INFRANOR®

DIGITAL SERVO DRIVES FOR BRUSHLESS AC MOTORS

XtrapulsPac™

Installation Guide

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:

- **XtrapulsPac™ STO** for the Safe Torque Off function
- **XtrapulsPac™ SF01 Safety version** operating manual
- **XtrapulsPac™ User Guide** for the operation of the drive (commissioning, configuration, ...)
- **XtrapulsPac™ Templates** for the templates of target applications.
- *Gem Drive Studio* **software Quick Start** manual for the drive parameterization.
- **EtherCAT® fieldbus interface** manual for the **XtrapulsPac™-et** version.
- **GDPS** 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)

INFRANOR® 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 INFRANOR® devices shall be eliminated by selective disposal and not with household waste.

INFRANOR 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.

INFRANOR reserves the right to change any information contained in this manual without notice.

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Chapter 1 – General

1.1 - INTRODUCTION

XtrapulsPac™ 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 **XtrapulsPac™** 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) SIL 2**.

The drive versions XtrapulsPac™-ed and XtrapulsPac™-kd equipped with the optional safety board (SF01 option) allow safe motion control monitoring: SS1, SS2, SOS, SLS, SDI, SBC according to IEC61800-5-2 and IEC61508 standards.

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

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

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

The **XtrapulsPac™** 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 **XtrapulsPac™** 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 **XtrapulsPac™** 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 **XtrapulsPac™** 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 **XtrapulsPac™** 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 **XtrapulsPac™** drives have their own DC/DC converter to provide the voltages required for the drive operation with a 24 V_{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 24 V_{DC} battery supply with specific wiring allows keeping the position even after switching off the auxiliary 24 V_{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 **XtrapulsPac™** 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 XtrapulsPac™ drive

1.2.3 - Reference to the standards:

XtrapulsPac™ series have been "cULus" listed according to UL508C and UL840 regarding the insulation.

XtrapulsPac™ series 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).

1.3 - OTHER DOCUMENTS

- **XtrapulsPac™** User guide
- **XtrapulsPac™** "Safe Torque Off" specification
- **XtrapulsPac™ SF01 Safety version**
- **XtrapulsPac™** Templates
- **Gem Drive Studio software** Quick Start manual
- **EtherCAT® fieldbus interface**
- **GDPS Power Supply Unit** manual

1.4 - ORDERING CODES

1.4.1 - Drives

1.4.1.1 - Ordering code of the drives

XtrapulsPac™- xx - U / I - mm - sf - PPACXX

Drive version
ak: Analog interfaces and CANopen® fieldbus
et: EtherCAT® fieldbus
ed: EtherCAT® fieldbus + digital encoder interface
kd: CANopen® fieldbus + digital encoder interface

Voltage range
230: Voltage range 230 V
400: Voltage range 400 V

Current ratings for 230 V drives
05 = 5 Arms
11 = 11 Arms
17 = 17 Arms
Current rating for 400 V drives
08 = 08 Arms
20 = 20 Arms
45 = 45 Arms
100 = 100 Arms
200 = 200 Arms

OPTIONS

Mounting version *(400 V range only, except for 200 A)*
PT: Push-through version
CP: Cold plate version

Safety option (Pac_ed and Pac-kd versions only)
SF01: safe motion control monitoring

Customization
PPACXX: XX = customization code

1.4.1.2 - Selection of the drive version

Feedback sensor	Input command			
	Analog drive	Stepper emulation	CANopen®	EtherCAT®
Transmitter resolver	**Pac-ak**	**Pac-ak**	**Pac-ak**	**Pac-et**
SinCos tracks resolver				
TTL encoder + HES	**Pac-ak**	**Pac-ak**	**Pac-ak** **Pac-kd**	**Pac-et** **Pac-ed**
SinCos encoder + HES				
Absolute single-turn SinCos encoder				
Hiperface® with SinCos channels				
ENDAT® 2.2 (without SinCos channels)	**-**	**-**	**Pac-kd**	**Pac-ed**
Hiperface DSL® (one single motor cable)				

1.4.2 - Connector sets

1.4.2.1 - Ordering code of the connector sets

If the connector kit is separately ordered from the drive, please use the following reference:

FXX - Pac - rrr

Connector set type	
FL:	With **command** connector set
FC:	With **power + motor** connector set
FCL:	With **power + motor + command** connector set

Rating suffix (not required for FL set)	
230	Connector kit for 230 V drives
402	Connector kit for 400 V / 08 A and 20 A drives
404	Connector kit for 400 V / 45 A and 100 A drives
420	Connector kit for 400 V / 200 A drives

1.4.2.2 - Connector set description

FC-Pac

X8: 5 pin plug connector for the auxiliary 24 V_{DC} supply and for the motor brake.
X9: power plug connector for mains and motor.
X10: mains power plug connector for Pac 400 V / 08 to 20 A

FL-Pac

X1: male 15 pin Sub D connector for the resolver, with the appropriate conducting cover.
X2: female 26 pin Sub D HD connector for the logic I/Os, with the appropriate conducting cover.
X3: male 26 pin Sub D HD connector for the encoder, with the appropriate conducting cover.
X5: female 9 pin Sub D connector for the RS232 / CAN link, with the appropriate conducting cover.

FCL-Pac

X1: male 15 pin Sub D connector for the resolver, with the appropriate conducting cover.
X2: female 26 pin Sub D HD connector for the logic I/Os, with the appropriate conducting cover.
X3: male 26 pin Sub D HD connector for the encoder, with the appropriate conducting cover.
X5: female 9 pin Sub D connector for the RS232 / CAN link, with the appropriate conducting cover.
X8: 5 pin plug connector for the auxiliary 24 V_{DC} supply and for the motor brake.
X9: power plug connector for mains and motor.
X10: mains power plug connector for XtrapulsPac™ 400 V / 08 A to 20 A

Chapter 2 – Specifications

2.1 - MAIN TECHNICAL DATA

2.1.1 - XtrapulsPac™-230/I

Design	Stand-alone
Available cooling version	Forced air (standard)
Operating power supply voltage (1)	110 to 230 V_{AC} +/- 10 % single-phase 50 - 60 Hz Grounded neutral system with balanced phase to ground voltage
Undervoltage threshold (1)	100 V_{DC}
Braking threshold (1)	390 V_{DC}
Overvoltage threshold (1)	430 V_{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	100 R / 35 W
External braking resistor (1)	Minimum external resistor: 50 Ω Infranor ordering code: dp 50/200
Minimum phase-to-phase inductance (1)	1 mH
Galvanic isolated auxiliary supply voltage	24 V_{DC} +/- 15 % - 400 mA (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 3 s (Arms) (1) +/-5 % (230 V_{AC})	Rated output current (Arms) (230 Vac)	Power losses at rated current (W)	Rated input current (Arms) (230 Vac, 60 Hz)	Certified max. protection line circuit fuses A60Q	Mains short-circuit power	UL listed
Pac-230/5	5	2.5	20	4.3	10 A	5 kA	yes
Pac-230/11	11	5.5	40	9.5	15 A	5 kA	yes
Pac-230/17	17	8.5	65	14.7	20 A	5 kA	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:

- 650 W for ratings 230/05 and 230/11,
- 1000 W for rating 230/17.

Note:
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 - XtrapulsPac™-400/08 and 20 A

Design		Stand-alone
Available cooling version		- Forced air (standard) - Push-through - Cold Plate
Operating power supply voltage according to the drive parameters		230 to 480 V_{AC} +/- 10 % three-phase 50 - 60 Hz Grounded neutral system with balanced phase to ground voltage.
Undervoltage threshold (1)		210 V_{DC}
Braking threshold (1)		790 V_{DC}
Overvoltage threshold (1)		910 V_{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		400 R / 35 W
External braking resistor	**XtrapulsPac™ 400/08**	Minimum external resistor: 100 Ω (1) Infranor ordering code: dp 100/100
	XtrapulsPac™ 400/20	Minimum external resistor: 50 Ω (1) Infranor ordering code: dp 50/200
Minimum phase-to-phase inductance (1)		2 mH
Galvanic isolated auxiliary supply voltage		24 V_{DC} +/- 15 % - 400 mA (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 3 s (Arms) (1) +/-5 % (480 V_{AC})	Rated output current (Arms) (460 V_{AC})	Power losses at rated current (W)	Rated input current (Arms) (480 V_{AC}, 60 Hz)	Certified max. protection line circuit fuses A60Q	Mains short-circuit power	UL listed
Pac-400/08	8	4	65	3.8	5 A	5 kA	yes
Pac-400/20	20	10	155	9.4	10 A	5 kA	yes

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

Maximum surrounding air temperature: 40°C.

2.1.3 - XtrapulsPac™-400/45 A, 100 A and 200 A

Design	Multi-axis
Available cooling versions	- Forced air (standard) - Push-through (except for 200 A current rating) - Cold Plate (except for 200 A current rating)
Operating power supply voltage according to the drive parameters	100 to 800 V_{DC}
Undervoltage threshold (1)	210 V_{DC}
Overvoltage threshold (1)	910 V_{DC}
EMC filter on the mains power supply	External
Motor phase-to-phase output voltage	95 % × $U_{DC}/\sqrt{2}$ Vrms
Minimum phase-to-phase inductance (1)	2 mH
Galvanic isolated auxiliary supply voltage	24 V_{DC} +/- 15 % - 500 mA (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 % (480 V_{AC})	Rated output current (Arms) (460 V_{AC})	Power losses at rated current (W)	Rated input current (Arms) (680 V_{DC})	UL listed
Pac-400/45	45 during 3 s (1)	22.5	345	26.3	yes
Pac-400/100	100 during 1 s (1)	35	535	41	yes
Pac-400/200	200 during 1 s (1)	75	1147	87.9	Complying with the UL standard

(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 (**Pac-ak and Pac-et 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 (**Pac-ed and Pac-kd versions only**) EnDat 2.2® encoder (**Pac-ed and Pac-kd versions only**)
Power protections	See section 3.1.1 - LEDs
Switching frequency	8 kHz
Analog input 1	±10 V (resolution: 12 bit)
Analog input 2	0 to +10 V (resolution: 12 bit)
Speed and position regulators	Sampling period = 0.5 ms Anti-wind-up system of the integrator Anti-resonance filter Adjustable digital gains
Speed loop bandwidth	Selectable cut-off frequency for 45° phase shift: 50 Hz (low), 75 Hz (medium) or 100 Hz (high)
Current loop bandwidth	Cut-off frequency for 45° phase shift: 500 Hz (low) or 1000 Hz (high)
Max. motor speed	Adjustable from 100 to 25'000 rpm
Drive reaction time (initialization delay before PWM on)	**XtrapulsPac™** 230 V: 6.25 ms **XtrapulsPac™** 400 V: 20 ms
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: 20 mA per output Programmable resolution: 64 ppr to 16384 ppr (according to max. motor speed). Max. pulses frequency: 437 kHz 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: 8 kHz Max. output current = 30 mA Transformation ratio: 0.3 to 0.5 (other values are factory set) SinCos tracks: 1 Vcc to 4 Vcc 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: 1 MHz Resolution: 500 to 10^6 ppr Incremental Sin/Cos encoder Heidenhain 1 Vcc Sin/Cos type or compliant Maximum signal frequency: 200 kHz Resolution: 500 to 10^6 ppr Interpolation factor: 256 Absolute single-turn Sin/Cos encoder Heidenhain ERN 1085 or compliant Maximum signal frequency: 200 kHz Resolution: 512 to 2048 ppr Interpolation factor: 256 Hiperface® standard with SinCos channels Maximum signal frequency: 200 kHz 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 24 V logic (max. pulse frequency = 10 kHz) - Non optocoupled 5 V to 24 V (max. pulse frequency = 50 kHz) - RS422 differential receiver (max. pulse frequency = 1 MHz) Resolution (steps per motor revolution): programmable.
Hall sensors input	5 V to 24 V positive logic voltage accepted External HES supply voltage required if different from 5 V 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 = 50 V, Imax = 300 mA
Motor brake output	**XtrapulsPac™** 230 V: not available / Use of the digital output **XtrapulsPac™** 400 V / 08 to 20 A: 24 V_{DC} / 1.5 A **XtrapulsPac™** 400 V / 45 to 200 A: 24 V_{DC} / 2.5 A
3 parameterizable logic outputs	Type PNP "high side" 24 V_{DC}, max. 300 mA
Analog output	2.5 V +/-2.5 V, resolution: 8 bit, load: 10 mA Low-pass filter: 160 Hz, 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	Pac-230/05, 11 and 17: 1.5 kg. Pac-400/08 and 20: 2.2 kg. Pac-400/45: 2.4 kg. Pac-400/100: 3.3 kg Pac-400/200: 8.5 kg

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 0.05 mm 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 400 V_{AC}	R_{TH} (K/W)
4	56	≤ 0.55
10	140	≤ 0.22
22.5	314	≤ 0.10
35	489	≤ 0.06

The file "Infranor thermal utility" is available for free download on the Infranor® website www.infranor.com for more detailed estimations.

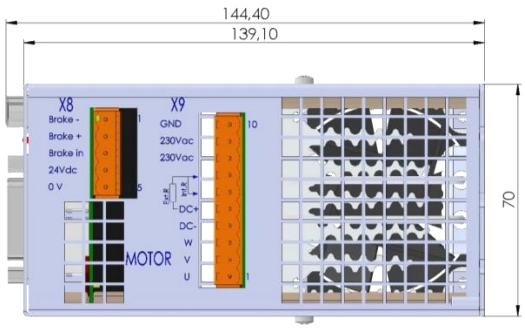
Mounting instructions:
Clean the contact surface of the heatsink with alcohol.
Apply a thermal interface between the drive plate and the heatsink. Recommended thermal interfaces:
A thin layer of thermal paste on the drive (recommended reference: RHODORSIL Paste 340).
Phase change thermal interface (recommended 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

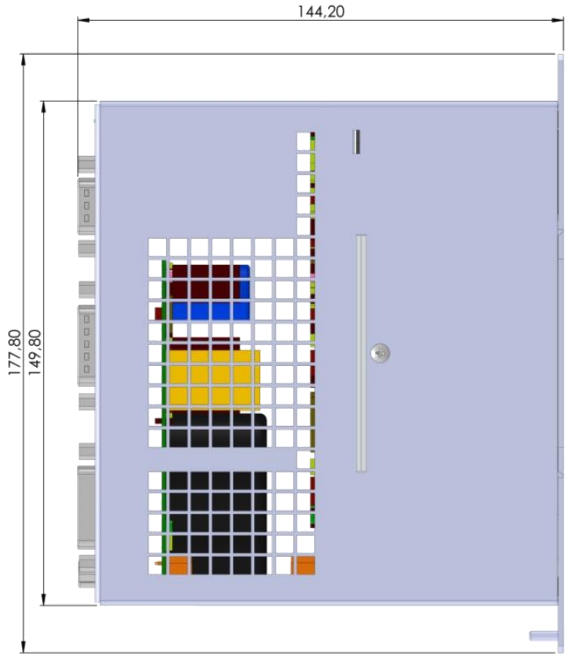
2.2.1 - XtrapulsPac™ 230 V dimensions

Dimensions are given in mm.

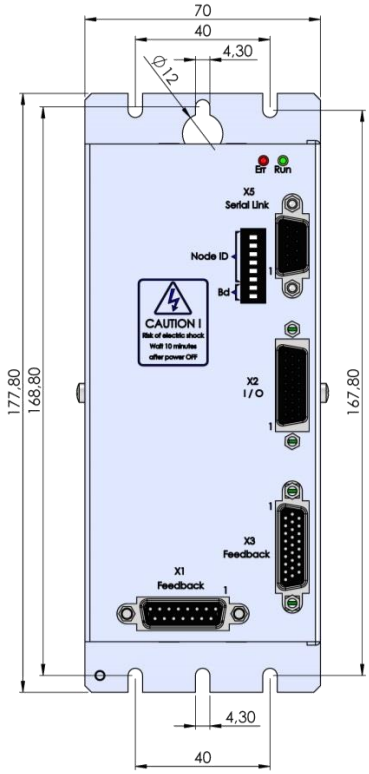
BOTTOM VIEW



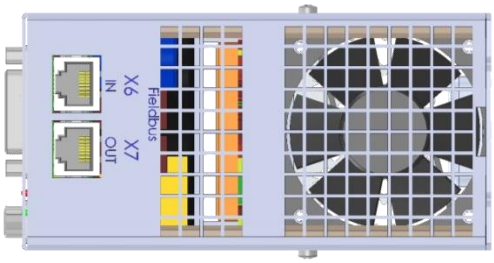
SIDE VIEW



FRONT VIEW



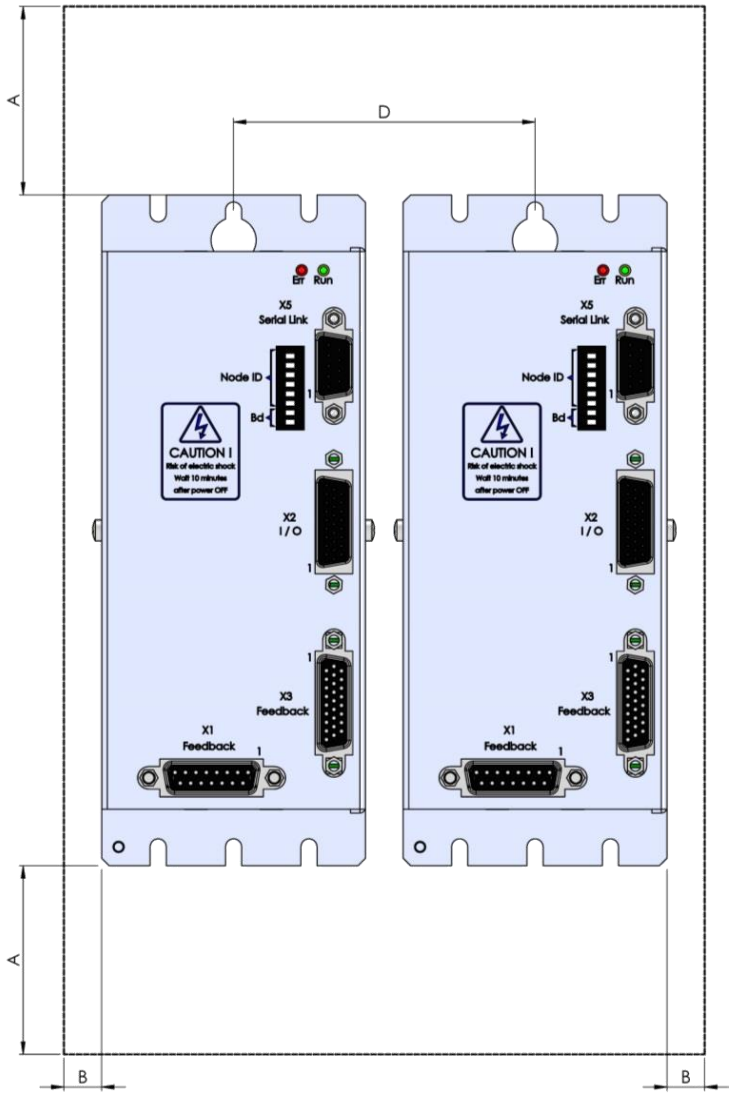
TOP VIEW



2.2.2 - XtrapulsPac™ 230 V: Panel layout dimensions

Dimensions are given in mm

VERTICAL MOUNTING IS MANDATORY



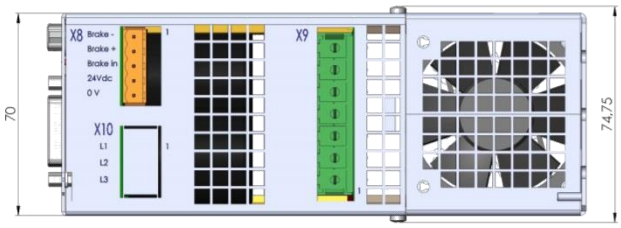
Description	Symbol	XtrapulsPac
Minimum top and bottom clearance	A	50
Minimum side clearance	B	10
Recommended pitch	D	80

2.2.3 - XtrapulsPac™ 400 V / 08 to 45 A dimensions

Dimensions are given in mm.

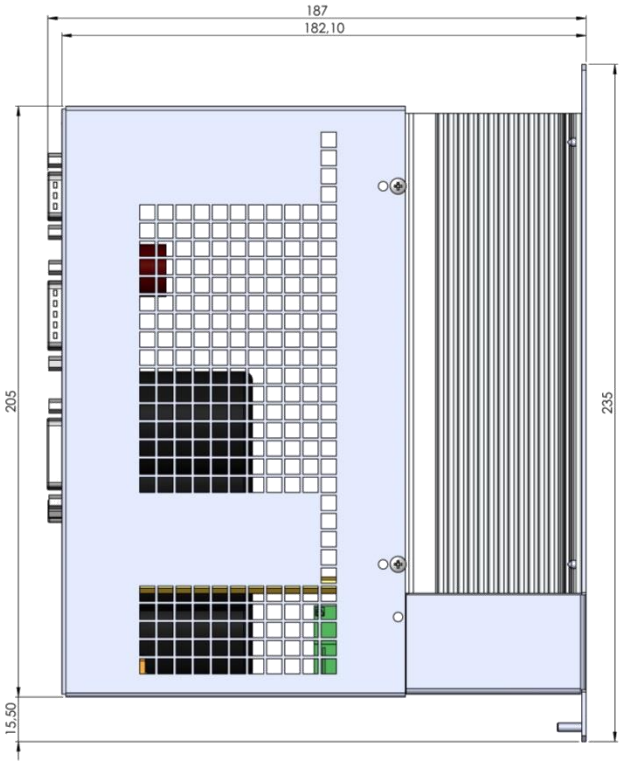
Standard version

BOTTOM VIEW

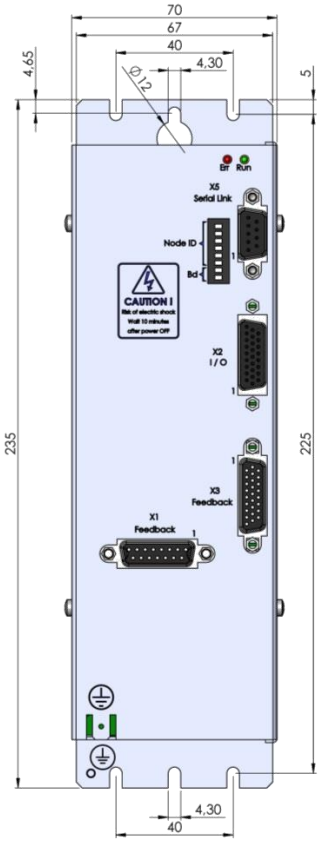


Note:
This bottom view is the one of the 400/45 drive (without X10 connector).
The X10 connector is only available on drives with 8 A and 20 A current ratings.

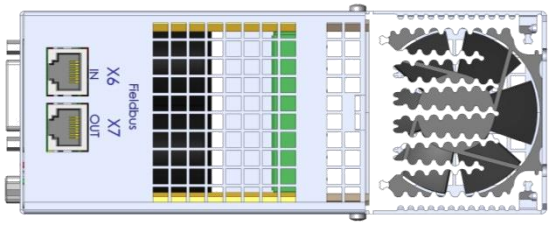
SIDE VIEW



FRONT VIEW

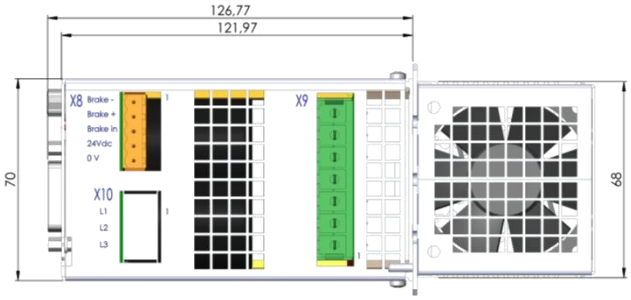


TOP VIEW



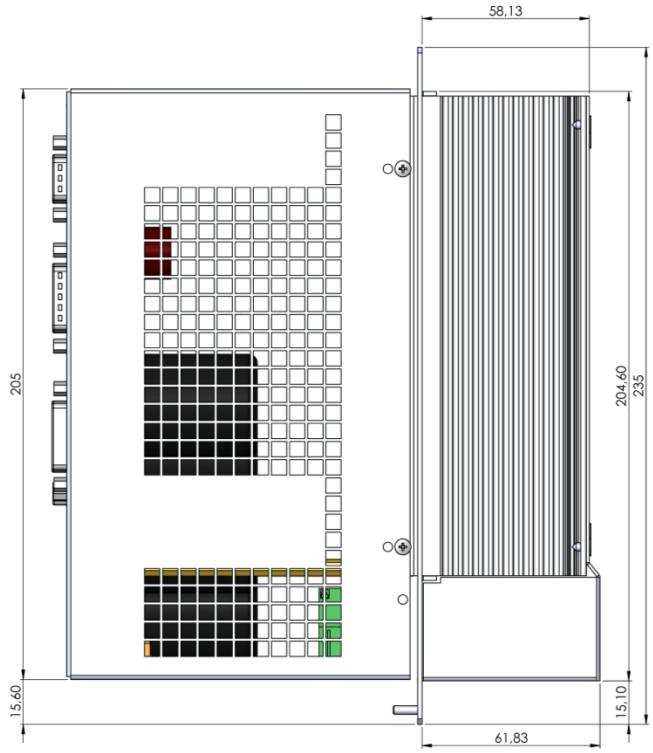
Push-through version

BOTTOM VIEW

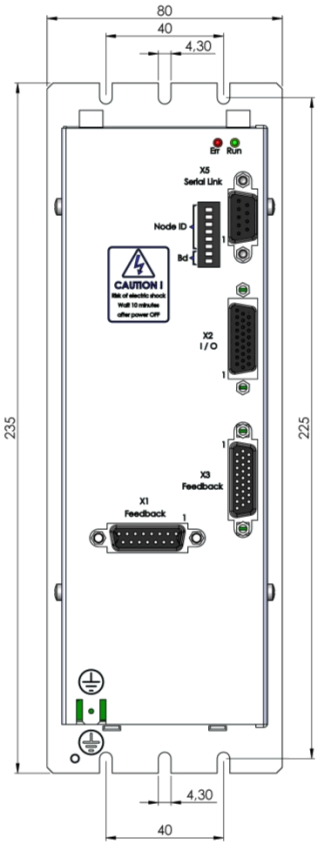


Note:
This bottom view is the one of the 400/45 drive (without X10 connector).
The X10 connector is only available on drives with 8 A and 20 A current ratings.

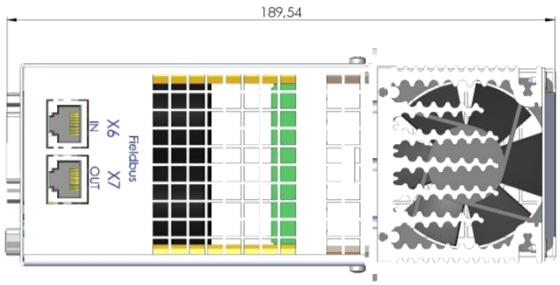
SIDE VIEW



FRONT VIEW



TOP VIEW

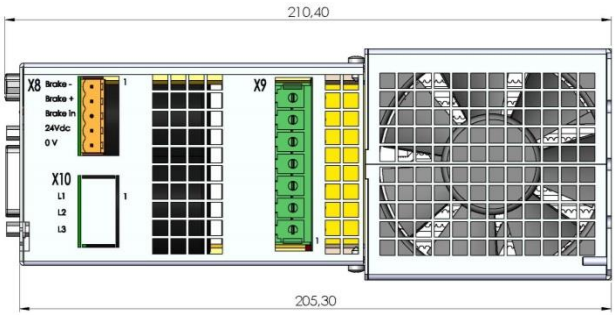


2.2.4 - XtrapulsPac™ 400 V / 100 A dimensions

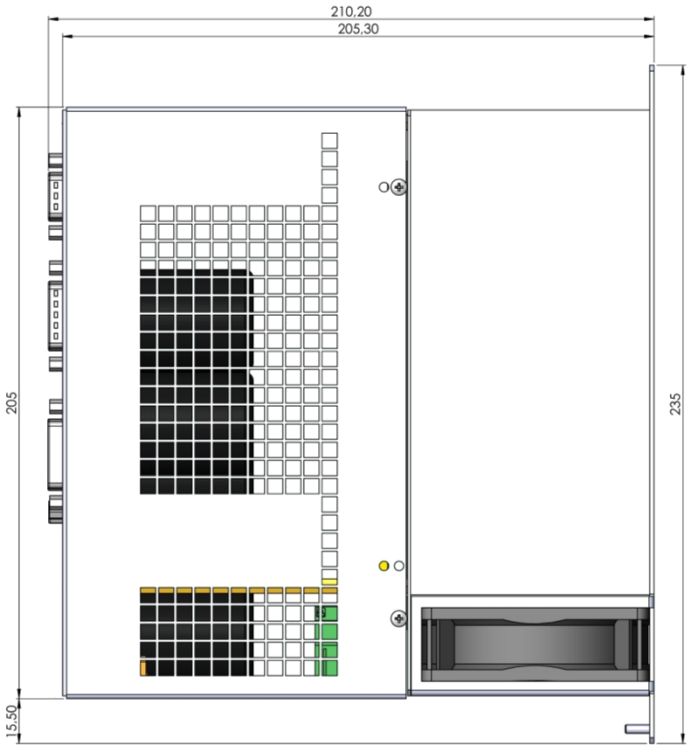
Dimensions are given in mm.

Standard version

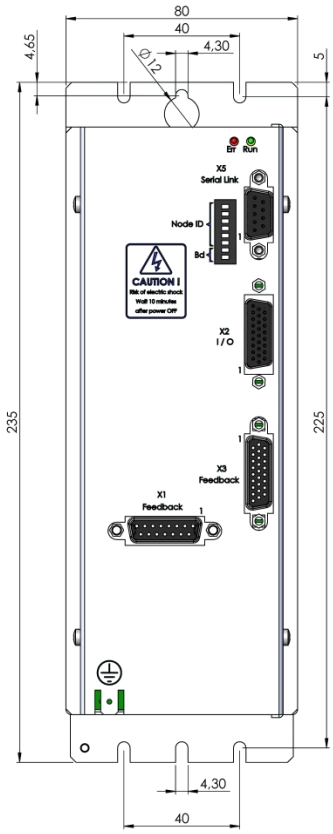
BOTTOM VIEW



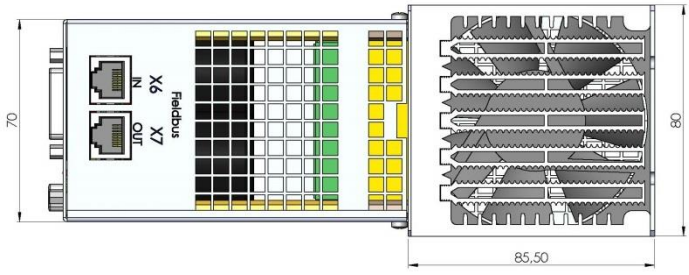
SIDE VIEW



FRONT VIEW

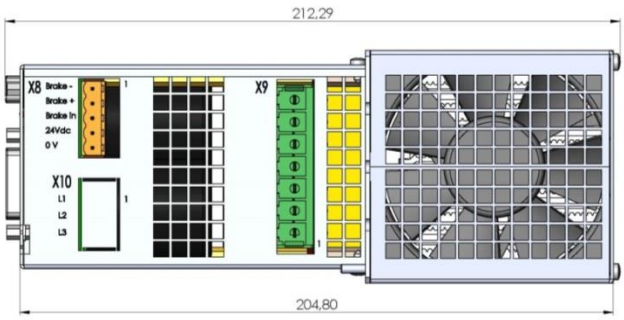


TOP VIEW

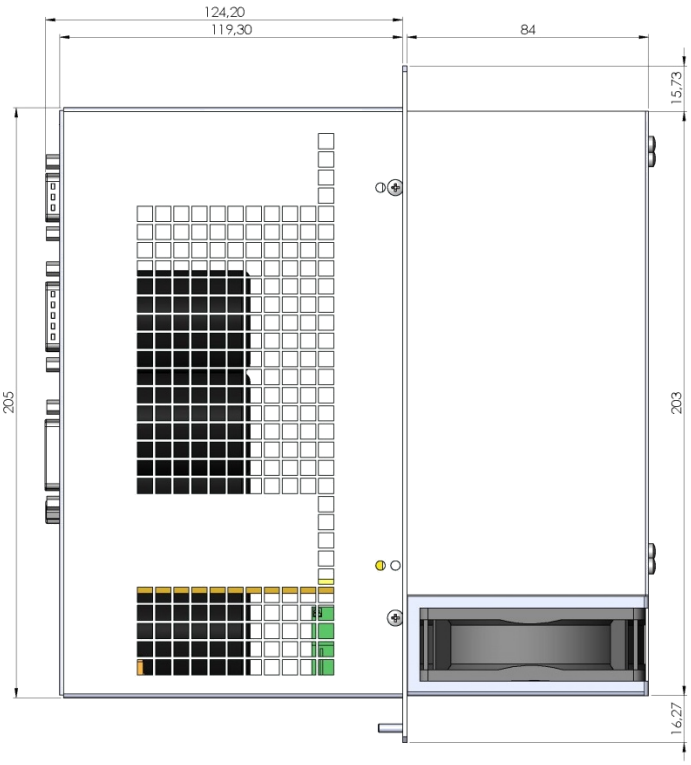


Push-through version

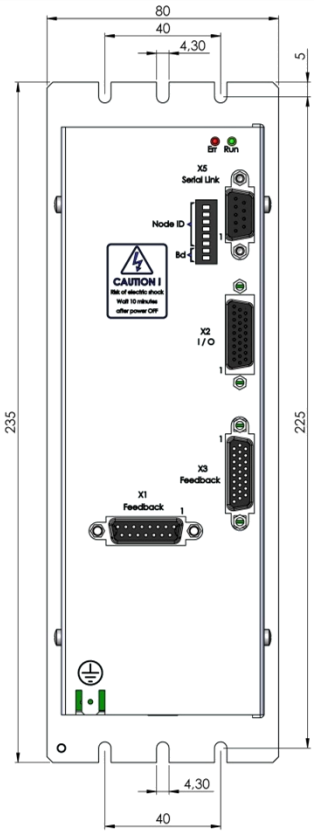
BOTTOM VIEW



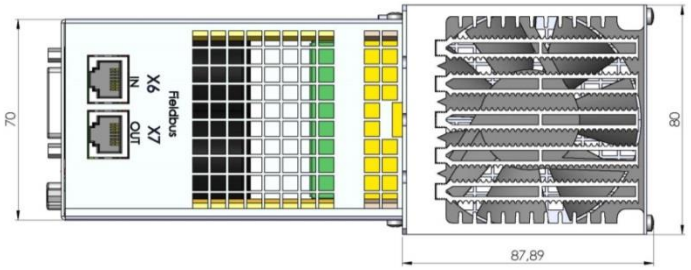
SIDE VIEW



FRONT VIEW

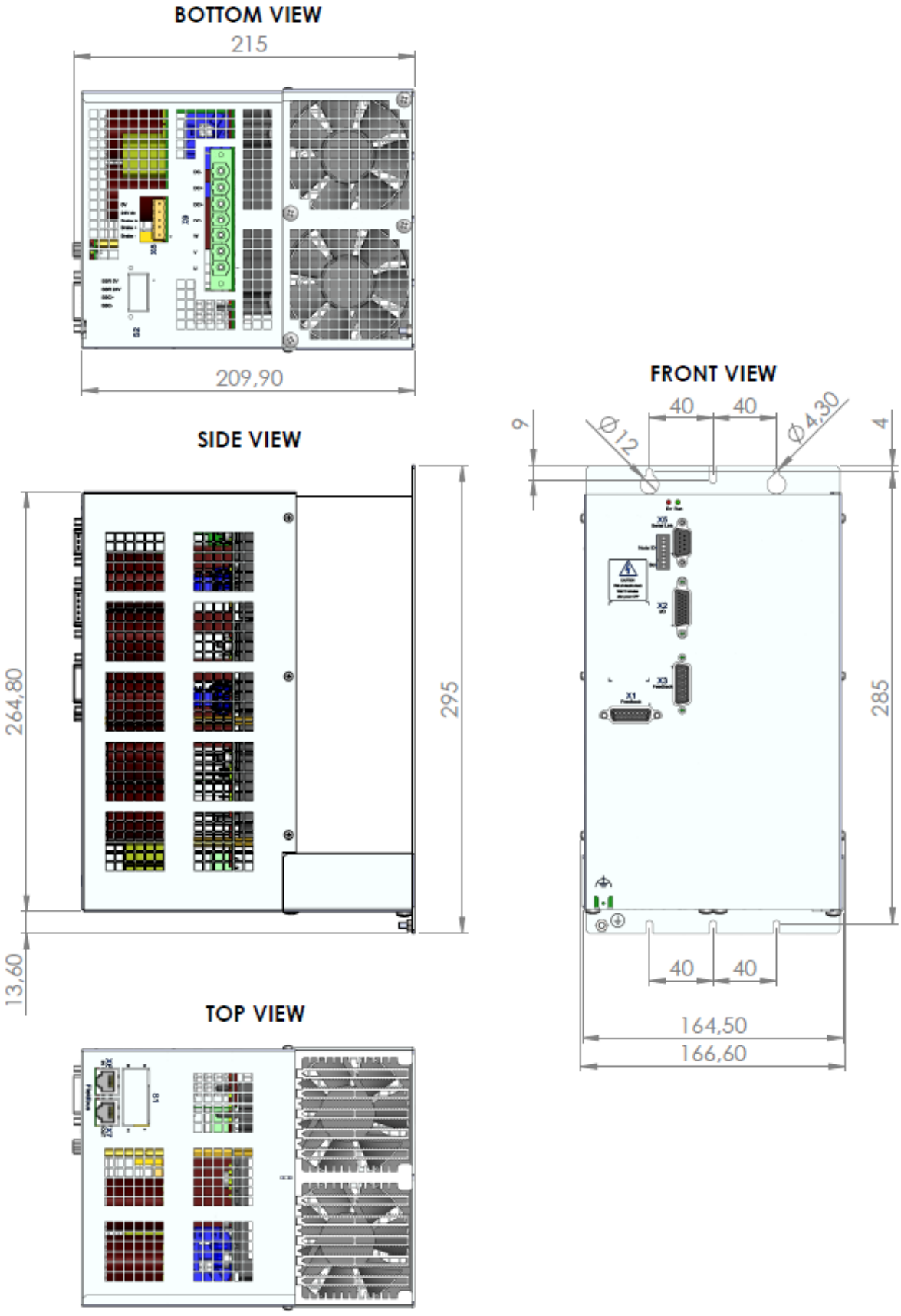


TOP VIEW



2.2.5 - XtrapulsPac™ 400 V / 200 A dimensions

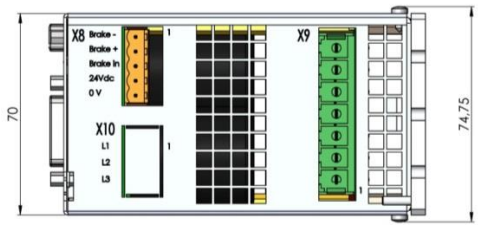
Dimensions are given in mm.



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

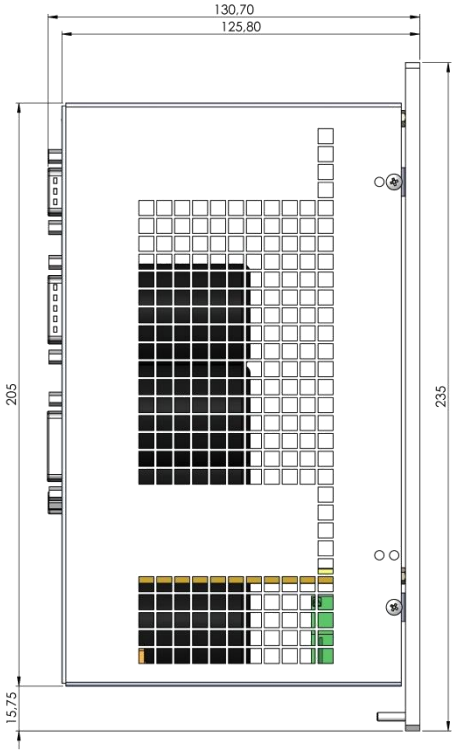
Dimensions are given in mm.

BOTTOM VIEW

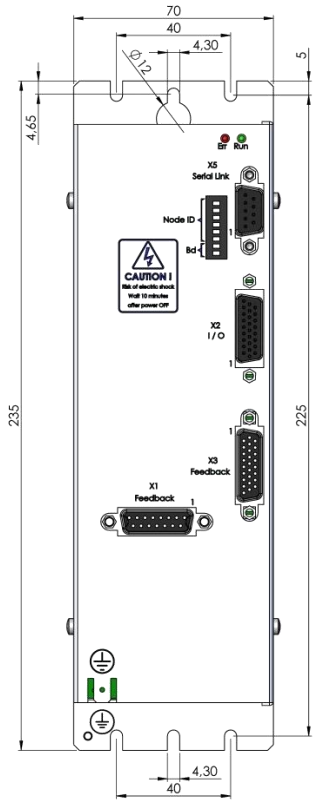


Note:
This bottom view is the one of the 400/45 drive (without X10 connector).
The X10 connector is only available on drives with 8 A and 20 A current ratings.

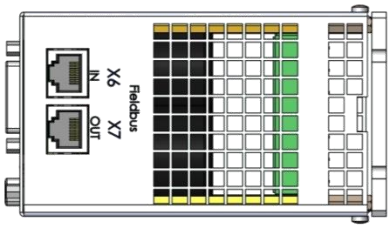
SIDE VIEW



FRONT VIEW



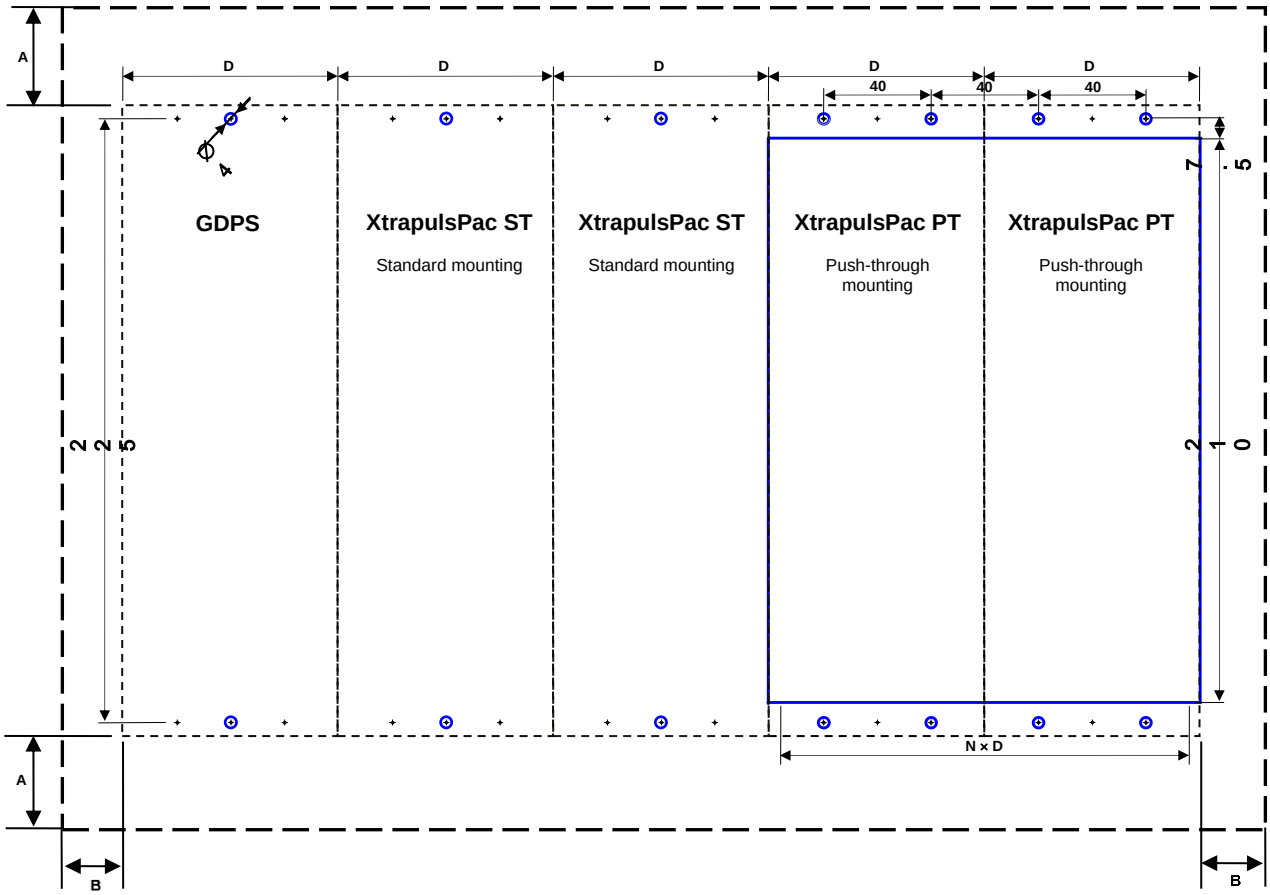
TOP VIEW



2.2.7 - XtrapulsPac™ 400 V: Panel layout dimensions

Dimensions are given in mm.

VERTICAL MOUNTING IS MANDATORY



Description	Symbol	XtrapulsPac
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 **XtrapulsPac™** 400 V / 100 A and 200 A drives side by side (recommended pitch = 100 mm).

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.
- 24 V_{DC} logic supply < 17.5 V_{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:

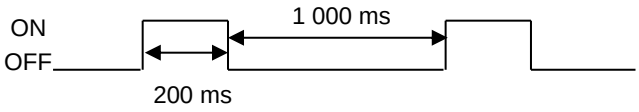
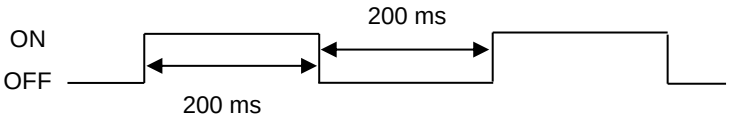
- The continuous lighting of the red **ERROR** LED,
- The drive disabling,
- The motor brake control if one of the logic outputs is configured as brake output,
- The opening of the **AOK** relay contact. This relay must be wired as described in the connection diagrams of section 4.1, in order to switch-off 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 - XtrapulsPac™-ak and XtrapulsPac™-kd 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 - XtrapulsPac™-et and XtrapulsPac™-ed versions: EtherCAT® communication bus

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

3.2 - DRIVE ADDRESSING: SELECTION OF THE TRANSMISSION SPEED

3.2.1 - XtrapulsPac™-ak and XtrapulsPac™-kd 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 - XtrapulsPac™-et and XtrapulsPac™-ed versions: EtherCAT® communication bus

See manual "EtherCAT® fieldbus interface".

3.3 - X1 CONNECTOR

3.3.1 - XtrapulsPac™-ak and XtrapulsPac™-et 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 XtrapulsCD1 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 100 Ω and 44 kΩ.
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		

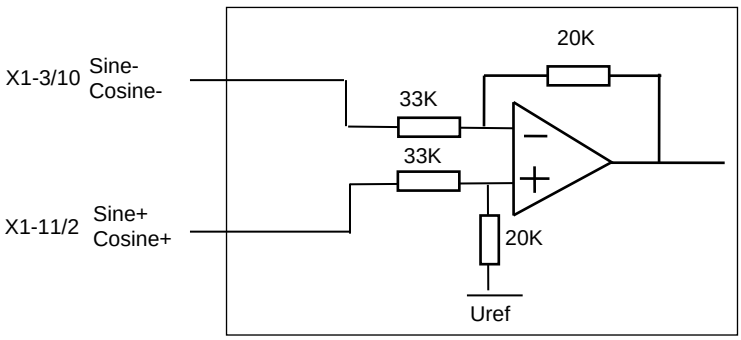
For the connection of other resolver types, see Chapter 5, section 1.

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 100 Ω and 44 kΩ.
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. 300 mA)
8	GND	O	Sensor supply GND
6	External supply	O	Sensor supply voltage (if ≠ 5 V). 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 - XtrapulsPac™-ed and XtrapulsPac™-kd versions

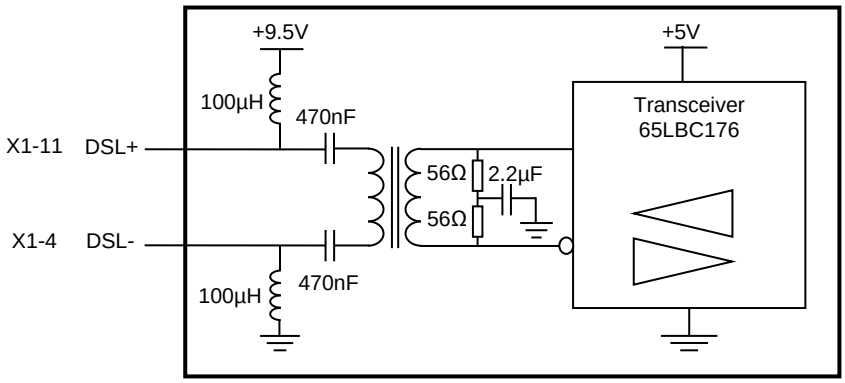
3.3.2.1 - X1 connector for Hiperface DSL® encoder (Sub D 15 pin female)

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: 9.5 V +/- 0.5 V - max.150 mA.
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 100 Ω and 44 kΩ.
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

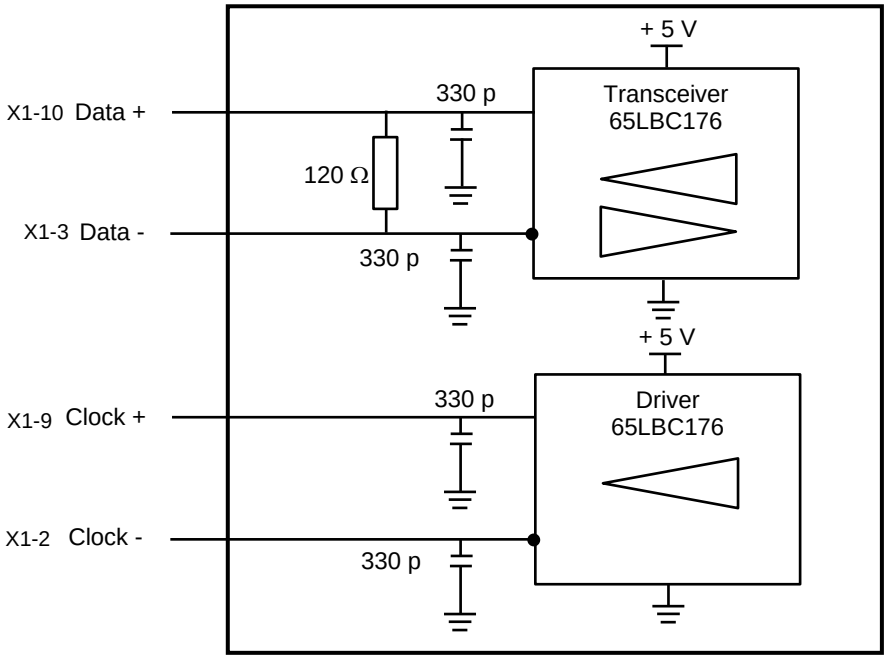


3.3.2.2 - X1 connector for EnDat 2.2® encoder (Sub D 15 pin female)

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 +5 V (150 mA max. output current).
8	GND	Supply GND
13	TC+	Motor thermal sensor inputs. The valid measurement range is between 100 Ω and 44 kΩ.
12	TC-	
Others	Reserved	

SPECIFICATION OF THE ENDAT2.2® INTERFACE



3.4 - INPUTS-OUTPUTS CONNECTOR: X2

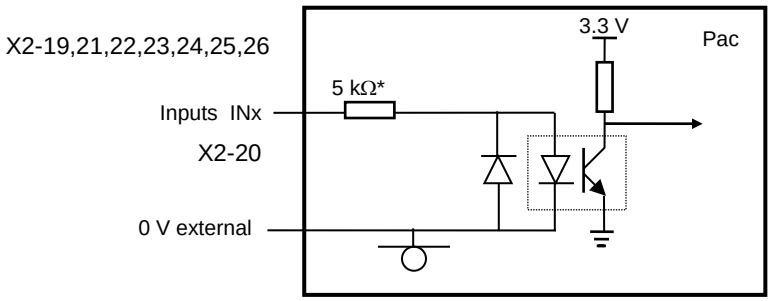
SUB D 26 PIN MALE HD CONNECTOR

PIN	FUNCTION	I/O	DESCRIPTION
1	ANA1+	I	Analog input nr. 1 Differential input +/-10 V *
10	ANA1-	I	
2	GND		Non differential analog input nr. 2 Direct input +/-10 V / GND reference
11	ANA2	I	
4	AOK-	O	OptoMos relay: high output impedance if fault Umax = 50 V, Imax = 300 mA 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. 24 V_{DC} / max. 300 mA	I	
5	OUT1	O	Non optocoupled DRIVER PNP "high side" logic outputs 24 V / 300 mA
15	OUT2	O	
6	OUT3	O	
16	Differential encoder output Marker Z-	O	Differential encoder outputs available on the **XtrapulsPac™-ak** version only. 5 V / 60 mA 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 XtrapulsPac™ 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 = 18 V < Vin <27 V Input impedance Zin = 5 kOhms Turn-on delay = 20 µs (**) Turn-off delay = 15 µs (**)
23	IN4	I	
24	IN3 / DIR (stepper motor emulation)	I	
25	IN2	I	
26	IN1	I	
12	ANA-OUT	O	Analog output 2.5 V +/- 2 V - 8 bits. 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 = 2 kOhm, Turn-on delay = 2 µs, Turn-off delay = 40 µs.

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

3.4.1 - Specification of the logic inputs



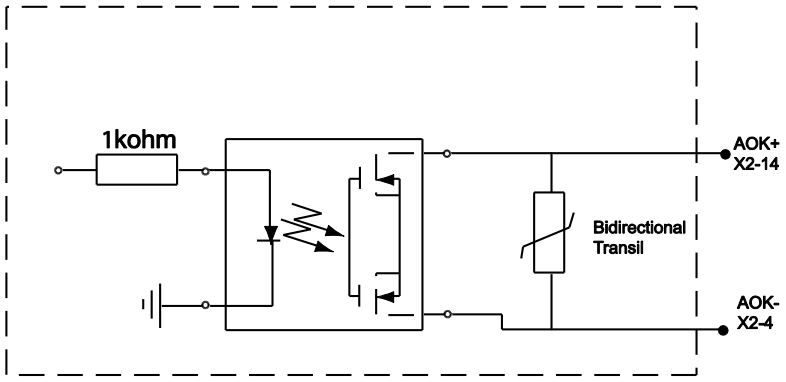
(*) For drives with serial number < 108210001: Zin = 2 kOhm

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

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

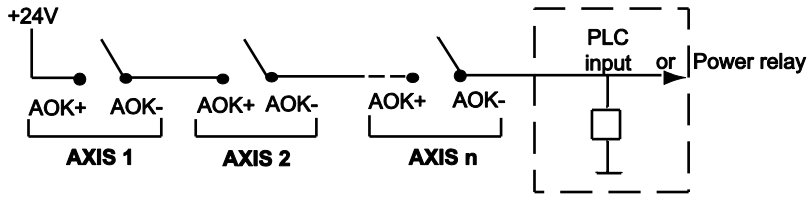
The use of the AOK output is mandatory in order to ensure the power supply connection.
It also ensures the protection of the electrical installation against the risk of fire in case of fatal failure of the power stage (e.g. transistor in short-circuit).

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.

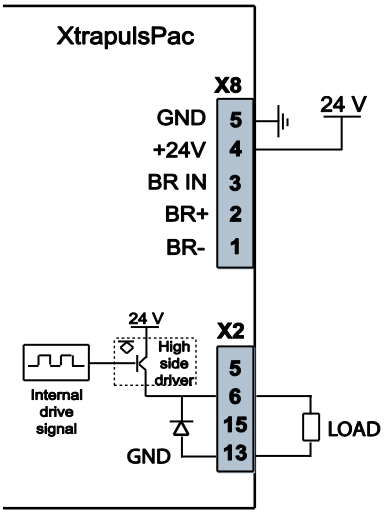


Polarized solid state output: closed if drive OK, open if fault.
Pmax = 10 W with Umax = 50 V - Imax = 300 mA.
For UL users, Umax = 42.4 V from an isolated power supply protected by a 3 A UL fuse.

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



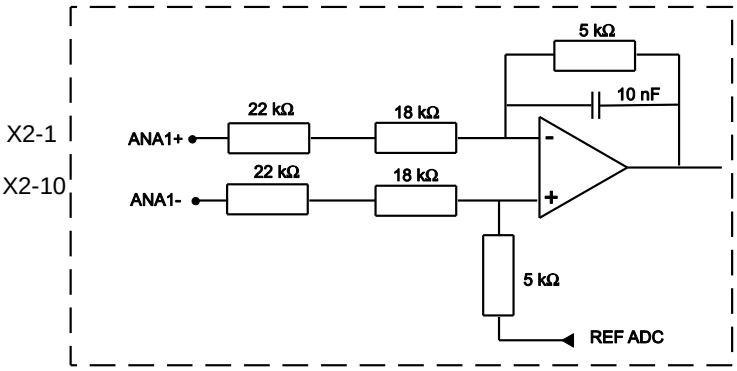
3.4.3 - Specification of the logic outputs OUT1 to OUT3

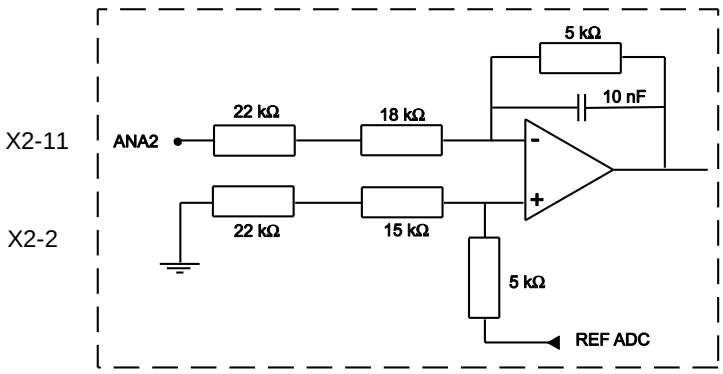


Digital outputs can be paralleled in order to increase the maximum output current.
Be careful to connect all paralleled outputs to the same drive signal.

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

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

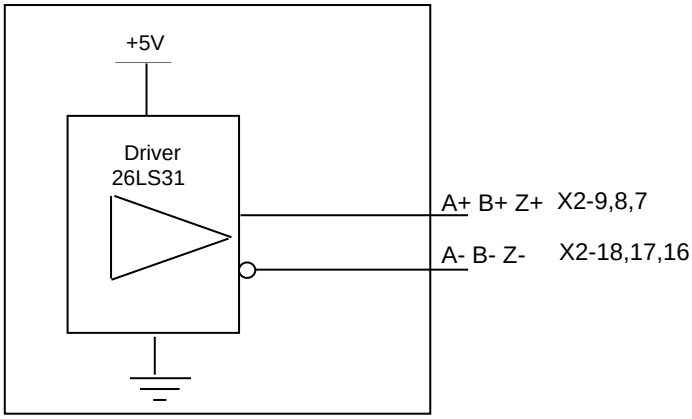




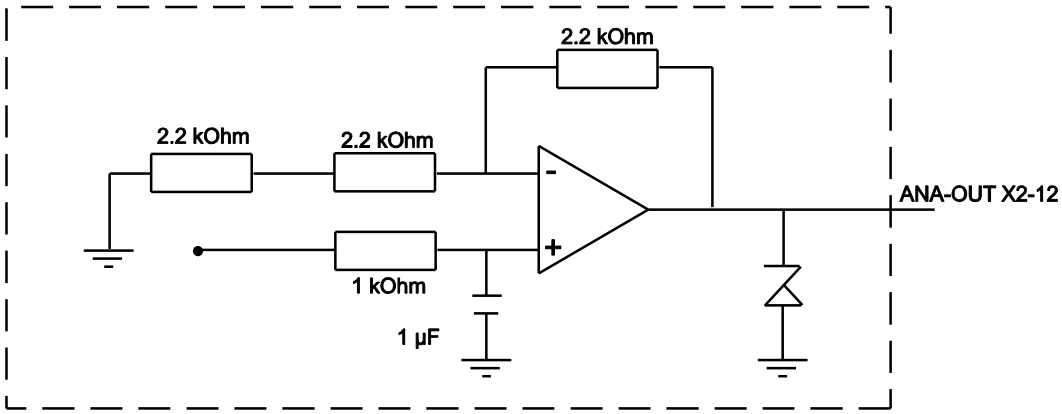
3.4.5 - Specification of the encoder output signals

Note: Available on the **XtrapulsPac™**-ak version only.

RS422 line transmitter: 20 mA 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	+5 V	Encoder supply voltage (total external consumption on all connectors = 300 mA 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	+ 9.5 V	Hall sensor internal supply voltage 9.5 V +/- 0.5 V (150 mA max. output current). Only available from serial number 11043098.
24	External supply	Hall sensor supply voltage (if ≠ 5 V_{DC} or 9.5 V_{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 100 Ω and 44 kΩ.
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 5 V to 24 V logic interface.

3.5.2 - X3 connector for incremental Sin/Cos & HES encoder input (SubD 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	+5 V	Encoder supply voltage (total external consumption on all connectors = 300 mA 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	+ 9.5 V	Hall sensor internal supply voltage 9.5 V +/- 0.5 V (150 mA max. output current). Only available from serial number 11043098.
24	External supply	Hall sensor supply voltage (if ≠ 5 V_{DC} or 9.5 V_{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 100 Ω and 44 kΩ.
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.

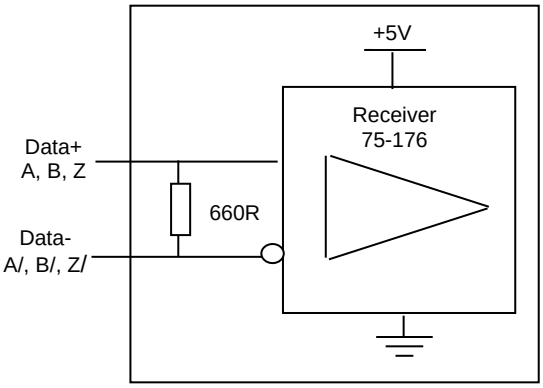
PIN	FUNCTION	REMARKS
3	Data-	Differential input of the Hiperface® encoder Data- channel
12	Data+	Differential input of the Hiperface® encoder Data+ channel
17	Sin- channel	Differential input of the Hiperface® encoder Sin- channel
18	Sin+ channel	Differential input of the Hiperface® encoder Sin+ channel
8	Cos- channel	Differential input of the Hiperface® encoder Cos- channel
9	Cos+ channel	Differential input of the Hiperface® encoder Cos+ channel
19	+ 9.5 V	Internal supply voltage 9.5 V +/- 0.5 V (150 mA max. output current). Only available from serial number 11043098.
24	External supply	Hiperface® encoder supply voltage (if ≠ 9.5 V). 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 100 Ω and 44 kΩ.
5	TC-	
Others	Reserved	

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

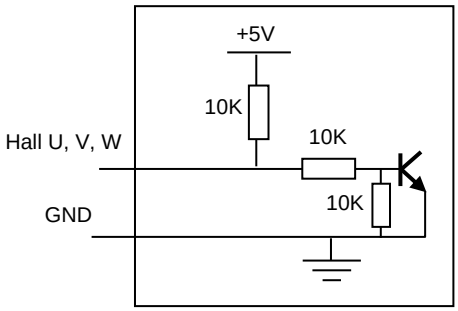
The single-turn absolute SinCos encoder configuration is software selectable and saved in the drive EEPROM.
This encoder configuration is only available from serial number 11043098.

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	+5 V	Encoder supply voltage (total external consumption on all connectors = max. 300 mA)
16	GND	Encoder supply GND
14	TC+	Motor thermal sensor inputs. The valid measurement range is between 100 Ω and 44 kΩ.
5	TC-	
Others	Reserved	

SPECIFICATION OF THE INCREMENTAL TTL ENCODER INPUT LINES



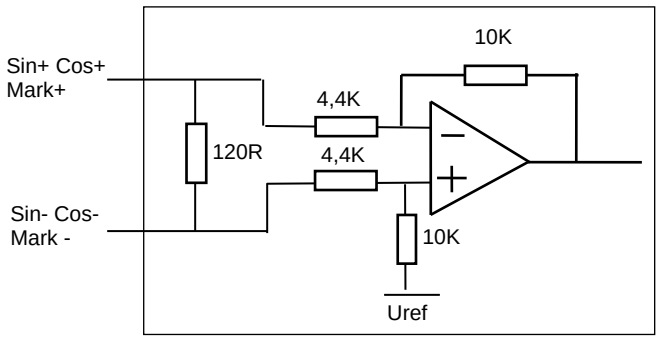
SPECIFICATION OF THE HALL SENSOR INPUT LINES



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

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 - XtrapulsPac™-ak and XtrapulsPac™-kd 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 - XtrapulsPac™-et and XtrapulsPac™-ed versions (EtherCAT® bus)

RJ45 standard connector

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 - XtrapulsPac™-ak and XtrapulsPac™-kd versions (CANopen® bus)

SUB D 9 pin male connector (same as XtrapulsCD1 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 - XtrapulsPac™-et and XtrapulsPac™-ed versions (EtherCAT® bus)

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

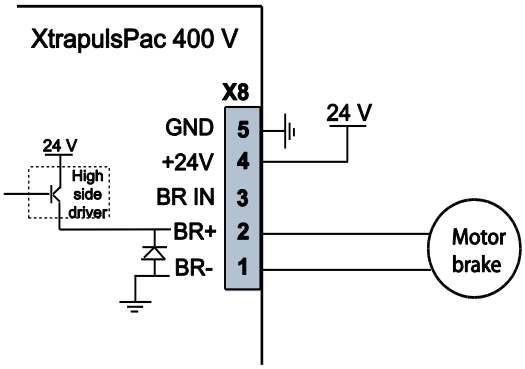
Manufacturer: Weidmüller
Type: BLZ 5.08 / 5
Reference: 152676
Tightening torque: 0.4 to 0.5 Nm

PIN	SIGNAL	I/O	FUNCTION	DESCRIPTION
1	Brake-	O	Motor brake output	Grounded potential reference (GND reference)
2	Brake+	O	Motor brake output	24 V_{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	24 V	I	Mains isolated 24 V_{DC} auxiliary power supply 0 V input referenced to the GND potential on the drive housing	24 V_{DC} supply: +/- 10 % Consumption without brake: 400 mA for **XtrapulsPac™** 230 V 500 mA for **XtrapulsPac™** 400 V UL: protection by means of a 3 A UL fuse
5	0V = GND	I		

3.8.1 - Motor brake output on XtrapulsPac™ 400 V drives

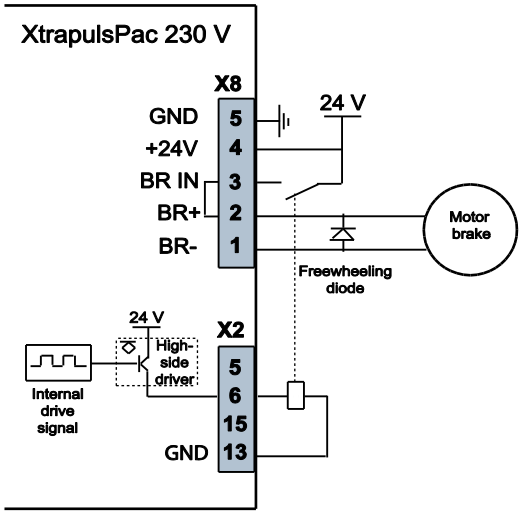
A high side driver output is provided to directly drive the motor brake.

Model	Rated output voltage	Maximum output current
XtrapulsPac™-400/08	24 V	1.5 A
XtrapulsPac™-400/20	24 V	1.5 A
XtrapulsPac™-400/45	24 V	2.5 A
XtrapulsPac™-400/100	24 V	2.5 A
XtrapulsPac™-400/200	24 V	2.5 A



3.8.2 - Motor brake output on XtrapulsPac™ 230 V 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 - XtrapulsPac™ 230 V: X9

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

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 100 Ω / 35 W braking resistor	Two possible wirings: - Internal braking resistor: 100 Ω / 35 W max Connect pins 6 and 7 together with a bridge, - External braking resistor: Min. value = 50 Ω Connect the external resistor between pins 5 and 7.
7	DR	O	Braking transistor output	
8	L1	I	230 V_{AC} single-phase mains input supply	230 V_{AC} single-phase +10 % / -15 % Fully integrated EMC mains filter.
9	L2	I		
10	GND		GND reference of the 230 V_{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 - XtrapulsPac™ 400 V / 45 A and 100 A: X9

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

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 Pac 400 V / 45 A - AWG10 / 105°C for Pac 400 V / 100 A Maximum length between two devices: 200 mm
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 - XtrapulsPac™ 400 V / 200 A: X9

Manufacturer: Phoenix Contact
Type: PC 16/7-STF-10.16
Reference: 1967508
Tightening torque: 1.7 to 1.8 Nm

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 08 / 105°C for Pac 400 V / 200 A *) Maximum length between two devices: 200 mm
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 actual power, use all four DC bus outputs in order to observe the wire section requirements.

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

3.9.4 - XtrapulsPac™ 400 V / 08 A and 20 A: X10

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

PIN	SIGNAL	I/O	FUNCTION	DESCRIPTION
1	L1	I	L1 mains phase	Three-phase mains inputs: 400 to 480 V_{AC} +10 % / - 15 %. 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 - XtrapulsPac™ 400 V / 08 A and 20 A: X9

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

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 400 Ω / 35 W braking resistor	Two possible wirings: - Internal braking resistor: 400 Ω / 35 W 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

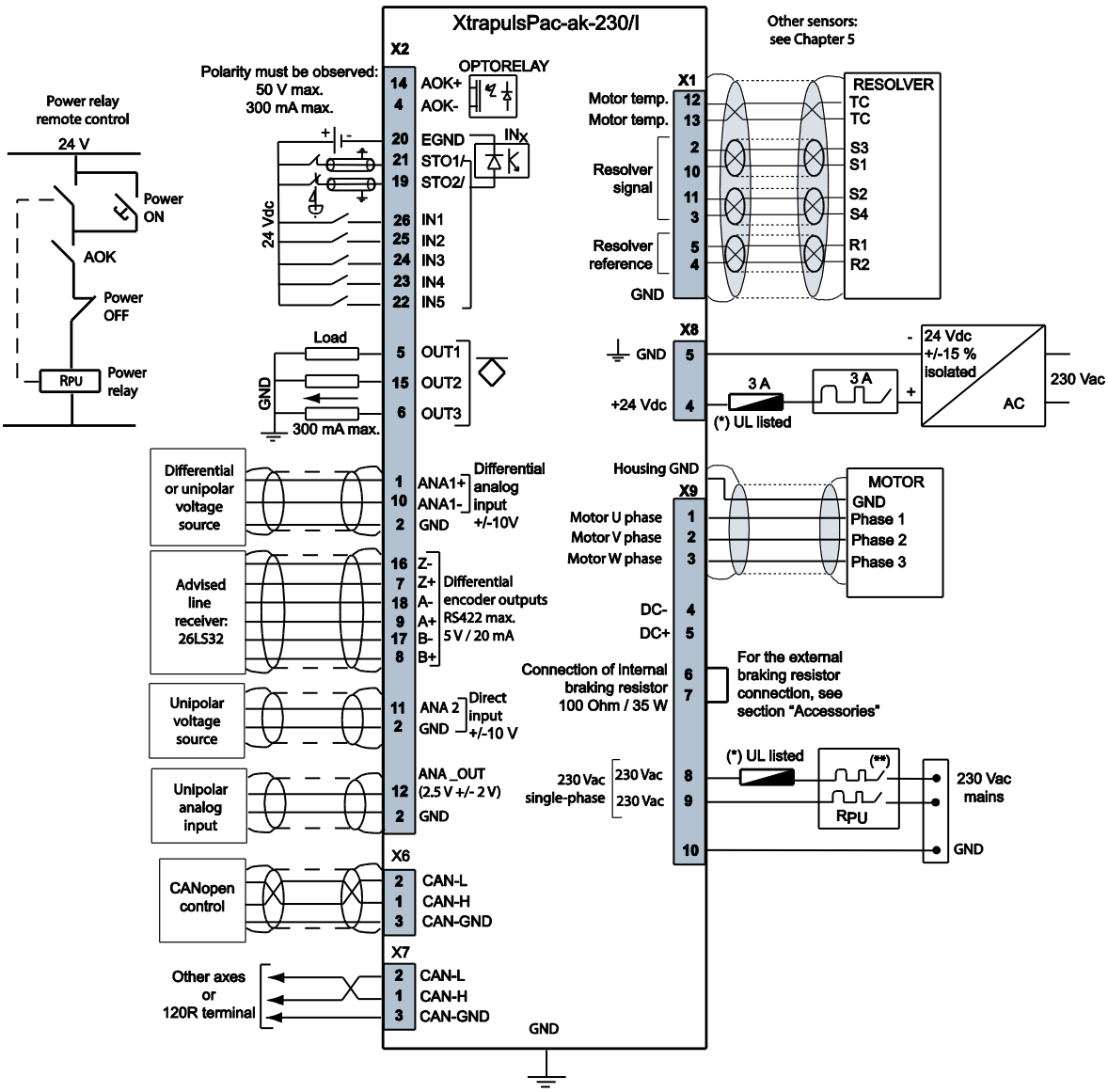
Type: Lug stud M3×10
Type: Lug stud M4x10 for XtrapulsPac™ 400 V / 200 A
Tightening torque: 2 Nm
Location: At the bottom left corner of the front panel.

Chapter 4 – Connections

4.1 - EXAMPLES OF CONNECTION DIAGRAMS

4.1.1 - XtrapulsPac™ 230 V

XtrapulsPac™-ak version



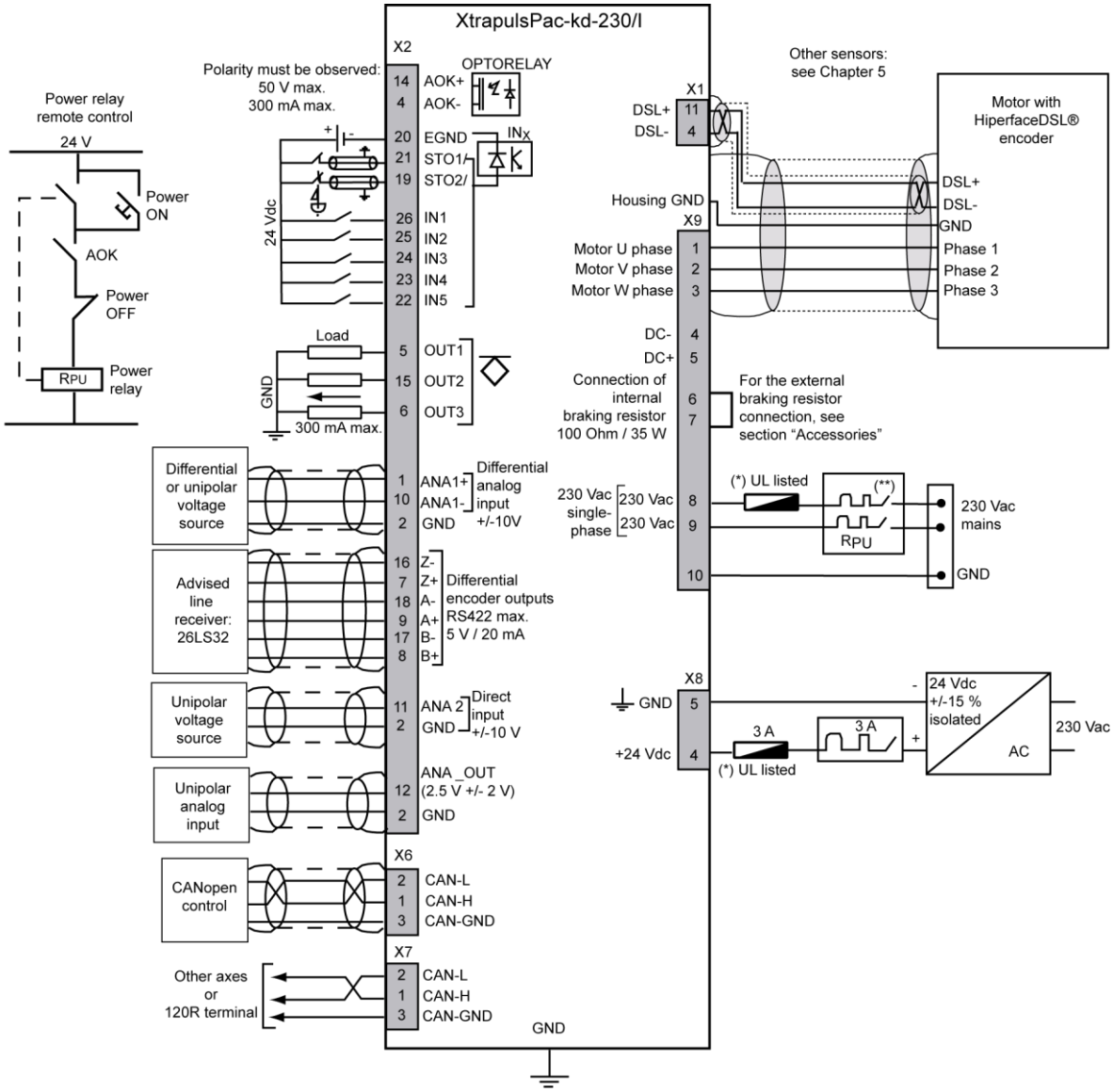
(*) See fuses table for the UL conformity.

(**) 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 24 V and power supply protection on source side must be made by the user.

XtrapulsPac™-kd version



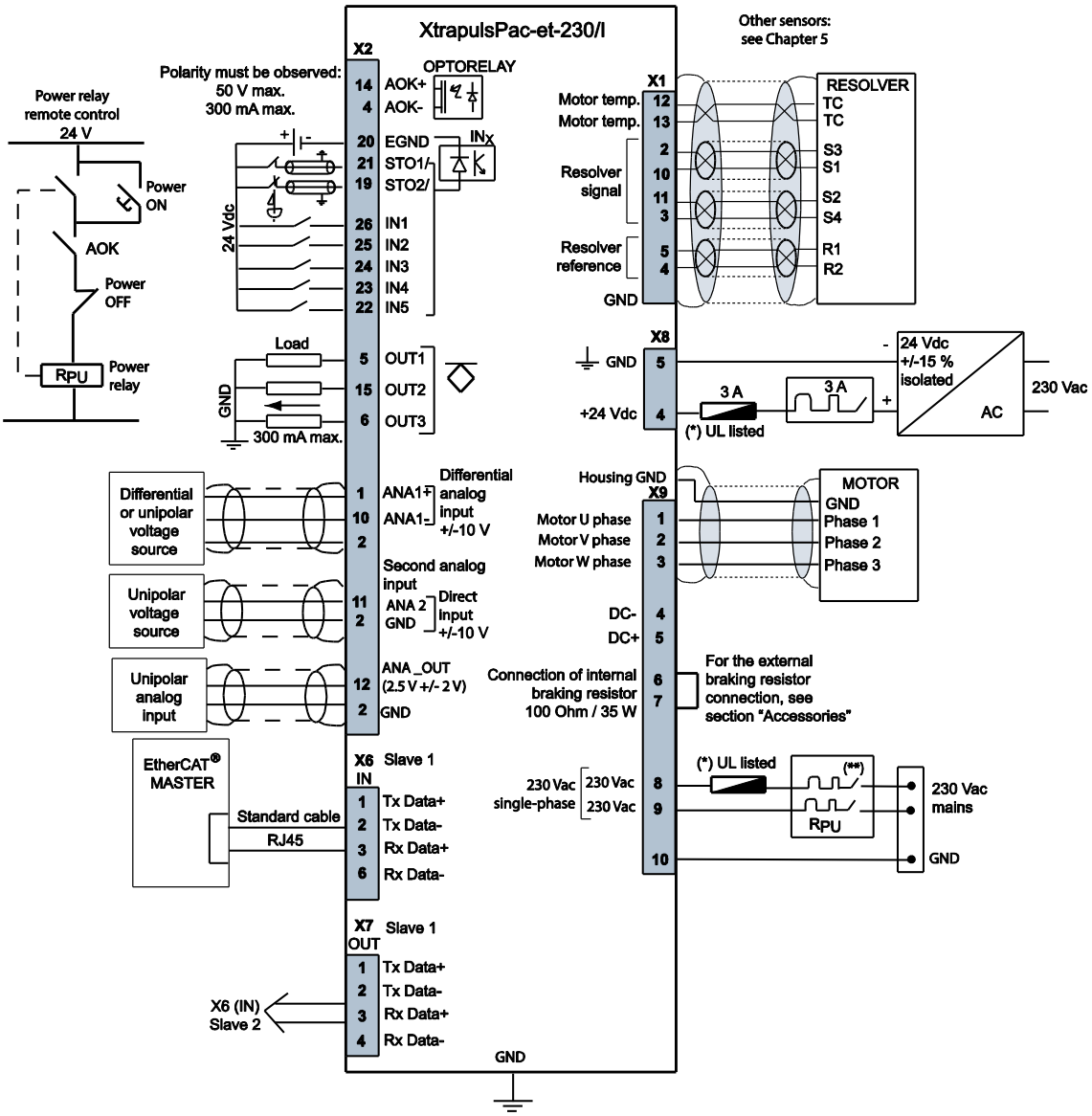
(*) See fuses table for the UL conformity.

(**) 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 24 V and power supply protection on source side must be made by the user.

XtrapulsPac™-et version



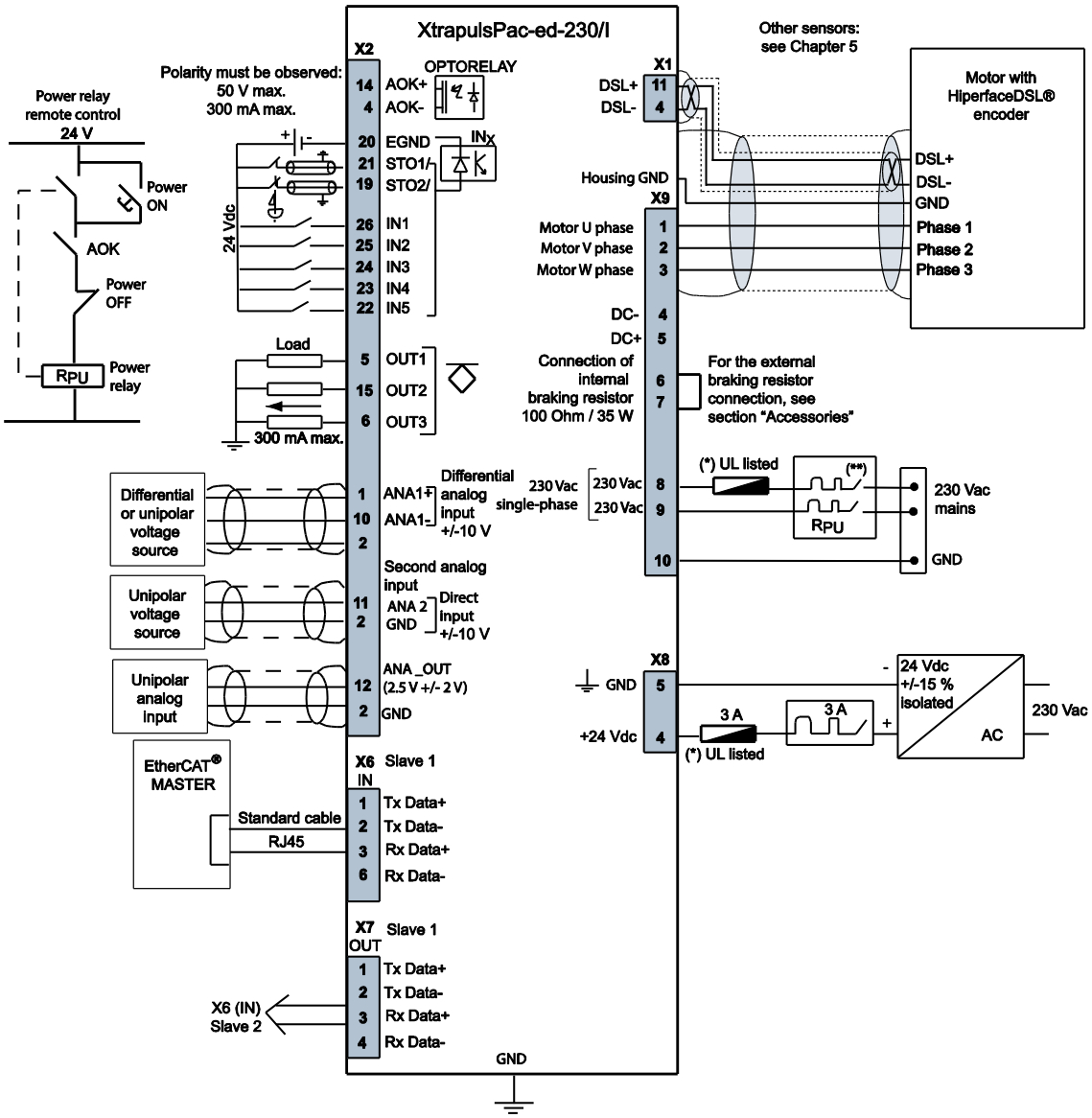
(*) See fuses table for the UL conformity.

(**) 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 24 V and power supply protection, on source side, must be made by the user.

XtrapulsPac™-ed version



(*) See fuses table for the UL conformity.

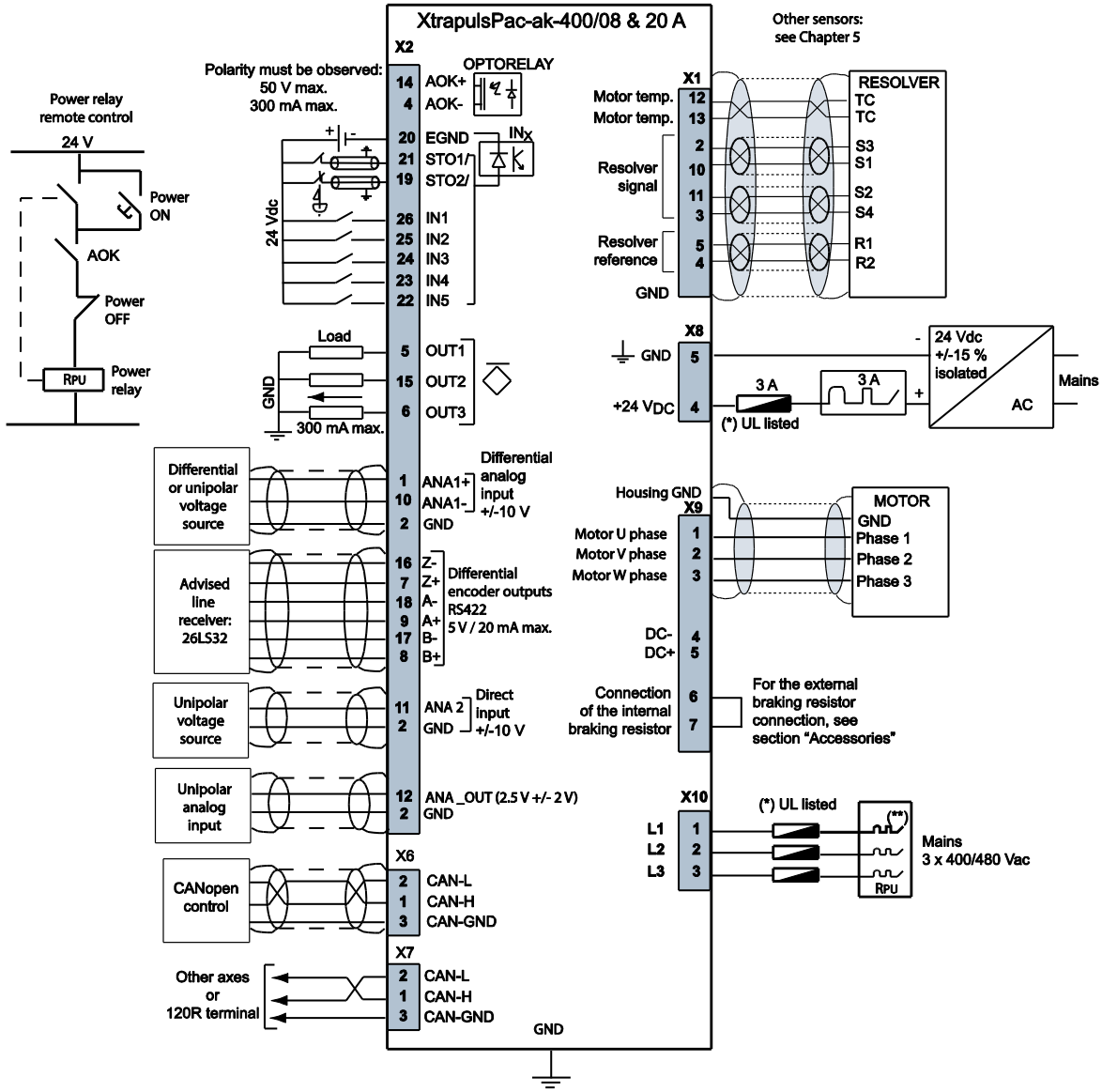
(**) Curve D circuit-breaker
I1s = 10 x In

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

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

4.1.2 - XtrapulsPac™ 400 V / 08 and 20 A

XtrapulsPac™-ak version



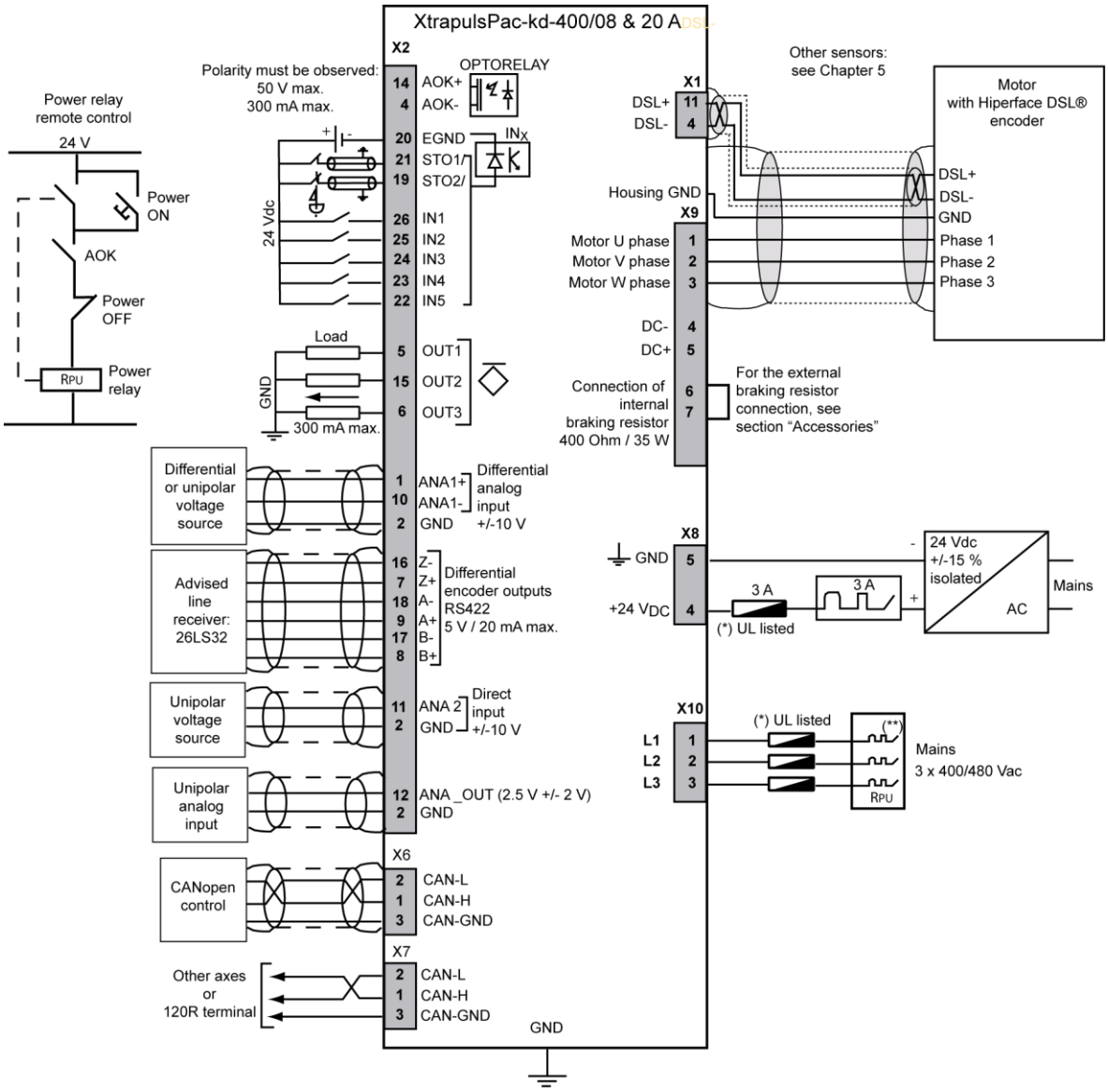
(*) See fuses table for the UL conformity.

(**) 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 24 V and power supply protection on source side must be made by the user.

XtrapulsPac™-kd version



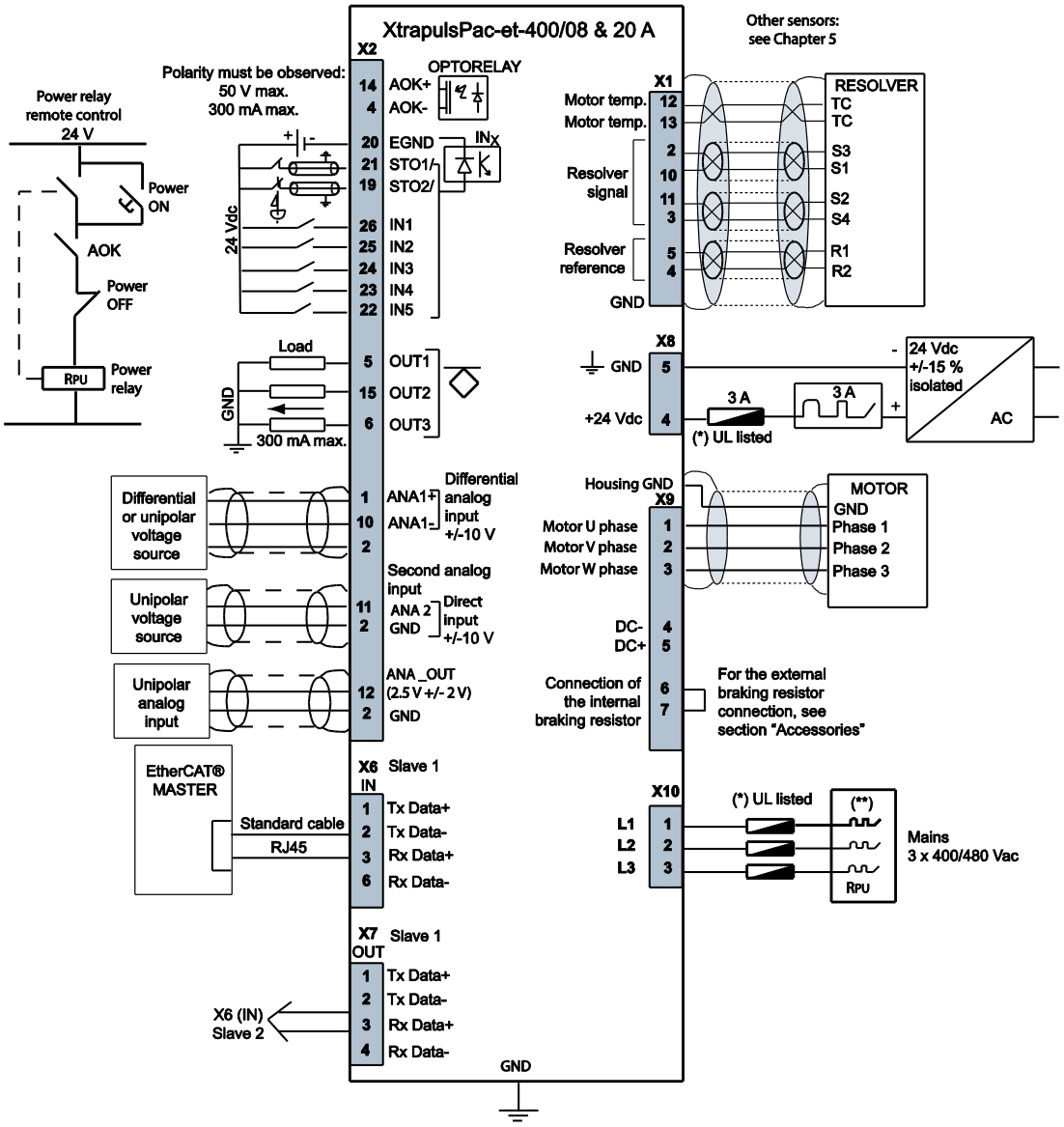
(*) See fuses table for the UL conformity.

(**) 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 24 V and power supply protection on source side must be made by the user.

XtrapulsPac™-et version



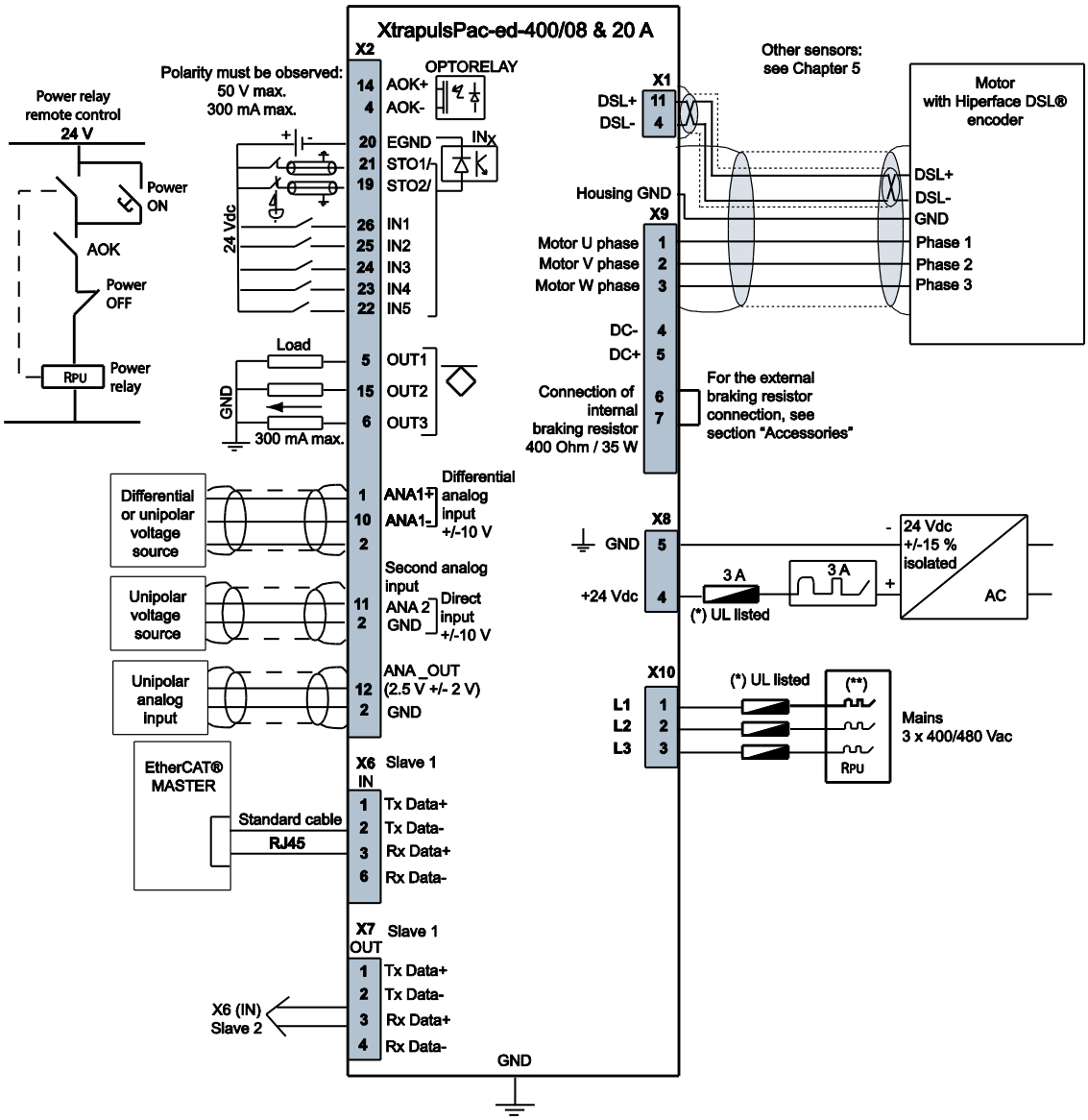
(*) See fuses table for the UL conformity.

(**) 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 24 V and power supply protection, on source side, must be made by the user.

XtrapulsPac™-ed version



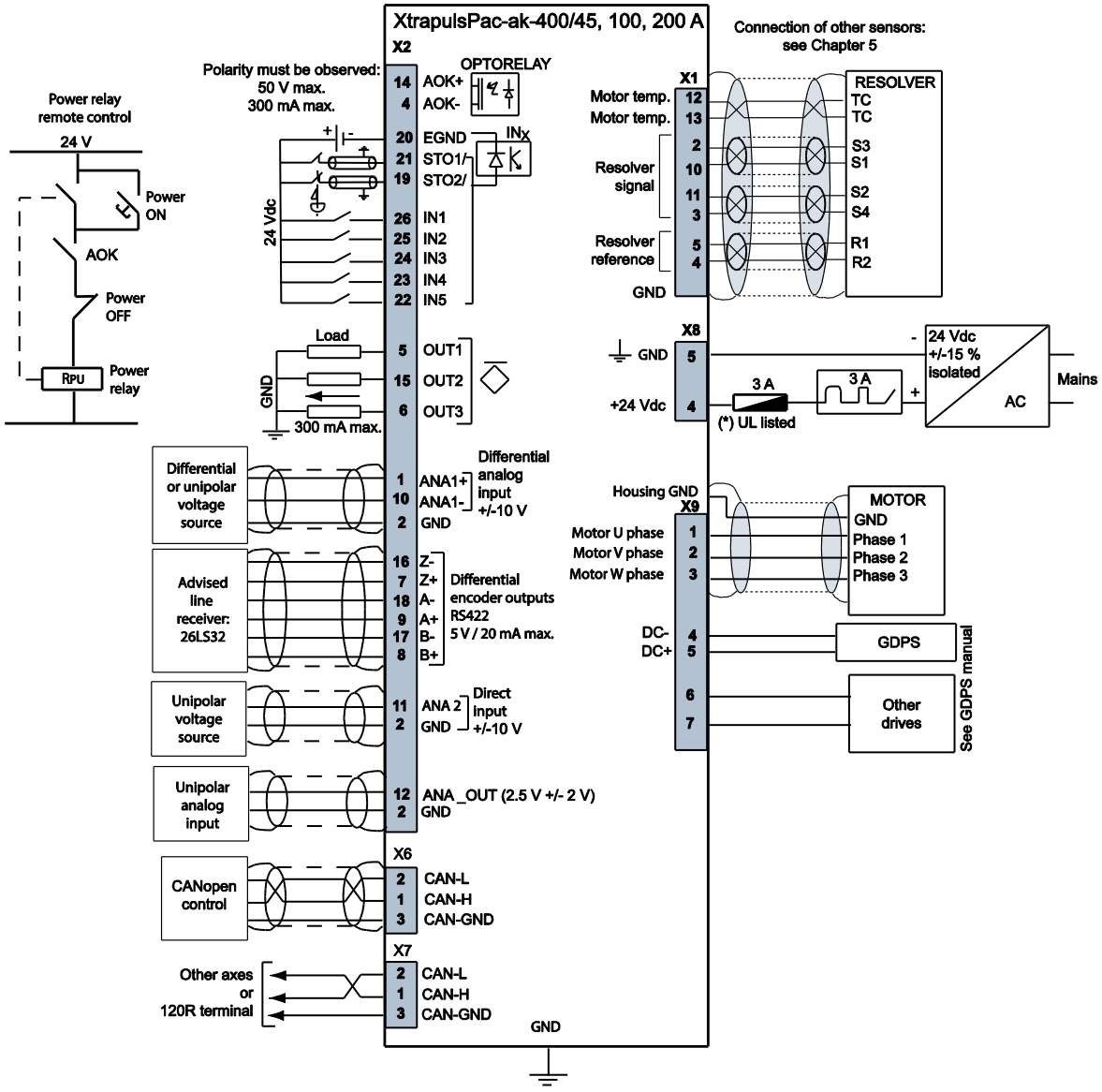
(*) See fuses table for the UL conformity.

(**) 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.

4.1.3 - XtrapulsPac™ 400 V / 45 A, 100 A and 200 A

XtrapulsPac™-ak version

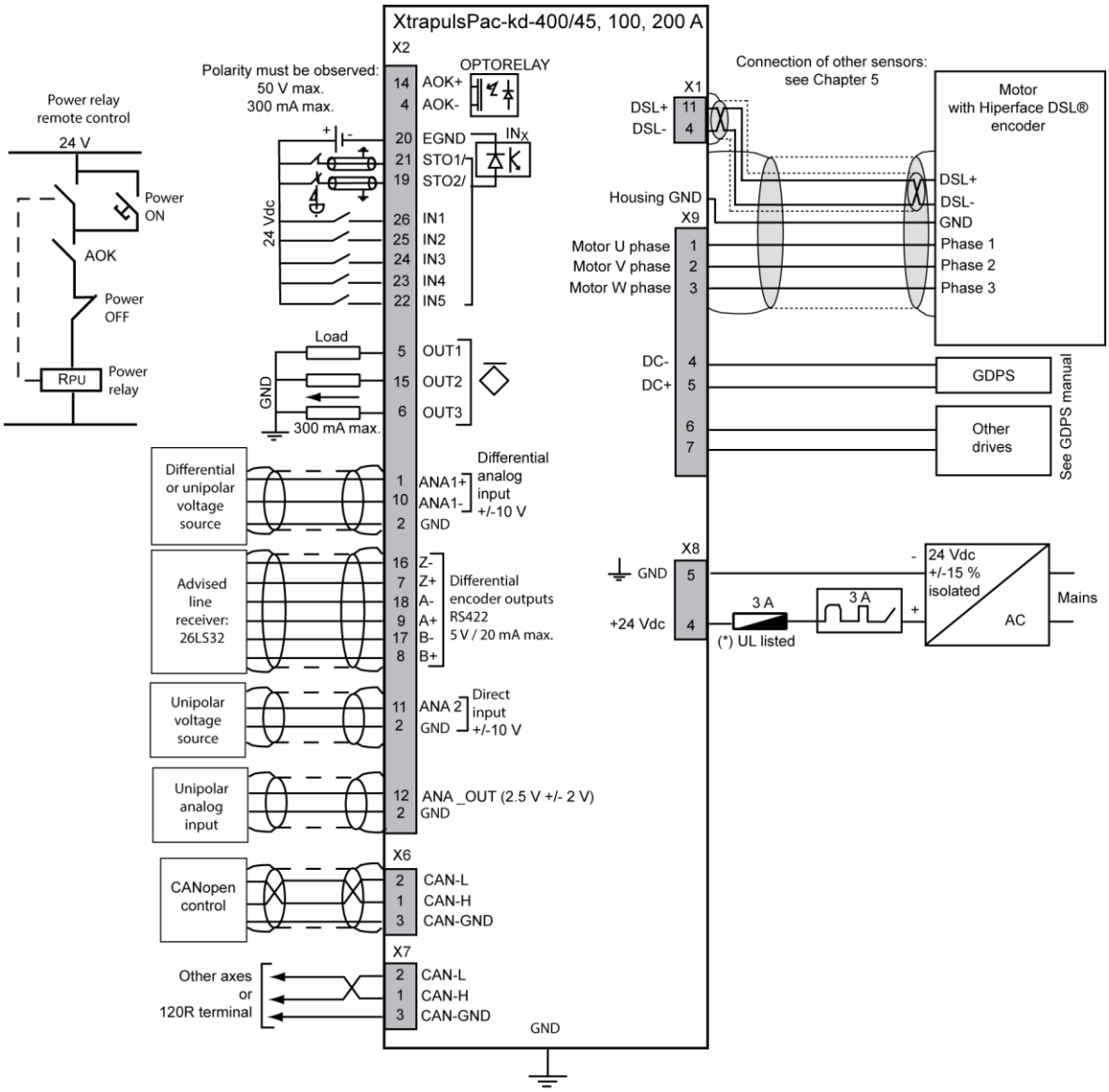


(*) See fuses table for the UL conformity.

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

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

XtrapulsPac™-kd version

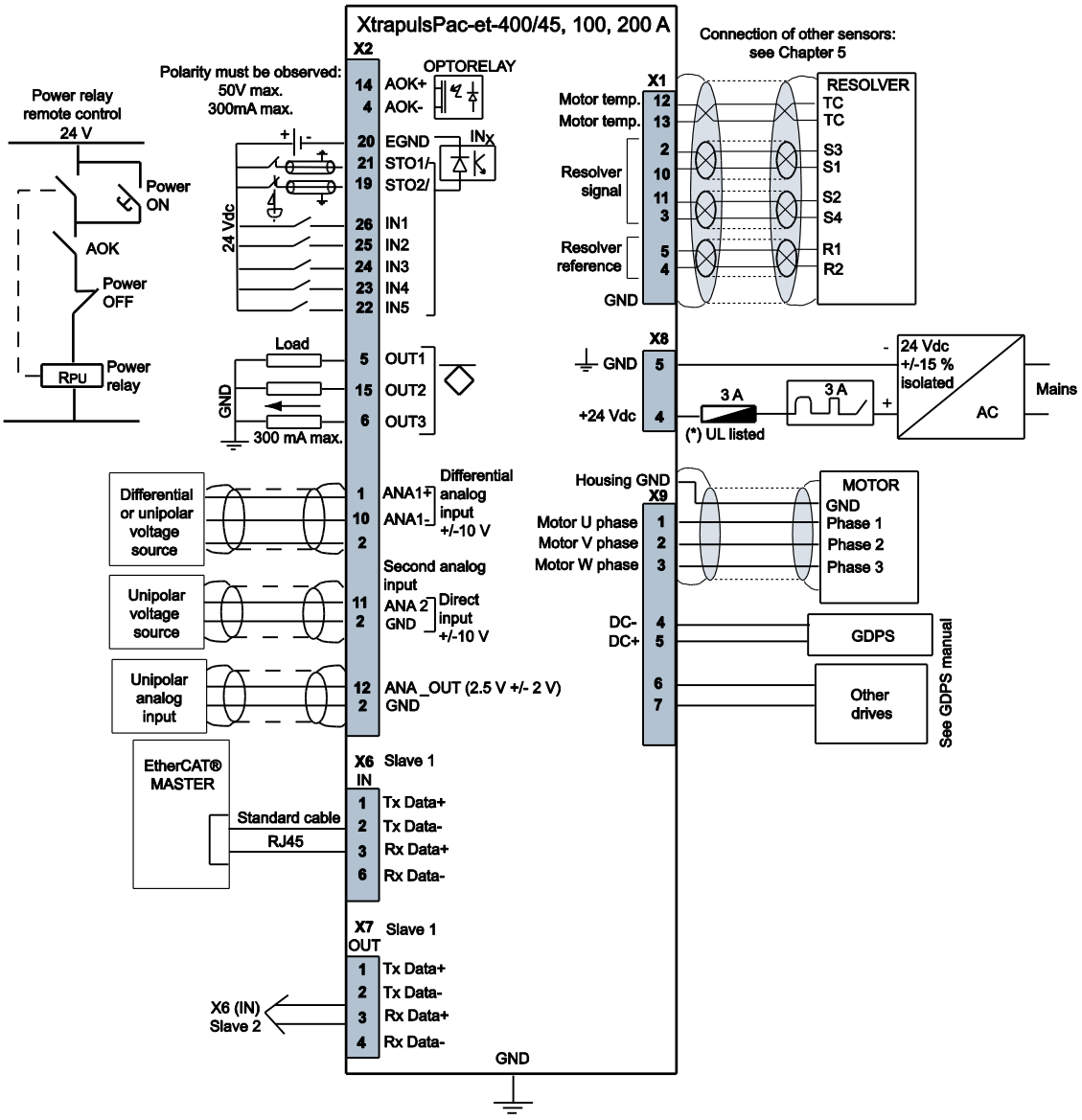


(*) See fuses table for the UL conformity.

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

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

XtrapulsPac™-et version

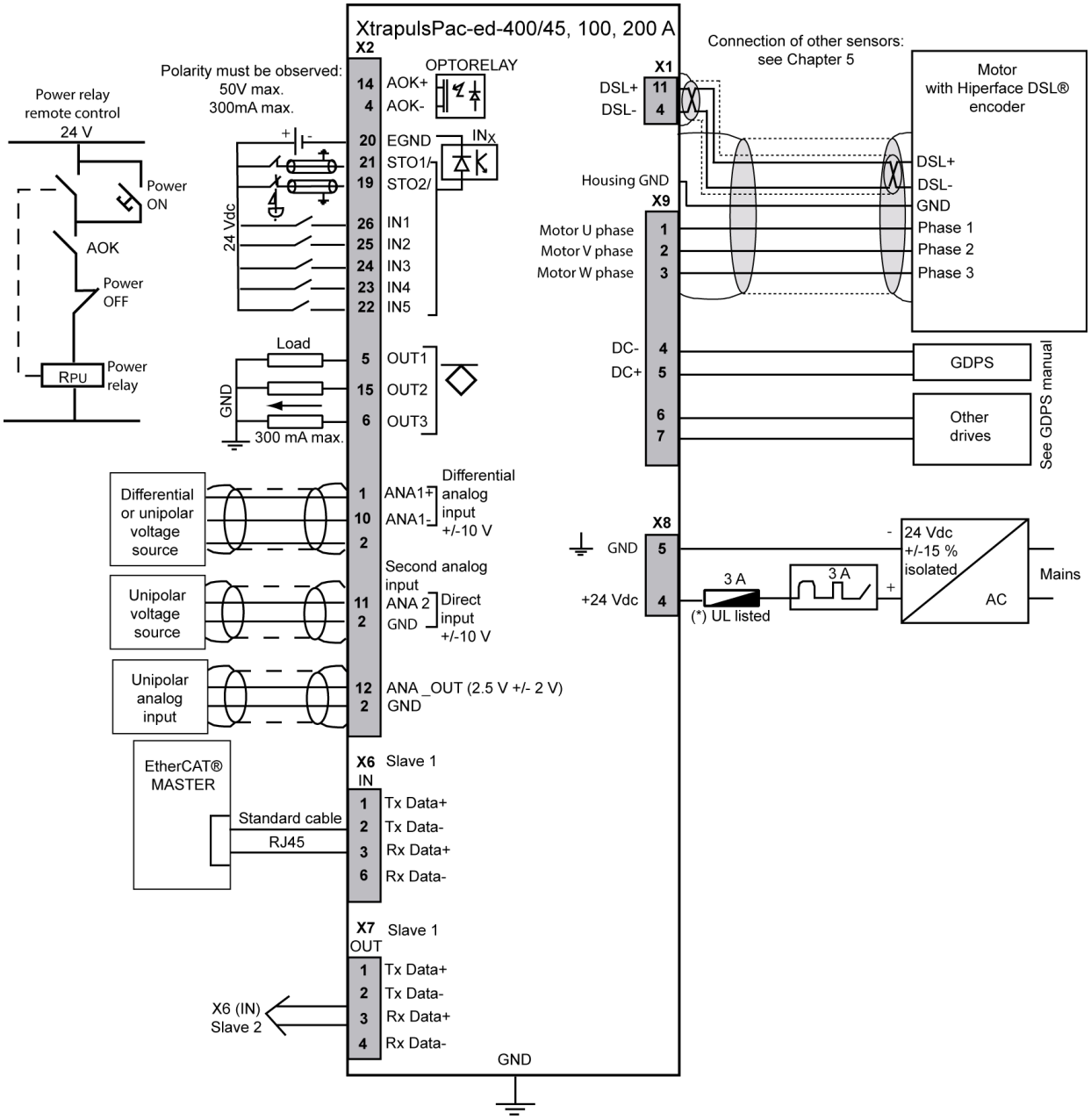


(*) See fuses table for the UL conformity.

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

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

XtrapulsPac™-ed 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.

4.1.4 - UL standard requirements

The UL listing requires the following conditions.

4.1.4.1 - 24 V 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 3 A UL certified fuse.

4.1.4.2 - Power supply and UL fuse ratings

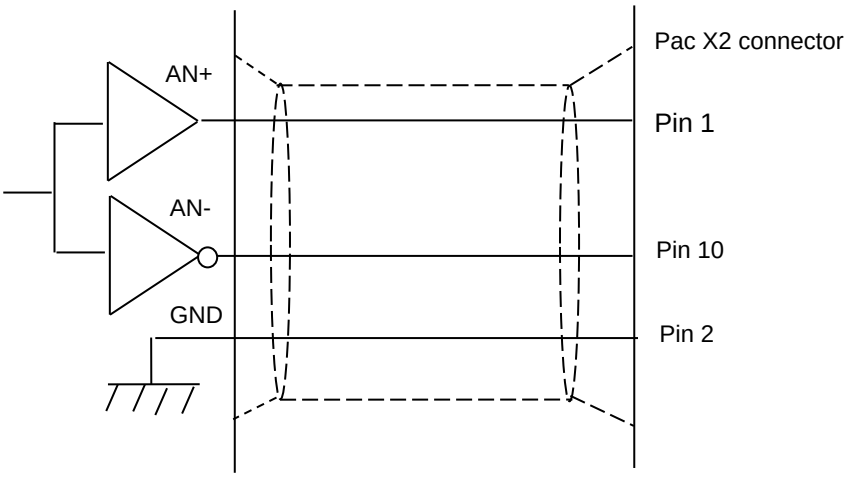
The recommended fuse model is a "semiconductor protection" type. The maximum mains short-circuit power must not exceed 5000 Arms, when protected by a UL fuse type A60Q.

On **XtrapulsPac™** drives, the fuse rating must be the following:

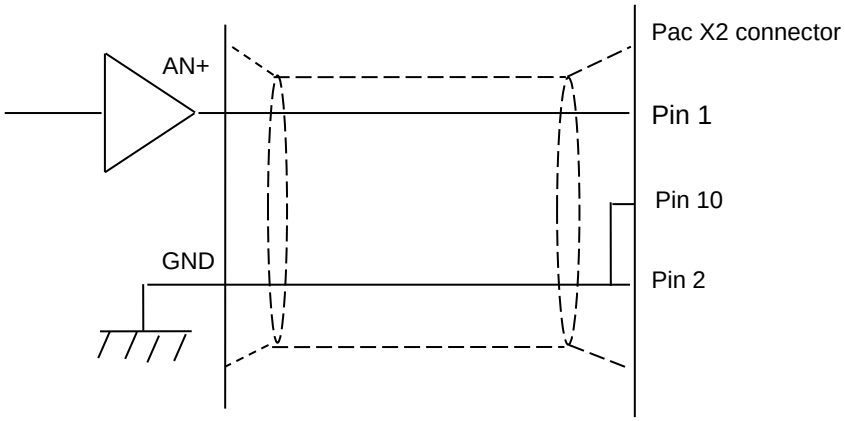
XtrapulsPac™-ak	Rated input current	FERRAZ Type A60Q
230 V / 05 A	4.3 A	A60Q5-2
230 V / 11 A	9.5 A	A60Q10-2
230 V / 17 A	14.7 A	A60Q15-2
400 V / 08 A	3.8 A	A60Q5-2
400 V / 20 A	9.4 A	A60Q10-2
400 V / 45 A	See XtrapulsGDPS manual	See XtrapulsGDPS manual
400 V / 100 A	See XtrapulsGDPS manual	See XtrapulsGDPS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

4.2 - ANALOG INPUTS CONNECTION

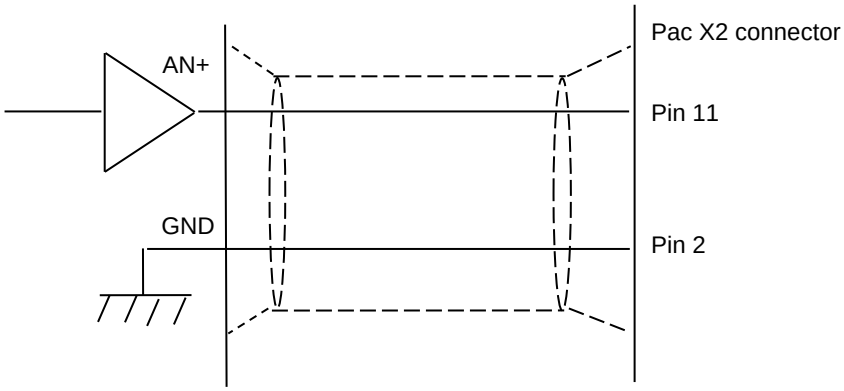
4.2.1 - ANA1 input connection with a differential analog signal source



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

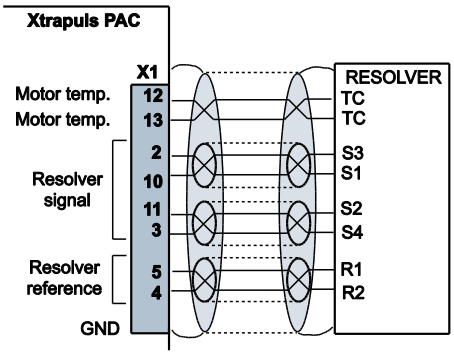


4.2.3 - ANA2 input connection

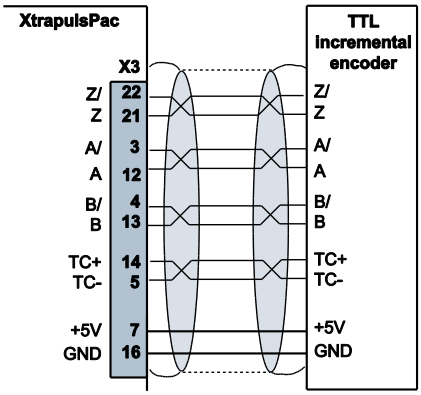


4.3 - CONNECTION TO VARIOUS SENSOR TYPES

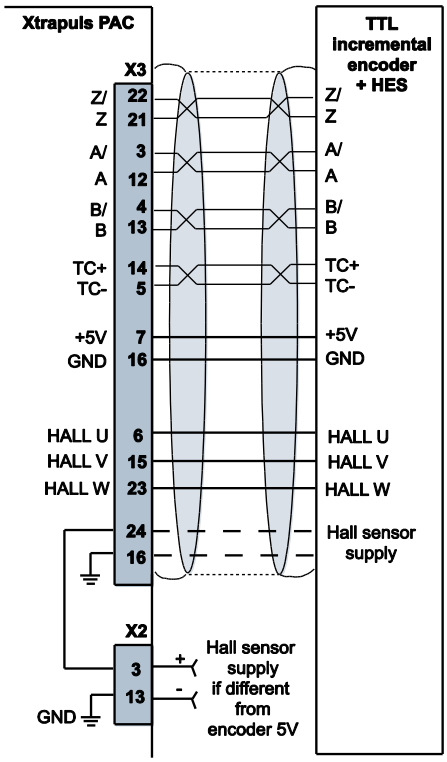
4.3.1 - Connection to a resolver: X1 - Sub D 15 pin female connector



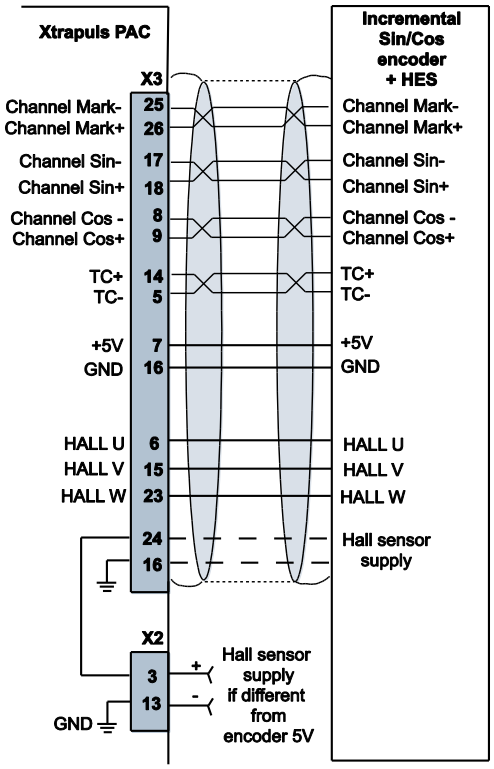
4.3.2 - Connection to an incremental TTL encoder: X3 - 26 pin female HD connector



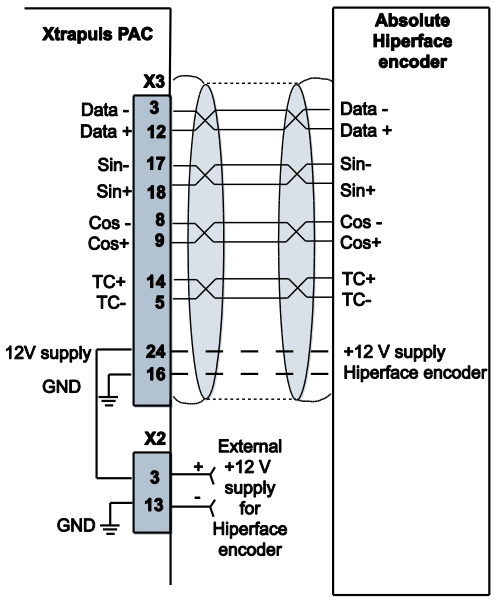
4.3.3 - Connection to an incremental TTL encoder with Hall sensor: X3 - 26 pin female HD connector



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

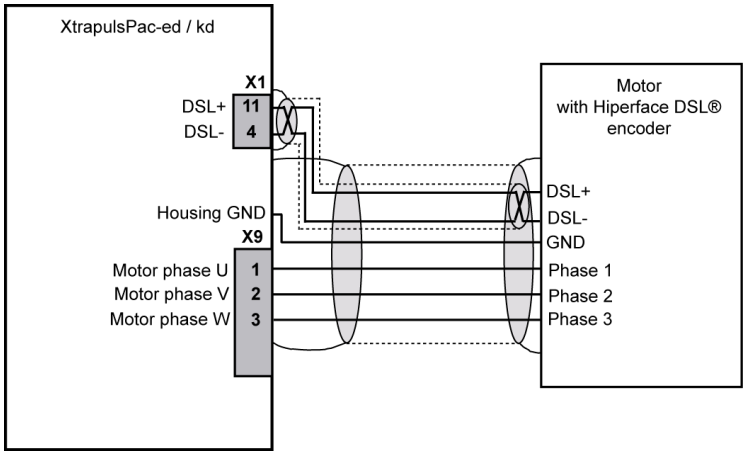


4.3.5 - Connection to an absolute Hiperface® encoder: X3 - 26 pin female HD connector



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

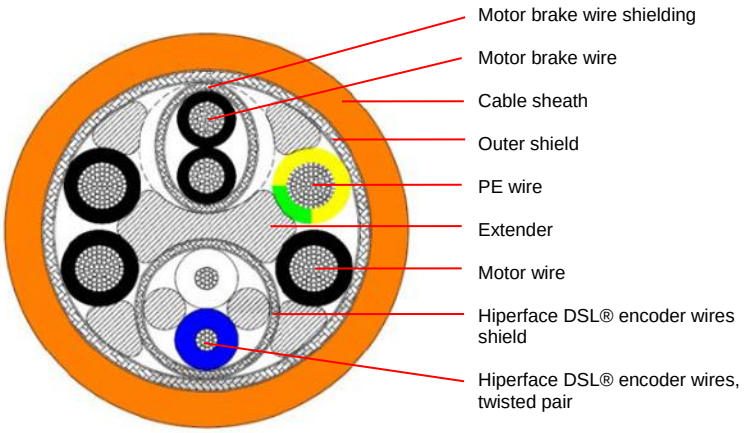
The two wires for Hiperface DSL® communication are integrated into the motor cable:



Hiperface DSL® cable specifications:

Property	Min	Typical	Max	Unit
Length			25	m
Characteristic impedance @ 10 MHz	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:

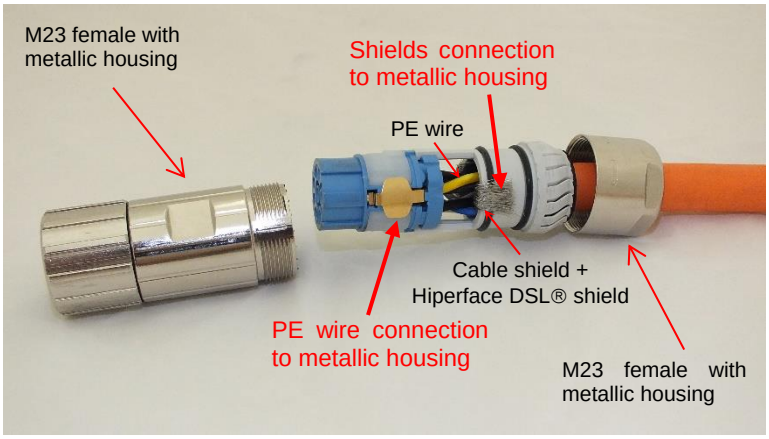


The shield as well as a proper ground connection have a significant impact on the DSL connection performance and may be considered as its key factor.

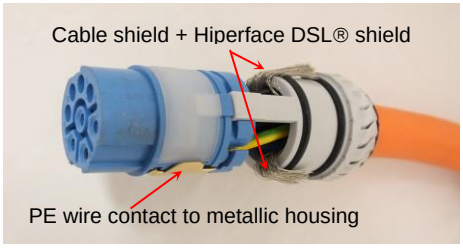
In the cable, the motor phases must be located symmetrically to the Hiperface DSL® communication wires.

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:

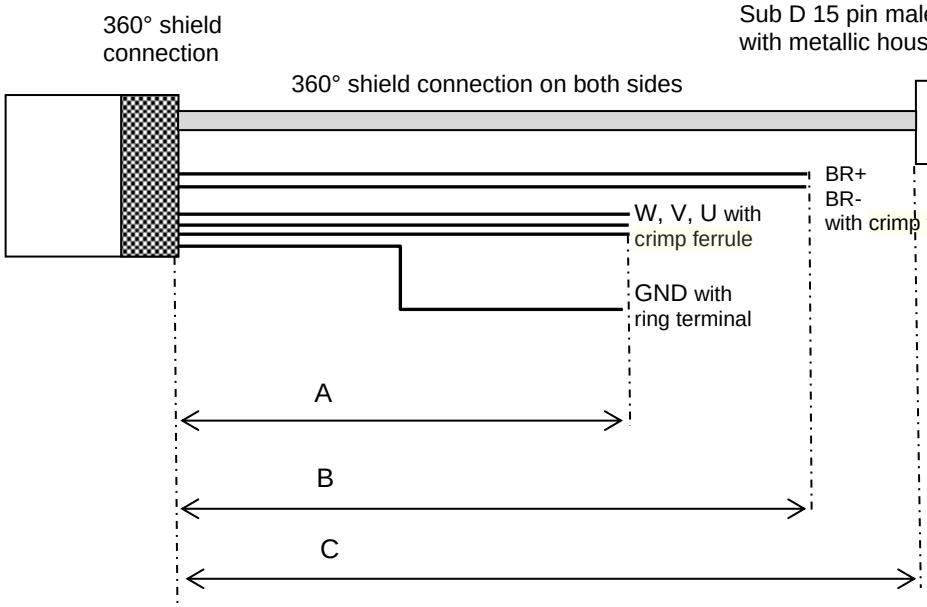


Internal details of the connector



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.

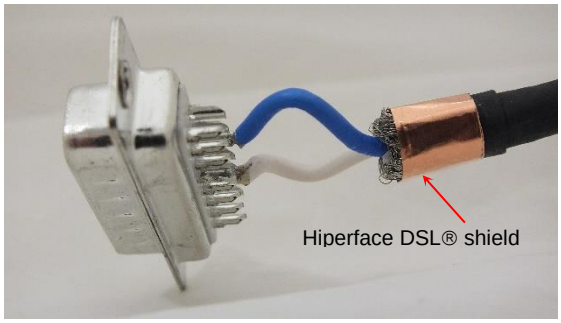
Drive side connections example:

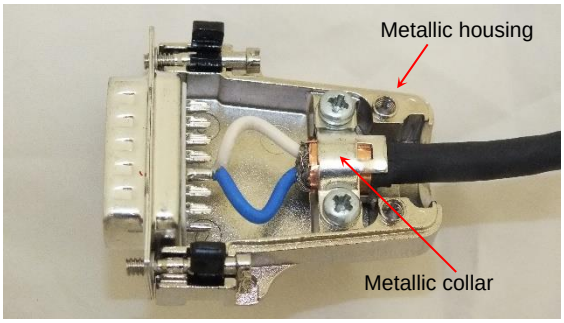


Length in cm	A	B	C
Pac 230 V	15	25	45
Pac 400 V	15	25	45
Pac 400 V / 200 A	20	25	50

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

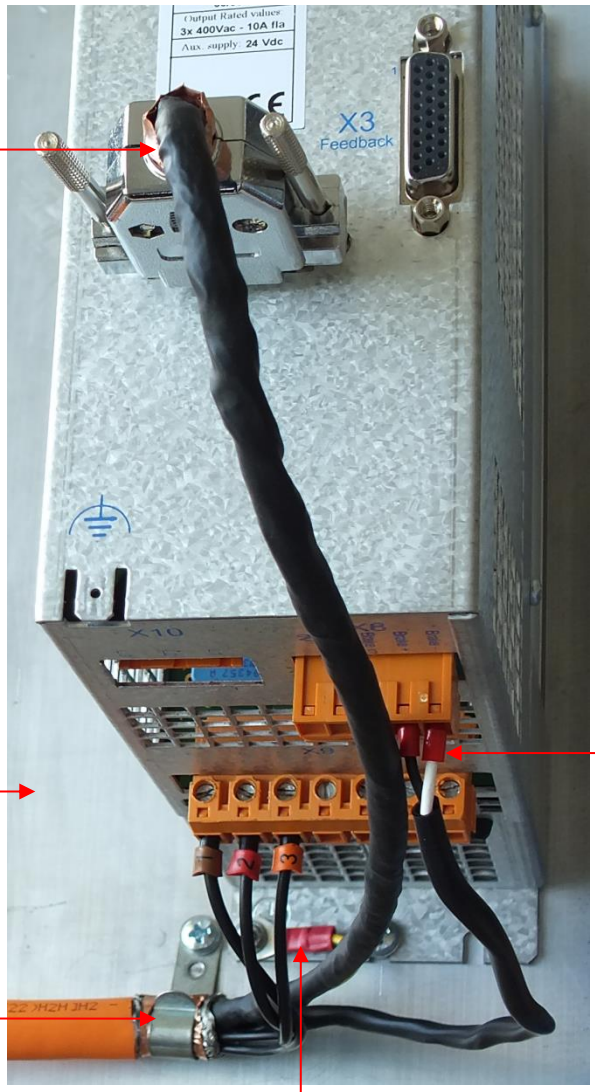
Sub D 15 connector assembly





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.

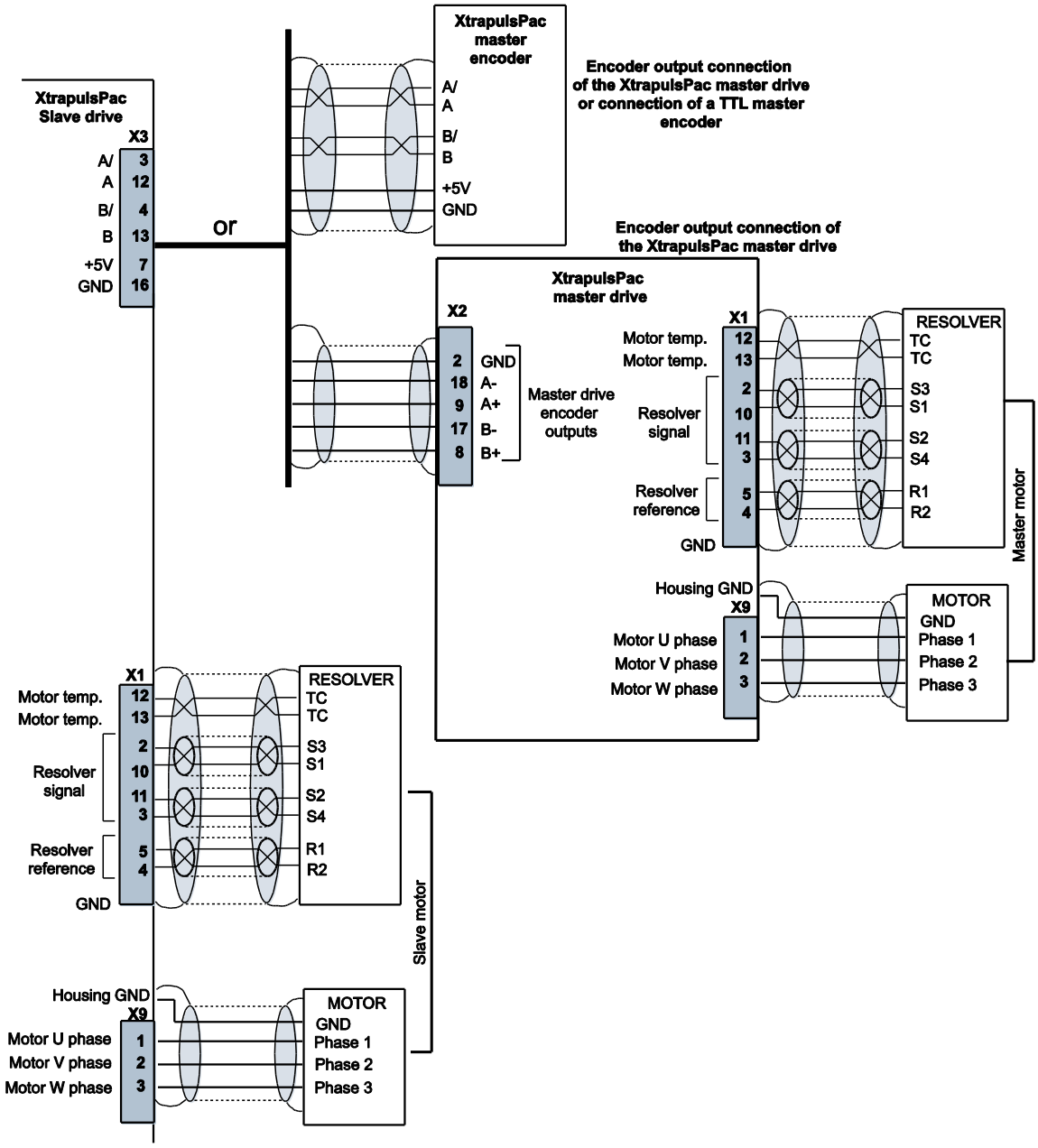
Conducting panel

Motor brake wire connection

360° shield connection with metallic collar.

PE connection

4.3.7 - Configuration of the XtrapulsPac™ 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 **XtrapulsPac™** master drive.

4.4 - ACCESSORIES AND CONNECTIONS

ENERGY RECUPERATION VIA A BRAKING RESISTOR

All **XtrapulsPac™** 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

XtrapulsPac™ 230V

XtrapulsPac™ 400V / 08 and 20 A

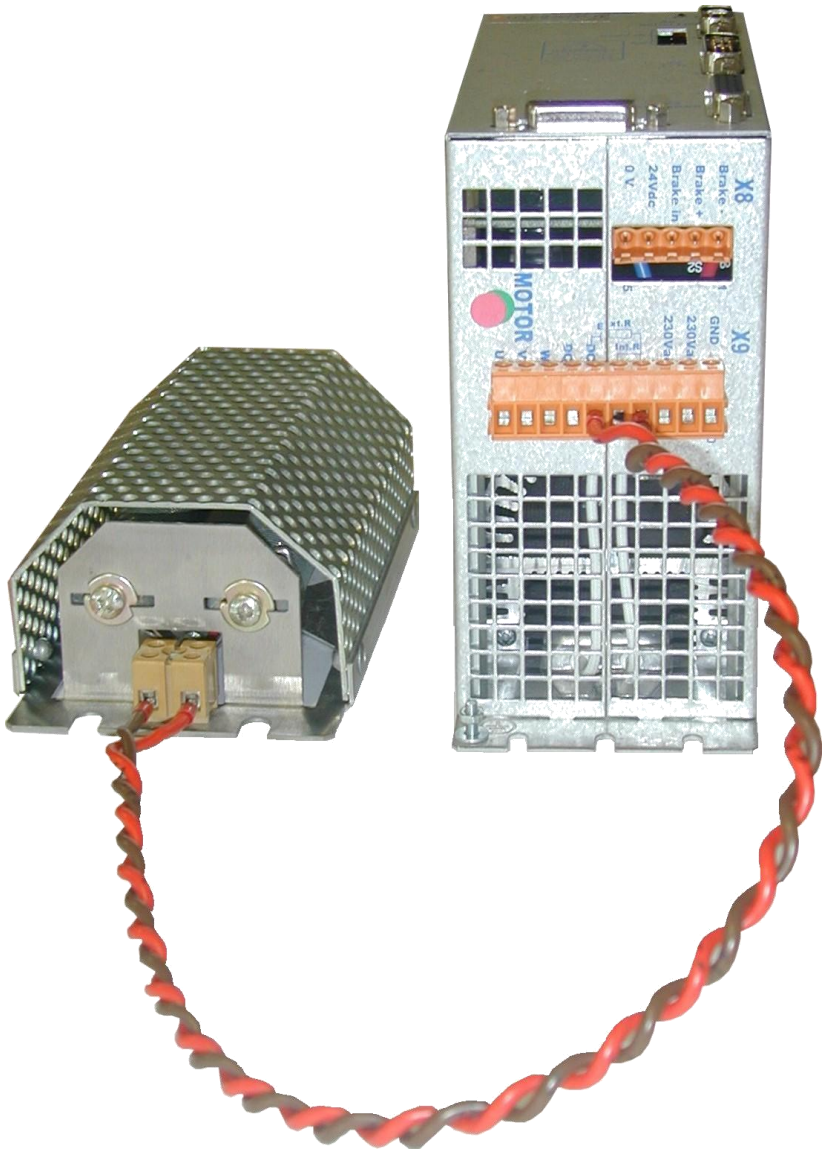
The **XtrapulsPac™** drive in stand-alone version is equipped with an internal 35 W braking resistor.
Its connection is made by means of a wiring bridge between pins 6 and 7 of the X9 connector.
If the required rated power of the braking resistor is higher than 35 W or if the pulse power is higher than 1500 W, 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.).

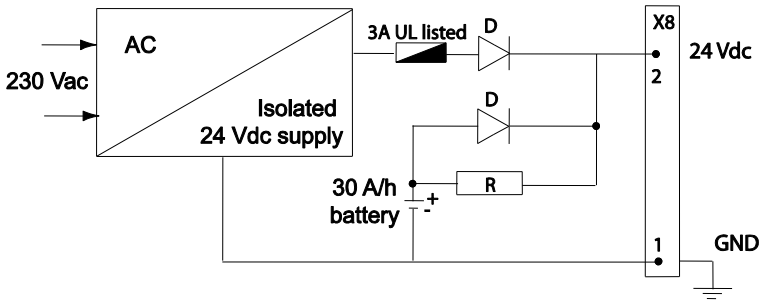
In order to avoid any EMC or electrical problem, some rules must be observed:

- 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. 1 m).



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).

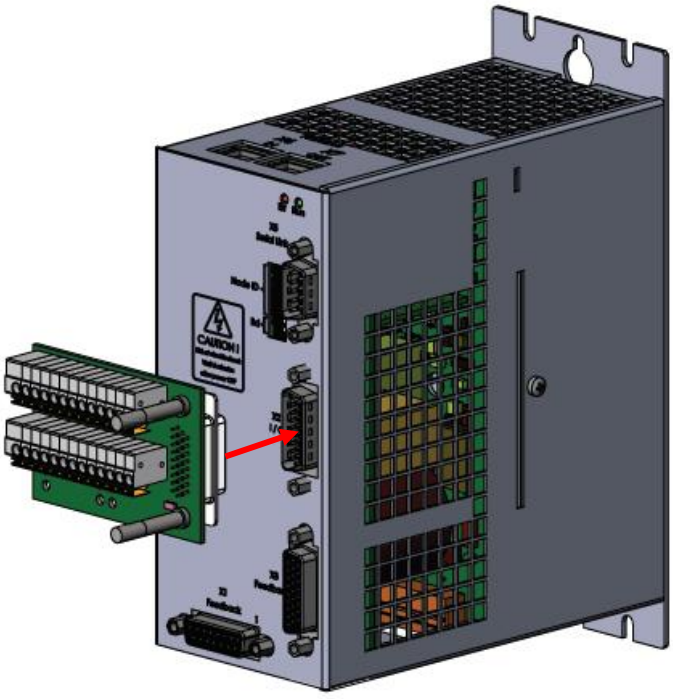
4.4.3 - Connection of a backup battery



The **XtrapulsPac™** drive consumption is 400 mA with 24 V_{DC}. So, a 24 V / 30 A/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.

4.4.4 - Connection of the accessory "I/O-Pac adapter"

The I/O-Pac adapter allows the direct connection of the input/output wires on a connector by avoiding the soldering of the wires on a Sub-D connector.



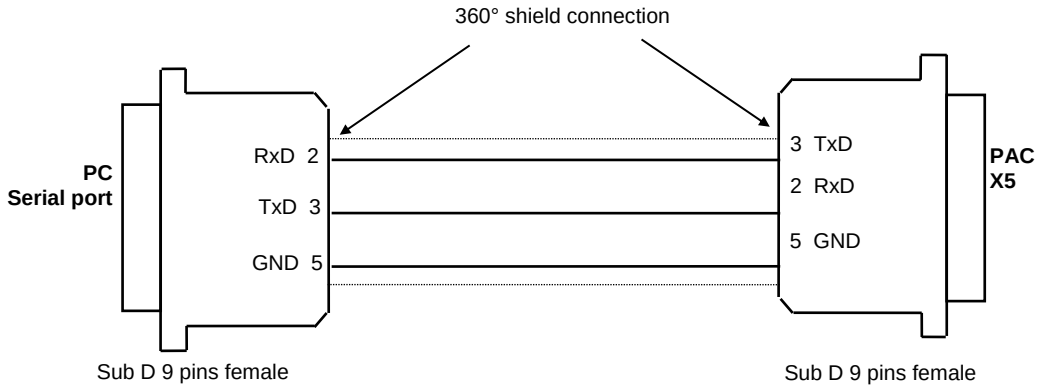
The wires connection on the X2-A and X2-B connectors requires the I/O-Pac adapter to be unplugged from the XtrapulsPac™ drive.

Connection table:

X2-A X2-B PINS	FUNCTION	I/O	DESCRIPTION
X2-A : 1	ANA1+	I	See the connector description in Chapter 3 - Inputs/Outputs
X2-A : 10	ANA1-	I	
X2-A : 2	GND		
X2-A : 11	ANA2	I	
X2-A : 4	AOK-	O	
X2-B : 14	AOK+	O	
X2-A : 13	GND		
X2-A : 3	Maximum external 24 Vdc supply: max. 300 mA	I	
X2-A : 5	OUT1	O	
X2-B : 15	OUT2	O	
X2-A : 6	OUT3	O	
X2-B : 16	Differential encoder output TOP Z-	O	
X2-A : 7	Differential encoder output TOP Z+	O	
X2-B : 17	Differential encoder output Voie B-	O	
X2-A : 8	Differential encoder output Voie B+	O	
X2-B : 18	Differential encoder output Voie A-	O	
X2-A : 9	Differential encoder output Voie A+	O	
X2-B : 19	STO2/	I	
X2-B : 20	EGND		
X2-B : 21	STO1/	I	
X2-B : 22	IN5 / PULSE (stepper motor emulation)	I	
X2-B : 23	IN4	I	
X2-B : 24	IN3 / DIR (stepper motor emulation)	I	
X2-B : 25	IN2	I	
X2-B : 26	IN1	I	
X2-A : 12	ANA-OUT	o	

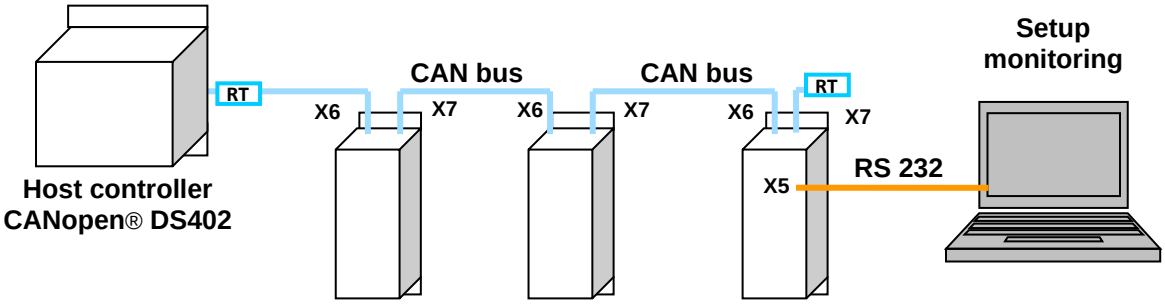
4.5 - CONNECTION TO THE "*GEM DRIVE STUDIO*" SOFTWARE TOOL

4.5.1 - Connection of the serial link to the X5 connector



4.5.2 - Multiaxis connection of the serial link

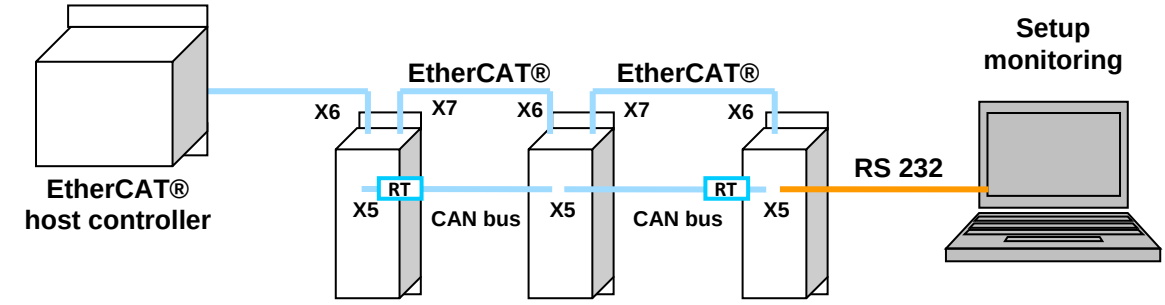
4.5.2.1 - XtrapulsPac™ drive in CANopen® configuration



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 - XtrapulsPac™ drive in EtherCAT® configuration



RT = 120 Ohm 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 10 mA continuous: the protection conductor section must be **at least** 10 mm² (Cu) or 16 mm² (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 300 mA 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: 0.77 Nm.

The reference potential must be the ground: 10 mm² 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 (< 0.1 Ω). 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.

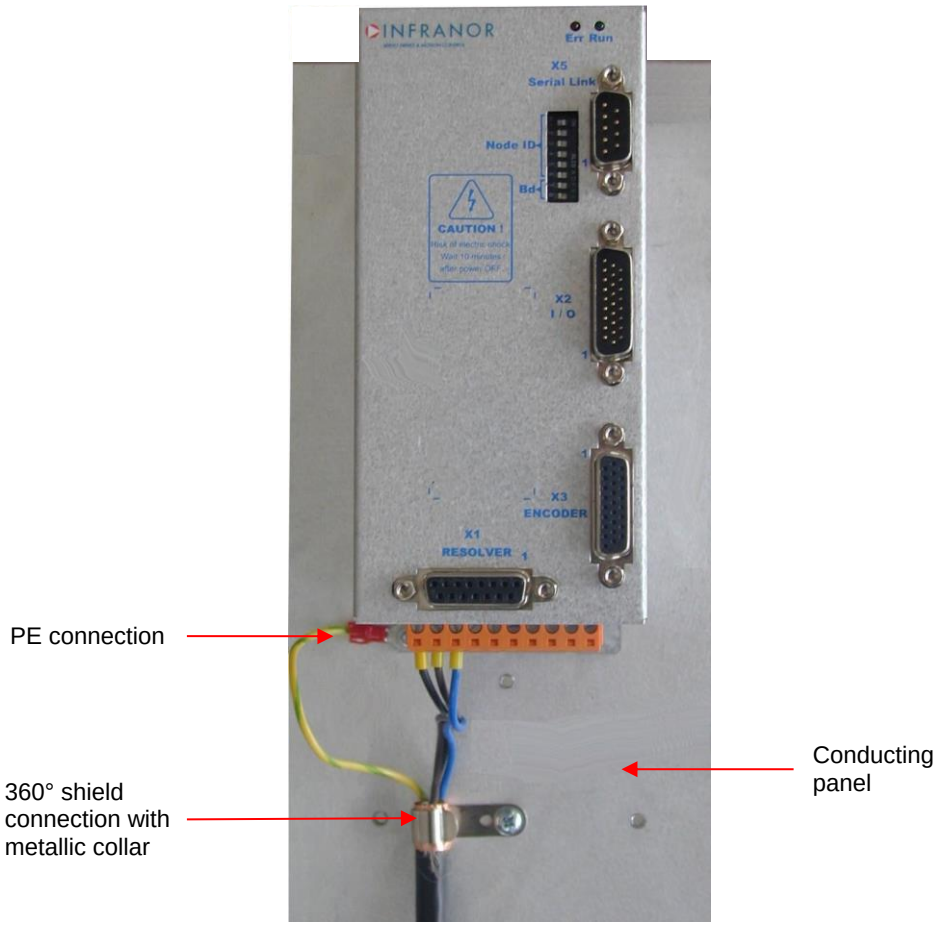
Cables with low potential should **never** run in the proximity of high power lines.

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 MUST 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 5 V ±5 % / 300 mA and 25 m cable length.
Supply voltage: 5 V ±5 % ⇨ΔU_{max} = 0.25 V ⇨ Minimum section: S = 1.2 mm².

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 (0.6 mm²),
- or use the same encoder type but in a version which allows a power supply voltage from 3.6 to 5.25 V / 300 mA. Minimum power voltage 3.6 V ⇨ΔU_{max} = 1.4 V ⇨ Min. section: S = 0.21 mm².

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 24 V_{DC} and power supplies. Check that the housing serigraphy actually corresponds to the power connections.
The 400 V_{AC} connection of a 230 V 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 24 V_{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.

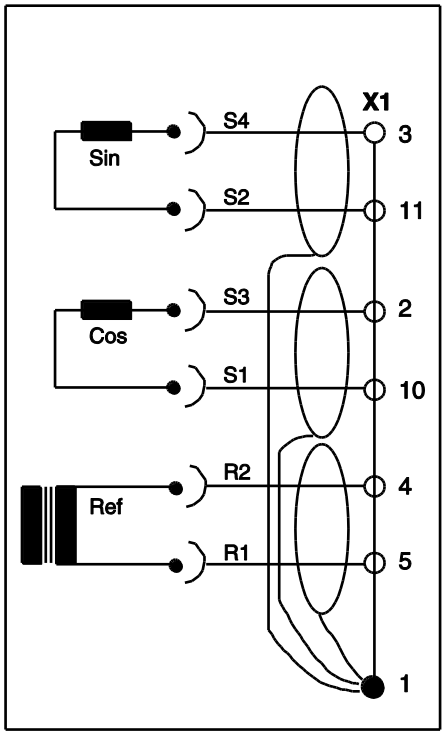
4.7.4 - Starting procedure

See **XtrapulsPac™ – User Guide**.

Chapter 5 – Appendix

5.1 - ADJUSTMENT TO VARIOUS RESOLVER TYPES

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



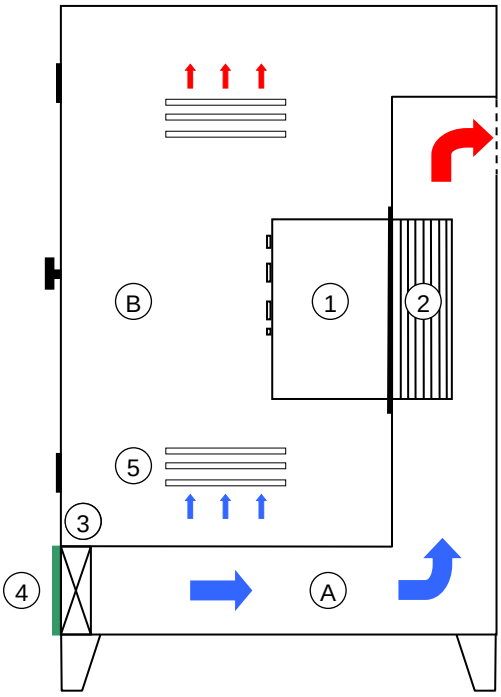
When using **resolvers** with **transformation ratios** out of the range 0.3 to 0.5, the adjustment must be factory set.

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

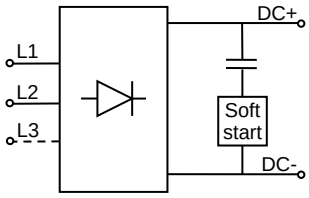
The thermal partition 'A' of the cabinet is cooled by forced air convection. The fresh air passes through a filter that needs to be periodically cleaned according to the pollution issued from the factory process.
The electronic partition 'B' of the cabinet is cooled by natural air convection.

5.3 - SOFT START SYSTEM

5.3.1 - Introduction

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

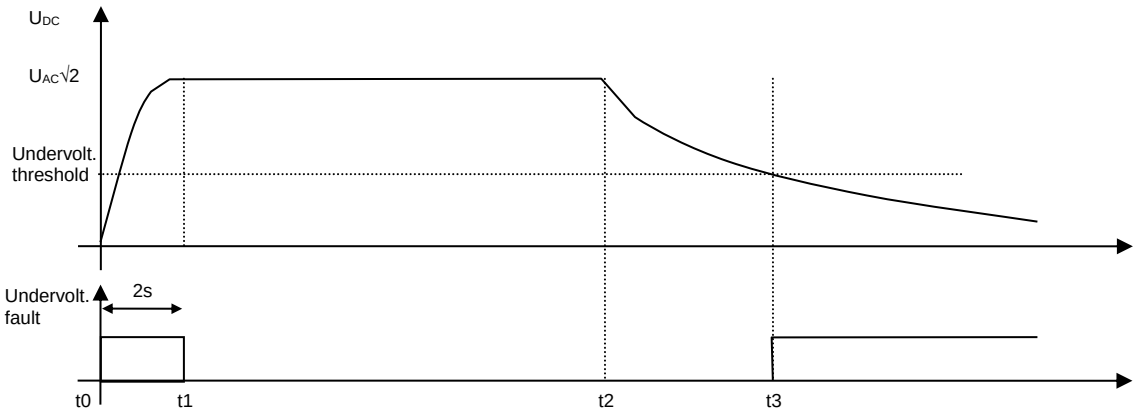
XtrapulsPac



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 **XtrapulsPac™** 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 I²t 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 35 W.
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. 1 m).

5.5 - LOW OPERATING VOLTAGE

XtrapulsPac™ drives offer the possibility to change the operating voltage.
Thanks to this feature, **XtrapulsPac™** drives are able to work within a wide voltage range of from 24 Vdc / 17 Vac up to 800 V_{DC} / 480 V_{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	4 kHz	0.15 mH	0.30 mH	0.48 mH	2 mH	4 mH
	8 kHz	0.08 mH	0.15 mH	0.24 mH	1 mH	2 mH
	16 kHz	0.04 mH	0.08 mH	0.12 mH	0.5 mH	1 mH
Minimum braking resistor		$standard\ minimum\ braking\ resistor \times \frac{actual\ operating\ voltage}{standard\ operating\ voltage}$				
Undervoltage threshold		17 V_{DC}	20 V_{DC}	30 V_{DC}	100 V_{DC}	210 V_{DC}
Braking threshold		30 V_{DC}	60 V_{DC}	85 V_{DC}	390V_{DC}	790 V_{DC}
Overvoltage threshold		35 V_{DC}	70 V_{DC}	100 V_{DC}	430 V_{DC}	910 V_{DC}

IMPORTANT

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

- Voltages below +15 V_{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 40 V_{DC} for a Pac 230 V
    - Below 80 V_{DC} for a Pac 400 V.

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

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 INFRANOR.

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 1000 m.
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 3000 m.
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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