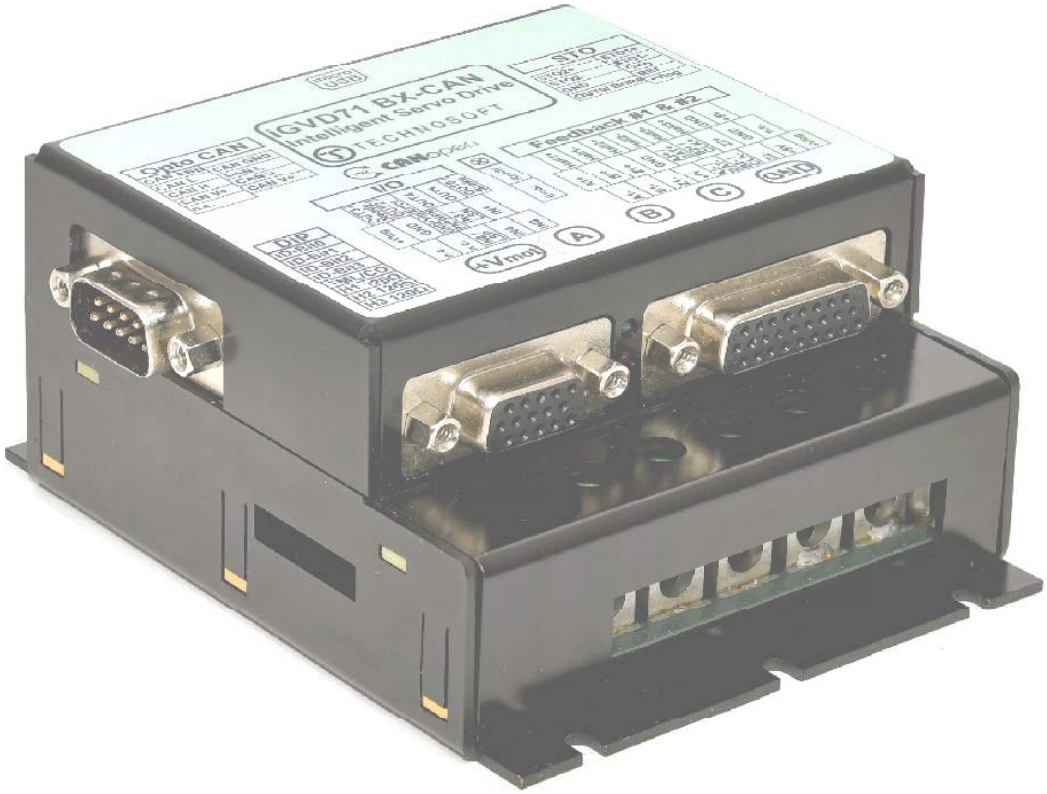
iGVD71
BX-CAN-STO

Intelligent Servo Drive for DC and Brushless Motors

TECHNOSOFT

Intelligent Servo Drives



Technical Reference

P025.027.iGVD71.CAN.STO.UM.150523

1 Read This First

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

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

2 About This Manual

This book is a technical reference manual for:

Product Name	Part Number	Output current		Communication
		Nominal	Peak	
iGVD71 BX-CAN-STO	**P025.027.E201**	71 A_{RMS} / 100A amplitude	100 A_{RMS} / 140A amplitude	CAN

In order to operate the **iGVD71 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 **iGVD71 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.

3 Notational Conventions

This document uses the following conventions:

- **iGVD71 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

4 Related Documentation

iGVD71 BX-CAN-STO Datasheet (P025.027.E201.DSH)

iGVD71 BX-CAN-STO Connection Diagram (P025.027.E201.CDG)

– describes the hardware connections of the iGVD 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

5 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

6 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***

6.1 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***

6.2 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.

6.3 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/

7 Product Overview

7.1 Introduction

The **iGVD71** is part of the **iPOS** family of fully digital servo drives, based on the latest DSP technology, offering the highest density of power and intelligence.

Suitable for control of **brushless DC**, **brushless AC** (vector control) and **brushed DC** motors, the **iGVD71** accept as position feedback **incremental encoders** (differential), **digital Hall** signals (differential or single-ended) and **absolute encoders** (SSI, BiSS-C and EnDAT2.2[1]).

All drives perform position, speed or torque control and work in single, multi-axis or stand-alone configurations. Thanks to the embedded motion controller, the iGVD71 BX-CAN-STO 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[2], 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 iGVD71 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 iGVD71 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 iGVD71 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 iGVD71 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 iGVD71 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 iGVD71 drives can also be controlled via a PC or a PLC using one of the **TML_LIB** motion libraries.

[1] Available starting with F514K firmware version

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

For iGVD71 BX-CAN-STO commissioning **EasySetUp** or **EasyMotion Studio** PC applications may be used.

EasySetUp is a subset of EasyMotion Studio, including only the drive setup part. The output of EasySetUp is a set of setup data that can be downloaded into the drive EEPROM or saved on a PC file. At power-on, the drive is initialized with the setup data read from its EEPROM. With EasySetUp it is also possible to retrieve the complete setup information from a drive previously programmed. EasySetUp shall be used for drive setup in all cases where the motion commands are sent exclusively from a master. Hence neither the iGVD71 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 iGVD71 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.**

7.2 Product Features

- Fully digital servo drive suitable for the control of **brushless DC**, **AC** and **brushed DC** motors
- **Motor supply**: 11-80V
- **Logic supply**[1]: 9-36V
- **Output current**[2]:
  - **Nominal :** 71 A_{RMS} / 100A amplitude
  - **Peak :** 100 A_{RMS} / 140A amplitude
- **PWM** switching frequency up to 120kHz
- **Communication:**
- CAN-bus 2.0B up to 1Mbit/s
- RS232 (micro USB port)
- **Digital and analog I/O's:**
- 1 x analogue input: 12-bit, 0-5V: Reference, Feedback or general purpose
- 5 x opto-isolated digital inputs, 12-36V, PNP/NPN selectable: 2 for limit switches, 3 general-purpose
- 4 x digital outputs, 0.2A PNP/ 0.3A NPN software selectable: Ready, Error, 2 general-purpose
- 1 x PNP/NPN 2A software configurable motor brake digital output: Out0/Brake
- **Feedback devices (dual-loop support)**

  1st feedback devices supported:
  - Incremental encoder interface (differential)

  2nd feedback devices supported:
  - Incremental encoder interface (differential)
  - SSI, BiSS-C and EnDAT2.2[3] interface
- Digital Hall sensor interface (single-ended / open collector or differential, selectable by DIP switch)
- Pulse & direction reference (differential) capability
- **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

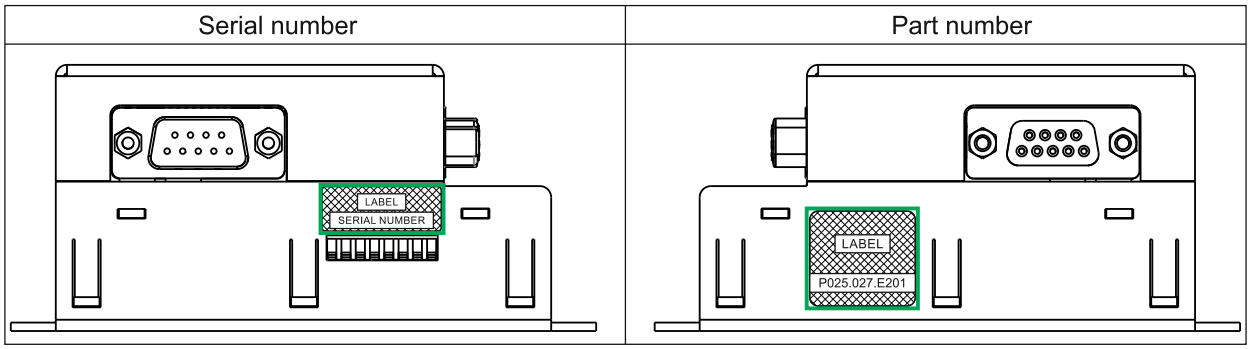
[1] Logic supply must be SELV/ PELV type (Safety Extra Low Voltage / Protective Extra Low Voltage)

[2] Nominal output current possible only with external radiator (not included) that can maintain lower plate temperature below 75ºC; The radiator is mounted under the drive using thermal paste or direct metal contact. Its size is application dependent

[3] Available starting with F514K firmware version

- 35 Homing modes
- **16 h/w selectable Axis ID** addresses
- **STO**[1]: 2 safe torque-off inputs, 18-36V SELV/PELV supply, safety integrity level (SIL3/Cat3/PLe) acc. to EN61800-5-1;-2/ EN61508-3;-4/ EN ISO 13849-1.
- **Two CAN operation modes** selectable by HW 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 E²ROM** 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

7.3 Identification Labels



The iGVD71 BX family can have the following part numbers and names on the identification label:

p.n. **P025.027.E201** name iGVD71 BX-CAN-STO – standard CAN execution

7.4 Supported Motor-Sensor Configurations

7.4.1 Single loop configurations

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

Motor sensors			Motor types		
Encoder[2]	**Digital Halls**	**Tacho**	**Brushless PMSM[3]**	**Brushless BLDC[4]**	**Brushed DC Voice coils**
Incremental encoder[5] / SSI / BISS-C / EnDAT2.2[6]			✓		✓
Incremental encoder[5] / SSI / BiSS-C / EnDAT2.2[6]	✓		✓	✓	
None	✓		✓		
None		✓			✓

[1] The STO circuit must be supplied with minimum 18V to enable PWM output
[2] Motor encoder can be either on Feedback 1 or on Feedback 2
[3] Sinusoidal. Brushless motor is controlled as PMSM using a field oriented control algorithm
[4] Trapezoidal. Brushless motor is controlled as a BLDC motor using Hall-based commutation.
[5] Only differential connection is available
[6] EnDAT 2.2 protocol is available starting with F514K firmware version

7.4.2 Dual loop configurations

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

Motor sensors			Motor types			Load sensors
Encoder	Digital Halls	Tacho	Brushless PMSM[1]	Brushless BLDC[2]	Brushed DC Voice coils	Encoder[3]
Incremental encoder[4] / SSI / BISS-C / EnDAT2.2[5 6]			✓		✓	Incremental encoder[4] / SSI / BiSS-C / EnDAT2.2[5 6]
Incremental encoder[4] / SSI / BiSS-C / EnDAT2.2[5 6]	✓			✓		Incremental encoder[4] / SSI / BiSS-C / EnDAT2.2[5 6]
None	✓		✓			Incremental encoder[4] / SSI / BiSS-C / EnDAT2.2[3 6]
None			✓			Incremental encoder[4] / SSI / BiSS-C / EnDAT2.2[5 6]
None		✓			✓	Incremental encoder[4] / SSI / BiSS-C / EnDAT2.2[5 6]

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

Example:

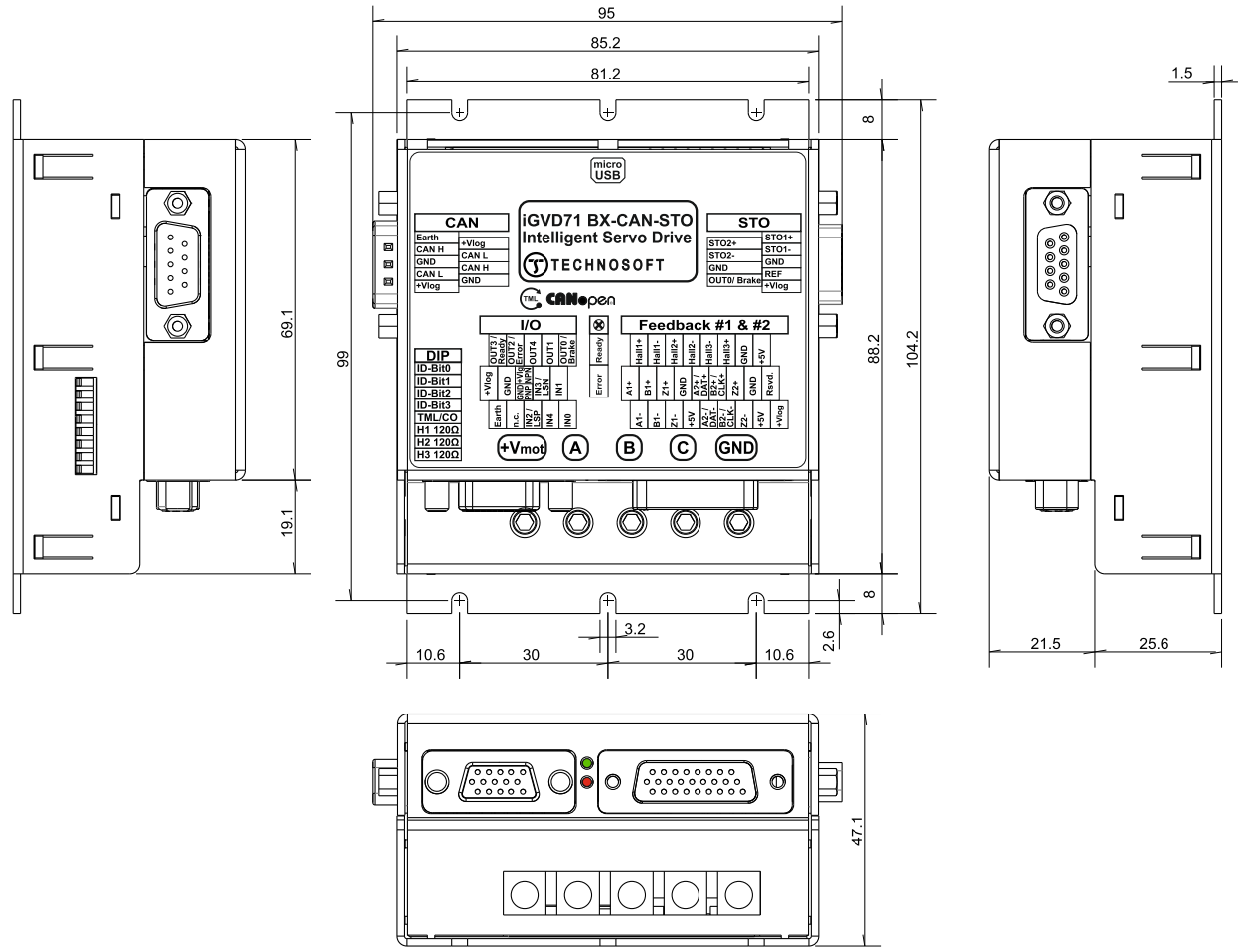
-PMSM motor with Incremental encoder (from feedback #1) on motor and Incremental encoder (from feedback#2) on load

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

[1] Sinusoidal. Brushless motor is controlled as PMSM using a field oriented control algorithm
[2] Trapezoidal. Brushless motor is controlled as a BLDC motor using Hall-based commutation.
[3] Load encoder is on Feedback 2 / 1, if motor encoder is on Feedback 1 / 2
[4] Only differential connection is available
[5] EnDAT 2.2 protocol is available starting with F514K firmware version
[6] SSI / BiSS-C / EnDAT2.2 can be only on Feedback #2

8 Hardware Installation

8.1 iGVD71 BX-CAN-STO Board Dimensions



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

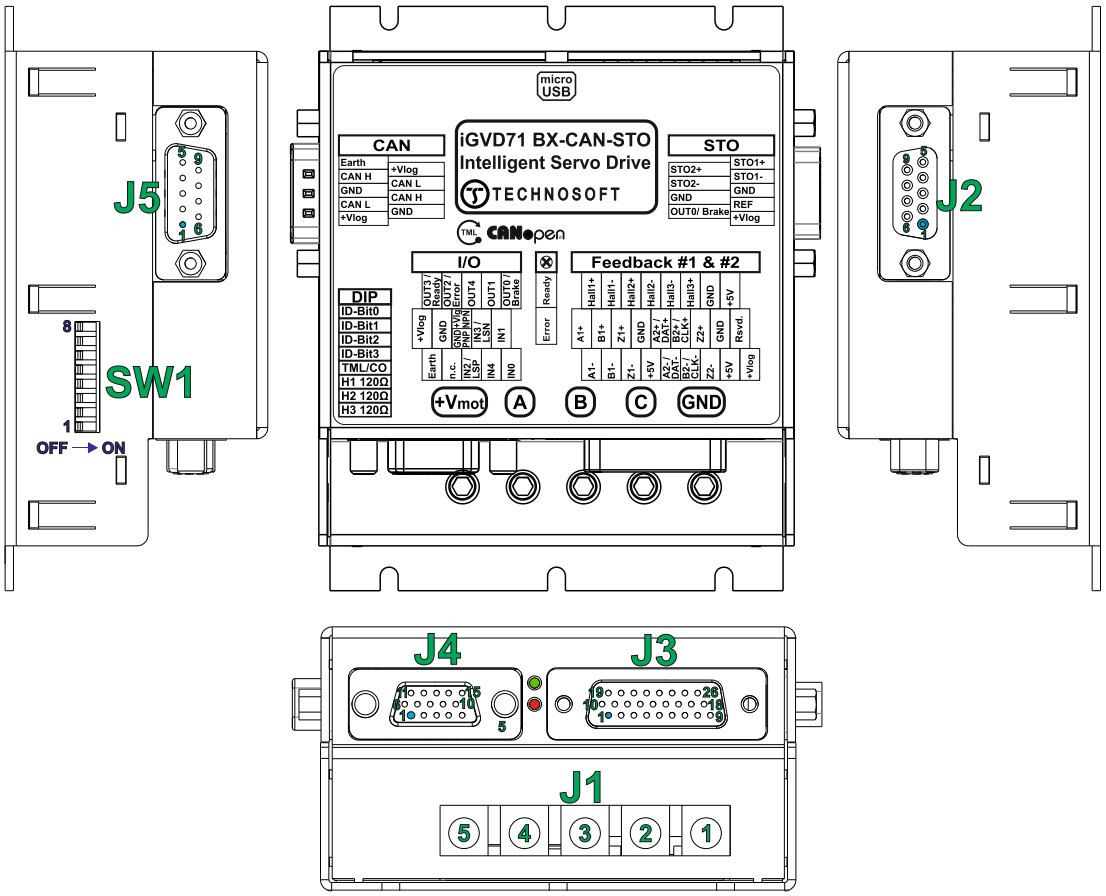
8.2 Mechanical Mounting

The iGVD71 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.

8.3 Connectors and Pinouts



J1

Pin	Name	Type	Description
1	GND	-	Negative return (ground) of the power supply
2	C	O	**Phase C** for 3-ph motors
3	B	O	**Phase B** for 3-ph motors, Motor- for DC brush motors
4	A	O	**Phase A** for 3-ph motors, Motor+ for DC brush motors
5	$+V_{MOT}$	I	Positive terminal of the motor supply: 11 to $80V_{DC}$.

J2

Pin	Name	Type	Description
1	$+V_{LOG}$	I	Positive terminal of the logic supply: 9 to $36V_{DC}$. Internally connected to other +Vlog pins.
2	REF	I	Analogue input, 12-bit, 0-5V. Used to read an analog position, speed or torque reference, or used as general-purpose analogue input
3	GND	-	Negative return (ground)
4	STO1-	I	Safe Torque Off input 1, negative return (opto-isolated, 18÷36V)
5	STO1+	I	Safe Torque Off input 1, positive input (opto-isolated, 18÷36V)
6	OUT0/Brake	O	Digital output used for an electro-mechanical brake,12-36V, 2A PNP/ 2A NPN software selectable
7	GND	-	Negative return (ground)
8	STO2-	I	Safe Torque Off input 2, negative return (opto-isolated, 18÷36V)
9	STO2+	I	Safe Torque Off input 2, positive input (opto-isolated, 18÷36V)

J5

Pin	Name	Type	Description
1&9	$+V_{LOG}$	I	Positive terminal of the logic supply: 9 to $36V_{DC}$. Internally connected to other +Vlog pins.
2&8	CAN L	I/O	CAN-Bus negative line (dominant low)
3&6	GND	-	Negative return (ground)
4&7	CAN H	I/O	CAN-Bus positive line (dominant high)
5	Earth	-	Earth connection; Internally connected to the metallic side of J2,3,4 and 5

J6

Pin	Name	Type	Description
USB		-	Standard micro-USB port. Is identified in Windows as RS232 COM port.

J3

Pin	Name	Type	Description
1	A1-	I	Incr. encoder1 A- diff. input
2	B1-	I	Incr. encoder1 B- diff. input
3	Z1-	I	Incr. encoder1 Z- diff. input
4	$+5V_{OUT}$	O	5V output supply
5	A2-/Pulse-/ Data-/SL-	I	Incr. encoder2 A- diff. input, or Pulse-, or Data- for SSI, or Slave- for BiSS; has internal 120Ω resistor between pins 5 and 14
6	B2-/Dir-/CLK-/MA-	I/O	Incr. encoder2 B- diff. input, or Dir-, or Clock- for SSI, or Master- for BiSS; has internal 120Ω resistor between pins 6 and 15
7	Z2-	I	Incr. encoder2 Z- diff. input; has internal 120Ω resistor between pins 7 and 16
8	$+5V_{OUT}$	O	5V output supply for sensors usage
9	$+V_{LOG}$	I	Positive terminal of the logic supply: 9 to $36V_{DC}$. Internally connected to other +Vlog pins.
10	A1+/ Pulse	I	Incr. encoder1 A+ diff. input, or Pulse
11	B1+/Dir	I	Incr. encoder1 B+ diff. input, or Dir
12	Z1+	I	Incr. encoder1 Z+ diff. input
13	GND	-	Return ground for sensors supply
14	A2+/Pulse+/ Data+/SL+	I	Incr. encoder2 A+ diff. input, or Pulse+, or Data+ for SSI, or Slave+ for BiSS; has internal 120Ω resistor between pins 5 and 14
15	B2+/Dir+/CLK +/MA+	I/O	Incr. encoder2 B+ diff. input, or Dir+, or Clock+ for SSI, or Master+ for BiSS; has internal 120Ω resistor between pins 6 and 15
16	Z2+	I	Incr. encoder2 Z+ diff. input; has internal 120Ω resistor between pins 7 and 16
17	GND	-	Return ground for sensors supply
18	n.c.		not connected
19	Hall 1+	I	Digital input Hall 1+ diff. sensor input; SW1 pin 3 can connect an 120Ω resistor between pins 19 and 20
20	Hall 1-	I	Digital input Hall 1- diff. sensor input; SW1 pin 3 can connect an 120Ω resistor between pins 19 and 20
21	Hall 2+	I	Digital input Hall 2+ diff. sensor input; SW1 pin 2 can connect an 120Ω resistor between pins 21 and 22
22	Hall 2-	I	Digital input Hall 2- diff. sensor input; SW1 pin 2 can connect an 120Ω resistor between pins 21 and 22
23	Hall 3-	I	Digital input Hall 3- diff. sensor input; SW1 pin 1 can connect an 120Ω resistor between pins 23 and 24
24	Hall 3+	I	Digital input Hall 3+ diff. sensor input; SW1 pin 1 can connect an 120Ω resistor between pins 23 and 24
25	GND	-	Return ground for sensors supply
26	$+5V_{OUT}$	O	5V output supply

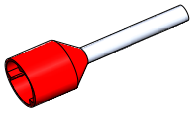
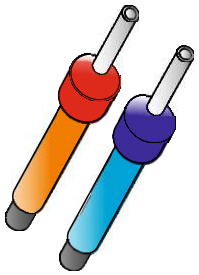
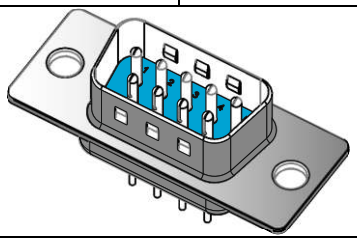
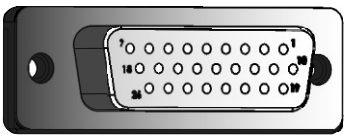
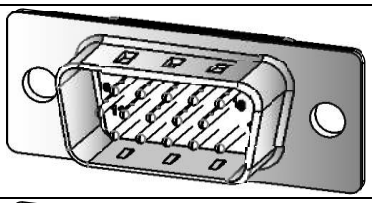
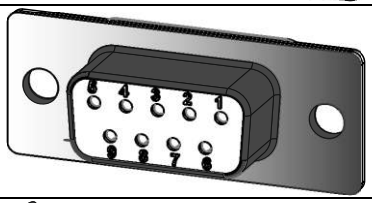
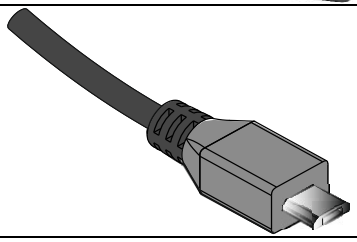
J4

Pin	Name	Type	Description
1	Earth	-	Earth connection; Internally connected to the metallic side of J2,3,4 and 5
2	n.c.	-	not connected
3	IN2/LSP	I	12-36V digital PNP/NPN opto-isolated input. Positive limit switch function
4	IN4	I	12-36V general-purpose digital PNP/NPN opto-isolated input.
5	IN0	I	12-36V general-purpose digital PNP/NPN opto-isolated input.
6	$+V_{LOG}$	I	Positive terminal of the logic supply: 9 to $36V_{DC}$. Internally connected to other +Vlog pins.
7	GND	-	Return ground for I/O pins
8	GND PNP / +Vlog NPN	-	PNP/NPN Inputs type selector. Connect to GND to use inputs as PNP; Connect to +Vlog to use inputs as NPN
9	IN3/LSN	I	12-36V digital PNP/NPN opto-isolated input. Negative limit switch function
10	IN1	I	12-36V general-purpose digital PNP/NPN opto-isolated input.
11	OUT3/Ready	O	12-36V drive Ready digital output, 0.2A PNP/ 0.3A NPN, software selectable
12	OUT2/Error	O	12-36V drive Error digital output, 0.2A PNP/ 0.3A NPN, software selectable
13	OUT4	O	12-36V general-purpose digital output, 0.2A PNP/ 0.3A NPN, software selectable
14	OUT1	O	12-36V general-purpose digital output, 0.2A PNP/ 0.3A NPN, software selectable
15	OUT0/Brake	O	Digital output used for an electro-mechanical brake,12-36V, 2A PNP/ 2A NPN software selectable

SW1

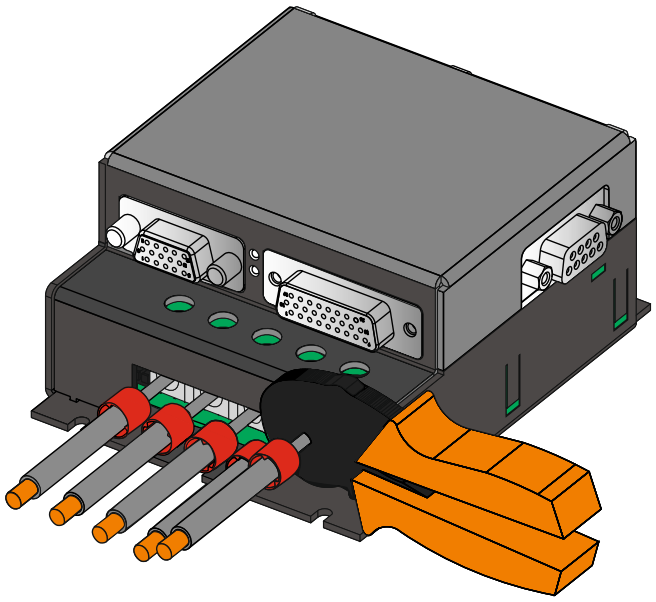
Pin	Name	Position	Description
1	H3 120Ω	up (ON)	Internally connect an 120Ω termination resistor between Hall 3+ and Hall 3- pins
2	H2 120Ω	up (ON)	Internally connect an 120Ω termination resistor between Hall 2+ and Hall 2- pins
3	H1 120Ω	up (ON)	Internally connect an 120Ω termination resistor between Hall 1+ and Hall 1- pins
4	TML/CO	up (ON)	Select CANopen communication protocol
		down (OFF)	Select TMLCAN communication protocol
5	ID-Bit3	-	Hardware AxisID selection switches They represent the first 4 LSB bits of an 8-bit Axis ID number. When all bits are 0 then AxisID=255; If AxisID = 255 in CANopen, the drive will be in "LSS inactive" state and the Green LED will flash at 1 second intervals
6	ID-Bit2	-	
7	ID-Bit1	-	
8	ID-Bit0	-	

8.3.1 Mating Connectors

Connector	Function	Component	Diagram
J1	Motor Phases Motor Supply	High AMP wire. 4mm HEX socket. 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. AWG 6-16 wire gauge. **Avoid generating metal debris/ filings into drive from the wire leads!** **In case of multi-stranded wires, a proper crimp ferrule must be used as wire terminal.**	 
J2	Logic Supply STO Analogue Reference Motor Brake	Generic 9-pin Sub-D male connector.	
J3	Feedback #1 Feedback #2 Digital Hall	Generic 26-pin High Density Sub-D male connector.	
J4	Inputs Outputs	Generic 15-pin High Density Sub-D male connector.	
J5	CAN	Generic 9-pin Sub-D female connector.	
J6	Micro USB	Standard Micro USB cable.	

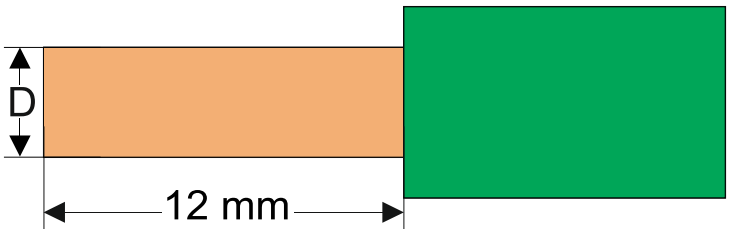
8.3.2 Recommendations for Motor Phases and Motor Power Supply wires

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	-		



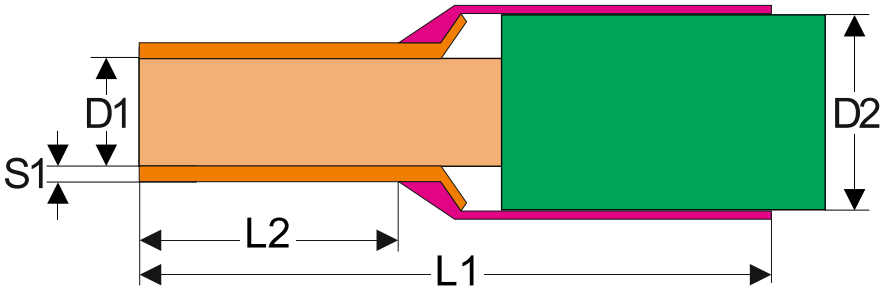
Cable connections

Solid wire or tinned strand wire



❖ D_{max} = 4.1 mm (AWG6)

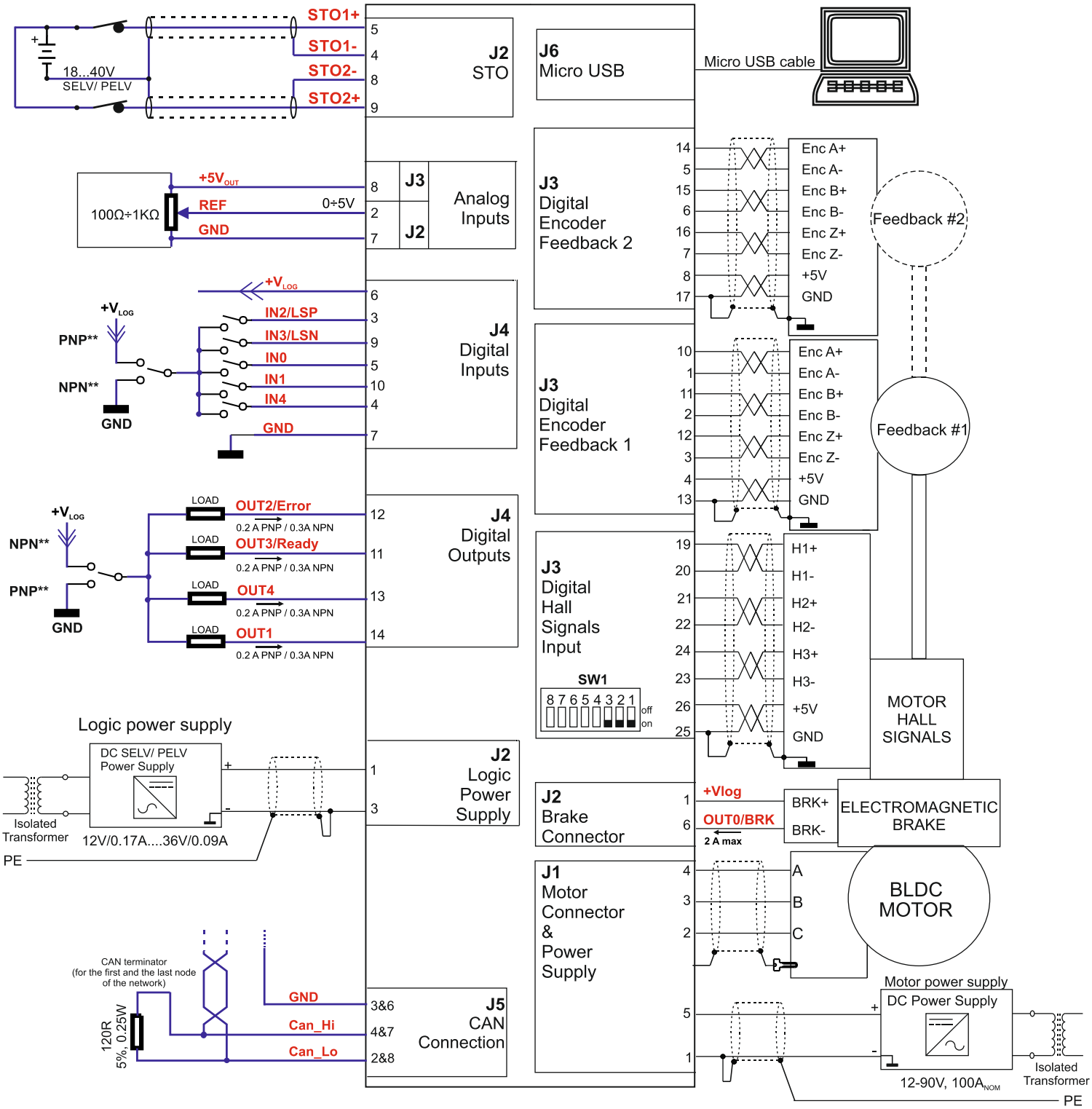
Strand wire with ferrule



❖ 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

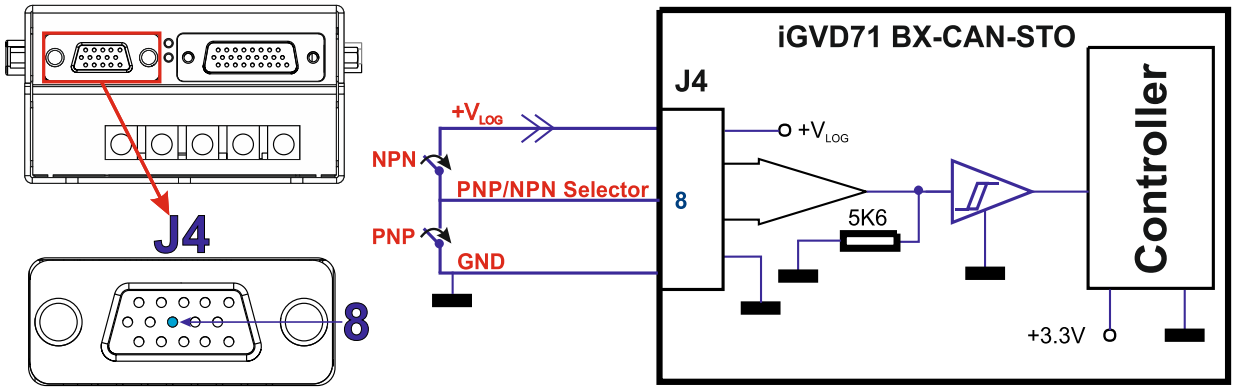
8.3.3 Connection diagram



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

8.4 Digital I/O Connection

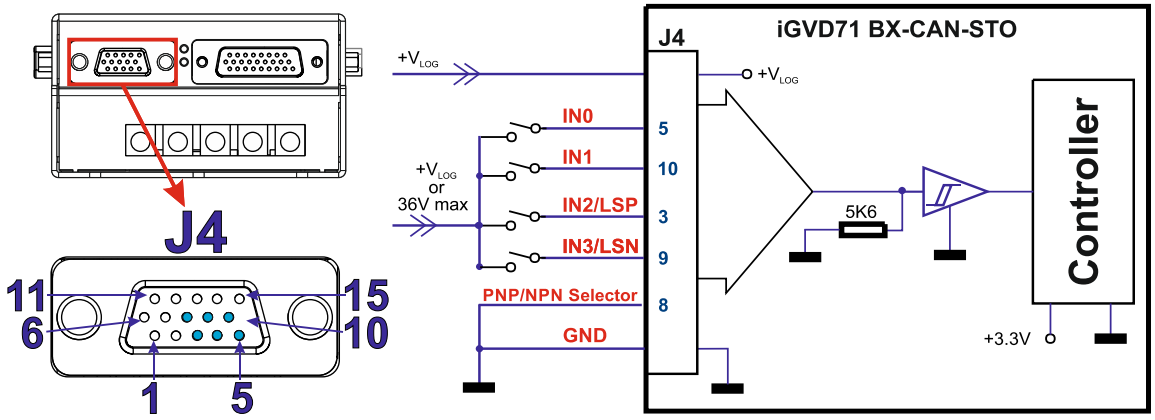
8.4.1 PNP/NPN Inputs selection



Remarks:

1. *If the hardware selection is not done (J4 pin 8 is not connected), the inputs state cannot be changed.*
2. *The inputs needs to be selected as PNP/ NPN also in the setup part, according to the hardware connection.*

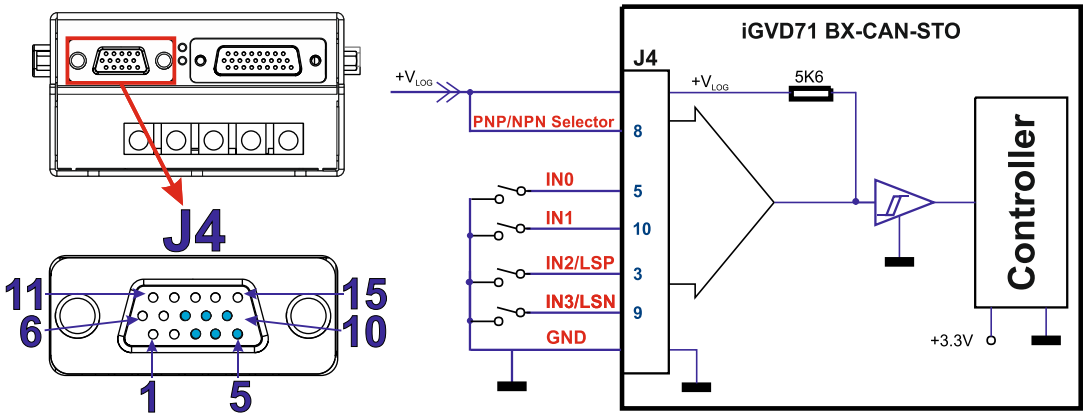
8.4.2 PNP inputs



Remarks:

1. *The PNP inputs are compatible with PNP outputs – the input must receive a positive voltage value: 12-36V 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.*

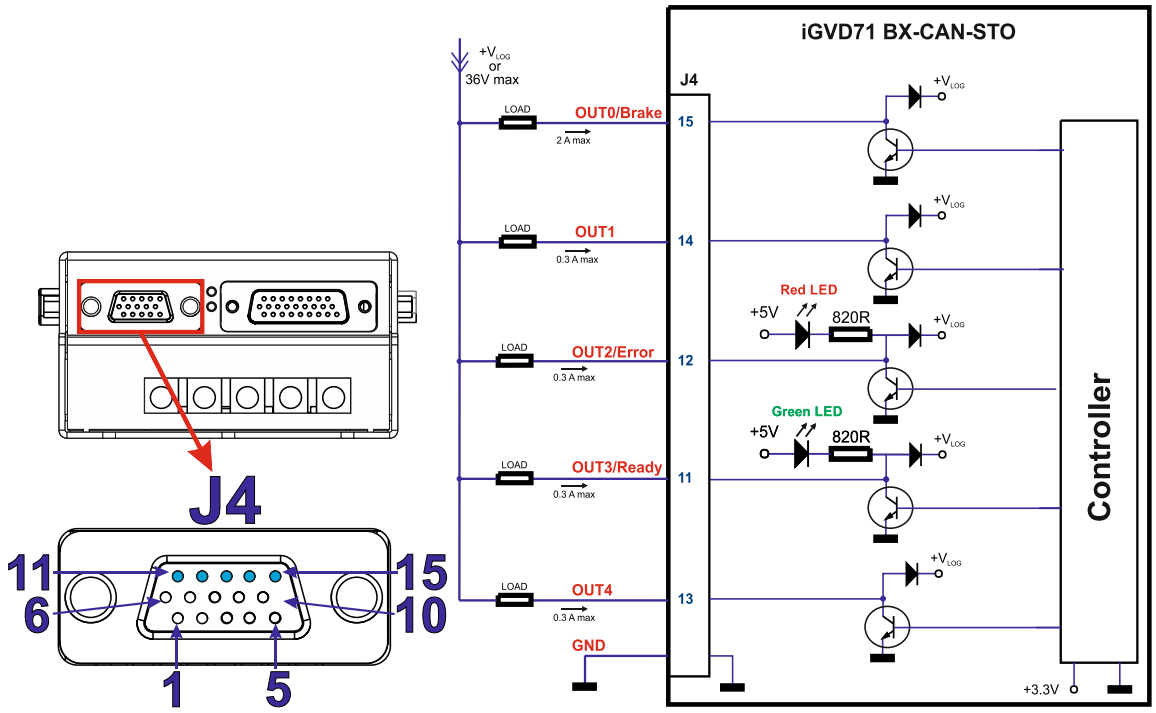
8.4.3 NPN inputs



Remarks:

1. *The NPN inputs are compatible with NPN outputs – the input must be pulled to GND 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.*

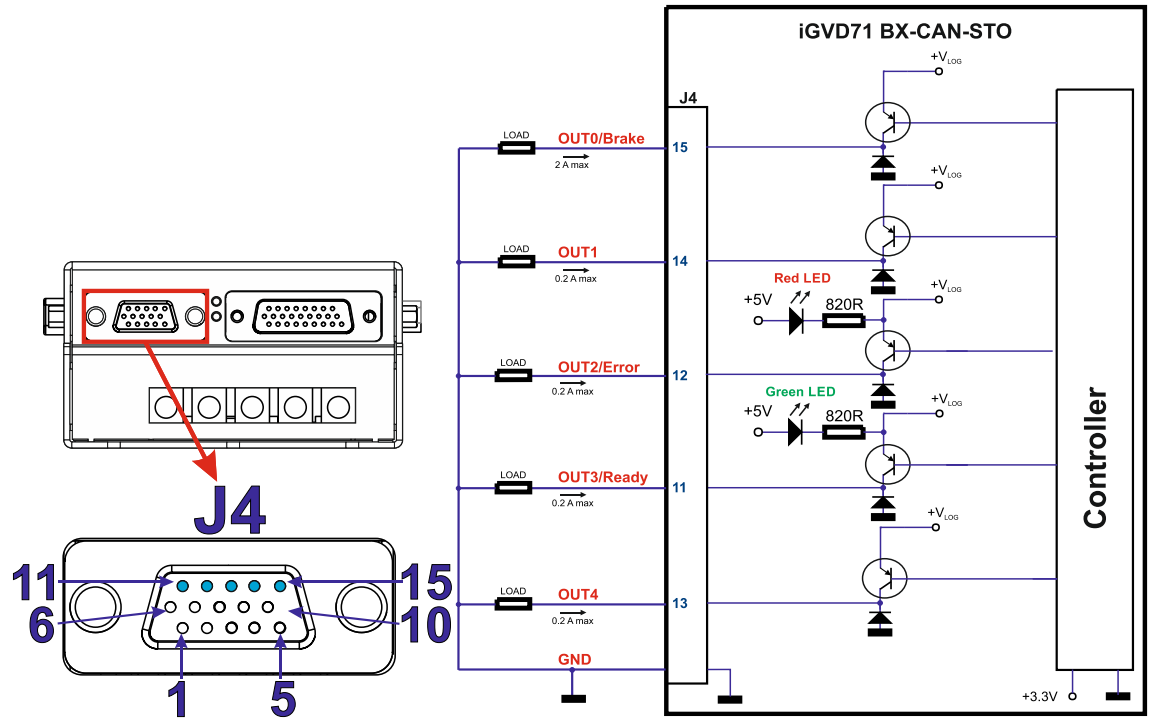
8.4.4 NPN Outputs



Remarks:

1. *The outputs are software selectable as PNP/NPN.*
2. *The NPN outputs are compatible with NPN inputs (load is tied to common $+V_{LOG}$, output pulls to GND when active and is floating when inactive*
3. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*

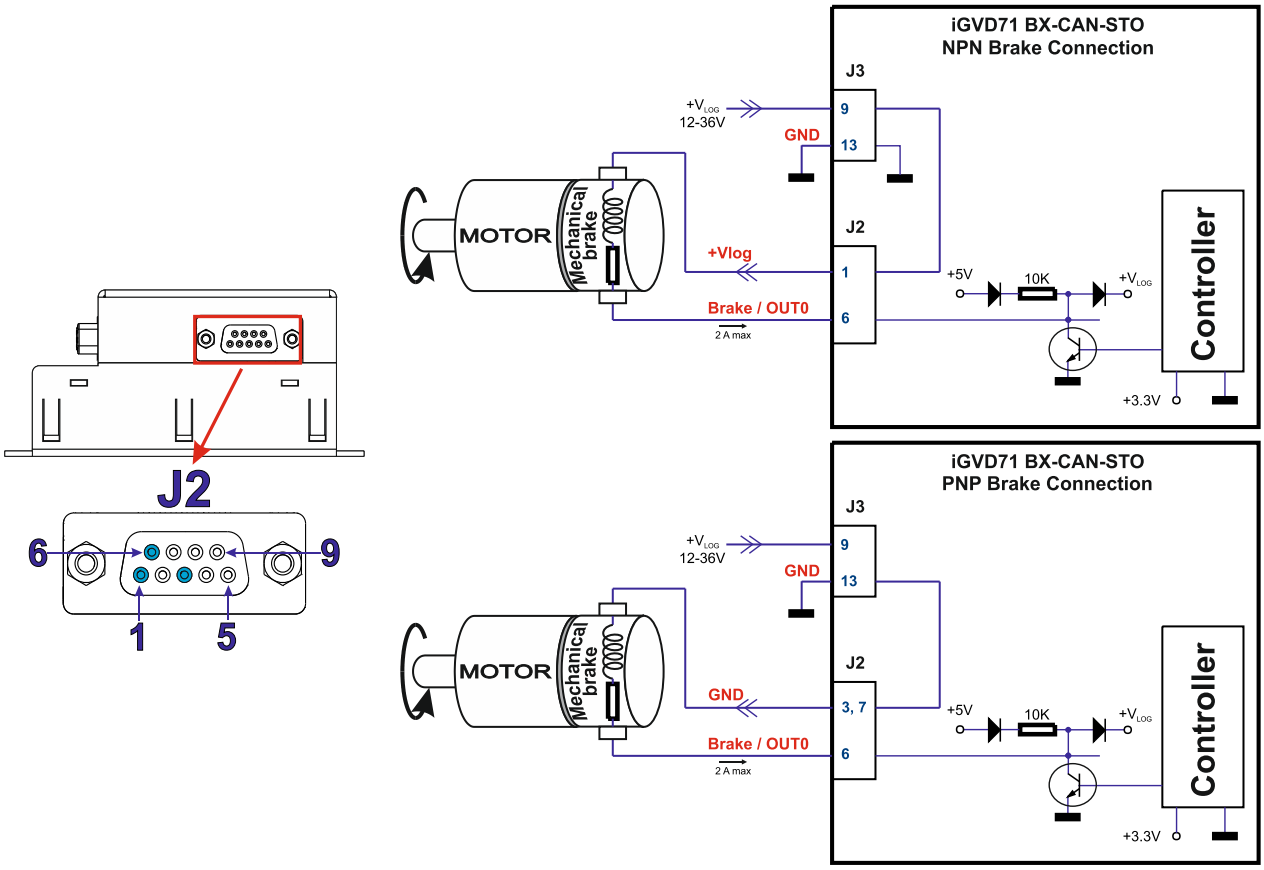
8.4.5 NPN Outputs



Remarks:

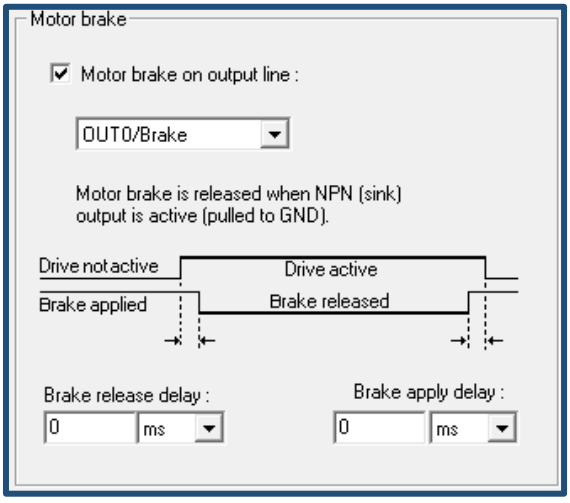
1. *The outputs are software selectable as PNP/NPN.*
2. *The PNP outputs are compatible with PNP inputs (load is tied to common $+V_{LOG}$, output pulls to GND when active and is floating when inactive*
3. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*

8.4.6 Solenoid driver connection for motor brake (NPN/PNP)

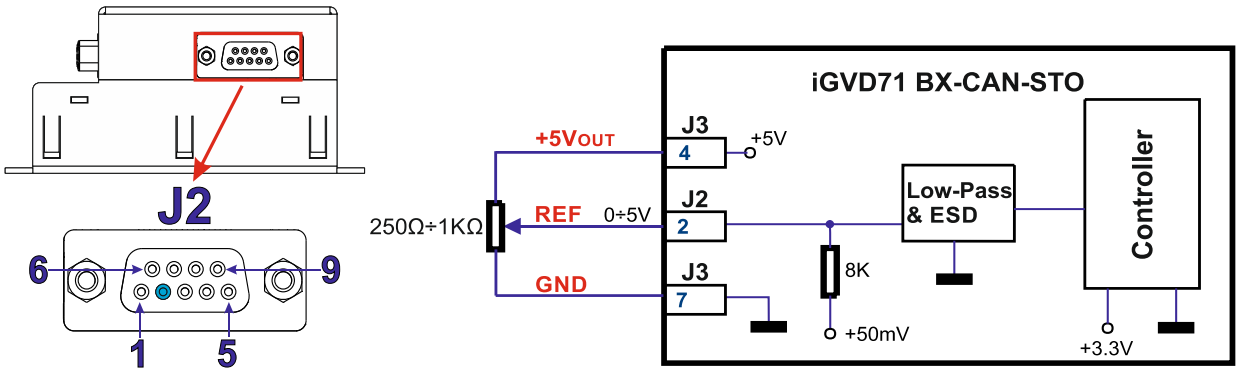


Remarks:

1. *The firmware can control the OUT0 output to automatically engage/disengage a mechanical brake when motor control is started/stopped.*
2. *The digital output can be used for an electro-mechanical brake, 12-36V, 2A PNP/ 2A NPN or as PNP/NPN general-purpose digital output.*
3. *The selection can be made by software. To enable the mechanical brake functionality select the checkbox from EasyMotion Studio:*



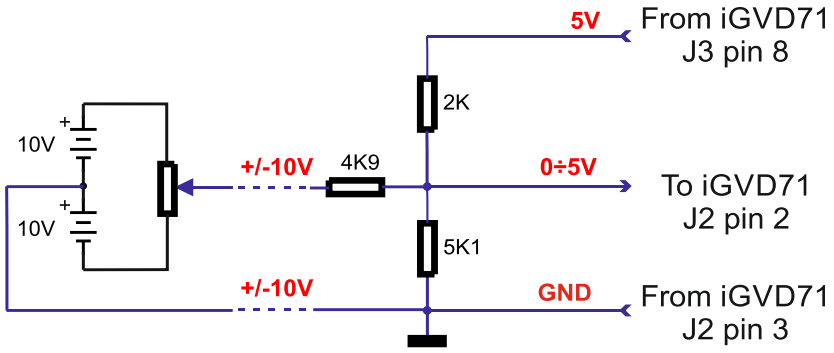
8.4.7 Analog Inputs Connection: 0-5V Input Range



Remark:

1. *Default input range for analog inputs is 0÷5 V for REF analogue input.*
2. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*

8.4.8 Analog Inputs Connection: +/- 10V Input Range adapter

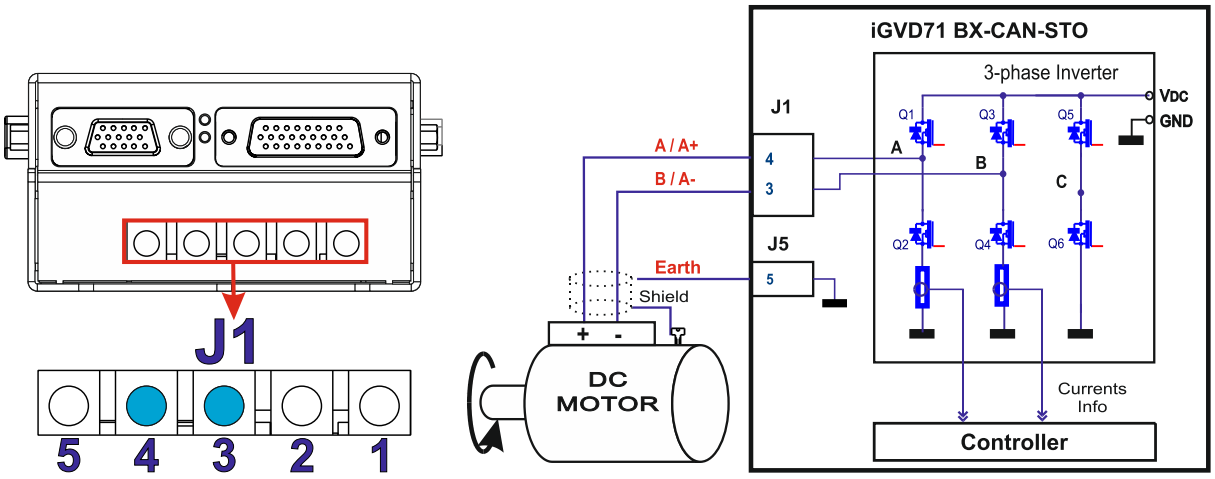


8.4.8.1 Recommendation for wiring

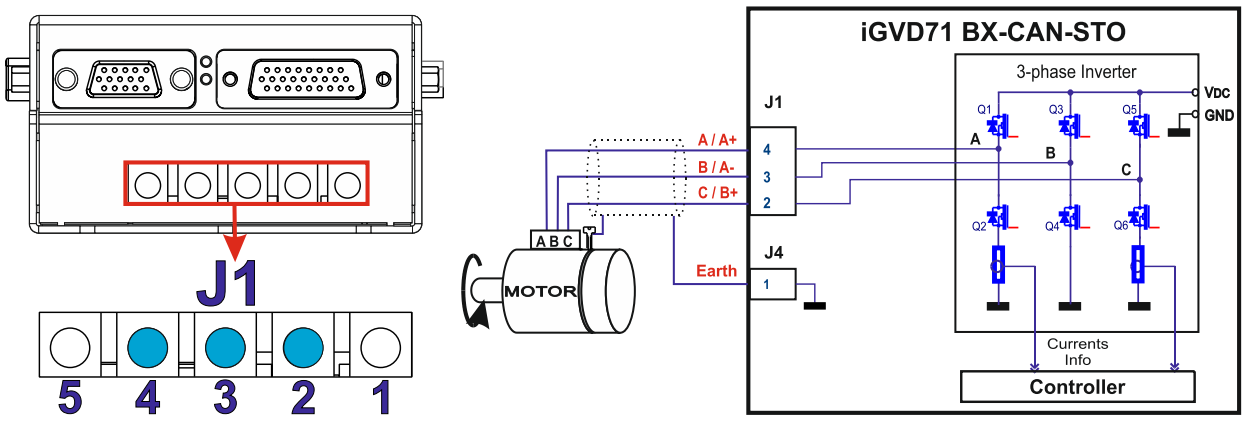
1. If the analogue signal source is single-ended, use a 2-wire twisted shielded cable as follows: 1st wire connects the live signal to the drive input; 2nd wire connects the source ground to the drive ground; shield will be connected to the drive ground terminal.
2. If the analogue signal source is differential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

8.5 Motor connections

8.5.1 DC Motor connection



8.5.2 Brushless Motor connection

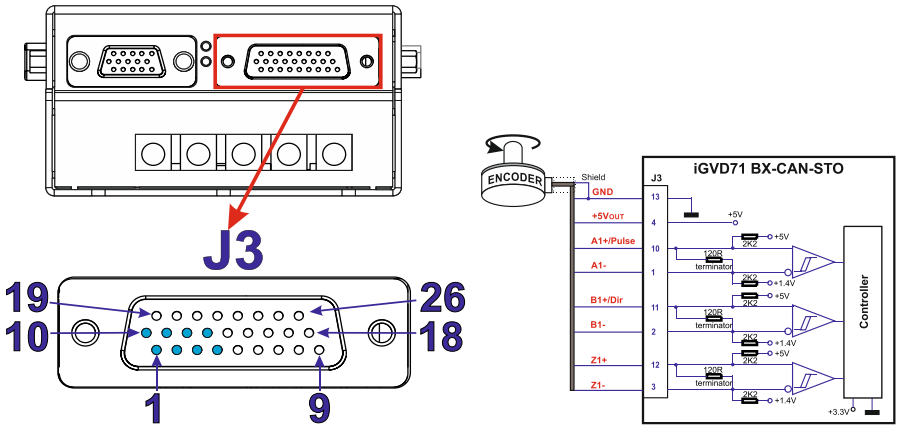


8.5.2.1 Recommendations for motor wiring

1. 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 GND pin. Leave the other end disconnected.
2. 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 iGVD71 outputs and the cable. The inductors must be magnetically shielded (toroidal, for example), and must be rated for the motor surge current. Typically the necessary values are around 100 µH.
3. A good shielding can be obtained if the motor wires are running inside a metallic cable guide.

8.6 Feedback connections

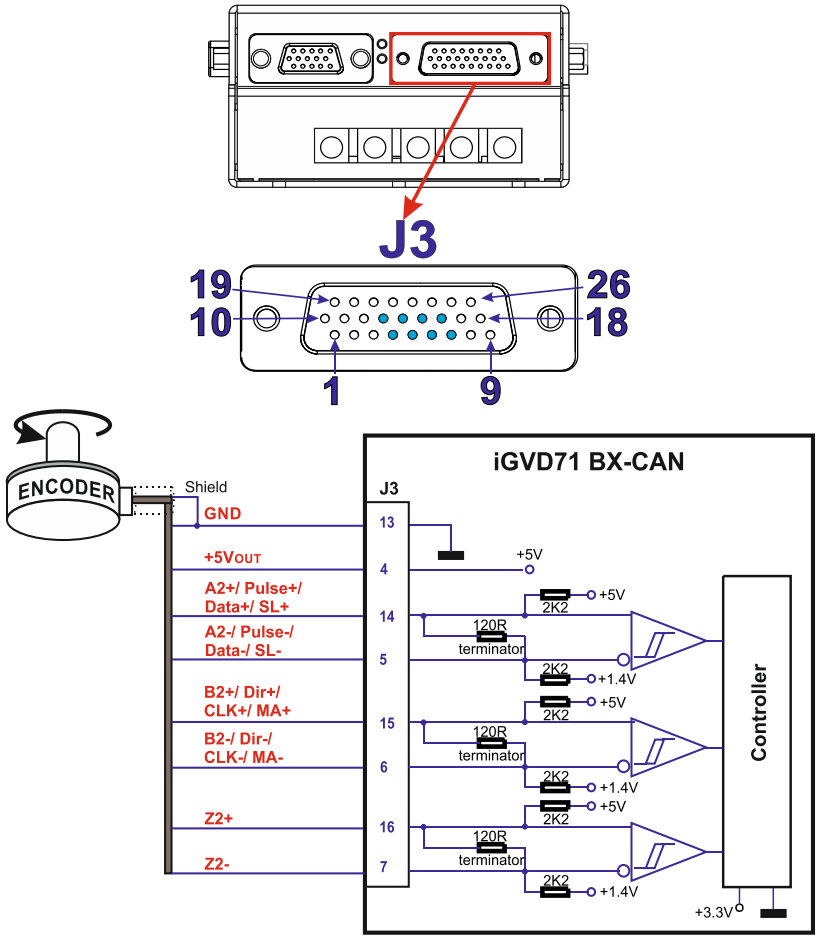
8.6.1 Feedback #1 - Differential Incremental Encoder Connection



Remarks:

1. *For Feedback #1 differential connection, 120Ω (0.25W) terminators are internally connected.*
2. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*

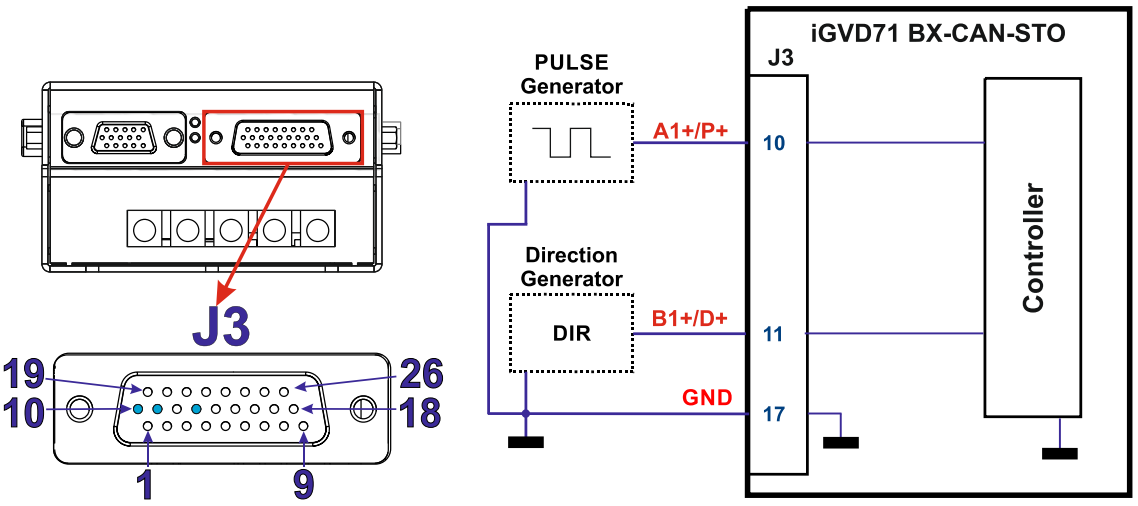
8.6.2 Feedback #2 - Differential Incremental Encoder Connection



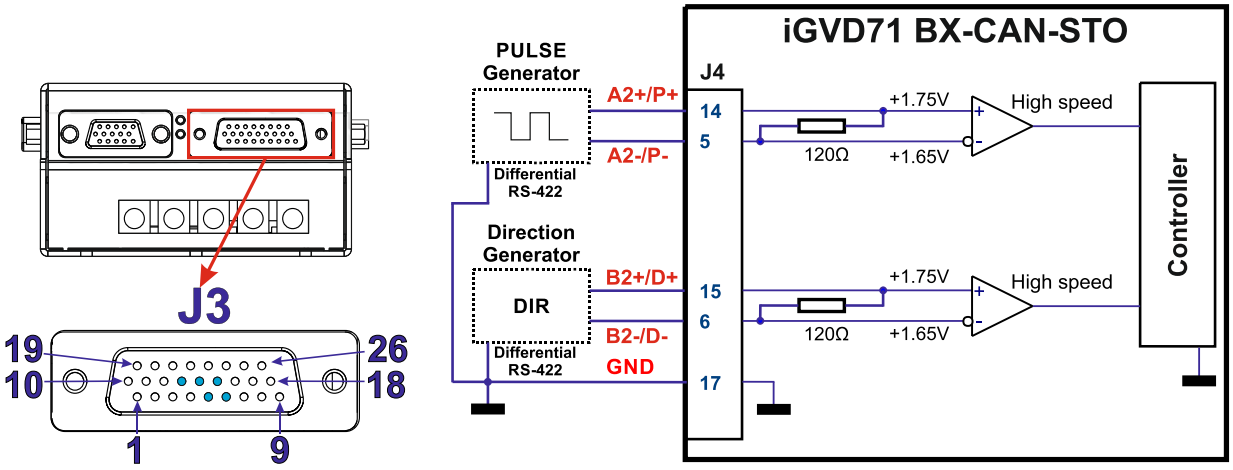
Remarks:

1. *For Feedback #2 differential connection, 120Ω (0.25W) terminators are internally connected.*
2. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*

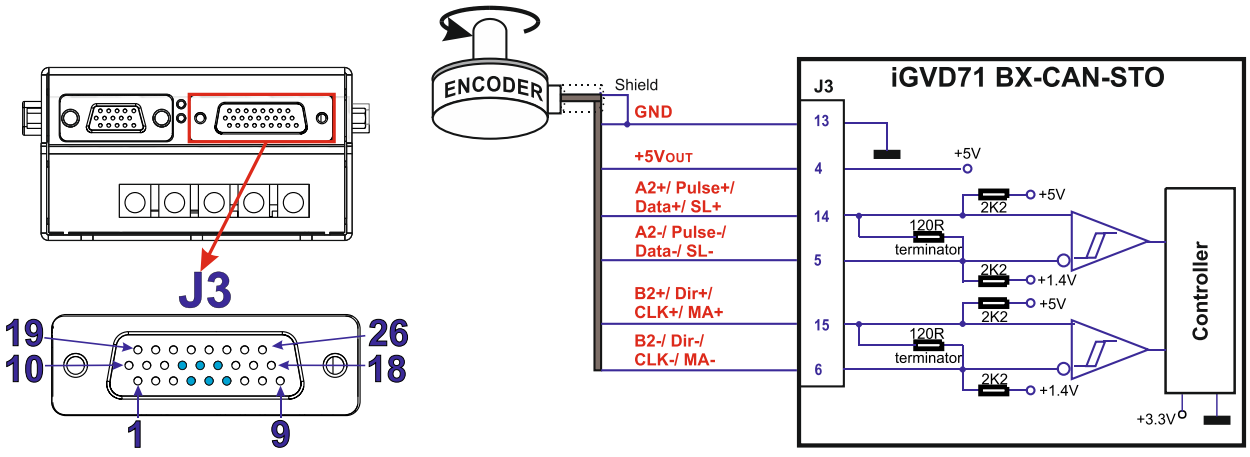
8.6.3 Feedback #1 – Single-Ended Pulse and Direction Connection



8.6.4 Feedback #2 – Differential Pulse and Direction Connection



8.6.5 Feedback #2 - Absolute Encoder Connection (SSI, BiSS-C, EnDAT 2.2)

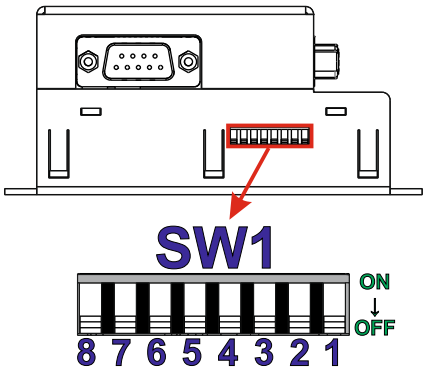


Remarks:

1. *For Feedback #2 absolute encoder connection, 120Ω (0.25W) terminators are internally connected.*
2. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*

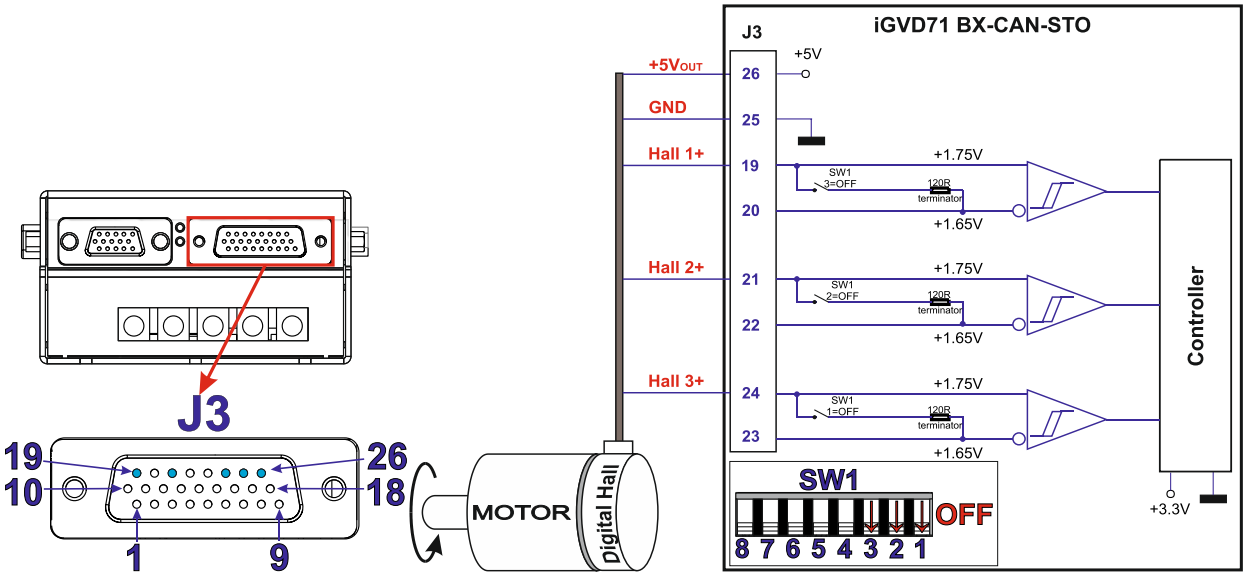
8.7 Digital Hall Connection

8.7.1 Hall termination resistors - SW1 Settings

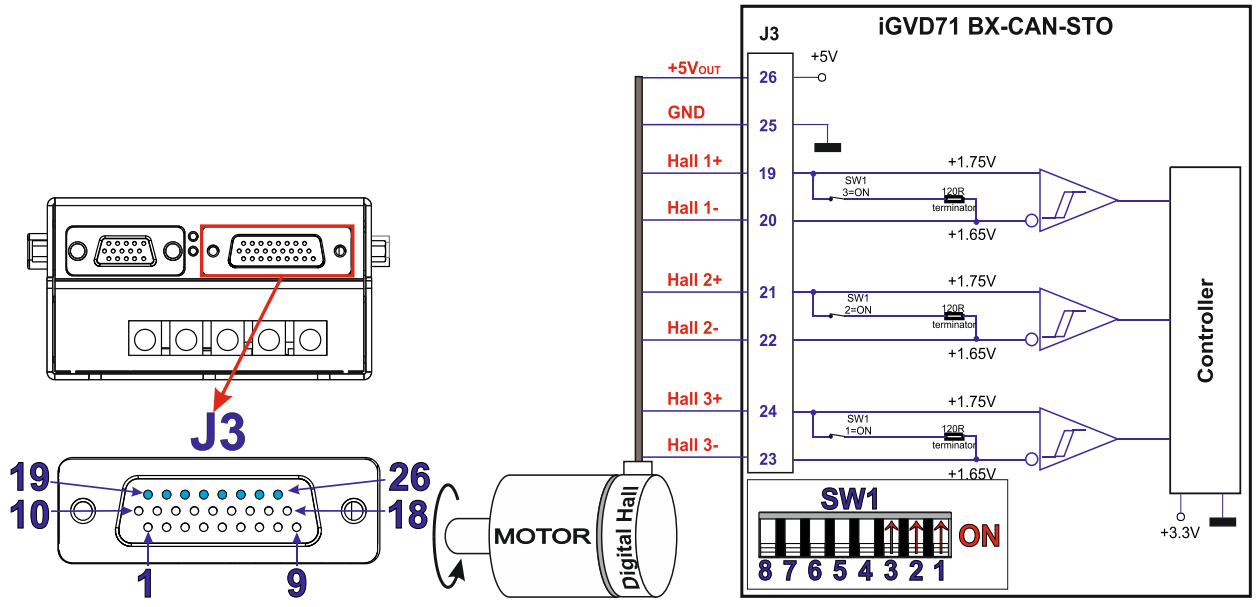


Pin	Name	Position	Description
1	**H3 120Ω**	up(ON)	Internally connect an 120Ω termination resistor between Hall 3+ and Hall 3- pins.
2	**H2 120Ω**	up(ON)	Internally connect an 120Ω termination resistor between Hall 2+ and Hall 2- pins.
3	**H1 120Ω**	up(ON)	Internally connect an 120Ω termination resistor between Hall 1+ and Hall 1- pins.

8.7.2 Single-Ended Digital Hall Connection

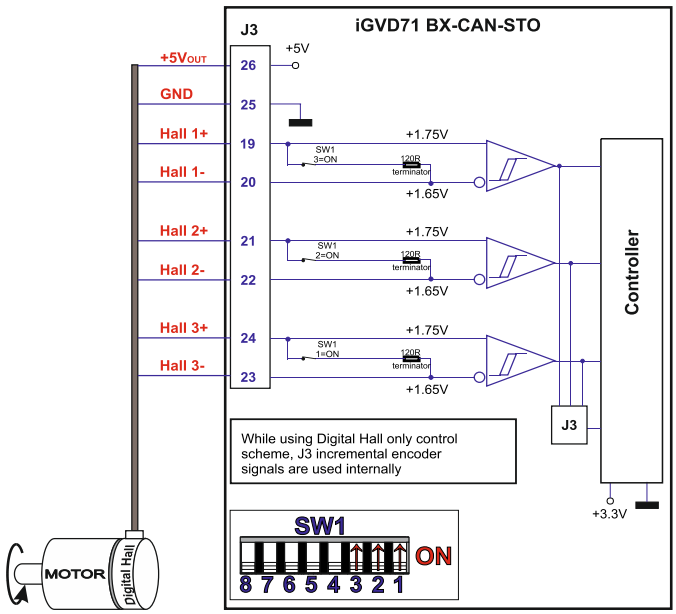


8.7.3 Differential Digital Hall Connection



8.7.4 Digital Hall Connection for Motor Control

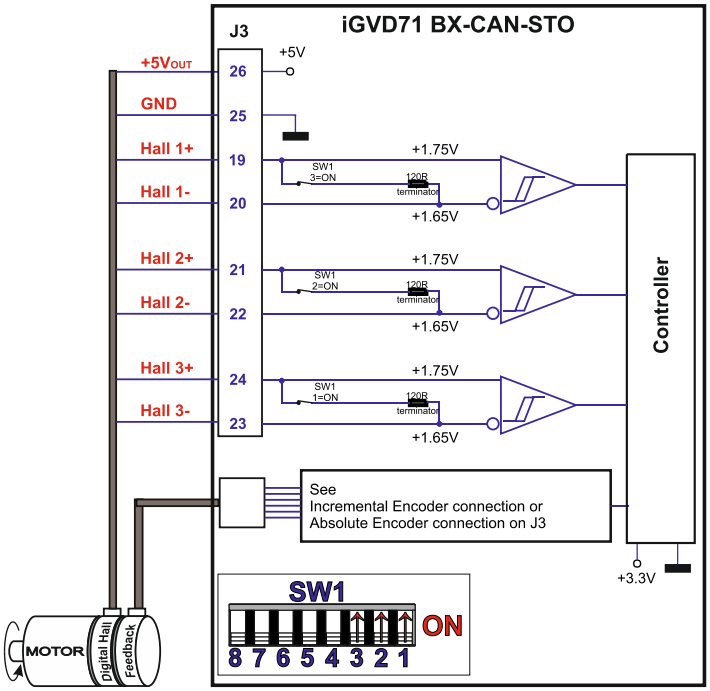
8.7.4.1 Digital Hall only control



Remarks:

1. *Digital Hall only control method can be achieved also using a single-ended digital Hall connection.*
2. *This connection is required when using the digital Halls as the only feedback device for the motor control.*
3. *While using this control scheme, the incremental encoder signals from J3 are used internally by the drive.*
4. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*

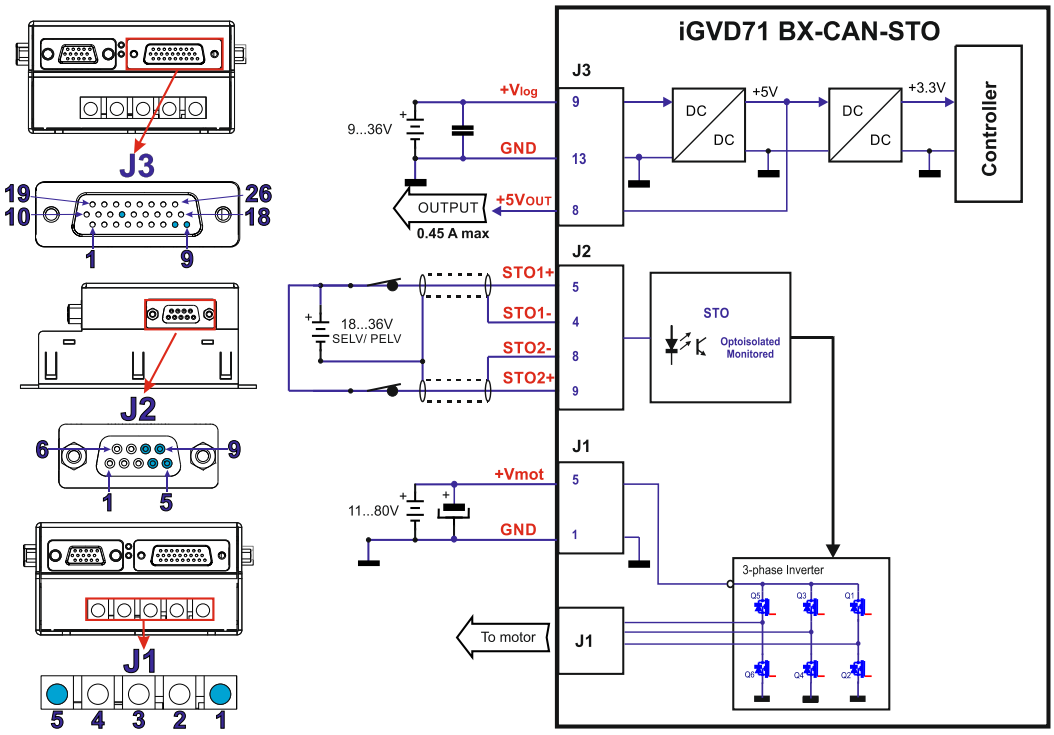
8.7.4.2 Digital Hall + Incremental or Absolute Encoder control



Remarks:

1. *Digital Hall + Incremental or Absolute Encoder control method can be achieved also using a single-ended digital Hall connection.*
2. *This connection is required when using Hall start method BLDC or PMSM and also for the Trapezoidal commutation method.*
3. *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.*
4. *The length of the cables must be up to 30m, reducing the exposure to voltage surges in industrial environment.*

8.8 Power Supply Connection



Remarks:

1. *The iGVD71 BX-CAN-STO requires three supply voltages: V_{LOG}, V_{MOT} and STO.*
2. *The STO circuit must be supplied with minimum 18V to enable PWM output.*
3. *Use short, thick wires between the iGVD71 and the motor power supply. If the wires are longer than 2 meters, use twisted wires for the supply and ground return.*
4. *For wires longer than 20 meters, add a capacitor of at least 4,700µF (rated at an appropriate voltage) right on the terminals of the iGVD71.*
5. *It is recommended to connect the negative motor supply return (GND) to the Earth protection near the power supply terminals.*

8.8.1 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 **86V**, 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} = 86V 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]

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

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

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

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

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

h_{final} – final system altitude [m]

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

R_{Ph} – motor phase resistance [Ω]

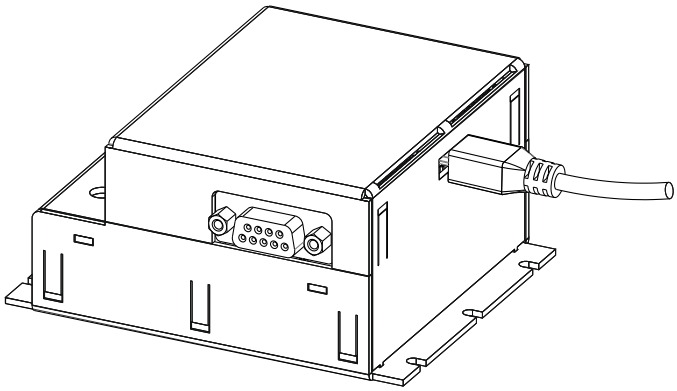
t_d – time to decelerate [s]

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

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

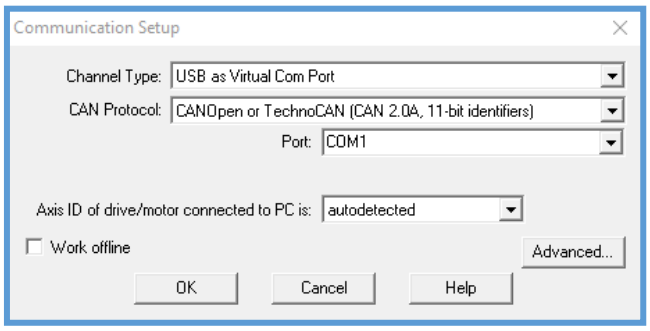
8.9 Communication connection

8.9.1 RS232 (Micro USB port) connection

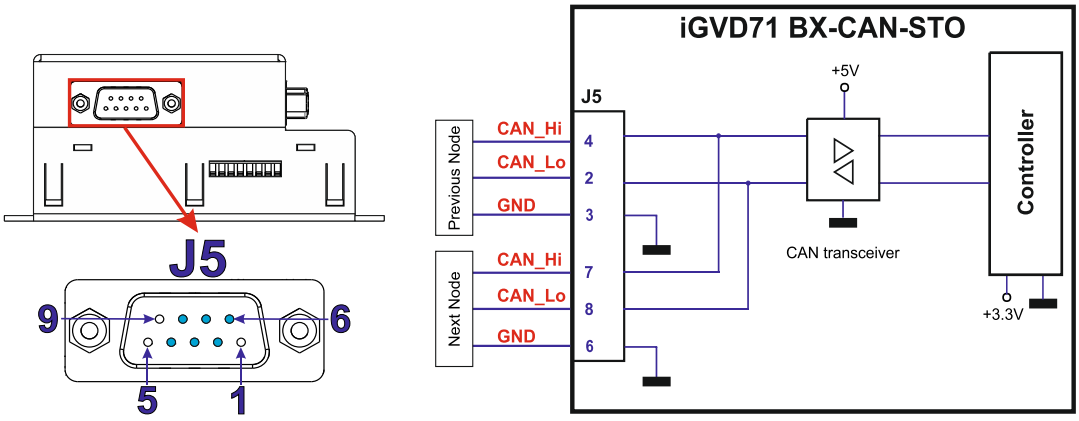


Remarks:

1. For the RS232 connection a standard **Micro USB cable** is required. The drivers are found automatically in Windows 10 and the device is identified as a COM port.
2. The RS232 communication includes micro USB to RS232 adapter.
3. In Easy Motion studio, choose the following communication settings:



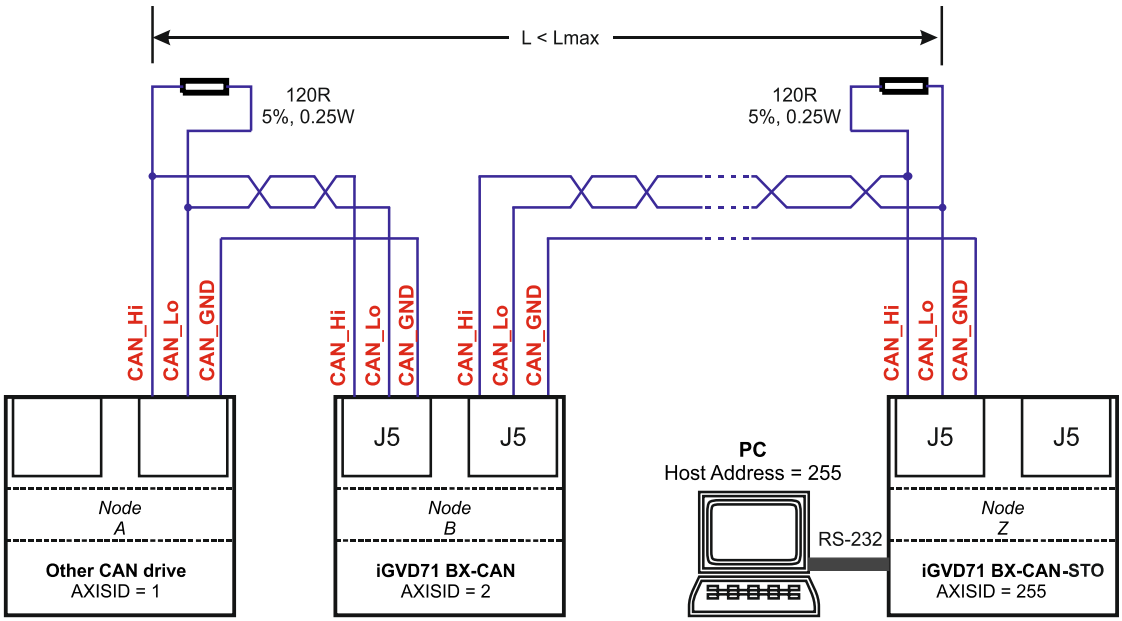
8.9.2 CAN-bus connection



Remarks:

1. *The CAN network requires a 120-Ohm terminator. This is not included in the iGVD71 drive.*
2. *CAN signals are not isolated from other iGVD71 circuits.*

8.9.2.1 Multiple-Axis CAN network



8.9.2.2 Recommendation for wiring

1. 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.
2. The 120Ω termination resistors must be rated at 0.2W minimum. Do not use winded resistors, which are inductive.

8.10 Disabling Autorun

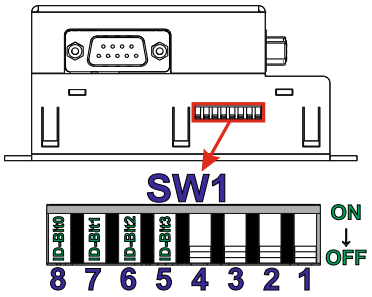
When an iGVD71 BX-CAN-STO is set in TMLCAN operation mode, by default after power-on, it enters automatically in **Autorun** mode. In this mode, if the drive has in its local EEPROM memory a valid TML application (motion program), it is automatically executed as soon as the motor supply V_{MOT} is turned on.

In order to disable *Autorun* mode, there are 3 methods:

1. **Software** - by writing value 0x0001 in first EEPROM location at address 0x4000.
2. **Hardware1** – set the drive temporarily in CANopen mode. While in CANopen state, no motion will autorun. Set SW1 pin4 in down position.
3. **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.

8.11 Axis ID Selection

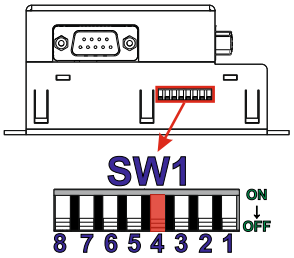


Pin	Name	Description
5	ID-Bit3	Hardware AxisID selection switches. Position: UP = ON = 1; DOWN = OFF = 0. They represent the first 4 LSB bits of an 8 bit Axis ID number. The AxisID can be computed using the formula: **AxisID = ID-Bit0 + 2 · ID-Bit1 + 4 · ID-Bit2 + 8 · ID-Bit3** When all bits are off then AxisID=255. When all bits are on then AxisID=15.
6	ID-Bit2	
7	ID-Bit1	
8	ID-Bit0	

Remarks:

1. All pins are sampled at power-up, and the drive is configured accordingly.
2. *If CANopen mode is selected and the AxisID is set to 255, the drive remains "non-configured" waiting for a CANopen master to configure it, using CiA-305 protocol.*
3. *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.*

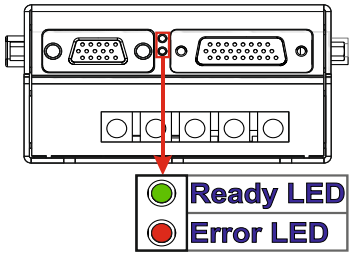
8.12 TMLCAN / CANopen selection



Pin	Name	Position	Function
4	TML/CO	Up (ON)	Select CANopen communication protocol.
		Down (OFF)	Select TMLCAN communication protocol.

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

8.13 LED indicators



LED name	LED color	Function
Ready LED		Lit after power-on when the drive initialization ends. Turned off when an error occurs.
Error LED		Turned on when the drive detects an error condition.

9 Electrical Specifications

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

- V_{LOG} = 24 VDC; V_{MOT} = 80VDC
- Supplies start-up / shutdown sequence: -any-
- Load current (sinusoidal amplitude) = 100A

9.1.1 Operating Conditions

		Min.	Typ.	Max.	Units
Ambient temperature		0		40[1, 3]	ºC
Ambient humidity	Non-condensing	0		90	%Rh
Altitude / pressure[2]	Altitude (vs. sea level)	-0.1	0 ÷ 2.5	[2]	Km
	Ambient Pressure	0 [2]	0.75 ÷ 1	10.0	atm

9.1.2 Storage Conditions

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

9.1.3 Mechanical Mounting

		Min.	Typ.	Max.	Units
External heatsink (cooling plate)	Current capability depends on heat transfer, heatsink dimension, cooling technique (natural or forced). Keep lower plate temperature at maximum 75ºC				

9.1.4 Environmental Characteristics

		Min.	Typ.	Max.	Units
Size (Length x Width x Height)	Without mating connectors		104.2 x 95 x 47.1		mm
			~4.1 x 3.74 x 1.85		inch
Weight	Without mating connectors		300		g
Power dissipation	Idle (no load)		3		W
	Operating		80÷100		
Efficiency			98		%
Cleaning agents	Dry cleaning is recommended		Only Water- or Alcohol- based		
Protection degree	According to IEC60529, UL508		IP20		-

9.1.5 Logic Supply Input (+V_{LOG})

			Min.	Typ.	Max.	Units
Supply voltage	Nominal values		12	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} = 12V		170		mA
		+V_{LOG} = 24V		110		
		+V_{LOG} = 36V		90		
Utilization Category	Acc. to 60947-4-1 (I_{PEAK}<=1.05*I_{NOM})		DC-1			

9.1.6 Motor Supply Input (+V_{MOT})

		Min.	Typ.	Max.	Units
Supply voltage	Nominal values	12	80	90	V_{DC}
	Absolute maximum values, drive operating but outside guaranteed parameters	11		94	V_{DC}
	Absolute maximum values, surge (duration ≤ 10ms) †	-1		95	V
Supply current	Idle		1	5	mA
	Operating	-130	±100	+130	A
	Absolute maximum value, short-circuit condition (Duration ≤ 10ms) †			140	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] iGVD71 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.

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

			Min.	Typ.	Max.	Units
Nominal (recommended) output current, continuous[1] *As long as drive lower plate does not exceed 75ºC	for DC brushed and BLDC motors with Hall-based trapezoidal control				86.6	A
	for PMSM motors with FOC sinusoidal control (sinusoidal amplitude value)				100	
	for PMSM motors with FOC sinusoidal control (sinusoidal effective value)				70.7	A_{RMS}
Motor output current, peak	*As long as drive back plate does not exceed 75ºC		-135		+135	A
Short-circuit protection threshold					±140	A
Short-circuit protection delay			5	10		µs
On-state voltage drop	Nominal output current; including typical mating connector contact resistance			±0.3	±0.5	V
Off-state leakage current				±0.5	±1	mA
Motor inductance (phase-to-phase)	Recommended value, for current ripple max. ±5% of full range; $+V_{MOT}$ = 60 V	F_{PWM}				µH
		20 kHz	300			
		40 kHz	150			
		60 kHz	100			
		80 kHz	75			
	Minimum value, limited by short-circuit protection; $+V_{MOT}$ = 60 V	20 kHz	150			µH
		40 kHz	75			
		60 kHz	50			
		80 kHz	38			
Motor electrical time-constant (L/R)	Recommended value for ±5% current measurement error	20 kHz	250			µs
		40 kHz	125			
		60 kHz	100			
		80 kHz	63			
Current measurement accuracy	FS = Full scale accuracy			±4	±8	%FS

9.1.8 Digital Inputs - opto-isolated - (IN0, IN1, IN2/LSP, IN3/LSN, IN4)

		Min.	Typ.	Max.	Units
Mode compliance	PNP (J4, pin8 connected to GND)	Connect digital input pin to +Vlog to change its state			
	NPN (J4, pin8 connected to +Vlog)	Connect digital input pin to GND to change its state			
Default state	Input floating (wiring disconnected)	Logic LOW			
Input voltage	Logic LOW	0		6	V
	Logic HIGH	11		36	
	Absolute maximum	-5		50	
Input current	Logic LOW	0		0.2	mA
	Logic HIGH	0.65	1.9	3.2	
	Absolute maximum	0		4	
Input frequency			2		kHz
Minimum pulse			500		µs
ESD protection	Human body model	±15			kV

9.1.9 Digital Outputs (OUT0/Brake, OUT1, OUT2, OUT3, OUT4)

		Min.	Typ.	Max.	Units
Mode compliance		PNP 24V			
Default state	Not supplied (+VLOG floating or to GND)	High-Z (floating)			
	Normal operation	Logic “High”			
Output voltage	Logic “HIGH”; output current = 0.2A		V_{LOG}-0.2	V_{LOG}-0.8	V
	Logic “LOW”; output current = 0, no load	open-collector			
	Logic “HIGH”, external load to GND		0		
	Absolute maximum, continuous	-0.3		V_{LOG}+0.3	
	Absolute maximum, surge (duration ≤ 1s) †	-0.5		V_{LOG}+0.5	
Output current	Logic “HIGH”, source current, continuous	OUT1,2,3,4		0.2	A
		OUT0/Brake		2	
	Logic “HIGH”, source current, pulse ≤ 5 s	OUT1,2,3,4		0.4	A
		OUT0/Brake		3	
	Logic “LOW”, means High-Z				mA
Minimum pulse width		2			µs
ESD protection	Human body model	±15			kV

[1] @20Khz F_{PWM}

Mode compliance		NPN 24V			
Default state	Not supplied (+V_{LOG} floating or to GND)	High-Z (floating)			
	Normal operation	High-Z			
Output voltage	Logic “LOW”; output current = 0.3A		0.2	0.8	V
	Logic “HIGH”; output current = 0, no load	open-collector			
	Logic “HIGH”, external load to +V_{LOG}		V_{LOG}		
	Absolute maximum, continuous	-0.3		V_{LOG}+0.3	
	Absolute maximum, surge (duration ≤ 1s) †	-0.5		V_{LOG}+0.5	
Output current	Logic “LOW”, sink current, continuous	OUT1,2,3,4		0.3	A
		OUT0/Brake		2	
	Logic “LOW”, sink current, pulse ≤ 5 s	OUT1,2,3,4		0.5	A
		OUT0/Brake		3	
	Logic “HIGH”, means High-Z				mA
Minimum pulse width		2			µs
ESD protection	Human body model	±15			kV

9.1.10 Brake output (OUT0/Brake)

			Min.	Typ.	Max.	Units
Out0/Brake: solenoid driver, 2A.						
Default state	Not supplied (+V_{LOG} floating or to GND)		High-Z (floating)			
	Immediately after power-up	Brake-	High-Z (floating)			
	Normal operation	Brake-	High-Z (floating)			
Output voltage	Logic “LOW” (Brake-)				0.2	V
	Logic “HIGH”; load present			+V_{LOG}		
	Logic “HIGH”, no load present			+5		
	Absolute maximum, continuous		-0.5		+V_{LOG} +0.3	
Output current	Logic “LOW”, sink current, continuous, Brake-				3	A
	Logic “HIGH”, leakage current; external load to +V_{LOG}; V_{OUT} = V_{LOG} max = 55V				0.2	mA

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

			Min.	Typ.	Max.	Units
Mode compliance			TTL / CMOS / Open-collector			
Default state	Input floating (Wiring disconnected)		Logic HIGH			
Input voltage	Logic “LOW”			0	0.8	V
	Logic “HIGH”		2	5		
	Floating voltage (Not connected)	H1+, H2+, H3+		4.4		
		H1-, H2-, H3-		1.8		
	Absolute maximum, surge (duration ≤ 1s) †		-10		+15	
Input current	Logic “LOW”; Pull to GND				1.2	mA
	Logic “HIGH”; Internal 4.7KΩ pull-up to +5		0	0	0	
Minimum pulse width			2			µs

Differential mode compliance	RS422 compliance	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			120		Ω
Input frequency	Differential mode	0		10	MHz
Minimum pulse width	Differential mode	50			ns
ESD protection	Human body model	±5			kV

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

		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

[1] Differential input HALL pins have internal 120Ω termination resistors connected across when SW1 pins 1,2,3 are ON
[2] All differential input pins have internal 120Ω termination resistors connected across

9.1.13 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		18		kΩ
Resolution			12		bits
Integral linearity				±2	bits
Offset error			±2	±10	bits
Gain error			±1%	±3%	% FS[1]
Bandwidth (-3dB)	Software selectable	0		1	kHz
ESD protection	Human body model	±5			kV

9.1.14 SSI, BiSS, EnDAT[2] 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)			

9.1.15 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

9.1.16 CAN-Bus

		Min.	Typ.	Max.	Units
Compliance	ISO11898, CiA-301v4.2, CiA 305 v2.2.13, 402v3.0				
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 SW1 switch	CANopen: 1 ÷ 15 & 127 (LSS non-configured); TMLCAN: 1-15 & 255			
	Software	1 ÷ 127 (CANopen); 1- 255 (TMLCAN)			
Voltage, CAN-Hi or CAN-Lo to GND		-26		26	V
ESD protection	Human body model	±15			kV
	Logic "HIGH", leakage current; external load to $+V_{LOG}$; $V_{OUT} = V_{LOG}$ max = 55V			0.2	mA

9.1.17 Supply Output (+5V)

		Min.	Typ.	Max.	Units
+5V output voltage	Current sourced = 250mA	4.8	5	5.2	V
+5V output current		600	650		mA
Short-circuit protection		Protected			
Over-voltage protection		NOT protected			
ESD protection	Human body model 0.1nF 1.5 kΩ	±1			kV

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

[2] EnDAT 2.2 protocol is available starting with F514K firmware version

[3] Availabile only for EnDAT and BiSS feedback options

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

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

9.1.19 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.

10 Memory Map

iGVD71 BX has 2 types of memory available for user applications: 16K×16 SRAM and up to 16K×16 serial E^2ROM.

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

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

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