CMZ SISTEMI ELETTRONICI

soga energyteam

Solutions in *motion*

LBD

Installation guide

Intelligence Production Movement

Doc. TR420901

WARNING

This is a general manual describing a series of servo drives having output capability suitable for driving AC brushless sinusoidal servo motors.

Please see also:

- **LBD SafeTorqueOff** for the Safe Torque Off function
- **LBD User Guide** for the operation of the drive (commissioning, configuration, ...)
- **LBD Templates** for the templates of target applications.
- **GDS** *(Gem Drive Studio)* **software Quick Start** manual for the drive parameterization.
- **LBD EtherCAT® fieldbus interface** manual for the **LBD ETC** version.
- **MMGDPS** manual, for the use of the GDPS power supply unit.

Instructions for storage, use after storage, commissioning as well as all technical details require the MANDATORY reading of the manual before getting the drives operational.

Maintenance procedures should be attempted only by highly skilled technicians having good knowledge of electronics and servo systems with variable speed (EN 60204-1 standard) and using proper test equipment.

The conformity with the standards and the "CE" approval is only valid if the items are installed according to the recommendations of the drive manuals. Connections are the user's responsibility if recommendations and drawings requirements are not met.

Any contact with electrical parts, even after power down, may involve physical damage.
Wait for at least 10 minutes after power down before handling the drives (a residual voltage of several hundreds of volts may remain during a few minutes).

Caution: Hot surface, risk of burns (wait for cooling after power down).

ESD INFORMATION (ElectroStatic Discharge)
CMZ Sistemi Elettronici S.r.l drives are designed for being best protected against electrostatic discharges. However, some components are particularly sensitive and may be damaged if the drives are not properly stored and handled.

STORAGE

- The drives must be stored in their original packaging.
- When taken out of their packaging, they must be stored positioned on one of their flat metal surfaces and on a dissipating or electrostatically neutral support.
- Avoid any contact between the drive connectors and material with electrostatic potential (plastic film, polyester, carpet…).

HANDLING

- If no protection equipment is available (dissipating shoes or bracelets), the drives must be handled via their metal housing.
- Never get in contact with the connectors.

WASTE DISPOSAL
This symbol indicates that CMZ Sistemi Elettronici S.r.l devices shall be eliminated by selective disposal and not with household waste.

CMZ Sistemi Elettronici S.r.l. does not assume any responsibility for any physical or material damage due to improper handling or wrong descriptions of the ordered items.
Any service on the items, which is not specified in the manual, will immediately cancel the warranty.

CMZ Sistemi Elettronici S.r.l reserves the right to change any information contained in this manual without notice.

Content

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Chapter 1 – General

1.1 - INTRODUCTION

LBD all-digital drives with sinusoidal PWM control are servo drives that provide the control of brushless AC motors with a position sensor.

The standard control interface can be:

- CANopen®[1],
- EtherCAT®[2],
- analog,
- stepper motor emulation,
- logic I/Os.

But the **LBD** range also offers more sophisticated functions such as:

- DS402 including position capture,
- Master/slave and electronic gearing functions,
- Positioner with motion sequencing.

All versions are delivered in standard with the integrated safety function **Safe Torque Off** (**STO)**.
Please see the LBD_STO_SIL3 manual for the Safe Torque Off function

With its very small dimensions, the **LBD** is available in various designs:

- stand-alone or multi-axis version,
- standard forced air, push-through or cold plate cooling versions.

Series **LBD** drives are fully configurable in order to fit various applications. Both drive versions of the **LBD** range are described below.

The **LBD** version with **CANopen® interface** can be used in the following application types:

- Axes controlled by CANopen® fieldbus according to the DS402 protocol,
- Stand-alone operation as a motion sequencer with control by means of logic I/Os,
- Traditional analog speed drive with +/- 10 V command and position output by A, B, Z encoder signal emulation,
- Stepper motor emulation with PULSE and DIR command signals.

The **LBD** version with **EtherCAT® interface** can be used in the following application types:

- Axes controlled by EtherCAT® fieldbus according to the DS402 protocol,
- Stand-alone operation as a motion sequencer with control by means of logic I/Os.

The configuration and parameterization software tool *Gem Drive Studio* allows a quick configuration of the **LBD** drives according to the target application (template).

[1] *CANopen® is a registered Community Trademark of CAN in Automation e.V., Germany*
[2] *EtherCAT® is a registered trade mark and a patented technology of Company Beckhoff Automation GmbH, Germany.*

1.2 - DESCRIPTION / COMPLIANCE WITH THE STANDARDS

1.2.1 - General description

The **LBD** drive directly controls the motor torque and speed from of the information provided by a high resolution position sensor (**resolver** or **encoder**). The sinusoidal current commutation generated from the information of this high resolution position sensor ensures very smooth motor torque/force control.

The **LBD** drive can be configured for the feedback of various position sensor types. The appropriate position sensor configuration is selectable by software and saved in the drive.

- With a **resolver** sensor feedback, the motor absolute position value over one revolution is available and the servo motor can immediately be enabled after the drive power up.
- With an **incremental encoder** only**,** a motor phasing procedure **(Phasing)** must be executed at each drive power up before the motor enabling.
- With an **incremental encoder + Hall Effect Sensors (HES)** feedback, the motor phasing procedure is no more necessary and the servo motor can immediately be enabled after the drive power up.
- With an **absolute single-turn, multi-turn** or **linear encoder** using the **HIPERFACE®** communication protocol and fitted with incremental SinCos outputs, the servo-motor can also be immediately enabled after the drive powering.
- With an **absolute single-turn or multi-turn digital encoder** using the **HIPERFACE DSL®** communication protocol, the servo-motor can also be immediately enabled after the drive powering.

Series **LBD** drives have their own DC/DC converter to provide the voltages required for the drive operation with a $24V_{DC}$ +/- 15 % supply source which is generally available on machines. The auxiliary supply allows keeping the drive logic supplies after the power supply has been switched off. Thus, the position output can be kept without new initializations of the machine. A $24V_{DC}$ battery supply with specific wiring allows keeping the position even after switching off the auxiliary $24V_{DC}$ supply. This wiring can be used for getting an "absolute" servo drive operation.

A soft start system limits the inrush current at the mains power on.

All control parameters are programmable via a serial link (e.g. RS-232) and saved in a memory. The auto-tuning and auto-phasing functions allow a quick and easy commissioning of the drive.

Thanks to the *Gem Drive Studio* software tool, which is PC compatible with the WINDOWS® operating system, all drive parameters can be displayed and easily modified.

Gem Drive Studio also allows the quick configuration of the **LBD** drive according to the application type: as an **Analog drive, Stepper motor emulation, Positioner, etc**.

The **Digital Oscilloscope** of this software tool ensures an easy and quick commissioning of the drive.

The *Gem Drive Studio* software also allows parameterization and diagnostic in a multi-axis configuration.

1.2.2 - Reference to the standards: CE

Electromagnetic compatibility

According to the Directive 2014/30/UE, the actuators are complying with the Electromagnetic Compatibility standards regarding the power servos, referenced in the EN 61800-3 – Part 3 about "Electrical power servo systems with variable speed":

EMISSION	
EN 61800-3	C3 category equipment – tables 17 and 18
IMMUNITY	
EN 61000.4-2-3-4.5-6	**Expected use**: **Second environment** including other areas than those directly supplied with electricity by a public low-voltage mains network.

NOTE: Industrial areas and technical rooms are examples of second environment.
Security:

Directive 93/68/EEC:	Low voltage directive
EN 61800-5-1: (Overvoltage category III, System Voltage = 300 V)	Electrical, Thermal and Energetic security requirements
EN 60204-1:	Safety of machinery: electrical equipment of machines
UL508C:	Power Conversion Equipment
UL840:	Insulation coordination for electrical equipment
EN 61800-5-2:	Adjustable speed electrical power drive systems: Safety requirements - Functional

EC conformity of the LBD drive

1.2.3 - Reference to the standards:

LBD series (except 400V/200A) have been "cULus" listed according to UL508C and UL840 regarding the insulation.

LBD series (except 400V/200A) were evaluated to:

- the Third Edition of UL508C, the UL Standard for Power Conversion Equipment for the UL Listing (USL),
- the CSA Standard for Industrial Control Equipment, C22.2 N° 14-10 for the Canadian UL Listing (CNL).

LBD 400V/200A has been "cULus" listed according to UL61800-5-1 and CSA 22.2 N°274 regarding the insulation.

LBD 400V/200A was evaluated to:

- UL61800-5-1, the UL Standard for adjustable speed electrical power drive system -Part 5-1: safety requirements-electrical, thermal and energy (USL),
- CSA C22.2 N°274-17 the CSA Standard for speed drives (CNL).

1.3 – OTHER DOCUMENTS

- **LBD** User guide
- **LBD** "Safe Torque Off" specification
- **LBD** Templates
- **Gem Drive Studio software** Quick Start manual
- **EtherCAT® fieldbus interface**
- **MMGDPS Power Supply Unit** manual

1.4 – ORDERING CODES

1.4.1 – Drives

1.4.1.1 – Ordering code of the drives

LBD23cc - xxx - ABC

Current ratings 230 V drives (Peak current)
5: 5 Arms
11: 11 Arms
17: 17 Arms

Interfacing
CAN: CANopen®, +/- 10 V, Pulse direction interfaces
ETC: EtherCAT®, +/- 10 V, Pulse direction interfaces
ETD: EtherCAT® + digital encoder interface
CND: CANopen® + digital encoder interface

Reserved
A, B: Reserved
C: Customization (only if 0 is UL certified)

1.4.1.2 – LBD 400 V

LBD40ccc - xxx . ABC

Current ratings 400 V drives (Peak current)
008: 8 Arms
020: 20 Arms
045: 45 Arms
100: 100 Arms
200: 200 Arms

Interfacing
CAN: CANopen®, +/- 10 V, Pulse direction interfaces
ETC: EtherCAT®, +/- 10 V, Pulse direction interfaces
ETD: EtherCAT® + digital encoder interface
CND: CANopen® + digital encoder interface

Mounting version (for 400 V range only)
A = 0: Standard version
A = 1: Push-through version
B: Reserved
C: Customization (only if 0 is UL certified)

1.4.1.3 – Selection of the drive version

Feedback sensor	Input command			
	Analog drive	Stepper emulation	CANopen®	EtherCAT®
Transmitter resolver	LBD CAN	LBD CAN	LBD CAN	LBD ETC
SinCos tracks resolver				
TTL encoder + HES	LBD CAN	LBD CAN	LBD CAN LBD CND	LBD ETC LBD ETD
SinCos encoder + HES				
Absolute single-turn SinCos encoder				
Hiperface® with SinCos channels				
ENDAT® 2.2 (without SinCos channels)	-	-	LBD CND	LBD ETD
Hiperface DSL® (one single motor cable)				

Chapter 2 – Specifications

2.1 – MAIN TECHNICAL DATA

2.1.1 – LBD-230/I

Design	Stand-alone
Available cooling version	Forced air (standard)
Operating power supply voltage (1)	110 to 230V_{AC} single-phase 50 – 60Hz Grounded neutral system with balanced phase to ground voltage
Undervoltage threshold (1)	100V_{DC}
Braking threshold (1)	390V_{DC}
Overvoltage threshold (1)	430V_{DC}
EMC filter on the mains power supply	Fully integrated in the drive
Motor phase-to-phase output voltage	95% of mains voltage
Integrated braking resistor	100R / 35W
External braking resistor (1)	Minimum external resistor: 50Ω
Minimum phase-to-phase inductance (1)	1mH
Galvanic isolated auxiliary supply voltage	24V_{DC} +/- 15% - 400mA (without motor brake)
EMC filter on auxiliary supply	Integrated in the drive

(1) These values correspond to the default configuration of the drive. For lower operating voltage, see Appendix "Low operating voltage".

OUTPUT CURRENT RATINGS

TYPE	Max. output current for 3s (Arms) (1) +/-5% (230V_{AC})	Rated output current (Arms) (230Vac)	Power losses at rated current (W)	Rated input current (Arms) (230Vac, 60Hz)	Certified max. protection line circuit fuses A60Q	Mains short-circuit power	UL listed
LBD-230/5	5	2.5	20	4.3	10A	5kA	yes
LBD-230/11	11	5.5	40	9.5	15A	5kA	yes
LBD-230/17	17	8.5	65	14.7	20A	5kA	yes

(1) Internal protection automatically divides the time by 3 at standstill.

Maximum surrounding air temperature: 40°C.

OPERATING POWER RESTRICTION

Maximum continuous RMS power ensuring a capacitor lifetime of 20'000 hours:
- 650W for ratings 230/05 and 230/11,
- 1000W for rating 230/17.

In applications with higher continuous power, external capacitors (ref. CAPABOX 230) must be added or the DC buses must be paralleled (see "DC bus interfacing" application note).
The CAPABOX accessory is not UL listed.

2.1.2 - LBD-400/08 and 20A

Design		Stand-alone
Available cooling version		- Forced air (standard) - Push-through - Cold Plate
Operating power supply voltage according to the drive parameters		230 to 480V_{AC} three-phase 50 - 60Hz Grounded neutral system with balanced phase to ground voltage.
Undervoltage threshold (1)		210V_{DC}
Braking threshold (1)		790V_{DC}
Overvoltage threshold (1)		910V_{DC}
EMC filter on the mains power supply		Fully integrated in the drive
Motor phase-to-phase output voltage		95% of mains voltage
Integrated braking resistor		400R / 35W
External braking resistor	**LBD 400/08**	Minimum external resistor: 100Ω (1)
	LBD 400/20	Minimum external resistor: 50Ω (1)
Minimum phase-to-phase inductance (1)		2mH
Galvanic isolated auxiliary supply voltage		24V_{DC} +/- 15% - 400mA (without motor brake)
EMC filter on auxiliary supply		Integrated in the drive

(1) These values correspond to the default configuration of the drive. For lower operating voltage, see Appendix "Low operating voltage".

OUTPUT CURRENT RATINGS

TYPE	Max. output current for 3s (Arms) (1) +/-5% (480V_{AC})	Rated output current (Arms) (460V_{AC})	Power losses at rated current (W)	Rated input current (Arms) (480V_{AC}, 60Hz)	Certified max. protection line circuit fuses A60Q	Mains short-circuit power	UL listed
LBD-400/08	8	4	65	3.8	5A	5kA	yes
LBD-400/20	20	10	155	9.4	10A	5kA	yes

(1) Internal protection automatically divides the time by 3 at standstill.

Maximum surrounding air temperature: 40°C.

2.1.3 - LBD-400/45A, 100A and 200A

Design	Multi-axis
Available cooling versions	- Forced air (standard) - Push-through (except for 200A current rating) - Cold Plate (except for 200A current rating)
Operating power supply voltage according to the drive parameters	100 to 800V_{DC}
Undervoltage threshold (1)	210V_{DC}
Overvoltage threshold (1)	910V_{DC}
EMC filter on the mains power supply	External
Motor phase-to-phase output voltage	95% × U_{DC}/√2Vrms
Minimum phase-to-phase inductance (1)	2mH
Galvanic isolated auxiliary supply voltage	24V_{DC} +/- 15% - 500mA (without motor brake)
EMC filter on auxiliary supply	Integrated in the drive

(1) These values correspond to the default configuration of the drive. For lower operating voltage, see Appendix "Low operating voltage".

OUTPUT CURRENT RATINGS

TYPE	Max. output current (Arms) +/-5% (480V_{AC})	Rated output current (Arms) (460V_{AC})	Power losses at rated current (W)	Rated input current (Arms) (680V_{DC})	UL listed
LBD-400/45	45 during 3s (1)	22.5	345	26.3	yes
LBD-400/100	100 during 1s (1)	35	535	41	yes
LBD-400/200	200 during 1s (1)	(IEC) 75 (UL) 57	1147 871	87.9 66	yes

(1) Internal protection automatically divides the time by 3 at standstill.

Maximum surrounding air temperature: 40°C.

2.1.4 - Technical specifications

Servo loops: current, speed, position	Digital
Position sensor	Transmitter resolver (**LBD CAN and LBD ETC versions only**) Sin and Cos tracks Incremental encoder (TTL or SinCos signals) Incremental encoder + Hall Effect sensors Absolute single-turn SinCos encoder Absolute Hiperface® encoder Absolute Hiperface DSL® encoder (**LBD ETD and LBD CND versions only**) EnDat 2.2® encoder (**LBD ETD and LBD CND versions only**)
Power protections	See section 3.1.1 - LEDs
Switching frequency	8kHz
Analog input 1	±10V (resolution: 12bit)
Analog input 2	0 to +10V (resolution: 12bit)
Speed and position regulators	Sampling period = 0.5ms Anti-wind-up system of the integrator Anti-resonance filter Adjustable digital gains
Speed loop bandwidth	Selectable cut-off frequency for 45° phase shift: 50Hz (low), 75Hz (medium) or 100Hz (high)
Current loop bandwidth	Cut-off frequency for 45° phase shift: 500Hz (low) or 1000Hz (high)
Max. motor speed	Adjustable from 100 to 25'000rpm
Drive reaction time (initialization delay before PWM on)	**LBD** 230V: 6.25ms **LBD** 400V: 20ms
Encoder position output for CANopen® version. No encoder output available on EtherCAT® version	Quadrature signals A & B with Z marker pulse. RS 422 line transmitter: 20mA per output Programmable resolution: 64ppr to 16384ppr (according to max. motor speed). Max. pulses frequency: 437kHz Accuracy in arc minutes = (8 + 5400/resolution) Note: the total position accuracy must take into account the accuracy of the resolver used.
Resolver input	Software selectable: Transmitter resolver: Excitation frequency: 8kHz Max. output current = 30mA Transformation ratio: 0.3 to 0.5 (other values are factory set) SinCos tracks: 1Vcc to 4Vcc Sin and Cos signals

Encoder input	Software selectable: Quadrature signals A& B + one Z marker pulse per revol. Line receiver RS-422 Max. frequency of encoder pulses: 1MHz Resolution: 500 to 10^6ppr Incremental Sin/Cos encoder Heidenhain 1Vcc Sin/Cos type or compliant Maximum signal frequency: 200kHz Resolution: 500 to 10^6 ppr Interpolation factor: 256 Absolute single-turn Sin/Cos encoder Heidenhain ERN 1085 or compliant Maximum signal frequency: 200kHz Resolution: 512 to 2048 ppr Interpolation factor: 256 Hiperface® standard with SinCos channels Maximum signal frequency: 200kHz Resolution: 16 to 2048 ppr Interpolation factor: 256 Hiperface DSL® standard
Pulse & Direction input	Software re-configuration of 2 logic inputs for stepper motor emulation. 3 selectable channels: - Optocoupled 24V logic (max. pulse frequency = 10 kHz) - Non optocoupled 5V to 24V (max. pulse frequency = 50kHz) - RS422 differential receiver (max. pulse frequency = 1MHz) Resolution (steps per motor revolution): programmable.
Hall sensors input	5V to 24V positive logic voltage accepted External HES supply voltage required if different from 5V HES sequence error detection
7 opto-isolated logic inputs	5 software configurable logic inputs 2 inputs dedicated to the STO (Safe Torque Off) function
"Amp OK" output	"OptoMos" relay: output open if fault Umax = 50V, Imax = 300mA
Motor brake output	**LBD** 230V: not available / Use of the digital output **LBD** 400V / 08 to 20A: $24V_{DC}$ / 1.5A **LBD** 400V / 45 to 200A: $24V_{DC}$ / 2.5A
3 parameterizable logic outputs	Type PNP "high side" $24V_{DC}$, max. 300mA
Analog output	2.5V +/-2.5V, resolution: 8bit, load: 10mA Low-pass filter: 160Hz, programmable output signal: all objects can be mapped.
Error display	Front panel LEDs + diagnostic via serial link or CAN bus
Motor and application parameterization	Serial link RS-232 or bus interface with CANopen® communication protocol
CAN interface	CANopen® Protocol (DS301, DSP402)
EtherCAT® interface	See **EtherCAT® Fieldbus Interface** manual

Automatic functions	Drive adjustment to the motor (AUTO-PHASING) Adjustment of the servo loops (AUTO-TUNING)
MTBF (Mean Time Between Failures)	> 100'000 hours
Maximum surrounding air temperature	- Operation: +5°C to +50°C: from 40°C, the rated current must be reduced by 3% per additional Celsius degree - Storage: -20°C to +70°C
Altitude	1000 m
Moisture	< 50 % at 40°C and < 90% at 20°C: EN 60204-1 standard **Condensation prohibited (storage and operation)**
Cooling	Natural air convection or forced air according to the current rating. Check for free air convection and for no obstruction of the upper or lower air admissions.
Protection degree of the drive	IP20
Environment	Open chassis to be mounted inside an IP54 cabinet protecting the drive from conducting dust and condensation (pollution degree 2 environment) and according to the room temperature requirements.
Mounting position	Vertical
Weight	LBD-230/05, 11 and 17: 1.5kg LBD-400/08 and 20: 2.2kg LBD-400/45: 2.4kg LBD-400/100: 3.3kg LBD-400/200: 8.5kg

2.1.5 - Cold Plate specifications

Heatsink requirements:

The heat transfer is ensured by an external heatsink that can work with various techniques (air, liquid, …).
For a proper running of the drive, the following specifications shall be fulfilled:

- The contact surface between the drive and the heatsink shall be at least as large as the drive plate.
- The planarity of the heatsink shall be better than 0.05mm all over the rear of the drive.
- The temperature of the heatsink should never exceed 70°C.
- Maximum surrounding air temperature :
    - 50°C
    - From 40°C, the rated current must be reduced by 3% per Celsius degree.
- A short preview of the maximum values for the thermal resistor of the heatsink is given in the following table:

Continuous motor current (A)	Losses (W) at 400V_{AC}	R_{TH} (K/W)
4	56	≤ 0.55
10	140	≤ 0.22
22.5	314	≤ 0.10
35	489	≤ 0.06

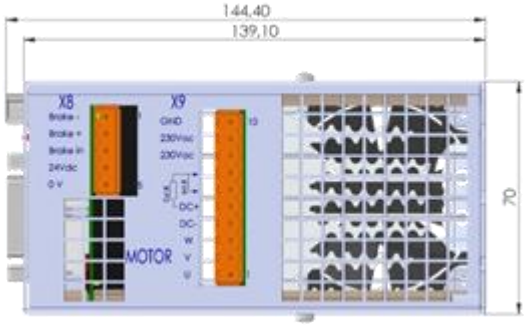
Mounting instructions:
Clean the contact surface of the heatsink with alcohol.
Apply a thermal interface between the drive plate and the heatsink. Recommended thermal interfaces:
A thin layer of thermal paste on the drive (recommended reference: RHODORSIL Paste 340).
Phase change thermal interface (recommended reference: Bergquist, Hi-Flow 225F-AC, 150×50 mm)
Fasten the drive with 4 screws and tooth lock washers.

2.2 - DIMENSIONS AND CONNECTOR LOCATION

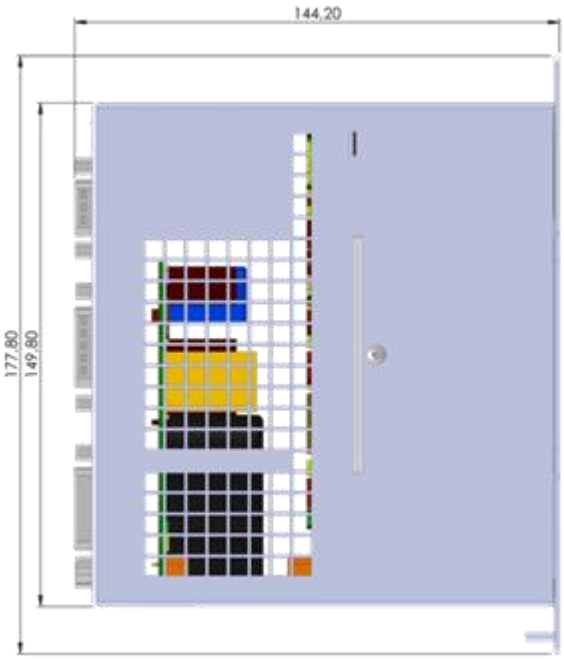
2.2.1 - LBD 230V dimensions

Dimensions are given in mm.

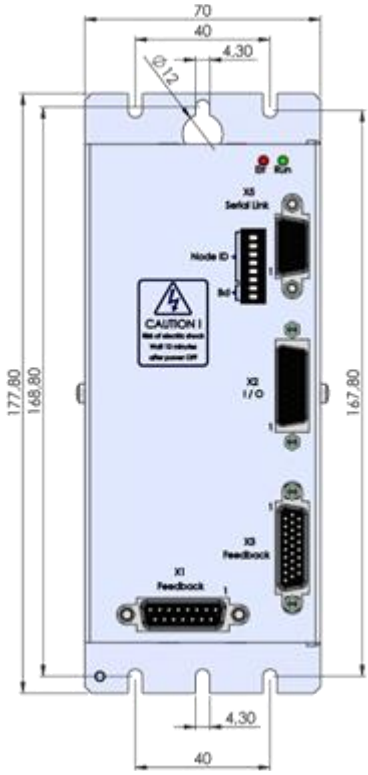
BOTTOM VIEW



SIDE VIEW



FRONT VIEW

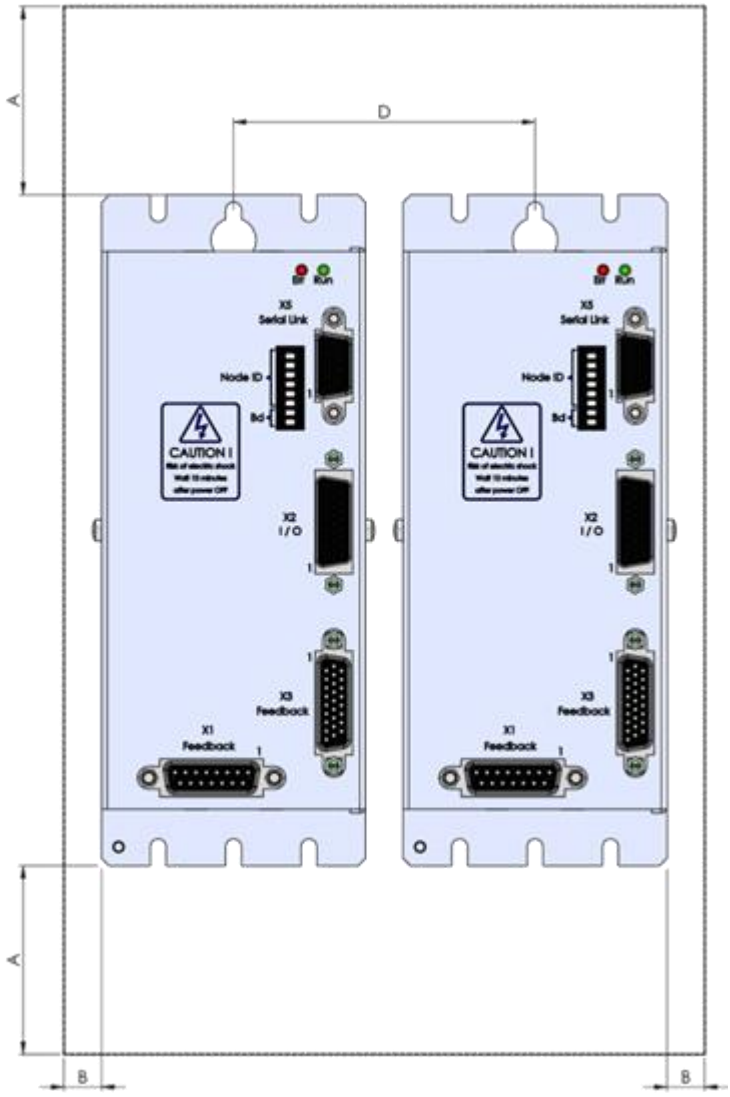


TOP VIEW

2.2.2 - LBD 230V: Panel layout dimensions

Dimensions are given in mm

VERTICAL MOUNTING IS MANDATORY



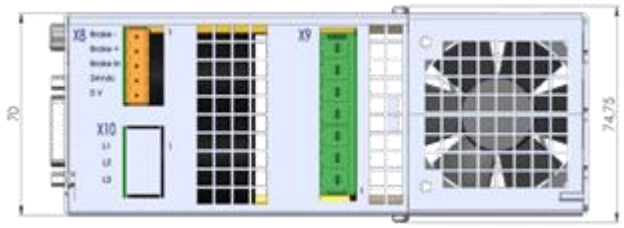
Description	Symbol	LBD
Minimum top and bottom clearance	A	50
Minimum side clearance	B	10
Recommended pitch	D	80

2.2.3 - LBD 400V / 08 to 45A dimensions

Dimensions are given in mm.

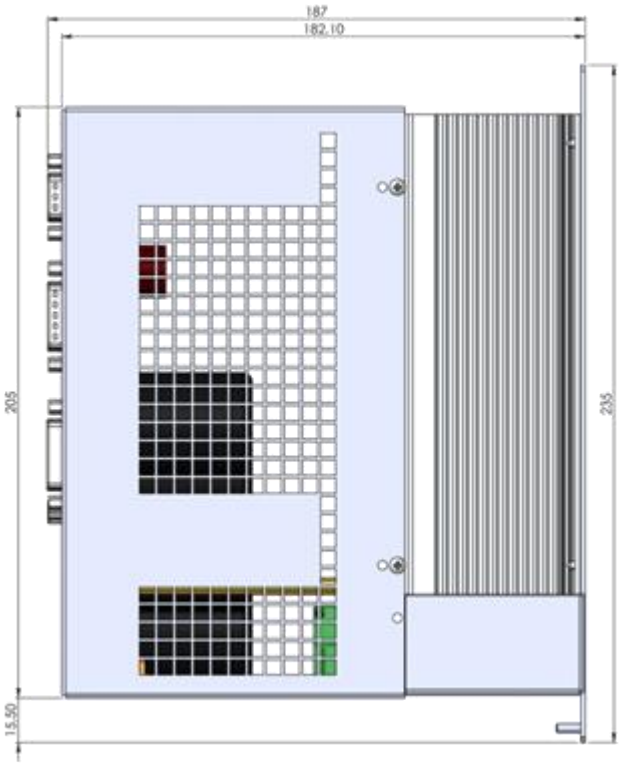
Standard version

BOTTOM VIEW

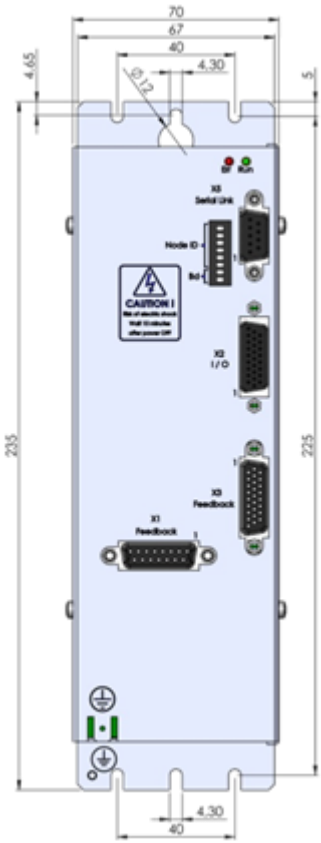


Note:
This bottom view is the one of the 400/45 drive (without X10 connector).
The X10 connector is only available on drives with 8A and 20A current ratings.

SIDE VIEW



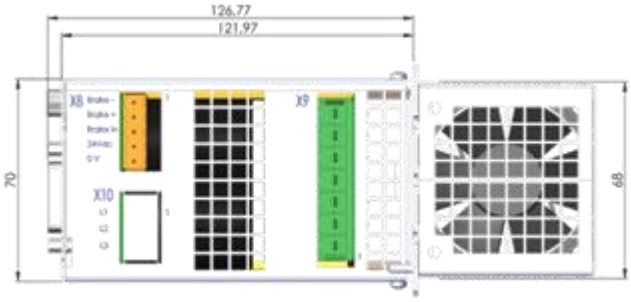
FRONT VIEW



TOP VIEW

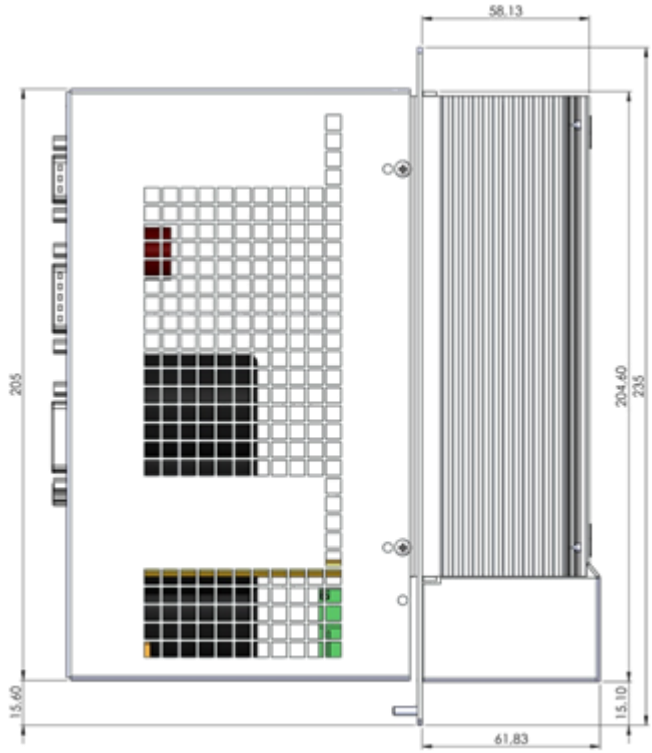
Push-through version

BOTTOM VIEW

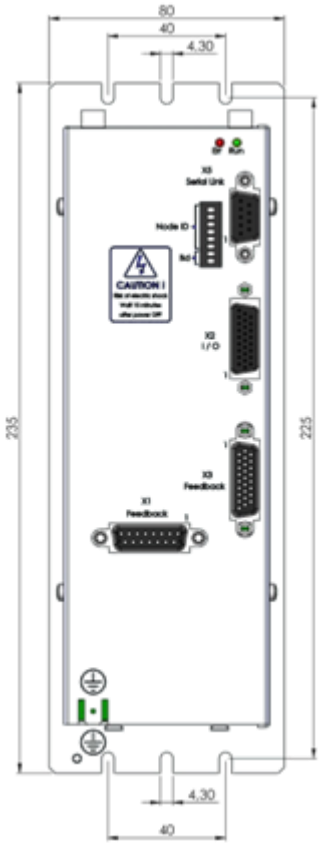


Note:
This bottom view is the one of the 400/45 drive (without X10 connector).
The X10 connector is only available on drives with 8A and 20A current ratings.

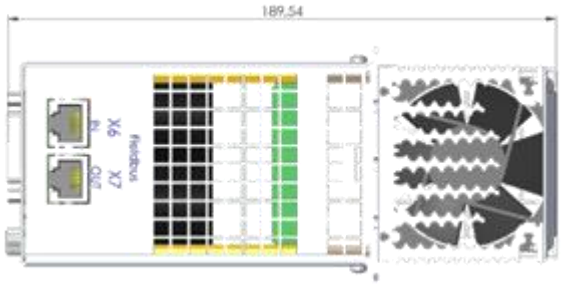
SIDE VIEW



FRONT VIEW



TOP VIEW

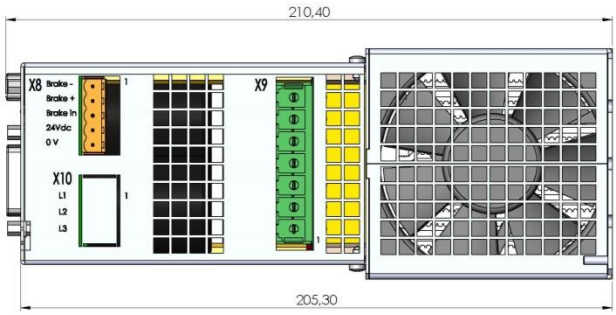


2.2.4 - LBD 400V / 100A dimensions

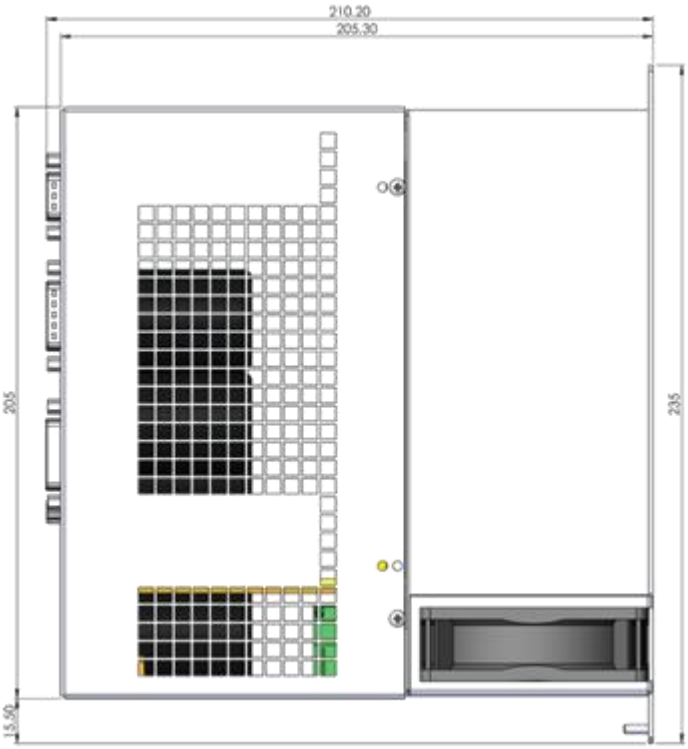
Dimensions are given in mm.

Standard version

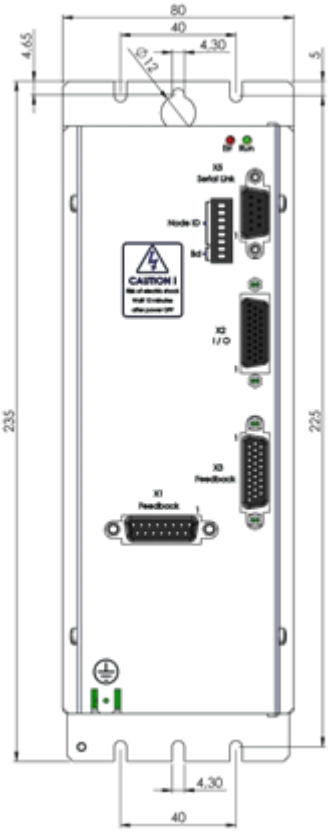
BOTTOM VIEW



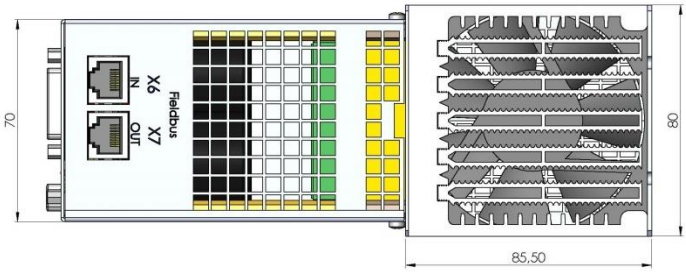
SIDE VIEW



FRONT VIEW

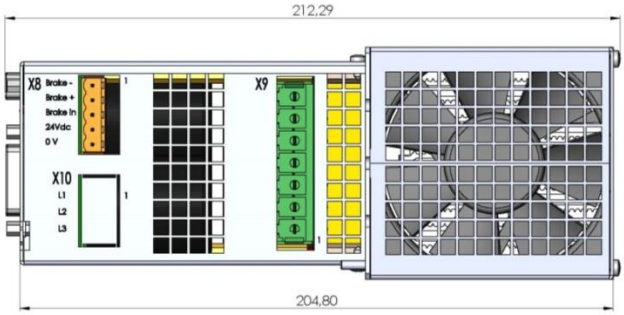


TOP VIEW

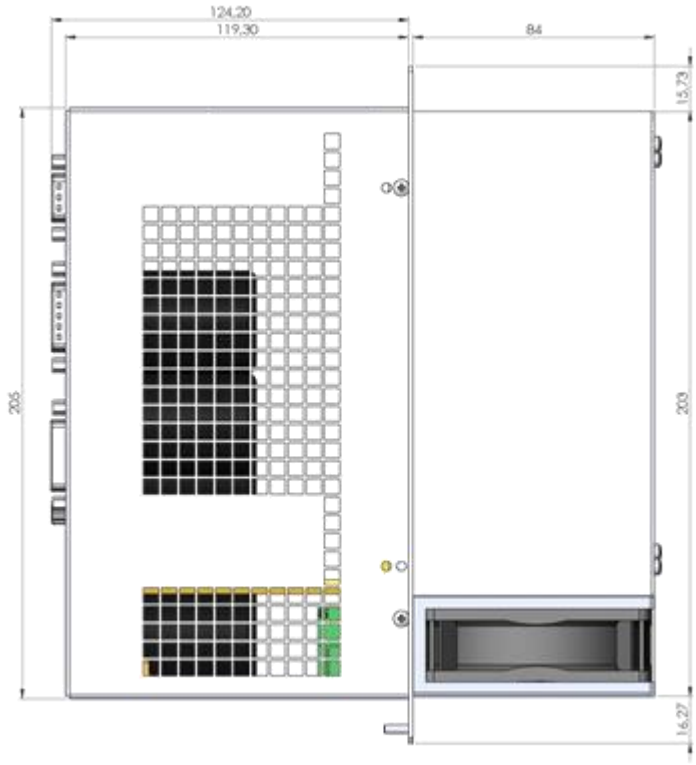


Push-through version

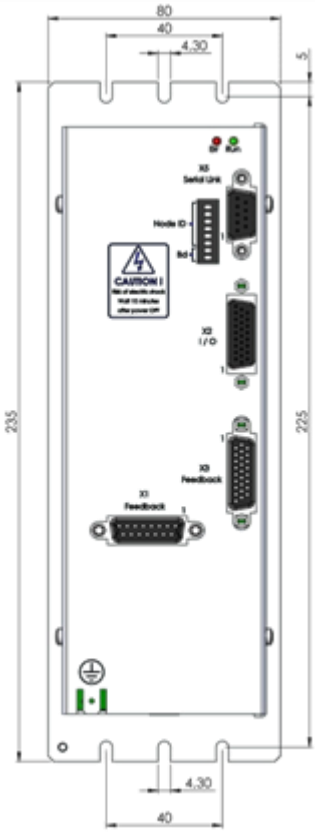
BOTTOM VIEW



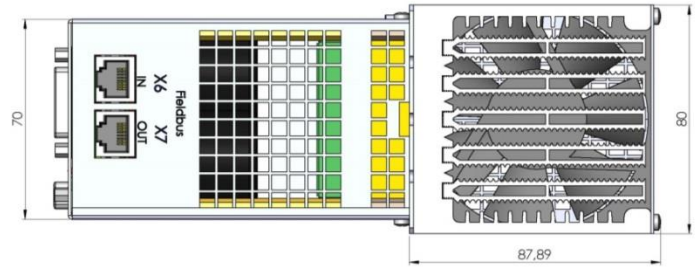
SIDE VIEW



FRONT VIEW



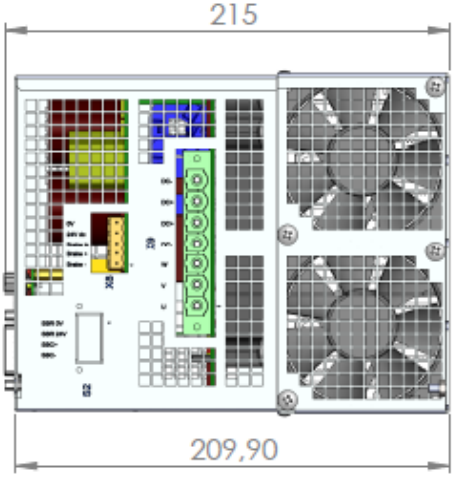
TOP VIEW



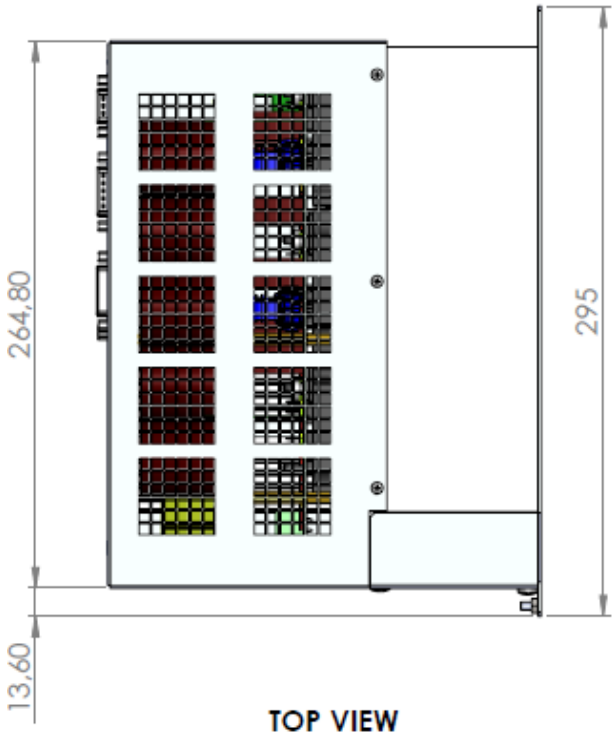
2.2.5 - LBD 400V / 200A dimensions

Dimensions are given in mm.

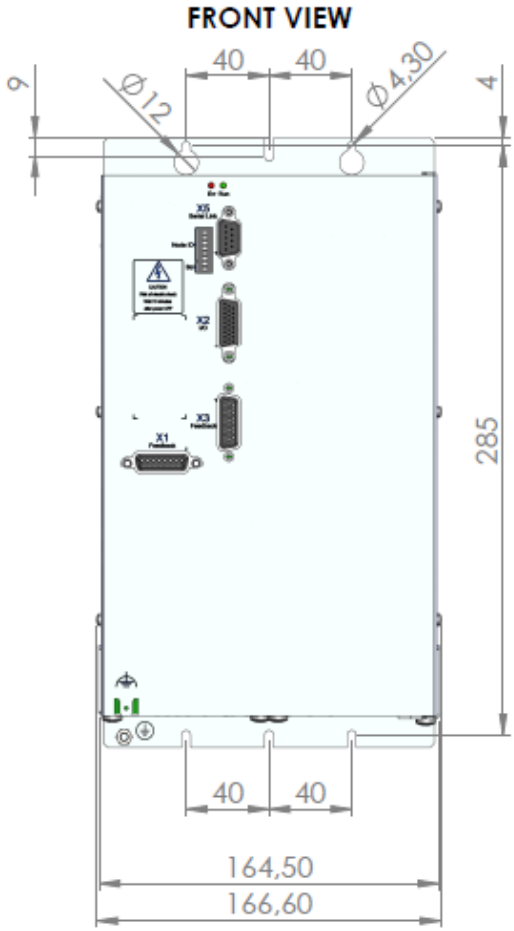
BOTTOM VIEW



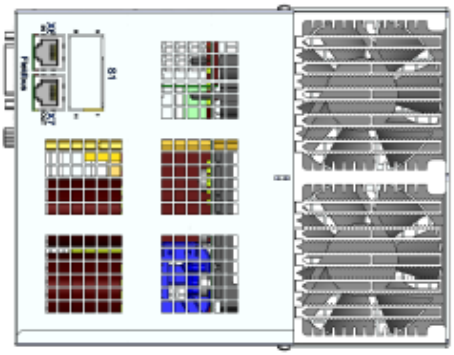
SIDE VIEW



FRONT VIEW



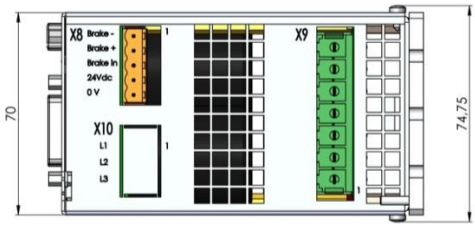
TOP VIEW



2.2.6 - LBD 400V / 8 to 100A Cold Plate dimensions

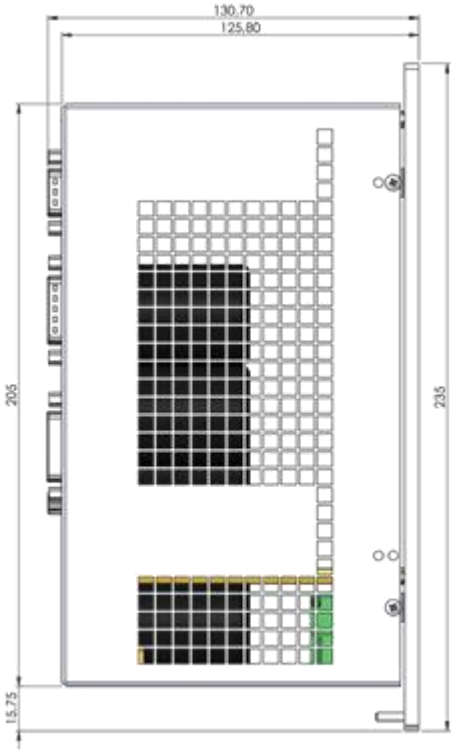
Dimensions are given in mm.

BOTTOM VIEW

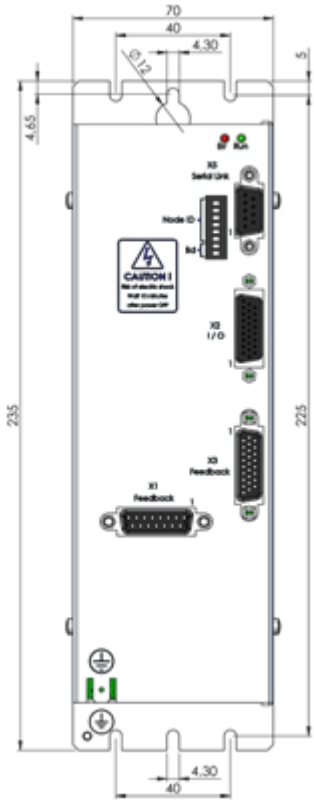


Note:
This bottom view is the one of the 400/45 drive (without X10 connector).
The X10 connector is only available on drives with 8A and20 A current ratings.

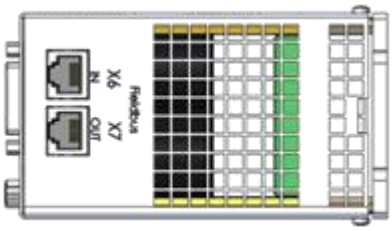
SIDE VIEW



FRONT VIEW



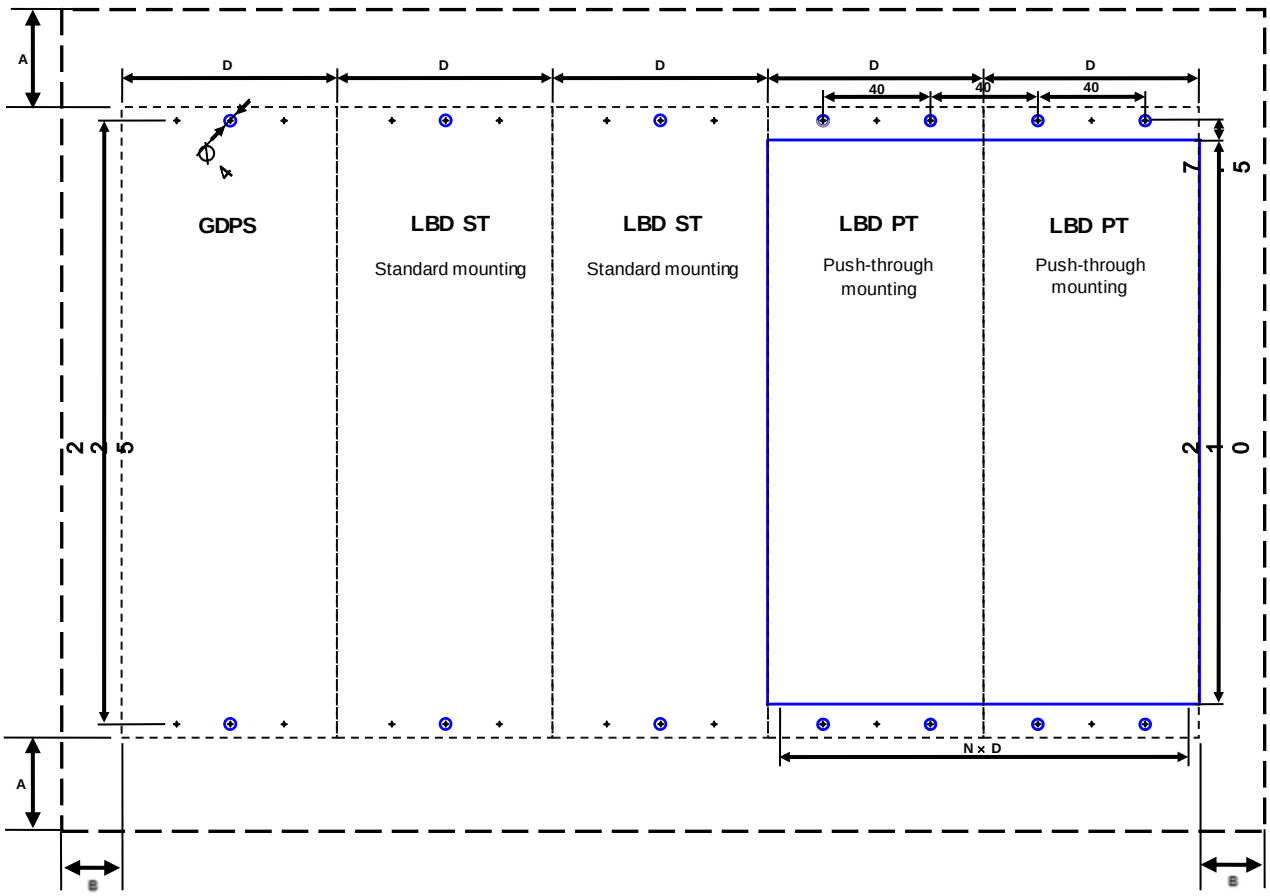
TOP VIEW



2.2.7 - LBD 400 V: Panel layout dimensions

Dimensions are given in mm.

VERTICAL MOUNTING IS MANDATORY



Description	Symbol	LBD
Minimum top and bottom clearance	A	50
Minimum side clearance	B	10
Recommended pitch (ST, PT and CP)	D	80*

Note:
* Due to width tolerances and thermal considerations, it is recommended avoiding the close mounting of two **LBD** 400V / 100A and 200A drives side by side (recommended pitch = 100mm).

Chapter 3 – Inputs - Outputs

3.1 - DISPLAY

3.1.1 - Leds

RUN (green) 

ERROR (red) 

RUN: status of the CANopen® or EtherCAT® communication bus connection (according to drive version)..

ERROR: faults grouped on the 'ERROR' LED: these errors are coded and can be displayed by means of the parameterization software tool.

ERROR LED unlit if no fault.
ERROR LED flashing: 'UNDERVOLTAGE' error: no power supply voltage.
ERROR LED continuously lit: fault.

The **ERROR** LED groups the following faults:

- Power supply overvoltage.
- $24V_{DC}$ logic supply < $17.5V_{DC}$.
- Motor phase / GND short-circuit.
- Braking system short-circuited or overheated, or braking resistor in open circuit.
- Motor phase / motor phase short-circuit, power stage overtemperature, defective IGBT module.
- Triggering of the I^2t protection.
- Counting error.
- Position following error
- EEPROM error.
- Procedure execution error (busy).
- Current offset error.
- Drive rating overcurrent.
- Motor temperature error.
- Resolver or encoder cable interruption.
- Hall sensors or absolute encoder error.

Notes

Any of these errors (except for the "Undervolt." error) involves:

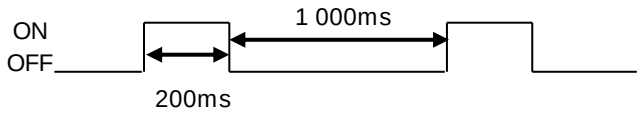
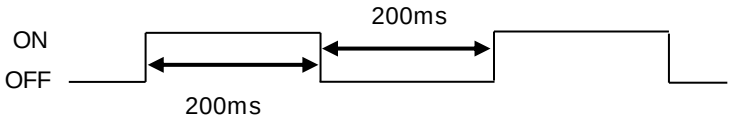
- The continuous lighting of the red **ERROR** LED,
- The drive disabling,
- The motor brake control if one of the logic outputs is configured as brake output,
- The opening of the **AOK** relay contact. This relay must be wired as described in the connection diagrams of section 4.1, in order to switch-off the power supply and keep a zero type standstill.

The 'UNDERVOLTAGE' error (flashing **ERROR** LED) involves:

- The drive disabling,
- The motor brake control.

3.1.2 – LBD CAN and LBD CND versions: CANopen® communication bus

RUN: The CANopen® RUN LED indicates the status of the NMT state machine (see DS-301 – 9.52 NMT state machine):

CAN RUN LED	STATUS	
FLASHING	STOP	
BLINKING	PRE-OPERATIONAL	
ON	OPERATIONAL	

See "DR-303-3 Indicator specification" for more information.

3.1.3 – LBD ETC and LBD ETD versions: EtherCAT® communication bus

*See "**EtherCAT® Fieldbus interface**" manual.*

3.2 - DRIVE ADDRESSING: SELECTION OF THE TRANSMISSION SPEED

3.2.1 – LBD CAN and LBD CND versions: CANopen® communication bus

Each drive of the network must be configured with one single address.
A DIP8 switch accessible by the operator allows configuring the drive address as well as the communication speed of the **CANopen**® bus.

- Addressing (6 selection bits):

Status of the cursors						Address
6	5	4	3	2	1	
OFF	OFF	OFF	OFF	OFF	OFF	0
OFF	OFF	OFF	OFF	OFF	ON	1
OFF	OFF	OFF	OFF	ON	OFF	2
...	...	...	...	...	...	...
ON	ON	ON	ON	ON	ON	63

- Communication speed (2 selection bits):

Status of the cursors		Speed
8	7	
OFF	OFF	1 Mbits
OFF	ON	500 Kbits
ON	OFF	250 Kbits
ON	ON	Reserved

3.2.2 – LBD ETC and LBD STD versions: EtherCAT® communication bus

See manual "EtherCAT® fieldbus interface".

3.3 - X1 CONNECTOR

3.3.1 – LBD CAN and LBD ETC versions

3.3.1.1 - X1 connector for transmitter resolver input (Sub D 15 pins female)

The Sub-D 15 pin female connector is compatible with the CD1-K series.

The "Transmitter resolver" configuration is software selectable and saved in the drive EEPROM.

PIN	FUNCTION	I/O	DESCRIPTION
1	Shield connection	I	The shield must have a 360° connection on the connector metal cover. This connection can be completed by connecting the wires to pin 1.
12	TC-	I	Motor thermal sensor inputs. The valid measurement range is between 100Ω and 44kΩ.
13	TC+	I	
2	S3 (cosine +)	I	Resolver signal
10	S1 (cosine -)	I	Resolver signal
11	S2 (sine +)	I	Resolver signal
3	S4 (sine -)	I	Resolver signal
5	R1 (reference +)	O	Resolver signal
4	R2 (reference -)	O	Resolver signal
6	Reserved		
7,8,9	Reserved		
14,15	Reserved		

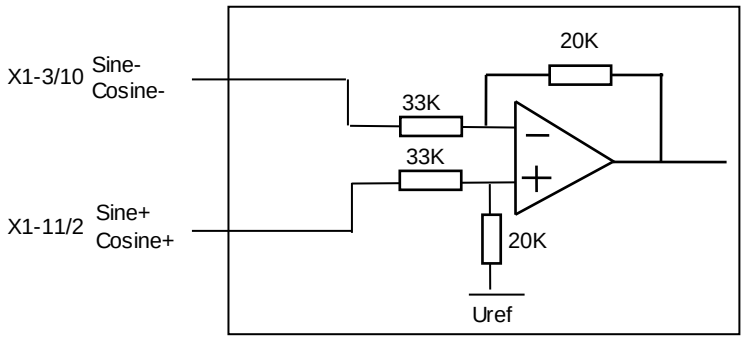
For the connection of other resolver types, see Chapter 5, section 1.

3.3.1.2 - X1 connector for SinCos tracks input (Sub D 15 pins female)

The "SinCos track" configuration is software selectable and saved in the drive EEPROM.

PIN	FUNCTION	I/O	DESCRIPTION
1	Shield connection	I	The shield must have a 360° connection on the connector metal cover. This connection can be completed by connecting the wires to pin 1.
12	TC-	I	Motor thermal sensor inputs. The valid measurement range is between 100Ω and 44kΩ.
13	TC+	I	
2	Cosine +	I	SinCos tracks signal
10	Cosine -	I	SinCos tracks signal
11	Sine +	I	SinCos tracks signal
3	Sine -	I	SinCos tracks signal
7	5 V	O	Sensor supply voltage (total external consumption on all connectors = max. 300mA)
8	GND	O	Sensor supply GND
6	External supply	O	Sensor supply voltage (if ≠ 5V). Supply to be provided via X2 connector, pin 3. Only available from serial number 11043098.
4,5,9	Reserved		
14,15	Reserved		

SPECIFICATION OF THE SINE AND COSINE CHANNELS



3.3.2 – LBD ETD and LBD CND versions

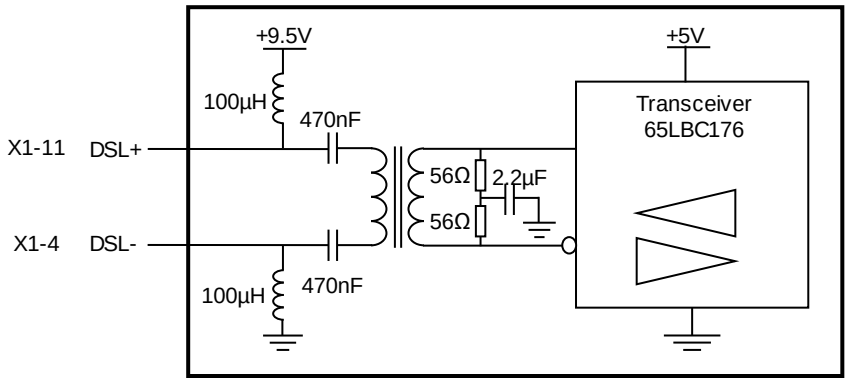
3.3.2.1 - X1 connector for Hiperface DSL® encoder (Sub D 15 pin female)

The “Hiperface DSL®“ configuration is software selectable and saved in the drive EEPROM.

PIN	FUNCTION	I/O	DESCRIPTION
11	+U / DSL+	I/O	Two-core cable Hiperface DSL® signals: Power supply output specifications: 9.5V +/- 0.5V - max.150mA.
4	GND / DSL-	I/O	
12	TC- *	I	Motor thermal sensor inputs if the thermal sensor is not connected to the Hiperface DSL® encoder inside the motor. The valid measurement range is between 100Ω and 44kΩ.
13	TC+ *	I	
Others	Reserved		

(*) The motor thermal sensor is generally connected to the Hiperface DSL® encoder inside the motor. So, the motor temperature monitoring is made via the Hiperface DSL® communication wires (DSL+ and DSL-).

SPECIFICATION OF THE HIPERFACE DSL® INTERFACE

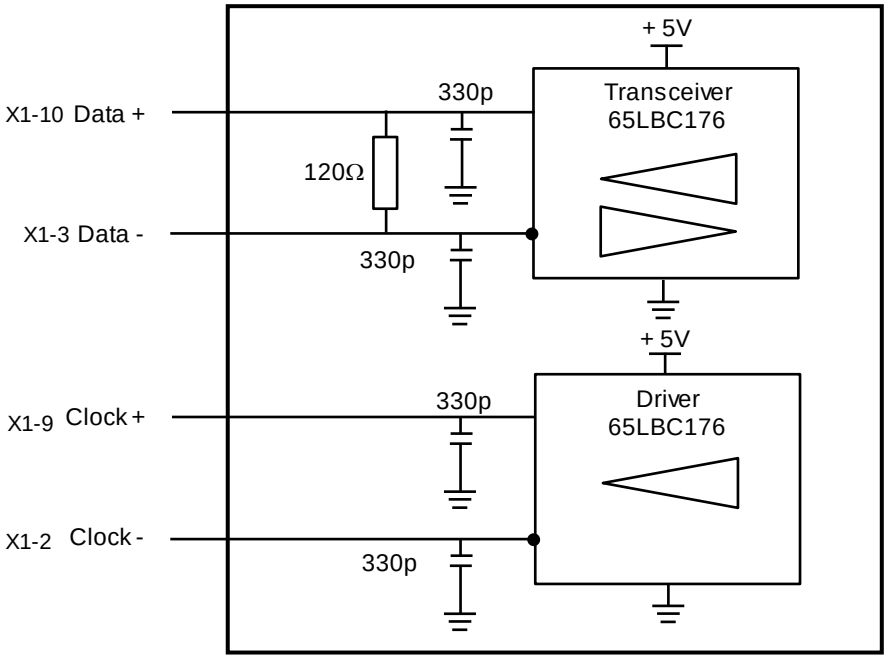


3.3.2.2 - X1 connector for EnDat 2.2® encoder (Sub D 15 pin female)

The “EnDat 2.2®“ configuration is software selectable and saved in the drive EEPROM.

PIN	FUNCTION	REMARKS
3	Data-	Differential input of the EnDat 2.2® encoder Data- channel
10	Data+	Differential input of the EnDat 2.2® encoder Data+ channel
2	Clock-	Differential input of the EnDat 2.2® encoder Clock- channel
9	Clock+	Differential input of the EnDat 2.2® encoder Clock+ channel
7	+ 5 V	Internal supply voltage +5V (150mA max. output current).
8	GND	Supply GND
13	TC+	Motor thermal sensor inputs. The valid measurement range is between 100Ω and 44kΩ.
12	TC-	
Others	Reserved	

SPECIFICATION OF THE ENDAT2.2® INTERFACE



3.4 - INPUTS-OUTPUTS CONNECTOR: X2

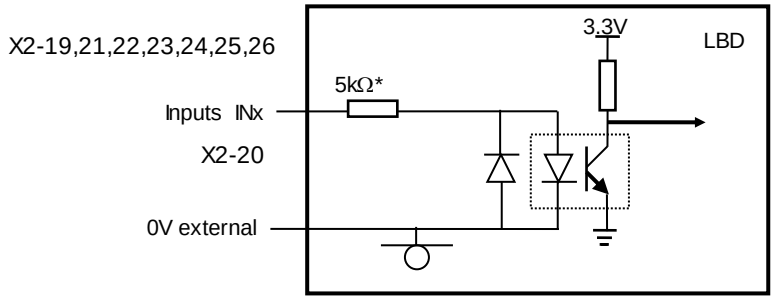
SUB D 26 PIN MALE HD CONNECTOR

PIN	FUNCTION	I/O	DESCRIPTION
1	ANA1+	I	Analog input nr. 1 Differential input +/-10V *
10	ANA1-	I	
2	GND		Non differential analog input nr. 2 Direct input +/-10V / GND reference
11	ANA2	I	
4	AOK-	O	OptoMos relay: high output impedance if fault Umax = 50V, Imax = 300mA Polarity must be observed: AOK+ = positive potential AOK- = negative potential
14	AOK+	O	
13	GND		External supply for Hall effect sensor, Hiperface® encoder, SinCos tracks sensor or digital multi-turn encoders.
3	External supply: max. 24V_{DC} / max. 300mA	I	
5	OUT1	O	Non optocoupled DRIVER PNP "high side" logic outputs 24V / 300mA
15	OUT2	O	
6	OUT3	O	
16	Differential encoder output Marker Z-	O	Differential encoder outputs available on the **LBD CAN** version only. 5V / 60mA via channels A, B, Z
7	Differential encoder output Marker Z+	O	
17	Differential encoder output channel B-	O	
8	Differential encoder output channel B+	O	
18	Differential encoder output channel A-	O	
9	Differential encoder output channel A+	O	
19	STO2/	I	See LBD Safe Torque Off manual, section 2.2.2.1.
20	EGND		
21	STO1/	I	
22	IN5 / PULSE (stepper motor emulation)	I	All logic inputs are optocoupled EGND = optocoupled input reference Vin voltage = 18V < Vin <27V Input impedance Zin = 5kOhms Turn-on delay = 20µs (**) Turn-off delay = 15µs (**)
23	IN4	I	
24	IN3 / DIR (stepper motor emulation)	I	
25	IN2	I	
26	IN1	I	
12	ANA-OUT	O	Analog output 2.5V +/- 2V - 8bits. Software configurable analog output

(*) For a non-differential input signal, ANA1- (pin 10) must be connected to GND (pin 2) on the drive side.
(**) For drives with serial number < 108210001: Zin = 2kOhm, Turn-on delay = 2µs, Turn-off delay = 40µs.

NOTE: IN5 and IN3 inputs can be used as PULSE and DIRECTION logic inputs for stepper motor emulation with optocoupled 24V interface.

3.4.1 - Specification of the logic inputs



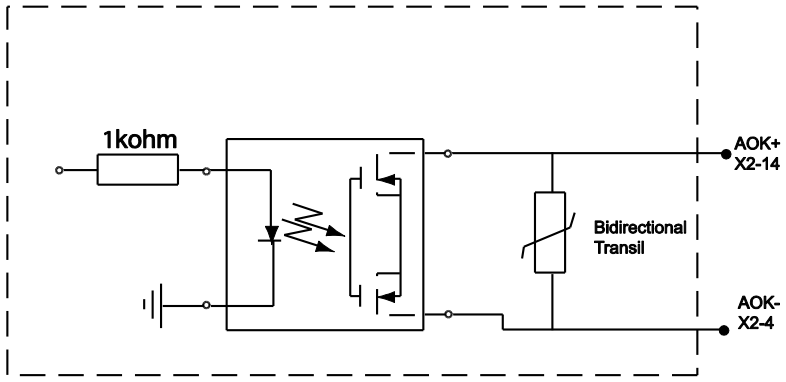
(*) For drives with serial number < 108210001: Zin = 2kOhm

These optocoupled inputs are working in positive logic.
The input voltage corresponding to level 1 must be between 18V and 27V.

3.4.2 - Specification of the logic output "AOK+/-" (polarized opto-relay output)

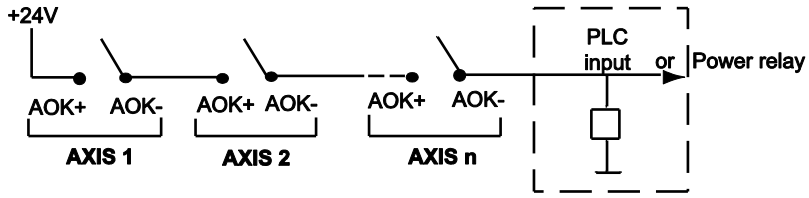
The use of the AOK output is mandatory in order to ensure the power supply connection.
It also ensures the protection of the electrical installation against the risk of fire in case of fatal failure of the power stage (e.g. transistor in short-circuit).

Caution: The opening of the AOK protective branch-circuit may be an indication that a fault has been interrupted. To reduce the risk of fire or electric shock, the reason for this fault shall be determined and eliminated before resetting the drive.

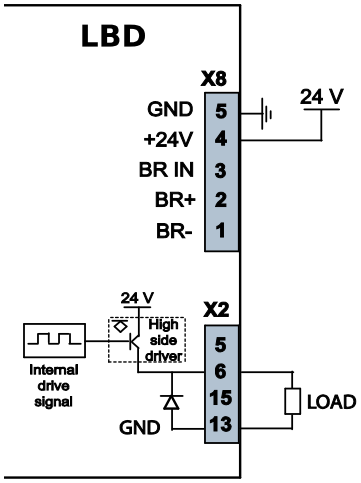


Polarized solid state output: closed if drive OK, open if fault.
Pmax = 10W with Umax = 50V - Imax = 300mA.
For UL users, Umax = 42.4V from an isolated power supply protected by a 3A UL fuse.

The AOK output is a solid state output: polarity must be observed (see wiring diagram below).



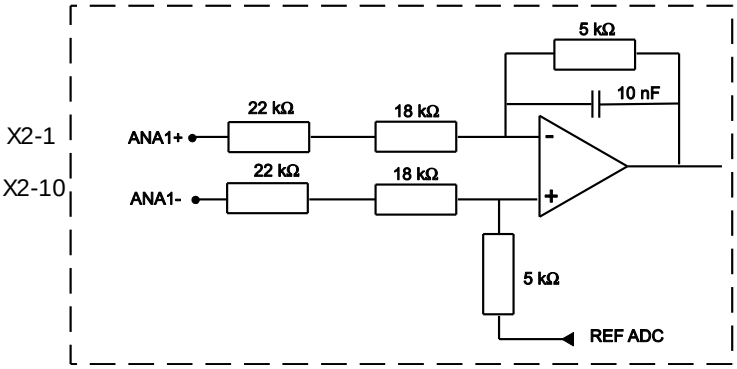
3.4.3 - Specification of the logic outputs OUT1 to OUT3

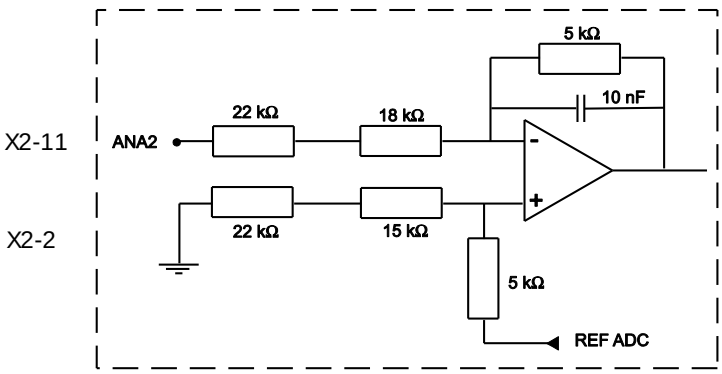


Digital outputs can be paralleled in order to increase the maximum output current.
Be careful to connect all paralleled outputs to the same drive signal.

Paralleled outputs	Output voltage	Maximum output current
1	24V	300mA
2	24V	400mA
3	24V	600mA

3.4.4 - Specification of the analog inputs ANA1+/- and ANA2

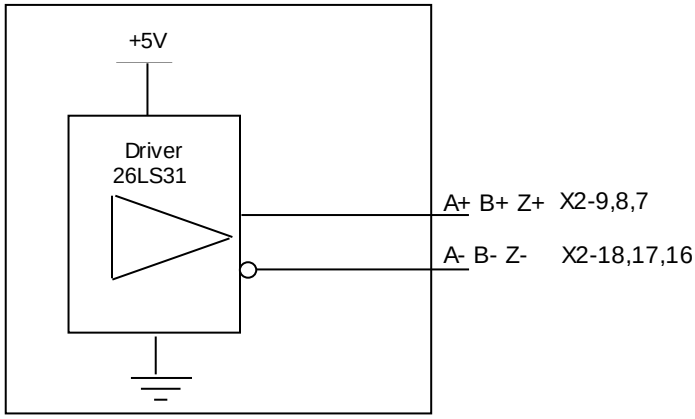




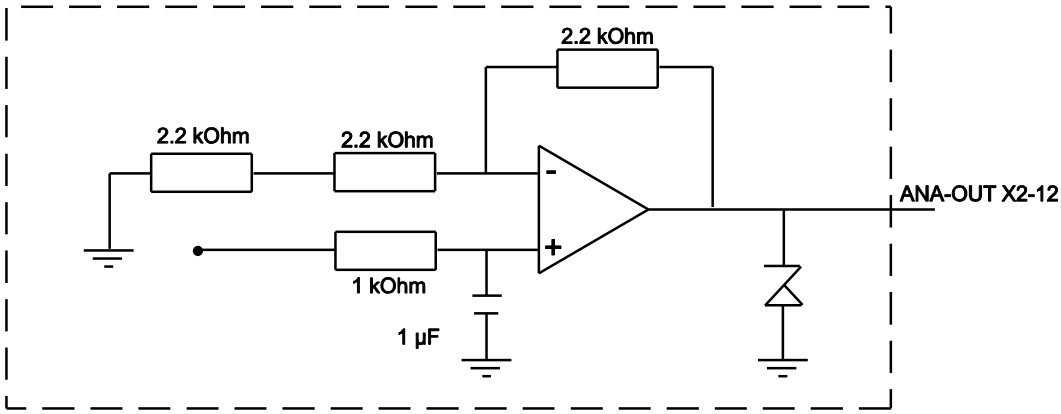
3.4.5 - Specification of the encoder output signals

Note: Available on the **LBD CAN** version only.

RS422 line transmitter: 20mA per output.



3.4.6 - Specification of the analog output



3.5 - ENCODER CONNECTORS: X3

3.5.1 - X3 connector for incremental TTL & HES encoder input (Sub D HD 26 pins female)

The "Incremental TTL & HES encoder" configuration is software selectable and saved in the drive EEPROM.

PIN	FUNCTION	REMARKS
22	Z/ marker pulse	Differential input of the encoder marker pulse Z/
21	Z marker pulse	Differential input of the encoder marker pulse Z
3	Channel A/	Differential input of the encoder channel A/ (or PULSE/ for stepper emulation)
12	Channel A	Differential input of the encoder channel A (or PULSE for stepper emulation)
4	Channel B/	Differential input of the encoder channel B/ (or DIR/ for stepper emulation)
13	Channel B	Differential input of the encoder channel B (or DIR for stepper emulation)
7	+5V	Encoder supply voltage (total external consumption on all connectors = 300mA max.)
16	GND	Encoder supply GND
6	HALL U	Hall sensor input signal phase U (or PULSE for stepper emulation)
15	HALL V	Hall sensor input signal phase V (or DIR for stepper emulation)
23	HALL W	Hall sensor input signal phase W
19	+ 9.5V	Hall sensor internal supply voltage 9.5V +/- 0.5V (150mA max. output current). Only available from serial number 11043098.
24	External supply	Hall sensor supply voltage (if ≠ $5V_{DC}$ or $9.5V_{DC}$). Supply to be provided via the X2 connector, pin 3.
16	GND	Hall sensors supply GND
14	TC+	Motor thermal sensor inputs. The valid measurement range is between 100Ω and 44kΩ.
5	TC-	
Others	Reserved	

NOTE 1: A and B channels can be used as PULSE and DIRECTION inputs for the stepper motor emulation with RS422 receiver interface.
NOTE 2: HALL U and HALL V inputs can be used as PULSE and DIRECTION logic inputs for the stepper motor emulation with 5V to 24V logic interface.

3.5.2 - X3 connector for incremental Sin/Cos & HES encoder input (Sub D HD 26 pins female)

The "Incremental SinCos& HES encoder" configuration is software selectable and saved in the drive EEPROM.

PIN	FUNCTION	REMARKS
25	Mark- channel	Differential input for the reference pulse of the Sin/Cos encoder channel Mark-
26	Mark+ channel	Differential input for the reference pulse of the Sin/Cos encoder channel Mark+
17	Sin- channel	Differential input for Sin- channel of the Sin/Cos encoder
18	Sin+ channel	Differential input for Sin+ channel of the Sin/Cos encoder
8	Cos- channel	Differential input for Cos- channel of the Sin/Cos encoder
9	Cos+ channel	Differential input for Cos+ channel of the Sin/Cos encoder
7	+5V	Encoder supply voltage (total external consumption on all connectors = 300mA max.)
16	GND	Encoder supply GND
6	HALL U	Hall sensors input signal phase U
15	HALL V	Hall sensors input signal phase V
23	HALL W	Hall sensors input signal phase W
19	+ 9.5V	Hall sensor internal supply voltage 9.5V +/- 0.5V (150mA max. output current). Only available from serial number 11043098.
24	External supply	Hall sensor supply voltage (if ≠ $5V_{DC}$ or $9.5V_{DC}$). Supply to be provided via the X2 connector, pin 3.
16	GND	Hall sensors supply GND
14	TC+	Motor thermal sensor inputs. The valid measurement range is between 100Ω and 44kΩ.
5	TC-	
Others	Reserved	

3.5.3 - X3 connector for "absolute Hiperface® encoder" input (Sub D HD 26 pins female)

The Hiperface® absolute encoder configuration is software selectable and saved in the drive EEPROM.

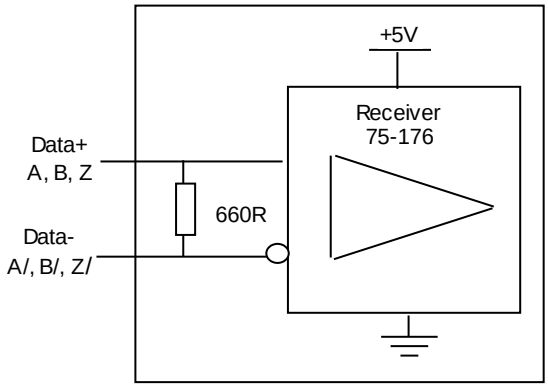
PIN	FUNCTION	REMARKS
3	Data-	Differential input of the Hiperface® encoder Data- channel
12	Data+	Differential input of the Hiperface® encoder Data+ channel
17	Sin- channel	Differential input of the Hiperface® encoder Sin- channel
18	Sin+ channel	Differential input of the Hiperface® encoder Sin+ channel
8	Cos- channel	Differential input of the Hiperface® encoder Cos- channel
9	Cos+ channel	Differential input of the Hiperface® encoder Cos+ channel
19	+ 9.5V	Internal supply voltage 9.5V +/- 0.5V (150mA max. output current). Only available from serial number 11043098.
24	External supply	Hiperface® encoder supply voltage (if ≠ 9.5V). Supply to be provided via the X2 connector, pin 3.
16	GND	Supply GND
14	TC+	Motor thermal sensor inputs. The valid measurement range is between 100Ω and 44kΩ.
5	TC-	
Others	Reserved	

3.5.4 - X3 connector for "single-turn absolute SinCos encoder" input (Sub-D HD 26 pins female)

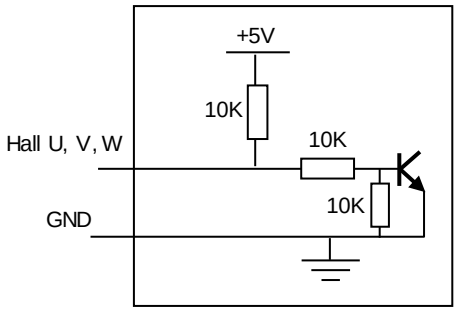
The single-turn absolute SinCos encoder configuration is software selectable and saved in the drive EEPROM.
This encoder configuration is only available from serial number 11043098.

PIN	FUNCTION	DESCRIPTION
25	Marker R-	Differential input of the Sin/Cos encoder reference pulse R
26	Marker R+	Differential input of the Sin/Cos encoder reference pulse R
17	Channel A-	Differential input of the Sin/Cos encoder channel A
18	Channel A+	Differential input of the Sin/Cos encoder channel A
8	Channel B-	Differential input of the Sin/Cos encoder channel B
9	Channel B+	Differential input of the Sin/Cos encoder channel B
1	Channel C-	Differential input of the Sin/Cos encoder channel C
10	Channel C+	Differential input of the Sin/Cos encoder channel C
2	Channel D-	Differential input of the Sin/Cos encoder channel D
11	Channel D+	Differential input of the Sin/Cos encoder channel D
7	+5V	Encoder supply voltage (total external consumption on all connectors = max. 300mA)
16	GND	Encoder supply GND
14	TC+	Motor thermal sensor inputs. The valid measurement range is between 100Ω and 44kΩ.
5	TC-	
Others	Reserved	

SPECIFICATION OF THE INCREMENTAL TTL ENCODER INPUT LINES



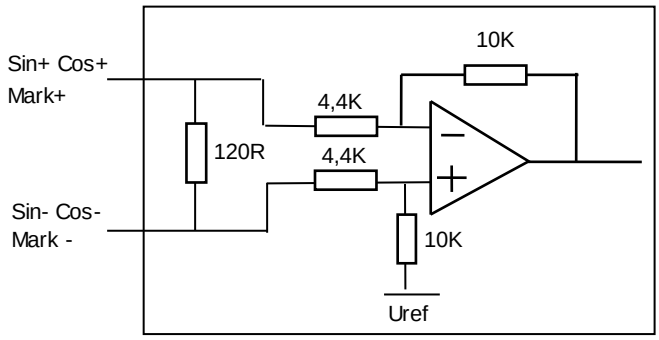
SPECIFICATION OF THE HALL SENSOR INPUT LINES



	Min.	Max.
High input voltage	3.3V	24V + 15%
Low input voltage	0V	0.6V

Hall inputs are compatible with open collector outputs, without any external component.

SPECIFICATION OF THE SIN/COS AND HIPERFACE® ENCODER SIGNALS



3.6 - FIELDBUS CONNECTORS: X6 AND X7

In order to ensure the best reliability and performances of the global system, it is recommended to use RJ45 Ethernet cables with a minimum level of category 5.

3.6.1 – LBD CAN and LBD CND versions (CANopen® bus)

RJ45 standard connector

X6 PIN / X7 PIN	SIGNAL	DESCRIPTION
1	CAN-H	Line CAN-H (dominant high)
2	CAN-L	Line CAN-L (dominant low)
3	CAN-GND	CAN Ground
4	Reserved	
5	Reserved	
6	Internally connected	X6-pin 6 connected to X7-pin 6 Only available from serial number 11043098.
7	GND	
8	Internally connected	X6-pin 8 connected to X7-pin 8 Only available from serial number 11043098.

3.6.2 – LBD ETC and LBD ETD versions (EtherCAT® bus)

RJ45 standard connector

X6 PIN / X7 PIN	SIGNAL	DESCRIPTION
1	Tx Data+	Differential signals
2	Tx Data-	
3	Rx Data+	Differential signals
6	Rx Data-	
Others		Reserved

For more information, see **EtherCAT® fieldbus Interface** manual.

3.7 - SERIAL LINK RS-232 CONNECTOR: X5

3.7.1 – LBD CAN version

SUB D 9 pin male connector (same as CD1-K series)

PIN	FUNCTION	REMARKS
5	GND	GND (shield connection if no 360° connection on the connector). 360° shield is strongly recommended.
3	TXD	Transmit data RS-232
2	RXD	Receive data RS-232

3.7.2 – LBD ETC, LBD ETD and LBD CND versions

SUB D 9 pin male connector

PIN	FUNCTION	REMARKS
5	GND	GND (shield connection if no 360° connection on the connector). 360° shield is strongly recommended.
3	TXD	Transmit data RS-232
2	RXD	Receive data RS-232
1	CAN-H	Line CAN-H (dominant high)
9	CAN-L	Line CAN-L (dominant low)
Others		Reserved

In the EtherCAT® version, the multi-axis parameter setting and monitoring using the *Gem Drive Studio* software can be performed via the CANopen® bus connection on the X5 connector.

3.8 - 24V_{DC} AUXILIARY POWER SUPPLY & MOTOR BRAKE CONNECTOR: X8

Manufacturer: Weidmüller
Type: BLZ 5.08 / 5
Reference: 152676
Tightening torque: 0.4 to 0.5Nm

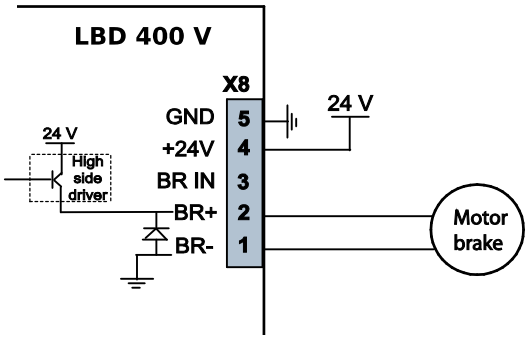
PIN	SIGNAL	I/O	FUNCTION	DESCRIPTION
1	Brake-	O	Motor brake output	Grounded potential reference (GND reference)
2	Brake+	O	Motor brake output	24V_{DC} motor brake output
3	Brake In	I	Signal connection for the motor brake supply wiring relay (optional)	Pins 2 and 3 internally connected on X8 for an easy wiring in case of external brake relay.
4	24V	I	Mains isolated 24V_{DC} auxiliary power supply 0 V input referenced to the GND potential on the drive housing	24V_{DC} supply: +/- 10% Consumption without brake: 400mA for **LBD** 230V 500mA for **LBD** 400V
5	0V = GND	I		

				UL: protection by means of a 3A UL fuse

3.8.1 - Motor brake output on LBD 400V drives

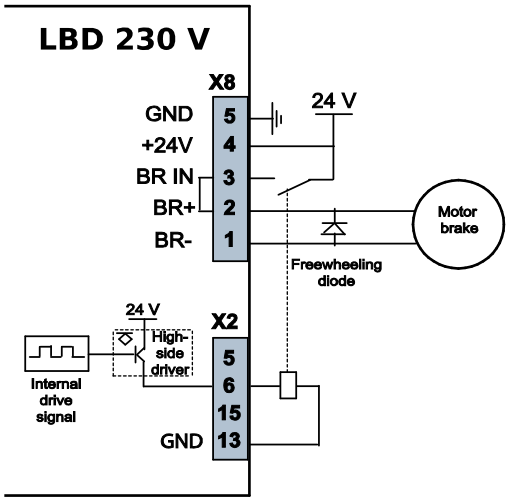
A high side driver output is provided to directly drive the motor brake.

Version	Rated output voltage	Maximum output current
LBD-400/08	24V	1.5A
LBD-400/20	24V	1.5A
LBD-400/45	24V	2.5A
LBD-400/100	24V	2.5A
LBD-400/200	24V	2.5A



3.8.2 - Motor brake output on LBD 230V drives

A logic output must be software configured as motor brake output.
BR IN and BR + are internally connected together for convenience when wiring the external relay.
If the brake consumption is higher than the digital output specification, an external relay must be used to control the motor brake.



3.9 - POWER CONNECTORS: X9 AND X10

3.9.1 - LBD 230V: X9

Manufacturer: Weidmüller
Type: BLZ 5.08 / 10
Reference: 152956
Tightening torque: 0.4 to 0.5Nm

PIN	SIGNAL	I/O	FUNCTION	DESCRIPTION
1	U	O	Motor phase U	Shielded motor cable: - PE connection on the bottom plate, - 360° shield connection.
2	V	O	Motor phase V	
3	W	O	Motor phase W	
4	DC-	I/O	DC bus negative voltage output	For the DC bus paralleling in multi-axis applications or connection with an external capacitor box (ref. CAPABOX). The direct connection of external capacitor is prohibited. See “DC bus interfacing” application note for more details.
5	DC+	I/O	DC bus positive voltage output	
6	Rint	O	Internal 100Ω / 35W braking resistor	Two possible wirings: - Internal braking resistor: 100Ω / 35W max Connect pins 6 and 7 together with a bridge, - External braking resistor: Min. value = 50Ω Connect the external resistor between pins 5 and 7.
7	DR	O	Braking transistor output	
8	L1	I	$230V_{AC}$ single-phase mains input supply	$230V_{AC}$ single-phase Fully integrated EMC mains filter.
9	L2	I		
10	GND		GND reference of the $230V_{AC}$ supply cable.	Reference potential of the drive housing. Connection to this pin is not required.

IMPORTANT

Motor and brake cables must be shielded.
The 360° shield connection must be ensured by metallic collars and connected to the ground reference potential.
The GND wire of the motor cable MUST be connected to the ground screw marked with the ground symbol on the housing bottom plate.
See section 4.6 for grounding and shielding precautions.

3.9.2 - LBD 400V / 45A and 100A: X9

Manufacturer: Phoenix Contact
Type: PC 5/ 7-STCL1-7.62
Reference: 1778117
Tightening torque: 0.7 to 0.8Nm

PIN	SIGNAL	I/O	FUNCTION	DESCRIPTION
1	U	O	Motor phase U	Shielded motor cable: - PE connection on the bottom plate, 360° shield connection.
2	V	O	Motor phase V	
3	W	O	Motor phase W	
4	DC-	I/O	DC bus negative voltage output	Input/Output to power drives. Recommended wire section: - AWG12 / 105°C for LBD 400V / 45A - AWG10 / 105°C for LBD 400V / 100A Maximum length between two devices: 200mm
5	DC+	I/O	DC bus positive voltage output	
6	DC+	I/O	DC bus positive voltage output	
7	DC-	I/O	DC bus negative voltage output	

The DC+/DC- polarity between the multi-axis power supply unit and the drives MUST be observed.

3.9.3 - LBD 400V / 200A: X9

	IEC standard	UL standard
Manufacturer: Phoenix Contact Type: SPC 16/ 7-STF-10,16 Reference: 1711420 Push-in spring		
Manufacturer: Phoenix Contact Type: PC 16/7-STF-10.16 Reference: 1967508 Tightening torque: 1.7 to 1.8Nm		

PIN	SIGNAL	I/O	FUNCTION	DESCRIPTION
1	U	O	Motor phase U	Shielded motor cable: - PE connection on the bottom plate, 360° shield connection.
2	V	O	Motor phase V	
3	W	O	Motor phase W	
4	DC-	I/O	DC bus negative voltage output	Input/Output to power drives. Recommended wire section: - AWG 06 / 105°C for LBD 400V / 200A *) Maximum length between two devices: 200mm
5	DC+	I/O	DC bus positive voltage output	
6	DC+	I/O	DC bus positive voltage output	
7	DC-	I/O	DC bus negative voltage output	

*) According to the actual power, the total cross section can be distributed on all four DC bus outputs.

The DC+/DC- polarity between the multi-axis power supply unit and the drives MUST be observed.

3.9.4 - LBD 400V / 08A and 20A: X10

Manufacturer: Phoenix Contact
Type: GMSTB 2.5/3-ST-7.62
Reference: 1767012
Tightening torque: 0.5 to 0.6Nm

PIN	SIGNAL	I/O	FUNCTION	DESCRIPTION
1	L1	I	L1 mains phase	Three-phase mains inputs: 400 to 480V_{AC} Fully integrated EMC mains filter.
2	L2	I	L2 mains phase	
3	L3	I	L3 mains phase	

Risk of electric shock
Even if the drive is powered via DC+ and DC- signals, the mobile part of the X10 connector must always be plugged.

3.9.5 - LBD 400V / 08A and 20A: X9

Manufacturer: Phoenix Contact
Type: GMSTB 2.5/7-ST-7.62
Reference: 1767054
Tightening torque: 0.5 to 0.6Nm

PIN	SIGNAL	I/O	FUNCTION	DESCRIPTION
1	U	O	Motor phase U	Shielded motor cable: - PE connection on the bottom plate, - 360° shield connection.
2	V	O	Motor phase V	
3	W	O	Motor phase W	
4	DC-	I/O	DC bus negative voltage output	For the DC bus paralleling in multi-axis applications.
5	DC+	I/O	DC bus positive voltage output	
6	Rint	O	Connection of the internal 400Ω / 35W braking resistor	Two possible wirings: - Internal braking resistor: 400Ω / 35W max. Connect pins 6 an 7 together by a bridge, - External braking resistor: see section 2.1.2 Connect the external resistor between pins 5 and 7.
7	DR	O	Connection to the braking transistor	

3.10 - MAINS GROUND CONNECTION

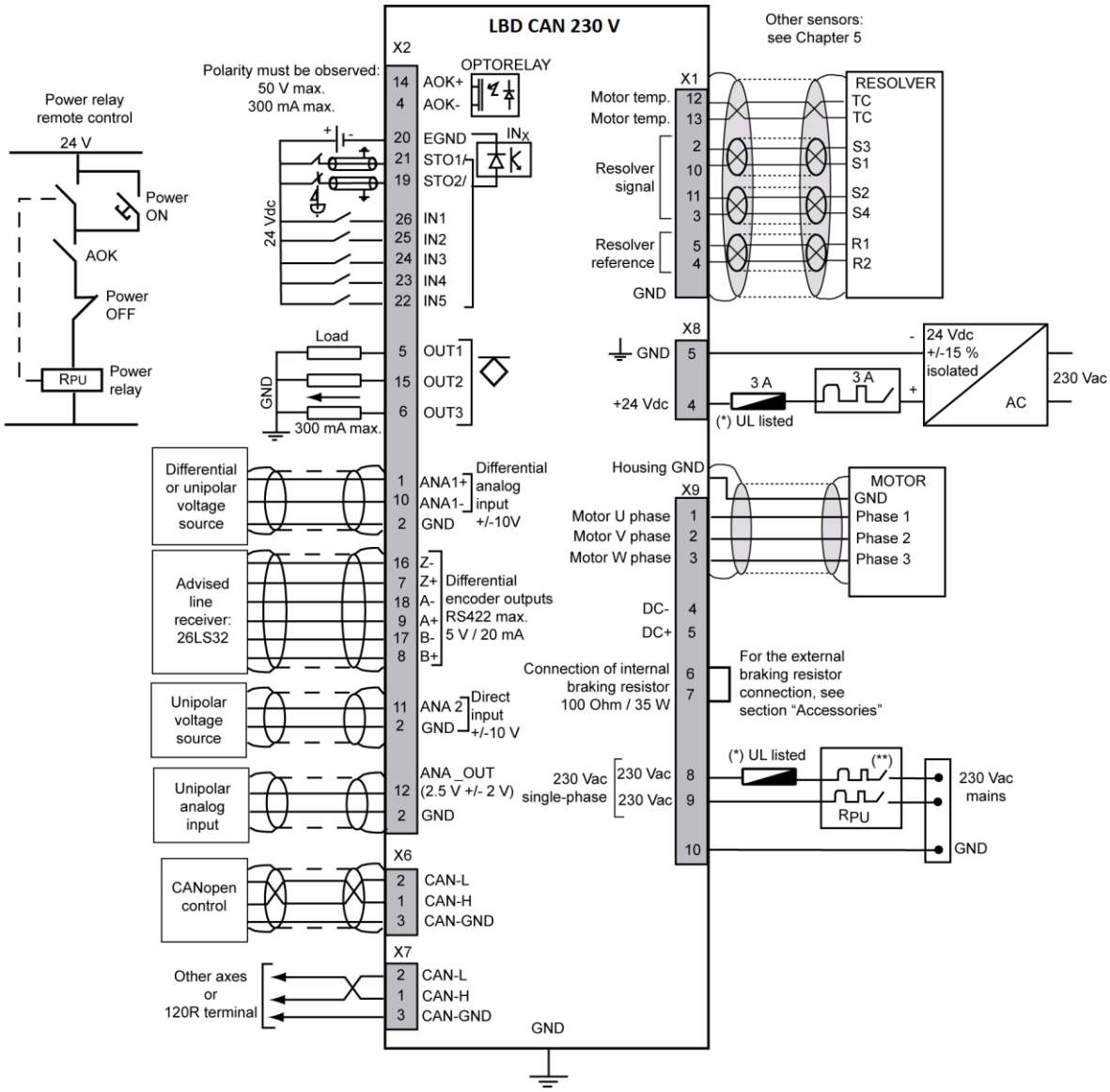
Type: Lug stud M3×10
Type: Lug stud M4x10 for LBD 400V / 200A
Tightening torque: 2Nm
Location: Left corner at the bottom of the front panel.

Chapter 4 – Connections

4.1 - EXAMPLES OF CONNECTION DIAGRAMS

4.1.1 - LBD 230V

LBD CAN version



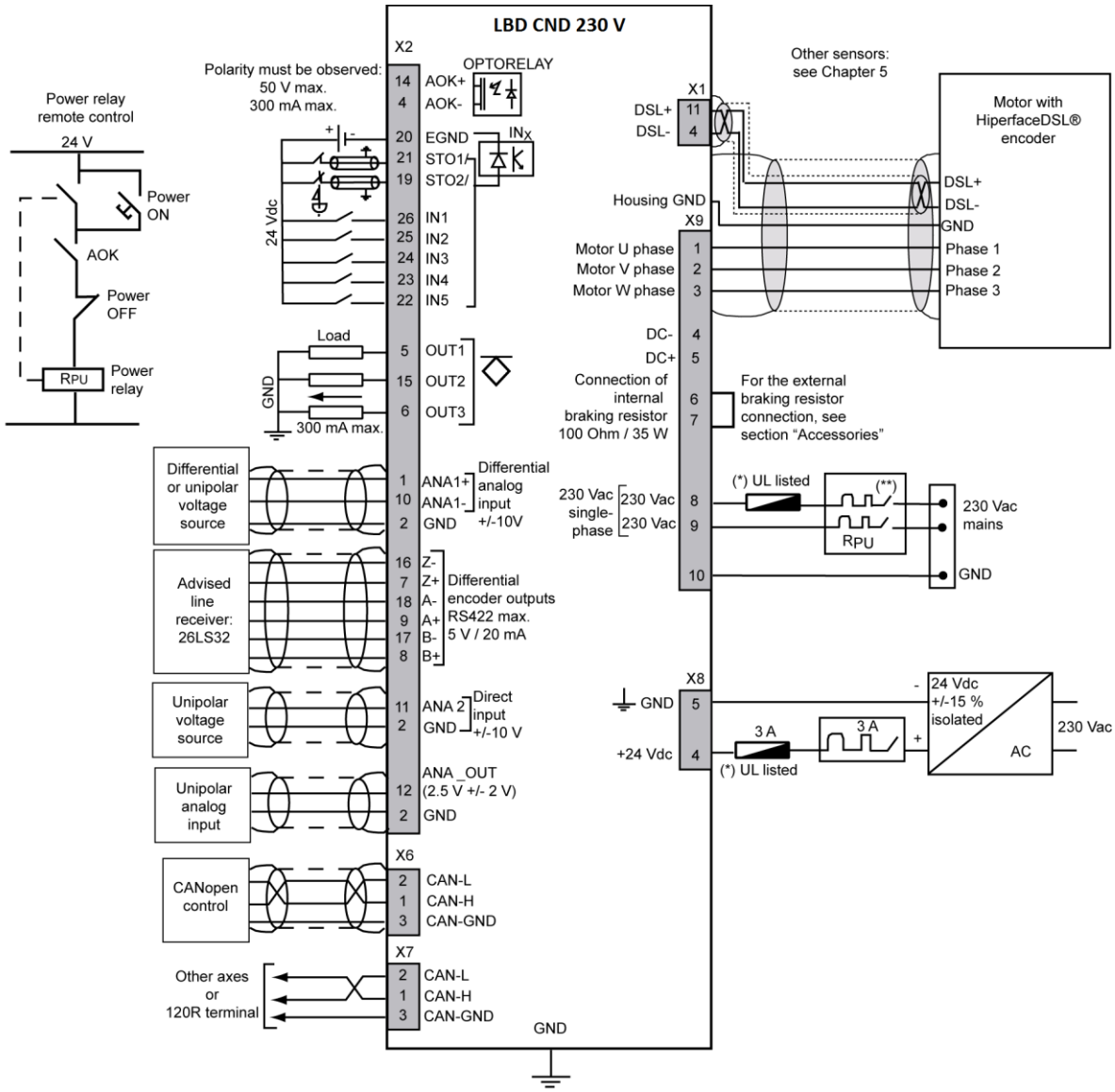
(*) See fuses table for the UL conformity.

(**) Curve D circuit-breaker
I1s = 10 x In

Use only copper conductors for the wiring terminations.
The torque values of the wiring terminations must comply with the certified bloc terminal.

Note: The 24V and power supply protection on source side must be made by the user.

LBD CND version



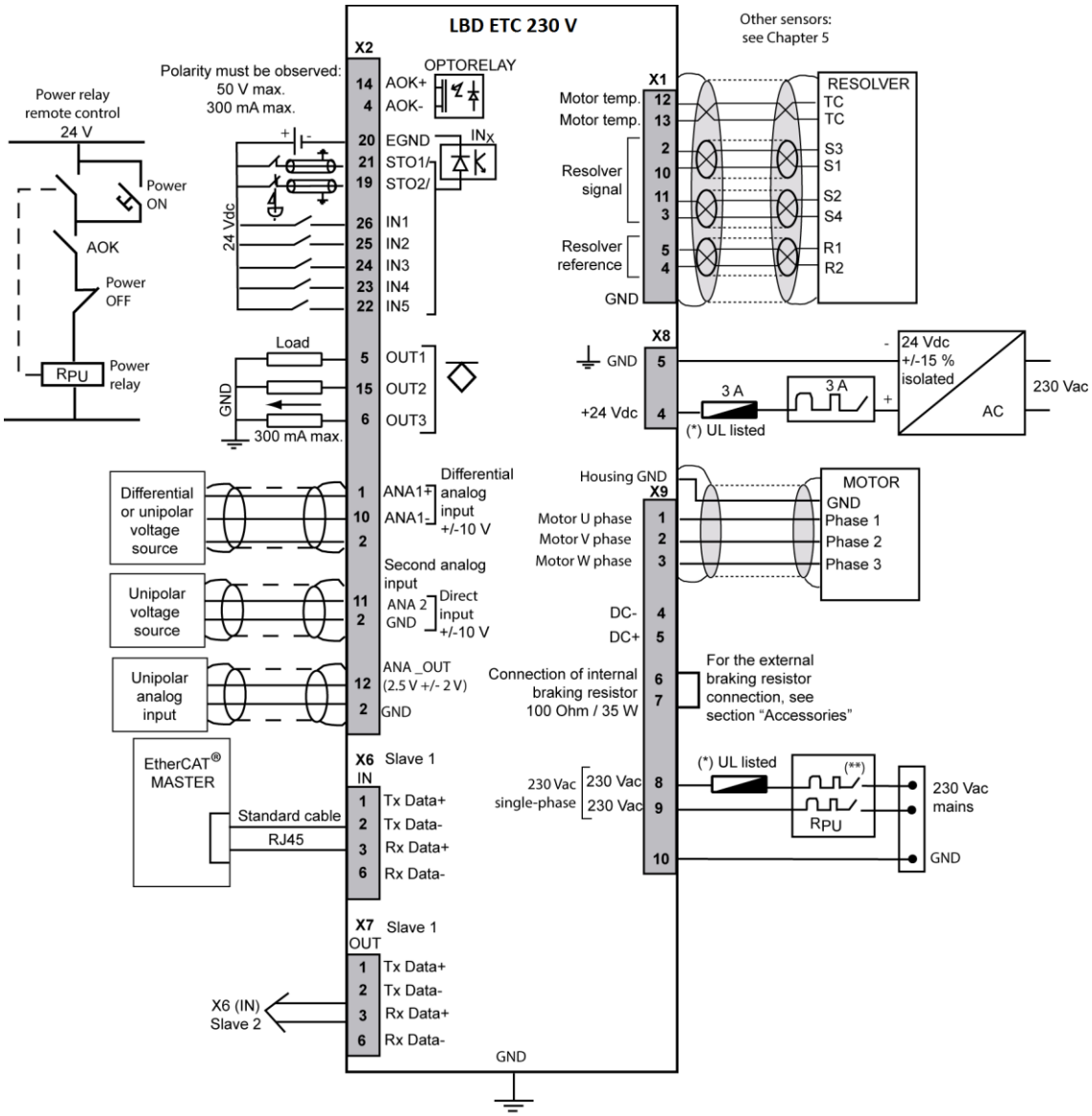
(*) See fuses table for the UL conformity.

(**) Curve D circuit-breaker
I1s = 10 x In

Use only copper conductors for the wiring terminations.
The torque values of the wiring terminations must comply with the certified bloc terminal.

Note: The 24V and power supply protection on source side must be made by the user.

LBD ETC version



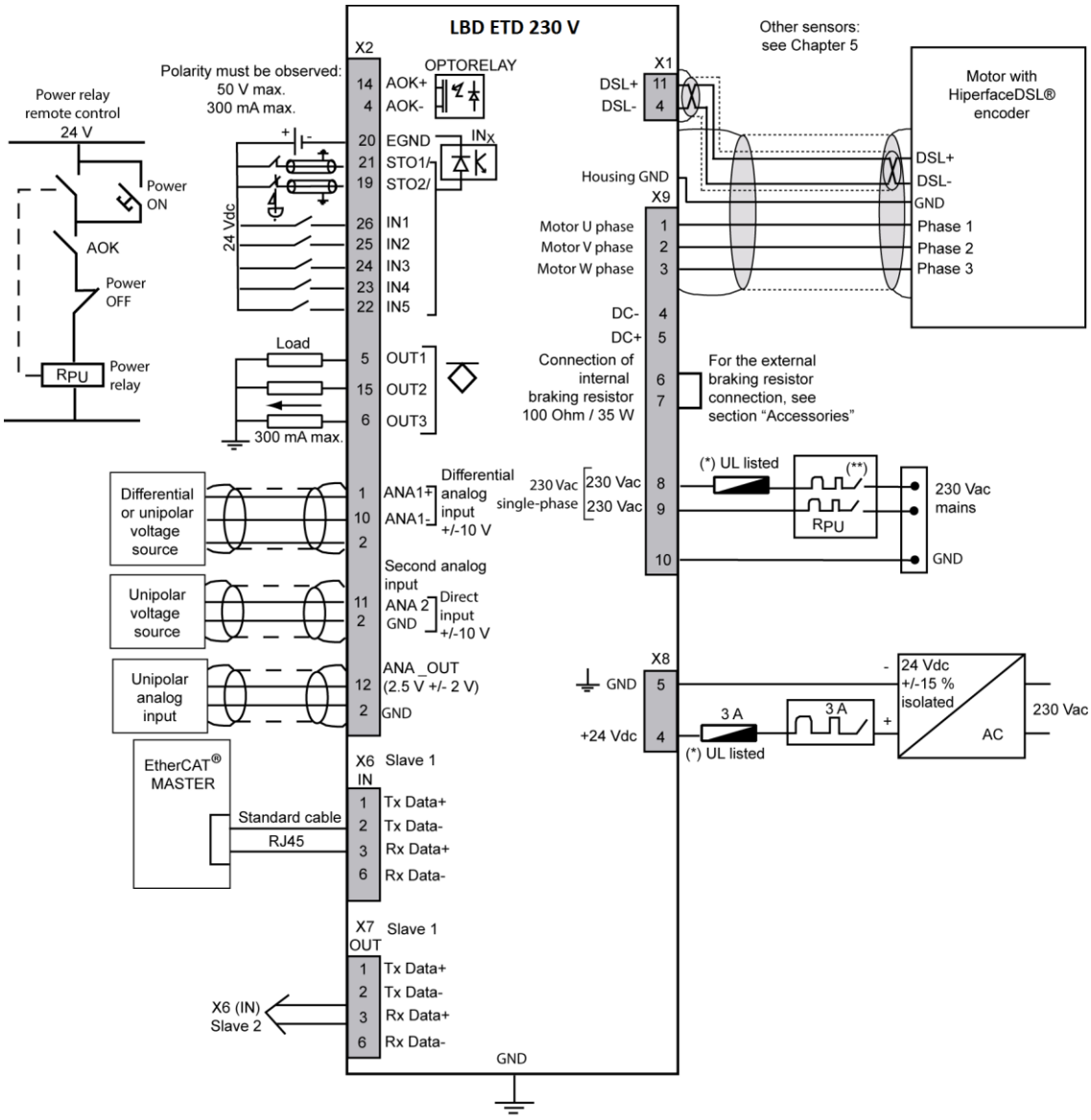
(*) See fuses table for the UL conformity.

(**) Curve D circuit-breaker
I1s = 10 x In

Use only copper conductors for the wiring terminations.
The torque values of the wiring terminations must comply with the certified bloc terminal.

Note: The 24V and power supply protection, on source side, must be made by the user.

LBD ETD version



(*) See fuses table for the UL conformity.

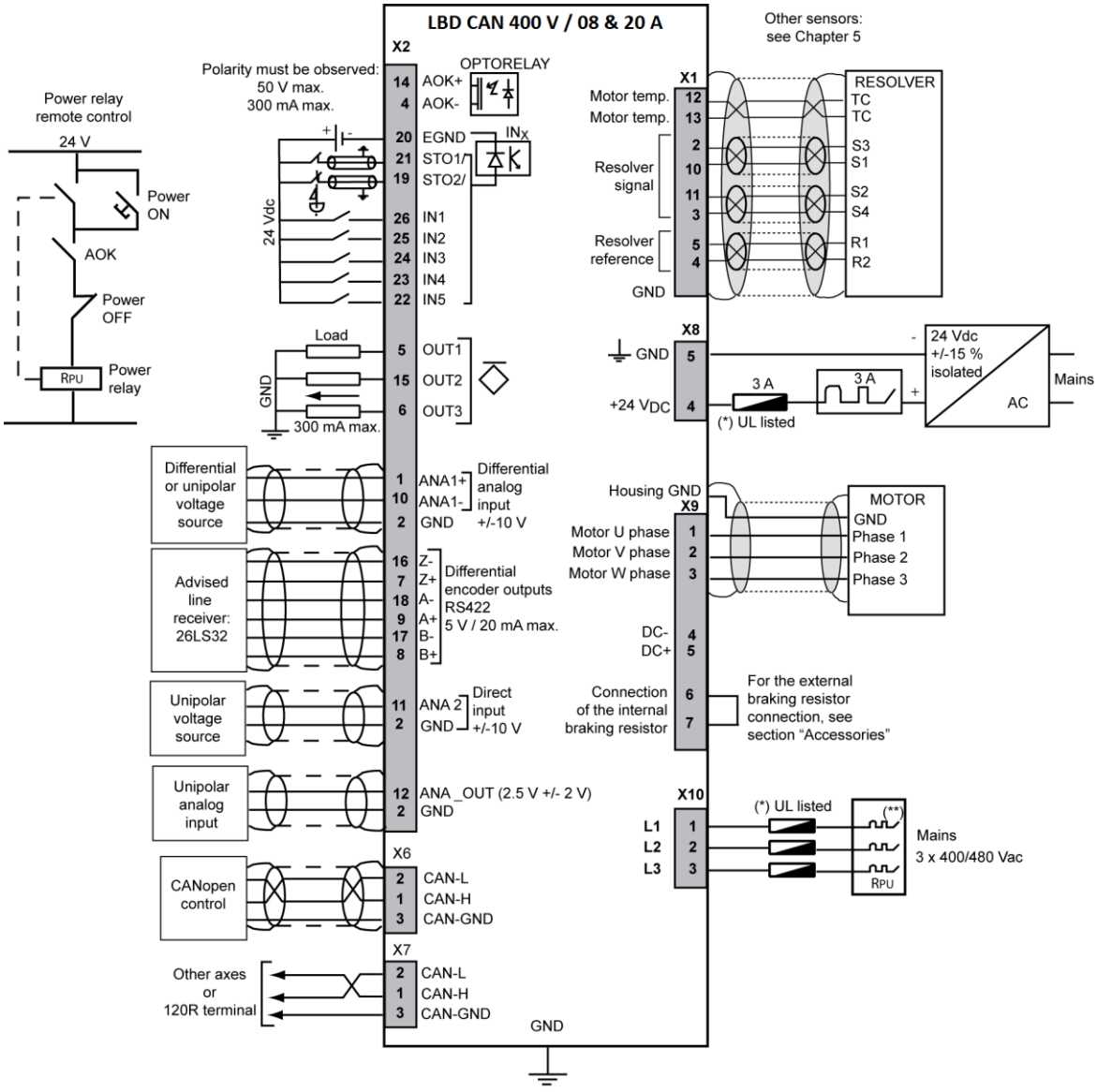
(**) Curve D circuit-breaker
I1s = 10 x In

Use only copper conductors for the wiring terminations.
The torque values of the wiring terminations must comply with the certified bloc terminal.

Note: The 24V and power supply protection, on source side, must be made by the user.

4.1.2 - LBD 400V / 08 and 20A

LBD CAN version



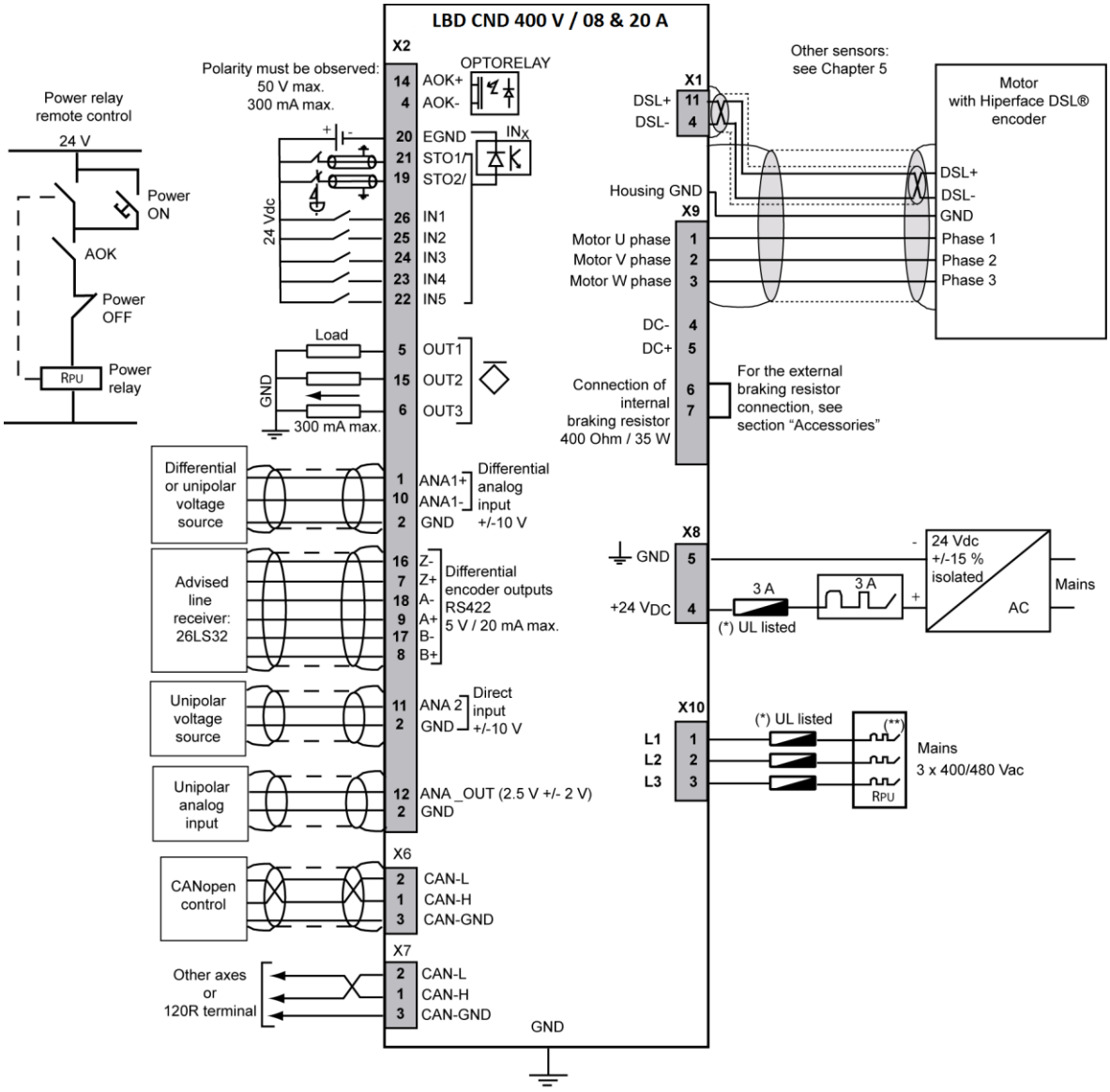
(*) See fuses table for the UL conformity.

(**) Curve D circuit breaker
I1s = 10 x In

Use only copper conductors for the wiring terminations.
The torque values of the wiring terminations must comply with the certified bloc terminal.

Note: The 24V and power supply protection on source side must be made by the user.

LBD CND version



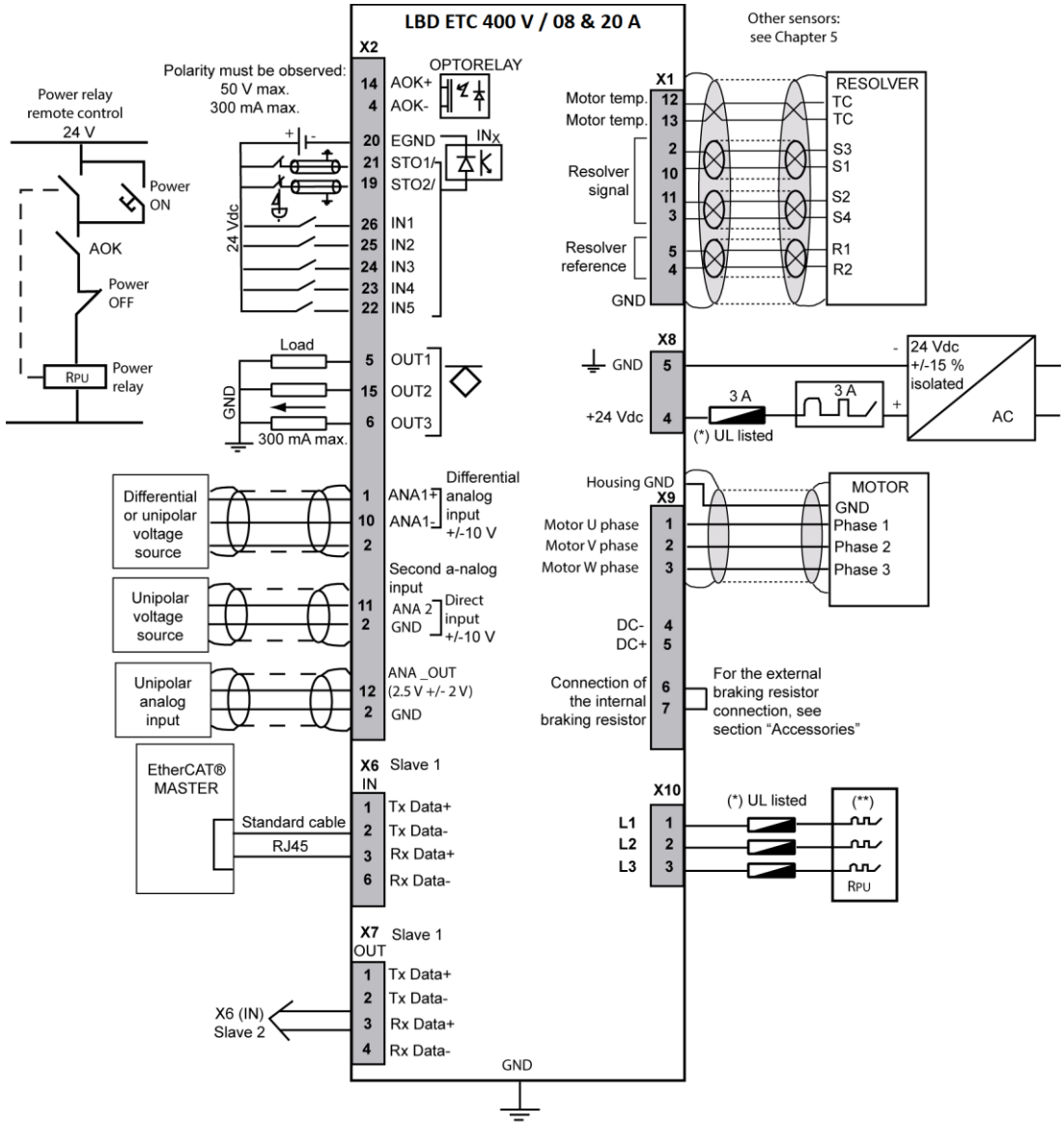
(*) See fuses table for the UL conformity.

(**) Curve D circuit breaker
I1s = 10 x In

Use only copper conductors for the wiring terminations.
The torque values of the wiring terminations must comply with the certified bloc terminal.

Note: The 24V and power supply protection on source side must be made by the user.

LBD ETC version



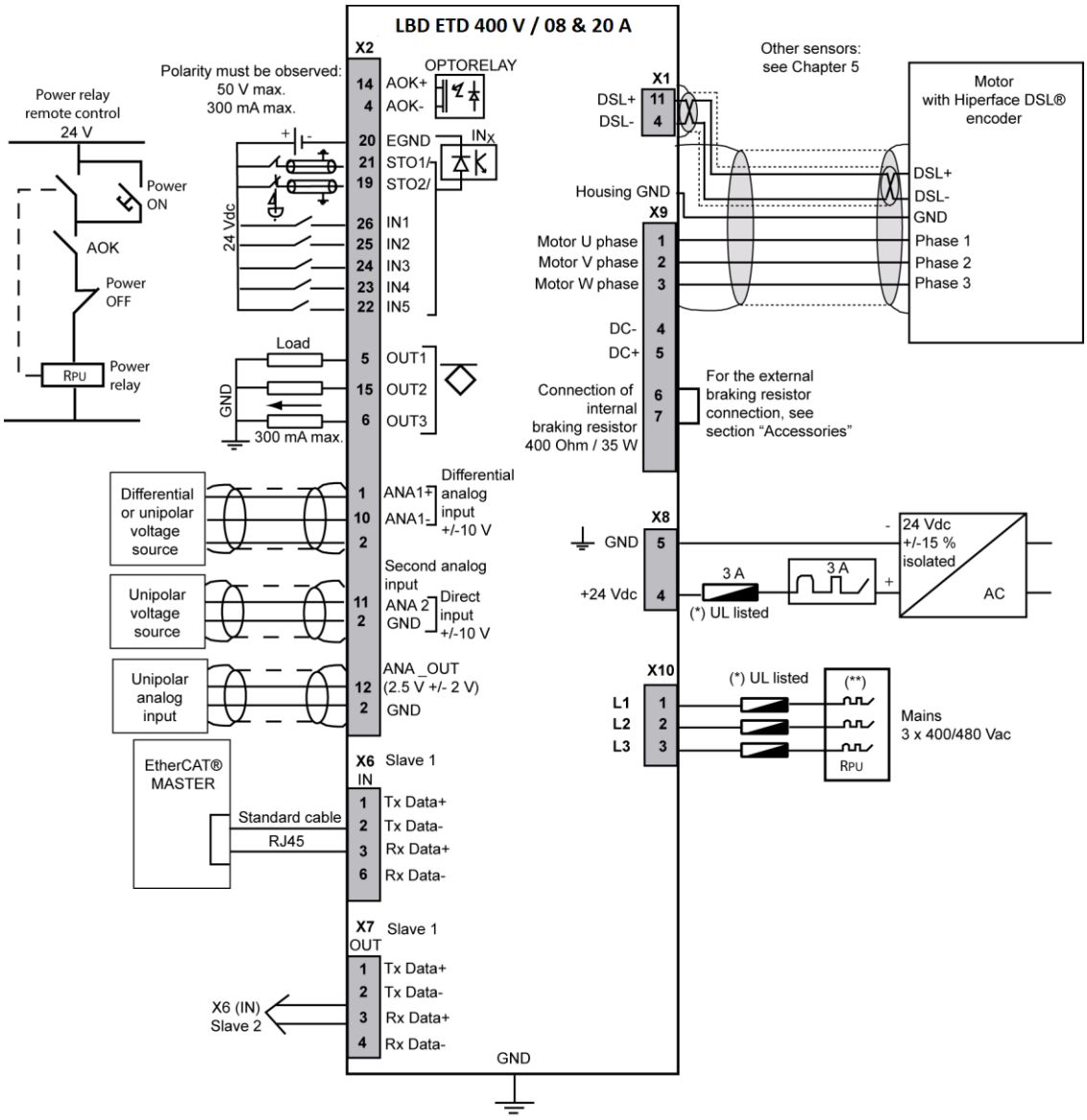
(*) See fuses table for the UL conformity.

(**) Curve D circuit-braker
I1s = 10 x In

Use only copper conductors for the wiring terminations.
The torque values of the wiring terminations must comply with the certified bloc terminal.

Note: The 24V and power supply protection, on source side, must be made by the user.

LBD ETD version



(*) See fuses table for the UL conformity.

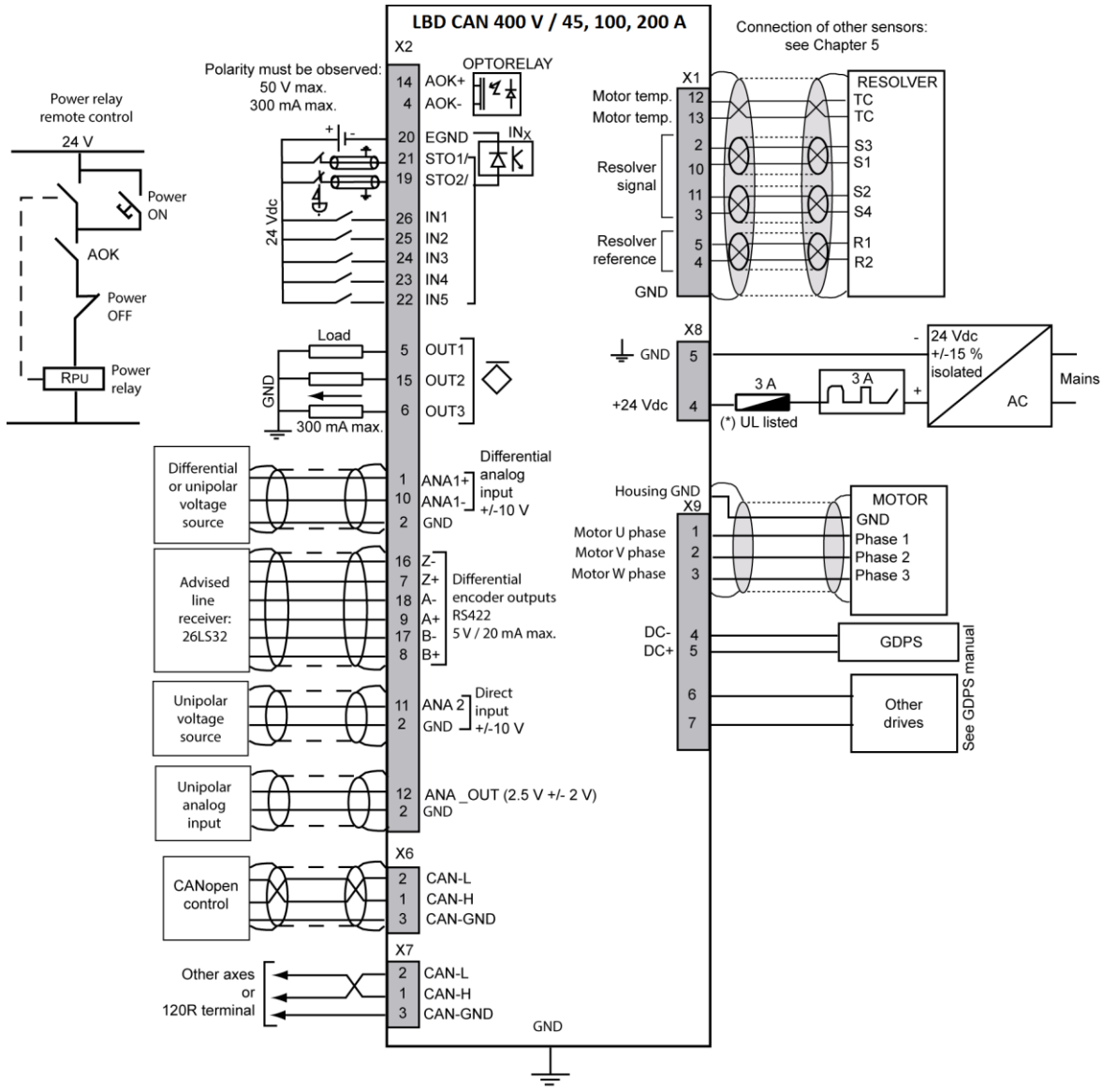
(**) Curve D circuit-braker
I1s = 10 x In

Use only copper conductors for the wiring terminations.
The torque values of the wiring terminations must comply with the certified bloc terminal.

Note: The 24V and power supply protection, on source side, must be made by the user.

4.1.3 - LBD 400 V / 45 A, 100 A and 200 A

LBD CAN version

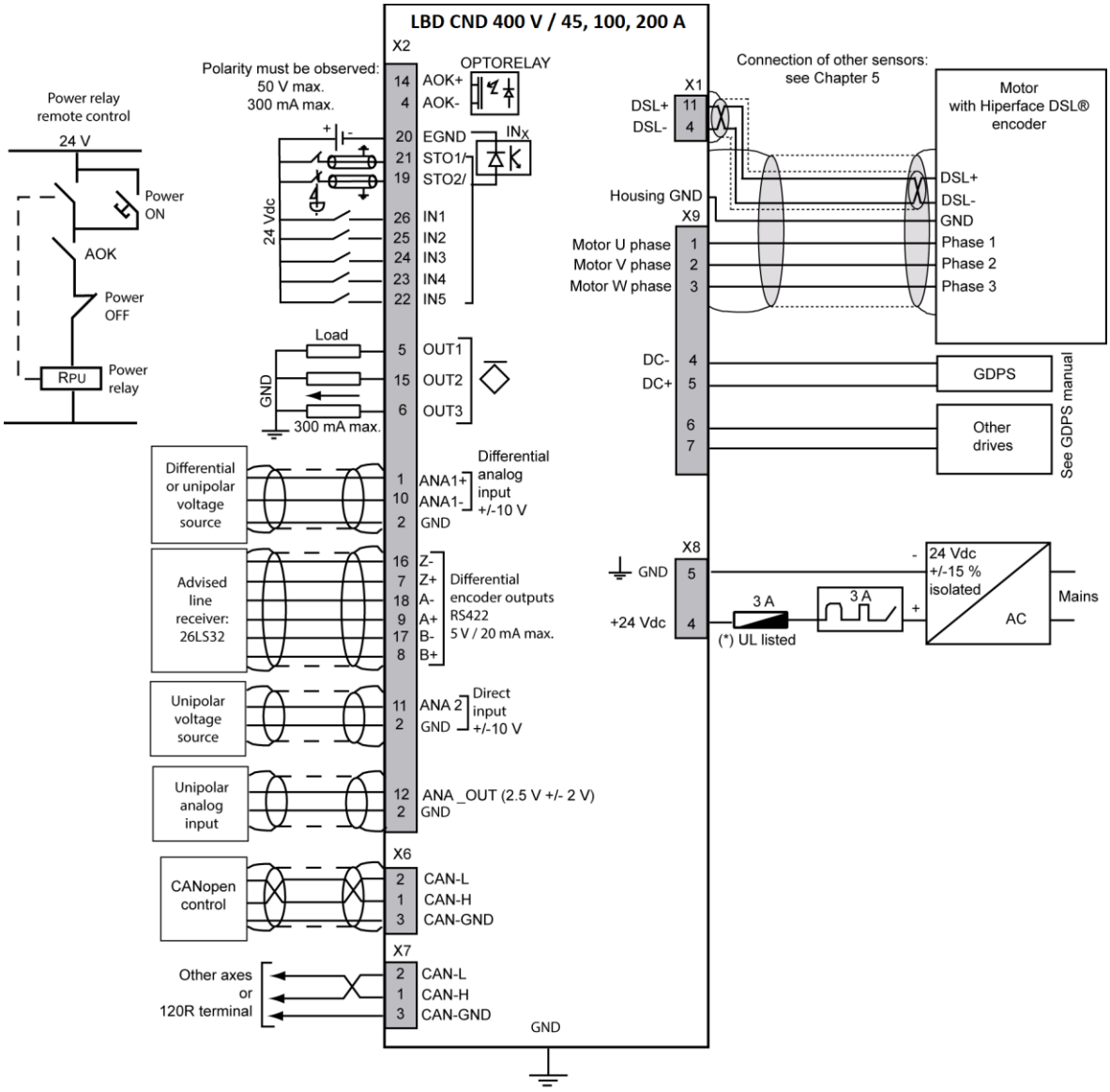


(*) See fuses table for the UL conformity.

Use only copper conductors for the wiring terminations.
The torque values of the wiring terminations must comply with the certified bloc terminal.

Note: The 24V and power supply protection, on source side, must be made by the user.

LBD CND version

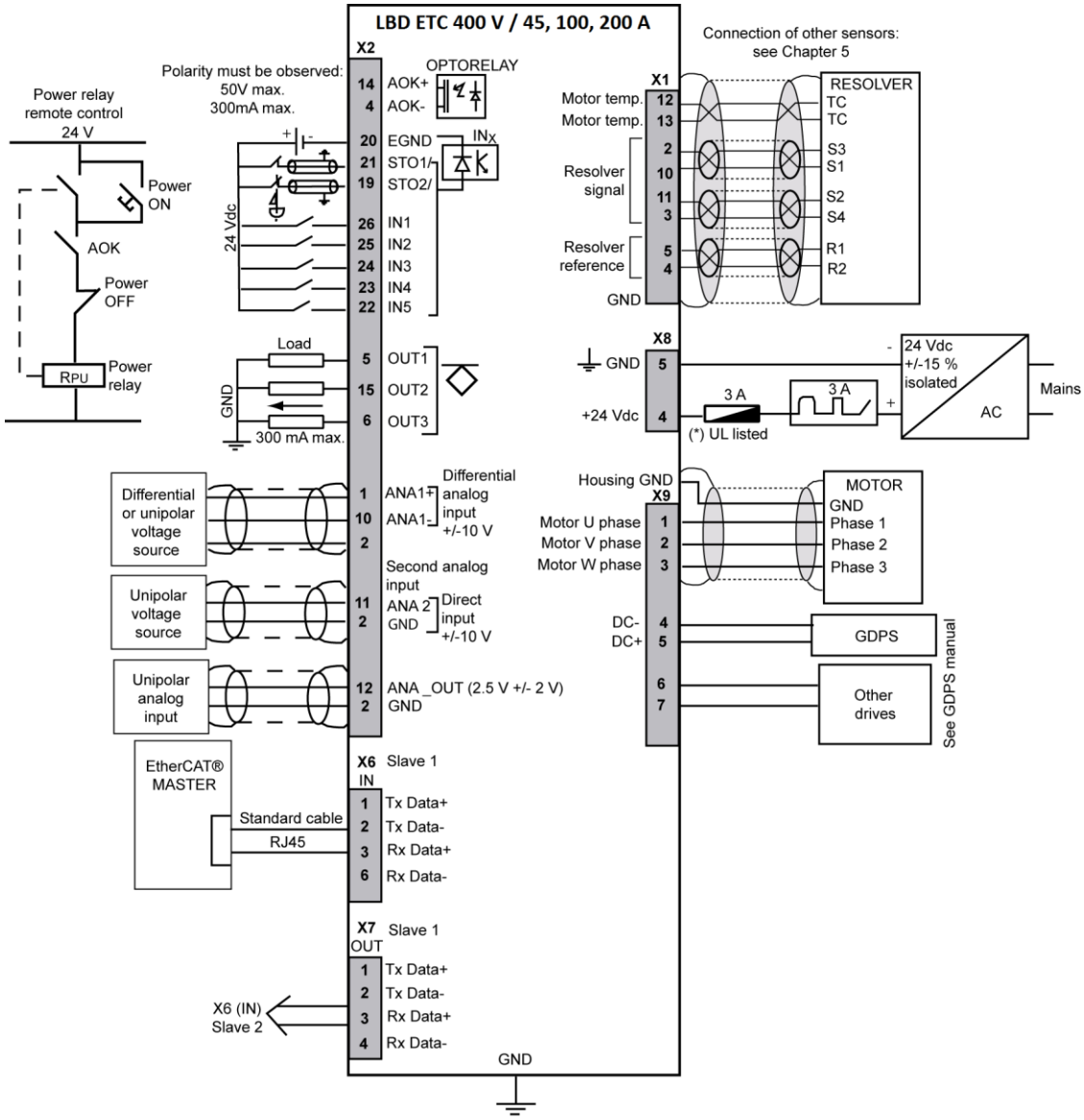


(*) See fuses table for the UL conformity.

Use only copper conductors for the wiring terminations.
The torque values of the wiring terminations must comply with the certified bloc terminal.

Note: The 24V and power supply protection, on source side, must be made by the user.

LBD ETC version

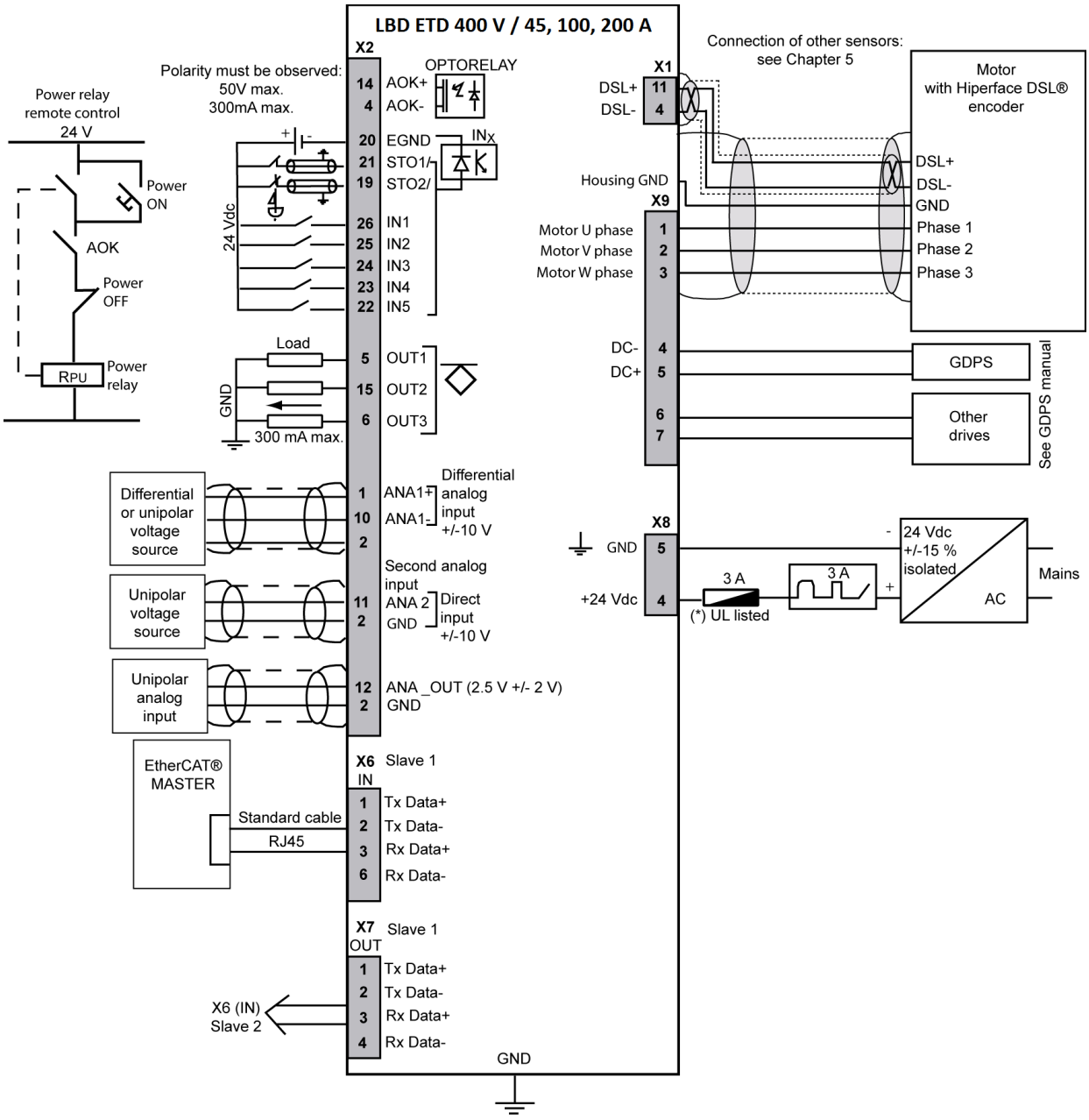


(*) See fuses table for the UL conformity.

Use only copper conductors for the wiring terminations.
The torque values of the wiring terminations must comply with the certified bloc terminal.

Note: The 24V and power supply protection, on source side, must be made by the user.

LBD ETD version



(*) See fuses table for the UL conformity.

Use only copper conductors for the wiring terminations.
The torque values of the wiring terminations must comply with the certified bloc terminal.

Note: The 24V and power supply protection, on source side, must be made by the user.

4.1.4 - UL standard requirements

The UL listing requires the following conditions.

4.1.4.1 - 24V supply

The final user has to provide an isolated auxiliary 24 V_{DC} +/-15% supply (e.g. with isolation transformer) for the auxiliary supply input, and protected by a 3A UL certified fuse.

4.1.4.2 - Power supply and UL fuse ratings

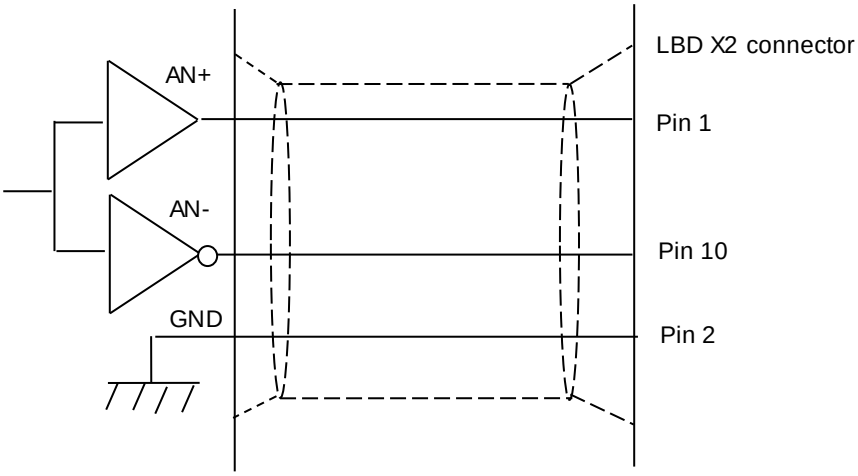
The recommended fuse model is a "semiconductor protection" type. The maximum mains short-circuit power must not exceed 5000Arms, when protected by a UL fuse type A60Q.

On **LBD** drives, the fuse rating must be the following:

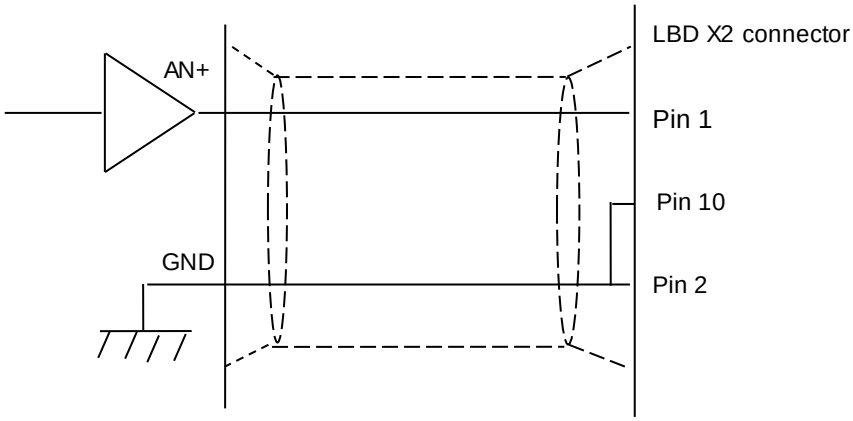
LBD CAN	Rated input current	FERRAZ Type A60Q
230V / 05A	4.3A	A60Q5-2
230V / 11A	9.5A	A60Q10-2
230V / 17A	14.7A	A60Q15-2
400V / 08A	3.8A	A60Q5-2
400V / 20A	9.4A	A60Q10-2
400V / 45A	See MMGDPS manual	See MMGDPS manual
400V / 100A	See MMGDPS manual	See MMGDPS manual
400V / 200A	See MMGDPS manual	See MMGDPS manual

4.2 - ANALOG INPUTS CONNECTION

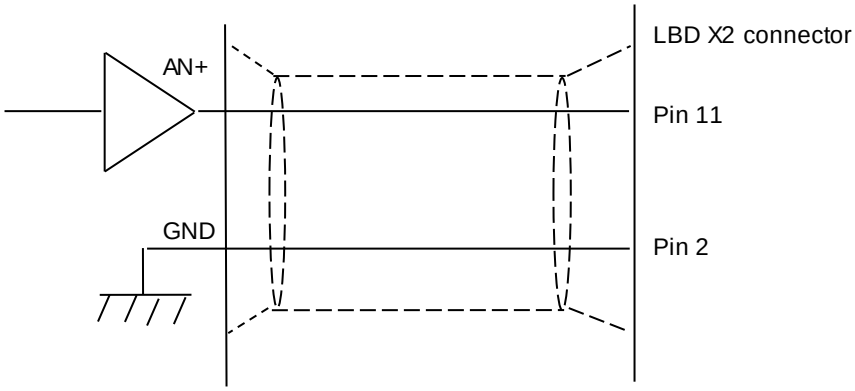
4.2.1 - ANA1 input connection with a differential analog signal source



4.2.2 - ANA1 input connection with a non-differential analog signal source

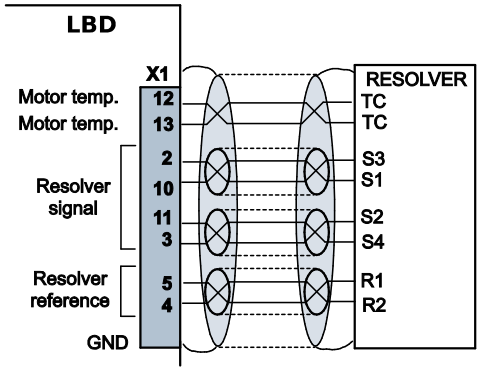


4.2.3 - ANA2 input connection

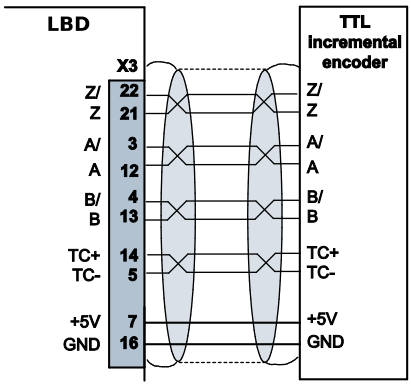


4.3 - CONNECTION TO VARIOUS SENSOR TYPES

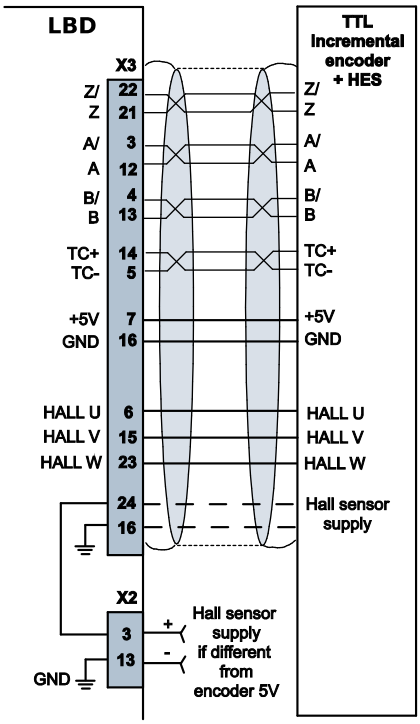
4.3.1 - Connection to a resolver: X1 - Sub D 15 pin female connector



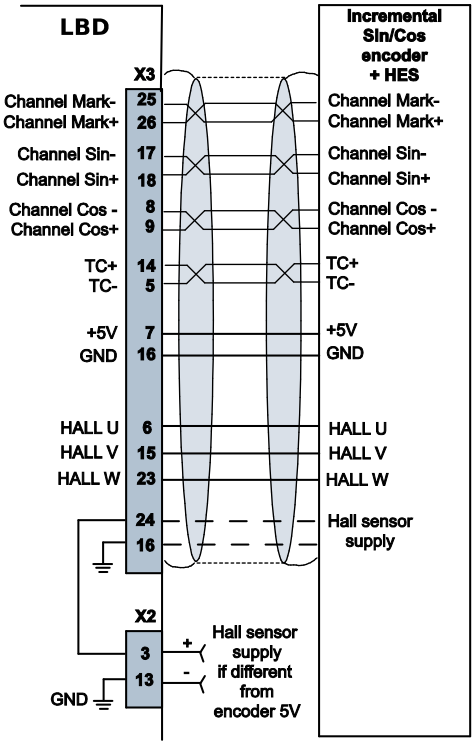
4.3.2 - Connection to an incremental TTL encoder: X3 - 26 pin female HD connector



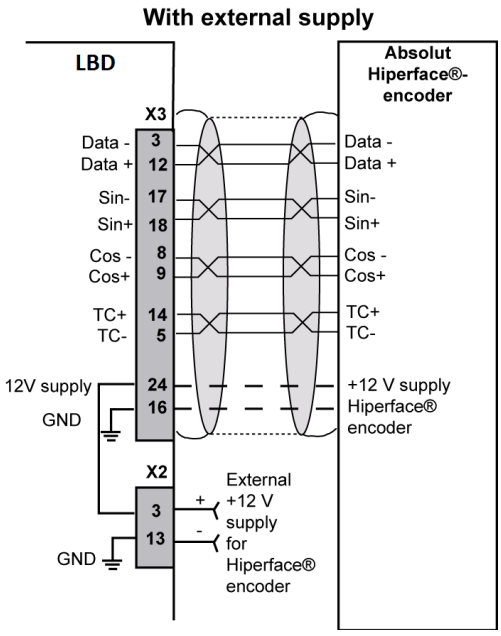
4.3.3 - Connection to an incremental TTL encoder with Hall sensor: X3 - 26 pin female HD connector

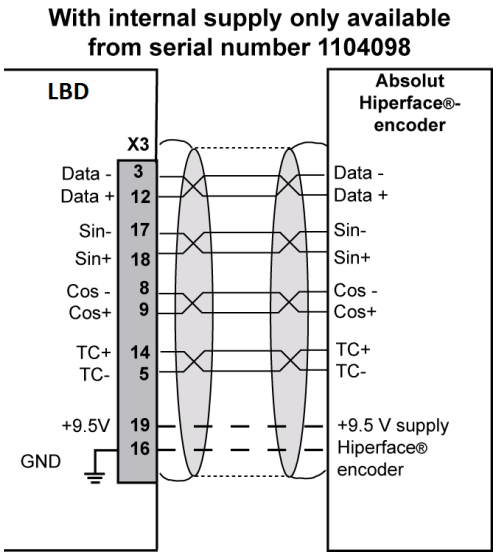


4.3.4 - Connection to an incremental Sin/Cos encoder with Hall sensor: X3 - 26 pin female HD connector



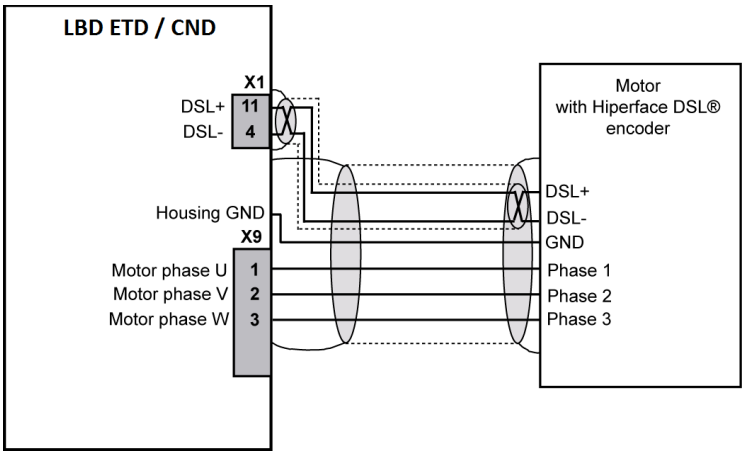
4.3.5 - Connection to an absolute Hiperface® encoder: X3 - 26 pin female HD connector





4.3.6 - Connection to an absolute Hiperface DSL® encoder: X1 - Sub D 15 pin female connector

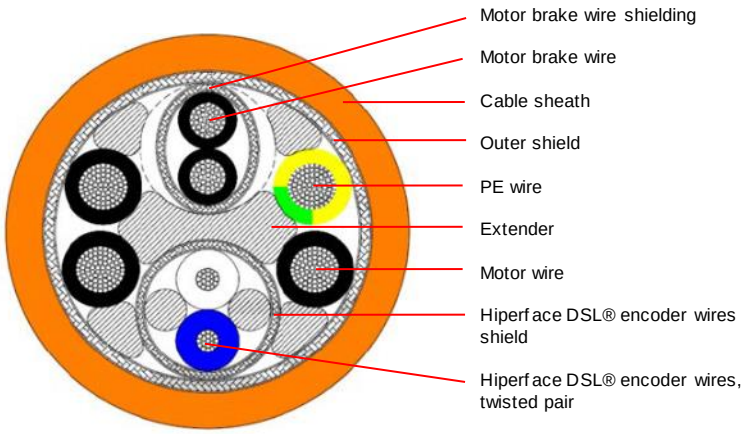
The two wires for Hiperface DSL® communication are integrated into the motor cable:



Hiperface DSL® cable specifications:

Property	Min	Typical	Max	Unit
Length			25	m
Characteristic impedance @ 10MHz	100	110	120	Ω
DC-loop resistance			0.1	Ω/m
Velocity ratio	0.66			c
Propagation delay		5		ns/m
Cut-off frequency	25			MHz
Maximum current per conductor	0.2			A
Operating temperature	-40		125	°C

Suggested cross-section of the integrated cable:

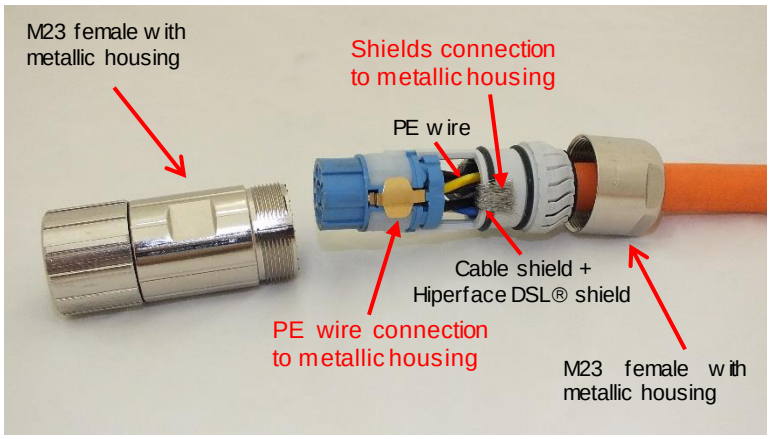


The shield as well as a proper ground connection have a significant impact on the DSL connection performance and maybe considered as its keyfactor.

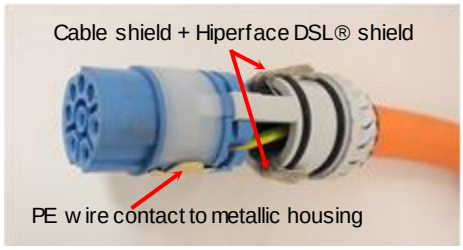
In the cable, the motor phases must be located symmetrically to the Hiperface DSL® communication wires.

Both Hiperface DSL® communication wires must be twisted and must have their own uninterrupted shield from the motor connector to the drive X1 connector.

Motor side connector assembly example:

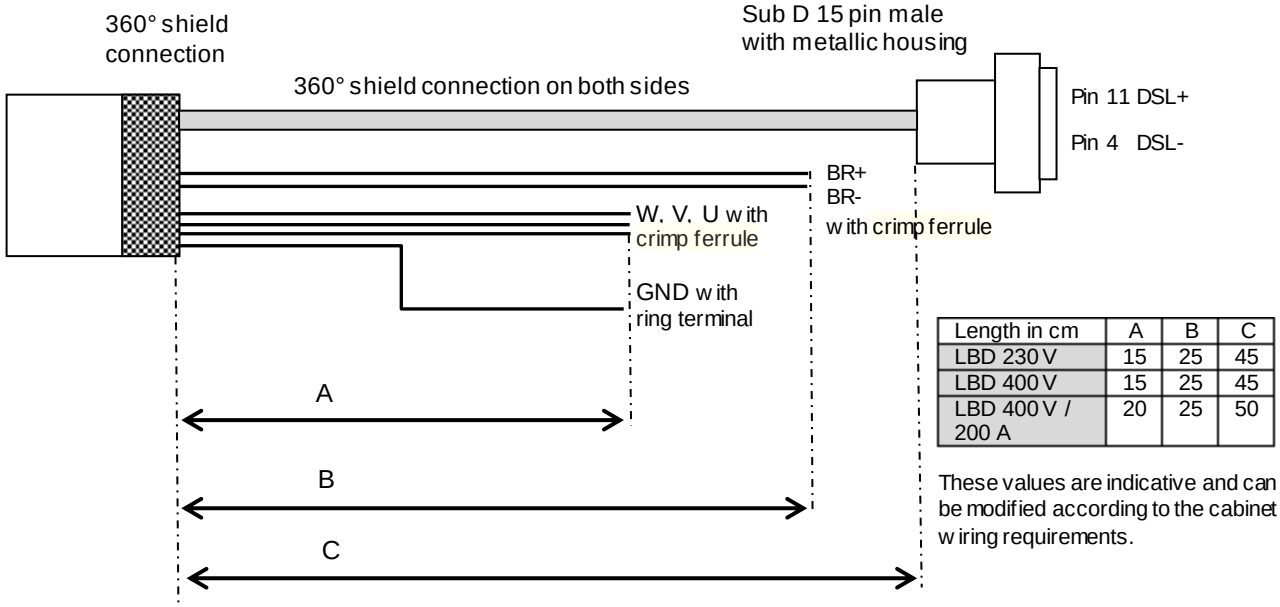


Internal details of the connector



The cable shield and the Hiperface DSL® shield must both be connected to the metallic housing (360° shield connection). The PE wire connection to metallic housing is mandatory.

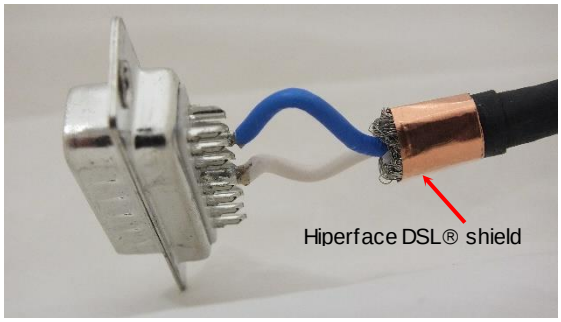
Drive side connections example:

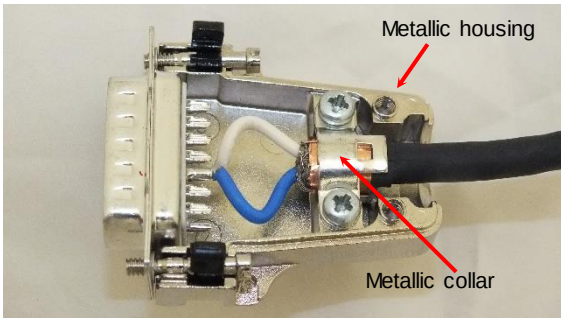


Length in cm	A	B	C
LBD 230 V	15	25	45
LBD 400 V	15	25	45
LBD 400 V / 200 A	20	25	50

These values are indicative and can be modified according to the cabinet wiring requirements.

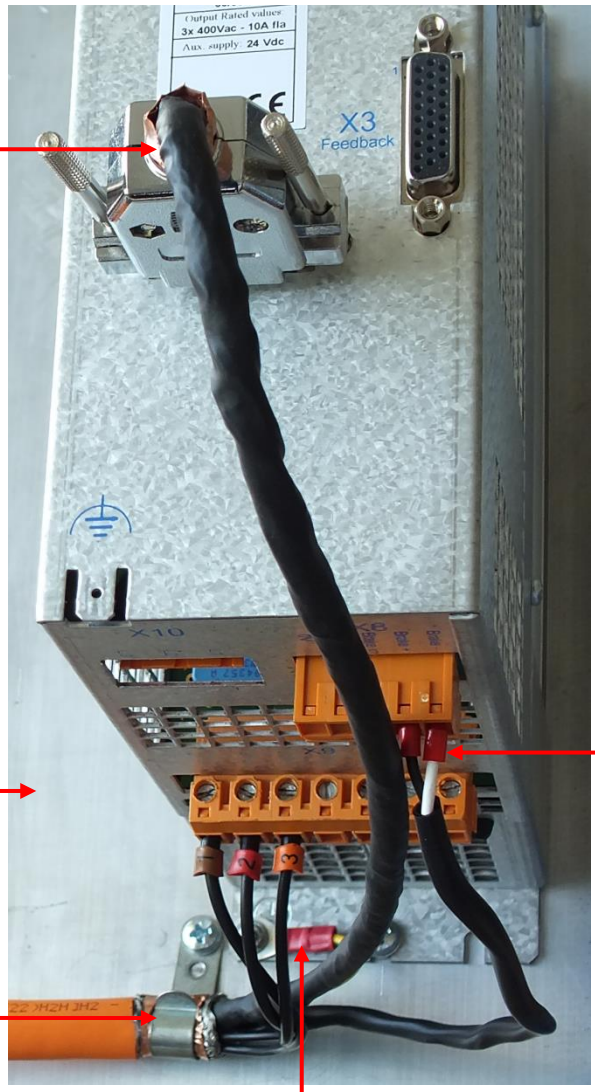
Sub D 15 connector assembly





A Sub D 15 connector with metallic housing or metalized plastic housing is mandatory.
360° connection on the Hiperface DSL® shield is mandatory.

Hybrid cable connexion example:



360° shield connection with metallic collar inside the connector.

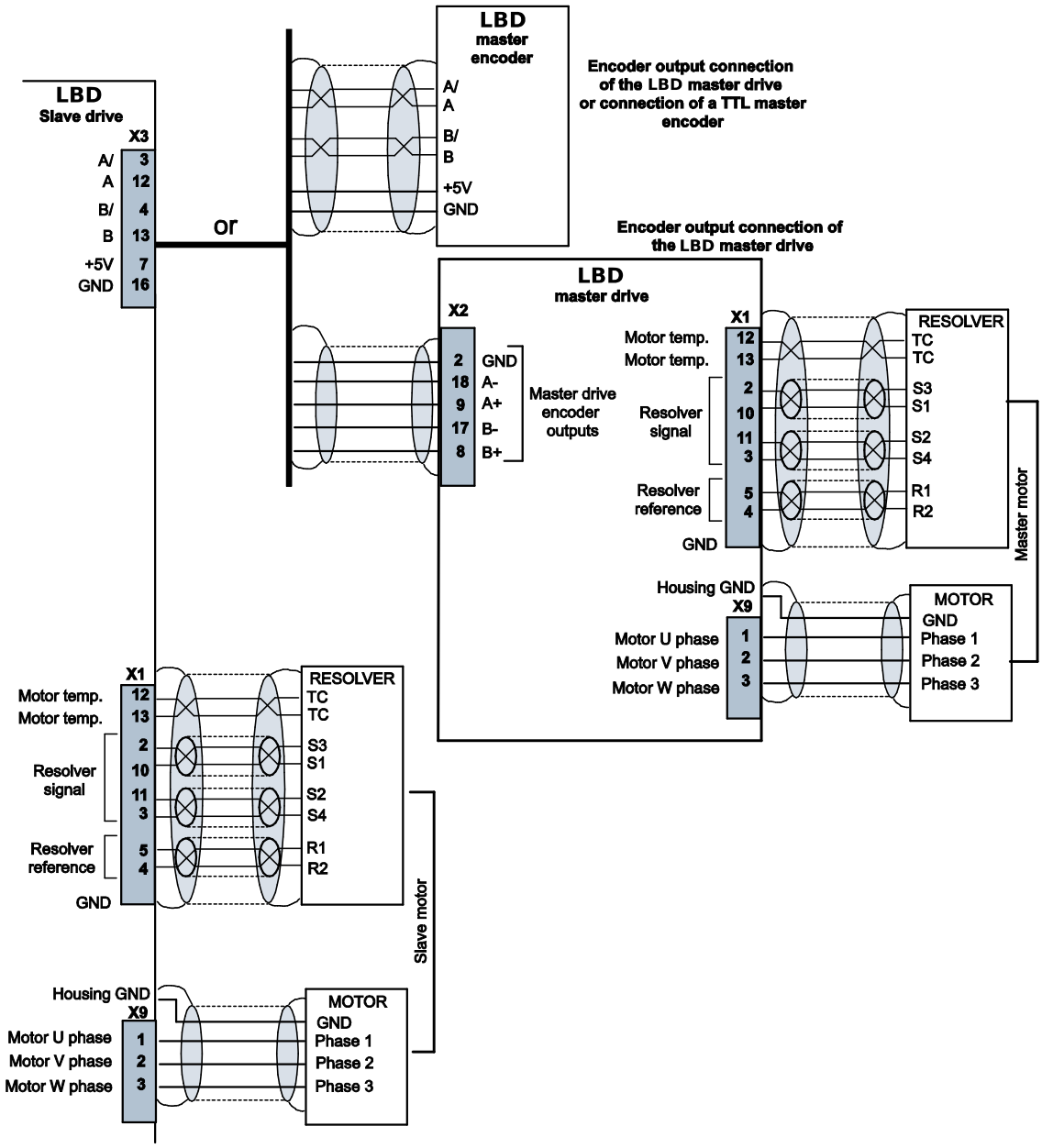
Conducting panel

Motor brake wire connection

360° shield connection with metallic collar.

PE connection

4.3.7 - Configuration of the LBD drive with "Software gearing" function



In master/slave "software gearing" applications, the drive controls the slave motor shaft position with regard to the input command sent by the master axis.
The position input command issued from the master axis can be interfaced either:

- with a master encoder

- or with the encoder output of an **LBD** master drive.

4.4 - ACCESSORIES AND CONNECTIONS

ENERGY RECUPERATION VIA A BRAKING RESISTOR

All **LBD** stand-alone drives are fitted with the power feedback system. When the motor is decelerating with high inertia and high speed, the mechanical braking energy is reflected to the drive. This energy is dissipated inside a resistor called "braking resistor".

An electronic control of the dissipated power avoids the overload of the braking resistor. So, if the energy reflected to the drives is too high, the DC bus voltage will rise up to the release of the "**Overvoltage**" fault.

4.4.1 - Connection of the internal braking resistor

LBD 230V

LBD 400V / 08 and 20A

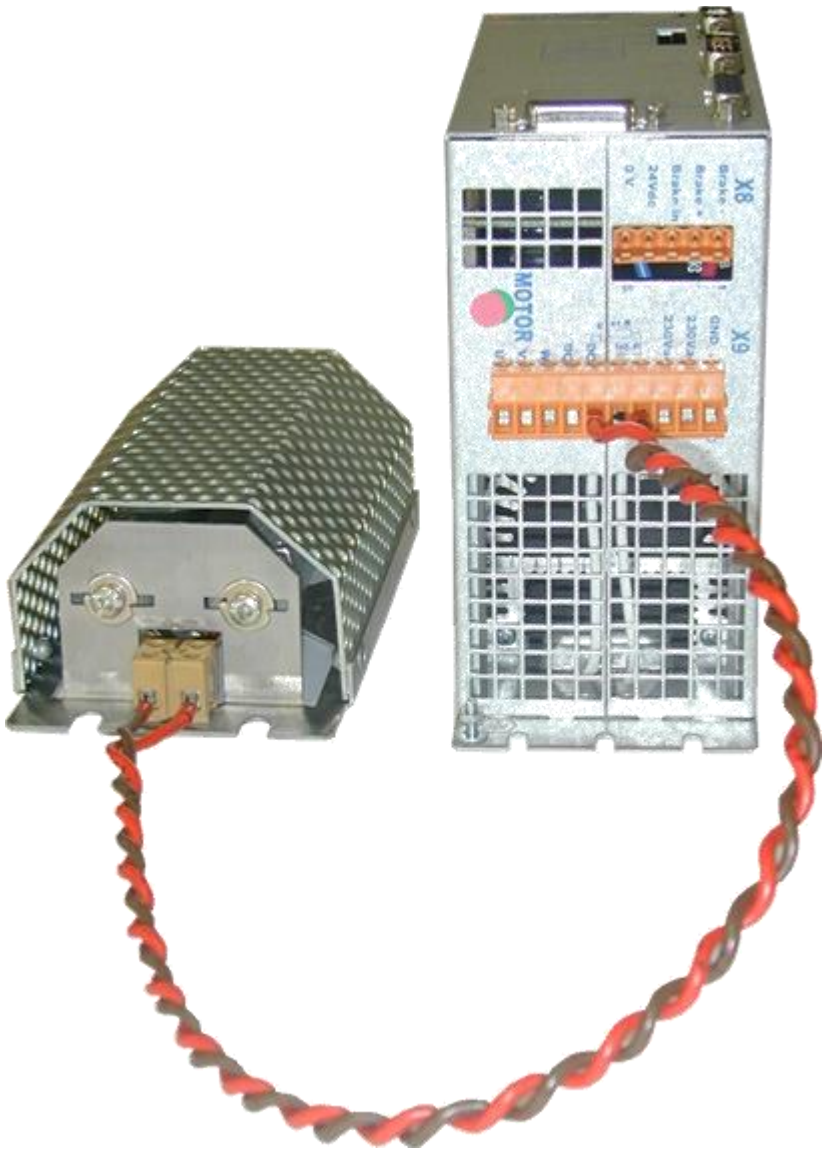
The **LBD** drive in stand-alone version is equipped with an internal 35W braking resistor.
Its connection is made by means of a wiring bridge between pins 6 and 7 of the X9 connector.
If the required rated power of the braking resistor is higher than 35W or if the pulse power is higher than 1500W, a larger external power resistor must be mounted (see manual "Braking resistors", section 2.1).

4.4.2 - Connection of the external braking resistor

The braking resistor MUST be mounted out of range of heat sensitive and inflammable parts (plastic, cable sleeves, etc.).

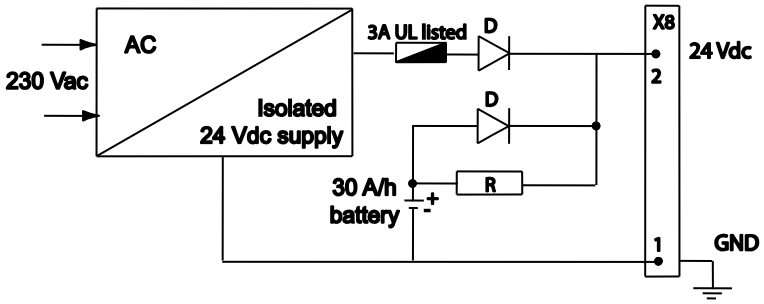
In order to avoid any EMC or electrical problem, some rules must be observed:

- heat must be evacuated,
- shielded cables or at least twisted wires must be used,
- wires must bear high voltage and high temperature (recommended type: UL1015, AWG 14)
- wires must be as short as possible (max. 1m).



The external braking resistor must be connected between pins 5 and 7 of X9.
Its connection requires the inhibition of the internal braking resistor (removal of the wiring bridge between pins 6 and 7 of X9).

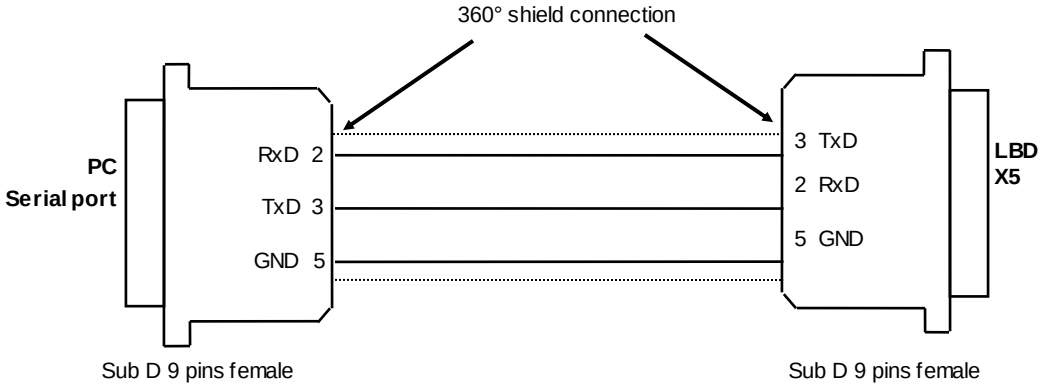
4.4.3 - Connection of a backup battery



The **LBD** drive consumption is 400mA with $24V_{DC}$. So, a 24V / 30A/h battery can keep the drive powered during e.g. a long 3-day week-end. This backup method is very interesting for saving the machine initialization as well as the axis position even when moving with the mains switched off.

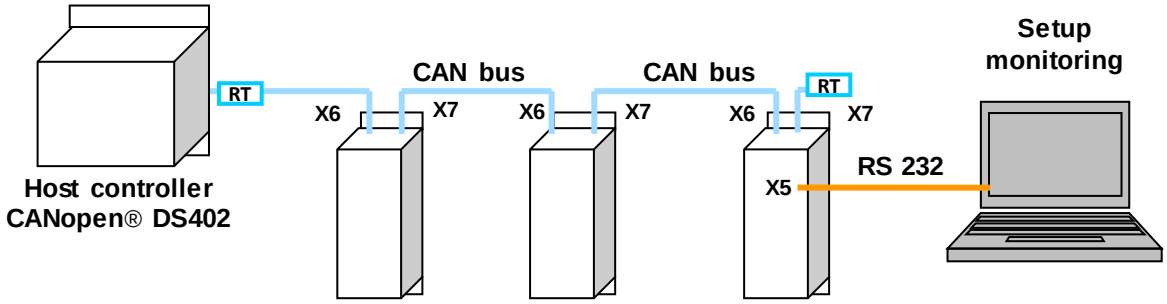
4.5 - CONNECTION TO THE "*GEM DRIVE STUDIO*" SOFTWARE TOOL

4.5.1 - Connection of the serial link to the X5 connector



4.5.2 - Multiaxis connection of the serial link

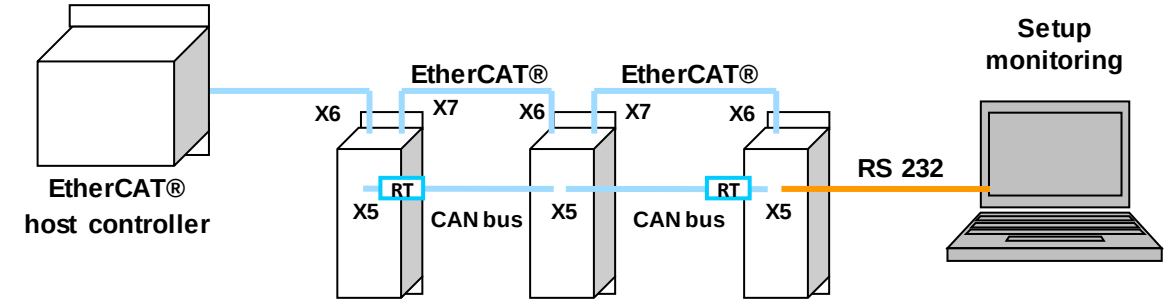
4.5.2.1 - LBD drive in CANopen® configuration



RT = 120 Ohm terminal resistor connected between CAN-L and CAN-H lines

The parameterization of all axes is made by one single connection to the first axis via the serial link RS232. The other axis are parameterized via the CAN bus.

4.5.2.2 - LBD drive in EtherCAT® configuration



RT = 120Ohm terminal resistor connected between CAN-L and CAN-H lines

In the EtherCAT® configuration, the RS232 and CAN communication is made via the SUB D 9 pins connector X5. The multi-axis parameterization is then made according to the diagram above.

4.6 - WIRING INSTRUCTIONS

According to the EN61000.4-2-3-4-5 and EN55011 standards.

4.6.1 - Ground connection

LEAKAGE CURRENT TO THE GROUND

The "Electronic Power Unit" equipment which includes the control, the drive, the motor and sensors, generates a leakage current to the ground higher than 10mA continuous: the protection conductor section must be **at least** 10mm² (Cu) or 16mm² (Al).

This product may generate a leakage current with a DC component.
If a Residual Current Device is used, it should be:
- of type A in single-phase applications,
- of type B in three-phase applications.

The use of a 300mA trip current is recommended.

The PE wire of the mains cable MUST be connected to the ground screw marked with the ground symbol on the front of the drive.
Fastening torque of the ground screw: 0.77Nm.

The reference potential must be the ground: 10mm² section or ground braid to the reference potential.

If there is a potential reference, e.g. a chassis or cabinet with low impedance between its various parts, it should be used for connections to this potential which shall be itself grounded.

Reference potential loops (especially with the ground) are allowed **only** if these loops have a very low impedance (< 0.1Ω). Any shield that is not used as a conductor can be connected at both ends under the condition to be connected over 360° at both ends by means of metal links in order to ensure the shield continuity.

4.6.2 - Shield connection

CAUTION!
Each potential conducting element must be **shielded**. Several potential conductors **in one single sleeve** must be **twisted and shielded**.

A shield has no effect if it is not connected:

- to a reference potential,
- via a 360° shield connection at both ends. This means that the whole shield sleeve circumference must be directly in contact with the reference signal without any conductor insertion.

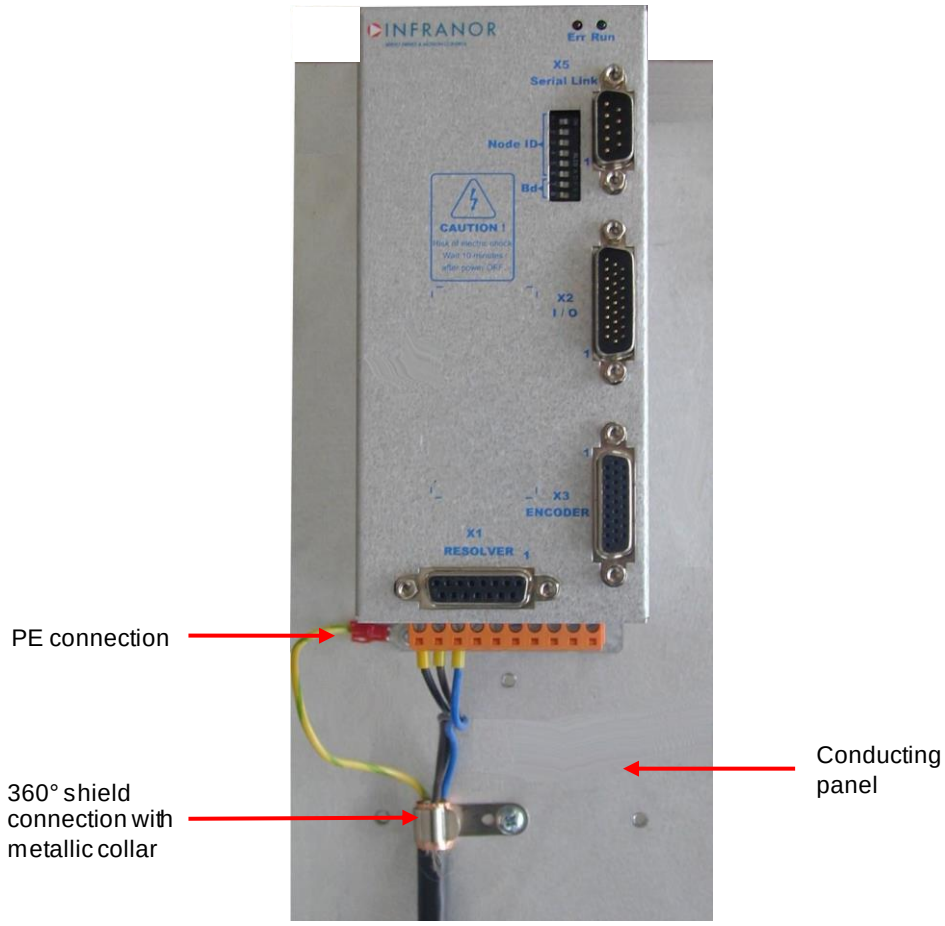
Cables with low potential should **never** run in the proximity of high power lines.

The connectors used for the compliance with the EN61000.4 standard must be made of metal or metalized and must allow the 360° shield connections.

The shield of the motor and brake cable must be connected over 360°.
The 360° shield connection must be ensured by metallic collars and connected to the ground reference potential.

The shield should never be interrupted or corrupted over the whole cable length.

4.6.3 - Example of ground and shield connections



4.6.4 - Motor, resolver and encoder cables

Motors, resolvers and encoders are grounded via their housing.
Cable inputs must be made by means of metal connectors with collars allowing the 360° shield connection.

The resolver cable must be pair twisted and shielded (sin, cos, ref.). Motor cables MU ST also be shielded and connected over 360° at both ends, as shown on the shield connection picture of section 4.6.3.

The encoder inputs A, B, C, D, Z and R require pair twisted and shielded cables. The shield must have a 360° connection via metallic collars at both ends.

Check that the voltage drop in the power supply lines of the encoder cable is complying with the technical specifications of the encoder. The voltage drop value for a given cable is calculated as follows:

$$\Delta U[V] = 40.10^{-6}.\frac{L_C[m].I[mA]}{S[mm^2]}$$

with
- ΔU: voltage drop in volts
- Lc: cable length in meters
- I: encoder current in milliamps (see technical specifications)
- S: section in square millimetres

Due to this voltage drop:

- an encoder with a wide power supply voltage range should be selected,
- if the encoder has power supply SENSE feedback lines, they can be connected to the power supply lines in order to reduce the voltage drop by the half (the SENSE feedback signal is not used in this drive).

Example

The application requires a linear Heidenhain encoder, supplied with 5V ±5% / 300mA and 25m cable length.
Supply voltage: 5V ±5% ⇨ΔU_{max} = 0.25V ⇨ Minimum section: S = 1.2mm².

Such a cross section is difficult to obtain, so the user can:

- either connect the SENSE feedback signal lines to the power supply lines, so the required wire section will be the half (0.6mm²),
- or use the same encoder type but in a version which allows a power supply voltage from 3.6 to 5.25V / 300mA. Minimum power voltage 3.6V ⇨ΔU_{max} = 1.4V ⇨ Min. section: S = 0.21mm².

Brake equipped motors must also have their brake cables shielded in order to be EMC compliant.

Maximum cable length: 100 m.

For cable length >25 m, we advise:

- the use of the maximum cable section allowed by the connectors,
- the mounting of a reactance with an inductive value between 1 % and 3 % of the motor inductive value for the motor cable. The reactance inductive value must be taken into account in the calculation of the current loops. The current rating of the reactance must be higher than or equal to the drive rating.

The reactance must be mounted at the drive output.
Due to the use of a reactance, a shielded cable is not mandatory anymore.
A more complex sinus filter type B84143V x R127 by company Epcos may also be mounted instead of the reactance.

UNDESIRABLE EFFECTS OF MOTOR CABLES LONGER THAN 25 M:

- Heating of the power module, the motor and the cable.
- High overvoltage on the motor windings, involving a shortening of their life time.

The reactance reduces the undesirable effects on motor and drive but it may be quite heated. This requires an appropriate fan.

4.6.5 - Serial link and CAN communication cables

Serial link and CAN communication cables must also be shielded according to the shield connection recommendations above.

CAUTION!
Control cables (resolver, serial link, CAN) and power cables must be connected and disconnected with the drive **turned OFF**.
Reminder:
The power voltage may remain several minutes at the power capacitor terminals.
A contact with high voltage may involve severe physical damage.

4.7 - FIRST POWERING OF THE DRIVE

4.7.1 - Very important

Check the connections, especially of the $24V_{DC}$ and power supplies. Check that the housing serigraphy actually corresponds to the power connections.
The $400V_{AC}$ connection of a 230V drive will destroy it!

If a logic input is software configured with the Enable function, it must be disabled.

Check for the braking resistor specifications if connected in place of the internal braking resistor.
Check for the correct groundings as well as the 360° shield connections.

WARNING !
During the machine adjustments, drive connection or parameterization errors may involve dangerous axis movements. It is the user's responsibility to take all necessary steps in order to reduce the risk of uncontrolled axis movements during the operator's presence in the pertaining area.

4.7.2 - Connection of the $24V_{DC}$ supply

The red **Err** LED on the front panel must be flashing ("Undervolt." error).
The **AOK** signal (pins 4 and 14 of X2) is closed. The power voltage relay (Rpu) can then be controlled according to the recommendations of Chapter 4, section 1 (connection diagram). The connection must be made in compliance with the X8 connector serigraphy.

4.7.3 - Connection of the mains power supply

The red **Err** front panel LED must be unlit.

Note: If a fault occurs, the red **Err** LED remains continuously lit.

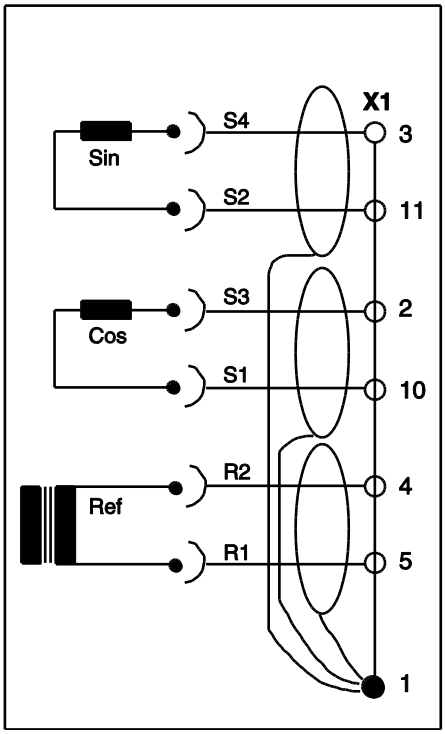
4.7.4 - Starting procedure

See **LBD – User Guide**.

Chapter 5 – Appendix

5.1 - ADJUSTMENT TO VARIOUS RESOLVER TYPES

See following wiring diagram for the resolver connection to the X1 connector:



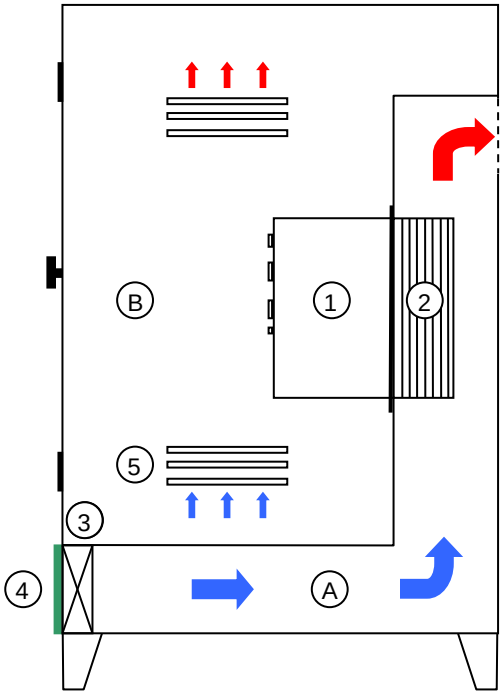
When using **resolvers** with **transformation ratios** out of the range 0.3 to 0.5, the adjustment must be factory set.

5.2 - CABINET EXAMPLE

The drive is IP20 classified (electronic part AND heatsink part). It must be mounted inside a housing protecting the drive from conducting dust and condensation (pollution degree 2 environment).

In order to take benefits of the push-through mounting, it is advised to use a cabinet with thermal boundary.

Recommended cabinet design when using the Push-through version:



A: Thermal partition of the cabinet
1: Drive
2: Heatsink of the drive
3: Fan
4: Filter

B: Electronics partition
5: Natural air convection inlet

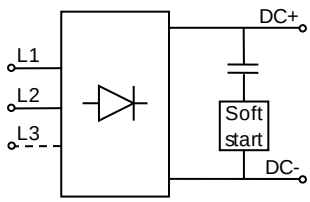
The thermal partition 'A' of the cabinet is cooled by forced air convection. The fresh air passes through a filter that needs to be periodically cleaned according to the pollution issued from the factory process.
The electronic partition 'B' of the cabinet is cooled by natural air convection.

5.3 - SOFT START SYSTEM

5.3.1 - Introduction

Due to the structure of diode rectifier followed by capacitors of the **LBD** drive, it is necessary to limit the inrush current at power up.
The **LBD** drive integrates a soft start system as described below:

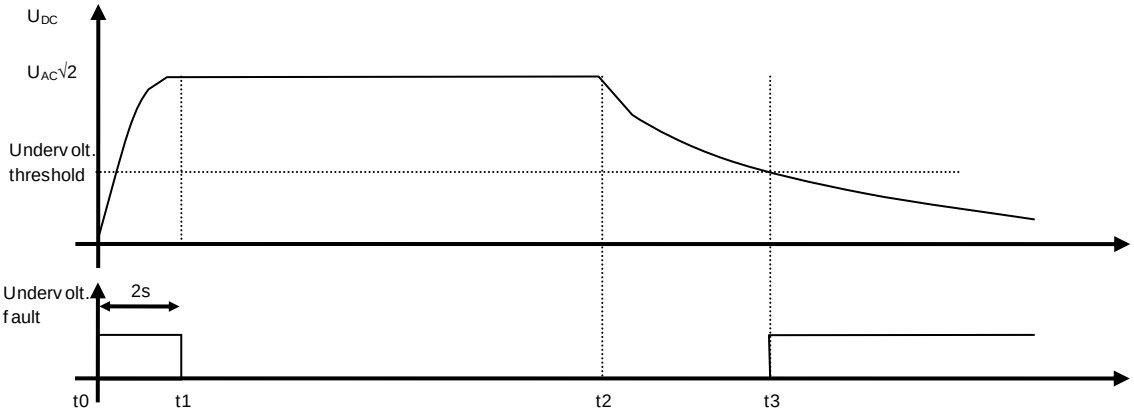
LBD



Note: The soft start system remains operational when the drive is powered by the DC- and DC+ inputs.

5.3.2 - Integration recommendations

In order to maximize the lifetime of internal components of the **LBD** drive and external electromechanical components, it is necessary to switch on only when the soft start system is enabled ("Undervoltage" fault displayed).



Details:

- At t0, the power supply of the drive is switched on. DC bus capacitors are charged via the soft start system.
- After a delay of 2 s at t1, the soft start system is disabled, and the "Undervoltage" fault goes off. The drive is ready to switch on.
- Between t1 and t2, normal operations are performed by the drive.
- At t2, the drive power supply is switched off. The drive remains operational while the DC bus voltage is higher than the undervoltage threshold.
- The delay between t2 and t3 is much depending on the application (drive on/off, positive/negative motor power).
- At t3, the DC bus voltage becomes lower than the undervoltage threshold. The "Undervoltage" fault is displayed, the drive is disabled and the soft start system is enabled.

5.4 - SIZING OF THE BRAKING SYSTEM

5.4.1 - Introduction

The braking I^2t function defines the maximum allowable duty cycle of the braking transistor.
When working with the internal braking resistor, the maximum continuous power must be limited at 35W.
It can be performed by selecting "Internal braking resistor" in the "Power supply parameters" windows of the *Gem Drive Studio* software.

5.4.2 - Method for the design of the braking system

Two different quantities are necessary to completely define an application:

- The peak power:
  - It defines the deceleration energy,
  - It is limited by the braking transistor current.
- The average power:
  - It defines the heat dissipation

1. Estimation of the regenerative power

The regenerative power must be calculated for each deceleration phase of each motor.

$$P_{LOAD} = \frac{J_{TOTAL}.(n_1^2 - n_2^2)}{180.t_{DEC}} - \frac{T_{LOAD}.(n_1 + n_2)}{19}$$

$$P_{MOTOR} = P_{LOAD}.\eta_{COUPLING}$$

$$P_{JOULE} = \frac{3}{2} R_{MOTOR}.I_{MOTOR}^2$$

$$P_{ELEC} = P_{MOTOR} - P_{JOULE}$$

with:
- P_{LOAD}: Power regenerated by the load during the deceleration phase in W
- J_{TOTAL}: Motor + load inertia of the axis reflected to the motor shaft in kg.m²
- n_1: Rotation speed at the beginning of the deceleration phase in rpm
- n_2: Rotation speed at the end of the deceleration phase in rpm
- t_{DEC}: Deceleration time in s
- T_{LOAD}: Torque applied by the load on the motor shaft at the beginning of the deceleration phase in Nm
- P_{MOTOR}: Power regenerated on the motor shaft in W
- $\eta_{COUPLING}$: Efficiency of the mechanical coupling (gearbox). If no gearbox is used, $\eta_{COUPLING} \approx 1$
- P_{JOULE}: Losses in the motor windings in W
- R_{MOTOR}: Winding resistance measured between two phases of the motor in Ω
- I_{MOTOR}: Average current in one phase of the motor during the deceleration phase in A
- P_{ELEC}: Average power managed by the drive during the deceleration phase in W.

2. Choice of the ohmic value

$$R_{MIN} \leq R_{BRAKING} < \frac{U_{BRAKING}^2}{2.\hat{P}_{ELEC}}$$

with:
- R_{MIN}: Minimum braking resistor value in Ohm according to section "Main technical data".
- $U_{BRAKING}$: Triggering threshold of the braking system in V.
- $R_{BRAKING}$: Braking resistor in Ω.
- $\hat{P}_{ELEC}$: Maximum of all P_{ELEC} calculated for all motors and for all deceleration phases in W.

3. Average power

The required average power must be calculated to correctly choose the size of the braking resistor and to take into account the heat dissipation effect in the near environment.

$$P_{AVERAGE} = \frac{\sum_{1,1}^{N,P} P_{ELEC}(n,p) \times T_{DEC}(n,p)}{T_{CYCLE}}$$

With:
- P_{ELEC}: Power managed by the drive axis n during the deceleration phase p in W

4. Braking I²t setup

$$P_{I^2t} = \frac{t_{ON}}{1000}.\frac{U_{BRAKING}^2}{R_{BRAKING}}$$

with:
- P_{I^2t}: Maximum average power allowed by the braking I²t function in W
- t_{ON}: Conduction time allowed by the braking I²t function in ms
- $U_{BRAKING}$: Triggering threshold of the braking system in V
- $R_{BRAKING}$: Braking resistor in Ω

5. Connection of the braking resistor

The braking resistor MUST be mounted out of range of heat sensitive and inflammable parts (plastic, cable sleeves, etc.).

In order to avoid any EMC or electrical problem, some rules must be observed:

- heat must be evacuated,
- shielded cable or at least twisted wires must be used,
- wires must bear high voltage and high temperature (recommended type: UL1015, AWG 14),
- wires must be as short as possible (max. 1m).

5.5 - LOW OPERATING VOLTAGE

LBD drives offer the possibility to change the operating voltage.
Thanks to this feature, **LBD** drives are able to work within a wide voltage range of from 24Vdc / 17Vac up to $800V_{DC}$ / $480V_{AC}$.

Please note that a specific operating voltage modifies the drive specifications according to the table below:

		Operating voltage				
		17 V_{AC} 24 V_{DC}	**34 V_{AC} 48 V_{DC}**	**48 V_{AC} 68 V_{DC}**	**230 V_{AC} 325 V_{DC}**	**400 V_{AC} 565 V_{DC}**
Minimum inductance	4kHz	0.15mH	0.30mH	0.48mH	2mH	4mH
	8kHz	0.08mH	0.15mH	0.24mH	1mH	2mH
	16kHz	0.04mH	0.08mH	0.12mH	0.5mH	1mH
Minimum braking resistor		$standard\ minimum\ braking\ resistor \times \frac{actual\ operating\ voltage}{standard\ operating\ voltage}$				
Undervoltage threshold		17V_{DC}	20V_{DC}	30V_{DC}	100V_{DC}	210V_{DC}
Braking threshold		30V_{DC}	60V_{DC}	85V_{DC}	390V_{DC}	790V_{DC}
Overvoltage threshold		35V_{DC}	70V_{DC}	100V_{DC}	430V_{DC}	910V_{DC}

IMPORTANT

The use of **LBD** drives at very low operating voltage suffers from several limitations:

- Voltages below +15V_{DC} cannot be accurately measured on the DC link.
- The capacitors bank is optimized for operation at rated voltage. The energy stored in capacitors is proportional to the square of the voltage. At very low voltage, the storage ability of the regenerative energy is limited. Extra storage (capacitors, battery, …) can be necessary to assume proper operation during high dynamic deceleration phases.
- The detection of a braking transistor error is not active:
  - Below 40V_{DC} for a LBD 230V
  - Below 80V_{DC} for a LBD 400V.

5.6 - MAINTENANCE

5.6.1 - Periodical checking

Maintenance procedures should be attempted only by highly skilled technicians having good knowledge of electronics and servo systems with variable speed (EN 60204-1 standard) and using proper test equipment.

Risk of electric shock
Any contact with electrical parts, even after power down, may involve physical damage. Wait for at least 10 minutes after power down before handling the drives (a residual voltage of several hundreds of volts may remain during a few minutes).

Hot surfaces
- Ensure that any contact with hot surfaces is avoided.
- Do not allow flammable or heat-sensitive parts in the immediate vicinity of hot surfaces
- Verify that the product has sufficiently cooled down before handling it.

Damage	Action	Periodicity
Shock on the housing	- Check the drive housing	Every year
Cooling	- Check the fan operation - Check the room temperature of the drive	Every year
Dust	Check connectors, fan, and cabinet cooling system	Every year
Corrosion	Check housing and electrical connection	Every year
Mechanical mounting	- Check the correct drive fastening - Check the tightening of the electrical connection	Every year

5.6.2 - Procedure after a long time storage

After a long-time storage, the leakage current of electrolytic capacitors increases dramatically.
In order to avoid any risk of damage or explosion, DC bus capacitors must be reformatted.
When the drive has been stored for 2 years or more, proceed as described below:

1. With a variable AC power supply, apply 25% of the rated voltage on the mains input during 30min,
2. With a variable AC power supply, apply 50% of the rated voltage on the mains input during 30min,
3. With a variable AC power supply, apply 75% of the rated voltage on the mains input during 30min,
4. With a variable AC power supply, apply 100% of the rated voltage on the mains input during 30min.

In order to avoid this procedure, the drive can also be powered at rated voltage every year during 1 hour.

5.6.3 - Warranty

Opening the housing will cancel the warranty.

5.7 - OPERATING ENVIRONMENT CONDITIONS

A - CLIMATIC CONDITIONS

1	-	Cooling fluid temperature	Air : 0°C to +40° C
2	-	Air temperature	+5°C to +40°C
3	-	Relative moisture	5% to 85% **without condensation**
4	-	Dust and particles	Clean air (pollution degree 2) Drive must be protected against conducting dust
5	-	Storage periods	< 1 year: no restrictions > 1 year: re-format the power capacitors according to section 5.6.1.

B - MECHANICAL INSTALLATION CONDITIONS

The drive must be mounted on a stiff surface, in rooms or additional housings without hindering the heatsink and the fan. The reliability may be increased by installing a cooling system (take care of condensation).
Other installation conditions must be specially analysed and subjected to a technical specification in agreement with CMZ Sistemi Elettronici S.r.l..

Mechanical mounting

Vertical, on the cabinet rear wall.

Vibrations

Vibrations must remain within the limit values of the IEC 60721-3-3, class 3M1 standard for fixed equipment.

Frequency (Hz)	Amplitude (mm)	Acceleration (m/s^2)
$2 \leq f < 9$	0,3	not applicable
$9 \leq f < 200$	not applicable	1

Vibrations which exceed these limits or the use on mobile equipment are considered as unusual operating conditions.

C - UNUSUAL OPERATING ENVIRONMENT CONDITIONS

The use of the power converter, of its pertaining control system and of the servo in conditions which are diverging from the usual ones defined by the IEC 60146-1-1 standard must be considered as abnormal. These abnormal operating conditions must be specified by the purchaser.

Abnormal operating conditions as those listed below may require a special construction or special protections. The conditions below must be notified if they are known or specified:

1. Exposure to corrosive gas.
2. Exposure to excessive moisture (relative moisture exceeding 85%).
3. Exposure to excessive dust.
4. Exposure to abrasive dust.
5. Exposure to water steam or condensation.
6. Exposure to oil steam.
7. Exposure to explosive dust or gas mixtures.
8. Exposure to salt air.
9. Exposure to abnormal vibrations, shocks, jerking.
10. Exposure to inclemency or water dripping.
11. Exposure to unusual storing or freight conditions.
12. Exposure to sudden or rough temperature variations.

13. Abnormal exiguity of the available room.
14. Abnormal high nuclear radiations.
15. Altitude higher than 1000m.
16. Long storage periods.
17. Outdoor equipment.

D - INSTALLATION, COMMISSIONING AND OPERATION

Normal and abnormal operating conditions apply the same way to installation, commissioning and use.

E - EQUIPMENT STORAGE

At receipt, the equipment must be immediately stored under adequate shelter. The transport packaging is not suited to outdoor or non-protected storing.

Climatic conditions

Equipments must be stored in the environment conditions specified by the IEC 60721-3-1 standard. This includes:

1 -	Room temperature: class 1K4	-25°C to +55°C
2 -	Relative moisture: class 1K3	5% to 95%

Modules and panels must be protected against condensation. Rough temperature and moisture variations should be avoided, as far as possible. If the temperature of the storing room is varying such as to subject the equipment to condensation or to frost, the equipment must then be protected by a reliable heating system which will keep it at a temperature slightly higher than the surrounding air temperature.
If the equipment has been subjected to a low temperature during a long time, it should not be unpacked before having reached the surrounding air temperature, in order to avoid condensation. Such moisture in some parts of the equipment may involve a faulty electric insulation.

F - PARTICULAR STORING RISKS

The following risks must be carefully considered:

1. Water: The equipment must be protected against rain, snow, rime, etc…
2. Altitude: The equipment should not be stored at an altitude higher than 3000m.
3. Corrosive agents: The equipment must be protected against salty sea spray, emanations of dangerous gasses or corrosive liquids, etc…
4. Duration: the specifications of the above mentioned items are only valid for a total transport and storing period of up to six months. Longer periods may require a special treatment (smaller surrounding air temperature range such as in class 1K3).
5. Rodents and mould: The storing conditions must avoid exposure to rodents and mould.

G - TRANSPORT

1 - Climatic conditions

The equipment can be transported in its standard packaging in the environment conditions specified by class 2K3 of the IEC 60721-3-2. This includes:

a - Surrounding air temperature: -25°C to +70°C
NOTE: The surrounding air temperature is the temperature which is the nearest to the equipment, i.e. the inside of the container.

b - Relative moisture: 95% at +40°C
NOTE: Some temperature and moisture combinations may cause condensation.

2 - Unusual climatic conditions

The possible transport of the equipment at temperatures lower than -25°C requires either a re-heating or the removal of components sensitive to low temperature.

3 - Mechanical conditions

The equipment may be transported in its standard packaging in the conditions specified by class 2M1 of the IEC 60721-3-2 standard.
This includes vibrations and shocks (see tables below).

***TABLE 4* – Vibration limits during the transport**

Frequencies (Hz)	Amplitude (mm)	Acceleration (m/s^2)
$2 \leq f < 9$	3.5	-
$9 \leq f < 200$	-	10
$200 \leq f < 500$	-	15

***TABLE 5* – Shock limits during the transport**

Mass (kg)	Free fall height (m)
$M < 20$	0.25
$20 \leq M < 100$	0.25
$100 \leq M$	0.10

NOTE: If the equipment may be subjected to shocks or vibrations beyond these limits, it will require special packaging or transport conditions.

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HEADQUARTERS

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