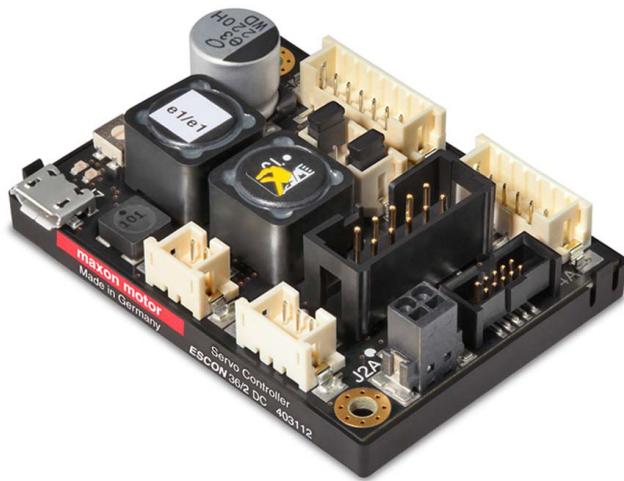


maxon

ESCON 36/2 DC

Hardware Reference



escon.maxongroup.com

ESCON 36/2 DC Servo Controller | P/N 403112
Hardware Reference
CCMC | Edition 2021-08 | DocID rel9011

TABLE OF CONTENTS

1 ABOUT	3
1.1 About this Document	3
1.2 About the Device	5
1.3 About the Safety Precautions	6
2 SPECIFICATIONS	7
2.1 Technical Data	7
2.2 Standards	10
3 SETUP	11
3.1 Generally applicable Rules	11
3.2 Determination of Power Supply	12
3.3 Cabling	13
3.4 Connections	14
3.5 Jumpers	29
3.6 Potentiometers	29
3.7 Status Indicators	30
4 WIRING	31
LIST OF FIGURES	40
LIST OF TABLES	41
INDEX	42

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 36/2 DC 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 36/2 DC 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

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, is not permitted and subject to prosecution under the applicable law.

© 2021 maxon. All rights reserved. Subject to change without prior notice.

CCMC | ESCON 36/2 DC Hardware Reference | Edition 2021-08 | DocID rel9011

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

1.2 About the Device

The ESCON 36/2 DC is a small-sized, powerful 4-quadrant PWM servo controller for the highly efficient control of permanent magnet-activated DC motors up to approximately 72 Watts.

The featured operating modes – speed control (closed loop), speed control (open loop), and current control – meet the highest requirements. The ESCON 36/2 DC 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 36/2 DC (403112)		
Electrical Rating	Nominal operating voltage $+V_{CC}$	10...36 VDC
	Absolute operating voltage $+V_{CC\ min} / +V_{CC\ max}$	8 VDC / 38 VDC
	Output voltage (max.)	$0.98 \times +V_{CC}$
	Output current I_{cont} / I_{max} (<60 s)	2 A / 4 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	limited by max. permissible speed (motor) and max. output voltage (controller)
Inputs & Outputs	Built-in motor choke	300 μ H; 2 A
	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 ($R_i = 38.5 \text{ k}\Omega$)
	Digital Input/Output 3 Digital Input/Output 4	+2.4...+36 VDC ($R_i = 38.5 \text{ k}\Omega$) / max. 36 VDC ($I_L < 500 \text{ mA}$)
Voltage Outputs	Encoder signals	A, A\, B, B\, (max. 1 MHz)
	Auxiliary output voltage	+5 VDC ($I_L \leq 40 \text{ mA}$)
	Encoder supply voltage	+5 VDC ($I_L \leq 70 \text{ mA}$)
Potentiometer	Potentiometer P1 (on board)	210°; linear
Motor Connections	+ Motor	
	- Motor	
Interface	USB 2.0 / USB 3.0	full speed
Status Indicators	Operation	green LED
	Error	red LED
Physical	Weight	approx. 30 g
	Dimensions (L x W x H)	55 x 40 x 16.1 mm
	Mounting holes	for M2.5 screws (max. tightening torque 0.16 Nm)

ESCON 36/2 DC (403112)			
Environmental Conditions	Temperature	Operation	-30...+45 °C
		Extended range ^{*1)}	+45...+81 °C Derating → Figure 2-1
		Storage	-40...+85 °C
	Altitude ^{*2)}	Operation	0...6'000 m MSL
		Extended range ^{*1)}	6'000...10'000 m MSL Derating → Figure 2-1
	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

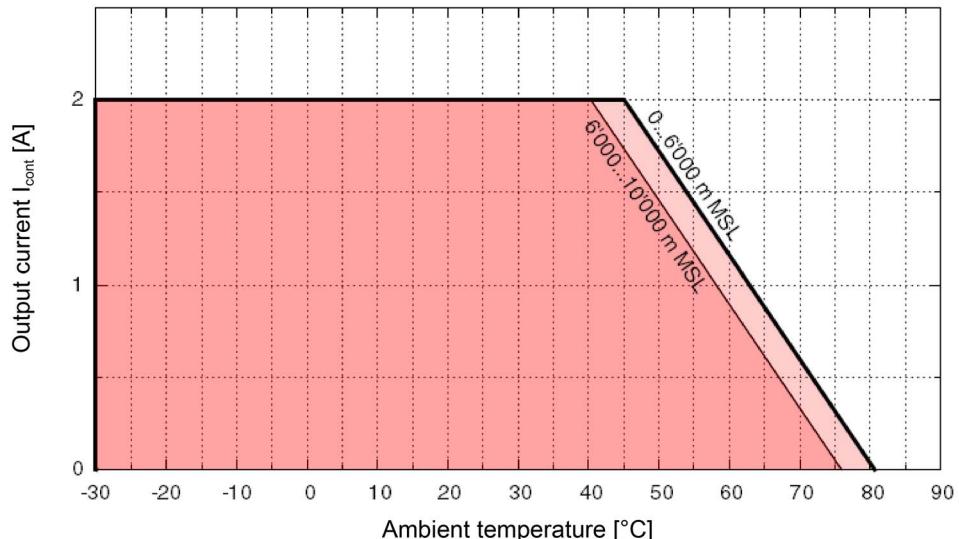


Figure 2-1 Derating Output Current

Protection functionality	Switch-off threshold	Recovery threshold
Undervoltage	7.2 V	7.4 V
Oversupply	43.1 V	41 V
Overcurrent	6.75 A	—
Thermal overload	95 °C	85 °C

Table 2-5 Limitations

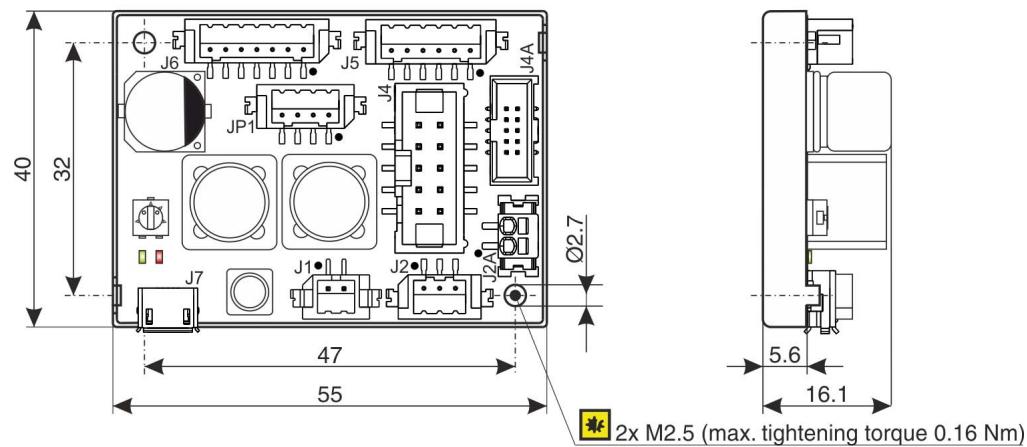


Figure 2-2 Dimensional Drawing [mm]

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
Applied Standards	IEC/EN 61000-6-3 IEC/EN 55022 (CISPR22)	Emission standard for residential, commercial and light-industrial environments
Applied Standards	IEC/EN 61000-4-3	Radio disturbance characteristics / radio interference
Applied Standards	IEC/EN 61000-4-4	Radiated, radio-frequency, electromagnetic field immunity test >10 V/m
Applied Standards	IEC/EN 61000-4-6	Electrical fast transient/burst immunity test ±2 kV
Applied Standards	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)
Safety Standards	MIL-STD-810F	Random transport (10...500 Hz up to 2.53 g _{rms})
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): 511'401 hours

Table 2-6 Standards

3 SETUP

IMPORTANT NOTICE: PREREQUISITES FOR PERMISSION TO COMMENCE INSTALLATION

The ESCON 36/2 DC 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

For each possible motor variant you will find information on the from/to connections and the cables you will require. If you should decide not to use the ready-made maxon cables, you must establish the respective connections as to → chapter "3.4.7 ESCON 36/2 DC Connector Set" on page 3-28 and → chapter "4 Wiring" on page 4-31.



Maximal permitted Supply Voltage

- *Make sure that supply power is between 10...36 VDC.*
- *Supply voltages above 38 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 36/2 DC are as follows; continuous max. 2 A / short-time (acceleration) max. 4 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.*



How to read the Wiring Details

The subsequent description follows this scheme:

- *Column "J... & Head A": Pin number...*
 - of the socket,
 - of the corresponding plug, and
 - of Head A of the matching prefab maxon cable.
- *Column "Prefab Cable": Wire color of the prefab maxon cable.*
- *Column "Head B": Pin number of Head B of the matching prefab maxon cable.*

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...36 VDC
Absolute output voltage	min. 8 VDC; max. 38 VDC
Output current	Depending on load <ul style="list-style-type: none"> • continuous max. 2 A • short-time (acceleration, <60 s) max. 4 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 @ 2 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:

$$V_{CC} \geq \left[\frac{U_N}{n_0} \cdot \left(n + \frac{\Delta n}{\Delta M} \cdot M \right) \cdot \frac{1}{0.98} \right] + 1[V]$$

3.3 Cabling

Here you can get the connection information required to commission your ESCON 36/2 DC. You will find all details for both approaches, Plug&Play and making your own cables.

PLUG&PLAY

Take advantage of maxon's prefab cable assemblies. They come as ready-to-use parts and will help you to reduce commissioning time to a minimum.

- a) Check the «Cable Selector» ([Table 3-7](#)) to find the cable assemblies' order number matching the setup you will be using.
- b) Follow the cross-reference to get the cable assemblies' pin assignment.

MAKE&BAKE YOUR OWN

- a) Check the «Cable Selector» ([Table 3-7](#)) to find the required cables for the setup you will be using.
- b) Follow the cross-reference to get the cable's specification and pin assignment.
- c) Utilize the installation kit ([page 3-28](#)) containing plugs and terminals that will fit the controller's sockets.

Cable		Order number	→ page	Socket	DC Motor with...	
Designation					Separated Motor/Encoder Cable	Integrated Motor/Encoder Ribbon Cable
Power Cable		403957	3-14	J1	X	X
DC Motor Cable		403962	3-15	J2	X	
Encoder Cable		275934	3-18	J4	O	O
I/O Cable 6core		403965	3-21	J5	X	X
I/O Cable 7core		403964	3-25	J6	O	O
USB Type A - micro B Cable		403968	3-27	J7	X	X

Legend: X = required / O = optional

Table 3-7 Cable Selector

3.4 Connections

The actual connection will depend on the overall configuration of your drive system and the type of motor you will be using. Some connections must be established in a given way, while for motor (J2/J2A and encoder (J4/J4A) alternative plug-in locations can be chosen from.

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.

3.4.1 Power (J1)



Figure 3-3 Power Socket J1

J1 & Head A	Prefab Cable	Head B	Signal	Description
Pin	Color	Pin		
1	white	-	Power_GND	Ground of supply voltage
2	brown	+	+V _{cc}	Power supply voltage (+10...+36 VDC)

Table 3-8 Power Socket J1 – Pin Assignment & Cabling

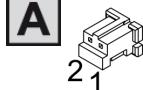
Power Cable (403957)		
A 		B
Cable cross-section		2 x 0.34 mm ²
Length		1.5 m
Head A		Suitable plugs Suitable contacts Hirose DF3-2S-2C... Hirose DF3-22SC...
Head B		Cable end sleeves 0.34 mm ²

Table 3-9 Power Cable

3.4.2 Motor (J2 / J2A)

**Potential Destruction**

Use only one of the two sockets – either J2 or J2A!

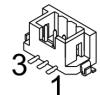
SOCKET J2

Figure 3-4 Motor Socket J2

J2 & Head A Pin	Prefab Cable Color	Head B Pin	Signal	Description
1	white		Motor (+M)	Motor +
2	brown		Motor (-M)	Motor -
3	black		Motor shield	Cable shield

Table 3-10 Motor Socket J2 – Pin Assignment & Cabling

DC Motor Cable (403962)		
A 		B
Cable cross-section		2 x 0.34 mm ² shielded
Length		1.5 m
Head A	Suitable plugs Suitable contacts	Hirose DF3-3S-2C Hirose DF3-22SC...
Head B		Cable end sleeves 0.34 mm ²

Table 3-11 DC Motor Cable

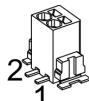
SOCKET J2A

Figure 3-5 Motor Socket J2A

J2A & Head A	Prefab Cable	Head B	Signal	Description
Pin	Color	Pin		
1			Motor (+M)	Motor +
2			Motor (-M)	Motor -

Table 3-12 Motor Socket J2A – Pin Assignment

Specification / Accessories		
Type	2 poles, spring-loaded contacts, pitch 2.5 mm	
Suitable cables	Rigid	0.14...0.5 mm ² , AWG 26-20 / wire stripping length 6 mm
	Flexible	0.2...0.5 mm ² , AWG 24-20 / wire stripping length 6 mm 0.25...0.5 mm ² , AWG 24-20 / wire stripping length 6 mm, cable end sleeves
Suitable tools	Miniature screwdriver, size "00"	

Table 3-13 Motor Socket J2A – Specification & Accessories

3.4.3 Encoder (J4 / J4A)



Potential Destruction

Use only one of the two sockets – either J4 or J4A!

SOCKET J4

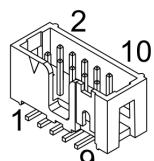


Figure 3-6 Encoder Socket J4

J4 & Head A Pin	Prefab Cable Color	Head B Pin	Signal	Description
1			Motor (+M)	Motor +M (→note below)
2			+5 VDC	Encoder supply voltage (+5 VDC; ≤70 mA)
3			GND	Ground
4			Motor (−M)	Motor −M (→note below)
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 & Cabling



Note

If you are using a **maxon DC motor with integrated Motor/Encoder Ribbon Cable**, make sure to close both JP1 jumpers (→chapter “3.5 Jumpers” on page 3-29).

Accessories		
Suitable strain relief	Lock	2 levers, Harting (09 18 000 9905)
	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

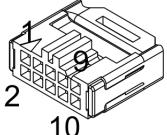
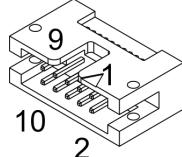
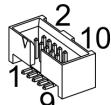
Encoder Cable (275934)	
A	
B	
Cable cross-section	10 x AWG28, round-jacket, flat cable, pitch 1.27 mm
Length	3 m
Head A	DIN 41651 female, pitch 2.54 mm, 10 poles, with strain relief
Head B	DIN 41651 Plug, pitch 2.54 mm, 10 poles, with strain relief

Table 3-16 Encoder Cable

SOCKET J4A

This seems to be the cable of my configuration although it comes with a connector compatible only with J4...

Figure 3-7 Encoder Socket J4A

J4A & Head A	Prefab Cable	Head B	Signal	Description
Pin	Color	Pin		
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 3-17 Encoder Socket J4A – Pin Assignment

Specification / Accessories	
Type	2 x 5 poles, half pitch box header, pitch 1.27/1.27 mm
Suitable plugs	Samtec: FFSD series W+P Products: 376 series Elcotron: IDC32 series
Suitable cables	Flat ribbon cable AWG 30

Table 3-18 Encoder Socket J4A – Specification & Accessories

**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

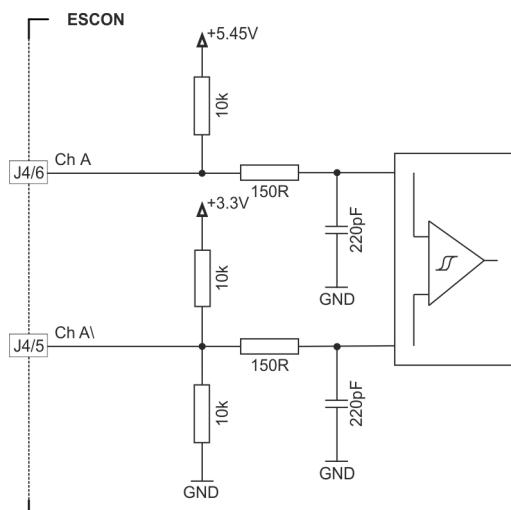


Figure 3-8 Encoder Input Circuit Ch A "Differential" (analogously valid also for Ch B)

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 $-50 \mu\text{A}$ @ 5 V
Input low current	I_{IL} = typically $-550 \mu\text{A}$ @ 0 V
Max. input frequency	100 kHz

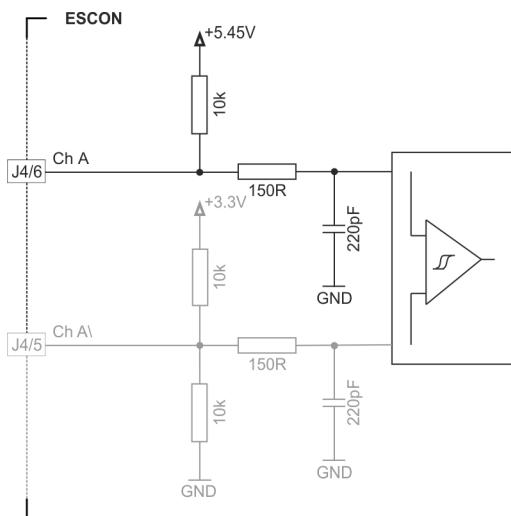


Figure 3-9 Encoder Input Circuit Ch A "Single-ended" (analogously valid also for Ch B)

3.4.4 Digital I/Os (J5)

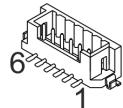


Figure 3-10 Digital I/Os Socket J5

J5 & Head A Pin	Prefab Cable Color	Head B Pin	Signal	Description
1	white		DigIN1	Digital input 1
2	brown		DigIN2	Digital input 2
3	green		DigIN/DigOUT3	Digital input/output 3
4	yellow		DigIN/DigOUT4	Digital input/output 4
5	grey		GND	Signal ground
6	pink		+5 VDC	Auxiliary output voltage (+5 VDC; ≤40 mA)

Table 3-19 Digital I/Os Socket J5 – Pin Assignment & Cabling

I/O Cable 6core (403965)		
A		B
Cable cross-section	6 x 0.14 mm ²	
Length	1.5 m	
Head A	Suitable plugs Suitable contacts	Hirose DF3-6S-2C Hirose DF3-2428SC...
Head B	Cable end sleeves 0.14 mm ²	

Table 3-20 I/O Cable 6core

3.4.4.1 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

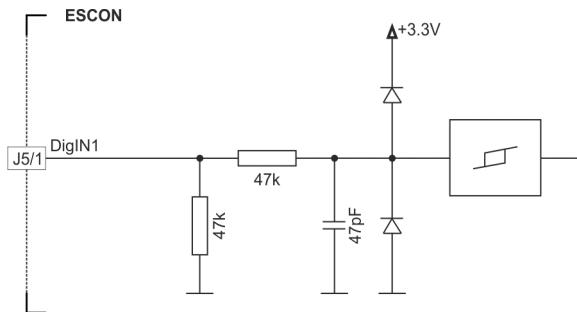


Figure 3-11 DigIN1 Circuit

3.4.4.2 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

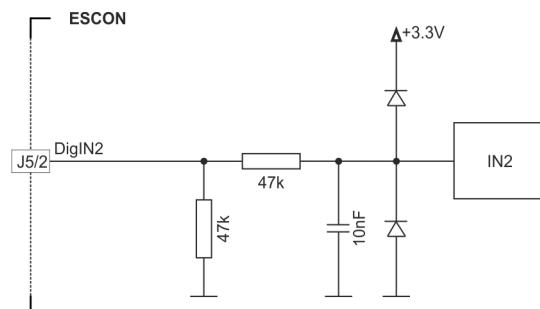


Figure 3-12 DigIN2 Circuit

3.4.4.3 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

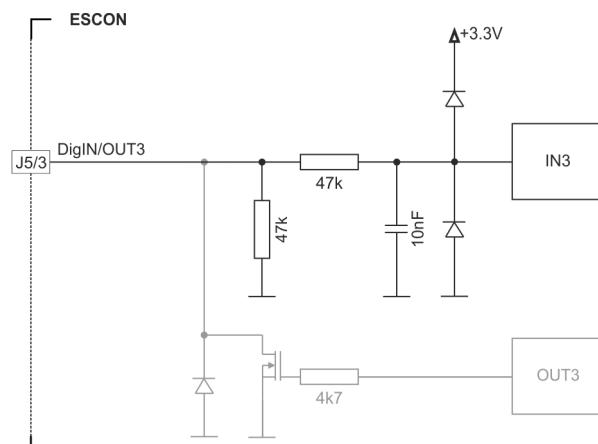


Figure 3-13 DigIN3 Circuit (analogously valid also for DigIN4)

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

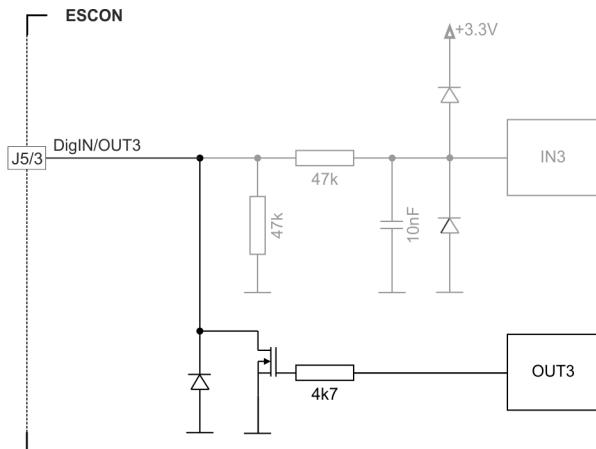


Figure 3-14 DigOUT3 Circuit (analogously valid also for DigOUT4)

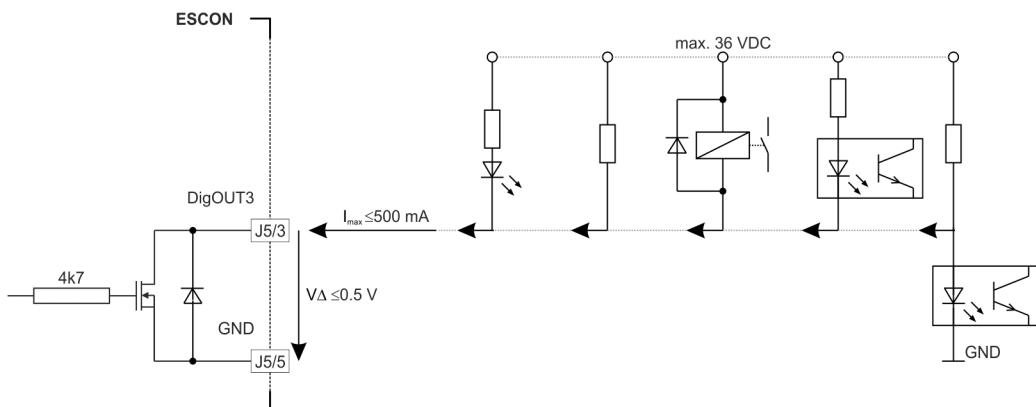


Figure 3-15 DigOUT3 Wiring Examples (analogously valid also for DigOUT4)

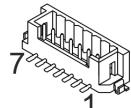
3.4.5 Analog I/Os (J6)

Figure 3-16 Analog I/Os Socket J6

J6 & Head A Pin	Prefab Cable Color	Head B Pin	Signal	Description
1	white		AnIN1+	Analog input 1, positive signal
2	brown		AnIN1-	Analog input 1, negative signal
3	green		AnIN2+	Analog input 2, positive signal
4	yellow		AnIN2-	Analog input 2, negative signal
5	grey		AnOUT1	Analog output 1
6	pink		AnOUT2	Analog output 2
7	blue		GND	Signal ground

Table 3-21 Analog I/Os Socket J6 – Pin Assignment & Cabling

I/O Cable 7core (403964)		
A		B
Cable cross-section	7 x 0.14 mm ²	
Length	1.5 m	
Head A	Suitable plugs Suitable contacts	Hirose DF3-7S-2C Hirose DF3-2428SC...
Head B	Cable end sleeves 0.14 mm ²	

Table 3-22 I/O Cable 7core

3.4.5.1 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

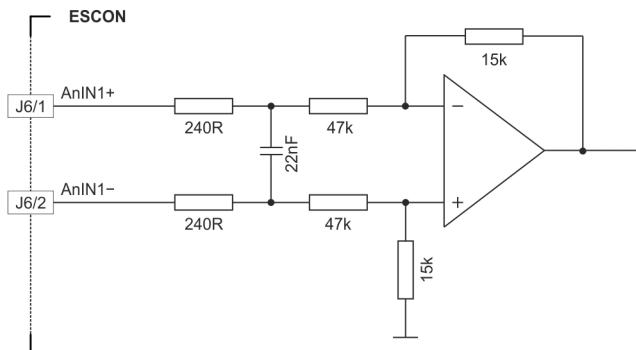


Figure 3-17 AnIN1 Circuit (analogously valid also for AnIN2)

3.4.5.2 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

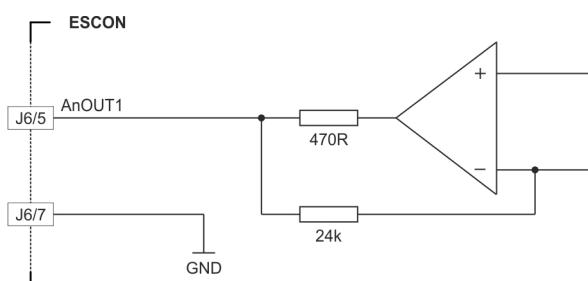


Figure 3-18 AnOUT1 Circuit (analogously valid also for AnOUT2)

3.4.6 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 3-23) refers to USB terminals of your PC.

J7 & Head A Pin	Prefab Cable Color	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 3-23 USB Socket J7 – Pin Assignment & Cabling

USB Type A - micro B Cable (403968)	
A	
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 3-24 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

3.4.7 ESCON 36/2 DC Connector Set

If you decide not to employ maxon's prefab cable assemblies, you might wish to use the prepackaged kit that contains all connectors required to make up your own cabling.

ESCON 36/2 DC Connector Set» (404404)		
For Socket	Specification	Quantity
J1	Hirose crimping socket, 2 poles (DF3-2S-2C)	1
J1, J2	Hirose crimping contact for Socket (DF3-22SC...)	6
J2	Hirose crimping socket, 3 poles (DF3-3S-2C)	1
J4	3M Retainer Clip with Strain Relief, H=13.5 mm (3505-8110)	1
J5	Hirose crimping socket, 6 poles (DF3-6S-2C)	1
J5, J6	Hirose crimping contact for Socket (DF3-2428SC...)	14
J6	Hirose crimping socket, 7 poles (DF3-7S-2C)	1

Table 3-25 ESCON 36/2 DC Connector Set – Content



Best Practice

If you should decide not to use the ready-made cable assemblies, we strongly suggest that you use the following hand tools:

- Hirose hand crimper (DF3-TA22HC) for crimping contacts DF3-22SC...
- Hirose hand crimper (DF3-TA2428HC) for crimping contacts DF3-2428SC...

3.5 Jumpers

**STOP**

Check on safety precautions before continuing (→page 1-6).

JUMPER JP1

For maxon DC motor with integrated Motor/Encoder Ribbon Cable, activate the motor terminal by setting both jumpers to CLOSED (→Figure 3-22, right).

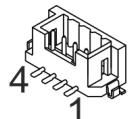


Figure 3-20 Jumper JP1

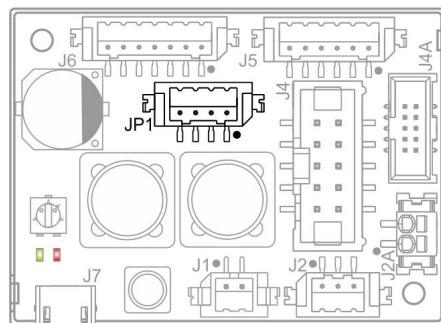


Figure 3-21 Jumper JP1 – Location



Figure 3-22 Jumper JP1 – OPEN, Default Setting (left) / CLOSED (right)

3.6 Potentiometers

POTENTIOMETER P1

Adjustment angle	210°
Type	Linear

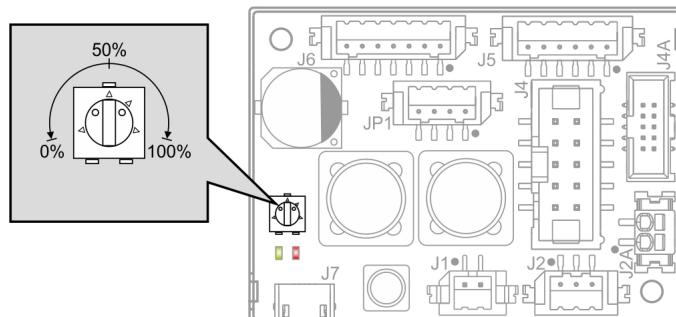


Figure 3-23 Potentiometer P1 – Location & Adjustment Range

3.7 Status Indicators

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

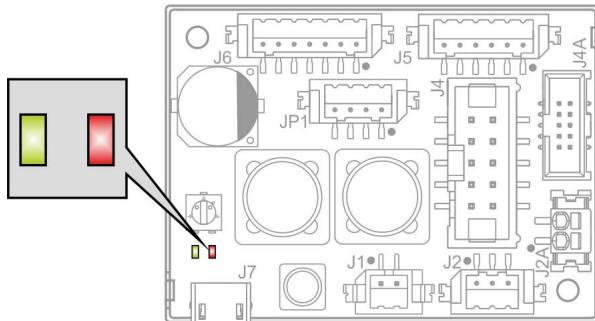


Figure 3-24 LEDs – Location

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
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	on	ERROR	<ul style="list-style-type: none"> Auto Tuning Identification Error Internal Software Error

Table 3-26 LEDs – Interpretation of Condition

4 WIRING

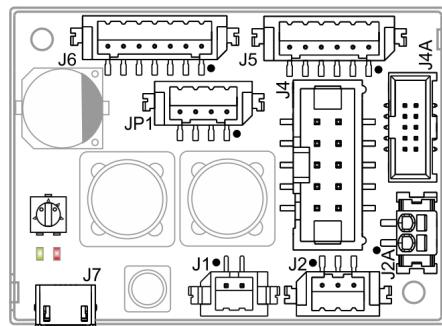


Figure 4-25 Interfaces – Designations and Location



Remark

The subsequent diagrams feature these signs:

- PCB mounting hole
- Ground safety earth connection (optional)

4.1 maxon DC motor

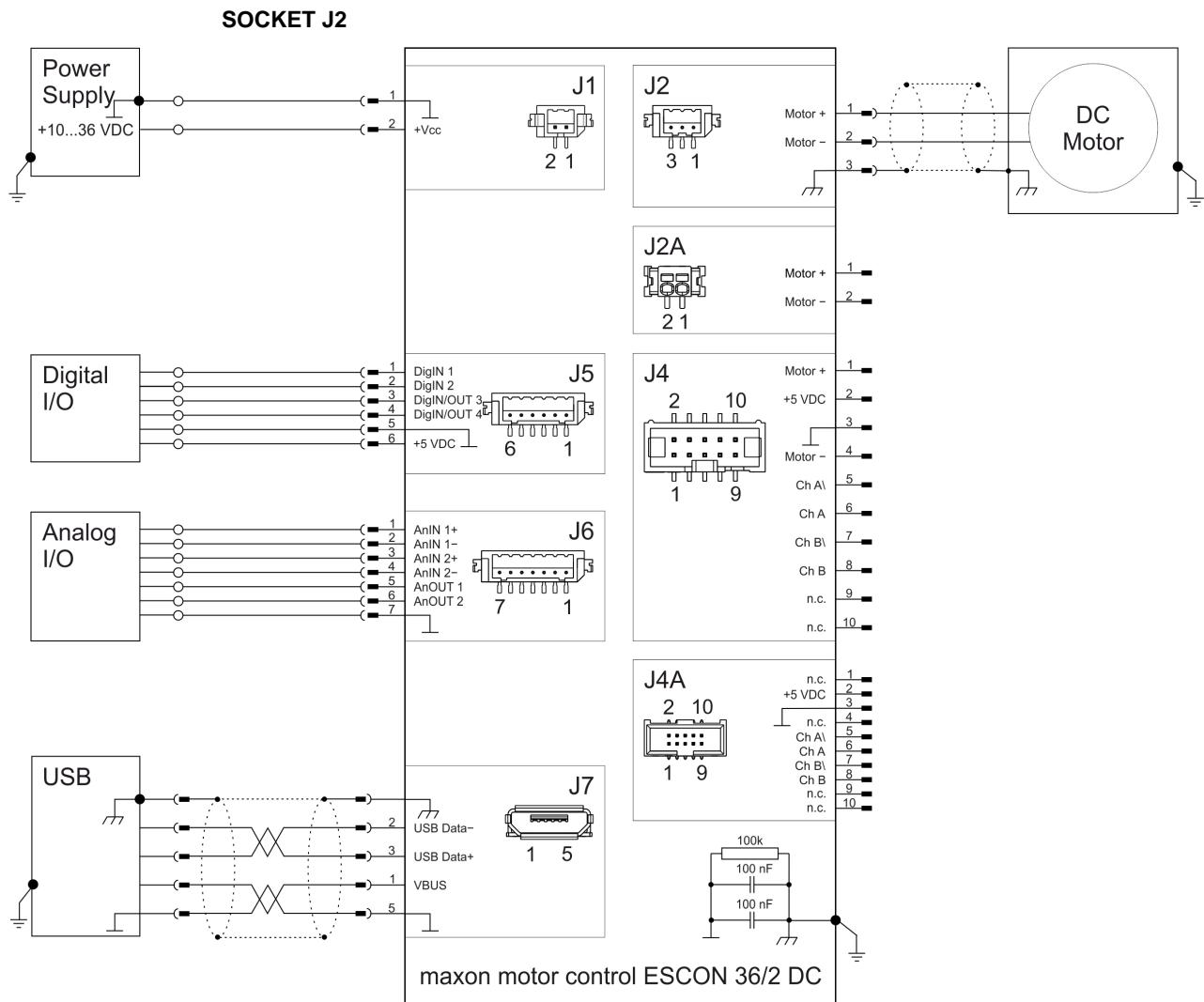


Figure 4-26 maxon DC motor (J2)

4.2 maxon DC motor with DC Tacho

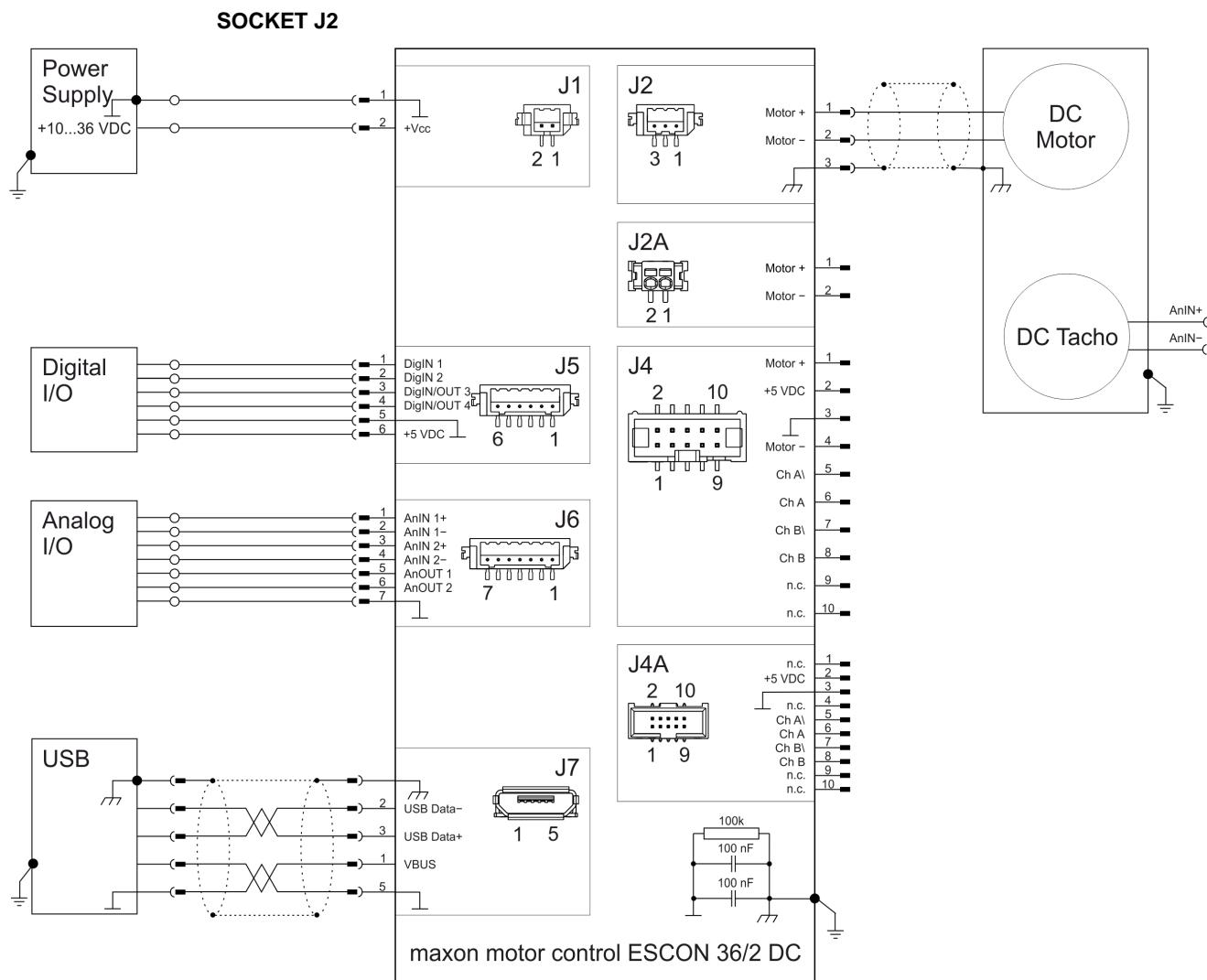


Figure 4-27 maxon DC motor with DC Tacho (J2)

4.3 maxon DC motor with separated Motor/Encoder Cable

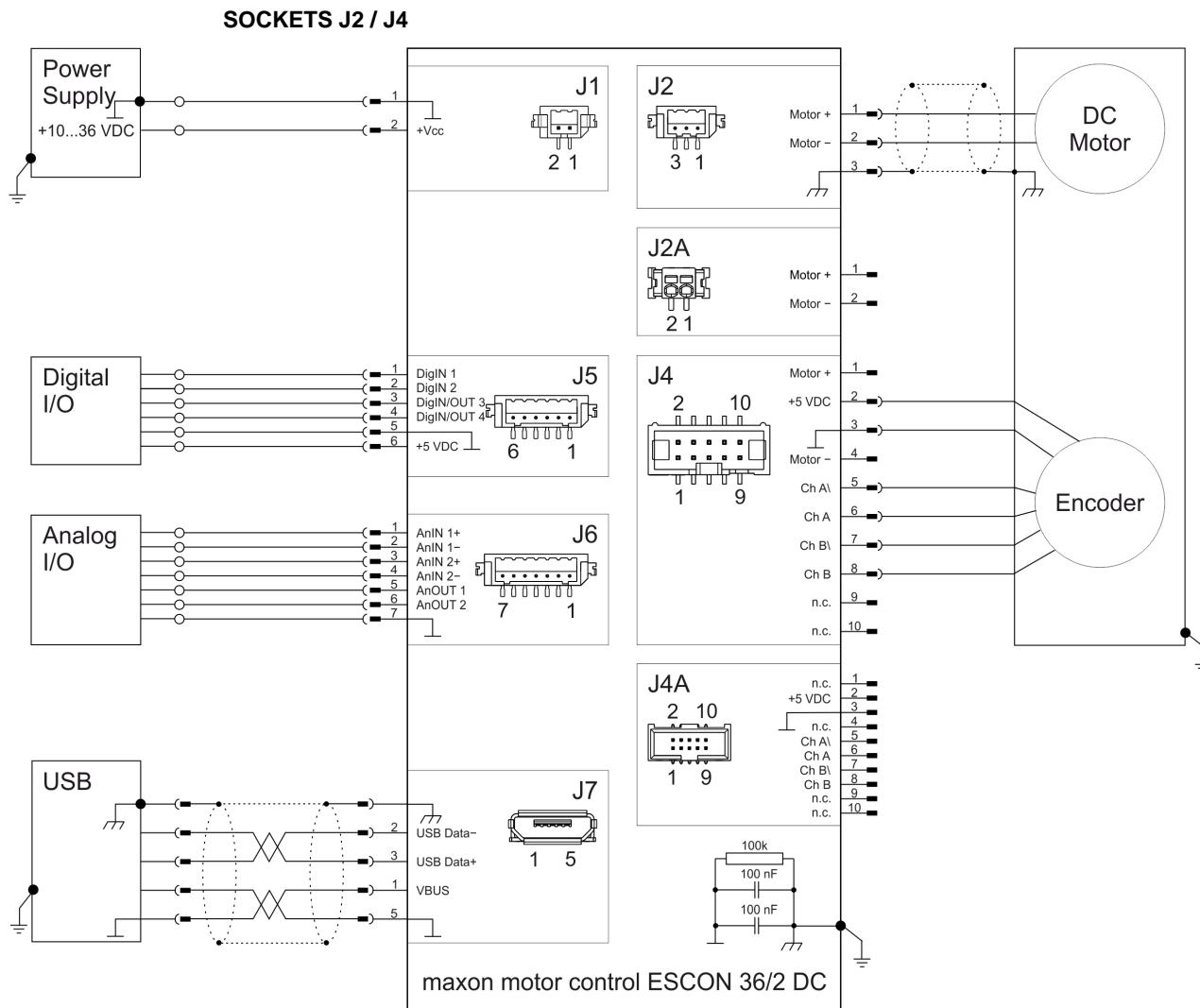


Figure 4-28 maxon DC motor with Encoder – separate Cables (J2 / J4)

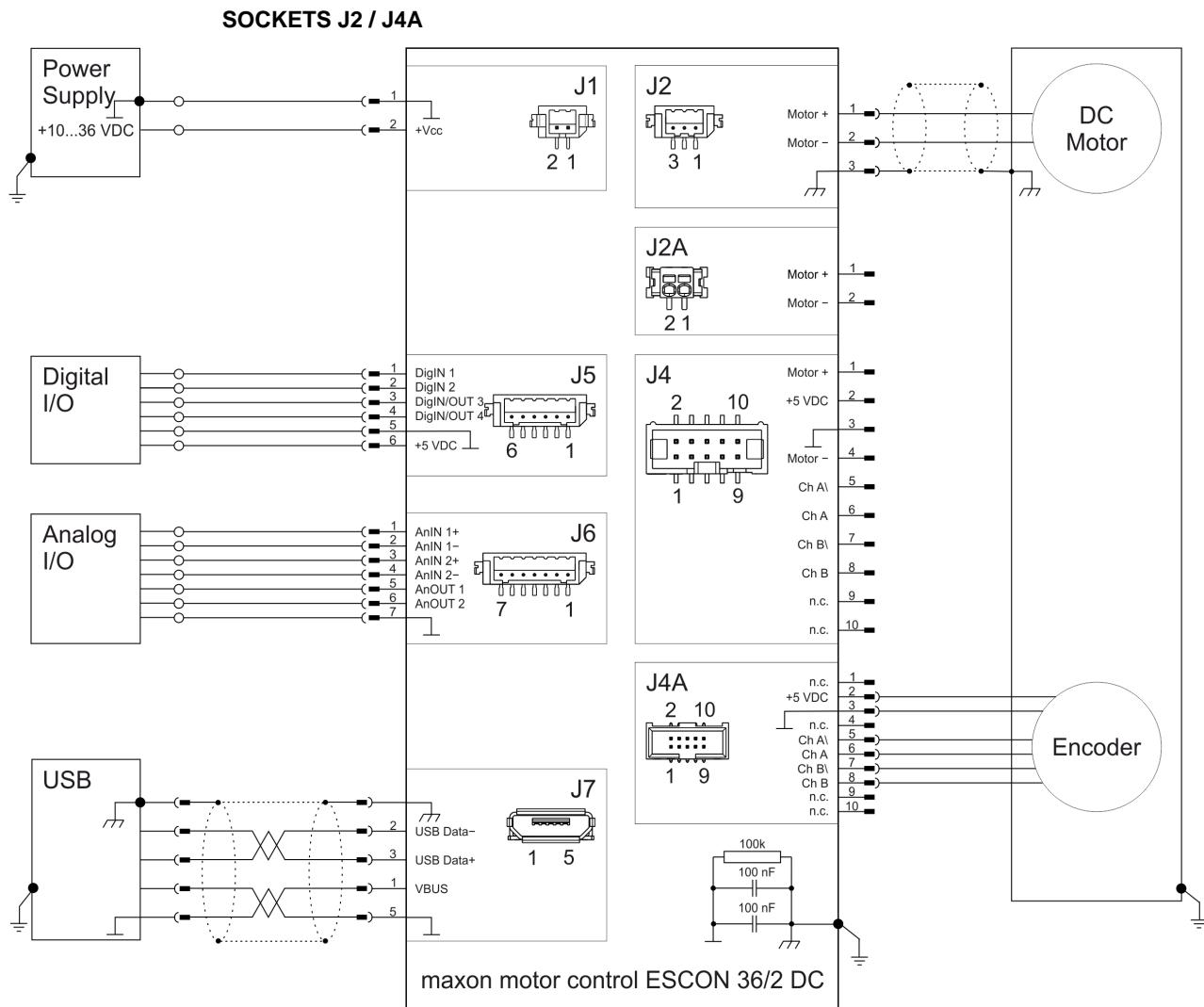


Figure 4-29 maxon DC motor with Encoder – separate Cables (J2 / J4A)

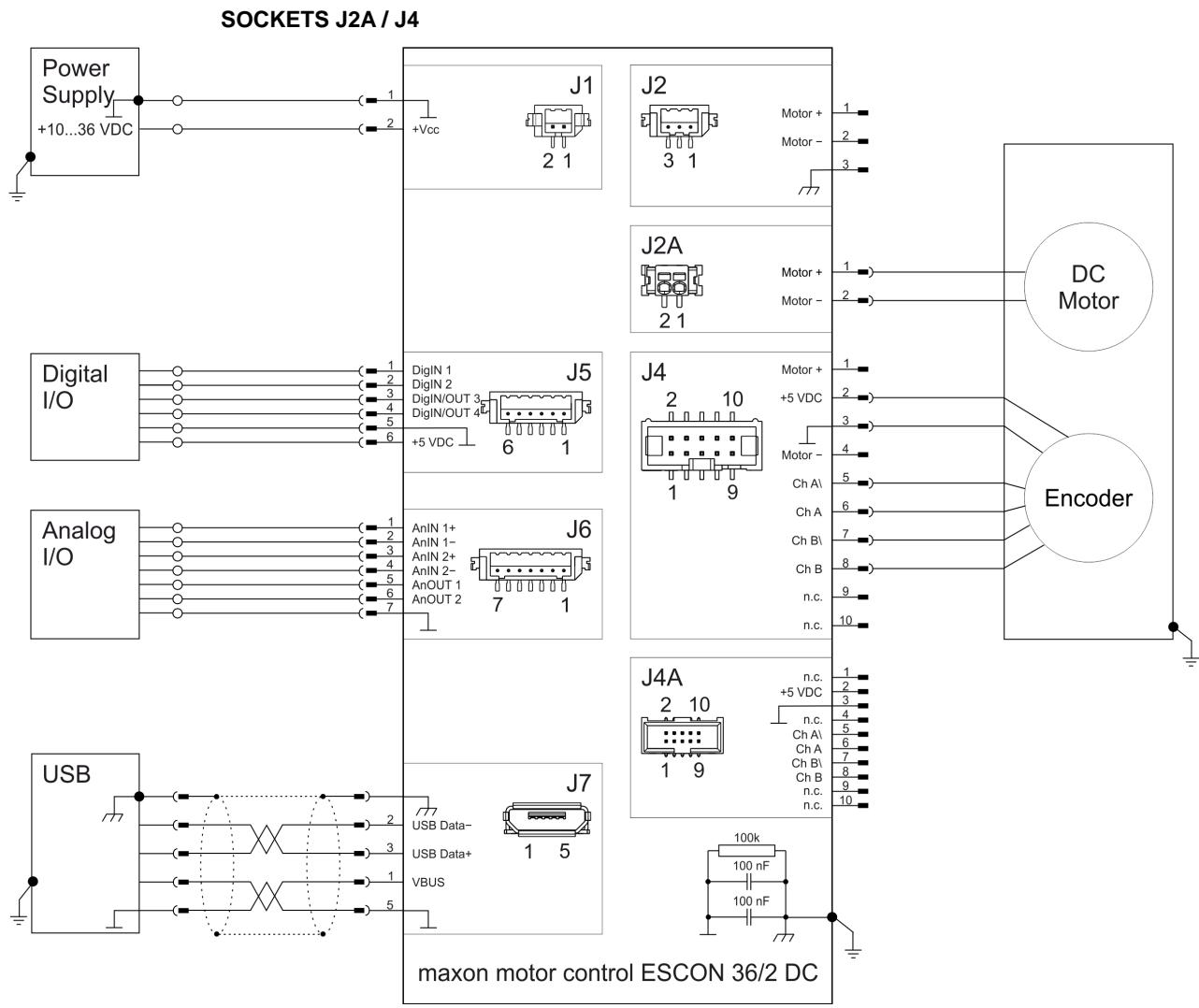


Figure 4-30 maxon DC motor with Encoder – separate Cables (J2A / J4)

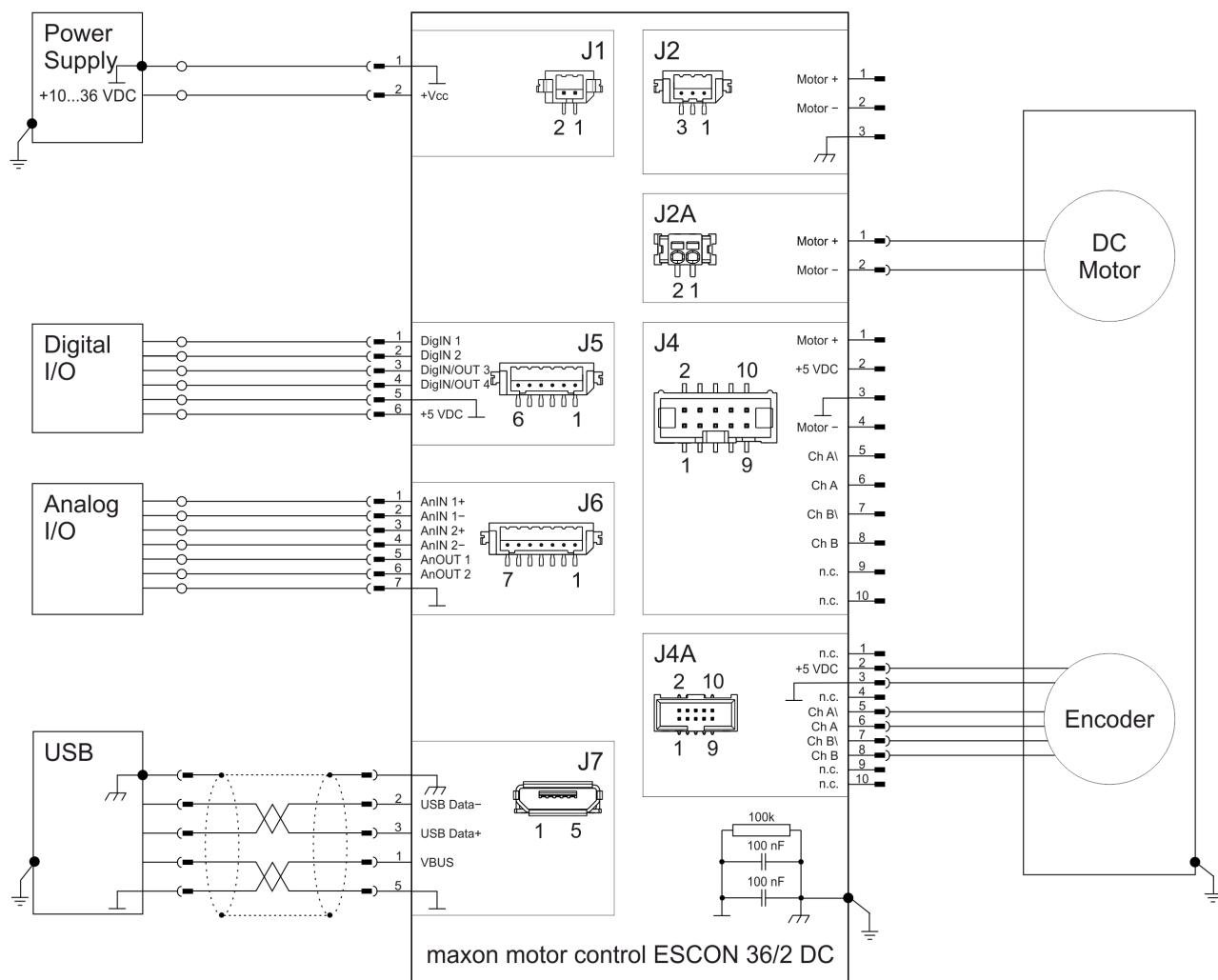
SOCKETS J2A / J4A


Figure 4-31 maxon DC motor with Encoder – separate Cables (J2A / J4A)

4.4 maxon DC motor with integrated Motor/Encoder Ribbon Cable

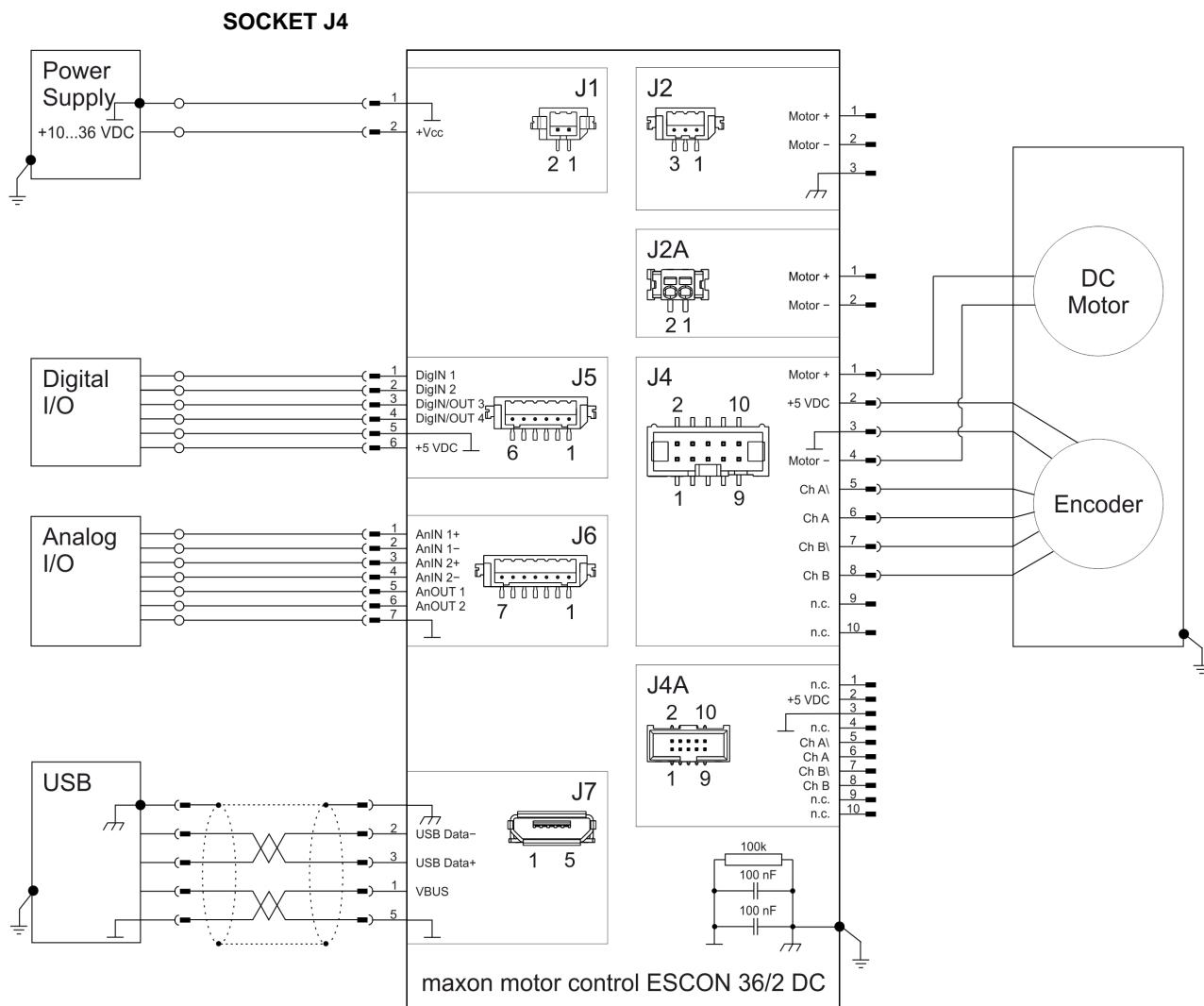


Figure 4-32 maxon DC motor with Encoder – integrated Ribbon Cable (J4)



Note

For jumper settings → chapter “Jumper JP1” on page 3-29.

••page intentionally left blank••

LIST OF FIGURES

Figure 2-1	Derating Output Current	8
Figure 2-2	Dimensional Drawing [mm]	9
Figure 3-3	Power Socket J1	14
Figure 3-4	Motor Socket J2	15
Figure 3-5	Motor Socket J2A	16
Figure 3-6	Encoder Socket J4	17
Figure 3-7	Encoder Socket J4A	18
Figure 3-8	Encoder Input Circuit Ch A “Differential” (analogously valid also for Ch B)	19
Figure 3-9	Encoder Input Circuit Ch A “Single-ended” (analogously valid also for Ch B)	20
Figure 3-10	Digital I/Os Socket J5	21
Figure 3-11	DigIN1 Circuit	22
Figure 3-12	DigIN2 Circuit	23
Figure 3-13	DigIN3 Circuit (analogously valid also for DigIN4)	23
Figure 3-14	DigOUT3 Circuit (analogously valid also for DigOUT4)	24
Figure 3-15	DigOUT3 Wiring Examples (analogously valid also for DigOUT4)	24
Figure 3-16	Analog I/Os Socket J6	25
Figure 3-17	AnIN1 Circuit (analogously valid also for AnIN2)	26
Figure 3-18	AnOUT1 Circuit (analogously valid also for AnOUT2)	26
Figure 3-19	USB Socket J7	27
Figure 3-20	Jumper JP1	29
Figure 3-21	Jumper JP1 – Location	29
Figure 3-22	Jumper JP1 – OPEN, Default Setting (left) / CLOSED (right)	29
Figure 3-23	Potentiometer P1 – Location & Adjustment Range	29
Figure 3-24	LEDs – Location	30
Figure 4-25	Interfaces – Designations and Location	31
Figure 4-26	maxon DC motor (J2)	32
Figure 4-27	maxon DC motor with DC Tacho (J2)	33
Figure 4-28	maxon DC motor with Encoder – separate Cables (J2 / J4)	34
Figure 4-29	maxon DC motor with Encoder – separate Cables (J2 / J4A)	35
Figure 4-30	maxon DC motor with Encoder – separate Cables (J2A / J4)	36
Figure 4-31	maxon DC motor with Encoder – separate Cables (J2A / J4A)	37
Figure 4-32	maxon DC motor with Encoder – integrated Ribbon Cable (J4)	38

LIST OF TABLES

Table 1-1	Notation used	3
Table 1-2	Symbols & Signs	4
Table 1-3	Brand Names and Trademark Owners	4
Table 2-4	Technical Data	8
Table 2-5	Limitations	8
Table 2-6	Standards	10
Table 3-7	Cable Selector	13
Table 3-8	Power Socket J1 – Pin Assignment & Cabling	14
Table 3-9	Power Cable	14
Table 3-10	Motor Socket J2 – Pin Assignment & Cabling	15
Table 3-11	DC Motor Cable	15
Table 3-12	Motor Socket J2A – Pin Assignment	16
Table 3-13	Motor Socket J2A – Specification & Accessories	16
Table 3-14	Encoder Socket J4 – Pin Assignment & Cabling	17
Table 3-15	Encoder Socket J4 – Accessories	17
Table 3-16	Encoder Cable	18
Table 3-17	Encoder Socket J4A – Pin Assignment	18
Table 3-18	Encoder Socket J4A – Specification & Accessories	19
Table 3-19	Digital I/Os Socket J5 – Pin Assignment & Cabling	21
Table 3-20	I/O Cable 6core	21
Table 3-21	Analog I/Os Socket J6 – Pin Assignment & Cabling	25
Table 3-22	I/O Cable 7core	25
Table 3-23	USB Socket J7 – Pin Assignment & Cabling	27
Table 3-24	USB Type A - micro B Cable	27
Table 3-25	ESCON 36/2 DC Connector Set – Content	28
Table 3-26	LEDs – Interpretation of Condition	30

INDEX**A**

additionally applicable regulations 6
 alerts 4
 analog inputs 26
 applicable EU directive 11

C

cables (prefab)
 DC Motor Cable 15
 Encoder Cable 18
 I/O Cable 6core 21
 I/O Cable 7core 25
 Power Cable 14
 USB Type A - micro B Cable 27
 country-specific regulations 6

D

digital inputs 22, 23

E

error display 30
 ESD 6
 EU directive, applicable 11

H

how to
 calculate required supply voltage 12
 find information on wiring 13
 interpret icons (and signs) used in the document 4

I

incorporation into surrounding system 11
 informative signs 4
 intended purpose of the device 5
 interfaces, location and designation 31

J

jumper JP1 29

L

LEDs 30

M

mandatory action signs 4

N

notations used 3

O

operating license 11
 operating status, display 30
 order numbers
 275934 18
 403112 7
 403957 14
 403962 15
 403964 25
 403965 21
 403968 27
 404404 28

P

performance data 7
 potentiometer P1 29
 precautions 6
 prerequisites prior installation 11
 prohibitive signs 4
 purpose
 of the device 5
 of this document 3

R

regulations, additionally applicable 6

S

safety alerts 4
 safety first! 6
 signs used 4
 sockets
 J1 14
 J2 15
 J2A 16
 J4 17
 J4A 18
 J5 21
 J6 25
 J7 27
 standards, fulfilled 10
 status display 30
 status LEDs 30
 supply voltage, required 12
 symbols used 4

T

technical data 7
tools, recommended 28

U

USB interface 27

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

© 2021 maxon. All rights reserved. Subject to change without prior notice.

CCMC | ESCON 36/2 DC Hardware Reference | Edition 2021-08 | DocID rel9011

maxon motor ag
Brünigstrasse 220
CH-6072 Sachseln

+41 41 666 15 00
www.maxongroup.com