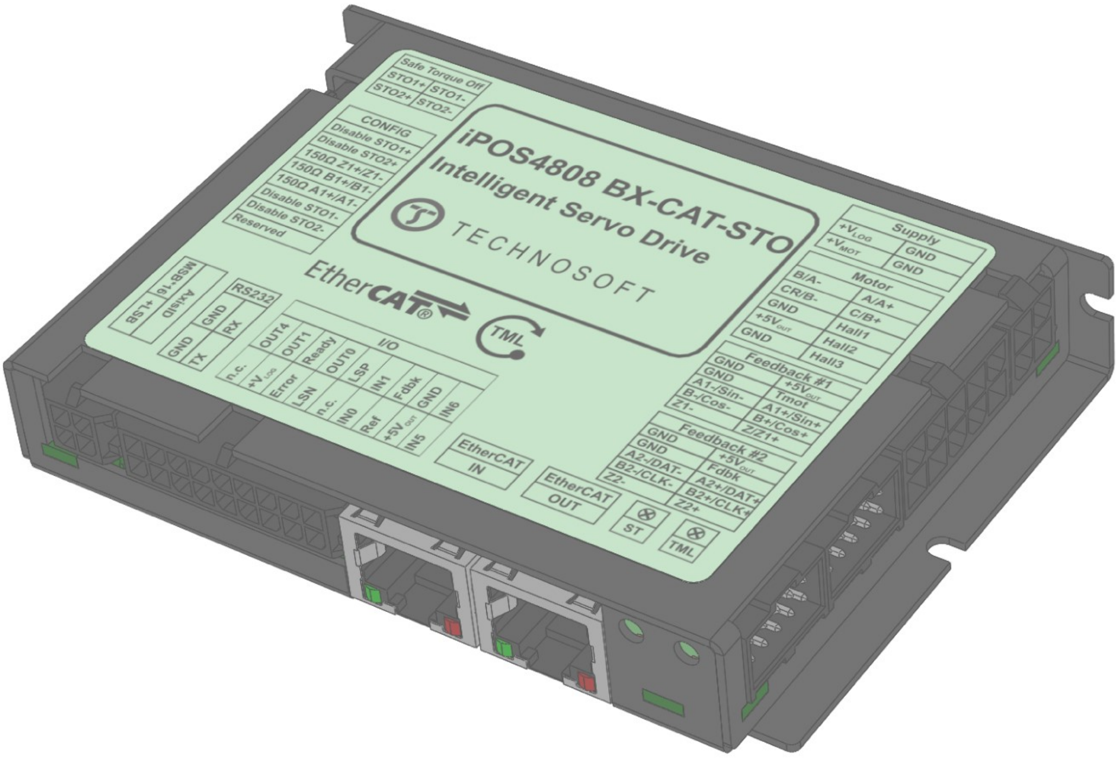
iPOS4808 BX-CAT-STO

Intelligent Servo Drive for Step, DC, Brushless DC and AC Motors

TECHNOSOFT

Intelligent Servo Drives



Technical Reference

P091.027.iPOS4808.BX.CAT.STO.UM.0522

Table of contents

Read This First

About This Manual

This book is a technical reference manual for:

Product Name	Part Number	Description
iPOS4808 BX-CAT-STO	P027.314.E221	Standard version that can support a differential encoder on Feedback #1, EtherCAT®, STO input
	P027.314.E721	Can support linear halls on Feedback #1, EtherCAT®, STO input

In order to operate the **iPOS4808** drives, you need to pass through 3 steps:

- ❑ **Step 1 Hardware installation**
- ❑ **Step 2 Drive setup** using Technosoft **EasySetUp** software for drive commissioning
- ❑ **Step 3 Motion programming** using one of the options:
  - ❑ An **EtherCAT® master**
  - ❑ The drives **built-in motion controller** executing a Technosoft Motion Language (**TML**) program developed using Technosoft **EasyMotion Studio** software
  - ❑ A **distributed control** approach which combines the above options, like for example a host calling motion functions programmed on the drives in TML

This manual covers **Step 1** in detail. It describes the **iPOS4808** hardware including the technical data, the connectors and the wiring diagrams needed for installation.

For Step 2 and 3, please consult the document ***iPOS Dual Loop drives Software reference***

(091.027.DL.Software.xxxx). It also includes the scaling factors between the real SI units and the drive internal units. For detailed information regarding the next steps, refer to the related documentation.

Notational Conventions

This document uses the following conventions:

- **iPOS4808**– all products described in this manual
- **IU units** – Internal units of the drive
- **SI units** – International standard units (meter for length, seconds for time, etc.)
- **STO** – Safe Torque Off
- **TML** – Technosoft Motion Language
- **CoE** – CAN application protocol over EtherCAT®

Trademarks

EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

Related Documentation

iPOS4808 BX-CAT-STO Datasheet (P027.314.E221.DSH)

– describes the hardware connections of the iPOS4808 BX-CAT-STO intelligent servo drive including the technical data and connectors.

iPOS family Safe Torque Off (STO) Operating instructions (091.099.STO.Operating.Instructions.xxxx)

– describes the principles of STO function, the applied standards, the safety-related data and the electrical data. It presents the requested information for installation and commissioning of STO function

iPOS Dual Loop drives Software reference (091.027.DL.Software.xxxx)

– describes the compatible software installation, drive software setup commissioning, introduction to TML motion programming, includes the scaling factors between the real SI units and the drive internal units.

Help of the EasySetUp software – describes how to use **EasySetUp** to quickly setup any Technosoft drive for your application using only 2 dialogues. The output of EasySetUp is a set of setup data that can be downloaded into the drive EEPROM or saved on a PC file. At power-on, the drive is initialized with the setup data read from its EEPROM. With EasySetUp it is also possible to retrieve the complete setup information from a drive previously programmed. **EasySetUp can be downloaded free of charge from Technosoft web page**

***CoE Programming* (part no. P091.064.UM.xxxx)** – explains how to program the Technosoft intelligent drives using **CAN application protocol over EtherCAT®** and describes the associated object dictionary.

Motion Programming using EasyMotion Studio (part no. P091.034.ESM.UM.xxxx) – describes how to use the EasyMotion Studio to create motion programs using in Technosoft Motion Language (TML). EasyMotion Studio platform includes **EasySetUp** for the drive/motor setup, and a **Motion Wizard** for the motion programming. The Motion Wizard provides a simple, graphical way of creating motion programs and automatically generates all the TML instructions. *With EasyMotion Studio you can fully benefit from a key advantage of Technosoft drives – their capability to execute complex motions without requiring an external motion controller, thanks to their built-in motion controller.* **A demo version of EasyMotion Studio (with EasySetUp part fully functional) can be downloaded free of charge from the Technosoft web page**

If you Need Assistance …

If you want to …	Contact Technosoft at …
Visit Technosoft online	World Wide Web: http://www.technosoftmotion.com/
Receive general information or assistance (see Note)	World Wide Web: http://www.technosoftmotion.com/ Email: contact@technosoftmotion.com
Ask questions about product operation or report suspected problems (see Note)	Fax: (41) 32 732 55 04 Email: hotline@technosoftmotion.com
Make suggestions about, or report errors in documentation.	Mail: Technosoft SA Avenue des Alpes 20 CH-2000 Neuchatel, NE Switzerland

1 Safety information

Read carefully the information presented in this chapter before carrying out the drive installation and setup! It is imperative to implement the safety instructions listed hereunder.

This information is intended to protect you, the drive and the accompanying equipment during the product operation. Incorrect handling of the drive can lead to personal injury or material damage.

The following safety symbols are used in this manual:

WARNING!	*SIGNALS A DANGER TO THE OPERATOR WHICH MIGHT CAUSE BODILY INJURY. MAY INCLUDE INSTRUCTIONS TO PREVENT THIS SITUATION*

CAUTION!	*SIGNALS A DANGER FOR THE DRIVE WHICH MIGHT DAMAGE THE PRODUCT OR OTHER EQUIPMENT. MAY INCLUDE INSTRUCTIONS TO AVOID THIS SITUATION*

1.1 Warnings

WARNING!	*TO AVOID ELECTRIC ARCING AND HAZARDS, NEVER CONNECT / DISCONNECT WIRES FROM THE DRIVE WHILE THE POWER SUPPLIES ARE ON*

WARNING!	*THE DRIVE MAY HAVE HOT SURFACES DURING OPERATION.*

WARNING!	*DURING DRIVE OPERATION, THE CONTROLLED MOTOR WILL MOVE. KEEP AWAY FROM ALL MOVING PARTS TO AVOID INJURY*

1.2 Cautions

CAUTION!	*THE POWER SUPPLIES CONNECTED TO THE DRIVE MUST COMPLY WITH THE PARAMETERS SPECIFIED IN THIS DOCUMENT*

CAUTION!	*TROUBLESHOOTING AND SERVICING ARE PERMITTED ONLY FOR PERSONNEL AUTHORISED BY TECHNOSOFT*

1.3 Quality system, conformance and certifications

	IQNet and **Quality Austria** certification about the implementation and maintenance of the Quality Management System which fulfills the requirements of Standard **ISO 9001:2015**.
	Quality Austria Certificate about the application and further development of an effective **Quality Management System** complying with the requirements of Standard **ISO 9001:2015**
	REACH Compliance - TECHNOSOFT hereby confirms that this product comply with the legal obligations regarding Article 33 of the European REACH Regulation 1907/2006 (Registration, Evaluation, Authorization and Restriction of Chemicals), which came into force on 01.06.2007.
	RoHS Compliance - Technosoft SA here with declares that this product is manufactured in compliance with the RoHS directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)
	Technosoft SA hereby declares that this product conforms to the following European applicable directives: **2014/30/EU** **Electromagnetic Compatibility (EMC) Directive** **2014/35/EU** **Low Voltage Directive (LVD)** **93/68/EEC** **CE Marking Directive**
	Conflict minerals statement - Technosoft declares that the company does not purchase 3T&G (tin, tantalum, tungsten & gold) directly from mines or smelters... We have no indication that Technosoft products contain minerals from conflict mines or smelters in and around the DRC.
	STO compliance – TUV SUD certifies that this product is SIL 3 / Cat 3 / PL e compatible and is in conformity with the following safety – related directives: **EN ISO 13849-1:2015 Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design** **EN 61800-5-1:2007 Adjustable speed electrical power drive systems — Safety requirements — Electrical, thermal and energy** **EN 61800-5-2:2007 Adjustable speed electrical power drive systems - Safety requirements –Functional** **EN 61508:2010 Functional safety of electrical/electronic/programmable electronic safety-related systems** **EN ISO 13849-1:2008 Safety of machinery - Safety-related parts of control systems** **EN 61326-3-1:2008 - General industrial applications - EMC - Immunity requirements for functional safety**

For other certifications visit: http://technosoftmotion.com/en/quality-system

2 Product Overview

2.1 Introduction

The **iPOS4808** is a family of fully digital intelligent servo drives, based on the latest DSP technology and they offer unprecedented drive performance combined with an embedded motion controller.

Suitable for control of brushless DC, brushless AC (vector control), DC brushed motors and step motors, the iPOS4808 drives accept as position feedback incremental encoders (quadrature or sine/cosine), absolute encoders (SSI and BiSS-C) and linear Hall signals[1].

All drives perform position, speed or torque control and work in single, multi-axis or stand-alone configurations. Thanks to the embedded motion controller, the iPOS4808 drives combine controller, drive and PLC functionality in a single compact unit and are capable to execute complex motions without requiring intervention of an external motion controller. Using the high-level Technosoft Motion Language (**TML**) the following operations can be executed directly at drive level:

- ❑ Setting various motion modes (profiles, PVT, PT, electronic gearing or camming, etc.)
- ❑ Changing the motion modes and/or the motion parameters
- ❑ Executing homing sequences
- ❑ Controlling the program flow through:
  - Conditional jumps and calls of TML functions
  - TML interrupts generated on pre-defined or programmable conditions (protections triggered, transitions on limit switch or capture inputs, etc.)
  - Waits for programmed events to occur
- ❑ Handling of digital I/O and analogue input signals
- ❑ Executing arithmetic and logic operations

By implementing motion sequences directly at drive level you can really distribute the intelligence between the master and the drives in complex multi-axis applications, reducing both the development time and the overall communication requirements. For example, instead of trying to command each movement of an axis, you can program the drives using TML to execute complex motion tasks and inform the master when these tasks are done. Thus, for each axis control the master job may be reduced at: calling TML functions stored in the drive EEPROM and waiting for a message, which confirms the TML functions execution completion.

For iPOS4808 commissioning **EasySetUp** or **EasyMotion Studio** PC applications may be used.

EasySetUp is a subset of EasyMotion Studio, including only the drive setup part. The output of EasySetUp is a set of setup data that can be downloaded into the drive EEPROM or saved on a PC file. At power-on, the drive is initialized with the setup data read from its EEPROM. With EasySetUp it is also possible to retrieve the complete setup information from a drive previously programmed. EasySetUp shall be used for drive setup in all cases where the motion commands are sent exclusively from a master. Hence neither the iPOS4808 TML programming capability nor the drive camming mode are used. **EasySetUp can be downloaded free of charge from Technosoft web page.**

EasyMotion Studio platform includes EasySetUp for the drive setup, and a **Motion Wizard** for the motion programming. The Motion Wizard provides a simple, graphical way of creating motion programs and automatically generates all the TML instructions. *With EasyMotion Studio you can execute complex motions, thanks to their built-in motion controller*s. EasyMotion Studio, may be used to program motion sequences in TML. This is the iPOS4808 typical CAN operation mode when TMLCAN protocol is selected. EasyMotion Studio can also be used with the CANopen protocol, if the user wants to call TML functions stored in the drive EEPROM or to use the camming mode. With camming mode, EasyMotion Studio offers the possibility to quickly download and test a cam profile and also to create a **.sw** file with the cam data. The .sw file can be afterwards stored in a master and downloaded to the drive, wherever needed. **A demo version of EasyMotion Studio (with EasySetUp part fully functional) can be downloaded free of charge from Technosoft web page.**

[1] Available only with P027.314.E721

2.2 Product Features

- Fully digital servo drive suitable for the control of rotary or linear brushless, DC brush, and step motors
- Very compact design
- Sinusoidal (FOC) or trapezoidal (Hall-based) control of brushless motors
- Open or closed-loop control of 2 and 3-phase steppers
- STO: 2 safe torque-off inputs, safety integrity level (SIL3/Cat3/PLe) acc. to EN61800-5-1;-2/ EN61508-3;-4/ EN ISO 13849-1. When left not connected will disable the motor outputs. This provides a dual redundant hardware protection that cannot be overdriven by the software or other hardware components.
- Various modes of operation, including: cyclic synchronous torque, velocity or position control(CST, CSV or CSP); position or velocity profiles, external analogue reference or sent via a communication bus
- Technosoft Motion Language (TML) instruction set for the definition and execution of motion sequences
- Standalone operation with stored motion sequences
- Communication:
  - RS-232 serial up to 115kbits/s
  - Dual 100Mbps EtherCAT® interfaces, for use in daisy-chaining topologies
- Digital and analog I/Os:
  - 6 digital inputs: 5-36 V, programmable polarity: sourcing/NPN or sinking/PNP: 2 Limit switches and 4 general-purpose
  - 5 digital outputs: 5-36 V, with 0.5 A, sinking/NPN open-collector (Ready, Error and 3 general-purpose)
  - NTC/PTC analogue Motor Temperature sensor input
- Electro-Mechanical brake support: software configurable digital output to control motor brake
- Feedback devices (dual-loop support)

  1st feedback devices supported:
  - Incremental encoder interface (single ended or differential[1])
  - Analog sin/cos encoder interface (differential $1V_{PP}$)
  - Linear Hall sensors interface[2]
  - Pulse & direction interface (single ended) for external (master) digital reference

  2nd feedback devices supported:
  - Incremental encoder interface (differential only)
  - Pulse & direction interface (differential only) for external (master) digital reference
  - BiSS-C / SSI / EnDAT[3] encoder interface

  Separate feedback devices supported:
  - Digital Hall sensor interface (single-ended and open collector)
  - 2 analogue inputs: 12 bit, 0-5V: Reference and Feedback (for Tacho) or general purpose
- Various motion programming modes:
  - Position profiles with trapezoidal or S-curve speed shape
  - Position, Velocity, Time (PVT) 3rd order interpolation
  - Position, Time (PT) 1st order interpolation
  - Cyclic Synchronous Position (CSP)
  - Cyclic Synchronous Velocity (CSV)
  - Cyclic Synchronous Torque (CST)
  - Electronic gearing and camming
  - 35 Homing modes
- 127 h/w selectable addresses
- EtherCAT® with CAN application protocol over EtherCAT (CoE) for CAT drives
- 16K × 16 internal SRAM memory for data acquisition
- 16K × 16 E^2ROM to store TML motion programs, cam tables and other user data
- PWM switching frequency up to 100kHz
- Motor supply: 12-50V
- Logic supply: 9-36V.
- STO supply: 18-40V

[1] Available only on P027.314.E221

[2] Available only on P027.314.E721

[3] Available starting with F515K firmware version

- Output current: 8[1] continuous; 20A peak
- Operating ambient temperature: 0-40°C (over 40°C with derating)
- Protections:
    - Short-circuit between motor phases
    - Short-circuit from motor phases to ground
    - Over-voltage
    - Under-voltage
    - Over-current
    - Over-temperature
    - Communication error
    - Control error
    - Feedback sensor error

2.3 Identification Labels

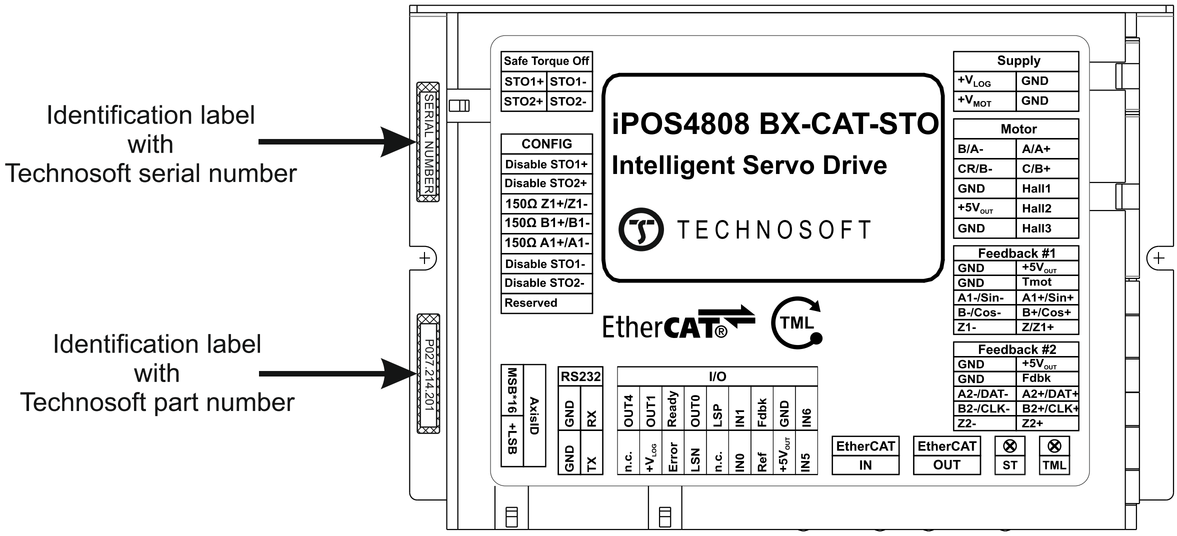


Figure 2.3.1. *iPOS4808 BX-CAT-STO identification labels*

The iPOS4808 BX-CAT can have the following part numbers and names on the identification label:

p.n. **P027.314.E221** name iPOS4808 BX-CAT-STO – standard EtherCAT® execution

p.n**. P027.324.E721** name iPOS4808 BX-CAT-STO – Linear Hall EtherCAT® execution

[1] 20A cont. with DC, step and BLDC motors (trapezoidal), 20A amplitude (14.2A_{RMS}) for PMSM (sinusoidal)

2.4 Supported Motor-Sensor Configurations

2.4.1 Single loop configurations

The position and/or speed are controlled using one feedback sensor. The other available feedback sensor input can be used for External reference Position or Velocity, Pulse and Direction, Electronic Gearing or Camming.

Sensor type (Sensor / Motor)	Sensor location	Brushless PMSM	Brushless BLDC	DC Brush	Stepper 2 phase	Stepper 3 phase
Incr. encoder	FDBK #1 (single ended or diff.) FDBK #2 (diff.)	Yes	-	Yes	Yes	-
Incr. encoder + Digital Hall	FDBK #1 (single ended or diff[1]) FDBK #2 (diff.) Digital halls interface	Yes	Yes	-	-	-
Digital halls only	Digital halls interface	Yes	-	-	-	-
Linear halls[2] (analogue)	Linear halls interface	Yes	-	-	-	-
SSI	FDBK #2 (diff.)	Yes	-	Yes	Yes	-
BiSS-C	FDBK #2 (diff.)	Yes	-	Yes	Yes	-
EnDAT[4]	FDBK #2 (diff.)	Yes	-	Yes	Yes	-
Analogue Sin/Cos	FDBK #1 (diff.)	Yes	-	Yes	Yes	-
Tacho	Analogue input: Feedback	-	-	Yes	-	-
Open-loop (no sensor)		-	-	-	Yes	Yes
Open-loop (with step loss detection using Incr. Encoder/ SinCos/ SSI/ BiSS/ EnDAT[3])	FDBK #1 (single ended or diff.) FDBK #2 (diff.)	-	-	-	Yes	Yes

2.4.2 Dual loop configurations

The motor speed control loop is closed on one feedback connected on the motor while the motor position control loop is closed on the other available feedback which is placed on the load. There is usually a transmission between the load and the motor.

Motor type	Feedback #1	Feedback #2
PMSM	• Incremental encoder (single-ended or differential[1]) • Analogue Sin/Cos encoder • Linear Halls[2] (only on motor)	• Incremental encoder (differential) • SSI/BiSS C/EnDAT[3] encoder
BLDC	• Incremental encoder (single-ended or differential) + Digital halls	• Incremental encoder (differential) + Digital Halls • SSI/BiSS C/EnDAT[3] encoder (only on load)
Stepper 2ph	• Incremental encoder (single-ended or differential) • Analogue Sin/Cos encoder	• Incremental encoder (differential) • SSI/BiSS C/EnDAT[3]encoder
DC Brush	• Incremental encoder (single-ended or differential) • Analogue Sin/Cos encoder • Analogue Tacho (only on motor)	• Incremental encoder (differential) • SSI/BiSS C/EnDAT[3] encoder

Each defined motor type can have any combination of the supported feedbacks either on motor or on load.

Examples: -PMSM motor with Incremental encoder (from feedback #1) on motor and Incremental encoder (from feedback#2) on load; -DC brush motor with SSI encoder (from feedback #2) on motor and Sin/Cos encoder (from feedback #1) on load.

[1] A differential encoder on Feedback #1 is available only with P027.314.E221

[2] Linear hall sensors are compatible only with P027.314.E701

[3] Available starting with F515K firmware version

3 Hardware Installation

3.1 iPOS4808 BX-CAT-STO Board Dimensions

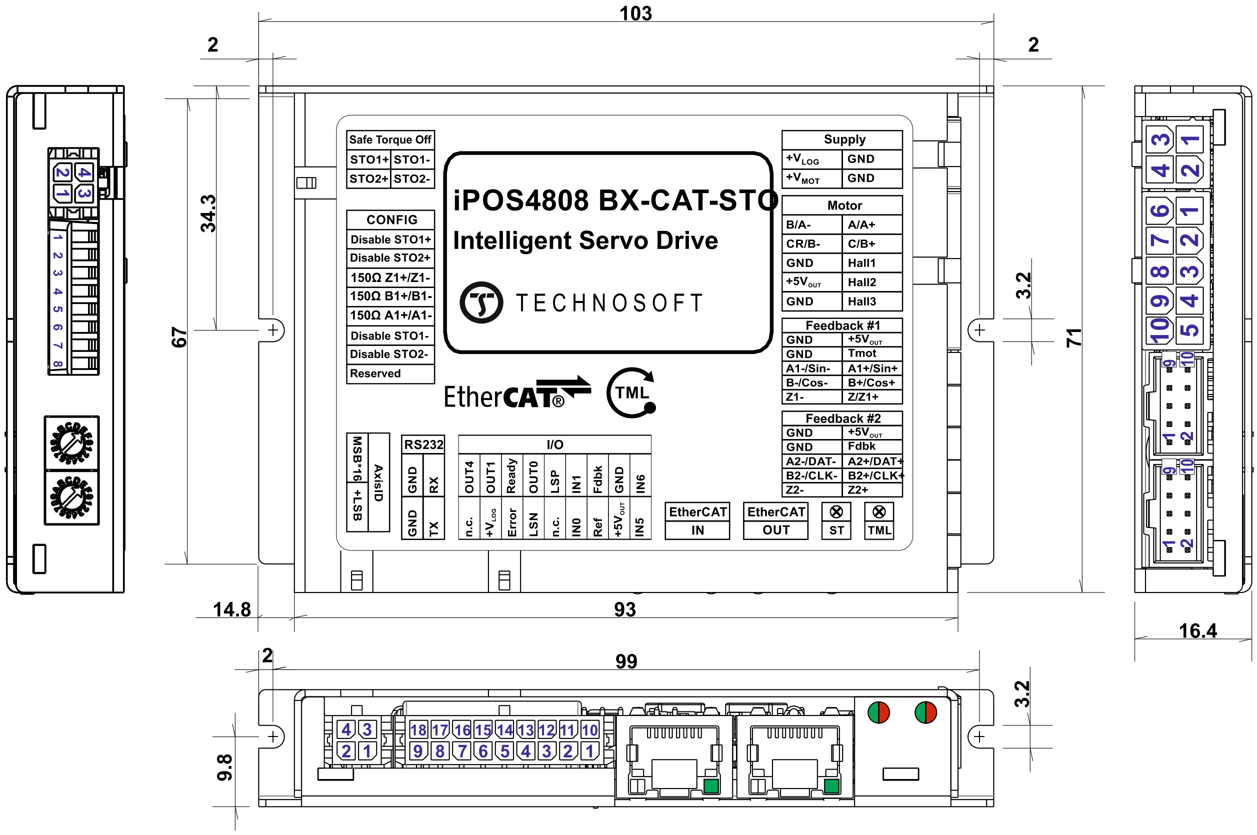


Figure 3.1.1. iPOS4808 BX-CAT-STO drive dimensions

All dimensions are in mm. The drawings are not to scale.

3.2 Mechanical Mounting

The iPOS4808 drive is intended to be mounted vertically on a on a metallic support using the provided mounting holes and the recommended mating connectors, as specified in chapter **3.3.2 Mating Connectors**.

For thermal calculations, the iPOS4808 BX-CAT-STO drive can be assumed to generate 3.7 Watt (= 8 BTU/hour) at idle, and up to 7.2 Watt (= 25 BTU/hour) worst case while driving a motor.

When the iPOS4808 BX-CAT is mounted vertically, its overall envelope (size) including the recommended mating connectors is shown in Figure 3.1. Fixing the iPOS4808 BX-CAT onto a support using the provided mounting holes is strongly recommended to avoid vibration and shock problems.

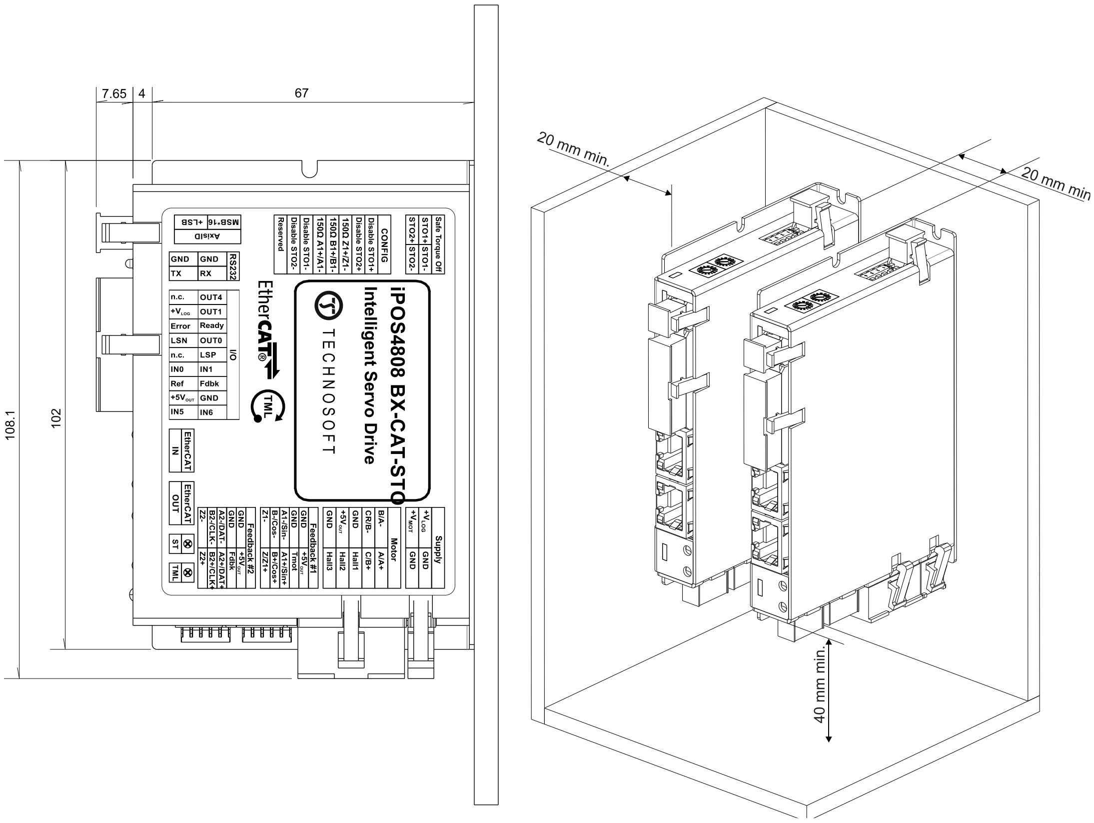


Figure 3.2.1. *iPOS4808 BX-CAT-STO dimensions with mating connectors*

and minimum spacing for vertical mounting

The iPOS4808 BX-CAT drive(s) can be cooled by natural convection. The support shall be thermally conductive (metallic), and shall be mounted vertically.

Figure 3.2.1 shows the minimum spacing to assure proper airflow by natural convection.

If closed completely in a box, ventilation openings shall be foreseen on the top and bottom sides.

If ventilation driven by natural convection is not enough to maintain the temperature surrounding the iPOS4808 BX-CAT drive(s), then alternate forced cooling methods must be applied.

3.3 Connectors and Pinouts

3.3.1 Pinouts for iPOS4808 BX-CAT-STO

SW1 & SW2 Axis ID selection switches

Switch	Position	Description
SW1	0..F	H/W Axis ID = SW2(MSB)*16 + SW1(LSB) Exception: SW2=0 and SW1 = 0 -->Axis ID = 255. Remark:SW2 should be set only between 0 and 7.
SW2	0..7	

SW3 HW Configuration piano switch

Pin	Position	Description
1	down(ON)	Disable STO1+ functionality. Connects internally +V_{LOG} to STO1+
2	down(ON)	Disable STO2+ functionality. Connects internally +V_{LOG} to STO2+
3	down(ON)	Connect an 150Ω resistor between Z1+ and Z1- feedback pins
4	down(ON)	Connect an 150Ω resistor between B1+ and B1- feedback pins
5	down(ON)	Connect an 150Ω resistor between A1+ and A1- feedback pins
6	down(ON)	Disable STO1- functionality. Connects internally GND to STO1-
7	down(ON)	Disable STO2- functionality. Connects internally GND to STO2-
8	down(ON)	Reserved

J9

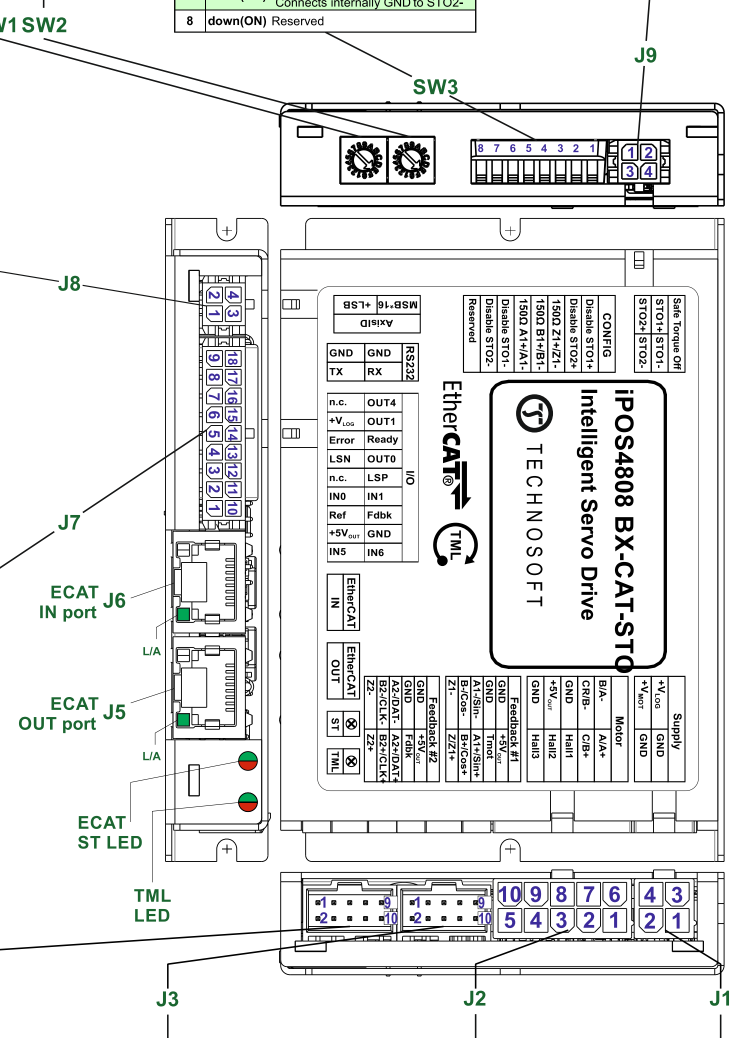
Pin	Name	Description
1	STO2+	Safe Torque Off input 2, positive input(opto-isolated, 18÷40V)
2	STO1+	Safe Torque Off input 1, positive input(opto-isolated, 18÷40V)
3	STO2-	Safe Torque Off input 2, negative return(opto-isolated, 0V)
4	STO1-	Safe Torque Off input 1, negative return(opto-isolated, 0V)

J8

Pin	Name	Description
1	232TX	RS-232 Data Transmission
2	GND	Return ground for RS-232 pins
3	232RX	RS-232 Data Reception
4	GND	Return ground for RS-232 pins

J7

Pin	Name	Description
1	IN5	12-36V general-purpose digital PNP/NPN input
2	+$5V_{OUT}$	5V output supply for I/O usage
3	REF	Analogue input, 12-bit, 0-5V. Used to read an analog position, speed or torque reference, or used as general purpose analogue input
4	IN0	12-36V general-purpose digital PNP/NPN input
5	n.c.	not connected
6	IN3/LSN	12-36V digital PNP/NPN input. Negative limit switch input
7	OUT2/Error	5-36V 0.5A, drive Error output, active low, NPN open-collector/TTL pull-up. Also drives the red Error LED.
8	+V_{LOG}	Positive terminal of the logic supply: 9 to $36V_{DC}$
9	n.c.	not connected
10	IN6	12-36V general-purpose digital PNP/NPN input
11	GND	Return ground for I/O pins
12	FDBK	Analogue input, 12-bit, 0-5V. Used to read an analogue position or speed feedback (as tacho), or used as general purpose analogue input; Connected also to J4 pin 8.
13	IN1	12-36V general-purpose digital PNP/NPN input
14	IN2/LSP	12-36V digital PNP/NPN input. Positive limit switch input
15	OUT0	5-36V 0.5A, general-purpose digital output, NPN open-collector/TTL pull-up
16	OUT3/Ready	5-36V 0.5A, drive Ready output, active low, NPN open-collector/TTL pull-up. Also drives the green Ready LED.
17	OUT1	5-36V 0.5A, general-purpose digital output, NPN open-collector/TTL pull-up
18	OUT4	5-36V 0.5A, general-purpose digital output, NPN open-collector/TTL pull-up



J4

Pin	Name	Description
1	Z2-	Incr. encoder2 Z- diff. input; has 150Ω resistor between pins 1 and 2
2	Z2+	Incr. encoder2 Z+ diff. input ; has 150Ω resistor between pins 1 and 2
3	B2-/Dir-/CLK-/MA-	Incr. encoder2 B- diff. input, or Dir-, or Clock- for SSI, or Master- for BiSS; has 150Ω resistor between pins 3 and 4
4	B2+/Dir+/CLK +/MA+	Incr. encoder2 B+ diff. input, or Dir+, or Clock+ for SSI, or Master+ for BiSS; has 150Ω resistor between pins 3 and 4
5	A2- /Pulse-/ Data-/SL-	Incr. encoder2 A- diff. input, or Pulse-, or Data- for SSI, or Slave- for BiSS; has 150Ω resistor between pins 5 and 6
6	A2+/Pulse+/ Data+/SL+	Incr. encoder2 A+ diff. input, or Pulse+, or Data+ for SSI, or Slave+ for BiSS; has 150Ω resistor between pins 5 and 6
7	GND	Return ground for sensors supply
8	FDBK	Analogue input, 12-bit, 0-5V. Used to read an analogue position or speed feedback (as tacho), or used as general purpose analogue input; Also connected to J7 pin12.
9	GND	Return ground for sensors supply
10	+$5V_{OUT}$	5V output supply for sensors usage

J3

Pin	Name	Description
1	Z1-	Incr. encoder1 Z- diff. input
2	Z1+	Incr. encoder1 Z single-ended, or Z+ diff. input
3	B1-/Cos-	Incr. encoder1 B- diff. input, or analogue encoder Cos- diff. input
4	B1+/Cos+/Dir	Incr. encoder1 B single-ended, or B+ diff. input, or Dir, or analogue encoder Cos+ diff. input
5	A1- /Sin-	Incr. encoder1 A- diff. input, or analogue encoder Sin- diff. input
6	A1+/Sin+/ Pulse	Incr. encoder1 A single-ended, or A+ diff. input, or Pulse, or analogue encoder Sin+ diff. input
7	GND	Return ground for sensors supply
8	Temp Mot	NTC/PTC input. Used to read an analog temperature value
9	GND	Return ground for sensors supply
10	+$5V_{OUT}$	5V output supply for I/O usage

J2

Pin	Name	Description
1	A/A+	**Phase A** for 3-ph motors, A+ for 2-ph steppers, Motor+ for DC brush motors
2	C/B+	**Phase C** for 3-ph motors, B+ for 2-ph steppers
3	Hall 1	Digital input Hall 1 sensor
4	Hall 2	Digital input Hall 2 sensor
5	Hall 3	Digital input Hall 3 sensor
6	B/A-	**Phase B** for 3-ph motors, A- for 2-ph steppers, Motor- for DC brush motors
7	CR/B-	**Chopping resistor** / Phase B- for step motors
8	GND	Negative return (ground) of the motor supply
9	+$5V_{OUT}$	5V output supply - internally generated
10	GND	Negative return (ground) of the motor supply

J1

Pin	Name	Description
1	GND	Negative return (ground) of the power supply
2	GND	Negative return (ground) of the power supply
3	+V_{LOG}	Positive terminal of the logic supply input: 9 to $36V_{DC}$
4	+V_{MOT}	Positive terminal of the motor supply: 11 to $50V_{DC}$.

3.3.2 Mating Connectors

Image	Connector	Description	Manufacturer	Part Number	Image
	J1	MINIFIT JR. receptacle housing, 2x2 way	MOLEX	39-03-9042	
	J2	MINIFIT JR. receptacle housing, 2x5 way	MOLEX	39-03-9102	
	J1,J2	CRIMP PIN, MINIFIT JR., 13A	MOLEX	45750-1111	
	J3, J4	C-Grid III™ Crimp Housing Dual Row, 10 Circuits, with retention	MOLEX	90142-0010	
		C-Grid III™ Crimp Housing Dual Row, 10 Circuits, without ention		90143-0010	
	J3, J4	C-Grid III™ Crimp Terminal	MOLEX	90119-0109	
	J7	MICROFIT RECEPTACLE HOUSING, 2x9 WAY	MOLEX	43025-1800	
	J8, J9	MICROFIT RECEPTACLE HOUSING, 2x2 WAY	MOLEX	43025-0400	
	J7, J8, J9	CRIMP PIN, MICROFIT, 5A	MOLEX	43030-0007	
	J5, J6	Standard 8P8C modular jack (RJ-45) male	-	-	

3.4 Connection diagrams

3.4.1 iPOS4808 BX-CAT-STO connection diagram

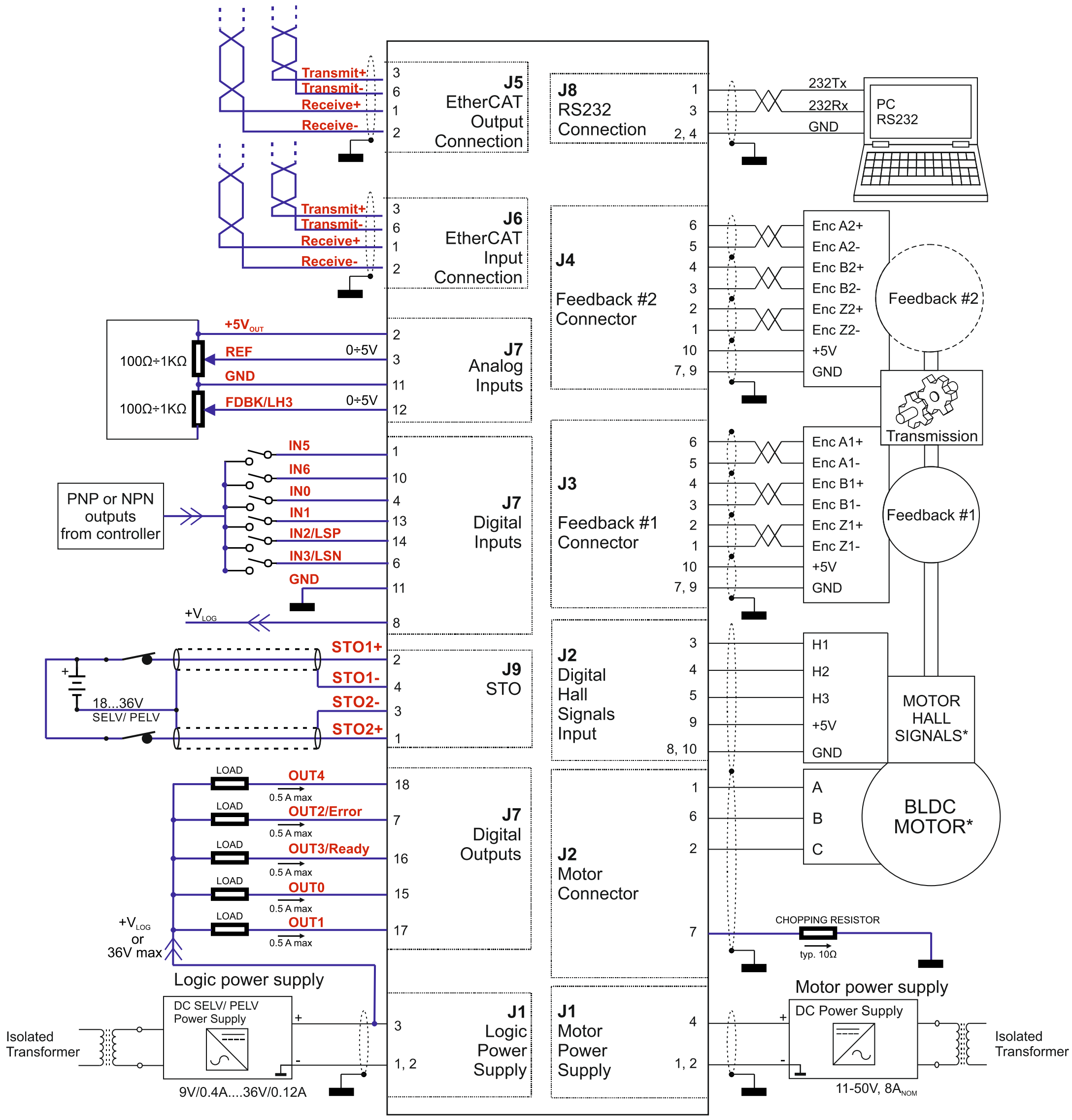


Figure 3.2. **iPOS4808 BX-CAT-STO Connection diagram**

* For other available feedback / motor options, check the detailed connection diagrams below

3.4.2 24V Digital I/O Connection

3.4.2.1 PNP inputs

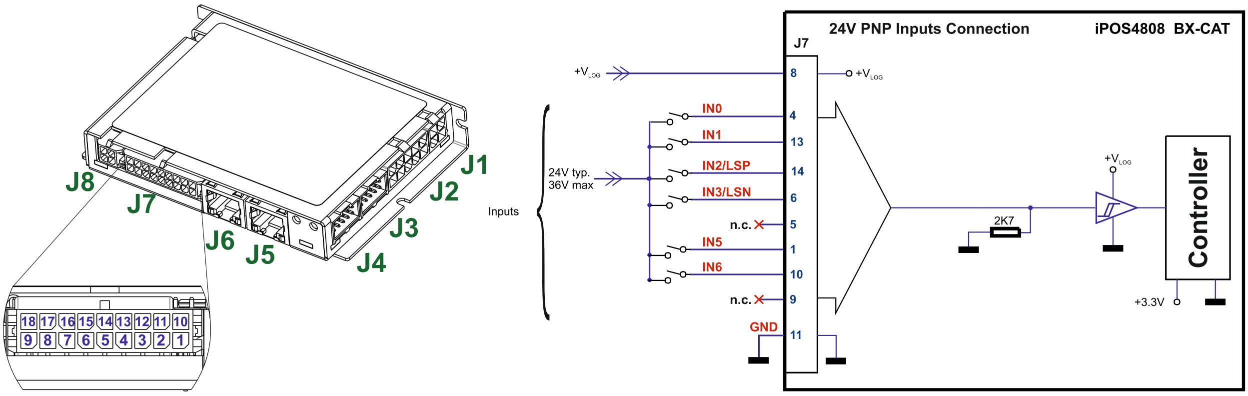


Figure 3.3. **24V Digital PNP Inputs connection**

Remarks:

1. *The inputs are selectable as PNP/ NPN by software.*
2. *The inputs are compatible with PNP type outputs (input must receive a positive voltage value (5-36V) to change its default state)*
3. *The length of the cables must be up to 30m, reducing the exposure to voltage surge in industrial environment.*

3.4.2.2 NPN inputs

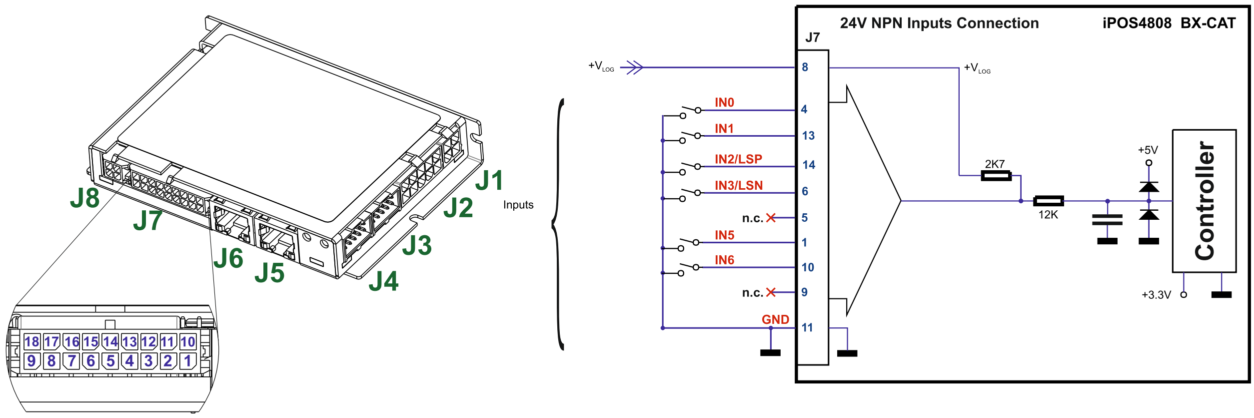


Figure 3.4. **24V Digital NPN Inputs connection**

Remarks:

1. *The inputs are selectable as PNP/ NPN by software.*
2. *The inputs are compatible with NPN type outputs (input must be pulled to GND to change its default state)*
3. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*

3.4.2.3 NPN outputs

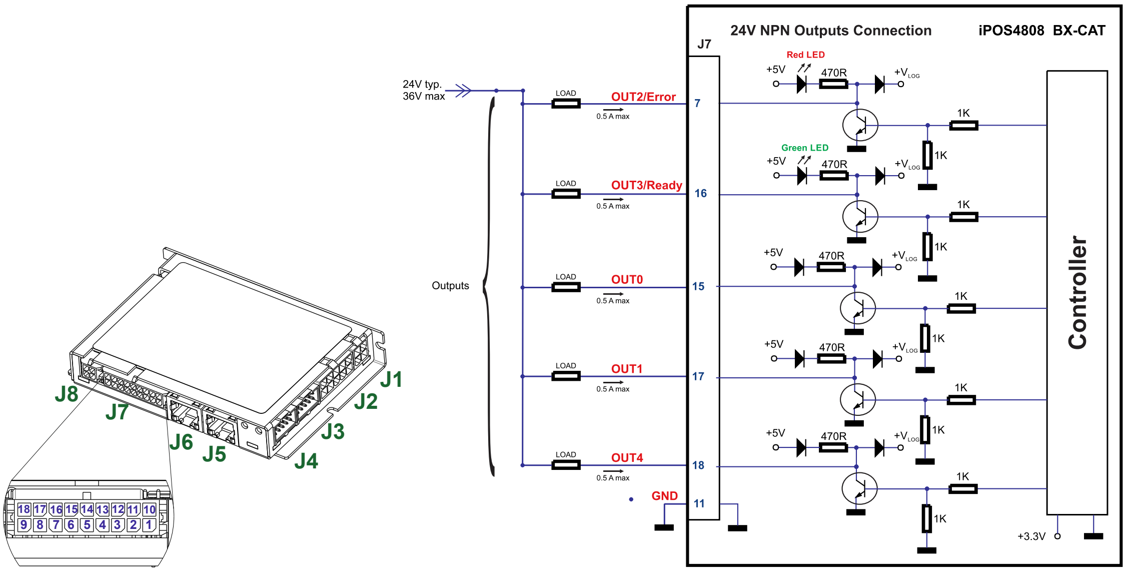


Figure 3.5. **24V Digital NPN Outputs connection**

Remark:

The outputs are compatible with NPN type inputs (load is tied to common +V_{LOG}, output pulls to GND when active and is floating when inactive)

3.4.3 5V Digital I/O Connection

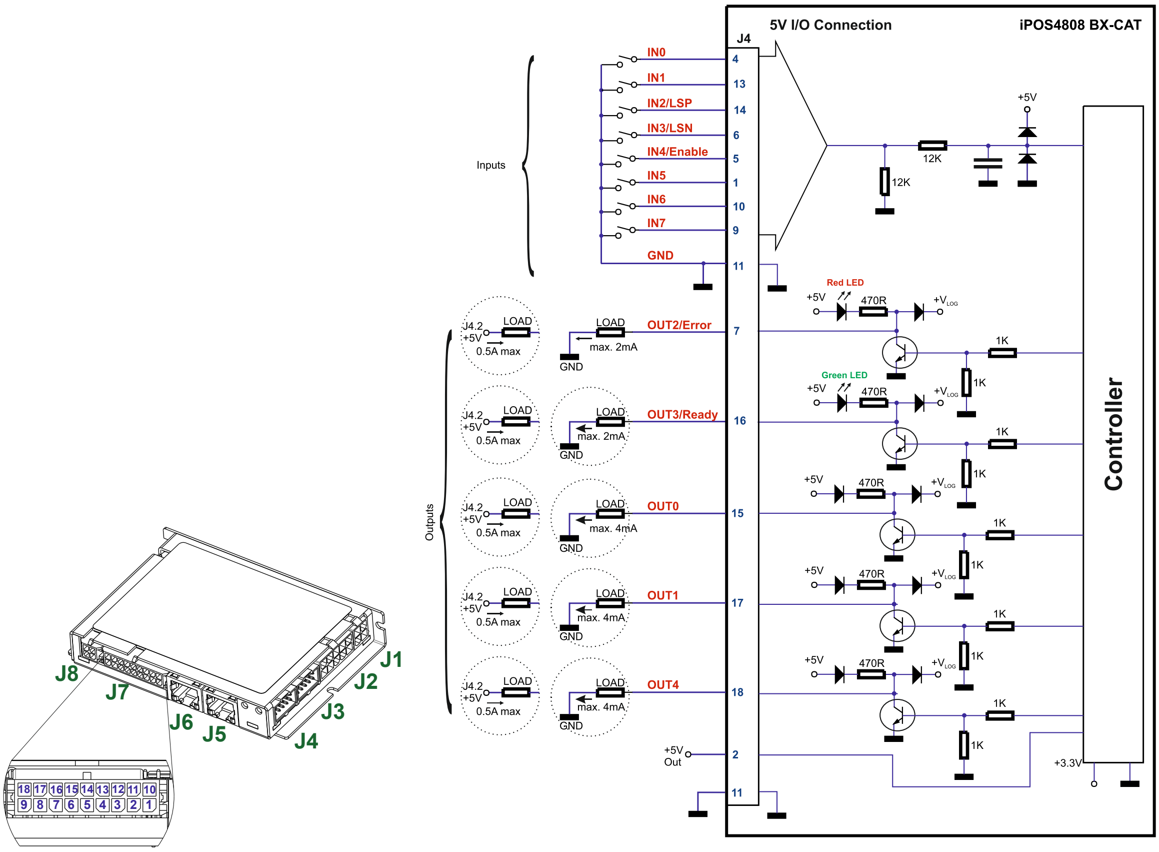


Figure 3.6. **5V Digital I/O connection**

Remarks:

1. *The inputs are selectable as PNP/ NPN by software. For the 5V connection they are selected as PNP. NPN is not compatible on a 5V connection.*
2. *The inputs are compatible with TTL(5V), LVTTL(3.3V), CMOS (3.3V-24V) outputs*
3. *The outputs are compatible with TTL (5V) and CMOS (5V) inputs*
4. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*

The output loads can be individually and independently connected to +5V or to GND.

3.4.4 Analog Inputs Connection

3.4.4.1 0-5V Input Range

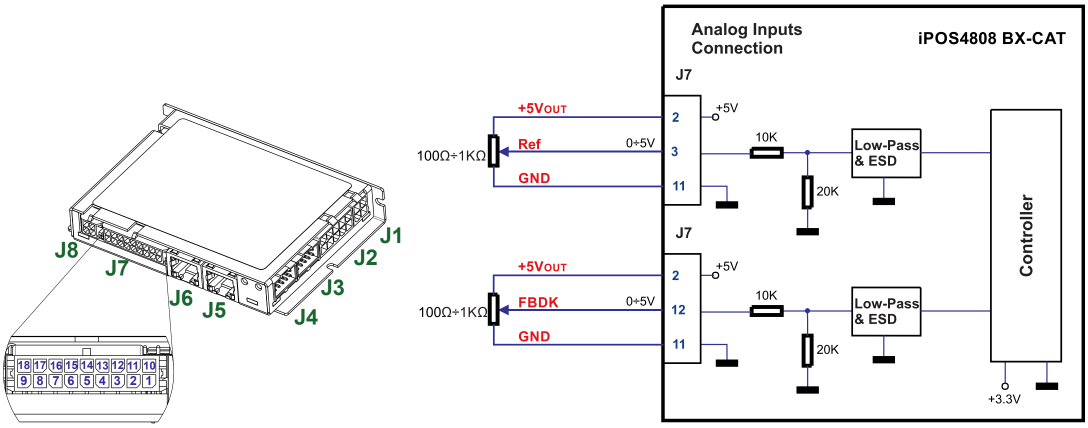


Figure 3.7. ***0-5V* Analog inputs connection**

Remarks:

1. *Default input range for analog inputs is 0÷5 V for REF and FBDK. For a +/-10 V range, see Figure 3.8.*
2. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*

3.4.4.2 +/- 10V to 0-5V Input Range Adapter

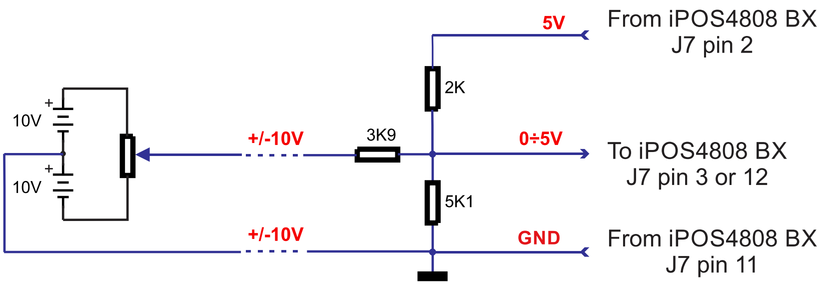


Figure 3.8. **+/-10V to 0-5V adapter**

Remark: *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*

3.4.4.3 Recommendation for wiring

a) If the analogue signal source is single-ended, use a 2-wire twisted shielded cable as follows: 1st wire connects the live signal to the drive input; 2nd wire connects the source ground to the drive ground; shield will be connected to the drive ground terminal.

b) If the analogue signal source is differential and the signal source ground is isolated from the drive GND, use a 2-wire twisted shielded cable as follows: 1st wire connects the source plus (positive, in-phase) to the drive analogue input; 2nd wire connects the source minus (negative, out-of-phase) to the drive ground (GND). Shield is connected only at the drive side, to the drive GND, and is left unconnected at the source side.

c) If the analogue signal source is differential and the signal source ground is common with the drive GND, use a 2-wire shielded cable as follows: 1st wire connects the source plus (positive, in-phase) to the drive analogue input; 2nd wire connects the source ground to the drive ground (GND); shield is connected only at the drive side, to the drive GND, and is left unconnected at the source side. The source minus (negative, out-of-phase) output remains unconnected.

3.4.5 Motor connections

3.4.5.1 Brushless Motor connection

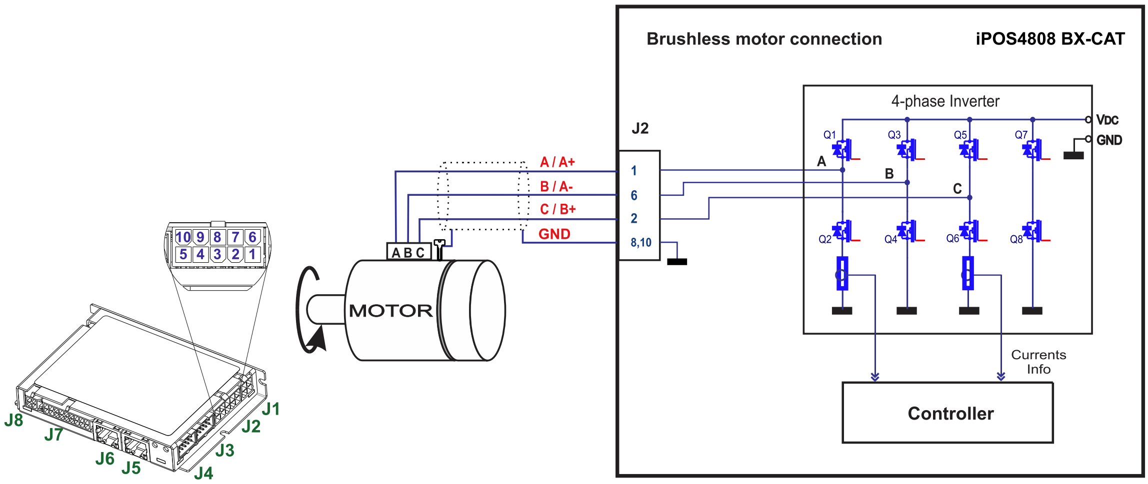


Figure 3.9. **Brushless motor connection**

3.4.5.2 2-phase Step Motor connection

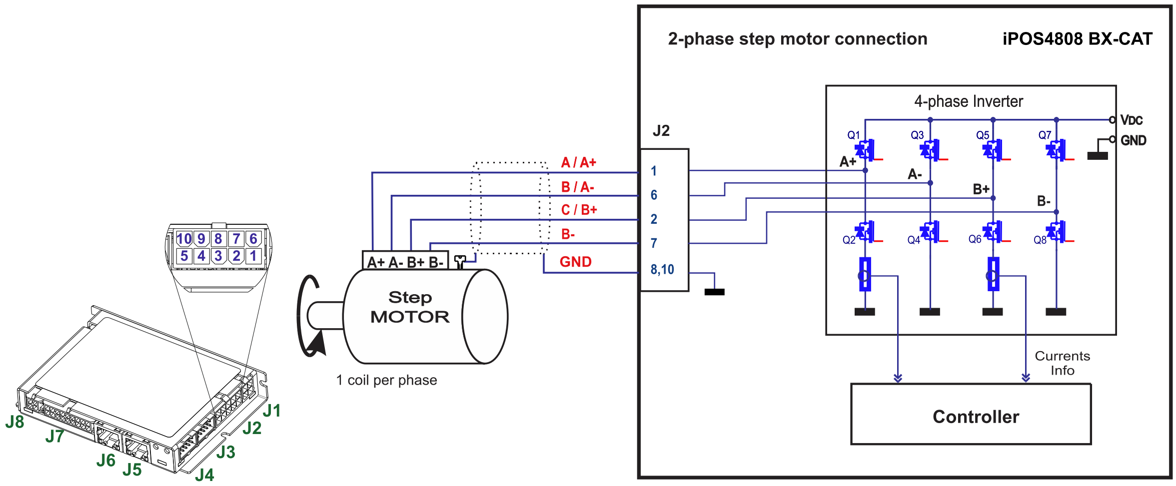


Figure 3.10. **2-phase step motor connection, one coil per phase**

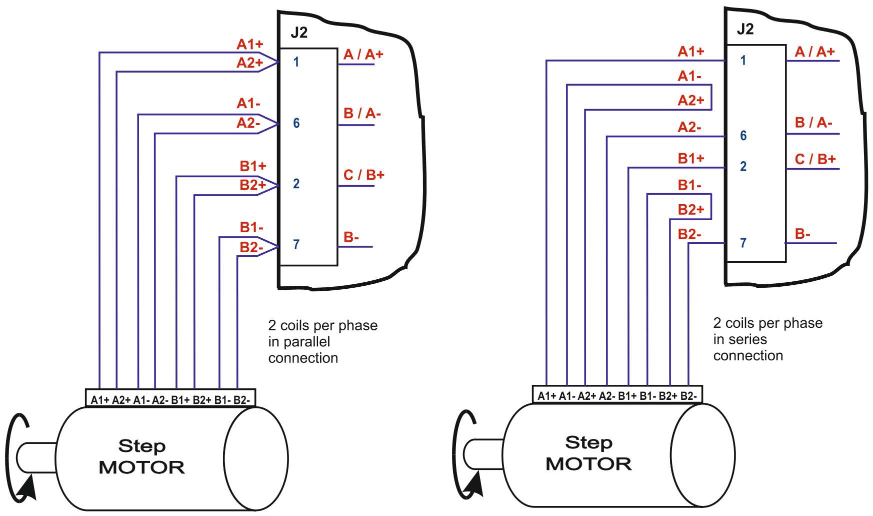


Figure 3.11. **2-phase step motor connection, two coils per phase**

3.4.5.3 3-Phase Step Motor connection

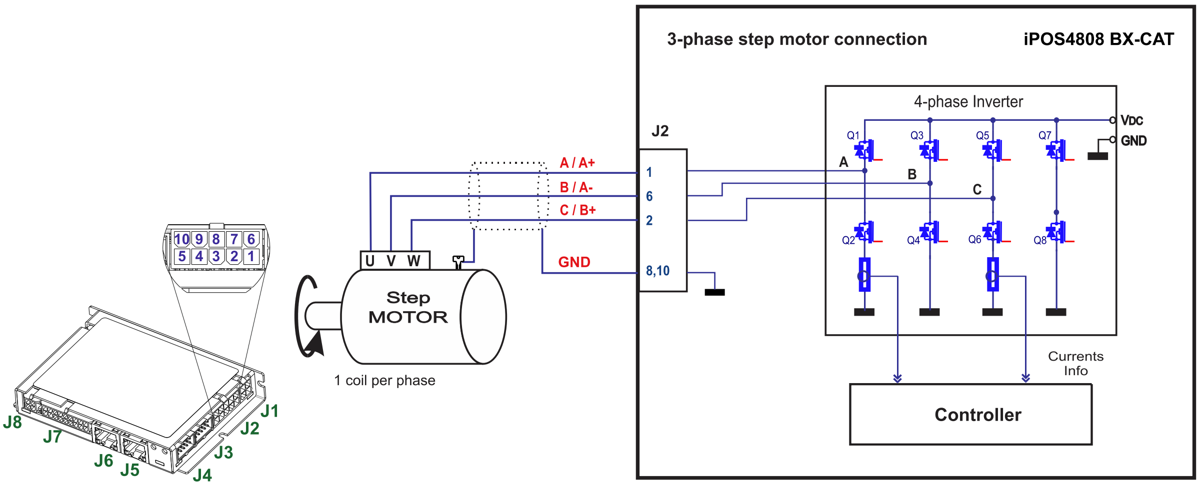


Figure 3.12. **3-phase step motor connection**

3.4.5.4 DC Motor connection

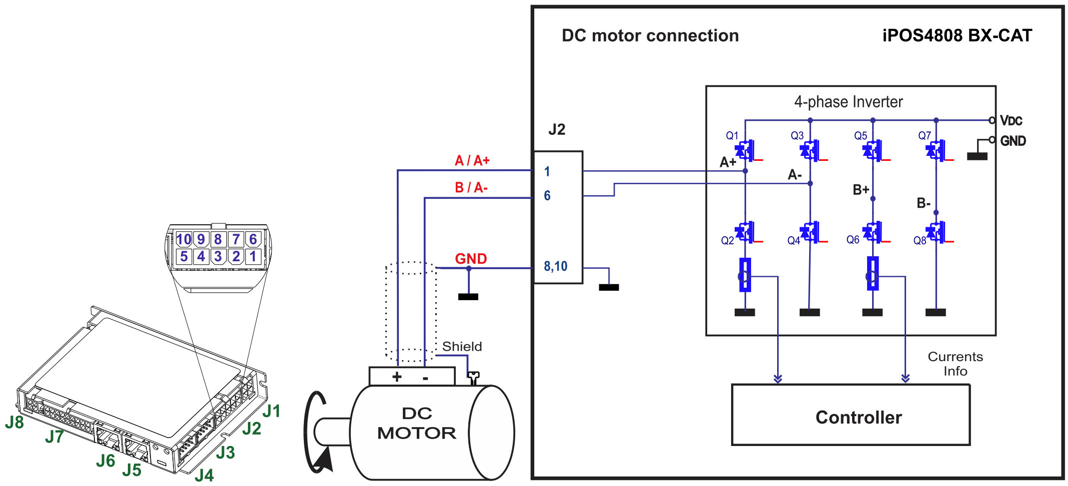


Figure 3.13. **DC Motor connection**

3.4.5.5 Recommendations for motor wiring

a) Avoid running the motor wires in parallel with other wires for a distance longer than 2 meters. If this situation cannot be avoided, use a shielded cable for the motor wires. Connect the cable shield to the iPOS4808 GND pin. Leave the other end disconnected.

b) The parasitic capacitance between the motor wires must not bypass 10nF. If very long cables (tens of meters) are used, this condition may not be met. In this case, add series inductors between the iPOS4808 outputs and the cable. The inductors must be magnetically shielded (toroidal, for example), and must be rated for the motor surge current. Typically the necessary values are around 100 µH.

A good shielding can be obtained if the motor wires are running inside a metallic cable guide.

3.4.6 Feedback connections

3.4.6.1 Single-ended Incremental Encoder #1 Connection

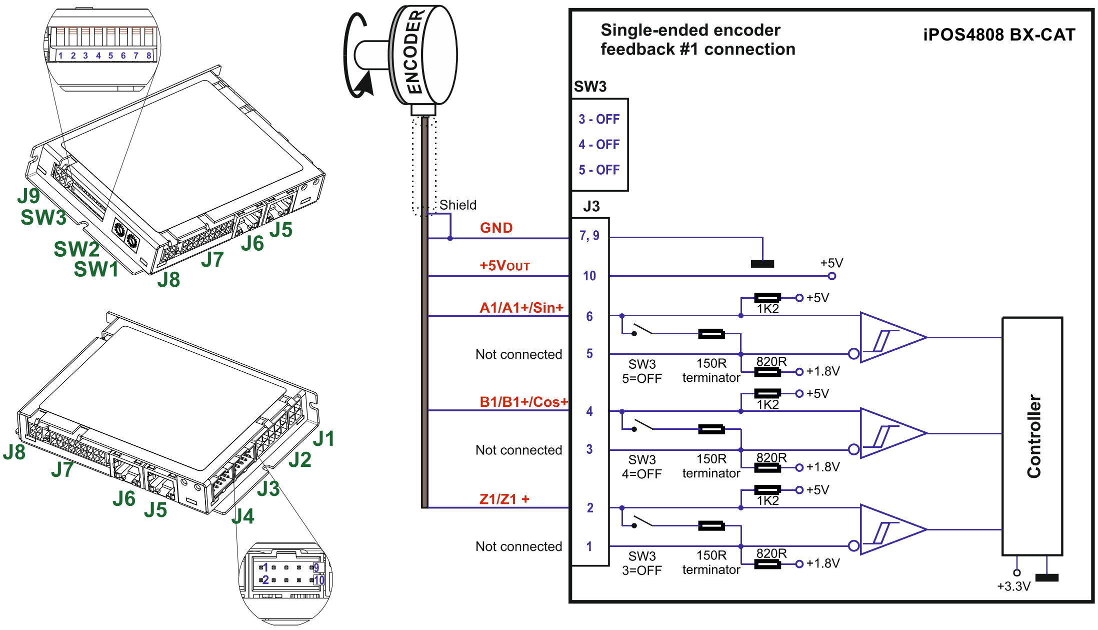


Figure 3.14. **Single-ended incremental encoder connection**

CAUTION!	***DO NOT CONNECT UNTERMINATED WIRES. THEY MIGHT PICK UP UNWANTED NOISE AND GIVE FALSE ENCODER READINGS.***

3.4.6.2 Differential Incremental Encoder #1 Connection

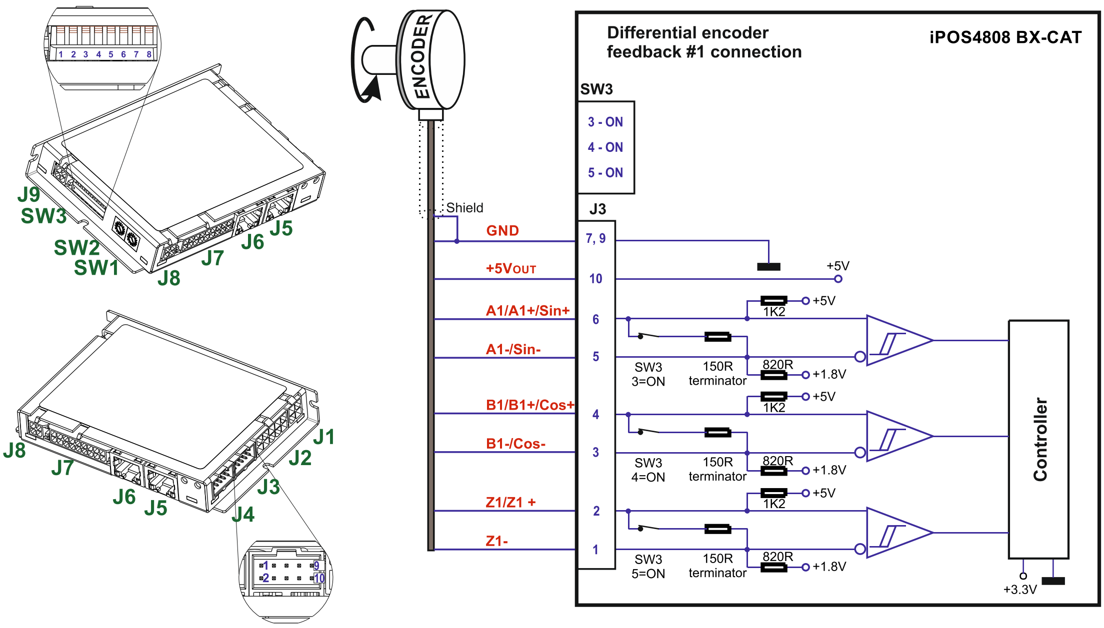


Figure 3.15. **Differential incremental encoder #1 connection**

Remarks:

1. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*

3.4.6.3 Pulse&Direction Encoder #1 Connection

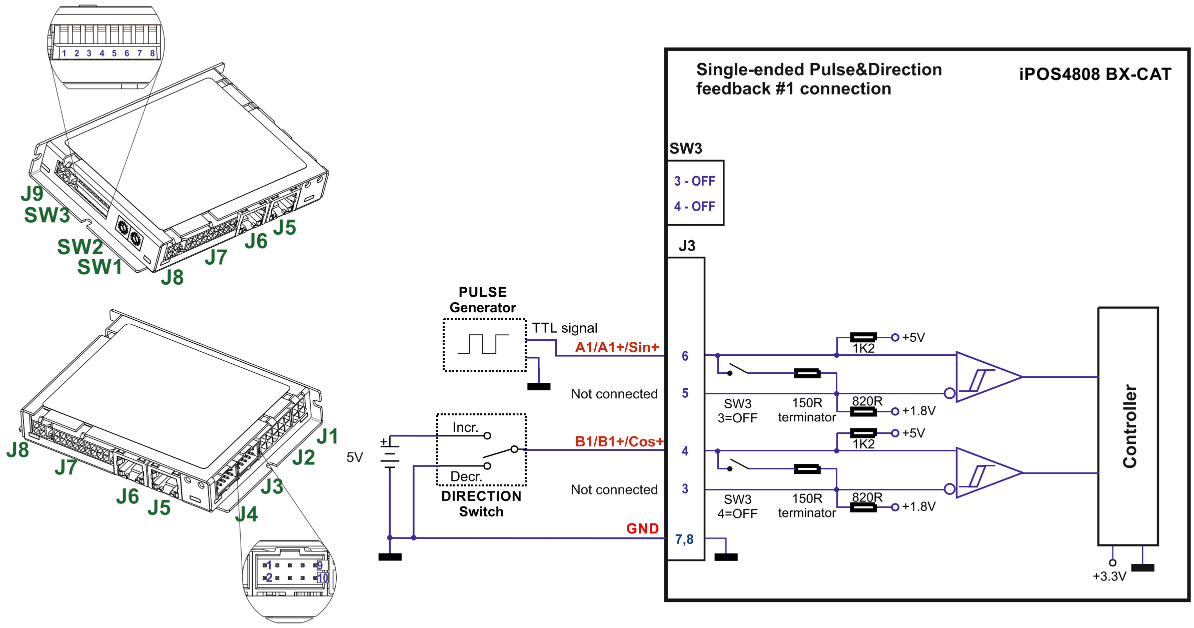


Figure 3.16. **Pulse&Direction encoder connection**

CAUTION!	*DO NOT CONNECT UNTERMINATED WIRES. THEY MIGHT PICK UP UNWANTED NOISE AND GIVE FALSE ENCODER READINGS.*

3.4.6.4 Differential Incremental Encoder #2 Connection

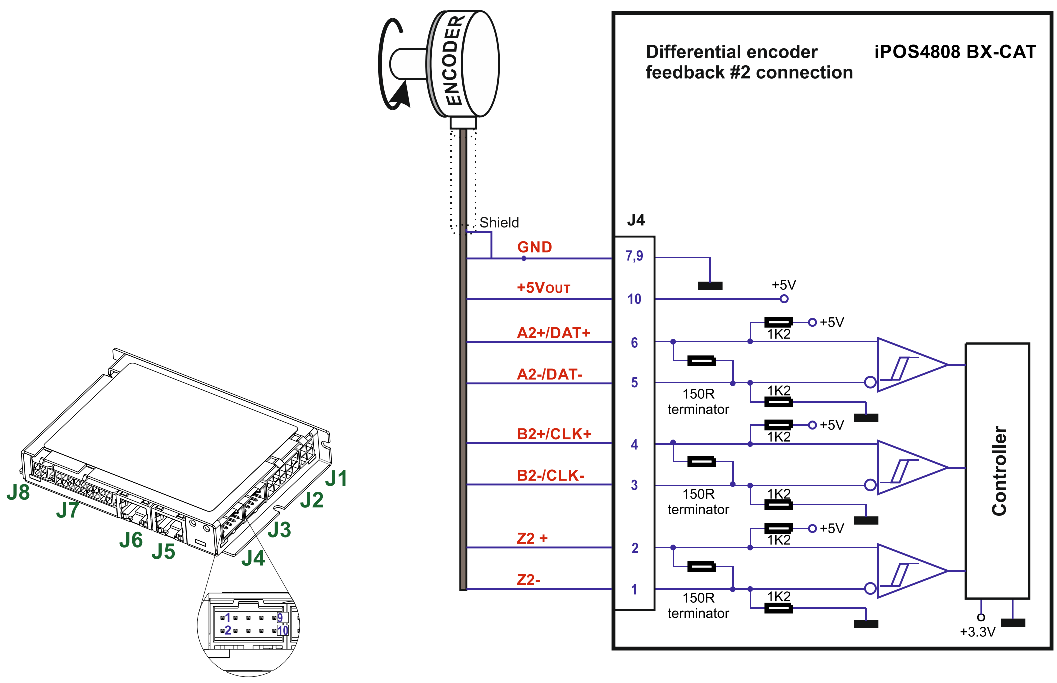


Figure 3.17. **Differential incremental encoder #2 connection**

Remarks:

1. *The encoder #2 input has internal terminators, equivalent to 120Ω (0.25W) , present in the drive.*
2. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*

3.4.6.5 SSI / EnDAT Encoder #2 Connection

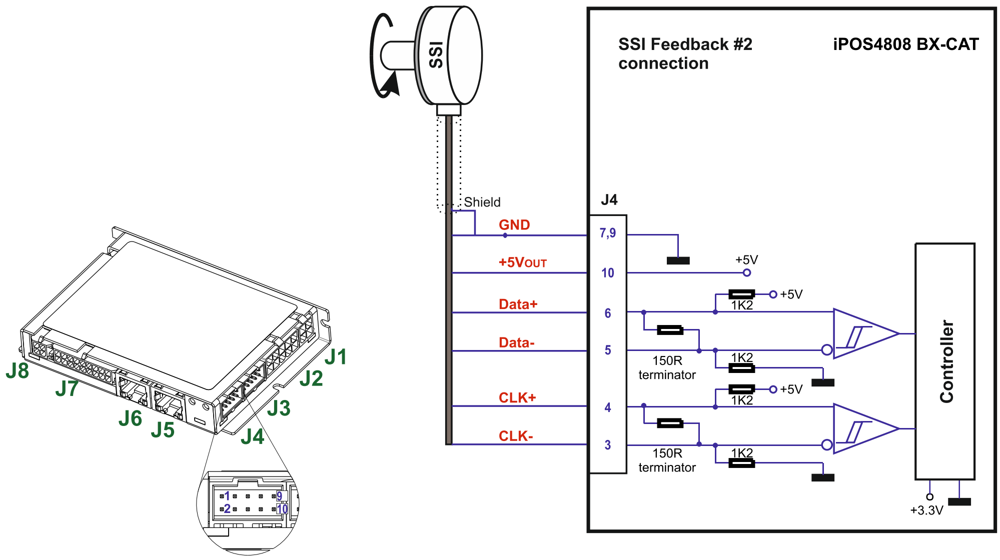


Figure 3.18. **SSI / EnDAT encoder #2 connection**

3.4.6.6 BiSS Encoder #2 Connection

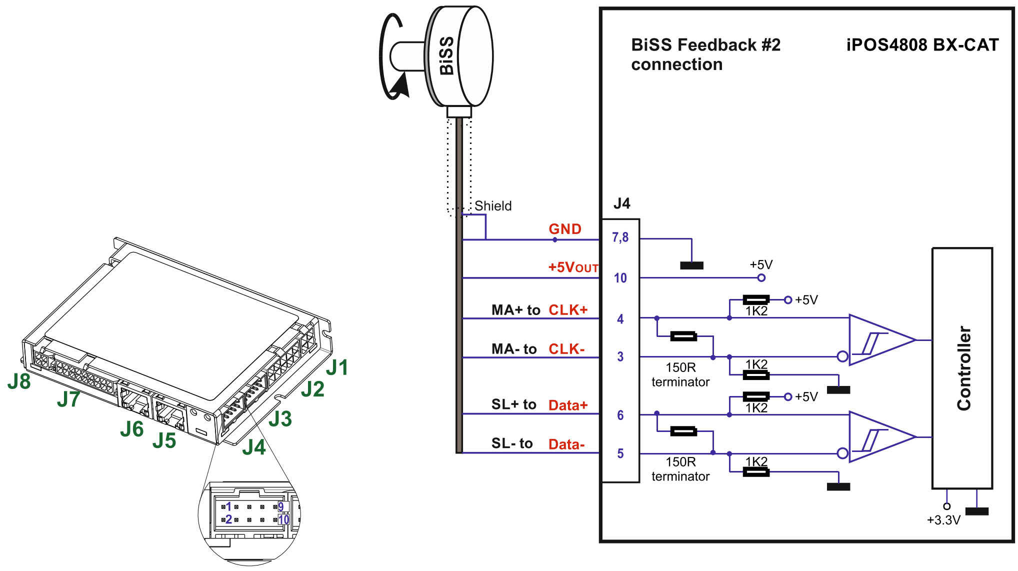


Figure 3.19. **BiSS-C encoder #2 connection**

Remarks:

1. *The encoder #2 input has internal terminators, equivalent to 120Ω (0.25W) , present in the drive.*
2. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*

3.4.6.7 Digital Hall Connection for Motor + Hall + Incremental Encoder

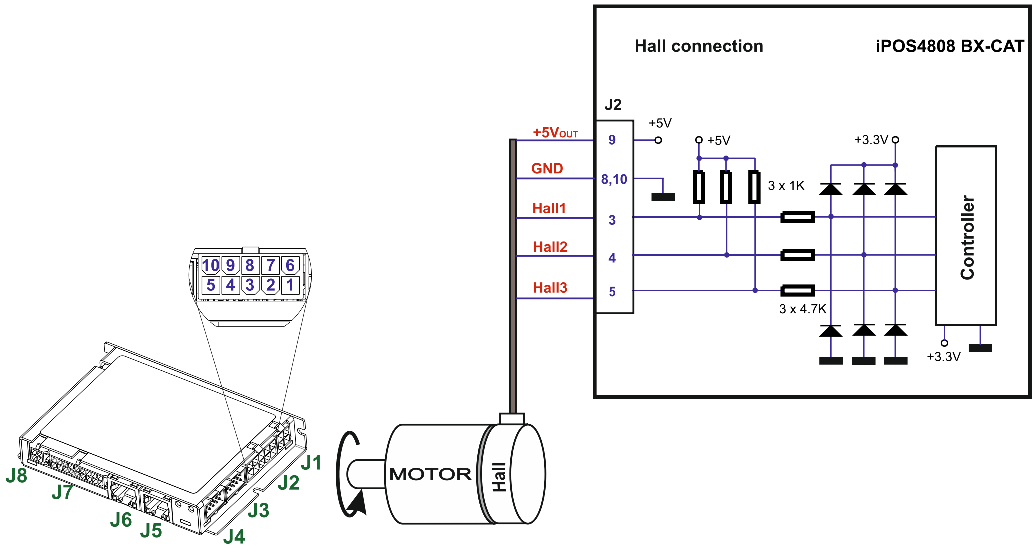


Figure 3.20. **Digital Hall connection**

Remarks:

1. *This connection is required when using Hall start method BLDC or PMSM and also for the Trapezoidal commutation method. The digital halls are not used in this case as a feedback measurement device. The actual motor control is done with an incremental encoder.*
2. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*

3.4.6.8 Digital Hall Connection for direct motor control without an encoder

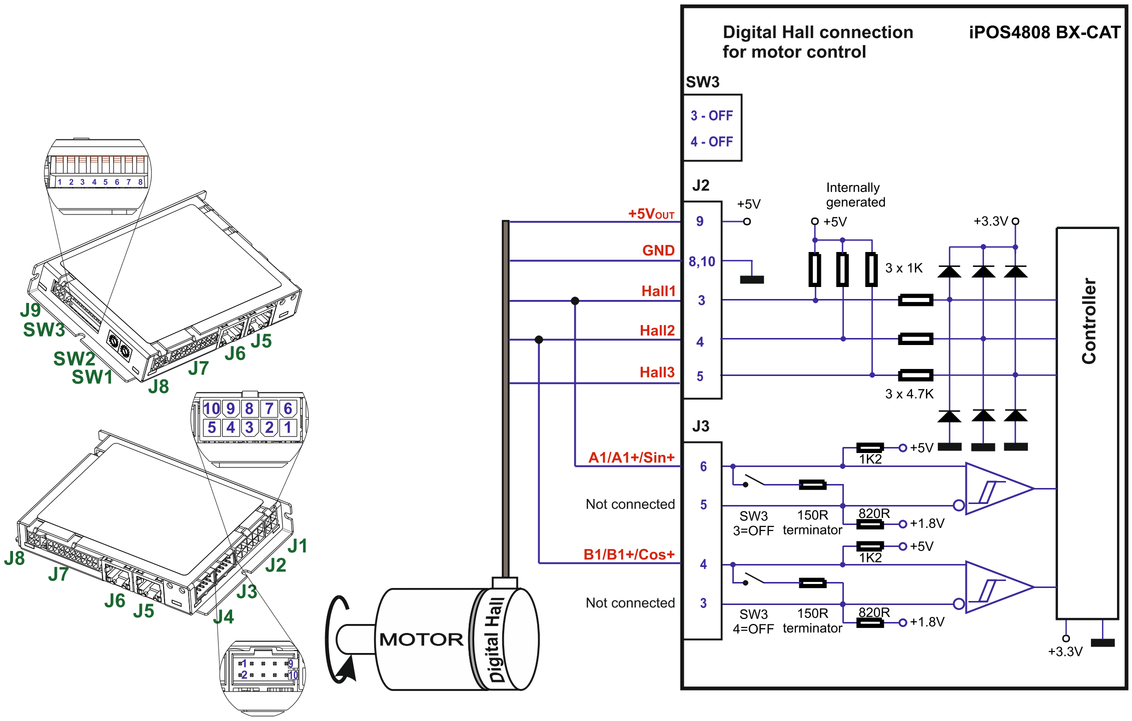


Figure 3.21. **Digital Hall connection**

Remarks:

1. *This connection is required when using only Digital hall signals as the main feedback device for motor control. In this case, no incremental encoder is needed.*
2. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*

3.4.6.9 Sine-Cosine Analog Encoder Connection

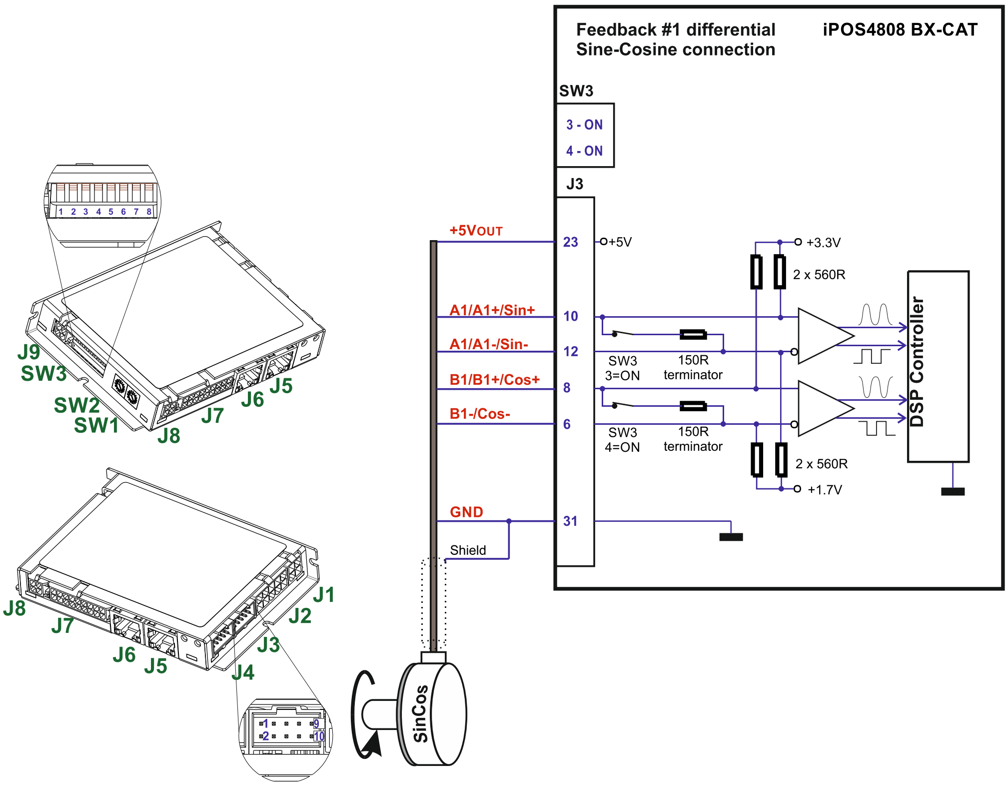


Figure 3.22. **Sine-Cosine analogue encoder connection**

3.4.6.10 Linear Hall Connection[1]

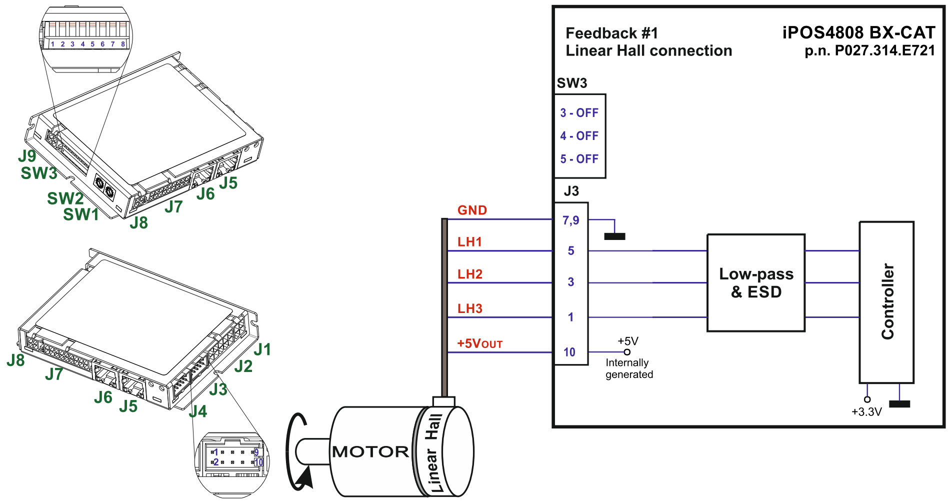


Figure 3.23. **Linear Hall connection**

3.4.6.11 Recommendations for wiring

a) Always connect both positive and negative signals when the position sensor is differential and provides them. Use one twisted pair for each differential group of signals as follows: A+/Sin+ with A-/Sin-, B+/Cos+ with B-/Cos-, Z+ with Z-. Use another twisted pair for the 5V supply and GND.

b) Always use shielded cables to avoid capacitive-coupled noise when using single-ended encoders or Hall sensors with cable lengths over 1 meter. Connect the cable shield to the GND, at only one end. This point could be either the iPOS4808 (using the GND pin) or the encoder / motor. Do not connect the shield at both ends.

c) If the iPOS4808 5V supply output is used by another device (like for example an encoder) and the connection cable is longer than 5 meters, add a decoupling capacitor near the supplied device, between the +5V and GND lines. The capacitor value can be 1...10 µF, rated at 6.3V.

[1] A linear hall connection is possible only with the drive Product ID: P027.314.E721

3.4.7 Power Supply and STO Connection

3.4.7.1 Supply Connection

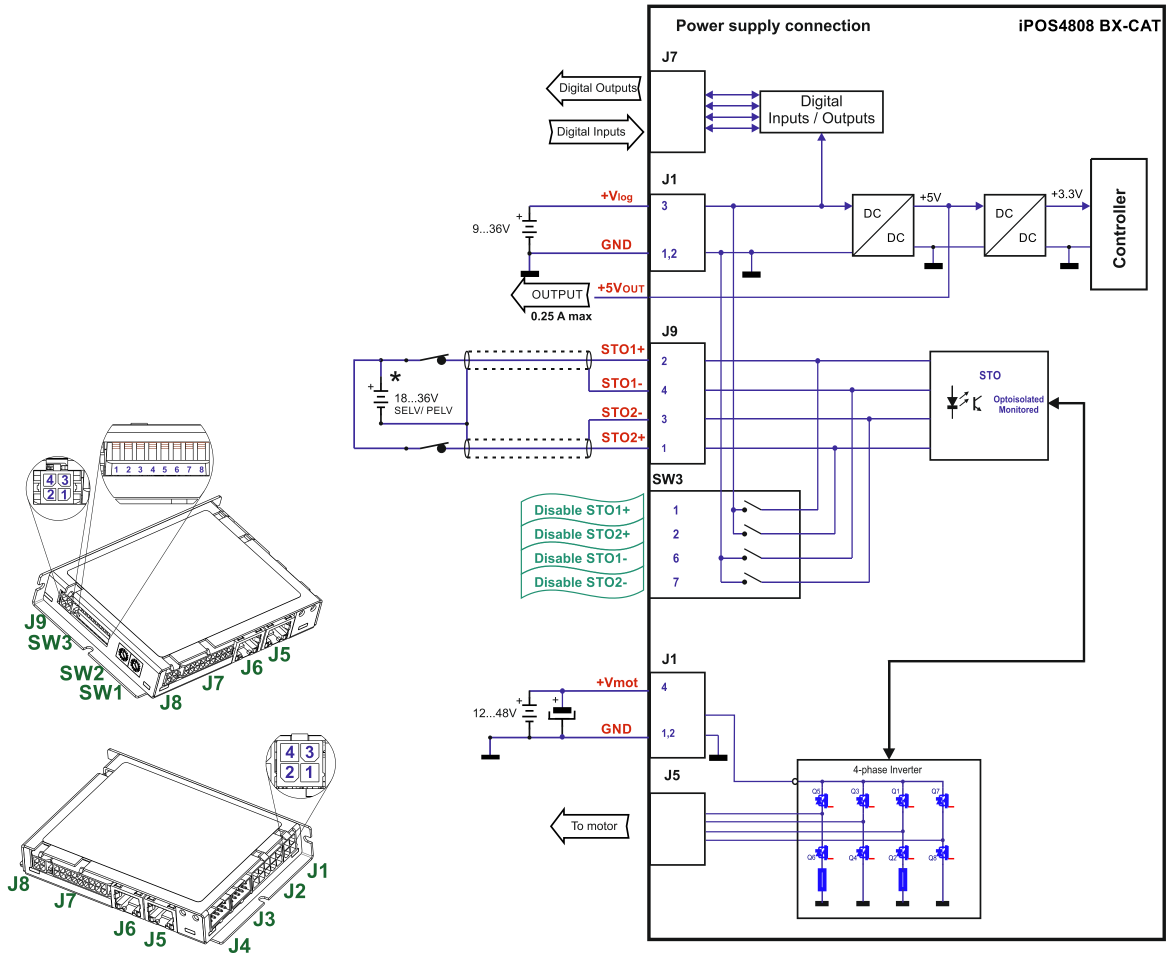


Figure 3.24. **Supply connection**

* The STO and +Vlog inputs can be supplied from the same power source as long as its output voltage is 18 to 36V DC from a SELV/ PELV power supply.

3.4.7.2 Recommendations for Supply Wiring

Always provide a nearby capacitor on the motor supply lines. The capacitor should be located within 10cm of the iPOS4808 connector, max. 20cm. The minimum recommended capacitance is 330µF for iPOS4808, always rated at the appropriate voltage.

Use short, thick wires between the iPOS4808 and the motor power supply. Connect power supply wires to all the indicated pins. If the wires are longer than 2 meters, use twisted wires for the supply and ground return. For wires longer than 20 meters, add a capacitor of at least 2,200µF (rated at an appropriate voltage) right on the terminals of the iPOS4808.

3.4.7.3 Recommendations to limit over-voltage during energy regeneration

During abrupt motion brakes or reversals the regenerative energy is injected into the motor power supply. This may cause an increase of the motor supply voltage (depending on the power supply characteristics). If the voltage bypasses 53V, the drive over-voltage protection is triggered and the drive power stage is disabled. In order to avoid this situation you have 2 options:

Option 1. Add a capacitor on the motor supply big enough to absorb the overall energy flowing back to the supply. The capacitor must be rated to a voltage equal or bigger than the maximum expected over-voltage and can be sized with the formula:

$$C \ge \frac{2 \times E_M}{U_{MAX}^2 - U_{NOM}^2}$$

where:

U_{MAX} = 53V is the over-voltage protection limit

U_{NOM} is the nominal motor supply voltage

E_M = the overall energy flowing back to the supply in Joules. In case of a rotary motor and load, E_M can be computed with the formula:

$$E_M = \underbrace{\frac{1}{2}(J_M + J_L)\varpi_M^2}_{\text{Kinetic energy}} + \underbrace{(m_M + m_L)g(h_{initial} - h_{final})}_{\text{Potential energy}} - \underbrace{3I_M^2 R_{Ph} t_d}_{\text{Copper losses}} - \underbrace{\frac{t_d \varpi_M}{2} T_F}_{\text{Friction losses}}$$

where:

J_M – total rotor inertia [kgm^2]

J_L – total load inertia as seen at motor shaft after transmission [kgm^2]

ϖ_M – motor angular speed before deceleration [rad/s]

m_M – motor mass [kg] – when motor is moving in a non-horizontal plane

m_L – load mass [kg] – when load is moving in a non-horizontal plane

g – gravitational acceleration i.e. 9.8 [m/s^2]

$h_{initial}$ – initial system altitude [m]

h_{final} – final system altitude [m]

I_M – motor current during deceleration [A_{RMS}/phase]

R_{Ph} – motor phase resistance [Ω]

t_d – time to decelerate [s]

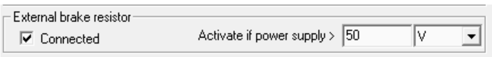
T_F – total friction torque as seen at motor shaft [Nm] – includes load and transmission

In case of a linear motor and load, the motor inertia J_M and the load inertia J_L will be replaced by the motor mass and the load mass measured in [kg], the angular speed ϖ_M will become linear speed measured in [m/s] and the friction torque T_F will become friction force measured in [N].

Option 2. Connect a chopping resistor R_{CR} between phase CR/B- and ground, and activate the software option of dynamic braking (see below).

This option is not available when the drive is used with a step motor.

The chopping resistor option can be found in the Drive Setup dialogue within EasyMotion / EasySetup and it is called "External brake resistor".



The chopping will occur when DC bus voltage increases over U_{CHOP}. This parameter (U_{CHOP}) should be adjusted depending on the nominal motor supply. Optimally (from a braking point of view), U_{CHOP} should be a few volts above the maximum nominal supply voltage. This setting will activate the chopping resistor earlier, before reaching dangerous voltages – when the over-voltage protection will stop the drive. Of course, U_{CHOP} must always be less than U_{MAX} – the over-voltage protection threshold.

Remark: *This option can be combined with an external capacitor whose value is not enough to absorb the entire regenerative energy E_M but can help reducing the chopping resistor size.*

Chopping resistor selection

The chopping resistor value must be chosen to respect the following conditions:

1. to limit the maximum current below the drive peak current I_{PEAK} = 0.9A

$$R_{CR} > \frac{U_{MAX}}{I_{PEAK}}$$

2. to sustain the required *braking power*:

$$P_{CR} = \frac{E_M - \frac{1}{2}C(U_{MAX}^2 - U_{CHOP}^2)}{t_d}$$

where C is the capacitance on the motor supply (external), i.e:

$$R_{CR} < \frac{U_{CHOP}^2}{2 \times P_{CR}}$$

3. to limit the average current below the drive nominal current I_{NOM}=0.9A

$$R_{CR} > \frac{P_{CR} \times t_d}{t_{CYCLE} \times I_{NOM}^2}$$

where t_{CYCLE} is the time interval between 2 voltage increase cycles in case of repetitive moves.

4. to be rated for an average power $P_{AV} = \frac{P_{CR} \times t_d}{t_{CYCLE}}$ and a peak power $P_{PEAK} = \frac{U_{MAX}^2}{R_{CR}}$

Remarks:

1. *If* $\frac{U_{MAX}}{I_{PEAK}} > \frac{U_{CHOP}^2}{2 \times P_{CR}}$ *the braking power* P_{CR} *must be reduced by increasing either* t_d *– the time to decelerate or C – the external capacitor on the motor supply*
2. *If* $\frac{P_{CR} \times t_d}{t_{CYCLE} \times I_{NOM}^2} > \frac{U_{CHOP}^2}{2 \times P_{CR}}$ *either the braking power must be reduced (see Remark 1) or* t_{CYCLE} *– the time interval between chopping cycles must be increased*

⚠	**WARNING!**	***THE CHOPPING RESISTOR MAY HAVE HOT SURFACES DURING OPERATION.***

3.4.8 Serial RS-232 connection

3.4.8.1 Serial RS-232 connection

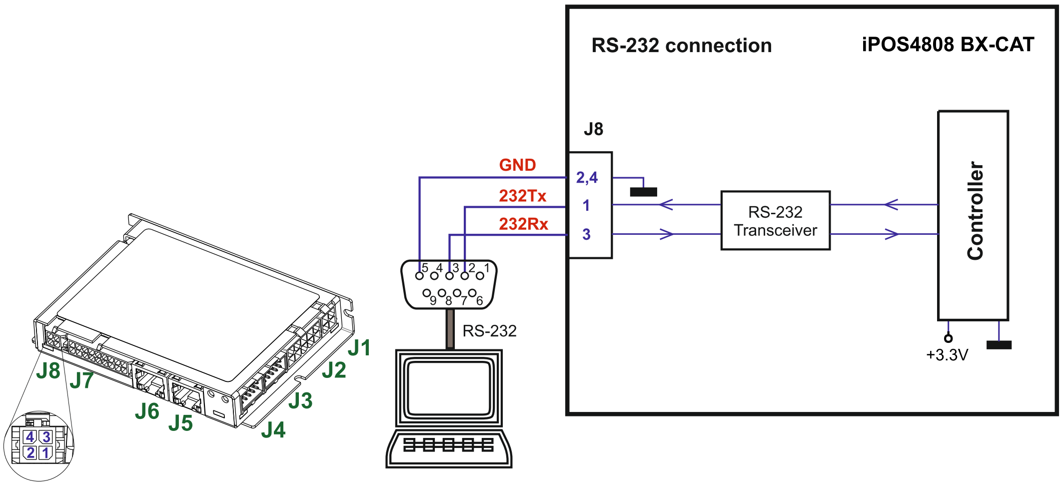


Figure 3.25. **Serial RS-232 connection**

3.4.8.2 Recommendation for wiring

a) If you build the serial cable, you can use a 3-wire shielded cable with shield connected to BOTH ends. Do not use the shield as GND. The ground wire (pin 31 of J4) must be included inside the shield, like the 232Rx and 232Tx signals
b) Always power-off all the iPOS4808 supplies before inserting/removing the RS-232 serial connector
c) Do not rely on an earthed PC to provide the iPOS4808 GND connection! The drive must be earthed through a separate circuit. Most communication problems are caused by the lack of such connection

3.4.9 Recommendations for EtherCAT Wiring

a) Build EtherCAT® network using UTP (unshielded twisted pair) cables rated CAT5E or higher (CAT6, etc.). Cables with this rating must have multiple characteristics, as described in TIA/EIA-568-B. Among these are: impedance, frequency attenuation, cross-talk, return loss, etc.

b) It is acceptable to use STP (shielded twisted pair) or FTP (foil twisted pair) cables, rated CAT5E or higher (CAT6, etc.). The added shielding is beneficial in reducing the RF (radio-frequency) emissions, improving the EMC emissions of the application.

c) The maximum length of each network segment must be less than 100 meters.

d) The network topology is daisy-chain. All connections are done using point-to-point cables. The global topology can be one of the two:

- Linear, when the J5 / OUT port of the last drive in the chain remains not connected. Master is connected to J6 / IN port of the first drive; J5 / OUT of the first drive is connected to J6 / IN of the following drive; J5 / OUT of the last drive remains unconnected.

  See ***Figure 3.27*** for a visual representation of the linear topology.

- Ring, when the J5 / OUT port of the last drive in the chain is connected back to the master controller, on the 2nd port of the master. This topology consists of the linear topology described above, plus an extra connection between the master, which has two RJ45 ports, to J5 / OUT of the last drive.

  See ***Figure 3.28*** for a visual representation of the ring topology.

e) Ring topology is preferred for its added security, since it is insensitive to one broken cable / connection along the ring (re-routing of communication is done automatically, so that to avoid the broken cable / connection)

f) It is highly recommended to use qualified cables, assembled by a specialized manufacturer. When using CAT5E UTP cables that are manufactured / commissioned / prepared on-site, it is highly recommended to check the cables. The check should be performed using a dedicated Ethernet cable tester, which verifies more parameters than simple galvanic continuity (such as cross-talk, attenuation, etc.). The activation of "Link" indicators will NOT guarantee a stable and reliable connection! This can only be guaranteed by proper quality of cables used, according to TIA/EIA-568-B specifications.

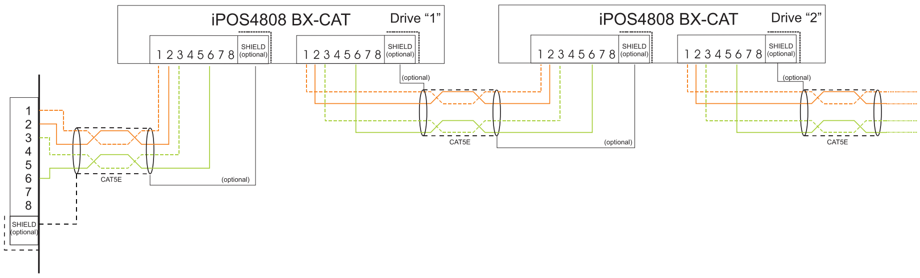


Figure 3.27. **EtherCAT wiring**

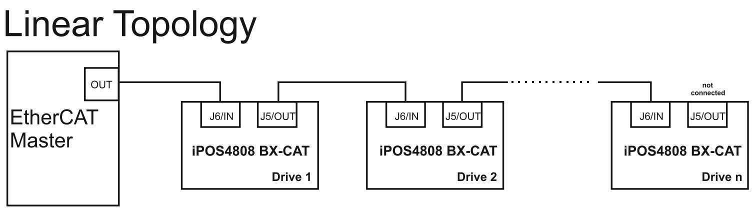


Figure 3.27. **EtherCAT network linear topology**

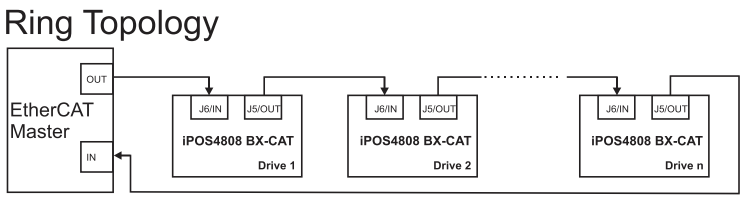


Figure 3.28. **EtherCAT network ring topology**

3.4.10 Disabling the setup table at startup

In some very rare cases, the setup table might be corrupted, leading to a loop where the drive resets continuously. This behavior can be noticed by seeing both the Ready and Error LED blinking for short periods of time continuously.

To recover from this behavior, the setup table can be invalidated by connecting all digital Hall inputs to GND, as shown in Figure ***3.30***.

On the next power on, the drive will load setup default settings and the Motion Error Register (MER) bit 2 will be 1. After a new valid setup table is loaded onto the drive, disconnect the hall sensors from GND and execute a new power off/ power on cycle.

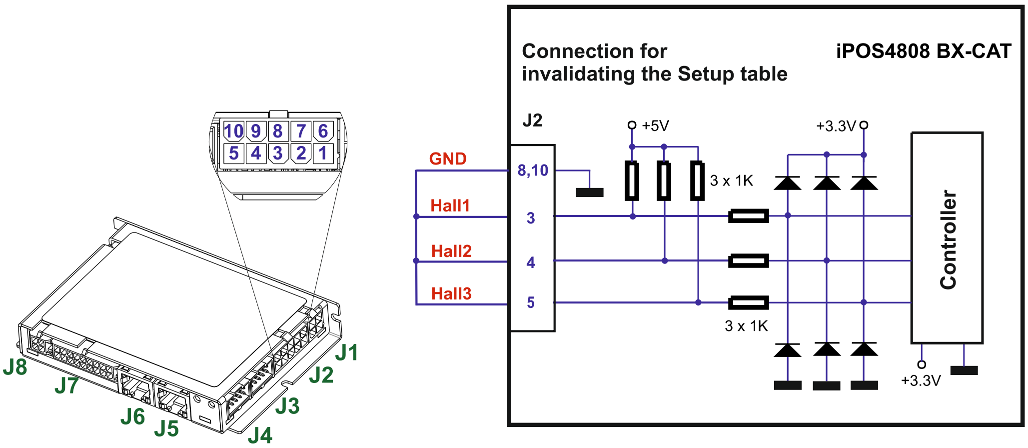


Figure 3.30. **Temporary connection during power-on to remove the drive from** Autorun **mode**

3.5 Axis ID Selection

The iPOS4808 BX-CAT drives supports all EtherCAT standard addressing modes. In case of device addressing mode based on node address, the iPOS4808 BX-CAT drive sets the configured station alias address with its AxisID value. The drive AxisID value is set after power on by:

Software, setting via EasySetUp a specific AxisID value in the range 1-255.

Hardware, by setting h/w in Easy setup and selecting a value between 1-127 from the Axis ID selection switches SW1 and SW2

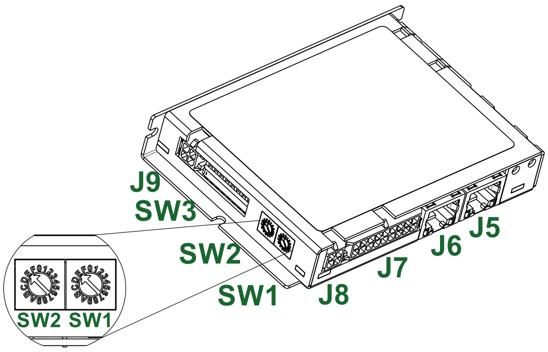


Figure 3.31. ***SW2 and SW3 – Axis ID rotary switches***

SW1 and SW2 AxisId selection switches can each select 16 positions, from 0 to 15 (hex 0xF).

The axis ID value will be = *SW1 value* + (*SW2 value* * 16).

If both switches are 0, then the resulting axis ID value will be 255 for RS232 communication and 0 for the ECAT configured station alias register.

Remark: *in an EtherCAT network, some masters accept multiple drives with the same configured station alias only if its value is 0. In a normal operation each drive should have its own unique AxisID on a network.*

3.5.1 LED indicators

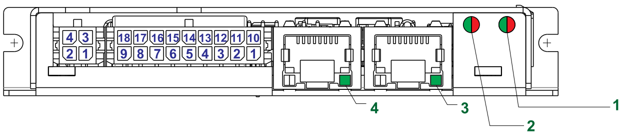


Figure 3.32. **LED indicators**

*Table 3.1 – **LED indicators***

LED no.	LED name	LED color	Function
1	Drive Ready/ Error	green	Lit after power-on when the drive initialization ends. Turned off when an error occurs.
		red	Turned on when the drive detects an error condition or when OUT2/Error is set to +Vlog with OUT(2)=0 TML instruction.
2	EtherCAT® ST	red and green	EtherCAT® ERROR and RUN indicators combined. Shows the state of the EtherCAT® Status Machine
3	EtherCAT® OUT Link/Activity	green	Shows the state of the physical link and activity.
4	EtherCAT® IN Link/Activity	green	Shows the state of the physical link and activity.

3.5.2 EtherCAT® Status indicator

The STATUS indicator displays the RUN states with a 180 degree phase shift to the ERROR states. An example is noted in Figure ***3.33***.

In case of a conflict between turning the indicator on green versus red, the indicator shall be turned to red. Apart from this situation, the bi-color STATUS indicator combines the behavior of the RUN indicator specified in Table **3.2** and the behavior of the ERROR indicator specified in Table **3.3**.

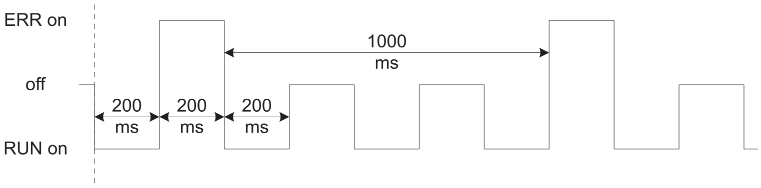


Figure 3.33. **STATUS indicator Example**

*Table 3.2 – **RUN Indicator States***

Indicator states	Slave State	Description
Off	INITIALISATION	The drive is in state INIT
Blinking	PRE-OPERATIONAL	The drive is in state PRE-OEPRATIONAL
Single Flash	SAFE-OPERATIONAL	The drive is in state SAFE-OPERATIONAL
On	OPERATIONAL	The drive is in state OPERATIONAL

*Table 3.3 – **ERROR Indicator States***

ERR state	Error name	Description
On	Application controller failure	An critical communication or application controller error has occurred
Double Flash	Process Data Watchdog Timeout/ EtherCAT Watchdog Timeout	An application watchdog timeout has occurred.
Single Flash	Local Error	Slave device application has changed the EtherCAT state autonomously, due to local error (see ETG.1000 part 6 EtherCAT State Machine). Error Indicator bit is set to 1 in AL Status register.
Blinking	Invalid Configuration	General Configuration Error
Flickering	Booting Error	Booting Error was detected. INIT state reached, but Error Indicator bit is set to 1 in AL Status register
Off	No error	The EtherCAT communication of the device is in working condition

For a more detailed description of EtherCAT® LED functionalities please read ETG.1300 S (R) V1.0.1 available at www.EtherCAT.org
.

3.6 Electrical Specifications

All parameters measured under the following conditions (unless otherwise specified):

T_{amb} = 0…40°C, V_{LOG} = 24 V_{DC}; V_{MOT} = 48V_{DC}; Supplies start-up / shutdown sequence: *-any-*
Load current (sinusoidal amplitude / continuous BLDC,DC,stepper) = 8A iPOS4808

3.6.1 Operating Conditions

		Min.	Typ.	Max.	Units
Ambient temperature[1]		0		+40	ºC
Ambient humidity	Non-condensing	0		90	%Rh
Altitude / pressure[2]	Altitude (referenced to sea level)	-0.1	0 ÷ 2.5	[2]	Km
	Ambient Pressure	0 [2]	0.75 ÷ 1	10.0	atm

3.6.2 Storage Conditions

		Min.	Typ.	Max.	Units
Ambient temperature		-40		105	ºC
Ambient humidity	Non-condensing	0		100	%Rh
Ambient Pressure		0		10.0	atm
ESD capability (Human body model)	Not powered; applies to any accessible part			±0.5	kV
	Original packaging			±15	kV

3.6.3 Mechanical Mounting

		Min.	Typ.	Max.	Units
Airflow		natural convection[3], closed box			

3.6.4 Environmental Characteristics

		Min.	Typ.	Max.	Units
Size (Length x Width x Height)	Without mating connectors	103 x 71 x 16.4			mm
		~4.06 x 2.8 x 0.65			inch
	With recommended mating connectors.	109 x 79 x 19.5			mm
		~4.3 x 3.1 x 0.77			inch
Weight	Without mating connectors	125			g
Power dissipation	Idle (no load)	3.4			W
	Operating	8.5			W
Efficiency		98			%
Cleaning agents	Dry cleaning is recommended	Only Water- or Alcohol- based			
Protection degree	According to IEC60529, UL508	IP20			-

3.6.5 Logic Supply Input (+V_{LOG})

		Min.	Typ.	Max.	Units
Supply voltage	Nominal values	9		36	V_{DC}
	Absolute maximum values, drive operating but outside guaranteed parameters	8		40	V_{DC}
	Absolute maximum values, continuous	-0.6		42	V_{DC}
	Absolute maximum values, surge (duration ≤ 10ms) †	-1		+45	V
	+V_{LOG} = 12V		130		mA
	+V_{LOG} = 24V		90	280	mA
	+V_{LOG} = 40V		85		mA

3.6.6 Motor Supply Input (+V_{MOT})

			Min.	Typ.	Max.	Units
Supply voltage	Nominal values		11		50	V_{DC}
	Absolute maximum values, drive operating but outside guaranteed parameters		9		52	V_{DC}
	Absolute maximum values, continuous		-0.6		54	V_{DC}
	Absolute maximum values, surge (duration ≤ 10ms) †		-1		57	V
Supply current	Idle			1	5	mA
	Operating	iPOS4808	-20	±8	+20	A
	Absolute maximum value, short-circuit condition (duration ≤ 10ms) †	iPOS4808			26	A

[1] Operating temperature at higher temperatures is possible with reduced current and power ratings

[2] iPOS4808 can be operated in vacuum (no altitude restriction), but at altitudes over 2,500m, current and power rating are reduced due to thermal dissipation efficiency.

[3] In case of forced cooling (conduction or ventilation) the spacing requirements may drop down to mechanical tolerances as long as the ambient temperature is kept below the maximum operating limit

3.6.7 Motor Outputs (A/A+, B/A-, C/B+, CR/B-)

			Min.	Typ.	Max.	Units
Nominal output current, continuous	for DC brushed, steppers and BLDC motors with Hall-based trapezoidal control				8	A
	for PMSM motors with FOC sinusoidal control (sinusoidal amplitude value)				8	
	for PMSM motors with FOC sinusoidal control (sinusoidal effective value)				5.67	
Motor output current, peak	maximum 2.5s		-20		+20	A
Short-circuit protection threshold			±22	±26	±30	A
Short-circuit protection delay			5	10		µs
On-state voltage drop	Nominal output current; including typical mating connector contact resistance			±0.3	±0.5	V
Off-state leakage current				±0.5	±1	mA
Motor inductance (phase-to-phase)	Recommended value, for ripple ±5% of measurement range; $+V_{MOT}$ = 48 V	F_{PWM} = 20 kHz	330			µH
		F_{PWM} = 40 kHz	150			
		F_{PWM} = 60 kHz	120			
		F_{PWM} = 80 kHz	80			
		F_{PWM} = 100 kHz	60			
	Absolute minimum value, limited by short-circuit protection; $+V_{MOT}$ = 48 V	F_{PWM} = 20 kHz	120			µH
		F_{PWM} = 40 kHz	40			
		F_{PWM} = 60 kHz	30			
		F_{PWM} = 80 kHz	15			
		F_{PWM} = 100 kHz	8			
Motor electrical time-constant (L/R)	Recommended value, for ±5% current measurement error due to ripple	F_{PWM} = 20 kHz	250			µs
		F_{PWM} = 40 kHz	125			
		F_{PWM} = 60 kHz	100			
		F_{PWM} = 80 kHz	63			
		F_{PWM} = 100 kHz	50			
Current measurement accuracy	FS = Full Scale			±4	±8	%FS

3.6.8 Digital Inputs (IN0, IN1, IN2/LSP, IN3/LSN, IN5, IN6)[1]

		Min.	Typ.	Max.	Units
Mode compliance		PNP			
Default state	Input floating (wiring disconnected)	Logic LOW			
Input voltage	Logic “LOW”	-10	0	2.2	V
	Logic “HIGH”	6.3		36	
	Floating voltage (not connected)		0		
	Absolute maximum, continuous	-10		+39	
	Absolute maximum, surge (duration ≤ 1s) †	-20		+40	
Input current	Logic “LOW”; Pulled to GND		0		mA
	Logic “HIGH”		1.3	2	
		Min.	**Typ.**	**Max.**	**Units**
Mode compliance		NPN			
Default state	Input floating (wiring disconnected)	Logic HIGH			
Input voltage	Logic “LOW”	-10		2.2	V
	Logic “HIGH”	6.3		36	
	Floating voltage (not connected)		3		
	Absolute maximum, continuous	-10		+36	
	Absolute maximum, surge (duration ≤ 1s) †	-20		+40	
Input current	Logic “LOW”; Pulled to GND	-1.6	0.6	1	mA
	Logic “HIGH”; Pulled to +24V	0	0	0.3	

Input frequency		0		150	kHz
Minimum pulse width		3.3			µs
ESD protection	Human body model	±2			kV

[1] The digital inputs are software selectable as PNP or NPN

3.6.9 Digital Outputs (OUT0, OUT1, OUT2/Error, OUT3/ Ready, OUT4)

			Min.	Typ.	Max.	Units
Mode compliance	All outputs (OUT0, OUT1, OUT2/Error, OUT3/Ready)		NPN 24V			
Default state	Not supplied (+V_{LOG} floating or to GND)		High-Z (floating)			
	Immediately after power-up	OUT0, OUT1,OUT4	Logic “HIGH”			
		OUT2/Error, OUT3/ Ready	Logic “LOW”			
	Normal operation	OUT0, OUT1, OUT2/Error, OUT4	Logic “HIGH”			
		OUT3/Ready	Logic “LOW”			
Output voltage	Logic “LOW”; output at nominal current				0.8	V
	Logic “HIGH”; output current = 0, no load	OUT2/Error, OUT3/ Ready	2.9	3	3.3	V
		OUT0, OUT1, OUT4	4	4.5	5	V
	Logic “HIGH”, external load to +V_{LOG}			V_{LOG}		
	Absolute maximum, continuous		-0.5		V_{LOG}+0.5	
	Absolute maximum, surge (duration ≤ 1s) †		-1		V_{LOG}+1	
Output current	Logic “LOW”, sink current, continuous OUT0, OUT1, OUT2, OUT3, OUT4				0.5	A
	Logic “LOW”, sink current, pulse ≤ 5 sec. OUT0, OUT1, OUT2, OUT3, OUT4				1	A
	Logic “HIGH”, source current; external load to GND; V_{OUT} >= 2.0V	OUT2/Error, OUT3/ Ready			2	mA
		OUT0, OUT1			4	mA
	Logic “HIGH”, leakage current; external load to +V_{LOG}; V_{OUT} = V_{LOG} max = 40V			0.1	0.2	mA
Minimum pulse width			2			µs
ESD protection	Human body model		±15			kV

3.6.10 Digital Hall Inputs (Hall1, Hall2, Hall3)

		Min.	Typ.	Max.	Units
Mode compliance		TTL / CMOS / Open-collector			
Default state	Input floating (wiring disconnected)	Logic HIGH			
Input voltage	Logic “LOW”		0	0.8	V
	Logic “HIGH”	2	5		V
	Floating voltage (not connected)		4.4		V
	Absolute maximum, surge (duration ≤ 1s) †	-10		+15	V
Input current	Logic “LOW”; Pull to GND			1.2	mA
	Logic “HIGH”; Internal 1KΩ pull-up to +5	0	0	0	mA
Minimum pulse width		2			µs
ESD protection	Human body model	±5			kV

3.6.11 Encoder #1 Inputs (A1+, A1-, B1+, B1-, Z1+, Z1-,)[1]

		Min.	Typ.	Max.	Units
Single-ended mode compliance	Leave negative inputs disconnected	TTL / CMOS / Open-collector			
Input voltage, single-ended mode A/A+, B/B+	Logic “LOW”			1.6	V
	Logic “HIGH”	1.8			V
	Floating voltage (not connected)		3.3		V
Input voltage, single-ended mode Z/Z+	Logic “LOW”			1.2	V
	Logic “HIGH”	1.4			V
	Floating voltage (not connected)		4.7		V
Input current, single-ended mode A/A+, B/B+, Z/Z+	Logic “LOW”; Pull to GND		5.5	6	mA
	Logic “HIGH”; Internal 2.2KΩ pull-up to +5	0	0	0	mA
Differential mode compliance	For full RS422 compliance, see [2]	TIA/EIA-422-A			
Input voltage, differential mode	Hysteresis	±0.06	±0.1	±0.2	V
	Differential mode	-14		+14	V
	Common-mode range (A+ to GND, etc.)	-11		+14	V
Input impedance, differential	A1+, A2+, B1+, B2+, Z1+, Z2+		2.2		kΩ
	A1-, A2-, B1-, B2-, Z1-, Z2-		1.6		kΩ
	Differential mode	0		10	MHz
	Differential mode	50			ns
ESD protection	Human body model	±1			kV

[1] Encoder #1 differential input pins needs termination resistors connected across; set SW3 pins 3,4 and 5 to ON

[2] For full RS-422 compliance, 120Ω termination resistors must be connected across the differential pairs, set SW3 pins 3,4 and 5 to ON. See *Figure 3.15. Differential incremental encoder #1 connection*

3.6.12 Encoder #2 Inputs (A2+, A2-, B2+, B2-, Z2+, Z2-)[1]

		Min.	Typ.	Max.	Units
Differential mode compliance		TIA/EIA-422-A			
Input voltage, differential mode	Hysteresis	±0.06	±0.1	±0.2	V
	Differential mode	-14		+14	
	Common-mode range (A+ to GND, etc.)	-11		+14	
Input impedance, differential			120		Ω
	Differential mode	0		10	MHz
	Differential mode	50			ns
ESD protection	Human body model	±1			kV

3.6.13 Linear Hall Inputs (LH1, LH2, LH3) [2]

		Min.	Typ.	Max.	Units
Input voltage	Operational range	0	0.5÷4.5	4.9	V
	Absolute maximum values, continuous	-7		+7	
	Absolute maximum, surge (duration ≤ 1s) †	-11		+14	
Input current	Input voltage 0…+5V	-1	±0.9	+1	mA
Interpolation Resolution	Depending on software settings			11	bits
Frequency		0		1	kHz
ESD protection	Human body model	±1			kV

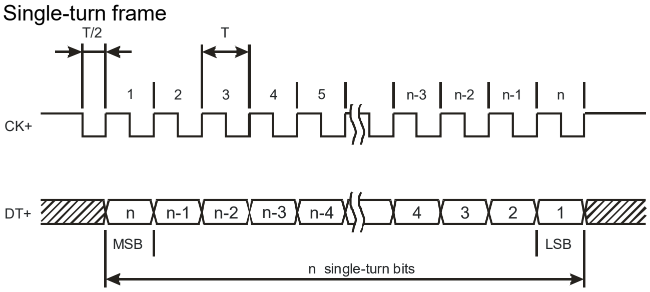
3.6.14 Sin-Cos Encoder Inputs (Sin+, Sin-, Cos+, Cos-)[3]

		Min.	Typ.	Max.	Units
Input voltage, differential	Sin+ to Sin-, Cos+ to Cos-		1	1.25	V_{PP}
Input voltage, any pin to GND	Operational range	-1	2.5	4	V
	Absolute maximum values, continuous	-7		+7	
	Absolute maximum, surge (duration ≤ 1s) †	-11		+14	
Input impedance	Differential, Sin+ to Sin-, Cos+ to Cos-	4.2	4.7		kΩ
	Common-mode, to GND		2.2		kΩ
Resolution with interpolation	Software selectable, for one sine/cosine period	2		10	bits
Frequency	Sin-Cos interpolation	0		450	kHz
	Quadrature, no interpolation	0		10	MHz
ESD protection	Human body model	±2			kV

3.6.15 SSI / EnDAT encoder interface

		Min.	Typ.	Max.	Units
Differential mode compliance (CLOCK, DATA) [1]		TIA/EIA-422			
CLOCK Output voltage	Differential; 50Ω differential load	2.0	2.5	5.0	V
	Common-mode, referenced to GND	2.3	2.5	2.7	
CLOCK frequency	Software selectable	1000, 2000, 3000			kHz
DATA Input hysteresis	Differential mode	±0.1	±0.2	±0.5	V
Data input impedance	Termination resistor on-board		120		Ω
DATA Input common mode range	Referenced to GND	-7		+12	V
	Absolute maximum, surge (duration ≤ 1s) †	-25		+25	
DATA format	Software selectable	Binary / Gray			
		Single-turn / Multi-turn			
		Counting direction			
DATA resolution	Total resolution (single turn or single turn + multi turn)			31	bit

Single-turn frame

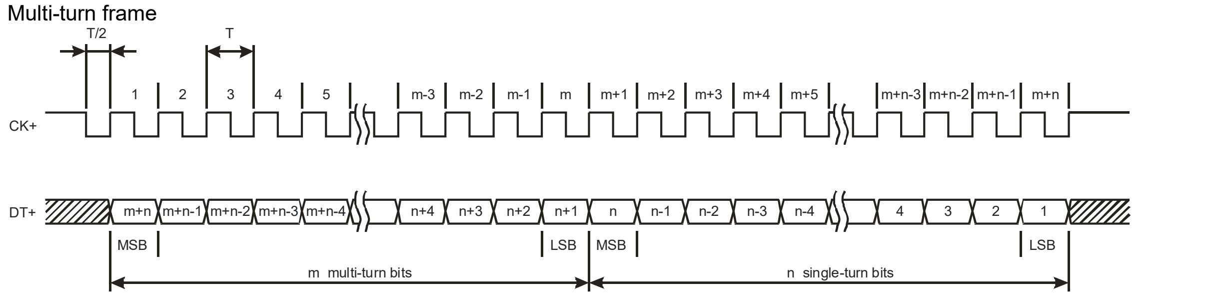


CK- and DT- signals have the same form with CK+ and DT+, but with opposite polarity.

[1] Encoder #2 differential input pins have internal 120Ω termination resistors connected across

[2] Linear hall inputs are available only with P027.314.E721

[3] For many applications, a termination resistor should be connected across SIN+ to SIN-, and across COS+ to COS-. This can be achieved by setting SW3 pins 3,4 and 5 to ON. Please consult the feedback device datasheet for confirmation.



CK- and DT- signals have the same form with CK+ and DT+, but with opposite polarity.

3.6.16 BiSS Encoder Interface

		Min.	Typ.	Max.	Units
Differential mode compliance (CLOCK, DATA)		TIA/EIA-422			
CLOCK Output voltage	Differential; 50Ω differential load	2.0	2.5	5.0	V
	Common-mode, referenced to GND	2.3	2.5	2.7	
CLOCK frequency	Software selectable	1000, 2000, 3000, 4000			kHz
DATA Input hysteresis	Differential mode	±0.1	±0.2	±0.5	V
Data input impedance	Termination resistor on-board		120		Ω
DATA Input common mode range	Referenced to GND	-7		+12	V
	Absolute maximum, surge (duration ≤ 1s) †	-25		+25	
	Software selectable	Single-turn / Multi-turn			
		Counting direction			
DATA resolution	Total resolution (single turn or single turn + multi turn)			31	bit
Protocol		BiSS C mode (sensor mode)			

3.6.17 Analog 0…5V Inputs (REF, FDBK)

		Min.	Typ.	Max.	Units
Input voltage	Operational range	0		5	V
	Absolute maximum values, continuous	-12		+18	
	Absolute maximum, surge (duration ≤ 1s) †			±36	
Input impedance	To GND		30		kΩ
Resolution			12		bits
Integral linearity				±2	bits
Offset error			±2	±10	bits
Gain error			±1%	±3%	% FS[1]
Bandwidth (-3dB)	Software selectable	0		1	kHz
ESD protection	Human body model	±2			kV

3.6.18 RS-232

		Min.	Typ.	Max.	Units
Standards compliance		TIA/EIA-232-C			
Bit rate	Depending on software settings	9600		115200	Baud
Short-circuit protection	232TX short to GND	Guaranteed			
ESD protection	Human body model	±2			kV

3.6.19 Supply Output (+5V)

		Min.	Typ.	Max.	Units
+5V output voltage	Current sourced = 250mA	4.8	5	5.2	V
+5V output current	iPOS4808 BX-CAT-STO	200	250		
Short-circuit protection		Yes			
Over-voltage protection		NOT protected			
ESD protection	Human body model	±2			kV

3.6.20 EtherCAT ports J5 and J6

		Min.	Typ.	Max.	Units
Standards compliance		IEEE802.3, IEC61158			
Transmission line specification	According to TIA/EIA-568-5-A	Cat.5e.UTP			
J5, J6 pinout	EtherCAT® supports MDI/MDI-X auto-crossover	TIA/EIA-568-A or TIA/EIA-568-B			
Software protocols compatibility		CoE, CiA402, IEC61800-7-301			
Node addressing	By software, via EasySetup	1 ÷ 255			-
	By hardware via hex sw1 and sw2	1 ÷ 127			-

[1] "FS" stands for "Full Scale"

MAC addressing	EtherCAT® uses no MAC address	none			-
ESD protection	Human body model	±15			kV

3.6.21 Safe Torque OFF (STO1+; STO1-; STO2+; STO2-)

		Min.	Typ.	Max	Units
Safety function	According to EN61800-5-2	STO (Safe Torque OFF)			
EN 61800-5-1/ -2 and EN 61508-5-3/ -4 Classification	Safety Integrity Level	safety integrity level 3 (SIL3)			
	PFHd (Probability of Failures per Hour - dangerous)	$8*10^{-10}$	$hour^{-1}$ (0.8 FIT)		
EN13849-1 Classification	Performance Level	Cat3/PLe			
	MTTFd (meantime to dangerous failure)	377	years		
Mode compliance		PNP			
Default state	Input floating (wiring disconnected)	Logic LOW			
Input voltage	Logic "LOW" (PWM operation disabled)	-20		5.6	V
	Logic "HIGH" (PWM operation enabled)	18		36	
	Absolute maximum, continuous	-20		+40	
Input current	Logic "LOW"; pulled to GND		0		mA
	Logic "HIGH", pulled to +Vlog		5	13	
Repetitive test pulses (high-low-high)	Ignored high-low-high			5	ms
				20	Hz
Fault reaction time	From internal fault detection to register DER bit 14 =1 and OUT2/Error high-to-low			30	ms
PWM operation delay	From external STO low-high transition to PWM operation enabled			30	ms
ESD protection	Human body model	±2			kV

† Stresses beyond values listed under "absolute maximum ratings" may cause permanent damage to the device. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

4 Memory Map

iPOS4808 BX-CAT has 2 types of memory available for user applications: 16K×16 SRAM and up to 16K×16 serial E^2ROM.

The SRAM memory is mapped in the address range: C000h to FFFFh. It can be used to download and run a TML program, to save real-time data acquisitions and to keep the cam tables during run-time.

The E^2ROM is mapped in the address range: 4000h to 7FFFh. It is used to keep in a non-volatile memory the TML programs, the cam tables and the drive setup information.

Remark: *EasyMotion Studio handles automatically the memory allocation for each motion application. The memory map can be accessed and modified from the main folder of each application*

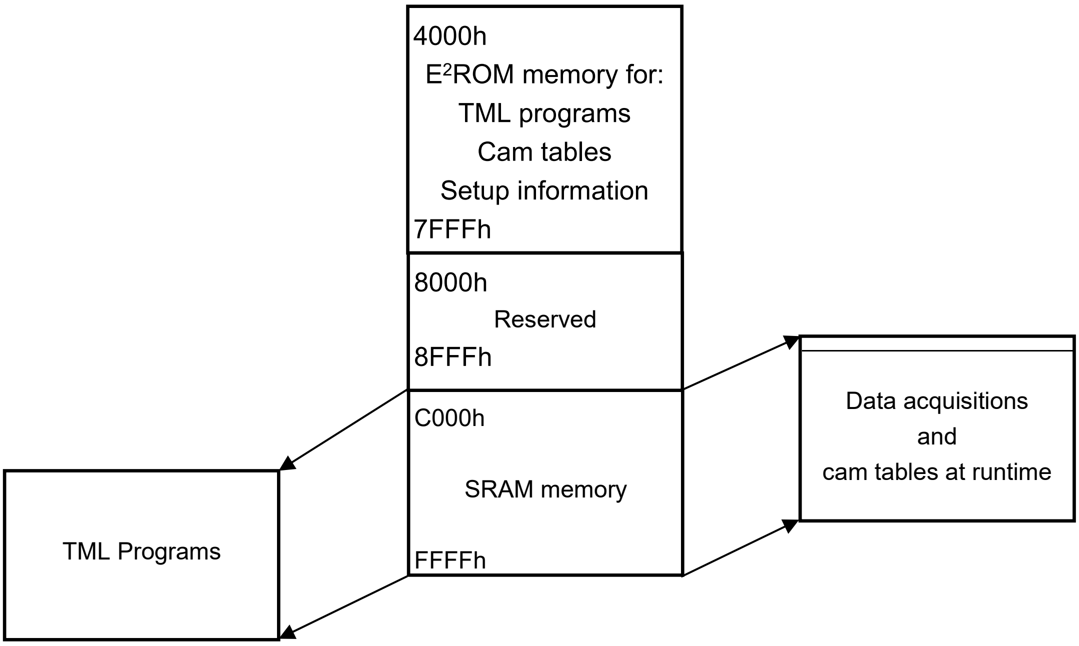


Figure 7.1. *iPOS4808 BX-CAT Memory Map*