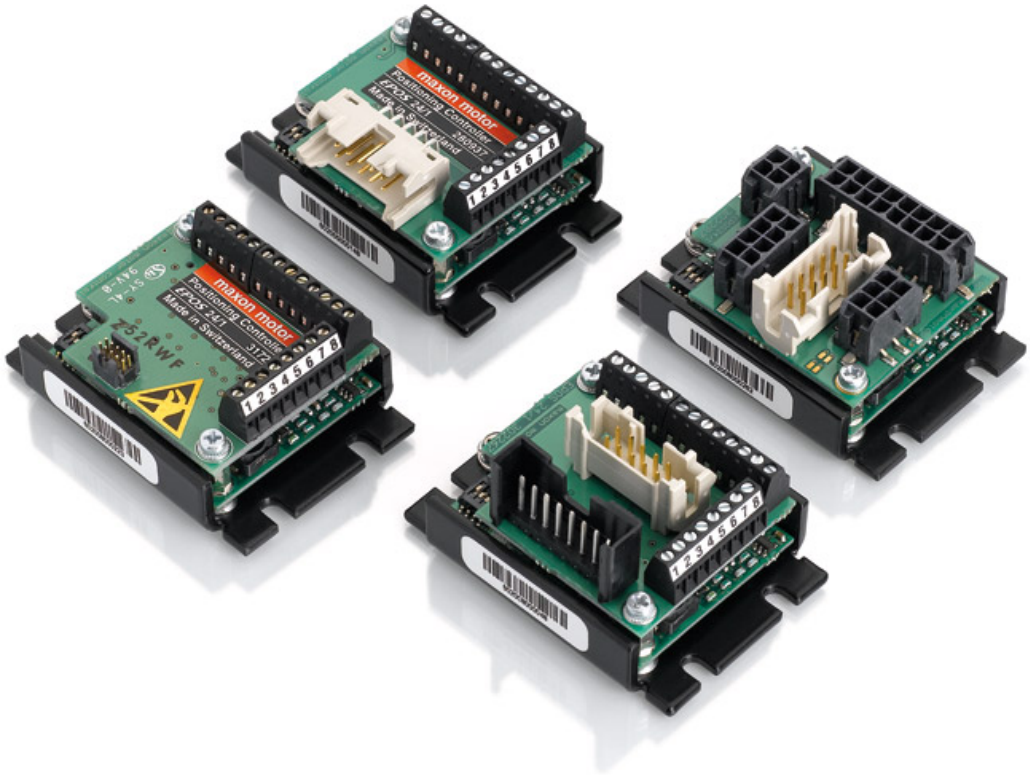
EPOS 24/1

Positioning Controller

Documentation

Hardware Reference



maxon document number: 573047-09

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1 Table of contents

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3 Introduction

This documentation “Hardware Reference” provides the hardware details of the EPOS 24/1 positioning controller. It contains performance data, connections, specification, pin assignment and wiring examples.

Figure 1: EPOS 24/1 photo

The maxon motor EPOS 24/1 is a small-sized full digital smart motion controller. Due to the flexible and high efficient power stage the EPOS 24/1 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 in the internet in http://www.maxonmotor.com category <Service>, subdirectory <Downloads>.

4 How to use this guide

Setup

Getting Started

Installation

- Cable Starting Set

- **Hardware Reference**

Configuration

- Graphical User Interface

Programming

- Windows DLL

- IEC1131 libraries

- Firmware Specification

- Communication Guide

Application

- Application Notes
- Application Samples

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 24/1 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 9 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%)	9 - 24 VDC
Max. output voltage	0.98 • V_{CC}
Max. output current I_{max} (<1sec)	2 A
Continuous output current I_{cont}	1 A
Switching frequency	50 kHz
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: EPOS 24/1 for DC/EC motors:	150 µH / 1 A
EPOS 24/1 for EC 6 motor:	300 µH / 0.7 A

6.2 Inputs

Hall sensor signals[1]	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”)	+2.4 … +24 VDC (Ri = 11 kΩ)
Digital input 2 (“General Purpose”)	+2.4 … +24 VDC (Ri = 11 kΩ)
Digital input 3 (“General Purpose”)	+2.4 … +24 VDC (Ri = 11 kΩ)
Digital input 4 (“Home Switch”)	+2.4 … +24 VDC (Ri = 11 kΩ)
Digital input 5 (“Positive Limit Switch”)	+2.4 … +24 VDC (Ri = 11 kΩ)
Digital input 6 (“Negative Limit Switch”)	+2.4 … +24 VDC (Ri = 11 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 node identification)	configured by DIP-Switch 1 … 4	

6.3 Outputs

Digital output 3 (“General Purpose”)	open drain	max. 24 VDC (I_L < 50 mA)
Digital output 4 (“General Purpose”)	open drain	max. 24 VDC (I_L < 50 mA)

6.4 Voltage outputs

Encoder supply voltage	+5 VDC, max. 100 mA
Hall sensors supply voltage[1]	+5 VDC, max. 30 mA
Auxiliary output voltage	+5 VDC, max. 10 mA

6.5 Motor connections

maxon EC motor[1]	**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	CAN_H (high); CAN_L (low)	max.1 MBit/s

6.7 LED indicator

Green LED	ENABLE
Red LED	FAULT

[1] Only in use with EPOS 24/1 for maxon EC motor

6.8 Ambient temperature- / Humidity range

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

6.9 Mechanical data

Weight ..... approx 45 g
Dimensions (L x W x H) ..... see dimension drawing
Mounting plate ..... for M3 screws

6.10 Connections

J1 Supply / control signals ..... PCB screw clamps
..... 13 poles; pitch 2.54 mm
J2 Communication / analogue inputs ..... PCB screw clamps
..... 8 poles; pitch 2.54 mm

EPOS 24/1 for maxon DC motors #280937

..... with interface according to MR-Encoder Type S with Line Driver and
..... MR-Encoder Type M with Line Driver
J3 Motor / Encoder ..... Plug DIN41651; 10 poles
..... for ribbon cable, pitch 1.27mm, AWG 28
Suitable locking clip: ..... Tyco C42334-A421-C42 (right); C42334-A421-C52 (left)

EPOS 24/1 for maxon EC 6 motor #317270

..... with digital Hall sensors and MR-Encoder
J6 Encoder ..... SMD Flex Print Connector; 4 poles
..... pitch 1.0mm, top contact style
J7 Motor / Hall ..... SMD Flex Print Connector; 8 poles
..... pitch 0.5mm, top contact style

EPOS 24/1 for maxon EC 16/EC 22 motors #302267

..... with digital Hall sensors and MR-Encoder
J8 Motor / Hall ..... STOCKO MKS1658; 8 poles; pitch 2.5 mm
J9 Encoder ..... Plug DIN41651; 10 poles
..... for ribbon cable, pitch 1.27mm, AWG 28
Suitable locking clip: ..... Tyco C42334-A421-C42 (right); C42334-A421-C52 (left)

EPOS 24/1 for maxon DC/EC motors #302287

DC motor ..... with digital Encoder
EC motor ..... with digital Hall sensors and digital Encoder
J10 Motor / Hall ..... dual row male header (8 poles) Molex Micro-Fit 3.0™
Suitable plug/terminal: ..... Molex Micro-Fit 3.0™ 430-25-0800 / female crimp terminal 430-30-0010
J11 Encoder ..... Plug DIN41651; 10 poles
..... for ribbon cable, pitch 1.27mm, AWG 28
Suitable locking clip: ..... Tyco C42334-A421-C42 (right); C42334-A421-C52 (left)
J12 RS232 ..... dual row male header (6 poles) Molex Micro-Fit 3.0™
Suitable plug/terminal: ..... Molex Micro-Fit 3.0™ 430-25-0600 / female crimp terminal 430-30-0010
J13 CAN ..... dual row male header (4 poles) Molex Micro-Fit 3.0™
Suitable plug/terminal: ..... Molex Micro-Fit 3.0™ 430-25-0400 / female crimp terminal 430-30-0010
J14 Supply / control signals ..... dual row male header (16 poles) Molex Micro-Fit 3.0™
Suitable plug/terminal: ..... Molex Micro-Fit 3.0™ 430-25-1600 / female crimp terminal 430-30-0010

6.11 Order number

EPOS 24/1 for maxon DC motors 280937
EPOS 24/1 for maxon EC 6 motor 317270
EPOS 24/1 for maxon EC 16/EC 22 motors 302267
EPOS 24/1 for maxon DC/EC motors 302287

7 Connections 280937, 317270, 302267

EPOS 24/1 for maxon DC motors #280937

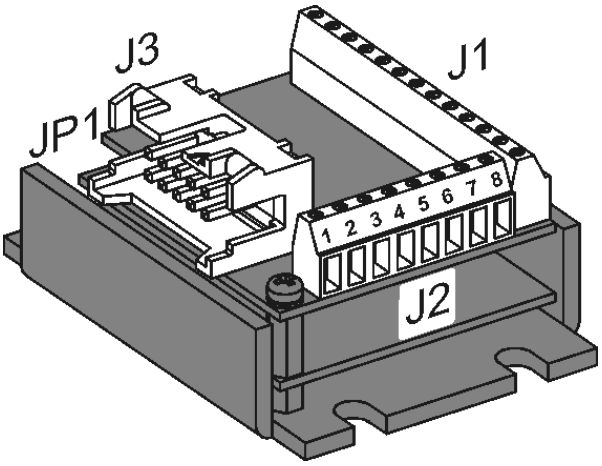


Figure 3: EPOS 24/1 for maxon DC motors connector description

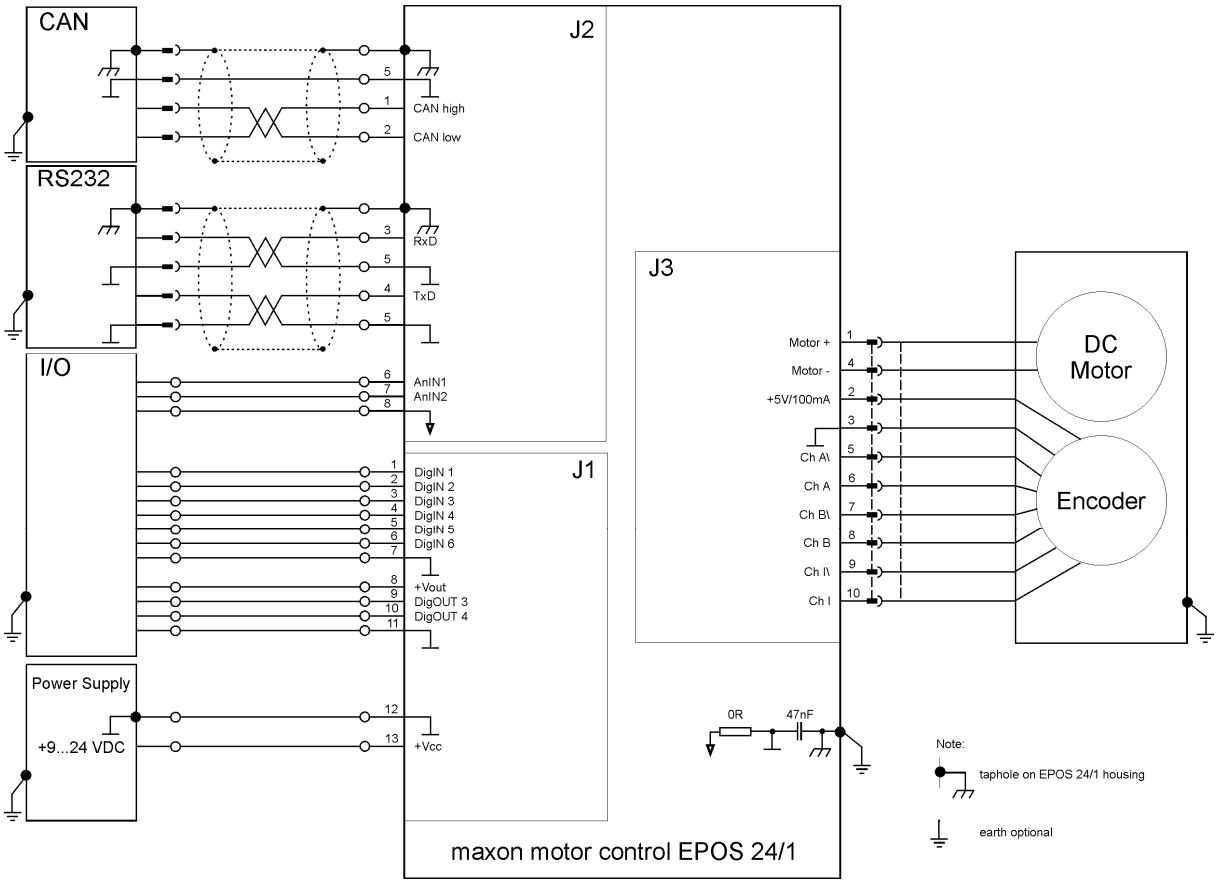


Figure 4: Wiring diagram for maxon DC motors (overview)

EPOS 24/1 for maxon EC 6 motor #317270

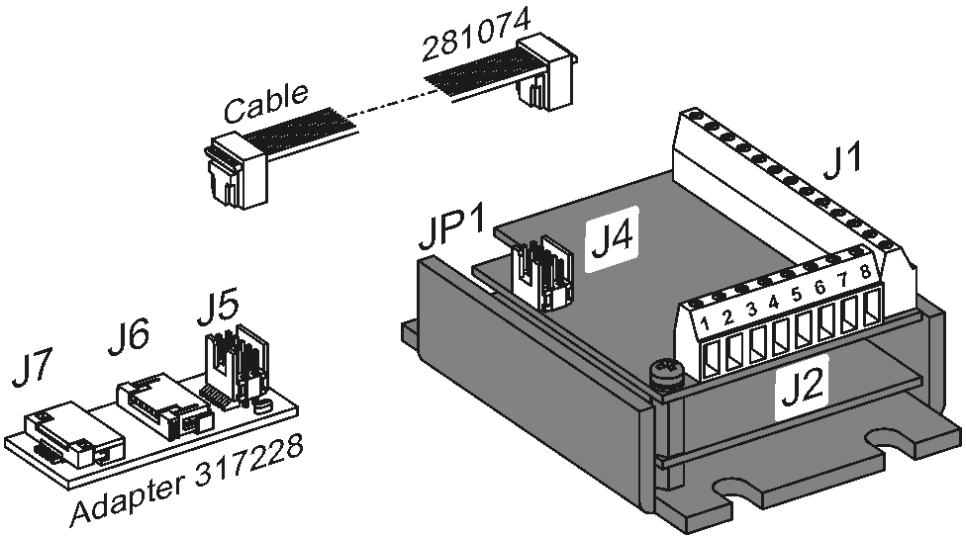


Figure 5: EPOS 24/1 for maxon EC 6 motor connector description

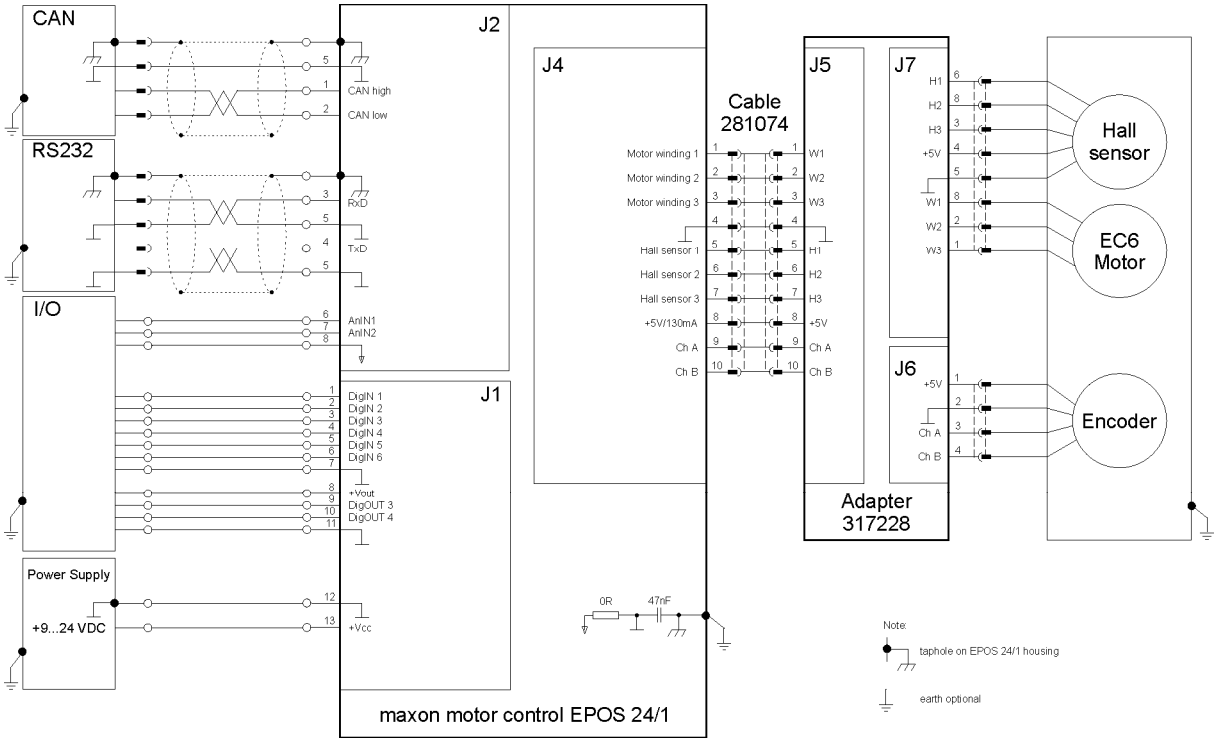


Figure 6: Wiring diagram for maxon EC 6 motor (overview)

EPOS 24/1 for maxon EC 16/EC 22 motors #302267

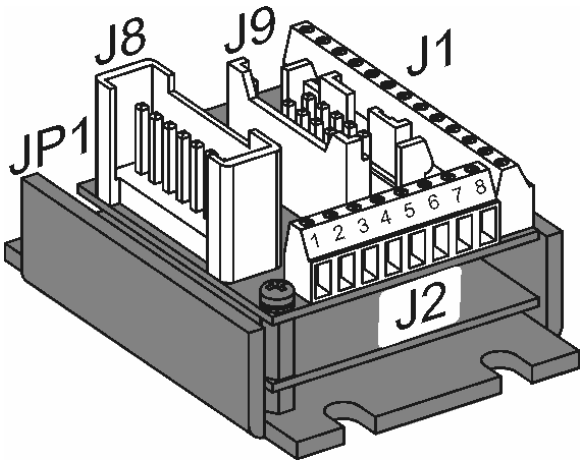


Figure 7: EPOS 24/1 for maxon EC 16/EC 22 motors connector description

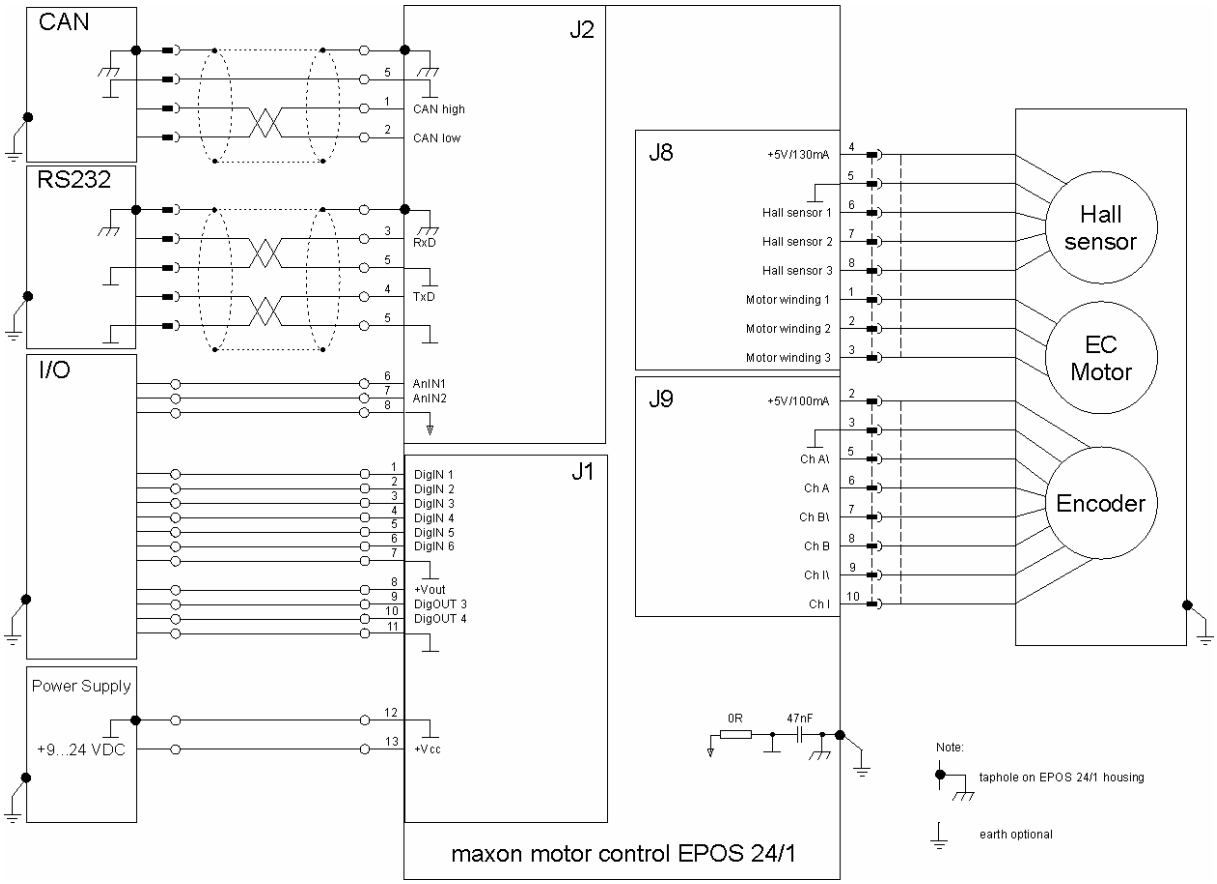


Figure 8: Wiring diagram for maxon EC 16/EC 22 motors (overview)

7.1 Connector (J1)

Signal connector contains multi-purpose digital I/O's. The digital inputs are configurable as: "Home Switch" or "Positive- or Negative Limit Switch". Additionally "General Purpose" digital I/O's are provided.

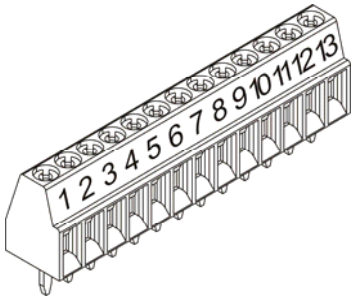


Figure 9: Connector (J1)

Pin No.	Signal	Description
1	DigIN 1	Digital input 1 "General Purpose"
2	DigIN 2	Digital input 2 "General Purpose"
3	DigIN 3	Digital input 3 "General Purpose"
4	DigIN 4	Digital input 4 "Home Switch"
5	DigIN 5	Digital input 5 "Positive Limit Switch"
6	DigIN 6	Digital input 6 "Negative Limit Switch"
7	D_Gnd	Digital signal ground
8	$+V_{OUT}$	Auxiliary supply voltage Output (+5 VDC / 10 mA)
9	DigOUT 3	Digital output 3 "General Purpose"
10	DigOUT 4	Digital output 4 "General Purpose"
11	D_Gnd	Digital signal ground
12	Power_Gnd	Power Ground
13	+Vcc (9 … 24 VDC)	Power supply voltage (+ 9 ... 24 VDC)

7.1.1 Digital input 1 “General Purpose“

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

Connector No. and Pin No.	Connector [J1] Pin number [1]
Input voltage	0 ... 24 VDC
Max. input voltage	-30 ... +30 VDC
Logic 0	< 0.7 VDC
Logic 1	> 2.4 VDC
Input resistance	typical 22 kΩ (< 3.3V) typical 11 kΩ (> 3.3V)
Input current at logic 1	typical 2 mA @ 24 VDC
Switching delay	< 300µs @ 5 VDC

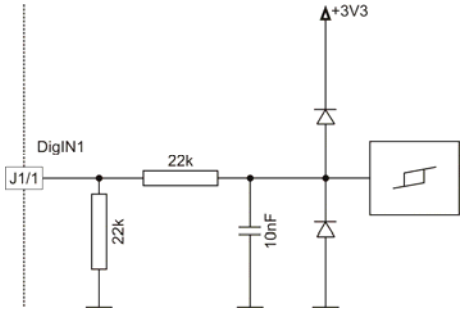


Figure 10: Digital input 1

7.1.2 Digital input 2 "General Purpose"

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

Connector No. and Pin No.	Connector [J1] Pin number [2]
Input voltage	0 ... 24 VDC
Max. input voltage	-30 ... +30 VDC
Logic 0	< 0.7 VDC
Logic 1	> 2.4 VDC
Input resistance	typical 22 kΩ (< 3.3 V) typical 11 kΩ (> 3.3 V)
Input current at logic 1	typical 2 mA @ 24 VDC
Switching delay	< 1 µs @ 5 VDC

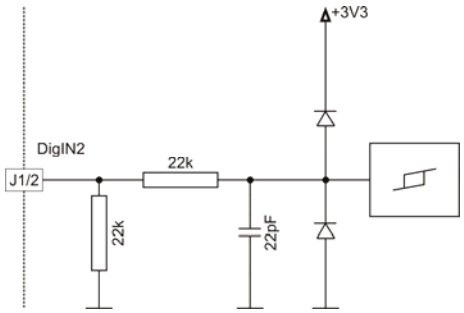


Figure 11: Digital input 2

7.1.3 Digital input 3 "General Purpose"

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

Connector No. and Pin No.	Connector [J1] Pin number [3]
Input voltage	0 ... 24 VDC
Max. input voltage	-30 ... +30 VDC
Logic 0	< 0.7 VDC
Logic 1	> 2.4 VDC
Input resistance	typical 22 kΩ (< 3.3 V) typical 11 kΩ (> 3.3 V)
Input current at logic 1	typical 2 mA @ 24 VDC
Switching delay	< 1 µs @ 5 VDC

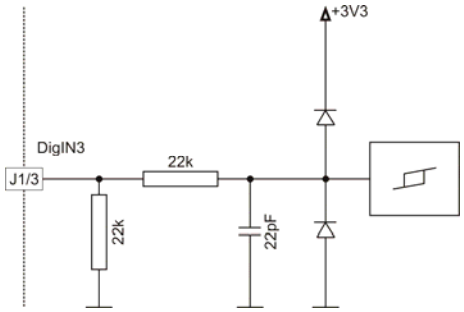


Figure 12: Digital input 3

7.1.4 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 [J1] Pin number [4]
Input voltage	0 ... 24 VDC
Max. input voltage	-30 ... +30 VDC
Logic 0	< 0.7 VDC
Logic 1	> 2.4 VDC
Input resistance	typical 22 kΩ (< 3.3 V) typical 11 kΩ (> 3.3 V)
Input current at logic 1	typical 2 mA @ 24 VDC
Switching delay	< 300 µs @ 5 VDC

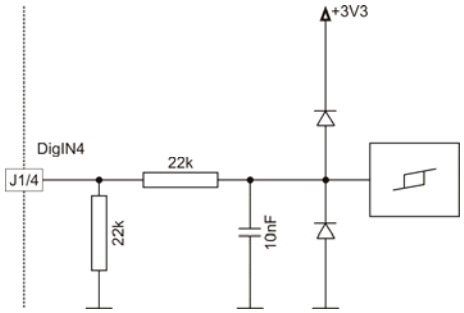


Figure 13: Digital input 4

Wiring examples:
a) Proximity switches type: **PNP**

3-wire model	R_{IN} = 11 kΩ

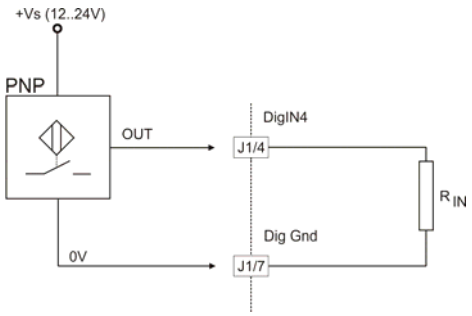


Figure 14: Digital input 4 external wiring example a)

b) Slotted optical sensor

	R_{IN} = 11 kΩ
	R_{ext} (12 V) = 20 kΩ
	R_{ext} (24 V) = 51 kΩ
Note:	Logic level thresholds

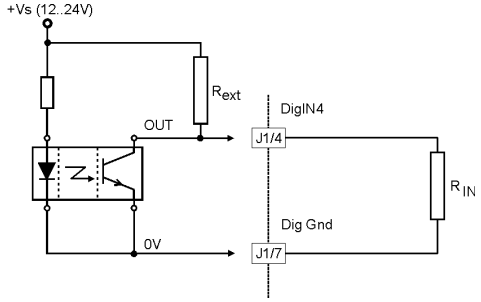


Figure 15: Digital input 4 external wiring example b)

7.1.5 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 [J1] Pin number [5]
Input voltage	0 ... 24 VDC
Max. input voltage	-30 ... +30 VDC
Logic 0	< 0.7 VDC
Logic 1	> 2.4 VDC
Input resistance	typical 22 kΩ (< 5 V) typical 11 kΩ (> 5 V)
Input current at logic 1	typical 2 mA @ 24 VDC
Switching delay	< 300 µs @ 5 VDC

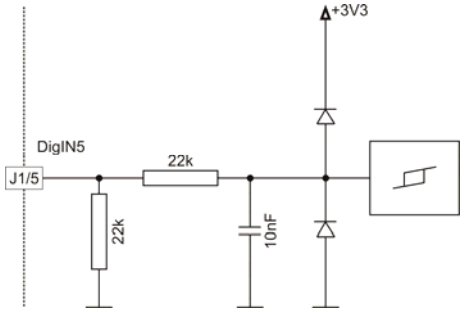


Figure 16: Digital input 5

Wiring examples:

a) Proximity switches type: **PNP**

3-wire model	R_{IN} = 11 kΩ

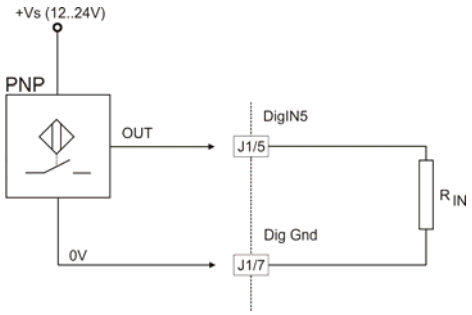


Figure 17: Digital input 5 external wiring example a)

b) Slotted optical sensor

	R_{IN} = 11 kΩ
	R_{ext} (12 V) = 20 kΩ
	R_{ext} (24 V) = 51 kΩ
Note:	Logic level thresholds

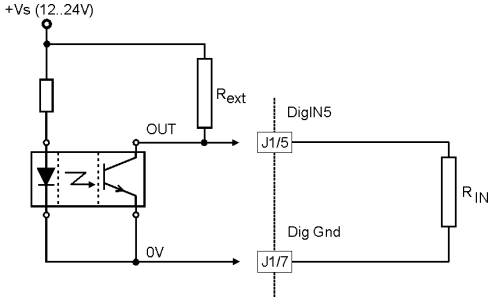


Figure 18: Digital input 5 external wiring example b)

7.1.6 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 [J1] Pin number [6]
Input voltage	0 ... 24 VDC
Max. input voltage	-30 ... +30 VDC
Logic 0	< 0.7 VDC
Logic 1	> 2.4 VDC
Input resistance	typical 22 kΩ (< 5 V) typical 11 kΩ (> 5 V)
Input current at logic 1	typical 2 mA @ 24 VDC
Switching delay	< 300 µs @ 5 VDC

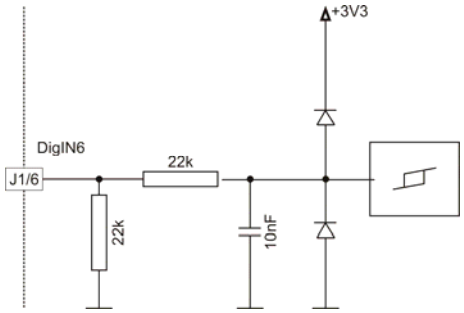


Figure 19: Digital input 6

Wiring examples:

a) Proximity switches type: **PNP**

3-wire model	R_{IN} = 11 kΩ

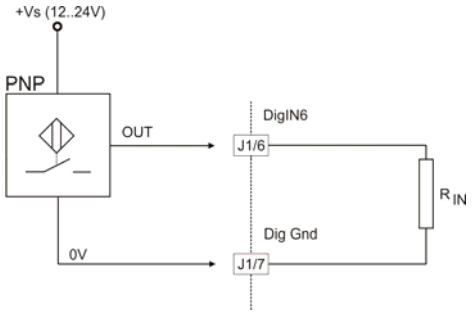


Figure 20: Digital input 6 external wiring example a)

b) Slotted optical sensor

	R_{IN} = 11 kΩ
	R_{ext} (12 V) = 20 kΩ
	R_{ext} (24 V) = 51 kΩ
Note:	Logic level thresholds

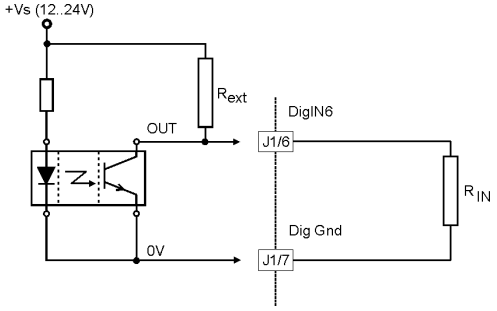


Figure 21: Digital input 6 external wiring example b)

7.1.7 Auxiliary output voltage

Auxiliary output voltage can be used as power supply for external devices (switches…) connected to EPOS 24/1 digital inputs. The auxiliary output voltage is short circuit protected.

Connector No. and Pin No.	Connector [J1] Pin number [8]
Output voltage	+5 VDC
Max. output current	10 mA

7.1.8 Digital output 3 "General Purpose"

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

Connector No. and Pin No.	Connector [J1] Pin number [9]
Circuit	Open Collector (internal pull-up resistor 2k2 and diode to +5 VDC)

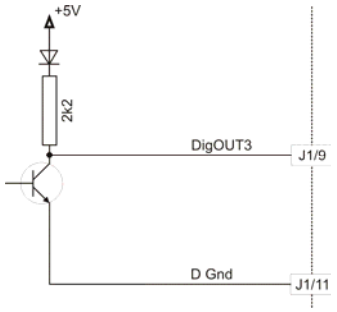


Figure 22: Digital output 3 circuit

Wiring examples:

a) DigOut3 "sink"

Max. input voltage	+30 VDC
Max. load current	50 mA
Max. voltage drop	< 1.0 V @ 50 mA

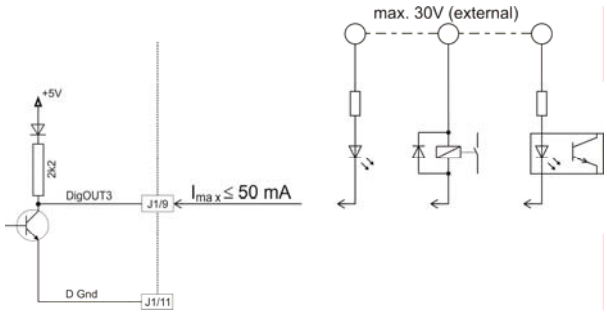


Figure 23: Digital output 3 external wiring example a)

b) DigOut3 "source"

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

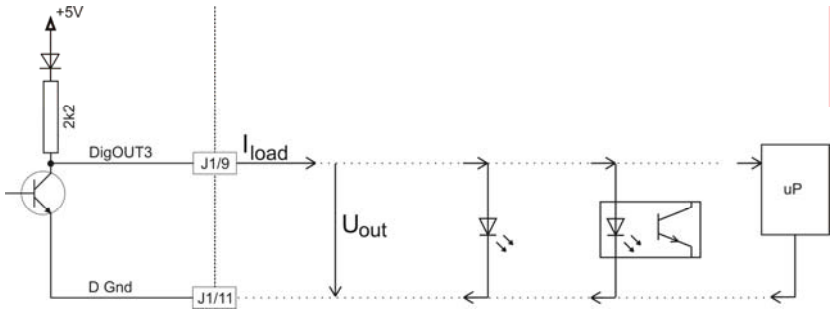


Figure 24: Digital output 3 external wiring example b)

7.1.9 Digital output 4 "General Purpose"

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

Connector No. and Pin No.	Connector [J1] Pin number [10]
Circuit	Open Collector (internal pull-up resistor 2k2 and diode to +5 VDC)

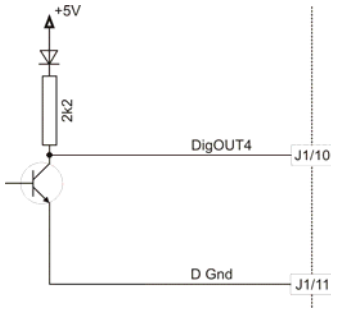


Figure 25: Digital output 4 circuit

Wiring examples:

a) DigOut4 "sink"

Max. input voltage	+30 VDC
Max. load current	50 mA
Max. voltage drop	< 1.0 V @ 50 mA

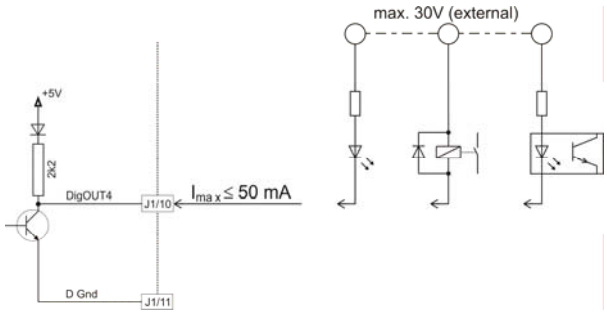


Figure 26: Digital output 4 external wiring example a)

b) DigOut4 "source"

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

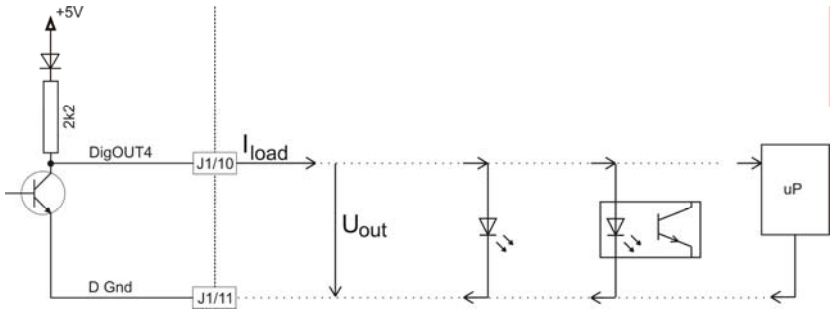


Figure 27: Digital output 4 external wiring example b)

7.1.10 Supply voltage

Connector No. and Pin No.	Connector [J1] Pin number [12,13]

Any available power supply can be used, provided that it meets the minimal requirements specified 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. 9 VDC; V_{CC} max. 24 VDC
Ripple	< 10 %
Output current	Depending on load, continuous max. 1 A acceleration, short-time max. 2 A

The required voltage can be calculated as follows:
Known values:
- Operating torque MB [mNm]
- Operating speed nB [min-1]
- Nominal motor voltage UN [Volt]
- Motor no-load speed at UN, n0 [min-1]
- Speed/torque gradient of the motor $\Delta n/\Delta M$ [min-1 mNm-1]

Sought value:
- Supply voltage VCC [Volt]

Solution:

$$V_{CC} = \frac{U_N}{n_0} \cdot (n_B + \frac{\Delta n}{\Delta M} \cdot M_B) \cdot \frac{1}{0.98} + 1[V]$$

Choose a power supply capable of supplying this calculated voltage under load. The formula takes a max. PWM cycle of 98 % and a 1 Volt maximum voltage drop at EPOS 24/1 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.

7.2 Connector (J2)

Connector J2 contains CAN bus and RS232 communication signals. Additional multi-purpose analogue inputs are provided.

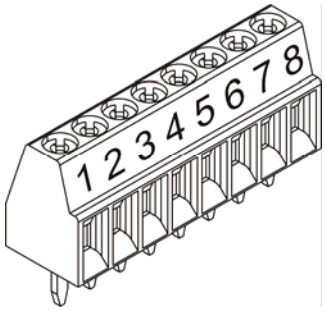


Figure 28: Connector (J2)

Pin No.	Signal	Description
1	CAN high	CAN high bus line
2	CAN low	CAN low bus line
3	RS232 RxD	RS232 receive line
4	RS232 TxD	RS232 transmit line
5	GND	Ground
6	AnIN 1	Analogue Input 1
7	AnIN 2	Analogue Input 2
8	A_Gnd	Analogue Ground

7.2.1 CAN communication

CAN high	Connector [J2] Pin number [1]
CAN low	Connector [J2] Pin number [2]
GND	Connector [J2] Pin number [5]

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 24/1	**CAN D-Sub (9 poles) (DIN41652)**
Connector J2 pin 1 “CAN high”	Pin 7 “CAN_H” high bus line
Connector J2 pin 2 “CAN low”	Pin 2 “CAN_L” low bus line
Connector J2 pin 5 “GND”	Pin 3 “CAN_GND” Ground

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

7.2.2 RS-232 communication

RS232 RxD	Connector [J2] Pin number [3]
RS232 TxD	Connector [J2] Pin number [4]
GND	Connector [J2] Pin number [5]

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

Notes:
- Please consider your PC’s serial port maximal baud rate.
- The standard baud rate setting (factory setting) is 38’400 bauds.
- Further RS232 information can be found in the “Communication Guide” documentation.

Connection EPOS - PC

Positioning Controller EPOS 24/1	**PC Interface (RS232), D-Sub (9 poles) DIN41652**
Connector J2 pin 3 “EPOS RxD”	Pin 3 “PC TxD”
Connector J2 pin 4 “EPOS TxD”	Pin 2 “PC RxD”
Connector J2 pin 5 “GND”	Pin 5 “GND”

7.2.3 Analogue input 1 "General Purpose"

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

Connector No. and Pin No.	Connector [J2] Pin number [6]
Input voltage range	0 ... 5 VDC
Max. input voltage	-30 ... +30 VDC
Input resistance	typical 36k against A_Gnd [8]
A/D converter	10-bit
Resolution	0.005 V

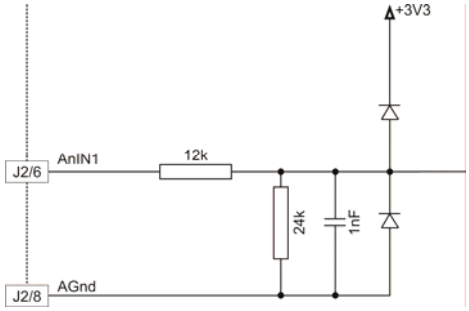


Figure 29: Analogue input 1 circuit

7.2.4 Analogue input 2 "General Purpose"

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

Connector No. and Pin No.	Connector [J2] Pin number [7]
Input voltage range	0 ... 5 VDC
Max. input voltage	-30 ... +30 VDC
Input resistance	typical 36k against A_Gnd [8]
A/D converter	10-bit
Resolution	0.005 V

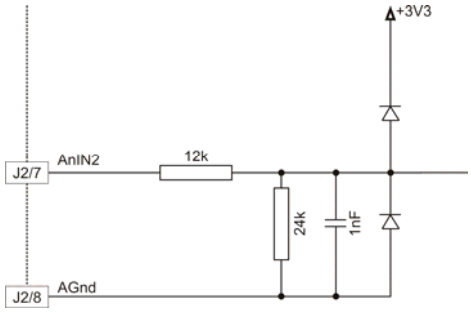


Figure 30: Analogue input 2 circuit

7.3 Motor / Encoder / Hall sensor connectors

7.3.1 maxon DC motor with integrated motor / encoder ribbon cable (J3)

Connect the maxon DC motor on Motor / Encoder connector (J3).

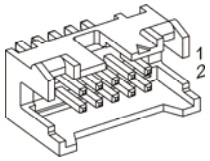


Figure 31: Motor / Encoder connector (J3)

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

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

Motor / Encoder pin-out suits to:
- maxon digital MR-Encoder type S with line driver
- maxon digital MR-Encoder type M with line driver

It is recommended to use encoders with built-in 3-channel line driver. The standard encoder adjustment (factory setting) refers to 500-counts per turn encoder. For other encoders the adjustment can be modified by 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

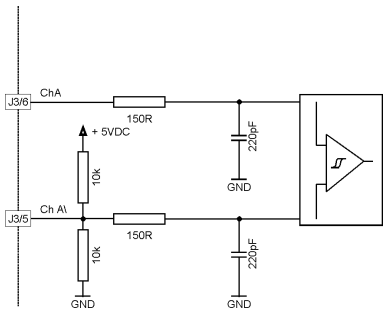


Figure 32: Encoder input circuit

7.3.2 maxon EC 6 motor with Hall sensor and digital MR-Encoder

Connect the maxon motor control cable order number 281074 to Motor / Hall sensor / Encoder connector (J4).

Note: The maxon motor control cable order number 281074 is included in delivery of article 317270.

Cable 281074

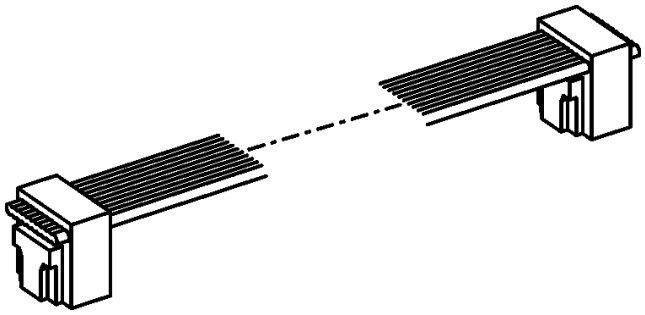


Figure 33: maxon motor control cable 281074

Motor / Hall sensor / Encoder connector (J4/J5)

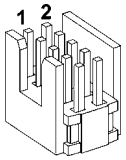


Figure 34: Motor / Hall sensor / Encoder connector (J4/J5)

Pin No.	Signal	Description
1	Motor winding 1	EC 6 motor winding 1
2	Motor winding 2	EC 6 motor winding 2
3	Motor winding 3	EC 6 motor winding 3
4	GND	Ground
5	Hall sensor 1	Hall sensor 1 Input
6	Hall sensor 2	Hall sensor 2 Input
7	Hall sensor 3	Hall sensor 3 Input
8	+5 VDC / 130 mA	Supply voltage +5 VDC / 130 mA
9	Channel A	Encoder Channel A
10	Channel B	Encoder Channel B

7.3.2.1 maxon motor control Adapter 317228 (included in delivery of article 317270)

Connect the maxon motor control cable order number 281074 to Motor / Hall sensor / Encoder connector (J5).

Adapter 317228

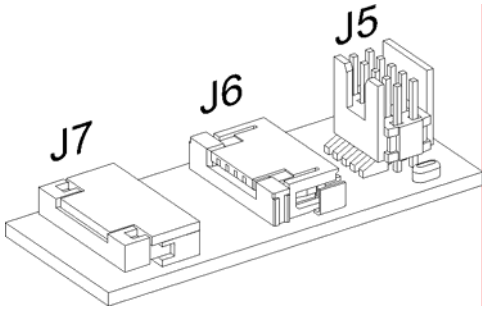


Figure 35: maxon motor control Adapter 317228

Connect the maxon MR-Encoder cable to connector (J6).

MR-Encoder (J6)

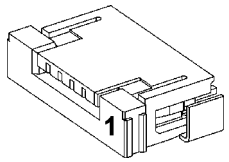


Figure 36: MR-Encoder connector (J6)

Pin No.	Signal	Description
1	+ 5 VDC / 100 mA	Encoder supply voltage +5 VDC / 100 mA
2	GND	Ground
3	Channel A	Encoder Channel A
4	Channel B	Encoder Channel B

Note: MR-Encoder connector (J6) FPC, top contact style

The Encoder interface fits to maxon EC 6 MR-Encoder.
This MR-Encoder is a 2-channel 100-count per turn type with maximum Encoder frequency of 100 kHz.

Encoder supply voltage	+5 VDC
Max. encoder supply current	100 mA
Low Level	Max. 1.5 V
High Level	Min. 3.0 V

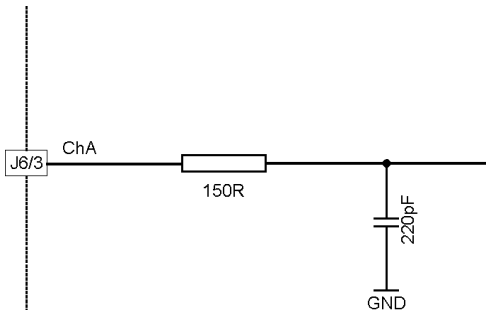


Figure 37: Encoder input circuit

Motor / Hall sensor (J7)

Connect the maxon Motor / Hall sensor cable to connector (J7).

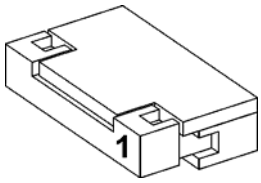


Figure 38: Motor / Hall sensor connector (J7)

Pin No.	Signal	Description
1	Motor winding 3	EC 6 motor winding 3
2	Motor winding 2	EC 6 motor winding 2
3	Hall sensor 3	Hall sensor 3 Input
4	+ 5 VDC / 30 mA	Hall sensor supply voltage +5 VDC / 30 mA
5	GND	Ground
6	Hall sensor 1	Hall sensor 1 Input
7	Hall sensor 2	Hall sensor 2 Input
8	Motor winding 1	EC 6 motor winding 1

Note: Motor / Hall sensor connector (J7) FPC, top contact style

The Hall sensors are needed for detecting the rotor position of maxon EC 6 motor.

Hall sensor supply voltage	+5 VDC
Max. Hall sensor supply current	30 mA
Max. input voltage	0…+10 VDC
Logic 0	typical < 0.8 VDC
Logic 1	typical > 2.4 VDC
Internal pull-up resistor	6.8 kΩ (against +5 VDC)

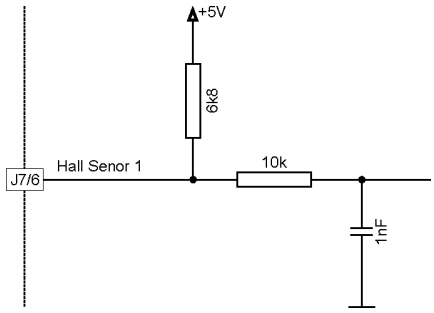


Figure 39: Hall sensor input circuit

7.3.3 maxon EC 16/EC 22 motor with Hall sensor and digital MR-Encoder

Connect the maxon EC 16/EC 22 motor on Motor / Hall sensor connector (J8).

Motor / Hall sensor connector (J8)

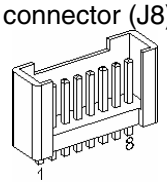


Figure 40: Motor / Hall sensor connector (J8)

Pin No.	Signal	Description
1	Motor winding 1	EC 16/22 motor winding 1
2	Motor winding 2	EC 16/22 motor winding 2
3	Motor winding 3	EC 16/22 motor winding 3
4	$+V_{Hall}$	Hall sensor supply voltage +5 VDC / 30 mA
5	GND	Ground of Hall sensor supply
6	Hall sensor 1	Hall sensor 1 Input
7	Hall sensor 2	Hall sensor 2 Input
8	Hall sensor 3	Hall sensor 3 Input

Notes: Suitable connector: MKF 13268-6-0-808
STOCKO Elektronik GmbH

7.3.3.1 Encoder connector (J9)

Encoder connector (J9)

Connect the Encoder on Encoder connector (J9).

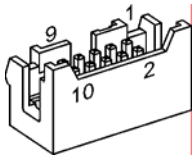


Figure 41: Encoder connector (J9)

Pin No.	Signal	Description
1	n.c.	Not connected
2	+5 VDC / 100 mA	Encoder supply voltage
3	GND	Ground
4	n.c.	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	Channel I\	Index complement
10	Channel I	Index

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

Motor / Encoder pin-out suits to:
- maxon digital MR-Encoder type M with line driver for EC motors
- maxon digital MR-Encoder type ML, L all with Line Driver
- maxon digital encoder HEDL 55_ with Line Driver RS422

It is recommended to use encoders with built-in 3-channel line driver. The standard encoder adjustment (factory setting) refers to 500-counts per turn encoder. For other encoders the adjustment can be modified by 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

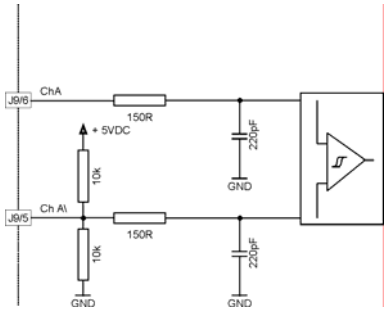


Figure 42: Encoder input circuit

8 Connections 302287

EPOS 24/1 for maxon DC/EC motors #302287

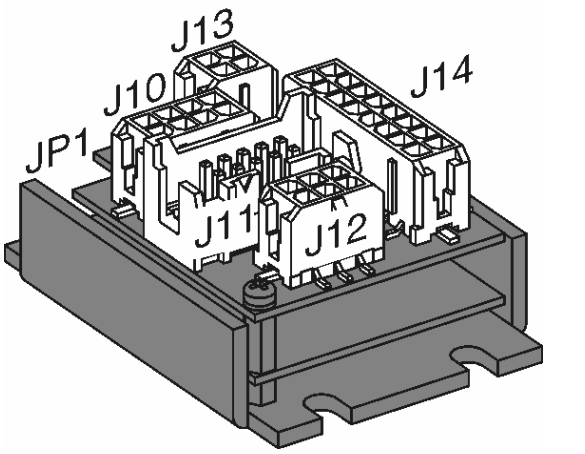


Figure 43: EPOS 24/1 for maxon DC/EC motors connector description

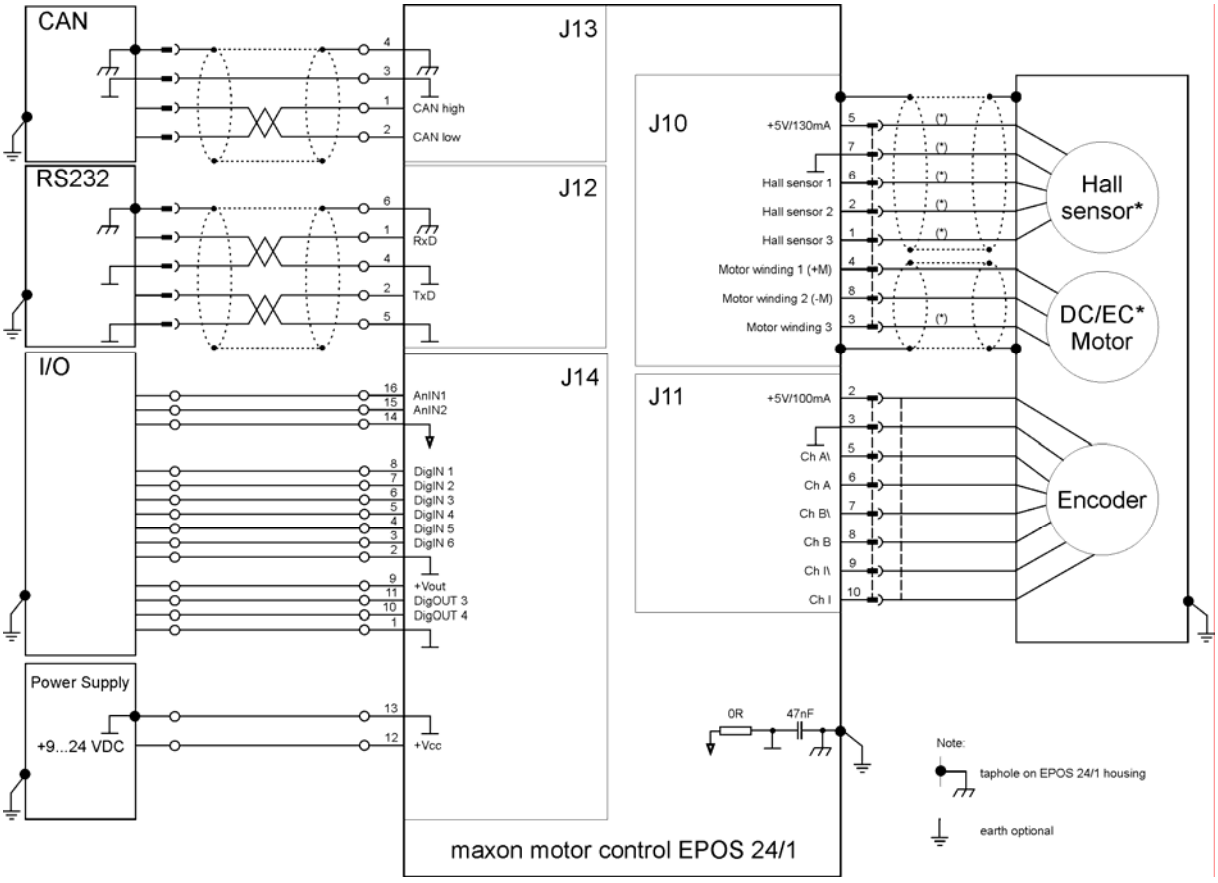


Figure 44: Wiring diagram for maxon DC/EC motors (overview)

8.1 Motor / Hall sensor connector (J10)

Connect the maxon DC motor (brush) or maxon EC motor (brushless) on Motor / Hall sensor connector (J10).

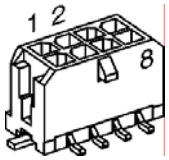


Figure 45: Motor / Hall sensor connector (J10)

DC motor

Pin No.	Signal	Description
1	n.c.	not connected
2	n.c	not connected
3	n.c	not connected
4	**M+**	**+ Motor terminal**
5	n.c	not connected
6	n.c	not connected
7	n.c	not connected
8	**M-**	**- Motor terminal**

Accessories: EPOS 24/1 DC Motor cable — maxon order number: 303490

Notes: Suitable connector: Molex Micro-Fit 3.0™ 8 poles (430-25-0800)

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

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

EC motor

Pin No.	Signal	Description
1	Hall sensor 3	Hall sensor 3 input
2	Hall sensor 2	Hall sensor 2 input
3	Motor winding 3	Winding 3
4	Motor winding 1	Winding 1
5	$+V_{Hall}$	Hall sensor supply voltage +5VDC / 30 mA
6	Hall sensor 1	Hall sensor 1 input
7	GND	Ground of Hall sensor supply
8	Motor winding 2	Winding 2

Accessories: EPOS 24/1 Motor / Hall sensor cable — maxon order number: 302948

Notes: Suitable connector: Molex Micro-Fit 3.0™ 8 poles (430-25-0800)

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

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

8.2 Motor / Encoder connector (J11)

Connect the Encoder cable
or the Encoder cable with integrated motor lines on Encoder connector (J11).

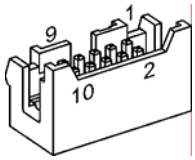


Figure 46: Encoder connector (J11)

8.2.1 maxon EC motor or maxon DC motor with separated motor and encoder cable

This is the standard adjustment (factory setting).

Pin No.	Signal	Description
1	n.c.	Not connected
2	+5 VDC / 100 mA	Encoder supply voltage
3	GND	Ground
4	n.c.	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	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

Motor / Encoder pin-out suits to:
- maxon digital MR-Encoder type M with line driver for EC motors
- maxon digital MR-Encoder type ML, L all with Line Driver
- maxon digital encoder HEDL 55__ with Line Driver RS422

It is recommended to use encoders with built-in 3-channel line driver. The standard encoder adjustment (factory setting) refers to 500-counts per turn encoder. For other encoders the adjustment can be modified by 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

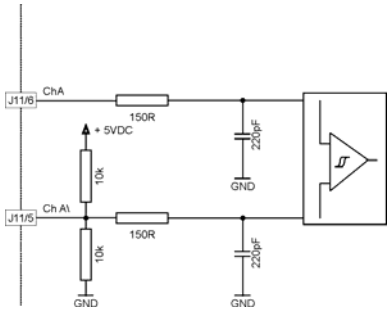


Figure 47: Encoder input circuit

8.2.2 maxon DC motor with integrated motor / encoder ribbon cable

To use the EPOS 24/1 #302287 with small DC motors with integrated motor / encoder ribbon cable, two simple modifications have to be done:

- The two marked solder pads have to be short circuited each.

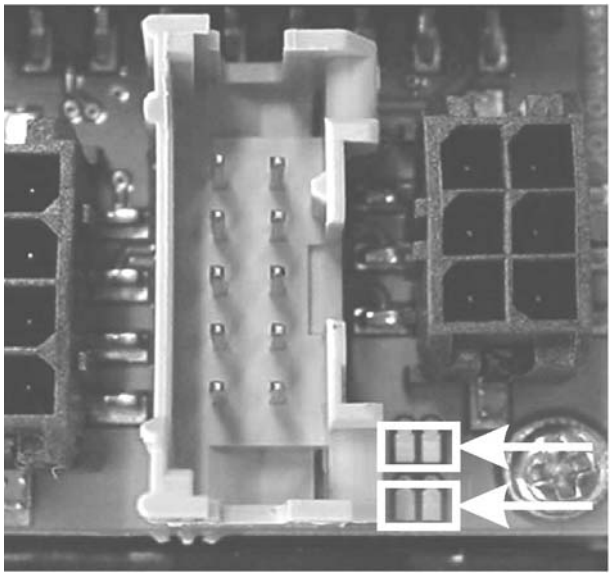


Figure 48: Location of solder pads

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: The flat ribbon cable can now connected directly to the connector J11. In this case the connector J10 (DC motor) will not be used

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

Motor / Encoder pin-out suits to:
- maxon digital MR-Encoder type S with line driver
- maxon digital MR-Encoder type M with line driver

8.3 RS232 connector (J12)

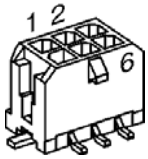


Figure 49: RS232 connector (J12)

Pin No.	Signal	Description
1	RS232 RxD	EPOS RS232 receive
2	RS232 TxD	EPOS RS232 transmit
3	n.c.	Not connected
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)

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

Notes:

- Please consider your PC's serial port maximal baud rate.
- The standard baud rate setting (factory setting) is 38'400 bauds.
- Further RS232 information can be found in the "Communication Guide" documentation.

Connection EPOS - PC

Positioning Controller EPOS 24/1	PC Interface (RS232), D-Sub (9 poles) DIN41652
Connector J12 pin 1 "EPOS RxD"	Pin 3 "PC TxD"
Connector J12 pin 2 "EPOS TxD"	Pin 2 "PC RxD"
Connector J12 pin 4+5 "GND"	Pin 5 "GND"

8.4 CAN connector (J13)

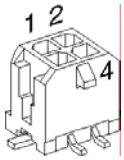


Figure 50: CAN connector (J13)

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 24/1 CAN Y-Cable	maxon order number: 319471
	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)

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 24/1	CAN D-Sub (9 poles) (DIN41652)
Connector J13 pin 1 “CAN high”	Pin 7 “CAN_H” high bus line
Connector J13 pin 2 “CAN low”	Pin 2 “CAN_L” low bus line
Connector J13 pin 3 “GND”	Pin 3 “CAN_GND” Ground
Connector J13 pin 4 “CAN shield”	Pin 3 “CAN_Shield” Cable shield

Notes:

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

8.5 Power / Signal connector (J14)

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

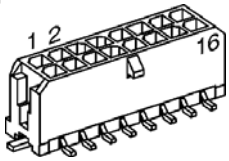


Figure 51: Power / Signal connector (J14)

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	$+V_{OUT}$	Auxiliary supply voltage Output (+5 VDC / 10 mA)
10	DigOUT 4	Digital output 4 "General Purpose"
11	DigOUT 3	Digital output 3 "General Purpose"
12	**+Vcc (9…24 VDC)**	**Power supply voltage (+9…+24 VDC)**
13	**Power_Gnd**	**Power Ground**
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)

Detailed electrical data and input circuit refer to:

Digital input 1 “General Purpose“
Digital input 2 "General Purpose"
Digital input 3 "General Purpose"
Digital input 4 "Home Switch"
Digital input 5 "Positive Limit Switch"
Digital input 6 "Negative Limit Switch"
Auxiliary output voltage
Digital output 3 "General Purpose"
Digital output 4 "General Purpose"
Supply voltage
Analogue input 1 "General Purpose"
Analogue input 2 "General Purpose"

9 CAN Node Identification (JP 1)

The CAN-ID (node address) is set at DIP-Switch 1 ... 4.
All addresses can be coded from 1 ... 15 using the binary code.

Switch	Binary code	Value
1	2^0	1
2	2^1	2
3	2^2	4
4	2^3	8

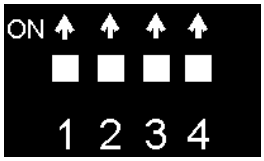
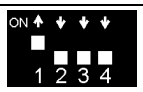
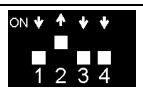
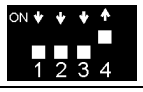
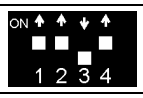
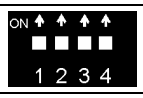


Figure 52: Table binary code value

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	
	Valence	1	2	4	8	
CAN-ID	**Switch setting**					**Calculation**
1		**1**	**0**	**0**	**0**	**1**
2		**0**	**1**	**0**	**0**	**2**
8		**0**	**0**	**0**	**1**	**8**
11		**1**	**1**	**0**	**1**	**1 + 2 + 8**
15		**1**	**1**	**1**	**1**	**1 + 2 + 4 + 8**

Note:
- The Node ID set by software is valid, if DIP-Switch is set to value 0.

10 LED status

The green LED shows the operating status and the red LED indicates an error of the positioning controller EPOS 24/1. 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)

11 Dimension drawings

Dimensions in [mm]

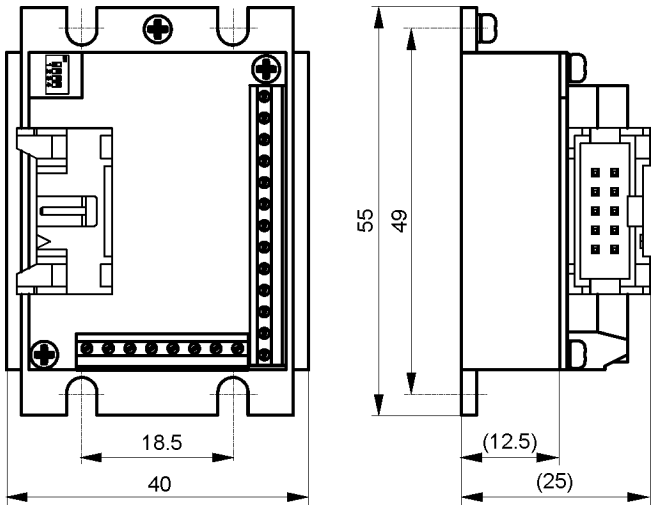


Figure 53: Dimensions EPOS 24/1 for DC motors 280937

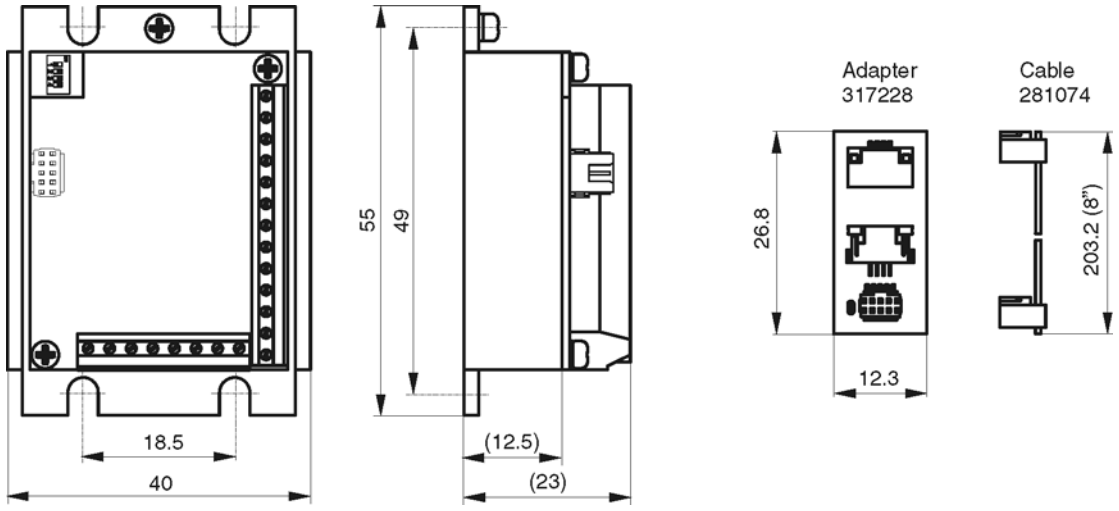


Figure 54: Dimensions EPOS 24/1 for EC 6 motor 317270

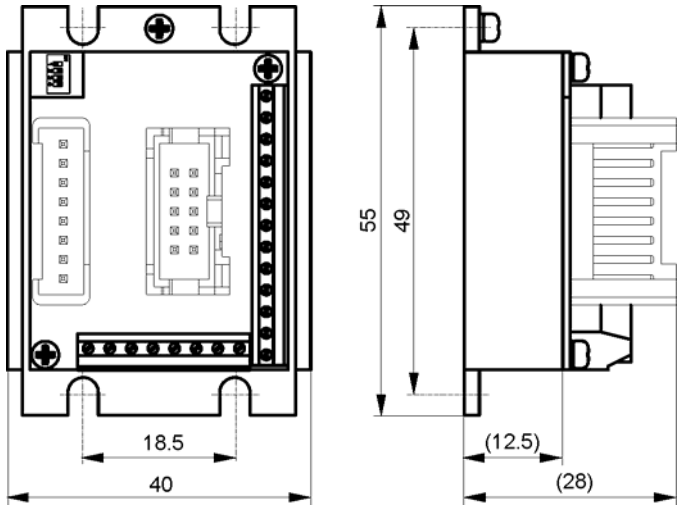


Figure 55: Dimensions EPOS 24/1 for EC 16/EC 22 motors 302267

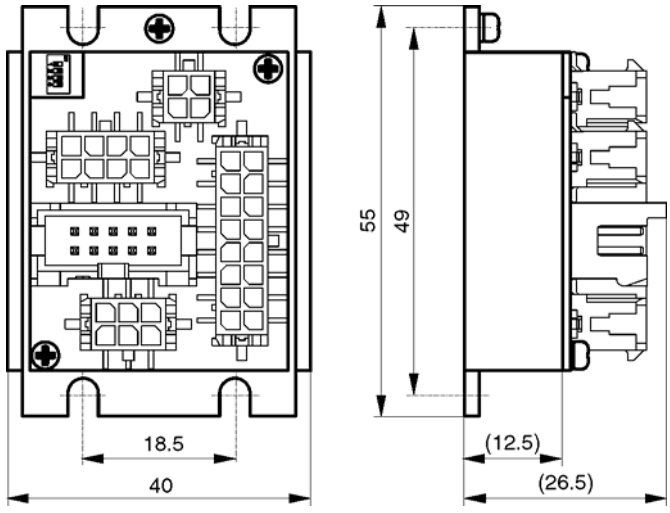


Figure 56: Dimensions EPOS 24/1 for DC/EC motors 302287