AXOR
★ INDUSTRIES ★
drives & motors

SINCE
1988
ITALY

SERVICE MANUAL

AXOR INDUSTRIES® MOTORS & DRIVES

ENGLISH

CE ℗b RoHS

MACK NANO

Universal Servo Drive

Ver.1 rev.11/19

Release	Notes
ver.1 rev. 03/'16	First preliminary edition.
ver.1 rev. 07/'16	Notes about supply. Note about ground connection. Notes about DC motor settings. Corrections.
ver.1 rev. 12/'16	Added steeper motor connections. Added setting and configuration of encoders. Chapter 1, 2, 4, 5 update. Corrections.
ver.1 rev. 02/'17	Corrections.
ver.1 rev. 11/'19	All chapter update.

**THIS MANUAL CONTAINS A DESCRIPTION OF NANO MACK®
AND A GUIDELINES FOR THE DRIVE'S INSTALLATION.**

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

Summary

1) Description

2) Installation

3) Diagnostic

4) Operative Modes

Summary

Chapter 1
# Description

1.1 General Description

The **Nano Mack**® is a very compact digital drive with high power density capable of piloting AC brushless motors, DC brushed motors and stepper motors, up to **2500W**. It is supplied by a DC voltage equal to **9÷182Vdc (see chapter 1.3 Technical Data)**. With the appropriate hardware setting, it support the following **OPERATIVE MODE**:

OPERATIVE MODES	
ANALOG SPEED	Speed piloting utilising an analogue reference.
DIGITAL SPEED	Speed piloting utilising a digital reference.
ANALOG TORQUE	Torque piloting utilising an analogue reference.
DIGITAL TORQUE	Torque piloting utilising a digital reference.
POSITION MODE	Piloting the motor with configured profile with speed and position. The positioner can be managed via hardware (using the digital inputs appropriately configured) or via USB (using the SpeederOne.2 interface). 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.
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.
PULSE/DIR MODE	It is possible to connect the drive to a motor piloting it with the CLOCK and DIR signals: the DIR signal defines the clockwise/counter clockwise rotation, while the CLOCK signal defines the speed rotation.
CANOPEN	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
CW/CCW	It is possible to connect the drive to a motor piloting it with the CLOCK and DIR signals: if pulses arrive at the CLOCK input, the motor rotates clockwise (CW); while if pulses arrive at the DIR input, the motor rotates counter clockwise (CCW).
SQUARE WAVE PERIOD	The motor is piloted with a "square wave" signal. This is useful for adjustments of the speed loop.
ANALOG TO POSITION	The motor moves between two programmable positions corresponding the min and max voltages at the dedicated pins.
DIGITAL POSITION	The motor moves between two digital positions.
RS485 MODBUS-RTU	It allows to communicate and control the drive by using the RS485 interface.

1.1 General Description

STANDARD FEATURES	
SPEEDERONE.2 SOFTWARE INTERFACE	The SpeederOne.2 interface allows user to set and manage all parameters, just using an mini (case A) or micro USB (case B) / USB single access cable.

SAFETY	
SAFETY	The converter is protected from short circuitry, the Max/Min Voltage, over-temperature of the converter & motor, I^2t of drive, I^2t of motor, etc.
SAFE TORQUE OFF FUNCTION	It is a safety function which avoids the accidental start-up of the motor in the absence of +24Vdc on indicated pins (See enclosure "STO Manual" to find more information provided by Axor on request).

FEEDBACK		
INCREMENTAL ENCODER	Incremental encoder (A, B, Z)	for Brushless, DC Brushed and Stepper (**ONLY CASE A**) motors
COMMUTATION ENCODER	Commutation encoder (A, B, Z) + hall (U, V, W)	for Brushless motor
SENSORLESS	-	for Brushless and Stepper (**ONLY CASE A**) motors
ARMATURE	-	for DC Brushed motor
HALL	Only hall (U, V, W)	for Brushless and DC Brushed motors
TACHOGENERATOR	-	for DC Brushed motor

DIGITAL INPUTS/ OUTPUTS	
4 DIGITAL INPUTS (D.IN1÷D.IN4) PROGRAMMABLE	The digital inputs are programmable with the option present see chapter 5.8 Digital I/0 window.
2 DIGITAL or ANALOG OUTPUTS PROGRAMMABLE	The digital outputs are programmable with the option present in see chapter 5.8 Digital I/0 window and see chapter 5.9 Analog I/0 window.
1 ANALOG DIFFERENTIAL INPUT (An.IN 1 + ／ ‒)	It is used for controlling the current from the drive or piloting the drive with an analogue speed reference from an external controller. Input: ±10V - Resolution: 12bit.
1 ANALOG COMMON MODE INPUT (An.Ref.Torque)	It is used for controlling the current from the drive (±10V - 12bit).

1.2 Mechanical Dimensions
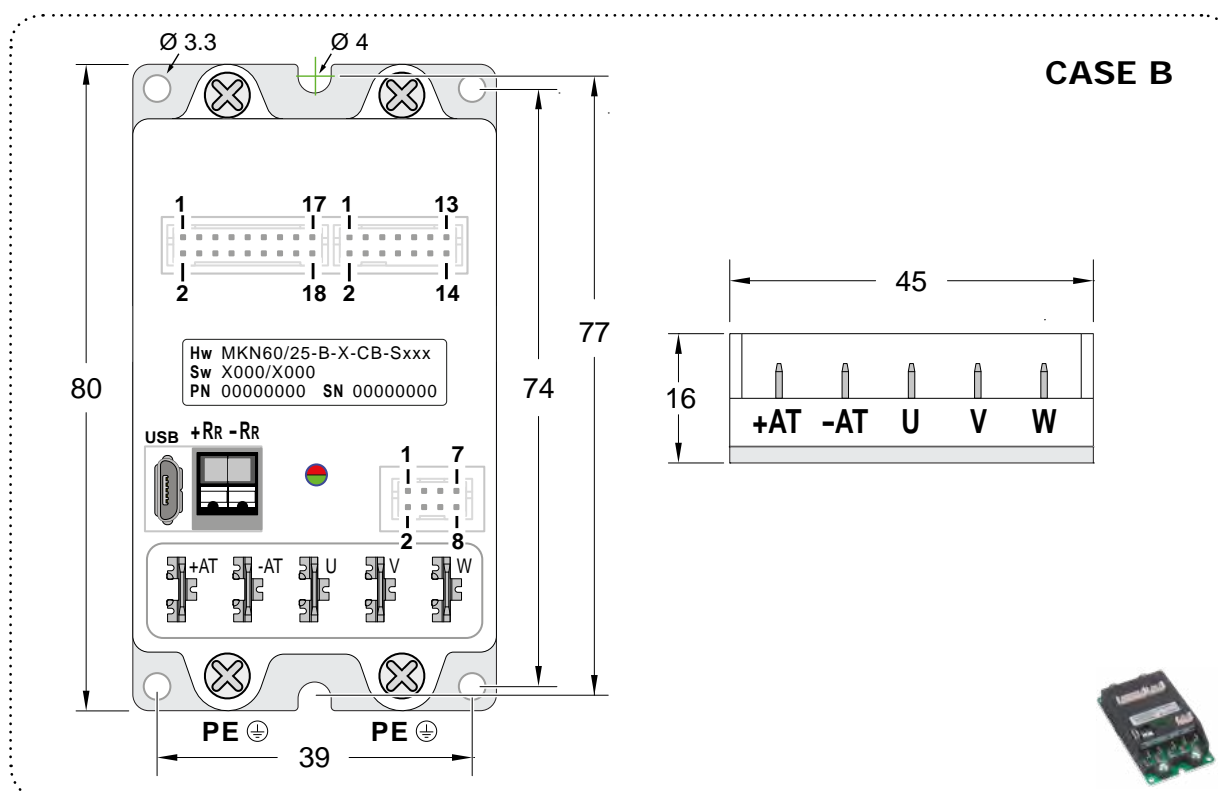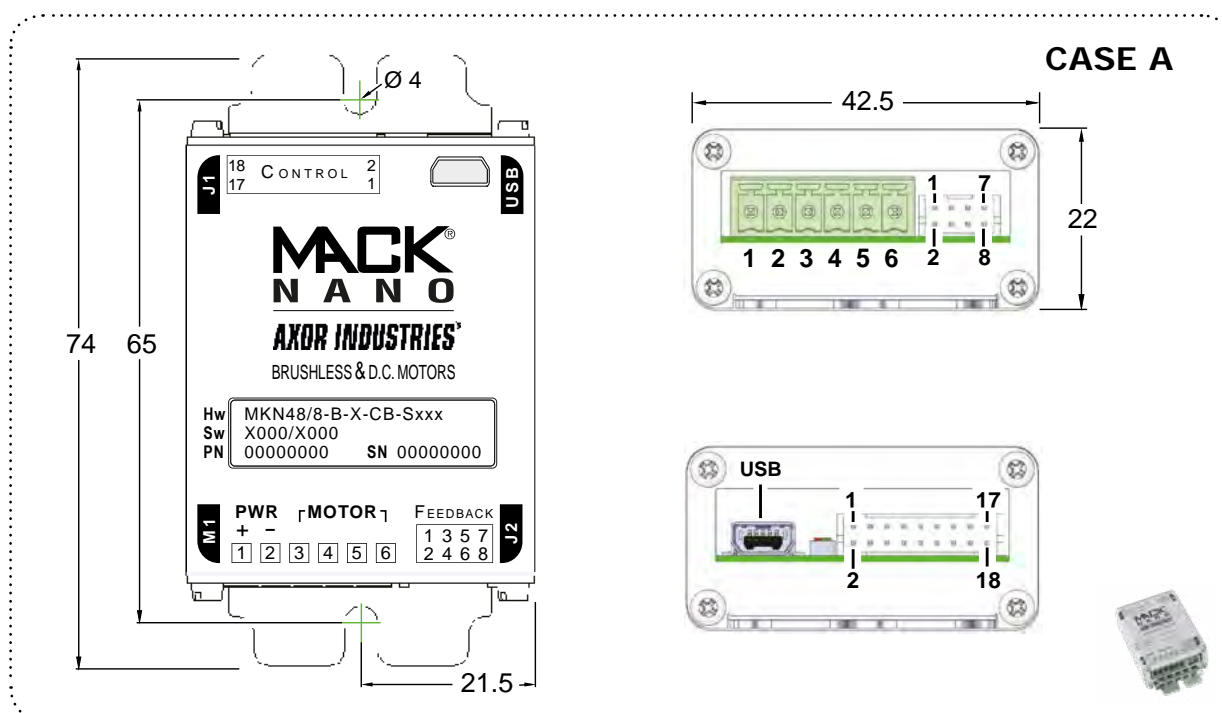
CASE A

CASE B

MECHANICAL SPECIFICATIONS			
Case Type		CASE A	CASE B
Drive assembly		Panel mount	Panel mount
External dimensions	mm	74 x 42.5 x 22	80 x 45 x 16
Weight	g	60	110

1.3 Technical Data

MKN 60 TECHNICAL DATA							
Size		**1**	**5**	**8**	**10**	25	50
Rated Current	Arms	1	5	8*	10*	25**	50**
Peak current x 3''	Arms	2	10	16	20	50	100
Power Supply	Vdc	**12 ÷ 60 (9 min - 82 max)** FOR CASE B EXTERNAL CAPACITOR IS MANDATORY					
Backup Logic Supply	Vdc	**12 ÷ 24 Vdc** (9 min - 30 max)					
Ext. Breaking Resistor	Ohm	-				≥ 2 Ω	
CASE Type		A ( )				B ( )	

MKN 110 TECHNICAL DATA			
Size		15	35
Rated Current	Arms	15**	35**
Peak current x 3''	Arms	30	70
Power Supply	Vdc	**12 ÷ 110 (9 min - 130 max)** FOR CASE B EXTERNAL CAPACITOR IS MANDATORY	
Backup Logic Supply	Vdc	**12 ÷ 24** (9 min - 30 max)	
Ext. Breaking Resistor	Ohm	≥ 5 Ω	
CASE Type		B ( )	

MKN 140 TECHNICAL DATA			
Size		8	25
Rated Current	Arms	8**	25**
Peak current x 3''	Arms	16	50
Power Supply	Vdc	**20 ÷ 140 (9 min - 182 max)** FOR CASE B EXTERNAL CAPACITOR IS MANDATORY	
Backup Logic Supply	Vdc	**12 ÷ 24** (9 min - 30 max)	
Ext. Breaking Resistor	Ohm	≥ 8 Ω	
CASE Type		B ( )	

NOTE
 * : Rated current refers to drive mounted on cabinet metal plate.
 ** : Rated current refers to drive mounted on aluminium plate or heat-sink (85°C Max).
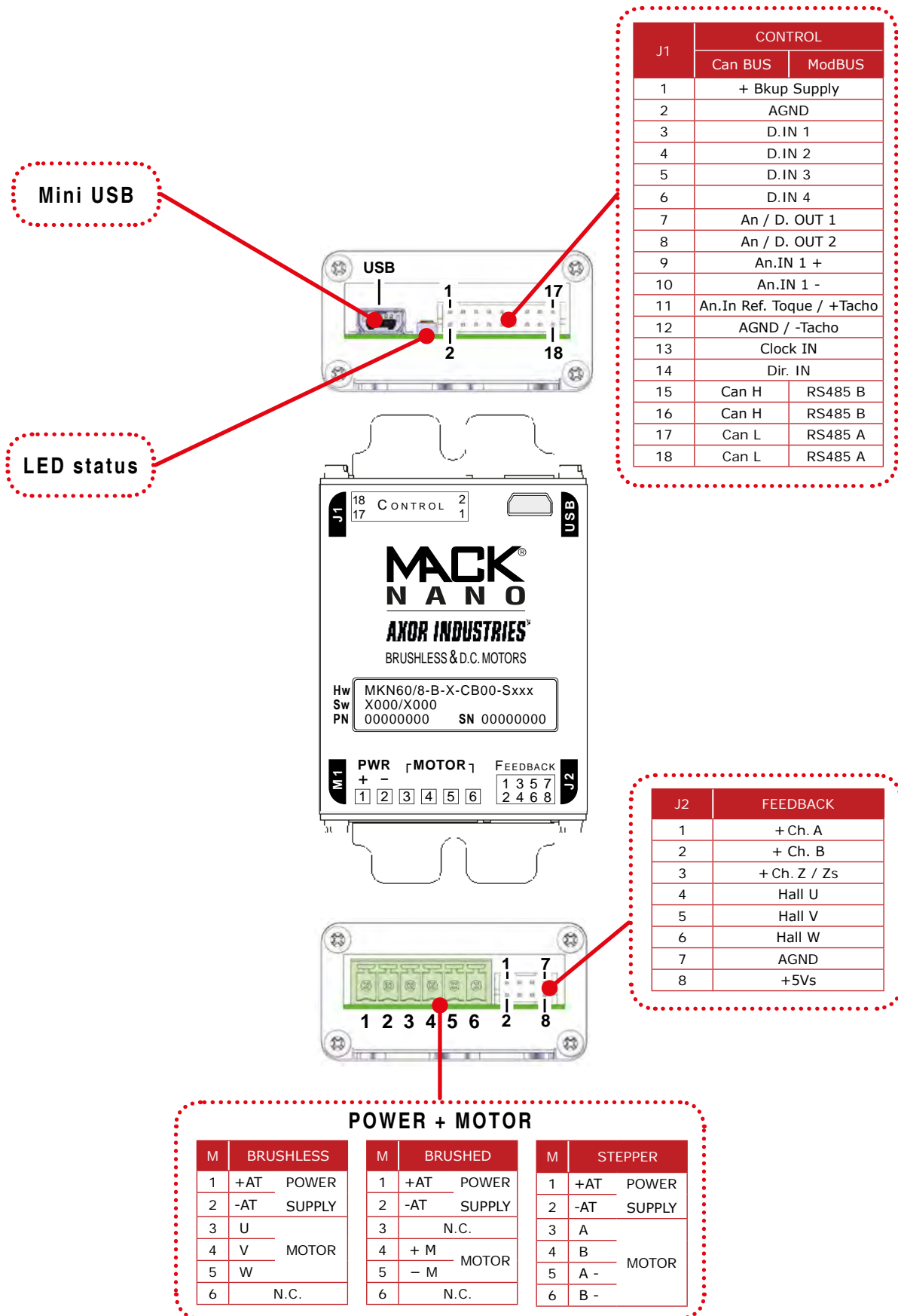
1.3 Technical Data

CONTROL SIGNALS	
Digital inputs	+24Vdc - 7mA (PLC compatible)
Digital/Analog outputs	+24Vdc - 20mA (PLC compatible)
Clock/Dir digital inputs	+5 - **differential mode** - Max. Frequency 500kHz +24V - **common mode** - Max. Frequency 100kHz
Differential analog inputs **(An.IN 1 + / −)**	±10V (±5%) - 12bit
Common analog inputs **(An.IN Ref.Torque)**	±10V (±5%) - 12bit

EXTERNAL FUSE PROTECTION				
		MKN 60	MKN 110	MKN 140
Power Line	F1	**RMS * 135%** **(next commercial standard - T-type)**		
Backup	F2	**1A / 250V** (T-type)		
Dumping resistor	F3	**5A / 250V** (T-type)		

T-type = time-lag.

AMBIENT CONDITION		
During operation	**Temperature**	From **+5°C** to **+40°C** (without condensation) [Class 3K3 according to EN 60721-3-3]. From **+40°C** to **+55°C** the drive must be derated 2.5%/°C in reference to nominal and peak current.
	Humidity	From **5%** to **85%** (without condensation) [Class 3K3 according to EN 60721-3-3].
	Vibration	Class 3M1 according to EN 60721-3-3.
During transport	**Temperature**	From **-25°C** to **+70°C** [Class 2K3 according to EN 60721-3-2].
	Humidity	Relative humidity max **85%** (without condensation) [Class 2K3 according to EN 60721-3-2].
	Vibration	Class 2M1 according to EN 60721-3-2.
During storage	**Temperature**	From **-20°C** to **+55°C** [Class 1K3 according to EN60721-3-1].
	Humidity	Relative humidity from **5%** to **85%** (without condensation) [Class 1K3 according to EN 60721-3-1].
	Vibration	Class 1M1 according to EN 60721-3-1.

Mini USB

LED status

J1	CONTROL	
	Can BUS	ModBUS
1	+ Bkup Supply	
2	AGND	
3	D.IN 1	
4	D.IN 2	
5	D.IN 3	
6	D.IN 4	
7	An / D. OUT 1	
8	An / D. OUT 2	
9	An.IN 1 +	
10	An.IN 1 -	
11	An.In Ref. Toque / +Tacho	
12	AGND / -Tacho	
13	Clock IN	
14	Dir. IN	
15	Can H	RS485 B
16	Can H	RS485 B
17	Can L	RS485 A
18	Can L	RS485 A

J2	FEEDBACK
1	+ Ch. A
2	+ Ch. B
3	+ Ch. Z / Zs
4	Hall U
5	Hall V
6	Hall W
7	AGND
8	+5Vs

POWER + MOTOR

M	BRUSHLESS	
1	+AT	POWER
2	-AT	SUPPLY
3	U	
4	V	MOTOR
5	W	
6	N.C.	

M	BRUSHED	
1	+AT	POWER
2	-AT	SUPPLY
3	N.C.	
4	+ M	MOTOR
5	− M	
6	N.C.	

M	STEPPER	
1	+AT	POWER
2	-AT	SUPPLY
3	A	
4	B	MOTOR
5	A -	
6	B -	

1.5 Connectors Guide CASE B

J1	CONTROL	
	Can BUS	ModBUS
1	+ Bkup Supply	
2	AGND	
3	D.IN 1	
4	D.IN 2	
5	D.IN 3	
6	D.IN 4	
7	An / D. OUT 1	
8	An / D. OUT 2	
9	An.IN 1 +	
10	An.IN 1 -	
11	An.IN Ref. Toque / +Tacho	
12	AGND / -Tacho	
13	Clock IN	
14	Dir. IN	
15	Can H	RS485 B
16	Can H	RS485 B
17	Can L	RS485 A
18	Can L	RS485 A

EMULATED ENCODER + SAFE TORQUE OFF

J3	
1	CHA +
2	CHA -
3	CHB +
4	CHB -
5	CHZ +
6	CHZ -
7	AGND
8	-
9	STO.IN 1
10	STO.IN 2
11 / 12	AGND
13	STO.OUT 2
14	STO.OUT 1

Hw MKN60/25-B-X-CB-Sxxx
Sw X000/X000
PN 00000000   SN 00000000

USB   +Rr -Rr
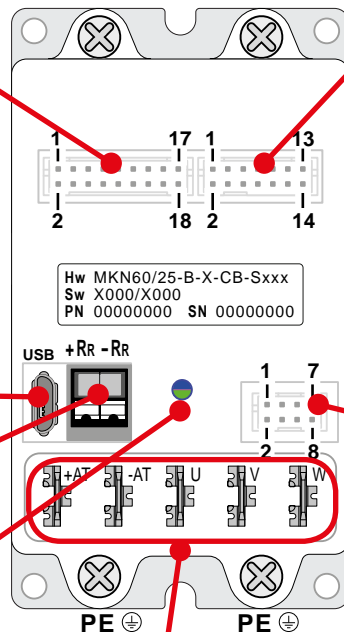
Micro USB

Regen Resistor

LED status

+AT   -AT   U   V   W

PE ⏚   PE ⏚

J2	FEEDBACK	
	X (STANDARD)	R (RESOLVER)
1	+ Ch. A	SEN +
2	+ Ch. B	SEN -
3	+ Ch. Z / Zs	COS +
4	Hall U	COS -
5	Hall V	EXC +
6	Hall W	EXC -
7	AGND	AGND
8	+5Vs	N.C.

POWER SUPPLY / MOTOR

BRUSHED			BRUSHLESS	
+ AT	POWER SUPPLY		+ AT	POWER SUPPLY
– AT			– AT	
PE			PE	
U	N.C.		U	MOTOR
V	+ M	MOTOR	V	
W	– M		W	
PE			PE	

1.6 Connectors description

J1	CONTROL	DESCRIPTION
1	+ Bkup Supply	+ Backup Supply
2	AGND	- Backup Supply
3	D.IN 1	Digital Input 1
4	D.IN 2	Digital Input 2
5	D.IN 3	Digital Input 3
6	D.IN 4	Digital Input 4
7	An / D. OUT 1	Analog / Digital Output 1
8	An / D. OUT 2	Analog / Digital Output 2
9	An.IN 1 +	Analog Input Positive Reference (+10V - 12bit)
10	AN.IN 1 −	Analog Input Negative Reference (−10V - 12bit)
11	An.IN Ref. Torque / +Tacho	Analog Input Toque ($\pm$10V - 12bit) / + Tachogenerator
12	AGND / − Tacho	AGND / - Tachogenerator
13	Clock IN	Clock Input
14	Dir. IN	Direction Input
Can BUS VERSION		
15/16	Can H	Can Channel High
17/18	Can L	Can Channel Low
ModBUS VERSION		
15/16	RS485 B	RS485 Channel B
17/18	RS485 A	RS485 Channel A

J2	FEEDBACK	DESCRIPTION
X (STANDARD VERSION)		
1	+ Ch. A	Channel A +
2	+ Ch. B	Channel B +
3	+ Ch. Z/Zs	Channel Z +
4	Hall U	Hall Sensor U
5	Hall V	Hall Sensor V
6	Hall W	Hall Sensor W
7	AGND	AGND (Encoder 0 of Power Supply)
8	+5Vs	+5Vs (Encoder Power Supply)
R (RESOLVER VERSION) - ONLY FOR CASE B		
1	SEN +	Sine +
2	SEN -	Sine -
3	COS +	Cosine +
4	COS -	Cosine -
5	EXC +	Excitation +
6	EXC -	Excitation -
7	AGND	AGND
8	N.C.	-

1.6 Connectors description

J3	ENC. EMULATED + STO	DESCRIPTION
1	CHA +	Channel A +
2	CHA -	Channel A –
3	CHB +	Channel B +
4	CHB -	Channel B –
5	CHZ +	Channel Z +
6	CHZ -	Channel Z –
7	AGND	AGND
8	-	-
9	STO.IN 1	Channel 1 safety input
10	STO.IN 2	Channel 2 safety input
11/12	AGND	0V
13	STO.OUT 2	The contact is closed if there are no malfunctions.
14	STO.OUT 1	

Motor and power supply connectors connection:

CASE A

M	BRUSHLESS		DESCRIPTION
1	+ AT		+ Power Supply
2	– AT		– Power Supply
3	U		Motor phase U
4	V	MOTOR	Motor phase V
5	W		Motor phase W
6	N.C.		Not connected

M	BRUSHED		DESCRIPTION
1	+ AT		+ Power Supply
2	– AT		– Power Supply
3	N.C.		Not connected
4	+ M		+ DC motor
5	– M	MOTOR	– DC motor
6	N.C.		Not connected

M	STEPPER		DESCRIPTION
1	+ AT		+ Power Supply
2	– AT		– Power Supply
3	A		Motor phase A +
4	B		Motor phase B +
5	A -	MOTOR	Motor phase A -
6	B -		Motor phase B -

CASE B

	BRUSHLESS	DESCRIPTION
+ AT	POWER SUPPLY	+ Power Supply
– AT		- Power Supply
PE		PE
U	MOTOR	Motor phase U
V		Motor phase V
W		Motor phase W
PE		PE

	BRUSHED	DESCRIPTION
+ AT	POWER SUPPLY	+ Power Supply
– AT		– Power Supply
PE		PE
U	N.C.	Not connected
V	+ M	+ DC motor
W	– M MOTOR	– DC motor
PE		PE

	DESCRIPTION
+RR	+ Regen Resistor
-RR	- Regen Resistor

1.7 Product plate and Ordering Code

On the **CASE A** there is a *product plate* like the follow:
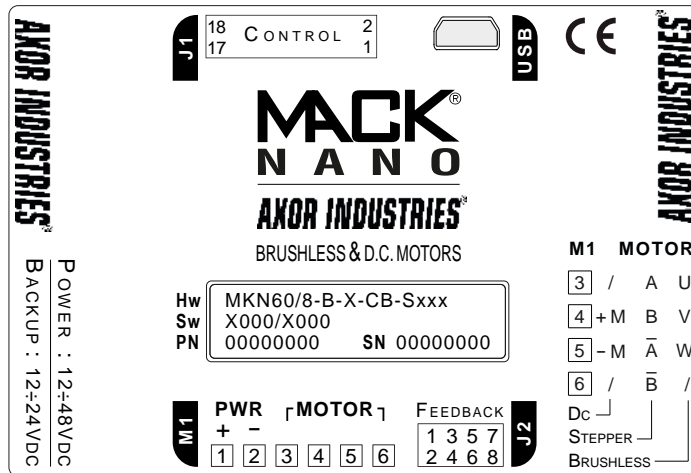
And on the **CASE B** there is a *product plate* like the follow:
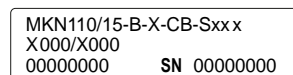
The *product plate* is composed as follow:

HARDWARE CODE ———— Hw

SOFTWARE CODE ———— Sw

PART NUMBER ———— PN

MKN110/15-B-X-CB-Sxxx
X000/X000
00000000   **SN** 00000000 ———— SERIAL NUMBER
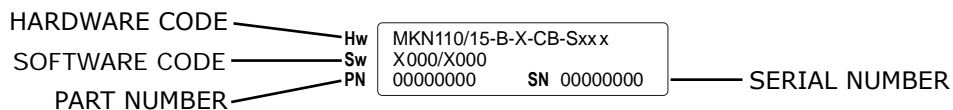
-HARDWARE CODE: drive's hardware configuration.
-SOFTWARE CODE: firmware and configuration file loaded in the drive.
-PART NUMBER: based on HARDWARE & SOFTWARE configuration.
-SERIAL NUMBER: drive unique identifier serial number.

The HARDWARE CODE it is also the ordering code is composed as follow:

MKN 60 / 8 - B - X - CB 0 0 - Sxxx

DRIVE LINE

MODEL & SIZE:
see chapter 1.3 Technical Data

MOTOR TYPE:
B = Standard:
   BL Brushless
   DC Brushed
S = Optional: (for case A only)
   SM Stepper
   BL Brushless
   DC Brushed

FEEDBACK:
X = Standard
R = Resolver (**for case B only**)

SPECIFIC NUMBER (opt):
   S xxx
   001÷999

EMULATED ENCODER / STO:
0 = w/out (std)
1 = with STO (safe torque off)   (opt)
2 = with EMULATED ENC.   (opt)
3 = with STO + EMULATED ENC. (opt)
for case B only

DUMPING CIRCUIT:
0 = w/out (std)
1 = with (opt)(**for case B only**)

CONTROL MODE:
CB = CanBus (std)
MB = RS 485 MODBUS-RTU (opt)

MOTOR-DRIVE COUPLING

During the machine assembly phase remember to correctly execute the proper drive/motor coupling. With this in mind, compare the drive label (see FIG.1) with the test certificate supplied with the drive. You will find on the test certificate the code and description of the adjustment file, along with the proper motor coupling for the drive (see FIG.2).

HW: MKN60/5-B-X-CB00-Sxxx
SW: B03E / X000 / D007

0444/440441   **Data**:   **Ord**:   **Cod**: 93960040

FIG.1 (Drive label)

Code of the adjustment file for which drive has been setup

Certificato di collaudo / *Test certificate*

MACK®NANØ

IO 00094 Rev D

Cliente / *Client* :
Totale pezzi / *Tot. pieces* :   **2**   di / *of* : **2**
Codice prod. / *Order code*:   **93960040**
HW: **MKN60/5-B-X-CB00-Sxxx**

N. Ordine/ *Order N.*:
Data / *Date* :
Matricola / *ID Number* :
SW: **B03E / X000 / D007**

Description of the adjustment file for which drive has been setup

N. Lotto com-reg / *N. Block com-reg*: **2/19**

File di taratura / *Adjustment file* :
MKN60_8_MKBM60_M_J32_0_EIS1_3
Versione firmware / *Firmware version*:
firmware_MKN_B_03E.mot
Versione CPLD / *CPLD version*:

Versione software /   *Software version*:
-

Tarature / *Settings* :

I rms / *Rated I* :   **5**   Arms
I peak / *Peak I* :   **16**   Arms
Speed limit: **3000**   Rpm
Note:

Motor to couple with drive

Etichetta prodotto / *Product label*

Caratteristiche motore / *Motor features* :
Tipo / *Type* :   **MKBM60_M_J32_0_EIS1_3**

Encoder :	**1024**	Impr/rev	I o : **5** A rms	U n : **48** V rms	
P. Motor :	**8**		I pk : **20** A rms	M o : **0,65** Nm	
P. Resolver :			Nn : **3000** Rpm	M pk : **2,6** Nm	
Phasing angle : **330** deg			L : **0,7** mH	Ke : **7** V/1000 rpm	
Brake : **no**			R : **0,35** ohm	K t : **0,12** Nm/A	

N. ID strumenti / *Instrument IDs*:

Tester
35

Lem

Misure relative alla qualità del prodotto / *Product quality tests* :

N. ID attrezzature di prod. / *N. ID prod equipment* :

Banco
155

Oscilloscopio
195

Misure relative a dati feedback per la progettazione / *Project feedback data tests* :

COLLAUDO / TEST

Questo documento certifica che l'apparecchiatura soddisfa i requisiti specificati nel contratto di acquisto, in quanto tutte le prove previste nelle procedure di collaudo sono state superate con esito positivo.
This document certifies that the device meets the requirements that are displayed on the purchase contreact, because all of the programmed tests on the test procedures were positive.

CSQ
UNI EN ISO 9001 CERTIFIED

IQNet

CE

Operatore C.Q. / *Quality test op* :

Firma / *Signature* :

AXOR sas - Viale Stazione 5, Montebello Vic.no (VI) Italia - Tel. +39 0444440441 - Fax +39 0444440418 - info@axorindustries.com

FIG.2 (Test Certificate)

Note: It is recommended that the client retains the test certificate of both drive and motor.

Chapter 2
Installation

2.1 General Advices

Transport

During the transport of the device respect the following indications:
- The transport must be made by qualified personnel.
- The temperature range must be between -25°C and +55°C [class 2K3 according to EN 60721-3-2].
- The max. humidity must be 85% (without condensation) [class 2K3 according to EN 60721-3-2].
- The system 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 device condition at its arrival to survey eventual damages.
- Avoid shocks (the drive has class 2M1 is according to EN 60721-3-2).

Storage

The unused drives must be storage in an environment having the following characteristics:
- Temperature from -25°C to +55°C;
- Max. relative humidity 85% (without condensation);
- Max. time with the drive powered off (without supply connections): 1 YEAR.

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 dc voltage for 30 minutes.

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

We recommend an accurate maintenance plane, according to using norms (for example CEI EN 60439-1). In particular, we recommend the following:
- If the casing is dirty, clean it with isopropanol or similar;
- If the drive is dirty: the cleaning is reserved to the producer;
- Monthly clean drives from external dirt and dust deposits.
- **ADOPT ALL NECESSARY MEASURE TO AVOID DUST DEPOSITS INSIDE THE DRIVE**.

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.

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

• The drive 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.

• Protect the drive from excessive mechanical vibrations in the electrical box.

2.2 Environmental conditions

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

Environmental conditions	
Storage temperature	From -20°C to +55°C
Working environmental temperature	From 0°C to +40°C (no derating). From +40°C to +55°C the drive must be derated 2.5%/°C in reference to nominal and peak current.
Humidity	From 10% to 85% (without condensation)
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 drives.
You must pay particular attention to the sizing of the (eventual) cooling system, remembering the electrical box size and power internal dissipation of the drive(s).
Monthly control the functioning of the extracted air filter and cooling air filter of the electrical cabinet, in particular control the functioning and cleaning of fans and filters.

• **Monthly** check the internal cleaning of the electrical panel and define an accurate cleaning plane, according to using norms (for example CEI EN 60439-1).

• **Monthly** check drive case for excess dust or dirt, that could interfere with the correct dissipation of the drive.

2.3 Cables characteristics

The following table illustrates the technical characteristics of all cables:

Cables		
TYPE	**SECTION**	**NOTES**
Backup Supply	**0.10-0.33** mm^2/ 26-22AWG	**-**
Motor Cable	**-**	It must be shielded and twisted. It must have a capacity less than 150pF/m. **The Max cable length is up to 10m without filter.**
Control signals and I/O signals from PLC/CNC	**0.10-0.33** mm^2/ 26-22AWG	*see cap. 2.4 Note about cable shielding on page 27.*
Encoder signals (commutation)	**0.10-0.33** mm^2/ 26-22AWG	It must be shielded. It must have a capacity less than 120pF/m.
Encoder signals (serial)	**0.10-0.33** mm^2/ 26-22AWG	Capacitance 800 ÷ 1000Hz : ≤90pF/m Characteristic Impedance at 10MHz : 110 ± 10 Ω
External resistor	**1.5**mm^2/15AWG	If the cable length is longer 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.
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.
SpeederOne.2 interface	**-**	Micro USB B 5P to USB A type male. The cable length must be shielded and 3m Max.

Notes:
- Avoid crossing, overlapping and twisting cables together. If it is absolutely necessary to cross them, do so at 90°.
- Use only copper conductors for cabling.

2.3 Cables characteristics

Following is the crimping process:

d... Wire cross section
D... Cross section of insulation
A... Stripping length
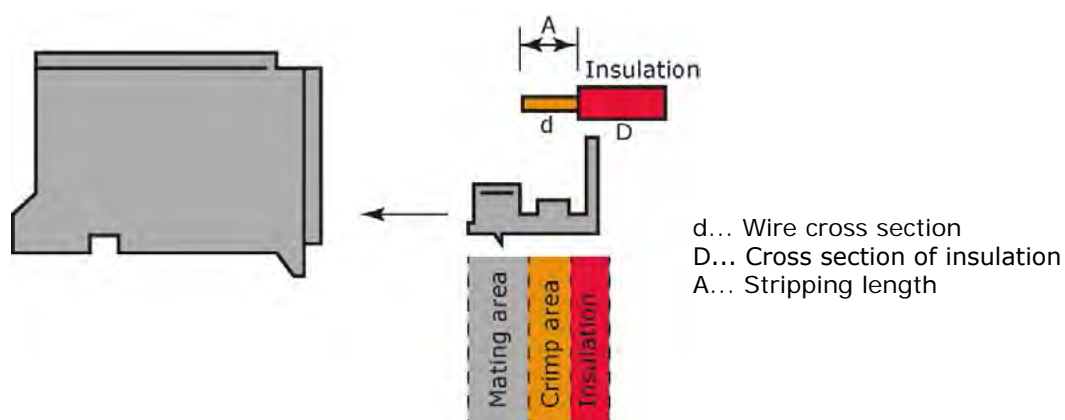
Connector	Article Code	Wire cross section	Max cross insulation section D	A length
J1	Crimp contact: SPHD-001T-P05 housing connector: PHDR-18VS	26...22 AWG 0,13...0,33 mm^2	1,5 mm	~ 1,5...2 mm
J2	Crimp contact: SPHD-001T-P05 housing connector: PHDR-08VS	26...22 AWG 0,13...0,33 mm^2	1,5 mm	~ 1,5...2 mm
Crimp tool: WC-240				

2.4 Note about cable shielding

The table below illustrates the symbols used in the following pages:

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.

Control signal cables

The conductor of the analogic signal must be twisted and shielded, and the shield must be connected to ground, remove the outside sheath and affix the shield to the zinced panel by using an U-clamp.

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 power cables with the control cables, 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** (0,2m) ⇨ remove the outside sheath and fix shield to the zinced panel, by using a U-clamp:
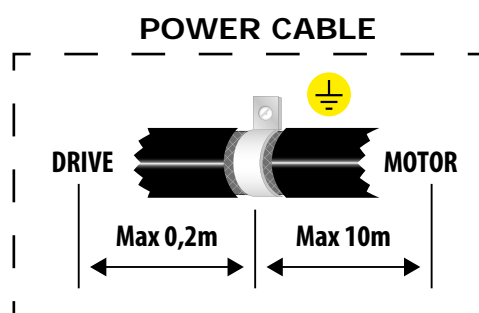
2.5 Basic installation

Nano Mack® **CASE A**:

BACKUP SUPPLY

CONNECT THE ZINCED
PANEL TO THE GROUND

FUSE (F₂)

LENGHT
MAX 10 cm

GROUND BAR

MACHINE
GROUND

J1 18 CONTROL 2
17   1

USB

MACK
NANO

AXOR INDUSTRIES®
BRUSHLESS & D.C. MOTORS

Hw MKN48/8-B-X-CB-Sxxx
Sw X000/X000
PN 00000000   SN 00000000

M1   PWR ⌐MOTOR⌐   FEEDBACK
     + −   1 3 5 7   J2
     1 2 3 4 5 6   2 4 6 8

ALL ENCODER'S CABLE
INTERNAL SHIELDS
(NO EXTENAL SHIELD)

FUSE (F₁)

POWER SUPPLY

WITH TRANSFORMER
(DON'T USE AUTOTRANSFORMER)

ZINCED PANEL

Nano Mack® **CASE B**:

Content inside the diagram:

PLACED AS FAR AS POSSIBLE ABOVE THE DRIVE OR OUT OF THE PANEL

CONNECT THE ZINCED PANEL TO THE GROUND

GROUND BAR

MACHINE GROUND

IF LONGER THAN 30cm, IT MUST BE TWISTED AND SHIELDED, THE SHIELD MUST BE CONNECTED TO THE GROUND ON BOTH ENDS WITH U-CLAMPS.

LENGHT MAX 10 cm

Hw MKN60/25-B-X-CB-Sxxx
SW X000/X000
PN 00000000   SN 00000000

FUSE (F$_3$)

USB

ALL ENCODER'S CABLE INTERNAL SHIELDS (NO EXTENAL SHIELD)

TWISTED

LENGHT MAX 15 cm

FUSE (F$_1$)

FUSE (F$_2$)

POWER SUPPLY

BACKUP SUPPLY

WITH TRANSFORMER (DON'T USE AUTOTRANSFORMER)

ZINCED PANEL

2.5 Basic installation

This procedure must be done only by qualified personal which are familiar with drives.

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 **connection to earth** of the electrical box where the drive is installed .

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- Connect the **cables for the motor's power** (*see cap. 2.10 Motor Power connection on page 39*).

   2- 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.

   3- Connect the AGND pin of J1 connector (pin 2 or pin 12) to ground bar of the electrical box.

   4- Connect the chassis of the drive to the ground bar of the electrical box by the zinced panel

   5- Connect the motor's feedback cable (*see cap. 2.11 Motor Feedback connections on page 40*).

   6- Connect the power supply cable (+AT/-AT) in the drive (*see cap. 2.7 Power & Backup common source on page 32*).

   7- Connect the **backup supply cable** (*see cap. 2.7 Power & Backup common source on page 32*).

   8- **Always insert a fuse F₁ and F₂ (**see cap. 1.3 Technical Data on page 11**)**.

   9- Connect the PC to the drive utilising an **shielded micro USB** cable. The cable length must be 3m max.

   10- Supply the drive with the **backup supply** and then the **power supply**.

   11- Open the *SpeederOne.2* interface.

   12- Select the desired operative mode.

   13- Configure the drive setting for the relative operative mode (*see cap. 4.1 Operative Modes on page 64*).

   14- Save in Eeprom and power off and on the drive to apply all the settings.

   15- Execute the tests on the drive and the motor.

2.6 Backup Supply connections

BACKUP SUPPLY

CASE A
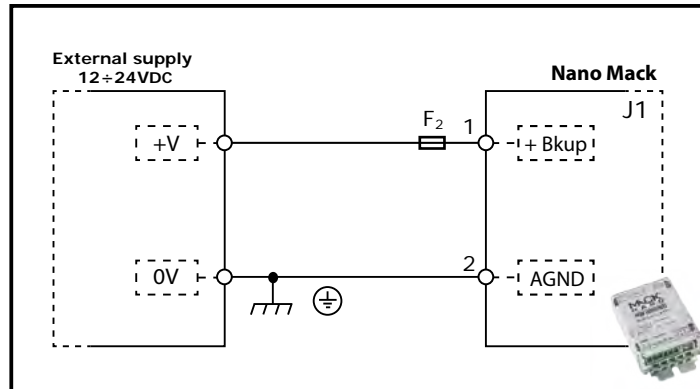
CASE B
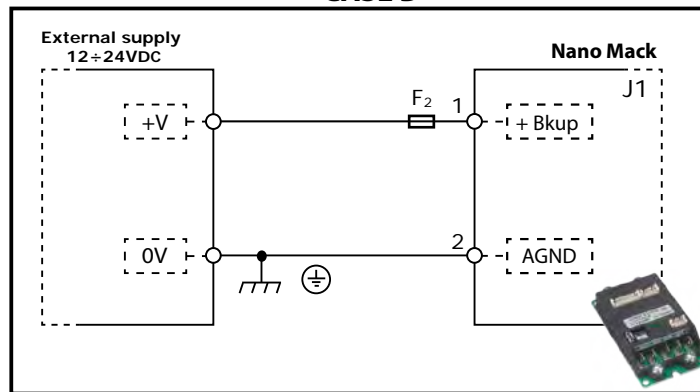
Notes:
- Accepted voltage: **12 ÷ 24VDC;**

- Max current required for the external supply: **0.1A;**

- We suggest to insert the F_2 (*see cap. 1.3 Technical Data on page 11*) fuse;

2.7 Power & Backup common source

POWER & BACKUP SUPPLY from common source
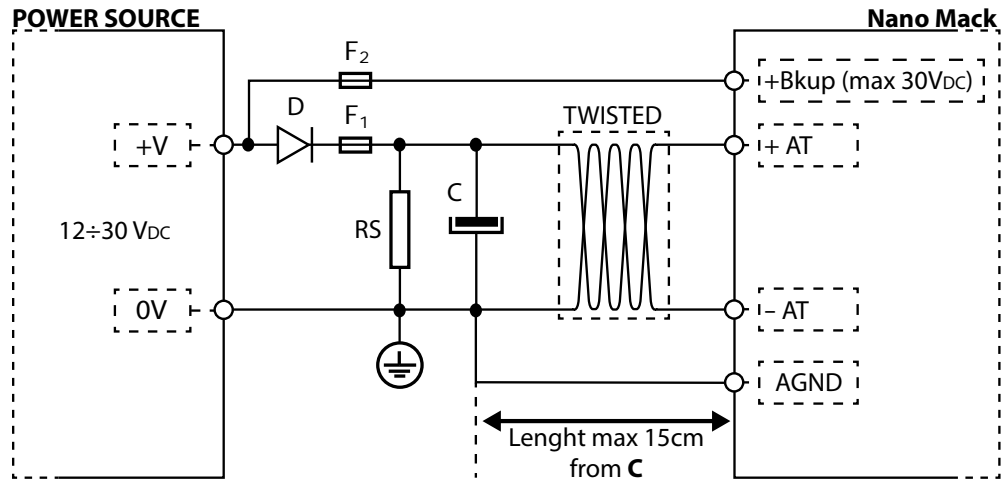
C & RS are optional for case A.

To calculate the capacitor (C), resistor (RS) and diode (D) use the following formulas:

$C\,(uF)\ \geq\ In\,(A)*20$

$I_{RMS(\,10\,khz\,)}$ Capacitor $\geq In/2$

$RS\,(OHM)\ \geq\ 20\,000\,000\,/\,C\,(uF)$

$D\,(I_F)\ \geq\ Ipeak\,(A)*2$

2.8 Power supply connections

POWER SUPPLY from battery
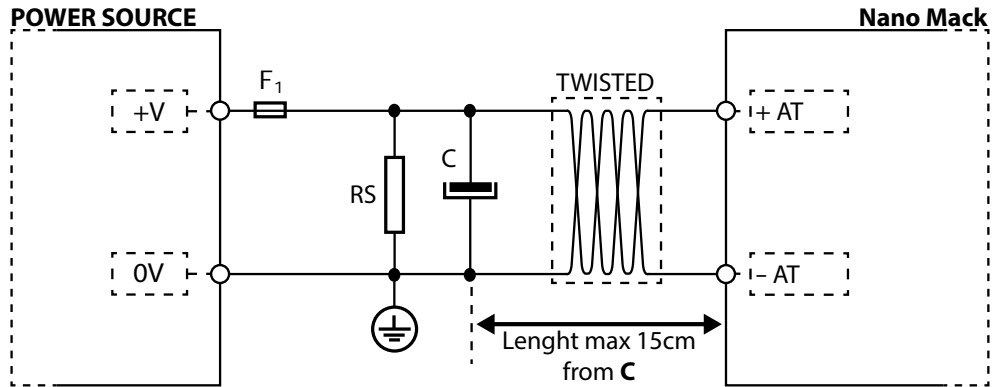
To calculate the capacitor (C) and resistor (RS) use the following formulas:

C (uF) $\geq$ In (A) * 20

$I_{RMS(10\ khz)}$ Capacitor $\geq$ In / 2

RS (OHM) $\geq$ 20 000 000 / C (uF)

2.8 Power supply connections

POWER SUPPLY from transformer
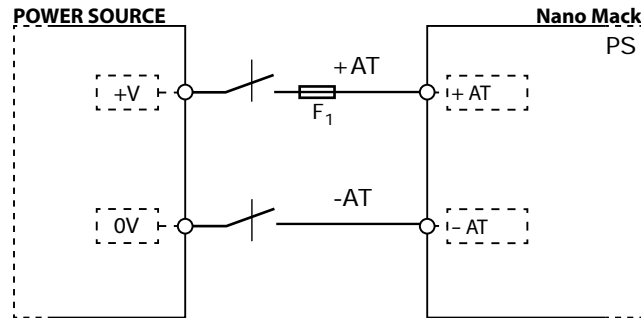
Note:
- We suggest to insert the **F₁** fuse (*see cap. 1.3 Technical Data on page 11*).

For the *power supply rating* use the scheme and the indications below:
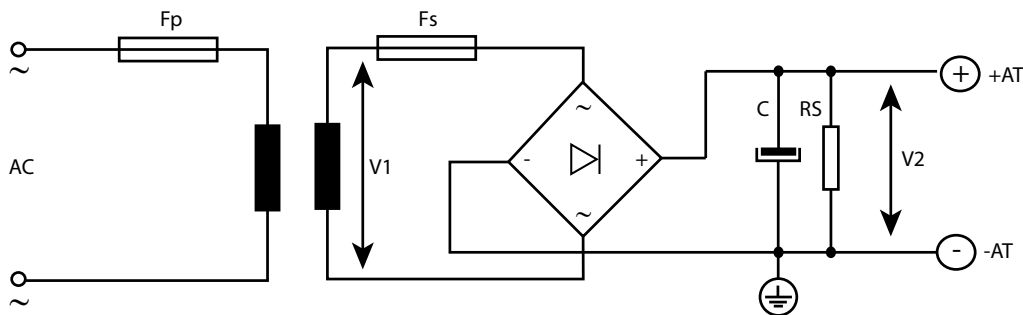
Transformer:

The drive has the internal zero signal connected with the negative pole (-AT), consequently **don't use auto-transformers**.
The factory recommends using transformers with the secondary winding that must be delta/triangle connected.

Voltage: The primary voltage depends on the available net voltage; while the secondary voltage will be calculated according to the motor's characteristics and according to the voltage drive range, using the value below:

$$V1(ac) = \frac{Vmotor}{0,9 \times 1.36}$$

where: **Vmotor = Emax + (Ri x In)**

Vmotor = This is the voltage between armature motor at max speed and nominal stall torque.

Emax = CEMF at max work speed (similar to max voltage, at max motor speed and no load).

Ri = Armature motor resistance with brushes.

In = Rated current at nominal torque.

The factory suggests keeping a margin by choosing AC voltage to avoid too high voltage during the deceleration phases of the motor.

2.8 Power supply connections

Power: nominal transformer power is referred to each motor power sum, on multi-axes applications:

$$P(VA) = (Pass\ M1 + Pass\ M2 + ...)\ x\ 1,25$$

Where: **Pass M = (n x Cn)/9,55** (Pass M = absorbed motor power in VA, n = speed in RPM, Cn = rated torque in Nm).

Notice: If multi-axis application is required, the transformer power rating may be reduced by 30% respecting the original equation.

Fuses

A fuse should be fitted into each of the transformer's primary and secondary windings, Fp and Fs. These fuses may be replaced with a magneto-termic switch with the same value.

The Fp fuse mounted on the primary protects the transformer.
This fuse must be the "slow" type.

$$Fp = \frac{P(VA)\ trafo.\ x\ 1,1}{V(primary)ac}$$

The Fs fuse mounted on the secondary also protects the transformer and that fuse must be the "slow" type.

$$Fs = \frac{P(VA)\ trafo.\ x\ 1,1}{V1(secondary)ac}$$

Filter capacitors

The capacitor filters the voltage from single phase bridge and recoveries the energy from the motor during the deceleration phase. Capacitor's value can be obtained with following formula:

$$C(uF) = \frac{P(VA)\ trasf.\ x\ 2\ 000}{V2}$$

where: V2 = capacitor voltage between positive and negative at no load speed.

About the filter capacitor, the factory recommends one with a working voltage of at least 100 Vdc.

DISCHARGE RESISTANCE

This resistance discharges the capacitor when amplifier is disconnected after power supply switch off. The value can be calculated with the following formula :

$$RS\ (Ohm) = \frac{20\ 000\ 000}{C(uF)}$$

$$P(W) = \frac{V2^2}{RS}$$

2.9 Regen resistance connections

EXTERNAL REGEN RESISTANCE connection

It is possible to use a **100W (for the ohm** *see cap. 1.3 Technical Data on page 11* **)** external resistance to absorb the excess of energy from decelerating or braking.
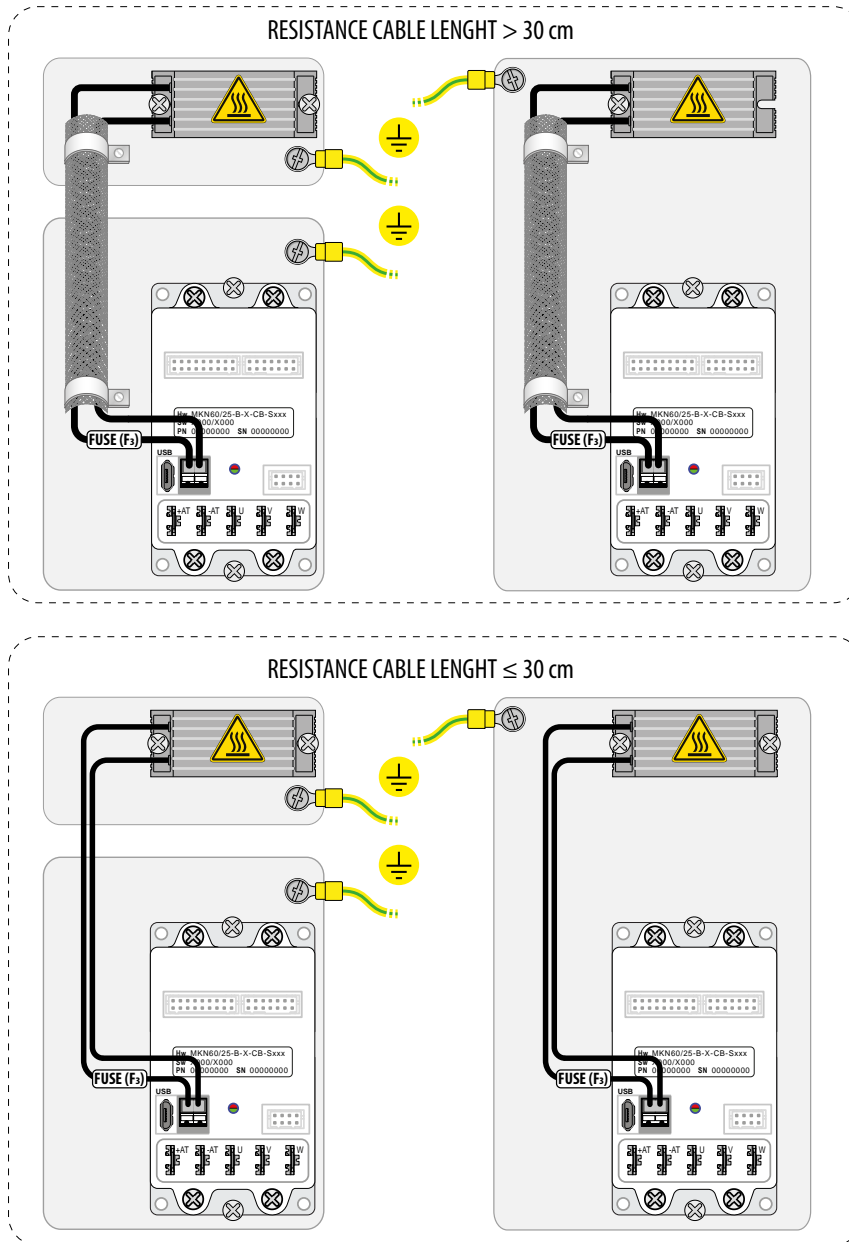
Notes:
- The resistance must be connected to the zinced panel utilising two screws, *possibly out of the panel or, if it is not possibly, inside the panel but as far as possible above the drive.*

- Insert the fuse **F$_3$** (*see cap. 1.3 Technical Data on page 11*).

- Do not mount the resistor on surfaces which can be damaged by heat.

- If the resistors are mounted externally, protect them.

2.9 Regen resistance connections

- Respect the distances illustrated in figure below:
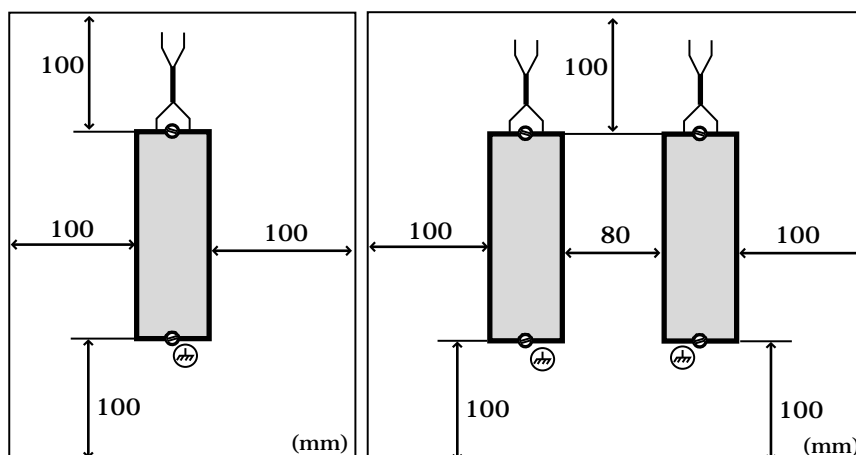
EXTERNAL REGEN RESISTANCE configuration

Connect the drive to the SpeederOne.2 then navigate to the **Breaking,** setup and insert the **REGEN RESISTANCE** detail and the desired **Braking Voltage.**

Notes:

- To deactivate the BRAKING function setup the "Resistance value", "Absorbed energy" and "Power" to 0.

- Save to Eeprom and power off and on the drive in order to apply the setting.

MOTOR POWER (brushless)

(See Note)
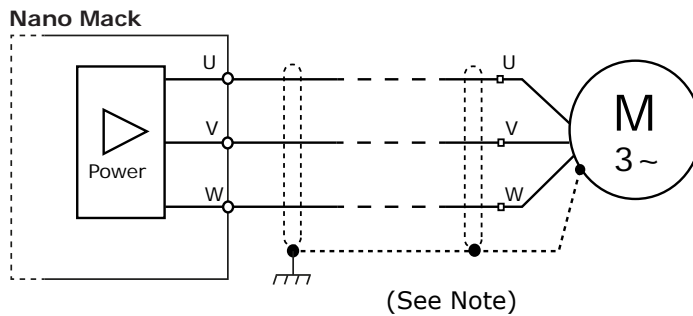
MOTOR POWER (DC brushed)

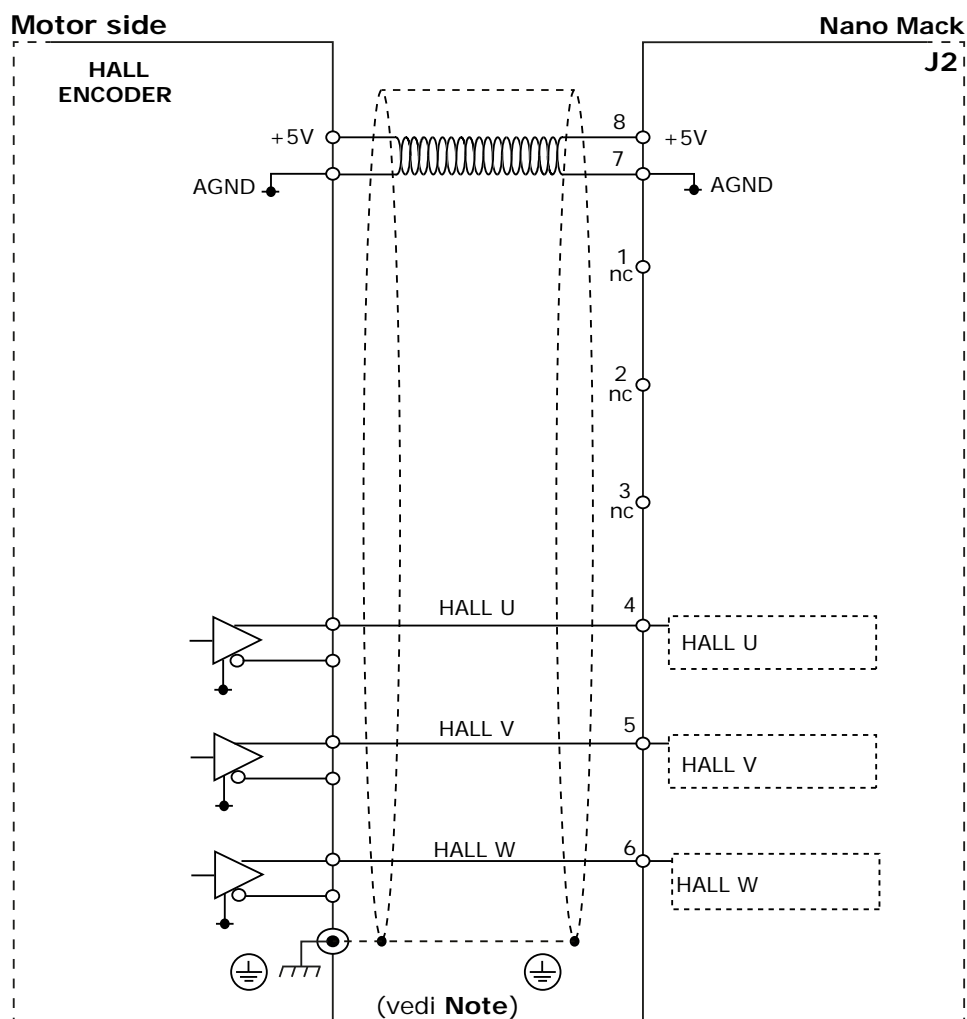(See Note)
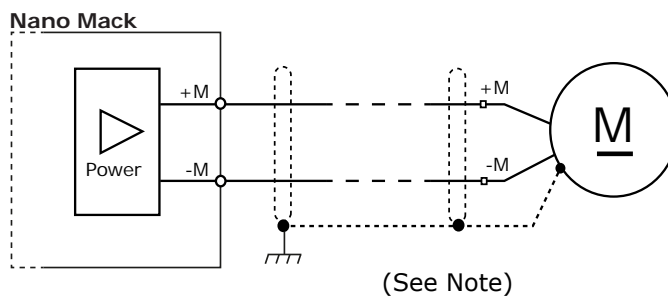
MOTOR POWER (stepper) only Case A

(See Note)
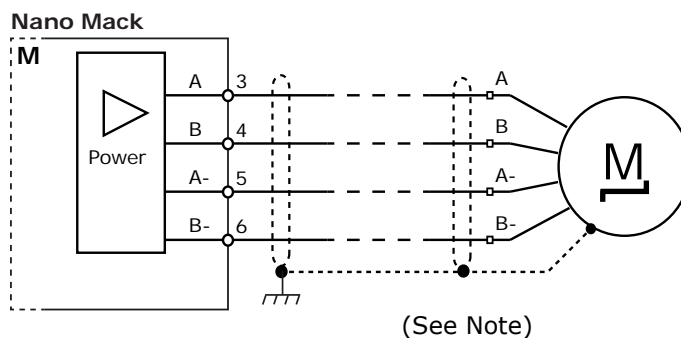
Note:
• The **earth connection** of the power cable's shield must be made on the zinc-coated panel (using a U-clamp) near the drive (0,2 m).
Motor side: the shield is connected to connector's metal ring, so it is connected to ground through motor's carcass.

POWER CABLE

DRIVE   MOTOR

Max 0,2m   **Max 10m**
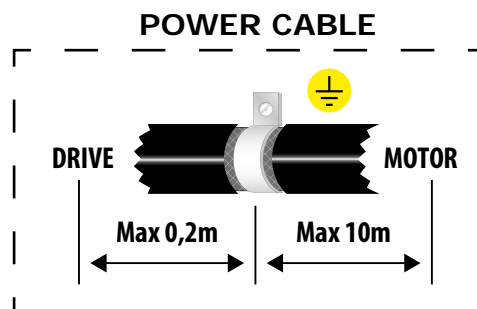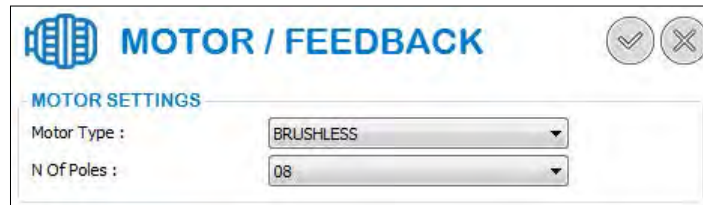
ATTENTION:
Before enabling the drive be sure the type of motor setted in the drive is correct (*see cap. 5.4 Motor / Feedback on page 96***).**

2.10 Motor Power connection

MOTOR configuration

Connect the drive to the SpeederOne.2 then navigate to the **Motor/Feedback** and select the type of Motor and, if brushless, the number of poles.
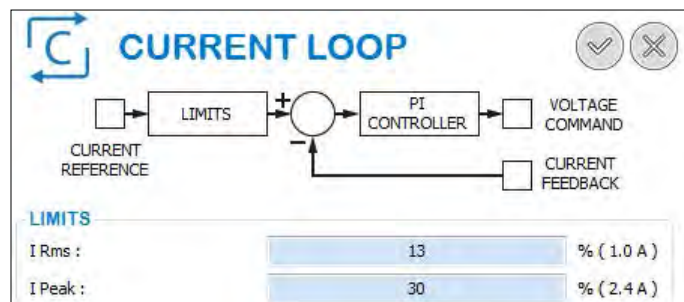
Navigate to the **Current Loop,** insert the motor current (**I Rms**) and motor peak current(**I Peak**).
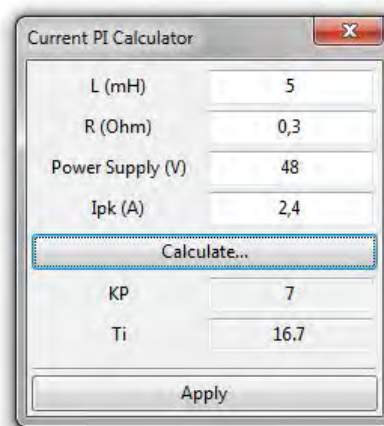
Run the tool **PI Calculator**.

Insert the detail, calculate and apply.

Save in Eeprom and reboot the drive.

COMMUTATION ENCODER FEEDBACK connection
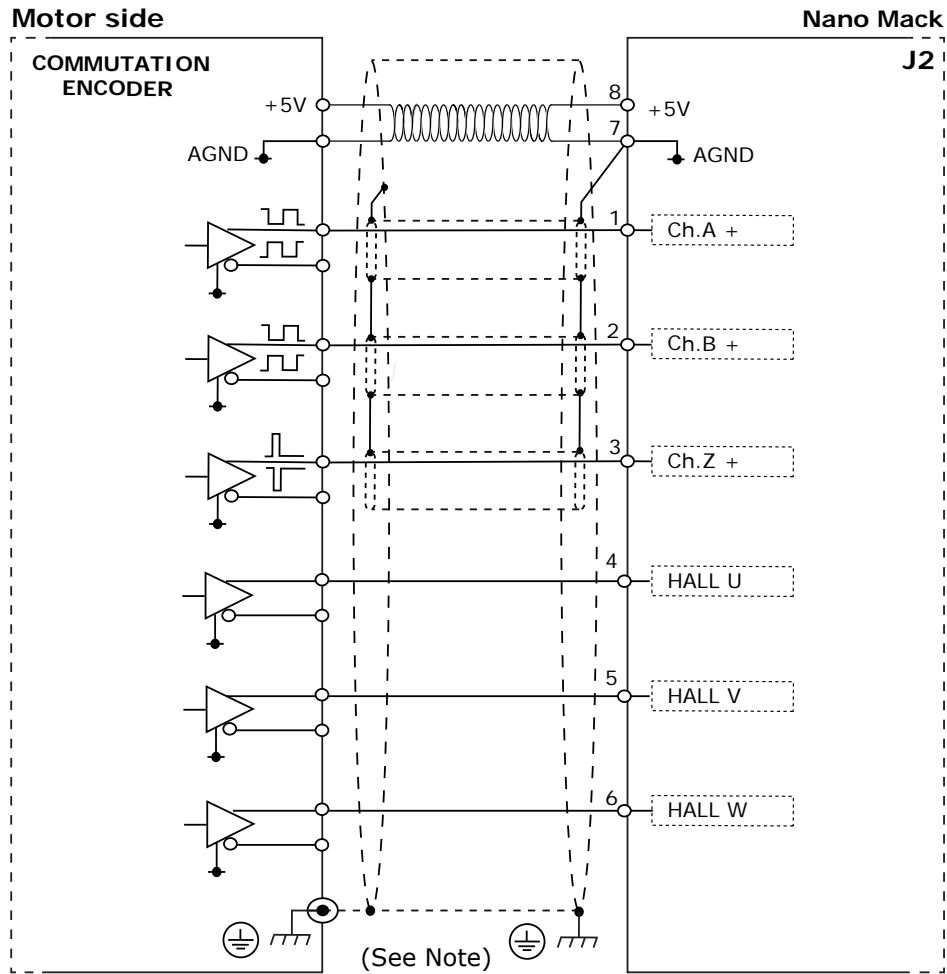
Note:

• The earth connection of the encoder cable's shield must be made on the zinc-coated panel (using a U-clamp) near the drive (0,2 m).

• Turning the motor clockwise (view from motor front side) , encoder signals must be as followings:
A) CHA leads CHB for CW rotation as viewed from the motor's front side;
B) CHZ is on the falling edge of HALL U signal;
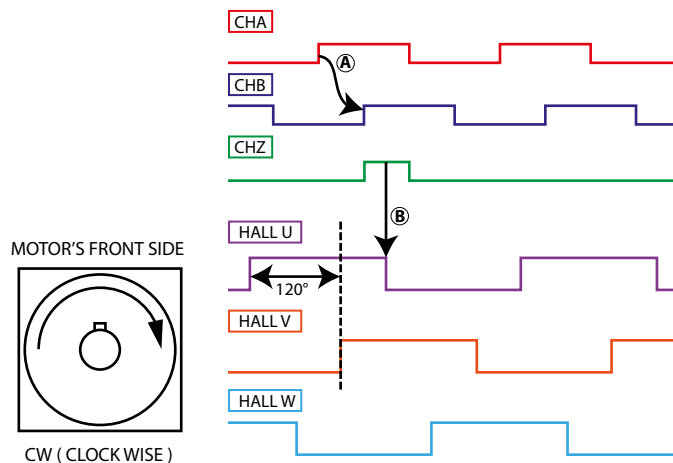
2.11 Motor Feedback connections

INCREMENTAL ENCODER FEEDBACK connection

(See Note)
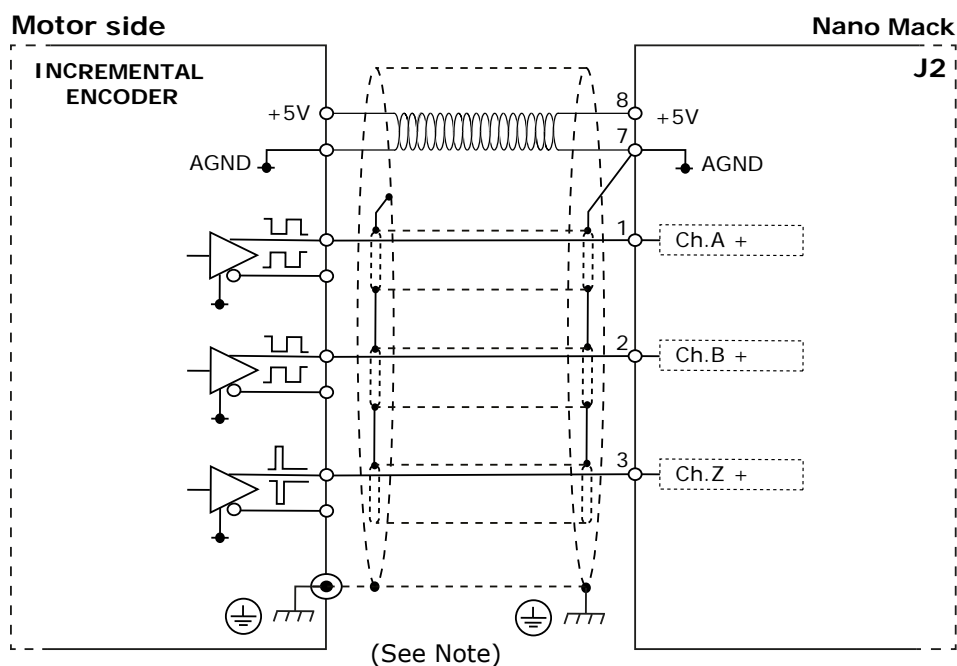
Notes:
- The connection of Ch.Z+/- is optional.
- The earth connection of the encoder cable's shield must be made on the zinc-coated panel (using a U-clamp) near the drive (0,2 m).

SERIAL INCREMENTAL ENCODER FEEDBACK connection
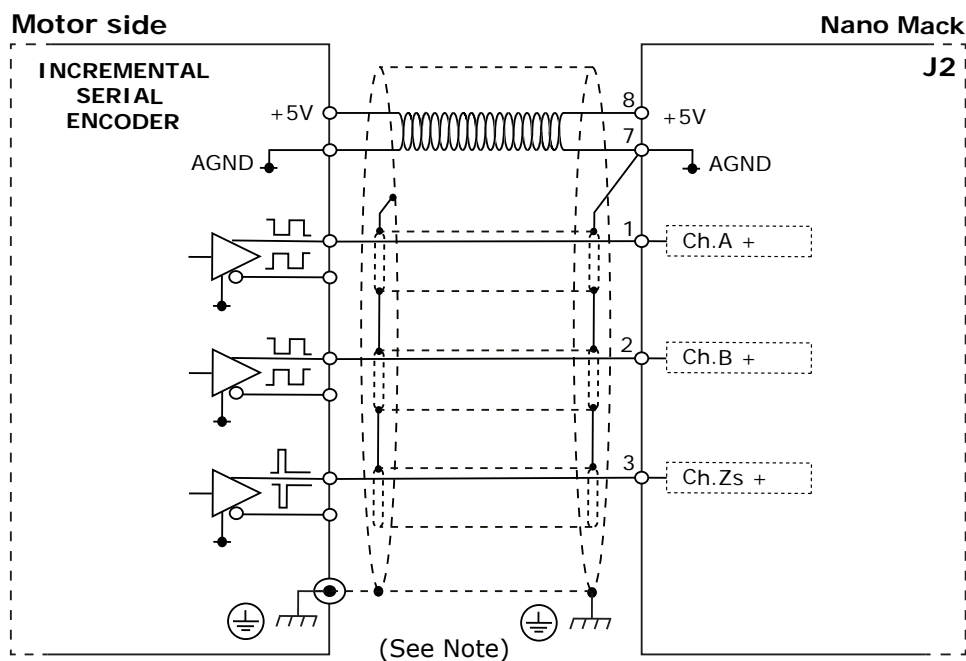
(See Note)

Note:
- The earth connection of the encoder cable's shield must be made on the zinc-coated panel (using a U-clamp) near the drive (0,2 m).

HALL ENCODER FEEDBACK connection

Note:
• The earth connection of the encoder cable's shield must be made on the zinc-coated panel (using a U-clamp) near the drive (0,2 m).

FEEDBACK Configuration

In the software interface, under **Motor/Feedback**, it's possible to setup the correct feedback with the relative settings (*see cap. 5.4 Motor / Feedback on page 96*).
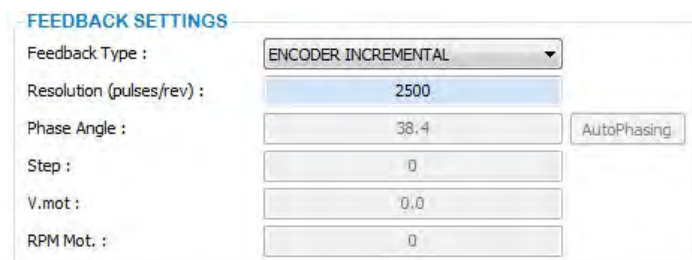
2.12 Digital inputs connection

DIGITAL INPUTS connection
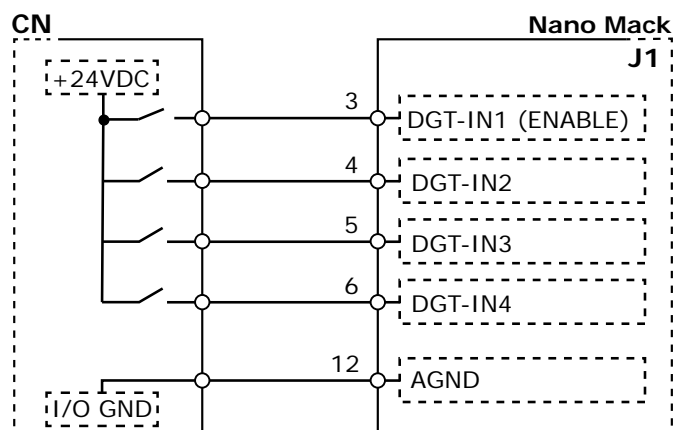
Notes:
• The enable signal should be **+24Vᴅᴄ - 7mA** (PLC compatible). The enable range is between **+14 ÷ 30Vᴅᴄ**; they are disabled with a voltage less than **+5Vᴅᴄ**.
• The **J1-1** terminal (**D.IN1 (ENABLE)**) is pre-setted as the drive's enable. If **J1-1** is **HIGH (+24VDC)** the drive is enabled (without active alarms and if start up sequence is respected);
If **J1-1** is **LOW (0V)**, the drive is disabled and the motor is without torque.

ATTENTION:
THE DRIVE'S ENABLE/DISABLE, BY USING THE DIGITAL INPUT, IS NOT CONSIDERED A SECURITY FUNCTION.

DIGITAL INPUTS configuration
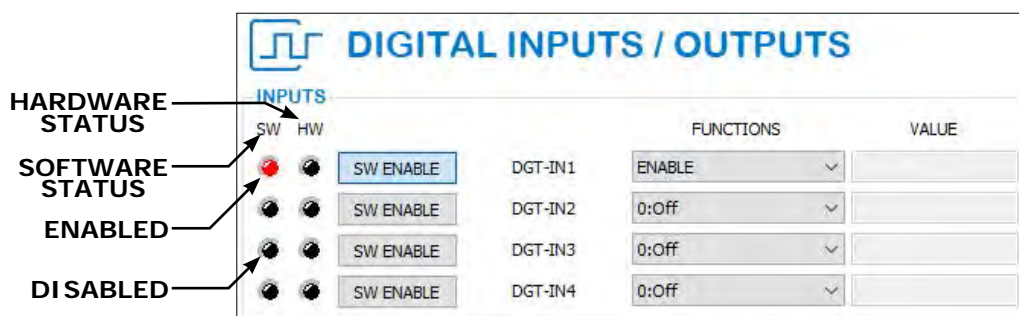
Under **FUNCTIONS** is possible to assign a function from the list (*see cap. 5.8 Digital I/0 window on page 104*) to the digital input, if required form the function the **VALUE** box will be enabled.

DIGITAL or ANALOG OUTPUTS connection (examples)

Example 1:
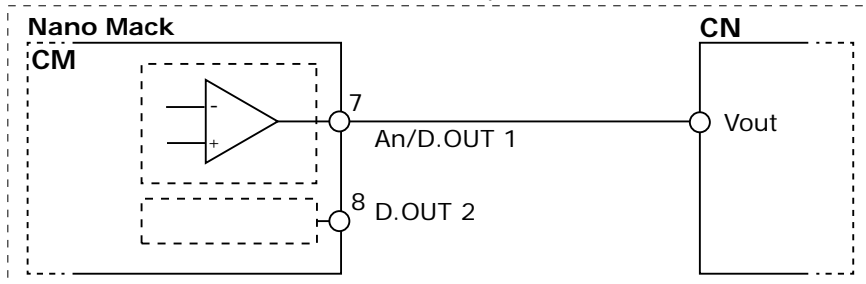
Vout (digital) = Vbackup
Vout (analog) = 10V max

Max. load
for each output: 20[mA]

Example 2:
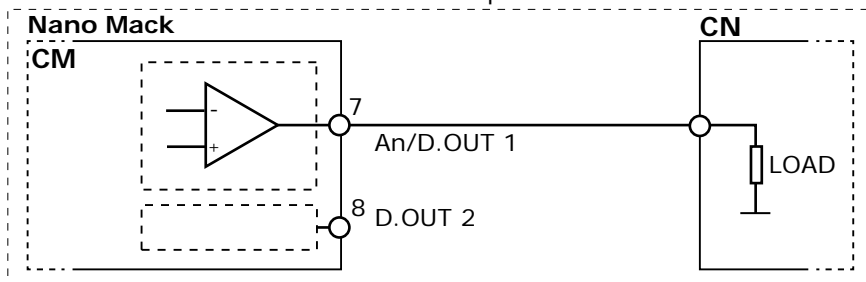
Example 3:
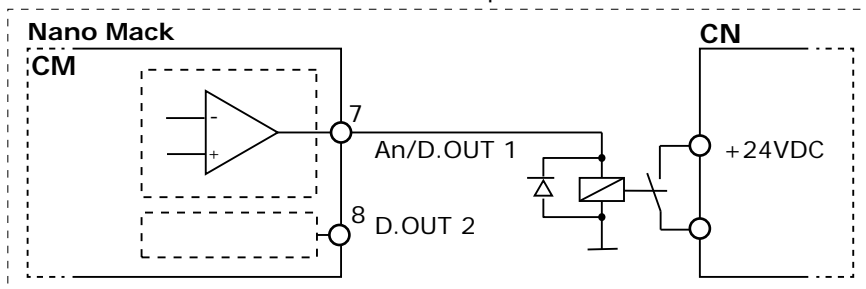
Always use a relay with a diode in parallel.

DIGITAL or ANALOG OUTPUTS Configuration

Under **FUNCTIONS** is possible to assign a function from the list (*see cap. 5.8 Digital I/0 window on page 104* for the supported options) to the analog/digital output, if required form the function the **VALUE** box will be enabled.

Notes:
   • The led under **HW** indicates the hardware status.

   • An/D.OUT 1 switch between analog or digital based on the function selected (*see cap. 5.8 Digital I/0 window on page 104 and see cap. 5.9 Analog I/0 window on page 107* for detail).

2.14 Analog inputs connections

ANALOG DIFFERENTIAL INPUTS (An.IN 1+/-)
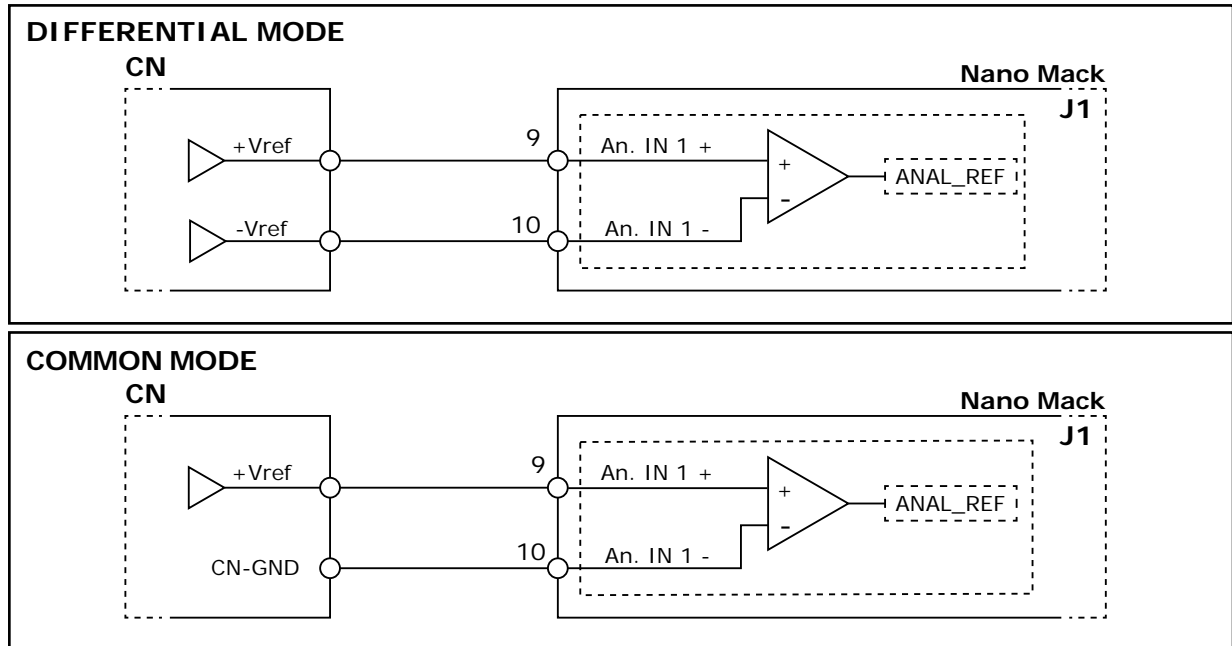
The **technical characteristics** of these inputs are as follows:
  • Voltage: ±10V Max Diff.

To change the sense of rotation, apply the positive voltage reference to J1-10, or change the "Rotary Direction" parameter in the "Velocity Loop" window (from Positive to Negative).
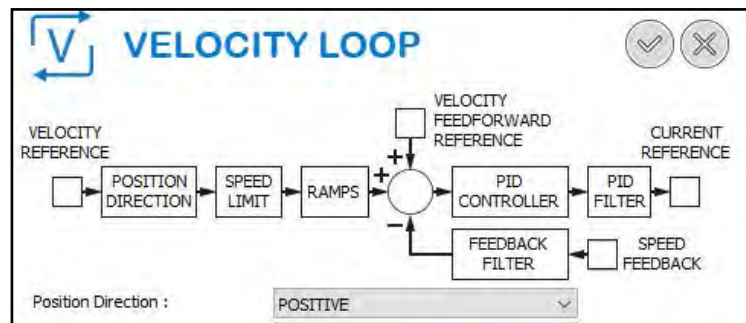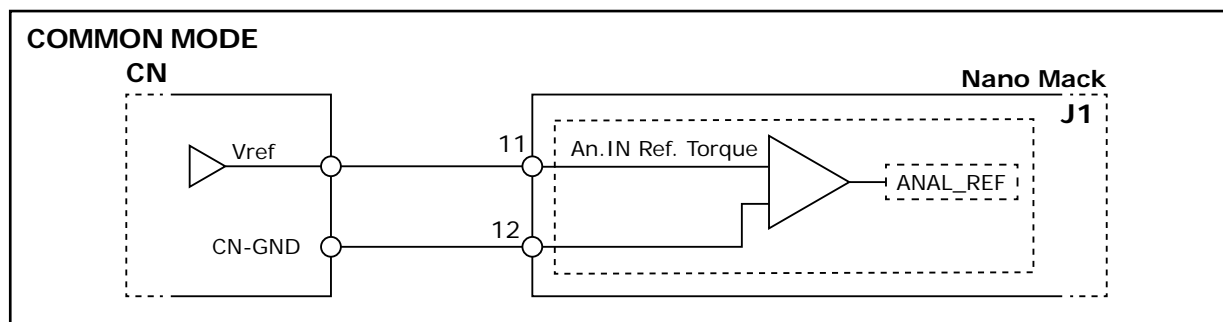

ANALOG DIFFERENTIAL INPUTS (An.IN 1+/-) configuration
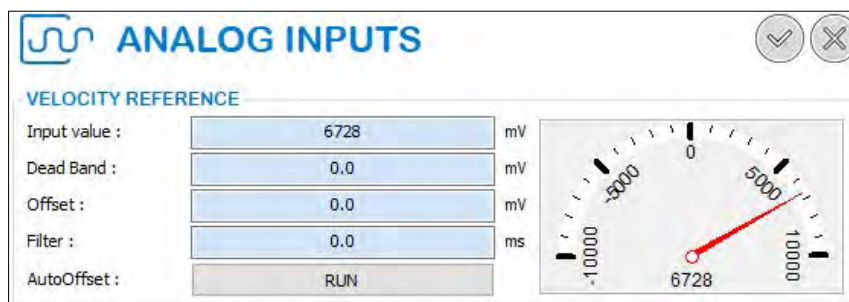
ANALOG INPUTS window allow to setup some filters on the analog input (*see cap. 5.9 Analog I/O window on page 107*).

2.14 Analog inputs connections

ANALOG COMMON MODE INPUT (An.IN Ref.Torque)

The **technical characteristics** of these inputs are as follows:
- Voltage: ±10V Max

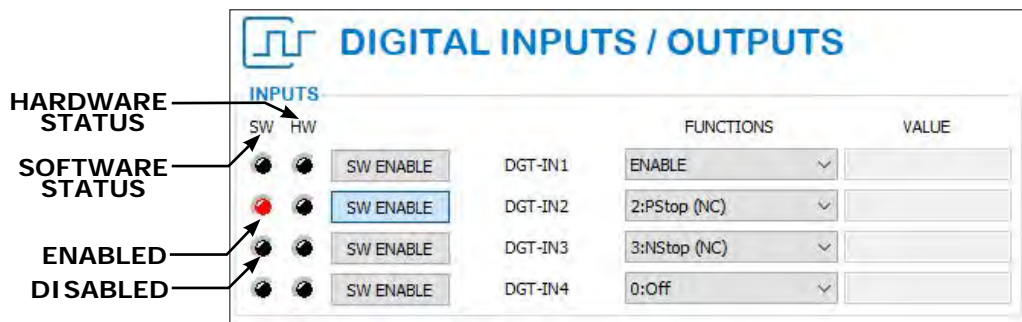## *ANALOG DIFFERENTIAL INPUTS (An.IN Ref.Torque) configuration*
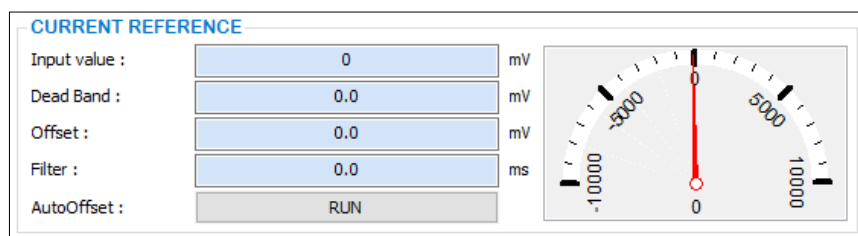
ANALOG INPUTS window allow to setup some filters on the analog input (*see cap. 5.9 Analog I/O window on page 107*).
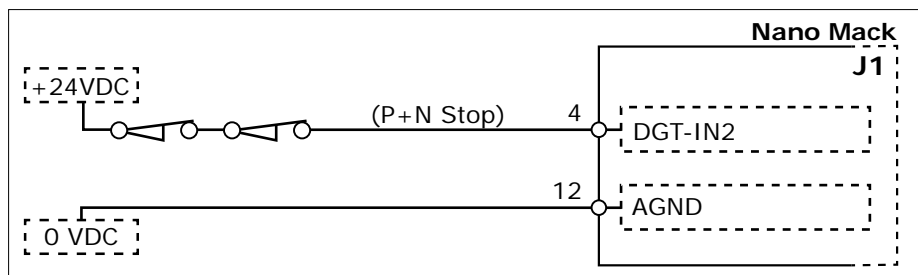
2.15 Limit Switch connections
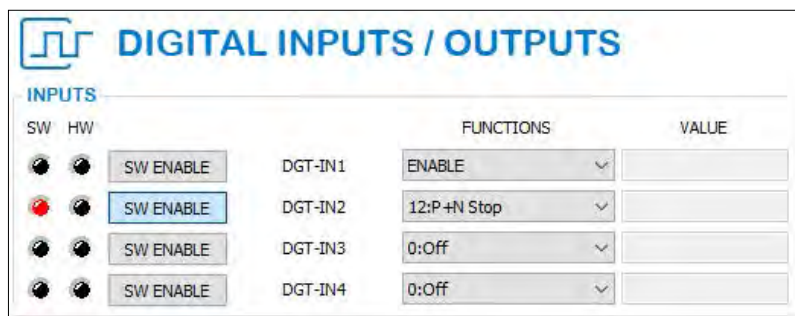
LIMIT SWITCH connection with PStop & NStop
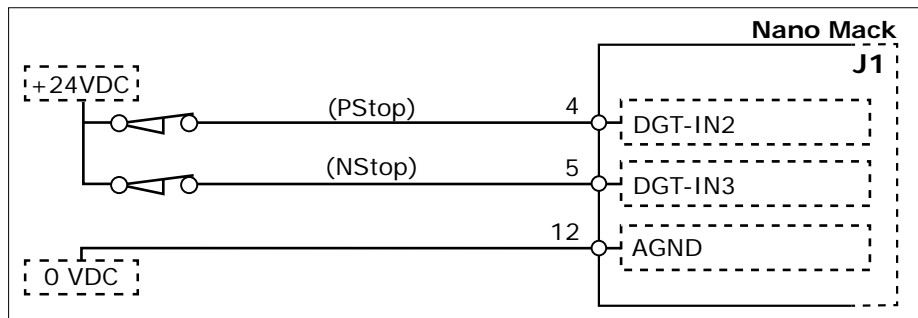
LIMIT SWITCH configuration with PStop & NStop

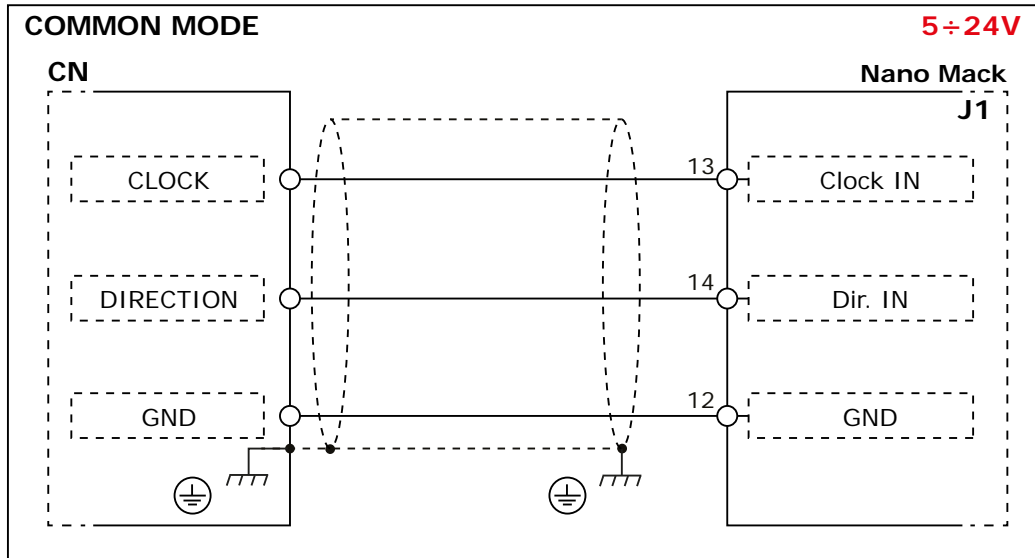## *LIMIT SWITCH* connection with P+N Stop

LIMIT SWITCH configuration with P+N Stop

2.16 Clock/Dir inputs connections
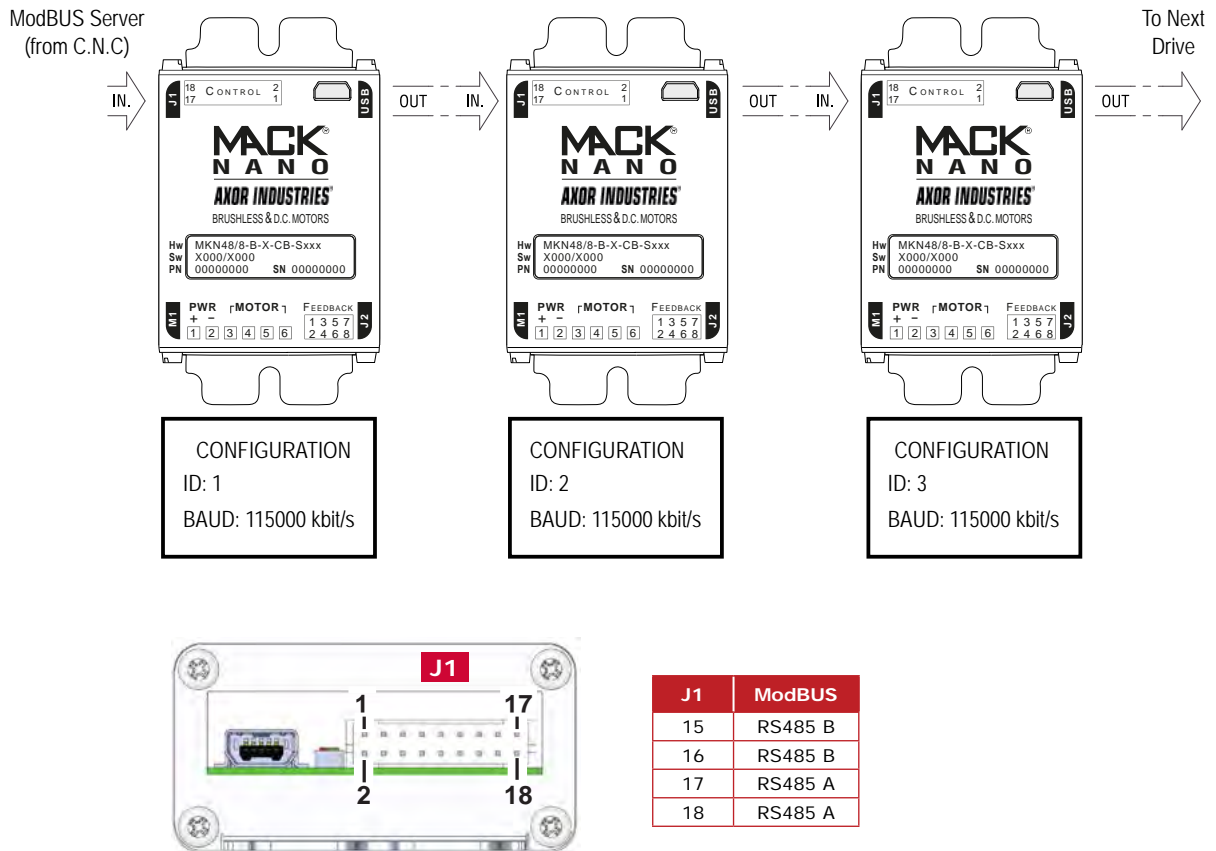
CLOCK/DIR connection

Notes:

• Set the operative mode "**5:Gearing**" (*see cap. 4.7 Gearing on page 72*), "**6:Pulse/Dir Mode**" (*see cap. 4.8 Pulse/Dir Mode on page 74*) or "**8:CW/CCW**" (*see cap. 4.12 CW/CCW on page 83*), and the relative setting with the software Interface .

2.17 RS485 connections

RS485 connection

| J1	ModBUS
15	RS485 B
16	RS485 B
17	RS485 A
18	RS485 A

Notes:
  • Is recommended to connect a **RESISTOR** on each end of the line of the same value of the twisted cable used as the line in order to avoid signal reflections.

  • See "**NanoMack - UniNano Mack ModBus Manual**" for a more detailed description about the ModBus RS485 protocol implemented on the drive.

RS485 configuration

In the software interface, under **GENERAL/SETTINGS**, set the ID and the RS485 baud rate. Always save in Eeprom to save the settings.
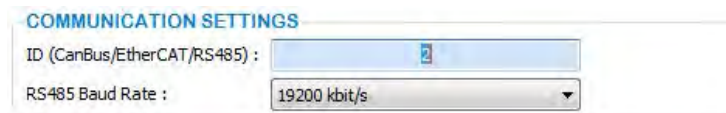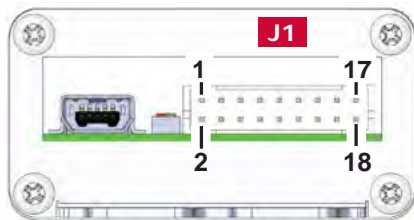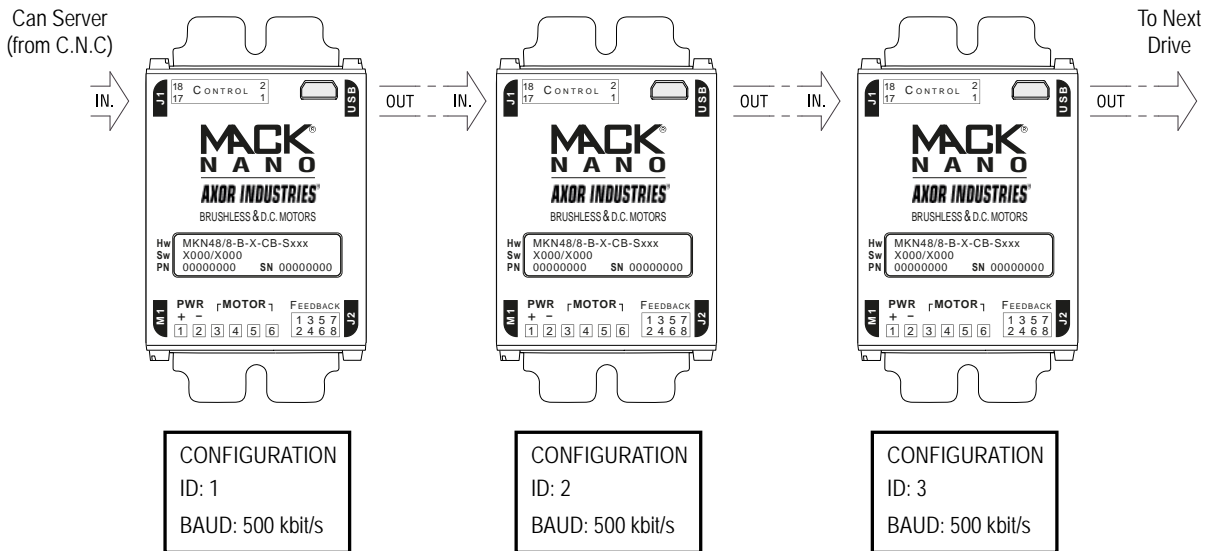

Notes:
  • **Ensure that each drive is allocated with a unique ID and the same baud rate.**

2.18 CanBus connections

CANBUS connection

Can Server (from C.N.C) → IN. | CONTROL | OUT → IN. | CONTROL | OUT → IN. | CONTROL | OUT → To Next Drive

CONFIGURATION
ID: 1
BAUD: 500 kbit/s

CONFIGURATION
ID: 2
BAUD: 500 kbit/s

CONFIGURATION
ID: 3
BAUD: 500 kbit/s

J1	Can BUS
15	Can H
16	Can H
17	Can L
18	Can L

Notes:
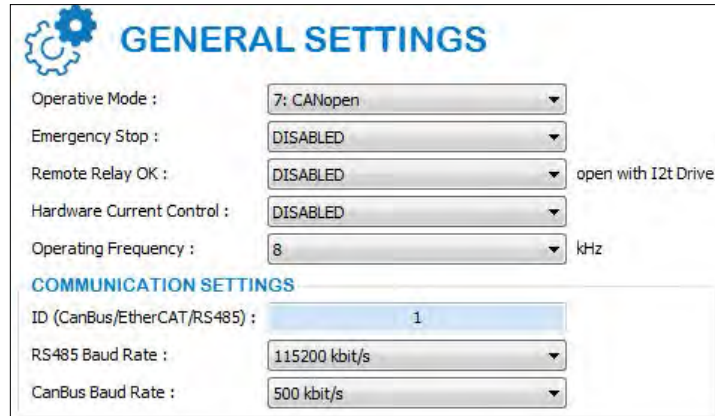- The bus-line must be terminated at both ends by **RESISTORS** (**120 Ohm**, 1/4W).

- See "**CanOpen/Ethercat Reference Manual**" for a more detailed description about the Can-Open protocol implemented on the drive.

CANBUS configuration

In the software interface, under **GENERAL/SETTINGS**, set the operative mode "**7: Can Open**", ID and the CanBus baud rate. Save always in Eeprom to save the settings.

Notes:
  • Ensure that each drive is allocated with a unique ID and the same baud rate. Otherwise, the network may hang.

2.19 Led

In the Nano Mack there is a LED (red or green, fixed or blinking) that visualizes the system's status:

COLOR and STATE	CAUSE
● green (blinking)	READY
● green (fixed)	RUN
● red (blinking)	I2t
● red (fixed)	ALARM
● ⇔ ● green ⇔ red (alternate)	ONLY BACKUP VOLTAGE

LED positions:
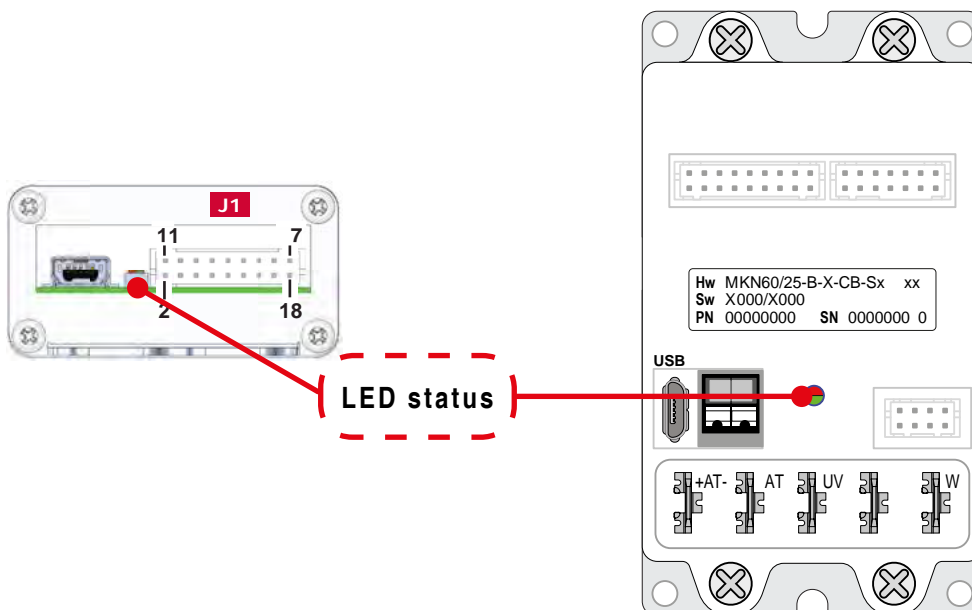
Chapter 3
Diagnostic

3.1 Alarms

The table below illustrates all the message errors supported by the drive:

	ALARM
1	**EEPROM** Error while memorising parameter to the drive's EEPROM or while reading parameters from Eeprom.
2	**Overcurrent** Short circuit between U, V, W or towards earth.
3	**Drive Temperature** Heat sink temperature too high (>90°C).
4	**Hall** This alarm comes on if one or more of the hall cell's wires are disconnected.
5	**Encoder** This alarm comes on if one or more of the encoder channels are interrupted.
6	**I2t Drive** The internal I2t function (refer to the rated current) has reached the maximum permitted.
7	**Motor Temperature** Motor heat sink temperature too high.
8	**Regenerative Resistance** The value I2t energy recovery has reached the maximum permitted.
9	**Min Voltage** Power supply under the minimum limit voltage.
10	**Pre-Alarm Recovery** 80% of the I2t energy recovery has been reached.
11	**USB Mack-Link** Malfunctions in the drive's communication.
12	*Reserved*
13	**Overvoltage** Power supply is over the maximum limit voltage.
14	**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.
15	**Limit Switch** The two fixed limit switches have both been disabled or interrupted.
16	*Reserved*
17	**Regenerative OC** Possible short-circuit in the regen resistance circuit.
18	*Reserved*
19	*Reserved*
20	**V Backup** The backup voltage is out of supported range.
21	*Reserved*
22	**STO** Malfunction in the Safe Torque Off safety function or wrong sequence.

23	*Reserved*
24	**Can Bus** Error during communication with CANopen protocol.
25	*Reserved*
26	**Homing Error** Position error too high during the homing procedure. The motor stops, but it is not disabled.
27	*Reserved*
28	*Reserved*
29	*Reserved*
30	*Reserved*
31	**Unsupported Operation** *Fixed*: the 'operating mode' / 'encoder' / 'CANopen OP mode' selected is not supported. *Blinking*: the operating mode selected need the drive to be restarted, save in Eeprom then power off and on the drive.
32	**Speed Following Error** The motor rotates at a different speed then the reference.

The table below illustrates the type of reset of the alarms:

ALARM	RESET*
1	NO
2	NO
3	AUTO
4	YES
5	YES
6	AUTO
7	NO
8	YES

ALARM	RESET*
9	AUTO
10	AUTO
11	YES
13	AUTO
14	YES
15	AUTO
17	NO
20	AUTO

ALARM	RESET*
22	YES
24	YES
26	YES
31	NO
32	YES

* - YES   = is resettable with a digital input setted with function "14:Alarm Reset", or with the software interface;

  - AUTO = auto-reset when out of the problem condition;

  - NO   = is not resettable with the reset input, need to be restarted removing and applying the backup supply;

3.2 Problem solving

SOLUTION FOR ALARM 1 (**EEPROM**):
● With the software interface try to save the parameters to the drive's EEPROM, then power off and on the drive, if the Alarm 1 appears then contact for assistance;

SOLUTION FOR ALARM 2 (**Overcurrent**):
● Power off the drive;
● Verify if the motor wire connection is correct (*see cap. 2.10 Motor Power connection on page 38*).
● If the connection are correct, check if there are any type of faulty wiring that can cause any type of short circuit:
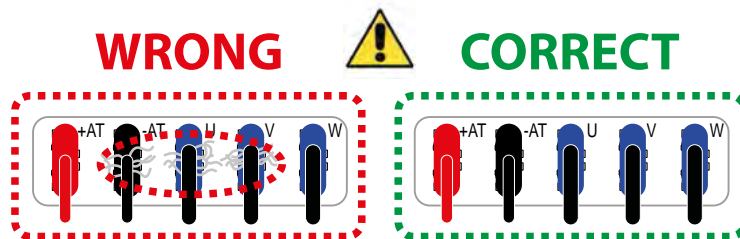
● If there aren't any faulty cable, disconnect only the motor phases (Brushless: U/V/W, DC: +M/-M, Stepper: +A/-A/+B/-B), leave the feedback connected, power up the drive and set it with the OP Mode: Digital speed (*see cap. 4.3 Digital Speed on page 67*) and with Speed 100 RPM, enable the drive. If the Alarm 2 appears then contact for assistance, if not that means the drive don't have the problem, continue on the next point.
● If there are an extension cable between the motor and the drive then:
  - If you have a replacement, try to replace it with an equal cable.
  - If you don't have a replacement, disconnect the cable form the motor and the drive, with a multimeter or multitester, check if there any short circuit between two wire of the cable. Check if there are wire's isolation damaged that can create any type of short circuit, because all the wire must be isolate form each-others, if there are any damaged or short circuit then replace the cable.
  Connect the cable between the drive and the motor, and try to enable the drive. If the Alarm 2 appears then continue on the next point.
● If you have a replacement motor, then replace it with an equal motor (a working one) and try to enable the drive, if the Alarm 2 appears then contact for assistance, if it not appears then that means the replaced motor have a problem.

SOLUTION FOR ALARM 3 (**Drive Temperature**):
● Verify the ambient temperature around the drive.
● Verify the heat dissipating power of the heat-sink where is mounted the drive.
● Verify if there are enough airflow in the cabinet that remove the hot air.
● Wait until the radiator has cooled off, the alarm will auto-reset when the temperature drop under 90°C, then enable the drive.

SOLUTION FOR ALARM 4 (**Hall**):
● Verify the cell's wire connection and feedback setting (*see cap. 2.11 Motor Feedback connections on page 40*), reset the alarm, then enable the drive.

3.2 Problem solving

SOLUTION FOR ALARM 5 (**Encoder**):
- Verify the wire connection and feedback setting (*see cap. 2.11 Motor Feedback connections on page 40*), reset the alarm, then enable the drive.

SOLUTION FOR ALARM 6 (**I2t Drive**):
- Disable the drive.
- The cause could be one of the following:
  - The working cycle could be too heavy;
  - A possible mechanical block / degradation or the some mechanical parts need of lubrication;
  - A motor phase inversion;
  - Incorrect motor phase angle;
  - The amplifier's dynamic costants: "KP", "KI" and "KD", could create useless current oscillation.
- Try running the motor with digital reference in OP Mode 10: Square Wave Period, be aware of the mechanical movement;

SOLUTION FOR ALARM 7 (**Motor Temperature**):
- Verify the motor case 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.

SOLUTION FOR ALARM 8 (**Regenerative Resistance**):
- Verify the resistor setting in the software interface.
- Verify the resistor connection.
- Verify 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 system.

SOLUTION FOR ALARM 9 (**Min Voltage**):
- Disable the drive.
- Verify the power supply connection on the drive (*see cap. 2.8 Power supply connections on page 33*).
- Verify the voltage level on the power input (*see cap. 1.3 Technical Data on page 11*).
- Verify the output voltage stability of the power supply, even during the working cycles.

SOLUTION FOR ALARM 10 (**Pre-Alarm Recovery**):
- This alarm will auto-reset when the I2t energy recovery drop under 80%.

SOLUTION FOR ALARM 11 (**USB Mack-Link**):
- Verify if the ground and earth connection are performed as showed in basic installation procedure (*see cap. 2.5 Basic installation on page 28).*
- Replace the USB cable if is damaged or is not shielded (*see cap. 2.3 Cables characteristics on page 25*).

SOLUTION FOR ALARM 13 (**Overvoltage**):
- Verify the power supply connection on the drive (*see cap. 2.8 Power supply connections on page 33*).
- Verify the voltage level on the power input (*see cap. 1.3 Technical Data on page 11*).
- When the input voltage level on power supply and connection are correct then the alarm will auto-reset.
- Verify that the working cycles are not excessive, if the problem appears during the running operation and there is not present any braking resistor maybe is necessary to install one (*see cap. 2.9 Regen resistance connections on page 36*).

SOLUTION FOR ALARM 14 (**Following Error**):
- Verify if the connection are correct.
- Verify if there are any mechanical block.
- With the software interface check:
  - The Max Position Error parameter and the dynamic gains under Position Loop;

3.2 Problem solving

SOLUTION FOR ALARM 15 (**Limit Switch**):
- Disable the drive.
- Verify the limit switch and the connections between them and the drive
- Verify the setting with the software interface.
- Then enable the drive.

SOLUTION FOR ALARM 17 (**Regenerative OC**):
- Verify the resistor setting in the software interface.
- Verify the resistor connection.
- Verify that the working cycles are not excessive.
- Verify if the motor going at half speed shows the same problem.

SOLUTION FOR ALARM 20 (V Backup):
- Disable the drive.
- Verify the backup supply connection on the drive (*see cap. 2.6 Backup Supply connections on page 31*).
- Verify the voltage level on the backup input (*see cap. 1.3 Technical Data on page 11*).
- When the input voltage level on backup and connection are correct then the alarm will auto-reset.

SOLUTION FOR ALARM 22 (STO):
- Verify if the STO wire connection.
- Verify the presence of the STO signals (STO.IN 1 / 2) applied on J3 connector.
- Verify the correct sequence of application of the STO signals and the Enable signal.
- If the Alarm appears then contact for assistance.

SOLUTION FOR ALARM 24 (**CanBus**):
- Verify cable connection.
- Verify all the drive in the node have the same baud rates and different ID.
- Reset the alarm and re-enable.

SOLUTION FOR ALARM 26 (**Homing Error**):
- Homing position non respected based on function.
- Zero Finding limit exceeded.

SOLUTION FOR ALARM 31 (**Unsupported Operation**):
- If fixed then the 'operating mode' / 'encoder' / 'CANopen OP mode' selected is not supported.
- If blinking then the operating mode selected need the drive to be restarted, save in Eeprom then power off and on the drive.

SOLUTION FOR ALARM 32 (**Speed Following Error**):
- Disable the drive.
- Verify the phasing angle with the software interface.
- Verify if the motor wire connection is correct (*see cap. 2.10 Motor Power connection on page 38*).
- Verify the encoder connection and setting (*see cap. 2.11 Motor Feedback connections on page 40*).
- Verify if there are any mechanical block.
- With the software interface check:
  - The Max Position Error parameter and the dynamic gains under Position Loop;
  - The dynamic gains under Velocity Loop;

OTHER PROBLEMS:

DRIVE DOESN'T STARTUP:

- Verify the voltage level on the backup input (*see cap. 1.3 Technical Data on page 11*).
- Verify the backup supply connection on the drive (*see cap. 2.6 Backup Supply connections on page 31*), backup supply is required to startup the drive.

DRIVE DOESN'T COMMUNICATE:

- Verify the USB cable is correctly connected.
- Try to replace the USB cable.
- Be sure the driver is installed.

Chapter 4
Operative Modes

4.1 Operative Modes

The drive supports the following operative modes:

| CONTROL	DESCRIPTION
ANALOG SPEED	It is **speed piloting** utilising an analogue reference.
DIGITAL SPEED	It is **speed piloting** utilising a digital reference.
ANALOG TORQUE	It is **torque piloting** utilising an analogue reference.
DIGITAL TORQUE	It is **torque piloting** utilising a digital reference.
POSITION MODE	The positioner can be managed via hardware (by using the digital inputs appropriately configured) or via USB (by using the Speeder One interface). 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.
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**).
PULSE/DIR MODE	It is possible to connect the drive to a motor piloting it with the CLOCK and DIR signals: the DIR signal defines the clockwise/counter clockwise rotation, while the CLOCK signal defines the speed rotation.
CANOPEN	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
CW/CCW	It is possible to connect the drive to a motor piloting it with the CLOCK and DIR signals: if pulses arrive at the CLOCK input, the motor rotates clockwise (CW); while if pulses arrive at the DIR input, the motor rotates counter clockwise (CCW).
SQUARE WAVE PERIOD	The motor is piloted with a "square wave" signal. This is useful for adjustments of the speed loop.
ANALOG to POSITION	The motor moves between two programmable positions corresponding the Min. and Max. voltages at the dedicated pins.
DIGITAL POSITION	The motor moves between two digital positions.

4.2 Analog Speed

The drive can control a motor by using a **differential or common mode analog speed reference (±Vᴅᴄ) from the CN or PLC**.

The procedure is the following:

1- Perform the *basic installation procedure (see cap. 2.5 Basic installation on page 28)*;

2- Use pins **An.IN 1+** and **An.IN 1-** to *apply the desired speed reference* ⇨ the axis card used in the Numerical Control or PLC can have two different types of analog reference outputs:
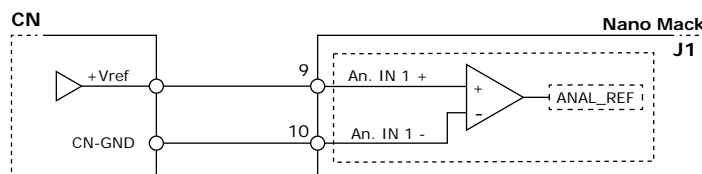
   • **Differential analog output**, in this case connect the positive speed reference to **An.IN 1+** and the negative speed reference to **An.IN 1-**.
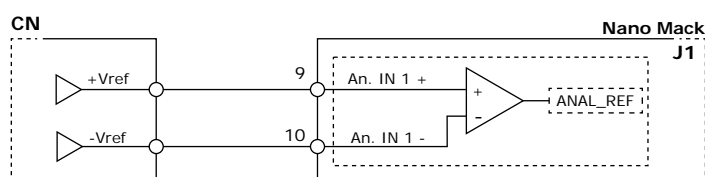
   • **Common mode reference analog output**, in this case connect the control's analogue output either to the **An.IN 1+** terminal or to the **An.IN 1-** terminal, depending upon the required rotational direction.

3- Execute the *settings of the offset of the velocity analog input reference **via SpeederOne.2 interface***:
   • Open the "**Analog Inputs**" window run **AutoOffset**.
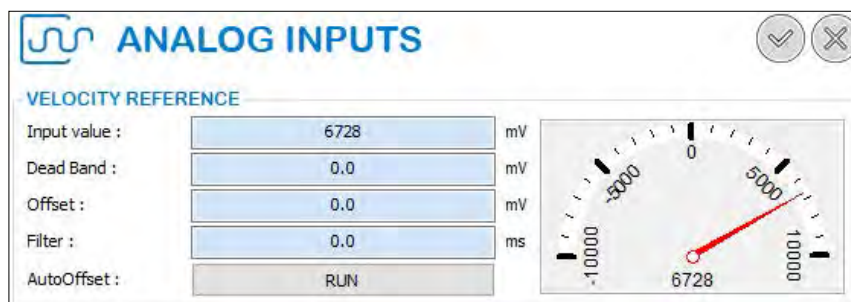
4- Enable analog speed control via software interface:
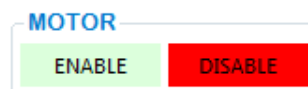   a- Set the operative mode **0:Analog Speed**;

b- It is possible to limit the torque by setting the % of Imax by the value Torque Sat.(the value 0,0% disable this function)(*).

c- **Save data to Eeprom**;

d- Enable/disable the drive by using the **Enable**/**Disable** buttons or giving +24V to the **D.IN1** (**ENABLE**) input.

e- When the desired speed reference arrive at the **An.IN 1+** and **An.IN 1-** the motor will move.

(*) Insert the calculate torque reference using this formula:

$$\frac{I_{desired} \times 100}{I_{peak}}$$

Example: Suppose we want to set a digital torque reference equal to 5A, having a drive size of 10/20 (10A=rated current, 20A=peak current) ⇨ insert in the window Torque Sat. the value 25, in fact (5x100)/20=25.

The value 0,0% disable the function.

ATTENTION: If the rotation is irregular or noisy, it should be necessary to *adjust the gains of the velocity loop* by using an adequate procedure.

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

4.3 Digital Speed

The drive can control a motor by using a *speed digital reference*.

The procedure is the following:

1- Perform the *basic installation procedure (see cap. 2.5 Basic installation on page 28)*;

2- Enable digital speed control via software interface*:*
a- Set the operative mode ***1:Digital Speed***;
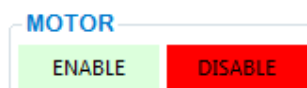

b- Insert the desired speed reference [in rpm];

c- It is possible to limit the torque by setting the % of Imax by the value Torque Sat.(the value 0,0% disable this function)(*).

d- **Save data to Eeprom**;

e- Enable/disable the drive by using the **Enable**/**Disable** buttons or giving +24V to the **D.IN1** (**ENABLE**) input.

3- If the turning is irregular or noisy, it should be necessary to *adjust the gains of the speed loop* by using an adequate procedure.

(*) Insert the calculate torque reference using this formula:

$$\frac{I_{desired} \times 100}{I_{peak}}$$

<u>Example</u>: Suppose we want to set a digital torque reference equal to 5A, having a drive size of 10/20 (10A=rated current, 20A=peak current) ⇨ insert in the window Torque Sat. the value 25, in fact (5x100)/20=25.

The value 0,0% disable the function.

4.4 Analog Torque

The drive can control a motor by using an **analog torque reference**.

The procedure is the following:

1- Perform the *basic installation procedure (see cap. 2.5 Basic installation on page 28)*;

2- Use pins **An.IN Ref. Torque** to *apply the desired* torque *reference* ⇨ the axis card used in the Numerical Control or PLC can have common mode types of analog reference outputs:
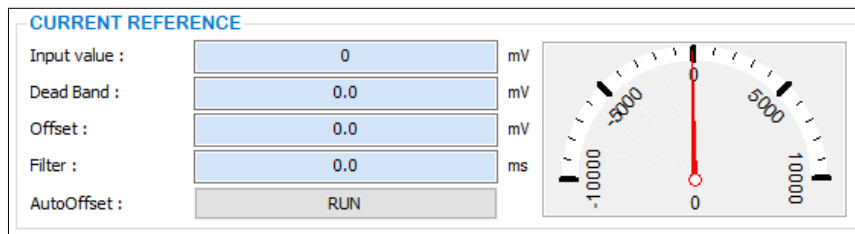
  • **Common mode reference analog output:**
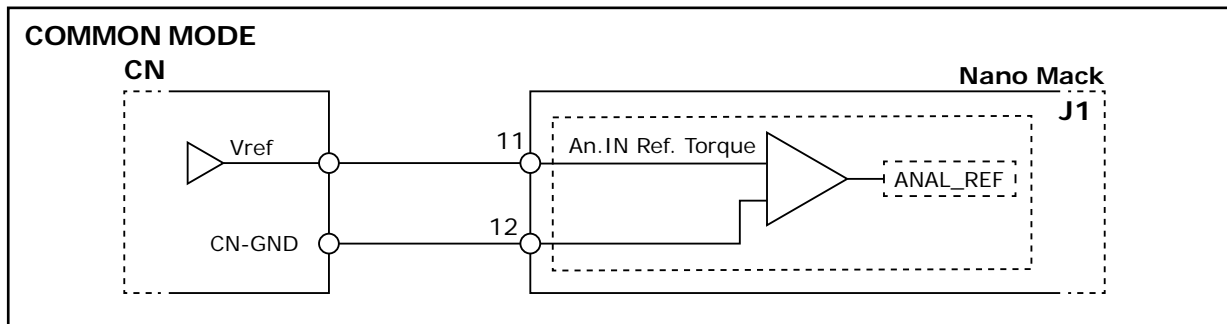
The formula for determining the voltage value to be applied in **An.IN Ref. Torque** in order to obtain the necessary current is as follows:

$$V_{REF} = \frac{10 * (+/-) \text{ I desired}}{\text{I peak}}$$

3- Execute the *settings of the offset of the velocity analog input reference* via software interface:
  • Open the "**Analog Inputs**" window run **AutoOffset**.

4- Enable analog torque control via software interface:
  a- Set the operative mode **2:Analog Torque**;

  b- It is possible to limit the max torque by setting the % of Imax by the value Torque Sat.(the value 0,0% disable this function)(*).
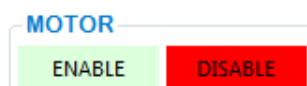
c- **Save data to Eeprom**;

d- Enable/disable the drive by using the **Enable**/**Disable** buttons or giving +24V to the **D.IN1** (**ENABLE**) input.

(*) Insert the calculate torque reference using this formula:

$$\frac{I_{desired} \times 100}{I_{peak}}$$

Example: Suppose we want to set a digital torque reference equal to 5A, having a drive size of 10/20 (10A=rated current, 20A=peak current) ⇨ insert in the window Torque Sat. the value 25, in fact (5x100)/20=25.

The value 0,0% disable the function.

ATTENTION: If the rotation is irregular or noisy, it should be necessary to *adjust the gains of the velocity loop* by using an adequate procedure.

4.5 Digital Torque

The drive can control a motor by using a **digital torque reference**.

The procedure is the following:

1- Perform the *basic installation procedure (see cap. 2.5 Basic installation on page 28)*;

2- Enable analog speed control via software interface:
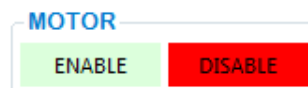   a- Set the operative mode **3:Digital Torque**;

    b- Insert the desired torque reference(*) in the window Torque Sat.;

    c- **Save data to Eeprom**;

    d- Enable/disable the drive by using the **Enable**/**Disable** buttons or giving +24V to the **D.IN1** (**ENABLE**) input.

(*) Insert the calculate torque reference using this formula:

$$\frac{I_{desired} \times 100}{I_{peak}}$$

Example: Suppose we want to set a digital torque reference equal to 5A, having a drive size of 10/20 (10A=rated current, 20A=peak current) ⇨ insert in the window Torque Sat. the value 25, in fact (5x100)/20=25.

**The value 0,0% disable the function.**

4.6 Position Mode

The drive can be controlled as **POSITIONER** by using the operative mode: "**4:Position Mode**".

It is possible to set up to **16 trapezoidal positioner profiles** on *Nano Mack* with the software interface in the ***Profile Tool*** window or by another *master ModBus by using the RS485 interface*.

It is possible to execute a *single profile* or a *sequence of blending profiles*.

The implemented **ABSOLUTE POSITIONER** executes transactions to *absolute quota* reference to the reference point.

Example: Suppose we want to blend the following profiles, having the origin (0 pulses) as reference point:
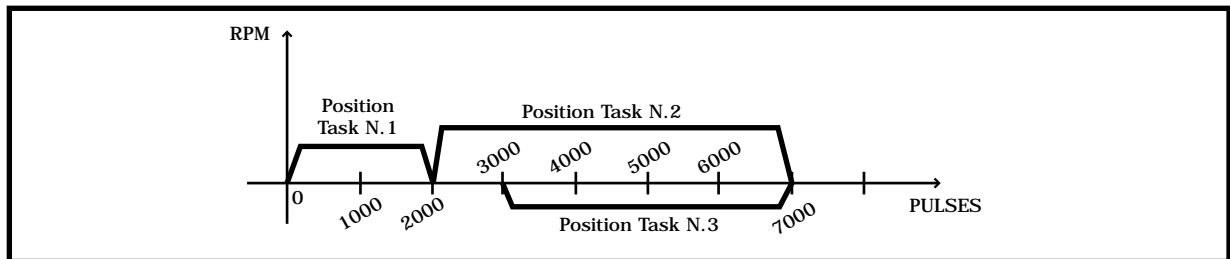
Notes:
• It is necessary to execute a correct *homing procedure* before starting an absolute positioner.

To select the **16 trapezoidal positioner profiles**, hardware input can be used with the following setup:

Profile N°	INPUTS			
	Dir. IN	Clock IN	An.IN Ref. Torque	An.IN 1 +
1	0	0	0	0
2	0	0	0	1
3	0	0	1	0
4	0	0	1	1
5	0	1	0	0
6	0	1	0	1
7	0	1	1	0
8	0	1	1	1
9	1	0	0	0
10	1	0	0	1
11	1	0	1	0
12	1	0	1	1
13	1	1	0	0
14	1	1	0	1
15	1	1	1	0
16	1	1	1	1

Notes:
• Connect **An.IN 1 -** to the **GND**;

See "***Positioner* Manual Mack**" for a more detailed description about the positioner implemented on the drives (contact Axor).

4.7 Gearing

It is possible to control the drive as a Slave by using the **increasing channels of an external encoder** or **the emulated encoder signals from a CN**, in this case:

1- Perform the *basic installation procedure (see cap. 2.5 Basic installation on page 28)*;

2- Use the **J1-13/J1-14** pins to connect relatively encoder signals +CHA / +CHB *(see cap. 1.6 Connectors description on page 15)*.

3- Set the operative mode "**5:Gearing**" in the OP. MODE menu.

4- It is possible to limit the torque by setting the % of Imax by the value Torque Sat.(the value 0,0% disable this function)(*).

5- Open the "**Position Loop**" window insert into the numerator and denominator of the **Gear Ratio**, the ratio that allows you to obtain the desired Slave speed in regards to the encoder.
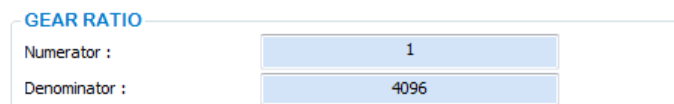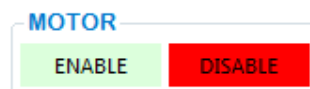

Example: For 4096 pulses/revolution set as in figure(1/4096)

6- **Save Data to Eeprom.**

7- Enable/disable the drive by using the **Enable**/**Disable** buttons or giving +24V to the **D.IN1** (**ENABLE**) input. The motor will remain blocked in torque with the position loop inserted and waiting to move.

8- When the pulse's arrive at the inputs the motor will move.

ATTENTION: If the rotation is irregular or noisy, it should be necessary to *adjust the gains of the speed loop* or *position loop* by using an adequate procedure.

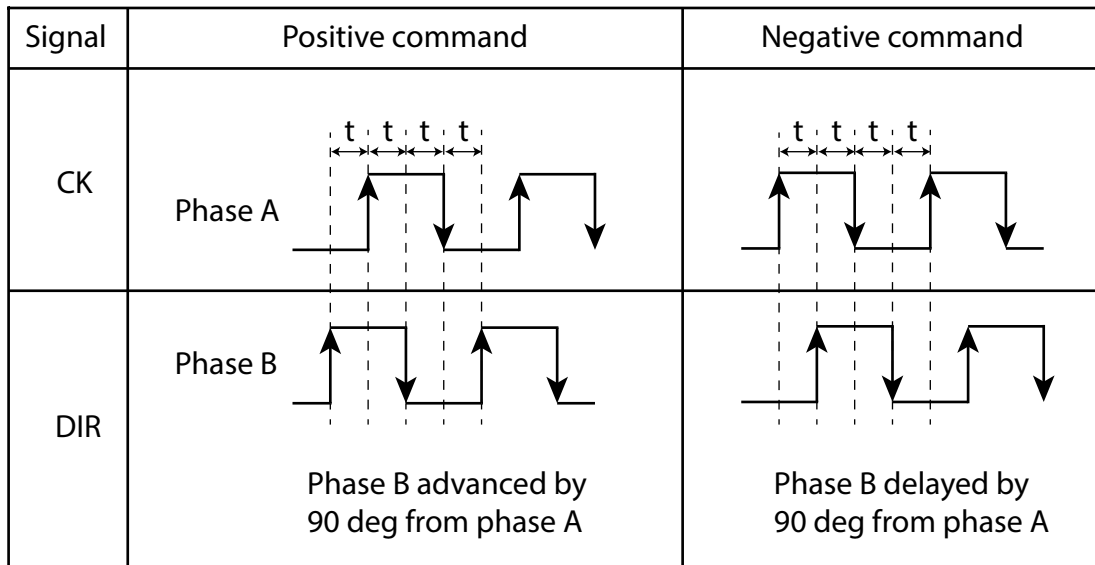(*) Insert the calculate torque reference using this formula:

$$\frac{I_{desired} \times 100}{I_{peak}}$$

Example: Suppose we want to set a digital torque reference equal to 5A, having a drive size of 10/20 (10A=rated current, 20A=peak current) ⇨ insert in the window Torque Sat. the value 25, in fact (5x100)/20=25.

The value 0,0% disable the function.

Inputs time requirements:

Signal	Positive command	Negative command
CK	Phase A Phase B Phase B advanced by 90 deg from phase A	Phase A Phase B Phase B delayed by 90 deg from phase A
DIR		

CK/DIR Signal	Max. allowable input frequency	Minimum required time width [µs] t
Line Driver	500kHz	2
Open Collector	200kHz	5

4.8 Pulse/Dir Mode

The **Pulse/Dir Mode** allows you to connect the drive to a **stepper-motor controller**.

The procedure is the following:

1- Perform the *basic installation procedure (see cap. 2.5 Basic installation on page 28)*;

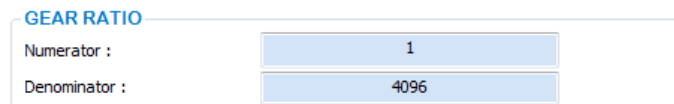**2**- Enable pulse/dir control via software interface:

a- Set the operative mode **6: Pulse/Dir Mode**;

b- Insert the desired torque reference(*) in the window Torque Sat.;

c- Open the "**Position Loop**" window insert into the numerator and denominator of the **Gear Ratio**, the ratio that allows you to obtain the desired speed in regards to the encoder.

Example: For 4096 pulses/revolution set as in figure(1/4096)

d- **Save data to Eeprom, turn off and on the drive**;

3- Execute hardware connections between drive and CN *(see cap. 2.16 Clock/Dir inputs connections on page 48)*.

(*) Insert the calculate torque reference using this formula:

$$\frac{I_{desired} \times 100}{I_{peak}}$$

<u>Example</u>: Suppose we want to set a digital torque reference equal to 5A, having a drive size of 10/20 (10A=rated current, 20A=peak current) ⇨ insert in the window Torque Sat. the value 25, in fact (5x100)/20=25.

**The value 0,0% disable the function.**

4.8 Pulse/Dir Command

4- For enabling the Pulse/Dir Mode follow this procedure:

a- Enable the drive giving +24V to the ENABLE input (D.IN1). The motor will remain locked in torque with the position loop inserted and waiting to move. See (1)

b- When the pulses arrive at the input the motor will move. See (2)

The **DIR** logic signal determines the motor's direction: with the signal **DIR = L** the motor turns clockwise (**CW**); with the signal **DIR = H**, the motor turns counter-clockwise (**CCW**).
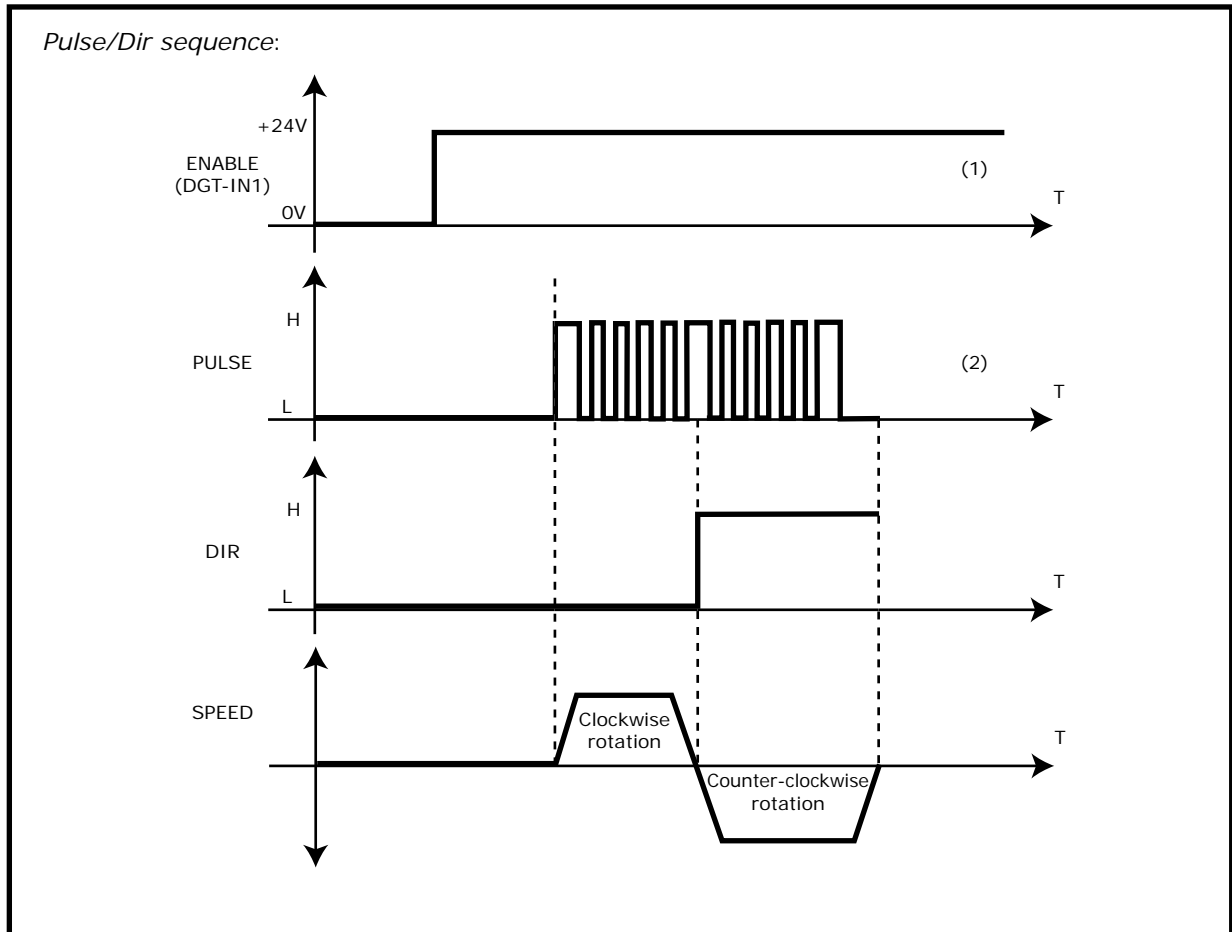
Pulse/Dir sequence:

ATTENTION: If the rotation is irregular or noisy, it should be necessary to *adjust the gains of the speed loop* or *position loop* by using an adequate procedure.

# 4.8 Pulse/Dir Command

Inputs time requirements:

Signal	Positive command	Negative command
CK	t1 t2	t1 t2
DIR	t3 H t3	t3 L t3
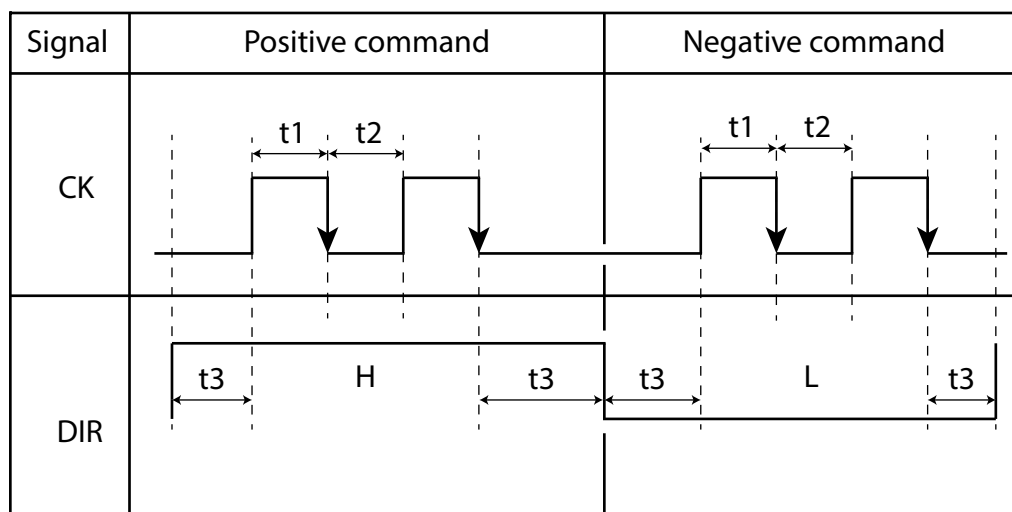
CK/DIR Signal	Max. allowable input frequency	Minimum required time width [µs]		
		t1	t2	t3
Line Driver	500kHz	1	1	1
Open Collector	200kHz	2.5	2.5	2.5

4.9 Homing - Settings

1- Operative mode settings:

Set the desired operative mode.

2- Settings on "POSITION LOOP" window:
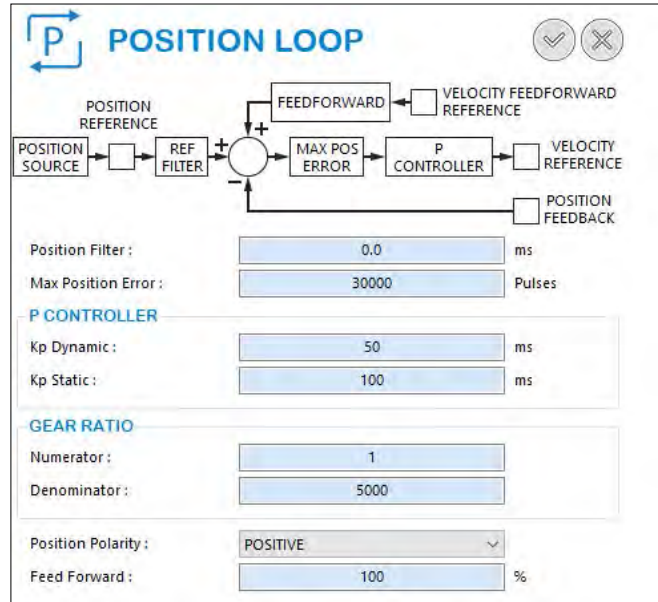
Position Filter

Not used during homing.

Max Position Error

This is the position error after which the drive goes into alarm 14 ("Following Error").
To calculate the value to insert in this field, use the following formula:

$$Max\_Position\_Error = \frac{K°}{360°} * 65536$$

where K° is the value in mechanical degrees of the maximum accepted error.
The maximum selectable position error is 180° (32767 pulses).

Example: If the maximum mechanical accepted error is 45° (1/8 mechanical turn), then the value to insert in the Max Position Error box is 8192, in fact 45°x65536/360°=8192.

Kp Dynamic

This is the position loop gain.

Kp Static

Not used.

Numerator

Not used during homing.

Denominator

Not used during homing.

Position Polarity

Positive or Negative. This parameter enables a complete inversion of axis control.

Feed Forward

This improves the system's dynamics. Suggested value: 100%.

3- Homing parameters settings:

Homing Method

It defines the method of homing (a video will explain how the selected homing work).

Torque Limit

It allows to limit the max torque in %, during the homing procedure.

Acceleration

This is the acceleration and deceleration time for the homing procedure. It is defined in milliseconds and allows values in ranges between 10 and 5000 ms. This time references the maximum motor speed set by using the "Speed Limit" parameter in the "Speed Loop" window, so the **actual acceleration** time can be found utilizing the following formula:

$$T\_acc\_homing \; [ms] = \frac{Speed\_homing \; [rpm] * T\_acc\_sett[ms]}{Speed\_motor[rpm]}$$

Where: **T_acc_homing** = real acceleration time during the homing search process;
            Speed_homing = speed set for the homing process ("Speed" parameter);
            Speed_motor = motor speed limit set on the interface ("Speed Limit" parameter);
            T_acc_set = value inserted in the "Acceleration" parameter.

For example if you have a motor with the following parameters:
- "Speed Limit" (on the "Speed Loop" window) = 3000 rpm;
- "Acceleration" (on the "Homing" window) =500 ms;
- "Speed" (on the "Homing" window) = 1000 rpm.

The acceleration time set in the homing window is the time that the motor should employ to accelerate from 0 rpm to the maximum speed (in this case 3000rpm).
The real acceleration time from 0 rpm to 1000 rpm is 167ms, in fact:

$$T\_acc\_homing \; [ms] = \frac{100 \; rpm * 500 \; ms}{3000 \; rpm} = 167 \; ms$$

Speed

This parameter sets the speed reference used during the homing process and it is given in "rpm".

Zero Speed

This defines the motor's speed during the realignment with the homing sensor and/or during the search for the encoder's zero pulse from the motor feedback after the home sensor is reached.

Homing Offset

This defines the difference between the zero position for the application and the machine's home position (which is found during homing process). It is measured in pulses and the allowed values are in ranges: $+/-(2^{32}-1)$. This value is assigned to the home position found at the end of a successful homing process. The Homing Offset value is obtained by the execution of the following calculation:

$$\text{Homing Offset} = n° \text{ turns (also not integer)} * 65536$$

Example: suppose we have an application where the distance between the home position and the zero position of the axis is equal to the distance that the axis can go with a rotation of 4 turns plus an addition 90° mechanical turn.

The first thing to do is to find the number of turns to insert into the formula. In this example: n° turns = 4 + 90°/360° = 4.25 to refer to the fraction of turn above 360°. Now it is possible to calculate utilizing the following operation: 4,25 *65536 = **278528**. This bold number is the value that must be inserted in the "Homing Offset" window.

After the setting of the desired homing parameters save the changes using the "Save To EEPROM" function on the software interface, doing this the drive's setup will become permanent.

5- Digital inputs/outputs settings:

A homing procedure needs following settings:

- a digital programmable input with function **"Start Homing"**;
- a digital programmable input with function **"Homing Sensor"**;
- an output with function **"Homing OK"**.
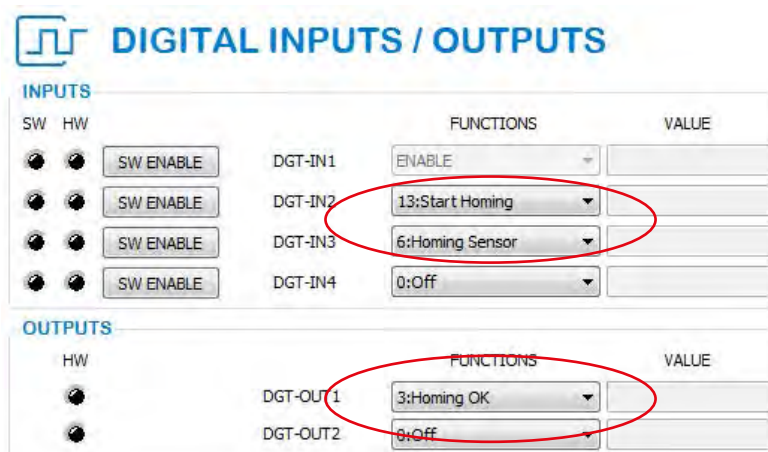
Homing sensor connection:

Connect homing sensor to the digital input pin set with the "**Homing Sensor**" function.
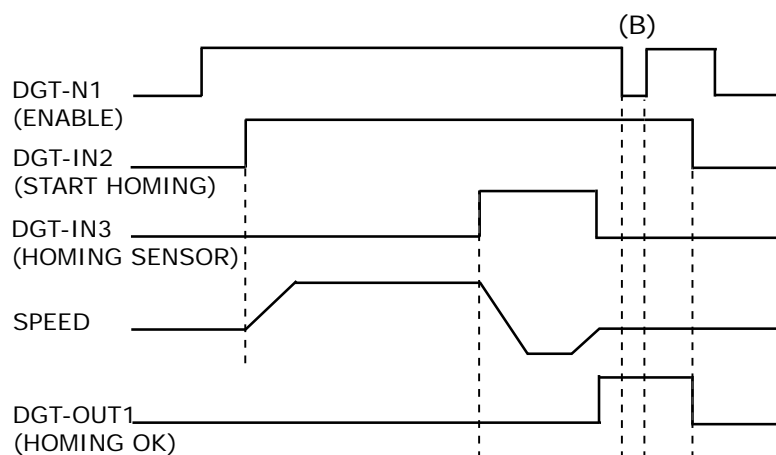
4.10 Homing - Example

Example: Homing sequence

Suppose to do the homing method: "**3 : Clockwise home switch (NO) and index pules**". The procedure is the following:

1- Select the desired operative mode.
2- In the "Homing" window of the interface set the desired homing method and its parameters.
Save all to the Eeprom.

3- Open the "**Digital Input/Outputs**" window and set:
    - A digital programmable input with the **"Start Homing"** function (for example: **DGT-IN2**);
    - A digital programmable input with the **"Homing Sensor"** function (for example: **DGT-IN3**);
    - A digital output with the **"Homing OK"** function (for example: **DGT-OUT1**);
Save all to the Eeprom.

4- Execute the homing procedure:

a- Enable the **DGT-IN1** (**Enable**) digital input ⇨ the motor will be on torque.
b- Enable the **DGT-IN2** (**Start Homing**) digital input ⇨ the motor moves to search the home position using the homing parameters saved on the interface. Every time this input is disabled the homing position is resetted.
c- When the home sensor output, connected to the **DGT-IN3** (**Homing Sensor**) digital input, is sensed active (in this example we considered a normally opened sensor), the motor decelerates and inverts its motion.
d- The home position is set when the falling edge of home sensor is received. When this happens the drive enables the **DGT-OUT1** (**Homing OK**) digital output. This value is kept high as soon as the **DGT-IN2** (**Start Homing**) digital input is kept high, independently of the **DGT-IN1** digital input (see (B) in the figure).
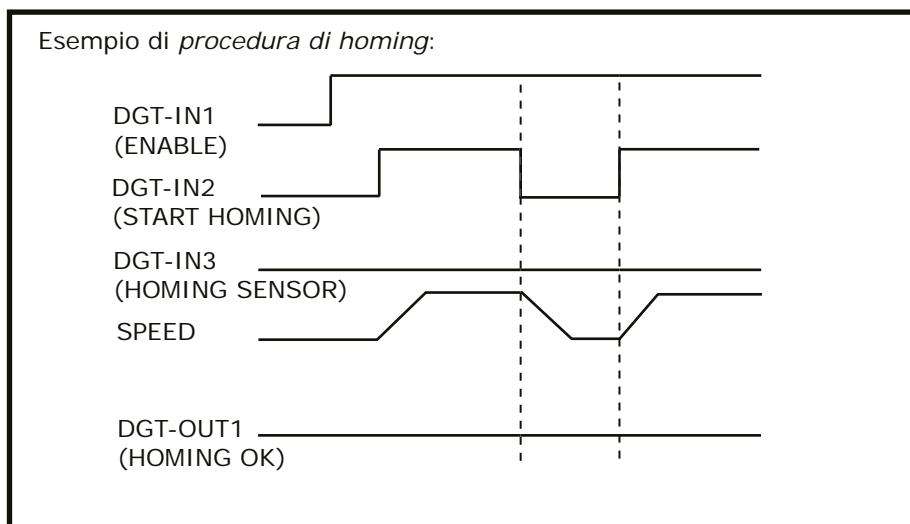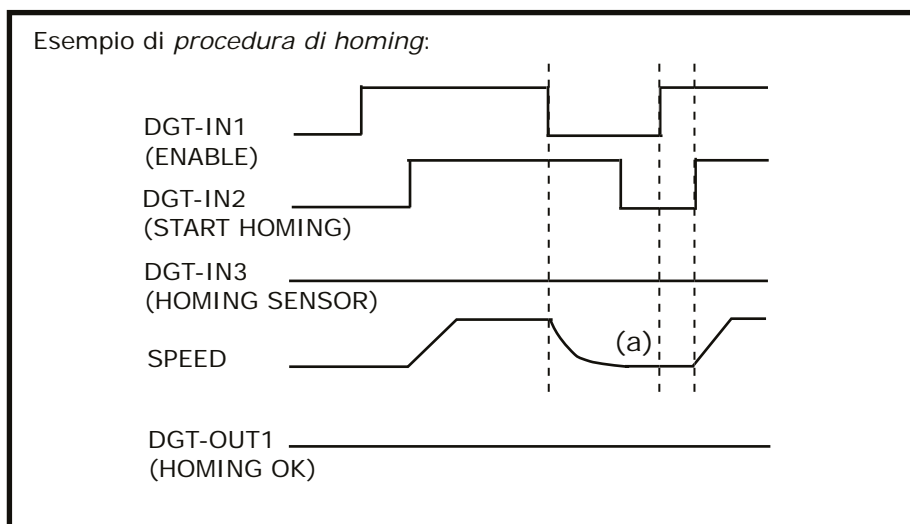

Example: *homing procedure*

4.10 Homing - Example

Warnings:

1) Disabling the **DGT-IN2** (**Start Homing**) digital input, before that the home position reached indication is generated, makes the homing process to abort. No home position is saved and the motor decelerates using the "**Acceleration**" parameter.

Esempio di *procedura di homing*:

DGT-IN1
(ENABLE)

DGT-IN2
(START HOMING)

DGT-IN3
(HOMING SENSOR)

SPEED

DGT-OUT1
(HOMING OK)

2) Disabling the **DGT-IN1** (**ENABLE**) digital input, before the ending of the homing procedure, causes the interruption of homing process. In this case no homing position is saved and the motor is left free (deceleration is depending of inertia and friction). A new homing process can be start disabling the **DGT-IN2** (**Start Homing**) input and then enabling the **DGT-IN1** and **DGT-IN2** digital inputs ((a) in figure).

Esempio di *procedura di homing*:

DGT-IN1
(ENABLE)

DGT-IN2
(START HOMING)

DGT-IN3
(HOMING SENSOR)

SPEED

(a)

DGT-OUT1
(HOMING OK)

4.11 CanBus - Settings

The drive can be controlled in CanBus interface.

The procedure is the following:

1- Perform the *basic installation procedure (see cap. 2.5 Basic installation on page 28)*;

2- In the "**Settings**" window set:

a- Set the operative mode "**7: Can Open**".

b- The baud rate parameter to define the communication speed and so the performance of the system. All drives connected to the network must have the same baud rate.

c- For each drive on the same network set a different "CanBus ID".

d- Save always in Eeprom to save the settings.

3- Connect the first drive to the CAN MASTER by using a CanBus cable.

4- Connect each drive to the preceding and the following by using a CanBus cable.

5- Connect a RESISTOR (120 ohm, 1/4W) between pins CAN H and CAN L of the last drive of the network.

See "**CanOpen/Ethercat Reference Manual**" for a more detailed description about the CanOpen protocol implemented on the drives (contact Axor).

4.12 CW/CCW

The **CW/CCW** allows you to connect the drive to a **stepper-motor controller**.
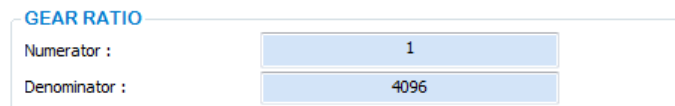
The procedure is the following:

1- Perform the *basic installation procedure (see cap. 2.5 Basic installation on page 28)*;

2- Enable CW/CCW control via software interface:

a- Set the operative mode **8: CW/CCW**;

b- Insert the desired torque reference(*) in the window Torque Sat.;

c- Open the "**Position Loop**" window insert into the numerator and denominator of the **Gear Ratio**, the ratio that allows you to obtain the desired speed in regards to the encoder.

Example: For 4096 pulses/revolution set as in figure(1/4096)

d- **Save data to Eeprom, turn off and on the drive**;

3- Execute hardware connections between drive and CN *(see cap. 2.16 Clock/Dir inputs connections on page 48)*.

(*) Insert the calculate torque reference using this formula:

$$\frac{I_{desired} \times 100}{I_{peak}}$$

Example: Suppose we want to set a digital torque reference equal to 5A, having a drive size of 10/20 (10A=rated current, 20A=peak current) ⇨ insert in the window Torque Sat. the value 25, in fact (5x100)/20=25.

The value 0,0% disable the function.

4.12 CW/CCW

4- For enabling the CW/CCW Mode follow this procedure:

a- Enable the drive giving +24V to the ENABLE input (D.IN1). The motor will remain locked in torque with the position loop inserted and waiting to move. See (1)

b- When the pulses arrive at the **DIR** input the motor will move in **CW** (clockwise rotation). See (2)

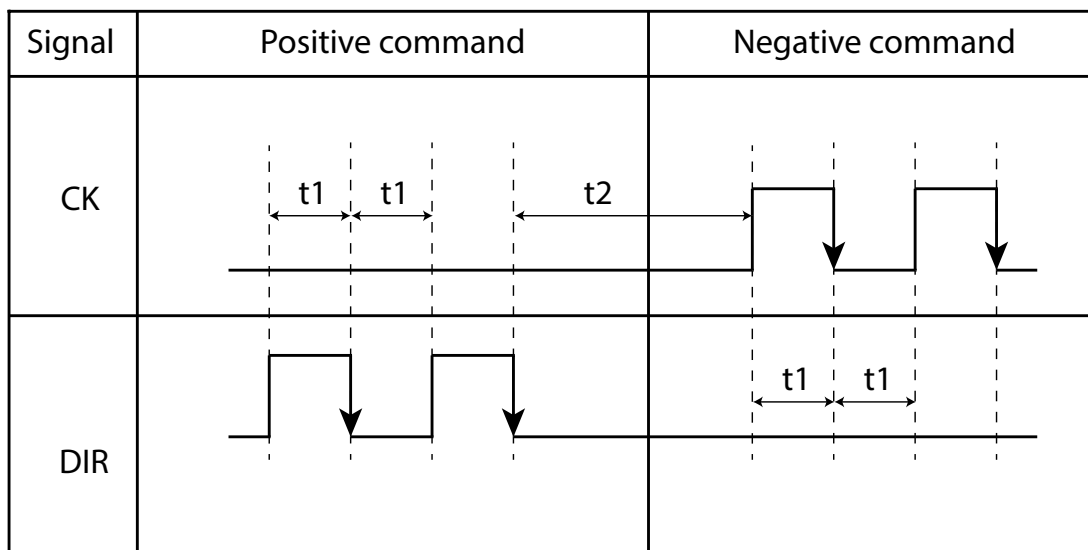c- When the pulses arrive at the **CK** input the motor will move in **CCW** (counter-clockwise rotation). See (3)

CW/CCW sequence:
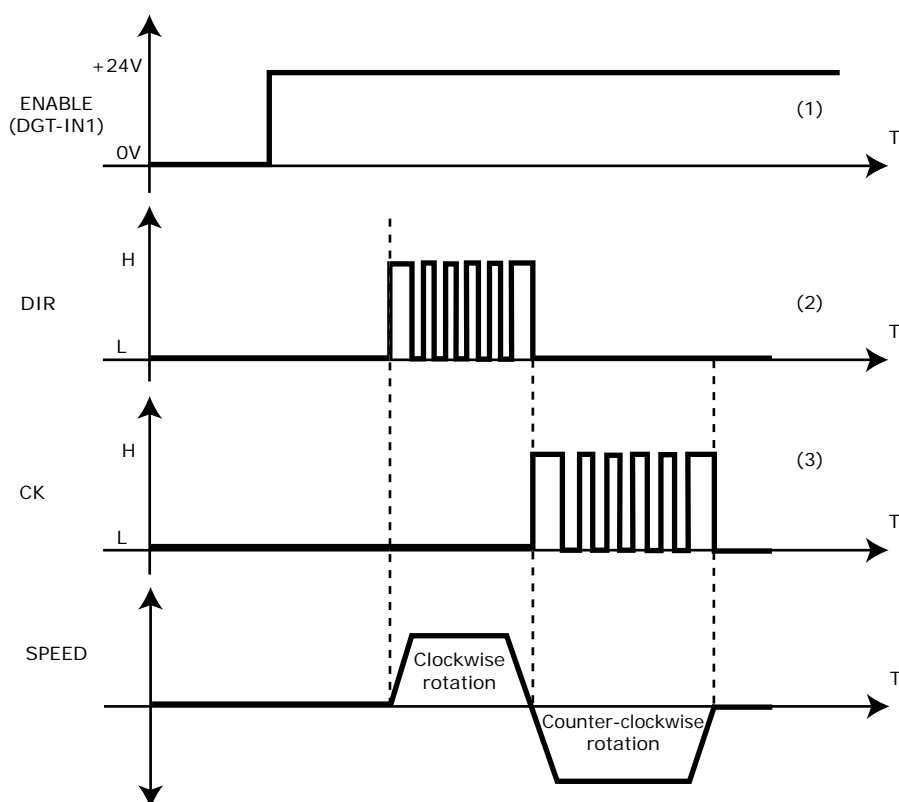
ATTENTION: If the rotation is irregular or noisy, it should be necessary to *adjust the gains of the speed loop* or *position loop* by using an adequate procedure.

Inputs time requirements:

Signal	Positive command	Negative command
CK		
DIR		

CK/DIR Signal	Max. allowable input frequency	Minimum required time width [μs]	
		t1	t2
Line Driver	500kHz	1	1
Open Collector	200kHz	2.5	2.5

4.13 Square Wave Period

The drive can control a motor by using a *speed digital reference in square wave*.

The procedure is the following:

1- Perform the *basic installation procedure (see cap. 2.5 Basic installation on page 28)*;

2- Enable digital speed control via software interface*:*

a- Set the operative mode **10:Square Wave Period**;

b- Insert the desired speed reference in Digital Speed;

c - Insert the desired reversal motor period in Time Delay;

d - Is possible to set the ramp of acceleration and deceleration in the Velocity Loop window;

e- It is possible to limit the torque by setting the % of Imax by the value Torque Sat.(the value 0,0% disable this function)(*).

f- **Save data to Eeprom**;

g- Enable/disable the drive by using the **Enable**/**Disable** buttons or giving +24V to the **D.IN1** (**ENABLE**) input.

3- **If the rotation is irregular or noisy, it should be necessary to *adjust the gains of the Velocity loop* or *position loop* by using an adequate procedure.**

(*) Insert the calculate torque reference using this formula:

$$\frac{I_{desired} \times 100}{I_{peak}}$$

Example: Suppose we want to set a digital torque reference equal to 5A, having a drive size of 10/20 (10A=rated current, 20A=peak current) ⇨ insert in the window Torque Sat. the value 25, in fact (5x100)/20=25.

The value 0,0% disable the function.

4.14 Analog to Position Control

The drive can control a motor between two programmable positions corresponding the Min. and Max. voltages at the dedicated pins.

The procedure is the following:
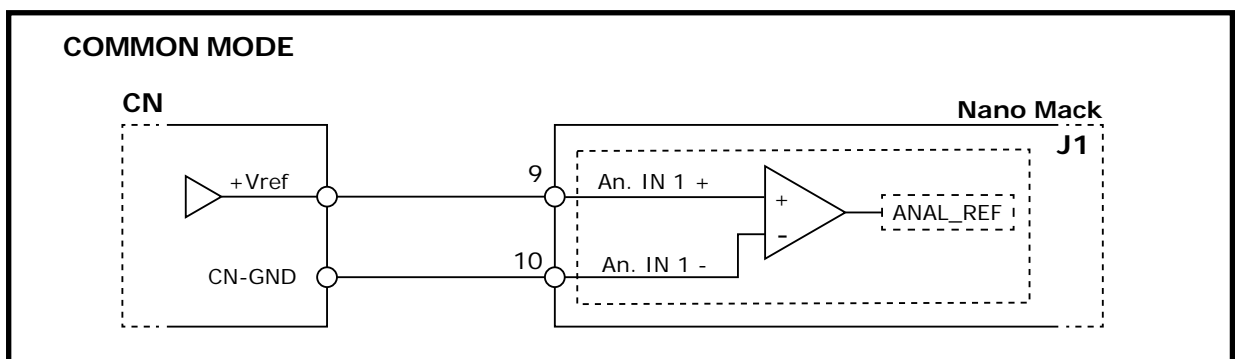 **1**- Perform the *basic installation procedure (see cap. 2.5 Basic installation on page 28)*;

  2- Use pins **An.IN 1+** and **An.IN 1-** to apply the desired speed reference.
  The control can have two different types of analog reference outputs:

  • **Differential analog output**, in this case connect the positive speed reference to **An.IN 1+** and the negative speed reference to **An.IN 1-**.
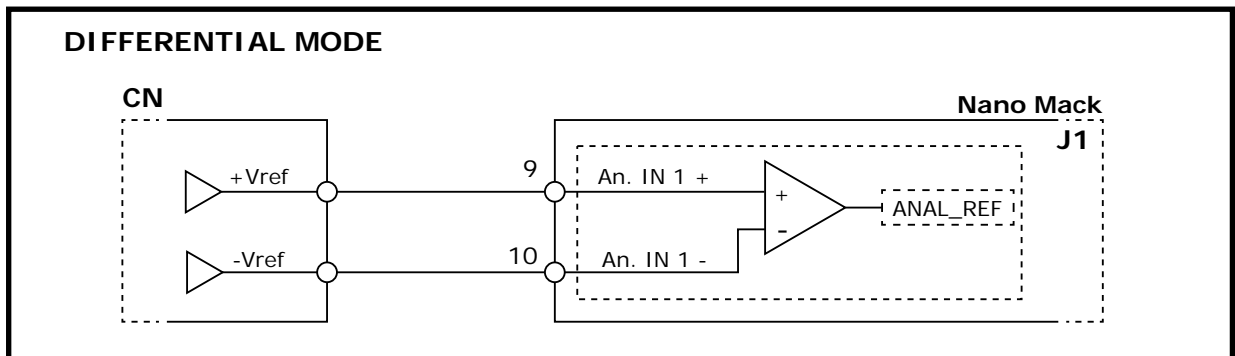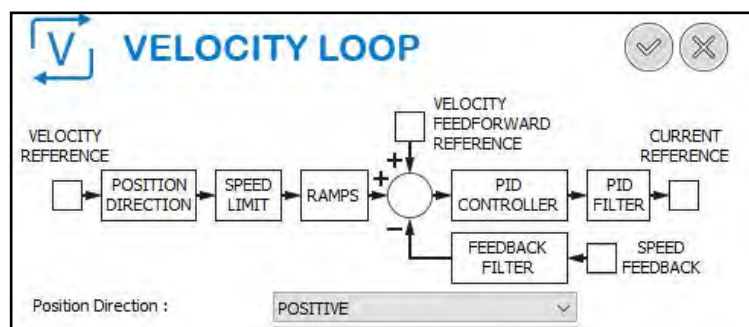

  • **Common mode reference analog output**, in this case connect the control's analogue output either to the **An.IN 1+** terminal or to the **An.IN 1-** terminal, depending upon the required rotational direction.
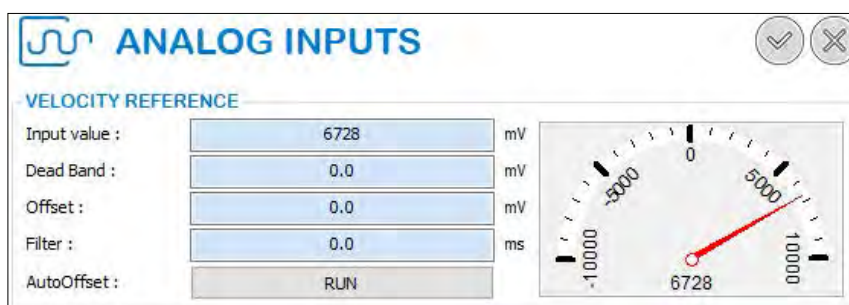

Note:
  To change the sense of rotation apply the positive voltage reference to **An.IN 1-**, or change the **Position Direction** parameter in the **Velocity Loop** window (from **Positive** to **Negative**).
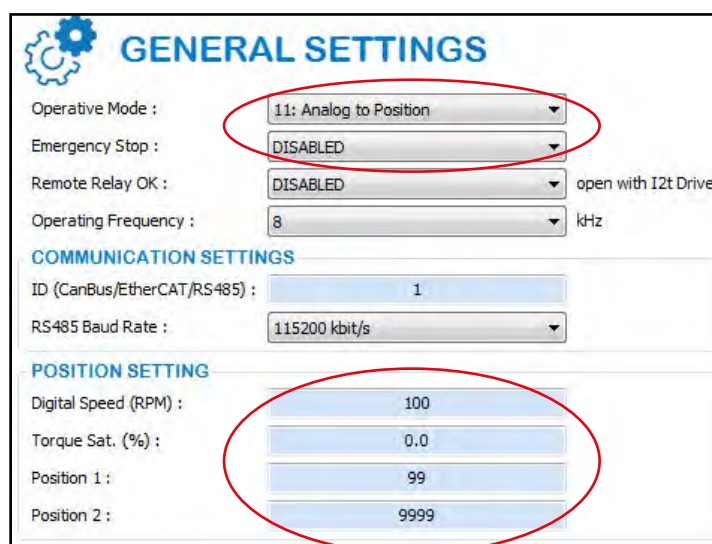
3- Execute the settings of the offset of the velocity analog input reference **via software interface**: open the "**Analog Inputs**" window and run the AutoOffset.

4- Enable analog speed control via *Speeder One interface*:

a- set the operative mode *11:Analog to Position* and keep the **Torque Sat**. box to **0,0**;

b- in *Digital Speed* box set the desired speed during movements;

c- in *Position 1* and *Position 2* set the desired position corresponding to the +10V and -10V at the dedicated inputs;

d- save settings to Eeprom.;

e- enable/disable the drive by using the **Enable**/**Disable** buttons.

ATTENTION: If the rotation is irregular or noisy, it should be necessary to *adjust the gains of the Velocity loop* or *position loop*.

4.15 Digital position

The drive can control a motor between two digital programmable positions.

The procedure is the following:
    1- Perform the *basic installation procedure (see cap. 2.5 Basic installation on page 28)*;

    2- Enable digital speed control via software interface*:*

    a- Set the operative mode **12: Digital position**;

    b- Insert the desired speed reference in **Digital Speed**;

    c- Insert the desired pause period which the motor wait after reaching the position in **Time Delay**;

    d- In *Position 1* and *Position 2* set the desired position;

    e - Is possible to set the ramp of acceleration and deceleration in the Velocity Loop window;

    e- It is possible to limit the torque by setting the % of Imax by the value Torque Sat.(the value 0,0% disable this function)(*).

    f- **Save data to Eeprom**;

    g- Enable/disable the drive by using the **Enable**/**Disable** buttons or giving +24V to the **D.IN1** (**ENABLE**) input.

    3- **If the rotation is irregular or noisy, it should be necessary to *adjust the gains of the Velocity loop* or *position loop* by using an adequate procedure.**

(*) Insert the calculate torque reference using this formula:

$$\frac{I_{desired} \times 100}{I_{peak}}$$

<u>Example</u>: Suppose we want to set a digital torque reference equal to 5A, having a drive size of 10/20 (10A=rated current, 20A=peak current) ⇨ insert in the window Torque Sat. the value 25, in fact (5x100)/20=25.

The value 0,0% disable the function.

Chapter 5
SpeederOne.2 Interface

5.1 Interface

The software *SpeederOne.2* interface allows you to setup, modify and save all parameters, by connecting a PC to the system.

PC minimum preconditions:
    Operative system: *Windows 7* and higher;
    Drive: Hard disk having at least 50 MB free;
    Interface: free USB port, rs485 to usb adapter..

Installation procedure:
    1- Run the installation file "**SpeederOne.2_Setup_X.XX.XXXXXXXX.exe**".
    2- At the end of the installation, to start the interface click on the link " **SpeederOne.2**" on your desktop (if created) or on the "**SpeederOne.2.exe**" file that you find on the directory: "C:\ Program\SpeederOne.2" (or in the directory selected during installation).

   The parameter variation, via interface, should be done only by technical qualified personnel.

After the program is started with the drive powered and connected to the pc, the following window will appear:
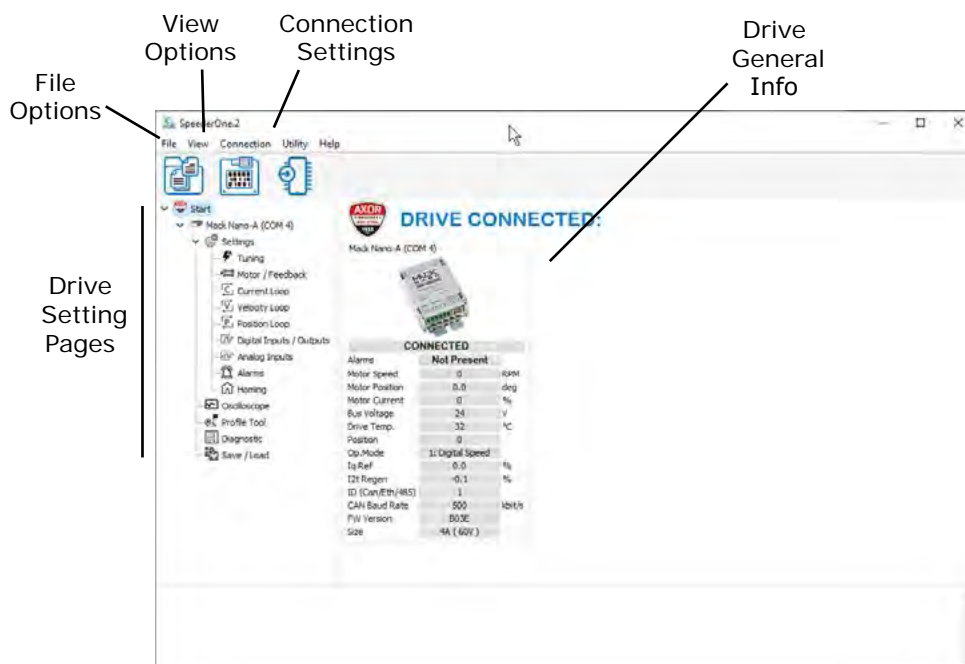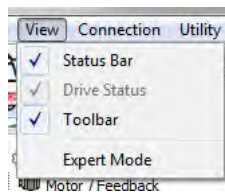
5.1 Interface

File

By clicking on it is possible to save and load drive's configuration file, create a virtual drive.
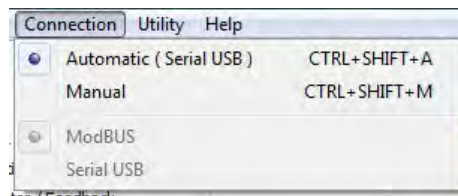

View

By clicking on it is possible to show/hide "Status Bar", "Drive Status", "Toolbar" and enable the "**Expert Mode**" to permit the user to write in the "**Diagnostic**" page.

Connection

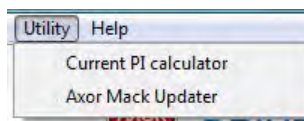By clicking on "**Connection**" it is possible to select *Automatic* to connect all the drive connected to the PC (only for serial USB connections), *Manual* to connect to a single drive and select between ModBus / Serial USB for the type of Manual Mode.
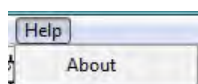

Utility

By clicking on "**Utility**" it is possible to found some useful tools.

About

This option shows the program version and additional information.

5.2 System Overview

SYSTEM OVERVIEW:

In "**System Overview**" it is possible to visualizes some drive's properties:

DRIVE / CONFIGURATION / COMMUNICATION
It visualizes the current setting of the drive:

- **Drive Version:** Drive Line

- **Size:** Nominal size in Ampere

- **Firmware Version:** Drive's current firmware

- **Firmware Date:** Drive's current firmware release date

- **Hardware Version:** Drive's motherboard version

- **Motor Type:** Current motor type selected

- **Feedback Type:** Current Feedback type selected

- **Operative Mode:** Current operative mode

- **ID(CAN/ETH/485):** CanBus / EtherCat / ModBus ID

- **Can Baud Rate:** CanBus Baud rate

5.3 General Settings

GENERAL SETTINGS:

In "**General Settings**" it is possible to change the operative mode and the relative settings:

Remote Relay OK
It enables or disables the *Open with I2t Drive* function, which opens the programmed output during the alarm 6: "I$_2$t Drive".

Hardware Current Control
It enables or disables the Max limit output current of the drive using an Analog Input.

Operating Frequency
Select the drive operating frequency(16KHz / 24KHz with derating of drive performances).
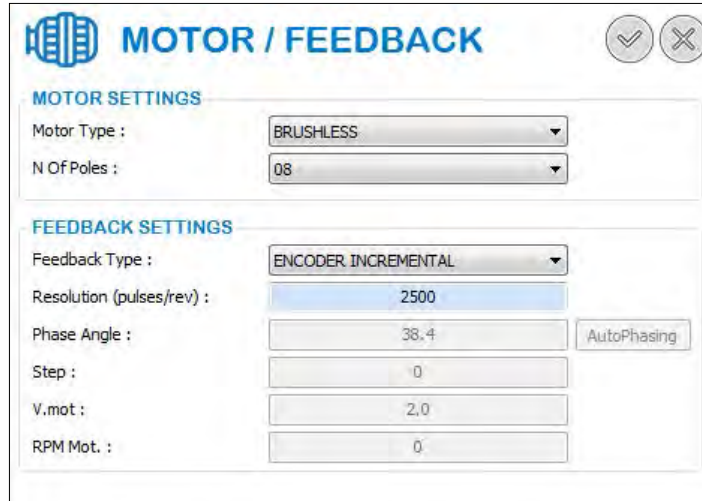
The "**Operative Mode**" menu allows you to select the operation mode of the drive. With every selection all associated information are automatically pre-disposed:

- **ID(CanBus/EtherCAT/RS485):** CanBus / EtherCat / ModBus ID

- **RS485 Baud Rate:** RS485 Baud rate

- **Can Baud Rate:** CanBus Baud rate

- **Digital Speed:** Digital speed reference

- **Torque Sat.:** Torque limit in % (0% means torque limit disabled)

- **Time Delay:** Square wave reverse time

- **Position 1:** Position 1.

- **Position 2:** Position 2.

5.4 Motor / Feedback

MOTOR / FEEDBACK:

In **"Motor/Feedback"** it is possible to change motor and feedback setting:

Motor Settings:

• **Motor Type**: Select the type of motor.

• **N° Of Poles**: If the motor type is brushless then select the number of motor's pole.

Feedback Settings:

• **Feedback Type**: Set the type of the motor feedback.

• **Revolution (pulses/rev)**: It contain the value of encoder pulses/rev.

• **Phase Angle**: It contain the phasing angle of the motor.

Step, V. mot, RPM Mot change their function according to the configuration motor/encoder.

5.4 Motor / Feedback

BRUSHLESS MOTOR:

Brushless + Encoder Commutation
With this coupling set only the following parameter:
- **Resolution:** insert the value of encoder pulses/rev.
- **Phase Angle:** It visualizes the phasing angle of the motor, previously calculated with the "**AutoPhasing**" procedures.

All other parameters are not to be set.

Brushless + Encoder Incremental serial (in Feedback Type select Encoder Incremental)
With this coupling set only the following parameter:
- **Resolution:** insert the value of encoder pulses/rev.
- **Phase Angle:** It visualizes the phasing angle of the motor, previously calculated with the "**AutoPhasing**" procedures.

All other parameters are not to be set.

Brushless + Encoder Incremental
With this coupling set only the following parameter:
- **Resolution:** insert the value of encoder pulses/rev.

All other parameters are not to be set.

Note: *At the first powerup happen the electrical phasing between motor and encoder, this can result in a slight movement of the motor*.

Brushless + Sensorless
With this coupling set only the following parameter:
- **Resolution:** insert the value of encoder pulses/rev.
- **Min. RPM:** minimum speed allowed in RPM.
- **Back EMF[V]/Back EMF[RPM]:** insert the BACK EMF of the motor[V/RPM].

All other parameters are not to be set.

Brushless + hall sensor
With this coupling set only the following parameter:
- **Resolution:** the value is calculated with the following formula:

    Resolution = hall cell number * 2

- **Phase Angle:** It visualizes the phasing angle of the motor, previously calculated with the "**AutoPhasing**" procedures.

All other parameters are not to be set.

5.4 Motor / Feedback

DC MOTOR (BRUSHED):

DC motor + Encoder Incremental
With this coupling set only the following parameter:
• **Resolution:** insert the value of encoder pulses/rev.

All other parameters are not to be set.

DC motor + Hall sensor
With this coupling set the following parameters:
• **Min. RPM:** minimum speed allowed in RPM.
• **Resolution:** the value is calculated with the following formula:

$$Resolution = hall\ cell\ number * 2$$

All other parameters are not to be set.

DC motor + Tachogenerator
With this coupling set the following parameters:
• **Offset:** in the oscilloscope set the "BEMF" option; then change the "**Offset**" parameter until BEMF=0.
• **Tacho Voltage:** tachogenerator voltage [V].
• **Rpm.mot at Tacho Voltage:** turns referenced to the tachogenerator voltage [1000 rpm].

All other parameters are not to be set.

Tacho Voltage is referred to the encoder voltage and not to the motor voltage.
In this configuration **Tacho Voltage** max is 40V.

DC motor + R.Armature
With this coupling set the following parameters:
• **Armature Resistance(Ohm*100):** armature resistance;
• **Motor Voltage:** motor voltage [V];
• **Rpm.mot at Motor Voltage:** motor turns correspondent to Motor Voltage [rpm];

All other parameters are not to be set.

"Motor Voltage" and " **Rpm.mot at Motor Voltage**"parameters do not fix the motor voltage and speed limits, but they defines the voltage/turn characteristic of the dc motor. Setting these parameters, it is possible to correct the slope of this characteristic.
The speed limit is the Speed Limit parameter.

5.4 Motor / Feedback

STEPPER MOTOR:

Stepper + Encoder Incremental
With this coupling set the following parameters:
- **Step:** insert the motor step.
- **Resolution:** insert the value of encoder pulses/rev.

All other parameters are not to be set.

Note: *At the first power-up happen the electrical phasing between motor and encoder, this can result in a slight movement of the motor.*

Stepper + Sensorless
With this coupling set the following parameters:
- **Min. RPM:** insert the motor step.
- **Back EMF[V]/Back EMF[RPM]:** insert the BACK EMF of the motor[V/RPM].
- **Resolution:** insert the definition of one motor revolution (MICROSTEPS).
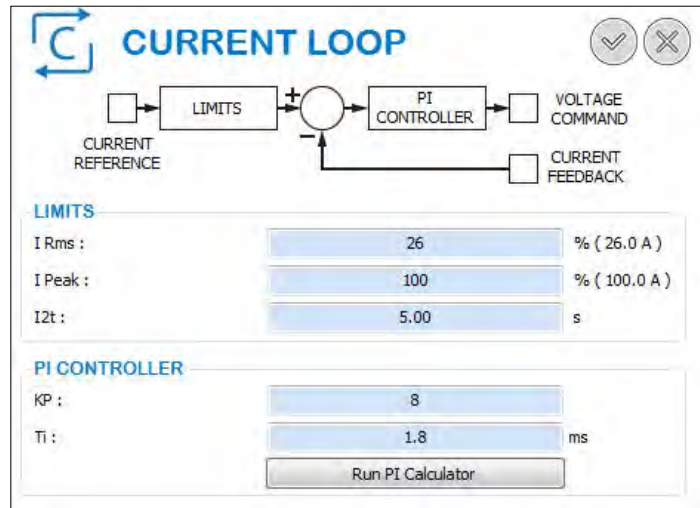
All other parameters are not to be set.

Note: *At the first power-up happen the electrical phasing between motor and encoder, this can result in a slight movement of the motor.*

5.5 Current Loop

CURRENT LOOP:

In "**Current Loop**" it is possible to modify the dynamic constants of the drive's current loop:

I rms: In this box it is possible to insert the percentage value of the rated current furnished by the drive. The numerical range is between 1 and 50 and it is referred to the peak current value.
Example: suppose we have a drive size 8/16, if we insert into this box the value 15%, we'll have a setting of rated current equal to 2,4A (in fact 16X15/100=2,4), so the drive will provide a rated current equal to 2,4A to the motor.

I peak: In this section it is possible to insert the percentage value of the peak current furnished by the drive. The numerical range is between 1 and 100
Example: suppose we have a drive size 8/16, if we insert into this box the value 75%, we'll have a setting of peak current equal to 12A (in fact 16X75/100=12), so the drive will provide a peak current equal to 12A to the motor.

The value of nominal and peak current is RMS.

I2T: Time of the peak current.
Typically with an adjustment of Ipeak = 100%, the time will be 5 seconds.

KP: It is the proportional gain of the current loop. This adjustment allows for optimizing the dynamic behaviour of the motor's current loop. The numerical range of this parameter varies from 0 up to 999.
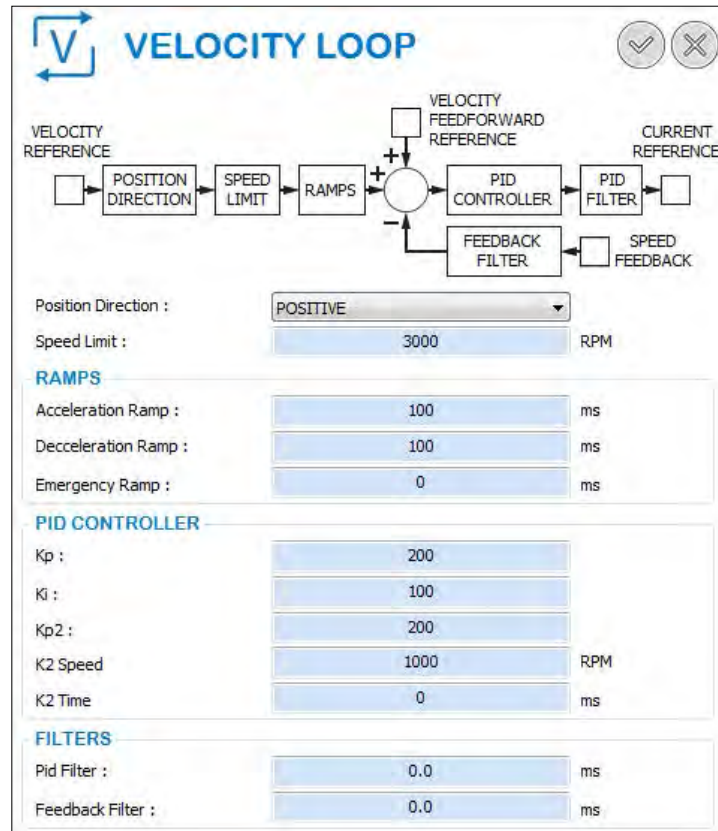
Ti: It is the integral time in "ms" of the current loop.
The numerical range of this parameter varies from 0 up to 999ms.

5.6 Velocity Loop

VELOCITY LOOP:

In "**Velocity Loop**"is possible modify the dynamic constants of the drive's velocity loop:

• **Position Direction**: It allows you to set the rotor's sense of rotation: Positive (CW) or Negative (CCW).

• **Speed Limit**: In this box there is the max speed of the motor coupled with the drive.

• **Acceleration Ramp**: It is possible to insert the value of the acceleration ramp "in ms". The range is between zero and 5000 ms (0-5sec).

• **Deceleration Ramp**: It is possible to insert the value of the deceleration ramp "in ms". The range is between zero and 5000 ms (0-5sec).

• **Emergency Ramp**: It is possible to insert the value of the deceleration ramp "in ms" during the emergency stop.

• **Kp**: It is the proportional gain of the speed loop.
This setting optimizes the dynamic behavior of the motor.

• **Ki**: It is the integral gain of the speed loop.
This setting optimizes the dynamic behavior of the motor.

5.6 Velocity Loop

• **Kp2:** If enabled (K2 Time different from 0), it is the proportional gain of the speed loop when the speed is less then K2 Speed for K2 Time.

• **K2 Speed:** Max Speed reference for switch from Kp to Kp2 after K2 Time.

• **K2 Time:** When the motor speed drop under K2 Speed and the K2 Time has passed , the drive switch from Kp to Kp2 (the value 0 disable the function).

• **Pid Filter:** It is a filter on the output of the speed regulator.

• **Feedback Filter:** It is a filter on the feedback speed.

5.7 Position Loop

POSITION LOOP:

In "**Position Loop**"is possible modify the dynamic costants of the drive's position loop:
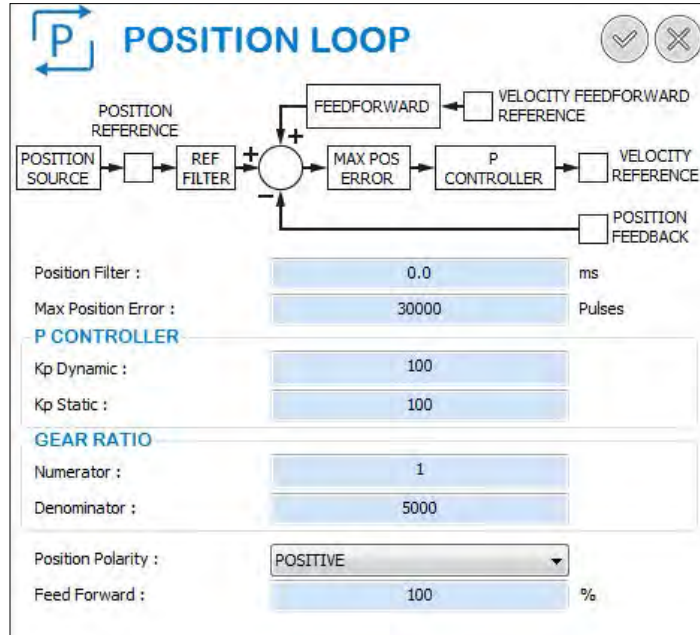
- **Position Filter**
It is a filter on the position reference. It can be used, at low speed, to limit axis' vibration or to make the system less noisy.

- **Max Position Error**
This is the position error after which the drive goes into alarm 14 ("Following Error").

- **Kp Dynamic**
This is the position loop gain. Suggested values: 1÷999.

- **Kp Static**
Set as Kp Dynamic.

- **Numerator**
This is the number of complete rotation of the axis with the number of pulse(denominator) received.

- **Denominator**
Number of pulses necessary to do the rotation setted in the numerator.

- **Position Polarity**
Positive or Negative. This parameter enables a complete inversion of axis control.

- **Feed Forward**
This improves the system's dynamics. Suggested value: 100%.

5.8 Digital I/0 window

This window allows you to modify **via software** the status of the **programmable digital inputs** and to control the hardware status of the **digital inputs and outputs**.

The "**St**" led visualises the **status (software)** of the digital inputs. Clicking on the button near the name of the digital input, the "St" led becomes red and a high logic signal is present on the input.

The "**Hw**" led visualises the **hardware status** of the digital input, if it is red a voltage is present on the input.

The "**Hw**" led, about digital outputs, visualises the **hardware status** of the digital outputs, if it is red the output is closed..

Near the name of each digital input/output there are two fields:
- There is a menu that allows you to select a **function**;
- There is a field where you can insert the **auxiliary variable** if necessary.

5.8 Digital I/O window

The **D.IN1**…**D.IN4** inputs can be set to enable the following functions:

FUNCTION	INPUT DESCRIPTION
0:Off	No function.
1:Ref-On	Enable motor rotation.
2:PStop (NC)	Positive limit switch normally closed. A low logical signal on this input disables the "CW" rotation of the motor.
3:NStop (NC)	Negative limit switch normally closed. A low logical signal on this input disables the "CCW" rotation of the motor.
4:Brake	Manual command for the digital output setted as "Out Brake"
5:Start Jog **7:Start Jog**	It enables a movement having the following parameters: • Acceleration time that is equal to the homing acceleration time; • Speed (in rpm) equal to the value set in the auxiliary variable; • Target equal to the positive extreme (PSTOP software) of the axis if the speed is positive, or equal to the negative extreme (NSTOP software) of the axis if the speed is negative; • Deceleration time that is equal to the homing acceleration time.
6:Homing Sensor	Homing sensor.
8:Start Task Num	Start the task set by the auxiliary variable. There is no possibility of blending with this function.
9:Start Task I/O	Start the task set by the digital inputs. There is not possibility of blending with this function.
10:Start Sequence	Start a sequence of tasks. The first task is set by the digital inputs, while the next tasks are set by using the "Next Profile" parameter associated to each task. At the end of each task the following automatically starts.
11:Start Next	Start a sequence of tasks. The first task is set by the digital inputs, while the next tasks are set by using the "Next Profile" parameter associated to each task. At the end of each task the motor stops, the user has to click the task button (clicking twice: disabling and enabling) in order to start the next task of the sequence.
12:P+N Stop	Positive and negative limit switch. A low logical signal on this input disables the CW or CCW rotation of the motor.
13:Start Homing	Start the homing procedure.
14:Alarm Reset	Reset the "resettable" alarms.
15:Speed Inv.	Inversion of the motor rotation.
16:TouchProbe1	The touch probe external input signals for capture the position value of the encoder.
17:TouchProbe2	The touch probe external input signals for capture the position value of the encoder.

Very Important Notes:

• **Before changing the function on a programmable input make sure that the function is disabled.**
For example:
  The "Start Homing" function is not active with a <u>low</u> signal on the dedicated input. The "Pstop" function is not active with a <u>high</u> signal on the dedicated input.

• **Remember to save to the EEPROM all settings made on the programmable digital input in order to make them permanent.**
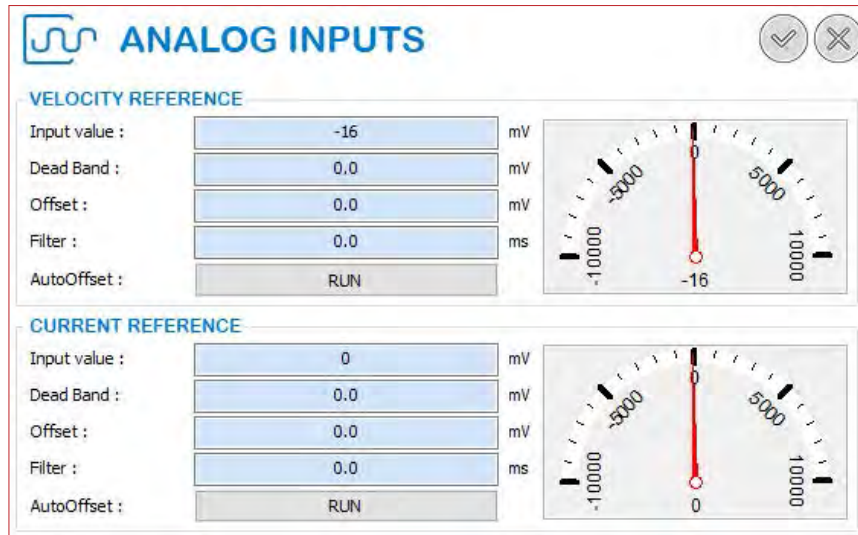
5.8 Digital I/O window

In the following table there are the setting functions for the two digital programmable outputs (**An/D.OUT1** and **D.OUT2**):

FUNCTION	OUTPUT DESCRIPTION
0:Off	Selecting this function the output will always be open.
1:|Speed|>x	If the absolute value of the actual speed is greater than the value inserted in the auxiliary variable, the output will be closed. On the contrary, if the absolute value of the actual speed is less than the value inserted in the auxiliary variable the output will be opened.
2:|Speed|<x	If the absolute value of the actual speed is less than the value inserted in the auxiliary variable, the output will be closed. On the contrary, if the absolute value of the actual speed is greater than the value inserted in the auxiliary variable the output will be opened.
3:Homing OK	The output will be closed after a complete and successful homing procedure. At the start of every new homing procedure the output will be opened.
4:I2t	The output will be closed if the I^2t condition is reached. When this condition comes down the output will be opened.
5:|Irms%|>x	If the absolute value of the actual current is greater than the value inserted in the auxiliary variable, the output will be closed. On the contrary, if the absolute value of the actual current is less than the value inserted in the auxiliary variable the output will be opened.
6:|Irms%|<x	If the absolute value of the actual current is less than the value inserted in the auxiliary variable, the output will be closed. On the contrary, if the absolute value of the actual current is greater than the value inserted in the auxiliary variable the output will be opened.
7:Target OK	The output will be closed after a successful position task. At the start of every new task the output will be opened.
8:Error	With this function the output is closed if one or more alarms are present. When all alarm are cleared the output will be opened.
9:Ready	When the control circuitry is powered up (with a minimum delay), the output will be closed.
10:Torque Reached	The output will be closed if the motor torque has reached the setted Digital Torque limit.
11:limitSw	The drive reached the software PSTOP/NSTOP setted in the profile position.
12:|Err Pos|>x	If the absolute value of the actual Position Error is greater than the value inserted in the auxiliary variable, the output will be closed. On the contrary, if the absolute value of the actual current is less than the value inserted in the auxiliary variable the output will be opened. The actual position error can be monitored in main window of Speeder One interface by selecting Posit_Err option in Analog Out1 or Analog Out2 menu.
13:|Err Pos|<x	If the absolute value of the actual Position Error is less than the value inserted in the auxiliary variable, the output will be closed. On the contrary, if the absolute value of the actual current is greater than the value inserted in the auxiliary variable the output will be opened. The actual position error can be monitored in main window of Speeder One interface by selecting Posit_Err option in Analog Out1 or Analog Out2 menu.
14:Next target	This function is to be utilized exclusively with either the Start Sequence function or the Start Next function on a programmable input. At the start of the first profile the output is opened and it will change status (toggled) at the start of every new profile.
16:Fan	The output will be closed if the temperature of the drive is higher than 40°C.
19:Out Brake	Digital output that allows to control an electromechanical brake motor via an external relay.
28:ZeroToggle	Every time the motor passes form the the zero encoder, the output is toggled.
31:Blink	The output is switched about every 500ms.

5.9 Analog I/O window

This window allows you to control and condition the analog signal of the differential or common mode reference from the external controller.

• **Input Value**
It visualises in "mV" the voltage measured on the analog inputs This value depends by the Offset, the Filter and the Dead Band settings.

• **Dead Band**
If the voltage on the analog inputs is within the range [-Dead Band, +Dead Band], the analog reference is zero.

● **Offset**
Voltage in "mV" on the analog inputs taken as zero reference.

• **Filter**
Filter in "ms" on the analog input signal.

● **Auto Offset**
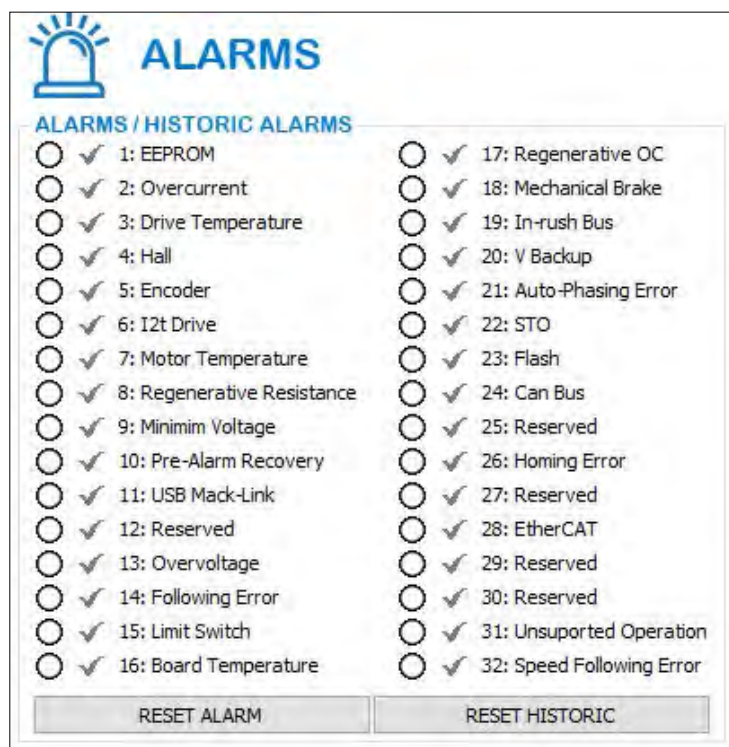This button *automatically* execute the settings of the offset.

5.9 Analog I/O window

In the following table there are the setting functions for the analog programmable outputs
(**An / D.OUT1** and **An / D.OUT2 (only case A)**):

FUNCTION	OUTPUT DESCRIPTION
0:Off	Selecting this function the output will always be open.
22:AbsI2t	The absolute value of the i2t counter(0÷100%) in analog signal (0÷10V).
23:AbsSpeed	The absolute value of the actual motor speed respect the max speed in analog signal (0÷10V).
25:ProgRef	Programmable output voltage (0÷10V).
26:Saturation	Max Output voltage (10V).
27:Half	Half Output voltage (5V).

5.10 Alarms window

This window show if there is any fault state of the drive.

For detail about the alarms *(see cap. 3.1 Alarms on page 56)*.

5.11 Homing window

This window allows you set the parameters of the **Homing procedure**:

The homing procedure uses the **signal of the homing sensor** and, eventually, the **zero signal of the encoder**.

Homing Method
It defines the type of homing.

Torque Limit
It allows limit the torque %, during the homing procedure

Acceleration
This is the acceleration and deceleration time for the homing procedure.
 It is defined in milliseconds and allows values in ranges between 10 and 5000 ms. This time references the maximum motor speed set by using the "Speed Limit" parameter in the "Velocity Loop" setting.

Speed
This parameter sets the speed reference used during the homing process and it is given in "rpm". The admitted values are in ranges between 10 and 1000 rpm.

Zero Speed
This defines the motor's speed during the realignment with the homing sensor and/or during the search for the encoder's zero pulse from the motor feedback after the home sensor is reached.
It allows values in ranges between 1 and 50 RPM. We suggested utilising low values for this parameter in order to obtain good precision.

Home Offset
This defines the difference between the zero position for the application and the machine's home position (which is found during homing process). It is measured in pulses and the allowed values are in ranges: +/-(2^32-1). This value is assigned to the home position found at the end of a successful homing process.

5.12 Braking Resistor window

This window allows you set the parameters of the **Braking Resistor**:

Resistance value
The value of the resistance in Ohm.

Absorbed energy
The absorbable adiabatic energy of the resistor in joule.

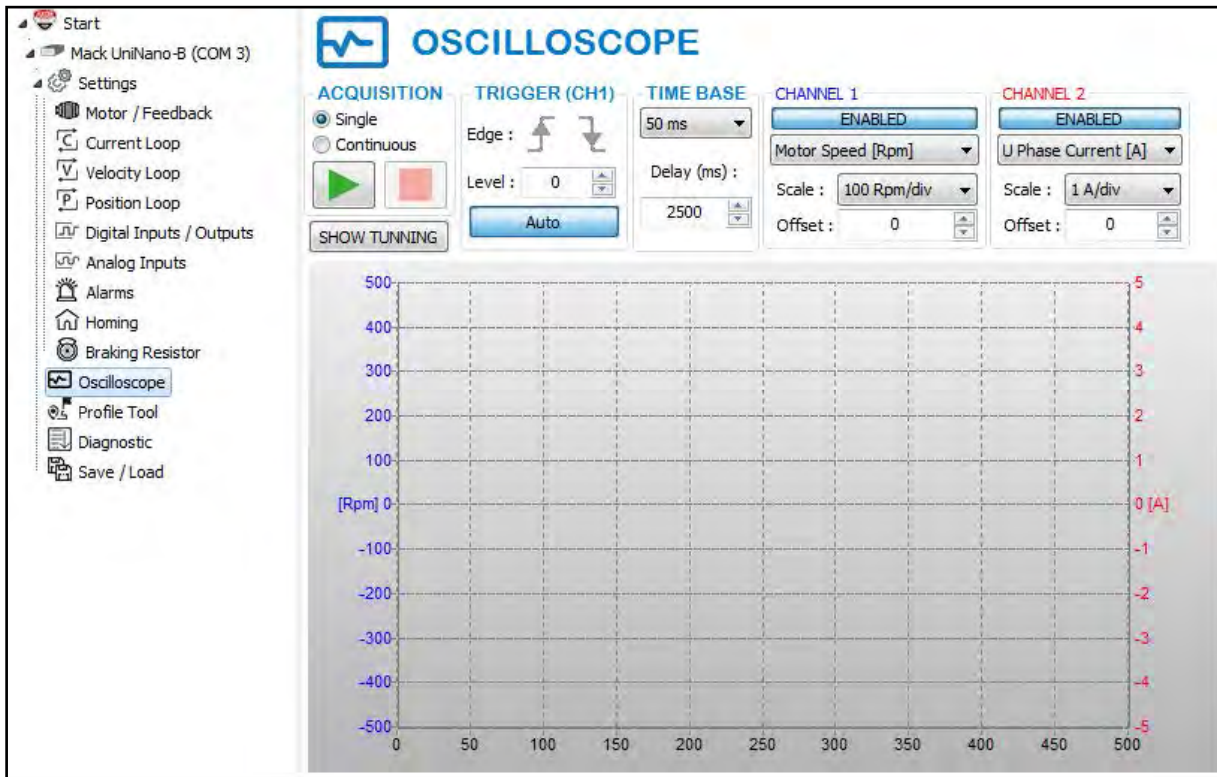### Power
The resistance braking power in Watt.

Braking Voltage
Level of voltage when the drive start braking.

5.13 Oscilloscope

Clicking on "**Oscilloscope**" it is possible to open the digital oscilloscope.
The oscilloscope functions as a normal two channel digital oscilloscope and it allows visualizing: *motor speed*, *phase current*, *position error*, etc.

5.13 Oscilloscope

DATA ACQUISITION:

Single Acquisition

Selecting the *Single Acquisition* option, the oscilloscope's behaviour is dependant upon enablement/disablement of a trigger event:

CASE 1: If the trigger event is enabled on rising edge or falling one of signal in Channel 1, the oscilloscope waits for the first trigger event. At trigger arrival the trace is visualized and data acquisition is stopped. To capture a new trigger event it is necessary to start a new acquisition by clicking on the icon ▶.

CASE 2: If trigger event is disabled, the oscilloscope acquires new data, it visualizes it, then it stops. To upgrade the trace it is necessary to start a new acquisition by clicking on the icon ▶.

Continuous Acquisition

Selecting the *Continuous Acquisition* option, the oscilloscope's behaviour depends upon enablement/disablement of trigger event:

CASE 1: If trigger event is enabled on the rising or falling edge of a signal in Channel 1, oscilloscope waits until the first trigger event. At trigger's arrival the trace is visualized and it is updated at each trigger event.

CASE 2: If trigger is disabled, oscilloscope continually acquires new data and updates traces.
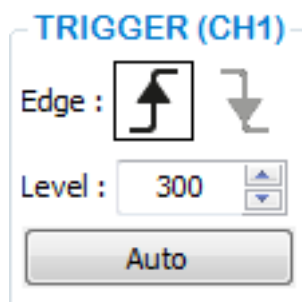
START/STOP DATA ACQUISITION:

It starts data acquisition in both modes *Single* or *Continuous Acquisition.*

It stops data acquisition in Continuous Acquisition mode, or in Single Acquisition mode if there is not a trigger event.

5.13 Oscilloscope

TRIGGER EVENT:

Enabling trigger event it is possible to acquire and visualize the traces only at the occurrence of a definite signal in Channel 1; that signal is characterized by a ring edge or a falling one and by a level (or amplitude). To enabled a trigger event it is necessary:

    1st to set the rising or falling edge (**Edge** icons);
    2d to set the desired level (**Level** parameter).

Clicking the **Auto** button it is possible to disable the trigger event ⇒ the oscilloscope will continue to acquire new data and update the traces.
You should use the **Auto** trigger function:
    • During first acquisition, in order the know the scale of input signals;
    • In presence of low repetitive signal rates;
    • In presence of dc signals.

TIME BASE:
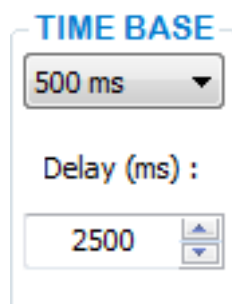
Time Base
This allows you to change the scale of the horizontal axis, the time base. The min. resolution is 1ms/div, while the max is 1s/div.

Delay
If the trigger event is enabled the value set in **Delay** fixes the point, in the horizontal axis, where the trigger event will be visualized; on the contrary, if the trigger event is disabled the value set in Delay is ignored.
The default value set for the Delay parameter is in the middle window.

5.13 Oscilloscope

SIGNAL SETTING:

Channel 1 (View) and Channel 2 (View)
This allows you to select the signal to visualize. The different options are as follows:
- The motor speed: **Speed [rpm]**
- The phase U current: **I_Phase_U [A]**
- The position error: **Posit_Err [Pulses]** (not yet enabled)
- The quadrature current: **Iq[A]**

Channel 1 (Scale) and Channel 2 (Scale)
The unit of vertical scale is automatically set by choosing an input signal:
- **Rpm/div** for speed
- **mA/div** or **A/div** for current
- **Pulses/div** for position error
However, it is possible to change the scale selecting from values in the **Scale** menu.

5.13 Oscilloscope

EXAMPLE: Suppose we want to visualize by digital oscilloscope *motor speed* and *phase current*.

The procedure is described below:

    1- Follow the *base installation procedure* illustrated in the previous chapter.

    2- Open the *Speeder One* interface and connect to the drive.

    3- Select, for example, the operative mode "**Square Wave**", then set a *speed reference* equal to 1000rpm and a *square wave period* equal to 2000ms.

    4- Open the **Oscilloscope** window by clicking on oscilloscope icon.

    5- In the Oscilloscope window set the *initial parameters*:
          a) Select **Continuous Acquisition**.
          b) Trigger ⇨ click on **Auto** button.
          c) Time base ⇨ set to 200ms/div.
          d) Channel 1: View ⇨ select Speed[rpm].
                         Scale ⇨ select 500rpm/div.
          e) Channel 2: View ⇨ select U Phase Current[A].
                         Scale ⇨ select 2A/div.
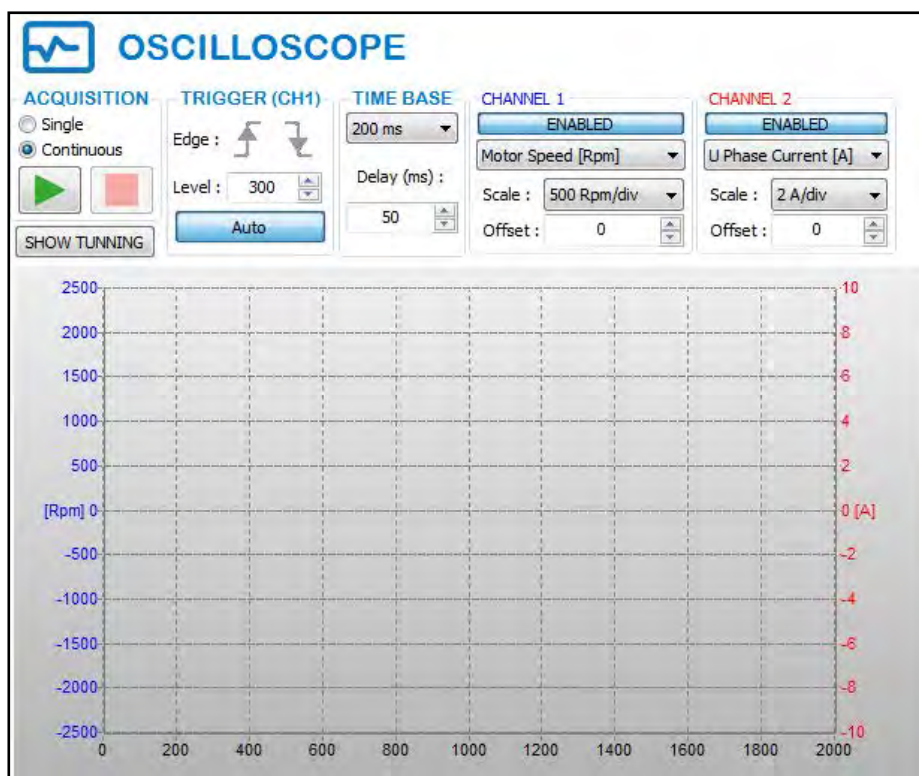
6- Enable the drive by clicking the **Enable** icon.

7- Start data acquisition by clicking the icon ▶. Wait a few seconds in order to acquire traces:
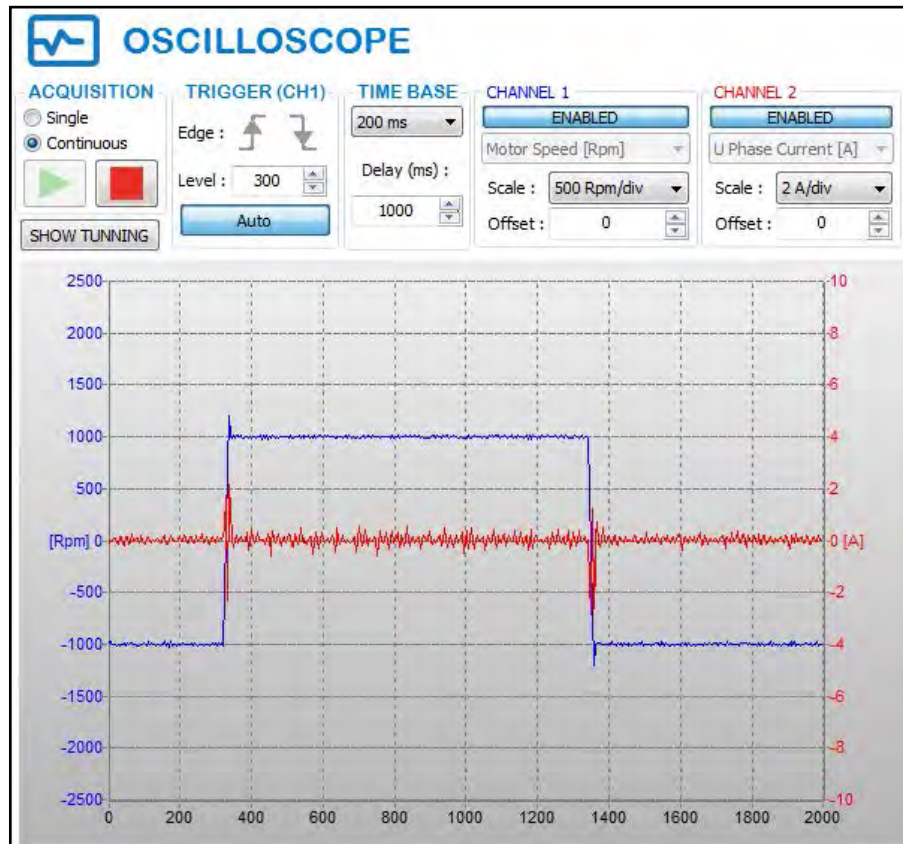
8- **Parameters corrections**:

a) If necessary, *adjust the vertical scale* of speed and current:
   • If the trace overflows the window ⇨ increase the scale.
   • If the trace is too pressed ⇨ decrease the scale.
In the above visualized trace, it is not necessary to change the speed scale nor the current scale.

b) Set the *Trigger* on the rising edge (or falling edge) of the signal in Channel 1, choosing a trigger level based upon the signal to be visualized. Setting a level that is too high will result in no data acquisition.
Having the above visualized traces, it is convenient to set the trigger on the rising edge and with a level equal to 500 (in the range between -1000 and +1000); in fact setting a level too high (>1000 or <-1000) should result in no valid trigger event.

c) If necessary, *adjust the horizontal scale*, *Time Base* parameter:
   • To visualize more periods of input signals ⇨ increase Time Base parameter.
   • To visualize less periods of input signals ⇨ decrease Time Base parameter.
In the above visualized trace, it is not necessary to change the time base.

d) To avoid the continuous trace refresh and to visualize the signal on the first valid trigger event:
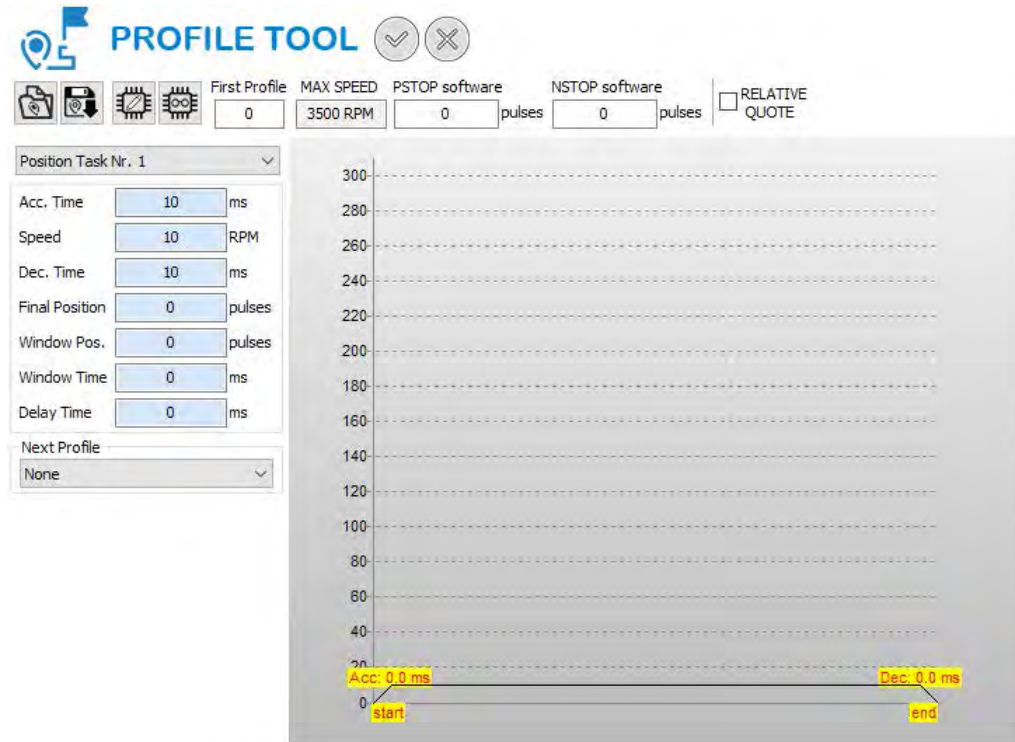   1. Click on icon ■.
   2. Select **Single Acquisition**.
   3. Click on icon ▶.
   4. At each new desired acquisition click on icon ▶.

Doing the adjustments described above, we acquired the traces illustrated in the following:
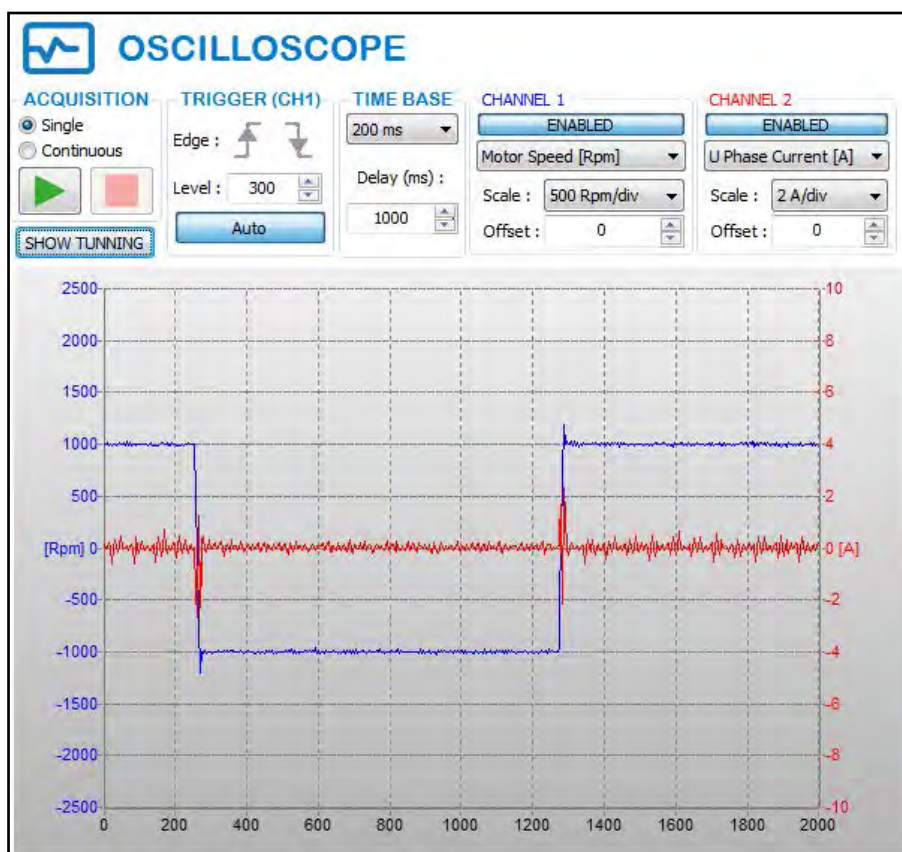
5.14 Profile Tool

In "**Profile Tool**" window it is possible to manage the positioner integrated in the drive:

Final position

It defines the absolute position reference for the selected position profile.
The admitted values are in the range $+/-(2^{31}-1)$. Setting the value 0 means "return to zero position" (the position found during homing <u>only if the Homing Offset was set to zero</u>).
To define the value (approximated at the nearest integer value) that should be inserted, the following formula will be used:

> Final position = n° turns (also not integer) * 65536

<u>Example</u>: We want to start from the position 0 after a successful homing procedure, with a Homing Offset value equal to zero. Suppose that the set task makes a rotation of the motor's shaft of 20 turns and 60° mechanical. First thing is to normalise 60° on 360° and add the obtained value to the number of integer turn: n° of turns = 20 + 60°/360° = 20 + 0,16 = 20,16 after this you must multiply by 65536 the obtained number like as follow: 20,16 * 65536 = 1321642,6 and insert in the Final Position parameter the integer part of the number found, in this case 1321642.

5.14 Profile Tool

Acc Time

It sets the acceleration time value for the trapezoidal profile ramp. This parameter admits values in the range: 10...5000 ms. The time value is refered to the max motor speed, "Speed Limit" parameter set in the "Speed Loop" window, so the real acceleration time related to the profile speed can be found using the following expression:

$$T\_acc \text{ [ms]} = \frac{Speed \text{ [rpm]} * T\_acc\_set \text{ [ms]}}{Speed\_motor \text{ [rpm]}}$$

where: **T_acc** = real acceleration time for the profile ramp;
Speed = speed set for the profile ("Speed" parameter);
Speed_motor = motor speed limit set on interface ("Speed Limit" parameter in the "Speed Loop" window);
T_acc_set = value inserted in the "Acc. Time" parameter.

Dec Time

It sets the deceleration time value of the trapezoidal profile ramp. This parameter admits values in the range: 10...5000 ms. The time value is refered to the max motor speed, "Speed Limit" parameter set in the "Speed Loop" window, so the real acceleration time related to the profile speed can be found using the following expression:

$$T\_dec \text{ [ms]} = \frac{Speed \text{ [rpm]} * T\_dec\_set \text{ [ms]}}{Speed\_motor \text{ [rpm]}}$$

where: **T_dec** = real deceleration time for the profile ramp;
Speed = speed set for the profile ("Speed" parameter);
Speed_motor = motor speed limit set on interface ("Speed Limit" parameter);
T_dec_set = value inserted in the "Dec. Time" parameter;

Speed

It sets the speed reference of the trapezoidal profile. This parameter is limited by "Max Position Speed".

Max Position Speed

It sets the maximum speed allowed for all motion position profiles. It is defined in "rpm" and rappresents the minimum value between 6000 rpm and the motor speed limit ("Speed Limit" parameter on the "Speed Loop" window).

Net Profile

It is the number of the following profile to execute after the quote reached of last task. This parameter is defined for concatenated profiles mode.

Window Pos.

It is the window of position quotes admitted around the sensor position to declare "position reached". It is defined in feedback pulses and can be calculated with the following formula:

$$Window\ Pos = n° \text{ turns (also not integer)} * 65536$$

Window Time

It is the time limit used when the motor is within the position window to set "target reached" indication.
It is declared in "ms" and admits values in the range: 0...65536.

Delay Time

It is the waiting time after the quote reached and after the "Window Time", to declare "position reached".

Note: The **Window Pos**, **Window Time**, and **Delay Time** parameters are utilised to guarantee a good positioning; in fact there are some situations (very high inertia, joint elasticity or belt, etc), where after a positioning there is an oscillation. Setting correctly these parameters it is possible to be sure that these oscillation is contained in a range (Window Pos) for a time over the time set in "Window Time" parameter.

5.14 Profile Tool

PSTOP Software
If the Final Position parameter is greater then the PTSOP Software, the task stops when the PSTOP target is reached.

NSTOP Software
If the Final Position parameter is greater then the NTSOP Software, the task stops when the NSTOP target is reached.

First profile
Set the initial profile, if 0 the drive start the task 1.

Note: Each profile is identified and saved with a number from 1 to 32 (for example "Position Task Nr. 1"), selectable in the dedicated menu on the "Profile Tool" window.

The "**Profile Tool**" window has 4 icons which helps you during the parameter configuration:

Open Profile File

Save Profile File

Load Data from Flash
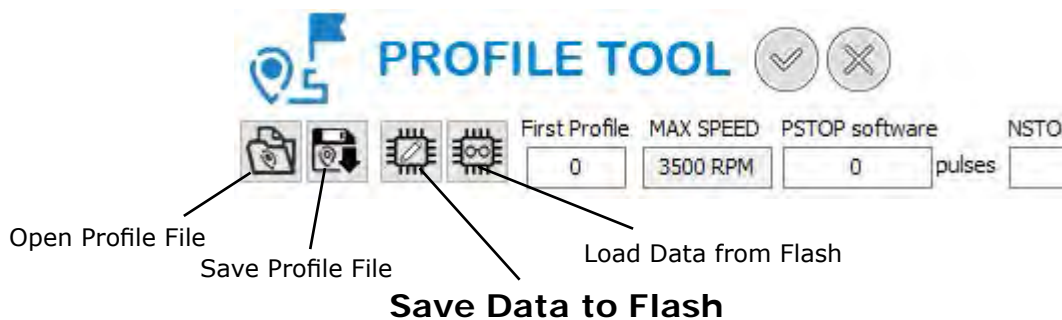
Save Data to Flash

Load Data from Flash
It permits the visualisation of the data saved into Flash. This values can be different from the precedent visualised value, if a saving process has not been performed yet.

Save Data to Flash
It permits to save the parameter into Flash. In this mode the parameter will be loaded automatically at the next power-up.

Save Profile File
It permits to save on a file the parameters set in the "Profile Tool" window.

Open Profile File
It permits the loading of the parameters saved on a file.

Note: The functions **Save Profile File** and **Open Profile File** are very useful if you want to configure more than a drive with the same setup.
In this case you can configure all parameters on a drive, save in flash and save the setup on a file.
For other drives it is not necessary to configure one by one the parameter of the single task but you can use the file saved before and load the parameter saved on the file. After this save the parameter into flash.

5.15 Diagnostic

This window allows you set all the parameters (advance mode):

DIAGNOSTIC

Descritption	Address	Min.	Max.	Read (decimal)	Read (hex)	Write
Drive Address	2	1	32767	1	0x0001	
Baud rate Rs485	3	0	32767	1152	0x0480	
Baud rate Can	4	50	1000	500	0x01F4	
CAN_CW	5	-32768	32767	0	0x0000	
CAN_SW	6	-32768	32767	5200	0x1450	
Nr. of motor poles	7	-3	56	8	0x0008	
Nr. of resol. poles	8	2	12	2	0x0002	
Encoder pulses/turn	9	1	8192	2500	0x09C4	
I2T motor	10	0	999	0	0x0000	
Phase angle	11	0	3600	384	0x0180	
Feedback type	12	0	20	4	0x0004	
I rated	13	1	50	26	0x001A	
I max	14	1	150	100	0x0064	
Kp current Iq	15	0	999	8	0x0008	
Ti current Iq	16	0	999	18	0x0012	
Analog In 1 Filter	17	0	1000	0	0x0000	
Kp current Id	18	0	999	0	0x0000	
Ti current Id	19	0	999	0	0x0000	
Fair_Fiera	20	-32768	32767	0	0x0000	
I2T drive	21	0	999	500	0x01F4	
Analog In 2 Filter	22	0	1000	0	0x0000	
Kp speed	23	0	2000	200	0x00C8	
Ki speed	24	0	2000	100	0x0064	
Kd speed	25	0	32000	200	0x00C8	
Feedback filter	26	0	999	0	0x0000	
Reference filter	27	0	999	0	0x0000	

5.16 Save/Load

This window allows you to:
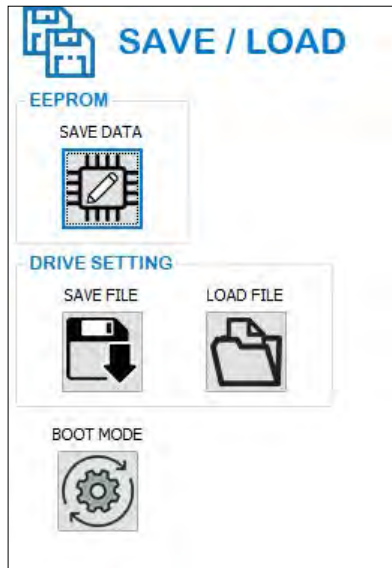
SAVE DATA
Save the drive configuration in the Eeprom permanently.

SAVE FILE
It allows you to save the drive configuration in a file on your PC.

LOAD FILE
It allows you to load the drive configuration from a file on your PC.

BOOT MODE
Put the drive in BOOT MODE.

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 **EC Directive on EMC** (**2004/108/EC**).

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.

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