maxon

# MAXPOS 50/5

## Hardware Reference


maxpos.maxongroup.com

MAXPOS 50/5 Positioning Controller | P/N 447293
Hardware Reference
CCMC | Edition 2019-08 | DocID rel8959

maxon

# TABLE OF CONTENTS



## READ THIS FIRST

***These instructions are intended for qualified technical personnel. Prior commencing with any activities****…*

- *you must carefully read and understand this manual and*
- *you must follow the instructions given therein.*

***The MAXPOS 50/5*** *is considered as partly completed machinery according to EU Directive 2006/42/EC, Article 2, Clause (g) and* ***is intended to be incorporated into or assembled with other machinery or other partly completed machinery or equipment****.*

***Therefore, you must not put the device into service****,…*

- *unless you have made completely sure that the other machinery fully complies with the EU directive's requirements!*
- *unless the other machinery fulfills all relevant health and safety aspects!*
- *unless all respective interfaces have been established and fulfill the herein stated requirements!*

# 1 ABOUT

## 1.1 About this Document

### 1.1.1 Intended Purpose

*Use the document to…*
***–stay safe,***
***–be fast,***
***–end up with set up and ready-to-go equipment.***

The purpose of the present document is to familiarize you with the MAXPOS 50/5 Positioning Controller. It will highlight the tasks for safe and adequate installation and/or commissioning. Follow the described instructions …

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

The present document is part of a documentation set and contains performance data and specifications, information on fulfilled standards, details on connections and pin assignment, and wiring examples. The below overview shows the documentation hierarchy and the interrelationship of its individual parts:

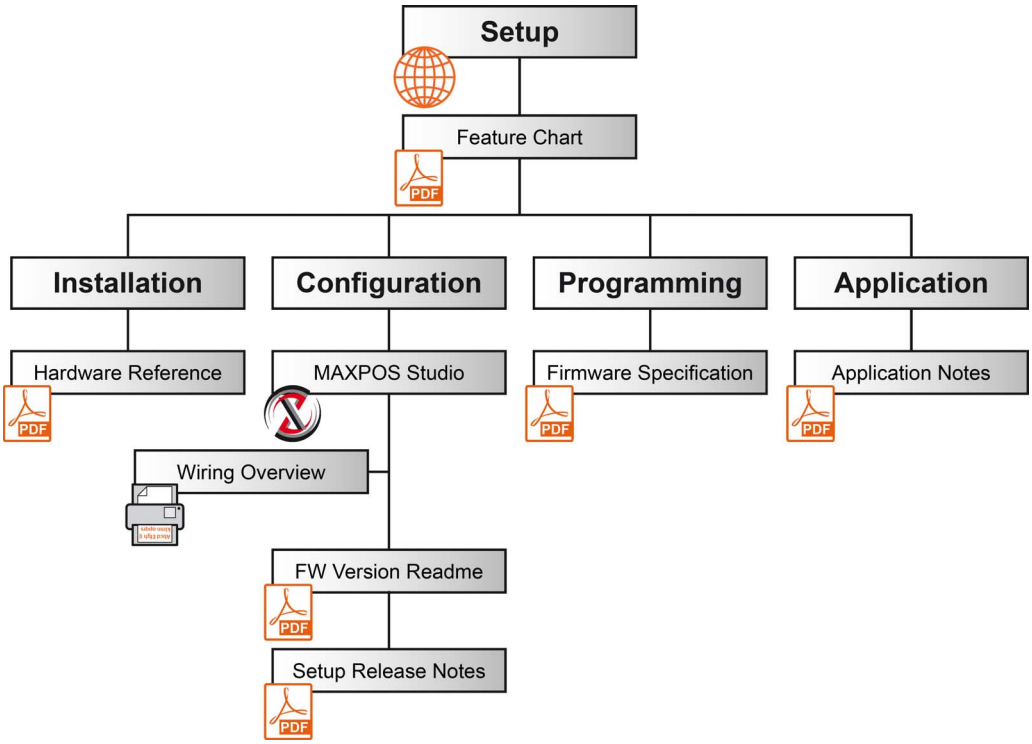


Figure 1-1 Documentation structure

### 1.1.2 Target Audience

The present document is intended for trained and skilled personnel. It conveys information on how to understand and fulfill the respective work and duties.

### 1.1.3 How to use

Take note of the following notations and codes which will be used throughout the document.

| Notation | Meaning |
|---|---|
| (n) | refers to an item (such as part numbers, list items, etc.) |
| ➔ | denotes “see”, “see also”, “take note of” or “go to” |

Table 1-1 Notation used

### 1.1.4 Symbols & Signs

In the course of the present document, the following symbols and signs will be used.

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

Table 1-2 Symbols and signs

### 1.1.5 Trademarks and Brand Names

For easier legibility, registered brand names are listed below and will not be further tagged with their respective trademark. It must be understood that the brands (the list below is not necessarily concluding) are protected by copyright and/or other intellectual property rights even if their legal trademarks are omitted in the later course of this document.

| Brand Name | Trademark Owner |
|---|---|
| Adobe® Reader® | © Adobe Systems Incorporated, USA-San Jose, CA |
| BiSS | © iC-Haus GmbH, DE-Bodenheim |
| EtherCAT® | © EtherCAT Technology Group, DE-Nuremberg, licensed by Beckhoff Automation GmbH, DE-Verl |
| Micro-Fit™<br>Mini-Fit Jr.™ | © Molex, USA-Lisle, IL |
| Pentium® | © Intel Corporation, USA-Santa Clara, CA |
| Windows® | © Microsoft Corporation, USA-Redmond, WA |

Table 1-3 Brand names and trademark owners

### 1.1.6 Copyright



CCMC | MAXPOS 50/5 Hardware Reference | Edition 2019-08 | DocID rel8959

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Brünigstrasse 220
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www.maxongroup.com

## 1.2 About the Device

*Capabilities of the device, included features, and supported motors.*

maxon's MAXPOS 50/5 is a fast and highly dynamic motion controller capable to efficiently control permanent magnet-activated brushed DC motors or brushless EC motors (BLDC) up to approximately 250 Watts. It is designed to support a multitude of feedbacks.

Field-oriented control offers the possibility to drive brushless EC motors with minimal torque ripple and low noise. A wide range of operating modes meet the highest requirements and allows flexible use in a variety of fields in industrial automation applications. The MAXPOS 50/5 is especially designed being commanded and controlled as a slave node in an EtherCAT network. In addition, the unit can be configured via USB interface.

Find the latest edition of the present document, as well as additional documentation and software to the MAXPOS Positioning Controller also on the Internet: ➔http://maxpos.maxongroup.com.

## 1.3 About the Safety Precautions

*Keep in mind:*
*Safety first!*
*Always!*

- Make sure that you have read and understood the note “READ THIS FIRST” on page A-2!
- Do not engage with any work unless you possess the stated skills (➔chapter “1.1.2 Target Audience” on page 1-3)!
- Refer to ➔chapter “1.1.4 Symbols & Signs” on page 1-4 to understand the subsequently used indicators!
- You must observe any regulation applicable in the country and/or at the site of implementation with regard to health and safety/accident prevention and/or environmental protection!

**DANGER**

***High Voltage and/or Electrical Shock***
***Touching live wires causes death or serious injuries!***
- *Consider any power cable as connected to live power, unless having proven the opposite!*
- *Make sure that neither end of cable is connected to live power!*
- *Make sure that power source cannot be engaged while work is in process!*
- *Obey lock-out/tag-out procedures!*
- *Make sure to securely lock any power engaging equipment against unintentional engagement and tag it with your name!*

***Requirements***
- *Make sure that all associated devices and components are installed according to local regulations.*
- *Be aware that, by principle, an electronic apparatus can not be considered fail-safe. Therefore, you must make sure that any machine/apparatus has been fitted with independent monitoring and safety equipment. If the machine/apparatus should break down, if it is operated incorrectly, if the control unit breaks down or if the cables break or get disconnected, etc., the complete drive system must return – and be kept – in a safe operating mode.*
- *Be aware that you are not entitled to perform any repair on components supplied by maxon.*

***Electrostatic Sensitive Device (ESD)***
- *Wear working cloth and use equipment in compliance with ESD protective measures.*
- *Handle device with extra care.*

# 2 SPECIFICATIONS

## 2.1 Technical Data

| MAXPOS 50/5 (447293) | | |
|---|---|---|
| Electrical Rating | Nominal power supply voltage $+V_{CC}$ | 10…50 VDC |
| | Nominal logic supply voltage $+V_C$ | 10…50 VDC |
| | Absolute supply voltage $+V_{min}$ / $+V_{max}$ | 8 VDC / 56 VDC |
| | Output voltage (max.) | 0.95 x $+V_{CC}$ |
| | Output current $I_{cont}$ / $I_{max}$ (<1.5 s) | 5 A / 15 A |
| | Pulse width modulation frequency | 100 kHz |
| | Sampling rate PI – current controller | 100 kHz (10 µs) |
| | Sampling rate PID – speed controller | 10 kHz (100 µs) |
| | Sampling rate PID – positioning controller | 10 kHz (100 µs) |
| | Max. efficiency | 96% |
| | Max. speed DC motor | limited by max. permissible speed (motor) and max. output voltage (controller) |
| | Max. speed EC motor (sinusoidal) | 200'000 rpm (1 pole pair) |
| | Built-in motor choke | 3 x 10 µH; 5 A |
| Inputs & Outputs | Digital Input 1 *1)<br>Digital Input 2 *1)<br>Digital Input 3 *1)<br>Digital Input 4 *1)<br>Digital Input 5 / STO-IN1 *1)<br>Digital Input 6 / STO-IN2 *1)<br>Logic/PLC<br>$+V_{DigIN}$<br>$+V_{DigOUT}$ | +2.4…+24 VDC (PLC/Logic)<br>+2.4…+24 VDC (PLC/Logic)<br>+2.4…+24 VDC (PLC/Logic)<br>+2.4…+24 VDC (PLC/Logic)<br>+9…+24 VDC (PLC)<br>+9…+24 VDC (PLC)<br>Configuration of Logic or PLC level at DigIN1…4<br>+5…+24 VDC<br>+5…+24 VDC |
| | Digital Output 1 *1)<br>Digital Output 2 *1)<br>Digital Output 3 *1)<br>Digital Output 4 / STO-OUT *1) | +5…+24 VDC ($I_L$ ≤500 mA)<br>+5…+24 VDC ($I_L$ ≤500 mA)<br>+5…+24 VDC ($I_L$ ≤500 mA)<br>+5…+24 VDC ($I_L$ ≤500 mA) |
| | Hall sensor signals | H1, H2, H3 for Hall effect sensor ICs (Schmitt trigger with open collector output) |
| | Digital incremental encoder signals | A, A\, B, B\, I, I\ (max. 5 MHz) |
| | Sensor signals<br>• Analog incremental encoder<br>• Digital incremental encoder<br>• Serial encoder (SSI / BiSS C*2)) | A, A\, B, B\, I, I\, Clock+, Clock−, Data+, Data− |

Continued on next page.

| MAXPOS 50/5 (447293) | | | |
|---|---|---|---|
| **Voltage Outputs** | Hall sensor supply voltage | +5 VDC ($I_L$ ≤30 mA) | |
| | Encoder supply voltage | +5 VDC ($I_L$ ≤70 mA) | |
| | Sensor supply voltage | +5 VDC ($I_L$ ≤150 mA) | |
| | Auxiliary output voltage $+V_{OUT}$ | $+V_{cc}$ > 30 VDC: $+V_{OUT}$ = +24 VDC ($I_L$ ≤300 mA)<br>$+V_{cc}$ < 30 VDC: $+V_{OUT}$ = $+V_{CC}$ − 5 V ($I_L$ ≤300 mA) | |
| **Motor Connections** | DC motor | + Motor, − Motor | |
| | EC motor | Motor winding 1, Motor winding 2, Motor winding 3 | |
| **Interfaces** | EtherCAT Input<br>EtherCAT Output | Full duplex (100 Mbit/s) as to IEEE 802.3 100 Base T | |
| | USB 2.0 / USB 3.0 | Full speed | |
| **Status Indicators** | Axis Status | Bicolor LED (red/green) | |
| | EtherCAT Status | Bicolor LED (red/green) | |
| | EtherCAT Port Activity/Link State | LED (green) | |
| **Physical** | Weight | approx. 302 g | |
| | Dimensions (L x W x H) | 140 x 103.5 x 27 mm | |
| | Mounting holes | for M4 screws | |
| **Environment** | Temperature | Operation | −30…+45 °C |
| | | Extended range *3) | +45…+56 °C<br>Derating ➔Figure 2-2 |
| | | Storage | −40…+85 °C |
| | Altitude *4) | Operation | 0…6'000 m MSL |
| | | Extended range *3) | 6'000…10'000 m MSL<br>Derating ➔Figure 2-2 |
| | Humidity | 5…90% (condensation not permitted) | |

*1) Galvanic isolation.
*2) BiSS encoders must support bidirectional communication.
*3) Operation within the extended range (temperature and altitude) is permitted. However, a respective derating (declination of output current $I_{cont}$) as to the stated values will apply.
*4) Operating altitude in meters above Mean Sea Level, MSL.

Table 2-4 Technical data

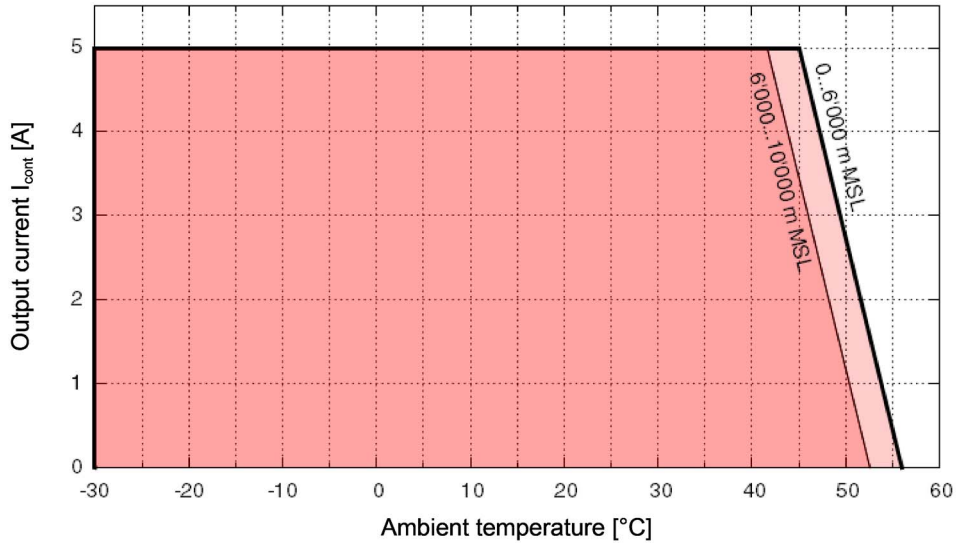



Figure 2-2 Derating output current

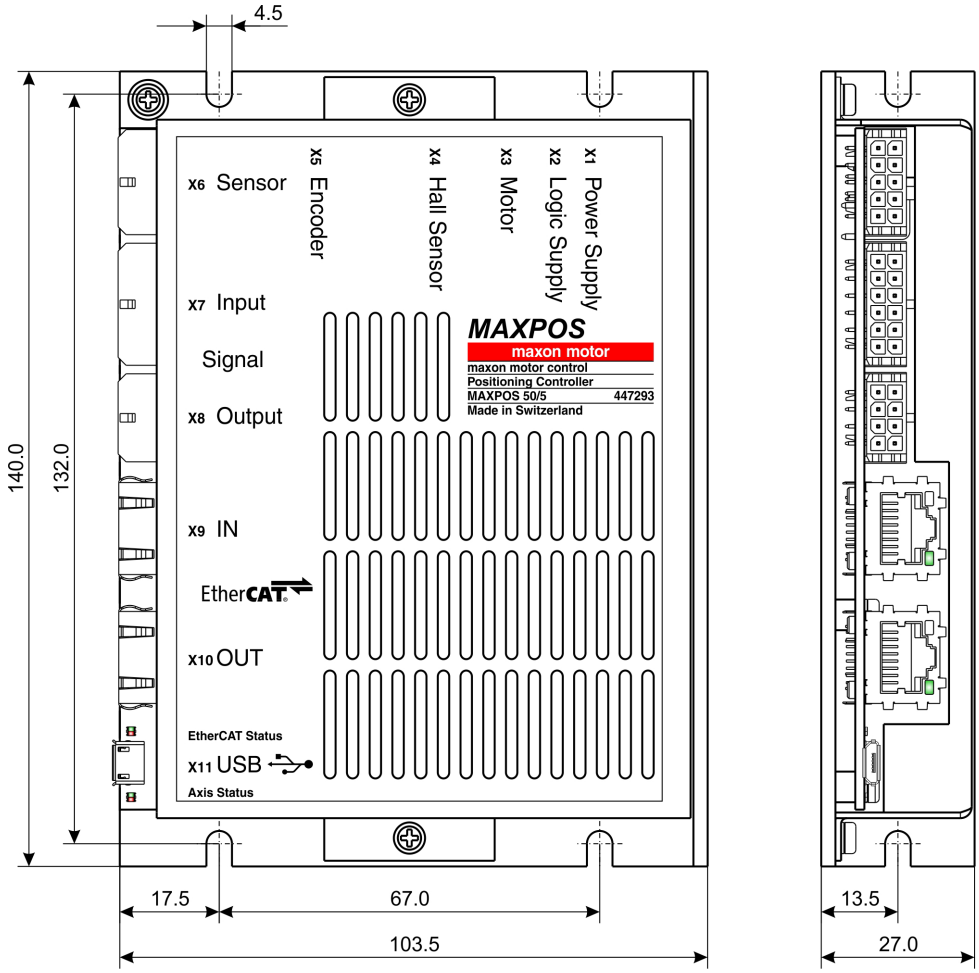



Figure 2-3 Dimensional drawing [mm]

## 2.2 Standards

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

***Important Notice***

*The device's compliance with the mentioned standards does not imply its compliance within the final, ready to operate setup. In order to achieve compliance of your operational system, you must perform EMC testing of the involved equipment as a whole.*

| Electromagnetic Compatibility | | |
|---|---|---|
| **Generic** | 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 (CISPR22) | Radio disturbance characteristics / radio interference |
| | IEC/EN 61000-4-2 | Electrostatic discharge immunity test 8 kV/6 kV |
| | IEC/EN 61000-4-3 | Radiated, radio-frequency, electromagnetic field immunity test >10 V/m |
| | IEC/EN 61000-4-4 | Electrical fast transient/burst immunity test ±2 kV |
| | IEC/EN 61000-4-6 | Immunity to conducted disturbances, induced by radio-frequency fields 10 Vrms |
| | IEC/EN 61000-4-8 | Power frequency magnetic filed 30 A/m |

| 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 E76251, E207844, E229342, and E243951; unassembled printed circuit board | |
| **Reliability** | MIL-HDBK-217F | Reliability prediction of electronic equipment<br>Environment: Ground, benign (GB)<br>Ambient temperature: 298 K (25 °C)<br>Component stress: In accordance with circuit diagram and nominal power<br>Mean Time Between Failures (MTBF): 149'081 hours |

Table 2-5 Standards

# 3 SETUP

Important Notice: Prerequisites for Permission to commence Installation

**The MAXPOS 50/5** is considered as partly completed machinery according to EU Directive 2006/42/EC, Article 2, Clause (g) and **is intended to be incorporated into or assembled with other machinery or other partly completed machinery or equipment**.

**WARNING**

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

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

## 3.1 Generally applicable Rules

***Maximal permitted Supply Voltage***

- *Make sure that supply power is between 10…50 VDC.*
- *Supply voltages above 56 VDC, or wrong polarity will destroy the unit.*
- *Note that the necessary output current is depending on the load torque. Yet, the output current limits of the MAXPOS 50/5 are as follows; continuous max. 5 A / short-time (acceleration) max. 15 A.*

***Hot plugging the USB interface may cause hardware damage***

*If the USB interface is being hot-plugged (connecting while the power supply is on), the possibly high potential differences of the two power supplies of controller and PC/Notebook can lead to damaged hardware.*

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

***How to read the Wiring Details***

*The subsequent description follows this scheme:*

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

## 3.2 Tools

| Tool | Manufacturer | Part Number |
|---|---|---|
| Hand crimper (63819-0000) for female crimp terminals | Molex | 430-30-xxxx |
| Hand crimper (63819-0900) for female crimp terminals | Molex | 444-76-xxxx |

Table 3-6 Recommended tools

## 3.3 Cabling

*Get an overview on interfaces, connections, and available accessories.*

Here you can get the connection information required to commission your MAXPOS 50/5. You will find all details for both approaches, Plug&Play and making your own cables.

**PLUG&PLAY**

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

a) Check the «Cable Selector» (➔Table 3-7) to find the cable assemblies' part number matching the setup you will be using.

b) Follow the cross-reference to get the cable assemblies' pin assignment.

**MAKE&BAKE YOUR OWN**

a) Check the «Cable Selector» (➔Table 3-7) to find the required cables for the setup you will be using.

b) Follow the cross-reference to get the cable's specification and pin assignment.

c) Use the installation kit (➔page 3-42) containing plugs and terminals that will fit the controller's sockets. Thereby, make sure to use tools as recommended (➔page 3-11).

| Socket | Cable | | |
|---|---|---|---|
| | Part number | Designation | ➔Page |
| X1 | 275829 | Power Cable | 3-14 |
| X2 | 275829 | Power Cable | 3-16 |
| X3 | 275851 | Motor Cable | 3-17 |
| X4 | 275878 | Hall Sensor Cable | 3-20 |
| X5 | 275934 | Encoder Cable | 3-22 |
| X6 | 451290 | Sensor Cable 5x2core | 3-25 |
| X7 | 451291 | Signal Cable 12core | 3-29 |
| X8 | 451292 | Signal Cable 8core | 3-35 |
| X9 | 422827 | Ethernet Cable | 3-39 |
| X10 | 422827 | Ethernet Cable | 3-39 |
| X11 | 403968 | USB Type A - micro B Cable | 3-41 |

Table 3-7 Cable selector

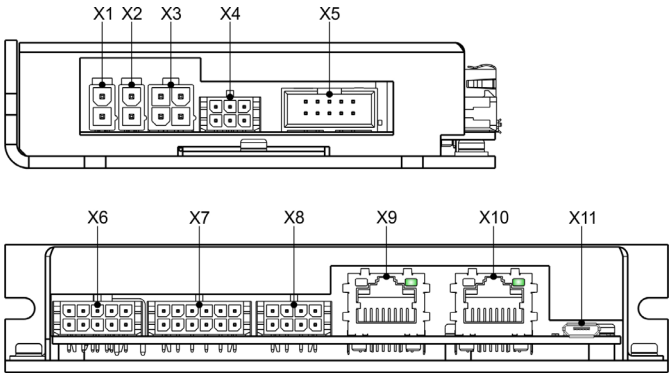



Figure 3-4 Interfaces – Designations and location

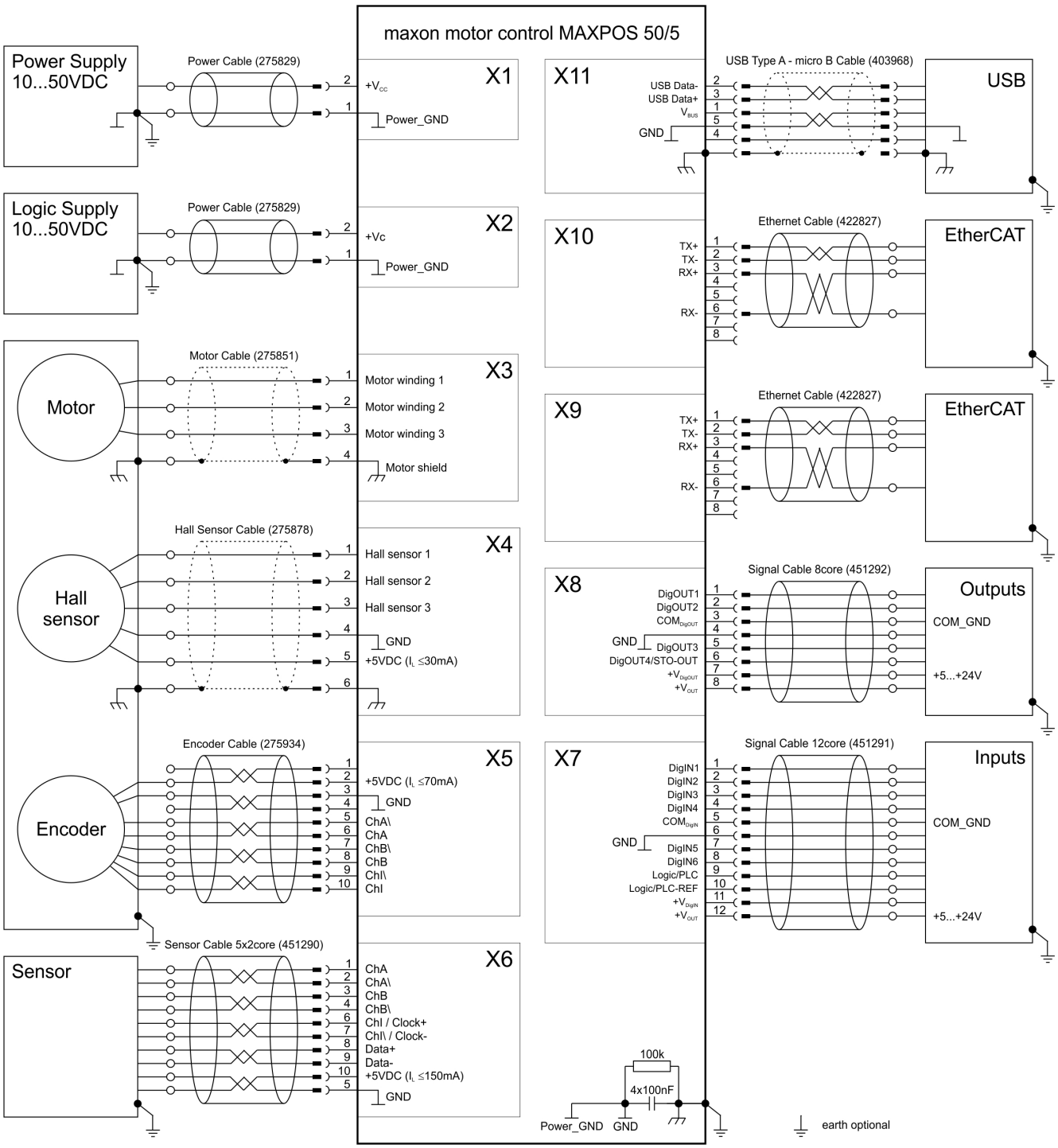



Figure 3-5 Wiring diagram

## 3.4 Connections

*Follow in given order to cover all subjects.*

The actual connection will depend on the overall configuration of your drive system and the type of motor you will be using.

Follow the description in given order and choose the connection scheme that suits the respective components you are using. For corresponding wiring diagrams ➔chapter “4 Wiring” on page 4-45.

### 3.4.1 Power Supply (X1)

Basically, any power supply may be used, provided it meets the below stated minimal requirements.

| Power Supply Requirements | |
|---|---|
| Nominal power supply voltage | $+V_{CC}$ 10…50 VDC |
| Absolute supply voltage | min. 8 VDC; max. 56 VDC |
| Output current | Depending on load<br>• continuous max. 5 A<br>• short-time (acceleration, <1.5 s) max. 15 A |

Table 3-8 Power supply requirements

Proceed as follows to determine the required voltage under load:

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

***Note***
*The formula already takes the following into account:*
- *Maximum PWM duty cycle of 95%*
- *Controller’s max. voltage drop of 1 V @ 5 A*

**KNOWN VALUES:**

- Operating torque M [mNm]
- Operating speed n [rpm]
- Nominal motor voltage $U_N$ [Volt]
- Motor no-load speed at $U_N$, $n_0$ [rpm]
- Speed/torque gradient of the motor $\Delta n/\Delta M$ [rpm/mNm]

**SOUGHT VALUE:**

- Power supply voltage $+V_{CC}$ [Volt]

**SOLUTION:**

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

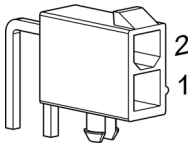



Figure 3-6 Power supply plug X1

| X1 & Head A Pin | Prefab Cable Color | Head B Pin | Signal | Description |
|---|---|---|---|---|
| 1 | black | – | Power_GND | Ground of supply voltage |
| 2 | black | + | $+V_{CC}$ | Power supply voltage (10…50 VDC) |

Table 3-9 Power supply plug X1 – Pin assignment

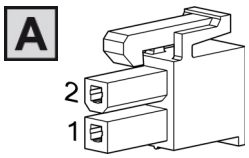
| Power Cable (275829) | | |
|---|---|---|
|   | | |
| Cross-section | 2 x 0.75 mm², grey | |
| Length | 3 m | |
| Head A | Plug | Molex Mini-Fit Jr., 2 poles (39-01-2020) |
| | Contacts | Molex Mini-Fit Jr. female crimp terminals (444-76-xxxx) |
| Head B | Cable end sleeves 0.75 mm² | |

Table 3-10 Power Cable

### 3.4.2 Logic Supply (X2)

By default, the logic is powered by the regular supply voltage. Optionally, you may wish to feed the logic supply voltage separately, permitting a safe and economical power backup feature. Basically, any power supply may be used, provided it meets the below stated minimal requirements.

| Power Supply Requirements | |
|---|---|
| Output voltage | $+V_C$ 10…50 VDC |
| Absolute supply voltage | min. 8 VDC; max. 56 VDC |
| Min. output power | $P_C$ min. 6.5 W |

Table 3-11 Logic supply requirements

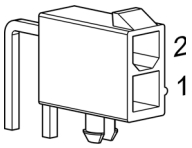



Figure 3-7 Logic supply plug X2

| X2 & Head A Pin | Prefab Cable Color | Head B Pin | Signal | Description |
|---|---|---|---|---|
| 1 | black | – | Power_GND | Ground of supply voltage |
| 2 | black | + | $+V_C$ | Logic supply voltage (10…50 VDC) |

Table 3-12 Logic supply plug X2 – Pin assignment

For details on the matching Power Cable ➔Table 3-10.

### 3.4.3 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.

***Note***
*If you are using a **maxon DC motor with integrated motor/encoder ribbon cable**, you will need to **change the jumpers JP1 and JP2** (➔"Hardware Settings" on page 3-18)!*

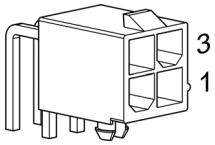



Figure 3-8 Motor plug X3

| X3 & Head A Pin | Prefab Cable Color | Head B Pin | Signal | Description |
|---|---|---|---|---|
| 1 | white | | Motor (+M)<br>Motor winding 1 | DC motor: Motor +<br>EC motor: Winding 1 |
| 2 | brown | | Motor (−M)<br>Motor winding 2 | DC motor: Motor −<br>EC motor: Winding 2 |
| 3 | green | | Motor winding 3 | EC motor: Winding 3 |
| 4 | black | | Motor shield | Cable shield |

Table 3-13 Motor plug X3 – Pin assignment

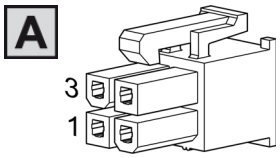
| Motor Cable (275851) | | |
|---|---|---|
|   | | |
| Cross-section | 3 x 0.75 mm² shielded, grey | |
| Length | 3 m | |
| Head A | Plug | Molex Mini-Fit Jr., 4 poles (39-01-2040) |
| | Contacts | Molex Mini-Fit Jr. female crimp terminals (444-76-xxxx) |
| Head B | Cable end sleeves 0.75 mm² | |

Table 3-14 Motor Cable

### 3.4.3.1 Hardware Settings

**JUMPERS**

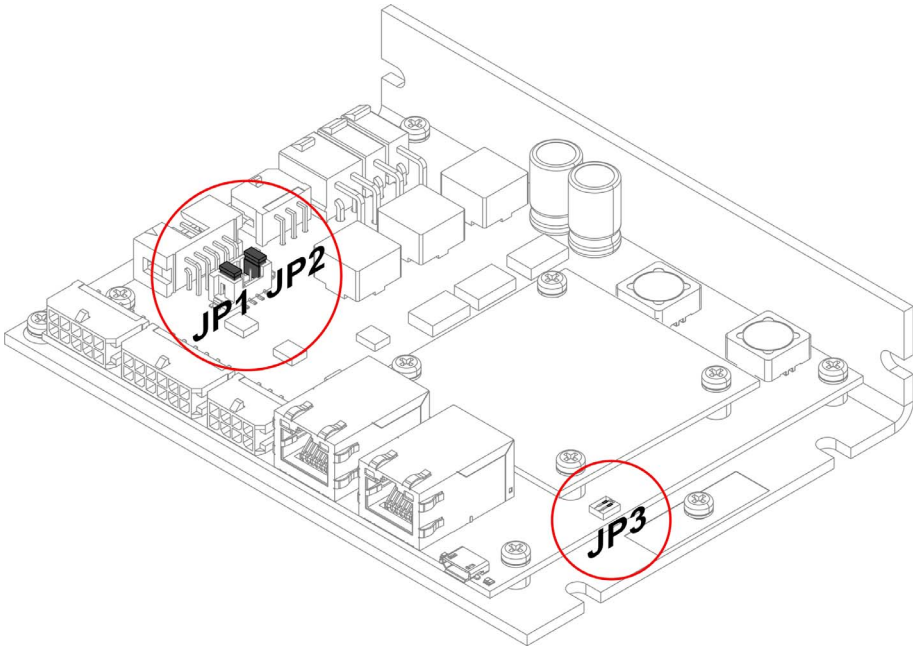



Figure 3-9 Jumpers – Location and factory setting

**JUMPERS JP1 & JP2**

If you are using a maxon DC motor with integrated motor/encoder ribbon cable, you will need to change the jumpers JP1 and JP2. Proceed as follows:

***STOP!***
*Check on safety precautions before continuing (➔page 1-6).*

1) Open housing and find jumpers JP1 and JP2.
2) Set jumpers JP1 and JP2 to “closed” position (➔Figure 3-10, right).

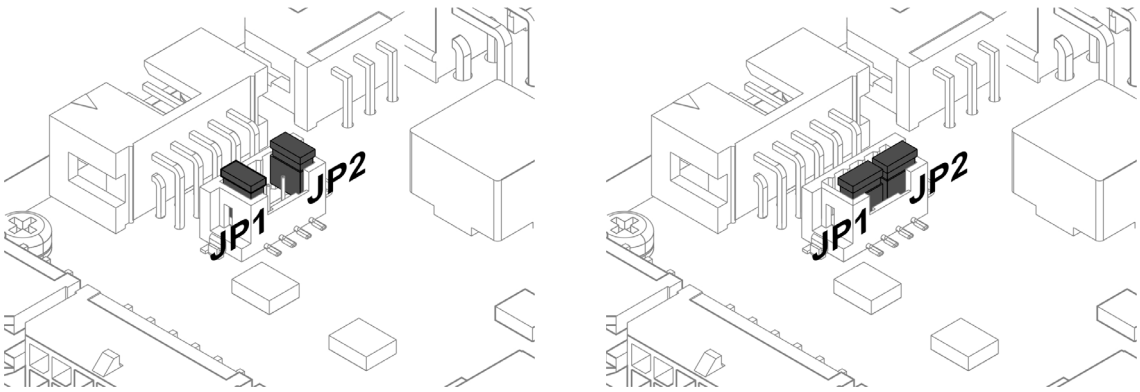



Figure 3-10 Jumpers JP1/JP2 – OPEN; factory setting (left) / CLOSED (right)

3) For encoder connections ➔chapter “3.4.5 Encoder (X5)” on page 3-22.

**JUMPER JP3**

To assign digital inputs 5 and 6 as «Safe Torque OFF (STO)» signal inputs, you will need to set jumper JP3 accordingly (for location ➔Figure 3-9).

1) Set both jumper switches 1 and 2 “OFF”.
2) For corresponding input/output connections ➔chapter “3.4.7.2 Digital Inputs (PLC Level)” on page 3-30 and ➔chapter “3.4.8.2 Digital Outputs” on page 3-36.


Figure 3-11 Jumper JP3 – ON; factory setting (left) / OFF; STO activated (right)

### 3.4.4 Hall Sensor (X4)

Suitable Hall effect sensors IC use «Schmitt trigger» with open collector output.

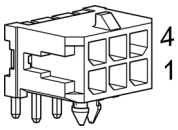



Figure 3-12 Hall sensor plug X4

| X4 & Head A Pin | Prefab Cable Color | Head B Pin | Signal | Description |
|---|---|---|---|---|
| 1 | green | | Hall sensor 1 | Hall sensor 1 input |
| 2 | brown | | Hall sensor 2 | Hall sensor 2 input |
| 3 | white | | Hall sensor 3 | Hall sensor 3 input |
| 4 | yellow | | GND | Ground |
| 5 | grey | | +5 VDC | Hall sensor supply voltage (+5 VDC; $I_L$ ≤30 mA) |
| 6 | black | | Hall shield | Cable shield |

Table 3-15 Hall sensor plug X4 – Pin assignment

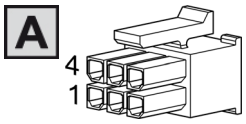
| Hall Sensor Cable (275878) | | |
|---|---|---|
|   | | |
| Cross-section | 5 x 0.14 mm² shielded, grey | |
| Length | 3 m | |
| Head A | Plug | Molex Micro-Fit 3.0, 6 poles (430-25-0600) |
| | Contacts | Molex Micro-Fit 3.0 female crimp terminals (430-30-xxxx) |
| Head B | Cable end sleeves 0.14 mm² | |

Table 3-16 Hall Sensor Cable

Continued on next page.

| Hall Sensor | |
|---|---|
| Hall sensor supply voltage | +5 VDC |
| Max. Hall sensor supply current | 30 mA |
| Input voltage | 0…24 VDC |
| Max. input voltage | +24 VDC |
| Logic 0 | typically <0.8 V |
| Logic 1 | typically >2.4 V |
| Internal pull-up resistor | 2.7 kΩ (against +5.65 V − 0.6 V) |

Table 3-17 Hall sensor specification

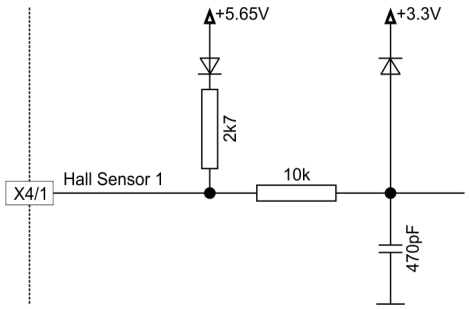



Figure 3-13 Hall sensor 1 input circuit (analogously valid for Hall sensors 2 & 3)

### 3.4.5 Encoder (X5)

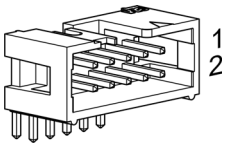



Figure 3-14 Encoder socket X5

| X5 & Head A Pin | Prefab Cable Color | Head B Pin | Signal | Description |
|---|---|---|---|---|
| 1 | brown | 1 | DC motor: Motor +<br>EC motor: none | DC motor: + Motor (➔Remark below)<br>EC motor: not connected |
| 2 | white | 2 | +5 VDC | Encoder supply voltage (+5 VDC; ≤70 mA) |
| 3 | red | 3 | GND | Ground |
| 4 | white | 4 | DC motor: Motor −<br>EC motor: none | DC motor: − Motor (➔Remark below)<br>EC motor: not connected |
| 5 | orange | 5 | Channel A\ | Channel A complement |
| 6 | white | 6 | Channel A | Channel A |
| 7 | yellow | 7 | Channel B\ | Channel B complement |
| 8 | white | 8 | Channel B | Channel B |
| 9 | green | 9 | Channel I\ | Channel I complement |
| 10 | white | 10 | Channel I | Channel I |

Table 3-18 Encoder socket X5 – Pin assignment

***Remark***
*May require change of jumper (JP1/JP2) settings (➔"Hardware Settings" on page 3-18).*

***Best Practice***
- *The use of encoder with built-in Line Driver is mandatory.*
- *Even though 2-channel will do, we strongly recommend to use only 3-channel versions!*
- *Implemented are three high-speed RS422 receivers featuring fault detection circuitry and fault status outputs. The receivers' inputs feature fault thresholds that detect the device's "not in valid state".*
- *The receivers indicate whether a receiver input is in open circuit condition (except index channel), short-circuit condition, or beyond the common mode range (smaller −10 V or higher +13.2 V). They also generate a fault indication if the differential input voltage drops below the 475 mV threshold.*
- *By default, the controller is set for a 500 counts per turn encoder. For other encoders, you will need to adjust respective settings via software.*

Continued on next page.

| Encoder Cable (275934) | |
|---|---|
|  | |
| Cross-section | 10 x AWG28, round-jacket, twisted pair flat cable, pitch 1.27 mm, grey |
| Length | 3.20 m |
| Head A | DIN 41651 female, pitch 2.54 mm, 10 poles, with strain relief |
| Head B | DIN 41651 Plug, pitch 2.54 mm, 10 poles, with strain relief |

Table 3-19 Encoder Cable

| Accessories | | |
|---|---|---|
| Suitable strain relief | Retainer | For sockets with strain relief:<br>1 retainer clip, height 13.5 mm, 3M (3505-8110) |
| | | For sockets without strain relief:<br>1 retainer clip, height 7.9 mm, 3M (3505-8010) |
| | Latch | For sockets with strain relief: 2 pieces, 3M (3505-33B) |

Table 3-20 Encoder socket X5 – Accessories

| Encoder | |
|---|---|
| Encoder supply voltage | +5 VDC |
| Max. encoder supply current | 70 mA |
| Min. differential input voltage | ±475 mV |
| Line receiver (internal) | EIA RS422 Standard |
| Max. encoder input frequency | 5 MHz |

Table 3-21 Encoder specification

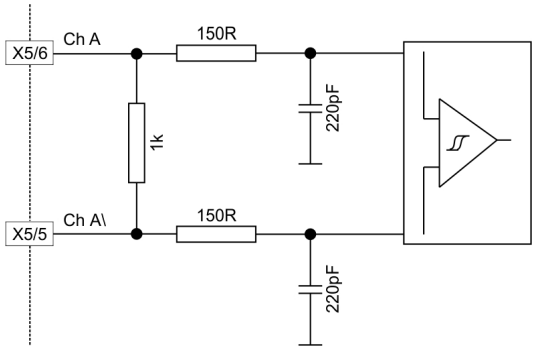



Figure 3-15 Encoder input circuit Ch A (analogously valid for Ch B)

Continued on next page.

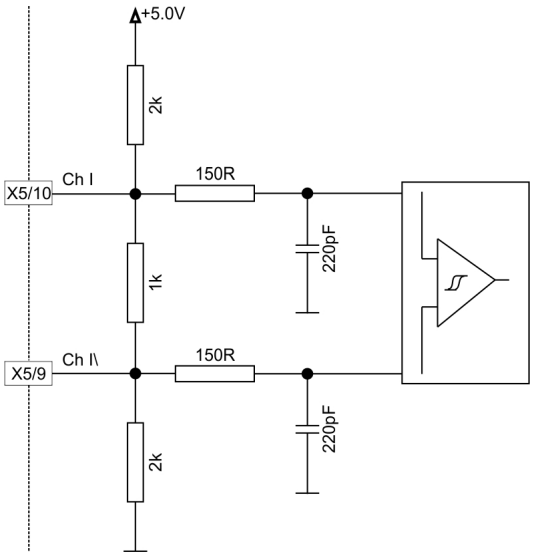



Figure 3-16 Encoder input circuit Ch I

### 3.4.6 Sensor (X6)

Additional sensors, both, incremental and serial encoders can be connected.

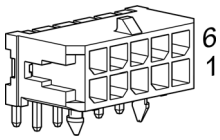



Figure 3-17 Sensor plug X6

| X6 & Head A Pin | Prefab Cable Color | Head B Pin | Signal | Description |
|---|---|---|---|---|
| 1 | white | | Channel A | Channel A |
| 2 | brown | | Channel A\ | Channel A complement |
| 3 | green | | Channel B | Channel B |
| 4 | yellow | | Channel B\ | Channel B complement |
| 5 | grey | | GND | Signal ground |
| 6 | blue | | Channel I | Channel I / Clock+ |
| 7 | red | | Channel I\ | Channel I complement / Clock− |
| 8 | black | | Data+ | Data+ |
| 9 | violet | | Data− | Data− |
| 10 | pink | | +5 VDC | Sensor supply voltage (+5 VDC; ≤150 mA) (➔Remark below) |

Table 3-22 Sensor plug X6 – Pin assignment

***Remark***

*Check on the applied sensor's data sheet. If the specified inrush current or the maximum continuous current of the sensor should exceed 150 mA, you can connect the encoder supply voltage (X5) or the Hall sensor supply voltage (X4) in parallel to the sensor supply voltage.*

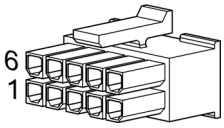
| Sensor Cable 5x2core (451290) | | |
|---|---|---|
| A  B | | |
| Cross-section | 5 x 2 x 0.14 mm², grey | |
| Length | 3 m | |
| Head A | Plug | Molex Micro-Fit 3.0, 10 poles (430-25-1000) |
| | Contacts | Molex Micro-Fit 3.0 female crimp terminals (430-30-xxxx) |
| Head B | Cable end sleeves 0.14 mm² | |

Table 3-23 Sensor Cable 5x2core

### 3.4.6.1 Incremental Encoders

| Digital Incremental Encoder | |
|---|---|
| Sensor voltage | +5 VDC |
| Max. sensor supply current | 150 mA |
| Min. differential input voltage | ±200 mV |
| Line receiver (internal) | EIA RS422 Standard |
| Max. encoder input frequency | 5 MHz |

Table 3-24 Digital incremental encoder specification

| Analog Incremental Encoder | |
|---|---|
| Sensor voltage | +5 VDC |
| Max. sensor supply current | 150 mA |
| Input voltage | ±1.8 V (differential) |
| Max. input voltage | ±12 VDC |
| Common mode voltage | −1…+4 VDC (referenced to GND) |
| Input resistance | 120 Ω |
| A/D converter | 12-bit |
| Resolution | 0.88 mV |
| Bandwidth | 50 kHz |

Table 3-25 Analog incremental encoder specification

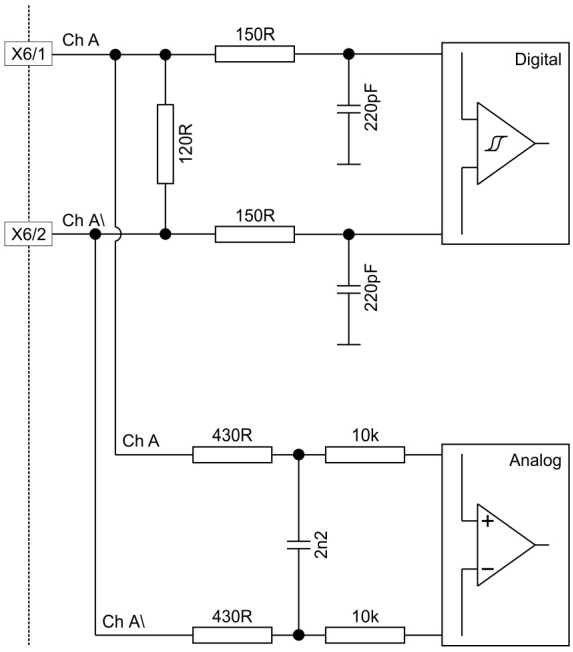



Figure 3-18 Incremental encoder – Sensor input circuit Ch A (analogously valid for Ch B)

Continued on next page.

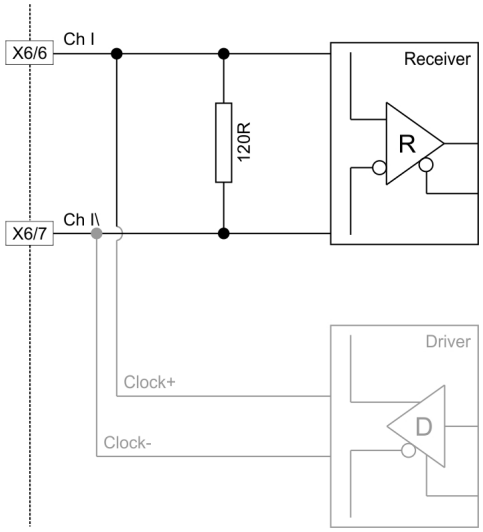



Figure 3-19 Incremental encoder – Sensor input circuit Ch I and clock output

### 3.4.6.2 Serial Encoders

| Serial Encoder | |
|---|---|
| Sensor voltage | +5 VDC |
| Max. sensor supply current | 150 mA |
| Min. differential input voltage | ±200 mV |
| Min. differential output voltage | ±1.5 V @ external load R=120 Ω |
| Max. output current | 60 mA |
| Line receiver (internal) | EIA RS485 Standard |
| Max. encoder input/output frequency | 16 MHz |

Table 3-26 Serial encoder specification

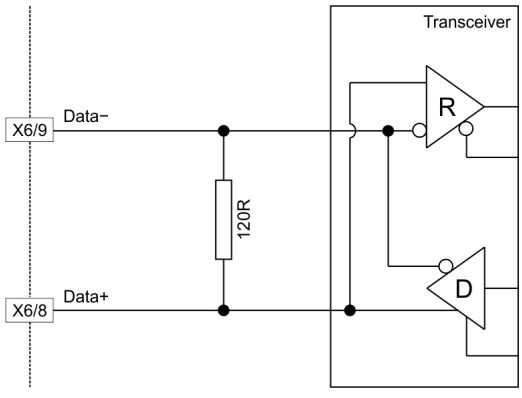



Figure 3-20 Serial encoder – Data circuit

Continued on next page.

| Clock Output | |
|---|---|
| Min. differential output voltage | ±1.5 V @ external load R=120 Ω |
| Max. output current | 60 mA |
| Line transceiver (internal) | EIA RS485 Standard |
| Max. output frequency | 16 MHz |

Table 3-27 Clock output specification

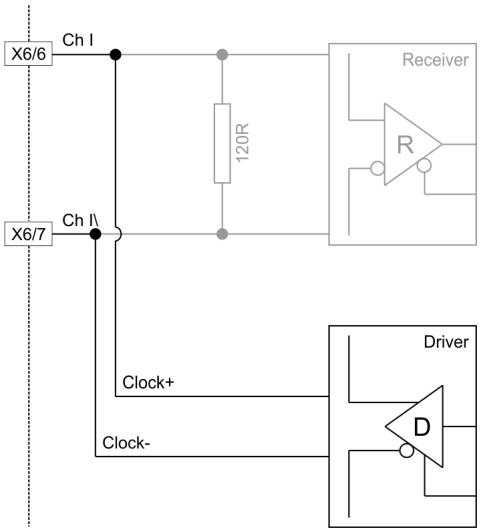



Figure 3-21 Serial encoder – Clock output

### 3.4.7 Signal Input (X7)

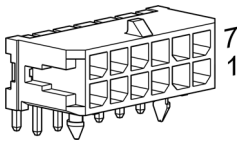



Figure 3-22 Signal input plug X7

| X7 & Head A Pin | Prefab Cable Color | Head B Pin | Signal | Description |
|---|---|---|---|---|
| 1 | white | | DigIN1 | Digital input 1 |
| 2 | brown | | DigIN2 | Digital input 2 |
| 3 | green | | DigIN3 | Digital input 3 |
| 4 | yellow | | DigIN4 | Digital input 4 |
| 5 | grey | | $COM_{DigIN}$ | Common signal to DigIN1…6 |
| 6 | pink | | GND | Signal ground |
| 7 | blue | | DigIN5/ STO-IN1 | Digital input 5 Safe Torque OFF input signal 1 |
| 8 | red | | DigIN6/ STO-IN2 | Digital input 6 Safe Torque OFF input signal 2 |
| 9 | black | | Logic/PLC | Configuration of Logic or PLC level at DigIN1…4 |
| 10 | violet | | Logic/PLC-REF | ➔Table 3-26 and Table 3-28 |
| 11 | grey/ pink | | $+V_{DigIN}$ | External supply input voltage for DigIN1…6 (+5…+24 VDC) |
| 12 | red/blue | | $+V_{OUT}$ | Auxiliary output voltage |

Table 3-28 Signal input plug X7 – Pin assignment

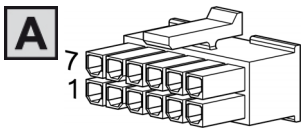
| Signal Cable 12core (451291) | | |
|---|---|---|
|   | | |
| Cross-section | 12 x 0.14 mm², grey | |
| Length | 3 m | |
| Head A | Plug | Molex Micro-Fit 3.0, 12 poles (430-25-1200) |
| | Contacts | Molex Micro-Fit 3.0 female crimp terminals (430-30-xxxx) |
| Head B | Cable end sleeves 0.14 mm² | |

Table 3-29 Signal Cable 12core

#### 3.4.7.1 Supply Voltage for DigINs

For galvanic isolated digital inputs, an external supply voltage must be applied. Basically, any power supply may be used, provided it meets the below stated minimal requirements.

| Supply Voltage for DigINs | |
|---|---|
| Supply voltage for DigINs $+V_{DigIN}$ | External supply input voltage for DigIN1…6 (+5…+24 VDC) |
| Min. current | 25 mA |

Table 3-30 Supply voltage for DigINs

#### 3.4.7.2 Digital Inputs (PLC Level)

| DigIN1…4 | |
|---|---|
| Type of input | Galvanic isolated, single-ended |
| Input voltage | +24 VDC |
| Max. input voltage | ±30 VDC |
| Logic 0 | $U_{in}$ <5 VDC |
| Logic 1 | $U_{in}$ >9 VDC |
| Input current at logic 1 | >1.5 mA @ 5 VDC<br>>2.0 mA @ 9 VDC<br>typically 2.6 mA @ 24 VDC |
| Switching delay | <2 µs @ 24 VDC |

Table 3-31 DigIN1…4 specification (PLC level)

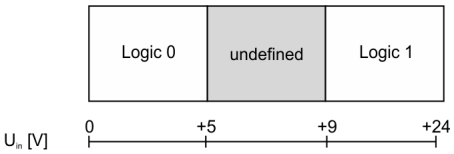



Figure 3-23 DigIN1…6 PLC Level

| DigIN5…6 | |
|---|---|
| Type of input | Galvanic isolated, single-ended |
| Input voltage | +24 VDC |
| Max. input voltage | ±30 VDC |
| Logic 0 | $U_{in}$ <5 VDC |
| Logic 1 | $U_{in}$ >9 VDC |
| Input current at logic 1 | >1.5 mA @ 5 VDC<br>>2.0 mA @ 9 VDC<br>typically 2.6 mA @ 24 VDC |
| Switching delay | <2 µs @ 24 VDC |

Table 3-32 DigIN5…6 specification (PLC level)

Continued on next page.

By default, the galvanic isolated digital inputs 5 and 6 are defined as “general purpose inputs” and may be configured for «Safe Torque OFF» by internal DIP switch. For location ➔chapter “3.4.3.1 Hardware Settings” on page 3-18, for corresponding output configuration ➔chapter “3.4.8.2 Digital Outputs” on page 3-36, “DigOUT4”.

- DIP switch JP3, switches 1 and 2 “ON” (factory setting): Safe Torque OFF deactivated
- DIP switch JP3, switches 1 and 2 “OFF”: Safe Torque OFF activated

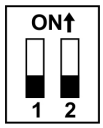



Figure 3-24 DIP Switch JP3 – Activation of DigIN5…6

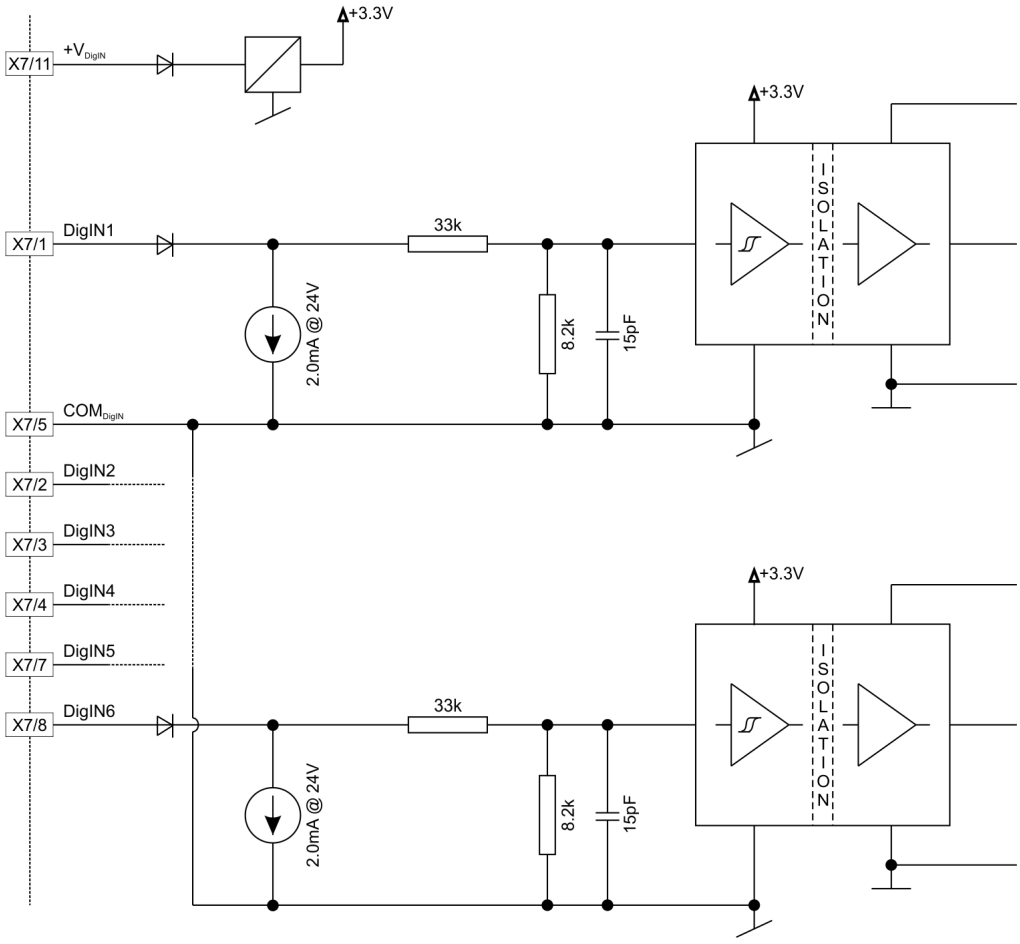



Figure 3-25 DigIN1…6 input circuit – PLC level

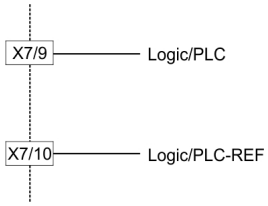



Figure 3-26 PLC Level (not connected)

### 3.4.7.3 Digital Inputs (Logic Level)

For external wire bridge details of DigIN1…4 in Logic level ➔Figure 3-28.

| DigIN1…4 | |
|---|---|
| Type of input | Galvanic isolated, single-ended |
| Input voltage | +2.4…+24 VDC |
| Max. input voltage | ±30 VDC |
| Logic 0 | <0.8 VDC |
| Logic 1 | >2.4 VDC |
| Input current at logic 1 | typically 2 mA @ 5 VDC |
| Switching delay | <2 µs @ 5 VDC |

Table 3-33 DigIN1…4 specification (logic level)

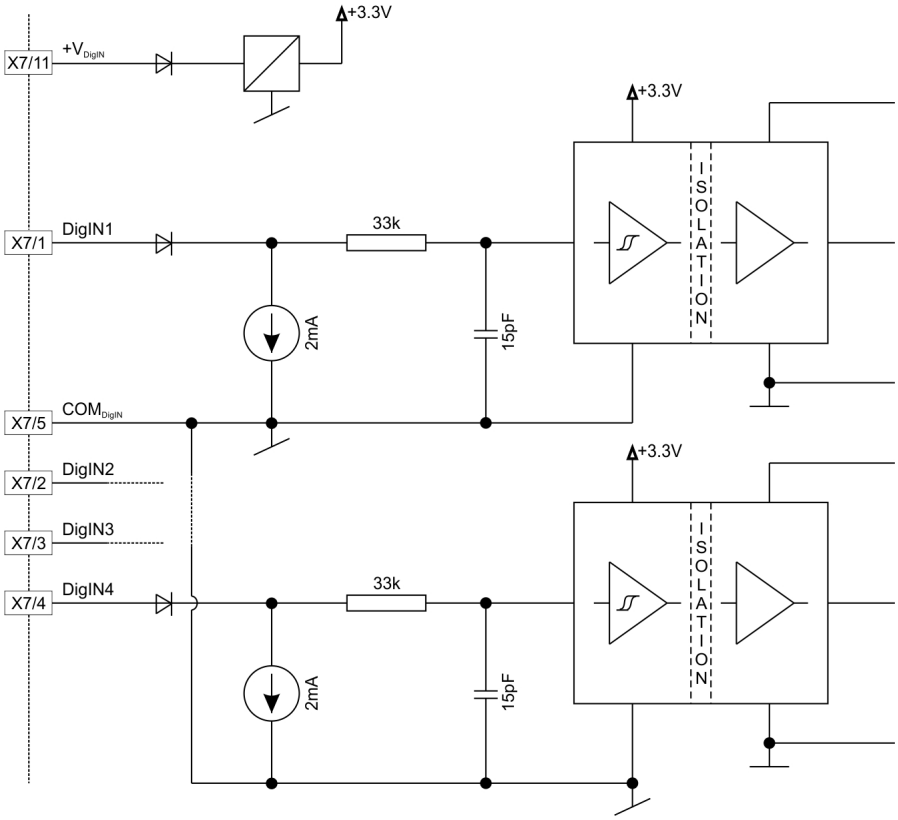



Figure 3-27 DigIN1…4 input circuit – Logic level

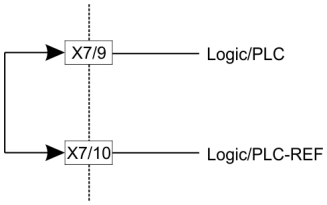



Figure 3-28 Logic level (connected)

Continued on next page.

**WIRING EXAMPLE: DIFFERENT TYPES OF PROXIMITY SWITCHES**

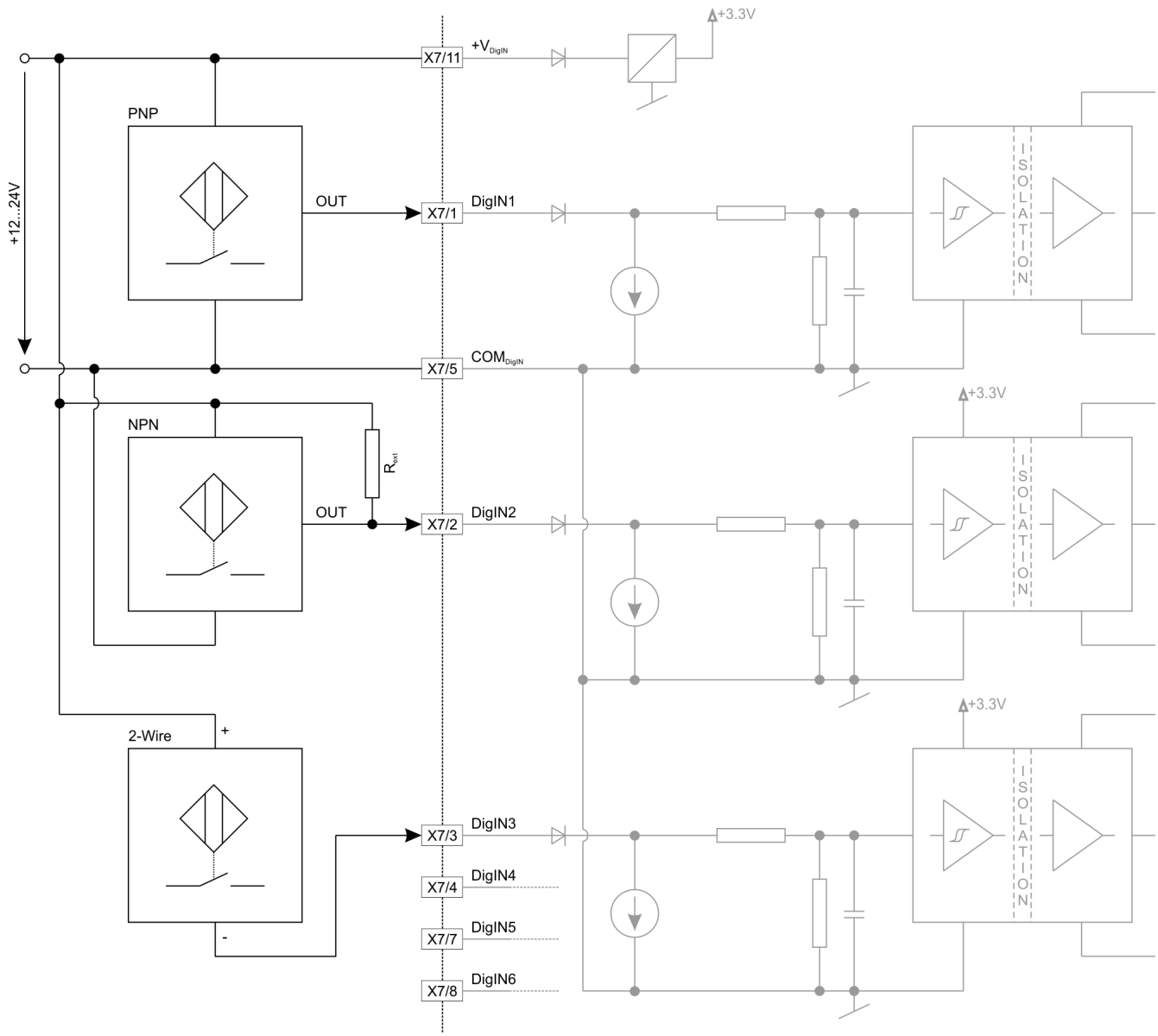



Figure 3-29 DigIN1…6 input circuit – Examples for external wiring

***Best Practice***

- *Preferably, use 3-wire PNP proximity switches.*
- *Using 3-wire NPN proximity switches requires an additional pull-up resistor.*
  *$R_{ext}$ (12 V) = 1000 Ω (200 mW)*
  *$R_{ext}$ (24 V) = 3300 Ω (200 mW)*
- *By principle, using 2-wire proximity switches is possible.*

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### SUPPLY OF INPUTS WITHOUT GALVANIC ISOLATION

For galvanic isolated digital inputs, an external supply voltage must be applied. If no external power supply is available, the device's auxiliary output voltage ($+V_{OUT}$) may be used. Thereby, galvanic isolation will be lost. For external wire bridge details ➔Figure 3-30.

| Auxiliary Output Voltage | |
|---|---|
| Output voltage | $+V_{cc}$ > 30 VDC: $+V_{OUT}$ = +24 VDC<br>$+V_{cc}$ < 30 VDC: $+V_{OUT}$ = $+V_{CC}$ − 5 V |
| Max. current | 300 mA |

Table 3-34 Analog output voltage specification

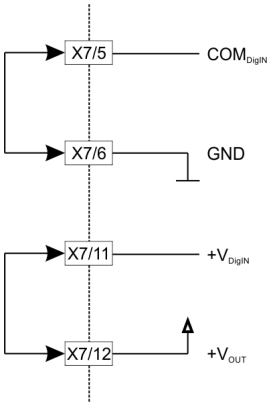



Figure 3-30 Input supply without galvanic separation

### 3.4.8 Signal Output (X8)

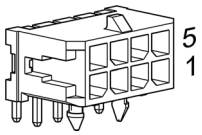



Figure 3-31 Signal output plug X8

| X8 & Head A Pin | Prefab Cable Color | Head B Pin | Signal | Description |
|---|---|---|---|---|
| 1 | white | | DigOUT1 | Digital output 1 |
| 2 | brown | | DigOUT2 | Digital output 2 |
| 3 | green | | $COM_{DigOUT}$ | Common signal to DigOUT |
| 4 | yellow | | GND | Signal ground |
| 5 | grey | | DigOUT3 | Digital output 3 |
| 6 | pink | | DigOUT4/ STO-OUT | Digital output 4<br>Safe Torque OFF output signal |
| 7 | blue | | $+V_{DigOUT}$ | External supply input voltage for DigOUT1…4 (+5…+24 VDC) |
| 8 | red | | $+V_{OUT}$ | Auxiliary output voltage |

Table 3-35 Signal output plug X8 – Pin assignment

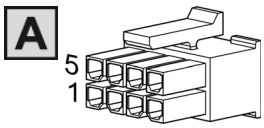
| Signal Cable 8core (451292) | | |
|---|---|---|
|  | | |
| Cross-section | 8 x 0.14 mm², grey | |
| Length | 3 m | |
| Head A | Plug | Molex Micro-Fit 3.0, 8 poles (430-25-0800) |
| | Contacts | Molex Micro-Fit 3.0 female crimp terminals (430-30-xxxx) |
| Head B | Cable end sleeves 0.14 mm² | |



Table 3-36 Signal Cable 8core

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#### 3.4.8.1 Supply Voltage for DigOUTs

For galvanic isolated digital outputs, an external supply voltage must be applied. Basically, any power supply may be used, provided it meets the below stated minimal requirements.

| Supply Voltage for DigOUTs | |
|---|---|
| Supply voltage for DigOUTs $+V_{DigOUT}$ | External supply input voltage for DigOUT1…4 (+5…+24 VDC) |
| Min. current | 20…2000mA (depending on load) |

Table 3-37 DigOUT supply voltage specification

#### 3.4.8.2 Digital Outputs

| DigOUT1…3 | |
|---|---|
| Type of output | Galvanic isolated, open source |
| Output voltage | $U_{out} \geq (+V_{DigOUT} - 0.2\ V)$ |
| Max. load current | $I_{load} \leq 500$ mA |
| Leakage current | $I_{leak} \leq 10$ µA |
| Switching delay (rising edge) | <50 µs @ 24 VDC; $I_{load} \leq 10$ mA |
| Switching delay (falling edge) | <200 µs @ 24 VDC; $I_{load} \leq 10$ mA |
| Max. load inductance | 175 mH @ 500 mA |

Table 3-38 DigOUT1…3 specifications

| DigOUT4 | |
|---|---|
| Type of output | Galvanic isolated, open source |
| Output voltage | $U_{out} \geq (+V_{DigOUT} - 0.2\ V)$ |
| Max. load current | $I_{load} \leq 500$ mA |
| Leakage current | $I_{leak} \leq 10$ µA |
| Switching delay (rising edge) | <50 µs @ 24 VDC; $I_{load} \leq 10$ mA |
| Switching delay (falling edge) | <200 µs @ 24 VDC; $I_{load} \leq 10$ mA |
| Max. load inductance | 175 mH @ 500 mA |

Table 3-39 DigOUT4 specifications

By default, the galvanic isolated digital output 4 is defined as “general purpose output” and may be configured for «Safe Torque OFF» by internal DIP switch. For location ➔chapter “3.4.3.1 Hardware Settings” on page 3-18. For corresponding input configuration ➔chapter “3.4.7.2 Digital Inputs (PLC Level)” on page 3-30, “DigIN5…6”.

- DIP switch JP3, switches 1 and 2 “ON” (factory setting): Safe Torque OFF deactivated
- DIP switch JP3, switches 1 and 2 “OFF”: Safe Torque OFF activated

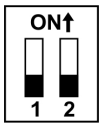



Figure 3-32 DIP switch JP3 – Activation of DigOUT4

Continued on next page.

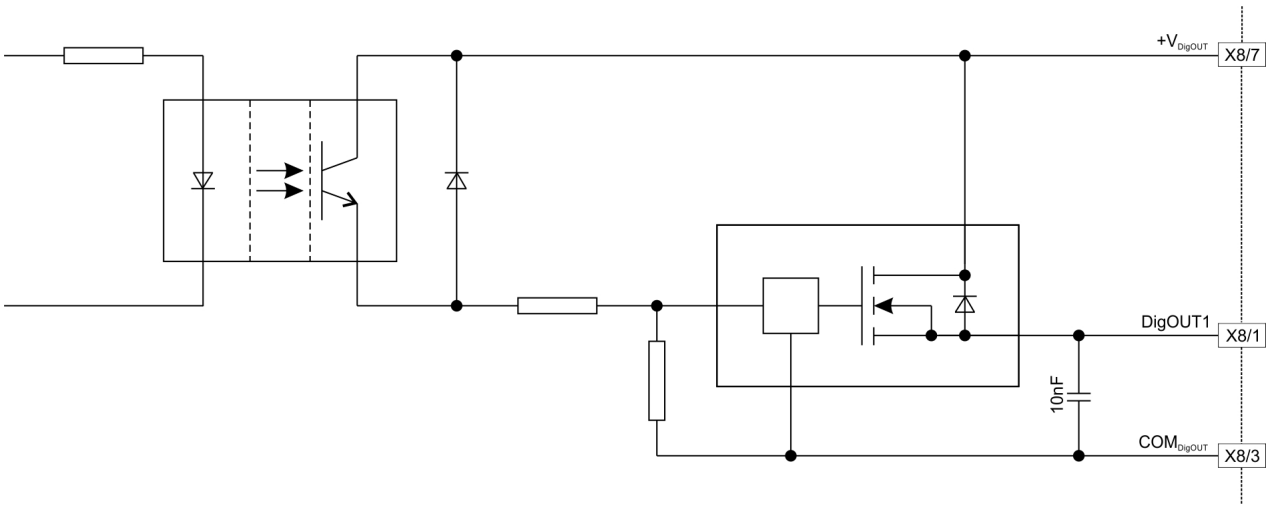



Figure 3-33 DigOUT1 output circuit (analogously valid for DigOUT2…4)

**WIRING EXAMPLE: PERMANENT MAGNET BRAKE**

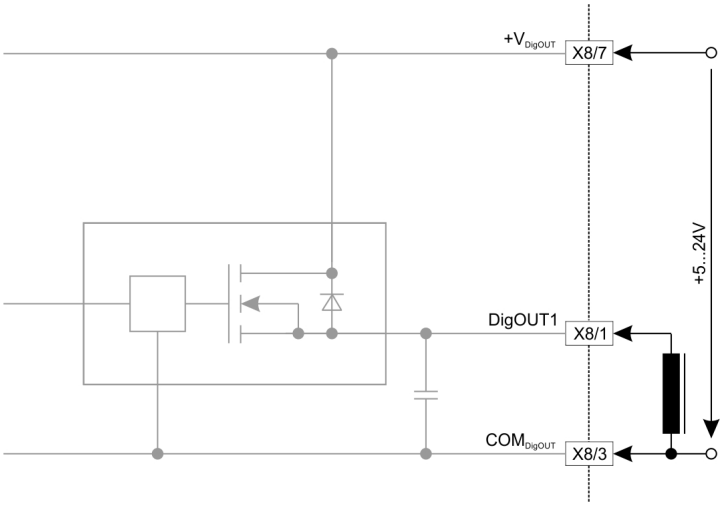



Figure 3-34 DigOUT1 output circuit – Example for permanent magnet brake

Continued on next page.

### WIRING EXAMPLE: LED / LOGIC / RELAY / PLC INPUT

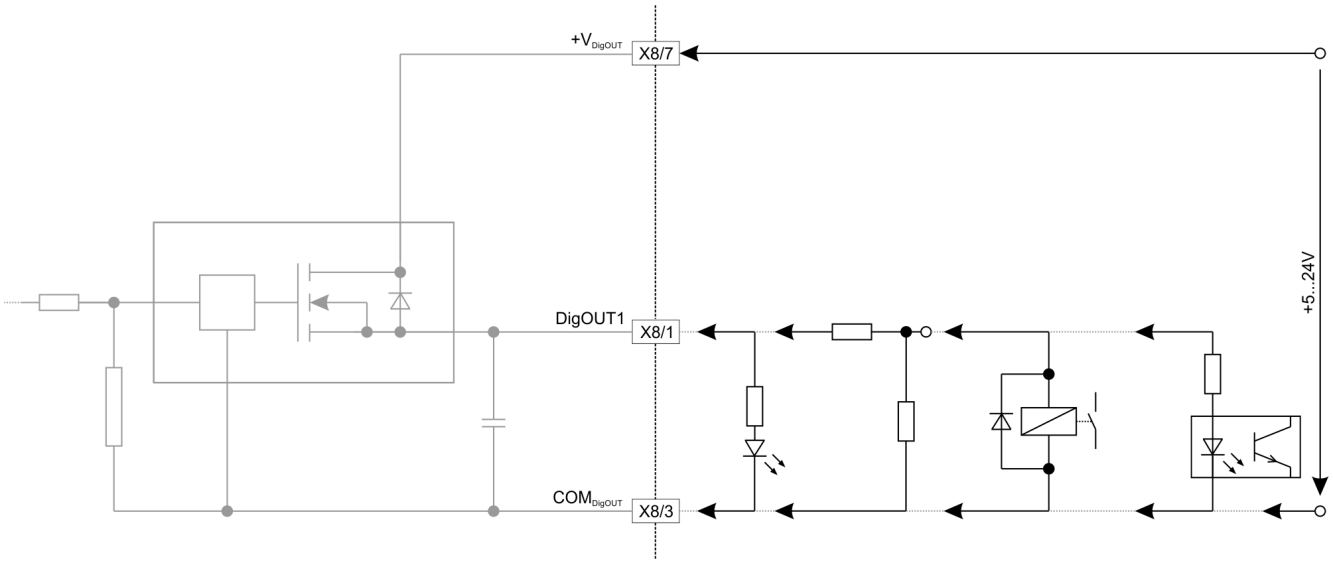



Figure 3-35 DigOUT1 output circuit – Example for LED, logic, relay, PLC input

### SUPPLY OF OUTPUTS WITHOUT GALVANIC ISOLATION

For galvanic isolated digital outputs, an external supply voltage must be applied. If no external power supply is available, the device's auxiliary output voltage ($+V_{OUT}$) may be used. Thereby, optical isolation will be lost. For external wire bridge details ➔Figure 3-36.

| Auxiliary Output Voltage | |
|---|---|
| Output voltage | $+V_{cc}$ > 30 VDC: $+V_{OUT}$ = +24 VDC<br>$+V_{cc}$ < 30 VDC: $+V_{OUT}$ = $+V_{CC}$ − 5 V |
| Max. current | 300 mA |

Table 3-40 Auxiliary output voltage specification

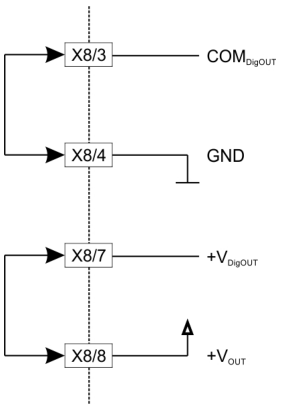



Figure 3-36 Output supply without optical separation

### 3.4.9 EtherCAT IN (X9) and EtherCAT OUT (X10)

The MAXPOS 50/5 features two EtherCAT sockets, one for input, the other for output. Both sockets are identical in respect to external wiring. In the subsequent description, only “EtherCAT IN (X9)” will be used which is analogously valid also for “EtherCAT OUT (X10)”.

***Potential Damage***

*Even though both EtherCAT sockets are prepared for identical external wiring, make sure to always connect them as follows:*

- *Use EtherCAT IN (X9) as «Input».*
- *Use EtherCAT OUT (X10) as «Output».*

*For detailed information ➔separate document «MAXPOS Communication Guide».*

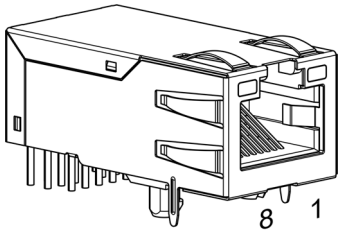



Figure 3-37 EtherCAT IN socket X9

| X9 & Head A Pin | Prefab Cable Color | Head B Pin | Signal | Description |
|---|---|---|---|---|
| 1 | white/ orange | 1 | TX+ | Transmission Data+ |
| 2 | orange | 2 | TX− | Transmission Data− |
| 3 | white/ green | 3 | RX+ | Receive Data+ |
| 4 | blue | 4 | n/a | not available |
| 5 | white/ blue | 5 | n/a | not available |
| 6 | green | 6 | RX− | Receive Data− |
| 7 | white/ brown | 7 | n/a | not available |
| 8 | brown | 8 | n/a | not available |

Table 3-41 EtherCAT IN socket X9 – Pin assignment

Continued on next page.

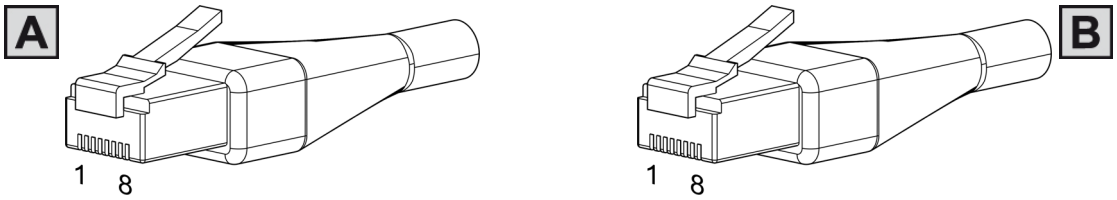
| Ethernet Cable (422827) | |
|---|---|
|  | |
| Cross-section | Cat. 5e SF/UTP (ISO/IEC 11801), 1:1 patch cable, green |
| Length | 2 m |
| Head A | RJ45 (8P8CS) EIA/TIA-568B |
| Head B | RJ45 (8P8CS) EIA/TIA-568B |

Table 3-42 Ethernet Cable

| EtherCAT | |
|---|---|
| Standard | IEEE 802.3 100 Base T |
| Max. bit rate | 100 Mbit/s (Full Duplex) |

Table 3-43 EtherCAT specifications

### 3.4.10 USB (X11)

***Hot plugging the USB interface may cause hardware damage***

*If the USB interface is being hot-plugged (connecting while the power supply is on), the possibly high potential differences of the two power supplies of controller and PC/Notebook can lead to damaged hardware.*

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

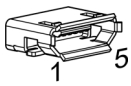



Figure 3-38 USB socket X11

***Note***

*Column "Head B" (➔Table 3-44) refers to USB terminals of your PC.*

| X11 & Head A Pin | Prefab Cable Color | Head B Pin | Signal | Description |
|---|---|---|---|---|
| 1 | | 1 | $V_{BUS}$ | USB BUS supply voltage input +5 VDC |
| 2 | | 2 | USB D− | USB Data− (twisted pair with Data+) |
| 3 | | 3 | USB D+ | USB Data+ (twisted pair with Data−) |
| 4 | | − | ID | not connected |
| 5 | | 4 | GND | USB ground |

Table 3-44 USB socket X11 – Pin assignment

| USB Type A - micro B Cable (403968) | |
|---|---|
|  | |
| Cross-section | According to USB 2.0 / USB 3.0 specification |
| Length | 1.5 m |
| Head A | USB Type "micro B", male |
| Head B | USB Type "A", male |

Table 3-45 USB Type A - micro B Cable

Continued on next page.

| USB | |
|---|---|
| USB Standard | USB 2.0 / USB 3.0 (full speed) |
| Max. bus supply voltage | +5.25 VDC |
| Typical input current | 20 mA |
| Max. DC data input voltage | −0.5…+3.8 VDC |

Table 3-46 USB specifications

### 3.4.11 MAXPOS 50/5 Connector Set

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

| Content of MAXPOS 50/5 Connector Set (451746) | | |
|---|---|---|
| **Socket** | **Specification** | **Quantity** |
| X1, X2 | Molex Mini-Fit Jr. 2 poles (39-01-2020) | 2 |
| X3 | Molex Mini-Fit Jr. 4 poles (39-01-2040) | 1 |
| X4 | Molex Micro-Fit 3.0 6 poles (430-25-0600) | 1 |
| X6 | Molex Micro-Fit 3.0 10 poles (430-25-1000) | 1 |
| X7 | Molex Micro-Fit 3.0 12 poles (430-25-1200) | 1 |
| X8 | Molex Micro-Fit 3.0 8 poles (430-25-0800) | 1 |
| X1, X2, X3 | Molex Mini-Fit Jr. female crimp terminals (444-76-xxxx) | 10 |
| X4, X6, X7, X8 | Molex Micro-Fit 3.0 female crimp terminals (430-30-xxxx) | 38 |
| X5 | 3M Retainer Clip with Strain Relief, H = 13.5mm (3505-8110) | 1 |

Table 3-47 MAXPOS 50/5 Connector Set – Content

***Best Practice***

*If you should decide not to use the ready-made cable assemblies, we strongly suggest that you use the recommended tools (➔"Tools" on page 3-11).*

## 3.5 Status Indicators

The MAXPOS 50/5 features three sets of LED indicators to display the device condition:

A Axis Status LEDs indicate operating status and error conditions

B EtherCAT Status LEDs indicate errors and RUN state conditions

C EtherCAT Port LEDs indicates port activity

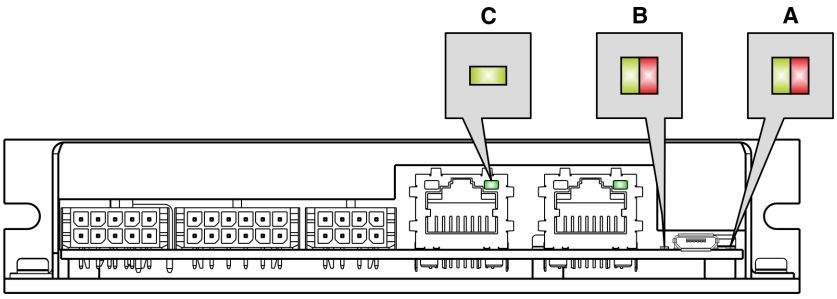



Figure 3-39 Status LEDs – Location

***For detailed information ➔separate document «MAXPOS Firmware Specification».***

### 3.5.1 Axis Status LEDs

The LEDs (➔Figure 3-39; **A**) display the actual status and possible errors of the MAXPOS:

- Green LED shows the status
- Red LED indicates errors

| LED | | Status / Error |
|---|---|---|
| **Green** | **Red** | |
| Slow | OFF | Power stage is disabled. MAXPOS is in status…<br>• "Switch ON Disabled"<br>• "Ready to Switch ON"<br>• "Switched ON" |
| ON | OFF | Power stage is enabled. MAXPOS is in status…<br>• "Operation Enable"<br>• "Quick Stop Active" |
| OFF | ON | FAULT state. MAXPOS is in status…<br>• "Fault" |
| ON | ON | Power stage is enabled. MAXPOS is in temporary status…<br>• "Fault Reaction Active" |
| Flash | ON | No valid firmware or firmware download in progress |
| Flash = Flashing (≈0.9 s OFF/≈0.1 s ON)<br>Slow = Slow blinking (≈1 Hz) | | |

Table 3-48 Axis status LEDs

### 3.5.2 EtherCAT Status LEDs

The LEDs (➔Figure 3-39; **B**) display the actual status and possible errors of the MAXPOS in respect to the EtherCAT network:

- Red LED indicates errors
- Green LED shows the RUN states

| LED | | Status / Error |
|---|---|---|
| Green | Red | |
| OFF | — | MAXPOS is in state INIT |
| Blink | — | MAXPOS is in state PRE-OPERATIONAL |
| Single flash | — | MAXPOS is in state SAFE-OPERATIONAL |
| ON | — | MAXPOS is in state OPERATIONAL |
| — | OFF | MAXPOS is in operating condition |
| — | Double flash | An application watchdog timeout has occurred.<br>Example: Timeout of Sync Manager Watchdog. |
| — | Single flash | MAXPOS has changed the EtherCAT state due to internal error.<br>*Example: Change of state "Op" to "SafeOpError" due to Sync Error.* |
| — | Blink | General Configuration Error<br>*Example: State change commanded by master is not possible due to actual settings (register, object, hardware configuration).* |
| Blink = continuous blinking (≈5 Hz)<br>Flash = Flashing (≈5 Hz), followed by pause of 1 second | | |

Table 3-49 EtherCAT status LEDs

### 3.5.3 EtherCAT Port LEDs

The LED (➔Figure 3-39; **C**) displays the actual status of the MAXPOS's EtherCAT ports (applies for both ports, X9 "IN" and X10 "OUT"):

- Green LED shows the link states

| LED<br>Green | Status |
|---|---|
| OFF | Port is closed |
| Flicker | Port is open / activity present |
| ON | Port is open |
| Flicker = continuous flickering (≈1 Hz) | |

Table 3-50 EtherCAT port LEDs

# 4 WIRING

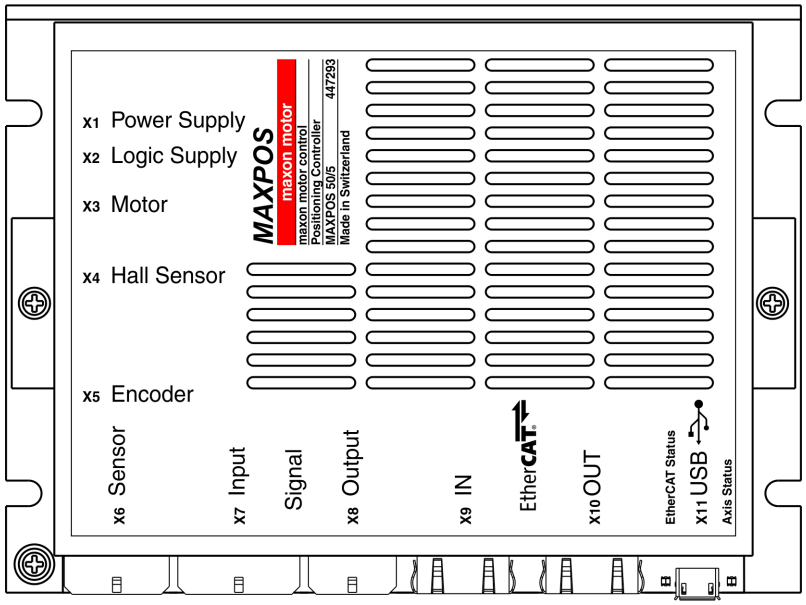



Figure 4-40 Interfaces – Designations and location

***Remark***

The subsequent diagrams feature this sign:

⏚ *Ground safety earth connection (optional)*

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## 4.1 Contents

## 4.2 DC Motors (brushed)

### 4.2.1 DC Motor without Sensor

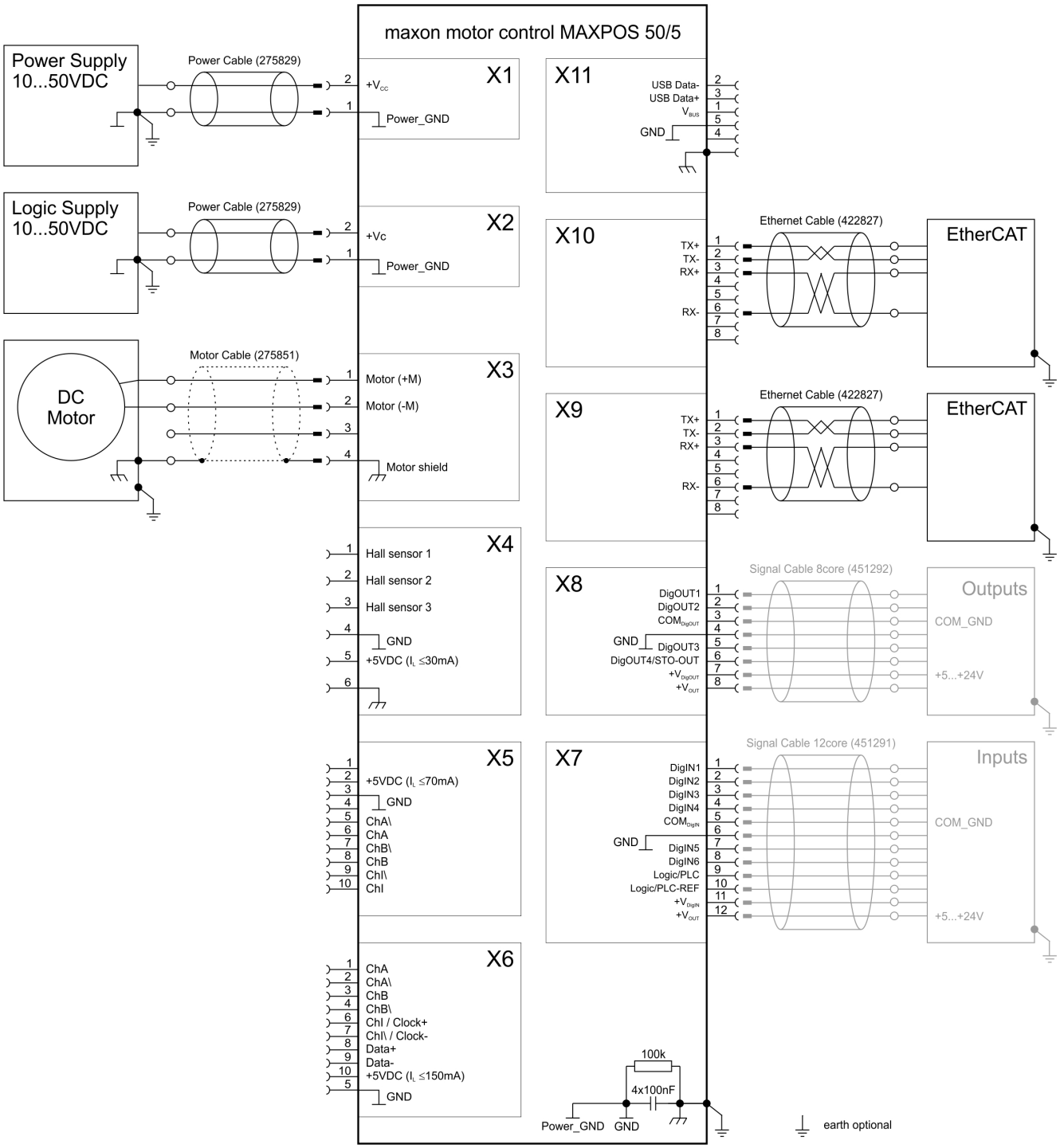


Figure 4-41 DC motor (no sensor)

***When using a DC motor without any feedback sensor, operation will only be possible in Cyclic Synchronous Torque Mode (CST). All other operation modes require an encoder as feedback sensor.***

### 4.2.2 DC Motor – Digital Incremental Encoder

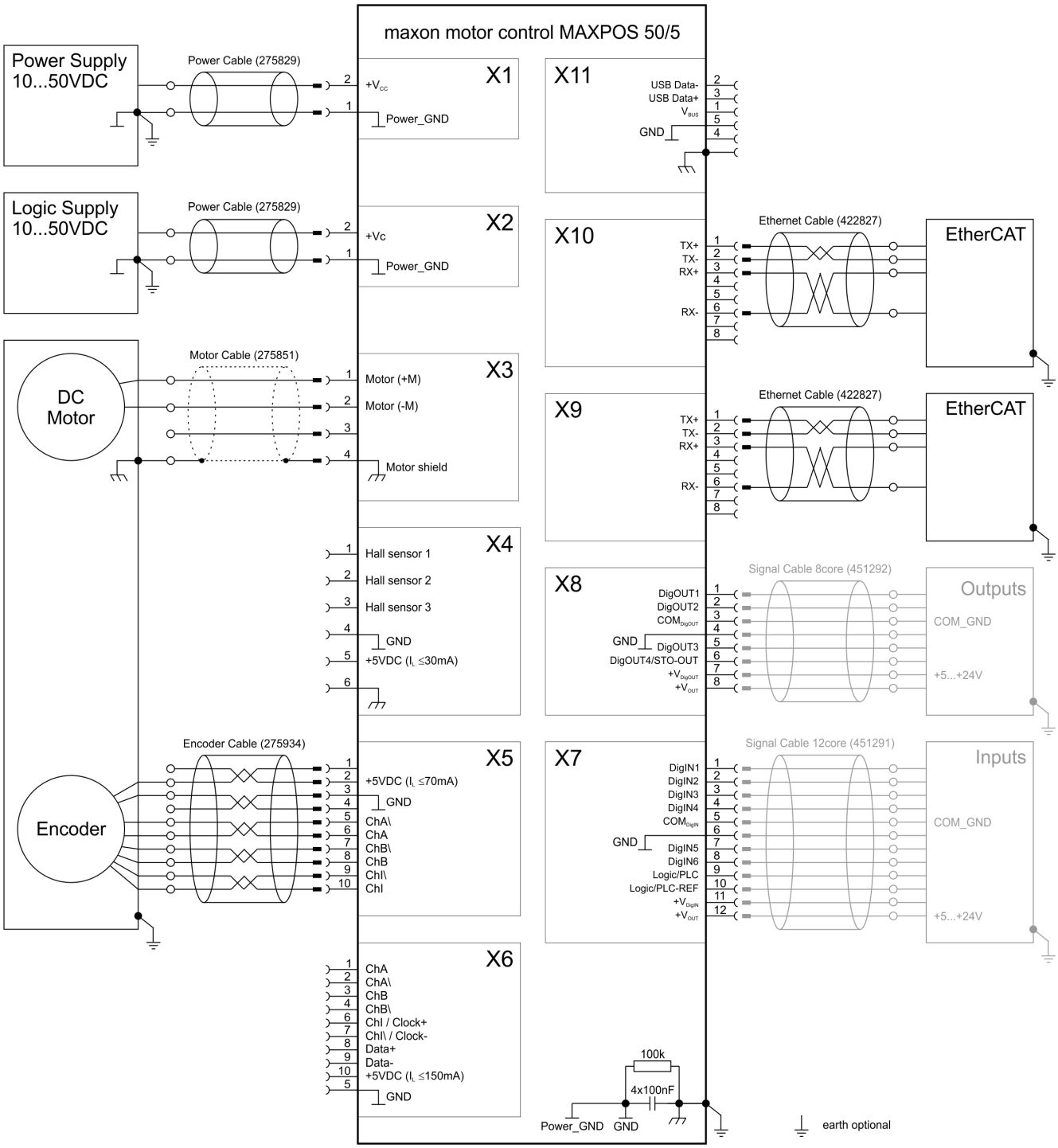


Figure 4-42 DC motor (digital incremental encoder)

### 4.2.3 DC Motor – Integrated Motor/Encoder Ribbon Cable

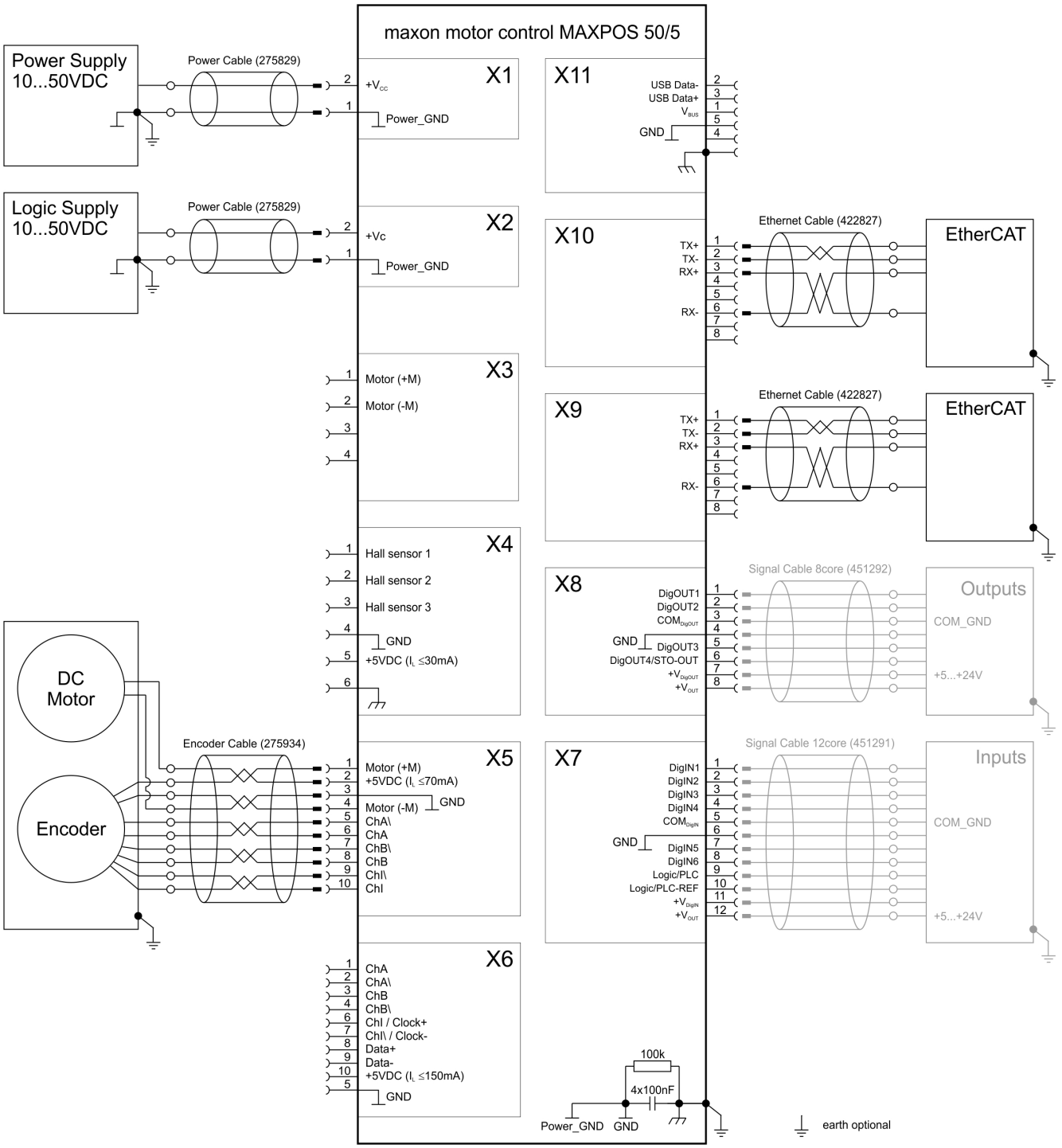


Figure 4-43 DC motor (integrated motor/encoder ribbon cable)

***Note***

*For jumper settings ➔chapter "3.4.3.1 Hardware Settings" on page 3-18.*

### 4.2.4 DC Motor – Digital Incremental Encoder (X6)

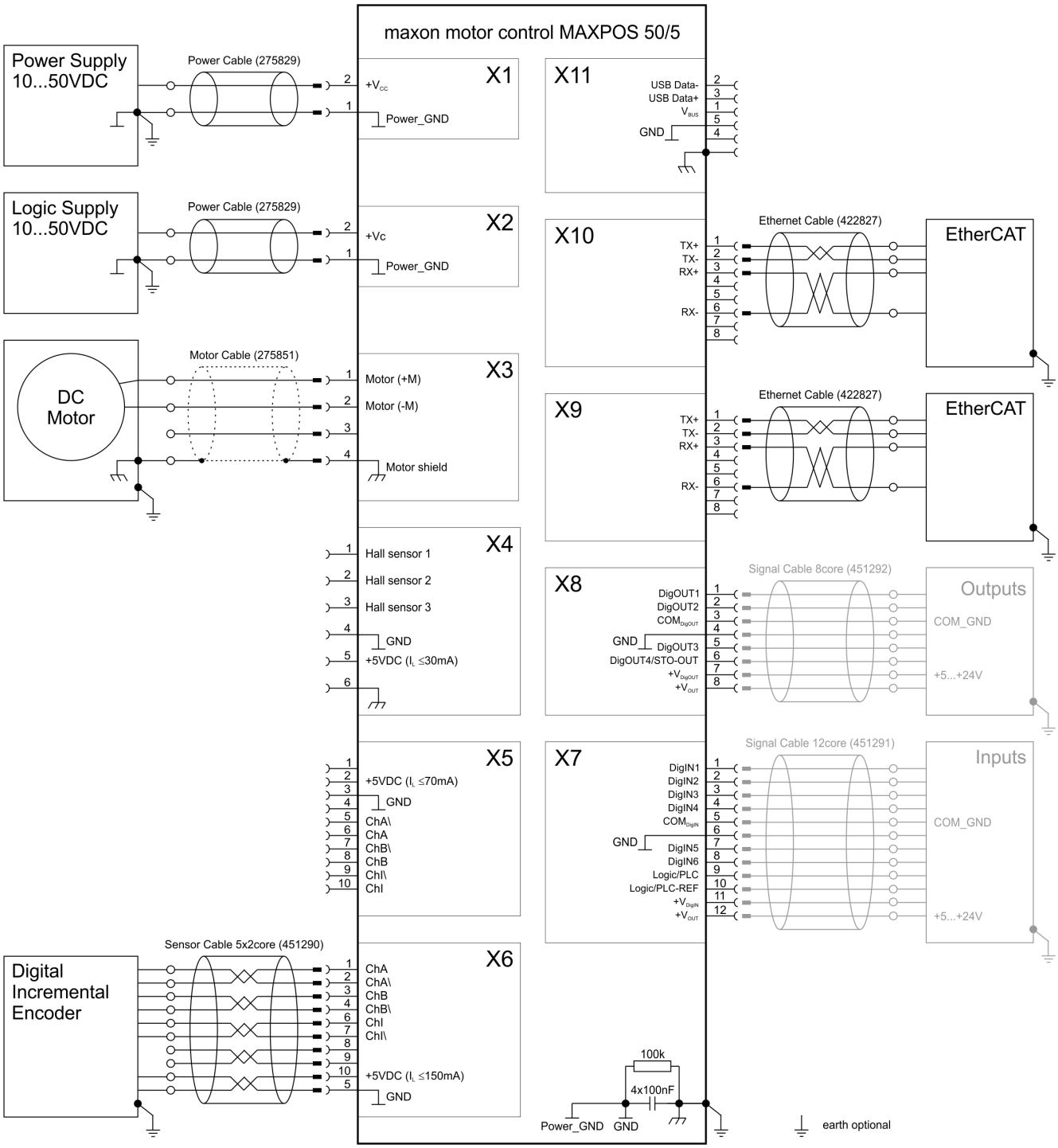


Figure 4-44 DC motor (digital incremental encoder – X6)

### 4.2.5 DC Motor – Digital & Digital Incremental Encoder

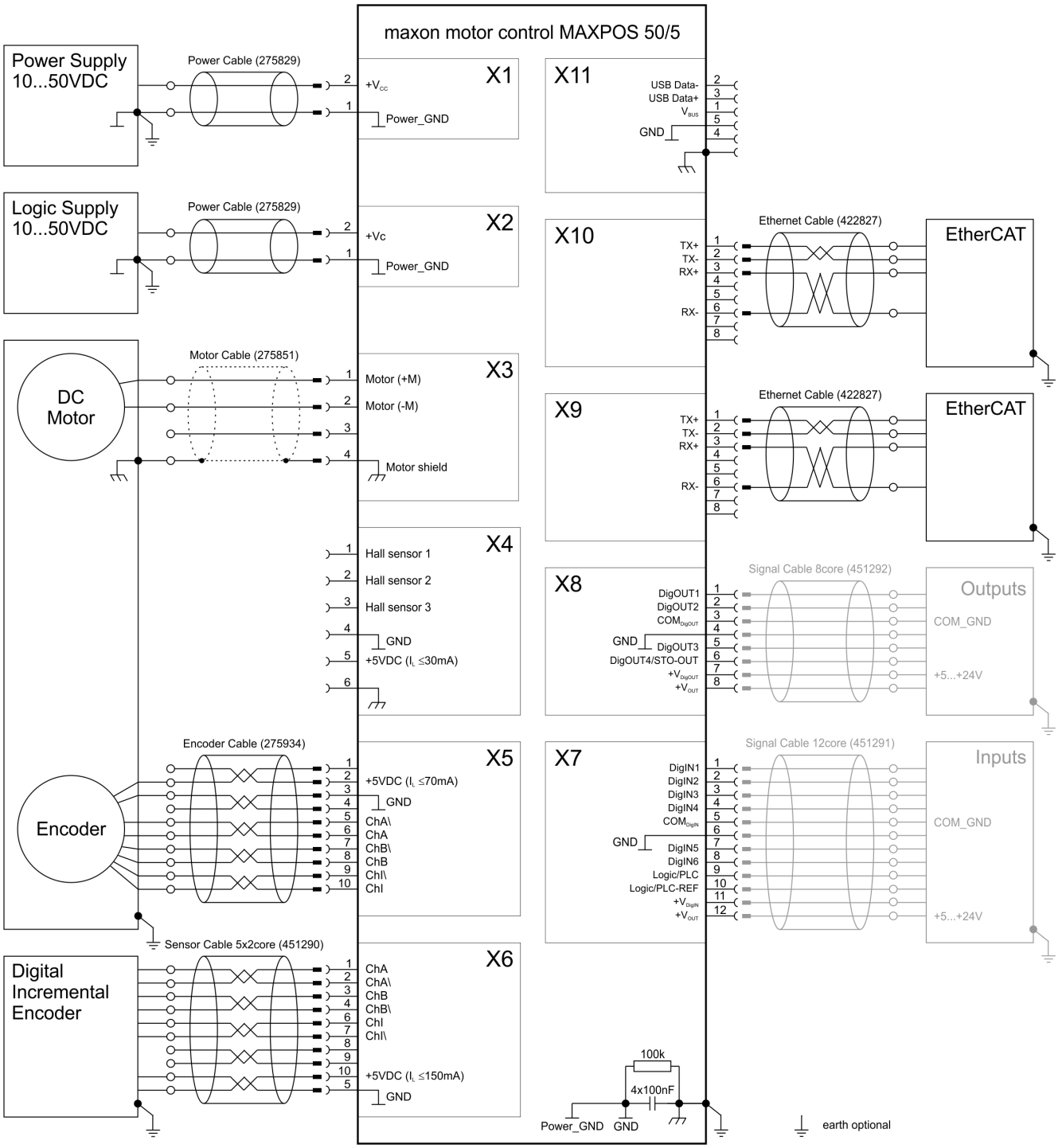


Figure 4-45 DC motor (digital & digital incremental encoder)

### 4.2.6 DC Motor – Integrated Motor/Encoder Ribbon Cable & Digital Incremental Encoder

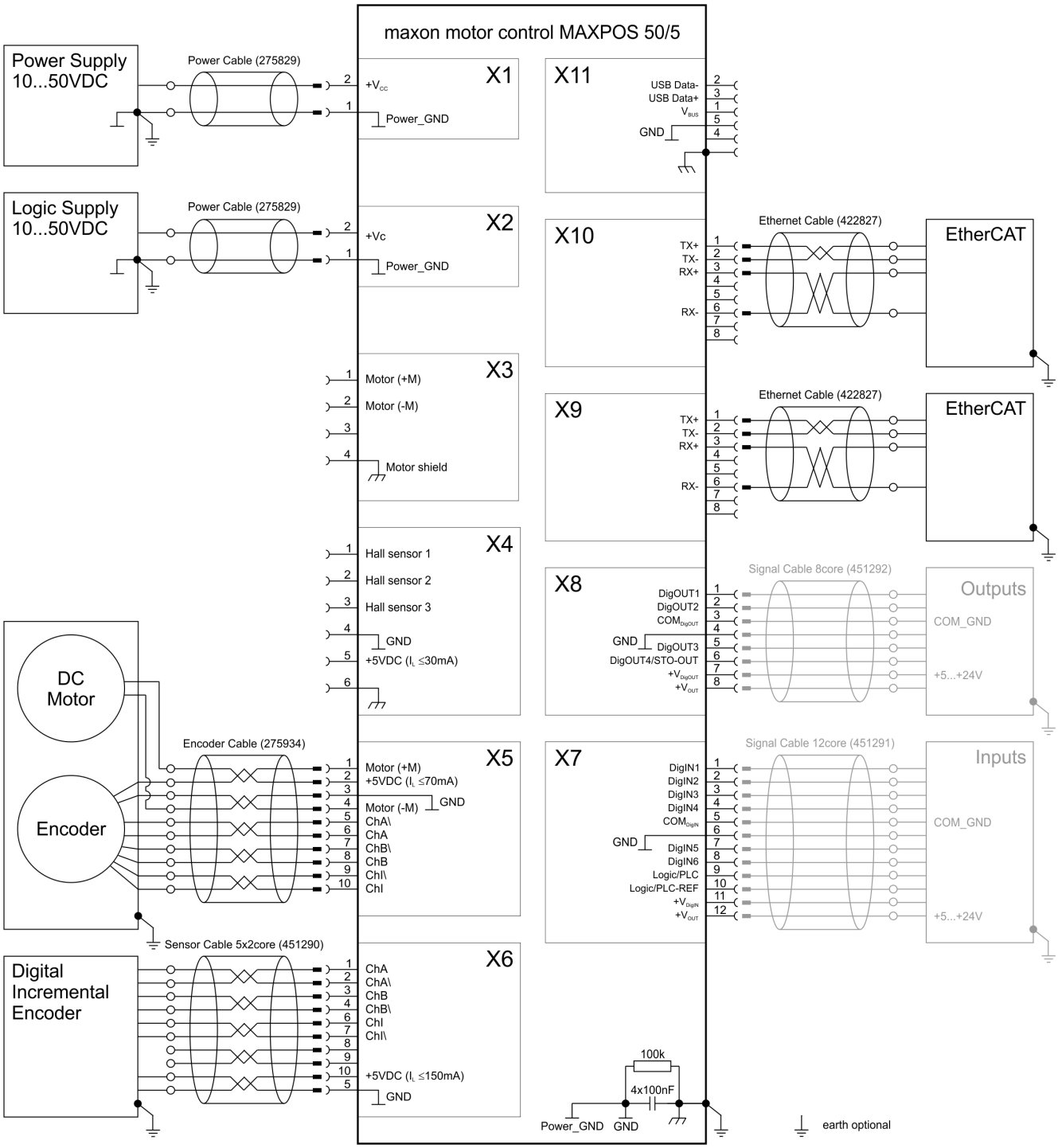


Figure 4-46 DC motor (integrated motor/encoder ribbon cable & digital incremental encoder)

***Note***
*For jumper settings ➔chapter "3.4.3.1 Hardware Settings" on page 3-18.*

### 4.2.7 DC Motor – Digital & Analog Incremental Encoder

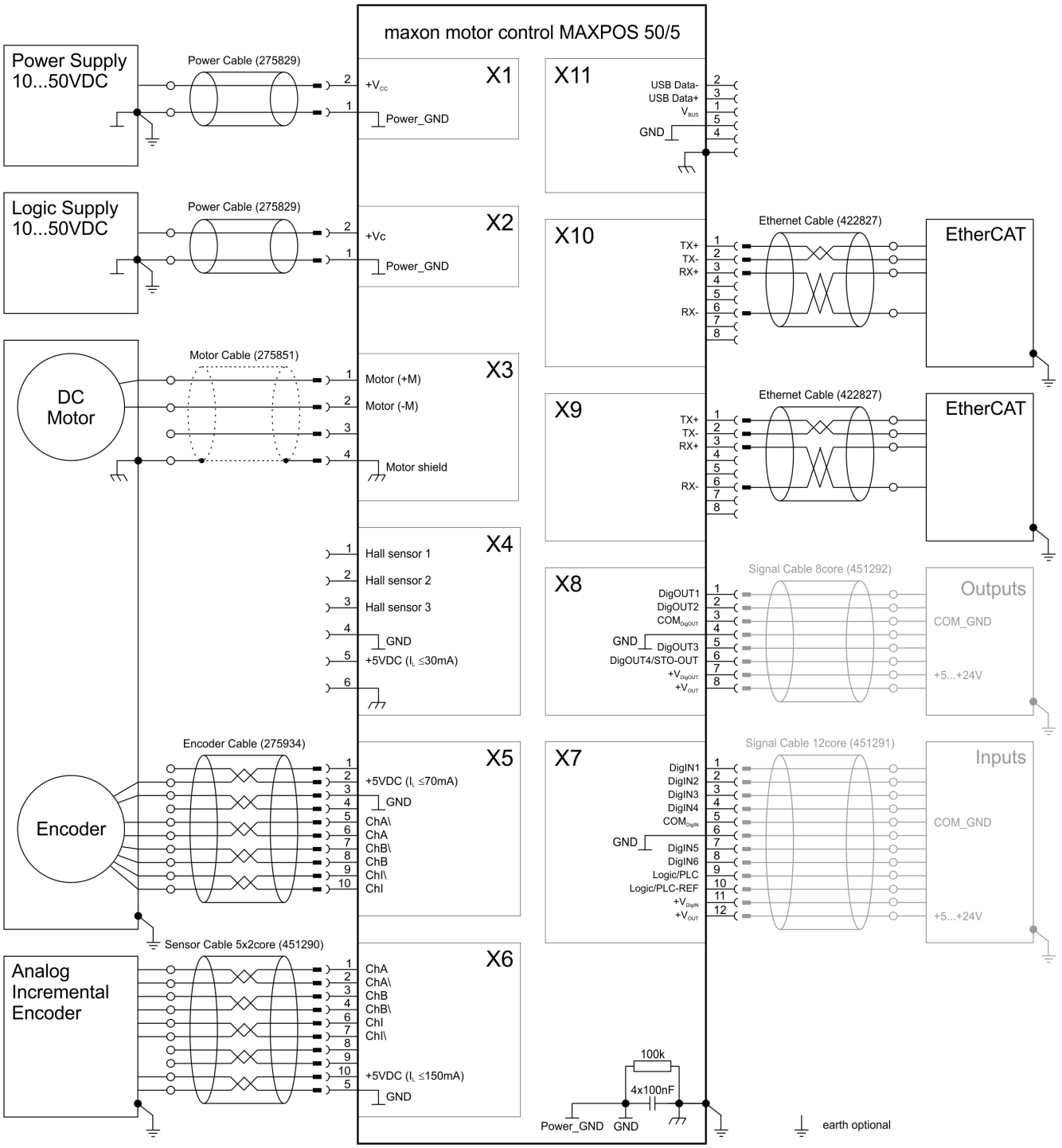


Figure 4-47 DC motor (digital & analog incremental encoder)

### 4.2.8 DC Motor – Integrated Motor/Encoder Ribbon Cable & Analog Incremental Encoder

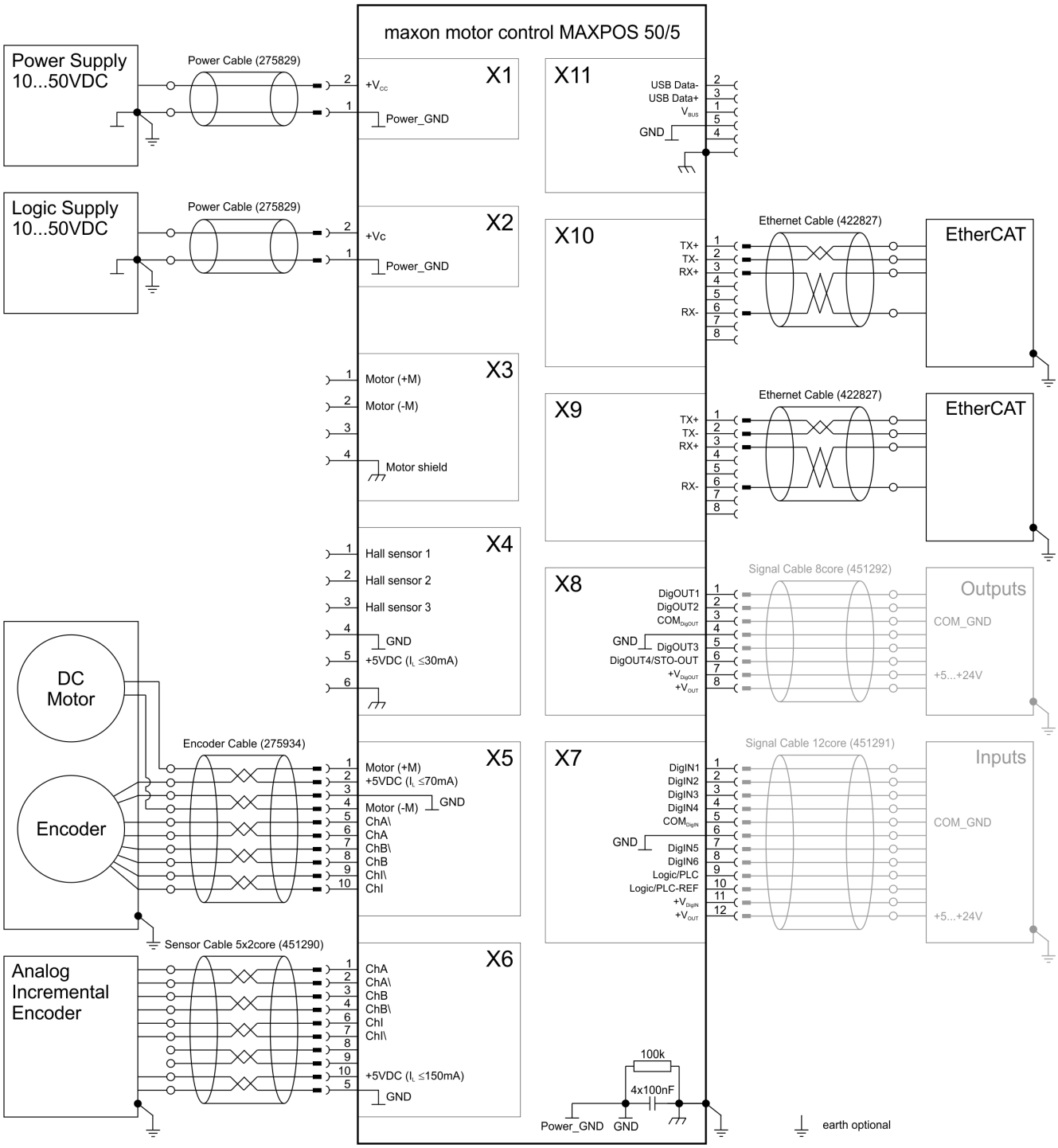


Figure 4-48 DC motor (integrated motor/encoder ribbon cable & analog incremental encoder)

***Note***
*For jumper settings ➔chapter "3.4.3.1 Hardware Settings" on page 3-18.*

### 4.2.9 DC Motor – Digital Incremental & SSI/BiSS Encoder

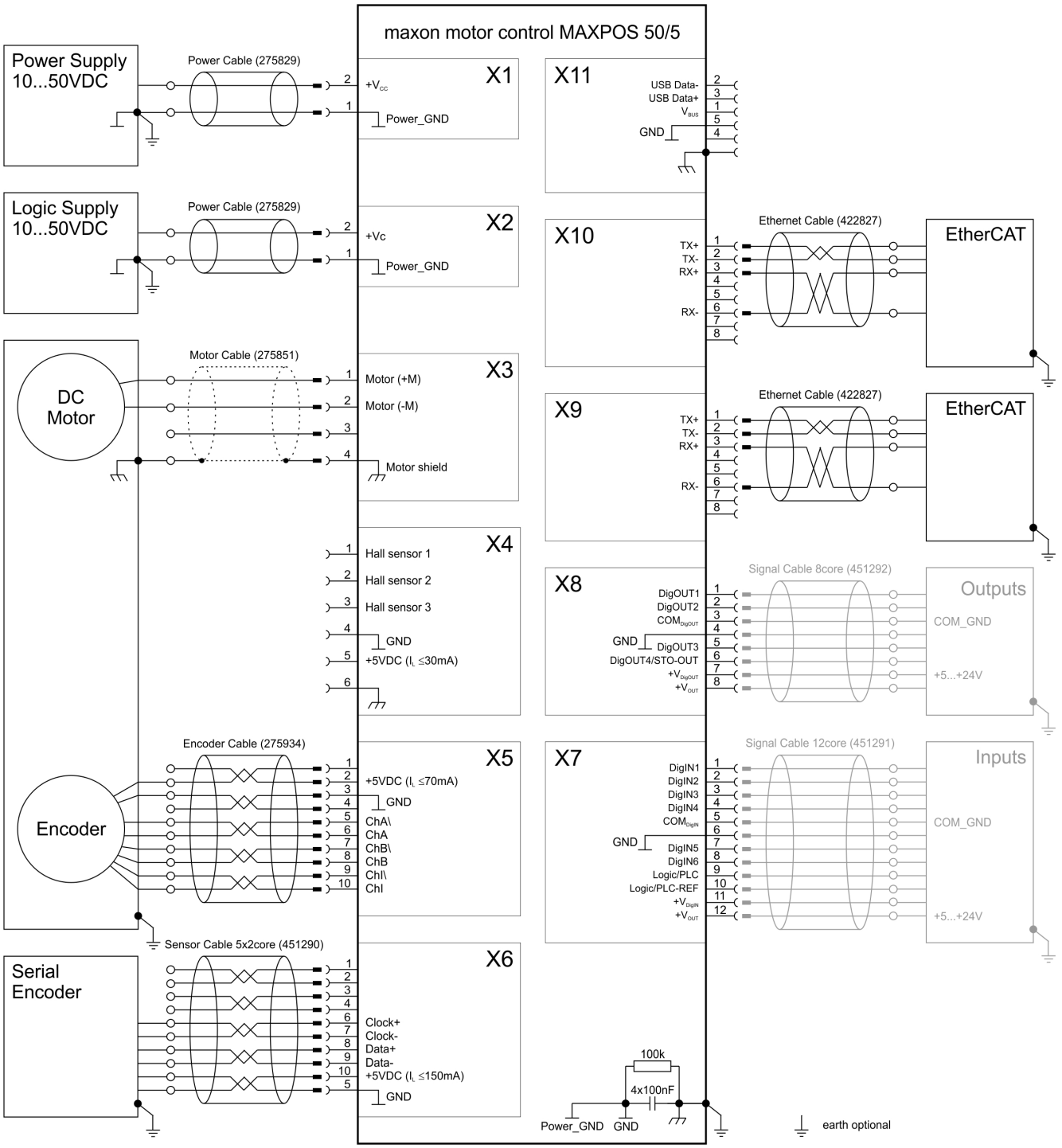


Figure 4-49 DC motor (digital incremental & SSI/BiSS encoder)

### 4.2.10 DC Motor – Integrated Motor/Encoder Ribbon Cable & SSI/BiSS Encoder

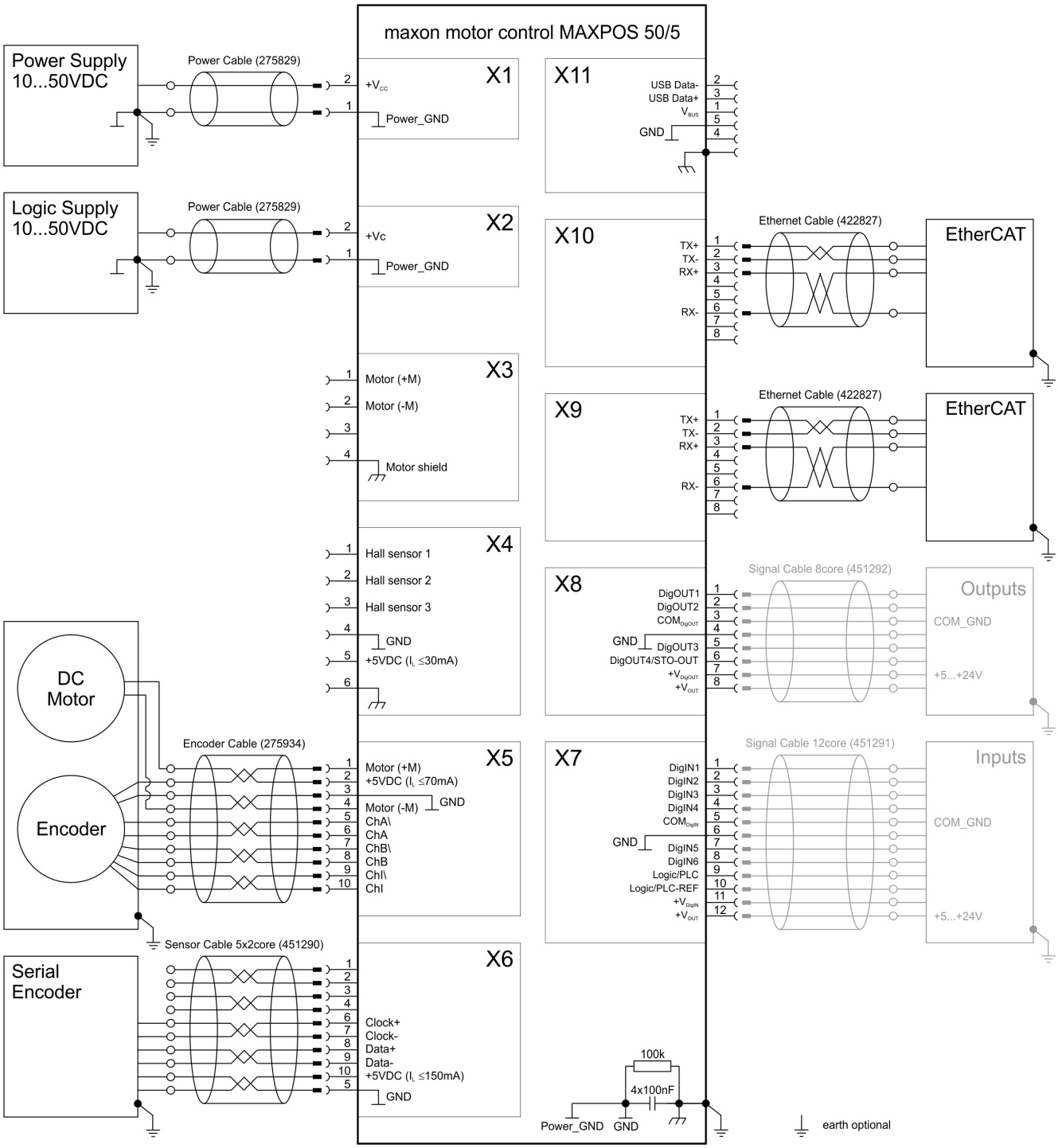


Figure 4-50 DC motor (integrated motor/encoder ribbon cable & SSI/BiSS encoder)

***Note***
*For jumper settings ➔chapter "3.4.3.1 Hardware Settings" on page 3-18.*

### 4.2.11 DC Motor – Analog Incremental Encoder

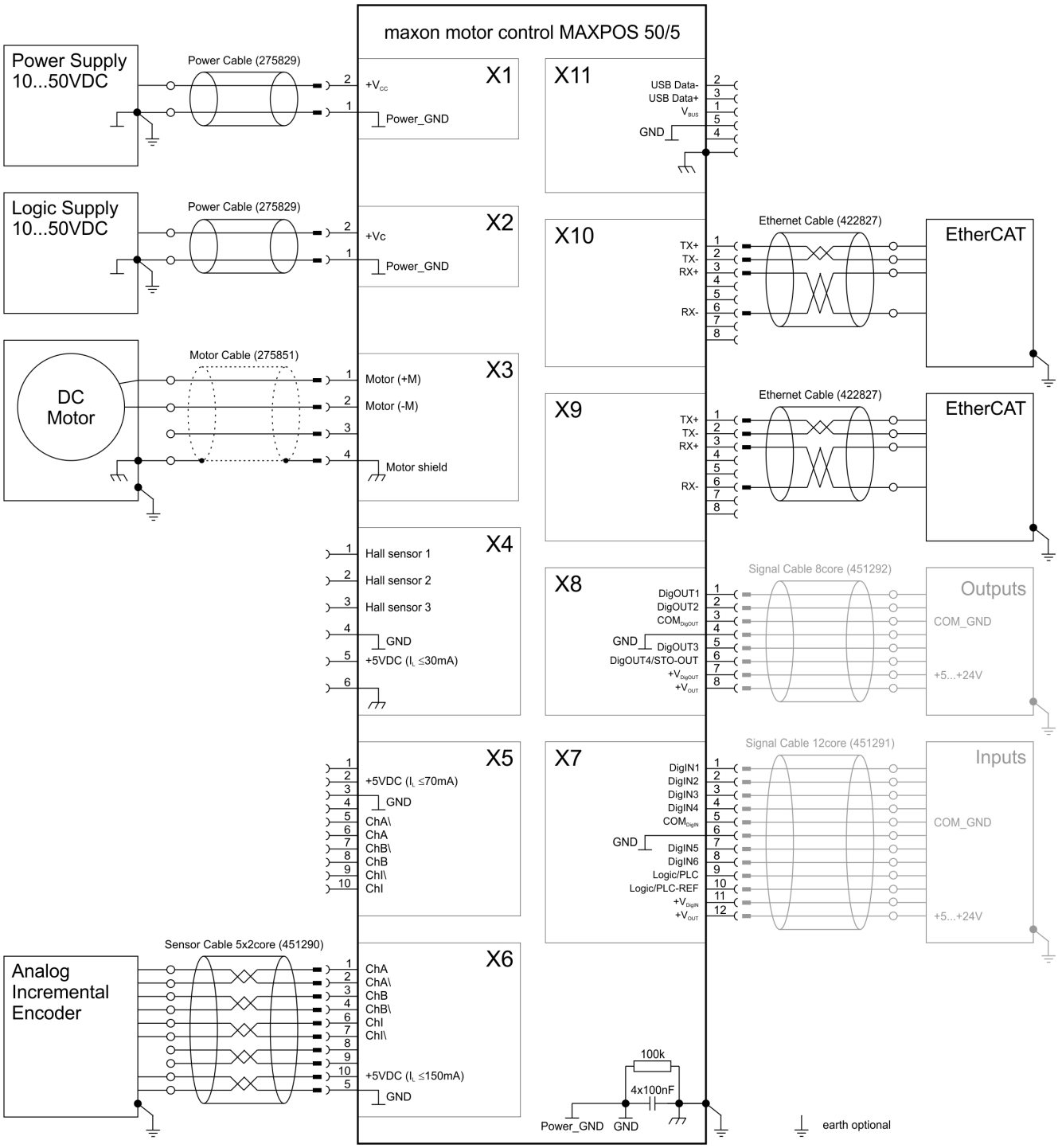


Figure 4-51 DC motor (analog incremental encoder)

### 4.2.12 DC Motor – SSI/BiSS Encoder

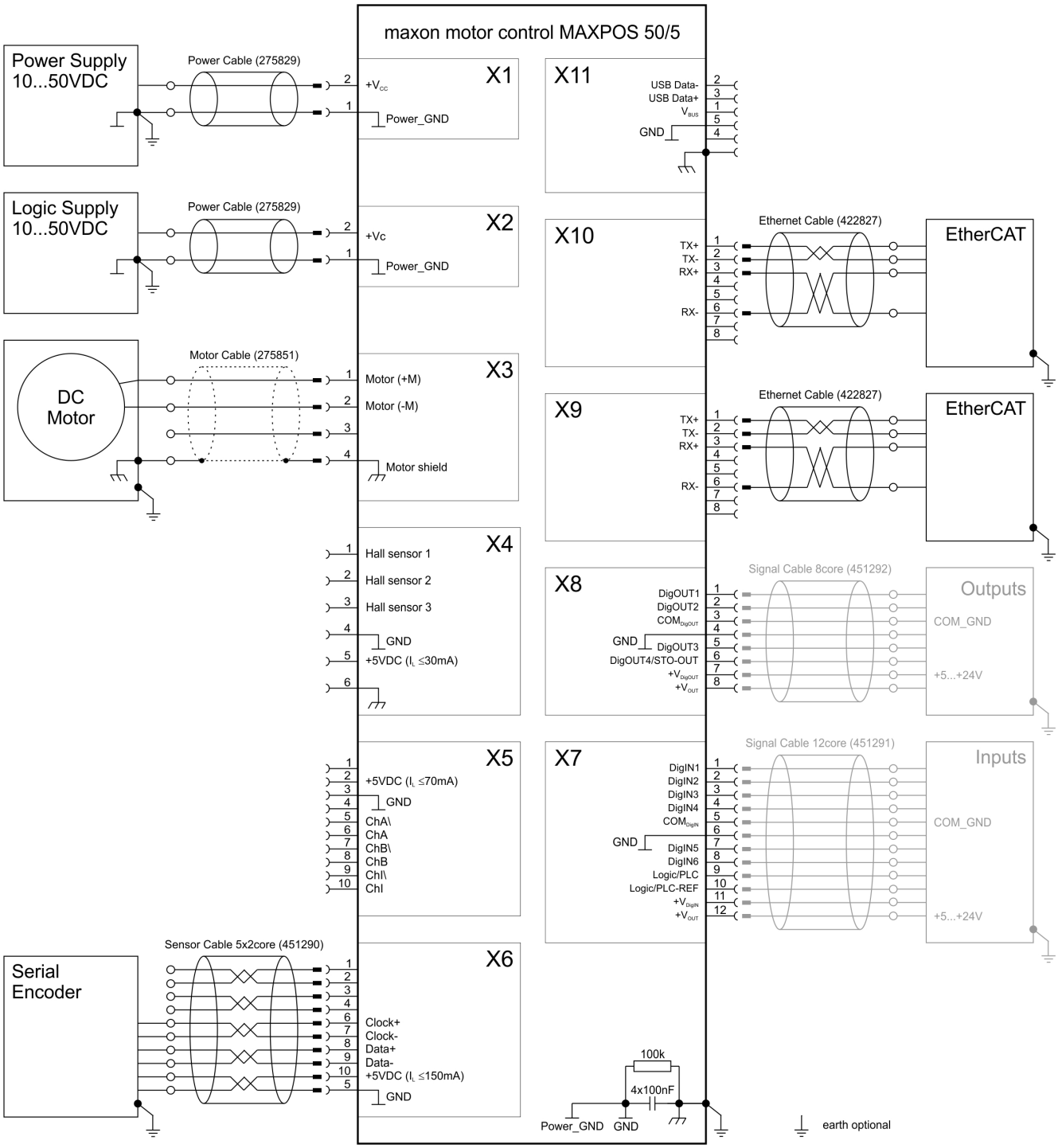


Figure 4-52 DC motor (SSI/BiSS encoder)

## 4.3 EC Motors (BLDC, brushless)

### 4.3.1 EC Motor – Hall Sensors

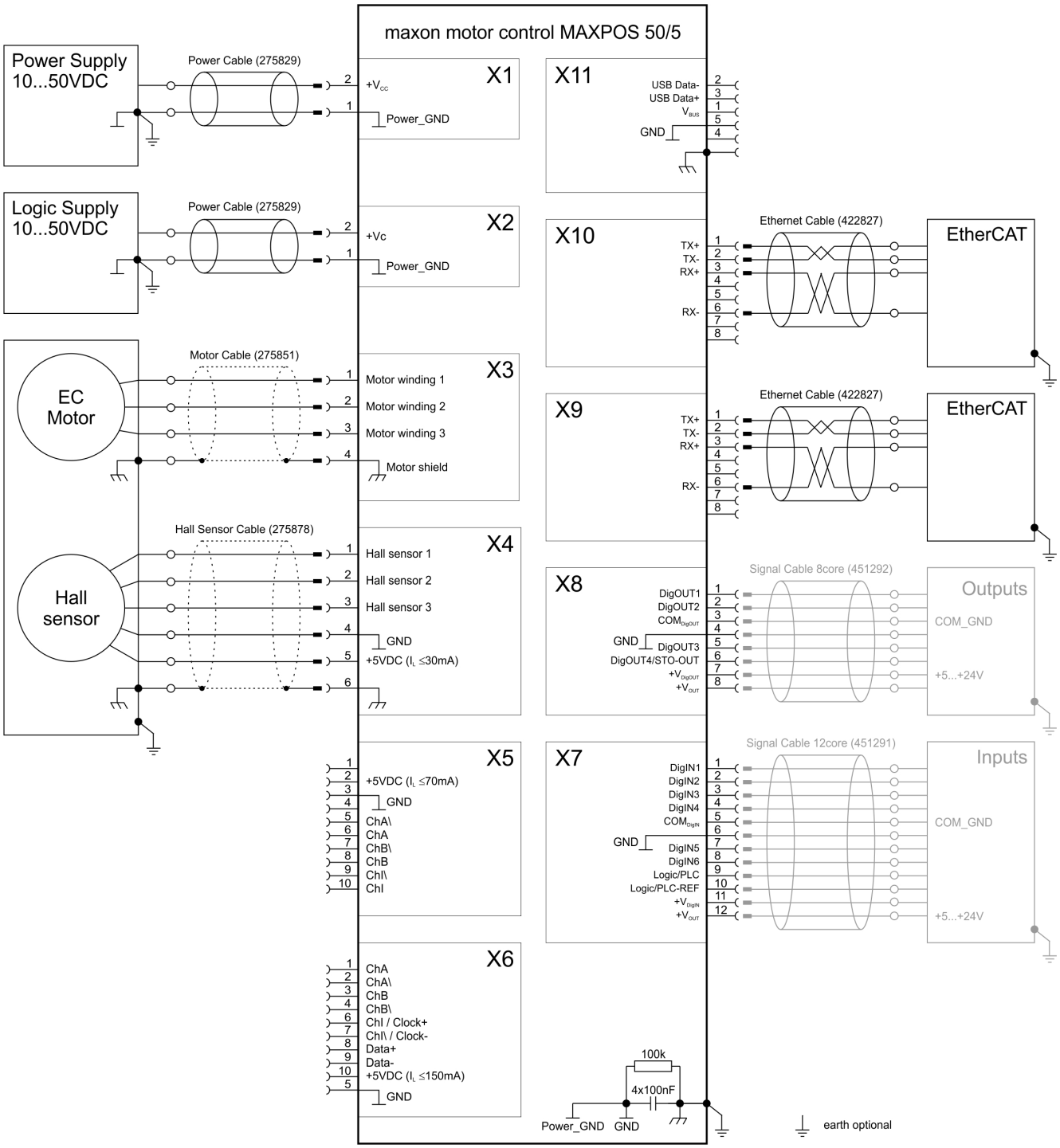


Figure 4-53 EC motor (Hall sensors)

### 4.3.2 EC Motor – Hall Sensors & Digital Incremental Encoder

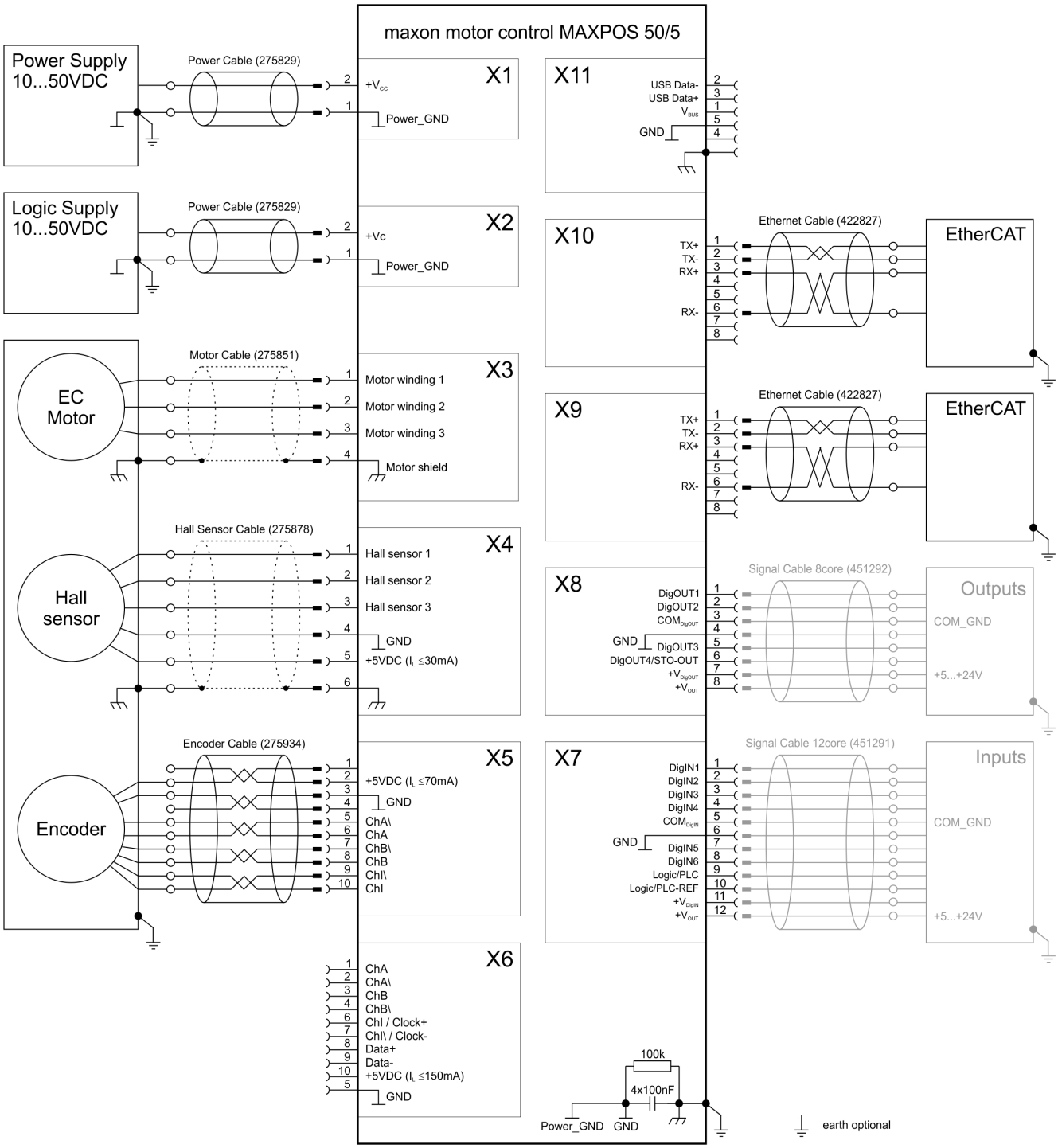


Figure 4-54 EC motor (Hall sensors & digital incremental encoder)

### 4.3.3 EC Motor – Hall Sensors & Digital Incremental Encoder (X6)

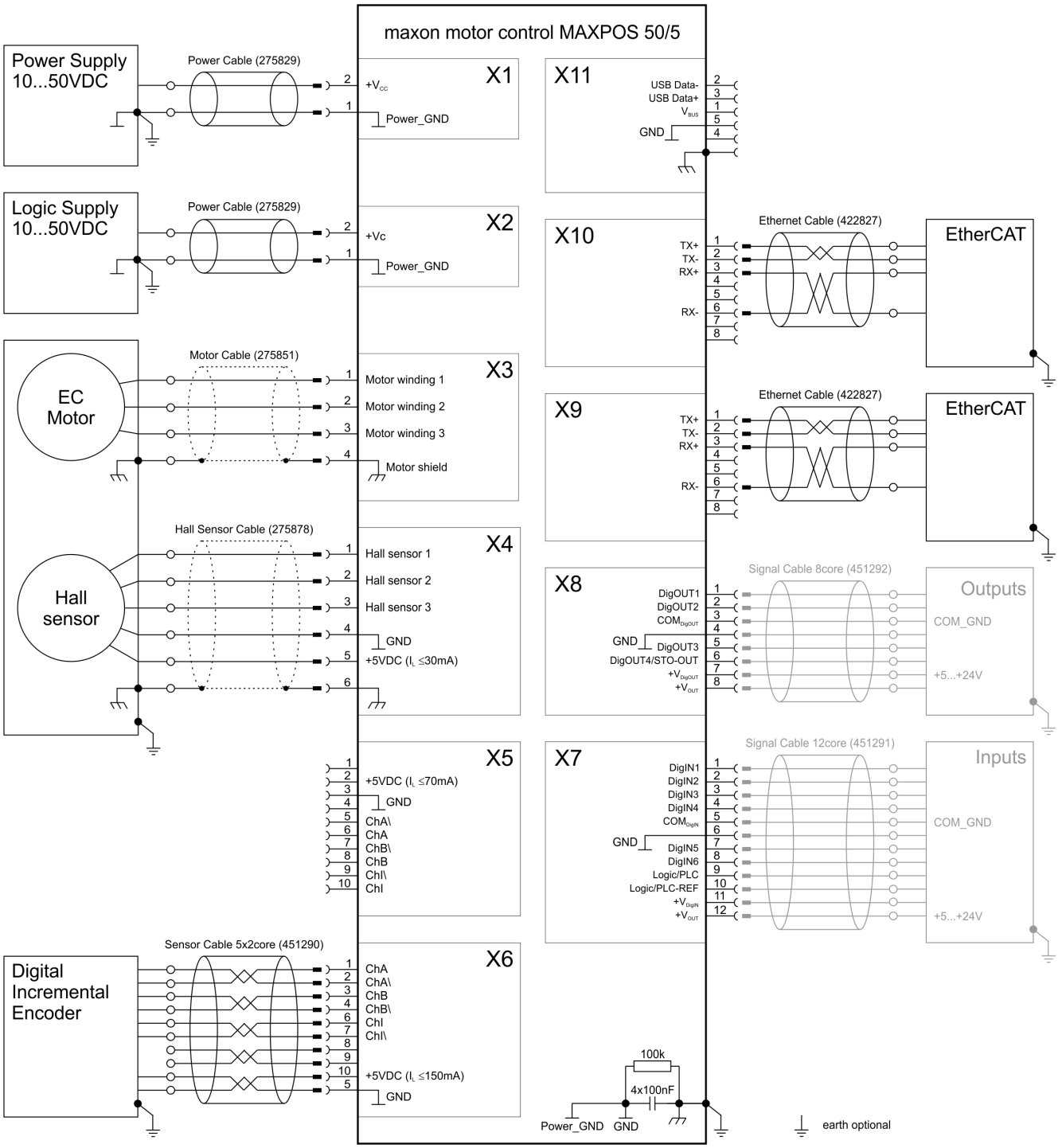


Figure 4-55 EC motor (Hall sensors & digital incremental encoder – X6)

### 4.3.4 EC Motor – Hall Sensors & Analog Incremental Encoder

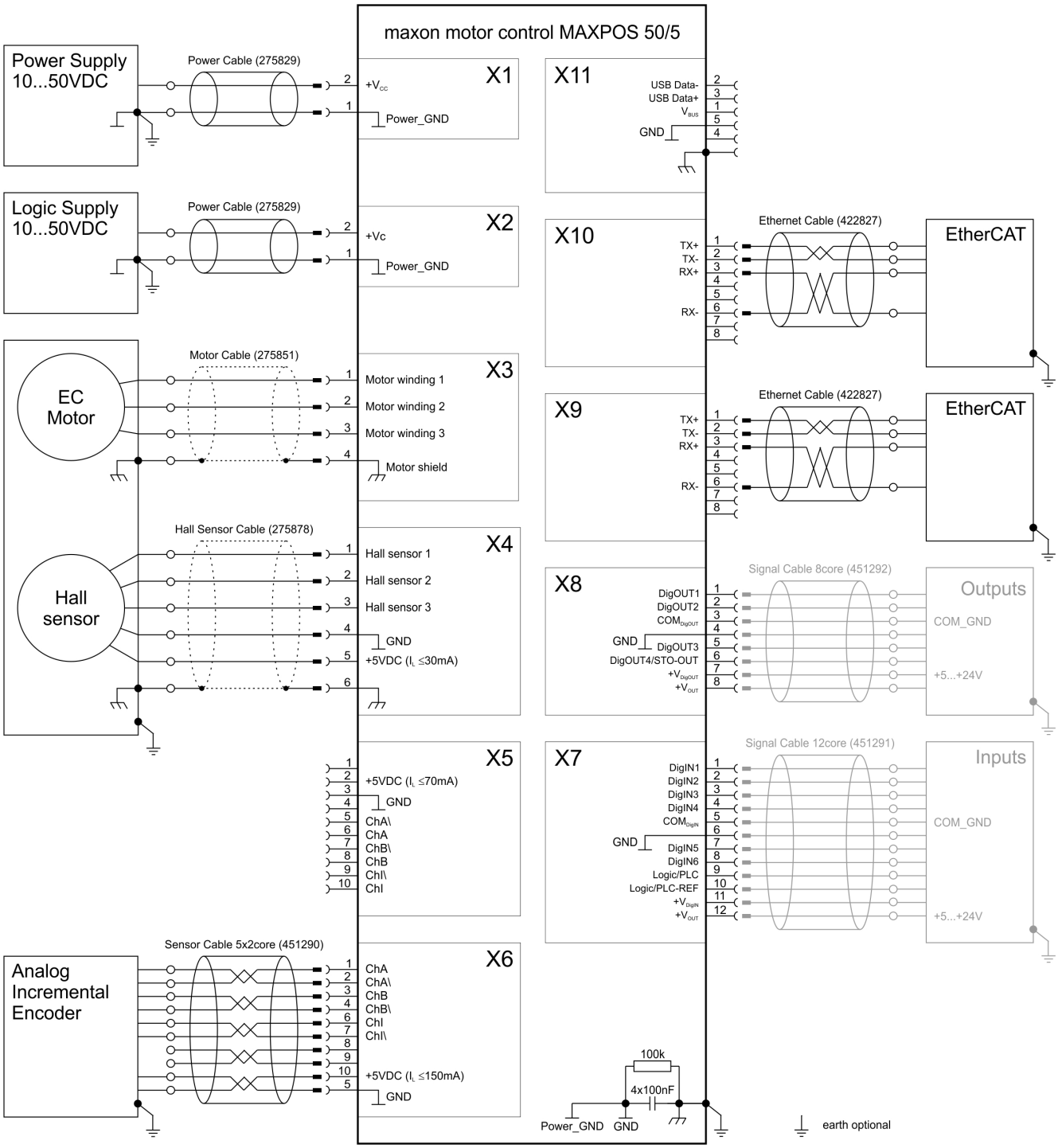


Figure 4-56 EC motor (Hall sensors & analog incremental encoder)

### 4.3.5 EC Motor – Hall Sensors & SSI/BiSS Encoder

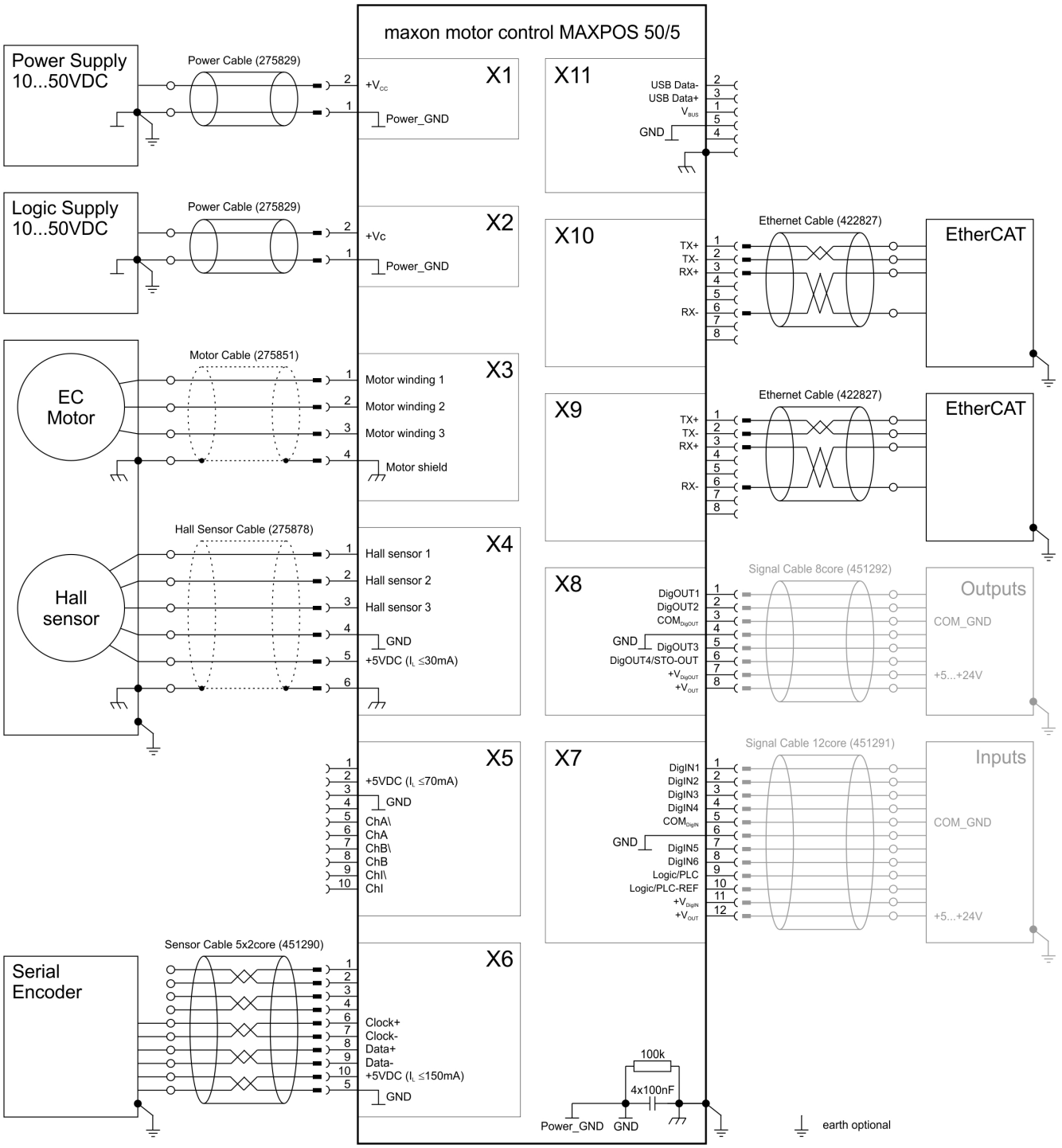


Figure 4-57 EC motor (Hall sensors & SSI/BiSS encoder)

### 4.3.6 EC Motor – Hall Sensors & Digital & Digital Incremental Encoder

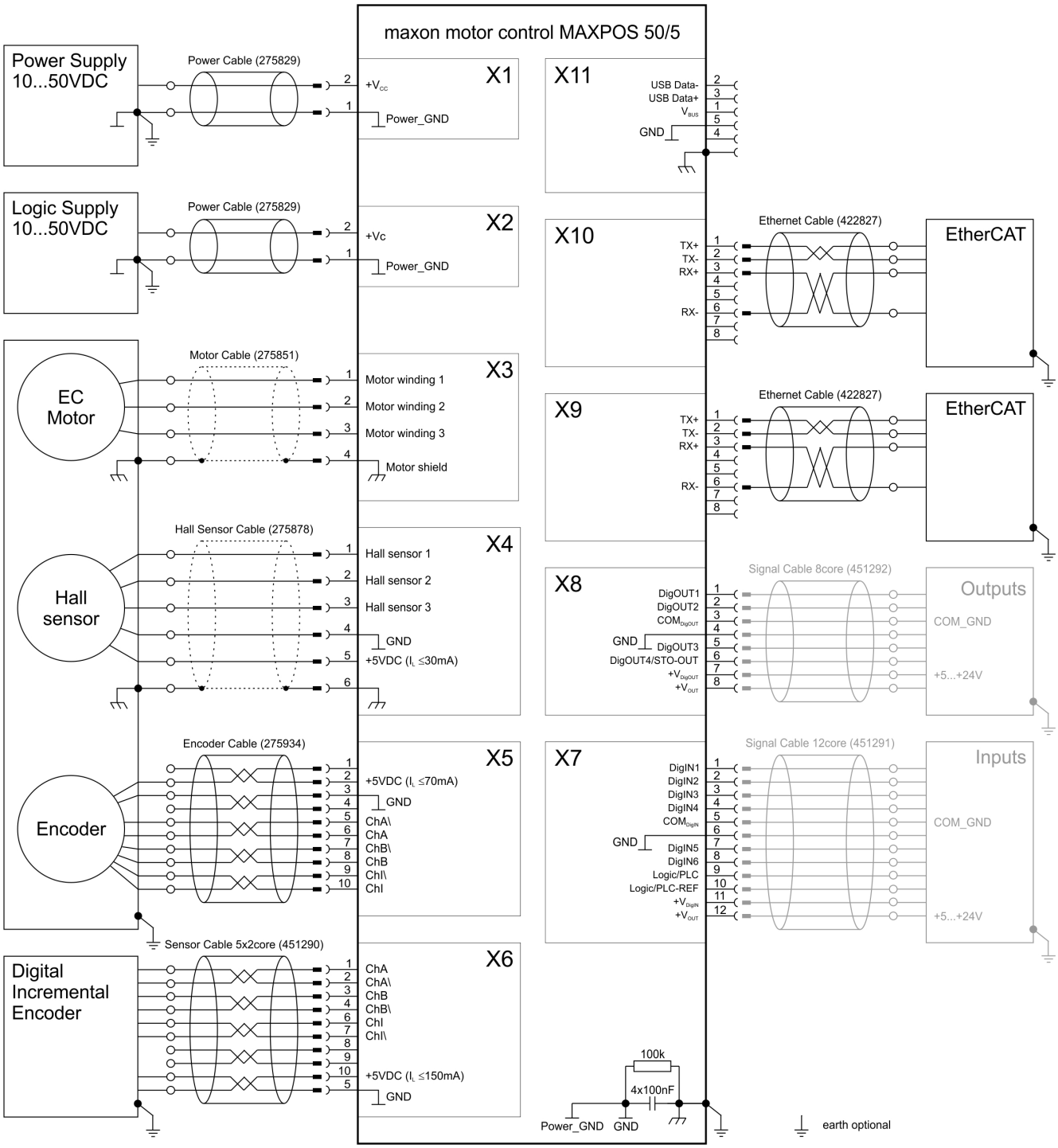


Figure 4-58 EC motor (Hall sensors & digital & digital incremental encoder)

### 4.3.7 EC Motor – Hall Sensors & Digital & Analog Incremental Encoder

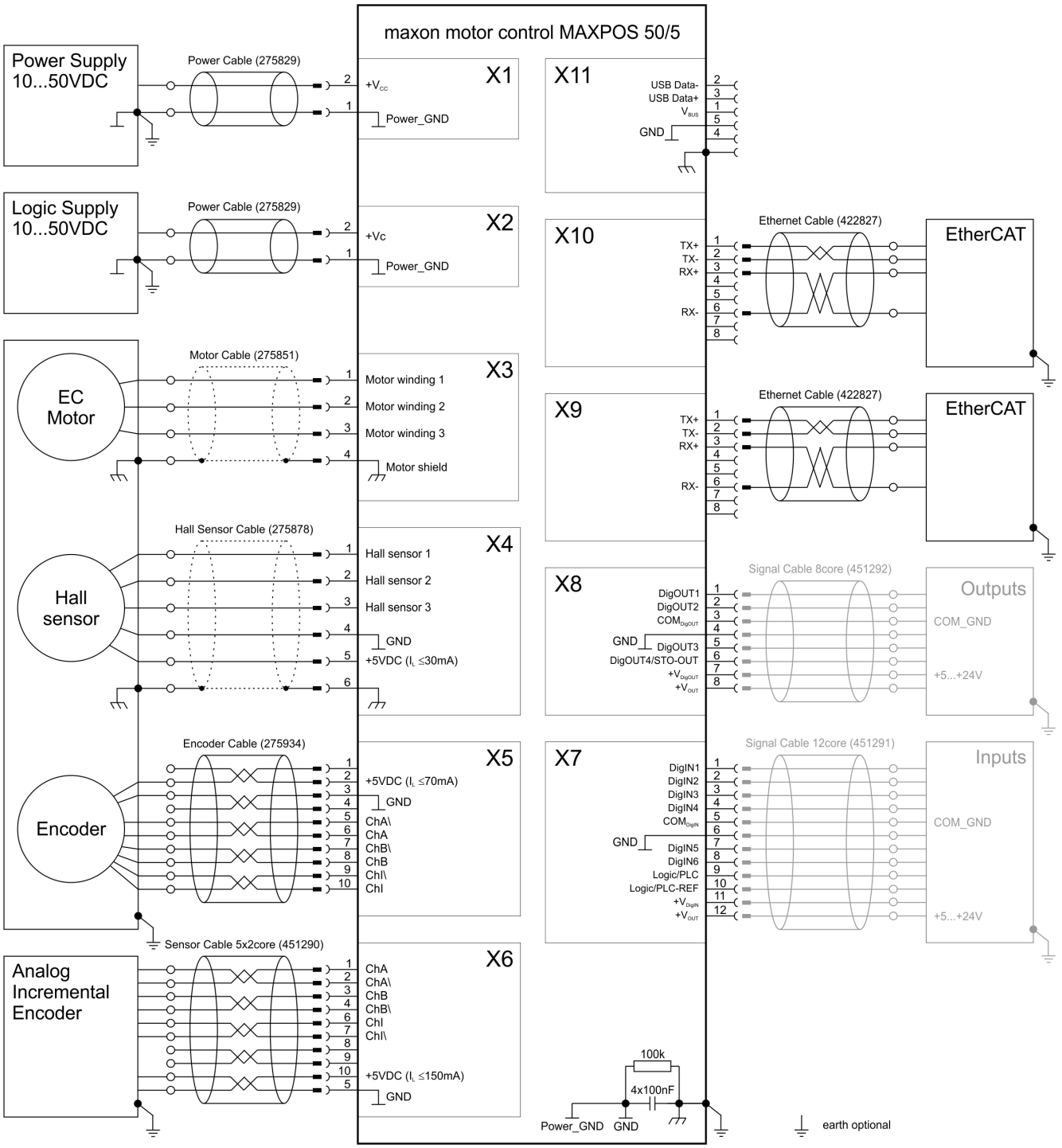


Figure 4-59 EC motor (Hall sensors & digital & analog incremental encoder)

### 4.3.8 EC Motor – Hall Sensors & Digital Incremental & SSI/BiSS Encoder

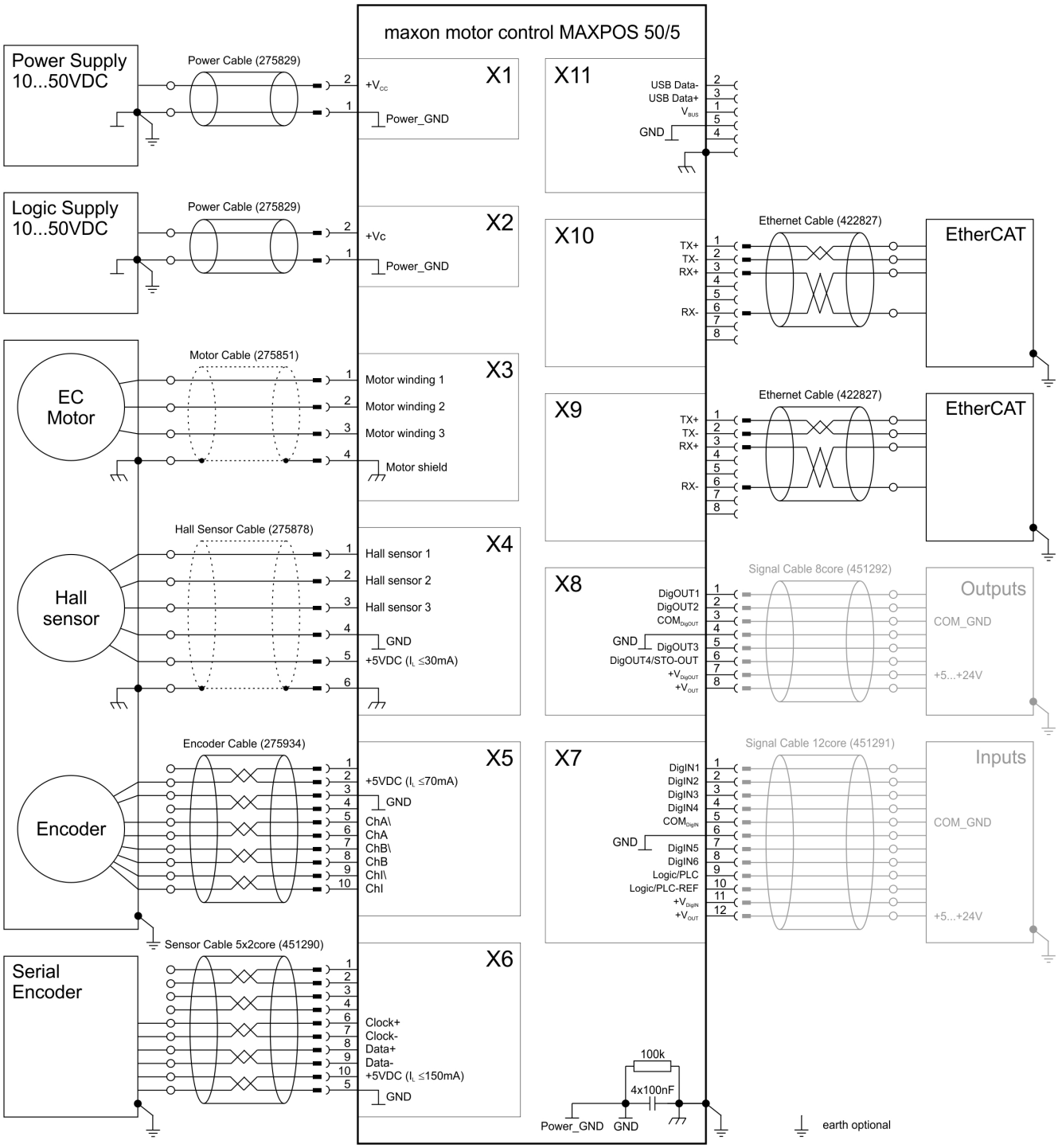


Figure 4-60 EC motor (Hall sensors & digital incremental & SSI/BiSS encoder)

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