



SERVICE MANUAL

ENGLISH

AXOR INDUSTRIES®
MOTORS
& DRIVES



MAGNUM 400

Stand Alone Brushless Servo Drive

Release	Notes
ver.1 rel.12/'05	New paging. Insert: Positioning and Homing Procedures. Corrections.
ver.1 rel.09/'06	New paging. Update chapters: "General Advices", "Installation", "Interfaces", "Diagnostic", "Appendix". Insert chapter: "7: Applications". Insert Index. Corrections.
ver.1 rel.03/'07	Update chapter: "5: Diagnostic". New chapter reserved to Positioner and Homing procedure. Update chapter "7: Applications": Reset Fault Function, Emergency Function, Stop Functions. Corrections.
ver.2 rel.09/'07	Manual reorganisation: first base version.
ver.2 rel.02/'08	Regen resistance dimensions insertion. Min/max dc bus voltage values insertion. Brake circuit set point insertion. Corrections.
ver.2 rel.12/'08	Corrections. Figure pag.31 corrected. Figure and note pag.39 corrected. Note pag.40 corrected. RS485 connection inserted.
ver.2 rel.01/'10	Note about regen resistance inserted.
ver.2 rel.09/'13	Correct note about resistor on RS485 interface.
ver.2 rel.04/'15	Update chapter: "5: Diagnostic".
ver.2 rel.05/'15	Corrections.

All rights reserved. Reproduction in whole or in part is prohibited without prior written consent of the copyright owner. All specifications are subject to change without prior notification.

This manual has been carefully checked. However, Axor does not assume liability for errors or inaccuracies.



**THIS MANUAL CONTAINS A DESCRIPTION OF MAGNUM400™
AND A GUIDELINES FOR THE DRIVE'S INSTALLATION;
FOR MORE DETAILS SEE ENCLOSURES ON THE CD PROVIDED WITH THE DRIVE.**

**USING THE DRIVE INCORRECTLY CAN INJURE PEOPLE OR DAMAGE THINGS.
FULLY RESPECT THE TECHNICAL DATA AND INDICATIONS ON CONNECTION
CONDITIONS.**

Summary

1) Description

1.1 Description	6
1.2 General view Magnum400	9
1.3 Technical Data	10
1.4 Mechanical Dimension	12
1.5 Product plate and Ordering Code	13

2) Installation

2.1 General Advices	16
2.2 Positioning	19
2.3 Environmental conditions	20
2.4 Cables	21
2.5 Connection to ground and earth	22
2.6 Note about cable shielding	23
2.7 Base installation procedure	24
2.8 Example of base connection	25
2.9 Supply connections	26
2.10 Motor power connection	27
2.11 Relè OK and regen resistance connections	28
2.12 Digital inputs connection	30
2.13 Digital outputs connections	31
2.14 Analog outputs connections	32
2.15 Analog inputs connections	33
2.16 Emulated encoder outputs connection	34
2.17 Pulse/Dir inputs connections	35
2.18 Feedback signals connections	37
2.19 Multidrop connection	39
2.20 Canbus connection	40
2.21 RS485 connection	41
2.22 Magnum400™ power up	42
2.23 Motor Test	43

3) Diagnostic

3.1 Display	46
3.2 Alarms	47

Index	50
--------------	-----------

Conformity	52
-------------------	-----------

Enclosures to the manual

On the CD provided with the drive there are the following enclosures (in pdf):

- Operative Modes Manual
- Additional Features Manual
- Speeder One Interface
- Positioner Manual
- Display and Keypad Manual
- Alarms Manual
- ModBus Manual
- CanOpen Reference Manual
- Cables Manual
- Oscilloscope Manual
- Procedures Manual (*available only on request*)

Chapter 1

Description

1.1 Description	6
1.2 General view Magnum400	9
1.3 Technical Data	10
1.4 Mechanical Dimension	12
1.5 Product plate and Ordering Code	13

1.1 Description

The **Magnum400™** is a digital drive capable of piloting both rotary AC brushless motors and linear motors, up to **30Nm**. It can be supplied by a 3-phase voltage equal to **400** or **480Vac**.

OPERATIVE MODES		
SPEED CONTROL	It is speed piloting utilising a digital reference or an analogue reference (differential or common mode).	standard
TORQUE CONTROL	It is torque piloting utilising a digital reference or an analogue reference. This function allows you to control the current from the drive.	standard
POSITION CONTROL	<p>The positioner can be managed via hardware (by using the digital inputs) or via RS232 (by using the Axor's <i>Speeder One</i> interface or another ModBus Master). It supports <i>32 programmable position profiles</i>; a <i>single task</i> or a <i>sequence of tasks</i> are permitted.</p> <p>The Homing Procedure is implemented. It uses the signal coming from the <i>homing sensor</i> and eventually the <i>zero signal</i> of the encoder.</p>	standard
ELECTRICAL AXIS (GEARING)	It is possible to pilot the drive with the quadrature signals of an emulated encoder from a Master drive or with the quadrature signals of an incremental encoder from a Master motor (Electrical Axis or Gearing).	standard
PULSE/DIRECTION	It is possible to connect the drive to a stepper-motor controller , piloting it with the +/-Pulse and +/-Dir signals (Pulse/Dir Mode).	standard
MULTIDROP RS232	It can work in Multidrop , where the first drive, connected via RS232 to the Master PC, is piloted with <i>ModBus communication</i> , while the other drives are piloted with the duplication of commands using the <i>CanBus interface</i> .	<i>optional</i>
RS485 INTERFACE	It is possible to communicate with two or more drives by using the RS485 interface .	<i>optional</i>
CANBUS	<p>It can be configured and controlled using CanBus. It supports the following Can Open protocols:</p> <ul style="list-style-type: none"> • part of the DS301-V4.02 • part of the DSP402-V2.0 	<i>optional</i>
Notes: <ul style="list-style-type: none"> • The current controller is vectorial with sampling time of 62,5µs. <p>The velocity and position loop both work with sampling time of 250µs.</p> <ul style="list-style-type: none"> • The current commutation is sinusoidal. 		
FEEDBACK		
ENCODER	incremental encoder signals + hall signals	standard
RESOLVER	2, 4, 6, 8 pole	<i>optional</i>

1.1 Description

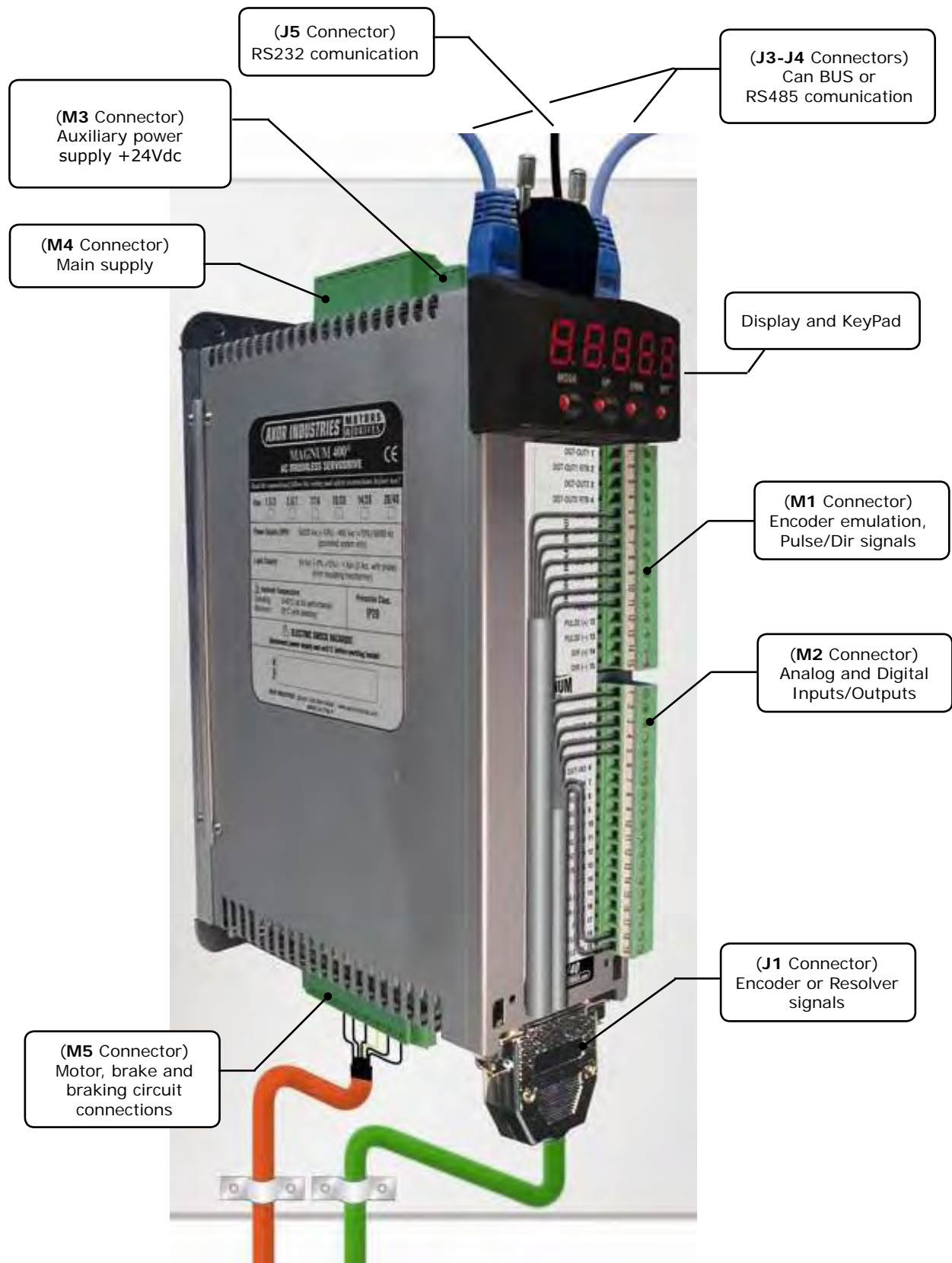
DIGITAL INPUTS/OUTPUTS		
9 DIGITAL INPUTS	They are programmable for: the limit switch, the holding brake, the homing and positioning procedures, the emergency stop, the reset alarm, etc.	standard
2 programmable DIGITAL OUTPUTS	They can be used to send messages from pre-programmed functions of the drive.	standard
EMULATED ENCODER OUTPUTS	There are 6 pins dedicated to emulated encoder with different programmed ratios (1/2, 1/4, 1/8, 1/16, 1/32, 1/64, 1/128) between output pulse/rev and encoder/resolver ones.	standard
ANALOG INPUTS/OUTPUTS		
1 ANALOG COMMON MODE INPUT (TPRC)	It is used for controlling the current from the drive.	standard
1 ANALOG DIFFERENTIAL or COMMON MODE INPUTS (+/-Vref)	It is used for piloting the drive with an analogue speed reference from an external controller.	standard
2 programmable ANALOG OUTPUTS	They allow you to visualise by the oscilloscope some of the drive's measurement values (for example: the velocity, the Iq current, etc.).	standard
GENERAL FEATURES		
KEYPAD	Four buttons (UP-DW-MODE-SET) allow the manual insertion of data without using a PC.	standard
DISPLAY	A display with 5 characters visualises: the inserted values, the drive's status, the alarms.	standard
SPEEDER ONE SOFTWARE INTERFACE	It allows you to set and manage all drive's parameters by using a PC connected to the drive. The communication between the drive and PC is done by a RS232 cable using the ModBUS protocol. The software works on the following operating systems: Windows 98, Windows 2000, Windows XP.	standard

1.1 Description

HOLDING BRAKE	The drive has circuitry that allows the control of the electromechanical brake integrated in the motor, which can be used <i>with motor not running, for blocking the motor's axis</i> . The drive supplies the brake with +24Vdc . It can be externally managed by the user or automatically by the drive.	<i>optional</i>
EMI FILTER	The drive is equipped with an integrated EMI anti-disturbance filter at the 3-phase power supply input and with another EMI anti-disturbance filter at the auxiliary +24V power supply input.	standard
REGEN CIRCUIT		standard
EXPANSION CARDS	There is a slot for expansion card to implement additional features.	<i>optional</i>
SAFETY		
SAFETY	The converter is protected from short circuitry, the Max/Min Voltage, the drive I ² t , the Motor I ² t , etc. When there is an alarm the "Relè OK" contact opens and the motor is stopped, or a message is visualised on the display without compromising the system's functioning.	standard
BLACK-OUT DYNAMIC BRAKE FUNCTION	It stops the motor when there is a black-out.	<i>optional</i>
EQUIPMENT		
a drive serie Magnum400™		standard
terminals: M1, M2, M3, M4, M5		
Service Manual		
a CD-ROM with Speeder One software interface and all enclosures to service manual		
Motor inductance, 3x1.2mH, for cables over 20/25 meters in length		<i>optional</i>
an external braking resistor (500W or 1000W)		
CBLS cable for motor feedback signal, encoder/resolver (meter multiple)		
CBLS power cable for motors series <i>SuperSAX</i> ;		
motors series <i>SuperSAX</i>		

All *optional* features have to be requested by using the proper ordering code (see "1.5 Product plate and Ordering code").

1.2 General view Magnum400



1.3 Technical Data

Nominal Data							
Nominal Voltage	Vac	Three phase: 3x480Vac +10% max, 3x400Vac -10%, 50/60Hz (Single phase permitted for setup only)					
Min/Max dc bus voltage	Vdc	400Vac			480Vac		
		400Vdc min ÷ 800Vdc max			500Vdc min ÷ 870Vdc max		
Auxiliary power supply (for back up)	Vdc	+24Vdc (0%, +15%) - 1Adc (3Adc with brake)					
Size		1,5/3	3,5/7	7/14	10/20	14/28	20/40
Nominal Current	Arms	1,5	3,5	7	10	14	20
Peak current for 5 sec.	Arms	3	7	14	20	28	40
Dissipation at nominal current	W	30	42	56	88	165	195
Dissipation with output stage disabled	W	20					
PWM output frequency	kHz	8					

Control signals	
Optoisolated digital inputs	+24Vdc - 7mA (PLC compatible)
Optoisolated digital outputs	+24Vdc - 50mA (PLC compatible)
Analog programmable outputs	±10V (±5%)
A common mode analog input (TPRC)	±10V max, 10kOhm input resistance
A differential or common analog input (+/-Vref)	±10V max, 40kOhm input resistance
Pulse/Dir digital inputs	+5V, optoisolated, max. frequency 250kHz
Emulated encoder outputs	$V_{OH}=2.5V \text{ min} - I_{OH}=-20mA$ $V_{OL}=0.5V \text{ max} - I_{OL}=20mA$

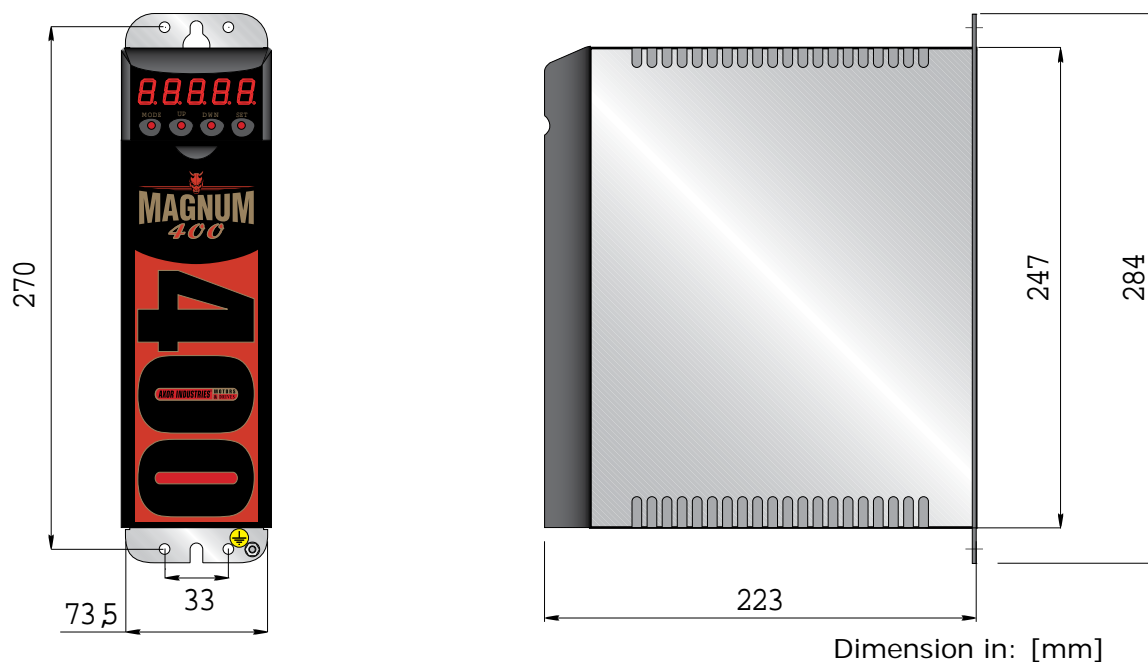
Braking Resistance		
Internal Resistance	200W - 660hm size: 1.5/3, 3.5/7, 7/14	
	200W - 330hm size: 10/20, 14/28, 20/40.	
External Resistance	500W - 660hm size: 1.5/3, 3.5/7, 7/14.	
	500W - 330hm size: 10/20, 14/28, 20/40.	
	1000W - 330hm +330hm 500W size: 1.5/3, 3.5/7, 7/14.	
	1000W - 660hm // 660hm 500W size: 10/20, 14/28, 20/40.	
Set point values	400Vac	480Vac
	695Vdc min ÷ 735Vdc max	815Vdc min ÷ 845Vdc max

1.3 Technical Data

Motor encoder inputs	
Encoder supply	+5V @ 220mA ($\pm 5\%$)
Differential encoder inputs line receiver	AM26LS33
Differential hall signal inputs line receiver	AM26LS33
Encoder max. frequency	250kHz

External Protections (fuses or similar)			
Size	1,5/3 and 3,5/7	7/14 and 10/20	14/28 and 20/40
Power supply (F_2)	6A T(Time Lag)	10A T	20A T
Auxiliary power supply (F_3)	6A T		
External braking resistor (F_4)	4A F(Fast)	6A F	6A F

1.4 Mechanical Dimension

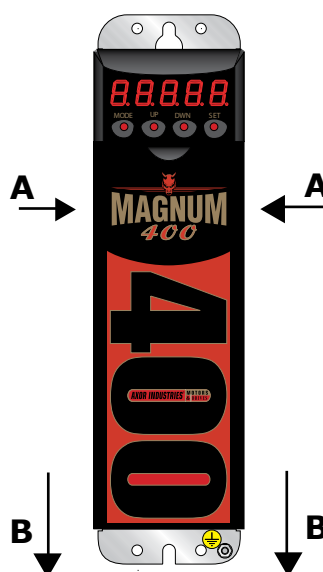


Mechanical specifications							
External dimensions	mm	284 x 223 x 73,5					
Size		1,5/3	3,5/7	7/14	10/20	14/28	20/40
Weight	Kg	4,2			4,6		

NOTE:

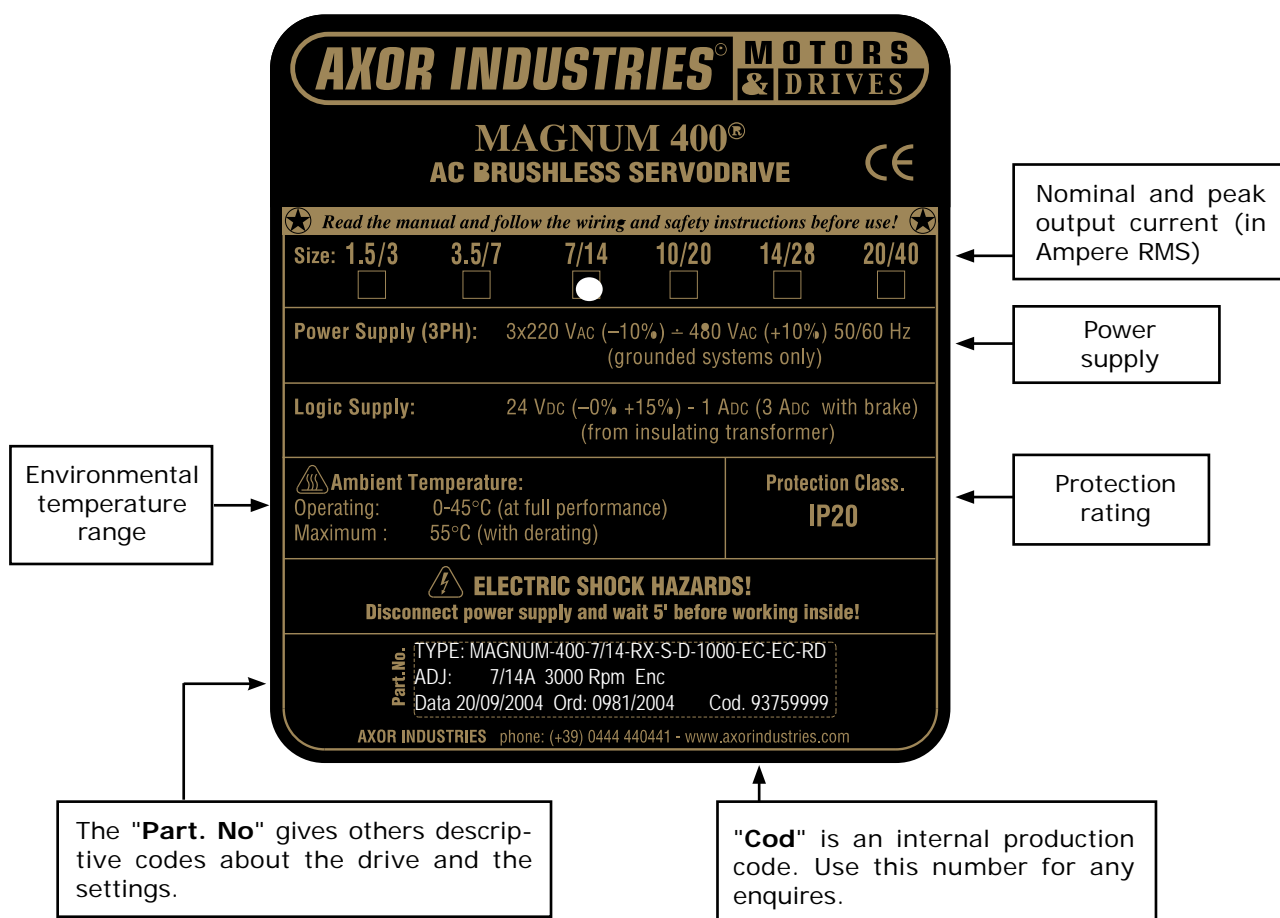
The **M1** and **M2** connectors are located under the plastic cover.

To open it, push the cover on the borders (see A), move it down and remove it (see B).

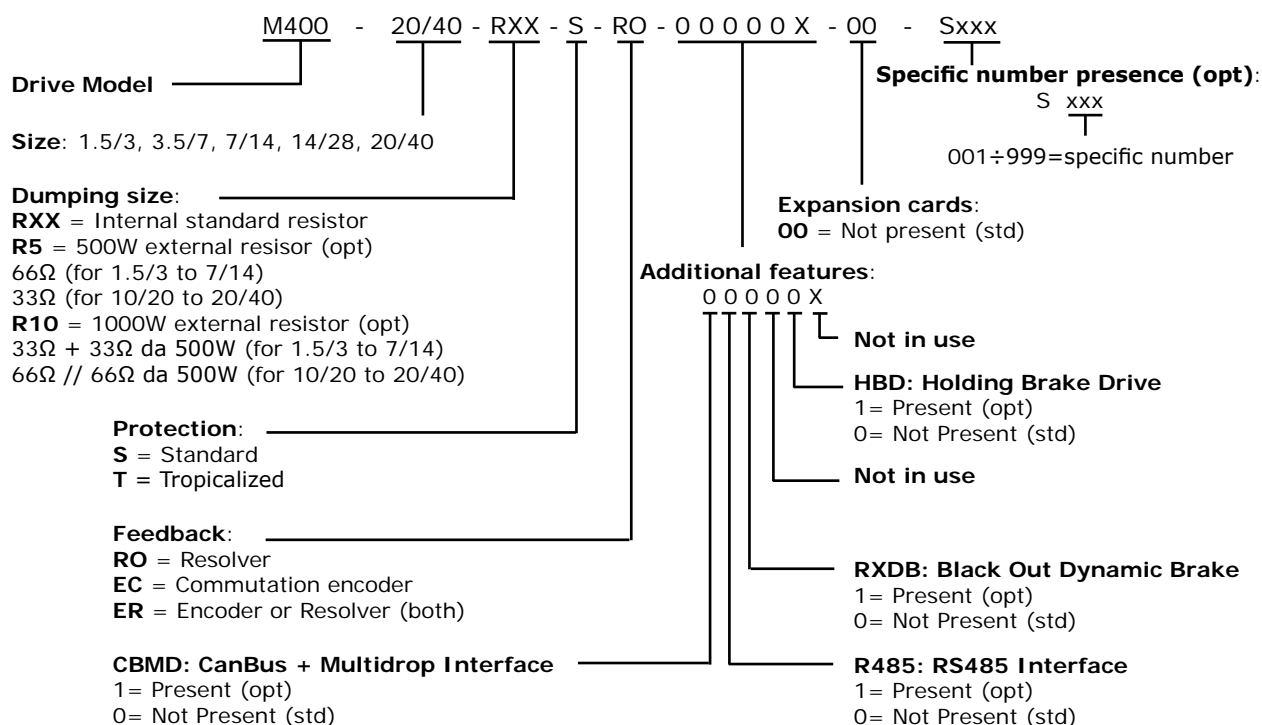


1.5 Product plate and Ordering Code

On the side of each **Magnum400™** there is a **product plate** like the following:



To order a digital drive serie **Magnum400™** refer to this **ordering code**:



Chapter 2

Installation

2.1 General Advices	16
2.2 Positioning	19
2.3 Environmental conditions	20
2.4 Cables	21
2.5 Connection to ground and earth	22
2.6 Note about cable shielding	23
2.7 Base installation procedure	24
2.8 Example of base connection	25
2.9 Supply connections	26
2.10 Motor power connection	27
2.11 Relè OK and regen resistance connections	28
2.12 Digital inputs connection	30
2.13 Digital outputs connections	31
2.14 Analog outputs connections	32
2.15 Analog inputs connections	33
2.16 Emulated encoder outputs connection	34
2.17 Pulse/Dir inputs connections	35
2.18 Feedback signals connections	37
2.19 Multidrop connection	39
2.20 Canbus connection	40
2.21 RS485 connection	41
2.22 Magnum400™ power up	42
2.23 Motor Test	43

2.1 General Advices

Transport

During the transport of the drive respect the following indications:

- the transport must be made by qualified personnel;
- avoid shocks;
- the temperature range must be between -25°C and +55°C;
- the max. humidity must be 95% (without condensation);
- The converters contains elements which are sensitive to electrostatic discharges. These elements can be damaged by careless manipulation.

Discharge static electricity from your body before touching the converter.

Avoid contact with material that insulates well (synthetic fibres, films of plastic material and so forth).

- we suggest to check the motor condition at its arrival to survey eventual damages.

Storage

The unused drives must be storage in an environment having the following characteristics:

- temperature from -25°C to +55°C;
- max. relative humidity 95% (without condensation);
- max. time with the drive powered off (without supply connections):
 - ✓ drive having a power supply $\geq 220\text{VAC}$ \Rightarrow **1 year**
 - ✓ drive having a power supply $\leq 145\text{VAC}$ (200VDC) \Rightarrow **2 years**

After this time, before enable the drive, it is necessary activate the capacitors following this procedure: remove all electrical connections, then supply the input terminals of the supply with the main voltage (three phase or single phase) for 30 minutes.

In details:

- for the drive having a power supply equal to 380VAC: power it by using a single phase (or three phase) supply equal to 220VAC;
- for the drive having a power supply equal to 220VAC: power it by using a single phase (or three phase) supply equal to 110÷130VAC.

In order to avoid this procedure, we suggest to power on the drive with its rated voltage for 30 minutes, before the max. time is reached.

Maintenance

The drives does not need maintenance.

Otherwise:

- if the casing is dirty: clean it with isopropanol or similar;
- if the drive is dirty: the cleaning is reserved to the producer;
- if the fans are dirty: clean them by using a dry brush.

Disposal

The disposal should be carried out by a certified company.

2.1 General Advices

Security standard

- This manual is exclusively addressed to technical personnel with the following requirements:

- Technician with knowledge on movimentation of elements sensitive to electrostatic discharges (for the transport).
- Technician with appropriate technical training and with vast knowledge on electrotechnics/drive technical field (for the installation and operation of servodrives).



Using the drive incorrectly can injure people or damage things. Fully respect the technical data and indications on connection conditions.

- As well as the points described in this manual, current regulations regarding safety and accident prevention must be followed in order to prevent accidents and residual risks.

- The user must analyse possible machine risks and take the necessary measures to avoid injuries to people and damage to things because of unpredictable movements.

- The converters contains elements which are sensitive to electrostatic discharges. These elements can be damaged by careless manipulation.

Discharge static electricity from your body before touching the converter.

Avoid contact with material that insulates well (synthetic fibres, films of plastic material and so forth).

- During operation, the converter surface can become hot. Protect the user from accidental contact and keep the indicated distances from all objects.

- Never loosen electrical connections while the servoamplifiers are being powered.

The appropriate terminals of the drive must always be connected to earth as instructed in this manual. After having disconnected the converters from the supply current, always wait at least 5 minutes before touching the powered components (e.g. contacts) or loosening connections.

- Switch off the converter and wait at least 5 minutes before opening it. Remove the fuses or switch off the main switch before removing the drive. When opening, place the converter on a surface that does not belong to the electrical panel.

- The residual charges in the capacitors can remain at a dangerous level for up to 5 minutes after disconnection from the mains. Measure the voltage at the intermediate circuit (+AT/-AT) and wait until it is below 15V.

- The command and power connections can still hold current even when the motor has stopped.

- The **Magnum400™** is equipped with electronic protections that deactivate it in case of irregularities. The motor, as a result, is not controlled and can stop or go into neutral (for a time determined by the type of system).

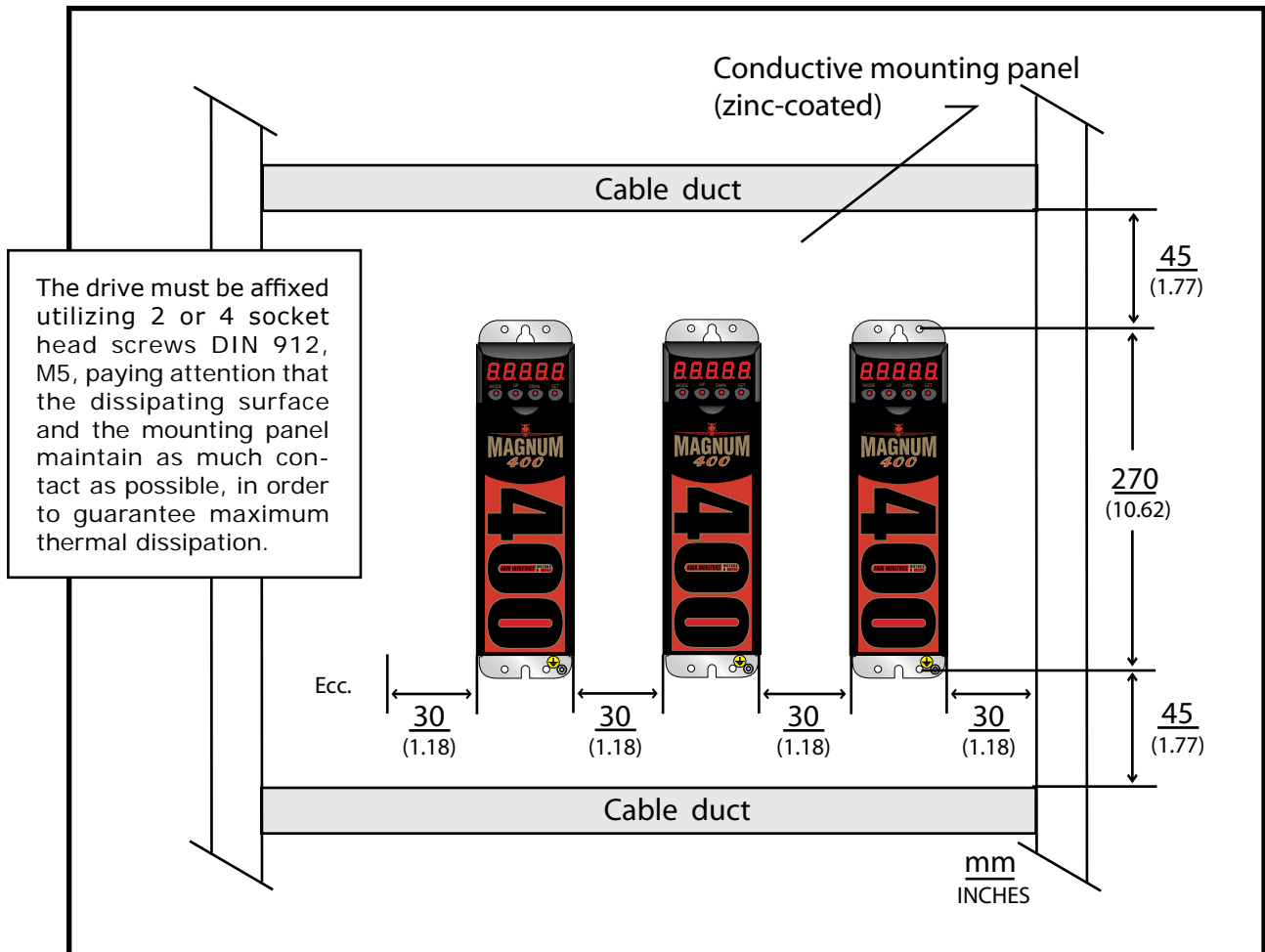
- During installation, avoid letting any residue with metallic components fall inside the drive.

2.1 General Advices

- Protect the converter from excessive mechanical vibrations in the electrical box.
- Check that the main supply and the nominal current are coherent with the rating of the drive. Be sure that the voltage between the connectors L1-L2-L3 is not greater than 10% of the nominal values. An excessively high voltage causes the breakdown of the load circuitry and of the drive.
- The **Magnum400™** is equipped with an integrated **EMI anti-disturbance filter** at the 3-phase power supply input and with another EMI anti-disturbance filter at the auxiliary +24V power supply input. Being implicit to filter operation the deviation towards earth or mass of the undesired frequencies, ensure that these devices can produce leakage currents towards earth, which are measurable in milliAmps. Please remember that "leakage currents" must be considered when settings differential devices in order to avoid useless interventions.
For safety reasons connect the prepared terminal to earth before powering the drive. Incorrect connections make filter operation unreliable.

2.2 Positioning

The **Magnum400™** is made to be fixed vertically to the **bottom of the electrical box** in order to guarantee reliable cooling, respecting the following distances:



Note: Arrange the power components (converters, main's filters, resistors, terminals, ...) in bins of the electrical panel different from those reserved to the command or control systems (PLC, PC, CNC, regulators, ...). This improves the level of immunity to interference of the system.

2.3 Environmental conditions

During the storage and the installation respect the followings environmental conditions:

Condizioni ambientali	
Storage temperature	-20°C...+55°C
Working environmental temperature	From 0°C to +45° C (no derating). From +45°C to +55°C the drive must be derated 2.5%/°C in reference to nominal and peak current.
Humidity	From 10% to 85%
Altitude	Up to 1000m without restriction. From 1000 to 2500m of altitude the converter must be derated in the output current of 1.5% every 100m.
Enclosure protection	IP20
Pollution level	LEVEL 2 (Norm EN60204/EN50178) The drives are designed to be utilized in an electrical box protected against the infiltration of polluting agents such as water, oil, conductive dust and others.

Notes:

- The electrical box must have suitably **filtered air vents**.
Leave the necessary space both above and below the converters.
- Periodically check drive case and fans for excess dust or dirt, that could interfere with the correct dissipation of the drive.

2.4 Cables

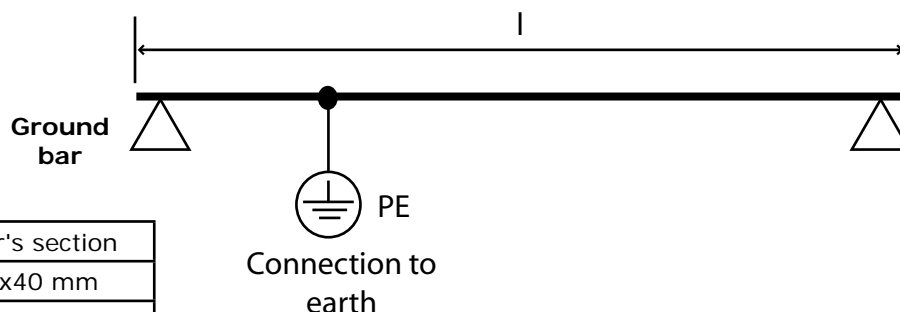
The following table illustrates the technical characteristics of all cables:

Cables (as norm EN60204)		
Type	Section	Notes
for the Main Supply	1.5mm ² /15AWG drive size: 1.5/3, 3.5/7, 7/14	Always insert a power relay or a thermal magnet on every phase of the products power supply.
	2.5mm ² /14AWG drive size: 10/20, 14/28, 20/40	
for the Auxiliary Supply	1.5mm ² /15AWG	Connect the 0V of the auxiliary supply to the ground bar.
for the Motor's Brake	0.75mm ²	It must shielded.
for the Motor's Power	1.5mm ² /15AWG drivesize: 1.5/3, 3.5/7, 7/14	It must be shielded. It must have a capacity of $\leq 150\text{pF/m}$. In the configuration without filter, the cable can reach a maximum length of 20/25m. If the length exceeds 20/25m, insert an Axor 3x1.2mH filter.
	2.5mm ² /14AWG drive size: 10/20, 14/28, 20/40	
for the Control signals and I/O signals from PLC/CNC	0.5mm ² /20AWG	See "2.6 Note about cable shielding"
for the Encoder signals	0.25-0.35mm ² / 22-24AWG	It must be shielded. It must have a capacity less than 120pF/m.
for the Resolver signals	0.25-0.35mm ² / 22-24AWG	
for external resistor	1.5mm ² /15AWG	The cable must be as short as possible. If the cable length is greater than 20/30cm, it must be twisted and shielded. The shield must be connected to ground on both ends, utilising u-clamps to the zinc panel of the electrical box.
for the RS232 communication	0.22mm ² /24AWG or 0.34mm ² /22AWG	The length of the cable must be equal to or less than 2.5m. It must be connected when the main supply and the auxiliary supply are both powered off. It must have a capacity less than 160pF/m.
for the CanBus communication	0.25mm ² /0.34mm ²	Cable capacitance: max 60 nF/km. Impedance characteristics : 100...120Ω. Lead resistance (loop): 159,8 Ω/km. The length depends upon the transmission speed: <ul style="list-style-type: none"> • 1000kbit/s \Rightarrow 20m max; • 500kbit/s \Rightarrow 70m max; • 250kbit/s \Rightarrow 115m max.
Note: <ul style="list-style-type: none"> • Avoid crossing, overlapping and twisting cables together. If it is absolutely necessary to cross them, do so at 90°. • On request Axor provides motor signal cables series <i>encoder or resolver</i> for motors series <i>Super-SAX</i>. 		

2.5 Connection to ground and earth

Make sure that the servodrive and the motor are connected to earth in accordance with the current norms.

This connection must be done by using a copper bar, mounted on insulating supports, as illustrated below:



l	Bar's section
0,5 ... 1 m	5x40 mm
1 ... 2 m	5x50 mm

then follow these indications:

1. Connect to the ground bar:

- ✓ the **earth power terminal of the drives**;
- ✓ the **CHASSIS** of all drives;
- ✓ the **DGT-IN RTN** pin of the digital inputs for each drive;
- ✓ the **0V of the auxiliary supply**;
- ✓ the **internal zero voltage of the CNC**;
- ✓ the **earth terminals of the PLC/CNC frames**;

2. Connect the **ground bar** to the zinc panel of the drive by using a screw, then connect that screw to **earth**.

3. Connect earth to the **motor's carcass**.

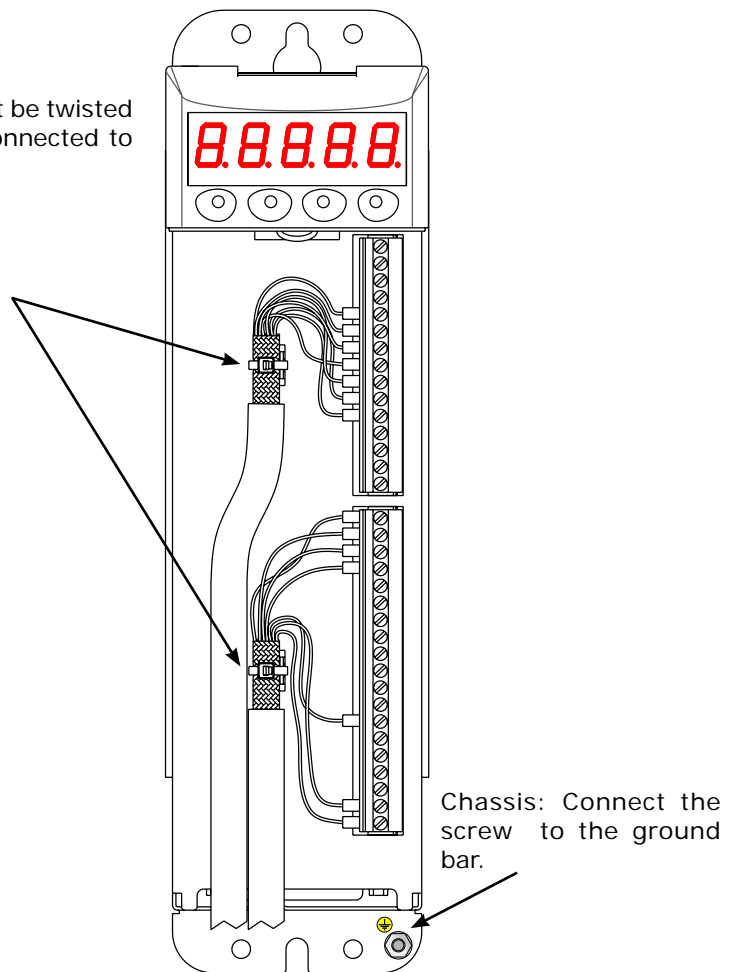
Symbol	Description
	It suggests a conductive connection as much as possible to the chassis, or the heat-sink, or the mounting panel of the electrical box.
	It refers to the earth connection.
	It refers to the connection of the shield to the drive's carcass as illustrated on page 23.
	It refers to the connection of the shield to the connector's metal ring.

2.6 Note about cable shielding

Control signal cables

The conductor of the analogic signal must be twisted and shielded, and the shield must be connected to ground as illustrated below:

Remove the outside sheath and affix the shield to the dedicated retainer rings, by using plastic clamps.



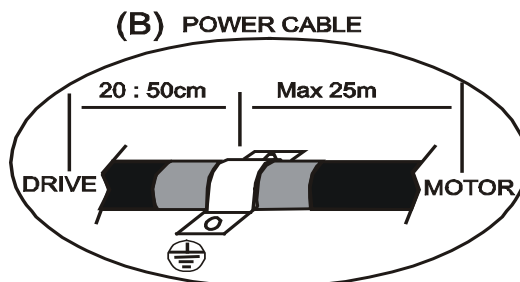
Note:

- To reduce the capacitive and inductive coupling, these cables must be run keeping a distance of more than 30cm from the power cables (10 cm if they are shielded).
- If it is absolutely necessary to cross the control cables with the I/O's, do so at 90°, in order to reduce the effect of the magnetic fields.

Motor cables

The shield of the motor cable (power and signal cables) are connected as follows:

- *drive side* (20:50cm) ⇒ remove the outside sheath and fix shield to the zinc panel, by using a u-clamp (Axor's cables have incorporated u-clamp):



- *motor side* ⇒ the shield is internally connected to the metal ring of the motor connector, thus to earth through the motor's carcass.

2.7 Base installation procedure



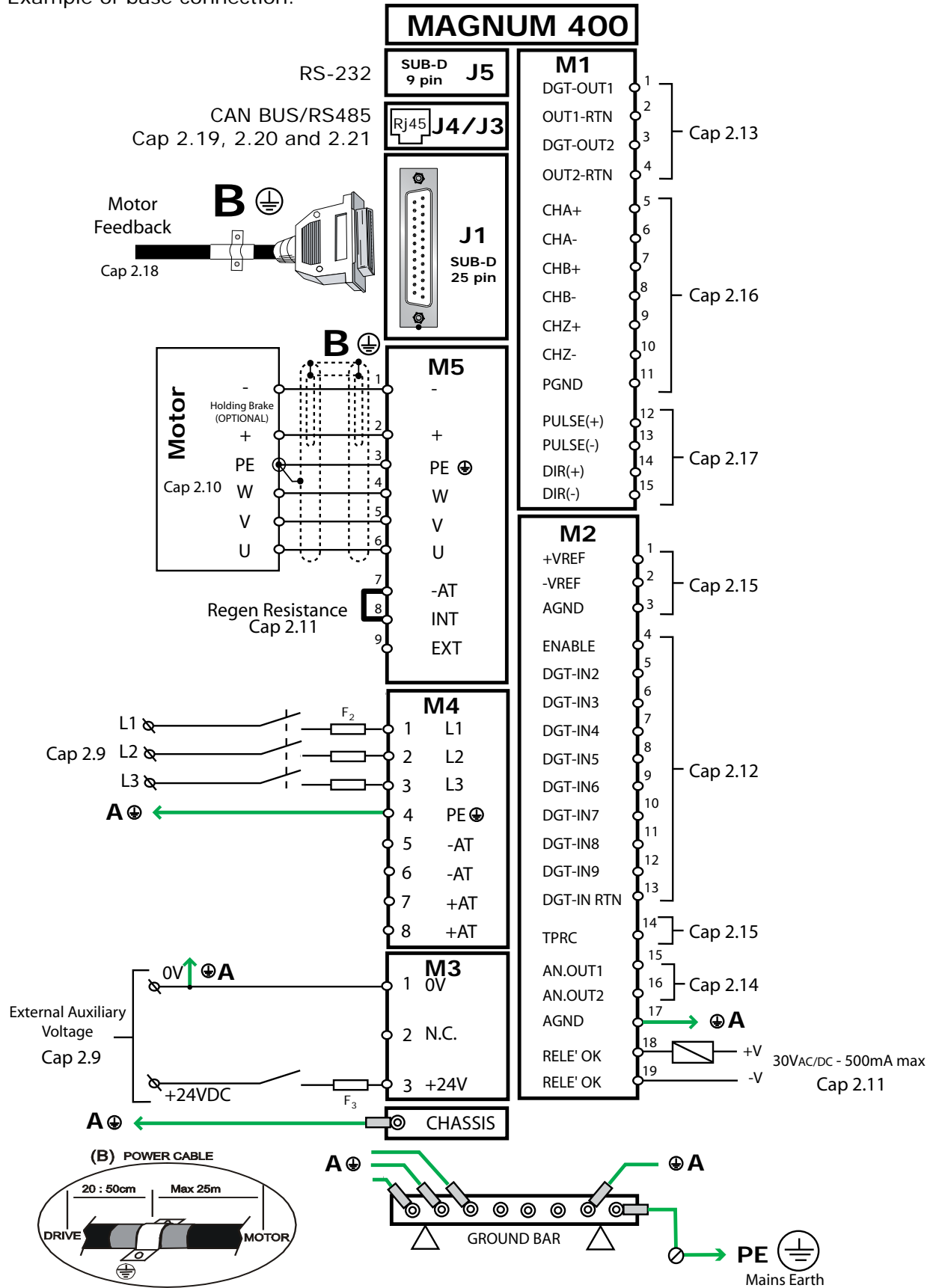
This procedure must be done only by qualified personnel which are familiar with drives. If you need more information contact Axor.

- a) **Power off** all the supplies of the electrical box.
- b) Verify:
 - ✓ the **drive-motor coupling** ⇒ the stall current (I_0) of the motor should be equal to/or greater than the nominal output current of the drive;
 - ✓ the **positioning** of the drive into the electrical box;
 - ✓ the **pollution level** and the **ventilation**;
 - ✓ the **connection to earth** of the electrical box where the drive is installed (see "2.5 Connection to ground and earth").
- c) Execute the wiring following this order, avoiding that wiring's pieces, cables, wires, screws, conductive objects, etc. do not enter into the drive through its slits:
 - 1- First connect **earth**.
 - 2- Connect the **cables for the motor's power** (U, V, W) and the **filter 3x1.2mH**, if the cable length is greater than 20/25m.
 - 3- Connect the **earth of the motor's power** (PE) and, if necessary, connect the cables of the **electromechanical brake**.
 - 4- Connect the **external shield** of the motor's cable: it must be shielded utilising a u-clamp to the zinc panel of the electrical box (see "2.6 Note about cable shielding").
 - 5- If the **internal braking resistor** is used, insert a bridge between pins INT and -AT.
If an **external braking resistor** is used, connect it between pins EXT and -AT by using a cable as short as possible. If the cable length is greater than 20/30 cm, the cable must be twisted and shielded, besides the shield must be connected to ground on both ends utilising u-clamps to the zinc panel of the electrical box.
 - 6- Connect the motor's feedback cable to the drive's **J1** connector
 - 7- Connect the **main power supply cable** (L1-L2-L3) and the **earth cable** (PE).
Always insert a power relay or a thermal magnet on every phase of the products power supply.
 - 8- Connect the **auxiliary supply cable** (+24V).
Use an external power supply, that must be stabilized and galvanically isolated from the main supply.
 - 9- Connect the PC to the drive utilising the **RS232** cable.
 - 10- Supply the drive with the **auxiliary supply** and then **main supply** following the *procedure* illustrated at the end of the chapter.
 - 11- Open the *Speeder One* interface.
 - 12- Execute the tests on the drive and the motor.

In the following page there is an *example of a basic connection*.

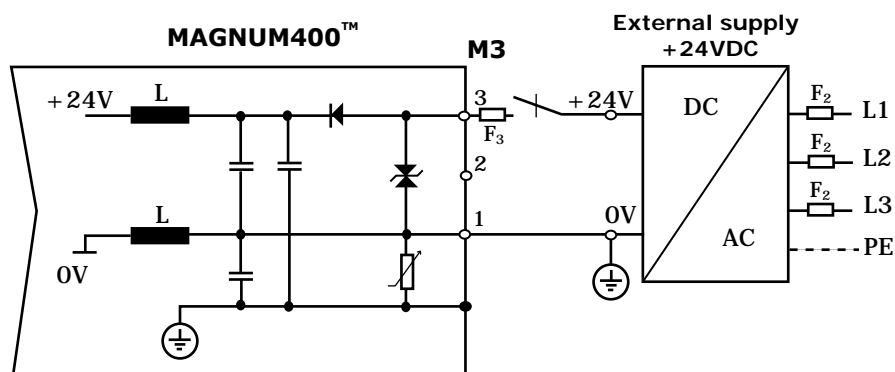
2.8 Example of base connection

Example of base connection:



2.9 Supply connections

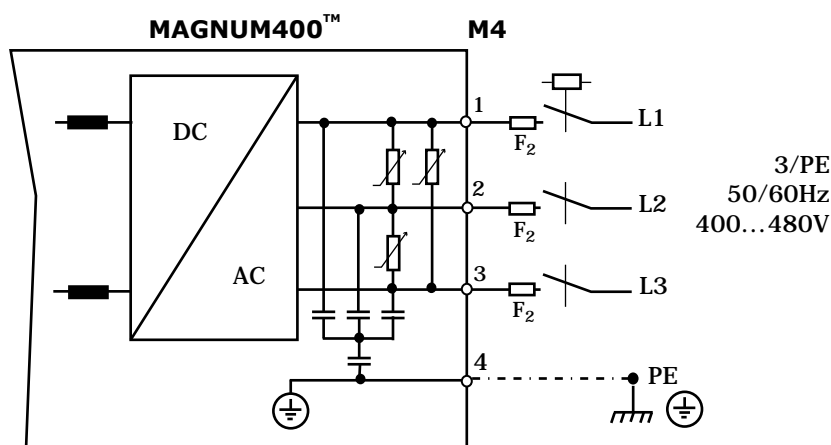
AUXILIARY SUPPLY +24Vdc



Note:

- Accepted voltage: **+24VDC** (0%/+15%);
- current required for the external supply: **3A** (motor with brake);
- current required for the external supply: **1A** (motor without brake);
- we suggest to insert the **F₃** (6A T) fuse;
- we suggest to connect the 0V of the external supply to the ground bar .

POWER SUPPLY



Note:

- **Always insert a power relay or a thermal magnet on every phase of the products power supply.**

• If a power supply between 400V and 480V is utilized and ground protection is not present, or there is an asymmetrical grounding system, an **isolation transformer** is required.
The **nominal power of the transformer** is calculated by adding the various wattage of each motor:

$$P_t = P_n + P_n + P_n + \dots$$

P_t = nominal power of the transformer (VA)

P_n = nominal power of each motor (VA), which can be calculated in this way:

$$P_n = n \times C_n / 9,55$$

P_n = nominal motor power (W)

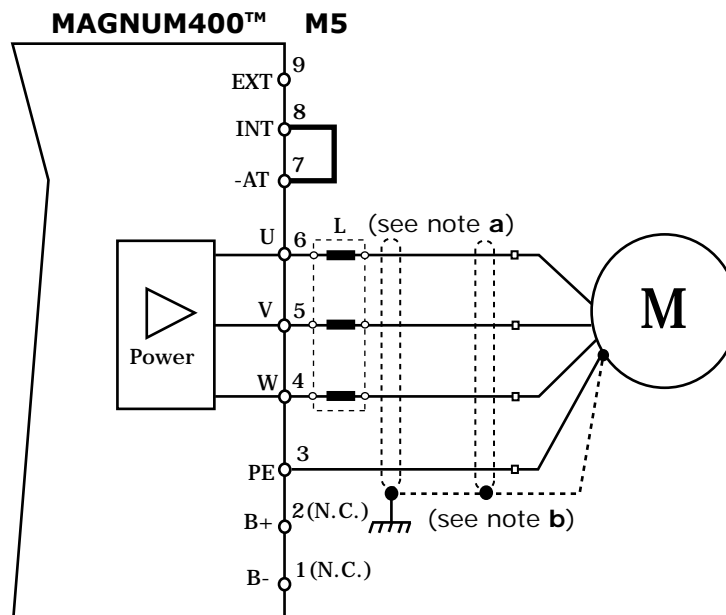
n = motor speed (rpm)

C_n = motor nominal torque (Nm)

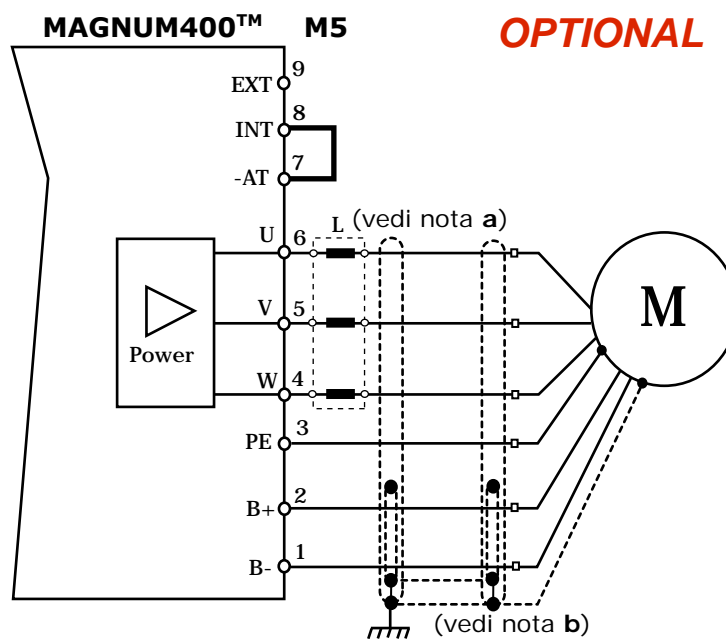
2.10 Motor power connection

MOTOR POWER + MOTOR HOLDING BRAKE

WITHOUT brake



WITH brake



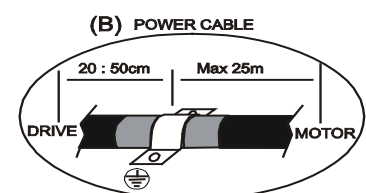
Technical characteristics of brake outputs:

- ✓ Output Voltage: **+24VDC** [0%, +15%].
- ✓ Maximum available current: **3A**.

Note:

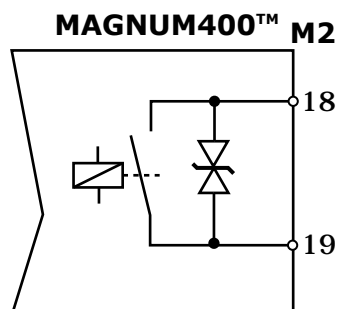
a- Use **3x1.2mH - 20Arms** filter series for connections with cables longer than 20/25 meters.

b- The **earth connection** of the power cable's shield must be made on the zinc-coated panel (using a u-clamp) near the drive (20-50cm). Motor side: the shield is connected to connector's metal ring, so it is connected to ground through motor's carcass.



2.11 Relè OK and regen resistance connections

RELE' OK connection

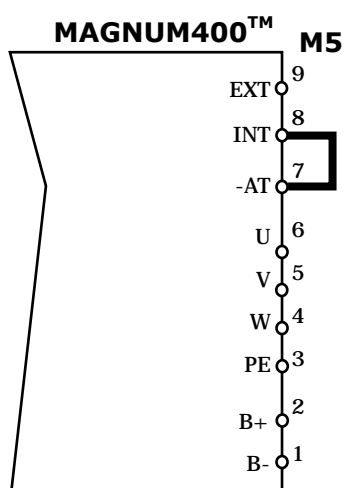


It is normally open when the drive is not supplied;
it is normally closed when the drive is supplied and
it has not active alarms.

30VAC/DC - 500mA max

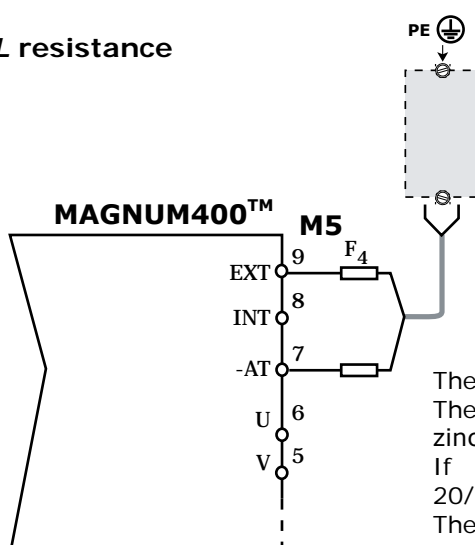
REGEN RESISTANCE connection

INTERNAL resistance



Attention: The internal braking
circuit is enabled only if a bridge is
present between pins 7 (-AT) and
8 (INT) on the M5 connector.

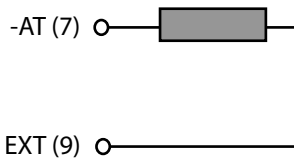
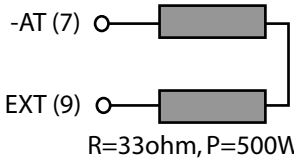
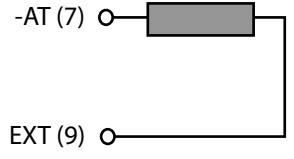
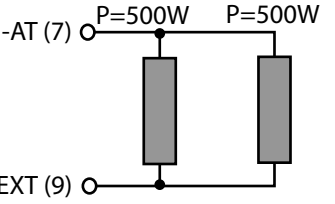
EXTERNAL resistance



OPTIONAL

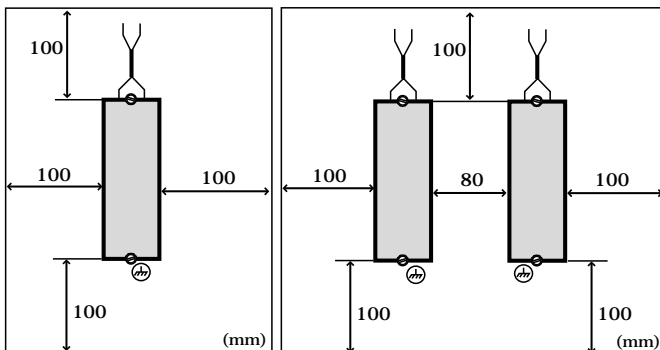
The cable must be as short as possible.
The resistances must be connected to the
zinc panel utilising two screws.
If the cable length is greater than
20/30cm, it must be twisted and shielded.
The shield must be connected to ground
on both ends, utilising u-clamps to the
zinc panel of the electrical box.

2.11 Relè OK and regen resistance connections

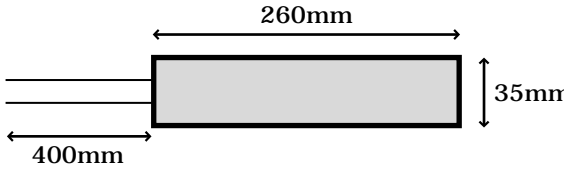
EXTERNAL BRAKING CIRCUIT				
Drive Size [A]	R5 Resistor P _{tot} =500W	Connection	R10 Resistor P _{tot} =1000W	Connection
1,5/3	1 resistor 66 ohm 500W	<div>R=66ohm, P=500W</div> 	2 series resistors 33 ohm 500W	<div>R=33ohm, P=500W</div> 
3,5/7				
7/14				
10/20	1 resistor 33 ohm 500W	<div>R=33ohm, P=500W</div> 	2 parallel resistors 66 ohm 500W	<div>R=66ohm P=500W R=66ohm P=500W</div> 
14/28				
20/40				

Notes:

- The temperature of the zinc panel of the electrical box can be higher than 200°C.
- Do not mount the resistor on surfaces which can be damaged by heat.
- If the resistors are mounted externally, protect them.
- Respect the following distances and shieldings:



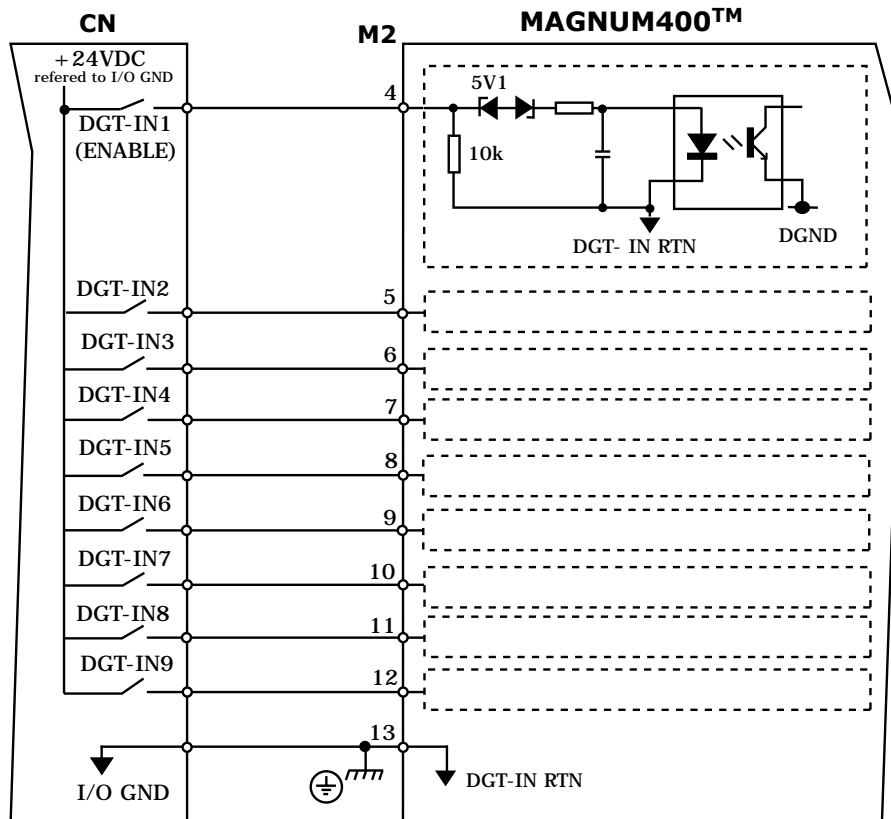
- Axor external resistances have the following dimensions:



Note: In accordance with the used resistance, internal or external, we recommend to correctly set the *Regen Resistance* parameter in the "General Setting" window in the *Speeder One* interface: **internal** (if the internal resistance is used), **external** (if an external resistance is used).

2.12 Digital inputs connection

DIGITAL INPUTS connection

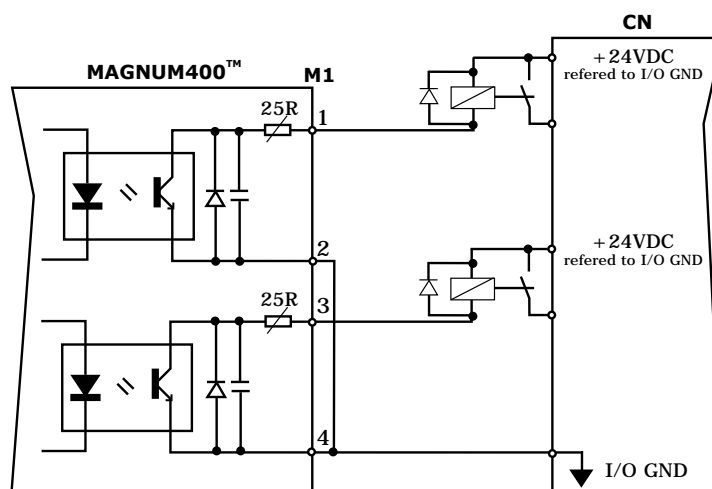


Notes:

- The enable signal should be **+24VDC-7mA** (PLC compatible). The enable range is between **+14V Min** and **+30V Max**.
- The **M2-4** terminal (**DGT-IN1 (ENABLE)**) is used only as the drive's enable. If M2-4 is HIGH (+24VDC) the drive is enabled (without active alarms and if start up sequence, illustrated on paragraph 2.21, is respected); if M2-4 is LOW (0V), the motor is without torque.
ATTENTION: THE DRIVE'S ENABLE/DISABLE, BY USING THE ENABLE INPUT, IS NOT CONSIDERED A SECURITY FUNCTION.
- The other inputs can be used to activate pre-programmed functions of the drive (for example: limit switch, electromechanical brake, homing and positioning procedures, emergency stop, etc.). For a detailed description of the pre-programmed functions see enclosure "*Speeder One Interface*", "*Additional Features Manual*" and "*Positioner Manual*" on the CD provided with the drive.
- Connect pin **M2-13 (DGT-IN RTN)** to the ground bar of the system.

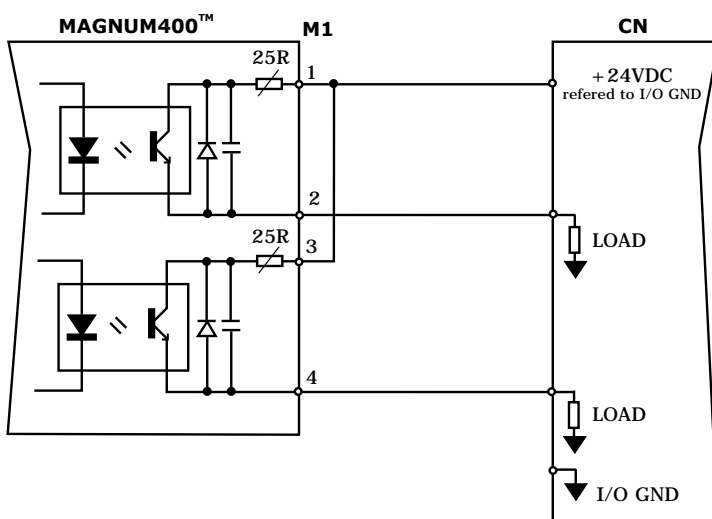
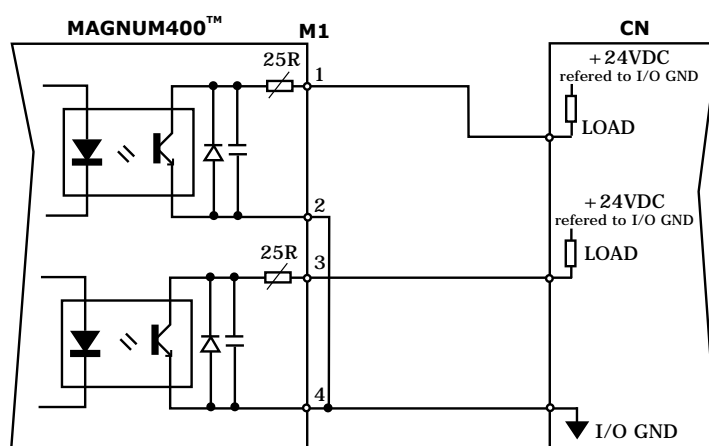
2.13 Digital outputs connections

DIGITAL OUTPUT Connection (example)



Max. load for each output:
50[mA].

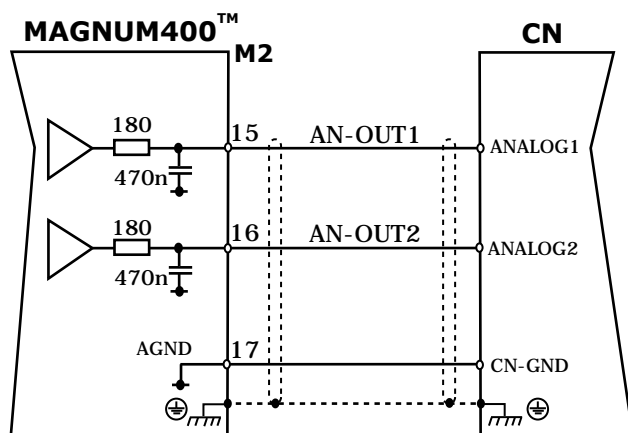
Always use a relay with a diode
in parallel.



This digital output can be used to send messages from the pre-programmed function of the drive.
For a detailed description of the pre-programmed functions see enclosure "Speeder One Interface" on the CD provided with the drive.

2.14 Analog outputs connections

ANALOG OUTPUTS Connections



They permit visualisation by oscilloscope of some of the drive's measurement values.

The two outputs furnish **+/-10Volt** as the low scale setting refers to.

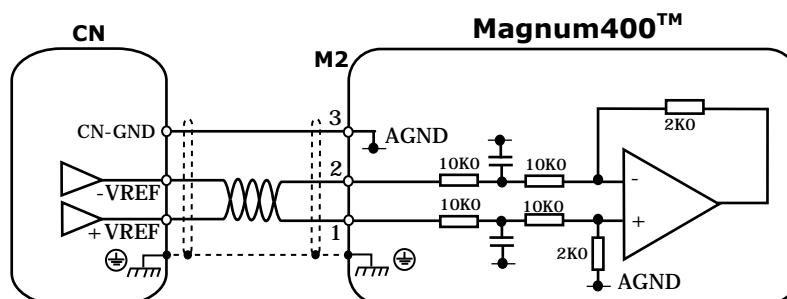
They can be set by the *Speeder One* interface.

Note: We suggest to connect the shield on both sides: drive side follow the indications illustrated on paragraph 2.6.

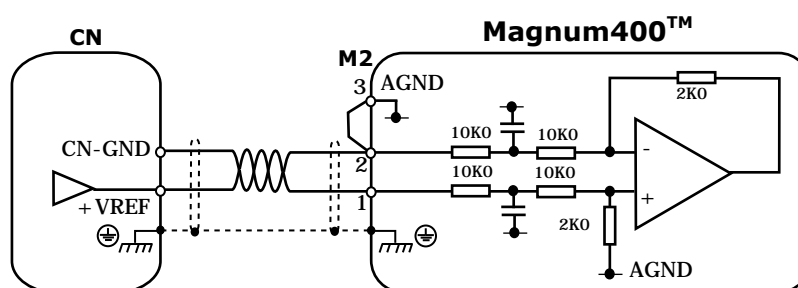
2.15 Analog inputs connections

ANALOG DIFFERENTIAL OR COMMON MODE INPUT (+/-Vref and TPRC) connection

DIFFERENTIAL MODE (+/-Vref)



COMMON MODE (+/-Vref)



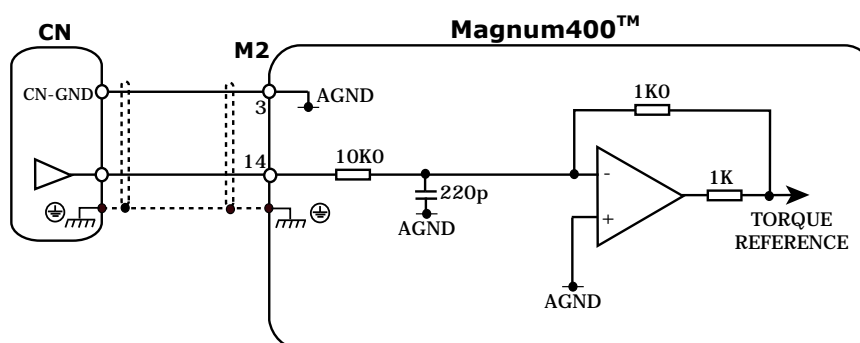
The **technical characteristics** of +/-Vref inputs are as follows:

- ✓ Voltage: **±10V** Max.
- ✓ Input impedance: **40k ohm**.

To change the sense of rotation, apply the positive voltage reference to **M2-1**, or change the **Rotary Direction** parameter in the **Speed** window (from **Positive** to **Negative**).

Note: We suggest connecting the shield on both sides: drive side, follow the indications illustrated on paragraph 2.6.

COMMON MODE (TPRC)



The **technical characteristics** of TPRC input are as follows:

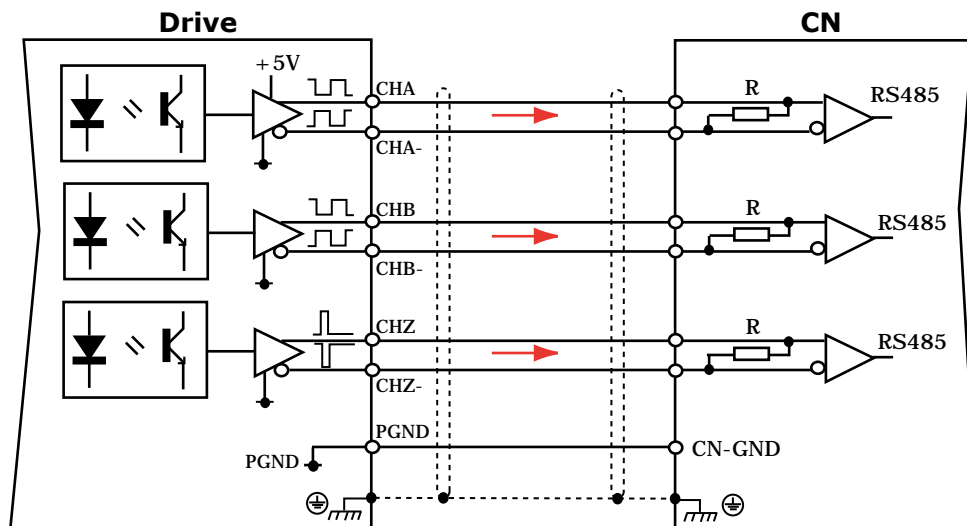
- ✓ Voltage: **±10V** Max.
- ✓ Input impedance: **10k ohm**.

Note: We suggest connecting the shield on both sides: drive side, follow the indications illustrated on paragraph 2.6.

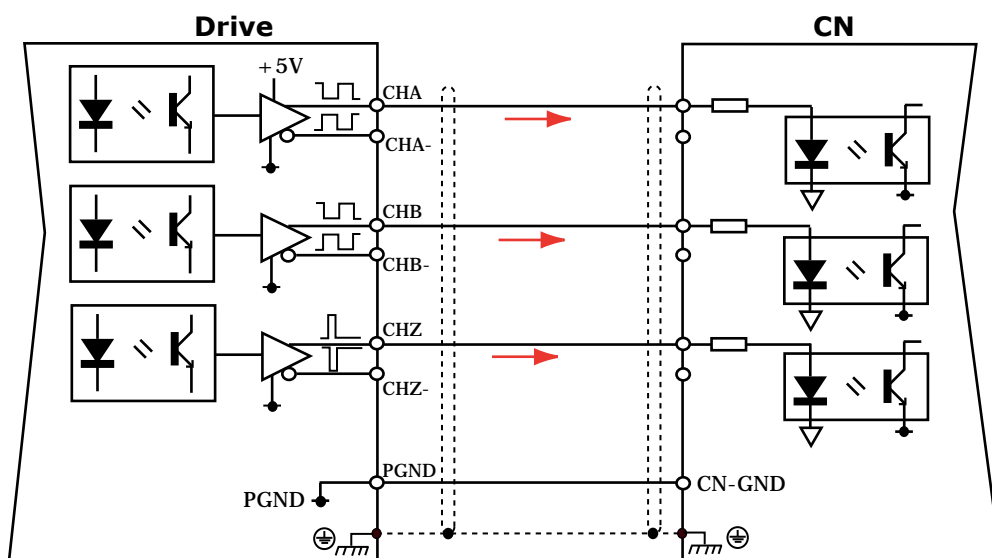
2.16 Emulated encoder outputs connection

EMULATED ENCODER OUTPUTS connection

LINE RECEIVER CN inputs



COMMON MODE CN inputs

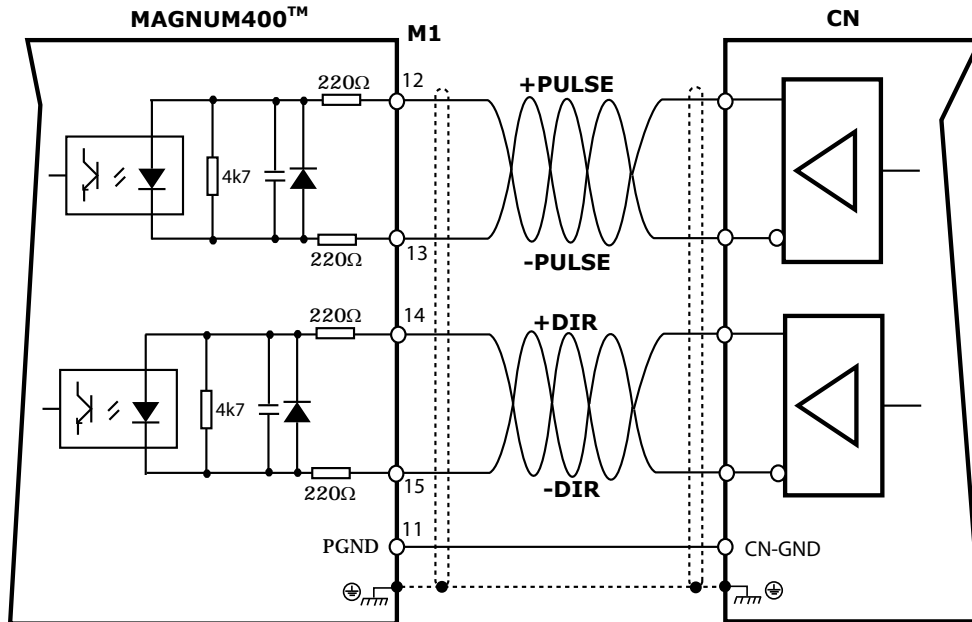


Note: We suggest connecting the shield on both sides: drive side, follow the indications illustrated on paragraph 2.6.

2.17 Pulse/Dir inputs connections

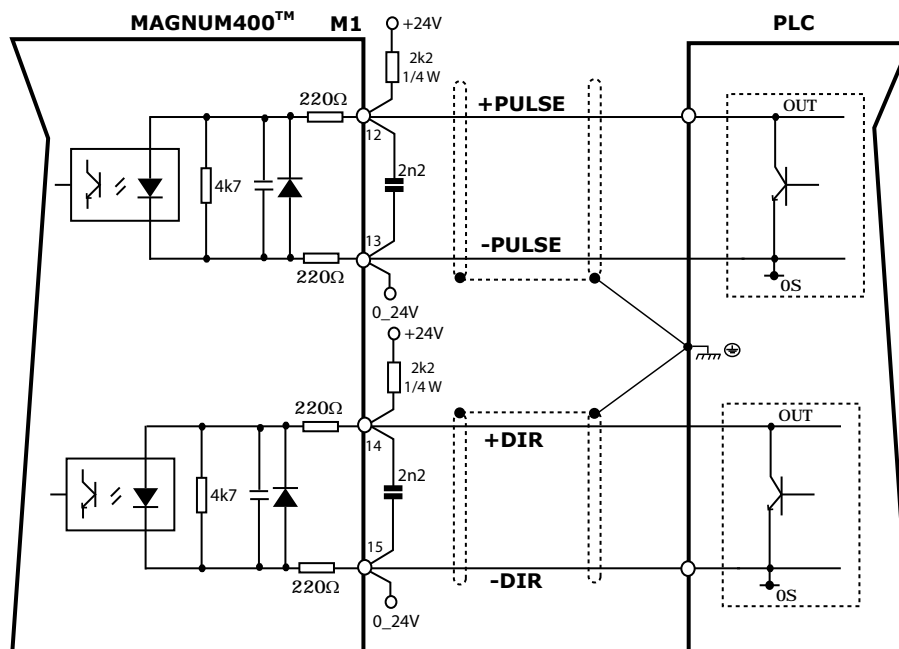
PULSE/DIRECTION MODE connection

Logical signal 0/+5V



Note: We suggest connecting the shield on both sides: drive side, follow the indications illustrated on paragraph 2.6.

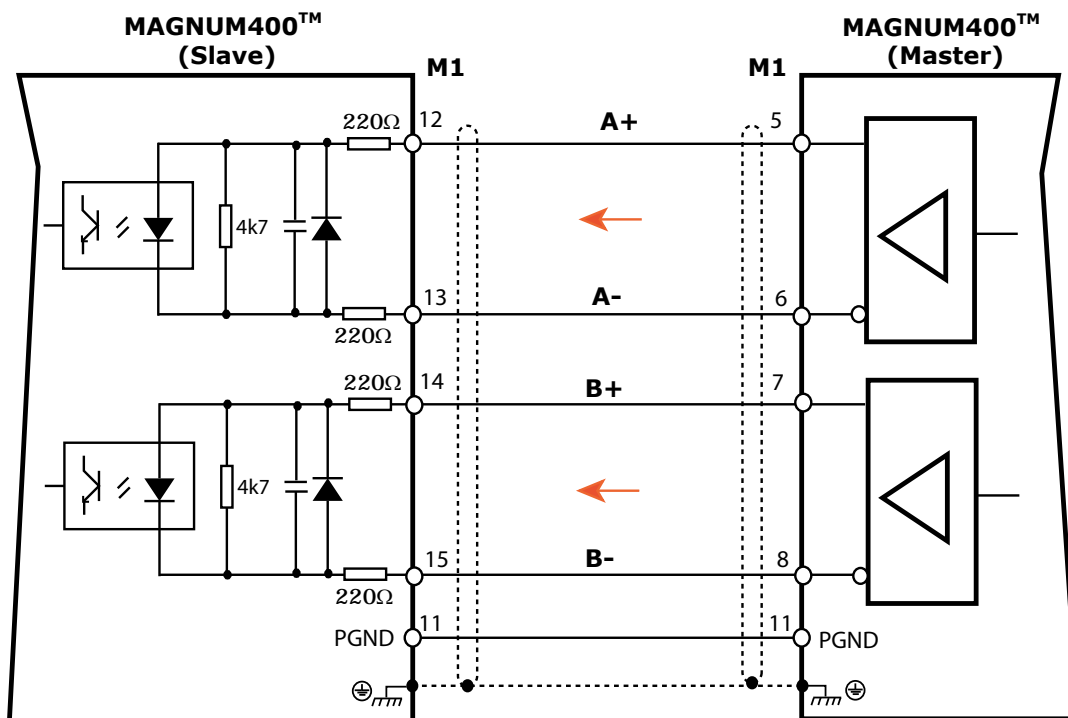
Logical signal 0/+24V open collector NPN



Note: We suggest to shield separately the couples of cable and to connect the shields together and to the PLC ground.

2.17 Pulse/Dir inputs connections

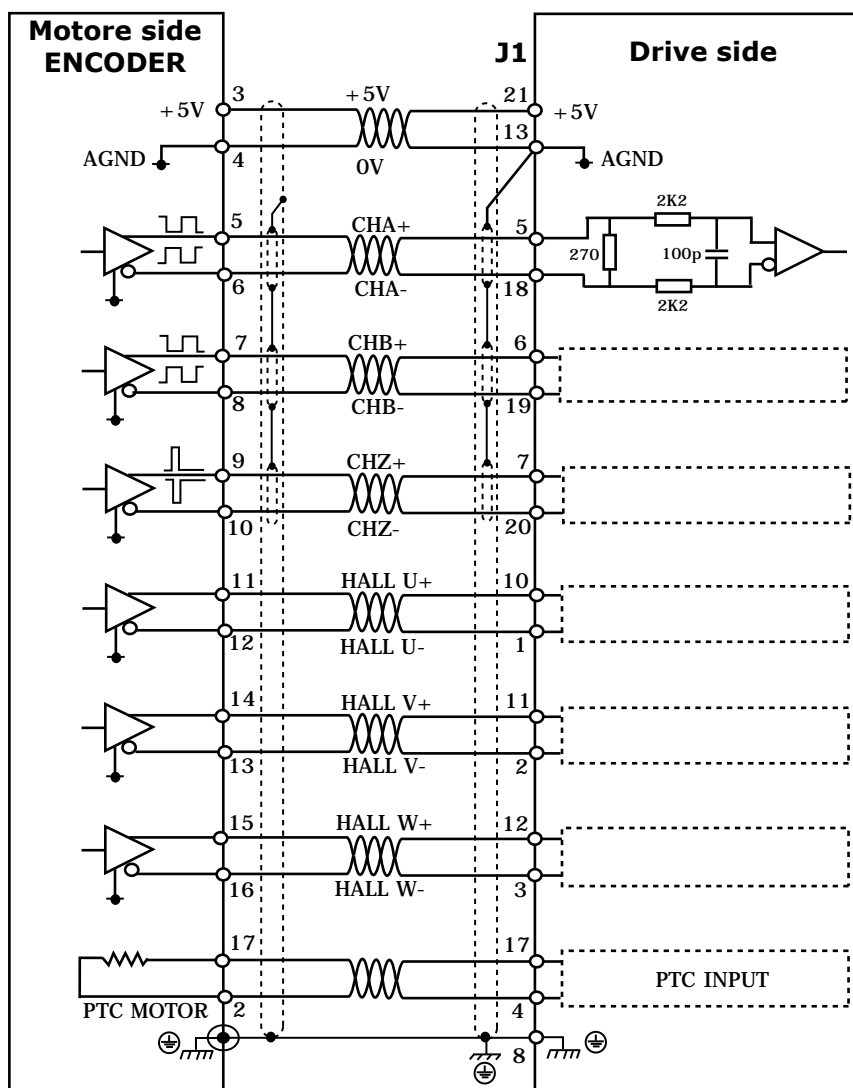
ELECTRICAL AXIS (GEARING) Connection



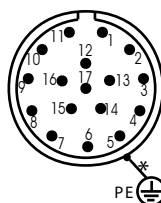
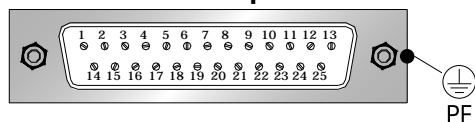
Note: We suggest connecting the shield on both sides: drive side, follow the indications illustrated on paragraph 2.6.

2.18 Feedback signals connections

ENCODER FEEDBACK connection



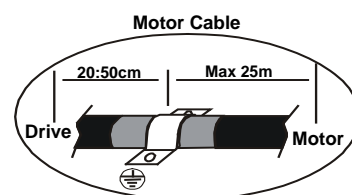
**J1 connector
Sub-D 25 pole**



**17 pole connector
(Encoder)**

If the motor has not the thermal protection (PTC MOTOR) you should bridge pins 4 and 17 on the "J1, Sub-D 25 pole" connector of the drive.

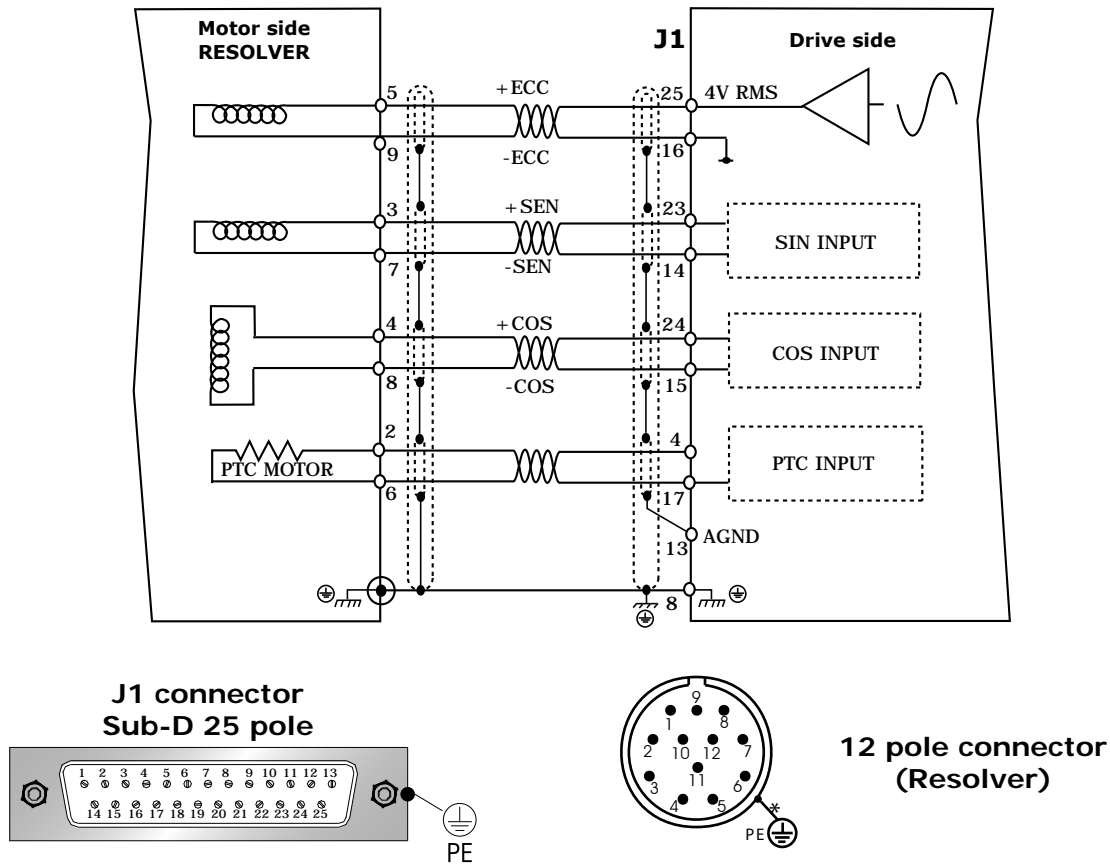
Note: The **ground connection** of the external shield must be made on the zinc-coated panel (using a u-clamp) near the drive (20-50cm).
Motor side: the shield is connected to connector's metal ring.



2.18 Feedback signals connections

RESOLVER FEEDBACK connection

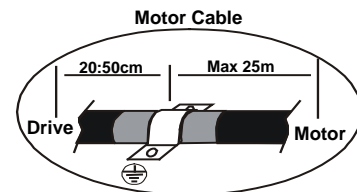
OPTIONAL



If the motor does not have thermal protection (PTC MOTOR) you should bridge pins 4 and 17 on the "J1, Sub-D 25 pole" connector of the drive.

Note: The **ground connection** of the external shield must be made on the zinc-coated panel (using a u-clamp) near the drive (20-50cm).

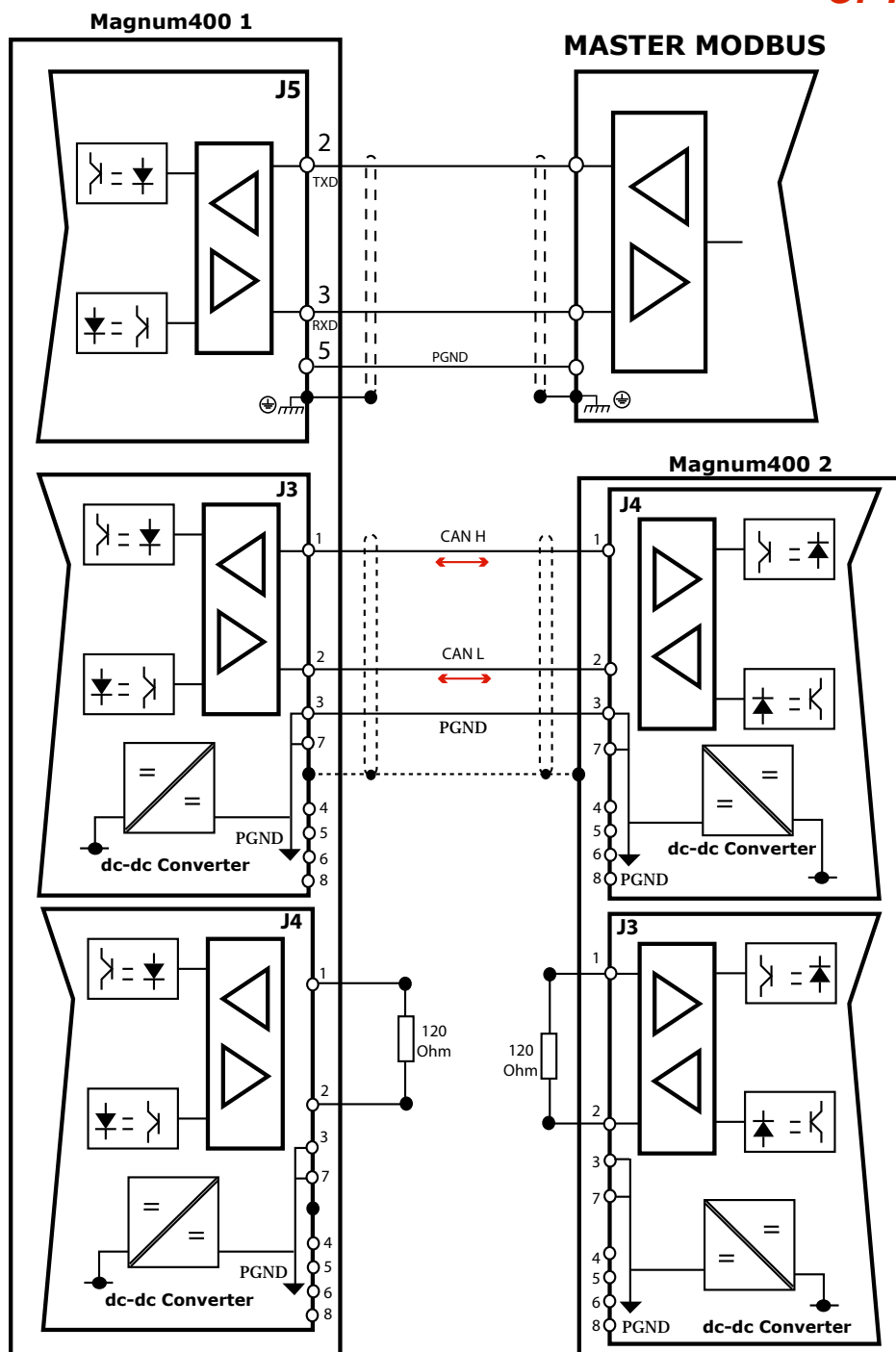
Motor side: the shield is connected to connector's metal ring.



2.19 Multidrop connection

MULTIDROP connection

OPTIONAL



Notes:

- Connect the first **Magnum400™** to the **Master** using the RS232 cable (**J5** connector); connect each additional drive with to the drive preceeding it using the Can Bus cables and the **J3** and **J4** connectors; connect a **RESISTOR (120 Ohm, 1/4W)** between pins **1** and **2** of the **J3** (or **J4**) connector of the first **Magnum400™** and another resistor between pins **1** and **2** of the **J3** (or **J4**) connector of the last drive.

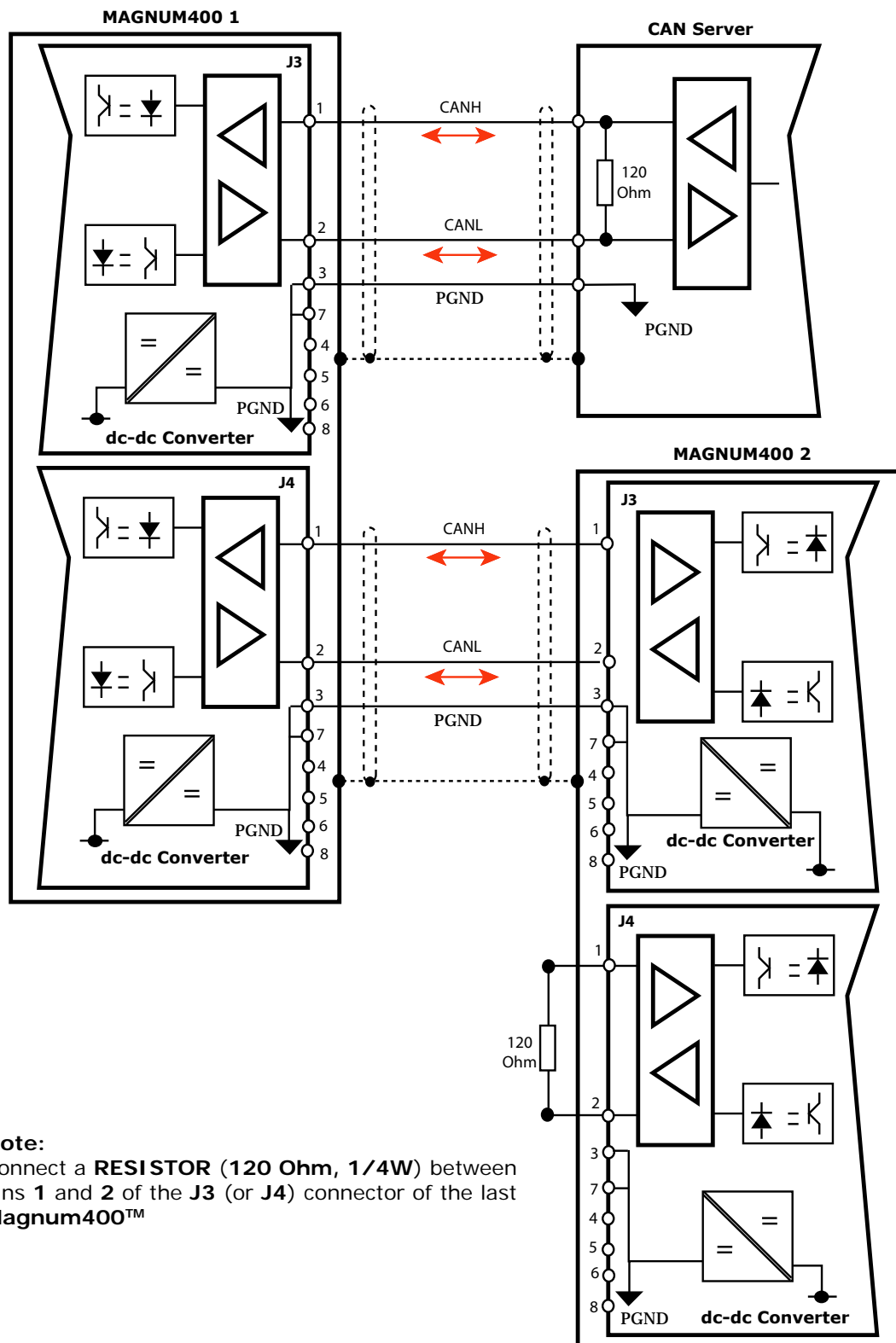
- Axor drives use **MODBUS communication protocol** specified in the **Modicon** instructions (see <http://www.modicon.com/techpubs/>).

For more information see enclosure "**Modbus Manual**" on the CD provided with the drive.

2.20 Canbus connection

CANBUS connection

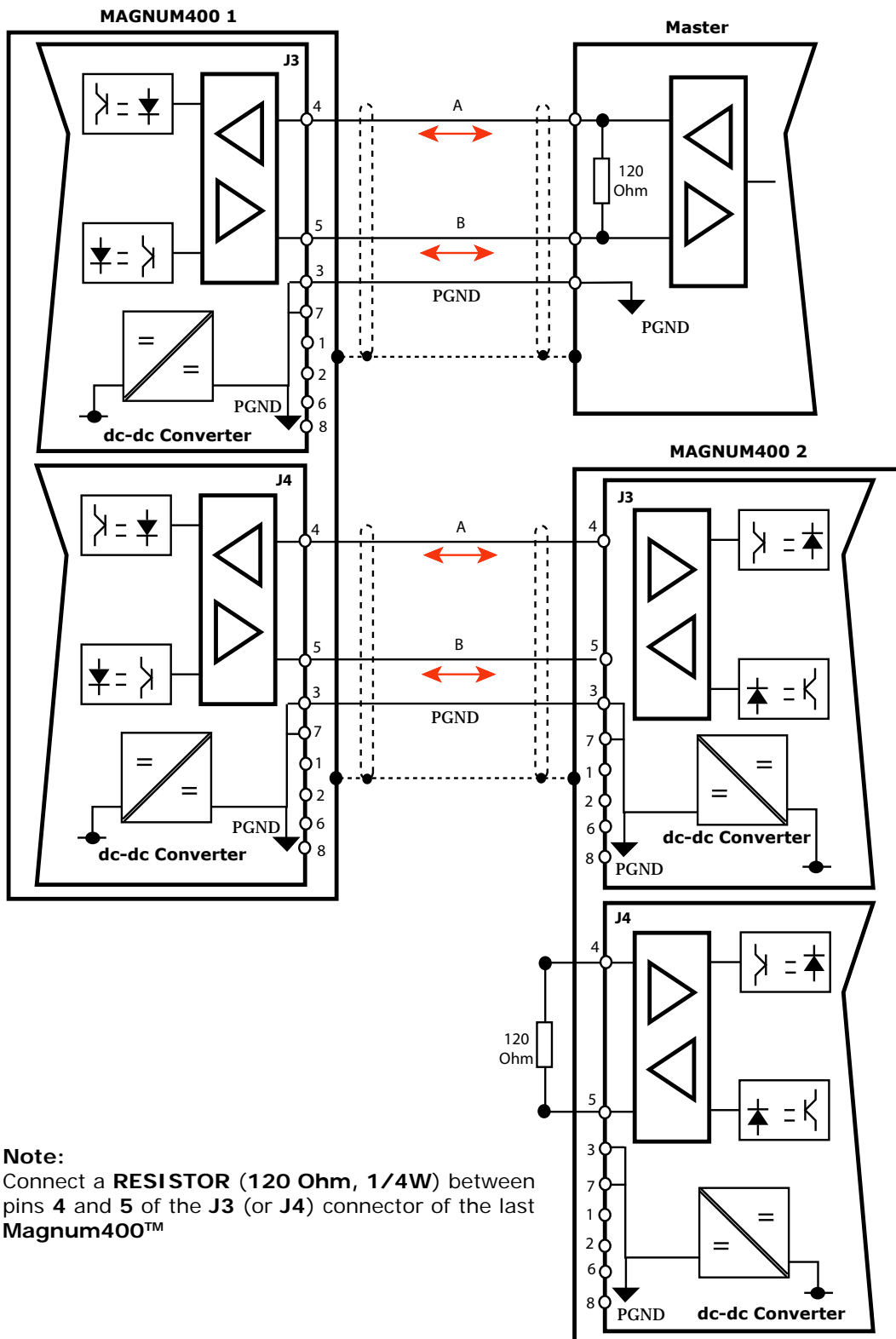
OPTIONAL



2.21 RS485 connection

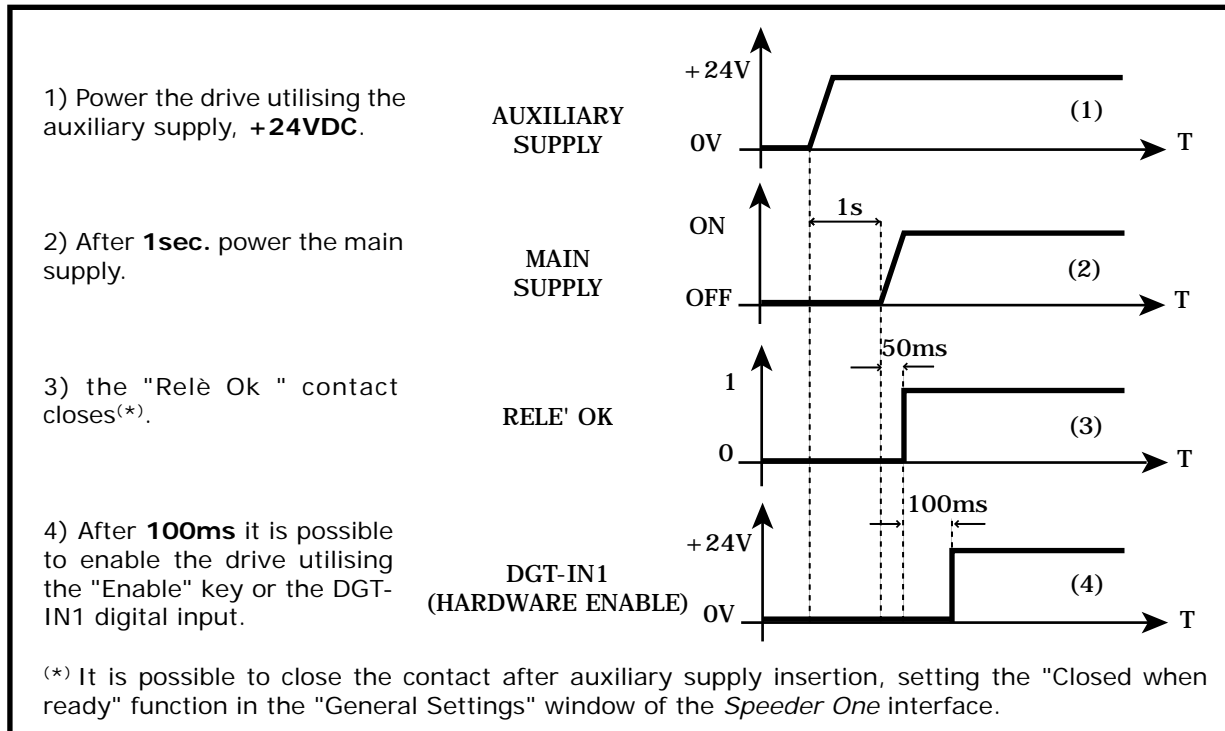
RS485 connection

OPTIONAL

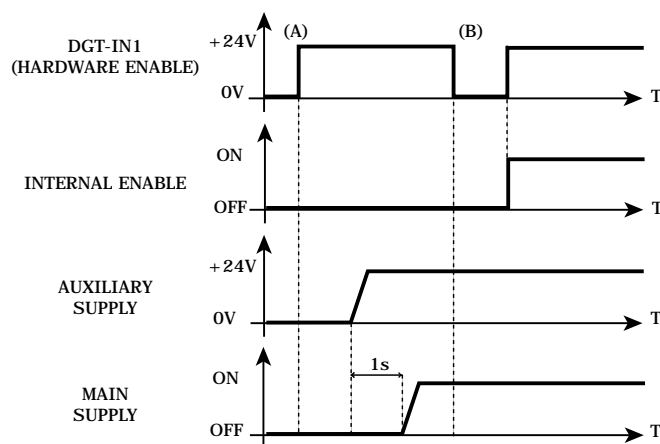


2.22 Magnum400™ power up

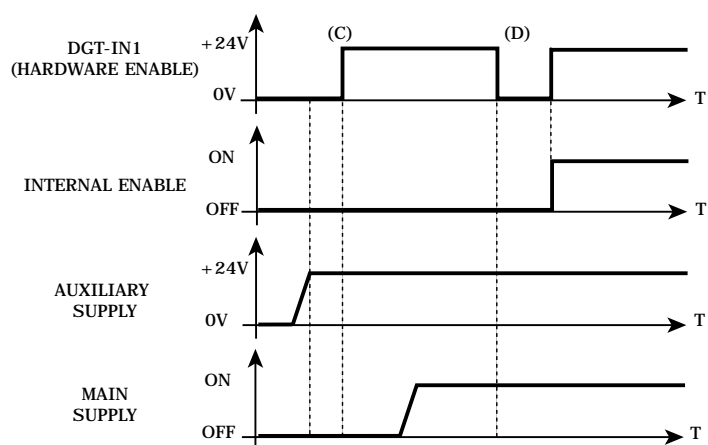
The power up of the **Magnum400™** must be done following this sequence, in order to save the drive and the electrical box:



Attention: If the DGT-IN1 (ENABLE) digital input is enabled by the CN before powering the drive (A), after powering the drive utilising the auxiliary supply and the main supply, it is necessary to disable and enable the DGT-IN1 input (B), in order to enable the INTERNAL ENABLE. If the DGT-IN1 is not disabled, then re-enabled, the INTERNAL ENABLE remains disabled and the user cannot execute any movement.



Attention: If the digital input DGT-IN1 (ENABLE) is enabled by the CN after powering the drive utilising the auxiliary supply, but before powering the drive utilising the main supply (C), it is necessary to disable and then re-enable DGT-IN1 input (D), in order to enable the INTERNAL ENABLE also. If the DGT-IN1 is not disabled then re-enabled, the INTERNAL ENABLE remains disabled and the user cannot execute any movement.

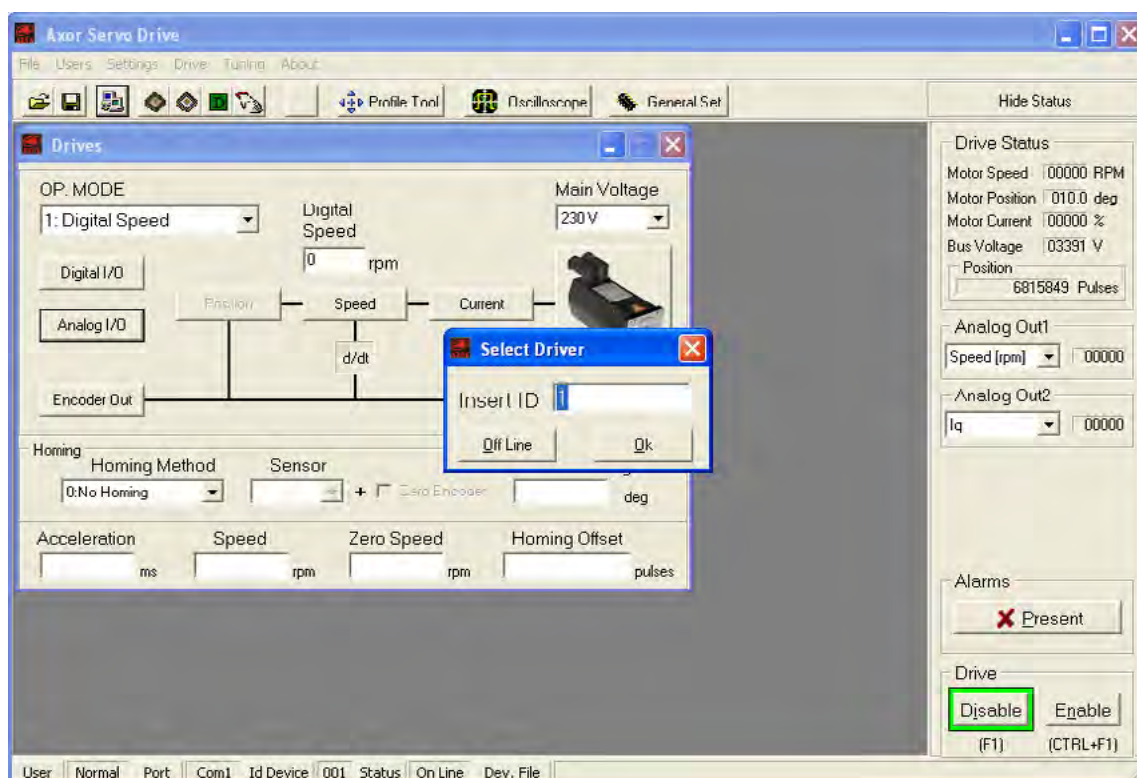


2.23 Motor Test



This procedure is a guide line for the first power up of the drive-motor system. **It must only be executed by technically qualified personnel. If you need more information contact Axor.**

- 1) Follow the basic procedure previously described. **ATTENTION: do not apply load to the motor.**
- 2) Install *Speeder One* interface from CD.
- 3) Power up the drive: apply the auxiliary supply and then the main supply (follow the procedure previously described).
- 4) Open the *Speeder One* interface clicking on "Axormb.exe" executable file on directory: "C:\Programm\Axor". The main window "Axor Servo Drive" and the "Select Driver" windows open simultaneously. On the **Select Driver** window insert the drive's address (all drives have **1 set** as default value), then click OK.



- 5) If the drive is **"Not configured"**, it is necessary to open a pre-set configuration file, following this procedure:

- in the main window select the **"File"** menu and then **"Open"**;
- in the directory: ...\\Axor\\Data\\Devices\\ select a file reference to the coupling drive-motor, then click on **"Open"**;
- save load parameters by using **"Save Data To EEPROM"** icon.

If the drive is *configured for a specified motor*, it is sufficient to check these parameters:

- ✓ Main voltage (*Main Voltage* menu in the main window of the interface)
- ✓ Number of motor poles (*Motor* window)
- ✓ Feedback type (*Motor* window)
- ✓ Encoder impulse/rev or resolver n° of poles (*Motor* window)
- ✓ Irms current (*Current* window)
- ✓ Ipk current (*Current* window)
- ✓ Speed Limit (*Speed* window)

2.23 Motor Test

6) If alarm should appear, resolve them before going forward (see chapter 3).

7) Set the operative mode "**1: Digital Speed**", set a speed reference equal to 100rpm, enable the drive with the **Enable** button.

If shaft turns correctly, at the set speed, without alarms, it is possible to connect the load and cable the machine. It is possible to proceed with the connection of the load and with the wiring of the machine; at the contrary, if alarms should be compared or if the behavior should not be as set, we suggest to control the connections and the settings (eventually contact Axor).

8) Connecting the load to the motor, it should be necessary to connect gains of speed loop, following this procedure:

a- Set the "**10: Square wave**" operating mode.

b- Set the "Speed_RPM" parameter on the "Analog OUT1" menu.

c- Connect the probe of the oscilloscope on pins **AN.OUT1** (speed signal) and **AGND** (zero signal).

d- Enable the drive.

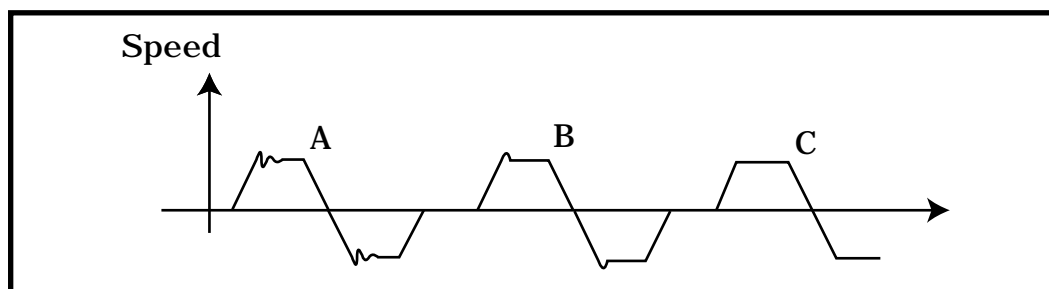
e- Adjust the KP and KI gains in a way that you obtain a stable step response in both directions. Increasing KP decreases the system's response time; however, the system gets closer to becoming unstable; therefore, during adjustment increase the KP to the oscillation limit and then reduce until secure oscillation stoppage.

Increasing KI the steady state diminishes, however increasing the overshoot, therefore after adjusting KP increase KI keeping the overshoot within authorized limits ($\pm 10\%$).

The figure below illustrates some typical oscilloscope tracks:

A) Proportional and integral gains too low. Increase the numerical values of KP and KI.

B) and C) Good proportional and integral gains.



9) At this point it is possible to set other parameters in reference to the desired operative mode (see enclosures "**Operative modes Manual**", "**Additional Features Manual**", "**Speeder One Interface**" available on the CD provided with the drive).

Chapter 3

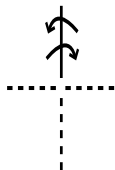
Diagnostic

3.1 Display
3.2 Alarms

46
47

3.1 Display

A **display LED** visualises: the drive's status, the inserted values, the alarms.

Symbol	Description
F	The digital input ENABLE is enabled, while the digital input set with the "Ref on" function is disabled.
E	The digital input ENABLE is disabled, while the digital input set with the "Ref on" function is enabled.
[]	The digital input ENABLE and the digital input set with the "Ref on" function are both enabled; the motor does not move.
 (segment appears rotating in a clockwise or counter-clockwise direction)	The rotor is turning in a clockwise or counter-clockwise direction.
0i	This appears when the negative limit switch (NSTOP) is interrupted.
0 i	This appears when the positive limit switch (PSTOP) is interrupted.
- - -	This appears when the converter is correctly powered on, the digital input ENABLE is disabled and there are no alarms.
24 UP	This appears when there is the +24VDC auxiliary supply, but not the main supply.
ALxx	There is alarm xx.
SEF	The Safe Torque Off function is enabled (the motor has not torque).

3.2 Alarms

The table below illustrates all the message errors:

ALARM		SOLUTION
AL1	EEPROM alarm Error while memorising parameter to the drive's EEPROM or reading parameters from drive's Eeprom.	Disable the drive, try to memorise the parameter, then re-enable.
AL2	Overcurrent alarm Short circuit between U, V, W or towards earth.	Disconnect the power, verify the wiring, then power up again.
AL3	Drive Temperature alarm Heat sink temperature too high, >70°C.	Disable the drive, verify: <ul style="list-style-type: none"> the forced ventilation functioning, the ambient temperature, wait until the radiator has cooled off, reset the alarm then enable the drive.
AL4	Hall alarm This alarm comes on if one or more of the hall cell's wires are disconnected.	Disable the drive, verify the cell's wire connection, reset the alarm, then enable the drive.
AL5	Encoder alarm This alarm comes on if one or more of the encoder channels are interrupted.	Disable the drive, control the connections, reset the alarm, then enable the drive. If the alarm persists contact Axor.
AL6	I²t Drive alarm The internal I ² t function has reached the maximum permitted. The cause could be one of the following: <ul style="list-style-type: none"> the working cycle could be too heavy; a possible mechanical block; motor phase inversion; the electronic brake is not unblocked; the amplifier's dynamic constants: "KP", "KI" and "KD", could create useless current oscillation. 	<i>It is only a message.</i> This does not cause the disabling of the drive's functioning, but it is possible to close the Relè OK contact during this alarm. The current is limited to the rated one, set in "Current" window.
AL7	Motor Temperature alarm Heat sink temperature too high. This causes the opening of the Ok Relè contact and disables the drive.	Disable the drive: <ul style="list-style-type: none"> control the heat sink temperature; decrease the dynamic constant if the motor is vibrating. This situation causes current oscillation and consequently the overheating of the motor. Wait until the motor has cooled off, reset the alarm, then enable the drive.
AL8	Regenerative Resistance alarm The value I ² t energy recovery has reached the maximum allowed. This causes the opening of the Ok Relè contact and disables the drive.	Disable the drive: <ul style="list-style-type: none"> check the AC power supply input; check that the working cycles are not excessive; verify if the motor, going at half speed, shows the same problem. Reset the alarm, then enable the drive.
AL9	Min/Max Voltage alarm Minimum or maximum converter voltage. See min/max voltage values at "1.3 Technical Data". This causes the opening of the Ok Relè contact and disables the drive.	Disable the drive, wait until the DC power supply voltage reaches the correct threshold, check the AC power supply input, then enable the drive.
AL10	Pre-Alarm Recovery alarm 80% of the I ² t energy recovery value has been reached. This does not cause the disabling of the drive.	Check the AC power supply input and the working cycles. This is <i>only a message</i> , it anticipates the intervention of the "Maximum recovery" alarm.

3.2 Alarms

AL12	Resolver alarm Missing one or more resolver signals. This causes the opening of the Ok Relè contact and disables the drive.	Disable the drive, control the resolver's contact, reset the alarm, then enable the drive.
AL14	Following Error The error between the position reference and the position feedback exceeds the "Max Position Error" parameter, because the "Max Position Error" parameter is too small, or the dynamic gains of the velocity-positioning loop are wrong. This causes the opening of the Ok Relè contact and disables the drive.	Disable the drive, check the Max Position Error parameter, check the dynamic gains, reset the alarm, then enable the drive.
AL15	Limit Switch The two fixed limited positions have both been disabled or interrupted. This causes the opening of the Ok Relè contact and disables the drive.	Disable the drive, check the limit contacts and external connections, then enable the drive.
AL17	Overcurrent regen resistance circuit Possible short-circuit in the regen resistance circuit. This causes the opening of the Relè OK contact and the disabling of the functioning.	Power off the drive, control the short-circuit, then power on the drive.
AL18	Mechanical Brake Overcurrent at the internal brake command or wrong connections. This causes the opening of the Ok Relè contact and disables the drive.	Disconnect the power: <ul style="list-style-type: none"> • control the external connections; • control the current absorption of the motor brake; • verify the settings of the "Holding Brake" parameter on the "Motor" window; then power up again.
24 UP	In-rush Bus <i>This is not an alarm.</i> Indication of the drive's in-rush phase or the lack of the main power supply.	
AL20	Auxiliary Voltage Presence of the main supply (L1, L2, L3), but the auxiliary +24Vdc voltage is missing. This causes the opening of the Ok Relè contact and disables the drive's functionality.	Disable the drive, connect the Auxiliary Voltage, and then re-enable.
AL21	Phasing Error or "Wake & Shake" The auto-phasing was not successful and causes the opening of the "Relay OK" contact and blocks functioning.	Disable the converter and check for friction or mechanical blockages on the axis.
AL23	Flash Alarm Errors in reading/writing parameters on the Flash memory, or Flash memory is empty. This causes the opening of the Ok Relè contact and disables the drive's functionality.	Disable the drive, save new values, then re-enable. If the problem persists contact Axor.
AL24	Can Bus Alarm Error during communication with CanOpen protocol. This causes the opening of the Ok Relè contact and disables the drive's functionality.	Disable the drive, check the cabling and re-enable. If the problem persists contact Axor.
AL26	Homing Error Position error too high during the homing procedure. The motor stops, but it is not disabled.	Check the homing setup, then reset the alarm using the "Start Homing" function.

3.2 Alarms

AL27	Encoder Pulse Counting Error Incorrect counting of the encoder pulses in a mechanical revolution of the motor shaft.	Check the connection of the shields in the green cable.
AL31	Intervention of the "IMMEDIATE STOP" function. The drive has detected the possibility of a "Run-away Motor"	It only generates, in Historical Alarm, the message "AL5" (ENCODER ALLARM).
AL32	Maximum speed exceeded The speed value set in the drive was exceeded.	This will generate Historical Alarm "AL32". And subsequently it will generate "AL31" which will initiate the Immediate Stop Function.

Index

A

Alarms 47
analog common mode input (TPRC) 7, 33
analog differential or common mode inputs (+/-Vref) 7, 33
Analog outputs 7, 32
Auxiliary supply +24Vdc 26

C

Cables 21
Canbus connection 40
Conformity 51
Connection to earth 22
Connection to ground 22

D

Digital inputs 7, 30
Digital output 7, 31
Display 7, 46
Disposal 16

E

EMI filter 8
emulated encoder outputs 7, 34
encoder connection 37
Environmental conditions 20
equipment 8
Example of base connection 25
Expansion cards 8

F

Fuse 11

G

General view 9

H

Holding brake 8

I

installation procedure 24

K

KeyPad 7

M

Maintenance 16
Mechanical Dimension 12
Motor holding brake 27
Motor power 27
Multidrop connection 39

Index

O

Operative Modes 6
 CanBus 6
 electrical axis 6
 multidrop RS232 6
 position control 6
 pulse/direction mode 6
 RS485 interface 6
 speed control 6
 Torque control 6
Ordering code 13

P

Positioning 19
Power supply 26
Product plate 13
Pulse/Dir digital inputs 35

R

Regen resistance 28
Rele' OK 28
resolver connection 38

S

Safety 8
 black-out dynamic brake function 8
 safety enable function 8
Security standard 16, 17, 18
Shielding 23
Speeder One 7
Storage 16

T

Transport 16

Conformity

European directives and norms

The servodrives are "*components*" that are intended to be incorporated into electrical plant and machines for industrial use.

When the servodrive is used into machines or plant, the electrical plant/machine must respect the following directives: **EC Machinery Directive (2006/42/EC)**, **EC Directive on EMC (2004/108/EC)**, **Low Voltage Directive (2006/95/EEC)**.

The machine/plant manufacturer must examine whether with its machine/plant still further or other standards or EEC guidelines are to be used.

EC Conformity

The **EC** mark that is applied to the drives references to the **Low Voltage Directive (2006/95/EC)** and **EC Directive on EMC (2004/108/EC)**.

The standard EN 61800-5-1 is applied to ensure conformance with the Low Voltage Directive.

The standard EN 61800-3 is applied to ensure conformance with the EMC Directive.

In reference to noise immunity and noise emission the converters fulfil the requirement to the category *second environment* (industrial environment).

If the installation of the drive is carried out differently than described in this manual, the user must carry out new measures to satisfy the requisites of law.



AXOR IND. s.a.s.

viale Stazione, 5 - 36054 Montebello Vic.no
Vicenza - Italy

phone (+39) 0444 440441

www.axorindustries.com - info@axorindustries.com

