MICROPHASE
Technology & Performance

TRACTION DRIVE BLDC

Servo Amplifier for Brushless Motors

CE

RoHS compliant

Servoamplifier

for

Brushless Motors

Service Manual

Declaration of conformity

<div>

DC & BLDC SERVODRIVES

Product name: DC1C-XXX
                         DC1L-XXX
                         SP1-XXX
                         SP1L-XXX
                         MCD1-XXX
                         TRXL/B-XXX
                         TRXL/C-XXX
                         MUDR-XXX

</div>

Manufacturer: MICROPHASE s.a.s.

Address: Via Palladio 23
               36051 Creazzo (VI) Italy

MICROPHASE s.a.s. assures that the drives listed above meet the following European Norms Standard:

in accordance with EC Directive 2014/30/EU (EMC Directive)

EN 55022, EN 61000-4-2

in accordance with EC Directive 2014/35/EU (Low Voltage Directive))

EN 61010-1

<div>

WARNING - Risk of damage and/or personal injury

This drives doesn't contain any user serviceable part. Attempting to replace any internal component, may result in damage to the unit and/or personal injury. This may also avoid the warranty.

</div>

Print in Italy rev.08/2017

CE   RoHS 2002/95/EC   RoHS COMPLIANCE

Index

1.1 Safety and note

Caution

Users must keep well clear in mind that this motion control equipment is capable of producing high forces and rapid movement so they must be used with attention especially during the application program's development.

This motion control equipments are sold as end-users products to be installed only by practical staff in accordance with all local safety laws and regulations. The device have to be enclosed such that any part is not be accessible while the system is powered on.

We strongly reccomend to follow these recommendations in order to avoid wrong uses of the equipment that may be impaired all the protections provided by the device.

Please read these notes carefully before powering up the drive

It is very important meet all applicable safety requirements during installation and operating of any motion control equipment. Any installer has to assume the responsibility to ensure that he recognizes and complies all the relevant safety standards. Any installation, not meeting the safety requirements, may damage the equipment or injury the user.

This motion control equipment shoul be handled, installed, setted-up and maintenanced only by competent personnel expert and trained in the installation of motion control electronic equipment. Such technicians should be aware of potential electrical and mechanical hazards. Shall never beliable or have any responsability if the products have been improperly stored, installed, used or maintened, or if the costumer has permitted any unauthorized modifications, adjustments, and/or repairs to the products.

Simbols security standard

Warning of dangerous current present
In case of doubt or in any case you don't know as to behave yourself, before access to the drive, power off the device and wait until all the leds are turned off.
May you have attention when you touch the drive because it may be hot.

Danger Sign
All the circuits in the Drive are potential sources of severe electrical shock, so follow these rules to avoiding possible personal injury.
- Power off the drive and wait until all the leds are turned off before touching, removing, connecting or any other critical action.
- Never disconnect any connectors before powering down the drive

1.2   Operation mode and feedback

Description

This is a drive capable of piloting both rotary **BLDC brushless** motors
motors, up to 5Nm. It's a High Performance full four quadrant drive. The mosfet output power stage is controlled by a 20 Khz PWM (Pulse Width Modulation) signal that allows it to drive servo motors where high dynamic performance and precise speed is required.

Operation mode

DESCRIPTION		
SPEED CONTROL INPUT	It is speed piloting using an analogue reference (differential or common mode)	STANDARD
TORQUE CONTROL INPUT	It is torque piloting using an analogue reference. This function allows you to control the current from the drive.	STANDARD

General characteristic

DESCRIPTION		
START INPUT	Start input, enable the drive with range from >9Vdc to +30Vdc (min/max)	STANDARD
FAULT OUTPUT	Fault drive, open collector output 50mA max. (Normally closed, opens when in protection mode)	STANDARD
2 ANALOG OUTPUT	1 motor velocity monitor "TEST", with range +/-8 Vdc output 1 current monitor "CURR", with range +/-8 Vdc output	STANDARD
LED INDICATOR	Four LEDs are located just in front of the potentiometers and show the current state of the drive	STANDARD

Velocity feedback

Closing the velocity feedback loop to motor may be done in several different ways to accommodate most applications. This types of velocity feedback are available with these Brushless or DC motors.

• BLDC Brushless motor with Hall effect + encoder
• BLDC Brushless motor with Fa-coder
• BLDC Brushless motor with only Hall effect (internal PWM Armature)

1.3   Model and size

Model available

POWER SUPPLY		
Model 12	8 - 28 Vdc*	14Vdc**
Model 24	17 - 54 Vdc*	24Vdc **
Model 48	17 - 54 Vdc*	48Vdc **
* Power supply min/max **Typical		

The power supply voltage has to be a transformer-isolated voltage or battery

Size available

CURRENT		
Size	Rated current (A)	Peak current (A)*
20/40	20	40
30/60	30	60
40/80	40	80
*Peak current during 2 sec		

Specifications

TECNICAL DATA CHARACTERISTICS	
Supply voltage output	0,9 Vdc Input
PWM frequency	20Khz
Operating temperature	0/+45°C
Storage temperature	-10/+70°C
Drift analog input	0,5uV/°C
Analog inputs (+/-VEL)	+/-10Vdc max, impedance 20Kohm cad.
Current monitor output (CURR)	+/- 8Vdc = Peak current
Velocity monitor output (TP1)	+/- 8Vdc = max velocity
Power supply output (+5V)	+5Vdc max 130 mA
Power supply output (+/-9.8V)	+/-9.8Vdc max. 4mA
Encoder max. frequency	300Khz with level $\geq$+2,8/24Vdc min/max
Fault drive output	NPN 50mA max.
Start input (Enable)	$\geq$+9V/+30Vdc (min/max)
Band width (current)	2KHz
Band width (velocity)	150Hz
Minimum Inductance motor	200uH
Weight	0,6kg
Contaminants	2° or better (Norms EN60204 e EN50178)
Altitude	Up to 1000m without restrictions, from 1000 to 2000m power derating 1,5%/100m
Flammability rating 94V-0	Cover material, the PCB and the electronic component meet 94V-0

1.4 View product

(1)   Dip switch

(2)   Adjustement zone

(3)   Calibration Potentiometers

(4)   Leds

(5)   Test point TP (Tacho test point)

(6)   M1 Signal terminal 16 pins MC1,5/16-ST-3,81 (pitch 3,81)

(7)   M2 Power Terminals 5 pins GMST 2.5/5-G-7,62 (pitch 7,62)

(8)   Fixing screw

(9)   Product Cover

(10)   Product ID Label

(11)   Fixing brackets

1.5   Ambient conditions
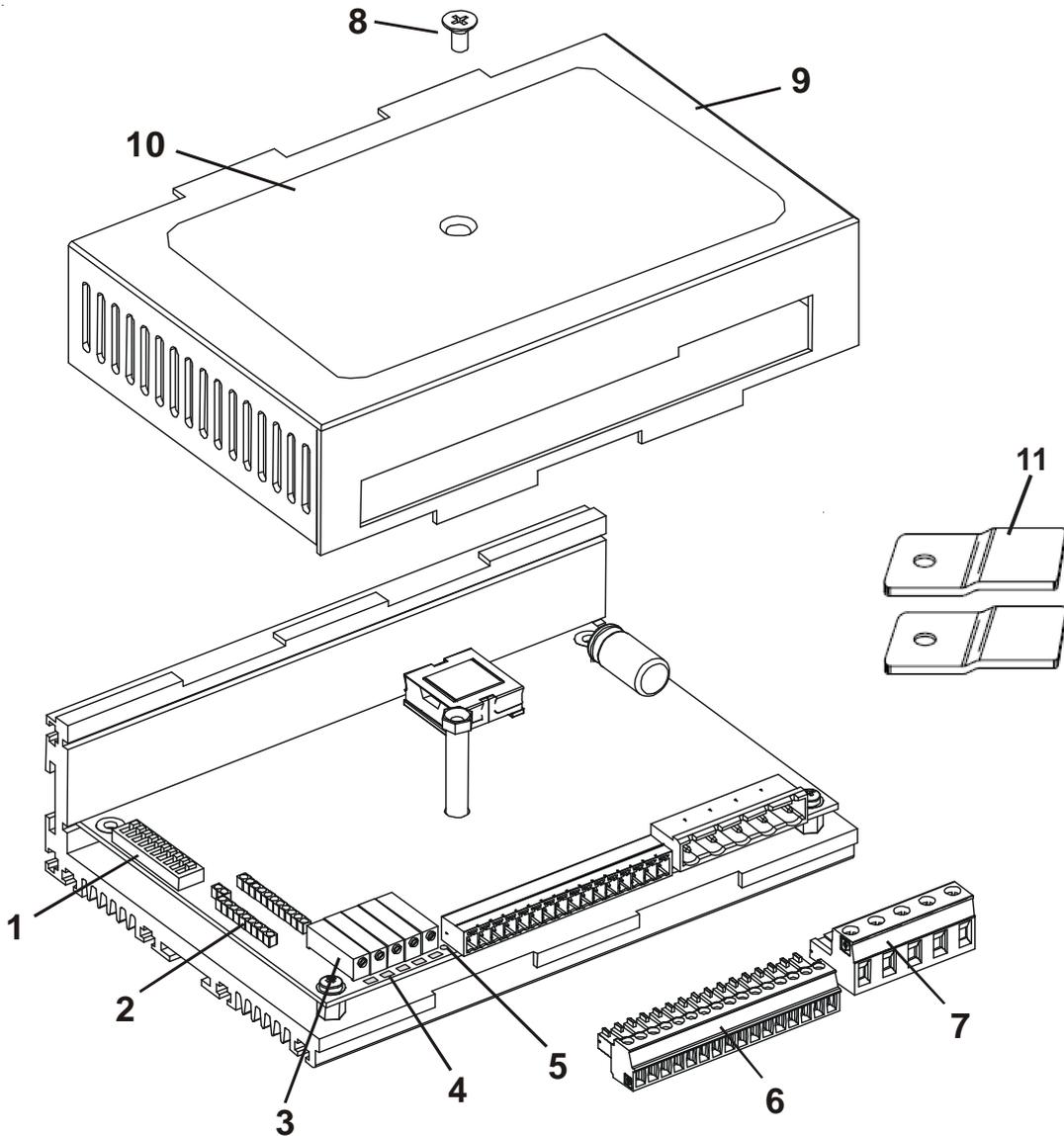
Dimensions are expressed in millimeters.
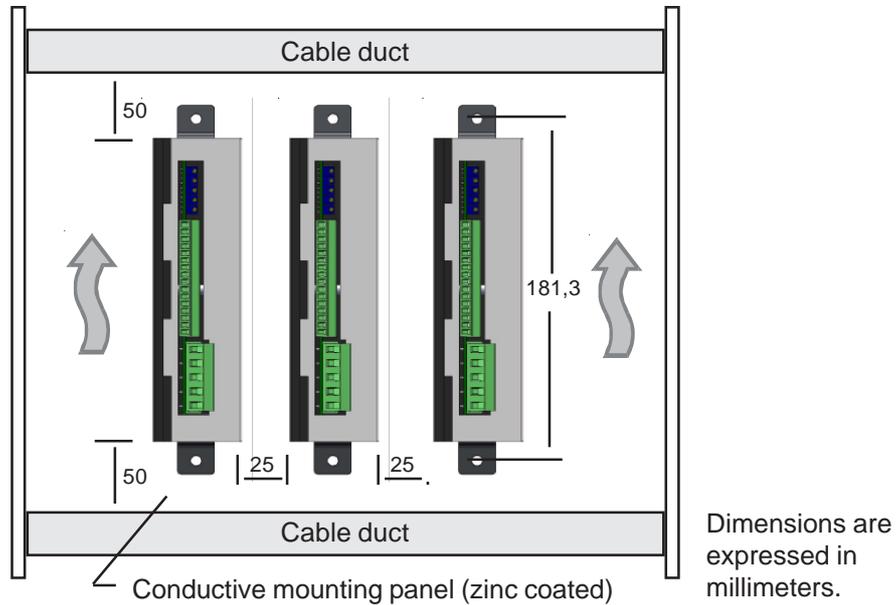
Positioning in the electrical box

Follow the instructions in the positioning of the servodrive in the electrical box.
- The drive is natural convection air flow cooled.
- To ensure the drive cooling and make the installation easier for the operator it must be installed vertically leaving a free space of at least 25 mm on each side of the device. The converter must be mounted vertically on the electrical box. In case you want to mount it horizontally, remove the cover.
- The electrical box must have suitably filtered air vents.
- Leave the necessary space both above and below the converters.
- Keep the drive from excessive mechanical vibration

Notes during the assembly

Caution: during the wiring of the servodrive in the electrical box, make sure that do not enter leading wires of copper or iron chips through the slits. Before performing the work cover the holes with a piece of paper tape. Naturally finished work this tape is removed.

1.6   Ventilation

This servodrive are intended only for use in close locations. Ambient characteristics: operating temperature from 0 to +40°C. Humidity limit s between 5% to 95% non condensing (Pollution degree 2 or better).
Supplementary ventilation may be requested in accordance to size. See the table below.
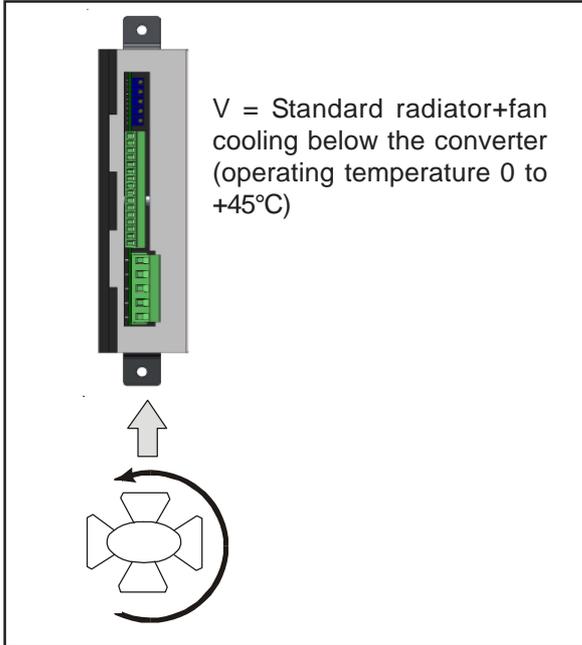
SIZE			
MODEL	20/40	30/60	40/80
12	N	N	N
24	N	N	N2 (V)
48	N	N2 (V)	V

N = Standard radiator (operating ambient temperature from 0 to 40°C)
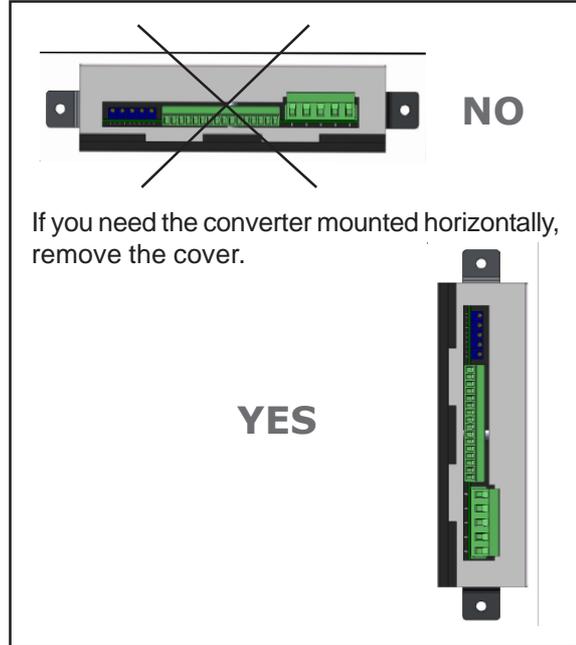N2 = Standard radiator (operating ambient temperature from 0 to 30°C)
V = Standard radiator + supplementary ventilation (operating ambient temperature from 0 to 45°C)
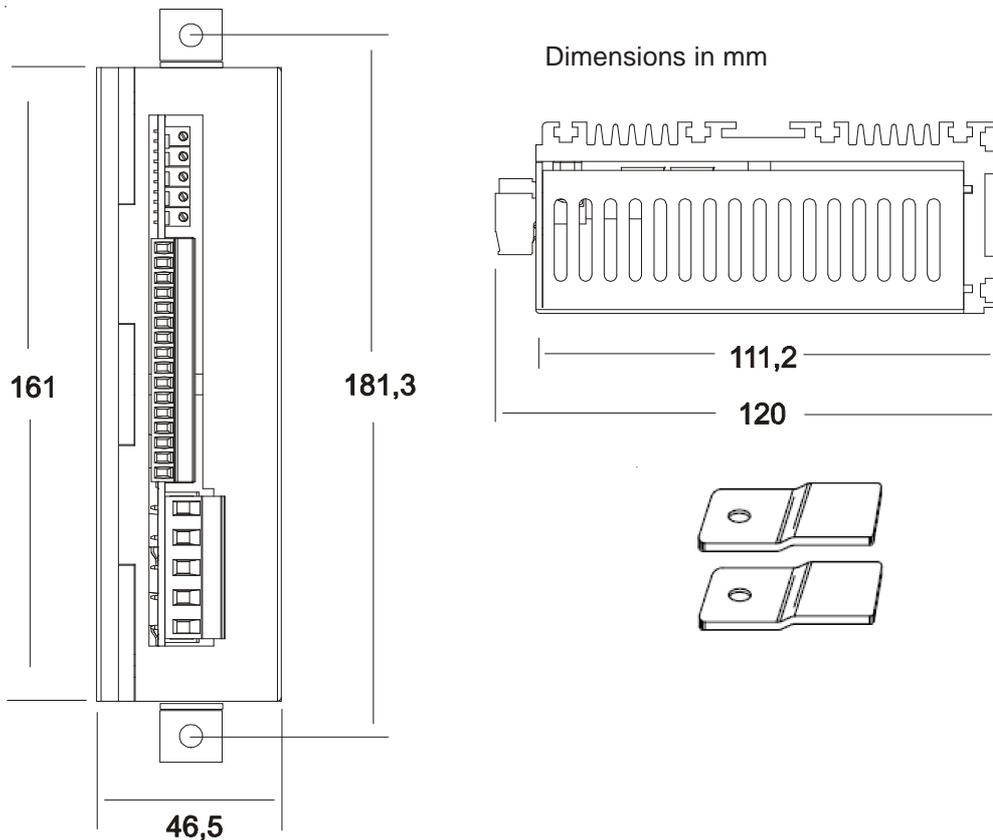
Supplementary ventilation

V = Standard radiator+fan cooling below the converter (operating temperature 0 to +45°C)

Mounting position

NO

If you need the converter mounted horizontally, remove the cover.

YES

1.7 Mechanical dimensions

161

181,3

46,5

Dimensions in mm

111,2

120

1.8   Signals input and output

The figure below shows the view of the converter terminals.

M1 Signal terminal 16 pins "type MC 1,5/16-ST-3,81"
POWER Terminals 5 pins "type GMST 2,5/7,62-G-7,62"

On the test point "TP1" you can see the signal of velocity speed. The output from 0 to + /-8V is from zero to maximum speed. At this point you can analyze the signal when you enable one of the following velocity feedback.
• Encoder
• Armature

NOTE: Depending on the type of motor to drive **"Brushless BLDC"**, follow the links relating to such applications.
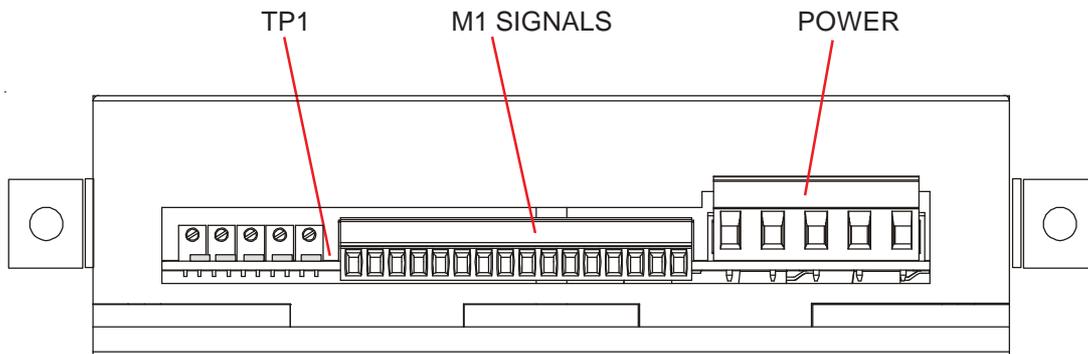
Power connector

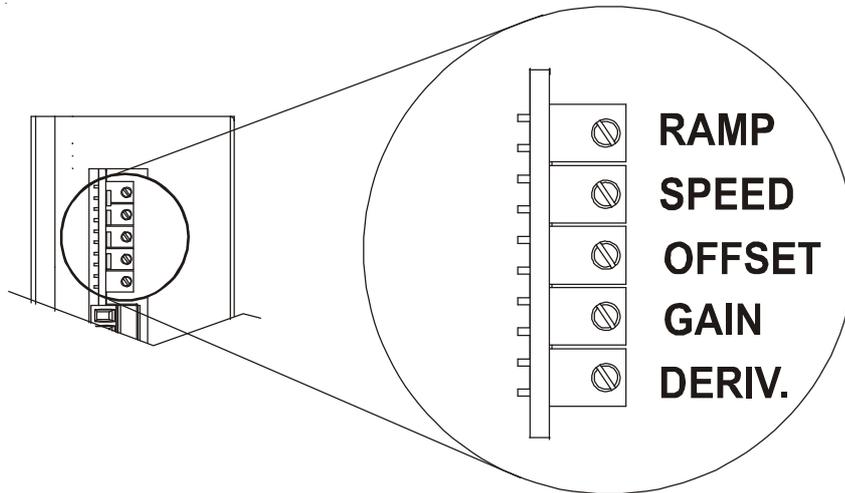| POWER	
+HV (IN)	Positive Power supply input
GND (IN)	Negative Power Supply input (GND)
U (OUT)	Motor connection U phase
V (OUT)	Motor connection V phase
W (OUT)	Motor connection W phase

NOTE: See also the connection diagrams in Chapters 2.X

Signal inputs and outputs

M1 CONNECTOR	
1 CURR	Current motor monitor (OUT): +/-4Vdc=Rated current, +/-8Vdc=Peak current output in Volts. This output may be used to monitor the torque the motor is producing (Standard setting)
2 FAULT (OUT)	Fault drive, open collector output max. 50mA **Normally closed, opens when the drive in protection mode**
3 REQ	REQ:, can be used in 2 distinct modes: 1) Motor Current limit mode (by REQ setting): A motor current limit mode connect an external resistor to GND reduces the maximun current. Connect a 1/4W o 1/8W resistor between the TPRC (pin 3) and GND (pin 4) terminals. A 47Kohm external resistor reduces the current by 50%. (Note: The drive velocity loop remains active) 2) Torque request (by REQ setting): Range: +/- 10V, which corresponds to the drives peak current output. In this mode the velocity loop is automatically disabled.
4 GND	Signal Common Ground Corrisponds to power supply's negative GND input
5 +10V (OUT)	Power supply +10Vdc max 4mA
6 –10V (OUT)	Power supply –10Vdc max 4mA
7 START (IN)	Positive drive enable with range $\geq$+9Vdc min. to +30Vdc max
8 +VEL (IN)	Reference Positive differential input (Velocity command)
9 -VEL (IN)	Reference Negative differential input (Velocity command)
10 ENC A (IN)	Encoder input Channel A (High logic level from $\geq$2,8V to +24Vdc max. Low logic level $\leq$1,5V).
11 ENC B (IN)	Encoder input Channel B (High logic level from $\geq$2,8V to +24Vdc max. Low logic level $\leq$1,5V)
12 +5V (OUT)	Power supply +5V max. 130mA
13 GND	Signal Common Ground. Corrisponds to power supply's negative GND input.
14 HALL 1 (IN) **15 HALL 2 (IN)** **16 HALL 3 (IN)**	Hall Sensor inputs from the motor. Each input has a pull-up resistor of 1 Kohm to internal +5V (High logic level $\geq$3,2V , Low logic level $\leq$1,5V)

NOTE: See also the connection diagrams in Chapters 2.X

1.9   Potentiometer adjustements

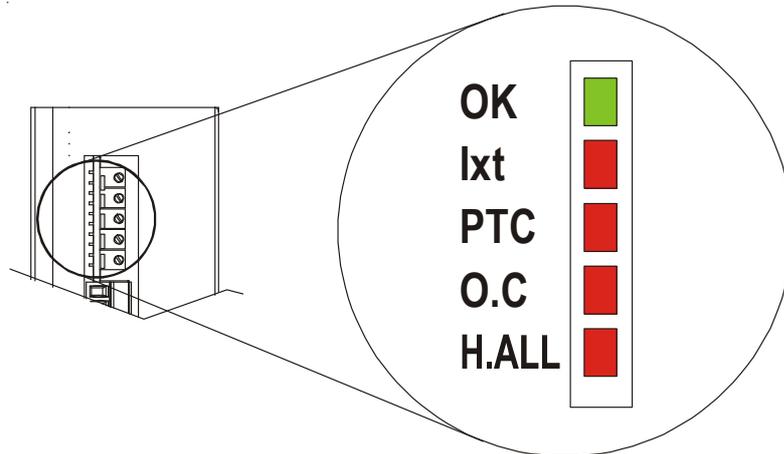The converter is equipped with 4 trimmer with the following meanings:

FUNCTION	
RAMP	**Ramp adjustement.** The dip switch 4, 5 and 6 select the acc/dec function (ramp). With this potentiometer we can adjust the slope of the acceleration and deceleration ramps. Turning the potentiometer clockwise (cw) increases the ramp time from 0,1 to 1 Sec (with 10 V input velocity).
SPEED	**Motor fine speed calibration.** With rotating clockwise (CW) or counterclockwise (CCW) is possible increase / decrease the speed of the motor with range + / -25%
OFFSET	**Offset adjustment.** Allows the balance to zero motor speed. Adjust this potentiometer to cancel any motor speed offset when the Velocity input is zero. (Max Velocity compensation +/- 250mV).
GAIN	**Gain potentiometer.** This adjustment improves the dynamic behavior of the motor. With a clockwise (CW) we increase the readiness and response of the motor. With a clockwise turn (CW) we increase the gain of the PI "internal speed loop".
DERIV.	**Derivative potentiometer.** Acting in a clockwise (CW) can dampen any oscillations of the motor due to a high moment of inertia of the load.

NOTE:
- In Chapter 3.5 explains how to dynamically tune the motor by acting on the 2 trimmer GAIN and DERIV.
- All potentiometers are disabled in Torque mode

1.10 Indicator Leds and protections

The protections are all displayed by five LEDs on the front of the drive. It also comes with a series of protections designed to safeguard in case of malfunction, the drive and the motor.

FUNCTION	
OK GREEN	**Normally ON.** Indicating the proper operation of all functions. It turns OFF in case of any anomaly "except protection intervention IxT". The faults that affect this LED are: Over/Under input voltage. Over temperature (PTC). Short Circuit (O.C), outputs shorted to each other or to ground or missing Hall.
IxT RED	**Normally OFF.** This indicator is lit if the converter exceeding the limit calibration of the rated current of the motor. When the current drawn back under the nominal pre-set, the alarm will auto resets and the LED turns off by itself.
PTC RED	**Normally OFF.** This indicator is lit when the internal temperature of the drive reaches 75℃ . Remove power and wait for the drive to cool before re-applying power. The operation causes the blocking of the drive and the storage of the alarm. NOTE: A fan, heat sink or air conditioner may be needed to remedy the problem.
O.C RED	**Normally OFF.** Indicates that between the motor terminals and/or ground, has been a short circuit. The operation causes the blocking of the drive and the storage of the alarm. Remove power supply and examine the motor connecting leads for shorts, before re-powering the converter to reset the alarm.
H.ALL RED	**Normally OFF.** If lit Indicates that the Hall signal is missing, or is missing the power supply +5V. Check the Hall signals with a voltmeter or an oscilloscope.

In chapter 3.6 it explains the possible reasons for the alarms of the converter.

1.11 Internal adjustement

If changes need to made to the internal drive setting powering, please wait at least 30 seconds after the power has been removed and the OK LED is off.
All of the personalizations are located inside of the DRIVE. (See figure above)
To gain access to the <u>adjustment pads</u> and the <u>Dip switch</u>, unscrew and remove the cover.

Dip swicth standard configuration

DIP SWITCH standard position are setting by factory for:
- Encoder feedback
- BRUSHLESS motor
- Ramp time disabled
- Standard Dynamic constant

| Dip 10: Closed (ON) |
| Dip 9:   Closed (ON) |
| Dip 8:   Closed (ON) |
| Dip 7:   Closed (ON) |
| Dip 6:   Closed (ON) |
| Dip 5:   Open (OFF) |
| Dip 4:   Open (OFF) |
| Dip 3:   Open (OFF) |
| Dip 2:   Closed (ON) |
| Dip 1:   Open (OFF) |
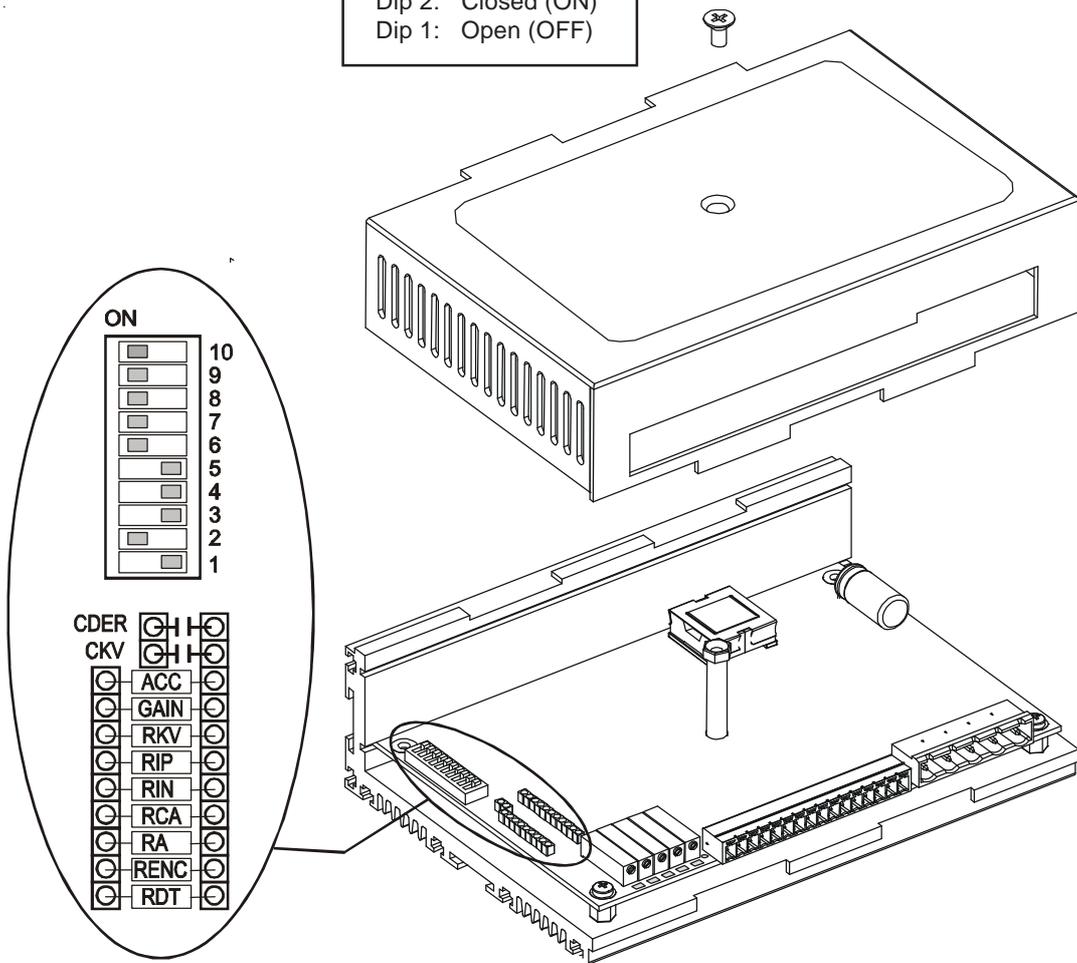
Note: In the various configurations with **Brushless** motor (see Chapters 2)
In the left-hand page for each chosen velocity feedback, is shown a typical connection with the notes of wiring of the converter.

Adjustement zone

| FUNCTION	
RDT	Tachogenerator resistor adjustement
RENC	Encoder resistor adjustement
RA	Armature resistor adjustement
RCA	Droop compensation for internal motor resistance (RI)
RIN	Rated drive current resistor
RIP	Peak drive current resistor
RKV	Resistor value that respectively form the proportional/integral network of the velocity Loop gain. Disabled by opening dip switch 7. Standard value is 100k.
GAIN	Changes static gain in the velocity loop. Open Dip switch 8 and insert RGAIN if a change is required. Consult factory for the correct value.
RACC	Resistor for setting acceleration time function. See Chapter 3.4
CKV	Capacitor value that respectively form the proportional/integral network of the velocity Loop gain. Disabled by opening dip switch 7. Standard value is 47nF.
CDER	Derivative constant capacitor, increases the velocity loop derivative constant. Consult factory for the correct value.

Dip switch

Note: For any feedback available, are listed in the various chapters related settings (see Chapter 2)

DIP SWITCH	
1	**Normally open (OFF).** *If closed* (ON) enable armature feedback.
2	**Normally closed (ON)**. *If open* (OFF), the alarm protection for missing Hall Effect Signals will not disable the drive.
3	**Normally open (OFF).**
4 and 5	**Normally open (OFF).** See Chapter 3.4 "Ramp time adjustment"
6	**Normally closed (ON)**. See Chapter 3.4 "Ramp time adjustment"
7	**Normally closed (ON)**. If Open , install components in the adjustment zone, for the dynamic velocity value CKV and RKV. (Standard value RKV=100Kohm , CKV= 47nF).
8	**Normally closed (ON)**. If Open you must insert the GAIN resistor. (Static Gain). Standard value= 27 ohm
9	**Normally closed (ON)**. In this position the pin (10 CHA) "M2 connector" is set for encoder input .
10	**Normally closed (ON)**. In this position the drive is set is for the encoder feedback. If Open (OFF), are enable other type of feedback.

2.0   *Power supply construction*

Normally the power supply is built by a transformer, a bridge rectifier and a filter capacity. Alternatively, the power supply can also be of switching type, in this case refer factory by the appropriate sizing. The converter have to be supplied from an isolating rectified transformer secondary or a DC isolated power supply.

Transformer
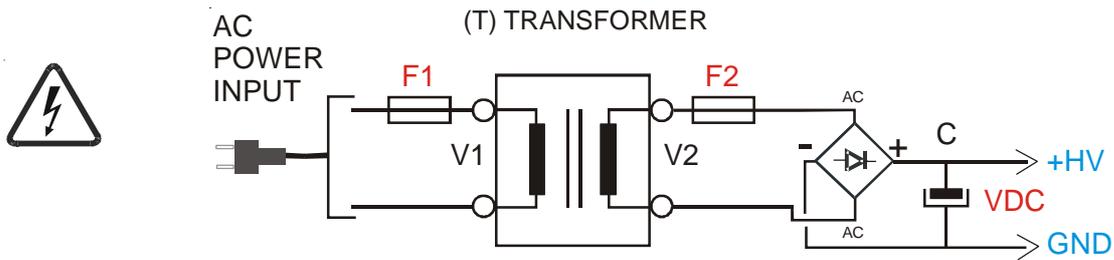
Voltage:
The primary voltage depends on what is available locally for a single phase. The secondary voltage is calculated from the motor's voltage at the required operating speed.
The secondary voltage VDC is:

$$VDC = V2 * 1,41$$

Example: If the secondary transformer V2 is 24Vac, the VDC output is 24*1,41=34Vdc

PAY ATTENTION:
- The drive has zero signal GND in conjunction with the zero power GND, thereby preventing the following links:
- Use a standard heavy duty power transformer without center taps on the secondary as shown in the schematic above.
- DO NOT USE AN AUTO TRANSFORMER.

Power transformer (T)

The transformer's nominal power is calculated based upon the sum of power from the single motors driven:

$$P(VA)=Pn1+Pn2+..$$

$$Pn\ Motor = N \ * \ Cn / 9,55$$

Where: **Pn Motor** =   Power absorbed motor in (W)
                N   =   Max. speed of motor in RPM.
                Cn   =   Nominal torque of motor in (Nm).

Note: In multi-axis applications, the transformer's power can be downgraded by 30%. If the max. power transformer calculated is over 6KVA contact the factory.

Voltage motor

If the secondary voltage of power supply is VDC, the Vdc motor is calculated by the formula:

$$VDC = Vdc\ motor / 0,83$$

Where the Vdc motor is a sum of FCEM + the drop R*I for the winding resistance motor

$$Vdc\ motor = E+(Ri * In)$$

The FCEM of the motor "E", may be calculated by the formula:

$$E = Ke * N° / 1000$$

Example: Brushless motor with the following data:

In =18 (A)
Ri = 0,2 (Ohm)
E=36 (V) at nominal speed 3000 (RPM)

Vdc motor = 36 + (0,2 * 18) = 39,6V

VDC =   39,6 / 0,83   = 47,71V

47,7V is the **VDC** voltage request for the power supply. You'll use a transformer with the secondary
V2 = 47,7 / 1,41= 34Vac. When you use the transformer with V2= 34/36Vac, it is correct.

For application from battery use type 48V

Misure unit:
E   = Ke *n°/1000 (Vdc)
Im = I motor (A)
Ri = Winding resistance (Ohm)
Ke =Voltage constant (V/kRPM)
n° = MAX speed (RPM)

Capacitor filter (C)

In regards to the capacitor filter we suggest a working voltage of:
*63VDC for Model 12 - 24 - 48
Tipical value is from 4700uF to 10.000uF

Capacity above the filter effect, helps to recover energy during braking of the motor.
If the converter during braking has the green LED that flashes you must increase the value of the
capacitor (eg. 10.000uF from a 20.000uF)

For application from battery is not necessary use a capacitor.

Fuses (F1) e (F2)

Fuses are required on both the primary and secondary of the transformer to protect against harm to
the system and the transformer itself. They need to be of the slow blow type to handle current in-rush
at power-up. Locate the primary fuse (F1) on the hot leg of the AC input power and the secondary fuse
(F2) on the + side of the secondary output, before the rectifier.

Primary of the transformer: Use the formula below to calculate the correct values:

F1 (A) = P (VA) trasfo. / V1

Secondary of the transformer: Use the table below

FUSE F2 (A)	SIZE Drive (A)
32	20/40
40	30/60
60	40/80

2.1   Note about connections

Multiple connection

In the case of multiple servodrives on the same power supply, make connections-type stars, see drawing back. Connect also feed converters using the shortest cable possible. If the cable length exceeds 2m, twist the + and - leads together as twisted pairs.
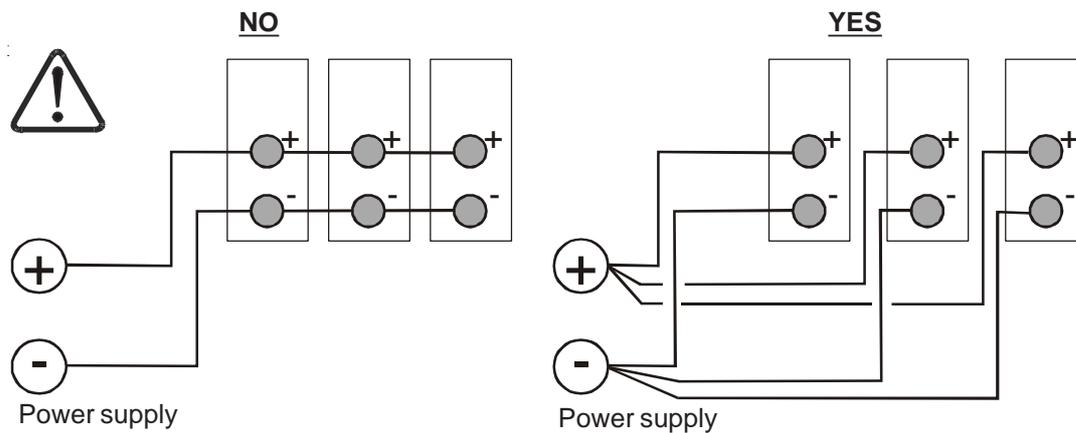
The drives have to be supplied from an isolating rectified transformer secondary or a DC isolated power supply.

EMC note

The conformity is assured only if it is installed following the precise assembly criteria expressed below. The fundamental assembly characteristics are summarized below:

1) The correct ground connection of predisposed parts.

2) Using the division of cables technique. Separate power cables from signal cables.

3) Use of shielded cables, both for power connection (to the transformer and the motor), and for signal connection (also to the controller).

4) Use of appropriate network to filter the line (transformer input), from disturbances conducted or produced by the drive. (series of filters released are available for this purpose)

2.2   Connection to earth and ground

Make sure that the servodrive and the motor are connected to earth in accordance with the current norms. This connection must be done by using a copper bar, mounted on insulating supports:

L bar	Bar's section
0,5 .. 1m	30 x 5 mm
1..2m	40 x 5 mm
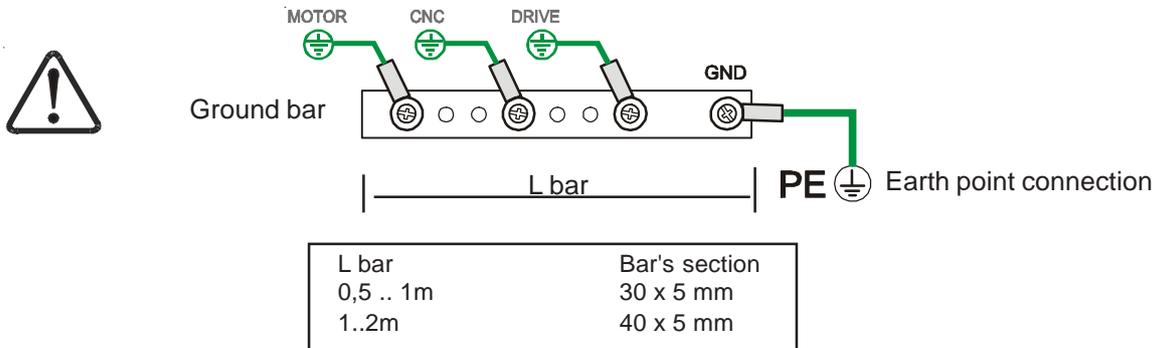
then follow these indications:

1. Connect to the ground bar:
   the internal "0V" zero voltage of the CNC;
   the earth terminals of the PLC/CNC frames;
   the "0V" of the auxiliary supply;
   the CHASSIS of all drives;
2. Connect the ground bar to the zinced panel of the drive by using a screw, then connect that screw to earth.
3. Connect earth to the motor's

 It suggests a conductive connection as much as possible to the chassis, or the heatsink, or the mounting panel of the electrical box.

 It refers to the earth connection.

Motor and Power cable (as norm EN60204)

SECTION	SIZE (A)
2,5mm^2/ 13-14AWG	20/40
4mm^2/ 11-12AWG	30/60
6mm^2/ 9AWG	40/80

Control signals cable (as norm EN60204)

SECTION
0,5mm^2/ 20AWG

Feedback signals cable (as norm EN60204)

SECTION
0,25 - 0,35mm^2/ 22 -24AWG

2.3 Brushless motor with encoder
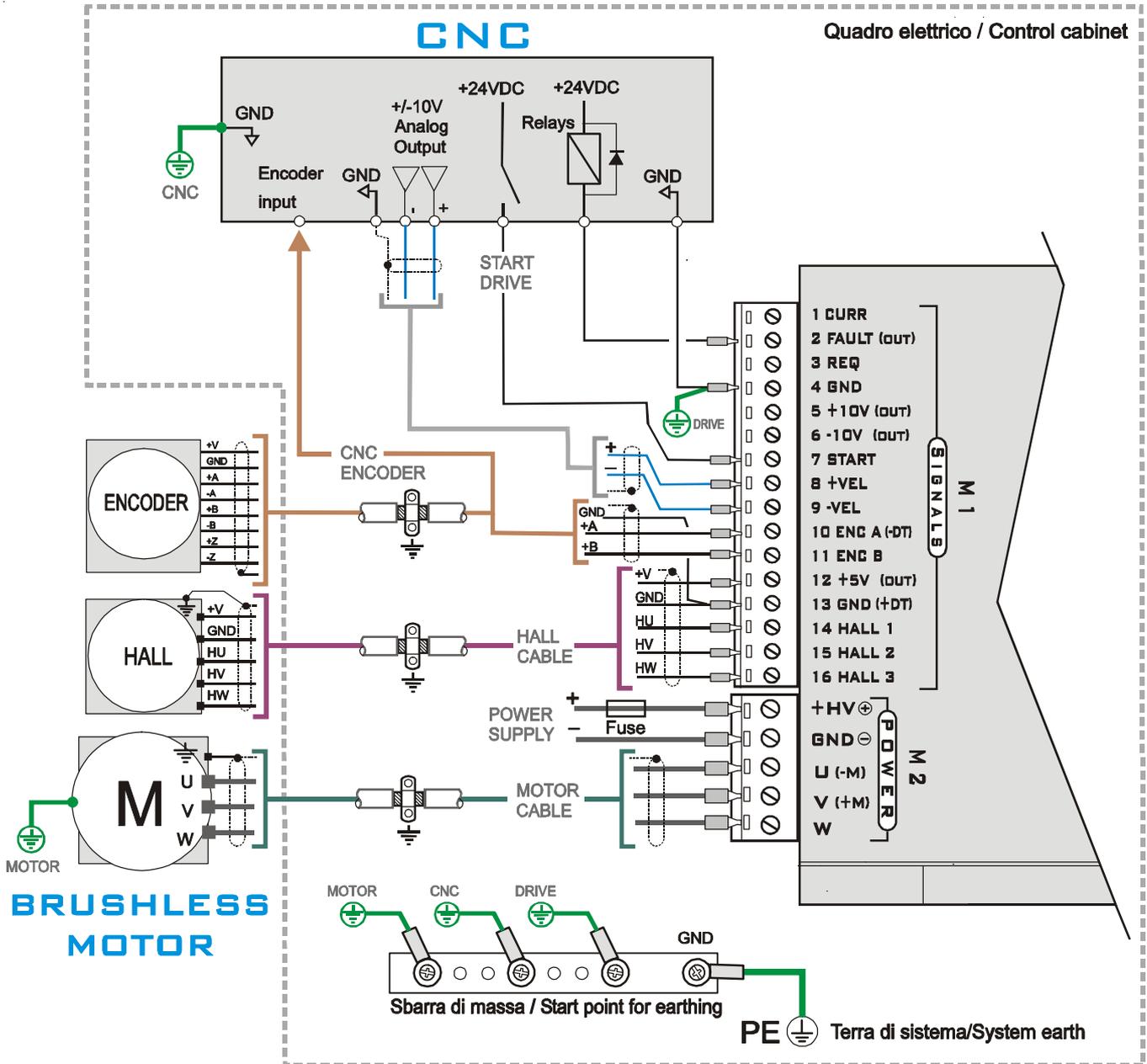
In the figure above is shown a typical connection of the drive in combination with a brushless motor (encoder + hall feedback).

The encoder with line driver output is connected directly to the control. Depart from the control wires A +, B +, GND to the converter (signals in common mode).

In the example the encoder is supply by the CNC, while the hall sensors are supplied by Drive (+V terminal 12).

It also possible to supply the encoder with the voltage present on the +5V of the drive (+V terminal 12), verifying that the absorption of the encoder does not exceed 100mA.

The converter is capable of providing 130mA max (100mA for encoder and 30mA for Hall sensors)

Hall sensors must be supplied using the internal +5V of the Drive (M1 connector 12). If an external supply is used, open dip switch 2

Setting for Brushless motor with encoder

In this configuration, the drive must set with the following dip switch and below internal setting:

DIP SWITCH   ADJUSTEMENTS
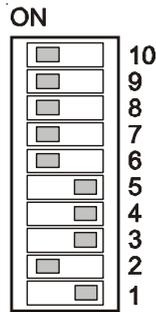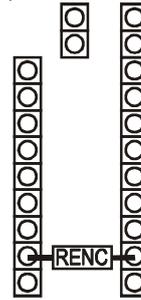
Solder Bridges set for:
- Brushless motor
- Encoder feedback
- Ramp time disabled
- Standard Dynamic constant

Note: On the adjustement zone are not considered here the other components used to determine other calibrations "for example. Calibration current rating etc.".

RENC resistor calculations

The drive is standard set with dip switch 10 closed and the resistance calibration speed RENC already mounted on board "27Kohm" (Calibration for speed = 3000rpm encoder with 10V reference and 500PPR line-count resolution encoder.)
For change this resistance open the drive and calculation the following formula:

RENC = 681*1000 / Fenc

The resistor RENC determine what is the max. speed of the motor at 10V of reference.

Where: **Fenc = PPR * rpm / 60**

Example: N° encoder (PPR) = 500
Motor max. speed 4000 rpm

Fenc = 500 * 4000 / 60= 33.333
RENC = 681*1000 / 33.333 = 20,4 kohm

The result of RENC resistance is 20 or 22 Kohm. Prefer resistance with 1% tolerance.

Once the resistor RENC is inserted, proceed with final speed adjustment.
Operate using trimmer SPEED on the front of the drive. With Clockwise Rotation the *speed increases*. With Counter Clockwise Rotation the *speed decreases*. The Range of regulation is about +/- 20%.

2.4 Brushless motor with hall signals
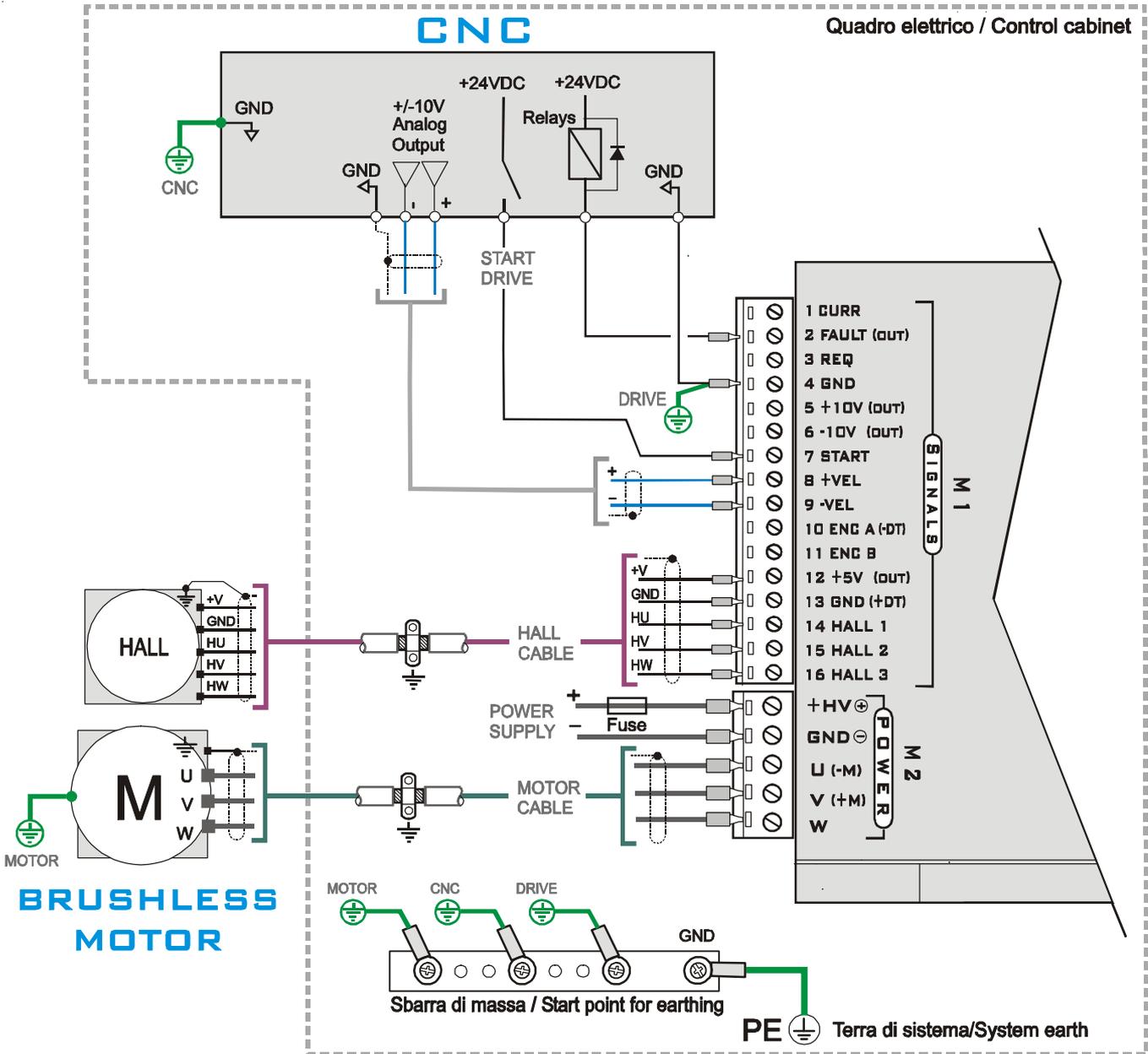
The following diagram shows an tipical application utilizing a Drive with Brushless motor (only Hall signals). These signals are used by the converter for the control of current and to regulate motor speed.

The adjustment range is lower than the use of 'Encoder + Hall, but sufficiently good for many applications.The voltage from the motor armature can be used as feedback when the motor doesn't have an Encoder. This function is enabled by closed Solder bridges below and inserting resistors **RA** and **RCA** on the personalization base. Armature feedback "PWM" gives good speed control along with acceptable torque at low velocity (>15 RPM). This method consider that such a solution is sensitive to Ri dropping inside the motor and can be compensated, however by inserting a compensation resistor **RCA.**

Setting for Brushless motor with hall signals

In this configuration, the drive must set with the following dip switch and below internal setting:

DIP SWITCH   ADJUSTEMENTS
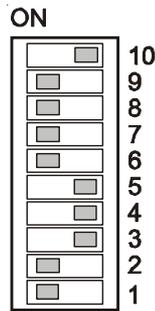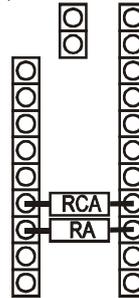
Solder Bridges set for:
- Brushless motor
- Hall feedback (Armature)
- Ramp time disabled
- Standard Dynamic constant

Note: On the adjustement zone are not considered here the other components used to determine other calibrations "for example. Calibration current rating etc.".

RA resistor calculations

Insert on base "RA" to adapt the system to use the motor voltage.

Where: **Vdc = Vrms * 1,41**

Table Vdc voltage   Value of RA in Kohm

RA	82	68	56	47	39	33	27	20	15	12	8,2	5,6	3,9	1
Value	57	53	49	45	42	38	34	28,5	23	20,5	16	12	10	5

Voltage output drive

EXAMPLE: **Brushless motor** with Ke= 10V/Krpm (Vdc)
Nominal speed N° =3000rpm
Risult: Vdc= 10*3000/1000= 30V

For the Example risult Vdc=30V. The table shows a resistor with a value of 27Kohm.

Once the resistor **RA** is inserted, proceed with final speed adjustment.
Operate using trimmer VEL on the front of the drive. With Clockwise Rotation the speed increases.
With Counter Clockwise Rotation the speed decreases
The Range of regulation is about +/- 20%.

Continue..

Setting for Brushless motor with hall signals

RCA resistor calculations

Insert an RCA resistor on the header (ajustement zone) to compensate for voltage loss due to the motor resistance reducing the loss of RPM.
The formula is as follows:

$$\text{RCA (Kohm)} = \frac{0{,}49 * 1000 * Vmot}{Vref * Ipk * Ri}$$

Where:
V= Nominal voltage of the motor
Ri=Max. cold motor resistance.
Ipk =Peak drive current.
Vref= max. applied reference voltage in VEL

Example: Drive 20/40A, Ri=0,2ohm, Vmot=24V, Reference=10V

Calculate: $$\text{RCA (Kohm)} = \frac{0{,}49 * 1000 * 24}{10 * 40 * 0{,}2} = 147\text{Kohm}$$

If after insertion of the resistor (150Kohm) the motor is unstable, increase the Resistance value of RCA.

2.5 Velocity inputs (+/-VEL)

Differential reference

(+/-VEL) This analog in differential mode has a 40Kohm of impedance input.
The following diagram shows an application utilizing a differential reference from a C.N.C
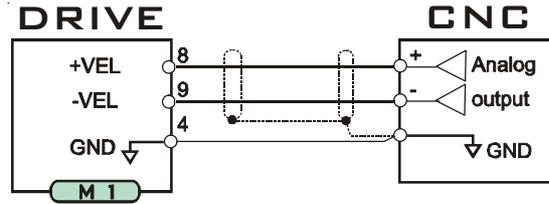
Common mode reference

This analog in common mode has a 20Kohm of impedance input.
The following diagram shows an application using speed reference connections from C.N.C in the Common Mode.
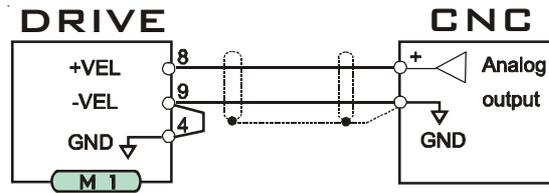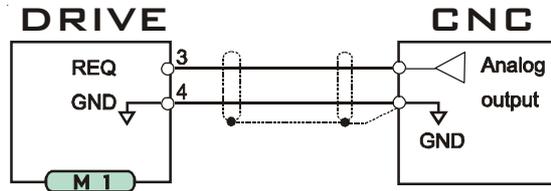

Speed reference from external potentiometer

The following figure shows an application with speed reference connections using an internal +/-10V power supply.
The speed potentiometer must have an included value between >5 and <10Kohm.
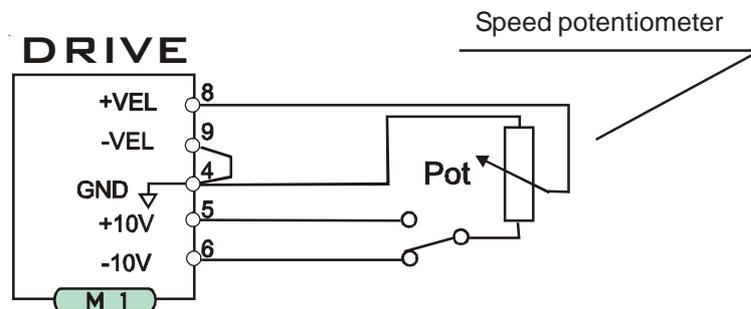
2.6   Current request (REQ)

With a voltage (example from a CNC output) you can command the drive in torque mode.

Applying a signal of +/-10V at REQ, the Drive to supply positive or negative peak current.
The formula to determine the value of Voltage to apply in REQ in order to obtain requested current is the following:

V(REQ) = 10 * Request current / PKcurrent Drive
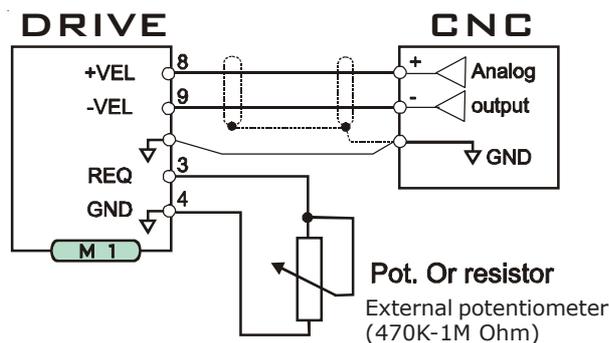
Example: (Drive size 20/40A,   request current 8A)

V(REQ) = 10 * 8 / 40 = 2V

NOTE:
In current reference the loop of internal velocity automatically excludes itself .

Current output limitation

With an external potentiometer connected from GND and REQ input, you have a limitation of output current (from zero to max. size) drive's.

Pot. Or resistor
External potentiometer
(470K-1M Ohm)

The speed ring remains active and uses the input reference signal. In this case the loop of internal velocity remains active.

2.7   Enabling with Start input

The standard drive is furnished in this configuration.
Start enable input has logic range: ≥+9V to +30Vdc (min/max)
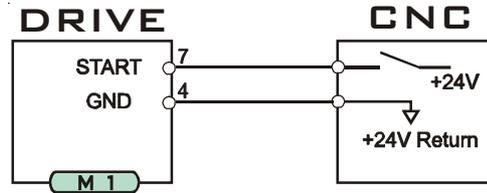
Unconnected Enable input = Drive Not Enabled
Enable Input +24Vdc = Drive Enabled

Is possible enable the drive connected the START input with +10V output "terminal 5"

2.8   Current monitor output

On this terminal is available analog output "current monitor of motor" with range 0V + /-8V. The value of 8V is the maximum current supplied by the drive. For example, if we have a size 20/40A, 8V corresponds at 40A circulating in the motor.
The signal can be positive or negative depending on the direction of rotation of the motor.

Output Impedance is 10Kohm. Consider the internal impedance in the case are linked external resistive divider.
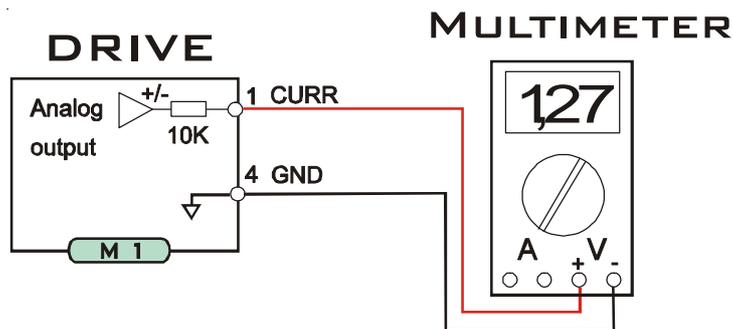
3.0   Speed balance (offset)

The drive is provided with zero adjustment OFFSET with the encoder feedback.
Adjust where necessary with the offset trimmer, to correct any external offset system. (This compensates approximately + / - 200mV on the reference input + /-VEL). With the reference input to zero, turn the trimmer until you stop the MOTOR.

This adjustment works with any type of speed feedback adopted
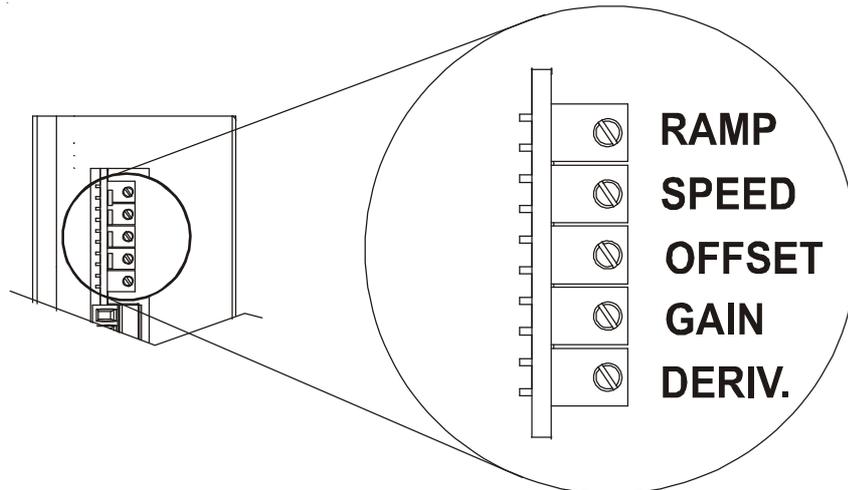
3.1   Current adjustement

RIN resistor (rated current adjustment)

Resistance RIN limits the value of the rated current supplied by the drive. Normally has the same value, of the stall current of DC motor. For the calculation see the following table:

Value of Rin in Kohm

RIN Value	*	56	22	12	6,8	4,7	3,9	2,7	1,8	1,5	1
20/40	20	19,4	18,4	17,4	16,2	15,2	14,2	13	11,4	10,6	9
30/60	30	27	26	25	23	22	20	18,5	16	15	13
40/80	40	38	36	34	32	30	28	26	24	22	18

Size drive (A)

Peak Current request (A)

Note * = No resistor mounted.

Example: on a converter 20/40A, inserting a resistance RIN 6.8Kohm the rated output current will not be 20A, but 16,2A

RIP resistor (Peak current adjustment)

RIP resistance limits the maximum current supplied by the converter. For the calculation see the following table:

Value of RIP in Kohm

RIP Value	*	470	390	220	150	120	100	82	68	56	47
20/40	40	37	35	32,4	30	28,2	26,4	25	24	21,4	20
30/60	60	52	49	46	42	40	37	35	33	31	30
40/80	80	74	70	64	60	56	52	50	47	44	40

Size drive (A)

Rated Current request (A)

Note * = No resistor mounted.

Example: on a converter 30/60A, inserting a resistance RIP 150Kohm the maximum output current will not be 60A, but 42A
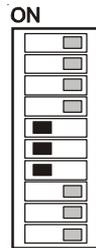
3.2   Ramp time adjustement

The product is standard setting with this feature is not enabled. To enable the ramp acceleration close the dip switch 4 and 5

A

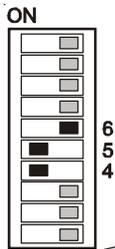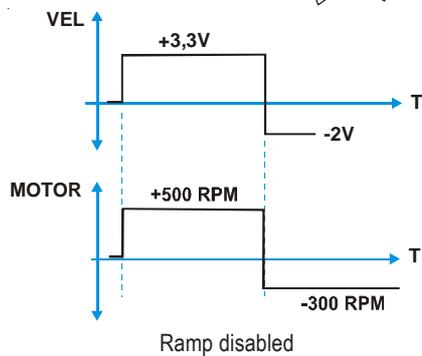| 4	5	6	FUNCTION	RANGE	SETTING
OFF	OFF	ON	Ramp disabled	NO	STD
ON	ON	ON	Rampa enabled	0,1 - 1sec	Variable with RAMP TRIMMER
ON	ON	OFF	Long ramp	by RACC	Variable with RAMP TRIMMER
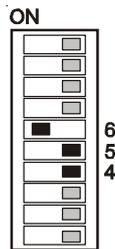
Ramp disabled

**Ramp enabled
0,1 - 1sec**

CLICK

B

RACC resistance value	820 Kohm	1,2 Mohm	3 Mohm
Ramp time	0,3 - 3 sec	0,5 - 4 sec	1,1 - 12 sec

Long ramp

CLICK

RACC on adj

VEL
+3,3V
T
-2V

MOTOR
+500 RPM
T
-300 RPM

Ramp disabled

VEL
+3,3V
T
-2V

MOTOR
+500 RPM
T
Tacc   Tdec   -300 RPM

Ramp enabled
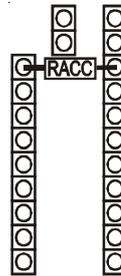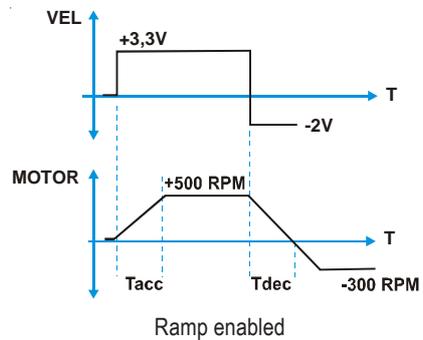
The time shown on the right are related to a change to step on the reference signal input + /-VEL of 10V. Example from 0 to 10V or 10 to 0V.

3.3   Dynamic adjustement

The multi-turn GAIN and DERIV trimmer allow to dynamically tune of the motor and its mechanics linked to it. These trimmers have full excursion from minimum to maximum, with 15 turns of rotation of the same.

The charts shown the track 1 "yellow" is the speed signal available in the point TEST. Track 2 blue highlights instead the current signal taken at terminal 1 (M1 signals connector pitch 3.81)

Signals are reported with a step voltage of the reference signal speed of about 2V.

These signals can be displayed by connecting the two probes of an oscilloscope at those points. The zero signal 0S (zero probes) can be connected by a wire to pin 4 (M1 signals connector pitch 3.81)

Velocity of the motor

Current of the motor

Behavior of the motor with both GAIN and DERIVATIVES trimmer to a minimum of function (trimmer totally rotated counterclockwise CCW). The speed signal is unstable, idem for the current signal of the motor. See chart at right
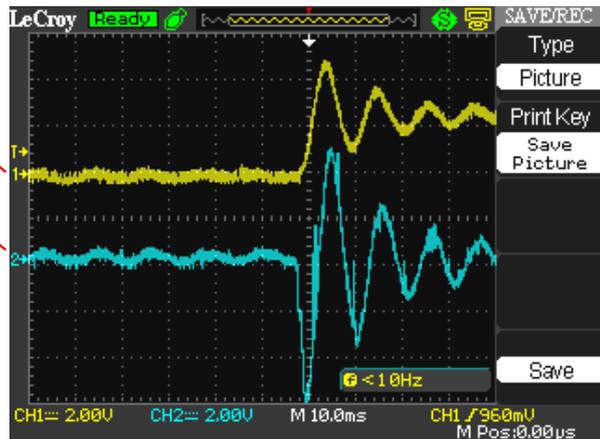
Turning clockwise CW the trimmer GAIN (4 / 5 turns) the dynamic behavior improves, not to exceed with this adjustement are otherwise the motor will be vibrating. See chart at right
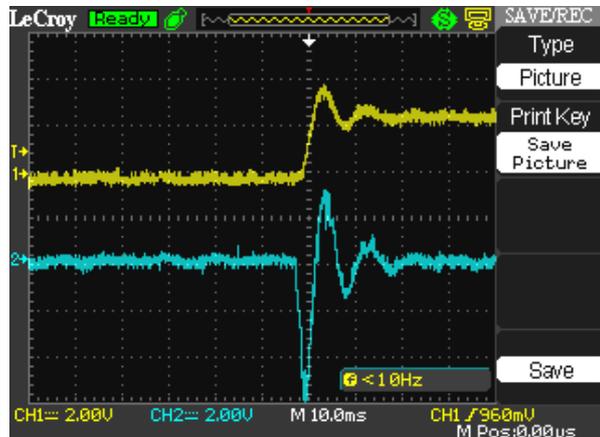
To further improve the behavior of the motor and mechanics related to it and the over all damping of the speed signal oscillation , act trimmer DERIV. turning it clockwise CW (4 / 5 turns). See chart at right
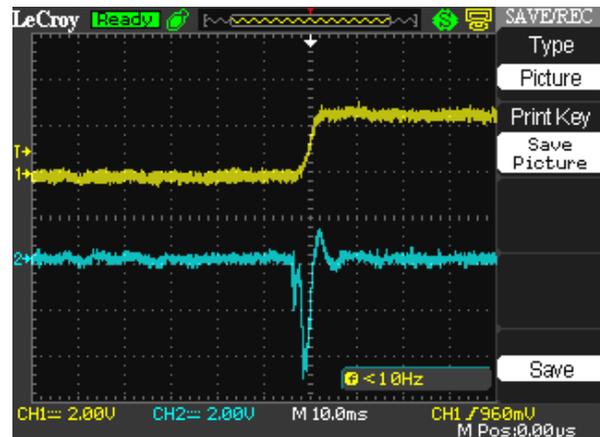
NOTE: The dynamic calibrations are performed using a reference speed (in + /-VEL) of about 1 or 2V. You can use the voltage output from the CNC control, paying attention to rule out the correction of space. Or use an external oscillator or a small battery 1.5 V

3.4 Troubleshooting

Possible reasons for the alarms

- When power supply is on the green OK LED doesn't come on. Check the voltage between +HV and -GND with a tester.

- During deceleration of the motor, the LED green blinks. Increase the capacity filter. (example from 10.000uF to 20.000uF)

- LED lights red O.C. Check the connections + M and-M can short circuit between these two wires, between one of these two wires and ground, or short circuit inside the motor.

- LED lights red ixt. Excessive mechanical load

- LED lights red PTC. Ambient temperature too high, or the converter does not have a minimum circulation of air cooling, ventilation or missing where expected from the size of the converter.

- At Startup or Enabling the H.ALL Led comes on. One or more missing Hall Signals. Missing power supply to Hall Cells.

- With the green LED the motor will not start when you enable the drive with START
Check for the enable signal START. Also verify the presence of the speed signal between the terminals + /-VEL

- Motor goes out of control when enabled.
- Encoder signals incorrectly connected (ENC A and ENC B signals swapped, or encoder power supply missing, or tachogenerator signals swapped)