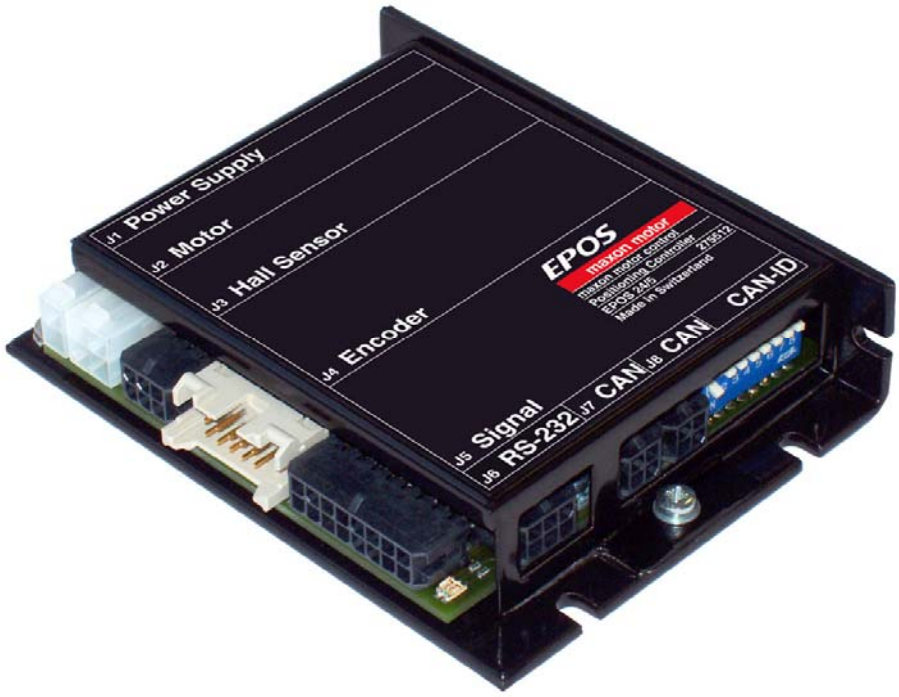
EPOS 24/5

Positioning Controller

Documentation

Hardware Reference



maxon document number: 573048-09

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3 Introduction

This documentation “Hardware Reference” provides the hardware details of the EPOS 24/5 positioning controller. It contains performance data, connections, specification, pin assignment and wiring examples.

Figure 1: EPOS 24/5 photo

The maxon motor EPOS 24/5 is a small-sized full digital smart motion controller. Due to the flexible and high efficient power stage the EPOS 24/5 drives brushed DC motors with digital encoder as well as brushless EC motors with digital Hall sensors and encoder.
The sinusoidal current commutation by space vector control offers to drive brushless EC motors with minimal torque ripple and low noise. The integrated position-, velocity- and current control functionality allows sophisticated positioning applications. It is specially designed being commanded and controlled as a slave node in the CANopen network. In addition the unit can be operated through any RS-232 communication port.
The latest edition of these “Hardware Reference”, additional documentation and software to the EPOS positioning controller may also be found on the internet in http://www.maxonmotor.com category <Service & Downloads>.

4 How to use this guide

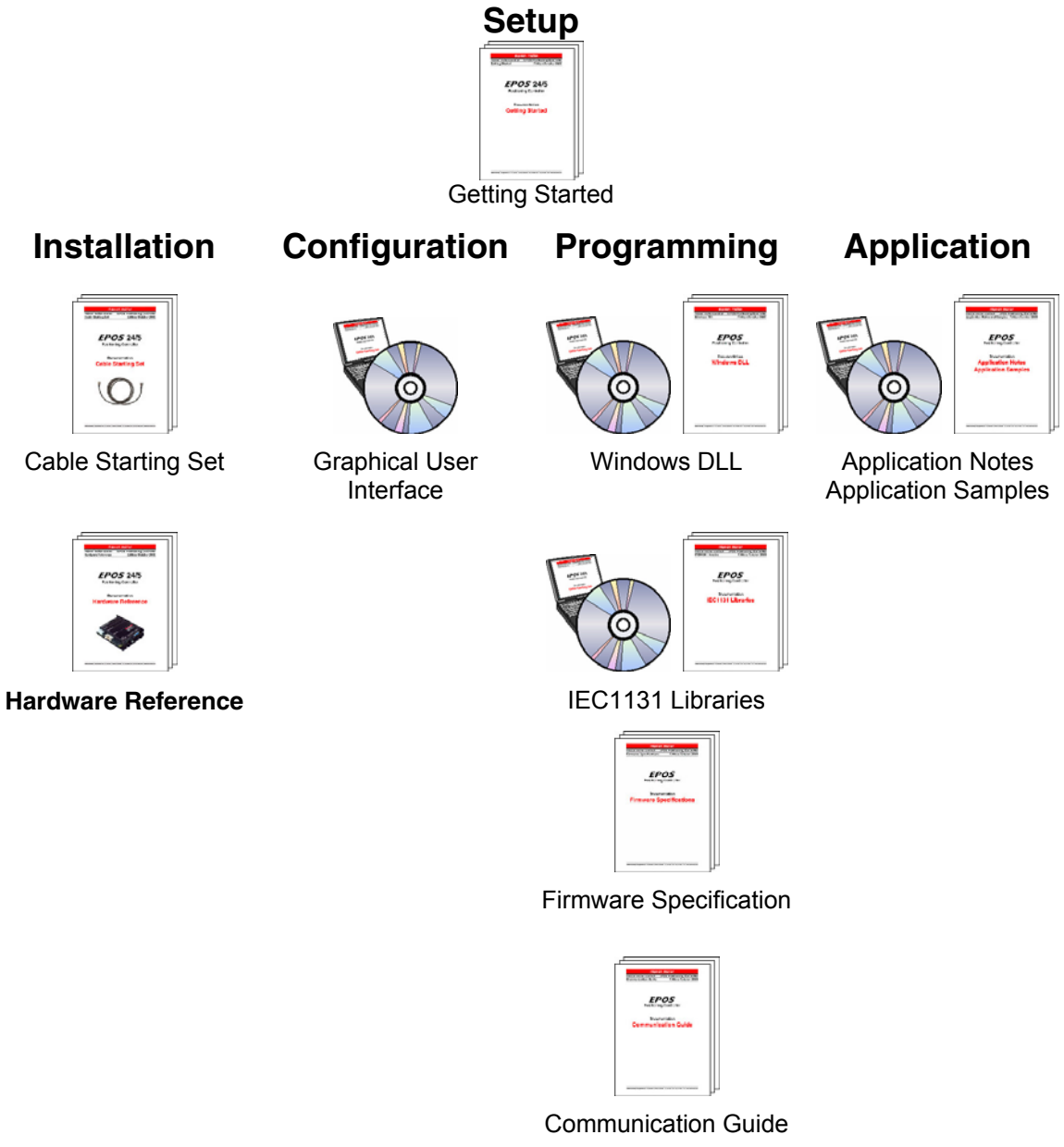


Figure 2: EPOS documentation hierarchy

5 Safety Instructions

Skilled Personnel
Installation and starting of the equipment shall only be performed by experienced, skilled personnel.

Statutory Regulations
The user must ensure that the positioning controller and the components belonging to it are assembled and connected according to local statutory regulations.

Load Disconnected
For primary operation the motor should be free running, i.e. with the load disconnected.

Additional Safety Equipment
An electronic apparatus is not fail-safe in principle. Machines and apparatus must therefore be fitted with independent monitoring and safety equipment. If the equipment breaks down, if it is operated incorrectly, if the control unit breaks down or if the cables break, etc., it must be ensured that the drive or the complete apparatus is kept in a safe operating mode.

Repairs
Repairs may be made by authorized personnel only or by the manufacturer. It is dangerous for the user to open the unit or make repairs to it.

Danger
Do ensure that during the installation of the EPOS 24/5 no apparatus is connected to the electrical supply. After switching on, do not touch any live parts!

Max. Supply Voltage
Make sure that the supply voltage is between 11 and 24 VDC. Voltages higher than 27 VDC or of wrong polarity will destroy the unit.

Electrostatic Sensitive Device (ESD)

6 Performance Data

6.1 Electrical data

Supply voltage V_{CC} (Ripple < 10%) ..... 11 - 24 VDC
Logic supply voltage V_C (Ripple < 10%) (optional) ..... 11 - 24 VDC
Max. output voltage ..... 0.9 • V_{CC}
Max. output current I_{max} (<1sec) ..... 10 A
Continuous output current I_{cont} ..... 5 A
Switching frequency ..... 50 kHz
Max. efficiency ..... 90 %
Sample rate PI - current controller ..... 10 kHz
Sample rate PI - speed controller ..... 1 kHz
Sample rate PID - positioning controller ..... 1 kHz
Max. speed (motors with 2 poles) ..... 25 000 rpm
Built-in motor choke per phase ..... 15 µH / 5 A

6.2 Inputs

Hall sensor signals ..... Hall sensor 1, Hall sensor 2 and Hall sensor 3
..... for Hall effect sensor IC's (Schmitt trigger with open collector output)
Encoder signals ..... A, A\, B, B\, I, I\ (max. 1MHz)
..... internal line receiver EIA standard RS-422

Digital input 1 (“General Purpose”) ..... +3.0 ... +24 VDC (Ri = 16 kΩ)
Digital input 2 (“General Purpose”) ..... +3.0 ... +24 VDC (Ri = 16 kΩ)
Digital input 3 (“General Purpose”) ..... +3.0 ... +24 VDC (Ri = 16 kΩ)
Digital input 4 (“Home Switch”) ..... +9.0 ... +24 VDC (Ri = 4.4 kΩ)
Digital input 5 (“Positive Limit Switch”) ..... +9.0 ... +24 VDC (Ri = 4.4 kΩ)
Digital input 6 (“Negative Limit Switch”) ..... +9.0 ... +24 VDC (Ri = 4.4 kΩ)

Analogue input 1 ..... Resolution 10-bit 0 ... +5 V (Ri = 36 kΩ)
Analogue input 2 ..... Resolution 10-bit 0 ... +5 V (Ri = 36 kΩ)

CAN-ID (CAN identification) ..... Configured by DIP-Switch 1...7

6.3 Outputs

Digital output 1 (“General Purpose”) ..... open drain max. 24 VDC (I_L < 100 mA)
Digital output 2 (“General Purpose”) ..... open drain max. 24 VDC (I_L < 100 mA)
Digital output 3 (“General Purpose”) ..... open drain max. 24 VDC (I_L < 100 mA)
Digital output 4 (“Brake”) ..... open drain max. 24 VDC (I_L < 1 A)

6.4 Voltage outputs

Encoder supply voltage ..... +5 VDC, max. 100 mA
Hall sensors supply voltage ..... +5 VDC, max. 30 mA
Auxiliary output voltage ..... V_{CC}, max. 1300 mA

6.5 Motor connections

maxon EC motor	maxon DC motor
Motor winding 1	+Motor
Motor winding 2	-Motor
Motor winding 3	

6.6 Interfaces

RS-232 .....RxD; TxD ..... max. 115 200 bit/s
CAN (1) .....CAN_H (high); CAN_L (low) ..... max.1 MBit/s
CAN (2) .....CAN_H (high); CAN_L (low) ..... max.1 MBit/s

6.7 LED indicator

2 colours LED ..... ENABLE / FAULT
..... green = ENABLE, red = FAULT

6.8 Ambient temperature- / Humidity range

Operating ..... -10 ... +45°C
Storage ..... -40 ... +85°C
Non condensating ..... 20 ... 80 %

6.9 Mechanical data

Weight ..... approx. 170 g
Dimensions (L x W x H) ..... 105 x 83 x 24 mm
Mounting plate ..... for M3 screws

6.10 Connections

Supply
On board: ..... dual row male header (2 poles) Molex Mini-Fit Jr.™
Suitable plug: ..... dual row female receptacle (2 poles) Molex Mini-Fit Jr.™ 39-01-2020
Suitable terminal: ... female crimp terminal Molex Mini-Fit Jr.™ 444-76-1111 (AWG 18-24)

Motor
On board: ..... dual row male header (4 poles) Molex Mini-Fit Jr.™
Suitable plug: ..... dual row female receptacle (4 poles) Molex Mini-Fit Jr.™ 39-01-2040
Suitable terminal: ... female crimp terminal Molex Mini-Fit Jr.™ 444-76-1111 (AWG 18-24)

Hall
On board: ..... dual row male header (6 poles) Molex Micro-Fit 3.0™
Suitable plug: ..... dual row female receptacle (6 poles) Molex Micro-Fit 3.0™ 430-25-0600
Suitable terminal: . female crimp terminal Molex Micro-Fit 3.0™ 430-30-0010 (AWG26-30)

Signal
On board: ..... dual row male header (16 poles) Molex Micro-Fit 3.0™
Suitable plug: ... dual row female receptacle (16 poles) Molex Micro-Fit 3.0™ 430-25-1600
Suitable terminal: .. female crimp terminal Molex Micro-Fit 3.0™ 430-30-0010(AWG26-30)

RS232
On board: ..... dual row male header (6 poles) Molex Micro-Fit 3.0™
Suitable plug: ..... dual row female receptacle (6 poles) Molex Micro-Fit 3.0™ 430-25-0600
Suitable terminal: .. female crimp terminal Molex Micro-Fit 3.0™ 430-30-0010(AWG26-30)

CAN
On board: ..... dual row male header (4 poles) Molex Micro-Fit 3.0™
Suitable plug: .... Dual row female receptacle (4 poles) Molex Micro-Fit 3.0™ 430-25-0400
Suitable terminal: .. female crimp terminal Molex Micro-Fit 3.0™ 430-30-0010(AWG26-30)

Encoder
On board: ..... Plug DIN41651 (10 poles) for flat band cable,
..... pitch 1.27mm, AWG 28
Suitable locking clip: ..... Tyco C42334-A421-C42 (right)
..... Tyco C42334-A421-C52 (left)

6.11 Order number

EPOS 24/5 ..... **275512**

7 Connections 275512

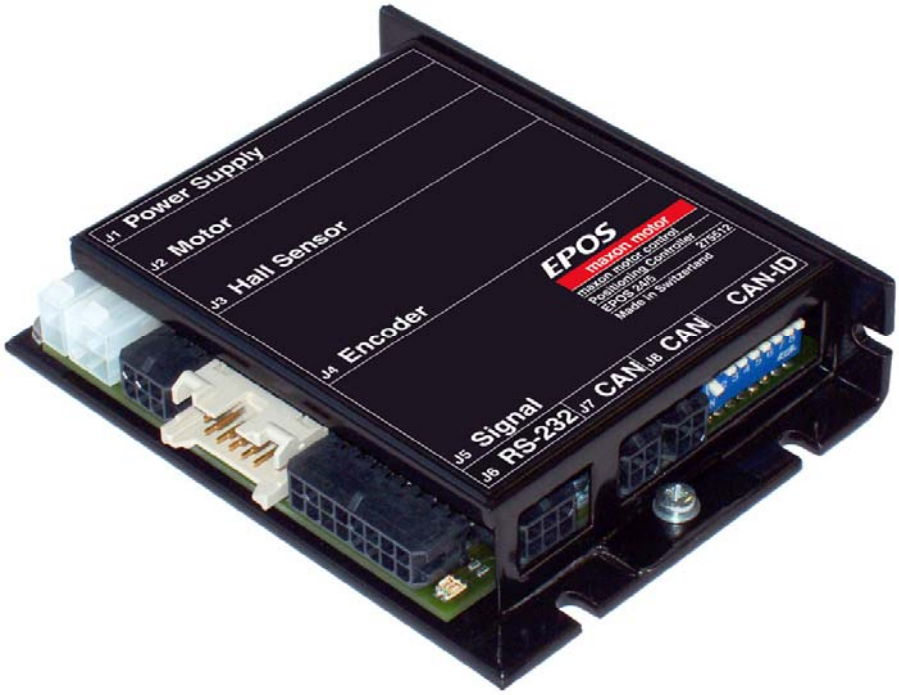


Figure 3: EPOS photo with connector description

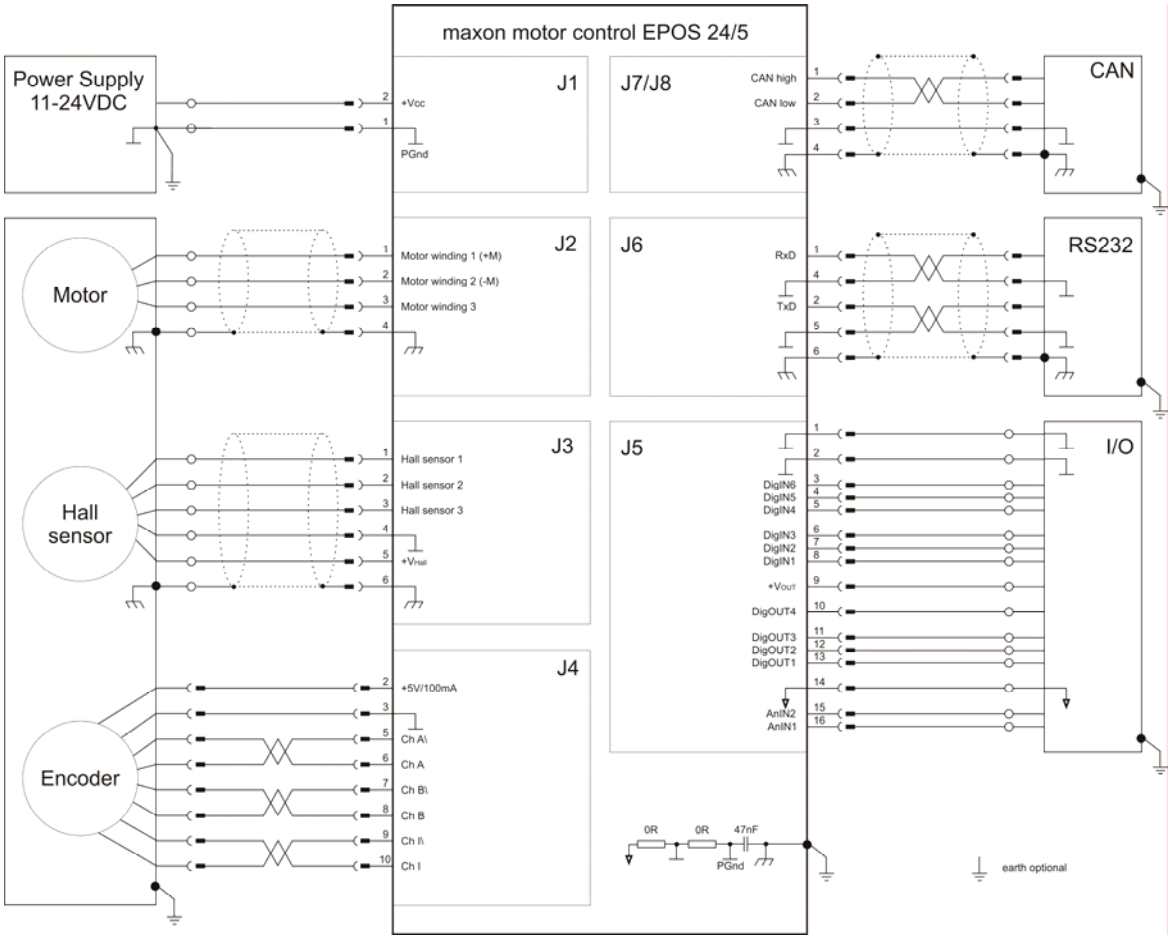


Figure 4: Wiring diagram (overview)

7.1 Power supply

7.1.1 Power supply connector (J1)

Any available power supply can be used, provided it meets the minimal requirements set out below.
During set up and adjustment phases, we recommend separating the motor mechanically from the machine to prevent damage due to uncontrolled motion.

Power supply requirements	
Output voltage	V_{CC} min. 11 VDC; V_{CC} max. 24 VDC
Ripple	< 10 %
Output current	Depending on load, continuous max. 5 A acceleration, short-time max. 10 A

The required voltage can be calculated as follows:

Known values:
- Operating torque M_B [mNm]
- Operating speed n_B [min^{-1}]
- Nominal motor voltage U_N [Volt]
- Motor no-load speed at U_N, n_0 [min^{-1}]
- Speed/torque gradient of the motor $\Delta n/\Delta M$ [min^{-1} mNm^{-1}]

Sought value:
- Supply voltage V_{CC} [Volt]

Solution:

$$V_{CC} = \frac{U_N}{n_0} \cdot (n_B + \frac{\Delta n}{\Delta M} \cdot M_B) \cdot \frac{1}{0.9} + 1[V]$$

Choose a power supply capable of supplying this calculated voltage under load. The formula takes a max. PWM cycle of 90 % and a 1 volts max. voltage drop at EPOS 24/5 into account.

Consider:
During braking of the load, the power supply must be capable of buffering the fed back energy, e.g. in a capacitor.
When using an electronically stabilized power supply observe that the over current protection shall not be activated in any operating state

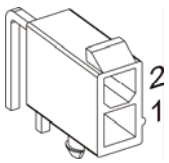


Figure 5: Power connector (J1)

Pin No.	Signal	Description
1	Power_Gnd	Ground of supply voltage
2	+V_{CC}	Supply voltage +11 ... +24 VDC

Accessories: EPOS power cable — maxon order number: **275829**

Notes: Suitable connector: Molex Mini-Fit Jr.™ 2 poles (39-01-2020)
Suitable crimp terminals: Molex Mini-Fit Jr.™ female crimp terminals (444-76-1111)
Suitable hand crimper: Molex hand crimper (69008-0724)

7.1.2 Separated logic supply

Optionally, the logic supply voltage can be sourced separately. This allows a safe and economical power backup feature.
Using separated logic supply an additional presetting has to be done.
The jumper JP4 can be found on board by opening the housing cover.

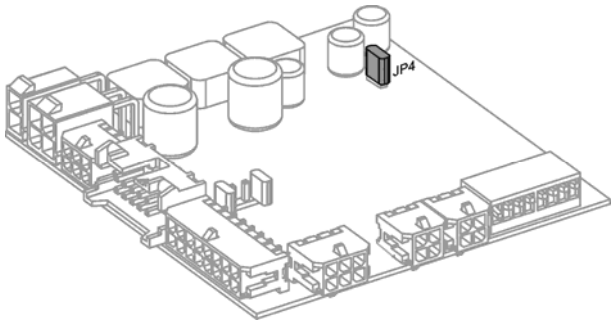


Figure 6: Location JP4 (factory setting)

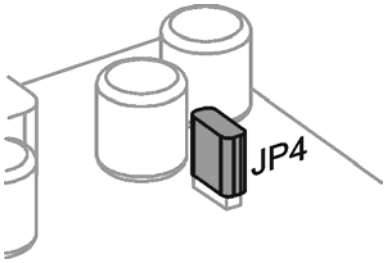
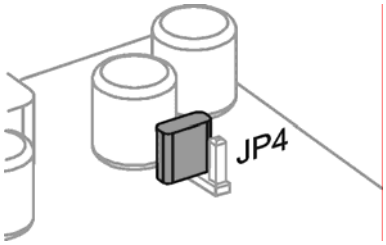
No separate logic supply is applied; the logic supply will be sourced by the power supply voltage automatically.	Logic supply (V_C) and power supply (V_{CC}) are sourced separately.
	
JP4 closed Connector [J5] Pin no. [9]: **+V_{OUT}** Auxiliary supply voltage **output** (+11 … +24 VDC)	JP4 open Connector [J5] Pin no. [9]: **+V_C** Logic supply voltage **input** (+11 … +24 VDC)

Figure 7: Configuration JP4

Any available power supply can be used, provided it meets the minimal requirements set out below.

Logic supply requirements	
Output voltage	V_C min. 11 VDC; V_C max. 24 VDC
Ripple	< 10 %
Max. output power	P_C max. 3 W

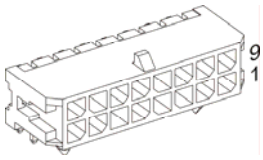


Figure 8: Signal connector (J5)

Pin No.	Signal	Description
1	D_Gnd	Digital signal ground
2	D_Gnd	Digital signal ground
3	DigIN 6	Digital input 6 “Negative Limit Switch”
4	DigIN 5	Digital input 5 “Positive Limit Switch”
5	DigIN 4	Digital input 4 “Home Switch”
6	DigIN 3	Digital input 3 “General Purpose”
7	DigIN 2	Digital input 2 “General Purpose”
8	DigIN 1	Digital input 1 “General Purpose”
9[1]	$+V_{OUT}$	Auxiliary supply voltage Output (+11 … 24 VDC)
9[2]	**$+V_c$**	**Logic supply voltage Input (+11 … 24 VDC)**
10	DigOUT 4	Digital output 4 “Brake”
11	DigOUT 3	Digital output 3 “General Purpose”
12	DigOUT 2	Digital output 2 “General Purpose”
13	DigOUT 1	Digital output 1 “General Purpose”
14	A_Gnd	Analogue signal ground
15	AnIN 2	Analogue input 2
16	AnIN 1	Analogue input 1

Accessories:	EPOS signal cable	maxon order number: **275932**
Notes:	Suitable connector:	Molex Micro-Fit 3.0™ 16 poles (430-25-1600)
	Suitable crimp terminals:	Molex Micro-Fit 3.0™ female crimp terminals (430-30-0010)
	Suitable hand crimper:	Molex hand crimper (69008-0983)

[1] If Jumper JP4 is set (initial setting; see chapter 7.5)
[2] Jumper JP4 is open (separate logic supply input)

7.2 Motor connector (J2)

7.2.1 maxon EC motor

Connect the maxon EC motor (brushless) motor windings on motor connector (J2).

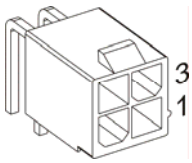


Figure 9: Motor connector (J2)

Pin No.	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

Accessories: EPOS motor cable — maxon order number: **275851**

Notes: Suitable connector: Molex Mini-Fit Jr.™ 4 poles (39-01-2040)

Suitable crimp terminals: Molex Mini-Fit Jr.™ female crimp terminals (444-76-1111)

Suitable hand crimper: Molex hand crimper (69008-0724)

7.2.2 maxon DC motor with separated motor and encoder cable

Connect the maxon DC motor (brush) on motor connector (J2).

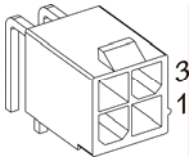


Figure 10: Motor connector (J2)

Pin No.	Signal	Description
1	Motor (+M)	DC motor: Motor +
2	Motor (-M)	DC motor: Motor -
3	Do not connected	Do not connected
4	Motor shield	Cable shield

Accessories: EPOS motor cable — maxon order number: **275851**

Notes: Suitable connector: Molex Mini-Fit Jr.™ 4 poles (39-01-2040)

Suitable crimp terminals: Molex Mini-Fit Jr.™ female crimp terminals (444-76-1111)

Suitable hand crimper: Molex hand crimper (69008-0724)

7.2.3 maxon DC motor with integrated motor/encoder ribbon cable

Using maxon DC motor with integrated motor/encoder ribbon cable an additional presetting has to be done.
The jumpers JP2 and JP3 can be found on board by opening the housing cover.

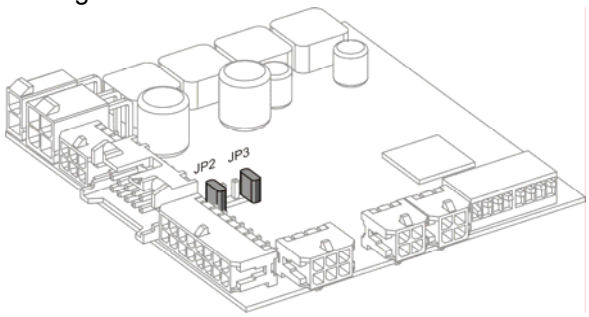


Figure 11: Location JP2 and JP3 (factory setting)

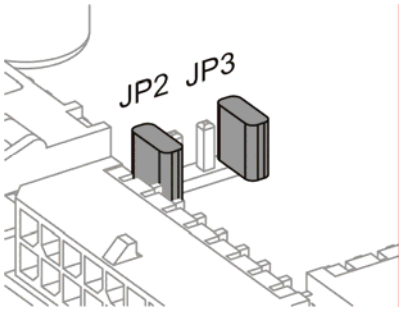
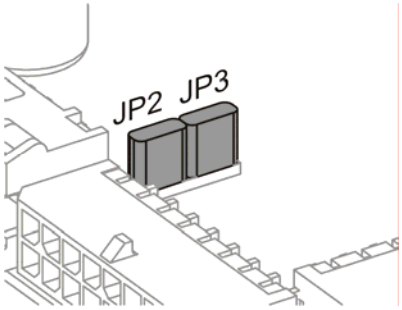
maxon DC motor with **separated** motor and encoder cable	maxon DC motor with **integrated** motor/encoder ribbon cable
	
JP2 open JP3 open	JP2 closed JP3 closed
Motor (J2): motor cable Encoder (J4): encoder cable	Motor (J2): **not connected** Encoder (J4): motor/encoder ribbon cable

Figure 12: Configuration JP2 and JP3

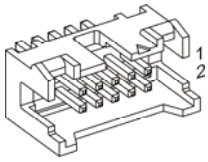


Figure 13: Encoder connector (J4)

Pin No.	Signal	Description
1	**Motor +**	**DC motor: + Motor**
2	+5 VDC / 100 mA	Encoder supply voltage
3	GND	Ground
4	**Motor -**	**DC motor: - Motor**
5	Channel A\	Channel A complement
6	Channel A	Channel A
7	Channel B\	Channel B complement
8	Channel B	Channel B
9	Channel I\	Index complement
10	Channel I	Index

Accessories: EPOS encoder cable — maxon order number: **275934**

Notes: Suitable connector: DIN 41651 Plug, pitch 2.54 mm, 10 poles, plug strain relief

7.3 Hall sensor connector (J3)

Hall sensors are needed for detecting rotor position of maxon EC motors (brushless).
Suitable for Hall Effect sensors IC using Schmitt-trigger with open collector output.

Hall sensor supply voltage	+5 VDC
Max. Hall sensor supply current	30 mA
Input voltage	0…+10 VDC
Logic 0	typical < 0.8 VDC
Logic 1	typical > 2.4 VDC
Internal pull-up resistor	2.7 kΩ (against +5 VDC)

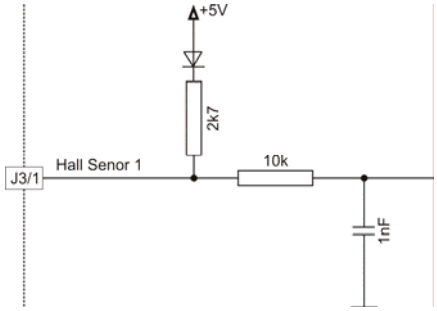


Figure 14: Hall sensor input circuit

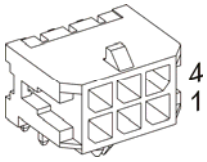


Figure 15: Hall sensor connector (J3)

Pin No.	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	GND	Ground of Hall sensor supply
5	$+V_{Hall}$	Hall sensor supply voltage +5 VDC / 30 mA
6	Hall shield	Cable shield

Accessories: EPOS Hall sensor cable — maxon order number: **275878**

Notes: Suitable connector: Molex Micro-Fit 3.0™ 6 poles (430-25-0600)

Suitable crimp terminals: Molex Micro-Fit 3.0™ female crimp terminals (430-30-0010)

Suitable hand crimper: Molex hand crimper (69008-0983)

7.4 Encoder connector (J4)

It is strongly recommended that the encoder be used with a built-in 3-channel line driver.
The standard encoder adjustment (original packing) refers to a 500-count per turn encoder. For other encoders the adjustment must be modified with the software.

Encoder supply voltage	+5 VDC
Max. encoder supply current	100 mA
Min. differential Input voltage	± 200 mV
Line receiver (internal)	EIA standard RS-422
Max. encoder input frequency	1 MHz

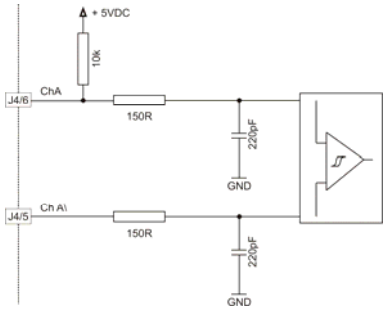


Figure 16: Encoder input circuit sketch

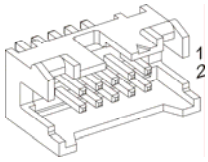


Figure 17: Encoder connector (J4)

Pin No.	Signal	Description
1	n.c. / Motor +	Not connected DC motor: + Motor *)
2	+5 VDC / 100 mA	Encoder supply voltage
3	GND	Ground
4	n.c. / Motor -	Not connected DC motor: - Motor *)
5	Channel A\	Channel A complement
6	Channel A	Channel A
7	Channel B\	Channel B complement
8	Channel B	Channel B
9	Channel I\	Index complement
10	Channel I	Index

*) if Jumper JP2 and JP3 are set (see chapter 7.2.3)

Encoder pin out suits for example to:
- maxon digital MR-Encoder type S, M, ML, L all with Line Driver
- maxon digital encoder HEDL 55_ with Line Driver RS 422

Accessories: EPOS encoder cable — maxon order number: **275934**

Notes: Suitable connector: — DIN 41651 Plug, pitch 2.54 mm, 10 poles, plug strain relief

7.5 Signal connector (J5)

Signal connector contains smart multi-purpose digital I/O's configurable as: "Positive and Negative Limit Switches", "Home Switch" and "Brake output".
Additionally "General Purpose" digital I/O's and analogue inputs are provided.

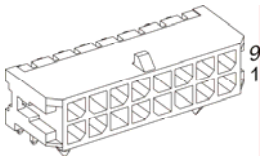


Figure 18: Signal connector (J5)

Pin No.	Signal	Description
1	D_Gnd	Digital signal ground
2	D_Gnd	Digital signal ground
3	DigIN 6	Digital input 6 "Negative Limit Switch"
4	DigIN 5	Digital input 5 "Positive Limit Switch"
5	DigIN 4	Digital input 4 "Home Switch"
6	DigIN 3	Digital input 3 "General Purpose"
7	DigIN 2	Digital input 2 "General Purpose"
8	DigIN 1	Digital input 1 "General Purpose"
9[3]	**$+V_{OUT}$**	**Auxiliary supply voltage Output (+11 … 24 VDC)**
9[4]	$+V_C$	Logic supply voltage Input (+11 … 24 VDC)
10	DigOUT 4	Digital output 4 "Brake"
11	DigOUT 3	Digital output 3 "General Purpose"
12	DigOUT 2	Digital output 2 "General Purpose"
13	DigOUT 1	Digital output 1 "General Purpose"
14	A_Gnd	Analogue signal ground
15	AnIN 2	Analogue input 2
16	AnIN 1	Analogue input 1

Accessories: EPOS signal cable — maxon order number: **275932**

Notes: Suitable connector: Molex Micro-Fit 3.0™ 16 poles (430-25-1600)

Suitable crimp terminals: Molex Micro-Fit 3.0™ female crimp terminals (430-30-0010)

Suitable hand crimper: Molex hand crimper (69008-0983)

[3] Jumper JP4 is set (initial setting)
[4] If Jumper JP4 is open (see chapter 7.1.2)

7.5.1 Digital input 1 “General Purpose“

“General Purpose” input by default and can be configured via software setting.

Connector No. and Pin No.	Connector [J5] Pin number [8]
Input voltage	0 ... 24 VDC
Max. input voltage	-30 ... +30 VDC
Logic 0	typical < 1.5 VDC
Logic 1	typical > 3.0 VDC
Input resistance	typical 16 kΩ
Input current at logic 1	typical 1.4 mA @ 24 VDC
Switching delay	< 2µs @ 5 VDC

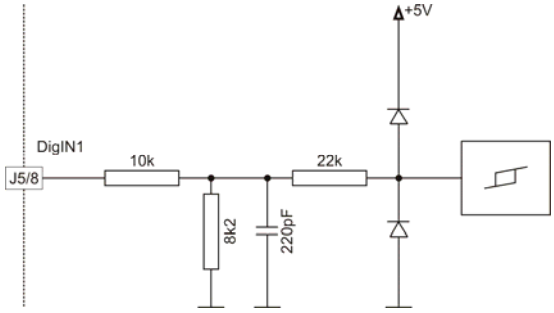


Figure 19: Digital input 1

7.5.2 Digital input 2 "General Purpose"

“General Purpose” input by default and can be configured via software setting.

Connector No. and Pin No.	Connector [J5] Pin number [7]
Input voltage	0 ... 24 VDC
Max. input voltage	-30 ... +30 VDC
Logic 0	typical < 1.5 VDC
Logic 1	typical > 3.0 VDC
Input resistance	typical 16 kΩ
Input current at logic 1	typical 1.4 mA @ 24 VDC
Switching delay	< 2µs @ 5 VDC

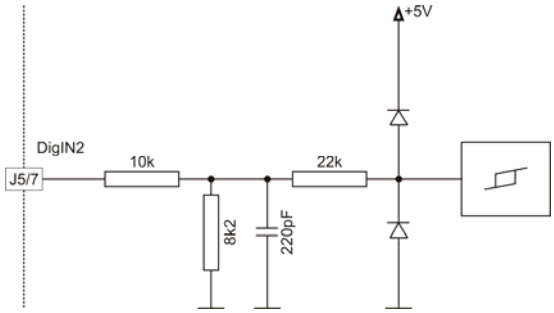


Figure 20: Digital input 2 circuit

7.5.3 Digital input 3 "General Purpose"

"General Purpose" input by default and can be configured via software setting.

Connector No. and Pin No.	Connector [J5] Pin number [6]
Input voltage	0 ... 24 VDC
Max. input voltage	-30 ... +30 VDC
Logic 0	typical < 1.5 VDC
Logic 1	typical > 3.0 VDC
Input resistance	typical 16 kΩ
Input current at logic 1	typical 1.4 mA @ 24 VDC
Switching delay	< 2µs @ 5 VDC

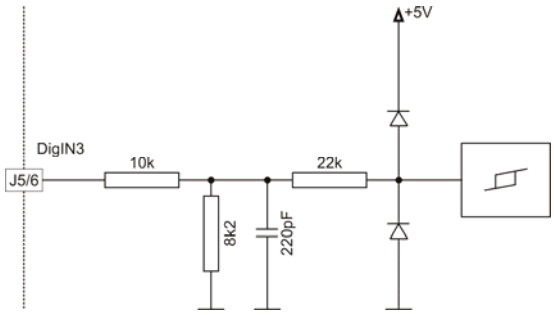


Figure 21: Digital input 3 circuit

7.5.4 Digital input 4 "Home Switch"

Determine the absolute position of the axis.

"Home Switch" input by default and can be configured via software setting.

Connector No. and Pin No.	Connector [J5] Pin number [5]
Input voltage	0 ... 24 VDC
Max. input voltage	-30 ... +30 VDC
Logic 0	typical < 5.0 VDC
Logic 1	typical > 9.0 VDC
Input resistance	typical 4.4 kΩ
Input current at logic 1	typical 5.5 mA @ 24 VDC
Switching delay	< 50µs @ 11V…24 VDC

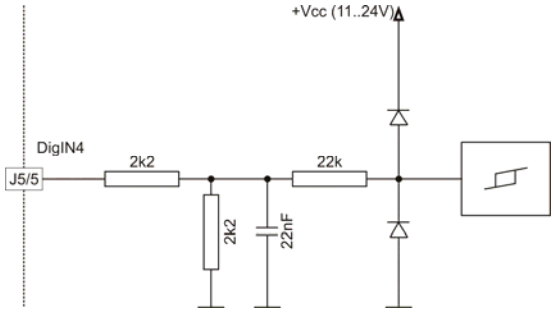


Figure 22: Digital input 4 circuit

Wiring examples:

a) Proximity switches type: **PNP**

3-wire model

R_{IN} = 4.4 kΩ

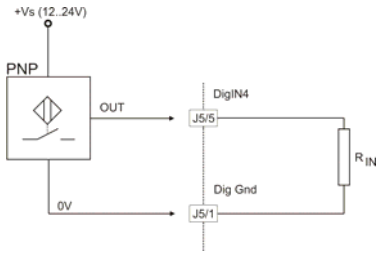
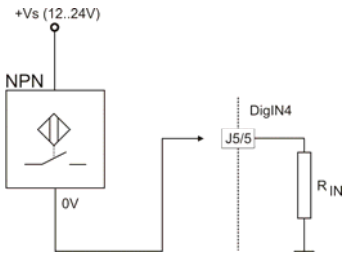


Figure 23: Digital input 4 external wiring example a)

b) Proximity switches type: **NPN**

2-wire model



3-wire model

R_{ext} (12 V) = 510 Ω (300 mW)

R_{ext} (24 V) = 4.3 kΩ (150 mW)

R_{IN} = 4.4 kΩ

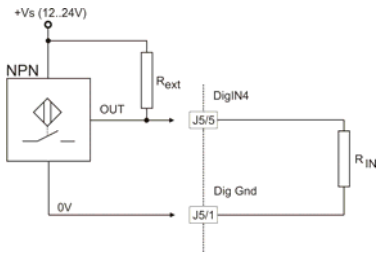


Figure 24: Digital input 4 external wiring example b)

7.5.5 Digital input 5 "Positive Limit Switch"

"Positive Limit Switch" input by default and can be configured via software setting.

Connector No. and Pin No.	Connector [J5] Pin number [4]
Input voltage	0 ... 24 VDC
Max. input voltage	-30 ... +30 VDC
Logic 0	typical < 5.0 VDC
Logic 1	typical > 9.0 VDC
Input resistance	typical 4.4 kΩ
Input current at logic	typical 5.5 mA @ 24 VDC
Switching delay	< 50µs @ 11V…24 VDC

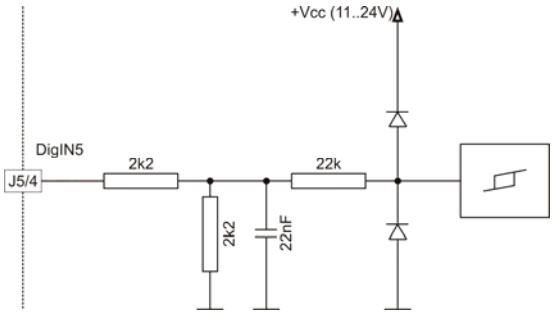


Figure 25: Digital input 5 circuit

Wiring examples:

a) Proximity switches type: **PNP**

3-wire model

R_{IN} = 4.4 kΩ

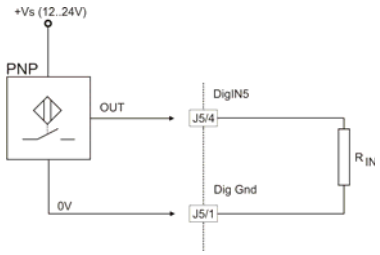
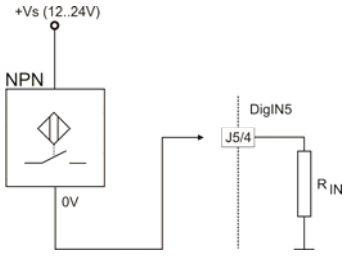


Figure 26: Digital input 5 external wiring example a)

b) Proximity switches type: **NPN**

2-wire model



3-wire model

R_{ext} (12 V) = 510 Ω (300 mW)

R_{ext} (24 V) = 4.3 kΩ (150 mW)

R_{IN} = 4.4 kΩ

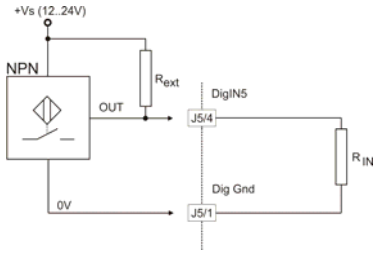


Figure 27: Digital input 5 external wiring example b)

7.5.6 Digital input 6 "Negative Limit Switch"

"Negative Limit Switch" input by default and can be configured via software setting.

Connector No. and Pin No.	Connector [J5] Pin number [3]
Input voltage	0 ... 24 VDC
Max. input voltage	-30 ... +30 VDC
Logic 0	typical < 5.0 VDC
Logic 1	typical > 9.0 VDC
Input resistance	typical 4.4kΩ
Input current at logic 1	typical 5.5 mA @ 24 VDC
Switching delay	< 50µs @ 11V…24 VDC

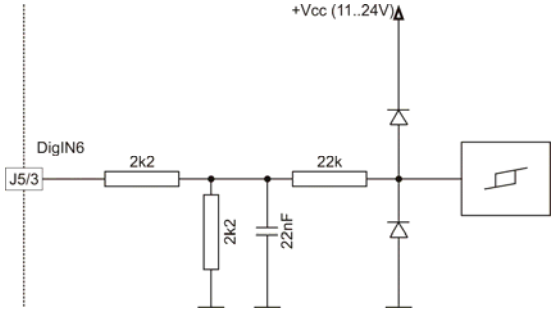


Figure 28: Digital input 6 circuit

Wiring examples:

a) Proximity switches type: **PNP**

3-wire model

R_{IN} = 4.4 kΩ

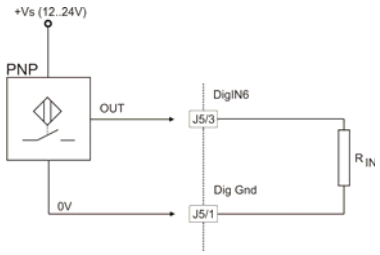
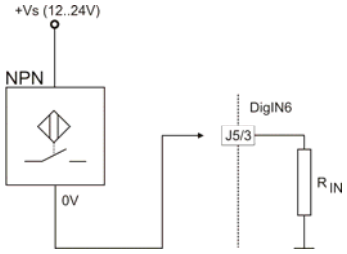


Figure 29: Digital input 6 external wiring example a)

b) Proximity switches type: **NPN**

2-wire model



3-wire model

R_{ext} (12 V) = 510 Ω (300 mW)

R_{ext} (24 V) = 4.3 kΩ (150 mW)

R_{IN} = 4.4 kΩ

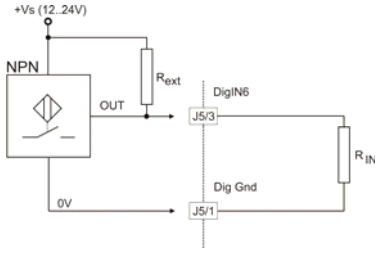


Figure 30: Digital input 6 external wiring example b)

7.5.7 Analogue input 1 "General Purpose"

"General Purpose" analogue input by default. **Not** configurable via software setting.

Connector No. and Pin No.	Connector [J5] Pin number [15]
Input voltage range	0 ... 5 VDC
Max. input voltage	-30 ... +30 VDC
Input resistance	typical 36k against AGnd [14]
A/D converter	10-bit
Resolution	0.005 V

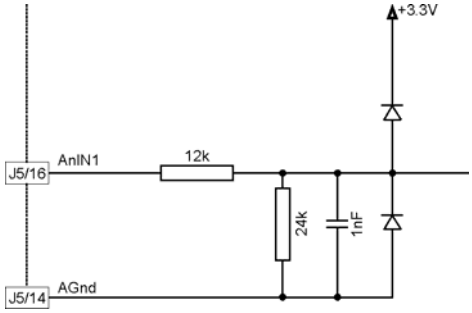


Figure 31: Analogue input 1 circuit

7.5.8 Analogue input 2 "General Purpose"

"General Purpose" analogue input by default. **Not** configurable via software setting.

Connector No. and Pin No.	Connector [J5] Pin number [14]
Input voltage range	0 ... 5 VDC
Max. input voltage	-30 ... +30 VDC
Input resistance	typical 36k against AGnd [14]
A/D converter	10-bit
Resolution	0.005 V

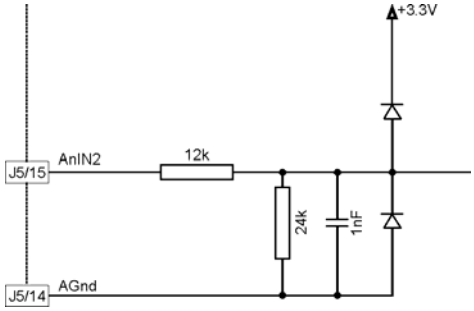


Figure 32: Analogue input 2 circuit

7.5.9 Auxiliary output voltage

Auxiliary output voltage can be used as power supply for external loads connected to EPOS 24/5 digital outputs.

Connector No. and Pin No.	Connector [J5] Pin number [9]
Output voltage	+11…+24 VDC
Max. output current	1300 mA

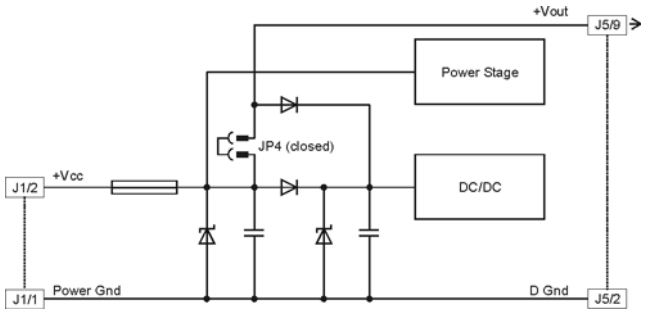


Figure 33: Auxiliary output voltage circuit

Note:
- Initial setting: Jumper JP4 closed (see also chapter 7.5)
- If jumper JP4 is open, the logic supply voltage can be sourced separately (see chapter 7.1.2)

7.5.10 Digital output 1 "General Purpose"

"General Purpose" output by default and can be configured via software setting.

Connector No. and Pin No.	Connector [J5] Pin number [13]
Circuit	Open drain (internal pull-up resistor 2k2 and diode to +5VDC)

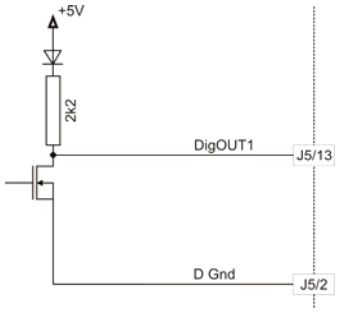


Figure 34: Digital output 1 circuit

Wiring examples:

a) DigOut1 "sinks"

Max. input voltage	+30 VDC
Max. load current	100 mA
Max. voltage drop	0.5 V @ 100 mA

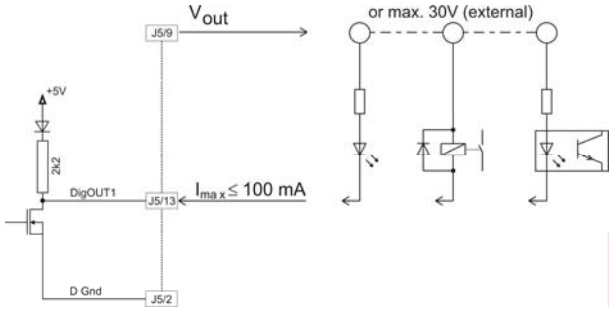


Figure 35: Digital output 1 external wiring example a)

b) DigOut1 "source"

Output voltage	$U_{out} \approx 5V - 0.75V - (I_{load} \times 2200\Omega)$
Max. load current	$I_{load} \leq 2mA$

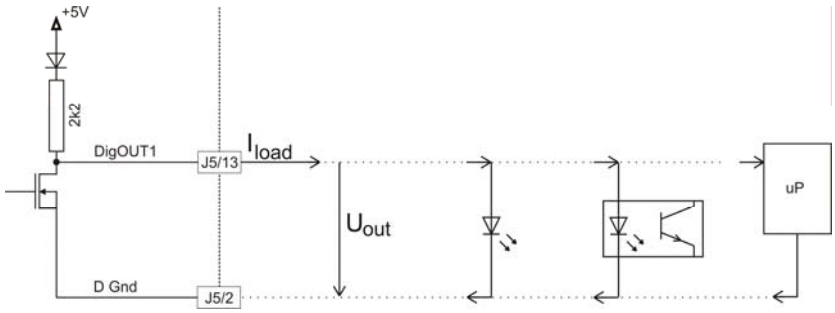


Figure 36: Digital output 1 external wiring example b)

7.5.11 Digital output 2 "General Purpose"

"General Purpose" output by default and can be configured via software setting.

Connector No. and Pin No.	Connector [J5] Pin number [12]
Circuit	Open drain (internal pull-up resistor 2k2 and diode to +5VDC)

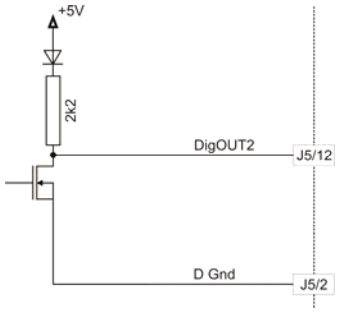


Figure 37: Digital output 2 circuit

Wiring examples:

a) DigOut2 "sinks"

Max. input voltage	+30 VDC
Max. load current	100 mA
Max. voltage drop	0.5 V @ 100 mA

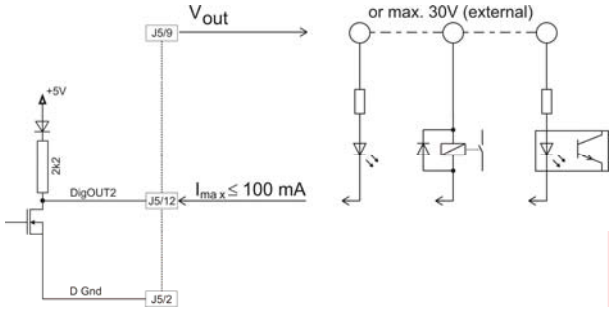


Figure 38: Digital output 2 external wiring example a)

b) DigOut2 "source"

Output voltage	$U_{out} \approx 5V - 0.75V - (I_{load} \times 2200\ \Omega)$
Max. load current	$I_{load} \leq 2mA$

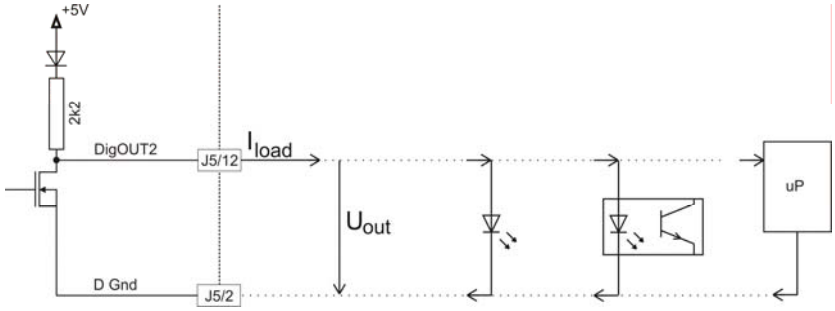


Figure 39: Digital output 2 external wiring example b)

7.5.12 Digital output 3 "General Purpose"

”General Purpose” output by default and can be configured via software setting.

Connector No. and Pin No.	Connector [J5] Pin number [11]
Circuit	Open drain (internal pull-up resistor 2k2 and diode to +5 VDC)

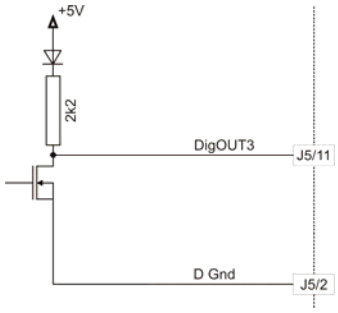


Figure 40: Digital output 3 circuit

Wiring examples:

a) DigOut3 “sinks"

Max. input voltage	+30 VDC
Max. load current	100 mA
Max. voltage drop	0.5 V @ 100 mA

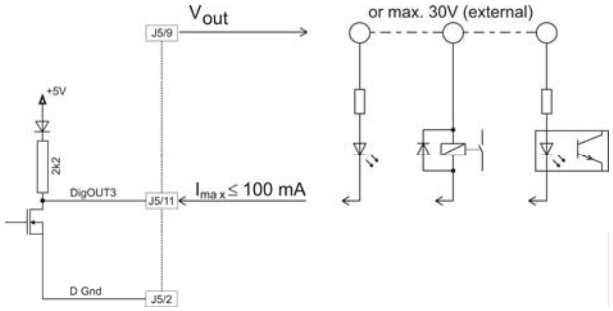


Figure 41: Digital output 3 external wiring example a)

b) DigOut3 “source”

Output voltage	$U_{out} \approx 5V - 0.75V - (I_{load} \times 2200\ \Omega)$
Max. load current	$I_{load} \leq 2mA$

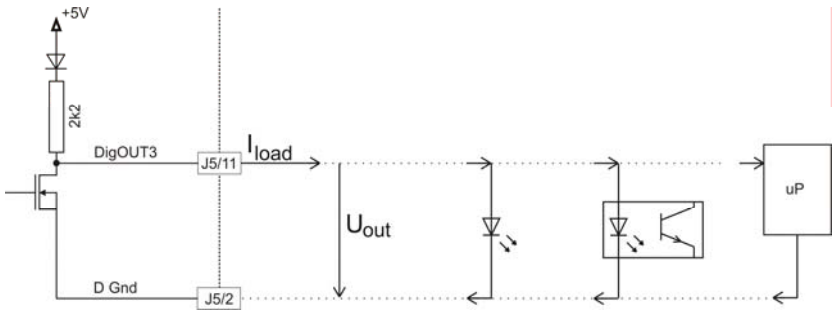


Figure 42: Digital output 3 external wiring example b)

7.5.13 Digital output 4 "Brake"

Apply permanent magnet brake for DC voltage.

Connector No. and Pin No.	Connector [J5] Pin number [10]
Circuit	Open drain (internal pull-up resistor 2k2 and diode to +5VDC)

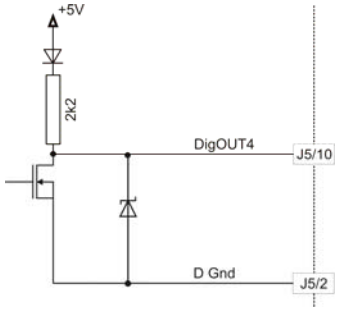


Figure 43: Digital output 4 circuit sketch

Wiring examples:

a) DigOut4 “sinks"

Max. input voltage	+30 VDC
Max. load current	1 A
Max. voltage drop	0.3 V @ 1 A

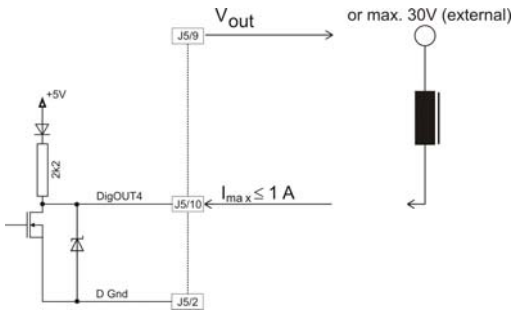


Figure 44: Digital output 4 external wiring example a)

b) DigOut4 “source”

Output voltage	$U_{out} \approx 5V - 0.75V - (I_{load} \times 2200\Omega)$
Max. load current	$I_{load} \leq 2mA$

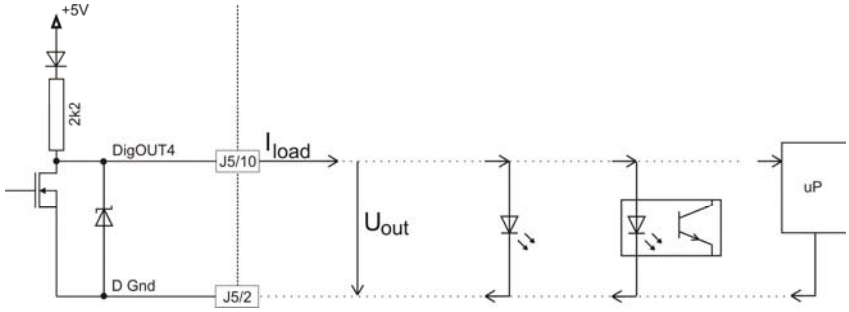


Figure 45: Digital output 4 external wiring example b)

7.6 RS-232 connector (J6)

Maximum input voltage	± 30 V
Output voltage	typical ± 9 V @ 3k to Ground
Maximum bit rate	115 200 bit/s
Internal RS232 driver/receiver	EIA RS232 standard

Note:
- Please consider your PC's serial port maximal baud rate.
- The standard baud rate setting (factory setting) is 38'400 bauds.

Connection EPOS - PC

Positioning Controller EPOS 24/5	**PC Interface (RS232), DIN41652**
Connector J6 pin 4+5 GND	Pin 5 GND
Connector J6 pin 1 "EPOS RxD"	Pin 3 "PC TxD"
Connector J6 pin 2 "EPOS TxD"	Pin 2 "PC RxD"

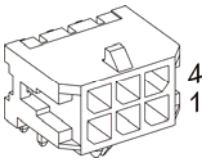


Figure 46: RS232 cable connector (J6)

Pin No.	Signal	Description
1	EPOS RxD	EPOS RS232 receive
2	EPOS TxD	EPOS RS232 transmit
3		
4	GND	RS232_Ground
5	GND	RS232_Ground
6	Shield	Cable shield

Accessories: EPOS RS232-COM cable — maxon order number: **275900**

Notes: Suitable connector: Molex Micro-Fit 3.0™ 6 poles (430-25-0600)

Suitable crimp terminals: Molex Micro-Fit 3.0™ female crimp terminals (430-30-0010)

Suitable hand crimper: Molex hand crimper (69008-0983)

7.7 CAN connector (J7, J8)

Standard type	CAN high-speed ISO 11898 compatible
Maximum bit rate	1 MBit/s
Max. number of CAN nodes	127
Protocol	CANopen DS-301 V4.02
Identifier setting	by DIP-Switch or software

Connection EPOS - CAN bus line CiA DS-102

Positioning Controller EPOS 24/5	**CAN 9 pin D-Sub (DIN41652)**
Connector J7 (J8) pin 1 “CAN high”	Pin 7 “CAN_H” high bus line
Connector J7 (J8) pin 2 “CAN low”	Pin 2 “CAN_L” low bus line
Connector J7 (J8) pin 3 “CAN GND”	Pin 3 “CAN_GND” Ground
Connector J7 (J8) pin 4 “CAN shield”	Pin 5 “CAN_Shield” Cable Shield

Note:
- Please consider your CAN Master port maximal baud rate.
- The standard baud rate setting (factory setting) is 1 MBit/s.
- Further CAN information may be found in the “Communication Guide” documentation.

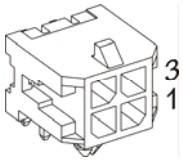


Figure 47: CAN connector (J7, J8)

Pin No.	Signal	Description
1	CAN high	CAN high bus line
2	CAN low	CAN low bus line
3	CAN GND	CAN Ground
4	CAN shield	Cable shield

Accessories:	EPOS CAN-COM cable	maxon order number: **275908**
	EPOS CAN-CAN cable	maxon order number: **275926**
	EPOS CAN termination plug	maxon order number: **275937**
Notes:	Suitable connector:	Molex Micro-Fit 3.0™ 4 poles (430-25-0400)
	Suitable crimp terminals:	Molex Micro-Fit 3.0™ female crimp terminals (430-30-0010)
	Suitable hand crimper:	Molex hand crimper (69008-0983)

7.8 CAN Node Identification (JP 1)

7.8.1 CAN-ID (node address)

The CAN-ID (node address) is set at DIP-Switch 1 ... 7.
All addresses can be coded from 1 ... 127 using the binary code.

Switch	Binary	Value
1	2^0	1
2	2^1	2
3	2^2	4
4	2^3	8
5	2^4	16
6	2^5	32
7	2^6	64

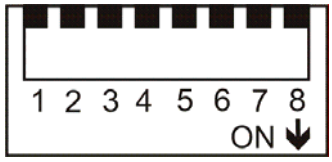


Figure 48: Table binary code value

If the value of all switches set at “ON” are added together, this gives the set CAN-ID (node address).

Examples:
The following table can be used as a guide, but is not comprehensive.

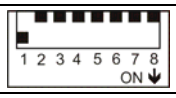
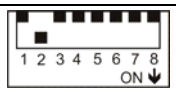
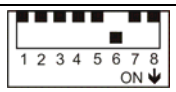
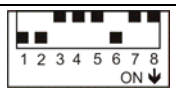
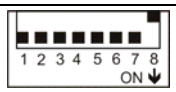
	Switch	1	2	3	4	5	6	7	
	Value	1	2	4	8	16	32	64	
CAN-ID	Switch setting								Calculation
1		1	0	0	0	0	0	0	1
2		0	1	0	0	0	0	0	2
32		0	0	0	0	0	1	0	32
35		1	1	0	0	0	1	0	1 + 2 + 32
127		1	1	1	1	1	1	1	1 + 2 + 4 + 8 + 16 + 32 + 64

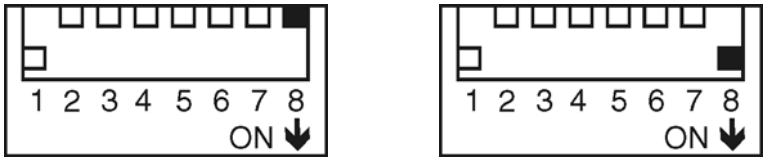
Figure 49: CAN ID examples

Notes:
- The Node ID set by software is valid, if DIP-Switch is set to value 0.
- DIP-Switch 8 has no impact on the CAN-ID.

7.8.2 CAN Bus Termination

The CAN-Bus line has to be terminated at both ends with a termination resistor of typically 120 Ω.

With DIP-Switch 8, an internal bus-termination resistor can be switched "ON" or "OFF".
Initially, the bus- termination is "OFF" (bus is **not** terminated).



DIP-Switch 8 “OFF” (initial setting): No bus-termination

DIP-Switch 8 “ON”: Bus terminated with 120 Ω

Figure 50: CAN-Bus termination

7.8.3 CAN Bus Termination Examples

Example 1: Multiple axis system with EPOS 24/5 within the CANopen bus.

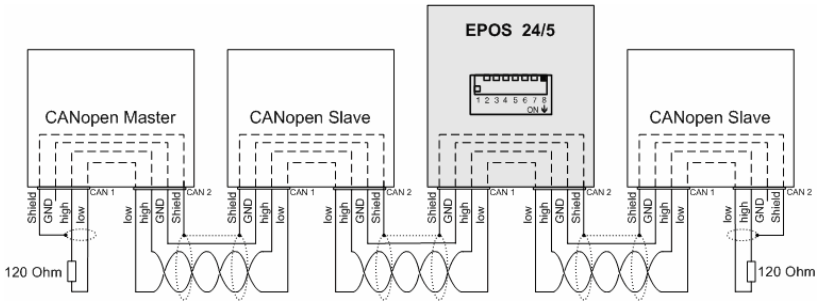


Figure 51: EPOS 24/5 without CAN-Bus termination

- No bus termination is necessary.
- DIP-switch 8 “OFF” (initial setting)

Example 2: Multiple axis system with EPOS 24/5 at the end of the CANopen bus line

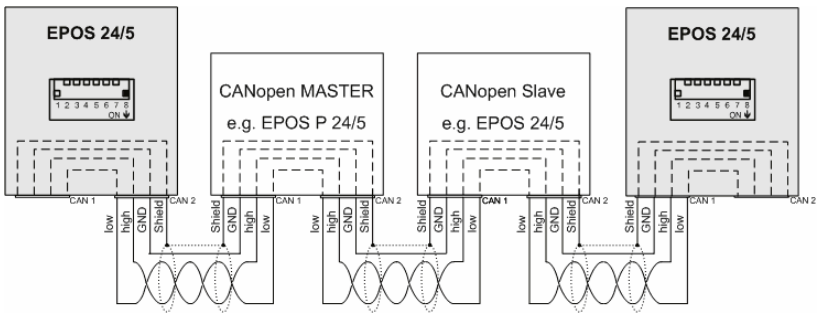


Figure 52: EPOS 24/5 with CAN-Bus termination

- Bus terminations have to be done at both ends of the bus line.
- DIP-switch 8 “ON”.

8 LED status

The green LED shows the operating status and the red LED indicates an error of the positioning controller EPOS 24/5. Detailed information may be found in the Firmware Specification document.

Red LED	Green LED	Description
OFF	Slow blinking (≈ 1Hz)	The EPOS is in state: - *Switch ON Disabled* - *Ready to Switch ON* - *Switched ON* The power stage is disabled
OFF	**ON**	The EPOS is in state: - *Operation Enable* - *Quick Stop Active* The power stage is enabled
ON	OFF	The EPOS is in state - *Fault*
ON	**ON**	The EPOS is in temporary state - *Fault Reaction Active* The power stage is enabled
ON	Flashing	There is no valid firmware on the EPOS (due to a failed firmware download)

9 Dimension drawing

Dimensions in [mm]

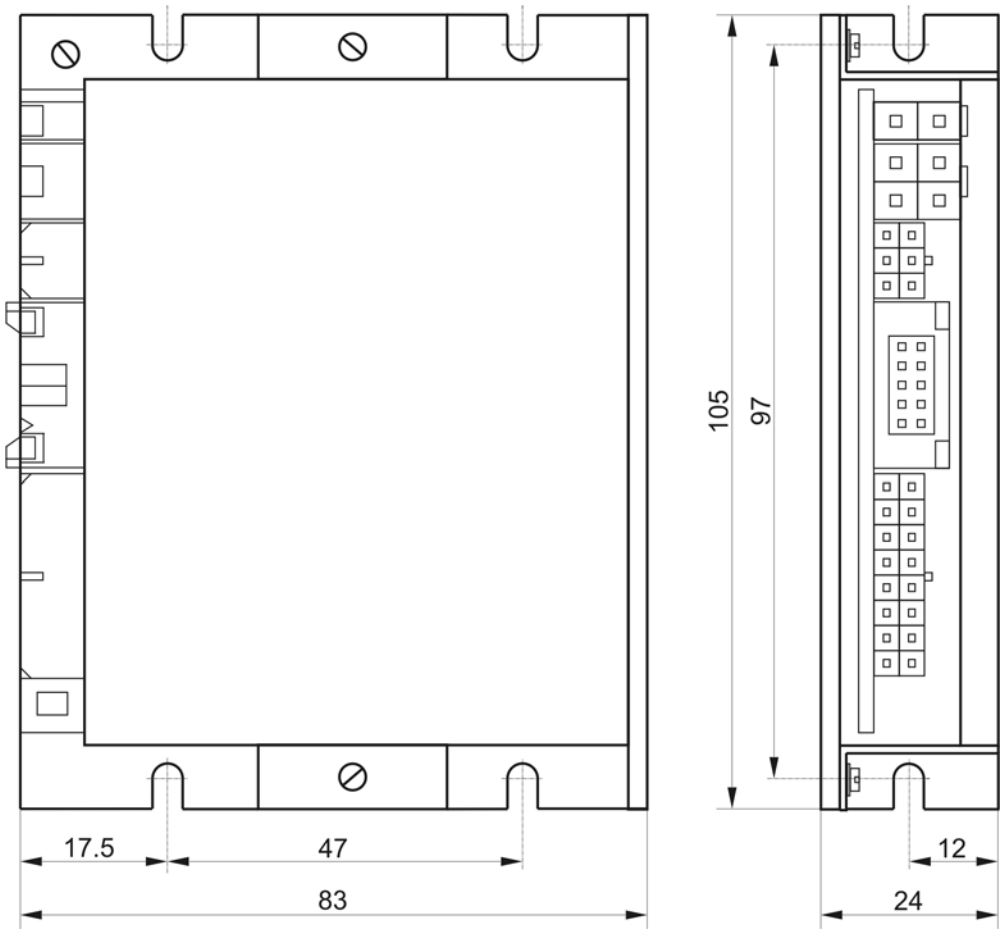


Figure 53: Dimensions EPOS 24/5