AXOR
★ INDUSTRIES ★
drives & motors
SINCE
1988
ITALY

SERVICE MANUAL

AXOR INDUSTRIES® MOTORS & DRIVES

ENGLISH

CE Pb RoHS✓

Micro B Net Digital
Brushless Servo Drive

Ver.2 rev.09/18

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: "Applications". Insert Index. Corrections.
ver.1 rel.01/'07	Update chapter: "5: Diagnostic". A new chapter reserved to Positioner and Homing procedure was created. Update chapter "6: Speeder One". Update chapter "7: Applications": Reset Fault Function, Emergency Function. Corrections.
ver.1 rel.04/'07	Update chapter: "4: Interface". Corrections.
ver.2 rel.09/'07	Manual re-organisation: first base version.
ver.2 rel.02/'08	Figures at page 36 and 37 changed. Corrections.
ver.2 rel.12/'08	Insert note about motor brake connection. Figure pag.25 updated. Corrections.
ver.2 rel.01/'10	Corrections.
ver.2 rel.09/'18	Update chapter: "2: Installation" with RS232 connection.

**THIS MANUAL CONTAINS A DESCRIPTION OF McbNET Digital™
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

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

The **McbNET Digital™** is a digital drive capable of piloting both rotary AC brushless motors and linear motors, up to **7,5Nm**. It can be supplied by a 3-phase or single phase voltage equal to **110** or **230Vac**.

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	The positioner can be managed via hardware (by using the digital inputs) or via RS232 (by using the Axor's *Speeder One* interface or another ModBus Master). It supports *32 programmable position profiles*; a *single task* or a *sequence of tasks* are permitted. The **Homing Procedure** is implemented. It uses the signal coming from the *homing sensor* and eventually the *zero signal* of the encoder.	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 *ModBus communication*, while the other drives are piloted with the duplication of commands using the *CanBus interface*.	*optional*
CANBUS	It can be configured and controlled using **CanBus**. It supports the following **Can Open** protocols: • part of the **DS301-V4.02** • part of the **DSP402-V2.0**	*optional*
Notes: • The current controller is vectorial with sampling time of 50μs. The velocity and position loop both work with sampling time of 200μs. • The current commutation is sinusoidal.		

FEEDBACK		
ENCODER	incremental encoder signals plus hall signals	standard
RESOLVER	2 pole	*optional*

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 3 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

EMI FILTER	The drive is equipped with an integrated **EMI anti-disturbance filter** at the 3-phase power supply input.	standard
REGEN CIRCUIT		standard
EXPANSION CARDS	There is a slot for expansion card to implement additional features.	*optional*

SAFETY		
SAFETY	The converter is protected from short circuitry, the Max/Min Voltage, the drive I^2t , the Motor I^2t , 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

EQUIPMENT	
a drive serie McbNET Digital™	standard
terminals: M1, M2A, M2B, M2C, M2D, M3	
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	*optional*
an external braking resistor 200W - 22 ohm	
CBLS cable for motor feedback signal, encoder/resolver (meter multiple)	
CBLS power cable for motors series *SuperSAX*;	
motors series *SuperSAX*	

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 McbNET Digital

J2 Connector
RS232 communication signals

J3 Connector
CanBus communication signals

Display

M3 Connector
Regen resistance

Keypad

M2A Connector
Control signals

Pre-alarm led

M1 Connector
Drive' power supply and motor's supply

M2B Connector
Analog IN/OUT and Pulse/Dir inputs

M2D Connector
Emulated encoder outputs

M2C Connector
Relè OK contact

Chassis

J1 Connector
Motor feedback signals

1.3 Technical Data

Rated Data						
Nominal Voltage	Vac	**3-Phase**: from 3x110Vac (-10%) to 3x230Vac (+10%), 50/60Hz **Single phase**: from 1x110Vac (-10%) to 1x230Vac (+10%), 50/60Hz				
Internal DC BUS (+AT, -AT)	Vdc	85 Vdc min - 400 Vdc max				
Size		2/4	4/8	6/12	8/16	
Nominal current	Arms	2	4	6	8	
Peak current for 2 sec.	Arms	4	8	12	16	
Dissipation at nominal current	W	28	42	58	76	
Dissipation with output stage disabled	W	12				
PWM output frequency	kHz	10				

| Control signals	
Opto-isolated digital inputs	+24Vdc - 7mA (PLC compatible)
Opto-isolated digital outputs	+24Vdc - 50mA (PLC compatible)
Analog programmable outputs	±10V (±5%)
Common mode analog input (TPRC)	±10V max, 10kOhm input resistance
Differential or common mode analog input	±10V max, 40kOhm input resistance
Pulse/Dir digital inputs	+5V, optoisolated, max frequency 200kHz
Auxiliary supply input (+14Vdc)	+14V (±5%), 50mA max.
Emulated encoder outputs	V_{OH}=2.5V min - I_{OH}=-20mA V_{OL}=0.5V max - I_{OL}=20mA

External braking resistor		
Continuous power of the braking module	W	200W max a 45°C
Brake circuit disconnection point DC	Vdc	370-375
Max Brake circuit set point DC	Vdc	385
Value of the resistor	Ohm	≥22 per 200W

Motor encoder inputs	
Encoder supply	+5V @ 220mA (±5%)
Differential encoder inputs line receiver RS485	AM26LS33
Differential hall signal inputs line receiver RS485	AM26LS33
Encoder max frequency	250kHz

External protections (fuses or similar)				
Size	2/4	4/8	6/12	8/16
F_2: **Supply Line fuses (Time-Lag)**	3A / 250V	5A / 250V	8A / 250V	10A / 250V
F_3: **External braking resistor fuses**	4A F (Fast)			

1.4 Mechanical Dimension

[case PM4]
McbNET Digital standard

[case PM4V]
McbNET Digital fan cooled

[case PM4B]
McbNET Digital with booster
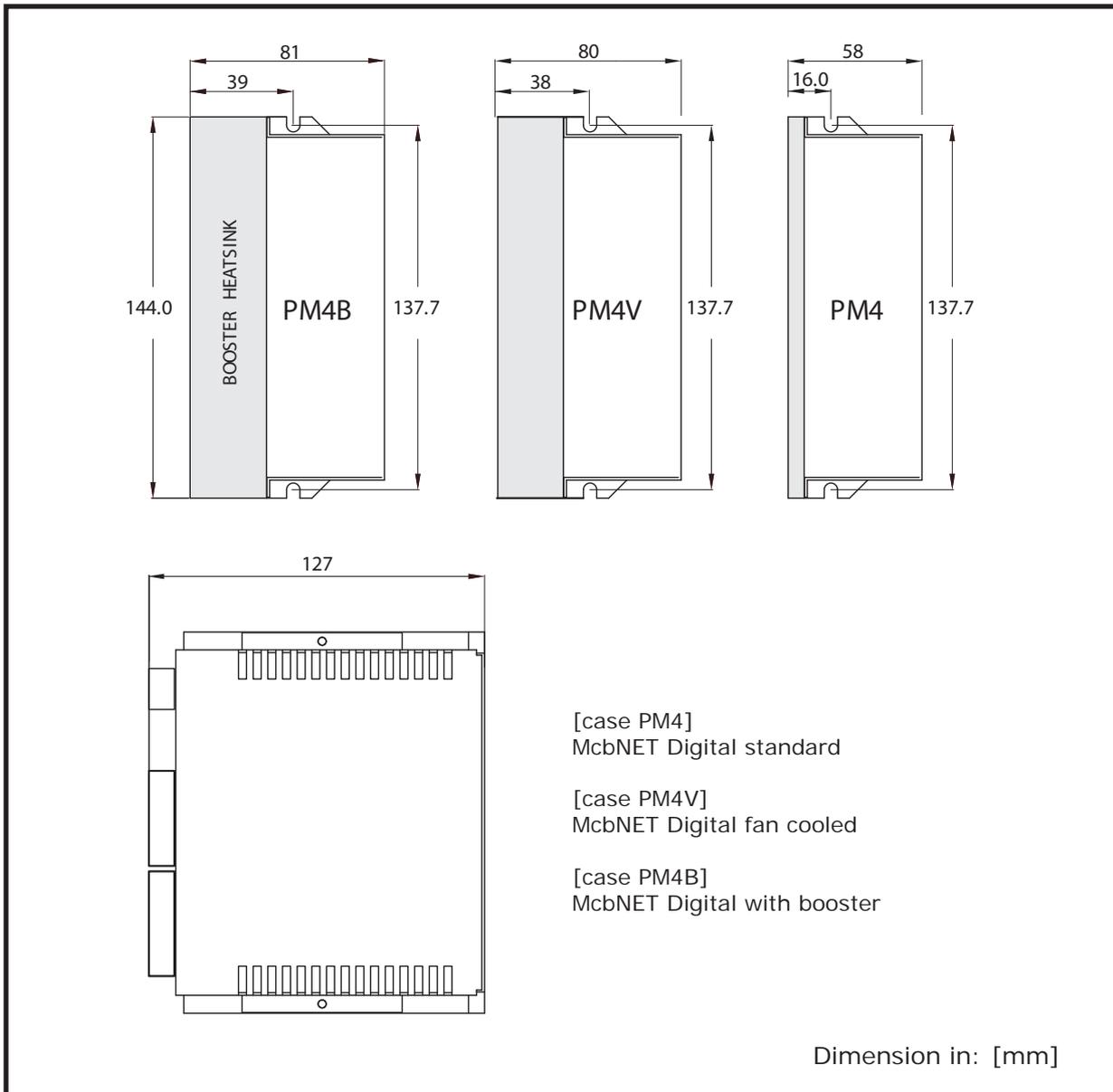
Dimension in: [mm]

Mechanical properties					
Drive mounting		Panel			
Size		2/4	4/8	6/12	8/16
Radiator's case		PM4	PM4	PM4B	PM4V
External dimensions [mm]	H	137,7	137,7	137,7	137,7
	L	58	58	80	81
	S	127	127	127	127
Weight	Kg	0,6	0,6	0,7	1

1.5 Product plate and Ordering Code

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

Power supply

Protection rating

MicroBnet Digital
AC BRUSHLESS SERVODRIVES
Read the manual and follow the wiring and safety instructions before use!

Power supply: 110Vac(-10%) + 230 Vac - 50/60 Hz
single or 3phase   (grounded systems only)

Size: 2/4   4/8   6/12   8/16

⚠ **Operating Temp.: 0 - 40°** | **Prot. Class IP20**

⚡ **ELECTRIC SHOCK HAZARDS!**
Disconnect power supply and wait 5' before working inside!

CE

Part.No.   Data 20/09/2004 Ord:0981/2004 Cod.93759999

AXOR ph.: (+39) 0444 440441 - www.axorindustries.com - made in Italy

J3 CAN BUS   J2 RS 232

J1 MOTOR FEED-BACK

Nominal and peak output current (in Ampere RMS)

Environmental temperature range

The "**Part. No**" gives others descriptive codes about the drive and the settings.

"**Cod.**" is an internal production code. Use this number for any enquires.

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

MCBNET D - 8/16 - T 220 - R1 - S - RO - 0 0 X - 00 - Sxxx

Drive's **name**

Type: **D** = digital

Size: 2/4, 4/8, 6/12, 8/16

Power supply mode:
T = Three phase (std)
M = Single phase (opt)

Power supply:
220 = 230Vac (std)
110 = 110Vac (opt)

Dumping size:
R1 = 100W external resistor (std)
R2 = 200W external resistor (opt)

Specific number presence (opt):
S xxx
001÷999=specific number

Expansion Card:
00 = Not present (std)

Additional features:
0 0 X

Not in use

RS485 Interface
1= Present (opt)
0= Not Present (std)

CanBus + Multidrop Interface
1= Present (opt)
0= Not Present (std)

Feedback:
EC = encoder
RO = resolver
EH = encoder+external hall

Protection:
S = standard
T = tropicalized

Chapter 2
Installation

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 -20°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 -20°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 ≥ 220VAC ⇨ **1 year**
  - ✓ drive having a power supply ≤ 145VAC (200VDC) ⇨ **2 years**

After this time, before enable the drive, it is necessary <u>activate the capacitors</u> 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 <u>30 minutes</u>. So, in this case power the **McbNET Digital**™ 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.

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 **McbNET Digital™** 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 **McbNET Digital™** is equipped with an integrated **EMI anti-disturbance filter** at the 3-phase 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 milliAmpers. 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 **McbNET Digital™** is made to be fixed vertically to the **bottom of the electrical box** in order to guarantee reliable cooling, respecting the following distances:
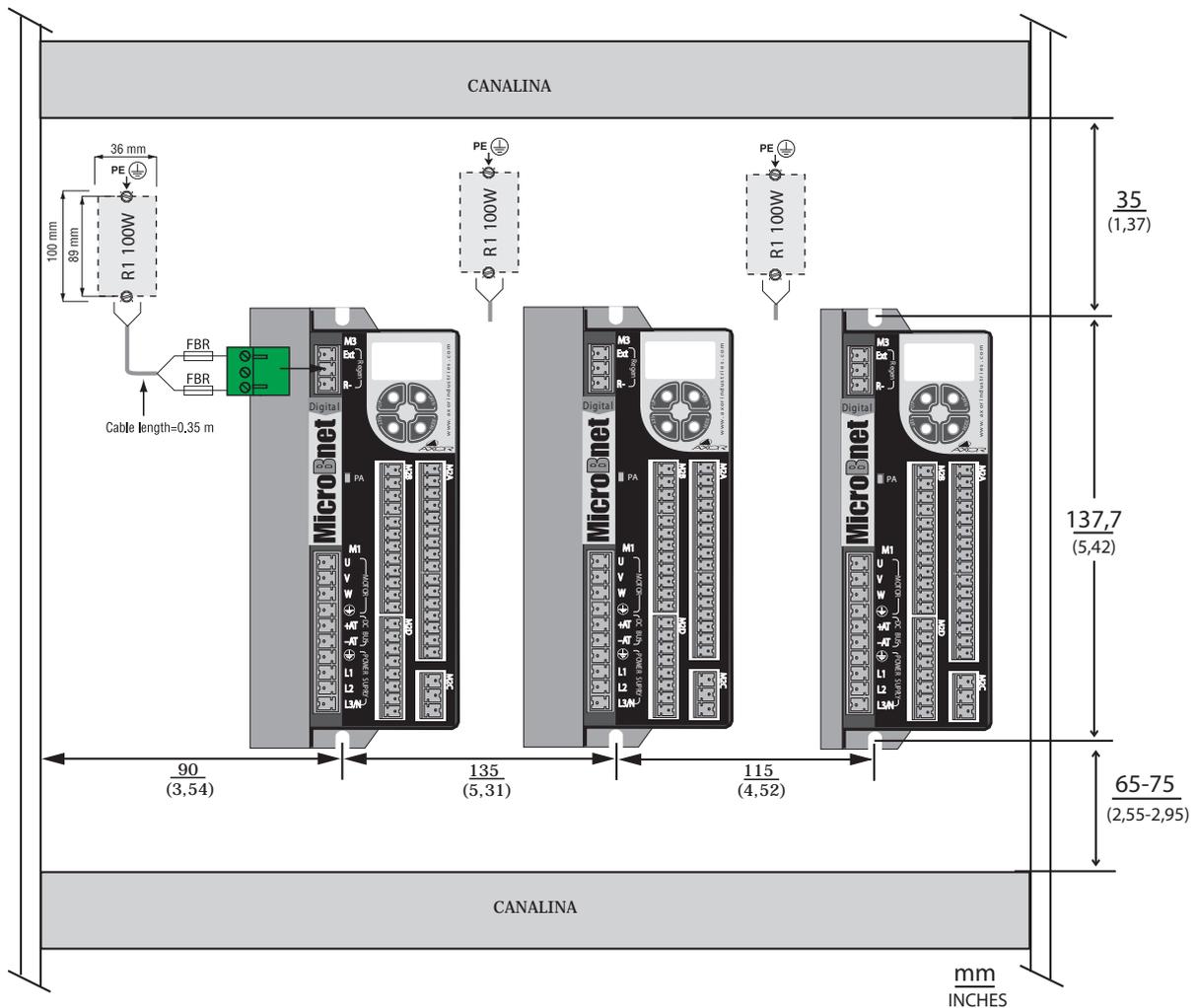
Note: Arrange the power components (converters, main's filters, resistors, terminals, ...) in bins of the electrical panel different from those reserved to the command or control systems (PLC, PC, CNC, regulators, ...). This improves the level of immunity to interference of the system.

2.3 Environmental conditions

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

Environmental conditions	
Ambient temperature in operation	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.
Storage temperature	-20°C…+55°C
Humidity	10%…85% without condensation
Altitude	Up to 1500m without restrictions. From 1500m to 2500m the output current must be derated 2%/100m.
Enclosure protection	IP20
Pollution level	LEVEL 2 Norm EN60204/EN50178

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	**1.5**mm^2/15AWG	**Always insert a power relay or a thermal magnet on every phase of the products power supply.**
for the Auxiliary Supply	**1.5**mm^2/15AWG	Connect the 0V of the auxiliary supply to the ground bar.
for the Motor's Brake	**0.75**mm^2	It must shielded.
for the Motor's Power	**1.5**mm^2/15AWG	It must be shielded. It must have a capacity of ≤150pF/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.
for the Control signals and I/O signals from PLC/CNC	**0.5**mm^2/20AWG	See "2.6 Note about cable shielding".
for the Encoder signals	**0.25-0.35**mm^2/ 22-24AWG	It must be shielded.
for the Resolver signals		It must have a capacity less than 120pF/m.
for external resistor	**1.5**mm^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 zinced panel of the electrical box.
for the RS232 communication	**0.22**mm^2/24AWG or **0.34**mm^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	**0.25**mm^2/**0.34**mm^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: • 1000kbit/s ⇨20m max; • 500kbit/s ⇨70m max; • 250kbit/s ⇨115m max.
Note: • 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 *encoder or resolver* for motors series *Super-SAX*.		

You can find more information about cables on enclosure "***Cables* Manual**" available on the CD provided with the drive.

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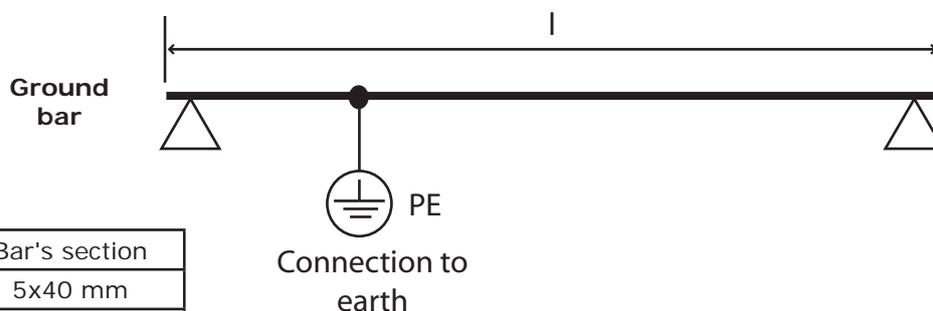
l	Bar's section
0,5 …1 m	5x40 mm
1 … 2 m	5x50 mm

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 zinced 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 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:

Connect the CHASSIS to the ground bar.

Remove the outside sheath and affix the shield to the zinced panel, by using u-clamps.
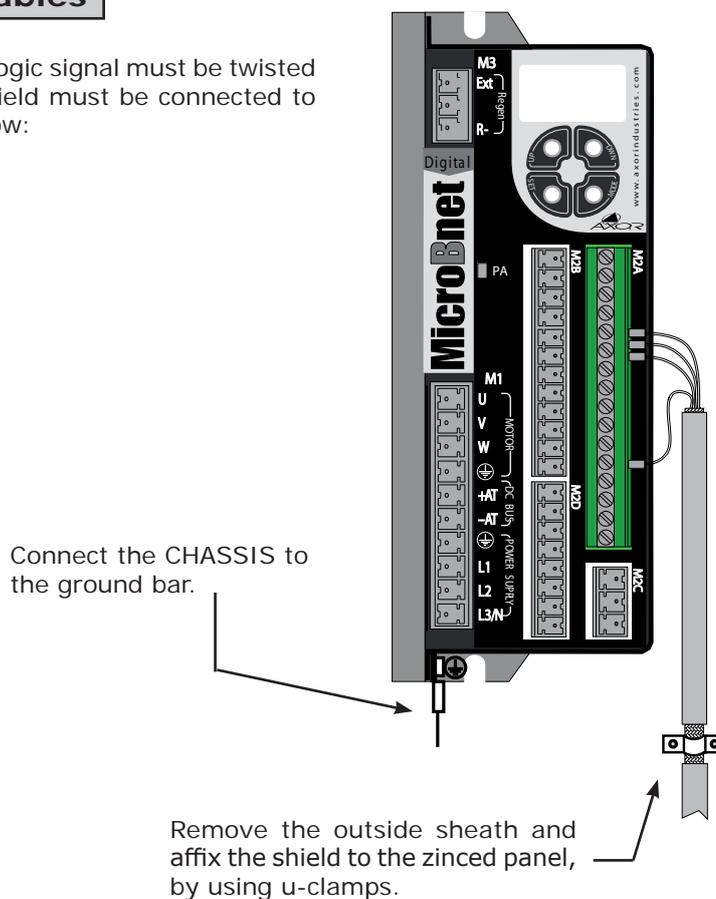
Note:
• To reduce the capacitive and inductive coupling, these cables must be run keeping a distance of more than 30cm from the power cables (10 cm if they are shielded).

• 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 zinced pannel, by using a u-clamp:

(B) POWER CABLE

20 : 50cm   Max 25m

DRIVE   MOTOR
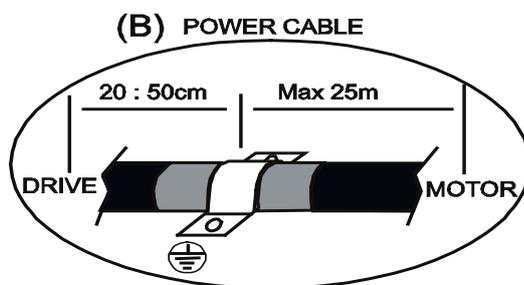
• *motor side* ⇨ The shield is internally connected to the metal ring of the motor connector, thus to earth through the motor's carcass.

2.7 Base installation procedure

This procedure must be done only by qualified personel 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_o) 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).

  4- Connect the **external shield** of the motor's cable: it must be shielded utilising a u-clamp to the zinced panel of the electrical box (see "2.6 Note about cable shielding").

  5- Connect the **external braking resistor** between pins EXT and R-, 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 zinced 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- If necessary, connect the **auxiliary supply cable** (+24V).
  We suggest the use of 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 **main supply** and, if necessary, with the **auxiliary supply**.

  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*.
You can find more information about all interfaces on enclosures "*Operative Modes* **Manual**", "*Additional Features* **Manual**", "*Positioner* **Manual**" available on the CD provided with the drive.

2.8 Example of base connection

Example of BASE connection:

McbNET Digital

M3	Ext	F_3
	R-	F_3

Cap 2.12

Motor feedback
B ⏚
Cap 2.19

J1
SUB-D
25 pin

M2A

DGT-IN1 (ENABLE)	1	
DGT-IN2	2	
DGT-IN3	3	
DGT-IN4	4	
DGT-IN5	5	
DGT-IN6	6	Cap 2.13
DGT-IN7	7	
DGT-IN8	8	
DGT-IN9	9	
DGT-IN RTN	10	
DGT-OUT1	11	
OUT1-RTN	12	
DGT-OUT2	13	Cap 2.14
OUT2-RTN	14	
AGND	15	
BACK UP IN	16	Cap 2.11

MOTOR
U V W ⏚

M1
U
V
W
⏚
B ⏚
+AT
-AT
⏚

Cap 2.10
DC Bus

L1 — L1
L2 — L2
L3 — L3/N
Cap 2.9 F_2

M2C
+V
30V AC/DC - 500mA max
Cap 2.11
Relè OK
1
2
3
Relè OK

M2D

1	A+	
2	A-	
3	B+	
4	B-	
5	Z+	Cap 2.17
6	Z-	
7	AGND	
8	AGND	

M2B

PULSE(+)	1	
PULSE(-)	2	
DIR(+)	3	Cap 2.18
DIR(-)	4	
+14V	5	Auxiliary supply output (50mA max)
AN-OUT1	6	
AN-OUT2	7	Cap 2.15
AGND	8	
+VREF	9	
-VREF	10	
AGND	11	Cap 2.16
TPRC	12	

J2 Rj11
RS232

J3 Rj45
CAN BUS
2.20 and 2.21

CHASSIS

(B) POWER CABLE
20 : 50cm   Max 25m
DRIVE   MOTOR

GROUND BAR

PE ⏚
Mains Earth

R1 100W
PE ⏚

POWER SUPPLY Connection

Notes:

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

• If the drive is supplied by using a transformer, the **nominal power of that transformer** is calculated by adding the various wattage of each motor:

$$Pt = Pn+Pn+Pn+...$$

Pt= nominal power of the transformer (VA)
Pn= nominal power of each motor (VA), which can be calculated in this way:

$$Pn = n \times Cn / 9,55$$

Pn=nominal motor power (W)
n= motor speed (rpm)
Cn= motor nominal torque (Nm)

• Instead of the 3-phase or single phase power supply, it is possible to use a continuos voltage, utilising the **+AT** and **-AT** pins on the **M1** connector.

• **You must not connected the DC buses of more than one drive in parallel, due to the drive's braking circuitry.**
This note must be respected, otherwise the drive may not function properly and be damaged.

The figura below displays some supply possibilities for the **McbNET Digital**™.

3-Phase McbNET Digital

Mains 380-400 Vac

L1
L2
L3
N
PE

400*/230 Vac

Fuse   F2   L1
Fuse   F2   L2
Fuse   F2   L3/N
        PE

*It depends by the available main supply.

3-PH 220VAC

Mains 220-230 Vac

L1
L2
L3
N
PE

F2   L1
F2   L2
F2   L3/N
      PE

3-PH 220VAC

Mains 110 Vac

L1
L2
L3
N
PE

F2   L1
F2   L2
F2   L3/N
      PE

3-PH 110VAC

Always insert a power relay or a thermal magnet on every phase of the products power supply (L1, L2 and L3/N) reference to the norm EN CEI 60204-1.

Single Phase McbNET Digital

Mains 380-400 Vac

L1
L2
L3
N
PE

400*/230 Vac

Fuse

F2 — L2

1-PH
220VAC

L3/N

PE

*It depends by the available main supply.

Mains 220-230 Vac

L1
L2
L3
N
PE

F2 — L2

1-PH
220VAC

F2 — L3/N

PE

Mains 380-400Vac

L1
L2
L3
N
PE

F2 — L2

1-PH
220VAC

F2 — L3/N

PE

Mains 220-230Vac

L1
L2
L3
N
PE

F2 — L2

1-PH
110VAC

F2 — L3/N

PE

IMPORTANT NOTE: Always insert a power relay or a thermal magnet on every phase of the products power supply (L1, L2 and L3/N) reference to the norm EN CEI 60204-1.

In the **single phase power supply** version it has an output voltage given by the following formula:

$$Vout = 0,9 * (Vac - Vd)$$

where

Vout = drive's output voltage.
Vac = power supply between **L2** and **L3/N**.
Vd = voltage fall caused by the single phase supply, proportional to the current absorbed by the motor, as can be seen in the figure near here:

Example: If the current absorbed by the motor is 6A, the voltage drop is about 17V; so in this case the maximum voltage outpust is 192V, infact:

Vout = 0,9 * (230-17) = 192V

Drop Vd (Vrms) vs Current absorbed by motor (Arms)
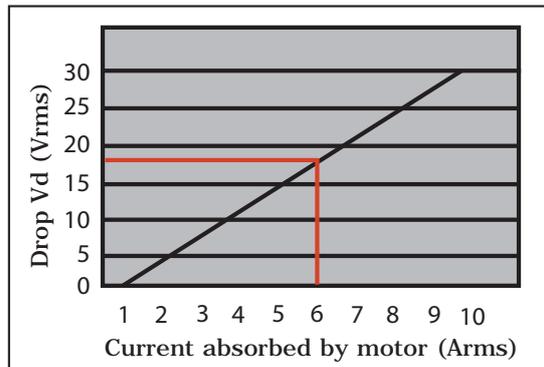
MOTOR POWER
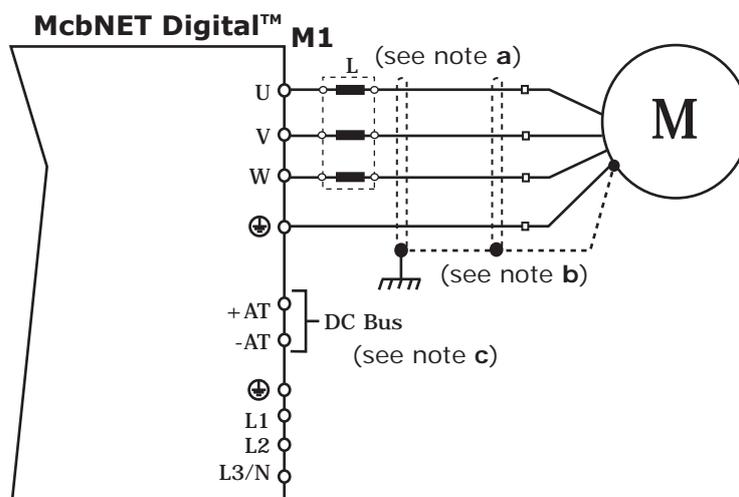
Note:

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.
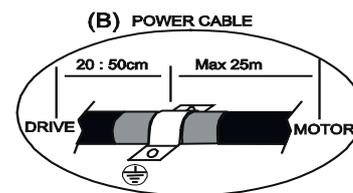
c- Pins +AT and -AT allow you to connect to DC bus.
ATTENTION: NOT CONNECT +Br AND - Br CONDUCTORS OF MOTOR POWER CABLE, PROVIDED BY AXOR, TO PINS +AT AND -AT.

ATTENTION: McbNET Digital DOES NOT MANAGE ELECTROMECHANICAL BRAKE INTEGRATED IN THE MOTOR.
IF MOTOR HAS NOT BRAKE, +Br AND -Br CONDUCTORS ARE NOT TO BE CONNECTED; IF MOTOR HAS BRAKE, THE BRAKE MANAGEMENT IS MADE EXTERNALLY BY PLC OR CN.

Example of connection:
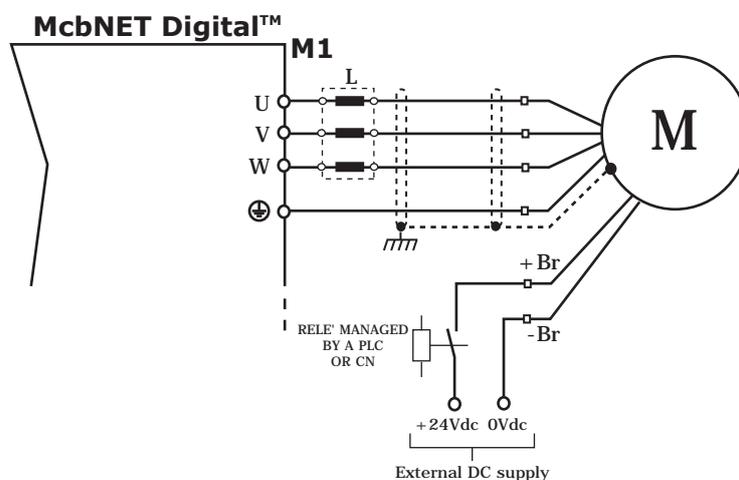
2.11 Relè OK and Back UP supply connections

RELE' OK connection

McbNET Digital™ M2C
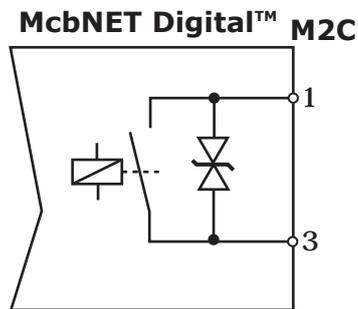
It is normally open when the drive is not supplied; it is normally closed when the drive is supplied and it has not active alarms.

30V$_{AC/DC}$ - 500mA max

BACK-UP SUPPLY (+24Vdc) connection

McbNET Digital

M2A

AGND — 15 — 0V

BACK-UP — 16 — +24VDC
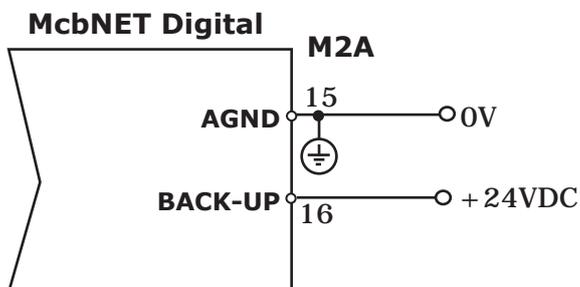
This supply is utilised to power the logic board and the encoder when the drive is shut off. In this condition the display visualises the symbol "---", while the "Relè OK" contact remains open.

Notes:

• Accepted current by input M2A-16: **+24Vdc** (+25%, -30%).

• The current's absorption on terminal M2A-16 is about **100mA**.

• Connect the 0V reference to the ground bar of the system.

2.12 Regen resistance connection

The **McbNET Digital™** is standard supplied with an external braking resistor of **100W-39 ohm** (**R1**).

The external resisor should be inserted between the **Ext** and **R-** terminals of the **M3** connector, near the drive, utilising the resisor's cables. Not extend this connection using othes cables.
If the cable is length more then 20/30cm, it must be twisted and shielded. The shield must be connected to ground, on both ends, utilising u clamps to the zinced panel of the electrical box.

If during the deceleration phase the led "**PA**" turns on, (**Pre-alarm Recovery**), probably it is necessary to change the R1 resistor with a higher resistor of **200W - 22 Ohm** (**R2**).

If the power accumulated by the motor during deceleration exceeds the set load power, the converter activates the **alarm 8**, "**I2t Brake**". This causes the opening of the "Relè OK" contact and the drive's stop. In this case disable the drive, then:
- be sure that the external resistance has the correct Ohm value and that it is connected as described in the manual;
- check the AC power supply input;
- check that the working cycles are not excessive;
- verified if the motor, going at half speed, shows the same problem;

reset the alarm, then enable the drive.

Before changing the R1 resistor, we suggest to contact Axor.

DIGITAL INPUTS connection
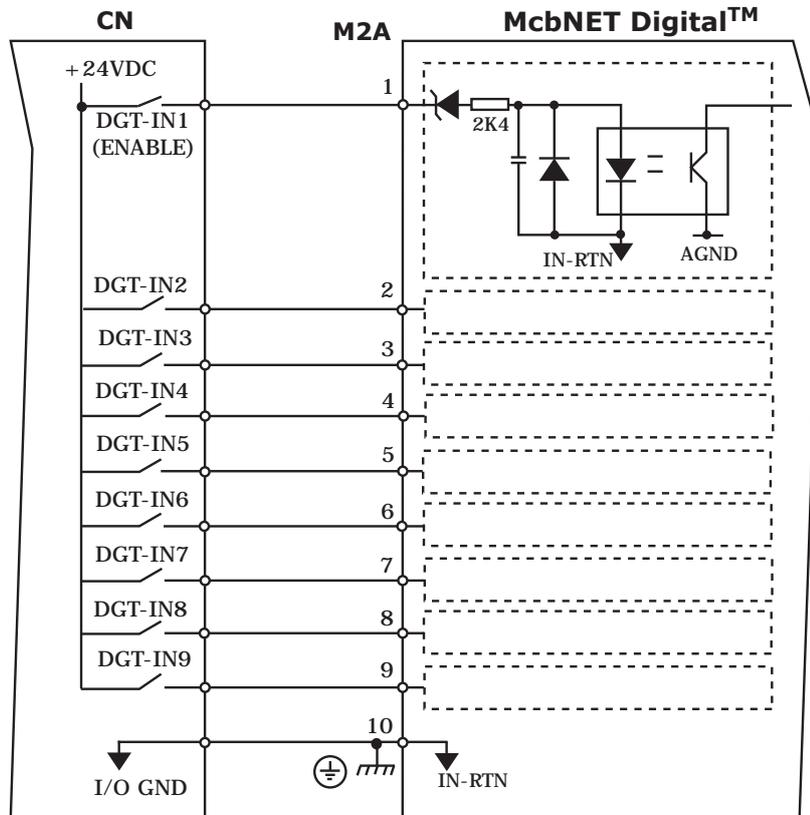
Notes:

• The enable signal should be +**24VDC-7mA** (PLC compatible). The enable range is between **+14V Min** and **+30V Max**.

• The **M2A-1** terminal (**DGT-IN1 (ENABLE)**) is used <u>only</u> as the drive's enable. If M2-4 is HIGH (+24VDC) the drive is enabled (without active alarms); if M2A-1 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 <u>pre-programmed functions</u> of the drive (for example: limit switch, 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 **M2A-10** (**DGT-IN RTN**) to the ground bar of the system.

DIGITAL OUTPUT Connection (example)
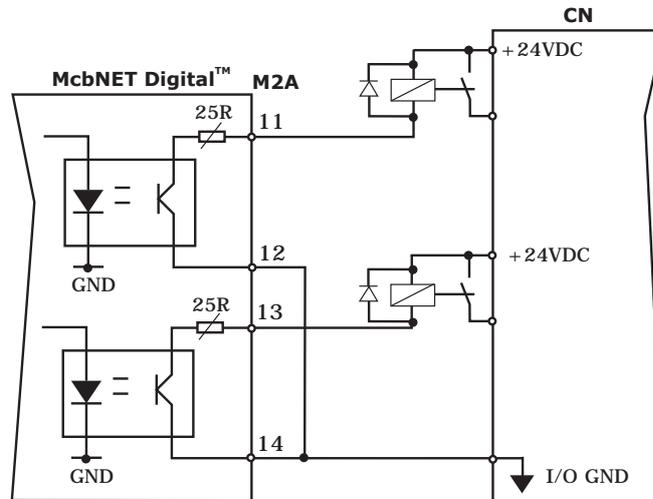
Max. load for each output: 50[mA].

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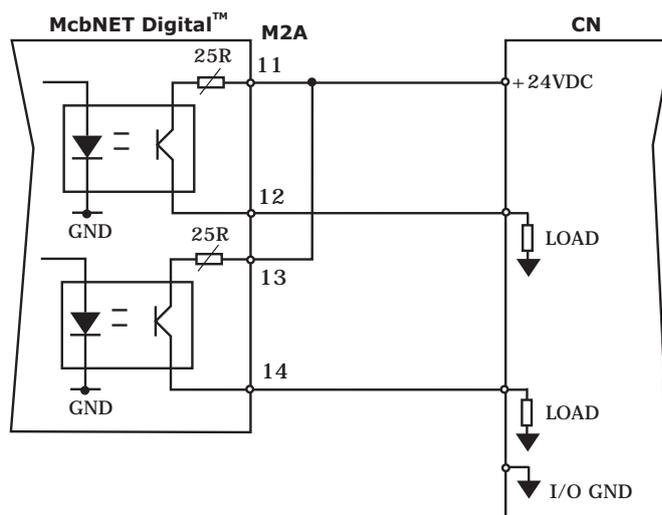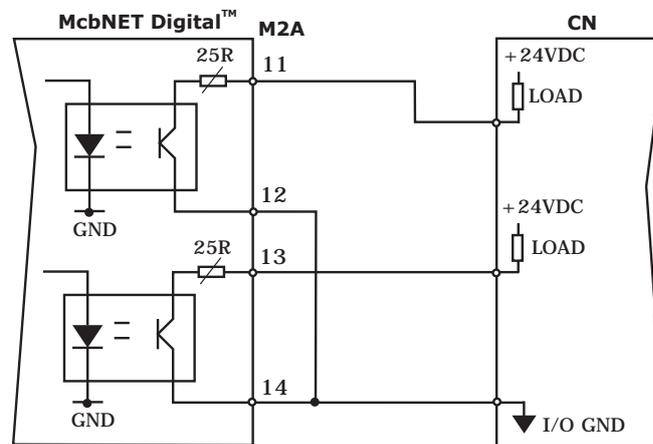
This digital output can be used to send messages from the pre-programmed function of the drive. For a detailed description of the pre-programmed functions see enclosure "**Speeder One Interface**" on the CD provided with the drive.

2.15 Analog outputs connections

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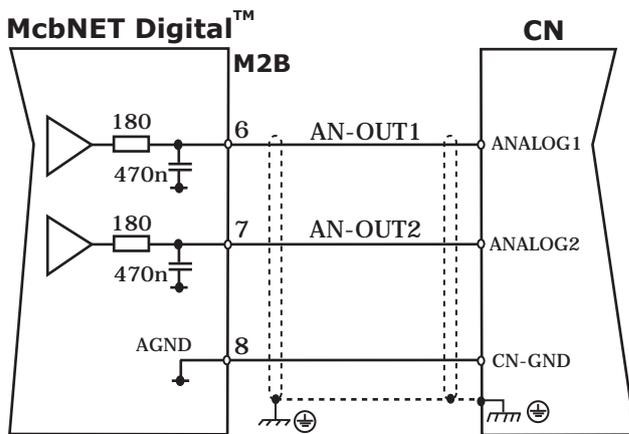
They permit visualisation by oscilloscope of some of the drive's measurement values.

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.

2.16 Analog inputs connections

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

DIFFERNTIAL MODE (+/-Vref)
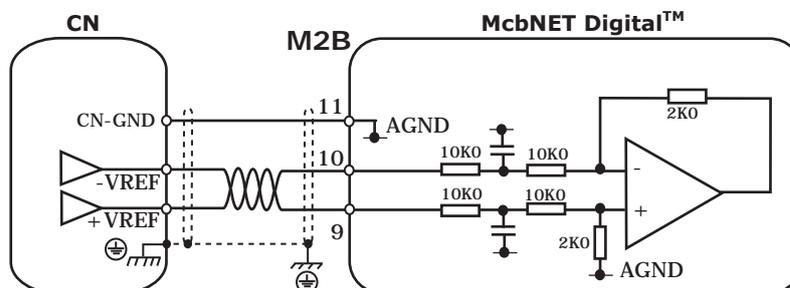
COMMON MODE (+/-Vref)
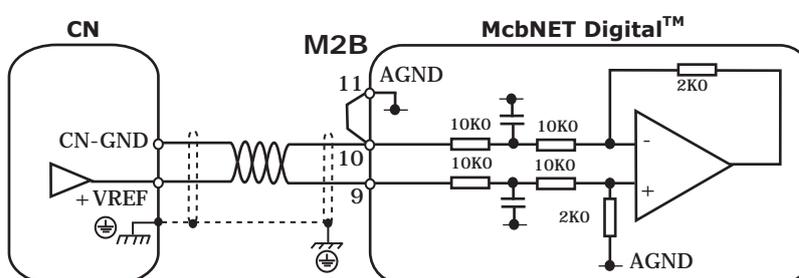
The **technical characteristics** of +/-Vref inputs are as follows:

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

To change the sense of rotation, apply the positive voltage reference to **M2B-10**, 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)
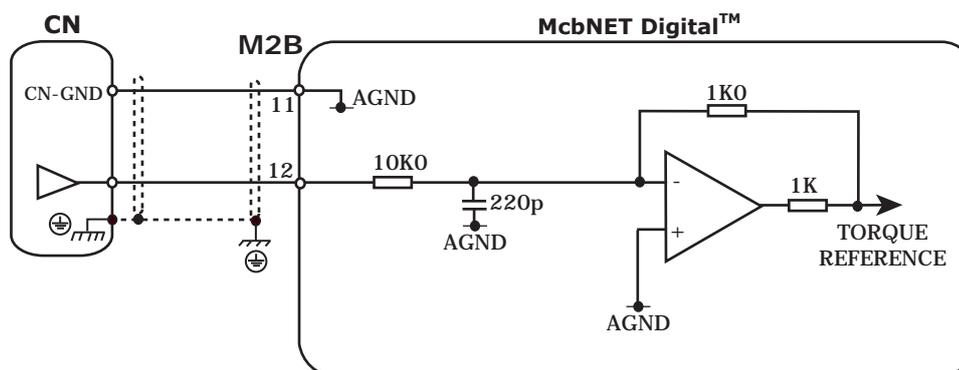
The **technical characteristics** of TPRC input are as follows:

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

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

EMULATED ENCODER OUTPUTS connection

LINE RECEIVER CN inputs
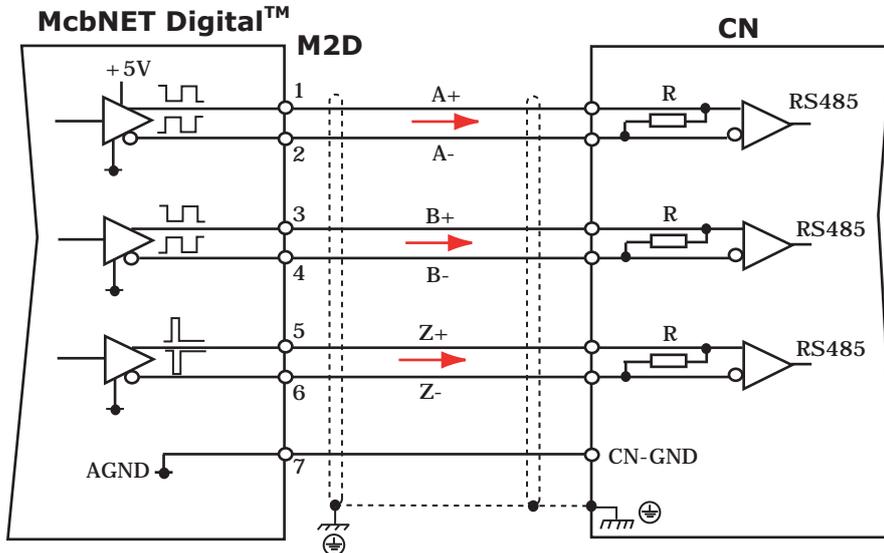
COMMON MODE CN inputs
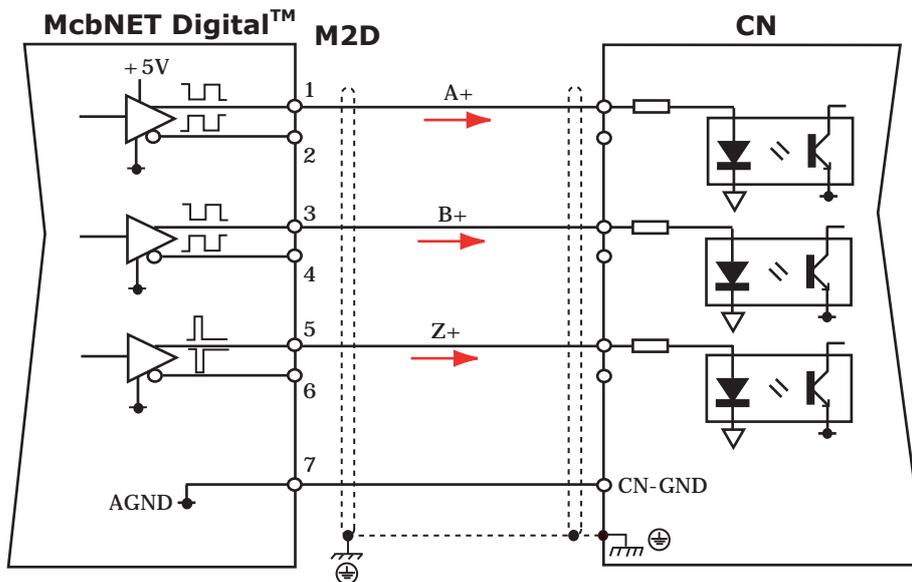
Note: We suggest connecting the shield on both sides: drive side, follow the indications illustrated on paragraph 2.6.

PULSE/DIRECTION MODE connection

Logical signal 0/+5V
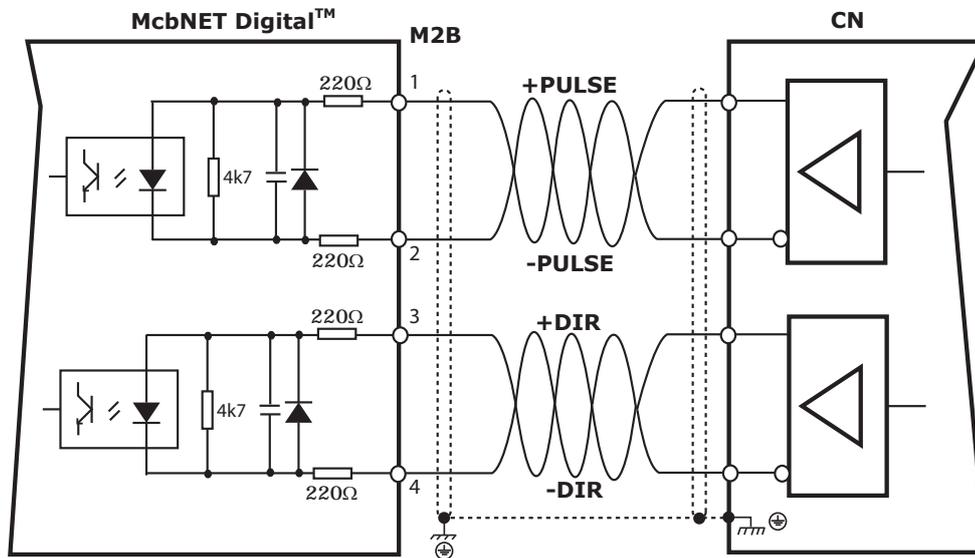
Note: We suggest connecting the shield on both sides: drive side, follow the indications illustrated on paragraph 2.6.

Logical signal 0/+24V open collector NPN
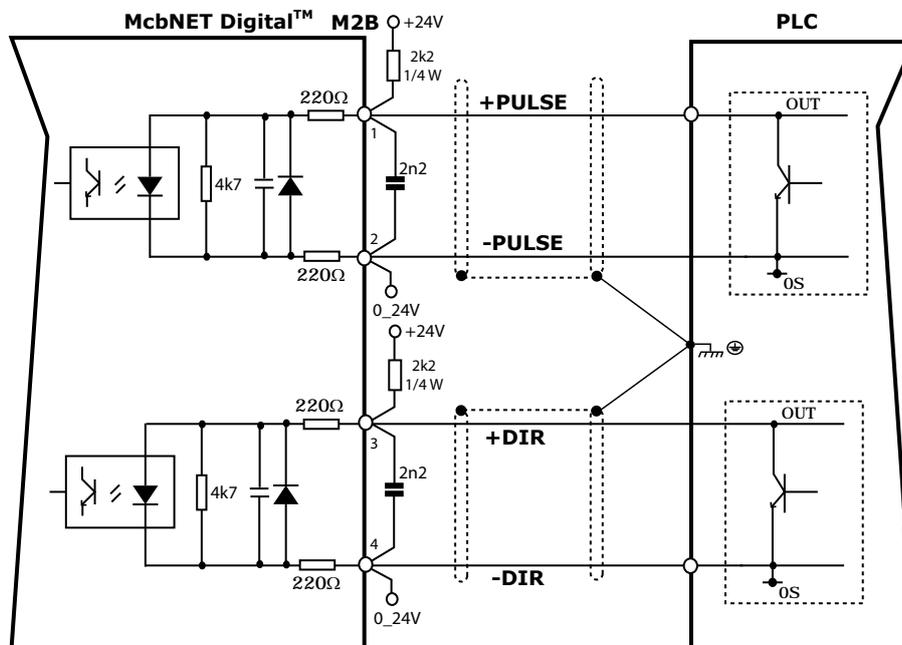
Note: We suggest to shield separatelly the couples of cable and to connect the shields together and to the PLC ground.

ELECTRICAL AXIS (GEARING) Connection
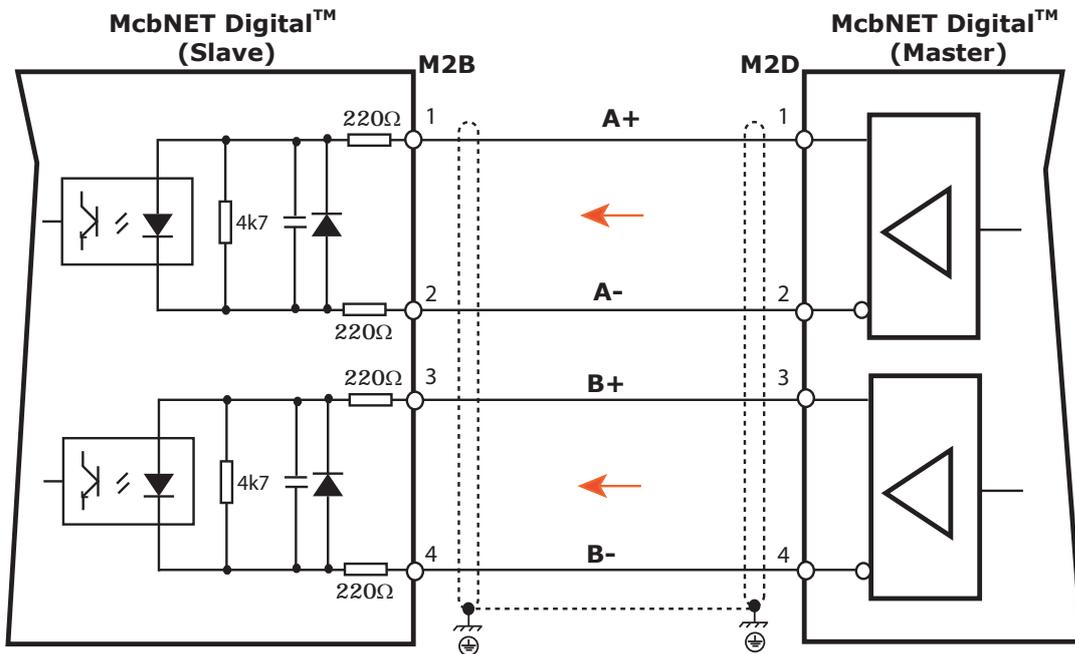
Note: We suggest connecting the shield on both sides: drive side, follow the indications illustrated on paragraph 2.6.

2.19 Feedback signals connections

Motor signal connector (*differential mode inputs*)

The figure illustrates the connections between an **Encoder with RS485 differential outputs** and the **McbNET Digital™**:

With this configuration improved transmission signal immunity is guarantee as opposed to common mode type signals.

Motor signal connector (*common mode inputs*)

The figure illustrates the connections between an **Encoder with Open Collector type outputs** and the **McbNET Digital™**:

If the motor has not the thermal protection (PTC MOTOR) you shuld bridge the 4 and 17 pins 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 cable tie) near the drive (20-50cm).
Motor size the shield is connected to connector's metal ring.

RESOLVER FEEDBACK connection

OPTIONAL

J1 connector
Sub-D 25 pole

12 pole connector
(Resolver)
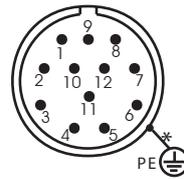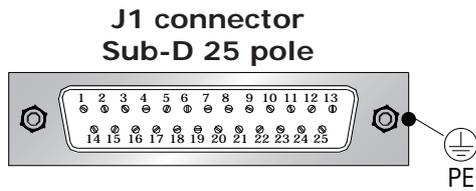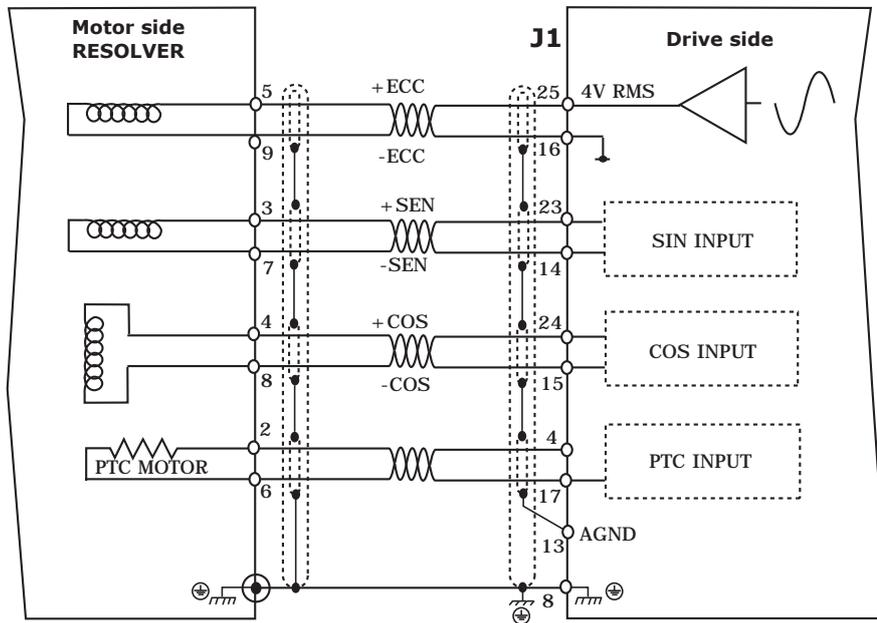

If the motor does not have thermal protection (PTC MOTOR) you should bridge pins 4 and 17 on the "J1, Sub-D 25 pole" connector of the drive.

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.

Motor Cable

20:50cm   Max 25m

Drive   Motor
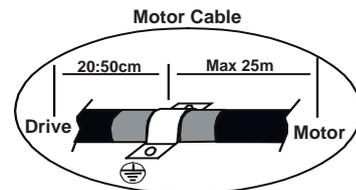
McbNET Digital™ (**RJ11 - 6 pole**):
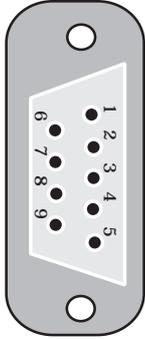
Sub-D 9 pole

Sub-D	MCBNETD	
n.c.	Pin 1	-
n.c.	Pin 2	-
Pin 2 (RxD)	Pin 3	(TxD)
Pin 3 (TxD)	Pin 4	(RxD)
Pin 5 (GND)	Pin 5	(GND)
n.c.	Pin 6	-

RJ11 6 pole
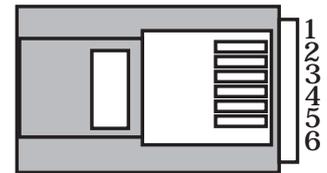
connector
PC side

connector
DRIVE side

MULTIDROP connection

OPTIONAL

CABLE
CANBUS

RESISTOR
(120Ohm - 0,25W at least)

CABLE
RS232

J2 J3 J3 J3

MASTER | McbNET 1 | McbNET 2 | McbNET 3
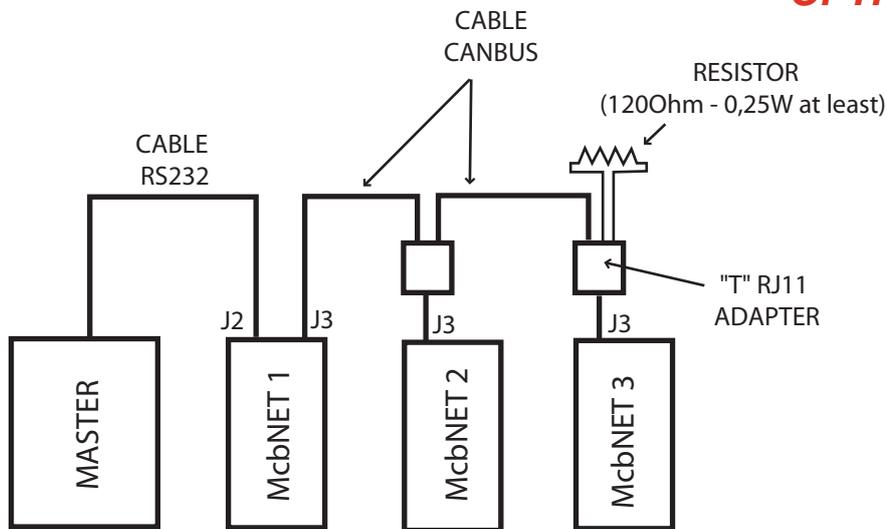
"T" RJ11
ADAPTER

Notes:
• Connect the first **McbNET Digital**™ to the **Master** by using the RS232 cable (**J2** connector) and to the following drive by using the CANBus cable; connect each drive with the following by using "T" RJ11 adaptors; connect a **RESISTOR** (**120 Ohm**, **1/4W**) between the pins 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.

CANBUS connection

OPTIONAL
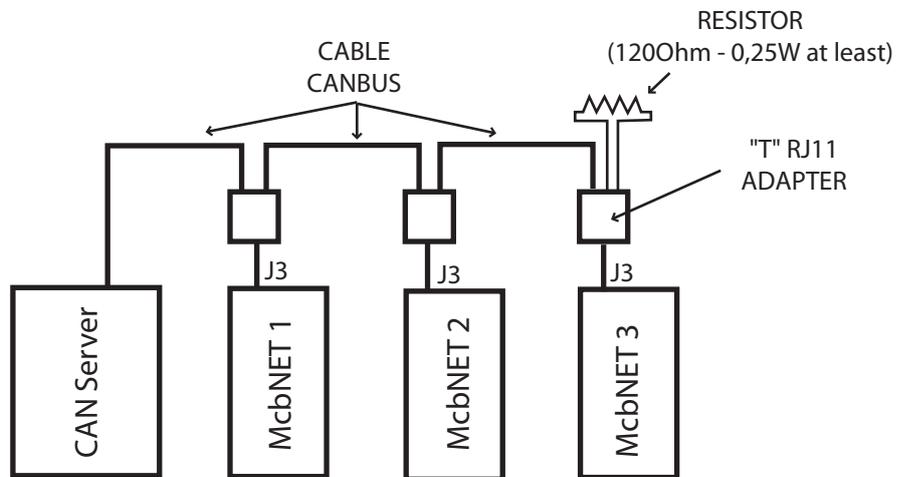
Note: Connect the first **McbNET Digital™** to the **MASTER** by using a CanBus cable (from the **J3** connector to the Master); connect each **McbNET Digital™** to the following by using "T" RJ11 adaptors; connect a **RESISTOR** (**120 Ohm**, **1/4W**) between the pins of the last drive of the network.

2.22 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. <u>**ATTENTION: do not apply load to the motor.**</u>

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.
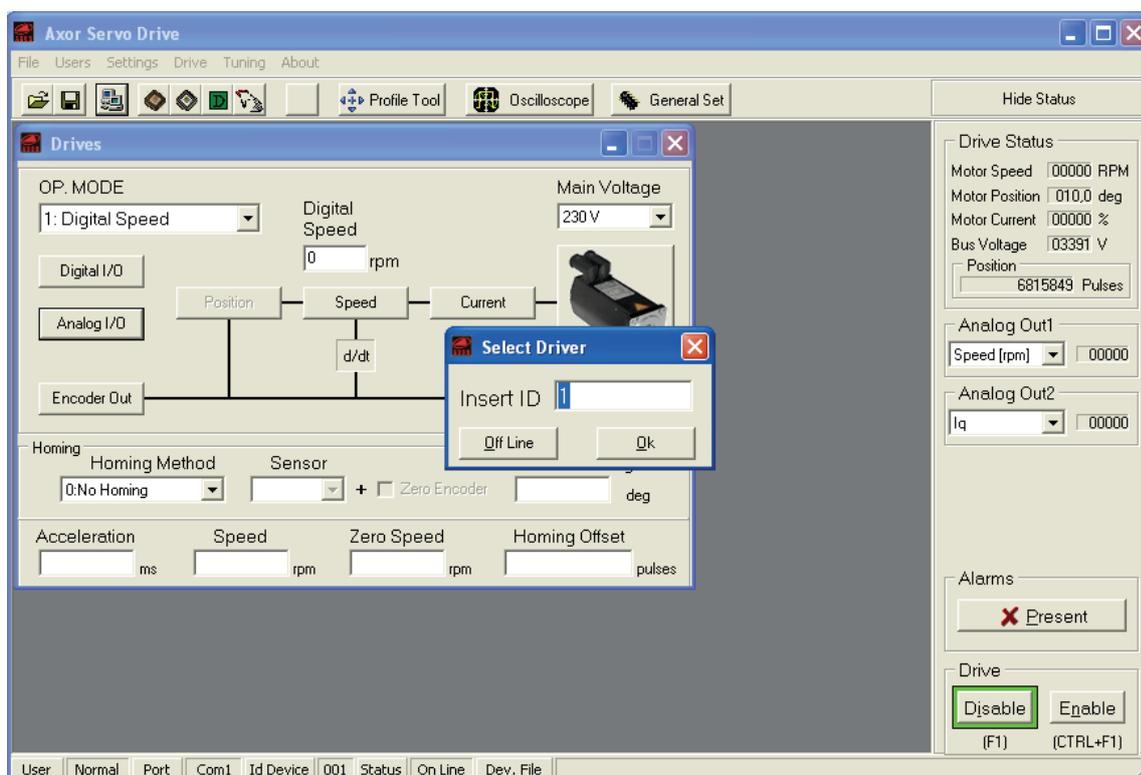
5) If the drive is "**Not configured**", it is necessary to open a pre-set connfiguration file, following this procedure:
   - in the main window select the "**File**"menu and then "**Open**";
   - in the directory: ...\Axor\Data\Devices\ select a file reference to the coupling drive-motor, then click 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)

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 teh set speed, without alarms, it is possible to connect the load and cable the machineè possibile procedere con il collegamento del carico e con il cablaggio della macchina; at teh contrary, if alarms should be compare or if the behavior should not be as set, we suggest to control te connections and the settings (eventually contact Axor).

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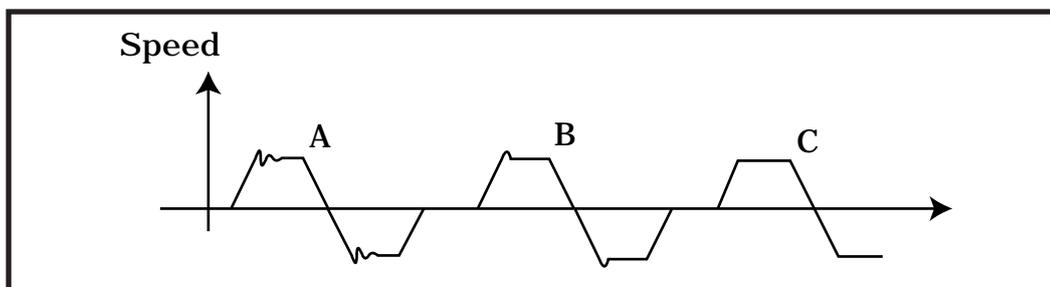
9) At this point it is possible to set other parameters in reference to the desired operative mode (see enclosures "*Operative modes* Manual", "*Additional Features* Manual", "*Speeder One* Interface" available on the CD provided with the drive.

Chapter 3
Diagnostic

3.1 Display

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.
0ı	This appears when the negative limit switch (NSTOP) is interrupted.
0 ı	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.
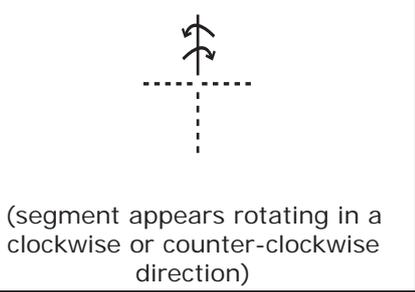
You can fin more information on enclosure "***Display and Keypad* Manual**" available on the CD provided with the drive.

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 while 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, >75°C.
		Disable the drive, verify:
		  • 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 I²t function has reached the maximum permitted. The cause could be one of the following:
	  • the working cycle could be too heavy;
	  • a possible mechanical block;
	  • motor phase inversion;
	  • the electronic brake is not unblocked;
	  • the amplifier's dynamic costants: "KP", "KI" and "KD", could create useless current oscillation.
		It is only a message.
		This does not cause the disabling of the drive's functioning.
		
		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:
		  • 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 I²t energy recovery has reached the maximum allowed.
	This causes the opening of the Ok Relè contact and disables the drive.
		Disable the drive:
		  • 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. 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 I²t 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 *only a message*, it anticipates the intervention of the "Maximum recovery" alarm.

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.
24 UP	**In-rush Bus** *This is not an alarm.* *Indication of the drive's in-rush phase.*	
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 functionability.	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 functionability.	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.

You can find more information on enclosure "*Alarm Manual*" available on the CD provided with the drive.

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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.

servo drives
& Motors
BRUSHLESS-BRUSHED

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