iPOS4850 BX

Intelligent Servo Drive for DC and Brushless Motors

TECHNOSOFT
MOTION TECHNOLOGY

Intelligent Servo Drives

Technical Reference

P091.029.iPOS4850 BX.UM.0726

Table of contents

Read This First

Whilst Technosoft believes that the information and guidance given in this manual is correct, all parties must rely upon their own skill and judgment when making use of it. Technosoft does not assume any liability to anyone for any loss or damage caused by any error or omission in the work, whether such error or omission is the result of negligence or any other cause. Any and all such liability is disclaimed.

The information in this document is subject to change without notice.

About This Manual

This book is a technical reference manual for:

Product Name	Part Number	Nominal current		Peak current	Communication	STO
iPOS4850 BX-CAT-STO	P029.300.E321	64A[1]	50A[2]	90A	EtherCAT	✓

In order to operate the iPOS4850 drives, you need to pass through 3 steps:

- **Step 1 Hardware installation**
- **Step 2 Drive setup** using Technosoft EasyMotion Studio II software for drive commissioning
- **Step 3 Motion programming** using one of the options:
  - An **EtherCAT® master**[3]
  - The drives built-in motion controller executing a Technosoft Motion Language (**TML**) program developed using Technosoft **EasyMotion Studio II 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 iPOS4850 hardware including the technical data, the connectors and the wiring diagrams needed for installation.

For **Step 2 and 3**, please consult the document ***EasyMotion Studio II – Quick Setup and Programming Guide.*** For detailed information regarding the next steps, refer to the related documentation.

Notational Conventions

This document uses the following conventions:

- **iPOS4850**– 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®

Related Documentation

iPOS4850 BX-CAT-STO Datasheet (P029.300.E321.DSH) – describes the hardware connections of the iPOS4850 BX intelligent servo drive including the technical data and connectors.

iPOS family Safe Torque Off (STO) Operating instructions (P091.099.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

EasyMotion Studio II – Quick Setup and Programming Guide (**P091.034.ESM II - Quick.Setup.and.Programming.Guide.xxxx)** – describes the compatible software installation, drive software setup commissioning, introduction to TML motion programming and motion evaluation tools.

Help of the EasyMotion Studio II software – **EasyMotion Studio II** simplifies the setup process for any Technosoft drive, enabling quick configuration. The software generates setup data that can be downloaded into the drive's EEPROM or saved as a file on a PC. Upon power-up, the drive initializes with the setup data read from its EEPROM.

[1] With adequate thermal heat sink
[2] No thermal heat sink (worst case scenario)
[3] When using and iPOS4850 BX-CAT-STO

Additionally, EasyMotion Studio II allows retrieval of complete setup information from a previously programmed drive. The **LITE version of EasyMotion Studio II** is available for free download from the Technosoft website.

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 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.*

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: sales@technosoftmotion.com
Ask questions about product operation or report suspected problems (see Note)	Tel: +41 (0)32 732 5500 Email: support@technosoftmotion.com
Make suggestions about, or report errors in documentation.	Mail: Technosoft SA Avenue des Alpes 20 CH-2000 Neuchatel, NE Switzerland

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***

CAUTION! ***Indicates areas SENSITIVE TO electrostatic discharges (ESD) WHICH REQUIRE HANDLING IN AN ESD PROTECTED ENVIRONMENT***

1.1 Warnings

WARNING! ***THE VOLTAGE USED IN THE DRIVE MIGHT CAUSE ELECTRICAL SHOCKS. DO NOT TOUCH LIVE PARTS WHILE THE POWER SUPPLIES ARE ON***

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***
CAUTION!	***THE DRIVE CONTAINS ELECTROSTATICALLY SENSITIVE COMPONENTS WHICH MAY BE DAMAGED BY INCORRECT HANDLING. THEREFORE THE DRIVE SHALL BE REMOVED FROM ITS ORIGINAL PACKAGE ONLY IN AN ESD PROTECTED ENVIRONMENT***

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: https://technosoftmotion.com/en/quality/

2 Product Overview

2.1 Introduction

The **iPOS4850 BX** 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) and **DC brushed** motors, the iPOS4850 BX drives accept as position feedback quadrature incremental encoders and absolute encoders (SSI, BiSS-C, EnDAT, Tamagawa, Panasonic, Nikon, Sanyo Denki).

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 iPOS4850 BX 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[1] or camming[1], 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
- Performing data transfers between axes
- Controlling motion of an axis from another one via motion commands sent between axes
- Sending commands to a group of axes (multicast). This includes the possibility to start simultaneously motion sequences on all the axes from the group
- Synchronizing all the axes from a network

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.

All iPOS4850 BX-CAT drives are equipped with an EtherCAT® communication interface that provides support for:

- **FoE (File-over-EtherCAT)**
- **EoE (Ethernet-over-EtherCAT)**
- **CoE (CAN application protocol over EtherCAT)**

For commissioning the Micro, the EasyMotion Studio II PC application is available in two versions: LITE and FULL.

The LITE version simplifies the setup process for any Technosoft drive, enabling quick commissioning. It generates setup data that can be downloaded into the drive's EEPROM or saved as a file on a PC. Upon power-up, the drive initializes with the setup data from its EEPROM. Additionally, the LITE version allows for the retrieval of complete setup information from a previously programmed drive and is available for free download from the Technosoft website.

The FULL version of EasyMotion Studio II is designed for commissioning and advanced motion programming. It supports the development of complex motion programs using TML, which are executed locally by the drive's integrated motion controller.

While the LITE version includes only the setup functionality, making it suitable for scenarios where motion programming is managed through an EtherCAT master, it can be upgraded to the FULL version by entering a license number obtained from Technosoft.

[1] Available if the master axis sends its position via a communication channel, or by using the secondary encoder input

2.2 Product Features

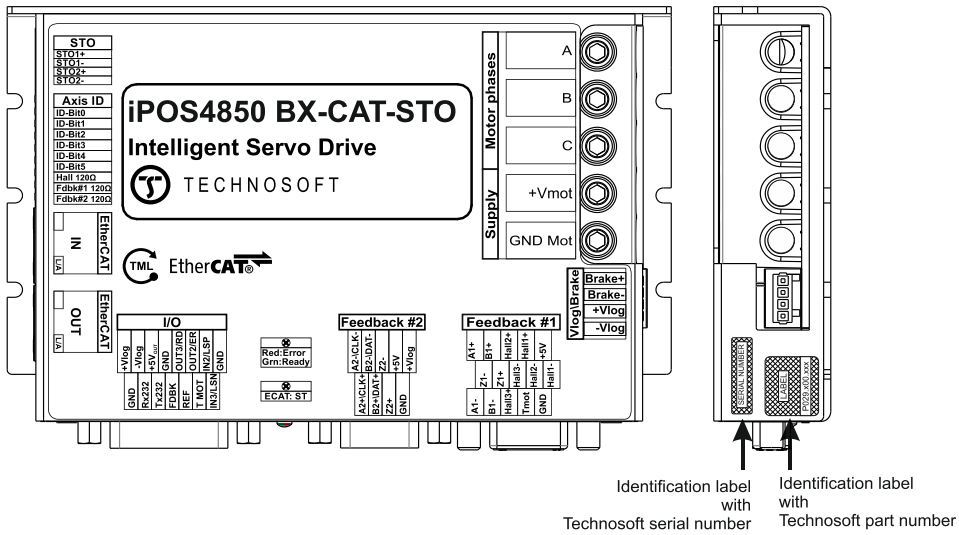
- Fully digital servo drive suitable for the control of rotary or linear brushless and DC brush motors
- Very compact design
- Sinusoidal (FOC) or trapezoidal (Hall-based) control of brushless motors
- Technosoft Motion Language (TML) instruction set for the definition and execution of motion sequences
- Standalone operation with stored motion sequences
- 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 position or speed profiles, Cyclic Synchronous Position (CSP), Cyclic Synchronous Velocity (CSV) and Cyclic Synchronous Torque (CST)
- Motor supply: 12-60V; Logic supply: 9-36V SELV/PELV type; STO supply: 18-36V (only for STO executions)
- Output current with / without external heat sink:
  - Nominal: 45 / 35.4A_{RMS} (64 / 50A sinusoidal amplitude)
  - Peak: 64A_{RMS} (90A sinusoidal amplitude)
- Thermal Protection: The internal temperature sensor disables the PWM outputs if the measured temperature exceeds 95°C
- PWM switching frequency up to 100kHz
- Communication:
  - RS-232 serial up to 115kbits/s
  - Dual 100Mbps EtherCAT® interfaces, for use in daisy-chaining topologies
- Digital and analog I/O's:
  - 2 digital inputs: 7-36 V, sinking/PNP: 2 limit switches or general-purpose
  - 2 digital outputs: 5-36 V, with 0.5 A, sinking/NPN open-collector, general-purpose
  - 2 indicator LEDs: One Green for TML Ready, one Red for TML Error signal or used as general purpose
  - 2 analogue inputs, 12-bit, 0-5V: Reference and Feedback (for Tacho), or general purpose
  - Solenoid driver for motor electro-mechanical brake, 2A, commanded by OUT0 or by automatically by software
- NTC/PTC analogue Motor Temperature sensor input
- Feedback devices (dual-loop support)

  1st feedback devices supported:
  - Incremental encoder interface (single-ended or differential)
  - Digital Hall sensor interface (single-ended or differential)

  2nd feedback devices supported:
  - Incremental encoder interface (single-ended or differential)
  - BISS / SSI / EnDAT / Tamagawa / Panasonic / Nikon / Sanyo Denki encoder interface
- Various motion programming modes:
  - 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
- 64 h/w selectable addresses selectable by DIN switch for CAT executions
- EtherCAT® supported protocols for CAT drives:
  - **CoE** - CAN application protocol over EtherCAT
  - **FoE** – File over EtherCAT – for setup/TML functions and firmware update
  - **EoE** – Ethernet over EtherCAT – for Easy Motion studio communication over EtherCAT
- 16K × 16 internal SRAM memory for data acquisition
- 24K × 16 E^2ROM to store TML motion programs, cam tables and other user data
- 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

2.3 Identification Labels



The iPOS4850 BX family can have the following part numbers and names on the identification label:

- **P029.300.E321** name **iPOS4850 BX-CAT-STO** – standard CAT execution with STO input

2.3.1 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.

Motor sensors			Motor types		
Encoder[1]	**Digital Halls**	**Tacho**	**Brushless PMSM[2]**	**Brushless BLDC[3]**	**Brushed DC Voice coils**
Incremental encoder / SSI / BISS-C / EnDAT2.2 / TAMAGAWA / Panasonic/ Nikon/ Sanyo Denki[4]			✓		✓
Incremental encoder / SSI / BISS-C / EnDAT2.2 / TAMAGAWA / Panasonic/ Nikon/ Sanyo Denki[4]	✓		✓	✓	
None	✓		✓		
None		✓			✓

2.3.2 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 sensors			Motor types			Load sensors
Encoder	**Digital Halls**	**Tacho**	**Brushless PMSM[2]**	**Brushless BLDC[3]**	**Brushed DC Voice coils**	**Encoder[5]**
Incremental encoder[4]			✓		✓	Incremental encoder / SSI / BISS-C / EnDAT2.2 / TAMAGAWA / Panasonic / Nikon / Sanyo Denki
Incremental encoder / SSI / BISS-C / EnDAT2.2 / TAMAGAWA / Panasonic / Nikon / Sanyo Denki[4]						Incremental encoder
Incremental encoder[4]	✓		✓	✓		Incremental encoder / SSI / BISS-C / EnDAT2.2 / TAMAGAWA / Panasonic / Nikon / Sanyo Denki[46]
Incremental encoder / SSI / BISS-C / EnDAT2.2 / TAMAGAWA / Panasonic / Nikon / Sanyo Denki[4]						Incremental encoder[4]
None	✓		✓			Incremental encoder[4]
None		✓			✓	Incremental encoder[4]

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

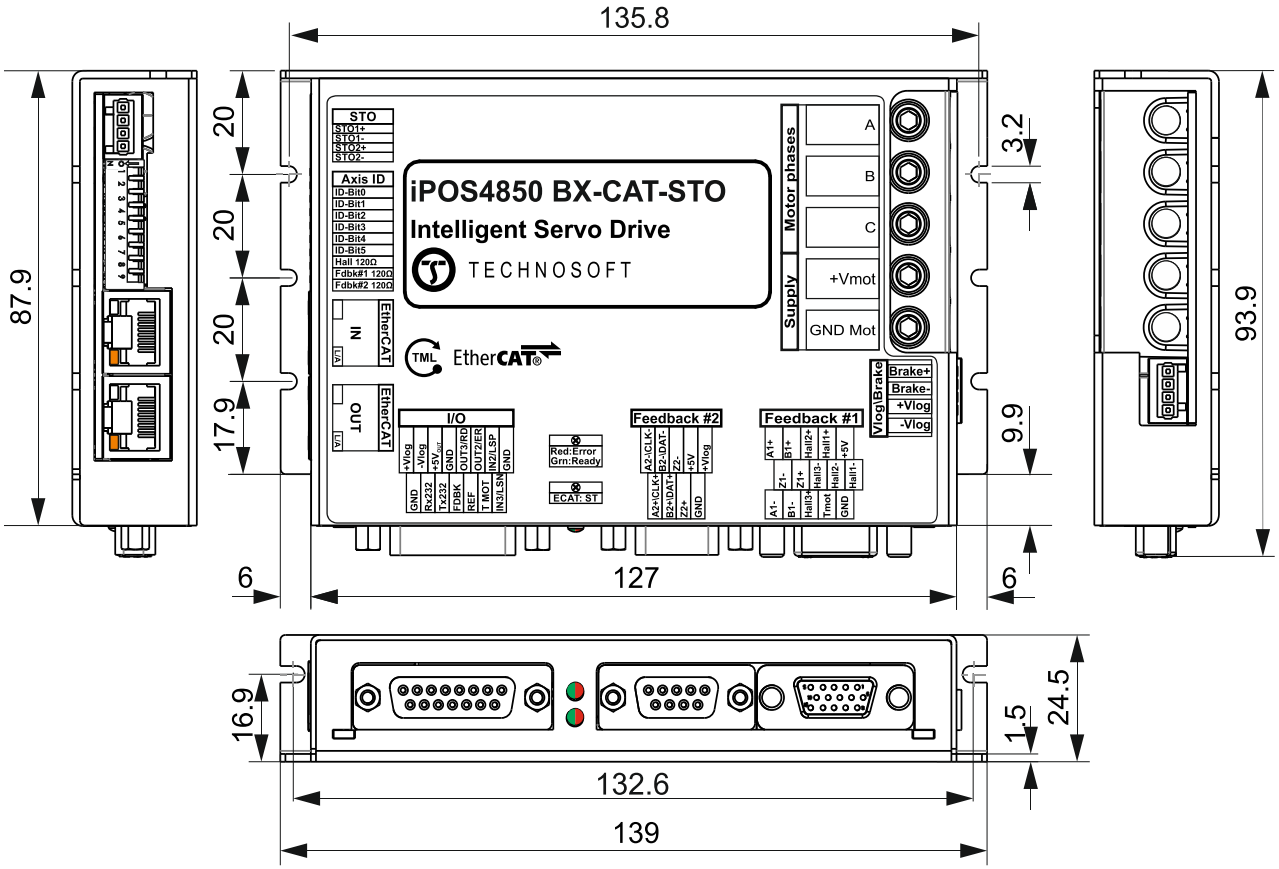
Example:

- PMSM motor with Incremental encoder (feedback #1) on motor and SSI encoder (feedback#2) on load
- DC brush motor with BISS-C encoder (feedback #2) on motor and Incremental encoder (feedback #1) on load.

[1] Motor encoder can be either on Feedback 1 or on Feedback 2
[2] Sinusoidal. Brushless motor is controlled as PMSM using a field oriented control algorithm
[3] Trapezoidal. Brushless motor is controlled as a BLDC motor using Hall-based commutation.
[4] For single-ended/ differential connection see SW1 settings (Chapter Feedback Connections)
[5] Load encoder is on Feedback 2 / 1, if motor encoder is on Feedback 1 / 2
[6] Load encoder can be only on Feedback 1

3 Hardware Installation

3.1 iPOS4850 BX-CAT-STO Board Dimensions



Global tolerance [mm]	0.1

All dimensions are in mm. Drawings not to scale.

Figure 1. iPOS4850 BX drive dimensions

3.2 Mechanical Mounting

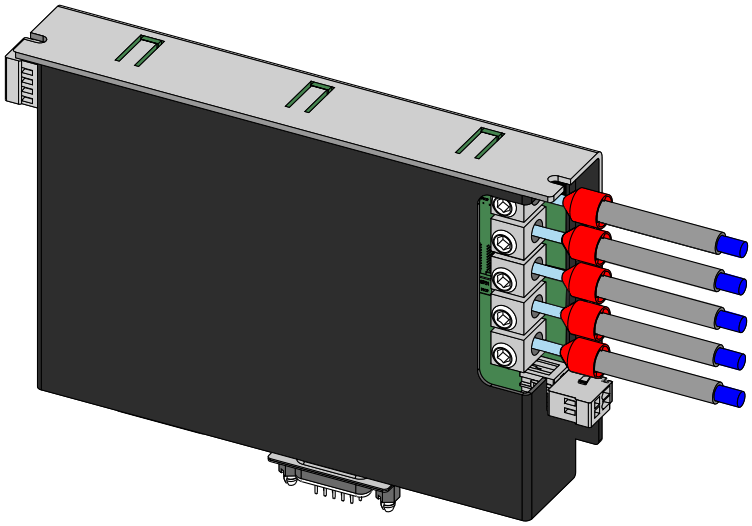
The iPOS4850 BX drive is intended to be mounted horizontally on a metallic support using the provided mounting holes and the recommended inserts and screws:

Image	Connector	Description	Manufacturer	Part Number
	-	Self-clinching nuts M3	PennEngineering® (PEM®)	KF2-M3-ET
	-	Screws M3x10	Bossard	BN610-M3x10

The metallic support must act as a cooling heat sink. For thermal calculations, use the graphs mentioned in chapter De-rating curves.

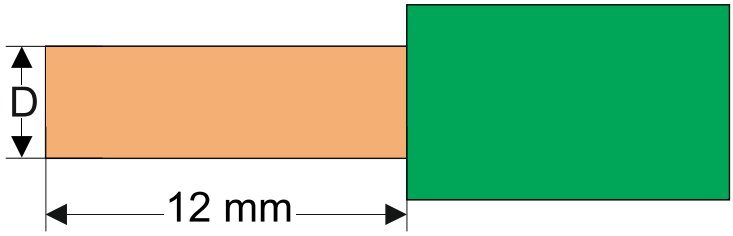
3.2.1 Recommendations for Motor Phases and Motor Power Supply wires

Torque Chart			
AWG 6-14 (mm^2 10 – 2.5)			
AWG	mm^2	In-lb	N-M
6	-	35	3.95
-	10		
8	-	25	2.82
-	6		
10	-	20	2.26
-	4		
12	-		
-	2.5		
14	-		



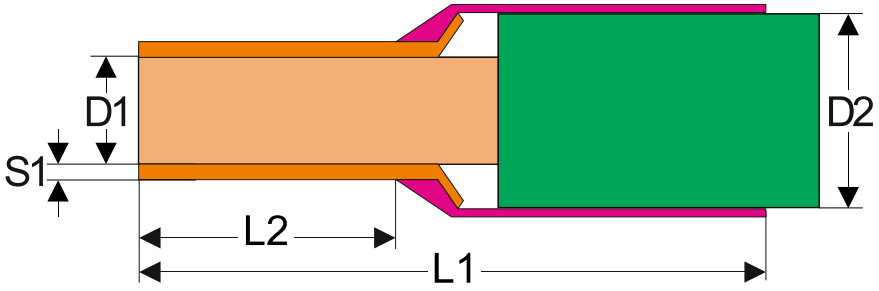
Cable connections

Solid wire or tinned strand wire



❖ D_{max} = 4.1 mm (AWG6)

Strand wire with ferrule



❖ Options for industrial standard ferrules

French and German Code <Polypropylene insulated and tin-plated electrolytic copper>											
Model No		Applicable wire		Style	Colour Code		Dimensions (mm)				
French Code	German Code	mm^2	AWG		French Code	German Code	L1	L2	D1	S1	D2
FWE2.5-8	GWE2.5-8	2.50	14	I	Grey	Blue	14	8	2.2	0.15	4.2
FWE4-10	GWE4-10	4.00	12	I	Orange	Grey	17	10	2.8	0.2	4.8
FWE6-12	GWE6-12	6.00	10	I	Green	Black	20	12	3.5	0.2	6.3
FWE10-12	GWE10-12	10.0	8	I	Brown	Ivory	22	12	4.5	0.2	7.6

3.3 Connectors and Pinout

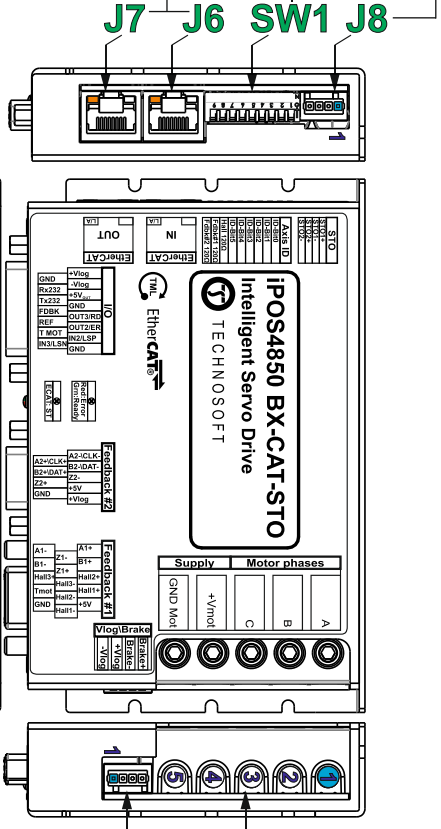
Pin	Name	Description
1	GND	Ground
2	IN2/LSP	5-36V digital PNP input. Positive limit switch input
3	OUT2/ Error	5-36V 0.5A, active low, NPN open-collector/TTL pull-up. Drive Error output (default), Can be set as general-purpose output.
4	OUT3/ Ready	5-36V 0.5A, active low, NPN open-collector/TTL pull-up. Drive Ready output (default), Can be set as general-purpose output.
5	GND	Ground
6	+5V$_{OUT}$	5V output supply
7	-V$_{LOG}$	Negative terminal of the logic supply input: 9 to 36V$_{DC}$ from SELV/ PELV type power supply; connected internally to all GND pins
8	+V$_{LOG}$	Positive terminal of the logic supply input: 9 to 36V$_{DC}$ from SELV/ PELV type power supply; connected internally to all +V$_{log}$ pins
9	IN3/LSN	5-36V digital PNP input. Negative limit switch input
10	Temp Mot	Analogue input, 12-bit, 0-3.3V. Used to read an analog temperature value
11	REF	Analogue input, 12-bit, 0-5V
12	FDBK	Analogue input, 12-bit, 0-5V
13	232TX	RS-232 Data Transmission
14	232RX	RS-232 Data Reception
15	GND	Ground

Pin	Name	Description
1	STO1+	Safe Torque Off input 1, positive input (Opto-isolated, 18÷36V)
2	STO1-	Safe Torque Off input 1, negative return (Opto-isolated, 0V)
3	STO2+	Safe Torque Off input 2, positive input (Opto-isolated, 18÷36V)
4	STO2-	Safe Torque Off input 2, negative return (Opto-isolated, 0V)

Apply between both STO1+, STO2+ and STO1-, STO2- 24V DC from SELV/ PELV power supply for motor PWM output operation

Pin	Name	Description
1	ID-Bit0	Hardware AxisID selection switches All ON – AxisID= 63 All OFF – AxisID = 255 When Axis ID is 255, the EtherCAT register called *"configured station alias"* will be 0.
2	ID-Bit1	
3	ID-Bit2	
4	ID-Bit3	
5	ID-Bit4	
6	ID-Bit5	
7	Hall 120Ω	Internally connects 120Ω termination resistors between J3.2 and J3.6; J3.3 and J3.7; J3.13 and J3.8.
8	Fdbk #1 120Ω	Internally connects 120Ω termination resistors between J3.5 and J3.15; J3.4 and J3.14; J3.9 and J3.10.
9	Fdbk #2 120Ω	Internally connects 120Ω termination resistors between J4.9 and J4. 5; J4.8 and J4.4; J4.7 and J4.3.

Port	Name	Description
J6	ECAT IN	EtherCAT standard RJ45 Ethernet IN port.
J7	ECAT OUT	EtherCAT standard RJ45 Ethernet OUT port.



Pin	Name	Description
1	+V$_{LOG}$	Positive terminal of the logic supply input: 12 to 36V$_{DC}$; connected internally to all +V$_{log}$ pins
2	+5V$_{OUT}$	5V output supply
3	Z2-	Incr. encoder2 Z- diff. input; for differential connection SW1 bit 9 must be ON
4	B2-/ Dir-/ Data-/SL-	Incr. encoder2 B2- diff. input or Dir-, or Data- for SSI, or Slave- for BiSS; for differential connection SW1 bit 9 must be ON
5	A2-/ Pulse-/CLK-/MA-	Incr. encoder2 A- diff. input, or Pulse-, or Clock- for SSI, or Master- for BiSS; or differential connection SW1 bit 9 must be ON
6	GND	Ground
7	Z2+	Incr. encoder2 Z single-ended input, Z2+ diff. input; for differential connection SW1 bit 9 must be ON
8	B2+/ Pulse+/ Data+/ SL+	Incr. encoder2 B single-ended input, B2+ diff. input or Pulse+, or Data+ for SSI, or Slave+ for BiSS; for differential connection SW1 bit 9 must be ON
9	A2+/ Pulse+/ CLK+/ MA+	Incr. encoder2 A single-ended input, A2+ diff. input or Pulse+, or Clock+ for SSI, or Master+ for BiSS; for differential connection SW1 bit 9 must be ON

Name	Color	Description
LED1	RED	Turned on when the drive detects an error condition
	GREEN	Lit after power-on when the drive initialization ends. Turned off when an error occurs.
LED2	RED	EtherCAT® ERROR and RUN indicators combined.
	GREEN	Shows the state of the EtherCAT® Status Machine

Pin	Name	Description
1	+5V$_{OUT}$	5V output supply for I/O usage
2	Hall 1+	Digital input Hall 1 sensor input or Hall1+ diff. sensor input; for differential connection SW1 bit 7 must be ON
3	Hall 2+	Digital input Hall 2 sensor input or Hall2+ diff. sensor input; for differential connection SW1 bit 7 must be ON
4	B1+	Incr. encoder1 B single-ended input, B1+ diff. input; for differential connection SW1 bit 8 must be ON
5	A1+	Incr. encoder1 A single-ended input, A1+ diff. input; for differential connection SW1 bit 8 must be ON
6	Hall 1-	Hall1- diff. sensor input; for differential connection SW1 bit 7 must be ON
7	Hall 2-	Hall2- diff. sensor input; for differential connection SW1 bit 7 must be ON
8	Hall 3-	Hall3- diff. sensor input; for differential connection SW1 bit 7 must be ON
9	Z1+	Incr. encoder1 Z single-ended input, Z1+ diff.; for differential connection SW1 bit 8 must be ON
10	Z1-	Incr. encoder1 Z- diff. input; for differential connection SW1 bit 8 must be ON
11	GND	Return ground for sensors supply
12	Temp Mot	Analogue input, 12-bit, 0-3.3V. Used to read an analog temperature value
13	Hall 3+	Digital input Hall 3 sensor input or Hall3+ diff. sensor input; for differential connection SW1 bit 7 must be ON
14	B1-	Incr. encoder1 B1- diff. input; for differential connection SW1 bit 8 must be ON
15	A1-	Incr. encoder1 A1- diff. input; for differential connection SW1 bit 8 must be ON

Pin	Name	Description
1	-V$_{LOG}$	Negative terminal of the logic supply input: 9 to 36V$_{DC}$ from SELV/ PELV type power supply connected internally to all GND pins
2	+V$_{LOG}$	Positive terminal of the logic supply input: 9 to 36V$_{DC}$ from SELV/ PELV type power supply; connected internally to all +V$_{log}$ pins
3	BRAKE-	Negative terminal for the motor brake input; commanded as OUT0; connected internally to all GND pins
4	BRAKE+	Positive terminal for the motor brake input; connected internally to all +V$_{log}$ pins

Pin	Name	Description
1	A/A+	Phase A for 3-ph motors, Motor+ for DC brush motors
2	B/A-	Phase B for 3-ph motors, Motor- for DC brush motors
3	C	Phase C for 3-ph motors
4	+V$_{MOT}$	Positive terminal of the motor supply input: 11 to 60V$_{DC}$
5	GND	Ground for motor supply

3.3.1 Mating Connectors

Image	Connector	Description	Manufacturer	Part Number	Image
	J1	High AMP wire. 4mm HEX socket. AWG 6-16 wire gauge. Strip: - min 8 mm for cables with isolation diameter less than 6.5 mm; - min 12 mm/ max 15 mm for cables with isolation diameter bigger than 6.5 mm. **Avoid generating metal debris/filings into drive from the wire leads!** In case of multi-stranded wires, a proper ferrule must be used as wire terminal. For more details, check chapter 12.			
	J2,J8*	Pluggable terminal block 4-pole Pin spacing 2.5 mm for the -STO version	Wago	733-104	
	**J3**	Feedback #1 + Digital Hall input		generic 15-pin High Density D-Sub male	
	J4	Feedback #2		Generic 9-pin Sub-D male	
	**J5**	I/O ; Analog; RS232		Generic 15-pin D-Sub male, DB15	
	J6,J7	Standard 8P8C modular jack (RJ-45) male			

* Mating connectors for J2 and J8 are included with the drive

3.4 Connection diagram

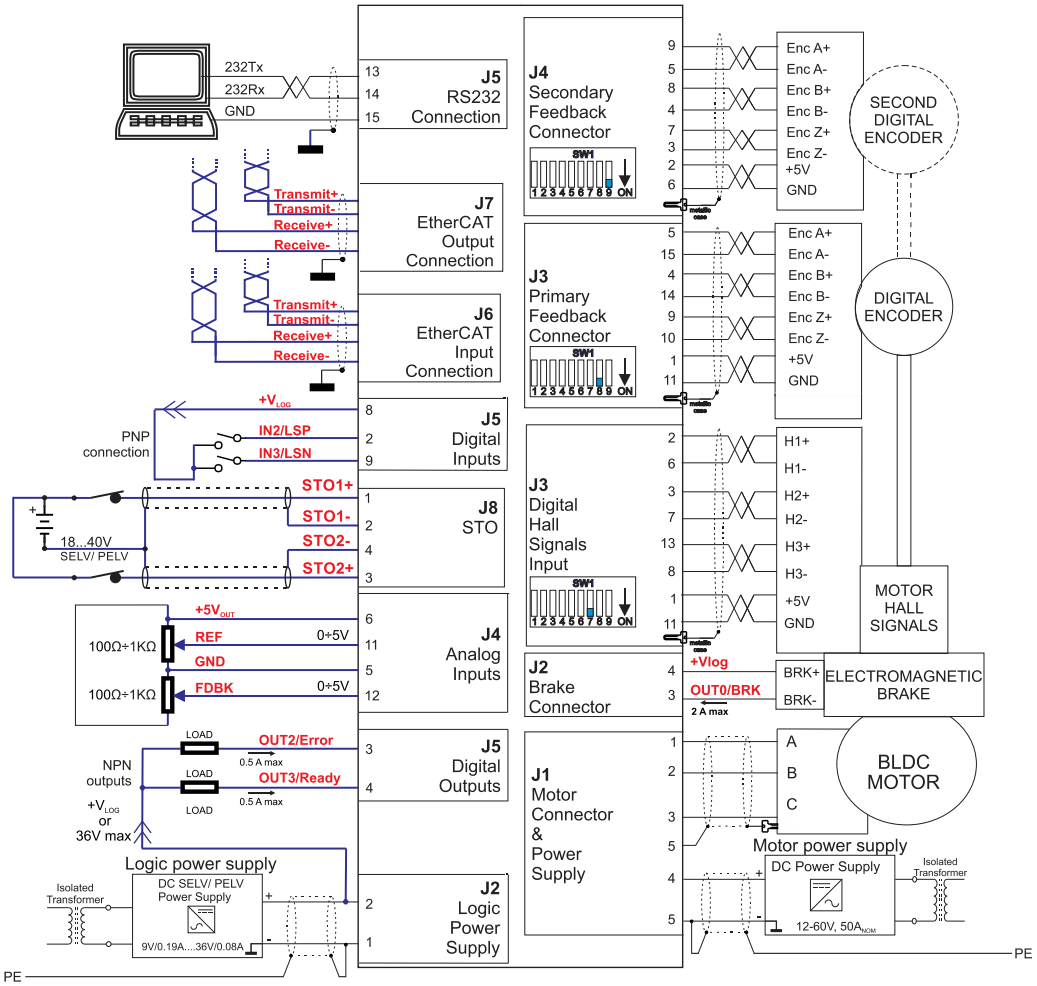


Figure 2. iPOS4850 BX-CAT-STO connection diagram

3.5 Digital I/O Connection

3.5.1 PNP inputs

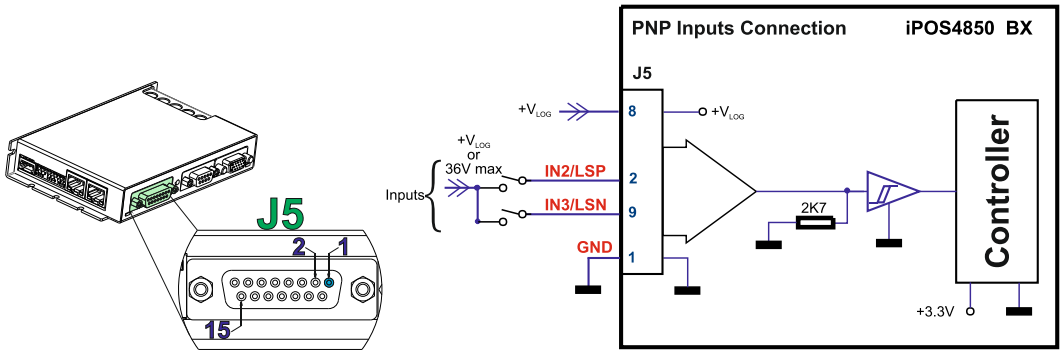


Figure 3. Digital PNP inputs (24V) connection

Remarks:

1. *The inputs are compatible with PNP type outputs (input must receive a positive voltage value (7-36V) to change its default state)*
2. *The length of the cables must be up to 30m, reducing the exposure to voltage surge in industrial environment.*

3.5.2 NPN outputs

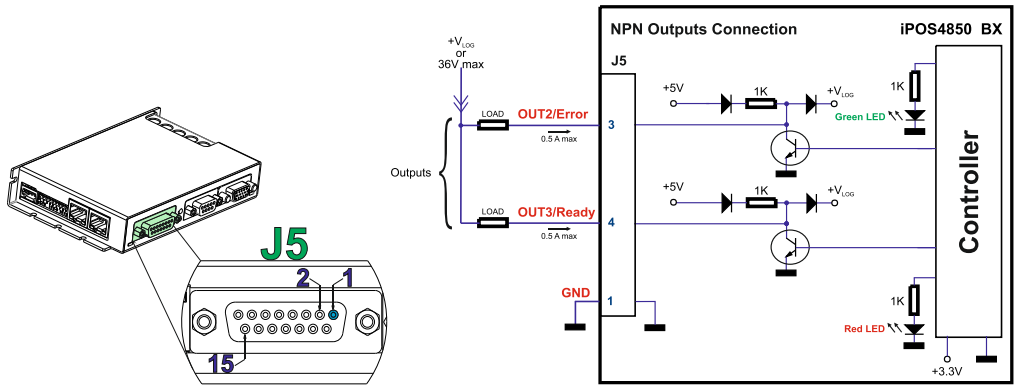


Figure 4. Digital PNP outputs (24V) connection

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)*

3.5.3 Solenoid driver connection for motor brake

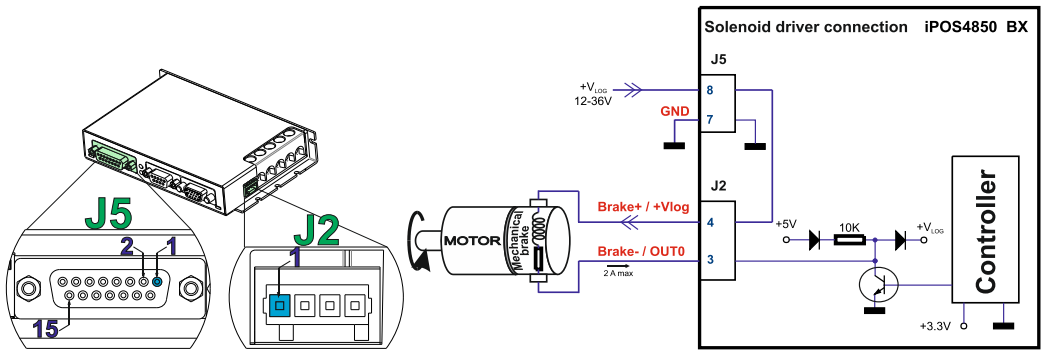
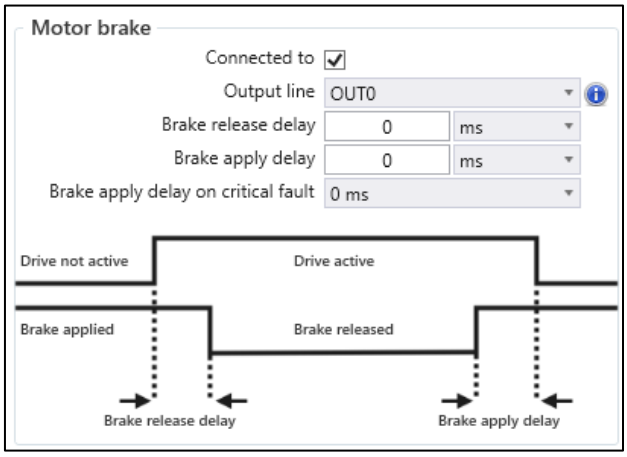


Figure 5. Solenoid driver connection

Remarks:

1. *The firmware automatically controls the Brake- output to engage or disengage the electro-mechanical brake when motor operation starts or stops.*
2. *The Brake- pin can also be used as the NPN digital output OUT0 (software configurable).*



3.6 Analog Inputs Connection

3.6.1 0-5V Input Range

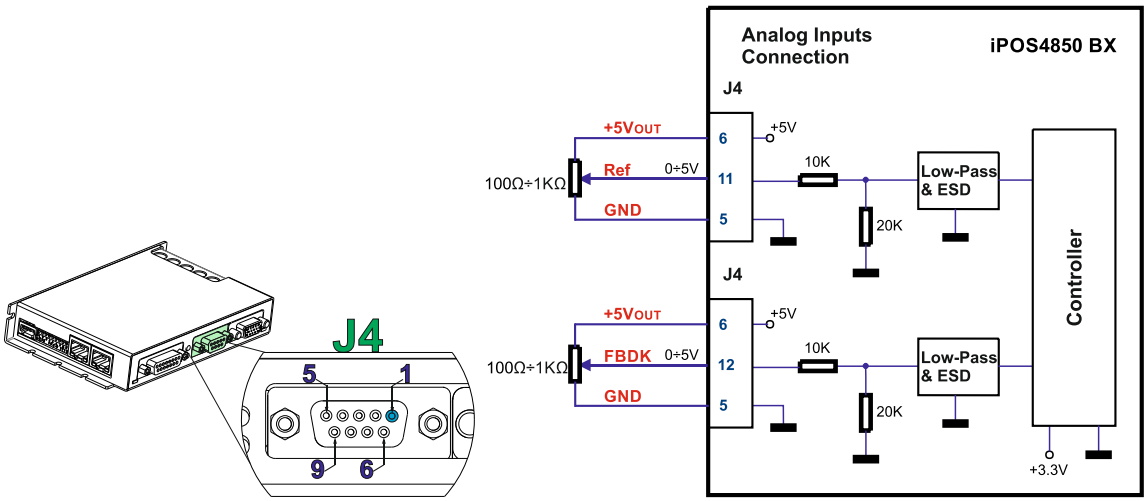


Figure 6. 0-5V Analog inputs connection

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

3.6.2 +/- 10V Input Range adapter

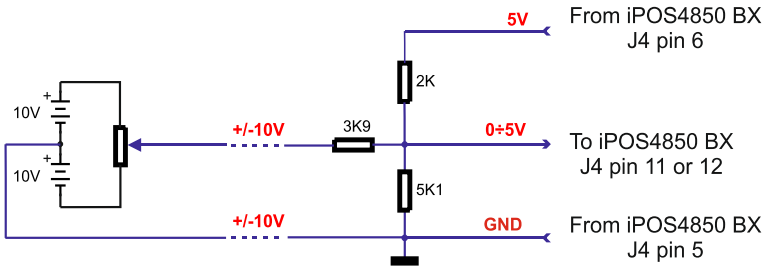
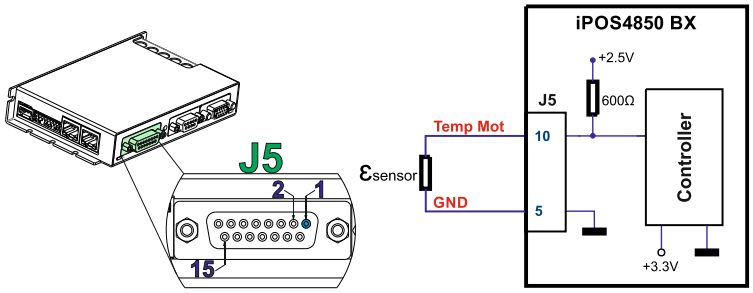


Figure 7. +/-10V Analog inputs connection

Remarks:

1. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*
2. *The switching between REF and FDBK signals can be done using the analog inputs setup section.*

3.6.3 Temperature sensor (Temp Mot)



Remarks:

1. *The temperature sensor can be either NTC or PTC (software selectable).*
2. *Using the internal resistor, the divider will create a voltage which is temperature-dependent. The voltage is read using an 12-bit ADC (analog-to-digital converter) with input range 0V … +3.3V.*
3. *The numerical result (AD8) is the following:*

$$AD8[0IU \dots 65520IU] = 65520 * Input\ Voltage[0V \dots 3.3V]/3.3V$$

$$InputVoltage[0V \dots 3.3V] = 2.5V * \mathcal{E}_{sensor} / (\mathcal{E}_{sensor} + 600\Omega)$$

4. *When the temperature protection is activated, the threshold is internally set to +1.65V.*
5. *An external biasing resistor is required to achieve +1.65V at the required temperature.*

3.6.4 Recommendation for wiring

a) If the analog signal source is single-ended, use a 2-wire shielded cable as follows: 1st wire connects the live signal to the drive positive input (+); 2nd wire connects the signal ground to the drive negative input(-).

b) If the analog signal source is differential and the signal source ground is isolated from the drive GND, use a 3-wire shielded cable as follows: 1st wire connects the signal plus to the drive positive input (+); 2nd wire connects the signal minus to the drive negative input (-) and 3rd wire connects the source ground to the drive GND

c) If the analog 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 signal plus to the drive positive input (+); 2nd wire connects the signal minus to the drive negative input (-)

d) For all of the above cases, connect the cable shield to the drive GND and leave the other shield end unconnected to the signal source. To further increase the noise protection, use a double shielded cable with inner shield connected to drive GND and outer shield connected to the motor chassis (earth).

3.7 Motor connections

3.7.1 Brushless Motor connection

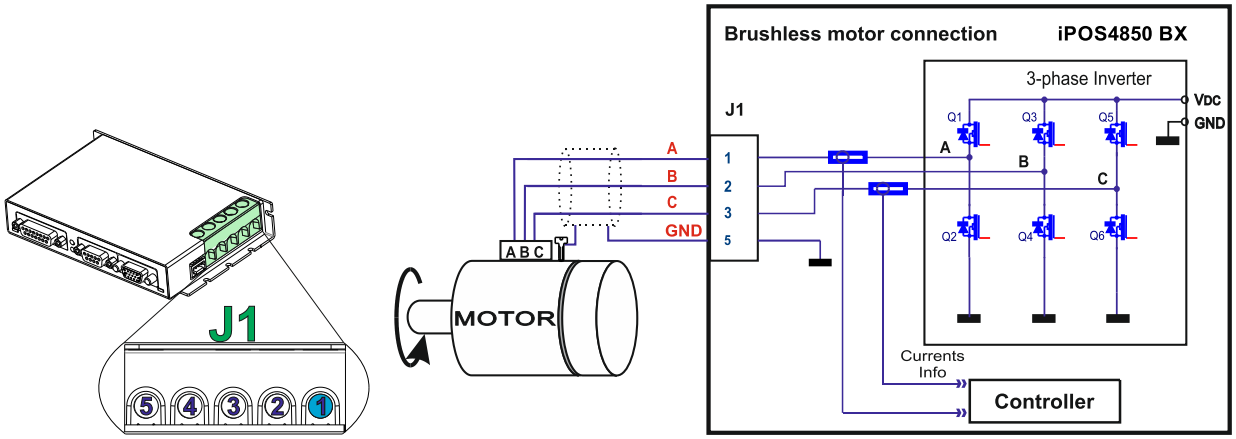


Figure 8. Brushless motor connection

Remark: *The STO circuit must be supplied with minimum 18V to enable PWM output.*

3.7.2 DC Motor connection

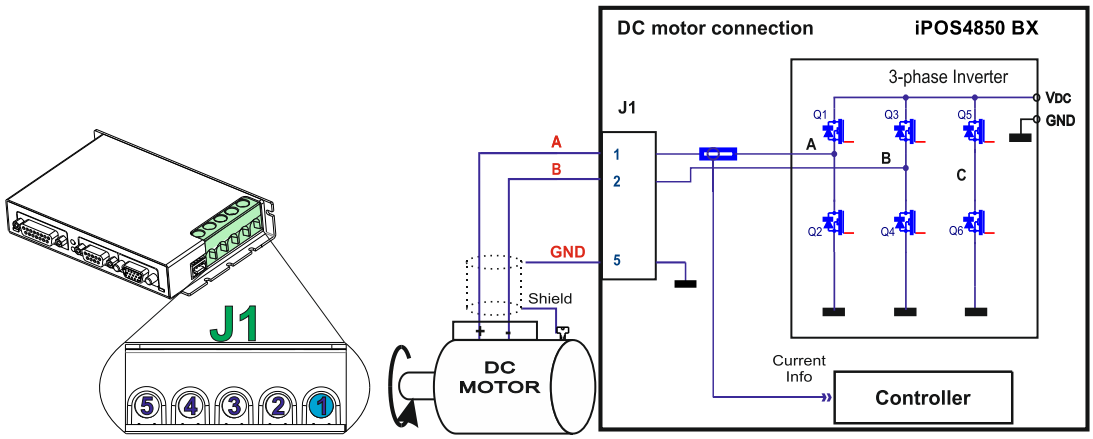


Figure 9. DC motor connection

Remark: *The STO circuit must be supplied with minimum 18V to enable PWM output.*

3.7.3 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.
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 drive 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.
c) A good shielding can be obtained if the motor wires are running inside a metallic cable guide. The shield must be connected to the GND at both ends.

3.8 Feedback connections

3.8.1 Feedback #1 - Single-ended Incremental Encoder Connection

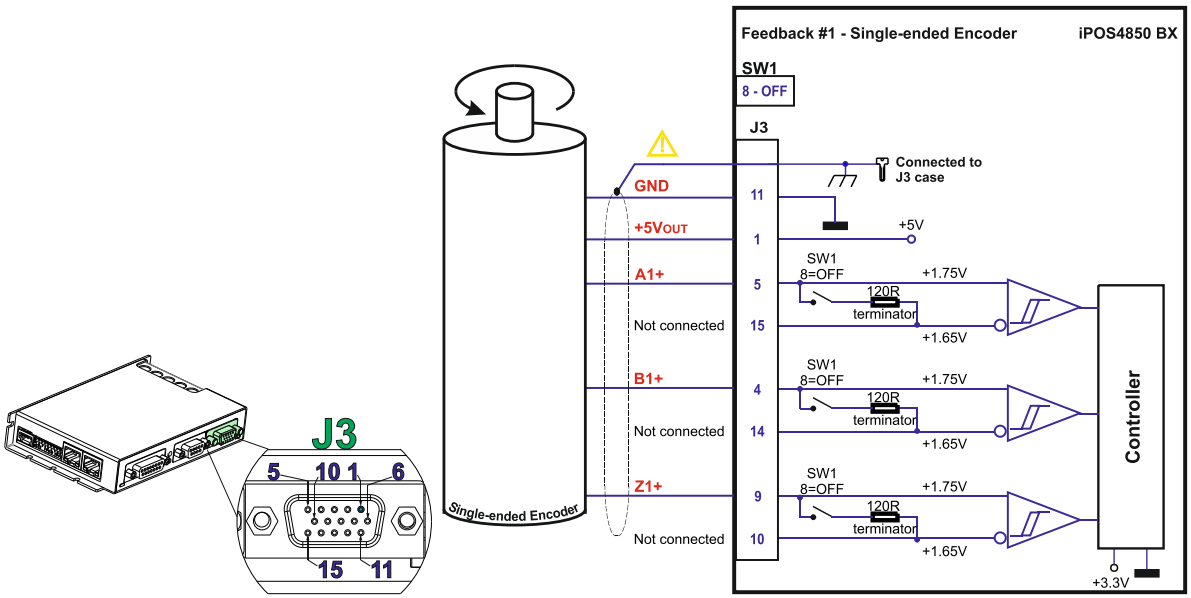


Figure 10. Feedback #1 - Single-ended Incremental Encoder Connection

CAUTION!

DO NOT CONNECT UNTERMINATED WIRES TO PINS J3.15, J3.14 AND J3.10. THEY MIGHT PICK UP UNWANTED NOISE AND GIVE FALSE ENCODER READINGS.

Encoder cable shield must be connected to system PE to avoid disturbances / noise induced by nearby cables.

3.8.2 Feedback #1 - Differential Incremental Encoder Connection

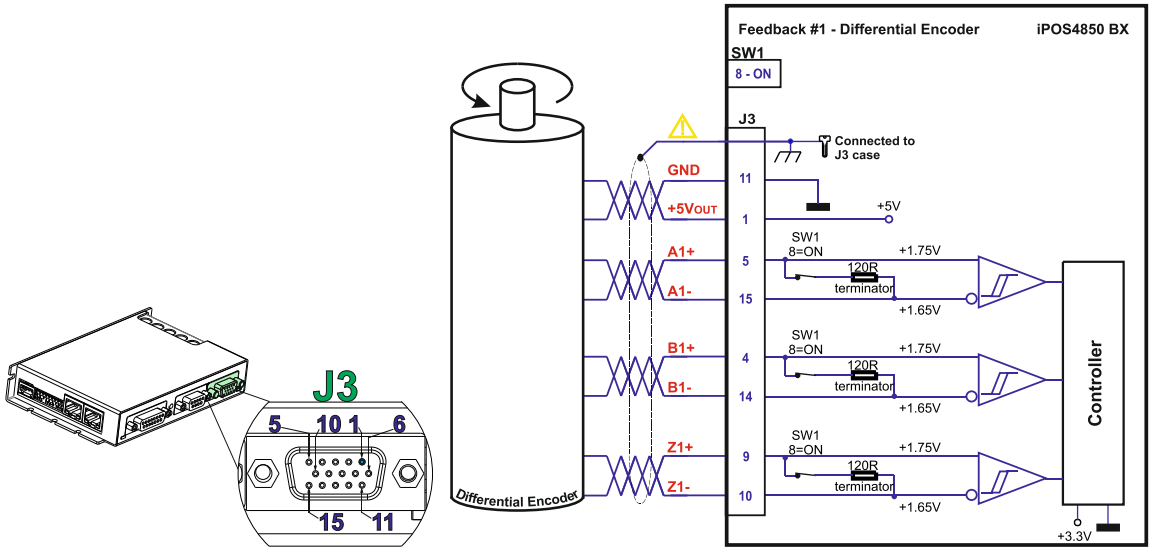


Figure 11. Feedback #1 - Differential Incremental Encoder Connection

CAUTION!

Encoder cable shield must be connected to system PE to avoid disturbances / noise induced by nearby cables.

Remarks:

1. *For Feedback #1 differential connection, 120Ω (0.25W) terminators are internally added by putting the SW1 pin 8 on "ON" position.*
2. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*

3.8.3 Feedback #2 - Single-ended Incremental Encoder Connection

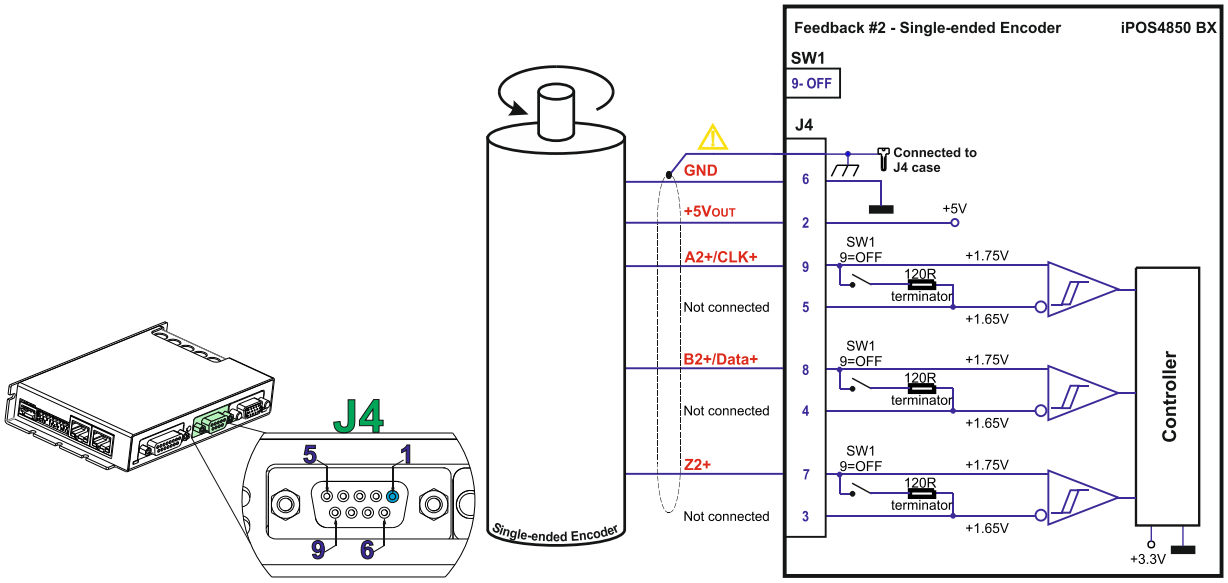


Figure 12. Feedback #2 - Single-ended Incremental Encoder Connection

CAUTION!

DO NOT CONNECT UNTERMINATED WIRES TO PINS J4.3, J4.4 AND J4.5. THEY MIGHT PICK UP UNWANTED NOISE AND GIVE FALSE ENCODER READINGS.

Encoder cable shield must be connected to system PE to avoid disturbances / noise induced by nearby cables.

3.8.4 Feedback #2 - Differential Incremental Encoder Connection

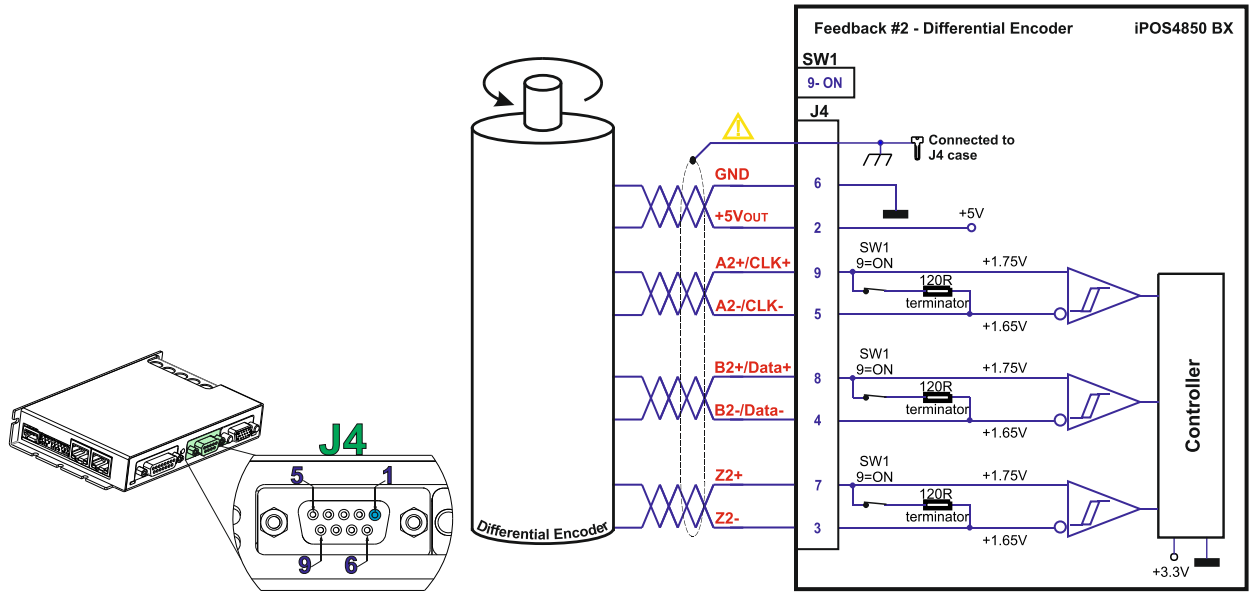


Figure 13. Feedback #2 - Differential Incremental Encoder Connection

CAUTION!

Encoder cable shield must be connected to system PE to avoid disturbances / noise induced by nearby cables.

Remarks:

1. *For Feedback #2 differential connection, 120Ω (0.25W) terminators are internally added by putting the SW1 pin 9 on "ON" position.*
2. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*

3.8.5 Pulse and direction connection

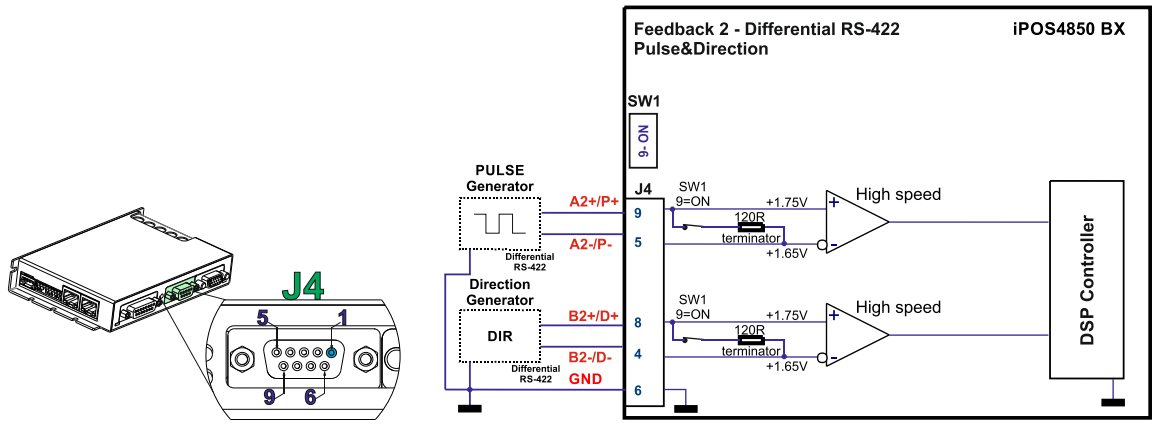


Figure 14. Feedback #2 – Pulse and Direction connection

Remarks:

1. *The same connection can be done on Feedback #1 – J3 using the same encoder signals (A and B signals).*
2. *A non-differential pulse and direction signal can be accepted only if the internal 120 Ω resistors are disconnected by SW1 pins 8 or 9, depending on the used feedback.*

3.8.6 Digital Hall Connection for Motor + Hall + Incremental or Absolute Encoder

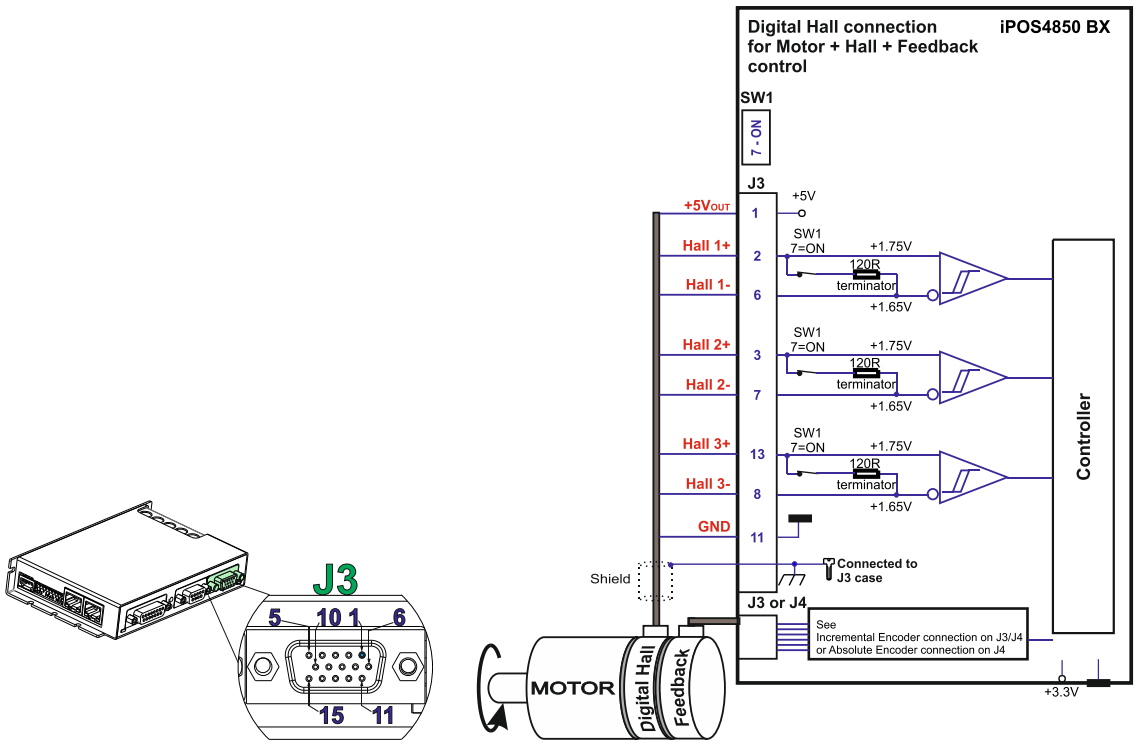


Figure 15. Digital Hall connection

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 or absolute encoder.*
2. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*
3. *In case the digital hall signals from the motor are single-ended, the internal 120 Ω resistors have to be disconnected (SW1 pin 8 must be "OFF").*

CAUTION!	***Digital Hall cable shield must be connected to system PE to avoid disturbances / noise induced by nearby cables.***

3.8.7 Digital Hall Connection for Motor + Digital Hall only control

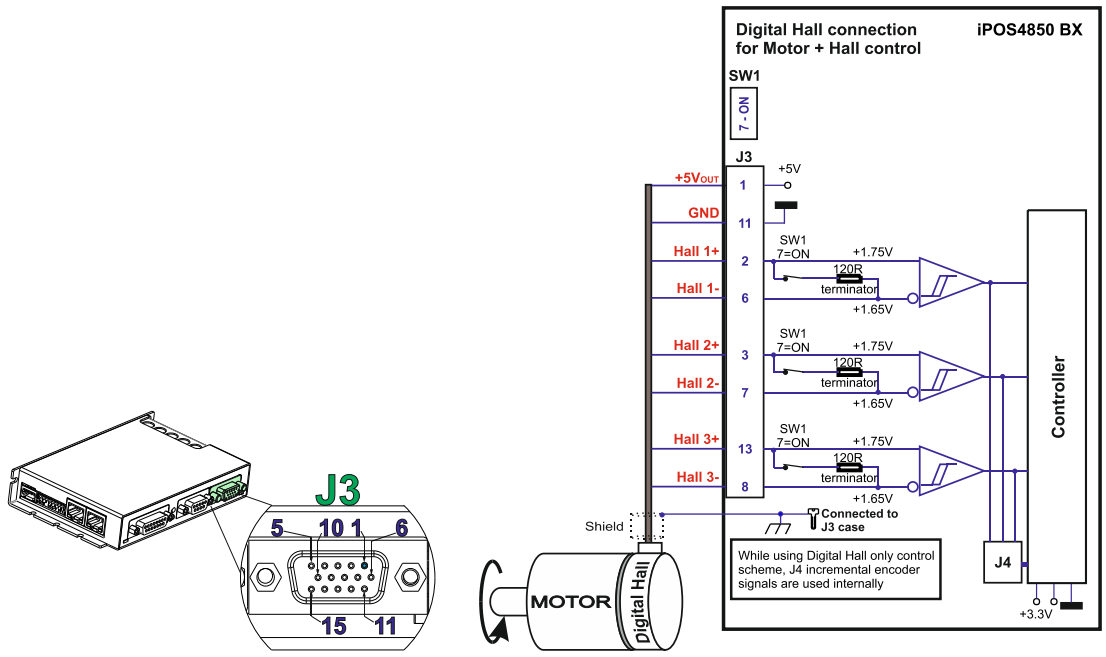


Figure 16. Digital Hall connection

Remarks:

1. *This connection is required when using the digital Halls as the only feedback device for the motor control.*
2. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*
3. *In case the digital hall signals from the motor are single-ended, the internal 120 Ω resistors have to be disconnected (SW1 pin 8 must be "OFF").*
4. *While using this control scheme, the incremental encoder signals from J4 are used internally by the drive*

CAUTION!	***Digital Hall cable shield must be connected to system PE to avoid disturbances / noise induced by nearby cables.***

3.8.8 Feedback #2 – Absolute Encoder Connection: SSI, BiSS, EnDAT

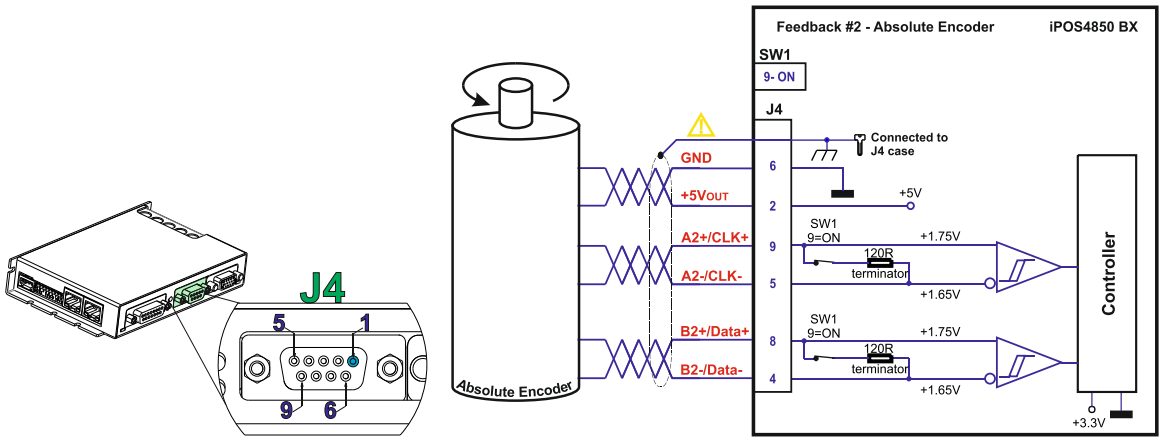


Figure 17. Feedback #2 – Absolute Encoder connection: SSI, BiSS, EnDAT

Remarks:

1. *For Feedback #2 absolute connection, 120Ω (0.25W) terminators are internally added by putting the SW1 pin 9 on "ON" position.*
2. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*

CAUTION!	***Encoder cable shield must be connected to system PE to avoid disturbances / noise induced by nearby cables.***

3.8.9 Feedback #2 – Absolute Encoder Connection: Panasonic, Tamagawa, Nikon, Sanyo Denki

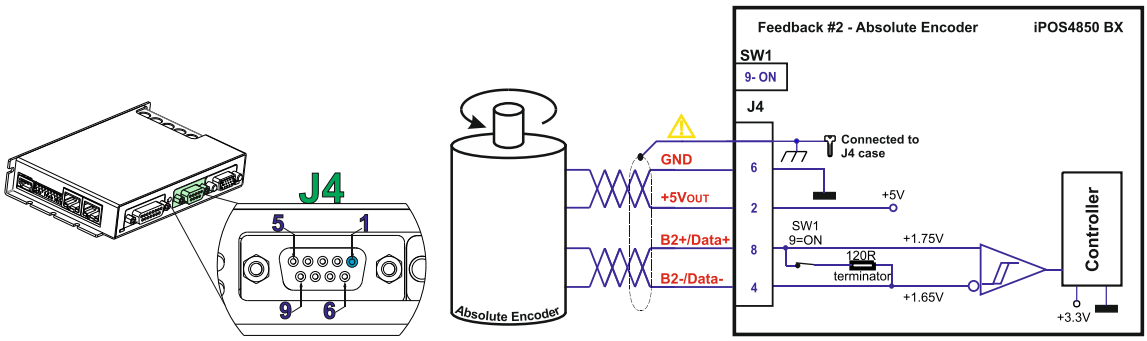


Figure 18. *Feedback #2 – Absolute Encoder connection: Panasonic, Tamagawa, Nikon, Sanyo Denki*

Remarks:

1. *For Feedback #2 absolute connection, 120Ω (0.25W) terminators are internally added by putting the SW1 pin 9 on "ON" position.*
2. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*

CAUTION!	***Encoder cable shield must be connected to system PE to avoid disturbances / noise induced by nearby cables.***

3.8.9.1 General recommendations for feedback 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: A1+/DAT1+ with A1-/DAT1-, B1+/CLK1+ with B1-/CLK1-, Z1+ with Z1-, A2+/DAT2+ with A2-/DAT2- and B2+/CLK2+ with B2-/CLK2-. 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 connector metallic case at one end, and it is also recommended to connect the other end to the motor chassis.

a) If the +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.

3.9 Power Supply Connection

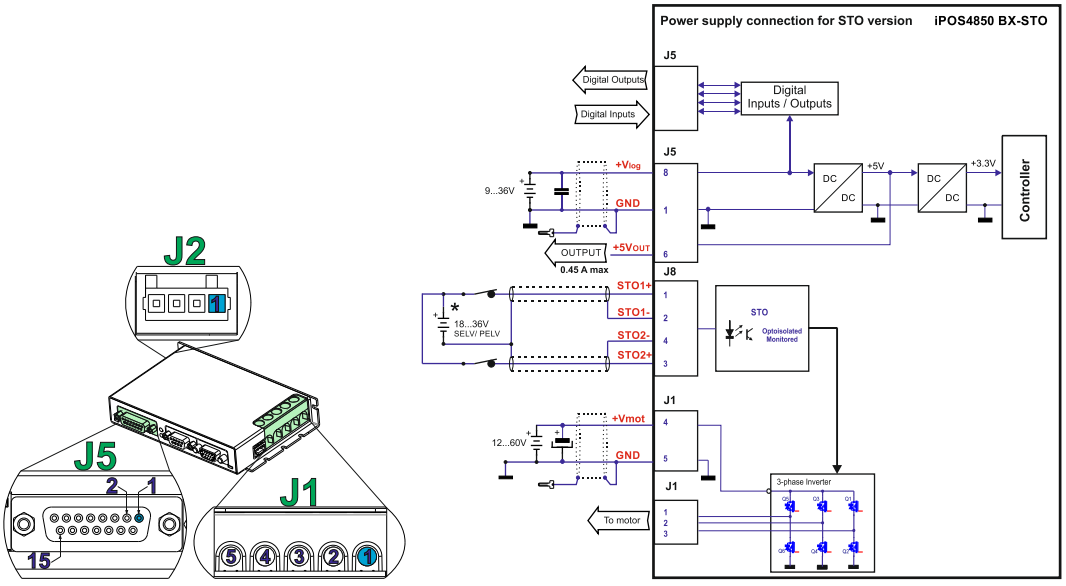


Figure 19. Supply connection

Remarks:

1. The iPOS4850 requires two supply voltages for non-STO versions: $+V_{log}$ and $+V_{mot}$; and three supply voltages for STO versions: $+V_{log}$, $+V_{mot}$ and STO.
2. *For the STO executions, when the STO inputs are left unconnected the motor outputs will be disabled. This provides a dual redundant hardware protection that cannot be overdriven by the software or other hardware components. The STO circuit must be supplied with minimum 18V to enable PWM output.*

3. *An external electrolytic capacitor may be added between +V_{mot} and GND, to help reduce over-voltage during load braking/ reversals. See paragraph 3.9.1.1 for details.*

3.9.1.1 Recommendations for Supply Wiring

a) Use short, thick wires between iPOS4850 and the motor power supply. Connect power supply wires to all the indicated pins. The logic and motor power supply cables shield must be connected to GND at both ends.

b) 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 1000µF (rated at an appropriate voltage) right on the terminals of the iPOS4850.

3.9.1.2 Recommendations to limit over-voltage during braking

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 **65V**, the drive over-voltage protection is triggered and the drive power stage is disabled.

To prevent this situation, you have two options:

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:

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

where:

U_{MAX} = 65V 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:

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

where:

J_M – total rotor inertia [kgm^2]

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

ω_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 ω_M will become linear speed measured in [m/s] and the friction torque T_F will become friction force measured in [N].

2. ***Connect a chopping resistor R_{CR}* to the BC90100 BX module:**

Codified as P038.100.E201, the brake chopper module is compatible with all Technosoft Intelligent Drives and supports currents **up to 100 A**[1]. The module must be connected to one of the drive's digital outputs. When the U_{CHOP} voltage threshold (configured in the Setup branch of EasyMotion II) is exceeded, the output is activated, triggering the BC90100

[1] Continuous rating, using a heatsink, with baseplate temperature maintained below 75 °C

BX module. This action connects the chopping resistor directly across the DC bus, allowing excess regenerative energy to be safely dissipated.

Access the module datasheet, along with guidelines for selecting and sizing the chopping resistor and any additional heatsink required for the BC90100 BX braking module, by clicking here ➡ More information.

3.10 Serial RS-232 connection

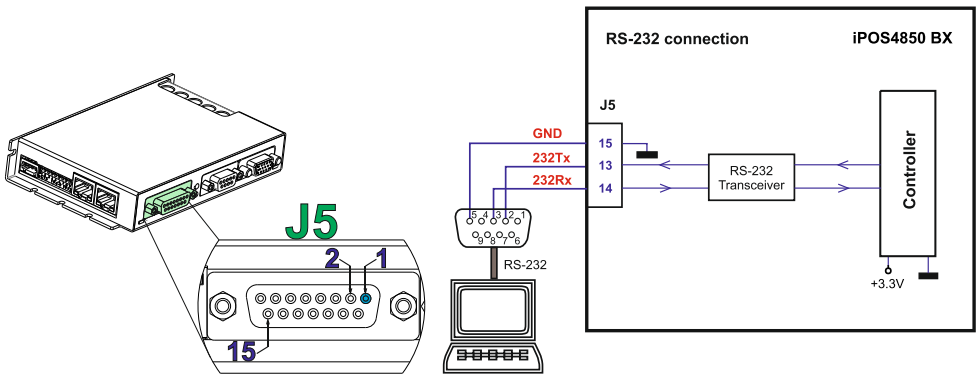


Figure 20. Serial RS-232 connection

Remark: *EasyMotion Studio II can communicate in parallel with serial RS232 communication while EtherCAT communication is active.*

3.10.1 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 15 of J5) must be included inside the shield, like the 232Rx and 232Tx signals.
b) Always power-off all the iPOS4850 BX supplies before inserting/removing the RS-232 serial connector
c) Do not rely on an earthed PC to provide the iPOS4850 BX GND connection! The drive must be earthed through a separate circuit. Most communication problems are caused by the lack of such connection.

CAUTION! **DO NOT CONNECT/DISCONNECT THE RS-232 CABLE WHILE THE DRIVE IS PWERED ON. THIS OPERATION CAN DAMAGE THE DRIVE**

3.11 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 J7 / OUT port of the last drive in the chain remains not connected. Master is connected to J6 / IN port of the first drive; J7 / OUT of the first drive is connected to J6 / IN of the following drive; J7 / OUT of the last drive remains unconnected.

   See Figure 21. EtherCAT network linear topology for a visual representation of the linear topology.
   - Ring, when the J7 / 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 J7 / OUT of the last drive.

   See Figure 22. EtherCAT network ring topology 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.

Linear Topology

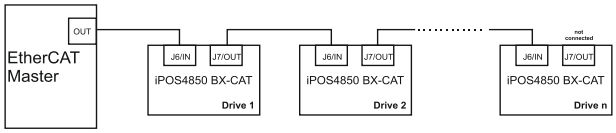


Figure 21. *EtherCAT network linear topology*

Ring Topology

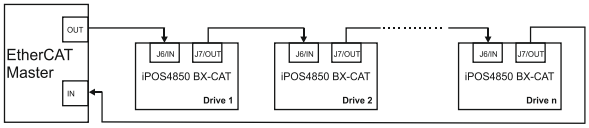


Figure 22. *EtherCAT network ring topology*

3.12 Disabling the setup table at startup

In rare instances, the setup table may become corrupted, causing the drive to continuously reset. This condition is indicated by both the Ready and Error LEDs blinking rapidly in succession.

To recover from this state, invalidate the setup table by connecting all digital Hall inputs to GND. Upon the next power-on, the drive will load the default settings and set bit 2 in the Motion Error Register, indicating “Invalid Setup Data.” Once a new valid setup table is loaded onto the drive, disconnect the Hall sensors from GND and perform another power cycle (power off and then on).

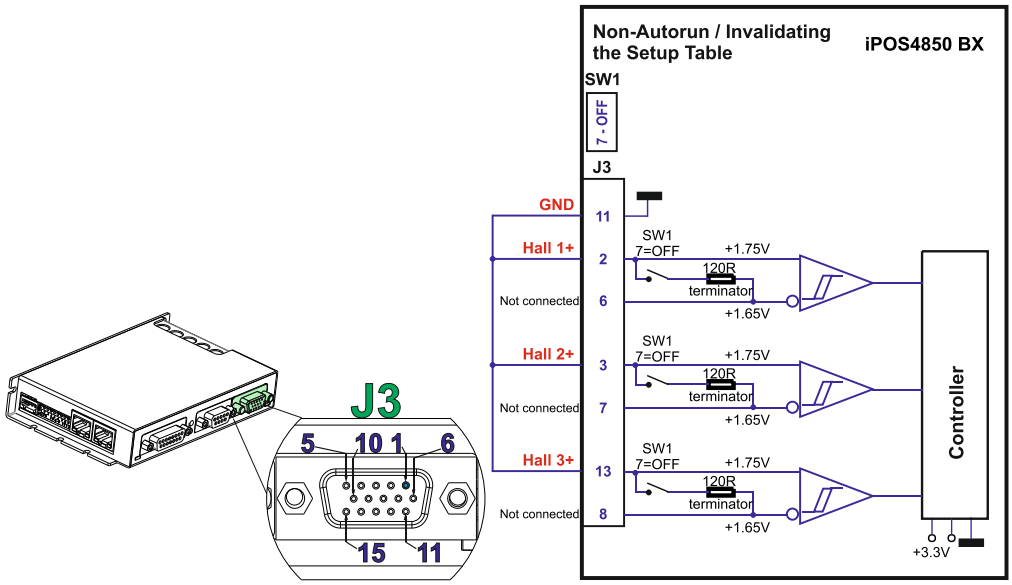


Figure 23. *Temporary connection during power-on to disable the setup table*

3.13 AxisID Selection

The iPOS4850 BX-CAT-STO drives support all EtherCAT standard addressing modes. In case of device addressing mode based on node address, the drive sets the EtherCAT register called “configured station alias” address with its AxisID value. The drive AxisID value is set after power on by:

- **Software**, Using EasyMotion Studio II, set a specific AxisID value in the range of 1-255 within the AxisID settings under the setup section.
- **Hardware**, In EasyMotion Studio II, select the 'H/W' option under AxisID settings in the setup section, then choose a value between 1-63 or 255 from SW1. The switch settings are sampled after every reset, including after power-up.

The Hardware Axis ID can be set by SW1 pins. SW1 is an 9 pole DIN switch:

- ON = pin is down
- OFF = in is up

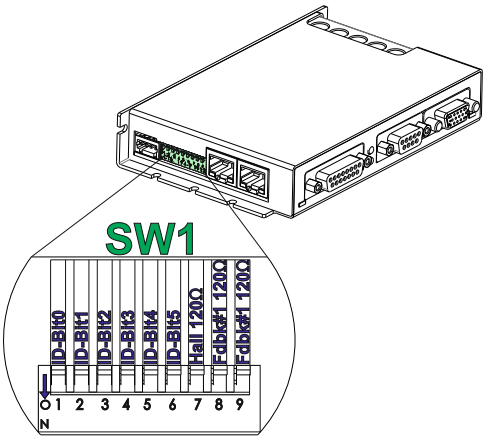


Figure 24. SW1 – DIP Switch settings

Remarks:

1. These three inputs are sampled after every reset, including after power-up.
2. *The axis ID is an 8 bit unsigned number. Its bits are controlled by the ID-bit0 to ID-bit5. In total, 64 axis ID HW values can result from the DIP switch combinations.*
3. *When the AxisID bits are all OFF, the drive Axis ID will be 255 and the EtherCAT register called "configured station alias" will be 0.*
4. *All pins are sampled at power-up, and the drive is configured accordingly.*

3.14 LED indicators

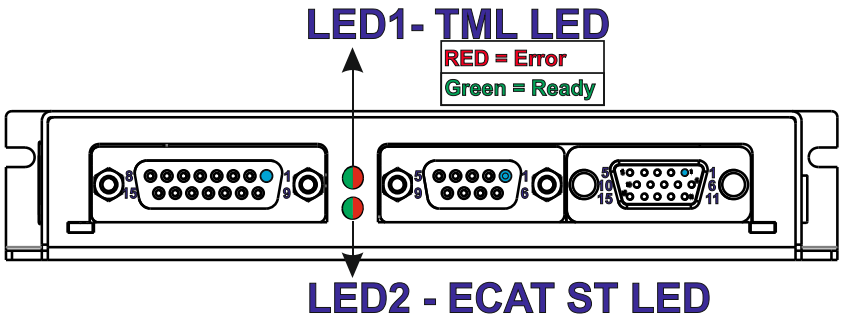


Figure 25. LED indicators

Table 1. LED indicators description

LED	LED name	LED color	Function
1	TML LED	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.
2	EtherCAT® ST	red/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.

3.14.1 EtherCAT® ST LED Indicator

The STATUS indicator displays the RUN states with a 180 degree phase shift to the ERROR states. An example is noted in Figure 26. STATUS indicator Example.

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 2. RUN Indicator States and the behavior of the ERROR indicator specified in Table 3. ERROR Indicator States.

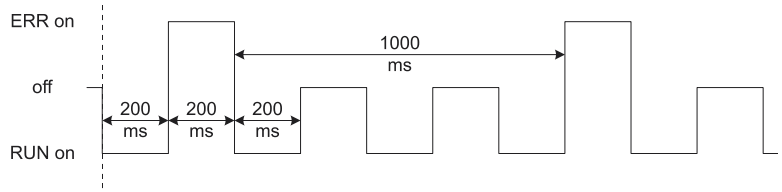


Figure 26. STATUS indicator Example

Table 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. 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

3.15 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) = 64A

3.15.1 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	2	Km
	Ambient Pressure	0 [2]	0.75 ÷ 1	10.0	atm

3.15.2 Storage Conditions

		Min.	Typ.	Max.	Units
Ambient temperature		-40		+85	ºC
Ambient humidity	Non-condensing	0		100	%Rh
Ambient Pressure		0		10.0	atm

3.15.3 Mechanical Mounting

		Min.	Typ.	Max.	Units
Mounted on heatsink	It is necessary to mount the iPOS4850 on a metallic heatsink using the provided mounting holes. If the integrated internal thermal sensor exceeds 95ºC, the drive outputs turn off.				

3.15.4 Operating temperature

		Min.	Typ.	Max.	Units
Ambient temperature – non condensing		0		40	°C
	It is necessary to mount the iPOS4850 on a metallic heatsink using the provided mounting holes. If the integrated internal thermal sensor exceeds 95ºC, the drive outputs turn off.				

3.15.5 Environmental Characteristics

		Min.	Typ.	Max.	Units
Size (Length x Width x Height)	without mating connectors		139 x 93.9 x 24.6		mm
			~5.47 x 3.7 x 0.97		inch
Weight			240		g
Power dissipation	Idle (no load)		3.6		W
	Operating		see theoretical chart		
Efficiency			98		%
Cleaning agents	Dry cleaning is recommended		Only Water- or Alcohol- based		
Protection degree	According to IEC60529, UL508		IP20		-

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

[2] iPOS4850 BX 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.

3.15.6 Logic Supply Input (+V_{LOG})

			Min.	Typ.	Max.	Units
Supply voltage	Nominal values		9	24	36	V_{DC}
	Absolute maximum values, drive operating but outside guaranteed parameters		8	24	40	V_{DC}
	Absolute maximum values, surge (duration ≤ 10ms) †		-1		+45	V
Supply current	No encoder and no load on digital outputs	+V_{LOG} = 9V		190		mA
		+V_{LOG} = 12V		170		
		+V_{LOG} = 24V		110		
		+V_{LOG} = 36V		80		
Utilization Category	Acc. to 60947-4-1 (I_{PEAK}<=1.05*I_{NOM})		DC-1			

3.15.7 Motor Supply Input (+V_{MOT})

		Min.	Typ.	Max.	Units
Supply voltage	Nominal values	12	48	60	V_{DC}
	Absolute maximum values, drive operating but outside guaranteed parameters	11		70	V_{DC}
	Absolute maximum values, surge (duration ≤ 10ms) †	-1		75	V
Supply current	Idle		1	5	mA
	Operating	-50	±10	+50	A
	Absolute maximum value, short-circuit condition (duration ≤ 10ms) †			100	A
Utilization Category	Acc. to 60947-4-1 (I_{PEAK}<=4*I_{NOM})	DC-3			

3.15.8 Motor Outputs (A/A+ , B/A- , C)

			Min.	Typ.	Max.	Units
Nominal output	Sinusoidal RMS [1]				45	A_{RMS}
	Sinusoidal RMS [2]				35.4	
	Sinusoidal amplitude [1]				64	A
	Sinusoidal amplitude [2]				50	
Peak current	maximum 13s with 6 AWG wires, external heatsink		-90		+90	A
Short-circuit protection threshold					±100	A
Short-circuit protection delay			5	10		µs
Off-state leakage current				±0.5	±1	mA
Motor inductance (phase-to-phase)	Recommended value, for current ripple max. ±5% of full range; +V_{MOT} = 48 V	F_{PWM} = 20 kHz	330			µH
		F_{PWM} = 40 kHz	150			
		F_{PWM} = 60 kHz	120			
	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			
Motor electrical time-constant (L/R)	Recommended value for ±5% current measurement error	F_{PWM} = 20 kHz	250			µs
		F_{PWM} = 40 kHz	125			
		F_{PWM} = 60 kHz	100			
Current measurement accuracy	FS = Full Scale			±5	±8	%FS

3.15.9 Digital Inputs (IN2/LSP, IN3/LSN)

			Min.	Typ.	Max.	Units
Mode compliance			PNP			
Default state	Input floating (wiring disconnected)		Logic LOW			
Input voltage	Logic “LOW”		-10	0	3.3	V
	Logic “HIGH”		6.7		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”	V_{LOG} = 24V		9.15		
		V_{LOG} = 36V		13.7		
Input frequency			0		150	kHz
Minimum pulse			3.3			µs
ESD protection	Human body model		±1			kV

3.15.10 Digital Outputs (OUT2/Error, OUT3/ Ready)

			Min.	Typ.	Max.	Units
Mode compliance	All outputs (OUT2/Error, OUT3/Ready)		NPN 24V			
Default state	Not supplied (+V_{LOG} floating or to GND)		High-Z (floating)			
	Immediately after power-up	OUT2/Error, OUT3/ Ready	Logic “LOW”			
	Normal operation	OUT2/Error	Logic “HIGH”			
		OUT3/Ready	Logic “LOW”			
Output voltage	Logic “LOW”; output current = 0.5A				0.8	V
	Logic “HIGH”; output current = 0, no load	OUT2/Error, OUT3/ Ready	2.9	3	3.3	
	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				0.5	A
	Logic “HIGH”, source current; external load to GND; V_{OUT} >= 2.0V	OUT2/Error, OUT3/ Ready			2	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

[1] With adequate thermal heat sink
[2] No thermal heat sink (worst case scenario)

3.15.11 Solenoid Driver (OUT0/Brake)

			Min.	Typ.	Max.	Units
Brake+/Brake-: solenoid driver, 2A, overcurrent protected (Brake+ connected internally to +Vlog). Current flows into solenoid from Brake+ to Brake-; commanded by OUT0 digital output						
Default state	Not supplied (+V_{LOG} floating or to GND)		High-Z (floating)			
	Immediately after power-up	Brake-	High-Z (floating)			
	Normal operation	Brake-	High-Z (floating)			
Output voltage	Logic "LOW" (Brake-)				0.2	V
	Logic "HIGH"; load present			+V_{LOG}		
	Logic "HIGH", no load present			+5		
	Absolute maximum, continuous		-0.5		55	
Output current	Logic "LOW", sink current, continuous, Brake-				2	A
	Logic "HIGH", leakage current; external load to +V_{LOG}; V_{OUT} = V_{LOG} max = 55V				0.2	mA

3.15.12 Digital Hall Inputs (Hall1+, Hall1-, Hall2+, Hall2-, Hall3+, Hall3-)[1]

		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		
	Floating voltage (Not connected)		4.4		
	Absolute maximum, surge (duration ≤ 1s) †	-10		+15	
Input current	Logic "LOW"; Pull to GND			1.2	mA
	Logic "HIGH". Internal 4.7KΩ pull-up to +5	0	0	0	
Minimum pulse width		2			µs
Differential mode compliance	For full RS422 compliance, see[1]	TIA/EIA-422-A			
Input voltage	Hysteresis	±0.06	±0.1	±0.2	V
	Differential mode	-14		+14	
	Common-mode range (A+ to GND, etc.)	-11		+14	
Input impedance, differential	A1+/A1-, B1+/B1-, Z1+/Z1-, A2+/A2-, B2+/B2-, Z2+/Z2-		120		Ω
Input frequency	Differential mode	0		10	MHz
Minimum pulse width	Differential mode	50			ns

3.15.13 Encoder #1 and #2 Inputs (A1+, A1-, B1+, B1-, Z1+, Z1-, A2+, A2-, B2+, B2-, Z2+, Z2-)

		Min.	Typ.	Max.	Units
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	
	Common-mode range (A+ to GND, etc.)	-11		+14	
Input impedance, differential	A1+/A1-, B1+/B1-, Z1+/Z1-, A2+/A2-, B2+/B2-, Z2+/Z2-		120		Ω
	Differential mode	0		10	MHz
	Differential mode	50			ns

3.15.14 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		14.7		kΩ
Resolution			12		bits
Integral linearity				±2	bits
Offset error			±2	±10	bits
Gain error			±1%	±3%	% FS3
Bandwidth (-3dB)	Software selectable	0		1	kHz
ESD protection	Human body model	±2			kV

3.15.1 RS-232

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

3.15.2 Supply Output (+5V)

		Min.	Typ.	Max.	Units
+5V output voltage	Current sourced = 250mA	4.8	5	5.2	V
+5V output current				450	mA
Short-circuit protection		Yes			
Over-voltage protection		NOT protected			
ESD protection	Human body model 0.1nF 1.5 kΩ	±2			kV

[1] To select differential mode use SW1 pin 7.
[2] To select differential mode use SW1 pin 8 / 9.
[3] "FS" stands for "Full Scale"

3.15.3 SSI, BiSS, EnDAT 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[1]		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)			56	bit
	If total resolution >31 bits, some bits must be ignored by software setting to achieve a max 31 bits resolution				
Protocol			BiSS C mode (sensor mode)		

3.15.4 EtherCAT ports (J6 and J7)

		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 DIN SW1		1 ÷ 63, 255		-
MAC addressing	EtherCAT® uses no MAC address		none		-
ESD protection	Human body model	±15			kV

3.15.5 Safe Torque OFF (STO1+; STO1-; STO2+; STO2-) for "–STO" executions

		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

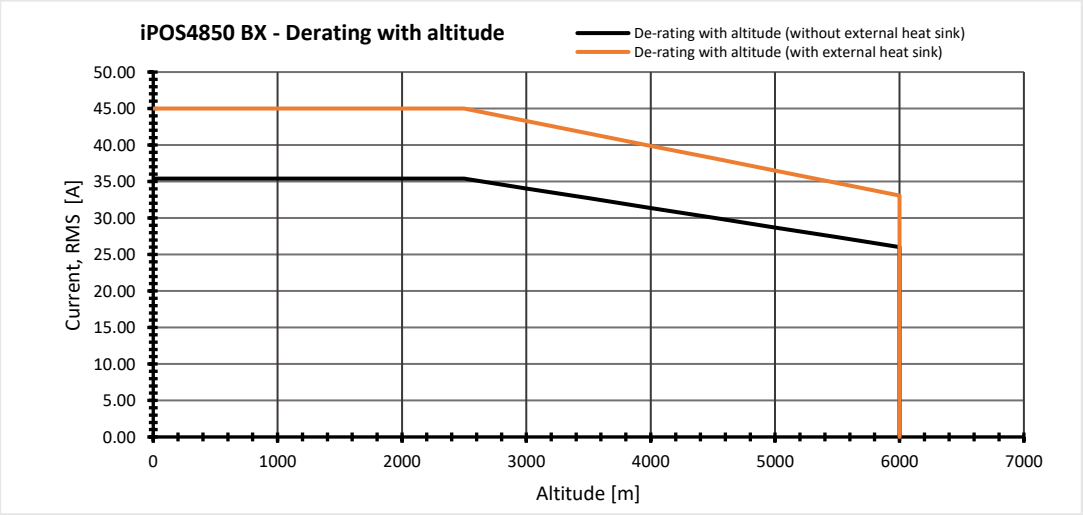
3.15.6 Conformity

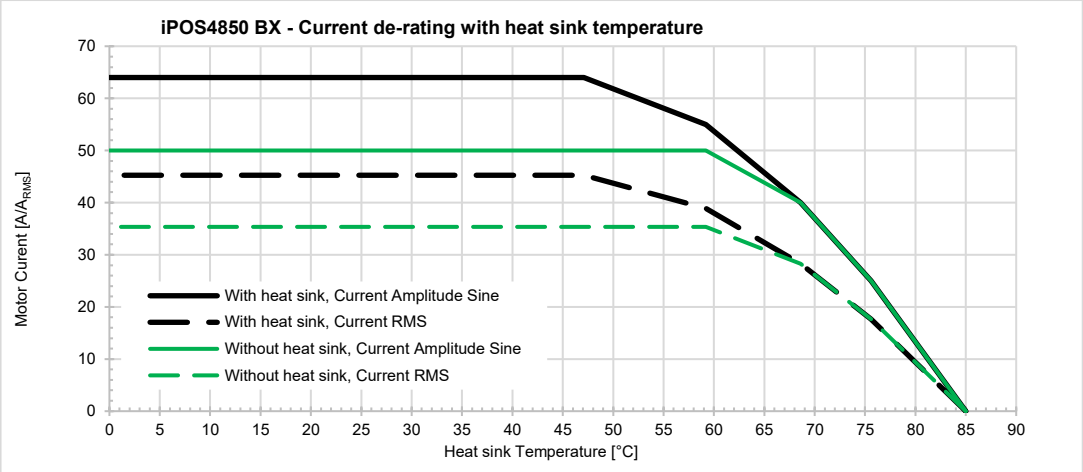
	Min.	Typ.	Max.	Units
EU Declaration	2014/30/EU (EMC), 2014/35/EU (LVD), 2011/65/EU (RoHS), 1907/2006/EC (REACH), 93/68/EEC (CE Marking Directive), EC 428/2009 (non dual-use item, output frequency limited to 590Hz)			

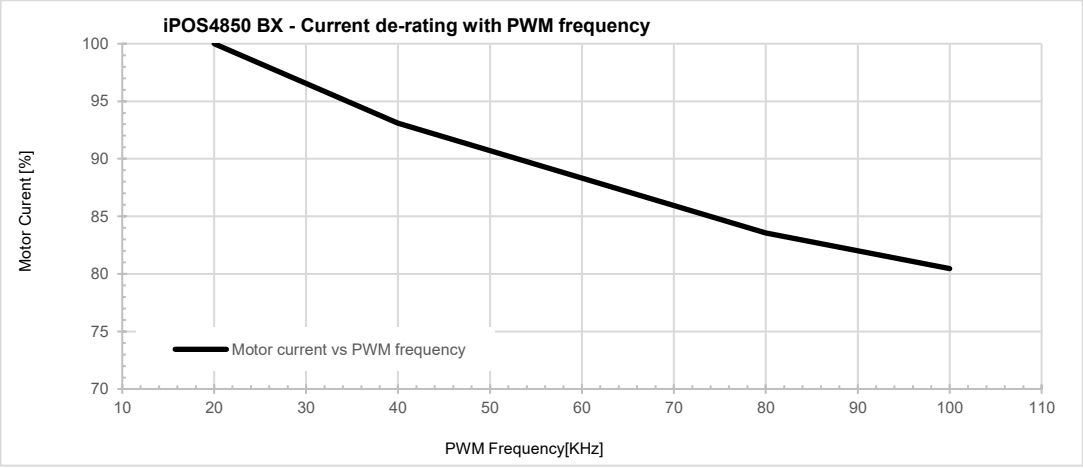
† Stresses beyond values listed under "absolute maximum ratings" may cause permanent damage to the device. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

[1] Availabile only for EnDAT and BiSS feedback options

3.15.7 De-rating curves







4 Memory Map

Micro has 2 types of memory available for user applications: 16K×16 SRAM and up to 24K×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: 2000h 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 II handles automatically the memory allocation for each motion application. The memory map can be accessed and modified from the "Memory Settings" dialogue of each application*

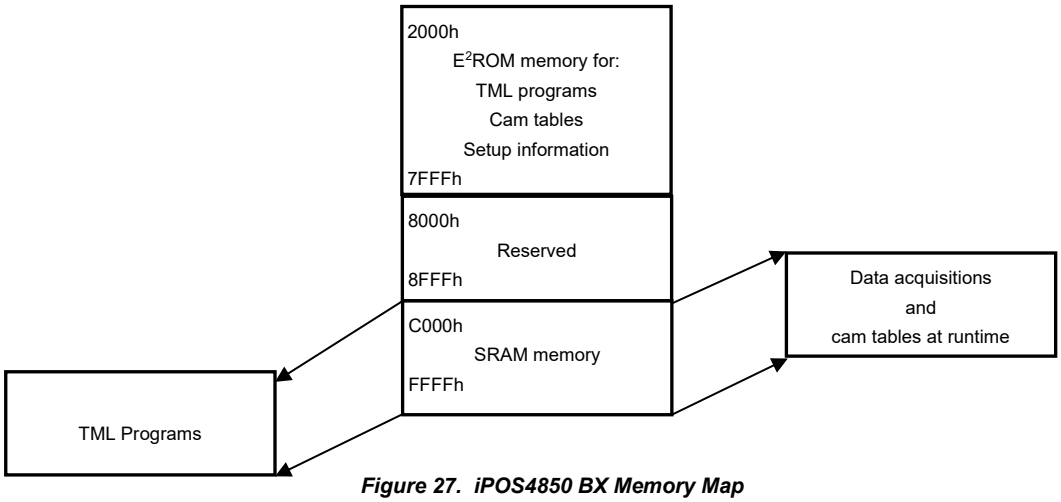


Figure 27. iPOS4850 BX Memory Map