

ESCON 70/10

Servo Controller

P/N 422969

Hardware Reference



escon.maxonmotor.com

Document ID: rel8449

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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 70/10 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 70/10 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! | |




| Type | Symbol | Meaning | |
|--------------------|---|--------------------------------|---|
| 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

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The present document – including all parts thereof – is protected by copyright. Any use (including reproduction, translation, microfilming, and other means of electronic data processing) beyond the narrow restrictions of the copyright law without the prior approval of maxon motor ag, is not permitted and subject to prosecution under the applicable law.

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1.2 About the Device

The ESCON 70/10 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 700 Watts.

The featured operating modes – speed control (closed loop), speed control (open loop), and current control – meet the highest requirements. The ESCON 70/10 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.maxonmotor.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 1-3 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 motor.



Electrostatic Sensitive Device (ESD)

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

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2 Specifications

2.1 Technical Data

| ESCON 70/10 (422969) | | |
|-----------------------------|---|--|
| Electrical Rating | Nominal operating voltage $+V_{CC}$ | 10...70 VDC |
| | Absolute operating voltage $+V_{CC\ min} / +V_{CC\ max}$ | 8 VDC / 76 VDC |
| | Output voltage (max.) | $0.95 \times +V_{CC}$ |
| | Output current I_{cont} / I_{max} (<20 s) | 10 A / 30 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 | 98% |
| | 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 15 μ H; 10 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 ($R_i = 38.5\ k\Omega$) |
| | Digital Input/Output 3 Digital Input/Output 4 | +2.4...+36 VDC ($R_i = 38.5\ k\Omega$) / 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 ($I_L \leq 10\ mA$) |
| | Hall sensor supply voltage | +5 VDC ($I_L \leq 30\ mA$) |
| | Encoder supply voltage | +5 VDC ($I_L \leq 70\ mA$) |
| 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 |

Specifications
Technical Data

| ESCON 70/10 (422969) | | | |
|---------------------------------|------------------------|--------------------------------------|---------------------------------------|
| Physical | Weight | approx. 259 g | |
| | Dimensions (L x W x H) | 125 x 78.5 x 27 mm | |
| | Mounting holes | for M4 screws | |
| Environmental Conditions | Temperature | Operation | -30...+45 °C |
| | | Extended range *1) | +45...+82 °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

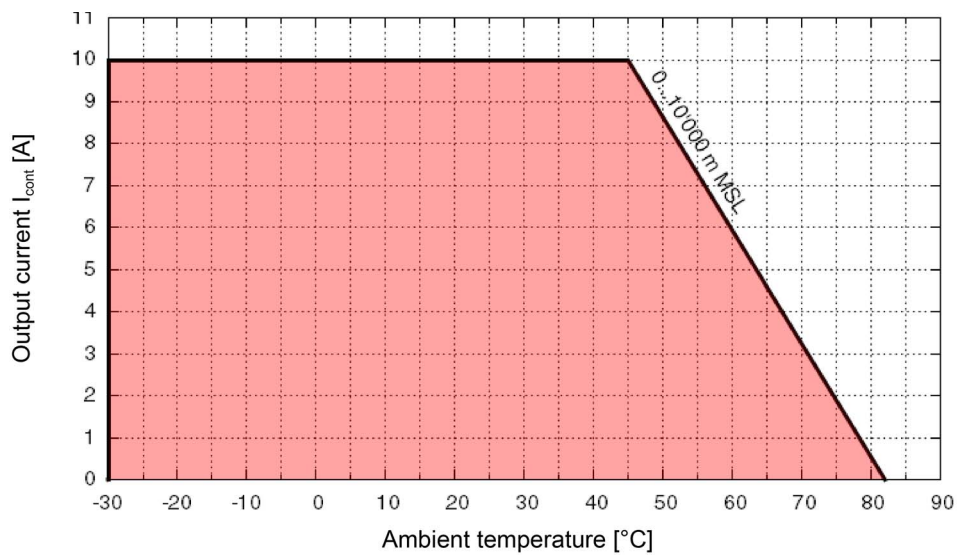


Figure 2-1 Derating Output Current

| Protection functionality | Switch-off threshold | Recovery threshold |
|--------------------------|----------------------|--------------------|
| Undervoltage | 7.2 V | 7.4 V |
| Overvoltage | 78 V | 75 V |
| Overcurrent | 50 A | — |
| Thermal overload | 110 °C | 90 °C |

Table 2-5 Limitations

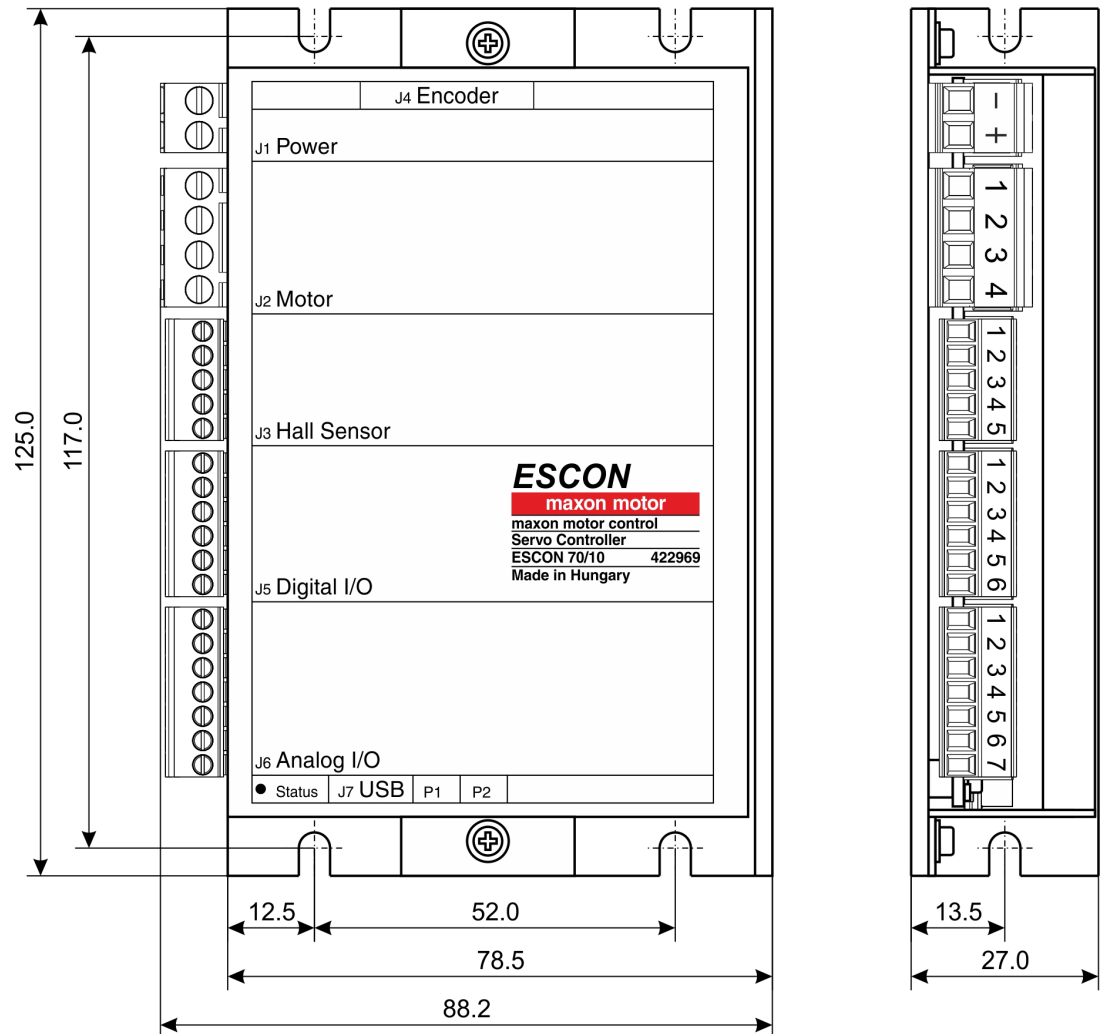


Figure 2-2 Dimensional Drawing [mm]

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 | Immunity for industrial environments |
| | 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, 10...500 Hz, 20 m/s ²) |
| | MIL-STD-810F | Random transport (10...500 Hz up to 2.53 g _{rms}) |
| Safety Standards | UL File Numbers E11792, 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): 280'383 hours |

Table 2-6 Standards

3 Setup

IMPORTANT NOTICE: PREREQUISITES FOR PERMISSION TO COMMENCE INSTALLATION

The ESCON 70/10 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...70 VDC.
- Supply voltages above 76 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 70/10 are as follows; continuous max. 10 A / short-time (acceleration) max. 30 A.



Built-in Motor Chokes

In a setup with low-inductive motor winding combined with high continuous current and high supply voltage, an additional external 3-phase motor choke will probably be necessary (for details →chapter "3.6 External Motor Chokes" on page 3-29).



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...70 VDC |
| Absolute output voltage | min. 8 VDC; max. 76 VDC |
| Output current | Depending on load <ul style="list-style-type: none"> • continuous max. 10 A • short-time (acceleration, <20 s) max. 30 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 95%
- Controller's max. voltage drop of 1 V @ 10 A

KNOWN VALUES:

- Operating torque M [mNm]
- Operating speed n [rpm]
- Nominal motor voltage U_N [Volt]
- Motor no-load speed at U_N, n₀ [rpm]
- Speed/torque gradient of the motor Δn/ΔM [rpm/mNm]

SOUGHT VALUE:

- Supply voltage +V_{CC} [Volt]

SOLUTION:

$$V_{CC} \geq \left[\frac{U_N}{n_0} \cdot \left(n + \frac{\Delta n}{\Delta M} \cdot M \right) \cdot \frac{1}{0.95} \right] + 1 [V]$$

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)

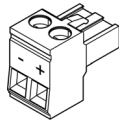


Figure 3-3 Power Plug J1

| J1 Pin | Signal | Description |
|--------|------------------|--------------------------------------|
| - | Power_GND | Ground of supply voltage |
| + | +V _{CC} | Power supply voltage (+10...+70 VDC) |

Table 3-7 Power Plug J1 – Pin Assignment

| Specification / Accessories | |
|-----------------------------|---|
| Type | Pluggable screw-type terminal block, 2 poles, pitch 5.0 mm |
| Suitable cables | 0.2...2.5 mm ² multi-core, AWG 24-12 0.2...2.5 mm ² single wire, AWG 24-12 |

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).

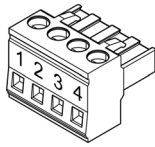


Figure 3-4 Motor Plug J2

| 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 5.0 mm |
| Suitable cables | 0.2...2.5 mm ² multi-core, AWG 24-12 0.2...2.5 mm ² single wire, AWG 24-12 |

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.

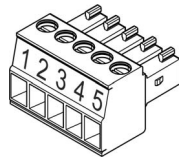


Figure 3-5 Hall Sensor Plug J3

| 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; $I_L \leq 30$ 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 mm ² multi-core, AWG 28-14 0.14...1.5 mm ² 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) |

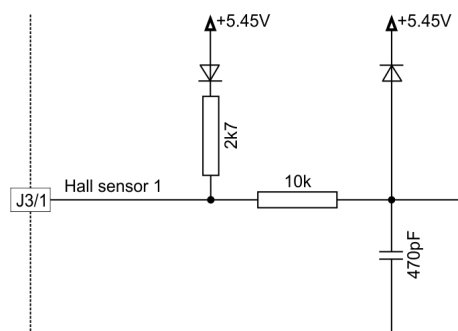


Figure 3-6 Hall Sensor 1 Input Circuit (analogously valid also for Hall Sensors 2 & 3)

3.3.4 Encoder (J4)

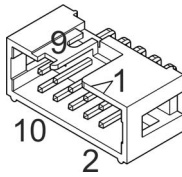


Figure 3-7 Encoder Socket J4

| 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

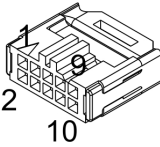
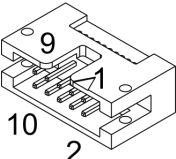
| Encoder Cable (275934) | |
|--|--|
| <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <div style="border: 1px solid black; padding: 2px; width: 20px; height: 20px; display: flex; align-items: center; justify-content: center; font-weight: bold;">A</div>  </div> <div style="text-align: center;"> <div style="border: 1px solid black; padding: 2px; width: 20px; height: 20px; display: flex; align-items: center; justify-content: center; font-weight: bold;">B</div>  </div> </div> | |
| Cable cross-section | 10 x AWG28, round-jacket, twisted pair flat cable, pitch 1.27 mm |
| Length | 3.20 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 |

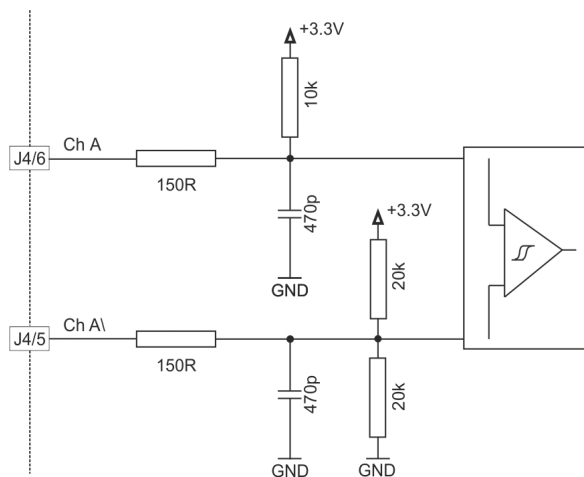


Figure 3-8 Encoder Input Circuit Ch A “Differential” (analogously valid also for Ch B)

| 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 +420 μ A @ 5 V |
| Input low current | I_{IL} = typically -170 μ A @ 0 V |
| Max. input frequency | 100 kHz |

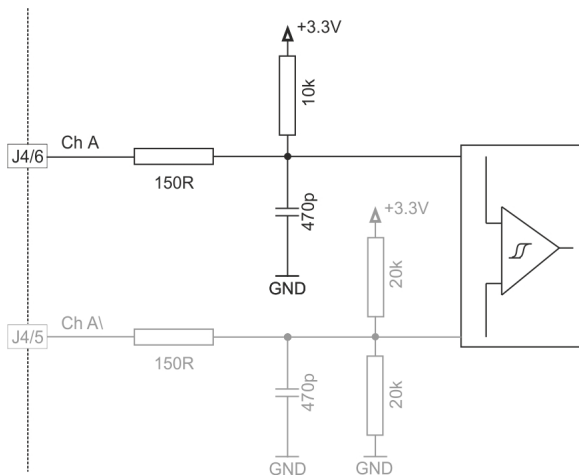


Figure 3-9 Encoder Input Circuit Ch A “Single-ended” (analogously valid also for Ch B)

3.3.5 Digital I/Os (J5)

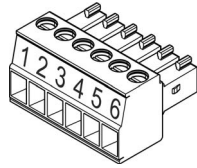


Figure 3-10 Digital I/Os Plug J5

| 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 mm ² multi-core, AWG 28-14 0.14...1.5 mm ² 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%) |
| RC Servo cycle duration | 3...30 ms |
| RC Servo pulse length | 1...2 ms |

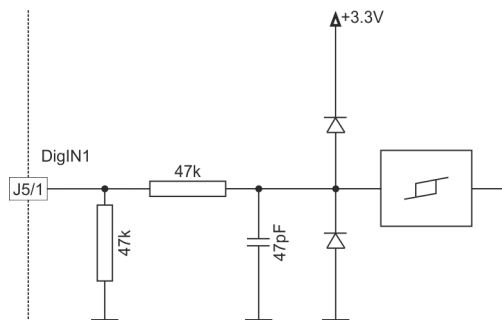


Figure 3-11 DigIN1 Circuit

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 |

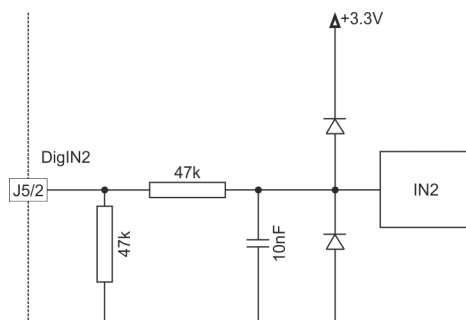


Figure 3-12 DigIN2 Circuit

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 |

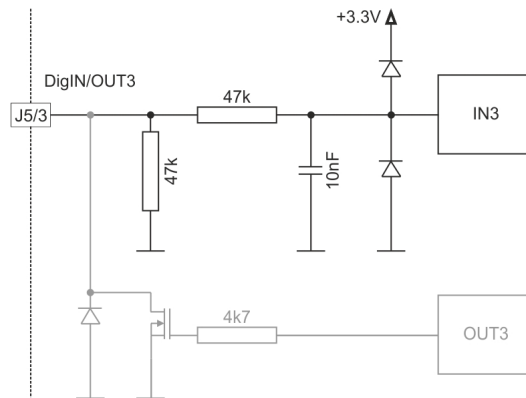


Figure 3-13 DigIN3 Circuit (analogously valid also for DigIN4)

| 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 |

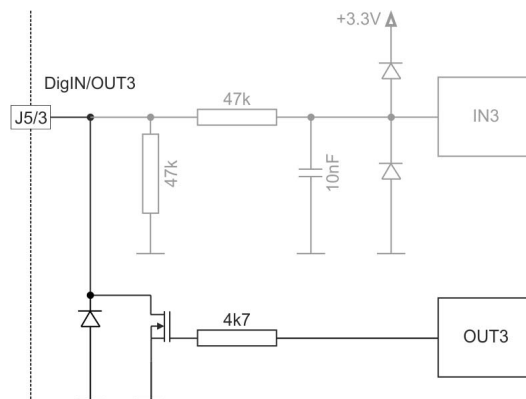


Figure 3-14 DigOUT3 Circuit (analogously valid also for DigOUT4)

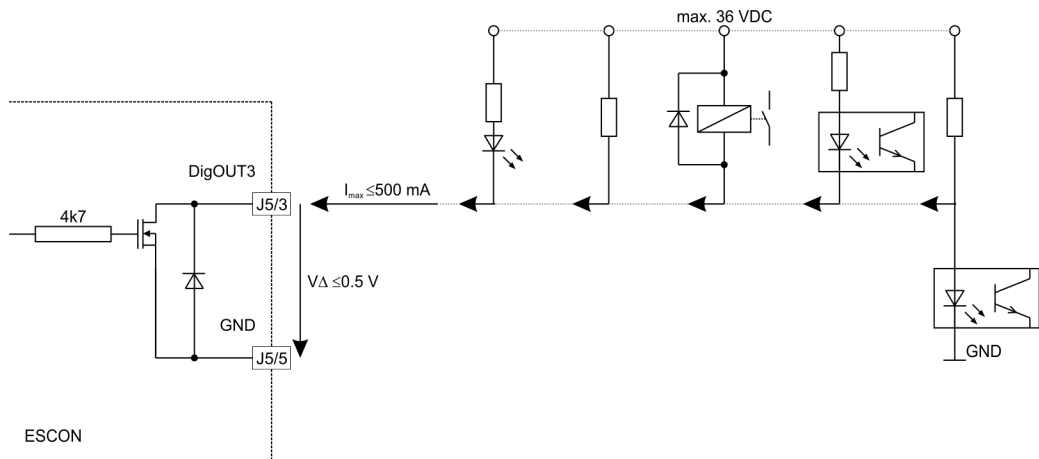


Figure 3-15 DigOUT3 Wiring Examples (analogously valid also for DigOUT4)

3.3.6 Analog I/Os (J6)

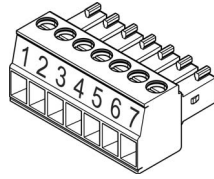


Figure 3-16 Analog I/Os Plug J6

| 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 mm ² multi-core, AWG 28-14 0.14...1.5 mm ² 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 | 80 k Ω (differential) 65 k Ω (referenced to GND) |
| A/D converter | 12-bit |
| Resolution | 5.64 mV |
| Bandwidth | 10 kHz |

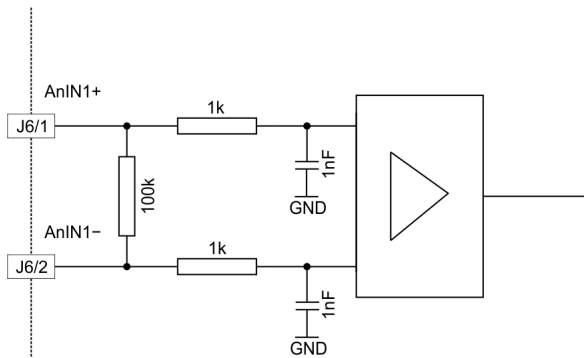


Figure 3-17 AnIN1 Circuit (analogously valid also for AnIN2)

3.3.6.2 Analog Outputs 1 and 2

| | |
|--------------------------------------|---|
| Output voltage | -4...+4 VDC |
| D/A converter | 12-bit |
| Resolution | 2.42 mV |
| Refresh rate | AnOUT1: 26.8 kHz AnOUT2: 5.4 kHz |
| Analog bandwidth of output amplifier | 50 kHz |
| Max. capacitive load | 300 nF Note: The slew rate will be limited proportional to the capacitive load (e.g. 5 V/ms @300 nF). |
| Max. output current | 1 mA |

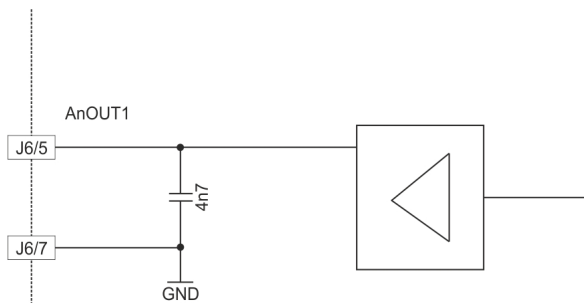


Figure 3-18 AnOUT1 Circuit (analogously valid also for AnOUT2)

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.

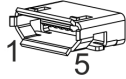


Figure 3-19 USB Socket J7



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) | |
|-------------------------------------|--|
| A | B |
| | |
| 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 |

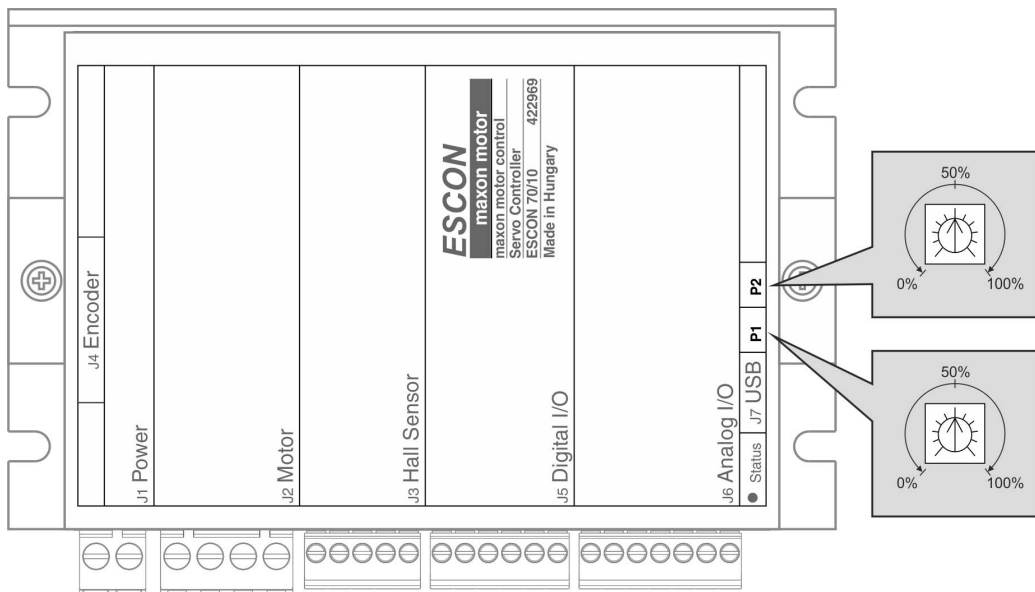


Figure 3-20 Potentiometers – Location & Adjustment Range

3.5 Status Indicators

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

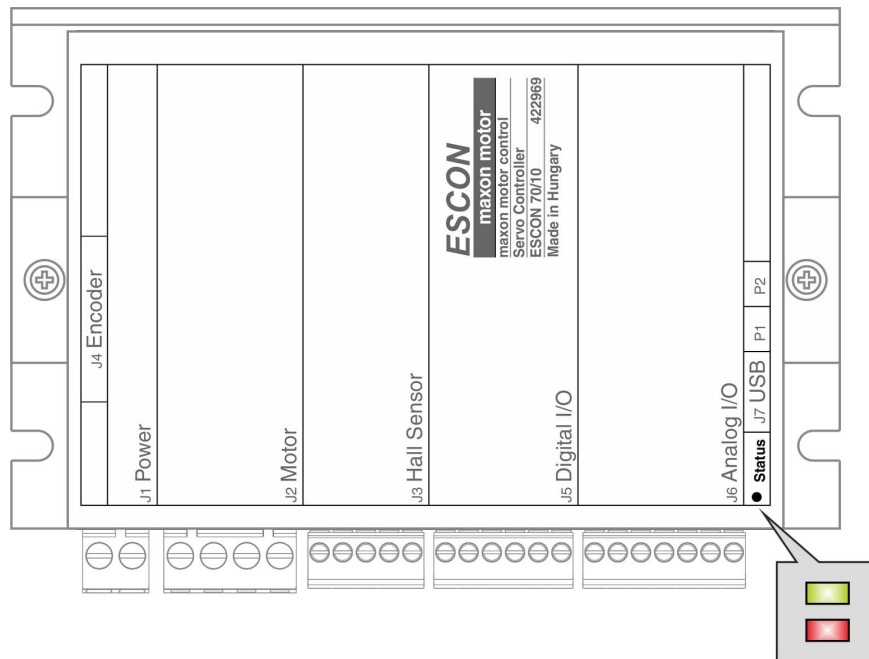


Figure 3-21 LEDs – Location

| LED | | Status / Error | |
|-------|-----|---------------------------|--|
| Green | Red | | |
| off | off | INIT | |
| slow | off | DISABLE | |
| on | off | ENABLE | |
| 2x | off | STOPPING; STOP STANDSTILL | |
| off | 1x | ERROR | <ul style="list-style-type: none"> +Vcc Overvoltage Error +Vcc Undervoltage Error +5 VDC Undervoltage Error |
| off | 2x | ERROR | <ul style="list-style-type: none"> Thermal Overload Error Overcurrent Error Power Stage Protection Error Internal Hardware Error |
| off | 3x | ERROR | <ul style="list-style-type: none"> Encoder Cable Break Error Encoder Polarity Error DC Tacho Cable Break Error DC Tacho Polarity Error |
| off | 4x | ERROR | <ul style="list-style-type: none"> PWM Set Value Input out of Range Error |
| off | 5x | ERROR | <ul style="list-style-type: none"> Hall Sensor Pattern Error Hall Sensor Sequence Error Hall Sensor Frequency too high Error |
| off | on | ERROR | <ul style="list-style-type: none"> Auto Tuning Identification Error Internal Software Error |

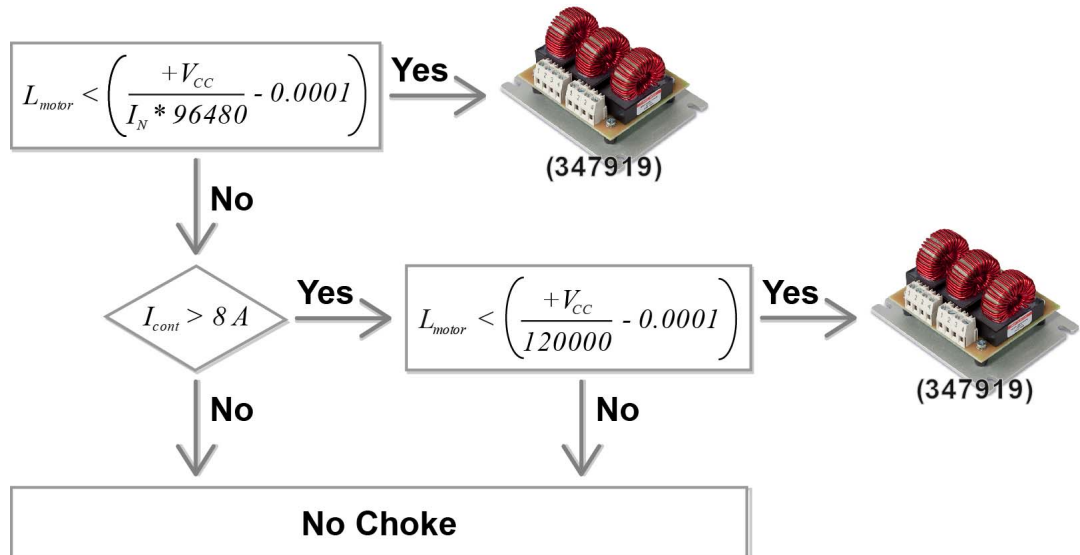
The diagram shows six horizontal traces representing LED pulse widths. The top trace is labeled 'slow' and has a red arrow above it indicating a pulse width of 1 second. The other traces are labeled '1x', '2x', '3x', '4x', and '5x'. A legend on the right indicates that the high state of the pulse is 'on' and the low state is 'off'.

Table 3-23 LEDs – Interpretation of Condition

3.6 External Motor Chokes

The ESCON 70/10 features built-in motor chokes that are suitable for most motors and applications. Nevertheless, in case of high power supply voltage $+V_{cc}$ in combination with high continuous output current and a motor with very low inductance, the current ripple will become too high. This will cause unnecessary motor heating and unstable control behavior. In this case, an additional, external 3-phase motor choke will be necessary.

Use the following formula to determine whether an additional motor choke will be required:



- $L_{motor}[H]$ Motor terminal inductance (→Line 11 in maxon catalog)
- $V_{cc}[V]$ Nominal operating voltage $+V_{cc}$
- $I_N[A]$ Motor nominal current (→Line 6 in maxon catalog)
- $I_{cont}[A]$ System continuous current

| Specification / Accessories | |
|-----------------------------|--|
| Type | Choke Module (347919) |
| | Rating 3 x 0.1 mH, 10.0 A nominal DC current, each |
| | Dimensions 90 x 70 x 49.7 mm (L x W x H) |
| | Connection Screw-type terminal block |

Table 3-24 External Motor Chokes – Specification & Accessories

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4 Wiring

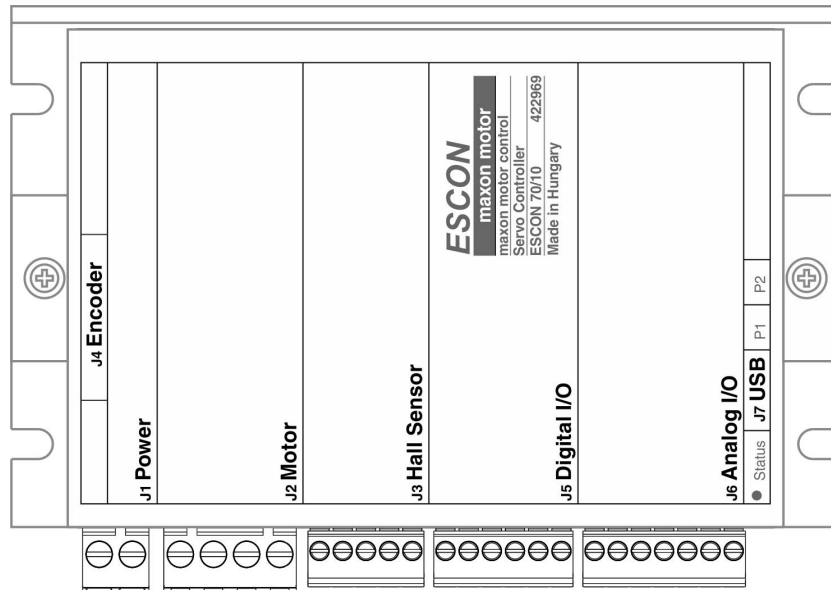



Figure 4-22 Interfaces – Designations and Location



Remark

The subsequent diagrams feature this sign:

-  Ground safety earth connection (optional)

4.1 DC Motors

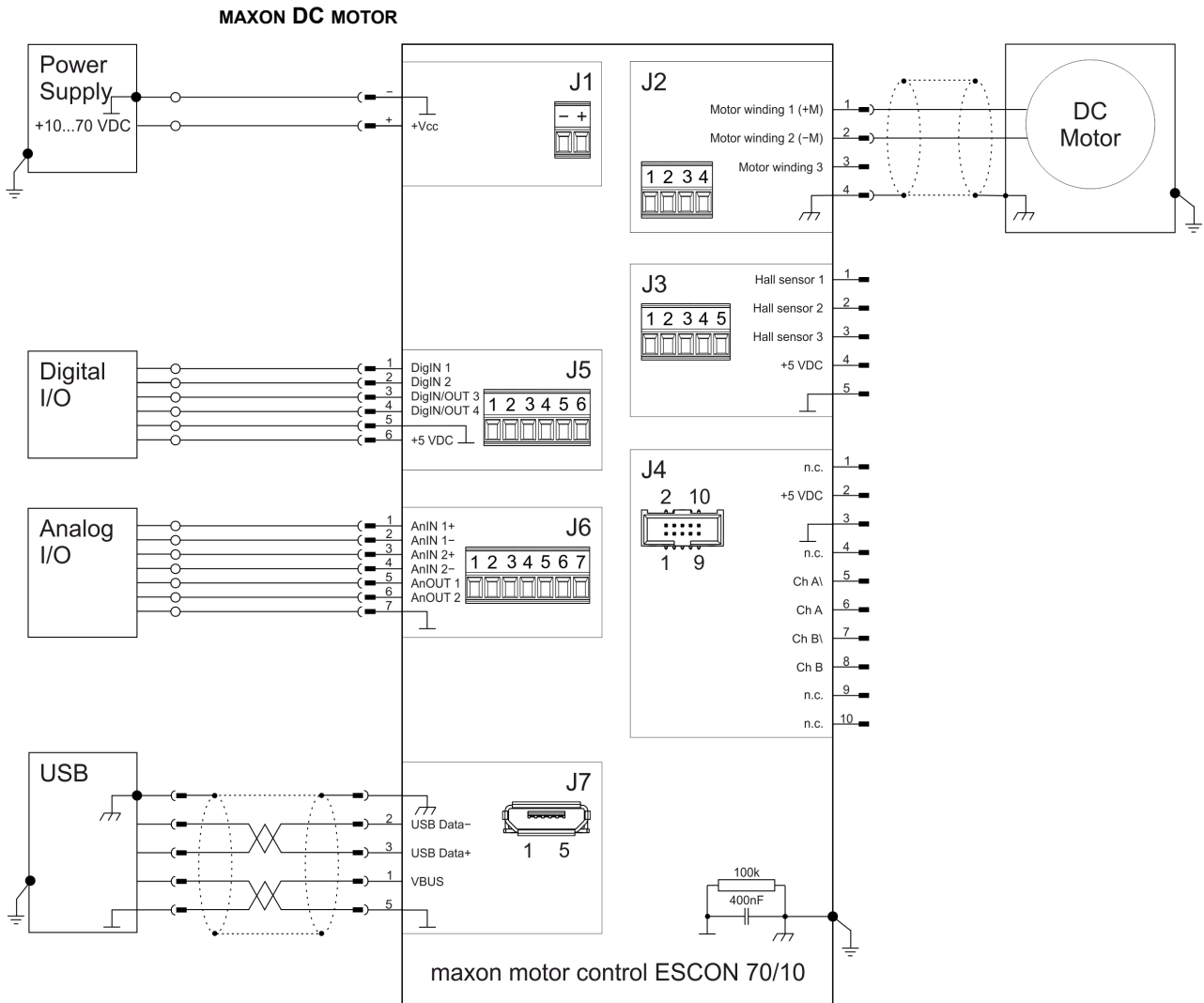


Figure 4-23 maxon DC motor (J2)

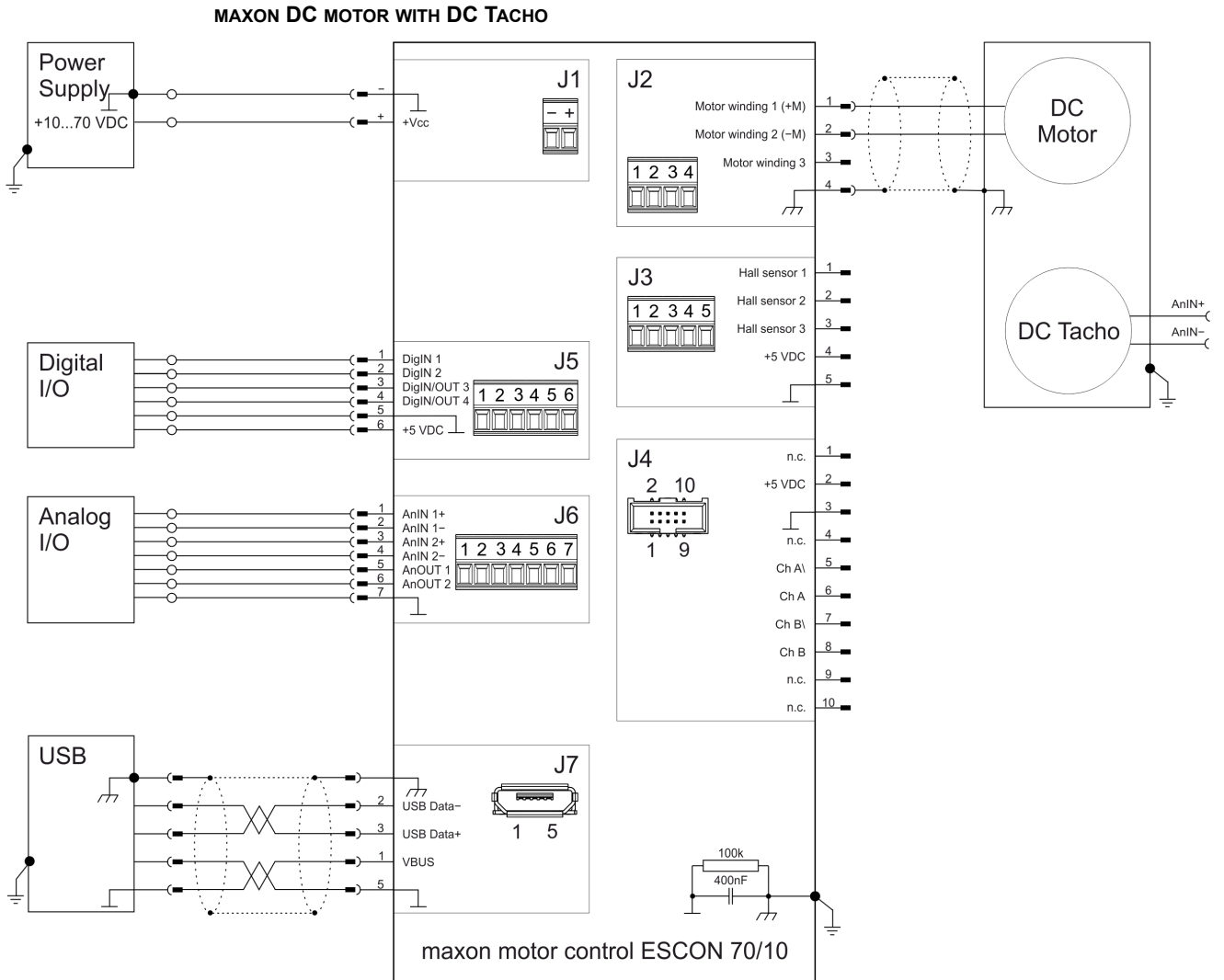


Figure 4-24 maxon DC motor with DC Tacho (J2)

MAXON DC MOTOR WITH ENCODER

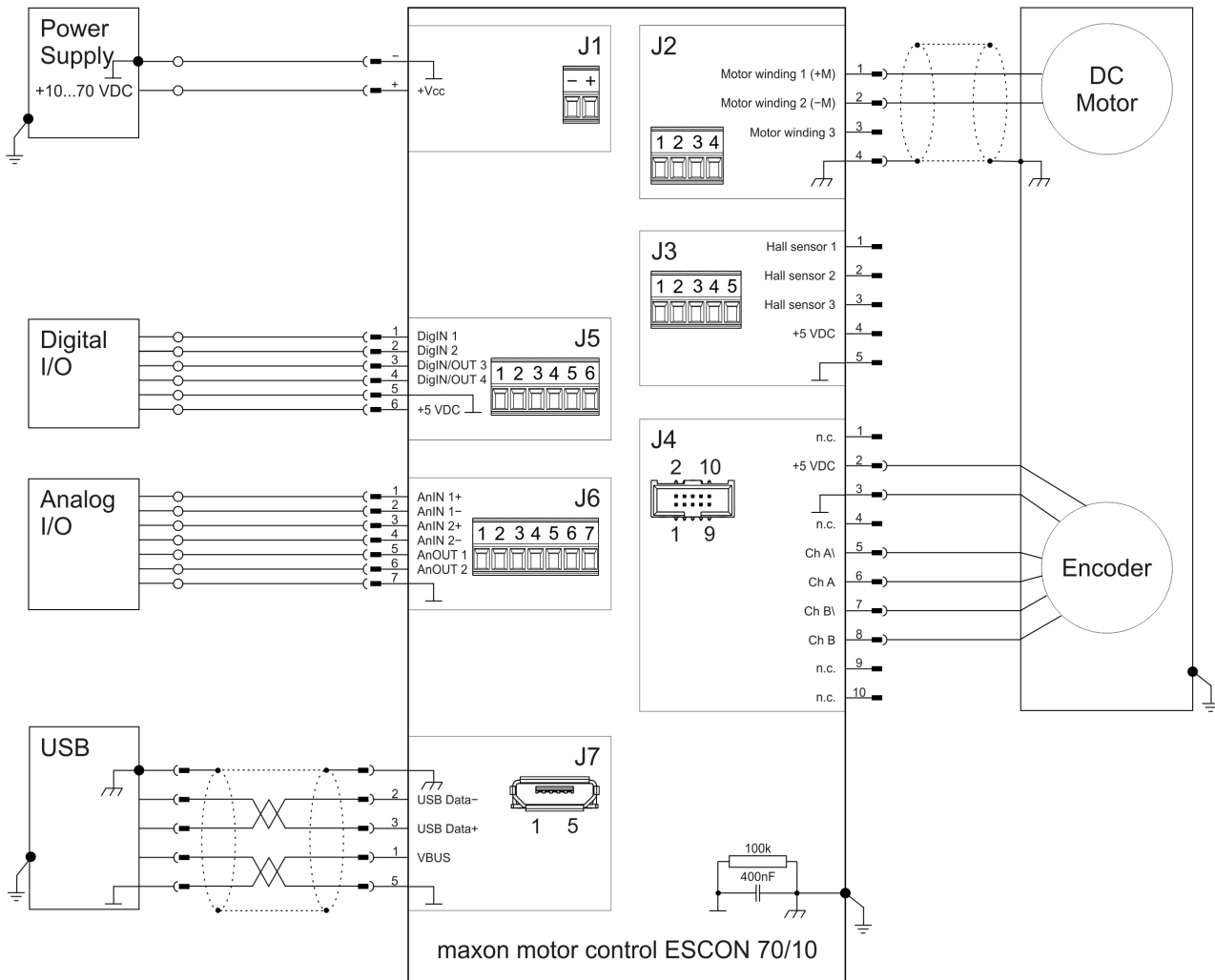


Figure 4-25 maxon DC motor with Encoder (J2 / J4)

4.2 EC Motors

MAXON EC MOTOR WITH HALL SENSORS

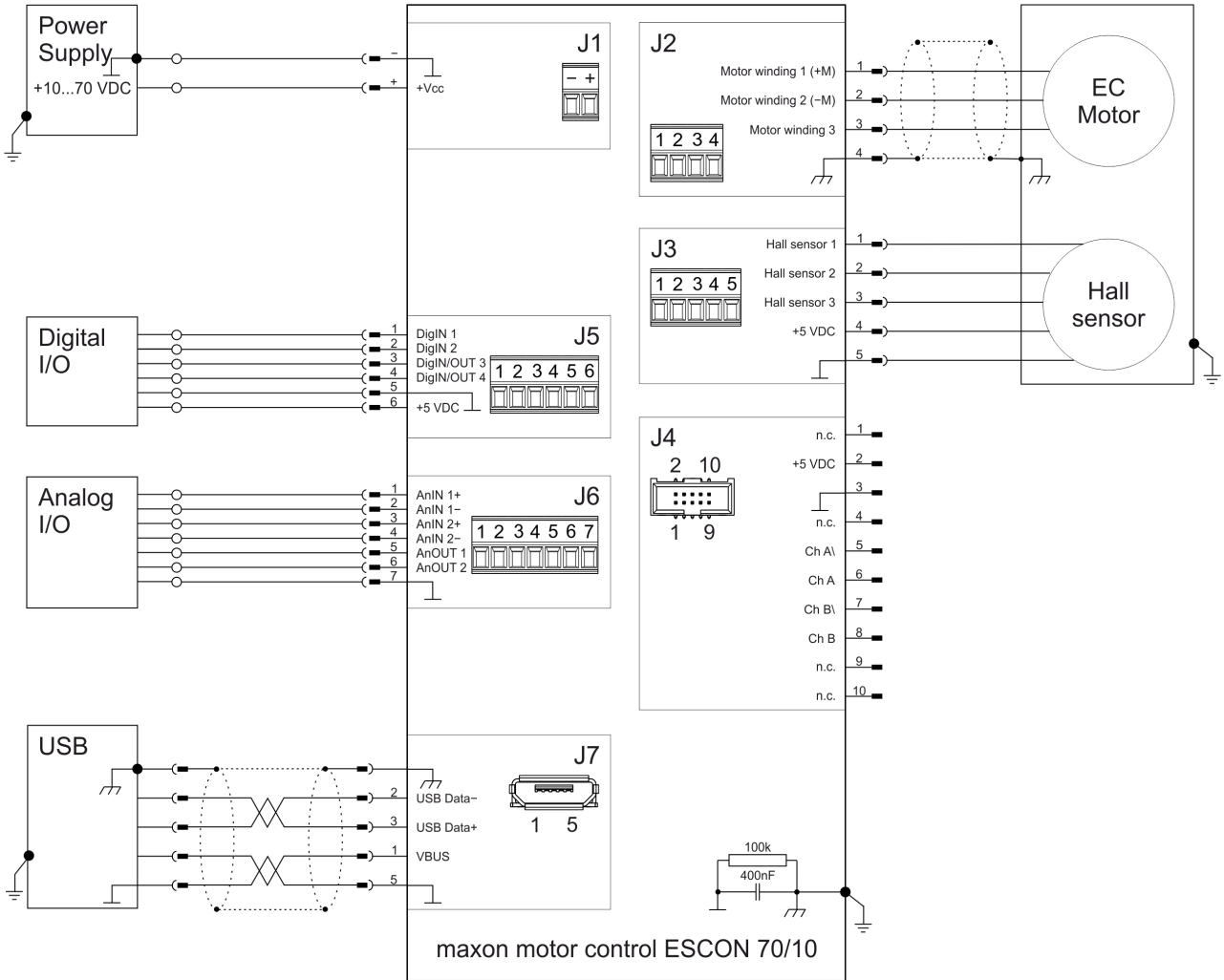


Figure 4-26 maxon EC motor with Hall Sensors (J2 / J3)

MAXON EC MOTOR WITH HALL SENSORS & ENCODER

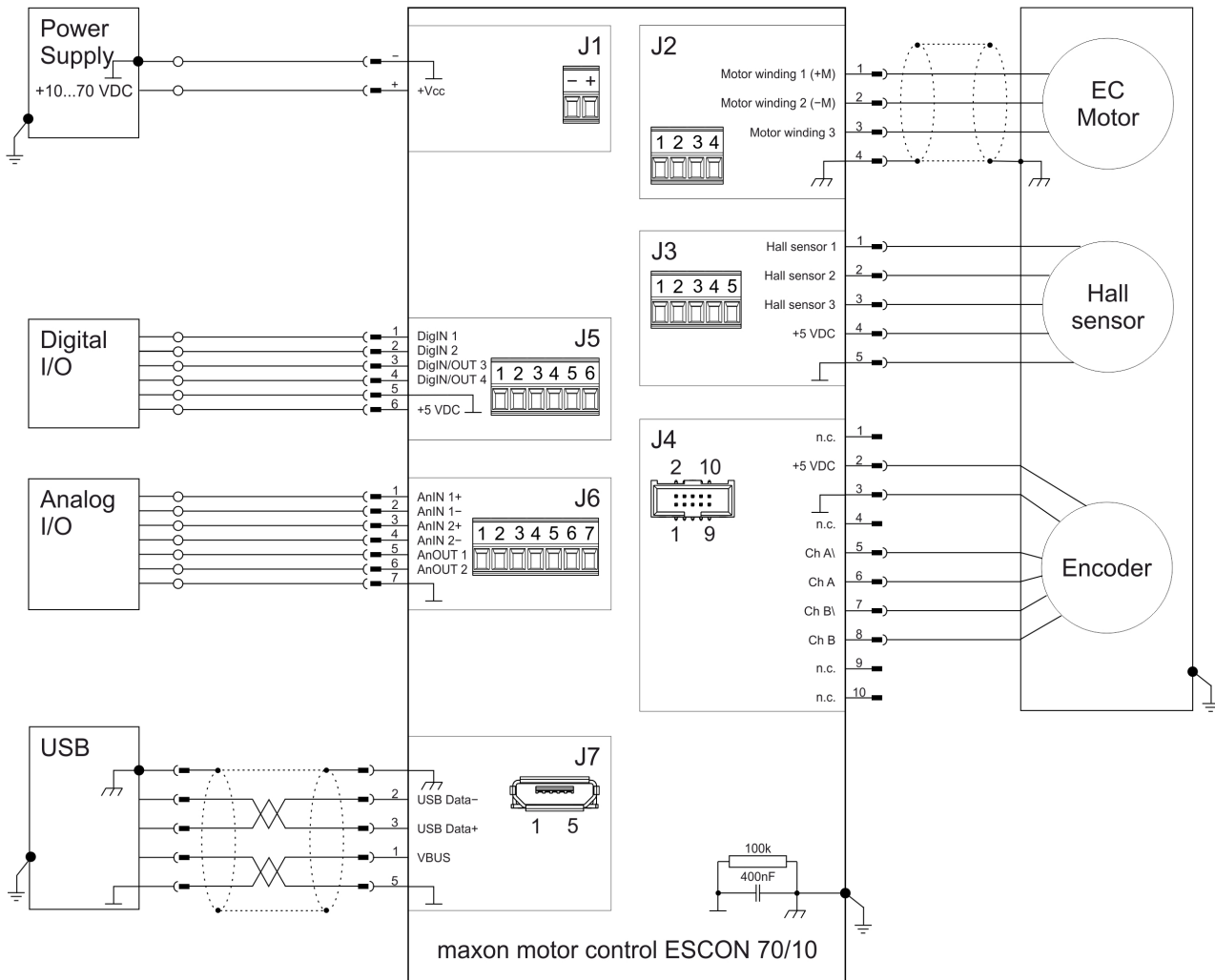


Figure 4-27 maxon EC motor with Hall Sensors & Encoder (J2 / J3 / J4)

5 Spare Parts

| Order number | Description |
|--------------|--|
| 432793 | 2 poles pluggable screw-type terminal block, pitch 5.0 mm, labeled 1...2 |
| 432794 | 4 poles pluggable screw-type terminal block, pitch 5.0 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 5-25 Spare Parts List

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