

Evaluation Board

ESCON2 EB Nano

with ESCON2 Nano 24/2

Hardware Reference

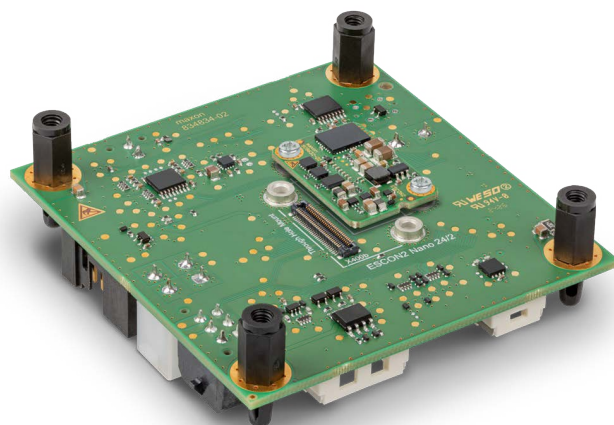
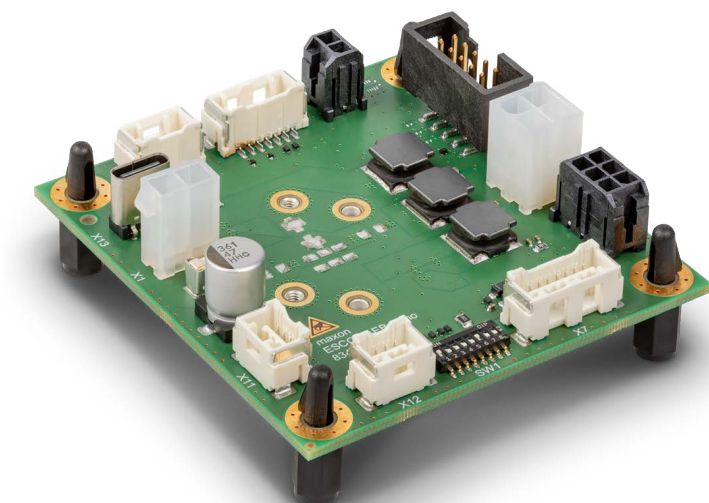


TABLE OF CONTENTS

1	ABOUT	5
1.1	About this document	5
1.2	About the devices	7
1.3	About the safety precautions	8
2	SPECIFICATIONS	9
2.1	Technical data	9
2.2	Thermal data	10
2.2.1	Test setup for data collection	10
2.2.2	Derating of output current (operation without additional heat sink).	11
2.2.3	Operation with additional heatsink	12
2.2.4	Thermal accessories	12
2.2.5	Power dissipation and efficiency	13
2.3	Limitations	14
2.4	Dimensional drawing	14
2.5	Standards	15
3	SETUP	17
3.1	Generally applicable rules	17
3.2	Connections	18
3.2.1	Cabling	18
3.3	Connection specifications	20
3.3.1	Power supply (X1).	20
3.3.2	Motor (X3).	22
3.3.3	Sensor 1 Hall sensor (X4).	23
3.3.4	Sensor 2 Encoder / I/Os (X5)	24
3.3.5	Digital I/Os (X7).	32
3.3.6	Analog I/Os (X8)	36
3.3.7	RS232 (X10).	39

READ THIS FIRST

These instructions are for qualified technical personnel only. Before you start any work:

- Read this manual carefully.
- Make sure that you understand this manual.
- Follow all instructions in this manual.

The product is partly completed machinery according to EU Directive 2006/42/EC, Article 2, Clause (g). You must incorporate it into or assemble it with other machinery or other partly completed machinery or equipment.

You must not put the device into service unless all these conditions are met:

- The complete machinery complies with all applicable requirements of EU Directive 2006/42/EC.
- The complete machinery fulfills all applicable health and safety requirements.
- All interfaces are implemented and comply with the requirements given in this manual.

3.3.8	CAN 1 (X11) & CAN 2 (X12)	40
3.3.9	USB (X13)	41
3.3.10	Motor temperature sensor (X16) (future release)	42
3.4	DIP switch configuration (SW1).	44
3.4.1	CAN ID (Node-ID)	44
3.4.2	CAN automatic bit rate detection	46
3.4.3	CAN bus termination	46
3.5	Status indicators	47
4	WIRING	49
4.1	Possible combinations to connect a motor	49
4.2	Main wiring diagram	51
4.3	Excerpts	52
4.3.1	Power supply	52
4.3.2	DC motor	52
4.3.3	EC (BLDC) motor	52
4.3.4	Sensor 1 Hall sensor	52
4.3.5	Sensor 2 Encoder / I/Os	53
4.3.6	Digital I/Os	54
4.3.7	Analog I/Os	54
4.3.8	RS232	55
4.3.9	CAN	55
4.3.10	USB	56
4.3.11	Motor temperature sensor (future release)	56
	LIST OF FIGURES	57
	LIST OF TABLES	59
	INDEX	61

••page intentionally left blank••

1 ABOUT

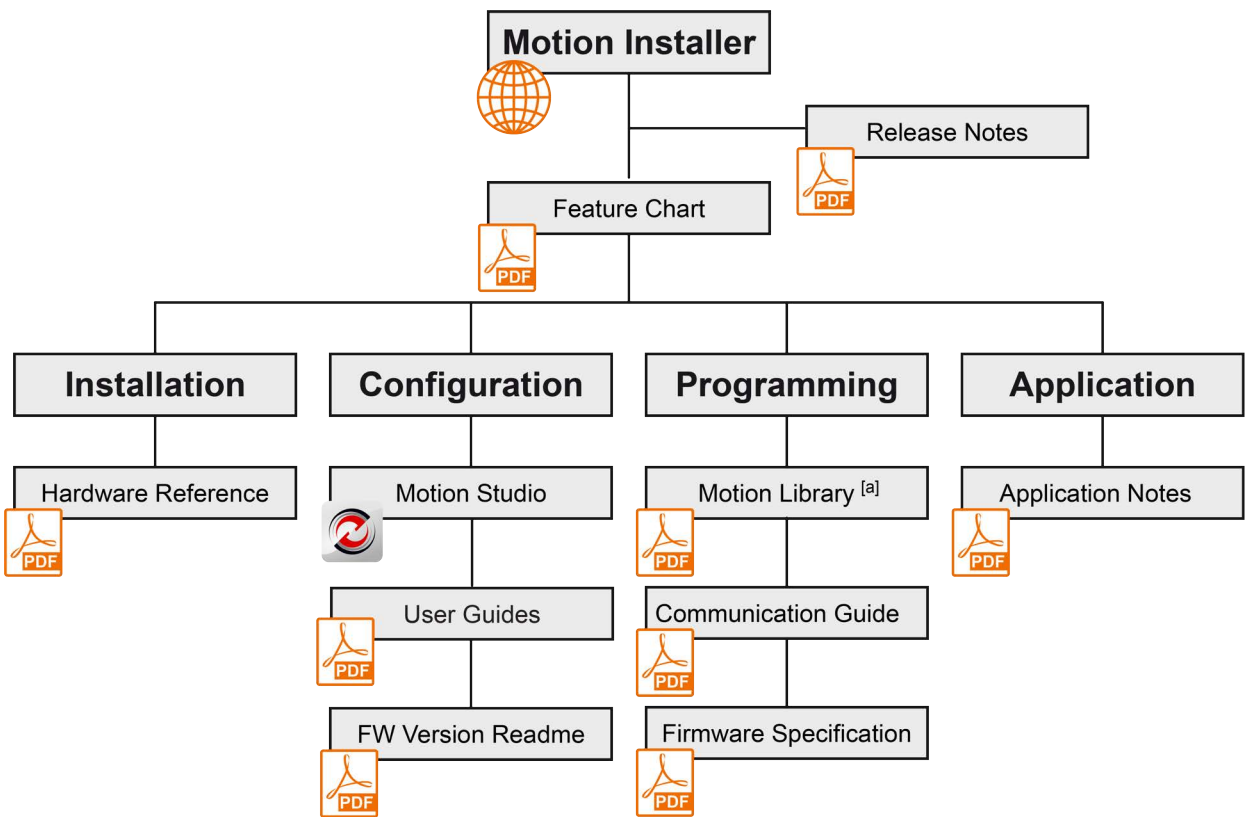
1.1 About this document

1.1.1 Intended purpose

This document familiarizes you with the ESCON2 EB Nano Evaluation Board, with the ESCON2 Nano 24/2 Servo Controller installed on it. It describes the tasks for safe and proper installation and commissioning. The controller is not included with the evaluation board and must be ordered separately. Follow the instructions:

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

This document is part of a documentation set. It includes performance data, specifications, standards information, connection details, pin assignments, and wiring examples. The overview below shows the documentation hierarchy and how its parts are related:



[a] including software programming examples

Figure 1-1 Documentation structure

Find the latest edition of this document, along with additional documentation and software for ESCON2 Evaluation Board, at: <http://escon.maxongroup.com>

1.1.2 Target audience

This document is intended for trained and skilled personnel. It provides information on how to understand and perform the respective tasks and duties.

1.1.3 How to use

Follow these notations and codes throughout the document.

Notation	Meaning
ESCON2	stands for «ESCON2 Servo Controller»
«Abcd»	indicating a title or a name (such as of document, product, mode, etc.)
(n)	refers to an item (such as a part number, list items, etc.)
*	refers to an internal value
➔	denotes “check”, “see”, “see also”, “take note of” or “go to”

Table 1-1 Notations used in this document

1.1.4 Symbols & signs

This document uses the following symbols and signs:

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

Table 1-2 Symbols and signs

1.1.5 Trademarks and brand names

All trademarks, brand names or other signs mentioned in this manual remain the property of their respective owners. They are protected by trademark, copyright, and/or other applicable laws. For easier reading, no symbols such as ® or ™ are being used with respect to the trademarks or brand names mentioned herein.

Nothing in this manual shall be construed as granting any rights with respect to the mentioned trademarks, brand names or other signs, including without limitation neither the right to use the mentioned trademarks, brand names or other signs without permission of the respective owners.

The trademarks, brand names or other signs are mentioned in this manual solely for information or identification purposes.

1.1.6 Copyright

© 2026 maxon. All rights reserved. Any use, in particular reproduction, editing, translation, and copying, without prior written approval is not permitted (contact: maxon international ltd., Brünigstrasse 220, CH-6072 Sachseln, +41 41 666 15 00, www.maxongroup.com). Infringements will be prosecuted under civil and criminal law. The mentioned trademarks belong to their respective owners and are protected under trademark laws. Subject to change without prior notice.

CCMC | ESCON2 EB Nano with ESCON2 Nano 24/2 Hardware Reference | Edition 2026-01 | DocID rel12878

1.1.7 Sources for additional information

For further details and additional information, please refer to the resources listed below:

Ref. no.	Reference
[1]	maxon: ESCON2 Communication Guide http://escon.maxongroup.com
[2]	maxon: ESCON2 Firmware Specification http://escon.maxongroup.com

Table 1-3 Sources for additional information

1.2 About the devices

The ESCON2 EB Nano Evaluation Board is for commissioning and evaluating the ESCON2 Nano 24/2 Servo Controller. It has industrial connectors compatible with maxon prefab cables. The controller is not included with the evaluation board and must be ordered separately.

The ESCON2 Nano 24/2 (P/N 809635) is a small, powerful 4-quadrant PWM Servo Controller. Its high power density allows flexible use for brushed DC motors and brushless EC (BLDC) motors up to 48 Watts. It supports various feedback options, such as Hall sensors, incremental encoders, and absolute sensors for many drive applications.

The device is designed to be controlled by analog and digital set values, or as a slave node in a CANopen network. You can also operate it via any USB or RS232 communication port of a Windows workstation. It has extensive analog and digital I/O functions.

Latest technology, such as field-oriented control (FOC), acceleration and velocity feed forward, in combination with highest control cycle rates allow sophisticated, ease-of-use motion control.

You can find the latest edition of this document on the Internet: → <http://escon.maxongroup.com>. This website also gives you access to related documents and software for ESCON2 servo controllers.



In addition, you can watch video tutorials in the ESCON video library. These tutorials show how to start with «Motion Studio». They also show how to set up communication interfaces, configure the controller, and give helpful tips, etc. Explore the video library on Vimeo: → <https://vimeo.com/album/4646396>

1.3 About the safety precautions

- Read and understand the note → «READ THIS FIRST»!
- Do not start any work unless you have the required skills → Chapter “1.1.2 Target audience” on page 1-5!
- Refer to → Chapter “1.1.4 Symbols & signs” on page 1-6 to understand the subsequently used indicators!
- Follow all applicable health, safety, accident prevention, and environmental protection regulations for your country and work site.



DANGER

High voltage and/or electrical shock

Touching live wires can cause death or serious injuries.

- *Treat all power cables as live unless proven otherwise.*
- *Ensure neither end of the cable is connected to live power.*
- *Ensure the power source cannot be turned on while you work.*
- *Follow lock-out/tag-out procedures.*



Requirements

- *Install all devices and components according to local regulations.*
- *Electronic devices are not fail-safe. Install separate monitoring and safety equipment for each machine. If the machine has a failure, the drive system must go into a safe state and stay in this state. Possible failures include incorrect operation, failure of the control unit, failure of the cables, or other faults.*
- *Do not repair any components that maxon supplies.*



Electrostatic sensitive device (ESD)

- *Observe precautions for handling Electrostatic sensitive devices.*
- *Handle the device with care.*

2 SPECIFICATIONS

2.1 Technical data

ESCON2 EB Nano (P/N 834838) with ESCON2 Nano 24/2 (P/N 809635)		
Electrical data	Nominal power supply voltage V_{CC}	5...24 VDC 6...24 VDC (with use of sensor supply voltage output)
	Nominal logic supply voltage V_C	—
	Absolute supply voltage V_{min} / V_{max}	4.75 VDC / 28 VDC 5.8 VDC / 28 VDC (with use of sensor supply voltage output)
	Output voltage (max.)	$0.90 \times V_{CC}$
	Output current $I_{cont} / I_{max} (< 6.5 \text{ s})$	2 A / 6 A (current measurement resolution: 5.37 mA)
	Pulse Width Modulation (PWM) frequency	50 kHz
	Sampling rate PI current controller	50 kHz
	Sampling rate PI speed controller	10 kHz
	Sampling rate analog input	50 kHz
	Max. efficiency	92 % → Figure 2-5
	Max. speed DC motor	Is limited by the max. permissible motor speed and the max. output voltage of the controller.
	Max. speed EC motor	120,000 rpm (FOC, 1 pole pair). Can be limited by the max. permissible motor speed and the max. output voltage of the controller.
	Built-in motor choke per phase	33 μH / 2.3 A
Inputs & outputs	Sensor 1 Digital Hall sensor H1, H2, H3	0...24 VDC (internal pull-up)
	Sensor 2 (choice between multiple functions): • Digital incremental encoder • SSI absolute encoder • BiSS C unidirectional absolute encoder • High-speed digital inputs 1...2 • High-speed digital inputs 3...4 • High-speed digital output 1	2-channel, EIA/RS422, max. 6.67 MHz 0.4...2 MHz (single-ended, configurable) 0.4...4 MHz (single-ended, configurable) EIA/RS422, max. 6.67 MHz Logic: 0...12 VDC, max. 6.25 MHz 3.3 VDC / $I_L \leq 24 \text{ mA}$ / $R_i = 75 \Omega$
	Digital Inputs 1...4	Logic: 0...25 VDC, inputs 1...2 PWM capable
	Digital Outputs 1...2	max. 36 VDC / $I_L \leq 500 \text{ mA}$ (open drain with internal pull-up)
	Analog Inputs 1...2	Resolution 12-bit, 0...5 VDC (referenced to GND), 10 kHz
	Analog Outputs 1...2	Resolution 12-bit, 0...3.3 VDC (referenced to GND), 25 kHz
	Motor temperature sensor [a]	Resolution 12-bit, 0...3.3 VDC (internal pull-up)
Voltage outputs	Sensor supply voltage V_{Sensor}	5 VDC / $I_L \leq 145 \text{ mA}$
	Peripheral supply voltage $V_{Peripheral}$	—

Continued on next page.

ESCON2 EB Nano (P/N 834838) with ESCON2 Nano 24/2 (P/N 809635)			
Motor connections	DC motor		+ Motor, – Motor
	EC motor		Motor winding 1, Motor winding 2, Motor winding 3
Communication interfaces	CAN		Max. 1 Mbit/s
	RS232		Max. 115'200 bit/s
	USB		12 Mbit/s (Full Speed)
Status indicators	Device status		Operation (green) Warning/Error (red)
Mechanical data	Dimensions (L × W × H)		70 × 67 × 24.4 mm
	Weight (approx.)	Evaluation Board	35 g
		with Controller	38 g
	Mounting		mounting holes ø4 mm with mounted spacers
Environmental conditions	Temperature	Operation	–40...+45 °C
		Extended range [b]	+45...+70 °C Derating: approx. –0.077 A/°C → Figure 2-2 with additional heatsink: → Figure 2-3
		Storage	–40...+85 °C
	Altitude [c]	Operation	0...500 m MSL
		Extended range [b]	500...10'000 m MSL Derating → Figure 2-2
	Humidity		5...90 % (condensation not permitted)

[a] The functionality will be available with a future firmware release.

[b] Operation within the extended range is permitted. However, a respective derating (declination of output current I_{cont}) as to the stated values will apply.

[c] Operating altitude in meters above Mean Sea Level, MSL.

Table 2-4 Technical data

2.2 Thermal data



Mandatory operation within the specified limits

- Operation within the specified thermal limits is mandatory.
- If the ambient temperature exceeds the specified limits, thermal overload can occur even at low output currents.

2.2.1 Test setup for data collection

Unless stated otherwise, maxon generated the thermal data using the ESCON2 EB Nano (P/N 834838) with the ESCON2 Nano 24/2 (P/N 809635) installed. This configuration simulates mounting on a customer-specific mother-board. The assembly is positioned upright with the connections of the Evaluation Board facing upward and the Nano on the bottom. It was placed on thermally poorly conductive holders, effectively floating in air.

2.2.2 Derating of output current (operation without additional heat sink)

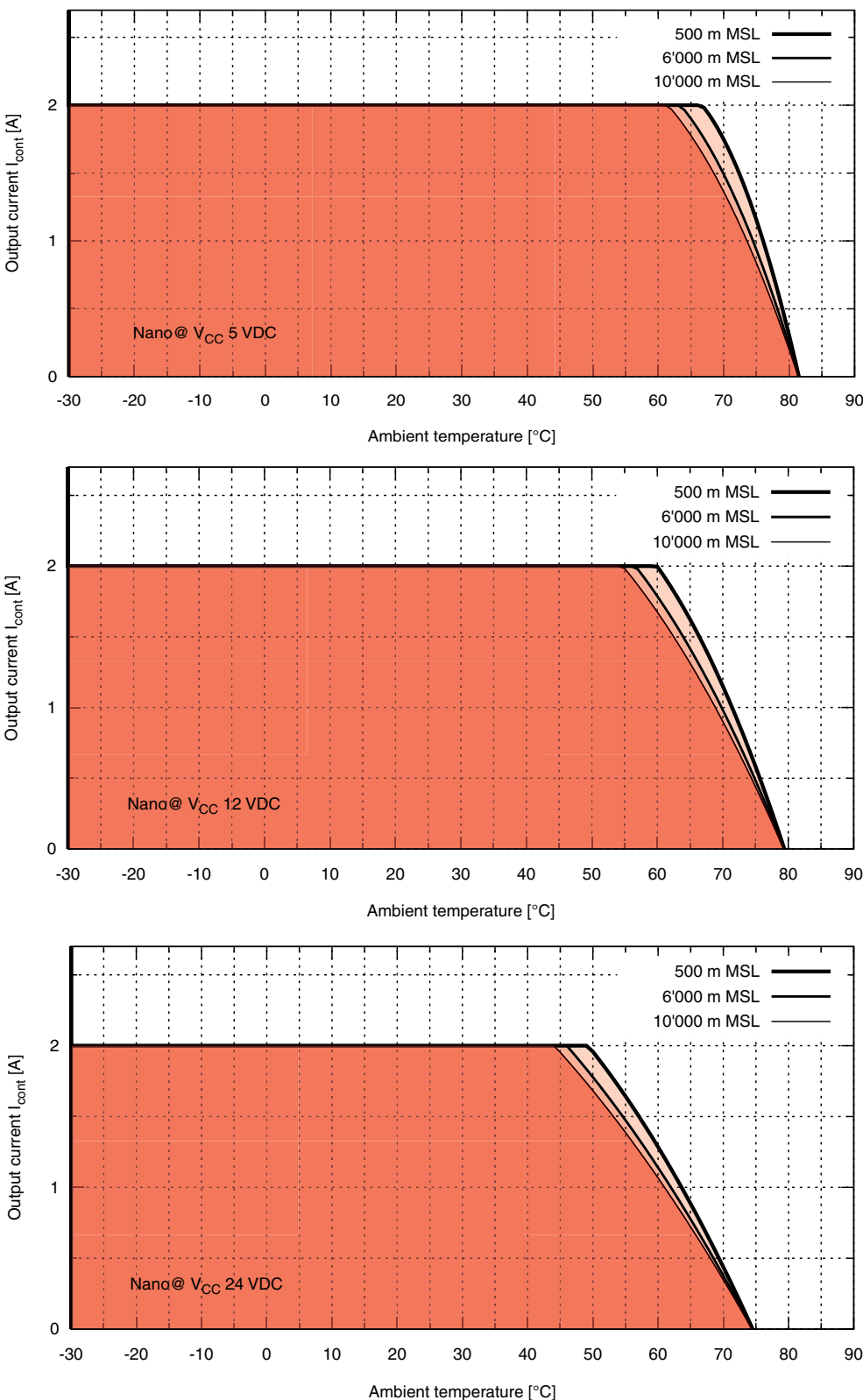


Figure 2-2 Derating of output current (operation without additional heatsink)

2.2.3 Operation with additional heatsink

During data collection in this chapter, the assembly was placed on its side. This position allows heat to flow upward from the additional heatsink, promoting effective passive cooling at the top.

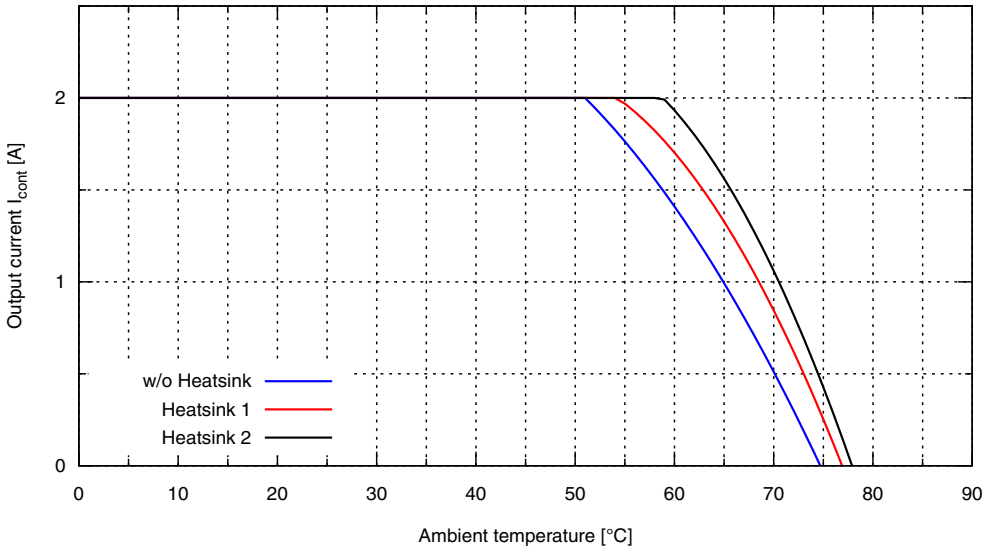


Figure 2-3 Extended operation @ V_{CC} 24 VDC with additional heatsink

Heatsink	Manufacturer	Type	Dimensions [mm]	Thermal resistance R _{th} [K/W]
1	Fischer Elektronik GmbH	SK 631 25 SA	25 × 19 × 6	27.5
2	Fischer Elektronik GmbH	SK 633 25 SA	25 × 19 × 14	18

Table 2-5 Heatsink – tested components

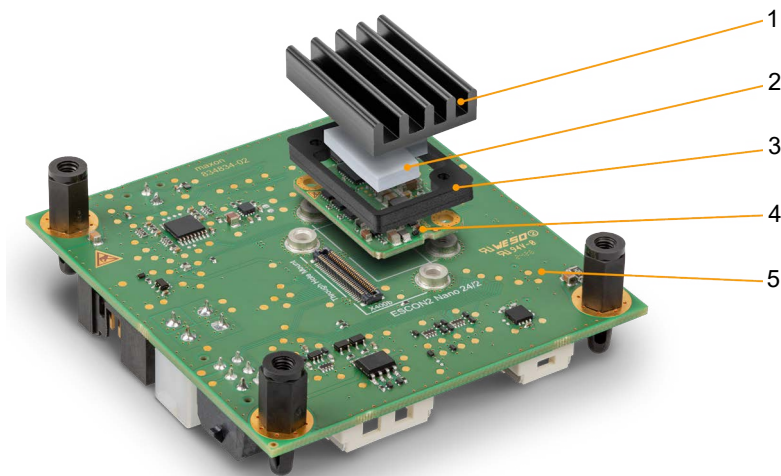
2.2.4 Thermal accessories

maxon offers the ESCON2 Nano 24/2 Thermal Accessory Kit (P/N 876085), consisting of a thermal pad and a mounting frame. Both fit the ESCON2 Nano 24/2 perfectly.

Specifications		
ESCON2 EB Nano Thermal Pad	Dimensions (L × W × H)	20 × 13 × 2.54 mm (with two cutouts at diagonally opposite corners of size 4.5 × 4.5 mm)
	Mounting	n/a (placed between controller and structure)
	Thermal conductivity	2.4 W/(mK)
ESCON2 EB Nano Mounting Frame	Dimensions (L × W × H)	25.6 × 18.6 × 3.7 mm
	Mounting	2 holes ø2.2 mm

Table 2-6 Thermal accessories – specification

CAD files are available on the maxon website as part of the ESCON2 Nano 24/2 Thermal Accessory Kit (P/N 876085).



- | | | | |
|---|----------------|---|----------------------|
| 1 | Heatsink [a] | 2 | Thermal Pad |
| 3 | Mounting Frame | 4 | ESCON2 Nano 24/2 [b] |
| 5 | ESCON2 EB Nano | | |

[a] The heatsink is not part of the accessory kit and shown for illustration purposes only.

[b] The ESCON2 Nano 24/2 can be mounted at two different positions on the evaluation board. Both positions are functionally identical. The difference is in the mechanical mounting: one position uses through holes, the other uses threaded holes. Both are for M2 screws.

Figure 2-4 Assembly with thermal accessories

2.2.5 Power dissipation and efficiency

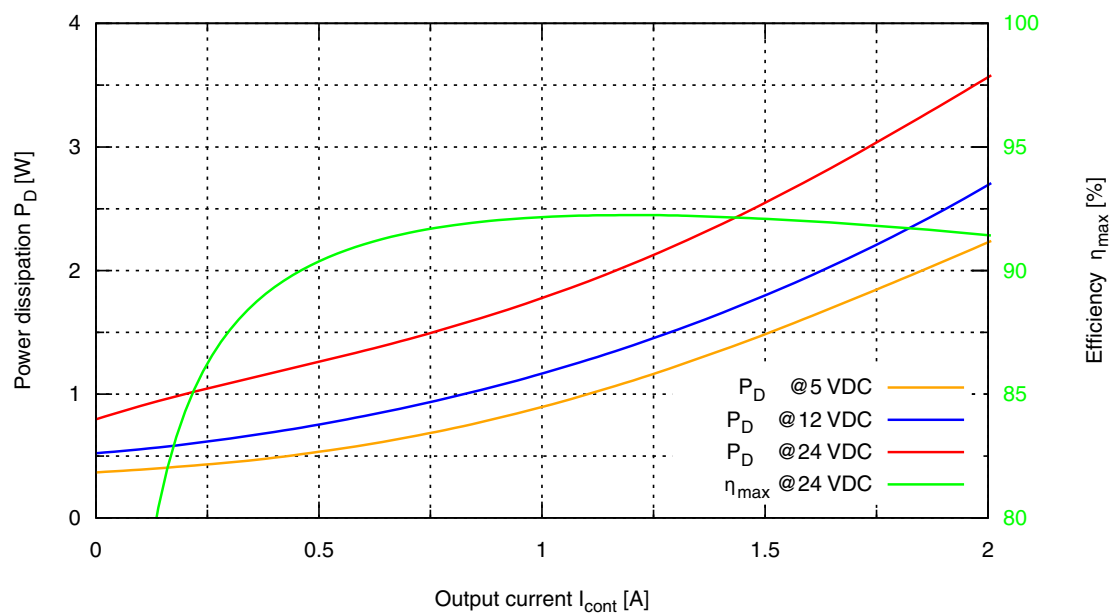


Figure 2-5 Power dissipation and efficiency

2.3 Limitations

Functionality		Switch-off threshold [a]	Recovery threshold [b]
Undervoltage		4.5 VDC	4.55 VDC
Overvoltage		31 VDC	29 VDC
Overcurrent		9 A	—
Thermal overload	logic	108 °C	98 °C
	power stage	90 °C	—

[a] The controller triggers the corresponding fault reaction. The controller changes to the disabled state. Refer to ➔ESCON2 Firmware Specification [2].

[b] The system allows you to reset the fault.

Table 2-7 Limitations

The device has a configurable output current limit and an overcurrent protection function. This protects the controller in case of a short circuit in a motor winding or a damaged power stage. The undervoltage, overvoltage, and thermal overload power stage protection limits are also configurable. For the thermal overload power stage protection, a linear derating of the maximum output current is implemented, which starts 10 °C below the switch-off threshold. For more information, see the ➔ESCON2 Firmware Specification [2].

2.4 Dimensional drawing

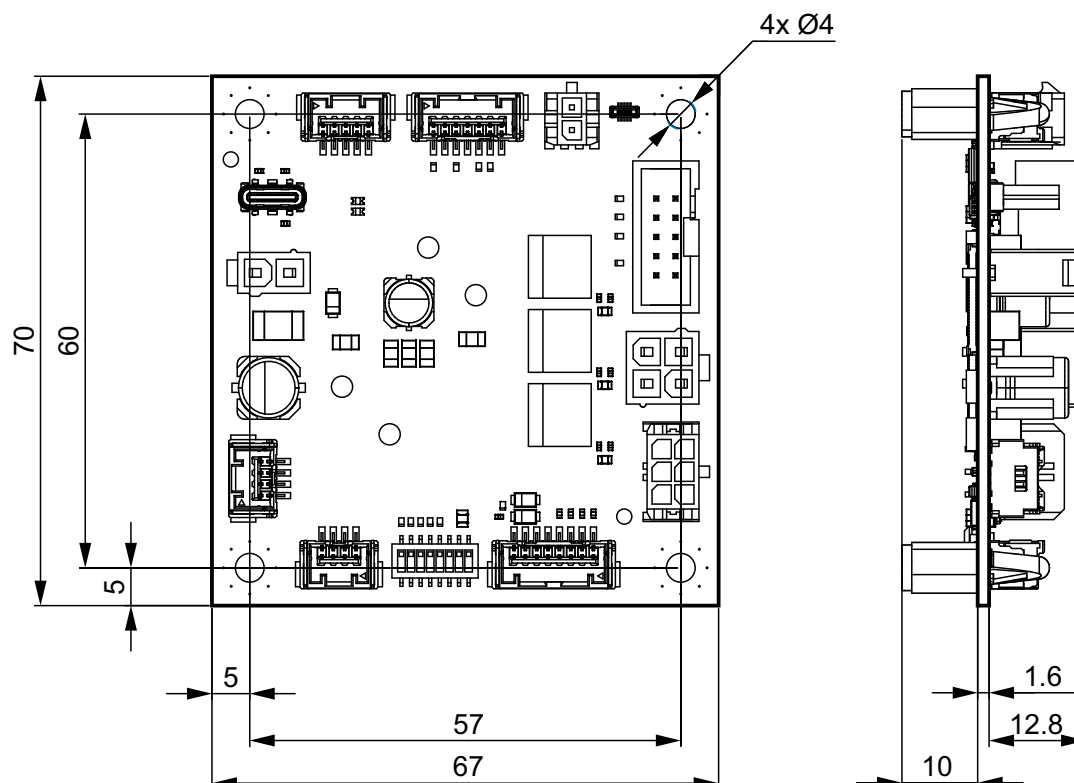


Figure 2-6 Dimensional drawing [mm]

The ESCON2 Nano 24/2 can be mounted at two different positions on the evaluation board. Both positions are functionally identical. The difference is in the mechanical mounting: one position uses through holes, the other uses threaded holes. Both are for M2 screws.

2.5 Standards

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



Important notice

Compliance of the device with the mentioned standards does not guarantee compliance in the final, ready-to-operate setup. To achieve compliance for your operational system, you must perform EMC testing on the complete equipment as a whole.

Electromagnetic compatibility		
Generic	IEC/EN 61000-6-2	Immunity for industrial environments
	IEC/EN 61000-6-3	Emission standard for residential, commercial and light-industrial environments
Applied	IEC/EN 55022 (CISPR32)	Radio disturbance characteristics / radio interference
	IEC/EN 61000-4-3	Radiated, radio-frequency, electromagnetic field immunity test >10 V/m
	IEC/EN 61000-4-4	Electrical fast transient/burst immunity test ± 2 kV
	IEC/EN 61000-4-6	Immunity to conducted disturbances, induced by radio-frequency fields 10 Vrms
Others		
Environment	IEC/EN 60068-2-6	Environmental testing – Test Fc: Vibration (sinusoidal, 10...500 Hz, 20 m/s ²)
	MIL-STD-810F	Random transport (10...500 Hz up to 2.53 g _{rms})
Safety	UL File Number	Unassembled printed circuit boards: E207844
Reliability	MIL-HDBK-217F [a]	Only ESCON2 Nano 24/2: Reliability prediction of electronic equipment Environment: Ground, benign (GB) Ambient temperature: 298 K (25 °C) Component stress: In accordance with circuit diagram and nominal power Mean Time Between Failures (MTBF): 988'899 hours

[a] The reliability calculation is based on MIL-HDBK-217F. Since component manufacturer data is more accurate, it has been used whenever possible.

Table 2-8 Standards

••page intentionally left blank••

3 SETUP

IMPORTANT NOTICE: PREREQUISITES FOR INSTALLATION PERMISSION

The **ESCON2 EB Nano Evaluation Board with ESCON2 Nano 24/2** is considered partly completed machinery according to EU Directive 2006/42/EC, Article 2, Clause (g). **It is intended to be incorporated into or assembled with other machinery or partly completed machinery or equipment.**



WARNING

Risk of injury

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

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



CAUTION

Burn hazard

Hot surfaces can cause burns.

- During operation, some parts of the device become very hot. Contact with these parts can burn your skin.
- Disconnect the power supply and secure it. Wait for the surface to cool before you do maintenance.

3.1 Generally applicable rules



Maximum permitted supply voltage

- Make sure that the power supply voltage is between 5...24 VDC, respectively 6...24 VDC if sensor supply voltage output is used.
- Supply voltages above 31 VDC or incorrect polarity will destroy the unit.
- The necessary output current depends on the load torque. The output current limits are:
 - continuous max. 2 A
 - short-time (acceleration) max. 6 A (< 6.5 s)



Hot plugging the USB interface may cause hardware damage

Do not hot-plug the USB interface (connecting while the power supply is on), the possibly high potential differences of the two power supplies of controller and PC/Notebook can lead to damaged hardware.

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



Best practice

Keep the motor mechanically disconnected during the setup and adjustment phase.

3.2 Connections

For in-depth details on connections →Chapter “3.3 Connection specifications” on page 3-20.

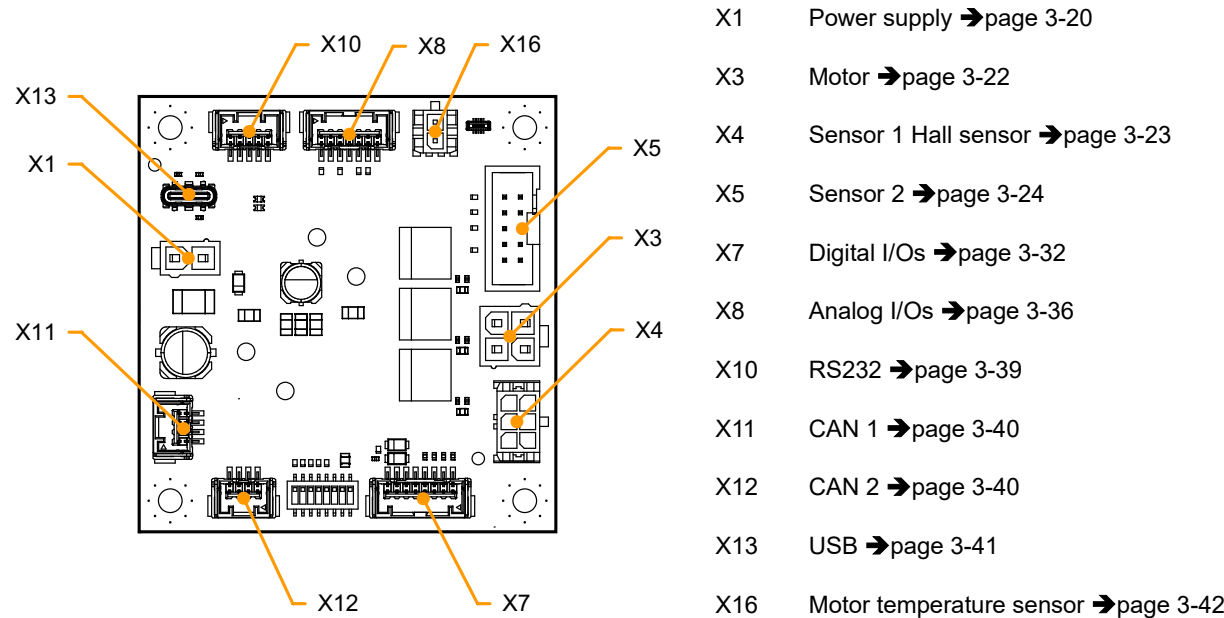


Figure 3-7 Connections

3.2.1 Cabling

PLUG&PLAY

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

- a) Check the following table and find the part number of the cable assembly that matches the setup you will be using.
- b) Follow the cross-reference to get the cable’s pin assignment.

Prefab cable assembly			
Connector	Designation	Part Number	→Page
X1	Power cable	275829	3-19
X3	Motor cable	275851	3-22
X4	Hall sensor cable	275878	3-23
X5	Encoder cable	275934	3-29
X7	Signal cable 8core	520853	3-33
X8	Signal cable 7core	520854	3-37
X10	RS232-COM cable	520856	3-39
X11	CAN-CAN cable	520858	3-40
	CAN-COM cable	520857	3-40
X12	CAN-CAN cable	520858	3-40
	CAN-COM cable	520857	3-40
X13	USB Type C – Type C cable	845854	3-41
	USB Type A – Type C cable	838461	3-42
X16	NTC cable	847301	3-43

Table 3-9 Prefab maxon cables

MAKE&BAKE YOUR OWN

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

Motion connector set (P/N 846644)		
Connector	Specification	Quantity
Connectors		
X1	Molex Mini-Fit Jr., 2 poles (39012020)	2
X3	Molex Mini-Fit Jr., 4 poles (39012040)	1
X4	Molex Micro-Fit 3.0, 6 poles (430250600)	1
X7	Molex CLIK-Mate, 8 poles (5025780800)	1
X8	Molex CLIK-Mate, 7 poles (5025780700)	1
X10	Molex CLIK-Mate, 5 poles (5025780500)	1
X11, X12	Molex CLIK-Mate, 4 poles (5025780400)	2
X16	Molex Micro-Fit 3.0, 2 poles (430250200)	1
Crimp Terminals		
X1, X3	Molex Mini-Fit Plus, AWG16 (457503112, 457503111)	8
X4, X16	Molex Micro-Fit 3.0, AWG26-30 (430300010, 430300004)	8
X7, X8, X10, X11, X12	Molex CLIK-Mate, AWG24-28 (5025790100, 5025790000)	30

Table 3-10 Motion connector set – Content

TOOLS

Tool	Manufacturer	Part Number
Hand crimper for Mini-Fit Jr. crimp terminals	Molex	2002182200
Hand crimper for Micro-Fit 3.0 crimp terminals	Molex	0638190000
Hand crimper for CLIK-Mate crimp terminals	Molex	2002187400

Table 3-11 Recommended tools

3.3 Connection specifications

The actual connection depends on your drive system configuration and the type of motor you are using. Follow the description in the given order and choose the wiring diagram (→see page 4-51) that best suits your components.



How to read pin assignment tables

In the subsequent sections of the document, you will come across tables outlining the pin assignments. These tables provide information about the hardware connectors, their corresponding wired signals, the assigned pins, and details regarding the prefab cables that are available.

- The initial column provides the pin numbers for the connectors.
- The second column specifies the pin numbers for the corresponding end (Head A) of the prefab cable.
- The third column describes the core color of the prefab cable.
- The fourth column indicates the pin numbers for the other end (Head B) of the prefab cable.

3.3.1 Power supply (X1)

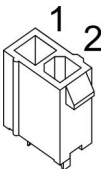


Figure 3-8 Power supply connector X1

X1 Pin	Prefab cable			Signal	Description
	Head A Pin	Cable color	Head B Pin		
1	1	black	–	GND	Ground
2	2	black	+	V _{CC}	Power supply voltage input (5...24 VDC / 6...24 VDC with use of V _{Sensor})

Table 3-12 Power supply connector X1 – Pin assignment

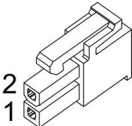
Power cable (P/N 275829)		
A 		B
Cross-section	2 × 0.75 mm ² , grey	
Length	3 m	
Head A	Plug	Molex Mini-Fit Jr., 2 poles (39012020)
	Contacts	Molex Mini-Fit Jr. female crimp terminals (457501112)
Head B	Wire end sleeves 0.75 mm ²	

Table 3-13 Power cable

Power supply requirements	
Nominal output voltage V_{CC}	5...24 VDC 6...24 VDC (with use of sensor supply voltage output)
Absolute output voltage V_{CC}	min. 4.75 VDC / max. 28 VDC min. 5.8 VDC / max. 28 VDC (with use of sensor supply voltage output)
Output current	Depending on load • continuous max. 2 A • short-time (acceleration) max. 6 A (< 6.5 s)

Table 3-14 Power supply requirements

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



The formula already takes the following into account:

- Maximum PWM duty cycle of 90 %
- Controller's max. voltage drop of 1 V @ 2 A

KNOWN VALUES:

- Operating torque M [mNm]
- Operating speed n [rpm]
- Nominal motor voltage U_N [Volt]
- Motor no-load speed at U_N ; n_O [rpm]
- Speed/torque gradient of the motor $\Delta n/\Delta M$ [rpm/mNm]

SOUGHT VALUE:

- Supply voltage V_{CC} [Volt]

SOLUTION:

$$V_{CC} \geq \left[\frac{U_N}{n_O} \cdot \left(n + \frac{\Delta n}{\Delta M} \cdot M \right) \cdot \frac{1}{0.90} \right] + 1 [V]$$

3.3.2 Motor (X3)

The controller is set to drive either maxon EC motor (BLDC, brushless DC motor) or maxon DC motor (brushed DC motor) with separated motor/encoder cable.

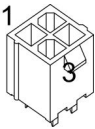


Figure 3-9 Motor connector X3



Best practice

Keep the motor mechanically disconnected during the setup and adjustment phase.

X3 Pin	Prefab cable			Signal	Description
	Head A Pin	Cable color	Head B Pin		
1	1	black		Motor winding 1	EC motor: Winding 1
				Motor (+M)	DC motor: Motor +
2	2	black		Motor winding 2	EC motor: Winding 2
				Motor (–M)	DC motor: Motor –
3	3	black		Motor winding 3	EC motor: Winding 3
				–	DC motor: DO NOT CONNECT
4	4	black		Motor shield	Cable shield

Table 3-15 Motor connector X3 – Pin assignment for maxon EC & DC motor

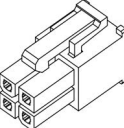
Motor cable (P/N 275851)			
A  3 1		B	
Cross-section	3 × 0.75 mm ² , shielded, grey		
Length	3 m		
Head A	Plug	Molex Mini-Fit Jr., 4 poles (39012040)	
	Contacts	Molex Mini-Fit Jr. female crimp terminals (45750)	
Head B	Wire end sleeves 0.75 mm ²		

Table 3-16 Motor cable

3.3.3 Sensor 1 Hall sensor (X4)

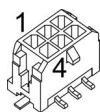


Figure 3-10 Sensor 1 Hall sensor connector X4

X4 Pin	Prefab cable			Signal	Description
	Head A Pin	Cable color	Head B Pin		
1	1	green		Hall sensor 1	Hall sensor 1 input
2	2	brown		Hall sensor 2	Hall sensor 2 input
3	3	white		Hall sensor 3	Hall sensor 3 input
4	4	yellow		GND	Ground
5	5	grey		V_{Sensor}	Sensor supply voltage output (5 VDC / $I_L \leq 145 \text{ mA}$)
6	6	black		Hall shield	Cable shield

Table 3-17 Hall sensor connector X4 – Pin assignment

Hall sensor cable (P/N 275878)		
A 4 1  B		
Cross-section	5 × 0.14 mm ² , shielded, grey	
Length	3 m	
Head A	Plug	Molex Micro-Fit 3.0, 6 poles (430250600)
	Contacts	Molex Micro-Fit 3.0 female crimp terminals (430300010)
Head B	Wire end sleeves 0.14 mm ²	

Table 3-18 Hall sensor cable



Important notice

The maximum supply current of the sensor supply voltage output V_{Sensor} is in total 145 mA. It can be used for:

- Hall sensors → Chapter “3.3.3 Sensor 1 Hall sensor (X4)” on page 3-23
- Incremental encoders → Chapter “3.3.4.1 Incremental encoder” on page 3-26
- SSI / BiSS C encoders → Chapter “3.3.4.2 SSI / BiSS C unidirectional absolute encoder” on page 3-27
- Other peripherals which need a 5 VDC supply.

All currents resulting from parts connected to the sensor supply voltage output V_{Sensor} must not exceed 145 mA in total.

Hall sensor	
Sensor supply voltage output V_{Sensor}	5 VDC
Max. sensor supply current	145 mA (→refer to Important notice)
Input voltage	0...24 VDC
Max. input voltage	24 VDC
Low-level input voltage	< 0.8 VDC
High-level input voltage	> 2.0 VDC
Internal pull-up resistor	2.7 k Ω (referenced to 5 VDC - 0.6 VDC)

Table 3-19 Sensor 1 Hall sensor specification

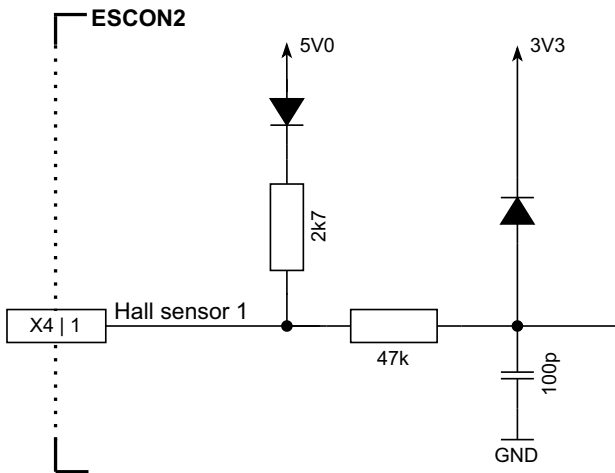


Figure 3-11 Sensor 1 Hall sensor input circuit (analogously valid for Hall sensors 2 & 3)

3.3.4 Sensor 2 Encoder / I/Os (X5)

Additional sensors, both incremental and serial encoders, or digital inputs and outputs can be connected. Only one sensor/function can be used at a time, i.e. either an incremental encoder, or an absolute encoder, or high-speed digital I/Os.



Best practice

For best performance and good resistance against electrical interference, **we recommend using encoders with a line driver (differential scheme)**. Otherwise, limitations may apply due to slow switching edges. Nevertheless, the controller supports both schemes – differential and single-ended (unsymmetrical).

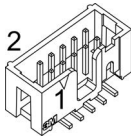


Figure 3-12 Sensor 2 connector X5

X5 Pin	Prefab cable			Signal	Description
	Head A Pin	Cable color	Head B Pin		
1	1	brown	1	Data	Data (SSI, BiSS C)
				HsDigIN4	High-speed digital input 4
2	2	white	2	V _{Sensor}	Sensor supply voltage output (5 VDC / I _L ≤ 145 mA)
3	3	red	3	GND	Ground
4	4	white	4	Clock	Clock (SSI, BiSS C)
				HsDigOUT1	High-speed digital output 1
5	5	orange	5	Channel A\	Digital incremental encoder channel A complement
				HsDigIN1\	High-speed digital input 1 complement
6	6	white	6	Channel A	Digital incremental encoder channel A
				HsDigIN1	High-speed digital input 1
7	7	yellow	7	Channel B\	Digital incremental encoder channel B complement
				HsDigIN2\	High-speed digital input 2 complement
8	8	white	8	Channel B	Digital incremental encoder channel B
				HsDigIN2	High-speed digital input 2
9	9	green	9	–	not connected
10	10	white	10	HsDigIN3	High-speed digital input 3

Table 3-20 Sensor 2 connector X5 – Pin assignment

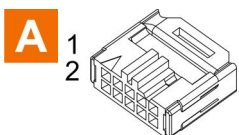
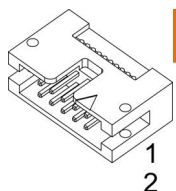
Encoder cable (P/N 275934)	
	
Cross-section	10 × AWG28, round-jacket, flat cable, pitch 1.27 mm
Length	3 m
Head A	DIN 41651 female, pitch 2.54 mm, 10 poles, with strain relief
Head B	DIN 41651 plug, pitch 2.54 mm, 10 poles, with strain relief

Table 3-21 Encoder cable



Important notice

The maximum supply current of the sensor supply voltage output V_{Sensor} is in total 145 mA. It can be used for:

- Hall sensors → Chapter “3.3.3 Sensor 1 Hall sensor (X4)” on page 3-23
- Incremental encoders → Chapter “3.3.4.1 Incremental encoder” on page 3-26
- SSI / BiSS C encoders → Chapter “3.3.4.2 SSI / BiSS C unidirectional absolute encoder” on page 3-27
- Other peripherals which need a 5 VDC supply.

All currents resulting from parts connected to the sensor supply voltage output V_{Sensor} must not exceed 145 mA in total.

3.3.4.1 Incremental encoder

Digital incremental encoder (differential)	
Sensor supply voltage output V_{Sensor}	5 VDC
Max. sensor supply current	145 mA (→refer to Important notice)
Min. differential input voltage	± 200 mV
Max. input voltage	$-9\dots+13$ VDC
Line receiver (internal)	EIA/RS422 standard
Max. input frequency	6.67 MHz

Table 3-22 Differential digital incremental encoder specification

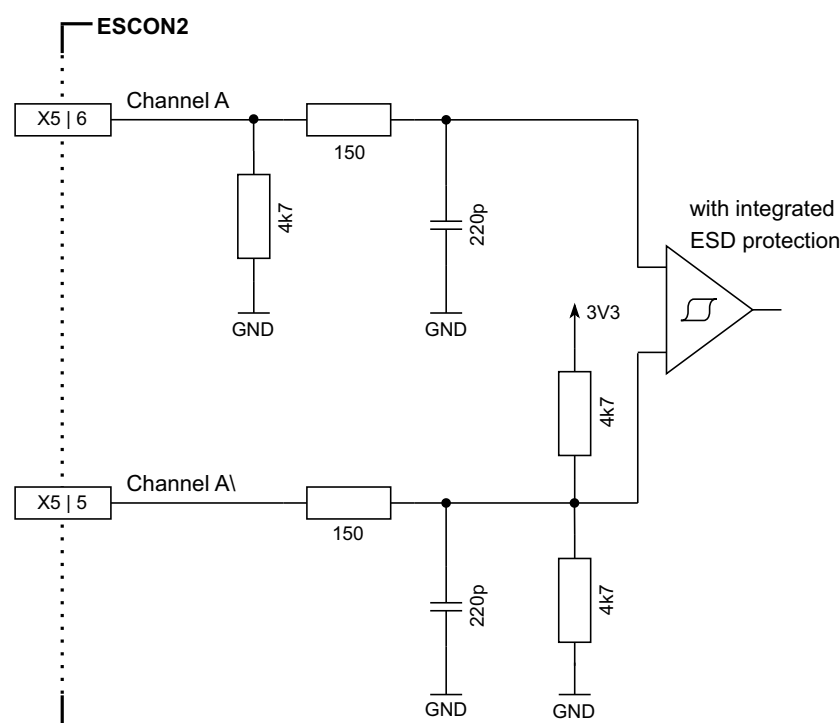


Figure 3-13 Digital incremental encoder input circuit Ch A “differential” (analogously valid for Ch B)

Digital incremental encoder (single-ended)		
Sensor supply voltage output V_{Sensor}	5 VDC	
Max. sensor supply current	145 mA (→refer to Important notice)	
Input voltage	0...5 VDC	
Max. input voltage	$-9\dots+13$ VDC	
Low-level input voltage	< 1 VDC	
High-level input voltage	> 2.4 VDC	
Input high current	I_{IH} = typically 1.25 mA @ 5 VDC	
Input low current	I_{IL} = typically -0.18 mA @ 0 VDC	
Max. input frequency	Push-pull	6.25 MHz
	Open collector	100 kHz (required external 3k3 pull-up)

Table 3-23 Single-ended digital incremental encoder specification

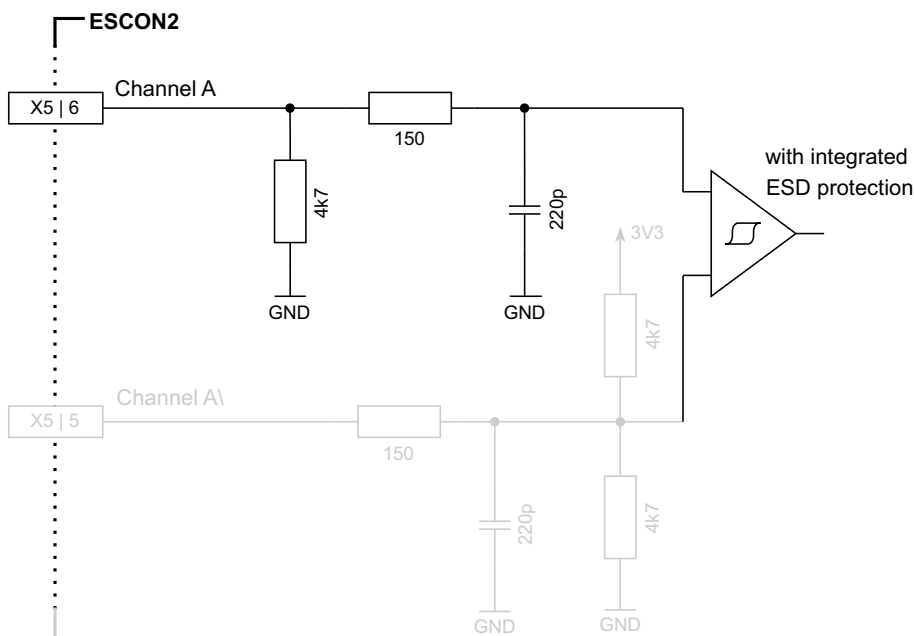


Figure 3-14 Digital incremental encoder input circuit Ch A “single-ended” (analogously valid for Ch B)

3.3.4.2 SSI / BiSS C unidirectional absolute encoder

SSI / BiSS C unidirectional absolute encoder (single-ended)		
Sensor supply voltage output V_{Sensor}		5 VDC
Max. sensor supply current		145 mA (→refer to Important notice)
Clock frequency	SSI	0.4...2 MHz
	BiSS C	0.4...4 MHz

Table 3-24 SSI / BiSS C unidirectional absolute encoder specification

The maximum clock frequency (data rate) depends on the encoder cable length and the encoder configuration. For more information, for example configurable clock frequencies (data rates), refer to the →ESCON2 Firmware Specification [2].

SSI / BiSS C unidirectional absolute encoder data channel	
Input voltage	0...5 VDC
Max. input voltage	± 12 VDC
Low-level input voltage	< 1.0 VDC
High-level input voltage	> 2.4 VDC
Input high current	I_{IH} = typically 0.33 mA @ 5 VDC (→refer to Important notice)
Input low current	I_{IL} = typically 0 mA @ 0 VDC (→refer to Important notice)
Max. input frequency	6.25 MHz
Total reaction time	< 1.5 ms

Table 3-25 Single-ended SSI / BiSS C unidirectional absolute encoder data channel specification

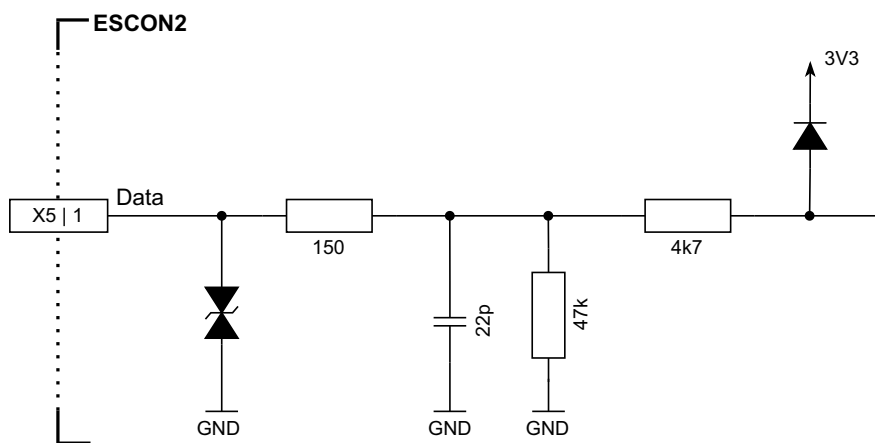


Figure 3-15 SSI absolute encoder data input (analogously valid for BiSS C)

SSI / BiSS C unidirectional absolute encoder clock channel		
Output voltage		3.3 VDC
Output resistance	Total	75 Ω (47 Ω + 28 Ω)
	Gate internal	28 Ω
Max. output current		24 mA
Clock frequency	SSI	0.4...2 MHz
	BiSS C	0.4...4 MHz

Table 3-26 Single-ended SSI / BiSS C unidirectional absolute encoder clock channel specification

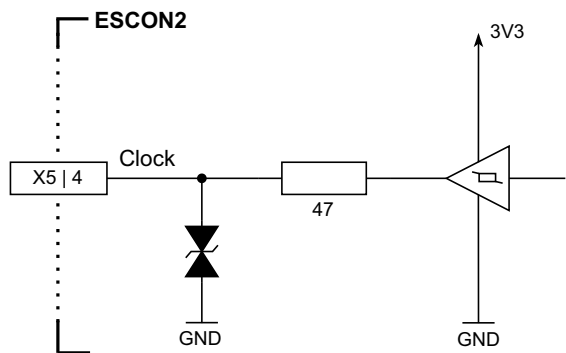


Figure 3-16 SSI absolute encoder clock output (analogously valid for BiSS C)

3.3.4.3 High-speed digital I/Os

Alternatively, the sensor interface can be used for high-speed digital I/O operation.

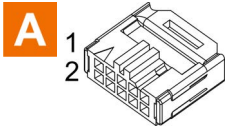
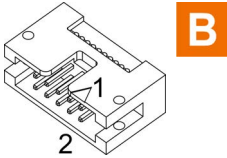
Encoder cable (P/N 275934)	
	
Cross-section	10 × AWG28, round-jacket, flat cable, pitch 1.27 mm
Length	3 m
Head A	DIN 41651 female, pitch 2.54 mm, 10 poles, with strain relief
Head B	DIN 41651 plug, pitch 2.54 mm, 10 poles, with strain relief

Table 3-27 Encoder cable

High-speed digital inputs 1...2 (differential)	
Max. input voltage	−9...+13 VDC
Min. differential input voltage	± 200 mV
Line receiver (internal)	EIA/RS422 standard
Max. input frequency	6.67 MHz
Total reaction time	< 1.5 ms

Table 3-28 Differential high-speed digital inputs specification

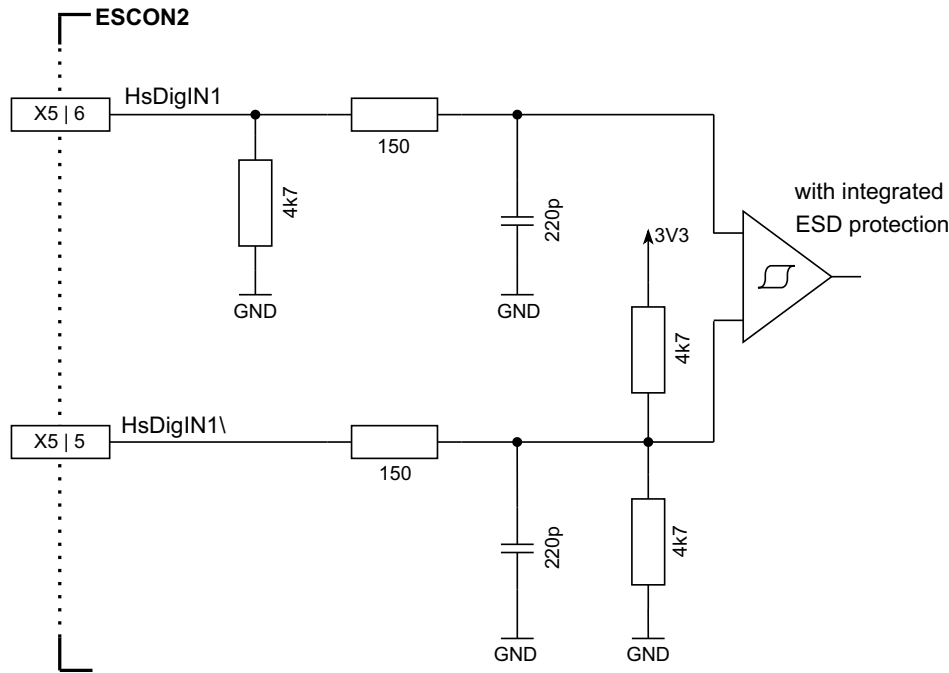


Figure 3-17 HsDigIN1 circuit “differential” (analogously valid for HsDigIN2)

High-speed digital inputs 1...4 (single-ended)		
Input voltage		0...5 VDC
Max. input voltage		-9...+13 VDC
Low-level input voltage		< 1.0 VDC
High-level input voltage		> 2.4 VDC
Input high current	HsDigIN1...3	I_{IH} = typically 1.25 mA @ 5 VDC
	HsDigIN4	I_{IH} = typically 0.33 mA @ 5 VDC
Input low current	HsDigIN1...3	I_{IL} = typically -0.18 mA @ 0 VDC
	HsDigIN4	I_{IL} = typically 0 mA @ 0 VDC
Max. input frequency		6.25 MHz
Total reaction time		< 1.5 ms

Table 3-29 Single-ended high-speed digital inputs specification

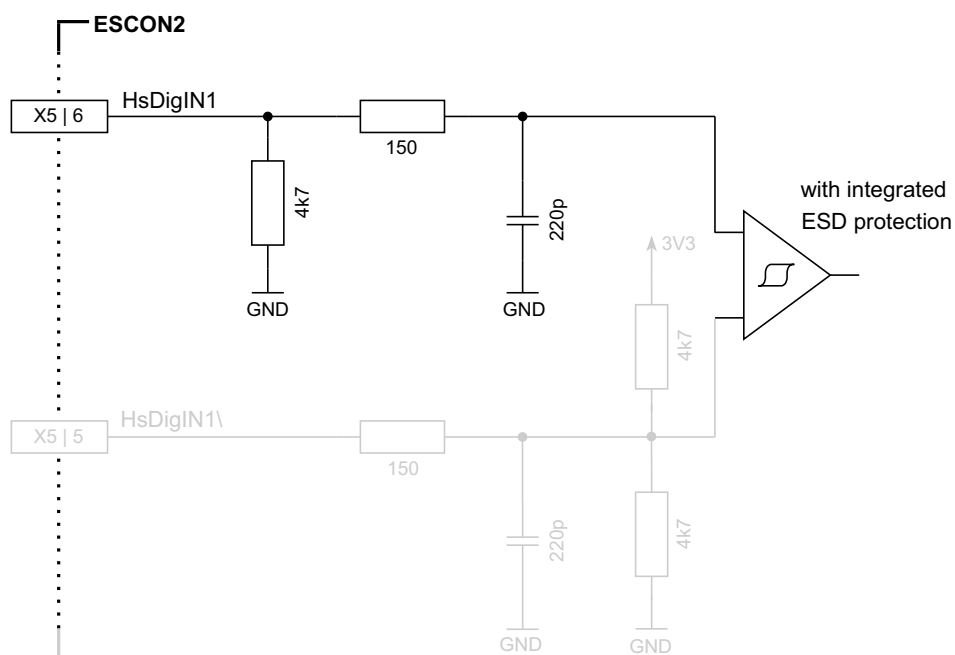


Figure 3-18 HsDigIN1 circuit "single-ended" (analogously valid for HsDigIN2...3)

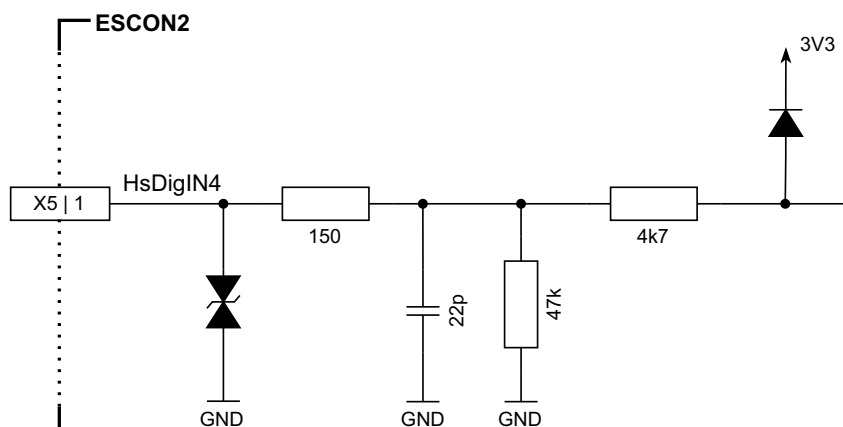


Figure 3-19 HsDigIN4 circuit "single-ended"

WIRING EXAMPLES

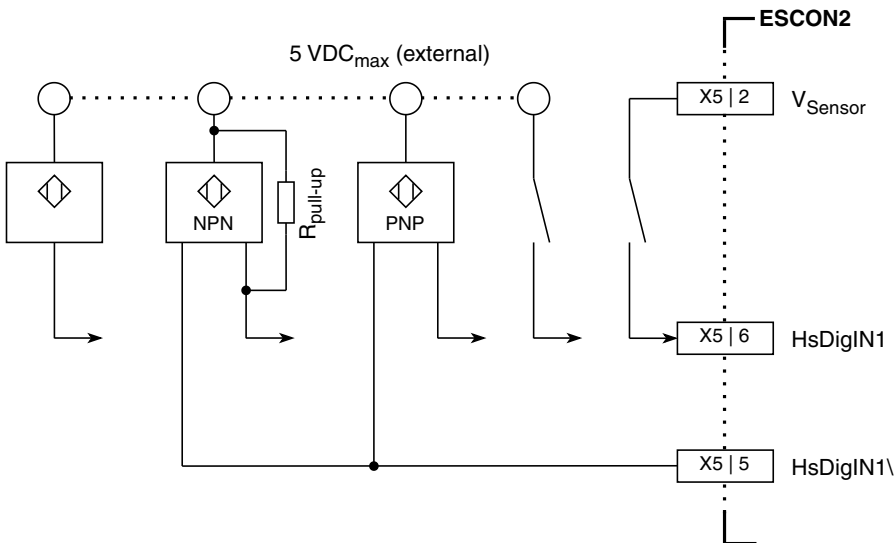


Figure 3-20 Wiring examples for proximity sensors and switches on HsDigIN1 (analogously valid for HsDigIN2)

High-speed digital output 1		
Output voltage		3.3 VDC
Output resistance	Total	75 Ω (47 Ω + 28 Ω)
	Gate internal	28 Ω
Max. output current		24 mA
Max. output frequency		25 kHz

Table 3-30 High-speed digital output specification

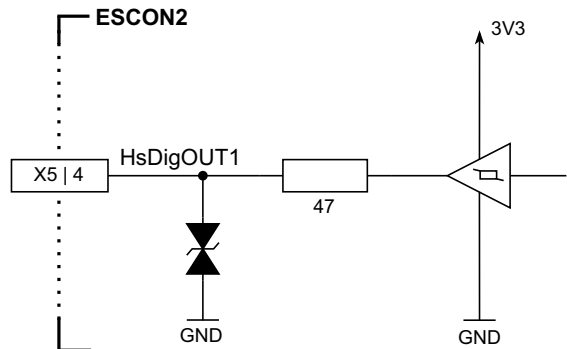


Figure 3-21 HsDigOUT1 circuit

WIRING EXAMPLES

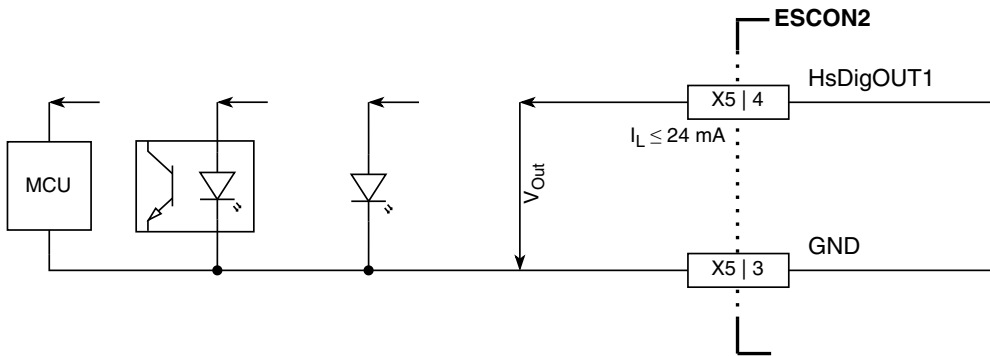


Figure 3-22 Wiring examples for "sourcing" on HsDigOUT1

3.3.5 Digital I/Os (X7)

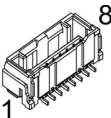


Figure 3-23 Digital I/Os connector X7

X7 Pin	Prefab cable			Signal	Description
	Head A Pin	Cable color	Head B Pin		
1	1	white		DigIN1	Digital input 1
2	2	brown		DigIN2	Digital input 2
3	3	green		DigIN3	Digital input 3
4	4	yellow		DigIN4	Digital input 4
5	5	grey		DigOUT1	Digital output 1
6	6	pink		DigOUT2	Digital output 2
7	7	blue		GND	Ground
8	8	red		V _{I/O}	Dual-use - Use V_{I/O} as the supply voltage for I/O operation (for example, switches). V_{I/O} = V_{Sensor} (5 VDC) - 0.75 VDC = 4.25 VDC. - Use V_{I/O}, internally connected to a freewheeling diode, when switching inductive loads powered by an external supply.

Table 3-31 Digital I/Os connector X7 – Pin assignment

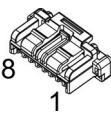
Signal cable 8core (P/N 520853)		
A  B		
Cross-section	8 × 0.14 mm ² , grey	
Length	3 m	
Head A	Plug	Molex CLIK-Mate, single row, 8 poles (5025780800)
	Contacts	Molex CLIK-Mate crimp terminals (5025790000)
Head B	Wire end sleeves 0.14 mm ²	

Table 3-32 Signal cable 8core

Digital inputs 1...2	
Input voltage	0...25 VDC
Max. input voltage	± 25 VDC
Low-level input voltage	< 0.8 VDC
High-level input voltage	> 2.1 VDC
Input resistance	typically 47 kΩ < 3.3 VDC typically 37 kΩ @ 5 VDC typically 25 kΩ @ 24 VDC
Input current at logic 1	typically 135 µA @ 5 VDC
Hardware switching delay	< 6 µs
Total reaction time	< 2.3 ms
PWM duty cycle (resolution)	10...90 % (0.1 %)
PWM frequency	50 Hz...10 kHz
PWM accuracy	typically +0.1 % absolute @ 50 Hz / 5 VDC typically +1.5 % absolute @ 10 kHz / 5 VDC

Table 3-33 Digital inputs 1...2 specification

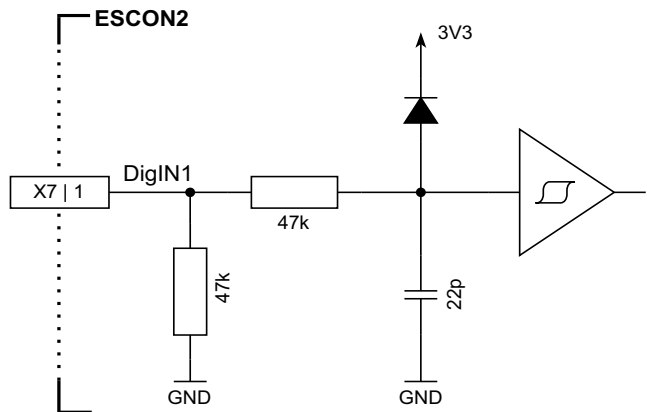


Figure 3-24 DigIN1 circuit (analogously valid for DigIN2)

Digital inputs 3...4	
Input voltage	0...25 VDC
Max. input voltage	± 25 VDC
Low-level input voltage	< 0.8 VDC
High-level input voltage	> 2.1 VDC
Input resistance	typically $47\text{ k}\Omega$ < 3.3 VDC typically $37\text{ k}\Omega$ @ 5 VDC typically $25\text{ k}\Omega$ @ 24 VDC
Input current at logic 1	typically $135\text{ }\mu\text{A}$ @ 5 VDC
Hardware switching delay	$< 300\text{ }\mu\text{s}$
Total reaction time	$< 2.3\text{ ms}$

Table 3-34 Digital inputs 3...4 specification

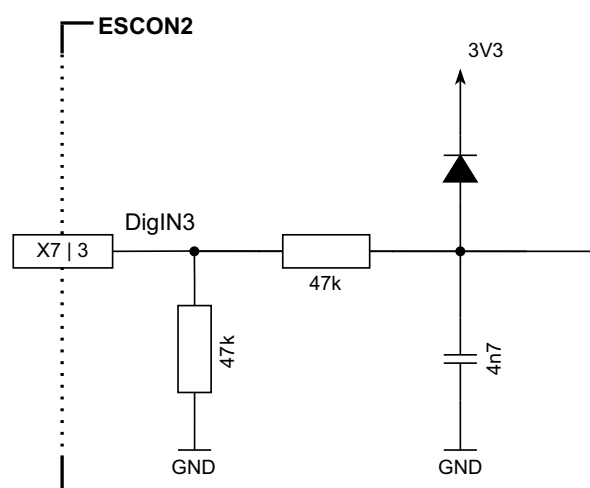


Figure 3-25 DigIN3 circuit (analogously valid for DigIN4)

WIRING EXAMPLES

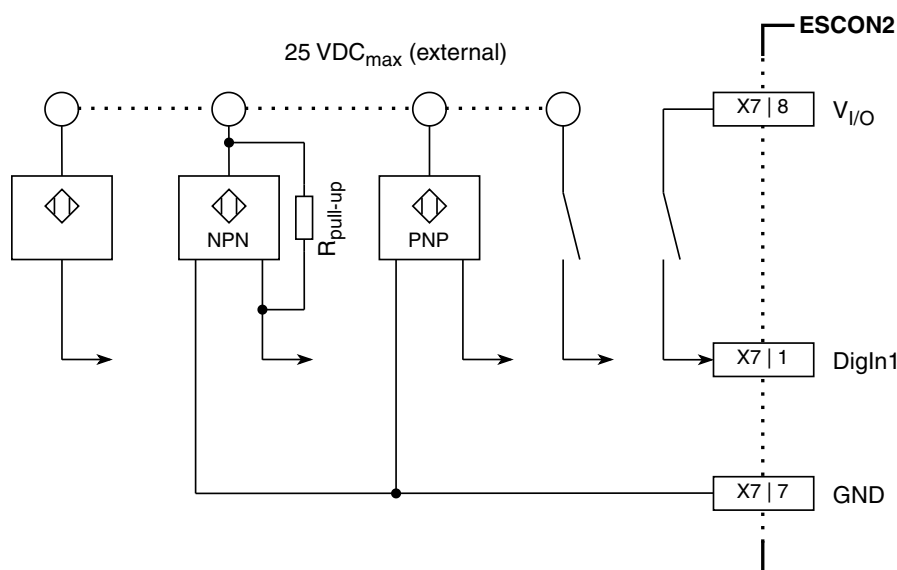


Figure 3-26 Wiring examples for proximity sensors and switches on DigIN1 (analogously valid for DigIN2..4)

Digital outputs 1...2 “sinking”	
Max. input voltage	36 VDC
Max. load current	500 mA
Max. voltage drop	0.25 VDC @ 500 mA
Max. load inductance	100 mH @ 24 VDC; 500 mA with internal clamping typically 45 VDC
Max. output frequency	25 kHz

Table 3-35 Digital outputs specification – Sinking

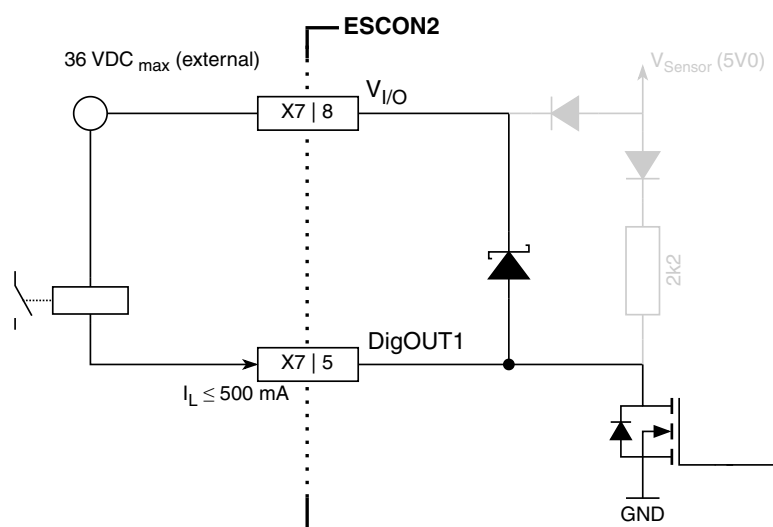


Figure 3-27 DigOUT1 circuit with wiring examples for “sinking” inductive loads (analogously valid for DigOUT2)



Freewheeling diode for inductive loads

When utilizing the digital output load switch for the operation of inductive loads, such as relays, and $V_{I/O}$ is not used, it is essential to confirm the presence of a freewheeling diode to prevent potential harm to the hardware. If possible, install the freewheeling diode at the load.

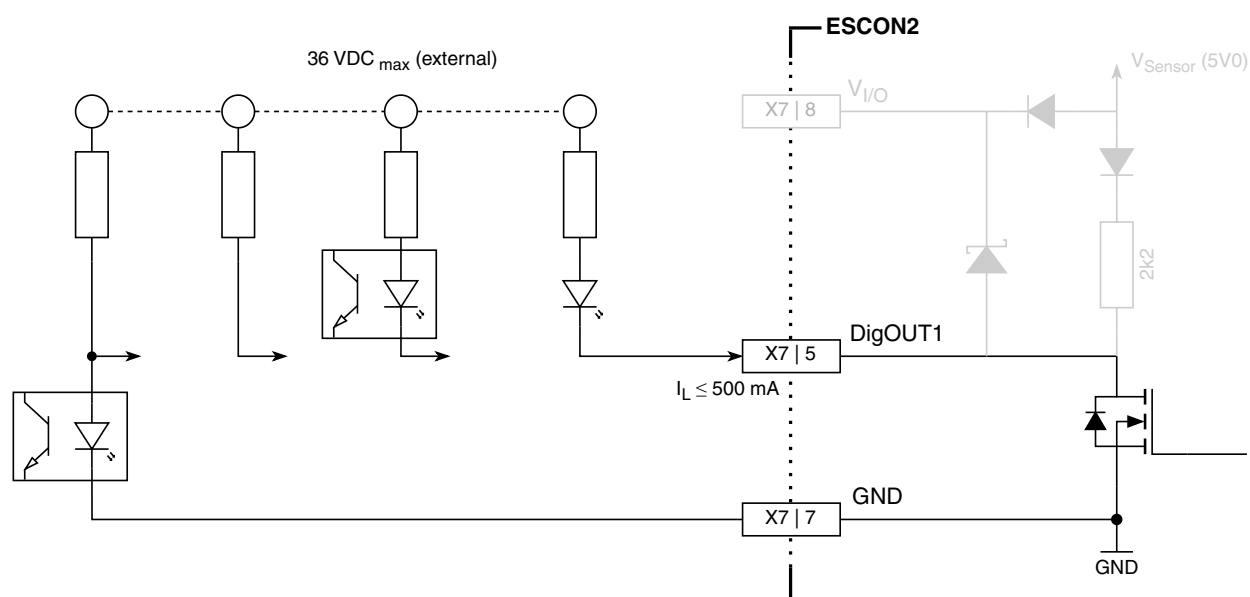


Figure 3-28 DigOUT1 circuit with wiring examples for “sinking” general-purpose loads (also valid for DigOUT2)

Table 3-36 Digital outputs specification – Sourcing

A diagram of a 7-pin D-sub connector. The pins are numbered 1 through 7, starting from the left and moving right. Pin 1 is the leftmost pin, and pin 7 is the rightmost pin.

X8 Pin	Prefab cable			Signal	Description
	Head A Pin	Cable color	Head B Pin		
1	1	white		AnIN1	Analog input 1
2	2	brown		-	not connected
3	3	green		AnIN2	Analog input 2
4	4	yellow		-	not connected
5	5	grey		AnOUT1	Analog output 1
6	6	pink		AnOUT2	Analog output 2
7	7	blue		GND	Ground

3-36

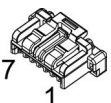
Signal cable 7core (P/N 520854)		
A  B		
Cross-section	7 × 0.14 mm ² , grey	
Length	3 m	
Head A	Plug	Molex CLIK-Mate, single row, 7 poles (5025780700)
	Contacts	Molex CLIK-Mate crimp terminals (5025790000)
Head B	Wire end sleeves 0.14 mm ²	

Table 3-38 Signal cable 7core

Analog inputs 1...2	
Input voltage	0...5 VDC
Max. input voltage	± 7.5 VDC
Input resistance	5.9 kΩ
A/D converter	12-bit
Resolution	1.22 mV
Bandwidth	10 kHz

Table 3-39 Analog inputs specification

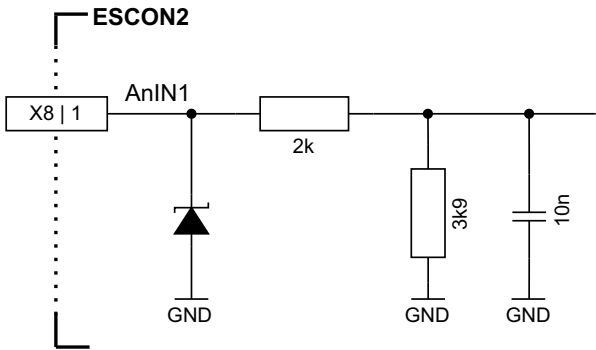


Figure 3-31 AnIN1 circuit (analogously valid for AnIN2)

WIRING EXAMPLES

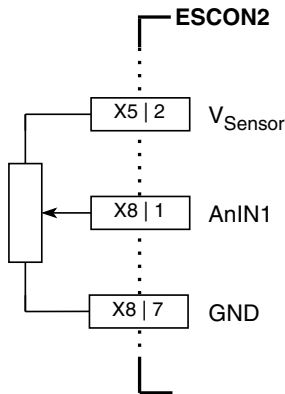


Figure 3-32 Wiring examples for a potentiometer on AnIN1 (analogously valid for AnIN2)

The figure above shows how to connect an external potentiometer to the analog input. It is recommended to use a potentiometer that has a resistance of 10 kΩ or more to reduce the load on the voltage output.

Analog outputs 1...2	
Output voltage	0...+3.3 VDC
D/A converter	12-bit
Resolution	0.81 mV
Refresh rate	50 kHz
Analog bandwidth of output amplifier	25 kHz
Max. capacitive load	300 nF Note: The increase rate is limited in proportion to the capacitive load (e.g. 5 V/ms @ 300 nF)
Max. output current limit	1 mA

Table 3-40 Analog output specification

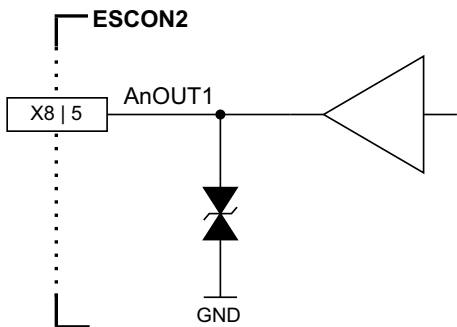


Figure 3-33 AnOUT1 circuit (analogously valid for AnOUT2)

3.3.7 RS232 (X10)

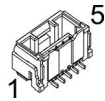


Figure 3-34 RS232 connector X10

X10 Pin	Prefab cable			Signal	Description
	Head A Pin	Cable color	Head B Pin		
1	1	white	3	RS232_RxD	RS232 receive
2	2	brown	5	GND	Ground
3	3	green	2	RS232_TxD	RS232 transmit
4	4	yellow	5	GND	Ground
5	5	Shield	Housing	Shield	Cable shield

Table 3-41 RS232 connector X10 – Pin assignment

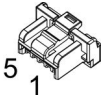
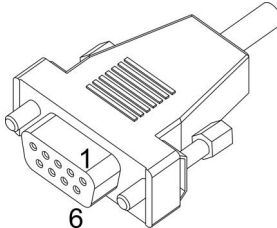
RS232-COM cable (P/N 520856)		
A  B 		
Cross-section	2 × 2 × 0.14 mm ² , twisted pair, shielded	
Length	3 m	
Head A	Plug	Molex CLIK-Mate, single row, 5 poles (5025780500)
	Contacts	Molex CLIK-Mate crimp terminals (502579)
Head B	Female D-Sub connector DIN 41652, 9 poles, with mounting screws	

Table 3-42 RS232-COM cable

RS232 interface	
Max. input voltage	±30 VDC
Output voltage	typically ±9 V @ 3 kΩ to GND
Max. bit rate	115'200 bit/s
RS232 transceiver	EIA RS232 standard

Table 3-43 RS232 interface specification



Bit rate setting

- Consider the master's maximal bit rate.
- The standard bit rate setting (factory setting) is 115'200 bit/s.

3.3.8 CAN 1 (X11) & CAN 2 (X12)

The ESCON2 is specially designed to be commanded and controlled via a Controller Area Network (CAN), a highly efficient data bus common in all fields of automation and motion control. It is preferably used as a slave node in the CANopen network.

For the CAN configuration check → Chapter “3.4 DIP switch configuration (SW1)” on page 3-44.

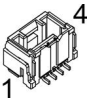


Figure 3-35 CAN 1 connector X11/CAN 2 connector X12

X11/12 Pin	Head A Pin	Prefab cable			Signal	Description
		Cable color	P/N 520858 Head B Pin	P/N 520857 Head B Pin		
1	1	white	1	7	CAN high	CAN bus high line
2	2	brown	2	2	CAN low	CAN bus low line
3	3	green	3	3	GND	Ground
4	4	yellow	4	5	CAN shield	Cable shield

Table 3-44 CAN 1 connector X11/CAN 2 connector X12 – Pin assignment

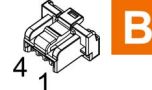
CAN-CAN cable (P/N 520858)		
 A  B		
Cross-section	2 × 2 × 0.22 mm ² , twisted pair, shielded	
Length	3 m	
Head A	Plug	Molex CLIK-Mate, single row, 4 poles (5025780400)
	Contacts	Molex CLIK-Mate crimp terminals (5025790000)
Head B	Plug	Molex CLIK-Mate, single row, 4 poles (5025780400)
	Contacts	Molex CLIK-Mate crimp terminals (5025790000)

Table 3-45 CAN-CAN cable

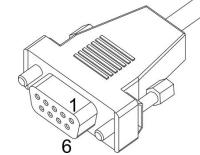
CAN-COM cable (P/N 520857)		
 A  B		
Cross-section	2 × 2 × 0.22 mm ² , twisted pair, shielded	
Length	3 m	
Head A	Plug	Molex CLIK-Mate, single row, 4 poles (5025780400)
	Contacts	Molex CLIK-Mate crimp terminals (5025790000)
Head B	Female D-Sub connector DIN 41652 9 poles, with mounting screws	

Table 3-46 CAN-COM cable

CAN interface	
Standard	ISO 11898-2:2003
Max. bit rate	1 Mbit/s
Max. number of CAN nodes	31/127 (via hardware/software setting)
Protocol	CiA 301 version 4.2.0
Node-ID setting	By DIP switch or software

Table 3-47 CAN interface specification



Note

- Consider the CAN master's maximal bit rate.
- The standard bit rate setting (factory setting) is 1 Mbit/s.
- Use 120 Ω termination resistor at both ends of the CAN bus.
- For detailed CAN information see separate document → [ESCON2 Communication Guide \[1\]](#).

3.3.9 USB (X13)



Hot plugging the USB interface may cause hardware damage

Do not hot-plug the USB interface (connecting while the power supply is on), the possibly high potential differences of the two power supplies of controller and PC/Notebook can lead to damaged hardware.

- Avoid potential differences between the power supply of controller and PC/Notebook or, if possible, balance them.
- Insert the USB connector first, then switch on the power supply of the controller.
- It is recommended to use a galvanic isolator to avoid potential differences.
With a galvanic isolator, you can also connect the USB while the system is powered (hot-plugging).
One suitable device is the USB Isolator 33204 from Wiesemann & Theis GmbH.

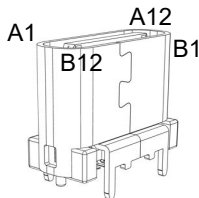


Figure 3-36 USB connector X13

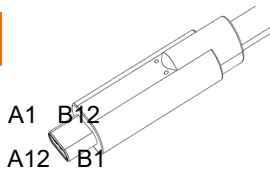
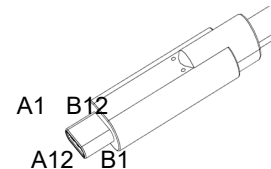
USB Type C - Type C cable (P/N 845854)	
A  B 	
USB standard	USB 3.2
Length	1.5 m
Head A	USB Type C
Head B	USB Type C

Table 3-48 USB Type C – Type C cable

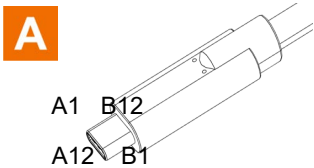
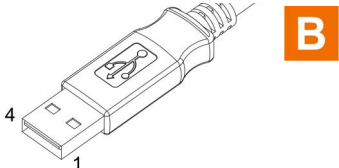
USB Type A - Type C cable (P/N 838461)	
 A1 B12 A12 B1	 4 1
USB standard	USB 2.0 / USB 3.0
Length	1.5 m
Head A	USB Type C
Head B	USB Type A

Table 3-49 USB Type A – Type C cable

USB	
Data signaling rate	12 Mbit/s (Full speed)
Max. bus supply voltage V_{Bus}	5.25 VDC
Max. DC data input voltage	-0.3...+3.8 VDC

Table 3-50 USB interface specification

3.3.10 Motor temperature sensor (X16) (future release)

The functionality will only be available with a future firmware release.

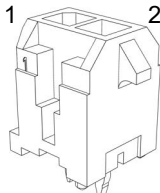


Figure 3-37 Motor temperature sensor connector X16

X16 Pin	Prefab cable			Signal	Description
	Head A Pin	Cable color	Head B Pin		
1	1	black		GND	Ground
2	2	red		MotorTemp	Motor temperature sensor input

Table 3-51 Motor temperature sensor connector X16 – Pin assignment

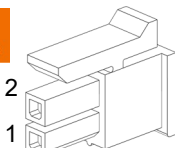
NTC cable (P/N 847301)		
A  B		
Cross-section	2 × 0.5 mm ² , grey	
Length	3 m	
Head A	Plug	Molex Micro-Fit 3.0, 2 poles (430250200)
	Contacts	Molex Micro-Fit 3.0 female crimp terminals (0430300001)
Head B	Wire end sleeves 0.5 mm ²	

Table 3-52 NTC cable

Motor temperature sensor input	
Input voltage	0...3.3 VDC
Max. input voltage	+24 VDC
A/D converter	12-bit
Internal pull-up resistor	3.3 kΩ (referenced to 3.3 VDC)

Table 3-53 Motor temperature sensor – specifications

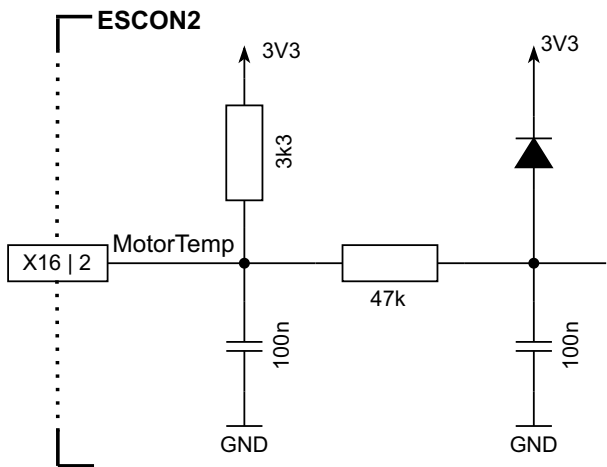


Figure 3-38 Motor temperature circuit

3.4 DIP switch configuration (SW1)

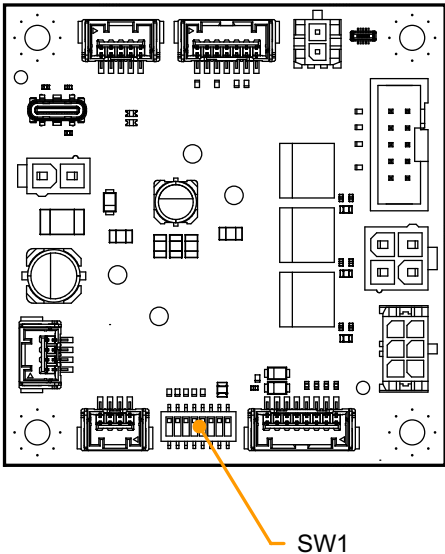


Figure 3-39 DIP switch SW1



DIP switch 8 has no functionality assigned and is not connected.

3.4.1 CAN ID (Node-ID)

The device’s identification (subsequently called “ID”) can be set by means of DIP switches 1...5 or software using binary code.



Setting the ID by DIP switch SW1

- DIP switches 6...8 do not have any impact on the ID.

Setting	Switch	Binary Code	Valence
1 8 ON OFF (factory setting)	1	2 ⁰	1
	2	2 ¹	2
	3	2 ²	4
	4	2 ³	8
	5	2 ⁴	16

Table 3-54 DIP switch SW1 – Binary code values

Continued on next page.

The set ID can be calculated by adding the valence of all activated switches. Use the following table as a (non-concluding) guide:

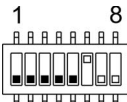
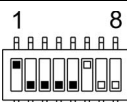
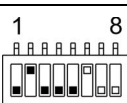
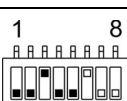
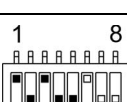
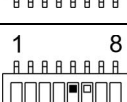
Setting	Switch					ID
	1	2	3	4	5	
 ON OFF	0	0	0	0	0	–
 ON OFF	1	0	0	0	0	1
 ON OFF	0	1	0	0	0	2
 ON OFF	0	0	1	0	0	4
 ON OFF	1	0	1	0	0	5
 ON OFF	0	0	0	1	0	8
 ON OFF	0	0	0	0	1	16
 ON OFF	1	1	1	1	1	31
0 = Switch "OFF" 1 = Switch "ON"						

Table 3-55 DIP switch SW1 – Examples

SETTING THE ID BY MEANS OF «MOTION STUDIO»

- The ID may be set by software (changing object 0×2000 «Node-ID», range 1...127).
- The ID set by software is valid if the ID is set to "0" (DIP switches 1...5 set to OFF).

3.4.2 CAN automatic bit rate detection

With this function, the CANopen interface can be put in a “listen only” mode. For further details see separate document ➔ESCON2 Firmware Specification [2]. Automatic bit rate detection is activated with DIP switch 6.

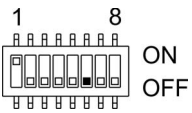
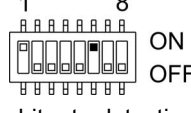
Switch	OFF	ON
6	 Automatic bit rate detection deactivated	 Automatic bit rate detection activated (factory setting)

Table 3-56 DIP switch SW1 – CAN automatic bit rate detection

3.4.3 CAN bus termination

A 120 Ω termination resistor can be "activated" with DIP switch 7.

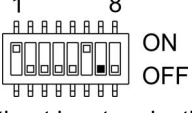
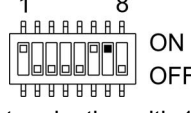
Switch	OFF	ON
7	 Without bus termination (factory setting)	 Bus termination with 120 Ω

Table 3-57 DIP switch SW1 – CAN bus termination

3.5 Status indicators

The Evaluation Board features a set of LED indicators to display the controller's condition.

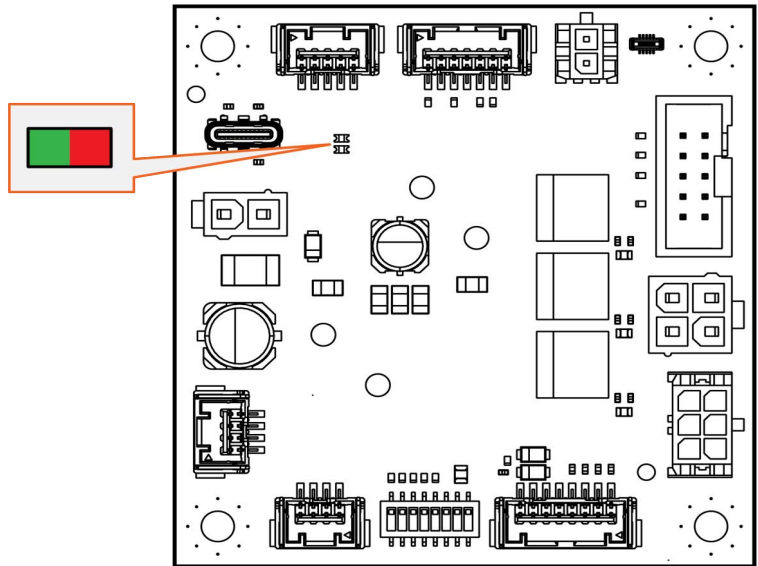


Figure 3-40 LEDs – Location

The LEDs display the actual status and possible warnings and errors of the ESCON2:

- Green LED shows the operation status
- Red LED indicates warnings and errors

LED		Warning / Error	Description
Green	Red		
Slow	OFF	No warning/error active.	Power stage is disabled. The ESCON2 is in status • Switch on disabled
Slow	Slow	At least one warning is active.	• Ready to switch on • Switched on
ON	OFF	No warning/error active.	Power stage is enabled. The ESCON2 is in status • Operation enabled
ON	Slow	At least one warning is active.	• Quick stop active
ON	ON	At least one error has occurred.	Power stage is enabled. The ESCON2 is in temporary status • Fault reaction active
OFF	ON	At least one error has occurred.	Power stage is disabled. The ESCON2 is in status • Fault
Flash	ON	n/a	Firmware update in progress or invalid application
Slow = LED is slowly blinking (0.5 s OFF, 0.5 s ON) Flash = LED is flashing (0.9 s OFF, 0.1 s ON)			

Table 3-58 Device status LEDs

••page intentionally left blank••

4 WIRING

This section provides wiring information for your setup. You can either use the consolidated wiring diagrams (see →Figure 4-42) featuring the full scope of interconnectivity and pin assignments, or you may use the connection over-views for either DC motor or EC (BLDC) motor to determine the wiring for your particular motor type and the appropriate feedback signals.

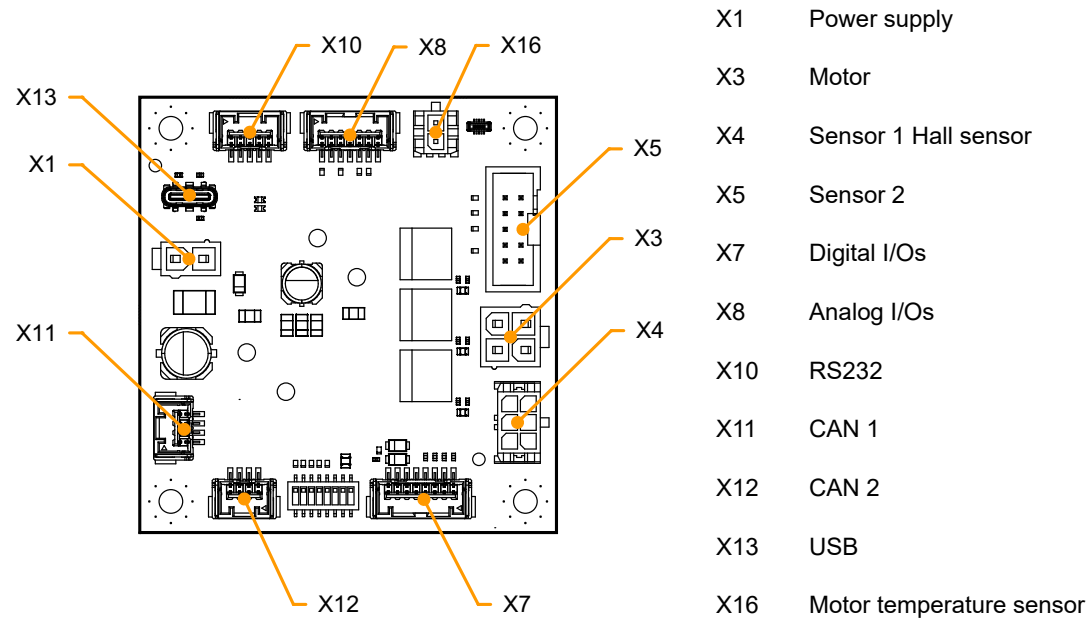


Figure 4-41 Interfaces – Designations and location



Signs and abbreviations used

The subsequent diagrams feature these signs and abbreviations:

- «EC motor» stands for brushless EC motor (BLDC).
-  Ground safety earth connection (optional).

4.1 Possible combinations to connect a motor

The following tables show feasible ways to connect the motor with its respective feedback signals or possible combinations thereof. To find the wiring that best suits your setup, proceed as follows:

- 1) Decide on the type of motor you are using and go to the respective subsection; →Chapter “4.1.1 DC motor” on page 4-50 or →Chapter “4.1.2 EC (BLDC) motor” on page 4-50.
- 2) Connect the power supply and the logic supply as shown in the referenced figure.
- 3) Check-out the listing for the combination that best suits your setup. Pick the wiring method # and go to the respective table; for DC motor see →Table 4-59, for EC (BLDC) motor see →Table 4-60.
- 4) Pick the row with the corresponding wiring method # and refer to the listed figure(s) to find the relevant wiring information.

4.1.1 DC motor

Power supply

Power supply Figure 4-43

Motor & feedback signals

Without sensor Method # DC1 [a]

Digital incremental encoder Method # DC2

SSI / BiSS C unidirectional absolute encoder Method # DC3

Method #	Sensor 2		➔Figure(s)
	Digital incremental encoder	SSI / BiSS C unidirectional absolute encoder	
DC1 [a]			4-44
DC2	✓		4-44 4-47
DC3		✓	4-44 4-48

[a] For method # DC1, only the operating mode current control can be used.

Table 4-59 Possible combinations of feedback signals for DC motor

4.1.2 EC (BLDC) motor

Power supply

Power supply Figure 4-43

Motor & feedback signals

Hall sensors Method # EC1

Hall sensors & Digital incremental encoder Method # EC2

Hall sensors & SSI / BiSS C unidirectional absolute encoder Method # EC3

SSI / BiSS C unidirectional absolute encoder Method # EC4

Method #	Sensor 1	Sensor 2		➔Figure(s)
	Hall sensors	Digital incremental encoder	SSI / BiSS C unidirectional absolute encoder	
EC1	✓			4-45 4-46
EC2	✓	✓		4-45 4-46 4-47
EC3	✓		✓	4-45 4-46 4-48
EC4			✓	4-45 4-48

Table 4-60 Possible combinations of feedback signals for EC (BLDC) motor

4.2 Main wiring diagram

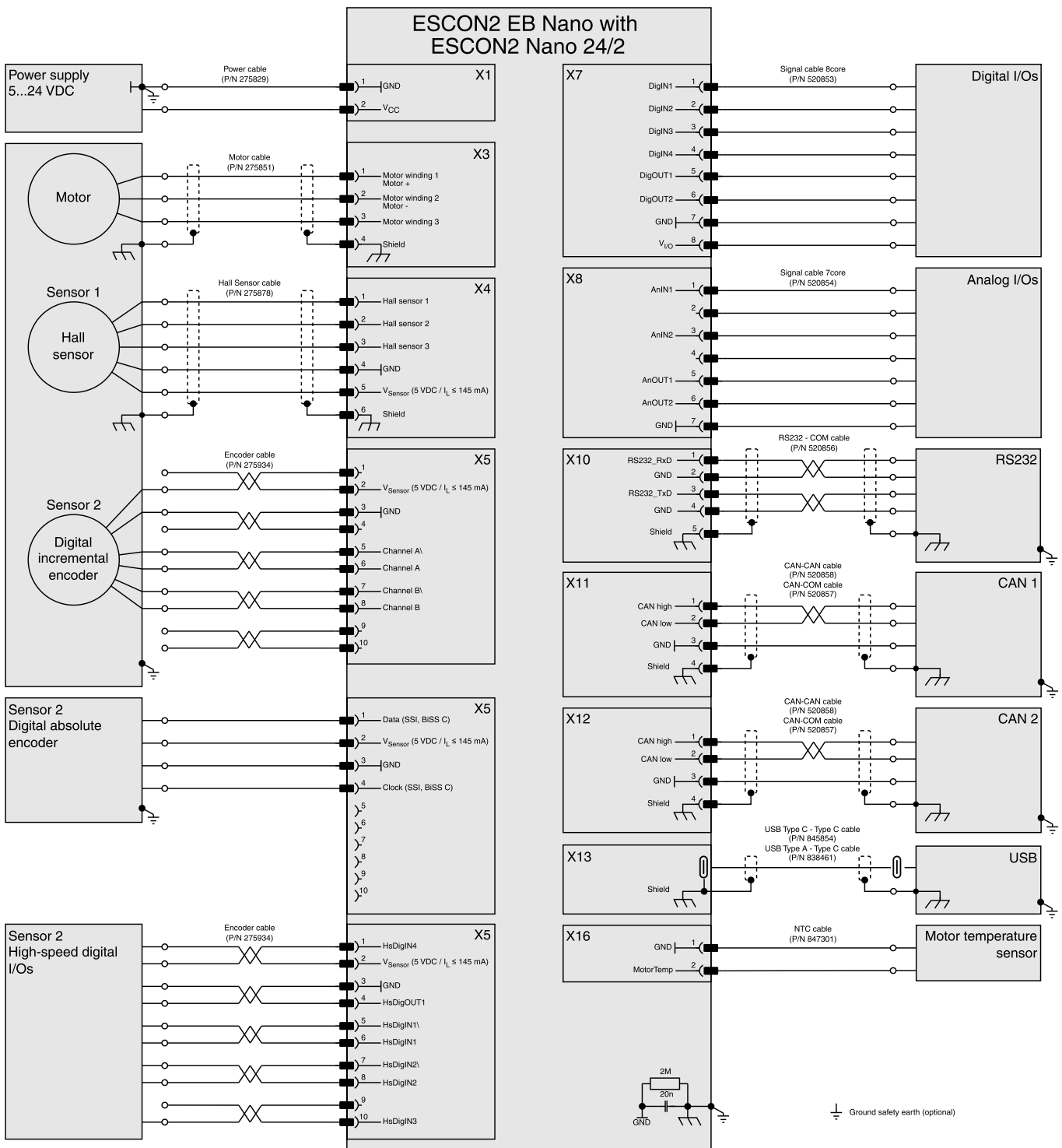


Figure 4-42 Main wiring diagram

4.3 Excerpts

4.3.1 Power supply

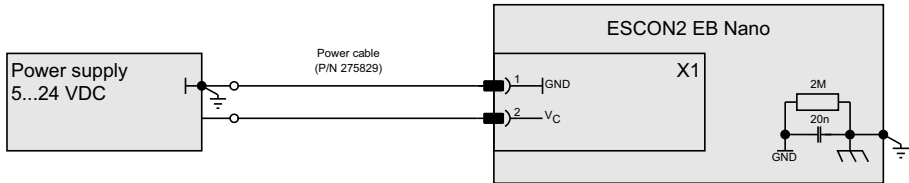


Figure 4-43 Power supply

4.3.2 DC motor

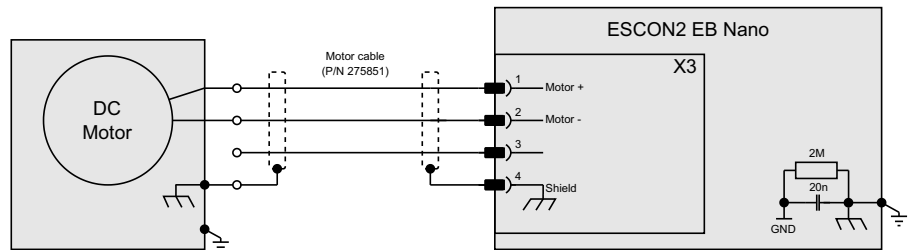


Figure 4-44 DC motor

4.3.3 EC (BLDC) motor

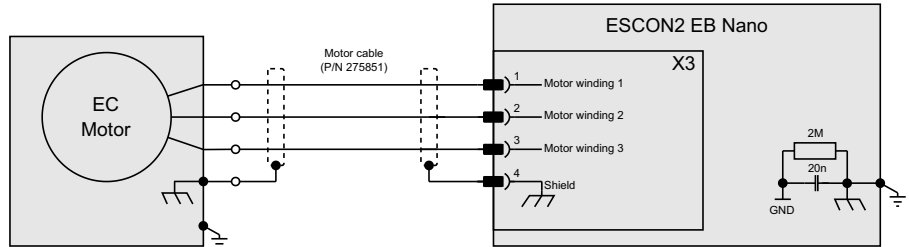


Figure 4-45 EC (BLDC) motor

4.3.4 Sensor 1 Hall sensor

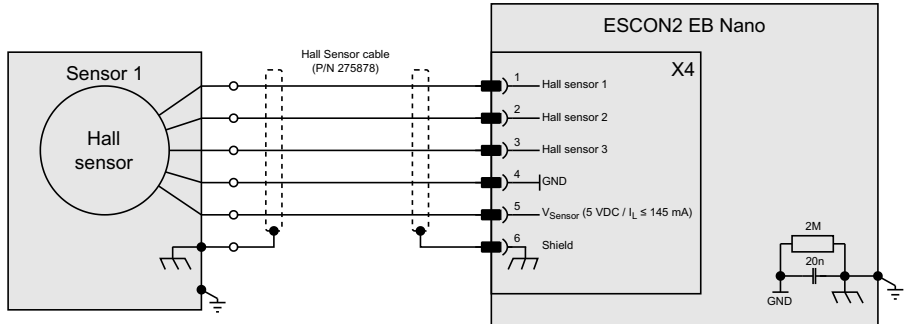


Figure 4-46 Sensor 1 Hall sensor

4.3.5 Sensor 2 Encoder / I/Os

4.3.5.1 Digital incremental encoder

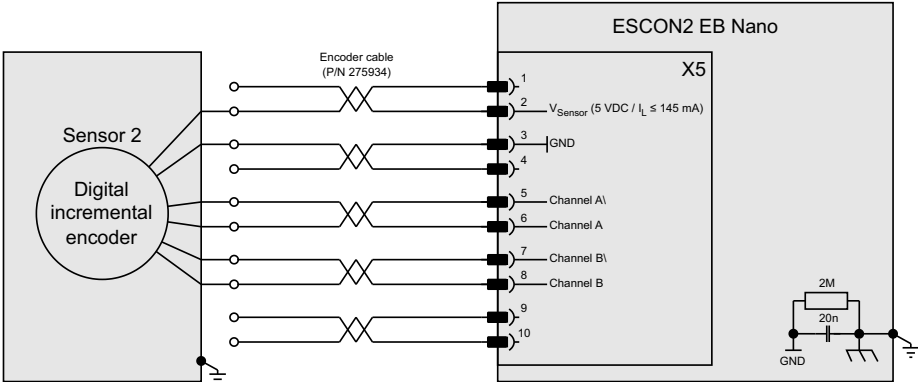


Figure 4-47 Digital incremental encoder

This interface can handle a digital incremental encoder, an SSI / BiSS C digital unidirectional absolute encoder or high-speed digital I/O's. Only one out of these three functions can be used at the same time.

4.3.5.2 SSI / BiSS C unidirectional absolute encoder

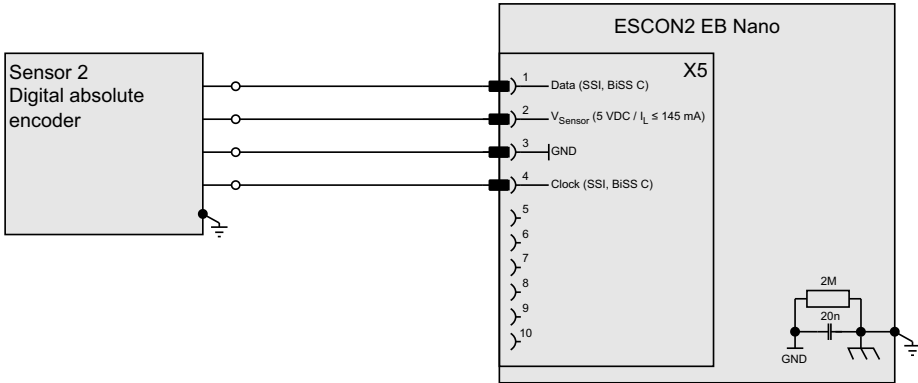


Figure 4-48 SSI / BiSS C unidirectional absolute encoder

This interface can handle a digital incremental encoder, an SSI / BiSS C digital unidirectional absolute encoder or high-speed digital I/O's. Only one out of these three functions can be used at the same time.

4.3.5.3 High-speed digital I/Os

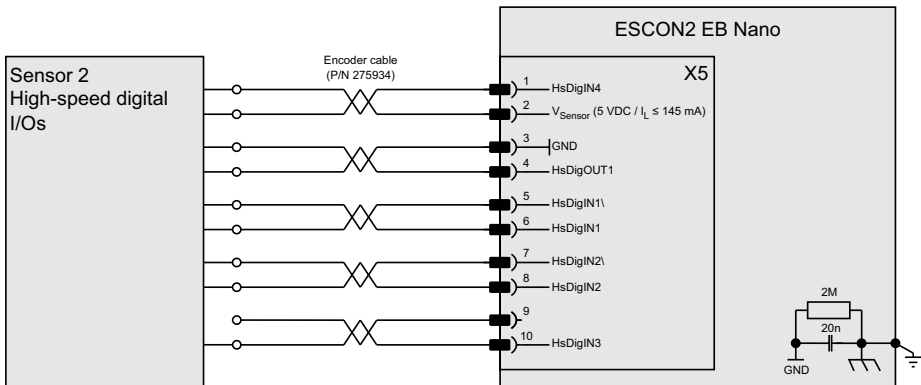


Figure 4-49 High-speed digital I/Os

This interface can handle a digital incremental encoder, an SSI / BiSS C digital unidirectional absolute encoder or high-speed digital I/O's. Only one out of these three functions can be used at the same time.

4.3.6 Digital I/Os

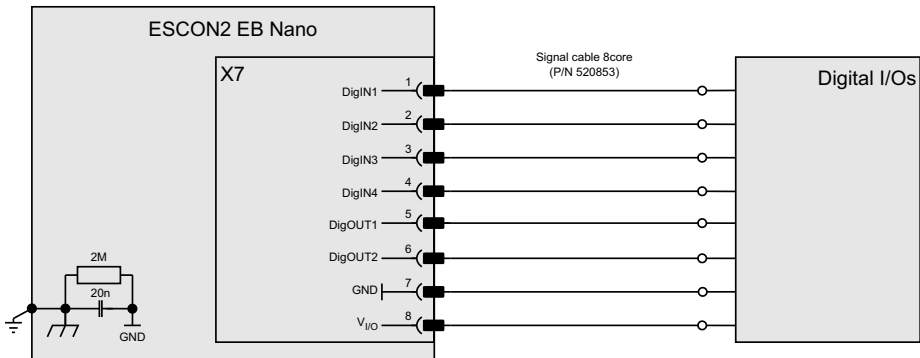


Figure 4-50 Digital I/Os

4.3.7 Analog I/Os

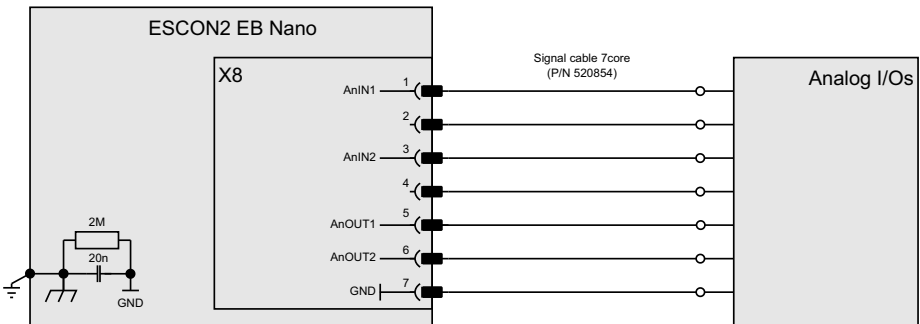


Figure 4-51 Analog I/Os

4.3.8 RS232

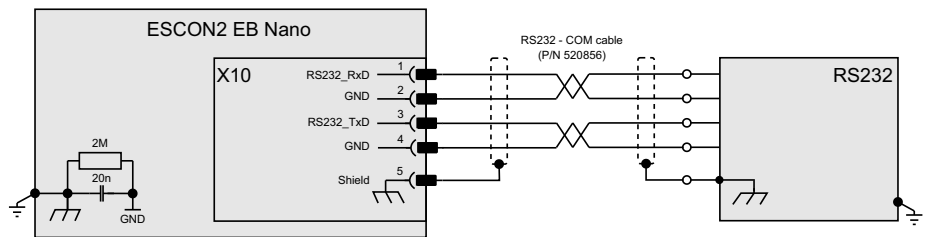


Figure 4-52 RS232

4.3.9 CAN

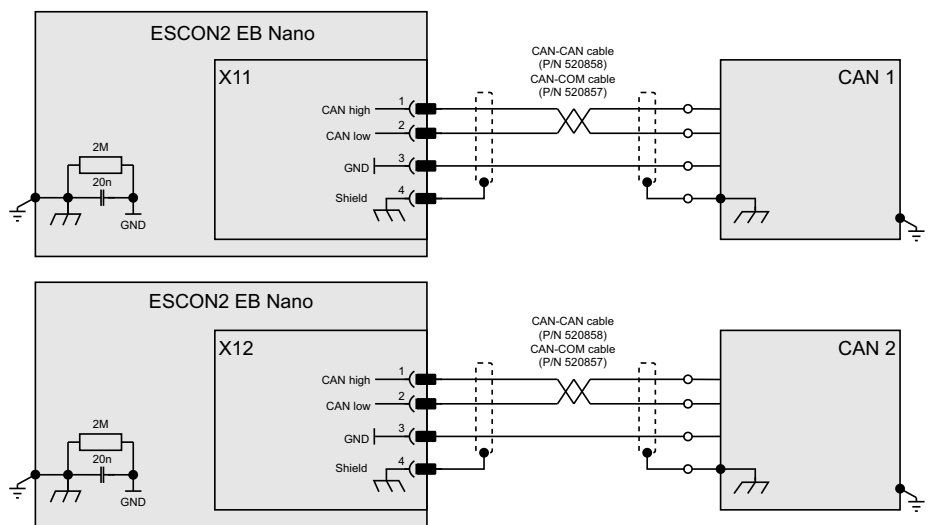


Figure 4-53 CAN

Depending on the preferred interface, one of the two prefab CAN cables can be used.

4.3.10 USB

4.3.10.1 USB-C

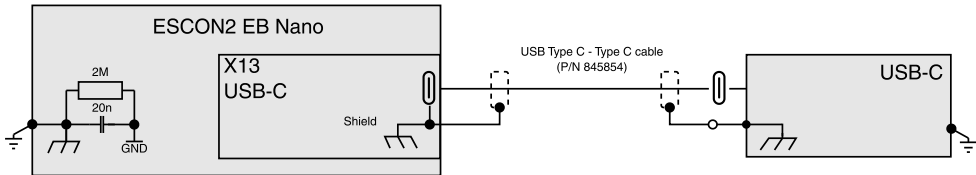


Figure 4-54 USB-C

4.3.10.2 USB-A

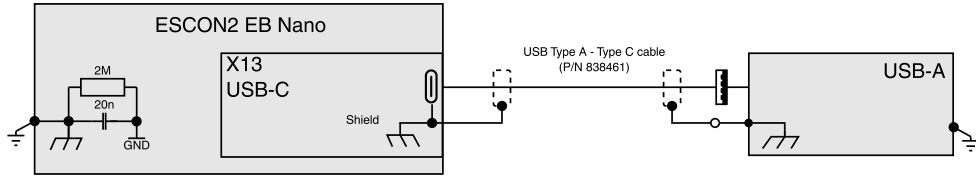


Figure 4-55 USB-A

4.3.11 Motor temperature sensor (future release)

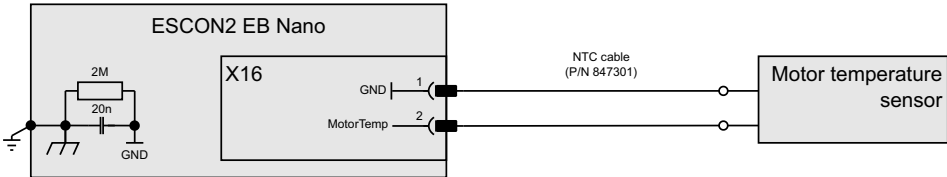


Figure 4-56 Motor temperature sensor

LIST OF FIGURES

Figure 1-1	Documentation structure	5
Figure 2-2	Derating of output current (operation without additional heatsink)	11
Figure 2-3	Extended operation @ VCC 24 VDC with additional heatsink	12
Figure 2-4	Assembly with thermal accessories	13
Figure 2-5	Power dissipation and efficiency	13
Figure 2-6	Dimensional drawing [mm]	14
Figure 3-7	Connections	18
Figure 3-8	Power supply connector X1	20
Figure 3-9	Motor connector X3	22
Figure 3-10	Sensor 1 Hall sensor connector X4	23
Figure 3-11	Sensor 1 Hall sensor input circuit (analogously valid for Hall sensors 2 & 3)	24
Figure 3-12	Sensor 2 connector X5	24
Figure 3-13	Digital incremental encoder input circuit Ch A “differential” (analogously valid for Ch B)	26
Figure 3-14	Digital incremental encoder input circuit Ch A “single-ended” (analogously valid for Ch B)	27
Figure 3-15	SSI absolute encoder data input (analogously valid for BiSS C)	28
Figure 3-16	SSI absolute encoder clock output (analogously valid for BiSS C)	28
Figure 3-17	HsDigIN1 circuit “differential” (analogously valid for HsDigIN2)	29
Figure 3-18	HsDigIN1 circuit “single-ended” (analogously valid for HsDigIN2...3)	30
Figure 3-19	HsDigIN4 circuit “single-ended”	30
Figure 3-20	Wiring examples for proximity sensors and switches on HsDigIN1 (analogously valid for HsDigIN2)	31
Figure 3-21	HsDigOUT1 circuit	31
Figure 3-22	Wiring examples for “sourcing” on HsDigOUT1	32
Figure 3-23	Digital I/Os connector X7	32
Figure 3-24	DigIN1 circuit (analogously valid for DigIN2)	33
Figure 3-25	DigIN3 circuit (analogously valid for DigIN4)	34
Figure 3-26	Wiring examples for proximity sensors and switches on DigIN1 (analogously valid for DigIN2...4)	34
Figure 3-27	DigOUT1 circuit with wiring examples for “sinking” inductive loads (analogously valid for DigOUT2)	35
Figure 3-28	DigOUT1 circuit with wiring examples for “sinking” general-purpose loads (also valid for DigOUT2)	35
Figure 3-29	DigOUT1 circuit with wiring examples for “sourcing” (analogously valid for DigOUT2)	36
Figure 3-30	Analog I/Os connector X8	36
Figure 3-31	AnIN1 circuit (analogously valid for AnIN2)	37
Figure 3-32	Wiring examples for a potentiometer on AnIN1 (analogously valid for AnIN2)	37
Figure 3-33	AnOUT1 circuit (analogously valid for AnOUT2)	38
Figure 3-34	RS232 connector X10	39
Figure 3-35	CAN 1 connector X11/CAN 2 connector X12	40
Figure 3-36	USB connector X13	41
Figure 3-37	Motor temperature sensor connector X16	42
Figure 3-38	Motor temperature circuit	43
Figure 3-39	DIP switch SW1	44
Figure 3-40	LEDs – Location	47
Figure 4-41	Interfaces – Designations and location	49

Figure 4-42 Main wiring diagram51

Figure 4-43 Power supply52

Figure 4-44 DC motor52

Figure 4-45 EC (BLDC) motor52

Figure 4-46 Sensor 1 Hall sensor52

Figure 4-47 Digital incremental encoder53

Figure 4-48 SSI / BiSS C unidirectional absolute encoder53

Figure 4-49 High-speed digital I/Os54

Figure 4-50 Digital I/Os54

Figure 4-51 Analog I/Os54

Figure 4-52 RS23255

Figure 4-53 CAN55

Figure 4-54 USB-C56

Figure 4-55 USB-A56

Figure 4-56 Motor temperature sensor56

LIST OF TABLES

Table 1-1	Notations used in this document	6
Table 1-2	Symbols and signs	6
Table 1-3	Sources for additional information	7
Table 2-4	Technical data	10
Table 2-5	Heatsink – tested components	12
Table 2-6	Thermal accessories – specification	12
Table 2-7	Limitations	14
Table 2-8	Standards	15
Table 3-9	Prefab maxon cables	19
Table 3-10	Motion connector set – Content	19
Table 3-11	Recommended tools	19
Table 3-12	Power supply connector X1 – Pin assignment	20
Table 3-13	Power cable	20
Table 3-14	Power supply requirements	21
Table 3-15	Motor connector X3 – Pin assignment for maxon EC & DC motor	22
Table 3-16	Motor cable	22
Table 3-17	Hall sensor connector X4 – Pin assignment	23
Table 3-18	Hall sensor cable	23
Table 3-19	Sensor 1 Hall sensor specification	24
Table 3-20	Sensor 2 connector X5 – Pin assignment	25
Table 3-21	Encoder cable	25
Table 3-22	Differential digital incremental encoder specification	26
Table 3-23	Single-ended digital incremental encoder specification	26
Table 3-24	SSI / BiSS C unidirectional absolute encoder specification	27
Table 3-25	Single-ended SSI / BiSS C unidirectional absolute encoder data channel specification	27
Table 3-26	Single-ended SSI / BiSS C unidirectional absolute encoder clock channel specification	28
Table 3-27	Encoder cable	29
Table 3-28	Differential high-speed digital inputs specification	29
Table 3-29	Single-ended high-speed digital inputs specification	30
Table 3-30	High-speed digital output specification	31
Table 3-31	Digital I/Os connector X7 – Pin assignment	32
Table 3-32	Signal cable 8core	33
Table 3-33	Digital inputs 1...2 specification	33
Table 3-34	Digital inputs 3...4 specification	34
Table 3-35	Digital outputs specification – Sinking	35
Table 3-36	Digital outputs specification – Sourcing	36
Table 3-37	Analog I/Os connector X8 – Pin assignment	36
Table 3-38	Signal cable 7core	37
Table 3-39	Analog inputs specification	37
Table 3-40	Analog output specification	38
Table 3-41	RS232 connector X10 – Pin assignment	39

Table 3-42	RS232-COM cable	39
Table 3-43	RS232 interface specification	39
Table 3-44	CAN 1 connector X11/CAN 2 connector X12 – Pin assignment	40
Table 3-45	CAN-CAN cable	40
Table 3-46	CAN-COM cable	40
Table 3-47	CAN interface specification	41
Table 3-48	USB Type C – Type C cable	41
Table 3-49	USB Type A – Type C cable	42
Table 3-50	USB interface specification	42
Table 3-51	Motor temperature sensor connector X16 – Pin assignment	42
Table 3-52	NTC cable	43
Table 3-53	Motor temperature sensor – specifications	43
Table 3-54	DIP switch SW1 – Binary code values	44
Table 3-55	DIP switch SW1 – Examples	45
Table 3-56	DIP switch SW1 – CAN automatic bit rate detection	46
Table 3-57	DIP switch SW1 – CAN bus termination	46
Table 3-58	Device status LEDs	47
Table 4-59	Possible combinations of feedback signals for DC motor	50
Table 4-60	Possible combinations of feedback signals for EC (BLDC) motor	50

INDEX

A

- alerts 6
 - CAUTION 6
 - DANGER 6
 - WARNING 6
- analog
 - inputs 37
 - outputs 38

B

- BiSS C 27
- BiSS C unidirectional absolute encoder 28
- bit rate
 - CAN 41
 - default 39, 41
 - detection 46
 - RS232 39

C

- cables (prefab)
 - CAN-CAN cable 40
 - CAN-COM cable 40
 - Encoder cable 25, 29
 - Hall sensor cable 23
 - Motor cable 22
 - NTC cable 43
 - Power cable 20
 - RS232-COM cable 39
 - Signal cable 7core 37
 - Signal cable 8core 33
 - USB Type A - Type C cable 42
 - USB Type C - Type C cable 41

CAN

- bit rate 41
- bus termination 41, 46
- ID (see "ID")
- interface 41
- choke, motor 9
- codes (used in this document) 6
- connections 18
- connector set 19
- connectors
 - X1 20
 - X10 39
 - X11 40
 - X12 40
 - X13 41
 - X16 42
 - X3 22
 - X4 23
 - X5 24
 - X7 32
 - X8 36
- country-specific regulations 8

D

- digital
 - inputs 33, 34
 - outputs 35, 36
- digital high-speed
 - inputs (differential) 29
 - inputs (single-ended) 30
 - output 31
- digital incremental encoder
 - (differential) 26
 - (single-ended) 26
- DIP switch SW1 44
- directive EU, applicable 17

E

- encoders
 - absolute 27
 - incremental 26
 - single-ended 27
 - SSI / BiSS C unidirectional absolute encoder 27
- ESD 8
- EU directive, applicable 17

H

- Hall sensor 23, 24
- high-speed digital
 - inputs (differential) 29
 - inputs (single-ended) 30
 - output 31
- how to
 - calculate the required supply voltage 21
 - interpret icons (and signs) used in this document 6

I

- ID (of the device) 44
- incorporation into surrounding system 17
- Incremental encoder 26
- informatory signs 6
- inputs
 - (differential) 29
 - (single-ended) 30
 - analog 37
 - digital 33, 34
 - high-speed digital 29
- interfaces
 - CAN 1 40
 - CAN 2 40
 - designation and location 49
 - RS232 39
 - USB 41
- internal motor chokes 9

L

- LED 47

M

mandatory action signs 6
Motion connector set 19
motor choke 9
motor connection 22
motor temperature sensor 42

N

Node-ID (see “ID”)
notations (used in this document) 6

O

outputs
 analog 38
 digital 35, 36
 high-speed digital 31

P

part numbers
 275829 20
 275851 22
 275878 23
 275934 25, 29
 520853 33
 520854 37
 520856 39
 520857 40
 520858 40
 809635 7, 9, 10
 834838 9, 10
 838461 42
 845854 41
 846644 19
 847301 43
 876085 12
performance data 9
pin assignment 20
power supply 20
precautions 8
prerequisites prior installation 17
prohibitive signs 6
purpose
 of the device 7
 of the document 5

R

RS232 39

S

safety alerts 6
safety first! 8
serial encoder 27
signs used 6
SSI 27
SSI absolute encoder 28
standards, fulfilled 15
status LEDs 47
supply voltage, required 21
SW1 44

symbols used 6

T

technical data 9
termination (CAN bus) 41, 46

U

USB 41

W

wiring examples
 analog I/Os 54
 CAN 55
 DC motor 52
 digital I/Os 54
 digital incremental encoder 53
 EC (BLDC) motor 52
 high-speed digital I/Os 54
 motor temperature sensor 56
 power supply 52
 RS232 55
 sensor 1 hall sensor 52
 sensor 2 encoder I/Os 53
 SSI / BiSS C unidirectional absolute encoder 53
 USB-A 56
 USB-C 56

••page intentionally left blank••

