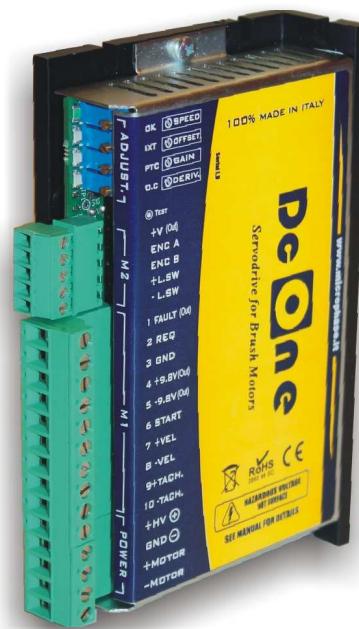


**MICROPHASE**

Technology & Performance

# **DC One servo drive**

**PRECISION SERVO DRIVE FOR DC MOTORS**



## Servoamplifier

for

*dc Motors*

## Service Manual

## Declaration of conformity

### DC & BLDC SERVODRIVES

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

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**

### 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.

All the informations and concepts included in this user guide are copyright, and are supplied to the user with the understanding that it may not be copied, disclosed or duplicated in whole or in part for any purpose not authorised by the factory. All specifications are subject to change without prior notification.

Print in Italy rev. 08/2017



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## 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 maintained 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 reliable or have any responsibility if the products have been improperly stored, installed, used or maintained, or if the costumer has permitted any unauthorized modifications, adjustments, and/or repairs to the products.

### Symbols 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 to drive **DC brush** motors, up to 3Nm. It's a High Performance full four quadrant drive servo amplifier. 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 $\geq 9$ Vdc to $+30$ Vdc (min/max)	STANDARD
LIMIT SWITCH INPUTS	Clockwise (CW) and Counter-clockwise (CCW) limit Switch inputs	STANDARD
FAULT OUTPUT	Fault drive, open collector output 50mA max. (Normally closed, opens when in protection mode)	STANDARD
1 ANALOG OUTPUT	1 motor velocity monitor "TEST", with range $\pm 8$ 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 DC brush motors.

- DC motor with encoder
- DC motor with internal PWM (Armature)
- DC motor with tachogenerator

## 1.3 Model and size

### Model available

POWER SUPPLY		
Model 12	9 - 27 Vdc*	12Vdc**
Model 65	20 - 84 Vdc*	60Vdc **
Model 100	30 - 130 Vdc*	100Vdc **
Model 130	35 - 165 Vdc*	130Vdc **

\* Power supply min/max \*\*Typical

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

### Size available

CURRENT		
Size	Rated current (A)	Peak current (A)*
1/2	1	2
2/4	2	4
4/8	4	8
7/14	7	14
10/20	10	20
12/24	12	24

\*Peak current during 2 sec

Max. size available for each model

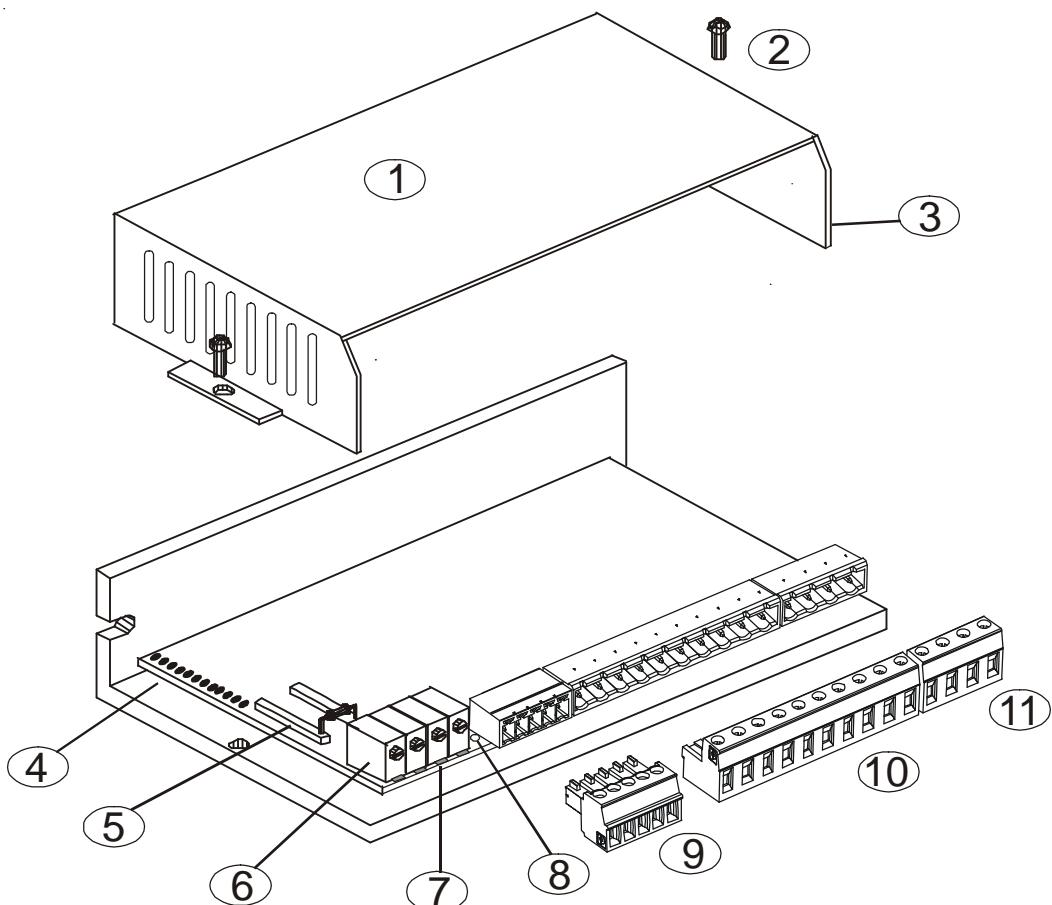
Note: for model 130 max. size is 10/20A

### Specifications

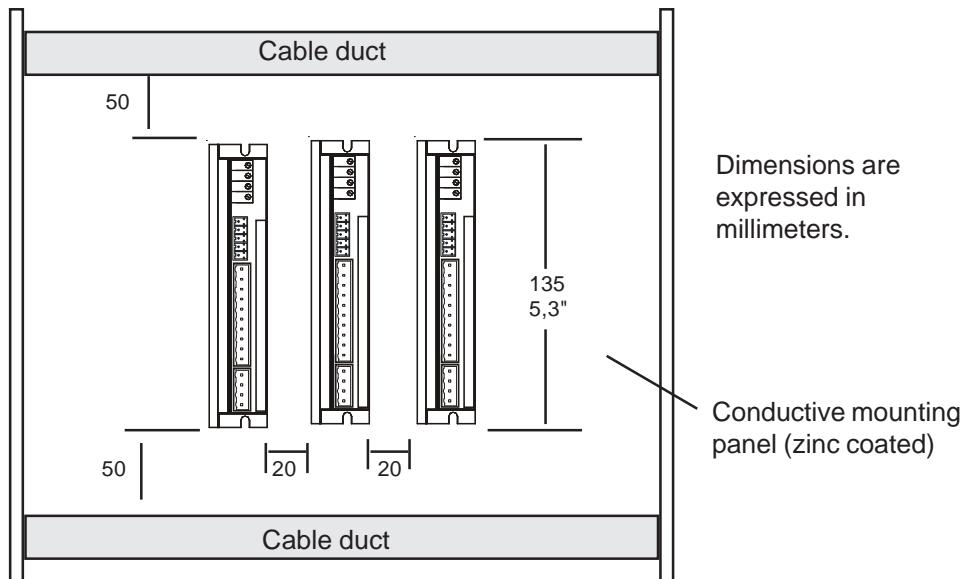
TECNICAL DATA CHARACTERISTICS	
Supply voltage output	0,9 Vdc Input
PWM frequency	20Khz
Operating temperature	0/+45°C
Storage temperature	-10/+70°C
Drift analog input	0,5uV/°C
Analog inputs (+/-VEL)	+/-10Vdc max, impedance 20Kohm
Velocity monitor output (Test)	+/- 8Vdc = max velocity
Power supply output (+V)	+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	$\geq$ +9V/+30Vdc (min/max)
Band width (current)	2KHz
Band width (velocity)	150Hz
Minimum Inductance motor	400uH
Weight	0,35kg 10.6oz
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) Product Label
- (2) Fixing screw
- (3) Product Cover
- (4) Solder bridges
- (5) Adjustment zone
- (6) Four calibration Potentiometers
- (7) Four Leds
- (8) TEST point (Encoder, Tacho or Armature velocity)
- (9) M2 Signal terminal 5 pins MC1,5/5-ST-3,81 (pitch 3,81)
- (10) M1 Signal terminal 10 pins GMST 2.5/10-G-5,08 (pitch 5,08)
- (11) POWER Terminal 4 pins GMST 2.5/5-G-5,08 (pitch 5,08)



## 1.5 Ambient conditions



### 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 20 mm (0,78 inch) 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 limits between 5% to 95% non condensing (Pollution degree 2 or better).

Supplementary ventilation may be requested in accordance to size. See the table below.

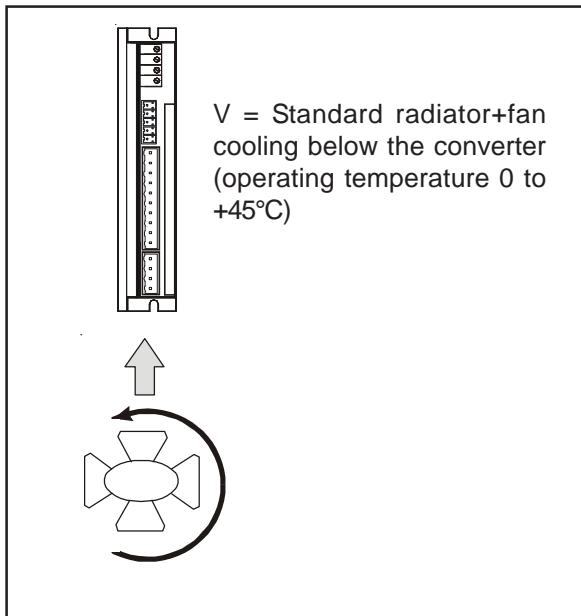
MODEL	SIZE			
	2/4	4/8	7/14	10/20
12	N	N	N	N
65	N	N	N	N
100	N	N	N	V
130	N	N	V	V

N = Standard radiator (operating ambient temperature from 0 to 40°C)

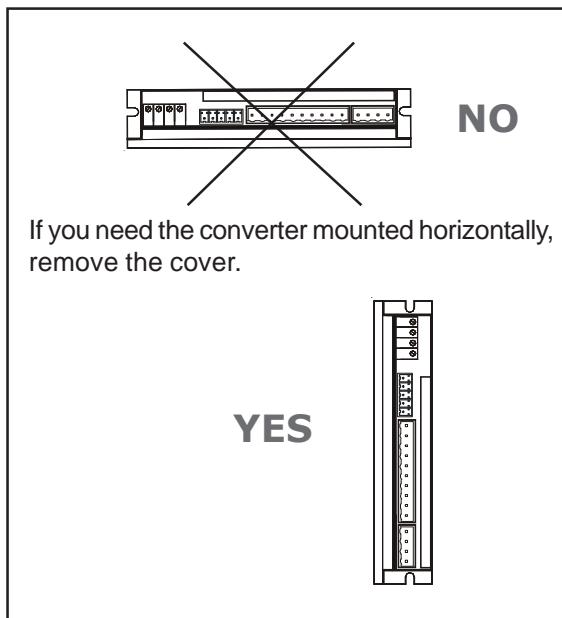
V = Standard radiator + supplementary ventilation (operating ambient temperature from 0 to 45°C)

(\*) = Not available

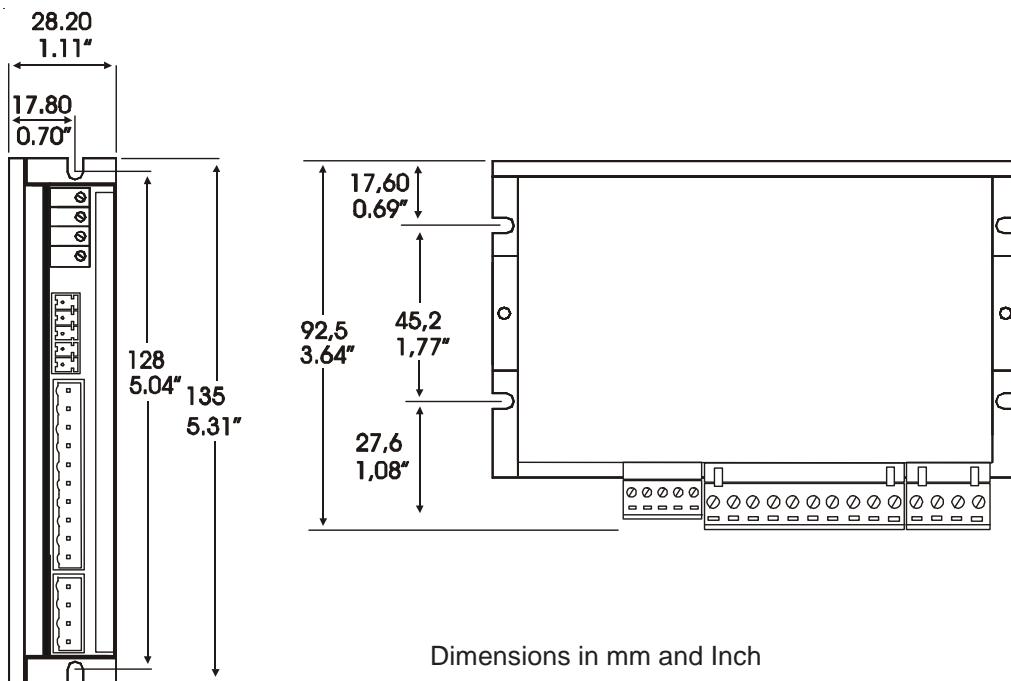
## Supplementary ventilation



## Mounting position



## 1.7 Mechanical dimensions



## 2.0 Signals input and output

The figure below shows the view of the converter terminals.

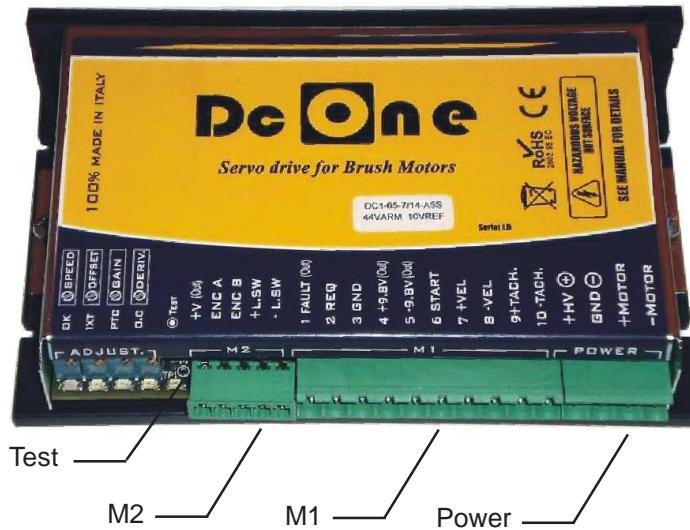
M1 Signal terminal 10 pins "type GMST 2,5/10-G-5,08"

M2 Signal terminal 5 pins "type MC 1,5/5-ST-3,81"

POWER Terminals 4 pins "type GMST 2,5/4-G-5,08"

On the test point "TEST" 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
- Tachogenerator



### Power connector

POWER	
<b>+HV (IN)</b>	Positive Power supply input
<b>GND (IN)</b>	Negative Power Supply input (GND)
<b>+MOTOR (OUT)</b>	Motor connection phase +M
<b>-MOTOR (OUT)</b>	Motor connection phase -M

NOTE: See also the connection diagrams in Chapters 4.1 - 4.2 - 4.3

## Signal inputs and outputs

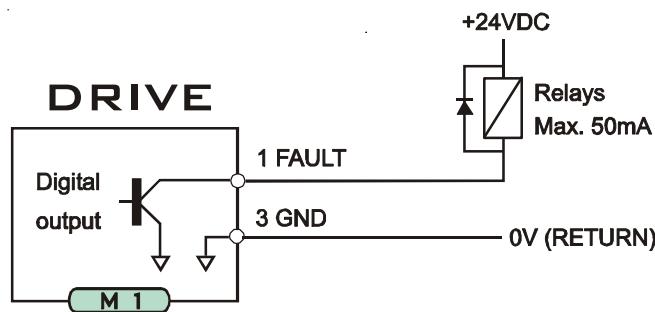
M1 CONNECTOR	
<b>1 FAULT (OUT)</b>	Fault drive, open collector output max. 50mA Normally closed, opens when the drive in protection mode
<b>2 REQ</b>	<u>REQ</u> : can be used in 2 distinct modes: 1) <u>Motor Current limit mode (by REQ setting)</u> : A motor current limit mode connect an external resistor to GND reduces the maximum current. Connect a 1/4W or 1/8W resistor between the REQ (pin 2) and GND (pin 3) terminals. A 47Kohm external resistor reduces the current by 50%. (Note: The drive velocity loop remains active) 2) <u>Torque request (by REQ setting)</u> : Range: +/- 10V, which corresponds to the drives peak current output. In this mode the velocity loop is automatically disabled.
<b>3 GND</b>	Signal Common Ground Corrisponds to power supply's negative GND input
<b>4 +9.8V (OUT)</b>	Power supply +9.8Vdc max 4mA
<b>5 -9.8V (OUT)</b>	Power supply -9.8Vdc max 4mA
<b>6 START (IN)</b>	Positive drive enable with range $\geq$ +9Vdc min. to +30Vdc max
<b>7 +VEL (IN)</b>	Reference Positive differential input (Velocity command)
<b>8 -VEL (IN)</b>	Reference Negative differential input (Velocity command)
<b>9 +TACH (IN)</b>	Positive +DT tachogenerator input. This signals corresponds to power supply's negative GND input.
<b>10 -TACH (IN)</b>	Negative -DT tachogenerator input.

M2 CONNECTOR	
<b>+V (OUT)</b>	Power supply +5V max. 130mA
<b>ENC A (IN)</b>	Encoder input Channel A (High logic level from $\geq$ 2,8V to +24Vdc max. Low logic level $\leq$ 1,5V)
<b>ENC B (IN)</b>	Encoder input Channel B (High logic level from $\geq$ 2,8V to +24Vdc max. Low logic level $\leq$ 1,5V)
<b>+L.SW (IN)</b>	Clockwise (CW) limit Switch input. (High logic level from $\geq$ 5V to +24Vdc max). To enable this function, you must open the internal soldiering point SG and SH. See chapter 2.10
<b>- L.SW (IN)</b>	Counter-Clockwise (CCW) limit Switch input. (High logic level from $\geq$ 5V to +24Vdc max). To enable this function, you must open the internal soldiering point SG and SH. See chapter 2.10

## 2.1 FAULT output

### (M1 signal terminal pin 1)

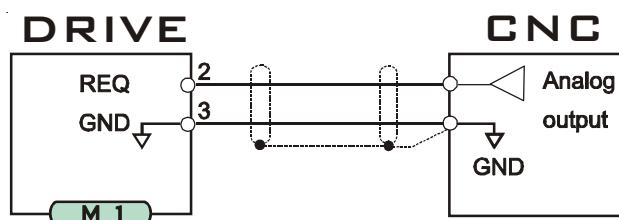
Fault drive, open collector output max. 50mA  
Normally closed, opens when the drive in protection mode



## 2.2 Current request (REQ)

### (M1 signal terminal pin 2)

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:

$$V(REQ) = 10 * \text{Request current} / \text{PKcurrent Drive}$$

Example: (Drive size 10/20A, request current 8A)

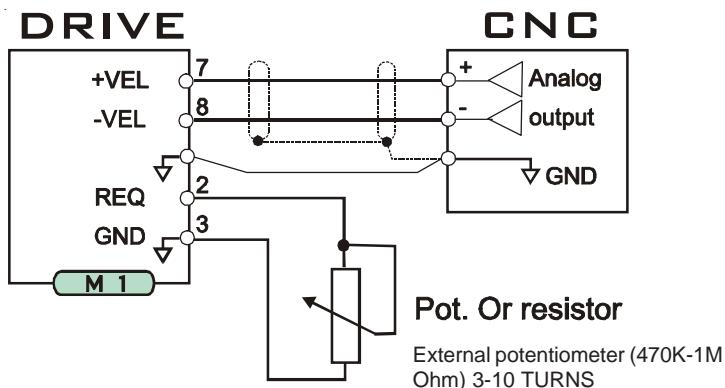
$$V(REQ) = 10 * 8 / 20 = 4V$$

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.



The speed loop remains active and uses the input reference signal +/-VEL.

Connect between terminal and GND terminal REQ a resistor 1/4W or 1/8W. (The figure is used a potentiometer connected to the rheostat). With external resistance tends to zero ohms, the output current tends to zero. Increasing the ohmic value of resistance, the value of current supplied increases. With 47K of the current is limited to 50% on the Maximum size. The loop motor speed remains active.

## 2.3 Signal common ground

### (M1 signal terminal pin 3)

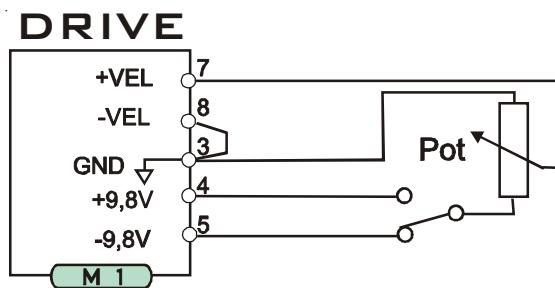
Signal Common Ground. Corresponds to power supply's negative GND input.

## 2.4 Ausiliary power supply +/-9.8V

### (M1 signal terminal pin 4 and 5)

In the terminals 4 (+9.8 V) and 5 (-9.8V) are available auxiliary supplies to power the potentiometer reference speed. In the attached drawing below is also added a switch that allows the reversal of the rotation motor speed .

The current capacity of the output is max +/-4mA  
Output +9.8V can also be used to enable the converter

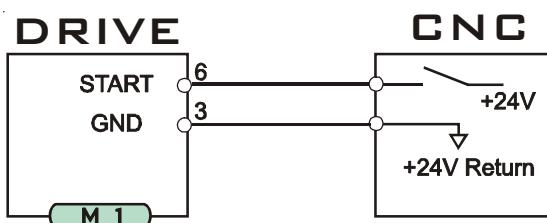


## 2.5 Start input

### (M1 signal terminal pin 6)

The standard drive is furnished in this configuration.

Start enable input has logic range:  $\geq +9V$  to  $+30Vdc$  (min/max)



Unconnected Enable input = Drive Not Enabled

Enable Input  $\geq +9V$  to  $+30Vdc$  = Drive Enabled

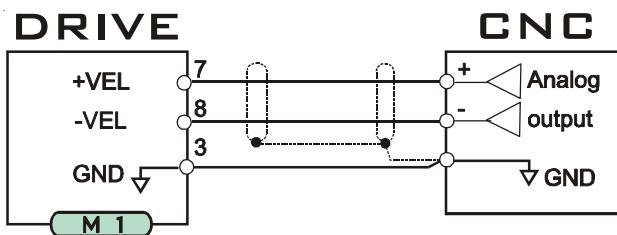
Is possible enable the drive connected the START input with +9.8V output "terminal 4"

## 2.6 Analog inputs (+/-VEL)

### (M1 signal terminal pin 7 and 8)

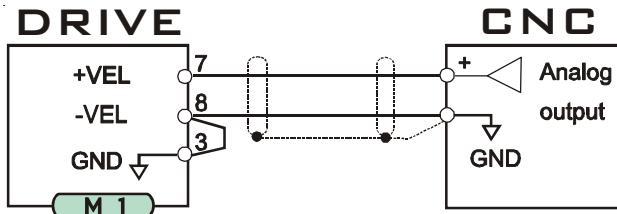
#### Differential reference

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



#### Common mode reference

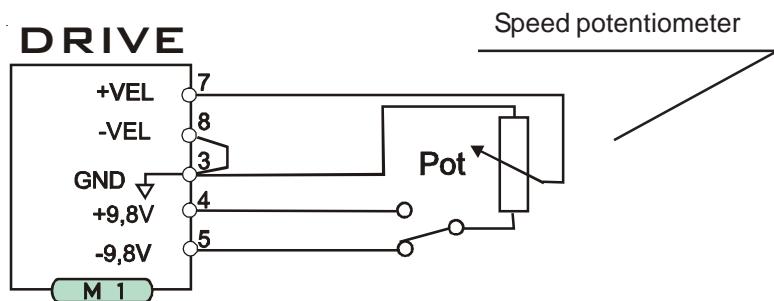
The following diagram shows an application using speed reference connections from C.N.C in the Common Mode. This analog in common mode has a 20Kohm of impedance input.



#### Speed reference from external potentiometer

The following figure shows an application with speed reference connections using an internal +/-9.8V power supply.

The speed potentiometer must have an included value between >5 and <10Kohm.



## 2.7 Tachogenerator input

### Tachogenerator input (M1 signal terminal pin 9 and 10)

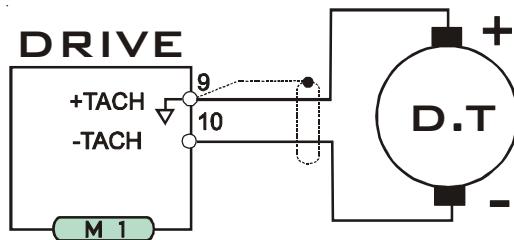
The following diagram shows the connection from tachogenerator and the drive DC ONE.

This function is enabled through the following settings on the solder point, and the insertion of RDT resistance on the adjustment zone. +TACH "pin 9" corresponds to power supply's negative GND input.

Connect the negative of tachometer to pin 10. Do not exceed voltage as input from tacho value of 50V. Example: If you use a 10V/KRPM no more than 5000rpm

If the motor rotates in an opposite direction to the expected one, switch off and reverse the motor and tachogenerator connections.

View the connections and settings from tachogenerator in chapter 4.2



## 2.8 Auxiliary power supply +V (out)

### (M2 signal terminal pin 1)

On the terminal (+V) is available auxiliary power supply voltage +5V (+12 V on request order). This output can be used to power the encoder on the motor. The capacity of the output current is 130mA max.

## 2.9 Encoder inputs

### (M2 signal terminal pin 2 and 3)

In the terminals 2 and 3 you can connect the inputs from an incremental encoder for the current feedback in response to encoder. Signals can come from encoder powered from +5V to +24V). Minimum high logic level  $\geq +2.8V/24V_{max}$ , Minimum low logic level  $< 1.5V$

Encoder can be connected either push-pull (wires A, B and GND) or line-driver encoder type (wires + A + B and GND). Remember to connect the zero encoder with the GND power converter.

View the connections and settings from encoder in chapter 4.1

## 2.10 Limit switch inputs

It's possible to enable clockwise (CW) and counter-clockwise (CCW) motor rotation by connecting the +L.SW and -L.SW inputs.

They may be used to block motor rotation when the machines overflow contact is intercepted.

The Enable input in regards to this input always has priority. To enable such a function, you must:

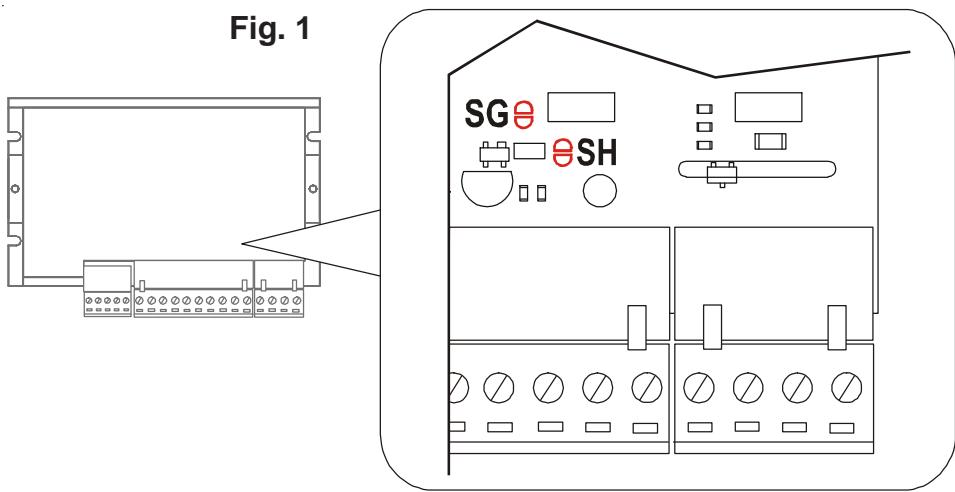
- Open soldering point SG and SH (see figure 1)
- Then connect on said input a positive voltage (between +5Vdc and + 24Vdc) coming from -for example two N.C. contacts (see figure 2 or 3)

**Function:** At opening one of the following contacts you enable the motor rotation in the corresponding direction.

**Note:**

- This Drive is factory set with the SG and SH solder bridge close
- DON'T connect any voltage in the +L.SW and -L.SW inputs if the soldering point SG and SH are closed
- When one of these said contacts is intercepted the motor stops with the required inertia.

Fig. 1



Example with external positive voltage  
(between +5Vdc and +24Vdc)

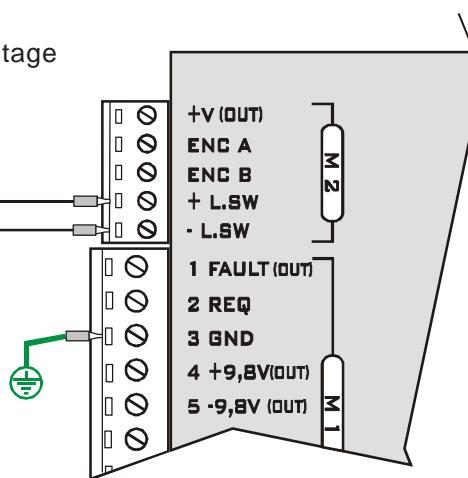
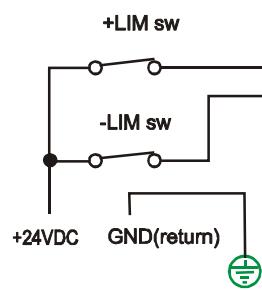


Fig. 2

## Limit switch inputs (continue)

Example with internal positive voltage (+9.8V)

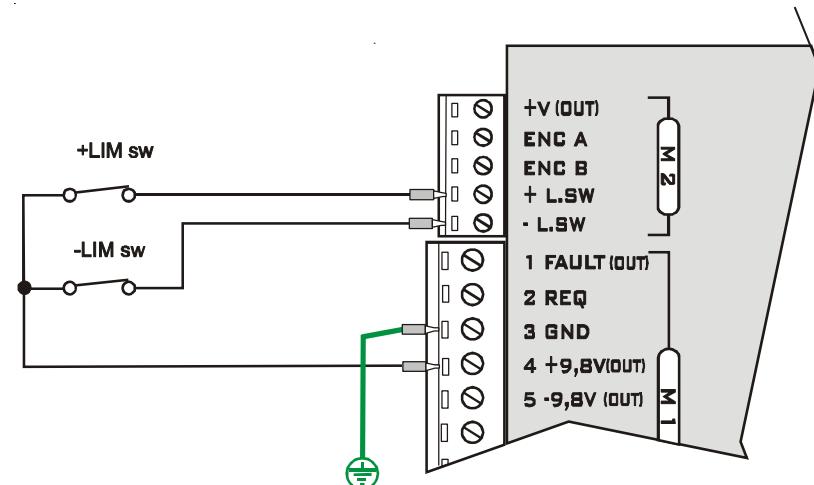
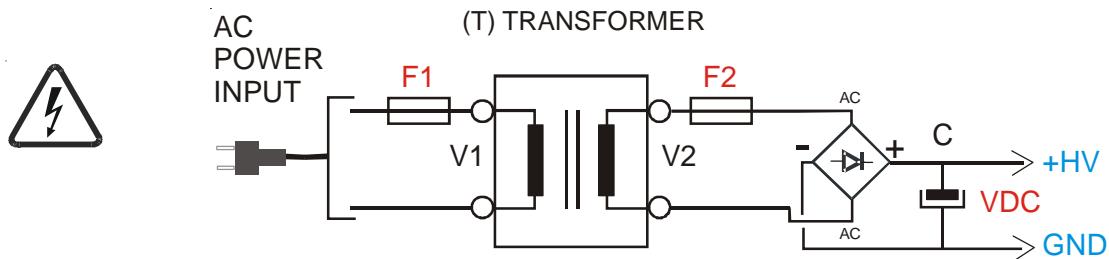


Fig. 3

### 3.0 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 45Vac, the VDC output is  $45 * 1,41 = 64Vdc$

#### 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:

$$P(VA) = Pn1 + Pn2 + \dots$$

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

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:

$$VDC = Vdc \text{ motor} / 0,85$$

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

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

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

$$E = Ke * N^{\circ} / 1000$$

### Power supply construction (continue)

*Example: Brush motor with the following data:*

$I_n = 5 \text{ (A)}$

$R_i = 1 \text{ (Ohm)}$

$E = 48 \text{ (V) at nominal speed 3000 (RPM)}$

$$V_{dc \text{ motor}} = 48 + (1 * 5) = 53V$$

$$VDC = 53 / 0,85 = 64V$$

64V is the **VDC** voltage request for the power supply. You'll use a transformer with the secondary **V2** =  $64 / 1,41 = 45\text{Vac}$

When you use the transformer with  $V2 = 44/45\text{Vac}$ , it is correct.

Misure unit:

$E = K_e * n^\circ / 1000 \text{ (Vdc)}$

$I_m = I \text{ motor (A)}$

$R_i = \text{Winding resistance (Ohm)}$

$K_e = \text{Voltage constant (V/kRPM)}$

$n^\circ = \text{MAX speed (RPM)}$

### Capacitor filter (C)

In regards to the capacitor filter we suggest a working voltage of:

\*100VDC for Model 65

\*160-200VDC for Model 100 and Model 130

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)



### 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:

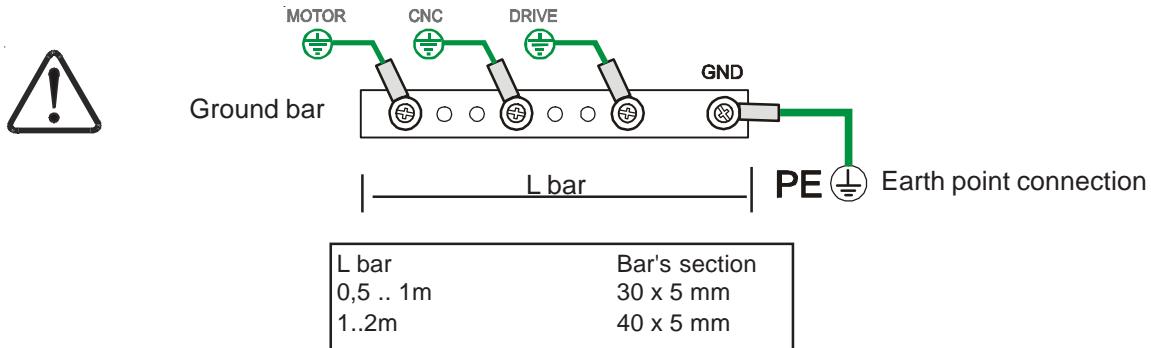
$$F1 \text{ (A)} = P \text{ (VA)} \text{ trasfo.} / V1$$

Secondary of the transformer: Use the table below

FUSE F2 (A)	SIZE Drive (A)
5	1/2 - 2/4
8	4/8
16	7/14
20	10/20 - 12/24

### 3.1 Connections 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:



then follow these indications:

1. Connect to the ground bar:  
the GND pin 3 of the Dc One  
the internal "0V" zero voltage of the CNC;  
the earth terminals of the PLC/CNC frames;  
the "0V" of the auxiliary supply;
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)
1,5mm <sup>2</sup> / 15AWG	1/2 2/4 4/8 7/14
2,5mm <sup>2</sup> / 13-14AWG	10/20 12/24

#### Control signals cable (as norm EN60204)

SECTION
0,5mm <sup>2</sup> / 20AWG

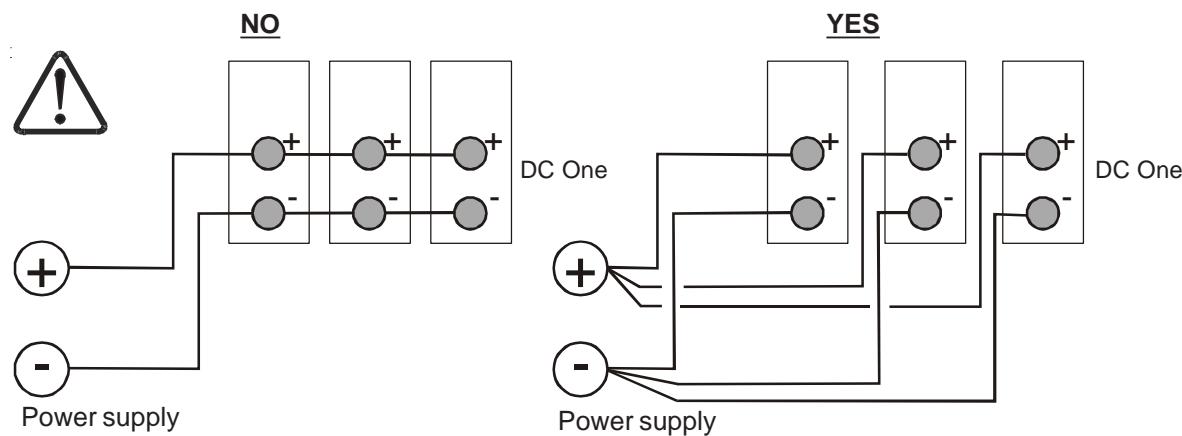
#### Feedback signals cable (as norm EN60204)

SECTION
0,25 - 0,35mm <sup>2</sup> / 22 -24AWG

## 3.2 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

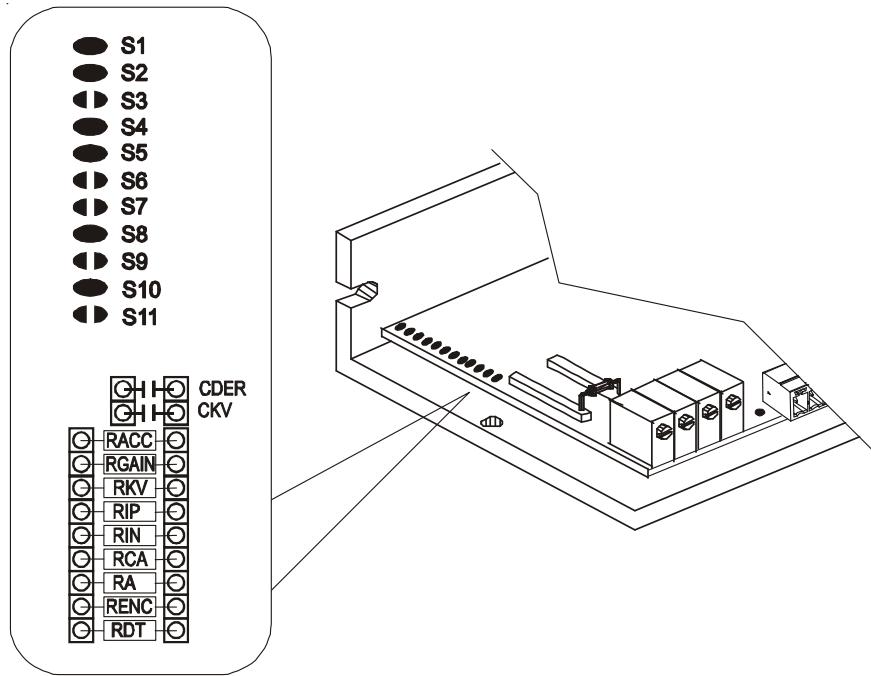
The conformity is assured only if it is installed following the precise assembly criteria expressed below. The fundamental assembly characteristics are summarized below:

- 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)

## 4.0 Internal adjustments

The **adjustments** are located inside the converter. All calibration pins are mounted on headers spaced. It is better to use resistors with 1/4 watt (10,16mm) pitch and the capacitors (5.08mm) pitch

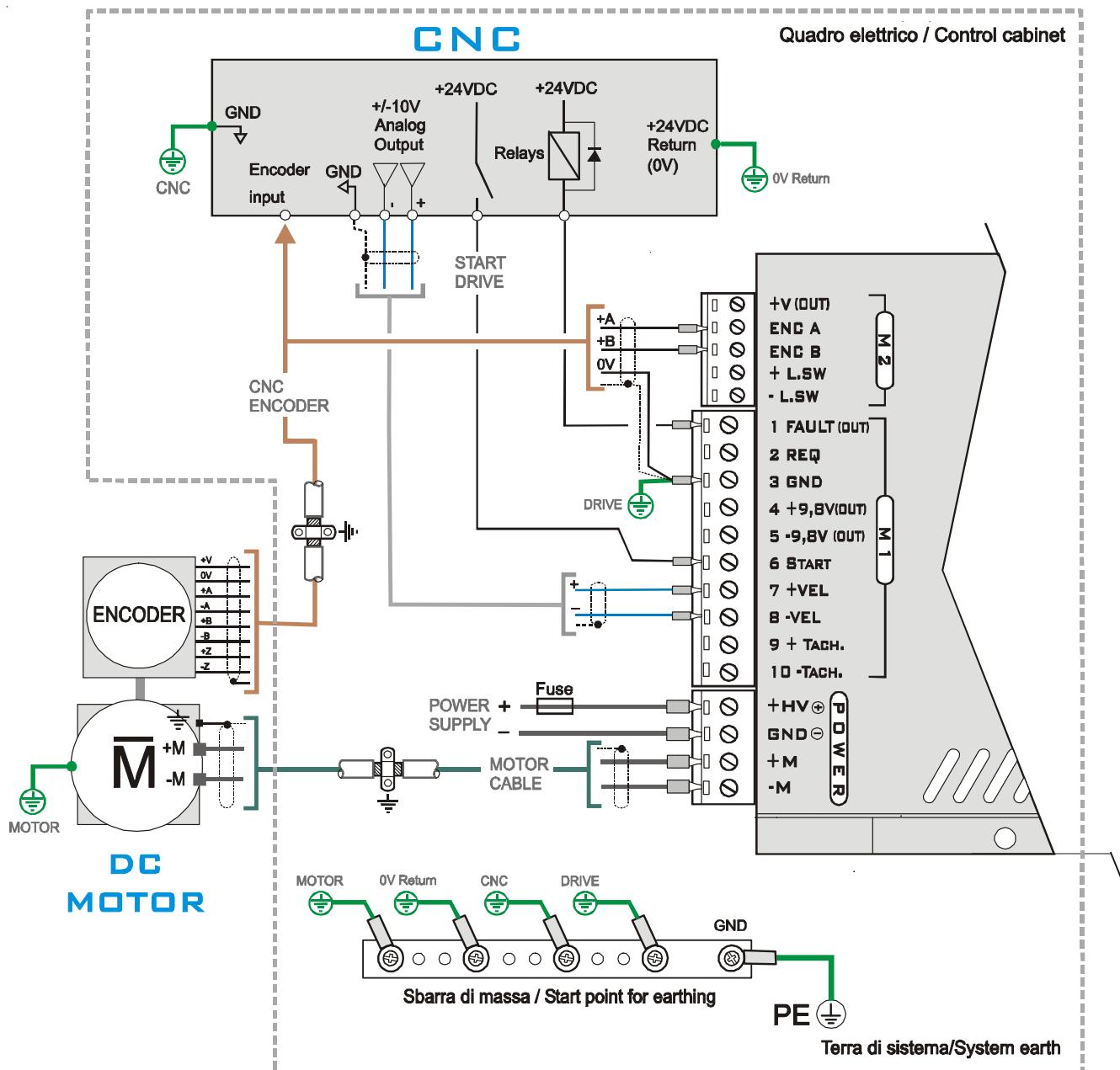
Are also present, 11 solder bridges, through which you can enable or disable features or parts of the converter. The converter in standard configuration (encoder feedback) is provided with the following point closed (ON).



The following pages highlight the various settings to be implemented over the area of adjustments to set the converter depending on the desired velocity feedback.

In the left-hand page for each chosen velocity feedback, is shown a typical connection with the notes of wiring of the converter.

## 4.1 Brush motor with encoder feedback



The following diagram shows an typical application utilizing a Dc One with Brush motor. The + M and -M output are identified on the POWER connector of the product.

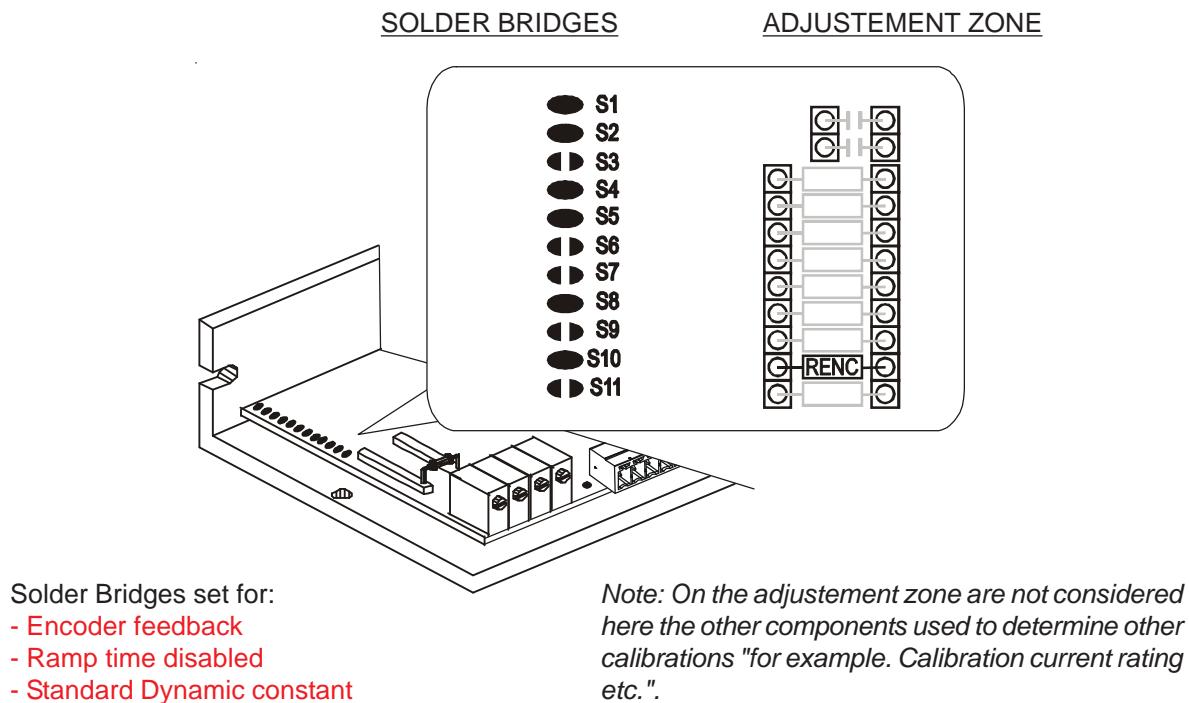
In this case the drive is feedback from encoder. The inputs signal encoder of the drive" ENC A and ENC B" are refer with the zero control signals of CNC.

To obtain good dynamic performance of the motor, we recommend the use of encoders with at least 2000/2048PPR. Acceptable performance is obtained anyway even with the use of encoders 500/512PPR.

Is possible to use the +5V output "+V terminal" for the supplies the encoder. Note: the maximum load on terminal +V is 130mA.

## Setting for Brush motor with encoder feedback

In this configuration, the drive must set with the following Solder bridges and below internal setting:



### RENC resistor calculations

The drive is standard set with solder bridge S8 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:

$$\text{RENC} = 681 * 1000 / \text{Fenc}$$

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

Where:  $\text{Fenc} = \text{PPR} * \text{rpm} / 60$

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

$$\text{Fenc} = 500 * 4000 / 60 = 33.333$$

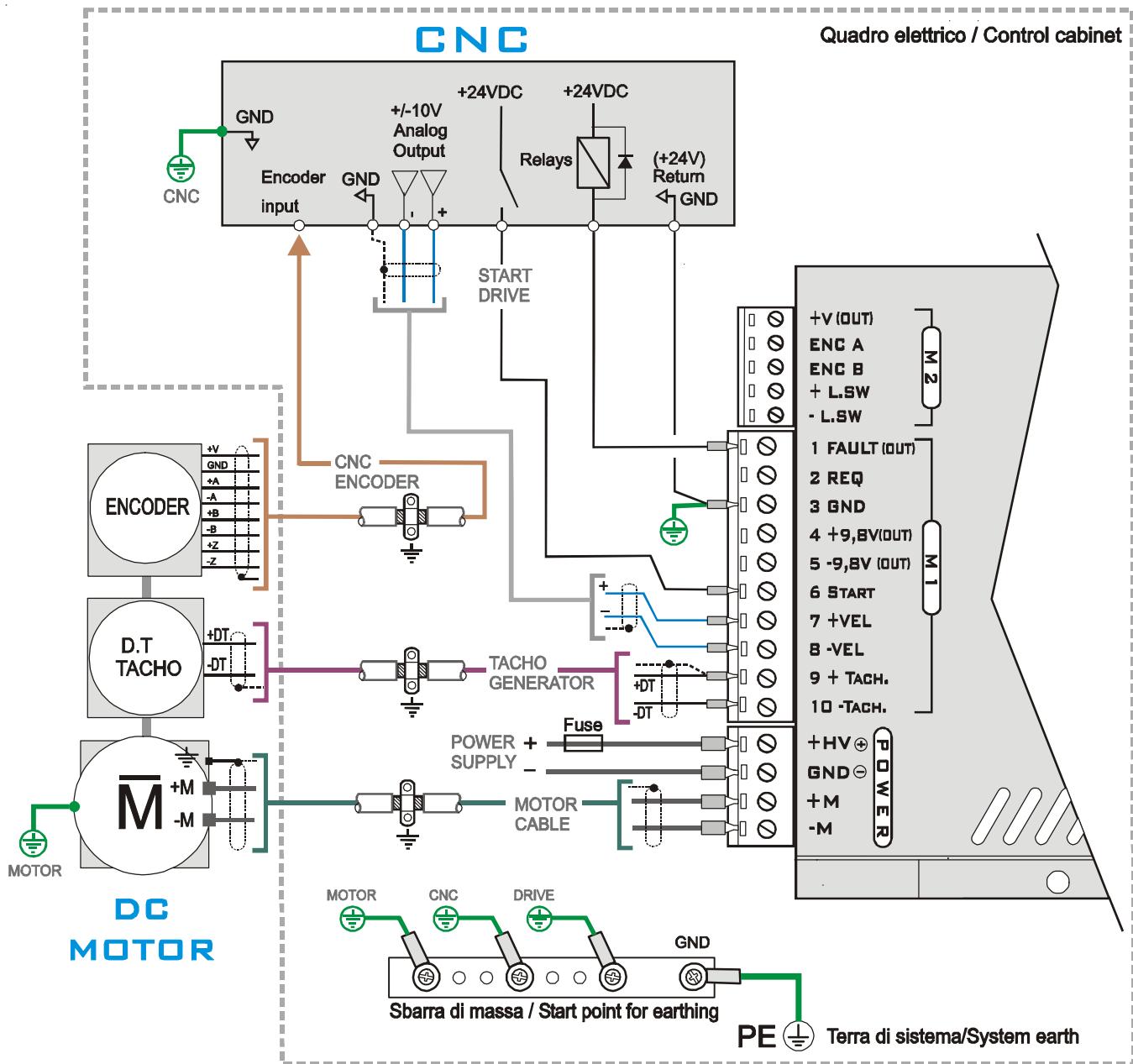
$$\text{RENC} = 681 * 1000 / 33.333 = 20,4 \text{ kohm}$$

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 +/- 25%.

## ***4.2 Brush motor with tachogenerator***



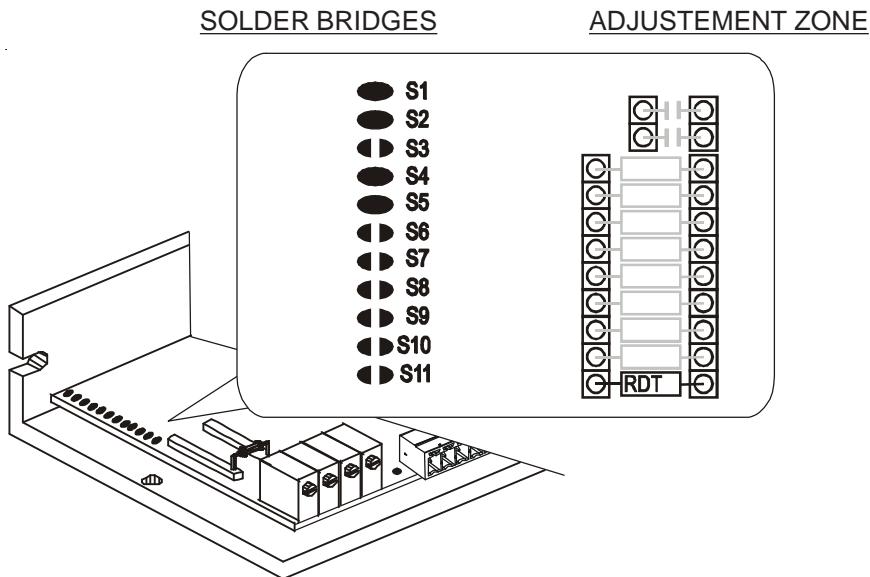
The following diagram shows a typical application utilizing a DC motor with Brush motor. The speed loop velocity is by tachogenerator feedback.

Signals from the encoder are connected only to the CNC for the control of space loop.

This function is enabled through the following settings on the solder point, and the insertion of RDT resistance on the adjustment zone.

## Setting for Brush motor with tachogenerator

In this configuration, the drive must set with the following solder bridges and below internal setting:



Solder Bridges set for:

- Tachogenerator 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.".*

### RDT resistor calculations

To calculate RDT resistor, please use the following formula:

$$RDT \text{ (Kohm)} = \frac{Kdt * N * 9,7}{1000 * Vref} - 7,9$$

Example: Brush DC motor with the tachogenerator costant  $Kdt=10V/KRPM$ , max. speed 2500RPM at 10V of speed reference. The result is below:

$$RDT \text{ (Kohm)} = \frac{10 * 2500 * 9,7}{1000 * 10} - 7,9 = 16.4 \text{ Kohm}$$

Insert the commercial value resistance 18Kohm. Prefer resistance with 1% tolerance.

Note:

**RDT** is the value of resistor expressed in Kohm with a power rating of 1/8 or 1/4w.

**Kdt** is the tachogenerator costant V/KRPM

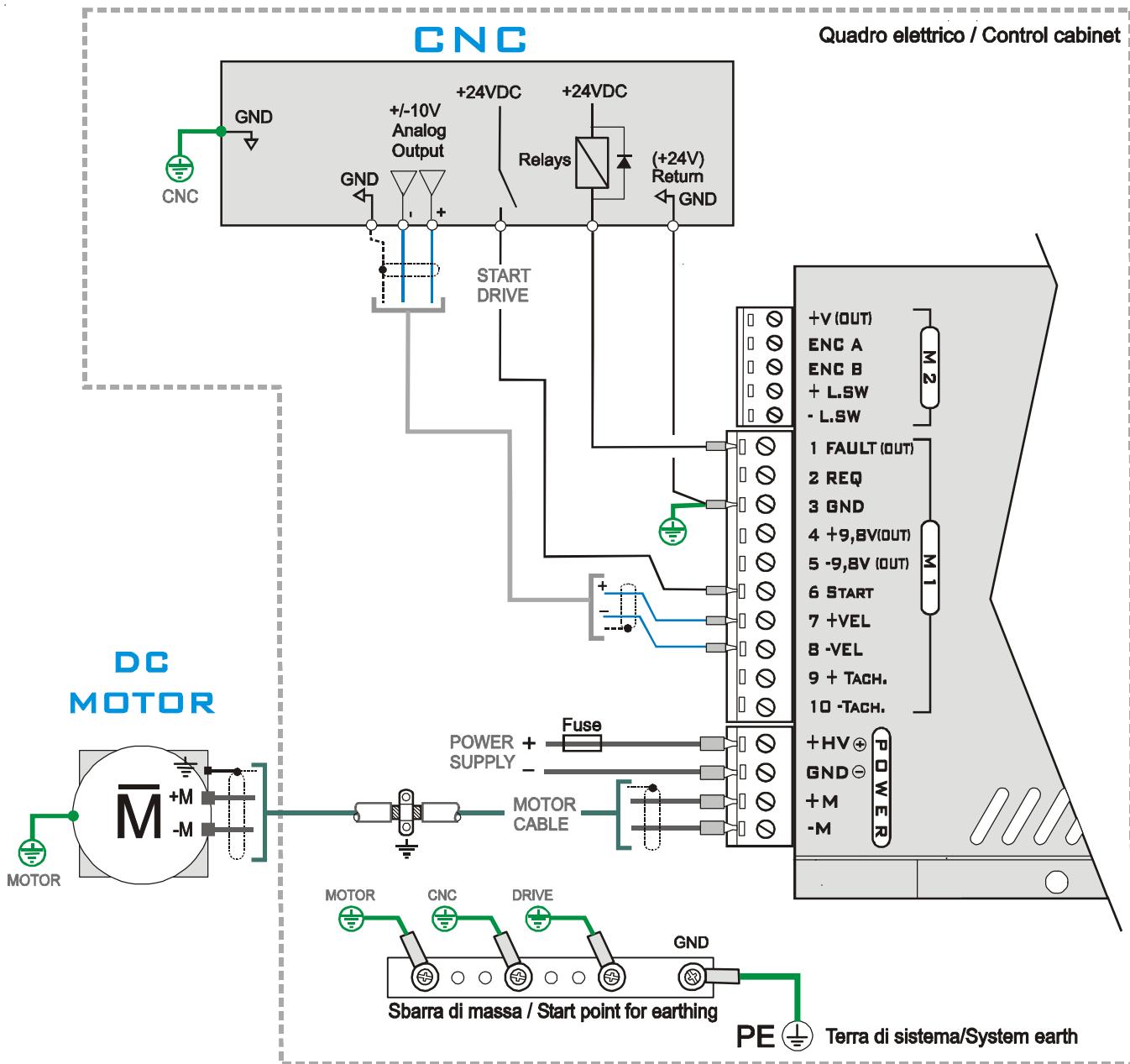
**N** is the max speed express in RPM.

**Vref** is the max voltage +/-VEL reference express in Volts.

Once the resistor **RDT** 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 +/- 25%.

## 4.3 Brush motor in armature feedback



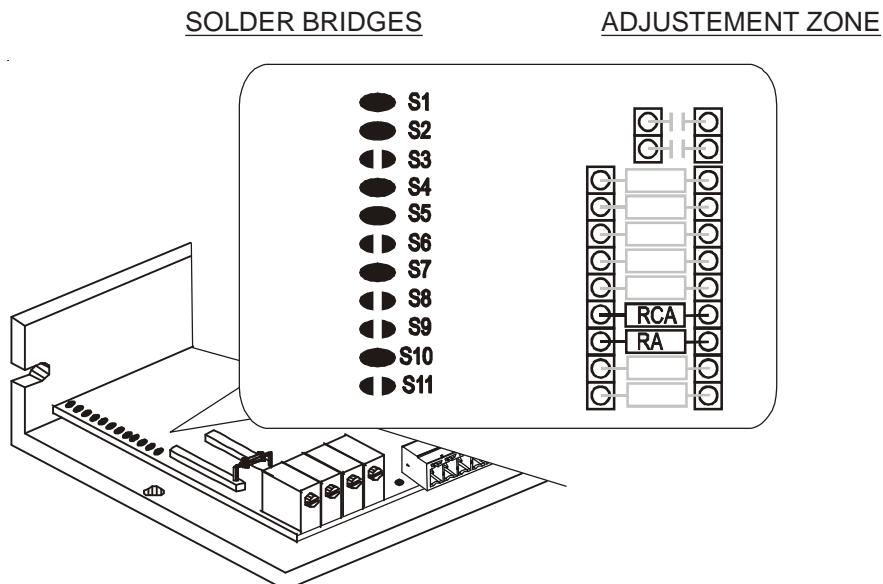
The following diagram shows an typical application utilizing a Dc One with Brush motor. The speed loop velocity is by internal armature feedback.

In the armature voltage PWM converter is used as the internal feedback of speed, when the motor has not an encoder.

This function is enabled through the following settings on the solder point, and the insertion of RA and RCA resistance on the adjustusement zone.

## Setting for Brush motor with armature

In this configuration, the drive must set with the following solder bridges and below internal setting:



Solder Bridges set for:

- Armature 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.".*

## RA resistor calculations

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

RA	Value of RA in Kohm											
	33	27	22	18	15	12	10	8,2	6,8	5,6	4,7	3,3
<b>Model 65</b>	59	53	47	42	37	31,5	28	24,5	21,5	19	16	13,5
<b>Model 100</b>	92	82	74	65	58	50	44	38	34	29	26	21,5
<b>Model 130</b>	92	82	74	65	58	50	44	38	34	29	26	21,5

Value of RA in Kohm

Voltage output drive

EXAMPLE:

**Brush DC motor** with  $K_e = 26V/Krpm$  (Vdc)

Nominal speed  $N = 2000rpm$

Result:  $Vdc = 26 * 2000 / 1000 = 52V$

Drive model 65

For the Example, result  $Vdc = 52V$ . The table shows a resistor with a value of 27Kohm.

Once the resistor **RA** 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  $\pm 25\%$ .

## Setting for Brush motor with armature (Continue)

### 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:

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

Where:

Vmot= Nominal voltage of the motor

Ri=Max. cold motor resistance.

Ipk =Peak drive current.

Vref= max. applied reference voltage in VEL

Example: Drive 7/14A, Ri=0,3ohm, Vmot=36V, Reference=10V

Calculate: 
$$\text{RCA (Kohm)} = \frac{0,49 * 1000 * 36}{10 * 14 * 0,3} = 420\text{K}$$

Insert a 470Kohm resistance. If after insertion of the resistor the motor is unstable, increase the Resistance value of RCA.

## 4.4 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:

Rin Value	*	Value of Rin in Kohm									
		56	22	12	6,8	4,7	3,9	2,7	1,8	1,5	1
1/2	1	0,95	0,9	0,85	0,8	0,75	0,7	0,6	0,55	0,5	0,4
2/4	2	1,9	1,8	1,7	1,6	1,5	1,4	1,3	1,1	1	0,9
4/8	4	3,9	3,7	3,5	3,2	3	2,8	2,6	2,2	2,1	1,8
7/14	7	6,8	6,5	6	5,7	5,3	5	4,6	4	3,7	3,1
10/20	10	9,7	9,2	8,7	8,1	7,6	7,1	6,5	5,7	5,3	4,4
12/24	12	11,7	11	10,5	9,6	9	8,4	7,8	6,6	6,3	5,4

Size drive (A)

Rated Current request (A)

Note \* = No resistor mounted.

Example: on a converter 7/14A, inserting a resistance RIN 6.8Kohm the rated output current will not be 7A, but 5.7A

### RIP resistor (Peak current adjustment)

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

Rip value	*	Value of RIP in Kohm									
		470	390	220	150	120	100	82	68	56	47
1/2	2	1,8	1,7	1,6	1,5	1,4	1,3	1,25	1,2	1,1	1
2/4	4	3,7	3,5	3,2	3	2,8	2,6	2,5	2,4	2,1	2
4/8	8	7,4	7	6,48	6	5,6	5,3	5	4,8	4,2	4
7/14	14	13	12,2	11,3	10,5	9,9	9,3	8,7	8,4	7,5	7
10/20	20	18,5	17,5	16,2	15	14,1	13,2	12,5	12	10,7	10
12/24	24	22,5	21	19,5	18	16,8	15,9	15	14,4	12,6	12

Size drive (A)

Peak Current request (A)

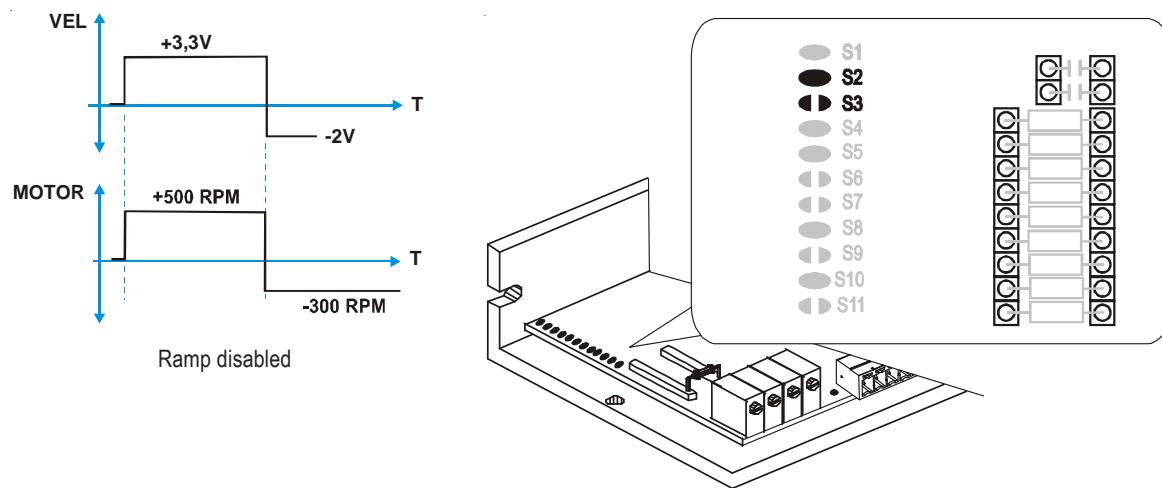
Note \* = No resistor mounted.

Example: on a converter 7/14A, inserting a resistance RIP 150Kohm the maximum output current will not be 14A, but 10.5A

## 4.5 Ramp time adjustement

The product is standard setting with this feature is not enabled (solder bridge S3 open)  
 To enable the ramp acceleration close the solder bridge S3 and insert the RACC resistance.  
 NOTE: The product comes standard with mounted 470ohm resistance value (0.8 sec ramp)

### Ramp disabled (standard setting)



### Ramp enabled

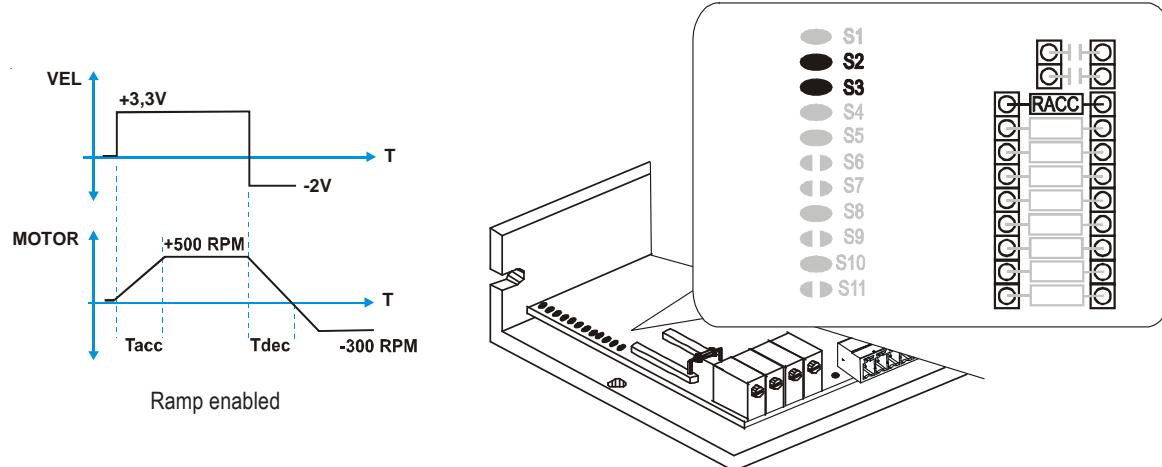


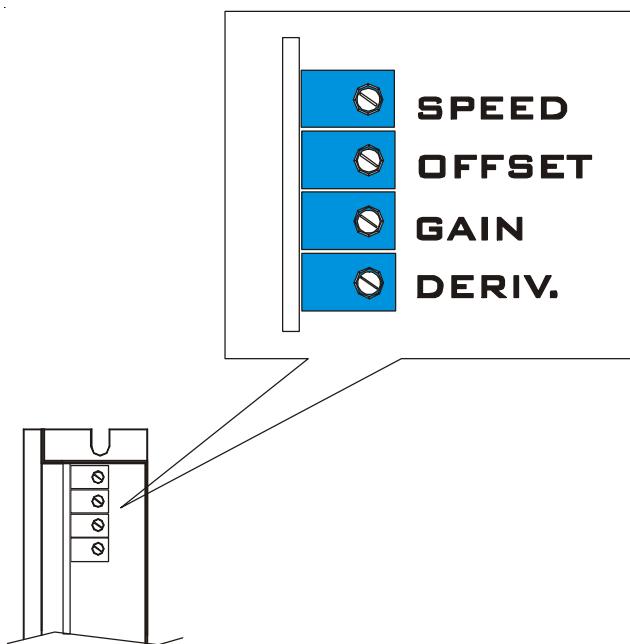
Table:

Resistance (ohm)	TIME (sec)
27 Ohm	15
68 Ohm	5
100 Ohm	3,16
470 Ohm	0,8
1K Ohm	0,32
1,5K Ohm	0,26
3,3K Ohm	0,16
10K Ohm	0,086

The time shown on the right are related to a change to step on the reference signal input +/VEL of 10V.

## 4.6 Potentiometer adjustments

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



FUNCTION	
SPEED	<b>Motor fine speed calibration.</b> With rotating clockwise (CW) or counterclockwise (CCW) is possible increase / decrease the speed of the motor with range + / -25%
OFFSET	<b>Offset adjustment.</b> 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	<b>Gain potentiometer.</b> 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.	<b>Derivative potentiometer.</b> 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 4.7 explains how to dynamically tune the motor by acting on the 2 trimmer GAIN and DERIV.
- All potentiometers are disabled in Torque mode

## 4.7 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.

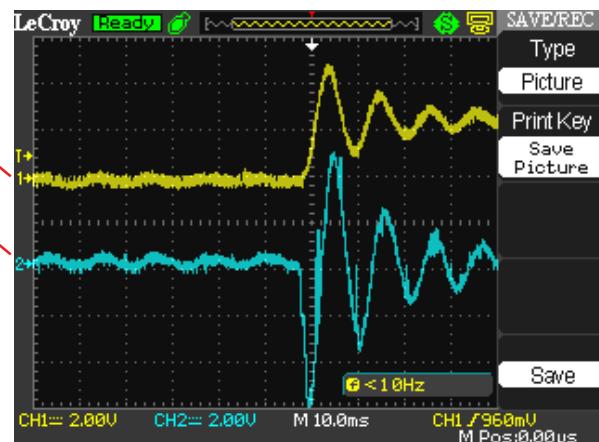
Signals are reported with a step voltage of the reference signal speed of about 2V.

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)

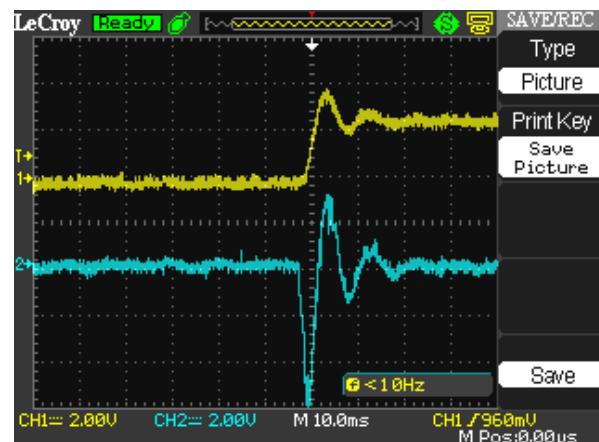
Velocity of the motor

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

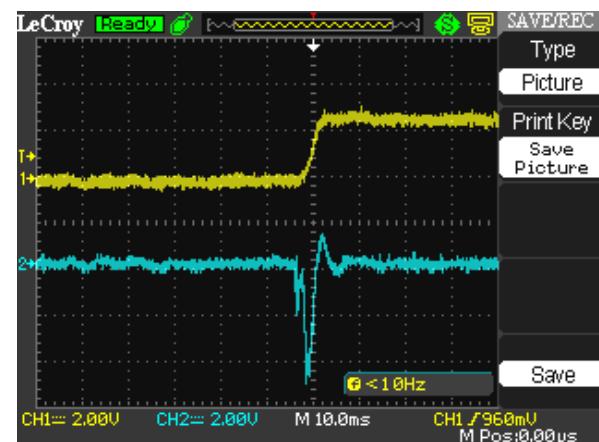


Turning clockwise CW the trimmer GAIN (4 / 5 turns) the dynamic behavior improves, not to exceed with this adjustement are otherwise the motor will be vibrating. See chart at right



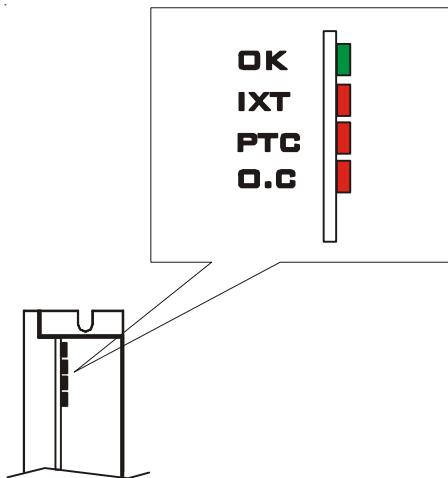
To further improve the behavior of the motor and mechanics related to it and the over all damping of the speed signal oscillation , act trimmer DERIV. turning it clockwise CW (4 / 5 turns). See chart at right

**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



## 4.8 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	
<b>OK GREEN</b>	<b>Normally ON.</b> 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.
<b>IxT RED</b>	<b>Normally OFF.</b> 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 preset, the alarm will auto resets and the LED turns off by itself.
<b>PTC RED</b>	<b>Normally OFF.</b> This indicator is lit when the internal temperature of the drive reaches 75°C . 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.
<b>O.C RED</b>	<b>Normally OFF.</b> 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.

### Possible reason for the allarms of the drive

- **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.
- **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)

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