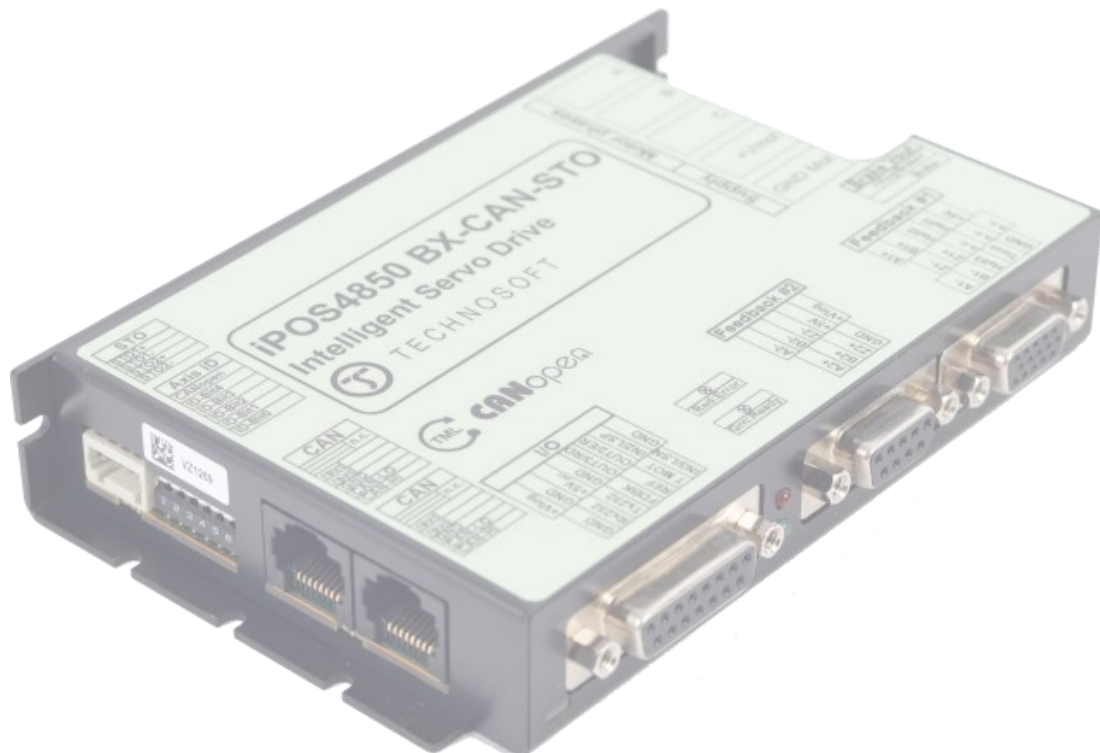# iPOS4850 BX

Intelligent Servo Drive for DC and Brushless Motors

TECHNOSOFT

Intelligent Servo Drives

Technical Reference

Table of contents

Read This First

About This Manual

This book is a technical reference manual for:

Product Name	Part Number	Nominal current		Peak current	Communication	STO
iPOS4850 BX-CAN	P029.200.E301				CAN	X
iPOS4850 BX-CAN-STO	P029.300.E301	64A[1]	50A[2]	90A	CAN	✓
iPOS4850 BX-CAT-STO	P029.300.E321				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 EasySetUp software for drive commissioning
- ❑ **Step 3 Motion programming** using one of the options:
  - ❑ A **CANopen master**[3] or an **EtherCAT® master**[4]
  - ❑ The drives built-in motion controller executing a Technosoft Motion Language (**TML**) program developed using Technosoft **EasyMotion Studio software**
  - ❑ A **TML_LIB motion library for PCs** (Windows or Linux) [5]
  - ❑ A **TML_LIB motion library for PLCs** [3]
  - ❑ 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 – 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
- **CANopen** – Standard communication protocol that uses 11-bit message identifiers over CAN-bus
- **TMLCAN** – Technosoft communication protocol for exchanging TML commands via CAN-bus, using 29bit message identifiers
- **CoE** – CAN application protocol over EtherCAT®

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[1] With adequate thermal heat sink
[2] No thermal heat sink (worst case scenario)
[3] When the iPOS4850 BX-CAN(-STO) is set in CANopen mode
[4] When using and iPOS4850 BX-CAT-STO
[5] Available only for CAN versions

iPOS4850 BX-CAN Datasheet (P029.200.E301.DSH)

iPOS4850 BX-CAN-STO Datasheet (P029.300.E301.DSH)

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

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

TML_LIB v2.0 (part no. P091.040.v20.UM.xxxx) – explains how to program in C, C++,C#, Visual Basic or Delphi Pascal a motion application for the Technosoft intelligent drives using TML_LIB v2.0 motion control library for PCs. The TML_lib includes ready-to-run examples that can be executed on Windows or Linux (x86 and x64).

TML_LIB_LabVIEW v2.0 (part no. P091.040.LABVIEW.v20.UM.xxxx) – explains how to program in LabVIEW a motion application for the Technosoft intelligent drives using TML_LIB_LabVIEW v2.0 motion control library for PCs. The TML_Lib_LabVIEW includes over 40 ready-to-run examples.

TML_LIB_S7 (part no. P091.040.S7.UM.xxxx) – explains how to program in a PLC Siemens series S7-300 or S7-400 a motion application for the Technosoft intelligent drives using TML_LIB_S7 motion control library. The TML_LIB_S7 library is IEC61131-3 compatible.

TML_LIB_CJ1 (part no. P091.040.CJ1.UM.xxxx) – explains how to program in a PLC Omron series CJ1 a motion application for the Technosoft intelligent drives using TML_LIB_CJ1 motion control library for PLCs. The TML_LIB_CJ1 library is IEC61131-3 compatible.

TML_LIB_X20 (part no. P091.040.X20.UM.xxxx) – explains how to program in a PLC B&R series X20 a motion application for the Technosoft intelligent drives using TML_LIB_X20 motion control library for PLCs. The TML_LIB_X20 library is IEC61131-3 compatible.

TechnoCAN (part no. P091.063.TechnoCAN.UM.xxxx) – presents TechnoCAN protocol – an extension of the CANopen communication profile used for TML commands

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

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!	**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

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 and BiSS-C).

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 CAN drives are equipped with a serial RS232 and a CAN 2.0B interface that can be set by hardware pins to operate in 2 communication protocol modes:
- ❑ **CANopen**
- ❑ **TMLCAN**

When **CANopen** mode is selected, the iPOS4850 BX conforms to **CiA 301 v4.2** application layer communication profile, the **CiA WD 305 v2.2.13** and **CiA DSP 402 v4.1.1** device profile for drives and motion control, now included in IEC 61800-7-1 Annex A, IEC 61800-7-201 and IEC 61800-7-301 standards. In this mode, the iPOS4850 BX may be controlled via a CANopen master. The iPOS drive offers the possibility for a CANopen master to call motion sequences/ functions, written in TML and stored in the drive EEPROM, using manufacturer specific objects. Also, the drives can communicate separately between each other by using non reserved 11 bit identifiers.

When **TMLCAN** mode is selected, the iPOS4850 BX behaves as standard Technosoft intelligent drive and conforms to Technosoft protocol for exchanging TML commands via CAN-bus. When TMLCAN protocol is used, it is not mandatory to have a master. Any iPOS4850 BX can be set to operate standalone, and may play the role of a master to coordinate both the network communication/synchronization and the motion application via TML commands sent directly to the other drives.

When higher level coordination is needed, apart from a CANopen master, the iPOS4850 BX drives can also be controlled via a PC or a PLC using one of the **TML_LIB** motion libraries.

For iPOS4850 BX commissioning **EasySetUp** or **EasyMotion Studio** PC applications may be used.

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

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 iPOS4850 BX 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 iPOS4850 BX 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.**

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:
  - CAN version: including: torque, speed or position control; position or speed profiles, Cyclic Synchronous Position (CSP) for CANopen mode, external reference mode (analogue or encoder feedback) or sent via a communication bus
  - EtherCAT version: 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
  - CAN-bus 2.0B up to 1Mbit/s (for CAN drives)
  - Dual 100Mbps EtherCAT® interfaces, for use in daisy-chaining topologies (for CAT drives)
- 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)
  - Pulse & direction interface (differential) for external (master) digital reference
  - Digital Hall sensor interface (single-ended or differential)

2nd feedback devices supported:

- Incremental encoder interface (single-ended or differential)
- Pulse & direction interface (differential) for external (master) digital reference
- 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) for CANopen mode and EtherCAT® drives.
  - Cyclic Synchronous Velocity (CSV) only for EtherCAT® drives.
  - Cyclic Synchronous Torque (CST) only for EtherCAT® drives.
  - Electronic gearing and camming
  - 35 Homing modes
- 32 h/w selectable addresses selectable by DIN switch for CAN executions
- 64 h/w selectable addresses selectable by DIN switch for CAT executions
- Two CAN operation modes selectable by DIN switch:
  - **CANopen** – conforming with CiA 301 v4.2, CiA WD 305 v2.2.13 and CiA DSP 402 v3.0
  - **TMLCAN** – intelligent drive conforming with Technosoft protocol for exchanging TML commands via CAN-bus
- 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^{2}ROM 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	• Over-current
• Short-circuit from motor phases to ground	• Over-temperature
• Over-voltage	• Communication error
• Under-voltage	• Control error

2.3   Identification Labels

Identification label with Technosoft serial number

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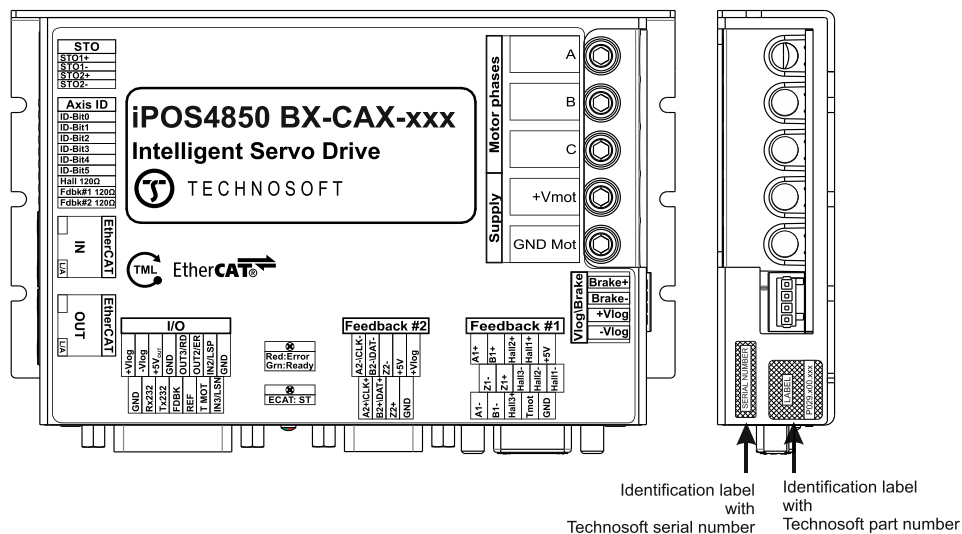
The iPOS4850 BX family can have the following part numbers and names on the identification label:

- **P029.200.E301** name **iPOS4850 BX-CAN** – standard CAN execution
- **P029.300.E301** name **iPOS4850 BX-CAN-STO** – standard CAN execution with STO input
- **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.

Sensor			Motor Brushless PMSM	Brushless BLDC	DC Brush
Sensor type	**Sensor location**				
Incr. encoder	FDBK #1 (single-ended/diff[1])		Yes	-	Yes
	FDBK #2 (single-ended/diff[1])				
Incr. encoder + Digital Hall	FDBK #1 (single-ended/diff[1])	Digital Halls Interface (single-ended/diff)	Yes	Yes	-
	FDBK #2 (single-ended/diff[1])				
BISS/ SSI / EnDAT / Tamagawa / Panasonic/ Nikon / Sanyo Denki	FDBK #2 (single-ended/diff[1])		Yes	-	Yes
Tacho	Analogue input: Feedback		-	-	Yes

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 type	Feedback #1	Feedback #2
PMSM	Incremental encoder (single-ended/diff)	Incremental encoder (single-ended/diff)
		BISS/ SSI/ EnDAT/ TAMAGAWA/ Panasonic/ Nikon/ Sanyo Denki encoder (differential)
BLDC	Incremental encoder (single-ended/diff) + Digital halls (single-ended/diff)	Incremental encoder (single-ended/diff) + Digital halls (single-ended/diff)
		BISS/ SSI/ EnDAT/ TAMAGAWA/ Panasonic/ Nikon/ Sanyo Denki encoder (differential)
DC Brush	Incremental encoder (single-ended/diff)	Incremental encoder (single-ended/diff)
	Analogue Tacho (only on motor)	BISS/ SSI/ EnDAT/ TAMAGAWA/ Panasonic/ Nikon/ Sanyo Denki encoder (differential)

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.

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[1] For single-ended/ differential connection see SW1 – pin 8 & 9 settings (Chapter

Feedback connections")

3   Hardware Installation

3.1   iPOS4850 BX-CAN/ BX-CAN-STO Board Dimensions
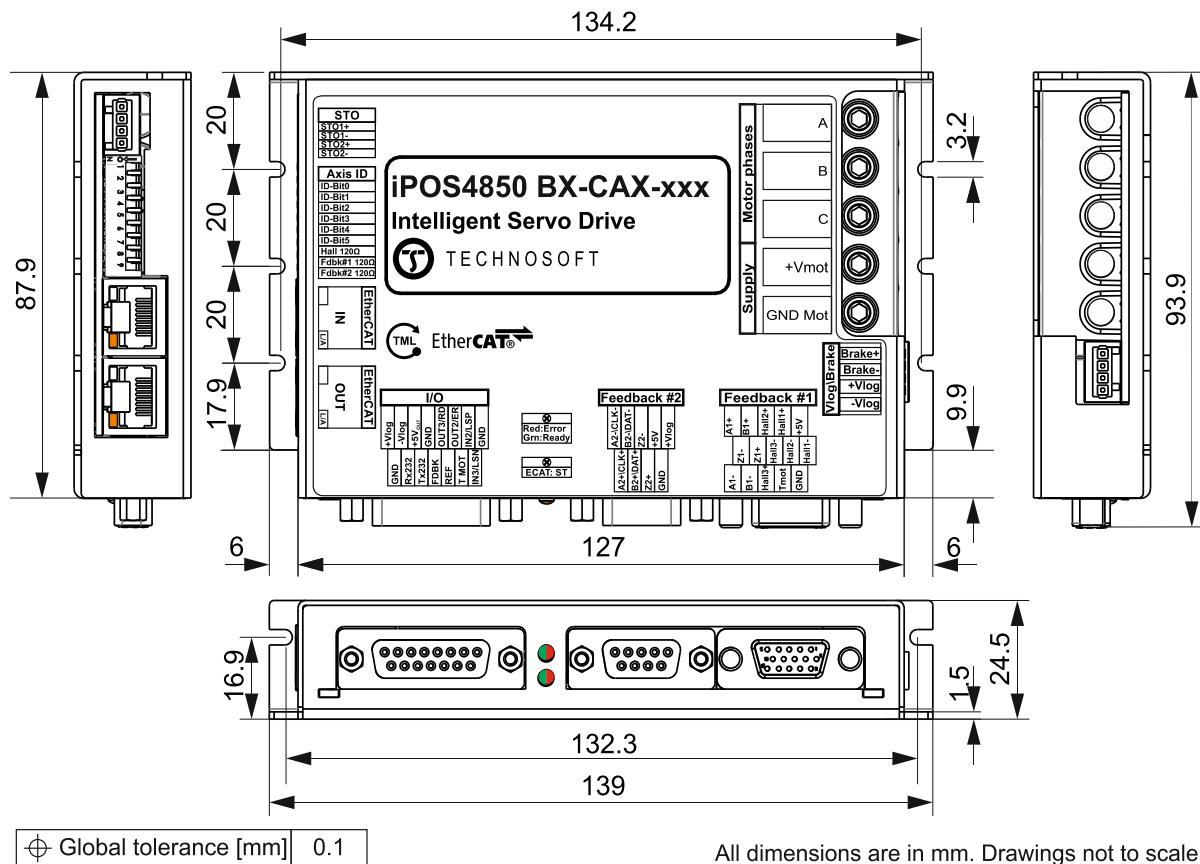
Figure 1. iPOS4850 BX drive dimensions

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 "**Error! Bookmark not defined.** – De-rating curves".

Torque Chart			
AWG 6-14 (mm² 10 – 2.5)			
AWG	mm²	In-lb	N-M
6	-	35	3.95
-	10		
8	-	25	2.82
-	6		
10	-	20	2.26
-	4		
12	-		
-	2.5		
14	-		
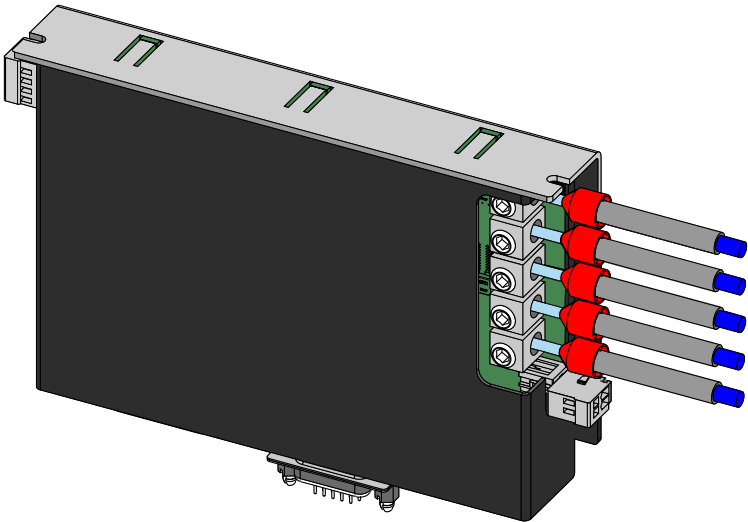
Cable connections

Solid wire or tinned strand wire
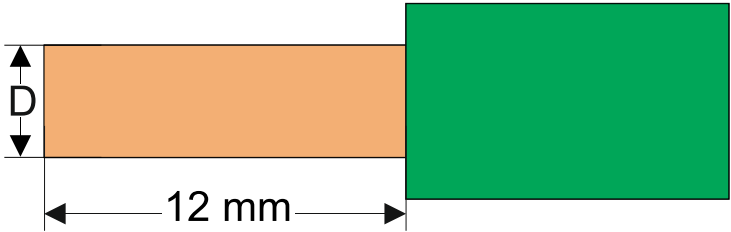
❖ D_{max} = 4.1 mm (AWG6)

Strand wire with ferrule
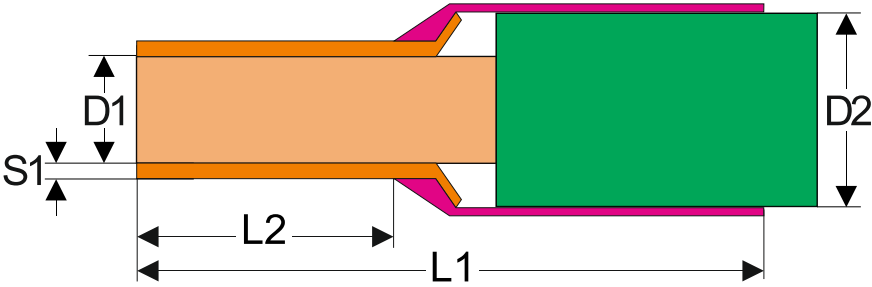
❖   Options for industrial standard ferrules

French and German Code <Polypropylene insulated and tin-plated electrolytic copper>											
Model No		Applicable wire		Style	Colour Code		Dimensions (mm)				
French Code	German Code	mm²	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

3.3.1 Pinouts for iPOS4850 BX-CAN

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	ID-Bit0	Hardware AxisID selection switches
2	ID-Bit1	All ON – AxisID= 31
3	ID-Bit2	All OFF – AxisID = 255
4	ID-Bit3	If AxisID = 255 in CANopen, the drive will be in "LSS inactive" state and the Green LED will flash at 1 second intervals
5	ID-Bit4	
6	CANOpen	ON - Select CANopen communication protocol OFF - Select TMLCAN communication protocol
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.

Pin	Name	Description
1	-	Reserved. Do not use.
2	GND	Return ground for CAN-Bus
3	Can-Hi	CAN-Bus positive line (dominant high)
4	Can-Lo	CAN-Bus negative line (dominant low)

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.

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

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

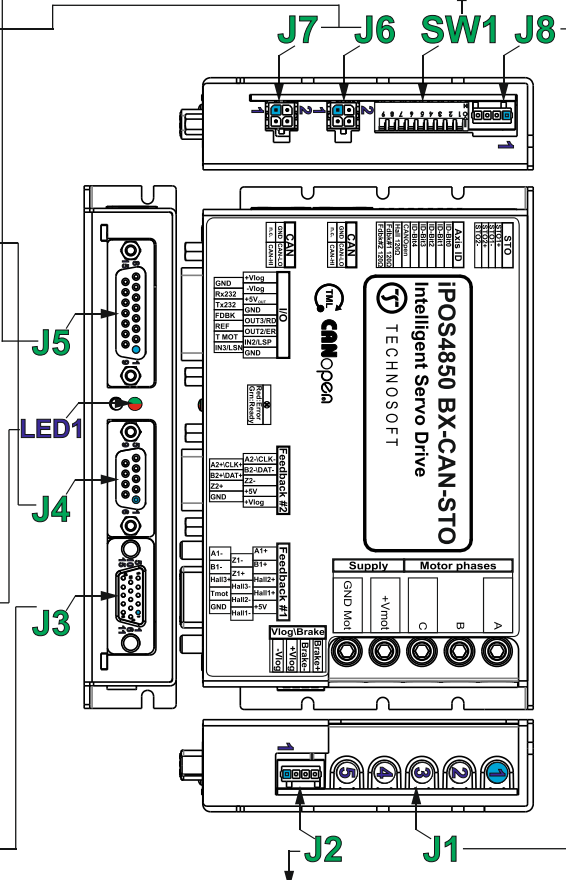| Pin	Name	Description
1	-	Reserved. Do not use.
2	GND	Return ground for CAN-Bus
3	Can-Hi	CAN-Bus positive line (dominant high)
4	Can-Lo	CAN-Bus negative line (dominant low)

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- 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.

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	STO1+	Safe Torque Off input 1, positive input (Opto-isolated, 18÷36V)	Apply between both STO1+, STO2+ and STO1-, STO2- 24V DC from SELV/ PELV power supply for motor PWM output operation
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)	

Pin	Name	Description
1	ID-Bit0	Hardware AxisID selection switches
2	ID-Bit1	All ON – AxisID= 31
3	ID-Bit2	All OFF – AxisID = 255
4	ID-Bit3	If AxisID = 255 in CANopen, the drive will be in "LSS inactive" state and the Green LED will flash at 1 second intervals
5	ID-Bit4	
6	CANOpen	ON - Select CANopen communication protocol OFF - Select TMLCAN communication protocol
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.

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

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

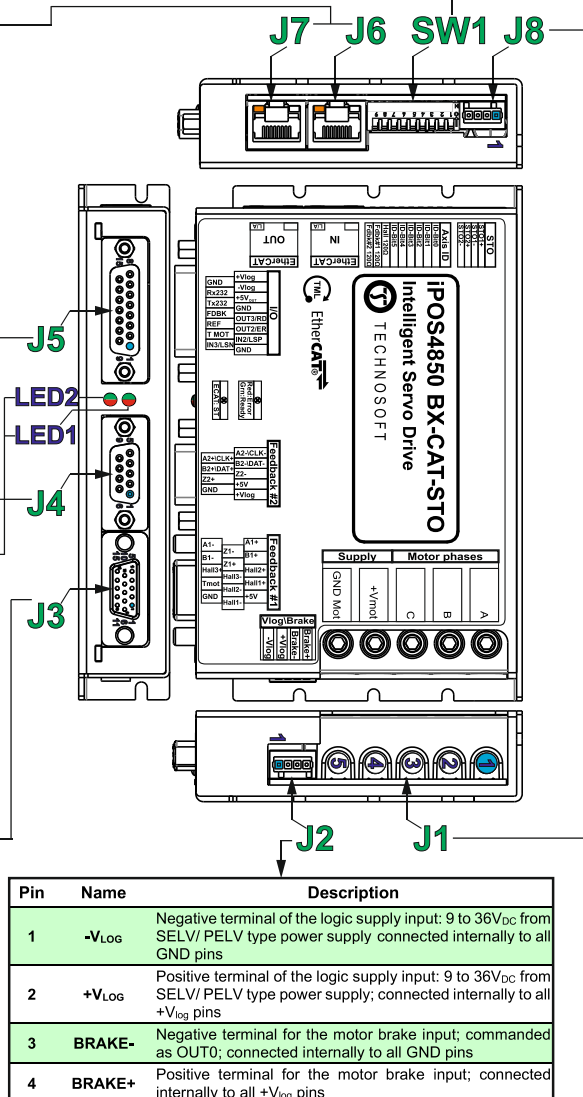| Port	Name	Description
J6	ECAT IN	EtherCAT standard RJ45 Ethernet IN port.
J7	ECAT OUT	EtherCAT standard RJ45 Ethernet OUT port.

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- 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	STO1+	Safe Torque Off input 1, positive input (Opto-isolated, 18÷36V)	Apply between both STO1+, STO2+ and STO1-, STO2- 24V DC from SELV/ PELV power supply for motor PWM output operation
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)	

Pin	Name	Description
1	ID-Bit0	
2	ID-Bit1	Hardware AxisID selection switches
3	ID-Bit2	All ON – AxisID= 63
4	ID-Bit3	All OFF – AxisID = 255
5	ID-Bit4	When Axis ID is 255, the EtherCAT register called
6	ID-Bit5	"configured station alias" will be 0.
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.

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

3.3.4 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 5.			
	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 (CAT drives)	Standard 8P8C modular jack (RJ-45) male			
	J6,J7 (CAN drives)	MICRO-FIT receptacle housing, 2x2 way	Molex	43025-0400	
	J6,J7 (CAN drives)	CRIMP PIN, MICROFIT, 5A	Molex	43030-0007	

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

3.4 Connection diagrams

3.4.1 iPOS4850 BX-CAN-STO connection diagram
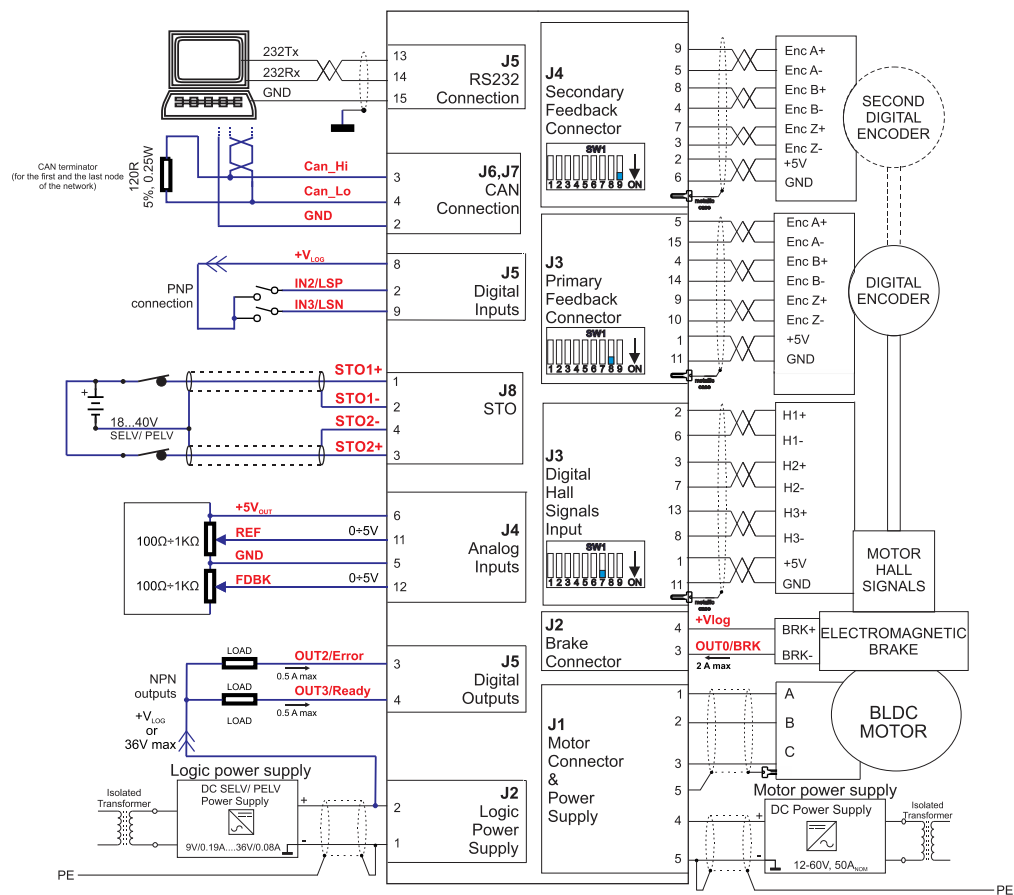
Figure 2. iPOS4850 BX-CAN-STO connection diagram

Figure 3. iPOS4850 BX-CAT-STO connection diagram

3.5   Digital I/O Connection

3.5.1   PNP inputs

Figure 4. 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.*

Figure 5. Digital PNP outputs (24V) connection

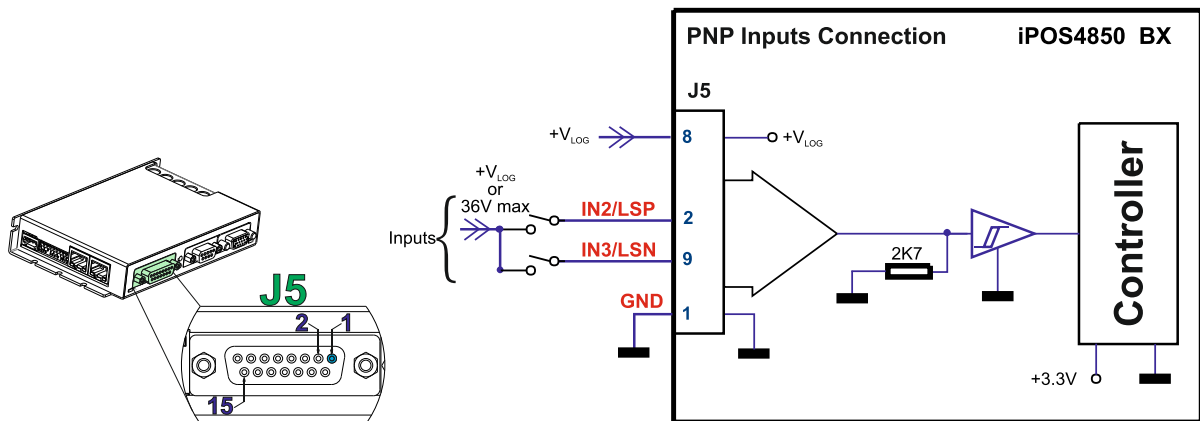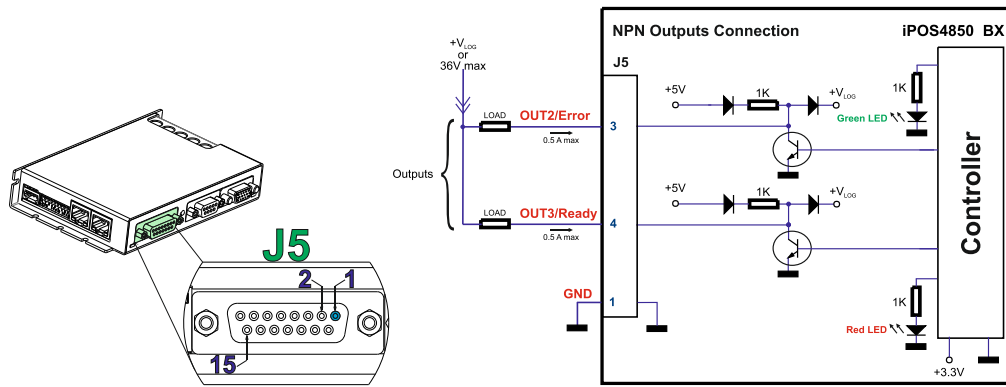**Remark:** *The outputs are compatible with NPN type inputs (load is tied to common +V$_{LOG}$, output pulls to GND when active and is floating when inactive)*

3.5.3   Solenoid driver connection for motor brake
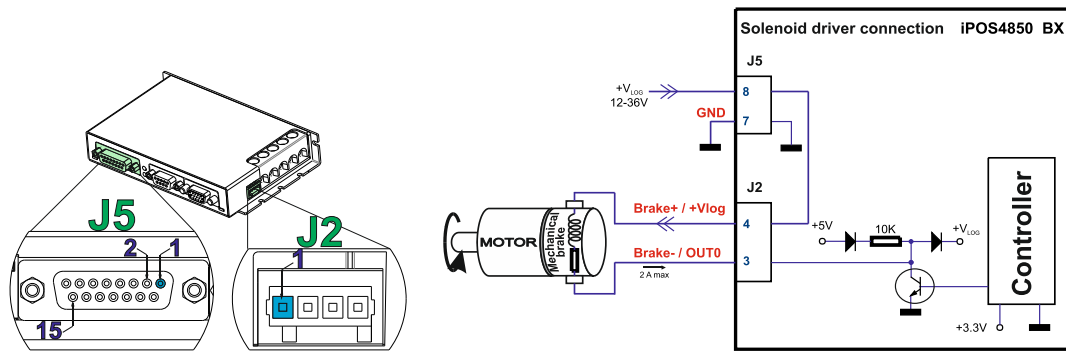
Figure 6. Solenoid driver connection

Remarks:

1. The firmware can control the Brake- output automatically to engage/disengage a mechanical brake when motor control is started/stopped.
2. The Brake- pin can also be used as the NPN digital output OUT0 (software configurable).

3.5.4   Temperature sensor (Temp Mot)
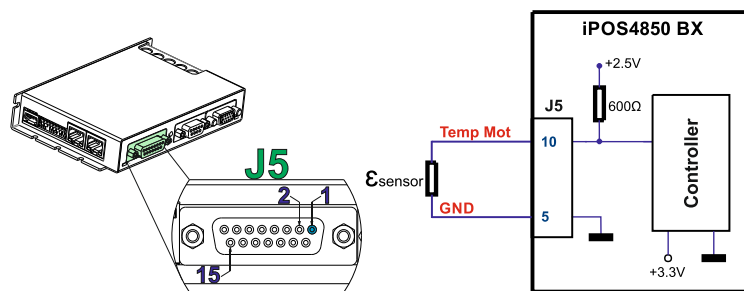
Remarks:

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:

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

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

4. When the temperature protection is activated, the threshold is internally set to +1.65V but it can also be changed using the "T1maxprot" variable.

3.6   Analog Inputs Connection

3.6.1   0-5V Input Range

Figure 7. 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
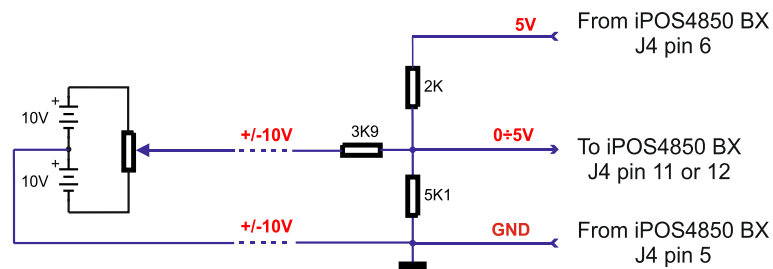
Figure 8. +/-10V Analog inputs connection

Remarks:

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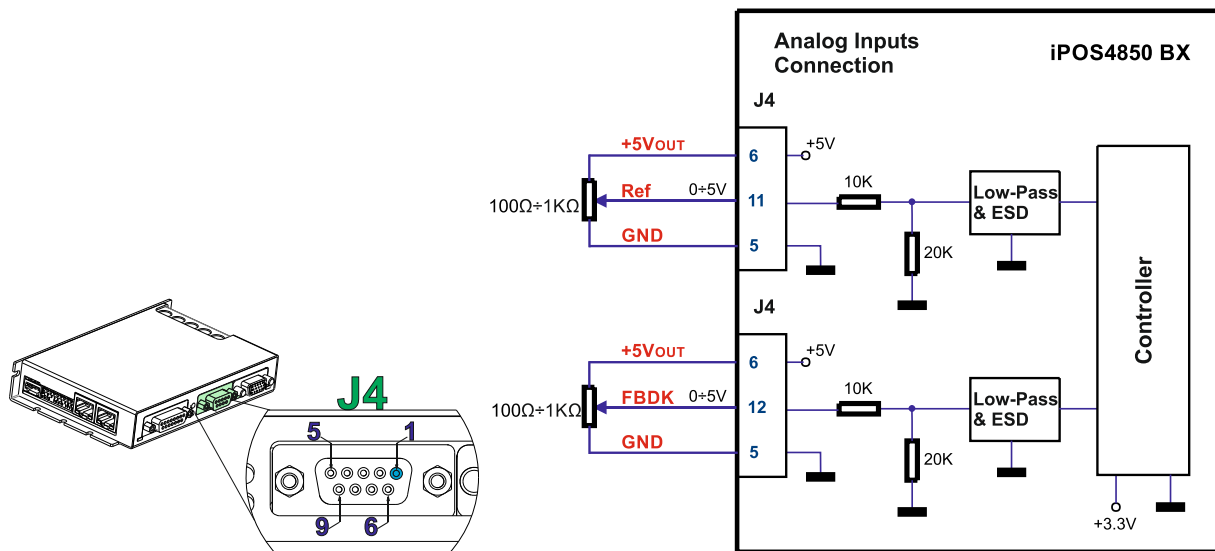2. *The switching between REF and FDBK signals can be done using the analog inputs setup selection in EasySetUp or EasyMotion Studio.*

3.6.3   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
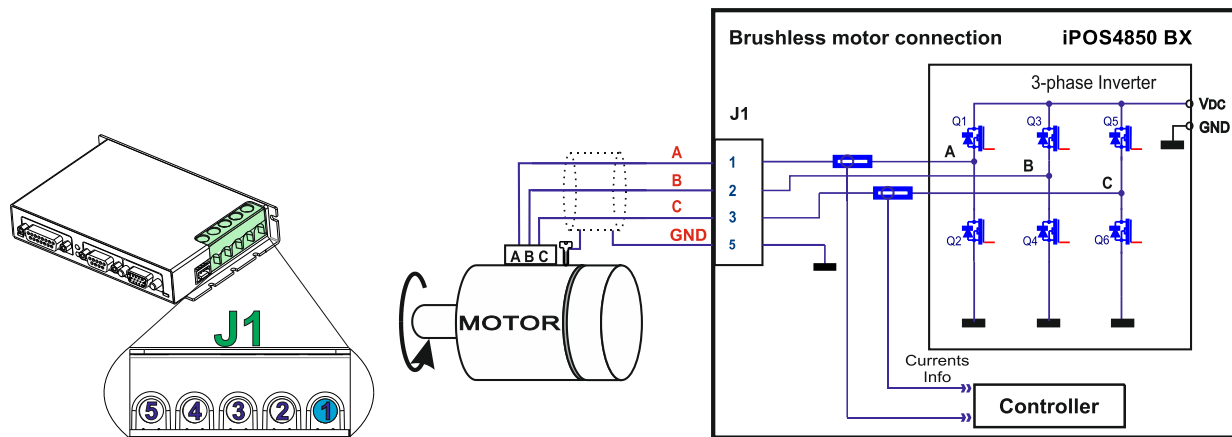
Figure 9. Brushless motor connection

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

3.7.2 DC Motor connection
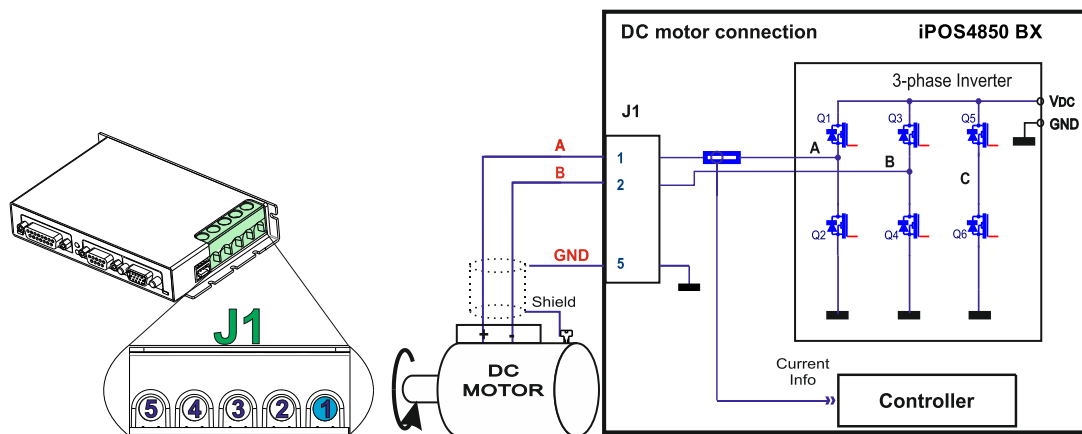
Figure 10. DC motor connection

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
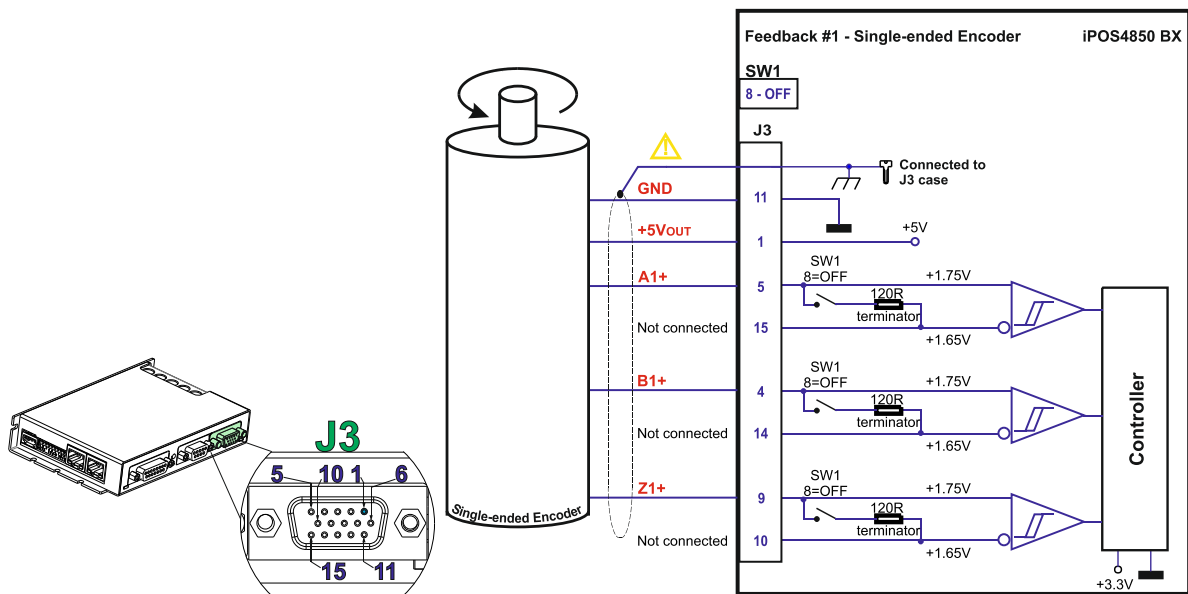
Figure 11. Feedback #1 - Single-ended Incremental Encoder Connection

⚠ 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
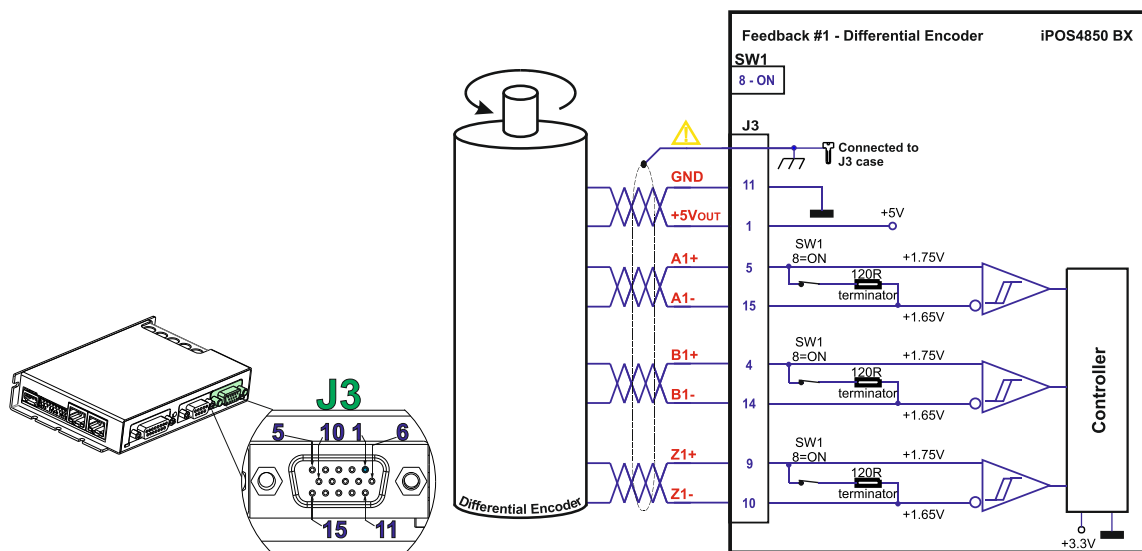
Figure 12. Feedback #1 - Differential Incremental Encoder Connection

⚠ 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
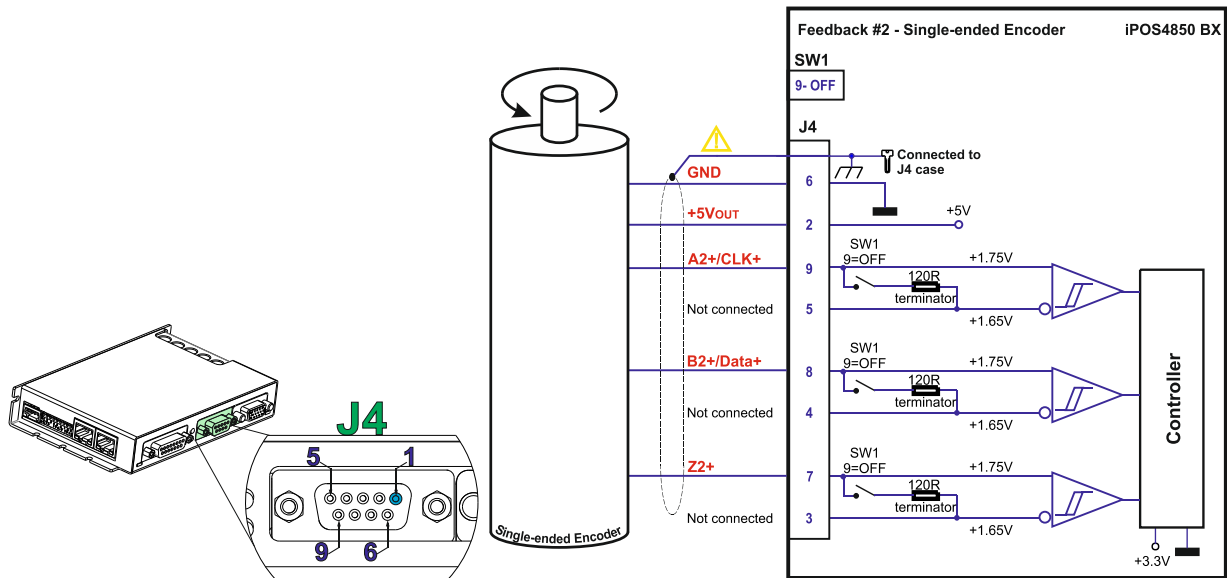
Figure 13. Feedback #2 - Single-ended Incremental Encoder Connection

⚠ 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
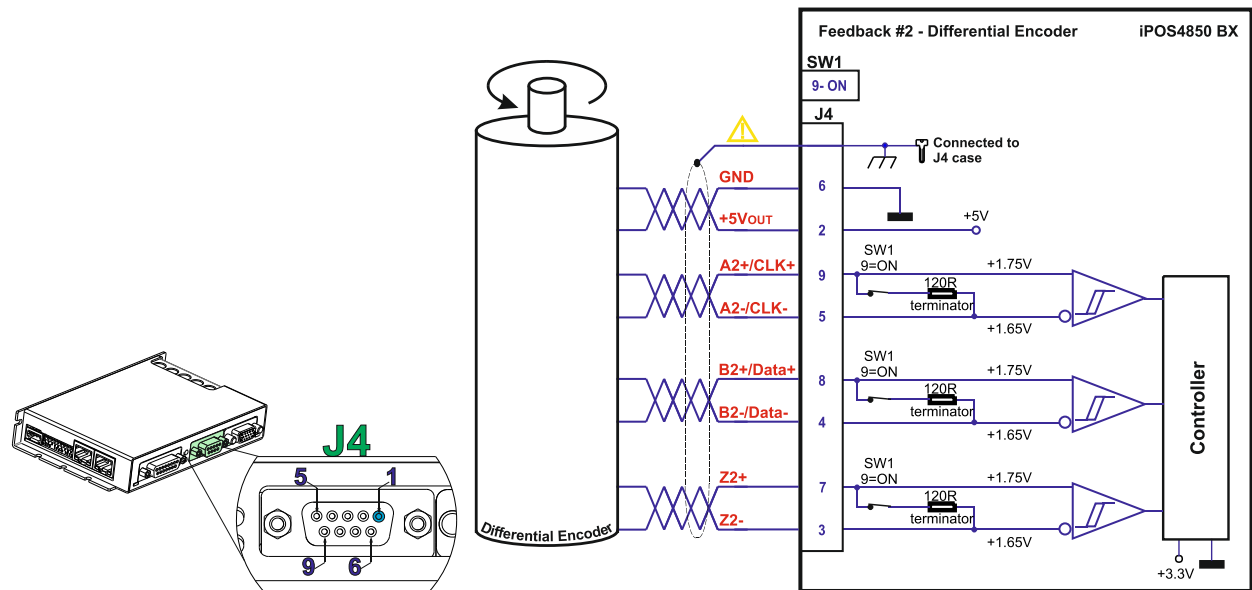
Figure 14. Feedback #2 - Differential Incremental Encoder Connection

⚠ 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
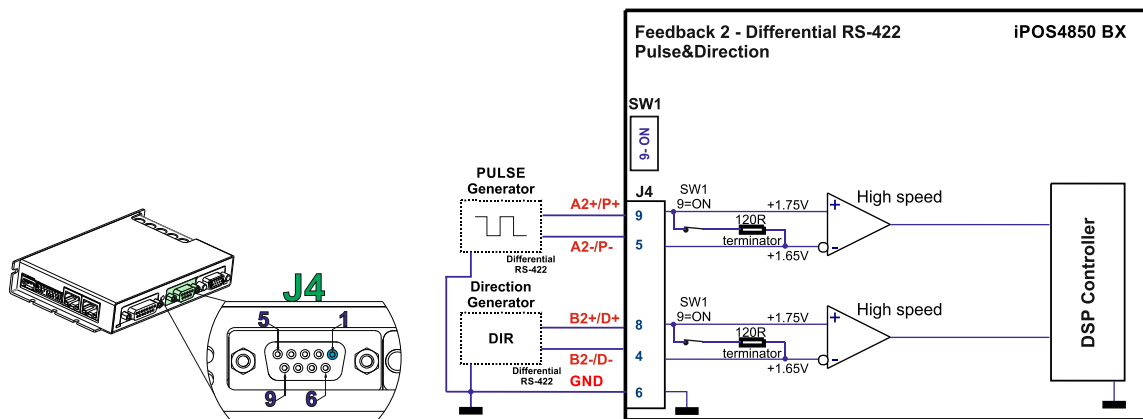
Figure 15. Feedback #2 – Pulse and Direction connection

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
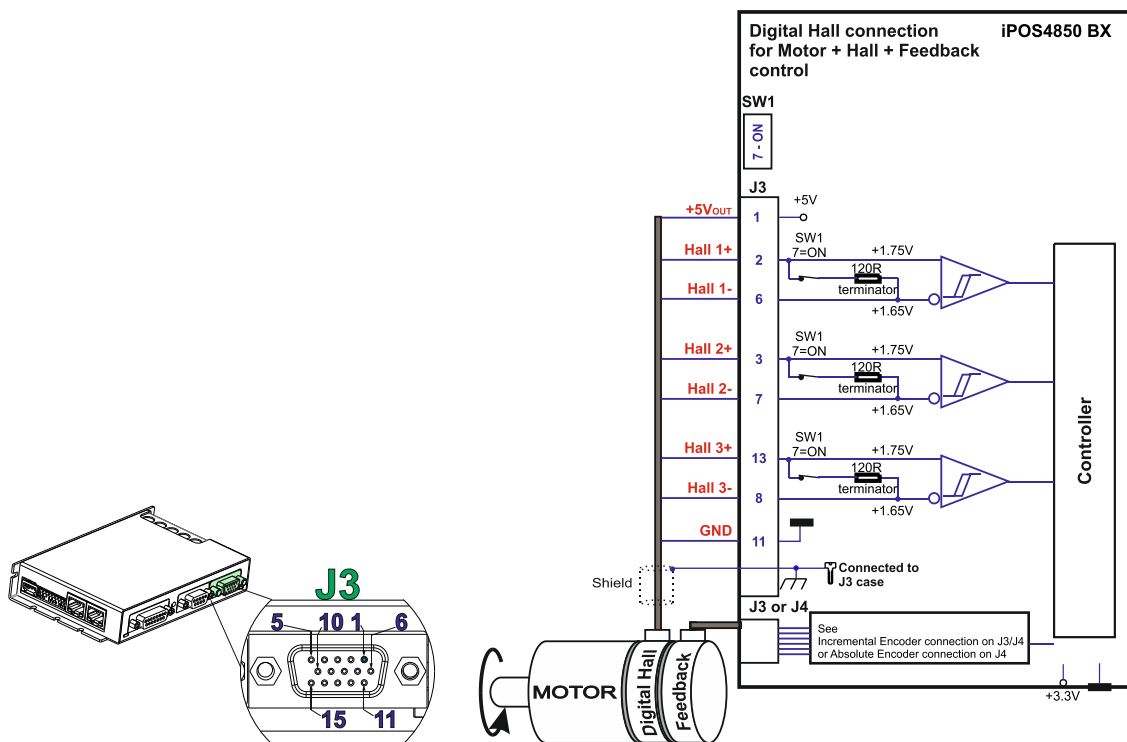
Figure 16. Digital Hall connection

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
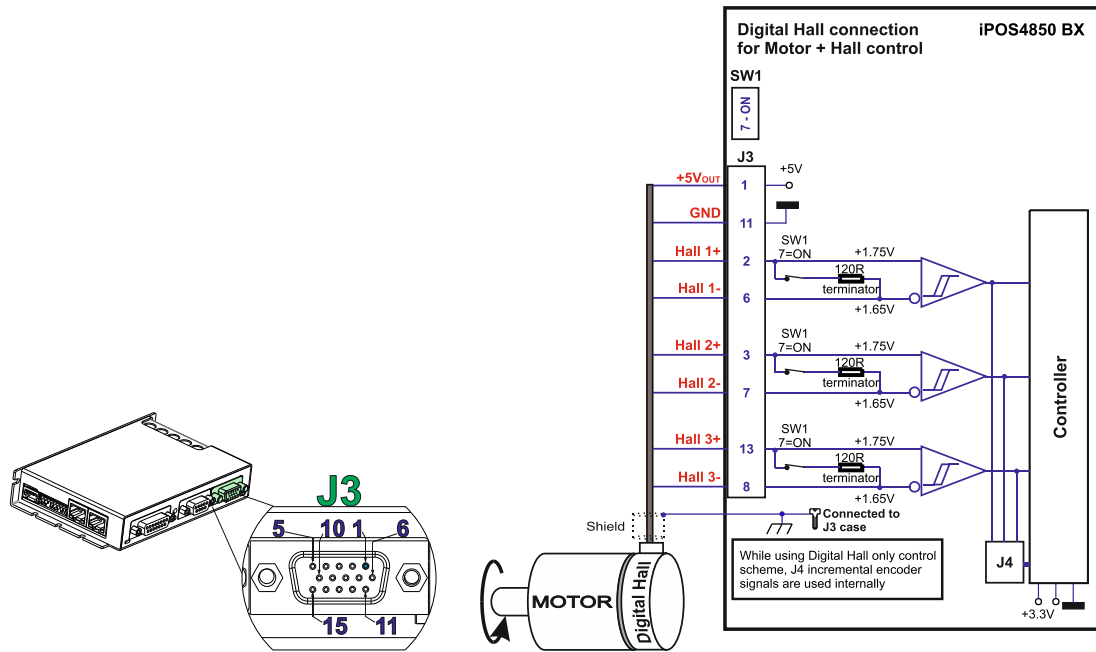
Figure 17. Digital Hall connection

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
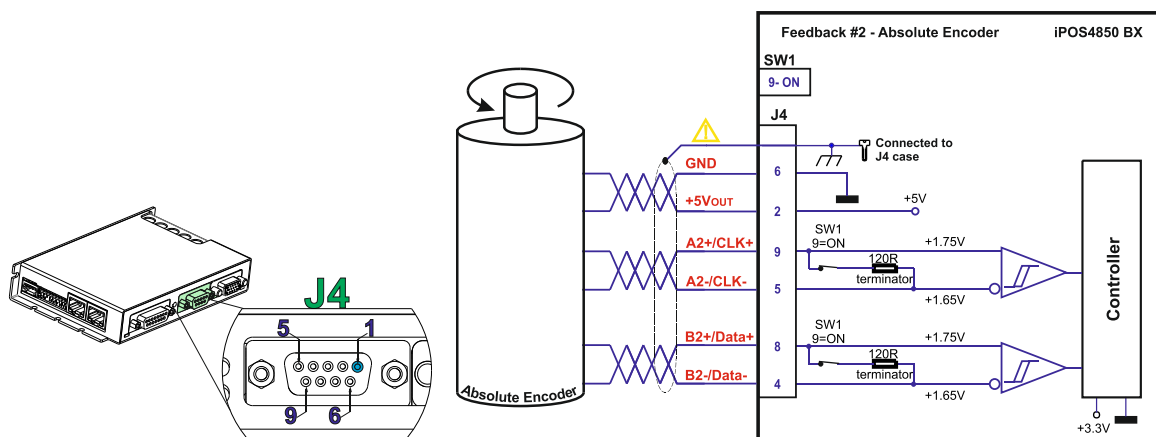
Figure 18. Feedback #2 – Absolute Encoder connection: SSI, BiSS, EnDAT

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
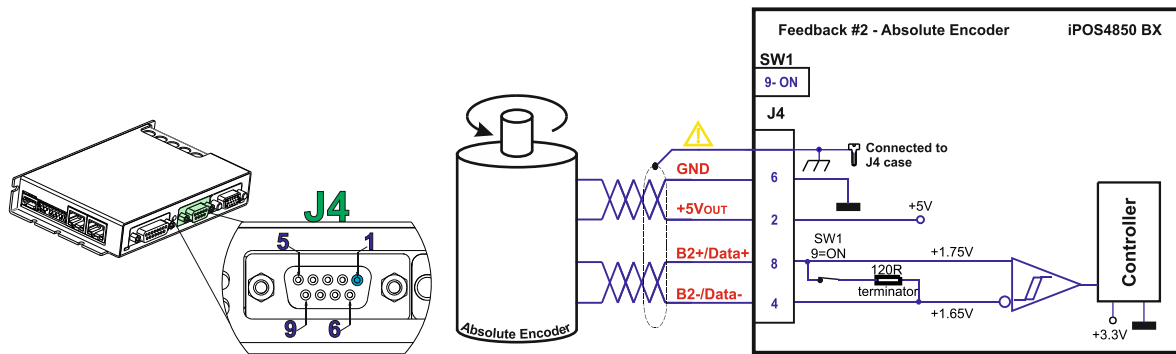
Figure 19. *Feedback #2 – Absolute Encoder connection: Panasonic, Tamagawa, Nikon, Sanyo Denki*

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
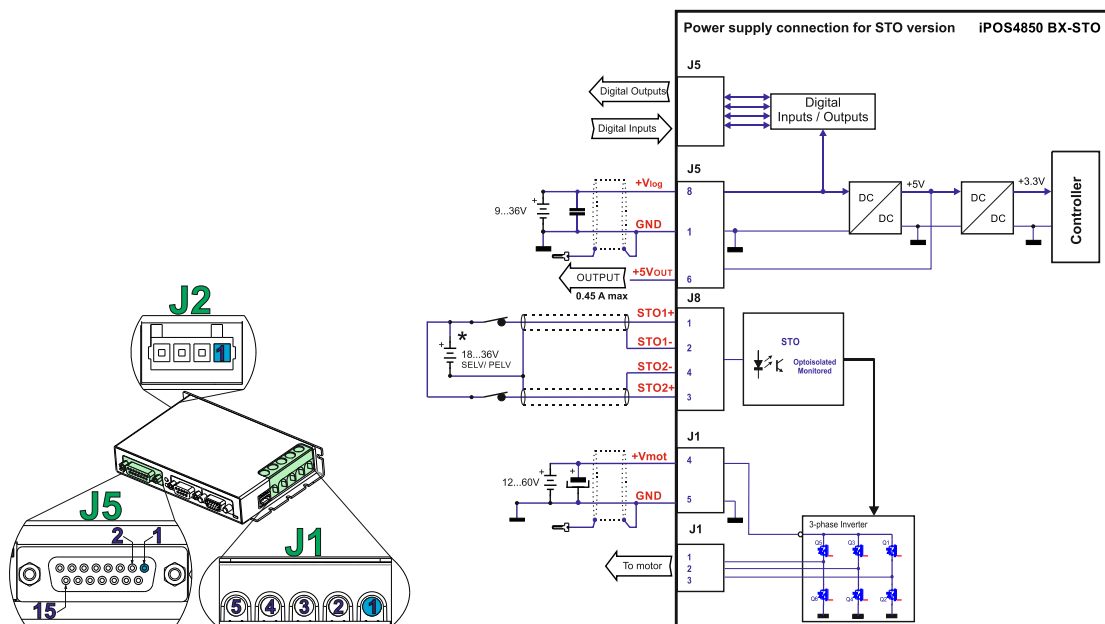
Figure 20. Supply connection

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 +Vmot 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.

In order to avoid this situation a capacitor can be added 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$_{MAX}$ = 61V 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:

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

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].

3.10   Serial RS-232 connection

3.10.1   Serial RS-232 connection
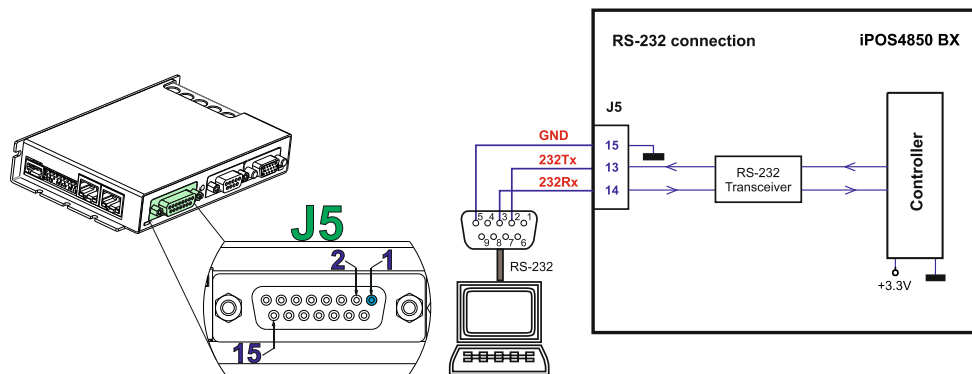
Figure 21. Serial RS-232 connection

Remark:.

1. *EasyMotion Studio can communicate either with RS232 or USB communication (not both at the same time).*
2. *EasyMotion Studio can communicate in parallel with serial RS232 communication while CAN or EtherCAT communication is active.*

3.10.2   Recommendation for wiring

b)   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.

c)   Always power-off all the iPOS4850 BX supplies before inserting/removing the RS-232 serial connector

d)   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   CAN-bus connection

3.11.1   CAN connection
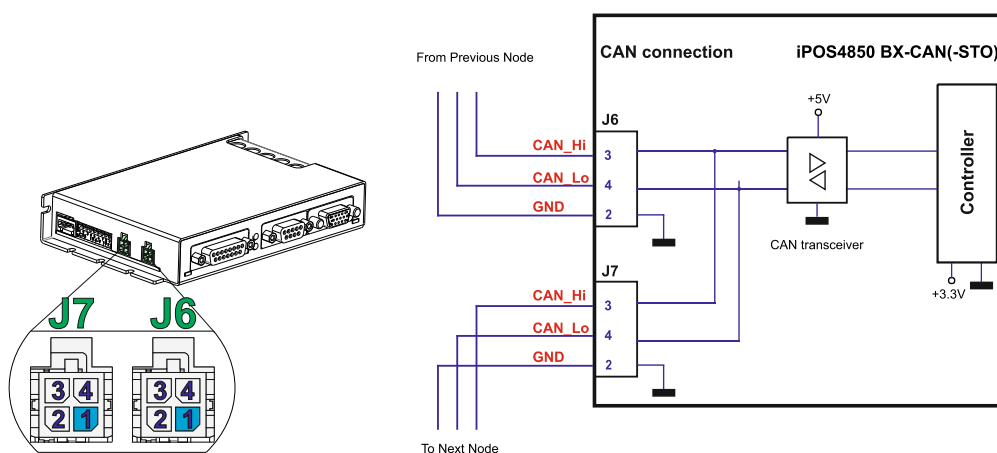
Figure 3.22. CAN connection

Remarks:

1. *The CAN network requires a 120-Ohm terminator. This is not included on the drive.*
2. *CAN signals are not isolated from other iPOS4850 BX circuits.*
3. *EasyMotion Studio can communicate in parallel with RS232 communication while CAN communication is active*

a) Build CAN network using cables with twisted wires (2 wires/pair), with CAN-Hi twisted together with CAN-Lo. It is recommended but not mandatory to use a shielded cable. If so, connect the shield to GND. The cable impedance must be 105 ... 135 ohms (120 ohms typical) and a capacitance below 30pF/meter.

b) When using a printed circuit board (PCB) motherboard based on FR-4 material, build the CAN network using a pair of 12mil (0.012") tracks, spaced 8 to 10mils (0.008"…0.010") apart, placed over a local ground plane (microstrip) which extends at least 1mm left and right to the tracks.

c) Whenever possible, use daisy-chain links between the CAN nodes. Avoid using stubs. A stub is a "T" connection, where a derivation is taken from the main bus. When stubs can't be avoided keep them as short as possible. For 1 Mbit/s (worst case), the maximum stub length must be below 0.3 meters.

d) The 120Ω termination resistors must be rated at 0.2W minimum. Do not use winded resistors, which are inductive.
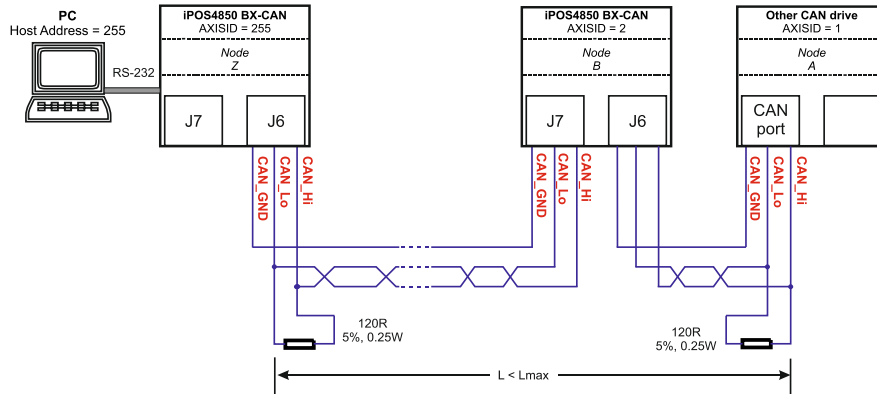
Figure 23. Multiple-Axis CAN network

3.12 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 24. 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 25. 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
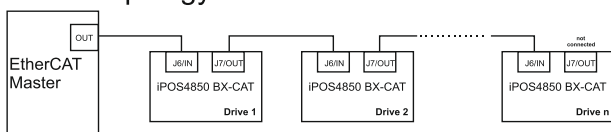
Figure 24. EtherCAT network linear topology

Ring Topology
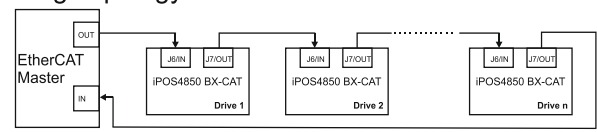
Figure 25. EtherCAT network ring topology

3.13 Disabling Autorun (for CAN drives); Disabling the setup table at startup (for CAT drives)

3.13.1 Disabling Autorun (for CAN drives)

When an iPOS4850 BX-CAN is set in TMLCAN operation mode, by default after power-on it enters automatically in Autorun mode. In this mode, if the drive has in its local EEPROM a valid TML application (motion program), this is automatically executed as soon as the motor supply V_{MOT} is turned on.

In order to disable Autorun mode, there are 2 methods:

a) Software - by writing value 0x0001 in first EEPROM location at address 0x2000

b) Hardware1 – set the drive temporarily in CANopen mode. While in CANopen state, no motion will autorun. Set SW1 pin6 in "ON" position.

c) Hardware2 – by temporary connecting all digital Hall inputs to GND, during the power-on for about 1 second, until the green LED is turned on, as shown in Figure 26. Temporary connection during power-on to remove the drive from Autorun mode or disable Setup". This option is particularly useful when it is not possible to communicate with the drive.

After the drive is set in non-Autorun/slave mode using 2nd method, the 1st method may be used to invalidate the TML application from the EEPROM. On next power on, in absence of a valid TML application, the drive enters in the non-Autorun/slave mode independently of the digital Hall inputs status.

3.13.2 Disabling the setup table at startup (for CAT drives)

I In some very rare cases, the setup table might be corrupted, causing the drive to reset continuously. This state can be noticed by seeing both the Ready and Error LED blinking for short periods of time continuously.

To recover from this state, the setup table must be invalidated by connecting all digital Hall inputs to GND.

On the next power on, the drive will load the default settings and set bit 2 from Motion Error Register – "Invalid Setup Data ". 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.
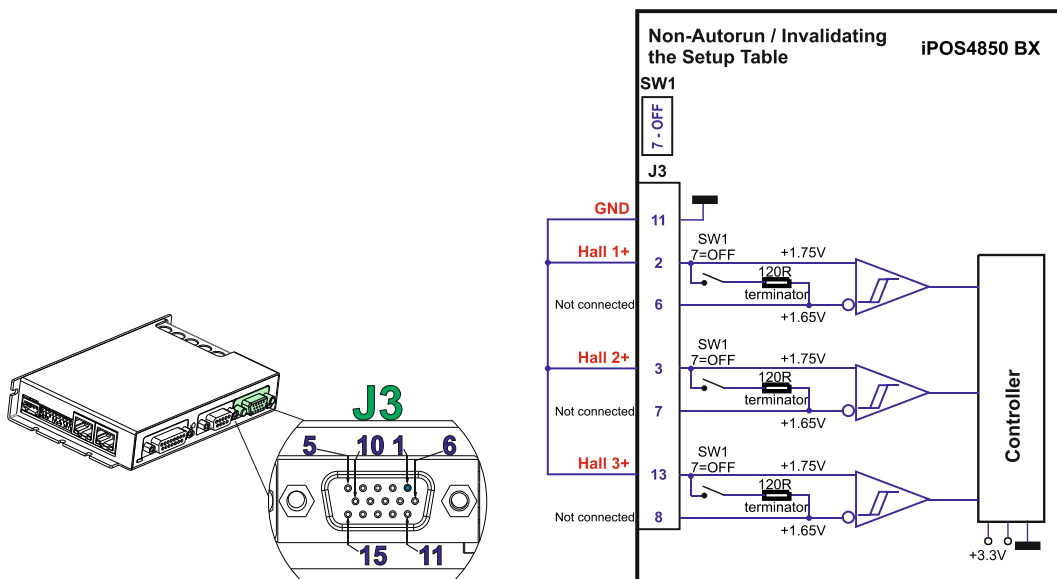
Figure 26. Temporary connection during power-on to remove the drive from Autorun mode or disable Setup

3.14 CAN Operation Mode and Axis ID Selection for CAN drives

The communication protocol as well as the Hardware Axis ID can be set by the SW1 switch.

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

The Operation mode is selected by the DIP switch pin6: ON= CANopen mode / OFF= TMLCAN mode

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 1-31, 255 from the switch SW1
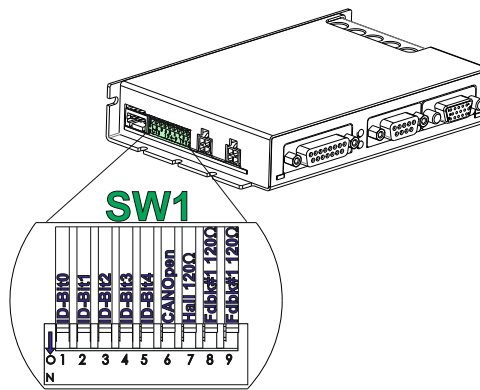
Figure 27. SW1 – DIP Switch settings

Remarks*:*

1. *The drive axis/address number is set when H/W is selected in Drive Setup under AxisID field or when the Setup is invalid.*

2. *The axis ID is an 8 bit unsigned number. Its bits are controlled by the ID-bit0 to ID-bit4. In total, 32 axis ID HW values can result from the DIP switch combinations.*

3. *All pins are sampled at power-up, and the drive is configured accordingly.*

4. *If TMLCAN mode is selected and the AxisID bits are all OFF, the resulting axis ID is 255*

5. *If CANopen mode is selected and the AxisID bits are all OFF, the resulting axis ID is 255 and the drive remains as "non-configured" waiting for a CANopen master to configure it, using CiA-305 protocol. A "non-configured" drive answers only to CiA-305 commands. All other CANopen commands are ignored and transmission of all other messages (including boot-up) is disabled. The Ready (green) LED will flash at 1 second time intervals while in this mode.*

3.15 LED indicators for CAN drives
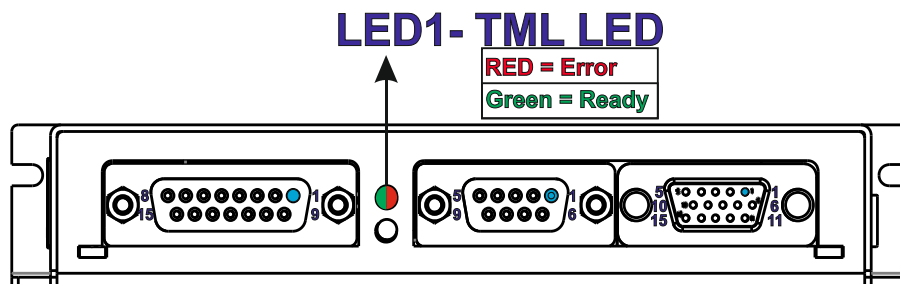
Figure 28. LED indicators

Table 1. LED indicators description

LED no.	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 .

3.16 AxisID Selection for CAT drives

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

- Hardware, by setting h/w in EasySetUp under AxisID value and selecting a value between 1-63, 255 from SW1

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
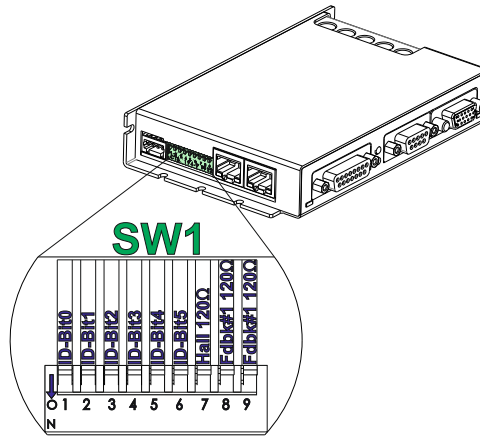
Figure 29. SW1 – DIP Switch settings

Remarks:

1. *The drive axis/address number is set when H/W is selected in Drive Setup under AxisID field or when the Setup is invalid.*

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.*

3.17 LED indicators for CAT drives
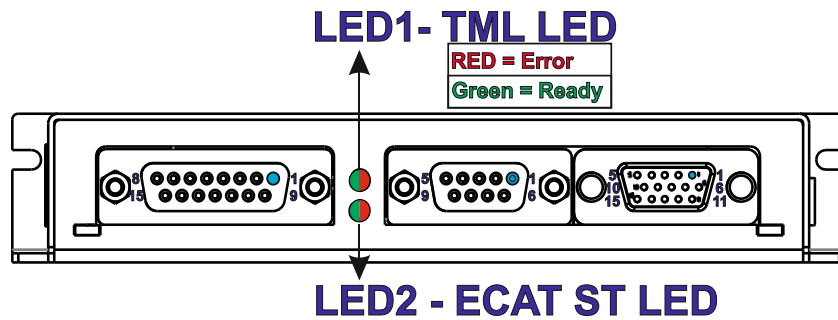
Figure 30. LED indicators

Table 2. 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.

3.17.1 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 31. 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 3. RUN Indicator States and the behavior of the ERROR indicator specified in Table 4. ERROR Indicator States.
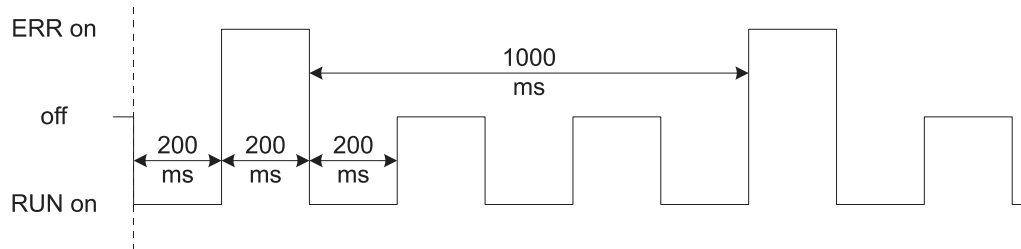
Figure 31. STATUS indicator Example

Table 3. 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 4. 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

3.18 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

3.18.1 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

3.18.2 Storage Conditions

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

---

[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.

3.18.3 Mechanical Mounting

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

3.18.4 Operating temperature

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

3.18.5 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		-

3.18.6 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			

3.18.7 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			

3.18.8 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

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

3.18.9   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		
	Logic "HIGH" — V_{LOG} = 36V		13.7		
Input frequency		0		150	kHz
Minimum pulse		3.3			µs
ESD protection	Human body model	±1			kV

Table note: Input current rows for Logic "HIGH" with $V_{LOG} = 24V$ (typ. 9.15 mA) and $V_{LOG} = 36V$ (typ. 13.7 mA).

3.18.10   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

3.18.11   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

3.18.12   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

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[1] To select differential mode use SW1 pin 7 (for more details see Figure 27. SW1 – DIP Switch settings)

3.18.13 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 [1]		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

3.18.14 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%	% FS[2]
Bandwidth (-3dB)	Software selectable	0		1	kHz
ESD protection	Human body model	±2			kV

3.18.1 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

3.18.2 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

3.18.3 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[3]			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)			

3.18.4 CAN-Bus for CAN executions

		Min.	Typ.	Max.	Units
Compliance		ISO11898, CiA-301v4.2, CiA 305 v2.2.13, 402v4.1.1			
Bit rate	Software selectable	125		1000	kbps
Bus length	1Mbps			25	m
	500Kbps			100	
	≤ 250Kbps			250	
Resistor	Between CAN-Hi, CAN-Lo		none on-board		
Node addressing	Hardware: by H/W DIN switches (SW1)	1 ÷ 31 & 255 (LSS non-configured) - CANopen; 1-31 & 255 - TMLCAN			
	Software	1 ÷ 127 (CANopen); 1- 255 (TMLCAN)			
Voltage, CAN-Hi or CAN-Lo to GND		-58		58	V
ESD protection	Human body model	±8			kV

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[1] To select differential mode use SW1 pin 8 / 9 (for more details see Figure 27. SW1 – DIP Switch settings)
[2] "FS" stands for "Full Scale"
[3] Availabile only for EnDAT and BiSS feedback options

3.18.5   EtherCAT ports (J6 and J7) for EtherCAT executions

		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

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

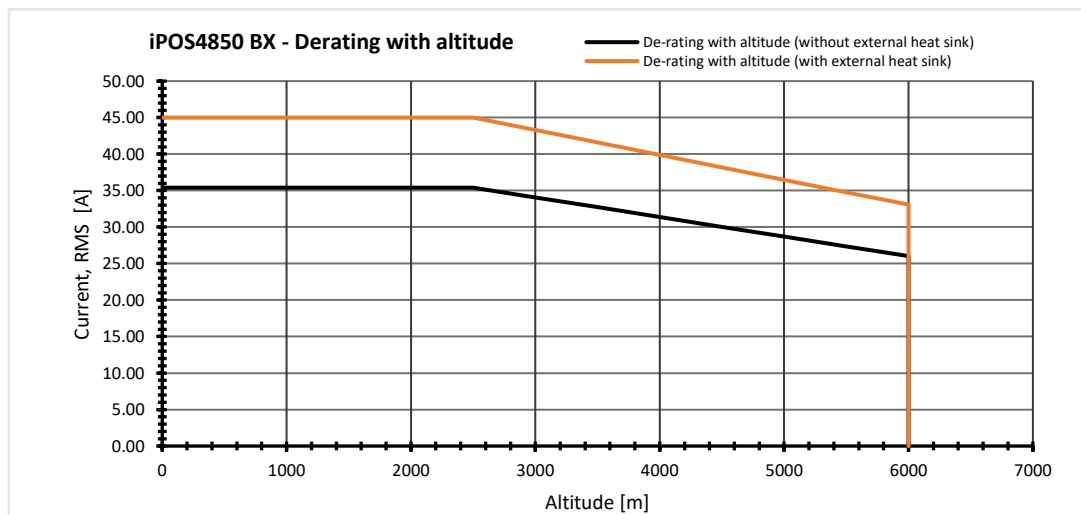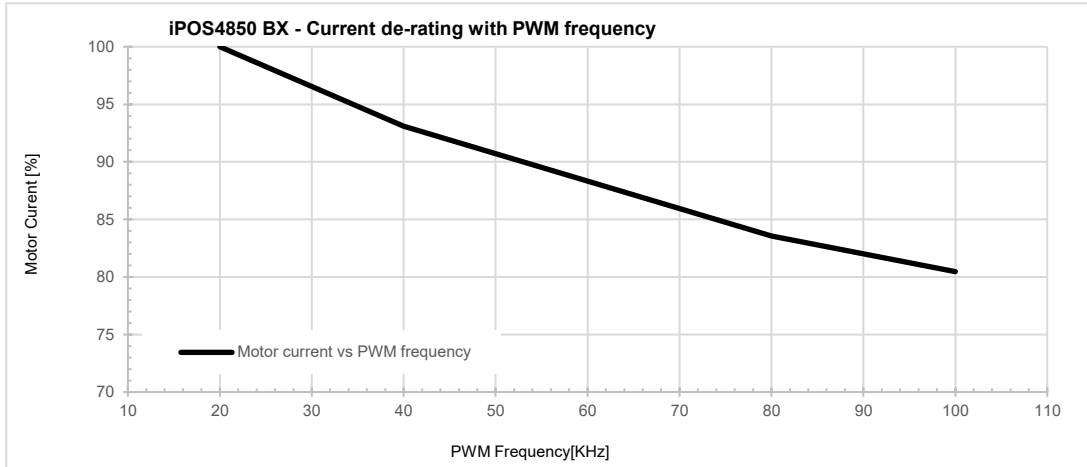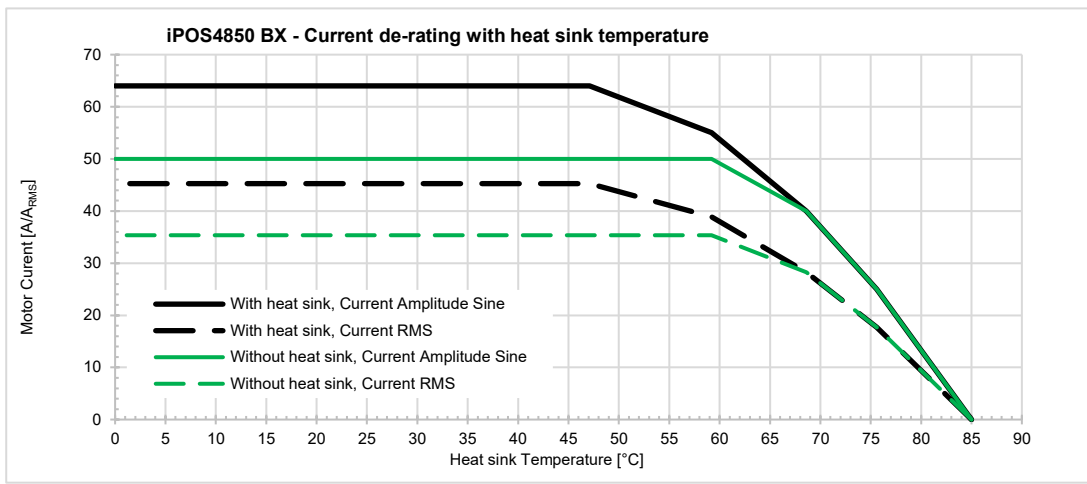|		Min.	Typ.	Max.	Units
Safety function	According to EN61800-5-2	STO (Safe Torque OFF)			
EN 61800-5-1/ -2 and EN 61508-5-3/ -4 Classification	Safety Integrity Level	safety integrity level 3 (SIL3)			
	PFHd (Probability of Failures per Hour - dangerous)	8*10^{-10}	hour^{-1} (0.8 FIT)		
EN13849-1 Classification	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

3.18.7   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.

3.18.8   De-rating curves

iPOS4850 BX - Derating with altitude

— De-rating with altitude (without external heat sink)
— De-rating with altitude (with external heat sink)

iPOS4850 BX - Current de-rating with heat sink temperature

Legend:
- With heat sink, Current Amplitude Sine
- With heat sink, Current RMS
- Without heat sink, Current Amplitude Sine
- Without heat sink, Current RMS

iPOS4850 BX - Current de-rating with PWM frequency

Legend:
- Motor current vs PWM frequency

4 Memory Map

iPOS4850 BX has 2 types of memory available for user applications: 16K×16 SRAM and up to 24K×16 serial E^{2}ROM.

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^{2}ROM 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 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
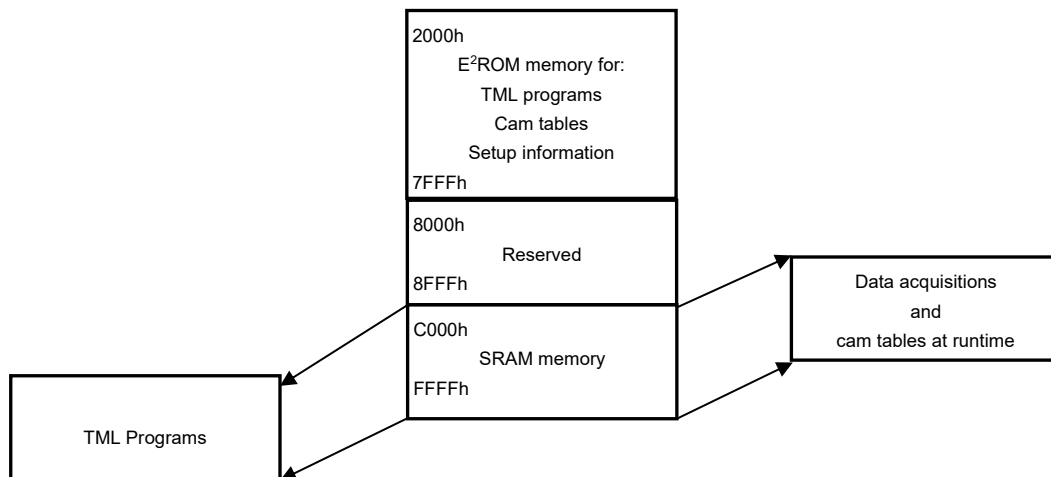

Figure 32. iPOS4850 BX Memory Map