ [rpm/mNm]

SOUGHT VALUE:
- Supply voltage $+V_{CC}$ [Volt]

SOLUTION:

$$V_{CC} \geq \left[\frac{U_N}{n_O} \cdot \left(n + \frac{\Delta n}{\Delta M} \cdot M\right) \cdot \frac{1}{0.98}\right] + 1[V]$$

3.3 Connections

The actual connection will depend on the overall configuration of your drive system and the type of motor you will be using.

Follow the description in given order and choose the connection scheme that suits the respective components you are using. For corresponding wiring diagrams ➔chapter “4 Wiring” on page 4-31.

3.3.1 Power (J1)

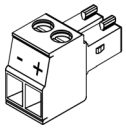


Figure 3-3 Power Plug J1

J1 Pin	Signal	Description
–	Power_GND	Ground of supply voltage
+	$+V_{CC}$	Power supply voltage (+10…+50 VDC)

Table 3-7 Power Plug J1 – Pin Assignment

Specification / Accessories	
Type	Pluggable screw-type terminal block, 2 poles, pitch 3.5 mm
Suitable cables	0.14…1.5 mm² multi-core, AWG 28-14 0.14…1.5 mm² single wire, AWG 28-14

Table 3-8 Power Plug J1 – Specification & Accessories

3.3.2 Motor (J2)

The servo controller is set to drive either maxon DC motor (brushed) or maxon EC motor (brushless).

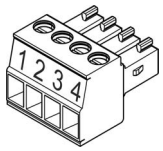


Figure 3-4 Motor Plug J2

J2 Pin	Signal	Description
1	Motor (+M)	DC motor: Motor +
2	Motor (−M)	DC motor: Motor −
3	not connected	–
4	Motor shield	Cable shield

Table 3-9 Motor Plug J2 – Pin Assignment for maxon DC motor (brushed)

J2 Pin	Signal	Description
1	Motor winding 1	EC motor: Winding 1
2	Motor winding 2	EC motor: Winding 2
3	Motor winding 3	EC motor: Winding 3
4	Motor shield	Cable shield

Table 3-10 Motor Plug J2 – Pin Assignment for maxon EC motor (brushless)

Specification / Accessories	
Type	Pluggable screw-type terminal block, 4 poles, pitch 3.5 mm
Suitable cables	0.14…1.5 mm² multi-core, AWG 28-14 0.14…1.5 mm² single wire, AWG 28-14

Table 3-11 Motor Plug J2 – Specification & Accessories

3.3.3 Hall Sensor (J3)

Suitable Hall effect sensors IC use «Schmitt trigger» with open collector output.

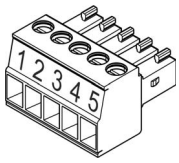


Figure 3-5 Hall Sensor Plug J3

J3 Pin	Signal	Description
1	Hall sensor 1	Hall sensor 1 input
2	Hall sensor 2	Hall sensor 2 input
3	Hall sensor 3	Hall sensor 3 input
4	+5 VDC	Hall sensor supply voltage (+5 VDC; I_L ≤30 mA)
5	GND	Ground

Table 3-12 Hall Sensor Plug J3 – Pin Assignment

Specification / Accessories	
Type	Pluggable screw-type terminal block, 5 poles, pitch 3.5 mm
Suitable cables	0.14…1.5 mm² multi-core, AWG 28-14 0.14…1.5 mm² single wire, AWG 28-14

Table 3-13 Hall Sensor Plug J3 – Specification & Accessories

Hall sensor supply voltage	+5 VDC
Max. Hall sensor supply current	30 mA
Input voltage	0…24 VDC
Max. input voltage	+24 VDC
Logic 0	typically <1.0 V
Logic 1	typically >2.4 V
Internal pull-up resistor	2.7 kΩ (against +5.45 V − 0.6 V)

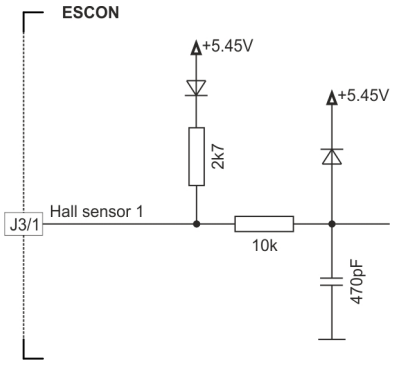


Figure 3-6 Hall Sensor 1 Input Circuit (analogously valid also for Hall Sensors 2 & 3)

3.3.4 Encoder (J4)

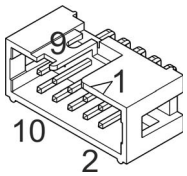


Figure 3-7 Encoder Socket J4

J4 Pin	Signal	Description
1	not connected	–
2	+5 VDC	Encoder supply voltage (+5 VDC; ≤70 mA)
3	GND	Ground
4	not connected	–
5	Channel A\	Channel A complement
6	Channel A	Channel A
7	Channel B\	Channel B complement
8	Channel B	Channel B
9	not connected	–
10	not connected	–

Table 3-14 Encoder Socket J4 – Pin Assignment

Accessories		
Suitable strain relief	Retainer	For sockets with strain relief: 1 retainer clip, height 13.5 mm, 3M (3505-8110)
		For sockets without strain relief: 1 retainer clip, height 7.9 mm, 3M (3505-8010)
	Latch	For sockets with strain relief: 2 pieces, 3M (3505-33B)

Table 3-15 Encoder Socket J4 – Accessories

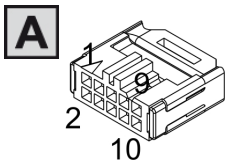
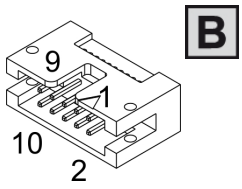
Encoder Cable (275934)	
 	
Cable cross-section	10 x AWG28, round-jacket, flat cable, pitch 1.27 mm
Length	3 m
Head A	DIN 41651 female, pitch 2.54 mm, 10 poles, with strain relief
Head B	DIN 41651 Plug, pitch 2.54 mm, 10 poles, with strain relief

Table 3-16 Encoder Cable

Best Practice

- *Because of its resistance against electrical interferences, **we recommend using differential scheme**. Nevertheless, the controller supports both schemes – differential and single-ended.*
- *The controller does not require an index impulse (Ch I, Ch I\).*
- *For best performance, **we strongly recommend using encoders with line driver**. Otherwise, speed limitations may apply due to slow switching edges.*

Differential	
Min. differential input voltage	±200 mV
Max. input voltage	+12 VDC / −12 VDC
Line receiver (internal)	EIA RS422 Standard
Max. input frequency	1 MHz

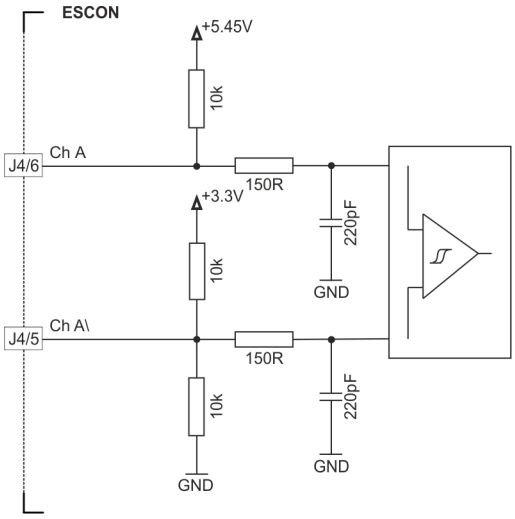


Figure 3-8 Encoder Input Circuit Ch A “Differential” (analogously valid also for Ch B)

Single-ended	
Input voltage	0…5 VDC
Max. input voltage	+12 VDC / −12 VDC
Logic 0	<1.0 V
Logic 1	>2.4 V
Input high current	I_{IH} = typically −50 µA @ 5 V
Input low current	I_{IL} = typically −550 µA @ 0 V
Max. input frequency	100 kHz

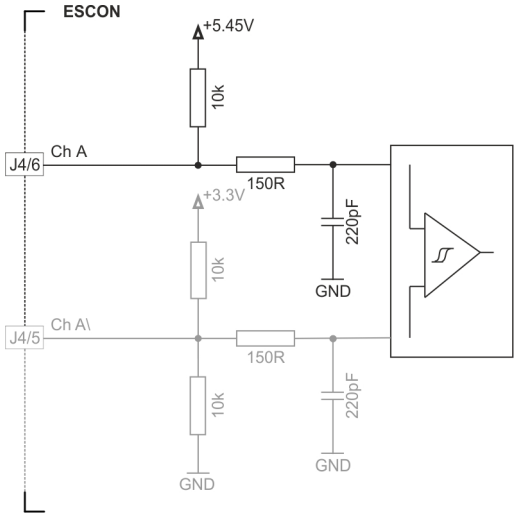


Figure 3-9 Encoder Input Circuit Ch A “Single-ended” (analogously valid also for Ch B)

3.3.5 Digital I/Os (J5)

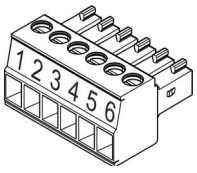


Figure 3-10 Digital I/Os Plug J5

J5 Pin	Signal	Description
1	DigIN1	Digital input 1
2	DigIN2	Digital input 2
3	DigIN/DigOUT3	Digital input/output 3
4	DigIN/DigOUT4	Digital input/output 4
5	GND	Signal ground
6	+5 VDC	Auxiliary output voltage (+5 VDC; ≤10 mA)

Table 3-17 Digital I/Os Plug J5 – Pin Assignment & Cabling

Specification / Accessories	
Type	Pluggable screw-type terminal block, 6 poles, pitch 3.5 mm
Suitable cables	0.14…1.5 mm² multi-core, AWG 28-14 0.14…1.5 mm² single wire, AWG 28-14

Table 3-18 Digital I/Os Plug J5 – Specification & Accessories

3.3.5.1 Digital Input 1

Input voltage	0…36 VDC
Max. input voltage	+36 VDC / −36 VDC
Logic 0	typically <1.0 V
Logic 1	typically >2.4 V
Input resistance	typically 47 kΩ (<3.3 V) typically 38.5 kΩ (@ 5 V) typically 25.5 kΩ (@ 24 V)
Input current at logic 1	typically 130 µA @ +5 VDC
Switching delay	<8 ms

PWM frequency range	10 Hz…5 kHz
PWM duty cycle range (resolution)	10...90% (0.1%)
PWM accuracy	typically 0.1% @ 10 Hz typically 0.5% @ 1 kHz typically 2.5% @ 5 kHz
RC Servo cycle duration	3…30 ms
RC Servo pulse length	1…2 ms

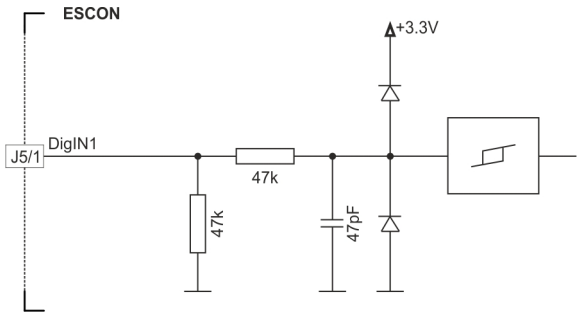


Figure 3-11 DigIN1 Circuit

3.3.5.2 Digital Input 2

Input voltage	0…36 VDC
Max. input voltage	+36 VDC / −36 VDC
Logic 0	typically <1.0 V
Logic 1	typically >2.4 V
Input resistance	typically 47 kΩ (<3.3 V) typically 38.5 kΩ (@ 5 V) typically 25.5 kΩ (@ 24 V)
Input current at logic 1	typically 130 µA @ +5 VDC
Switching delay	<8 ms

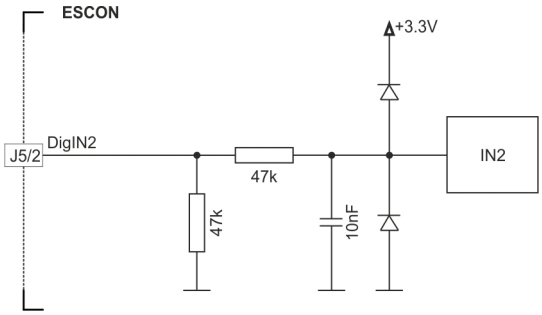


Figure 3-12 DigIN2 Circuit

3.3.5.3 Digital Inputs/Outputs 3 and 4

DigIN	
Input voltage	0…36 VDC
Max. input voltage	+36 VDC
Logic 0	typically <1.0 V
Logic 1	typically >2.4 V
Input resistance	typically 47 kΩ (<3.3 V) typically 38.5 kΩ (@ 5 V) typically 25.5 kΩ (@ 24 V)
Input current at logic 1	typically 130 µA @ +5 VDC
Switching delay	<8 ms

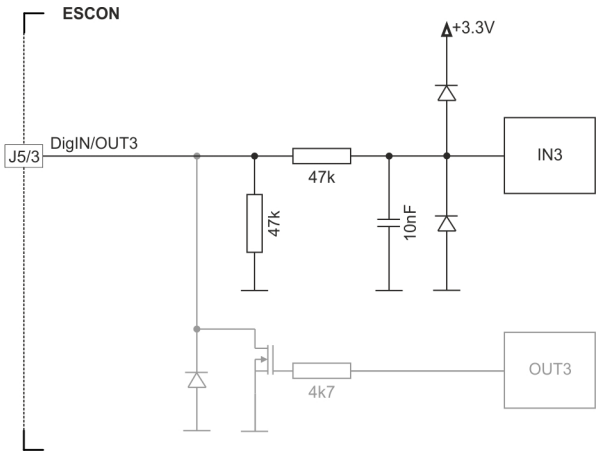


Figure 3-13 DigIN3 Circuit (analogously valid also for DigIN4)

DigOUT	
Max. input voltage	+36 VDC
Max. load current	500 mA
Max. voltage drop	0.5 V @ 500 mA
Max. load inductance	100 mH @ 24 VDC; 500 mA

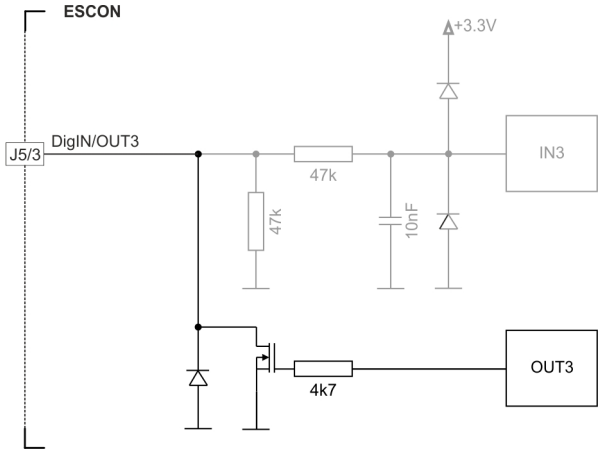


Figure 3-14 DigOUT3 Circuit (analogously valid also for DigOUT4)

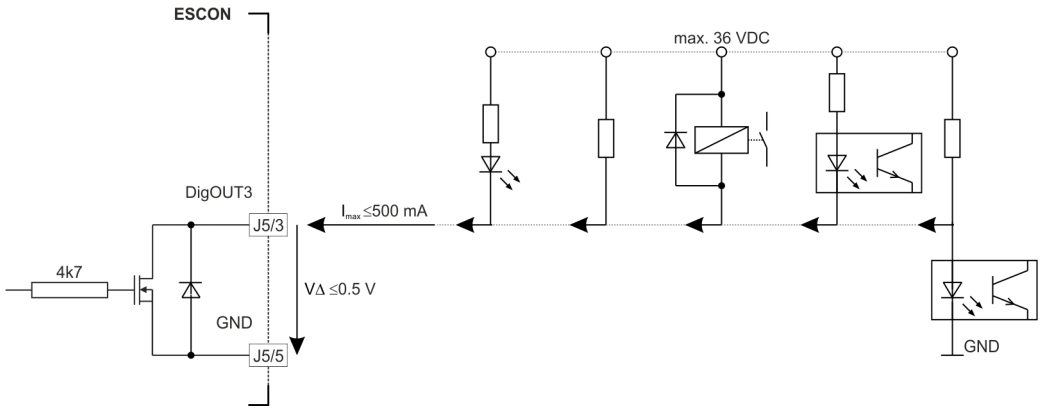


Figure 3-15 DigOUT3 Wiring Examples (analogously valid also for DigOUT4)

3.3.6 Analog I/Os (J6)

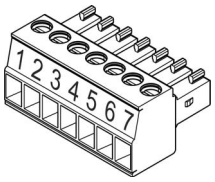


Figure 3-16 Analog I/Os Plug J6

J6 Pin	Signal	Description
1	AnIN1+	Analog input 1, positive signal
2	AnIN1−	Analog input 1, negative signal
3	AnIN2+	Analog input 2, positive signal
4	AnIN2−	Analog input 2, negative signal
5	AnOUT1	Analog output 1
6	AnOUT2	Analog output 2
7	GND	Signal ground

Table 3-19 Analog I/Os Plug J6 – Pin Assignment & Cabling

Specification / Accessories	
Type	Pluggable screw-type terminal block, 7 poles, pitch 3.5 mm
Suitable cables	0.14…1.5 mm² multi-core, AWG 28-14 0.14…1.5 mm² single wire, AWG 28-14

Table 3-20 Analog I/Os Plug J6 – Specification & Accessories

3.3.6.1 Analog Inputs 1 and 2

Input voltage	−10…+10 VDC (differential)
Max. input voltage	+24 VDC / −24 VDC
Common mode voltage	−5…+10 VDC (referenced to GND)
Input resistance	100 kΩ (differential) 50 kΩ (referenced to GND)
A/D converter	12-bit
Resolution	5.07 mV
Bandwidth	10 kHz

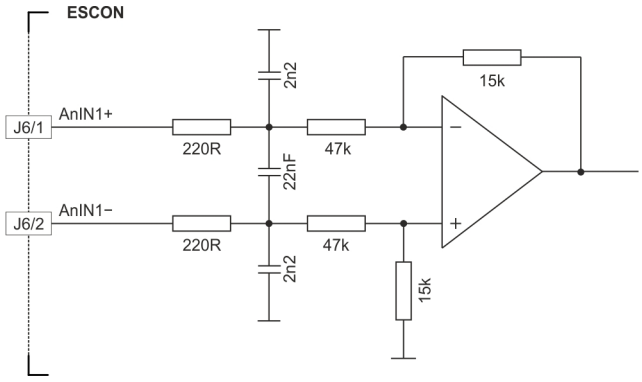


Figure 3-17 AnIN1 Circuit (analogously valid also for AnIN2)

3.3.6.2 Analog Outputs 1 and 2

Output voltage	−4…+4 VDC
D/A converter	12-bit
Resolution	2.30 mV
Refresh rate	AnOUT1: 26.8 kHz AnOUT2: 5.4 kHz
Analog bandwidth of output amplifier	20 kHz
Max. capacitive load	10 nF
Max. output current	1 mA

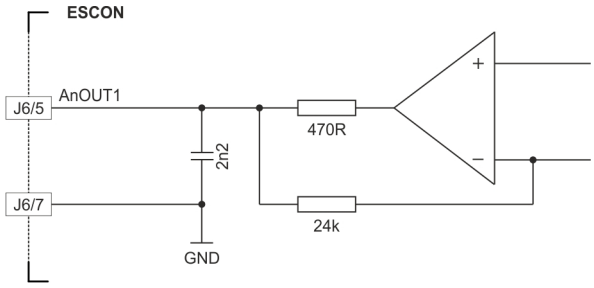


Figure 3-18 AnOUT1 Circuit (analogously valid also for AnOUT2)

3.3.7 USB (J7)

Hot plugging the USB interface may cause hardware damage
If the USB interface is being hot-plugged (connecting while the power supply is on), the possibly high potential differences of the two power supplies of controller and PC/Notebook can lead to damaged hardware.
- *Avoid potential differences between the power supply of controller and PC/Notebook or, if possible, balance them.*
- *Insert the USB connector first, then switch on the power supply of the controller.*

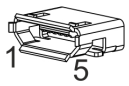


Figure 3-19 USB Socket J7

Note
Column "Head B" (➔Table 3-21) refers to USB terminals of your PC.

J7 & Head A Pin	Head B Pin	Signal	Description
1	1	V_{BUS}	USB BUS supply voltage input +5 VDC
2	2	D−	USB Data− (twisted pair with Data+)
3	3	D+	USB Data+ (twisted pair with Data−)
4	–	ID	not connected
5	4	GND	USB ground

Table 3-21 USB Socket J7 – Pin Assignment & Cabling

USB Type A - micro B Cable (403968)	
	
Cable cross-section	According to USB 2.0 / USB 3.0 specification
Length	1.5 m
Head A	USB Type "micro B", male
Head B	USB Type "A", male

Table 3-22 USB Type A - micro B Cable

USB Standard	USB 2.0 / USB 3.0 (full speed)
Max. bus supply voltage	+5.25 VDC
Typical input current	60 mA
Max. DC data input voltage	−0.5…+3.8 VDC

3.4 Potentiometers

POTENTIOMETERS P1 & P2

Adjustment angle	240°
Type	Linear

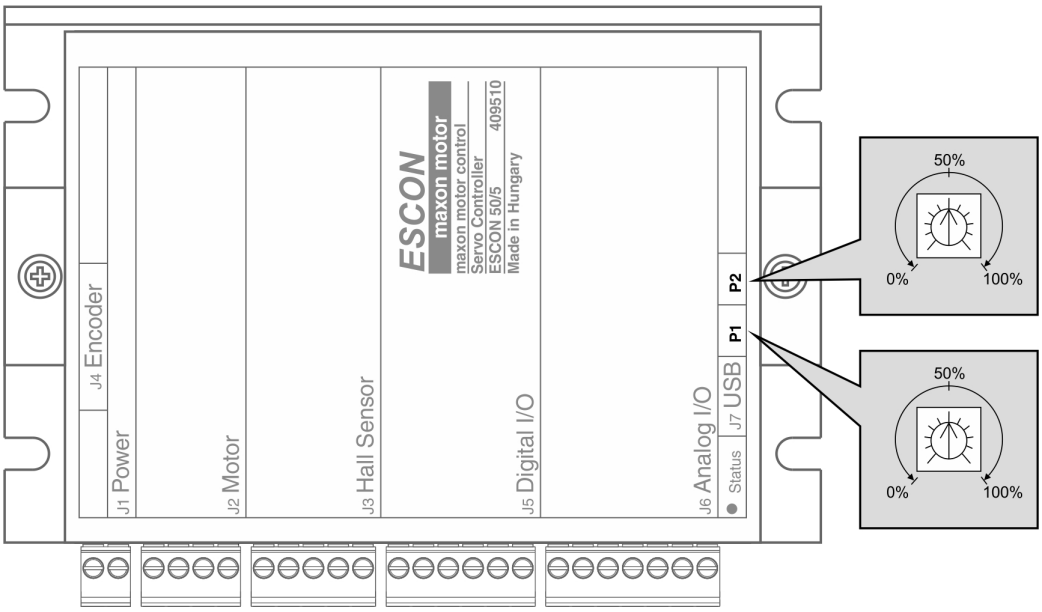


Figure 3-20 Potentiometers – Location & Adjustment Range

3.5 Status Indicators

Light-emitting diodes (LEDs) indicate the actual operating status (green) and possible errors (red).

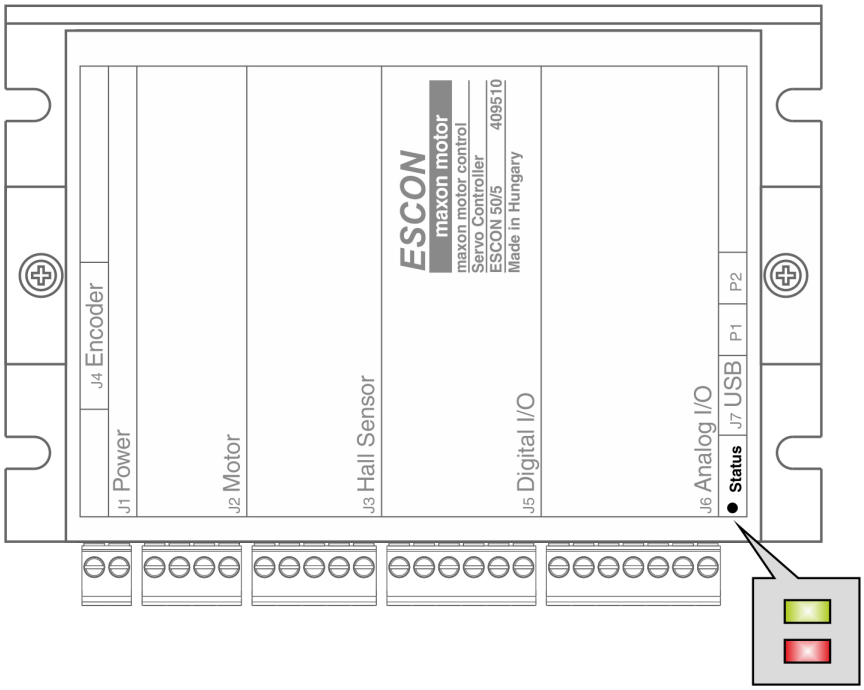


Figure 3-21 LEDs – Location

LED		Status / Error	
Green	Red		
off	off	INIT	
slow	off	DISABLE	
on	off	ENABLE	
2x	off	STOPPING; STOP STANDSTILL	
off	1x	ERROR	• +Vcc Overvoltage Error • +Vcc Undervoltage Error • +5 VDC Undervoltage Error
off	2x	ERROR	• Thermal Overload Error • Overcurrent Error • Power Stage Protection Error
off	3x	ERROR	• Encoder Cable Break Error • Encoder Polarity Error • DC Tacho Cable Break Error • DC Tacho Polarity Error
off	4x	ERROR	• PWM Set Value Input out of Range Error
off	5x	ERROR	• Hall Sensor Pattern Error • Hall Sensor Sequence Error • Hall Sensor Frequency too high Error

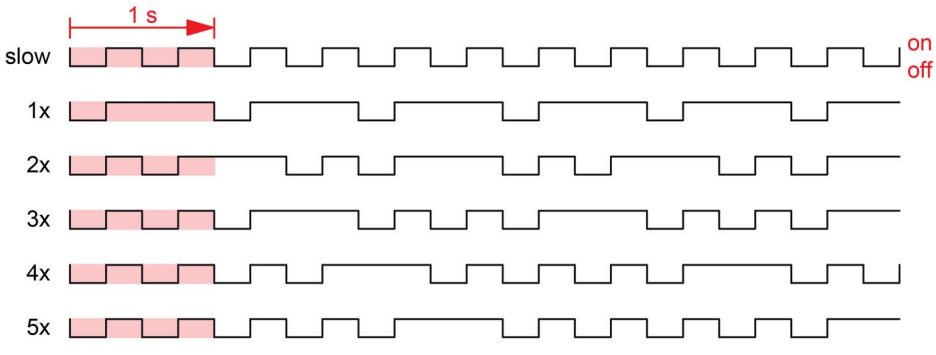
LED		Status / Error	
Green	Red		
off	on	ERROR	• Auto Tuning Identification Error • Internal Software Error
			

Table 3-23 LEDs – Interpretation of Condition

maxon

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4 WIRING

Figure 4-22 Interfaces – Designations and Location

Remark

The subsequent diagrams feature this sign:

- ⏚ *Ground safety earth connection (optional)*

4.1 DC Motors

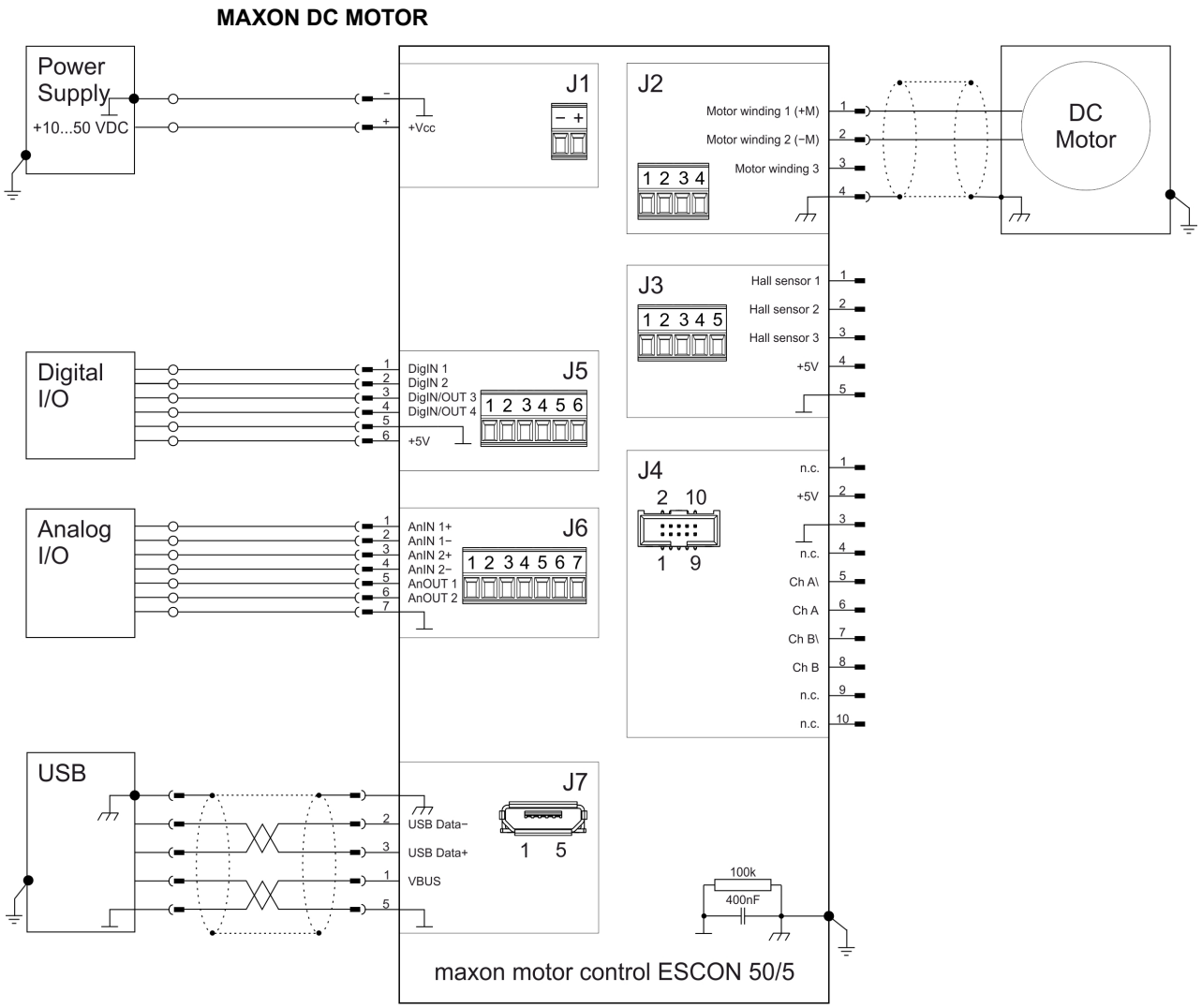

Figure 4-23 maxon DC motor (J2)

MAXON DC MOTOR WITH DC TACHO

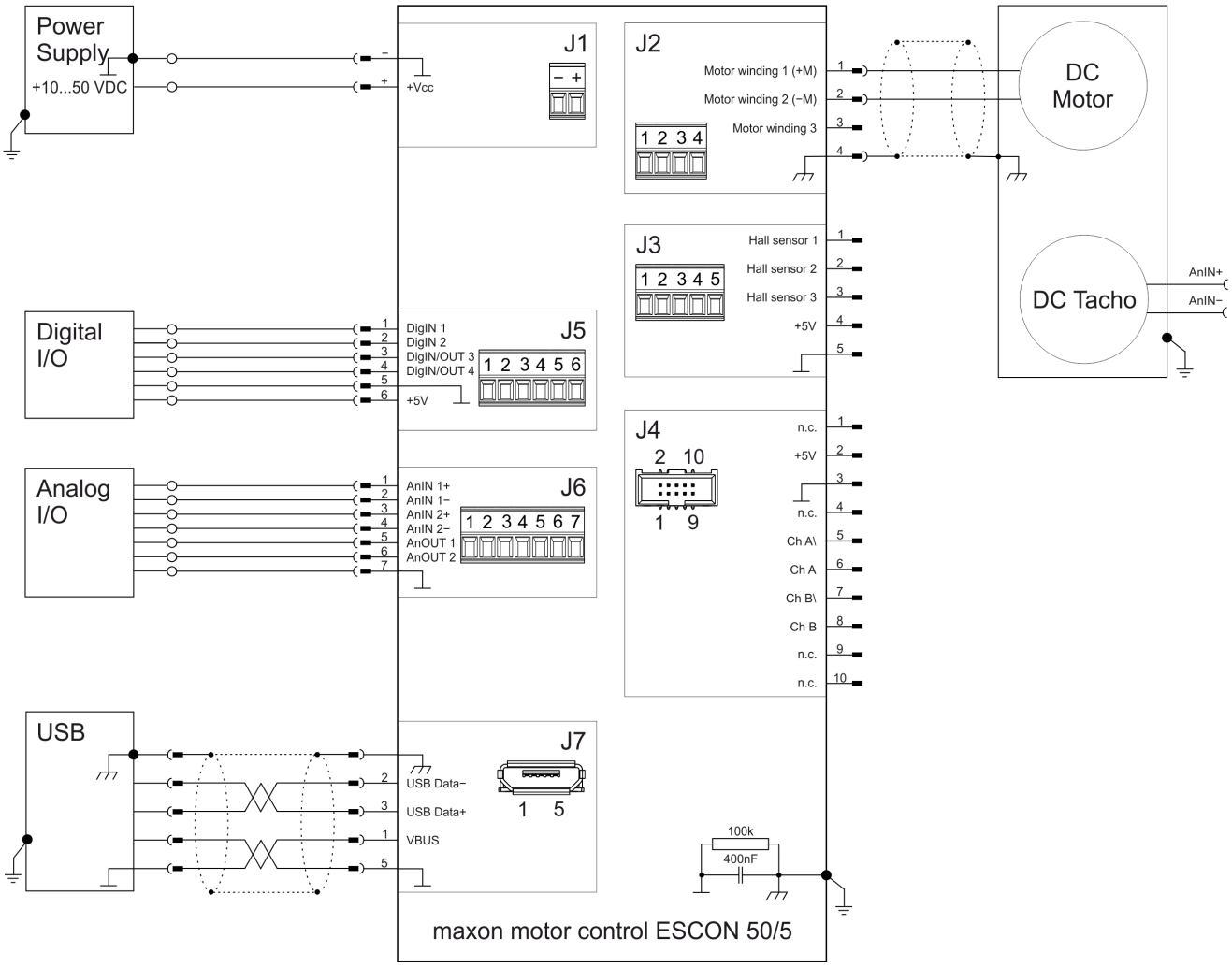

Figure 4-24 maxon DC motor with DC Tacho (J2)

MAXON DC MOTOR WITH ENCODER

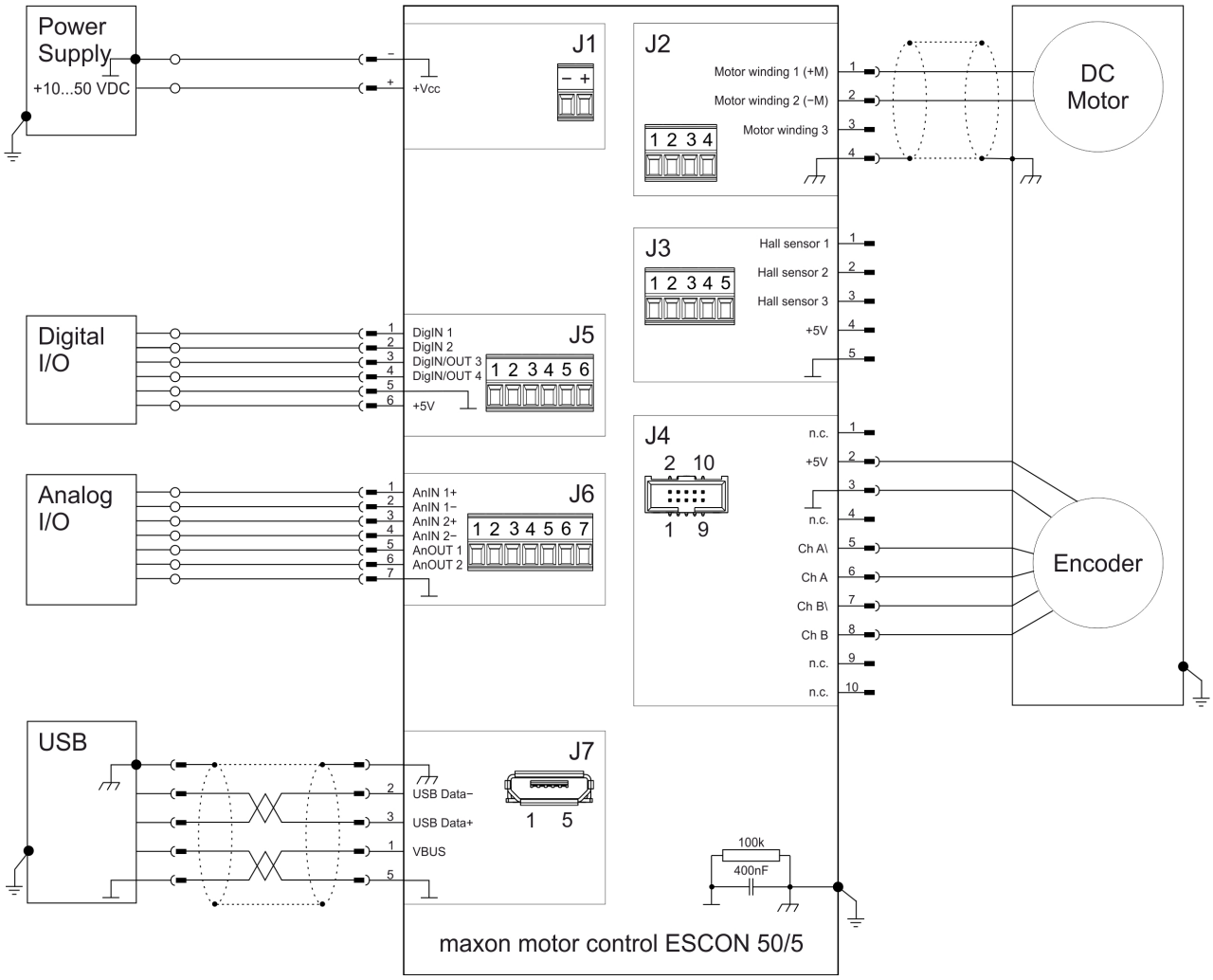

Figure 4-25 maxon DC motor with Encoder (J2 / J4)

4.2 EC Motors

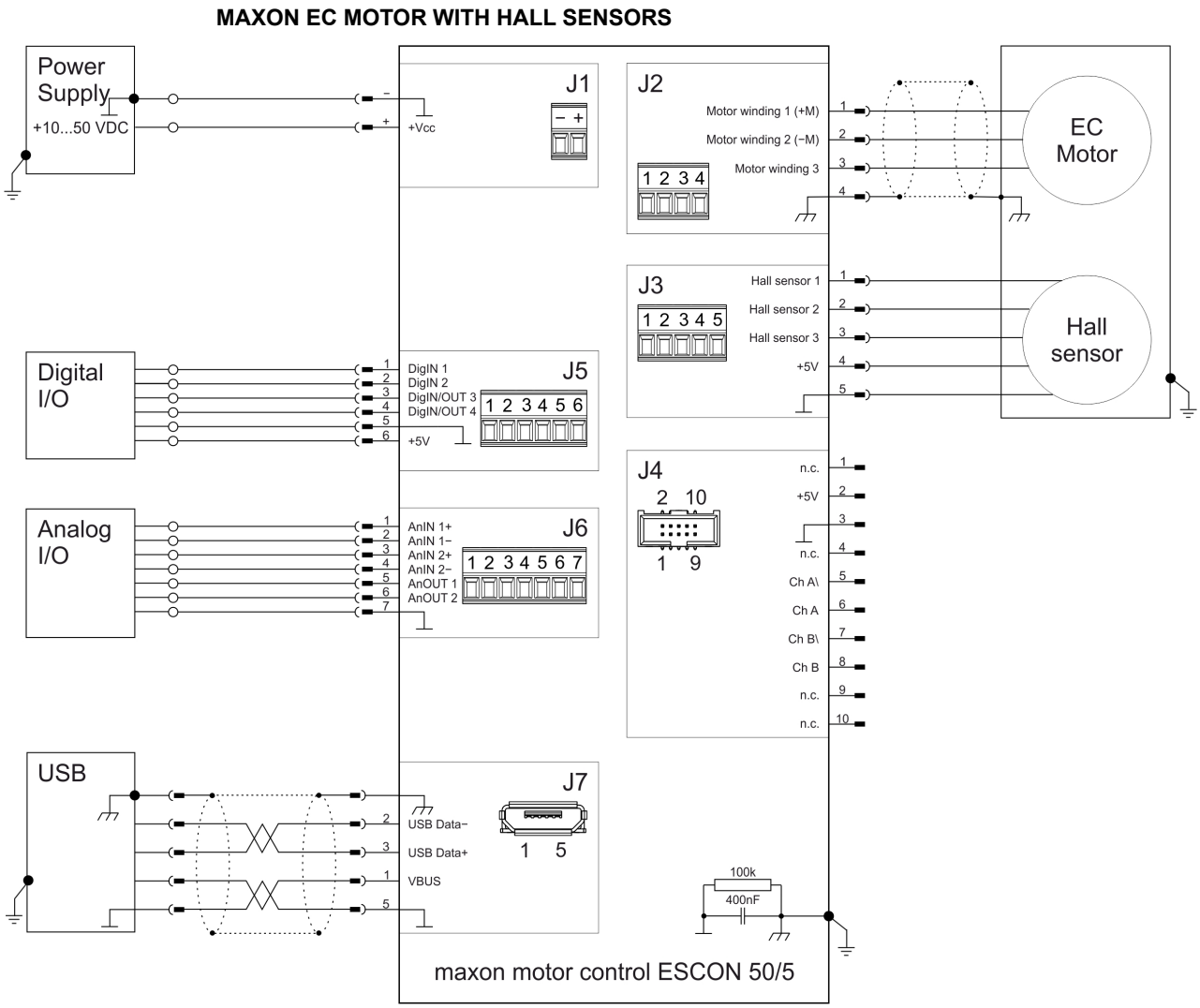

Figure 4-26 maxon EC motor with Hall Sensors (J2 / J3)

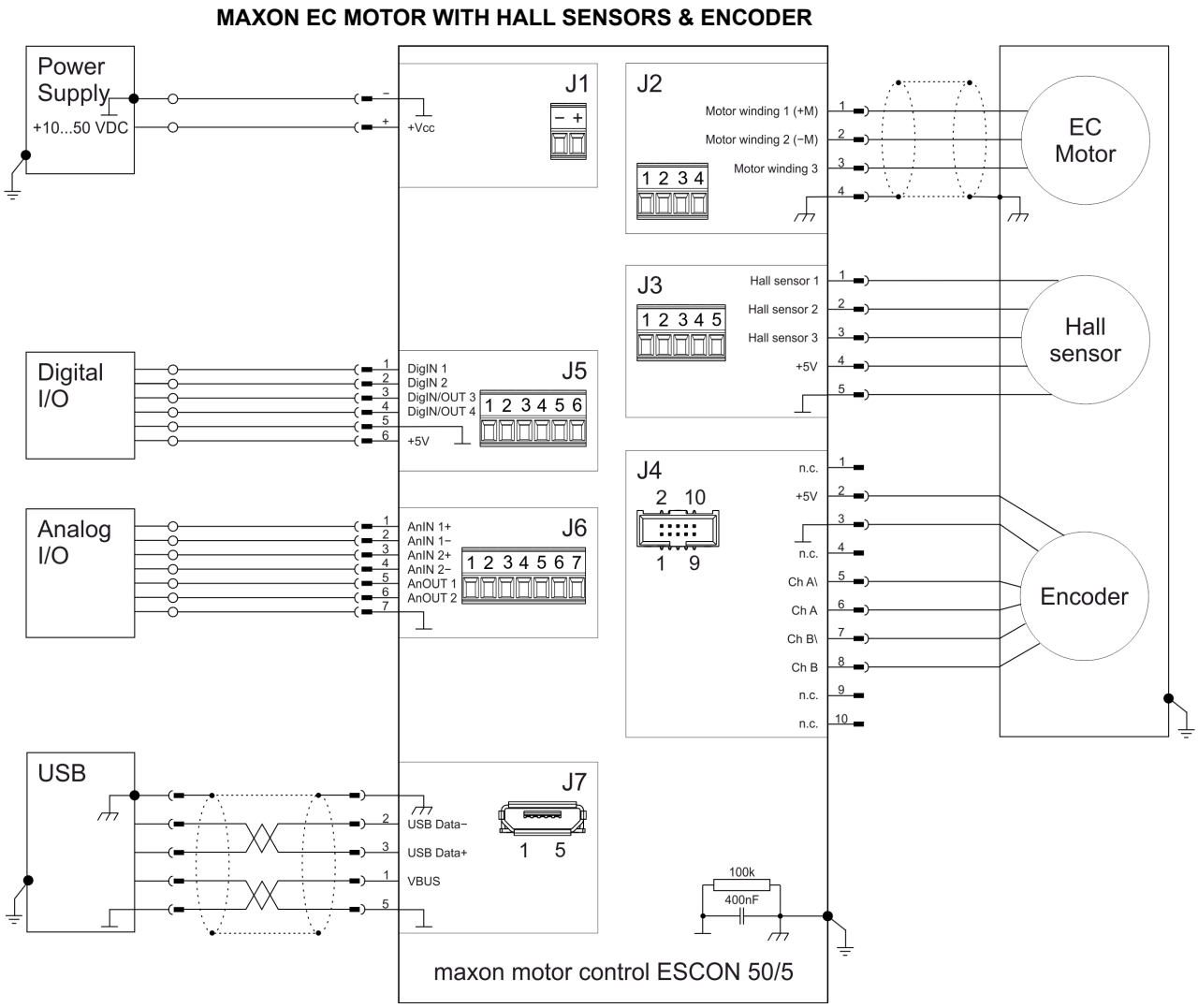

Figure 4-27 maxon EC motor with Hall Sensors & Encoder (J2 / J3 / J4)

5 SPARE PARTS

Order number	Description
425562	2 poles pluggable screw-type terminal block, pitch 3.5 mm, labeled 1…2
425563	4 poles pluggable screw-type terminal block, pitch 3.5 mm, labeled 1…4
425564	5 poles pluggable screw-type terminal block, pitch 3.5 mm, labeled 1…5
425565	6 poles pluggable screw-type terminal block, pitch 3.5 mm, labeled 1…6
425566	7 poles pluggable screw-type terminal block, pitch 3.5 mm, labeled 1…7

Table 5-24 Spare Parts List

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