ALFA series inverter installation and operating manual

ALFAVERT

CONTENTS

1 Safety-related information

1.1. Reference

These instructions refer to Carpanelli ALFA series motors with integrated drive and single phase power supply. Contact Carpanelli directly for further information not included in this file.
The manufacturer will not be held liable for damage to persons, property or costs resulting from errors or shortcomings in this file.
The manufacturer reserves the right to modify this file without prior notice.
Carpanelli Motori Elettrici will not be held liable for malfunctioning, damage to persons or machinery resulting from failure to comply with the instructions and precautions in this manual

1.2 Personal hazard

If the necessary protections are improperly removed, ALFA series motors are equipped with live and/or moving parts which pose a risk of serious injury to persons or damage to objects: to avoid such an eventuality, all transport, commissioning and maintenance operations must only be carried out by specifically qualified technical personnel.
A precautionary measure which is absolutely necessary consists in earthing the unit.
Pay special attention to the risk of burns, since during normal operation some parts of the unit can reach 60°C.
Disconnect the unit from the mains before removing it; there can be hazardous voltage inside for up to 3 minutes after being disconnected.
It is recommended to use a superfast fuse on one of the two power phases to prevent damaging the inverter by accidental short-circuits. See the inverter current on the rating plate and multiply it by two to choose the size of the fuse.

1.3 Intended use

Alfavert motors are intended, as components, exclusively for professional use in industrial machinery, pursuant to standard EN61000-3-2.
Using Alfavert motors in lifting applications where malfunctioning can pose a hazard to persons or objects is not permitted.
It is also not permitted to commission the unit before you are certain that the machine meets the requirements in EMC Directive 89/336/EEC and that the final product complies with the Machinery Directive 89/392/EEC.

1.4 Environment of use It is prohibited to use the unit in anti-explosion environments. It is prohibited to use it where the safety of the machinery and persons is only guaranteed by the unit, without the aid of other systems subordinated to it.

1.5 Protection IP55 Rating. The end user is responsible to seal the cover when leaving the factory, namely by correctly positioning gaskets and appropriately tightening the cable glands.

2 General description

2.1 Composition of the unit Carpanelli ALFA motors with built-in inverter and single phase power supply are units consisting of a three-phase motor and a single phase power inverter built into the motor casing.

2.2 Power cooling The motor is equipped with a fan connected to the motor shaft, requiring a minimum air flow to cool both the motor and inverter. For continuous work below 900 RPM, it is recommended to use a power fan to request as an optional when placing the order.

2.3 Control mode These units implement a variable speed drive where the rotation speed of the motor shaft, depending on the frequency of the current with which the inverter powers the motor, can substantially be controlled in three different ways:

- By means of Input terminal board (see paragraph 3.2).
- By means of Vmin and Vmax trimmer regulation (see paragraph 3.4)
- By means of a serial line RS485 (on demand).

Since the output current frequency of the inverter and the rotation speed of the motor shaft are linked to the number of polar pairs of the motor, this manual uses both the concept of speed control and frequency control. Keep in mind that they are not exactly equivalent (e.g. it is evident that when the motor is subject to a relevant load, the mechanical speed may even considerably differ from that of no-load speed linked to inverter frequency).

3 Instructions for use

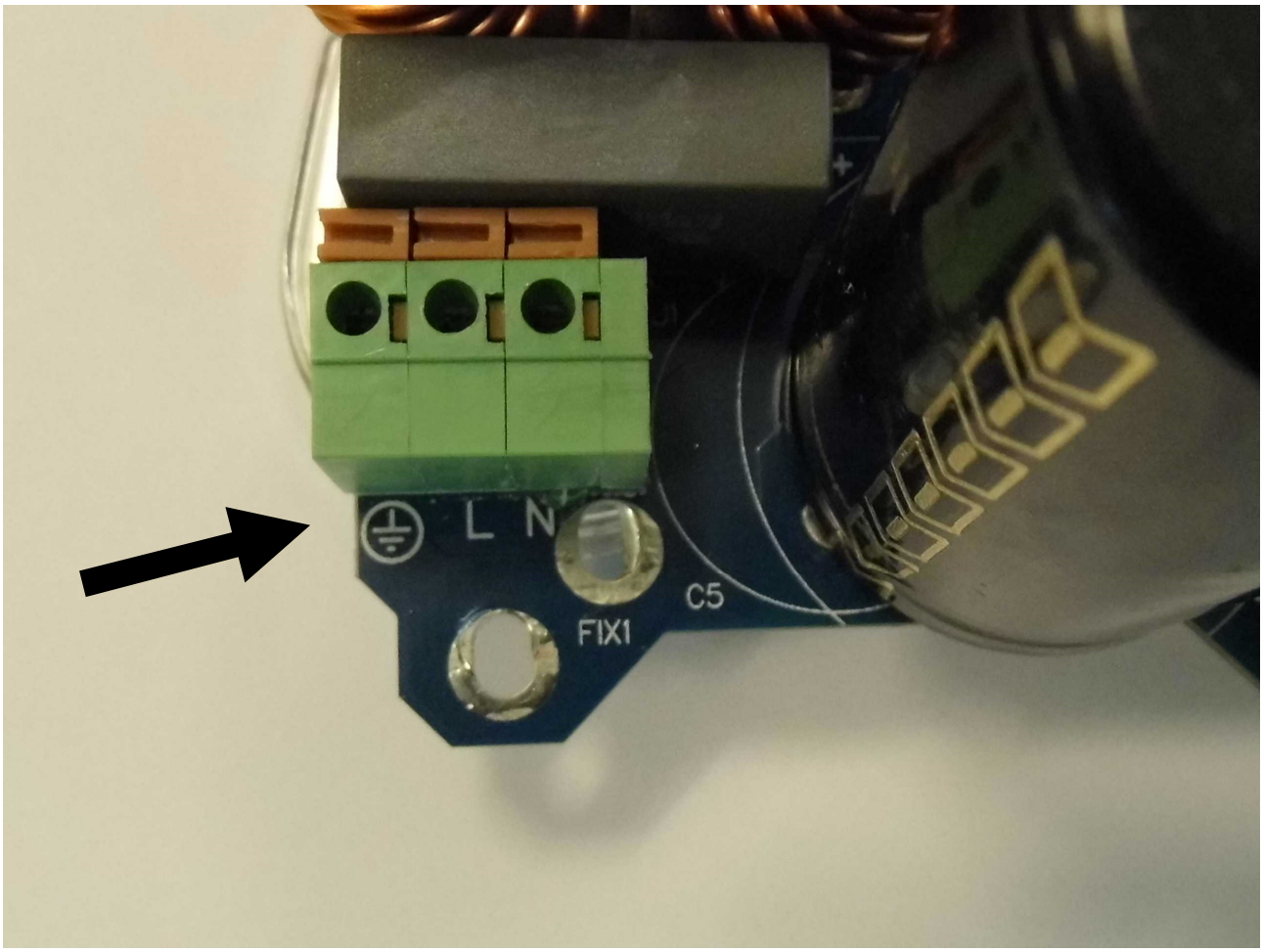
The devices for controlling the motor and the relative diagnostic instruments are illustrated below.

To aid understanding, some modified pictures of the inverter PCB are shown directly so that the user can easily identify the devices and see how to adjust them.

3.1 Power supply terminal board

With reference to the figure at the bottom left, the terminal board includes:

- Terminals for connection to the mains L and N
- Earth terminal PE



3.2 The signal INPUT terminal board for motor control.

The Input terminal board has respectively from right to left in figure 3:

1. Free opto-isolated terminal for special applications.
2. **RUN/START** opto-isolated terminal to start motor: this terminal requires voltage 9-24Vdc; if there is external voltage from PLC or similar, connect 0 VDC to terminal 6 and the positive pole of the external 9-24Vdc source to RUN. If there are no external sources, use a simple switch that closes between Terminal 4 and 2.
3. **DIR** opto-isolated terminal for motor rotation direction: this terminal requires voltage 9-24Vdc; if there is external voltage from PLC or similar, connect 0VDC to terminal 6 and the positive pole of the external 9-24VDC source to **DIR**. If there are no external sources, use a simple switch that closes between Terminal 4 and 3. If 0VDC is open turn clockwise, if +9-24Vdc is closed turn anticlockwise.
4. Internal power supply terminal **+18 Vdc** is useful when there are no external power sources for input signals.
5. **REF** opto-isolated terminal for motor speed reference: if there is external voltage from PLC or similar, connect 0VDC to terminal 6 and apply 0-10Vdc so that speed variation is within the setting range of the Vmin and Vmax trimmers. If there are no external sources, you may use a simple 10K potentiometer, preferably Multi-turn, which closes between Terminal 6 COM 0Vdc, 5 REF for speed variation and 4 for +18VDC.
6. **0 VDC** opto-isolated terminal is the common pole of reference of the input signals.
7. **POT** opto-isolated terminal is the supply of the potentiometer.

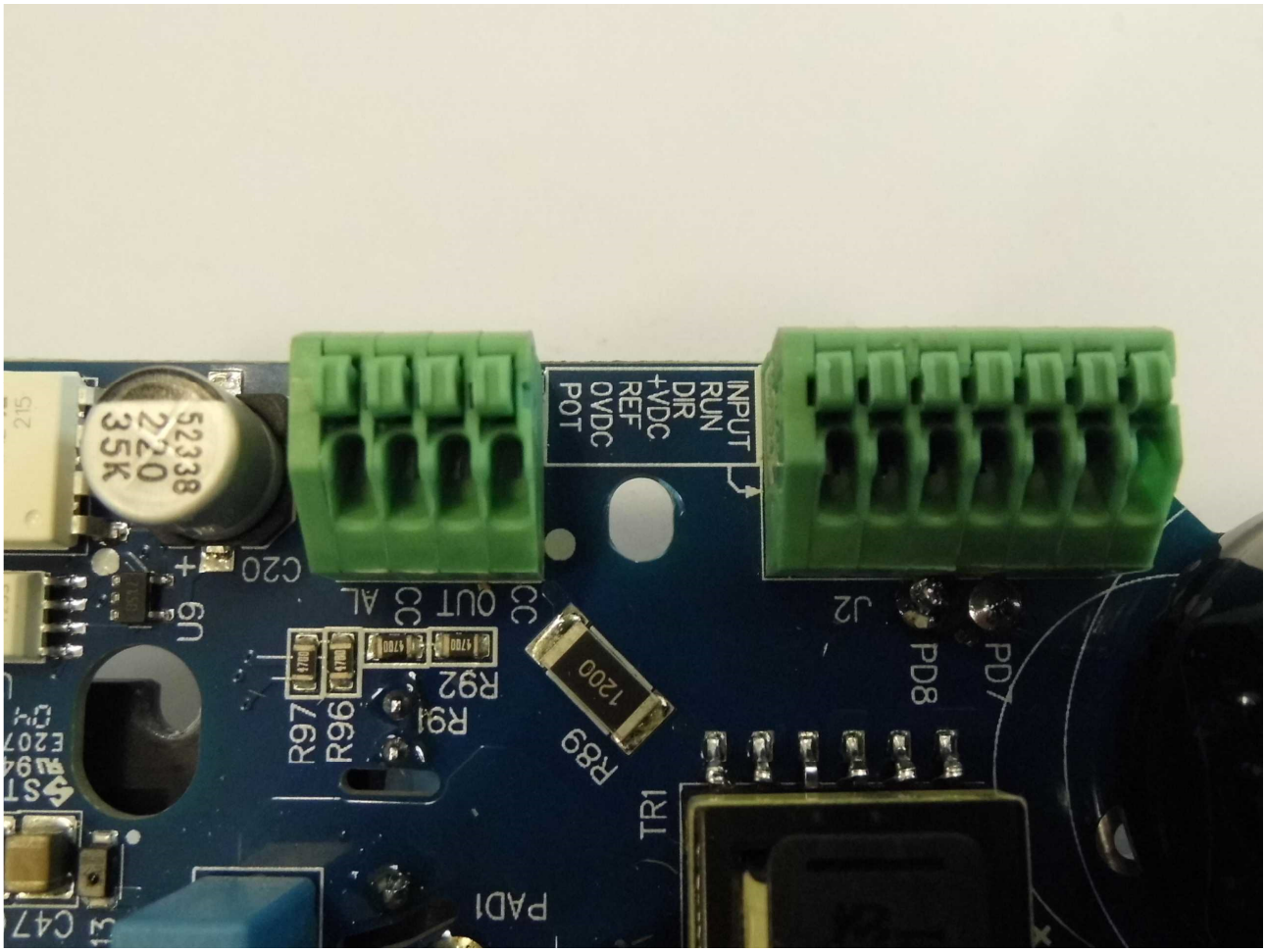


FIGURE 3

3.3 The signal OUTPUT terminal board for motor control.

The Output terminal board has two static relay outputs respectively connecting A with B and C with D.

- C with D is the alarm and diagnostic relay of the motor inverter system. When the inverter is running without alarms, the relay is Normally closed; when operating faults of the system occur, the relay in synchronism with the internal status LED starts to open the contact according to a time code described below:

Two sequential openings	IGBT Fault Max IGBT current exceeded
Three sequential openings	Overload beyond rated power
Four sequential openings	Overtemperature IGBT
Five sequential openings	Undervoltage
Six sequential openings	Overvoltage
Seven sequential openings	Max_current set Trimmer
Eight sequential openings	Current fault Max current threshold exceeded
Nine sequential openings	Overtemperature Microprocessor
Ten sequential openings	Overtemperature motor

- A with B is an output available for future programmable applications on request of the customer.

3.4 Regulation trimmer

The inverter board has 4 trimmers applied displayed in figure 4 with the following functions:

1. **Max Current** In this inverter, the max current supplied to the motor can be regulated in order to limit the torque of the motor when necessary. For example, if the motor drives a system which must be subject to safety rules such as a door which, if closed, may crush someone, by regulating the current and thereby the torque, when the door touches the person with the current limit, the inverter stops the motor without harming anyone.
2. **Acc/Dec** This trimmer allows you to adjust the acceleration ramp corresponding exactly to the deceleration ramp, adjustable from 1 second to 15 seconds. This function allows you to adjust the ramp according to the moment of inertia of the load and the regeneration quantity of the motor when braking with high inertial loads.
3. **Vmin** Vmin is the trimmer which regulates the minimum rotation speed of the motor shaft from 0Hz to 95Hz. When the trimmer is set at minimum, the minimum speed of the motor will be 0Hz. If a user needs to control an application where the minimum speed must be for example 30Hz, he may set the trimmer so that the minimum frequency does not drop below 30Hz and therefore when with the potentiometer or with external 0-10V it reaches the minimum, the inverter supplies 30Hz. If you want to adjust the speed simply without any device, just set Vmax at maximum and Vmin will become like a potentiometer which can regulate from 5Hz to 95Hz.
4. **Vmax** Vmax is the trimmer which regulates the maximum rotation speed of the motor shaft from 100Hz down to 5Hz. When the trimmer is set at minimum, the minimum speed of the motor will be 5Hz. If a user needs to control an application where the maximum speed must be for example 50Hz, he may set the trimmer so that the maximum frequency does not exceed 50Hz and therefore when with the potentiometer or with external 0-10V it reaches the maximum, the inverter supplies 50Hz.

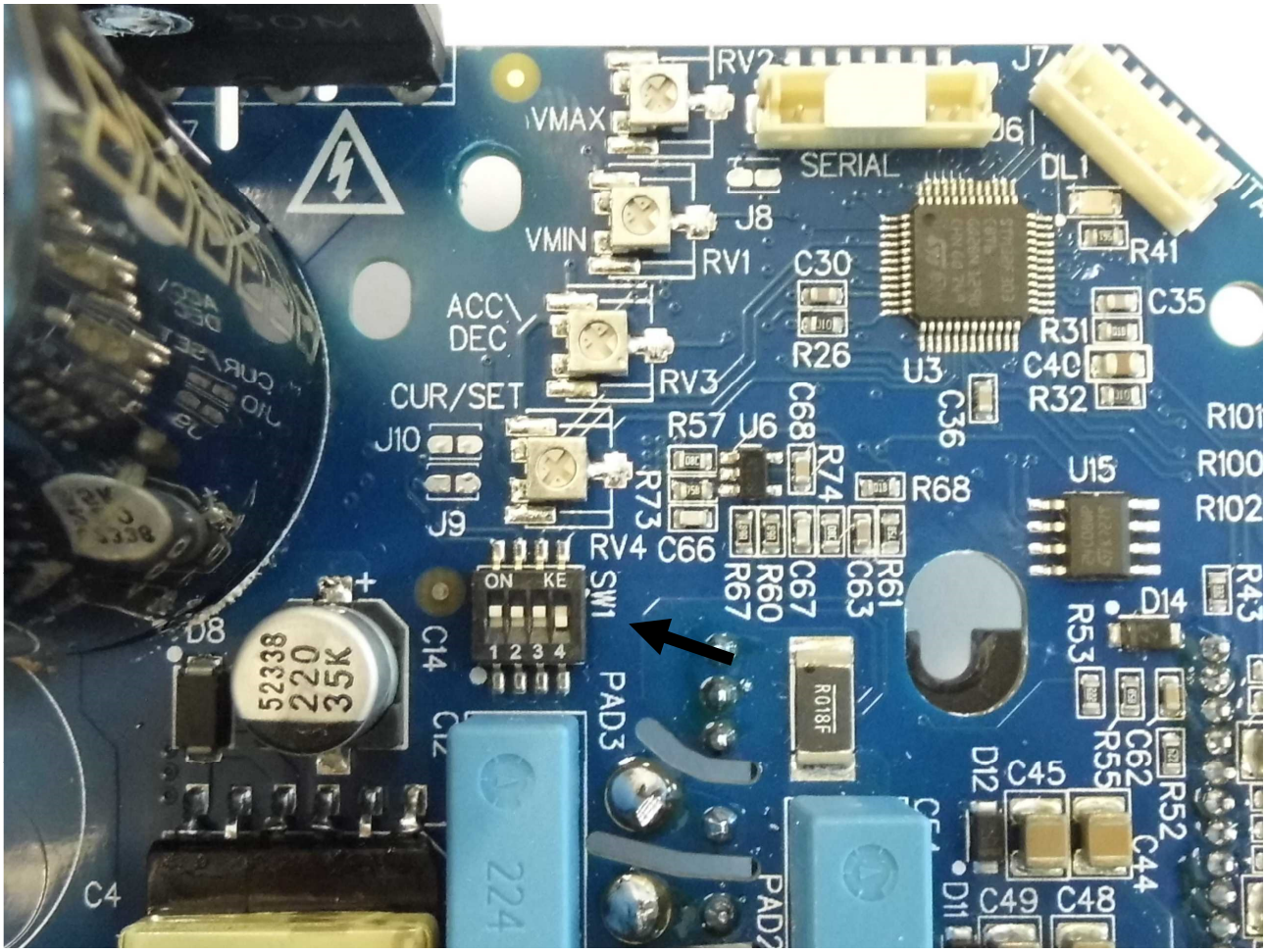


FIGURE 4

3.5 Dip Switch SW1

Near the regulation Trimmer there is a Dip Switch called **Sw1** (see figure 4 with red arrow above) allowing you to have possible combinations of various settings. These combinations are customisable on demand of the customer for special applications. There are the following settings in standard configuration:

SW1-1: TYPE OF INTERNAL OR EXTERNAL CONTROL

SW1-1 – OFF

Speed adjusted by trimmers. This means that without any external signals, the Vmin trimmer can become a speed regulator from 0Hz to Vmax. If Vmax is set at maximum, then Vmin can regulate from 0 to 100Hz.

SW1-1 – ON

Speed adjusted by REF_EXT analogue 0-10V or signal of the potentiometer. In this case, Vmin and Vmax are the lower and upper speed limits of the external reference. For example if Vmin is set at 10Hz and Vmax at 70Hz, when the potentiometer is set at zero or the external reference at 0VDC, the motor runs at 10Hz whereas when the potentiometer is at Maximum or external reference at 10VDC the motor runs at 70Hz.

SW1-2: AUTOSTART WHEN THE INVERTER IS ENERGISED

SW1-2 – OFF
When the inverter switches on, the ON edge of RUN is required to start the motor (if at ignition RUN ON the motor does not start – wait for OFF and then ON edge) designed for the safety standards of appliances.
SW1-2 – ON
At ignition, if RUN is ON the motor starts immediately
NOTE The autostart ON mode is the exclusive responsibility of the end user.

SW1-3: TORQUE AND BOOST TYPE

SW1-3 – OFF
Quadratic torque, silent V/F curve and with low absorption below 10Hz Boost OFF configuration, in practice the motor torque rises depending on the frequency. Ideal for Applications with Quadratic Torque such as Fans or applications whose load depends on the angular speed of the machine.
SW1-3 – ON
Linear Torque V/F Curve with high starting torque even less than 10Hz constant torque from 5 to 50Hz. Boost on configuration. Applications at constant torque are more noisy with frequency < 20Hz.

SW1-4: PWM SWITCHING FREQUENCY

SW1-4 – OFF
PWM frequency 5kHz Maximum of the torque and Power supplied and efficiency range of motor power supply curve with minimum heating. The classic hissing sound produced by the PWM frequency can be perceived.
SW1-4 – ON
PWM frequency 10kHz. In this case the motor is quieter and is suitable to be inserted in environments where the allowed noise level is critical. In this configuration the IGBTs of the inverter have a great amount of idle time and therefore a loss of efficiency which could raise the temperature of the inverter. **Remember that for this reason in this configuration the inverter must be weakened by 20% to maintain the same temperature curve.** In any case it is recommended to use power cooling on a motor already below 35Hz.

On demand the frequency of 15Khz is available making the inverter and motor completely silent, but in this case, the inverter must be further weakened by 35%. It is recommended to have Power cooling as for 10Khz.

NOTE: To change this PWM frequency switch, you MUST switch off the inverter.

3.6 Serial Connector RS232

This connector allows you to interface with a PC and to communicate in Modbus protocol with differential output RS485.
This option is not possible on standard inverters.

4 Technical specifications

4.1 Inverter section technical specifications

MEC motor size			56-63-71	80-90	90-100
Power supply					
Mains voltage	U	VAC	Single phase 200 – 260		
Mains frequency		Hz	45 – 66		
Line current (1)		A	2.5-3.5-5	8-11.5	15
Minimum fuse range (2)		A	4-5-6.3	10- 15*	25
Allowed cross-section of wires in terminals		mm^2	0.5 – 2.5 (AWG 24 – 12)		
Output to motor					
Power at motor shaft (3)	P	kW	<=0.37	0.75-1.10*	1.50
Output voltage		V	3 x 230 U		
Output current at rated P	i	A	1.9	3.3-4.3	5.7
Overload	A	%nom	200% 1 sec.; 150% 1 min.		
Protections			Overload, regenerative voltage, module temperature rise, motor logic, opto- isolated inputs		
Output frequency		Hz	5 – 100		
PWM carrier frequency		kHz	5-10 (15 on demand)		
Signal inputs					
High logic level voltage values		V	9 – 24		
Low logic level voltage values		V	0 – 1		
Logic inputs impedance (except ENAB)		Ω	10k ohm		
Analogue input voltage (reference)		V	0 – 10		
Analogue input impedance voltage		Ω	10k ohm		
Analogue input current (reference)		mA	1		
Analogue input impedance current		Ω			
ENAB input voltage		V	9 – 24		
ENAB input current		mA	1		
Signal outputs					
Potential-free contact voltage		V	30VDC		
Potential-free contact output current		mA	100		
Environment					
Max operating temperature	T	°C	40		
Max installation altitude		masl	1000		
Casing protection rating			IP 55		

5 Mechanical installation

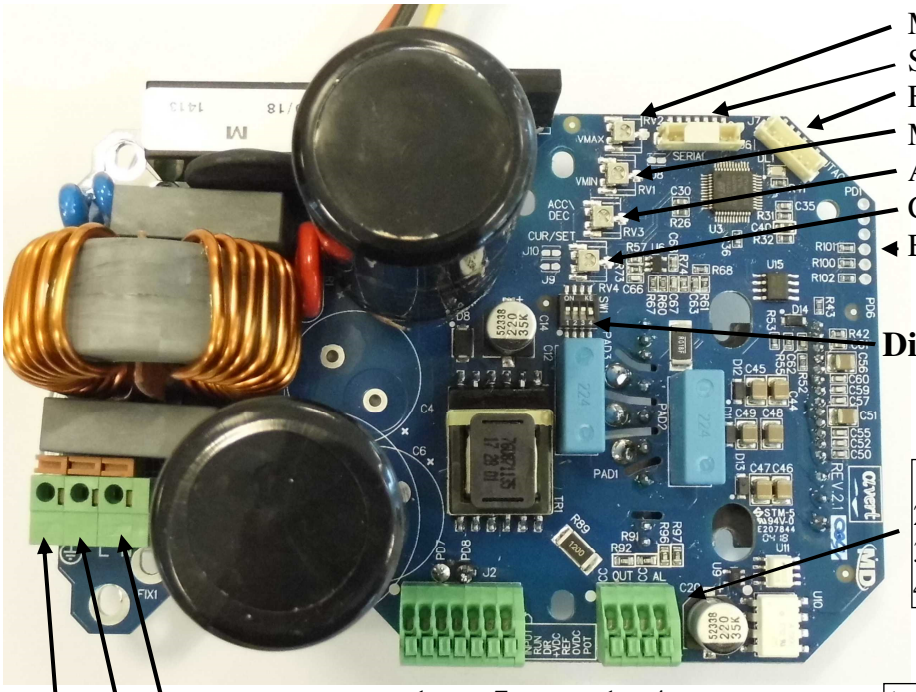
5.1 Controls

For proceeding with the mechanical installation, check that the indications on the rating plate of the unit comply with the mains voltage. The unit should also be checked to make sure it is intact and has not undergone any damage, for example during transportation.
Also check that the application conditions are compatible with the indications in section 3 of the technical specifications.

5.2 Assembly precautions

- Before mounting the unit, thoroughly clean the motor shaft by using normal solvent, however making sure that it does not penetrate into the seal rings or bearings which could damage them.
- Check that the motor shaft is correctly aligned with the controlled machine, also checking radial and axial loads.
- Absolutely avoid having the motor shaft undergo shocks or blows which could deform it and/or damage the internal electronic parts.
- Make sure that the cooling air is free to circulate, leaving at least 20 mm of free space between the bottom of the fan cover cap and any obstacles.
- In moist environments, carefully seal the inlet of the wires in the terminal board, also spreading sealant on the thread of the cable glands.
- To guarantee the IP55 protection rating, electricians performing electric connections must respect conventional closure rules of the inverter cover, paying appropriate care in positioning the protective gasket correctly and appropriately tightening the cable glands. Failure to comply with this rule shall make the item's warranty null and void immediately.

QUICK START



Dip Switch SW1	
SW1 – OFF : Internal adjustment with trimmer	**ON** : Adjustment with External Ref.
SW2 – OFF : Autostart Off	**ON** : Autostart On
SW3 – OFF : Quadratic Torque	**ON** : Linear Torque
SW4 – OFF : PWM Switching Freq. 5kHz	**ON** : PWM Switching Freq. 10kHz (15kHz on demand)

LED	**FUNCTION**
Continuous Light	Ready
1 Flash	Run
2 Flash	Fault IGBT
3 Flash	Overload
4 Flash	Overtemperature
5 Flash	Undervoltage
6 Flash	Overvoltage
7 Flash	Max Current
8 Flash	Fault Current
9 Flash	Overtemperature Microprocessor
10 Flash	Overtemperature motor