

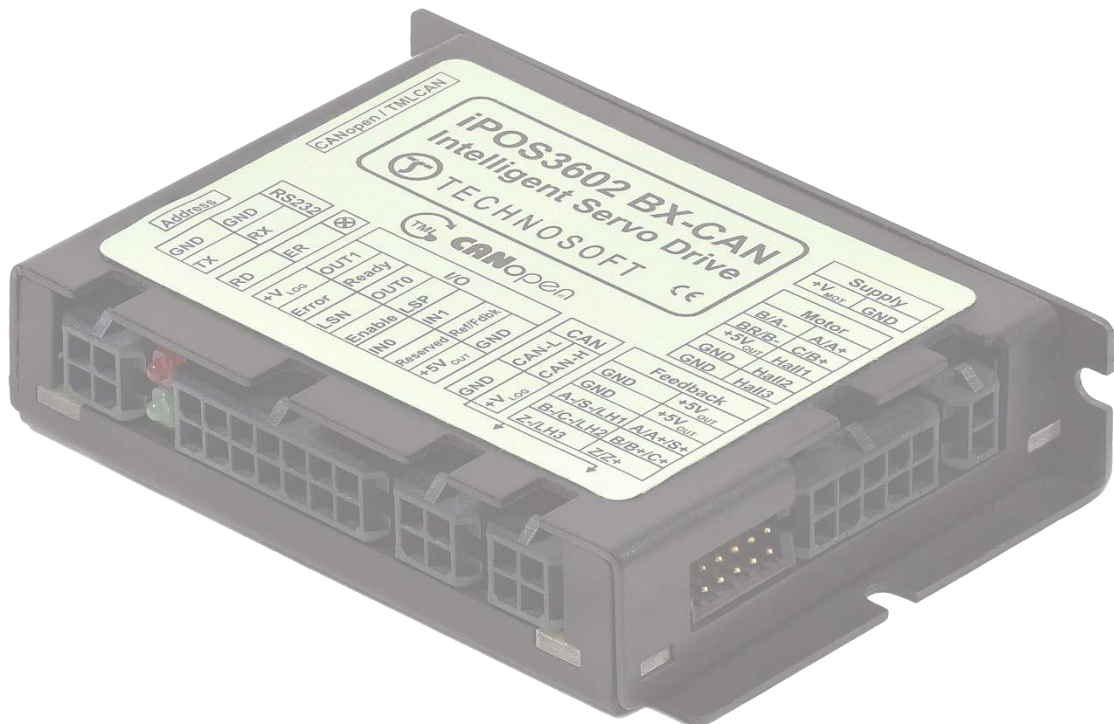
# iPOS3602 BX-CAN/ iPOS3604 BX-CAN

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



T E C H N O S O F T

Intelligent Servo Drives



## Technical Reference

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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   | Firmware | Description   |
|-----------------|---------------|----------|---|
| iPOS3602 BX-CAN | P028.001.E201 | F509x    | 2A nominal, Standard version, CAN, Differential encoder input |
| iPOS3602 BX-CAN | P028.001.E601 | F509x    | 2A nominal, Single-Ended encoder input, CAN                   |
| iPOS3602 BX-CAN | P028.001.E701 | F524x    | 2A nominal, Linear Hall version, CAN                          |
| iPOS3604 BX-CAN | P028.002.E201 | F508x    | 4A nominal, Standard version, CAN, Differential encoder input |
| iPOS3604 BX-CAN | P028.002.E601 | F508x    | 4A nominal, Single-Ended encoder input, CAN                   |
| iPOS3604 BX-CAN | P028.002.E701 | F523x    | 4A nominal, Linear Hall version, CAN                          |

In order to operate the **iPOS360x** 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**<sup>1</sup>
  - ☐ 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) <sup>2</sup>
  - ☐ A **TML\_LIB motion library for PLCs** <sup>3</sup>
  - ☐ 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 **iPOS360x** 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 (P091.034.ESM-Quick.Setup.and.Programming.Guide.UM.xxxx)**. It also includes the scaling factors between the real SI units and the drive internal units. For detailed information regarding the next steps, refer to the related documentation.

## Notational Conventions

This document uses the following conventions:

- **iPOS360X** – 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.)
- **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

<sup>1</sup> when the iPOS360x BX-CAN is set in CANopen mode

<sup>2</sup> available only for TMLCAN protocol

**iPOS3602 BX-CAN Datasheet ( P028.001.E101.DSH)**

**iPOS3604 BX-CAN Datasheet ( P028.002.E101.DSH)**

**iPOS3602 BX-CAN Single-ended Encoder Datasheet ( P028.001.E601.DSH)**

**iPOS3604 BX-CAN Single-ended Encoder Datasheet ( P028.002.E601.DSH)**

**iPOS3602 BX-CAN Linear Halls Datasheet ( P028.001.E701.DSH)**

**iPOS3604 BX-CAN Linear Halls Datasheet ( P028.002.E701.DSH)**

– describes the hardware connections of the iPOS3604 BX CAN intelligent servo drive including the technical data and connectors.

**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 and **CiA DSP 402\_2 v4.1** 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

**IO-iPOS360X (part no. P091.028.IO-iPOS360X.UM.xxxx)** – describes the IO iPOS360x I/O extension board included in the **iPOS360X Starter Kits**.

## If you Need Assistance ...

| If you want to ...  | Contact Technosoft at ...  |
|---|--|
| Visit Technosoft online   | World Wide Web: <a href="http://www.technosoftmotion.com/">http://www.technosoftmotion.com/</a>  |
| Receive general information or assistance (see Note)                          | World Wide Web: <a href="http://www.technosoftmotion.com/">http://www.technosoftmotion.com/</a><br>Email: <a href="mailto:sales@technosoftmotion.com">sales@technosoftmotion.com</a> |
| Ask questions about product operation or report suspected problems (see Note) | Tel: +41 (0)32 732 5500<br>Email: <a href="mailto:support@technosoftmotion.com">support@technosoftmotion.com</a>   |
| Make suggestions about, or report errors in documentation.                    | Mail: Technosoft SA<br>Avenue des Alpes 20<br>CH-2000 Neuchatel, NE<br>Switzerland   |

## 1 Safety information

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

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

The following safety symbols are used in this manual:



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



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

### 1.1 Warnings



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



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



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

### 1.2 Cautions



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



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

### 1.3 Quality system, conformance and certifications



**IQNet and Quality Austria** certification about the implementation and maintenance of the Quality Management System which fulfills the requirements of Standard **ISO 9001:2015**.

**Quality Austria Certificate** about the application and further development of an effective **Quality Management System** complying with the requirements of Standard **ISO 9001:2015**

**REACH Compliance** - **TECHNOSOFT** hereby confirms that this product comply with the legal obligations regarding Article 33 of the European REACH Regulation 1907/2006 (Registration, Evaluation, Authorization and Restriction of Chemicals), which came into force on 01.06.2007.

**RoHS Compliance** - **Technosoft SA** here with declares that this product is manufactured in compliance with the RoHS directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

**Technosoft SA** hereby declares that this product conforms to the following European applicable directives:

|            |   |
|------------|---|
| 2014/30/EU | Electromagnetic Compatibility (EMC) Directive |
| 2014/35/EU | Low Voltage Directive (LVD)                   |
| 93/68/EEC  | CE Marking Directive                          |

**Conflict minerals statement** - **Technosoft** declares that the company does not purchase 3T&G (tin, tantalum, tungsten & gold) directly from mines or smelters...

**We have no indication that Technosoft products contain minerals from conflict mines or smelters in and around the DRC.**

For other certifications visit: <https://technosoftmotion.com/en/quality/>



## 2 Product Overview

### 2.1 Introduction

The **iPOS360X** is a family of fully digital intelligent servo drives, based on the latest DSP technology and they offer unprecedented drive performance combined with an embedded motion controller.

Suitable for control of brushless DC, brushless AC (vector control), DC brushed motors and step motors, the iPOS360x BX-CAN drives accept as position feedback incremental encoders (quadrature or sine/cosine) and linear Halls signals.

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 iPOS360X 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<sup>1</sup> or camming<sup>1</sup>, 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 axis in 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 iPOS360X 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 iPOS360X conforms to **CiA 301 v4.2** application layer communication profile and **CiA DSP 402\_2 v4.1** 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 iPOS360X 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 iPOS360X 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 iPOS360X 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 iPOS360X drives can also be controlled via a PC or a PLC using one of the **TML\_LIB** motion libraries.

For iPOS360X commissioning **EasySetup** or **EasyMotion Studio** PC applications may be used.

---

<sup>1</sup> 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 iPOS360X 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 controllers.* EasyMotion Studio, may be used to program motion sequences in TML. This is the iPOS360X 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, DC brush, and step motors
- Very compact design
- Sinusoidal (FOC) or trapezoidal (Hall-based) control of brushless motors
- Open or closed-loop control of 2 and 3-phase steppers
- 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: 9-36V
- Logic supply: 7-36V
- Output current:
  - iPOS3602 BX-CAN: 2A<sup>2</sup> continuous; 3.2A peak
  - iPOS3604 BX-CAN: 4A<sup>3</sup> continuous; 10A peak
- PWM switching frequency up to 120kHz
- Communication:
  - RS-232 serial up to 115kbits/s
  - CAN-bus 2.0B up to 1Mbit/s
- Digital and analog I/Os:
  - 5 digital inputs: 5-36V, PNP or NPN software selectable: Enable, Limit switch +, Limit switch –, 2 general-purpose
  - 4 digital outputs : 5-36V, 0.5A, NPN open-collector: Ready, Error, 2 general-purpose
  - 1 analogue input: 12-bit, 0-5V (Reference or Feedback) or general-purpose
- Electro-Mechanical brake support: software configurable digital output to control motor brake
- Feedback devices:
  - Incremental encoder interface (single ended or differential depending on drive part number)
  - Digital Hall sensor interface (single-ended and open collector regardless of drive part number)
  - Linear Hall sensor interface (depending on drive part number)
  - Analogue Sin/Cos encoder interface (differential 1V<sub>pp</sub> depending of drive part number )
- Various motion programming modes:
  - Position profiles with trapezoidal or S-curve speed shape
  - Position, Velocity, Time (PVT) 3<sup>rd</sup> order interpolation
  - Position, Time (PT) 1<sup>st</sup> order interpolation
  - Cyclic Synchronous Position (CSP) for CANopen mode.

<sup>2</sup> 2A cont. with DC, step and BLDC motors (trapezoidal), 2A amplitude (1.41A<sub>RMS</sub>) for PMSM (sinusoidal)

<sup>3</sup> 4A cont. with DC, step and BLDC motors (trapezoidal), 4A amplitude (2.82A<sub>RMS</sub>) for PMSM (sinusoidal)

- Electronic gearing and camming
- 35 Homing modes
- Hardware and Software CAN selectable addresses
- Two CAN operation modes selectable by jumper:
  - **CANopen** – conforming with **CiA 301 v4.2** and **CiA DSP 402\_2 v4.1**
  - **TMLCAN** – intelligent drive conforming with Technosoft protocol for exchanging TML commands via CAN-bus
- 2K × 16 internal SRAM memory for data acquisition
- 4K × 16 E<sup>2</sup>ROM to store TML motion programs, cam tables and other user data
- Operating ambient temperature:
  - 0-40°C – iPOS360X BX-CAN
- Protections:
  - Short-circuit between motor phases
  - Short-circuit from motor phases to ground
  - Over-voltage
  - Under-voltage
  - Over-current
  - Communication error
  - Control error
  - Over-temperature
- Firmware on drive:
  - F508M+ or F523E+ for iPSO3604
  - F509M+ or F524E+ for iPSO3602

## 2.3 Identification Labels

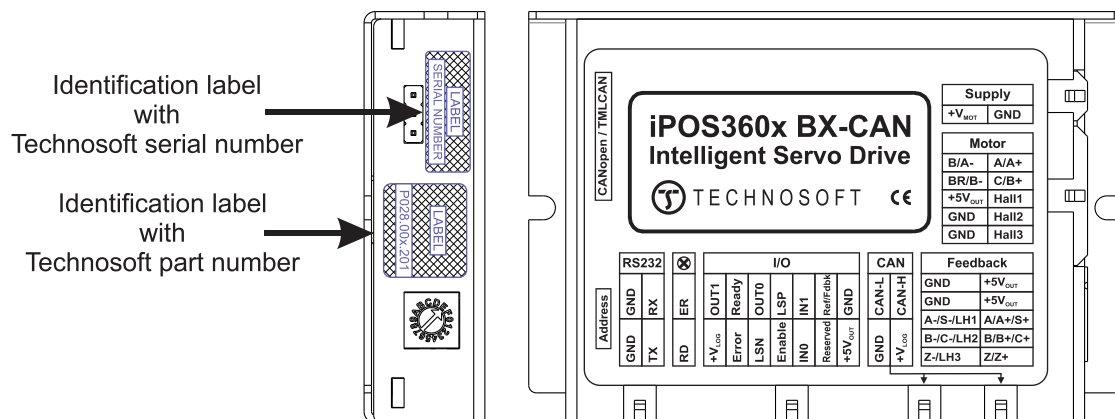


Figure 2.3.1. iPOS360X BX-CAN identification labels

The iPOS360X BX can has the following part number and name on the identification label:

| Product Name           | Part Number   | Firmware | Description   |
|------------------------|---------------|----------|---|
| <b>iPOS3602 BX-CAN</b> | P028.001.E201 | F509x    | 2A nominal, Standard version, CAN, Differential encoder input |
| <b>iPOS3602 BX-CAN</b> | P028.001.E601 | F509x    | 2A nominal, Single-Ended encoder input, CAN                   |
| <b>iPOS3602 BX-CAN</b> | P028.001.E701 | F524x    | 2A nominal, Linear Hall version, CAN                          |
| <b>iPOS3604 BX-CAN</b> | P028.002.E201 | F508x    | 4A nominal, Standard version, CAN, Differential encoder input |
| <b>iPOS3604 BX-CAN</b> | P028.002.E601 | F508x    | 4A nominal, Single-Ended encoder input, CAN                   |
| <b>iPOS3604 BX-CAN</b> | P028.002.E701 | F523x    | 4A nominal, Linear Hall version, CAN                          |

## 2.4 Supported Motor-Sensor Configurations

The position and/or speed are controlled using one feedback sensor.

| Sensor type \ Motor                                      | Brushless PMSM | Brushless BLDC | DC Brush | Stepper 2 phase | Stepper 3 phase |
|--|----------------|----------------|----------|-----------------|-----------------|
| Incr. encoder***   | Yes            | -              | Yes      | Yes             | -               |
| Incr. encoder*** + Digital Hall                          | Yes            | Yes            | -        | -               | -               |
| Sin-Cos encoder**  | Yes            | -              | -        | -               | -               |
| Digital halls only                                       | Yes            | -              | -        | -               | -               |
| Linear Halls*  | Yes*           | -              | -        | -               | -               |
| Tacho  | -              | -              | Yes      | -               | -               |
| Open-loop (no sensor)                                    | -              | -              | -        | Yes             | Yes             |
| Open-loop (with step loss detection using incr. Encoder) | -              | -              | -        | Yes             | Yes             |
| Open-loop with incr. encoder on load                     | -              | -              | -        | Yes             | Yes             |

\*Linear Halls are supported with part number: P028.00x.**E701**

\*\*Sin-Cos encoder supported with part number: P028.00x. **E201**

\*\*\*Incremental encoder supported with part number: P028.00x. **E201** (differential) and P028.00x. **E601** (single-ended)

## 3 Hardware Installation

### 3.1 iPOS360X BX-CAN Board Dimensions

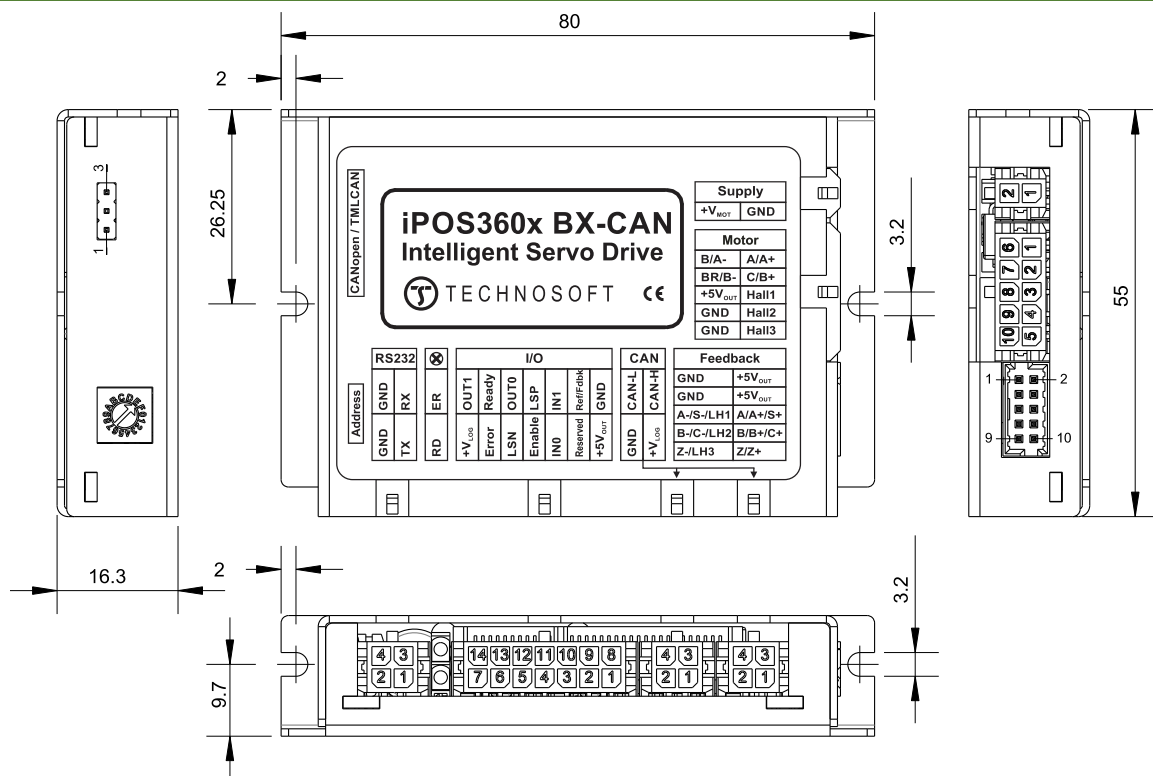


Figure 3.1.1. iPOS360X BX-CAN drive dimensions

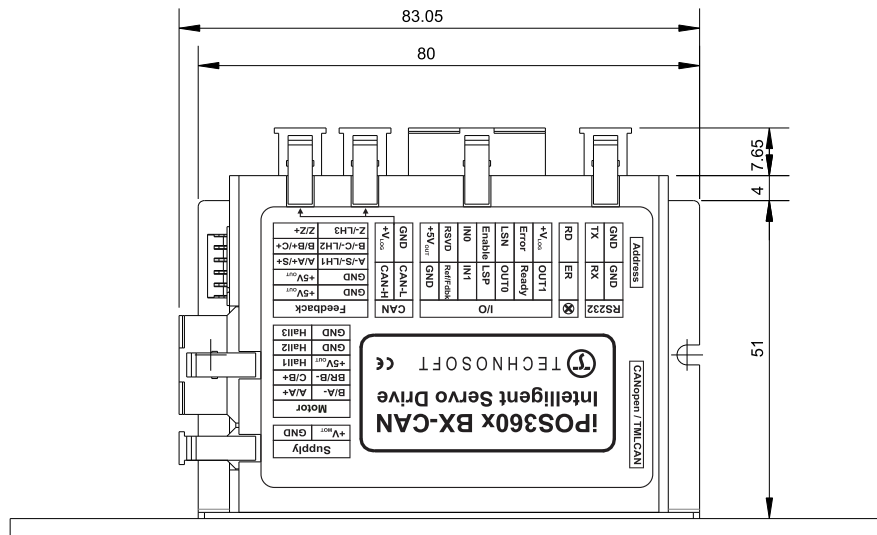
All dimensions are in mm. The drawings are not to scale.

## 3.2 Mechanical Mounting

The iPOS360x BX-CAN drive is intended to be mounted vertically or horizontally on a metallic support using the provided mounting holes and the recommended mating connectors, as specified in chapter **Error! Reference source not found.**3.4.4.

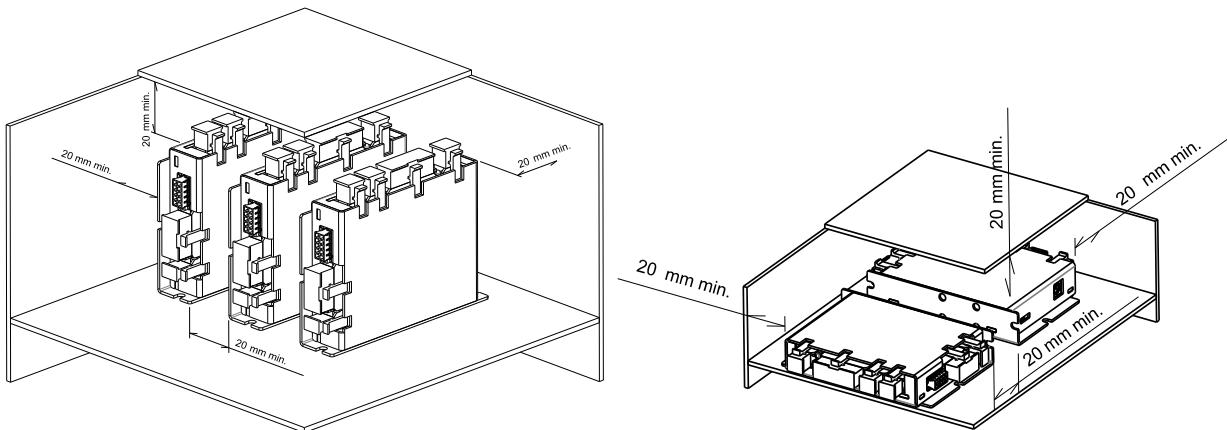
For thermal calculations, each iPOS360x drive can be assumed to generate 1 Watt at idle, and up to 5 Watts (= 17 BTU/hour) worst case while driving a motor and using all digital outputs.

When the iPOS360x BX-CAN is mounted vertically, its overall envelope (size) including the recommended mating connectors is shown in Figure 3.1. Fixing the iPOS360x BX-CAN onto a support using the provided mounting holes is strongly recommended to avoid vibration and shock problems.



**Figure 3.2.1.** iPOS360x BX-CAN dimensions with mating connectors

The iPOS360x BX-CAN drive(s) can be cooled by natural convection. The support shall be thermally conductive (metallic), and can be mounted vertically or horizontally.



**Figure 3.2.2.** Recommended spacing for vertical and horizontal mounting, worst case: non-metallic, closed box

The figures above show the minimum spacing to assure proper airflow by natural convection.

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

If ventilation driven by natural convection is not enough to maintain the temperature surrounding the iPOS360x BX-CAN drive(s), then alternate forced cooling methods must be applied.

**Remark:** In case of using a metallic box, with ventilation openings, all spacing values may be reduced substantially. With proper ventilation, keeping the air surrounding the iPOS360x BX-CAN inside the limits indicated, the spacing values may be reduced down to zero.

### 3.3 EMC recommendations

The drive is compliant to the requirements of the following European directives, when installed as described in this User Manual:

- 93/68/EEC CE Marking Directive
- 2014/30/EU Electromagnetic Compatibility (EMC) Directive
- EN 61800-3:2012 Adjustable speed electrical power drive systems, Part3: EMC
- product standard

The drive shall be installed as shown in the Figure below, in order to meet the above EMC requirements:

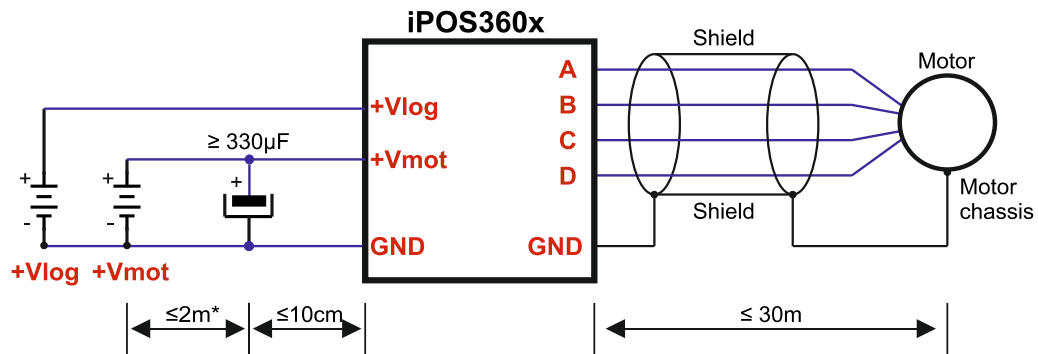


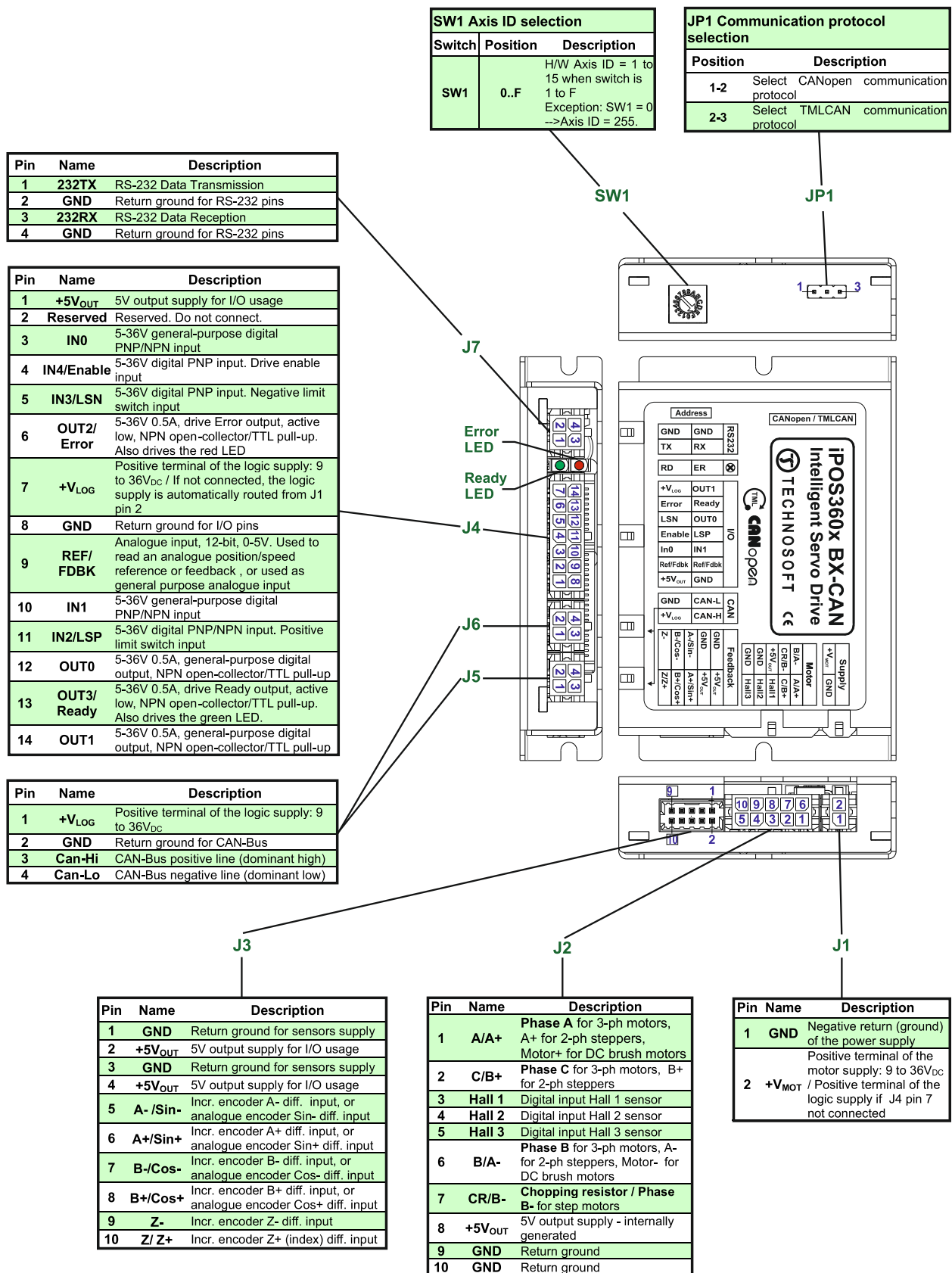
Figure 3.3 EMC recommended connections

\* if +Vmot to capacitor wire length  $\geq 2\text{m}$ , use twisted wires for the supply and ground return (Vmot and GND)

\* if +Vmot to capacitor wire length  $\geq 20\text{m}$ , the capacitor value must be  $\geq 2200\mu\text{F}$ .

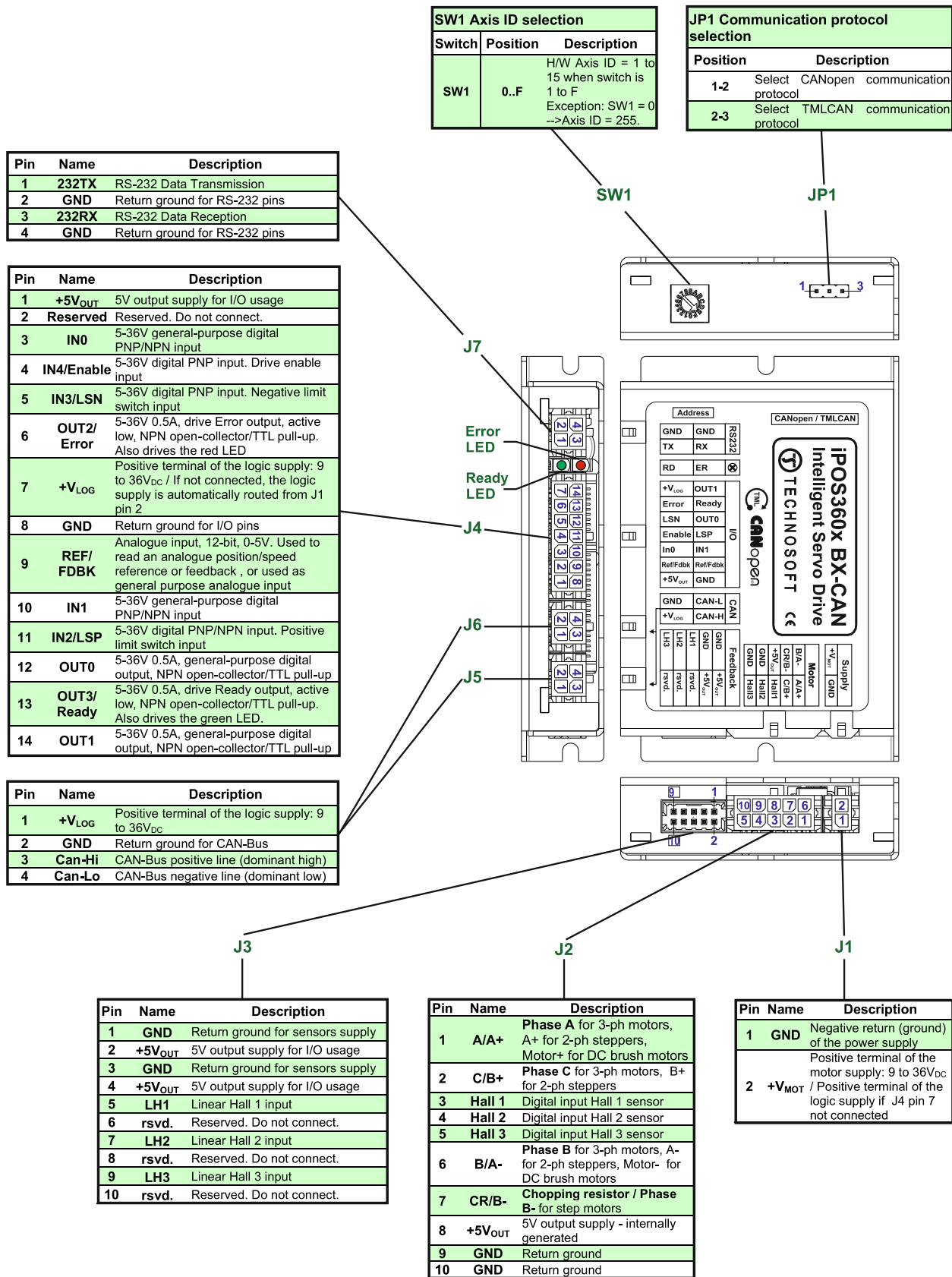
## 3.4 Connectors and Pinouts

### 3.4.1 Pinouts for iPOS360x BX-CAN (standard differential encoder version; P028.00x.E201)



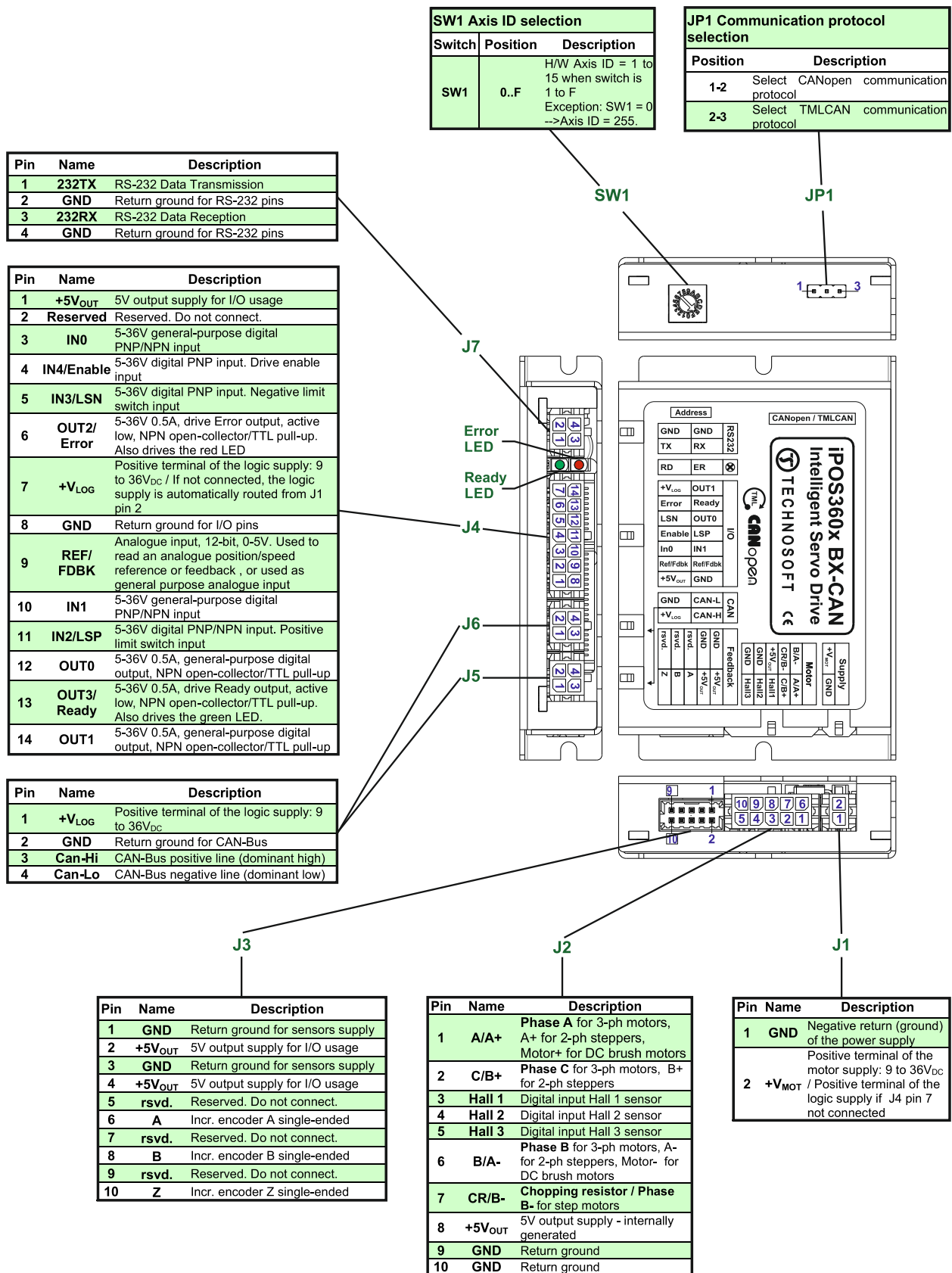
### 3.4.2 Pinouts for iPOS360x BX-CAN (linear halls encoder version; P028.00x.E701)

**Remark:** the linear halls version label contains LH1,2,3 signals present for J3 description.












### 3.4.3 Pinouts for iPOS360x BX-CAN (single-ended encoder version; P028.00x.E601)



### 3.4.4 Mating Connectors (for all versions)

| Image   | Connector             | Description                            | Manufacturer | Part Number | Image   |
|---|-----------------------|--|--------------|-------------|---|
|  | J1                    | MICRO-FIT receptacle housing, 2x1 way  | MOLEX        | 43025-0200  |  |
|   | J2                    | MICRO-FIT. receptacle housing, 2x5 way | MOLEX        | 43025-1000  |   |
|  | J5, J6, J7            | MICRO-FIT receptacle housing, 2x2 way  | MOLEX        | 43025-0400  |  |
|   | J4                    | MICRO-FIT receptacle housing, 2x7 way  | MOLEX        | 43025-1400  |   |
|  | J1,J2,J4,<br>J5,J6,J7 | CRIMP PIN, MICRO-FIT, 5A               | MOLEX        | 43030-0007  |   |
|   |                       |  |              |             |   |
|  | J3                    | CRIMP PIN, MILLI-GRID                  | MOLEX        | 50394-8400  |  |
|   | J3                    | MILLI-GRID receptacle housing, 2x5 way | MOLEX        | 51110-1056  |   |

## 3.5 Connection diagrams

### 3.5.1 iPOS360X BX-CAN connection diagram (differential encoder input version)

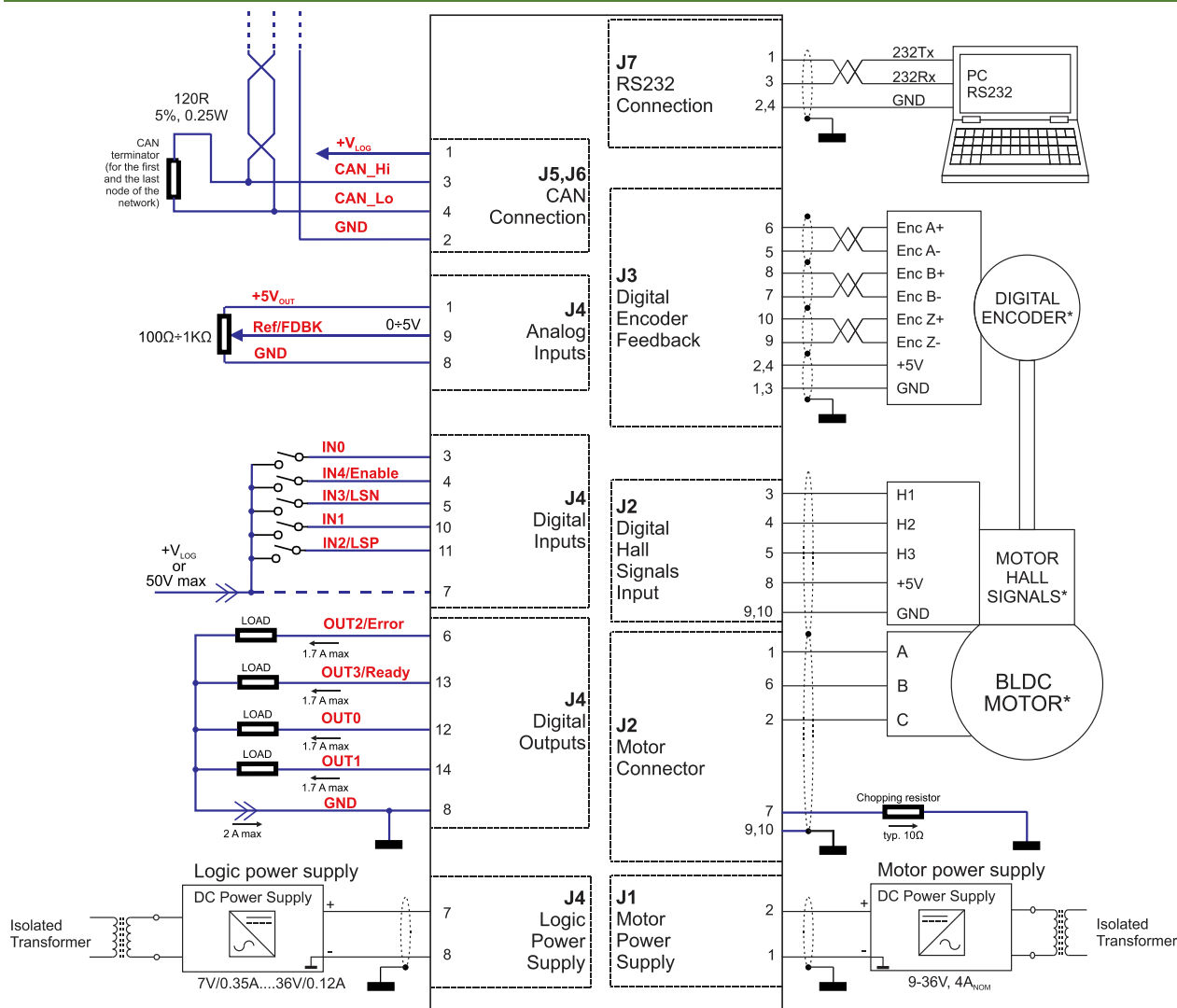


Figure 3.4. iPOS360X BX-CAN Connection diagram with a differential encoder

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

3.5.2 iPOS360X BX-CAN connection diagram (Linear Halls input version)

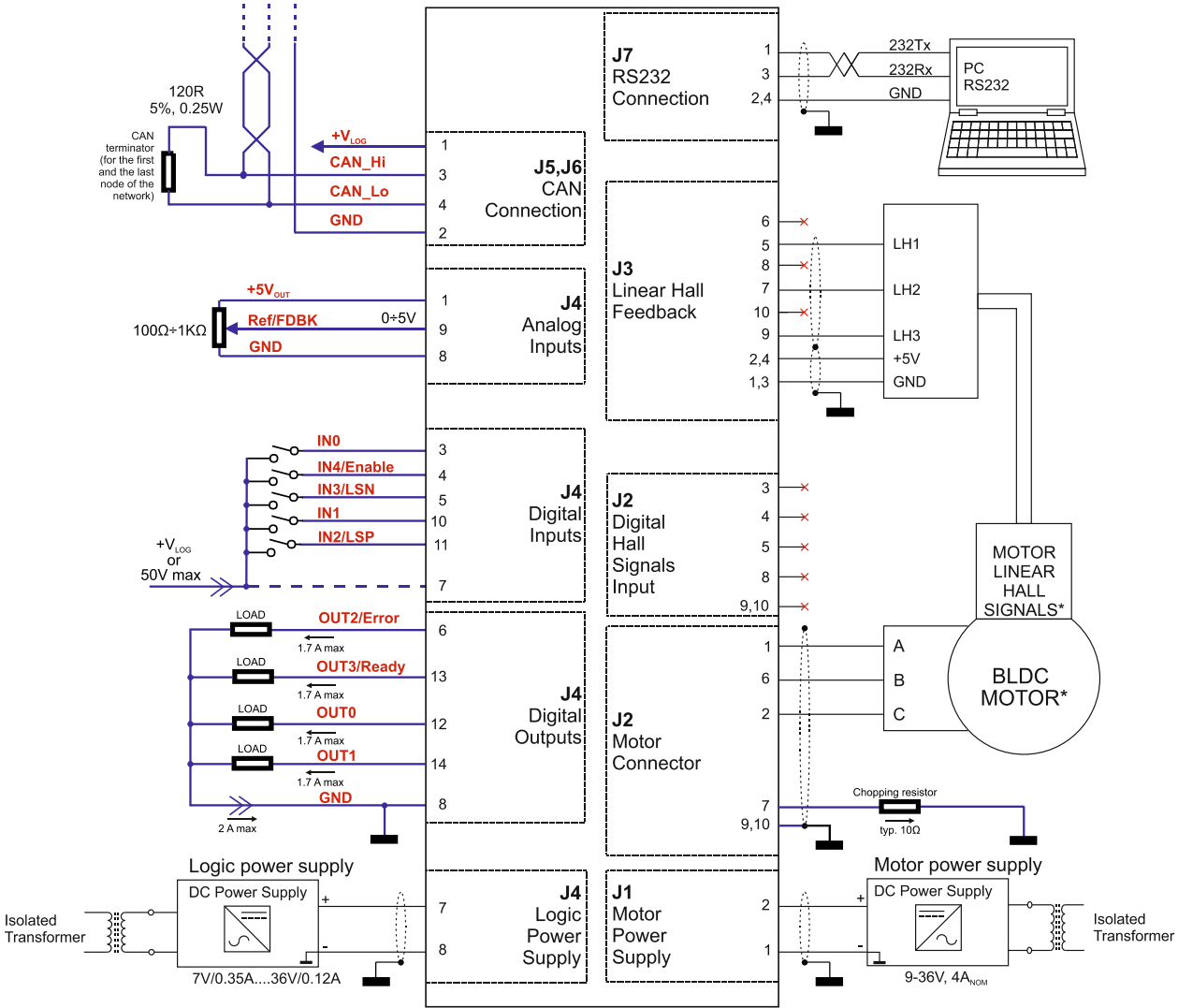


Figure 3.5. iPOS360X BX-CAN Connection diagram with Linear Halls

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

3.5.3 iPOS360X BX-CAN connection diagram (single-ended encoder input version)

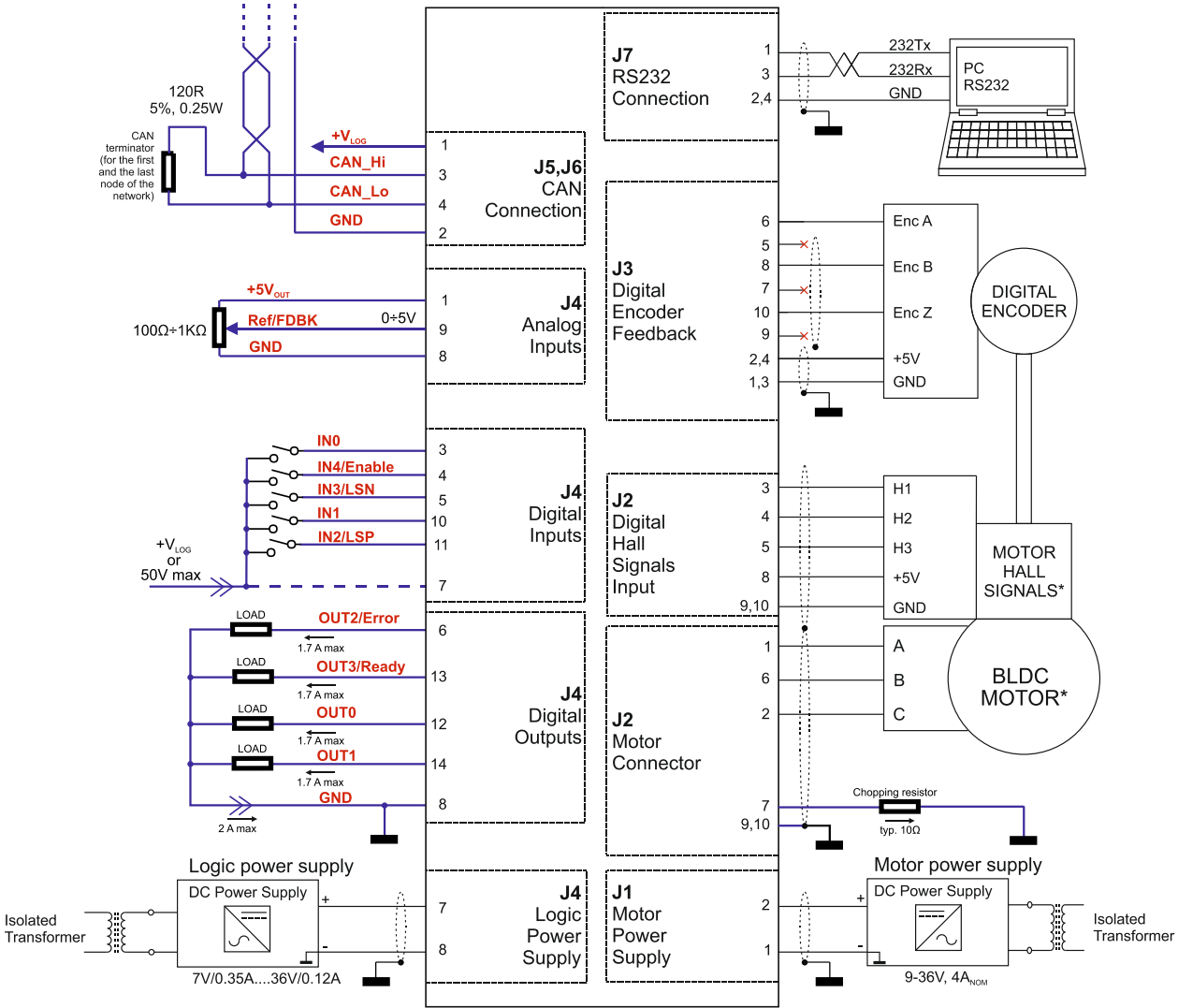


Figure 3.6. iPOS360X BX-CAN Connection diagram with a single-ended encoder

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

### 3.5.4 24V Digital I/O Connection

#### 3.5.4.1 PNP inputs

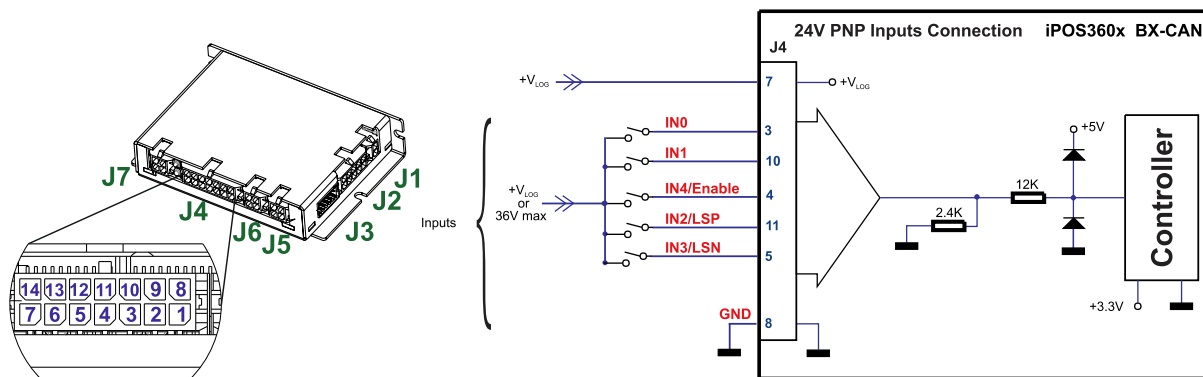


Figure 3.7. 24V Digital PNP Inputs connection

#### Remarks:

1. If Vlog is not supplied, the digital inputs will not work.
2. The inputs are selectable as PNP/ NPN by software.
3. The inputs are compatible with PNP type outputs (input must receive a positive voltage value (5-36V) to change its default state)

#### 3.5.4.2 NPN inputs

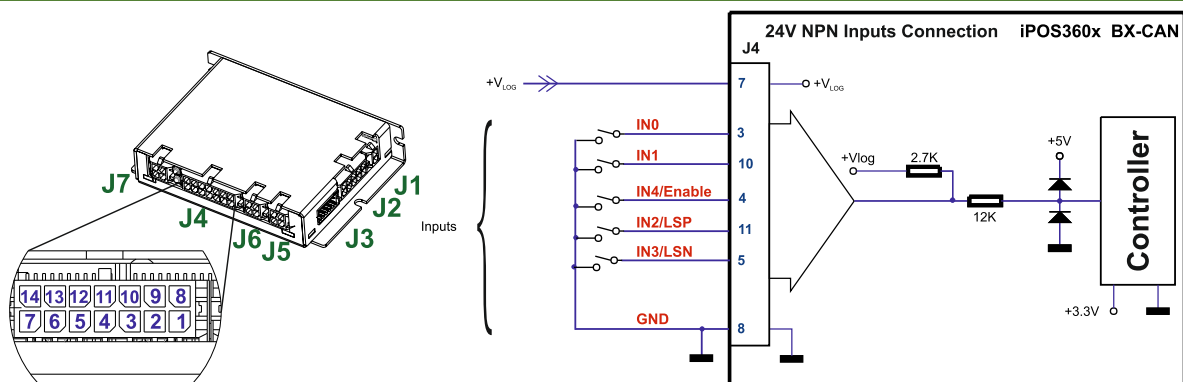


Figure 3.8. 24V Digital NPN Inputs connection

#### Remarks:

1. If Vlog is not supplied, the digital inputs will not work.
2. The inputs are selectable as PNP/ NPN by software.
3. The inputs are compatible with NPN type outputs (input must be pulled to GND to change its default state)

### 3.5.4.3 NPN outputs

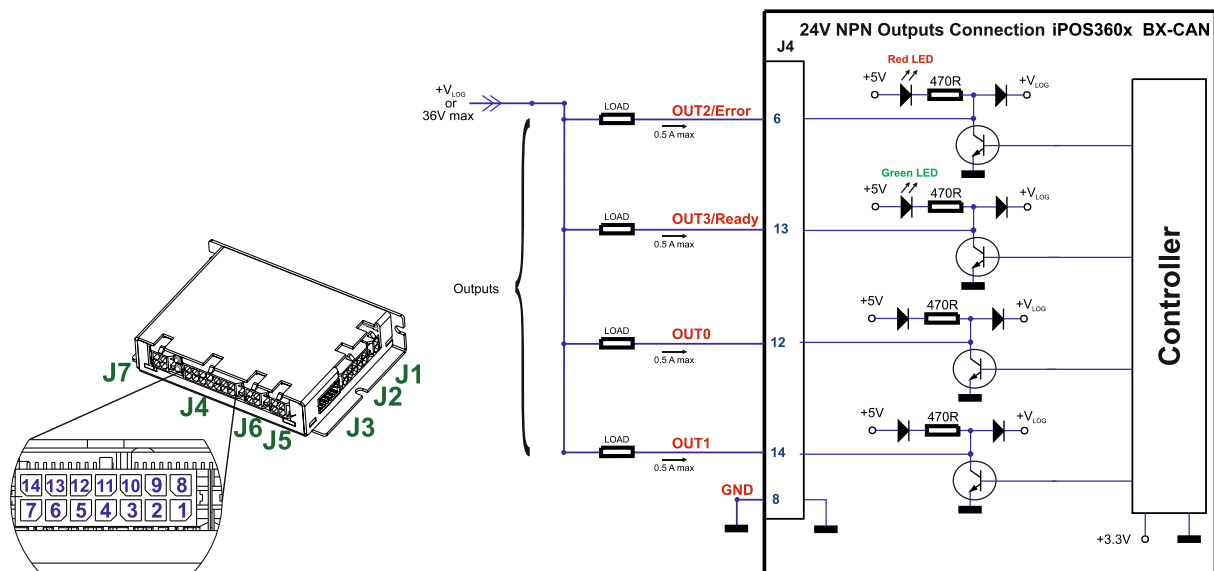


Figure 3.9. 24V Digital NPN Outputs connection

#### Remarks:

1. The outputs are compatible with NPN type inputs (load is tied to common +VLOG, output pulls to GND when active and is floating when inactive)
2. The outputs are NOT compatible with PNP inputs! Even if it seems to work, proper operation is NOT guaranteed!

### 3.5.5 5V Digital I/O Connection

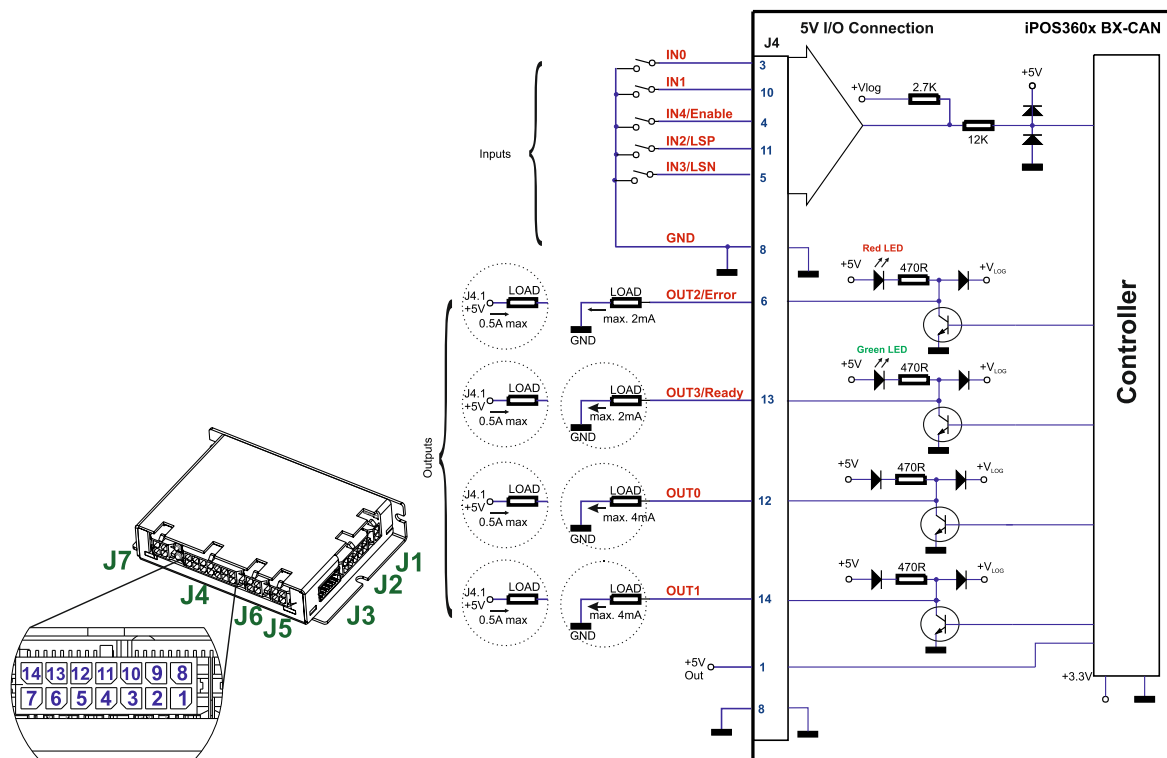


Figure 3.10. 5V Digital I/O connection

#### Remarks:

1. The inputs are selectable as PNP/ NPN by software. For this connection they are selected as NPN.
2. The inputs are compatible with TTL(5V), LVTTTL(3.3V), CMOS and open collector outputs
3. The outputs are compatible with TTL (5V) inputs
4. The output loads can be individually and independently connected to +5V or to GND.

### 3.5.6 Analog Inputs Connection

#### 3.5.6.1 0-5V Input Range

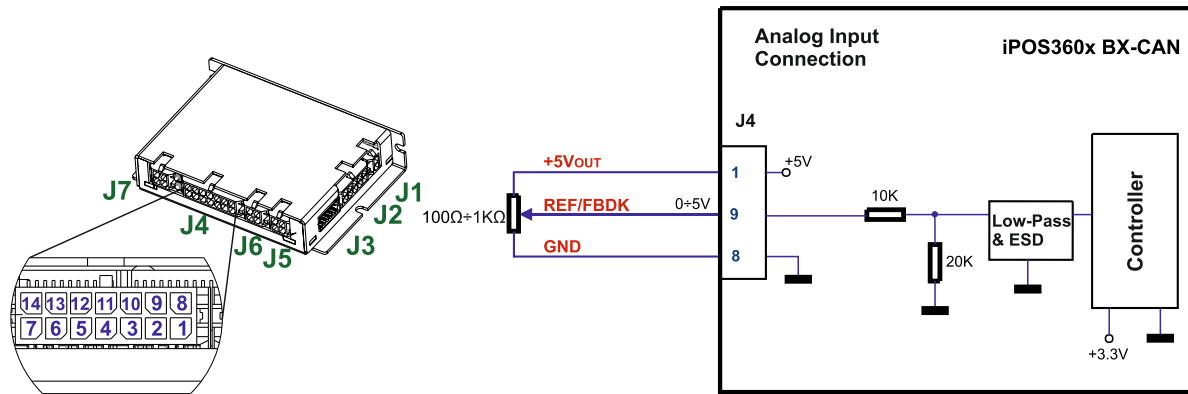


Figure 3.11. 0-5V Analog inputs connection

#### Remarks:

1. The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.
2. Default input range for analog inputs is 0÷5 V for REF and FBDK. For a +/-10 V range, see [Figure 3.7](#).

#### 3.5.6.2 +/-10V to 0-5V Input Range Adapter

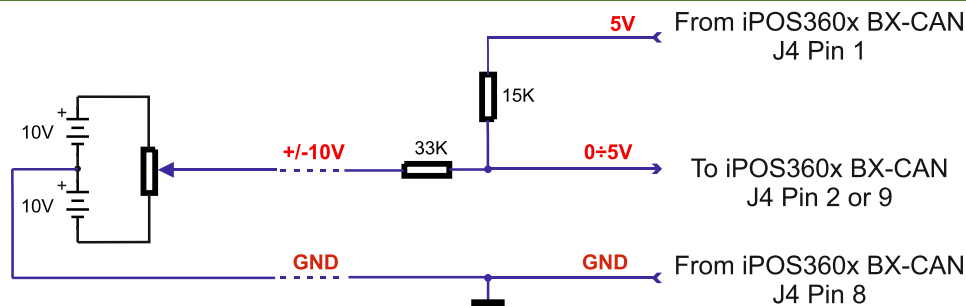


Figure 3.12. +/-10V to 0-5V adapter

Equivalent input impedance is 43Kohm. Floating input voltage is 3.3V. For best TML conversion, use the following parameters: RFOFSSET=0xC00 (3072); RFGAIN=0x8839 (34873) in your project file.

#### 3.5.6.3 Recommendation for wiring

- a) If the analogue signal source is single-ended, use a 2-wire twisted shielded cable as follows: 1<sup>st</sup> wire connects the live signal to the drive input; 2<sup>nd</sup> wire connects the source ground to the drive ground; shield will be connected to the drive ground terminal.
- b) If the analogue signal source is differential and the signal source ground is isolated from the drive GND, use a 2-wire twisted shielded cable as follows: 1<sup>st</sup> wire connects the source plus (positive, in-phase) to the drive analogue input; 2<sup>nd</sup> wire connects the source minus (negative, out-of-phase) to the drive ground (GND). Shield is connected only at the drive side, to the drive GND, and is left unconnected at the source side.
- c) If the analogue signal source is differential and the signal source ground is common with the drive GND, use a 2-wire shielded cable as follows: 1<sup>st</sup> wire connects the source plus (positive, in-phase) to the drive analogue input; 2<sup>nd</sup> wire connects the source ground to the drive ground (GND); shield is connected only at the drive side, to the drive GND, and is left unconnected at the source side. The source minus (negative, out-of-phase) output remains unconnected.



3.5.7 Motor connections

3.5.7.1 Brushless Motor connection

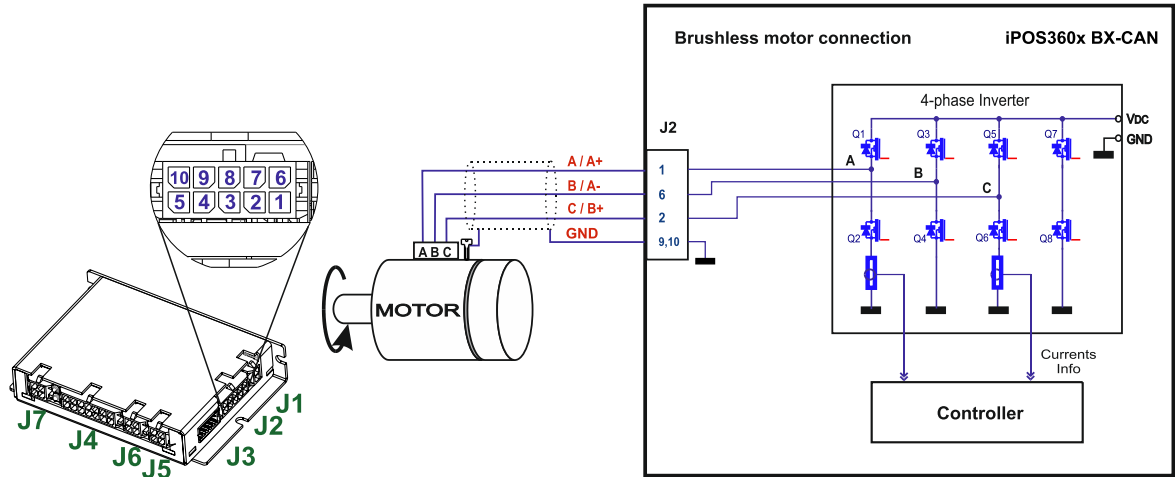


Figure 3.13. Brushless motor connection

3.5.7.2 2-phase Step Motor connection

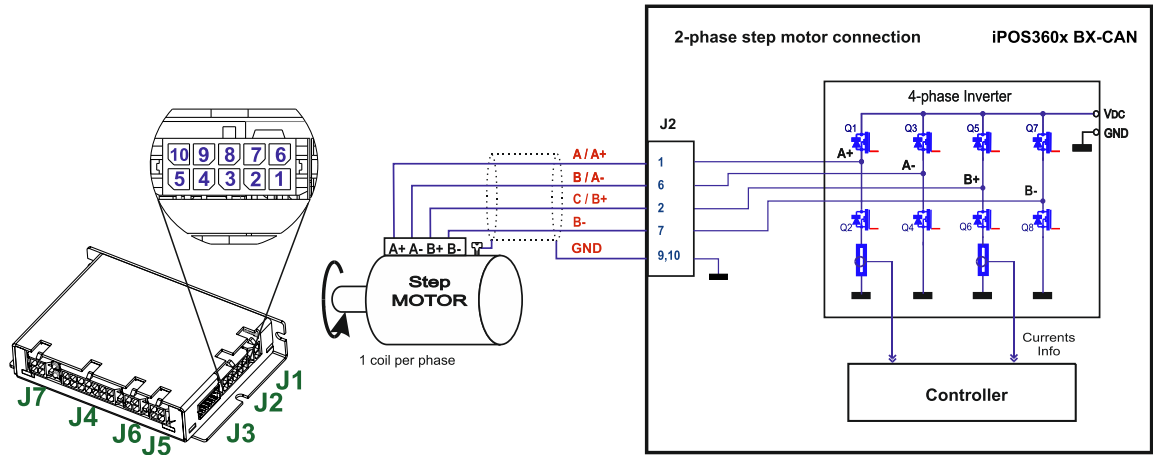


Figure 3.14. 2-phase step motor connection, one coil per phase

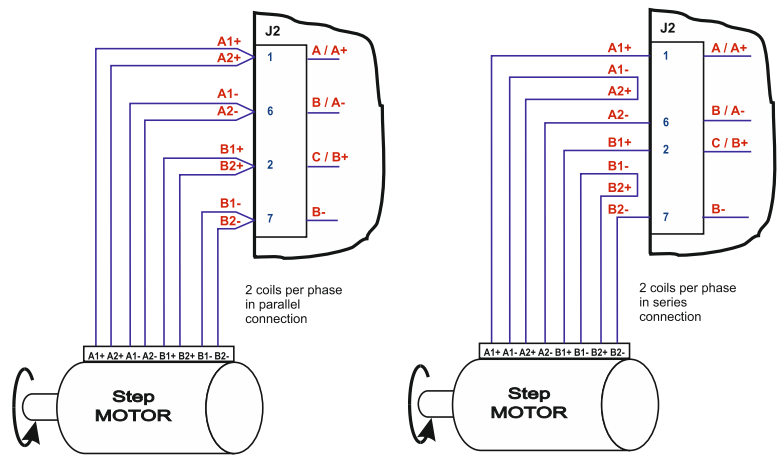


Figure 3.15. 2-phase step motor connection, two coils per phase

### 3.5.7.3 3-Phase Step Motor connection

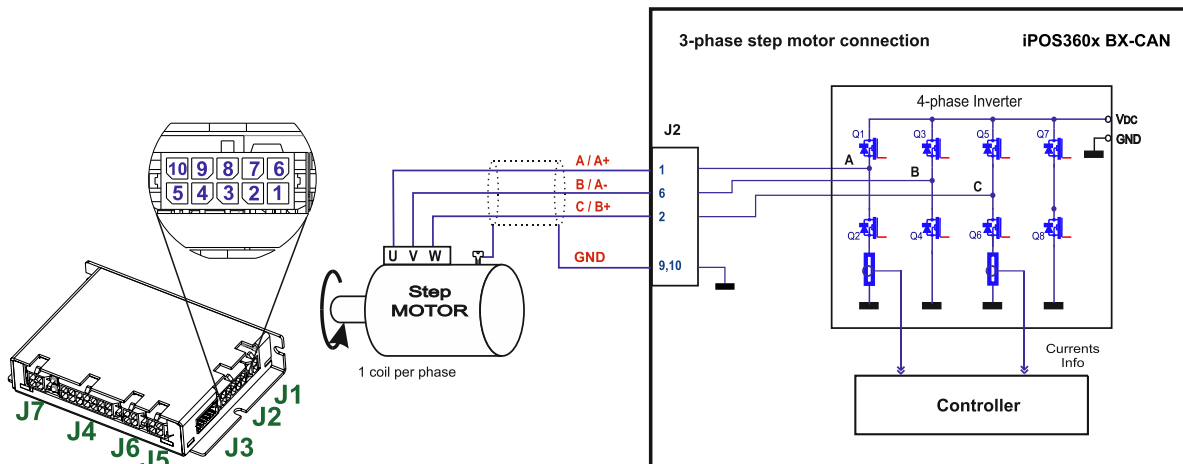


Figure 3.16. 3-phase step motor connection

### 3.5.7.4 DC Motor connection

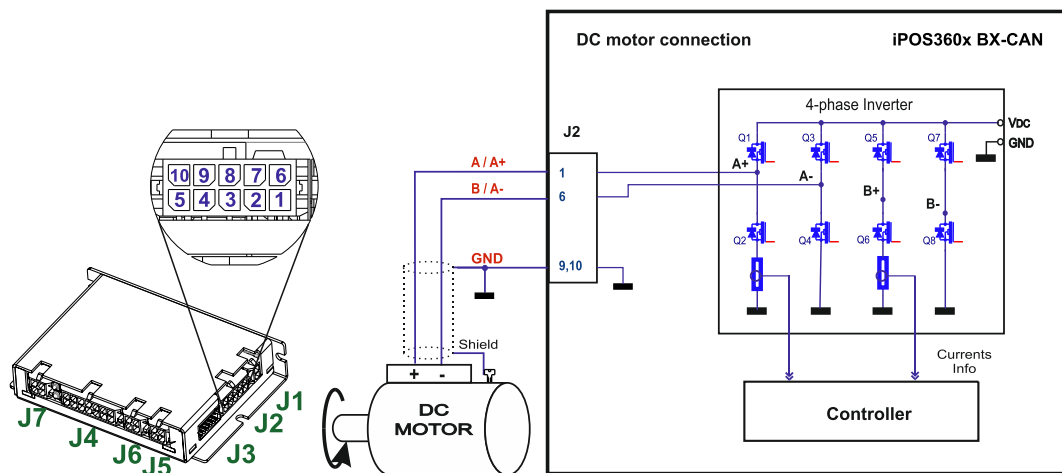


Figure 3.17. DC Motor connection

### 3.5.7.5 Recommendations for motor wiring

- 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 iPOS360X GND pin. Leave the other end disconnected.
- 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 iPOS360X 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  $\mu$ H.
- A good shielding can be obtained if the motor wires are running inside a metallic cable guide.

### 3.5.8 Feedback connections

#### 3.5.8.1 Single-ended Incremental Encoder Connection ( only with P028.00x.E601)

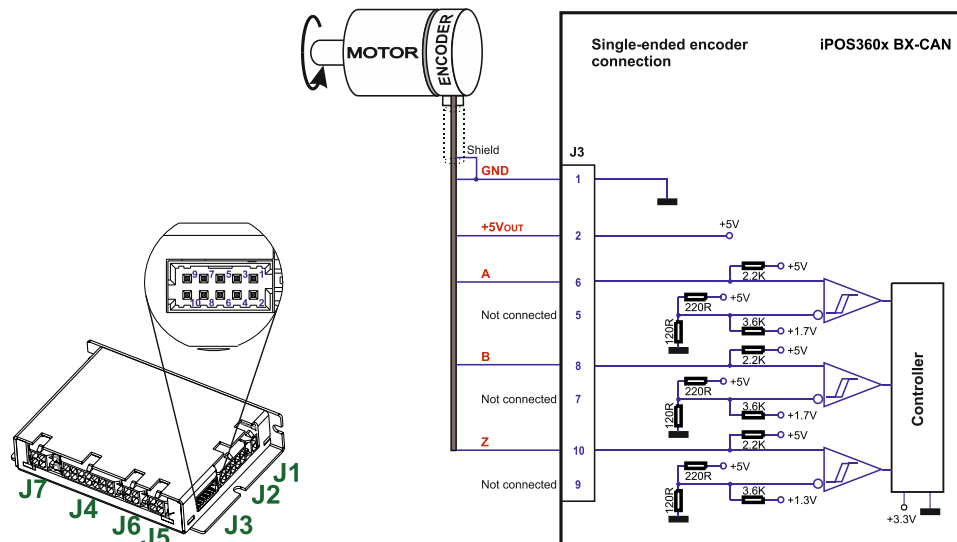


Figure 3.18. Single-ended incremental encoder connection



**CAUTION!**

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

#### 3.5.8.2 Differential Incremental Encoder Connection ( only with P028.00x.E201)

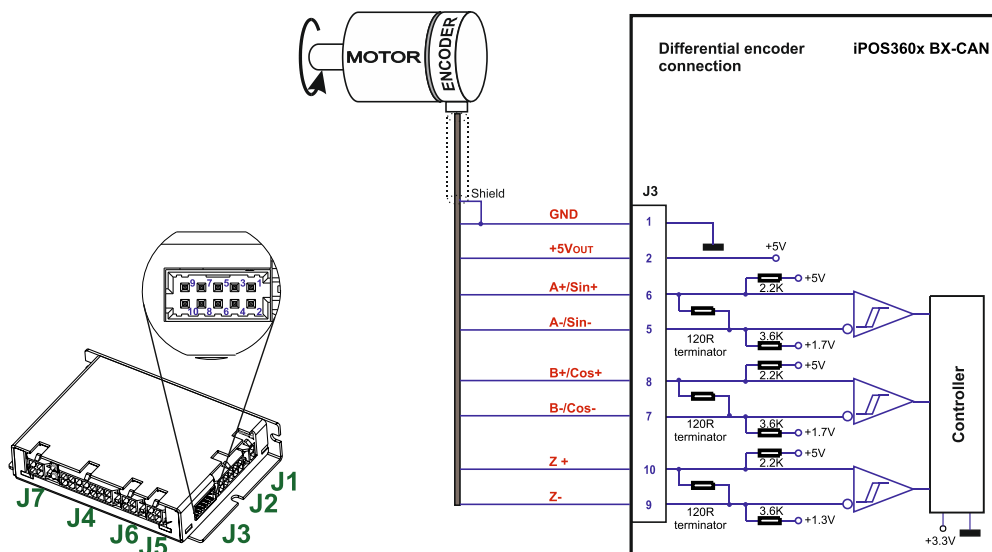


Figure 3.19. Differential incremental encoder connection

#### Remarks:

1. For the encoder differential connection, internal 120 $\Omega$  (0.25W) terminators are included in the drive.
2. The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.

### 3.5.8.3 Digital Hall Connection for Motor + Hall + Incremental Encoder

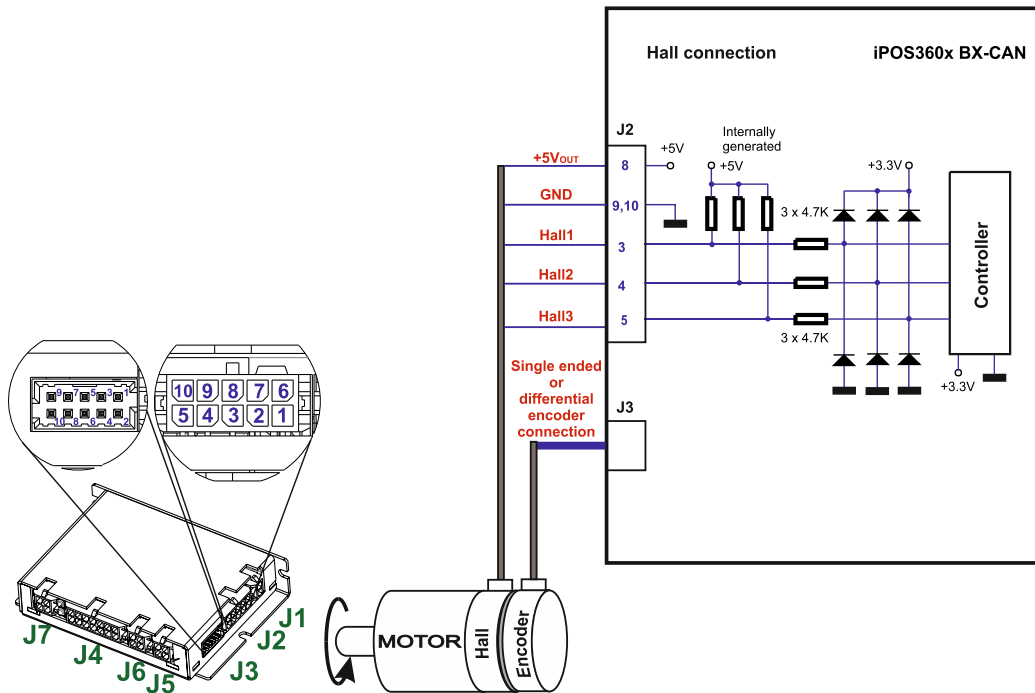


Figure 3.20. Digital Hall connection

#### Remarks:

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

### 3.5.8.4 Digital Hall Connection for direct motor control without an encoder ( only with P028.00x.E601)

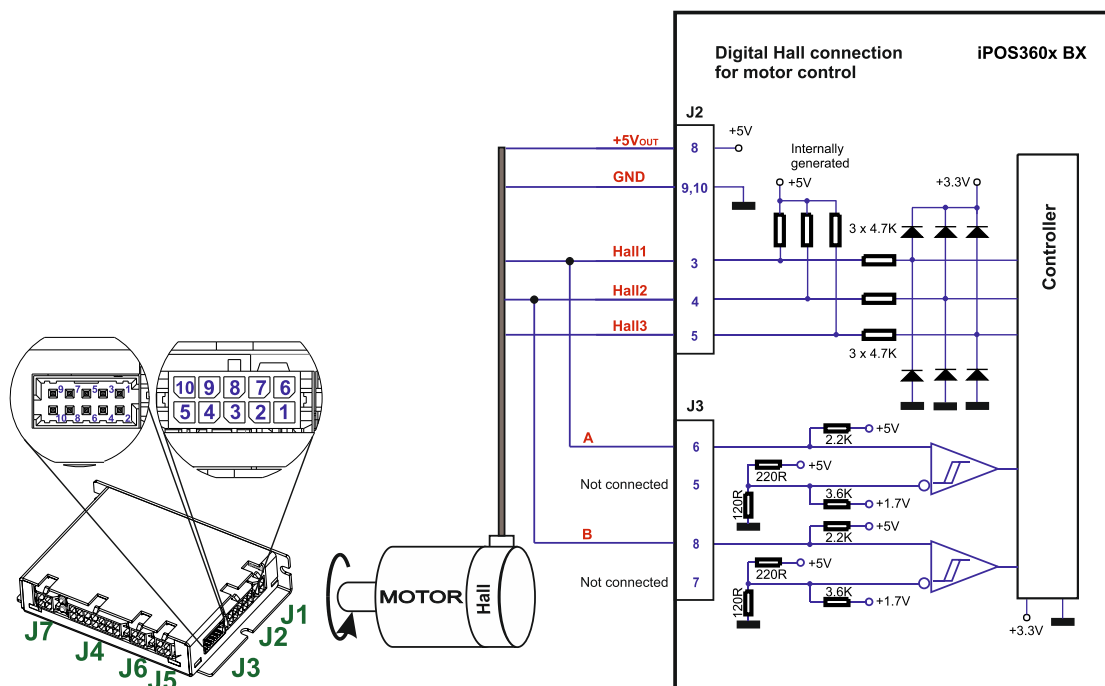


Figure 3.21. Digital Hall connection

#### Remarks:

1. This connection is required when using only Digital hall signals as the main feedback device for motor control. In this case, no incremental encoder is needed.
2. Do not connect unterminated wires. They might pick up unwanted noise and give false encoder readings.
3. The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.

### 3.5.8.5 Linear Hall Connection ( only with P028.00x.E701)

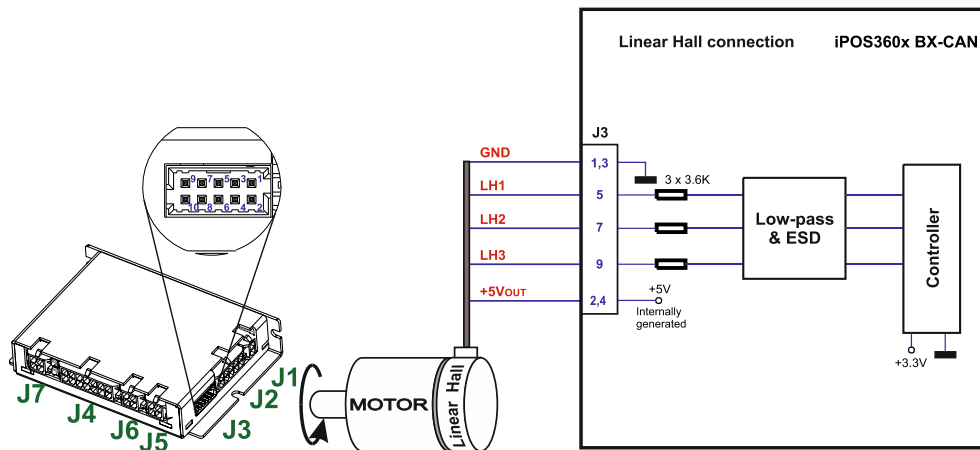


Figure 3.22. Linear Hall connection

### 3.5.8.6 Sin-Cosine Analog Encoder Connection ( only with P028.00x.E201)

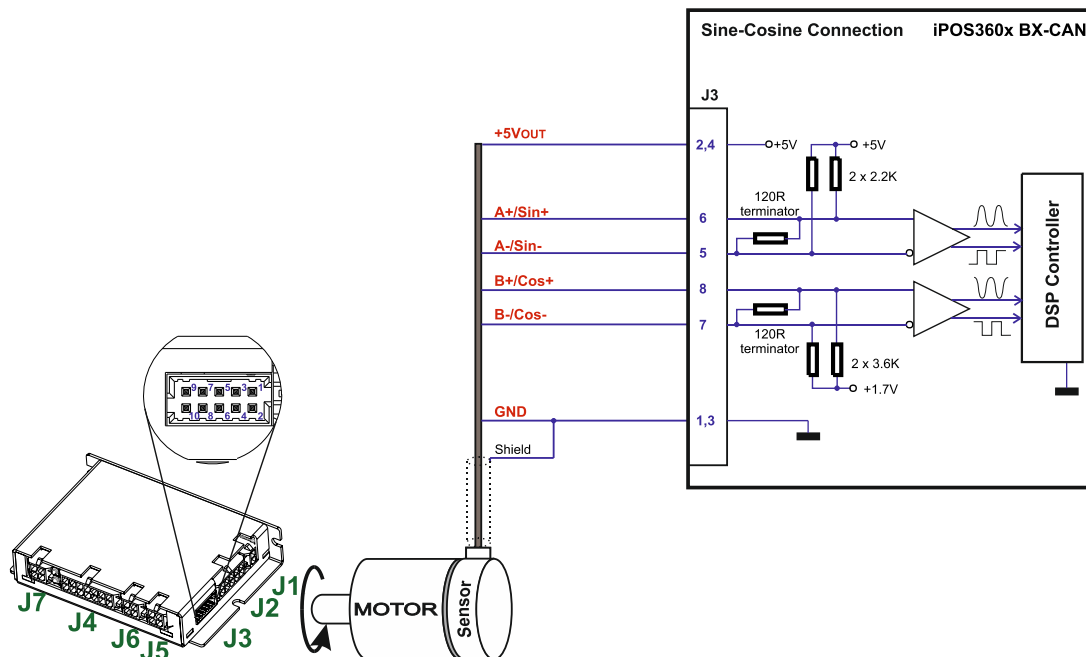


Figure 3.23. Sine-Cosine analog encoder connection

### 3.5.8.7 Recommendations for wiring

- Always connect both positive and negative signals when the position sensor is differential and provides them. Use one twisted pair for each differential group of signals as follows: A+/Sin+ with A-/Sin-, B+/Cos+ with B-/Cos-, Z+ with Z-. Use another twisted pair for the 5V supply and GND.
- Always use shielded cables to avoid capacitive-coupled noise when using single-ended encoders or Hall sensors with cable lengths over 1 meter. Connect the cable shield to the GND, at only one end. This point could be either the iPOS360x (using the GND pin) or the encoder / motor. Do not connect the shield at both ends.
- If the iPOS360x 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  $\mu\text{F}$ , rated at 6.3V
- For the differential connection, internal 120 $\Omega$  (0.25W) terminators are included in the drive.

### 3.5.9 Power Supply Connection

#### 3.5.9.1 Supply Connection

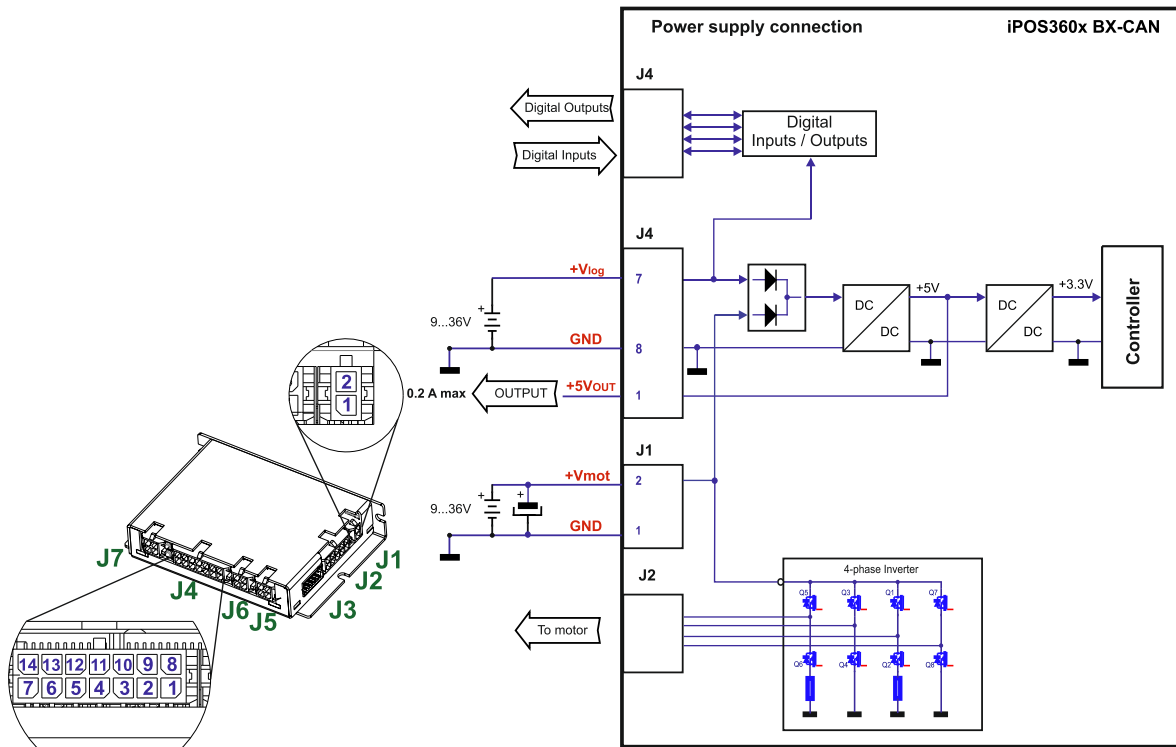


Figure 3.24. Supply connection



#### CAUTION!

*The logic power supply requires a minimum rising slew-rate of 75V/s in order to correctly sample the operation mode and AxisID settings. The drive starts to operate from 4.9V and samples correctly the AD circuit from 7V.*

#### 3.5.9.2 Recommendations for Supply Wiring

Always provide a nearby capacitor on the motor supply lines. The capacitor should be located within 10cm of the iPOS360x edge connector, max. 20cm. The minimum recommended capacitance is 330µF for iPOS3604, or 220µF for iPOS3602, always rated at the appropriate voltage.

Use short, thick wires between the iPOS360x and the motor power supply. Connect power supply wires to all the indicated pins. If the wires are longer than 2 meters, use twisted wires for the supply and ground return. For wires longer than 20 meters, add a capacitor of at least 2,200µF (rated at an appropriate voltage) right on the terminals of the iPOS3604, respectively 1,000µF for the iPOS3602.

#### 3.5.9.3 Recommendations to limit over-voltage during energy regeneration

During abrupt motion decelerations 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 gets higher than 39V, the drive over-voltage protection is triggered and the drive power stage is disabled. In order to avoid this situation you have 2 options:

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

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

where:

$U_{MAX}$  = 38V 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:

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

where:

$J_M$  – total rotor inertia [kgm<sup>2</sup>]

$J_L$  – total load inertia as seen at motor shaft after transmission [kgm<sup>2</sup>]

$\omega_M$  – 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<sup>2</sup>]

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

$h_{\text{final}}$  – final system altitude [m]

$I_M$  – motor current during deceleration [A<sub>RMS</sub>/phase]

$R_{Ph}$  – motor phase resistance [ $\Omega$ ]

$t_d$  – time to decelerate [s]

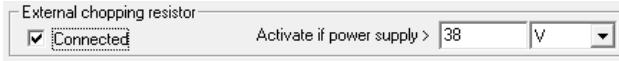
$T_F$  – total friction torque as seen at motor shaft [Nm] – includes load and transmission

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  $\omega_M$  will become linear speed measured in [m/s] and the friction torque  $T_F$  will become friction force measured in [N].

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

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

The chopping resistor option can be found in the Drive Setup dialogue within EasyMotion / EasySetup.



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

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

### Chopping resistor selection

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

1. to limit the maximum current below the drive peak current  $I_{PEAK} = 3.2A$  for iPOS3602 and  $I_{PEAK} = 10A$  for iPOS3604.

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

2. to sustain the required *braking power*:

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

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

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

3. to limit the average current below the drive nominal current  $I_{NOM}=2A$  for iPOS3602 and  $4A$  for iPOS3604



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

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

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

**Remarks:**

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

|   |                 |  |
|---|-----------------|--|
|  | <b>WARNING!</b> | <b>THE CHOPPING RESISTOR MAY HAVE HOT SURFACES DURING OPERATION.</b> |
|---|-----------------|--|

### 3.5.10 Serial RS-232 connection

#### 3.5.10.1 Serial RS-232 connection

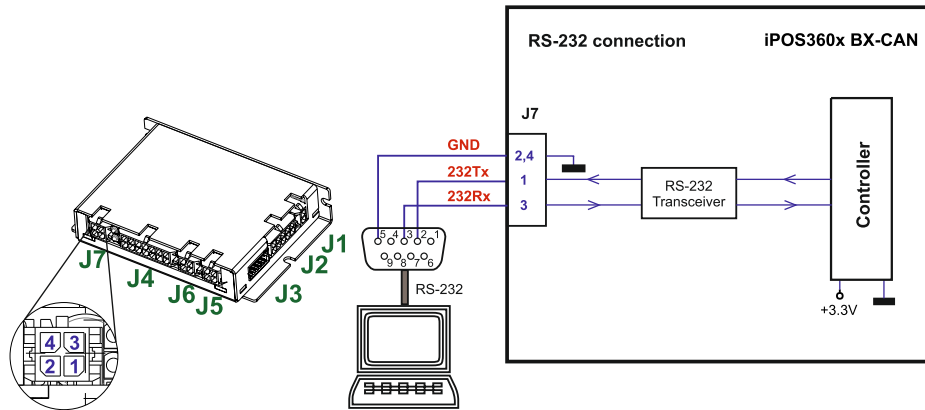


Figure 3.25. Serial RS-232 connection

#### 3.5.10.2 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 must be included inside the shield, like the 232Rx and 232Tx signals
- b) Always power-off all the iPOS360X supplies before inserting/removing the RS-232 serial connector
- c) Do not rely on an earthed PC to provide the iPOS360X GND connection! The drive must be earthed through a separate circuit. Most communication problems are caused by the lack of such connection

### 3.5.11 CAN-bus connection

#### 3.5.11.1 CAN connection

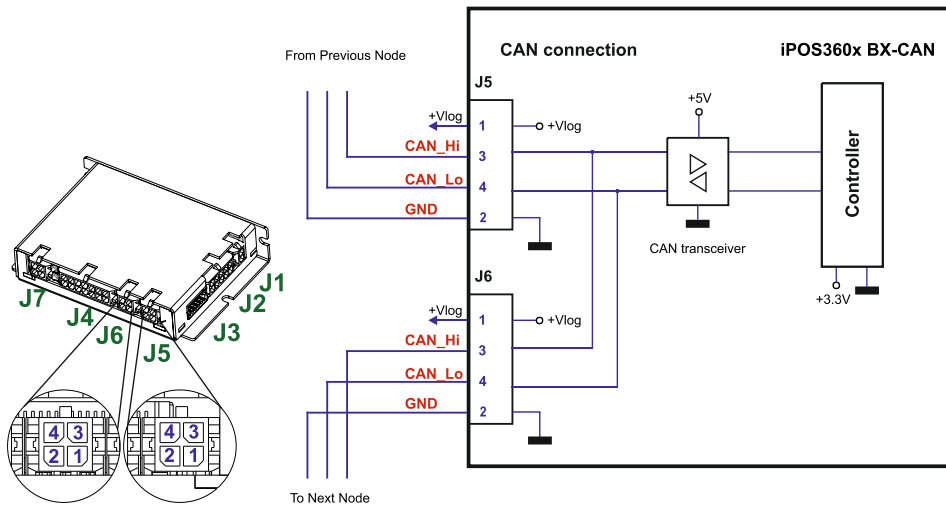


Figure 3.26. CAN connection

#### Remarks:

1. The CAN network requires a 120-Ohm terminator. This is not included in the drive. Figure 3.22 shows how to connect it on your network
2. CAN signals can sustain up to +/-36V without damage.

#### 3.5.11.2 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) 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.
- c) The 120Ω termination resistors must be rated at 0.2W minimum. Do not use winded resistors, which are inductive.

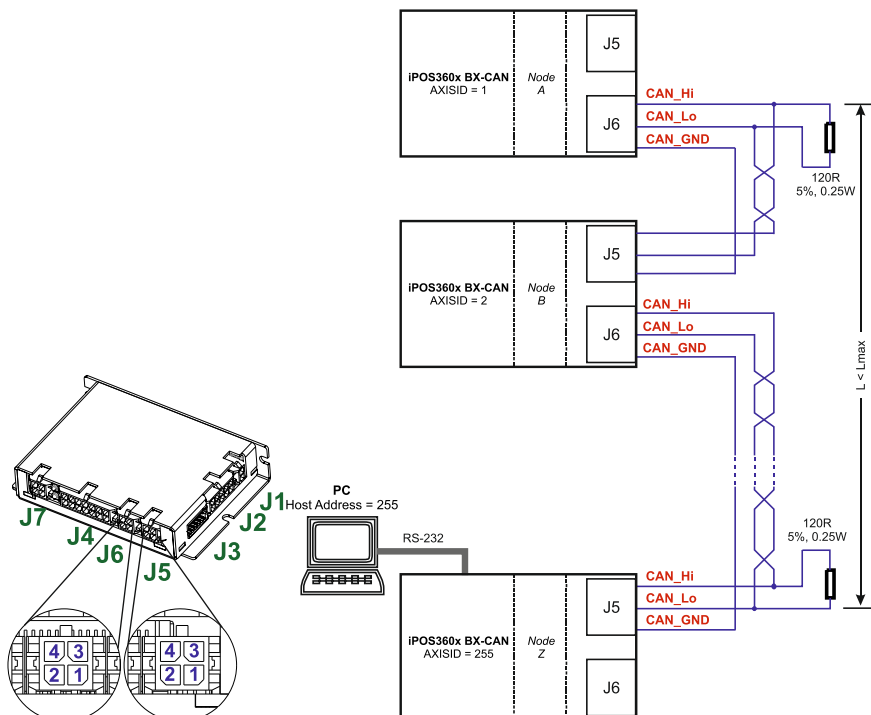


Figure 3.27. Multiple-Axis CAN network

### 3.5.12 Disable of Autorun Mode

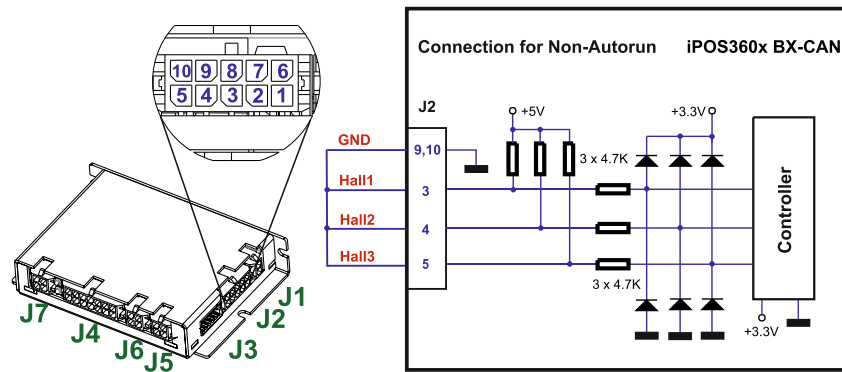


Figure 3.28. Temporary connection during power-on to disable the drive from Autorun mode

When the iPOS360x is configured for TMLCAN communication protocol, the default operation mode is *Autorun*. If a TML program is present in the EEPROM of the drive, the iPOS360x will start its execution.

In case the TML program becomes corrupted, i.e. due to strong electromagnetic fields, the *Autorun* mode can be disabled by:

- Software: writing the value **1** in the first EEPROM location (address 0x4000). You can use the *Command Interpreter* from EasySetUp / EasyMotion Studio to execute the following instructions:  
**var\_i1 = 0x4000; (var\_i1), spi = 1;**
- Hardware:
  - connecting all digital Hall inputs to GND, as shown in **Figure 3.23**. This option is particularly useful when you are unable to establish communication with the drive.
  - temporarily connect JP1 in position 1-2 to switch to CANopen protocol. After a drive restart, the drive will not auto-run any program while in CANopen. Reconfigure the settings as needed and switch back to TMLCAN.

After the drive is set in *slave / non-Autorun* mode using the second method, the first one may be used to disable the TML application from the EEPROM. On next power on the drive will enter in the *slave / non-Autorun* mode independently of the digital Hall inputs status

## 3.6 CAN Operation Mode and Axis ID Selection

### 3.6.1 Selection of the Operation Mode

On iPOS360x BX-CAN, the selection of the operation mode CANopen or TMLCAN is done by setting the JP1 position:

- CANopen mode, JP1 = position 1-2
- TMLCAN mode, JP2 = position 2-3 or OFF

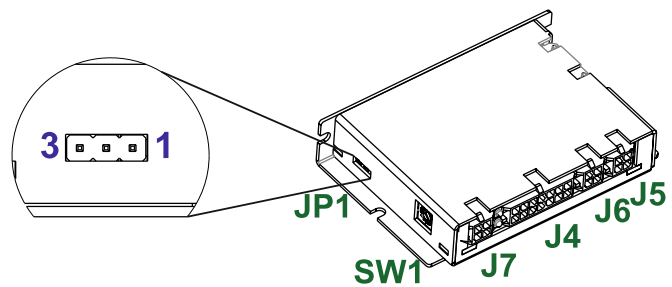


Figure 3.29. JP1 Location

3.6.2 Selection of the Axis ID

The Hardware Axis ID selection is done through the hex switch SW1. It contains numbers from 0x0 to 0xF. Depending on SW1 position, the axis ID will be:

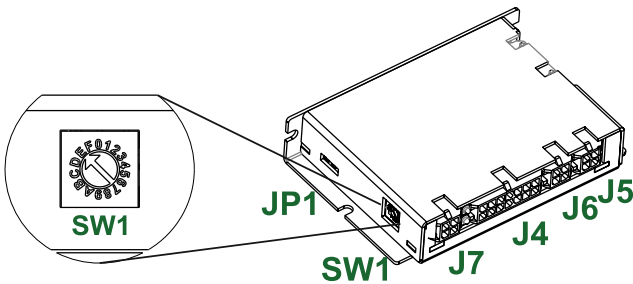


Figure 3.30. SW1 Location

| SW1 position | AxisID |
|--------------|--------|
| 0x0          | 255    |
| 0x1          | 1      |
| 0x2          | 2      |
| 0x3          | 3      |
| 0x4          | 4      |
| 0x5          | 5      |
| 0x6          | 6      |
| 0x7          | 7      |
| 0x8          | 8      |
| 0x9          | 9      |
| 0xA          | 10     |
| 0xB          | 11     |
| 0xC          | 12     |
| 0xD          | 13     |
| 0xE          | 14     |
| 0xF          | 15     |

3.6.3 LED indicators

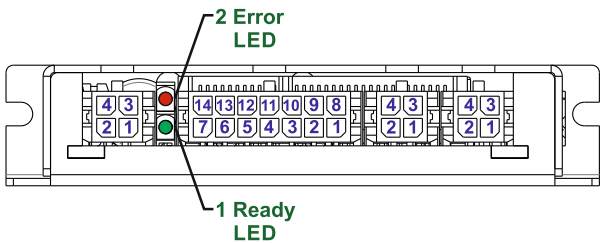


Figure 3.31. LED indicators

Table 3.1 – LED indicators

| LED no. | LED name    | LED color | Function  |
|---------|-------------|-----------|---|
| 1       | Drive Ready | green     | Lit after power-on when the drive initialization ends. Turned off when an error occurs.                               |
| 2       | Drive 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. |

### 3.7 Electrical Specifications

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

$T_{amb} = 0 \dots 40^{\circ}\text{C}$ ,  $V_{LOG} = 24 V_{DC}$ ;  $V_{MOT} = 24V_{DC}$ ; Supplies start-up / shutdown sequence: **-any-**

Load current (sinusoidal amplitude / continuous BLDC,DC,stepper) = 4A iPOS3604/ 2A iPOS3602

#### 3.7.1 Operating Conditions

|                                  |                                    | Min.           | Typ.     | Max.         | Units              |
|----------------------------------|------------------------------------|----------------|----------|--------------|--------------------|
| Ambient temperature              | iPOS360X BX-CAN                    | 0              |          | +40          | $^{\circ}\text{C}$ |
| Ambient humidity                 | Non-condensing                     | 0              |          | 90           | %Rh                |
| Altitude / pressure <sup>1</sup> | Altitude (referenced to sea level) | -0.1           | 0 + 2.5  | <sup>1</sup> | Km                 |
|                                  | Ambient Pressure                   | 0 <sup>1</sup> | 0.75 + 1 | 10.0         | atm                |

#### 3.7.2 Storage Conditions

|                                   |   | Min. | Typ. | Max.      | Units              |
|-----------------------------------|---|------|------|-----------|--------------------|
| Ambient temperature               | iPOS360X BX-CAN                             | -40  |      | 105       | $^{\circ}\text{C}$ |
| Ambient humidity                  | Non-condensing                              | 0    |      | 100       | %Rh                |
| Ambient Pressure                  |   | 0    |      | 10.0      | atm                |
| ESD capability (Human body model) | Not powered; applies to any accessible part |      |      | $\pm 0.5$ | kV                 |
|                                   | Original packaging                          |      |      | $\pm 15$  | kV                 |

#### 3.7.3 Mechanical Mounting

|  |   | Min.                           | Typ. | Max. | Units |
|--|---|--------------------------------|------|------|-------|
| Airflow                                  |   | natural convection, closed box |      |      |       |
| Spacing required for vertical mounting   | Between adjacent drives                               | 30                             |      |      | mm    |
|  | Between drives and nearby walls                       | 30                             |      |      | mm    |
|  | Between drives and roof-top                           | 20                             |      |      | mm    |
| Spacing required for horizontal mounting | Between adjacent drives                               | 4                              |      |      | mm    |
|  | Between drives and nearby walls                       | 5                              |      |      | mm    |
|  | Space needed for drive removal                        | 10                             |      |      | mm    |
|  | Between drives and roof-top                           | 15                             |      |      | mm    |
| Insertion force                          | Using recommended mating connectors; without retainer |                                | 20   | 36   | N     |
| Extraction force                         |   | 5                              | 10   |      | N     |

#### 3.7.4 Environmental Characteristics

|   |                                     | Min.                          | Typ. | Max. | Units |
|---|-------------------------------------|-------------------------------|------|------|-------|
| iPOS360x BX-CAN<br>Size ( Length x Width x Height ) | Without mating connectors           | 80 x 55 x 16.3                |      |      | mm    |
|   |                                     | ~3.15 x 2.17 x 0.64           |      |      | inch  |
|   | With recommended mating connectors. | 84 x 63 x 16.3                |      |      | mm    |
|   |                                     | ~3.3 x 2.5 x 0.64             |      |      | inch  |
| Weight  |                                     |                               | 70   |      | g     |
| Cleaning agents                                     | Dry cleaning is recommended         | Only Water- or Alcohol- based |      |      |       |
| Protection degree                                   | According to IEC60529, UL508        |                               | IP00 |      | -     |

#### 3.7.5 Logic Supply Input (+V<sub>LOG</sub>)

|                |  | Min. | Typ. | Max. | Units    |
|----------------|--|------|------|------|----------|
| Supply voltage | Nominal values   | 7    | 24   | 36   | $V_{DC}$ |
|                | Absolute maximum values, drive operating but outside guaranteed parameters | 4.9  |      | 42   | $V_{DC}$ |
|                | Absolute maximum values, surge (duration $\leq 10\text{ms}$ ) <sup>†</sup> | -1   |      | +45  | V        |
|                | Minimum power supply voltage rising slew-rate                              | 75   |      |      | V/s      |
| Supply current | +V <sub>LOG</sub> = 7V   |      | 125  | 300  | mA       |
|                | +V <sub>LOG</sub> = 12V  |      | 80   | 200  |          |
|                | +V <sub>LOG</sub> = 24V  |      | 50   | 125  |          |
|                | +V <sub>LOG</sub> = 40V  |      | 40   | 100  |          |

<sup>1</sup> iPOS360x 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.

### 3.7.6 Motor Supply Input (+V<sub>MOT</sub>)

|                |  |          | Min. | Typ. | Max. | Units           |
|----------------|--|----------|------|------|------|-----------------|
| Supply voltage | Nominal values   |          | 9    |      | 36   | V <sub>DC</sub> |
|                | Absolute maximum values, drive operating but outside guaranteed parameters     |          | 8.5  |      | 40   | V <sub>DC</sub> |
|                | Absolute maximum values, surge (duration ≤ 10ms) <sup>†</sup>                  |          | -1   |      | 45   | V               |
| Supply current | Idle   |          |      | 1    | 5    | mA              |
|                | Operating  | iPOS3604 | -10  | ±4   | +10  | A               |
|                |  | iPOS3602 | -3.2 | ±2   | +3.2 | A               |
|                | Absolute maximum value, short-circuit condition (duration ≤ 10ms) <sup>†</sup> | iPOS3604 |      |      | 15   | A               |
|                |  | iPOS3602 |      |      | 5    | A               |

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

|                                      |   | Min.                       | Typ. | Max. | Units |
|--------------------------------------|---|----------------------------|------|------|-------|
| Nominal output current, continuous   | for DC brushed, steppers and BLDC motors with Hall-based trapezoidal control          | iPOS3604                   |      | 4    | A     |
|                                      |   | iPOS3602                   |      | 2    |       |
|                                      | for PMSM motors with FOC sinusoidal control (sinusoidal amplitude value)              | iPOS3604                   |      | 4    |       |
|                                      |   | iPOS3602                   |      | 2    |       |
|                                      | for PMSM motors with FOC sinusoidal control (sinusoidal effective value)              | iPOS3604                   |      | 2.82 |       |
| Motor output current, peak           | maximum 2.5s  | iPOS3604                   | -10  | +10  | A     |
|                                      | maximum 24s   | iPOS3602                   | -3.2 | +3.2 |       |
| Short-circuit protection threshold   | measurement range   | iPOS3604                   | ±13  | ±15  | A     |
|                                      |   | iPOS3602                   | ±4.3 | ±5   |       |
| Short-circuit protection delay       |   | 5                          | 10   |      | µs    |
| On-state voltage drop                | Nominal output current; including typical mating connector contact resistance         |                            | ±0.3 | ±0.5 | V     |
| Off-state leakage current            |   |                            | ±0.5 | ±1   | mA    |
| Motor inductance (phase-to-phase)    | Recommended value, for ripple ±5% of measurement range; +V <sub>MOT</sub> = 36 V      | F <sub>PWM</sub> = 20 kHz  | 250  |      | µH    |
|                                      |   | F <sub>PWM</sub> = 40 kHz  | 120  |      |       |
|                                      |   | F <sub>PWM</sub> = 80 kHz  | 60   |      |       |
|                                      |   | F <sub>PWM</sub> = 60 kHz  | 100  |      |       |
|                                      |   | F <sub>PWM</sub> = 100 kHz | 45   |      |       |
|                                      | Absolute minimum value, limited by short-circuit protection; +V <sub>MOT</sub> = 36 V | F <sub>PWM</sub> = 20 kHz  | 75   |      | µH    |
|                                      |   | F <sub>PWM</sub> = 40 kHz  | 25   |      |       |
|                                      |   | F <sub>PWM</sub> = 60 kHz  | 20   |      |       |
|                                      |   | F <sub>PWM</sub> = 80 kHz  | 10   |      |       |
|                                      |   | F <sub>PWM</sub> = 100 kHz | 5    |      |       |
| Motor electrical time-constant (L/R) | Recommended value, for ±5% current measurement error due to ripple                    | F <sub>PWM</sub> = 20 kHz  | 250  |      | µs    |
|                                      |   | F <sub>PWM</sub> = 40 kHz  | 125  |      |       |
|                                      |   | F <sub>PWM</sub> = 60 kHz  | 100  |      |       |
|                                      |   | F <sub>PWM</sub> = 80 kHz  | 63   |      |       |
|                                      |   | F <sub>PWM</sub> = 100 kHz | 50   |      |       |
| Current measurement accuracy         | FS = Full Scale   |                            | ±4   | ±8   | %FS   |

### 3.7.8 Digital Inputs (IN0, IN1, IN2/LSP, IN3/LSN, IN4/Enable)

|                     |  | Min.   | Typ. | Max. | Units |
|---------------------|--|--|------|------|-------|
| Mode compliance     |  | PNP  |      |      |       |
| Default state       | Input floating (wiring disconnected)         | Logic LOW  |      |      |       |
| Input voltage       | Logic "LOW"                                  |  | 0    | 1.6  | V     |
|                     | Logic "HIGH"                                 | 1.8  | 24   | 39   |       |
|                     | 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"                                 |  | 2.9  | 3.4  |       |
|                     |  | Min.   | Typ. | Max. | Units |
| Mode compliance     |  | NPN/ TTL / CMOS / LVTTTL (3.3V) / Open-collector |      |      |       |
| Default state       | Input floating (wiring disconnected)         | Logic HIGH                                       |      |      |       |
| Input voltage       | Logic "LOW"                                  | 2  | 5+24 |      | V     |
|                     | Logic "HIGH"                                 |  | 3    |      |       |
|                     | Floating voltage (not connected)             | -10  |      | +30  |       |
|                     | Absolute maximum, continuous                 | -20  |      | +40  |       |
|                     | Absolute maximum, surge (duration ≤ 1s)†     | 2  | 5+24 |      |       |
| Input current       | Logic "LOW"; Pulled to GND                   |  | 0.6  | 1    | mA    |
|                     | Logic "HIGH"; Internal 4.7KΩ pull-up to +3.3 | 0  | 0    | 0    |       |
|                     | Logic "HIGH"; Pulled to +5V                  |  | 0.15 | 0.2  |       |
|                     | Logic "HIGH"; Pulled to +24V                 |  | 2    | 2.5  |       |
| Input frequency     |  | 0  |      | 150  | kHz   |
| Minimum pulse width |  | 3.3  |      |      | µs    |
| ESD protection      | Human body model                             | ±2   |      |      | kV    |

### 3.7.9 Digital Outputs (OUT0, OUT2/Error, OUT3/ Ready)

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

### 3.7.10 Digital Hall Inputs (Hall1, Hall2, Hall3)

|                     |  | Min.                        | Typ. | Max. | Units |
|---------------------|--|-----------------------------|------|------|-------|
| Mode compliance     |  | TTL / CMOS / Open-collector |      |      |       |
| Default state       | Input floating (wiring disconnected)       | Logic HIGH                  |      |      |       |
| Input voltage       | Logic "LOW"                                |                             | 0    | 0.8  | V     |
|                     | Logic "HIGH"                               | 2                           | 5    |      |       |
|                     | 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    |
| ESD protection      | Human body model                           |                             | ±5   |      | kV    |

### 3.7.11 Analog 0..5V Input (REF/FDBK)

|                        |  | Min. | Typ. | Max. | Units                   |
|------------------------|--|------|------|------|-------------------------|
| Input voltage          | Operational range                                    | 0    |      | 4.95 | V                       |
|                        | Absolute maximum values, continuous                  | -12  |      | +18  |                         |
|                        | Absolute maximum, surge (duration ≤ 1s) †            |      |      | ±36  |                         |
| Input impedance        | To GND   |      | 30   |      | kΩ                      |
| Resolution             | 12   |      |      |      | bits                    |
| Integral linearity     |  |      |      |      | ±4 bits                 |
| Differential linearity | No missing codes                                     |      |      |      | ±1 bits                 |
| Offset error           | Assuming parameter R <sub>OFFSET</sub> =0            |      |      |      | ±4 bits                 |
| Gain error             | Assuming parameter R <sub>GAIN</sub> =0x7EB8 (32440) |      |      |      | ±1.5% % FS <sup>1</sup> |
| Bandwidth (-3dB)       | Software selectable                                  | 0    |      | 1    | kHz                     |
| ESD protection         | Human body model                                     | ±2   |      |      | kV                      |

<sup>1</sup> "FS" stands for "Full Scale"



### 3.7.12 Linear Hall Inputs (LH1, LH2, LH3) for PN P028.00x.E701

|                          |   | Min. | Typ.    | Max. | Units |
|--------------------------|---|------|---------|------|-------|
| Input voltage            | Operational range                       | 0    | 0.5+4.5 | 4.9  | V     |
|                          | Absolute maximum values, continuous     | -7   |         | +7   |       |
|                          | Absolute maximum, surge (duration ≤ 1s) | -11  |         | +14  |       |
| Input current            | Input voltage 0...+5V                   | -1   | ±0.9    | +1   | mA    |
| Interpolation resolution | Depending on software settings          | 9    |         | 13   | bits  |
| Frequency                |   | 0    |         | 4    | kHz   |
| ESD protection           | Human body model                        | ±1   |         |      | kV    |

### 3.7.13 Sin-Cos Encoder Inputs (Sin+, Sin-, Cos+, Cos-) for PN P028.00x.E201

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

### 3.7.14 Differential encoder inputs (A+, A-, B+, B-, Z+, Z-) for PN P028.00x.E201

|                              |                                   | Min.          | Typ. | Max. | Units |
|------------------------------|-----------------------------------|---------------|------|------|-------|
| Differential mode compliance |                                   | TIA/EIA-422-A |      |      |       |
| Input voltage, differential  | Hysteresis                        | ±0.06         | ±0.1 | ±0.2 | V     |
|                              | Operating range                   | -14           |      | +14  |       |
| Input voltage, common-mode   | Operating range (A+ to GND, etc.) | -11           |      | +14  |       |
| Input impedance              | A+, B+, Z+                        |               | 120  |      | Ω     |
|                              | A-, B-, Z-                        | 1.3           |      | 1.6  | kΩ    |
|                              | Differential mode                 | 0             |      | 10   | MHz   |
|                              | Differential mode                 | 50            |      |      | ns    |
| ESD protection               | Human body model                  | ±1            |      |      | kV    |

### 3.7.15 Single-ended encoder inputs (A, B, Z) for PN P028.00x.E601

|  |  | Min.                        | Typ. | Max. | Units |
|--|--|-----------------------------|------|------|-------|
| Single-ended mode compliance             | Leave negative inputs disconnected                   | TTL / CMOS / Open-collector |      |      |       |
| Input voltage, single-ended mode A, B    | Logic "LOW"  |                             |      | 1.6  | V     |
|  | Logic "HIGH"   | 1.8                         |      |      |       |
|  | Floating voltage (not connected)                     |                             | 4.5  |      |       |
| Input voltage, single-ended mode Z       | Logic "LOW"  |                             |      | 1.2  | V     |
|  | Logic "HIGH"   | 1.4                         |      |      |       |
|  | Floating voltage (not connected)                     |                             | 4.7  |      |       |
| Input current, single-ended mode A, B, Z | Logic "LOW"; Pull to GND                             |                             | 2.5  | 3    | mA    |
|  | Logic "HIGH"; Internal 2.2KΩ pull-up to +5           | 0                           | 0    | 0    |       |
| Input frequency                          | Single-ended mode, Open-collector / NPN              | 0                           |      | 500  | kHz   |
| Minimum pulse width                      | Single-ended mode, Open-collector / NPN              | 1                           |      |      | μs    |
| Input voltage, any pin to GND            | Absolute maximum values, continuous                  | -7                          |      | +7   | V     |
|  | Absolute maximum, surge (duration ≤ 1s) <sup>†</sup> | -11                         |      | +14  |       |
| ESD protection                           | Human body model                                     | ±1                          |      |      | kV    |

### 3.7.16 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    |

### 3.7.17 CAN-Bus

|                                  |                                   | Min.                               | Typ. | Max. | Units |
|----------------------------------|-----------------------------------|------------------------------------|------|------|-------|
| Compliance                       |                                   | ISO11898, CiA-301v4.2, 402         |      |      | 2v4.1 |
| Bit rate                         | Software selectable               | 250                                |      | 1000 | Kbps  |
| Bus length                       | 1Mbps                             |                                    |      | 40   | m     |
|                                  | 500Kbps                           |                                    |      | 100  |       |
|                                  | ≤ 250Kbps                         |                                    |      | 250  |       |
| Resistor                         | Between CAN-Hi, CAN-Lo            | none on-board                      |      |      |       |
| Node addressing                  | Hardware ( CANopen selection pin) | 127 (CANopen); 255 (TMLCAN);       |      |      |       |
|                                  | Software                          | 1 - 127 (CANopen); 1- 255 (TMLCAN) |      |      |       |
| Voltage, CAN-Hi or CAN-Lo to GND |                                   | -36                                |      | 36   | V     |
| ESD protection                   | Human body model                  | ±15                                |      |      | kV    |

### 3.7.18 Supply Output (+5V)

|                          |                         | Min.                        | Typ. | Max. | Units |
|--------------------------|-------------------------|-----------------------------|------|------|-------|
| +5V output voltage       | Current sourced = 350mA | 4.8                         | 5    | 5.2  | V     |
| +5V output current       | iPOS360X BX-CAN         | 250                         | 350  |      | mA    |
| Short-circuit protection |                         | Yes / Drive resets at event |      |      |       |
| Over-voltage protection  |                         | NOT protected               |      |      |       |
| ESD protection           | Human body model        | ±1                          |      |      | kV    |

### 3.7.19 Conformity

|                |  |
|----------------|--|
| EU Declaration | 2014/30/EU (EMC), 2014/35/EU (LVD),<br>2011/65/EU (RoHS), 1907/2006/EC (REACH),<br>93/68/EEC (CE Marking Directive),<br>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.

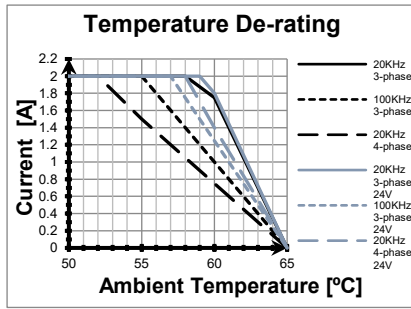


Figure 3.32 iPOS3602 BX De-rating with ambient temperature

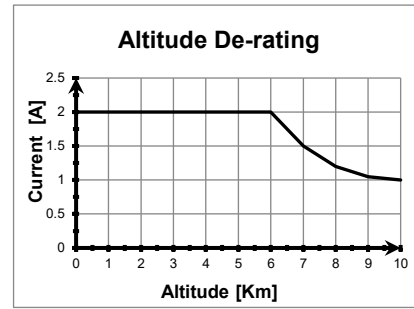


Figure 3.33 iPOS3602 BX De-rating with altitude

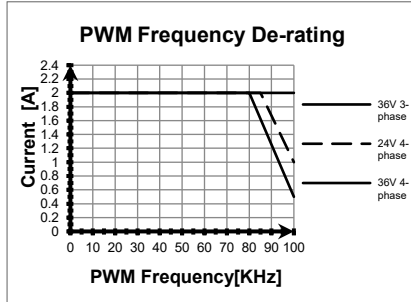


Figure 3.34 iPOS3602 BX Current De-rating with PWM frequency

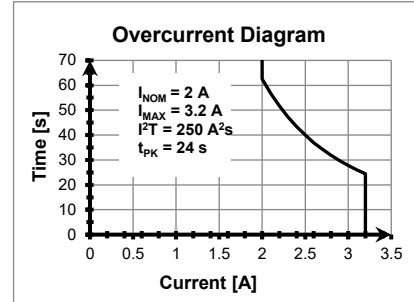


Figure 3.35 iPOS3602 BX Over-current diagram

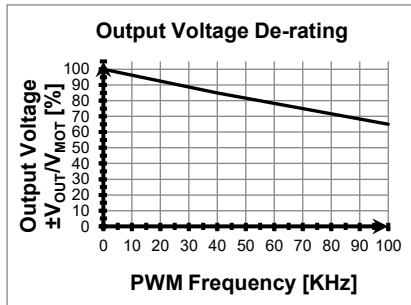


Figure 3.36. iPOS360x BX Output Voltage De-rating with PWM frequency<sup>1</sup>

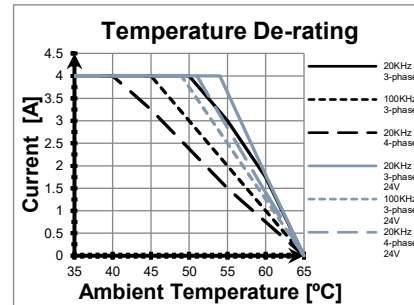


Figure 3.37. iPOS3604 BX De-rating with ambient temperature

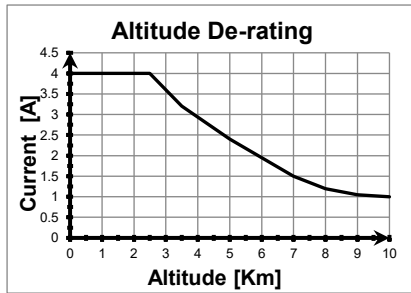


Figure 3.38. iPOS3604 BX De-rating with altitude

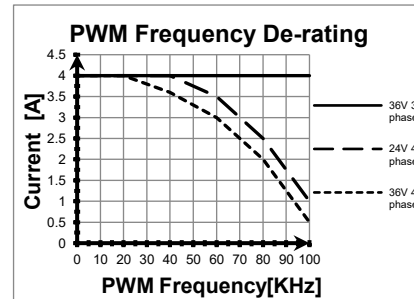


Figure 3.39. iPOS3604 BX Current De-rating with PWM frequency

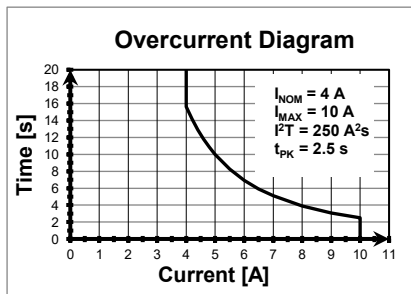


Figure 3.40. iPOS3604 BX Over-current diagram



**CAUTION!**

**FOR PWM FREQUENCIES LESS THAN 20 KHZ, CORRELATE THE PWM FREQUENCY WITH THE MOTOR PARAMETERS IN ORDER TO AVOID POSSIBLE MOTOR DAMAGE.**

<sup>1</sup>  $V_{OUT}$  – the output voltage,  $V_{MOT}$  – the motor supply voltage

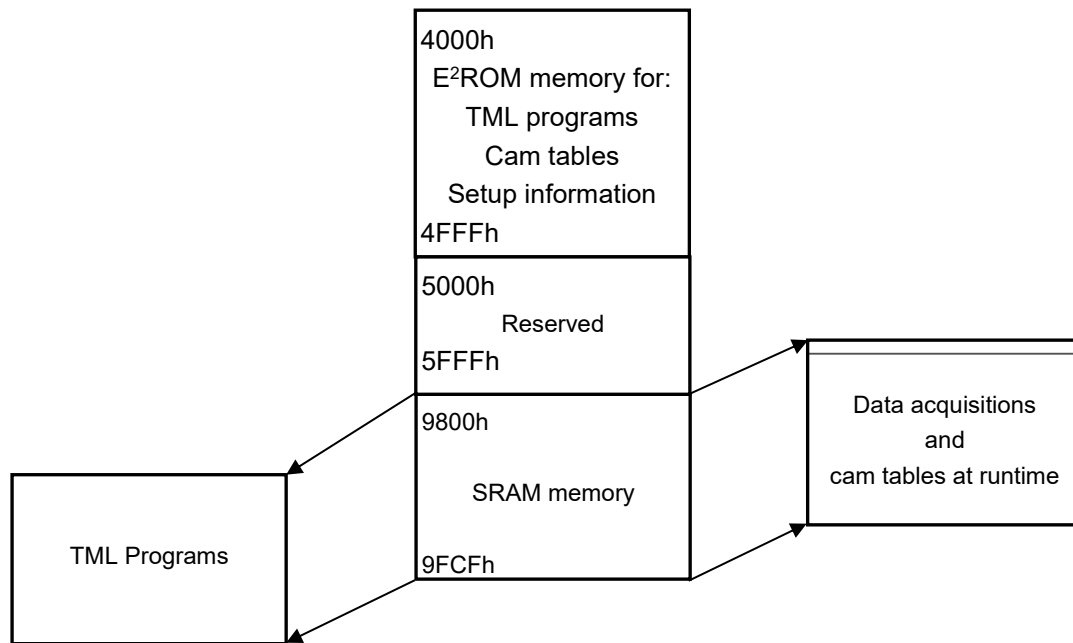
## 4 Memory Map

iPOS360X BX has 2 types of memory available for user applications: 2K×16 SRAM and 4K×16 serial E<sup>2</sup>ROM.

The SRAM memory is mapped in the address range: 9800h to 9FFFh. 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<sup>2</sup>ROM is mapped in the address range: 4000h to 4FFFh. 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 4.1.** iPOS360X BX Memory Map



T E C H N O S O F T