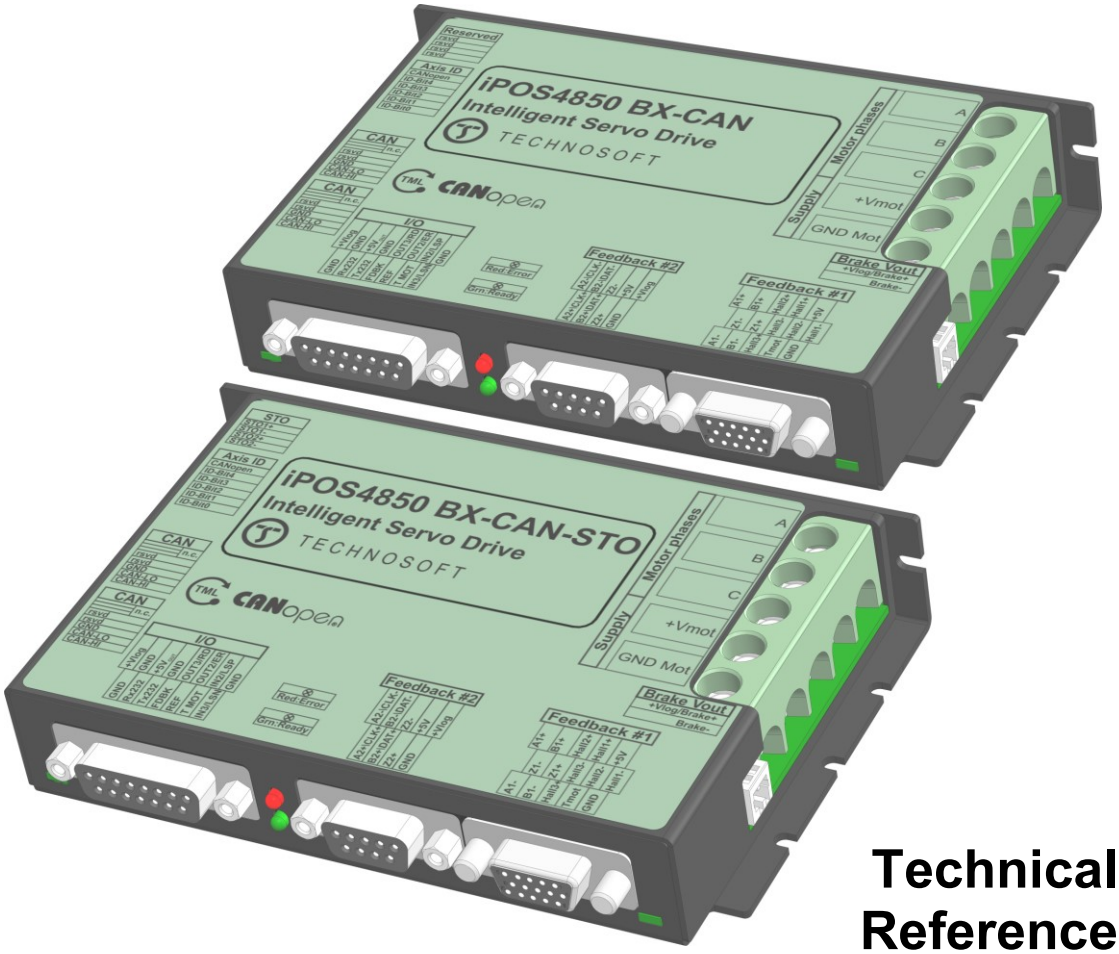
iPOS4850 BX-CAN / BX-CAN-STO

Intelligent Servo Drive for DC and Brushless Motors

TECHNOSOFT

Intelligent Servo Drives



Technical Reference

P091.029.iPOS4850 BX-CAN.UM.0223

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Read This First

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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.E201	64A[1]	50A[2]	90A	CAN	X
iPOS4850 BX-CAN-STO	P029.300.E201				CAN	✓

In order to operate the **iPOS4850 BX** 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 either one of the options:
  - A **CANopen master**
  - 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)
  - A **TML_LIB motion library for PLCs**
  - 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 BX** 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 BX**– 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

[1] With adequate thermal heat sink

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

Related Documentation

iPOS4850 BX-CAN Datasheet (P029.200.E201.DSH)

iPOS4850 BX-CAN-STO Datasheet (P029.300.E201.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 (091.099.STO.Operating.Instructions.xxxx)

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

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**

iPOS CANopen Programming **(part no. P091.063.iPOS.UM.xxxx)** – explains how to program the iPOS family of intelligent drives using **CANopen** protocol and describes the associated object dictionary for **CiA 301 v.4.2** application layer and communication profile, **CiA WD 305 v.2.2.13** layer settings services and protocols 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

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

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***

To prevent electrostatic damage, avoid contact with insulating materials, such as synthetic fabrics or plastic surfaces. In order to discharge static electricity build-up, place the drive on a grounded conductive surface and also ground yourself.

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/

1.4 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.

[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.**

1.5 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
- Various modes of operation, 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
- Technosoft Motion Language (TML) instruction set for the definition and execution of motion sequences
- Standalone operation with stored motion sequences
- Motor supply: 12-60V
- Logic supply: 9-36V
- STO supply: 18-36V (only with the iPOS4850 BX-CAN-STO)
- 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
- Digital and analog I/Os:
  - 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 (differential)
  - Pulse & direction interface (differential) for external (master) digital reference

  2nd feedback devices supported:
  - Incremental encoder interface (differential)
  - SSI/BiSS/EnDAT[1] interface
  - Pulse & direction interface (differential) for external (master) digital reference
- Separate feedback devices supported:

[1] Available starting with F514K firmware version

- Digital Hall sensor interface (differential)
- 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
  - Electronic gearing and camming
  - 35 Homing modes
- 32 h/w selectable addresses selectable by DIN switch
- Two CAN operation modes selectable by h/w 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
- 16K × 16 internal SRAM memory for data acquisition
- 16K × 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
  - Short-circuit from motor phases to ground
  - Over-voltage
  - Under-voltage
  - Over-current
  - Over-temperature
  - Communication error
  - Control error

1.6 Identification Labels

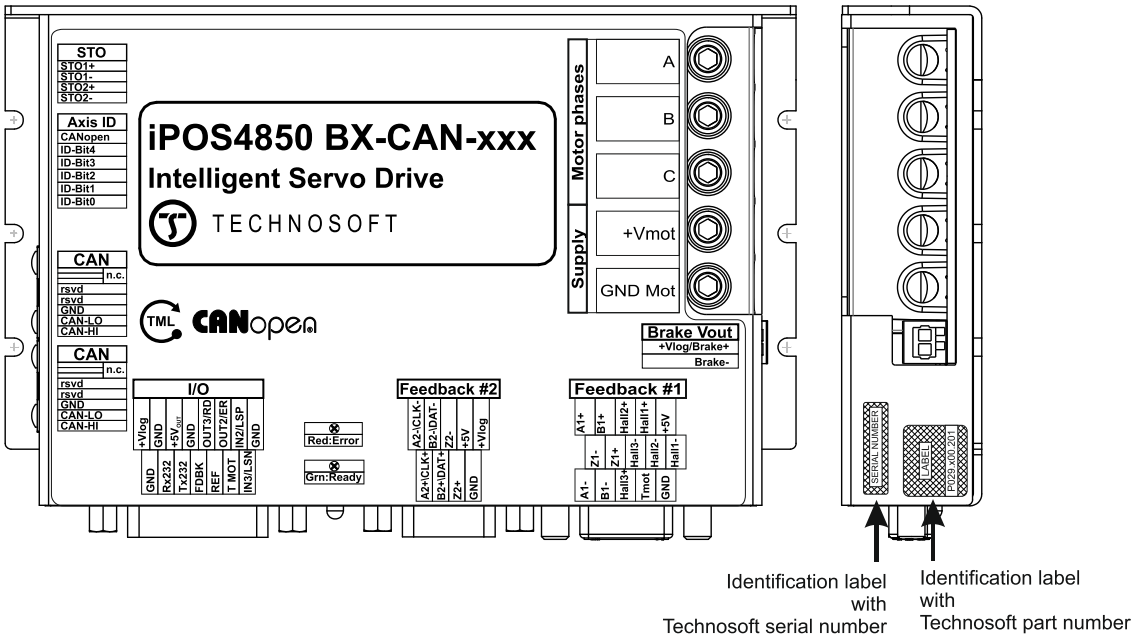


Figure 1.6.1. *iPOS4850 BX-CAN identification labels*

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

p.n. **P029.200.E201** name iPOS4850 BX-CAN – standard CAN execution

p.n. **P025.300.E201** name iPOS4850 BX-CAN-STO – standard CAN execution with STO input

1.7 Supported Motor-Sensor Configurations

1.7.1 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 (differential)		Yes	-	Yes
	FDBK #2 (differential)				
Incr. encoder + Digital Hall	FDBK #1 (differential)	Digital Halls interface (differential)	Yes	Yes	-
	FDBK #2 (differential)				
Digital Halls Only	FDBK #1 (differential)		Yes	-	-
SSI	FDBK #2 (differential)		Yes	-	Yes
BiSS-C	FDBK #2 (differential)		Yes	-	Yes
EnDAT[1]	FDBK #2 (differential)		Yes	-	Yes
Tacho	Analogue input: Feedback		-	-	Yes

1.7.2 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 (differential) Digital Hall only (differential)	Incremental encoder (differential) SSI/BiSS C/EnDAT[1] encoder (differential)
BLDC	Incremental encoder (differential) + Digital halls (differential)	Incremental encoder (differential) + Digital halls (differential) SSI/BiSS C/EnDAT[1] encoder (differential)
DC Brush	Incremental encoder (differential) Analogue Tacho (only on motor)	Incremental encoder (differential) SSI/BiSS C/EnDAT[1] 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 (from feedback #1) on motor and Incremental encoder (from feedback#2) on load

-DC brush motor with BiSS C encoder (from feedback #2) on motor and Incremental encoder (from feedback #1) on load.

[1] Available starting with F514K firmware version

1.8 iPOS4850 BX-CAN/ BX-CAN-STO Board Dimensions

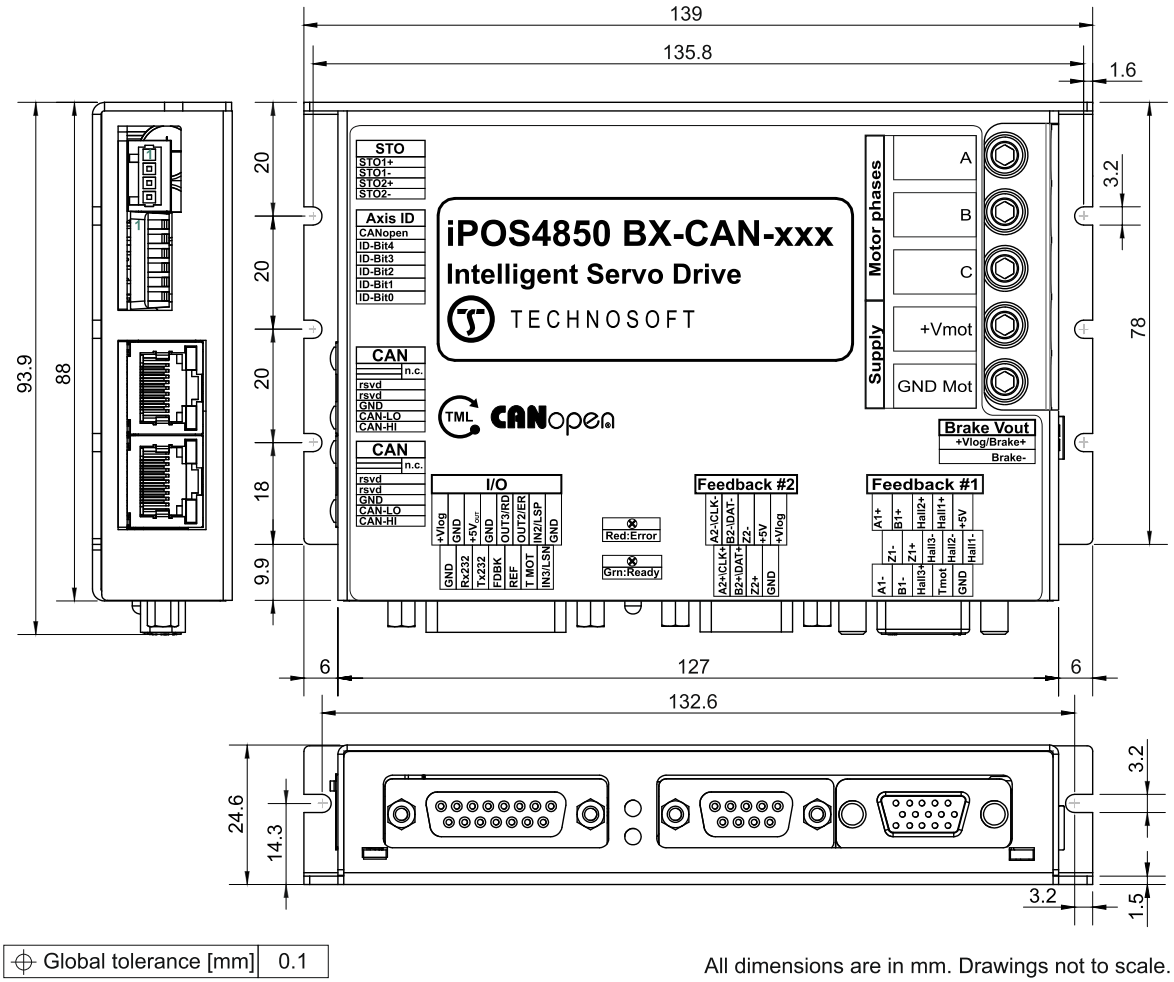
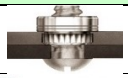


Figure 1.8.1. *iPOS4850 BX-CAN/ BX-CAN-STO drive dimensions*

1.9 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*".*

1.10 Connectors and Pinouts

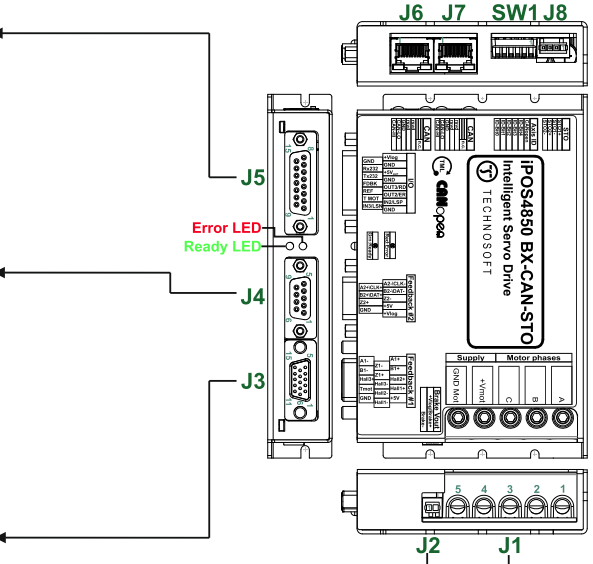
1.10.1 Pinouts for iPOS4850 BX-CAN-STO

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, drive Error output, active low, NPN open-collector/TTL pull-up. Also drives the red LED
4	OUT3/ Ready	5-36V 0.5A, drive Ready output, active low, NPN open-collector/TTL pull-up. Also drives the green LED.
5	GND	Ground
6	+5V$_{OUT}$	5V output supply
7	GND	Ground
8	+V$_{LOG}$	Positive terminal of the logic supply input: 9 to 36V$_{DC}$ from SELV/ PELV type power supply
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	CANopen	ON (down): CANopen OFF (up): TMLCAN
2	ID-Bit4	Hardware AxisID
3	ID-Bit3	selection switches
4	ID-Bit2	All OFF –> AxisID =
5	ID-Bit1	255 for TMLCAN
6	ID-Bit0	or 127 for CANopen

Pin	Name	Description
1	Can-Hi	CAN-Bus positive line
2	Can-Lo	CAN-Bus negative line
3	GND	Return ground
4, 5	-	Reserved.
6..8	n.c.	Not connected

Pin	Name	Description		
1	STO1+	Safe Torque Off input 1, (opto-isolated, 18÷36V)	positive input	Apply between both STO1+, STO2+ and STO1-, STO2- 24V DC from SELV/ PELV power supply for motor PWM output operation
2	STO1-		negative return	
3	STO2+	Safe Torque Off input 2, (opto-isolated, 18÷36V)	positive input	
4	STO2-		negative return	



Pin	Name	Description
1	+V$_{LOG}$	Positive terminal of the logic supply input: 9 to 36V$_{DC}$
2	+5V$_{OUT}$	5V output supply
3	Z2-	Incr. encoder2 Z- diff. input; has 120Ω resistor between pins 3 and 7
4	B2-/ Dir-/ Data-/SL-	Incr. encoder2 B- diff. input, or Dir-, or Data- for SSI, or Slave- for BiSS; has 120Ω resistor between pins 4 and 8
5	A2-/ Pulse-/CLK-/MA-	Incr. encoder2 A- diff. input, or Pulse-, or Clock- for SSI, or Master- for BiSS; has 120Ω resistor between pins 5 and 9
6	GND	Ground
7	Z2+	Incr. encoder2 Z+ diff. input; has 120Ω resistor between pins 3 and 7
8	B2+/ Pulse+/ Data+/ SL+	Incr. encoder2 B+ diff. input, or Dir+, or Data+ for SSI, or Slave+ for BiSS; has 120Ω resistor between pins 4 and 8
9	A2+/ Pulse+/ CLK+/ MA+	Incr. encoder2 A+ diff. input, or Pulse+, or Clock+ for SSI, or Master+ for BiSS; has 120Ω resistor between pins 5 and 9

Pin	Name	Description
1	+5V$_{OUT}$	5V output supply for I/O usage
2	Hall 1+	Digital input Hall 1+ diff. sensor input; has 120Ω resistor between pins 2 and 6
3	Hall 2+	Digital input Hall 2+ diff. sensor input; has 120Ω resistor between pins 3 and 7
4	B1+	Incr. encoder1 B+ diff. input; has 120Ω resistor between pins 4 and 14
5	A1+	Incr. encoder1 A+ diff. input; has 120Ω resistor between pins 5 and 15
6	Hall 1-	Digital input Hall 1- diff. sensor input; has 120Ω resistor between pins 2 and 6
7	Hall 2-	Digital input Hall 2- diff. sensor input; has 120Ω resistor between pins 3 and 7
8	Hall 3-	Digital input Hall 3- diff. sensor input; has 120Ω resistor between pins 13 and 8
9	Z1+	Incr. encoder1 Z+ diff. input; has 120Ω resistor between pins 9 and 10
10	Z1-	Incr. encoder1 Z- diff. input; has 120Ω resistor between pins 9 and 10
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+ diff. sensor input; has 120Ω resistor between pins 13 and 8
14	B1-	Incr. encoder1 B- diff. input; has 120Ω resistor between pins 4 and 14
15	A1-	Incr. encoder1 A- diff. input; has 120Ω resistor between pins 5 and 15

Pin	Name	Description
1	BRAKE-	Negative terminal for the motor brake input; commanded as OUT0
2	+Vlog/ BRAKE+	Positive terminal for the motor brake input; connected internally to +Vlog

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

1.10.2 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 1.10.4 chapter.			
	J2*	Pluggable terminal block 2-pole Pin spacing 2.5 mm	Wago	733-102	
	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	-	-	
	J8*	Pluggable terminal block 4-pole Pin spacing 2.5 mm for the -STO version	Wago	733-104	

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

1.10.3 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, drive Error output, active low, NPN open-collector/TTL pull-up. Also drives the red LED
4	OUT3/ Ready	5-36V 0.5A, drive Ready output, active low, NPN open-collector/TTL pull-up. Also drives the green LED.
5	GND	Ground
6	$+5V_{OUT}$	5V output supply
7	GND	Ground
8	$+V_{LOG}$	Positive terminal of the logic supply input: 9 to $36V_{DC}$ from SELV/ PELV type power supply
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

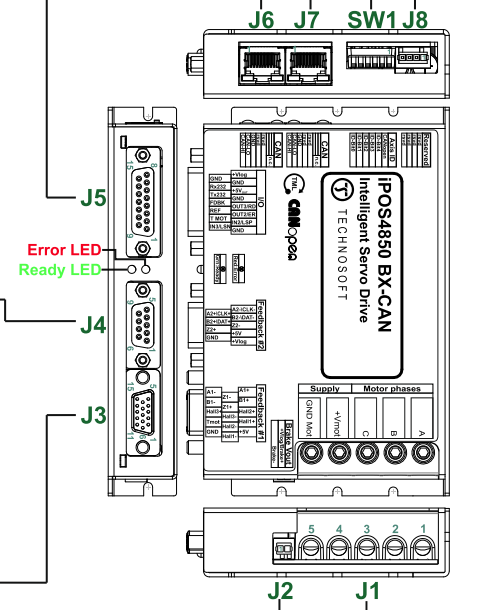
Pin	Name	Description
1	$+V_{LOG}$	Positive terminal of the logic supply input: 9 to $36V_{DC}$
2	$+5V_{OUT}$	5V output supply
3	Z2-	Incr. encoder2 Z- diff. input; has 120Ω resistor between pins 3 and 7
4	B2-/ Dir-/ Data-/SL-	Incr. encoder2 B- diff. input, or Dir-, or Data- for SSI, or Slave- for BiSS; has 120Ω resistor between pins 4 and 8
5	A2-/ Pulse-/CLK-/MA-	Incr. encoder2 A- diff. input, or Pulse-, or Clock- for SSI, or Master- for BiSS; has 120Ω resistor between pins 5 and 9
6	GND	Ground
7	Z2+	Incr. encoder2 Z+ diff. input; has 120Ω resistor between pins 3 and 7
8	B2+/ Pulse+/ Data+/ SL+	Incr. encoder2 B+ diff. input, or Dir+, or Data+ for SSI, or Slave+ for BiSS; has 120Ω resistor between pins 4 and 8
9	A2+/ Pulse+/ CLK+/ MA+	Incr. encoder2 A+ diff. input, or Pulse+, or Clock+ for SSI, or Master+ for BiSS; has 120Ω resistor between pins 5 and 9

Pin	Name	Description
1	$+5V_{OUT}$	5V output supply for I/O usage
2	Hall 1+	Digital input Hall 1+ diff. sensor input; has 120Ω resistor between pins 2 and 6
3	Hall 2+	Digital input Hall 2+ diff. sensor input; has 120Ω resistor between pins 3 and 7
4	B1+	Incr. encoder1 B+ diff. input; has 120Ω resistor between pins 4 and 14
5	A1+	Incr. encoder1 A+ diff. input; has 120Ω resistor between pins 5 and 15
6	Hall 1-	Digital input Hall 1- diff. sensor input; has 120Ω resistor between pins 2 and 6
7	Hall 2-	Digital input Hall 2- diff. sensor input; has 120Ω resistor between pins 3 and 7
8	Hall 3-	Digital input Hall 3- diff. sensor input; has 120Ω resistor between pins 13 and 8
9	Z1+	Incr. encoder1 Z+ diff. input; has 120Ω resistor between pins 9 and 10
10	Z1-	Incr. encoder1 Z- diff. input; has 120Ω resistor between pins 9 and 10
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+ diff. sensor input; has 120Ω resistor between pins 13 and 8
14	B1-	Incr. encoder1 B- diff. input; has 120Ω resistor between pins 4 and 14
15	A1-	Incr. encoder1 A- diff. input; has 120Ω resistor between pins 5 and 15

Pin	Name	Description
1	Can-Hi	CAN-Bus positive line
2	Can-Lo	CAN-Bus negative line
3	GND	Return ground
4, 5	-	Reserved.
6..8	n.c.	Not connected

Pin	Name	Description
1	CANopen	ON (down): CANopen OFF (up): TMLCAN
2	ID-Bit4	Hardware AxisID
3	ID-Bit3	selection switches
4	ID-Bit2	All OFF –> AxisID =
5	ID-Bit1	255 for TMLCAN
6	ID-Bit0	or 127 for CANopen

Description
Reserved

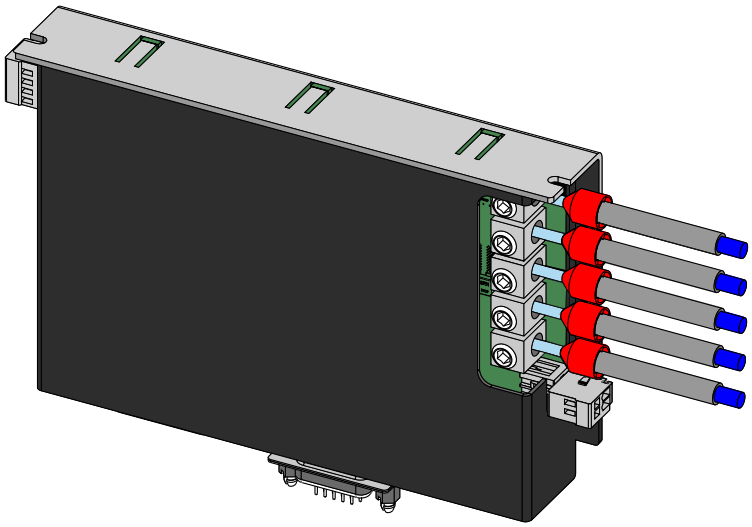


Pin	Name	Description
1	BRAKE-	Negative terminal for the motor brake input; commanded as OUT0
2	+Vlog/ BRAKE+	Positive terminal for the motor brake input; connected internally to +Vlog

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

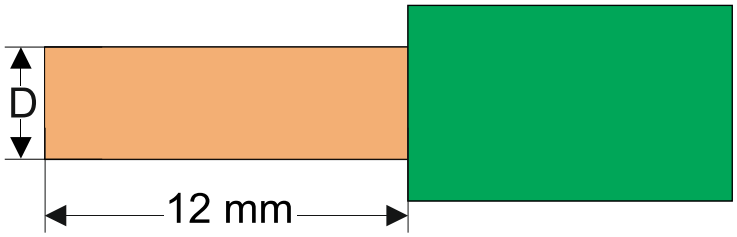
1.10.4 Recommendations for Motor Phases and Motor Power Supply wires

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	-		



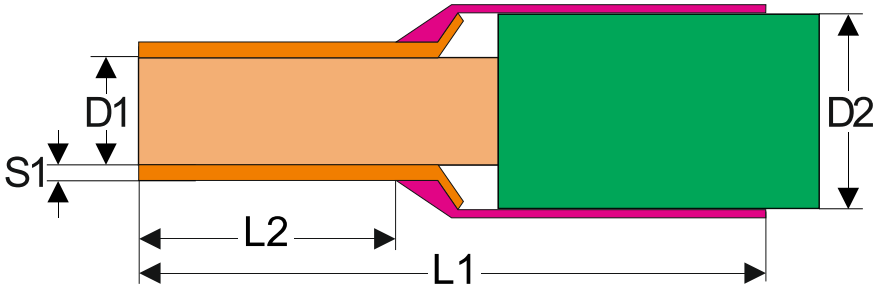
Cable connections

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

1.11 Connection diagrams

1.11.1 iPOS4850 BX-CAN-STO connection diagram

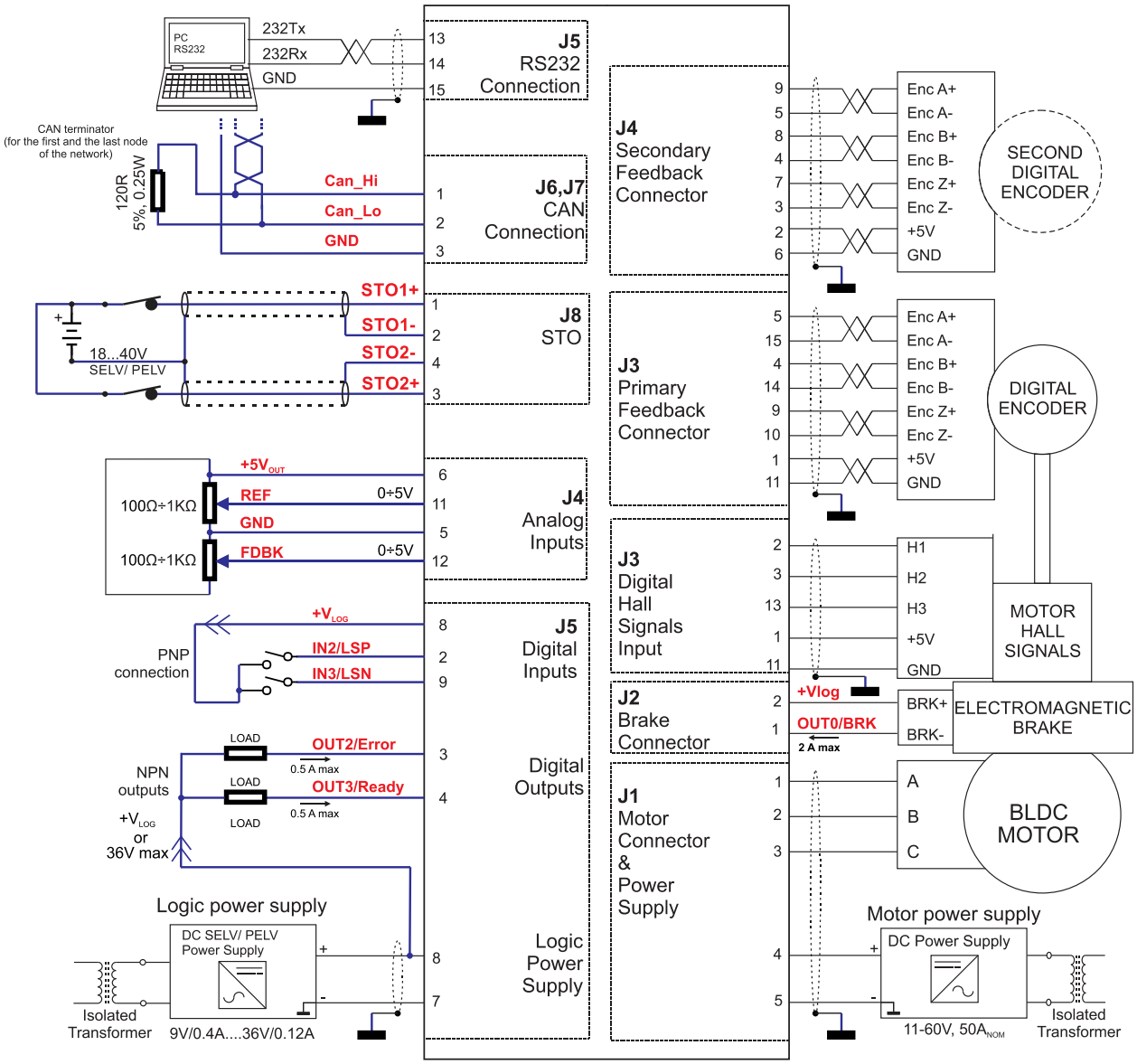


Figure 0.2. **iPOS4850 BX-CAN-STO Connection diagram**

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

1.11.2 iPOS4850 BX-CAN connection diagram

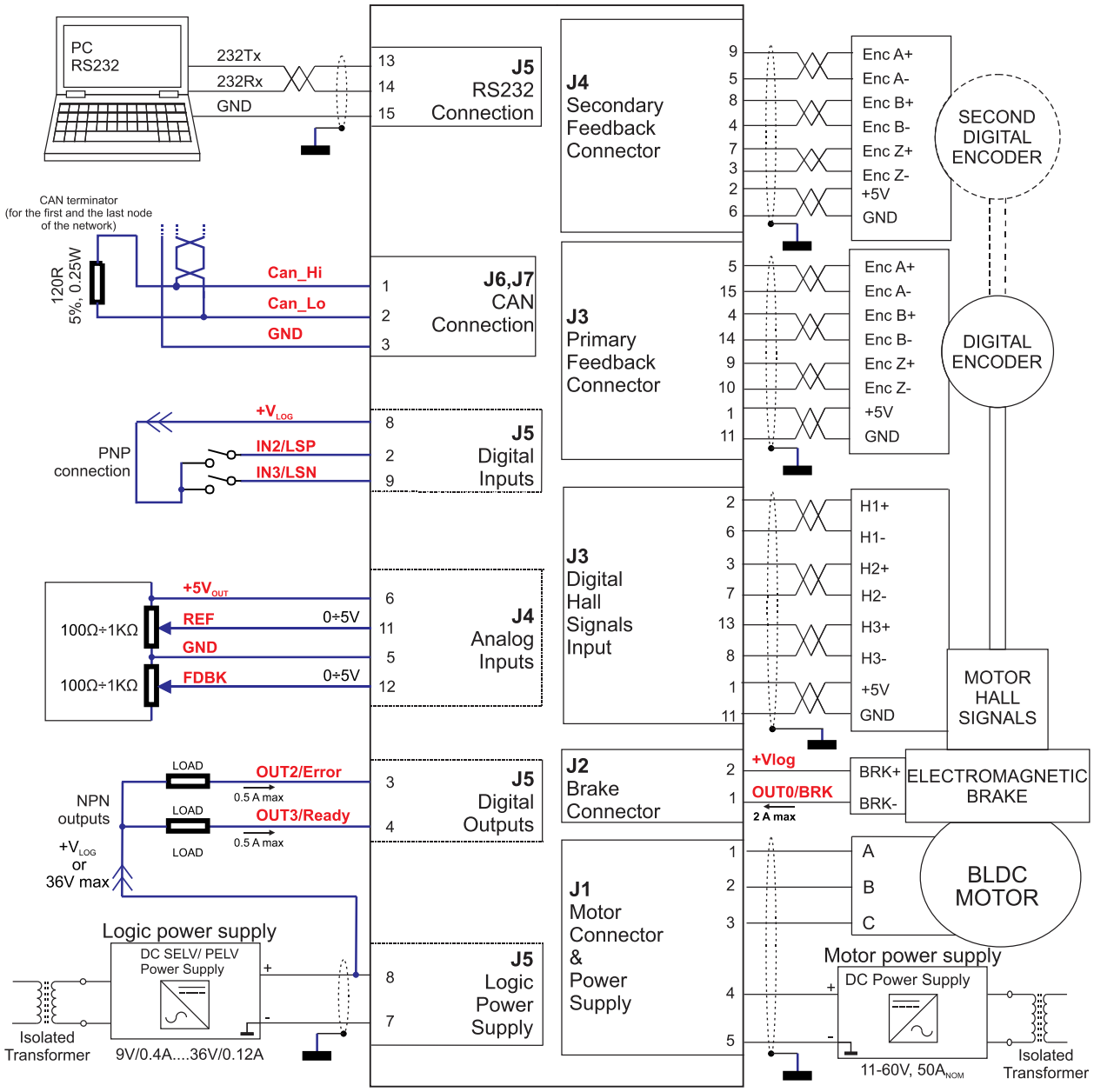


Figure 0.3. **iPOS4850 BX-CAN Connection diagram**

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

1.11.3 24V Digital I/O Connection

1.11.3.1 PNP inputs

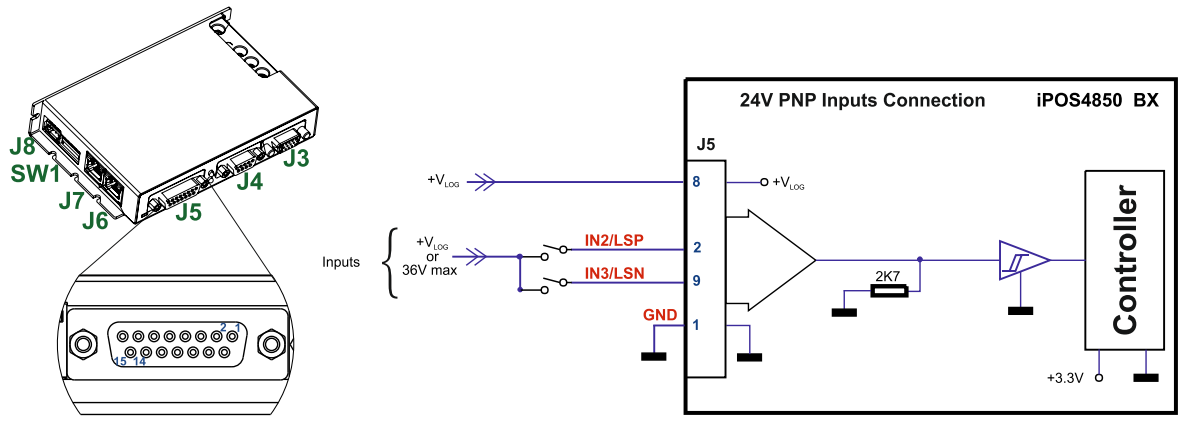


Figure 0.4. **24V Digital PNP Inputs connection**

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.*

1.11.3.2 NPN outputs

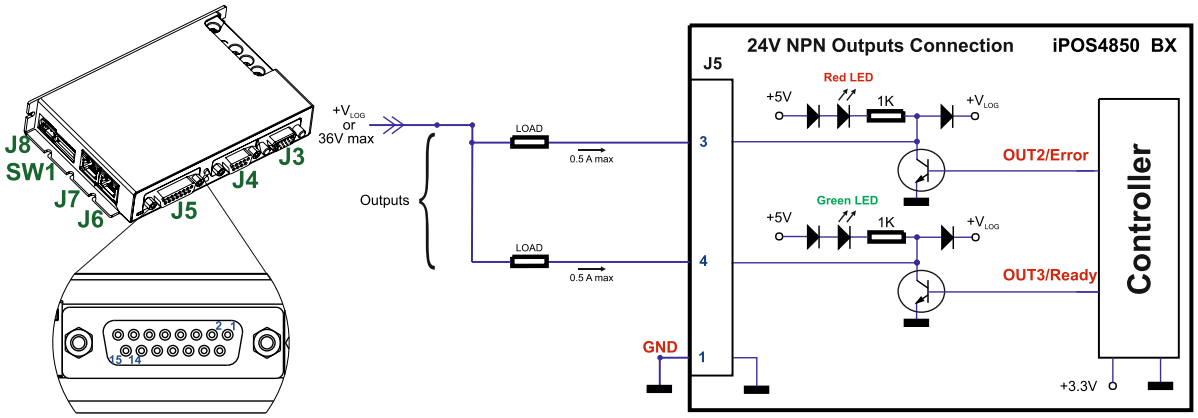


Figure 0.5. **24V Digital NPN Outputs connection**

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

1.11.3.3 Solenoid driver connection for motor brake

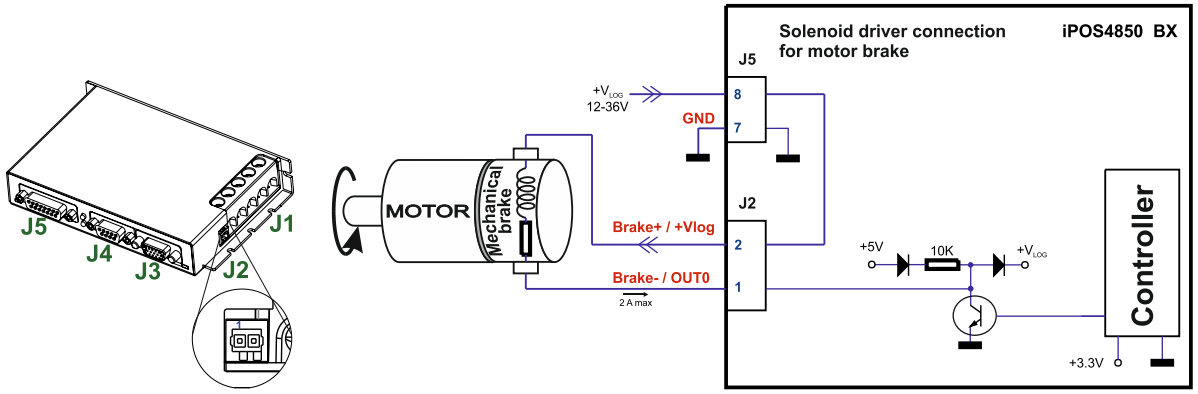


Figure 0.6. **24V Digital NPN Outputs connection**

Remark: *The **Brake-** pin can also be used as the NPN digital output OUT0. The firmware can control this output automatically to engage/disengage a mechanical brake when motor control is started/stopped.*

1.11.4 Analog Inputs Connection

1.11.4.1 0-5V Input Range

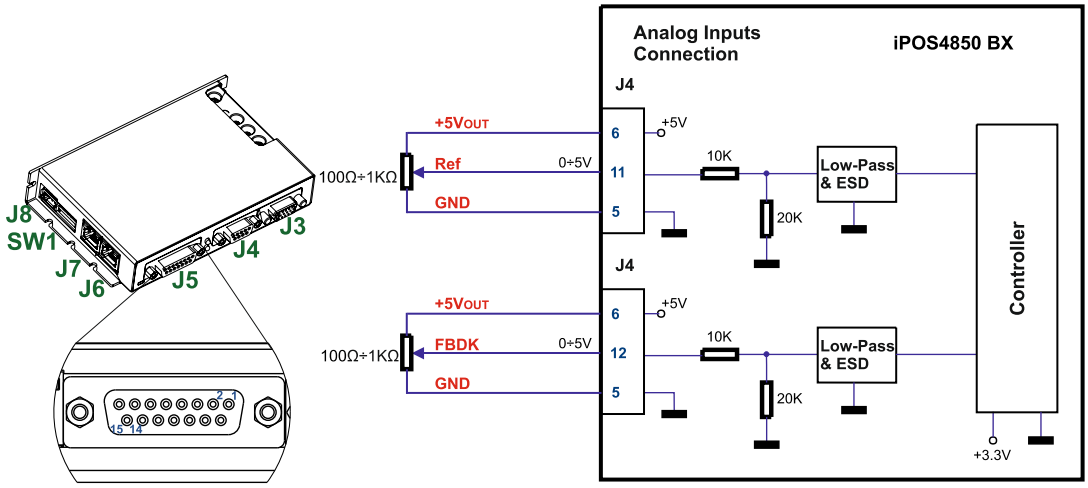


Figure 0.7. ***0-5V* Analog inputs connection**

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

1.11.4.2 +/- 10V Input Range adapter

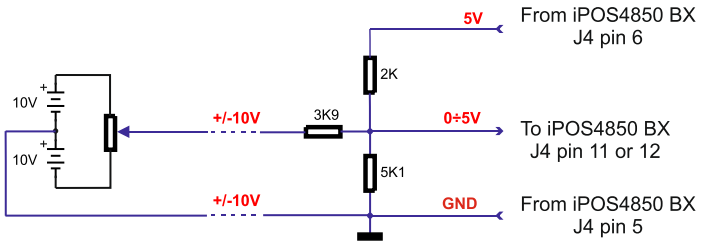


Figure 0.8. **+/-10V Analog inputs connection**

Remarks:

1. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*
2. *To switch by software Ref and Fdbk signals, set the TML register ASR bit 10 to 1.*

1.11.4.3 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).

1.11.5 Motor connections

1.11.5.1 Brushless Motor connection

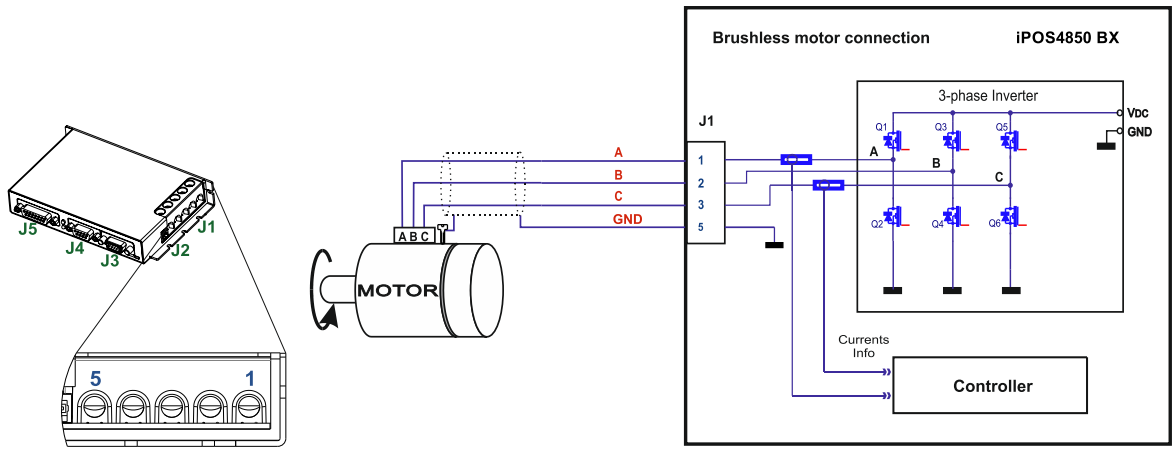


Figure 0.9. **Brushless motor connection**

Remark: *On -STO version, to hardware enable the motor outputs, connect STO1+ and STO2+ pins to +Vlog and STO1- and STO2- to GND.*

1.11.5.2 DC Motor connection

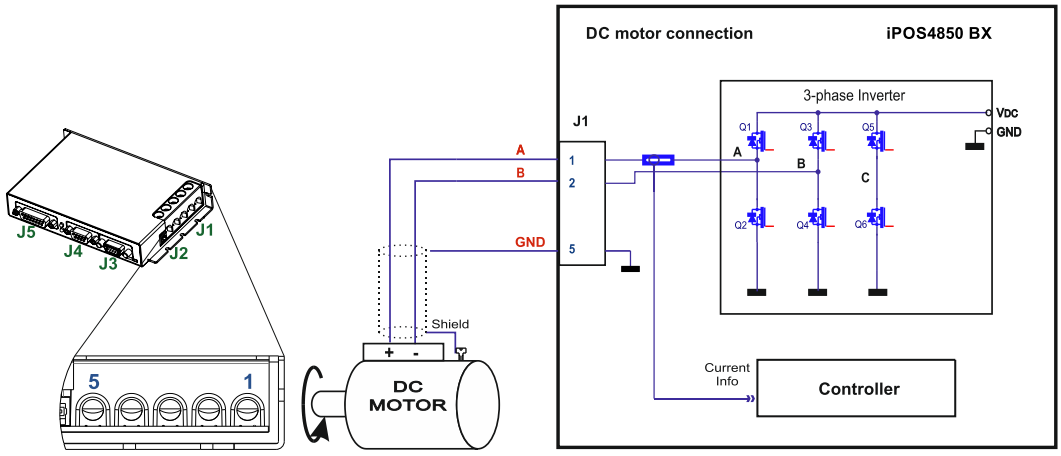


Figure 0.10. **DC Motor connection**

Remark: The STO circuit must be supplied with minimum 18V to enable PWM output. *STO1+ and STO2+ pins can be connected also to +V_{LOG} and STO1- and STO2- to GND.*

1.11.5.3 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. Connect the cable shield to the iPOS4850 BX GND pin. Leave the other end disconnected.
b) A good shielding can be obtained if the motor wires are running inside a metallic cable guide.

1.11.6 Feedback connections

1.11.6.1 Differential Incremental Encoder #1 Connection

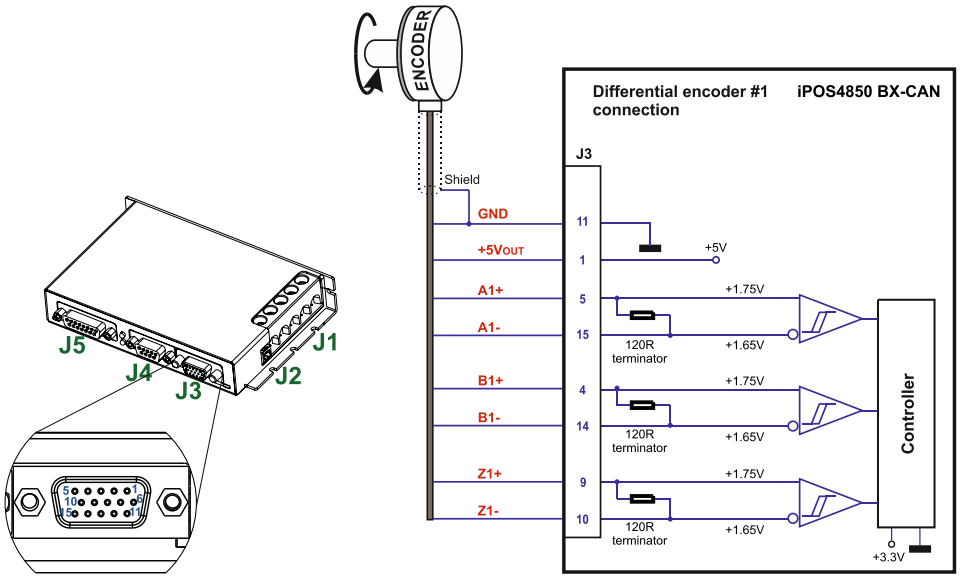


Figure 0.11. **Differential incremental encoder #1 connection**

Remarks:

1. *The encoder #1 input has internal terminators, equivalent to 120Ω (0.25W), present in the drive.*
2. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*
3. *A non-differential encoder signals can be accepted only if the internal 120 Ω resistors are disconnected. Contact Technosoft to order a different hardware configuration of the iPOS4850 BX drive. However the single ended encoder signals are more prone to electrical noise which can lead to loss of motor control.*

1.11.6.2 Differential Incremental Encoder #2 Connection

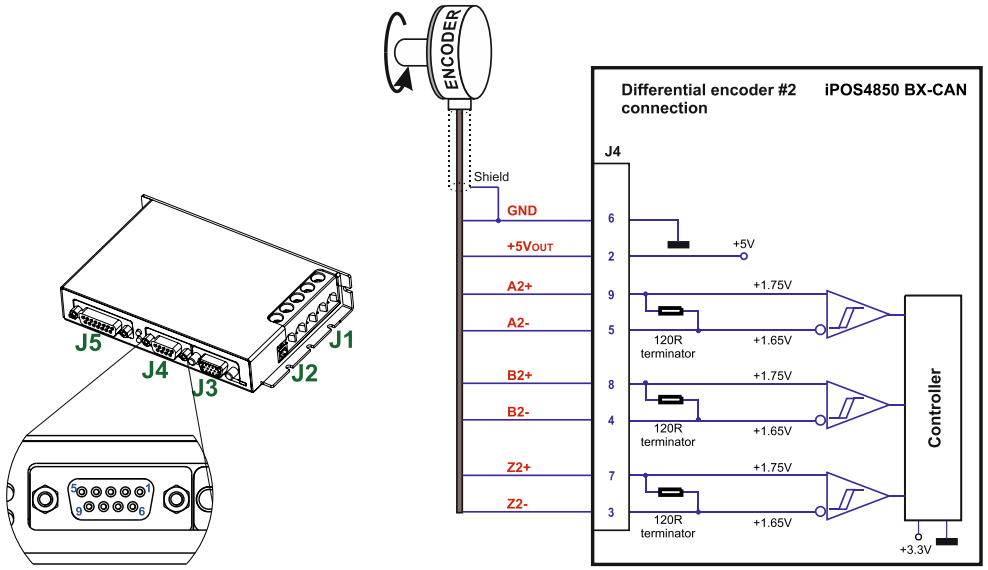


Figure 0.12. **Differential incremental encoder #2 connection**

Remarks:

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

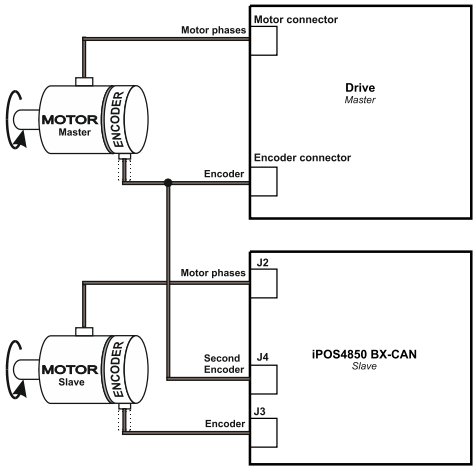


Figure 0.13. ***J4 – Master – Slave connection using encoder#2 input***

1.11.6.3 Pulse and direction connection

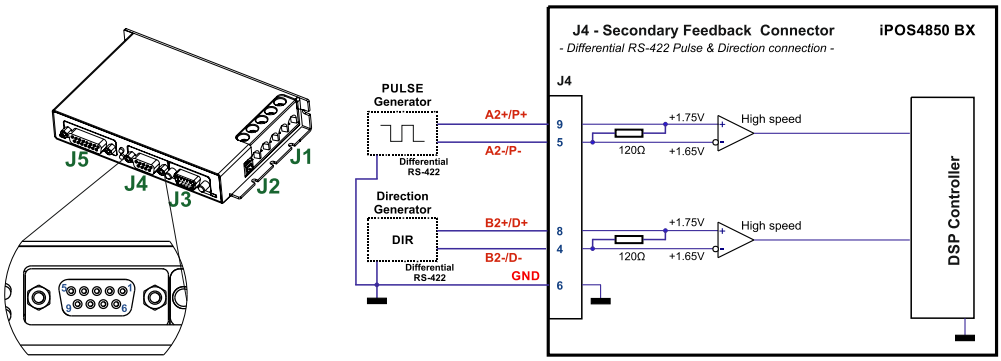


Figure 0.14. **Pulse and direction connection**

Remarks:

1 *The same pulse and direction connection can be done on J3 Encoder#1 using the same A and B encoder signals Encoder#2*

2 *A non-differential pulse and direction signal can be accepted only if the internal 120 Ω resistors are disconnected. Contact Technosoft to order a different hardware configuration of the iPOS4850 BX drive.*

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

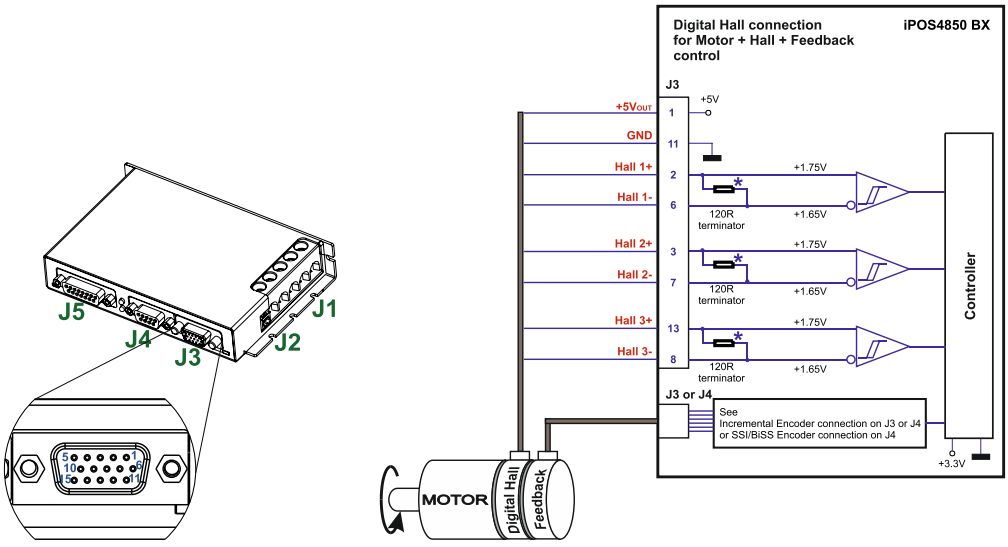


Figure 0.15. **Digital Hall connection**

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. Contact Technosoft to order a different hardware configuration of the iPOS4850 BX drive.*

2.1.1.2 Digital Hall Connection for Motor + Digital Hall only control

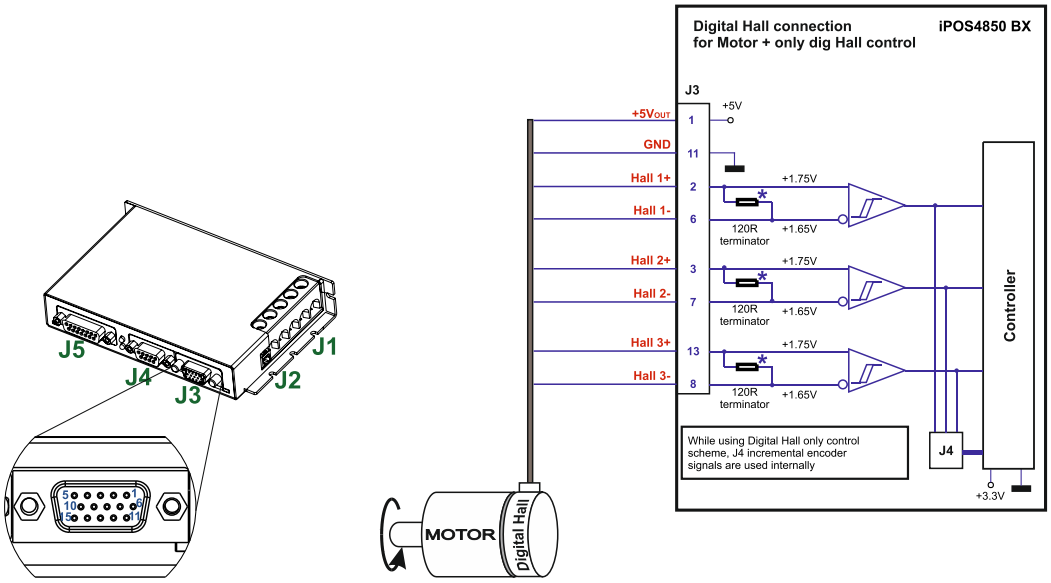


Figure 0.16. **Digital Hall connection**

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. Contact Technosoft to order a different hardware configuration of the iPOS4850 BX drive.*
4. *While using this control scheme, the incremental encoder signals from J4 are used internally by the drive.*

2.1.1.3 SSI / BiSS / EnDAT on Encoder #2 Connection

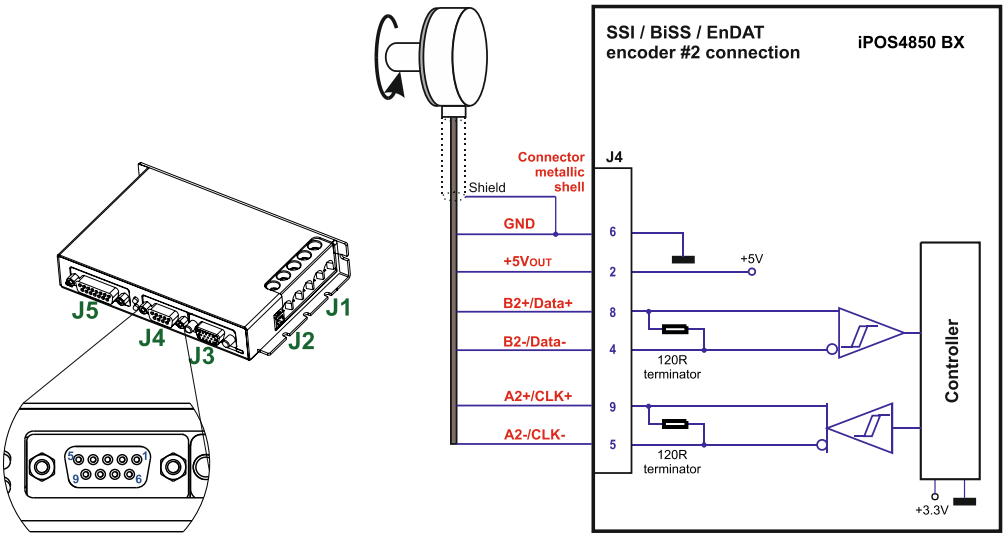


Figure 0.17. **SSI encoder #2 connection**

Remarks:

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

2.1.2 Power Supply Connection

2.1.2.1 Supply Connection for iPOS4850 BX-CAN-STO

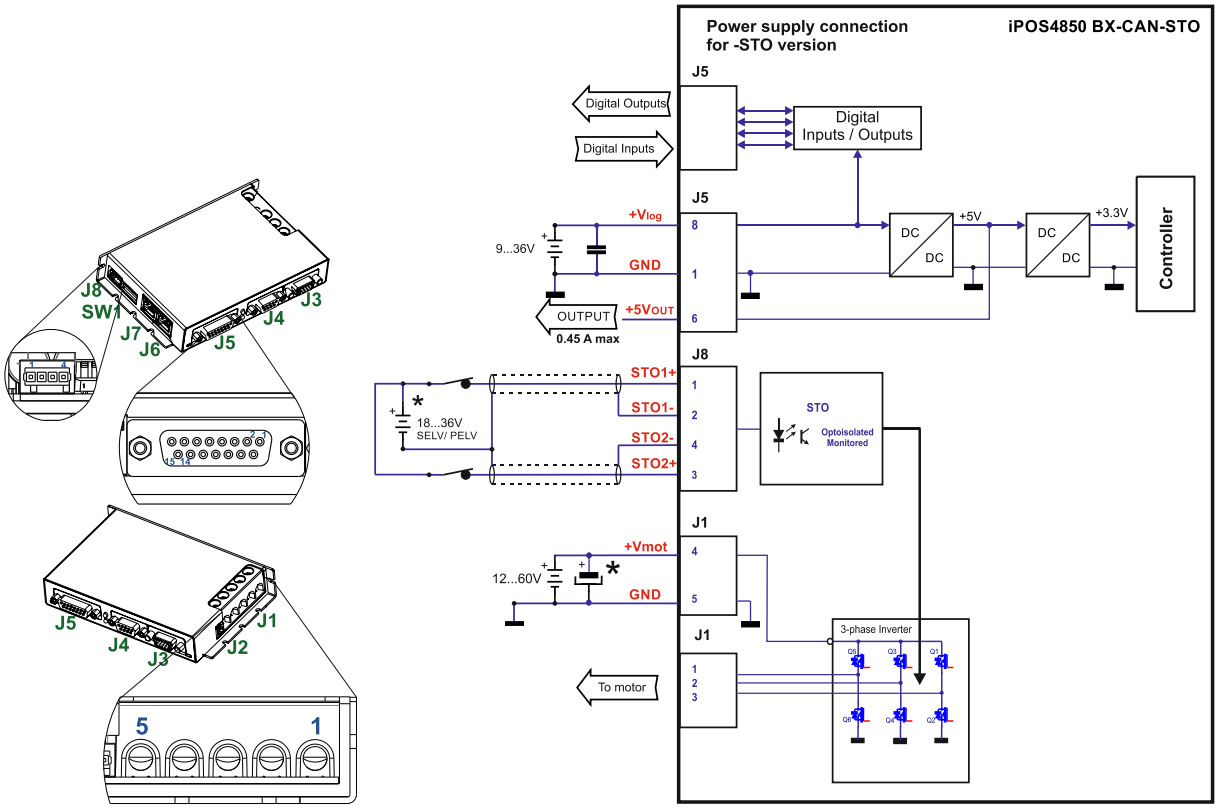


Figure 0.18. **Supply connection**

*An external electrolytic capacitor may be added between +V_{MOT} and GND, to help reduce over-voltage during load braking/ reversals. See paragraph **2.1.2.3** for details.

2.1.2.2 Supply Connection for iPOS4850 BX-CAN (without STO)

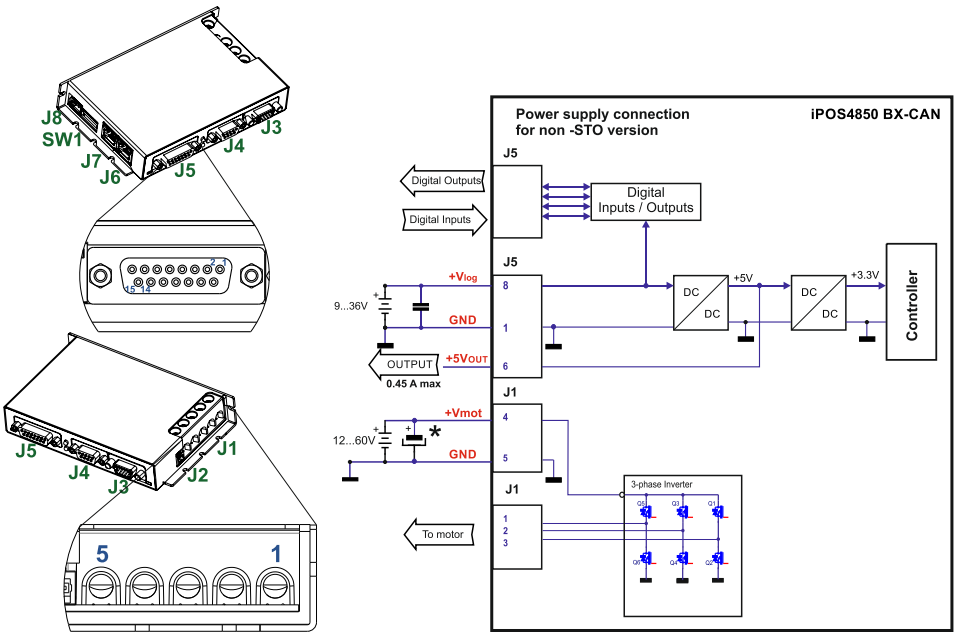


Figure 0.19. **Supply connection**

*An external electrolytic capacitor may be added between +V_{MOT} and GND, to help reduce over-voltage during load braking/ reversals. See paragraph **2.1.2.3** for details.

2.1.2.3 Recommendations for Supply Wiring

The iPOS4850 BX always requires two supply voltages: Vlog and Vmot.

Use short, thick wires between the iPOS4850 BX and the motor power supply. Connect power supply wires to all the indicated pins. If the wires are longer than 2 meters, use twisted wires for the supply and ground return. For wires longer than 20 meters, add a capacitor of at least 10,000µF (rated at an appropriate voltage) right on the terminals of the iPOS4850 BX.

It is recommended to connect the negative motor supply return (GND) to the Earth protection near the power supply terminals.

2.1.2.4 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:

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

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].

2.1.3 Serial RS-232 connection

2.1.3.1 Serial RS-232 connection

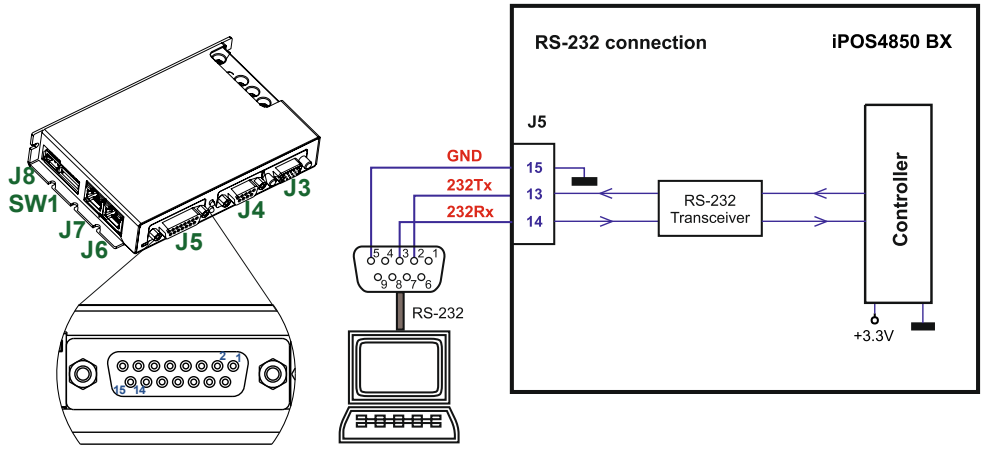


Figure 0.20. **Serial RS-232 connection**

2.1.3.2 Recommendation for wiring

a) If you build the serial cable, you can use a 3-wire shielded cable with shield connected to BOTH ends. Do not use the shield as GND. The ground wire (pin 15 of J5) must be included inside the shield, like the 232Rx and 232Tx signals.
b) Always power-off all the iPOS4850 BX-CAN 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***

2.1.4 CAN-bus connection

2.1.4.1 CAN connection

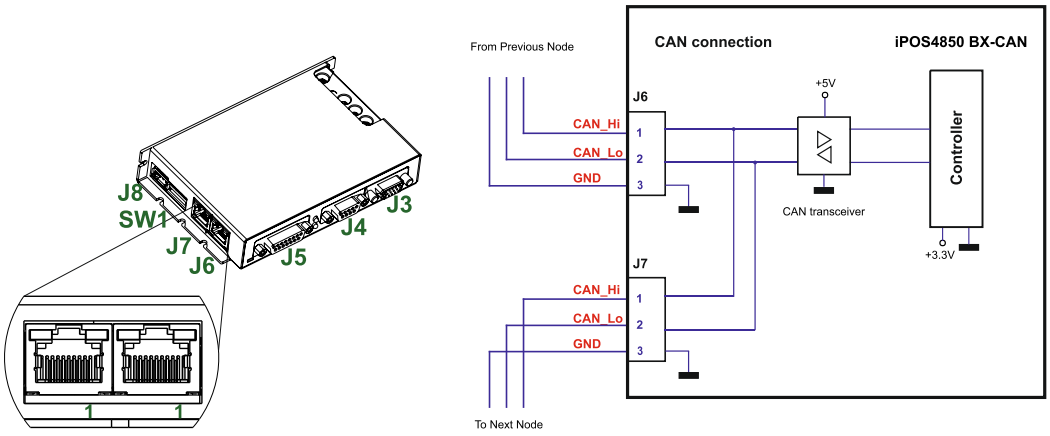


Figure 0.21. **CAN connection**

Remarks:

1. *The CAN network requires a 120-Ohm terminator. This is not included on the drive.* ***Figure 0.22*** *shows how to connect it on your network*
2. *CAN signals are not isolated from other iPOS4850 BX circuits.*

2.1.4.2 Recommendation for wiring

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) The 120Ω termination resistors must be rated at 0.2W minimum. Do not use winded resistors, which are inductive.

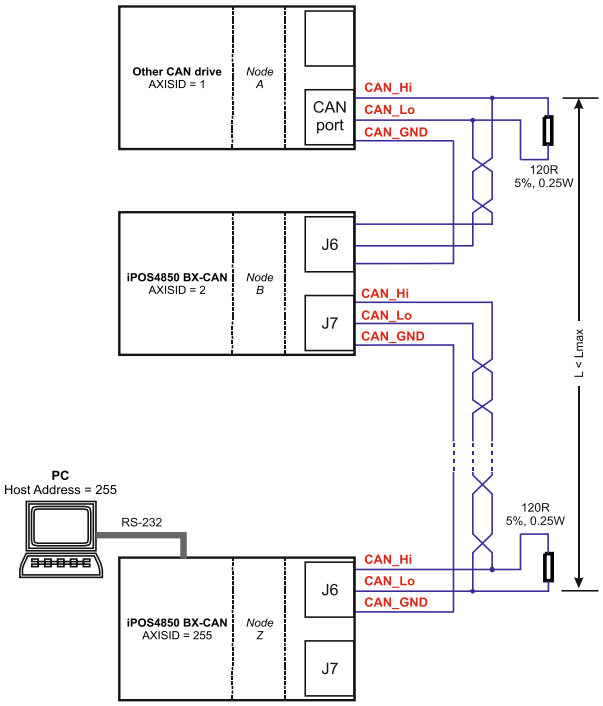


Figure 0.22. **Multiple-Axis CAN network**

2.1.5 Disabling Autorun

When any iPOS CAN drive 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 3 methods:

a) **Software** - by writing value 0x0001 in first EEPROM location at address 0x4000

b) **Hardware1** – set the drive temporarily in CANopen mode. While in CANopen state, no motion will autorun. Set SW1 pin1 in down 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. 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.

2.2 CAN Operation Mode and Axis ID Selection (SW1 settings)

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 pin1:

- 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 from the switch SW1

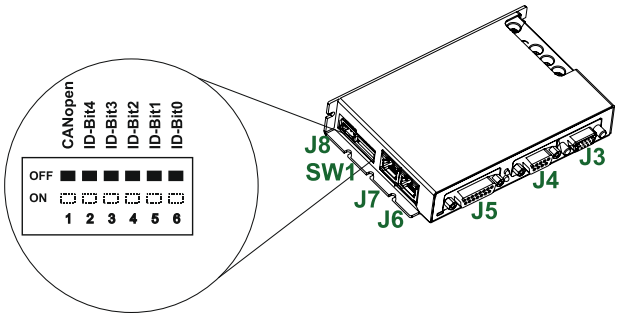


Figure 0.23. *SW1 – DIP Switch*

- Position 1: On = CANopen mode; Off = TMLCAN mode
- Positions 2 … 6 are ID Bit0 to Bit 4.
- Axis ID switches The drive axis/address number is set when H/W is selected in Drive Setup under AxisID field or when the Setup is invalid.
- The axis ID is an 8 bit unsigned number. Its first 5 bits are controlled by the ID-bit0 to ID-bit4. Bits 5,6 and 7 of this variable is always 0. In total, 32 axis ID HW values can result from the DIP switch combinations.

All pins are sampled at power-up, and the drive is configured accordingly.
If TMLCAN mode is selected and the AxisID bits are all OFF, the resulting axis ID is 255

If CANopen mode is selected and the AxisID bits are all OFF, the resulting RS232 axis ID is 127 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.

2.3 LED indicators

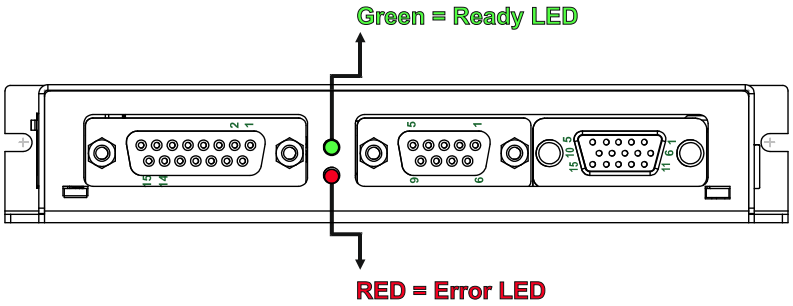


Figure 0.24. **LED indicators**

Table 0.1 ***– LED indicators***

LED no.	LED name	LED color	Function
1	Ready	green	Lit after power-on when the drive initialization ends. Turned off when an error occurs.
2	Error	red	Turned on when the drive detects an error condition or when OUT2/Error is set to +Vlog with OUT(2)=0 TML instruction.

2.4 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

2.4.1 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	0.75 ÷ 1	10.0	atm

2.4.2 Storage Conditions

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

2.4.3 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 95^{0}C, the drive outputs turn off.				

2.4.4 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 95^{0}C, the drive outputs turn off.				

2.4.5 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			-

2.4.6 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		280		mA
		+V_{LOG} = 12V		200		
		+V_{LOG} = 24V		130		
		+V_{LOG} = 36V		90		
Utilization Category	Acc. to 60947-4-1 (I_{PEAK}<=1.05*I_{NOM})		DC-1			

2.4.7 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			

[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.

2.4.8 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 accuracy			±5	±8	%FS

2.4.9 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

2.4.10 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} >= 2V		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

2.4.11 Digital Hall Inputs (Hall1+, Hall1-, Hall2+, Hall2-, Hall3+, Hall3-)[3]

		Min.	Typ.	Max.	Units
Differential mode compliance	For full RS422 compliance, see [3]	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

[1] With adequate thermal heat sink

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

[3] All differential input pins have internal 120Ω termination resistors connected across

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

		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

2.4.13 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

2.4.14 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)			

2.4.15 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

2.4.16 CAN-Bus

		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 DIN switches	CANopen: 1 ÷ 31 & 127 (LSS non-configured); TMLCAN: 1-31 & 255			
	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

2.4.17 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		

[1] All differential input pins have internal 120Ω termination resistors connected across
[2] “FS” stands for “Full Scale”
[3] Availabile only for EnDAT and BiSS feedback options

	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

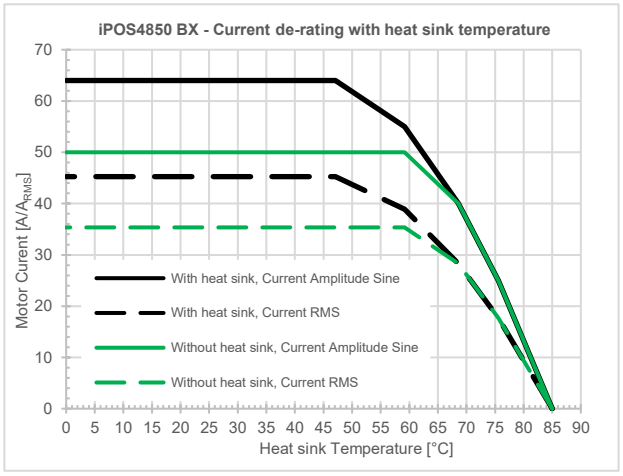
2.4.18 Supply Output (+5V)

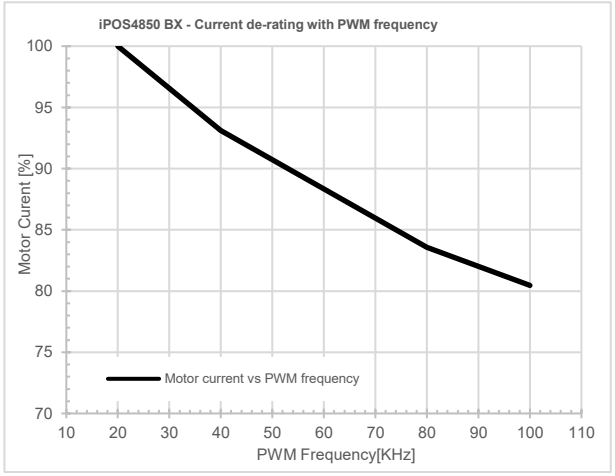
		Min.	Typ.	Max.	Units
+5V output voltage	Current sourced = 250mA	4.8	5	5.2	V
+5V output current				450	mA
Short-circuit protection		Yes			
Over-voltage protection		NOT protected			
ESD protection	Human body model 0.1nF 1.5 kΩ	±2			kV

2.4.19 Safe Torque OFF (STO1+; STO1-; STO2+; STO2-) for –STO version

		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

2.4.20 De-rating curves





2.4.21 Reliability data

			Min.	Typ.	Max.	Units
MTBF	MIL-HDBK-217F, Notice 2, TEMP = 25ºC, ENV: GB	iPOS4850 BX-CAN-STO		37.11		years

2.4.22 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.

Memory Map

iPOS4850 BX has 2 types of memory available for user applications: 16K×16 SRAM and up to 16K×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: 4000h to 7FFFh. It is used to keep in a non-volatile memory the TML programs, the cam tables and the drive setup information.

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

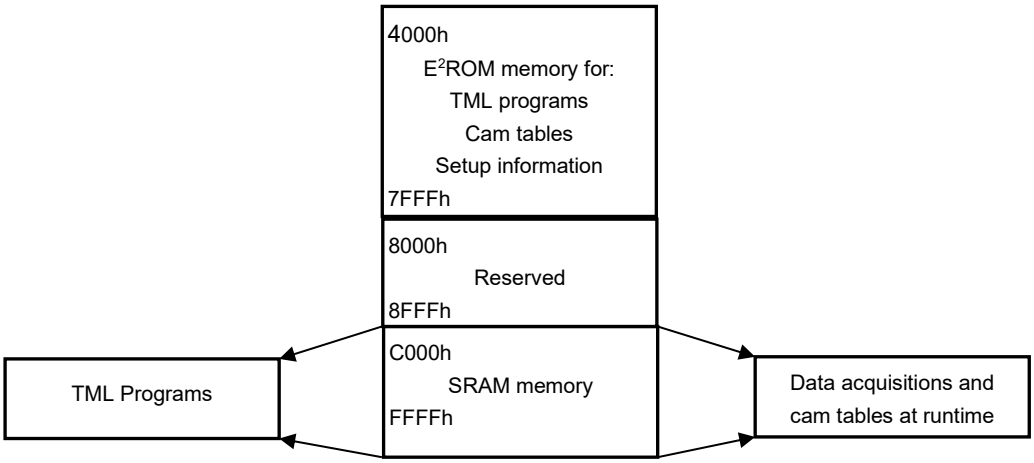


Figure 7.1. *iPOS4850 BX Memory Map*